SYSMAC CJ Series

CJ1W-ECT21

EtherCAT® Slave Unit

OPERATION MANUAL

OMRON

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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 a CJ-series CPU Unit. Please read this manual and make sure you understand the functionality and performance of the CJ-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 5 Troubleshooting

Section 6 Maintenance and Replacement

Appendices

Index

Manual Structure

Page Structure and Icons

The following page structure is used in this manual.

Level 1 heading
Level 2 heading
Level 3 heading
Gives the current headings.

Level 2 heading

Level 3 heading

A step in a procedure
Indicates a procedure.

Page tab
Gives the number of the main section.

Special information
Icons indicate precautions, additional information, or reference information.

Manual name

4   Installation and Wiring

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.

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 the differences in specifications and functionality for CPU Units and EtherCAT Slave Units with different unit versions and for different versions of the CX-Programmer is given.

Note   References are provided to more detailed or related information.

Precautions on Terminology

- In this manual, "download" refers to transferring data from the CX-Programmer to the physical PLC and "upload" refers to transferring data from the physical PLC to the CX-Programmer.
- The CJ-series EtherCAT Slave Unit can connect with the CJ-series CPU Unit, CP-series CPU Unit and the NSJ-series CPU Unit. In this manual, the CJ-series CPU Unit is used as an example.

Terms and Conditions Agreement

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 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.	

▌Transferring

Always confirm safety at the destination node before transferring a program to another node or changing contents of the I/O memory area. Doing either of these without confirming safety may result in injury.	
Confirm safety before transferring data files stored in the file memory (Memory Card or EM file memory) to the I/O area (CIO) of the CPU Unit using a programming device. Otherwise, the devices connected to the output Unit may malfunction regardless of the operation mode of the CPU Unit.	

▌Fail-safe Measures

Provide safety measures in external circuits (i.e., not in the Programmable Controller), including the following items, to ensure safety in the system if an abnormality occurs due to malfunction of the PLC or another external factor affecting the PLC operation. Not doing so may result in serious accidents.	
Unintended outputs may occur when an error occurs 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.	
The PLC will turn OFF all outputs when its self-diagnosis function detects any error or when a severe failure alarm (FALS) instruction is executed. Unexpected operation, however, may still occur for errors in the I/O control section, errors in I/O memory, and other errors that cannot be detected by the self-diagnosis function. As a countermeasure for all such errors, external safety measures must be provided to ensure safety in the system.	

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.

When the 24-V DC output (service power supply to the PLC) is overloaded or short-circuited, the voltage may drop and result in the outputs being turned OFF. As a countermeasure for such problems, external safety measures must be provided to ensure safety in the system.

Fail-safe measures must be taken by the customer to ensure safety in the event of incorrect, missing, or abnormal signals caused by broken signal lines, momentary power interruptions, or other causes. Serious accidents may result from abnormal operation if proper measures are not provided.

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 PLC on a network.

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 edit only after confirming that no adverse effects will be caused by extending the cycle time. Otherwise, the input signals may not be readable.

Precautions for Safe Use

Disassembly and Dropping

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

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.
- Be sure to attach the end cover provided with the CPU Unit to the right-most Unit. CJ-series PLCs will not operate properly if the end cover is not attached.

Transporting

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

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.

Wiring

- Follow the instructions in this manual to correctly perform wiring.
  Double-check all wiring and switch settings before turning ON the power supply. Incorrect wiring may result in burning.
- Use parts and tools appropriate for wiring.
- 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, Memory Units, expansion cables, and other items with locking devices are properly locked into place. Improper locking may result in malfunction.
- Before you connect a computer to the PLC, 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 PLC may cause failure or malfunction.
- Use crimp terminals for wiring. Do not connect bare stranded wires directly to terminals. Connection of bare stranded wires may result in burning.

Power Supply Design

- Do not exceed the rated supply capacity of the Power Supply Units in the CJ-series PLC. The rated supply capacities are given in the operation manual of the CPU Units.

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

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

  Operation is not possible if an NJ/NX-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 operation manual of the CPU Units 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 operation manual of the CPU Units.

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

Turning ON the Power Supply

- Always turn ON power to the PLC before turning ON power to the control system. If the PLC power supply is turned ON after the control power supply, temporary errors may result in control system signals because the output terminals on DC Output Units and other Units may momentarily turn ON when power is turned ON to the PLC.

- Double-check all wiring and switch settings 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

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

- Always turn OFF the power supply to the PLC before attempting 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.

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 Operating Mode at Startup)
  - b) Changing the user program or settings
  - c) Changing set values or present values
  - d) Forced refreshing
- After you change any slave or Unit settings, carefully check the safety of the controlled system before you restart the Unit.

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.
- 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

- When replacing parts, be sure to confirm that the rating of a new part is correct. Not doing so may result in malfunction or burning.
- After replacing Units, resume operation only after transferring to the new CPU Unit and/or Special I/O Units the contents of the DM Area, HR Area, and other data required for resuming operation. Not doing so may result in unexpected operation.
- If you replace a CPU Bus Unit or Special I/O Unit, refer to operation manual for the Unit for information on the data required for individual Units and redo the necessary settings.

Disposal

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

Precautions for Correct Use

Storage, Mounting, and Wiring

- Do not operate the control system 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 static electricity or other forms of noise
    b) Locations subject to strong electromagnetic fields
    c) Locations subject to possible exposure to radioactivity
    d) 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.
- 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.
- Install the control system away from sources of heat and ensure proper ventilation. Not doing so may result in malfunction, in operation stopping, or in burning.
- Use proper connection methods and EtherCAT communication cables. Otherwise, communications may be faulty. Refer to *2-3 EtherCAT Network Wiring* on page 2-10.
- 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.

EtherCAT Communications

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

Operating Environment

- The operating environment of the PLC System can have a large effect on the longevity and reliability of the system. Improper operating environments can lead to malfunction, failure, and other unforeseeable problems with the PLC System. Be sure that the operating environment is within the specified conditions at installation and remains within the specified conditions during the life of the system.

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 comply with EC Directives. To ensure that the machine or device in which the CJ-series PLC is used complies with EC Directives, the PLC must be installed as follows:

- The CJ-series PLC must be installed within a control panel.
- You must use reinforced insulation or double insulation for the DC power supplies used for the communications power supply and I/O power supplies.
- CJ-series PLCs complying 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 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 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-series product that complies with shipbuilding standards and the machinery or system in which you use the CJ-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 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 CJ-series CJ1W-ECT21 EtherCAT Slave Units in Korea.

A 급 기기 (업무용 방송통신기자재)
이 기기는 업무용(A 급) 전자파적합기기로서 판매자
또는 사용자는 이 점을 주의하시기 바라며, 가정외의
지역에서 사용하는 것을 목적으로 합니다.

Class A Device (Broadcasting Communications Device for Office Use)

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

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

Unit Versions
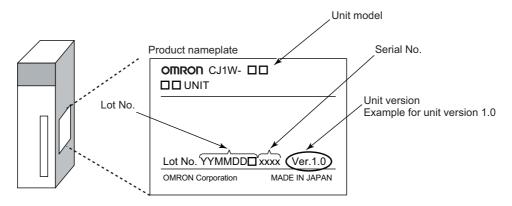
Unit Versions

A "unit version" has been introduced to manage CPU Units in the CJ 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 Support Software

CX-Programmer version 4.0 can be used to confirm the unit version using the *Unit Manufacturing Information*.
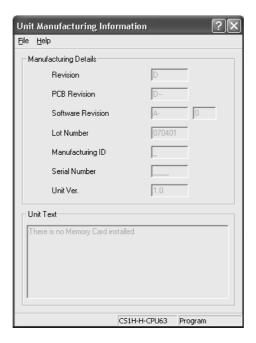
Precautions for Correct Use

The unit versions of Pre-Ver.1.0 Units cannot be confirmed in Unit Manufacturing Information. The following dialog box is displayed.

In the IO Table Window, right-click the Unit to check the Unit Version and select **Unit Manufacturing Information.**

The following Unit Manufacturing Information Dialog Box will be displayed.

Unit Versions and CX-Programmer Versions

The functions that are supported depend on the unit version of the Unit. The version of CX-Programmer that supports the functions that were added for an upgrade is also required to use those functions.

Refer to *A-7 Version Information* on page A-33 for the functions that are supported by each 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	W541	CJ1W-ECT21	Learning how to use an EtherCAT Slave Unit.	The following items are described: the overall system and configuration methods of an EtherCAT Slave Unit, information on hardware and functions to set up, control and monitor the EtherCAT Slave Unit.
CX-Programmer Operational Manual	W446	CXONE-AL□□C-V4 CXONE-AL□□D-V4	Learning the functions and application methods of the CX-Programmer software.	Provides information on how to use the CX-Programmer for all functionality except for function blocks.
SYSMAC CJ Series Programmable Controllers Operation Manual	W393	CJ1G-CPU□□ CJ1M-CPU□□ CJ1G-CPU□□P CJ1G/H-CPU□□H	Learning the functions and application methods of the CJ Series PLC.	Provides an outline of, and describes the design, installation, maintenance, and other basic operations for the CJ-series PLCs.
SYSMAC CJ Series CJ2 CPU Unit Software User's Manual	W473	CJ2H-CPU6□-EIP CJ2H-CPU6□ CJ2M-CPU□□	Learning the functions and application methods of the CJ2 Series PLC Software.	Describes the following for CJ2 CPU Units: • CPU Unit operation • Internal memory • Programming • Settings • Function built into the CPU Unit Use together with the *SYSMAC CJ Series CJ2 CPU Unit Hardware User's Manual* (W472).
SYSMAC CJ Series CJ2 CPU Unit Hardware User's Manual	W472	CJ2H-CPU6□-EIP CJ2H-CPU6□ CJ2M-CPU□□	Learning the functions and application methods of the CJ2 Series PLC Hardware.	Describes the following for CJ2 CPU Units: • Overview and features • Basic system configuration • Part nomenclature and functions • Mounting and setting procedure • Remedies for errors Use together with the S*YSMAC CJ Series CJ2 CPU Unit Software User's Manual* (W473).
SYSMAC ONE NSJ Series Controllers Operation Manual	W452	NSJ5-TQ□□(B)-G5D NSJ5-SQ□□(B)-G5D NSJ8-TV□□(B)-G5D NSJ10-TV□□(B)-G5D NSJ12-TS□□(B)-G5D NSJ5-TQ□□(B)-M3D NSJ5-SQ□□(B)-M3D NSJ8-TV□□(B)-M3D NSJW-ETN21 NSJW-CLK21-V1 NSJW-IC101	Learning the functions and application methods of the NSJ Series Controller.	Provides basic specifications on NSJ Controllers, including an overview, designing, installation, and maintenance.
SYSMAC CP Series CP1H CPU Unit Operation Manual	W450	CP1H-X40D□-□ CP1H-XA40D□-□ CP1H-Y20DT-D	Learning the functions and application methods of the CP1H Series Controller.	Provides basic specifications on CP-series CP1H PLCs, including an overview, designing, installation, and maintenance.

Manual name	Cat. No.	Model numbers	Application	Description
NJ/NX-series CPU Unit Software User's Manual	W501	NX701-□□□□ NJ501-□□□□ NJ301-□□□□ NJ101-□□□□	Learning how to program and set up an NJ/NX-series CPU Unit. Mainly software 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 Use this manual together with the *NX-series CPU Unit Hardware User's Manual* (Cat. No. W535) or the *NJ-series CPU Unit Hardware User's Manual* (Cat. No. W500).
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.
NJ/NX-series CPU Unit Built-in EtherCAT® Port User's Manual	W505	NX701-□□□□ 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. Use this manual together with the *NX-series CPU Unit Hardware User's Manual* (Cat. No. W535) or *NJ-series CPU Unit Hardware User's Manual* (Cat. No. W500) and with the *NJ/NX-series CPU Unit Software User's Manual* (Cat. No. W501).
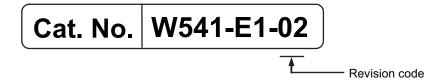
Terminology

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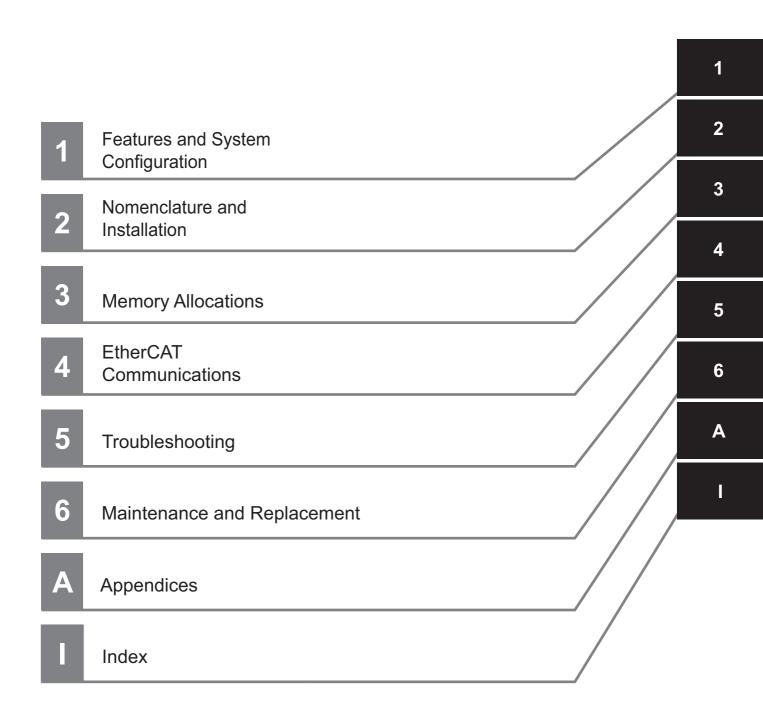
A manual revision code appears as a suffix to the catalog number on the front and back covers of the manual.

$$\boxed{\text{Cat. No.} \mid \text{W541-E1-02}}$$

Revision code

Revision code	Date	Revised content
01	April 2015	Original production
02	April 2019	Added information on the unit version that supports a ring topology.

