OMRON

Machine Automation Controller

CJ-series

EtherCAT® Slave Unit

Operation Manual
for NJ-series CPU Unit

CJ1W-ECT21

EtherCAT Slave Unit

W542-E1-02

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Introduction

Thank you for purchasing a CJ-series CJ1W-ECT21 EtherCAT Slave Unit.

This manual contains information that is necessary to use the CJ-series CJ1W-ECT21 EtherCAT Slave Unit for an NJ-series CPU Unit. Please read this manual and make sure you understand the functionality and performance of the NJ-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 product.

- CJ-series EtherCAT Slave Unit

    CJ1W-ECT21

CONTENTS

Section 1   Features and System Configuration

Section 2   Nomenclature and Installation

Section 3   Data Exchange with the CPU Unit

Section 4   EtherCAT Communications

Section 5 Troubleshooting

Section 6 Maintenance and Replacement

Appendices

Index

CONTENTS

Manual Structure

Page Structure and Icons

The following page structure is used in this manual.

Level 2 heading

Level 3 heading

A step in a procedure
Indicates a procedure.

Special information

Icons indicate precautions, additional information, or reference information.

Manual name

4   Installation and Wiring — Level 1 heading
— Level 2 heading
— Level 3 heading
Gives the current headings.

4-3   Mounting Units

4-3-1   Connecting Controller Components

The Units that make up an NJ-series Controller can be connected simply by pressing the Units together and locking the sliders by moving them toward the back of the Units. The End Cover is connected in the same way to the Unit on the far right side of the Controller.

1   Join the Units so that the connectors fit exactly.

2   The yellow sliders at the top and bottom of each Unit lock the Units together. Move the sliders toward the back of the Units as shown below until they click into place.

Precautions for Correct Use

The sliders on the tops and bottoms of the Power Supply Unit, CPU Unit, I/O Units, Special I/O Units, and CPU Bus Units must be completely locked (until they click into place) after connecting the adjacent Unit connectors.

Page tab
Gives the number of the main section.

NJ-series CPU Unit Hardware User's Manual (W500)   4-9

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.

Version Information

Information on differences in specifications and functionality for CPU Units and EtherCAT Slave Units with different unit versions and for different versions of the Sysmac Studio is given.

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.
- In this manual, "CPU Unit" refers to an NJ-series CPU Unit.

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Warranty, Limitations of Liability

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Safety Precautions

Definition of Precautionary Information

The following notation is used in this manual to provide precautions required to ensure safe usage of an EtherCAT Slave Unit. The safety precautions that are provided are extremely important to safety. Always read and heed the information provided in all safety precautions.

The following notation is used.

⚠ **WARNING**	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. Additionally, there may be severe property damage.

⚠ **Caution**	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or property damage.

Symbols

🚫	The circle and slash symbol indicates operations that you must not do. The specific operation is shown in the circle and explained in text. This example indicates prohibiting disassembly.
⚠	The triangle symbol indicates precautions (including warnings). The specific operation is shown in the triangle and explained in text. This example indicates a precaution for electric shock.
⚠	The triangle symbol indicates precautions (including warnings). The specific operation is shown in the triangle and explained in text. This example indicates a general precaution.
⚫	The filled circle symbol indicates operations that you must do. The specific operation is shown in the circle and explained in text. This example shows a general precaution for something that you must do.
⚠	The triangle symbol indicates precautions (including warnings). The specific operation is shown in the triangle and explained in text. This example indicates the precaution for high temperatures.

Warnings

⚠ **WARNING**

During Power Supply

Do not touch any of the terminals or terminal blocks while the power is being supplied. Doing so may result in electric shock.

Do not attempt to take any Unit apart. In particular, high-voltage parts are present in the Power Supply Unit while power is supplied or immediately after power is turned OFF. Touching any of these parts may result in electric shock. There are sharp parts inside the Unit that may cause injury.

Fail-safe Measures

Unintended outputs may occur when an error occurs in variable memory or in memory used for CJ-series Units. As a countermeasure for such problems, external safety measures must be provided to ensure safe operation of the system. Emergency stop circuits, interlock circuits, limit circuits, and similar safety measures must be provided in external control circuits.

Provide measures in the communications system and user program to ensure safety in the overall system even if errors or malfunctions occur in data link communications or remote I/O communications.

Provide safety measures in external circuits to ensure safety in the system if an abnormality occurs due to malfunction of the CPU Unit, other Units, or slaves or due to other external factors affecting operation.

Not doing so may result in serious accidents due to incorrect operation.

The CJ-series Controller continues normal operation for a certain period of time when a momentary power interruption occurs. This means that the CJ-series Controller may receive incorrect signals from external devices that are also affected by the power interruption. Accordingly, take suitable actions, such as external fail-safe measures and interlock conditions, to monitor the power supply voltage of the external device as required.

You must take fail-safe measures to ensure safety in the event of incorrect, missing, or abnormal signals caused by broken signal lines, momentary power interruptions, or other causes. Not doing so may result in serious accidents due to incorrect operation.

The Controller outputs may remain ON or OFF due to deposition or burning of the output relays or destruction of the output transistors.

As a countermeasure for such problems, external safety measures must be provided to ensure safe operation of the system.

The CPU Unit refreshes I/O even when the program is stopped (i.e., even in PROGRAM mode). Confirm safety thoroughly in advance before changing the status of any part of memory allocated to I/O Units, Special I/O Units, or CPU Bus Units. Any changes to the data allocated to any Unit may result in unexpected operation of the loads connected to the Unit. Any of the following operation may result in changes to memory status.

- Transferring I/O memory data to the CPU Unit from a programming device.
- Changing present values in memory from a programming device.
- Force-setting/-resetting bits from a programming device.
- Transferring I/O memory files from a Memory Card or EM file memory to the CPU Unit.
- Transferring I/O memory from a host computer or from another Controller on a network.

The CPU Unit will turn OFF all outputs from Basic Output Units in the following cases. The slaves will operate according to the settings in the slaves.

- If an error occurs in the power supply
- If the power supply connection becomes faulty
- If a CPU watchdog timer error or CPU reset occurs
- If a major fault level Controller error occurs
- While the CPU Unit is on standby until RUN mode is entered after the power is turned ON

External safety measures must be provided to ensure safe operation of the system in such cases.

Downloading

Always confirm safety at the destination before you transfer a user program, configuration data, setup data, device variables, or values in memory used for CJ-series Units from the Sysmac Studio. The devices or machines may perform unexpected operation regardless of the operating mode of the CPU Unit.

Actual Operation

Check the user program, data, and parameter settings for proper execution before you use them for actual operation.

Voltage and Current Inputs

Make sure that the voltages and currents that are input to the Units and slaves are within the specified ranges.

Inputting voltages or currents that are outside of the specified ranges may cause accidents or fire.

Cautions

⚠ Caution

Application

Do not touch any Unit when power is being supplied or immediately after the power supply is turned OFF. Doing so may result in burn injury.

Wiring

Be sure that all terminal screws and cable connector screws are tightened to the torque specified in the relevant manuals. The loose screws may result in fire or malfunction.

Online Editing

Execute online editing only after confirming that no adverse effects will be caused by deviations in the timing of I/O. If you perform online editing, the task execution time may exceed the task period, I/O may not be refreshed with external devices, input signals may not be read, and output timing may change.

Precautions for Safe Use

Online Editing

When performing online editing with the combination of a CPU Unit with a unit version of 1.04 or later and Sysmac Studio version 1.05 or higher, the CPU Unit saves a program updated by the online editing to built-in non-volatile memory. Sysmac Studio shows a message that it is in a backup operation. Do not turn OFF the power supply to the Controller while this message is displayed. If the power supply to the Controller is turned OFF, a Controller error will occur when power is reapplied.

Disassembly and Dropping

- Do not attempt to disassemble, repair, or modify any Units. Doing so may result in malfunction or fire.
- Do not drop any Unit or subject it to abnormal vibration or shock. Doing so may result in Unit malfunction or burning.

Transporting

- When transporting the Unit, use special packing boxes and protect it from being exposed to excessive vibration or impacts during transportation.

Mounting

- After connecting Power Supply Units, CPU Units, I/O Units, Special I/O Units, or CPU Bus Units together, secure the Units by sliding the sliders at the top and bottom of the Units until they click into place. Correct operation may not be possible if the Units are not securely properly.

Installation

- Always connect to a ground of 100 Ω or less when installing the Units. A ground of 100 Ω or less must be installed when shorting the GR and LG terminals on the Power Supply Unit.
- Install the Unit properly. Improper installation of the Unit may result in malfunction.

Wiring

- Follow the instructions in this manual to correctly perform wiring.
  Double-check all wiring and switch settings before turning ON the power supply.
- Do not pull on the cables or bend the cables beyond their natural limit.
  Do not place heavy objects on top of the cables or other wiring lines. Doing so may break the cables.
- Mount terminal blocks and connectors only after checking the mounting location carefully.
  Be sure that the terminal blocks, expansion cables, and other items with locking devices are properly locked into place.
- Before you connect a computer to the CPU Unit, disconnect the power supply plug of the computer from the AC outlet. Also, if the computer has an FG terminal, make the connections so that the FG terminal has the same electrical potential as the FG (GR) terminal on the Power Supply Unit. A difference in electric potential between the computer and Controller may cause failure or malfunction.
- Use crimp terminals for wiring. Do not connect bare stranded wires directly to terminals. Incorrect wiring may result in burning.

Power Supply Design

- Do not exceed the rated supply capacity of the Power Supply Units in the NJ-series Controller. The rated supply capacities are given in the *NJ-series CPU Unit Hardware User's Manual* (Cat. No. W500).

  If the capacity is exceeded, operation may stop, malfunctions may occur, or data may not be backed up normally for power interruptions.

  Use NJ-series Power Supply Units for both the NJ-series CPU Rack and Expansion Racks.

  Operation is not possible if a CJ-series Power Supply Unit is used with an NJ-series CPU Unit or an NJ-series Power Supply Unit is used with a CJ-series CPU Unit.

- Surge current occurs when the power supply is turned ON. When selecting fuses or breakers for external circuits, consider the above precaution and allow sufficient margin in shut-off performance. Refer to the relevant manuals for surge current specifications. Refer to the *NJ-series CPU Unit Hardware User's Manual* (Cat. No. W500) for surge current specifications.

- If the full dielectric strength voltage is applied or turned OFF using the switch on the tester, the generated impulse voltage may damage the Power Supply Unit. Use the adjustment on the tester to gradually increase and decrease the voltage.

- Apply the voltage between the Power Supply Unit's L1 or L2 terminal and the GR terminal when testing insulation and dielectric strength.

- Do not supply AC power from an inverter or other device with a square-wave output. Internal temperature rise may result in smoking or burning. Always input a sinusoidal wave with the frequency that is given in the *NJ-series CPU Unit Hardware User's Manual* (Cat. No. W500). Refer to the *NJ-series CPU Unit Hardware User's Manual* (Cat. No. W500).

- Apply the voltage between the Power Supply Unit's L1 or L2 terminal and the GR terminal when testing insulation and dielectric strength.

- Install external breakers and take other safety measures against short-circuiting in external wiring.

Turning ON the Power Supply

- It takes up to approximately 10 to 20 s to enter RUN mode after the power is turned ON. During that time, outputs will be the values specified in the Unit or slave. Use the RUN output on the Power Supply Unit, for example, to implement fail-safe circuits so that external devices do not operate incorrectly.

- Configure the external circuits so that the power supply to the control system turns ON only after the power supply to the Controller has turned ON. If the power supply to the Controller is turned ON after the control power supply, temporary errors may result in incorrect control system signals because the output terminals on Output Units may momentarily turn ON when power supply is turned ON to the Controller.

- If you transfer data from a backup file on an SD Memory Card to the Controller when the power supply is turned ON, properly select the data groups to transfer. If the data for an unintended data group is transferred to the Controller, it may cause the equipment to operate unpredictably.

- Double-check all wiring before turning ON the power supply. Incorrect wiring may result in burning.

Actual Operation

- Check the user program, data, and parameter settings for proper execution before you use them for actual operation.

- Confirm that the I/O Communication Area Setting Table and I/O Reference Area Setting Table settings are correct. Incorrect system settings can cause unexpected behavior.

Turning OFF the Power Supply

- Never turn OFF the power supply to the Controller when the BUSY indicator is flashing. While the BUSY indicator is lit, the user program and settings in the CPU Unit are being backed up in the built-in non-volatile memory. This data will not be backed up correctly if the power supply is turned OFF. Also, a major fault level Controller error will occur the next time you start operation, and operation will stop.

- Do not turn OFF the power supply or remove the SD Memory Card while SD Memory Card access is in progress (i.e., while the SD BUSY indicator flashes). Data may become corrupted, and the Controller will not operate correctly if it uses corrupted data. To remove the SD Memory Card from the CPU Unit while the power supply is ON, press the SD Memory Card power supply switch and wait for the SD BUSY indicator to turn OFF before you remove the SD Memory Card.

- Do not disconnect the cable or turn OFF the power supply to the Controller when downloading data or the user program from Support Software.

- Always turn OFF the power supply to the Controller before you attempt any of the following.

  a) Mounting or removing I/O Units or the CPU Unit

  b) Assembling the Units

  c) Setting DIP switches or rotary switches

  d) Connecting cables or wiring the system

  e) Connecting or disconnecting the connectors

- Do not touch the terminals on the Power Supply Unit immediately after turning OFF the power supply. Residual voltage may cause electrical shock.

- Never turn OFF the power supply to the Controller until RUN mode is entered after the power is turned ON. If the power supply is turned OFF, a Battery-backup Memory Check Error may occur at next time you start operation. If a Battery-backup Memory Check Error occurs, the variables retained are set to their initial values and the Holding, DM and EM Areas in memory used for CJ-series Units are cleared to all zeros. If you want to resume the operation, reload the correct data for the variables retained and CJ-series Unit memory, as required.

Operation

- Confirm that no adverse effect will occur in the system before you attempt any of the following.

  a) Changing the operating mode of the CPU Unit (including changing the setting of the Startup Mode)

  b) Changing the user program or settings

  c) Changing set values or present values

  d) Forced refreshing

- If two different function modules are used together, such as when you use CJ-series Basic Units and EtherCAT slaves, take suitable measures in the user program and external controls to ensure that safety is maintained in the controlled system if one of the function modules stops. The relevant outputs will behave according to the slave or Unit specifications if a partial fault level error occurs in one of the function modules.

- Always confirm safety at the connected equipment before you reset Controller errors for a CJ-series Special Unit. When a Controller error is reset, the Unit where the Controller error with an event level of observation or higher will be restarted.

  Before you reset all errors, confirm that no Controller errors with an event level of observation or higher have occurred for the CJ-series Special Unit. Observation level events do not appear on the Controller Error Tab Page, so it is possible that you may restart the CJ-series Special Unit without intending to do so.

  You can check the status of the _CJB_UnitErrSta[0,0] to _CJB_UnitErrSta[3,9] error status variables on a Watch Tab Page to see if an observation level Controller error has occurred.

- After you change any slave or Unit settings, carefully check the safety of the controlled system before you restart the Unit.

Battery Backup

- The user program and initial values for the variables are stored in non-volatile memory in the CPU Unit. The present values of variables with the Retain attribute and the values of the Holding, DM, and EM Areas in the memory used for CJ-series Units are backed up by a Battery. If the Battery is not connected or the Battery is exhausted, the CPU Unit detects a Battery-backup Memory Check Error. If that error is detected, variables with a Retain attribute are set to their initial values and the Holding, DM, and EM Areas in memory used for CJ-series Units are cleared to all zeros. Perform thorough verifications and provide sufficient measures to ensure that the devices perform safe operation for the initial values of the variables with Retain attributes and the resulting operation.

Debugging

- Forced refreshing ignores the results of user program execution and refreshes I/O with the specified values. If forced refreshing is used for inputs for which I/O refreshing is not supported, the inputs will first take the specified values, but they will then be overwritten by the user program. This operation differs from the force-set/reset functionality of the CJ-series PLCs.
- You cannot upload or download information for forced refreshing with the Sysmac Studio. After down-loading data that contains forced refreshing, change to RUN mode and then use the Sysmac Studio to perform the operation for forced refreshing.
  Depending on the difference in the forced status, the control system may operate unexpectedly.
- Do not specify the same address for the AT specification for more than one variable.
  Doing so would allow the same entity to be accessed with different variable names, which would make the user program more difficult to understand and possibly cause programming mistakes.

General Communications

When you use data link communications, check the error information that is given in _ErrSta (Controller Error Status) to make sure that no error has occurred in the source device. Create a user program that uses reception data only when there is no error in the source device. If there is an error in the source device, the data for the data link may contain incorrect values.

EtherCAT Communications

- Make sure that the communications distance, number of nodes connected, and method of connection for EtherCAT are within specifications.
- Do not connect EtherCAT communications to EtherNet/IP, a standard in-house LAN, or other networks. An overload may cause the network to fail or malfunction.
- 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.
- 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 settings. 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.
- 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 will behave according to the slave specifications. Confirm that the system will not be adversely affected before you disconnect a slave.
- When an EtherCAT slave is disconnected or disabled, communications will stop and control of the outputs will be lost not only for the disconnected slave, but for all slaves connected after it. Confirm that the system will not be adversely affected before you disconnect or disable a slave.

Unit Replacement

- Make sure that the required data, including the user program, configurations, settings, variables, and memory used for CJ-series Units is transferred to a CPU Unit that was replaced and to externally connected devices before restarting operation.

  Be sure to include the tag data link settings, routing tables, and other CPU Bus Unit data, which are stored in the CPU Unit.

Disposal

- Dispose of the Units according to local ordinances as they apply.

Precautions for Correct Use

Storage, Mounting, and Wiring

- Do not operate or store the Controller in the following locations. Operation may stop or malfunctions may occur.
    - a) Locations subject to direct sunlight
    - b) Locations subject to temperatures or humidity outside the range specified in the specifications
    - c) Locations subject to condensation as the result of severe changes in temperature
    - d) Locations subject to corrosive or flammable gases
    - e) Locations subject to dust (especially iron dust) or salts
    - f) Locations subject to exposure to water, oil, or chemicals
    - g) Locations subject to shock or vibration
- Take appropriate and sufficient countermeasures when installing the Controller in the following locations.
    - a) Locations subject to strong, high-frequency noise
    - b) Locations subject to static electricity or other forms of noise
    - c) Locations subject to strong electromagnetic fields
    - d) Locations subject to possible exposure to radioactivity
    - e) Locations close to power lines
- Before touching a Unit, be sure to first touch a grounded metallic object in order to discharge any static build-up.
- Install the Controller away from sources of heat and ensure proper ventilation. Not doing so may result in malfunction, in operation stopping, or in burning.
- An I/O bus check error will occur and the Controller will stop if an I/O Connecting Cable's connector is disconnected from the Rack. Be sure that the connectors are secure.
- Do not allow foreign matter to enter the openings in the Unit. Doing so may result in Unit burning, electric shock, or failure.
- Do not allow wire clippings, shavings, or other foreign material to enter any Unit. Otherwise, Unit burning, failure, or malfunction may occur. Cover the Units or take other suitable countermeasures, especially during wiring work.
- Use proper connection methods and EtherCAT communication cables. Otherwise, communications may be faulty. Refer to *2-3 EtherCAT Network Wiring* on page 2-9.
- Use the rated power supply voltage for the Power Supply Units. Take appropriate measures to ensure that the specified power with the rated voltage and frequency is supplied in places where the power supply is unstable.

Error Processing

- In applications that use the results of instructions that read the error status, consider the affect on the system when errors are detected and program error processing accordingly. For example, even the detection of a minor error, such as Battery replacement during operation, can affect the system depending on how the user program is written.

EtherCAT Communications

- Do not disconnect the EtherCAT slave cables during operation. The outputs will become unstable.

SD Memory Cards

- Insert the SD Memory Card all the way.

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.*1

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.

*1. Applicable EMC (Electromagnetic Compatibility) standards are as follows:

EMS (Electromagnetic Susceptibility): EN 61131-2

EMI (Electromagnetic Interference): EN 61131-2 (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 CJ-series PLCs and NJ-series Controllers comply with EC Directives. To ensure that the machine or device in which the CJ-series PLC or the NJ-series Controller is used complies with EC Directives, the PLC or the Controller must be installed as follows:

- The CJ-series PLC or the NJ-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.
- CJ-series PLCs and NJ-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 UL and CSA Standards

Some CJ-series PLCs and NJ-series Controllers comply with UL and CSA standards. Refer to the OMRON website (http://www.ia.omron.com/) or consult your OMRON representative for the applicable standards for each model. The *Instruction Sheet* is provided with the product depending on the models. The *Instruction Sheet* provides the application conditions for complying with the standards.

Conformance to Shipbuilding Standards

Some CJ-series PLCs and NJ-series Controllers comply with shipbuilding standards. Refer to the OMRON website (http://www.ia.omron.com/) or consult your OMRON representative for the applicable standards for each model. If you use a CJ or an NJ-series product that complies with shipbuilding standards and the machinery or system in which you use the CJ or NJ-series products must also comply with the standards, consult with your OMRON representative. Application conditions are defined according to the installation location. Application may not be possible for some installation locations.

Usage Conditions for NK and LR Shipbuilding Standards

- The CJ-series PLC or the NJ-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.

Name	Manufacturer	Model
Noise filter	Cosel Co., Ltd.	TAH-06-683

Conformance to KC Standards

Observe the following precaution if you use the CJ1W-ECT21 EtherCAT Slave Units in Korea.

A 급 기기 (업무용방송통신기자재)
이 기기는 업무용(A 급) 전저파작합기기로서 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.

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/.

Unit Versions

Unit Versions

A "unit version" has been introduced to manage CPU Units in the CJ and NJ Series according to differences in functionality accompanying Unit upgrades.

Notation of Unit Versions on Products

The unit version is given to the right of the lot number on the nameplate of the products for which unit versions are being managed, as shown below.

Example of a CJ-series Unit.
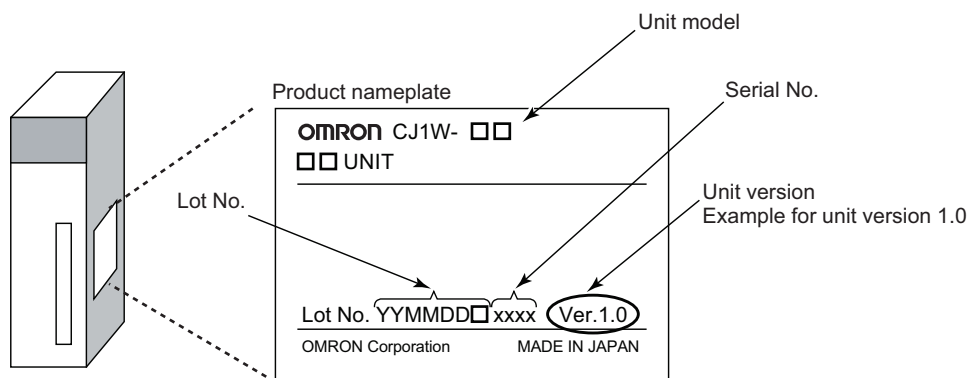
The following information is provided on the ID information label.

Item	Description
Unit model	Gives the model of the Unit.
Unit version	Gives the unit version of the Unit.
Lot number and serial number	Gives the lot number and serial number of the Unit. • YYMMDD: Lot number (□: For use by OMRON) • xxxx: Serial number

Confirming Unit Versions with Sysmac Studio

You can use the Production Information on the Sysmac Studio to check the unit version of the CPU Unit, CJ-series Special I/O Units and CJ-series CPU Bus Units. The unit versions of CJ-series Basic I/O Units cannot be checked from the Sysmac Studio.

● **CPU Unit and CJ-series Units**

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.
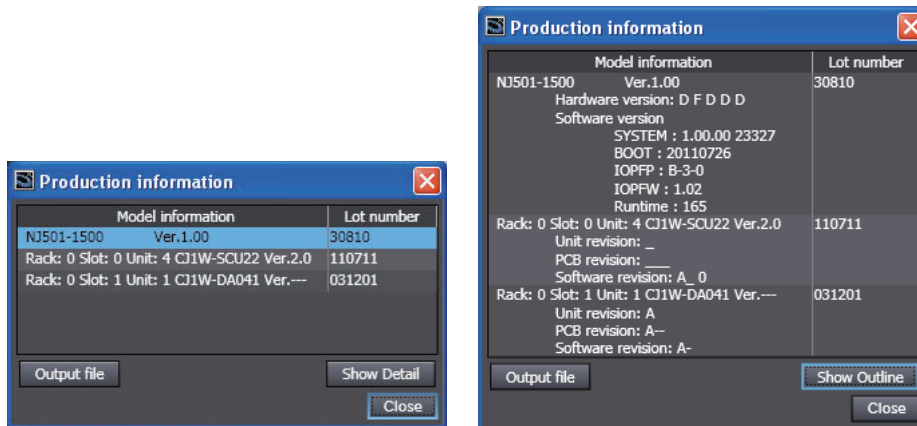
Simple Display   Detailed Display

In this example, "Ver.1.00" is displayed next to the unit model.

The following items are displayed.

CPU Unit	CJ-series Units
Unit model	Unit model
Unit version	Unit version
Lot number	Lot number
	Rack number, slot number and unit number

Unit Versions and Sysmac Studio Versions

The functions that are supported depend on the unit version of the 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 _A-6 Version Information_ on page A-33 for the functions that are supported by each unit version.

Related Manuals

The following manuals are related. Use these manuals for reference.

Manual name	Cat. No.	Model numbers	Application	Description
CJ-series EtherCAT® Slave Units Operation Manual for NJ-series CPU Unit	W542	CJ1W-ECT21	Learning about the functions and operating procedures when the CJ-series EtherCAT Slave Unit is used in an NJ-series system configuration.	The functions and operating procedures when the CJ-series EtherCAT Slave Unit is used in an NJ-series system configuration are described.
NJ-series CPU Unit Hardware User's Manual	W500	NJ501-□□□□ NJ301-□□□□ NJ101-□□□□	Learning the basic specifications of the NJ-series CPU Units, including introductory information, designing, installation, and maintenance. Mainly hardware information is provided.	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
NJ/NX-series CPU Unit Software User's Manual	W501	NX701-□□□□ NX102-□□□□ NX1P2-□□□□ NJ501-□□□□ NJ301-□□□□ NJ101-□□□□	Learning how to program and set up an NJ/NX-series CPU Unit. Mainly software information is provided.	The following information is provided on an NJ/NX-series CPU Unit. • CPU Unit operation • CPU Unit features • Initial settings • Programming based on IEC 61131-3 language specifications
NJ/NX-series CPU Unit Built-in EtherCAT® Port User's Manual	W505	NX701-□□□□ NX102-□□□□ NX1P2-□□□□ NJ501-□□□□ NJ301-□□□□ NJ101-□□□□	Using the built-in EtherCAT port on an NJ/NX-series CPU Unit.	Information on the built-in EtherCAT port is provided. This manual provides an introduction and provides information on the configuration, features and setup.
NJ/NX-series Troubleshooting Manual	W503	NX701-□□□□ NX102-□□□□ NX1P2-□□□□ NJ501-□□□□ NJ301-□□□□ NJ101-□□□□	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.
Sysmac Studio Version 1 Operation Manual	W504	SYSMAC -SE2□□□	Learning about the operating procedures and functions of the Sysmac Studio.	Describes the operating procedures of the Sysmac Studio.

Terminology

Term	Abbreviation	Description
application layer status, AL 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	---	A collection of device dependent information and functionality providing consistency between similar devices of the same device type.
device variable	---	A variable in the NJ/NX-series CPU Unit to which process data on an EtherCAT slave is allocated. Slave process data is accessed by directly reading and writing device variables from user applications on the NJ/NX-series CPU Unit.
EtherCAT slave controller	ESC	A controller for EtherCAT slave communications.
EtherCAT slave information	ESI	An XML file that contains setting information for an EtherCAT slave.
EtherCAT state machine	ESM	An EtherCAT communications 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.
I/O map settings	---	Settings that assign variables to I/O ports. Assignment information between I/O ports and variables.
I/O port	---	A logical interface that is used by the CPU Unit to exchange data with an external device (slave or Unit).
I/O refreshing	---	Cyclic data exchange with external devices that is performed with predetermined memory addresses.
index	---	Address of an object within an application process.
network configuration information	---	The EtherCAT network configuration information held by the EtherCAT master.
object	---	An abstract representation of a particular component within a device, which consists of data, parameters, and methods.
object dictionary	OD	Data structure 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.
PDO communications	---	An acronym for process data communications.
Pre-Operational	---	A state in EtherCAT communications where only SDO communications are possible with the slaves, i.e., no I/O can be performed.
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 in which process data objects (PDOs) are used to exchange information cyclically and in realtime. This is also called PDO communications.

Term	Abbreviation	Description
process data object	PDO	A structure that describes the mappings of parameters that have one or more process data entities.
receive PDO	RxPDO	A process data object received by an EtherCAT slave.
Safe-Operational	---	A state in EtherCAT communications where only SDO communications and reading input data from slaves are possible. Outputs from slaves are not performed.
SDO communications	---	One type of EtherCAT communications in which service data objects (SDOs) are used to transmit information whenever 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 Manager	SM	Collection of control elements to coordinate access to concurrently used objects.
task period	---	The interval at which the primary periodic task or a periodic task is executed.
transmit PDO	TxPDO	A process data object sent from an EtherCAT slave.

Revision History

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

Cat. No. | W542-E1-02

Revision code

Revision code	Date	Revised content
01	April 2015	Original production
02	July 2020	Corrected errors.

Sections in this Manual

1

Features and System Configuration

This section provides an introduction to EtherCAT networks and includes features, system configurations, specifications and setting procedures.

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.

Although EtherCAT is a unique communications protocol, standard Ethernet technology is used for the physical layer, which means you can use Ethernet cables for wider application.

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 How EtherCAT Works

With EtherCAT, Ethernet frames pass through all of the slave nodes.

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

The Ethernet frames that are 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.
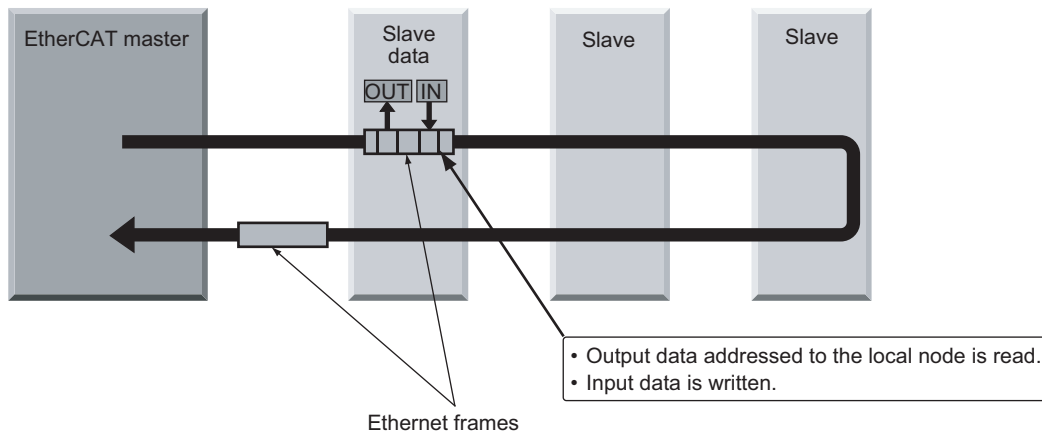
The data exchanges that are cyclically performed between the EtherCAT master and EtherCAT slaves use EtherCAT datagrams that are stored directly in the Ethernet frames.

Each EtherCAT datagram consists of a header (including the data length and one or more slave addresses), data, and a working counter (i.e., check bits).

If you think of an Ethernet frame as a train, the EtherCAT datagrams would be the cars of the train.

Ethernet frame

| Ethernet header | Ethernet data (1,498 bytes max.) | CRC |

EtherCAT header

1st to nth EtherCAT datagrams   EtherCAT frame

| 1st EtherCAT datagram | 2nd EtherCAT datagram | . . . . . | nth EtherCAT datagram |

| Header | Data | WKC |

WKC: Working counter
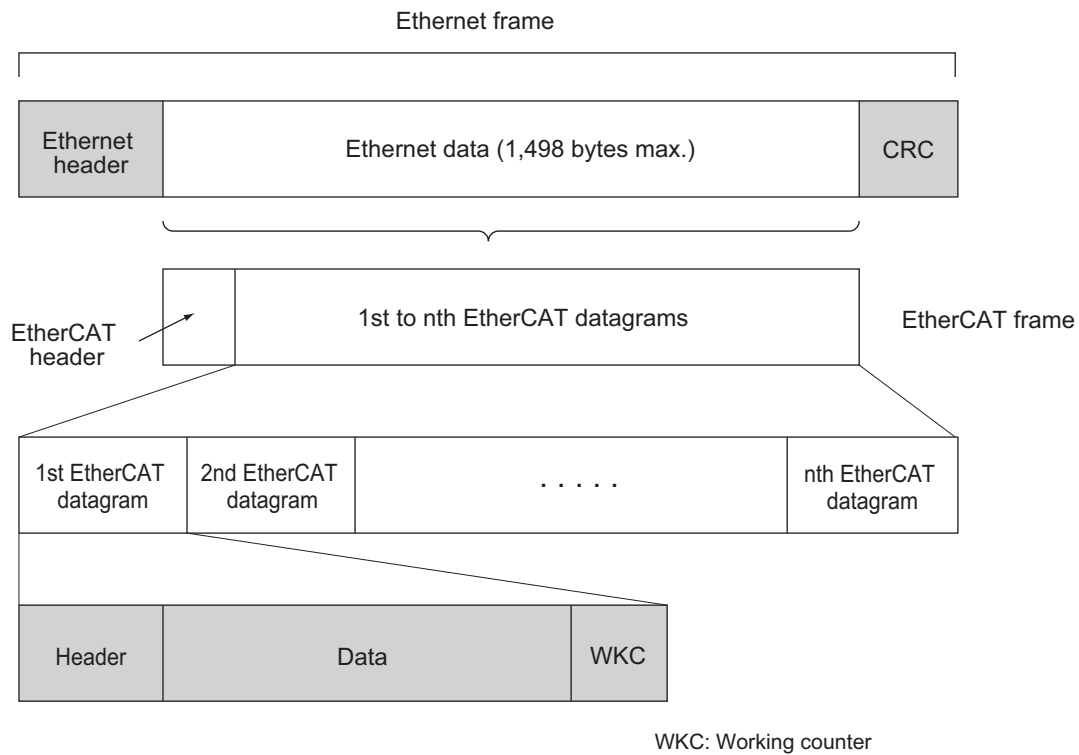
1-1-2   Types of EtherCAT Communications

The following 2 types of communications are available with EtherCAT.

PDO communications are executed in each EtherCAT communications cycle to refresh data continuously. SDO communications are executed between PDO communications.

Process Data Communications (PDO Communications)

PDO communications transfers process data cyclically and in realtime.

