MITSUBISHI ELECTRIC

Programmable Automation Controllers

MELSEC MX Controller

MELSEC MX Controller MX-F Model (Support EtherCAT) User's Manual

-MXF100-8-N32-EC
-MXF100-16-N32-EC

SAFETY PRECAUTIONS

(Read these precautions before using this product.)

Before using Mitsubishi Electric programmable automation controllers, please read the manuals for the products used and the relevant manuals carefully and pay full attention to safety to handle the products correctly. If products are used in a different way from that specified by manufacturers, the protection function of the products may not work properly.

In this manual, the safety precautions are classified into two levels: "⚠WARNING" and "⚠CAUTION".

⚠ **WARNING**	Indicates that incorrect handling may cause hazardous conditions, resulting in death or severe injury.
⚠ **CAUTION**	Indicates that incorrect handling may cause hazardous conditions, resulting in minor or moderate injury or property damage.

Under some circumstances, failure to observe the precautions given under "⚠CAUTION" may lead to serious consequences.

Observe the precautions of both levels because they are important for personal and system safety.

Make sure that the end users read this manual and then keep the manual in a safe place for future reference.

When using the MELSEC iQ-F series extension devices, refer to the safety precautions described in the user's manual for the extension devices used.

[Design Precautions]

⚠ WARNING

- Configure safety circuits external to the controller to ensure that the entire system operates safely even when a fault occurs in the external power supply or the controller. Failure to do so may result in an accident due to an incorrect output or malfunction.
  - Emergency stop circuits, protection circuits, and protective interlock circuits for conflicting operations (such as forward/reverse rotations or upper/lower limit positioning) must be configured external to the controller system.
  - Note that when the controller detects an error, such as a watchdog timer error, during self-diagnosis, all outputs are turned off. Also, when an error that cannot be detected by the controller occurs in an input/output control block, output control may be disabled. External circuits and mechanisms should be designed to ensure safe machinery operation in such a case.
  - Outputs may remain on or off due to a failure of a component such as a relay and transistor in an output circuit. For output signals that may lead to serious accidents, external circuits and mechanisms should be designed to ensure safe machinery operation in such a case.
- Construct an interlock circuit in the program so that the whole system always operates on the safe side before executing the control (for data change) of the controller system in operation. Read the manual thoroughly and ensure complete safety before executing other controls (program change, parameter change, forced output, and operation status change) to the controller system in operation. Improper operation may damage machines or cause accidents.
- Configure an external safety circuit such as a fuse in the output circuit. When a load current exceeding the rated value or an overcurrent caused by a load short-circuit flows for a long time, it may cause smoke and fire.
- For the operating status of each station after a communication failure, refer to manuals relevant to the network. Incorrect output or malfunction may result in an accident.
- To ensure that the entire system operates safely, configure interlock circuits external to the controller. Failure to do so may result in an accident due to an incorrect output or malfunction.
  - OPR (Homing) is controlled by two kinds of data: an OPR direction and an OPR speed. Deceleration is performed when the proximity dog signal turns on. If an incorrect OPR direction is set, motion control may continue without deceleration.
  - When the controller detects an error, the operation decelerates and stops or suddenly stops, depending on the parameter settings. Set the parameters to meet the specifications of the system used.
- If safety standards (such as robot safety rules) apply to the system using the controller, drive unit, and servo motor, ensure that the safety standards are satisfied.
- Configure a safety circuit external to the module or drive unit if the abnormal operation of the controller or drive unit differs from the safety directive operation in the system.

[Design Precautions]

⚠ CAUTION

- When controlling an inductive load such as a lamp load, heater, or solenoid valve, take proper measures so that the flowing current does not exceed the value corresponding to the maximum load specification of the resistance load. A large current (approximately 10 times greater than normal) may flow when the output is turned on.
- Design circuits so that the entire system will always operate safely even if the time required for the controller to enter the RUN state varies when the controller is powered off and on or reset. The time taken to enter the RUN state varies depending on the system configuration, parameter settings, and/or program size.
- Simultaneously turn on and off the power supplies of the controller, extension modules, and expansion adapters.
- If a long-time power failure or an abnormal voltage drop occurs, the controller stops, and output is turned off. When the power supply is restored, it will automatically restart (when the RUN/STOP/RESET switch is on RUN side).

[Security Precautions]

⚠ WARNING

- To maintain the security (confidentiality, integrity, and availability) of the controller and the system against unauthorized access, denial-of-service (DoS) attacks, computer viruses, and other cyberattacks from unreliable networks and devices via network, take appropriate measures such as firewalls, virtual private networks (VPNs), and antivirus solutions.

[Installation Precautions]

⚠ WARNING

- Make sure to cut off all phases of the power supply externally before attempting installation or wiring work. Failure to do so may cause electric shock or damage to the product. Use the product within the generic environment specifications described in this manual.
- Never use the product in areas with excessive dust, oily smoke, conductive dust, corrosive gas (salt air, Cl_2, H_2S, SO_2, or NO_2), flammable gas, or vibration or impacts, or expose it to high temperature, condensation, or rain and wind. If the product is used in such conditions, electric shock, fire, malfunctions, deterioration or damage may occur.

[Installation Precautions]

⚠ CAUTION

- Do not touch the conductive parts of the product directly. Doing so may cause device failures or malfunctions.
- When drilling screw holes or wiring, make sure that cutting and wiring debris do not enter the ventilation slits of the controller system. Failure to do so may cause fire, equipment failures or malfunctions.
- Install the product on a flat surface. If the mounting surface is rough, undue force will be applied to the PC board, thereby causing nonconformities.
- Install the product securely using a DIN rail.
- Connect the expansion adapter securely to their designated connectors. Loose connections may cause malfunctions.
- Work carefully when using a screwdriver such as installation of the product. Failure to do so may cause damage to the product or accidents.
- Connect the extension cables, peripheral cables, input/output cables and battery connecting cable securely to their designated connectors. Loose connections may cause malfunctions.
- When using an SD memory card, insert it into the SD memory card slot. Check that it is inserted completely. Poor contact may cause malfunction.
- Turn off the power before attaching or detaching the following devices. Failure to do so may cause equipment failures or malfunctions.
  - Peripheral devices, expansion adapter, and connector conversion adapter
  - Extension modules and connector conversion module
  - Battery
- Hold the connector part of the Ethernet cable and perform installation or removal in a straight direction. If the cable is pulled out while connected to the module, it may cause damage to the module or the cable, or may cause a malfunction due to poor cable contact.

[Wiring Precautions]

⚠ WARNING

- Make sure to cut off all phases of the power supply externally before attempting installation or wiring work. Failure to do so may cause electric shock or damage to the product.
- Connect the power supply wiring to the dedicated terminals described in this manual. If an AC power supply is connected to a DC input/output terminal or DC power supply terminal, the controller will burn out.
- The temperature rating of the cable should be 80℃ or more. It may differ depending on the extension devices. For details, refer to the user's manual of the extension devices.
- Make sure to perform wiring in accordance with the following precautions. Failure to do so may cause electric shock, equipment failures, a short-circuit, wire breakage, malfunctions, or damage to the product.
  - The disposal size of the cable end should follow the dimensions described in the manual.
  - Twist the ends of stranded wires and ensure that there are no loose wires.
  - Do not solder-plate the electric wire ends.
  - Do not connect more than the specified number of wires or electric wires of unspecified size.
  - Affix the electric wires so that neither the terminal block nor the connected parts are directly stressed.
- For details on wiring for the MELSEC iQ-F series modules such as intelligent function modules and expansion adapters, refer to the manuals for each product.

[Wiring Precautions]

⚠ CAUTION

- For the controller system, provide a ground resistance of 100Ω or less according to the following manual.
  📖 MELSEC MX Controller MX-F Model User's Manual
- Install controller so that excessive force will not be applied to terminal blocks, I/O connectors, communication connectors, or communication cables. Failure to do so may result in wire damage/ breakage or controller failure.
- Make sure to observe the following precautions to prevent any damage to the machinery or accidents due to malfunction of the controller caused by abnormal data written to the controller due to the effects of noise.
  - Do not bundle the power line, control line and communication cables together with or lay them close to the main circuit, high-voltage line, load line or power line. As a guideline, lay the power line, control line and communication cables at least 100mm away from the main circuit, high-voltage line, load line or power line.
  - Ground the shield of the shield wire or shielded cable at one point on the controller system. However, do not use common grounding with heavy electrical systems.
  - Ground the shield of the analog I/O wire in accordance with the manuals of each model. However, do not use common grounding with heavy electrical systems.
- Do not connect the EtherCAT network to other networks such as LANs for general-purpose. Doing so may result in network failure or malfunction due to overload.

[Computer Connection Precautions]

⚠ WARNING

- Do not ground on the +24V side. The controller is a non-insulated type, and the ground terminal of the power supply terminal and the FG metal fitting on the bottom of the product are conductive to the RJ45 connector shell (P1, P2) and the USB connector shell inside the controller. Therefore, the external power supply may be short-circuited depending on how peripheral devices are connected. Also, the connector shell and SG (24G) may have been short-circuited in the USB cable.

[Computer Connection Precautions]

⚠ CAUTION

- When connecting a personal computer to a controller having a USB interface, observe the following precautions as well as the instructions described in the manual for the personal computer used. Failure to do so may cause the controller to fail.
  (1) When the personal computer is AC-powered
  When the personal computer has a 3-pin AC plug or an AC plug with a ground wire, use a grounding receptacle or ground the ground wire. Ground the personal computer and the controller with a ground resistance of 100 ohms or less.
  When the personal computer has a 2-pin AC plug without a ground wire, connect the computer to the module by following the procedure below. For power supplied to the personal computer and the controller, using the same power source is recommended.
  1. Unplug the personal computer from the AC receptacle.
  2. Check that the personal computer is unplugged from the AC receptacle. Then, connect the personal computer to the controller with a USB cable.
  3. Plug the personal computer into the AC receptacle.
  (2) When the personal computer is battery-powered
  The personal computer can be connected to the module without taking specific measures.
  For details, refer to the following.
  Cautions When Using Mitsubishi Programmable Controllers or GOTs Connected to a Personal Computer With the RS-232/USB Interface (FA-A-0298)

[Startup and Maintenance Precautions]

⚠ WARNING

- Do not touch any terminal while the power is on. Doing so may cause electric shock or malfunctions.
- Before cleaning or retightening terminals, cut off all phases of the power supply externally. Failure to do so may cause electric shock.
- Before modifying the program, performing forced output, or running or stopping the controller while the system is running, read through this manual carefully, and ensure complete safety. Improper operation may damage machines or cause accidents.
- Do not change the program in the controller from two or more peripherals at the same time (such as from an engineering tool and a GOT). Doing so may cause destruction or malfunction of the controller program.
- Use the battery for holding clock data in conformance to this manual.
  - Use the battery for the specified purpose only.
  - Connect the battery correctly.
  - Do not charge, disassemble, heat, put in fire, short-circuit, connect reversely, solder, swallow, or burn the battery, or apply excessive forces (such as vibration, impact, drop) to the battery.
  - Do not store or use the battery at high temperatures or expose to direct sunlight.
  - Do not expose to water, bring near fire or touch liquid leakage or other contents directly.
  - When replacing the battery, make sure to use our specified product (FX3U-32BL).
  - When a battery error occurs (SM52 is on), follow the description in this manual. Incorrect handling of the battery may cause heat excessive generation, bursting, ignition, liquid leakage or deformation, and lead to injury, fire or failures and malfunction of facilities and other equipment.

[Startup and Maintenance Precautions]

⚠ CAUTION

- Do not disassemble or modify the controller. Doing so may cause fire, equipment failures, or malfunctions. For repair, contact your local Mitsubishi Electric representative.
- After the first use of the product, do not insert/remove the SD memory card to/from the controller more than 500 times. Exceeding the limit may cause malfunction.
- Turn off the power before connecting or disconnecting any extension cable. Failure to do so may cause device failures or malfunctions.
- Turn off the power before attaching or detaching the following devices. Failure to do so may cause device failures or malfunctions.
  - Peripheral devices, expansion adapter, and connector conversion adapter
  - Extension modules and connector conversion module
  - Battery
- Do not use the chemicals for cleaning.
- If there is the possibility of touching the controller system inside a control panel in maintenance, make sure to discharge to avoid the influence of static electricity.
- Since there are risks such as burn injuries, please do not touch the surface of the equipment with bare hands when it is operating in an environment which exceeds ambient temperature of 40℃.
- Use any radio communication device such as a cellular phone or PHS (Personal Handy-phone System) 25cm or more away in all directions from the controller system. Failure to do so may cause malfunction.
- After power-off, wait for 1 second or more, then turn on the power. If the interval between power-off and on is insufficient, the module may not start up.
- Before starting the operation, check if the brake function operates correctly.
- Before testing the operation, set a low speed value for the speed limit parameter so that the operation can be stopped immediately upon occurrence of a hazardous condition.
- Confirm and adjust the program and each parameter before operation. Unpredictable movements may occur depending on the machine.
- When using the absolute position system, on starting up, and when the module or absolute position motor has been replaced, always perform a homing.
- After maintenance and inspections are completed, check that the positions detected in the absolute position detection are correct.

[Operating Precautions]

⚠ CAUTION

- Construct an interlock circuit in the program so that the whole system always operates on the safe side before executing the control (for data change) of the controller in operation. Read the manual thoroughly and ensure complete safety before executing other controls (program change, parameter change, forced output, and operation status change) to the controller in operation. Improper operation may damage machines or cause accidents.
- Do not go near the machine during test operations or during operations such as teaching. Doing so may lead to injuries.
- When the reference axis speed specification is used in interpolation operation, the speed of the partner axis (2nd, 3rd, or 4th axis) may exceed the set speed and ultimately the speed limit value.

[Disposal Precautions]

⚠ CAUTION

- When disposing of this product, treat it as industrial waste.
- When disposing of batteries, separate them from other wastes according to the local regulations. For details on battery regulations in EU member states, refer to the following.
  📖 MELSEC MX Controller MX-F Model User's Manual

[Transportation Precautions]

⚠ CAUTION

- When transporting the controller with the optional battery, turn on the controller before shipment, confirm that SM52 is off, and check the battery life. If the controller is transported with the on status of SM52 or the battery exhausted, the battery-backed data may be unstable during transportation.
- The controller system is a precision instrument. During transportation, avoid impacts larger than those specified in the general specifications by using dedicated packaging boxes and shock-absorbing palettes. Failure to do so may cause failures in the controller system. After transportation, verify operation of the controller system and check for damage of the mounting part or other parts.
- When transporting lithium batteries, follow required transportation regulations. (For details on the regulated products, refer to this manual.)
- The halogens (such as fluorine, chlorine, bromine, and iodine), which are contained in a fumigant used for disinfection and pest control of wood packaging materials, may cause failure of the controller system. Prevent the entry of fumigant residues into the controller system or consider other methods (such as heat treatment) instead of fumigation. The disinfection and pest control measures must be applied to unprocessed raw wood.

INTRODUCTION

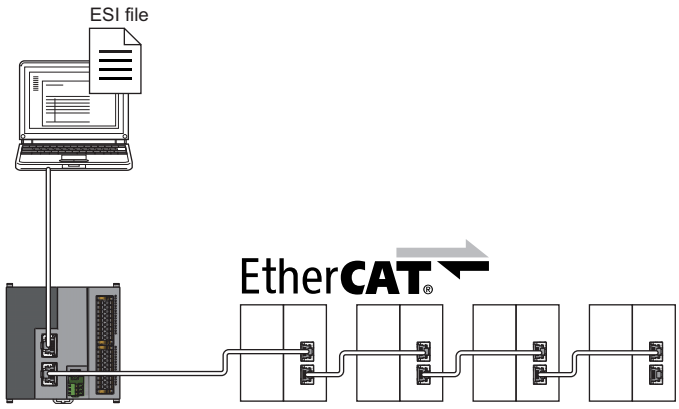
Thank you for purchasing the Mitsubishi Electric programmable automation controllers.
This manual describes the procedures before operation, specifications, functions, devices, parameters, and troubleshooting of the relevant products listed below.
Before using this product, please read this manual and the relevant manuals carefully and develop familiarity with the functions and performance of the controller to handle the product correctly.
When applying the program examples provided in this manual to an actual system, ensure the applicability and confirm that it will not cause system control problems.
Note that the menu names and operating procedures may differ depending on an operating system in use and its version. When reading this manual, replace the names and procedures with the applicable ones as necessary.
Please make sure that the end users read this manual.

Relevant products

MXF100-8-N32-EC, MXF100-16-N32-EC

Overview

The MELSEC MX Controller MX-F Model (Support EtherCAT) is a controller that connects to the EtherCAT network and enables data communication between devices that support EtherCAT.



Manual page organization

This manual describes the specifications of EtherCAT.

It does not include information on the specifications common to the MX-F Model and the MX-F Model I/O module.

Refer to the manuals corresponding to the items listed below.

Item	Reference
Part names	■Controller Page 18 PART NAMES ■MX-F Model I/O module 📖 MELSEC MX Controller MX-F Model User's Manual
Procedures before operation	■EtherCAT communication settings • Page 24 START-UP PROCEDURE • Page 26 PARAMETER SETTINGS ■Installation, wiring, connection to a personal computer 📖 MELSEC MX Controller MX-F Model User's Manual
System configuration	■System configuration for EtherCAT communication Page 22 SYSTEM CONFIGURATION ■Overall configuration, extension modules, module assignment 📖 MELSEC MX Controller MX-F Model User's Manual
Specifications	■Performance specifications of EtherCAT Page 50 SPECIFICATIONS ■General specifications, performance specifications excluding EtherCAT 📖 MELSEC MX Controller MX-F Model User's Manual
Function list	Page 52 FUNCTION LIST
Controller operation	📖 MELSEC MX Controller MX-F Model User's Manual
Devices, labels, and constants	📖 MELSEC MX Controller MX-F Model User's Manual
Programming	📖MELSEC MX Controller MX-F Model Programming Manual
Maintenance and inspection	📖 MELSEC MX Controller MX-F Model User's Manual
Troubleshooting	■When using the EtherCAT function • Page 162 TROUBLESHOOTING PROCEDURE • Page 167 TROUBLESHOOTING BY SYMPTOM • Page 169 ERROR CODES • Page 180 EVENT LIST ■When using other functions 📖 MELSEC MX Controller MX-F Model User's Manual
Handling of batteries	📖 MELSEC MX Controller MX-F Model User's Manual
External dimensions	📖 MELSEC MX Controller MX-F Model User's Manual
Special relay (SM)	📖 MELSEC MX Controller MX-F Model User's Manual
Special register (SD)	📖 MELSEC MX Controller MX-F Model User's Manual
Buffer memory	■EtherCAT function part Page 188 Buffer Memory ■CPU function part 📖 MELSEC MX Controller MX-F Model User's Manual

Point

- The MX-F Model (Support EtherCAT) does not support CC-Link IE TSN.
- The MX-F Model (Support EtherCAT) is not compatible with multi-axis servo amplifiers. (For MELSERVO, MR-J5W-G-N1, MR-J5D-G-N1, and MR-MD333G-N1 are not supported.)
- The MX-F Model (Support EtherCAT) does not support normal-speed synchronization and low-speed synchronization of the network communication cycle synchronization function. Even if "Synchronize with Low-Speed" or "Synchronize with Normal-Speed" is set in CPU Module Logging Configuration Tool, the module will not operate according to the setting.

CONTENTS

RELEVANT MANUALS

MELSEC MX Controller

Manual name [manual number]	Description
MELSEC MX Controller MX-F Model (Support EtherCAT) User's Manual [SH-082746ENG] (this manual)	System configuration, procedures before operation, parameter settings, specifications, functions, programming, and troubleshooting of EtherCAT
MELSEC MX Controller MX-F Model User's Manual [SH-082634ENG]	Procedures before operation, specifications, devices, memory, functions, parameters, and troubleshooting of the controller
MELSEC MX Controller MX-F Model Programming Manual [SH-082691ENG]	Program language specifications, controller instructions, standard functions/ function blocks, and specifications of motion control function blocks

Software

Manual name [manual number]	Description
GX Works3 Operating Manual [SH-081215ENG]	System configuration, parameter settings, and online operations of GX Works3

TERMS

Unless otherwise specified, this manual uses the following terms.

Term	Description
Auto increment address	One of the EtherCAT address specifications. The addresses are assigned based on the sorting order of SubDevices. Their numbers to be assigned are 0, -1, -2, and thereafter, starting from the closest to the MainDevice.
Buffer memory	A memory to store data such as setting values and monitored values. The data include setting values and monitored values of the network function.
Bus mismatch	Bus mismatch refers to a state where the network configuration setting and the actual network configuration do not match. For example, this status occurs in the following situations. • A SubDevice that is present in the module extended parameter (ENI file) is not actually connected. • A SubDevice that is not present in the module extended parameter (ENI file) is actually connected. • The connection order of SubDevices differs between the module extended parameter (ENI file) and the actual order. • When checking the device ID, the device ID of the SubDevice differs between the one set in the module extended parameter (ENI file) and the actual ID.
Bus scan	The configuration of the SubDevices that actually exist on the EtherCAT network is verified against the SubDevice configuration set in the ENI.
Cable Redundancy	This function maintains communication in the event of a cable or device failure in the EtherCAT system.
Cycle time	Cycle for process data communication
Data assurance	A handshake function that prevents access conflicts between the user program and EtherCAT communication on the input and output data of process data communication
Device	A memory of the controller to store data. Devices such as X, Y, M, D, and others are provided depending on the intended use.
Device ID	An ID of the two-byte length to be assigned for identifying SubDevices
Distributed clock	A high-precision time synchronization function that synchronizes the time of all EtherCAT devices
Engineering tool	A tool used for setting up programmable controllers, programming, debugging, and maintenance
ESM state	A status defined by ESM, such as Operational or Pre-Operational
EtherCAT	EtherCAT stands for Ethernet Control Automation Technology and is an industrial network system based on an Ethernet system. EtherCAT is a predefined protocol whose technology is proposed by Beckhoff Automation GmbH and whose maintenance and management are handled by EtherCAT Technology Group.
EtherCAT MainDevice class	Class A MainDevice is a standard EtherCAT MainDevice, and Class B MainDevice is a MainDevice with limited functionality. Class B is used only in limited cases, such as low-end embedded systems, where available resources are insufficient to support all the functions of Class A.
Global label	A label that is valid for all the program data when multiple program data are created in the project. There are two types of global label: a module specific label (module label), which is generated automatically by GX Works3, and an optional label, which can be created for any specified device.
Hot Connect	This function makes it possible to dynamically disconnect, connect, and change the position of a single SubDevice or a group of SubDevices while the EtherCAT system is running.
Intelligent function module	A module that has functions other than input and output, such as an A/D converter module and D/A converter module
Line cross	The state that a cable is connected to the wrong ports between the MainDevice and SubDevice, or between SubDevices. Example: Connecting P1 of the controller to OUT of a SubDevice, and connecting IN of a SubDevice to IN of a SubDevice
Mailbox communication	This function provides non-periodic communication from the MainDevice to a specific SubDevice. Using mailboxes, various non-periodic communication protocols (such as SDO communication) can be implemented.
MainDevice	A module that controls multiple SubDevices connected to EtherCAT network
Module label	A label that represents one of memory areas (I/O signals and buffer memory areas) specific to each module in a given character string. For the module used, GX Works3 automatically generates this label, which can be used as a global label.
Node address	One of the EtherCAT address specifications. The number is assigned to each SubDevice. It can be set in the range 1 to 65535.
Object dictionary	An information table held by an EtherCAT module. It stores EtherCAT module information.
Process data communication	Communication that is simultaneously performed at a fixed cycle to all SubDevices
Reference clock	A device that has a system time and provides the reference time to other devices on the network
SubDevice	A module that reads data in the frame sent from the MainDevice and simultaneously writes data, which is sent to the MainDevice, to the frame using the on-the-fly method
Sync unit	A unit that groups process data within a network By dividing a sync unit, data can be exchanged independently of each other.
WKC error	An error indicates that the expected WKC does not match the actual WKC in EtherCAT communications. This error occurs when a SubDevice does not exist, is faulty, or when data is not processed correctly during communications.

GENERIC TERMS AND ABBREVIATIONS

Unless otherwise specified, this manual uses the following generic terms and abbreviations.

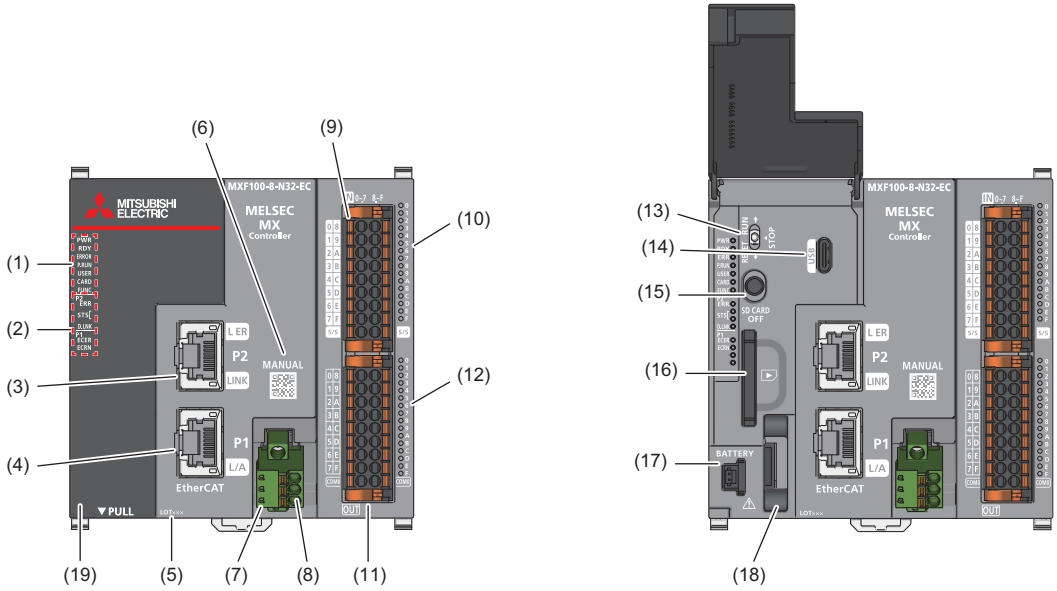
Generic term/abbreviation	Description
ARTT	An abbreviation for Actual Round Trip Time. The time that was actually used to perform process data communications and mailbox communications.
ENI file	An abbreviation for EtherCAT Network Information file. A file that is used for the MainDevice. The file stores configuration information on the EtherCAT network, such as connection order of SubDevices. In addition, this file contains information to identify the SubDevices (such as vendor information) and to initialize each SubDevice. The MainDevice initializes and establishes the network based on the information contained in ENI file. For the MX-F Model (Support EtherCAT), the ENI file is stored in the module extended parameter.
ERTT	An abbreviation for Expected Round Trip Time. The time, which is set in the module extended parameter, is assigned for process data communications and mailbox communications.
ESI file	An abbreviation for EtherCAT SubDevice Information file. A file that describes information as EtherCAT SubDevice.
ESM	An abbreviation for EtherCAT State Machine. A state machine that determines the network operations of MainDevice and SubDevice.
FoE	An abbreviation for File Access over EtherCAT. A protocol is used to send and receive file data in both directions in the EtherCAT network.
LRD	An abbreviation for Logical Read This command will be used in the EtherCAT communication protocol to read data from the SubDevice memory area. It acquires data from the specified address and returns data to the MainDevice.
LRW	An abbreviation for Logical Read/Write This command will be used in the EtherCAT communication protocol to simultaneously read from and write to a SubDevice. It is used to read data from the specified data area and write new data.
LWR	An abbreviation for Logical Write This command will be used in the EtherCAT communication protocol to write data to a SubDevice. It writes data sent from the MainDevice to the specified address.
MX-F Model	A generic term for the following modules: MXF100-8-N32, MXF100-8-P32, MXF100-16-N32, MXF100-16-P32
MX-F Model (Support EtherCAT)	A generic term for the following modules: MXF100-8-N32-EC, MXF100-16-N32-EC
PDO	An abbreviation for Process Data Object. It is data to be sent and received through process data communications.
SDO	An abbreviation for Service Data Object. It is data to be sent and received through mailbox communications.
WKC	An abbreviation for Working Counter. A counter, defined in the EtherCAT protocol specification, indicates that the EtherCAT frame has been correctly processed when it passes through each SubDevice in the network. When a SubDevice correctly processes the command, the SubDevice increases the WKC value. For example, WKC increases as shown below. • LRD: +1 • LWR: +1 • LRW: +2

1 PART NAMES

1.1 MX-F Model (Support EtherCAT)

This chapter describes the part names of the controller.
For the MX-F Model I/O module, refer to the following.
MELSEC MX Controller MX-F Model User's Manual

Front



No.	Name	Description
(1)	Operation status display LED	
	PWR LED	Indicates the operating status of the power supply. • On: Powered • Flashing: Not powered/hardware failure
	RDY LED ERROR LED	Indicates the operating status of the hardware and the error level. (☞ Page 163 Troubleshooting with LED Indicators) ●RDY LED—ERROR LED status • On—off: Normal operation • On—on: Minor error • On—flashing: Moderate error • Flashing—off: Initial processing • Off—on/flashing: Major error
	P.RUN LED	Indicates the operating status of the program. • On: Being executed (RUN state) • Flashing: Being suspended (PAUSE state) • Off: Stopped (STOP state) or stop error
	USER LED	Indicates the status of the annunciator (F). • On: Annunciator (F) ON • Off: Normal operation For the annunciator (F), refer to the following. MELSEC MX Controller MX-F Model User's Manual
	CARD LED	Indicates the status of the SD memory card. • On: SD memory card available • Flashing (every 50ms): Accessing the SD memory card • Flashing (every 200ms): Preparing SD memory card • Off: Card not inserted or can be removed

No.	Name	Description
(1)	FUNC LED	Indicates the external input/output forced on/off function operating status, the write status of program restoration information, or the registration status of device test with execution conditions. • Flashing: Indicates the external input/output forced on/off function execution (when registered), the state in which program restoration information is not written, or the registration status of device test with execution conditions.
(2)	Operation status display LED (operating status of P2)	
	ERR LED	Indicates the operating status of the P1 or P2 network part. • On: An error occurs in the network part or an error is detected in all stations. • Flashing: An error occurs in the network part or data link faulty station is detected. • Off: The network part is operating normally.
	STS LED	The LED is always off.
	D LINK LED	The LED is always off.
	Operation status display LED (operating status of P1)	
	ECER LED*1	Indicates the communication error status of EtherCAT. • On: Application error • Single flash: Device communication status error • Double flash: Communication error • Blinking: Line structure error • Off: No error
	ECRN LED*1	Indicates the communication status of EtherCAT. • On: Operational (EtherCAT communication being performed) • Single flash: Safe-Operational (Status before becoming Operational) • Blinking: Pre-Operational (Network initial setting being performed) • Off: From power-on or restart until Init (EtherCAT communication part being initialized)
(3)	Ethernet port (P2)	A port for Ethernet. Connect an Ethernet cable. For Ethernet cable standards, wiring methods, and wiring precautions, refer to the following. 📖 MELSEC MX Controller MX-F Model User's Manual
	L ER LED	Indicates the port status. • On: Abnormal data received • Off: Normal data received
	LINK LED	Indicates the link status. • On: Link-up • Flashing: Data being sent or received • Off: Link-down
(4)	Ethernet port (P1)	A port for EtherCAT. Connect an Ethernet cable. Use an Ethernet cable that conforms to the following standards. • Single shielded STP cable compatible with Category 5e or higher • RJ45 connector • IEEE802.3 (1000BASE-T) • ANSI/TIA/EIA-568-B (Category 5e) However, it is recommended to use a double shielded STP cable compatible with Category 5e or higher. For wiring methods and wiring precautions, refer to the following. 📖 MELSEC MX Controller MX-F Model User's Manual
	L/A LED	Indicates the link status. • On: Link-up • Flashing: Communicating after link-up • Off: Link-down
(5)	LOT number	Indicates the LOT (date of manufacture YYM) of the module.
(6)	Two-dimensional code for web manual	A two-dimensional code for the web manual link
(7)	Test terminal	A terminal for checking power continuity
(8)	Controller power terminal block	A power terminal block for the controller. ⏚ shows a function grounding terminal.
(9)	Input terminal block	A terminal block for input
(10)	Input display LED	LEDs for input • On: Input ON • Off: Input OFF
(11)	Output terminal block	A terminal block for output
(12)	Output display LED	LEDs for output • On: Output ON • Off: Output OFF

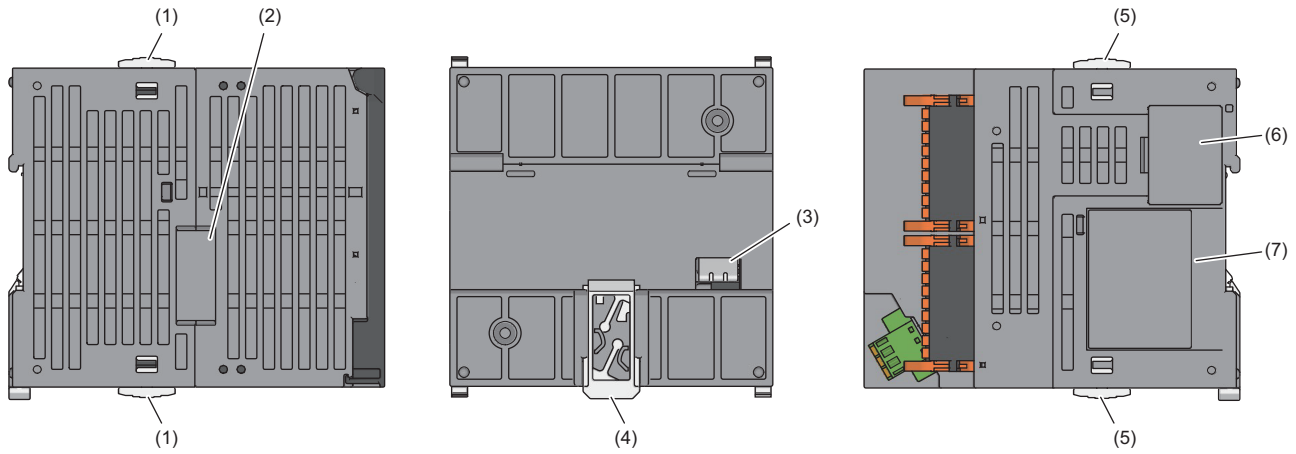
No.	Name	Description
(13)	RUN/STOP/RESET switch	A switch for controlling the operating status of the controller • RUN: Executes the program. • STOP: Stops the program. • RESET: Resets the controller. (Keep the switch in the RESET position for approximately one second.) Operate the RUN/STOP/RESET switch with your fingers. To prevent the switch from being damaged, do not use any tool such as a screwdriver.
(14)	USB port*2	A connector for a USB-compatible peripheral (Connector type: Type-C)
(15)	SD CARD OFF button	A switch for stopping card access when the SD memory card is removed
(16)	SD memory card slot	A slot where an SD memory card is inserted
(17)	Battery connector	A connector for connecting to the battery (FX3U-32BL). ⚠ is a mark that indicates the need to check the battery installation and replacement procedures when using a battery.
(18)	Battery compartment	A compartment for storing the battery (FX3U-32BL) when the battery is connected
(19)	Top cover	A cover for protecting the switches and connectors

*1 The following operations repeat depending on the type of flashing.

Flashing type	Operation
BL (Blinking)	200ms on → 200ms off
SF (Single Flash)	200ms on → 1000ms off
DF (Double Flash)	200ms on → 200ms off → 200ms on → 1000ms off

*2 When a cable is connected to the USB connector at all times, clamp the cable to prevent a poor connection, moving, and disconnection by unintentional pulling.

Side, back

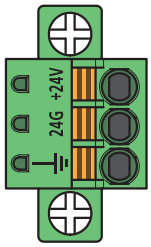


No.	Name	Description
(1)	Expansion adapter connecting hook	When connecting an expansion adapter, secure it with this hook.
(2)	Expansion adapter connector cover	A cover for protecting the expansion adapter connector
(3)	FG metal fitting	A spring for connecting to a DIN rail
(4)	DIN rail mounting hook	A hook for mounting on a DIN rail
(5)	Extension module connecting hook	When connecting an extension module, secure it with this hook.
(6)	Extension connector cover	A cover for protecting the extension connector
(7)	Nameplate*1	The product model name, manufacturer's serial number, power supply specifications, MAC address, and HW version are shown. ⚠ is a mark that instructs the use of a copper wire with an appropriate temperature rating (80℃ or more) for wiring.

*1 Products that do not have the nameplates are not covered by the warranty.

Terminal layout

Power terminal block



I/O terminal block

Indicates that the terminals are connected to each other in the controller.

Input	
X00	X08
X01	X09
X02	X0A
X03	X0B
X04	X0C
X05	X0D
X06	X0E
X07	X0F
S/S	S/S

Output	
Y00	Y08
Y01	Y09
Y02	Y0A
Y03	Y0B
Y04	Y0C
Y05	Y0D
Y06	Y0E
Y07	Y0F
COM0	COM0

Point

For examples of wires and wiring to be used, refer to the following.

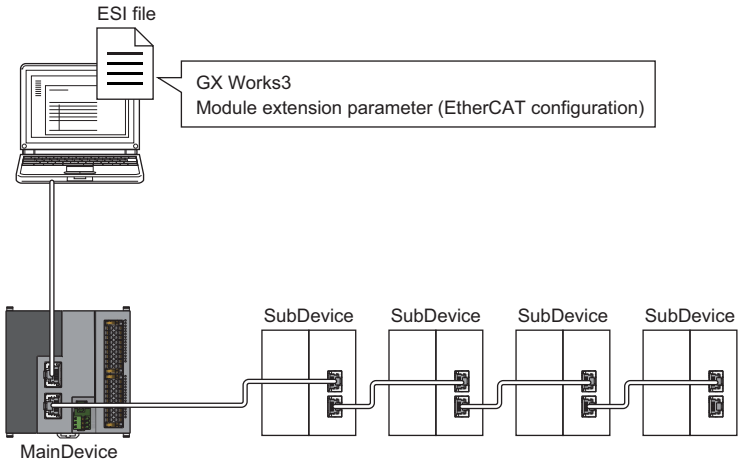
MELSEC MX Controller MX-F Model User's Manual

2 SYSTEM CONFIGURATION

This chapter describes the EtherCAT system configuration.

2.1 Connection Example

The MX-F Model (Support EtherCAT) operates as the MainDevice on EtherCAT and can control the SubDevices in the network.



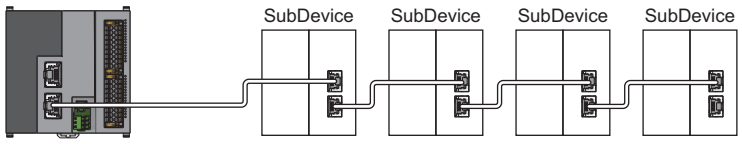
Point

- EtherCAT Configuration is a tool that is started from the engineering tool and is used to configure settings for communication with the SubDevices.
- By registering the ESI file provided by each SubDevice manufacturer in EtherCAT Configuration, settings for communication with the SubDevices can be easily configured.

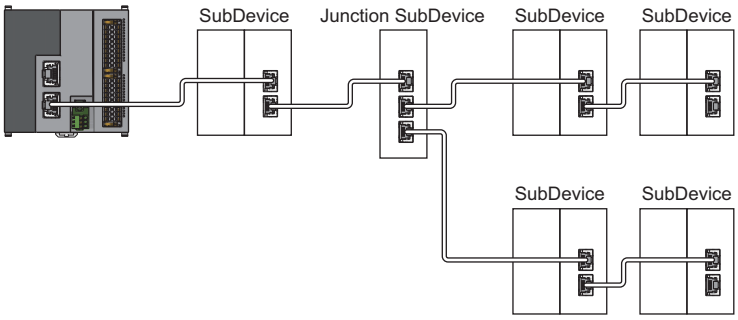
Connection methods

The following connection methods are available for the SubDevices.

■Line topology



■Star topology



Point

Connection using an industrial switch is not possible. To branch connections, use a Junction SubDevice (branch SubDevice).

2.2 Available Software Packages

The following table lists software that can be used.

Product	Supported version
GX Works3	"1.125F" or later
EtherCAT Configuration	"1.00A" or later
CPU Module Logging Configuration Tool	"1.178L" or later
GX LogViewer Version 1	"1.178L" or later

Point

For information on EtherCAT Configuration, contact your local Mitsubishi Electric representative.
For the operating environment for EtherCAT Configuration and its installation and uninstallation, refer to the following.
EtherCAT Configuration Tool Installation Instructions

3 START-UP PROCEDURE

This chapter describes the procedure for communicating with EtherCAT SubDevices.

This manual only provides detailed information about Step 9: Setting parameters. For other steps, refer to the following.

📖 MELSEC MX Controller MX-F Model User's Manual

Procedure	Description
1. Preliminary inspection	Before supplying power, check that the power supply is grounded and input/output devices are wired properly.
2. Installing a battery	Install a battery to the controller.
3. Inserting an SD memory card	Insert an SD memory card to the controller as needed.
4. Installation and wiring	Mount the modules, attach them to a DIN rail, and perform wiring. Use a double shielded Ethernet cable that conforms to the following standards. • STP cable compatible with Category 5 or higher • RJ45 connector • ETG.1600 (100BASE-T)
5. Powering on the system	Check the following before powering on the system. • A cable is correctly connected to the power supply. • Power supply voltage is within the specified range. • The controller is in the STOP state. • The controller is connected to a personal computer on which the engineering tool has been installed. Use the same power supply for the controller and other extension modules or expansion adapters. Alternatively, configure a system where the power supply is turned on before the controller. After power-off, wait for one second or more, then turn on the power. If the interval between power-off and on is insufficient, the module may not start up.
6. Starting up the engineering tool	Start up the engineering tool that has been installed on the personal computer connected to the controller.
7. Registering user information (user authentication function)	Register a user name and password used to log in to the project. Then, write the user information to the controller.
8. Initializing the controller	Initialize the controller using the engineering tool.
9. Setting parameters	Set parameters using the engineering tool. (☞ Page 26 PARAMETER SETTINGS)
10. Creating programs	Create a program using the engineering tool.
11. Writing to the controller	Write the parameters set and the program created by using the engineering tool to the controller.
12. Resetting the controller	Restart the system in either of the following ways. • Powering off and on • Resetting the controller
13. Checking for errors	Check the controller LEDs. If an error is detected, identify the error using the engineering tool, and eliminate the error cause.
14. Network diagnostics	Using network diagnostics, check if the cables are connected properly and communications are performed normally with the parameters.
15. Test operation	Check whether the created program was executed properly.
16. Executing the program	Set the controller to the RUN state and check that the P. RUN LED turns on.
17. Monitoring the program	Check that the program operates normally using the engineering tool.

MEMO

4 PARAMETER SETTINGS

This chapter describes the parameter settings required for communication with EtherCAT SubDevices.

1. Set the module extended parameters. (☞ Page 26 Setting Module Extended Parameters)
2. Set the network labels. (☞ Page 36 Setting Network Labels)
3. Configure the motion settings. (Only when the motion functions are used) (☞ Page 41 Motion Setting)
4. Write the set parameters to the controller. (☞ Page 49 Writing Parameters)

Precautions

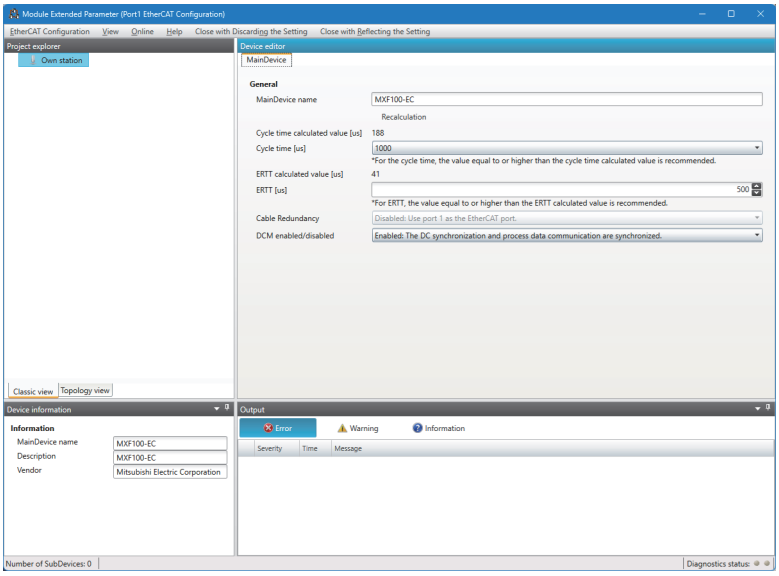
The motion system supports the following driver control modes, and the drive unit connected to the motion system needs to support cyclic synchronous position mode (csp).