Sections in this Manual

1

2

3

4

5

6

A

I

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.
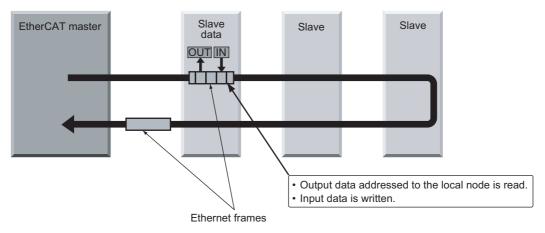
1-1-1   How EtherCAT Works

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.
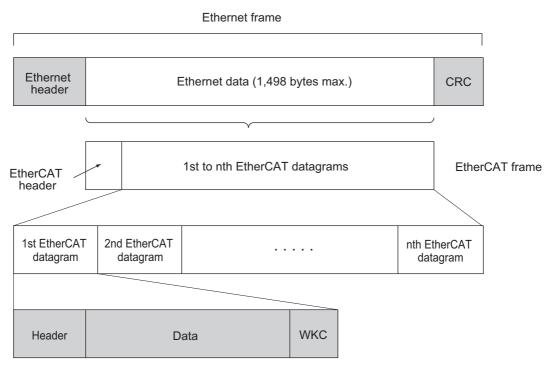
This mechanism ensures high speed and realtime data transmission.

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.

WKC: Working counter

1-1-2   Types of EtherCAT Communications
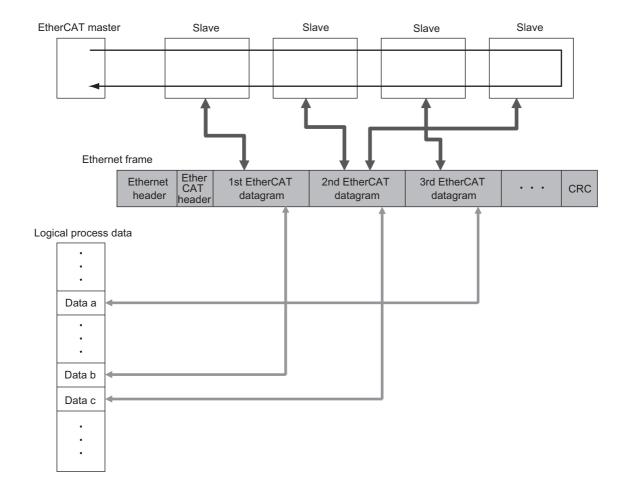
The following 2 types of communications are available with EtherCAT.

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.
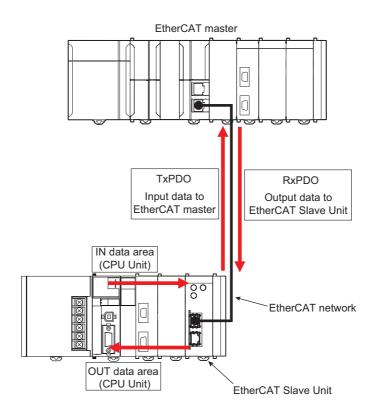
• Reading and writing process data
• Setting slaves
• Monitoring slave status

1-2   EtherCAT Slave Unit Features

The EtherCAT Slave Unit has the following features when used with the CJ-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.
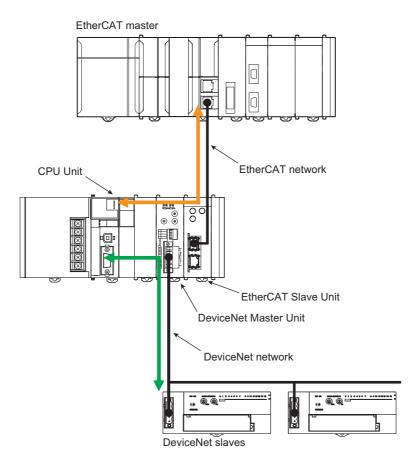
Adjustable Data Exchange Sizes

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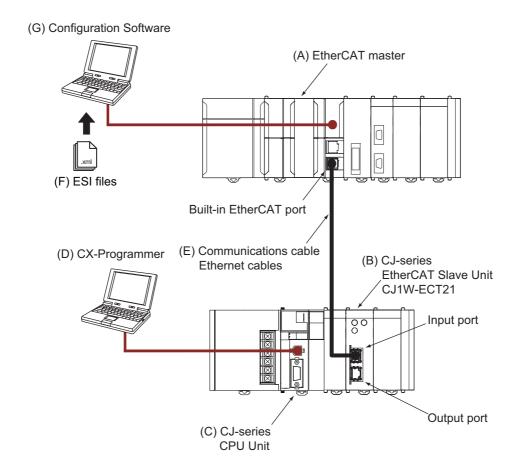
Integration with Other Networks

Interface with multiple networks such as EtherCAT and DeviceNet.

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) CX-Programmer

(E) Communications cable
Ethernet cables

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

Input port

Output port

(C) CJ-series
CPU Unit

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 CJ-series CPU Unit and the EtherCAT master.
(C)	CJ-series CPU Unit[2]	The main Unit that controls a CJ-series PLC. The CPU Unit refreshes I/O for other Units and slaves, etc.
(D)	CX-Programmer[3]	The CX-Programmer runs on a personal computer and it is used to configure I/O Communication Area Setting Table to communicate between the CJ-series CPU Unit and the EtherCAT Slave Unit and to program, monitor, and debug the CJ-series PLC.

Letter	Item	Description
(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.
(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-7 Version Information* on page A-33 for information on CPU Unit version compatibility when connecting EtherCAT Slave Units to CJ/CP/NSJ-series CPU Units.

*3. Refer to *A-7 Version Information* on page A-33 for information on the versions of the CX-Programmer that you can use to set up CJ-series EtherCAT Slave Units.

1-4 Specifications

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

1-4-1 General Specifications

The general specifications conform to those of the CJ-series PLCs, CP-series PLCs and NSJ-series PLCs.

1-4-2 Functional and Performance Specifications

This section provides the functional and performance specifications of the EtherCAT Slave Unit.
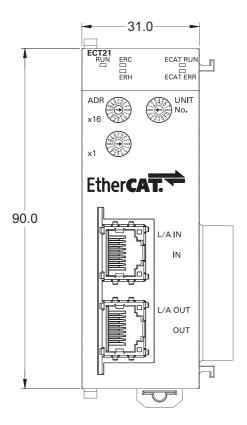
Item		Specification
Model number		CJ1W-ECT21
Applicable PLCs		CJ-series, CP-series, NSJ-series
Unit classification		CPU Bus Unit
Applicable unit numbers		0 to F
Mounting position		CPU Rack or Expansion Rack
Number of Units that can be mounted		16 Units max. (you must allocate unique words)
CPU Unit words used	Allocated CIO Area words (CPU Bus Unit words)	25 words/Unit (one unit number's words)
		Unit Status 1, Unit Status 2, Slave Status 1, Slave Status 2
	Allocated DM Area words (CPU Bus Unit words)	100 words/Unit (one unit number's words)
		I/O Communication Area Setting Table, I/O Communication Area Reference Table
	Other I/O memory	I/O communication area in any area[1]
	CPU Bus Unit setting area	Not used
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[2]
	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
Weight		97 g max.
Dimensions		31 × 90 × 65 mm (W × H × D)
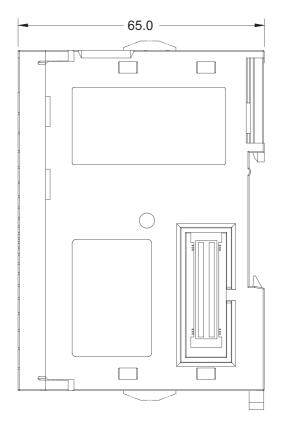
*1. Set with allocated DM area words (CPU Bus Unit words) or CX-Programmer.

*2. The CJ-series EtherCAT Slave Unit conforms to EtherCAT standards. Confirm the specifications of the connected EtherCAT master for the support topology. The EtherCAT Slave Unit with unit version 1.0 or later supports a ring topology.

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.

Procedure		Item	Description	Reference
1	Making Hardware Settings and Wiring the EtherCAT Slave Unit	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 2-6
		Installation	Mount the EtherCAT Slave Unit in the CPU Rack or Expansion Rack.	*2-2 Installing the EtherCAT Slave Unit* on page 2-8
		Wiring	Connect the EtherCAT Slave Unit and the EtherCAT master with the communication cable.	*2-3 EtherCAT Network Wiring* on page 2-10

Procedure		Item	Description	Reference
2	Making Software Settings for the EtherCAT Slave Unit	Connecting CX-Programmer	Connect the CX-Programmer to the CJ-series CPU Unit.	*CX-Programmer Operation Manual* (W446)
		Turning ON power to the CJ-series CPU Unit	Turn ON the power supply to the CJ-series PLC.	---
		Going online with the CX-Programmer	Place the CX-Programmer online with the CJ-series CPU Unit.	*CX-Programmer Operation Manual* (W446)
		Creating the I/O tables	Create the I/O table with CX-Programmer.	*A-5 Creating I/O Tables* on page A-24
		Setting and transferring the I/O Communication Area Setting Table	Set the I/O Communication Area Setting Table with one of the following methods. • Use the Edit Parameters Dialog Box in the CX-Programmer. • Use the allocated DM area words. Transfer the setting to the EtherCAT Slave Unit.	• *3-4 I/O Communication Area Settings* on page 3-16 • *3-3 DM Area Allocations* on page 3-9
		Restarting the EtherCAT Slave Unit	Cycle the power supply of the CJ-series PLC or restart the EtherCAT Slave Unit.	---
		Checking the I/O Communication Area Reference Table	Check the I/O Communication Area Reference Table with one of the following methods. • Use the Edit Parameters Dialog Box in the CX-Programmer. • Use the allocated DM area words.	• *3-4 I/O Communication Area Settings* on page 3-16 • *3-3 DM Area Allocations* on page 3-9
		Creating and transferring the user program	Create the user program. Transfer the user program to the CJ-series CPU Unit with the CX-Programmer.	*CX-Programmer Operation Manual* (W446)

Procedure	Item	Description	Reference
3	Setting the Ether-CAT Master	Installing 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.	
		Creating 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
4	Confirming Operation	Checking indicators	Check the indicators on the EtherCAT master and the EtherCAT Slave Unit.	• *2-1-2 Indicators* on page 2-3 • *5-2-1 Checking for Errors and Troubleshooting with the Indicators* on page 5-5 • 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 CX-Programmer and EtherCAT master Configuration Software.	• *CX-Programmer Operation Manual* (W446) • Manuals for the EtherCAT master

2

Nomenclature and Installation

This section describes the nomenclature, installation and wiring of the EtherCAT Slave Unit.
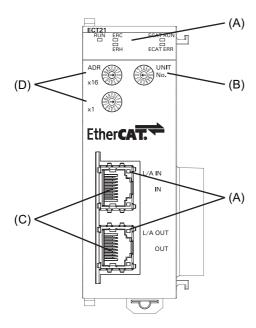
2-1   Nomenclature

This section provides the nomenclature for the EtherCAT Slave Unit.

2-1-1   Nomenclature and Functions
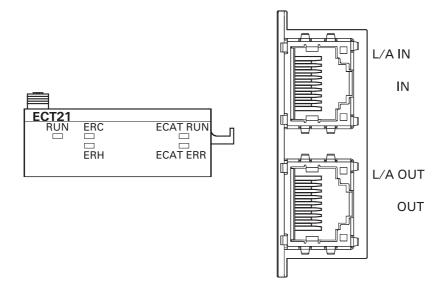
This section provides the names and functions of the items on the front panel of the EtherCAT Slave Unit.