The EtherCAT master maps the logical process data space to the nodes to achieve cyclic communications between the EtherCAT master and slaves.
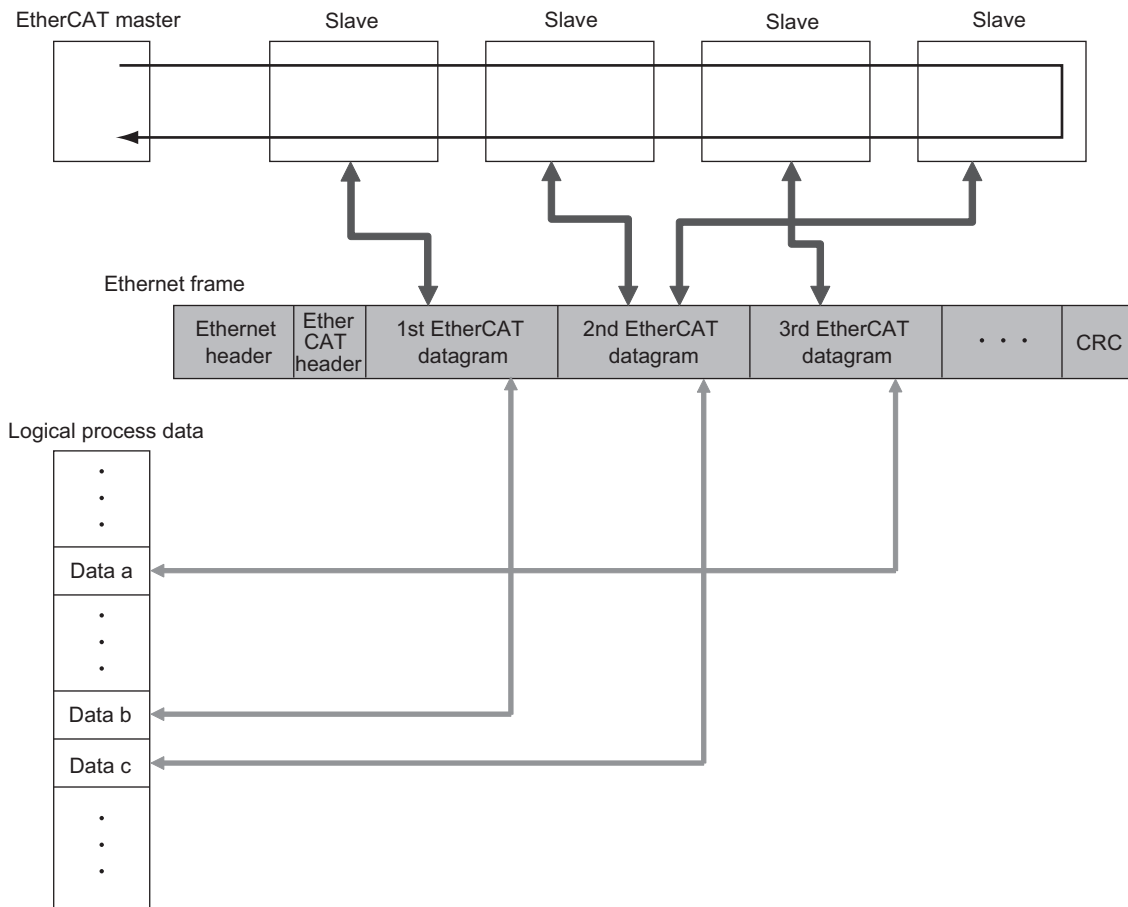
Mailbox Communications (SDO Communications)

SDO communications is used to perform message communications.

Whenever necessary, the EtherCAT master sends a command to a slave, and then the slave returns a response to the EtherCAT master.

The following data communications can be performed.

- Reading and writing process data
- Setting slaves
- Monitoring slave status

1-2 EtherCAT Slave Unit Features

The EtherCAT Slave Unit has the following features when used with the NJ-series CPU Unit.

Data Exchange Between EtherCAT Master and CPU Unit

Exchange data over the EtherCAT network between the EtherCAT master and the CPU Unit through the EtherCAT Slave Unit.
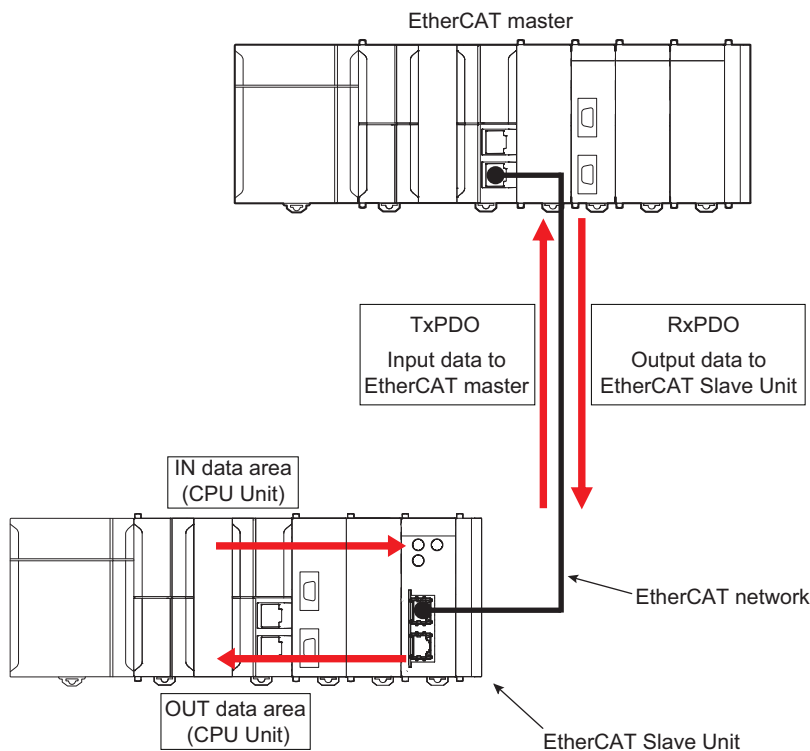
Adjustable Data Exchange Sizes

Choose the amount of data to exchange over the EtherCAT network from 0, 50, 100, 200 or 400 bytes.

Integration with Other Networks

Interface with multiple networks such as EtherCAT and DeviceNet.

EtherCAT master

EtherCAT network

EtherCAT network

CPU Unit

EtherCAT Slave Unit

DeviceNet Master Unit

DeviceNet network

DeviceNet slaves
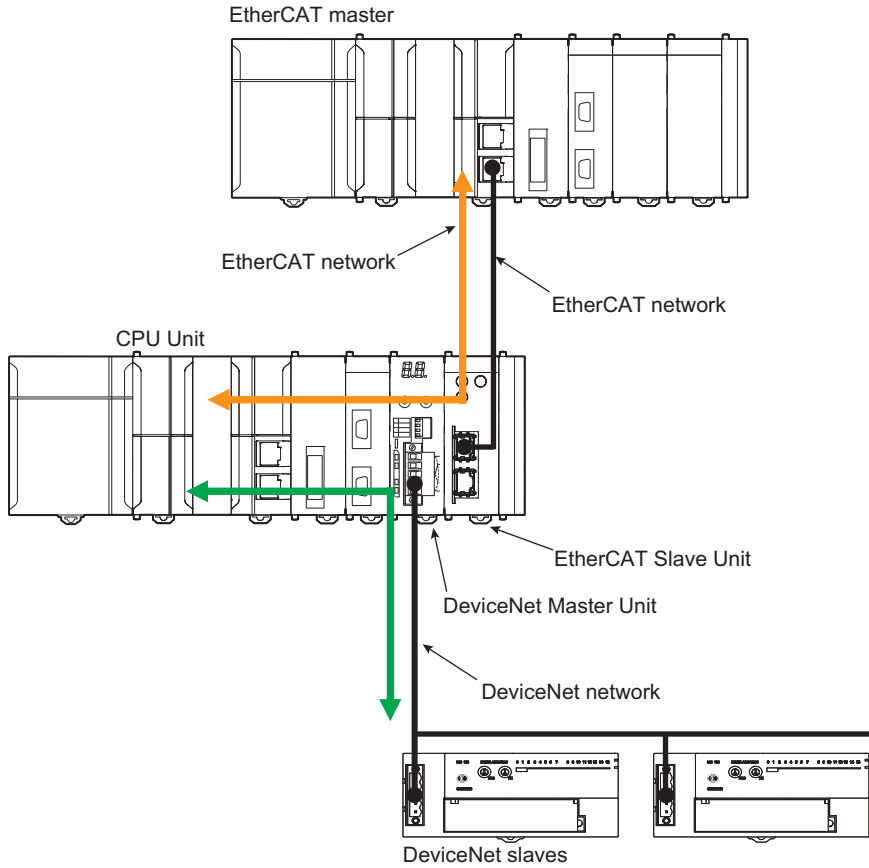
1-3 System Configuration of CJ-series EtherCAT Slave Unit

An example of a system configuration for a CJ-Series EtherCAT Slave Unit is shown below.

(G) Configuration Software

(A) EtherCAT master

(F) ESI files

Built-in EtherCAT port

(D) Sysmac Studio Support Software

(E) Communications cable Ethernet cables

(B) CJ-series EtherCAT Slave Unit CJ1W-ECT21

Input port

(C) NJ-series CPU Unit

Output port

Letter	Item	Description
(A)	EtherCAT master[*1]	The EtherCAT master manages the EtherCAT network, monitors the status of the slaves and exchanges I/O data with the slaves.
(B)	CJ-series Ether-CAT Slave Unit (CJ1W-ECT21)	The CJ-series EtherCAT Slave Unit can perform the following functions over an EtherCAT network. • Process data communications with the EtherCAT master • Message communications (SDO communications) with the EtherCAT master • Exchange data between the NJ-series CPU Unit and the EtherCAT master
(C)	NJ-series CPU Unit[*2]	The Unit that serves as the center of control for a Machine Automation Controller. The CPU Unit executes tasks, refreshes I/O for other Units and slaves, etc.

Letter	Item	Description
(D)	Sysmac Studio Support Software[3]	The Sysmac Studio runs on a personal computer and it is used to configure the EtherCAT network and EtherCAT slaves, and to perform programming, monitoring, and troubleshooting. You can connect the computer in which the Sysmac Studio is installed to the peripheral USB port or built-in EtherNet/IP port on an NJ-series CPU Unit. Refer to the *Studio Version 1 Operation Manual* (Cat. No. W504) for details on placing the Sysmac Studio online.
(E)	Communications Cable	Use a double-shielded cable with aluminum tape and braiding of category 5 (100BASE-TX) or higher, and use straight wiring.
(F)	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 EtherCAT master Configuration Software to easily allocate slave process data and make other settings. The ESI files for OMRON EtherCAT slaves are already installed in the Sysmac Studio. You can update the Sysmac Studio to get the ESI files for the most recent models.
(G)	Configuration Software	Configuration Software runs on a personal computer and it is used to configure the EtherCAT network and EtherCAT slaves.

*1. An EtherCAT Slave Unit cannot be connected to any of the OMRON CJ1W-NC□81/□82 Position Control Units even though they can operate as EtherCAT masters.

*2. Refer to *A-6 Version Information* on page A-33 for information on the unit versions of the NJ-series CPU Unit that can use EtherCAT Slave Units.

*3. Refer to *A-6 Version Information* on page A-33 for information on the versions of the Sysmac Studio that you can use to configure CJ-series EtherCAT Slave Units.

1-4 Specifications

This section provides the general specifications for the EtherCAT Slave Unit.

1-4-1 General Specifications

The general specifications conform to those of the NJ-series CPU Units.

1-4-2 Functional and Performance Specifications

This section provides the functional and performance specifications of the EtherCAT Slave Unit.

Item		Specification
Model number		CJ1W-ECT21
Applicable Controller		NJ Series
Unit classification		CPU Bus Unit
Applicable unit numbers		0 to F
Mounting position		CPU Rack or Expansion Rack
Number of Units that can be mounted		16 Units max.
Words allocated in the memory used for CJ-series Unit	I/O port (not retained during power interruptions)[1]	25 words/Unit
		Unit Status 1, Unit Status 2, Slave Status 1, Slave Status 2
	I/O port (retained during power interruptions)[1]	100 words/Unit
		I/O Communication Area Setting Table, I/O Communication Area Reference Table
	Other I/O memory[2]	I/O communication area in any area[3]
Transmission specifications	Communications protocol	EtherCAT protocol
	Modulation	Baseband
	Baud rate	100 Mbps
	Physical layer	100BASE-TX (IEEE 802.3)
	Topology	Depends on the specifications of the EtherCAT master
	Transmission media	Category 5 or higher twisted-pair cable (Recommended cable: double-shielded cable with aluminum tape and braiding)
	Transmission distance	Distance between nodes: 100 m or less
	Send/receive PDO data sizes	Allocatable IN and OUT data area sizes of 0, 50, 100, 200 or 400 bytes
	Mailbox data size	Input: 512 bytes
		Output: 512 bytes
	Mailbox	Emergency messages and SDO requests
	Refreshing methods	Free-Run Mode
	Node address setting range	1 to 255 (hardware switch setting)
		1 to 65535 (software switch setting)
Current consumption		340 mA max. at 5 V DC

Item	Specification
Weight	97 g max.
Dimensions	31 × 90 × 65 mm (W × H × D)

*1. Access via the device variables for CJ-series Unit.

*2. Using the user-defined variable for R/W to the allocation area.

*3. The IN and OUT data exchanged with the EtherCAT master is designated to memory areas by configuring the I/O Communication Area Setting Table. Refer to *3-1 Data Exchange Between the EtherCAT Slave Unit and the CPU Unit* on page 3-2.

1-4-3   Dimensions

This section provides the external dimensions of the EtherCAT Slave Unit.
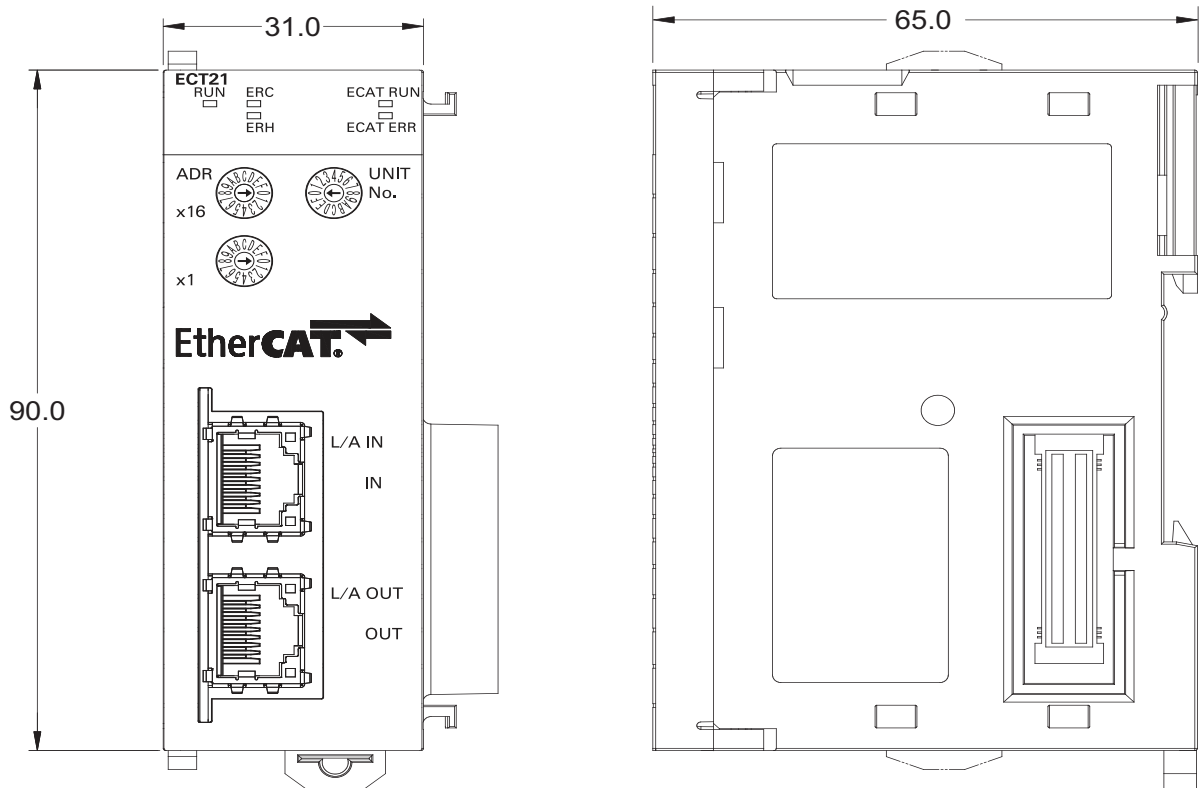
1-5   Setting Procedures

The basic setting procedures for the EtherCAT Slave Unit are described below. Use the Sysmac Studio to create programs and configure the EtherCAT Slave Unit.

Procedure			Item	Description	Reference
1	Programming and Software Settings	Creating POUs, global variables and Unit configuration	Creating a project	Create a project in the Sysmac Studio.	*Sysmac Studio Version 1 Operation Manual* (Cat. No. W504)
			Creating and registering global variables and POUs	• Register variables for accessing the I/O data of the EtherCAT Slave Unit. • Create algorithms of each POU and register associated local variables.	• *NJ/NX-series CPU Unit Software User's Manual* (Cat. No. W501) • *3-1-2 Accessing From the User Program* on page 3-4
			Creating the Unit configuration	• Register the EtherCAT Slave Unit in the Unit configuration in **Configurations and Setup - CPU/Expansion Racks**. • Set the device name and unit number of the EtherCAT Slave Unit.	*Sysmac Studio Version 1 Operation Manual* (Cat. No. W504)
			Allocating device variables for CJ-series Unit	Allocate device variables for CJ-series Unit with the **I/O Map**.	• *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504) • *3-2 Device Variables for CJ-series Unit (Status)* on page 3-9 • *3-3 Device Variables for CJ-series Unit (I/O Communication Area Setting)* on page 3-18
		Setting the initialization data of the EtherCAT Slave Unit	Setting the I/O Communication Area Setting Table	Set the I/O Communication Area Setting Table on the Edit Special Unit Settings Tab Page.	*3-4 I/O Communication Area Settings* on page 3-29

2	Making Hardware Settings and Wiring	Setting the unit number and node address	Set the unit number and the node address of the EtherCAT Slave Unit with the hardware switches.	*2-1-3 Switch Settings* on page 2-5
		Installation	Mount the EtherCAT Slave Unit to the CPU Rack or Expansion Rack.	*2-2 Installing the EtherCAT Slave Unit* on page 2-7
		Wiring	Connect the EtherCAT Slave Unit and the EtherCAT master with the communication cable.	*2-3 EtherCAT Network Wiring* on page 2-9

Procedure		Item	Description	Reference
3	Downloading the User Program and Settings	Turning ON power to the NJ-series Controller	Turn ON the power supply to the NJ-series Controller.	*Sysmac Studio Version 1 Operation Manual* (Cat. No. W504)
		Online connection from Sysmac Studio	Use the Sysmac Studio to establish communications with the NJ-series Controller and go online.	
		Downloading the user program and settings	Download the user program, CPU/Expansion Rack configuration and settings for the EtherCAT Slave Unit. Use the synchronization operation of the Sysmac Studio to download the data. Clear the selection of the following check box in the Synchronization Pane. Do not transfer the following items (all items are not transferred). • CJ-series Special Unit parameters and EtherCAT slave backup parameters • Slave Terminal Unit operation settings and NX Unit application data After the synchronization process is completed, the EtherCAT Slave Unit is restarted to enable the settings.	• *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504) • *3-4 I/O Communication Area Settings* on page 3-29
		Checking the I/O Communication Area Reference Table	Check the I/O Communication Area Reference Table on the Edit Special Unit Settings Tab Page.	*3-4 I/O Communication Area Settings* on page 3-29

Procedure		Item	Description	Reference
4	Setting the EtherCAT Master	Installing the ESI files	Install the ESI file of the EtherCAT Slave Unit into the Configuration Software.	Manuals for the EtherCAT master
		Turning ON the power supply to the EtherCAT master	Turn ON the power supply to the EtherCAT master.	
		Creating the network configuration information	Create the network configuration information as follows. • Network configuration • PDO Mapping Assign PDOs of the same size as the setting value of the IN and OUT data area size in the I/O Communication Area Setting Table of the EtherCAT Slave Unit.	
		Create the communication settings	Create the EtherCAT master's network communication settings.	
		Downloading the settings to the EtherCAT master	Download the network configuration information and the communication settings to the EtherCAT master.	
		Starting EtherCAT communication	Enable EtherCAT network communications.	

Procedure		Item	Description	Reference
5	Confirming Operation	Checking indicators	Check the indicators on the EtherCAT master and the EtherCAT Slave Unit.	• *2-1-2 Indicators* on page 2-2 • *5-2-1 Checking for Errors and Troubleshooting with the Indicators* on page 5-7 • Manuals for the EtherCAT master
		Checking I/O data	Check the I/O data exchange of the EtherCAT master and EtherCAT Slave Unit with the Sysmac Studio and EtherCAT master Configuration Software.	• *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504) • Manuals for the EtherCAT master

2

Nomenclature and Installation

This section describes the nomenclature, installation and wiring of the EtherCAT Slave Unit.

2-1   Nomenclature

This section provides nomenclature for the EtherCAT Slave Unit.

2-1-1   Nomenclature and Functions

This section provides the names and functions of the items on the front panel of the EtherCAT Slave Unit.
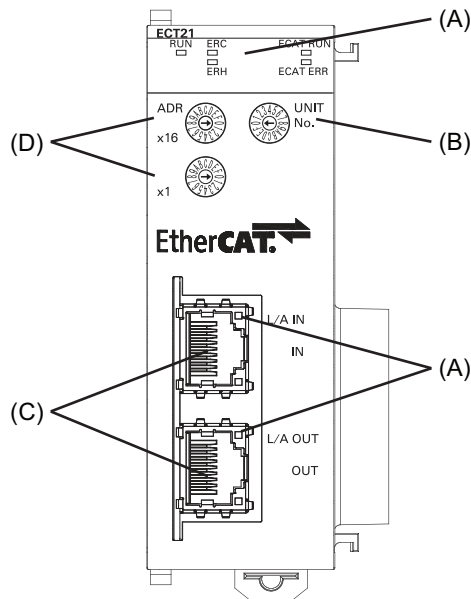
Letter	Name	Function
(A)	Indicators	The indicators show the current operating status of the Unit and the connection status of the IN and OUT EtherCAT ports.
(B)	Unit number switch	This switch sets the unit number of the EtherCAT Slave Unit as a one-digit hexadecimal value.
(C)	Communication connectors	These connectors are connected to the communications cables of the EtherCAT network. There are two connectors: one for the input port and one for the output port.
(D)	Node address switches	These switches set the node address as a two-digit hexadecimal value.

2-1-2   Indicators

An EtherCAT Slave Unit is equipped with the following indicators that provide the operating status of the node itself and the overall network.
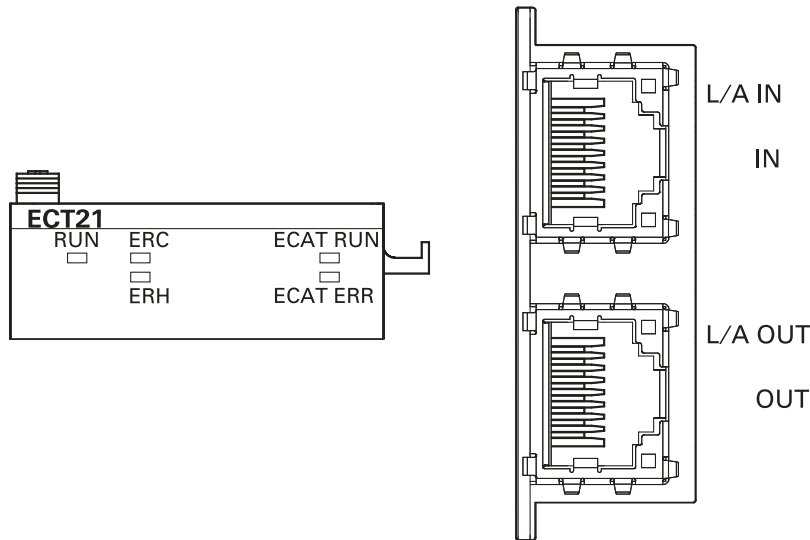
● **Overview of Indicators**

Name	Meaning
L/A IN	The L/A IN indicator shows the link activity of the input port.
L/A OUT	The L/A OUT indicator shows the link activity of the output port.
ECAT RUN	The ECAT RUN indicator shows the operating status of EtherCAT communications for the EtherCAT Slave Unit.
ECAT ERR	The ECAT ERR indicator provides information on errors in the EtherCAT Slave Unit.
RUN	The RUN indicator provides information on the operation of the EtherCAT Slave Unit.
ERC	The ERC indicator provides information about errors of the EtherCAT Slave Unit.
ERH	The ERH indicator provides information about errors of the CPU Unit.

● **Indicator Details**

Name	Color	Status	Meaning
L/A IN L/A OUT	Green	Lit	Link established in physical layer
		Flickering	Operating after establishing link
		Not lit	Link not established in physical layer
ECAT RUN	Green	Lit	Operational state
		Blinking	Pre-Operational state
		Single flash	Safe-Operational state
		Flickering	Initializing process
		Not lit	Init state

Name	Color	Status	Meaning
ECAT ERR	Red	Lit	• Special Unit Error
			• ESC Initial Error
		Blinking	• CPU Unit Major Fault
			• CPU Unit Watchdog Timer Error
			• CPU Unit Service Monitoring Error
			• I/O Refresh Error
			• I/O Bus Error
			• SII Unit Verification Error
			• Mailbox Setting Error
			• Verification Error
			• Illegal State Transition Request Received
			• Restart
		Single flash	• CPU Unit Major Fault
			• CPU Unit Watchdog Timer Error
			• CPU Unit Service Monitoring Error
			• I/O Refresh Error
			• I/O Bus Error
		Double flash	I/O Communication Error (Process Data WDT Error)
		Flickering	ESC Error
		Not lit	No error
RUN	Green	Lit	The Unit is in operation.
		Not lit	The Unit is not in operation.
ERC	Red	Lit	The Unit has an error.
			• CPU Unit Faulty
			• Special Unit Error
			• ESC Error
			• SII Unit Verification Error
			• Special Unit Memory Error
			• I/O Communication Error (Process Data WDT Error)
			• Mailbox Setting Error
			• Verification Error
			• Illegal State Transition Request Received
			• ESC Initial Error
		Flashing	The Unit has an error.
			• EtherCAT Slave Unit Faulty
		Not lit	The Unit is normal.
ERH	Red	Lit	The CPU Unit has an error.
			• Duplicate Unit Number
			• CPU Unit Faulty
			• I/O Table Not Registered
			• CPU Unit Major Fault
			• CPU Unit Watchdog Timer Error
			• CPU Unit Service Monitoring Error
			• I/O Refresh Error
			• I/O Bus Error
		Not lit	The CPU Unit is normal.

● **Indicator State Timing**

The flashing patterns for flickering, blinking, single flash, and double flash are given below.
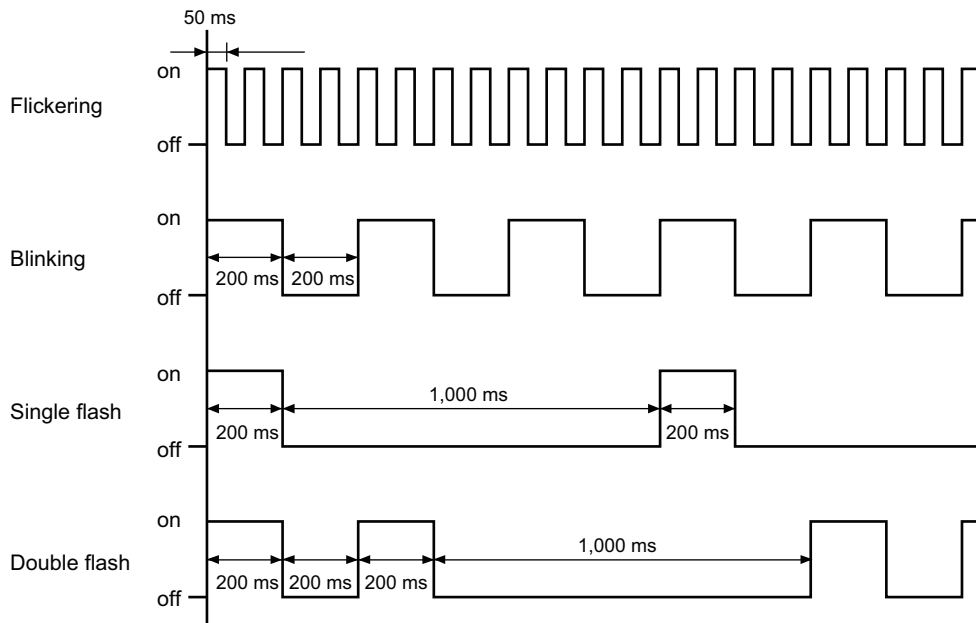
2-1-3   Switch Settings

This section describes the functions of the rotary hardware switches on the front panel of the EtherCAT Slave Unit.

Unit Number Switch

The unit number switch sets the unit number of the EtherCAT Slave Unit as a CPU Bus Unit.

 UNIT
No.

Setting method: One-digit hexadecimal

Setting range: 0 to F hex

The unit number is set to 0 at the factory.

You can set any unit number from 0 to F as long as it has not been set on another CPU Bus Unit connected to the same Controller.

Precautions for Safe Use

- Use a small flat-blade screwdriver to turn the rotary switches; be careful not to damage the switch.
- Always turn OFF the Controller's power supply before setting the unit number.

Additional Information

If the unit number is the same as one set on another CPU Bus Unit connected to the same Controller, a major fault level controller error "Duplicate Unit Number" will occur. After correcting the unit number setting, cycle the power to the Controller.

Node Address Switches

The node address switches set the node address of the EtherCAT Slave Unit to enable the EtherCAT master to recognize the EtherCAT Slave Unit.

The value of node address is loaded to register 0012h of the EtherCAT slave controller when the power supply to the CJ1W-ECT21 is turned ON.

The upper switch sets the sixteens digit (most significant digit) and the lower switch sets the ones digit (least significant digit).

ADR

x16

x1

There are two methods to set the node address: hardware switches and software switches.

The switch settings are used to select the method to use.

● Set the Node Address with Hardware Switches

Use the switch settings to set the node address from 1 to 255. If these switches are not set to 00, the node address that is set on the switches will be used.

Setting method: Two-digit hexadecimal

Setting range: 01 to FF hex

The node address is set to 00 at the factory.

● Setting the Node Address with Software Switches

To set the node address with software switches, set the node address switches to 00. When the switches are set to 00, use the EtherCAT master Configuration Software to set a range from 1 to 65535 for the node address.

ⓘ Precautions for Correct Use

- The node address that is set with hardware or software switches is read only when the Unit initializes (upon power-up or restart). Changing the node address while the Unit is operational will not effect the EtherCAT Slave Unit unless a restart or power-up is applied.
- An error may occur on the EtherCAT master if the same node address is set for more than one slave present on the EtherCAT network.
- An error may occur on the EtherCAT master if the node address is not within the setting range specified for the EtherCAT master.

2-2   Installing the EtherCAT Slave Unit

This section describes how to mount the EtherCAT Slave Unit to an NJ-series system.

2-2-1   System Configuration Precautions

You can mount up to 16 Units on the CPU Rack or an Expansion Rack per CPU Unit (but no more than 10 Units on one Rack).

2-2-2   Mounting

This section describes how to mount the EtherCAT Slave Unit to an NJ-series CPU Rack or an NJ-series Expansion Rack.

1   Carefully align the connectors to mount the EtherCAT Slave Unit.
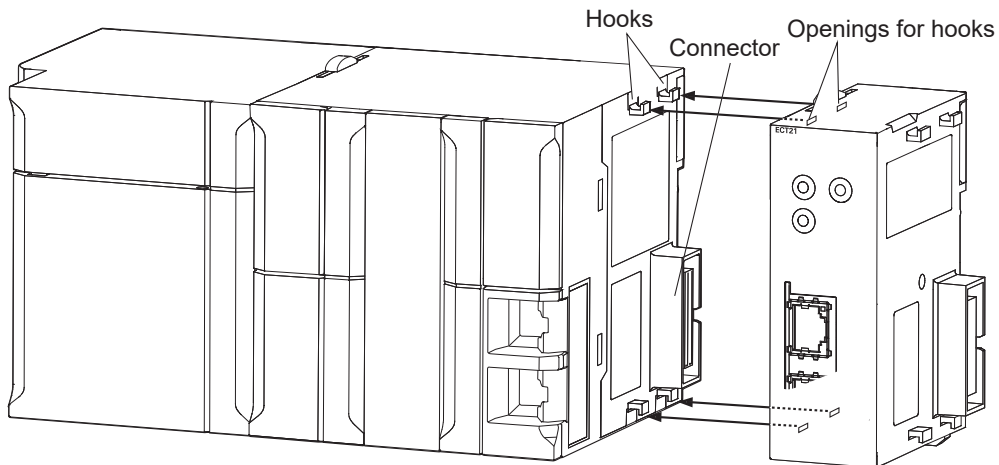
2   Move the yellow sliders on the top and bottom of the Unit until they click into position, to lock.
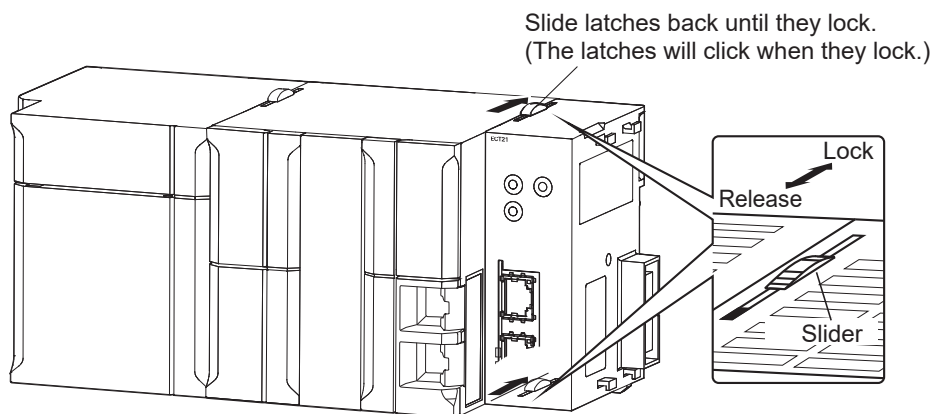
> ⊲ **Precautions for Safe Use**
>
> If the sliders are not securely locked, the EtherCAT Slave Unit functions may not operate sufficiently.

To dismount the Unit, move the sliders to the "Release" direction.

2-2-3   Handling Precautions

This section provides handling precautions for the EtherCAT Slave Unit.

- Always turn OFF the Controller before you mount or dismount a Unit or connect or disconnect cables.
- Provide separate conduits or ducts for the I/O lines to prevent noise from high-tension lines or power lines.
- Prevent wire clippings, cutting chips or other materials from getting inside the Unit. They could cause scorching, failure, and malfunction. Pay particular attention to this during installation and take measures such as covering with a cover.

2-3   EtherCAT Network Wiring

This section describes how to install the EtherCAT network.

2-3-1   Installation Standards

To ensure that the EtherCAT communication network is installed properly, refer to IEC 61784-5-12 standard in conjunction with IEC 61918.

2-3-2   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 all applicable standards and specifications. 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.

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 dust, 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.

2-3-3   Preparations for Installation

Prepare the following devices.

Product	Remarks
Twisted-pair cable (Cables with the following connectors can also be used.)	100BASE-TX (Category 5 or higher)
	Double shielding with aluminum tape and braiding
RJ45 connectors	Shielded

Recommended products are given in the following tables.

