OMRON

Machine Automation Controller

NJ/NX-series CPU Unit Built-in EtherCAT_® Port

User's Manual

NX701-17
NX701-16
NJ501-15□□
NJ501-14□□
NJ501-13□□
NJ301-12□□
NJ301-11
NJ101-10
NJ101-90□□





W505-E1-12

- NOTE -

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Introduction

Thank you for purchasing an NJ/NX-series CPU Unit.

This manual contains information that is necessary to use the NJ/NX-series CPU Unit. Please read this manual and make sure you understand the functionality and performance of the NJ/NX-series CPU Unit before you attempt to use it in a control system.

Keep this manual in a safe place where it will be available for reference during operation.

Intended Audience

This manual is intended for the following personnel, who must also have knowledge of electrical systems (an electrical engineer or the equivalent).

- Personnel in charge of introducing FA systems.
- · Personnel in charge of designing FA systems.
- Personnel in charge of installing and maintaining FA systems.
- · Personnel in charge of managing FA systems and facilities.

For programming, this manual is intended for personnel who understand the programming language specifications in international standard IEC 61131-3 or Japanese standard JIS B 3503.

Applicable Products

This manual covers the following products.

- NX-series CPU Units
 - NX701-17□□
 - NX701-16□□
- NJ-series CPU Units
 - NJ501-15
 - NJ501-14□□
 - NJ501-13□□
 - NJ301-12
 - NJ301-11□□
 - NJ101-10□□
 - NJ101-90□□

Part of the specifications and restrictions for the CPU Units are given in other manuals. Refer to *Relevant Manuals* on page 2 and *Related Manuals* on page 22.

Relevant Manuals

The following table provides the relevant manuals for the NJ/NX-series CPU Units.

Read all of the manuals that are relevant to your system configuration and application before you use the NJ/NX-series CPU Unit.

Most operations are performed from the Sysmac Studio Automation Software. Refer to the *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504) for information on the Sysmac Studio.

		Basic inf	ormatior	<u>ו</u>		Manual					
Purpose of use	NX-series CPU Unit Hardware User's Manual	NJ-series CPU Unit Hardware User's Manual	NJ/NX-series CPU Unit Software User's Manual	NJ/NX-series Instructions Reference Manual	NJ/NX-series CPU Unit Motion Control User's Manual	NJ/NX-series Motion Control Instructions Reference Manual	NJ/NX-series CPU Unit Built-in EtherCAT Port User's Manual	NJ/NX-series CPU Unit Built-in EtherNet/IP Port User's Manual	NJ-series Database Connection CPU Unit User's Manual	NJ-series SECS/GEM CPU Units User's Manual	NJ/NX-series Troubleshooting Manual
Introduction to NX-series Controllers	•										
Introduction to NJ-series Controllers		•									
Setting devices and hardware											
Using motion control					•						
Using EtherCAT							•				
Using EtherNet/IP	•	•						•			
Using the database connection service									•		
Using the GEM Services										•	
Software settings											
Using motion control					•						
Using EtherCAT							•				
Using EtherNet/IP			•					•			
Using the database connection service									•		
Using the GEM Services										•	
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Using motion control					•	•					
Using EtherCAT							•				
Using EtherNet/IP			•	•				•			
Using the database connection service									•		
Using the GEM Services										•	
Programming error processing											•
Testing operation and debugging											
Using motion control					•						
Using EtherCAT			•				•				
Using EtherNet/IP								•			
Using the database connection service									•		
Using the GEM Services										•	
Learning about error management and corrections											•

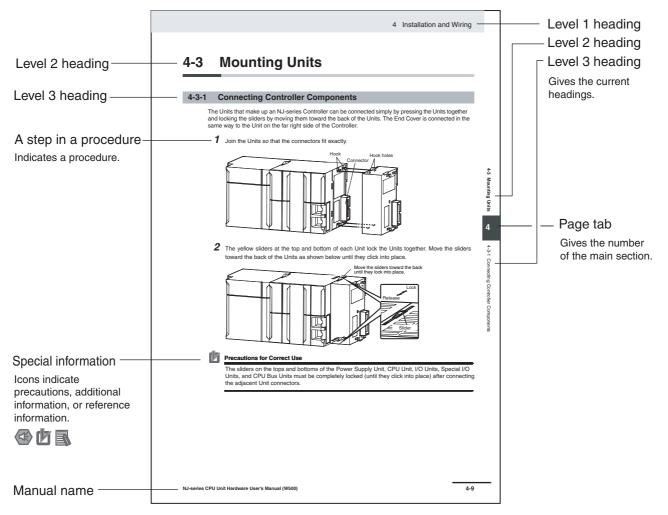
		Manual									
		Basic inf	formatio	า							
Purpose of use	NX-series CPU Unit Hardware User's Manual	NJ-series CPU Unit Hardware User's Manual	NJ/NX-series CPU Unit Software User's Manual	NJ/NX-series Instructions Reference Manual	NJ/NX-series CPU Unit Motion Control User's Manual	NJ/NX-series Motion Control Instructions Reference Manual	NJ/NX-series CPU Unit Built-in EtherCAT Port User's Manual	NJ/NX-series CPU Unit Built-in EtherNet/IP Port User's Manual	NJ-series Database Connection CPU Unit User's Manual	NJ-series SECS/GEM CPU Units User's Manual	NJ/NX-series Troubleshooting Manual
Maintenance											
Using motion control		•			•						
Using EtherCAT	•	-					•				
Using EtherNet/IP								•			

* Refer to the *NJ/NX-series Troubleshooting Manual* (Cat. No. W503) for the error management concepts and an overview of the error items. Refer to the manuals that are indicated with triangles for details on errors for the corresponding Units.

Manual Structure

Page Structure

The following page structure is used in this manual.



This illustration is provided only as a sample. It may not literally appear in this manual.

Special Information

Special information in this manual is classified as follows:

Precautions for Safe Use

Precautions on what to do and what not to do to ensure safe usage of the product.



Precautions for Correct Use

Precautions on what to do and what not to do to ensure proper operation and performance.



Additional Information

Additional information to read as required.

This information is provided to increase understanding or make operation easier.

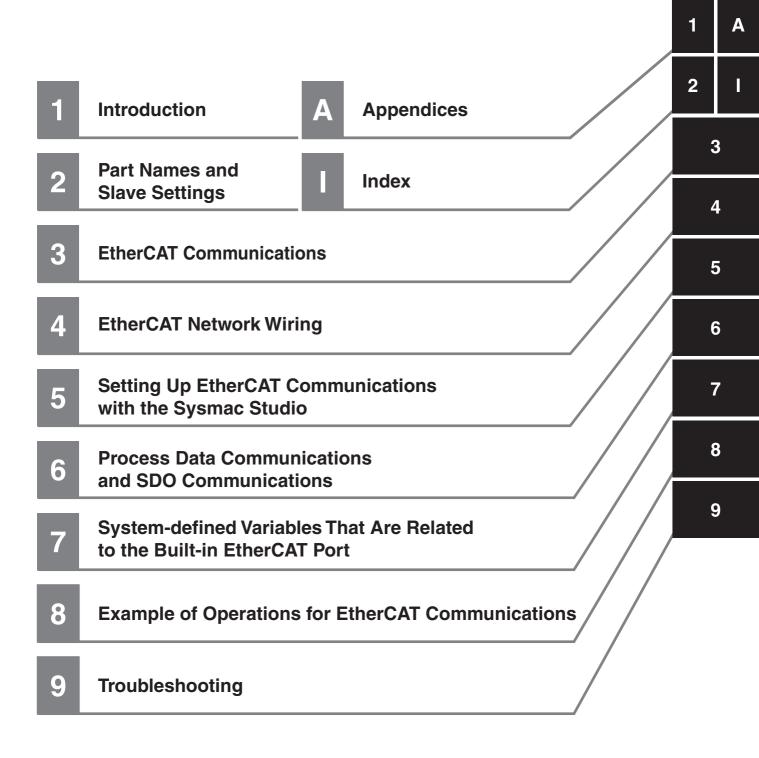
Note References are provided to more detailed or related information.

Precaution on Terminology

In this manual, "download" refers to transferring data from the Sysmac Studio to the physical Controller and "upload" refers to transferring data from the physical Controller to the Sysmac Studio.

For the Sysmac Studio, synchronization is used to both upload and download data. Here, "synchronize" means to automatically compare the data for the Sysmac Studio on the computer with the data in the physical Controller and transfer the data in the direction that is specified by the user.

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Warranty, Limitations of Liability

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Omron Companies shall not be responsible for the user's programming of a programmable Product, or any consequence thereof.

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Data presented in Omron Company websites, catalogs and other materials is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of Omron's test conditions, and the user must correlate it to actual application requirements. Actual performance is subject to the Omron's Warranty and Limitations of Liability.

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Safety Precautions

Refer to the following manuals for safety precautions.

- NX-series CPU Unit Hardware User's Manual (Cat No. W535)
- NJ-series CPU Unit Hardware User's Manual (Cat No. W500)
- NJ/NX-series CPU Unit Software User's Manual (Cat. No. W501)

Precautions for Safe Use

Refer to the following manuals for precautions for safe use.

- NX-series CPU Unit Hardware User's Manual (Cat No. W535)
- NJ-series CPU Unit Hardware User's Manual (Cat No. W500)
- NJ/NX-series CPU Unit Software User's Manual (Cat. No. W501)

Precautions for Correct Use

Refer to the following manuals for precautions for correct use.

- NX-series CPU Unit Hardware User's Manual (Cat No. W535)
- NJ-series CPU Unit Hardware User's Manual (Cat No. W500)
- NJ/NX-series CPU Unit Software User's Manual (Cat. No. W501)

Regulations and Standards

Conformance to EC Directives

Applicable Directives

- EMC Directives
- · Low Voltage Directive

Concepts

• EMC Directive

OMRON devices that comply with EC Directives also conform to the related EMC standards so that they can be more easily built into other devices or the overall machine. The actual products have been checked for conformity to EMC standards.*

Whether the products conform to the standards in the system used by the customer, however, must be checked by the customer. EMC-related performance of the OMRON devices that comply with EC Directives will vary depending on the configuration, wiring, and other conditions of the equipment or control panel on which the OMRON devices are installed. The customer must, therefore, perform the final check to confirm that devices and the overall machine conform to EMC standards.

 * Applicable EMC (Electromagnetic Compatibility) standards are as follows: EMS (Electromagnetic Susceptibility): EN 61131-2 and EN 61000-6-2 EMI (Electromagnetic Interference): EN 61131-2 and EN 61000-6-4 (Radiated emission: 10-m regulations)

• Low Voltage Directive

Always ensure that devices operating at voltages of 50 to 1,000 VAC and 75 to 1,500 VDC meet the required safety standards. The applicable directive is EN 61131-2.

• Conformance to EC Directives

The NJ/NX-series Controllers comply with EC Directives. To ensure that the machine or device in which the NJ/NX-series Controller is used complies with EC Directives, the Controller must be installed as follows:

- The NJ/NX-series Controller must be installed within a control panel.
- You must use reinforced insulation or double insulation for the DC power supplies connected to DC Power Supply Units and I/O Units.
- NJ/NX-series Controllers that comply with EC Directives also conform to the Common Emission Standard (EN 61000-6-4). Radiated emission characteristics (10-m regulations) may vary depending on the configuration of the control panel used, other devices connected to the control panel, wiring, and other conditions.

You must therefore confirm that the overall machine or equipment complies with EC Directives.

Conformance to KC Standards

Observe the following precaution if you use NX-series Units in Korea.

A 급 기기 (업무용 방송통신기자재)

이 기기는 업무용(A급) 전자파적합기기로서 판매자

또는 사용자는 이 점을 주의하시기 바라며, 가정외의

지역에서 사용하는 것을 목적으로 합니다.

Class A Device (Broadcasting Communications Device for Office Use)

This device obtained EMC registration for office use (Class A), and it is intended to be used in places other than homes.

Sellers and/or users need to take note of this.

Conformance to Shipbuilding Standards

The NJ/NX-series Controllers comply with the following shipbuilding standards. Applicability to the shipbuilding standards is based on certain usage conditions. It may not be possible to use the product in some locations. Contact your OMRON representative before attempting to use a Controller on a ship.

Usage Conditions for NK and LR Shipbuilding Standards

- The NJ/NX-series Controller must be installed within a control panel.
- Gaps in the door to the control panel must be completely filled or covered with gaskets or other material.
- The following noise filter must be connected to the power supply line.

Noise Filter

Manufacturer	Model
Cosel Co., Ltd.	TAH-06-683

Software Licenses and Copyrights

This product incorporates certain third party software. The license and copyright information associated with this software is available at http://www.fa.omron.co.jp/nj_info_e/.

Versions

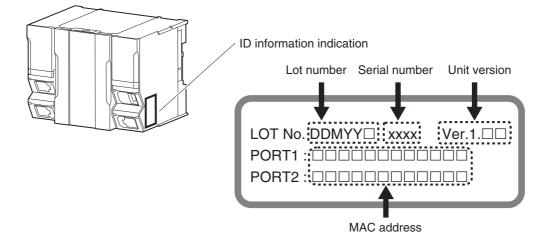
Unit versions are used to manage the hardware and software in NJ/NX-series Units and EtherCAT slaves. The unit version is updated each time there is a change in hardware or software specifications. Even when two Units or EtherCAT slaves have the same model number, they will have functional or performance differences if they have different unit versions.

Checking Versions

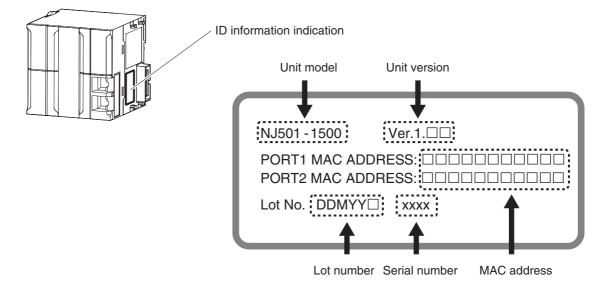
You can check versions on the ID information indications or with the Sysmac Studio.

Checking Unit Versions on ID Information Indications

The unit version is given on the ID information indication on the side of the product. The ID information on an NX-series NX701- \Box \Box \Box CPU Unit is shown below.



The ID information on an NJ-series NJ501-1500 CPU Unit is shown below.



Checking Unit Versions with the Sysmac Studio

You can use the Sysmac Studio to check unit versions. The procedure is different for Units and for EtherCAT slaves.

• Checking the Unit Version of an NX-series CPU Unit

You can use the Production Information while the Sysmac Studio is online to check the unit version of a Unit. You can only do this for the CPU Unit.

1 Right-click CPU Rack under Configurations and Setup - CPU/Expansion Racks in the Multiview Explorer and select *Production Information*.

The Production Information Dialog Box is displayed.

• Checking the Unit Version of an NJ-series CPU Unit

You can use the Production Information while the Sysmac Studio is online to check the unit version of a Unit. You can do this for the CPU Unit, CJ-series Special I/O Units, and CJ-series CPU Bus Units. You cannot check the unit versions of CJ-series Basic I/O Units with the Sysmac Studio.

Use the following procedure to check the unit version.

1 Double-click CPU/Expansion Racks under Configurations and Setup in the Multiview Explorer. Or, right-click CPU/Expansion Racks under Configurations and Setup and select *Edit* from the menu.

The Unit Editor is displayed.

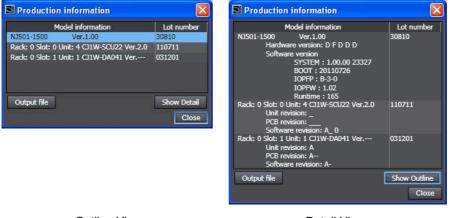
2 Right-click any open space in the Unit Editor and select *Production Information*.

The Production Information Dialog Box is displayed.

• Changing Information Displayed in Production Information Dialog Box

1 Click the **Show Detail** or **Show Outline** Button at the lower right of the Production Information Dialog Box.

The view will change between the production information details and outline.



Outline View

Detail View

The information that is displayed is different for the Outline View and Detail View. The Detail View displays the unit version, hardware version, and software versions. The Outline View displays only the unit version.

• Checking the Unit Version of an EtherCAT Slave

You can use the Production Information while the Sysmac Studio is online to check the unit version of an EtherCAT slave. Use the following procedure to check the unit version.

1 Double-click **EtherCAT** under **Configurations and Setup** in the Multiview Explorer. Or, rightclick **EtherCAT** under **Configurations and Setup** and select **Edit** from the menu.

The EtherCAT Tab Page is displayed.

2 Right-click the master on the EtherCAT Tab Page and select **Display Production Information**.

The Production Information Dialog Box is displayed. The unit version is displayed after "Rev."

Production Information	×
Type information	Serial number
Node10 R88D-KN01L-ECT Rev:2.1 (OMRON Corporation)	0x00000000
Node9 R88D-KN01L-ECT Rev:2.1 (OMRON Corporation)	0x0000000
Output file Close	

Unit Versions of CPU Units and Sysmac Studio Versions

The functions that are supported depend on the unit version of the NJ/NX-series CPU Unit. The version of Sysmac Studio that supports the functions that were added for an upgrade is also required to use those functions.

Refer to the *NJ/NX-series CPU Unit Software User's Manual* (Cat. No. W501-E1-02 or later) for the relationship between the unit versions of the CPU Units and the Sysmac Studio versions, and for the functions that are supported by each unit version.

Related Manuals

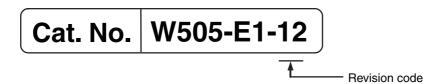
The followings are the manuals related to this manual. Use these manuals for reference.

Manual name	Cat. No.	Model numbers	Application	Description
NX-series CPU Unit Hardware User's Manual	W535	NJ701-□□□	Learning the basic specifi- cations of the NX-series CPU Units, including intro- ductory information, designing, installation, and maintenance. Mainly hard- ware information is pro- vided.	 An introduction to the entire NX-series system is provided along with the following information on the CPU Unit. Features and system configuration Introduction Part names and functions General specifications Installation and wiring Maintenance and inspection Use this manual together with the <i>NJ/NX-series CPU Unit Software User's Manual</i> (Cat. No. W501).
NJ-series CPU Unit Hardware User's Manual	W500	NJ501-□□□ NJ301-□□□ NJ101-□□□	Learning the basic specifi- cations of the NJ-series CPU Units, including intro- ductory information, designing, installation, and maintenance. Mainly hard- ware information is pro- vided.	 An introduction to the entire NJ-series system is provided along with the following information on the CPU Unit. Features and system configuration Introduction Part names and functions General specifications Installation and wiring Maintenance and inspection Use this manual together with the <i>NJ/NX-series CPU Unit Software User's Manual</i> (Cat. No. W501).
NJ/NX-series CPU Unit Software User's Manual	W501	NX701-□□□ NJ501-□□□ NJ301-□□□ NJ101-□□□	Learning how to program and set up an NJ/NX- series CPU Unit. Mainly software informa- tion is provided.	 The following information is provided on a Controller built with an NJ/NX-series CPU Unit. CPU Unit operation CPU Unit features Initial settings Programming based on IEC 61131-3 language specifications Use this manual together with the <i>NX-series CPU Unit Hardware User's Manual</i> (Cat. No. W535) or <i>NJ-series CPU Unit Hardware User's Manual</i> (Cat. No. W500).
NJ/NX-series Instructions Reference Manual	W502	NX701-□□□ NJ501-□□□ NJ301-□□□ NJ101-□□□	Learning detailed specifi- cations on the basic instructions of an NJ/NX- series CPU Unit.	The instructions in the instruction set (IEC 61131-3 specifications) are described. When programming, use this manual together with the <i>NX-series CPU Unit Hardware User's Manual</i> (Cat. No. W535) or <i>NJ-series CPU Unit Hardware User's Manual</i> (Cat. No. W500) and <i>NJ/NX-series CPU Unit Software User's Manual</i> (Cat. No. W501).
NJ/NX-series CPU Unit Motion Control User's Manual	W507	NX701-000 NJ501-000 NJ301-000 NJ101-000	Learning about motion control settings and pro- gramming concepts.	The settings and operation of the CPU Unit and programming concepts for motion control are described. When programming, use this manual together with the <i>NX-series CPU Unit Hardware</i> <i>User's Manual</i> (Cat. No. W535) or <i>NJ-series</i> <i>CPU Unit Hardware User's Manual</i> (Cat. No. W500) and <i>NJ/NX-series CPU Unit Software</i> <i>User's Manual</i> (Cat. No. W501).

Manual name	Cat. No.	Model numbers	Application	Description
NJ/NX-series Motion Control Instructions Ref- erence Manual	W508	NX701-000 NJ501-000 NJ301-000 NJ101-000	Learning about the specifi- cations of the motion con- trol instructions that are provided by OMRON.	The motion control instructions are described. When programming, use this manual together with the <i>NX-series CPU Unit Hardware User's</i> <i>Manual</i> (Cat. No. W535) or <i>NJ-series CPU Unit</i> <i>Hardware User's Manual</i> (Cat. No. W500), <i>NJ/NX-series CPU Unit Software User's Manual</i> (Cat. No. W501) and <i>NJ/NX-series CPU Unit</i> <i>Motion Control User's Manual</i> (Cat. No. W507).
NJ/NX-series CPU Unit Built-in EtherCAT® Port User's Manual	W505	NX701-000 NJ501-000 NJ301-000 NJ101-000	Using the built-in EtherCAT port on an NJ/NX-series CPU Unit.	Information on the built-in EtherCAT port is pro- vided. This manual provides an introduction and provides information on the configuration, fea- tures, and setup. Use this manual together with the <i>NX-series</i> <i>CPU Unit Hardware User's Manual</i> (Cat. No. W535) or <i>NJ-series CPU Unit Hardware User's</i> <i>Manual</i> (Cat. No. W500) and <i>NJ/NX-series CPU</i> <i>Unit Software User's Manual</i> (Cat. No. W501).
NJ/NX-series CPU Unit Built-in EtherNet/IP™ Port User's Manual	W506	NX701-□□□ NJ501-□□□ NJ301-□□□ NJ101-□□□	Using the built-in Ether- Net/IP port on an NJ/NX- series CPU Unit.	Information on the built-in EtherNet/IP port is provided. Information is provided on the basic setup, tag data links, and other features. Use this manual together with the <i>NX-series</i> <i>CPU Unit Hardware User's Manual</i> (Cat. No. W535) or <i>NJ-series CPU Unit Hardware User's</i> <i>Manual</i> (Cat. No. W500) and <i>NJ/NX-series CPU</i> <i>Unit Software User's Manual</i> (Cat. No. W501).
NJ-series Database Con- nection CPU Units User's Manual	W527	NJ501-1□20	Using the database con- nection service with NJ- series Controllers	Describes the database connection service.
NJ-series SECS/GEM CPU Units User's Manual	W528	NJ501-1340	Using the GEM Services with NJ-series Controllers.	Information is provided on the GEM Services.
NJ/NX-series Trouble- shooting Manual	W503	NX701-000 NJ501-000 NJ301-000 NJ101-000	Learning about the errors that may be detected in an NJ/NX-series Controller.	Concepts on managing errors that may be detected in an NJ/NX-series Controller and information on individual errors are described. Use this manual together with the <i>NX-series</i> <i>CPU Unit Hardware User's Manual</i> (Cat. No. W535) or <i>NJ-series CPU Unit Hardware User's</i> <i>Manual</i> (Cat. No. W500) and <i>NJ/NX-series CPU</i> <i>Unit Software User's Manual</i> (Cat. No. W501).
Sysmac Studio Version 1 Operation Manual	W504	SYSMAC- SE2□□□	Learning about the operat- ing procedures and func- tions of the Sysmac Studio.	Describes the operating procedures of the Sysmac Studio.
NX-series EtherCAT® Coupler Unit User's Manual	W519	NX-ECC	Learning how to use an NX-series EtherCAT Cou- pler Unit and EtherCAT Slave Terminals	The system and configuration of EtherCAT Slave Terminals, which consist of an NX-series EtherCAT Coupler Unit and NX Units, are described along with the hardware, setup, and functions of the EtherCAT Coupler Unit that are required to configure, control, and monitor NX Units through EtherCAT.

Revision History

A manual revision code appears as a suffix to the catalog number on the front and back covers of the manual.



Revision code	Date	Revised content
01	July 2011	Original production
02	March 2012	Added information on the NJ301- $\Box\Box\Box$ and corrected mistakes.
03	May 2012	 Added information on functional support for unit version 1.02 and later of the CPU Units. Corrected mistakes.
04	August 2012	 Added information on functional support for unit version 1.03 and later of the CPU Units. Corrected mistakes.
05	February 2013	 Added information on functional support for unit version 1.04 and later of the CPU Units. Corrected mistakes.
06	April 2013	 Added information on functional support for unit version 1.05 and later of the CPU Units. Corrected mistakes.
07	June 2013	 Added information on functional support for unit version 1.06 and later of the CPU Units. Corrected mistakes.
08	September 2013	 Added information on functional support for unit version 1.07 and later of the CPU Units. Corrected mistakes.
09	December 2013	 Added information on functional support for unit version 1.08 and later of the CPU Units. Corrected mistakes.
10	July 2014	Corrected mistakes.
11	January 2015	 Added information on functional support for unit version 1.10 and later of the CPU Units. Corrected mistakes.
12	April 2015	 Added information on the NX701-□□□. Added information on the NJ101-□□□. Corrected mistakes.

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Introduction

This section provides an overview of EtherCAT communications, describes the system configuration and specifications, and provides operating procedures.

1-1	Introd	luction to EtherCAT	1-2
	1-1-1	EtherCAT Features	
	1-1-2	EtherCAT Communications	
	1-1-3	EtherCAT Features for NJ/NX-series CPU Units	
1-2	Syste	m Configuration and Configuration Devices	
	1-2-1	System Configuration	
	1-2-2	Determining the Network Configuration	
1-3	Specif	fications of Built-in EtherCAT Port	
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1-1 Introduction to EtherCAT

EtherCAT (Ethernet Control Automation Technology) is a high-performance industrial network system that enables faster and more efficient communications based on Ethernet. Each node achieves a short communications cycle time by transmitting Ethernet frames at high speed. Furthermore, even though EtherCAT is a unique protocol, it offers excellent general-purpose applicability. For example, you can use Ethernet cables because EtherCAT utilizes standard Ethernet technology for the physical layer. And the effectiveness of EtherCAT can be fully utilized not only in large control systems that require high processing speeds and system integrity, but also in small and medium control systems.

1-1-1 EtherCAT Features

EtherCAT provides the following features.

High-speed Communications at 100 Mbps

The I/O response time from signal input to signal output has been significantly reduced. By fully utilizing the optimized Ethernet frame bandwidth to transmit data using a high-speed repeat method, it is possible to efficiently transmit a wide variety of data.

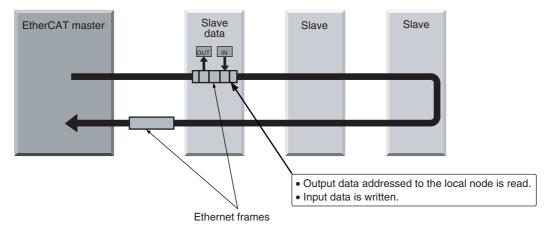
1-1-2 EtherCAT Communications

EtherCAT does not send data to individual slave nodes on the network, instead, it passes Ethernet frames through all of the slave nodes.

When frame passes through a slave node, the slave node reads and writes data in the areas allocated to it in the frames in a few nanoseconds.

The Ethernet frames transmitted by the EtherCAT master pass through all EtherCAT slaves without stopping. The last slave returns all of the frames, which again pass through all of the slaves before returning to the EtherCAT master.

This mechanism ensures high speed and realtime data transmission.



1-1-3 EtherCAT Features for NJ/NX-series CPU Units

EtherCAT in the NJ/NX-series CPU Units has the following features.

Synchronization of the CPU Unit Processing Period and the EtherCAT Communications Cycle

The period of sequence processing and motion processing in the CPU Unit matches the process data communications cycle of EtherCAT.

This enables high-precision sequence control and motion control with a stable fixed period.

Also, with the NX-series CPU Unit, slaves to be synchronized can be divided into two groups with different process data communications cycles. This means that slaves are separately processed in one group that needs high-speed communications and the other that needs not.

Accessing Data with Device Variables without Considering Addresses

EtherCAT slaves are accessed using device variables in the same way as the Units on the NJ-series CPU Racks and Expansion Racks. Various types of data in Servo Drive and the encoder input slaves are accessed using structure-type Axis Variables prepared in advance.

This enables access to slaves on EtherCAT without regard to addresses.

Optimum Functionality and Ease of Operation Based on Unified Specifications

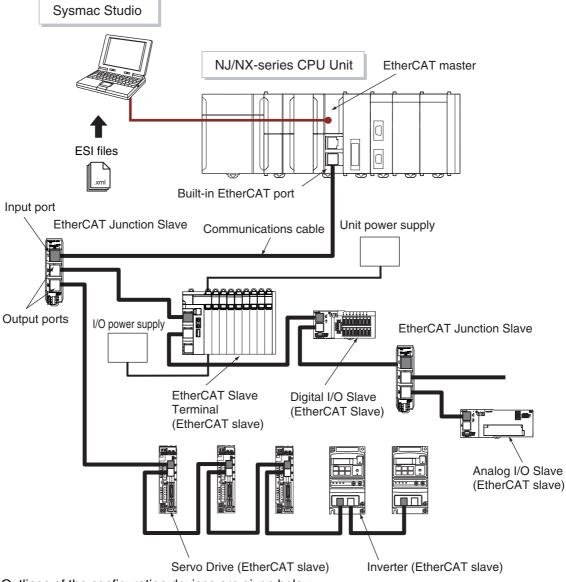
You can use the NJ/NX-series Machine Automation Controllers together with Sysmac devices* and the Sysmac Studio Automation Software to achieve optimum functionality and ease of operation.

* "Sysmac devices" is a generic name for EtherCAT slaves and other OMRON control components that were designed with the same communications and user interface specifications.

1-2 System Configuration and Configuration Devices

1-2-1 System Configuration

The EtherCAT network configuration and configuration devices are shown below.



Outlines of the configuration devices are given below.

• EtherCAT Master

The EtherCAT master manages the network, monitors the status of slaves, and exchanges I/O data with slaves. There is one output port.

Output Port

The output port transmits EtherCAT communications data to other devices. When you connect the output port to another device, always connect it to the input port on the other device. Normal communications will not be possible if you connect to the output port on another device.

1 Introduction

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Input Port

This port is used to input EtherCAT communications data. Always connect it to the output port on another device. Normal communications will not be possible if you connect to the input port on another device.

• EtherCAT Slaves

Each EtherCAT slave outputs the output data that it received from the EtherCAT master through the EtherCAT network. It also sends input data to the EtherCAT master through the EtherCAT network.

- · Each slave has one input port and at least one output port.
- In the EtherCAT network, you can use the salves and Junction Slaves that are listed below in total up to the maximum number of slaves.
- Assign node addresses to the slaves and Junction Slaves. The node address can be any value within the settable node address range, and can be assigned without any distinction between the slaves and Junction Slaves. But any node address should not be used more than once.
- The EtherCAT slaves can be classified into two: whether they support synchronization based on a distributed clock (DC) or not.
 - a) Non-synced Slaves

These slaves perform sequence control that does not require synchronization between them. Digital I/O Slaves and Analog I/O Slaves are among this type. They do not support a distributed clock (DC).

b) Synced Slaves

These slaves are synchronized based on the distributed clock (DC). Servo Drives and encoder input slaves are among this type.

- **Note 1** Refer to *1-3-1 Performance Specifications* for details on the maximum number of slaves and the settable node address range.
 - **2** The slaves are synchronized even when multiple non-synced slaves and Junction Slaves are connected.

The following tables lists some of the OMRON EtherCAT slaves that are available.

Name	Туре	Model	Synced/ Non-synced Slaves	Reference Clock* ¹	Assigning an axis
Digital I/O Slaves	Slaves with screw terminals and 2-tier terminal block	GX-□D16□1/OC1601	Non-synced Slaves	Exist	Not possible
	Slaves with screw terminals and 3-tier terminal block	GX-ID16□2/OD16□2/MD16□2	Non-synced Slaves	Exist	Not possible
	Slaves with e-CON connectors	GX-□D16□8/□D32□8	Non-synced Slaves	Exist	Not possible
Analog I/O Slaves	Slaves with screw terminals and 2-tier terminal block	GX-AD0471/DA0271	Non-synced Slaves	Exist	Not possible
NX-series Ether- CAT Coupler Unit	NX Series	NX-ECC201 ^{*2} NX-ECC202 ^{*3} NX-ECC203 ^{*4}	Synced Slaves	Exist	Not possible (Some of the connected NX Units can be assigned to an axis.)
Multifunctional, Compact Inverters	MX2 Series	3G3MX2 with EtherCAT Communications Unit 3G3AX-MX2-ECT	Non-synced Slaves	Exist	Not possible
Advanced General- purpose Inverters	RX Series	3G3RX-V1 with EtherCAT Communications Unit 3G3AX-RX-ECT	Non-synced Slaves	Exist	Not possible

Name	Туре	Model	Synced/ Non-synced Slaves	Reference Clock*1	Assigning an axis
AC Servo Drive	G5-series Servo Drive with EtherCAT communications	R88M-K/R88D-KN□-ECT	Synced Slaves	Exist	Possible
Linear Servo Drives	G5-series Linear Servo Drives with EtherCAT communi- cations	R88L-EC/R88D-KN□-ECT-L	Synced Slaves	Exist	Possible
Encoder Input Slaves	Slave with 3-tier ter- minal block	GX-EC0211/EC0241	Synced Slaves	Exist	Possible
Vision Sensors	FH Series	FH-1000 FH-3000	Synced Slaves	Exist	Not possible
Specialized Vision Sensors for Posi- tioning	FQ-M-series Sensors with EtherCAT Com- munications	FQ-MS12□(-□)-ECT	Synced Slaves	Exist	Not possible
	FZM1-series Vision Sensors	FZM1-35□-ECT	Synced Slaves	Exist	Not possible
Digital Sensor Com- munications Unit	E3NW Series	E3NW-ECT	Synced Slaves	Exist	Not possible
Fiber Sensor Com- munications Unit	E3X Series	E3X-ECT	Synced Slaves	Exist	Not possible
Confocal Fiber Type Displacement Sen- sors	ZW Series	ZW-CE1	Synced Slaves	Exist	Not possible

*1 Shows whether or not the slave provides a reference clock. A slave or a master that provides a reference clock is required for a system configuration that enables synchronization between slaves based on a distributed clock (DC). When you connect a slave that supports the reference clock, you must meet some conditions. Refer to *4-1-1 Supported Network Topologies* for detail on the conditions.

- *2 A CPU Unit with unit version 1.05 or later and Sysmac Studio version 1.06 or higher are required.
- *3 A CPU Unit with unit version 1.07 or later and Sysmac Studio version 1.08 or higher are required.
- *4 A CPU Unit with unit version 1.07 or later and Sysmac Studio version 1.11 or higher are required.

EtherCAT Junction Slave

This is a special Unit for branching EtherCAT network wiring. Cascade connections are possible within the range of node addresses that the EtherCAT master can handle.

Each Junction Slave has one input port and more than one output port. The output ports on each Junction Slave can be connected to another Junction Slave or other EtherCAT slaves.

The Junction Slave supports the reference clock that is required for a system configuration that enables synchronization between slaves based on a distributed clock (DC).

The following models are examples of some of the OMRON EtherCAT slaves.

Slave type/name	Number of ports	Model
EtherCAT Junction Slave	3 ports	GX-JC03
	6 ports	GX-JC06

Precautions for Safe Use

You cannot use standard Ethernet hubs or repeater hubs with EtherCAT communications. If you use one of these, a major fault level error or other error may occur.

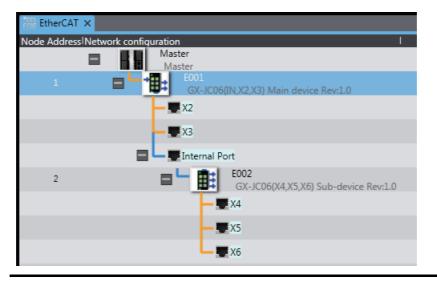


Precautions for Correct Use

- GX-JC03 and GX-JC06 EtherCAT Junction Slaves do not have hardware switches for node address setting. The Sysmac Studio is required to set the node addresses for these slaves. The node addresses are set to 0 by default. If you use these slaves with the default node address, a Network Configuration Verification Error will occur.
- A GX-JC03 EtherCAT Junction Slave needs only one node address. A GX-JC06 EtherCAT Junction Slave needs two node addresses.

Additional Information

A GX-JC06 EtherCAT Junction Slave which appears to be one Unit is actually composed of two slaves. The two slaves appear as "Main device" and "Sub-device" in the Sysmac Studio, respectively, as shown in the figure below. The In port of Sub-device appears as "Internal Port" in the Sysmac Studio and it is internally connected to the Main device.



Sysmac Studio

The Sysmac Studio runs on a personal computer and it is used to configure EtherCAT networks and slaves, and to program, monitor, and debug the Controller.

Communications Cables

Use a straight, shielded twisted-pair cable (double shielding with aluminum tape and braiding) of Ethernet category 5 (100BASE-TX) or higher.

ESI (EtherCAT Slave Information) File

The ESI files contain information unique to the EtherCAT slaves in XML format. You can load an ESI file into the Sysmac Studio, to easily allocate slave process data and make other settings.

• Unit Power Supplies

This power supply is for slave communications and internal operation.

• I/O Power Supply

This power supply is for I/O operations of external devices connected to the slaves.

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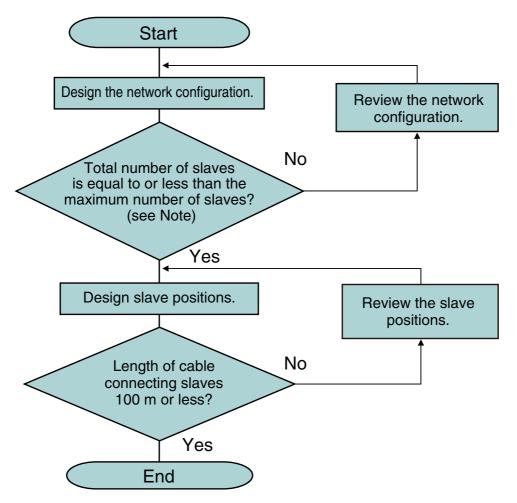


Additional Information

With a CPU Unit with unit version 1.06 or later and Sysmac Studio version 1.07 or higher, you can add NX-series Safety Control Units to the EtherCAT network. You can use NX-series Safety Control Units on EtherCAT Slave Terminals to build a safety control system on EtherCAT.

1-2-2 Determining the Network Configuration

Determine the type, total number, and positions of slaves in the network. Check the total number of slaves and the cable length between slaves based on the following workflow.





Precautions for Safe Use

- You cannot use standard Ethernet hubs or repeater hubs with EtherCAT communications. If you use one of these, a major fault level error or other error may occur.
- Make sure that the communications distance, number of devices connected, and method of connection for EtherCAT are within specifications.

1-3 Specifications of Built-in EtherCAT Port

1-3-1 Performance Specifications

	Specification			
Item	NX701-□□□	NJ501-□□□□/ NJ301-□□□□	NJ101-□□□□	
Communications proto- col	EtherCAT protocol			
Supported services	CoE (Process data communications and SDO communications)*1			
Synchronization	DC (Distributed Clock)			
Physical layer	100BASE-TX			
Modulation	Baseband			
Baud rate	100 Mbit/s (100BASE-TX)			
Duplex mode ^{*2}	Auto			
Topology ^{*3}	Line, daisy chain, and branching			
Transmission media	Twisted-pair cable of category 5 or higher (Recommended cable: straight, double-shielded cable with aluminum tape and braiding)			
Maximum transmission distance between nodes	100 m			
Maximum number of slaves	512	192	64	
Settable node address range	1 to 512 1 to 192			
	Input: 11,472 bytes Output: 11,472 bytes	Input: 5,736 bytes Output: 5,736 bytes		
Maximum process data size	However, the data must not exceed 8 frames (the maximum number of pro- cess data frames).	However, the data must not exceed 4 frames (the max- imum number of process data frames).		
Maximum size per slave	Input: 1,434 bytes			
	Output: 1,434 bytes			
Maximum message size	2,048 bytes			
	 Primary periodic task 125 µs, 250 µs to 8 ms (in 250-µs increments) 	500 μs ^{*5} , 1,000 μs, 2,000 μs, or 4,000 μs	1,000 μs, 2,000 μs, or 4,000 μs	
Communications cycle	 Priority-5 periodic task 125 μs, 250 μs to 100 ms (in 250-μs incre- ments)^{*4} 			
Sync jitter	1 μs max.			

*1 Refer to 3-1-1 CoE (CAN Application Protocol over EtherCAT) for details on CoE.

*2 Connection is possible only in full duplex mode. Half-duplex connections will result in link OFF status.

- *3 Wiring in a ring configuration is not possible.
- *4 Setting is available only for integer multiples of the task period of the primary periodic task.
- *5 Unit version 1.03 or later of the CPU Unit is required to use this setting on the NJ301-

1-3 Specifications of Built-in EtherCAT Port

List of Supported Functions

Function name	Description		
Process data communica- tions	PDO mapping using CoE		
	Fail-soft operation for slave communications errors		
	Stop operation for slave communications errors		
DC (distributed clock)	Clock synchronization		
SDO communications	CoE		
	Emergency message server (receptions from slaves)		
	SDO requests and responses		
	Communications between slaves		
Configuration	Automatic setting of device variable names, etc.		
	Setting node address using hardware switches on the slaves		
	Setting node address using the Sysmac Studio		
	Network scan (collection of information on devices connected to the network)		
	Display of network configuration information (display of supported topology)		
RAS functions	Slave configuration check when starting network		
	Reading of error information (emergency error history, subscription information, etc.)		
	Packet monitoring*		
	Troubleshooting information		
Operations during errors	When error occurs (stop communications or change to fail-soft operation)		
	Restoring communications when errors are cleared (Moves to operational state.)		
Slave information	Enabling/disabling slaves		
	Disconnecting/reconnecting slaves		

* For the NJ301-DDD and NJ101-DDD CPU Units, unit version 1.10 or later and Sysmac Studio version 1.12 or higher are required to use the packet monitoring function.

1-4 EtherCAT Communications Procedure

1-4-1 Overview

Step	Section
1. Mounting and Setting Devices and Hardware	2-2 Setting the Node Addresses of the EtherCAT Slaves
\downarrow	
2. Laying EtherCAT Communications Cables	Section 4 EtherCAT Network Wiring
\downarrow	
3. Creating the EtherCAT Network Configuration	5-2 Creating the EtherCAT Network Con- figuration
\downarrow	
4. Setting EtherCAT Slave Variables and Axes	5-3 Setting EtherCAT Slave Variables and Axes
\downarrow	
5. Setting EtherCAT Parameters	5-4 EtherCAT Master and Slave Parame- ter Settings
\downarrow	
6. Programming	Section 6 Process Data Communications and SDO Communications
\downarrow	
7. Turning ON Power and Going Online from the Sysmac Studio	2-1-3 Connecting the Sysmac Studio
	3-3 State Transitions for EtherCAT Com- munications
\downarrow	•
8. Online Debugging	5-5 Comparing and Merging EtherCAT Network Configurations
\downarrow	
9. Downloading the Network Configuration Information and the User Program	5-6 Downloading the Network Configura- tion Information
\downarrow	
10. Checking Indicators	5-7 Confirming Communications after Completing EtherCAT Configuration and Settings

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1-4-2 Details

Step	Step Description		Section
1. Mounting and Setting Devices and Hardware	• Use the hardware switches on all of the EtherCAT slaves in the network to set the node addresses. (The starting node address and sequence are not specified.) See the manuals for each slave for infor- mation on the procedure for setting node addresses.		2-2 Setting the Node Addresses of the EtherCAT Slaves
	Note Use the Sysmac Studio to set the node address if there are no hardware switches or the node address is beyond the range that can be set with the hardware switches.		
	Connect the EtherCAT slaves and exter- nal I/O devices.		
\downarrow			
2. Laying EtherCAT Communi- cations Cables	Connect the EtherCAT slaves to the Ether- CAT port of the NJ/NX-series CPU Unit. If there is more than one EtherCAT slave, connect them using a daisy chain or branch wiring.		Section 4 EtherCAT Net- work Wiring
\downarrow		I	
3. Creating the EtherCAT Net- work Configuration	 Use the Sysmac Studio to create a new project. (a) Create EtherCAT network configuration offline. or (b) Go online and create the EtherCAT network configuration from the actual network devices. Do so after making the online connection that is described in step 7. 	Create EtherCAT net- work configuration with EtherCAT under Con- figurations and Setup.	5-2 Creating the EtherCAT Net- work Configura- tion
\downarrow			
Setting EtherCAT Slave Variables and Axes			
All EtherCAT Slaves	Allocate variables to the I/O ports.	Make the settings with	5-3-1 Register-

-	Variables and Axes			
	All EtherCAT Slaves	 Allocate variables to the I/O ports. If necessary, change the names of automatically generated device variables for each I/O port to user-defined variable names. 	Make the settings with I/O Map under Config- urations and Setup.	5-3-1 Register- ing Device Vari- ables for All EtherCAT Slaves
	Only EtherCAT Servo Drive and encoder input slaves	 Set up the axes. Create axes (axes variables). Set the axis types for the Axis Variables (to a servo axis, virtual axis, etc.), and set the IDs of the Servo Drives. Axis Variables are automatically registered in the global variable table 	Create and set up the axes from Axis Settings under Configuration and Setup – Motion Control Setup – Axis Settings – Add.	5-3-2 Axis Set- tings for Servo Drives and Encoder Input Slaves

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1-4 EtherCAT Communications Procedure

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1-4-2 Details

Step		Description		Section
5	Setting EtherCAT Parame- ters			
	Setting EtherCAT Master Parameters	Set the EtherCAT master parameters. (Examples: Fail-soft Operation Setting and Wait Time for Slave Startup)	Operation Setting and master with EtherCAT	5-4-1 Setting EtherCAT Mas- ter
		The values that are set are reflected in the network configuration information.	and Setup.	
	Setting EtherCAT Slave Parameters	Set the EtherCAT slave parameters. Example: Enable/disable slaves.	Create EtherCAT slaves with EtherCAT under Configurations and Setup.	5-4-2 Setting EtherCAT Slaves

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*				
6	Programming			
	Process Data Communica- tions	Specify the device variables in the user pro- gram. Input conditions include system-defined variables for network error flags and normal or error flags for each slave.	Create the programs with POUs under Pro- gramming.	6-1 Process Data Communi- cations (PDO Communica- tions)
		 Assign to the task that refreshes I/O for each EtherCAT slave. 	Set it for each slave from I/O Control Task Settings under Config- urations and Setup - Task Settings.	
	SDO Communications	Read and write the following specified data for slaves:	Create the programs with POUs under Pro-	6-2 SDO Com- munications
		Use EC_CoESDORead and EC_CoESDOWrite instructions.	gramming.	
		 SDO data in slaves (parameters, error information, etc.) 		

 \downarrow

7. Turning ON Power and Going Online from the Sysmac Studio	 Turn ON the power supply to EtherCAT slaves. Turn ON the I/O power supplies to the slaves. Turn ON the power supply to NJ/NX-series Controller. Use the Sysmac Studio to set communications with the NJ/NX-series Controller and go online. 	Select <i>Communica-</i> <i>tions Setup</i> from the Controller Menu and make the settings to go online.	2-1-3 Connect- ing the Sysmac Studio 3-3 State Tran- sitions for EtherCAT Com- munications
↓ 8. Online Debugging	Compare and merge the network configura- tion that was set on the Sysmac Studio and the actual network configuration.	Right-click the Ether- CAT master under <i>Configurations and</i> <i>Setup – EtherCAT</i> and select Actual network configuration.	5-5 Comparing and Merging EtherCAT Net- work Configura- tions

 \downarrow

Step	Description	Sysmac Studio operation	Section
9. Downloading the Network Configuration Information and the User Program	 Download the network configuration information (EtherCAT configuration, process data information, and parameters). Note Use the synchronization operation of the Sysmac Studio to download the project. 	Select Synchroniza- <i>tion</i> from the Controller Menu to download and verify the network con- figuration information.	5-6 Download- ing the Network Configuration Information
\downarrow			
10. Checking Indicators	Check the indicators on the NJ/NX-series CPU Unit.		5-7 Confirming Communica-
	 A flashing yellow EtherCAT LINK/ACT indicator shows that data is being transmitted and received after the link is established. A solid green EtherCAT NET RUN indicator shows the davise is in the operational. 		tions after Com- pleting EtherCAT Con- figuration and Settings
	tor shows the device is in the operational state (normal communications state).		
	 If the EtherCAT NET ERR indicator is not lit, there is no error. 		

2

Part Names and Slave Settings

This section provides the part names and describes the slave settings and Sysmac device functions.

2-1	Part Na	ames and Functions	. 2-2
	2-1-1	Built-in EtherCAT Port Indicators	2-2
	2-1-2	Windows Used in Sysmac Studio	2-4
	2-1-3	Connecting the Sysmac Studio	2-7
2-2	Setting	the Node Addresses of the EtherCAT Slaves	. 2-9
2-3	Feature	es of Sysmac Devices	2-12
2-3	Featur 2-3-1	es of Sysmac Devices	
2-3		•	2-12
2-3	2-3-1	Sysmac Devices	2-12 2-12
2-3	2-3-1 2-3-2	Sysmac Devices	2-12 2-12 2-15

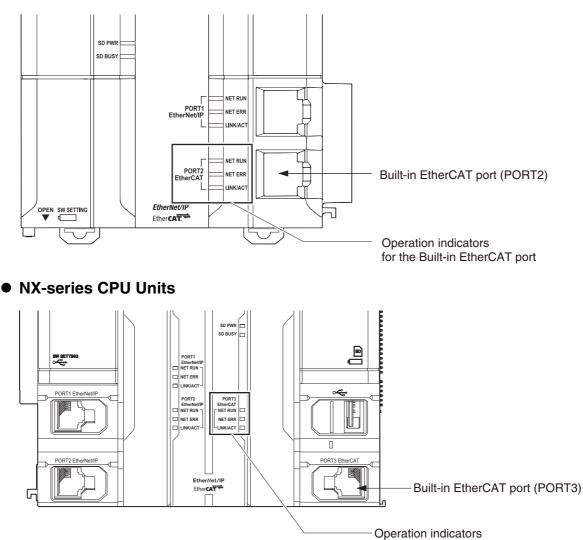
2-1 Part Names and Functions

2-1-1 Built-in EtherCAT Port Indicators

The indicators show the operating status of the built-in EtherCAT port on an NJ/NX-series CPU Unit.

The locations of indicators of the built-in EtherCAT port on the CPU Unit as well as the colors and statuses of indicators associated with corresponding operating status are shown below.

The locations of the built-in EtherCAT port indicators are shown below.



• NJ-series CPU Units

for the Built-in EtherCAT port

Label	Color	Status	Meaning
		Lit	EtherCAT communications are in progress.
NET RUN			 Inputs and outputs for I/O data are in opera- tion.
		Flashing	EtherCAT communications are being estab- lished.
			This indicator shows either of the following conditions.
	Green		 Only message communications are in oper- ation.
			 Only message communications and I/O data inputs are in operation.
		Not lit	EtherCAT communications are stopped.
			 The power supply is OFF or the CPU Unit was reset.
			 A MAC Address Error, Communications Controller Error, or other error occurred.
		Lit	A hardware error or unrecoverable error occurred, such as for exception processing.
NET ERR	Red	Flashing	A recoverable error occurred.
		Not lit	There are no errors.
		Lit	A link was established.
LINK/ACT	Yellow	Flashing	Data communications are in progress after establishing link.
			Flashes every time data is sent or received.
		Not lit	The link was not established.

The operating status corresponding to colors and status of the built-in EtherCAT port indicators are shown below.

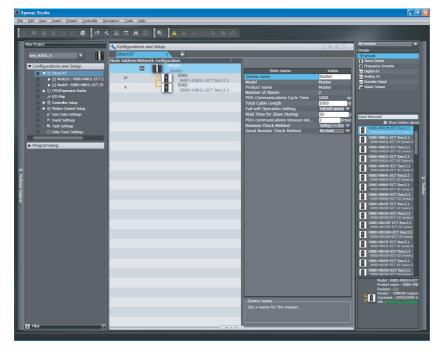
Refer to 3-3-2 Control States for EtherCAT Communications for details on the states.

2-1-2 Windows Used in Sysmac Studio

Use the Sysmac Studio to create the EtherCAT network configuration and to make other settings. The following windows are used.