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 Unit 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.
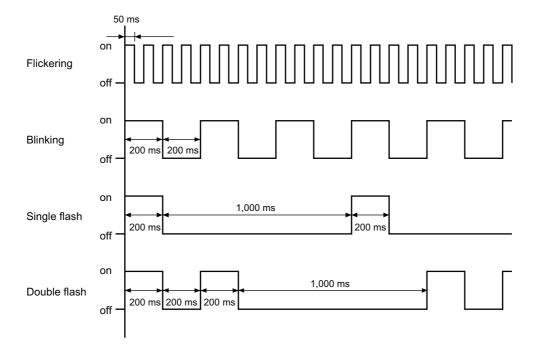
● Indicator Details

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 Fatal Error
			• I/O Bus Error
			• Output OFF Error
			• CPU Unit Watchdog Timer Error
			• CPU Unit Service Monitoring Error
			• I/O Refresh Error
			• SII Unit Verification Error
			• Mailbox Setting Error
			• Verification Error
			• Illegal State Transition Request Received
			• Restart
		Single flash	• CPU Unit Fatal Error
			• Output OFF Error
			• 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
			• ESC Initial 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
		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.
			• Unit Number Duplication
			• CPU Unit Faulty
			• I/O Table Not Registered
			• CPU Unit Fatal Error
			• 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. The unit number determines which data area words and DM area words are allocated to the Unit that contain data such as unit status, slave status, the I/O Communication Area Setting Table and the I/O Communication Area Reference Table.

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 CPU Unit.

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 PLC's power supply before setting the unit number.

Additional Information

If the same unit number is set on more than one CPU Bus Unit mounted in a PLC, a Unit Number Duplication error will occur in the PLC and the EtherCAT Slave Unit will not be able to start operating.

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 a CJ-series PLC system.

2-2-1   System Configuration Precautions

Up to 16 EtherCAT Slave Units can be mounted to the CJ-series PLC system when Expansion Racks are present.

If EtherCAT Slave Units are mounted in combination with other CPU Bus Units (e.g., Controller Link Units), the maximum total number of CPU Bus Units that can be mounted is 16.
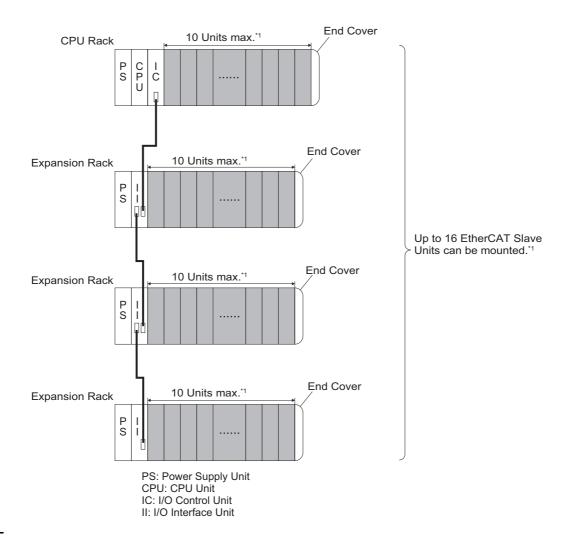
Precautions for Correct Use

Be sure that the total current consumption of all the Units connected to the same CPU Rack or Expansion Rack does not exceed the output capacity of the Power Supply Unit.

2-2-2   Mounting to a CJ-series PLC
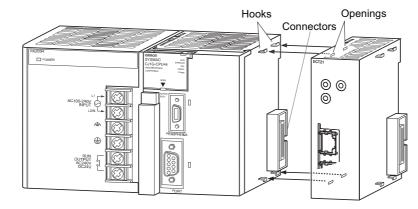
EtherCAT Slave Units can be mounted in a CJ-series CPU Rack or a CJ-series Expansion Rack. Connect the EtherCAT Slave Unit in any of the positions shown below using the sliders on the top and bottom of the Unit.

PS: Power Supply Unit
CPU: CPU Unit
IC: I/O Control Unit
II: I/O Interface Unit
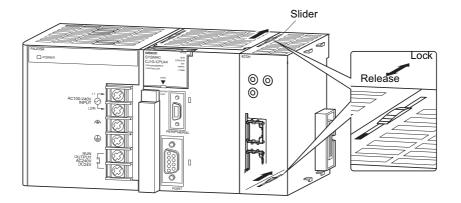
*1. The maximum number of EtherCAT Slave Units that can be mounted to a CJ-series PLC depends on the model of the CPU Unit. Refer to the operation manual of the specific CPU Unit for more details.

Mounting Procedure

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 PLC's power supply 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.
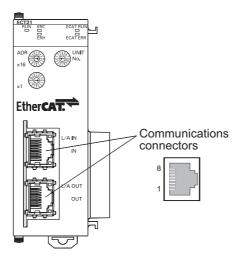
Precautions for Correct Use

- 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
1	White-Green
2	Green
3	White-Orange
4	Blue
5	White-Blue
6	Orange
7	White-Brown
8	Brown
Hood	Shield[1]

Wire color	Pin No.
White-Green	1
Green	2
White-Orange	3
Blue	4
White-Blue	5
Orange	6
White-Brown	7
Brown	8
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.
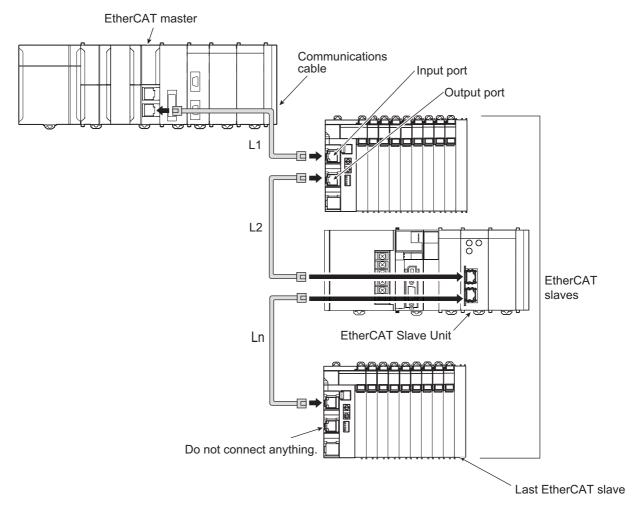
2-3-6   Connecting Communications Cables to Units

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.

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

Memory Allocations

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

3-1   Overview of the Memory Allocated to the EtherCAT Slave Unit

The following CPU Unit words are allocated to the EtherCAT Slave Unit.

- CPU Unit's allocated CIO Area words

  These words contain the status information.

- CPU Unit's allocated DM Area words

  These words contain the I/O Communication Area Setting Tables and I/O Communication Area Reference Tables.

The words shown in the following diagram are allocated according to the unit number setting. For each Unit, there are 25 words allocated in the CIO Area and 100 words allocated in the DM Area.

- First word allocated in the CIO Area: n = CIO 1,500 + (25 x unit number)
- First word allocated in the DM Area: m = D30,000 + (100 x unit number)

CPU Unit   EtherCAT Slave Unit

● Allocated CIO Area words
  (Allocated to the Unit as a CPU Bus Unit)

Unit number 0	CIO 1500 / CIO 1501 ～ CIO 1524	25 words
Unit number 1	CIO 1525 / CIO 1526 ～ CIO 1549	25 words
～	~	
Unit number 15	CIO 1875 / CIO 1876 ～ CIO 1899	25 words

Local memory
～
25 words

Unit/Slave status
(I/O refresh)

● Allocated DM Area words
  (Allocated to the Unit as a CPU Bus Unit)

Unit number 0	D30000 / D30001 ～ D30099	100 words
Unit number 1	D30100 / D30101 ～ D30199	100 words
～	~	
Unit number 15	D31500 / D31501 ～ D31599	100 words

I/O Communication
Area Setting Tables
(I/O refresh)

Local memory
～
100 words

I/O Communication
Area Reference
Tables
(Power ON or
restart the Unit)

Precautions for Correct Use

Setting results are refreshed when the Unit restarts or when the Unit is powered ON.

3-2   CIO Area Allocations

This section describes CIO area allocations for the EtherCAT Slave Unit.

3-2-1   Overview of the Allocated CIO Area Words

Various kinds of data are stored in the allocated CIO Area words, which are identified by the offset from the beginning word (n) allocated to each Unit.

The beginning word n is calculated by the following equation:

Beginning word n = CIO 1500 + (25 × unit number)

Offset		Bit				Data direction
		15	8 7		0	
0	n					
1	n+1					
2	n+2					
3	n+3					
4	n+4					
5	n+5		(Reserved)			
6	n+6					
7	n+7					
8	n+8					
9	n+9					
10	n+10		Unit Status 1			EtherCAT Slave Unit → CPU Unit
11	n+11		Unit Status 2			
12	n+12		Slave Status 1			EtherCAT Slave Unit → CPU Unit
13	n+13		Slave Status 2			
14	n+14					
15	n+15					
16	n+16					
17	n+17					
18	n+18					
19	n+19		(Reserved)			
20	n+20					
21	n+21					
22	n+22					
23	n+23					
24	n+24					
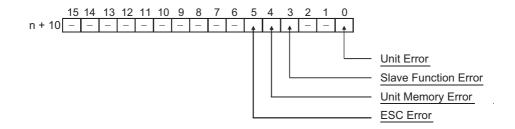
Precautions for Correct Use

The reserved words are regularly refreshed with all zeroes.

3-2-2   Details of the Allocated CIO Area Words

This section provides the details of the allocated CIO area words.
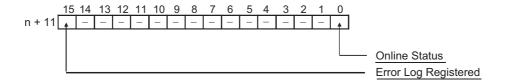
Unit Status 1 (n+10)

Bit	Name	Manipulated by	Unit operation
0	Unit Error	Unit	ON: Displays EtherCAT Slave Unit operating errors Unit Error turns ON if any bit from 01 to 15 in Unit Status 1 is ON (OR information of bits 01 to 15). OFF: Indicates that the error did not occur or turns OFF when the error is cleared. Default: OFF
1 to 2	Reserved	---	---
3	Slave Function Error	Unit	ON: Indicates that at least one slave error occurred. Refer to Slave Status 1. The slave errors are as follows: • Slave AL Status Error • SII Unit Verification Error • Verification Error • Mailbox Setting Error • I/O Communication Error • Illegal State Transition Request Received • I/O Refresh Error OFF: Indicates that none of the above errors occurred or turns OFF when all of above errors are cleared. Default: OFF This bit cannot be turned OFF unless the error is recovered from the EtherCAT master.
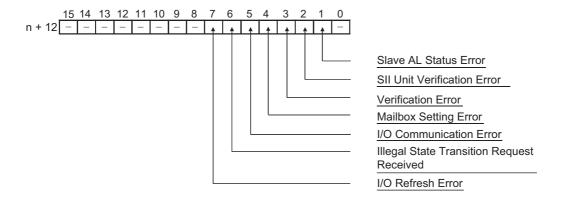
Bit	Name	Manipulated by	Unit operation
4	Unit Memory Error	Unit	ON: Indicates an error in internal memory where the error log or I/O communication area data is stored. The error occurs when the Unit starts up or when the error log is written. OFF: Indicates that the error did not occur. Once this error occurs, the bit will remain ON and will not return to OFF. Default: OFF
5	ESC Error	Unit	ON: Indicates an error in ESC. OFF: Indicates that the error has not occurred. Once this error occurs, the bit will remain ON and will not return to OFF. Default: OFF
6 to 15	Reserved	---	---

Unit Status 2 (n+11)

Bit	Name	Manipulated by	Unit operation
0	Online Status	Unit	ON: Indicates that the Unit is online and capable of communicating on the network. OFF: 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: OFF
1 to 14	Reserved	---	---
15	Error Log Registered	Unit	ON: Indicates that an error log was registered. Turns ON at the first error log registration for the Unit. OFF: Indicates that no errors are registered in the error log. Turns OFF when the Unit receives an error log clear request. Default: OFF
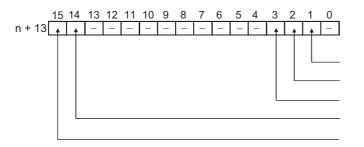
Slave Status 1 (n+12)

Bit	Name	Manipulated by	Unit operation
0	Reserved	---	---
1	Slave AL Status Error	Unit	ON: Indicates that the slave detects an AL status error. OFF: Indicates that the error has not occurred. Default: OFF
2	SII Unit Verification Error	Unit	ON: Indicates that an error occurred in the slave information stored in SII when the power supply is turned ON. OFF: Indicates that the error has not occurred. Default: OFF
3	Verification Error	Unit	ON: Indicates that the I/O communication area size does not match with the Sync Manager size set by the EtherCAT master. OFF: Indicates that the I/O communication area size matches with the Sync Manager size set by the EtherCAT master. Default: OFF
4	Mailbox Setting Error	Unit	ON: 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). OFF: Indicates the error has not occurred. Default: OFF

Bit	Name	Manipulated by	Unit operation
5	I/O Communication Error	Unit	ON: Indicates that RxPDO data from the EtherCAT master is not refreshed during the monitoring time. OFF: Indicates that RxPDO data from the EtherCAT master is refreshed during the monitoring time. Default: OFF
6	Illegal State Transition Request Received	Unit	ON: Indicates that an unexpected state transition request has been sent from the EtherCAT master. OFF: Indicates that an unexpected state transition request has not been sent from the EtherCAT master. Default: OFF
7	I/O Refresh Error	Unit	ON: Indicates that an I/O Refresh Error occurred while in operation. OFF: Indicates that an I/O Refresh Error has not occurred while in operation. Default: OFF
8 to 14	Reserved	---	---

Slave Status 2 (n+13)

Bit	Name	Manipulated by	Unit operation
0	Reserved	---	---
1	Available Mailbox Communication	Unit	ON: Indicates that mailbox communication is available for the Unit. OFF: Indicates that mailbox communication is not available for the Unit. Default: OFF This bit will remain ON while the Unit is in the Pre-Operational, Safe-Operational or Operational state. This bit will also remain ON if the IN port link is not established with another device.