Cables with Connectors

● **Sizes and Conductor Pairs: AWG 22 × 2 Pairs**

Product name	Manufacturer	Length (m)[1]	Model
Cables with Connectors on Both Ends (RJ45/RJ45)	OMRON Corporation	0.3	XS5W-T421-AMD-K
		0.5	XS5W-T421-BMD-K
		1	XS5W-T421-CMD-K
		2	XS5W-T421-DMD-K
		5	XS5W-T421-GMD-K
		10	XS5W-T421-JMD-K
Cables with Connectors on Both Ends (M12/RJ45)	OMRON Corporation	0.3	XS5W-T421-AMC-K
		0.5	XS5W-T421-BMC-K
		1	XS5W-T421-CMC-K
		2	XS5W-T421-DMC-K
		5	XS5W-T421-GMC-K
		10	XS5W-T421-JMC-K

*1. Refer to the *XS5/XS6 Industrial Ethernet Connectors Catalog* (Cat. No. G019) for the latest lineup of these Cables.

Cables and Connectors

● **Sizes and Conductor Pairs: AWG 24 x 4 Pairs**

Part name	Manufacturer	Model
Cables	Hitachi Cable, Ltd.	NETSTAR-C5E SAB 0.5 × 4P CP[1]
	Kuramo Electric Co., Ltd.	KETH-SB[1]
	SWCC Showa Cable Systems Co., Ltd.	FAE-5004[1]
	Nihon Electric Wire & Cable Co., Ltd.	IETP-SB[1]
RJ45 Connectors	Panduit Corporation	MPS588-C[1]

*1. A combination of the above cables and connectors is recommended for use.

● **Sizes and Conductor Pairs: AWG 22 x 2 Pairs**

Part name	Manufacturer	Model
Cables	Kuramo Electric Co., Ltd.	KETH-PSB-OMR[1]
	Nihon Electric Wire & Cable Co., Ltd.	PNET/B[1]
RJ45 Assembly Connectors	OMRON Corporation	XS6G-T421-1[1]

[1]. A combination of the above cables and connectors is recommended for use.

📝 **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.

• Use only the specified communication cables.

2-3-4   Pin Arrangements of Communications Connectors

The pin arrangement of the EtherCAT communications connectors is given below.
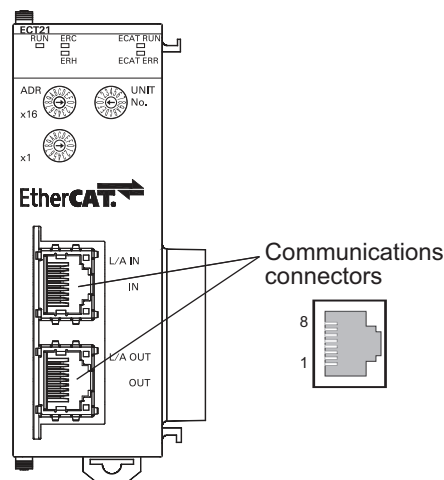
Pin No.	Signal Name	Abbreviation
1	Send data +	TD+
2	Send data –	TD-
3	Receive data +	RD+
4	Not used	---
5	Not used	---
6	Receive data -	RD-
7	Not used	---
8	Not used	---

2-3-5   Connecting Communications Cables and Connectors

Use straight connections for the communications cables and connectors, as shown below.

Pin No.	Wire color		Wire color	Pin No.
1	White-Green		White-Green	1
2	Green		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		Brown	8
Hood	Shield[*1]		Shield[*1]	Hood
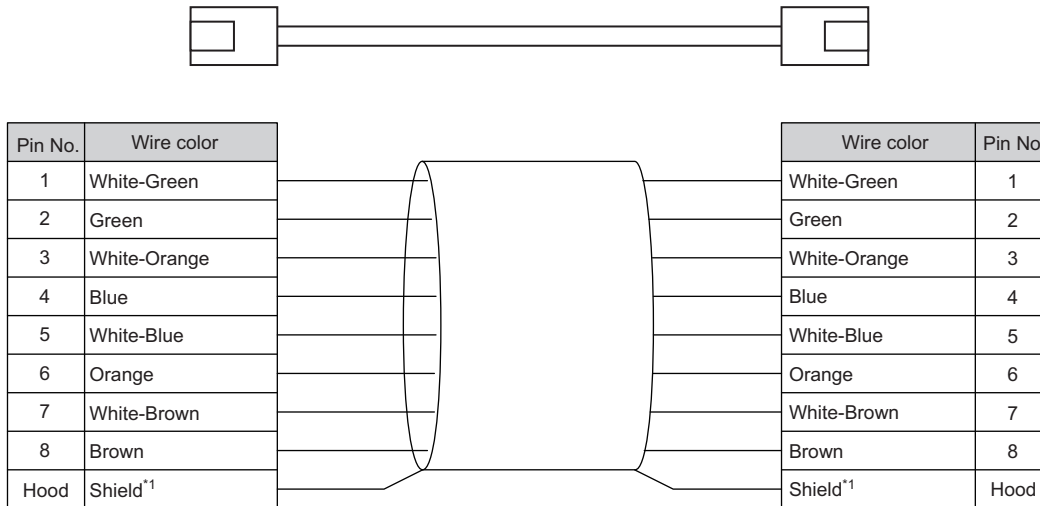
*1. Connect the cable shield wire to the connector hood at both ends of the cable.

Additional Information

There are two connection methods for Ethernet cables: T568A and T568B.

The T568A connection method is shown in the above figure, but the T568B connection method can also be used.

2-3-6   Connecting Communication Cables to Units

Cable connections can be made freely in EtherCAT networks.

The following example shows daisy-chain connections.

Connect the communications cable from the EtherCAT master to the input port on the EtherCAT Slave Unit, and then connect another communications cable from the output port on the EtherCAT Slave Unit to the input port on the next EtherCAT slave.

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

![Figure showing EtherCAT master connected via communications cable to EtherCAT slaves. Labels: EtherCAT master, Communications cable, Input port, Output port, L1, L2, Ln, EtherCAT slaves, EtherCAT Slave Unit, Do not connect anything., Last EtherCAT slave]
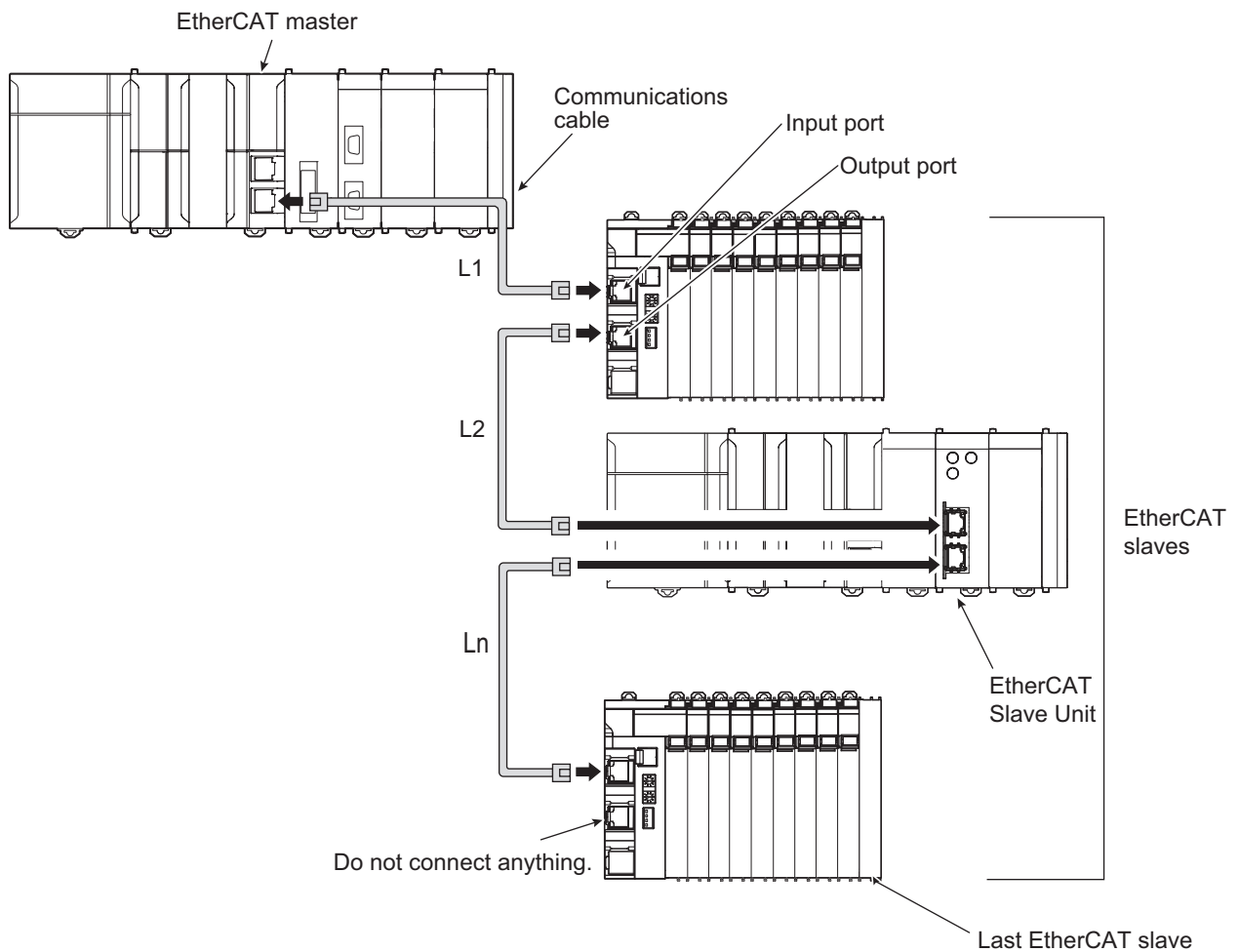
✋ Precautions for Correct Use

- The cable between any two nodes (L1, L2 ... Ln) must be 100 m or less.
- Firmly connect the communications cable connector until it clicks into place.
- When you install the communications cables, observe the cable specifications (e.g., bending radius) of the cable manufacturer.
- Do not disconnect the communications cables from the EtherCAT Slave Units during operation. The outputs from the EtherCAT master may become unstable.

📝 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.

3

Data Exchange with the CPU Unit

This section describes the words allocated to the EtherCAT Slave Unit. These words both enable controlling the EtherCAT Slave Unit and accessing Unit and Slave status.

3-1   Data Exchange Between the Ether-CAT Slave Unit and the CPU Unit

Data exchange between this Unit and the CPU Units uses the I/O port and memory for CJ-series Unit allocated to the EtherCAT Slave Unit.

3-1-1   Data Flow

The CPU Units and CJ-series EtherCAT Slave Units exchange data as shown in the table and chart below.

Access methods from the user program	AT specification destination	Data exchange timing	Classification of Unit data
Device variable for CJ-series Unit	I/O port	During I/O refresh	Unit Status
			Slave Status
			I/O Communication Area Setting Table[1]
		Power ON or Unit restart	I/O Communication Area Reference Table
User-defined variable	Memory used for CJ-series Unit	During I/O refresh	I/O data

*1. The setting results are exchanged when the CPU Unit is powered ON or when the Unit is restarted.

The I/O Communication Area Setting Table and I/O Communication Area Reference Table data are retained in the CPU Unit by the battery even during power interruptions.
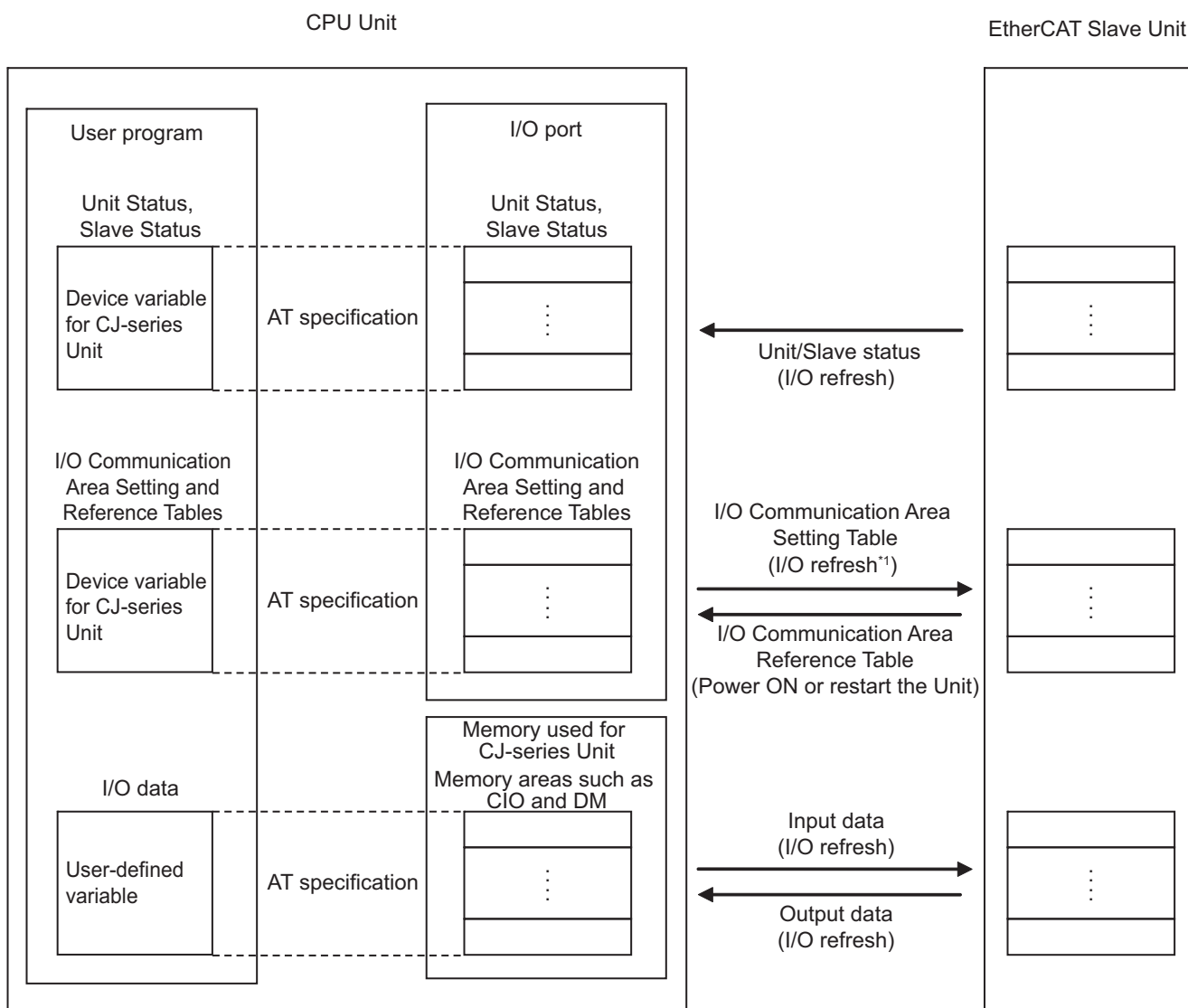
CPU Unit

EtherCAT Slave Unit

*1. The setting results are exchanged when the CPU Unit is powered ON or when the Unit is restarted.

Device Variables for CJ-series Units

Device variables for CJ-series Units are variables for which AT is specified for the I/O port explained below. The user program uses device variables for CJ-series Unit to access the configuration Unit such as EtherCAT Slave Unit.

Refer to *How to Create Device Variables for CJ-series Unit* on page 3-5 for allocation of the device variables for CJ-series Unit to the I/O port.

● **I/O Port**

An "I/O port" is a logical interface for data exchange by a CPU Unit with an EtherCAT Slave Unit or other configuration Unit.

An I/O port has a unique pre-defined name for each unit model and function.

An I/O port is automatically created by preparing the Unit configuration with Sysmac Studio.

Refer to *3-2 Device Variables for CJ-series Unit (Status)* on page 3-9 and *3-3 Device Variables for CJ-series Unit (I/O Communication Area Setting)* on page 3-18 for details on the I/O ports defined for the EtherCAT Slave Unit.

The EtherCAT Slave Unit has two types of I/O ports; one is for the following unit status/slave status data and the other is for I/O communication area setting and reference tables.

● **Unit Status, Slave Status**

Unit operating status and error data are allocated with these I/O ports.

● **I/O Communication Area Setting and Reference Tables**

IN and OUT data area type, starting word, size and setting results are set and referenced with these I/O ports. The setting data is transferred to the EtherCAT Slave Unit and updated when the Controller is powered ON, the Controller is reset or the EtherCAT Slave Unit is restarted. Refer to the *NJ/NX-series CPU Unit Software User's Manual* (Cat. No. W501) for Unit restart methods.

Precautions for Safe Use

Confirm that the I/O Communication Area Setting and Reference Table settings are correct. Incorrect system settings can cause unexpected behavior.

User-defined Variables

The user program accesses the I/O data that has been allocated with the I/O Communication Area Setting Table via the user-defined variables with an AT specification. User-defined variables are created using Sysmac Studio.

Have the necessary user-defined variables created before creating a program.

Refer to the *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504) for details on creating user-defined variables using Sysmac Studio.

Precautions for Correct Use

The user is responsible for management of the memory used for CJ-series Unit. Please take great care to avoid overlapping of reference areas between user-defined variables.

3-1-2 Accessing From the User Program

From the user program, various types of information are exchanged using AT specified device variables for CJ-series Unit that are allocated to the I/O ports, and AT specified user-defined variables that are allocated to I/O data.

To exchange data, use the data that is listed in the following table in the user program.

Classification of Unit data	AT specification destination	Access methods from the user program
Unit Status	I/O port	Device variable for CJ-series Unit
Slave Status		
I/O Communication Area Setting Table		
I/O Communication Area Reference Table		
I/O data	Memory used for CJ-series Unit	User-defined variable

How to Create Device Variables for CJ-series Unit

Use **I/O Map** in Sysmac Studio to allocate device variables for CJ-series Unit to an I/O port. Specify variable names using one of the methods shown below.

(a) Select and allocate existing variables.

(b) Input a new variable name.

(c) Automatically create with **Create Device Variable**.

The following shows the structure of a variable name created automatically with method (c).
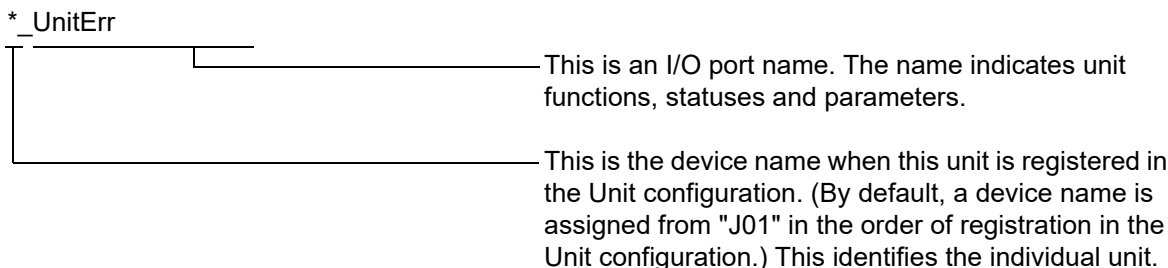
*_UnitErr

This is an I/O port name. The name indicates unit functions, statuses and parameters.

This is the device name when this unit is registered in the Unit configuration. (By default, a device name is assigned from "J01" in the order of registration in the Unit configuration.) This identifies the individual unit.

Refer to *3-2 Device Variables for CJ-series Unit (Status)* on page 3-9 and *3-3 Device Variables for CJ-series Unit (I/O Communication Area Setting)* on page 3-18 for details on device variables for CJ-series Unit.

In the explanations from here on, the device name automatically created is used as the device variable name for CJ-series Unit, for example **_UnitErr.*

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

How to Create User-defined Variables

In this Unit, input and output data exchanged with the EtherCAT master is allocated to the memory used for CJ-series Unit.

Use the Sysmac Studio to register user-defined variables to the variable table. Use user-defined variables to specify the AT specification of the memory used for CJ-series Unit to which the slave is allocated.

Generally, array variables are created.

Below is an example of allocation to user-defined variables.

Item	Setting
OUT data area type	CIO Area (CIO)
First word in OUT data area	3200
OUT data area size	200 bytes
IN data area type	CIO Area (CIO)
First word in IN data area	3300
IN data area size	200 bytes

In this case, the I/O data of each area is allocated as follows:

Words allocated	I/O data
CIO 3200	Output001
...	...
CIO 3299	Output100
CIO 3300	Input001
...	...
CIO 3399	Input100

Allocate the I/O data to the user-defined variables as shown in the examples below.

The example below uses the following data types:
- Slave_OutData_A (WORD type)
- Slave_InData_A (WORD type)

The example below uses the following data types.
- Slave_OutData_B (BOOL type)
- Slave_InData_B (BOOL type)

CJ-series EtherCAT Slave Units Operation Manual for NJ-series CPU Unit (W542)

The example below uses the following data types:

- Slave_OutData_C (union)
- Slave_InData_C (union)

Global Variables ✕				
Name	Data Type	Initial Value	AT	
Slave_OutData_C	ARRAY[0..99] OF Mem		%3200	
Slave_InData_C	ARRAY[0..99] OF Mem		%3300	

Section0 - Program0 ✕

Variables

Namespace - Using

Internals / Externals

Name	Data Type	Initial Value	AT	Retain	Constant	Comment	
x	BOOL	False		☐	☐		
Word_1	WORD			☐	☐		
Bit_1	BOOL	False		☐	☐		

```
                                                        Slave_OutData_C[15].b[15]
0        x                                                        ( )

1   Slave_InData_C[15].b[15]                                     Bit_2
         | |                                                      ( )
```
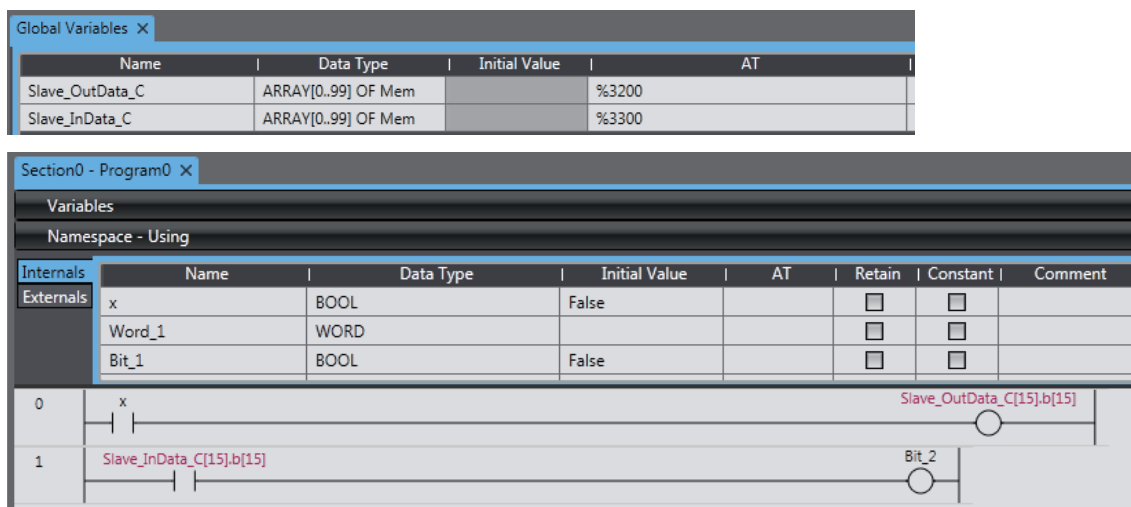
When you use the union, prepare the union data type Mem that you can access with WORD and BOOL as shown below.

Data Types

Structures / Union / Enumerated

Name	Base Type
▼ Mem	UNION
w	WORD
b	ARRAY[0..15] OF BOOL
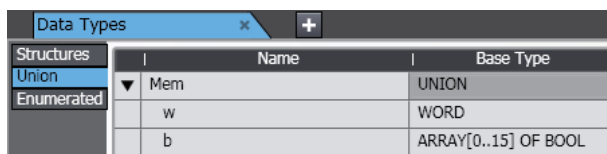
Use one of the data types or multiple data types shown in the examples to create user-defined variables according to the user program.

When the user program accesses the I/O data only with WORD type, use the WORD-type user-defined variables *Slave_OutData_A* and *Slave_InData_A* defined in the example.

The user-defined variables and I/O data of the EtherCAT Slave Unit are allocated as follows:

I/O data	User-defined variable name	Address
OUT slave I/O data (Output001)	Slave_OutData_A[0]	3200
...	...	...
OUT slave I/O data (Output100)	Slave_OutData_A[99]	3299
IN slave I/O data (Input001)	Slave_InData_A[0]	3300
...	...	...
IN slave I/O data (Input100)	Slave_InData_A[99]	3399

The user program accesses the I/O data with WORD-type variables.

When the user program accesses the I/O data only with BOOL type, use the BOOL-type user-defined variables *Slave_OutData_B* and *Slave_InData_B* defined in the example. The user-defined variables and I/O data of the EtherCAT Slave Unit are allocated as follows:

I/O data	User-defined variable name	Address
Output001, Bit 0	Slave_OutData_B[0,0]	3200.00
Output001, Bit 1	Slave_OutData_B[0,1]	3200.01
...	...	...
Output100, Bit 15	Slave_OutData_B[99,15]	3299.15
Input001, Bit 0	Slave_InData_B[0,0]	3300.00

I/O data	User-defined variable name	Address
Input001, Bit 1	Slave_InData_B[0,1]	3300.01
...	...	...
Input100, Bit 15	Slave_InData_B[99,15]	3399.15

The user program accesses the I/O data with BOOL-type variables.

When the user program accesses the I/O data with both WORD type and BOOL type, use the union-type user-defined variables *Slave_OutData_C* and *Slave_InData_C* defined in the example. The user-defined variables and I/O data of the EtherCAT Slave Unit are allocated as follows:

I/O data	User-defined variable name	Address
Output001	WORD type Slave_OutData_C[0].w BOOL type Slave_OutData_C[0].b[0] to Slave_OutData_C[0].b[15]	3200 3200.00 3200.15
...	...	...
Output100	WORD type Slave_OutData_C[99].w BOOL type Slave_OutData_C[99].b[0] to Slave_OutData_C[99].b[15]	3299 3299.00 3299.15
Input001	WORD type Slave_InData_C[0].w BOOL type Slave_InData_C[0].b[0] to Slave_In-Data_C[0].b[15]	3300 3300.00 3300.15
...	...	...
Input100	WORD type Slave_InData_C[99].w BOOL type Slave_InData_C[99].b[0] to Slave_In-Data_C[99].b[15]	3399 3399.00 3399.15

The user program accesses the I/O data with WORD-type or BOOL-type variables.

📖 **Additional Information**

Refer to the *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504) for details on memory used for CJ-series Unit, variable allocation and user-defined variable registration.

3-2   Device Variables for CJ-series Unit (Status)

This section describes the device variables Unit Status and Slave Status for the CJ-series Unit.

In this section, the variable names that are created automatically in the I/O Map are used.

3-2-1   List of Device Variables for CJ-series Unit

When you operate and reference Unit status and slave status, use the following device variables for CJ-series Unit allocated to the I/O port of this Unit.

Name of device variable for CJ-series Unit	Type	R/W	Name
*_Unit1Sta	WORD	R	Unit Status 1
*_Unit2Sta	WORD	R	Unit Status 2
*_Slave1Sta	WORD	R	Slave Status 1
*_Slave2Sta	WORD	R	Slave Status 2

The function of each device variable for the CJ-series Unit is explained below.

3-2-2   Unit Status 1

The following device variable for CJ-series Unit is used to reference all information of Unit Status 1.

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
*_Unit1Sta	WORD	R	Unit Status 1	Bit 00: Unit Error
				Bit 01: Reserved by system
				Bit 02: Reserved by system
				Bit 03: Slave Function Error
				Bit 04: Unit Memory Error
				Bit 05: ESC Error
				Bit 06: Reserved by system
				Bit 07: Reserved by system
				Bit 08: Reserved by system
				Bit 09: Reserved by system
				Bit 10: Reserved by system
				Bit 11: Reserved by system
				Bit 12: Reserved by system
				Bit 13: Reserved by system
				Bit 14: Reserved by system
				Bit 15: Reserved by system
				Default: 16#0000

The following device variables for CJ-series Unit are used to reference individual information.

Name of device variables for CJ-series Unit	Type	R/W	Name	Function
*_UnitErr	BOOL	R	Unit Error	TRUE: Displays EtherCAT Slave Unit operating errors. *_UnitErr (Unit Error) changes to TRUE if any bit from 01 to 15 in *_Unit1Sta (Unit Status 1) is TRUE (OR information of bits 01 to 15). FALSE: Indicates that the error did not occur. Or, changes to FALSE when the error is cleared. Default: FALSE
*_SlaveFuncErr	BOOL	R	Slave Function Error	TRUE: Indicates that at least one slave error occurred. Refer to *_Slav1Sta (Slave Status 1). The slave errors are as follows: • *_AlStatusErr (Slave AL Status Error) • *_SiiVerifyErr (SII Unit Verification Error) • *_VerificationErr (Verification Error) • *_MailboxSettingErr (Mailbox Setting Error) • *_IOCommErr (I/O Communication Error) • *_InvadlidReqState (Illegal State Transition Request Received) • *_IORefErr (I/O Refresh Error) FALSE: Indicates that none of the above errors occurred or changes to FALSE when all of above errors are cleared. Default: FALSE This bit cannot be changed to FALSE unless the error is recovered from the EtherCAT master except for observation errors.
*_MemErr	BOOL	R	Unit Memory Error	TRUE: Indicates an error in internal memory where the error log or I/O communication area data is stored. The error occurs when the Unit starts up or when the error log is written. FALSE: Indicates that the error did not occur. Once this error occurs, the bit will remain TRUE and will not return to FALSE. Default: FALSE
*_EscErr	BOOL	R	ESC Error	TRUE: Indicates an error in ESC. FALSE: Indicates that the error has not occurred. Once this error occurs, the bit will remain TRUE and will not return to FALSE. Default: FALSE

3-2-3   Unit Status 2

The following device variable for CJ-series Unit is used to reference all information of Unit Status 2.

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
*_Unit2Sta	WORD	R	Unit Status 2	Bit 00: Online Status
				Bit 01: Reserved by system
				Bit 02: Reserved by system
				Bit 03: Reserved by system
				Bit 04: Reserved by system
				Bit 05: Reserved by system
				Bit 06: Reserved by system
				Bit 07: Reserved by system
				Bit 08: Reserved by system
				Bit 09: Reserved by system
				Bit 10: Reserved by system
				Bit 11: Reserved by system
				Bit 12: Reserved by system
				Bit 13: Reserved by system
				Bit 14: Reserved by system
				Bit 15: Error Log Registered
				Default: 16#0000

The following device variables for CJ-series Unit are used to reference individual information.

Name of device variables for CJ-series Unit	Type	R/W	Name	Function
*_OnlineSta	BOOL	R	Online Status	TRUE: Indicates that the Unit is online and capable of communicating on the network. FALSE: Indicates that the Unit is offline. A Unit will go offline under the following conditions: • Operation is stopped by the hardware/software check at startup. • An ESC Error has occurred. Default: FALSE
*_ErrLogSta	BOOL	R	Error Log Registered	TRUE: Indicates that an error log was registered. Changes to TRUE at the first error log registration for the Unit. FALSE: Indicates that no errors are registered in the error log. Changes to FALSE when the Unit receives an error log clear request. Default: FALSE

3-2-4   Slave Status 1

The following device variable for CJ-series Unit is used to reference all information of Slave Status 1.

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
*_Slave1Sta	WORD	R	Slave Status 1	Bit 00: Reserved by system
				Bit 01: Slave AL Status Error
				Bit 02: SII Unit Verification Error
				Bit 03: Verification Error
				Bit 04: Mailbox Setting Error
				Bit 05: I/O Communication Error
				Bit 06: Illegal State Transition Request Received
				Bit 07: I/O Refresh Error
				Bit 08: Reserved by system
				Bit 09: Reserved by system
				Bit 10: Reserved by system
				Bit 11: Reserved by system
				Bit 12: Reserved by system
				Bit 13: Reserved by system
				Bit 14: Reserved by system
				Bit 15: Reserved by system
				Default: 16#0000

The following device variables for CJ-series Unit are used to reference individual information.

Name of device variables for CJ-series Unit	Type	R/W	Name	Function
*_AlStatusErr	BOOL	R	Slave AL Status Error	TRUE: Indicates that the slave detects the AL status error. FALSE: Indicates that the error has not occurred. Default: FALSE
*_SiiVerifyErr	BOOL	R	SII Unit Verification Error	TRUE: Indicates that an error occurred in the slave information stored in SII when the power supply was turned ON. FALSE: Indicates that the error has not occurred. Default: FALSE
*_VerificationErr	BOOL	R	Verification Error	TRUE: Indicates that the I/O communication area size does not match with the Sync Manager size set by the EtherCAT master. FALSE: Indicates that the I/O communication area size matches with the Sync Manager size set by the EtherCAT master. Default: FALSE
*_MailboxSettingErr	BOOL	R	Mailbox Setting Error	TRUE: Indicates that the Unit is requested to change Pre-Operational state without mailbox settings or the mailbox size setting is outside the allowable range (512 bytes). FALSE: Indicates the error has not occurred. Default: FALSE

Name of device variables for CJ-series Unit	Type	R/W	Name	Function
*_IOCommErr	BOOL	R	I/O Communication Error	TRUE: Indicates that RxPDO data from the EtherCAT master is not refreshed during the monitoring time. FALSE: Indicates that RxPDO data from the EtherCAT master is refreshed during the monitoring time. Default: FALSE
*_InvadlidReqState	BOOL	R	Illegal State Transition Request Received	TRUE: Indicates that an unexpected state transition request has been sent from the EtherCAT master. FALSE: Indicates that an unexpected state transition request has not been sent from the EtherCAT master. Default: FALSE
*_IORefErr	BOOL	R	I/O Refresh Error	TRUE: Indicates that an I/O Refresh Error occurred while in operation. FALSE: Indicates that an I/O Refresh Error has not occurred while in operation. Default: FALSE

3-2-5   Slave Status 2

The following device variable for CJ-series Unit is used to reference all information of Slave Status 2.

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
*_Slave2Sta	WORD	R	Slave Status 2	Bit 00: Reserved by system
				Bit 01: Available Mailbox Communication
				Bit 02: Input Data Valid
				Bit 03: Output Data Valid
				Bit 04: Reserved by system
				Bit 05: Reserved by system
				Bit 06: Reserved by system
				Bit 07: Reserved by system
				Bit 08: Reserved by system
				Bit 09: Reserved by system
				Bit 10: Reserved by system
				Bit 11: Reserved by system
				Bit 12: Reserved by system
				Bit 13: Reserved by system
				Bit 14: IN Port Link Status
				Bit 15: OUT Port Link Status
				Default: 16#0000

The following device variables for CJ-series Unit are used to reference individual information.