• Creating the EtherCAT Network Configuration

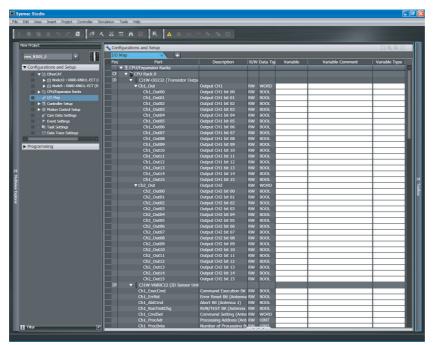
Use the EtherCAT Configuration Editor offline to register slaves in the EtherCAT slave configuration. Or, upload the network configuration online.



• Setting EtherCAT Slave Variables and Axes

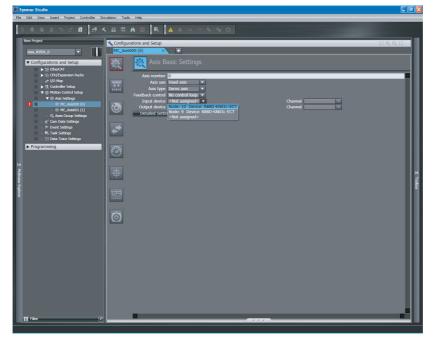
I/O Map: Used to allocate device variables.

Use the I/O Map to assign device variables to the I/O ports of the EtherCAT slaves.



Axis Settings: Used to create Axis Variables and set parameters for Servo Drive and encoder input slaves.

Use the Axis Settings to assign Axis Variables to the Servo Drive/encoder input slaves.



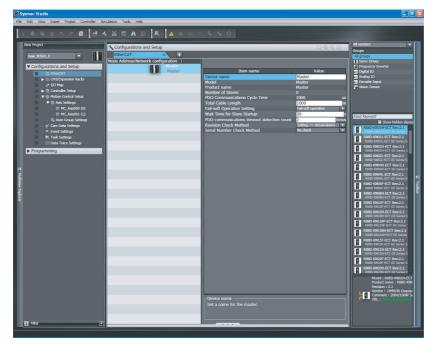
Setting Axis Parameters:

Edit View Insert Project Controller	Simulation Tools Help		
ାରାର୍ବ ମାମ୍ମ ମି	< 当 ○ A ○ R ▲ ≥ ○ ○ ○		
New Project	Configurations and Setup		
new_N3501_0	Axes Setting Table ×		
inew_incont_o	Parameters to show All		
Configurations and Setup			
EtherCAT	Axis Name Axis Basic Settings	1 MC_Axis000(0)	2 MC_Axis001(1)
CPU/Expansion Racks	Axis use	Used axis	Used axis
"+ I/O Map	Axis type	Servo axis	Servo axis
Controller Setup	Feedback control	No control loop	No control loop
▼ ⊕ Motion Control Setup	Input device	10	9
V 🗇 Axis Settings	Channel	.CH1	CH1
 W MC, Axis000 (0) 	Output device	10	
MC_Addisol (0)	Channel	(B)	
Aves Group Settings	▼ Unit Conversion Settings		
	Unit of display	pulse	pulse
6 Cam Data Settings	Command pulse count per motor rotation Work travel distance per motor rotation	10000 pulse/rev 10000 pulse/rev	10000 pulse/rev 10000 pulse/rev
Event Settings	▼ Operation Settings	10000 pulse/rev	10000 pulse/rev
L Stask Settings	Maximum velocity	400000000 pulse/s	40000000 pulse/s
L 💀 Data Trace Settings	Velocity warning value	0 %	0.96
Programming	Maximum jog velocity	1000000 pulse/s	1000000 pulse/s
	Maximum acceleration	0 pulse/s^2	0 pulse/s^2
	Acceleration warning value	0 %	0 %
	Maximum deceleration	0 pulse/s^2	0 pulse/s^2
	Deceleration warning value	0 %	0 %
		id acceleration/deceleration (Blending is char	Use rapid acceleration/deceleration (Blending is ch.
	Operation selection at Reversing	Deceleration stop	Deceleration stop
	Positive torque warning value	0.%	0 %
	Negative torque warning value	0 %	0 % 10 pulse
	In-position range In-position check time	10 pulse 0 msec	0 msec
	Actual velocity filter time constant	0 msec	0 msec
	Zero position range	10 pulse	10 pulse
	V Other Operation Settings	to pase	To past.
	Immediate stop input stop method	Immediate stop	Immediate stop
	Limit input stop method	Immediate stop	Immediate stop
	Drive error reset monitoring time	200 msec	200 msec
	Maximum positive torque limit	300.0 %	300.0 %
	Maximum negative torque limit	300.0 %	300.0 %
	▼ Limit Settings		
	Software limits	Disabled	Disabled 2147483647 pulse
	Positive software limit	2147483647 pulse	2147483647 pulse -2147483648 pulse
	Negative software limit Following error over value	-2147483648 pulse 0 pulse	-214/483648 puise 0 puise
	Following error over value	0 pulse 0 pulse	0 pulse
	Homing Settings	0 puse	U puise
	Homing method	Zero position preset	Zero position preset
	Home input signal	Use Z-phase input as home	Use Z-phase input as home
	Homing start direction	Positive direction	Positive direction
	Operation selection at positive limit input	Reverse turn/immediate stop	Reverse turn/immediate stop
	Home input detection direction	Positive direction	Positive direction
	Operation selection at negative limit input	Reverse turn/immediate stop	Reverse turn/immediate stop
	Homing velocity	10000 pulse/s	10000 pulse/s
Fil Alter	Homing approach velocity	1000 pulse/s	1000 pulse/s

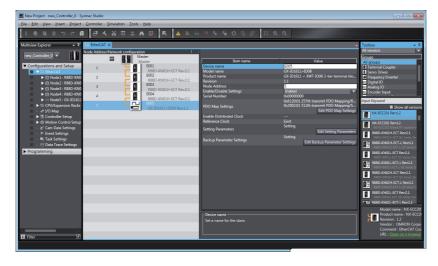
• EtherCAT Master and Slave Parameters Settings

Set the EtherCAT master and slave parameters after selecting a master or slave on the EtherCAT network configuration.

• Parameter Setting for the EtherCAT Master



· Parameter Setting for the EtherCAT Slaves



Refer to *Section 5 Setting Up EtherCAT Communications with the Sysmac Studio* for the Sysmac Studio procedures.

2-1-3 Connecting the Sysmac Studio

You can connect the Sysmac Studio to the NJ/NX-series CPU Unit through the USB or EtherNet/IP port. You must set the connection method, IP address to connect to, and other parameters for communications between the computer and Controller.

1 Select *Communications Setup* from the Controller Menu.

The Communications Setup Dialog Box is displayed.

Communications Setup	
▼ Connection type	
Select a method to connect with the Controller to use every time you go online. Direct connection via US8 Remote connection via US8 Ethemet connection via US8 Direct connection vi	
Remote connection via USB Ethemet connection via a hub	
▼ Remote IP Address	
Select a method to connect with the Controller to use every time you go online.	
▼ Options	
Confirm the serial ID when going online. Check forced refreshing when going offline.	
▼ Response Monitor Time	
Set the Response Monitor Time in the communications with the Controller.	
OK Cancel	

2 Select the connection method for the connection configuration from the Connection type Area.

If you specify a Remote connection via USB or an Ethernet connection via a hub, enter the IP address of the Controller in the Remote IP Address Area. Also set the Options and Response Monitor Time parameter to the required time. Refer to *Communications Setup Dialog Box Settings* on the next page for information on the settings.

3

Click the OK Button.

This completes the setup.

Item		Description		
Connection type	Specify the connection method to use for online communications. The specified connection method is used when you go online.			
Remote IP Address	If you specify a USB read troller that you normally	mote or Ethernet hub connection, set the IP address of the Con-		
	USB Communica- tions Test Button	These buttons perform a communication test with the Controller at the specified IP address. The result is displayed as follows:		
	Ethernet Communica-	Normal: "Test OK"		
	tions Test Button	 Error: "The Controller was not found." or "There is more than one Controller with the specified IP address." 		
Options	Confirm the serial ID when going online.	If you select this option, the names and serial IDs are compared between the project and the Controller when you go online to make sure that a connection is made to the intended Controller.		
	Check forced refresh- ing when going offline.	If you select this option, a check is made to see if any forced refreshing values are still in effect before going offline.		
Response Monitor Time	Ionitor You can set the response monitor time for communications with the Controller. An error is displayed if a response is not received before this time expires.			
Note The time can be set to between 1 and 3,600 s.		set to between 1 and 3,600 s.		

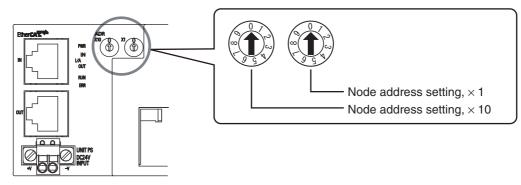
• Communications Setup Dialog Box Settings

2-2 Setting the Node Addresses of the EtherCAT Slaves

Setting Node Address Using Hardware Switches

Setting the node address is described here. An OMRON GX-series Remote I/O Terminal is used as the slave. With a GX-series Remote I/O Terminal, the node address is set on hardware switches. With a GX-series Remote I/O Terminal, these switches are used to set the node address as a slave on the EtherCAT network.

The 10s digit is set using the left rotary switch and the 1s digit is set using the right rotary switch. The setting range is from 00 to 99.



The node address setting values are described in the following table.

Switch setting	Node address setting
00	Set with the Sysmac Studio*.
01 to 99	Set with the hardware switches.

* Refer to 1-3-1 Performance Specifications for details on the settable node address range.

Setting the Node Address from the Sysmac Studio

Use the Sysmac Studio to set the node address if there are no hardware switches or the node address is beyond the range that can be set with the hardware switches.

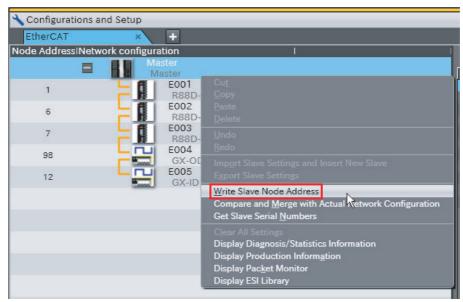
7 Start the Sysmac Studio and go online with the Controller.

2

2 Double-click EtherCAT under Configurations and Setups on the Multiview Explorer. Or, rightclick EtherCAT under Configurations and Setups and select *Edit*.



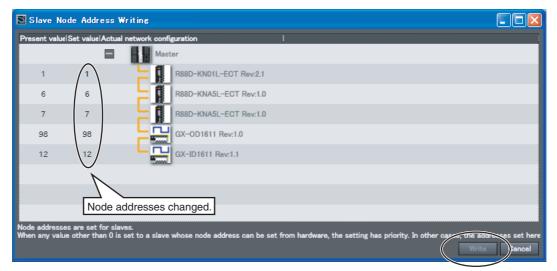
3 Right-click the EtherCAT master that is displayed in the Edit Pane and select *Write Slave Node Address*.



The Slave Node Address Writing Dialog Box is displayed.

4 If there are slaves for which the node address is not set (i.e., for which the present value is 0) or if there is more than one slave with the same node address (indicated by "!"), change the set values of the slave addresses, and then click the **Write** Button.

(If the correct node addresses are set for all of the slaves, click the Cancel Button.)



The node addresses are written to the actual slaves.

Additional Information

- The switch setting is read only once when the power is turned ON. Even if the setting is changed after the power supply is turned ON, the new setting will not be used until the next time that power is turned ON.
- If same node address is set for more than one node, a Slave Node Address Duplicated Error occurs and the operation of the slave stops. If a duplicated node address is set, the systemdefined variable _EC_SlavAdrDupErr (Slave Node Address Duplicated Error) changes to TRUE.
- Use the Sysmac Studio to set the node address if there are no hardware switches or the node address is beyond the range that can be set with the hardware switches.

2

2-3 Features of Sysmac Devices

2-3-1 Sysmac Devices

"Sysmac devices" is a generic name for EtherCAT slaves and other OMRON control components that were designed with the same communications and user interface specifications. You can use the NJ/NX-series Machine Automation Controllers together with Sysmac devices and the Sysmac Studio Automation Software to achieve optimum functionality and ease of operation.

2-3-2 Sysmac Device Features

You can connect Sysmac device slaves to an NJ/NX-series Machine Automation Controller to use the following features.

Sysmac device feature	Description
Troubleshooting	OMRON defines component error status as Sysmac errors for the entire Sysmac Series.
	You can use Sysmac errors to display errors that occur in slaves on the Sysmac Studio together with corrections for the errors.
Backing up and restoring parameters	An optional feature in the version-1.0.1 ESI specifications is used to enable backing up and restoring slave parameters (called backup parameters).
Saving node address settings	The node address setting for each slave is stored in non-volatile memory within the slave.
Verifying the EtherCAT network configuration using serial num- bers	You can verify the EtherCAT network configuration based on serial numbers.

2

Troubleshooting

OMRON defines component error status as Sysmac errors for the entire Sysmac Series.

You can use Sysmac errors to display errors that occur in slaves on the Sysmac Studio together with corrections for the errors.

This allows you to detect slave errors and isolate the causes of the errors.

If a Sysmac error occurs in a slave, the values of the *_EC_SlavErr* system-defined variable and the element of the *_EC_SlavErrTbl* system-defined variable that corresponds to the slave node address change.

Refer to 9-1-1 How to Check for Errors for details on the values.

Additional Information

- This feature is not supported for OMRON slaves that are not Sysmac devices and slaves that are manufactured by other companies. Check the error detection methods for each slave.
- Before you reset an error from the NJ/NX-series EtherCAT master, make sure you confirm the cause of the error in the slave.
- Sysmac errors are not displayed on the Troubleshooting Dialog Box when the slaves are in Init state. When a slave in Init state where a Sysmac error was detected is connected, you cannot confirm the Sysmac error that was detected by the slave until communications are restarted with that slave. Therefore, if an error that results in a slave going to Init state and a slave Sysmac error are detected at the same time, first reset the slave Init state, restart communications with the slave, and then check the Sysmac error. Then, eliminate the cause of the error and reset the error. Refer to *9-2-2 Error Descriptions* for the errors that result in the Slave entering Init state.
- If you delete the assignment of the Sysmac error status from the processing data communications data, e.g., to reduce the load on the EtherCAT communications line, you will not be able to use the Sysmac error status in troubleshooting. (To delete the assignment, edit the PDO map settings in the EtherCAT master settings on the Sysmac Studio so that the map object that is mapped to object 2002 hex is not selected.) If you do so, you can detect errors that occur in the slave applications other than communications errors only through the transmission of emergency messages or status information that is mapped for other process data communications. Use emergency messages and other status information for which PDOs are mapped to detect slave errors in this case. Transmission of emergency messages is disabled by default for OMRON slaves.
- When the EtherCAT master detects an emergency message from a slave, the *_EC_SlavEmergErr* system-defined variable changes to TRUE. Check the contents of the emergency message from the slave on the Troubleshooting Dialog Box.
- Refer to Section 9 Troubleshooting for details on checking for errors and corrections.

Backing Up and Restoring Parameters

The Sysmac devices use an option in the version-1.0.1 ESI specifications to enable backing up and restoring the backup parameters that are specified in the ESI files in non-volatile memory in the slaves.

You can back up and restore the backup parameters that are stored from the Sysmac Studio.

This makes it easy to set slaves when they are replaced.



Additional Information

- If you use slaves from other manufacturers, obtain the slave information files that are compliant with the version-1.0.1 ESI specifications from the slave manufacturers.
- Refer to 9-4-3 Backing Up Settings for the procedure to back up slave data from the Sysmac Studio.
- Refer to 9-4-4 Restoring Settings for the procedure to restore slave data from the Sysmac Studio.
- Refer to A-3 Multi-vendor Environments for information on ESI.

Saving Node Address Settings

Each Sysmac device stores its own node address setting in non-volatile memory within the slave.

This allows the master to identify slaves on the network.

The node addresses are set as given below depending on the type of slave.

- Slaves with Hardware Switches
 0: The node address is set from the Sysmac Studio.
 Not 0: The setting on the hardware switches is used.
- Slaves without Hardware Switches The node address is set from the Sysmac Studio.



Precautions for Correct Use

- Set a node address for every slave so that the slaves can be identified on the EtherCAT network. Do not assign the same node address more than once.
- If you connect slaves from other manufacturers to the NJ/NX-series EtherCAT master, set the node addresses for them from the Sysmac Studio. (The NJ/NX-series EtherCAT master recognizes the value that is stored at address 0x0012 in the EtherCAT slave controller of the slave as the node address.)
- For OMRON slaves that are not Sysmac devices, set the node addresses on the hardware switches. If the node address switches are set to 0, a Network Configuration Verification Error occurs.



Additional Information

- Refer 2-2 Setting the Node Addresses of the EtherCAT Slaves or the manuals for each slave for the procedure to set the node addresses.
- Refer to 5-4-2 Setting EtherCAT Slaves for information on setting node addresses with the Sysmac Studio.

Verifying the EtherCAT Network Configuration Using Serial Numbers

Each Sysmac device slave stores its serial number in non-volatile memory within the slave.

If serial number verification is enabled in the EtherCAT master settings, the EtherCAT network configuration is verified based on the serial numbers when the EtherCAT master is started. The following are enabled by verification of the serial numbers.

- If the EtherCAT network configuration changes, the serial numbers will not match and a Network Configuration Verification Error occurs. This helps prevent forgetting to set the parameters when a slave is replaced.
- The serial numbers of any of the slaves can be checked from the EtherCAT master.

Additional Information

Refer to 5-4-1 Setting EtherCAT Master for information on checking serial numbers.

2-3-3 List of Sysmac Devices

The following table lists the OMRON Sysmac slaves. Refer to the manual for the slave for information on OMRON slaves that are not listed in the following table.

Name	Model	Revision
AC Servo Drives	R88D-KN	Revision 2.1 or later
Multifunctional, Compact Inverter	3G3AX-MX2-ECT	Revision 1.1 or later
Digital I/O Slaves		Revision 1.1 or later
Analog I/O Slaves	GX-AD0□71 GX-DA0□71	Revision 1.1 or later
Encoder Input Slaves	GX-EC02□1	Revision 1.1 or later
Vision Sensors	FH-100 FH-3000	Revision 1.0 or later
Specialized Vision Sensors for Positioning	FQ-MS12□-ECT	Revision 1.0 or later
	FQ-MS12□-M-ECT	
Smart Fiber Sensor Communications Unit	E3X-ECT	Revision 1.0 or later
EtherCAT Junction Slaves	GX-JC03	Revision 1.0 or later
	GX-JC06	
NX-series EtherCAT Coupler Unit*	NX-ECC201 ^{*1}	Revision 1.0 or later
	NX-ECC202*2	Revision 1.2 or later
	NX-ECC203 ^{*3}	Revision 1.3 or later
Advanced General-purpose Inverters	3G3RX-V1 with EtherCAT Commu- nications Unit 3G3AX-RX-ECT	Revision 1.0 or later
Linear Servo Drive	R88L-EC	Revision 1.0 or later
	R88D-KN□-ECT-L	
Digital Sensor Communications Unit	E3NW-ECT	Revision 1.0 or later
Fiber Sensor Communications Unit	E3X-ECT	Revision 1.0 or later
Confocal Fiber Type Displacement Sensors	ZW-CE1	Revision 1.0 or later

*1 A CPU Unit with unit version 1.05 or later and Sysmac Studio version 1.06 or higher are required.

*2 A CPU Unit with unit version 1.07 or later and Sysmac Studio version 1.08 or higher are required.

*3 A CPU Unit with unit version 1.07 or later and Sysmac Studio version 1.11 or higher are required.

2-3-4 Sysmac Device Features and EtherCAT Masters

The following table shows the relationship between Sysmac device features and EtherCAT masters.

OMRON Sysmac Device Slaves

	OMRON Eth			
Sysmac device feature	NJ/NX-series CPU Unit NX701-000 NJ501-000 NJ301-000 NJ101-000	CJ1W-NC⊡8⊡ CJ-series Position Control Unit	EtherCAT master from another manufacturer	
Troubleshooting	Supported.	Not supported.*1	Not supported.*1	
Backing up and restor- ing parameters	Supported.*2	Partially supported.*3	Partially supported.*4	
Saving node address settings	Supported.	Supported.	Partially supported.*5	
Verifying the EtherCAT network configuration	Supported.	Not supported.	Partially supported.*6	

*1 Error notification is provided with emergency messages.

*2 EtherCAT slaves for which data can be backed up have specific precautions. Refer to the *NJ/NX-series CPU Unit Software User's Manual* (Cat. No. W501) for details on the precautions.

- *3 You cannot specify data to back up and restore.
- *4 The ability to back up and restore data depends on the ability of the EtherCAT master from another manufacturer.
- *5 The ability to store node addresses depends on the ability of the EtherCAT master from another manufacturer.
- *6 The ability to verify serial numbers depends on the ability of the EtherCAT master from another manufacturer.

OMRON Slaves That Do Not Support Sysmac Devices

	OMRON Eth			
Sysmac device feature	NJ/NX-series CPU Unit NX701-000 NJ501-000 NJ301-000 NJ101-000	CJ1W-NC⊡8⊡ CJ-series Position Control Unit	EtherCAT master from another manufacturer	
Troubleshooting	Not supported.*1	Not supported.*1	Not supported.*1	
Backing up and restor- ing parameters	Supported.*2	Partially supported.*3	Partially supported.*4	
Saving node address settings	Partially supported.*5	Partially supported.*5	Partially supported.*6	
Verifying the EtherCAT network configuration	Not supported.	Not supported.	Partially supported.*7	

*1 Error notification is provided with emergency messages.

*2 EtherCAT slaves for which data can be backed up have specific precautions. Refer to the *NJ/NX-series CPU Unit Software User's Manual* (Cat. No. W501) for details on the precautions.

- *3 You cannot specify the data that is backed up and restored.
- *4 The ability to back up and restore data depends on the ability of the EtherCAT master from another manufacturer.
- *5 Setting is possible on the node address switches. Node addresses set with the software cannot be stored in the slave.
- *6 The ability to store node addresses depends on the ability of the EtherCAT master from another manufacturer.
- *7 The ability to verify serial numbers depends on the ability of the EtherCAT master from another manufacturer.

Slaves from Other Manufacturers

If you connect slaves from other manufacturers to an OMRON EtherCAT master, some slave functions are not supported or restricted as follows.

- When you use an ESI file that is not supported by the Sysmac Studio, some slave functions may be restricted or not settable, or the slave may not operate properly.
- The node address setting from the Sysmac Studio may not be supported by some slave specifications.
- Verification with serial numbers is not possible for slaves that do not have the serial number in SII.

3

EtherCAT Communications

This section describes the different types of EtherCAT communications, EtherCAT settings, and state transitions.

3-1	EtherC	CAT Communications Types and Settings	. 3-2
	3-1-1	CoE (CAN Application Protocol over EtherCAT)	3-2
	3-1-2	Types of Communications	3-5
	3-1-3	Types of EtherCAT Variables	3-6
	3-1-4	Settings Required for EtherCAT Communications	3-7
3-2	Progra	mming EtherCAT Communications	. 3-8
3-3	State 1	Fransitions for EtherCAT Communications	. 3-9
	3-3-1	Self Diagnosis at Startup	3-9
	3-3-2	Control States for EtherCAT Communications	3-9
	3-3-3	CPU Unit Status in Relation to EtherCAT	.3-11

3-1 EtherCAT Communications Types and Settings

3-1-1 CoE (CAN Application Protocol over EtherCAT)

The EtherCAT port built into the NJ/NX-series CPU Unit uses CoE (CAN application protocol over EtherCAT) to exchange information with slaves over EtherCAT. CoE implements message communications of CAN application over an EtherCAT network. With CoE, the parameters and control information held by the slaves are specified according to data specifications for the object dictionary.

Process data Communications and SDO Communications

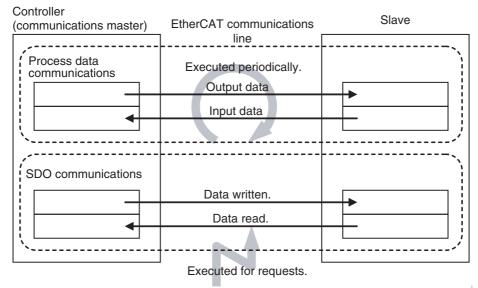
There are two communications that are used to communicate data between the master and slaves. These are described below.

• Process Data Communications:

Communications using process data objects (PDOs) to exchange information in realtime with a fixed period.

• SDO Communications:

Communications using service data objects (SDOs) for communicating information when required.



The EtherCAT port built into the NJ/NX-series CPU Unit uses process data communications for commands to refresh I/O data in a fixed control period, including I/O data for EtherCAT slaves, and position control data for Servomotors. It uses SDO communications for commands to read and write data, such as for parameter transfers, at specified times.

Process data communications are executed each control cycle to refresh data continuously, and SDO communications are executed between PDO communications.

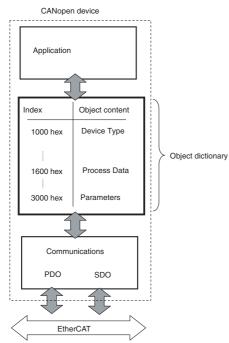
3-1 EtherCAT Communications Types and Settings

Additional Information

Object Dictionary

The object dictionary is a data table within the device that interfaces the application and communications. It describes the information handled by the device. Each piece of information is called an object. Each object is assigned a 4-digit hexadecimal index.

Each object is divided into a data type area, a CoE communications area, and a manufacturer-specific area.



Process data communications is used to read and write the process data in the CoE communications area in these objects.

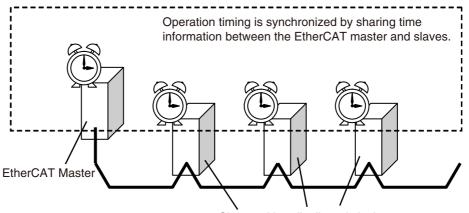
SDO communications is used to read and write the parameters within the manufacturer-specific area in these objects.



Additional Information

Distributed Clock (DC)

This is a unique EtherCAT feature that enables precise clock synchronization. The DC-based clock synchronization enables sharing the same time between the EtherCAT master and the slaves. This enables the timing of the operation of the EtherCAT master and slaves to be synchronized with the shared time.



Slaves with a distributed clock

The clock that gives the standard network time is called a "reference clock". The reference clock is provided either by the master or a slave that supports the function to provide a reference clock, to the other slaves. As described in the table below, whether the master or slave provides a reference clock depends on the used CPU Unit.

When NX-series CPU Units Is Used	When NJ-series CPU Units Is Used
	Of the slaves that provide a reference clock, the slave that is the closest to the EtherCAT master on the wiring. In the above figure. the left most slave of the slaves with the DC functionality.*

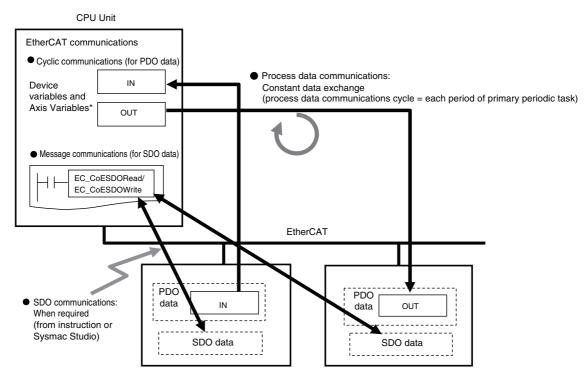
* Slaves with the DC functionality can provide a reference clock.

The EtherCAT master uses this reference clock to send frames so that the EtherCAT master and slaves remain synchronized. The slaves that support a distributed clock (i.e., synchronized slaves) perform advanced time synchronization by performing input and outputs based on the reference clock.

3-1-2 Types of Communications

The following two methods are used to exchange data between master and slaves in EtherCAT communications.

Communication type	Name of communication type	Timing of processing	Type of data
Cyclic communications	Process data communications (PDO communications)	Constant (process data communications cycle)	PDO data
Message communications	SDO communications	When required.	SDO data



* Device variables for EtherCAT slaves

Axis Variables only for Servo Drive and encoder input slaves to which axes are allocated

Process Data Communications (PDO Communications)

PDO communications is used for constant data exchange between the master and slaves. It is called process data communications. PDO data (i.e., I/O data that is mapped to PDOs) that is allocated in advance is input and output periodically each EtherCAT process data communications cycle (i.e., the task period of primary periodic task or priority-5 periodic task).

It is accessed from the NJ/NX-series CPU Unit in the following ways.

- · With device variables for EtherCAT slave I/O
- With Axis Variables for Servo Drive and encoder input slaves to which an axis is allocated

Additional Information

You can use the priority-5 periodic task only with NX-series CPU Units.

SDO Communications

SDO communications are used to read and write specified slave data from the master when required. This is called SDO communications.

You can read/write the following specified slave data with the EC_CoESDORead (Read CoE SDO) instruction or the EC_CoESDOWrite (Write CoE SDO) instruction.

• SDO data in slaves (parameters, error information, etc.)

3-1-3 Types of EtherCAT Variables

Variable type Description Allocated Device variables These are common in-out variables for EtherCAT slaves. You can change variables the names of these variables. Device variables for I/O ports TO \bigcirc \bigcirc CPU Unit EtherCAT master Basic I/O Unit Basic I/O Unit Unit Special Unit Special EtherCAT EtherCAT EtherCAT EtherCAT slave slave slave Slave configuration

There are three types of EtherCAT variables as listed below.

Variable type		Description
Allocated variables	Axis Variables	These are structure variables for I/O and parameters for Servo Drive and encoder input slaves. You can change the names of these variables. CPU Unit Axis Variable A Axis Variable B Allocated. EtherCAT Slave
System- defined vari- ables	System-defined variables for EtherCAT master	These variables are defined by the system for communications parameters, communication status, and other functions. You cannot change the names of these variables.

3-1-4 Settings Required for EtherCAT Communications

For EtherCAT communications, you must set the following network configuration information from the Sysmac Studio and download it to the CPU Unit.

- Network configuration: Master and slave configuration
- EtherCAT master settings: Parameters settings, such as the Fail-soft Operation Setting or Wait Time

for Slave Startup

Process data information: Allocation information for slave PDO data

Additional Information

EtherCAT communications cannot be performed unless the correct network configuration information is downloaded to the CPU Unit. Refer to *Section 5 Setting Up EtherCAT Communications with the Sysmac Studio* for details.

3-2 Programming EtherCAT Communications

The user program in the NJ/NX-series CPU Unit reads/writes EtherCAT slave data and performs motion control for Servo Drive and encoder input slaves.

Slave type	Type of data	Timing	Instructions	Variables
Slaves to which you cannot assign axes	Process data	Constantly read/written	Read/write instructions such as LD, OUT and MOV	Device variables
	SDO data	Read/written as required	EtherCAT instructions (EC_CoESDORead or EC_CoESDOWrite)	User-defined variables
Slaves to which you can assign axes	Process data	Constantly read/written	Motion control instruc- tions or read/write instructions such as LD, OUT and MOV	Axis Variables or device variables
	SDO data	Read/written as required	EtherCAT instructions (EC_CoESDORead or EC_CoESDOWrite)	User-defined variables

3-3 State Transitions for EtherCAT Communications

3-3-1 Self Diagnosis at Startup

The EtherCAT master executes the following self-diagnosis when the power is turned ON. The results of self-diagnosis are provided in the following system-defined variables as EtherCAT master errors if errors are detected.

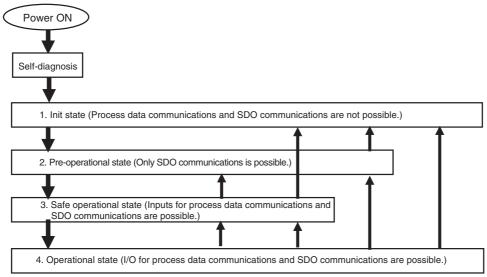
Diagnosis	Detected error type	System-defined variables
Diagnosis of network configuration information	Network configuration information error	_EC_NetCfgErr
Diagnosis of communications port	MAC address error	_EC_MacAdrErr
	Communications controller error	_EC_LanHwErr

Refer to 9-1 Overview of Errors for details on error types.

3-3-2 Control States for EtherCAT Communications

Control State Machine

EtherCAT communications provides four control states. Communications is controlled by moving between these states.



After the power is turned ON, the communications master and slaves go from the Init state to the Preoperational state, Safe-operational state, and then Operational state before starting EtherCAT communications. Afterwards, EtherCAT communications are performed while the state changes automatically between these states according to error occurrence and other conditions.

State	Description	Process data communications	SDO communications	RUN indicator
1. Init	Communications are being initialized. Com- munications are not possible.	Not allowed	Not allowed	Not lit
	This state continues if the network is not configured.			
2. Pre-operational	Only SDO communi- cations are possible in this state. Communications always enters this state after initializa- tion, and changes to the safe-operational state after initial set- ting of the network is performed.	Not allowed	Possible	Flashing
3. Safe operational	In this state, SDO communications and only inputs for pro- cess data communi- cations are possible. Communications always enters this state before going into the Operational state.	Only inputs are possible	Possible	Flashing
4. Operational	This is the normal state for communica- tions.	Possible	Possible	Lit

The current control state can be determined using the RUN indicator on the front panel.

3

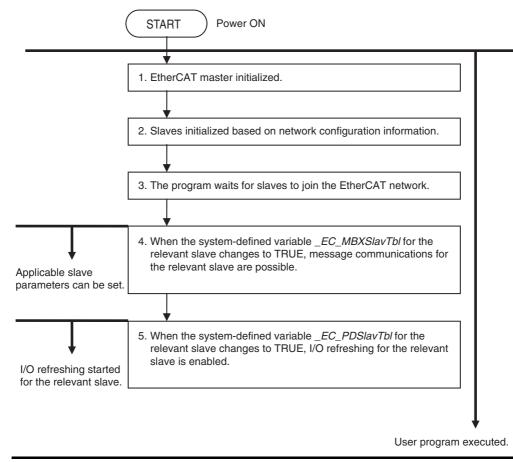
Additional Information

I/O Refreshing

The procedure from startup of the EtherCAT network until process data I/O can be refreshed is shown below. There is no correlation between the startup of the EtherCAT network and the execution of the user program. Design the user program by adding the system-defined variables* for the relevant slaves to the interlock conditions of the device variables for the slaves.

* _EC_ActSlavTbl[1..n], _EC_MBXSlavTbl[1..n], _EC_PDSlavTbl[1..n], _EC_DisconnSlavTbl[1..n], and _EC_DisableSlavTbl[1..n]

Here, *n* is the maximum value of the settable node address. Refer to *1-3-1 Performance Specifications* for the maximum value of the settable node address.



3-3-3 CPU Unit Status in Relation to EtherCAT

Refer to A-1 EtherCAT Status in Relation to CPU Unit Status for details on the following: memory related to the EtherCAT master, the ability to download master settings and slave settings, and the status of slaves according to the CPU Unit operating mode and the status of Controller errors.

4

EtherCAT Network Wiring

This section describes how to connect and wire an EtherCAT network.

4-1	Laying the EtherCAT Network		
	4-1-1	Supported Network Topologies	4-2
	4-1-2	Installation Precautions	4-4
	4-1-3	Installing EtherCAT Communications Cables	4-4
	4-1-4	Connecting Communications Cables	4-8
	4-1-5	Cable Connection Procedure	4-9

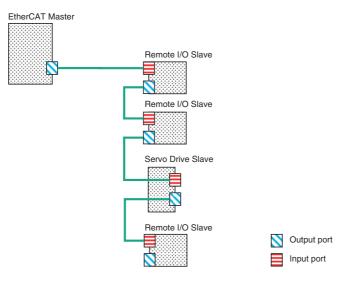
4-1 Laying the EtherCAT Network

This section describes how to install EtherCAT networks.

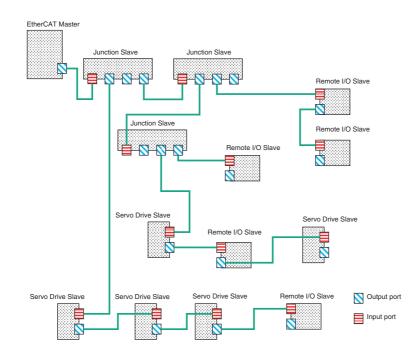
4-1-1 Supported Network Topologies

The NJ/NX-series CPU Unit can be connected using daisy chain connections with no branching, or with branching connections using Junction Slaves. This supports redundancy, and all topologies other than rings. Examples of topology without branching and with branching (Junction Slaves) are shown below.

No Branching



• Branching



Precautions for Safe Use

You cannot use standard Ethernet hubs or repeater hubs with EtherCAT communications. If you use one of these, a major fault level error or other error may occur.

Precautions for Correct Use

When you use a system configuration in which an EtherCAT Junction Slave is connected to synchronized slaves that support distributed clocks, you need a master or slave that can provide a reference clock.

With the NX-series CPU Unit, the EtherCAT master provides a reference clock.

With the NJ-series CPU Unit, at least one of the following two conditions must be met because the EtherCAT master does not provide a reference clock.

- A slave that provides a reference clock must be connected between the EtherCAT master and the first EtherCAT Junction Slave.
- The EtherCAT Junction Slave must provide a reference clock.

However, the above conditions do not apply when synchronization is not performed between slaves that support providing a distributed clock in the entire EtherCAT network.

You can determine whether the EtherCAT Junction Slave supports a reference clock from the Reference Clock setting in the Sysmac Studio slave settings. OMRON EtherCAT Junction Slaves support a reference clock.

Additional Information

If you use EtherCAT Junction Slaves, the EtherCAT Junction Slave ports that are actually connected to slaves will communicate normally even if they do not agree with the Sysmac Studio network configuration.

If you need to make the Sysmac Studio network configuration consistent with the ports that are actually connected to slaves, use the compare and merge function of the Sysmac Studio to check the actual configuration.

4

4-1-2 Installation Precautions

Basic precautions for the installation of EtherCAT networks are provided below.

Precautions when Installing a Network

 When you install an EtherCAT network, take sufficient safety precautions and perform the installation according to standards and specifications. (Refer to JIS X5252 or to electrical facility technical references.)

An expert well versed in safety measures and the standards and specifications should be asked to perform the installation.

- Do not install EtherCAT network equipment near sources of noise. If the network must be installed in an area with noise, take steps to address the noise, such as placing equipment in metal cases.
- When using a shielded cable with the shields on both ends of the cable connected to connector hoods, ground loops induced by improper earthing methods may decrease noise immunity and cause device damage. To prevent ground loops caused by differences in potential between device earthing points, the reference potential between the devices must be stabilized. Design earthing appropriately so that noise current does not flow to ground lines between the devices. For earthing methods, refer to the *NJ-series CPU Unit Hardware User's Manual* (Cat. No. W500) and the *NX-series CPU Unit Hardware User's Manual* (Cat. No. W535).

Precautions when Installing Communications Cables

- Check the following items on the communications cables that are used in the network.
 - Are there any breaks?
 - Are there any shorts?
 - Are there any connector problems?
- When you connect the cable to the communications connectors on devices, firmly insert the communications cable connector until it locks in place.
- Do not lay the communications cables together with high-voltage lines.
- Do not lay the communications cable near devices that generate noise.
- Do not lay the communications cables in locations subject to high temperatures or high humidity.
- Do not lay the communications cables in locations subject to excessive dirt and dust or to oil mist or other contaminants.
- There are limitations on the bending radius of communications cables. Check the specifications of the communications cable for the bending radius.

4-1-3 Installing EtherCAT Communications Cables

Ethernet communications cables and connectors are used to connect the built-in EtherCAT port with EtherCAT slaves.

Use a straight, shielded twisted-pair cable (double shielding with aluminum tape and braiding) of Ethernet category 5 (100BASE-TX) or higher.

Cable with Connectors

• Sizes and Conductor Pairs: AWG 27 × 4 Pairs

Product name	Manufacturer	Cable length [m]*	Model	Contact information
Standard type Cable with Connec-	OMRON Corporation	0.3	XS6W- 6LSZH8SS30CM-Y	OMRON Customer
tors on Both Ends (RJ45/RJ45)		0.5	XS6W- 6LSZH8SS50CM-Y	Service Center
		1	XS6W- 6LSZH8SS100CM-Y	
		10	XS6W- 6LSZH8SS1000CM-Y	

* Cables are available in the following lengths: 0.2, 0.3, 0.5, 1, 1.5, 2, 3, 5, 7.5, 10, 15, and 20 m. Refer to the *Industrial Ethernet Connectors Catalog* (Cat. No. G019).

• Sizes and Conductor Pairs: AWG 22 × 2 Pairs

Product name	Manufacturer	Cable length [m]*	Model	Contact information	
Rugged type	OMRON	0.3	XS5W-T421-AMD-K	OMRON Customer	
Cable with Connec-	Corporation	0.5	XS5W-T421-BMD-K	Service Center	
tors on Both Ends (RJ45/RJ45)		1	XS5W-T421-CMD-K		
Rugged type	OMRON	2	XS5W-T421-DMC-K	OMRON Customer	
Cable with Connec-	Corporation	5	XS5W-T421-GMC-K	Service Center	
tors on Both Ends (M12/RJ45)		10	XS5W-T421-JMC-K		
Rugged type	OMRON	0.3	XS5W-T422-AMC-K	OMRON Customer	
Cable with Connec-	Corporation	0.5	XS5W-T422-BMC-K	Service Center	
tors on Both Ends (M12L/RJ45)		1	XS5W-T422-CMC-K]	

* Cables are available in the following lengths: 0.3, 0.5, 1, 2, 3, 5, 10, and 15 m. Refer to the *Industrial Ethernet Connectors Catalog* (Cat. No. G019).

Cables and Connectors

• Sizes and Conductor Pairs: AWG 24 × 4 Pairs

Part name	Manufacturer	Model	Contact information
Cables	Tonichi Kyosan Cable, Ltd.	NETSTAR-C5E SAB $0.5 \times 4P^*$	Planning Department, Kanetsu Co., Ltd.
	Kuramo Electric Co.	KETH-SB*	Kuramo Electric Co.
	SWCC Showa Cable Systems Co.	FAE-5004*	SWCC Showa Cable Sys- tems Co.
RJ45 Connectors	Panduit Corporation	MPS588*	Panduit Corporation US Headquarters

* We recommend that you use combinations of the above Cables and Connectors.

• Sizes and Conductor Pairs: AWG 22 × 2 Pairs

Part name	Manufacturer	Model	Contact information
Cables	Kuramo Electric Co.	KETH-PSB-OMR*	Kuramo Electric Co.
	Nihon Electric Wire&Cable Co.,Ltd.	PNET/B*	Nihon Electric Wire&Cable Co.,Ltd.
RJ45 Assembly Connec- tors	OMRON Corporation	XS6G-T421-1*	OMRON Customer Ser- vice Center

* We recommend that you use combinations of the above Cables and Connectors.

Precautions for Correct Use

- The maximum length between nodes is 100 m. However, some cables are specified for less than 100 m. Generally speaking, if the conductors are twisted wire rather than solid wire, transmission performance will be lower, and reliable communications may not be possible at 100 m. Confirm details with the cable manufacturer.
- When selecting a connector, confirm that it is applicable to the cable that will be used. Confirm the following items: Conductor size, conductor type (solid wire or twisted wire), number of twisted pairs (2 or 4), outer diameter, etc.

Additional Information

If an Ethernet cable of category 5 or higher is used, communications will be possible even if the cable is not shielded. However, we recommend a cable with double, aluminum tape and braided shielding to ensure sufficient noise immunity.

Attaching the Connectors to the Cable and Pin Assignments

		[
Pin No.	Wire color]	Wire color	Pin No.
1	White-Green		White-Green	1
2	Green	<u>}</u> /_∖ ∖	Green	2
3	White-Orange		White-Orange	3
4	Blue		Blue	4
5	White-Blue		White-Blue	5
6	Orange]	Orange	6
7	White-Brown]	White-Brown	7
8	Brown	$\vdash \forall \qquad /$	Brown	8
Hood	Shield		Shield	Hood

Use straight wiring to attach the connectors to the communications cable.

*1 Connect the cable shield to the connector hood at both ends of the cable.

*2 There are two connection methods for Ethernet: T568A and T568B. The T568A connection method is shown above, but the T568B connection method can also be used.

Connector Specifications

Specification	Description			
Electrical characteristics	Conforms to IEEE 802.3 standards.			
Connector structure	RJ45 8-pin modular connector (Conforms to ISO 8877.)			

Pin Assignments

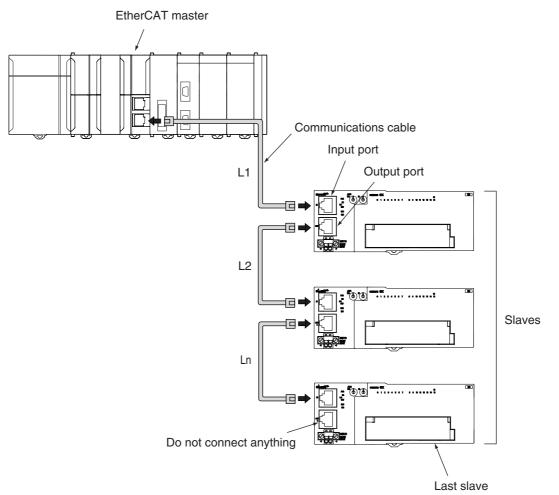
Pin No.	Signal name	Abbreviation	Signal direction
1	Transmission data +	TD+	Output
2	Transmission data –	TD–	Output
3	Reception data +	RD+	Input
4	Not used.		
5	Not used.		
6	Reception data –	RD-	Input
7	Not used.		
8	Not used.		
 Hood	Frame ground	FG	

4

4-1-4 Connecting Communications Cables

Cable connections can be made freely in EtherCAT networks. Connect the communications cable from the EtherCAT master to the input port on the first slave, and then connect the communications cable to the next slave to the output port on the first slave.

Do not connect anything to the output port of the slave at the end of the network.



The cable between any two nodes (L1, L2 ... Ln) must be 100 m or less. Use the Sysmac Studio to confirm if communications are possible for the total cable length. Firmly connect the communications cable connector until it clicks into place.

Precautions for Correct Use

Always perform one of the following operations before you disconnect the communications cable to a EtherCAT slave during operation.

- Disconnect the EtherCAT slave from the network.
- Disable the EtherCAT slaves and all slaves connected after it.

Refer to 9-4 Replacing Slaves during Communications for information on replacing slaves during operation.

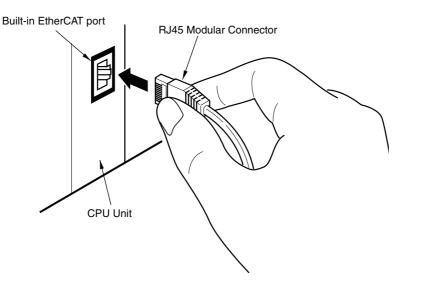
Additional Information

Make sure the cable between each pair of devices connects an output port to an input port. Normal communications are not possible if an output port is connected to another output port or an input port is connected to another input port.

4-1-5 Cable Connection Procedure

Precautions for Correct Use

- Turn OFF the Controller's power supply before connecting or disconnecting Ethernet communications cable.
- Allow extra space for the bending radius of the communications cable. The required space depends on the communications cable, connector, and CPU Unit that are used. Refer to the *NJ-series CPU Unit Hardware User's Manual* (Cat. No. W500) for details on the NJ-series CPU Unit. Refer to the *NX-series CPU Unit Hardware User's Manual* (Cat. No. W535) for details on the NX-series CPU Unit.
- **1** Lay the Ethernet communications cable.
- 2 Connect the Ethernet communications cable to the built-in EtherCAT port on the NJ/NX-series CPU Unit. Firmly insert the connector until it locks into place.



5

Setting Up EtherCAT Communications with the Sysmac Studio

This section describes how to set the network configuration information and how to check EtherCAT communications from the Sysmac Studio.

5-1	Overv	iew of Network Configuration Information	5-2
		ng the EtherCAT Network Configuration	
		g EtherCAT Slave Variables and Axes	
	5-3-1	Registering Device Variables for All EtherCAT Slaves	
	5-3-2	Axis Settings for Servo Drives and Encoder Input Slaves	5-10
5-4	Ether	CAT Master and Slave Parameter Settings	5-11
	5-4-1	Setting EtherCAT Master	
	5-4-2	Setting EtherCAT Slaves	
5-5	Comp	aring and Merging EtherCAT Network Configurations	5-24
	5-5-1	Comparing and Merging with the Actual Network Configuration from the Sysmac Studio	
	5-5-2	Automatically Creating the Network Configuration	
	5-5-3	Using the Sysmac Studio to Obtain Serial Numbers	
		from the Actual Network Configuration	5-31
5-6	Downl	oading the Network Configuration Information	5-33
	5-6-1	Downloading the Network Configuration Information from the Sysmac Studio	5-33
E 7	Confin		
5-7		ming Communications after Completing EtherCAT	5-35

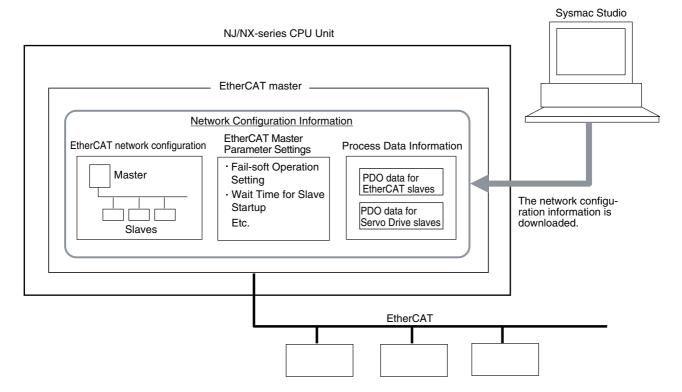
5-1 Overview of Network Configuration Information

To execute EtherCAT communications, you must create the following three types of data with the Sysmac Studio and download the data to the CPU Unit. When this data is set, the network configuration information is automatically created.

When you download the network configuration information to the CPU Unit, the EtherCAT master initializes slaves and performs process data communications based on the network configuration information. This section describes the procedures to set the network configuration information and how to check EtherCAT communications.

Network Configuration Information

Network configuration infor-	1. EtherCAT network configuration
mation	 Process data information This is allocation information for PDO data in the slaves. It is also called PDO mapping data.
	3. EtherCAT master and slave parameter settings (Examples: Fail-soft Operation Setting and Wait Time for Slave Startup)

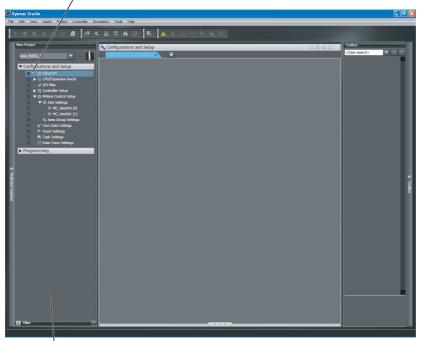


5-2 Creating the EtherCAT Network Configuration

This section describes how to create the EtherCAT network configuration.

- **1** Start the Sysmac Studio offline.
- 2 Double-click EtherCAT under Configurations and Setup on the Multiview Explorer. Or, rightclick EtherCAT under Configurations and Setup and select *Edit*.

Double-click EtherCAT or rightclick EtherCAT and select Edit.



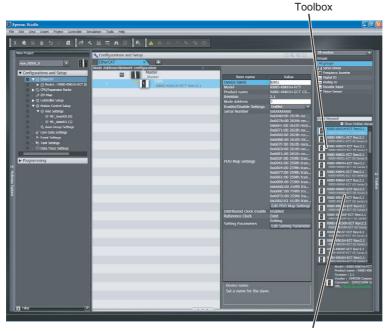
Multi-view Explorer

EtherCAT master will be displayed in the Edit Pane.

Sysmac Studio				
X 🖲 🖻 🗆 🗢 🖉 🗛	. 🚜 🗔 🗚 🔟 💐 🗛 🙈 🔗 🔗			
File Edit View Insert Project Controller Sim	udetor. Toda 14b	Iten name Model Model Product name Productione Call and Learne Call and Learne Production Learne Call and Learne Production Learne Product	Value Value Master Hader 1000 ur Hight quarks 2000	Constant and a second sec
🚦 Ner 🕑		Device name Set a name for the master.		Model : R8B0-N011H-ECT Product name : R8B0-NN Revision : 2.1 Commerci : 2000/100W St URL :
1 filter		,,,,		

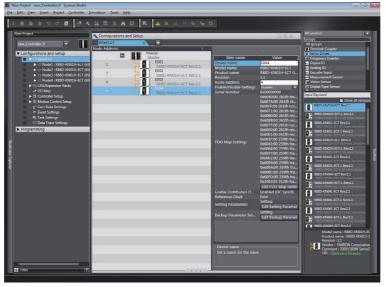
Edit Pane

3 Select a slave in the Toolbox, drag it to the Edit Pane, and drop it under the master. The slave will be added under the master.



Drag the slaves.

4 Select another slave in the Toolbox, drag it to the Edit Pane, and drop it under the slave to which you want to connect it to. The slave will be added under the slave.