Driver control mode	AxisName.Md.Driver_Mode	Description
Homing mode (hm)	6: hm	Executes homing operation by a driver.
Cyclic synchronous position mode (csp)	8: csp	Executes control following the sequential position command from the controller in each communication cycle.
Cyclic synchronous velocity mode (csv)	9: csv	Executes control following the velocity command from the controller in each communication cycle.
Cyclic synchronous torque mode (cst)	10: cst	Executes control following the torque command from the controller in each communication cycle.

4.1 Setting Module Extended Parameters

1. Open the module extended parameters (EtherCAT Configuration).

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port1: EtherCAT)] ⇨ [Module Extended Parameter]



Point

- This chapter describes only the settings required for communication. Adjust the setting details according to the functions and environment used. For details on the various settings, refer to the following.

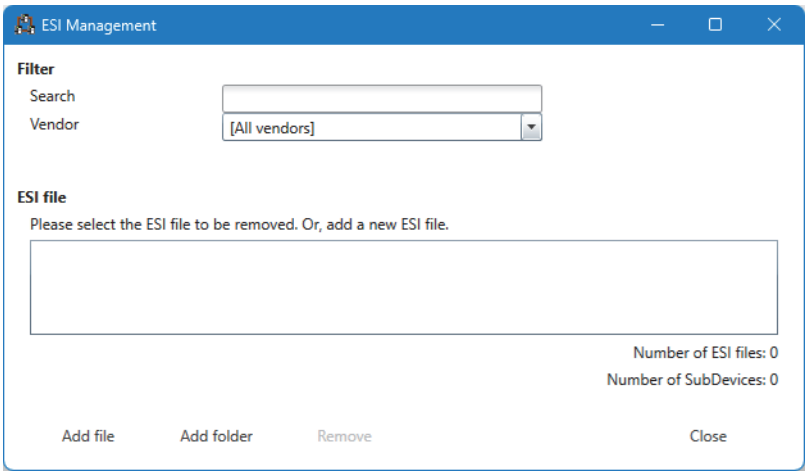
☞ Page 109 MODULE EXTENDED PARAMETERS (EtherCAT CONFIGURATION)

- After configuring the settings, click "Close with Reflecting the Setting" to close the module extended parameters (EtherCAT Configuration).

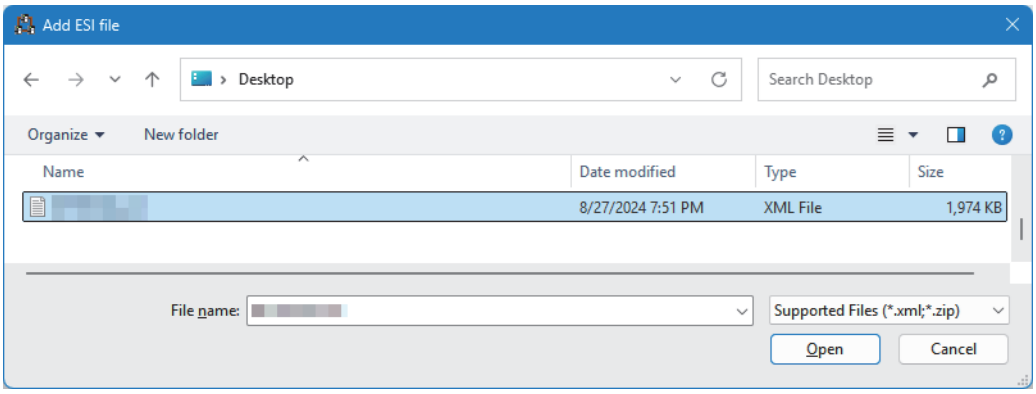
Registering ESI files (first time only)

Register the ESI files of the SubDevices and the modules to be connected to the controller.

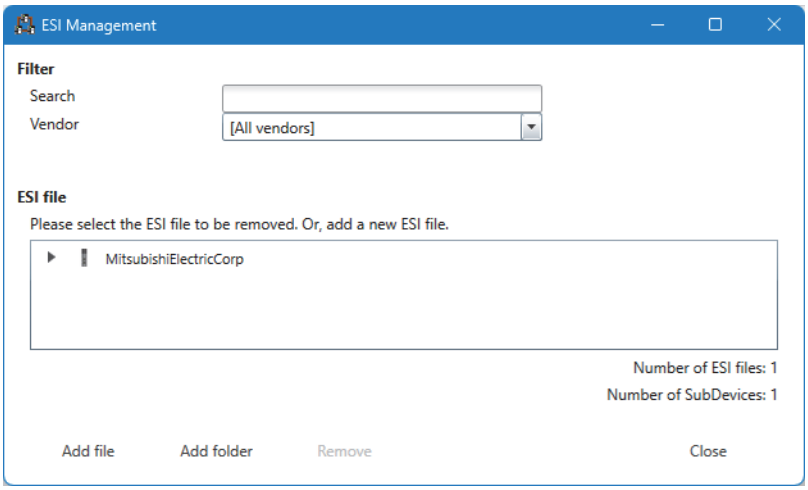
[EtherCAT Configuration] ⇨ [ESI Management]



1. Click the [Add file] button in the "ESI Management" window. (To add a folder, click the [Add folder] button.)
2. Specify the ESI file to be registered and click the [Open] button to start the registration.



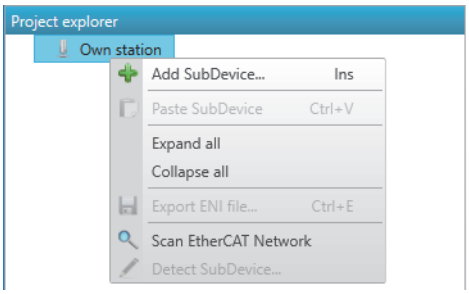
3. When the registration is completed, the ESI file added to the "ESI Management" window will be displayed.



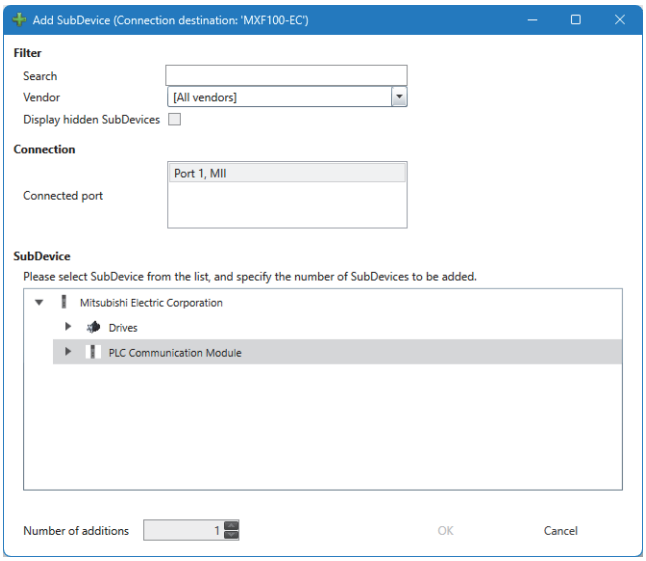
Adding SubDevices

Add a SubDevice to the module extended parameters (EtherCAT Configuration).

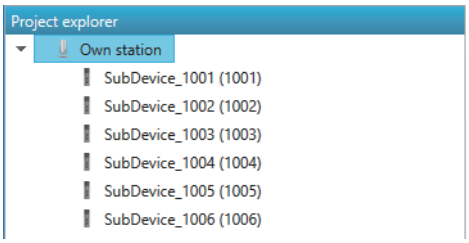
1. Right-click the "Own station" or the SubDevice in the "Project explorer" window and click "Add SubDevice".



2. In the following window, specify the SubDevices and the number to be added and click the [OK] button.



3. The SubDevices are added to the "Project explorer" window.



Point

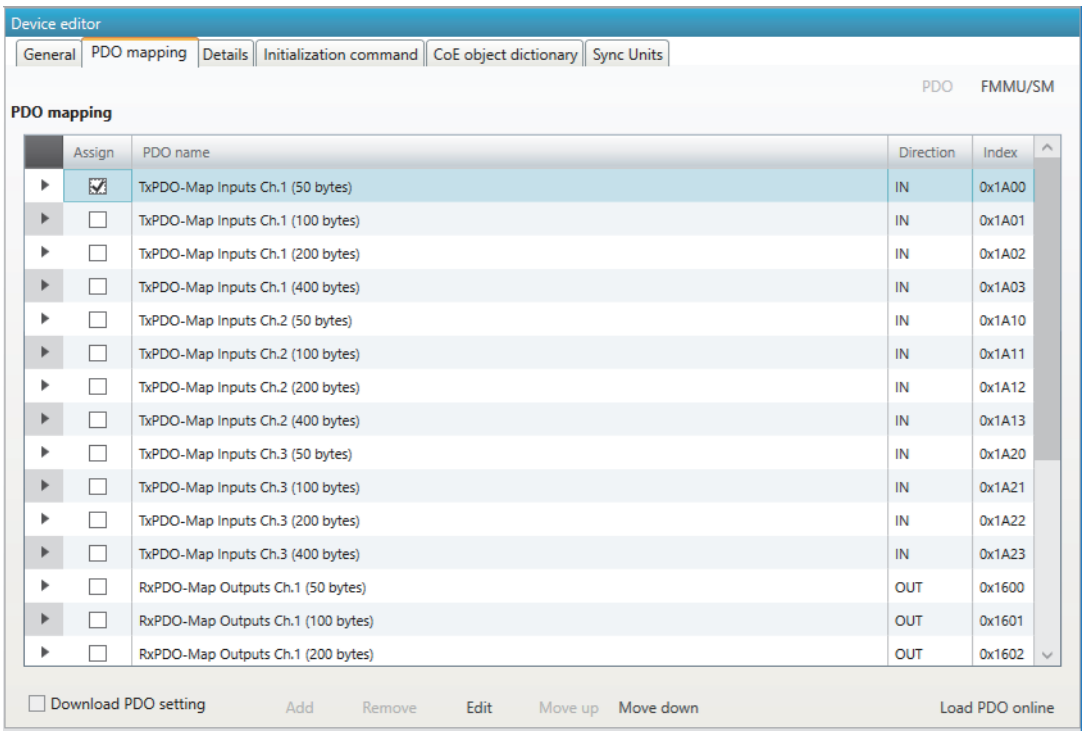
- Adding SubDevices also sets the topology. Therefore, in the connection process, follow the order displayed in the "Project explorer" window. To change the order of SubDevices, select the SubDevice to be moved, and perform [Cut SubDevice] → [Paste SubDevice].
- When a SubDevice is added, a node address is set. Use the node address for EtherCAT communication. The node address that is set in the module on the SubDevice side is not used for EtherCAT communication.

PDO settings

Configure settings using the PDO registered in the SubDevice.

1. Select the checkboxes of "Assign" for PDOs to be used from the PDO mapping of the SubDevice.

SubDevice ⇨ "Device editor" window ⇨ [PDO mapping] tab



2. Check the parameters of the SubDevices and the modules, and change them if necessary.

☞ Page 128 SubDevice and Module Settings

3. Check the MainDevice parameters and change them if necessary.

☞ Page 120 MainDevice Setting

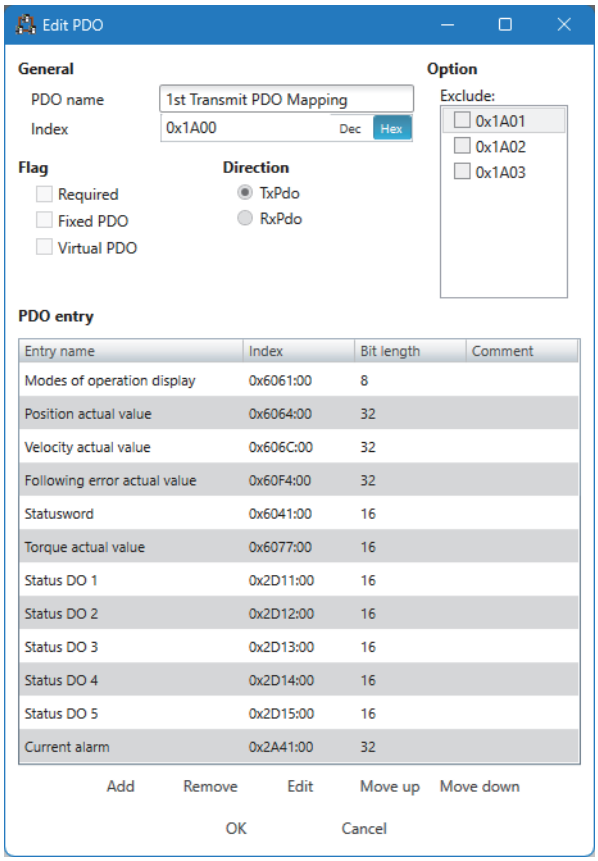
For the settings required for each function, refer to the description of each function.

When using the motion functions

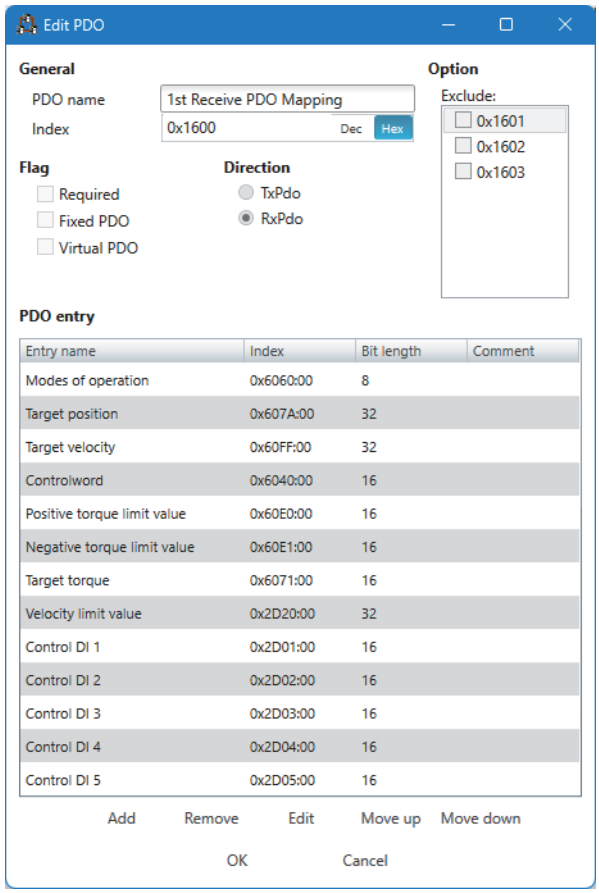
This section describes the settings to use the motion functions.

SubDevice ⇨ "Device editor" window ⇨ [PDO mapping] tab ⇨ Select the PDO to use ⇨ [Edit]

■TxPDO setting example



■RxPDO setting example



Point

Configure the settings so that the total size of each TxPDO and RxPDO is within 40 words. If the size exceeds 40 words, an error will be detected.

Even an entry with a bit length of 8 occupies one word.

■TxPDO

○: Can be set (recommended), —: Cannot be set

Entry name[*1]	Index	Data type	Bit length	Setting		Description
				MELSERVO	Other than MELSERVO	
Modes of operation display	0x6061: 00	SINT	8	Required	Required	Acquires the current control mode of the drive unit.
Position actual value	0x6064: 00	DINT	32	Required	Required	Acquires the current position in the command unit of the drive unit.
Velocity actual value	0x606C: 00	DINT	32	○	○	Acquires the current speed of the drive unit. The speed unit changes depending on the combination of the servo motor and the position data unit set in the drive unit. If this object is not set, the following restrictions will be applied during speed control. • The motor speed received from the drive unit at control mode switching is not used. (The speed initial value is 0.) • The velocity commanded to the drive unit immediately after control mode switching is "0: Command velocity".
Following error actual value	0x60F4: 00	DINT	32	○	○	Acquires the droop pulses of the drive unit.
Statusword	0x6041: 00	UINT	16	Required	Required	Acquires the PDS status transition of the drive unit and other drive unit statuses.
Torque actual value	0x6077: 00	INT	16	○	○	Acquires the current torque of the drive unit. If this object is not set, the feedback torque received from the drive unit at control mode switching is not used. The torque initial value is 0.
Status DO 1	0x2D11: 00	UINT	16	○	—	Acquires the output device status of the drive unit. If MELSERVO is used and this object is not set, or MELSERVO is not used, the following restriction will be applied. • When the absolute position system is used, the motion system cannot detect whether the drive unit loses the home position. Therefore, if the drive unit loses the home position, it may be restored to an incorrect position when the motion system power is turned on again or reset. If an alarm related to the loss of absolute position occurs in the drive unit, execute homing.
Status DO 2	0x2D12: 00	UINT	16	○	—	Acquires the output device status of the drive unit. If MELSERVO is used and this object is not set, or MELSERVO is not used, the following restriction will be applied. • If the axis is stopped with MC_Stop while MC_MoveVelocity/ MC_TorqueControl is being executed, Done may turn on before the motor stops. To check that the motor has stopped, refer to object data_VelActualValue[*3] (AxisName.Md.Io_VelActualValue) and check that the speed is 0.
Status DO 3	0x2D13: 00	UINT	16	○	—	Acquires the output device status of the drive unit.

Entry name[*1]	Index	Data type	Bit length	Setting		Description
				MELSERVO	Other than MELSERVO	
Status DO 4	0x2D14: 00	UINT	16	○	—	Acquires the output device status of the drive unit. If MELSERVO is used and this object is not set, or MELSERVO is not used, the following restriction will be applied. • Multi-axis graphs are not available in the engineering tool (MR Configurator2).
Status DO 5	0x2D15: 00	UINT	16	○	—	Acquires the output device status of the drive unit.
Current alarm	0x2A41: 00	UDINT	32	○	—	Acquires the latest alarm occurred in the drive unit. If this object is not set, axis monitor data (AxisName.Md.DriverErrorID) will not be reflected when an alarm occurs in the drive unit.
Error code[*2]	0x603F: 00	UINT	16	Not required (When Current alarm is set)	○	Acquires the latest alarm occurred in the drive unit. If this object is not set, axis monitor data (AxisName.Md.DriverErrorID) will not be reflected when an alarm occurs in the drive unit.

*1 The name is displayed as defined in the ESI file. Therefore, it may differ depending on the drive unit used.

*2 Drive unit error detail code (AxisName.Md.DriverErrorDetailID) of the axis monitor data cannot be used when Error code is mapped.

*3 It is unavailable when Velocity actual Value (0x606C:00) is not mapped. The monitor value fluctuates slightly even after the motor has stopped.

■RxPDO

○: Can be set (recommended), —: Cannot be set

Entry name[*1]	Index	Data type	Bit length	Setting		Description
				MELSERVO	Other than MELSERVO	
Modes of operation	0x6060: 00	SINT	8	Required	Required	Sets the control mode to the drive unit.
Target position	0x607A: 00	DINT	32	Required	Required	Sets the position command that is used in cyclic synchronous position mode (csp) to the drive unit.
Target velocity	0x60FF: 00	DINT	32	○	○	Sets the velocity command that is used in cyclic synchronous velocity mode (csv) to the drive unit. If this object is not set, speed control cannot be used.
Controlword	0x6040: 00	UINT	16	Required	Required	Sets the PDS status switching direction and the drive unit control direction to the drive unit.
Positive torque limit value	0x60E0: 00	UINT	16	○	○	The torque generated by the servo motor or the thrust generated by the linear servo motor can be limited. It sets the following limit value: the torque for the CCW power running/CW regeneration of the servo motor or the thrust for positive direction power running/negative direction regeneration of the linear servo motor. If this object is not set, the torque limit value is not sent to the driver. For the torque limit value used in the driver, refer to the manual for the driver used.

Entry name[*1]	Index	Data type	Bit length	Setting		Description
				MELSERVO	Other than MELSERVO	
Negative torque limit value	0x60E1: 00	UINT	16	○	○	The torque generated by the servo motor or the thrust generated by the linear servo motor can be limited. It sets the following limit value: the torque for CW power running/CCW regeneration of the servo motor or the thrust for negative direction power running/ positive direction regeneration of the linear servo motor. If this object is not set, the torque limit value is not sent to the driver. For the torque limit value used in the driver, refer to the manual for the driver used.
Target torque	0x6071: 00	INT	16	○	○	Sets the torque command that is used in cyclic synchronous torque mode (cst) to the drive unit. If this object is not set, torque control cannot be used.
Velocity limit value	0x2D20: 00	UDINT	32	○	—	Sets the speed limit value that is used in cyclic synchronous torque mode (cst) to the drive unit. If MELSERVO is used and this object is not set, or MELSERVO is not used, the following restrictions will be applied. • Velocity limit in cst cannot be set using LimitVelocity. • The command torque is changed to 0 when a stop cause occurs. • Continuous operation to torque control (ct) cannot be used.
Control DI 1	0x2D01: 00	UINT	16	○	—	Sets the input device status to the drive unit.
Control DI 2	0x2D02: 00	UINT	16	○	—	Sets the input device status to the drive unit.
Control DI 3	0x2D03: 00	UINT	16	○	—	Sets the input device status to the drive unit.
Control DI 4	0x2D04: 00	UINT	16	○	—	Sets the input device status to the drive unit. If MELSERVO is used and this object is not set, or MELSERVO is not used, the following restriction will be applied. • Multi-axis graphs are not available in the engineering tool (MR Configurator2).

Entry name*1	Index	Data type	Bit length	Setting		Description
				MELSERVO	Other than MELSERVO	
Control DI 5	0x2D05: 00	UINT	16	○	—	Sets the input device status to the drive unit. If MELSERVO is used and this object is not set, or MELSERVO is not used, the following restrictions will be applied. • The upper limit signal (FLS)/lower limit signal (RLS) cannot be input to the drive unit via the motion system. • If the motion system detects a limit signal (AxisName.Md.HwStrokeLimit_FlsStatus/ AxisName.Md.HwStrokeLimit_RlsStatus), the motor will stop with a stop command from the motion system. Therefore, there is a delay compared to the case when FLS/RLS is input directly to the drive unit. When using the stop function with FLS/RLS, wire the limit signal directly to the drive unit. • MC_Home cannot input the dog signal to the drive unit via the motion system. When using the homing method with the dog signal, wire the dog signal directly to the drive unit.

*1 The name is displayed as defined in the ESI file. Therefore, it may differ depending on the drive unit used.

Distributed clock settings

When using the motion functions, set "DC for synchronization" as the operation mode. (☞ Page 93 Distributed Clock Function)

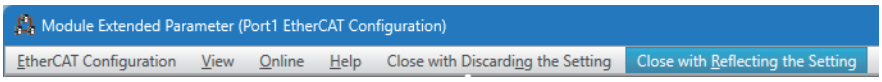
Otherwise, an error will occur.

The operation mode name is displayed as defined in the ESI file. Therefore, the name may differ depending on the SubDevice.

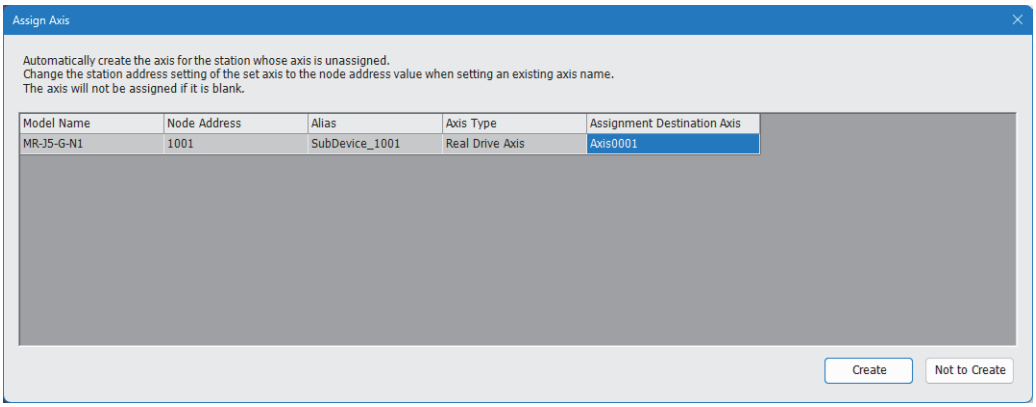
Automatic axis generation

If the drive unit is set as a SubDevice, the axis can be generated automatically.

1. Configure the settings, then click "Close with Reflecting the Setting".



2. Check information on the axis to be generated, then click [Create].



4.2 Setting Network Labels

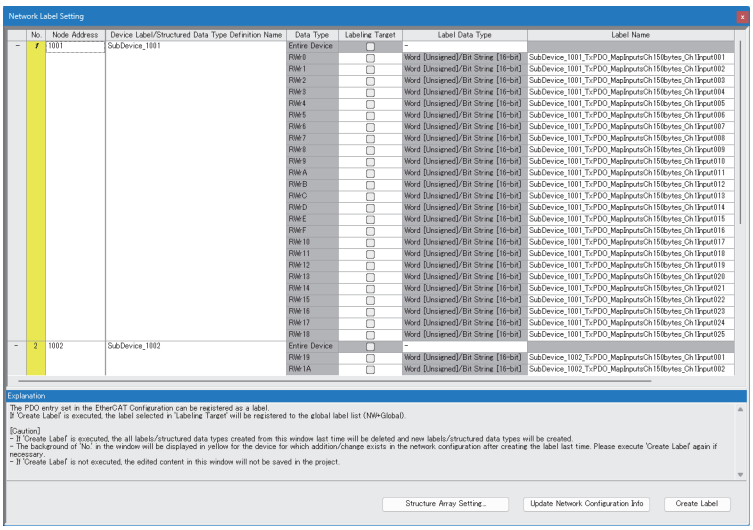
Set the network labels of the EtherCAT port.

Label programming is possible for each EtherCAT index.

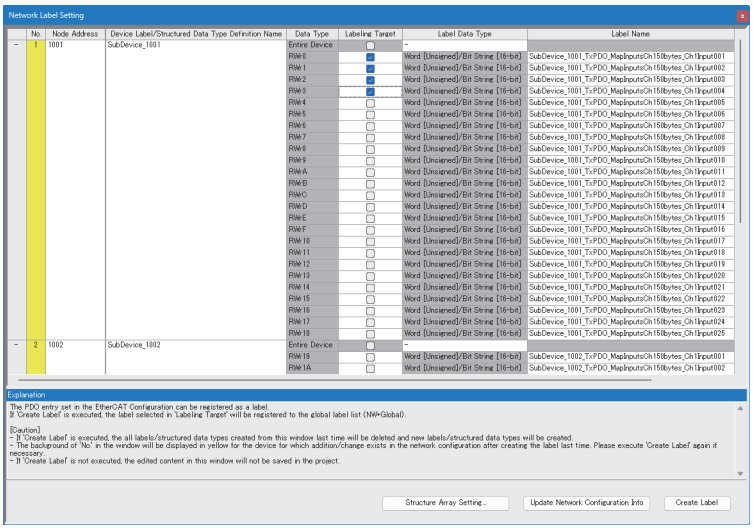
When not using a structure array

1. Click [Update Network Configuration Info] in the "Network Label Setting" window.

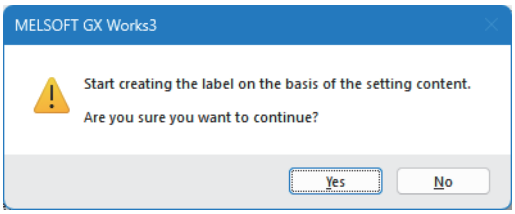
Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port1: EtherCAT)] ⇨ [Network Label Setting]



2. Insert a check in "Labeling Target" for the index where a label is to be generated.

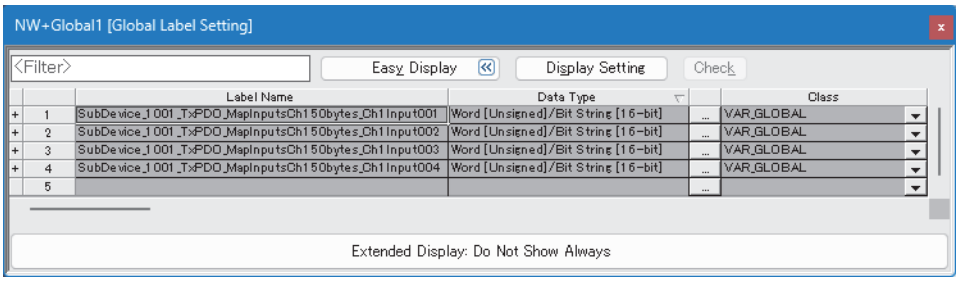


3. Click [Create Label] to generate a label.



4. The generated label is displayed in the global label list.

Navigation window ⇨ [Label] ⇨ [Global Label] ⇨ [NW+Global1]



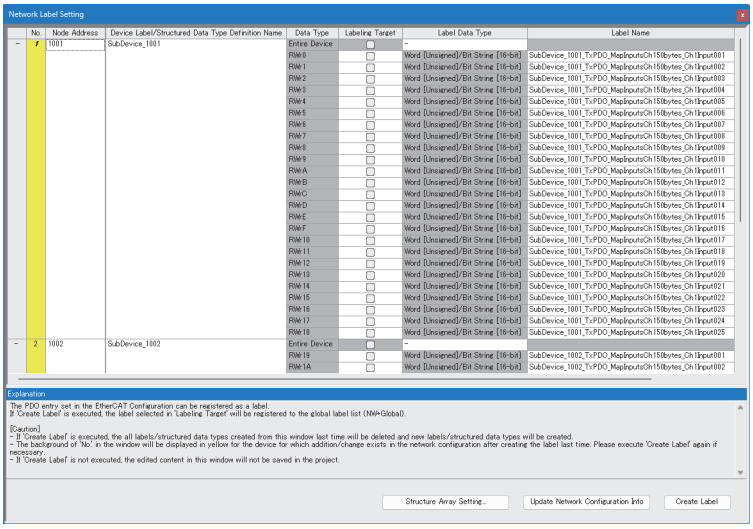
Point

For labels used in motion control, generate them, then select the "Access from External Device" check box.

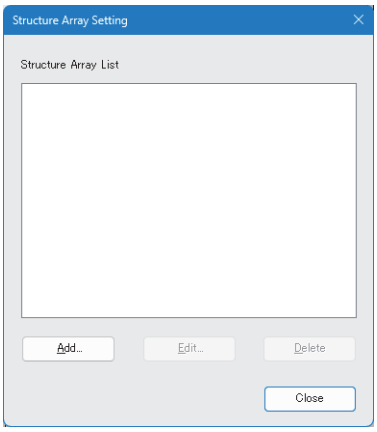
When using a structure array

1. Click [Update Network Configuration Info] in the "Network Label Setting" window.

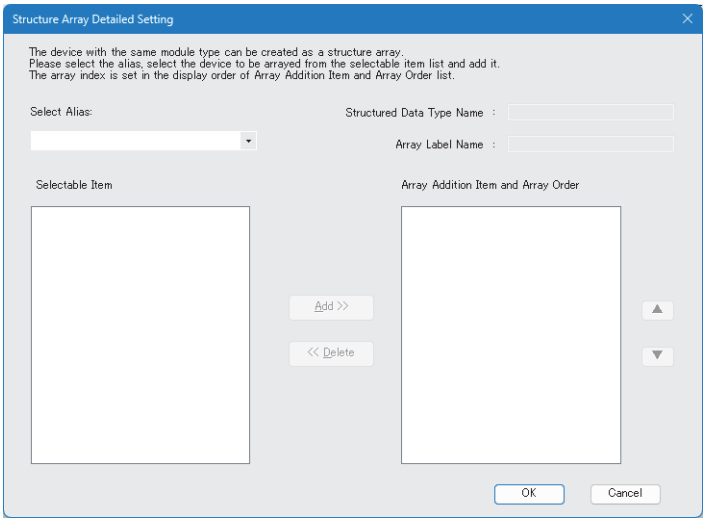
Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port1: EtherCAT)] ⇨ [Network Label Setting]



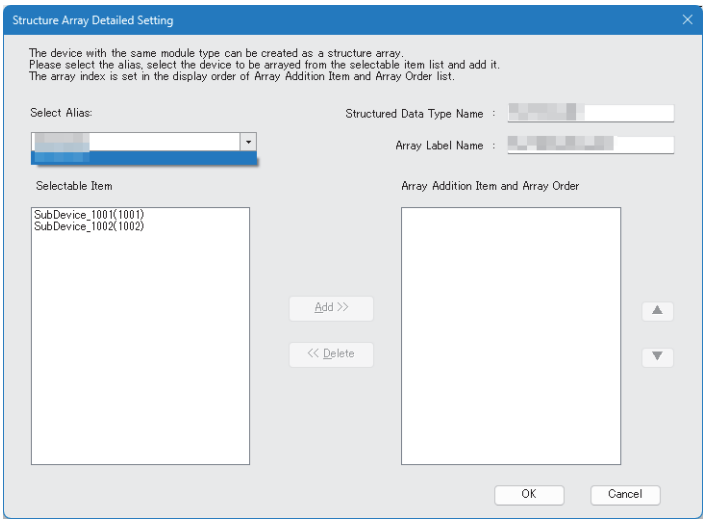
2. Click [Structure Array Setting] to display the "Structure Array Setting" window.



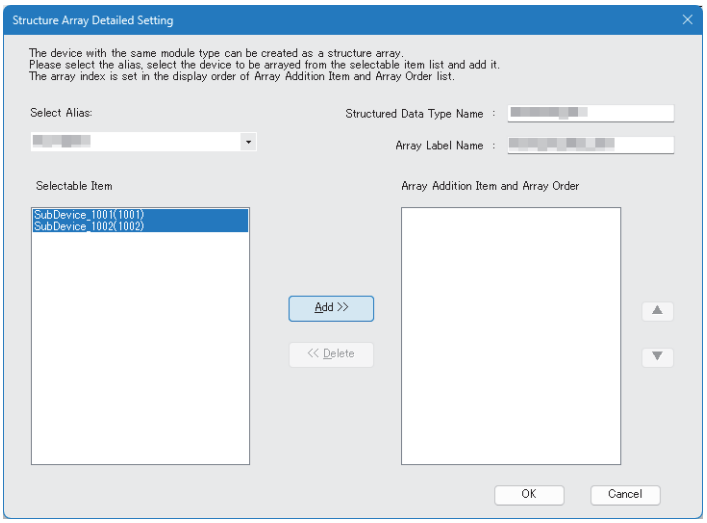
3. Click [Add] to display the "Structure Array Detailed Setting" window.



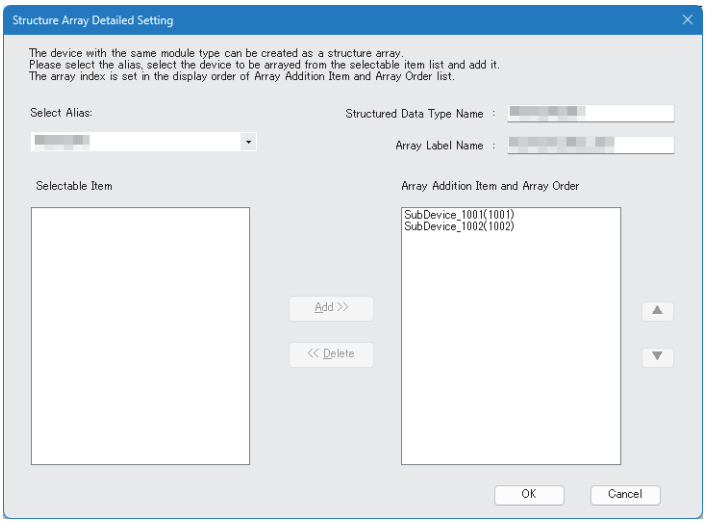
4. Select the device to be added from "Select Alias".



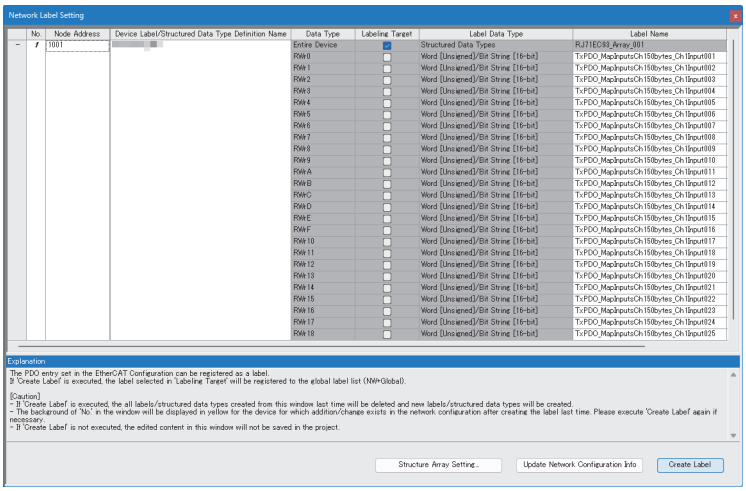
5. Select the item to be added from "Selectable Item", then click [Add].



6. Click [OK] to close the window.

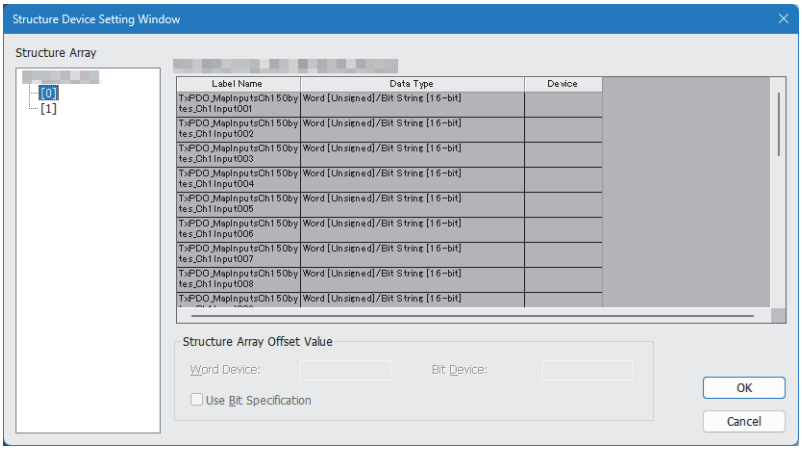


7. Click [Create Label] in the "Network Label Setting" window to generate a label.



8. The generated label is displayed in the global label list.

Navigation window ⇨ [Label] ⇨ [Global Label] ⇨ [NW+Global1]



Point

For labels used in motion control, generate them, then select the "Access from External Device" check box.

4.3 Motion Setting

Set parameters to use the motion functions.

Point

For connection with MELSERVO, refer to the following.

☞ Page 227 Connection with MELSERVO

Motion system setting

Navigation window ⇨ [Motion Setting] ⇨ [Motion System Setting]

Setting Item

Item	Setting
Motion System Parameter Constant	
Excluded Warning	
For Manufacturer Setting	0000
Operation Cycle Setting[1]	
Number of Cycle Over Warning Detections	1
Number of Cycle Over Error Detections	5
Cycle Over Error Selection	3:Moderate Error
Profile Root Drive	/rom
PLC Ready Interlock Selection	1:Interlock with PLC function
Working Counter Error Detection Level	4
Motion System Parameter	
All Axes Forced Stop Signal	
Signal	
Target	
Signal Detection Method	0:Detection at TRUE
Compensation Time	0.0 s
Filter Time	0.0 s
Stop Selection at All Axes Stop Cause Occurr	3:Alternative Acceleration/Deceleration
Deceleration at All Axes Stop	0.0

Working counter error detection level

No data is received from the drive unit when a working counter (WKC) error occurs. Set MotionSystem.PrConst.WorkingCounterErrorDetectionLevel for the number of communication cycles during the time from when a WKC error occurs on the network until the motion system detects the working counter error.

Point

The presence or absence of WKC errors can be checked with SubDevice error status bit 6 (Invalid input data).

If a working counter error is detected during operation, the error stop processing will be performed. When a working counter error is detected, remove the cause of the WKC error and execute the axis error reset.

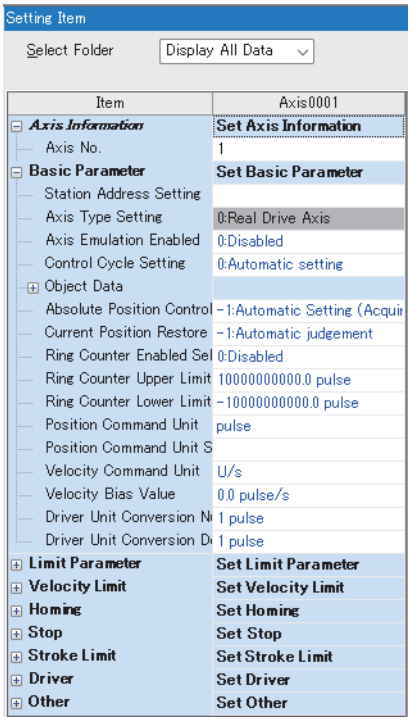
If the control mode is homing mode (hm), cyclic synchronous velocity mode (csv), or cyclic synchronous torque mode (cst), the under-control FB will end without switching the control mode to cyclic synchronous position mode (csp).

Precautions

If a WKC error occurs during initial communication with a SubDevice, the current position will not be restored.

Axis parameter

Navigation window ⇨ [Axis]



Axis type setting

Specify "Real Drive Axis" or "Real Encoder Axis".

When an axis is automatically generated from the module extended parameter, the settings at the time of generation are reflected. (☞ Page 35 Automatic axis generation)

Axis type	Description
Real Drive Axis	Outputs commands using a servo amplifier connected to EtherCAT.
Real Encoder Axis	Generates the current position from the output pulses of the synchronous encoder which is connected to a servo amplifier on EtherCAT.

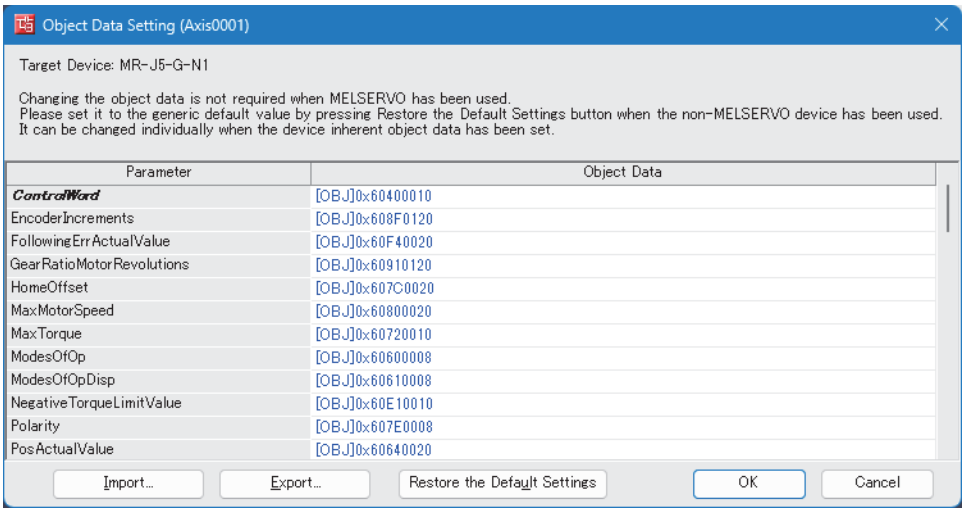
Station address setting

Set the node address assigned in the module extended parameter.

When an axis is automatically generated from the module extended parameter, the settings at the time of generation are reflected. (☞ Page 35 Automatic axis generation)

Object data settings

[Object Data] ⇨ [+] ⇨ Target object ⇨ [...]



This operation is not required when MELSERVO is used as a SubDevice.