Name of device variables for CJ-series Unit	Type	R/W	Name	Function
*_AvailableMailbox	BOOL	R	Available Mailbox Communica-tion	TRUE: Indicates that mailbox communication is available for the Unit. FALSE: Indicates that mailbox communication is not available for the Unit. Default: FALSE This variable will remain TRUE while the Unit is in Pre-Operational, Safe-Operational or Operational state. This variable will also remain TRUE if the IN port link is not established with another device.
*_InDataValid	BOOL	R	Input Data Valid	TRUE: Indicates that the Unit is processing transmit by process data communication. Data is valid and usable for control. FALSE: Indicates that the Unit is not processing transmit by process data communication. Data is invalid and unusable for control. Default: FALSE This variable will remain TRUE while the Unit is in Safe-Operational state or Operational state. This variable will also remain TRUE if the IN port link is not established with another device. Refer to *A-2 Programming Example to Detect Valid I/O Process Data* on page A-11.

Name of device variables for CJ-series Unit	Type	R/W	Name	Function
*_OutDataValid	BOOL	R	Output Data Valid	TRUE: Indicates that the Unit is processing receive by process data communication. Data is valid and usable for control. FALSE: Indicates that the Unit is not processing receive by process data communication. Data is invalid and unusable for control. Default: FALSE This variable will remain TRUE while the Unit is in Operational state. This variable will also remain TRUE if the IN port link is not established with another device. Refer to *A-2 Programming Example to Detect Valid I/O Process Data* on page A-11.
*_LKSta1	BOOL	R	IN Port Link Status	TRUE: Indicates when a link on the IN port is established with another device. FALSE: Indicates when a link on the IN port is not established with another device. Default: FALSE
*_LKSta2	BOOL	R	OUT Port Link Status	TRUE: Indicates when a link on the OUT port is established with another device. FALSE: Indicates when a link on the OUT port is not established with another device. Default: FALSE

3-3   Device Variables for CJ-series Unit (I/O Communication Area Setting)

This section describes the device variables I/O Communication Area Setting Table and I/O Communication Area Reference Table for the CJ-series Unit.

In this section, the variable names that are created automatically in the I/O Map are used.

3-3-1   List of Device Variables for CJ-series Unit

The following device variables for CJ-series Unit are used to allocate the I/O communications area and to reference the I/O communications area settings. The I/O communication area table is defined by area type, first word and size for IN and OUT areas.

The OUT data area is used to receive (RxPDO) data from the EtherCAT master. The IN data area is used to send (TxPDO) data to the EtherCAT master.

● I/O Communication Area Setting Table

Name of device variable for CJ-series Unit	Type	R/W	Name
*_AlocOutAreaType	BYTE	RW	OUT data area type
*_AlocOutAreaOffset	WORD	RW	First word in OUT data area
*_AlocOutAreaSize	UINT	RW	OUT data area size
*_AlocInAreaType	BYTE	RW	IN data area type
*_AlocInAreaOffset	WORD	RW	First word in IN data area
*_AlocInAreaSize	UINT	RW	IN data area size
*_AlocSta	WORD	R	Setting results

You can use one of the following methods to adjust the I/O Communication Area Setting Table.
- Use Edit Special Unit Settings Tab Page of Sysmac Studio.
- Use a user program.

If it is necessary to change the system settings while the user program is being executed, use the user program to change the system settings.

Precautions for Correct Use

A Unit restart is required after I/O communication allocations are changed or set to enable the settings. The area is updated when the Unit reads the I/O Communication Area Setting Table after power ON or restart.

● **I/O Communication Area Reference Table**

Name of device variable for CJ-series Unit	Type	R/W	Name
*_RefOutAreaType	BYTE	R	OUT data area type
*_RefOutAreaOffset	WORD	R	First word in OUT data area
*_RefOutAreaSize	UINT	R	OUT data area size
*_RefInAreaType	BYTE	R	IN data area type
*_RefInAreaOffset	WORD	R	First word in IN data area
*_RefInAreaSize	UINT	R	IN data area size

The function of each device variable for the CJ-series Unit is explained below.

3-3-2 I/O Communication Area Setting Table

This section describes the device variables for the I/O Communication Area Setting Table.

OUT Data Area Type

Use this device variable to specify the output word data area type that is used for sending data to the EtherCAT master (RxPDO).

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
*_AlocOutAreaType	BYTE	RW	OUT data area type	Specifies the OUT data area memory type. Data range: 16#00 to 14[1] Default: 16#00

*1. Expansion Data Memory (EM) areas vary for NJ-series CPU Unit models. Check the NJ-series CPU Unit specifications for bank availability.

● **Memory Area Codes for the EtherCAT Slave Unit OUT Data Area**

Code	Area type in memory for CJ-series Unit
16#00	---
16#01	CIO Area (CIO)
16#03	Data Memory (DM)
16#04	Work Area (WR)
16#05	Holding Area (HR)
16#08 to 14	Expansion Data Memory (EM) Bank 0 to Bank C[1]

*1. Expansion Data Memory (EM) areas vary for NJ-series CPU Unit models. Check the NJ-series CPU Unit specifications for bank availability.

First Word In OUT Data Area

Use this device variable to specify the starting word that is used for sending data to the EtherCAT master (RxPDO).

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
*_AlocOutAreaOffset	WORD	RW	First word in OUT data area	Specifies the OUT data area starting word. Data range is based on the area type. Refer to *First Output Word in Memory for the EtherCAT Slave Unit OUT Data Area* on page 3-20 for the data range of each area type. Default: 16#0000

● **First Output Word in Memory for the EtherCAT Slave Unit OUT Data Area**

Area type in memory for CJ-series Unit	Word range
---	Do not use
CIO Area (CIO)	16#0000 to 17FF
Data Memory (DM)	16#0000 to 7FFF
Work Area (WR)	16#0000 to 01FF
Holding Area (HR)	16#0000 to 01FF
Expansion Data Memory (EM) Bank 0 to Bank C[1]	16#0000 to 7FFF (E0_00000 to E0_32767, ···, EC_00000 to EC_32767) for all banks

[1]. Expansion Data Memory (EM) areas vary for NJ-series CPU Unit models. Check the NJ-series CPU Unit specifications for bank availability.

OUT Data Area Size

Use this device variable to specify the OUT data area size that is used for sending data to the EtherCAT master (RxPDO). This size must match the EtherCAT master configuration size for RxPDO in bytes.

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
*_AlocOutAreaSize	UINT	RW	OUT data area size	Specifies the OUT data area size. Data selection of 0, 50, 100, 200 or 400 is possible. Default: 0

● **Size of EtherCAT Slave Unit OUT Data Area in Bytes**

Area size	Setting value
0 bytes	0
50 bytes	50
100 bytes	100
200 bytes	200
400 bytes	400

IN Data Area Type

Use this device variable to specify the input word data area type that is used for receiving data from the EtherCAT master (TxPDO).

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
*_AlocInAreaType	BYTE	RW	IN data area type	Specifies the IN data area memory type. Data range: 16#00 to 14[*1] Default: 16#00

*1. Expansion Data Memory (EM) areas vary for NJ-series CPU Unit models. Check the NJ-series CPU Unit specifications for bank availability.

● **Memory Area Codes for the EtherCAT Slave Unit IN Data Area**

Code	Area type in memory for CJ-series Unit
16#00	---
16#01	CIO Area (CIO)
16#03	Data Memory (DM)
16#04	Work Area (WR)
16#05	Holding Area (HR)
16#08 to 14	Expansion Data Memory (EM) Bank 0 to Bank C[*1]

*1. Expansion Data Memory (EM) areas vary for NJ-series CPU Unit models. Check the NJ-series CPU Unit specifications for bank availability.

First Word In IN Data Area

Use this device variable to specify the starting word that is used for receiving data from the EtherCAT master (TxPDO).

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
*_AlocInAreaOffset	WORD	RW	First word in IN data area	Specifies the IN data area starting word. Data range is based on the area type. Refer to *First Input Word in Memory for the EtherCAT Slave Unit IN Data Area* on page 3-22 for the data range of each area type. Default: 16#0000

● First Input Word in Memory for the EtherCAT Slave Unit IN Data Area

Area type in memory for CJ-series Unit	Word range
---	Do not use
CIO Area (CIO)	16#0000 to 17FF
Data Memory (DM)	16#0000 to 7FFF
Work Area (WR)	16#0000 to 01FF
Holding Area (HR)	16#0000 to 01FF
Expansion Data Memory (EM) Bank 0 to Bank C[1]	16#0000 to 7FFF (E0_00000 to E0_32767, ⋯, EC_00000 to EC_32767) for all banks

*1. Expansion Data Memory (EM) areas vary for NJ-series CPU Unit models. Check the NJ-series CPU Unit specifications for bank availability.

IN Data Area Size

Use this device variable to specify the IN data area size that is used for receiving data from the Ether-CAT master (TxPDO). This size must match the EtherCAT master configuration size for TxPDO in bytes.

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
*_AlocInAreaSize	UINT	RW	IN data area size	Specifies the IN data area size. Data selection of 0, 50, 100, 200 or 400 is possible. Default: 0

● **Size of EtherCAT Slave Unit IN Data Area in Bytes**

Area size	Setting value
0 bytes	0
50 bytes	50
100 bytes	100
200 bytes	200
400 bytes	400

Setting Results

Use this device variable to determine the results of the IN and OUT data area configuration.

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
*_AlocSta	WORD	R	Setting results	Indicates that status of the IN and OUT data area configuration. Data range: 16#0000 to FFFF Default: 16#0000

● **Setting Results Codes**

Code	Description	Corrective action
16#0000[*1]	Completed normally.	---
16#1101	Incorrect area setting.	Ensure that the memory area codes for *_AlocOutAreaType and *_AlocInAreaType device variables are set to the allowable values.
16#1103	The first word is outside the setting range.	Ensure that *_AlocOutAreaOffset and *_AlocInAreaOffset are set in valid memory areas for the corresponding memory area type set with the *_AlocInAreaType and *_AlocOutAreaType device variables.
16#1104	The allocated data area exceeds the valid word range.	Ensure that the IN and OUT data area range setting does not exceed valid memory locations for the corresponding memory area type set with the *_AlocInAreaType and *_AlocOutAreaType device variables.
16#110C	The area size is outside the setting range.	Ensure that *_AlocOutAreaSize and *_AlocInAreaSize device variables are set to allowable values for the corresponding memory area type set with the *_AlocInAreaType and *_AlocOutAreaType device variables.

*1. If the EtherCAT Slave Unit is set with default values, the setting result code will be 16#0000 and the Unit cannot perform process data communications with the EtherCAT master.

Precautions for Correct Use

- A Unit restart is required after I/O communication allocations are changed or set to enable the new settings.
- If the user sets both IN and OUT data area sizes to zero or the I/O allocation settings are invalid, the Unit will be in the Pre-Operational state and cannot perform process data communications with the EtherCAT master.
- Select valid areas in the CPU Unit that do not interfere or overlap with another memory area that is already in use. Also ensure the size of the area is within a valid memory area by properly setting the first word and size values for the memory type selected. Otherwise, an incorrect area setting result will occur.
- EM memory area availability and size vary depending on the CPU Unit series and model type. Refer to the operation manuals of the CPU Units for details on the EM memory area specification.

3-3-3 I/O Communication Area Reference Table

This section describes the device variables for the I/O Communication Area Reference Table.

OUT Data Area Type

Use this device variable to refer to the output word data area type that is allocated for sending data to the EtherCAT master (RxPDO).

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
*_RefOutAreaType	BYTE	R	OUT data area type	References the OUT data area memory type. Data range: 16#00 to 14[1] Default: 16#00

*1. Expansion Data Memory (EM) areas vary for NJ-series CPU Unit models. Check the NJ-series CPU Unit specifications for bank availability.

● **Reference Memory Area Codes for the EtherCAT Slave Unit OUT Data Area**

Code	Area type in memory for CJ-series Unit
16#00	---
16#01	CIO Area (CIO)
16#03	Data Memory (DM)
16#04	Work Area (WR)
16#05	Holding Area (HR)
16#08 to 14	Expansion Data Memory (EM) Bank 0 to Bank C[1]

*1. Expansion Data Memory (EM) areas vary for NJ-series CPU Unit models. Check the NJ-series CPU Unit specifications for bank availability.

First Word In OUT Data Area

Use this device variable to refer to the starting word that is allocated for sending data to the EtherCAT master (RxPDO).

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
*_RefOutAreaOffset	WORD	R	First word in OUT data area	References the OUT data area starting word. Data range is based on the area type. Refer to *Reference First Output Word in Memory for the EtherCAT Slave Unit OUT Data Area* on page 3-25 for the data range of each area type. Default: 16#0000

● **Reference First Output Word in Memory for the EtherCAT Slave Unit OUT Data Area**

Area type in memory for CJ-series Unit	Word range
---	Do not use
CIO Area (CIO)	16#0000 to 17FF
Data Memory (DM)	16#0000 to 7FFF
Work Area (WR)	16#0000 to 01FF
Holding Area (HR)	16#0000 to 01FF
Expansion Data Memory (EM) Bank 0 to Bank C[1]	16#0000 to 7FFF (E0_00000 to E0_32767, ···, EC_00000 to EC_32767) for all banks

*1. Expansion Data Memory (EM) areas vary for NJ-series CPU Unit models. Check the NJ-series CPU Unit specifications for bank availability.

OUT Data Area Size

Use this device variable to refer to the OUT data area size that is allocated for sending data to the EtherCAT master (RxPDO).

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
*_RefOutAreaSize	UINT	R	OUT data area size	References the OUT data area size. Data range of 0, 50, 100, 200 or 400 is possible. Default: 0

● **Reference Size of EtherCAT Slave Unit OUT Data Area in Bytes**

Area size	Reference value
0 bytes	0
50 bytes	50
100 bytes	100
200 bytes	200
400 bytes	400

IN Data Area Type

Use this device variable to refer to the input word data area type that is allocated for receiving data from the EtherCAT master (TxPDO).

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
*_RefInAreaType	BYTE	R	IN data area type	References the IN data memory area. Data range: 16#00 to 14[*1] Default: 16#00

*1. Expansion Data Memory (EM) areas vary for NJ-series CPU Unit models. Check the NJ-series CPU Unit specifications for bank availability.

● **Reference Memory Area Codes for the EtherCAT Slave Unit IN Data Area**

Code	Area type in memory for CJ-series Unit
16#00	---
16#01	CIO Area (CIO)
16#03	Data Memory (DM)
16#04	Work Area (WR)
16#05	Holding Area (HR)
16#08 to 14	Expansion Data Memory (EM) Bank 0 to Bank C[*1]

*1. Expansion Data Memory (EM) areas vary for NJ-series CPU Unit models. Check the NJ-series CPU Unit specifications for bank availability.

First Word In IN Data Area

Use this device variable to refer to the starting word that is allocated for receiving data from the EtherCAT master (TxPDO).

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
*_RefInAreaOffset	WORD	R	First word in IN data area	References the IN data area starting word. Data range is based on the area type. Refer to *Reference First Input Word in Memory for the EtherCAT Slave Unit IN Data Area* on page 3-27 for the data range of each area type. Default: 16#0000

● Reference First Input Word in Memory for the EtherCAT Slave Unit IN Data Area

Area type in memory for CJ-series Unit	Word range
---	Do not use
CIO Area (CIO)	16#0000 to 17FF
Data Memory (DM)	16#0000 to 7FFF
Work Area (WR)	16#0000 to 01FF
Holding Area (HR)	16#0000 to 01FF
Expansion Data Memory (EM) Bank 0 to Bank C[1]	16#0000 to 7FFF (E0_00000 to E0_32767, ···, EC_00000 to EC_32767) for all banks

*1. Expansion Data Memory (EM) areas vary for NJ-series CPU Unit models. Check the NJ-series CPU Unit specifications for bank availability.

IN Data Area Size

Use this device variable to refer to the IN data area size that is allocated for receiving data from the EtherCAT master (TxPDO).

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
*_RefInAreaSize	UINT	R	IN data area size	References the IN data area size. Data range of 0, 50, 100, 200 or 400 is possible. Default: 0

● **Reference Size of EtherCAT Slave Unit IN Data Area in Bytes**

Area size	Reference value
0 bytes	0
50 bytes	50
100 bytes	100
200 bytes	200
400 bytes	400

3-4   I/O Communication Area Settings

This section describes the I/O communication area settings, such as IN and OUT data area type, starting word and size for the EtherCAT Slave Unit with the Sysmac Studio.

3-4-1   The Unit Edit Special Unit Settings Tab Page

The Edit Special Unit Settings Tab Page of EtherCAT Slave Unit is used for setting and referencing the I/O communication area table.

The Edit Special Unit Settings Tab Page has two tables.

• I/O Communication Area Setting Table
• I/O Communication Area Reference Table

I/O Communication Area Setting Table

Item name	Setting method	Description	Data range	Default
OUT data area type	Pull down list	Memory area type used for CJ-series Unit as RxPDO data from the EtherCAT master	• Do not use • CIO Area • Data Memory • Work Area • Holding Relay • Expansion Data Memory Bank 0 to C	Do not use
First word in OUT data area	Direct input	Starting word of the OUT data area used for CJ-series Unit	Ranges vary by OUT data area type. • CIO: 0000 to 17FF hex • DM: 0000 to 7FFF hex • WR: 0000 to 01FF hex • HR: 0000 to 01FF hex • EM: 0000 to 7FFF hex[*1]	16#0000
OUT data area size	Pull down list	OUT data area size in bytes	• 0 byte • 50 byte • 100 byte • 200 byte • 400 byte	0 byte
IN data area type	Pull down list	Memory area type used for CJ-series Unit as TxPDO data to the EtherCAT master	• Do not use • CIO Area • Data Memory • Work Area • Holding Relay • Expansion Data Memory Bank 0 to C	Do not use
First word in IN data area	Direct input	Starting word of the IN data area used for CJ-series Unit	Ranges vary by IN data area type. • CIO: 0000 to 17FF hex • DM: 0000 to 7FFF hex • WR: 0000 to 01FF hex • HR: 0000 to 01FF hex • EM: 0000 to 7FFF hex[*1]	16#0000
IN data area size	Pull down list	IN data area size in bytes	• 0 byte • 50 byte • 100 byte • 200 byte • 400 byte	0 byte

*1. Expansion Data Memory (EM) areas are not available for all NJ-series CPU Units. Refer to the operation manuals of the CPU Units for details on the EM memory area specification.

I/O Communication Area Reference Table

Item name	Setting method	Description	Data range	Default
OUT data area type	Read Only	Reference memory area type used for CJ-series Unit as RxPDO data from the Ether-CAT master	• Do not use • CIO Area • Data Memory • Work Area • Holding Relay • Expansion Data Memory Bank 0 to C	Do not use
First word in OUT data area		Reference starting word of the OUT data area used for CJ-series Unit	Ranges vary by OUT data area type. • CIO: 0000 to 17FF hex • DM: 0000 to 7FFF hex • WR: 0000 to 01FF hex • HR: 0000 to 01FF hex • EM: 0000 to 7FFF hex[*1]	16#0000
OUT data area size		Reference OUT data area size in bytes	• 0 byte • 50 byte • 100 byte • 200 byte • 400 byte	0 byte
IN data area type		Reference memory area type used for CJ-series Unit as TxPDO data to the EtherCAT master	• Do not use • CIO Area • Data Memory • Work Area • Holding Relay • Expansion Data Memory Bank 0 to C	Do not use
First word in IN data area		Reference starting word of the IN data area used for CJ-series Unit	Ranges vary by IN data area type. • CIO: 0000 to 17FF hex • DM: 0000 to 7FFF hex • WR: 0000 to 01FF hex • HR: 0000 to 01FF hex • EM: 0000 to 7FFF hex[*1]	16#0000
IN data area size		Reference IN data area size in bytes	• 0 byte • 50 byte • 100 byte • 200 byte • 400 byte	0 byte

*1. Expansion Data Memory (EM) areas are not available for all NJ-series CPU Units. Refer to the operation manuals of the CPU Units for details on the EM memory area specification.

3-4-2   Setting Procedure with the Sysmac Studio

This section provides the setting procedure of the I/O Communication Area Setting Table with the Sysmac Studio.

1   Register the EtherCAT Slave Unit in the Unit configuration in **Configurations and Setup - CPU/Expansion Racks**.

Double-click the EtherCAT Slave Unit or right-click the EtherCAT Slave Unit and select **Edit Special Unit Settings** from the menu.

Refer to the *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504).
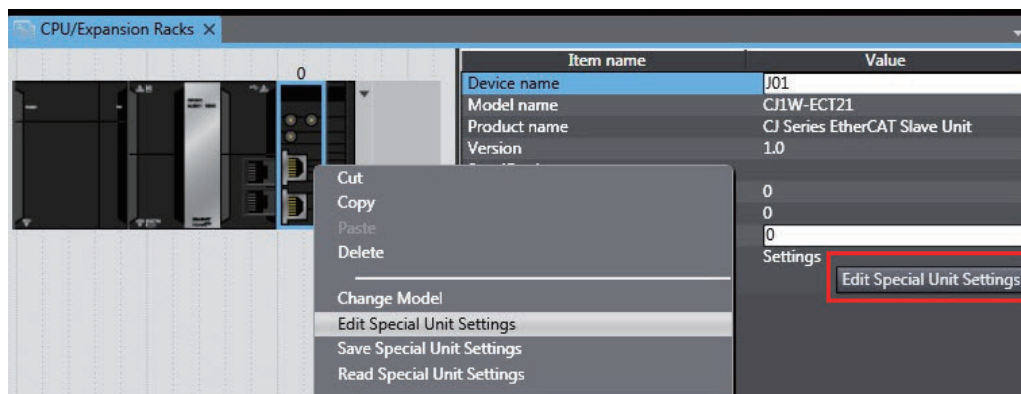
The Edit Special Unit Settings Tab Page will be displayed.

2 Set the I/O Communication Area Setting Table on the Edit Special Unit Settings Tab Page.

I/O Communication Area Setting Table

3 Establish communications with the NJ-series Controller and go online. Download the CPU/Expansion Rack configuration and settings for the EtherCAT Slave Unit. Use the synchronization operation of the Sysmac Studio to download the data.

Clear the selection of the following (all items are not transferred).

- CJ-series Special Unit parameters and EtherCAT slave backup parameters.
- Slave Terminal Unit operation settings and NX Unit application data.

After downloading the settings, the EtherCAT Slave Unit will automatically restart to enable the settings.

4 Check the indicators on the EtherCAT Slave Unit.

If the RUN indicator is lit while the ERC and ERH indicators are not lit, it indicates that the Ether-CAT Slave Unit has recognized the new I/O communication area settings. Refer to *Setting Results Codes* on page 3-23.

5 Check the I/O Communications Area Reference Table values in the Edit Special Unit Settings Tab Page.

Click the **Compare** Button. If the compare is successful, click the **Transfer from Controller** Button to update the I/O Communications Area Reference Table values. If the compare is unsuccessful, transfer the settings again. Refer to the *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504) for the comparison and transfer of the Special Unit setting procedure.
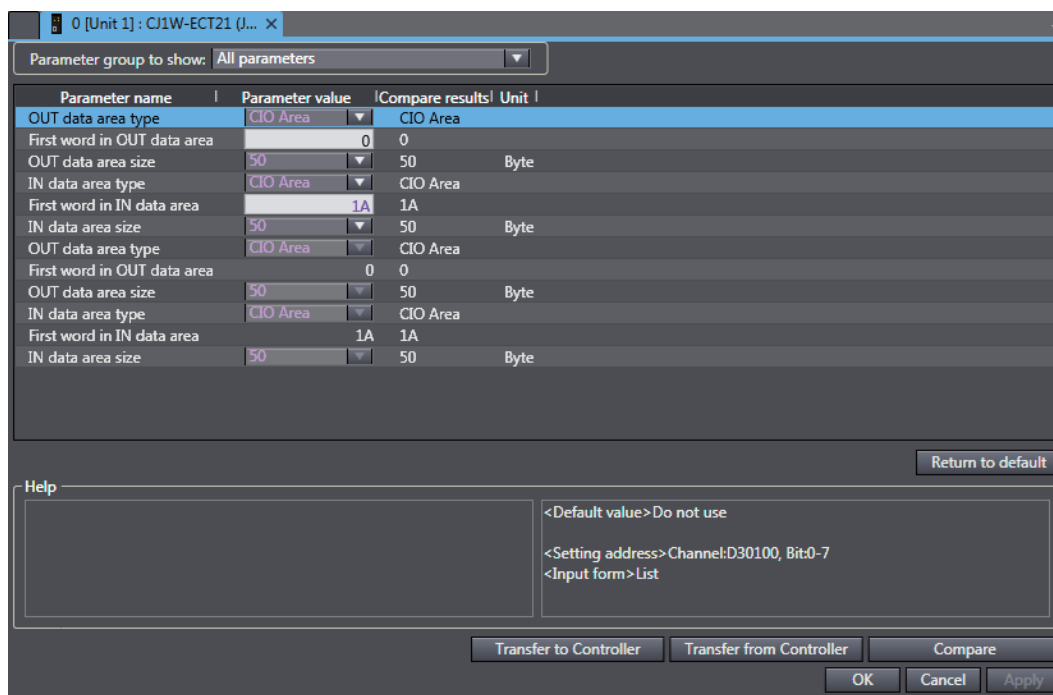
Precautions for Safe Use

- If the node address is not set correctly, invalid device parameters may be set in the wrong EtherCAT Slave Unit, so check the connected Unit before downloading parameters.

- The EtherCAT Slave Unit must restart in order to enable the parameter settings that are transferred to it. Verify that restarting the Unit will not cause any problems in the system before restarting it.
  If the synchronization operation of the Sysmac Studio is used for downloading, the EtherCAT Slave Unit restarts automatically.

4

EtherCAT Communications

This section provides an introduction to EtherCAT communications and EtherCAT communication performance details.

4-1 Structure of CAN Application Protocol over EtherCAT (CoE)

EtherCAT allows the use of multiple protocols for communications. However, the EtherCAT Slave Unit uses the CAN application protocol over EtherCAT (CoE) as the device profile for the CAN application protocol. The CoE is a communications interface that is designed to provide compatibility with EtherCAT devices. The CAN application protocol is an open network standard.

The following figure shows how the CoE is structured for an EtherCAT Slave Unit.

```
┌─────────────────────────────────────────────────────────────┐
│ EtherCAT Slave Unit                                          │
│  ┌────────────────────────────────────────────────────────┐ │
│  │ Application layer          ┌──────────────────────────┐ │ │
│  │                            │   Slave Unit application │ │ │
│  │                            └──────────────────────────┘ │ │
│  │                                        ⇕                 │ │
│  │                            ┌──────────────────────────┐ │ │
│  │                            │    Object dictionary     │ │ │
│  │                            └──────────────────────────┘ │ │
│  │  ┌──────────┐  ┌───────────────┐  ┌──────────────────┐ │ │
│  │  │Transitions│  │ SDO (mailbox) │  │  PDO mappings    │ │ │
│  │  │ of comms  │  │               │  ├──────────────────┤ │ │
│  │  │  states   │  │               │  │PDO comms (cyclic)│ │ │
│  │  └──────────┘  └───────────────┘  └──────────────────┘ │ │
│  └────────────────────────────────────────────────────────┘ │
│        ⇕                 ⇕                    ⇕               │
│  ┌────────────────────────────────────────────────────────┐ │
│  │ ┌──────────┐  ┌───────────────┐  ┌──────────────────┐  │ │
│  │ │ Registers│  │    Mailbox    │  │   Process data   │  │ │
│  │ └──────────┘  └───────────────┘  └──────────────────┘  │ │
│  │           ┌─────────────┐   ┌──────────┐               │ │
│  │           │ SyncManager │   │   FMMU   │               │ │
│  │           └─────────────┘   └──────────┘               │ │
│  │              EtherCAT data link layer                   │ │
│  └────────────────────────────────────────────────────────┘ │
│  ┌────────────────────────────────────────────────────────┐ │
│  │              EtherCAT physical layer                     │ │
│  └────────────────────────────────────────────────────────┘ │
└─────────────────────────────────────────────────────────────┘
```
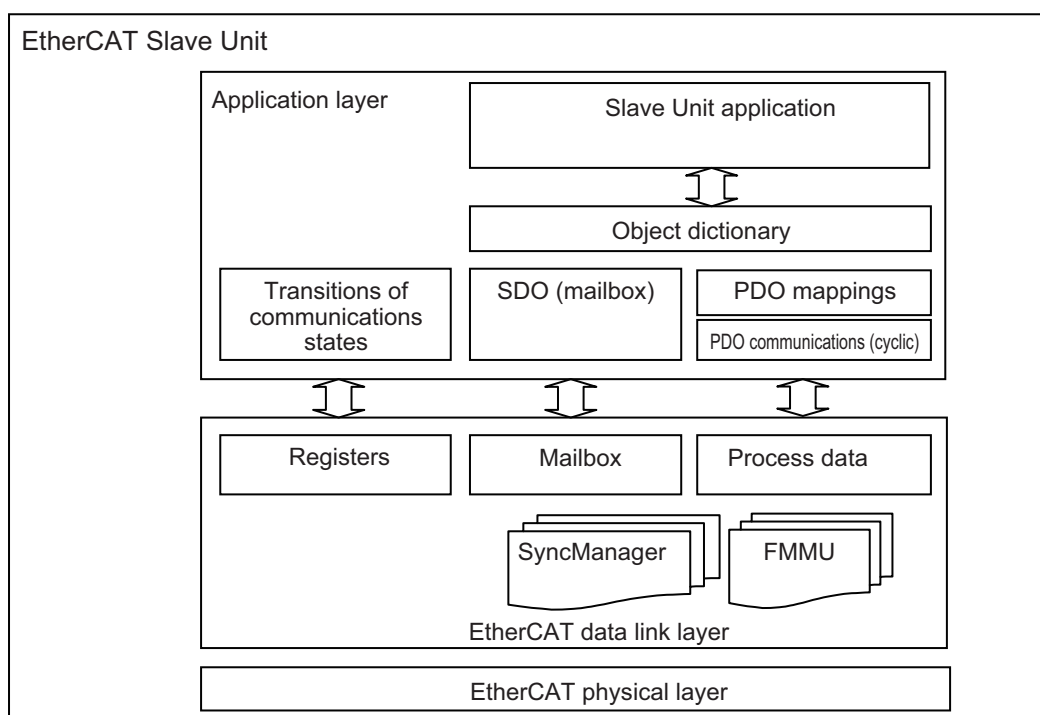
The object dictionary for the CAN application protocol is broadly divided into PDOs (process data objects) and SDOs (service data objects).

PDOs are contained in the object dictionary. The PDOs can be mapped in the object dictionary. The process data is defined by the PDO mappings. PDOs are used in PDO communications for periodic exchange of process data.

SDOs are the objects that can be read and written. SDOs are used in non-periodic SDO communications (event-driven message communications).

If you use the CoE interface to set the object dictionary for PDOs and SDOs, you can provide EtherCAT devices with the same device profiles as the CAN application protocol.

4-2   EtherCAT Slave Information Files (ESI Files)

The setting information for an EtherCAT slave is provided in an ESI file (EtherCAT slave information). The EtherCAT communications settings are defined based on the ESI files of the connected slaves and the network connection information.

You can create the network configuration information by installing ESI files into the network setup software (Configuration Software).

You can download the network configuration information to the EtherCAT master to configure the EtherCAT network.
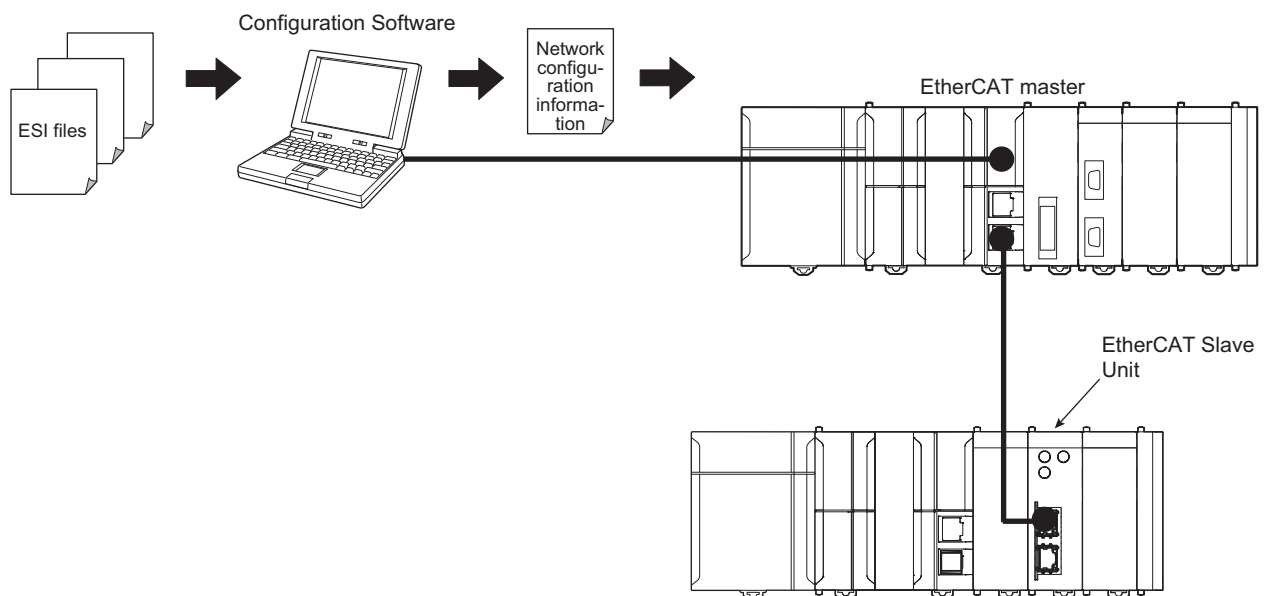
Communications are started according to the communications settings and the network configuration based on the ESI files that are installed.

ESI files for the EtherCAT Slave Units can be downloaded from the OMRON website.

4-3   Transitions of Communications States

The state transition model for communications control of the EtherCAT Slave Units is controlled by the EtherCAT master.

The following figure shows the communications state transitions from when the power supply is turned ON.
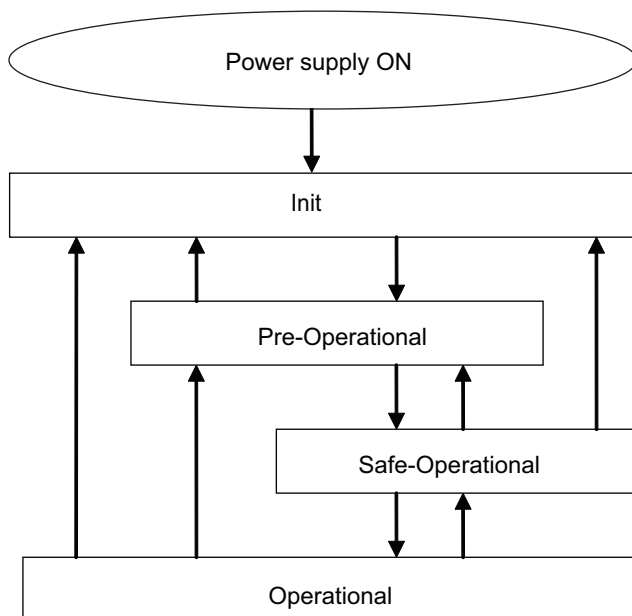
Status	SDO communications	Sending PDOs	Receiving PDOs	Description
Init	Not possible	Not possible	Not possible	Communications are being initialized. Communications are not possible.
Pre-Operational	Possible	Not possible	Not possible	Only SDO communications (message communications) are possible in this state. This state is entered after initialization is completed. It is used to initialize network settings.
Safe-Operational	Possible	Possible	Not possible	In this state, both SDO communications (message communications) and sending PDOs are possible. Information, such as status, is sent from the EtherCAT Slave Unit.
Operational	Possible	Possible	Possible	This is the normal state for communications. PDO communications are used to control the I/O data.