Bit	Name	Manipulated by	Unit operation
2	Input Data Valid	Unit	ON: Indicates that the Unit is processing transmit by process data communication. Data is valid and usable for control. OFF: Indicates that the Unit is not processing transmit by process data communication. Data is invalid and unusable for control. Default: OFF This bit will remain ON while the Unit is in Safe-Operational state or Operational state. This bit will also remain ON 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-8 for a programming example to check validity of input data.
3	Output Data Valid	Unit	ON: Indicates that the Unit is processing receive by process data communication. Data is valid and usable for control. OFF: Indicates that the Unit is not processing receive by process data communication. Data is invalid and unusable for control. Default: OFF This bit will remain ON while the Unit is in Operational state. This bit will also remain ON 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-8 for a programming example to check validity of output data.
4 to 13	Reserved	---	---
14	IN Port Link Status	Unit	ON: Indicates when a link on the IN port is established with another device. OFF: Indicates when a link on the IN port is not established with another device. Default: OFF
15	OUT Port Link Status	Unit	ON: Indicates when a link on the OUT port is established with another device. OFF: Indicates when a link on the OUT port is not established with another device. Default: OFF

3-3 DM Area Allocations
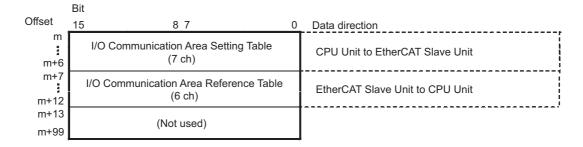
This section describes DM area allocations for the EtherCAT Slave Unit.

3-3-1 Overview of the Allocated DM Area Words

The various kinds of data are stored in the offset positions shown in the following diagram, from the beginning word in the area for each Unit.

The beginning word m is calculated by the following equation:

Beginning word m = D30000 + (100 x unit number)

✔ Precautions for Correct Use

Setting results are refreshed when the Unit restarts or when the Unit is powered ON.

3-3-2 Details of the Allocated DM Area Words

This section provides the details of the allocated DM area words.

I/O Communication Area Setting Table
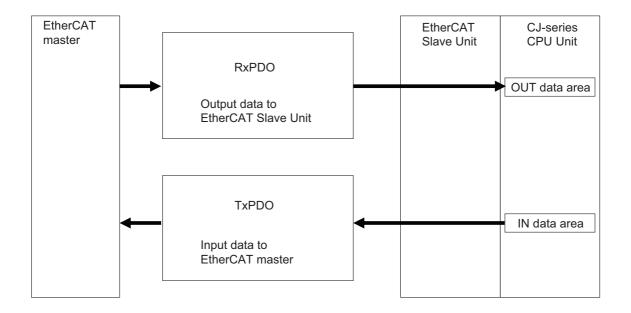
Set values in this area to specify the input and output words used by the EtherCAT Slave Unit. Changes to the I/O Communication Area Setting Table require a Unit restart to take effect.

● **Relationship Between I/O Communication Area and Process Data Objects**
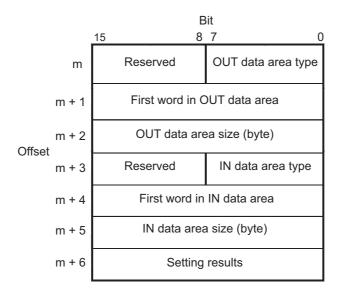
IN and OUT data area settings determine where the PDO data that is exchanged over the EtherCAT network is allocated in the memory of the CPU Unit.

The IN data area is used to send (TxPDO) data to the EtherCAT master.

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

● **I/O Communication Area Setting Table Detail**

Word	Bit	Name	Manipulated by	Default value	Function
m	00 to 07	OUT data area type	User	00 hex	Set the area type code. • 00 hex: not used • 01 hex: CIO Area (CIO) • 03 hex: Data Memory (DM) • 04 hex: Work Area (WR) • 05 hex: Holding Relay Area (HR) • 08 to 14 hex: Expansion Memory (EM) bank 0 to C[*1]
	08 to 15	Reserved	---	---	Reserved by system
m + 1	00 to 15	First word in OUT data area	User	0000 hex	Set the starting word of the OUT data area. Setting 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[*1]: 0000 to 7FFF hex
m + 2	00 to 15	OUT data area size	User	0000 hex	Set the OUT data area size in bytes from one of the following. • 00 hex: 0 byte • 32 hex: 50 byte • 64 hex: 100 byte • C8 hex: 200 byte • 190 hex: 400 byte
m + 3	00 to 07	IN data area type	User	00 hex	Set the area type code. • 00 hex: not used • 01 hex: CIO Area (CIO) • 03 hex: Data Memory (DM) • 04 hex: Work Area (WR) • 05 hex: Holding Relay Area (HR) • 08 to 14 hex: Expansion Memory (EM) bank 0 to C[*1]
	08 to 15	Reserved	---	---	Reserved by system

Word	Bit	Name	Manipulated by	Default value	Function
m + 4	00 to 15	First word in IN data area	User	0000 hex	Set the starting word of the IN data area. Setting 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]
m + 5	00 to 15	IN data area size	User	0000 hex	Set the IN data area size in bytes from one of the following. • 00 hex: 0 byte • 32 hex: 50 byte • 64 hex: 100 byte • C8 hex: 200 byte • 190 hex: 400 byte
m + 6	00 to 15	Setting results	Unit	0000 hex	Display the setting results. Refer to *Setting Results Codes* on page 3-12 for the code.

*1. EM areas are not available for all CJ-series CPU Units. Refer to the operation manuals of the CPU Units for details on the EM memory area specification.

● **Setting Results Codes**

Result code	Description	Corrective action
0000 hex[1]	Completed normally.	---
1101 hex	Incorrect area setting.	Ensure that the memory area codes for OUT data area type and IN data area type are set to the allowable values.
1103 hex	The first word is outside the setting range.	Ensure that the first word in OUT data area and first word in IN data area are set as valid memory areas for the corresponding memory area type set with the OUT data area type and IN data area type codes.
1104 hex	The allocated data area exceeds the valid word range.	Ensure that the OUT data area range and IN data area range setting does not exceed valid memory locations for the corresponding memory area type set with the OUT data area type and IN data area type codes.
110C hex	The area size is outside the setting range.	Ensure that the OUT data area size and IN data area size are set to allowable values for the corresponding memory area type set with the OUT data area type and IN data area type codes.

*1. If the EtherCAT Slave Unit is set with default values, the setting result code will be 0000 hex and the Unit cannot perform process data communications with the EtherCAT master.
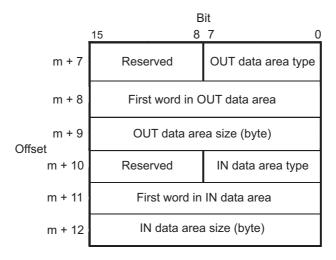
![Precautions icon] **Precautions for Correct Use**

- 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.

I/O Communication Area Reference Table

Refer to this area for the I/O communications area settings established in the EtherCAT Slave Unit.

Word	Bit	Name	Manipulated by	Default value	Function
m + 7	00 to 07	OUT data area type	Unit	00 hex	The area type code in use is indicated. • 00 hex: not used • 01 hex: CIO Area (CIO) • 03 hex: Data Memory (DM) • 04 hex: Work Area (WR) • 05 hex: Holding Relay Area (HR) • 08 to 14 hex: Expansion Memory (EM) bank 0 to C[*1]
	08 to 15	Reserved	---	---	Reserved by system
m + 8	00 to 15	First word in OUT data area	Unit	0000 hex	The starting word of the OUT data area in use is indicated. The 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[*1]: 0000 to 7FFF hex
m + 9	00 to 15	OUT data area size	Unit	0000 hex	The OUT data area size in use is indicated. The value is in bytes from one of the following. • 00 hex: 0 byte • 32 hex: 50 byte • 64 hex: 100 byte • C8 hex: 200 byte • 190 hex: 400 byte

Word	Bit	Name	Manipulated by	Default value	Function
m + 10	08 to 15	IN data area type	Unit	00 hex	The area type code in use is indicated. • 00 hex: not used • 01 hex: CIO Area (CIO) • 03 hex: Data Memory (DM) • 04 hex: Work Area (WR) • 05 hex: Holding Relay Area (HR) • 08 to 14 hex: Expansion Memory (EM) bank 0 to C[1]
	08 to 15	Reserved	---	---	Reserved by system
m + 11	00 to 15	First word in IN data area	Unit	0000 hex	The starting word of the IN data area in use is indicated. The 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]
m + 12	00 to 15	IN data area size	Unit	0000 hex	The IN data area size in use is indicated. The value is in bytes from one of the following. • 00 hex: 0 byte • 32 hex: 50 byte • 64 hex: 100 byte • C8 hex: 200 byte • 190 hex: 400 byte

*1. EM areas are not available for all CJ-series CPU Units. Refer to the operation manuals of the CPU Units for details on the EM memory area specification.

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 CX-Programmer.

3-4-1   The Unit Edit Parameters Dialog Box

The Edit Parameters Dialog Box of the EtherCAT Slave Unit is used for setting and referencing the I/O communication area table. The Edit Parameters Dialog Box 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	PLC memory area type used for RxPDO data from the EtherCAT master	• Do not use • CIO Area • Data Memory • Work Area • Holding Relay • Expansion Data Memory Bank 0 to C[*1]	Do not use
First word in OUT data area	Direct input	Starting word of the OUT data area	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]	0000 hex
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	PLC memory area type used for TxPDO data to the EtherCAT master	• Do not use • CIO Area • Data Memory • Work Area • Holding Relay • Expansion Data Memory Bank 0 to C[*1]	Do not use
First word in IN data area	Direct input	Starting word of the IN data area	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]	0000 hex
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. EM areas are not available for all CJ-series CPU Units. Refer to the operation manuals of the CPU Units for details on the EM memory area specification.
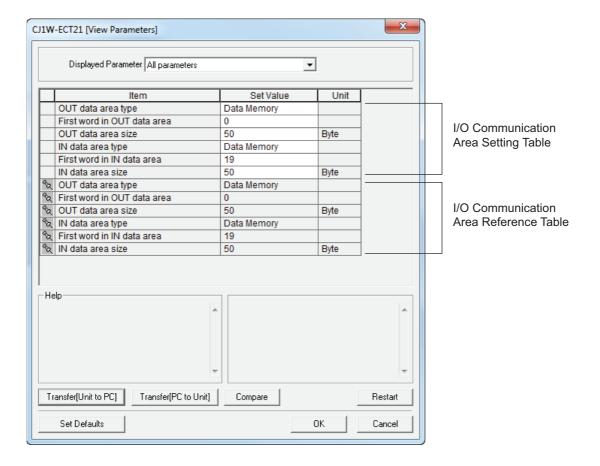
I/O Communication Area Reference Table

Item name	Setting method	Description	Data range	Default
OUT data area type	Read Only	The reference PLC memory area type used for RxPDO data from the EtherCAT master.	• Do not use • CIO Area • Data Memory • Work Area • Holding Relay • Expansion Data Memory Bank 0 to C[*1]	Do not use
First word in OUT data area		The reference starting word of the OUT data area.	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]	0000 hex
OUT data area size		The reference OUT data area size in bytes.	• 0 byte • 50 byte • 100 byte • 200 byte • 400 byte	0 byte
IN data area type		The reference PLC memory area type used for TxPDO data to the EtherCAT master.	• Do not use • CIO Area • Data Memory • Work Area • Holding Relay • Expansion Data Memory Bank 0 to C[*1]	Do not use
First word in IN data area		The reference starting word of the IN data area.	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]	0000 hex
IN data area size		The reference IN data area size in bytes.	• 0 byte • 50 byte • 100 byte • 200 byte • 400 byte	0 byte
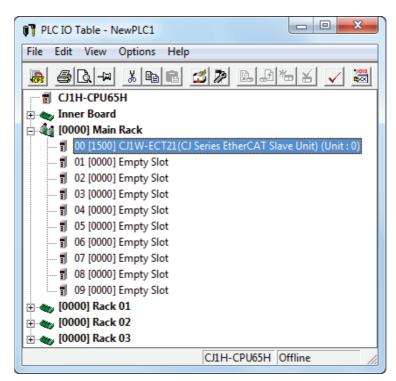
*1. EM areas are not available for all CJ-series CPU Units. Refer to the operation manuals of the CPU Units for details on the EM memory area specification.