For detailed procedures, such as those for deleting slaves, or copying and pasting slaves, refer to the *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504).

Refer to the *NX-series EtherCAT Coupler Unit User's Manual* (Cat. No. W519) and the *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504) for information on creating the EtherCAT Slave Terminal configuration.

Refer to A-8 MDP Settings for EtherCAT Network Slaves in the Sysmac Studio Version 1 Operation Manual (Cat. No. W504) for information on MDP slaves and editing the configurations of the modules that you can connect to the MDP slaves.

Additional Information

You can go online and read the actual network configuration from the Sysmac Studio to display it and to use it as the network configuration in the project. For details, refer to *5-5-2 Automatically Creating the Network Configuration*.

5

, creating in

5-3 Setting EtherCAT Slave Variables and Axes

Device variables are used to read and write process data for EtherCAT slaves. Axis variables are used to manipulate slaves to which axes are assigned from the Motion Control Function Module. This section describes how to register device variables and set the axes.

5-3-1 Registering Device Variables for All EtherCAT Slaves

You use the I/O Map Tab Page in the Sysmac Studio to assign device variables to the I/O ports. The device variables that you create are registered in the global variable table. Use one of the following three methods.

- · Selecting variables that were previously registered in a variable table
- Inputting new device variable names
- · Automatically creating device variable names

Selecting Variables That Were Previously Registered in a Variable Table

You can select variables that are already registered on the menu on the I/O Map Tab Page. For example, this method can be used to register device variables in the following cases.

- To write the program before the slave configuration information is created.
- · To reuse programming from another project.

Use the following procedure.

- **1** Register the variables in advance in the global variable table or the local variable table of one of the POUs.
- 2 Program using those variables.
- **3** Create the slave configuration information.
- 4 Double-click I/O Map under Configurations and Setup on the Multiview Explorer. Or, rightclick I/O Map under Configurations and Setup and select *Edit*.



5 Select the variables from the pull-down list in the I/O Map Tab Page to assign them to I/O ports.

🔧 Configurat	tions and Setup						DQQD
I/O Map	× +						
Position	Port	Descripti	on	R/W	Data Type	Variable	Variable Co
	CPU/Expansion Racks						<u></u>
CPU Racl	CPU Rack 0		Salac	tue	ar_dofin	ed variables that were previo	usly
	EtherCAT Network Configuration					global variable table.	
EtherCAT	Master		regist	erec	in the	giobal variable table.	
Node1	R88D-KN01H-ECT						
	Controlword	Controlword		w	WORD		
	Target position	Target position		W	DINT		
	Target velocity	Command spee	d for the	W	DINT 🌔	E001_Target_position	
	Target torque	Target torque		w	INT	COO1_Target_velocity	
	Modes of operation	Modes of opera		w	SINT	E001_Max_profile_velocity E001_Position_actual_value	
	Touch probe function	Touch probe fu		w	WORD	E001_Touch_probe_pos1_pos_value	
	Max profile velocity	Max profile velo		w	UDINT	E001_Touch_probe_pos2_pos_value	
	Positive torque limit value	Positive torque			UINT	E001_Digital_inputs	
	Negative torque limit value	Negative torque	e limit val	w	UINT		
	Error code	Error code		R	WORD		
	Statusword	Statusword		R	WORD		
	Position actual value	Position actual		R	DINT		
	Torque actual value	Torque actual v		R	INT		
	Modes of operation display	Modes of opera		R	SINT		
	Touch probe status	Touch probe sta	atus	R	WORD		

Inputting New Device Variable Names

You can input the required device variable names. For example, this method can be used to register device variables in the following case.

To give suitable names to device variables that are assigned to I/O for I/O slaves.

Use the following procedure.

1 Double-click I/O Map under Configurations and Setup on the Multiview Explorer. Or, rightclick I/O Map under Configurations and Setup and select *Edit*.



2 Select the I/O port on the I/O Map Tab Page and enter the variable name in the Variable Column.

🔧 Config	gurations and Setup					ji q q ji
I/O M	ap 🛛 🗙 🚹					
Pos	Port	Description	R/W	Data Ty	Variable	Variable G
	CPU/Expansion Racks					
CF	V TOPU Rack 0					
[0	CJ1W-OD232 (Transistor Outpu					
7	▼ Ch1_Out	Output CH1	RW	WORD	\frown	
	Ch1_Out00	Output CH1 bit 00	RW	BOOL (sample001	
	Ch1_Out01	Output CH1 bit 01	RW	BOOL		
	Ch1_Out02	Output CH1 bit 02	RW	BOOL		
	Ch1_Out03	Output CH1 bit 03	RW	BOOL		
	Ch1_Out04	Output CH1 bit 04	RW	BOOL		
	Ch1_Out05	Output CH1 bit 05	RW	BOOL		
	Ch1_Out06	Output CH1 bit 06	RW	BOOL		
	Ch1_Out07	Output CH1 bit 07	RW	BOOL		

Device variables are assigned to the I/O ports of the slaves.

5

3

To specify a variable table for the scope, specify the Variable Type.

Confi	igurations and Setup						[] Q G
I/0 M	tap 🗙 🛨						
Pos	Port	Description	R/W	Data Type	Variable	Variable Comm	Variable Type
	🔎 🔍 CPU/Expansion Racks						
СР	CPU Rack Ø						
	🔎 EtherCAT Network Configuration						
Et	Master						
No	R88D-KN01H-ECT						
	Controlword	Controlword	W	WÓRD	E001_Controlword		Global Variable
	Target position	Target position	W	DINT	E001_Target_posi	1	Global Variable
	Target velocity	Command speed for the	W	DINT	E001_Target_velo	9	Global Variable
	Target torque	Target torque	W	INT	E001_Target_torq	4	Global Variable
	Modes of operation	Modes of operation	W	SINT	E001_Modes_of_op	6	Global Variable
	Touch probe function	Touch probe function	W	WÓRD	E001_Touch_probe	-	Global Variable
	Max profile velocity	Max profile velocity	W	UDINT	E001_Max_profile		Global Variable
	Positive torque limit value	Positive torque limit	W	UINT			
	Negative torque limit value	Negative torque limit	W	UINT			
	Error code	Error code	R	WÓRD			
	Statusword	Statusword	R	WORD			
	Position actual value	Position actual value	R	DINT			
	Torque actual value	Torque actual value	R	INT			
	Modes of operation display	Modes of operation dis	R	SINT			
	Touch probe status	Touch probe status	R	WÓRD			
	Touch probe pos1 pos value	The latch position for	R	DINT			
	Touch probe pos2 pos value	The latch position for	R	DINT			
	Digital inputs	Digital inputs	R	DWORD			
	▼Sysmac Error Status	Sysmac error status	R	ВҮТЕ			
	Observation	Observation levels of	R	BOOL			

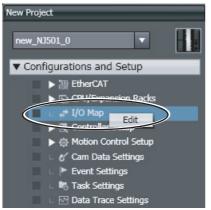
Automatically Creating Device Variable Names

The device variable names will be created by combining the device name and the I/O port name. The device names are set in the slave parameters. The default device names are "E" followed by a serial number that starts from 001. For example, this method can be used to register device variables in the following case.

• To eliminate the work that is involved in obtaining the device variable names.

Use the following procedure.

1 Double-click I/O Map under Configurations and Setup on the Multiview Explorer. Or, rightclick I/O Map under Configurations and Setup select *Edit*.



The I/O Map Tab Page will be displayed.

2 Select a slave or I/O ports on the I/O Map Tab Page, right-click, and select *Create Device Variable*.

C onfigurat	ions and Setup			Deries	and the state of the	TACT
I/O Map	× +		Device variables that were automatically create			
Position	Port	Description	R/W	/ Data Type	y v v v v v v v v v v v v v v v v v v v	Variable Comm
	CPU/Expansion Racks					
CPU Rack	CPU Rack 0					
	EtherCAT Network Configuration	1				
EtherCAT	Master					
Node1	R88D-KN01H-ECT				<u> </u>	
	Controlword	Controlword	w	WORD	E001_Controlword	
	Target position	Target position	w	DINT	E001_Target_position	
92 	Target velocity	Command speed for the	w	DINT	E001_Target_velocity	
	Target torque	Target torque	w	INT	E001_Target_torque	
	Modes of operation	Modes of operation	w	SINT	E001_Modes_of_operation	
	Touch probe function	Touch probe function	w	WORD	E001_Touch_probe_function	
22	Max profile velocity	Max profile velocity	w	UDINT	E001_Max_profile_velocity	
	Positive torque limit value	Positive torque limit valu	w	UINT	E001_Positive_torque_limit_value	
	Negative torque limit value	Negative torque limit val	w	UINT	E001_Negative_torque_limit_value	
	Error code	Error code	R	WORD	E001_Error_code	
22 	Statusword	Statusword	R	WORD	E001_Statusword	
	Position actual value	Position actual value	R	DINT	E001_Position_actual_value	
	Torque actual value	Torque actual value	R	INT	E001_Torque_actual_value	
	Modes of operation display	Modes of operation displ	R	SINT	E001_Modes_of_operation_display	
	Touch probe status	Touch probe status	R	WORD	E001_Touch_probe_status	
	Touch probe pos1 pos value	The latch position for La	R	DINT	E001_Touch_probe_pos1_pos_value	
	Touch probe pos2 pos value	The latch position for La	R	DINT	E001_Touch_probe_pos2_pos_value	
	Digital inputs	Digital inputs	R	DWORE	E001_Digital_inputs	
	▼ Sysmac Error Status	Sysmac error status	R	BYTE	E001_Sysmac_Error_Status	
	Observation	Observation levels of inf	R	BOOL	E001_Observation	
	Minor Fault	Minor Fault levels of info	R	BOOL	E001_Minor_Fault	
Node2	R88D-KN01H-ECT					
	Controlword	Controlword	w	WORD		
	Target position	Target position	w	DINT		
	Target velocity	Command speed for the	w	DINT	1	

3

If you specify a variable table for the scope, specify the Variable Type afterward.

_	igurations and Setup		_				🗆 ପ୍ ପ୍
I/O M	tap × 🕂						
Pos	Port	Description	R/W	Data Type	Variable	Variable Comm	Variable Type
	👤 CPU/Expansion Racks						
СР	CPU Rack Ø						
	🔎 EtherCAT Network Configuration						
Et	Master						
No	R88D-KN01H-ECT						
	Controlword	Controlword	W	WORD	E001_Controlword		Global Variables
	Target position	Target position	W	DINT	E001_Target_posit		Global Variables
	Target velocity	Command speed for the	W	DINT	E001_Target_velo		Global Variables
	Target torque	Target torque	W	INT	E001_Target_torq		Global Variables
	Modes of operation	Modes of operation	W	SINT	E001_Modes_of_op		Global Variables
	Touch probe function	Touch probe function	W	WORD	E001_Touch_probe		Global Variables
	Max profile velocity	Max profile velocity	W	UDINT	E001_Max_profile		Global Varial 🔻
	Positive torque limit value	Positive torque limit	W	UINT			Global Variables
	Negative torque limit value	Negative torque limit	W	UINT			Program0 Interna
	Error code	Error code	R	WORD			
	Statusword	Statusword	R	WÓRD			
	Position actual value	Position actual value	R	DINT			
	Torque actual value	Torque actual value	R	INT			
	Modes of operation display	Modes of operation dis	R	SINT			
	Touch probe status	Touch probe status	R	WORD			
	Touch probe pos1 pos value	The latch position for	R	DINT			
	Touch probe pos2 pos value	The latch position for	R	DINT			
	Digital inputs	Digital inputs	R	DWORD			
	▼Sysmac Error Status	Sysmac error status	R	ВҮТЕ			
	Observation	Observation levels of	R	BOOL			

Device variables are automatically assigned to the I/O ports of the slaves and registered in the variable table that is specified by the variable type.



Additional Information

- · We recommend that you set device names.
- To delete the mapping for the variable that is assigned to a port, delete the contents of the cell in the *Variable* Column or right-click the cell and select **Reset Assignment**. The mapping of the device variable is deleted. The variable is not deleted from the variable table.

Refer to *NJ/NX-series CPU Unit Software User's Manual* (Cat. No. W501) for details on device variables.

• If you do not specify anything in the *Variable Type* Column when you register a variable or create device variables, the variables are automatically registered in the global variable table.

5-3-2 Axis Settings for Servo Drives and Encoder Input Slaves

To operate slaves that can be assigned to axes in the Motion Control Function Module, you have to make axes settings. For details on the items and procedures of the axes setting, refer to the *NJ/NX-series CPU Unit Motion Control User's Manual* (Cat. No. W507).

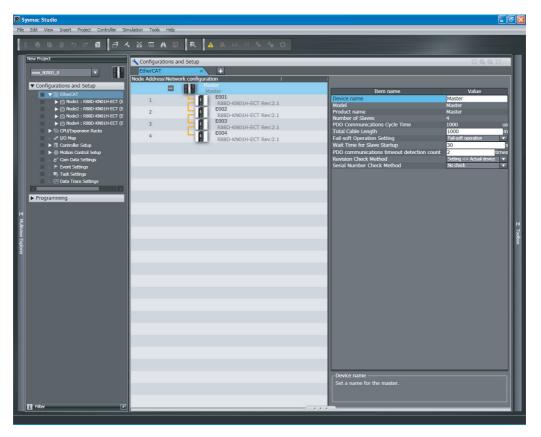
5-4 EtherCAT Master and Slave Parameter Settings

5-4-1 Setting EtherCAT Master

1 Double-click EtherCAT under Configurations and Setup on the Multiview Explorer. Or, rightclick EtherCAT under Configurations and Setup and select *Edit*.



- 2 Select the EtherCAT master that is displayed in the Edit Pane.
 - Screen for NJ-series



• Screen for NX-series

New Project - new_Controller_0 - S	ysmac Studio					
<u>File Edit View Insert Project</u>	<u>C</u> ontroller <u>S</u> imul	ation <u>T</u> ools <u>H</u> el	р			
X曲協会ちぐ自	1 8 4 20	a 🖁 🛱	🔍 🕅 🙀 🔉 🕹) # \$ * 0 0 0 2 0 0 0	Q	
Multiview Explorer 🔹 🖡	🚟 EtherCAT 🗙				•	Toolbox - All vendors
new_Controller_0 🔻	Node Address Netw	ork configuration Master Maste	r.	Item name	Value	Groups
Configurations and Setup V EtherCAT	1		001 R88D-KN01H-ECT Rev:2.1 002	Device name Model name	Master Master	Terminal Coupler Servo Drives
 Mode1 : R88D-KN0 Node2 : R88D-KN0 			002 R88D-KN01H-ECT Rev:2.1 003	Product name Number of Slaves PDO Communications Cycle 1	Master 5 1000 us	Frequency Inverter Digital IO Analog IO
 ▶ <i>○ Node3 : R88D-KN0</i> ▶ <i>○ Node4 : R88D-KN0</i> ▶ <i>○ Node5 : GX-ID1611</i> 	4	L 👬 E	R88D-KN01H-ECT Rev:2.1 004 R88D-KN01H-FCT Rev:2.1	PDO Communications Cycle 2 Reference Clock	us Exist	Encoder Input
 Node5 : GX-ID1011 CPU/Expansion Racks I/O Map 	5		005 3X-ID1611+ID08 Rev:1.1	Total Cable Length Fail-soft Operation Setting Wait Time for Slave Startup	1000 m Fail-soft operation ▼ 30 s	Input Keyword Show all versions NX-ECC201 Rev1.2
▶ 艮 Controller Setup ▶ 敬 Motion Control Setup				PDO communications timeout detection count Revision Check Method Serial Number Check Method	2 times Setting <= Actual device v No check v	NX-ECC201 EtherCAT coupler V NX-ECC202 Rev:1.2
				senal Number Check Method	NO CRECK	NX-ECC202 EtherCAT coupler V R88D-KN01H-ECT Rev:2.1 R28D-KN01H-ECT GS Series Ser
 Task Settings Data Trace Settings Programming 						R88D-KN01H-ECT-L Rev:1.1
Friegramming						R88D-KN01L-ECT G5 Series Ser R88D-KN01L-ECT-L Rev:1.1
						R88D-KN01L-ECT-L G5 Series Si R88D-KN02H-ECT Rev:2.1 R88D-KN02H-ECT G5 Series Ser
						R88D-KN02H-ECT-L Rev:1.1
						R88D-KN02L-ECT Rev:2.1 R88D-KN02L-ECT G5 Series Sen
				Decision		Model name : NX-ECC20
				Set a name for the master.		Product name : NX-ECC2 Revision : 1.2 Vendor : OMRON Corpo
< > Filter						Comment : EtherCAT Cou URL : <u>Open on a browser</u>

The EtherCAT master settings are listed below.

Name	Editing	Remarks
Device name	OK	Displays the name of the EtherCAT master.
		Default setting: Master
Model	Not	Always "Master."
	allowed.	
Product name	Not allowed.	Always "Master."
Number of Slaves	Not	The number of slaves is automatically calculated based on the
	allowed.	topology.
		Display range: 0 to the maximum number of slaves.*1
PDO Communications Cycle*2	Not	Displays the time of Process Data Communications Cycle.
	allowed.	This is automatically input based on the task period of the pri- mary periodic task.
		Display range: 500 to 4,000 μs.
		Default setting: 1,000 μs
PDO Communications Cycle 1*3	Not	Displays the time of Process Data Communications Cycle 1.
	allowed.	This is automatically input based on the task period of the pri- mary periodic task.
		Display range: 125, 250 to 8,000 µs.
		Default setting: 1,000 μs
PDO Communications Cycle 2 ^{*4}	Not	Displays the time of Process Data Communications Cycle 2.
	allowed.	This is automatically input based on the task period of the pri- ority-5 periodic task. ^{*4}
		Display range: 125, 250 to 100,000 μs.
		Default setting: 2,000 μs
Reference Clock	Not	Displays whether the master provides a reference clock.*5
	allowed.	Exist: The master provides a reference clock.
		Not Exist: The master does not provides a reference clock.
Total Cable Length ^{*6}	OK	This is the total cable length between the slaves.
		Setting range: 1 to the maximum number of slaves \times 100 $\text{m}^{\star1}$
		Default setting: 1,000 m

Name	Editing	Remarks
Fail-soft Operation Setting	ОК	Select <i>Stop</i> or <i>Fail-soft operation</i> for communications with all slaves on the network when the master detects a communications error (cable disconnection, slave malfunction, etc.).
		Default setting: Fail-soft operation
		Refer to 9-1 Overview of Errors for details on errors.
Wait Time for Slave Startup	OK	Set the time to wait from the detection of the link on the Ether- CAT port until all slaves join the network.
		Setting range: 3 to 200 s
		Default setting: 30 s
		Process data communications start if all slaves are present within the wait time. If all of the slaves are not present after the wait time elapses, a Network Configuration Verification Error occurs.
		When you use a slave that takes time to start, use a longer wait time setting to prevent errors.
PDO Communications Timeout Detection Count	OK	A Process Data Reception Timeout error occurs if process data (PDO) communications timeouts occur continuously more often than the specified number of times.
		Increase the setting if Process Data Reception Timeout errors occur frequently, such as in high-noise environments.
		Set the value to 2 or higher for a slave that needs to be replaced.
		Setting range: 1 to 8 errors
		Default setting: 2 errors
Revision Check Method	ОК	Specify the method to use to verify the revision numbers that are stored in the network configuration information (setting) against the actual revision numbers of the slaves (actual device) at the start of communications.
		Communications will not start if there are unverified slaves, and a Network Configuration Verification Error will occur.
		Setting values: Setting <= Actual device, Setting = Actual
		device, or No check ^{*7}
		Default setting: Setting <= Actual device
Serial Number Check Method ^{*8}	OK	Specify whether to verify the slave serial numbers that are stored in the network configuration information against the serial numbers that are set in the actual slaves when initiating communications.
		Communications will not start if there are unverified slaves, and a network configuration verification error will occur.
		Setting values: Setting = Actual device or No check
		Default setting: No check
DC Synchronous Correction ^{*9}	ОК	Specify whether to use the slave monitoring option during DC Synchronous Correction which ensures sync jitter accuracy of the DC time.
		If <i>Enable slave monitoring option</i> is selected, the master exe- cutes DC Synchronous Correction while monitoring the DC time of the slave.
		Use this setting if a Slave Application Error occurs when the slaves are started. The error can be prevented if you select <i>Enable slave monitoring option</i> and reconnect the slave. If the error does not occur any more, that means a longer time is required for the startup of all slaves and slave reconnection.
		Setting range: Enable, or Disable slave monitoring option
	1	Default setting: Disable slave monitoring option

*1 Refer to 1-3-1 Performance Specifications for the maximum number of slaves.

- *2 Displayed only with the NJ-series CPU Unit.
- *3 Displayed only with the NX-series CPU Unit.
- *4 When the priority-5 periodic task is not used, "---" is displayed.
- *5 *Exist* is displayed with the NX-series CPU Unit, *Not Exist* is displayed with the NJ-series.

*6 The total cable length is set because it is used for simulation of the task execution times on the Sysmac Studio. Setting the total cable length will enable taking into consideration the delay that is caused by the cable lengths when the Sysmac Studio estimates the task execution times. The operation of the Controller is not affected even if the setting of the total cable length is not correct (e.g., if you do not change the default setting). If you use the default setting, the simulation results will reflect the delay for a 1,000-meter total cable length. If this setting is different from the actual total cable length, the delay on the actual system will be different than the delay in the simulation results.

- *7 Refer to the following table, *Communications with Slaves Based on the Result of Revision Number Check*, for the operation of communications with slaves that are determined by the result of revision number check.
- *8 If the set value is *Setting = Actual device*, communications are not started with a slave, in a network, that is replaced. If it is necessary to replace a slave while the set value is *Setting = Actual device*, you must correct the network configuration information and transfer it to the EtherCAT master again. Set this parameter to *Setting = Actual device* only when strict management of the equipment configuration is required.
- *9 A CPU Unit with unit version 1.10 or later and Sysmac Studio version 1.12 or higher are required to use this function.

• Communications with Slaves Based on the Result of Revision Number Check

Setting value of Revision Check Method	Result of revision number check	Communications with slaves	
Setting <= Actual device	Setting > Actual device	Communications are not possible.	
	Setting = Actual device	Communications are possible.	
	Setting < Actual device	Communications are possible.	
Setting = Actual device	Setting > Actual device	Communications are not possible.	
	Setting = Actual device	Communications are possible.	
	Setting < Actual device	Communications are not possible.	
No check	Setting > Actual device	Communications are possible.	
	Setting = Actual device	Communications are possible.	
	Setting < Actual device	Communications are possible.	

Precautions for Safe Use

- If the Fail-soft Operation Setting parameter is set to *Stop*, process data communications will stop for all slaves when an EtherCAT communications error is detected in a slave. The Servo Drive will operate according to the Servo Drive specifications. Make sure that the Fail-soft Operation parameter setting results in safe operation when a device error occurs.
- If verifying revisions is disabled, parameters are also transferred to slaves with different Ether-CAT revisions. If an incompatible revision of a slave is connected, incorrect parameters may be set and operation may not be correct. If you disable the revision check, make sure that only compatible slaves are connected before transferring the parameters.

Additional Information

Network Configuration Verification

The network configuration information is verified against the actual network when the EtherCAT master is started. If an inconsistency is found during verification, the system-defined variable for a Network Configuration Verification Error provides notification.

This setting applies to the entire system and cannot be changed for individual slaves.

Verified information	Required/optional	Description
Number of slaves connected	Required	Number of slaves in the network
Vendor ID	Required	Vendor ID of each slave
Product code	Required	Product code of each slave
Revision	Optional ^{*1}	Revision number of each slave
Serial number	Optional*1*2	Serial numbers of all slaves

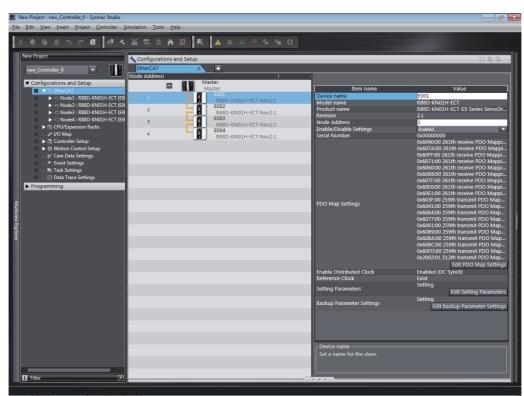
*1 Options are available.

*2 Serial number verification is performed for all slaves in the EtherCAT topology. You cannot specify different verification methods for individual slaves. The default setting is *No check*.

5-4-2 Setting EtherCAT Slaves

1 Double-click **EtherCAT** under **Configurations and Setup** on the Multiview Explorer. Or, rightclick **EtherCAT** under **Configurations and Setup** and select *Edit*.





- **2** Select an EtherCAT slave that is displayed in the Edit Pane.
 - Screen for NJ-series

• Screen for NX-series

<u>E</u> dit <u>V</u> iew <u>I</u> nsert <u>P</u> roject	-						
	5 4 20	🖾 🖧 🛤	B 🕅 🗛 🔌	8 8 5 6 0 9 8 0			
ltiview Explorer 🗸 🖣	🚟 EtherCAT 🗙					-	Toolbox
ew_Controller_0 🔻	Node Address Netwo	rk configuration Master	1				All vendors Groups
		Maste		Item name		Value	All groups
Configurations and Setup	1		01 88D-KN01H-ECT Rev:2.1	Device name	E005		Terminal Coupler
EtherCAT Image: Control of the second sec	2		IOD-KINUTH-ECT KEV:2.1	Model name Product name	GX-ID1611+ID	WT-ID08 2-tier terminal blo	 Servo Drives Frequency Inverter
 O Node1 : R88D-KN0 O Node2 : R88D-KN0 	2		88D-KN01H-ECT Rev:2.1	Revision	1.1		Digital IO
 O Node2 : R88D-KN0 O Node3 : R88D-KN0 	3		03	PDO Communications Cycle	PDO Commun	ications Cycle 1 (1000 us)	Analog IO
 Mode3 : R88D-KN0 Node4 : R88D-KN0 			88D-KN01H-ECT Rev:2.1	Node Address	5		Encoder Input
Node4 : Ka6D-KN0 • Node5 : GX-ID1611	4		88D-KN01H-ECT Rev:2.1	Enable/Disable Settings Serial Number	Enabled 0x00000000		Input Keyword
CPU/Expansion Racks				Serial Number		th transmit PDO Mapping/R	1 2
L at I/O Map			X-ID1611+ID08 Rev:1.1	PDO Map Settings	0x2002:01 512	th transmit PDO Mapping/S	Show all ve
Controller Setup				r bo map settings		Edit PDO Map Settings	GX-ID1611+ID08 Rev:1.1 GX-ID1611 + XWT-ID08 2-6
Motion Control Setup				Enable Distributed Clock			GX-ID1611+ID08-1 Rev:1.1
□ ∟ & Cam Data Settings				Reference Clock	Exist		GX-ID1611 + XWT-ID08-1 2
Event Settings				Setting Parameters	Setting		GX-ID1611+ID16 Rev:1.1
🗆 🗉 Task Settings					e:	Edit Setting Parameters	GX-ID1611 + XWT-ID16 2-ti
🗆 🗆 🗠 Data Trace Settings				Backup Parameter Settings	Setting	dit Backup Parameter Settings	GX-ID1611+ID16-1 Rev:1.: GX-ID1611 + XWT-ID16-1 2
Programming							GX-ID1611+OD08 Rev:1.1 GX-ID1611 + XWT-OD08 2-
							GX-ID1611+OD08-1 Rev:1
							GX-ID1611+OD16 Rev:1.1
							GX-ID1611+OD16-1 Rev:1
							GX-ID1611 Rev:1.1 GX-ID1611 2-tier terminal b
							GX-ID1612 Rev:1.1
							Model name : GX-I
				C Device name			Product name : GX
				Set a name for the slave.			Revision : 1.1
							Vendor : OMRON Comment : 2-tier te
Filter							Comment : 2-tier te URL : Open on a br

The EtherCAT slave settings are listed as below.

Name	Editing	Remarks
Device name	OK	Displays the name of the slave.
		Default setting: E*** (where * is a serial number starting from 001)
		The default value is automatically generated based on the
		node address.
Model	Not allowed.	Automatically displays the name of the slave model.
Product name	Not allowed.	Displays the product name of the slave.
Revision	Not allowed.	Displays the revision of the slave.
PDO Communications Cycle ^{*1}	Not allowed.	Displays the process data communications cycle assigned for the slave.
		Either of the following values is displayed.
		PDO Communications Cycle 1
		Communications cycle is the task period of the pri- mary periodic task.
		PDO Communications Cycle 2
		Communications cycle is the task period of the prior- ity-5 periodic task.
Node Address	OK	Sets the node address.
		The default value is set automatically when a slave is added.
		Setting range: Settable node address range*2

Name	Editing	Remarks
Enable/Disable Settings	ОК	Enables or disables the slave as a communications tar- get. • Enabled: The slave will operate.
		 Disabled: The slave will not operate.^{*3}
		Set the following slaves as disabled slaves: slaves that are not installed on the physical EtherCAT network but are scheduled for addition at a later date or slaves that not used due to changes in the device configuration during system operation.
		Even for disabled slaves, process data allocations can be set and used as system-defined variables and device variables in the user program.
		Default setting: Enabled
Serial Number	Not	Displays the serial number of the slave.
	allowed.	Default: 0x00000000 (when offline)
		The value is updated to the serial number of the physical slave when you select <i>Get Slave Serial Numbers</i> from the menu for the master.
		A Network Configuration Verification Error occurs if the serial number on the Sysmac Studio and the serial number of the physical slave do not agree when the Serial Number Check Method in the master settings is set to <i>Setting = Actual device</i> .
		Refer to <i>5-5-3 Using the Sysmac Studio to Obtain Serial</i> <i>Numbers from the Actual Network Configuration</i> for how to access the serial number of the physical slave.
PDO Map Settings	ОК	Default allocations of process data for slaves are provided by the Sysmac Studio.
		When the network configuration is created, device vari- ables are automatically created in the initial process data allocations. You can read and write these process data allocations as device variables from the user program.
		When valid PDOs are present, a list of them is displayed.
		When valid PDOs are not present, "" is displayed.
		If editing the process data allocations is required, click the Edit PDO Map Settings Button at the bottom of the list. Refer to <i>Changing the PDO Map Settings</i> for details.
Enable Distributed Clock	ОК	If a slave provides a distributed clock, <i>Enabled</i> is displayed. If a slave provides a distribute clock which allows disable setting, either <i>Enabled</i> or <i>Disabled</i> is displayed. You can select enabling or disabling the clock.
		If the distributed clock is enabled, you can select the syn- chronization timing (Sync0 or Sync1) for some slaves. If Sync0 is selected, <i>Enabled (DC Sync0)</i> is displayed.
		If a slave does not provide a distributed clock, "" is displayed.

Name	Editing	Remarks
Reference Clock		Displays whether the slave provides a reference clock.*4
	allowed.	<i>Exist</i> is displayed if the slave provides a reference clock.
		<i>Not exist</i> is displayed if the slave does not provide a reference clock.
Setting Parameters	OK	If a slave has an initial parameter setting function, <i>Setting</i> is displayed.
		If a slave does not have an initial parameter setting func- tion, "" is displayed.
		To edit the settings, click the Edit Setting Parameters Button.
Backup Parameter Settings	OK	If a slave has a backup parameter setting function, <i>Set-ting</i> is displayed.
		If a slave does not have a backup parameter setting func- tion, "" is displayed.
		To edit the settings, click the Edit Backup Parameter Settings Button.

- *1 Displayed only with the NX-series CPU Unit.
- *2 Refer to 1-3-1 Performance Specifications for the settable node address range.
- *3 Network errors do not occur even if disabled slaves are not present on the EtherCAT network. You can use them to prepare for future system expansions or to operate without them for the current system. You can execute a special instruction to enable a disabled slave during system operation. You can also execute the special instruction to disable a slave during system operation.
- *4 With the NJ-series CPU Unit, if you configure the system to connect the EtherCAT Junction Slave and to synchronize the slaves that have an enabled distributed clock, there must be a slave that provides a reference clock between the Master and the first EtherCAT Junction Slave. Or, the first EtherCAT Junction Slave must provide a reference clock.

Version Information

A CPU Unit with unit version 1.04 or later and Sysmac Studio version 1.05 or higher are required to disable EtherCAT slaves with the special instruction.

Changing the PDO Map Settings

Default allocations of process data for slaves are defined in the ESI files.

Depending on the slave, you may have to change the process data assignment as required by the application.

The operations on the Sysmac Studio is shown as follows.

1 Select the slave for which to change the allocated data. The parameters and allocated data for the slave will appear.

File Edit Vew Insert Project Image: Control insert New Project Image: Control insert Image: Control	
New Project Configurations and Setup Configurations and Setup Configurations and Setup Configurations and Setup Configurations and Setup Matter Configurations and Setup Confi	Dr
Image: Controller.0 Image: Controller.0 Configurations and Setup Image: Controller.0 Image: Controller.0	Dr
Configurations and Setup Configurat	
Configurations and Setup Configurat	
V Decked and the Model: Control Feedback Value No.dod:: 1	
 Controller Setup Controller Setup	
Image: marked in the	
Control = Statup Con	
L _# 1/O Map 4 00000000 ► @ Motion Control Setup ► @ Motion Control Setup ► @ Motion Control Setup ► @ Motion Control Setup ► @ Motion Control Setup	
Controller Setup Con	
L & Cam Data Settings 0x60FF:00 261th receive PDO Ma	opi
L >> Event Settings 0x6071:00 261th receive PDO Ma	
Ing Task Settings 0x606000 261th receive POO Ma 0x606000 261th receive POO Ma 0x606000 261th receive POO Ma	
Data Frace Settings 0x607F:00 261th receive PDO Ma	
Programming Ox000000 261th receive POO Ma Ox000100 261th receive POO Ma	
Allocated / 0x603F:00 259th transmit PDO M	
data PDO Map Settings 0x604x02 259th transmit PDO M	
2 UX00000 25911 faitainii POO M Ox607700 25911 faitainii POO M	ap
data PDO Map Settings 0x6641300 239th transmit PDO Map Settings 0x6641300 239th transmit PDO Map Settings 0x6677300 239th transmit PDO Model300 239th transmit PDO Model30	
	ap
0x608c30 239th transmt PDO M 0x60PC30 239th transmt PDO M	
0x00r0u0 25th trainint POO M 0x200201 512th trainint POO M	
Edit PDO Map Set	ings
Finable Distributed Clock Enabled (DC Synco)	
Slave Slave String string and the string	
parameters sation	ters
Backup Parameter Settings Edit Backup Parameter Set	ings
/ Device name	
Set a name for the slave.	
H Filter	
A filer	

2 Click the **Edit PDO Map Settings** Button at the lower right of the allocated data in the pane.

🔧 Configurations :	and Setup		(i) Q Q
EtherCAT	× +		
Node Address			
	Master Master	Item name	Value
		Device name	F001
1	R88D-KN01H-ECT Rev:2.1	Model name	R88D-KN01H-ECT
2	E002 R88D-KN01H-ECT Rev:2.1	Product name	R88D-KN01H-ECT G5 Series ServoDr
-		Revision	2.1
3	E003 R88D-KN01H-ECT Rev:2.1	Node Address	1
		Enable/Disable Settings	Enabled
4	E004 R88D-KN01H-ECT Rev:2.1	Serial Number	0x0000000
		PDO Map Settings	0x6040:00 261th receive PDO Mappi 0x607x00 261th receive PDO Mappi 0x607F:00 261th receive PDO Mappi 0x6071:00 261th receive PDO Mappi 0x6088:00 261th receive PDO Mappi 0x6088:00 261th receive PDO Mappi 0x6081:00 259th transmit PDO Map 0x6081:00 259th transmit PDO Map 0x6080:00 259th transmit PDO Map
		Enable Distributed Clock Reference Clock	Enabled (DC Synco) Exist
			Setting
		Setting Parameters	Edit Setting Parameters
		Backup Parameter Settings	Setting Edit Backup Parameter Settings

PDO Map				PDO entries i	ncluded	in 1st rece	eive PDO Mapping	
		Process Data Size : Input 208 Output 64		Index 0x6040:00	Size 16 [bi	Data type WORD	PDO entry name Controlword	Comment Controlword
Selection	Input/Output	Name	Flag	 0x607A:00	32 [bi	DINT	Target position	Target position
		No option		0x60B8:00	16 [bi [.]	WORD	Touch probe func	Touch probe fu
\odot	Output	1st receive PDO Mapping	Editable					
	Output	258th receive PDO Mapping						
	Output	259th receive PDO Mapping						
	Output	260th receive PDO Mapping						
	Output	261th receive PDO Mapping						
	Output	262th receive PDO Mapping						
		No option						
Ŏ	Input	1st transmit PDO Mapping	Editable					
Ŏ	Input	258th transmit PDO Mapping						
0	Input	259th transmit PDO Mapping						
	Input	260th transmit PDO Mapping						
\odot	Input	261th transmit PDO Mapping						
		No option						
۲	Input	512th transmit PDO Mapping						
				<				
					Γ	Move L	p Move Down	Align
					PDO Ent			elete PDO Entry

The Edit PDO Map Settings Window will appear. Edit the allocated data as required.

3 Select the output data (RxPDO) and input data (TxPDO) in the PDO Map. You can add or delete the PDOs with Editable Flags as entries for the objects to use for the slaves. Refer to A-3-4 Editing PDO Entry Tables for details.

4 Click the OK Button.

EtherCAT Slave Enable/Disable Settings

• Relation between Enable/Disable Settings and Instruction Settings

The following table gives the relation between the enable/disable setting of an EtherCAT slave and the results of instruction execution.

EtherCAT slave setting	Instruction setting	Result	
Enable	Enable	Enabled (normal end)	
	Disable	Disabled	
Disabled with physical slaves*1, *2	Enable	Enabled	
	Disable	Disabled (normal end)	
Disabled with no physical slave, or disconnected	Enable or disable	Error (error end)	

- *1 Even if a slave physically exits, it cannot be enabled or disabled if there are any of the following errors.
 - If there is a Network Configuration Information Error or Network Configuration Error in the master.
 - If the slave is disconnected from the network or if it has a Slave Initialization Error, Process Data Communications Error, or Slave Application Error.
- *2 If a slave is disabled (either with or without a physical slave), you cannot disconnect the slaves.

Precautions for Correct Use

If you use the special instruction to change the enable/disable setting of a slave, turning OFF the power supply to the master will discard the change and revert the setting to those set from Sysmac Studio. To retain the changed setting, you must change the setting from the Sysmac Studio and then transfer the network configuration information to the CPU Unit.

• Relation between Changes in the Enable/Disable Setting and I/O Operations

The I/O operations that occur for changes in the enable/disable settings of an EtherCAT slave are given in the following table.

	Inp	uts	Outputs		
Change in status	Input refresh values	Device variable values	Device variable values	Output refresh val- ues	
Disabled slaves after turning ON the power supply or transferring the EtherCAT network configuration infor- mation	Input refreshing is performed but not applied to the device variables.	0 or FALSE	Depends on results of user program execution.	Output refreshing is not performed.	
Slaves changed from disabled to enabled	Input refreshing is performed.	Input refresh val- ues are applied.	Depends on results of user program exe- cution.	The values of the device variables are output.	
Slaves changed from enabled to disabled	Input refreshing is performed but not applied to the device variables.	The values from before the status of the slave was changed are retained.	Depends on results of user program execution.	Depends on the set- tings of the slave and on slave mod- els. With GX-series EtherCAT Slaves, a value is output according to the Error Mode Output setting on each slave.	

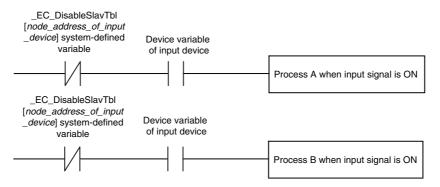


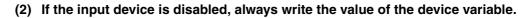
Precautions for Correct Use

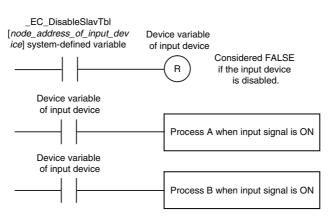
For a slave that changed from enabled to disabled, the values of the device variables from before the change are retained.

Use the following processing to confirm if a slave is enabled or disabled.

(1) Confirm that the slave is enabled before you access the device variables of the input device.







• Relation between Operation and the Slave Information at a Disabled Slave

If the actual network configuration has a slave in a position of a slave set to disable (or disabled slave), the slave operation depends on the slave information. The operation differs by the result of comparison between the slave information of the disabled slave and the slave information of the slave on the actual network configuration.

Slave inf	ormation		Operation for disabled slave						
Node address	Vendor ID/ Product code	Message com- munications	Process data communica- tions	Error	Back up/ Restore/verify				
Same	Same	Performed	Not performed	Normal opera- tion (no error)	Performed				
Same	Different	Not performed	Not performed	Network Config- uration Verifica- tion Error	Not performed				
Different	Same	Not performed	Not performed	Network Config- uration Verifica- tion Error	Not performed				
Different	Different	Not performed	Not performed	Network Config- uration Verifica- tion Error	Not performed				

The table below gives the operation of the disabled slave.

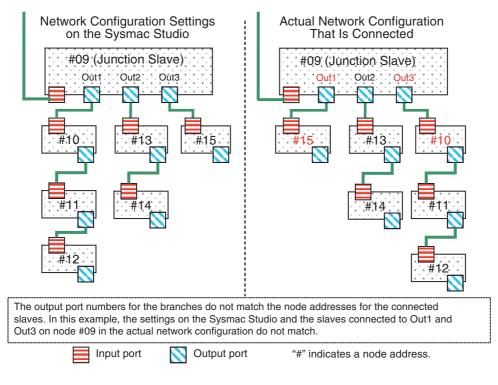
5-5 Comparing and Merging EtherCAT Network Configurations

5-5-1 Comparing and Merging with the Actual Network Configuration from the Sysmac Studio

Use the Sysmac Studio to compare the network configuration information settings in the Sysmac Studio with the actual network configuration that is connected, including branch lines and branch locations. The following items are compared.

- Node addresses
- Vendor IDs
- Product codes
- Revisions
- · Connected ports

If the settings in the Sysmac Studio and the actual network configuration match completely, it is possible to determine the locations of errors when they occur. If differences are shown in the comparison results, merge the configurations from the Sysmac Studio.



Use the following procedure to compare and merge the network configuration settings on the Sysmac Studio and the actual network configuration.



Start the Sysmac Studio and go online with the Controller.

2 Double-click EtherCAT under Configurations and Setup in the Multiview Explorer. Or, rightclick EtherCAT under Configurations and Setup and select *Edit*.

🔊 Sy	/smac	Studio	(
File	Edit	View	Insert	Pro	oject	Contr	oller	Si
X		Â				2	đ	,
	New Pr	oject			_			
	new	_NJ501_	0			-		
	▼ Co	onfigura	ations	and	Setup	,		
	Ľ	▶ 5	Ether	xpa	Edit			
			I/O M Contr		ietup			
			Motio	n Con	trol Se	tup		
			Cam I			s		
			Event					
			Data			gs		

The Edit Pane is displayed.

3 Right-click the EtherCAT master that is displayed in the Edit Pane and select **Compare and Merge with Actual Network Configuration**.

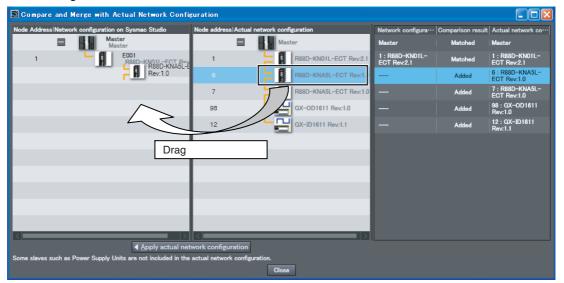
🔧 Configurations and Setup	
EtherCAT × +	
Node Address/Network configuration	1
1 Master Master 1 R88	Cu <u>t</u> <u>C</u> opy
The Moo	Paste Delete
	Undo Redo
	Import Slave Settings and Insert New Slave Export Slave Settings
	Write Slave Node Address Compare and Merge with Actual Network Configuration Get Slave Serial <u>N</u> umbers
	Clear All Settings Display Diagnosis/Statistics Information Display Production Information Display Packet Monitor Display ESI Library

5-5-1 Comparing and Merging with the Actual Network Configuration from the Sysmac Studio

The Compare and Merge with Actual Network Configuration Dialog Box is displayed. The results of comparing the settings on the Sysmac Studio with the actual network configuration are displayed in the *Comparison results* Column.

📓 Compan	S Compare and Merge with Actual Network Configuration										
Node Addre	ssiNetwo	ork configuration	on Sysmac Studio	Node address	Actual	network conf	iguration	Network configura	Comparison result	Actual network co···	
		Mas Ma	iter ister			Mas Nas	ter	Master	Matched	Master	
1			E001 R88D-KN01L-ECT Rev	1			R88D-KN01L-ECT Rev:2.1	1 : R88D-KN01L- ECT Rev:2.1	Matched	1 : R88D-KN01L- ECT Rev:2.1	
				6			R88D-KNA5L-ECT Rev:1.0		Added	6 : R88D-KNA5L- ECT Rev:1.0	
				7		- 6	R88D-KNA5L-ECT Rev:1.0		Added	7 : R88D-KNA5L- ECT Rev:1.0	
				98			GX-OD1611 Rev:1.0		Added	98 : GX-OD1611 Rev:1.0	
				12			GX-ID1611 Rev:1.1		Added	12 : GX-ID1611 Rev:1.1	
<											
Some clayer	e uch ee	Downer Supphy II	Apply actual net nits are not included in the			ration					
Come siaves	s such as	T ONCE OUPPIN O		account is two in	c co ninge	Close					

4 If there is a slave that exists only on the actual network, "Added" is displayed in the *Comparison results* Column. Drag the slave in the actual network configuration to the Sysmac Studio network configuration.



After you drag the missing slaves and add them to the network configuration on the Sysmac Studio, the *Comparison results* Column will show that everything in the configurations matches.

5 Click the **Close** Button.

de Address Netw	ork configuration	on Sysmac Studio	Node address Act	tual network configu	ration	Network configura…	Comparison result	Actual network co-
	Ma: Ma	ster		Master		Master	Matched	Master
1	- 0	E001 R88D-KN01L-ECT Rev	1		88D-KN01L-ECT Rev:2.1	1 : R88D-KN01L- ECT Rev:2.1	Matched	1 : R88D-KN01L- ECT Rev:2.1
6		E002 R88D-KNA5L-ECT Rev	6		88D-KNA5L-ECT Rev:1.0	6 : R88D-KNA5L- ECT Rev:1.0	Matched	6 : R88D-KNA5L- ECT Rev:1.0
7		E003 R88D-KNA5L-ECT Rev	7		88D-KNA5L-ECT Rev:1.0	7 : R88D-KNA5L- ECT Rev:1.0	Matched	7 : R88D-KNA5L- ECT Rev:1.0
98	는믎	E004 GX-OD1611 Rev:1.0	98		X-OD1611 Rev:1.0	98 : GX-OD1611 Rev:1.0	Matched	98 : GX-OD1611 Rev:1.0
		E005 GX-ID1611 Rev:1.1	12		X-ID1611 Rev:1.1	12 : GX-ID1611 Rev:1.1	Matched	12 : GX-ID1611 Rev:1.1
	_			_				
		Apply actual net	K configuratio	20				

The Sysmac Studio returns to the Edit Pane. This completes the operation to compare and merge with the actual network configuration.

"Removed" is displayed in the *Comparison results* Column for a slaves that exist only in the settings on the Sysmac Studio. The following example shows a case where a node address is different in the settings on the Sysmac Studio and in the actual network configuration. As a result, "Added" and "Removed" are displayed in the *Comparison results* Column.

📓 Compare	e and Merge with Actual Network Config	guration				
Node Addres	sslNetwork configuration on Sysmac Studio	Node address Actual n	etwork configuration	Network configura…	Comparison result	Actual network co····
	Master Master	-	Master	Master	Matched	Master
1	E001 R88D-KN01L-ECT Rev	1	R88D-KN01L-ECT Rev:2.1	1 : R88D-KN01L- ECT Rev:2.1	Matched	1 : R88D-KN01L- ECT Rev:2.1
6	E002 R88D-KNA5L-ECT Rev	6	R88D-KNA5L-ECT Rev:1.0	6 : R88D-KNA5L- ECT Rev:1.0	Matched	6 : R88D-KNA5L- ECT Rev:1.0
7	E003 R88D-KNA5L-ECT Rev	7	R88D-KNA5L-ECT Rev:1.0	7 : R88D-KNA5L- ECT Rev:1.0	Matched	7 : R88D-KNA5L- ECT Rev:1.0
98	E004 GX-OD1611 Rev:1.0	98	GX-OD1611 Rev:1.0	98 : GX-OD1611 Rev:1.0	Matched	98 : GX-OD1611 Rev:1.0
	E005 GX-ID1611 Rev:1.1	12	GX-ID1611 Rev:1.1		Added	12 : GX-ID1611 Rev:1.1
				11 : GX-ID1611 Rev:1.1	Removed	
<	Apply actual net		>			
Some slaves	such as Power Supply Units are not included in the		ation.			
Some Slaves		ascaal notwork comgan	Close			

Here, either correct the node address in the network configuration on the Sysmac Studio or the node address in the physical slave in the actual network configuration, and then repeat the compare and merge operation to confirm that the configurations are the same.



Additional Information

- Make sure that the communications cables between the master and slaves are connected correctly before you perform the compare and merge operation. The Compare and Merge with Actual Network Configuration Dialog Box is not displayed if the connections are not correct.
- The Compare and Merge with Actual Network Configuration Dialog Box is not displayed if there is a slave in the actual network configuration for which the node address is not set or if the same address is set for more than one slave in the actual network configuration. Make sure that node addresses are set correctly for the slaves in the actual network configuration before you perform the compare and merge operation.
- When the compare and merge operation is performed, the synchronization between the Sysmac Studio and the Controller is lost. Synchronize the Sysmac Studio and Controller before you perform any online operations for the slaves. Refer to the *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504) for information on synchronization.

5-5-2 Automatically Creating the Network Configuration

Instead of manually setting the network configuration offline, you can also automatically create the network configuration on the Sysmac Studio based on the actual network configuration. Use the following procedure to automatically duplicate the actual network configuration on the Sysmac Studio.

- **1** Start the Sysmac Studio and go online with the Controller.
- 2 Double-click EtherCAT under Configurations and Setup in the Multiview Explorer. Or, rightclick EtherCAT under Configurations and Setup and select *Edit*.



3 Right-click the EtherCAT master that is displayed in the Edit Pane and select **Compare and Merge with Actual Network Configuration**.

EtherCAT	× +	
ode Address/Netv	ork configuration	
	Master M Cut Copy Paste Delete	
	<u>U</u> ndo <u>R</u> edo	
	Export Slave S <u>W</u> rite Slave N	Settings ode Address
	Get Slave Seri	
		osis/Statistics Information action Information

The Compare and Merge with Actual Network Configuration Dialog Box is displayed.

ode Address/Network configuration on Sysmac Studio	Node address Ac	tual network config	uration	Network configura	·· Comparison result	t Actual network co-
Master Master		Maste	r	Master	Matched	Master
	1		R88D-KN01L-ECT Rev:2.1		Added	1 : R88D-KN01L- ECT Rev:2.1
	6		R88D-KNA5L-ECT Rev:1.0		Added	6 : R88D-KNA5L- ECT Rev:1.0
	7		R88D-KNA5L-ECT Rev:1.0		Added	7 : R88D-KNA5L- ECT Rev:1.0
	98		GX-OD1611 Rev:1.0		Added	98 : GX-OD1611 Rev:1.0
	12		GX-ID1611 Rev:1.1		Added	12 : GX-ID1611 Rev:1.1
4 Apply actual	network configuration	0.0				
me slaves such as Power Supply Units are not included in 1						

4 Click the **Apply actual network configuration** Button.

The actual network configuration is duplicated in the network configuration on Sysmac Studio, and the *Comparison results* Column shows that everything in the configurations matches. (The network configuration on the Sysmac Studio is created based on the actual network configuration.)



le Address Netv	ork configuration	on Sysmac Studio	Node address A	ctual network con	figuration	Network configura…	Comparison result	Actual network co
	Ma Ma	ster aster	1	Mas	ster	Master	Matched	Master
1		E001 R88D-KN01L-ECT Rev	1		R88D-KN01L-ECT Rev:2.1	1 : R88D-KN01L- ECT Rev:2.1	Matched	1 : R88D-KN01L- ECT Rev:2.1
6		E002 R88D-KNA5L-ECT Rev	6	- 6	R88D-KNA5L-ECT Rev:1.0	6 : R88D-KNA5L- ECT Rev:1.0	Matched	6 : R88D-KNA5L- ECT Rev:1.0
7		E003 R88D-KNA5L-ECT Rev	7	- 6	R88D-KNA5L-ECT Rev:1.0	7 : R88D-KNA5L- ECT Rev:1.0	Matched	7 : R88D-KNA5L- ECT Rev:1.0
98		E004 GX-OD1611 Rev:1.0	98		GX-OD1611 Rev:1.0	98 : GX-OD1611 Rev:1.0	Matched	98 : GX-OD1611 Rev:1.0
12		E005 GX-ID1611 Rev:1.1	12		GX-ID1611 Rev:1.1	12 : GX-ID1611 Rev:1.1	Matched	12 : GX-ID1611 Rev:1.1
		Apply actual net						

Go offline, and then assign device variables, set the axis parameters, set up the tasks, and set the master and slave parameters.