4-4   Process Data Objects (PDOs)

This section describes the process data objects that are used by the EtherCAT Slave Unit.

4-4-1   Introduction

Process data objects (PDOs) are used to transfer data during cyclic communications in real time.

There are two types of process data objects (PDOs): the RxPDOs, which are used by the EtherCAT Slave Unit to receive data from the EtherCAT master; and the TxPDOs, which are used by the Ether-CAT Slave Unit to send data to the EtherCAT master.
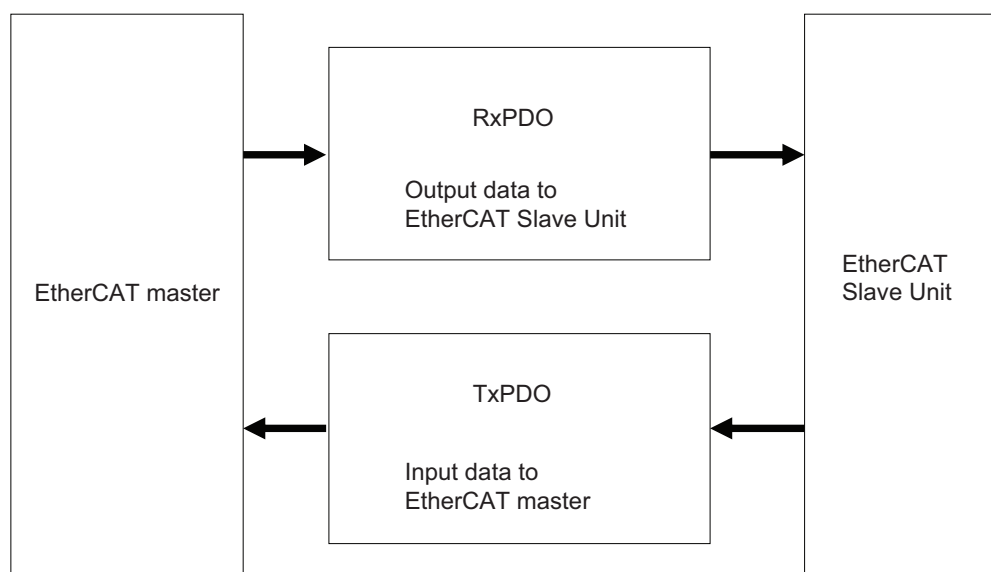
The EtherCAT application layer can hold more than one object to enable the transfer of various process data of the EtherCAT Slave Unit.

The contents of the process data are defined in the PDO mapping objects.

EtherCAT Slave Units support PDO mapping for I/O control.

4-4-2   PDO Mappings

PDO mapping objects contain the I/O data for the EtherCAT Slave Units. PDO mapping objects for the RxPDOs are managed in the object dictionary from indexes 1600 to 17FF hex. The TxPDOs are managed in the object dictionary from indexes 1A00 to 1BFF hex.

PDO Mapping Scheme in EtherCAT

The PDO mapping scheme in EtherCAT is described below.

Three application objects (A, B, and D) are allocated to the PDO (name: PDO_1) at index 1ZZZ hex.

As described here, PDO mapping shows how application objects are assigned to PDOs.

Indexes and subindexes are also assigned to application objects.
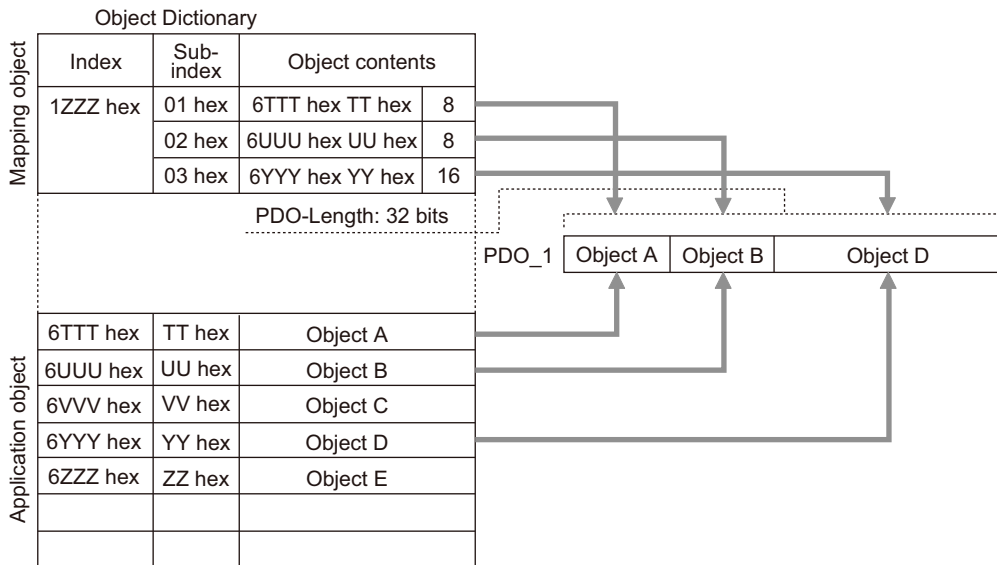
PDO Mapping with EtherCAT Slave Units

EtherCAT Slave Units have fixed PDO mapping and adjustments to the application objects are not possible. The fixed PDO mapping of the EtherCAT Slave Units is provided in the table below.

● RxPDO

PDO mapping object		I/O Output Data Area object[1]			Description
Name	**Index number**	**Name**	**Index number**	**Sub-index number**	
257th receive PDO Mapping	1700 hex	Output001 to Output025	7000 hex	01 to 19 hex	OUT data area size is 50 bytes.
258th receive PDO Mapping	1701 hex	Output001 to Output050		01 to 32 hex	OUT data area size is 100 bytes.
259th receive PDO Mapping	1702 hex	Output001 to Output100		01 to 64 hex	OUT data area size is 200 bytes.
260th receive PDO Mapping	1703 hex	Output001 to Output200		01 to C8 hex	OUT data area size is 400 bytes.

*1. The I/O Output Data Area object is the application object of the PDO mapping.

● **TxPDO**

PDO mapping object		I/O Input Data Area object[1]			Description
Name	Index number	Name	Index number	Sub-index number	
257th transmit PDO Mapping	1B00 hex	Input001 to Input025	6000 hex	01 to 19 hex	IN data area size is 50 bytes.
258th transmit PDO Mapping	1B01 hex	Input001 to Input050		01 to 32 hex	IN data area size is 100 bytes.
259th transmit PDO Mapping	1B02 hex	Input001 to Input100		01 to 64 hex	IN data area size is 200 bytes.
260th transmit PDO Mapping	1B03 hex	Input001 to Input200		01 to C8 hex	IN data area size is 400 bytes.

*1. The I/O Input Data Area object is the application object of the PDO mapping.

4-4-3   Assigning PDOs

This section provides details for assigning PDOs to an EtherCAT slave.

Scheme for Assigning PDOs to EtherCAT Slaves

You can assign more than one PDO to an EtherCAT slave.

Here, PDOs are assigned to index 1C12 hex for the RxPDO, and 1C13 hex for the TxPDO.

The following example shows how PDOs are assigned.
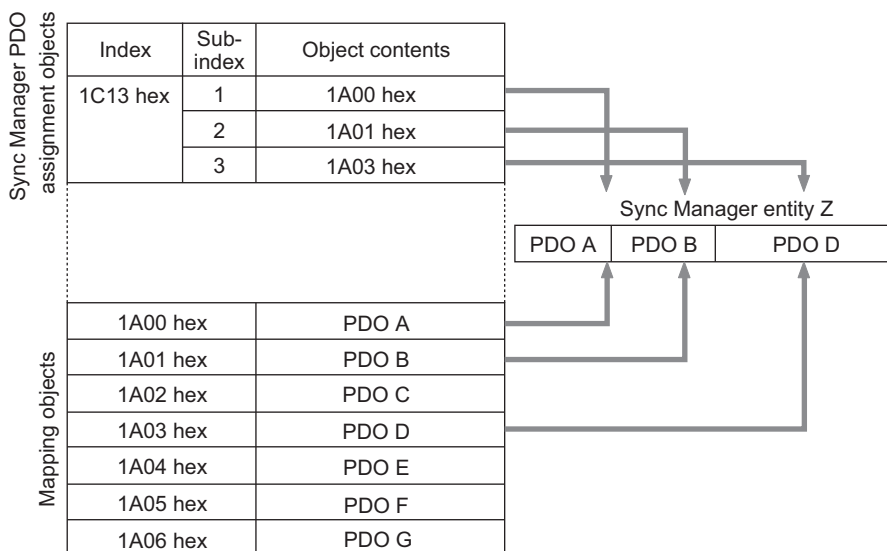
In this example, three PDOs (PDO A, PDO B, and PDO D) are assigned to index 1C13 hex (for the TxPDOs).

Similarly, a PDO (for the RxPDO) is assigned to index 1C12 hex.

These assignments determine the PDOs to use for communications between the EtherCAT master and slave.

Assigning PDOs to EtherCAT Slave Units

When assigning PDOs to the EtherCAT Slave Unit, refer to the IN and OUT data area size that have been configured for the EtherCAT Slave Unit.

Assign PDOs of the same size as the setting value. PDOs are not assigned by default to an EtherCAT Slave Unit. An example is shown in the table below.

I/O communication area reference table			PDO assignment
Name	Name of device variable for CJ-series Unit	Value	
OUT data area size	*_RefOutAreaSize	100 (100 bytes)	258th receive PDO Mapping
IN data area size	*_RefInAreaSize	50 (50 bytes)	257th transmit PDO Mapping

Refer to *3-3 Device Variables for CJ-series Unit (I/O Communication Area Setting)* on page 3-18 for the I/O Communication Area Reference Table.

Refer to *4-4-2 PDO Mappings* on page 4-5 for PDO Mapping of the EtherCAT Slave Unit.

Precautions for Correct Use

The IN and OUT data area size allocation for the EtherCAT Slave Unit must be the same size as the PDO mapping for the EtherCAT master. Refer to *3-3 Device Variables for CJ-series Unit (I/O Communication Area Setting)* on page 3-18 for more information. If the sizes do not match, an error will occur.

4-5   Service Data Objects (SDOs)

This section describes the service data objects that are supported by the EtherCAT Slave Unit.

4-5-1   Introduction

EtherCAT Slave Units support SDO communications.

The EtherCAT master can read and write data from and to entries in the object dictionary with SDO communications to make parameter settings and monitor status.

Refer to *A-5 CoE Objects* on page A-22 for the objects that you can use with SDO communications.

4-5-2   Abort Codes

The following table lists the abort codes for the SDO communications errors.

Value	Meaning
06010000 hex	Unsupported access to an object.
06010002 hex	Attempt to write to a read-only object.
06020000 hex	The object does not exist in the object directory.
06040041 hex	The object cannot be mapped to the PDO.
06040042 hex	Number/length of mapped objects exceeds PDO length.
06070010 hex	Data type does not match, length of service parameter does not match.
06090011 hex	Missing subindex.
06090030 hex	Value of parameter exceeded range (only for write access).

4-6   Communications Performance

This section describes the PDO I/O response times and message response time for the EtherCAT Slave Unit.

4-6-1   I/O Response Time

This section describes the method for calculating the maximum I/O response time of the EtherCAT Slave Unit.

The I/O response time is the time from when the NJ-series CPU Unit processes the output data from the EtherCAT master until the EtherCAT master inputs the processed result.

Timing Chart for I/O Response Time

A timing chart for the I/O response time is provided in the figure below. Use this timing chart with the provided formula to determine the maximum I/O response time.

I/O: I/O refreshing
UPG: User program execution
MC: Motion control
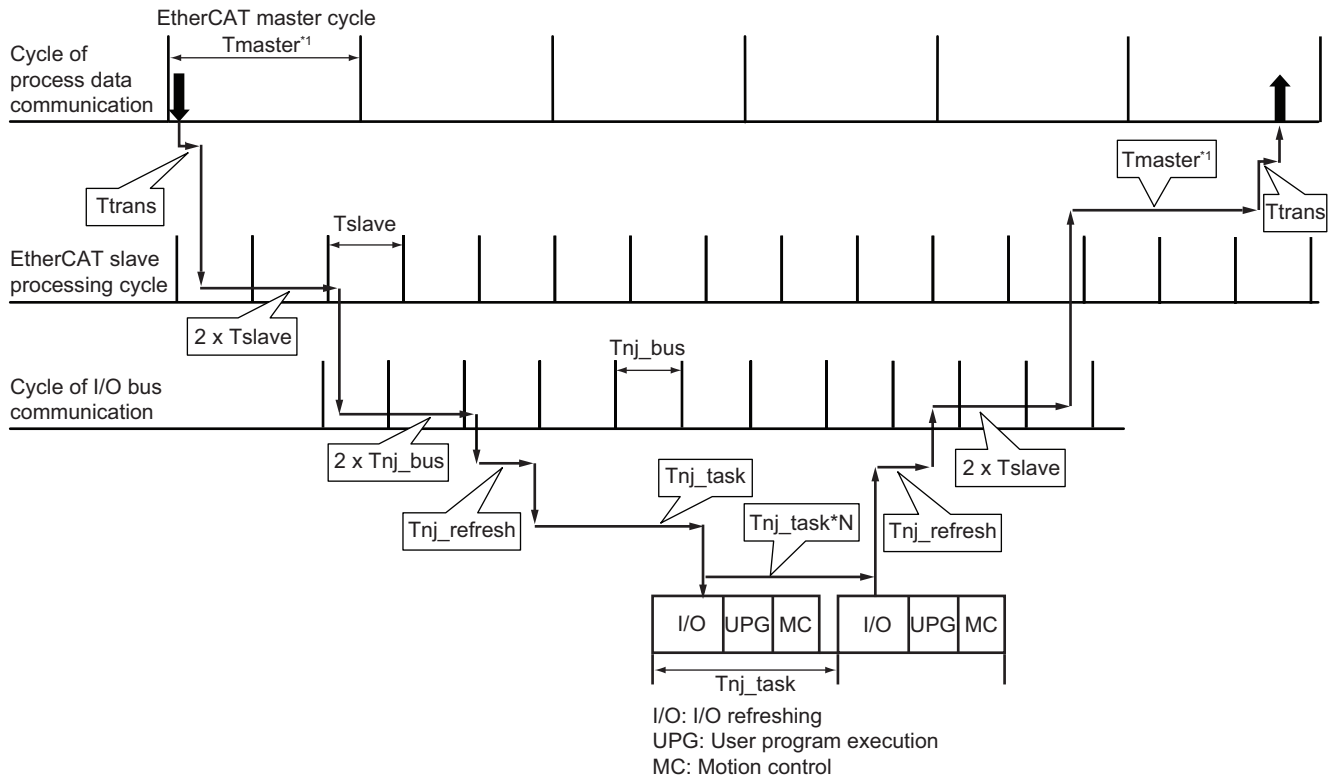
Element	Description
Tmaster[1]	Cycle time of the EtherCAT master
Tslave	Processing time of the EtherCAT Slave Unit
Tnj_task	Task period of the primary periodic task for the CPU Unit with a mounted EtherCAT Slave Unit
Ttrans	Transmission time of the EtherCAT master
Tnj_bus	The I/O bus communication cycle in the NJ-series CPU Unit
Tnj_refresh	Refresh time when the NJ-series CPU Unit exchanges the process data with the I/O bus

*1. The cycle time of the EtherCAT master is based on the assumption that the EtherCAT master cycle is the same as the cycle of process data communication. Refer to the EtherCAT master manual about the relationship between these cycles.

I/O Response Time Formula

A formula is provided below to calculate the I/O response time.

> Maximum I/O Response Time =   Tmaster + (4 x Tslave) + ((1 + N) x Tnj_task) + (2 x Tnj_bus) +
> (2 x Ttrans) + (2 x Tnj_refresh)

The elements used in the maximum I/O response time formula are described below. Units of these elements are in ms.

● Tmaster

The cycle time of the EtherCAT master is assumed to be the same as the process data communication cycle.

Use the process data communication cycle that is set in the EtherCAT master.

● Tslave

The EtherCAT Slave Unit processing time can be calculated with the formula below.

> Tslave =   1.5 + (0.0007 x (IN data area size + OUT data area size))

Units of IN and OUT data area size are in channels (CH).

● Tnj_task

This is the time that is set for the task period of the primary periodic task in the CPU Unit that is connected to the EtherCAT Slave Unit. The value of N can be found with the following information.

• If the task period is ≤ 1.000 ms, use a value of 2 for N.
• If the task period is > 1.000 ms, use a value of 1 for N.

● Tnj_bus

The I/O bus communication cycle in the NJ-series CPU Unit can be calculated with the formula below.

> Tnj_bus = (Number of CPU Bus Units + 1) / Task period

● Ttrans

The transmission time of the EtherCAT master can be calculated with the formula below.

> Ttrans = ((1.24 x Number of EtherCAT slaves) + (0.09 x EtherCAT frame length in bytes)) / 1000

The number of EtherCAT slaves represents the number of EtherCAT slaves that are present on the same EtherCAT network. An EtherCAT Slave Unit is considered to be one EtherCAT slave.

The EtherCAT frame length in bytes represents the data byte size of the EtherCAT frame on the same EtherCAT network.

● **Tnj_refresh**

The refresh time while the NJ-series CPU Unit exchanges the process data with the I/O bus can be calculated with the following formula.

Tnj_refresh = 0.2 + (0.0007 x (IN data area size + OUT data area size))

Units of IN and OUT data area size are in channels (CH).

4-6-2   SDO Message Response Time

This section describes the method for calculating the SDO message response time of the EtherCAT Slave Unit.

The message response time is the time from when the EtherCAT master sends the SDO data with the mailbox until it receives the SDO response from the target EtherCAT Slave Unit.

Timing Chart for SDO Message Response Time

A timing chart for the SDO message response time is provided in the figure below. Use this timing chart with the provided formula to determine the minimum SDO message response time.
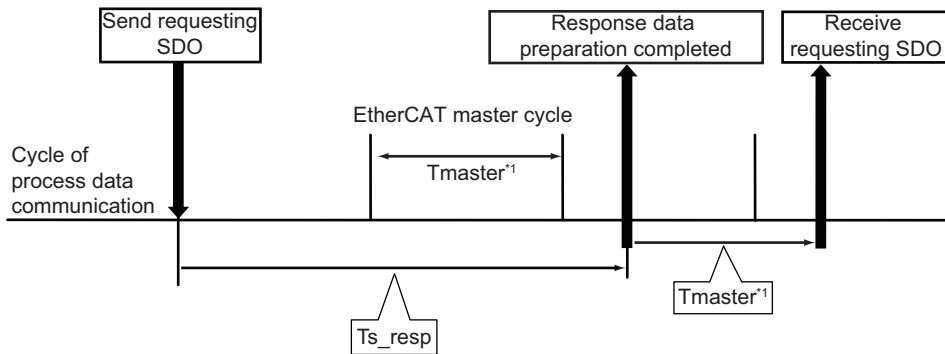
Element	Description
Ts_resp	EtherCAT Slave Unit message response time is 2 ms.
Tmaster[1]	Cycle time of the EtherCAT master

*1. The cycle time of the EtherCAT master is based on the assumption that the EtherCAT master cycle is the same as the cycle of process data communication. Refer to the EtherCAT master manual about the relationship between these cycles.

Minimum SDO Message Response Time Formula

A formula is provided below to calculate the SDO message response time.

Minimum SDO Message Response Time = (((Ts_resp / Tmaster) + 1[1]) x Tmaster) +
(((data byte size of response message / 512) + 1[2]) x Tmaster) + Tmaster

---

*1. If Tmaster divides Ts_resp evenly, there is no need to add 1 in the formula.

*2. If 512 divides the data byte size of the message response evenly, there is no need to add 1.

The elements used in the minimum SDO message response time formula are described below. Units of these elements are in ms.

● **Tmaster**

The cycle time of the EtherCAT master is assumed to be the same as process data communication cycle.

Use the process data communication cycle that is set in the EtherCAT master.

● **Ts_resp**

This is the time from when the message request is received until the EtherCAT Slave Unit completes generating the response.

5

Troubleshooting

There are several ways to check errors on an EtherCAT Slave Unit. If an error occurs, refer to this section to troubleshoot the error.

5-1   Error Notification and Check Methods

This section describes error notification, checking methods and procedures when an error has occurred in the EtherCAT Slave Unit.

5-1-1   Error Notification Methods

The EtherCAT Slave Unit uses the following methods to notify the NJ-series CPU Unit or EtherCAT master that errors have occurred.

EtherCAT master

Notification to the master:
• Emergency message
• AL status

Indicators

NJ-series
CPU Unit

CJ-series
EtherCAT Slave Unit
CJ1W-ECT21

Notification to the NJ-series CPU Unit:

• Unit status

• Slave status

• Event log
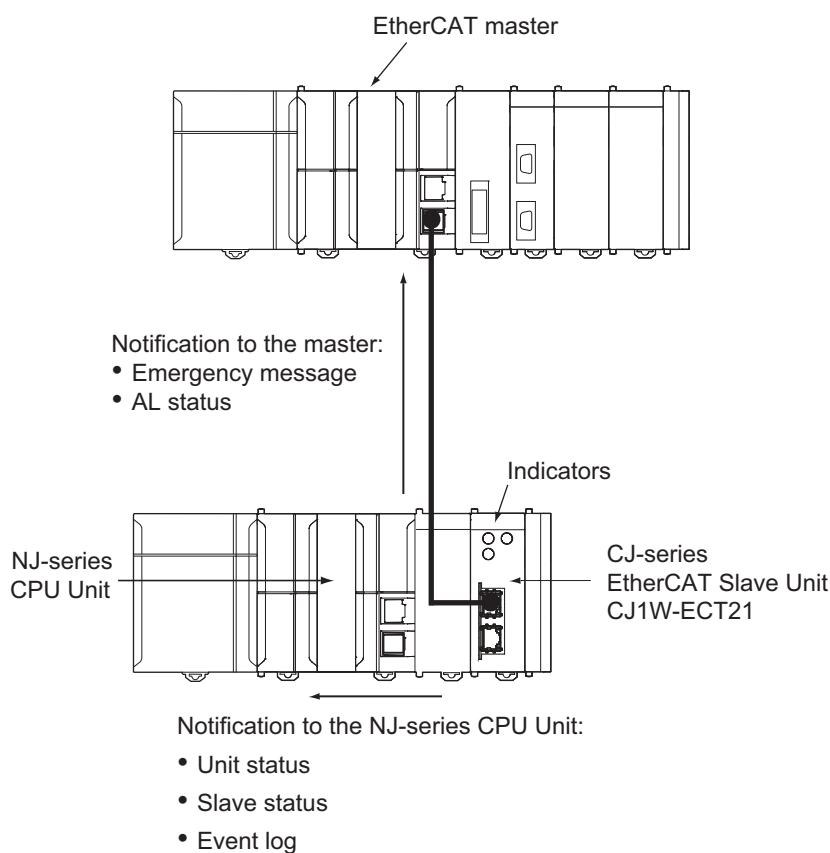
Type of error notification	Overview	Notification method
Emergency message	The emergency message reports application level errors. The error code contains the CiA-defined error code, and an additional error code in the unique header area.	When an error occurs, the EtherCAT Slave Unit notifies the EtherCAT master.
AL status	This status reports errors related to EtherCAT communications. The ETG-defined method is used for the error detection and error code.	When an error occurs, the error is written to the AL status register to notify the EtherCAT master.

Type of error notification	Overview	Notification method
Unit status, Slave status	The status of the EtherCAT Slave Unit allotted to device variables for the CJ-series Unit is notified.	When an error occurs, the EtherCAT Slave Unit notifies the NJ-series CPU Unit.
Event log	A record of EtherCAT Slave Unit errors and information detected by the NJ-series CPU Unit. Use the same methods to manage all of the events that occur on the NJ-series Controller.	When an error occurs, the EtherCAT Slave Unit notifies the NJ-series CPU Unit.
Indicators	These are the indicators on the Ether-CAT Slave Unit.	---

5-1-2 How to Check for Errors

Use the following methods to check the status of errors on the EtherCAT Slave Unit.

Configuration Software
• AL status
• Emergency message

EtherCAT master

Sysmac Studio
• Event log
• Error log

Indicators

CJ-series
EtherCAT Slave Unit
CJ1W-ECT21

NJ-series
CPU Unit
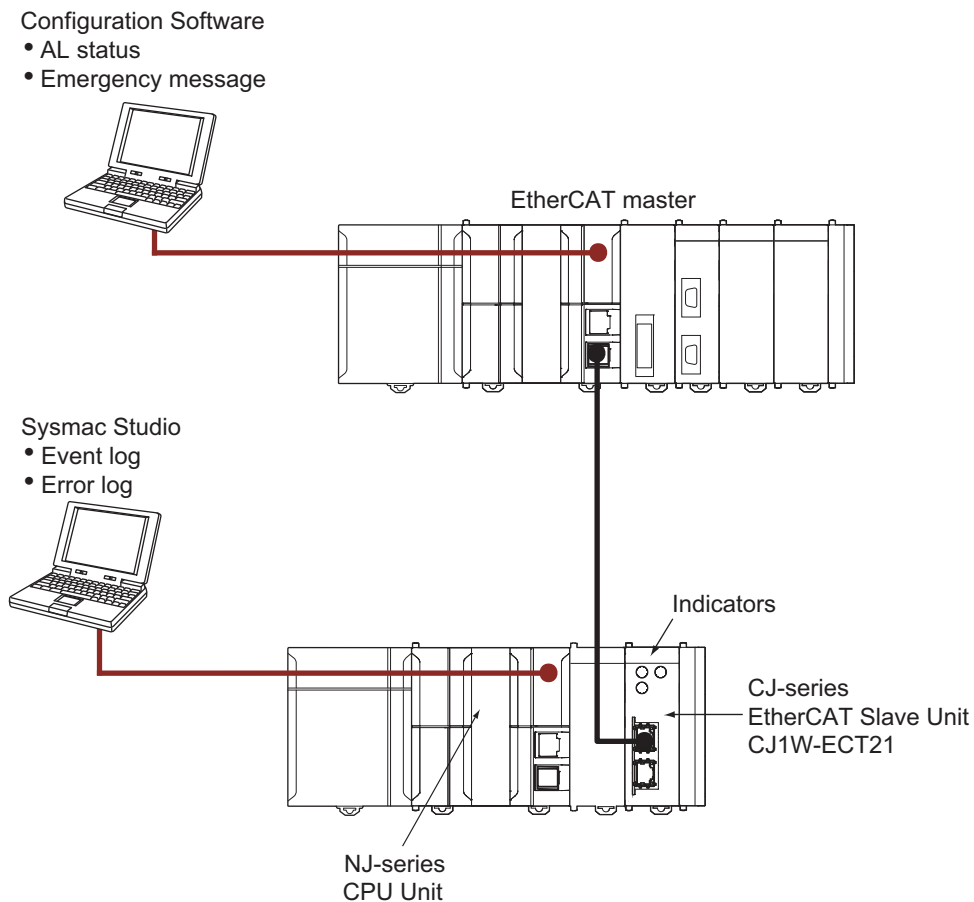
Checking method	Information provided
Checking the indicators	The indicators provide the status of the EtherCAT Slave Unit and the level of the error.
Troubleshooting with the Sysmac Studio	You can check for current Controller errors, a log of past Controller errors, error sources, error causes and corrections. You can also check error logs from EtherCAT Slave Units.[1] The error log is recorded by the error log function of the EtherCAT Slave Unit.
Checking the Unit status and slave status areas	These areas indicate the status of the EtherCAT Slave Unit and the level of the error.
Checking with Configuration Software	The emergency message code and AL status code method depends on the specifications of the EtherCAT master and Configuration Software specifications.

*1. Detailed information, such as error causes and corrections, is not displayed. To check detailed information, use the event codes that are displayed and refer to the error codes that are given in this manual.

Refer to *5-3-2 Error Log Error Codes* on page 5-16 for details on error codes of the EtherCAT Slave Unit. Refer to *5-2-1 Checking for Errors and Troubleshooting with the Indicators* on page 5-7 for information such as error causes and corrections of error codes.

Precautions for Correct Use

• Check the event logs of the EtherCAT Slave Unit with the Sysmac Studio connected online to the NJ-series CPU Unit that is mounted to the CPU Rack or an Expansion Rack given in the following diagram.

The events of the EtherCAT Slave Unit are not notified to the NJ/NX-series CPU Unit via EtherCAT communications.

Sysmac Studio cannot access event logs of the EtherCAT Slave Unit

NJ/NX-series CPU Unit

EtherCAT master

Event logs

Sysmac Studio can access event logs of the EtherCAT Slave Unit

NJ-series CPU Unit

The events of the EtherCAT Slave Unit are not notified to the NJ-series CPU Unit via EtherCAT communications

Event logs

CJ-series EtherCAT Slave Unit CJ1W-ECT21
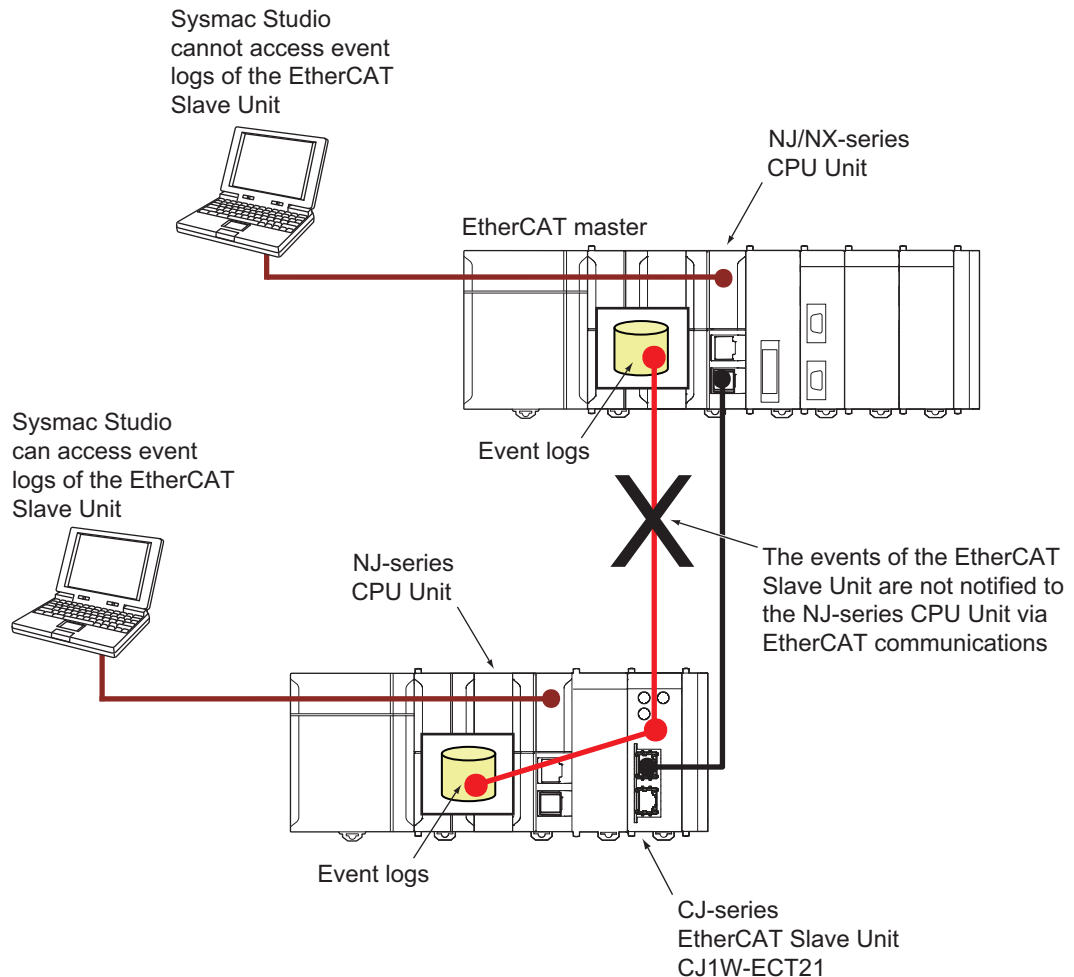
• In the same way as for the event logs, check the error logs of the EtherCAT Slave Unit with the Sysmac Studio connected online to the NJ-series CPU Unit that is mounted to the CPU Rack or an Expansion Rack.

You cannot check the error logs of the EtherCAT Slave Unit via EtherCAT communications.

5-1-3 Procedures to Check Errors

The basic checking procedures for errors are described below.

1 Check whether an error exists on the EtherCAT Slave Unit with the Sysmac Studio that is connected to the EtherCAT master.

2 If an error occurs in the EtherCAT Slave Unit, check the following items to determine the cause of an error.

- Check indicators
- Check the event log, the error log and the status with the Sysmac Studio that is connected to the CPU Unit

5-2   Troubleshooting with Indicators

Use the indicators to determine the error status of the EtherCAT Slave Unit. Refer to *2-1-2 Indicators* on page 2-2 for more information on indicators.

5-2-1   Checking for Errors and Troubleshooting with the Indicators

This section provides information for checking errors and troubleshooting with the indicators on the EtherCAT Slave Unit.

Indicators

Name	Function
L/A IN	The L/A IN indicator shows the link activity of the input port.
L/A OUT	The L/A OUT indicator shows the link activity of the output port.
ECAT RUN	The ECAT RUN indicator shows the operating status of EtherCAT communications for the EtherCAT Slave Unit.
ECAT ERR	The ECAT ERR indicator provides information on errors in the EtherCAT Slave Unit.
RUN	The RUN indicator provides information on the operation of the EtherCAT Slave Unit.
ERC	The ERC indicator provides information about errors of the EtherCAT Slave Unit.
ERH	The ERH indicator provides information about errors of the CPU Unit.

Indicator Timing Status

Here, the following abbreviations are used to describe the status of the indicators.