3-4-2 Setting Procedure with the CX-Programmer
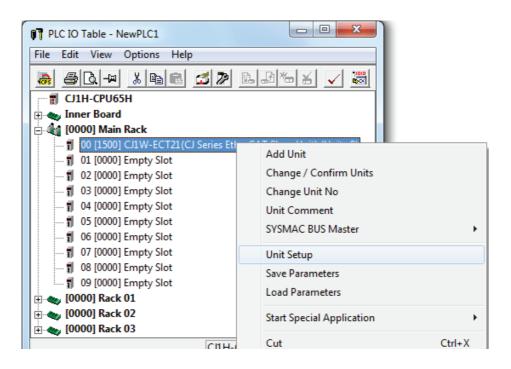
This section provides the setting procedure of the I/O Communication Area Setting Table with CX-Programmer.
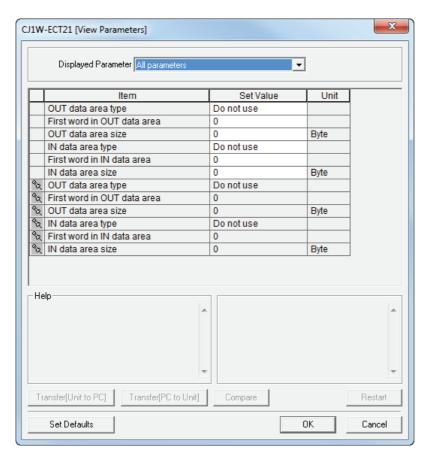
1 Double-click **IO Table and Unit Setup** Icon in the project workspace in the CX-Programmer. The PLC IO Table Window will be displayed.

When the EtherCAT Slave Unit is registered in the I/O tables of the CX-Programmer, the Unit will be displayed in the I/O tables. Refer to *A-5 Creating I/O Tables* on page A-24 for details.
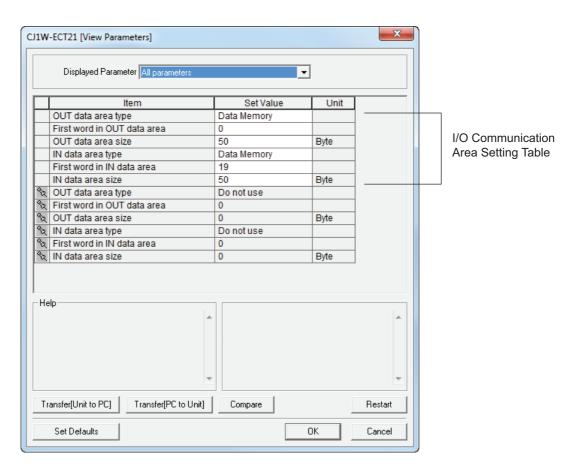
2 Right-click the EtherCAT Slave Unit in the I/O table and select *Unit Setup* from the menus.
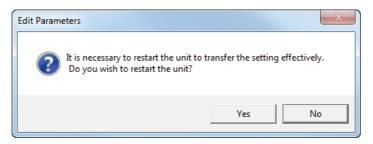
The Edit Parameters Dialog Box will be displayed.

3   Make the necessary settings.

I/O Communication Area Setting Table
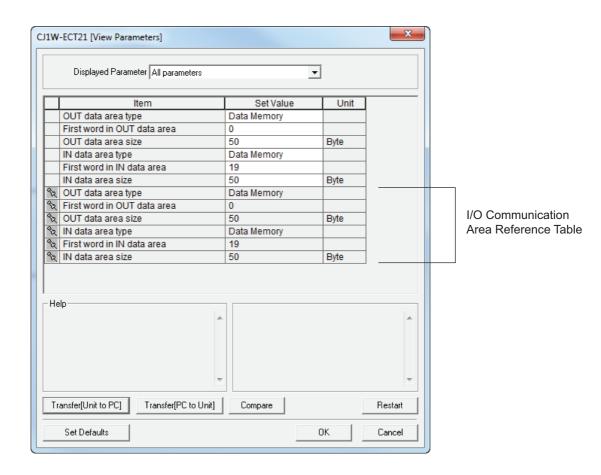
4   Place the CX-Programmer online with the PLC and transfer the settings to the EtherCAT Slave Unit.

5   After transferring the settings using the EtherCAT Slave Unit Edit Parameters Dialog Box, a message will ask if you wish to restart the EtherCAT Slave Unit.

Click the **Yes** Button. The EtherCAT Slave Unit will be restarted to enable the settings.

6   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 3-12.

7   Check the I/O Communication Area Reference Table in the Edit Parameters Dialog Box.

Click the **Compare** Button. If the compare is successful, click the **Transfer[Unit to PC]** Button to update the I/O Communication Area Reference Table values. If the compare is unsuccessful, transfer the settings again. Refer to the *CX-Programmer Operation Manual* (Cat. No. W446) for the Edit Parameters Dialog Box operation.

I/O Communication Area Reference Table

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. When the Special Unit Settings and the other data in the PLC are transferred, the EtherCAT Slave Unit will be restarted automatically.

4

EtherCAT Communications
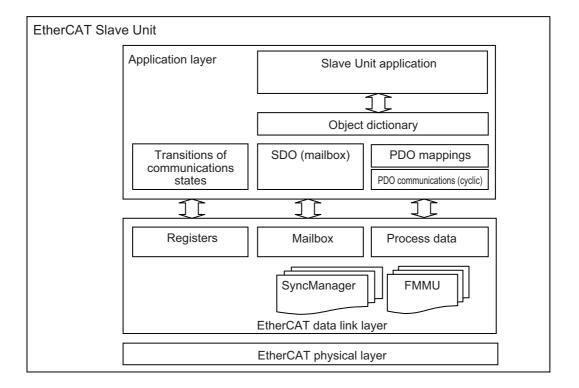
This section provides an introduction to EtherCAT communications.

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.

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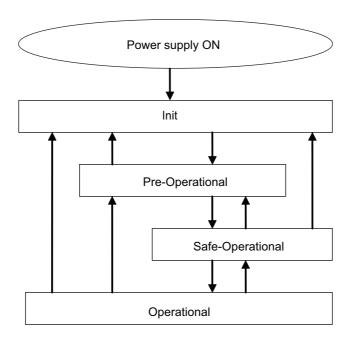
ESI files for the EtherCAT Slave Units can be downloaded from the OMRON website.

4-3   Transitions of Communications States

The state transition model for communications control of the EtherCAT Slave Unit 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.
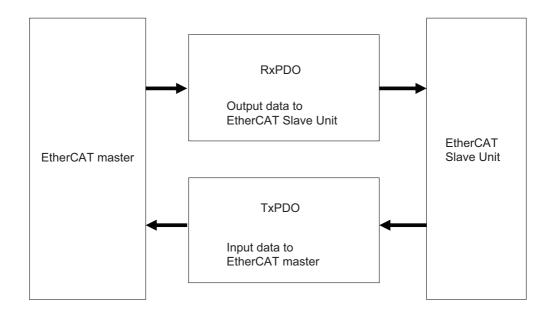
4-4   Process Data Objects (PDOs)

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.
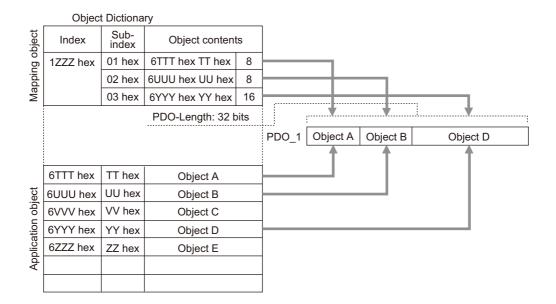
PDO Mapping Scheme in EtherCAT

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.

Object Dictionary

PDO Mapping with EtherCAT Slave Units

EtherCAT Slave Units have fixed PDO mapping and adjustments to the 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
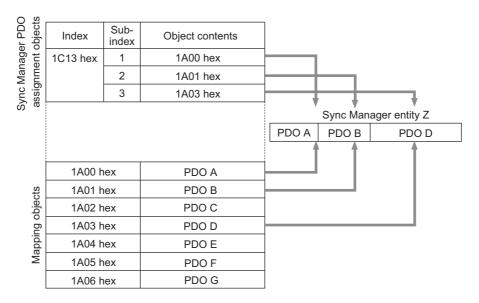
This section provides details for assigning PDOs to an EtherCAT Slave.

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	Offset	Value	
OUT data area size	m + 9	64 hex (100 bytes)	258th receive PDO Mapping
IN data area size	m + 12	32 hex (50 bytes)	257th transmit PDO Mapping

Refer to *3-3-2 Details of the Allocated DM Area Words* on page 3-9 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 *3-3-1 Overview of the Allocated DM Area Words* on page 3-9. 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-4 CoE Objects* on page A-13 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 the message response times for the EtherCAT Slave Unit.
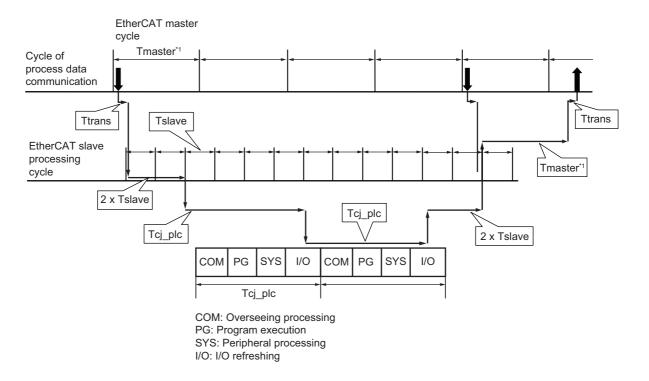
4-6-1   I/O Response Time

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 CJ-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.

COM: Overseeing processing
PG: Program execution
SYS: Peripheral processing
I/O: I/O refreshing

Element	Description
Tmaster[1]	Cycle time of the EtherCAT master.
Tslave	Processing time of the EtherCAT Slave Unit.
Tcj_plc	Cycle time of the CJ-series CPU Unit.
Ttrans	Transmission 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.

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) + (2 x Tcj_plc) + (2 x Ttrans)

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).

● Tcj_plc

The PLC cycle time can be obtained by referring to the CPU Unit's operation manual.

The I/O refresh time of the PLC is the maximum time required for I/O data to be exchanged between the CPU Unit and the EtherCAT Slave Unit. The PLC cycle time is increased when an EtherCAT Slave Unit is mounted as shown in the formula below.

I/O Refresh Time = A + (B x (IN data area size + OUT data area size))

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

Use the values of A and B in table below for the CPU type that has the EtherCAT Slave Unit mounted.

CPU type	Value of A	Value of B
CJ1M	0.3	0.0008
CJ2H	0.3	0.0024
CJ2M	0.3	0.0024

● 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.
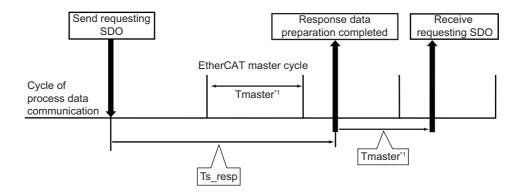
4-6-2   SDO Message Response Time

This section describes the method for calculating the minimum 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
Tmaster[1]	Cycle time of the EtherCAT master.
Ts_resp	EtherCAT Slave Unit message response time is 2 ms.

*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 the 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 the 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 Checking 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 CJ-series CPU Unit or EtherCAT master that errors have occurred.

EtherCAT master

Notification to the master:
• Emergency message
• AL status

Indicators

CJ-series
CPU Unit

CJ-series
EtherCAT Slave Unit
CJ1W-ECT21

Notification to the CJ-series CPU Unit:
• Unit status
• Slave status

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.
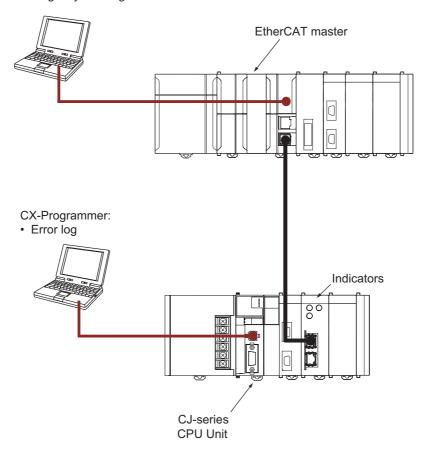
Type of error notification	Overview	Notification method
AL status	This status reports errors related to Ether-CAT communications. The ETG-defined method is used for the error detection and error code.	When an error occurs, the error is written to the AL status register to notify the EtherCAT master.
Unit status, Slave status	The status of the EtherCAT Slave Unit allocated to CIO Area is notified.	When an error occurs, the EtherCAT Slave Unit notifies the CJ-series CPU Unit.
Indicators	These are the indicators on the EtherCAT 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

CX-Programmer:
• Error log

Indicators

CJ-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.