If anything other than MELSERVO is used, set the general default value with [Restore the Default Settings] and then review the setting value by referring to the following.

Parameter	Setting value (default)		Description
	MELSERVO	Other than MELSERVO	
ControlWord*2	[OBJ]0x60400010*1	[OBJ]0x60400010*1	Requests the drive unit to switch the status.
EncoderIncrements*2	[OBJ]0x608F0120*1	[OBJ]0x608F0120	Acquires the encoder resolution of the drive unit. If the drive unit does not support the object (0x608F: 01), set the encoder resolution of the motor to be used. (0 to 4294967295) When a linear servo motor is connected, set the virtual one-revolution resolution. Example: [CONST]536870912
FollowingErrActualValue*2	[OBJ]0x60F40020*1	[OBJ]0x60F40020*1	Acquires the droop pulses of the drive unit.
GearRatioMotorRevolutions	[OBJ]0x60910120*1	[OBJ]0x60910120	Acquires the servo motor axis speed (numerator) of the drive unit. If the drive unit does not support the object (0x6091: 01), set the electronic gear numerator set in the drive unit. Example: [CONST]1 If the field is left blank, [CONST]1 is assumed to be set.
HomeOffset	[OBJ]0x607C0020*1	[OBJ]0x607C0020	Sets the difference between zero position and homing position of the machine coordinate system in the drive unit. If the drive unit does not support the object (0x607C: 00), leave it as a blank field. If the field is left blank, the difference between zero position and homing position of the machine coordinate system is assumed to be zero.
MaxMotorSpeed*2	[OBJ]0x60800020*1	[OBJ]0x60800020	Acquires the maximum speed of the servo motor from the drive unit. If the drive unit does not support the object (0x6080: 00), set the maximum speed of the motor. For rotary servo motors, the unit is r/min. For linear servo motors, the unit is mm/s. Example (for rotary servo motors): [CONST]3000
MaxTorque	[OBJ]0x60720010*1	[OBJ]0x60720010	Acquires the maximum torque of the servo motor from the drive unit. The field can be omitted (left blank) as it is not used in the motion system.
ModesOfOp*2	[OBJ]0x60600008*1	[OBJ]0x60600008*1	Requests the drive unit to switch the control mode.
ModesOfOpDisp*2	[OBJ]0x60610008*1	[OBJ]0x60610008*1	Acquires the control mode of the drive unit.

Parameter	Setting value (default)		Description
	MELSERVO	Other than MELSERVO	
NegativeTorqueLimitValue	[OBJ]0x60E10010*1	[OBJ]0x60E10010	Sets a negative direction torque limit value to the drive unit. If the drive unit does not support the object (0x60E1: 00), leave it as a blank field. In that case, the following function cannot be used. • Torque limit value change function (MCv_SetTorqueLimit, AxisName.Cd.NegativeTorqueLimitValue)
Polarity	[OBJ]0x607E0008*1	[OBJ]0x607E0008	Acquires the rotation direction of the drive unit. If the drive unit does not support the object (0x607E: 00), set the rotation direction according to the following. • Bit 0(reserved) • Bit 1(reserved) • Bit 2(reserved) • Bit 3(reserved) • Bit 4(reserved) • Bit 5(0: Servo motor CCW rotation with positive torque, 1: Servo motor CW rotation with positive torque) • Bit 6(0: Servo motor CCW rotation at positive speed, 1: Servo motor CW rotation at positive speed) • Bit 7(0: Servo motor CCW rotation in positioning address increase direction, 1: Servo motor CW rotation in positioning address increase direction) Example: (Bit 5 = 1, Bit 6 = 1, Bit 7 = 1). [CONST]224 If the field is left blank, [CONST]0 is assumed to be set.
PosActualValue*2	[OBJ]0x60640020*1	[OBJ]0x60640020*1	Acquires the current position of the drive unit.
PosEncoderResolution*2	[OBJ]0x608F0008*1	[OBJ]0x608F0008	Acquires the number of data items related to the encoder resolution from the drive unit. If the drive unit does not support the object (0x608F: 00), set [CONST]2.
PosEncoderResolutionMotorRevolutions*2	[OBJ]0x608F0220*1	[OBJ]0x608F0220	Acquires the number of physical pulses per rotation of the encoder (PPR/CPR) from the drive unit. If the drive unit does not support the object (0x608F: 02), set [CONST]1.
PositiveTorqueLimitValue	[OBJ]0x60E00010*1	[OBJ]0x60E00010	Sets a positive direction torque limit value to the drive unit. If the drive unit does not support the object (0x60E0: 00), leave it as a blank field. In that case, the following function cannot be used. • Torque limit value change function (MCv_SetTorqueLimit, AxisName.Cd.PositiveTorqueLimitValue)
ShaftRevolutions	[OBJ]0x60910220*1	[OBJ]0x60910220	Sets the drive axis speed (denominator) of the drive unit. If the drive unit does not support the object (0x6091: 02), set the electronic gear denominator set in the drive unit. Example: [CONST]1 If the field is left blank, [CONST]1 is assumed to be set.

Parameter	Setting value (default)		Description
	MELSERVO	Other than MELSERVO	
SiUnitPos	[OBJ]0x60A80020[*1]	[OBJ]0x60A80020	Acquires the SI unit position of the drive unit. If the drive unit does not support the object (0x60A8: 00), set the position data unit of the drive unit according to the following. ■Bit 31-24 Set the magnification. • 0x00: $\times 10^{0}$ • 0xFF: $\times 10^{-1}$ • 0xFE: $\times 10^{-2}$ • 0xFD: $\times 10^{-3}$ (m) • 0xFA: $\times 10^{-6}$ (μ) • 0xF7: $\times 10^{-9}$ (n) ■Bit 23-16 Set the numerator unit. • 0x00: pulse • 0x01: m • 0x41: degree • 0xB4: revolution • 0xC0: inch ■Bit 15-8 Set the denominator unit. • 0x00: Dimensionless unit ■Bit 7-0 reserved
			The following shows setting examples. If the corresponding unit is not listed, refer to CiA402 SI unit position. • [CONST]0x00010000 (m) • [CONST]0xFD010000 (mm) • [CONST]0xFA010000 (μm) • [CONST]0xF7010000 (nm) • [CONST]0x00B40000 (revolution) • [CONST]0x00410000 (degree) • [CONST]0xFA410000 ($\times 10^{-6}$ degree) • [CONST]0x00000000 (pulse) • [CONST]0x00C00000 (inch) If the field is left blank, [CONST]0x00000000 (pulse) is assumed to be set.

Parameter	Setting value (default)		Description
	MELSERVO	Other than MELSERVO	
SiUnitVel	[OBJ]0x60A90020[*1]	[OBJ]0x60A90020	Acquires the SI unit speed of the drive unit. If the drive unit does not support the object (0x60A9: 00), set the speed unit of the drive unit according to the following. ■Bit 31-24 Set the magnification. • 0x00: $\times 10^{0}$ • 0xFF: $\times 10^{-1}$ • 0xFE: $\times 10^{-2}$ • 0xFD: $\times 10^{-3}$ (m) • 0xFA: $\times 10^{-6}$ (μ) • 0xF7: $\times 10^{-9}$ (n) ■Bit 23-16 Set the numerator unit. • 0x00: pulse • 0x01: m • 0x41: degree • 0xB4: revolution • 0xC0: inch ■Bit 15-8 Set the denominator unit. • 0x03: s • 0x47: min ■Bit 7-0 reserved
			The following shows setting examples. If the corresponding unit is not listed, refer to CiA402 SI unit velocity. • [CONST]0x00010300 (m/s) • [CONST]0xFD010300 (mm/s) • [CONST]0xFA010300 (μm/s) • [CONST]0xF7010300 (nm/s) • [CONST]0x00B44700 (r/min) • [CONST]0x00410300 (degree/s) • [CONST]0xFA410300 ($\times 10^{-6}$ degree/s) • [CONST]0x00000300 (pulse/s) • [CONST]0x00C00300 (inch/s) If the field is left blank, [CONST]0xFEB44700 ($\times 10^{-2}$r/min) is assumed to be set.
StatusWord[*2]	[OBJ]0x60410010[*1]	[OBJ]0x60410010[*1]	Acquires the status of the drive unit.
SupportedDriveModes[*2]	[OBJ]0x65020020	[OBJ]0x65020020	Acquires the control mode supported by the drive unit. If the drive unit does not support the object (0x6502: 00), set the drive unit supported control mode according to the following. Also, if the data set homing method needs to be used with MC_Home, set Bit 5 to zero. • Bit 4-0 (reserved) • Bit 5 (Homing mode (hm)) • Bit 6 (reserved) • Bit 7 (Cyclic synchronous position mode (csp)) • Bit 8 (Cyclic synchronous velocity mode (csv)) • Bit 9 (Cyclic synchronous torque mode (cst)) • Bit 31-10 (reserved) Example: (hm, csp, csv, cst). [CONST]0x000003A0
TargetPos[*2]	[OBJ]0x607A0020[*1]	[OBJ]0x607A0020[*1]	Sets the command position output to the drive unit.
TargetTorque	[OBJ]0x60710010[*1]	[OBJ]0x60710010[*1]	Sets the command torque output to the drive unit. If the field is left blank or the object (0x6071: 00) is not set for PDO mapping, torque control is not available.
TargetVelocity	[OBJ]0x60FF0020[*1]	[OBJ]0x60FF0020[*1]	Sets the command velocity output to the drive unit. If the field is left blank or the object (0x60FF: 00) is not set for PDO mapping, speed control is not available.
TorqueActualValue	[OBJ]0x60770010[*1]	[OBJ]0x60770010[*1]	Acquires the current torque of the drive unit. If the field is left blank or the object (0x6077: 00) is not set for PDO mapping, the torque initial value will be "target torque" regardless of the setting of torque initial value selection.
VelActualValue	[OBJ]0x606C0020[*1]	[OBJ]0x606C0020[*1]	Acquires the current speed of the drive unit. If the field is left blank or the object (0x606C: 00) is not set for PDO mapping, the motor speed received from the drive unit at control mode switching is not used. (The speed initial value is 0.)

Parameter	Setting value (default)		Description
	MELSERVO	Other than MELSERVO	
ControlDi1	[OBJ]0x2D010010*1	—	Set the input device to the drive unit.
ControlDi2	[OBJ]0x2D020010*1	—	
ControlDi3	[OBJ]0x2D030010*1	—	
ControlDi4	[OBJ]0x2D040010*1	—	
ControlDi5	[OBJ]0x2D050010*1	—	
ControlDi6	[OBJ]0x2D060010*1	—	
ControlDi7	[OBJ]0x2D070010*1	—	
CurrentAlarm	[OBJ]0x2A410020*1	[OBJ]0x603F0010	Acquires the alarm occurring in the drive unit. • For MELSERVO: If the object (0x2A41: 00) is not set for PDO mapping, axis monitor data (AxisName.Md.DriverErrorID, AxisName.Md.DriverErrorDetailID) will not be reflected when an alarm occurs in the drive unit. • For Non-MELSERVO: If the object (0x603F: 00) is not set for PDO mapping, axis monitor data (AxisName.Md.DriverErrorID) will not be reflected when an alarm occurs in the drive unit.
EncoderStatus1	[OBJ]0x2D350120*1	—	Acquires the encoder status of the drive unit. If the drive unit does not support the object (0x2D35: 01), the absolute position system settings of the drive unit cannot be acquired. Configure the following settings according to the drive unit settings. [Axis Parameter Setting] → [Basic Parameter] → [Absolute Position Control Setting] • 0 (Disable absolute position system) • 1 (Enable absolute position system) If -1 (Automatic Setting (Acquire from Connected Device)) is set, a connection setting incorrect warning for drive unit will be detected, causing 0 (Disable absolute position system) to be used for operation.
StatusDo1	[OBJ]0x2D110010*1	—	Acquires the output device of the drive unit.
StatusDo2	[OBJ]0x2D120010*1	—	
StatusDo3	[OBJ]0x2D130010*1	—	
StatusDo4	[OBJ]0x2D140010*1	—	
StatusDo5	[OBJ]0x2D150010*1	—	
StatusDo6	[OBJ]0x2D160010*1	—	
StatusDo7	[OBJ]0x2D170010*1	—	
SupportedControlDi1	[OBJ]0x2D000110*1	—	Acquires the input device supported by the drive unit.
SupportedControlDi2	[OBJ]0x2D000210*1	—	
SupportedControlDi3	[OBJ]0x2D000310*1	—	
SupportedControlDi4	[OBJ]0x2D000410*1	—	
SupportedControlDi5	[OBJ]0x2D000510*1	—	
SupportedControlDi6	[OBJ]0x2D000610*1	—	
SupportedControlDi7	[OBJ]0x2D000710*1	—	
SupportedStatusDo1	[OBJ]0x2D100110*1	—	Acquires the output device supported by the drive unit.
SupportedStatusDo2	[OBJ]0x2D100210*1	—	
SupportedStatusDo3	[OBJ]0x2D100310*1	—	
SupportedStatusDo4	[OBJ]0x2D100410*1	—	
SupportedStatusDo5	[OBJ]0x2D100510*1	—	
SupportedStatusDo6	[OBJ]0x2D100610*1	—	
SupportedStatusDo7	[OBJ]0x2D100710*1	—	
VelLimitValue	[OBJ]0x2D200020*1	—	Sets the speed limit value for the drive unit.
EncoderStatus2	[OBJ]0x2D350220*1	—	Acquires the scale measurement encoder status from the drive unit. If the drive unit does not support the object (0x2D35: 02), the drive unit cannot be used as a real encoder axis.

Parameter	Setting value (default)		Description
	MELSERVO	Other than MELSERVO	
ScaleCycleCounter	[OBJ]0x2D360020*1	—	Acquires the position within one revolution of the scale measurement encoder from the drive unit. If the drive unit does not support the object (0x2D36: 00), the drive unit cannot be used as a real encoder axis.
ScaleAbsCounter	[OBJ]0x2D370020*1	—	Acquires the multiple revolution counter of the scale measurement encoder from the drive unit. If the drive unit does not support the object (0x2D37: 00), the drive unit cannot be used as a real encoder axis.
ScaleMeasurementEncoderResolution	[OBJ]0x2D380020*1	—	Acquires the resolution of the scale measurement encoder from the drive unit. If the drive unit does not support the object (0x2D38: 00), the drive unit cannot be used as a real encoder axis.
ScaleMeasurementEncoderReceptionStatus	[OBJ]0x2D3C0020*1	—	Acquires the position within one revolution of the scale measurement encoder from the drive unit. If the drive unit does not support the object (0x2D3C: 00), the drive unit cannot be used as a real encoder axis.

*1 Always use the default value.

*2 If the field is left blank, an object data setting incorrect error will be detected at system startup.

Point

The setting values of object data can be exported to a CSV file, and can also be reflected at once by importing the CSV file.

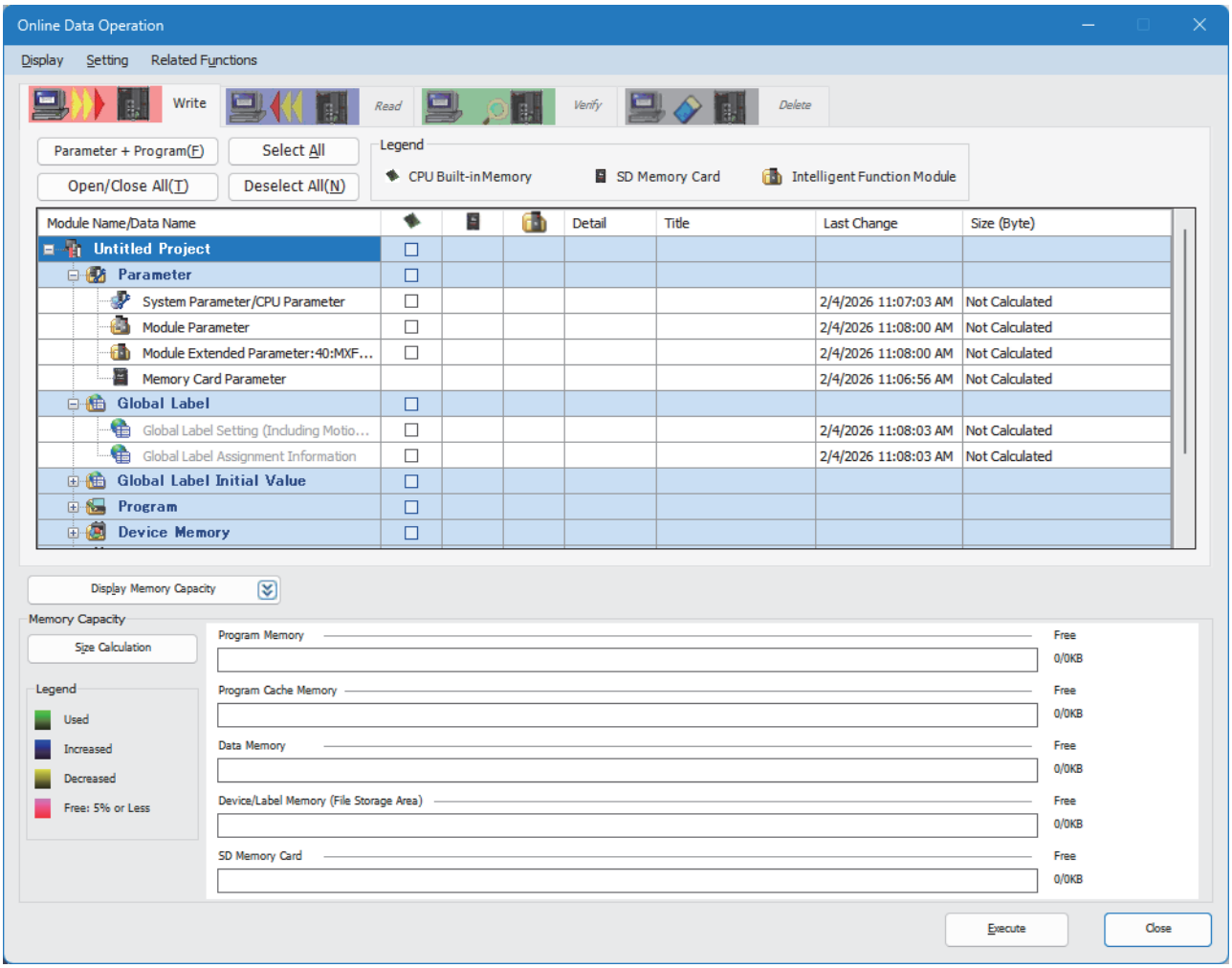
4.4 Writing Parameters

Write the set parameters to the controller.

Operating procedure

1. Select the content to be written in the "Online Data Operation" window, and click the [Execute] button.

[Online] ⇨ [Write to PLC]



2. When writing is complete, a completion message is displayed. Click the [OK] button.

3. Turn the controller power on, and check that no error occurs. Errors can be checked on the LED indicator of the controller or the system monitor of the engineering tool.

5 SPECIFICATIONS

This section describes the controller specifications.
For the MX-F Model I/O module, refer to the following.
MELSEC MX Controller MX-F Model User's Manual

5.1 General Specifications

The general specifications are the same as those of the MX-F Model. For details, refer to the following.
MELSEC MX Controller MX-F Model User's Manual

5.2 Performance Specifications

Performance specifications are shown below.

Item			Description
EtherCAT communication specifications			CAN application protocol over EtherCAT (CoE)
Transmission specifications	Type		100BASE-TX
	Data transmission speed		100Mbps
	Minimum synchronization cycle		250μs
	Communication mode		Full-duplex
	Interface		• P1 (EtherCAT port): RJ45 connector • P2 (Ethernet port): RJ45 connector
	Transmission method		Base band
	Maximum number of connectable stations per network		72
	Maximum station-to-station distance		100m
	Topology		Line topology, star topology
PDO (process data communication)	Maximum number of link points per network	Input	8192 points (8192 words)
		Output	8192 points (8192 words)
	Maximum number of link points per station	Input	8192 points (8192 words)
		Output	8192 points (8192 words)
SDO (mailbox communication)	Size	Input	400 words
		Output	400 words
	Function		SDO Upload, SDO Download
Number of occupied I/O points	Input		• Input terminal: 16 points • EtherCAT function part: 32 points occupied • Motion function part: 32 points occupied
	Output		• Output terminal: 16 points • EtherCAT function part: 32 points occupied • Motion function part: 32 points occupied
Power consumption			• Controller alone: 13.6W or less • Maximum configuration for connection to the controller: 32.0W or less (external 24VDC power supply of extension devices is not included)
External dimensions	Height		90mm
	Width		91mm
	Depth		105mm
Weight			0.45kg

Point

For other specifications, refer to the following. However, the output type is sink output only.
MELSEC MX Controller MX-F Model User's Manual

MEMO

6 FUNCTION LIST

The following table lists the functions of the MX-F Model (Support EtherCAT).

Item	Description	Reference
EtherCAT communication function	This function is related to EtherCAT communication.	Page 52 EtherCAT Communication Function
Motion control	This function is related to motion control.	Page 53 Motion Control
Programming	This function is related to the programming languages that can be used and the data used in the program.	Page 55 Programming
I/O control and high-speed input/output function	This function is related to I/O control and high-speed input/output.	Page 55 I/O Control and High-Speed Input/Output Function
Positioning function	This function is related to positioning control.	Page 56 Positioning Function
Analog function	This function is related to the analog adapter that connects to the controller.	Page 57 Analog Function
Ethernet	This function is related to the Ethernet port of the controller.	Page 59 Ethernet
Serial communication	This function is related to serial communication of the controller.	Page 60 Serial Communication Function
Online operation (debug, monitor)	This function is related to online operations such as debugging and monitoring.	Page 60 Online Operation (Debug, Monitor)
Data collection	This function is related to data collection.	Page 61 Data Collection
Security	This function is related to prevention of unauthorized access and tampering.	Page 61 Security
Maintenance/troubleshooting	This function is related to controller maintenance and troubleshooting.	Page 62 Maintenance/Troubleshooting

6.1 EtherCAT Communication Function

Item	Description	Reference
Process data communication (PDO communication)	Performs periodic data communication between the controller and the SubDevice using PDO.	Page 65 Process Data Communication (PDO Communication)
Mailbox communication (SDO communication)	Use SDO to perform non-periodic data communication from the controller to the SubDevice.	Page 69 Mailbox Communications (SDO Communications)
ESM state change function	Controls the ESM state of the MainDevice and SubDevices using the buffer memory.	Page 80 ESM State Change Function
Sync unit function	Groups SubDevices and enables independent data exchange between them.	Page 85 Sync Unit Function
Communication between SubDevices function	Performs data exchange between SubDevices without data processing by the MainDevice (data transfer by a program).	Page 89 Communication Between SubDevices Function
Distributed clock function	Performs time synchronization for all EtherCAT devices (MainDevices and SubDevices) that are connected in EtherCAT and support the distributed clock.	Page 93 Distributed Clock Function
Redundancy function	Increases network redundancy by creating a ring topology in the EtherCAT system, including the controller, allowing communication to be maintained in the event of a cable or device failure.	Page 100 Redundancy Function
Hot Connect function	Hot Connect allows SubDevices to be added or removed from an active system in the EtherCAT network.	Page 101 Hot Connect Function
Output hold clear setting	Holds or clears the output on the sending side when the controller CPU or motion function is changed to STOP or when a stop error occurs.	Page 104 Output Hold Clear Setting Function
Connection retry setting at startup	Sets the connection retry method and connection retry time when communication with a SubDevice fails during the controller startup.	Page 106 Connection Retry Setting at Startup

6.2 Motion Control

For details on the functions, refer to the following.

MELSEC MX Controller MX-F Model User's Manual

Point

The motion control function specifications differ from those of the MX-F Model. (☞ Page 63 Function Comparison)

Function		Description
Axis management	Technical units	Set the position command unit and the velocity command unit used in the motion control for the unit setting. Since the unit can be specified freely depending on the control target, intuitive programming and monitoring are available.
	Servo ON/OFF	Executes servo ON/OFF of the real axis connected to a motion system. The real axis can be operated by servo ON.
	Follow up	Reflects the input (current position) from the axis-assigned SubDevice in the set position of the axis.
	Absolute position control	Restores the current position of an axis.
Operation cycle		In a motion system, operation processing related to motion control is performed in the fixed cycle (motion operation cycle).
Start and stop	Start	Starts motion control.
	Retrigger/continuous update	Changes the control of the ongoing FB with a retrigger/continuous update. With a retrigger/continuous update of the FB, input variables can be imported again to the ongoing FB instance without interrupting operation.
	Multiple start (buffer mode)	Executes multiple motion control FBs continuously without stopping by executing the motion FB of another instance to the axis and the axes group that are executing the motion control FB.
	Stop	Stops motion control.
	Forced stop	Stops axes by the forced stop signal.
Homing	Driver homing method	Switches the driver to Homing mode, and executes the homing based on the positioning pattern set on the driver side.
	Data set homing method	Executes homing to a virtual axis and a real axis that does not have home position information on the SubDevice side. It is completed in a motion system, and external signals or other functions are not used.
Axis control	Single axis positioning control	Executes positioning to the specified position by using address information.
	Single axis speed control	Executes the speed control for the specified axis with the specified speed.
	Single axis manual control	Executes the random positioning operation by inputting a signal from an external device.
	Multiple axes positioning control	Uses address information and executes positioning to the specified position using interpolation control.
Direct control	Absolute position follow-up control	Changes the target position of the absolute position by restart/continuous update, and performs positioning control without completing the instruction.
	Velocity control	Switches the driver control mode to csv (cyclic synchronous velocity mode), and performs the control excluding the position loop.
	Torque control	Switches the driver control mode to cst (cyclic synchronous torque mode), and performs the control.
Motion cyclic control	Motion cyclic positioning control	Switches the control mode of the drive unit to csp (cyclic synchronous position mode), and sends the target position.
	Motion cyclic velocity control	Switches the control mode of the drive unit to csv (cyclic synchronous velocity mode), and sends the target velocity.
	Motion cyclic torque control	Switches the control mode of the drive unit to cst (cyclic synchronous torque mode), and sends the target torque.
Synchronous control	Cam operation	Operates by synchronizing the slave axis with the master axis based on cam table.
	Gear operation	Sets the speed ratio between the master axis and the slave axis, and starts gear operation.
	Addition/subtraction positioning	Combines the movement amount of two axes and transmits.
Operation profile data		Performs opening profile for the cam and reading/writing for the cam.
Advanced synchronous control		Advanced synchronous control can be achieved using software instead of controlling mechanically with gears, clutches, speed change gears, cams, or others.

Function			Description
Functions related to position	Current position change function		Changes the set position and cumulative current position to any address.
	Command in-position		Checks the remaining distance to the target position, and turns the command in-position flag to TRUE. The command in-position flag is used as an advance signal indicating the completion of the control beforehand.
	Software stroke limit		Sets an address as the movable range. Even if a movement command to the address outside the setting range is issued, the command will not be executed. By not executing the command outside the movable area, even if an incorrect command or unexpected operation occurs, the system will not operate out of the movable area and damage to the machine can be prevented.
	Hardware stroke limit		Limit switches are set at the upper/lower limit of the physical movable range, and the control is stopped by the input of a signal from the limit switch. Damage to the machine can be prevented by stopping the control before the upper/lower limit of the physical movable range is reached.
Functions related to speed	Acceleration/deceleration processing function		Adjusts the acceleration/deceleration of each motion control to the acceleration/deceleration curve suitable for device.
	Velocity limit		Limits the command velocity to a value within the velocity limit value setting range when the command velocity during control exceeds the velocity limit value. By limiting the command velocity within the preset range of the velocity limit value, even if an incorrect command or unexpected operation occurs, damage to the machine can be prevented.
	Override function		By setting the override coefficient, the target speed and the target acceleration/deceleration can be changed during control.
Functions related to torque	Torque limit		Limits the generated torque to a value within the torque limit value range when the torque generated in the servomotor exceeds the torque limit value. It controls the operation so that unnecessary force is not applied to the load and machine by limiting the generated torque.
	Torque limit value change function		Changes the torque limit value during control.
Compensation function		Driver unit conversion function	Converts the machine feed value to the driver command value and passes it to the target position (Target position). Also, it converts the current position (Position actual value) of the driver and calculates the actual position.
Command filter		Smoothing filter	Used to suppress load-side vibration, such as work-side vibration and base shake. Frequencies higher than the set frequency can be removed.
		Direction limit filter	Restricts the movement of the slave axis to one direction relative to the movement of the master axis. This helps to avoid reverse operation caused by machine vibration or other factors.
		Speed limit filter	Limits a speed of axis. The speed input by the master axis can be limited to the specific speed and can be output to the slave axis.
		Backlash compensation filter	Compensates amount of mechanical backlash (play). Outputs the extra commands equivalent to the set up backlash compensation amount each time the movement direction changes.
Input variable change in execution			Changes input variables during control. In the control whose start condition is the execution command (Execute), data such as target position (Position) and velocity (Velocity) can be re-imported without interrupting the operation by the execution command (Execute) retrigger.
External signal selection			Sets I/O signals to be used in various control.
Touch probe			Records (latches) any data at trigger input signal detection.
Axis emulate			Performs axis control on the real axis without connecting any SubDevice. When using the emulate function, even if the SubDevice is not connected, the axis can be operated virtually (regarded as it is connected). This function enables debugging of the user program at the start-up of the device and allows for verification of the positioning operation.
Axis control wait			Starts the axis operation of the simultaneously-started motion FBs immediately at the input timing of the execution permission signal.

6.3 Programming

For details on the functions, refer to the following.

MELSEC MX Controller MX-F Model Programming Manual

Function		Description
Programming language	Ladder diagram	A graphic language which describes ladders consisting of contacts and coils.
	Structured text language (ST)	A textual language which describes programs by using statements (such as IF) and operators.
	Function block diagram/ ladder diagram (FBD/ LD)	A graphic language which describes programs by connecting blocks that perform predefined processing, variable elements, and constant elements along the flow of data and signals.
Program setting		Sets the program execution order and execution type.
Constant scan		Repeatedly runs a program while retaining the scan time constant.
Interrupt function	Multiple interrupt function	When an interrupt caused by another factor occurs during the execution of an interrupt program, this function stops the program with the lower priority according to the configured priority, and runs the higher-priority program whenever its execution condition is satisfied.
Device/label memory area setting		Sets the capacity of each area in the device/label memory.
Initial device/label value setting		Sets the initial values of devices and labels used in the program directly (not via the program) to the devices, labels, and buffer memory areas of intelligent function modules.
Latch function		Holds the device/label data in the controller even at power-off.

6.4 I/O Control and High-Speed Input/Output Function

For details on the functions, refer to the following.

MELSEC MX Controller MX-F Model User's Manual

Function	Description
High-speed counter function	The controller's built-in I/O can be used to count the number of high-speed pulse inputs that cannot be counted by a conventional counter.
Pulse width measurement function	The pulse width/cycle for up to 4 channels can be measured from the controller.
Pulse catch function	Allows catching pulse signals that are incompletely sampled in regular input processing.
PWM function	PWM for up to 4 channels can be output from the controller.
General-purpose input function	The input response time can be set using parameters.

6.5 Positioning Function

For details on the functions, refer to the following.

MELSEC MX Controller MX-F Model User's Manual

Function		Description
Homing	Mechanical OPR	The DSZR/DDSZR instruction starts the OPR operation in the direction set by the OPR direction setting. After the speed is reached, the operation will be performed at the specified OPR speed.
	High-speed OPR	The positioning is performed for the home position address established by the mechanical OPR. The OPR can be performed at high speed without using the near-point dog signal and the zero signal.
Positioning control	1-speed positioning	Acceleration is started at the bias speed when pulses are output by the positioning instruction. After the speed has reached the command velocity, the operation will be performed at the command velocity up to the point where deceleration is possible.
	2-speed positioning	1-speed positioning of table 1 is performed by the table operation instruction. After the target position is reached, the 1-speed positioning of table 2 is performed from acceleration/deceleration.
	Multi-speed operation	1-speed positioning operation is continued several times by the table operation instruction. From where deceleration is possible, the last table decelerates and stops.
	Interrupt stop	1-speed positioning is performed by the table operation instruction. When interruption input signal 1 is detected during pulse output operation, the operation decelerates and stops.
	Interrupt 1 speed positioning	Acceleration is started at the bias speed when pulses are output by the positioning instruction. After the speed has reached the command velocity, the operation will be performed at the command velocity.
	Interrupt 2 speed positioning	The variable speed operation of table 1 is performed by the table operation instruction. When the interrupt input signal 2 is turned on, the interrupt 1-speed positioning of table 2 is performed from acceleration/deceleration.
	Variable speed operation	Acceleration is started at the bias speed when pulses are output by the positioning instruction. After the speed has reached the command velocity, the operation will be performed at the command velocity.
	Table operation	A positioning control program can be created with the table set in the engineering tool. The specified table operation is started by the table operation instruction.

6.6 Analog Function

For details on the functions, refer to the following.

MELSEC MX Controller MX-F Model User's Manual

Analog input function

Item		Description
A/D conversion enable/disable setting function		Controls whether to enable or disable the A/D conversion for each channel.
Range switching function		Allows switching the input range of an analog input for each channel. Switching the range makes it possible to change the input conversion characteristics.
A/D conversion method	Sampling processing	Sequentially A/D-converts the analog input values and stores the digital output values in a special register area.
	Averaging processing	Averages the digital output values for each channel and stores the average value in a special register area. The following three types of averaging processing are provided. • Time average • Count average • Moving average
Disconnection detection function		Disconnection can be detected for each channel.
Over scale detection function		Detects analog input values that exceed an input range.
Digital clipping function		Fixes a digital operation value to the maximum or minimum value of digital operation value output range when an input current or voltage exceeds the input range.
Scaling function		Scales the digital output value within a range between the specified scaling upper limit value and scaling lower limit value. This function reduces the time and effort to create a program of the scale conversion.
Warning output function	Process alarm	Outputs a warning when a digital operation value enters the preset alarm output range.
	Rate alarm	Outputs a warning when the change rate of a digital output value is equal to or greater than the rate alarm upper limit value, or equal to or smaller than the rate alarm lower limit value.
Shift function		Adds (shifts) the set conversion value shift amount to the digital output value and stores the result in the digital operation value. When the conversion value shift amount is changed, the change will be reflected in the digital operation value in real time, allowing fine adjustments to be easily performed during system startup.
Convergence detection function		Detects whether the digital operation value is within a certain range for a specified time.
Maximum value/minimum value hold function		Stores the maximum value and minimum value of the digital operation value in a special register area for each channel.
Deviation detection between channel function		Detects whether there is a difference of more than a certain level in digital operation values between channels.
Offset/gain setting function		Corrects errors in digital output value.
Offset/gain initialization function		Initializes the offset and gain values in the built-in memory.
Changing settings in controller operation		Changes the parameters set by the engineering tool by using the special device.
Starting/stopping the analog function in accordance with the controller status		The operation of the analog adapter can be checked by the controller.
Alarm clear request		Clears the alarm code.

Analog output function

Item	Description
D/A conversion enable/disable function	Sets whether to enable or disable the D/A conversion for each channel.
Range switching function	Allows switching the output range of an analog output for each channel. Switching the range makes it possible to change the output conversion characteristics.
Shift function	Adds a set input value shifting amount to a digital value.
Warning output function	Outputs a warning when the digital value exceeds the warning output upper limit value or becomes less than the warning output lower limit value.
Scaling function	Performs scale conversion on digital values within a specified range between a scaling upper limit value and a scaling lower limit value. The program for scale conversion can be omitted.
Analog output HOLD/CLEAR function	Sets whether to hold (HOLD) or clear (CLEAR) the analog output value that was being output when the operation status of the controller is RUN, STOP, or a stop error.
D/A output enable/disable setting function	Specifies whether to output the D/A conversion value or offset value for each channel. The conversion speed is constant, regardless of the output enable/disable status.
Disconnection detection function	Monitors the analog output value and detects a disconnection.
External power supply disconnection detection function	Detects that the external power supply 24VDC is not supplied or is shut off.
Offset/gain setting function	Corrects errors in D/A conversion values for each channel.
Offset/gain initialization function	Initializes the offset and gain values in the built-in memory.
Analog output test when controller is in STOP status function	Analog output tests can be carried out when the controller is in the STOP status.
Changing settings in controller operation	Changes the parameters set by the engineering tool by using the special device.
Starting/stopping the analog function in accordance with the controller status	The operation of the analog adapter can be checked by the controller.
Alarm clear request	Clears the alarm code.

Temperature sensor input

Function list		Description
Conversion enable/disable function		Sets whether to enable or disable the temperature conversion for each channel. Disabling the conversion on unused channels reduces the conversion cycles.
Temperature resistance choice function		A resistance temperature detector type can be selected for each channel. Selecting the resistance temperature detector type sets the input conversion characteristics.
Thermocouple type choice function		A thermocouple type can be selected for each channel. Selecting the thermocouple type sets the input conversion characteristics.
Disconnection detection function		Performs disconnection detection for each channel.
Temperature conversion method	Sampling processing	Executes the temperature conversion on analog input every END processing and stores the result as a measured temperature value in a special register area.
	Averaging processing	Averages measured temperature values for each channel, and stores the average value in a special register area. The following three types of averaging processing are provided. • Time average • Count average • Moving average
Temperature unit choice function		Sets the temperature unit (Celsius/Fahrenheit) for each analog adapter.
Maximum value/minimum value hold function		Stores the maximum and minimum values of measured temperature values in a special register area for each channel.
Warning output function	Process alarm	Outputs an alarm when a measured temperature value enters the preset alarm output range.
	Rate alarm	Outputs an alert when the change of a measured temperature value is equal to or greater than the rate alarm upper limit value, or equal to or smaller than the rate alarm lower limit value.
Offset/gain setting function		Corrects errors in measured temperature value.
Offset/gain initialization function		Initializes the offset and gain values in the built-in memory.
Changing settings in controller operation		Changes the parameters set by the engineering tool by using the special device.
Starting/stopping the analog function in accordance with the controller status		The operation of the analog adapter can be checked by the controller.
Alarm clear request		Clears the alarm code.

6.7 Ethernet

For details on the functions, refer to the following.

MELSEC MX Controller MX-F Model User's Manual

○: Supported, ×: Not supported

Function		Port for EtherCAT	Port for Ethernet	Description
Connection with MELSOFT products and a GOT	Direct connection	×	○	Allows the programming and monitoring using the engineering tool, and monitoring and testing programmable controller from the GOT with Ethernet connection. Remote operation can be performed using the long-distance connectivity and high-speed communications of the Ethernet.
	Specifying IP address	×	○	
	Searching the CPU module on the network	×	○	
SLMP communications		×	○	Reads/writes the buffer memory, devices, and others from the external device such as a personal computer or an HMI (Human Machine Interface) to an SLMP-compatible device. Data can also be read/written to a device in the controller.
Predefined protocol communications		×	○	Allows the communication processing only with the program of the start instruction when the protocol data for communications with the external device is registered using the engineering tool. The protocol required for communications with the external device (such as temperature controller and barcode reader) can be set easily using the engineering tool's communication protocol support function.
Socket communications		×	○	Used to perform one-to-one bidirectional communication with an external device, or to perform one-to-many unidirectional communication. Any data (10238 bytes maximum) can be exchanged with an external device connected by Ethernet over TCP/IP, UDP, TLS, and DTLS using the dedicated instructions. Encryption is possible using TLS and DTLS for a communication route that crosses the trust boundary.
File transfer function (FTP server)		×	○	Reads/writes data in file units using the dedicated FTP (File Transfer Protocol) commands from an external device.
File transfer function (FTP client)		×	○	Enables the controller, as an FTP client, to transfer files to an FTP server connected over Ethernet by using the file transfer function instructions.
OPC UA server function		×	○	The external device with the OPC UA client function can access labels of the controller.
Time setting function (SNTP client)		×	○	Automatically sets the time of the controller by collecting clock data from the time information server (SNTP server) connected to the network at the specified timing.
Network setting change function		×	○	Changes the network settings (such as IP address) of the controller without changing the parameter settings.
Built-in Ethernet communication load monitor function		×	○	Visualizes the load status of Ethernet communication processing.
DNS client function		×	○	Queries the DNS server for the IP address based on the server name set in the file transfer function (FTP client). Using the returned IP address, each client function performs communication processing.
Discard received data at CPU STOP		×	○	Discards data received from the communication destination via socket communications when the status of the controller is changed from RUN to STOP (PAUSE).

6.8 Serial Communication Function

For details on the functions, refer to the following.

📖 MELSEC MX Controller MX-F Model User's Manual

Function	Description
MC protocol function	Accesses MC protocol-compatible devices from an external device (such as a personal computer or an HMI) using serial communication. The controller can communicate using QnA compatible 3C/4C frames.
MODBUS RTU communication function	Controls 32 slaves for RS-485 communication or one slave for RS-232 communication by a single master.
Non-protocol communication function	Exchanges data between a printer, bar code reader, or other devices with no protocol.

6.9 Online Operation (Debug, Monitor)

For details on the functions, refer to the following.

📖 MELSEC MX Controller MX-F Model User's Manual

Function		Description
Online change	Conversion + online change	Converts and writes programs and data edited with engineering tools during RUN. Edited contents spanning multiple files or multiple portions can be written to the controller at once.
	Online change (files)	Writes programs and data to the running controller in units of files.
Monitor function	Circuit monitor	Checks the status of the running program on the program editor.
	Device/buffer memory batch monitor	Checks the current values of the device and buffer memory in a batch.
	Watch	Registers device and label and checks the current values.
	Performance monitor	Visualizes the breakdown of operation cycle and load status for each core.
	Real-time monitor function	Uses GX LogViewer to monitor the contents of a specified device/label of the controller in real time at a specified interval or a desired timing.
	Position data history	Saves positioning data of each axis as history when an event related to the absolute position control occurs.
Remote operation	Remote RUN/STOP	Externally changes the controller to RUN or STOP with the RUN/STOP/RESET switch of the controller set to RUN.
	Remote PAUSE	Externally changes the controller to PAUSE with the RUN/STOP/RESET switch of the controller set to RUN.
	Setting RUN-PAUSE contacts	Sets RUN-PAUSE contacts.
	Remote RESET	Externally resets the controller in the STOP state (including when the controller stopped due to an error).

6.10 Data Collection

For details on the functions, refer to the following.

MELSEC MX Controller MX-F Model User's Manual

Function	Description
Data logging function	Collects device, string, and other data at specified intervals or timing, and stores data as a data file. From the CPU Module Logging Configuration Tool (free of charge), items such as target data, collection interval, and start condition can be set easily.

6.11 Security

For details on the functions, refer to the following.

MELSEC MX Controller MX-F Model User's Manual

Function		Description
Protection of information assets in the controller	User authentication function	Restricts user access of the controller. It is used to set access restrictions according to the worker's role.
	All information initialization of controllers	Batch deletes devices/labels, files, and some security information stored in non-volatile memory. It is used to delete the remaining data.
	Firmware update function	Updates the controller firmware version. It is used to eliminate firmware vulnerabilities.
	Event history function	Displays and saves the event log when an event occurs in a system that consists of controllers, so that the details can be understood. It is used to save and check the event that occurred.
Protection of the network connected to the controller	Encrypted communication function	Encrypts communication data. It is used to prevent eavesdropping and falsification of communication data when the controller communicates with devices outside the trust boundary.
	IP filter function	Identifies the IP address of the communication destination and prevents access from an illegal IP address. It is used to allow access only to the IP address of a specific device.
	Function to set whether to use default open port	Closes unused ports on the controller. It is used to close unused ports in preparation for port scans.
	Bandwidth limitation function against DoS-attacks	Restricts resources used by the controller when DoS attacks occur. It is used to limit the bandwidth in preparation for DoS attacks.
Protection of operation by controller	Controller operation setting at error detection	Sets the operation by the controller. It is used to perform a preset operation even if an error occurs.

6.12 Maintenance/Troubleshooting

For details on the functions, refer to the following.