Abbreviation	Indicator status
Lit	Lit
Not Lit	Not lit
FS	This abbreviation indicates flashing pattern other than flickering, blinking, single flash, and double flash.
FK	Flickering
B	Blinking
SF	Single flash
DF	Double flash
---	Undefined

The flashing patterns for flickering, blinking, single flash, and double flash are given below.
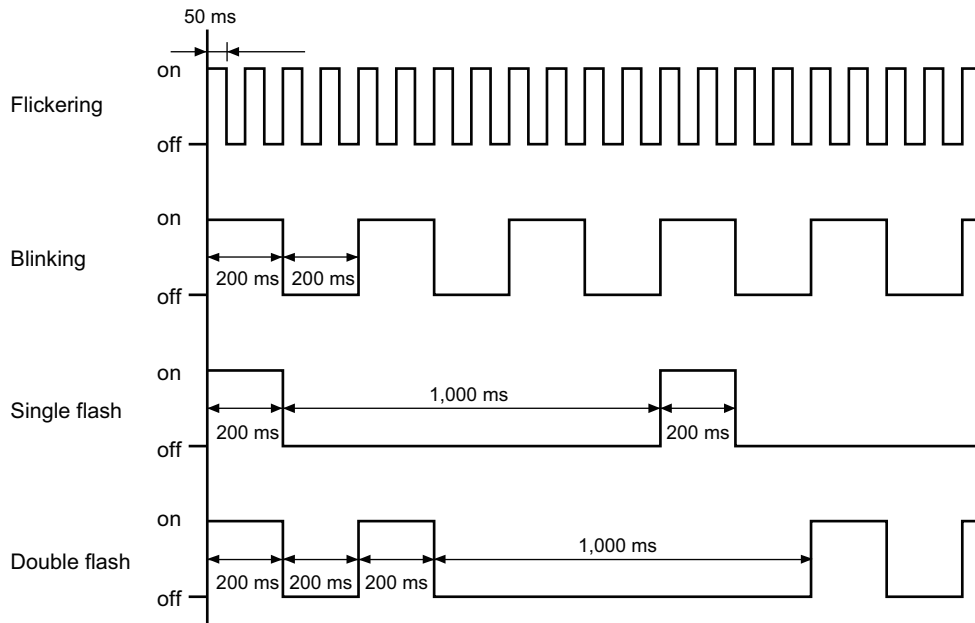
Error Descriptions

● **Errors Related to CPU Unit Data Exchange During Init State or Pre-Operational State**

Indicator					Error	Cause	Unit operation	Error log (hex)	Status of device variables for CJ-series Units	Countermeasures
ECAT RUN	ECAT ERR	ERC	ERH	RUN						
Not Lit	Not Lit	Not Lit	Lit	Not Lit	Duplicate Unit Number	The same unit number is set on another Unit.	Operation stops and error is recorded in the error log.	0006	---	Set the unit numbers correctly and then restart the EtherCAT Slave Unit.
					CPU Unit Faulty	---		000F		Replace the CPU Unit if the error recurs after restarting the CPU Unit.
					I/O Table Not Registered	The CPU Unit's I/O table is not registered.		0006		Create the I/O table.
Not Lit	Not Lit	Lit	Lit		CPU Unit Faulty	---	Operation stops	---		Replace the CPU Unit if the error recurs when the CPU Unit is restarted.
		FS	Not Lit		EtherCAT Slave Unit Faulty					Replace the EtherCAT Slave Unit if the same error recurs when the Unit is mounted to another CPU Unit.

Indicator					Error	Cause	Unit opera-tion	Error log (hex)	Status of device vari-ables for CJ-series Units	Countermeasures
ECAT RUN	ECAT ERR	ERC	ERH	RUN						
B[*1]	B[*1]	Not Lit	Lit	---	CPU Unit Major Fault	A major fault occurred in the CPU Unit.	An emer-gency code is sent if EtherCAT Slave Unit is in Pre-Opera-tional state.	---	*_AlStatus-Err (Slave AL Status Error) is TRUE.[*2]	Clear the cause of the error and then restart the CPU Unit.
					CPU Unit Watchdog Timer Error	An error occurred in the CPU Unit.	An emer-gency code is sent if EtherCAT Slave Unit is in Pre-Opera-tional state and records the error in the error log.	0001		Replace the CPU Unit.
					CPU Unit Service Monitoring Error	Servicing from the CPU Unit was not completed within the fixed interval. The monitoring time is normally 11 s. An error occurred while exchanging data with the CPU Unit. The start delay time at startup was set to more than 10 sec-onds for the the CPU Unit.		0002		Turn OFF the error bit of AL status from the EtherCAT master. When the error remains, check and correct the CPU Unit's operating environment.
					I/O Bus Error	An error occurred while exchanging data with the CPU Unit.		000E	---	Check and correct the CPU Unit's operating environ-ment and then cycle power to the CPU Unit.
					I/O Refresh Error	The I/O communica-tion area does not exist in the CPU Unit. This can occur when the I/O communica-tion area is set incor-rectly, when the Unit is mounted to a dif-ferent CPU Unit with a different number of EM banks or when EM has been con-verted to file mem-ory.		0347	*_IORefErr (I/O Refresh Error) is TRUE.[*2]	Check the I/O com-munication area and change to the correct allocation and restart the Eth-erCAT Slave Unit.

*1. If the EtherCAT master requests transition to Safe-Operational state or Operational state, the Unit remains in the Pre-Op-erational state, the ECAT ERR and ECAT RUN indicators are blinking.

*2. If the EtherCAT master requests transition to Safe-Operational state or Operational state, the Unit remains in the Pre-Op-erational state, and the device variable *_AlStatusErr is TRUE.

● **Errors Related to CPU Unit Data Exchange During Operational State or Safe-Operational State**

Indicator					Error	Cause	Unit opera-tion	Error log (hex)	Status of device vari-ables for CJ-series Units	Countermeasures
ECAT RUN	ECAT ERR	ERC	ERH	RUN						
B	SF	Not Lit	Lit	---	CPU Unit Major Fault	A major fault occurred in the CPU Unit.	The Ether-CAT Slave Unit changes to Pre-Opera-tional state. An emer-gency code is sent.	---	*_AlStatusErr (Slave AL Sta-tus Error) is TRUE.	Clear the cause of the error, restart the CPU Unit and then turn OFF the error bit of AL status from the EtherCAT master.
					CPU Unit Watchdog Timer Error	An error occurred in the CPU Unit.	The Ether-CAT Slave Unit changes to Pre-Opera-tional state and an error is recorded in the error log. An emer-gency code is sent.	0001		Replace the CPU Unit.
					CPU Unit Service Monitoring Error	Servicing from the CPU Unit was not completed within the fixed interval. The monitoring time is normally 11 s.		0002		Check the CPU Unit's operating environment and then turn OFF the error bit of AL sta-tus from the EtheR-CAT master.
					I/O Bus Error	An error occurred while exchanging data with the CPU Unit.		000E	---	Check the CPU Unit's operating environment, cycle power to the CPU Unit, and then turn OFF the error bit of AL status from the EtherCAT master.
					I/O Refresh Error	The I/O communi-cation area does not exist in the CPU Unit. This can occur when EM has been converted to file memory.		0347	*_AlStatusErr (Slave AL Sta-tus Error) and *_IORefErr (I/O Refresh Error) are TRUE.	Check the I/O com-munication area, change to the cor-rect allocation and then restart the Eth-erCAT Slave Unit.

● **Errors Related to Memory Access**

Indicator					Error	Cause	Unit operation	Error log (hex)	Status of device variables for CJ-series Units	Countermeasures
ECAT RUN	ECAT ERR	ERC	ERH	RUN						
Not Lit	B	Lit	Not Lit	---	SII Unit Verification Error	A SII Unit Verification Error occurred in the EtherCAT Slave Unit information stored in SII when the power was applied.	The EtherCAT Slave Unit does not enter Pre-Operational state.	---	*_AlStatusErr (Slave AL Status Error) and *_SiiVerifyErr (SII Unit Verification Error) are TRUE.	Restart the EtherCAT Slave Unit. Replace the EtherCAT Slave Unit if the error recurs.
---	---				Special Unit Memory Error	An error occurred in the EtherCAT Slave Unit's non-volatile memory itself. This error occurs when attempting to read or write to the error log.	• Records an error 0602 in the RAM error log area • Remaining writes to non-volatile memory are all ignored and normal operation continues • Error records will continue to be written to RAM	0602	*_MemErr (Unit Memory Error) is TRUE.	

● **Unit Errors**

Indicator					Error	Cause	Unit operation	Error log (hex)	Status of device variables for CJ-series Units	Countermeasures
ECAT RUN	ECAT ERR	ERC	ERH	RUN						
Not Lit	Lit	Lit	Not Lit	---	Special Unit Error	An error occurred in the EtherCAT Slave Unit.	Operation stops and error is recorded in the error log.	0601	---	Restart the CPU Unit. Replace the EtherCAT Slave Unit if the error recurs.
					ESC Initial Error	An initialization error occurred in ESC.	Operation stops.	---		Replace the EtherCAT Slave Unit if the error recurs.
						It was not possible to write the node address to the EtherCAT Slave Unit by Configuration Software.				Write the node address again.
	FK				ESC Error	A timeout occurred while accessing ESC.	---		*_EscErr (ESC Error) is TRUE.	Replace the EtherCAT Slave Unit if the same error occurs when the Unit is mounted to another CPU Unit.

● **EtherCAT Slave Errors**

Indicator					Error	Cause	Unit opera-tion	Error log (hex)	Status of device vari-ables for CJ-series Units	Countermea-sures
ECAT RUN	ECAT ERR	ERC	ERH	RUN						
SF	DF	Lit	Not Lit	---	I/O Com-munica-tion Error (Process Data WDT Error)	The EtherCAT Slave Unit did not receive the frame from the EtherCAT master for more than SM watch dog time (100 ms).	Records the error in the error log	0345	*_AlStatusErr (Slave AL Sta-tus Error) and *_IOCommErr (I/O Communi-cation Error) are TRUE.	Clear the cause of the error and then turn OFF the error bit of AL status from the EtherCAT master.
Not Lit	B				Mailbox Setting Error	The mailbox setting from the EtherCAT master is invalid.	---	---	*_AlStatusErr (Slave AL Sta-tus Error) and *_MailboxSet-tingErr (Mail-box Setting Error) are TRUE.	Correct the mail-box settings and then turn OFF the error bit of AL sta-tus from the Ether-CAT master.
B					Verifica-tion Error	A mismatch occurred between the RxPDO setting size from the Ether-CAT master and the OUT data area size set in the Eth-erCAT Slave Unit.	Records the error in the error log	0344	*_AlStatusErr (Slave AL Sta-tus Error) and *_Verifica-tionErr (Verifi-cation Error) are TRUE.	Correct the OUT data area size set-ting to match the EtherCAT master RxPDO setting and then turn OFF the error bit of AL status from the EtherCAT master.
						A mismatch occurred between the TxPDO setting size from the Ether-CAT master and the IN data area size set in the Eth-erCAT Slave Unit.				Correct the IN data area size set-ting to match the EtherCAT master TxPDO setting and then turn OFF the error bit of AL status from the EtherCAT master.
						The TxPDO and RxPDO are not assigned when the Unit changes from Pre-Operational state to Safe-Oper-ational state.				Correct the TxPDO and RxPDO settings and then turn OFF the error bit of AL status from the EtherCAT master.
---					Illegal State Tran-sition Request Received	An illegal state transition request was received.	---	---	*_AlStatusErr (Slave AL Sta-tus Error) and *_In-vadlidReqState (Illegal State Transistion Request Received) are TRUE.	Turn OFF the error bit of AL sta-tus from the Ether-CAT master.
						A transition request to an unknown state was received.				

● **Others**

Indicator					Error	Cause	Unit operation	Error log (hex)	Status of device variables for CJ-series Units	Countermea-sures
ECAT RUN	ECAT ERR	ERC	ERH	RUN						
---	---	---	---	---	IN Port Link OFF	The IN port link is turned off after turned on once.	---	---	*_LKSta1_ (IN Port Link Status) is TRUE.	Connect the EtherCAT communica-tions cable.
					OUT Port Link OFF	The OUT port link is turned off after turned on once.			*_LKSta2_ (OUT Port Link Status) is TRUE.	
Not Lit	B			Lit	Restart	The Unit was restarted.			*_AlStatusErr_ (Slave AL Status Error) is TRUE.	Turn OFF the error bit of AL status from the EtherCAT master.
						The voltage is present in the Unit immedi-ately after power is turned OFF. The power is turned ON in this state.				

5-2-2   Corrective Actions When the CPU Unit's Indicators are Lit or Flashing

Use the following table to troubleshoot the system when the CPU Unit's ERR indicator is lit or flashing when the EtherCAT Slave Unit is mounted.

Error	Corrective action
An I/O verification error occurred.	• Confirm that the Unit is connected properly. • Compare the Unit configuration with the actual configuration of Units and correct the Unit configuration.
A CPU Bus Unit setting error occurred.	A Unit model in the Unit configuration is different from the Unit model that is mounted in the Controller. Compare the Unit configuration with the actual configuration of Units and correct the Unit configuration.
A CPU Bus Unit error occurred.	• Confirm that the Unit is connected properly. • Restart the Unit. Replace the Unit if it does not restart.
An I/O bus error occurred.	• Confirm that the Unit is connected properly. • Restart the Unit. Replace the Unit if it does not restart.

Refer to the CPU Unit's user's manual for details.

5-3 Error Log Function of the EtherCAT Slave Unit

Errors detected by the EtherCAT Slave Unit are stored in the error log along with the date and time of their occurrence. The error log can be read and cleared from the Sysmac Studio.

5-3-1 Error Log Data

This section provides details about the error log data configuration and storage location.

Error Log Data Configuration

● **Error Descriptions**

A short description of the error is given.

● **Detailed Error Code**

The detailed error code provides further troubleshooting information on the error.

Refer to *5-3-2 Error Log Error Codes* on page 5-16 for the error descriptions and detailed error codes.

● **Clock Information**

The year, month, day, hour, minutes, and sections that the error occurred are recorded.

> **Additional Information**
>
> The CPU Unit's time information is used for the time stamps in the EtherCAT Slave Unit's error log records. If the time information cannot be read from the CPU Unit, the time stamp will contain all zeroes.
>
> Moreover, if the battery is replaced in an NJ-series Controller, the time of the CPU Unit's built-in clock must be set again the next time that power is turned ON. If the built-in clock time is not set, the correct time information will not be recorded. If this error log is read from the CPU Unit, the time information will not be consistent.

Storage Location of Error Log Data

● **Error Log Data in RAM**

When an error occurs, one record is stored in the error log table in RAM inside the EtherCAT Slave Unit.

Up to 250 records are recorded.

● **Error Log Data in Non-volatile Memory**

When a high-priority error occurs, a record is stored both in the error log table in RAM and in the error log table in non-volatile memory in the EtherCAT Slave Unit. The contents of the error log table in non-volatile memory is retained even if the power supply to the Controller is turned OFF or the Controller is reset. (When the Controller is reset, the error log table in the non-volatile memory is automatically loaded to the error log table in RAM.) One record is stored in the non-volatile memory for each error. Up to 250 records are stored. When the maximum number of records is exceeded, the oldest records are deleted and only the newest records are retained.

● **Clearing Error Log Data**

You can use the Controller event log functions of the Sysmac Studio to clear the error log data from the RAM or non-volatile memory in the EtherCAT Slave Unit.

Refer to the *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504) for the functions and operating procedures for the Controller event logs.

5-3-2 Error Log Error Codes

The following table lists the error log error codes.

Error code (hex)	Error	Cause	Detail code		Saved in non-volatile memory
			First byte	Second byte	
0001	CPU Unit Watchdog Timer Error	An error occurred in the CPU Unit.	00 hex	00 hex	Yes
0002	CPU Unit Service Monitoring Error	Servicing from the CPU Unit was not completed within the fixed interval. The monitoring time is normally 11s.	Monitoring time (ms)		Yes
0006	Other CPU Error	• The CPU Unit's I/O table is not registered. • The same unit number is set on another Unit.	Bit D11: Unit not in Registered I/O Tables Bit D14: Duplicate unit number setting (other bits are reserved for system use)		Yes
000E	I/O Bus Error	An error occurred while exchanging data with the CPU Unit.	00 hex	00 hex	Yes
000F	CPU Unit Initialization Error	Timeout while awaiting access right of cyclic area during initialization.			
0344	Verification Error	• A mismatch occurred between the RxPDO setting size from the EtherCAT master and the OUT data area size setting in the EtherCAT Slave Unit. • A mismatch occurred between the TxPDO setting size from the EtherCAT master and the IN data area size setting in the EtherCAT Slave Unit. • The TxPDO and RxPDO are not assigned when the Unit changes from Pre-Operational state to Safe-Operational state.	06 hex	00 hex	No

| Error code (hex) | Error | Cause | Detail code | | Saved in non-volatile memory |
			First byte	Second byte	
0345	I/O Communication Error	The EtherCAT Slave Unit did not receive the frame from the EtherCAT master for more than SM watch dog time (100 ms).	02 hex	00 hex	No
0347	I/O Refresh Error	The I/O communication area does not exist in the CPU Unit. This can occur when the I/O communication area is set incorrectly, when the Unit is mounted to a different CPU Unit with a different number of EM banks or when EM has been converted to file memory.	02 hex	00 hex	No
0601	Special Unit Error	An error occurred in the EtherCAT Slave Unit.	Uncertain contents		Yes
0602	Special Unit Memory Error	An error occurred in the EtherCAT Slave Unit's non-volatile memory itself.	01: Read error 02: Write error	06 hex: Error log	Yes [1]

*1. If a memory error occurs in the error log area of non-volatile memory, the record will not be stored in non-volatile memory.

5-4 Troubleshooting with Event Logs of the NJ-series Controller

This section describes troubleshooting methods using the event logs.

5-4-1 Overview of Event Logs

You use the same methods to manage all of the events that occur on the NJ-series Controller. (The events include errors and information.) You can use the Sysmac Studio or an NS-series PT to confirm current Controller events and the logs of events that have occurred. These logs are called event logs. Controller errors that occur for this Unit are also reported as events in the NJ-series CPU Unit.

Refer to the *NJ/NX-series CPU Unit Software User's Manual* (Cat. No. W501) for details on the event logs in an NJ-series CPU Unit. Refer to the *NJ/NX-series Troubleshooting Manual* (Cat. No. W503) for details on Controller errors, confirmation methods and corrections.
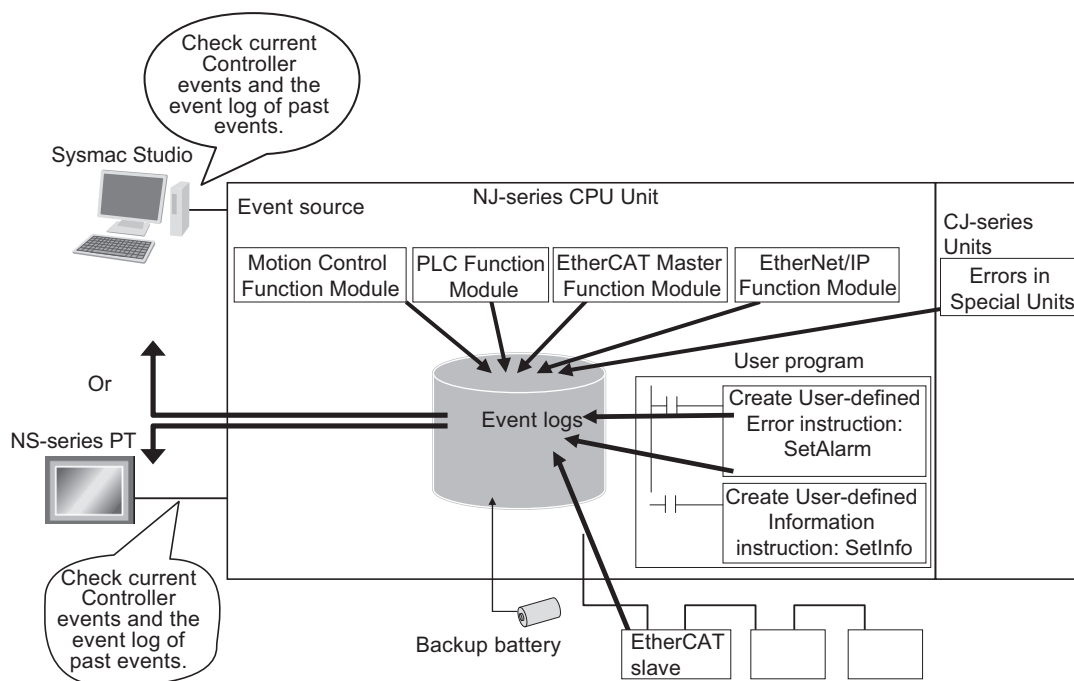
5-4-2 Event Codes for Errors and Troubleshooting Procedures

This section describes the errors (events) that can occur and how to troubleshoot them.

Error Table

The errors (i.e., events) that can occur in the CJ-series EtherCAT Slave Unit are given on the following pages. The following abbreviations are used in the *Level* column.

Abbreviation	Meaning
Maj	Major fault level
Prt	Partial fault level
Min	Minor fault level
Obs	Observation level
Info	Information level

Refer to the *NJ/NX-series Troubleshooting Manual* (Cat. No. W503) for all NJ-series event codes.

| Event code | Event name | Meaning | Assumed cause | Level | | | | | Reference |
				Maj	Prt	Min	Obs	Info	
05400000 hex	ESC Error	An error occurred in the EtherCAT slave communications controller.	• An error occurred in the Ether-CAT slave communications controller.			√			P. 5-21
05410000 hex	Special Unit Memory Error	An error occurred when writing to internal memory where the error log is saved.	• Non-volatile memory failure			√			P. 5-21
05420000 hex	SII Unit Verifi-cation Error	An error occurred in Slave Unit verifica-tion.	• An error occurred in Slave Unit information.			√			P. 5-22
35680000 hex	I/O Refresh Error	The I/O memory in the destination CPU Unit for I/O refreshing could not be found when refreshing in the CPU Unit.	• The data area type, data area size and first word in the data area were outside of the speci-fied range. • I/O words are allocated in an EM bank that does not exist.			√			P. 5-22
35690000 hex	Mailbox Set-ting Error	An incorrect mail-box setting was detected for the Sync Manager. (AL-Status Code: 0016 hex)	• An incorrect mailbox setting was detected for the Sync Manager.			√			P. 5-23
356A0000 hex	Verification Error	• An error was detected in the RxPDO settings. (AL-Status Code: 001D hex) • An error was detected in the TxPDO settings. (AL-Status Code: 001E hex)	• An error was detected in the PDO settings.			√			P. 5-23
356B0000 hex	Illegal State Transition Request Received	• An incorrect state transition request was received. (AL-Status Code: 0011 hex) • An unclear state transition request was received. (AL-Status Code: 0012 hex)	• An incorrect state transition request was received. • An unclear state transition request was received.			√			P. 5-24
852C0000 hex	I/O Commu-nication Error	Process data com-munications were stopped for more than the specified period of time.	• The EtherCAT communications cable is disconnected or bro-ken. • There is an error in the Ether-CAT master.			√			P. 5-24

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 description 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 control.[1]	**Recovery**	Gives the recovery method.[2]	**Log category**	Tells which log the error is saved in.[3]
Effects	**User program**	Tells what will happen to execution of the user program.[4]	**Operation**	Provides special information on the operation that results from the error.		
Indicators	Gives the status of the built-in EtherNet/IP port and built-in EtherCAT port indicators. Indicator status is given only for errors in the EtherCAT Master Function Module and the EtherNet/IP Function Module.				
System-defined variables	**Variable**		**Data type**		**Name**	
	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 correction	**Assumed cause**		**Correction**		**Prevention**	
	Lists the possible causes, corrections, and preventive measures for the error.				
Attached information	This is the attached information that is displayed by the Sysmac Studio or an HMI[5].				
Precautions/ Remarks	Provides precautions, restrictions, and supplemental information. If the user can set the event level, the event levels that can be set, the recovery method, operational information, and other information are also provided.				

*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	ESC Error			Event code	05400000 hex
Meaning	An error occurred in the EtherCAT slave communications controller.				
Source	PLC Function Module		**Source details**	CJ-series Unit	**Detection timing**	At power ON or Controller reset
Error attributes	**Level**	Minor fault	**Recovery**	Cycle the power supply	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The EtherCAT communications stops in Init state.		
System-defined variables	**Variable**		**Data type**		**Name**	
	None		---		---	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	An error occurred in the EtherCAT slave communications controller.		Replace the EtherCAT Slave Unit.		None	
Attached information	None					
Precautions/ Remarks	None					

Event name	Special Unit Memory Error			Event code	05410000 hex
Meaning	An error occurred when writing to internal memory where the error log is saved.				
Source	PLC Function Module		**Source details**	CJ-series Unit	**Detection timing**	At power ON, Controller reset, or error log save
Error attributes	**Level**	Minor fault	**Recovery**	Cycle the power supply	**Log category**	System
Effects	**User program**	Continues.	**Operation**	Not affected.		
System-defined variables	**Variable**		**Data type**		**Name**	
	None		---		---	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	Non-volatile memory failure		Replace the EtherCAT Slave Unit.		None	
Attached information	None					
Precautions/ Remarks	None					

Event name	SII Unit Verification Error		Event code	05420000 hex	
Meaning	An error occurred in Slave Unit verification.				
Source	PLC Function Module		Source details	CJ-series Unit	Detection timing	At power ON or Controller reset
Error attributes	Level	Minor fault	Recovery	Cycle the power supply	Log category	System
Effects	User program	Continues.	Operation	The EtherCAT communications stops in Init state.		
Sys-tem-defined variables	Variable		Data type		Name	
	None		---		---	
Cause and correction	Assumed cause		Correction		Prevention	
	An error occurred in Slave Unit information.		Replace the EtherCAT Slave Unit.		None	
Attached information	None					
Precautions/ Remarks	None					

Event name	I/O Refresh Error		Event code	35680000 hex	
Meaning	The I/O memory in the destination CPU Unit for I/O refreshing could not be found when refreshing in the CPU Unit.				
Source	PLC Function Module		Source details	CJ-series Unit	Detection timing	At power ON or Controller reset
Error attributes	Level	Minor fault	Recovery	Automatic recovery	Log category	System
Effects	User program	Continues.	Operation	The EtherCAT communications stops in Init state.		
Sys-tem-defined variables	Variable		Data type		Name	
	None		---		---	
Cause and correction	Assumed cause		Correction		Prevention	
	The data area type, data area size and first word in the data area were outside of the specified range.		Correct the I/O allocations so that the data area type, data area size and first word in the data area are allocated within the specified range.		Allocate the data area type, data area size and first word in the data area within the specified range.	
	I/O words are allocated in an EM bank that does not exist.		Correct the I/O allocations so that only I/O words that exist in the I/O memory of a CPU Unit are allocated.		Allocate only I/O words that exist in the I/O memory of a CPU Unit.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Mailbox Setting Error			Event code	35690000 hex	
Meaning	An incorrect mailbox setting was detected for the Sync Manager.					
Source	PLC Function Module		Source details	CJ-series Unit	Detection timing	When moving from Init state to Pre-Operational state.
Error attributes	Level	Minor fault	Recovery	Automatic recovery	Log category	System
Effects	User program	Continues.	Operation	The EtherCAT communications stops in Init state.		
System-defined variables	Variable		Data type		Name	
	None		---		---	
Cause and correction	Assumed cause		Correction		Prevention	
	An incorrect mailbox setting was detected for the Sync Manager.		Correct the mailbox setting and then download the settings to the EtherCAT master again.		Set the communications for the EtherCAT Slave Unit that are set in the EtherCAT master according to the ESI.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Verification Error			Event code	356A0000 hex	
Meaning	An error was detected in the RxPDO settings.					
	An error was detected in the TxPDO settings.					
Source	PLC Function Module		Source details	CJ-series Unit	Detection timing	When moving from Pre-Operational to Safe-Operational state
Error attributes	Level	Minor fault	Recovery	Automatic recovery	Log category	System
Effects	User program	Continues.	Operation	The EtherCAT communications stops in Pre-Operational state.		
System-defined variables	Variable		Data type		Name	
	None		---		---	
Cause and correction	Assumed cause		Correction		Prevention	
	An error was detected in the PDO settings.		Correct the PDO setting and then download the settings to the EtherCAT master again.		Set the communications for the EtherCAT master according to the ESI.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Illegal State Transition Request Received			Event code	356B0000 hex	
Meaning	An incorrect state transition request was received.					
	An unclear state transition request was received.					
Source	PLC Function Module		Source details	CJ-series Unit	Detection timing	At EtherCAT communica- tions state tran- sition
Error attributes	Level	Minor fault	Recovery	Automatic recovery	Log category	System
Effects	User program	Continues.	Operation	The EtherCAT communications depends on the state when the state transition request was received.		
Sys- tem-defined variables	Variable		Data type		Name	
	None		---		---	
Cause and correction	Assumed cause		Correction		Prevention	
	An incorrect state transition request was received.		Change states correctly accord- ing to EtherCAT specifications.		Change the communications state as following for the EtherCAT Slave Unit: Between Init state and Pre-Operational state, between Pre-Operational state and Safe-Operational state, or between Safe-Operational state and Operational state.	
	An unclear state transition request was received.					
Attached information	None					
Precautions/ Remarks	None					

Event name	I/O Communications Error			Event code	852C0000 hex	
Meaning	Process data communications were stopped for more than the specified period of time.					
Source	PLC Function Module		Source details	CJ-series Unit	Detection timing	Continuously
Error attributes	Level	Minor fault	Recovery	Automatic recovery	Log category	System
Effects	User program	Continues.	Operation	The EtherCAT communications enters Safe-Opera- tional state.		
				The output data from the EtherCAT master is retained.		
Sys- tem-defined variables	Variable		Data type		Name	
	None		---		---	
Cause and correction	Assumed cause		Correction		Prevention	
	The EtherCAT communications cable is disconnected or broken.		Connect the EtherCAT communi- cations cable securely.		Connect the EtherCAT communi- cations cable securely.	
	There is an error in the EtherCAT master.		Check the operation of the Ether- CAT master and take appropriate measures if there is a problem.		None	
Attached information	None					
Precautions/ Remarks	None					

5-5 Troubleshooting with Emergency Messages

EtherCAT Slave Units are able to report emergency messages to the EtherCAT master by using the SDO communications if they detect errors.

5-5-1 Emergency Message Notification

When the power supply is turned ON, the EtherCAT Slave Unit always starts with the *Notification* setting.

Emergency messages cannot be sent while there is an EtherCAT communications error.

Byte	0	1	2	3	4	5	6	7
Contents	Emergency error code		Reserved		0000 hex			

Refer to *5-5-2 Emergency Error Codes* on page 5-25 for the meanings of the emergency messages.

5-5-2 Emergency Error Codes

The following table lists the emergency error codes that are used with EtherCAT Slave Units and the meaning of each error.

Error code (hex)	Error type	Error name	Description	Notification to EtherCAT master	Corrective action
5530	Memory access error	Special Unit Memory Error	An error occurs while reading or writing the error log. All error log records cannot be used during initialization or registering an error log record.	Yes	Restart the EtherCAT Slave Unit. Replace the EtherCAT Slave Unit if the error recurs.
6140		SII Unit Verification Error	A verification error occurred in the slave information stored in SII when the power supply was turned ON.	No	
6120	Unit error	Special Unit Error	An error occurred in the EtherCAT Slave Unit.		Restart the CPU Unit. Replace the EtherCAT Slave Unit if the error recurs.
7030		ESC Error	An error occurred in the ESC.		Replace the EtherCAT Slave Unit if the same error recurs when the Unit is mounted to another CPU Unit.

Error code (hex)	Error type	Error name	Description	Notification to EtherCAT master	Corrective action
FF02	Errors related to the CPU Unit	CPU Unit Major Fault	A major fault occurred in the CPU Unit.	Yes	Clear the cause of the error, restart the CPU Unit and then turn OFF error bit of AL status from the EtherCAT master.
FF04		CPU Unit Watchdog Timer Error	An error occurred in the CPU Unit.		Replace the CPU Unit.
FF05		CPU Unit Service Monitoring Error	Servicing from the CPU Unit was not completed within the fixed interval. The start delay time at startup was set to more than 10 seconds for the the CPU Unit.		Turn OFF the error bit of AL status from the EtherCAT master. When the error remains, check and correct the CPU Unit's operating environment.
		I/O Bus Error	An error occurred while exchanging data with the CPU Unit.		Check the CPU Unit's operating environment and then turn OFF error bit of AL status from the EtherCAT master.
FF07		I/O Refresh Error	The I/O communication area does not exist in the CPU Unit. This can occur when the I/O communication area is set incorrectly, when the Unit is mounted to a different CPU Unit with a different number of EM banks or when EM has been converted to file memory.		Check the I/O communication area, reset with a correct allocation and then restart the EtherCAT Slave Unit.

5-6   Troubleshooting with AL Status

This status reports errors related to EtherCAT communications.

The following table lists the AL status codes that are used with the EtherCAT Slave Units.

AL status code (hex)	Status name	Contents	Notification to EtherCAT master	Corrective action
0011	Illegal State Transition Request Received	An incorrect state transition request was received.	Possible	Change the status correctly.
0012	Error State Transition Received	An unclear state transition request was received.		Change the status correctly.
0014	SII Unit Verification Error	The non-volatile memory for SII backups does not match the information in the SII (VendorID, ProductCode, RevisionNo, and Serial No.).		Cycle the power supply. If the error still occurs, replace the EtherCAT Slave Unit.
0016	Mailbox Setting Error	An incorrect mailbox setting was detected for the Sync Manager.		Correct the settings and then download the settings to the EtherCAT master again.
001B	Process Data WDT Error	A timeout was detected for an I/O data send frame.		Review the following items, and restart the slave based on the specifications of the connected EtherCAT master. • Wire the EtherCAT communications cable correctly. • Check to see if the EtherCAT communications cable is exposed to excessive noise.
001D	RxPDO Setting Error	A mismatch occurred between the RxPDO setting size from the EtherCAT master and the OUT data area size setting in the EtherCAT Slave Unit.		Correct the OUT data area size to match the EtherCAT master RxPDO setting and then turn OFF the error bit of AL status from the EtherCAT master.
001E	TxPDO Setting Error	A mismatch occurred between the TxPDO setting size from the EtherCAT master and the IN data area size setting in the EtherCAT Slave Unit.		Correct the IN data area size to match the EtherCAT master TxPDO setting and then turn OFF the error bit of AL status from the EtherCAT master.

AL status code (hex)	Status name	Contents	Notification to EtherCAT master	Corrective action
0024	TxPDO Mapping Error	The TxPDO and RxPDO are not assigned after the Unit receives a request to change from Pre-Operational state to Safe Operational state.	Possible	Correct the communication area input and output data size to match the EtherCAT master TxPDO and RxPDO settings and then turn OFF the error bit of AL status from the EtherCAT master.
8000	Slave Restarted	The Unit was restarted.		Turn OFF the error bit of AL status from the EtherCAT master.
		The voltage is present in the Unit immediately after power is turned OFF. The power is turned ON in this state.		
8004	Errors Related to the CPU Unit	An error was detected in the CPU Unit. The AL status code is caused by the following errors. • CPU Unit Major Fault • CPU Unit Watchdog Timer Error • CPU Unit Service Monitoring Error • I/O Refresh Error		Refer to *5-2-1 Checking for Errors and Troubleshooting with the Indicators* on page 5-7 for error corrective actions.

6

Maintenance and Replacement

This section describes the procedures for cleaning, inspecting and replacing EtherCAT Slave Units.

6

6-1 Cleaning and Inspection

This section describes the routine cleaning and inspection recommended as regular maintenance.

6-1-1 Cleaning

Clean the EtherCAT Slave Units regularly as described below in order to keep the network in its optimal operating condition.

- Wipe the Unit daily with a dry, soft cloth.
- When a spot can't be removed with a dry cloth, dampen the cloth with a neutral cleanser (2% solution), wring out the cloth, and wipe the Unit.
- A smudge may remain on the Unit from gum, vinyl, or tape that was left on for a long time. Remove the smudge when cleaning.

Precautions for Correct Use

Never use volatile solvents such as paint thinner, benzene, or chemical wipes. These substances could damage the surface of the Unit.

6-1-2 Inspection

Be sure to inspect the system periodically to keep it in its optimal operating condition. In general, inspect the system once every 6 to 12 months, but inspect more frequently if the system is used with high temperature or humidity or under dirty/dusty conditions.

Inspection Equipment

Prepare the following equipment before inspecting the system.

● **Required Equipment**

Have a standard and Phillips-head screwdriver, multimeter, alcohol, and a clean cloth.