Checking method	Information provided
Displaying error log for CPU Bus Units or Special I/O Units in the I/O table with CX-Programmer	The error log is recorded by the error log function of the EtherCAT Slave Unit. The error log can be read with FINS commands to the 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 Configuration Software provides the emergency message code and AL status code[1].

*1. Available information is specific to the EtherCAT master used and the functions of its Configuration Software.

5-1-3   Procedures to Check Errors

The basic procedures to check errors are described below.

1   Check whether an error exists on the EtherCAT Slave Unit with the Configuration Software 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 error log and the status with the CX-Programmer that is connected to the PLC

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 2-3 for 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
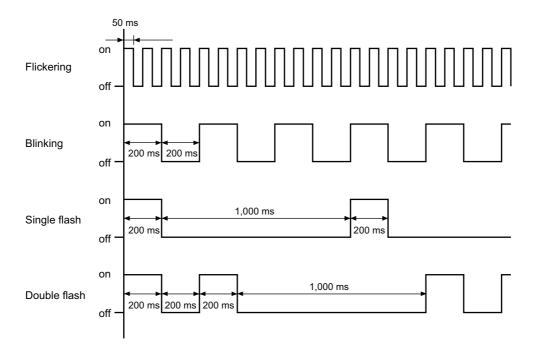
Name	Function
L/A IN	The L/A IN indicator shows the link activity of the input port.
L/A OUT	The L/A OUT indicator shows the link activity of the output port.
ECAT RUN	The ECAT RUN indicator shows the operating status of EtherCAT communications for the EtherCAT Slave Unit.
ECAT ERR	The ECAT ERR indicator 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 a 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.

CJ-series EtherCAT Slave Units Operation Manual (W541)

Error Descriptions

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

Indicator					Error	Cause	Unit operation	Error log (hex)	CIO area	Countermeasures
ECAT RUN	**ECAT ERR**	**ERC**	**ERH**	**RUN**						
Not Lit	Not Lit	Not Lit	Lit	Not Lit	Unit Number Duplication	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 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 operation	Error log (hex)	CIO area	Countermea-sures
ECAT RUN	ECAT ERR	ERC	ERH	RUN						
B[*1]	B[*1]	Not Lit	Lit	---	CPU Unit Fatal Error	A fatal error occurred in the CPU Unit.	An emergency code is sent if EtherCAT Unit is in Pre-Operational state.	---	(n+12) bit 01[*2]	Clear the cause of the error, and restart the CPU Unit.
			Not Lit		Output OFF Error	An Output OFF condition occurred in the CPU Unit.				Clear the cause of the error.
			Lit		CPU Unit Watchdog Timer Error	An error occurred in the CPU Unit.	An emergency code is sent if the EtherCAT Slave Unit is in Pre-Operational 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.		0002		Check and correct the CPU Unit's operating environment.
					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.		0347	(n+12) bit 01[*2] (n+12) bit 07	Check the I/O communication area and change to the correct allocation and restart the EtherCAT Slave Unit.
					I/O Bus Error	An error occurred while exchanging data with the CPU Unit.		000E	---	Check and correct the CPU Unit's operating environment and then cycle power to the PLC.

*1. If the EtherCAT master requests transition to Safe-Operational state or Operational state, the Unit remains in the Pre-Operational 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-Operational state and the CIO area (n+12) bit 01 is ON.

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

Indicator					Error	Cause	Unit operation	Error log (hex)	CIO area	Countermeasures
ECAT RUN	ECAT ERR	ERC	ERH	RUN						
B	SF	Not Lit	Lit	---	CPU Unit Fatal Error	A fatal error occurred in the CPU Unit.	The EtherCAT Slave Unit changes to Pre-Operational state. An emergency code is sent.	---	(n+12) bit 01	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 EtherCAT Slave Unit changes to Pre-Operational state and an error is recorded in the error log. An emergency 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 status from the EtherCAT master.
					I/O Refresh Error	The I/O communication area does not exist in the CPU Unit. This can occur when EM has been converted to file memory.		0347	(n+12) bit 01 (n+12) bit 07	Check the I/O communication area and change to the correct allocation and restart the EtherCAT Slave Unit.
					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 PLC, and then turn OFF the error bit of AL status from the EtherCAT master.
			Not Lit		Output OFF Error	An Output OFF condition occurred in the CPU Unit.	The EtherCAT Slave Unit changes to Pre-Operational state. An emergency code is sent.	---	(n+12) bit 01	Clear the cause of the error and then turn OFF the error bit of AL status from the EtherCAT master.

● **Errors Related to Memory Access**

Indicator					Error	Cause	Unit operation	Error log (hex)	CIO area	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.	---	(n+12) bit 01 (n+12) bit 02	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	(n+10) bit 04	

● **Unit Errors**

Indicator					Error	Cause	Unit operation	Error log (hex)	CIO area	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.
	FK				ESC Error	A timeout occurred while accessing ESC.	---	---	(n+10) bit 05	Replace the EtherCAT Slave Unit if the same error recurs when the Unit is mounted to another CPU Unit.
	Lit				ESC Initial Error	An initialization error occurred in the ESC.	Operation stops.		---	Replace the Unit if the error recurs.
						It was not possible to write the node address to the EtherCAT Slave Unit with the Configuration Software.				Write the node address again.

● **EtherCAT Slave Errors**

Indicator					Error	Cause	Unit opera-tion	Error log (hex)	CIO area	Countermea-sures
ECAT RUN	ECAT ERR	ERC	ERH	RUN						
SF	DF	Lit	Not Lit	---	I/O Communication 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	(n+12) bit 01 (n+12) bit 05	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.	---	---	(n+12) bit 01 (n+12) bit 04	Correct the mailbox settings and then turn OFF the error bit of AL status from the EtherCAT master.
B					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.	Records the error in the error log	0344	(n+12) bit 01 (n+12) bit 03	Correct the OUT data area size setting 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 EtherCAT master and the IN data area size setting in the EtherCAT Slave Unit.				Correct the IN data area size setting 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-Operational state.				Correct the TxPDO and RxPDO settings and then turn OFF the error bit of AL status from the EtherCAT master.
---					Illegal State Transition Request Received	An illegal state transition request was received.	---	---	(n+12) bit 01 (n+12) bit 06	Turn OFF the error bit of AL status from the EtherCAT master.
						A transition request to an unknown state was received.				

● **Others**

Indicator					Error	Cause	Unit opera-tion	Error log (hex)	CIO area	Countermeasures
ECAT RUN	ECAT ERR	ERC	ERH	RUN						
---	---	---	---	---	IN Port Link OFF	The IN port link is turned off after turned on once.	---	---	(n+13) bit 14	Connect the Ether-CAT communica-tions cable.
					OUT Port Link OFF	The OUT port link is turned off after turned on once.			(n+13) bit 15	
Not Lit	B			Lit	Restart	The Unit was restarted.			(n+12) bit 01	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.				

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

Use the following table to troubleshoot the system if the CPU Unit's ERR/ALM 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. • Check the I/O table with the I/O table verification operation and correct it if necessary. After correcting it, perform the I/O table create operation.
A CPU Bus Unit setting error occurred.	• The CPU Bus Unit model registered in the I/O tables does not match the model of CPU Bus Unit actually mounted. Check the I/O tables with the I/O table verification operation and correct it if necessary. After correcting the I/O tables, perform the I/O table create operation.
A CPU Bus Unit error occurred.	• Confirm that the Unit is connected properly. • Restart the Unit. Replace the Unit if it doesn't restart.
An I/O bus error occurred.	• Confirm that the Unit is connected properly. • Restart the Unit. Replace the Unit if it doesn't restart.

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

5-3 Error Log Function

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 accessed by using the CX-Programmer. Refer to the *CX-Programmer Operation Manual* (Cat. No. W446) for error log monitoring operations. The error log can be read and cleared with FINS commands to the Unit.

Some error log records are cleared when the CPU Unit's power goes OFF and other records are not cleared.

5-3-1 Error Log Data Specifications

Each time an error occurs, one error record is recorded in the EtherCAT Slave Unit's RAM error log table. You can record a maximum of 203 records. If another error occurs when the table is full, the oldest record will be erased to make room for the new error record.

The error log table records the following information.

- Error code
- Detail code
- Time of occurrence (The CPU Unit's time is used for the time stamp.)

Refer to *5-3-4 Error Log Error Codes* on page 5-15 for more information on error and detail codes.

Item	Specifications
Record length	10 bytes/record
Number of records	203 records max.
Data type	Binary (time information: BCD)

The structure of each record is as follows.

Bit

15	8	7	0

Error code	
Detail code	
Minutes	Seconds
Day of month	Hour
Year	Month

5-3-2   Error Log Registration

This section provides details about the error log registration function of the EtherCAT Slave Unit.

Error Log Storage Area

When an error occurs, information on the error and the time stamp are stored in the Unit's internal RAM as an error log record. Serious errors are recorded in non-volatile memory as well as RAM. The time read from the CPU Unit during cyclic servicing is used for the time stamp.

The error log records stored in non-volatile memory are copied to RAM when the Unit starts operating, so these records are retained even when the Unit's power is turned OFF or the Unit is restarted.

When the error log is read, the error log records in RAM are read. When the error log is cleared, the error log records in both RAM and non-volatile memory are erased.

The EtherCAT Slave Unit does not record errors caused by the EtherCAT network.

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 be as follows.

- When the error log is read with a FINS command

  The time stamp contains all zeroes.
- When the error log is read from the CX-Programmer

  The invalid data and time are displayed.

Moreover, if the battery is replaced in a CJ-series CPU Unit, 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.

Error Log Overflows

The error log can record up to 203 records. If another error occurs when the log is full, the oldest record will be erased to make room for the new error record.

5-3-3   FINS Commands for Error Logs

The following FINS commands can be sent to the EtherCAT Slave Unit to read or clear the error log.

Command code		Function name
MRC	SRC	
21	02	ERROR LOG READ
	03	ERROR LOG CLEAR

5-3-4   Error Log Error Codes

This section provides details of 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 11 s.	Monitoring time (ms)		
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.)		
000E	I/O Bus Error	An error occurred while exchanging data with the CPU Unit.	00 hex	00 hex	
000F	CPU Unit Initialization Error	Timeout while awaiting access right of cyclic area during initialization.			
0118	Illegal Packet Discarded	The frame was aborted because of an illegal packet reception.	FINS Command: • Bit 15: OFF • Bits 08 to 14: Source network address • Bits 00 to 07: Source node address FINS Response: • Bit 15: ON • Bits 08 to 14: Destination network address • Bits 00 to 07: Destination node address		No
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	
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	
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	
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.

5-4   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.

5-4-1   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 *5-4-2 Emergency Error Codes* on page 5-16 for the meanings of the emergency messages.

5-4-2   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 occurred 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	An 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 Fatal Error	A fatal error occurred in the CPU Unit.	Yes	Clear the cause occurred error, and restart CPU Unit, and then turn OFF error bit of AL status from Ether-CAT master.
FF03		Output OFF Error	An Output OFF condition occurred in the CPU Unit.		
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.		Check the CPU Unit's operating environment, and then turn OFF error bit of AL status from Ether-CAT master.
		I/O Bus Error	An error occurred while exchanging data with the CPU Unit.		
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 I/O communication area and reset with a correct allocation and restart the EtherCAT Slave Unit.

5-5 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.		
0014	SII Unit Verification Error	The non-volatile memory for SII back-ups 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 them 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.
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.		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. The voltage is present in the Unit immediately after power is turned OFF. The power is turned ON in this state.		Turn OFF the error bit of AL status from the EtherCAT master.
8004	Errors Related to the CPU Unit	An error was detected in the CPU Unit. The AL status code is caused by one of the following errors. • CPU Unit Fatal Error • CPU Unit Watchdog Timer Error • CPU Unit Service Monitoring Error • I/O Refresh Error • I/O Bus Error		Refer to *5-2-1 Checking for Errors and Troubleshooting with the Indicators* on page 5-5 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 - 3

6-1 Cleaning and Inspection

6

6-1-2 Inspection

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 is replaced, verify that the following steps have been made correctly.
- Set the node address and unit number.
- Connect the communication cables.

Precautions for Correct Use

After replacing Units, resume operation only after transferring to the new CPU Unit and/or Special I/O Units the contents of the DM Area, HR Area, and other data required for resuming operation. Not doing so may result in unexpected operation.

The EtherCAT Slave Unit does not contain data that is backed up for the simple backup function.

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, information on CoE objects, supplemental information for creating I/O tables, FINS commands 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 Ether-CAT master.

In this example, the NJ-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-series CPU Unit.

A-1-1 System Configuration

The following configuration is used for this example.