Additional Information

- Make sure that the communications cables between the master and slaves are connected correctly before you perform this operation. The Compare and Merge with Actual Network Configuration Dialog Box is not displayed if the connections are not correct.
- The Compare and Merge with Actual Network Configuration Dialog Box is not displayed if there is a slave in the actual network configuration for which the node address is not set or if the same address is set for more than one slave in the actual network configuration. Make sure that node addresses are set correctly for the slaves in the actual network configuration before you perform this operation.
- Even if you have previously set them on the Sysmac Studio, the following configuration and settings are discarded when you automatically create the network configuration on the Sysmac Studio based on the actual network configuration: network configuration, master settings, and any slave settings (including enable settings, PDO map settings, setting parameter settings, backup parameter settings, device variable assignments in the I/O map, slave assignments to Axes Variables registered in the axis settings, and master settings to control slaves that are registered in the task setup). To merge the actual network configuration information without losing the current settings in the Sysmac Studio, use the compare and merge operation to create the network configuration. Refer to 5-5-1 Comparing and Merging with the Actual Network Configuration from the Sysmac Studio for information on the operation to compare and merge with the actual network configuration on the Sysmac Studio.
- When the compare and merge operation is performed, the synchronization between the Sysmac Studio and the Controller is lost. Synchronize the Sysmac Studio and Controller before you perform any online operations for the slaves. Refer to the *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504) for information on synchronization.

5-5-3 Using the Sysmac Studio to Obtain Serial Numbers from the Actual Network Configuration

If the Serial Number Check Method in the EtherCAT master settings is set to *Setting = Actual device*, you must download the network configuration information in which the slave serial numbers are set to the CPU Unit. Use the following procedure to get the serial numbers of the physical slaves and apply them as the serial numbers of the slaves in the settings on the Sysmac Studio.



Start the Sysmac Studio and go online with the Controller.

2

Double-click EtherCAT under Configurations and Setup in the Multiview Explorer. Or, right-



3 Right-click the EtherCAT master that is displayed in the Edit Pane and select **Get Slave Serial Numbers**.

	Configurations			QQU
ai poso o 🗸 🔫	EtherCAT	× +		
	Node Address Netw	work configuration		
Configurations and Setup	=	Master		Mahan
EtherCAT			Item name	Value
Node10 : R88D-KN01L-ECT (I	10	Сору		Master
▶	9	Paste		Master
CPU/Expansion Racks	,	Delete	s	2
∟ "‡+ I/O Map		Undo	tions Cycle Time	1000 ι
Controller Setup	-	Redo	,th	1000 г
▶ 樹 Motion Control Setup		Import Slave Settings and Insert New Slav		Fail-soft o.
🗆 🗆 💕 Cam Data Settings		Export Slave Settings	ave Startup	30
💷 🕨 Event Settings		Write Slave Node Address	tions timeout detection count	: 2 time Setting <
🗆 🖿 Task Settings		Compare and Merge with Actual Network	Configuration heck Method	No check
🗆 🗆 🖸 Data Trace Settings		Get Slave Serial Numbers		NO GREEK
		Clear All Settings		
Programming		Display Diagnosis/Statistics Information		
		Display Production Information		
		Display Packet Monitor		
	-	Display ESI Library		

The serial numbers of the physical slaves are saved as the serial numbers in the slave settings on the Sysmac Studio.



Additional Information

- Make sure that the communications cables between the master and slaves are connected correctly before you perform this operation. You cannot get the serial numbers of the slaves unless the connections are correct.
- You cannot get the serial numbers of the slaves if there is a slave in the actual network configuration for which the node address is not set or if the same address is set for more than one slave in the actual network configuration. Make sure that node addresses are set correctly for the slaves in the actual network configuration before you perform this operation.
- You cannot get the serial numbers of the slaves unless the Compare and Merge with Actual Network Configuration Dialog Box shows that the entire slave configurations agree. Make sure that the Compare and Merge with Actual Network Configuration Dialog Box shows that the entire slave configurations agree before you perform this operation. However, you can get the serial numbers of the slaves even if the entire slave configurations do not agree if there are slaves in the Sysmac Studio settings that are disabled.
- If you get the serial numbers of the slaves when there are disabled slaves that do not exist in the actual network configuration, the serial numbers of the disabled slaves will be cleared to 0x00000000 in the settings on the Sysmac Studio. If the disabled slaves exist in the actual network configuration, the serial numbers of the slaves in the actual network configuration are saved in the settings on the Sysmac Studio.
- Any serial numbers that are set for slaves in the settings on the Sysmac Studio are overwritten when the serial numbers are obtained from the actual network configuration. Make sure that it is OK to overwrite the serial numbers on the Sysmac Studio before you perform this operation.
- When you get the serial numbers from the slaves on the actual network configuration, the synchronization between the Sysmac Studio and the Controller is lost. Synchronize the Sysmac Studio and Controller before you perform any online operations for the slaves. Refer to the *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504) for information on synchronization.

5-6 Downloading the Network Configuration Information

5-6-1 Downloading the Network Configuration Information from the Sysmac Studio

You must download the network configuration information in the project from the Sysmac Studio to the NJ/NX-series CPU Unit. Use the synchronize operation to download the network configuration information. Refer to the *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504) for information on synchronization.

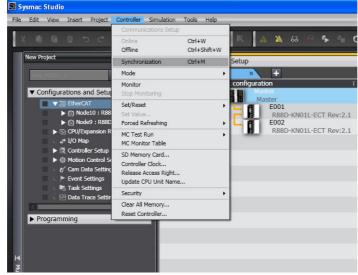
Precautions for Safe Use

After you transfer the user program, the CPU Unit is restarted and communications with the EtherCAT slaves are cut off. During that period, the slave outputs behave according to the slave specifications.

The time that communications are cut off depends on the EtherCAT network configuration. Before you transfer the user program, confirm that the system will not be adversely affected.

Precautions for Correct Use

- If a Link OFF Error occurs, remove the cause of the error and retry downloading the network configuration information after the error is reset.
- **1** Go online and select *Synchronization* from the Controller Menu.



The Synchronization Dialog Box is displayed.

2 Click the **Transfer to Controller** Button.

	Computer: Data Name	Computer: Update DaController: Update Da	Controller: Data Name	Compare
1 1	▼NJ501		▼NJ501	
 ✓ 9 ■ 9 				
🔲 🚨 🔒	EtherCAT Slave Settings		EtherCAT Slave Settings	
	CPU/Expansion Racks	3/5/2015 4:57:32 PM 3/5/2015 4:57:32 PM	CPU/Expansion Racks	
	▼ CPU Rack	3/5/2015 4:57:32 PM 3/5/2015 4:57:32 PM	▼ CPU Rack	
	▼ Units	3/5/2015 4:57:32 PM 3/5/2015 4:57:32 PM	▼ Units	
	▼Controller Setup	3/5/2015 4:57:32 PM 3/5/2015 4:57:32 PM	▼ Controller Setup	
	Operation Settings	3/5/2015 4:57:32 PM 3/5/2015 4:57:32 PM	Operation Settings	
		rt 3/5/2015 4:57:32 PM 3/5/2015 4:57:32 PM	∟ Built-in EtherNet/IP Por	
	Motion Control Setup	3/5/2015 4:57:32 PM 3/5/2015 4:57:32 PM	Motion Control Setup	
	Axis Settings	3/5/2015 4:57:32 PM 3/5/2015 4:57:32 PM	Axis Settings	
	Axes Group Settings	3/5/2015 4:57:32 PM 3/5/2015 4:57:32 PM	Axes Group Settings	
	Cam Data Settings	3/5/2015 4:57:29 PM 3/5/2015 4:57:29 PM	L Cam Data Settings	
	Event Settings	3/5/2015 4:57:32 PM 3/5/2015 4:57:32 PM	Event Settings	
	Task Settings	3/5/2015 4:57:32 PM 3/5/2015 4:57:32 PM	Task Settings	
	▼ POUs	3/5/2015 4:56:18 PM 3/5/2015 4:56:18 PM	▼ POUs	
	▼ Programs	3/5/2015 4:56:18 PM 3/5/2015 4:56:18 PM	▼ Programs	
	▼ Program0	3/5/2015 4:57:32 PM 3/5/2015 4:57:32 PM	▼ Program0	
	Variables	3/5/2015 4:57:31 PM 3/5/2015 4:57:31 PM	Variables	
	Section0	3/5/2015 4:57:31 PM 3/5/2015 4:57:31 PM	L Section0	
	Functions	3/5/2015 4:56:18 PM 3/5/2015 4:56:18 PM	Functions	
	Function Blocks	3/5/2015 4:56:18 PM 3/5/2015 4:56:18 PM	Function Blocks	
	🔻 Data	3/5/2015 4:56:18 PM 3/5/2015 4:56:18 PM	▼ Data	
	Data Types	3/5/2015 4:57:28 PM 3/5/2015 4:57:28 PM	Data Types	
	Global Variables	3/5/2015 4:57:29 PM 3/5/2015 4:57:29 PM	Global Variables	
	Libraries	3/5/2015 4:57:31 PM 3/5/2015 4:57:31 PM	Libraries	
Legend: S	ynchronized Different			
Clear th	e present values of variables	with Retain attribute (Valid for Transfer to Con	troller).	
		Valid for Transfer to Controller). All data will b		ion is changed.
	transfer the following. (All ite			
- CJ-ser	ies Special Unit parameters a	nd EtherCAT slave backup parameters.		
		ngs and NX Unit application data.		
🗹 Do not	transfer the EtherNet/IP conn	ection settings (built-in port and Unit).		
		Transfer To Controller Transfer From Cor	ntroller Recompare	Close

The network configuration information is downloaded from the Sysmac Studio to the Controller.

Additional Information

国

The backup parameters of EtherCAT slaves are out of the scope of synchronization and are not downloaded to the slaves for the default settings. To transfer the backup parameters, clear the selection of the *Do not transfer Special Unit parameters and backup parameters of EtherCAT slaves (out of synchronization scope).* Check Box in the Synchronization Pane.

5-7 Confirming Communications after Completing EtherCAT Configuration and Settings

If normal network configuration information is downloaded to the CPU Unit, EtherCAT communications start automatically regardless of the operating mode of the CPU Unit.

EtherCAT communications are in operational state (normal communications state) if the EtherCAT NET RUN indicator on the front of the NJ/NX-series CPU Unit is lit green.

Refer to 9-2-1 Error Table if the EtherCAT NET RUN indicator is not lit green.

If network configuration information is not downloaded to the CPU Unit, the EtherCAT master will not perform process data communications. Because of this, notification of errors will not occur. The Ether-CAT communications will be in the Init state (where both process data communications and SDO communications are disabled).

You can check from the user program to see if I/O refreshing is normal by checking the system-defined variable _*EC_PDSlavTbl* (Process Data Communicating Slave Table).



Precautions for Safe Use

- EtherCAT communications are not always established immediately after the power supply is turned ON. Use the system-defined variable in the user program to confirm that communications are established before you attempt to control device variables and Axis Variables.
- After you change any EtherCAT slave or Special Unit settings, carefully check the safety of the controlled system before you restart the Unit.

Precautions for Correct Use

When you change the EtherCAT slave configuration and reconfigure the axis allocation settings, you must download the network configuration information again.

6

Process Data Communications and SDO Communications

This section describes the timing of communications, response times, and special instructions for process data communications and SDO communications. It also provides sample programming.

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	6-1-1	Allocated Variables for Process Data Communications	6-2
	6-1-2	Process Data Communications Refresh Timing	6-4
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6-1 Process Data Communications (PDO Communications)

Process data communications cyclically exchanges data between the master and slaves in the process data communications cycle (i.e., the task period of primary periodic task or priority-5 periodic task).

From the user program in the NJ/NX-series CPU Unit, slave data is accessed through allocated variables.



Additional Information

You can use the priority-5 periodic task only with NX-series CPU Units.

6-1-1 Allocated Variables for Process Data Communications

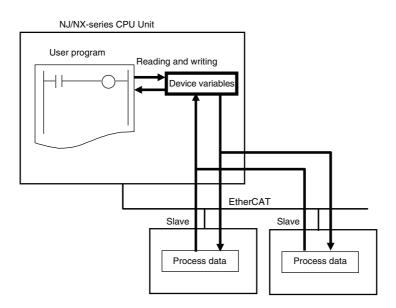
The variables that are allocated depend on the slave type as shown in the following table.

Slave type	Allocated variables	Operation screen in Sysmac Studio
EtherCAT slaves which are not assigned to axes	Device Variables	І/О Мар
EtherCAT slaves which are assigned to axes	Axis Variables	Axis Settings

Allocated variables are specified for parameters of instructions in the user program.

Device Variables

The user program in an NJ/NX-series CPU Unit can read and write EtherCAT slave process data that is not assigned to axes through device variables. (The slave process data is I/O data that is exchanged between the master and slaves in each period.)

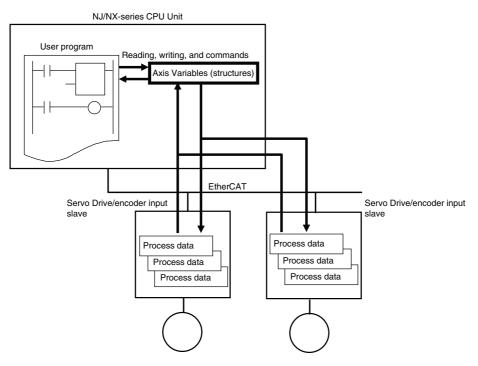


Axis Variables

Servo Drives and encoder input slaves that are assigned to axes on EtherCAT can be controlled by specifying Axis Variables (structures) as parameters for motion control instruction in-out variables.

Axis Variables (structures) consist of the following data.

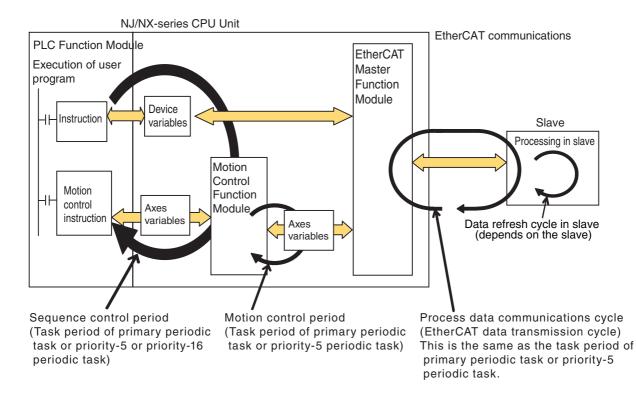
- Parameters: Maximum acceleration rate, software limits, etc.
- I/O: Home proximity input, Servo ON, etc.
- Operating status: Accelerating, waiting for in-position state, etc.
- Error and warning status: Excessive following error, acceleration error, etc.



6-1-2 Process Data Communications Refresh Timing

The process data communications cycle is the same as the task period of the primary periodic task or the priority-5 periodic task for sequence control. It is also the same as the motion control period.

The control periods between each function module and between the function module and the slave are shown as follows.



Task period of primary periodic task or priority-5 periodic task = Motion control period = Process data communications cycle

Precautions for Correct Use

- You can use the priority-5 periodic task only with NX-series CPU Units.
- With an NX-series CPU Unit, you can perform process data communications separately in each task period of the primary periodic task and the priority-5 periodic task. If these two process data communications cycles must be distinguished, the cycle for the primary periodic task is called process data communications cycle 1 and the cycle for the priority-5 periodic task is called process data communications cycle 2.
- With an NX-series CPU Unit, you can execute motion control in the primary periodic task and in the priority-5 periodic task. If these two motion controls must be distinguished, the one executed by the primary periodic task is called motion control 1 and the other executed by the priority-5 periodic task is called motion control 2.
- NJ-series CPU Units perform process data communications only in the primary periodic task.

Relationship Between Process Data Communications Cycle and Task Setting

The process data communications cycles of the primary periodic task and priority-5 periodic task are synchronized with the task period of the task to which I/O refreshing is assigned for each EtherCAT slave.

Assigning I/O refreshing to tasks, setting procedure on Sysmac Studio, and I/O refreshing timing are shown as follows.

• Assigning I/O Refreshing to Tasks

I/O refreshing of the EtherCAT slaves is assigned to the tasks.

Tasks to which assignment is possible and unit of assignment are different depending on the I/O refreshing target. Unit of assignment refers to a target or a group of targets for I/O refreshing that can be assigned to one I/O controlling task. For example, when the unit of assignment is Slave Terminal, you can assign I/O refreshing to only one task even if more than one NX Unit is connected to a Communications Coupler Unit.

The following table shows the relationship among the I/O refreshing target, the assignable task, and the unit of assignment.

I/O refreshing target	Assignable task	Unit of assignment
Communications Coupler Unit	Primary periodic task or priority-5	Slave Terminal
with an NX Unit assigned to an axis on the Slave Terminal	periodic task*	
Communications Coupler Unit	Primary periodic task or priority-5	
without an NX Unit assigned to an axis on the Slave Terminal	and priority-16 periodic tasks*	
EtherCAT slaves to which axes are assigned	Primary periodic task or priority-5 periodic task*	Slave
Other EtherCAT slaves	Primary periodic task or priority-5 and priority-16 periodic tasks*	

* You can use the priority-5 periodic task only with NX-series CPU Units.

Sysmac Studio Setting Procedure

For each slave and Unit without axis assignments, set the tasks to perform I/O refreshing in the I/O Control Task Settings on the Task Settings Tab Page of the Sysmac Studio.

For details, refer to the NJ/NX-series CPU Unit Software User's Manual (Cat. No. W501).

For each slave and Unit with axis assignments, select the motion control instruction to use in the **Motion Control Setup** of the Sysmac Studio. This sets the tasks to perform I/O refreshing.

For details, refer to the NJ/NX-series CPU Unit Motion Control User's Manual (Cat. No. W507).

• Timing of I/O Refreshing

The table below shows when I/O is refreshed for each type of EtherCAT slaves.

Task that controls I/O	Execution period of I/O refreshing
Primary periodic task	Task period of the primary periodic task ^{*1}
Priority-5 periodic task ^{*2}	Task period of the priority-5 periodic task ^{*1}
Priority-16 periodic task	Task period of the primary periodic task*1*3

- *1 Refer to the manual for the specific slave to check if the I/O refreshing period agrees with the communications cycle supported with the slave. An error occurs if you use the Sysmac Studio to set the I/O refreshing timing to a communications cycle that is not supported with the slave. The error occurs only with the OMRON slaves that is set for synchronization.
- *2 You can use the priority-5 periodic task only with NX-series CPU Units.
- *3 EtherCAT communications take place in the I/O refreshing timing for the primary periodic task. If the priority-16 periodic task is used to control EtherCAT slaves, data will be refreshed by I/O refreshing in the task period of the priority-16 periodic task.

Relationship between tasks to execute I/O refreshing, process data communications cycle, and motion control is shown as follows.

• NX-series CPU Units

Task to execute I/O refreshing	Process data communications cycle	Motion control
Primary periodic task	Process data communications cycle 1	Motion control 1
Priority-5 periodic task	Process data communications cycle 2	Motion control 2

• NJ-series CPU Units

Task to execute I/O refreshing	Process data communications cycle	Motion control
Primary periodic task	Process data communications cycle	Motion control

Restrictions for Multiple Communications Cycles

With the NX-series CPU Unit, you can perform process data communications at each task period specific to the primary periodic task and the priority-5 periodic task. On the other hand, there is only one EtherCAT network line. Therefore, some restrictions are placed on the process data communications in multiple communications cycles, as shown below.

 When the number of slaves controlled by the master increases, the process data communications cycles of both primary periodic task and priority-5 periodic task will get longer.

Consider the following countermeasures if the process data communications cycle for each task exceeds the task period.

- If you want to maintain the number of the slaves, increase the task period of the task whose process data communications cycle exceeds the task period.
- If you want to maintain the task period, decrease the number of the slaves.
- The process data communications for the primary periodic task is processed in priority over the process data communications for the priority-5 periodic task. Therefore, the size of process data for the priority-5 periodic task that can be processed becomes smaller than that for the primary periodic task even if both tasks have the same task period.

Consider the following countermeasures if the process data communications cycle for the priority-5 periodic task exceeds the task period.

- If you want to maintain the process data size of priority-5 periodic task, increase the period of the priority-5 periodic task.
- If you want to maintain the period of priority-5 periodic task, decrease the process data size of the priority-5 periodic tasks that are assigned for the entire slaves.

6-1-3 Checking the Validity of the Process Data

When reading and writing the device variables and axes variables that input and output process data with slaves, the validity of the process data must be checked.

When EtherCAT communications are not established, such as immediately after the power supply to the CPU Unit is turned ON, the process data is invalid. Thus values become invalid for the device variables and axes variables that input and output the process data. If EtherCAT communications were established previously, the device variables and axes variables retain the values updated while Ether-CAT commutations were established then.

Once the EtherCAT communications are established, the process data becomes valid, therefore values of the device variables and axes variables which input and output the process data become also valid. Be sure to read and write the device variables and axes variables that input and output the process data, after confirming that the process data is valid.

Use the following system-defined variables to check the validity of the process data.

- Checking the validity of the process data for each slave.
 - _EC_PDSlavTbl (Process Data Communicating Slave Table)
- Checking the validity of the process data for the entire slaves.

_EC_PDActive (Process Data Communications Status)



Precautions for Correct Use

If noise occurs or an EtherCAT slave is disconnected from the network, any current communications frames may be lost. If frames are lost, slave I/O data is not communicated, and unintended operation may occur. The slave outputs depend on the slave specifications. For details, refer to relevant manuals for each slave. If a noise countermeasures or slave replacement is required, perform the following processing.

- Program the _EC_InDataInvalid (Input Data Invalid), _ECIndata1Invalid (Input Data1 Invalid), or _EC_InData2Invalid (Input Data2 Invalid) system-defined variable as an interlock condition in the user program.
- Set the PDO communications timeout detection count setting in the EtherCAT master to 2 or higher. Refer to *5-4-1 Setting EtherCAT Master* for the setting procedure.

A sample programming to check the validity of the process data is shown in the next section.

Sample Programming to Check the Validity of the Process Data for Each Slave

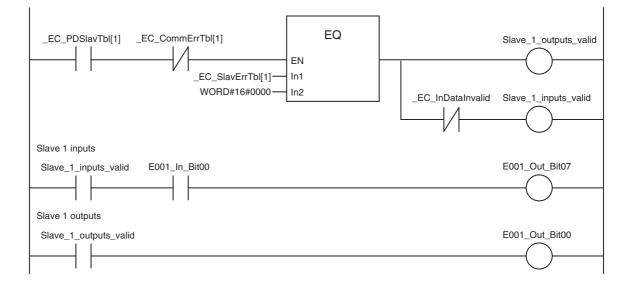
With this sample program, validity of the process data is checked individually for each slave, and the data inputs and outputs with the salve are controlled.

The slave with which the process data is input and output is given the node address 1 and named "slave 1".

The _EC_PDSlavTbl (Process Data Communicating Slave Table) system-defined variable is used to see if the process data inputs and outputs are valid for the slave 1.

If the process data inputs and outputs with the slave 1 are valid, *E001_Out_Bit07* changes to TRUE when *E001_In_Bit00* changes to TRUE. Also, when the process data outputs with the slave 1 are valid, *E001_Out_Bit00* changes to TRUE.

• LD



ST

IF _EC_PDSIavTbl[1]=TRUE AND _EC_CommErrTbl[1]=FALSE AND _EC_SIavErrTbl[1]=WORD#16#0 THEN

A:=TRUE;

ELSE

A:=FALSE;

END_IF;

```
(* Output valid condition *)
```

IF A=TRUE THEN

Slav_Out:=TRUE; ELSE Slav_Out:=FALSE;

END_IF;

```
(* Input valid condition *)
IF A=TRUE AND InDataInvalid=FALSE THEN
    Slav_In:=TRUE;
    ELSE
    Slav_In:=FALSE;
    END_IF;
```

```
(* Output data valid *)
```

```
IF Slav_Out=TRUE THEN
```

E001_Out_Bit00:=TRUE; ELSE E001_Out_Bit00:=FALSE;

END_IF;

```
(* Input data valid *)
```

IF Slav_In=TRUE AND E001_In_Bit00=TRUE THEN

E001_Out_Bit07:=TRUE;

ELSE

E001_Out_Bit07:=FALSE;

END_IF;

```
Additional Information
```

You can read the status of the *_EC_PDSlavTbl* (Process Data Communicating Slave Table) system-defined variables from the user program to see if I/O refreshing is normal.

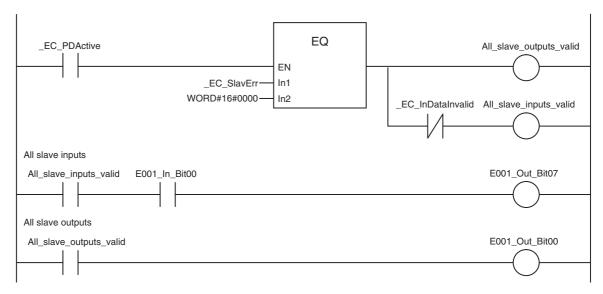
Sample Programming to Check the Validity of the Process Data for Entire Slaves

With this sample program, validity of process data is checked collectively for all slaves that are connected to the network, and the process data inputs and outputs with the slaves are controlled.

The _EC_PDActive (Process Data Communications Status) system-defined variable is used to see if the process data inputs and outputs are valid for all of the slaves.

If the process data inputs and outputs with all slaves are valid, *E001_Out_Bit07* changes to TRUE when *E001_In_Bit00* changes to TRUE. Also, when the process data outputs with all slaves are valid, *E001_Out_Bit00* changes to TRUE.

• LD



• ST

IF _EC_PDActive=TRUE AND _EC_SlavErr=WORD#16#0 THEN A:=TRUE; ELSE

A:=FALSE;

END_IF;

```
(* Output valid condition *)
```

IF A=TRUE THEN

AllSlav_Out:=TRUE;

ELSE

AllSlav_Out:=FALSE;

END_IF;

(* Input valid condition *)

IF A=TRUE AND InDataInvalid=FALSE THEN

```
AllSlav_In:=TRUE;
ELSE
```

AllSlav_In:=FALSE; END_IF;

```
(* Output data valid *)
IF ALLSIav_Out=TRUE THEN
E002_Out_Bit00:=TRUE;
ELSE
E002_Out_Bit00:=FALSE;
END_IF;
```

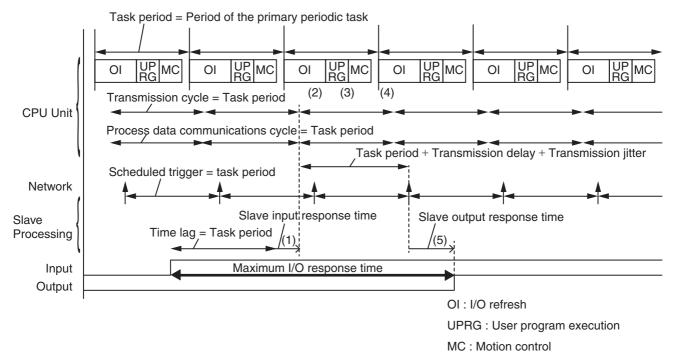
(* Input data valid *) IF ALLSIav_In=TRUE AND E002_In_Bit00=TRUE THEN E002_Out_Bit07:=TRUE; ELSE E002_Out_Bit07:=FALSE; END_IF;

6-1-4 System Response Time in Process Data Communications

This section defines the maximum I/O response time of process data communications in the system.

Standard Synchronization Timing

The following timing chart shows when sequence control and motion control are performed within the task period of the primary periodic task in which EtherCAT communications were refreshed.



- (1) The slave generates process data send frames with I/O information from sensors and other devices.
- (2) The EtherCAT receives the process data frames that was sent from the slave through I/O refreshing for the CPU Unit, and reads it as input data in the CPU Unit.
- (3) Based on the input data, the CPU Unit processes user program execution and motion control to determine the output data.
- (4) The EtherCAT master generates a send frame of the process data with the output data produced in (3), and sends the frame to the slave before the slave performs reception processing.
- (5) The slave receives the send frame of the process data from the EtherCAT master in the periodic trigger timing, and outputs data to relays and other output devices.

Calculation Formula for Maximum I/O Response Time

The maximum I/O response time is calculated for each periodic task of the CPU Unit in which I/O is refreshed for EtherCAT slaves.

The formula for calculating the maximum I/O response time is as follows:

Maximum I/O response	Process data communication cycle (= Task period of the periodic task \star1) $\times2$
time =	+ Slave input response time + Slave output response time
	+ Transmission delay + Transmission jitter

^{*1} The task period of the primary periodic task or the priority-5 periodic task. The priority-5 periodic task is applicable only when you use an NX-series CPU Unit.

• Transmission Delay

This section defines the transmission delay for the EtherCAT master. The following methods are provided to calculate the transmission delay times for the CPU Unit series and the periodic tasks in which I/O is refreshed.

CPU Unit series	Periodic task of the CPU Unit in which I/O is refreshed	Calculation method	
NX-series	Primary periodic task	 Calculation with Sysmac Studio 	
		Calculation by a formula	
	Priority-5 periodic task	Calculation with Sysmac Studio	
NJ-series	Primary periodic task	Calculation by a formula	

(1) Calculation with the Sysmac Studio

You can use the Sysmac Studio to display the transmission delay time for the EtherCAT master. For details on this display method, refer to *Displaying the Transmission Delay Time for the EtherCAT Master with the Sysmac Studio* on page 6-14.

(2) Calculation by a formula

Transmission delay (µs) =	1.24 (μ s) × number of EtherCAT slaves + 0.082 (μ s) × EtherCAT frame
	length (bytes)

The parameters necessary for the calculation are described below.

Parameter	Description	
Number of EtherCAT Slaves	This is the number of all of the EtherCAT slaves in the same EtherCAT net- work. An EtherCAT Slave Terminal is counted as one EtherCAT slave.	
EtherCAT Frame Length in Bytes	The EtherCAT frame length is the data byte size that is calculated under the following conditions for the EtherCAT slaves in the same EtherCAT network and for which I/O is refreshed in the primary periodic task.	
	• If the total data size is less than 64 bytes, use 64 bytes in the calculation.	
	• For EtherCAT slaves that have both input and output data, use the larger of the input data size and output data size.	
	For example, the EtherCAT frame length in bytes for the following configu- ration is as given below.	
	Configuration Example	
	Two OMRON GX-series EtherCAT slaves: Data size of 20 bytes/slave	
	 One EtherCAT Slave Terminal: Input data size of 50 bytes and output data size of 30 bytes 	
	EtherCAT frame length = 20 bytes + 20 bytes + 50 bytes = 90 bytes	

Transmission Jitter

This section defines the transmission jitter for the EtherCAT master.

The value of transmission jitter varies depending on the CPU Unit series.

CPU Unit series	Transmission jitter		
NX-Series	10 μs		
NJ-Series	100 μs		

6

• Slave Input Response Time

This is the time from a slave reads input information from output devices until the slave transmits a frame as a process data on the EtherCAT communications. This is the time required for internal processing that is specific to each slave. Refer to the manuals for the relevant slaves.

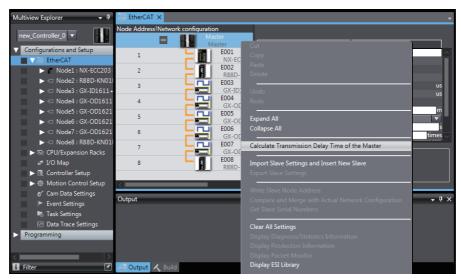
Slave Output Response Time

This is the time from a slave receives a frame as a process data on the EtherCAT communications until the slave outputs the frame as output data to external output devices. This is the time required for internal processing that is specific to each slave. Refer to the manuals for the relevant slaves.

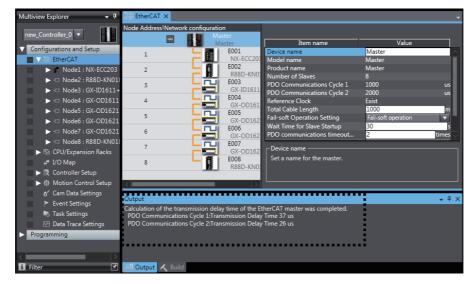
Displaying the Transmission Delay Time for the EtherCAT Master with the Sysmac Studio

You can use the Sysmac Studio to display the transmission delay time for the built-in EtherCAT port of the NX-series CPU Unit. Use the following procedure to display the transmission delay time with the Sysmac Studio.

1 Right-click the EtherCAT master or EtherCAT slave in the EtherCAT Tab Page and select *Calculate Transmission Delay Time of the Master*.



- 2
 - The transmission delay times for PDO communications cycle 1 and PDO communications cycle 2 are displayed in the Output Tab Page.



The transmission delay times of the EtherCAT master depend on the periodic tasks of the CPU Units that refresh I/O with the EtherCAT slaves, as shown below.

Periodic task of the CPU Unit in which I/O is refreshed	Applicable transmission delay time of the EtherCAT master
Primary periodic task	Transmission delay time for PDO communica- tions cycle 1
Priority-5 periodic task	Transmission delay time for PDO communica- tions cycle 2

Precautions for Correct Use

- Sysmac Studio does not support the transmission delay time display function for the built-in EtherCAT ports of the NJ-series CPU Units.
- You can use the Sysmac Studio to calculate and display the transmission delay times of the EtherCAT master according to the configuration information such as the number of EtherCAT slaves and the EtherCAT frame lengths. When you changed the EtherCAT configurations or setup, you must perform this function again.

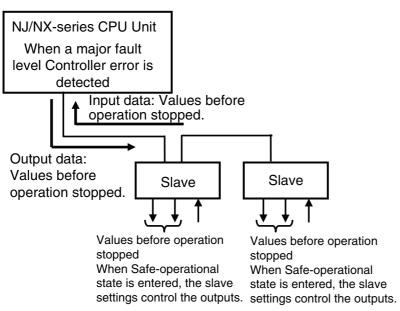
Version Information

Sysmac Studio version 1.13 or higher is required to use the transmission delay time display function for the EtherCAT master.

6-1-5 I/O Operations for Major Fault Level Controller Errors and I/O Refreshing with Specified Values

I/O Operations for Major Fault Level Controller Errors

If the NJ/NX-series CPU Unit detects a major fault level Controller error, all slave outputs will retain the process data values from before operation stopped in Operational state. Then the slaves will move to Safe-Operational state and the slave settings will control the slave outputs. The inputs from the slaves will retain the process data values from before operation stopped. Message communications are continued.^{*}



Operation stopped

When a major fault level Controller error occurs, the values of the variables are not output to the slaves even if they are initialized. The slave settings will control the slave outputs.

	Operation stopped.
Values of variables	Values before operation stoppedInitial valuesDefault setting $\rightarrow \rightarrow \rightarrow$
Slave state	Operational Safe-operational* Safe-operational $\rightarrow \rightarrow$
Inputs from slaves	$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$
Slave output values	Values before operation stoppedAccording to settingsAccording to settings
	When all slaves have entered Safe-operational state, the slave Gradually change. settings control all of the outputs.

* The following errors may occur when the slave enters to the Safe-Operational state.

- Slave Application Error
- Slave Initialization Error

The formula and the maximum time required for all the slaves to enter Safe-Operational state and for the output to reach to the value set from the slave settings are shown below. This formula applies to only OMRON slaves.

CPU Unit	Formula	Maximum time
NX-series	PDO communications timeout detection count \times Task period of the task assigned to slave ^{*1} + 10 ms	The result given from the left for- mula. The maximum time is 100 to 110 ms if the calculation result is 110 ms or less.
NJ-series	Slave Sync Manager WDT error detection time (100 ms) ^{*2} + Communications cycle (4 ms max.) + Margin	110 ms

*1 If multiple tasks are assigned, the longest task period is used for calculation.

*2 The Slave Sync Manager WDT error detection time is the time from when the last process data is received until a reception error is detected.

Precautions for Correct Use

You cannot obtain current errors from slaves after a major fault occurs except for those in Ether-CAT Slave Terminals.

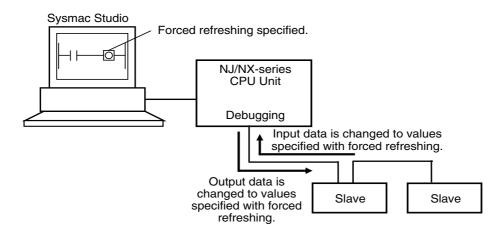
Additional Information

When a major fault level Controller error occurs, the related system-defined variables have the following values.

- For NX-series CPU Units
 - _EC_InData1Invalid = TRUE
 - _EC_InData2Invalid = TRUE
 - _EC_PDSlavTbl[] = FALSE
 - _EC_MBXSlavTbl[] = Values before operation stopped
- For NJ-series CPU Units
 - _EC_InDataInvalid = TRUE
 - _EC_PDSlavTbl[] = FALSE
 - _EC_MBXSlavTbl[] = Values before operation stopped

Forced Refreshing

You can specify forced refreshing from the Sysmac Studio for debugging. This allows you to change process data output values to the slaves and input values from the slaves to the values that you specify in advance.



Relationship between Major Fault Level Controller Errors, Normal Operation, and Forced Refreshing

Forced refreshing functions as shown in the following table for major fault level Controller errors and for normal operation.

Condition		Major fault level controller error*	Normal operation		
Forced refreshing	Enabled	Output data: Values from before operation stopped (Operational state).	Output data: Forced refreshing values Input data: Forced refreshing values		
		Slave settings control the outputs (Safe-operational state).			
		Input data: Values from before oper- ation stopped (Operational state).			
	Disabled	Output data: Values from before	Output data: Process data		
		operation stopped (Operational state).	Input data: Process data		
		Slave settings control the outputs (Safe-operational state).			
		Input data: Values from before oper- ation stopped (Operational state).			

* If a major fault level Controller error occurs, the output values from before operation stopped are retained while the slaves are in Operational state and the slave settings control the outputs after the slaves enter Safe-operational state.

6

Precautions for Safe Use

- You can select whether the master continues or stops communications with all slaves when a communications error occurs. Refer to 5-4-1 Setting EtherCAT Master for details.
- If noise occurs or an EtherCAT slave is disconnected from the network, any current communications frames may be lost. If frames are lost, slave I/O data is not communicated, and unintended operation may occur. The slave outputs behave according to the slave specifications. For details, refer to relevant manuals for each slave. If a noise countermeasures or slave replacement is required, perform the following processing.
 - Program the _EC_InDataInvalid (Input Data Invalid), _EC_InData1Invalid (Input Data 1 Invalid), _EC_InData2Invalid (Input Data 2 Invalid) system-defined variables as an interlock condition in the user program. Refer to 6-1-3 Checking the Validity of the Process Data.
 - Set the PDO communications timeout detection count setting in the EtherCAT master to at least 2. Refer to *5-4-1 Setting EtherCAT Master* for the setting procedure.
- If a communications error prevents the slaves from receiving signals from the master, the slave settings will control the slave outputs. During the time that is required to change from normal operation to a communications error status, frames will be lost. The outputs for lost frames are different for synced slaves (Servo Drives and encoders) and non-synced slaves. The slave settings will control the slave outputs for synced slaves. The previous values are retained for the slave outputs for non-synced slaves.

	Normal operation	Frames lost	Communications error status
Outputs from synced slaves (Servo Drives and encoders)	Controlled by the values of device variables.	Controlled by the slave settings.	Controlled by the slave settings.
Outputs from non-synced slaves	Controlled by the values of device variables.	The previous val- ues are output.	Controlled by the slave settings.

For details, refer to relevant manuals for each slave.

Additional Information

You can check from the user program to see if I/O refreshing is normal by checking one of the system-defined variables *EC_PDSlavTbl* (Process Data Communicating Slave Table).

6-2 SDO Communications

SDO communications are performed by using EtherCAT instructions to access SDO data in slaves when required.

6-2-1 EtherCAT Instructions

You can perform the following SDO communications with EtherCAT instructions.

· Reading and writing of SDO data

Reading and Writing SDO Data

Function	Instruction	Description
CoE messages (Read CoE SDO)	EC_CoESDORead	You set parameters to read data from the slave's object diction- ary (SDO data).
CoE messages (Write CoE SDO)	EC_CoESDOWrite	You set parameters to write data to the slave's object dictionary (SDO data).

6-2-2 Sample Programming

This sample uses an EtherCAT communications instruction to read the software version of an OMRON R88D-KN01L-ECT Servo Drive. The node address of the slave is 1.

The object index for the software version is 16#100A. The subindex is 0. The read value is stored in STRING variable *VersionInfo*.



Built-in EtherCAT port

LD

External	Variable Trigger SdoObject		Data type		Initial value	;	Comment
External							
External			BOOL Fal		False		Execution condition
		ject			(Index:=0, Subindex:=0, IsCompleteAccess:=False)		SDO parameter
	VersionInfo		STRING[256]	.,			Read data
	EC_CoESDORead	_instance	EC_CoESDORe	ad			
				a .			
Variables	Variable		Data type	Constar		-	Comment
l	_EC_MBXSlavTbl	ARRAY[1	192] OF BOOL	\square	Message Co	mmunica	ations Enabled Slave Tab
Accept trigger. Trigger _EC_I	MBXSlavTbl[1]		(@)MOVE				
	-	6#100A—	EN ENO	— — SdoO	bject.Index		
	L	ISINT#0-	(@)MOVE EN ENO- In Out		bject.Subindex		
		FALSE-	(@)MOVE EN ENO- In Out	— — SdoO	bject.IsComlet	eAccess	5
	ι	UINT#1 — loObject — JINT#20 —	EC_COESDOR EC_COES Execute NodeAdr SdoObj TimeOut ReadDat	DORead D B	one — usy — rror —		
	Ver	sionInfo —		AbortCo ReadS			
Processing after	r normal end		L				
Trigger E	C_CoESDORead_ir	stance.Do		-	ig after normal	end	
Processing after				.			
Trigger E	C_CoESDORead_ir	stance.Err		-	ig after error er	nd	

6-2-3 Execution Timing of SDO Communications

SDO communications are executed in the system service time of the NJ/NX-series CPU Unit. System services are executed in the period between execution of all of the tasks.

Refer to the *NJ/NX-series CPU Unit Software User's Manual* (Cat. No. W501) for details on the execution timing of system services.

6-2-4 Minimum Message Response Time for SDO Communications

The minimum message response time for SDO communications is the time from when the SDO communications instruction is executed in the user program until execution of the instruction is completed.

When the instruction is executed in the user program, the master sends a frame to the slave in the system service. When the slave receives the frame, it processes it. When the slave completes processing, the master receives a response from the slave to complete execution of the instruction.

Additional Information

The minimum message response time depends on the unused time in task execution, slave SDO size, and slave SDO processing time. In the timing chart below, the time from when the SDO communications instruction is executed until execution of the instruction is completed should be used for reference only.

NX-series CPU Units

The calculation formula for the minimum message response time differs between when the task period of primary periodic task is smaller than 2 ms and when the task period is 2 ms or longer.

When the Task Period of the Primary Periodic Task Is Smaller than 4 ms

Minimum message response time (ms) = Task period of the task that executes the SDO communications instruction

> + (Slave SDO processing time^{*1}/Task period of primary periodic task)*2 × Task period of primary periodic task

> + (SDO response data size/Transmission size)*2 × Task period of primary periodic task

- *1 The slave SDO processing time depends on the slaves. Refer to the manual for the slave.
- *2 Round up the calculation result in parentheses to make an integer.

The transmission size is determined by the task period of primary periodic task as shown below.

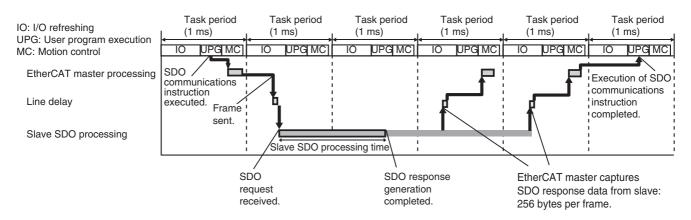
Task period of primary periodic task	Transmission size
125 μs	64 bytes
250 μs	128 bytes
500 μs or longer	256 bytes

Performance Model Example

The following timing chart shows an example of the timing from an execution of the SDO communications instruction to the completion of the instruction execution, based on the performance model below.

Here, it is assumed that the program that executes the SDO communications instructions is assigned to the primary periodic task.

Task period of primary periodic task [ms]	1
SDO response data size [byte]	512
Slave SDO processing time [ms]	1.2
Message response time [ms]	5



When the Task Period of the Primary Periodic Task is 4 ms or Longer

Minimum message response time (ms) = Task period of the task that executes SDO communications instruction + (Slave SDO processing time*1/Divided period*2)*3 × Divided period

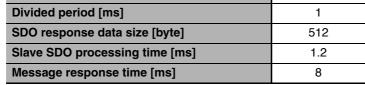
- + (SDO response data size/352 bytes)^{*3} \times Divided period
- *1 The slave SDO processing time depends on the slaves. Refer to the manual for the slave.
- *2 The divided period is obtained by dividing the task period of primary periodic task. If the task period of primary periodic task is equal to or more than 2 ms, the EtherCAT master sends a message communications frame to a slave and receives a message response data from the slave, according to the divided period. Assign 1 ms to the divided period for this calculation.
- *3 Round up the calculation result in parentheses to make an integer.

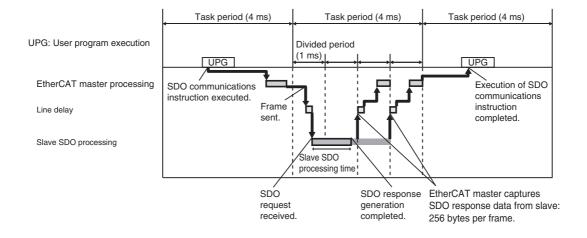
The following timing chart shows an example of the timing from an execution of the SDO communications instruction to the completion of the instruction execution, based on the performance model below.

Here, it is assumed that the program that executes the SDO communications instructions is assigned to the primary periodic task.

Task period of primary periodic task [ms]	4
Divided period [ms]	1
SDO response data size [byte]	512
Slave SDO processing time [ms]	1.2
Message response time [ms]	8

Performance Model Example





6-2 SDO Communications

NJ-series CPU Units

The calculation formula for the minimum message response time is given below.

ii - ta	Task period of the task that executes SDO communications nstruction + (Slave SDO processing time ^{*1} /Task period of primary periodic task) ^{*2} × Task period of primary periodic task + (SDO response data size/256 bytes) ^{*2} × Task period of primary periodic task
•	

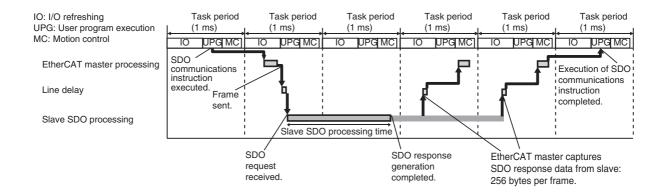
- *1 The slave SDO processing time depends on the slaves. Refer to the manual for the slave.
- *2 Round up the calculation result in parentheses to make an integer.

The following timing chart shows an example of the timing from an execution of the SDO communications instruction to the completion of the instruction execution, based on the performance model below.

Here, it is assumed that the program that executes the SDO communications instructions is assigned to the primary periodic task.

Performance Model Example

Task period of primary periodic task [ms]	1
SDO response data size [byte]	512
Slave SDO processing time [ms]	1.2
Message response time [ms]	5



6-3 Instructions Used in EtherCAT Communications

6-3-1 EtherCAT Instructions

Function	Instruction	Description	
Start EtherCAT Packet Monitor	EC_StartMon	Starts packet monitoring of the EtherCAT master built into the NJ/NX-series CPU Unit.	
Stop EtherCAT Packet Monitor	EC_StopMon	Stops packet monitoring of the EtherCAT master built into the NJ/NX-series CPU Unit.	
Save Packet Data File	EC_SaveMon	Saves captured data in a file in the system of the NJ/NX-series CPU Unit. The packet monitor is a func- tion of the EtherCAT master built into the NJ/NX-series CPU Unit. The captured files in the system of the NJ/NX-series CPU Unit are not retained when the power is interrupted.	
Copy Packet Data File to SD Memory Card	EC_CopyMon	Copies the captured data that was saved in the sys- tem of the NJ/NX-series CPU Unit to a file on an SD Memory Card. The captured data is previously saved from EtherCAT master built into the NJ-series CPU Unit into the system of the NJ/NX-series CPU Unit. The files saved to an SD Memory Card are retained after the power is interrupted.	
Disconnect EtherCAT Slave	EC_DisconnectSlave	Temporarily disconnects a slave from the EtherCAT network for maintenance, such as replacement of the slave.	
Connect EtherCAT Slave	EC_ConnectSlave	Reconnects a temporarily disconnected slave to the EtherCAT network after maintenance, such as replacement of the slave.	
Enable/Disable EtherCAT Slave	EC_ChangeEnableSetting	Enables or disables an EtherCAT slave.	
Get EtherCAT Error Status	GetECError	Gets the status of Controller errors (partial faults or minor faults) that occur in the EtherCAT master and the highest-level event code for the current errors.	
Reset EtherCAT Error	ResetECError	Resets Controller errors in the EtherCAT master. (Execute this instruction only after eliminating the cause of the error.)	

Note Refer to the *NJ/NX-series Instructions Reference Manual* (Cat. No. W502) for details on the instructions that are used with EtherCAT communications.

Additional Information

"Enable/disable," "Connected/disconnected," and "physical slave/no physical slave" are defined as follows:

Enable/Disable Setting

This setting tells whether process data communications are performed for an EtherCAT slave. You can make this setting from the Sysmac Studio and you can change the setting with the EC_ChangeEnableSetting (Enable/Disable EtherCAT Slave) instruction.

Connected/Disconnected Setting

This setting is used to temporarily disconnect a slave from the network when the slave is replaced and then to connect the slave to the network again.

However, if an EtherCAT slave in a daisy-chain connection is disconnected, all of the slaves that are connected after it are disconnected. This point is different from the enable/disable setting.

Physical Slave/No Physical Slave

This indicates whether the EtherCAT slave is physically connected.

The following table shows how these states combine.

Enable/disable setting	Connected/discon- nected setting	Physical slave/no physical slave	Combined state
Enabled	Connected	Present	Present
		Not installed	None
			(You cannot connect a non-exiting slave to the network.)
	Disconnected	Present	Present
		Not installed	
Disabled		Present	Present
	(The concept of con- nected/disconnected does not apply if a slave is disabled.)	Not installed	

7

System-defined Variables That Are Related to the Built-in EtherCAT Port

This section describes the system-defined variables that are related to the built-in EtherCAT port.

7-1	System-defined Variables That Are Related to the Built-in EtherCAT Port						
	7-1-1	What Are System-defined Variables?	.7-2				
	7-1-2	System-defined Variables	.7-3				

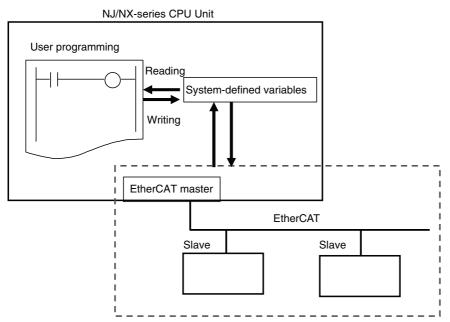
7-1-3 EtherCAT Master Function Module, Category Name: _EC7-8

7-1 System-defined Variables That Are Related to the Built-in EtherCAT Port

7-1-1 What Are System-defined Variables?

System-defined variables are variables that are defined by the system for use with EtherCAT communications. These are provided in advance in the global variable table. The user program can input status and set parameters for the EtherCAT master and slaves by reading

The user program can input status and set parameters for the EtherCAT master and slaves by reading and writing system-defined variables.