● **Equipment Required Occasionally**

Depending on the system conditions, a synchroscope, oscilloscope, thermometer, or hygrometer (to measure humidity) might be needed.

Inspection Procedure

Check the items in the following table and correct any items that are below standard.

Item		Standard	Equipment
Environmental conditions	Ambient and cabinet temperature	0°C to 55°C	Thermometer
	Ambient and cabinet humidity	10% to 90% (with no condensation or icing)	Hygrometer
	Dust/dirt accumulation	None	Check visually

Item		Standard	Equipment
Installation	Are the Units installed securely?	No looseness	Phillips head screwdriver
	Are the communications connectors fully inserted and locked?	No looseness	Check visually
	Are the connecting cables undamaged?	No damage	

6-2   Replacing Faulty Units

Replace a faulty EtherCAT Slave Unit as soon as possible. We recommend having spare Units available to restore network operation as quickly as possible.

6-2-1   Precautions

Observe the following precautions when replacing a faulty Unit.

- After replacement make sure that there are no errors with the new Unit.
- When a Unit is being returned for repair, attach a sheet of paper detailing the problem and return the Unit to your OMRON dealer.
- If there is a faulty contact, try wiping the contact with a clean, lint-free cloth dampened with alcohol.

Precautions for Safe Use

To prevent electric shock when replacing a Unit, be sure to stop communications in the network and turn OFF the power supplies to all of the nodes (master and slaves) before removing the faulty Unit.

6-2-2   Settings When Replacing EtherCAT Slave Units

When a Unit has been replaced, verify that the following steps have been made correctly.

- Set the node address and unit number.
- Connect the communication cables.

A

Appendices

The appendix provides an example of operations, a programming example to detect valid I/O process data, information on process data exchange in PROGRAM mode, supplemental information for differences in available functions, information on CoE objects and version information.
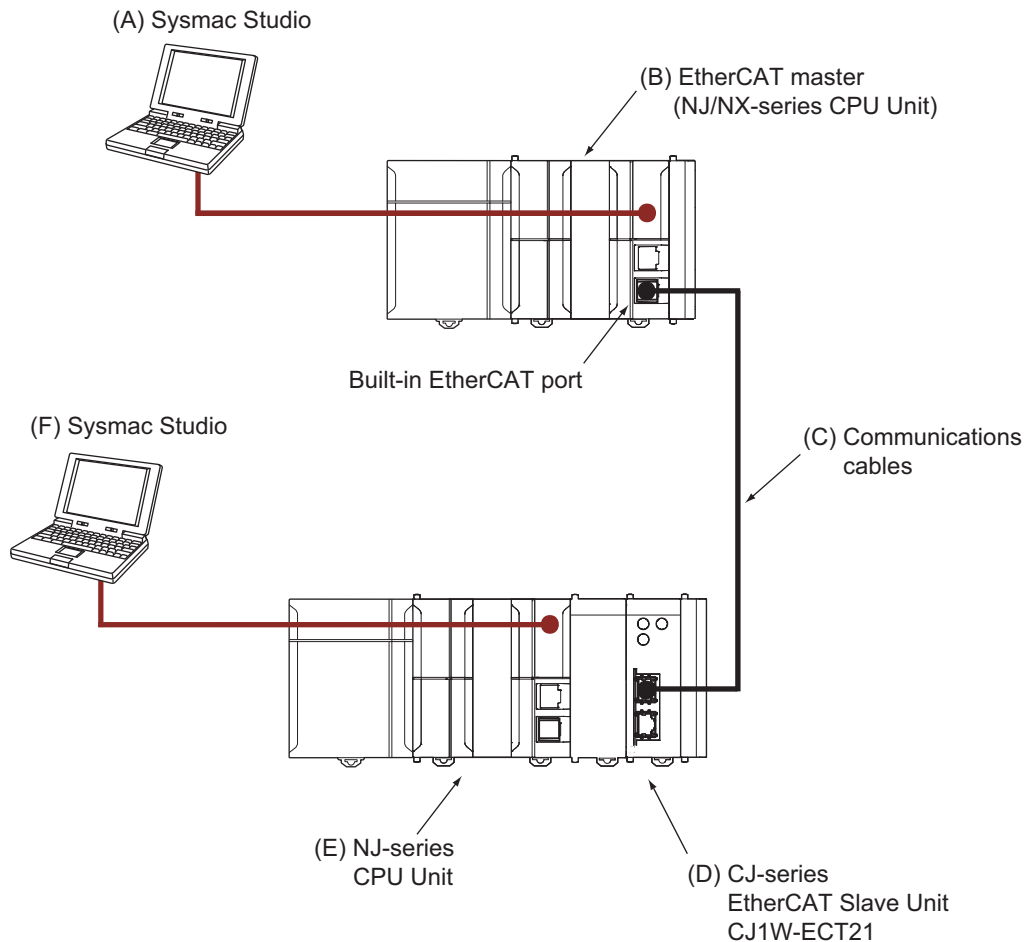
A-1 Example of Operations for EtherCAT Slave Unit Communications

This section provides an example of operations for EtherCAT Slave Unit communications with an EtherCAT master.

In this example, the NJ/NX-series CPU Unit's built-in EtherCAT port is used as the EtherCAT master. Refer to the *NJ/NX-series CPU Unit Built-in EtherCAT Port User's Manual* (Cat. No. W505) for instructions on using the built-in EtherCAT port on the NJ/NX-series CPU Unit.

A-1-1 System Configuration

The following configuration is used for this example.

(A) Sysmac Studio

(B) EtherCAT master (NJ/NX-series CPU Unit)

Built-in EtherCAT port

(F) Sysmac Studio

(C) Communications cables

(E) NJ-series CPU Unit

(D) CJ-series EtherCAT Slave Unit CJ1W-ECT21

Symbol	Description	Comment
(A)	Sysmac Studio	Used to configure the EtherCAT master
(B)	EtherCAT master (NJ/NX-series CPU Unit)	Built-in EtherCAT port on NJ/NX-series CPU Unit
(C)	Communications cables	---
(D)	CJ-series EtherCAT Slave Unit	CJ1W-ECT21
(E)	NJ-series CPU Unit	---
(F)	Sysmac Studio	Used to configure the EtherCAT Slave Unit

A-1-2 Setting Condition

The following setting conditions are used in this example.

I/O Communication Area Setting Table

Set the I/O Communication Area Setting Table with the following values.

Name	Setting value
IN data area size	50 bytes
IN data area type	CIO
First word in IN data area	001A hex
OUT data area size	50 bytes
OUT data area type	CIO
First word in OUT data area	0000 hex

PDO Mapping for the EtherCAT Master

Set the PDO mapping with the following values.

Name	Setting value
Output	257th receive PDO Mapping
Input	257th transmit PDO Mapping

EtherCAT Slave Unit Switch Settings

Set the node address and unit number with the following values.

Name	Setting value
Node address	01
Unit number	01

A-1-3   Flow of the Setting Procedure

Use the following procedure to establish EtherCAT Slave Unit communications with an EtherCAT master.

Procedure	Reference
1. CJ1W-ECT21 setting	*A-1-4 CJ1W-ECT21 Setting Procedure* on page A-4
2. EtherCAT master setting	*A-1-5 EtherCAT Master Setting Procedure* on page A-8
3. Start EtherCAT communication	*A-1-6 Start EtherCAT Communication* on page A-10

## A-1-4   CJ1W-ECT21 Setting Procedure

Use Sysmac Studio to create programs and make the EtherCAT Slave Unit settings. Refer to *Sysmac Studio Version 1 Operating Manual* (Cat. No. W504) for Sysmac Studio operating procedures.

1 Create a project in the Sysmac Studio.

2 Register variables for accessing the I/O data of the EtherCAT Slave Unit. Create algorithms of each POU and register associated local variables.

Refer to *3-1-2 Accessing From the User Program* on page 3-4.

3 Register the EtherCAT Slave Unit in the Unit configuration in **Configurations and Setup - CPU/Expansion Racks.** Set the device name and unit number of the EtherCAT Slave Unit.
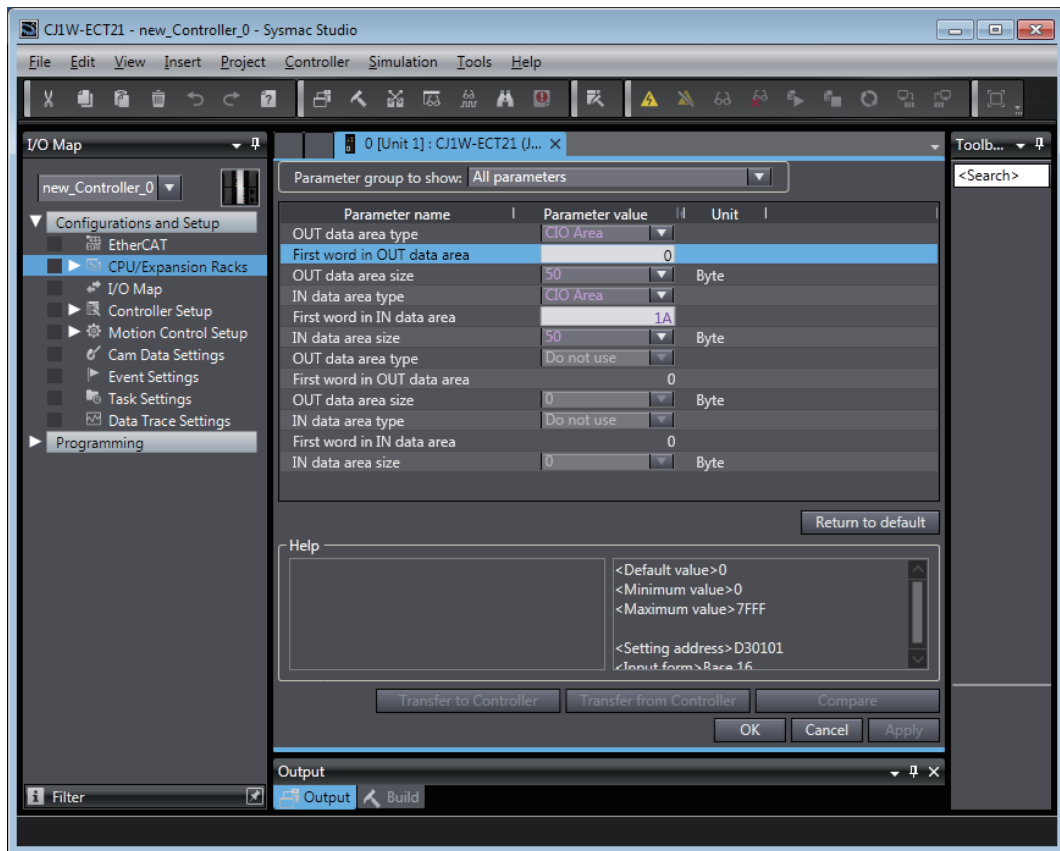
An example is shown below.
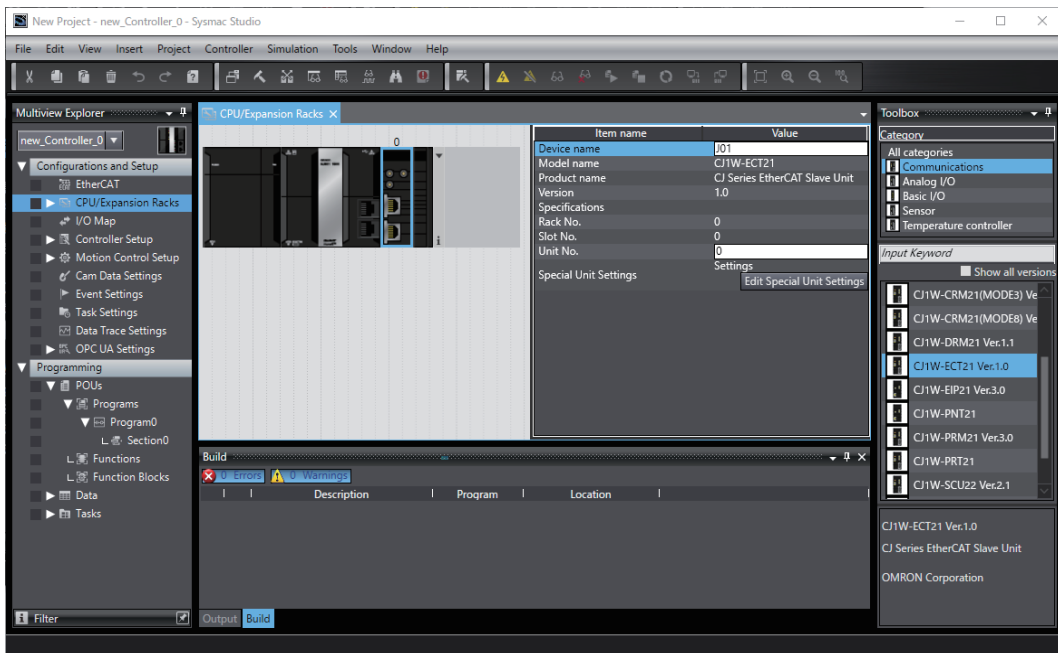
4 Allocate device variables for CJ-series Unit on the **I/O Map**.

An example is shown below.
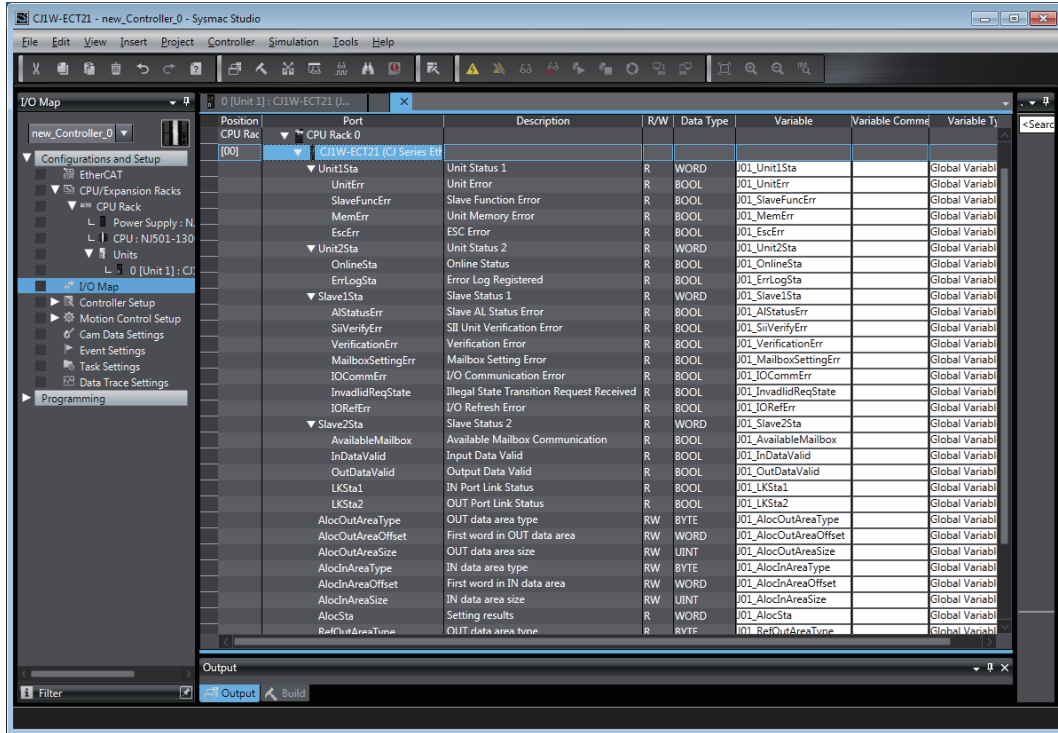
5 Set the I/O Communication Area Setting Table on the Edit Special Unit Settings Tab Page. An example is shown below.


6 With the power OFF, set the unit number and node address with the corresponding hardware switches. Refer to *2-1-3 Switch Settings* on page 2-5.

7 Mount the EtherCAT Slave Unit to the NJ-series CPU Rack. Refer to *2-2-2 Mounting* on page 2-7.

8 Connect the communications cable between the EtherCAT master and EtherCAT Slave Unit. Refer to *2-3 EtherCAT Network Wiring* on page 2-9.

9 Turn ON the power supply to the NJ-series Controller.

10 Download the user program, CPU/Expansion Rack configuration and settings for the EtherCAT Slave Unit. Use the synchronization operation of the Sysmac Studio to download the data.

To transfer the settings for the EtherCAT Slave Unit, clear the selection of the following check box on the Synchronization Pane.

Do not transfer the following. (All items are not transferred.)

• CJ-series Special Unit parameters and EtherCAT slave backup parameters.

• Slave Terminal Unit operation settings and NX Unit application data.
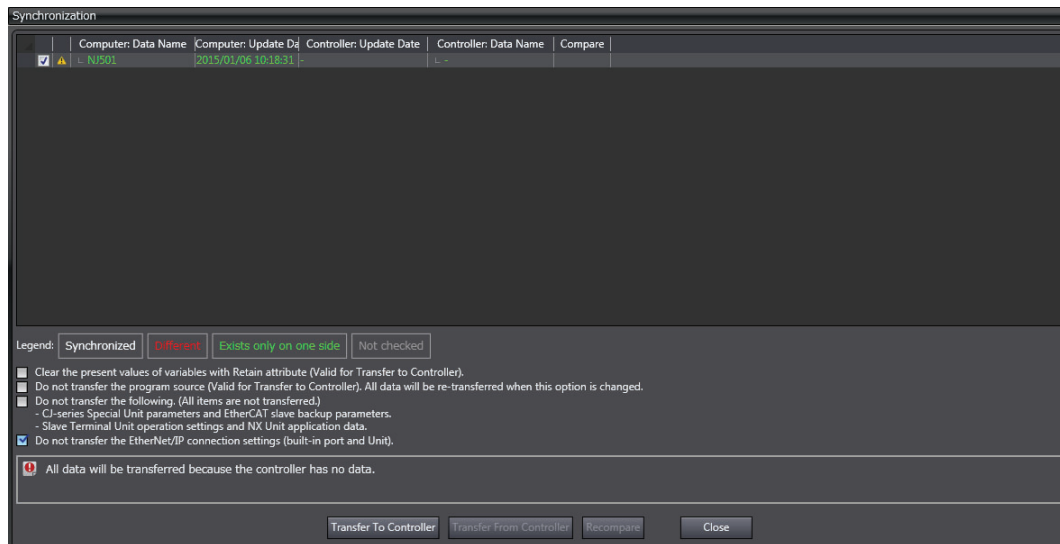
After downloading the settings, the EtherCAT Slave Unit will automatically restart to enable the settings.

11 Check the I/O Communications Area Reference Table values in the Edit Special Unit Settings Tab Page.

Click the **Compare** Button. If the compare is successful, click the **Transfer from Controller** Button to update the I/O Communications Area Reference Table values. If the compare is unsuccessful, transfer the settings again. Refer to the *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504) for the comparison and transfer of the Special Unit setting procedure.
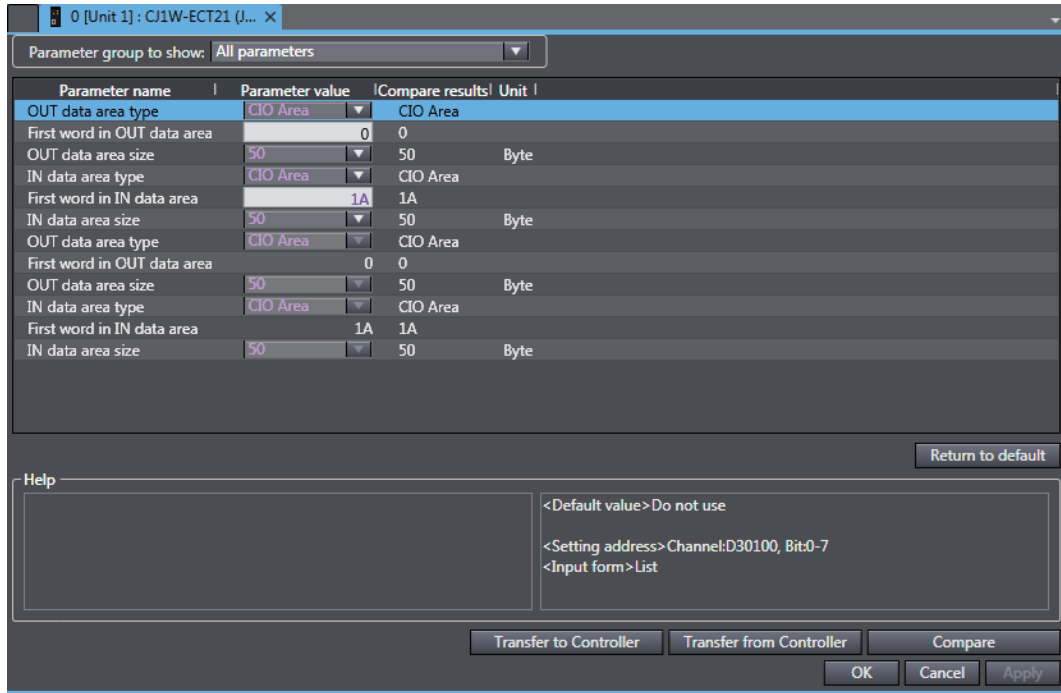
A-1-5 EtherCAT Master Setting Procedure

The setting procedure of the EtherCAT master is provided below. Refer to the *Sysmac Studio Version 1 Operating Manual* (Cat. No. W504) for Sysmac Studio operating procedures.

The ESI files for OMRON EtherCAT slaves are already installed in the Sysmac Studio. Update the Sysmac Studio to get the ESI files for the most recent EtherCAT Slave Unit.

1 Create a project in the Sysmac Studio.

2 Create the EtherCAT network configuration offline.

3 Register the EtherCAT Slave Unit in the network configuration and set the node address of the EtherCAT Slave Unit.

An example is shown below.
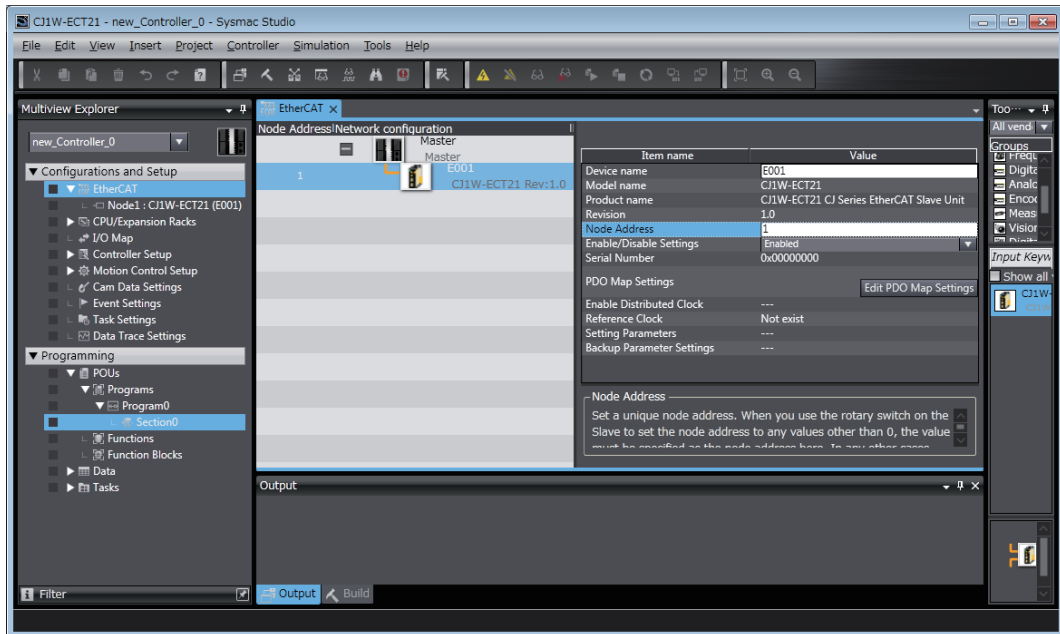
4 Set the PDO mapping of the EtherCAT Slave Unit. Assign the PDOs of the same size as the setting value of the IN and OUT data area size in the I/O Communication Area Setting Table of the EtherCAT Slave Unit.

An example is shown below.
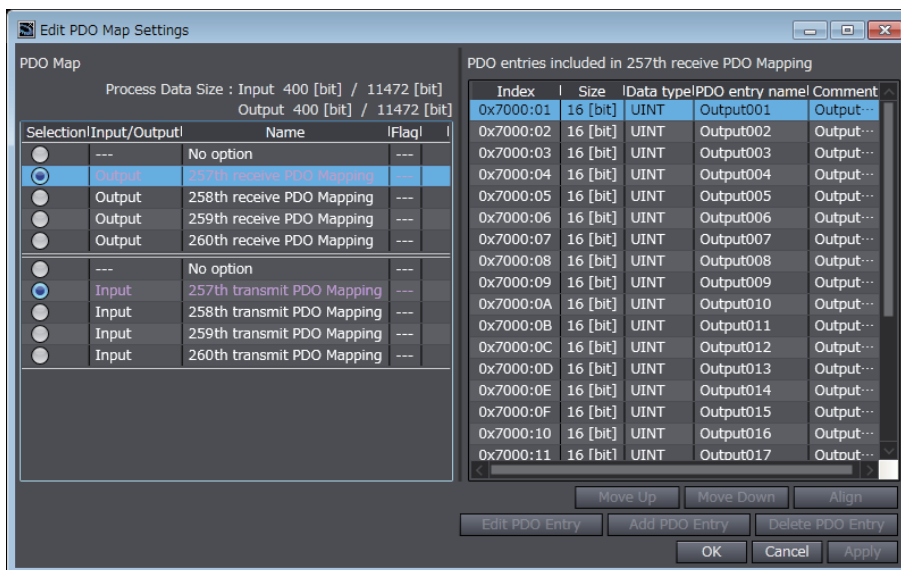

5 Set the EtherCAT master parameters if necessary.

Refer to the *NJ/NX-series CPU Unit Built-in EtherCAT Port User's Manual* (Cat. No. W505) for details on the parameters of the built-in EtherCAT port of the NJ/NX-series CPU Unit.

6 Assign the I/O data that is assigned in the PDO mapping settings to device variables. Assign the device variables to I/O ports in the I/O Map.

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

An example is shown below where variable names are automatically created.
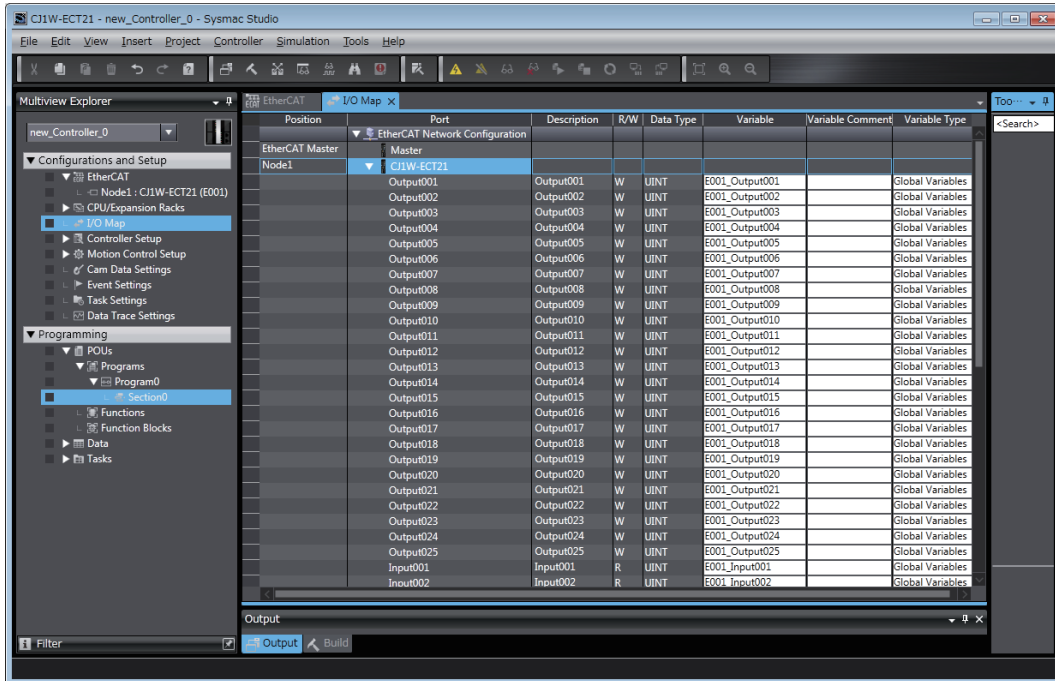
7 Create the user program using the device variables.

8 Turn ON the power supply to the NJ-series Controller.

9 Use the Sysmac Studio to set communications with the NJ-series Controller and go online.

10 Download the network configuration information and the user program to the NJ-series Controller. Use the synchronization operation of the Sysmac Studio to download the data.

A-1-6 Start EtherCAT Communication

If the I/O Communication Area Setting Table, PDO mapping and switch settings are configured properly, EtherCAT communications should occur.

Verify EtherCAT communications by checking the indicators and I/O data exchange.

A-2 Programming Example to Detect Valid I/O Process Data

The following programming example should be used to confirm that I/O process data is valid for an EtherCAT Slave Unit mounted to an NJ-series CPU Unit.

This example uses the Unit Status 1 and Slave Status 2 device variables. Refer to *3-2 Device Variables for CJ-series Unit (Status)* on page 3-9 for details of the Unit Status 1 and Slave Status 2 device variables. The unit number of the EtherCAT Slave Unit is set to 01 for this example.
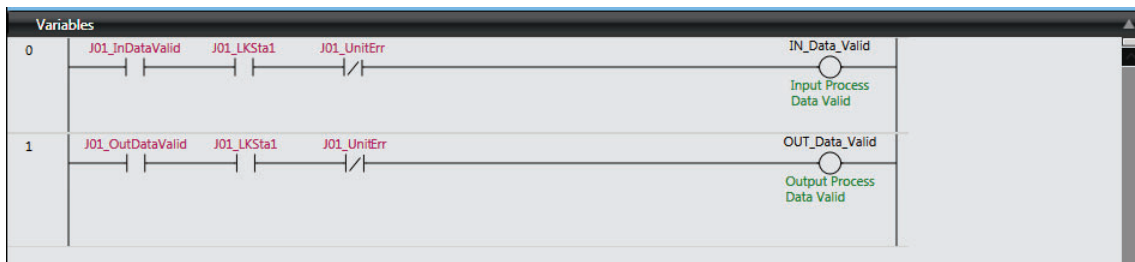
Device variable	Name	Description
*_UnitErr	Unit Error	Indicates EtherCAT Slave Unit operating errors.
*_InDataValid	Input Data Valid	Indicates that the Unit is processing transmit by process data communication. Data is valid and usable for control.
*_OutDataValid	Output Data Valid	Indicates that the Unit is processing receive by process data communication. Data is valid and usable for control.
*_LKSta1	IN Port Link Status	Indicates when a link on the IN port is established with another device.

A-3 Process Data Exchange in PROGRAM Mode

When an EtherCAT master or NJ-series CPU Unit with a mounted EtherCAT Slave Unit enters PRO-GRAM mode, the EtherCAT Slave Unit will continue to exchange process data over the EtherCAT net-work. However, this process data is not updated in the CPU Unit that is in PROGRAM mode and is no longer accurate. The EtherCAT Slave Unit will maintain its current state and will not automatically indi-cate this condition. It is necessary to monitor this condition with the user program to determine if the exchanged process data remains accurate.

A-3-1 Detection Method and Timing Considerations

This section describes the following items.

- The method for detecting transition of the EtherCAT master and the CPU Unit to PROGRAM mode
- Consideration of detection timing

Detection Method

The suggested method to detect that an EtherCAT master and a CPU Unit enter PROGRAM mode requires the user program that toggles process data bits ON and OFF between the EtherCAT master and an NJ-series CPU Unit with a mounted EtherCAT Slave Unit. If the process data bits stop toggling, the user program is no longer executing which is an indication that the EtherCAT master and the CPU Unit are in PROGRAM mode.

Refer to the manuals for the EtherCAT master and the NJ-series CPU Unit's user's manual for more information on creating the user program.

Timing Considerations

When implementing these detection methods, it is important to consider the maximum I/O response time of the EtherCAT Slave Unit. Both program examples include a timer instruction to detect that pro-cess data is not changing within a fixed amount of time. This time should be adjusted to a value that is more than the maximum I/O response time. Refer to *4-6-1 I/O Response Time* on page 4-10 for details on the maximum I/O response time.

A-3-2 Program Example for the EtherCAT Master

Use the following program example as a guide to detect that the NJ-series CPU Unit with a mounted EtherCAT Slave Unit enters PROGRAM mode. In the following example, an NJ-series CPU Unit's built-in EtherCAT port is used as the EtherCAT master.
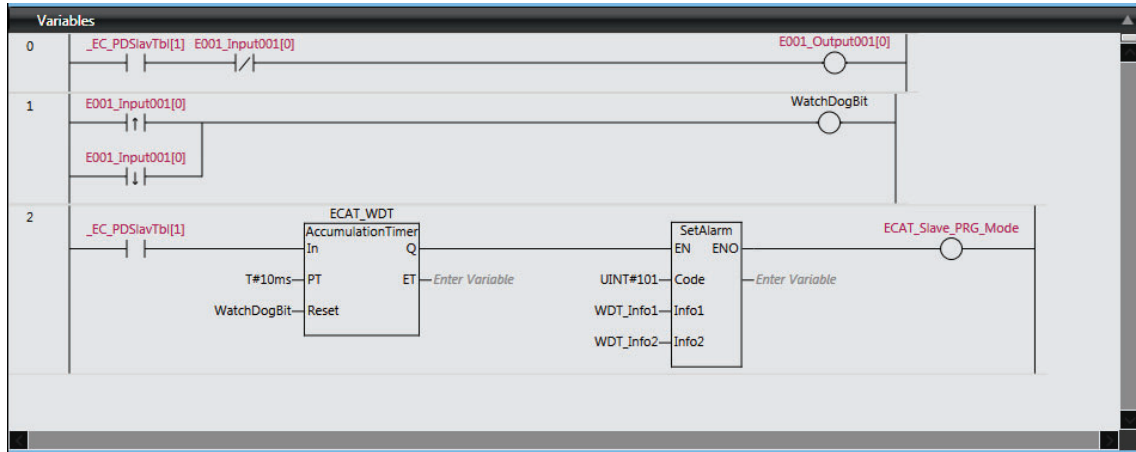
This program example uses the following items.

Item	Description
_EC_PDSlavTbl[1]	System-defined variable for the NJ-series CPU Unit to indicate that the EtherCAT slave (node 01) is performing process data communications.
E001_Input001[0]	Device variable assigned to the EtherCAT Slave Unit.
E001_Output001[0]	
WatchDogBit	Internal variable to reset the accumulation timer when E001_Input001[0] changes state.
AccumulationTimer instruction	Instruction that checks for a stop in bit toggling for a preset time amount that will occur when the NJ-series CPU Unit with a mounted EtherCAT Slave Unit enters PROGRAM mode. Refer to *Timing Considerations* on page A-12.
SetAlarm instruction	Instruction that creates a user-defined error when the NJ-series CPU Unit with a mounted EtherCAT Slave Unit enters PROGRAM mode.
ECAT_Slave_PRG_Mode	External variable to indicate that the NJ-series CPU Unit with a mounted EtherCAT Slave Unit has entered PROGRAM mode.