Letter	Description	Comment
(A)	Sysmac Studio	Used to configure the EtherCAT master
(B)	EtherCAT master (NJ-series CPU Unit)	Built-in EtherCAT port on NJ-series CPU Unit
(C)	Communications cable	---
(D)	CJ-series EtherCAT Slave Unit	CJ1W-ECT21
(E)	CJ-series CPU Unit	---
(F)	CX-Programmer	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
OUT data area type	CIO
First word in OUT data area	0000 hex
OUT data area size	50 byte
IN data area type	CIO
First word in IN data area	001A hex
IN data area size	50 byte

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.
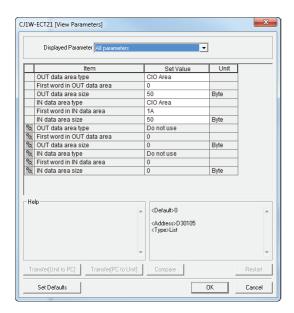
Procedure	Reference
1. CJ1W-ECT21 setting	*A-1-4 CJ1W-ECT21 Setting Procedure* on page A-4
2. EtherCAT master setting	*A-1-5 EtherCAT Master Setting Procedure* on page A-5
3. Start EtherCAT communication	*A-1-6 Start EtherCAT Communication* on page A-7

A-1-4   CJ1W-ECT21 Setting Procedure

This section provides the setting procedure for establishing EtherCAT Slave Unit communications.

1 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 2-6.

2 Mount the EtherCAT Slave Unit to the CPU Rack. Refer to *2-2-2 Mounting to a CJ-series PLC* on page 2-8.

3 Connect the communications cable between the EtherCAT master and EtherCAT Slave Unit. Refer to *2-3 EtherCAT Network Wiring* on page 2-10.

4 Connect the CX-Programmer to the CJ-series CPU Unit.

5 Turn ON the power supply to the CJ-series PLC.

6 Place the CX-Programmer online with the CJ-series CPU Unit.

7 Create the I/O table with CX-Programmer. Refer to *A-5 Creating I/O Tables* on page A-24.

8 Set the I/O Communication Area Setting Table. Refer to *3-4-2 Setting Procedure with the CX-Programmer* on page 3-19.
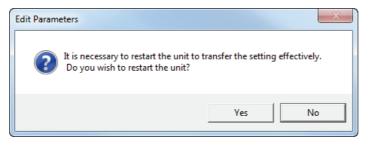
The example is shown below.

9 Transfer the I/O table, I/O Communication Area Setting Table and user program to the CJ-series PLC.
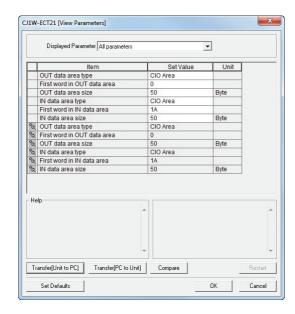
After transferring the settings using the EtherCAT Slave Unit Edit Parameters Dialog Box, a message will ask if you wish to restart the EtherCAT Slave Unit.

Click the **Yes** Button. The EtherCAT Slave Unit will be restarted to enable the settings.

10 Check the I/O Communication Area Reference Table in the Edit Parameters Dialog Box.

Click the **Compare** Button. If the compare is successful, click the **Transfer[Unit to PC]** Button to update the I/O Communication Area Reference Table values. If the compare is unsuccessful, transfer the settings again. Refer to the *CX-Programmer Operation Manual* (Cat. No. W446) for the Edit Parameters Dialog Box operation.

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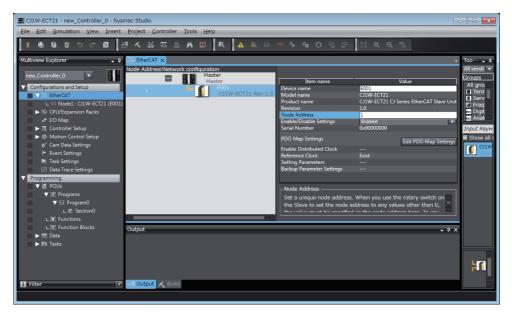
The ESI files for OMRON EtherCAT slaves are already installed in the Sysmac Studio. Update the Sysmac Studio to get the ESI files for the most recent EtherCAT Slave Unit.

1 Create a project in the Sysmac Studio.

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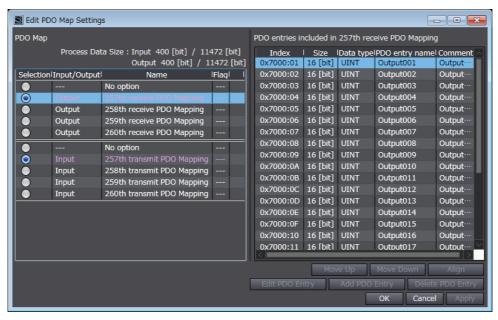
3 Register the EtherCAT Slave Unit in the network configuration and set the node address of the EtherCAT Slave Unit.

The 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.

The example is shown below.
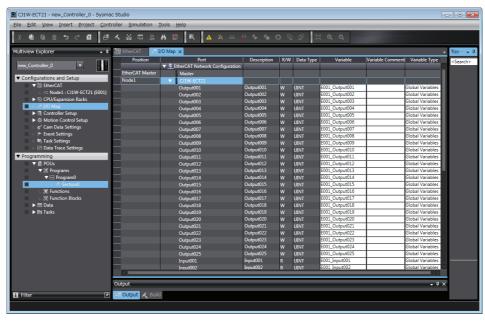
5 Set the EtherCAT master parameters if necessary.

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-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.

The example is shown below when 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
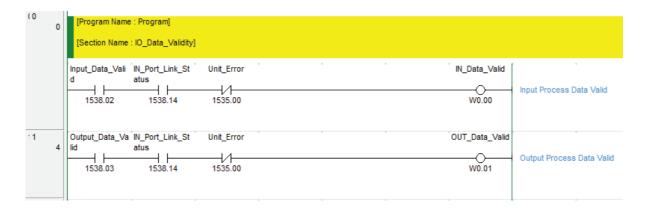
If the I/O Communication Area Setting Table, PDO mapping and switch settings are configured properly, EtherCAT communications should occur.

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 a CJ-series CPU Unit.

This example uses bits in Unit Status 1 and Slave Status 2. Refer to *3-2 CIO Area Allocations* on page 3-3 for details of Unit Status 1 and Slave Status 2. The unit number of the EtherCAT Slave Unit is set to 01 for this example.

Bit	Name	Description
(n + 10) bit 00	Unit Error	Indicates EtherCAT Slave Unit operating errors
(n + 13) bit 02	Input Data Valid	Indicates that the Unit is processing transmit by process data communication. Data is valid and usable for control.
(n + 13) bit 03	Output Data Valid	Indicates that the Unit is processing receive by process data communication. Data is valid and usable for control.
(n + 13) bit 14	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 a CJ-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 a CJ-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.
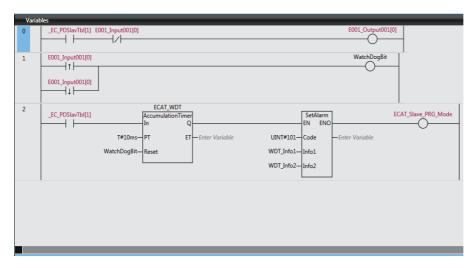
Refer to the manuals for the EtherCAT master and the CJ-series CPU Unit's user's manual for more information on creating the user program.

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 CJ-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.
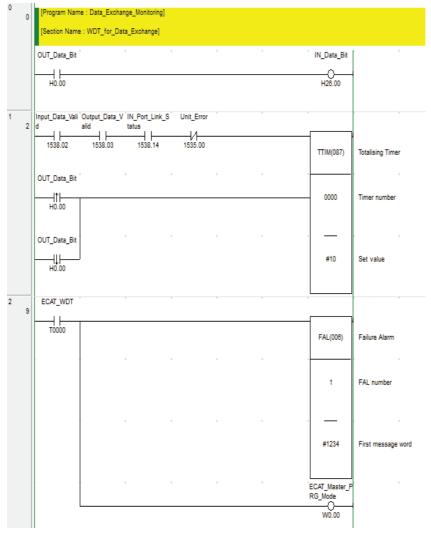
Item	Description
_EC_PDSlavTbl[1]	System-defined variable for the NJ-series CPU Unit to indicate that the EtherCAT slave (node 01) is performing process data communications.
E001_Input001[0]	Device variable assigned to the EtherCAT Slave Unit.
E001_Output001[0]	
WatchDogBit	Internal variable to reset 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 CJ-series CPU Unit with a mounted EtherCAT Slave Unit enters PROGRAM mode. Refer to *Timing Considerations* on page A-9.
SetAlarm instruction	Instruction that creates a user-defined error when the CJ-series CPU Unit with a mounted EtherCAT Slave Unit enters PROGRAM mode.
ECAT_Slave_PRG_Mode	External variable to indicate that the CJ-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. A CJ-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_Bit	Process data exchanged with the EtherCAT master.
IN_Data_Bit	
Input_Data_Valid	Slave Status 2 bit to indicate that the EtherCAT Slave Unit is processing transmit by process data communication.
Output_Data_Valid	Slave Status 2 bit to indicate that the EtherCAT Slave Unit is processing receive by process data communication.
IN_Port_Link_Status	Slave Status 2 bit to indicate that the EtherCAT Slave Unit's IN port has a link established with another device.
Unit_Error	Unit Status 1 bit to indicate an EtherCAT Slave Unit operating error.

Item	Description
TTIM(087) 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-9.
FAL(006) instruction	Instruction that creates a user-defined error when the EtherCAT master enters PROGRAM mode.
ECAT_Master_PRG_Mode	Bit to indicate that the EtherCAT master has entered PROGRAM mode.

A-4 CoE Objects

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

A-4-1 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-4-2 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-4-3 Format of Objects

The following table describes objects with the following format.

Index (hex)	Subindex (hex)	Object name	Default	Data range	Unit	Data attribute	Size	Access	PDO mapping	Complete access
\<Index\>	\<Subindex\>	\<Object name\>	\<Default setting\>	\<Data range\>	\<Unit\>	\<Data attribute\>	\<Size\>	\<Access\>	\<Possible/Not possible\>	\<Possible/Not possible\>

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-4-4 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	Not possi-ble	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-ECT21 (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)	Subindex (hex)	Object name	Default	Data range	Unit	Data attribute	Size	Access	PDO mapping	Complete access
1009	---	Manufacturer Hardware Version	"A" (padded with 19 spaces, character 20 hex)	"A" (padded with 19 spaces, character 20 hex)	---	---	20 byte (VS)	RO	Not possible	Not possible

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

Index (hex)	Subindex (hex)	Object name	Default	Data range	Unit	Data attribute	Size	Access	PDO mapping	Complete access
100A	---	Manufacturer Software Version	"V1.00" (padded with 15 spaces, character 20 hex)	"V1.00" (padded with 15 spaces, character 20 hex)	---	---	20 byte (VS)	RO	Not possible	Not possible

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

This object provides information on the EtherCAT Slave Unit.
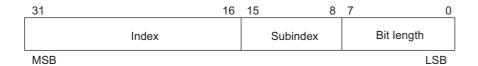
- Subindex 01 hex provides the vendor's ID.
- Subindex 02 hex provides the value that is assigned to the EtherCAT Slave Unit.
- Subindex 03 hex provides the revision number of the EtherCAT Slave Unit.

  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-4-5　　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.

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)	Subin-dex (hex)	Object name	Default	Data range	Unit	Data attri-bute	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 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 03 to 31									
	32	50th Output Object to be mapped	70003210 hex	70003210 hex	---	---	4 byte (U32)	RO	Not possi-ble	---

- These objects store the RxPDO entries.

Index (hex)	Subin-dex (hex)	Object name	Default	Data range	Unit	Data attri-bute	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 possi-ble	---
	01	1st Output Object to be mapped	70000110 hex	70000110 hex	---	---	4 byte (U32)	RO	Not possi-ble	---
	02	2nd Output Object to be mapped	70000210 hex	70000210 hex	---	---	4 byte (U32)	RO	Not possi-ble	---
	Sub indexes 03 to 63									
	64	100th Output Object to be mapped	70006410 hex	70006410 hex	---	---	4 byte (U32)	RO	Not possi-ble	---

- These objects store the RxPDO entries.

Index (hex)	Subin-dex (hex)	Object name	Default	Data range	Unit	Data attri-bute	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 possi-ble	---
	01	1st Output Object to be mapped	70000110 hex	70000110 hex	---	---	4 byte (U32)	RO	Not possi-ble	---
	02	2nd Output Object to be mapped	70000210 hex	70000210 hex	---	---	4 byte (U32)	RO	Not possi-ble	---
	Sub indexes 03 to C7									
	C8	200th Output Object to be mapped	7000C810 hex	7000C810 hex	---	---	4 byte (U32)	RO	Not possi-ble	---

- 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)	Subin-dex (hex)	Object name	Default	Data range	Unit	Data attri-bute	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 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 18										
	19	25th Input Object to be mapped	60001910 hex	60001910 hex	---	---	4 byte (U32)	RO	Not possi-ble	---

- 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
1B01	---	258th transmit PDO Mapping	---	---	---	---	---	---	---	Possible
	00	Number of objects in this PDO	32 hex	32 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 31										
	32	50th Input Object to be mapped	60003210 hex	60003210 hex	---	---	4 byte (U32)	RO	Not possi-ble	---

- 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
1B02	---	259th transmit PDO Mapping	---	---	---	---	---	---	---	Possible
	00	Number of objects in this PDO	64 hex	64 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 63										
	64	100th Input Object to be mapped	60006410 hex	60006410 hex	---	---	4 byte (U32)	RO	Not possi-ble	---

• These objects store the TxPDO entries.