MELSEC MX Controller MX-F Model User's Manual

Function		Description
Self-diagnostics function		Checks if a problem exists in the controller.
Event history function		Collects operations executed and errors detected from the modules, and saves them in the controller. The saved logs can be checked in chronological order.
Scan monitoring function		Detects a hardware failure or program error by monitoring that the END processing is performed within a set scan time.
Error clear		Batch-clears all the continuation errors being detected.
Boot operation		Transfers the files stored on the SD memory card to the storage memory which is automatically determined by the controller when the controller is powered off and on or is reset.
Firmware update function		Enables users to update firmware versions of controllers and intelligent function modules using the engineering tool.
Clock	Time zone setting	Enables the clock of the programmable controller to work in the local time zone by specifying the time zone.
	Daylight saving time function	Adjusts the time of the controller for daylight saving time.
Ethernet	Ethernet diagnostics	Monitors communication status on the Ethernet-equipped module and external device.
	IP address duplication detection	Detects duplication when one network has stations with the same IP address.

7 MOTION FUNCTIONS

This chapter describes the functional differences with the MX-F Model.

Point

For the motion functions, refer to the following and use the functions by replacing the contents shown in this chapter.

MELSEC MX Controller MX-F Model User's Manual

7.1 Function Comparison

The following table lists the differences in the motion functions.

Item	MX-F Model (Support EtherCAT)	MX-F Model
Network	EtherCAT	CC-Link IE TSN
Operation cycles mixed	One group	Three groups

Unavailable functions

The following table lists the unavailable functions.

Item		Remarks
Motion operation fixed-cycle execution	Operation cycles mixed	Because the operation cycle is one group
Operation cycles mixed	Control operation cycle synchronization (MCv_SyncOperationCycles)	Because the operation cycle is one group
Direct control (position follow-up/speed/torque control)	Continuous operation to torque control	Because the continuous operation to torque control mode is not supported
Operation profile data format	Digital cam switch data format	Because the digital cam switch is not supported
External signal selection	External signal high-accuracy input	Because high-accuracy input is not supported
	External signal high-accuracy output	Because high-accuracy output is not supported
Digital cam switch		Because the digital cam switch is not supported
CC-Link IE TSN compatible device connection		Because the supported networks are different

Functions with different specifications

The following table lists functions with different specifications.

Item	Difference
Homing control	Home offset has been removed from the conditions for the driver homing method.
Command filter	Operation cycles mixed is not supported.
Synchronous control	Operation cycles mixed is not supported.
Operation profile function	Digital cam switch data is not supported.
Advanced synchronous control	High-accuracy input is not supported.
External signal selection	[LINK] specification is not supported.
Touch probe	High-accuracy input is not supported.
Motion operation processing time monitor	Operation cycles mixed is not supported.

Unavailable function blocks

The following function blocks cannot be used with the MX-F Model (Support EtherCAT).

FB	Name	Description
MC_DigitalCamSwitch	Digital cam switch output	Outputs on/off signals according to a value of any data.
MCv_SyncOperationCycles	Control operation cycle synchronization	Synchronizes the control operation cycle of the axis with the set cycle.

Unavailable object data

The following object data cannot be used with the MX-F Model (Support EtherCAT).

Name	Description
Sync ABS counter	Acquires the encoder multiple revolution counter from the drive unit.
Sync cycle counter	Acquires the encoder position within one revolution from the drive unit.

8 EtherCAT FUNCTIONS

This chapter describes the EtherCAT functions.
Set the module extended parameters according to the functions and environment used. For details on the various settings, refer to the following.
☞ Page 109 MODULE EXTENDED PARAMETERS (EtherCAT CONFIGURATION)

8.1 Process Data Communication (PDO Communication)

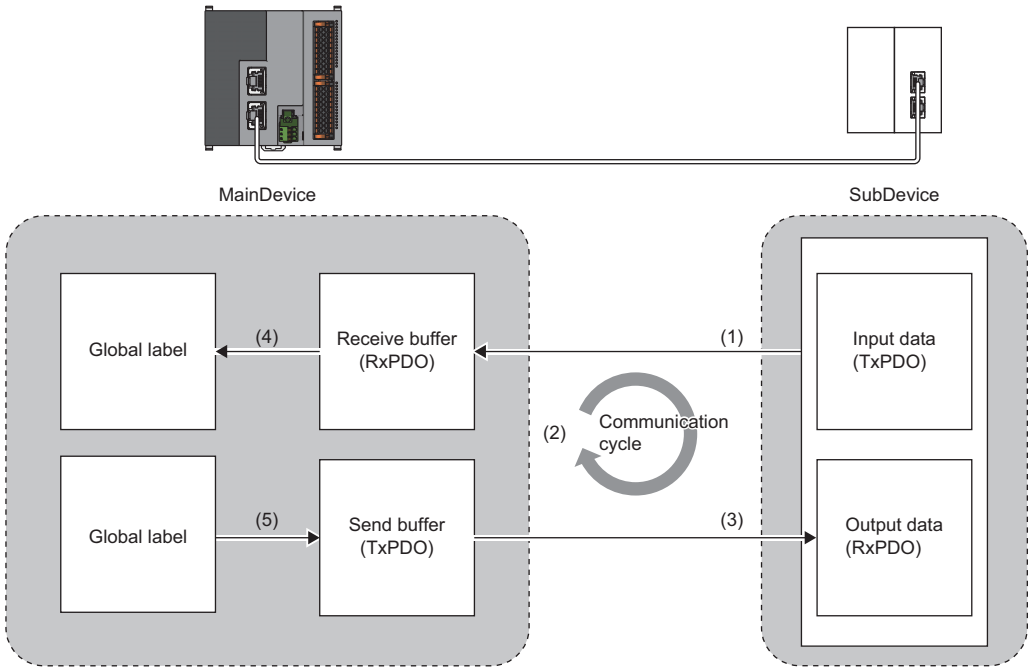
Use PDO to perform periodic data communication between the controller and the SubDevice.

Overview

The controller communicates data with the SubDevice at set cycles (cycle time).

Type	Description
Sending data	The controller sends data to the SubDevice. The data is sent from the TxPDO of the controller to the RxPDO of the SubDevice.
Receiving data	The controller receives data sent from the SubDevice. The data sent from the TxPDO of the SubDevice is received by the RxPDO of the controller.

PDO output and PDO input are each assigned a global label (network label), so the PDO data is operated using the label.



(1) Data received from the SubDevice is stored in the receive buffer.
(2) Communication is performed at the set cycle time.
(3) Data stored in the send buffer is sent to the SubDevice.
(4) Data is transferred with input refresh.
(5) Data is transferred with output refresh.

Point

- The I/O data of PDO communication is automatically assured at the time of I/O refresh.
- The global label that stores the data to be received or sent can be generated from "Network Label Setting". (☞ Page 36 Setting Network Labels)

Example program

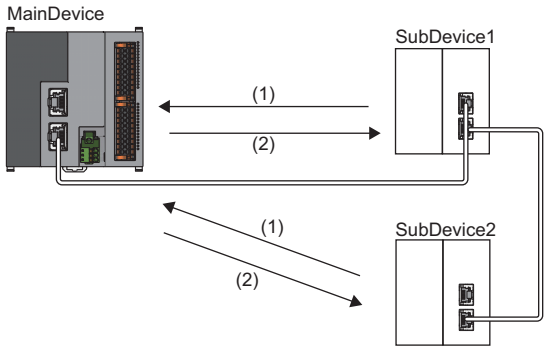
This section describes a program example where the controller communicates using 50 bytes (25 words) of I/O data each for SubDevice1 and SubDevice2.

Point

This program example is created for the following operations. Also, the module parameters are set to the default settings.

- As a sample, the first word of each SubDevice is used.
- The sample adds 1 to the PDO input and returns it to the PDO output.

System configuration



(1) 50 bytes of input (only the first word is used)
(2) 50 bytes of output (only the first word is used)

Module extended parameter

On "Project explorer", set two EtherCAT SubDevices to be used. (☞ Page 28 Adding SubDevices)

Labels and devices

■Module labels

In this program example, the program is created with module labels corresponding to each buffer memory area.

Label name	Description	Data type
MX_EC.bSts_ModuleREADY	EtherCAT function READY	Bit
MX_EC.uSts_CommunicationState_D	Communication state (Direct)	Word [unsigned]
MX_EC.stnSts_SubDeviceInfo[0].uVal_SubDeviceErrorStatus_D	SubDevice error state (1st SubDevice) (Direct)	Word [unsigned]
MX_EC.stnSts_SubDeviceInfo[1].uVal_SubDeviceErrorStatus_D	SubDevice error state (2nd SubDevice) (Direct)	Word [unsigned]

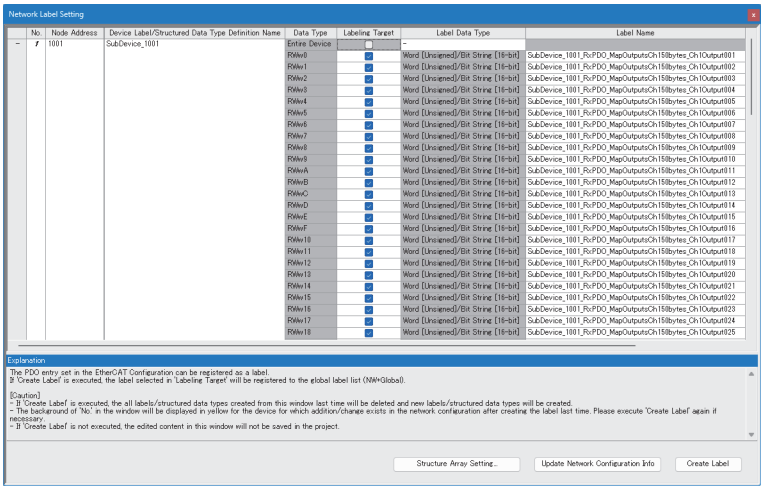
■Global labels

	Label Name	Data Type		Class	Assign (Device/Label)
1	wCommunication_Ready_MC	Word [Signed]	...	VAR_GLOBAL	N0
2	bCommunication_Ready	Bit	...	VAR_GLOBAL	

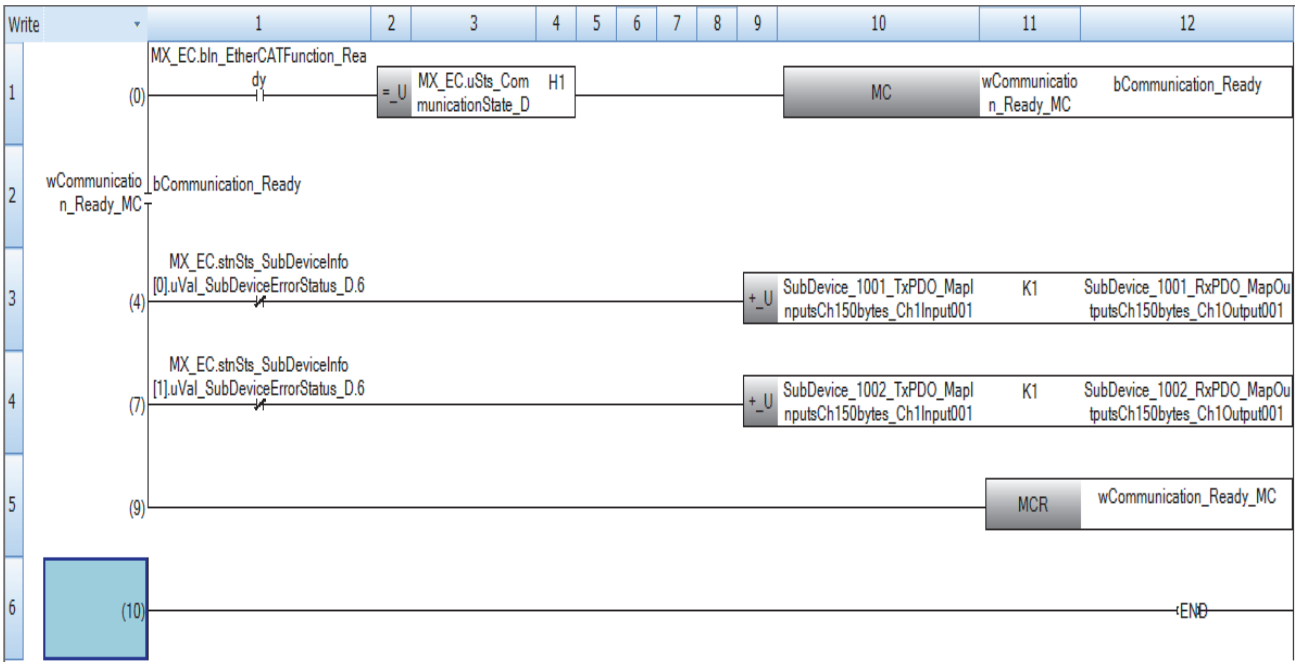
■Global labels generated from network labels

	Label Name	Data Type		Class
1	SubDevice_1001_RxPDO_MapOutputsCh150bytes_Ch1Output001	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
2	SubDevice_1001_RxPDO_MapOutputsCh150bytes_Ch1Output002	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
3	SubDevice_1001_RxPDO_MapOutputsCh150bytes_Ch1Output003	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
4	SubDevice_1001_RxPDO_MapOutputsCh150bytes_Ch1Output004	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
5	SubDevice_1001_RxPDO_MapOutputsCh150bytes_Ch1Output005	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
6	SubDevice_1001_RxPDO_MapOutputsCh150bytes_Ch1Output006	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
7	SubDevice_1001_RxPDO_MapOutputsCh150bytes_Ch1Output007	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
8	SubDevice_1001_RxPDO_MapOutputsCh150bytes_Ch1Output008	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
9	SubDevice_1001_RxPDO_MapOutputsCh150bytes_Ch1Output009	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
10	SubDevice_1001_RxPDO_MapOutputsCh150bytes_Ch1Output010	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
11	SubDevice_1001_RxPDO_MapOutputsCh150bytes_Ch1Output011	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
12	SubDevice_1001_RxPDO_MapOutputsCh150bytes_Ch1Output012	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
13	SubDevice_1001_RxPDO_MapOutputsCh150bytes_Ch1Output013	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
14	SubDevice_1001_RxPDO_MapOutputsCh150bytes_Ch1Output014	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
15	SubDevice_1001_RxPDO_MapOutputsCh150bytes_Ch1Output015	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
16	SubDevice_1001_RxPDO_MapOutputsCh150bytes_Ch1Output016	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
17	SubDevice_1001_RxPDO_MapOutputsCh150bytes_Ch1Output017	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
18	SubDevice_1001_RxPDO_MapOutputsCh150bytes_Ch1Output018	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
19	SubDevice_1001_RxPDO_MapOutputsCh150bytes_Ch1Output019	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
20	SubDevice_1001_RxPDO_MapOutputsCh150bytes_Ch1Output020	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
21	SubDevice_1001_RxPDO_MapOutputsCh150bytes_Ch1Output021	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
22	SubDevice_1001_RxPDO_MapOutputsCh150bytes_Ch1Output022	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
23	SubDevice_1001_RxPDO_MapOutputsCh150bytes_Ch1Output023	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
24	SubDevice_1001_RxPDO_MapOutputsCh150bytes_Ch1Output024	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
25	SubDevice_1001_RxPDO_MapOutputsCh150bytes_Ch1Output025	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
26	SubDevice_1001_TxPDO_MapInputsCh150bytes_Ch1Input001	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
27	SubDevice_1001_TxPDO_MapInputsCh150bytes_Ch1Input002	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
28	SubDevice_1001_TxPDO_MapInputsCh150bytes_Ch1Input003	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
29	SubDevice_1001_TxPDO_MapInputsCh150bytes_Ch1Input004	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL
30	SubDevice_1001_TxPDO_MapInputsCh150bytes_Ch1Input005	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL

In the "Network Label Setting", RWr0 to RWr31 are generated as "Labeling Target". (☞ Page 36 Setting Network Labels)



Example program



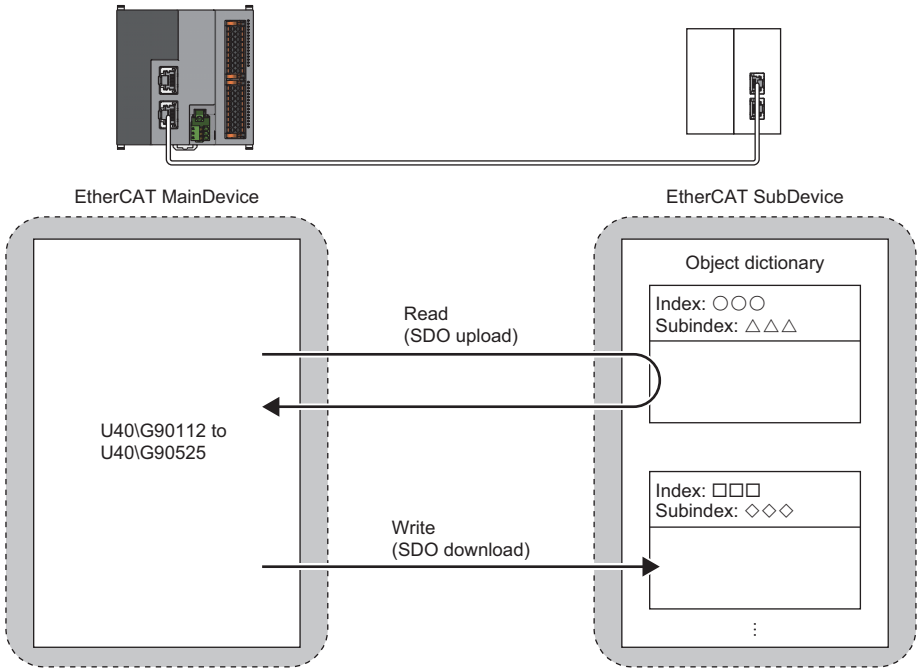
8.2 Mailbox Communications (SDO Communications)

Use SDO to perform non-periodic data communication from the controller to the SubDevice.

Overview

This communication function reads/writes object dictionary from one EtherCAT device to another EtherCAT device.
It allows reading various types of information stored in the object dictionary of a SubDevice or setting a SubDevice via the object dictionary.
For information on the object dictionaries available for each SubDevice, refer to the manual of the SubDevice used.
The following are executed at the timing specified by the controller.

Type	Description
SDO upload	Reads the object dictionary.
SDO download	Writes to the object dictionary.



■Related buffer memory areas

The following table lists the related buffer memory areas.

Item	Name	Buffer memory	Reference
SDO communication area	SDO control command	U40\G90112	Page 207 'SDO control command' (U40\G90112)
	SDO transmit node address	U40\G90113	Page 207 'SDO transmit node address' (U40\G90113)
	SDO transmit index number	U40\G90114	Page 207 'SDO transmit index number' (U40\G90114)
	SDO transmit subindex number	U40\G90115	Page 207 'SDO transmit subindex number' (U40\G90115)
	SDO transmit data size	U40\G90116 to U40\G90117	Page 207 'SDO transmit data size' (U40\G90116 to U40\G90117)
	SDO transmit data	U40\G90118 to U40\G90517	Page 207 'SDO transmit data' (U40\G90118 to U40\G90517)
	SDO executed control command	U40\G90518	Page 207 'SDO executed control command' (U40\G90518)
	SDO receive node address	U40\G90519	Page 207 'SDO reception node address' (U40\G90519)
	SDO receive index number	U40\G90520	Page 207 'SDO reception index number' (U40\G90520)
	SDO receive subindex number	U40\G90521	Page 207 'SDO reception subindex number' (U40\G90521)
	SDO receive data size	U40\G90522 to U40\G90523	Page 207 'SDO reception data size' (U40\G90522 to U40\G90523)
	SDO receive data	U40\G90524 to U40\G90923	Page 207 'SDO reception data' (U40\G90524 to U40\G90923)
	SDO error code	U40\G90924	Page 207 'SDO error code' (U40\G90924)
	SDO detail error code	U40\G90926 to U40\G90927	Page 207 'SDO detail error code' (U40\G90926 to U40\G90927)

■Control command

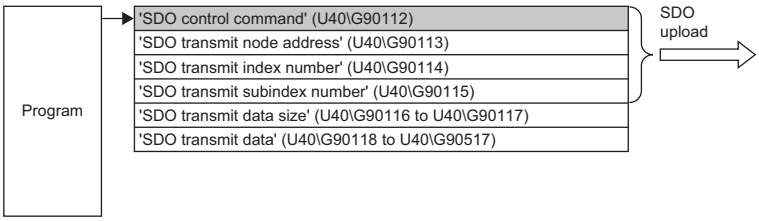
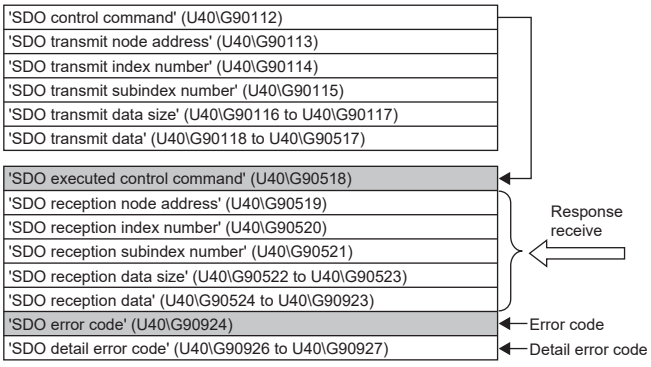
The following table lists the SDO control commands.

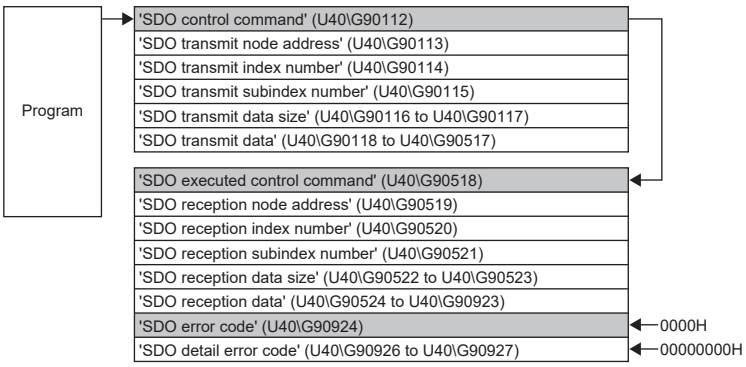
Value	Command	Reference
0000H	No command	Page 207 'SDO control command' (U40\G90112)
0001H	SDO communication UPLOAD	
0002H	SDO communication DOWNLOAD	

SDO upload

Reading procedure

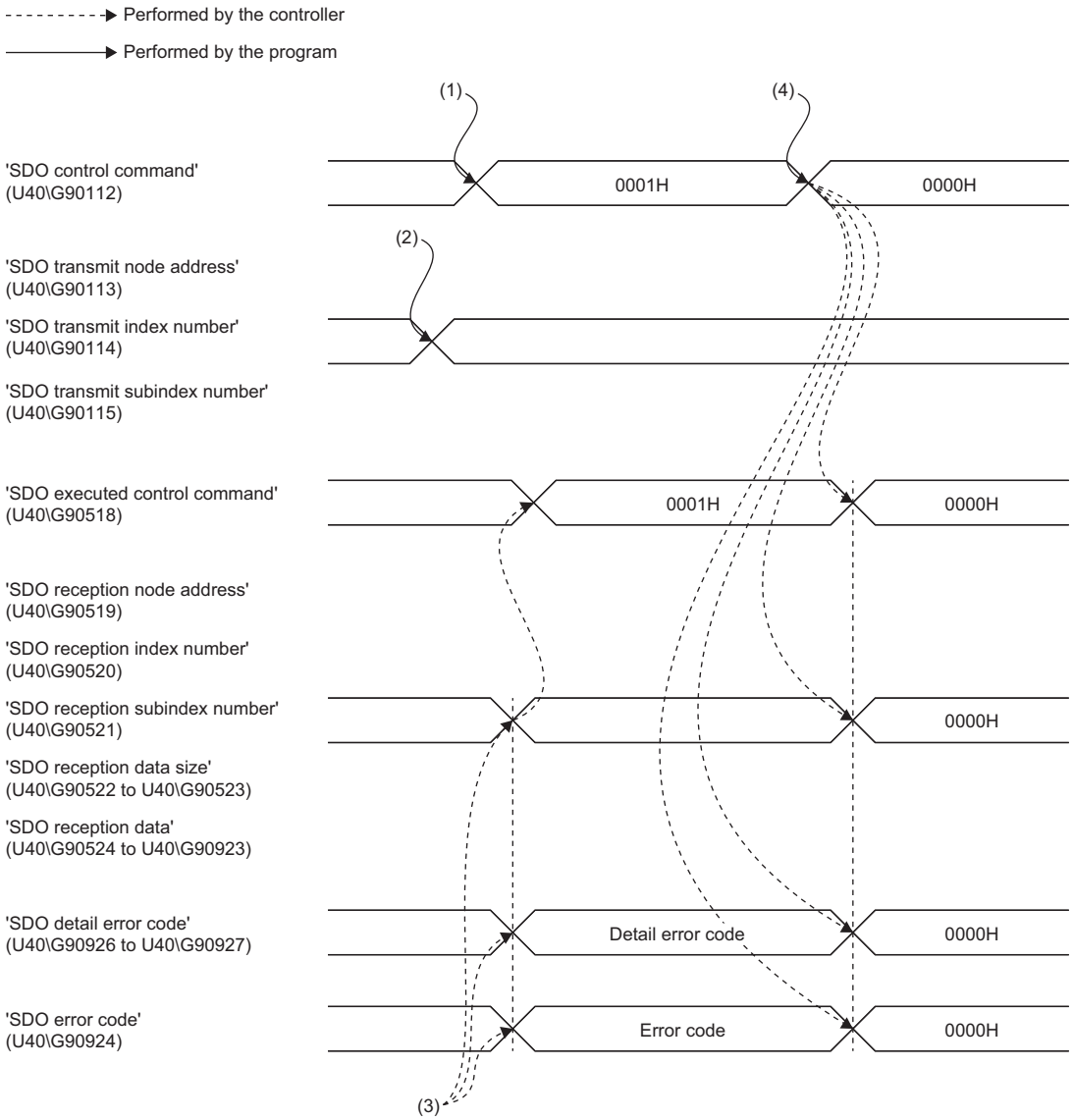
The following table lists the SDO upload procedure.

Process	Description
1. Determining whether SDO communication can be executed	A program is used to check the values of the following buffer memory areas to determine whether SDO communication can be executed. • The value of 'SDO control command' (U40\G90112) is 0000H (No command). • The value of 'SDO executed control command' (U40\G90518) is 0000H (No command). When the above conditions are satisfied, perform the processing No.2 or later. If the values of 'SDO control command' (U40\G90112) and 'SDO executed control command' (U40\G90518) do not match, it indicates that the previous SDO communication has not been completed, and new communication cannot be performed.
2. Storing the necessary information about a SubDevice subject to SDO upload	A program is used to store information about the SubDevice subject to SDO upload in the following buffer memory areas. • 'SDO transmit node address' (U40\G90113) • 'SDO transmit index number' (U40\G90114) • 'SDO transmit subindex number' (U40\G90115)
3. Storing 0001H (SDO communication UPLOAD) in 'SDO control command' (U40\G90112)	SDO upload is executed by storing 0001H (SDO communication UPLOAD) in the 'SDO control command' (U40\G90112) using a program. 
4. Receiving an SDO upload response	When an SDO upload response is received from a SubDevice, the received data will be stored in the corresponding buffer memory area listed below. • 'SDO receive node address' (U40\G90519) • 'SDO receive index number' (U40\G90520) • 'SDO receive subindex number' (U40\G90521) • 'SDO receive data size' (U40\G90522 to U40\G90523) • 'SDO receive data' (U40\G90524 to U40\G90923) Also, the same value as 'SDO control command' (U40\G90112) will be stored in 'SDO executed control command' (U40\G90518). If an error occurs during SDO upload, the error code will be stored in 'SDO error code' (U40\G90924) and the detail error code will be stored in 'SDO detail error code' (U40\G90926 to U40\G90927). When no error occurs, 0000H (No error) and 00000000H (No detail error) will be stored. 
5. Acquiring data from 'SDO receive data' (U40\G90524 to U40\G90923)	A program is used to check the size of data to be acquired from 'SDO receive data size' (U40\G90522 to U40\G90523) and to acquire the checked size of data from 'SDO receive data' (U40\G90524 to U40\G90923). If an error occurs, the program acquires the error code from 'SDO error code' (U40\G90924) and 'SDO detail error code' (U40\G90926 to U40\G90927).

Process	Description
6. Storing 0000H (No command) in 'SDO control command' (U40\G90112)	A program is used to store 0000H (No command) in 'SDO control command' (Un\G90112). During the operation, the value of 'SDO executed control command' (Un\G90518) becomes 0000H (No command) and the following buffer memory areas are cleared to zero. • 'SDO receive node address' (U40\G90519) • 'SDO receive index number' (U40\G90520) • 'SDO receive subindex number' (U40\G90521) • 'SDO receive data size' (U40\G90522 to U40\G90523) • 'SDO receive data' (U40\G90524 to U40\G90923) • 'SDO error code' (U40\G90924) • 'SDO detail error code' (U40\G90926 to U40\G90927) 

Timing chart

The following figure shows the timing chart for SDO upload.

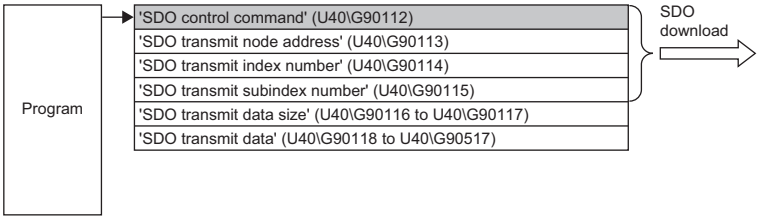
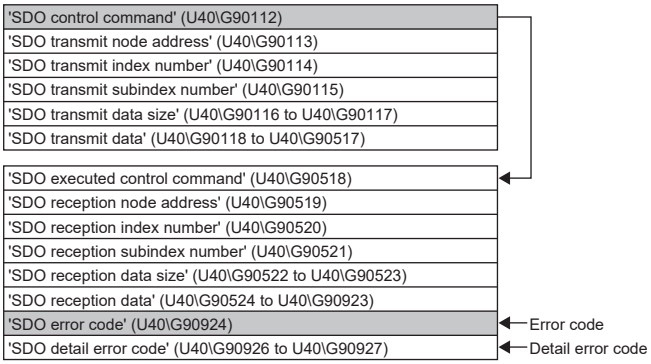


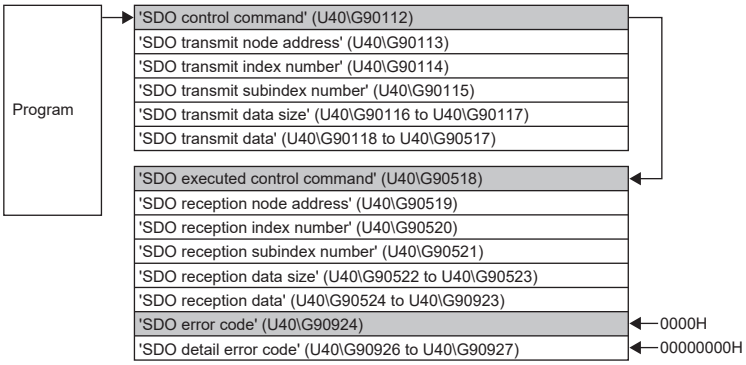
(1) 0001H (SDO communication UPLOAD) is stored in 'SDO control command' (U40\G90112).
(2) The information about the SubDevice subject to SDO upload is stored.
(3) An SDO upload response is received.
(4) 0000H (No command) is stored in 'SDO control command' (U40\G90112).

SDO download

Writing procedure

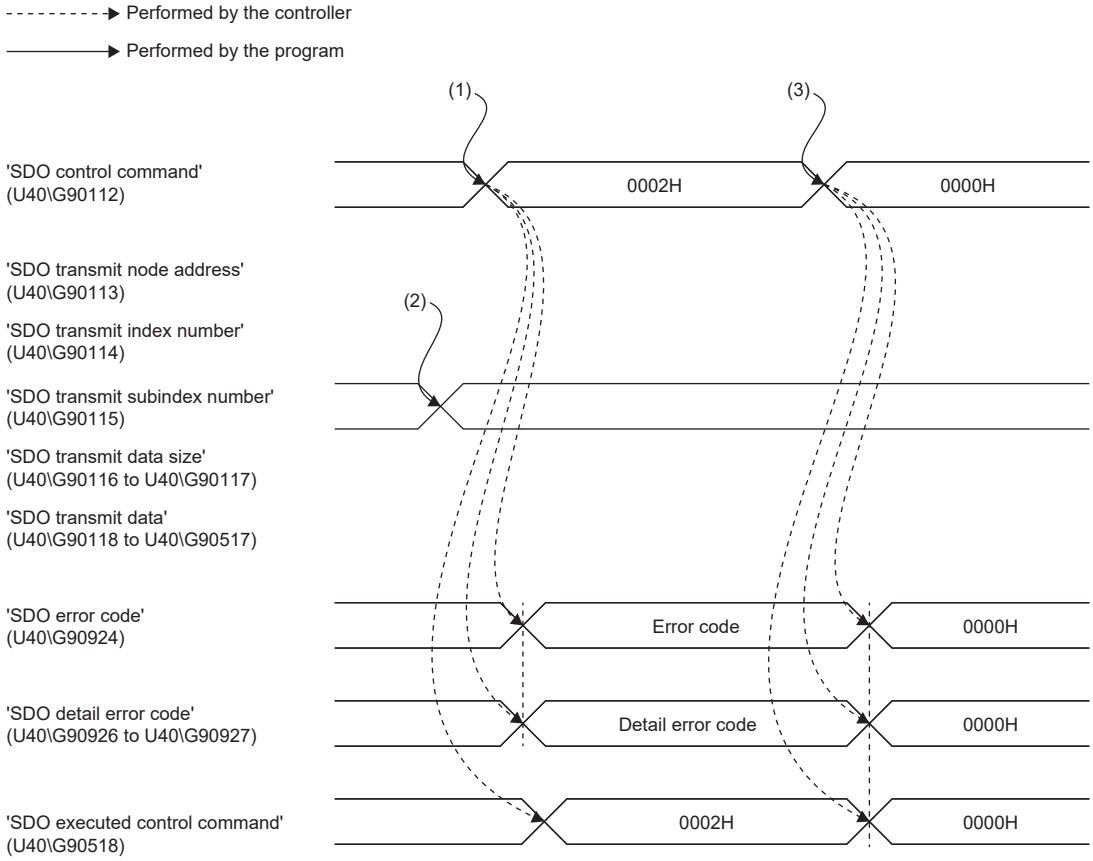
The following table lists the SDO download procedure.

Process	Description
1. Determining whether SDO communication can be executed	A program is used to check the values of the following buffer memory areas to determine whether SDO communication can be executed. • The value of 'SDO control command' (U40\G90112) is 0000H (No command). • The value of 'SDO executed control command' (U40\G90518) is 0000H (No command). When the above conditions are satisfied, perform the processing No.2 or later. If the values of 'SDO control command' (U40\G90112) and 'SDO executed control command' (Un\G90518) do not match, it indicates that the previous SDO communication has not been completed, and new communication cannot be performed.
2. Storing the necessary information about a SubDevice subject to SDO download	A program is used to store information about the SubDevice subject to SDO download in the following buffer memory areas. • 'SDO transmit node address' (U40\G90113) • 'SDO transmit index number' (U40\G90114) • 'SDO transmit subindex number' (U40\G90115) • 'SDO transmit data size' (U40\G90116 to U40\G90117) • 'SDO transmit data' (U40\G90118 to U40\G90517)
3. Storing 0002H (SDO communication DOWNLOAD) in 'SDO control command' (U40\G90112)	A program is used to execute SDO download by storing 0002H (SDO communication DOWNLOAD) in 'SDO control command' (U40\G90112). 
4. Storing the same value as 'SDO control command' (U40\G90112) in 'SDO executed control command' (U40\G90518)	The same value as 'SDO control command' (U40\G90112) will be stored in 'SDO executed control command' (U40\G90518). If an error occurs during SDO download, the error code will be stored in 'SDO error code' (U40\G90924) and the detail error code will be stored in 'SDO detail error code' (U40\G90926 to U40\G90927). When no error occurs, 0000H (No error) and 00000000H (No detail error) will be stored. 

Process	Description
5. Storing 0000H (No command) in 'SDO control command' (U40\G90112)	A program is used to store 0000H (No command) in 'SDO control command' (U40\G90112). During the operation, the value of 'SDO executed control command' (Un\G90518) becomes 0000H (No command) and the following buffer memory areas are cleared to zero. • 'SDO error code' (U40\G90924) • 'SDO detail error code' (U40\G90926 to U40\G90927) 

Timing chart

The following figure is the timing chart of mailbox communication (SDO communication).



(1) 0002H (SDO communication DOWNLOAD) is stored in 'SDO control command' (U40\G90112).

(2) The information about the SubDevice subject to SDO download is stored.

(3) 0000H (No command) is stored in 'SDO control command' (U40\G90112).

Program example

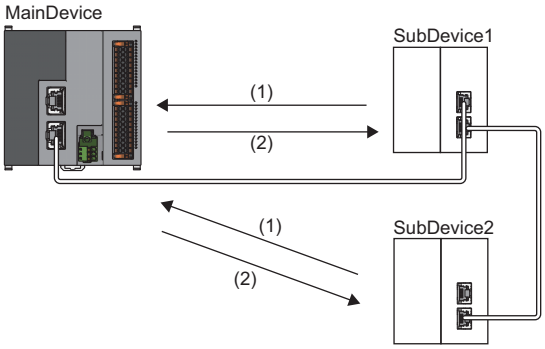
This section describes examples where the controller executes SDO communication (download/upload) with SubDevice2.

Point

The program examples access the following. Also, the module parameters are set to the default settings.

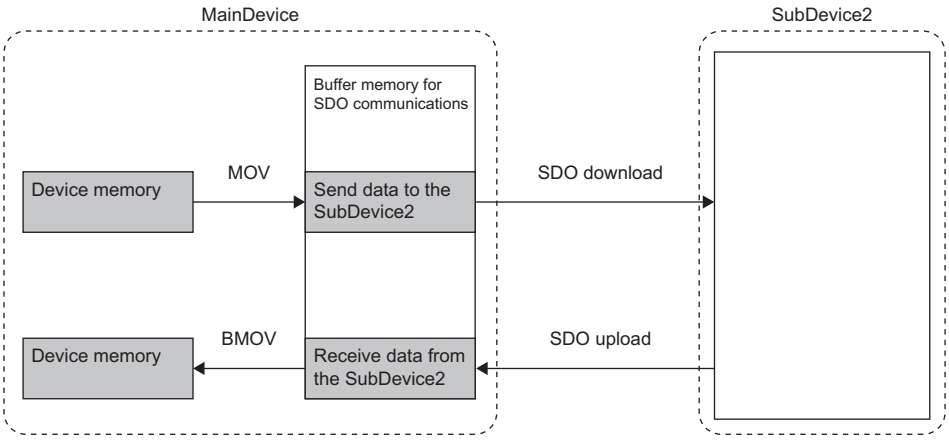
- Node address: 1002
- Index number: 7001H
- Subindex number: 1H

System configuration



(1) 50 bytes of input (only the first word is used)
(2) 50 bytes of output (only the first word is used)

Device assignment



Module extended parameter

On "Project explorer", set two EtherCAT SubDevices to be used. (☞ Page 28 Adding SubDevices)

Labels and devices

■Module labels

In this program example, the program is created with module labels corresponding to each buffer memory area.

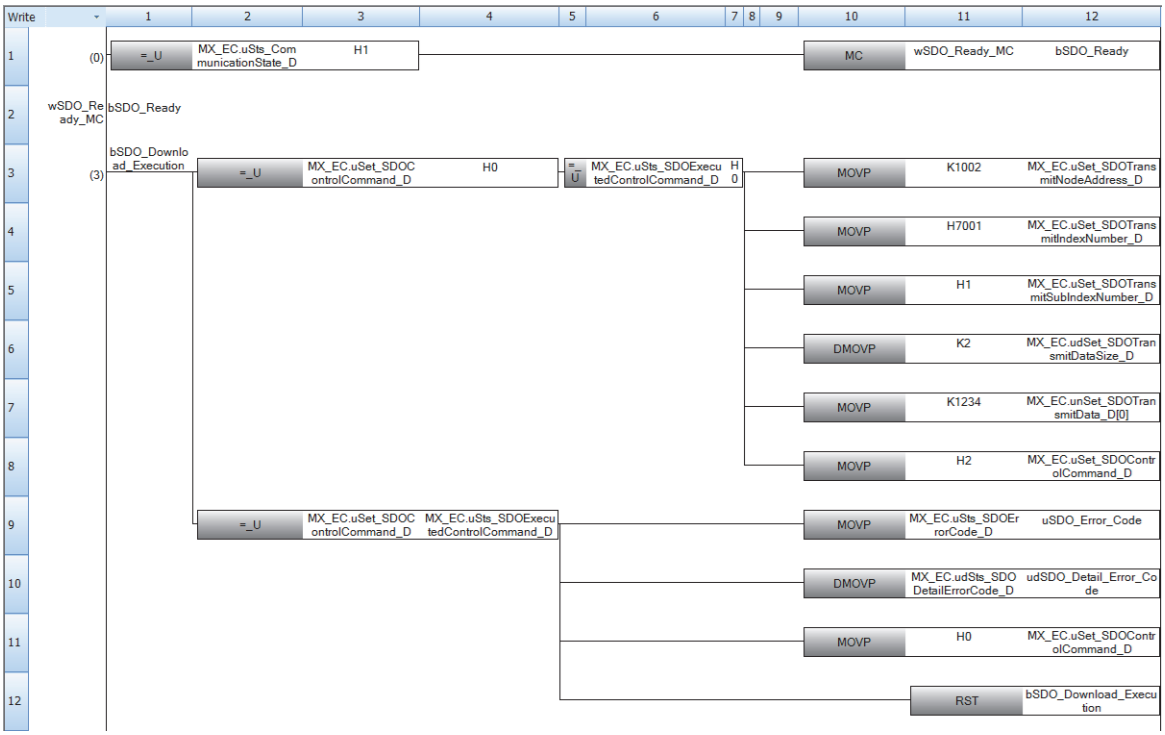
Label name	Description	Data type	Device
MX_EC.uSts_CommunicationState_D	Communication state (Direct)	Word [unsigned]	U40\G16386
MX_EC.uSet_SDOControlCommand_D	SDO control command (Direct)	Word [unsigned]	U40\G90112
MX_EC.uSet_SDOTransmitNodeAddress_D	SDO transmit node address (Direct)	Word [unsigned]	U40\G90113
MX_EC.uSet_SDOTransmitIndexNumber_D	SDO transmit index number (Direct)	Word [unsigned]	U40\G90114
MX_EC.uSet_SDOTransmitSubIndexNumber_D	SDO transmit subindex number (Direct)	Word [unsigned]	U40\G90115
MX_EC.udSet_SDOTransmitDataSize_D	SDO transmit data size (Direct)	Double word [unsigned]	U40\G90116 to U40\G90117
MX_EC.unSet_SDOTransmitData_D	SDO transmit data (Direct)	Word [unsigned]	U40\G90118 to U40\G90517
MX_EC.uSts_SDOExecutedControlCommand_D	SDO executed control command (Direct)	Word [unsigned]	U40\G90518
MX_EC.udSts_SDOReceiveDataSize_D	SDO receive data size (Direct)	Double word [unsigned]	U40\G90522 to U40\G90523
MX_EC.unSts_SDOReceiveData_D	SDO receive data (Direct)	Word [unsigned]	U40\G90524 to U40\G90923
MX_EC.uSts_SDOErrorCode_D	SDO error code (Direct)	Word [unsigned]	U40\G90924
MX_EC.udSts_SDODetailErrorCode_D	SDO detail error code (Direct)	Double word [unsigned]	U40\G90926 to U40\G90927

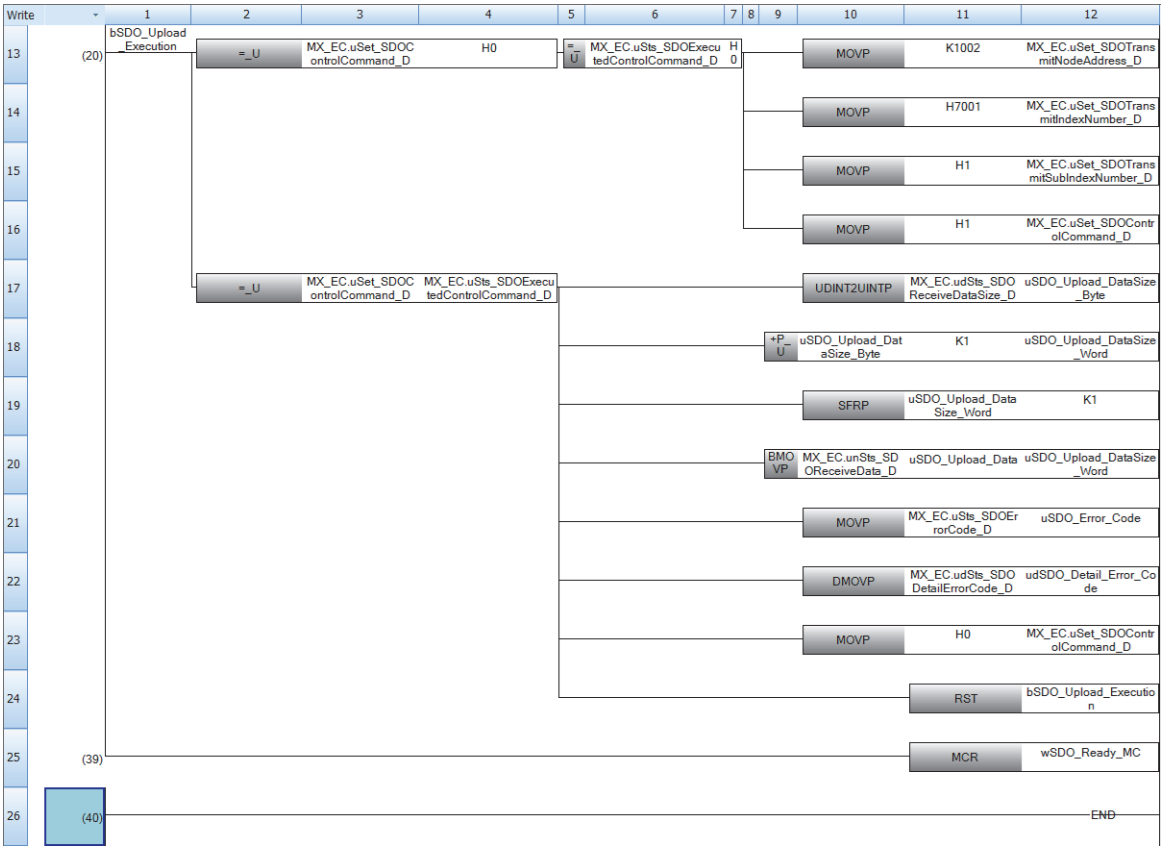
■Global labels

	Label Name	Data Type		Class	Assign (Device/Label)
1	wSDO_Ready_MC	Word [Signed]	...	VAR_GLOBAL	N1
2	bSDO_Ready	Bit	...	VAR_GLOBAL	
3			...		
4	bSDO_Download_Execution	Bit	...	VAR_GLOBAL	
5	bSDO_Upload_Execution	Bit	...	VAR_GLOBAL	
6			...		
7	uSDO_Upload_DataSize_Byte	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL	
8	uSDO_Upload_DataSize_Word	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL	
9	uSDO_Upload_Data	Word [Unsigned]/Bit String [16-bit](0..399)	...	VAR_GLOBAL	
10			...		
11	uSDO_Error_Code	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL	
12	udSDO_Detail_Error_Code	Double Word [Unsigned]/Bit String [32-bit]	...	VAR_GLOBAL	

- bSDO_Download_Execution: Turn on this bit to execute the SDO download.
- bSDO_Upload_Execution: Turn on this bit to execute the SDO upload.
- uSDO_Error_Code and udSDO_Detail_Error_Code: When an error occurs in SDO communication, the error code will be stored in this label.