A-3-3 Program Example for the EtherCAT Slave Unit

Use the following program example as a guide to detect that the EtherCAT master enters PROGRAM mode. An NJ-series CPU Unit with a mounted EtherCAT Slave Unit is used in the example below. The EtherCAT Slave Unit's unit number is set to 01.
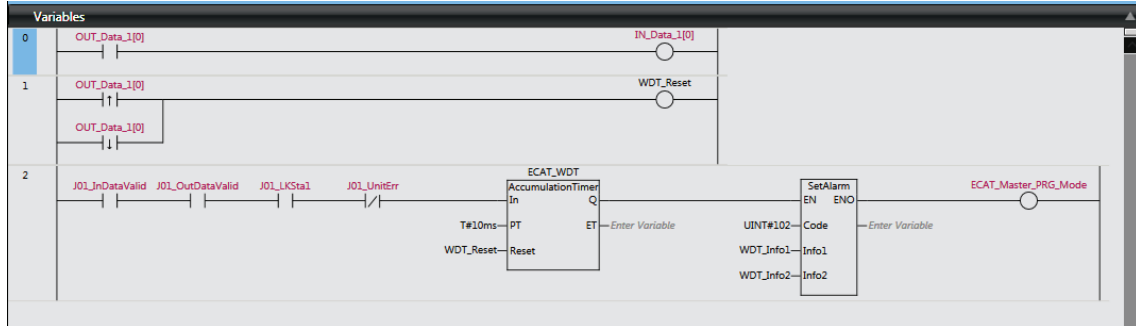
This program example uses the following items.

Item	Description
OUT_Data_1[0]	Process data exchanged with the EtherCAT master.
IN_Data_1[0]	
WDT_Reset	Internal variable to reset the accumulation timer when OUT_Data_1[0] changes state.
*_InDataValid	Slave Status 2 device variable to indicate that the EtherCAT Slave Unit is processing transmit by process data communication.
*_OutDataValid	Slave Status 2 device variable to indicate that the EtherCAT Slave Unit is processing receive by process data communication.
*_LKSta1	Slave Status 2 device variable to indicate that the EtherCAT Slave Unit's IN port has a link established with another device.
*_UnitErr	Unit Status 1 device variable to indicate an EtherCAT Slave Unit operating error.
AccumulationTimer instruction	Instruction that checks for a stop in bit toggling for a preset time amount that will occur when the EtherCAT master enters PROGRAM mode. Refer to *Timing Considerations* on page A-12.
SetAlarm instruction	Instruction that creates a user-defined error when the EtherCAT master enters PROGRAM mode.
ECAT_Master_PRG_Mode	External variable to indicate that the EtherCAT master has entered PROGRAM mode.

A-4 Differences in Available Functions Depending on the CPU Unit (NJ or CJ Series)

Some of the specifications when an EtherCAT Slave Unit is connected to a CJ-series CPU Unit are different from the specifications when the EtherCAT Slave Unit is connected to an NJ-series CPU Unit. A list of these differences is provided below.

A-4-1 Functional Differences

There are differences in function support, function names, and specifications between when an Ether-CAT Slave Unit is connected to a CJ-series CPU Unit and when the EtherCAT Slave Unit is connected to an NJ-series CPU Unit.

Functions with Different Names

The names of the functions are different between when an EtherCAT Slave Unit is connected to a CJ-series CPU Unit and when the EtherCAT Slave Unit is connected to an NJ-series CPU Unit. The corresponding names are listed in the following table.

Item	EtherCAT Slave Unit connected to a CJ-series CPU Unit	EtherCAT Slave Unit connected to an NJ-series CPU Unit
Backup functions[1]	Simple backup function	SD Memory Card backup function[2]
	Backup with PLC backup tool	Sysmac Studio Controller backups

[1]. The EtherCAT Slave Unit does not have parameters that require backup because all values are transferred from the NJ-series device variables after power ON.

[2]. An NJ-series CPU Unit with unit version 1.03 or later and Sysmac Studio version 1.04 or higher are required.

A-4-2 Differences in Accessing from User Program

When this Unit is operated with an NJ-series device, a user program accesses various functions provided by the EtherCAT Slave Unit through device variables for CJ-series Unit that specifies AT specification for the memory used for CJ-series Unit.

The device variables for CJ-series Unit in the NJ-series CPU Unit's memory for CJ series Unit that correspond to the addresses and bit positions in the CJ-series CPU Unit's I/O memory are listed below.

First word allocated in the CIO Area: n = CIO 1,500 + Unit number × 25 (Unit number: 0 to 15)

First word allocated in the DM Area: m = D30,000 + Unit number × 100 (Unit number: 0 to 15)

CPU Bus Unit Words Allocated in CIO Area

● CIO n + 10 (Unit Status 1)

The device variable for CJ-series Unit that corresponds to all bits of a word starting with CIO n is as follows:

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word address	Bit	Variable name	CJ-series function name
CIO n + 10	0 to 15	*_Unit1Sta	Unit Status 1 The functions of bits 0 to 15 of CIO n+ 10 correspond to those of bits 0 to 15 of this CJ-series Unit device variable.

The device variables for CJ-series Units that correspond to bits 0 to 15 of a word starting with CIO n + 10 are as follows:

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word address	Bit	Variable name	CJ-series function name
CIO n + 10	0	*_UnitErr	Unit Error
	1	---	Reserved by system
	2	---	Reserved by system
	3	*_SlaveFuncErr	Slave Function Error
	4	*_MemErr	Unit Memory Error
	5	*_EscErr	ESC Error
	6	---	Reserved by system
	7	---	Reserved by system
	8	---	Reserved by system
	9	---	Reserved by system
	10	---	Reserved by system
	11	---	Reserved by system
	12	---	Reserved by system
	13	---	Reserved by system
	14	---	Reserved by system
	15	---	Reserved by system

● CIO n + 11 (Unit Status 2)

The device variable for CJ-series Unit that corresponds to all bits of a word starting with CIO n + 11 is as follows:

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word address	Bit	Variable name	CJ-series function name
CIO n + 11	0 to 15	*_Unit2Sta	Unit Status 2 The functions of bits 0 to 15 of CIO n+ 11 correspond to those of bits 0 to 15 of this CJ-series Unit device variable.

The device variables for CJ-series Units that correspond to bits 0 to 15 of a word starting with CIO n + 11 are as follows:

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word address	Bit	Variable name	CJ-series function name
CIO n + 11	0	*_OnlineSta	Online Status
	1	---	Reserved by system
	2	---	Reserved by system
	3	---	Reserved by system
	4	---	Reserved by system
	5	---	Reserved by system
	6	---	Reserved by system
	7	---	Reserved by system
	8	---	Reserved by system
	9	---	Reserved by system
	10	---	Reserved by system
	11	---	Reserved by system
	12	---	Reserved by system
	13	---	Reserved by system
	14	---	Reserved by system
	15	*_ErrLogSta	Error Log Registered

● CIO n + 12 (Slave Status 1)

The device variable for CJ-series Unit that corresponds to all bits of a word starting with CIO n + 12 is as follows:

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word address	Bit	Variable name	CJ-series function name
CIO n + 12	0 to 15	*_Slave1Sta	Slave Status 1 The functions of bits 0 to 15 of CIO n+ 12 correspond to those of bits 0 to 15 of this CJ-series Unit device variable.

The device variables for CJ-series Units that correspond to bits 0 to 15 of a word starting with CIO n + 12 are as follows:

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word address	Bit	Variable name	CJ-series function name
CIO n + 12	0	---	Reserved by system
	1	*_AlStatusErr	Slave AL Status Error
	2	*_SiiVerifyErr	SII Unit Verification Error
	3	*_VerificationErr	Verification Error
	4	*_MailboxSettingErr	Mailbox Setting Error
	5	*_IOCommErr	I/O Communication Error
	6	*_InvadlidReqState	Illegal State Transition Request Received
	7	*_IORefErr	I/O Refresh Error
	8	---	Reserved by system
	9	---	Reserved by system
	10	---	Reserved by system
	11	---	Reserved by system
	12	---	Reserved by system
	13	---	Reserved by system
	14	---	Reserved by system
	15	---	Reserved by system

● **CIO n + 13 (Slave Status 2)**

The device variable for CJ-series Unit that corresponds to all bits of a word starting with CIO n + 13 is as follows:

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word address	Bit	Variable name	CJ-series function name
CIO n + 13	0 to 15	*_Slave2Sta	Slave Status 2 The functions of bits 0 to 15 of CIO n+ 13 correspond to those of bits 0 to 15 of this CJ-series Unit device variable.

The device variables for CJ-series Units that correspond to bits 0 to 15 of a word starting with CIO n + 13 are as follows:

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word address	Bit	Variable name	CJ-series function name
CIO n + 13	0	---	Reserved by system
	1	*_AvailableMailbox	Available Mailbox Communication
	2	*_InDataValid	Input Data Valid
	3	*_OutDataValid	Output Data Valid
	4	---	Reserved by system
	5	---	Reserved by system
	6	---	Reserved by system
	7	---	Reserved by system
	8	---	Reserved by system
	9	---	Reserved by system
	10	---	Reserved by system
	11	---	Reserved by system
	12	---	Reserved by system
	13	---	Reserved by system
	14	*_LKSta1	IN Port Link Status
	15	*_LKSta2	OUT Port Link Status

CPU Bus Unit Words Allocated In DM Area

The data from D m to D m+6 are parameters in the I/O Communication Area Setting Table. The data from D m+7 to D m+ 12 are parameters in the I/O Communication Area Reference Table.

● D m (OUT Data Area Type)

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word address	Bit	Variable name	CJ-series function name
D m	0 to 7	*_AlocOutAreaType	OUT data area type

● D m + 1 (First Word In OUT Data Area)

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word address	Bit	Variable name	CJ-series function name
D m + 1	0 to 15	*_AlocOutAreaOffset	First word in OUT data area

● D m + 2 (OUT Data Area Size)

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word address	Bit	Variable name	CJ-series function name
D m + 2	0 to 15	*_AlocOutAreaSize	OUT data area size

● D m+ 3 (IN Data Area Type)

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word address	Bit	Variable name	CJ-series function name
D m + 3	0 to 7	*_AlocInAreaType	IN data area type

● **D m + 4 (First Word In IN Data Area)**

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word address	Bit	Variable name	CJ-series function name
D m + 4	0 to 15	*_AlocInAreaOffset	First word in IN data area

● **D m + 5 (IN Data Area Size)**

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word address	Bit	Variable name	CJ-series function name
D m + 5	0 to 15	*_AlocInAreaSize	IN data area size

● **D m + 6 (Setting Results)**

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word address	Bit	Variable name	CJ-series function name
D m + 6	0 to 15	*_AlocSta	Setting results

● **D m + 7 (OUT Data Area Type)**

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word address	Bit	Variable name	CJ-series function name
D m + 7	0 to 7	*_RefOutAreaType	OUT data area type

● **D m + 8 (First Word In OUT Data Area)**

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word address	Bit	Variable name	CJ-series function name
D m + 8	0 to 15	*_RefOutAreaOffset	First word in OUT data area

● **D m + 9 (OUT Data Area Size)**

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word address	Bit	Variable name	CJ-series function name
D m + 9	0 to 15	*_RefOutAreaSize	OUT data area size

● **D m + 10 (IN Data Area Type)**

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word address	Bit	Variable name	CJ-series function name
D m + 10	0 to 7	*_RefInAreaType	IN data area type

● **D m + 11 (First Word In IN Data Area)**

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word address	Bit	Variable name	CJ-series function name
D m + 11	0 to 15	*_RefInAreaOffset	First word in IN data area

● D m + 12 (IN Data Area Size)

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word address	**Bit**	**Variable name**	**CJ-series function name**
D m + 12	0 to 15	*_RefInAreaSize	IN data area size

A-5 CoE Objects

This section explains the CoE objects that are implemented by the EtherCAT Slave Unit.

A-5-1 Object Dictionary Area

The CAN application protocol over EtherCAT (CoE) is based on the object dictionary for the CAN application protocol.

All objects are assigned 4-digit hexadecimal indexes. The objects are structured in the following areas.

Indexes	Area	Description
0000 to 0FFF hex	Data Type Area	This area contains the data type definitions.
1000 to 1FFF hex	CoE Communications Area	The objects in this area are defined for use by all servers that perform specialized communications. • PDO mapping objects
2000 to 2FFF hex	Manufacturer-specific Area 1	The objects in this area are defined for all OMRON products.
3000 to 5FFF hex	Manufacturer-specific Area 2	The objects in this area are defined for the EtherCAT Slave Unit.
6000 to 9FFF hex	Device Profile Area	The objects in this area are defined by the CiA401 Generic I/O Module Device Profile (a profile that specifies the CAN application protocol interface for devices with digital I/O and analog I/O).
A000 to FFFF hex	Reserved Area	This area is reserved for future use.

A-5-2 Data Type

The following data types are used in this profile.

Data type	Abbreviation	Size	Range of values
Unsigned8	U8	1 byte	0 to 255
Unsigned16	U16	2 bytes	0 to 65,535
Unsigned32	U32	4 bytes	0 to 4,294,967,295
Visible String	VS	---	---

A-5-3 Format of Objects

The following table describes objects with the following format.

Index (hex)	Subin-dex (hex)	Object name	Default	Data range	Unit	Data attri-bute	Size	Access	PDO mapping	Complete access
<Index>	<Subin-dex>	<Object name>	<Default setting>	<Data range>	<Unit>	<Data attri-bute>	<Size>	<Access>	<Possi-ble/Not possible>	<Possi-ble/Not pos-sible>

Items with the <> brackets are replaced with data. Each item has the following meaning.

Item	Description
Index	This is the index of the object that is expressed as a four-digit hexadecimal number.
Subindex	This is the subindex of the object that is expressed as a two-digit hexadecimal number.
Object name	This is the name of the object. For a subindex, this is the name of the subindex.
Default	This is the value that is set when the product is shipped from the factory.
Data range	For a read-only (RO) object, this is the range of the data that you can read. For a read/write (RW) object, this is the setting range of the data.
Unit	The unit is the physical units.
Data attribute	This is the timing when changes to writable objects are enabled. • A: Enabled at all times • B: When moving from Pre-Operational state to Safe-Operational state • C: When moving from Pre-Operational state to Init state • R: When the power supply is reset or the Unit is restarted • ---: Write-prohibited
Size	This is the size of the object in bytes.
Access	This data indicates if the object is read-only or read/write. • RO: Read only • RW: Read/write
PDO mapping	This indicates if you can map the object to a PDO.
Complete access[1]	This indicates whether the object allows complete access.

*1. Complete access is used to read and write to a batch of objects. It allows you to read or write to all subindexes of an object.

A-5-4 Communication Objects

The indexes from 1000 to 1018 hex are for communication objects for the EtherCAT Slave Unit.

Index (hex)	Subin-dex (hex)	Object name	Default	Data range	Unit	Data attri-bute	Size	Access	PDO mapping	Complete access
1000	---	Device Type	00000000 hex	00000000 hex	---	---	4 byte (U32)	RO	1000	Not possible

• This object stores the device profile number that the Slave uses.

Index (hex)	Subin-dex (hex)	Object name	Default	Data range	Unit	Data attri-bute	Size	Access	PDO mapping	Complete access
1008	---	Manufacturer Device Name	CJ1W-ECT 21 (padded with 10 spaces, character 20 hex)	CJ1W-ECT21 (padded with 10 spaces, character 20 hex)	---	---	20 byte (VS)	RO	Not possi-ble	Not possible

• This object provides the model of the EtherCAT Slave Unit in ASCII code.

Index (hex)	Subin-dex (hex)	Object name	Default	Data range	Unit	Data attri-bute	Size	Access	PDO mapping	Complete access
1009	---	Manufacturer Hardware Version	"A" (padded with 19 spaces, char-acter 20 hex)	"A" (padded with 19 spaces, char-acter 20 hex)	---	---	20 byte (VS)	RO	Not possi-ble	Not possi-ble

• This object provides the hardware version of the EtherCAT Slave Unit in ASCII code.

Index (hex)	Subin-dex (hex)	Object name	Default	Data range	Unit	Data attri-bute	Size	Access	PDO mapping	Complete access
100A	---	Manufacturer Software Version	"V1.00" (pad-ded with 15 spaces, char-acter 20 hex)	"V1.00" (pad-ded with 15 spaces, char-acter 20 hex)	---	---	20 byte (VS)	RO	Not possi-ble	Not possi-ble

• This object provides the software version of the EtherCAT Slave Unit in ASCII code. Start with"V" (56 hex), and delimit three characters of ASCII codes with a period (2E hex), e.g. "V1.00". If it is com-posed of plural modules, delimit them with a space (20 hex) and return the version in 20 bytes or shorter which is filled from the head, e.g. "V1.00 V1.02 V1.01".

Index (hex)	Subin-dex (hex)	Object name	Default	Data range	Unit	Data attri-bute	Size	Access	PDO mapping	Complete access
1018	---	Identity Object	---	---	---	---	---	---	---	Possible
	00	Number of entries	04 hex	04 hex	---	---	1 byte (U8)	RO	Not possi-ble	---
	01	Vendor ID	00000083 hex	00000083 hex	---	---	4 bytes (U32)	RO	Not possi-ble	---
	02	Product Code	000000BA hex	000000BA hex	---	---	4 bytes (U32)	RO	Not possi-ble	---
	03	Revision Number	00010000 hex	00010000 hex	---	---	4 bytes (U32)	RO	Not possi-ble	---
	04	Serial Number	Every slave has a unique number	00000000 to FFFFFFFF hex	---	---	4 bytes (U32)	RO	Not possi-ble	---

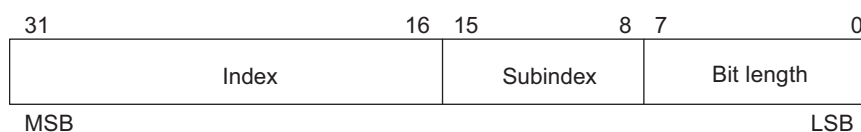This object provides information on the EtherCAT Slave Unit.

• Subindex 01 hex provides the vendor's ID.

• Subindex 02 hex provides the value that is assigned to the EtherCAT Slave Unit.

• Subindex 03 hex provides the revision number of the EtherCAT Slave Unit.

   Bits 16 to 31: These bits provide the major revision number of the EtherCAT Slave Unit.

   Bits 0 to 15: These bits provide the minor revision number of the EtherCAT Slave Unit.

• Subindex 04 hex provides the serial number of the EtherCAT Slave Unit. This is a unique value for each product.

A-5-5 PDO Mapping Objects

The PDO mapping objects for the EtherCAT Slave Unit are listed in the following table.

Index (hex)	Description
1700 to 1703	Receive PDO mappings
1B00 to 1B03	Transmit PDO mappings

Subindexes 01 hex and on give the mapped application object information.

```
 31                          16 15        8 7              0
┌───────────────────────────────┬──────────┬──────────────┐
│            Index               │ Subindex │  Bit length  │
└───────────────────────────────┴──────────┴──────────────┘
 MSB                                                   LSB
```

Bits 16 to 31: Index of the assigned object

Bits 8 to 15: Subindex of the assigned object

Bits 0 to 7: Bit length of the assigned object (i.e., a bit length of 32 bits is given as 20 hex)

Receive PDO Mapping Objects for the EtherCAT Slave Unit

The indexes from 1700 to 1703 hex are for receive PDO mapping objects for the EtherCAT Slave Unit.

Index (hex)	Subin-dex (hex)	Object name	Default	Data range	Unit	Data attri-bute	Size	Access	PDO mapping	Complete access
1700	---	257th receive PDO Mapping	---	---	---	---	---	---	---	Possible
	0	Number of objects in this PDO	19 hex	19 hex	---	---	1 byte (U8)	RO	Not possi-ble	---
	1	1st Output Object to be mapped	70000110 hex	70000110 hex	---	---	4 byte (U32)	RO	Not possi-ble	---
	2	2nd Output Object to be mapped	70000210 hex	70000210 hex	---	---	4 byte (U32)	RO	Not possi-ble	---
	Sub indexes 3 to 18									
	19	25th Output Object to be mapped	70001910 hex	70001910 hex	---	---	4 byte (U32)	RO	Not possi-ble	---

• These objects store the RxPDO entries.

Index (hex)	Subindex (hex)	Object name	Default	Data range	Unit	Data attribute	Size	Access	PDO mapping	Complete access
1701	---	258th receive PDO Mapping	---	---	---	---	---	---	---	Possible
	0	Number of objects in this PDO	32 hex	32 hex	---	---	1 byte (U8)	RO	Not possible	---
	1	1st Output Object to be mapped	70000110 hex	70000110 hex	---	---	4 byte (U32)	RO	Not possible	---
	2	2nd Output Object to be mapped	70000210 hex	70000210 hex	---	---	4 byte (U32)	RO	Not possible	---
	Sub indexes 03 to 31									
	32	50th Output Object to be mapped	70003210 hex	70003210 hex	---	---	4 byte (U32)	RO	Not possible	---

- These objects store the RxPDO entries.

Index (hex)	Subindex (hex)	Object name	Default	Data range	Unit	Data attribute	Size	Access	PDO mapping	Complete access
1702	---	259th receive PDO Mapping	---	---	---	---	---	---	---	Possible
	00	Number of objects in this PDO	64 hex	64 hex	---	---	1 byte (U8)	RO	Not possible	---
	01	1st Output Object to be mapped	70000110 hex	70000110 hex	---	---	4 byte (U32)	RO	Not possible	---
	02	2nd Output Object to be mapped	70000210 hex	70000210 hex	---	---	4 byte (U32)	RO	Not possible	---
	Sub indexes 03 to 63									
	64	100th Output Object to be mapped	70006410 hex	70006410 hex	---	---	4 byte (U32)	RO	Not possible	---

- These objects store the RxPDO entries.

Index (hex)	Subindex (hex)	Object name	Default	Data range	Unit	Data attribute	Size	Access	PDO mapping	Complete access
1703	---	260th receive PDO Mapping	---	---	---	---	---	---	---	Possible
	00	Number of objects in this PDO	C8 hex	C8 hex	---	---	1 byte (U8)	RO	Not possible	---
	01	1st Output Object to be mapped	70000110 hex	70000110 hex	---	---	4 byte (U32)	RO	Not possible	---
	02	2nd Output Object to be mapped	70000210 hex	70000210 hex	---	---	4 byte (U32)	RO	Not possible	---
	Sub indexes 03 to C7									
	C8	200th Output Object to be mapped	7000C810 hex	7000C810 hex	---	---	4 byte (U32)	RO	Not possible	---

- These objects store the RxPDO entries.

Transmit PDO Mapping Objects for the EtherCAT Slave Unit

The indexes from 1B00 to 1B03 hex are for transmit PDO mapping objects for the EtherCAT Slave Unit.

Index (hex)	Subindex (hex)	Object name	Default	Data range	Unit	Data attribute	Size	Access	PDO mapping	Complete access
1B00	---	257th transmit PDO Mapping	---	---	---	---	---	---	---	Possible
	00	Number of objects in this PDO	19 hex	19 hex	---	---	1 byte (U8)	RO	Not possible	---
	01	1st Input Object to be mapped	60000110 hex	60000110 hex	---	---	4 byte (U32)	RO	Not possible	---
	02	2nd Input Object to be mapped	60000210 hex	60000210 hex	---	---	4 byte (U32)	RO	Not possible	---
	Sub indexes 03 to 18									
	19	25th Input Object to be mapped	60001910 hex	60001910 hex	---	---	4 byte (U32)	RO	Not possible	---

• These objects store the TxPDO entries.

Index (hex)	Subindex (hex)	Object name	Default	Data range	Unit	Data attribute	Size	Access	PDO mapping	Complete access
1B01	---	258th transmit PDO Mapping	---	---	---	---	---	---	---	Possible
	00	Number of objects in this PDO	32 hex	32 hex	---	---	1 byte (U8)	RO	Not possible	---
	01	1st Input Object to be mapped	60000110 hex	60000110 hex	---	---	4 byte (U32)	RO	Not possible	---
	02	2nd Input Object to be mapped	60000210 hex	60000210 hex	---	---	4 byte (U32)	RO	Not possible	---
	Sub indexes 03 to 31									
	32	50th Input Object to be mapped	60003210 hex	60003210 hex	---	---	4 byte (U32)	RO	Not possible	---

• These objects store the TxPDO entries.

Index (hex)	Subindex (hex)	Object name	Default	Data range	Unit	Data attribute	Size	Access	PDO mapping	Complete access
1B02	---	259th transmit PDO Mapping	---	---	---	---	---	---	---	Possible
	00	Number of objects in this PDO	64 hex	64 hex	---	---	1 byte (U8)	RO	Not possible	---
	01	1st Input Object to be mapped	60000110 hex	60000110 hex	---	---	4 byte (U32)	RO	Not possible	---
	02	2nd Input Object to be mapped	60000210 hex	60000210 hex	---	---	4 byte (U32)	RO	Not possible	---
	Sub indexes 03 to 63									
	64	100th Input Object to be mapped	60006410 hex	60006410 hex	---	---	4 byte (U32)	RO	Not possible	---

- These objects store the TxPDO entries.

Index (hex)	Subin-dex (hex)	Object name	Default	Data range	Unit	Data attri-bute	Size	Access	PDO mapping	Complete access
1B03	---	260th transmit PDO Mapping	---	---	---	---	---	---	---	Possible
	00	Number of objects in this PDO	C8 hex	C8 hex	---	---	1 byte (U8)	RO	Not possi-ble	---
	01	1st Input Object to be mapped	60000110 hex	60000110 hex	---	---	4 byte (U32)	RO	Not possi-ble	---
	02	2nd Input Object to be mapped	60000210 hex	60000210 hex	---	---	4 byte (U32)	RO	Not possi-ble	---
	Sub indexes 03 to C7									
	C8	200th Input Object to be mapped	6000C810 hex	6000C810 hex	---	---	4 byte (U32)	RO	Not possi-ble	---

- These objects store the TxPDO entries.

A-5-6 Sync Manager Communication Objects

The EtherCAT communications memory is set with objects 1C00 to 1C13 hex

Index (hex)	Subin-dex (hex)	Object name	Default	Data range	Unit	Data attri-bute	Size	Access	PDO mapping	Complete access
1C00	---	Sync Manager Communication Type	---	---	---	--	---	---	---	Possible
	00	Number of entries	04 hex	04 hex	---	---	1 byte (U8)	RO	Not possi-ble	---
	01	Communication Type Sync Man-ager 0	01 hex	01 hex	---	---	1 byte (U8)	RO	Not possi-ble	---
	02	Communication Type Sync Man-ager 1	02 hex	02 hex	---	---	1 byte (U8)	RO	Not possi-ble	---
	03	Communication Type Sync Man-ager 2	03 hex	03 hex	---	---	1 byte (U8)	RO	Not possi-ble	---
	04	Communication Type Sync Man-ager 3	04 hex	04 hex	---	---	1 byte (U8)	RO	Not possi-ble	---

- The Sync Managers are set as follows:

    SM0: Mailbox receive (EtherCAT master to an EtherCAT Slave Unit)

    SM1: Mailbox send (EtherCAT Slave Unit to EtherCAT master)

    SM2: Process data output (EtherCAT master to EtherCAT Slave Unit)

    SM3: Process data input (EtherCAT Slave Unit to EtherCAT master)

Index (hex)	Subin- dex (hex)	Object name	Default	Data range	Unit	Data attri- bute	Size	Access	PDO mapping	Complete access
1C10	---	Sync Manager 0 PDO Assignment	---	---	---	--	---	---	---	Possible
	00	Number of assigned PDO	00 hex	00 hex	---	---	1 byte (U8)	RO	Not possi- ble	---

- This object provides the number of PDO mappings that are used by Sync Manager 0.
- The Mailbox Receive Sync Manager does not have any PDOs.

Index (hex)	Subin- dex (hex)	Object name	Default	Data range	Unit	Data attri- bute	Size	Access	PDO mapping	Complete access
1C11	---	Sync Manager 1 PDO Assignment	---	---	---	--	---	---	---	Possible
	00	Number of assigned PDO	00 hex	00 hex	---	---	1 byte (U8)	RO	Not possi- ble	---

- This object provides the number of PDO mappings that are used by Sync Manager 1.
- The Mailbox Transmit Sync Manager does not have any PDOs.

Index (hex)	Subin- dex (hex)	Object name	Default	Data range	Unit	Data attri- bute	Size	Access	PDO mapping	Complete access
1C12	---	Sync Manager 2 PDO Assignment	---	---	---	---	---	---	---	Possible
	00	Number of assigned RxPDOs	00 hex	00 to 01 hex	---	---	1 byte (U8)	RO	Not possi- ble	---
	01	1st PDO Map- ping object index of assigned RxPDO	0000 hex	0000 hex, 1700 to 1703 hex	---	---	2 byte (U16)	RO	Not possi- ble	---

- This object provides the receive PDO that is used by Sync Manager 2.

Index (hex)	Subin- dex (hex)	Object name	Default	Data range	Unit	Data attri- bute	Size	Access	PDO mapping	Complete access
1C13	---	Sync Manager 3 PDO Assignment	---	---	---	--	---	---	---	Possible
	00	Number of assigned TxP- DOs	00 hex	00 to 01 hex	---	---	1 byte (U8)	RO	Not possi- ble	---
	01	1st PDO Map- ping object index of assigned TxPDO	0000 hex	0000 hex, 1B00 to 1B03 hex	---	---	2 byte (U16)	RO	Not possi- ble	---

- This object provides the transmit PDO that is used by the Sync Manager 3.

Index (hex)	Subin-dex (hex)	Object name	Default	Data range	Unit	Data attri-bute	Size	Access	PDO mapping	Complete access
1C32	---	Sync Manager 2 Synchronization	---	---	---	--	---	---	---	Possible
	00	Number of Syn-chronization Parameters	20 hex	20 hex	---	---	1 byte (U8)	RO	Not possi-ble	---
	01	Synchronization Type	0000 hex	0000 hex	---	---	2 byte (U16)	RW	Not possi-ble	---
	02	Cycle Time	00000000 hex	00000000 hex	ns	---	4 byte (U32)	RO	Not possi-ble	---
	04	Synchronization Types supported	0001 hex	0001 hex	---	---	2 byte (U16)	RO	Not possi-ble	---
	05	Minimum Cycle Time	00000000 hex	00000000 hex	ns	---	4 byte (U32)	RO	Not possi-ble	---

- This object provides the specifications of the EtherCAT communications mode for Sync Manager 2.
- Subindex 01 hex provides the EtherCAT communications mode for Sync Manager 2 of the EtherCAT Slave Unit.

  0000 hex: Free-Run Mode
- Subindex 02 hex provides the cycle time. In Free-Run Mode, the time between two local timer events is provided.
- Subindex 04 hex provides the type of synchronization that is supported by the EtherCAT Slave Unit.
- Subindex 05 hex provides the minimum cycle time that is supported by the EtherCAT Slave Unit.

Index (hex)	Subin-dex (hex)	Object name	Default	Data range	Unit	Data attri-bute	Size	Access	PDO mapping	Complete access
1C33	---	Sync Manager 3 Synchronization	---	---	---	--	---	---	---	Possible
	00	Number of Syn-chronization Parameters	20 hex	20 hex	---	---	1 byte (U8)	RO	Not possi-ble	---
	01	Synchronization Type	0000 hex	0000 hex	---	---	2 byte (U16)	RW	Not possi-ble	---
	02	Cycle Time	00000000 hex	00000000 hex	ns	---	4 byte (U32)	RO	Not possi-ble	---
	04	Synchronization Types supported	0001 hex	0001 hex	---	---	2 byte (U16)	RO	Not possi-ble	---
	05	Minimum Cycle Time	00000000 hex	00000000 hex	ns	---	4 byte (U32)	RO	Not possi-ble	---

- This object provides the specifications of the EtherCAT communications mode for Sync Manager 3.
- Subindex 01 hex provides the EtherCAT communications mode for Sync Manager 3 of the EtherCAT Slave Unit.

  0000 hex: Free-Run Mode
- Subindex 02 hex provides the cycle time. In Free-Run Mode, the time between two local timer events is provided.
- Subindex 04 hex provides the type of synchronization that is supported by the EtherCAT Slave Unit.
- Subindex 05 hex provides the minimum cycle time that is supported by the EtherCAT Slave Unit.

A-5-7 Device Profile Area

The device profile area for the EtherCAT Slave Unit is listed below.

Index (hex)	PDO mapping
6000	I/O Input Data Area
7000	I/O Output Data Area

I/O Input Data Area

This object does not allow complete access.

The reading and writing specifications for this object are listed below.
- If the object is mapped to a PDO, reading and writing are not allowed.
- If the object is not mapped to a PDO, reading and writing depend on the communications control status. The specifications are given in the following table.

Status	Specification
Pre-Operational	Reading and writing are not allowed.
Safe-Operational	Reading is allowed and writing is not allowed.
Operational	

Index (hex)	Subindex (hex)	Object name	Default	Data range	Unit	Data attribute	Size	Access	PDO mapping	Complete access
6000	---	I/O Input Data Area	---	---	---	---	---	---	---	Not possible
	00	Number of entries	C8 hex	C8 hex	---	---	1 byte (U8)	RO	Not possible	---
	01	Input001	0000 hex	0000 to FFFF hex	---	---	2 byte (U16)	RO	Possible	---
	Sub indexes 2 to C7									
	C8	Input200	0000 hex	0000 to FFFF hex	---	---	2 byte (U16)	RO	Possible	---

I/O Output Data Area

This object does not allow complete access.

The reading and writing specifications for this object are listed below.
- If the object is mapped to a PDO, reading and writing are not allowed.
- If the object is not mapped to a PDO, reading and writing depend on the communications control status. The specifications are given in the following table.

Status	Specification
Pre-Operational	Reading and writing are not allowed.
Safe-Operational	Reading is allowed and writing is not allowed.
Operational	Reading and writing are allowed.

Index (hex)	Subin-dex (hex)	Object name	Default	Data range	Unit	Data attri-bute	Size	Access	PDO mapping	Complete access
7000	---	I/O Output Data Area	---	---	---	---	---	---	---	Not possible
	00	Number of entries	C8 hex	C8 hex	---	---	1 byte (U8)	RO	Not possi-ble	---
	01	Output001	0000 hex	0000 to FFFF hex	---	A	2 byte (U16)	RW	Possible	---
	Sub indexes 2 to C7									
	C8	Output200	0000 hex	0000 to FFFF hex	---	A	2 byte (U16)	RW	Possible	---

A-6 Version Information

The following table shows the relationship between the unit version of the EtherCAT Slave Unit, the unit version of the CPU Unit and the version of the Sysmac Studio.

Refer to version-related information on the CPU Unit for corresponding versions when using CPU Unit versions and Sysmac Studio versions that are later or higher than the corresponding versions given in the following table.

Model number of Eth-erCAT Slave Unit	Unit version	Corresponding unit version/version[1]	
		Unit version of NJ-series CPU Unit	Sysmac Studio version
CJ1W-ECT21	Ver. 1.0	Ver. 1.10 or later	Ver. 1.13 or higher

*1. Some Units do not have all of the versions given in the above table. If a Unit does not have the specified version, support is provided by the oldest available version after the specified version. Refer to the user's manuals for the specific Units for the relation between models and versions.

I

Index

I

Index

O

P

R

S

T

U

V

W

I

CJ-series EtherCAT Slave Units Operation Manual for NJ-series CPU Unit (W542)