7-1-2 System-defined Variables

• Functional Classification: EtherCAT Communications Errors

Variable name	Meaning	Function	Data type	Range of values	Reference
_EC_ErrSta	Built-in EtherCAT Error	This system-defined variable provides the col- lective status of errors in the EtherCAT Mas- ter Function Module.	WORD	16#0000 to 16#00F0	page 7-8
		Refer to <i>Meanings of Error Status Bits</i> given later for the meaning of individual bits.			
_EC_PortErr	Communications Port Error	This system-defined variable provides the col- lective status of errors in the communications ports for the EtherCAT master. Refer to <i>Meanings of Error Status Bits</i> given later for the meaning of individual bits.	WORD	16#0000 to 16#00F0	page 7-8
_EC_MstrErr	Master Error	This system-defined variable provides the col- lective status of EtherCAT master errors and slave errors detected by the EtherCAT mas- ter. Refer to <i>Meanings of Error Status Bits</i> given later for the meaning of individual bits.	WORD	16#0000 to 16#00F0	page 7-8
_EC_SlavErr	Slave Error	This system-defined variable provides the col- lective status of all the error status for Ether- CAT slaves. Refer to <i>Meanings of Error Status Bits</i> given later for the meaning of individual bits.	WORD	16#0000 to 16#00F0	page 7-8
_EC_SlavErrTbl	Slave Error Table	This system-defined variable gives the error status for each EtherCAT slave. The error status is given for each slave in the actual system configuration. This variable array indicates slaves in which there are errors. Status is provided for each EtherCAT slave node address (1 to 512).*1 Refer to <i>Meanings of Error Status Bits</i> given later for the meaning of individual bits.	ARRAY [1512] OF WORD ^{*1}	16#0000 to 16#00F0	page 7-9
_EC_MacAdrErr	MAC Address Error	TRUE if there is an illegal MAC address.	BOOL	TRUE or FALSE	page 7-9
_EC_LanHwErr	Communications Controller Error	TRUE if there is a communications controller hardware error.	BOOL	TRUE or FALSE	page 7-9
_EC_LinkOffErr	Link OFF Error	TRUE if the communications controller link is not established.	BOOL	TRUE or FALSE	page 7-9
_EC_NetCfgErr	Network Configuration Information Error	TRUE if there is illegal network configuration information.	BOOL	TRUE or FALSE	page 7-9
_EC_NetCfgCmpErr	Network Configuration Verification Error	TRUE if the network configuration information does not match the actual network configura- tion.	BOOL	TRUE or FALSE	page 7-10
_EC_NetTopologyErr	Network Configuration Error	TRUE if there is a network configuration error (too many devices connected or ring connection).	BOOL	TRUE or FALSE	page 7-10
_EC_PDCommErr	Process Data Communications Error	TRUE if there is an unexpected slave discon- nection or connection or if a slave WDT error is detected during process data communica- tions.	BOOL	TRUE or FALSE	page 7-10
_EC_PDTimeoutErr	Process Data Reception Time- out Error	TRUE if a timeout occurs while receiving pro- cess data.	BOOL	TRUE or FALSE	page 7-10
_EC_PDSendErr	Process Data Transmission Error	TRUE if there is a process data transmission error (cannot send within the process data communications cycle or transmission jitter is over the limit).	BOOL	TRUE or FALSE	page 7-10

Variable name	Meaning	Function	Data type	Range of values	Reference
_EC_SlavAdrDupErr	Slave Node Address Duplicated Error	TRUE if the same node address is set for more than one slave.	BOOL	TRUE or FALSE	page 7-10
_EC_SlavInitErr	Slave Initialization Error	TRUE if there is an error in an initialization command addressed to a slave.	BOOL	TRUE or FALSE	page 7-11
_EC_SlavAppErr	Slave Application Error	TRUE if there is an error in the slave's appli- cation status register.	BOOL	TRUE or FALSE	page 7-11
_EC_MsgErr	EtherCAT Message Error	TRUE when a message is sent to a slave that does not support messages or when there is an error in the format of the response to a message that was sent to a slave.	BOOL	TRUE or FALSE	page 7-11
_EC_SlavEmergErr	Emergency Mes- sage Detected	TRUE if the master detects an emergency message that was sent by a slave.	BOOL	TRUE or FALSE	page 7-11
_EC_CommErrTbl	Communications Error Slave Table	Slaves are given in the table in the order of slave node addresses. The corresponding slave element is TRUE if the master detected an error for the slave.	ARRAY [1512] OF BOOL ^{*2}	TRUE or FALSE	page 7-11
_EC_CycleExceeded	EtherCAT Com- munications Cycle Exceeded	TRUE if the CPU unit cannot establish com- munications within the set communications period at startup.	BOOL	TRUE or FALSE	page 7-12
		Note You can use this system-defined variable only for NX-series CPU Units.			

*1 For NJ-series CPU Units, the node address is 1 to 192 and the data type is Array [1..192] OF WORD.

*2 For NJ-series CPU Units, the data type is Array [1..192] OF BOOL.

Additional Information

Typical Relationships for the Built-in EtherCAT Error Flags

Variable Name	Meaning	Variable Name	Meaning	Variable Name	Meaning	Event level	
_EC_ErrSta	Built-in	_EC_PortErr	Communi-	_EC_MacAdrErr	MAC Address Error	Partial fault	
	EtherCAT Error		cations Port Error	_EC_LanHwErr	Communications Controller Error	level	
				_EC_LinkOffErr	Link OFF Error	Minor fault	
		_EC_MstrErr	Master Error	_EC_NetCfgErr	Network Configura- tion Information Error	level	
				_EC_NetCfgCmpErr	Network Configura- tion Verification Error		
				_EC_NetTopologyErr	Network Configura- tion Error		
				_EC_PDCommErr	Process Data Com- munications Error	-	
				_EC_PDTimeoutErr	Process Data Recep- tion Timeout Error		
				_EC_PDSendErr	Process Data Trans- mission Error		
				_EC_SlavAdrDupErr	Slave Node Address Duplicated Error		
				_EC_SlavInitErr	Slave Initialization Error	-	
				_EC_SlavAppErr	Slave Application Error		
				_EC_CommErrTbl	Communications Error Slave Table		
				_EC_CycleExceeded	EtherCAT Communi- cations Cycle Exceeded		
				_EC_MsgErr	EtherCAT Message Error	Observation	
				_EC_SlavEmergErr	Emergency Message Detected	1	
		_EC_SlavErr	Slave Error	_EC_SlavErrTbl	Slave Error Table	Defined by the slave.	

Note The values of all system-defined variables that are related to errors in EtherCAT communications do not change until the cause of the error is removed and then the error in the Controller is reset with the trouble-shooting functions of the Sysmac Studio or the ResetECError instruction.

Variable name	Meaning	Function	Data type	Range of values	Reference
_EC_RegSlavTbl	Registered Slave Table	This table indicates the slaves that are regis- tered in the network configuration information. Slaves are given in the table in the order of slave node addresses. The element for a slave is TRUE if the corresponding slave is registered.	ARRAY [1512] OF BOOL [*]	TRUE or FALSE	page 7-12
_EC_EntrySlavTbl	Network Connected Slave Table	This table indicates which slaves are con- nected to the network. Slaves are given in the table in the order of slave node addresses. The element for a slave is TRUE if the corre- sponding slave has entered the network.	ARRAY [1512] OF BOOL [*]	TRUE or FALSE	page 7-12
_EC_MBXSlavTbl	Message Com- munications Enabled Slave Table	This table indicates the slaves that can per- form message communications. Slaves are given in the table in the order of slave node addresses. The element for a slave is TRUE if message communications are enabled for it (pre-opera- tional, safe-operation, or operational state). Note Use this variable to confirm that mes- sage communications are possible for the relevant slave before you execute	ARRAY [1512] OF BOOL [*]	TRUE or FALSE	page 7-12
		message communications with an EtherCAT slave.			
_EC_PDSlavTbl	Process Data Communicating Slave Table	This table indicates the slaves that are per- forming process data communications. Slaves are given in the table in the order of slave node addresses. The element for a slave is TRUE if process data of the corresponding slave is enabled (operational) for both slave inputs and out- puts.	ARRAY [1512] OF BOOL [*]	TRUE or FALSE	page 7-13
		Note Use this variable to confirm that the data for the relevant slave is valid before controlling an EtherCAT slave.			
_EC_DisconnSlavTbl	Disconnected Slave Table	Slaves are given in the table in the order of slave node addresses. The element for a slave is TRUE if the corre- sponding slave was disconnected.	ARRAY [1512] OF BOOL [*]	TRUE or FALSE	page 7-13
_EC_DisableSlavTbl	Disabled Slave Table	Slaves are given in the table in the order of slave node addresses. The element for a slave is TRUE if the corre- sponding slave is disabled.	ARRAY [1512] OF BOOL [*]	TRUE or FALSE	page 7-13
_EC_PDActive	Process Data Communications Status	TRUE when process data communications are performed with all slaves*. *Disabled slaves are not included.	BOOL	TRUE or FALSE	page 7-13
_EC_PktMonStop	Packet Monitoring Stopped	TRUE when packet monitoring is stopped.	BOOL	TRUE or FALSE	page 7-14
_EC_LinkStatus	Link Status	TRUE if the communications controller link status is Link ON.	BOOL	TRUE or FALSE	page 7-14
_EC_PktSaving	Saving Packet Data File	Shows whether a packet data file is being saved. TRUE: Packet data file being saved. FALSE: Packet data file not being saved.	BOOL	TRUE or FALSE	page 7-14

• Functional Classification: EtherCAT Communications Status

Variable name	Meaning	Function	Data type	Range of values	Reference
_EC_InDataInvalid	Input Data Invalid	TRUE when process data communications in the primary periodic task are not normal and the input data is not valid.	BOOL	TRUE or FALSE	page 7-14
_EC_InData1Invalid	Input Data1 Invalid	 TRUE when process data communications established in the primary periodic task are not normal and the input data is not valid. Note You can use this system-defined variable only for NX-series CPU Units. 	BOOL	TRUE or FALSE	page 7-14
_EC_InData2Invalid	Input Data2 Invalid	 TRUE when process data communications established in the priority-5 periodic task are not normal and the input data is not valid. Note You can use this system-defined variable only for NX-series CPU Units. 	BOOL	TRUE or FALSE	page 7-15

* For NJ-series CPU Units, the data type is Array [1..192] OF BOOL.

Note All system-defined variables that are related to the status of EtherCAT communications give the current status.

• Meanings of Error Status Bits

The meanings of the individual bits in the above error status variables are given below.

Bit	Name	Description	Value	Meaning
15	Master Detection*1	This bit indicates whether the master	TRUE	Error
		detected an error in the slaves that it manages.	FALSE	No error
14	Slave Summary*2	Indicates whether there is an error at	TRUE	Error
		a level below the function module.	FALSE	No error
8 to 13	Not used.			-
7	Major Fault	Indicates if there is a major fault level	TRUE	Error
		error.	FALSE	No error
6	Partial Fault Indicates if there is a partial fault level		TRUE	Error
		error.	FALSE	No error
5	Minor Fault	Indicates if there is a minor fault level	TRUE	Error
		error.	FALSE	No error
4	Observation	Indicates if there is an observation	TRUE	Error
		level error.	FALSE	No error
0 to 3	Not used.	•	•	•

*1 For the EtherCAT Master Function Module, only _EC_SlavErrTbl (Slave Error Table) is used.

*2 For the EtherCAT Master Function Module, only _EC_ErrSta (Built-in EtherCAT Error) is used.

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7-1-3 EtherCAT Master Function Module, Category Name: _EC

• Functional Classification: EtherCAT Communications Errors

Variable name	_EC_ErrSta	_EC_ErrSta					
Meaning	Built-in EtherCAT	Error		Global/local	Global		
Function	This system-defined variable provides the collective status of errors in the EtherCAT Master Function Module.						
	Refer to Meanings	Refer to Meanings of Error Status Bits provided above for the meanings of the error status bits.					
Data type	WORD			Range of values	16#0000 to 16#00F0		
R/W access	R	Retained	Not retained.	Network Publish	Published.		
Usage in user program	Possible.	Related instruc-	Get EtherCAT Err	or Status			
	tions		GetECError				
			Reset EtherCAT Error				
			 ResetECError 				

Variable name	_EC_PortErr						
Meaning	Communications	Port Error		Global/local	Global		
Function	This system-defined variable provides the collective status of errors in the communications ports for the Ether- CAT master.						
	Refer to Meanings	Refer to Meanings of Error Status Bits provided above for the meanings of the error status bits.					
Data type	WORD			Range of values	16#0000 to 16#00F0		
R/W access	R	Retained	Not retained.	Network Publish	Published.		
Usage in user program	Possible.	Related instruc-	Get EtherCAT Err	or Status			
		tions	GetECError				
			Reset EtherCAT Error				
			ResetECError				

Variable name	_EC_MstrErr	_EC_MstrErr						
Meaning	Master Error			Global/local	Global			
Function	This system-defined variable provides the collective status of EtherCAT master errors and slave errors detected by the EtherCAT master.							
	Refer to Meanings of Error Status Bits provided above for the meanings of the error status bits.							
Data type	WORD			Range of values	16#0000 to 16#00F0			
R/W access	R	Retained	Not retained.	Network Publish	Published.			
Usage in user program	Possible.	Related instruc-	Get EtherCAT Err	or Status				
		tions	GetECError					
			Reset EtherCAT Error					
			 ResetECError 					

Variable name	_EC_SlavErr	_EC_SlavErr						
Meaning	Slave Error			Global/local	Global			
Function	This system-defin	This system-defined variable provides the collective status of all the error status for EtherCAT slaves.						
	Refer to Meanings	Refer to Meanings of Error Status Bits provided above for the meanings of the error status bits.						
Data type	WORD			Range of values	16#0000 to 16#00F0			
R/W access	R	Retained	Not retained.	Network Publish	Published.			
Usage in user program	Possible.	Related instruc-	Get EtherCAT Err	or Status				
		tions	GetECError					
			Reset EtherCAT Error					
			 ResetECError 					

Variable name	_EC_SlavErrTbl					
Meaning	Slave Error Table			Global/local	Global	
Function	This system-define	ed variable gives th	ne error status for ea	ach EtherCAT slave).	
	The error status is	given for each slav	ve in the actual syst	tem configuration.		
	This variable array indicates slaves in which there are errors. Status is provided for each EtherCAT slave node address (1 to 512).*					
	Refer to Meanings	s of Error Status Bit	ts provided above fo	or the meanings of t	he error status bits.	
Data type	Array [1512] OF	WORD*		Range of values	16#0000 to 16#00F0	
R/W access	R	Retained	Not retained.	Network Publish	Published.	
Usage in user program	Possible.	Related instruc-	Get EtherCAT Err	or Status		
		tions • GetECError				
	Reset EtherCAT Error					
			ResetECError			

* For NJ-series CPU Units, the node address is 1 to 192 and the data type is Array [1..192] OF WORD.

Variable name	_EC_MacAdrErr					
Meaning	MAC Address Error			Global/local	Global	
Function	TRUE if there is a	TRUE if there is an illegal MAC address.				
Data type	BOOL			Range of values	TRUE or FALSE	
R/W access	R	Retained	Not retained.	Network Publish	Published.	
Usage in user program	Possible.	Related instruc-	Reset EtherCAT Error			
		tions	ResetECError			

Variable name	_EC_LanHwErr						
Meaning	Communications Controller Error			Global/local	Global		
Function	TRUE if there is a	TRUE if there is a communications controller hardware error.					
Data type	BOOL			Range of values	TRUE or FALSE		
R/W access	R	Retained	Not retained.	Network Publish	Published.		
Usage in user program	Possible.	Related instruc-	Reset EtherCAT Error				
		tions	ResetECError				

Variable name	_EC_LinkOffErr					
Meaning	Link OFF Error			Global/local	Global	
Function	TRUE if the comm	TRUE if the communications controller link is not established.				
Data type	BOOL			Range of values	TRUE or FALSE	
R/W access	R	Retained	Not retained.	Network Publish	Published.	
Usage in user program	Possible.	Related instruc-	Reset EtherCAT Error			
		tions	ResetECError			

Variable name	_EC_NetCfgErr						
Meaning	Network Configuration Information Error			Global/local	Global		
Function	TRUE if there is ill	TRUE if there is illegal network configuration information.					
Data type	BOOL			Range of values	TRUE or FALSE		
R/W access	R	Retained	Not retained.	Network Publish	Published.		
Usage in user program	Possible.	Related instruc-	Reset EtherCAT Error				
		tions	 ResetECError 				

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7 System-defined Variables That Are Related to the Built-in EtherCAT Port

Variable name	_EC_NetCfgCmpErr						
Meaning	Network Configuration Verification Error			Global/local	Global		
Function	TRUE if the netwo	TRUE if the network configuration information does not match the actual network configuration.					
Data type	BOOL			Range of values	TRUE or FALSE		
R/W access	R	Retained	Not retained.	Network Publish	Published.		
Usage in user program	Possible.	Related instruc-	Reset EtherCAT Error				
		tions	ResetECError				

Variable name	_EC_NetTopologyErr					
Meaning	Network Configuration Error			Global/local	Global	
Function	TRUE if there is a	TRUE if there is a network configuration error (too many devices connected or ring connection).				
Data type	BOOL			Range of values	TRUE or FALSE	
R/W access	R	Retained	Not retained.	Network Publish	Published.	
Usage in user program	Possible.	Related instruc-	Reset EtherCAT Error			
		tions	ResetECError			

Variable name	_EC_PDCommErr					
Meaning	Process Data Communications Error			Global/local	Global	
Function	TRUE if there is an unexpected slave disconnection or connection or if a slave WDT error is detected during pro- cess data communications.					
Data type	BOOL			Range of values	TRUE or FALSE	
R/W access	R	Retained	Not retained.	Network Publish	Published.	
Usage in user program	Possible.	Related instruc-	Reset EtherCAT E			
		tions	ResetECError			

Variable name	_EC_PDTimeoutErr						
Meaning	Process Data Reception Timeout Error			Global/local	Global		
Function	TRUE if a timeout	TRUE if a timeout occurs while receiving process data.					
Data type	BOOL			Range of values	TRUE or FALSE		
R/W access	R	Retained	Not retained.	Network Publish	Published.		
Usage in user program	Possible.	Related instruc- Reset EtherCAT Error					
		tions	ResetECError				

Variable name	_EC_PDSendErr					
Meaning	Process Data Transmission Error			Global/local	Global	
Function	TRUE if there is a process data transmission error (cannot send within the process data communications period or transmission jitter is over the limit).					
Data type	BOOL			Range of values	TRUE or FALSE	
R/W access	R	Retained	Not retained.	Network Publish	Published.	
Usage in user program	Possible.	Related instruc- tions	Reset EtherCAT Error • ResetECError			

Variable name	_EC_SlavAdrDupErr						
Meaning	Slave Node Address Duplicated Error			Global/local	Global		
Function	TRUE if the same	TRUE if the same node address is set for more than one slave.					
Data type	BOOL			Range of values	TRUE or FALSE		
R/W access	R	Retained	Not retained.	Network Publish	Published.		
Usage in user program	Possible.	Related instruc-	Reset EtherCAT Error				
		tions	ResetECError				

Variable name	_EC_SlavInitErr						
Meaning	Slave Initialization Error			Global/local	Global		
Function	TRUE if there is a	TRUE if there is an error in an initialization command addressed to a slave.					
Data type	BOOL			Range of values	TRUE or FALSE		
R/W access	R	Retained	Not retained.	Network Publish	Published.		
Usage in user program	Possible.	Related instruc-	Reset EtherCAT Error				
		tions	ResetECError				

Variable name	_EC_SlavAppErr	_EC_SlavAppErr					
Meaning	Slave Application Error			Global/local	Global		
Function	TRUE if there is a	TRUE if there is an error in the slave's application status register.					
Data type	BOOL			Range of values	TRUE or FALSE		
R/W access	R	Retained	Not retained.	Network Publish	Published.		
Usage in user program	Possible.	Related instruc-	Reset EtherCAT Error				
		tions	ResetECError				

Variable name	_EC_MsgErr						
Meaning	EtherCAT Messag	je Error		Global/local	Global		
Function		TRUE when a message is sent to a slave that does not support messages or when there is an error in the format of the response to a message that was sent to a slave.					
Data type	BOOL			Range of values	TRUE or FALSE		
R/W access	R	Retained	Not retained.	Network Publish	Published.		
Usage in user program	Possible.	Related instruc-	CoE messages (F	Read CoE SDO)			
		tions	• EC_CoESDORead				
			CoE messages (Write CoE SDO)				
			 EC_CoESDOW 	rite			

Variable name	_EC_SlavEmergErr						
Meaning	Emergency Mess	age Detected		Global/local	Global		
Function	TRUE if the maste	TRUE if the master detects an emergency message that was sent by a slave.					
Data type	BOOL	BOOL			TRUE or FALSE		
R/W access	R	Retained	Not retained.	Network Publish	Published.		
Usage in user program	Possible.	Related instruc- Reset EtherCAT Error					
		tions	ResetECError				

Variable name	_EC_CommErrTbl							
Meaning	Communications Error Slave Table			Global/local	Global			
Function	Slaves are given i	Slaves are given in the table in the order of slave node addresses.						
	The corresponding slave element is TRUE if the master detected an error for the slave.							
Data type	Array [1512] OF	BOOL*		Range of values	TRUE or FALSE			
R/W access	R	Retained	Not retained.	Network Publish	Published.			
Usage in user program	Possible.	Related instruc-	Reset EtherCAT Error					
		tions	ResetECError					

* For NJ-series CPU Units, the data type is Array [1..192] OF BOOL.

Note The values of all system-defined variables that are related to errors in EtherCAT communications do not change until the cause of the error is removed and then the error in the Controller is reset with the troubleshooting functions of the Sysmac Studio or the ResetECError instruction.

Variable name	_EC_CycleExceeded								
Name	EtherCAT Com	EtherCAT Communications Cycle Exceeded Global/local Global							
Function		TRUE if the CPU unit cannot establish communications within the set communications period at startup. Note You can use this system-defined variable only for NX-series CPU Units.							
Data types	BOOL			Range of values	TRUE or FALSE				
R/W access	R	Retained.	Not retained.	Network Publish	Published.				
Usage in user pro- gram	Possible.	Related instructions							

• Functional Classification: EtherCAT Communications Status

Variable name	_EC_RegSlavTbl							
Meaning	Registered Slave	Table		Global/local	Global			
Function	This table indicates the slaves that are registered in the network configuration information.							
	Slaves are given in the table in the order of slave node addresses.							
	The element for a	The element for a slave is TRUE if the corresponding slave is registered.						
Data type	Array [1512] OF	BOOL [*]		Range of values	TRUE or FALSE			
R/W access	R	Retained	Not retained.	Network Publish	Published.			
Usage in user program	Possible.	Related instruc- tions						

* For NJ-series CPU Units, the data type is Array [1..192] OF BOOL.

Variable name	_EC_EntrySlavTb	_EC_EntrySlavTbl						
Meaning	Network Connecte	ed Slave Table		Global/local	Global			
Function	This table indicate	This table indicates which slaves are connected to the network.						
	Slaves are given i	Slaves are given in the table in the order of slave node addresses.						
	The element for a	The element for a slave is TRUE if the corresponding slave has entered the network.						
Data type	Array [1512] OF	BOOL*		Range of values	TRUE or FALSE			
R/W access	R	Retained Not retained.			Published.			
Usage in user program	Possible.	Related instruc- tions	d instruc					

* For NJ-series CPU Units, the data type is Array [1..192] OF BOOL.

Variable name	_EC_MBXSlavTbl							
Meaning	Message Commu	nications Enabled	Slave Table	Global/local	Global			
Function	This table indicate	This table indicates the slaves that can perform message communications.						
	Slaves are given i	n the table in the o	rder of slave node a	addresses.				
		The element for a slave is TRUE if message communications are enabled for it (pre-operational, safe-operation, or operational state).						
	Note Use this variable to confirm that message communications are possible for the relevant slave before you execute message communications with an EtherCAT slave.							
Data type	Array [1512] OF	BOOL*		Range of values	TRUE or FALSE			
R/W access	R	Retained	Not retained.	Network Publish	Published.			
Usage in user program	Possible.	Related instruc-	Disconnect Ether	CAT Slave				
		tions	EC_DisconnectSlave					
			Connect EtherCAT Slave					
			EC_ConnectSla	ive				

* For NJ-series CPU Units, the data type is Array [1..192] OF BOOL.

Variable name	_EC_PDSlavTbl						
Meaning	Process Data Con	nmunicating Slave	Table	Global/local	Global		
Function	This is a table that	indicates the slave	es that are performin	ng process data co	mmunications.		
	Slaves are given i	n the table in the or	der of slave node a	ddresses.			
	The element for a slave is TRUE if process data of the corresponding slave is enabled (operational) for both slave inputs and outputs.						
	Note Use this variable to confirm that the data for the relevant slave is valid before controlling an EtherCAT slave.						
Data type	Array [1512] OF	BOOL*		Range of values	TRUE or FALSE		
R/W access	R	Retained	Not retained.	Network Publish	Published.		
Usage in user program	Possible.	Related instruc-	Disconnect Ether	CAT Slave			
		tions	EC_DisconnectSlave				
			Connect EtherCAT Slave				
			EC_ConnectSlave	•			

* For NJ-series CPU Units, the data type is Array [1..192] OF BOOL.

Variable name	_EC_DisconnSlavTbl						
Meaning	Disconnected Slav	ve Table		Global/local	Global		
Function	Slaves are given i	Slaves are given in the table in the order of slave node addresses.					
	The element for a	The element for a slave is TRUE if the corresponding slave was disconnected.					
Data type	Array [1512] OF BOOL*			Range of values	TRUE or FALSE		
R/W access	R	Retained	Not retained.	Network Publish	Published.		
Usage in user program	Possible.	Related instruc-	Disconnect Ether	CAT Slave			
		tions	EC_DisconnectSlave				
			Connect EtherCAT Slave				
			 EC_ConnectSla 	ve			

* For NJ-series CPU Units, the data type is Array [1..192] OF BOOL.

	Variable name	_EC_DisableSlavTbl							
Ī	Meaning	Disabled Slave Table			Global/local	Global			
Ī	Function	Slaves are given i	Slaves are given in the table in the order of slave node addresses.						
		The element for a	The element for a slave is TRUE if the corresponding slave is disabled.						
	Data type	Array [1512] OF	BOOL [*]		Range of values	TRUE or FALSE			
	R/W access	R	Retained	Not retained.	Network Publish	Published.			
	Usage in user program	Possible.	Related instruc- tions						

* For NJ-series CPU Units, the data type is Array [1..192] OF BOOL.

Variable name	_EC_PDActive	_EC_PDActive							
Meaning	Process Data Cor	nmunications Statu	s	Global/local	Global				
Function	TRUE when proce	RUE when process data communications are performed with all slaves*.							
Data type	BOOL			Range of values	TRUE or FALSE				
R/W access	R	Retained	Not retained.	Network Publish	Published.				
Usage in user program	Possible.	Related instruc-	Disconnect Ether	rCAT Slave					
		tions	EC_DisconnectSlave						
			Connect EtherCAT Slave						
			EC_ConnectSla	ive					

* Disabled slaves are not included.

7 System-defined Variables That Are Related to the Built-in EtherCAT Port

Variable name	_EC_PktMonStop	_EC_PktMonStop						
Meaning	Packet Monitoring	Stopped		Global/local	Global			
Function	TRUE when pack	TRUE when packet monitoring is stopped.						
Data type	BOOL			Range of values	TRUE or FALSE			
R/W access	R	Retained	Not retained.	Network Publish	Published.			
Usage in user program	Possible.	Related instruc-	Stop Packet Moni	tor				
		tions	• EC_StopMon					
			Start Packet Monitor					
			 EC_StartMon 					

Variable name	_EC_LinkStatus	EC_LinkStatus				
Meaning	Link Status			Global/local	Global	
Function	TRUE if the communications controller link status is Lin			ON.		
Data type	BOOL			Range of values	TRUE or FALSE	
R/W access	R	Retained	Not retained.	Network Publish	Published.	
Usage in user program	Possible.	Related instruc- tions				

Variable name	_EC_PktSaving						
Meaning	Saving Packet Data File			Global/local	Global		
Function	Shows whether a packet data file is being saved.						
	TRUE: Packet data file being saved.						
	FALSE: Packet da	FALSE: Packet data file not being saved.					
Data type	BOOL	BOOL		Range of values	TRUE or FALSE		
R/W access	R Retained Not retained.			Network Publish	Published.		
Usage in user program	Possible.	Related instruc-	Saving Packet Da	ita File			
		tions	 EC_SaveMon 				

Variable name	_EC_InDataInvalid				
Meaning	Input Data Invalid			Global/local	Global
Function	TRUE when process data communications are not norm			al and the input dat	a is not valid.
Data type	BOOL	BOOL			TRUE or FALSE
R/W access	R	Retained	Not retained.	Network Publish	Published.
Usage in user program	Possible.	ossible. Related instruc- tions			

Note All system-defined variables that are related to the status of EtherCAT communications give the current status.

Variable name	_EC_InData1Inva	_EC_InData1Invalid						
Meaning	Input Data1 Invali	d		Global/local	Global			
Function	TRUE when process data communications established in the primary periodic period are not normal and the input data is not valid.							
	You can use this s	You can use this system-defined variable only for NX-series CPU Units.						
Data type	BOOL	BOOL			TRUE or FALSE			
R/W access	R	Retained	Not retained.	Network Publish	Published.			
Usage in user program	Possible.	Related instruc- tions			·			

Note All system-defined variables that are related to the status of EtherCAT communications give the current status.

Variable name	_EC_InData2Inva	_EC_InData2Invalid				
Meaning	Input Data2 Invali	d		Global/local	Global	
Function	input data is not v	TRUE when process data communications established in input data is not valid. Note You can use this system-defined variable only for I				
Data type	BOOL			Range of values	TRUE or FALSE	
R/W access	R	Retained	Not retained.	Network Publish	Published.	
Usage in user program	Possible.	Related instruc- tions				

Note All system-defined variables that are related to the status of EtherCAT communications give the current status.

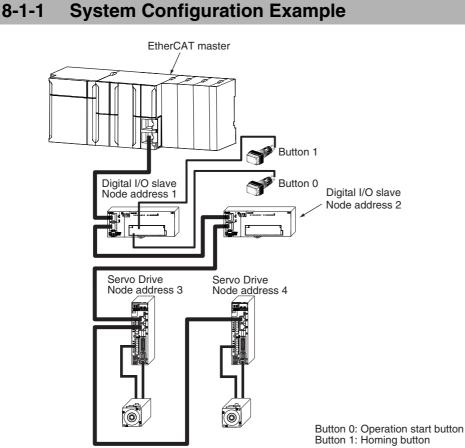
8

Example of Operations for EtherCAT Communications

This section provides a series of example operations for when an NJ/NX-series CPU Unit is connected to slaves.

8-1	Examp	le of Operations for EtherCAT Communications	8-2
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8-1 Example of Operations for EtherCAT Communications



There are no restrictions on the order of node addresses.

8-1-2 Wiring and Settings

Wiring

- Install the Controller and slaves.
- Connect communications cables to the EtherCAT master and slaves.
- Connect the power supply.

Settings

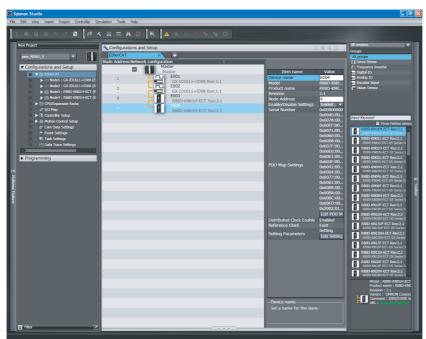
• Set the node address for each slave.

8-1-3 Setting the EtherCAT Network Configuration

Start the Sysmac Studio and make the following settings.

• Creating the EtherCAT Network Configuration

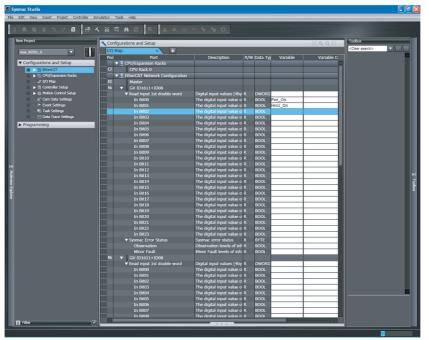
Use the EtherCAT Configuration Editor to create the slave configuration.



In this example, digital I/O slaves are set to node addresses 1 and 2 and Servo Drives are set to node addresses 3 and 4.

• Assigning Device Variables to Digital I/O Slaves (Node Addresses 1 and 2)

Use the I/O Map to assign device variables to the I/O ports of the slaves.



In this example, *Pwr_On* is assigned to bit 0 of slave 1 and *Hm1_On* is assigned to bit 1 of slave 1.

• Axis Settings for the Servo Drives (Node Addresses 3 and 4)

Add an axis to the Motion Control Setup and then assign the Servo Drive with node address 3 to the axis to set the axis.

Sysmac Studio		
File Edit View Insert Project Controller		
X 🖲 🗎 单 Ə Ə		
New Project	Configurations and Setup	Toolbox
new_N3501_0 🔻 🚽	MC_Axisb00 (0) × +	<clear search=""></clear>
▼ Configurations and Setup	। 🥂 🏘 🧑 Axis Basic Settings	
EtherCAT Scrupture Content	Axis number 0	
L e [#] I/O Map ► II Controller Setup	uuuu Axis use Used axis ▼ ↓+++ Axis type Servo axis ▼	
▼ ⊕ Motion Control Setup ▼ ⊕ Axis Settings	Feedback control No control loop 🔻	
L @r MC_Axis000 (0) G Axes Group Settings	Input device Notassigneds Channel Channel Channel Channel 	
🗆 🖉 Cam Data Settings	Detailed Settin Node: 4 Device: R88D-KN01H-ECT <not assigned=""></not>	
I Event Settings 	*	
 Data Trace Settings Programming 		
P regionaning	Ø	
R	+	M
briew I	Ψ	Toola
oplore	123	R
	Ō	
fiker (

In the same way, add an axis and assign the Servo Drive with node address 4 to it.

• Setting EtherCAT Master Parameters

Set the parameters for the EtherCAT master from the EtherCAT master settings.

Setting Slave Parameters

Set the slave parameters from the EtherCAT configuration slave settings. If a communications error prevents the slaves from receiving signals from the EtherCAT master, the slave settings will control the slave outputs.

Assigning Tasks to Slaves

Use Task Settings to assign tasks to slaves.

- Set Period/Execution Conditions for each task from Task Settings.
- Set names of the tasks that are assigned to the slaves from I/O Control Task Settings.

8-1-4 Programming

• Programming

When the operation start button is pressed, the *Pwr_On* variable changes to TRUE and axis control is enabled. (See rung 0.)

		PWR MC Pov			
Pwr_On	_EC_PDSlavTbl[MC_Axis000.Cfg.NodeAddress] MC_Axis000	— Axis — — — — Enable	Status Busy Error	MC_Axis000 Enter Variable Enter Variable Enter Variable	Pwr1_Status

When the homing button is pressed, the $Hm1_On$ variable changes to TRUE and homing is performed. (See rung 1.)

1		HM1		1
		MC_Home		
	Hm1_On Pwr1_Status MC_Axis000—		-MC_Axis000 Hr	m1_D
		Execute Done		\bigcirc
			-Enter Variable	Ŭ
		CommandAborted		
			-Enter Variable	
		ErrorID	Enter Variable	

• Assigning Programs to Tasks

Use Task Settings to assign programs to tasks and set the program execution order.

 Assign programs to tasks and set the program execution order from Program Assignment Settings.

8-1-5 Offline Debugging

You can use the Simulator to check the program and task execution times with offline debugging.

8-1-6 Turning the Power ON

Turn ON the following power supplies.

- Slave unit power supply (The PWR indicator on the slave will light when the power supply turns ON.)
- Slave I/O power supply
- Controller power supply

8-1-7 Online Debugging

Compare and merge the network configuration that was set on the Sysmac Studio and the actual configuration.

8-1-8 Downloading the Network Configuration Information and the User Program

Download the network configuration information and the user program that were created on the Sysmac Studio to the Controller.

Note Use the synchronization operation of the Sysmac Studio to download the data.

8-1-9 Confirming the Start of Communications

Check to make sure that all registered slaves are participating in the network and that communications start.

Make sure that the master indicators are in the following status.

NET RUN indicator	Lit
NET ERR indicator	Not lit
LINK/ACT indicator (physical layer LINK)	Flashing

Make sure that the status indicators on all slaves are in the following status.

PWR indicator	Lit
RUN indicator	Lit
ERR indicator	Not lit
L/A IN (physical layer LINK inputs)	Flashing
L/A OUT (physical layer LINK outputs)	Flashing (Not lit on the last slave.)

9

Troubleshooting

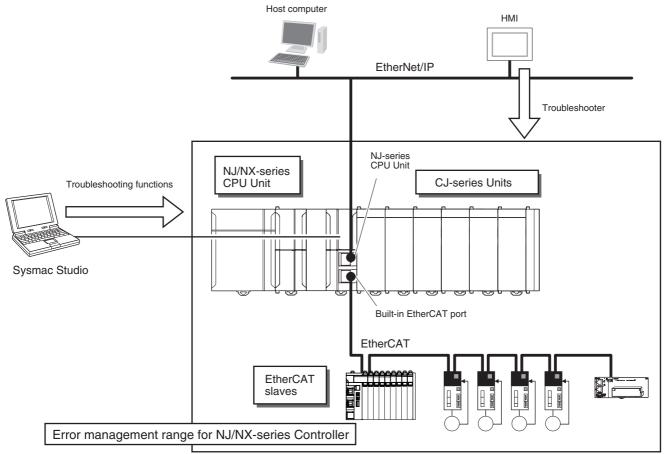
This section describes the event codes, error confirmation methods, and corrections for errors that can occur for EtherCAT communications. It also describes how to replace slaves.

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9-1 Overview of Errors

You manage all of the errors that occur on the NJ/NX-series Controller as events. The same methods are used for all events. This allows you to see what errors have occurred and find corrections for them with the same methods for the entire range of errors that is managed (i.e., CPU Unit, NX-series Slave Terminals, EtherCAT slaves,* and CJ-series Units).

* Only Sysmac devices are supported.



You can use the troubleshooting functions of the Sysmac Studio or the Troubleshooter on an HMI to quickly check for errors that have occurred and find corrections for them.

To perform troubleshooting from an HMI, connect the HMI to the built-in EtherNet/IP port on the CPU Unit.

This manual describes the errors that originate in the EtherCAT Master Function Module. Refer to the *NJ/NX-series Troubleshooting Manual* (Cat. No. W503) for specific corrections when errors occur and for troubleshooting information on the entire NJ/NX-series Controller.

Precautions for Correct Use

- · CJ-series Units can be used only with an NJ-series CPU Unit.
- Refer to the appendices of the NJ/NX-series Troubleshooting Manual (Cat. No. W503) for the applicable range of the HMI Troubleshooter.

9-1-1 How to Check for Errors

You can check to see if an error has occurred with the following methods.

Checking method	What you can check
Checking the indicators	You can check the error status of the CPU Unit and EtherCAT port.
Troubleshooter of the Sys- mac Studio	You can check for current Controller errors, a log of past Controller errors, error sources, error causes, and corrections.
Checking with the Trouble- shooter of an HMI*	You can check for current Controller errors, a log of past Controller errors, error sources, causes, and corrections.
Checking with instructions that read function module error status	You can check the highest-level status and highest-level event code in the current Controller errors.
Checking with system- defined variables	You can check the current Controller error status for each function module.

* To perform troubleshooting from an HMI, connect the HMI to the built-in EtherNet/IP port on the CPU Unit. Refer to the appendices of the *NJ/NX-series Troubleshooting Manual* (Cat. No. W503) for the applicable range of the HMI Troubleshooter.

This section describes the above checking methods.

Checking the Indicators

CPU Unit Operating Status

You can use the PWR indicator on the Power Supply Unit and the RUN and ERROR indicators on the CPU Unit to determine the event level for an error. The following table shows the relationship between the Controller's indicators and the event level.

The following table shows the relationship between the CPU Unit indicators and the event level for an NX-series CPU Unit.

	Indicators		CPU Unit operating status	Error confirmation with the Sys-
PWR	RUN	ERROR		mac Studio or an HMI
Not lit	Not lit	Not lit	Power Supply Error	Not possible: Refer to the NJ/NX-
Lit	Not lit	Not lit	CPU Unit Reset ^{*1}	<i>series Troubleshooting Manual</i> (Cat. No. W503).
Lit	Not lit or flashing	Lit	CPU Unit Error ^{*2}	
Lit	Flashing for 30 s or longer	Not lit	System Initialization Error	
Lit	Not lit	Lit	Major fault level ^{*2}	Possible: Connect the Sysmac Stu-
Lit	Lit	Flashing	Partial fault level	dio or an HMI and check the cause of and correction for the error in the
Lit	Lit	Flashing	Minor fault level	troubleshooting functions of the
Lit	Lit	Not lit	Observation	Sysmac Studio or the Trouble- shooter of the HMI.
Lit	Lit	Not lit	Normal operation in RUN mode	
Lit	Not lit	Not lit	Normal operation in PROGRAM mode ^{*1}	
Lit	Flashing	Not lit	Normal operation in startup state	

*1 If you can connect communications to the CPU Unit from the Sysmac Studio with a direct connection via USB, the CPU Unit is in PROGRAM mode. If you cannot connect communications, the CPU Unit is being reset.*3

*2 If you can connect communications to the CPU Unit from the Sysmac Studio with a direct connection via USB, a major fault level error has occurred. If you cannot connect communications, a CPU Unit Error has occurred.*3

*3 If you cannot connect communications to the CPU Unit from the Sysmac Studio, it is also possible that the USB cable is faulty or that the connection type on the Sysmac Studio is not set for a direct connection via USB. Refer to the *NJ/NX-series Troubleshooting Manual* (Cat. No. W503) if you cannot connect communications to the CPU Unit.

Indicators			CPU Unit operating status	Error confirmation with the Sys-			
PWR	RUN	ERROR	CFO Onit Operating status	mac Studio or an HMI			
Not lit	Not lit	Not lit	Power Supply Error	Not possible: Refer to the NJ/NX-			
Lit	Not lit	Not lit	CPU Unit Reset ^{*1}	<i>series Troubleshooting Manual</i> (Cat. No. W503).			
Lit	Flashing	Lit	Incorrect Power Supply Unit Con- nected				
Lit	Not lit	Lit	CPU Unit Watchdog Timer Error*2				
Lit	Not lit	Lit	Major fault level ^{*2}	Possible: Connect the Sysmac Stu-			
Lit	Lit	Flashing	Partial fault level	dio or an HMI and check the cause of and correction for the error in the			
Lit	Lit	Flashing	Minor fault level	troubleshooting functions of the			
Lit	Lit	Not lit	Observation	Sysmac Studio or the Trouble- shooter of the HMI.			
Lit	Lit	Not lit	Normal operation in RUN mode				
Lit	Not lit	Not lit	Normal operation in PROGRAM mode ^{*1}				
Lit	Flashing	Not lit	Normal operation in startup state				

The following table shows the relationship between the CPU Unit indicators and the event level for an NJ-series CPU Unit.

*1 If you can connect communications to the CPU Unit from the Sysmac Studio with a direct connection via USB, the CPU Unit is in PROGRAM mode. If you cannot connect communications, the CPU Unit is being reset.^{*3}

*2 If you can connect communications to the CPU Unit from the Sysmac Studio with a direct connection via USB, a major fault level error has occurred. If you cannot connect communications, a watchdog timer error has occurred in the CPU Unit.*3

*3 If you cannot connect communications to the CPU Unit from the Sysmac Studio, it is also possible that the USB cable is faulty or that the connection type on the Sysmac Studio is not set for a direct connection via USB. Refer to the *NJ/NX-series Troubleshooting Manual* (Cat. No. W503) if you cannot connect communications to the CPU Unit.

• EtherCAT Port Error Status

If the EtherCAT NET ERR indicator is also lit in addition to the PWR, RUN, and ERROR indicators, then an error that affects process data communications occurred for the EtherCAT port. The indicator lets you check the status given in the following table.

Indicator	Indicated status
EtherCAT NET ERR	EtherCAT Port Status
	• Lit: An error for which normal status cannot be recovered through user actions (i.e., errors for which you must replace the CPU Unit or contact your OMRON representative) has occurred.
	• Flashing: An error for which normal status can be recovered through user actions has occurred.
	Not lit: An error that affects process data communications has not occurred.

Checking with the Troubleshooting Function of Sysmac Studio

When an error occurs, you can connect the Sysmac Studio online to the Controller to check current Controller errors and the log of past Controller errors. You can also check the cause of the error and corrections.

Refer to the *NJ/NX-series Troubleshooting Manual* (Cat. No. W503) for the procedures to check for errors with the Sysmac Studio.

Checking with the Troubleshooter of an HMI

If you can connect communications between an HMI and the Controller when an error occurs, you can check for current Controller errors and the log of past Controller errors. You can also check the cause of the error and corrections.

To perform troubleshooting from an HMI, connect the HMI to the built-in EtherNet/IP port on the CPU Unit.

Refer to the *NJ/NX-series Troubleshooting Manual* (Cat. No. W503) for the procedures to check for errors with an HMI.

Checking with Instructions That Read Error Status

You can use instructions in the user program to check the error status of each function module. The following instruction is used to read the error status of the EtherCAT Master Function Module.

Instruction	Name	Outline of function
GetECError	Get EtherCAT Error Status	The GetECError instruction gets the highest level status (partial fault or minor fault) and highest level event code of the current Controller errors in the EtherCAT Master Function Module.

For details on the instructions that get error status, refer to the *NJ/NX-series Instructions Reference Manual* (Cat. No. W502).

Checking with System-defined Variables

You can use system-defined variables to check for errors in the EtherCAT Master Function Module.

• Error Status Variables

You can check for errors in each function module of the NJ/NX-series Controller with error status variables. The following variables show the error status of the EtherCAT Master Function Module.

Variable name	Data type	Meaning	Function
_EC_ErrSta	WORD	Built-in EtherCAT Error	Gives the collective error status of all error sta- tus for the EtherCAT Master Function Module.
_EC_PortErr	WORD	Communications Port Error	Gives the collective error status of all error sta- tus for the EtherCAT communications port.
_EC_MstrErr	WORD	Master Error	Gives the collective error status of the EtherCAT master error status and slave error status detected by the EtherCAT master.
_EC_SlavErr	WORD	Slave Error	Gives the collective error status of the error sta- tus for all EtherCAT slaves.
_EC_SlavErrTbl	ARRAY[1n] OF WORD ^{*1}	Slave Error Table	Gives the error status for each EtherCAT slave.

*1 "n" is 512 for an NX-series CPU Unit and 192 for an NJ-series CPU Unit.

The meanings of the individual bits in the above error status variables are given below.

Bit	Name	Description	Value	Meaning
15	Master Detection*1	This bit indicates whether the master	TRUE	Error
		detected an error in the slaves that it manages.	FALSE	No error
14	Slave Summary*2	Indicates whether there is an error at	TRUE	Error
		a level below the function module.	FALSE	No error
8 to 13	Reserved.			
7	Major Fault	Indicates if there is a major fault level error.	TRUE	Error
			FALSE	No error
6	Partial Fault	Indicates if there is a partial fault level	TRUE	Error
		error.	FALSE	No error
5	Minor Fault	Indicates if there is a minor fault level	TRUE	Error
		error.	FALSE	No error
4	Observation	Indicates if there is an observation	TRUE	Error
		level error.	FALSE	No error
0 to 3	Reserved.			

*1 For the EtherCAT Master Function Module, only _EC_SlavErrTbl (Slave Error Table) is used.

*2 For the EtherCAT Master Function Module, only _EC_ErrSta (Built-in EtherCAT Error) is used.

• Other System-defined Variables Related to Errors

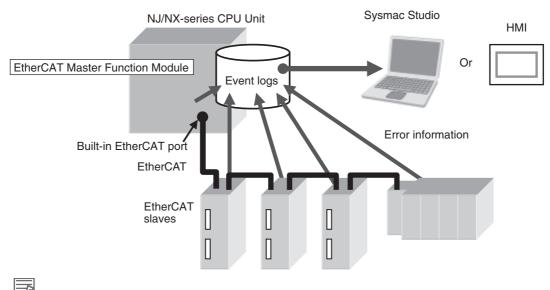
For the EtherCAT Master Function Module, there are other system-defined variables that show error status in addition to the error status variables. Refer to *7-1-2 System-defined Variables* for system-defined variables that are related to errors.

9-1-2 Errors Related to the EtherCAT Master Function Module

This section describes the errors that are related to the EtherCAT Master Function Module.

Locations of Errors in the EtherCAT Master Function Module

Errors can occur internally in the EtherCAT Master Function Module, or they can occur in the built-in EtherCAT port or in EtherCAT slaves.



Additional Information

If any one of the following errors occurs at the same time for more than one slave, only the error for the slave that is closest to the master is recorded in the event log. The same error is not recorded in the event log for slaves that are connected further from the master.

- Network Configuration Verification Error
- Process Data Communications Errors (when caused by a disconnected cable)
- Slave Node Address Duplicated
- Slave Initialization Error

Classifications

There are the following sources of errors in the EtherCAT Master Function Module.

Classification	Description
Communications port errors	If an error is detected in overall EtherCAT communications, the correspond- ing bit in the Communications Port Error status variable shows the error.
EtherCAT master errors	If the EtherCAT master detects an error in its own settings or processing, the corresponding bit in the Master Error status variable shows the error. If the EtherCAT master detects an error in a slave, the corresponding bit in the Master Error status variable shows the error.
EtherCAT slave errors	If the EtherCAT master detects an error in a slave, the error status for the slave will show that the master detected an error. ^{*1*2*3}

*1 The EtherCAT master periodically reads error status information from the slaves. It updates the systemdefined variables at the same time as the I/O data.

*2 The EtherCAT master will set the bits for EtherCAT slaves that do not report error status to FALSE in the Slave Error Table.

*3 If the error in the slave is corrected after it occurs, you do not need to reset it. It is reset automatically. (This applies to CPU Unit with unit version 1.05 or later.)



Additional Information

Refer to the *NX-series EtherCAT Coupler Unit User's Manual* (Cat. No. W519) for the events that can occur for an EtherCAT Slave Terminal.

Event Levels

This section describes the operation of the EtherCAT Master Function Module for each event level.

Event level of the error	Operation
Major fault	All NJ/NX-series Controller control operations stop for errors in this event level.
Partial fault	All control operations for one of the function modules in the NJ/NX-series Con- troller stop for errors in this event level. If a partial fault level error occurs in the EtherCAT Master Function Module, all functions of the EtherCAT Master Func- tion Module stop.
Minor fault	Some of the control operations for one of the function modules in the NJ/NX- series Controller stop for errors in this event level. If a minor fault level error occurs for the EtherCAT Master Function Module, EtherCAT communications are possible, but control may be affected. User action is required.
Observation	Errors in the observation level do not affect NJ/NX-series Controller control oper- ations. Observations are reported in order to prevent them from developing into errors at the minor fault level or higher.
Information	Events that are classified as information provide information that do not indicate errors.

EtherCAT Master Function Module Errors by Source

Source Level	Communications port	EtherCAT master	EtherCAT slaves
Major fault	None	None	None
Partial fault	 Communications Controller Failure MAC Address Error Link OFF Error 	EtherCAT Processing Error	None
Minor fault	• None	 Slave Node Address Duplicated Network Configuration Information Error EtherCAT Communications Cycle Exceeded Controller Insufficient Memory Warning Network Configuration Error Network Configuration Verification Error Slave Initialization Error Process Data Transmission Error Process Data Reception Timeout Error 	 Network Configuration Verification Error Slave Application Error Process Data Communications Error Slave Node Address Duplicated Slave Initialization Error
Observation	None	 EtherCAT Slave Backup Failed EtherCAT Slave Restore Operation Failed EtherCAT Message Error 	Emergency Message Detected
Information	None	Errors Reset	Slave DisconnectedSlave ConnectedSlave DisabledSlave Enabled

The following tables list the errors in each event level that can occur for each source.

* Slave errors that are detected by the master are listed. There will also be a master error if any of these errors occurs. For slave errors that are not detected by the master, the errors and levels are defined by the individual slaves. Refer to the manual for the slave.

Refer to the *NX-series EtherCAT Coupler Unit User's Manual* (Cat. No. W519) for the events that can occur for an EtherCAT Slave Terminal.

9-2 Troubleshooting

This section describes the errors that can occur and the corrections for them.

9-2-1 Error Table

The errors (i.e., events) that can occur in the Built-in EtherCAT Master Function Module are given on the following pages. Event levels are given as following in the tables:

Maj: Major fault level

Prt: Partial fault level

Min: Minor fault level

Obs: Observation

Info: Information

A version in parentheses in the *Event code* column is the unit version of the CPU Unit when the event occurs for only specific unit versions of the CPU Unit.

Refer to the *NJ/NX-series Troubleshooting Manual* (Cat. No. W503) for all of the event codes that may occur in an NJ/NX-series Controller.