Program example





8.3 ESM State Change Function

This function controls the ESM state of the MainDevice and SubDevices using the buffer memory.

Overview

In EtherCAT, a state machine called the ESM (EtherCAT State Machine) is defined to determine the operating status of EtherCAT devices, with each status referred to as an ESM state.
ESM states normally transition automatically, but they can be transitioned manually at a desired timing, for example, to stop process data communication.
Also, to address issues such as an unintentional stop of communication, troubleshooting may be possible by checking the ESM state of the SubDevice.
In EtherCAT, the following ESM states and state machines are defined.

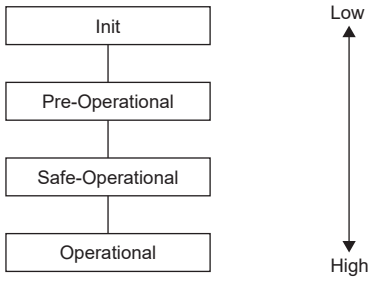
○: Communication allowed, ×: Communication not allowed

ESM state	Abbreviated name	Description	Process data communication	Mailbox communication
Init	INIT	Initial status. The MainDevice initializes the network.	×	×
Pre-Operational	PREOP	Mailbox communication is available when the SubDevice supports it.	×	○
Safe-Operational	SAFEOP	• Mailbox communication is available when the SubDevice supports it. • Process data communication will be enabled from the SubDevice to the MainDevice, but disabled from the MainDevice to the SubDevice.	○ (SubDevice to MainDevice only)	○
Operational	OP	• Mailbox communication is available when the SubDevice supports it. • Process data communication is available.	○	○
Bootstrap*1	BOOT	This status is used for updating the SubDevice firmware.	×	○ (Only for FoE communication)

*1 Some SubDevices do not support Bootstrap. Check the manual of the SubDevice used.

■ESM state relationship

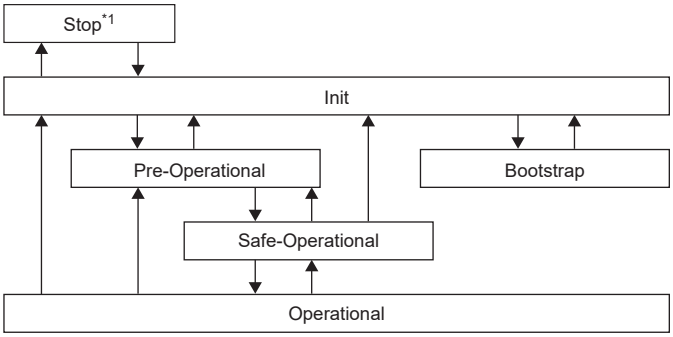
When ESM states are shown in comparison, the Init side is expressed as the lower order and the Operational side as the higher order. (Bootstrap is excluded.)



Expression example	
Notation	**Description**
Safe-Operational or above	Safe-Operational or Operational state
Drop from Operational to Pre-Operational	Transition from Operational to Pre-Operational state

■ESM state transition

The following figure is the status transition diagram of the ESM states.



*1 The stop status is not defined by the EtherCAT protocol specification. Therefore, there is a possibility that the stop status does not exist for SubDevices.
The stop status is a management status of the controller and refers to a status where EtherCAT communication stops.
The stop status may be expressed as Unknown.

Point

- Changes in the SubDevice status are typically made upon a request from the MainDevice. For conditions where the SubDevice status transitions autonomously, refer to the manual of the SubDevice used.
- When the ESM state of the MainDevice is changed, all SubDevices transition to the same ESM state, except in cases where the transition cannot occur due to an error in the SubDevice itself or other reasons.
- In general, SubDevices will not transition to the ESM state higher than that of the MainDevice. (Example: When the controller is Safe-Operational, SubDevices cannot be changed to Operational.)

ESM state change

The MainDevice can be changed to a specified ESM state at a desired timing using a program.
Also, when the controller starts, it is changed from RUN to STOP, or a stop error occurs, the ESM state can be changed automatically.
When the ESM state of the MainDevice is changed, all SubDevices transition to the same ESM state, except in cases where the transition cannot occur due to an error in the SubDevice itself or other reasons.

■ESM state change functions and conditions

The following table lists the functions and conditions by which the ESM state of the MainDevice is changed.
If multiple requests are issued to change the ESM state, they will be processed in the order in which they are received by the MainDevice.

Item		Description
Change by the MainDevice	When the MainDevice starts	After the bus scan at the start of the MainDevice is completed, the MainDevice and all SubDevices are automatically changed to the Operational status.
	Operation of the ESM state transition setting at controller stop or stop error	When the controller is changed from RUN to STOP or a stop error occurs, the MainDevice and all SubDevices are automatically transitioned to the specified ESM state.
Change by a program (buffer memory operation)		The MainDevice and all SubDevices are changed to any desired ESM state.

Checking and changing the current value of ESM states using the buffer memory

The following operations can be performed from the buffer memory.

- Checking the ESM state of the MainDevice and each SubDevice
- Changing the ESM state of the MainDevice
- Changing the ESM state of each SubDevice
- Setting the ESM state change when a SubDevice is connected

■Related buffer memory areas

The following table lists the related buffer memory areas.

Item	Name	Buffer memory	Reference
Current ESM state	MainDevice ESM state	U40\G0	Page 192 'MainDevice ESM state' (U40\G0)
	SubDevice ESM state	U40\G1 to U40\G72	Page 192 'SubDevice ESM state' (U40\G1 to U40\G72)
ESM state change	MainDevice ESM state change request	U40\G4096	Page 193 'MainDevice ESM state change request' (U40\G4096)
	MainDevice ESM state change response	U40\G4097	Page 193 'MainDevice ESM state change response' (U40\G4097)
	MainDevice ESM state change error code	U40\G4098	Page 194 'MainDevice ESM state change error code' (U40\G4098)
	MainDevice ESM state change detail error code	U40\G4100 to U40\G4101	Page 194 'MainDevice ESM state change detail error code' (U40\G4100 to U40\G4101)
	SubDevice ESM state change request	U40\G4112	Page 195 'SubDevice ESM state change request' (U40\G4112)
	SubDevice ESM state change response	U40\G4113	Page 195 'SubDevice ESM state change response' (U40\G4113)
	SubDevice ESM state change error code	U40\G4114	Page 196 'SubDevice ESM state change error code' (U40\G4114)
	SubDevice ESM state change detail error code	U40\G4116 to U40\G4117	Page 196 'SubDevice ESM state change detail error code' (U40\G4116 to U40\G4117)
	ESM state setting at SubDevice connection	U40\G4118	Page 196 'ESM state setting at SubDevice connection' (U40\G4118)

■How to check the ESM state

The current ESM state of the MainDevice and SubDevices can be checked using the buffer memory of the controller.

- In 'MainDevice ESM state' (U40\G0), the current ESM state of the MainDevice can be checked.
- In 'SubDevice ESM state' (U40\G1 to U40\G72), one word is allocated sequentially for each SubDevice, starting from the first one, up to the maximum number of devices, and the ESM state of SubDevices can be checked in the order corresponding to the offset from the starting address.

■How to change the ESM state

The ESM state of the MainDevice and SubDevices can be transitioned using the buffer memory of the controller.

- The ESM state of the MainDevice can be changed by storing a value in 'MainDevice ESM state change request' (U40\G4096).
- When the ESM state of the MainDevice is changed, the ESM state of all SubDevices will also be changed.
- The ESM state can be changed for each SubDevice by storing a value in 'SubDevice ESM state change request' (U40\G4112).
- In 'SubDevice ESM state change request' (U40\G4112), 'SubDevice ESM state change response' (U40\G4113), 'SubDevice ESM state change error code' (U40\4114), and 'SubDevice ESM state change detail error code' (U40\G4116 to U40\G4117), an area is allocated sequentially for each SubDevice, starting from the first one, up to the maximum number of devices, and the ESM state of SubDevices can be changed in the order corresponding to the offset from the starting address.

ESM state change procedure

This section describes the procedure for changing the ESM state.

■To change the ESM state of the MainDevice

Process	Description
1. Determining whether the MainDevice ESM state can be changed	Check that the value of 'MainDevice ESM state change request' (U40\G4096) is equal to the value of 'MainDevice ESM state change response' (U40\G4097). When an ESM state change request has already been made to the MainDevice, the next MainDevice ESM state change request cannot be made until the previous request is completed.
2. Storing the ESM state in 'MainDevice ESM state change request' (U40\G4096)	Use a program to store the transition target ESM state in 'MainDevice ESM state change request' (U40\G4096). • Init: H0001 • Pre-Operational: 0002H • Safe-Operational: 0004H • Operational: 0008H
3. Checking that the value of 'MainDevice ESM state change request' (U40\G4096) is equal to the value of 'MainDevice ESM state change response' (U40\G4097)	When the request is completed, the same value as 'MainDevice ESM state change request' (U40\G4096) will be stored in 'MainDevice ESM state change response' (U40\G4097). (Completion of the request can be determined by checking that the same value is stored.)
4. Checking whether any error occurs	If necessary, check whether any error occurs. If an error occurs, 'MainDevice ESM state change error code' (U40\G4098) will be stored. When a detail error code is present, it will be stored in 'MainDevice ESM state change detail error code' (U40\G4100 to U40\G4101).
5. Storing 0000H (No request/Clear request) in 'MainDevice ESM state change request' (U40\G4096)	Use a program to store 0000H (No request/Clear request for this area) in 'MainDevice ESM state change request' (U40\G4096). When 0000H (No request/Clear request for this area) is stored in 'MainDevice ESM state change response' (U40\G4097) by MXF (EC), the following buffer memory areas will be cleared to zero. • 'MainDevice ESM state change error code' (U40\G4098) • 'MainDevice ESM state change detail error code' (U40\G4100 to U40\G4101)

■To change the ESM state of a SubDevice

Process	Description
1. Determining whether the SubDevice ESM state can be changed	Check that the value of 'MainDevice ESM state change request' (U40\G4096) is equal to the value of 'MainDevice ESM state change response' (U40\G4097), and that the value of 'SubDevice ESM state change request' (U40\G4112) of the target SubDevice is equal to the value of 'SubDevice ESM state change response' (U40\G4113). When an ESM state change request has been made to the MainDevice and the target SubDevice, an ESM state change request cannot be made to the next SubDevice until the request is completed.
2. Storing the ESM state in 'SubDevice ESM state change request' (U40\G4112)	Use a program to store the transition target ESM state in 'SubDevice ESM state change request' (U40\G4112). • Init: H0001 • Pre-Operational: 0002H • Safe-Operational: 0004H • Operational: 0008H
3. Checking that the value of 'SubDevice ESM state change request' (U40\G4112) is equal to the value of 'SubDevice ESM state change response' (U40\G4113)	When the request is completed, the same value as the 'SubDevice ESM state change request' (U40\G4112) will be stored in the 'SubDevice ESM state change response' (U40\G4113). (Completion of the request can be determined by checking that the same value is stored.)
4. Checking whether any error occurs	If necessary, check whether any error occurs. If an error occurs, 'SubDevice ESM state change error code' (U40\G4114) will be stored. When a detail error code is present, it will be stored in 'SubDevice ESM state change detail error code' (U40\G4116 to U40\G4117).
5. Storing 0000H (No request/ Clear request) in 'SubDevice ESM state change request' (U40\G4112)	Use a program to store 0000H (No request/Clear request for this area) in 'SubDevice ESM state change request' (U40\G4112). When 0000H (No request/Clear request for this area) is stored in 'SubDevice ESM state change response' (U40\G4113) by MXF (EC), the following buffer memory areas will be cleared to zero. • 'SubDevice ESM state change error code' (U40\G4114) • 'SubDevice ESM state change detail error code' (U40\G4116 to U40\G4117)

Concurrent ESM state change requests

- When 'SubDevice ESM state change request' (U40\G4112) is executed after 'MainDevice ESM state change request' (U40\G4096) is executed and before it is completed, an error will occur in 'SubDevice ESM state change request' (U40\G4112).
- When 'MainDevice ESM state change request' (U40\G4096) is executed after 'SubDevice ESM state change request' (U40\G4112) is executed and before it is completed, 'MainDevice ESM state change request' (U40\G4096) will be prioritized. The SubDevice will be in the ESM state specified in 'MainDevice ESM state change request' (U40\G4096), but 'SubDevice ESM state change request' (U40\G4112) will not result in an error.

Point

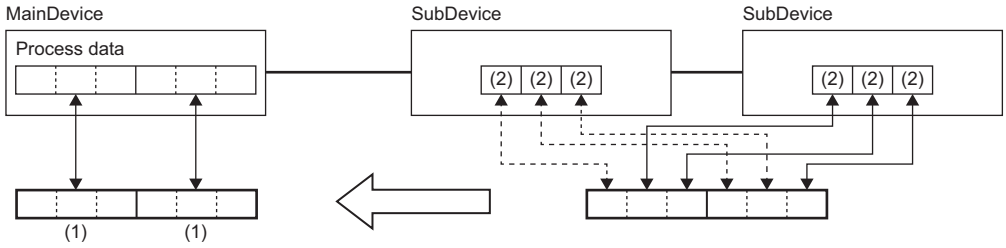
When a bus scan fails (a bus mismatch occurs), a corrective action can be taken, and then this function can be used to change the ESM state of the MainDevice, allowing communication to begin without resetting the controller.

8.4 Sync Unit Function

This function groups SubDevices and enables independent data exchange between them.

Overview

A sync unit is a unit that collects process data in the network and a MainDevice and SubDevices exchange data by using this unit.

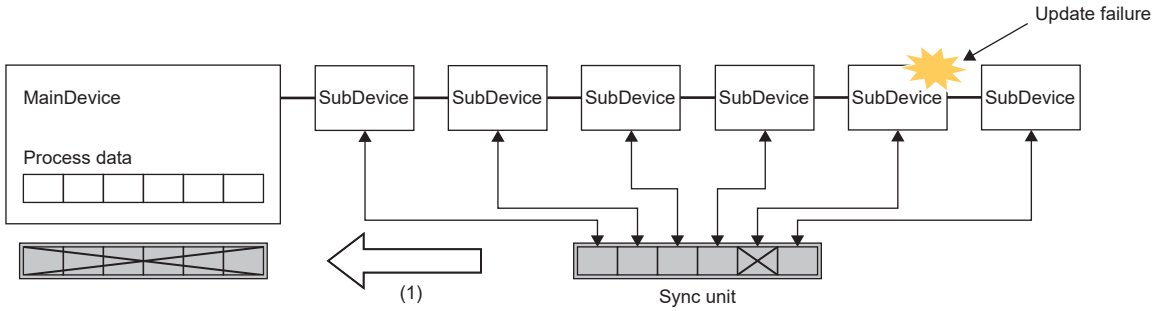


(1) MainDevice sync unit
(2) SubDevice sync unit

The MainDevice can combine the sync units for the SubDevices and allocate them to the sync units for the MainDevice. As the result, if a SubDevice where sync units are set fails to update the process data, the MainDevice can discard only the data of the SubDevices that belong to the same sync unit.

Ex.

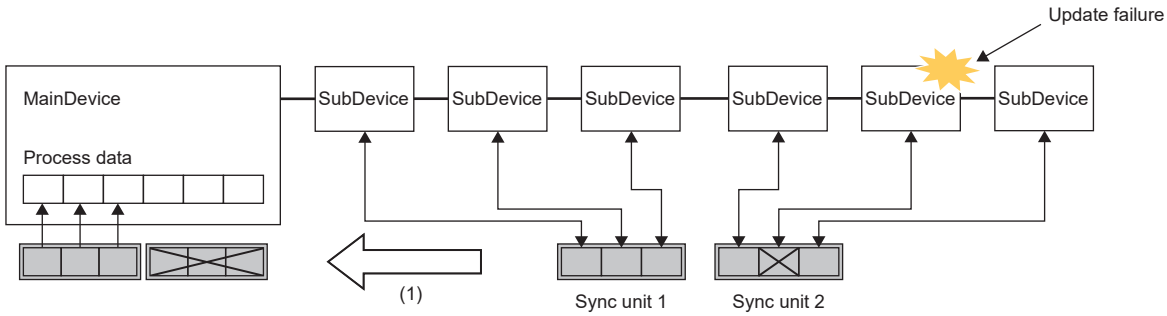
When one sync unit is set for the MainDevice (When this function is not used)



(1) If a communication data error exists even for a single device, all the process data will be discarded.

Ex.

When two sync units are set for the MainDevice



(1) Even if a communication data error exists, only the process data of sync unit 2 will be discarded, but the process data of sync unit 1 can be updated.

Setting method

To use this function, configure the following settings.

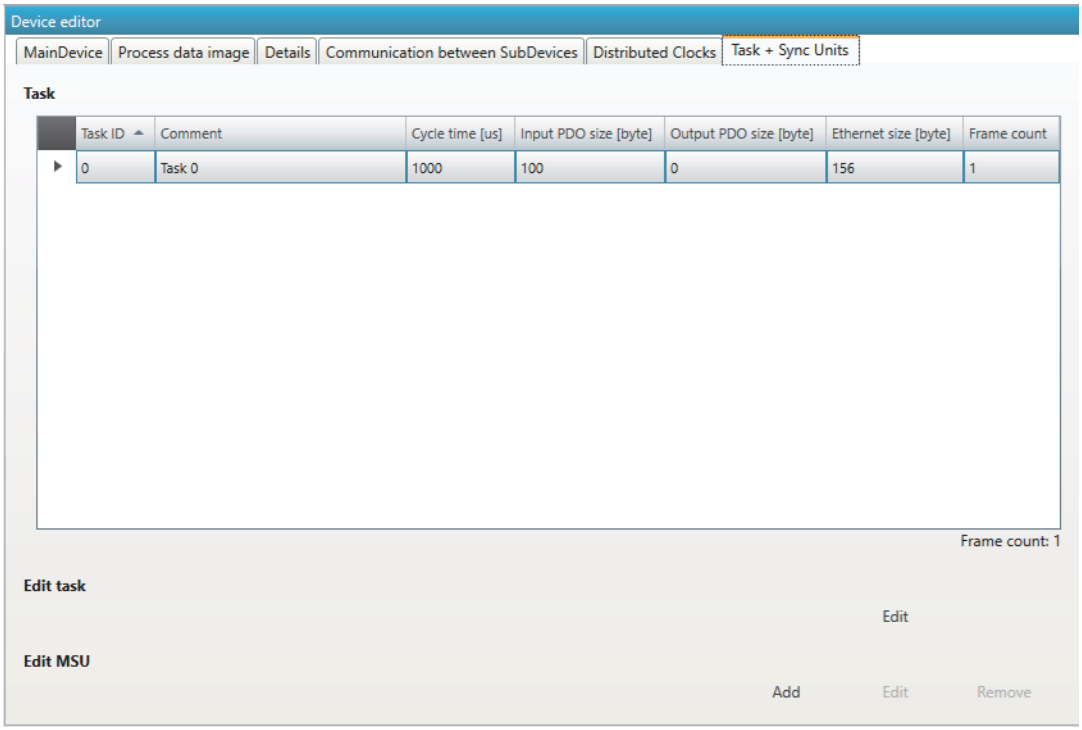
■How to configure the settings from the sync unit setting window of the own station and the target SubDevice

1. Open the module extended parameter window.

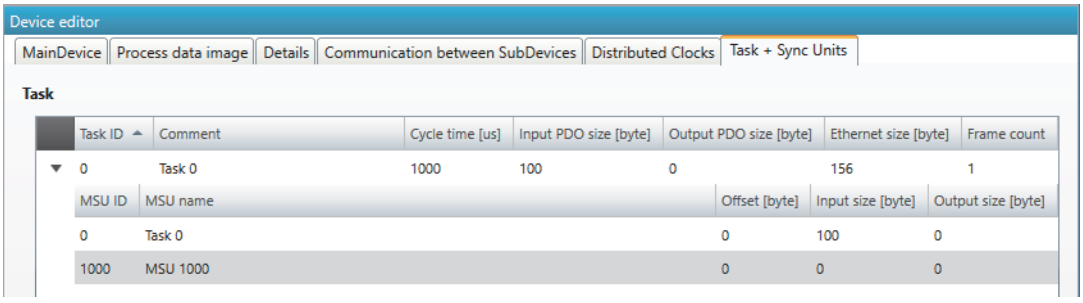
Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port1: EtherCAT)] ⇨ [Module Extended Parameter]

2. Set the MSU in the controller.

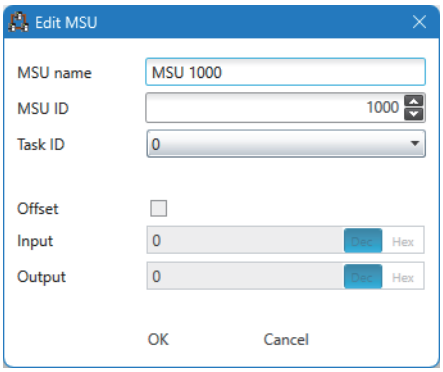
Own station ⇨ "Device editor" window ⇨ [Task + Sync Units] tab



3. From "Edit MSU", click the [Add] button to add a line for the MSU.

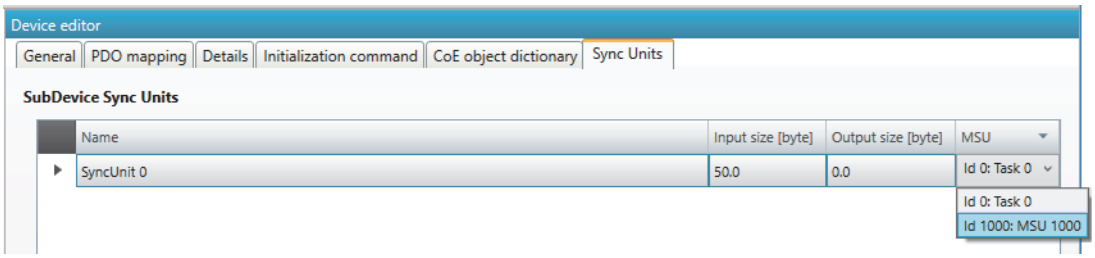


4. From "Edit MSU", click the [Edit] button to set the details for sync units for the controller.



5. Set the sync unit for the target SubDevice.

Target SubDevice ⇨ "Device editor" window ⇨ [Sync Units] tab



6. Click the "MSU" column and allocate the master sync unit.

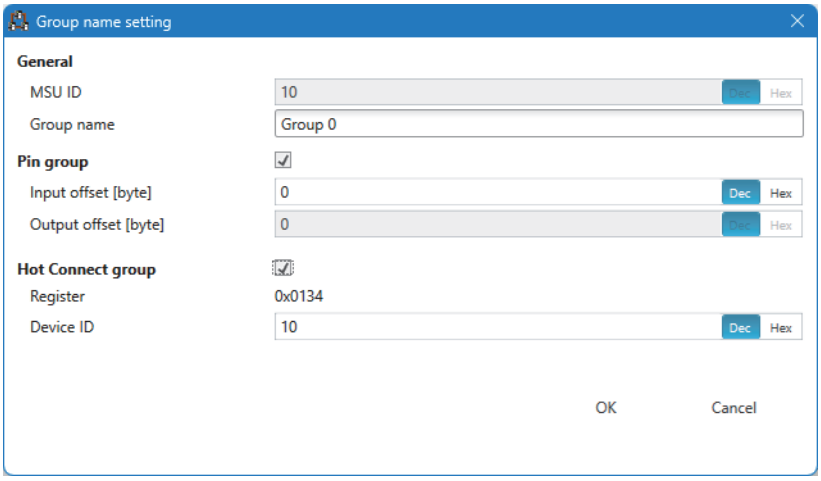
7. Set other SubDevices to be connected in the same manner.

■How to create a group and add a sync unit

1. Select the SubDevices to be grouped and create a group.

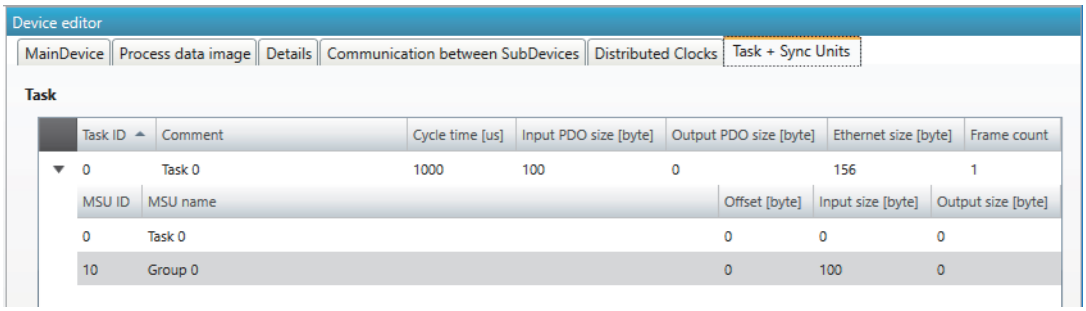
"Project explorer" window ⇨ Select the SubDevices ⇨ Right-click ⇨ "Create group"

2. In the "Group name setting" window, set a pin group and Hot Connect group. (Optional)



By setting the pin group, the MSU offset can be fixed. When the group is not set, the offset will automatically be adjusted to prevent overlap with other MSUs.
When the Hot Connect group is set, the sync unit will also be added.

3. When a group is created by clicking the [OK] button, the MSU will be created. SubDevices that belong to the created group will use the MSU.



8.5 Communication Between SubDevices Function

This function performs data exchange between SubDevices without data processing by the MainDevice (data transfer by a program).

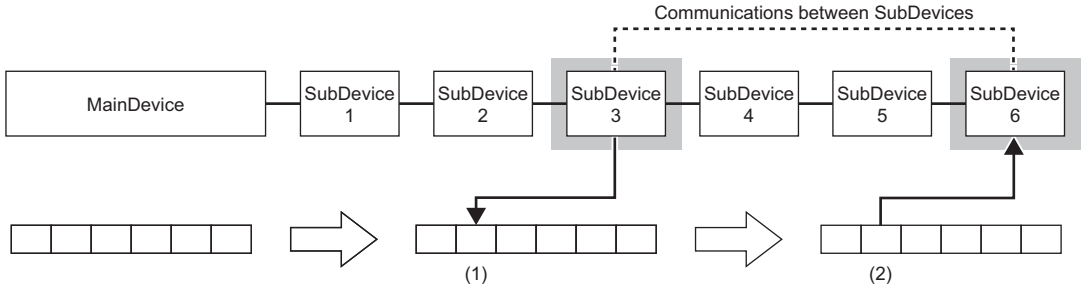
For data exchange using inter-SubDevice communication, the following methods are available.

- Same-cycle method (☞ Page 89 Same-cycle method)
- Next-cycle method (☞ Page 90 Next-cycle method)

Same-cycle method

The same-cycle method performs reading and writing of process data in the same cycle between SubDevices whose the communication between SubDevices function is set.

Since datagrams pass through the SubDevices in order from the MainDevice, the SubDevice that reads the process data must be positioned upstream (on the MainDevice side) of the SubDevice that writes the data.

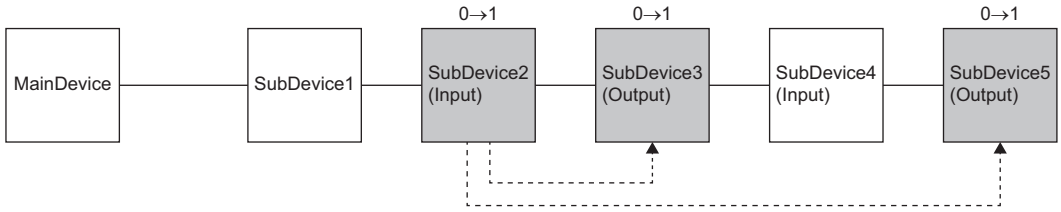


(1) Process data is read from SubDevice3.
(2) Process data read in (1) is written to SubDevice6.

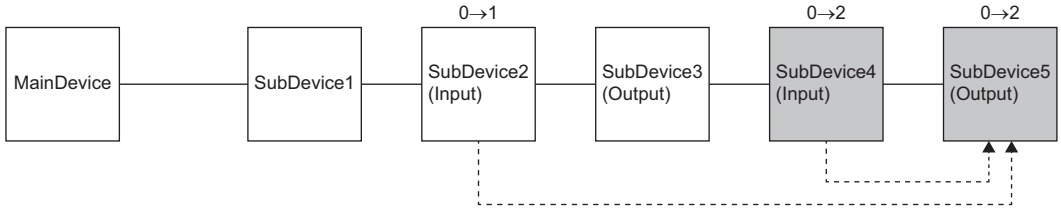
Precautions

In the same-cycle method, the following function and settings cannot be used. To use them, select the next-cycle method.

- A setting in which multiple different output SubDevices are assigned for a single input SubDevice



- A setting in which a single output SubDevice is assigned for multiple different input SubDevices



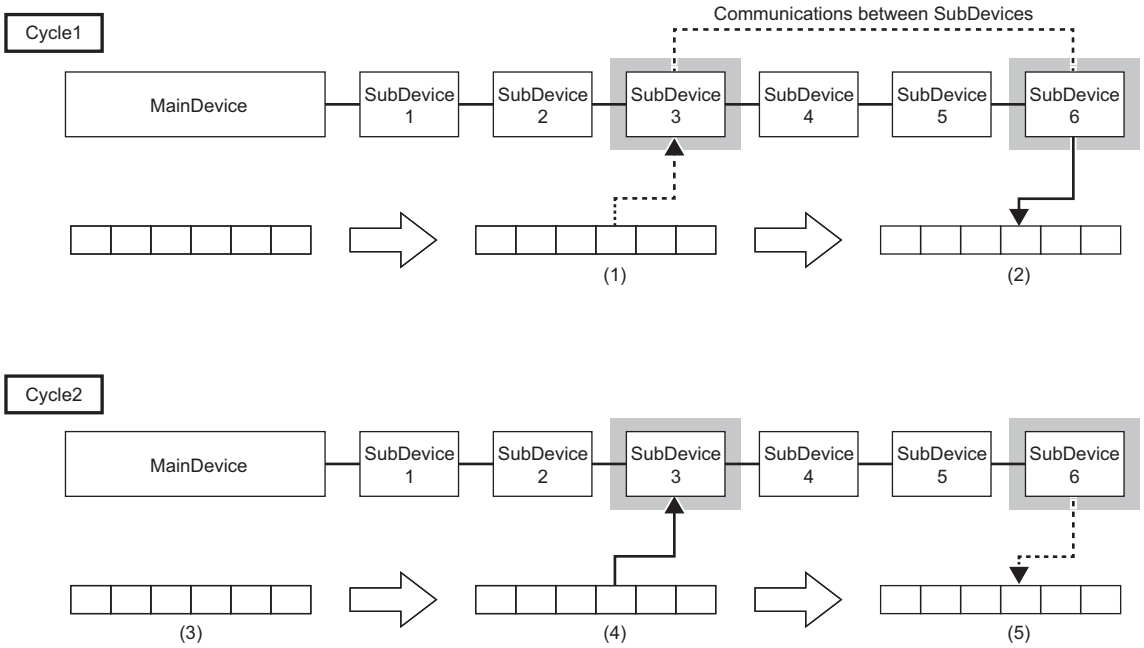
- A setting that includes SubDevices which have both Input and Output PDOs.

Next-cycle method

The next-cycle method performs communication across the next cycles between SubDevices whose the communication between SubDevices function is set.

Data will be read from the sending-side SubDevice in the current cycle and will be written to the receiving-side SubDevice in the next cycle.

For the next-cycle method, the order of SubDevices in the network is not affected.

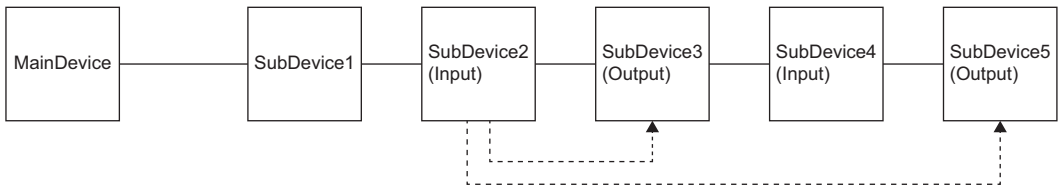


(1) Process data from the previous cycle is written to SubDevice3.
(2) Process data is read from SubDevice6.
(3) The WKC check is performed.
(4) Process data read in the previous cycle is written to SubDevice3.
(5) Process data for the next cycle is read.

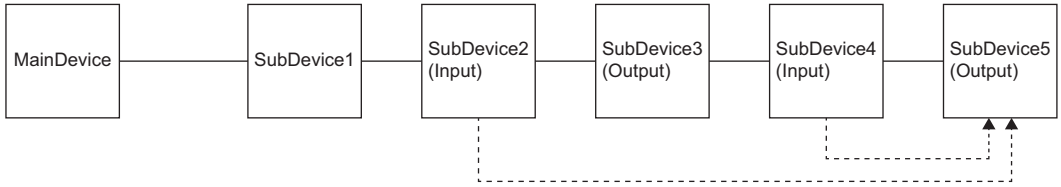
Precautions

The following shows the operation when the next-cycle method is set, and the number of SubDevices differ between input and output.

- When the setting is configured so that multiple different output SubDevices are assigned for a single input SubDevice, the process data of the input SubDevice will be written to all output SubDevices.



- When one output SubDevice is assigned to multiple different input SubDevices, the process data of the most downstream input SubDevice will be written to the output SubDevice.



Setting method

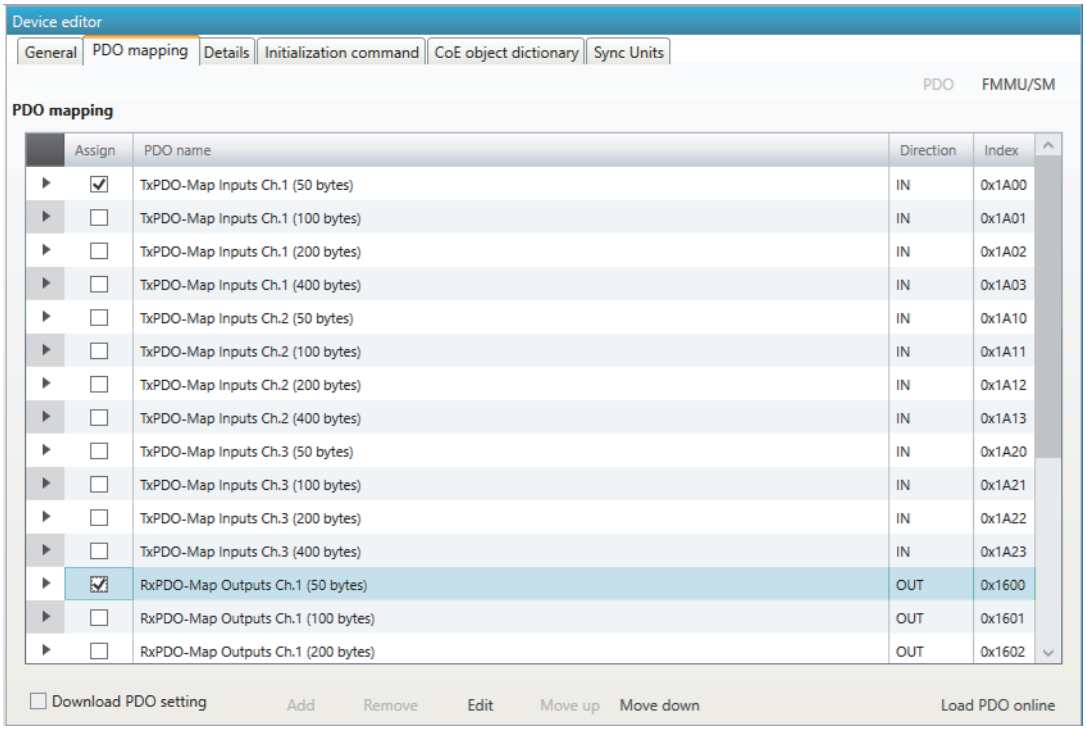
To use this function, configure the following settings.

1. Open the module extended parameter window.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port1: EtherCAT)] ⇨ [Module Extended Parameter]

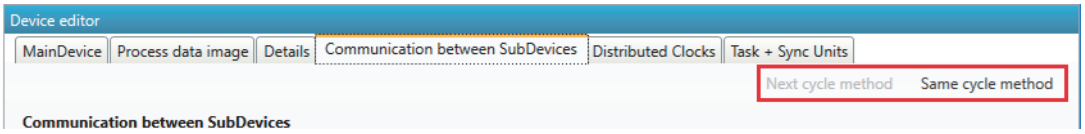
2. Assign PDOs of SubDevices to be used for inter-SubDevice communication.

Target SubDevice ⇨ "Device editor" window ⇨ [PDO mapping] tab

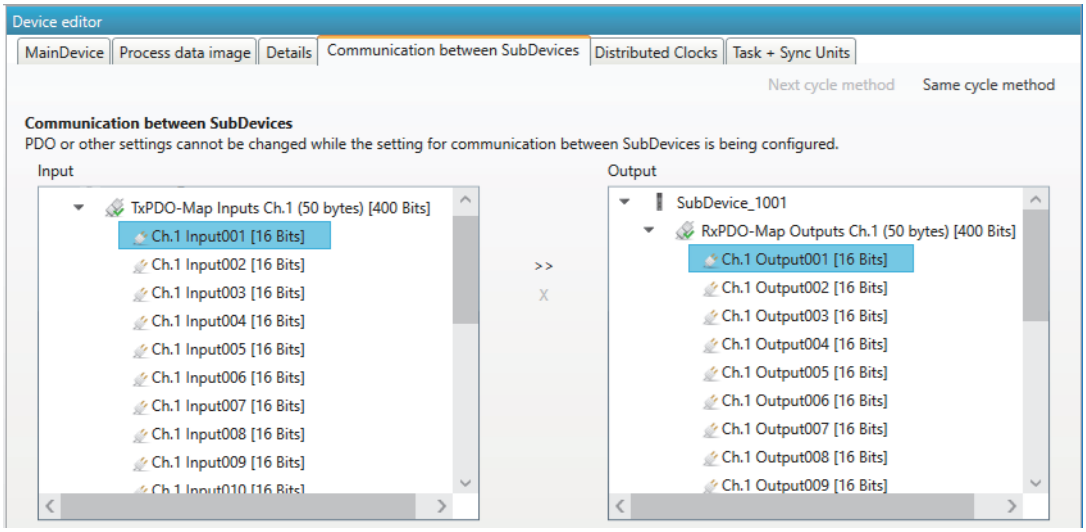


3. Configure the inter-SubDevice communication settings for the controller. The next-cycle method is shown below. When setting the same-cycle method, click the [Same cycle method] button.

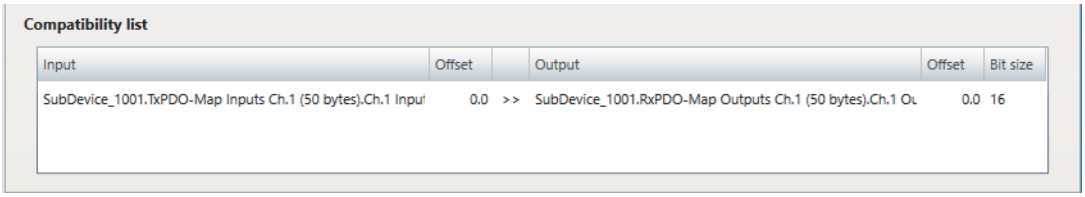
[Own station] ⇨ "Device editor" window ⇨ [Communication between SubDevices] tab



4. Select the data to which to perform inter-SubDevice communication on the "Input" side and the "Output" side, and click the [>>] button.



5. When the settings are completed, the details will be displayed in "Compatibility list".

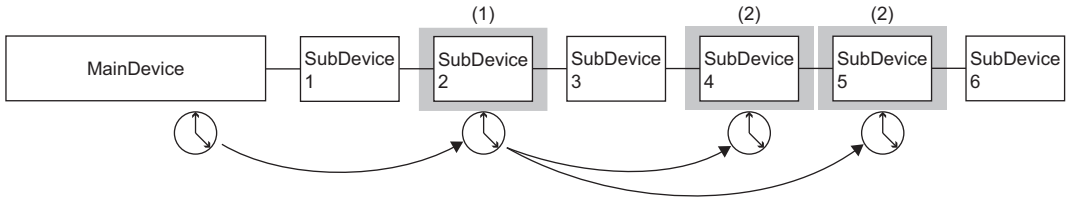


8.6 Distributed Clock Function

This function performs time synchronization for all EtherCAT devices (MainDevices and SubDevices) that are connected in EtherCAT and support the distributed clock.
Synchronizing the time of EtherCAT devices enables simultaneous input and output for all the EtherCAT devices using the distributed clock.