Index (hex)	Subindex (hex)	Object name	Default	Data range	Unit	Data attribute	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 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 C7										
	C8	200th Input Object to be mapped	6000C810 hex	6000C810 hex	---	---	4 byte (U32)	RO	Not possible	---

• These objects store the TxPDO entries.

A-4-6　Sync Manager Communication Objects

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

Index (hex)	Subindex (hex)	Object name	Default	Data range	Unit	Data attribute	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 possible	---
	01	Communication Type Sync Manager 0	01 hex	01 hex	---	---	1 byte (U8)	RO	Not possible	---
	02	Communication Type Sync Manager 1	02 hex	02 hex	---	---	1 byte (U8)	RO	Not possible	---
	03	Communication Type Sync Manager 2	03 hex	03 hex	---	---	1 byte (U8)	RO	Not possible	---
	04	Communication Type Sync Manager 3	04 hex	04 hex	---	---	1 byte (U8)	RO	Not possible	---

• 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 Mapping 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 TxPDOs	00 hex	00 to 01 hex	---	---	1 byte (U8)	RO	Not possi-ble	---
	01	1st PDO Mapping 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-4-7　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-5 Creating I/O Tables

This section describes how to create I/O tables for the EtherCAT Slave Unit.

A-5-1 I/O Table Overview

I/O tables are used to identify Units mounted to the PLC and to allocate I/O to them. With CJ-series PLCs, whenever there is a change to the Unit configuration it is necessary to create I/O tables and register the mounted Units in the CPU Unit.

The I/O tables can be created in the following ways.
• Using the CX-Programmer offline
• Using the CX-Programmer online to create the I/O table based on the Units mounted to the PLC
• Using the Programming Console to create the I/O table based on the Units mounted to the PLC
• Using the CPU Unit's automatic I/O allocation at startup

A-5-2 Connecting Programming Devices to the PLC

To create the I/O tables, connect a programming device (such as a CX-Programmer or Programming Console) to the PLC.

Applicable Programming Devices

The following programming devices can be used with CJ-series PLCs.

● CX-Programmer

For information on how to connect and operate the CX-Programmer, refer to the *CX-Programmer Operation Manual* (Cat. No. W446).

● Programming Console

Model number	Key sheet (required)	Recommended cable (required)
C200H-PRO27-E	CS1W-KS001-E	CS1W-CN224 (cable length: 2.0 m)
		CS1W-CN624 (cable length: 6.0 m)
CQM1-PRO01-E		CS1W-CN114 (cable length: 0.1 m)

Precautions for Correct Use

A Programming Console cannot be used with the CJ2H-CPU□□(-EIP) and CJ2M-CPU3□ CPU Units. Use the CX-Programmer.

A-5-3 Procedure for Creating I/O Tables
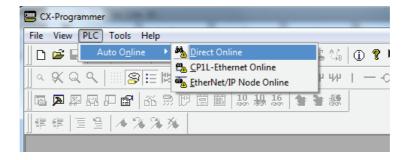
This section provides the procedure for creating I/O tables for the EtherCAT Slave Unit using the CX-Programmer.

CX-Programmer
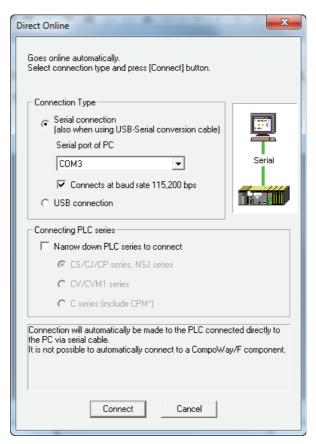
This section describes how to register an EtherCAT Slave Unit in the I/O tables using the CX-Programmer (version 9.54 or higher). Refer to the *CX-Programmer Operation Manual* (Cat. No. W446) for details on the operating procedures.

This section describes how to register the CJ1W-ECT21 in the I/O tables by creating the I/O tables on a computer with the CX-Programmer. In this example, the computer is connected to the PLC using a serial cable. The CJ1W-ECT21 is connected to a CJ1H-CPU65 CPU Unit.

1 Start the CX-Programmer, and then select *PLC - Auto Online - Direct Online* from the menus.
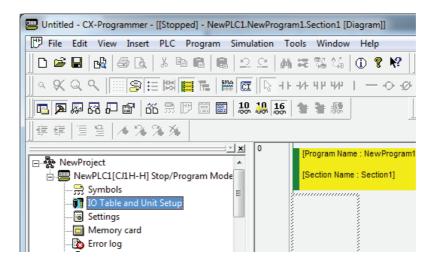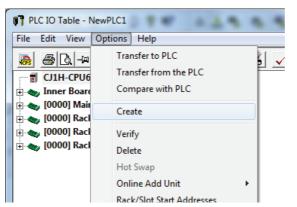
2 The Direct Online Dialog Box will be displayed. Select a serial connection, select the name of the applicable computer serial port, and then press the **Connect** Button.
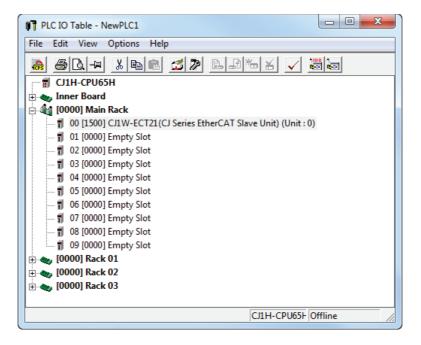
3 If the connection process is successful, the system will be connected online. Here, check the operating mode of the PLC. If the operating mode is not PROGRAM mode, change the mode by selecting *PLC - Operating Mode - Program* from the menus.

4 Double-click **IO Table and Unit Setup** Icon in the project workspace in the CX-Programmer. The PLC IO Table Window will be displayed. Select *Options - Create* from the menus.

5 The EtherCAT Slave Unit will be displayed at the position it is mounted in the PLC.

Programming Console
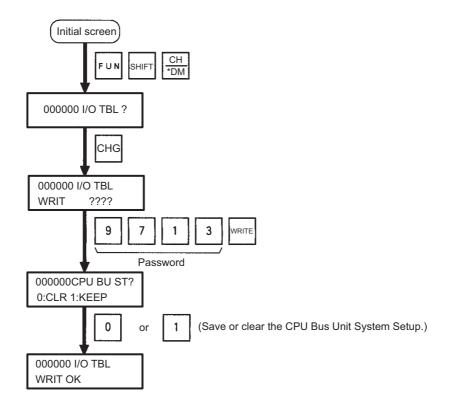
This section provides the procedure for creating the I/O tables using a Programming Console. For details on using the Programming Console, refer to the Programming Console's operation manual.

Use the following procedure to create the I/O tables.

> 📝 **Additional Information**
>
> With the CJ Series, it is necessary to create I/O tables only when the user is allocating I/O manually.

```
              ┌─────────────────┐
              │  Initial screen │
              └─────────────────┘
                       │
              ┌─────┐┌──────┐┌──────┐
              │ FUN ││SHIFT ││ CH   │
              └─────┘└──────┘│ *DM  │
                             └──────┘
                       │
              ┌──────────────────────┐
              │  000000 I/O TBL ?     │
              └──────────────────────┘
                       │
                    ┌─────┐
                    │ CHG │
                    └─────┘
                       │
              ┌──────────────────────┐
              │  000000 I/O TBL       │
              │  WRIT      ????       │
              └──────────────────────┘
                       │
              ┌───┐┌───┐┌───┐┌───┐ ┌───────┐
              │ 9 ││ 7 ││ 1 ││ 3 │ │ WRITE │
              └───┘└───┘└───┘└───┘ └───────┘
                  └──────────────┘
                      Password
                       │
              ┌──────────────────────┐
              │  000000CPU BU ST?     │
              │  0:CLR 1:KEEP         │
              └──────────────────────┘
                       │
                 ┌───┐      ┌───┐
                 │ 0 │  or  │ 1 │  (Save or clear the CPU Bus Unit System Setup.)
                 └───┘      └───┘
                       │
              ┌──────────────────────┐
              │  000000 I/O TBL       │
              │  WRIT OK              │
              └──────────────────────┘
```

A-6 FINS Commands

This section explains the FINS commands that are supported by the EtherCAT Slave Unit.

A-6-1   Introduction

The following FINS command codes can be used to perform various functions with the EtherCAT Slave Unit.

Command code		Function name
MRC	SRC	
05	01	CONTROLLER DATA READ
21	02	ERROR LOG READ
	03	ERROR LOG CLEAR

A-6-2   Details on FINS Commands

This section describes details for FINS commands used with the EtherCAT Slave Unit.
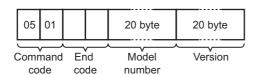
Controller Data Read (0501)

This command reads the model and version of the EtherCAT Slave Unit.

● Command Block

```
05   01
```
Command code

● Response Block

```
05 | 01 |   |   | 20 byte | 20 byte
```
Command End   Model   Version
code   code   number

● Parameters

Name	Description
Model number	The model number of the EtherCAT Slave Unit is returned as ASCII characters occupying 20 bytes (i.e., 20 characters each). If all bytes are not used, the remaining bytes will be all spaces (ASCII 20 hex). • Example Model: CJ1W-ECT21
Version	The version of the EtherCAT Slave Unit is returned as ASCII characters occupying 20 bytes (i.e., 20 characters each). If all bytes are not used, the remaining bytes will be all spaces (ASCII 20 hex). • Example Version: V1.00

● **End Code**
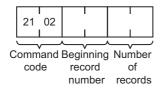
End code (hex)	Description
0000	Normal
1001	Command too large
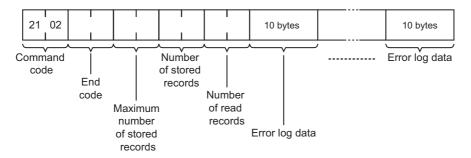
Error Log Read (2102)

This command reads the error log.

● **Command Block**

Command code | Beginning record number | Number of records

● **Response Block**

Command code | End code | Maximum number of stored records | Number of stored records | Number of read records | Error log data | Error log data

● **Parameters**
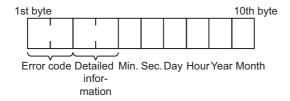
Name	Description
Beginning record number (command)	Specify the first record to be read. The first record number can be specified in the range between 0000 and 00F9 hex (0 to 249 decimal). The 0000 hex record is the oldest record.
Number of records (command)	The number of records to read is specified between 0001 and 0063 hex (1 to 99 decimal).
Maximum number of stored records (response)	Indicates the maximum number of records that can be stored in the error log. The maximum number of error log records depends on the model of CPU Unit or CPU Bus Unit being used. In an EtherCAT Slave Unit, the maximum number of stored records is fixed at 00FA hex (250 decimal).
Number of stored records (response)	The number of records stored at the time the command is executed is returned.
Number of read records (response)	The number of actual records read is returned as a hexadecimal value.
Error log data (response)	The specified number of error log records from the beginning record number is returned sequentially. The total number of bytes in the error log is calculated as the number of records x 10 bytes/record. Each error log record thus comprises 10 bytes. Refer to *Error Log Data Format* on page A-31.

● **Error Log Data Format**

Name	Description
Error code	Details of the error stored in the record. Refer to *5-3-4 Error Log Error Codes* on page 5-15 for details.
Detailed information	
Minute, Second, Day, Hour, Year, Month	Indicates the time at which the error stored in the record occurred.

● **Precautions**

If the error log contains fewer records than the number specified in the number of records parameter, all records stored in the error log at the time the command is executed will be returned and the command executed will end normally.

● **End Code**

End code (hex)	Description
0000	Normal end
1001	Command too large
1002	Command too small
1103	Beginning record number is out of range
110C	The number of read records is 0000 hex
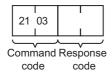
Error Log Clear (2103)

This command clears the error log for the EtherCAT Slave Unit and resets the number of stored records to 0.

● **Command Block**

```
┌──────┐
│ 21 03│
└──────┘
 ╰──┬──╯
Command code
```

● **Response Block**

```
┌──────┬──────┐
│ 21 03│      │
└──────┴──────┘
 ╰──┬──╯ ╰──┬──╯
Command  Response
  code     code
```

● **End Code**

End code (hex)	Description
0000	Normal end
1001	Command too large

A-7   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 CX-Programmer.

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

Model number of EtherCAT Slave Unit	Unit version	Corresponding unit version/version[1]			
		Unit version of CJ-series CPU Unit	Unit version of CP-series CPU Unit	Unit version of NSJ Controller	CX-Programmer version
CJ1W-ECT21	Ver.1.0	The oldest available version or later			Ver. 9.54 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

Index

I

CJ-series EtherCAT Slave Units Operation Manual (W541)