Event code	Event norse	Mooning	Assumed source			Leve	I		Reference
Event code	Event name	Meaning	Assumed cause	Maj	Prt	Min	Obs	Info	Reference
04400000 hex	Communica- tions Control- ler Failure	An error was detected in the hardware test at startup.	 The CPU Unit has failed. 		V				page 9-16
14400000 hex	MAC Address Error	The MAC address is incorrect.	The CPU Unit has failed.		V				page 9-16
44010000 hex	EtherCAT Fault	A fatal error was detected in the EtherCAT Master Function Module.	Software is corrupted.		V				page 9-17
84200000 hex	Link OFF Error	A Link OFF state occurred.	 The Ethernet cable is broken between the master and slaves. The Ethernet cable connector is disconnected. The Ethernet cable is not con- nected. 		V				page 9-18
24200000 hex	Slave Node Address Duplicated	The same slave address is used for two nodes.	 The same node address is set for more than one slave. 			V			page 9-19
34400000 hex	Network Configura- tion Informa- tion Error	There is an error in the network config- uration information.	 The power supply to the Con- troller was interrupted or com- munications with the Sysmac Studio were disconnected while downloading the network con- figuration information. 			V			page 9-20
34410000 hex (Ver. 1.10 or later)	EtherCAT Communica- tions Cycle Exceeded	Process data com- munications could not be performed with the specified communications cycle.	 The transmission delay time in the actually connected configu- ration is longer than the trans- mission delay time calculated for the user-set cable length. The set task period or commu- nications cycle is too short. 			\checkmark			page 9-21

Eventeede	Eventneme	Mooning	Accument			Leve	I		Reference
Event code	Event name	Meaning	Assumed cause	Maj	Prt	Min	Obs	Info	Reference
5001 0000 hex (Ver. 1.02 or later)	Controller Insufficient Memory Warning	The amount of data for the EtherCAT slave configuration, network-published information, or other data exceeds the value that is specified for the CPU Unit. You may not be able to per- form online editing or other operations.	• The amount of data for the EtherCAT slave configuration, network-published information, or other data exceeds the value that is specified for the CPU Unit.			\checkmark			page 9-21
84210000 hex	Network Configura- tion Error	The EtherCAT net- work configuration is incorrect.	 Slave output ports are connected to each other. The master and slave are connected with the slave output port. The number of connected slaves exceeded the maximum number of slaves for the Ether-CAT master. 			V			page 9-22
84220000 hex	Network Configura- tion Verifica- tion Error	A slave that is in the network configura- tion information is not connected. Or, a slave that is not in the network config- uration information is connected.	 A slave that is in the network configuration information is not connected. There is a node address mismatch. A different slave from the one that is specified in the network configuration information is connected. A slave that is not in the network configuration information is connected. A slave that is not in the network configuration information is connected. The hardware switches for the slave node address were changed to a value other than 0 after the <i>Write Slave Node Address</i> operation was performed from the Sysmac Studio. The Ethernet physical layer is broken between two slaves. 			V			page 9-24
84230000 hex	Slave Initial- ization Error	Slave initialization failed.	 An error occurred in EtherCAT master processing. An initialization error occurred in the EtherCAT slave. An initialization error occurred in the EtherCAT Coupler Unit. A major fault level Controller error occurred. The Ethernet cable is broken or the specified cable is not being used. A connector on the Ethernet cable is disconnected, the contact is faulty, or parts are faulty. A general-purpose Ethernet hub is connected. The master failed. The slave failed. Noise. 			\checkmark			page 9-26

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Event code	Eventury	Meaning	Assumed cause	Level					Deferrer
	Event name			Maj	Prt	Min	Obs	Info	Reference
84280000 hex	Slave Appli- cation Error	An error occurred in the slave applica-tion.	 An error was detected in the slave's application layer status register. 			V			page 9-28
84290000 hex	Process Data Transmis- sion Error	Sending process data failed.	 It was not possible to send the EtherCAT frame during the EtherCAT communications period. The frame transmission jitter exceeded the limit. 			V			page 9-29
842B0000 hex	Process Data Reception Timeout	Process data reception timed out.	 The Ethernet cable is broken or the specified cable is not being used. A connector on the Ethernet cable is disconnected, the con- tact is faulty, or parts are faulty. A general-purpose Ethernet hub is connected. The master failed. The slave failed. The Ethernet cable is too long. The CPU Unit task period is too short. Noise 			V			page 9-30
842C0000 hex	Process Data Communica- tions Error	An error occurred in process data com- munications.	 A slave left the network even though the disconnection oper- ation was not performed. The Ethernet cable is broken or the specified cable is not being used. A connector on the Ethernet cable is disconnected, the con- tact is faulty, or parts are faulty. The slave failed. 			V			page 9-31
102F0000 hex (Ver. 1.03 or later)	EtherCAT Slave Backup Failed	The backup opera- tion for an Ether- CAT slave ended in an error.	 There is no connection between the EtherCAT master and the slave (Link OFF). An error caused an incorrect EtherCAT master status. The EtherCAT network configu- ration information does not agree with the physical network configuration. The request to the EtherCAT slave failed. The EtherCAT master was tem- porarily unable to perform the processing because it was exe- cuting other processing. Initialization of the EtherCAT slave failed. It was not possible to read the backup parameters from the EtherCAT slave. Communications with an OMRON Communications Cou- pler Unit or NX Unit failed. 				~		page 9-32

Event name EtherCAT	Meaning	Assumed cause	Maj	Det				Reference
		Assumed cause	iviaj	Prt	Min	Obs	Info	
Slave tion for a	The restore opera- tion for an Ether- CAT slave ended in an error.	There is no connection between the EtherCAT master and the slave (Link OFF).				V		page 9-34
		 An error caused an incorrect EtherCAT master status. 						
		• The EtherCAT network configu- ration information does not agree with the physical network configuration.						
		The request to the EtherCAT slave failed.						
		 The EtherCAT master was temporarily unable to perform the processing because it was executing other processing. Initialization of the EtherCAT slave failed 						
		 It was not possible to write the backup parameters to the MX2/RX Series Inverter. 						
		 It was not possible to write the backup parameters to the EtherCAT slave. 						
		 Incorrect backup data was detected. 						
		• The EtherCAT network configu- ration in the backup data does not agree with the physical net- work configuration.						
	An error occurred at an OMRON Communications Cou- pler Unit. The following causes are possible.							
		 Reading a backup file failed at the Communications Cou- pler Unit (when attached information 4 is 1). Communications with the Communications Coupler Unit or NX Unit failed (when 						
		 attached information 4 is 2). The Unit Configuration of the NX Units in the Communications Coupler Unit when data was backed up did not agree with the actual configuration of NX Units (when attached information 4 is 3). 						
Emergency Message Detected	An emergency message was detected.	 An emergency message was received from a slave. 				V		page 9-36
EtherCAT Message Error	An error occurred in a message commu- nications with the slave.	 Refer to the attached informa- tion to check the error. 				V		page 9-37
Slave Dis- connected	A slave was discon- nected for a discon- nection command.	 An operation to disconnect the slave was executed from the Sysmac Studio. The EC_DisconnectSlave 					\checkmark	page 9-38
	Failed Emergency Message Detected EtherCAT Message Error Slave Dis-	FailedFailedSlave DisconnectedSlave DisconnectedA slave was disconnected	FailedIn the order descent status.FailedThe EtherCAT master status.The EtherCAT master status.The EtherCAT network configuration information does not agree with the physical network configuration.The request to the EtherCAT slave failed.The EtherCAT master was temporarily unable to perform the processing because it was executing other processing.Initialization of the EtherCAT slave failed.Initialization of the EtherCAT slave failed.It was not possible to write the backup parameters to the EtherCAT slave failed.It was not possible to write the backup parameters to the EtherCAT slave.Incorrect backup parameters to the EtherCAT slave.Incorrect backup data does not agree with the physical network configuration.An error occurred at an OMRON Communications Coupler Unit. 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The following causes are possible.Reading a backup file failed at the Communications Cou- pler Unit (when attached information 4 is 1).Communications Coupler Unit when data was backed up did not agree with the actual configuration of NX Units in the Communica- to NU Unit siled (when attached information 4 is 2).Emergency Message DetectedAn error occurred in a message commu- nications with the slave.Slave Dis- connected for a discon- nected for a discon- nection command An eperation to disconnect the slave.Slave Dis- connectedA slave was discoor- nected for a discon- nected for a discon- nection command An eperation t	Failed The EtherCAT master status. • The EtherCAT metwork configuration information does not agree with the physical network configuration. • The request to the EtherCAT slave failed. • The EtherCAT master status. • The request to the EtherCAT slave failed. • The EtherCAT master was temporarily unable to perform the processing because it was executing other processing. • Initialization of the EtherCAT slave failed. • It was not possible to write the backup parameters to the EtherCAT slave. • In twas not possible to write the backup parameters to the EtherCAT slave. • Incorrect backup data was detected. • The EtherCAT network configuration in the backup parameters to the EtherCAT slave. • Incorrect backup data does not agree with the physical network configuration. • An error occurred at an OMRON Communications Coupler Unit. The tollowing causes are possible. • Reading a backup file failed at the Communications Coupler Unit (when attached information 4 is 1). • Communications Oupler Unit (when attached information 4 is 2). • The Unit Configuration a 1s 2). • The Unit Configuration of the NX Units in the Communications Coupler Unit when data was backed up did not agree with the actual configuration of NX Units (when attached information 4 is 3). Emergency Message was detected. • An error occurred at an Source with the actual configuration of NX Units (when attached information 4 is 3). Emergency Message was detected. • An error occurred with the actual configuration of NX Units (when att	Failed EtherCAT master status. Field The EtherCAT network configuration information does not agree with the physical network configuration. • The EtherCAT master was temporally unable to perform the processing because it was executing other processing. • The EtherCAT master was temporally unable to perform the processing because it was executing other processing. • Initialization of the EtherCAT siave failed. • It was not possible to write the backup parameters to the MX2/TX Series Inverter. • It was not possible to write the backup parameters to the EtherCAT slave. • Incorrect backup data was detected. • The EtherCAT network configuration in the backup parameters to the EtherCAT slave. • Incorrect backup data does not agree with the physical network configuration in the backup data does not agree with the physical network configuration or for the the backup parameters are possible. • The EtherCAT network configuration or NL Unit The following causes are possible. • Reading a backup file failed at the Communications Coupler Unit. The toilCoving causes are possible. • Reading a backup file failed attached information 4 is 1). • Communications Coupler Unit or NX Unit Rialed (when attached information 4 is 3). • The Unit Configuration or in XU Units (when attached information 4 is 3). • The Unit Configuration or NX Unit site (when attached information 4 is 3). • The Unit Configuration or in XU Units (when attached information 4 is 3). • An emergency message was received from a slave. EtherCAT	Failed The EtherCAT master status. The EtherCAT network configuration information does not agree with the physical network configuration. The EtherCAT slave failed. The request to the EtherCAT slave failed. The EtherCAT master was temporarily unable to perform the processing because it was executing other processing. Initialization of the EtherCAT slave failed. It was not possible to write the backup parameters to the MX2/RX Series Inverter. It was not possible to write the backup parameters to the MX2/RX Series Inverter. It was not possible to write the backup data was detected. The EtherCAT slave. In the order to the physical network configuration. An error occurred at an OMRON Communications Coupler Unit. The following causes are possible. Peading a backup file failed at the Communications 4 is 1). Communications Coupler Unit when attached information 4 is 2). Emergency An emergency message was backed up did not agree with the actual configuration of the NX Units (when attached information 4 is 3). Emergency An emergency message was received from a slave. Paterot AT An error occurred in a message communications found of the slave. Slave Die A amergency message was received from a slave. Paterot AT An error occurred in a slave. EtherCAT An error occurred in a message communications found of the Slave Networe slave. Slave Networe

Event code	Event name	Meaning	Assumed cause	Level					Reference
				Maj	Prt	Min	Obs	Info	Reference
94410000 hex	Slave Con- nected	A slave was recon- nected for a recon- nection command.	 An operation to reconnect the slave was executed from the Sysmac Studio. The EC_ConnectSlave instruction was executed. 					V	page 9-39
94430000 hex	Errors Reset	A command was received to reset errors.	 An error reset operation was performed from the Sysmac Studio. The ResetECError instruction was executed. 					V	page 9-40
94440000 hex (Ver. 1.04 or later)	Slave Dis- abled	The EtherCAT Slave was disabled.	The EC_ChangeEnableSetting instruction was executed.					V	page 9-41
94450000 hex (Ver. 1.04 or later)	Slave Enabled	The EtherCAT Slave was enabled.	The EC_ChangeEnableSetting instruction was executed.						page 9-41

9-2-2 Error Descriptions

This section describes the information that is given for individual errors.

Controller Error Descriptions

The items that are used to describe individual errors (events) are described in the following copy of an error table.

Event name	Gives the name of	the error.		Event code	Gives the code of	the error.	
Meaning	Gives a short desc	ription of the error.					
Source	Gives the source of the error.		Source details	Gives details on the source of the error.	Detection timing	Tells when the error is detected.	
Error attributes	Level	Tells the level of influence on con- trol.*1	Recovery	Gives the recov- ery method.*2	Log category	Tells which log the error is saved in. ^{*3}	
Effects	User program	Tells what will hap- pen to execution of the user pro- gram.*4	Operation	Provides special ir from the error.	ecial information on the operation that results or		
Indicators		f the built-in EtherNe CAT Master Function	•			us is given only for	
System-defined	Variable		Data type		Name		
variables	Lists the variable names, data types, and meanings for system-defined variables that provide direct error notification, that are directly affected by the error, or that contain settings that cause the error.						
Cause and cor-	Assumed cause		Correction	n Prevention			
rection	Lists the possible	causes, corrections,	and preventive mea	sures for the error.			
Attached information	This is the attached information that is displayed by the Sysmac Studio or an HMI.*5						
Precautions/ Remarks	Provides precaution	ons, restrictions, and	supplemental inforn	nation.			

*1 One of the following:

Major fault: Major fault level Partial fault: Partial fault level Minor fault: Minor fault level Observation Information

*2 One of the following:

Automatic recovery: Normal status is restored automatically when the cause of the error is removed. Error reset: Normal status is restored when the error is reset after the cause of the error is removed. Cycle the power supply: Normal status is restored when the power supply to the Controller is turned OFF and then back ON after the cause of the error is removed. Controller reset: Normal status is restored when the Controller is reset after the cause of the error is removed. Depends on cause: The recovery method depends on the cause of the error.

- *3 One of the following: System: System event log Access: Access event log
- *4 One of the following: Continues: Execution of the user program will continue. Stops: Execution of the user program stops. Starts: Execution of the user program starts.
- *5 Refer to the appendices of the *NJ/NX-series Troubleshooting Manual* (Cat. No. W503) for the applicable range of the HMI Troubleshooter.

Error Descriptions

Event name	Communications Controller Failure		Event code	04400000 hex			
Meaning	An error was detected in the hardware test at startup.						
Source	Built-in EtherCAT			Communications port	Detection timing	At power ON or Controller reset	
Error attributes	Level	Partial fault	Recovery	Cycle the power supply or reset the Controller.	Log category	System	
Effects	User program	Continues.	Operation	Slave:	er waits in the Init state. setting is not possible. Process data communi- e not possible.		
Indicators	EtherCAT NET R	UN	EtherCAT NET E	EtherCAT NET ERR		ACT	
			Lights.	Lights.			
System-defined	Variable		Data type		Name		
variables	_EC_LanHwErr		BOOL	BOOL		Communications Controller Error	
Cause and	Assumed cause		Correction	Correction		Prevention	
correction	The CPU Unit has	s failed.	Replace the CPL	Replace the CPU Unit.		None	
Attached information	None						
Precautions/ Remarks	None						

Event name	MAC Address Error			Event code	14400000 hex		
Meaning	The MAC address	s is incorrect.					
Source	EtherCAT Master	Function Module	Source details Communications port		Detection timing	At power ON or Controller reset	
Error attributes	Level	Partial fault	Recovery	Cycle the power supply or reset the Controller.	Log category	System	
Effects	User program	Continues.	Operation	Master: The master waits i Slave: Parameter setting cations are not pos	is not possible. Process data communi-		
Indicators	EtherCAT NET R	JN	EtherCAT NET ERR		EtherCAT LINK/ACT		
			Lights.				
System-defined	Variable		Data type		Name		
variables	_EC_MacAdrErr		BOOL	BOOL		MAC Address Error	
Cause and	Assumed cause		Correction	Correction		Prevention	
correction	The CPU Unit has	s failed.	Replace the CPU	Unit.	None		
Attached information	None		·				
Precautions/ Remarks	None						

Event name	EtherCAT Fault			Event code	44010000 hex		
Meaning	A fatal error was d	etected in the Ether	CAT Master Function	n Module.			
Source	EtherCAT Master	Function Module	Source details	Master	Detection timing	During communi- cations	
Error attributes	Level	Partial fault	Recovery	Cycle the power supply or reset the Controller.	Log category	System	
Effects	User program	Continues.	Operation	Master: The EtherCAT Master Function Module stops. Slave: Parameter setting is not possible. Process data communications are not possible. If the error occurred during synchronized communications between the master and slave, then the error occurred at the slave. The error is processed according to settings in the slave.			
Indicators	EtherCAT NET RU	JN	EtherCAT NET ERR		EtherCAT LINK/ACT		
			Lights.				
System-defined	Variable		Data type		Name		
variables	None						
Cause and	Assumed cause		Correction		Prevention		
correction	Software is corrup	ted.	Replace the CPU	Replace the CPU Unit.		None	
Attached information	Attached informati Attached informati	on 1: System inform on 2: System inform on 3: System inform on 4: System inform	nation 2 nation 3				
Precautions/ Remarks	None						

Event name	Link OFF Error			Event code	84200000 hex	84200000 hex	
Meaning	A Link OFF state of	occurred.			-		
Source	EtherCAT Master	Function Module	Source details	Communications port	Detection timing	At power ON, at Controller reset, or during commu nications	
Error attributes	Level	Partial fault	Recovery	Error reset	Log category	System	
Effects	User program Continues.		Operation	Master:			
				Other communicat detected.	ions errors caused b	by this error are not	
				Slave:			
				Parameter setting is not possible. Process data comm cations are not possible. If the error occurred during sy chronized communications between the master and sla then the error occurred at the slave. The error is pro- cessed according to settings in the slave.			
Indicators	EtherCAT NET RU	herCAT NET RUN		R	EtherCAT LINK/ACT		
			Flashes at 1-s inte	rvals.			
System-defined	Variable		Data type		Name		
variables	_EC_LinkOffErr		BOOL		Link OFF Error		
	_EC_LinkStatus	_EC_LinkStatus		BOOL		Link Status	
Cause and	Assumed cause		Correction		Prevention		
correction	The Ethernet cable is broken between the master and slaves.		Check the Etherne the master and sla damaged or discor replace the cable i	ve to see if they are nnected and	if they are operating properly.		
	The Ethernet cable connected.	e connector is dis-	Reconnect the connector and make sure it is mated correctly.		Confirm that the Ethernet cable is connected securely.		
	The Ethernet cable is not connected.		Confirm that all Ethernet cables are connected and connect any cables that are not connected.				
Attached information	None		1		1		
Precautions/ Remarks	None						

Event name	Slave Node Addres	ss Duplicated		Event code	24200000 hex	
Meaning	The same slave ac	dress is used for t	wo nodes.			
Source	EtherCAT Master I	Function Module	Source details	Slave Detection At power ON, a timing Controller reset or during communications		
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	 Master: If error is detection when the master is started: Communications stop. The master waits in the Ini Owner of the Fail-soft operation is set to <i>Fail-soft</i> and error is detected during operation: Slaves that were normal continue to operate. Slav after the new slave that caused the duplicated ad error remain in the Init state. When the Fail-soft operation is set to <i>Stop</i> and the is detected during operation: The slaves that were normal enter the Pre-operation state. Slaves after the new slave that caused the cated address error remain in the Init state. Slave: No error occurred. Parameters other than the node address cannot be and process data communications cannot be perfor for the new slave that caused the duplicated address and all slaves after it. 		aits in the Init state. <i>o Fail-soft</i> and the operate. Slaves duplicated address <i>o Stop</i> and the error the Pre-operational t caused the dupli- t state. ss cannot be set not be performed
Indicators	EtherCAT NET RU	IN	EtherCAT NET EF	R	EtherCAT LINK/AC	СТ
			Flashes at 1-s inte	ervals.		
System-defined	Variable		Data type		Name	
variables	_EC_SlavAdrDupE	Err	BOOL		Slave Node Addre	ss Duplicated Error
Cause and	Assumed cause		Correction		Prevention	
correction		The same node address is set for more than one slave.		the node address switch or address set value of the slave, nange it to prevent address ation.		
Attached information	None		·			
Precautions/ Remarks	The slave cannot b	be used unless the	slave node address i	s set.		

Event name	Network Configuration Information Error Ever			Event code	34400000 hex		
Meaning	There is an error	in the network config	uration information.		-		
Source	EtherCAT Master	Function Module	Source details	Master	Detection timing	At power ON or Controller reset	
Error attributes	Level	Minor fault	Recovery	Automatic recovery	Log category	System	
Effects	User program	Continues.	Operation	Master: The master waits i	n the Init state.		
				Slave: Parameter setting cations are not pos	is not possible. Proc ssible.	cess data communi-	
Indicators	EtherCAT NET R	UN	EtherCAT NET E	EtherCAT NET ERR		EtherCAT LINK/ACT	
			Flashes at 1-s int	ervals.	s		
System-defined	Variable		Data type		Name		
variables	_EC_NetCfgErr		BOOL		Network Configuration Information Error		
Cause and	Assumed cause	Assumed cause		Correction		Prevention	
correction	The power supply to the Controller was interrupted or communications with the Sysmac Studio were discon- nected while downloading the net- work configuration information.		tion, set the netwo	Perform the Clear All Memory opera- tion, set the network configuration information, and then save it in the master again.		Do not turn OFF the power supply to the Controller or disconnect commu- nications with the Sysmac Studio while downloading the network con- figuration information.	
Attached information	Attached Informat	tion 1: Error Details (0001 hex: Illegal pa	rameter, 0014 hex: E	rror opening file)		
Precautions/ Remarks	None						

Event name	EtherCAT Commu	inications Cycle Exce	eeded	Event code	34410000 hex*		
Meaning	Process data com	munications could ne	ot be performed with	the specified comm	unications cycle.		
Source	EtherCAT Master	Function Module	Source details	Master	Detection timing	At start of com- munications	
Error attributes	Level	Minor fault	Recovery	Automatic recovery	Log category	System	
Effects	User program	Continues.	Operation Master: The master waits in Slave: Parameter setting is cations are not poss		s not possible. Process data communi-		
Indicators	EtherCAT NET RU	JN	EtherCAT NET ER	EtherCAT NET ERR		ст	
			Flashes at 1-s intervals.				
System-defined	Variable		Data type		Name		
variables	_EC_CycleExceed	_EC_CycleExceeded		BOOL		EtherCAT Communications Cycle Exceeded	
Cause and	Assumed cause	Assumed cause		Correction			
correction	The transmission delay time in the actually connected configuration is longer than the transmission delay time calculated for the user-set cable length.		Set the cable lengt with the actual con	•	Set the cable lengt with the actual cor	•	
	The set task period or communica- tions cycle is too short.		Use the Simulator and set a task period (communications cycle) that enables communications.		Use the Simulator and set a task period (communications cycle) that enables communications.		
Attached information	None						
Precautions/ Remarks	None						

* This event code occurs for unit version 1.10 or later of the CPU Unit.

Event name	Controller Insufficie	ent Memory Warning]	Event code	50010000 hex*	
Meaning			ave configuration, network-published information, or other You may not be able to perform online editing or other op			
Source	EtherCAT Master I EtherNet/IP Functi	Function Module or on Module			Detection timing	At power ON, download, or online editing
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	Not affected.		
Indicators	EtherCAT NET RU	IN	EtherCAT NET E	RR	EtherCAT LINK/ACT	
System-defined	Variable		Data type	Data type		
variables	None					
Cause and	Assumed cause		Correction		Prevention	
correction	The amount of data for the EtherCA slave configuration, network-pub- lished information, or other data exceeds the value that is specified for the CPU Unit.		Reduce the number of PDOs that are used by the EtherCAT slaves.NoneReduce the number of data types that are used for network variables or reduce the length of the text strings that are used for names.Image: Comparison of the text strings that are used for names.			
Attached information	None					
Precautions/ Remarks	You may not be able to perform online editing or other operatio			erations.		

* This event code occurs for unit version 1.02 or later of the CPU Unit.

Event name	Network Configuration Error			Event code	84210000 hex		
Meaning	The EtherCAT ne	twork configuration is	s incorrect.				
Source	EtherCAT Master	Function Module			Detection timing	At power ON, at Controller reset, or during commu- nications	
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System	
Effects	User program	Continues.	Operation	Refer to Precautio	ns/Remarks.		
Indicators	EtherCAT NET RUN		EtherCAT NET ERR		EtherCAT LINK/ACT		
			Flashes at 1-s int	Flashes at 1-s intervals.			
System-defined	Variable		Data type		Name		
variables	_EC_NetTopolog	_EC_NetTopologyErr		BOOL		Network Configuration Error	
Cause and	Assumed cause	Assumed cause		Correction		Prevention	
correction	Slave output ports each other.	Slave output ports are connected to each other.		Correct the Ethernet cable connec- tions.		Confirm that there are no incorrect Ethernet cable connections.	
		The master and slave are connected with the slave output port.					
	The number of connected slaves exceeded the maximum number of slaves for the EtherCAT master.		keep the number below the maximum mum number of			nore than the maxi- slaves are connected network.	

Attached information	Error Details: 0000 hex: Too many slaves, 0001 hex: Incorrect connections, such as a ring connection
Precautions/	Master:
Remarks	• The following applies if fail-soft operation is set to <i>Fail-soft</i> , the event was detected when the power supply was turned ON or the Controller was reset, and the error details in the attached information is 0000 hex: The maximum number of slaves from the beginning will enter the Operational state and continue to operate. The slaves past the maximum number of slaves will remain in Init state and communications will stop.
	• The following applies if fail-soft operation is set to <i>Stop</i> , the event was detected when the power supply was turned ON or the Controller was reset, and the error details in the attached information is 0000 hex: The maximum number of slaves from the beginning will enter the Pre-operational state and only message communications will continue. The slaves past the maximum number of slaves will remain in Init state and communications will stop.
	• The following applies if the event was detected when the power supply was turned ON or the Controller was reset, and the error details in the attached information is 0001 hex: All slaves will remain in the Init state and communications will stop.
	• The following applies if fail-soft operation is set to <i>Fail-soft</i> , the event was detected during communications, and the error details in the attached information is 0000 hex: The maximum number of slaves from the beginning will enter the Operational state and continue to operate. The slaves past the maximum number of slaves will remain in Init state and communications will stop.
	• The following applies if fail-soft operation is set to <i>Stop</i> , the event was detected during communications, and the error details in the attached information is 0000 hex: The maximum number of slaves from the beginning will enter the Pre operational state and communications will stop. The slaves past the maximum number of slaves will remain in Init state and communications will stop.
	• The following applies if fail-soft operation is set to <i>Fail-soft</i> , the event was detected during communications, and the error details in the attached information is 0001 hex. The slaves that are normal continue to operate. If you are using distributed clocks to synchronize the slaves, a Synchronization Error may occur between the slaves.
	Slave:
	No error occurred.
	• The following applies if fail-soft operation is set to <i>Fail-soft</i> , the event was detected when the power supply was turned ON or the Controller was reset, and the error details in the attached information is 0000 hex: The maximum number of slaves from the beginning will enter the Operational state, it will be possible to set parameters, and process data communications will continue. The slaves past the maximum number of slaves will remain in the Init state and it will not be possible to set parameters or perform process data communications for them.
	 The following applies if fail-soft operation is set to <i>Stop</i>, the event was detected when the power supply was turned ON or the Controller was reset, and the error details in the attached information is 0000 hex: The maximum number of slaves from the beginning will enter the Pre-operational state, it will be possible to set parameters, but process data communications will not be possible. The slaves past the maximum number of slaves will remain in the Init state and it will not be possible to set parameters or perform process data communications for them.
	• The following applies if the event was detected when the power supply was turned ON or the Controller was reset, and the error details in the attached information is 0001 hex: All slaves will remain in the Init state and it will not be possible to set parameters or perform process data communications.
	• The following applies if fail-soft operation is set to <i>Fail-soft</i> , the event was detected during communications, and the error details in the attached information is 0000 hex: The slaves before the node where the error occurred will enter the Operational state, it will be possible to set parameters, and process data communications will continue. For the slave where the error occurred and all slaves after it, it will not be possible to set parameters or perform process data communications.
	• The following applies if fail-soft operation is set to <i>Stop</i> , the event was detected during communications, and the error details in the attached information is 0000 hex: It will be possible to set parameters but it will not be possible to perform process data communications for all slaves in the Pre-operational state. It will not be possible to set parameters or perform process data communications for all slaves in the Init state.
	• The following applies if fail-soft operation is set to <i>Fail-soft</i> , the event was detected during communications, and the error details in the attached information is 0001 hex: Process data communications will be possible for all slaves that are operating normally. If you are using distributed clocks to synchronize the slaves and a Synchronization Error is detected, only input refreshing is enabled. It will be possible to set parameters.
	There are restrictions on the number of slave node addresses, and not on the number of slaves per se. This is because there are slaves, such as Junction Slaves, that use more than one node. Also, if the maximum number of slaves are connected and an attempt is made to make a ring connection, a Too Many Slaves error (0000 hex) occurs.

Event name	Network Configura	ation Verification Er	ror	Event code	84220000 hex		
Meaning	A slave that is in the ration information		ration information is	not connected. Or, a	a slave that is not in	the network configu-	
Source	EtherCAT Master	Function Module	Source details	timing Controlle or during		At power ON, at Controller reset, or during commu- nications	
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System	
Effects	User program	Continues.	Operation	Master: Slaves that are c		etwork configuration	
				information enter the Operational state. Slaves that are not consistent with the network configuration informatio and all subsequent slaves remain in Init state.		guration information	
		-		Slave:			
				Depends on the slave communications status.			
				When Fail-soft O	peration Is Set to S	top	
		-		Master:			
			Slaves that are consistent with the network configuration information enter the Pre-operational state. Slaves that are not consistent with the network configuration informa- tion and all subsequent slaves will remain in the Init state				
				Slave:			
					slave communications status.		
Indicators	EtherCAT NET RU	JN	EtherCAT NET E		EtherCAT LINK/	ACT	
			Flashes at 1-s int	ervals.			
System-defined variables	Variable		Data type		Name		
vanabios	_EC_NetCfgCmpI	Err	BOOL		Network Configu Error	ration Verification	
	When Inconsisten Verification _EC_CommErrTb		Array[1n] of BO	Array[1n] of BOOL* Communications Error		S Error Slave Table	

Cause and	Assumed cause	Correction	Prevention
correction	A slave that is in the network configu- ration information is not connected.	Connect the slaves that are in the net- work configuration information. Or, connect the Sysmac Studio and set and save the network configuration information with the slave deleted in the master.	Set and save the network configura- tion information for the configuration actually connected in the master.
	There is a node address mismatch.	Make the slave node address settings consistent with the network configura- tion information.	
	A different slave from the one that is specified in the network configuration information is connected.	Connect the slave that is specified in the network configuration information. Or, connect the Sysmac Studio and set and save the network configura- tion information with the correct slaves in the master.	
	A slave that is not in the network con- figuration information is connected.	Disconnect the slave that is not in the network configuration information from the network. Or, connect the Sysmac Studio and set and save the network configuration information with the slave added in the master.	
	The hardware switches for the slave node address were changed to a value other than 0 after the <i>Write</i> <i>Slave Node Address</i> operation was performed from the Sysmac Studio.	To use the value that is set on the hardware switches, reset the error. When the error is reset, there will be a disagreement between the hardware switches and the value that was writ- ten from the Sysmac Studio. A Slave Application Error (84280000 hex) will occur and you must then reset the error again. If this error occurs when the slave is disconnected or disabled, reset the error first and then connect or enable the slave. When you do, a Slave Application Error (84280000 hex) will occur. Reset the error again and then connect or enable the slave.	To use the value that is set on the hardware switches, reset the error. When the error is reset, there will be a disagreement between the hardware switches and the value that was writ- ten from the Sysmac Studio. A Slave Application Error (84280000 hex) will occur and you must then reset the error again. If this error occurs when the slave is disconnected or disabled, reset the error first and then connect or enable the slave. When you do, a Slave Application Error (84280000 hex) will occur. Reset the error again and then connect or enable the slave.
		To use the node address that was set from the Sysmac Studio, set the hard- ware switches to a node address of 0 and cycle the power supply to the slave.	To use the node address that was set from the Sysmac Studio, set the hard- ware switches to a node address of 0 and cycle the power supply to the slave.
	The Ethernet physical layer is broken between two slaves.	In cases not caused by the above causes, confirm the location of the break in the Ethernet cable and replace the cable.	None
Attached information	None		
Precautions/ Remarks	If you add check items in the options fo	or network configuration verification, chec	ck whether the items match.

Event name	Slave Initialization	Error		Event code	84230000 hex	
Meaning	Slave initialization	failed.				
Source	EtherCAT Master	Function Module	Source details	Master/Slave	Detection timing	At power ON, Controller reset, error reset, or major fault level Controller error
Error attributes	Level	Minor fault	Recovery	Error reset/hard- ware replace- ment	Log category	System
Effects	User program	Continues.	Operation	When Fail-soft Op	eration Is Set to Fa	il-soft
				Master:		
	Master: • When the master fails to enter F after initialization: Communications stop in the lnit the error occurred. Slaves in top where the error occurred enter of continue to operate. • When the master fails to enter s tional state: Only the slave with the error will The normal slaves enter the Op tinue to operate. Slave: This depends on the slave commu- When Fail-soft Operation Is Set to Master: • When the master fails to enter F after initialization: All slaves enter the Init state an • When the master fails to enter s tional state: All slaves enter the Pre-operatio cations stop.		n: s stop in the Init star ed. Slaves in topolo occurred enter Operate. er fails to enter state with the error will stor es enter the Operation he slave communic the slave communic er fails to enter Pre- n: the Init state and co er fails to enter state	te at the slave where gy up to the slave prational state and es after Pre-opera- op state transitions. tional state and con- eations status. <i>op</i> operational state pmmunications stop. es after Pre-opera-		
				Slave:		
				-	he slave communic	
Indicators	EtherCAT NET RU	IN	EtherCAT NET E	RR	EtherCAT LINK/A	ACT
			Flashes at 1-s int	ervals.		
System-defined	Variable		Data type		Name	
variables	_EC_SlavInitErr		BOOL		Slave Initializatio	n Error
	_EC_CommErrTbl		Array[1n] of BO	OL*	Communications	Error Slave Table

Cause and	Assumed cause	Correction	Prevention	
correction	An error occurred in EtherCAT master processing.	Connect the Sysmac Studio and reconfigure and save the network configuration information in the mas- ter again. If this error occurs again, check that there are no errors in the slave synchronization settings and the PDO mapping information, and correct any errors that are found.	Correctly set the slave synchroniza- tion settings, PDO mapping informa- tion, and configure and save network configuration information in the mas- ter.	
	An initialization error occurred in the EtherCAT slave.	The Module config send method parameter is sometimes displayed for a slave in the EtherCAT network con- figuration on the Sysmac Studio even if a send method cannot be set. If that occurs, set the Module config send method parameter to Do not send and perform synchronization again. Or, cycle the power supply to the Ether- CAT slave. If this error persists, replace the EtherCAT slave.	None	
	An initialization error occurred in the EtherCAT Coupler Unit. Connect the Sysmac Studio to the USB port on the EtherCAT Coupler Unit, check the error details, and take suitable measures for the error.		None	
	A major fault level Controller error occurred.	If a major fault level Controller error occurs, process data communications stop. If a Slave Application Error (84280000 hex) occurs at this time, this event also occurs. Perform cor- rections for the major fault level Con- troller error.	Perform preventive measures for major fault level Controller errors.	
	The Ethernet cable is broken or the specified cable is not being used.	The causes given on the left are pos- sible if the error occurs from when the	Make sure that the cable is not bro- ken and use the specified cable.	
	A connector on the Ethernet cable is disconnected, the contact is faulty, or parts are faulty.	system starts operation or if it always occurs after a specific time after the system starts operation. Use the diagnostic and statistical	Confirm that the Ethernet cable con- nector is mated securely.	
	A general-purpose Ethernet hub is connected.	information from the Sysmac Studio and check the EtherCAT communica- tions status.	When branching an EtherCAT net- work, use an EtherCAT Junction Slave.	
	The master failed.	If the Ethernet cable between the	None	
	The slave failed.	master and slave is broken or if the specified cable was not used, replace the cable. Or, reconnect the connec- tor and make sure it is mated cor- rectly. If a general-purpose Ethernet hub is connected, replace it with an EtherCAT Junction Slave. If the CPU Unit or an EtherCAT slave fails, replace it.	None	
	Noise.	If this error occurs irregularly, imple- ment noise countermeasures.	Implement noise countermeasures.	
Attached information	Attached information 1: System information 1 Attached information 2: System information 2 Attached information 3: System information 3			
Precautions/ Remarks	Attached information 4: System information 4: None			

Event name	Slave Application I	Error		Event code	84280000 hex		
Meaning	An error occurred	An error occurred in the slave application.					
Source	EtherCAT Master	Function Module	Source details	Slave	Detection timing	During communi- cations	
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System	
Effects	User program	Continues.	Operation	When Fail-soft Op	eration Is Set to Fail	-soft	
				Master:			
				operation continue	nications status is no s. The status of slav ror is also not manip	es with an applica	
				Slave:			
					An error occurred. Operation is according to the state transition behavior of the slave where the error occurred.		
				When Fail-soft Op Master:	eration Is Set to Sto	D	
				All slaves enter the cation layer status	e Pre-operational sta error occurs.	ate when an appli-	
				Slave:			
				An error occurred. state.	All slaves enter the	Pre-operational	
Indicators	EtherCAT NET RU	IN	EtherCAT NET EF	R	EtherCAT LINK/A	СТ	
			Flashes at 1-s inte	ervals.			
System-defined	Variable		Data type		Name		
variables	_EC_SlavAppErr		BOOL	BOOL		Error	
	_EC_CommErrTbl	_EC_CommErrTbl		Array[1n] of BOOL*		Error Slave Table	
Cause and	Assumed cause		Correction		Prevention		
correction	An error was detected in the slave's application layer status register.		Clear the error from the EtherCAT None slave where the application error occurred. occurred. Use the procedure given in the slave documentation.				
Attached information	Attached Informati	on 1: AL status cod	e for the slave where	e the error was detec	ted.		
Precautions/ Remarks	None						

Event name	Process Data Tran	smission Error		Event code	84290000 hex	
Meaning	Sending process d	ata failed.			•	
Source	EtherCAT Master I	Function Module	Source details	s Master Detection During cor timing cations		
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	When Fail-soft Ope	eration Is Set to Fail	-soft
				Master:		
				Operation continue	es.	
				Slave:		
				The error occurs of	nly with synced slav	es.
					eration Is Set to Stop	D
				Master:		
				Slave:	Pre-operational sta	lie.
				Errors only occur in synced slaves.		
Indicators	EtherCAT NET RU		EtherCAT NET ER	· · · · ·	EtherCAT LINK/AC	די
Indicators		11				
Custom defined	Variable		Flashes at 1-s intervals.			
System-defined variables			Data type			
	_EC_PDSendErr		BOOL		Process Data Transmission Error	
Cause and correction	Assumed cause		Correction		Prevention	
Correction	CAT frame during	It was not possible to send the Ether- CAT frame during the EtherCAT com- munications period.		Connect the Sysmac Studio, increase the task period setting of the primary periodic task or priority-5 periodic		l of the primary prity-5 periodic task vides sufficient pro-
	The frame transmission jitter exceeded the limit.		task, and set and s configuration inforr CAT master.	ave the network nation in the Ether-	cessing time. Use check the necessa munications period	ry EtherCAT com-
Attached information	Attached Information 1: Error Details (Frame generation was late for the transmission timing: 0000 hex, If the transmis sion jitter exceeded the limit: 0001 hex					hex, If the transmis-
	Attached Information 2: System information					
Precautions/ Remarks	None					

Event name	Process Data Rece	eption Timeout		Event code	842B0000 hex	
Meaning	Process data rece	otion timed out.			-	
Source	EtherCAT Master F	Function Module	Source details	Master	Detection timing	During communi- cations
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation		es. n synced slaves. C tional state is enter slave. eration Is Set to <i>St</i> e Pre-operational s	perational state con- red if the state transi
Indicators	EtherCAT NET RU	N	EtherCAT NET EF		EtherCAT LINK/	ACT
			Flashes at 1-s inte			
System-defined	Variable		Data type		Name	
variables	_EC_PDTimeoutE	rr .	BOOL		Process Data Reception Timeout	
Cause and	Assumed cause	•	Correction		Prevention	
correction	The Ethernet cable is broken or the		The causes given on the left are pos-		Make sure that the cable is not bro-	
	specified cable is not being used.		sible if the error occurs from when the system starts operation or if it always occurs after a specific time after the system starts operation. Use the diag- nostic and statistical information from the Sysmac Studio and check the EtherCAT communications status. If the Ethernet cable between the mas-		ken and use the specified cable.	
	A connector on the Ethernet cable is disconnected, the contact is faulty, or parts are faulty.				Confirm that the Ethernet cable con- nector is mated securely.	
	A general-purpose Ethernet hub is connected.				When branching an EtherCAT net- work, use an EtherCAT Junction Slave.	
	The master failed.		ter and slave is broken or if the speci-		None	
	The slave failed.		fied cable was not used, replace the cable. Or, reconnect the connector and make sure it is mated correctly. If a general-purpose Ethernet hub is connected, replace it with an Ether- CAT Junction Slave. If the CPU Unit or an EtherCAT slave fails, replace it.		None	
	The Ethernet cable	e is too long.	The causes given on the left are pos- sible if the error occurs from when the		Make the Ethernet cable as short as possible.	
	The CPU Unit task period is too short.		system starts operation. If the Ether- net cable is too long, shorten it. If the error still occurs, connect the Sysmac Studio, increase the task period of the primary periodic task or priority-5 peri- odic task, and reconfigure the Con- troller.		priority-5 periodic task	
	Noise		If this error occurs irregularly, imple- ment noise countermeasures.		Implement noise	countermeasures.
Attached information	None					
Precautions/ Remarks	None					

Event name	Process Data Communications Error Event		Event code	842C0000 hex			
Meaning	An error occurred	in process data com	munications.				
Source	EtherCAT Master	Function Module	Source details	Slave	Detection timing	During communi- cations	
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System	
Effects	User program	Continues.	Operation	Master: Operation continue Slave: An error occurred. watchdog error oc state. Check for co system-defined va When Fail-soft Op Master: All slaves enter the Slave: An error occurred.	Operational state continues. If a PDI curs in a slave, the slave enters the In mmunications errors for each slave ir riables _ <i>EC_CommErrTbl</i> []. eration Is Set to <i>Stop</i> e Pre-operational state. When operation stops, all slaves enter I state. If a PDI watchdog error occurs		
Indicators	EtherCAT NET RU	JN	EtherCAT NET EI		EtherCAT LINK/		
			Flashes at 1-s intervals.				
System-defined	Variable		Data type		Name		
variables	EC_PDCommErr		BOOL		Process Data Communications Error		
	 _EC_CommErrTbl		Array[1n] of BOC	DL*	Communications	Error Slave Table	
	 _EC_PDActive		BOOL		Process Data Co	mmunications Status	
Cause and	Assumed cause		Correction		Prevention		
correction	A slave left the network even though the disconnection operation was not performed.		before removing t	nnection operation he slave from the hernet cable is bro-		onnection operation the slave from the	
	The Ethernet cable is broken or the specified cable is not being used. A connector on the Ethernet cable is disconnected, the contact is faulty, or parts are faulty.		The causes given on the left are pos- sible if the error occurs from when the system starts operation or if it always occurs after a specific time after the system starts operation. Use the diagnostic and statistical information from the Sysmac Studio and check the EtherCAT communica- tions status. If the Ethernet cable between the master and slave is broken or if the specified cable was not used, replace the cable. Or, reconnect the connec- tor and make sure it is mated cor- rectly.		Confirm that the Ethernet cable connector is mated securely.		
Attached information	Attached Informati	on 1: Error Details ((slave. 0001 hex: Slave WE	DT error, 0002 hex: S	lave disconnected)	
Precautions/ Remarks	None						

Event name	EtherCAT Slave B	ackup Failed		Event code	102F0000 hex**	I
Meaning	The backup opera	tion for an EtherCAT	slave ended in an	error.		
Source	EtherCAT Master	Function Module	Source details	Master	Detection timing	During backup operation
Error attributes	Level	Observation	Recovery		Log category	System
Effects	User program	Continues.	Operation	Not affected.		
Indicators	EtherCAT NET RU	JN	EtherCAT NET EF	R	EtherCAT LINK/	ACT
System-defined	Variable		Data type		Name	
variables	_EC_DisconnSlav	Tbl	Array[1n] of BOC)L ^{*2}	Disconnected S	lave Table
Cause and	Assumed cause		Correction		Prevention	
correction	There is no conne EtherCAT master OFF).	ction between the and the slave (Link	Wire the EtherCA securely.	T master and slave	securely and ma	AT master and slave ake sure that a con- lished before you up the data.
	An error caused an incorrect Ether- CAT master status.		Use the Sysmac Studio or the Trou- bleshooter of an HMI to check for errors and eliminate any EtherCAT errors.		Back up the data when there are no EtherCAT errors.	
	The EtherCAT net information does r physical network o	•	Make sure that network configuration information agrees with the physical network configuration.		Back up the data only when the net- work configuration information agrees with the physical network configura- tion.	
	The request to the EtherCAT slave failed.			ermeasures if there ent noise. If the situ-		le securely. Imple- ntermeasures if there bient noise.
	The EtherCAT master was temporar- ily unable to perform the processing because it was executing other pro- cessing.		Try backing up the data again.		None	
	Initialization of the EtherCAT slave failed.		Connect any slaves that are discon- nected. Use the Sysmac Studio or the Troubleshooter of an HMI to check for the following errors: Slave Initializa- tion Error, Slave Application Error, and Process Data Communications Error. Eliminate any errors that you find.			
	It was not possible to read the backup parameters from the EtherCAT slave.		manufacturer of th read all of the para as backup parame backup parameter	ameters that are set	None	

Cause and	Communications with an OMRON	Connect the cable securely.	Connect the cable securely.			
correction	Communications Coupler Unit or NX	Mount the NX Unit securely.	Mount the NX Unit securely.			
	Unit failed.	Implement noise countermeasures if there is excessive ambient noise.	Implement noise countermeasures if there is excessive ambient noise.			
		If the problem still exists, replace the Communications Coupler Unit or the NX Unit.				
Attached	Attached Information 1: Error Details (1	The following values are in the order of the	ne causes of the error.)			
information	0001 hex: Link OFF					
	0002 hex: Incorrect master status					
	0003 hex: Configuration information does not agree with network configuration.					
	0004 hex: The request to the EtherCAT slave failed.					
	0005 hex: Master status temporarily prevented processing.					
	0006 hex: An error occurred in slave initialization or a slave is disconnected from the network.					
	0007 hex: Reading the backup data failed.					
	000B hex: Error at OMRON Communications Coupler Unit					
	Attached Information 2: Error Location					
	0: Master					
	1 or higher: Slave node address					
	Attached Information 3: Error Location Details (only when attached information 1 is 000B hex).					
	0: Communications Coupler Unit					
	1 to 63: Unit number of NX Unit					
	Attached Information 4: Cause of Error at OMRON Communications Coupler Unit (only when attached information 1 is 000B hex).					
	2: Communications with the Comm	unications Coupler Unit or NX Unit failed	d.			
Precautions/ Remarks	None					

*1 This event code occurs for unit version 1.03 or later of the CPU Unit.

Event name	EtherCAT Slave R	estore Operation Fa	iled	Event code	10300000 hex*	
Meaning	The restore operat	ion for an EtherCAT	slave ended in an e	error.		
Source	EtherCAT Master I	Function Module	Source details	Master	Detection timing	During restore operation
Error attributes	Level	Observation	Recovery		Log category	System
Effects	User program	Continues.	Operation	Not affected.		
Indicators	EtherCAT NET RU	N	EtherCAT NET EF	R	EtherCAT LINK/	ACT
System-defined	Variable		Data type		Name	
variables	None					
Cause and	Assumed cause		Correction		Prevention	
correction	There is no connect EtherCAT master a OFF).		Wire the EtherCA securely.	T master and slave	securely, and ma	AT master and slave ake sure that a con- ished before you re the data.
	An error caused ar CAT master status		Use the Sysmac S bleshooter of an H errors and elimina errors.		Restore the data EtherCAT errors	a when there are no s.
	The EtherCAT network configuration information does not agree with the physical network configuration.		information agree network configura Always use a slav same or higher that that was used who backed up even if for the Revision C backup. Set <i>No cl</i> Number Check Ma up the data. If you with the Serial Nur set to <i>Setting = A</i> use the restore fur change the netwo from the Sysmac the network config transfer the slave node address is s	slave revision that is the tr than the slave revision when the data was en if you set <i>No check</i> on Check Method for <i>lo check</i> for the Serial k Method and then back you replace a slave Number Check Method <i>= Actual device</i> , do not e function. Instead, etwork configuration hac Studio, download onfiguration, and then ave parameters. If the is set on the hardware the same setting as		on information agrees
	The request to the EtherCAT slave failed.		ment noise counter is excessive ambi	The cable securely. Imple- ter noise countermeasures if there cessive ambient noise. If the situ- does not improve, replace the rCAT slave.		termeasures if there
	The EtherCAT master was temporar- ily unable to perform the processing because it was executing other pro- cessing.		Try restoring the data again.		None	
	Initialization of the EtherCAT slave failed.		Use the Sysmac Studio or the Trou- bleshooter of an HMI to check for the following errors: Slave Initialization Error, Slave Application Error, and Process Data Communications Error. Eliminate any errors that you find.		Restore the data when there is no Process Data Communications Error.	
	It was not possible parameters to the Inverter.		Download the parameters to the Inverter using the "To Drive" menu of the Sysmac Studio.		Data is sometimes not restored due to Inverter restrictions. If that occurs, download the parameters to the Inverter using the "To Drive" menu o the Sysmac Studio.	

Cause and correction	It was not possible to write the backup parameters to the EtherCAT slave.	The ESI file may be incorrect. Ask the manufacturer of the slave if you can write all of the parameters that are set as backup parameters. If all of the backup parameters can be written, the slave is faulty. Replace the slave.	None
	Incorrect backup data was detected.	Format the SD Memory Card with the Sysmac Studio and then place the backup file on it.	Do not remove the SD Memory Card or turn OFF the power supply while the SD BUSY indicator is lit. Or, replace the SD Memory Card periodi- cally according to the write life of the SD Memory Card.
	The EtherCAT network configuration in the backup data does not agree with the physical network configura- tion.	Make sure that the EtherCAT network configuration in the backup data agrees with the physical network con- figuration.	Make sure that the EtherCAT network configuration in the backup data agrees with the physical network con- figuration before you try to restore the data.
	 An error occurred at an OMRON Communications Coupler Unit. The following causes are possible. Reading a backup file failed at the Communications Coupler Unit (when attached information 4 is 1). Communications with the Commu- nications Coupler Unit or NX Unit failed (when attached information 4 is 2). The Unit Configuration of the NX Units in the Communications Cou- pler Unit when data was backed up did not agree with the actual config- uration of NX Units (when attached information 4 is 3). 	 Try backing up the data again (when attached information 4 is 1). Connect the cable securely. Mount the NX Unit securely. Implement noise countermeasures if there is excessive ambient noise. If the problem still exists, replace the Communications Coupler Unit or the NX Unit (when attached infor- mation 4 is 2). Make the Unit Configuration of the NX Units in the Communications Coupler Unit when data was backed up agree with the actual configuration of NX Units (when attached information 4 is 2 or 3). Correct the hardware switches on the Communications Coupler Unit so that they are the same as when the data was backed up (when attached information 4 is 3). 	 Format an SD Memory Card with the Sysmac Studio and then place the backup file on it. Also, do not remove the SD Mem- ory Card or turn OFF the power supply while the SD BUSY indicator is lit (when attached information 4 is 1). Connect the cable securely. Mount the NX Unit securely. Implement noise countermeasures if there is excessive ambient noise (when attached information 4 is 2). Restore the data while the Unit Configuration of the NX Units in the Communications Coupler Unit agrees with the actual configura- tion of NX Units (when attached information 4 is 2 or 3). Restore the data while the hard- ware switches on the Communica- tions Coupler Unit are the same as when the data was backed up (when attached information 4 is 3).