Overview

DC synchronization of the controller (distributed clock synchronization) supports the bus shift method in which the time of the SubDevice clock is synchronized by correcting the reference clock based on the MainDevice time.



(1) Reference clock
(2) SubDevices that use the distributed clock

The operation modes of the distributed clock are listed below.

Item	Description
Freerun	In this method, the MainDevice and SubDevices input and output process data without synchronization between the SubDevices.
DC synchronization	Synchronizes the time between SubDevices. In this method, synchronization is achieved by starting the I/O processing based on the synchronized time.

Point

When DC synchronization is used, note that the following problems may occur when an Ethernet cable is disconnected or restored.

- Synchronization accuracy drops.
- A synchronization loss occurs. (Some SubDevices transition to a status such as Safe-Operational.)
- An error is detected and the function is not restored depending on the SubDevices.

■Reference clock

This clock provides time information to be used as a reference during time synchronization with the distributed clock.
A device that serves as the reference clock provides time information to other devices in the network.
A SubDevice that serves as the reference clock for DC synchronization can be checked using the following buffer memory area.

Name	Buffer memory	Reference
Current reference clock supply node address	U40\G16448	Page 201 'Current reference clock supply node address' (U40\G16448)

Freerun setting method

This section describes how to set up freerun.

Point

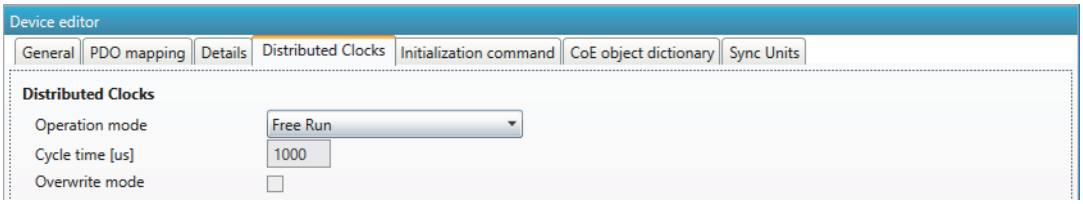
To check if this function is supported by a SubDevice and for the setting procedure, refer to the manual of the SubDevice used.

1. Open the module extended parameter window.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port1: EtherCAT)] ⇨ [Module Extended Parameter]

2. From the SubDevice distributed clock setting window, select "Free Run"*1 as the operation mode.

Target SubDevice ⇨ "Device editor" window ⇨ [Distributed Clocks] tab



*1 The name defined in the ESI file is displayed, so the name may differ depending on the SubDevice.

DC synchronization setting method

This section describes how to set up DC synchronization. DC synchronization requires separate settings for the MainDevice and SubDevices.

Point

To check if this function is supported by a SubDevice and for the setting procedure, refer to the manual of the SubDevice used.

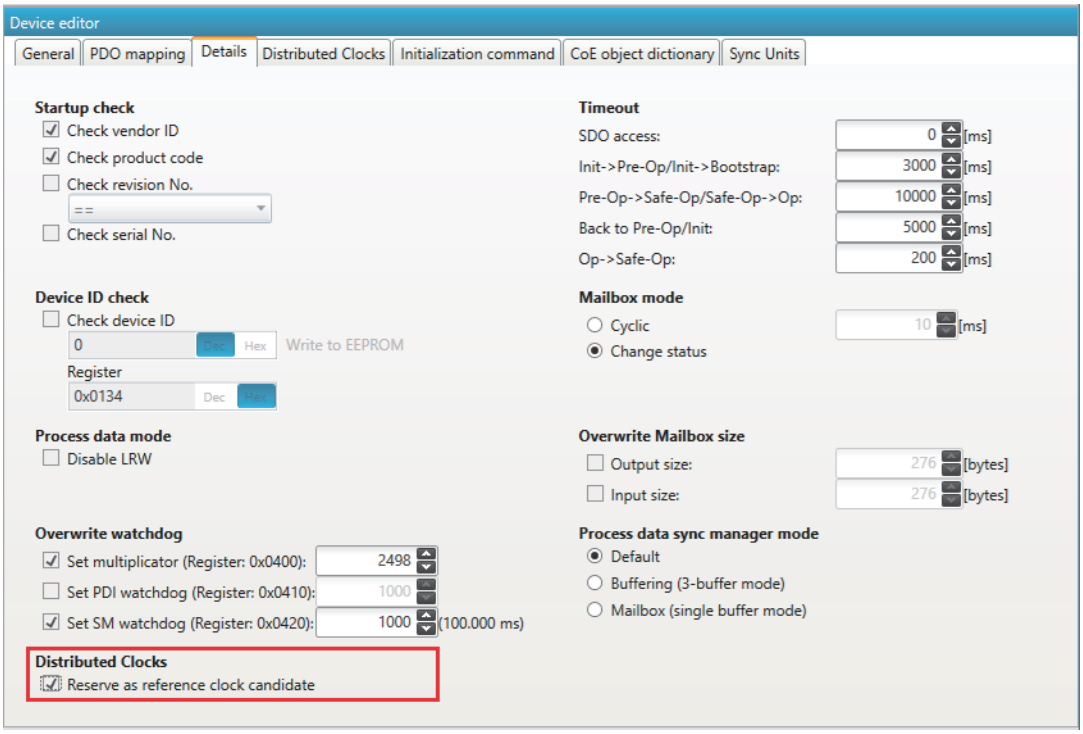
■Setting method on the SubDevice side

1. Open the module extended parameter window.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port1: EtherCAT)] ⇨ [Module Extended Parameter]

2. Reserve a SubDevice for which DC synchronization is to be performed as a reference clock candidate. (Optional)

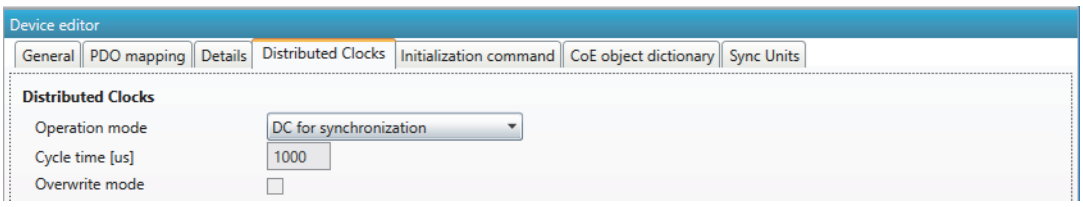
Target SubDevice ⇨ "Device editor" window ⇨ [Details] tab



- By enabling this setting, if the reference clock is isolated from the network due to disconnection, power-off, or other reasons, the set SubDevice can take over as the reference clock.
- When this setting is enabled for multiple SubDevices, the reference clock will be selected among the devices.
- If there is no SubDevice that can be used as the reference clock, DC synchronization cannot be executed.

3. Select "DC for synchronization" of the operation mode. (Required)*1

Target SubDevice ⇨ "Device editor" window ⇨ [Distributed Clocks] tab

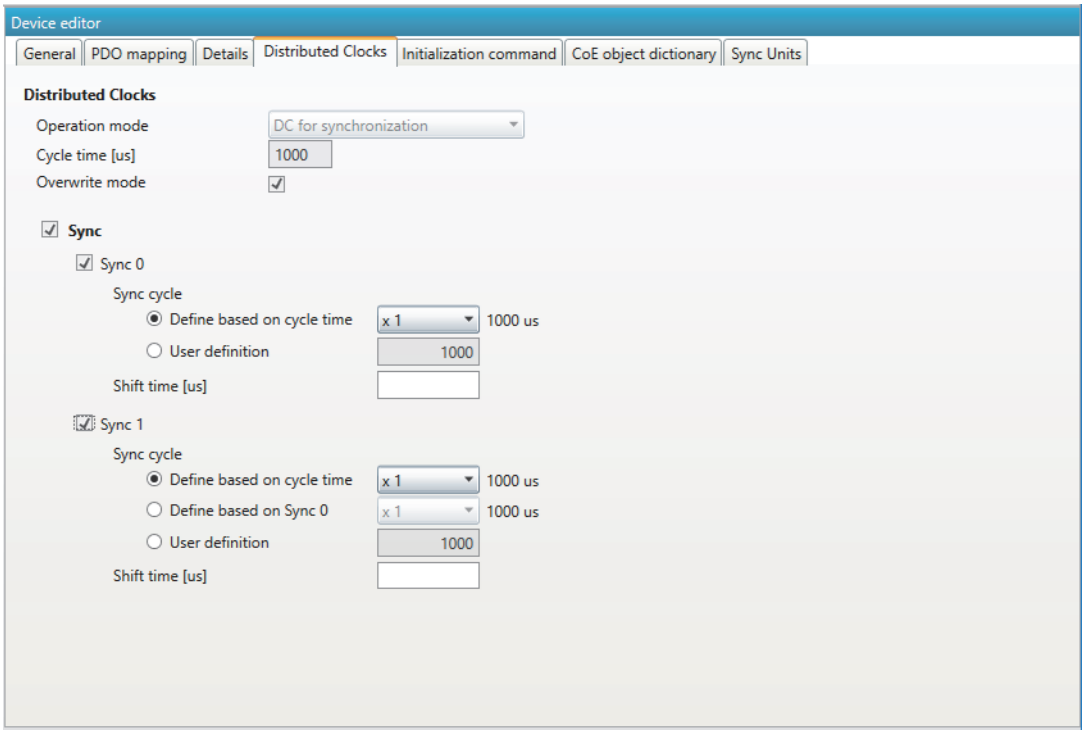


*1 The name defined in the ESI file is displayed, so the name may differ depending on the SubDevice.

4. Change the synchronization cycle. (Optional)

When the synchronization cycle is not changed, synchronization is executed based on the MainDevice cycle time.

Target SubDevice ⇨ "Device editor" window ⇨ [Distributed Clocks] tab



Select the checkbox of "Overwrite mode" to enable the synchronization cycle change.

Item	Description
Sync 0	Sync 0 is the main synchronization cycle for SubDevices. For applications and details of "Sync 0" of the SubDevice, refer to the manual of the SubDevice used.
Sync 1	Sync 1 is an auxiliary synchronization cycle for synchronizing at a timing different from "Sync 0". For applications and details of "Sync 1" of the SubDevice, refer to the manual of the SubDevice used.
Sync cycle	Set the cycle for synchronizing the SubDevice. In general, the MainDevice communication cycle is used as the reference, and the time is synchronized at each cycle (the same value as the communication cycle is the synchronization cycle). When the operation cycle of the SubDevice is long, set the cycle as desired such as once at the Nth cycle (multiples of N of the communication cycle are the synchronization cycle).
Shift time	Allows for shifting the timing for synchronizing the SubDevice. To correct or intentionally shift the operation timing between SubDevices (such as at the start of processing and when reflecting in input and output), the synchronization timing can be delayed or advanced.

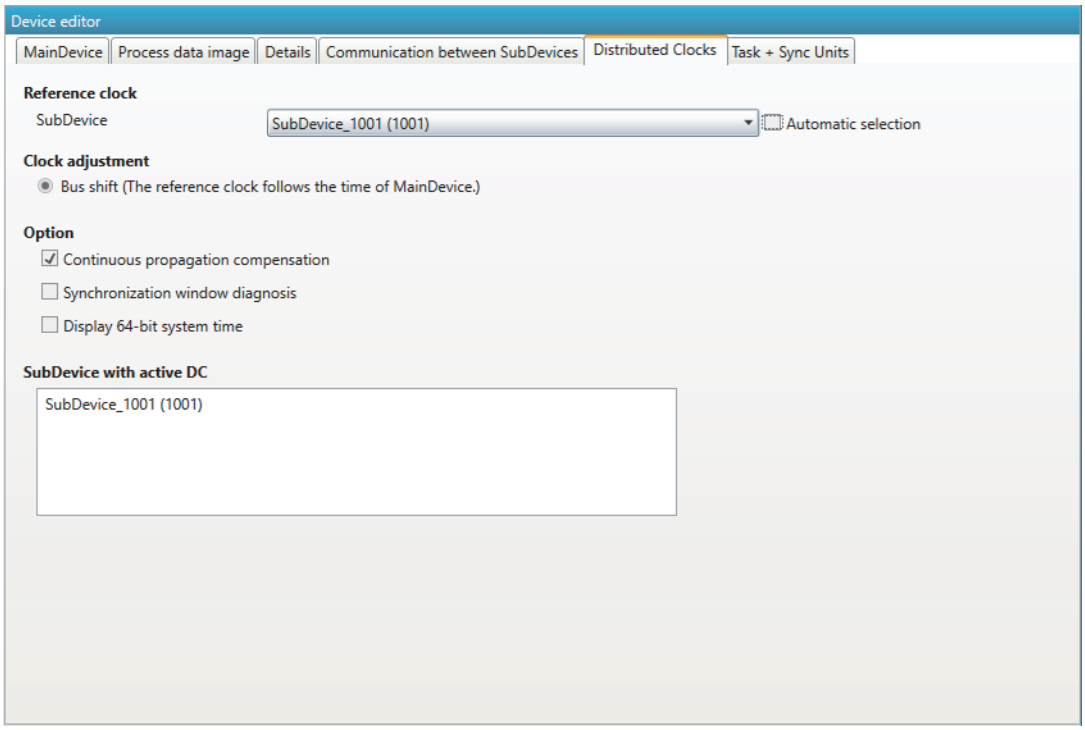
■Setting method on the MainDevice side

1. Open the module extended parameter window.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port1: EtherCAT)] ⇨ [Module Extended Parameter]

2. Select the reference clock. (Required)

Own station ⇨ "Device editor" window ⇨ [Distributed Clocks] tab



- Manual selection (When the auto selection checkbox is not selected): A manually-selected SubDevice will be used as the reference clock.
- Auto selection (When the auto selection checkbox is selected): Among the SubDevices displayed on the list, the one that is closest to the own station and whose DC Mode is synchronization mode will be used as the reference clock.

3. Specify the option. (Optional)

Item	Description
Continuous propagation compensation	Enabling this setting is recommended. By enabling this setting, a DC synchronization deviation caused by the propagation delay between the SubDevices will be corrected. If a disconnection or wiring change occurs during communication, the propagation delay between the SubDevices will change, causing a deviation in DC synchronization. Changes in propagation delay are regularly checked and DC synchronization deviation is corrected to compensate for synchronization.
Synchronization window diagnosis	By enabling this setting, the SubDevices will be monitored to detect synchronization losses (where the time deviates by more than a certain amount from the reference clock).
Display 64-bit system time	When this setting is enabled, the time of the reference clock will be synchronized to 64 bits (unit: ns). When this setting is disabled, only the lower 32 bits will be synchronized. When the SubDevice to be used is of the type that acquires I/O timing at the specified time, this setting may change the following ranges within which the specification and acquisition are possible. Enable this setting if needed. • When disabled: Approximately 4 seconds (4294967296ns) • When enabled: Approximately 571 years

Process data synchronization via the DCM

Enabling the DCM ensures that all the set SubDevices use the same cycle process data at the DC synchronization timing.

Point

In DC synchronization, the I/O processing start timing will be synchronized between SubDevices, but the send/receive timing of process data communication will not be synchronized. Therefore, process data from a different cycle may be used depending on the SubDevice. To use the same cycle process data, enable the DCM.

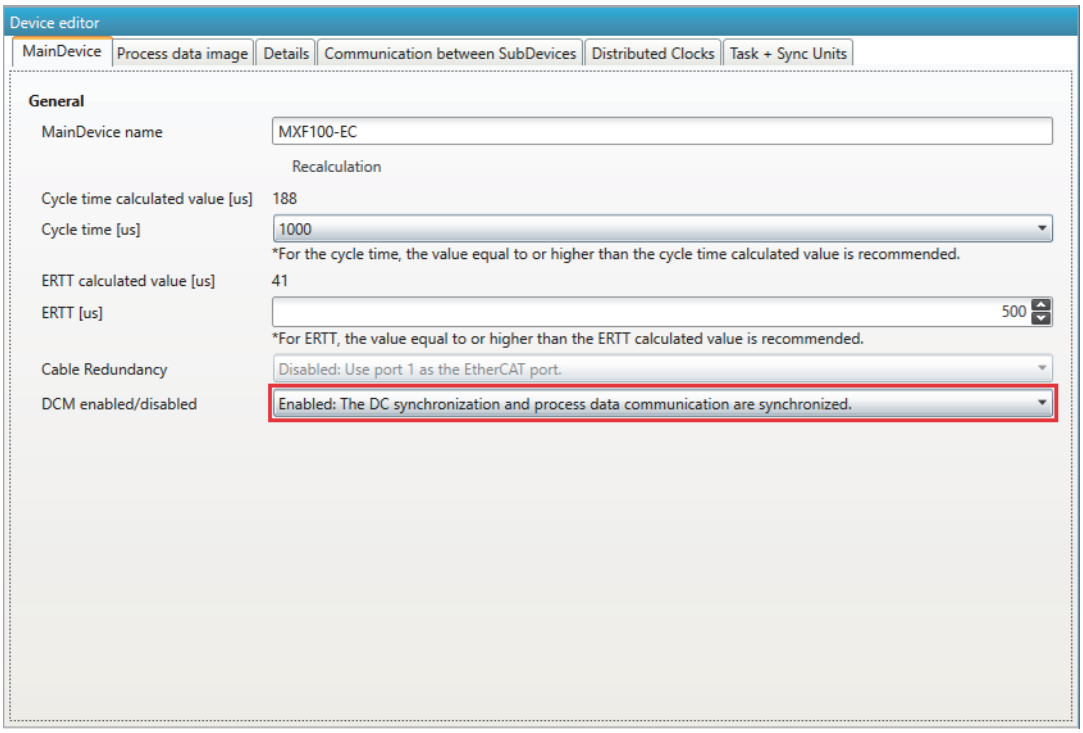
■Setting method

1. Open the module extended parameter window.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port1: EtherCAT)] ⇨ [Module Extended Parameter]

2. Set "DCM enabled/disabled" to "Enabled".

Own station ⇨ "Device editor" window ⇨ [MainDevice] tab



DC synchronization status and synchronization window diagnostics

The synchronization window diagnostics checks whether the time of all SubDevices subject to DC synchronization is synchronized with the reference clock.

When the time of one or more SubDevices deviates from the reference clock by a certain amount or more, an error will be notified.

This function only operates when "Synchronization window diagnosis" is enabled.

In addition, when the MainDevice is Pre-Operational or lower, the synchronization window diagnostics will be stopped.

■Related buffer memory areas

The following table lists the related buffer memory areas.

Name	Buffer memory	Reference
DC synchronization setting disabled	U40\G16389.0	Page 200 'DC/DCM error status' (U40\G16389)
DC Sync stopped	U40\G16389.2	
DC SubDevice Sync error	U40\G16389.3	
DC Sync error counter	U40\G16516 to U40\G16517	Page 203 'DC Sync error counter' (U40\G16516 to U40\G16517)

DCM synchronization diagnostics

The DCM synchronization diagnostics checks whether the MainDevice is synchronized with the DC system time.
An error will be notified even when synchronization is difficult because the reference clock greatly differs between the MainDevice and the DC system time.

■Related buffer memory areas

The following table lists the related buffer memory areas.

Name	Buffer memory	Reference
DCM setting disabled	U40\G16389.8	Page 200 'DC/DCM error status' (U40\G16389)
DCM Sync error	U40\G16389.9	
DCM Sync error counter	U40\G16518 to U40\G16519	Page 203 'DCM Sync error counter' (U40\G16518 to U40\G16519)

DC system time

DC synchronization synchronizes the time of SubDevices. This synchronized time is called the DC system time.
The reference clock will be the synchronization source of this DC system time, and other SubDevices will be synchronized with the reference clock.
When the DCM is enabled, the time of SubDevices will be synchronized with the local time of the MainDevice.
During DC synchronization, the reference clock is corrected using the local time of the MainDevice to synchronize the time of SubDevices.

■Related buffer memory areas

The following table lists the related buffer memory areas.

Name	Buffer memory	Reference
DC system time disabled	U40\G16389	Page 200 'DC/DCM error status' (U40\G16389)
DC system time	Lower: U40\G16452 to U40\G16453 Upper: U40\G16454 to U40\G16455	Page 201 'DC system time (upper bits)' (U40\G16454 to U40\G16455) and 'DC system time (lower bits)' (U40\G16452 to U40\G16453)
DCM Sync0 offset	U40\G16458 to U40\G16459	Page 202 'DCM Sync0 offset' (U40\G16458 to U40\G16459)

■Precautions

- The local time of the controller and the DC system time will be reset and will start from 0 every time DC synchronization is initialized.
- The latest DC system time (the time at the cyclic start of the previous cycle) can be acquired with 'DC system time' (U40\G16452 to U40\G16455).
- When "Display 64-bit system time" is disabled, only the lower 32 bits will be synchronized. In that case, the upper 32 bits of 'DC system time' (U40\G16452 o U40\G16455) will be corrected by the MainDevice, but they do not necessarily match the SubDevices.
- DC synchronization synchronizes the time of SubDevices with the reference clock by communication. Therefore, synchronization is not possible in the following cases.
  - The reference clock is not present.
  - A SubDevice is disconnected.
  - The time of SubDevices is deviated due to a wiring change, communication error, or difference in clocks between SubDevices.

8.7 Redundancy Function

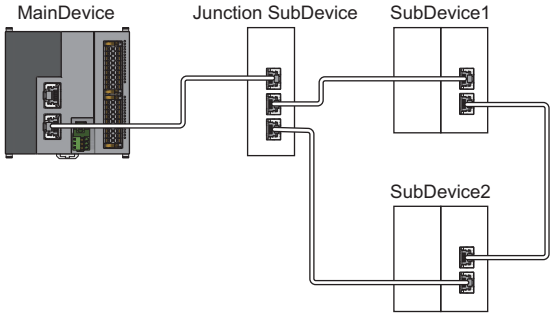
This function increases network redundancy by creating a ring topology in the EtherCAT system, including the controller, allowing communication to be maintained in the event of a cable or device failure.

Junction Redundancy

Junction Redundancy is a configuration method that uses Junction SubDevices (branch SubDevices) to increase network redundancy.

Ex.

The MainDevice branches the network via Junction SubDevices, and the SubDevices are connected to each other at the branch points, creating a ring topology redundant network.



8.8 Hot Connect Function

Hot Connect allows SubDevices to be added to or removed from an active system in the EtherCAT network.

Overview

SubDevices to be connected to the MainDevice are categorized into required SubDevices and optional SubDevices.

Item	Description
Required SubDevice	Refers to SubDevices that are not set to the Hot Connect group. Required SubDevices must always be connected to the network.
Optional SubDevice	Refers to SubDevices that are set to the Hot Connect group. Optional SubDevices can be either connected to the network or not. SubDevices can also be connected or disconnected while the system is operating. (Connection and disconnection are performed for each Hot Connect group.)

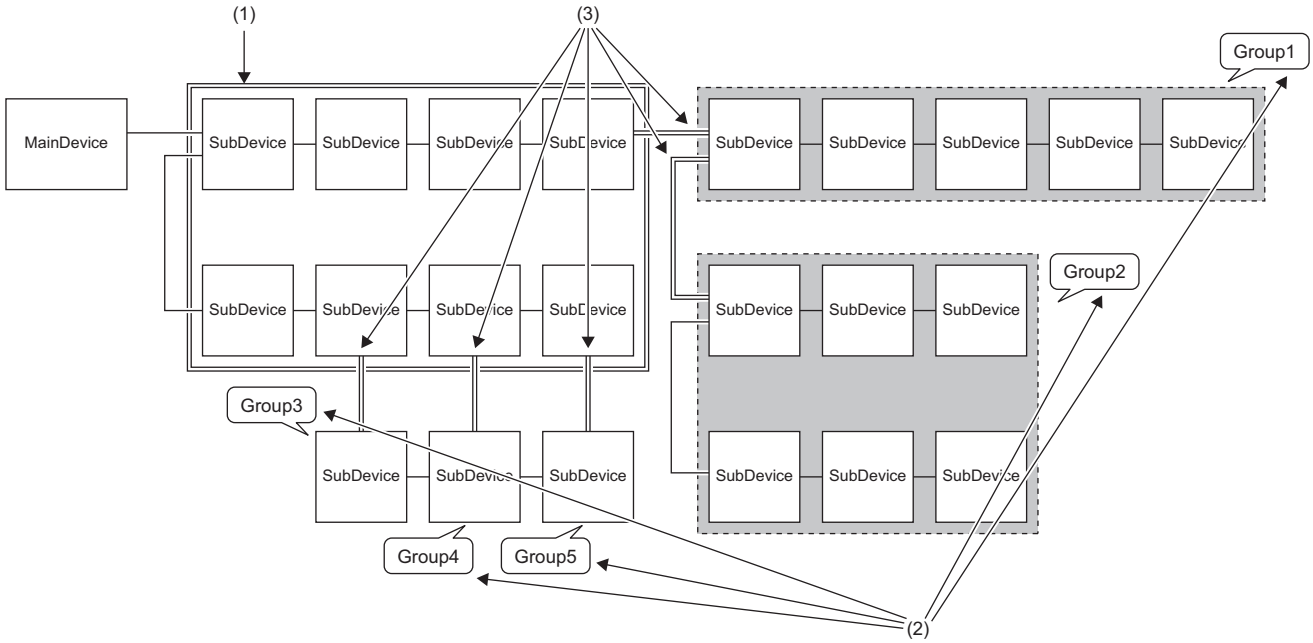
Hot Connect application

The following are examples of uses for Hot Connect.

- SubDevices that were not present immediately after the system was powered on can be connected while the system is operating.
- For cases such as device replacement, the optional SubDevice can be disconnected or connected while the system is operating.

Connection example

The following figure shows a Hot Connect group connection example.



(1) Required SubDevice
A SubDevice that is not a Hot Connect group member is a required SubDevice.
(2) Hot Connect group
A SubDevice that is a Hot Connect group member is an optional SubDevice.
The number of member SubDevices can be one or more for each Hot Connect group.
(3) Unoccupied port
Hot Connect groups can be connected or disconnected even while the system is operating.

Setting method

The procedure for setting up a Hot Connect group is described below.

■Setting on the SubDevice side

1. Set the device ID to the first SubDevice for which the Hot Connect group is to be set.

For the device ID setting method, refer to the manual of the SubDevice used.

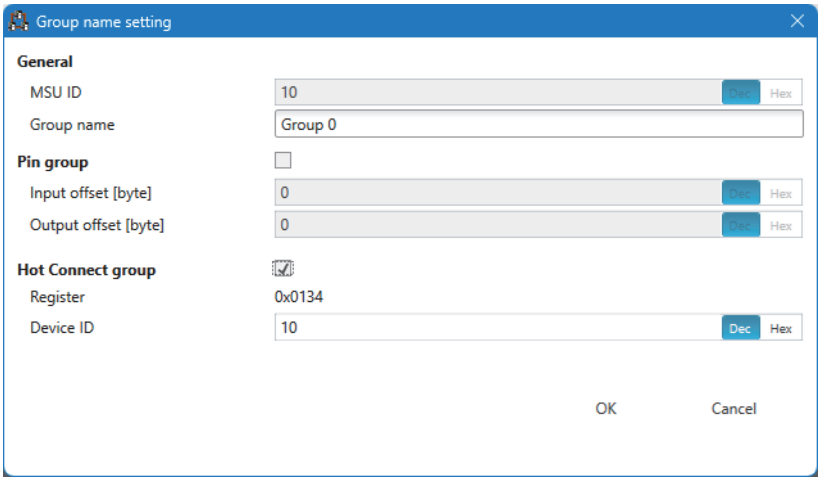
■Setting on the MainDevice side

1. Open the module extended parameter window.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port1: EtherCAT)] ⇨ [Module Extended Parameter]

2. Select the SubDevices to be set in the Hot Connect group and create a group.

"Project explorer" window ⇨ Select SubDevices and right-click. ⇨ "Create group"

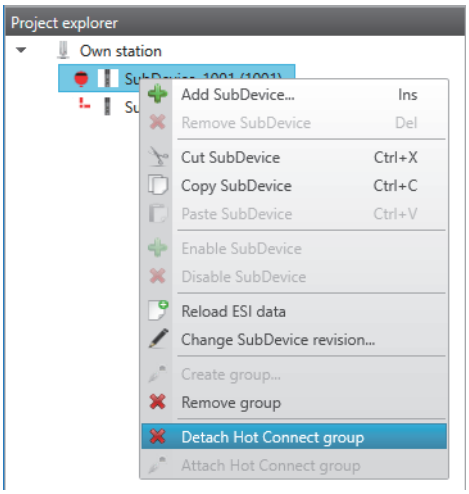


3. Set the following items for the created group, and click the [OK] button.

- Enter a group name.
- Select the Hot Connect group checkbox.
- In Device ID, enter the device ID of the first SubDevice in the Hot Connect group.

4. To clear the restriction of the Hot Connect group position, detach the Hot Connect group.

Select the first SubDevice in the Hot Connect group, right-click, and click "Detach Hot Connect group".



Point

Hot Connect group positions will be restricted to the positions shown in the topology view by default, but this restriction can be cleared by detaching the Hot Connect group.

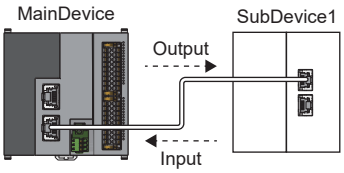
Hot Connect group events

The following table lists the events to be registered when an optional SubDevice is disconnected or returned.

Event code (Hex)	Name
00665H	Hot Connect group return detection completion notification
00666H	Hot Connect group disconnection detection completion notification

8.9 Output Hold Clear Setting Function

This function holds or clears the output on the sending side when the controller CPU or motion function is changed to STOP or when a stop error occurs.
The output on the sending side refers to the PDO output data from the MainDevice (controller) to the SubDevice.



This function runs for each SubDevice based on the operating status of the controller CPU or motion function and the error status. The operating status and error status that are the basis for this function differ depending on whether the module is controlled by the motion system.

Item	Operating status and error status
Module not controlled by the motion system	Operates when the operating status of the CPU function is STOP or when the program stops due to an error that occurred in the controller.
Module controlled by the motion system	Operates when the operating status of the motion function is STOP or when the motion operation stops due to an error that occurred in the controller.

*1 The motion system controls the main module and extension module that meet any of the following conditions when the motion system starts up.
· When an MC_TRIGGER_REF type or MC_OUTPUT_REF type global label refers to the refresh target (network label or device) of cyclic data of a main module or extension module
· When an MC_TRIGGER_REF type global label refers to a CANopen object of a main module or extension module
· Modules that refer to the input (X) and output (Y) that have been set to the module synchronization timing control mode with an MC_OUTPUT_REF type global label
· Modules that refer to the clutch signal setting of the advanced synchronization control function

Point

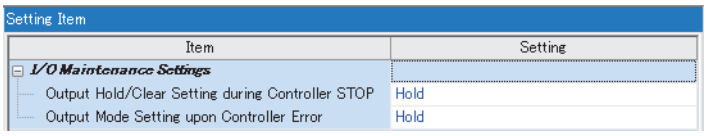
- The operating status of the CPU function can be checked using the system monitor.
- The stop error status of the CPU function and motion function can be checked by executing module diagnostics.
- The operating status and stop error status of the motion function can be checked by using the label.

For the system monitor, module diagnostics, and labels, refer to the following.
MELSEC MX Controller MX-F Model User's Manual

I/O maintenance settings

Configure the settings using the module parameters for the EtherCAT port.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port1: EtherCAT)] ⇨ [Module Parameter (EtherCAT)] ⇨ [Application Settings]



Item	Description	Setting range
Output Hold/Clear Setting during Controller STOP	Sets whether to hold or clear the PDO data output when the CPU or motion function of the controller changes to STOP. This controller can only be set to "Hold".	Hold
Output Mode Setting upon Controller Error	Sets whether to hold or clear the PDO data output when the CPU or motion function of the controller stops due to an error.	• Hold (default) • Clear

Point

If a controller stop error occurs while the ESM state of the MainDevice is SAFEOP or higher, the controller transitions the ESM state of the MainDevice and SubDevices to SAFEOP.

Output hold clear setting parameter combination

The output results depending on the parameter combinations for output hold clear settings and the controller status are shown below.

■In the STOP state without stop error

The output operates as follows according to the setting when the controller is STOP.

When the controller is STOP	When a controller stop error occurs	Output result
Hold	—	Hold

■In the RUN state with stop error

The output operates as follows according to the setting when a controller stop error occurs.

When the controller is STOP	When a controller stop error occurs	Output result
—	Hold	Hold
—	Clear	Clear

■In the STOP state with stop error

The output is held when both the settings for when the controller is STOP and for when a controller stop error occurs are specified as "Hold".

If either of the settings for when the controller is STOP or for when a controller stop error occurs is specified as "Clear", the value will be cleared.

When the controller is STOP	When a controller stop error occurs	Output result
Hold	Hold	Hold
Hold	Clear	Clear

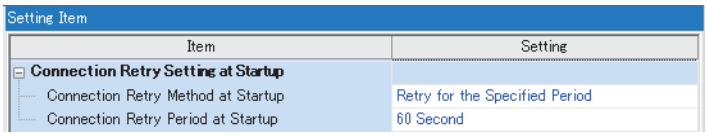
Point

Output to the module (SubDevice) controlled by the motion system is held regardless of the RUN/STOP status, the presence or absence of a stop error, and the settings.

8.10 Connection Retry Setting at Startup

Use the module parameters to configure the setting. During retries, errors such as bus mismatches will not be detected.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port1: EtherCAT)] ⇨ [Module Parameter (EtherCAT)] ⇨ [Application Settings]



Item	Description	Setting range
Connection Retry Method at Startup	Sets the connection retry method when communication with a SubDevice fails during the controller startup.	• Retry Endlessly • Retry for the Specified Period (default)
Connection Retry Period at Startup	Sets the connection retry time when communication with a SubDevice fails during the controller startup. Connection retries are performed once per second during the connection retry period.	1 to 65535 (Default: 60 seconds)

8.11 Network Communication Cycle Synchronization

This function synchronizes program execution and data update timing of the controller according to the communication cycle of the EtherCAT network.

For details on program execution and data flow when the network communication cycle synchronization function is used, refer to the following.

☞ Page 220 Processing time of process data communication (PDO communication)

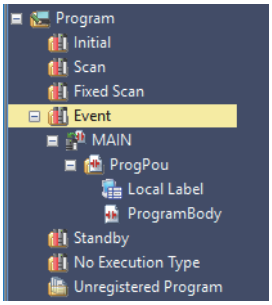
Precautions

- The MX-F (Support EtherCAT) supports the basic cycle only. It does not support the normal-speed and low-speed cycles.
- In a network communication cycle synchronization program, data updates are synchronized only for SubDevices with DC synchronization (Distributed clock) enabled. For SubDevices with DC synchronization disabled, data update timing is not synchronized. For details on data update timing for SubDevices with DC synchronization disabled, refer to the following.

☞ Page 224 PDO transmission delay time (Network communication cycle asynchronization)

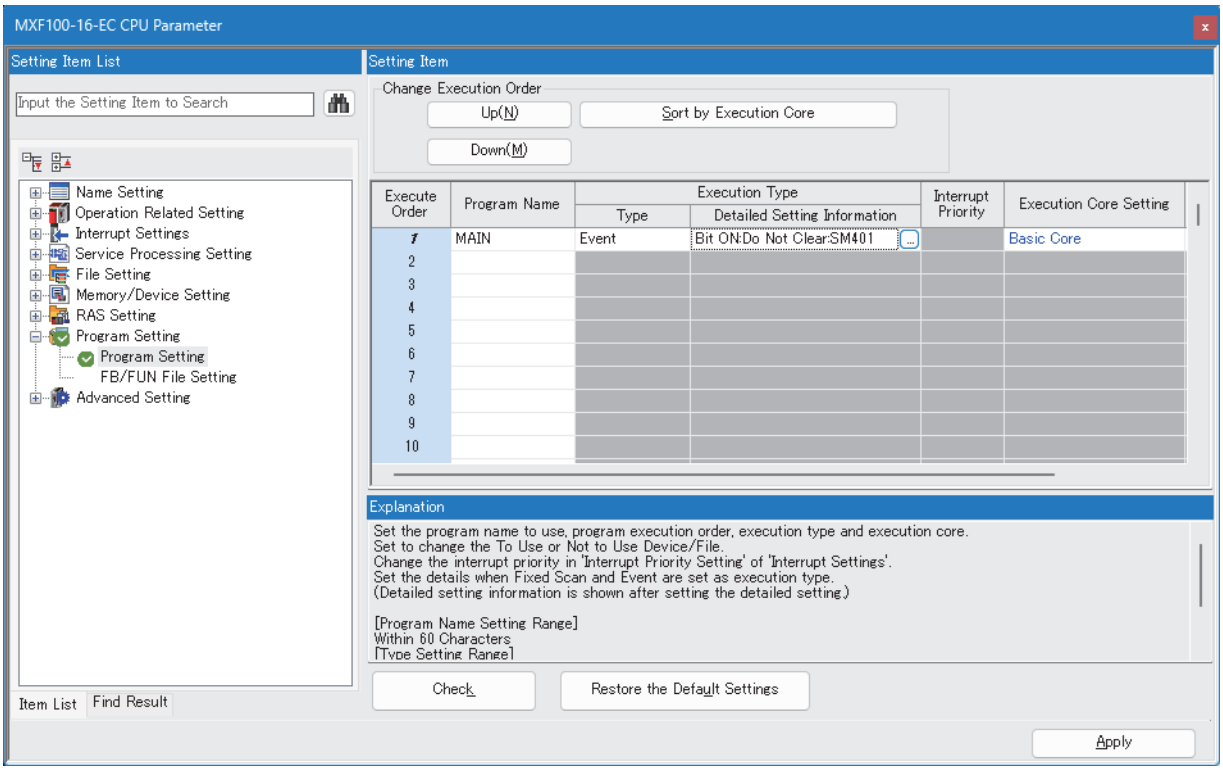
Setting method of a network communication cycle synchronization program

1. Set the execution type of a program intended for network communication cycle synchronization to [Event].



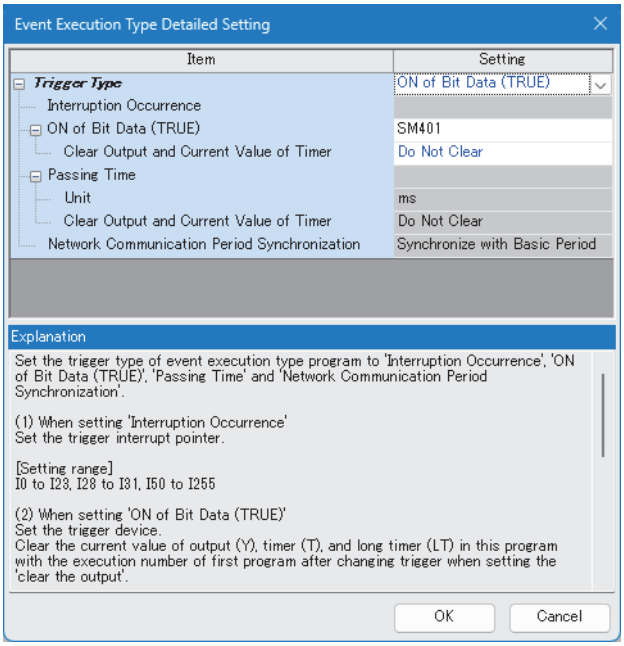
2. Open the program settings.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Program Setting] ⇨ [Program Setting] ⇨ <Detailed Setting>

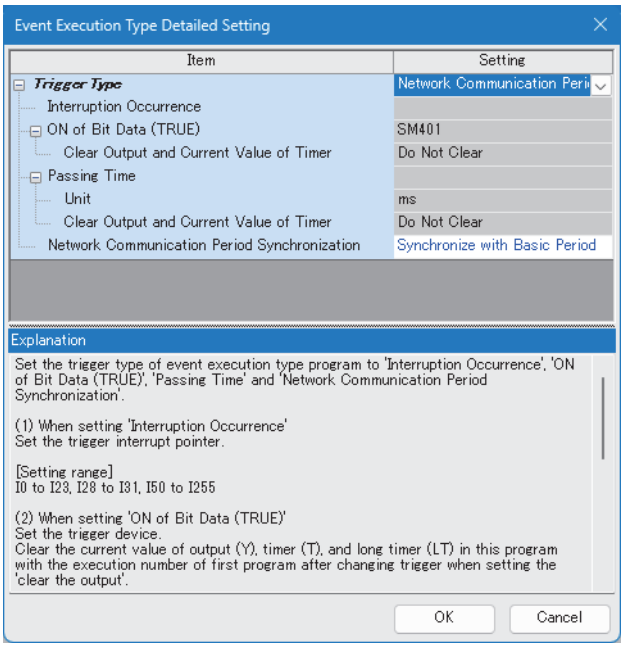


3. Open the "Event Execution Type Detailed Setting" window.

"Execution Type" ⇨ "Detailed Setting Information"



4. Select "Network Communication Period Synchronization" for "Trigger Type", then click [OK].



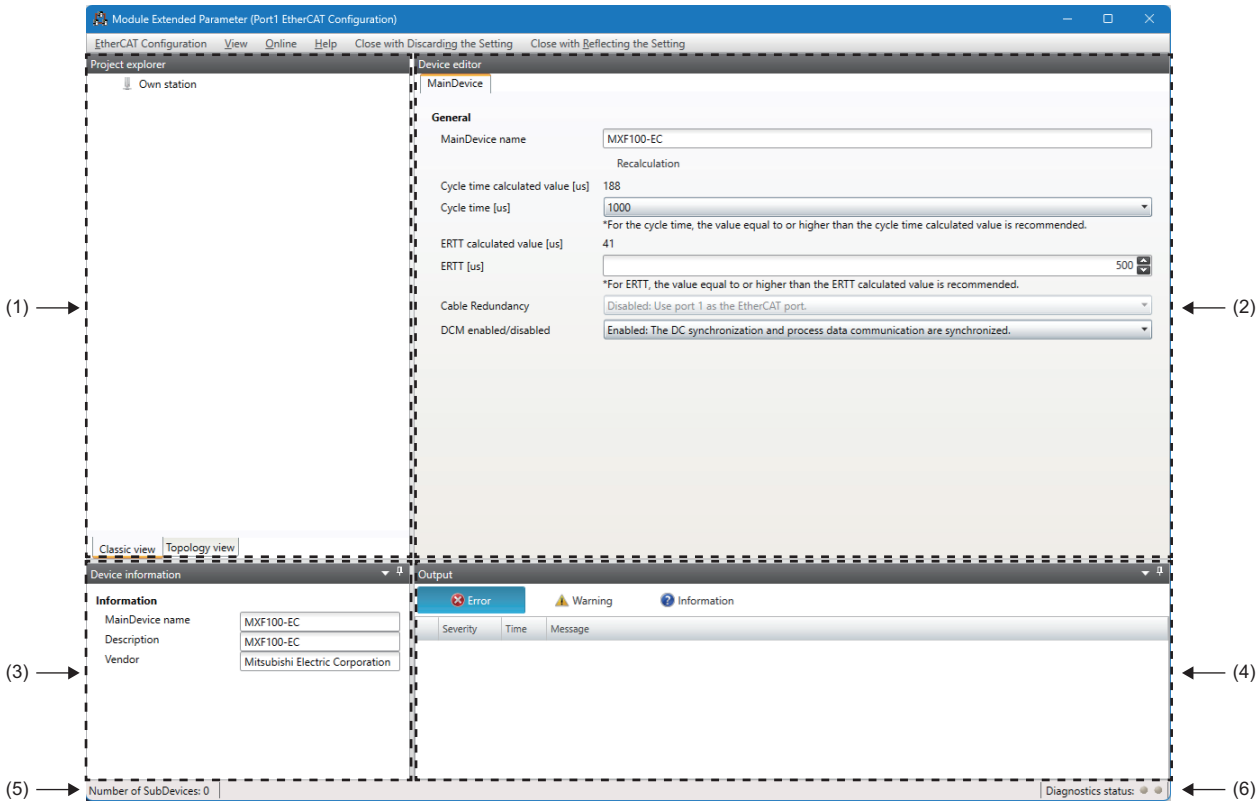
5. Click [Apply] to close the settings.

9 MODULE EXTENDED PARAMETERS (EtherCAT CONFIGURATION)

The EtherCAT configuration is set up by using the module extended parameters. This chapter describes the window configuration and how to operate the window display.

9.1 Window Configuration

This section describes the window configuration at the startup of the module extended parameter (EtherCAT configuration) window.



Displayed items

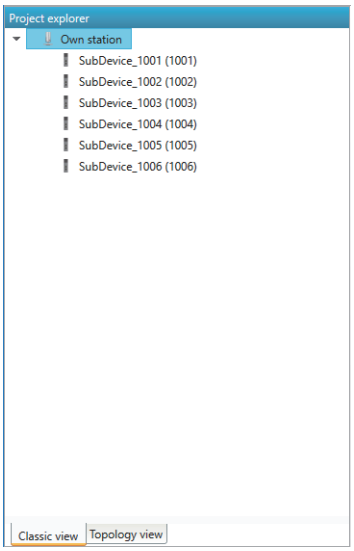
No.	Name	Description
(1)	"Project explorer" window	This window has two tabs, Classic view and Topology view, which are displayed by switching between them. ☞ Page 110 "Project explorer" window
(2)	"Device editor" window	Set the parameters related to EtherCAT for the own station (MainDevice) and the SubDevices. ☞ Page 113 "Device editor" window
(3)	"Device information" window	Information such as the device name and the node address of the modules selected in the "Project explorer" window is displayed. The display differs depending on the own station (MainDevice), SubDevices, and modules. ☞ Page 113 "Device information" window
(4)	"Output" window	The processing result message is displayed after operating in the "Project explorer" window and the "Device editor" window. ☞ Page 114 "Output" window
(5)	Status bar	Displays the number of SubDevices.
(6)	Diagnostics status	Displays the communication status of EtherCAT diagnostics.

"Project explorer" window

This window has two tabs, Classic view and Topology view, which are displayed by switching between them.

Classic view

In the classic view, the own station (MainDevice) and the SubDevices are displayed in a tree format and the operations are performed by selecting each module.



■Display icons

The following table lists the icons that are displayed in the classic view.

Icon	Description
	Indicates the own station (MainDevice).
or others	Indicates SubDevices. This icon is defined by an ESI file in the SubDevices.
	Indicates that the number of stations in the group is one (only one module).
	Indicates that the number of stations in the group is one, and it is detached from a Hot Connect group.
	Indicates that the number of stations in the group is two or more, and it is the start station.
	Indicates that the number of stations in the group is two or more, and it is the start station which is detached from a Hot Connect group.
	Indicates that the number of stations in the group is two or more, and it is the station other than the start station and end station.
	Indicates that the number of stations in the group is two or more, and it is the end station.

■Operation

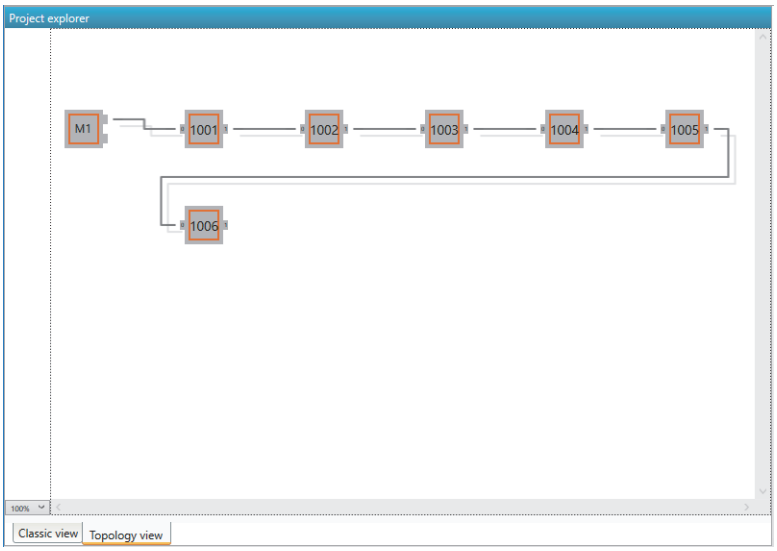
The following table lists the operations that can be performed in the classic view.

Select "Own station" or any SubDevices and right-click.

Target station	Item	Description
Own station	Add SubDevice	Adds SubDevices.
	Paste SubDevice	Pastes the SubDevices which were copied or cut.
	Expand all	Displays all the SubDevices in the layers below "Own station".
	Collapse all	Hides all the SubDevices in the layers below "Own station".
	Export ENI file	Exports the set parameters to the ENI file.
	Scan EtherCAT Network	Scans the EtherCAT network configuration.
	Detect SubDevice	Detects connected SubDevices.
SubDevice	Add SubDevice	Adds SubDevices.
	Remove SubDevice	Removes the selected SubDevices.
	Cut SubDevice	Cuts the selected SubDevices.
	Copy SubDevice	Copies the selected SubDevices.
	Paste SubDevice	Pastes the copied SubDevices.
	Add module	Adds modules.
	Remove module	Removes modules.
	Enable SubDevice	Enables the disabled SubDevices.
	Disable SubDevice	Disables the selected SubDevices. (Can be used as a reserved station)
	Reload ESI data	Updates the information of the ESI data to the selected SubDevices.
	Change SubDevice revision	Changes the revision of the selected SubDevices.
	Create group	Sets a group for the selected SubDevices.
	Remove group	Removes the set groups.
	Detach Hot Connect group	Detaches the set Hot Connect group from the groups.
	Attach Hot Connect group	Attaches the detached SubDevices to the Hot Connect group again.
Module	Add module	Adds modules.
	Remove module	Removes the selected modules.
	Cut module	Cuts the selected modules.
	Copy module	Copies the selected modules.
	Paste module	Pastes the copied modules.

Topology view

In the topology view, the connection destinations of the own station (MainDevice) and SubDevices to be set can be checked.

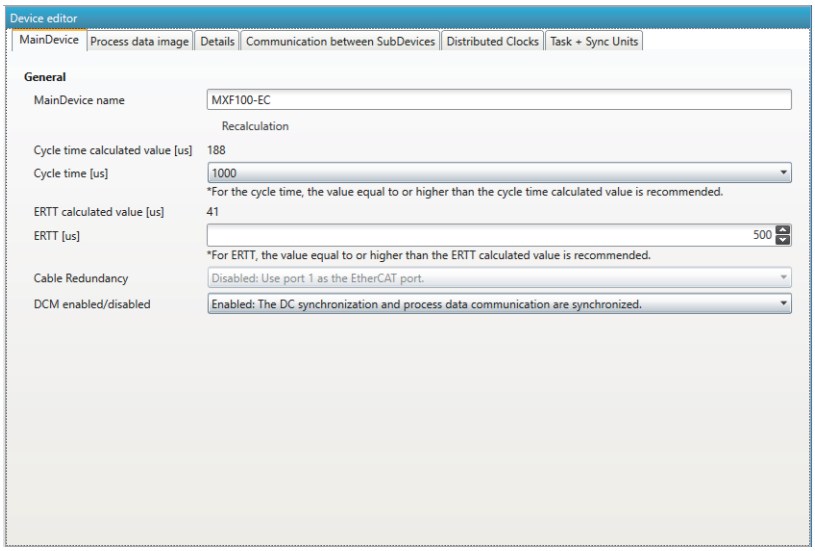


■Display icons

Icon	Description
	Indicates the own station (MainDevice). The terminals indicating the ports are displayed on the right side of the icon, and the port on the upper side is connected to the port on the SubDevice side.
	Indicates a SubDevice. The number in the center of the icon indicates the node address. The terminal indicated by a port has a corresponding port number. Since the number of ports differs depending on SubDevices, the display of the terminal indicating the port changes. Also, when the terminal connected to a module exists, the background turns green and "P" is displayed in the number part of the terminal.
	When a SubDevice with multiple ports cannot be placed on the right side of the icon, the terminals are displayed on the lower side. A number such as 'RE1' or 'RE2' is displayed on the terminal. The same icon exists in another place and they are linked.
	Indicates a module. The number in the center of the icon indicates the slot number to which the module is connected. The terminal indicated by a port has a number. "0" is displayed on the left side of the icon and "P" is displayed on the right side of the icon.
	Indicates an icon of the SubDevice in E-Bus. The number in the center of the icon indicates the node address. The terminal indicated by a port has numbers. "0" is displayed on the left side of the icon and "1" is displayed on the right side of the icon.
	Indicates an icon of the E-Bus cover. The number in the center of the icon indicates the model name. The terminal indicated by a port has a number, and "0" is displayed on the left side of the icon. The icon of E-Bus with an output port has the terminal on the right side and "1" is displayed.
	Indicates that the icon is linked from the port source of the corresponding icon, and the connection destination is displayed on the right side of the icon. The number in the center of the icon is a serial number.
	Indicates that an unconnected SubDevice exists, and the target SubDevice and other information are displayed on the right side of the icon. (This error will occur if the network that was connected before disabling is removed when enabling the disabled SubDevice.) The number in the center of the icon is a serial number.
	Indicates that the disabled SubDevice exists, and the target SubDevice and other information are displayed on the right side of the icon. The number in the center of the icon is a serial number.
	Indicates that the SubDevice detached from the Hot Connect group exists, and the target SubDevice and other information are displayed on the right side of the icon. The number in the center of the icon is a serial number.

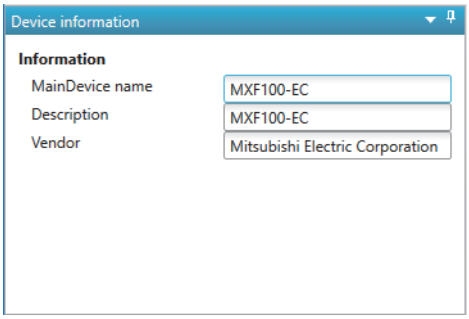
"Device editor" window

Set the parameters related to EtherCAT for the own station (MainDevice) and the SubDevices.
The settings are classified by the tabs and differ depending on the models of the own station (MainDevice) and SubDevices.



"Device information" window

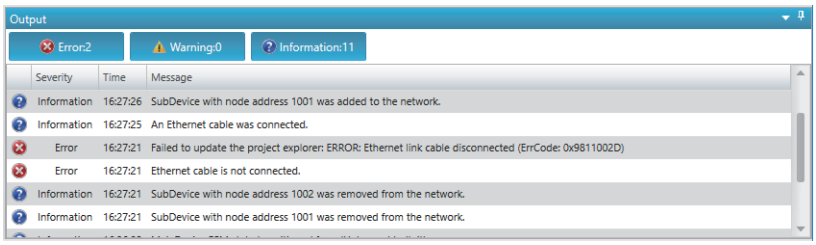
Information such as the device name and the node address of the modules selected in the "Project explorer" window is displayed.
The display differs depending on the own station (MainDevice), SubDevices, and modules.



Selected module	Item	Description
Own station (MainDevice)	MainDevice name	Displays the device name of the MainDevice.
	Description	Displays the device name of the MainDevice.
	Vendor	Displays "Mitsubishi Electric Corporation".
SubDevice	Device name	Displays the device name of the SubDevice.
	Description	Displays the description of the SubDevice.
	Vendor	Displays the vendor name and the vendor ID of the SubDevice.
	Node address	Displays the node address of the selected SubDevice.
	Auto increment address	Displays an auto increment address of the selected SubDevice. (Hexadecimal/decimal notation)
Module	Module name	Displays module name. When an empty slot is selected, the content displayed is blank.
	Vendor	Displays the vendor name and the vendor ID of the module.
	Description	Displays the description of the module. When an empty slot is selected, the content displayed is blank.

"Output" window

The processing result message is displayed after operating in the "Project explorer" window and the "Device editor" window.
The messages display the priority, time, and message content.
The priority is classified into Error, Warning, and Information.



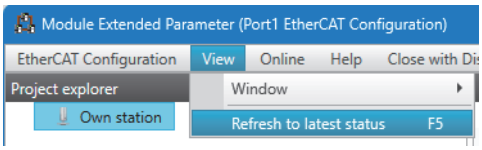
Clicking the Error, Warning, or Information button at the top of the window can display or hide the messages.

9.2 Operations Related to Display

Refreshing to latest status

Refresh the contents of the module extended parameter (EtherCAT configuration) window to the latest status.

[View] ⇨ [Refresh to latest status]

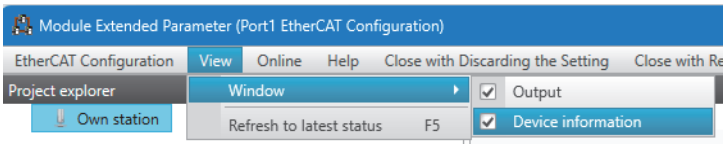


Displaying/hiding windows

Displaying or hiding the "Device information" window and "Output" window can be switched.

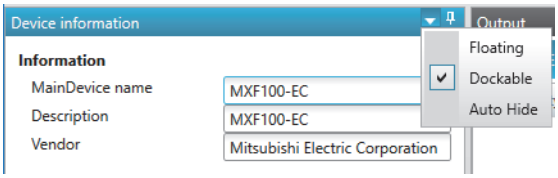
[View] ⇨ [Window] ⇨ [(Target display items)]

Displaying or hiding the windows is switched based on whether the checkbox is selected.



Window operation

Clicking the [▼] button in the upper right can switch the "Device Information" window and the "Output" window to the following display items.

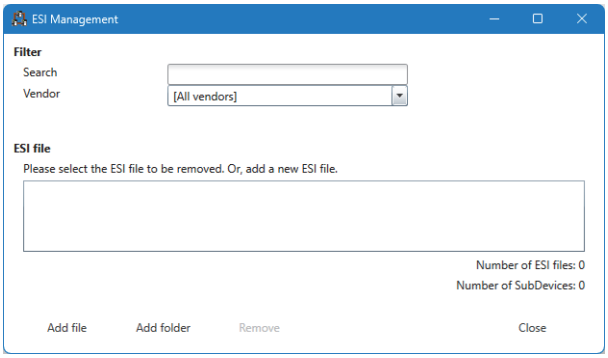


Item	Description
Floating	Dragging a docking window to any location displays it independently of the main frame. (Floating display)
Dockable (Default)	Dragging and dropping the floating window onto the guidance area in the main frame incorporates the window into the main frame. (Docking display)
Auto Hide	Auto Hide minimizes the window to the edge of the main frame, but expands it when the mouse pointer hovers over it. (Auto expand display)

9.3 Registering/Removing ESI Files

ESI files manage the SubDevice information for setting the parameters in the module extended parameter (EtherCAT configuration) window.
Register or remove the ESI files in the "ESI Management" window.

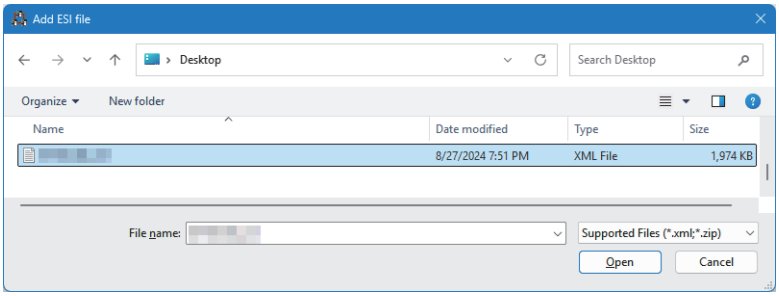
[EtherCAT Configuration] ⇨ [ESI Management]



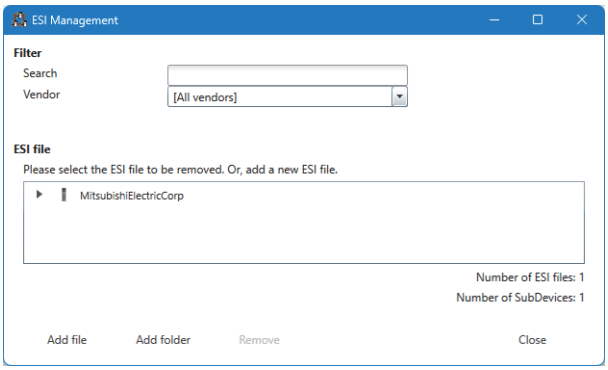
Registering ESI files

This section describes how to register the ESI files.

1. Click the [Add file] or [Add folder] button in the "ESI Management" window.
2. Specify the ESI file to be registered and click the [Open] button to start the registration.



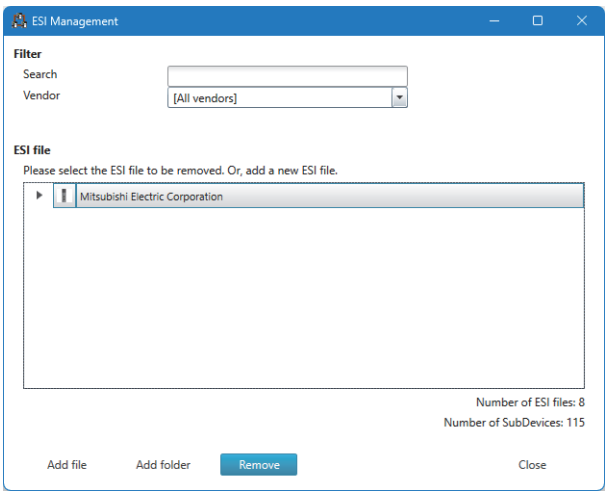
3. When the registration is completed, the ESI file added to the "ESI Management" window will be displayed.



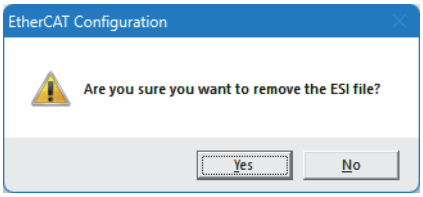
Removing ESI files

This section describes how to remove the ESI files.

1. Select the ESI file to be removed and click the [Remove] button in the "ESI Management" window.



2. Click the [Yes] button.



3. When removing file is completed, the ESI file will be removed from the "ESI Management" window.

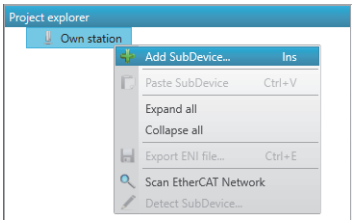
9.4 Adding SubDevices and Modules

Add SubDevices and modules to be connected to the MainDevice to the module extended parameter (EtherCAT configuration) window.

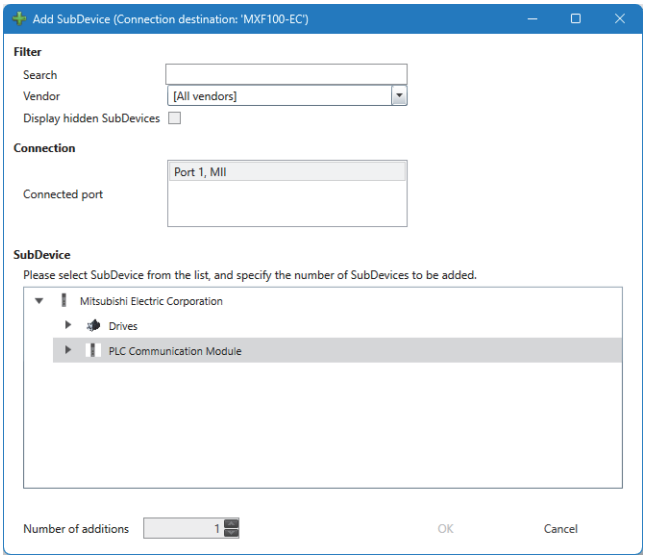
Adding SubDevices

This section describes how to add SubDevices.

1. Right-click the "Own station" or the SubDevice in the "Project explorer" window and click "Add SubDevice".

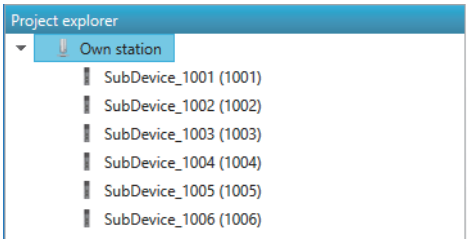


2. In the following window, specify the SubDevices and the number to be added and click the [OK] button.



Item		Description
Filter	Search	Input the keyword of the SubDevice to be searched.
	Vendor	Select the vendor name of the registered ESI file.
Display hidden SubDevices		When displaying the hidden SubDevices, select the checkbox.
Connection	Connected port	Displays the ports of the SubDevice to which the SubDevices to be added are connected.
SubDevice		Displays the lists of the selectable SubDevices.
Number of additions		Specify the number of SubDevices to be added. (1 to 72)

3. The SubDevices are added to the "Project explorer" window.

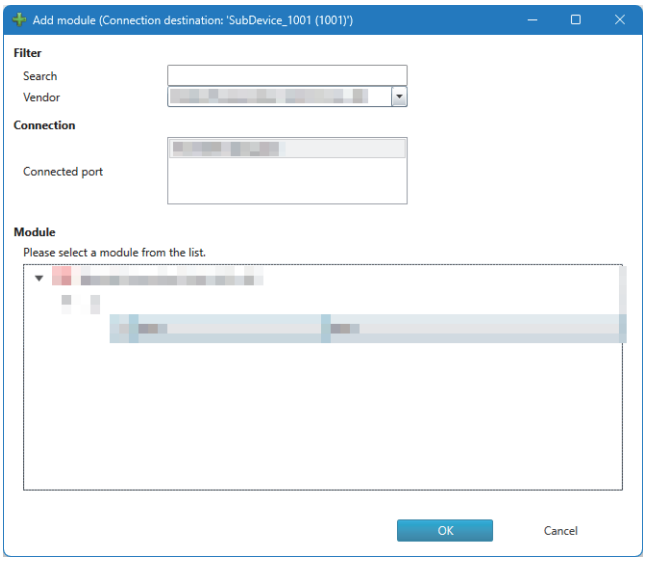


Adding modules

Modules can be added to the SubDevices that are compatible with the modules.

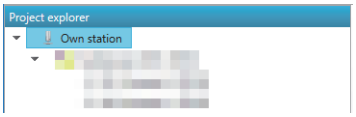
This section describes how to add the modules.

1. Right-click the SubDevice in the "Project explorer" window and click "Add module".
2. In the following window, specify the module to be added and click the [OK] button.



Item		Description
Filter	Search	Input the keyword of the module to be searched.
	Vendor	Select the vendor name of the registered ESI file.
Connection	Connected port	Displays the ports of the SubDevice to which the modules to be added are connected.
Module		Displays the lists of the selectable modules.

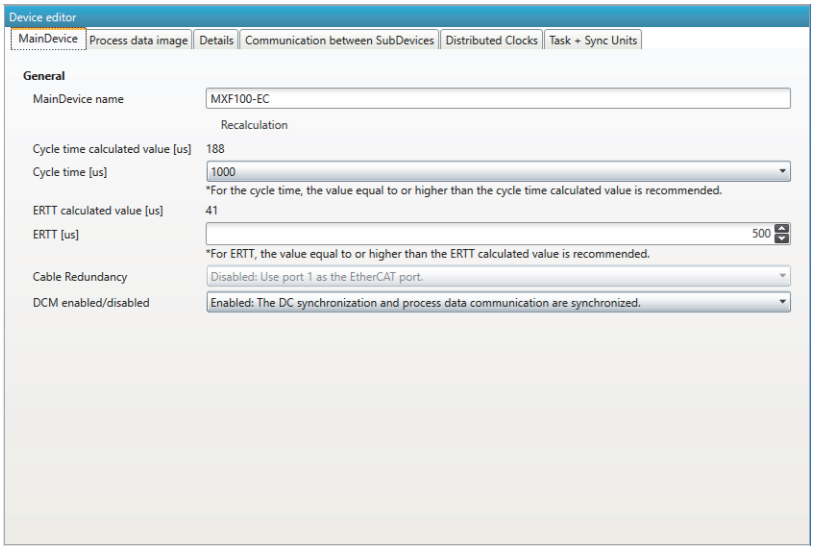
3. The modules are added to the "Project explorer" window.



9.5 MainDevice Setting

Set the parameters for EtherCAT communications to the controller.

Select the "Own station" in the "Project explorer" window and set the parameters in the "Device editor" window.



Point

Add the SubDevices to be connected via EtherCAT to the "Project explorer" window before setting the parameters of the controller. (☞ Page 118 "Output" window)

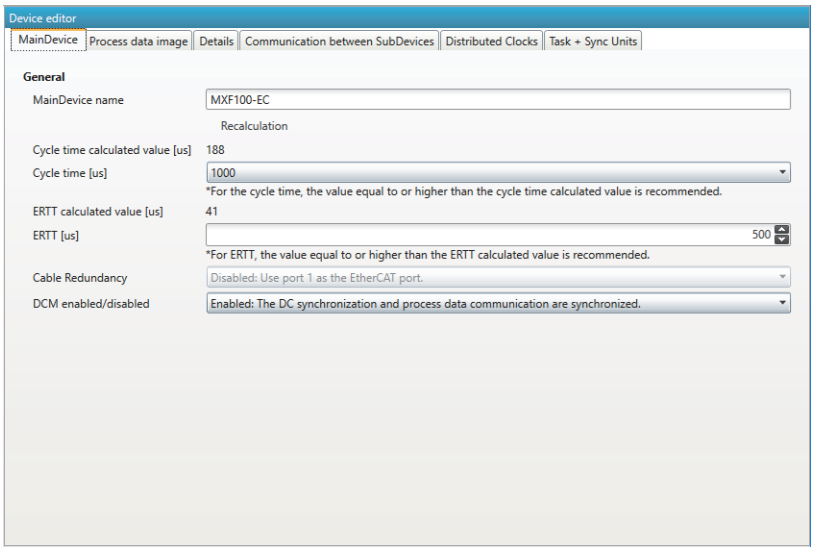
Adding the SubDevices displays the tabs to be set in the controller.

The following table lists the parameters of the controller.

Item	Reference
[MainDevice] tab	Page 121 [MainDevice] tab
[Process data image] tab	Page 122 [Process data image] tab
[Details] tab	Page 123 [Details] tab
[Communication between SubDevices] tab	Page 124 [Communication between SubDevices] tab
[Distributed Clocks] tab	Page 125 [Distributed Clocks] tab
[Task + Sync Units] tab	Page 126 [Task + Sync Units] tab

[MainDevice] tab

The following table lists the settings on the [MainDevice] tab.



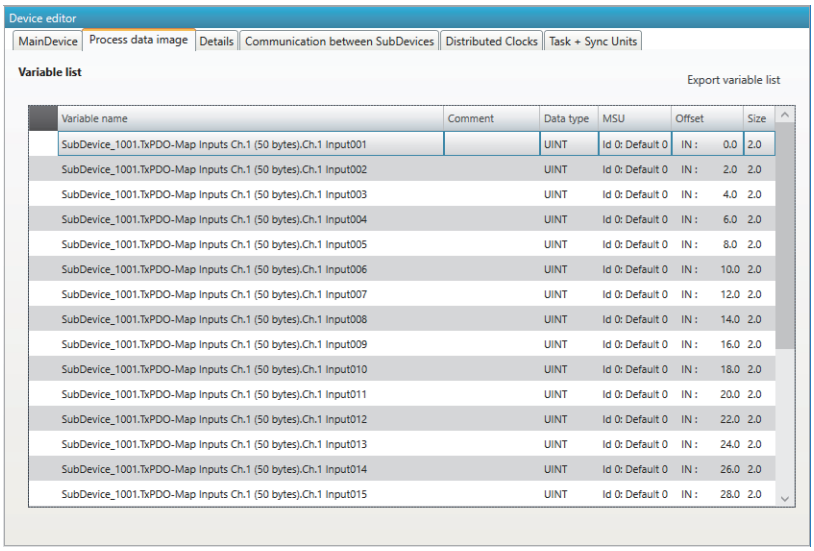
Item	Description	Setting range
MainDevice name	Set the device name of the MainDevice. The set name is reflected to the information in the "Device information" window.	1 to 80 characters
Cycle time calculated value [µs]	Displays the cycle time calculated value.*1 Clicking the [Recalculation] button updates the value to the latest calculated value.	—
Cycle time [µs]	Set the cycle time of the reference EtherCAT. The set value is set to the cycle time of the task when the task ID is 0.	• 250 • 500 • 1000 • 2000 • 4000 • 8000 (Default: 1000)
ERTT calculated value [µs]	Displays the calculated value of ERTT.*1 Clicking the [Recalculation] button updates the value to the latest calculated value.	—
ERTT [µs]	Set ERTT (Expected Round Trip Time).	1 to 16000 (Default: 500)
Cable Redundancy	Set the port to operate the network.	• Disabled: Use port 1 as the EtherCAT port. • Enabled: Use port 1 as the EtherCAT port and port 2 as the redundant port. (Default: Disabled: Use port 1 as the EtherCAT port.)
DCM enabled/disabled	Set whether to enable the DCM function. When disabled, the settings in the [Distributed Clocks] tab of the MainDevice and the SubDevice are ignored.	• Enabled: The DC synchronization and process data communication are synchronized. • Disabled: The synchronization time of the DC synchronization and process data communication are not synchronized. (Default: Enabled: The DC synchronization and process data communication are synchronized.)

*1 The calculation value is a reference value calculated from the setting value.
For details, refer to the following.
☞ Page 222 Cycle time and ERTT

*2 No connection can be made if a cycle time that is not supported by the SubDevice is set. Check the specifications of the SubDevice to configure the settings.

[Process data image] tab

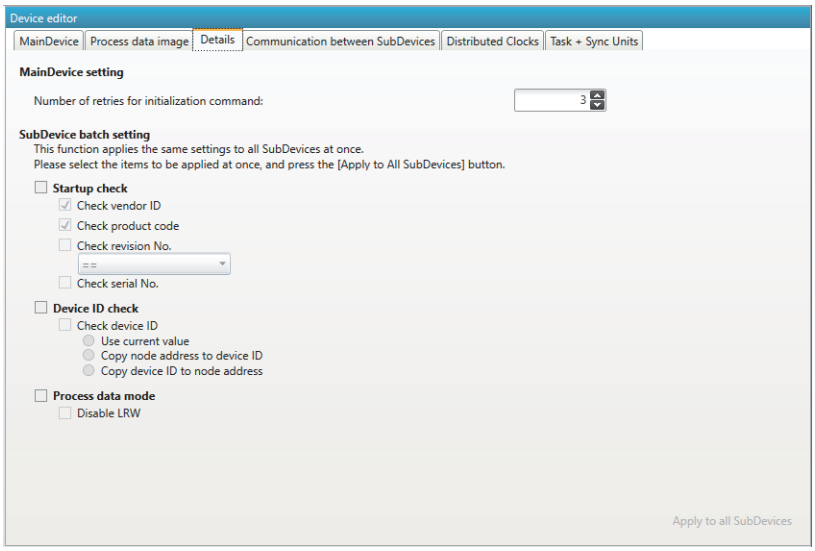
The following table lists the settings on the [Process data image] tab.



Item	Description
Variable list	Displays the PDO settings in the SubDevices. (☞ Page 131 [PDO mapping] tab) The displayed items are Variable name, Comment, Data type, MSU, Offset, and Size. Variable name is displayed with the form of |SubDevice name|, |PDO name|, and |Entry name|.
[Export variable list] button	Exports the displayed variable list to CSV format.

[Details] tab

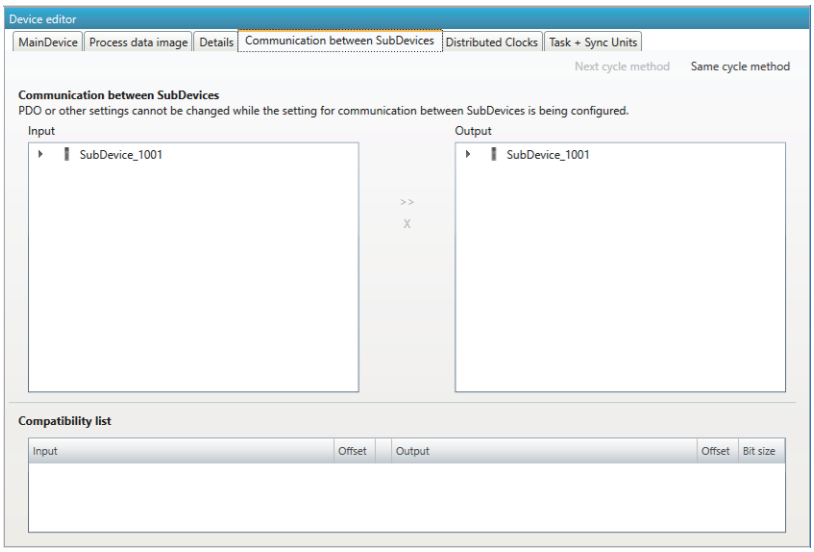
The following table lists the settings on the [Details] tab.



Item		Description	Setting range
MainDevice setting	Number of retries for initialization command	Set the number of retries for initialization command. If the processing is not completed within the set number of times, a send error occurs.	0 to 99 (Default: 3)
SubDevice batch setting	Startup check	When setting the following items to the SubDevices in a batch, select the checkboxes. If the information in the ESI file registered in the EtherCAT Configuration differs from that of the SubDevice connected to the controller, an error will occurs. • Check vendor ID • Check product code • Check revision No. • Check serial No. When checking the revision number, select one of the following: ■== Check whether the revision number is the same as the number in the ESI file. ■>= Check whether the number is equal to or greater than the revision number in the ESI file. ■LW== Check whether the lower word of the revision number in the ESI file is the same. ■LW==, HW>= Check whether the lower word of the revision number in the ESI file is the same and the upper word is equal to or greater than the revision number in the ESI file. ■HW== Check whether the upper word of the revision number in the ESI file is the same. ■HW==, LW>= Check whether the upper word of the revision number in the ESI file is the same, and the lower word is equal to or greater than the revision number in the ESI file.	—
	Device ID check	When setting the following items to the SubDevices in a batch, select the checkboxes. • Check device ID Select one of the following items: • Use current value • Copy node address to device ID • Copy device ID to node address	—
	Process data mode	When setting the following items to the SubDevices in a batch, select the checkboxes. • Disable LRW	—
[Apply to all SubDevices]		Applies the selected items to all SubDevices added in the "Project explorer" window by selecting the items in [SubDevice batch setting] and clicking the [Apply to all SubDevices] button.	—

[Communication between SubDevices] tab

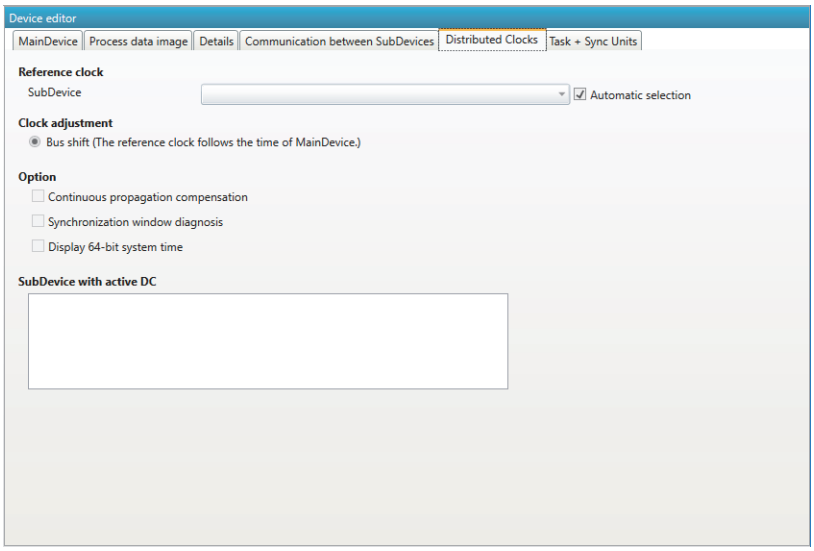
The following table lists the settings on the [Communication between SubDevices] tab.



Item	Description
[Next cycle method] button	Select the method for the communication between SubDevices. When communications between SubDevices are performed using the same cycle method, click the [Same cycle method] button. (Default: Next cycle method) If the method is changed by clicking the button, the settings are held. For each method, refer to the following. ☞ Page 89 Communication Between SubDevices Function
[Same cycle method] button	
Communication between SubDevices	Displays the PDO mapping information (SubDevice name, PDO information, and the PDO entry information) set in each SubDevice in "Input" and "Output". (☞ Page 131 [PDO mapping] tab)
[>>] button	Adds the settings in "Compatibility list" by selecting data to be used for communication between SubDevices from "Input" and "Output" in "Communication between SubDevices" and by clicking the [>>] button.
[X] button	Deletes the settings of the communication between SubDevices. Selecting the row displayed in "Compatibility list" and clicking the [X] button deletes the settings.
Compatibility list	Displays the settings of the communication between SubDevices.

[Distributed Clocks] tab

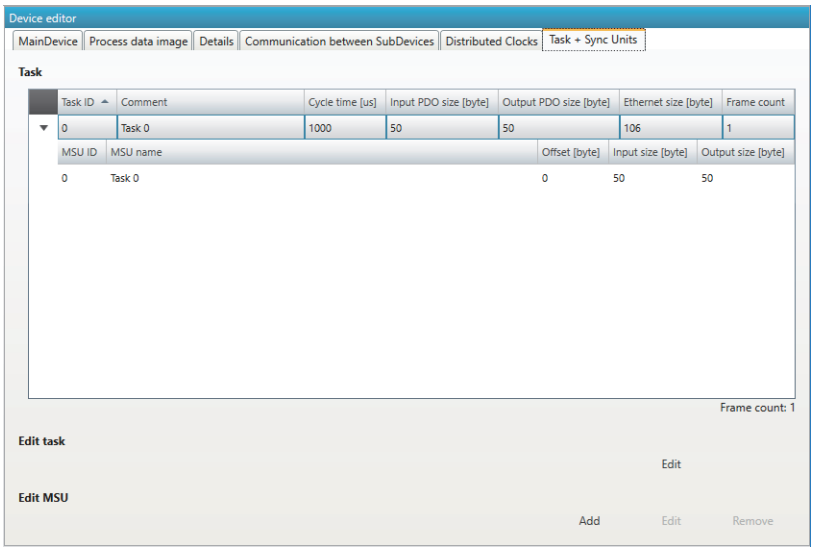
The following table lists the settings on the [Distributed Clocks] tab.



Item	Description
Reference clock	Select the SubDevice to set the reference clock. The SubDevice with the distributed clock function that is closest to the controller is displayed by default and the checkbox for "Automatic selection" is selected. (When no SubDevice with the distributed clocks function exists, the checkbox is blank.) When any SubDevice is selected and the reference clock is set, deselect the "Automatic selection" and select the target SubDevice.
Clock adjustment	Matches the synchronization of the reference clock with the time data of the controller. (Always enabled)
Option	Specify the option of the reference clock. For details, refer to the following. ☞ Page 93 Distributed Clock Function ■Continuous propagation compensation When enabling the continuous propagation compensation, select the checkbox. ■Synchronization window diagnosis When enabling the synchronization window diagnosis, select the checkbox. ■Display 64-bit system time When displaying the 64-bit system time, select the checkbox.
SubDevice with active DC	Displays the SubDevice with distributed clocks enabled.

[Task + Sync Units] tab

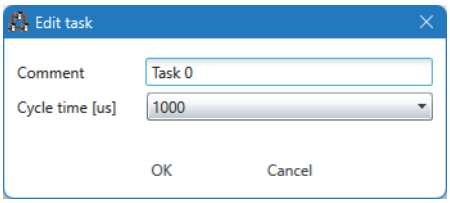
The following table lists the settings on the [Task + Sync Units] tab.



Item		Description
Task		Displays the list of the task. In the list, "Task ID", "Comment", "Cycle time [μs]", "Input PDO size [byte]", "Output PDO size [byte]", "Ethernet size [byte]", and "Frame count" are displayed. In addition, click the [▶] button to display the list of the MSU (master sync unit). "MSU ID", "MSU name", "Offset [byte]", "Input size [byte]", and "Output size [byte]" are displayed in the list of the MSU. For the MSU, refer to the following. ☞ Page 85 Sync Unit Function
Frame count		Displays the total value of the frame count.
Edit task	[Edit] button	The task settings can be configured by selecting the row of a task in "Task" and clicking the [Edit] button. (☞ Page 127 Edit task)
Edit MSU	[Add] button	Add the MSU to the list in "Task" by clicking the [Add] button. When the MSU has been added, the MSU is displayed as follows. (Items other than the following items are set to 0.) • MSU ID: "1000" or greater (displayed in serial numbers) • MSU name: "MSU 1000" or greater (displayed in serial numbers)
	[Edit] button	Set the MSU settings by selecting the MSU in "Task" and clicking the [Edit] button. (☞ Page 127 Edit MSU) Note that the default row (row that MSU ID is 0) cannot be changed.
	[Remove] button	Remove the selected MSU by selecting the MSU in "Task" and clicking the [Remove] button.

■Edit task

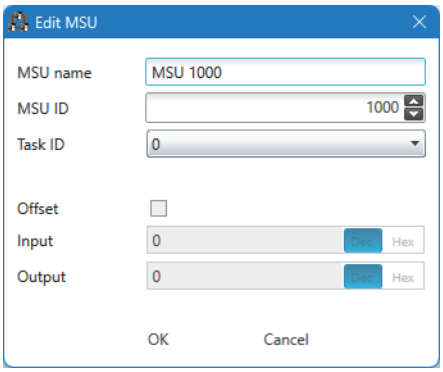
The following table lists the settings on the "Edit task" window.



Item	Description	Setting range
Comment	Set the comment.	None (Default: Task 0)
Cycle time [μs]	Set the cycle time of the task. Changing the settings changes the value of "Cycle time [μs]" in the [MainDevice] tab.	• 250 • 500 • 1000 • 2000 • 4000 • 8000 (Default: The cycle time set in the [MainDevice] tab)

■Edit MSU

The following table lists the settings on the "Edit MSU" window.

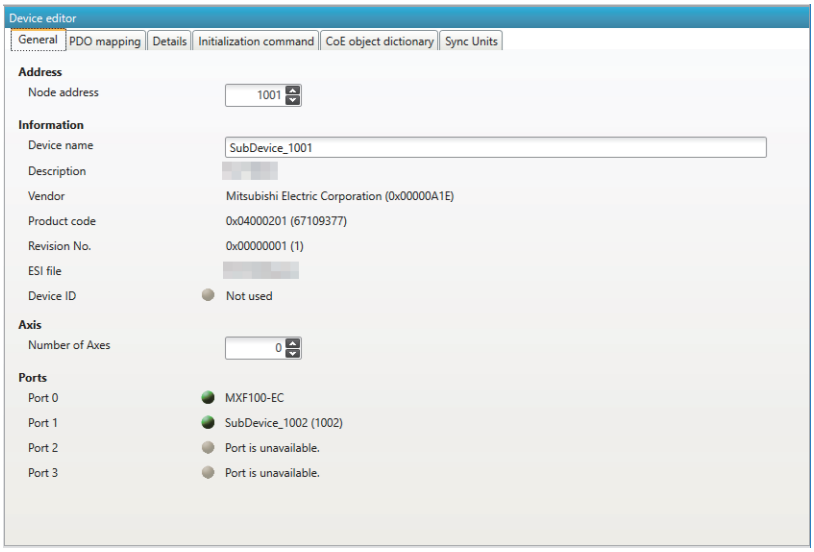


Item	Description	Setting range
MSU name	Set the name of the master sync units.	None (Default: Depends on the order of the added MSUs.)
MSU ID	Set the ID of the master sync unit.	1000 to 1999 (Default: Depends on the order of the added MSUs.)
Task ID	Displays task ID.	Fixed to 0
Offset	When setting the offset of the master sync units, select the checkbox.	• Not selected • Selected (Default: Not selected)
Input	Set the Input offset. Click the [Dec] button to input decimal numbers. Click the [Hex] button to input hexadecimal numbers.	0 to 65535 (0x0000 to 0xFFFF) (Default: 0)
Output	Set the Output offset. Click the [Dec] button to input decimal numbers. Click the [Hex] button to input hexadecimal numbers.	0 to 65535 (0x0000 to 0xFFFF) (Default: 0)

9.6 SubDevice and Module Settings

Set the parameters of the added SubDevices and modules.