Attached	Attached Information 1: Error Details (The following values are in the order of the causes of the error.)
information	0001 hex: Link OFF
	0002 hex: Incorrect master status
	0003 hex: Configuration information does not agree with network configuration.
	0004 hex: The request to the EtherCAT slave failed.
	0005 hex: Master status temporarily prevented processing.
	0006 hex: An error occurred in slave initialization.
	0007 hex: Writing the backup data failed.
	0008 hex: The backup data is not correct.
	0009 hex: The network configuration does not agree with the network configuration in the backup data.
	000A hex: The service is not supported
	000B hex: Error at OMRON Communications Coupler Unit
	Attached Information 2: Error Location
	0: Master
	1 or higher: Slave node address
	Attached Information 3: Error Location Details (only when attached information 1 is 000B hex).
	0: Communications Coupler Unit
	1 to 63: Unit number of NX Unit
	Attached Information 4: Cause of Error at OMRON Communications Coupler Unit (only when attached information 1 is 000B hex).
	1: Reading the backup file failed.
	2: Communications with the Communications Coupler Unit or NX Unit failed.
	3: The Unit Configuration does not agree with the Unit Configuration in the backup data.
Precautions/ Remarks	None

 $^{\star}\,$ This event code occurs for unit version 1.03 or later of the CPU Unit.

Event name	Emergency Message Detected		Event code	64200000 hex		
Meaning	An emergency me	An emergency message was detected.				
Source	EtherCAT Master Function Module		Source details	Slave	Detection timing	During communi- cations
Error attributes	Level	Observation	Recovery		Log category	System
Effects	User program	Continues.	Operation	Slave:		
				An error occurred.	Other operation is r	not affected.
Indicators	EtherCAT NET RU	IN	EtherCAT NET EF	R	EtherCAT LINK/ACT	
System-defined	Variable		Data type		Name	
variables	_EC_SlavEmergErr		BOOL		Emergency Message Detected	
Cause and	Assumed cause		Correction	Correction		
correction	An emergency message was received from a slave.		Clear the error from the EtherCAT slave where the application error occurred. Use the procedure given in the slave documentation.		Refer to the information given in the manual for the slave and implement countermeasures to prevent the problem.	
Attached	Attached Informati	on 1: Slave emerge	ncy code			
information	Attached information 2: Slave error register object value					
	Attached Informati	on 3: Slave emerge	ncy data. Only the lo	wer five bytes are va	alid.	
Precautions/ Remarks	None					

Event name	EtherCAT Message Error			Event code	842D0000 hex	
Meaning	An error occurred	n a message comm	unications with the s	lave.		
Source	EtherCAT Master	Function Module	Source details	Master	Detection timing	During communi- cations
Error attributes	Level	Observation	Recovery		Log category	System
Effects	User program	Continues.	Operation	Slave:		<u> </u>
				An error occurred.	Other operation is n	ot affected.
Indicators	EtherCAT NET RU	IN	EtherCAT NET ER	IR	EtherCAT LINK/AC	СТ
System-defined	Variable		Data type		Name	
variables	_EC_MsgErr		BOOL		EtherCAT Message Error	
Cause and	Assumed cause		Correction		Prevention	
correction	Refer to the attached information to check the error.		Send messages or support the messa tify the error messa details that are giv information, and co	ge protocol. Iden- age with the error en in the attached	Use messages that match the slave specifications. Also check to make sure that messages are addressed the correct node.	
Attached information	information, and correct the message. Attached Information 1: Error Details 1st byte: 00 hex: Error message reception, 02 hex: Illegal or unsupported message discarded, 04 hex: Message with illegal destination address discarded 2nd byte: For Transmission: 00 hex: Error, 01 hex: VoE (AoE), 02 hex: EoE, 03 hex: CoE, 04 hex: FoE, 05 hex: SoE, 0F hex: VoE For Reception: 80 hex: Error, 81 hex: VoE (AoE), 82 hex: EoE, 83 hex: CoE, 84 hex: FoE, 85 hex: SoE, 8F hex: VoE, Attached information 2: Source node address. If the source is the master: 0 Attached Information 3: Transmission destination node address. If the destination is the master: 0 Attached information 4: Error service data. This data is valid only when byte 2 of attached information 1 is 00 or 80 hex.					
Precautions/ Remarks	None					

Event name	Slave Disconnected Event code			94400000 hex			
Meaning	A slave was discor	nnected for a discon	nection command.				
Source	EtherCAT Master	Function Module	Source details Slave		Detection timing	When slave dis- connection is specified during communications	
Error attributes	Level	Information	Recovery		Log category	System	
Effects	User program	Continues.	Operation	Master:			
				and all slaves aft stopped for the s	nmunications are sto er it. Monitoring of to lave and all slaves at	pology changes is	
					nove to Init state. You ers with the Sysmac S are not possible.		
Indicators	EtherCAT NET RU	IN	EtherCAT NET ERR		EtherCAT LINK/ACT		
System-defined	Variable		Data type		Name		
variables	_EC_DisconnSlavTbl		Array[1n] of BOOL*		Disconnected Sla	ve Table	
	_EC_PDSlavTbl		Array[1n] of BOOL*		Process Data Communicating Slave Table		
	_EC_MBXSlavTbl		Array[1n] of BOOL*		Message Communications Enabled Slave Table		
Cause and	Assumed cause		Correction		Prevention		
correction	An operation to disconnect the slave was executed from the Sysmac Stu- dio.						
	The EC_DisconnectSlave instruction was executed.						
Attached information	None						
Precautions/ Remarks	None						

Event name	Slave Connected			Event code	94410000 hex	
Meaning	A slave was recon	nected for a reconne	ection command.		•	
Source	EtherCAT Master Function Module		Source details	Slave	Detection timing	When slave reconnection is specified during communications
Error attributes	Level	Information	Recovery		Log category	System
Effects	User program	Continues.	Operation	Master:		
				The slave enters the Operational state again, and proces data communications restart. Slave:		again, and process
				Enters Operationa	l state.	
Indicators	EtherCAT NET RU	IN	EtherCAT NET EF	R	EtherCAT LINK/ACT	
System-defined	Variable		Data type		Name	
variables	_EC_DisconnSlavTbl		Array[1n] of BOOL*		Disconnected Slave Table	
	_EC_PDSlavTbl		Array[1n] of BOOL*		Process Data Communicating Slave Table	
	_EC_MBXSlavTbl		Array[1n] of BOOL*		Message Communications Enabled Slave Table	
Cause and	Assumed cause		Correction	Prevention		
correction	An operation to rea was executed from dio.					
	The EC_ConnectSlave instruction was executed.					
Attached information	None					
Precautions/ Remarks	None	None				

Event name	Errors Reset Event code			Event code	94430000 hex		
Meaning	A command was r	eceived to reset err	ors.		•		
Source	EtherCAT Master	Function Module	Source details	Source details Master		When errors are reset	
Error attributes	Level	Information	Recovery		Log category	System	
Effects	User program	Continues.	Operation	Master: The current errors are reset and the network is verific again. If the error is not detected again, process data communications with the slave for which communicat were stopped are restarted. Slave: The slave where the error occurred enters the Operation state.			
Indicators	EtherCAT NET RU	JN	EtherCAT NET E	EtherCAT NET ERR		EtherCAT LINK/ACT	
System-defined	Variable		Data type		Name		
variables	_EC_PDSlavTbl		Array[1n] of BOO	Array[1n] of BOOL*		Process Data Communicating Slave Table	
	_EC_MBXSlavTbl		Array[1n] of BOOL*		Message Communications Enabled Slave Table		
Cause and	Assumed cause		Correction		Prevention		
correction		An error reset operation was per- formed from the Sysmac Studio.					
	The ResetECError instruction was executed.						
Attached information	None						
Precautions/ Remarks	None						

Event name	Slave Disabled			Event code	94440000 hex*1		
Meaning	The EtherCAT Sla	ve was disabled.					
Source	EtherCAT Master Function Module		Source details	Slave	Detection timing	At execution of setting instruction	
Error attributes	Level	Information	Recovery		Log category	System	
Effects	User program	Continues.	Operation	Master:			
				Process data com	munications stop for	the slave.	
				Slave:			
				· ·	perational state. It will be possible to set cess data communications are not possi-		
Indicators	EtherCAT NET RU	İN	EtherCAT NET ERR		EtherCAT LINK/ACT		
System-defined	Variable		Data type		Name		
variables	_EC_PDSlavTbl		Array[1n] of BOOL*2		Process Data Communicating Slave Table		
	_EC_DisableSlavTbl		Array[1n] of BOOL*2		Disabled Slave Table		
Cause and	Assumed cause		Correction	Correction		Prevention	
correction	The EC_ChangeEnableSetting instruction was executed.						
Attached information	None						
Precautions/ Remarks	None	None					

*1 This event code occurs for unit version 1.04 or later of the CPU Unit.

*2 "n" is 512 for an NX-series CPU Unit and 192 for an NJ-series CPU Unit.

Event name	Slave Enabled			Event code	94450000 hex*1		
Meaning	The EtherCAT Sla	The EtherCAT Slave was enabled.					
Source	EtherCAT Master Function Module Source details		Slave	Detection timing	At execution of setting instruction		
Error attributes	Level	Information	Recovery		Log category	System	
Effects	User program	Continues.	Operation	Master:			
					The slave enters the Operational state again, and proces data communications restart. Slave:		
				Enters the Ope	rational state.		
Indicators	EtherCAT NET R	EtherCAT NET RUN EtherCAT NET Ef		RR	EtherCAT LINK/	ACT	
System-defined	Variable		Data type	Data type		Name	
variables	_EC_PDSlavTbl		Array[1n] of BO	Array[1n] of BOOL*2		Process Data Communicating Slave Table	
	_EC_DisableSlavTbl		Array[1n] of BOOL*2		Disabled Slave	Disabled Slave Table	
Cause and	Assumed cause		Correction	rection			
correction	The EC_ChangeEnableSetting instruction was executed.						
Attached information	None		-				
Precautions/ Remarks	None						

*1 This event code occurs for unit version 1.04 or later of the CPU Unit.

*2 "n" is 512 for an NX-series CPU Unit and 192 for an NJ-series CPU Unit.

9

9-2-2 Error Descriptions

9-2-3 Resetting Errors

There are three methods to reset errors.

- Sysmac Studio
- HMI
- Execution of the Reset EtherCAT Error (ResetECError) instruction

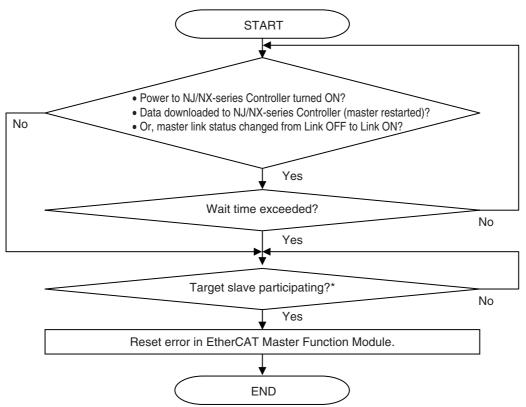
Refer to the *NJ/NX-series Troubleshooting Manual* (Cat. No. W503) for the resetting procedures from the Sysmac Studio or an HMI. Refer to the *NJ/NX-series Instructions Reference Manual* (Cat. No. W502) for details on the Reset EtherCAT Error (ResetECError) instruction.

Resetting Errors in the EtherCAT Master Function Module

Before you reset the following errors, always make sure that the slave with the error is participating in the network.

- Resetting a Network Configuration Verification Error or Process Data Communications Error while the power supply to the slave is ON or while the cable is connected
- Resetting a Link OFF Error while the power supply is ON to the first slave where the cable was disconnected or while the cable is connected

Use the following procedure.



* Check the _EC_EntrySlavTbl[] (Network Connected Slave Table) system-defined variable to see if a slave is participating.

Also, set the wait time in the EtherCAT master settings (EtherCAT master parameter settings) long enough to allow for the power supply startup time of all of the slaves. If you reset the error in the Ether-CAT Master Function Module without using the above procedure, the EtherCAT master may access a slave with a different node address than the specified node address, or other unexpected operations may occur. Also, the error may not be reset correctly.

Resetting Slave Errors

You can reset errors in the EtherCAT Master Function Module to reset slave errors. However, process data communications between the EtherCAT master and EtherCAT slave must be active to reset a slave error.

If process data communications with the slave are not active, check the slave after you reset errors in the EtherCAT Master Function Module to see if process data communications are active. Then, to reset the error in the slave, reset errors in the EtherCAT Master Function Module again.

9

9-2-4 Diagnostic and Statistical Information

The diagnostic and statistical information provides statistics on the number of communications frames sent and received by the EtherCAT master and EtherCAT slaves as well as the number of frames for which errors were detected. Use this information to diagnose the EtherCAT network line quality.

You can use it to diagnosis the EtherCAT network line qualify for the following:

- · Confirming that the EtherCAT network was correctly installed
- Finding the causes of communications errors that occur during normal operation

Use the following procedure from the Sysmac Studio to access the diagnostic and statistical information for the master and slaves.

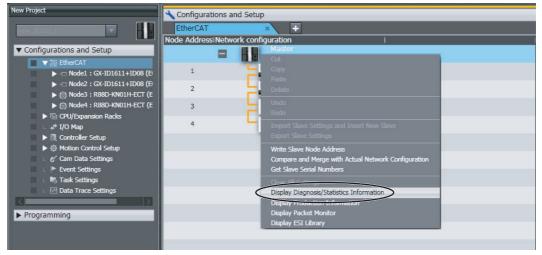
1 Start the Sysmac Studio and go online with the Controller.



Double-click EtherCAT under Configurations and Setup in the Multiview Explorer. Or, rightclick EtherCAT under Configurations and Setup and select *Edit*.



3 Right-click the master on the EtherCAT Tab Page and select **Display Diagnosis/Statistics Information** from the menu.



The Diagnosis/Statistics Information Dialog Box is displayed.

Use the tabs to change between the master diagnostic and statistical information and slave diagnostic and statistical information.

Diagnosis/Statistics Information		×				
Master Diagnosis/Statistics Slave Diagnosis/Statistics ×						
Label	Value					
Total frames Sent	44303					
Total frames Received	44303					
Frame reception timeout count						
Reception buffer overflow count						
Non-EtherCAT frames received						
Link OFF count						
Discarded process data receptions						
Discarded message receptions						
Lost repeat-send frames	0					
Network propagation delay time	2582	[ns]				
PDO communications cycle 1 - Current transmission cycle	1000032	[ns]				
PDO communications cycle 1 - Maximum transmission cycle	1000113	[ns]				
PDO communications cycle 1 - Minimum transmission cycle	999873	[ns]				
PDO communications cycle 1 - Transmission jitter	32	[ns]				
PDO communications cycle 2 - Current transmission cycle						
PDO communications cycle 2 - Maximum transmission cycle						
PDO communications cycle 2 - Minimum transmission cycle						
PDO communications cycle 2 - Transmission jitter						
CRC Error Frames Received						
Frame reception errors						
Collision count						
Short frames received						
Overlength frames received						
Last updated: 1/20/2015 3:56:07 PM						
	ear Upd	ate				
Output File						
	С	lose				

Master Diagnostic and Statistical Information, and Slave Diagnostic and Statistical Information

This section describes the meanings and functions of the items and buttons that are displayed on the Master Diagnosis/Statistic Tab Page and the Slave Diagnosis/Statistic Tab Page. You can use them to diagnose the current EtherCAT network line quality. You can also save diagnostic and statistical information to a file.

Master Diagnostic and Statistical Information

This section describes the displayed information and buttons on the Master Diagnosis/Statistic Tab Page.

The following items are displayed for the master diagnostic and statistical information.

Diagnosis/Statistics Information		×				
Master Diagnosis/Statistic Slave Diagnosis/Statistics ×						
Label	Value					
Total frames Sent	44303					
Total frames Received	44303					
Frame reception timeout count						
Reception buffer overflow count						
Non-EtherCAT frames received						
Link OFF count						
Discarded process data receptions						
Discarded message receptions						
Lost repeat-send frames						
Network propagation delay time	2582	[ns]				
PDO communications cycle 1 - Current transmission cycle	1000032					
PDO communications cycle 1 - Maximum transmission cycle	1000113	[ns]				
PDO communications cycle 1 - Minimum transmission cycle	999873	[ns]				
PDO communications cycle 1 - Transmission jitter	32	[ns]				
PDO communications cycle 2 - Current transmission cycle						
PDO communications cycle 2 - Maximum transmission cycle						
PDO communications cycle 2 - Minimum transmission cycle						
PDO communications cycle 2 - Transmission jitter						
CRC Error Frames Received						
Frame reception errors						
Collision count						
Short frames received						
Overlength frames received						
Last updated: 1/20/2015 3:56:07 PM						
Cle	ear Upd	ate				
Output File						
	C	lose				

Some items are related to EtherCAT network errors and some are not.

The items in the following table are not related to EtherCAT network errors.

Item	Displayed information
Total frames Sent	The total number of EtherCAT frames sent by the master.
Total frames Received	The total number of EtherCAT frames received by the master.
Network propagation delay time ^{*1}	The propagation delay time until the frame reaches the last DC slave from the master or slave that provides the reference clock.
PDO communications cycle 1 - Current transmission cycle ^{*2}	The present value of the process data transmission cycle (ns) for PDO communications cycle 1.
PDO communications cycle 1 - Maxi- mum transmission cycle ^{*2}	The maximum value of the process data transmission cycle (ns) for PDO communications cycle 1.
PDO communications cycle 1 - Minimum transmission cycle ^{*2}	The minimum value of the process data transmission cycle (ns) for PDO communications cycle 1.

Item	Displayed information
PDO communications cycle 1 - Trans- mission jitter	The jitter in the process data transmission cycle (ns) for PDO communications cycle 1.
PDO communications cycle 2 - Current transmission cycle ^{*3}	The present value of the process data transmission cycle (ns) for PDO communications cycle 2.
PDO communications cycle 2 - Maxi- mum transmission cycle ^{*3}	The maximum value of the process data transmission cycle (ns) for PDO communications cycle 2.
PDO communications cycle 2 - Minimum transmission cycle ^{*3}	The minimum value of the process data transmission cycle (ns) for PDO communications cycle 2.
PDO communications cycle 2 - Trans- mission jitter	The jitter in the process data transmission cycle (ns) for PDO communications cycle 2.

*1 This value cannot be cleared by the **Clear** Button.

- *2 This information is valid only if slaves that support a distributed clock are assigned to the primary periodic task. If slaves that support a distributed clock are not assigned to the primary periodic task, "-" is displayed.
- *3 This information is valid only if slaves that support a distributed clock are assigned to the priority-5 periodic task. If the CPU Unit does not have a priority-5 periodic task or if slaves that support a distributed clock are not assigned to the priority-5 periodic task, "-" is displayed.

Item	Displayed information	Assumed cause	Possible correction
Frame reception time- out count	The number of frame reception timeouts that occurred.	A cause to a Process Data reception Timeout Error occurred, which increases the Frame reception time- out count. The Frame reception time- out count will increase also when the count in the CRC Error Frames Received, Short frames received, or Overlength frames received increases.	Refer to <i>EtherCAT Net- work Diagnostic Proce- dure</i> on page 9-53.
Reception buffer over- flow count	The number of frames dis- carded due to buffer over- flows when receiving data.	There are too many frames on the EtherCAT network that are not Ether- CAT frames.	These frames will interfere with EtherCAT communi- cations. See if there are computers or other non- EtherCAT devices con- nected to the EtherCAT network and remove them if there are any.
Non-EtherCAT frames received	The number of frames received other than Ether- CAT frames.	There are frames on the EtherCAT network that are not EtherCAT frames.	These frames will interfere with EtherCAT communi- cations. See if there are computers or other non- EtherCAT devices con- nected to the EtherCAT network and remove them if there are any.
Link OFF count	The number of times link OFF was detected.	A cause to a Link OFF Error occurred.	Refer to <i>9-2 Troubleshoot-ing</i> and remove the cause of the error.
Discarded process data receptions	The number of process data packets discarded when receiving process data.	A slave did not update the PDO data within the com- munications cycle. The value sometimes increases when the net- work is started or commu- nicating slaves are replaced.	If the value increases every time you press the Update Button, increase the length of the PDO communications cycle.
Discarded message receptions	The number of messages discarded in mailbox reception.	A cause to an EtherCAT Message Error occurred.	Refer to <i>9-2 Troubleshoot-ing</i> and remove the cause of the error.
CRC Error Frames Received	The number of frames received that resulted in CRC errors.	The frames on the Ether- CAT network are cor- rupted.	Refer to EtherCAT Net- work Diagnostic Proce- dure on page 9-53.
Frame reception errors	The number of frames resulting in reception errors from the Ethernet controller (EtherMAC).	The frames on the Ether- CAT network are cor- rupted due to noise.	Implement noise counter- measures.

The items in the following table are related to EtherCAT network errors. The table gives the displayed information, assumed cause, and possible correction.

Item	Displayed information	Assumed cause	Possible correction
Collision count	The total number of delay collisions on the line after start of transmissions.	A repeater hub is con- nected.	You cannot use repeater hubs with EtherCAT com- munications. See if there are repeater hubs con- nected to the EtherCAT network and remove them if there are any.
Short frames received	The number of frames received with less than 64 bytes.	The frames on the Ether- CAT network are cor- rupted due to noise. Computers or other non- EtherCAT devices are connected.	Refer to <i>Frame reception timeout count</i> on page 9-48.
Overlength frames received	The number of frames received with more than 1,522 bytes.	The frames on the Ether- CAT network are cor- rupted due to noise. Computers or other non- EtherCAT devices are connected.	Refer to <i>Frame reception timeout count</i> on page 9-48.

The following table describes the buttons on the Master Diagnosis/Statistic Tab Page.

Button	Description	
Clear	Clears the master diagnostic and statistical information to zeros.	
Update	Gets the diagnostic and statistical information from the master and updates the display.	
Output File	Outputs the diagnostic and statistical information to a csv file in a specified folder.	
	The file will include the items from both the master diagnostic and statistical information and the slave diagnostic and statistical information.	
	The following items are output for the slave diagnostic and statistical information: node addresses, model names, port names, and numbers of error frames. If the number of error frames exceeds 255, 255 is output.	

The following items are output to the csv file.

Last updated: 11/25/2014 12:00:00			
Lasel	Value		
Total frames Sent	4233		-
Total frames Received	4233		
	0		
Frame reception timeout count			
Reception buffer overflow count	0		
Non-EtherCAT frames received	0		
Link OFF count	0		
Discarded process data receptions	0		
Discarded message receptions	0		
Lost repeat-send frames,	0		
Network propagation delay time	0		
PDO communications cycle 1 - Current transmission cycle	0		
PDO communications cycle 1 - Maxi- mum transmission cycle	0		
PDO communications cycle 1 - Mini- mum transmission cycle	0		
PDO communications cycle 1 - Trans- mission jitter	0		
PDO communications cycle 2 - Current transmission cycle	0		
PDO communications cycle 2 - Maxi- mum transmission cycle	0		
PDO communications cycle 2 - Mini- mum transmission cycle	0		
PDO communications cycle 2 - Trans- mission jitter	0		
CRC Error Frames Received	0		
Frame reception errors	0		
Collision count	0		
Short frames received	0		
Overlength frames received	0		
<u> </u>			
Last updated: 12/2/2013 4:14:59 PM			1
Node Address	Model Name	Port Name	Error Frames
64	GX-JC06-H(IN,X2,X3) Main device	IN	0
64	GX-JC06-H(IN,X2,X3) Main device	X2	0
64	GX-JC06-H(IN,X2,X3) Main device	X3	0
64	GX-JC06-H(IN,X2,X3) Main device	Internal Port	0
3	GX-ID1611	PortA	0
3	GX-ID1611	PortB	0
4	GX-MD1612	PortA	0
4	GX-MD1612	PortB	0
5	NX-ECC201	PortA	0
5	NX-ECC201	PortB	0
65	GX-JC06-H(X4,X5,X6) Sub-device	Connect to GX-JC06- H(IN,X2,X3)	0
65	GX-JC06-H(X4,X5,X6) Sub-device	X4	0
65	GX-JC06-H(X4,X5,X6) Sub-device	X5	0
65	GX-JC06-H(X4,X5,X6) Sub-device	X6	0



Precautions for Correct Use

- The diagnostic and statistical information is cleared to zeros when the power supply to the Controller is turned ON.
- Even if communications are normal, values other than 0 may occur for the frame reception timeout count and the number of CRC error frames received. Refer to *EtherCAT Network Diagnostic Procedure* on page 9-53 to determine if the EtherCAT network is operating normally.

• Slave Diagnostic and Statistical Information

This section describes the displayed information and buttons on the Slave Diagnosis/Statistic Tab Page.

📓 Diag	S Diagnosis/Statistics Information					
Ma	ster Diag	gnosis/Statistic× Slave Diagnosi	s/Statistics ×			
Node	Address	Model Name	Port Name	Error Frames		
64		GX-JC06-H(IN,X2,X3) Main device	IN	0		
			X2	0		
			Х3	0		
			Internal Port	0		
3		GX-ID1611	PortA	0		
			PortB	0		
4		GX-MD1612	PortA	0		
			PortB	0		
5		NX-ECC201	PortA	0		
			PortB	0		
65		GX-JC06-H(X4,X5,X6) Sub-device		0		
			X4	0		
			X5	0		
			X6	0		
Last u	odated: :	12/2/2013 4:02:57 PM				
				Update		
Outpu	ut File					
				Close		

The following table describes the slave diagnostic and statistical information.

Item	Displayed information
Node Address	The node address of the slave.
	The node address is given only for the first port.
Model Name The model number of the slave.	
	The model number is given only for the first port.

Item	Displayed information
Port Name	The names of the input ports and output ports of the slave.
	The port names are defined in the slave's ESI file. If no name is defined, <i>Port A, Port B, Port C,</i> or <i>Port D</i> is displayed. If there are two ports i.e., an input and an output port, <i>Port A</i> and <i>Port B</i> are displayed. The input port which is the only input port displayed first followed by the output ports (some slaves have more than one output port).
Error Frames	The number of error frames received on the slave's input and output ports. This diagnostic and statistical information is obtained from the slave.
	Range: 0 to 254 255 or more is displayed if 255 or more error frames were received.
	If the relevant slave does not exist or if the information was not obtained from the slave, <i>Failed</i> is displayed.
Last updated	The time and date when the Update Button was last clicked is displayed.

The following table describes the buttons on the Slave Diagnosis/Statistic Tab Page.

Button	Description
Update	Gets the diagnostic and statistical information from the slaves and updates the display.
Output File	Outputs the diagnostic and statistical information to a csv file in a specified folder.
	The file will include the items from both the master diagnostic and statistical information and the slave diagnostic and statistical information.
	Refer to <i>Master Diagnostic and Statistical Information</i> on page 9-46 for the items that are output.

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Precautions for Correct Use

- To clear the slave diagnostic and statistical information to zeros, cycle the power supplies to the slaves.
- When you display the slave diagnostic and statistical information, first open a Sysmac Studio project where the network configuration agrees with the actual network. If the network configuration in the project does not agree with the actual network, the slave diagnostic and statistical information is not displayed correctly. If a project is not available, create a new project, make the network configuration in the project agree with the actual network, and then display the slave diagnostic and statistical information. Refer to the *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504) for information on building the network configuration.

EtherCAT Network Diagnostic Procedure

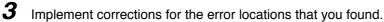
You can use the following procedure to diagnose the EtherCAT network line quality for the following items in the master diagnostic and statistical information.

- Frame reception timeout count
- CRC Error Frames Received

If the diagnostic results show that the EtherCAT network is not operating normally, you can find the location of the error.

An outline procedure from EtherCAT network diagnosis through correction is given below.

- **1** Check for errors in the trends shown in the master diagnostic and statistical information.
- **2** Find the locations of the errors with trends in the slave diagnostic and statistical information.



4 Confirm status after implementation of the correction.

A detailed procedure for each of the above steps is given below.

• Checking for Errors in Trends in Master Diagnostic and Statistical Information

Check for trends in the items in the master diagnostic and statistical information to diagnose errors in the EtherCAT network. Use the following diagnostic procedure.

- **1** Click the Master Diagnosis/Statistics Tab.
- 2 Click the Update Button.
- **3** Record the values of the frame reception timeout count and number of CRC error frames received.

Total frames Received 443 Frame reception timeout count 443 Frame reception buffer overflow count 443 Non-EtherCAT frames received 1000 Link OFF count 1000 Discarded process data receptions 1000 Discarded message receptions 25 Network propagation delay time 25 PDO communications cycle 1 - Current transmission cycle 10000 PDO communications cycle 1 - Maximum transmission cycle 10000	303	
Total frames Sent 44. Total frames Received 44. Total frames Received 44. Frame reception timeout count 44. Reception buffer overflow count 44. Non-EtherCAT frames received 44. Link OFF count 50. Discarded process data receptions 50. Lost repeat-send frames 10000 PDO communications cycle 1 - Current transmission cycle 10000 PDO communications cycle 1 - Maximum transmission cycle 9996 PDO communications cycle 2 - Current transmission cycle 9996 PDO communications cycle 2 - Maximum transmission cycle 9996	303 303 0 0	
Total frames Received 443 Frame reception timeout count 443 Frame reception buffer overflow count 443 Non-EtherCAT frames received 1000 Link OFF count 5 Discarded process data receptions 5 Discarded message receptions 10000 PDO communications cycle 1 - Current transmission cycle 10000 PDO communications cycle 1 - Maximum transmission cycle 9991 PDO communications cycle 1 - Minimum transmission cycle 9991 PDO communications cycle 2 - Current transmission cycle 9991 PDO communications cycle 2 - Maximum transmission cycle 9991	303 0 0	
Frame reception timeout count Reception buffer overflow count Non-EtherCAT frames received Link OFF count Discarded process data receptions Discarded message receptions Lost repeat-send frames Network propagation delay time PDO communications cycle 1 - Current transmission cycle PDO communications cycle 1 - Maximum transmission cycle PDO communications cycle 1 - Transmission cycle PDO communications cycle 2 - Maximum transmission cycle PDO communications cycle 2 - Maximum transmission cycle	0	
Reception buffer overflow count Non-EtherCAT frames received Link OFF count Discarded process data receptions Discarded message receptions Lost repeat-send frames Network propagation delay time PDO communications cycle 1 - Current transmission cycle PDO communications cycle 1 - Maximum transmission cycle PDO communications cycle 1 - Transmission cycle PDO communications cycle 2 - Current transmission cycle PDO communications cycle 2 - Maximum transmission cycle	0	
Non-EtherCAT frames received Link OFF count Discarded process data receptions Discarded message receptions Lost repeat-send frames Network propagation delay time PDO communications cycle 1 - Current transmission cycle PDO communications cycle 1 - Maximum transmission cycle PDO communications cycle 1 - Minimum transmission cycle PDO communications cycle 2 - Current transmission cycle PDO communications cycle 2 - Current transmission cycle PDO communications cycle 2 - Maximum transmission cycle		
Link OFF count Discarded process data receptions Discarded message receptions 20 Lost repeat-send frames 21 PDO communications cycle 1 - Current transmission cycle 10000 PDO communications cycle 1 - Maximum transmission cycle 10000 PDO communications cycle 1 - Maximum transmission cycle 9996 PDO communications cycle 2 - Current transmission cycle 9996 PDO communications cycle 2 - Maximum transmission cycle 9996 PDO communications cycle 2 - Maximum transmission cycle 9996	0	
Discarded process data receptions Discarded message receptions Lost repeat-send frames Network propagation delay time PDO communications cycle 1 - Current transmission cycle PDO communications cycle 1 - Maximum transmission cycle PDO communications cycle 1 - Transmission tycle PDO communications cycle 2 - Current transmission cycle PDO communications cycle 2 - Maximum transmission cycle		
Discarded message receptions Lost repeat-send frames 22 Network propagation delay time 22 10000 PDO communications cycle 1 - Current transmission cycle 10000 10000 PDO communications cycle 1 - Maximum transmission cycle 9998 9998 PDO communications cycle 1 - Transmission tycle 9998 9998 PDO communications cycle 2 - Current transmission cycle 9998 PDO communications cycle 2 - Maximum transmission cycle 9998	0	
Lost repeat-send frames 21 Network propagation delay time 21 PDO communications cycle 1 - Current transmission cycle 10000 PDO communications cycle 1 - Maximum transmission cycle 10000 PDO communications cycle 1 - Maximum transmission cycle 9998 PDO communications cycle 2 - Current transmission cycle 9998 PDO communications cycle 2 - Current transmission cycle 9998		
Network propagation delay time 21 PDO communications cycle 1 - Current transmission cycle 10000 PDO communications cycle 1 - Maximum transmission cycle 10000 PDO communications cycle 1 - Maximum transmission cycle 9998 PDO communications cycle 2 - Current transmission cycle 9998 PDO communications cycle 2 - Current transmission cycle 9998 PDO communications cycle 2 - Current transmission cycle 9998		
PDO communications cycle 1 - Current transmission cycle 10000 PDO communications cycle 1 - Maximum transmission cycle 10000 PDO communications cycle 1 - Minimum transmission cycle 9991 PDO communications cycle 2 - Current transmission cycle 9991 PDO communications cycle 2 - Current transmission cycle 9991 PDO communications cycle 2 - Maximum transmission cycle 9910		
PDO communications cycle 1 - Maximum transmission cycle 1000: PDO communications cycle 1 - Minimum transmission cycle 999 PDO communications cycle 2 - Current transmission cycle 999 PDO communications cycle 2 - Current transmission cycle 900 PDO communications cycle 2 - Maximum transmission cycle 1000:	582	[ns]
PDO communications cycle 1 - Minimum transmission cycle PDO communications cycle 1 - Transmission jitter PDO communications cycle 2 - Current transmission cycle PDO communications cycle 2 - Maximum transmission cycle	032	[ns]
PDO communications cycle 1 - Transmission jitter PDO communications cycle 2 - Current transmission cycle PDO communications cycle 2 - Maximum transmission cycle	113	[ns]
PDO communications cycle 2 - Current transmission cycle PDO communications cycle 2 - Maximum transmission cycle	373	[ns]
PDO communications cycle 2 - Maximum transmission cycle	32	[ns]
PDO communications cyclo 2 - Minimum transmission cyclo		
PDO communications cycle 2 - Minimum transmission cycle		
PDO communications cycle 2 - Transmission jitter		
CRC Error Frames Received		
Frame reception errors		
Collision count		
Short frames received		
Overlength frames received		
Last updated: 1/20/2015 3:56:07 PM Clear U		
Output File	Jpd	ate
	Jpd	ate

4 Repeat steps 2 and 3, above, several times at one-minute intervals.

If the value of the frame reception timeout count or number of CRC error frames received does not increase, then the EtherCAT network is operating normally.

If the value of the frame reception timeout count or number of CRC error frames received increases, then the EtherCAT network is not operating normally.

If the EtherCAT network is not operating normally, find the error location with the information in *Finding the Locations of Errors with Trends in Slave Diagnostic and Statistical Information* on page 9-54.

Finding the Locations of Errors with Trends in Slave Diagnostic and Statistical Information

You can check for trends of values in the slave diagnostic and statistical information to find the locations of the errors.

Use the following procedure to find the locations of errors.

- **1** Click the Slave Diagnosis/Statistics Tab.
- 2 Click the Update Button.
- **3** Record the number of error frames.

Diagnos	Diagnosis/Statistics Information				
Master	Diagnosis/Statistic × Slave	Diagnosis/Statistics ×			
Node Add		Port Name	Error Frames		
64	GX-JC06-H(IN,X2,X3) M		0		
		X2	0		
		X3	0		
		Internal Port	0		
3	GX-ID1611	PortA	0		
		PortB	0		
4	GX-MD1612	PortA	20		
-	10/ 500001	PortB	0		
5	NX-ECC201	PortA	0		
65		PortB	0		
65	GX-JC00-H(X4,X5,X6) 50	ub-device Connect to GX-JC06-H(IN,X2,			
		X4 X5	0		
		X3 X6	0		
		A0			
Last updat	Last updated: 12/2/2013 4:02:57 PM				
			Update		
Output Fil	P				
output fil					
			Close		

4

Repeat steps 2 and 3, above, several times at one-minute intervals.

5 Find the locations of errors based on the recorded slave diagnostic and statistical information.

Use the node address and port name of the following types of ports to find the error locations.

- · Ports where the number of error frames increase
- Ports where the Failed is displayed for the number of error frames

The error locations that you find will change depending on the configuration of slave connection. Refer to the network configuration diagram to find error locations.

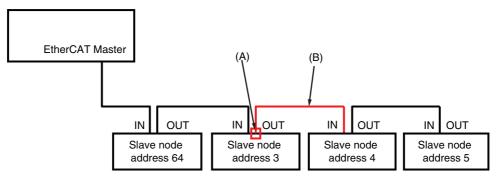
Two examples of EtherCAT network configurations are given with different slave connection positions.

Assume that the number of error frames is 55, which is an increase from the value obtained last time, for port A of node address 4. Port A is displayed first for the slave, so it is an input port.

Example 1: Network Configuration Where an EtherCAT Junction Slave Is Not Used

The network configuration is shown below.

NJ/NX-series CPU Unit



The Slave Diagnosis/Statistics Tab Page is shown below.

📓 Diagnos	sis/Statistics Info	ormation			
Master	Diagnosis/Statis	tic × Slav	e Diagnosis/Statistics ×		
Node Add	dress Model Name	Port Name	Error Frames		
64	GX-OD3218			0	
		PortB		0	
3	GX-ID1611			0	
4	GX-MD1612	PortB PortA		55	
-	GA MD1012	PortB		0	
5	NX-ECC201			o	Input port of node address 4
		PortB		0	
Last updat	ted: 12/2/2013 3	:57:50 PM		Update	

The number of errors for the input port for node address 4 is 55, so you can see that error frames were received on the input port for node address 4.

Therefore, you can assume that there is a problem between the output port for node address 3 and the input port for node address 4.

This corresponds to location (A) or (B) in the network configuration diagram.

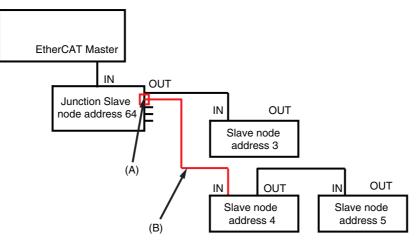
Concretely, you can assume the following possible error locations.

- The device at node address 3
- The cable between the output port at node address 3 and the input port at node address 4 or the connectors at those ports

Example 2: Network Configuration Where an EtherCAT Junction Slave Is Used

The network configuration is shown below.

NJ/NX-series CPU Unit



The Slave Diagnosis/Statistics Tab Page is shown below.

	🕈 Diagnosis/S	-			
	Master Diag	gnosis/Statistic× Slave Diagnosis	s/Statistics ×		
	Node Address		Port Name	Error Frames	
	64	GX-JC06-H(IN,X2,X3) Main device		0	
			X2	0	
			X3 Internal Port	0	
	3	GX-ID1611	PortA	0	
	5	GX ID1011	PortB	0	
	4	GX-MD1612	PortA	55	s land a sub of
			PortB	0	Input port of
	5	NX-ECC201	PortA	0	node address 4
			PortB	0	
	65	GX-JC06-H(X4,X5,X6) Sub-device		0	
			X4	0	
			X5	0	
			X6	U	
	Last updated:	12/2/2013 4:02:57 PM			
				Update	
	Output File				
				Close	
L				Gibbo	

The number of errors for the input port for node address 4 is 55, so you can see that error frames were received on the input port for node address 4.

Therefore, you can assume that there is a problem between the output port for node address 64 and the input port for node address 4.

This corresponds to location (A) or (B) in the network configuration diagram.

Concretely, you can assume the following possible error locations.

- The device at node address 64
- The cable between the output port at node address 64 and the input port at node address 4 or the connectors at those ports

This is the procedure to find error locations when *Failed* is displayed for the number of error frames.

In the EtherCAT network configuration, *Failed* is sometimes displayed for more than one slave.

In the system configuration for example 2, assume that *Failed* is displayed for the number of error frames for node addresses 4 and 5.

	Diagnosis/Statistics Information				
	Master Diagnosis/Statistic × Slave Diagnosis/Statistics ×				
Г	Node Address	Model Name	Port Name	Error Frames	
	64	GX-JC06-H(IN,X2,X3) Main device	IN	0	
			X2	0	
			X3	1	
Ш			Internal Port	0	
	3	GX-ID1611	PortA	0	
Ш			PortB	0	
	4	GX-MD1612	PortA	Failed	
Ш			PortB	Failed	
	5	NX-ECC201	PortA	Failed	
ш			PortB	Failed	
	65	GX-JC06-H(X4,X5,X6) Sub-device		0	
ш			X4	0	
			X5	0	
ш			X6	0	
	ast updated:	12/2/2013 4:05:00 PM			
	ast apaatoon	12,2,2010 1100100 1111		Update	
	Output File				
				Close	

If *Failed* is displayed for the number of error frames, the slave currently cannot communicate. If a slave cannot communicate, all of the slaves connected after it cannot communicate. In network configuration diagram of example 2, node address 5 is connected after node address 4.

Therefore, you can assume that there is an error in node address 4 that prevents communications.

Concretely, you can assume the following possible error locations.

- The device at node address 64
- The cable between the output port at node address 64 and the input port at node address 4 or the connectors at those ports
- The device at node address 4

• Implementing Corrections for Error Locations

Implement corrections for the error locations that you found.

The following table provides corrections for the causes as assumed from the diagnostic and statistical information.

Master statistical infor- mation trend		Slave statistical informa- tion trend	Assumed error cause	Possible correction
The frame reception timeout count is	The num- ber of CRC error frames received is not increas- ing.		The Ethernet cable is bro- ken or the specified cable was not used.	If the Ethernet cable is broken or if the specified cable was not used, replace the cable.
increasing.			A general-purpose Ether- net hub is connected.	If a general-purpose Ethernet hub is con- nected, replace it with an EtherCAT Junction Slave.
			The EtherCAT master or EtherCAT slave failed.	If the CPU Unit or an EtherCAT slave fails, replace it.
		The number of error frames has increased.	A connector on the Ether- net cable is disconnected, the contact is faulty, or parts are faulty.	Reconnect the connector and make sure it is mated correctly.
			The EtherCAT slave failed.	If an EtherCAT slave fails, replace it.
	The num- ber of CRC error frames received is increasing.		There is noise.	Implement noise counter- measures.

• Confirming After Implementing Corrections

To confirm that the error locations were corrected, perform the procedure in *Checking for Errors in Trends in Master Diagnostic and Statistical Information* on page 9-53 again to make sure the network is operating normally.

9-3 Precautions When Connecting or Disconnecting Slaves during Communications

9-3-1 Procedure for Connecting and Disconnecting Slaves during Communications

Always use the following procedure to turn OFF the slave power supply or connect/disconnect cables during EtherCAT master communications.*

* This includes the pre-operational, safe-operational, and operational states.

Step 1. Use the Sysmac Studio or an instruction to send a command to disconnect the slave.

Step 2. Confirm that the slave was disconnected normally.

Step 3. Turn OFF the power supply to the slave or disconnect the cable.

If you turn OFF the power supply or disconnect the cable without performing steps 1 and 2, the slaves that are operating may be adversely affected.

9-3-2 Prohibition to Physically Disconnecting a Slave and Resetting an Error or Connecting a Slave at the Same Time

If you perform the following operation a or b at the same time as operation c, a Slave Initialization Error will occur.

- a) Turn OFF the power supply to the slave or disconnect the cable.
- b) Turn ON the power supply to the slave or connect the cable.
- c) Reset an error in the EtherCAT Master Function Module or connect the slave.*
- * This can happen when the Reset EtherCAT Error (ResetECError) instruction or Connect EtherCAT Slave (EC_ConnectSlave) instruction is cyclically executed in the user program.

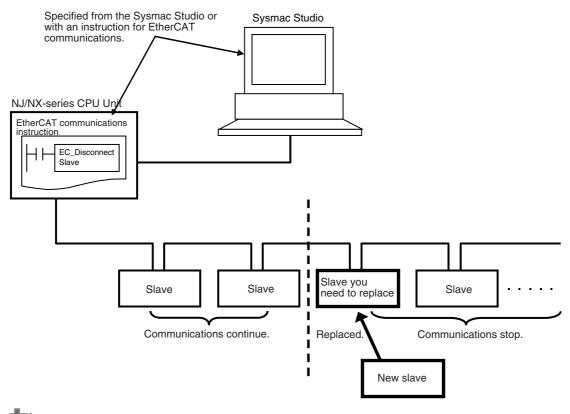
If you perform these operations at the same time, the EtherCAT master may access a slave with a different node address than the specified node address, or other unexpected operations may occur. Therefore, never turn OFF the power supply to the slave or disconnect the cable at the same time as you reset an error or connect a slave.

NJ/NX-series CPU Unit Built-in EtherCAT Port User's Manual (W505)

9-4 Replacing Slaves during Communications

9-4-1 Introduction

You can temporarily stop and start communications with a specified slave and all subsequent slaves without stopping the entire communications system. This makes it possible to replace slaves during communications for maintenance, or for replacement when a slave malfunctions.



Precautions for Correct Use

- A Process Data Communications Error occurs if you physically disconnect a slave from the network without executing the disconnection instruction.
- A Network Configuration Verification Error occurs if the correct node address is not set for a slave that was replaced with the disconnection instruction and a connection is made to a different port than the one that was used for the disconnection instruction.

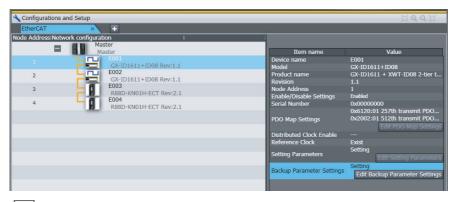
9-4-2 Slave Replacement Methods

The slave to be replaced is first disconnected from the network and then reconnected after you replace it. Use one of the following methods to disconnect and reconnect the slave.

Method 1: Connecting and Reconnecting Specified Slaves from the Sysmac Studio Method 2: Execute the Disconnect EtherCAT Slave and Connect EtherCAT Slave instructions. Execute the following instructions in the user program. You can use a pushbutton or an HMI to input the execution condition.

Function	Instruction	Description
Disconnect EtherCAT Slave	EC_DisconnectSlave	Temporarily disconnects a slave from the EtherCAT network for maintenance, such as replacement of the slave.
Connect EtherCAT Slave	EC_ConnectSlave	Reconnects a temporarily disconnected slave to the EtherCAT network after maintenance, such as replacement of the slave.

If the EtherCAT slave to replace has backup parameters, we recommend that you use the Sysmac Studio to replace the slave. (You can specify backing up the parameters in the EtherCAT slave from the Sysmac Studio.)



Additional Information

The disconnection and reconnection operations are not required for slaves that are disabled with the EtherCAT Slave Enable/Disable Settings. You therefore cannot disconnect and reconnect them from the Sysmac Studio. If you execute the disconnection and connection instructions, they will result in errors.

9-4-3 Backing Up Settings

Before you replace an EtherCAT slave that is currently performing communications, the settings of the EtherCAT slave to replace are backed up. The settings of an EtherCAT slave are divided according to the storage locations and setting methods into initial parameters and backup parameters, as shown in the following table.

Slave settings	Storage location	Slave setting method
Initial parameters	EtherCAT master	These parameters are set automatically from the EtherCAT master when EtherCAT communications start or when a slave is connected.
Backup parameters	EtherCAT slaves	You set these parameters by transferring them to the slaves from the Backup Parameter Settings Tab Page of the Sys- mac Studio. The data can also be transferred from the EtherCAT Drive Tab Page.

To replace an EtherCAT slave, you first back up the backup parameters that are stored in the EtherCAT slave.

1 Click the **Edit Backup Parameter Settings** Button in the EtherCAT Slave Setting Tab Page.

The Backup Parameter Settings Tab Page is displayed.

2 Click the **Transfer from Slave** Button.

All of the backup parameters that are stored in the EtherCAT slave and displayed in the list are transferred from the EtherCAT slave.

🔧 Configurations	and Setup			ЦQQ(Д
EtherCAT	Node1 : GX-ID1611+ID08×	+		
0x3000:00 Input Tir	Item name ne Constant/Input Time Constant 2: 1 ms		Value	
chocologico inpacifi				
				Return to Default
Help Data type :				
Comment : Sets the	e input filter.			
			Transfer to Slave Transfer fro	m Slave Compare
			Hansier to Slave Hansier Inc	OK Cancel Apply
				and anneal oppay

3 Click the **Compare** Button.

Check to be sure that you have correctly obtained the backup parameters in step 2.

Additional Information

- You can back up the EtherCAT slave settings for any EtherCAT slave that is connected to the network (i.e., whenever the <u>EC_EntrySlavTbl[]</u> (Network Connected Slave Table) systemdefined variable is TRUE) either before of after the disconnection command is sent to the EtherCAT slave.
- You can also set the EtherCAT drive slaves from the EtherCAT Drive Tab Page. Back up the settings information from the EtherCAT Drive Tab Page. Refer to the *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504) for the applicable EtherCAT drive slaves.
- You do not need to back up the settings to replace an EtherCAT slave that does not have backup parameters.

9-4-4 Restoring Settings

After you replace the EtherCAT slave, you restore the settings that you backed up before you replaced the slave. The backup parameters that were backed up are restored to the EtherCAT slave.

1 Click the Edit Backup Parameter Settings Button in the EtherCAT Slave Setting Tab Page.

The Backup Parameter Settings Tab Page is displayed.

2 Click the **Transfer to Slave** Button.

All of the backup parameters that are stored in the EtherCAT slave and displayed in the list are downloaded to the EtherCAT slave.

Configurations a				_	DQQD
EtherCAT	Node1 : GX-ID1611+ID08x	+			
DOGLOGICA TOTAL TOTAL	Item name e Constant/Input Time Constant 2: 1 ms		Value		
soootoo Input nin	e constant/input nine constant 2: 1 ms				
					Return to Default
alp					
da husa i					
ita type : mment : Sets the	inout filtor				
	input linter.				
			Transfer to Slave	Transfer from Slave	Compare
			Transfer to Slave	mansier from Slave	
				OK	Cancel Apply

3 Click the **Compare** Button.

Check to be sure that you have correctly transferred the backup parameters in step 2.

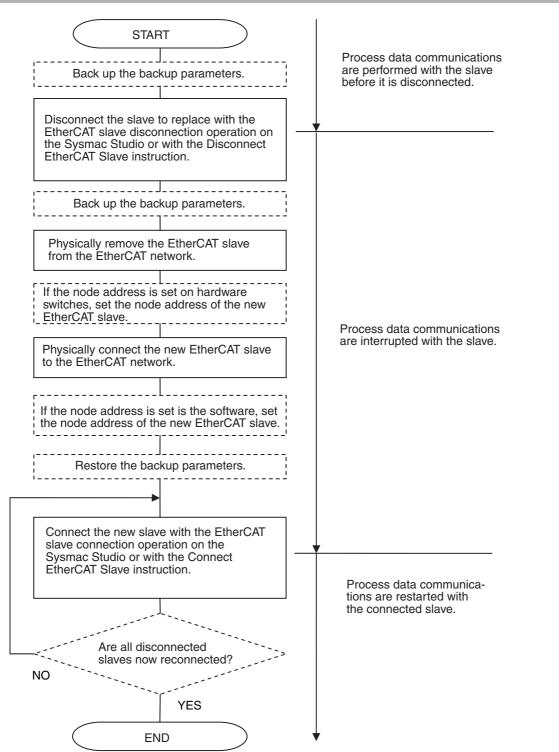
Precautions for Correct Use

Restore the settings to the EtherCAT slave before you connect the EtherCAT slave to restart process data communications. Restore the EtherCAT slave settings while the slave is connected to the network (i.e., whenever the *_EC_EntrySlavTbl[]* (Network Connected Slave Table) system-defined variable is TRUE). You must set the node address of the EtherCAT slave before it can participate in the network.

Additional Information

- You can set the EtherCAT drive slaves from the EtherCAT Drive Tab Page. Restore the settings information from the EtherCAT Drive Tab Page. Refer to the *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504) for the applicable EtherCAT drive slaves.
- You do not need to restore the settings to replace an EtherCAT slave that does not have backup parameters.

9-4-5 Replacement Procedure



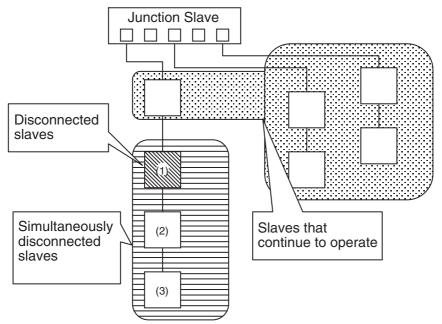
Note: Steps shown in dotted boxes depend on the system.

Precautions for Safe Use

- When an EtherCAT slave is disconnected from the Sysmac Studio or with an instruction, communications will stop and control of the outputs will be lost not only for the disconnected slave, but for all slaves connected after it. Always confirm system safety before you disconnect an EtherCAT slave.
- If noise occurs or an EtherCAT slave is disconnected from the network, any current communications frames may be lost. If frames are lost, slave I/O data is not communicated, and unintended operation may occur. The slave outputs behave according to the slave specifications. For details, refer to relevant manuals for each slave. If a noise countermeasures or slave replacement is required, perform the following processing.
 - Program the _EC_InDataInvalid (Input Data Invalid) system-defined variable as an interlock condition in the user program. Refer to 6-1-3 Checking the Validity of the Process Data.
 - Set the PDO communications timeout detection count setting in the EtherCAT master to at least 2. Refer to *5-4-1 Setting EtherCAT Master* for the setting procedure.

Disconnecting Slaves

If a slave is disconnected, slaves connected after the designated slave (on the output side) in a daisy chain are disconnected at the same time. Slaves connected before the disconnected slave (on the input side) and slaves connected beyond Junction Slaves continue to operate. (If (1) is disconnected in the following figure, (2) and (3) are also disconnected.)



The status of the system-defined variables for disconnected slaves are listed in the following table. The status in the following table are reached immediately after disconnection. This status does not change even if a slave is physically removed from the actual network configuration or physically connected to the actual network configuration again. The corresponding element in the Network Connected Slave Table changes to FALSE when the slave is physically removed from the actual network configuration.

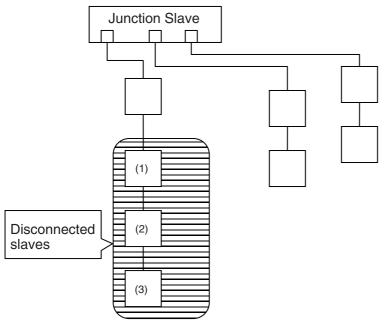
System-defined variable name	Description	Value
_ <i>EC_RegSlavTbl[]</i> (Registered Slave Table)	This variable shows the slaves that are reg- istered in the network configuration informa- tion.	Remains TRUE.
_EC_EntrySlavTbl[] (Network Con- nected Slave Table)	This variable shows the slaves that are reg- istered in the network configuration informa- tion and connected to the network.	The corresponding element changes to FALSE when the slave is removed from the actual network configuration.
_EC_MBXSlavTbl[] (Message Commu- nications Enabled Slave Table)	This variable shows the slaves that are reg- istered in the network configuration informa- tion and able to perform message communications.	The corresponding element changes to FALSE after the Ether- CAT slave is disconnected from the Sysmac Studio or with an instruction.
_EC_PDSlavTbl[] (Process Data Com- municating Slave Table)	This variable shows the slaves that are reg- istered in the network configuration informa- tion and performing process data communications.	The corresponding element changes to FALSE after the Ether- CAT slave is disconnected from the Sysmac Studio or with an instruction.
_EC_DisconnSlavTbl[] (Disconnected Slave Table)	This variable shows the slaves that are reg- istered in the network configuration informa- tion and disconnected from the network.	The corresponding element changes to TRUE after the Ether- CAT Slave is disconnected from the Sysmac Studio or with an instruction.

Reconnecting Slaves

When reconnecting disconnected slaves after replacement or inspection, make sure that the following conditions are met and then reconnect them. If they are reconnected without meeting following conditions, process data communications with the slaves will not start again, and a network configuration verification error will occur. If the conditions are met, *_EC_EntrySlavTbl* will be TRUE.

- Make sure that the slave's node address is set correctly.
- Make sure that there are no errors in the order that the slaves are connected.

There are no restrictions on the order when reconnecting slaves that are in a daisy chain. For example, even if slaves (1) to (3) in a configuration such as the one shown in the following figure are disconnected, there are no restriction on the reconnection order of slaves (1) to (3). (For example, the slaves can be reconnected in the order (3), (2), (1) or (1), (3), (2).)



The status of the system-defined variables for disconnected slaves that have been successfully reconnected are listed in the following table.

System-defined variable name	Description	Value
_ <i>EC_RegSlavTbl[</i>] (Registered Slave Table)	This variable shows the slaves that are regis- tered in the network configuration information.	Remains TRUE.
_EC_EntrySlavTbl[] (Network Con- nected Slave Table)	This variable shows the slaves that are regis- tered in the network configuration information and connected to the network.	Shows actual network configu- ration (changes to FALSE for disconnection and to TRUE for connection).
_EC_MBXSlavTbl[] (Message Commu- nications Enabled Slave Table)	This variable shows the slaves that are regis- tered in the network configuration information and able to perform message communications.	The corresponding element changes to TRUE after the EtherCAT slave is connected from the Sysmac Studio or with an instruction
_ <i>EC_PDSlavTbl[]</i> (Process Data Com- municating Slave Table)	This variable shows the slaves that are regis- tered in the network configuration information and performing process data communications.	The corresponding element changes to TRUE after the EtherCAT slave is connected from the Sysmac Studio or with an instruction
_ <i>EC_DisconnSlavTbl[]</i> (Disconnected Slave Table)	This variable shows the slaves that are regis- tered in the network configuration information and disconnected from the network.	The corresponding element changes to FALSE after the EtherCAT Slave is disconnected from the Sysmac Studio or with an instruction.

Additional Information

Synchronization correction processing is performed to reconnect synced slaves. Therefore, several seconds may be required per slave until reconnection is completed.

9

A

Appendices

The appendices describe the relation of EtherCAT communications to overall CPU Unit status, packet monitoring functions, and multi-vendor application.

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A-1 EtherCAT Status in Relation to CPU Unit Status

The status of EtherCAT master memory, the ability to download master and slave settings, and the slave status are given below for different CPU Unit operating modes, Controller errors, and other status.

A-1-1 When the Power Supply Is Turned ON

Mem	ory related to E	EtherCAT mast	er	Slaves		
Device vari- ables	Category _EC sys- tem-defined variables	Network configura- tion infor- mation	Diagnos- tic and sta- tistical informa- tion/Proto- col monitor	Downloading master and slaves settings	Slave outputs	Slave communica- tions status
Devices vari- ables that are not retained: Initial values Axes vari- ables: Initial values	Initial values		Cleared to all zeros.		The status of slave outputs before the start of EtherCAT com- munications depend on the slave. Slaves output values of device variables after EtherCAT communications start.	Enters the Opera- tional state.

A-1 EtherCAT Status in Relation to CPU Unit Status

A

A-1-2 CPU Unit Operating Modes

	Memor	y related to E	therCAT mas	ster		Sla	ves
CPU Unit sta- tus	Device vari- ables	Category _EC sys- tem- defined variables	Network configura- tion infor- mation	Diagnostic and statis- tical infor- mation/Prot ocol moni- tor	Downloading master and slaves set- tings	Slave out- puts	Slave com- munica- tions status
PROGRAM mode	Shows the I/O data exchanged on the EtherCAT communica- tions.	Continually shows EtherCAT communica- tions sta- tus. (Does not depend on the oper- ating mode of the CPU Unit.)	Does not change. (Does not depend on the operat- ing mode of the CPU Unit.)	Continually shows EtherCAT communica- tions sta- tus. (Does not depend on the oper- ating mode of the CPU Unit.)	 Master set- tings: OK Slave set- tings: OK (However, setting may not be possi- ble depend- ing on the status of the slave.) 	Continually shows the output data sent from the Ether- CAT master. (Does not depend on the operat- ing mode of the CPU	Does not change. (Does not depend on the operat- ing mode of the CPU Unit.)
Switching between PRO- GRAM and RUN mode	Device vari- ables that are not retained: Ini- tial values Axes variables: Retained					Unit.)	
RUN mode	Shows the I/O data exchanged on the EtherCAT communica- tions.				 Master set- tings: Not possible. Slave set- tings: OK (However, setting may not be possi- ble depend- ing on the status of the slave.) 		

A-1-3 Controller Errors Other Than Errors in the Built-in EtherCAT Master

	Memory related to EtherCAT master					Sla	ves
CPU Unit sta- tus	Device vari- ables	Category _EC sys- tem- defined variables	Network configura- tion infor- mation	Diagnos- tic and sta- tistical informa- tion/Proto- col monitor	Downloading master and slaves set- tings	Slave out- puts	Slave com- munica- tions status
A major fault level Control- ler error occurs.	Device vari- ables that are not retained: Ini- tial values Axes variables: Retained	Continually shows EtherCAT communica- tions sta- tus. (Does not depend on the oper- ating mode of the CPU Unit.)	Does not change. (Does not depend on the operat- ing mode of the CPU Unit.)	Continually shows EtherCAT communi- cations sta- tus. (Does not depend on the operating mode of the CPU Unit.)		In Opera- tional state, the values from before operation stopped are output. When the slaves have entered Safe-opera- tional state, the outputs depend on the slave settings. Inputs are enabled.	EtherCAT communica- tions stop. Enters the Safe-Opera- tional state.
A partial fault level Control- ler error occurs. A minor fault level Control- ler error occurs.	Shows the I/O data exchanged on the EtherCAT communica- tions.					Continually shows the output data sent from the Ether- CAT master. (Does not depend on the operat- ing mode of the CPU Unit.)	Does not change. (Does not depend on the operat- ing mode of the CPU Unit.)

Refer to 9-1 Overview of Errors if a Controller error occurs in the built-in EtherCAT master.

A-1-4

	Memor	Memory related to EtherCAT master				Sla	ves
CPU Unit sta- tus	Device vari- ables	Category _EC sys- tem- defined variables	Network configura- tion infor- mation	Diagnos- tic and sta- tistical informa- tion/Proto- col monitor	Downloading master and slaves set- tings	Slave out- puts	Slave com- munica- tions status
Memory all clear	Cleared to all zeros.	Entirely ini- tialized (0).	Deleted.	Cleared to all zeros.		Depends on the slave settings.	EtherCAT communica- tions stop.

A-1-5 When the Power Supply Is Turned OFF

Ν	Memory related to EtherCAT master				Slave	s
Device vari- ables	Category _EC system- defined vari- ables	Network con- figuration information	Diagnostic and statistical informa- tion/Protocol monitor	Downloading master and slaves set- tings	Slave outputs	Slave com- munica- tions status
Does not change.	Does not change.	Does not change.	Updating the protocol moni- tor stops.		Depends on the slave settings.	EtherCAT communica- tions stop.

Others

A

A-2 Monitoring Packets

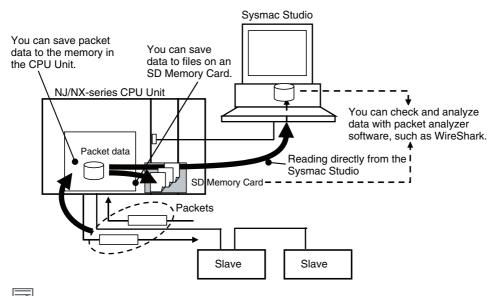
Packet monitoring stores a certain number of the most recent packets sent and received by the Ether-CAT master along with time information.

You can use an EtherCAT communications instruction or the Sysmac Studio to save the captured packet data in packet data files in the system in the CPU Unit.

You can use any of the following methods to obtain the packet data saved in the system memory in the CPU Unit.

- · Reading directly from the Sysmac Studio
- · Saving to an SD Memory Card inserted in the CPU Unit

You can view the captured packet data with packet analyzer software, such as WireShark. You can also use the data for analysis applications, such as error analysis and data mining.



Additional Information

For the NJ301-DDD and NJ101-DDD CPU Units, unit version 1.10 or later and Sysmac Studio version 1.12 or higher are required to use the packet monitoring function.

The _EC_PktMonStop system-defined variable, which shows the operating status of packet monitoring, will always be TRUE in an NJ301-□□□ CPU Unit with unit version 1.09 or earlier.

If you execute any EtherCAT instructions for packet monitoring (EC_StartMon, EC_StopMon, EC_SaveMon, or EC_CopyMon) in the user program, an error is returned that says packet monitoring cannot be used.

Starting and Stopping Packet Monitor

You can start and stop packet monitoring either with instructions in the user program or with operations on the Sysmac Studio.

Using Instructions in the User Program

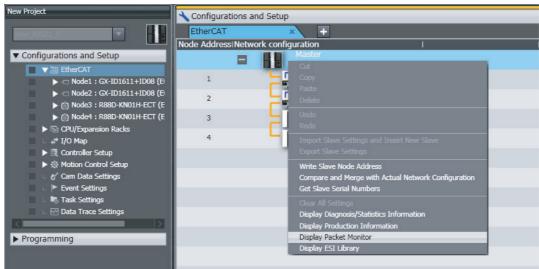
- EC_StartMon (Start EtherCAT Packet Monitor) instruction: Starts the execution of packet monitoring and continues to update a fixed number of packets.
- EC_StopMon (Stop EtherCAT Packet Monitor) instruction: Stops the execution of packet monitoring.

• Operation from the Sysmac Studio

- **1** Start the Sysmac Studio and go online with the Controller.
- 2 Double-click EtherCAT under Configurations and Setups in the Multiview Explorer. Or, rightclick EtherCAT under Configurations and Setups and select *Edit*.



3 Right-click in the EtherCAT Network Configuration Tab Page and select **Display Packet Moni***tor* from the menu.



The Packet Monitor Dialog Box is displayed.

4 Click the **Start** Button to begin monitoring packets.



5 Click the **Stop** Button to stop monitoring packets.

Packet Monitor		
Packet monitor sta	tus	Monitoring
Start	Stop	Save Packet Data
		Close

Saving Packet Data

Reading Data from the Sysmac Studio

After you stop packet monitoring, you can use the Sysmac Studio to read the packet data and save it in a file.

- **1** Stop monitoring packets.
- 2 Click the Save Packet Data Button to save the packet data.



The Save Dialog Box is displayed.

3 Input a file name, and then click the **Save** Button.

A TCPDump packet data file with a .cap extension is saved.

Saving to an SD Memory Card from Memory in the CPU Unit

Stop monitoring packets, and then execute the EC_SaveMon (Save EtherCAT Packets) instruction to save a given quantity of collected packet data in memory in the CPU Unit. Then, execute the EC_CopyMon (Transfer EtherCAT Packets) instruction to save the packet data that was saved in the CPU Unit to a file on an SD Memory Card inserted into the CPU Unit. You can specify the name of the file that is saved in the SD Memory Card. The number of files is limited only by the space that is available on the SD Memory Card.

Additional Information

- Packet data in the CPU Unit's memory is not retained when the power is interrupted.
- Packet data cannot be saved while packets are being monitored.
- · Packet monitoring cannot be started while saving packet data.
- If an SD Memory Card is not inserted and you execute the instruction to copy the data to the SD Memory Card, then an error is returned. If there is no SD Memory Card, only the one file in the CPU Unit's memory can be read to the Sysmac Studio.
- · Packet monitoring starts when the power is turned ON.

Packet Monitoring Specifications

Item	Specification
Maximum data size of one packet data file	12 MB
Maximum number of packets that can be obtained	3,904 packets
Format of packet data file	TCPDump format (cap)
Time information	Recorded (unit: µs) The elapsed time starting when packet monitoring begins is recorded. (Packet moni- toring can be started when power turns ON, for an EtherCAT instruction, or for a Sysmac Studio opera- tion.)
Save location for packet data file	CPU Unit's system: 1 file SD Memory Card inserted in CPU Unit: Multiple files (up to capacity of SD Memory Card)

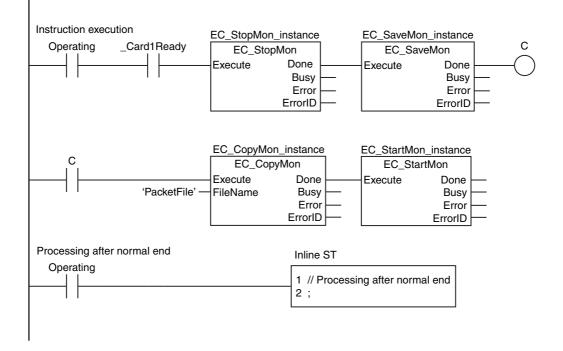
Sample Programming

This sample transfers EtherCAT communications packets to an SD Memory Card when an EtherCAT slave error occurs. The file name is 'PacketFile.' The processing procedure is as follows:

- **7** The system-defined variable _*EC_ErrSta* (EtherCAT Error) is monitored and processing is started if an error occurs.
- **2** The EC_StopMon instruction is used to stop execution of packet monitoring for EtherCAT communications.
- **3** The EC_SaveMon instruction is used to save EtherCAT communications packet data to a file in the system of the CPU Unit.
- **4** The EC_CopyMon instruction is used to copy that file to the SD Memory Card.
- **5** The EC_StartMon instruction is used to restart execution of packet monitoring for EtherCAT communications.



LD							
20	Internal Variables	Variable	D	ata type	Initial value	Comment	
	Tunabioo	OperatingEnd	воо	L	False	Processing completed	
		Operating	BOO		False	Execution condition	
A			BOOL		False		
		В	BOO		False		
		С	BOO	L	False		
		RS_instance	RS				
		EC_StopMon_instance		StopMon			
		EC_SaveMon_instance EC_CopyMon_instance					
		EC_StartMon_instance		StartMon			
			/ [_0_0				
	External	Variable Da	ata type	Constar	nt C	Comment	
	Variables		ORD			nerCAT Error	
			JOL			nitoring Stopped	
						cket Data File	
			JOL			ry Card Enabled Flag	
						ry ourd Enabled Flag	
Dete	rmine if ins	struction execution is co	mpleted	4.			
EC	_StartMon	_instance.Done	O	peratingEr	nd		
				$-\bigcirc$			
	I	1		\bigcirc			
FC	StopMon	_instance.Error					
	•	'					
EC	_SaveMon	_instance.Error					
	I	1					
FC	ConvMor	_instance.Error					
EC	_StartMon	_instance.Error					
	I						
Moni	itor for Eth	erCAT errors.					
				T FC	PktMonStop	EC_StopMon_instance	Ruev A
		<>	Up				.Busy A
		EN	In		⊣/⊢	//	— ()
	EC_ErrSta				V I	V I	Ŭ
l wo	RD#16#00) — In2					
A	EC Sav	eMon_instance.Busy		wMon inc	tanco Rucy	EC_StartMon_instance.B	UCV P
	LO_Sav		-0_00p		stance.busy		usy B
H		/		/⊢		//	()
' '		VI		V I		VI	\bigcirc
				RS_i	nstance		
B	-	_EC_PktSaving		F	RS (Operating	
\vdash		//		Set	Q1 -	_()	
		V I Operatin	gEnd —	Reset1		\bigcirc	
				L			



ST

Internal Variables	Variable	Data type	Initial value	Comment
	EC_Err	BOOL	False	Controller error in the EtherCAT Master Function Module.
	EC_Err_Trigger	BOOL	False	Detect when EC_Err changes to TRUE.
	DoEC_PktSave	BOOL	False	Processing
	Stage	INT	0	Stage change
	R_TRIG_instance	R_TRIG		
	EC_StopMon_instance	EC_StopMon		
	EC_SaveMon_instance	EC_SaveMon		
	EC_CopyMon_instance	EC_CopyMon		
	EC_StartMon_instance	EC_StartMon		

External
Variables

iables	Variable	Data type	Constant	Comment
	_EC_ErrSta	WORD	[Built-in EtherCAT Error
	_EC_PktMonStop	BOOL	[Packet Monitoring Stopped
	_EC_PktSaving	BOOL	[Saving Packet Data File
	_Card1Ready	BOOL	\square	SD Memory Card Enabled Flag

```
// Start sequence when _EC_ErrSta changes to TRUE.
```

```
EC_Err:=(_EC_ErrSta <> WORD#16#00);
```

```
R_TRIG_instance(Clk:=EC_Err, Q=>EC_Err_Trigger);
```

IF ((EC_Err_Trigger=TRUE) AND (DoEC_PktSave=FALSE) AND (_EC_PktMonStop=FALSE) AND (_EC_PktSaving=FALSE) AND (_Card1Ready=TRUE)) THEN DoEC_PktSave:=TRUE; :=INT#1; Stage EC_StopMon_instance(Execute:=FALSE); // Initialize instance. EC_SaveMon_instance(Execute:=FALSE); EC_CopyMon_instance(Execute:=FALSE); EC_StartMon_instance(Execute:=FALSE); END_IF; // Instruction execution IF (DoEC_PktSave=TRUE) THEN CASE Stage OF 1: // Stop EtherCAT packet monitor. EC_StopMon_instance(Execute :=TRUE); IF (EC_StopMon_instance.Done=TRUE) THEN // Normal end Stage:=INT#2; ELSIF (EC_StopMon_instance.Error=TRUE) THEN // Error end Stage:=INT#10; END_IF; // Save EtherCAT packet data to file in system. 2 : EC_SaveMon_instance(Execute :=TRUE);

```
IF (EC_SaveMon_instance.Done=TRUE) THEN
Stage:=INT#3; // Normal end
ELSIF (EC_SaveMon_instance.Error=TRUE) THEN
Stage:=INT#20; // Error end
END_IF;
```

3 : // Copy EtherCAT packet data file to the SD Memory Card. EC_CopyMon_instance(Execute :=TRUE, FileName:='PacketFile'); IF (EC_CopyMon_instance.Done=TRUE) THEN

```
Stage:=INT#4; // Normal end
ELSIF (EC_CopyMon_instance.Error=TRUE) THEN
Stage:=INT#30; // Error end
END_IF;
```

```
A-2 Monitoring Packets
```

- 4 : // Restart EtherCAT packet monitoring. EC_StartMon_instance(Execute :=TRUE);
 - IF (EC_StartMon_instance.Done=TRUE) THEN Stage:=INT#0; // Normal end ELSIF (EC_StartMon_instance.Error=TRUE) THEN Stage:=INT#40; // Error end END_IF;
- 0 : // Processing after normal end DoEC_PktSave:=FALSE;

```
ELSE // Processing after error end
DoEC_PktSave:=FALSE;
END_CASE;
END_IF:
```

This section provides precautions and describes documentation for multi-vendor environments.

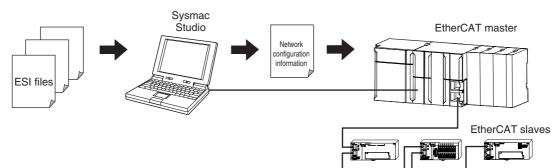
A-3-1 EtherCAT Slave Information File (ESI Files)

Setting information for EtherCAT is defined in EtherCAT slave information (ESI) files. These files are provided by the individual slave manufacturers. Various EtherCAT communications settings are defined based on the ESI definitions of connected slaves.

You can install the ESI files in the Sysmac Studio to use them to edit the EtherCAT configuration in the Sysmac Studio and create the network configuration information.

You can download the network configuration information to the EtherCAT master to configure the Ether-CAT network.

Contact the manufacturer or the point of purchase to obtain the most recent ESI files for slaves that are manufactured by other companies.



Communications are started according to the communications settings and the network configuration in the ESI files that are installed.

Additional Information

ESI file versions that are lower than ESI version-1.0.1 specifications are not supported. If you install an ESI file version that is not supported, a message saying that you cannot use the slave is displayed by the Sysmac Studio.

The NJ/NX-series CPU Units do not support variables with some of the data types that are defined in ETG.1020. If variables with any unsupported data types are included in the slave information (ESI), you cannot use the slave.

The following tables gives the data types that are supported by different Sysmac Studio versions.

Data Type	Sysmac Studio Ver.			
Data Type	1.09 or higher	1.08	1.07 or lower	
BIT1, BIT2, BIT3, BIT4, BIT5, BIT6, BIT7, and BIT8	Supported.	Supported.	Not supported.	
BITARR8, BITARR16, and BITARR32	Supported.	Supported.	Not supported.	
ARRAY[0n] OF BYTE	Supported.	Not supported.*	Not supported.*	
ARRAY[0n] OF UINT	Supported.	Not supported.*	Not supported.*	
INT24, INT40, INT48, and INT56	Not supported.	Not supported.	Not supported.	
UINT24, UINT40, UINT48, and UINT56	Not supported.	Not supported.	Not supported.	
STRING(n)	Not supported.	Not supported.	Not supported.	

* With Sysmac Studio version 1.06, 1.07, or 1.08, you can read ESI files and assign device variables. However, you cannot monitor them in the I/O Map.

If variables with any of these data types are included in the slave information (ESI), a message saying that you cannot use the slave is displayed in the ESI Library Dialog Box of the Sysmac Studio.

A-3-2 Connecting Slaves from Other Manufacturers to an OMRON Master

You can install the ESI file for a slave from another manufacturer in the Sysmac Studio to handle the slave in the same way as an OMRON slave. (Only the ESI files for OMRON slaves for which connect-ability has been confirmed are installed in the Sysmac Studio in advance.)

When connecting a slave from another manufacturer to an OMRON master, refer to the manuals for the other manufacturer's slaves, and then ask your OMRON representative if you have any questions.

Additional Information

EtherCAT setup software that is provided by other manufacturers cannot be connected to NJ/NX-series CPU Units.

A-3-3 Installing ESI Files

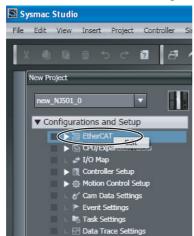
• Procedure

An ESI (EtherCAT slave information) file is an XML file that describes the connection information and profile of the EtherCAT slave.

To connect an EtherCAT slave that is manufactured by other company to an NJ/NX-series master, you must install the ESI file for that slave in the Sysmac Studio to enable setting the slave.

Use the following procedure to install an ESI file.

1 Double-click EtherCAT under Configurations and Setup in the Multiview Explorer. Or, rightclick EtherCAT under Configurations and Setup and select *Edit*.



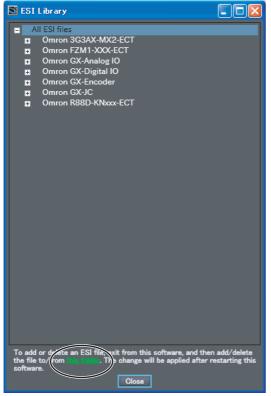
The edit pane is displayed.

2 Right-click the EtherCAT master that is displayed in the edit pane and select **Display ESI Library**.

EtherCAT	× +
ode Address/Netwo	k configuration
	Master Cu <u>f</u> Copy Paste Delete
	— <u>U</u> ndo <u>R</u> edo
	Import Slave Settings and Insert New Slave Export Slave Settings
	<u>W</u> rite Slave Node Address Compare and <u>M</u> erge with Actual Network Configuration Get Slave Serial <u>N</u> umbers
	Clear All Settings Display Diagnosis/Statistics Information Display Production Inform <u>a</u> tion <u>Display Packet Monit</u> or
	Display ESI Library

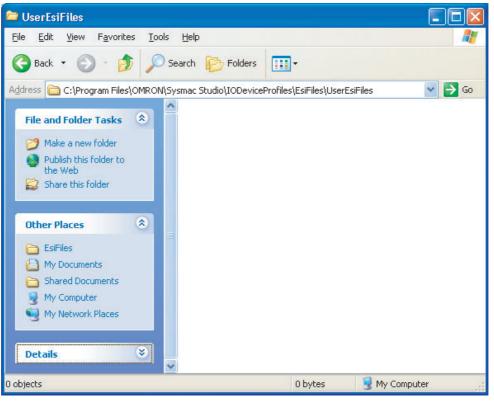
The ESI Library Dialog Box is displayed.

3 Click the **this folder** link in the ESI Library Dialog Box.



The contents of the EsiFiles folder are displayed.

4 Copy the ESI file for the EtherCAT slave that is manufactured by another company and paste it in the EsiFiles folder. Obtain the ESI file from the slave manufacturer. The ESI file must conform to the most recent ETG ESI specifications.



5 Restart the Sysmac Studio.

The ESI file that you installed is displayed in the ESI Library Dialog Box after you restart the Sysmac Studio.

Α

• Procedure to Confirm ESI File Installation

Use the following procedure to confirm that an ESI file was installed correctly

1 Double-click **EtherCAT** under **Configurations and Setup** in the Multiview Explorer. Or, rightclick **EtherCAT** under **Configurations and Setup** and select *Edit*.



The edit pane is displayed.

2 Right-click the EtherCAT master that is displayed in the edit pane and select **Display ESI Library**.

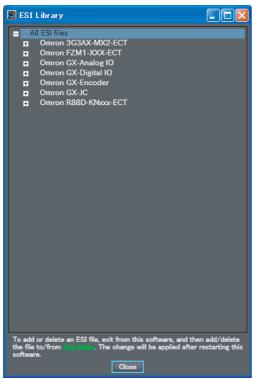
🔧 Configurations and	Setup
EtherCAT	× +
Node Address Networ	k configuration
	Master
	Cu <u>t</u>
	Copy
	Paste
	Delete
	Undo
	Redo
	Import Slave Settings and Insert New Slave
	Export Slave Settings
	Write Slave Node Address
	Compare and Merge with Actual Network Configuration
	Get Slave Serial <u>N</u> umbers
	Clear All Settings
	Display Diagnosis/Statistics Information
	Display Production Information
	Display Packet Monitor
	Display ESI Library
	M

The ESI Library Dialog Box is displayed.





Click the + Icon to the left of the name of the ESI file that was added.



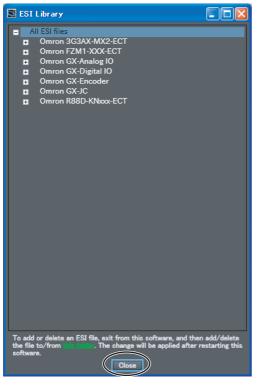
The slave definitions in the ESI file are expanded so that you can check the following items.

- Model
- Revision
- Product name

S ESI Library	
All ESI files Omron 3G3AX-MX2-ECT Omron FZM1-XXX-ECT Omron FZM1-XXX-ECT Omron CX-Analog IO Over the text of t	- Model - Revision
Omron CX-Digital IO Omron CX-Encoder Omron CX-Encoder Omron CX-ECT R88D-KNA5L-ECT Rev: 1 0 R88D-KNA5L-ECT Rev: 1 0 R88D-KNA5L-ECT Rev: 1 0	- Product name
R88D-KN02L-ECT Rev.1.0 (R88D-KN02L-ECT GS Series ServoDrive/Motor) R88D-KN02L-ECT Rev.1.0 (R88D-KN02L-ECT GS Series ServoDrive/Motor) R88D-KN04L-ECT Rev.1.0 (R88D-KN04L-ECT GS Series ServoDrive/Motor) R88D-KN01H-ECT Rev.1.0 (R88D-KN01H-ECT GS Series ServoDrive/Motor)	
R88D-KN02H-ECT Rev: 1.0 (R88D-KN02H-ECT G5 Series ServoDrive/Motor) R88D-KN04H-ECT Rev: 1.0 (R88D-KN04H-ECT G5 Series ServoDrive/Motor) R88D-KN08H-ECT Rev: 1.0 (R88D-KN08H-ECT G5 Series ServoDrive/Motor) R88D-KN10H-ECT Rev: 1.0 (R88D-KN10H-ECT G5 Series ServoDrive/Motor)	
R88D-KN15H-ECT Rev: 1.0 (R88D-KN15H-ECT G5 Series ServoDrive/Motor) R88D-KN20H-ECT Rev: 1.0 (R88D-KN20H-ECT G5 Series ServoDrive/Motor) R88D-KN30H-ECT Rev: 1.0 (R88D-KN30H-ECT G5 Series ServoDrive/Motor) R88D-KN50H-ECT Rev: 1.0 (R88D-KN50H-ECT G5 Series ServoDrive/Motor)	
R88D-KN75H-ECT Rev:1.0 (R88D-KN75H-ECT G5 Series ServoDrive/Motor) R88D-KN150H-ECT Rev:1.0 (R88D-KN150H-ECT G5 Series ServoDrive/Motor) R88D-KN106F-ECT Rev:1.0 (R88D-KN106F-ECT G5 Series ServoDrive/Motor) R88D-KN10F-ECT Rev:1.0 (R88D-KN10F-ECT G5 Series ServoDrive/Motor)	
R88D-KN15F-ECT Rev.1.0 (R88D-KN15F-ECT G5 Series ServoDrive/Motor) R88D-KN20F-ECT Rev.1.0 (R88D-KN20F-ECT G5 Series ServoDrive/Motor) R88D-KN30F-ECT Rev.1.0 (R88D-KN30F-ECT G5 Series ServoDrive/Motor) R88D-KN50F-ECT Rev.1.0 (R88D-KN50F-ECT G5 Series ServoDrive/Motor)	
R8BD-KN75F-ECT Rev: 1.0 (R8B0-KN75F-ECT GS Saries ServoDrive/Motor) R8BD-KN75F-ECT Rev: 1.0 (R8B0-KN150F-ECT GS Saries ServoDrive/Motor) R8BD-KN150F-ECT Rev: 1.0 (R8BD-KN150F-ECT GS Saries ServoDrive/Motor)	
change will be applied after restarting this software. Close	



If an exclamation mark is not displayed, click the **Close** Button.



Additional Information

If an ESI file for a slave cannot be used in the Sysmac Studio, an exclamation mark is displayed to the left of the file name. If an exclamation mark is displayed, obtain an ESI file with the cause corrected from the slave manufacturer, and then install the ESI file again.

A-3-4 Editing PDO Entry Tables

A PDO entry table maps objects in a slave to the process data that is used for communications between the master and the slave.

You cannot necessarily edit all of the PDO mappings in a PDO entry table.

You can add and delete objects in a PDO entry table or you can change the order of the entries. The Sysmac Studio provides the functionality to edit slave PDO entry tables.

	Index	Size	Data type	PDO entry name	Comment
	0x6000:00	16[bit]	UINT	uiAAA	
	0x6001:00	8[bit]	USINT	b2BBB	
Order of entries	0x6002:00	8[bit]	USINT	b4CCC	
	0x6008:00	16[bit]	UINT	uiddd	
+	0x6010:00	32[bit]	UDINT	udEEE	

Editing a PDO Entry Table

Initially, a slave PDO entry table contains the default objects. Some slaves have objects other than these default objects.

You can add objects other than the default objects to the PDO entry table, or you can delete objects from the PDO entry table. However, the following restrictions apply:

• Byte Boundaries

An OMRON master must arrange entry objects by byte boundaries. (This applies only to objects that are one byte or larger in size.)

If an entry object is bit data, padding must be entered to adjust the boundaries. Padding is meaningless data that is added to the end of an entry so that an object ends at a boundary of the specified size. You can use the following methods to arrange objects within byte boundaries.

- Click the **Align** Button. Padding is automatically entered. Refer to the descriptions of the buttons below for details.
- Add padding to the PDO entries manually.

In the following example, 2 bits of padding are entered to adjust the byte boundary when entering objects with BIT2 and BIT4 data types for PDO entries.

Index	Size	Data type	PDO entry name	Comment
0x6000:00	16[bit]	UINT	uiAAA	
0x6001:00	2[bit]	BIT2	b2BBB	
0x6002:00	4[bit]	BIT4	b4CCC	
0x0000:00	2[bit]			
0x6010:00	32[bit]	UDINT	udEEE	

Because an object with 2 bits and an object with 4 bits are entered, 2 bits of padding must be added to adjust the byte boundary (8 bits).

• Connecting to Slaves from Other Manufacturers

When connecting a slave from another manufacturer, refer to the manuals for the other manufacturer's slaves, and then ask your OMRON representative if you have any questions. Α

The following buttons are used to edit a PDO entry table. The meanings of the buttons are given below.

📓 Edit PD	O Map Setting	5								
PDO Map					P	DO entries i	ncluded	in 1st tran	smit PDO Mapping	
		Process Data Size : Input 192 [Output 64				Index 0x6041:00		Data type WORD	PDO entry name Statusword	Comment Statusword
Selection	Input/Output		Flag			0x6064:00	32 [bi	DINT	Position actual va	Position actual va
		No option				0x60B9:00	16 [bi	WORD	Touch probe status	Touch probe stat
	Output	1st receive PDO Mapping	Editable			0x60BA:00	32 [bi	DINT	Touch probe pos	The latch positio
0	Output	258th receive PDO Mapping				0x60BC:00	32 [bi	DINT	Touch probe pos	The latch positio
Ŏ	Output	259th receive PDO Mapping				0x0000:00	8 [bit]			
	Output	260th receive PDO Mapping				0x603F:00	16 [bi [.]	WORD	Error code	Error code
	Output	261th receive PDO Mapping				0x60FD:00	32 [bi	DWORD	Digital inputs	Digital inputs
	Output	262th receive PDO Mapping								
		No option								
\odot	Input	1st transmit PDO Mapping	Editable							
	Input	258th transmit PDO Mapping								
	Input	259th transmit PDO Mapping								
	Input	260th transmit PDO Mapping								
Ŏ	Input	261th transmit PDO Mapping								
		No option								
٢	Input	512th transmit PDO Mapping								
						<				
								Move U	p Move Down	Align
						Edit I	PDO Ent		Add PDO Entry D	elete PDO Entry
						Call	PDO Ent			
									OK Ca	ncel Apply

• Add PDO Entry Button and Delete PDO Entry Button

Use these buttons to add objects to and delete objects from the PDO entry table. "0x0000:00" is for padding. The default size is 8 bits.

Edit PDO Entry Button

Use this button to change the size of padding (i.e., the number of bits) in the PDO mapping.

Move Up Button and Move Down Button

Use these buttons to change the order of the PDO entries by moving objects up and down.

Align Button

Use this button to automatically order the PDO entries and adjust byte boundaries.

The PDO entries are ordered according to the type, descending PDO entry size, ascending indices, and then ascending subindices.

For the type, data arranged by byte boundaries (INT, BYTE, STRING, etc.) comes first, followed by data arranged by bit boundaries (BIT, BIT8, etc.).



Version Information

- Sysmac Studio version 1.08 or higher is required to use the following buttons to edit PDO entry tables: Edit PDO Entry, Move Up, Move Down, and Align.
- Sysmac Studio version 1.08 or higher is required to add "0x0000:00" to a PDO entry table.

A-3-4 Editing PDO Entry Tables

Editing Methods for PDO Entries

Adding PDO Entries

Click the **Add PDO Entry** Button. The entry table from the slave is displayed. Select the object to add with the cursor and click the **OK** Button to add it.

The selected object is added at the location of the cursor in the PDO entry table.

📓 Edit PDO Map Se	tings			
PDO N 📓 Edit PDO	Map Settings		nsmit PDO Mapping	Comment
0x4001:00 0x4015:00 0x4015:00 0x4016:00 0x4016:00 0x4017:00 0x4018:00 0x4018:00 0x4018:00 0x4018:00 0x4018:00 0x4018:00 0x4011:00 0x4016:00 0x4011:00 0x4011:00 0x4010:00 0x402:00 0x6061:00 0x6063:00	Statusword1 / Statusword1 Sub Error Code / Sub Error Code Velocity Demand Value / Velocity Demand Value Motor Velocity Demand Value / Motor Velocity Demand Value Motor Velocity Demand Value / Motor Velocity Demand Value Motor Velocity Demand Value / After Filtering / Motor Velocity Demand V Position Demand Value After Filtering / Position Demand Value After Filt Following Error Actual Internal Value / Following Error Actual Internal Va Motor Velocity Actual Value / Motor Velocity Actual Value Speed Limit Value / Speed Limit Value Fully-closed Following Error / Fully-closed Following Error Hybrid Following Error / Hybrid Following Error Velocity Demand Value After Filtering / Velocity Demand Value After Filt Reference Position for CSP / Reference Position for CSP Modes of operation display / Modes of operation display Position demand value / Position demand value Velocity actual internal value / Position actual internal value Velocity actual undernal value / Position demand value Position actual internal value / Position demand value	type RD T RD T RD ORD	PDO entry name Statusword Position actual va Touch probe status Touch probe pos Touch probe pos Error code Digital inputs	Statusword Position actual va Touch probe stat The latch positio. The latch positio. Error code Digital inputs
Data type : Comment		ove L	Add PDO Entry	Align Delete PDO Entry Incel Apply

Editing PDO Entries

Use the cursor to select padding (0x0000:00) in the PDO entry table and click the **Edit PDO Entry** Button. Enter the size and click the **OK** Button. The size of the padding will change.

DO Map					PDO entries i	ncluded	in 1st tran	smit PDO Mapping	
		Process Data Size : Input 192 Output 64	[bit] / 240 [[bit] / 192		Index 0x6041:00	Size 16 Ibi	Data type WORD	PDO entry name Statusword	Comment Statusword
Selection	Input/Output	Name	Flag	1	0x6064:00	32 [bi	DINT	Position actual va	Position actual v
0		No option			0x60B9:00	16 [bi	WORD	Touch probe status	Touch probe sta
0	Output	1st receive PDO Mapping	Editable		0x60BA:00	32 [bi	DINT	Touch probe pos	The latch position
Ŏ	Output	258th receive PDO Mapping			0x60BC:00	32 [bi	DINT	Touch probe pos	The latch position
0	Output	259th receive PDO Mapping			0x0000:00	8 [bit]			
•	Output	260th receive PDO Mapping			0x603F:00	16 [bi	WORD	Error code	Error code
0	Output	261th receive PDO Mapping			0x60FD:00	32 [bi	DWORD	Digital inputs	Digital inputs
	Output	262th receive PDO Mapp 📓	dit PDO Ent	ry		×			
0		No option Siz	te: 8	[bit	t]				
\odot	Input	1st transmit PDO Mappir			01				
0	Input	258th transmit PDO Map			OK Ca	incel			
\odot	Input	259th transmit PDO Mapping			6				
•	Input	260th transmit PDO Mapping							
\frown	Input	261th transmit PDO Mapping							
		No option							
ŏ									
0	Input	512th transmit PDO Mapping							
ŏ	Input	512th transmit PDO Mapping		-	1. Ja				
ŏ	Input	512th transmit PDO Mapping			<				Þ
ŏ	Input	512th transmit PDO Mapping			<		Move U	p Move Down	Align

A-3-5 Settings for MDP-compatible Slaves from Other Manufacturers

The MDP (Modular Device Profile) defines the data structure for the settings in EtherCAT slaves. It is an EtherCAT specification. You can use slaves that support MDPs from other manufacturers on the EtherCAT Tab Page.

There are two sets of settings, slave and module, for MDP-compatible slaves.

1 Right-click the slave in the EtherCAT Tab Page and select *Edit Module Configuration*.

An Edit Pane for the module configuration is displayed.

New Project - new_Controller_0 - Sysmac St	🖻 New Project - new_Controller_0 - Sysmac Studio					
<u>File Edit View Insert Project Controller Simu</u>	ation <u>T</u> ools <u>H</u> elp					
X 単自立 つ C B A	¥ ஃ # Ø K 🔺 🔌 & 🖗 🀆	■ O º: #				
Yew Project • www_configurations and Setup • • <	Configurations and Setup Etheral Sold 1: 750-354 (2001) Tormals 3d 1 Termals 2 Termals 3 Termals 4 Termals 5 Termals 4 Termals 7 Termals 7 Termals 7 Termals 7 Termals 7 Termals 7 Termals 8 Termals 9 Termals 11 Termals 12 Termals 13 Termals 14 Termals 15 Termals 16 Termals 17 Termals 18 Termals 20 Termals 21 Termals 22 Termals 23 Termals 24 Termals 25 Termals	Ren name Value Decide name 250-354 Product name 200-354 thire Caf fieldow. Product name 00/200000 Wunder of modules 01/200000 Wunder of modules 01/200000 POD Maps Settings 01/200000 PDD Maps Settings 01/200000 PDD Maps Settings 01/200000 Module config and method 02/200000 Device name 02/200000 Set a ranee for the slave. 02/200000	Toolox 0 Provid 1 Antoing Orbot 1 Antoing Orbot 1 Antoing Orbot 1 Operation 1 Antoing Orbot 1			
	27 Terminals 28 Terminals					
Filter			Toolbox			
Cross Reference Output Build Watch (Project) Cross Reference			<u>+</u> #×			

	Index	Size	Data type	PDO entry name	Comment
	0x6000:00	16[bit]	UINT	uiAAA	
	0x6001:00	2[bit]	BIT2	b2BBB	
	0x6002:00	4[bit]	BIT4	b4CCC	
	0x0000:00	2[bit]			
ר'/	0x6010:00	32[bit]	UDINT	udEEE	

/Because an object with 2 bits and an object with 4 bits are entered,2 bits of padding must be added to adjust the byte boundary (8 bits).

2

Select a slave on the Edit Pane for the module configuration. A list of the slave settings is displayed.

			_	
lPosi		l Module 📉		
Node	2 : 750-354 (E002)			
0	Terminals		Item name	Value
1	Terminals		Device name	E002
2	Terminals		Model	750-354
3	Terminals		Product name	750-354 EtherCat fieldbus
4	Terminals		Revision	0x0000002
5	Terminals		Number of modules	
6	Terminals			0xF200:01 Output/K-Bus C
7	Terminals			0xF200:02 Output/Input Pr
8	Terminals			0xF200:03 Output/Output 0xF200:04 Output/Output
9	Terminals			0xF200:05 Output/Diagnos
10	Terminals			0xF100:01 Input/K-Bus Cyc
11	Terminals		PDO Map Settings	0xF100:02 Input/Input Pro
12	Terminals			0xF100:03 Input/Output Pr 0xF100:04 Input/Output Pr
13	Terminals			0x10F3:04 Input/New Mess
14	Terminals			0xF100:05 Input/Diagnosti
15	Terminals			Edit PDO Map Settings
16	Terminals		Module config send method	Do not send
17	Terminals		Module coning seria metriou	bo not bend

Some items in the slave settings only display the current setting. The other items in the slave settings are changeable. The set values and their meanings are given below for the settings that are only displayed.

Name	Meaning of setting
Device name	The device name that is set in the EtherCAT configuration
Model	The model number of the slave
Product name	The product name of the slave
Revision	The revision of the slave
Number of modules	The number of modules that are connected

You can edit the *PDO Map Settings* and *Module config send method*. The meanings of these settings are given below.

PDO Map Settings

- The PDO Map Settings displays the settings for the process data assigned for the slave.
- When valid PDOs are present, a list of them is displayed.
- When valid PDOs are not present, "---" is displayed.
- Process data is assigned for each slave in default by the Sysmac Studio. To change the process data assignments, click the **Edit PDO Map Settings** Button. For details, refer to *5-3 Setting EtherCAT Slave Variables and Axes*.

Module config send method

- This is the area to select whether to send the module configuration information to the device or not.
- When you select *Send*, module configuration information commands are created for the devices. However, the slaves must support this function.
- When you select *Do not send*, module configuration information commands are not created for the devices.
- The default is Do not send.

3 Select the location at which to register a module and double-click the module to register in the Toolbox. Or, drag the module from the Toolbox to the location to register it on the Edit Pane for the module configuration.

The module is registered and a list of module settings is displayed.

Positi	Slot	l Module	_		
Node2 :	750-354 (E002)				
0	Terminals	750-404 (5B in; 5B out) (M1)		Item name	Value
1	Terminals			Device name	M1
2	Terminals			Model	750-404 (5B in; 5B out)
3	Terminals			Product name	750-404 (5B in; 5B out)
4	Terminals			Connected position	
5	Terminals				0x7000:01 Output(s)/Contro
6	Terminals				0x7000:02 Output(s)/DWor.
7	Terminals			PDO Map Settings	0x6000:01 Input(s)/Status 0x6000:02 Input(s)/DWord
8	Terminals				Edit PDO Map Settings
9	Terminals				Earch bo hap bearing.
10	Terminals				

Some items in the module settings only display the current setting. The other items in the module settings are changeable. The set values and their meanings are given below for the settings that are only displayed.

Name	Set value that is displayed
Model	The model name of the device is displayed.
Product name	The product name of the device is displayed.
Connected position	The connected position of the device is displayed.

You can edit the *Device name* and the *PDO Map Settings*. The meanings of these settings are given below.

Device Name

- The name of the module is displayed.
- The default is M#. "#" is a serial number that starts from 1.

PDO Map Settings

- The PDO Map Settings displays the settings for the process data assigned for the module.
- When valid PDOs are present, a list of them is displayed.
- When valid PDOs are not present, "---" is displayed.
- Process data is assigned for each module in default by the Sysmac Studio. To change the process data assignments, click the **Edit PDO Map Settings** Button. For details, refer to *5-3 Setting EtherCAT Slave Variables and Axes*.

Glossary **A-4**

Use the following list of EtherCAT terms for reference.

Term	Abbrevia- tion	Description	
AL status (application layer status)	-	Status for indicating information on errors that occur in an application on a slave.	
CAN application protocol over Ether- CAT	CoE	A CAN application protocol service implemented on EtherCAT.	
CAN in Automation	CiA	CiA is the international users' and manufacturers' group that develops and supports higher-layer protocols.	
device profile	-	Collection of device dependent information and functionality provid- ing consistency between similar devices of the same device type.	
device variables	-	Variables in the NJ/NX-series CPU Unit to which process data on EtherCAT slaves are allocated. Slave process data is accessed by directly reading and writing these device variables from user applica- tions on the NJ/NX-series CPU Unit.	
distributed clocks	DC	Clock distribution mechanism used to synchronize EtherCAT Slave Units and the EtherCAT Master Units.	
EtherCAT Master Function Module	-	One of the function modules. This module controls the EtherCAT slaves as the EtherCAT master.	
EtherCAT slave controller	ESC	A controller for EtherCAT slave communication.	
EtherCAT slave information	ESI	An XML file that contains setting information for an EtherCAT Slave Unit.	
EtherCAT state machine	ESM	An EtherCAT communication state machine.	
EtherCAT Technology Group	ETG	The ETG is a global organization in which OEM, End Users and Technology Providers join forces to support and promote the further technology development.	
index	-	Address of an object within an application process.	
network configuration information	-	The EtherCAT network configuration information held by the Ether- CAT master.	
object	-	Abstract representation of a particular component within a device, which consists of data, parameters, and methods.	
object dictionary	OD	Data structure addressed by Index and Sub-index that contains description of data type objects, communication objects and application objects.	
Operational	-	A state in EtherCAT communications where SDO communications and I/O are possible.	
packet monitoring	-	A function that enables the EtherCAT master to capture packets flowing over an EtherCAT line and store them in the master. You can start and stop capturing packets from the Sysmac Studio or with EtherCAT communications instructions.	
PDO communications	-	An acronym for process data communications.	
Pre-operational	-	A state in EtherCAT communications where only SDO communica- tions are possible without being able to perform I/O.	
process data	-	Collection of application objects designated to be downloaded cyclically or acyclically for the purpose of measurement and control.	
process data communications –		One type of EtherCAT communications that uses process data objects (PDOs) to exchange information in realtime with a fixed cycle. This is also called PDO communications.	
process data object	PDO	Structure described by mapping parameters containing one or several process data entities.	
receive PDO	RxPDO	A process data object received by an EtherCAT Slave Unit.	

Term	Abbrevia- tion	Description
Safe operational	-	A state in EtherCAT communications where only SDO communica- tions and reading input data from slaves are possible. Outputs from slaves are not performed.
SDO communications	-	One type of EtherCAT communications that uses service data objects (SDOs) for communicating information when required.
service data object	SDO	CoE asynchronous mailbox communications where all objects in the object dictionary can be read and written.
Slave Information Interface	SII	Slave information that is stored in non-volatile memory in the slave.
subindex	-	Sub-address of an object within the object dictionary.
sync jitter	-	The offset in the operation timing between slaves.
sync manager	SM	Collection of control elements to coordinate access to concurrently used objects.
system-defined variable	-	A variable in the NJ/NX-series CPU Unit for providing information such as the EtherCAT communications status and error status. Sta- tus information about EtherCAT communications is obtained by read- ing system-defined variables from user applications in the NJ/NX- series CPU Unit.
transmission jitter	-	The jitter in the process data transmission period (ns).
transmit PDO	TxPDO	A process data object sent from an EtherCAT Slave Unit.
WireShark	-	Freeware for monitoring and capturing packets.

A

A-5 Version Information

This appendix describes the changes in and additions to functional specifications that were made for changes in the unit version of the CPU Units.

• Changes in and Additions to Functional Specifications

The following table gives the unit version of the CPU Units and the Sysmac Studio version for each addition or change to the functional specifications.

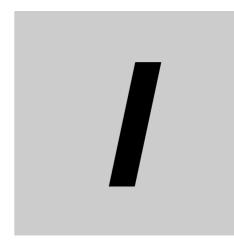
Function	Addition/change	Reference	Unit version	Sysmac Studio version
Backup and restore operations	Addition	page 9-62 and 9-63	1.03	1.04
Enabling/disabling	Addition	page 5-18 and 5-21	1.04	1.05
Packet monitoring ^{*1}	Addition	page 6-27 and A-6	1.10	1.12

*1 This function was added to the NJ301- and NJ101- CPU Units. The function is supported with all other CPU Unit models regardless of their versions.

• Adding the EtherCAT Slaves That You Can Use

If you use a newer unit version of the CPU Unit, you can increase the OMRON EtherCAT Slaves that you can use. Refer to *1-2-1 System Configuration* for details.

For detailed information on the NX-series EtherCAT Communications Coupler Units and NX Units, refer to the *NX-series Data Reference Manual* (Cat. No. W525). For detailed information on other OMRON EtherCAT Slaves, refer to the manual for the specific Slave.



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