Select a SubDevice or a module in the "Project explorer" window and set the parameters in the "Device editor" window.



The following table lists the parameters of the SubDevice and module.

Item	Reference
[General] tab	Page 129 [General] tab
[Module] tab	Page 130 [Module] tab
[PDO mapping] tab	Page 131 [PDO mapping] tab
[Group] tab	Page 135 [Group] tab
[E-Bus current] tab	Page 136 [E-Bus current] tab
[Details] tab	Page 137 [Details] tab
[Distributed Clocks] tab	Page 140 [Distributed Clocks] tab
[Initialization command] tab	Page 142 [Initialization command] tab
[CoE object dictionary] tab	Page 145 [CoE object dictionary] tab
[Sync Units] tab	Page 146 [Sync Units] tab
[MDP slot] tab	Page 147 [MDP slot] tab

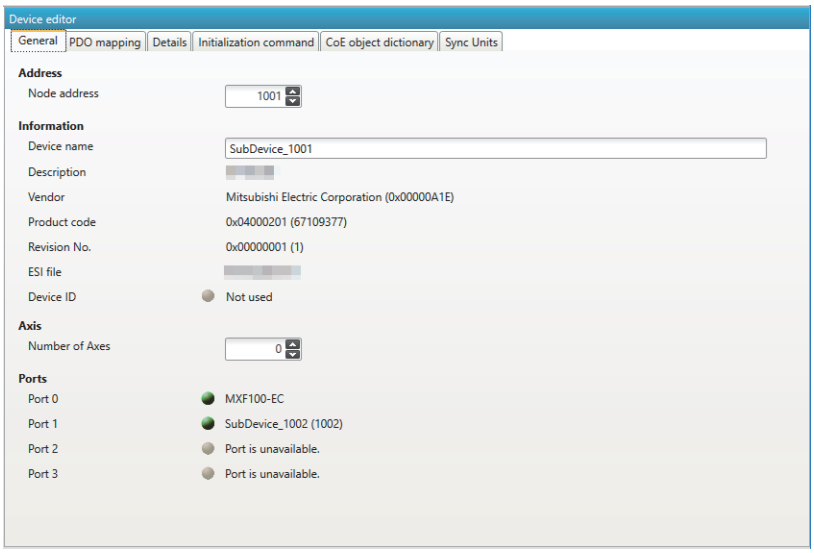
Point

The parameters that can be set differ depending on SubDevices and modules.

For details, refer to the manual for the SubDevice to be used.

[General] tab

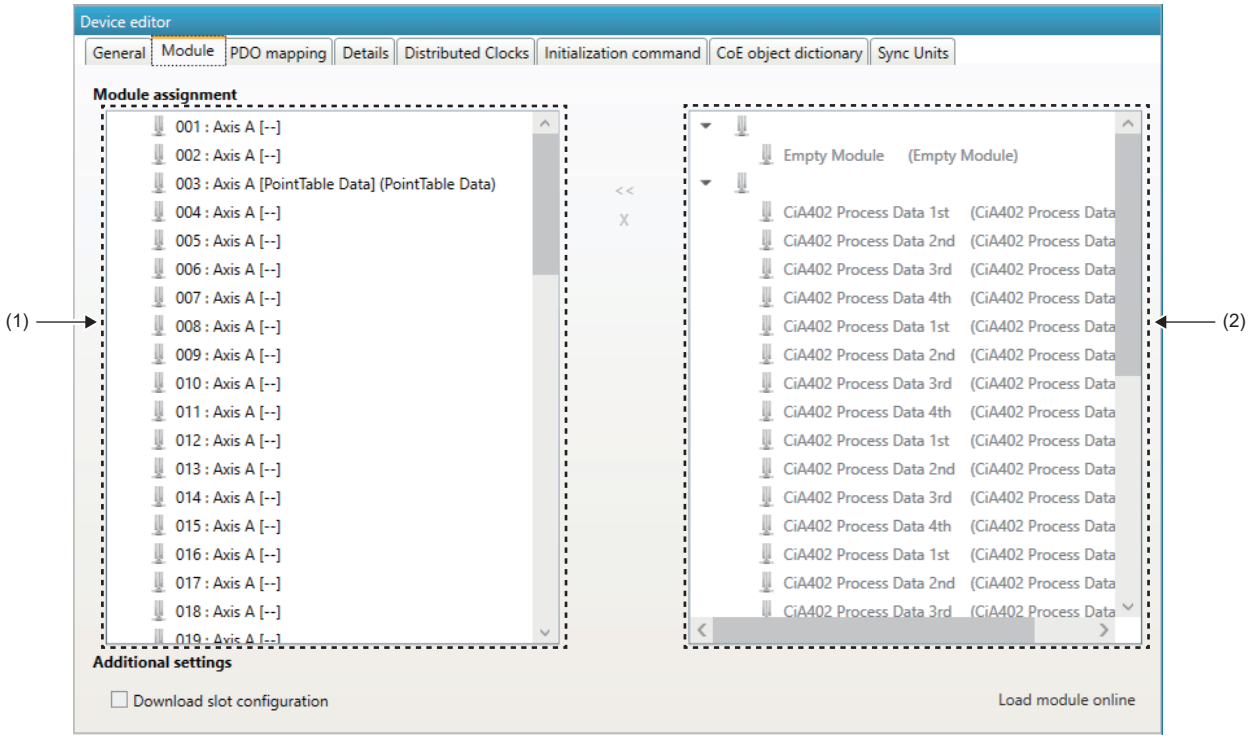
The following table lists the settings on the [General] tab.



Item		Description	Setting range
Address	Node Address	Set the node address of the SubDevice.	1 to 65535 (Default: Depends on the order of the added SubDevices.)
Information	Device name	Set the device name of the SubDevice. Device name is displayed in the following order by default. SubDevice_Node Address [Device model name]	1 to 80 characters (UTF-8) (Default: Depends on the added SubDevices.)
	Description	Displays each information of the SubDevice. For the settings, refer to the manual for the SubDevice to be used.	—
	Vendor		
	Product code		
	Revision No.		
	ESI file		
	Device ID	Displays the setting status of the device ID of the SubDevice. The settings in "Device ID check" in the [Details] tab are reflected to this item. (☞ Page 123 [Details] tab) When "Check device ID" is selected, the device ID is displayed. "Check device ID" is not selected. "Check device ID" is selected.	—
Axis	Number of Axes	Set the number of axes of the SubDevice. If 0 is set, the SubDevice is treated as having no axes.	Depends on the added SubDevices.
Ports		Displays the connection status of the port on the SubDevice. The number of ports differs depending on the SubDevices. Port is unavailable. Port is disconnected. Port is connected. (The device name of the connection destination is displayed.)	—

[Module] tab

The following table lists the settings on the [Module] tab.



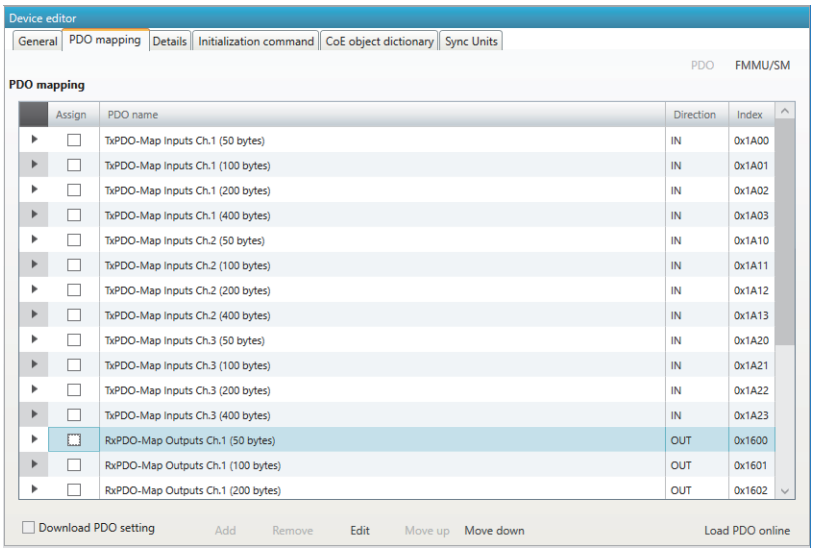
Item		Description
Module assignment	(1)	Displays the slot list of the SubDevices. The slot list is displayed with the form of |number|: |slot name| [module model name] (description of the module). For the settings, refer to the manual for the SubDevice to be used.
	(2)	Displays the module list of the SubDevices. For the settings, refer to the manual for the SubDevice to be used.
	[<<] button	Assigns the module to the slot in (1) by selecting a module from (2) and clicking the [<<] button. When all slots in (1) are used, the [<<] button cannot be clicked.
	[X] button	Releases the module assigned to the slot by selecting the slot in (1) and clicking the [X] button. The slot that released the module becomes an empty slot and a module selected from (2) can be assigned to the slot.
Additional settings	Download slot configuration	Sets whether to download the slot configuration information of the current slot to the SubDevice.

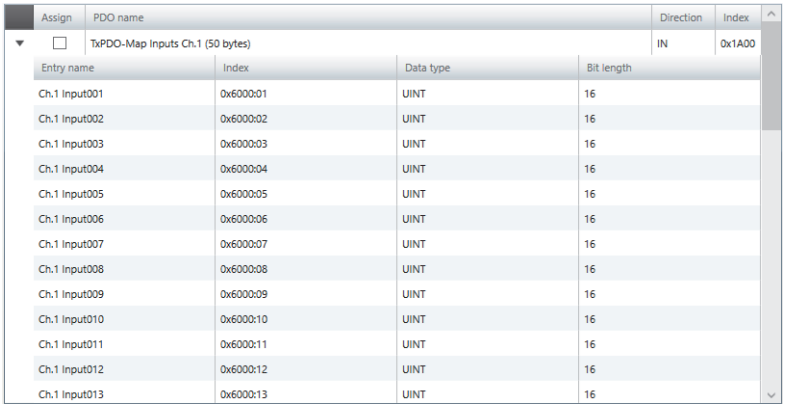
[PDO mapping] tab

The following shows the settings on the [PDO mapping] tab.

■PDO mapping window

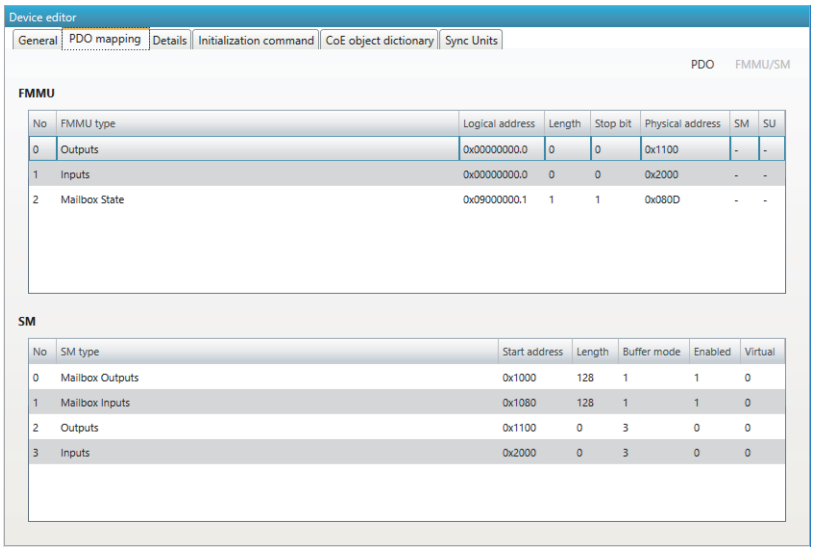
The following table lists the display items on the PDO mapping window.



Item	Description
[PDO] button	Switches the display of the PDO mapping. (PDO mapping window is displayed by default.) Clicking the [FMMU/SM] button displays the FMMU/SM window. (☞ Page 132 FMMU/SM window)
[FMMU/SM] button	
PDO mapping	Displays the PDO list of the SubDevice. ■Assign The selected PDO can be used by selecting the checkbox of "Assign". ■PDO name The PDO name is displayed. The name differs depending on the SubDevice. ■Direction "IN" or "OUT" is displayed. • IN: Indicates the object to be received to the SubDevice. • OUT: Indicates the object to be sent from the SubDevice. ■Index PDO index is displayed. ■[▶] button Each PDO entry list is displayed by clicking the [▶] button. "Entry name", "Index", "Data type", and "Bit length" are displayed in the entry list.  When the PDO is set, select the row of the PDO or the entry to be set and click the [Edit] button. For details on the PDO settings, refer to the following. ☞ Page 149 PDO Settings The rows can be moved by selecting a PDO row and clicking the [Move up] or [Move down] button.
Download PDO setting	The following can be performed by selecting the checkbox. ■Create a new PDO Click the [Add] button. (☞ Page 133 Adding and setting of PDO) ■Remove the displayed PDO Select the PDO to be deleted and click the [Remove] button.

■FMMU/SM window

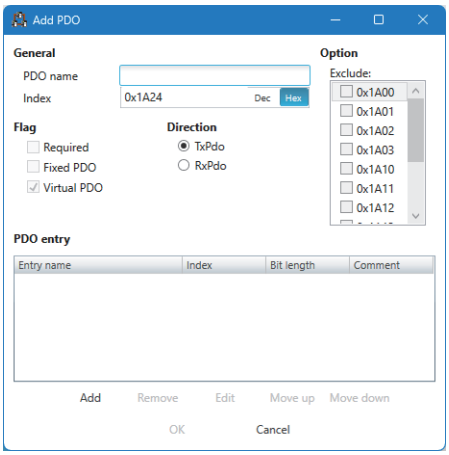
The following table lists the display items on the FMMU/SM window.



Item	Description
[PDO] button [FMMU/SM] button	Switches the display of the PDO mapping. Click the [PDO] button to switch to the PDO mapping window. (☞ Page 131 PDO mapping window)
FMMU	Displays the FMMU information list. ■No The numbers are sequentially displayed starting from 0. ■FMMU type The FMMU type is displayed. ■Logical address The logical address of the FMMU is displayed. ■Length The bit length in the logical address space of the FMMU is displayed. ■Stop bit Stop bit of the FMMU is displayed. ■Physical address The address of the physical memory for the ESC is displayed. ■SM (sync manager) The number of the sync manager is displayed. ■SU (sync unit) The IDs of the sync units are displayed.
SM	Displays the SM information list. (ESI file information of SubDevices is displayed.) ■No The numbers are sequentially displayed starting from 0. ■SM type The SM type is displayed. ■Start address The SM physical start address of the ESC memory is displayed. ■Length The memory area to be used for the SM is displayed. (Unit: byte) ■Buffer mode EtherCAT communication type (mailbox communications or process data communications) is displayed. • 1: Mailbox communications The messages in the mailbox are protected from being overwritten. • 3: Process data communications The latest memory is guaranteed for the memory where the MainDevice can write data and where data can be read from the SubDevice. ■Enabled • When "Buffer mode" is 1 (mailbox communications): 1 is displayed when SM is enabled (Enable attribute), 0 is displayed when SM is disabled. • When "Buffer mode" is 3 (process data communications): When PDO is set in SM, 1 is displayed if the entry is one or more, and 0 is displayed if there is no entry. ■Virtual 1 is displayed when the virtual of SM is enabled (Virtual attribute). (Default is 0.)

■Adding and setting of PDO

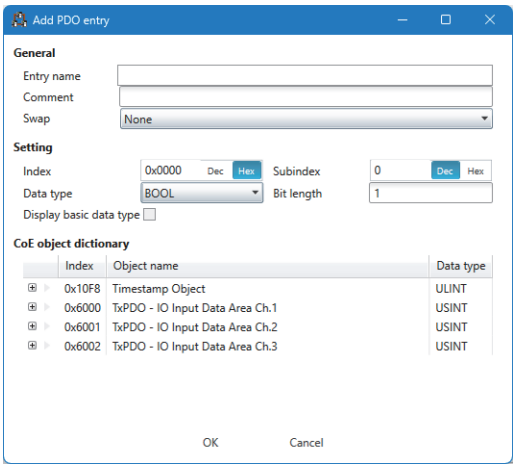
The following table lists the settings for adding or editing PDO.

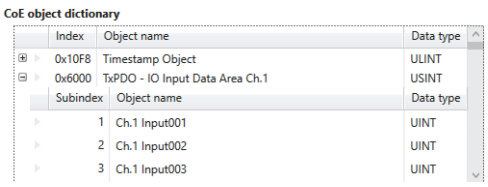


Item		Description	Setting range
General	PDO name	Set the PDO name.	No limit on the number of characters (UTF-8) (Default: blank)
	Index	Set the index of the PDO. Click the [Dec] button to input decimal numbers. Click the [Hex] button to input hexadecimal numbers.	0 to 65535 (0x0000 to 0xFFFF) (Default: Depends on the order of the added PDOs.)
Flag	Required	When the checkbox is selected, the set PDO cannot be removed. (Cannot be set)	—
	Fixed PDO	When the checkbox is selected, the entry cannot be added or removed to/from the set PDO. (Cannot be set)	—
	Virtual PDO	When the checkbox is selected, the PDO does not have the entry. (Cannot be set)	—
Direction		Select the direction of the PDO from the following: • TxPdo: PDO for input • RxPdo: PDO for output	• TxPdo • RxPdo (Default: TxPdo)
Sync manager		Specify the number for the sync manager to be managed for the PDO to be set. The number differs depending on the SubDevice to be set.	— (Default: blank)
Option		Select the checkboxes of the PDO to be excluded for the PDO to be set.	—
PDO entry		Displays the entry list to be set in PDO. "Entry name", "Index", "Bit length", and "Comment" are displayed in the entry list. Click the [Add] button to create the entry. The created entry can be edited by selecting it and clicking the [Edit] button. For details, refer to the following. ☞ Page 149 PDO Settings The created entry can be removed by selecting it and clicking the [Remove] button. The rows can be moved by selecting an entry row and clicking the [Move up] or [Move down] button.	—

■Adding and setting PDO entry

The following table lists the settings for adding or editing the entry.

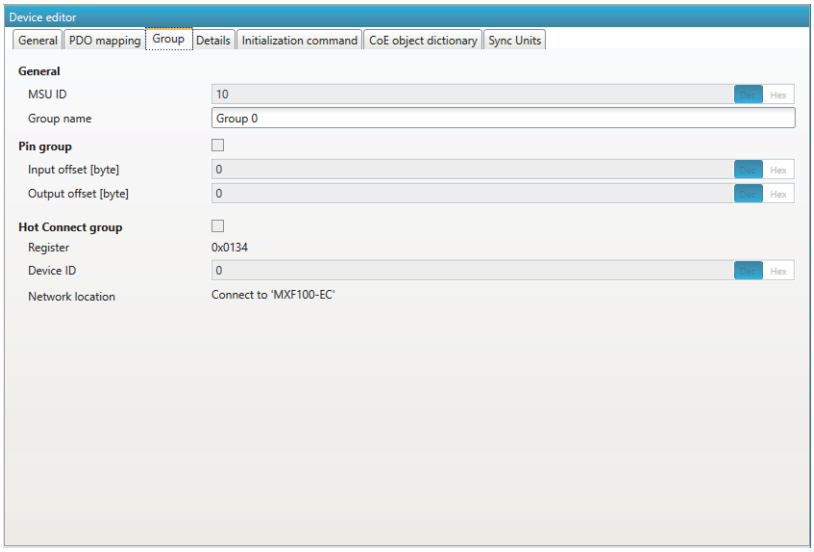


Item		Description	Setting range
General	Entry name	Set the entry name.	No limit on the number of characters (UTF-8) (Default: blank)
	Comment	Set the comment of the entry.	No limit on the number of characters (UTF-8) (Default: blank)
	Swap	Select swap mode of the entry. The selection items of each mode differ depending on the object selected in "CoE object dictionary". ■None Not used. ■Swap high and low bytes High and low bytes are swapped. ■Swap high and low words High and low words are swapped. ■Swap both A byte swap or word swap is performed.	• None • Swap high and low bytes • Swap high and low words • Swap both (Default: None)
Setting	Index	Set the index of the entry. Click the [Dec] button to input decimal numbers. Click the [Hex] button to input hexadecimal numbers.	0 to 65535 (0x0000 to 0xFFFF) (Default: 0x0000)
	Subindex	Set the subindex of the entry. Click the [Dec] button to input decimal numbers. Click the [Hex] button to input hexadecimal numbers.	0 to 65535 (0x0000 to 0xFFFF) (Default: 0)
	Data type	Select the data type of the entry from the list. The selection items in the list differ depending on the object selected in "CoE object dictionary"	—
	Bit length	Displays the bit length of the entry. The bit length is determined by the item selected in "Data type".	—
	Display basic data type	The item of the list selected in "Data type" becomes the basic data type when the checkbox is selected.	• Not selected • Selected (Default: Not selected)
CoE object dictionary		Displays the lists of the CoE object dictionary. "Index", "Object name", and "Data type" are displayed from the ESI file information of the SubDevice. The settings of the PDO entry are automatically changed by selecting the object in the CoE object dictionary. In addition, click the [+] button to display the list of the subindex. 	—

[Group] tab

The following table lists the settings of the [Group] tab.

The [Group] tab is displayed when a group is created. (☞ Page 154 Creating a Group)

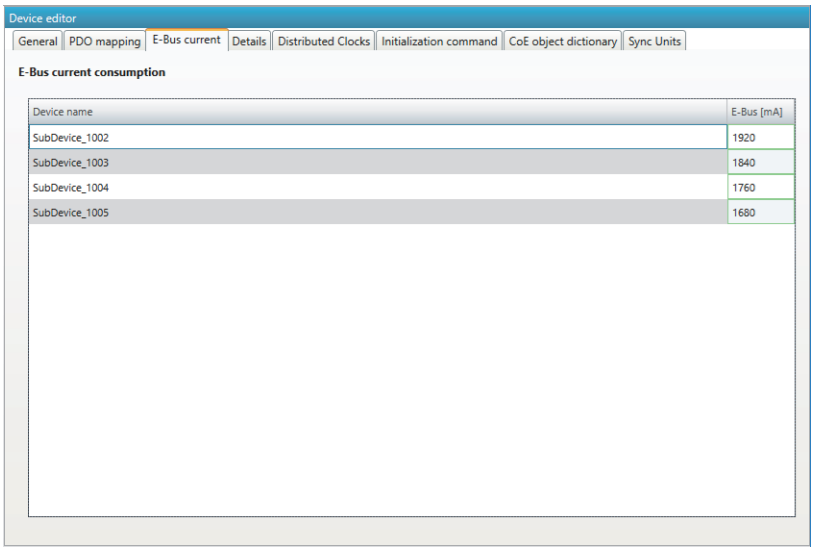


Item		Description	Setting range
General	MSU ID	Displays the MSU ID set in the group.	—
	Group name	Displays the group name set in the group. The group name can be changed. (Duplication is possible.)	No limit on the number of characters (UTF-8) (Default: Settings when the group is created)
Pin group		"Input offset [byte]" or "Output offset [byte]" can be set by selecting the checkbox. When setting a pin group, enable the PDO in the [PDO mapping] tab. (☞ Page 131 [PDO mapping] tab)	• Not selected • Selected (Default: Settings when the group is created)
Input offset [byte]		Set the input offset in the group. Click the [Dec] button to input decimal numbers. Click the [Hex] button to input hexadecimal numbers.	0 to 65535 (0x0000 to 0xFFFF) (Default: Value when the group is created)
Output offset [byte]		Set the Output offset in the group. Click the [Dec] button to input decimal numbers. Click the [Hex] button to input hexadecimal numbers.	0 to 65535 (0x0000 to 0xFFFF) (Default: Value when the group is created)
Hot Connect group		The group to be registered will become a Hot Connect group by selecting the checkbox. For the Hot Connect group, refer to the following. ☞ Page 101 Hot Connect Function	• Not selected • Selected (Default: Settings when the group is created)
Register		Displays the register area set in "Device ID check" in the [Details] tab.	—
Device ID		Set the device ID in the Hot Connect group.*1 Click the [Dec] button to input decimal numbers. Click the [Hex] button to input hexadecimal numbers.	0 to 65535 (0x0000 to 0xFFFF) (Default: Value when the group is created)
Network location		Displays the connection destination of the SubDevice.	—

*1 Since 0 is not normally used for the device ID, set a value other than 0.

[E-Bus current] tab

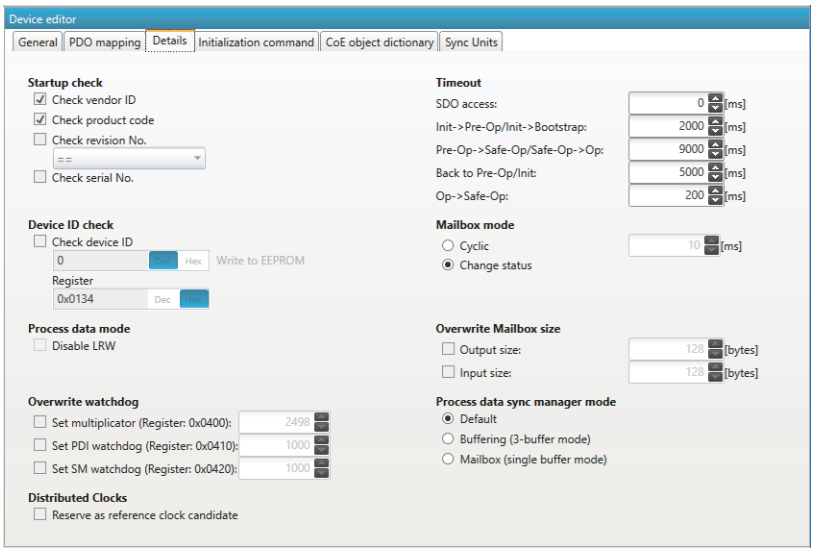
The following table lists the settings on the [E-Bus current] tab.



Item		Description
E-Bus current consumption	Device name	Displays the list of the device name of the connected SubDevices.
	E-Bus [mA]	Displays the amount of remaining current after the current is consumed up to the SubDevice in the same row. (Unit: mA)

[Details] tab

The following table lists the settings on the [Details] tab.



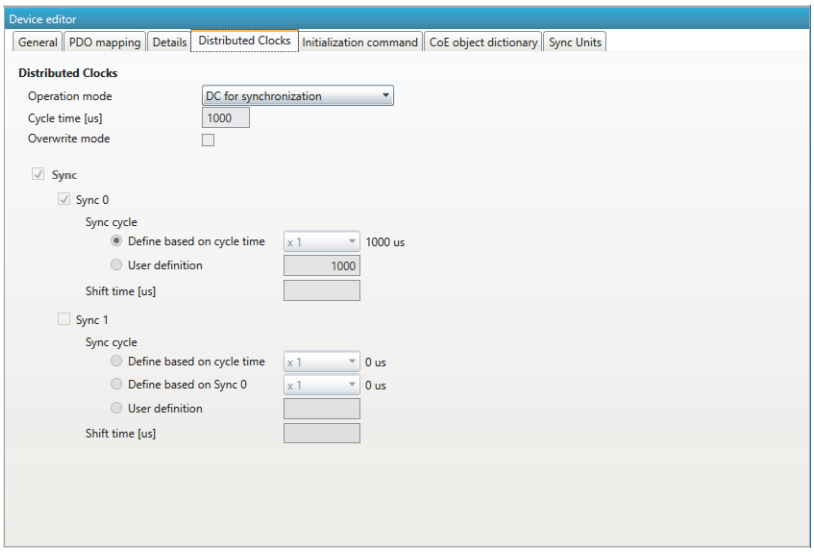
Item		Description	Setting range
Startup check	Check vendor ID	Checks the information of the ESI file registered in EtherCAT Configuration and the vendor ID of the SubDevice by selecting the checkbox. If those pieces of information differ, an error occurs.	• Selected • Not selected (Default: Selected)
	Check product code	Checks the information of the ESI file registered in EtherCAT Configuration and the product code of the SubDevice by selecting the checkbox. If those pieces of information differ, an error occurs.	• Not selected • Selected (Default: Depends on the SubDevice.)
	Check revision No.	Checks the information of the ESI file registered in EtherCAT Configuration and the revision number of the SubDevice by selecting the checkbox. If those pieces of information differ, an error occurs. Also, set the comparison method at check from the following. (☞ Page 137 [Details] tab) • == • >= • LW== • LW==, HW>= • HW== • HW==, LW>=	• Not selected • Selected (Default: Depends on the SubDevice.)
	Check serial No.	Checks the information of the ESI file registered in EtherCAT Configuration and the serial number of the SubDevice by selecting the checkbox. If those pieces of information differ, an error occurs.	• Not selected • Selected (Default: Depends on the SubDevice.)
Device ID check	Check device ID	■Checkbox Selecting the checkbox compares the device ID to be set with the device ID of the SubDevice. • When the checkbox is selected, if the input value of the device ID to be set is 0, the value is updated to the same value as the node address of the SubDevice. (Values other than 0 are not updated.) (☞ Page 129 [General] tab) • When the checkbox is deselected, if the input value of the device ID to be set is the same as the node address of the SubDevice, the value is updated to 0. (If there is a mismatch, the value is not updated.) ■Input value Set the device IDs for comparing the device IDs of the SubDevices. Click the [Dec] button to input decimal numbers. Click the [Hex] button to input hexadecimal numbers. ■Register Set the address of the register area that stores the device ID of the SubDevice.	■Checkbox • Not selected • Selected (Default: Not selected) ■Input value 0 to 65535 (0x0000 to 0xFFFF) (Default: 0) ■Register 0 to 65535 (0x0000 to 0xFFFF) (Default: Depends on the SubDevice.)
Process data mode	Disable LRW	Selecting the checkbox does not use the LRW command when accessing the process data of the SubDevice. (The LRD command and the LWR command are used.)	• Not selected • Selected (Default: Depends on the SubDevice.)

Item		Description	Setting range
Overwrite watchdog	Set multiplicator	■Checkbox Selecting the checkbox writes the set value to the specified register area (0x0400) of the SubDevice. The set values are the reference values for the PDI watchdog and the SM watchdog. ■Input value Set the values to be written to the register area.	■Checkbox • Not selected • Selected (Default: Not selected) ■Input value 0 to 99999 (Default: 2498)
	Set PDI watchdog	■Checkbox Selecting the checkbox writes the set value to the specified register area (0x0410) of the SubDevice. Also, the value of the PDI watchdog timer is displayed to the right side of the input value. The PDI watchdog timer value is calculated by the following calculation formula. PDI watchdog timer (unit: ms) = (the input value of "Set multiplicator" + 2) × 40ns ÷ 1000000ns × the input value of "Set PDI watchdog" ■Input value Set the values to be written to the register area.	■Checkbox • Not selected • Selected (Default: Not selected) ■Input value 0 to 99999 (Default: 1000)
	Set SM watchdog	■Checkbox Selecting the checkbox writes the set value to the specified register area (0x0420) of the SubDevice. Also, the value of the SM watchdog timer is displayed to the right side of the input value. The SM watchdog timer value is calculated by the following calculation formula. SM watchdog timer (unit: ms) = (the input value of "Set multiplicator" + 2) × 40ns ÷ 1000000ns × the input value of "Set SM watchdog" ■Input value Set the values to be written to the register area.	■Checkbox • Not selected • Selected (Default: Not selected) ■Input value 0 to 99999 (Default: 1000)
Distributed Clocks	Reserve as reference clock candidate	When the SubDevice of the reference clock is disconnected, the SubDevice with this setting automatically becomes the reference clock.	• Not selected • Selected (Default: Not selected)
Timeout	SDO access	Set the timeout time at SDO access. (Unit: ms)	0 to 999999 (Default: 0)
	Init->Pre-Op/ Init->Bootstrap	Set the timeout time for the following ESM state transitions. (Unit: ms) • Init → Pre-Operational • Init → Bootstrap	0 to 999999 (Default: Depends on the SubDevice.)
	Pre-Op->Safe-Op/ Safe-Op->Op	Set the timeout time for the following ESM state transitions. (Unit: ms) • Pre-Operational → Safe-Operational • Safe-Operational → Operational	0 to 999999 (Default: Depends on the SubDevice.)
	Back to Pre-Op/Init	Set the timeout time for the following ESM state transitions. (Unit: ms) • The ESM states other than Pre-Operational → Pre-Operational • The ESM states other than Init → Init	0 to 999999 (Default: Depends on the SubDevice.)
	Op->Safe-Op	Set the timeout time for the following ESM state transitions. (Unit: ms) • Operational → Safe-Operational	0 to 999999 (Default: Depends on the SubDevice.)
Mailbox mode		Set the mailbox mode to be used for the SubDevice from the following: • Cyclic: Reads the Input mailbox at the set cycle. • Change status: Reads the Input mailbox at any timing. When "Cyclic" is selected, set the interval of the mailbox reading cycle. (Unit: ms)	■Radio button • Cyclic • Change status (Default: Change status) ■Input value 0 to 99999 (Default: 10)

Item		Description	Setting range
Overwrite Mailbox size	Output size	Selecting the checkbox changes the Output mailbox size. (Unit: byte)	■Checkbox • Not selected • Selected (Default: Not selected) ■Input value 0 to 999999 (Default: Depends on the SubDevice.)
	Input size	Selecting the checkbox changes the Input mailbox size. (Unit: byte)	■Checkbox • Not selected • Selected (Default: Not selected) ■Input value 0 to 999999 (Default: Depends on the SubDevice.)
Process data sync manager mode		Sets the sync manager mode to be used for the SubDevice. • Default: Uses the setting of the ESI file of the SubDevice. • Buffering (3-buffer mode): Uses 3-buffer mode. • Mailbox (single buffer mode): Uses single buffer mode.	• Default • Buffering (3-buffer mode) • Mailbox (singe buffer mode) (Default: Default)

[Distributed Clocks] tab

The following table lists the settings on the [Distributed Clocks] tab.

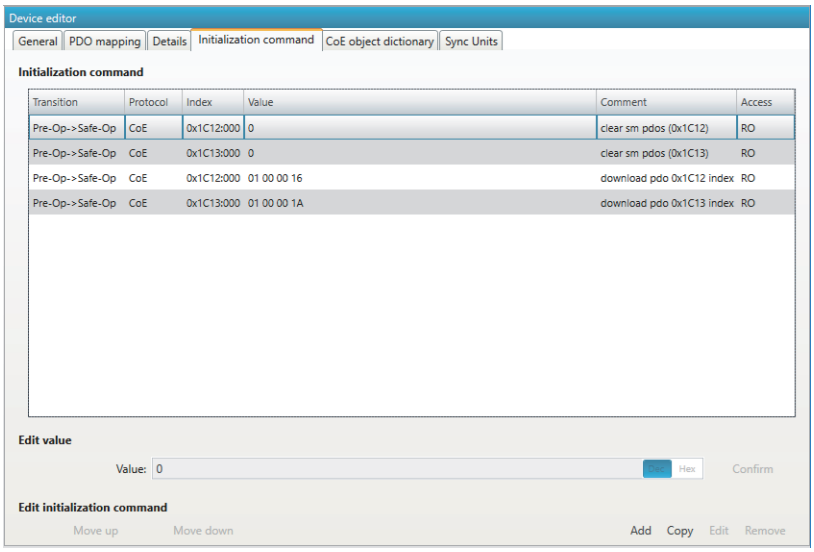


Item			Description	Setting range
Distributed Clocks	Operation mode		Set the operation mode of the distributed clocks. The settings depend on the SubDevice to be used.	—
	Cycle time [μs]		Displays the cycle time of the distributed clocks. (Unit: μs)	—
	Overwrite mode		Reflects the settings of "Sync" to the distributed clocks by selecting the checkbox. Without selecting the checkbox, the settings under "Sync" cannot be set.	• Not selected • Selected (Default: Not selected)
	Sync		Reflects the settings of "Sync 0" and "Sync 1" to the distributed clocks by selecting the checkbox. Without selecting the checkbox, "Sync 0" and "Sync 1" cannot be set.	• Not selected • Selected (Default: Depends on the SubDevice.)
	Sync 0		Uses the sync 0 sets the reference for the cycle time of the distributed clocks by selecting the checkbox.	• Not selected • Selected (Default: Depends on the SubDevice.)
	Sync 0	Sync cycle	Set the sync cycle of the sync 0. The set value is displayed to the right side of the input value. (Unit: μs) Select either of the following items and input the setting value. • Define based on cycle time: Set the coefficient to be applied to the cycle time. • User definition: Directly specify the sync cycle. When 0 is specified, the value set in "Cycle time [μs]" will be used.	■Radio button • Define based on cycle time • User definition (Default: Depends on the SubDevice.) ■Define based on cycle time "/100", "/50", "/40", "/30", "/25", "/20", "/16" "/10" "/8" "/5" "/4", "/3", "/2", "×1", "×2", "×3", "×4", "×5", "×8", "×10", "×16", "×20", "×25", "×30", "×40", "×50", "×100" (Default: Depends on the SubDevice.) ■User definition 0.01 to 4294967.29 (Default: Depends on the SubDevice.)
		Shift time [μs]	Set the shift time to be added to the sync cycle of the sync 0. (Unit: μs)	-2147483.64 to 2147483.64 (Default: Depends on the SubDevice.)

Item			Description	Setting range
Distributed Clocks	Sync 1		Uses the sync 1 sets the reference for the cycle time of the distributed clocks by selecting the checkbox.	• Not selected • Selected (Default: Depends on the SubDevice.)
	Sync 1	Sync cycle	Set the sync cycle of the sync 1. The set value is displayed to the right side of the input value. (Unit: μs) Select either of the following items and input the setting value. • Define based on cycle time: Set the coefficient to be applied to the cycle time. • Define based on Sync 0: Set the sync 1 cycle based on "Sync cycle" of "Sync 0". • User definition: Directly specify the sync cycle When 0 is specified, the value set in "Cycle time [μs]" will be used.	■Radio button • Define based on cycle time • Define based on Sync 0 • User definition (Default: Depends on the SubDevice.) ■Define based on cycle time "×1" to "×1024" (Default: Depends on the SubDevice.) ■Define based on Sync 0 "×1" to "×1024" (Default: Depends on the SubDevice.) ■User definition 0.01 to 4294967.29 (Default: Depends on the SubDevice.)
		Shift time [μs]	Set the shift time to be add to the sync cycle of the sync 1. (Unit: μs)	-2147483.64 to 2147483.64 (Default: Depends on the SubDevice.)

[Initialization command] tab

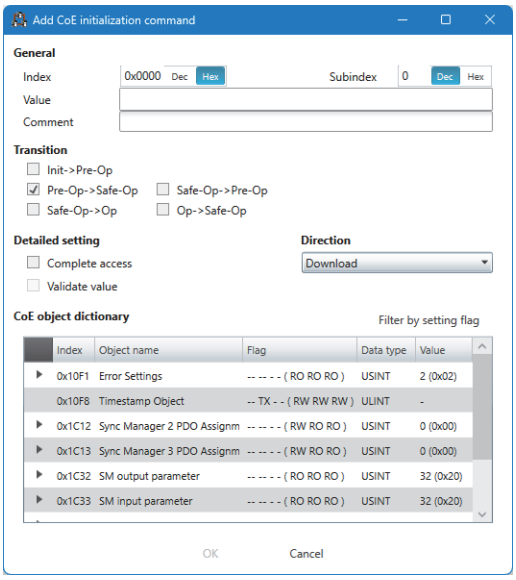
The following table lists the settings on the [Initialization command] tab.



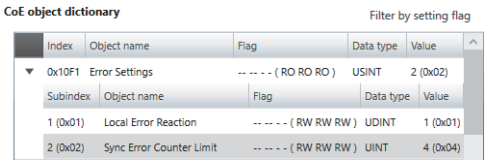
Item	Description
Initialization command	Displays the initialization command in a list. When this item is defined in the ESI file of a SubDevice, the list is displayed by default. ■Transition The timing to execute the initialization command is displayed with the ESM state transitions. ■Protocol The protocol of the initialization command is displayed. ■Index The start address to be targeted for the initialization command is displayed. |Index (hexadecimal)| : |Subindex (decimal)| is displayed. ■Value The value used by the initialization command is displayed. ■Comment The comment of the initialization command is displayed. ■Access The access right of the command is displayed. • RO: Read Only • RW: Read/Write
Edit value	Set the value used by the initialization command. The setting range differs depending on the data type to be used.
Edit initialization command	The following operations can be performed. ■Add initialization command Clicking the [Add] button creates a new initialization command. (☞ Page 143 Adding and setting the initialization command) ■Set the displayed initialization command Select a row in the list in "Initialization command" and click the [Edit] button. (☞ Page 143 Adding and setting the initialization command) ■Copy the initialization command Select a row in the list in "Initialization command" and click the [Copy] button. (☞ Page 143 Adding and setting the initialization command) ■Move the initialization command Select a row in the list in "Initialization command" and click the [Move up] button or the [Move down] button. ■Remove the initialization command Select a row in the list in "Initialization command" to be removed and click the [Remove] button. When the initialization command is defined in the ESI file of a SubDevice, the command cannot be removed.

■Adding and setting the initialization command

The following table lists the settings for adding or editing the initialization command.

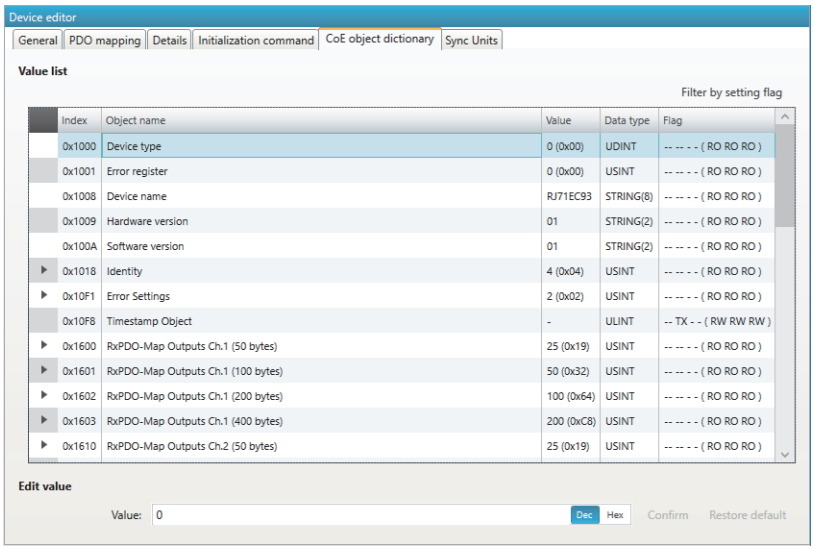


Item		Description	Setting range
General	Index	Set the index of the address to be accessed by the initialization command. Click the [Dec] button to input decimal numbers. Click the [Hex] button to input hexadecimal numbers. Note that 0 (0x0000) cannot be set; change the value. ■Default When a new initialization command is added, the index will be "0x0000". All settings, except the new one, will be the index of the selected initialization command.	0 to 65535 (0x0000 to 0xFFFF) (Default: Refer to the left description.)
	Subindex	Set the subindex of the address to be accessed by the initialization command. Click the [Dec] button to input decimal numbers. Click the [Hex] button to input hexadecimal numbers. ■Default When a new initialization command is added, the subindex will be "0". All settings, except the new one, will be defined in the ESI file of the SubDevice.	0 to 65535 (0x0000 to 0xFFFF) (Default: Refer to the left description.)
	Value	Set the value to be used for the initialization command. ■Default When a new initialization command is added, the field is blank. All settings, except the new one, will be defined in the ESI file of the SubDevice.	—
	Comment	Set the comment of the initialization command. ■Default When a new initialization command is added, the field is blank. All settings, except the new one, will be defined in the ESI file of the SubDevice.	No limit on the number of characters (UTF-8) (Default: Refer to the left description.)
Transition		Set the timing to execute the initialization command by selecting the following checkboxes. (Multiple selections allowed) • Init->Pre-Op • Pre-Op->Safe-Op • Safe-Op->Pre-Op • Safe-Op->Op • Op->Safe-Op ■Default When adding a new initialization command, the checkbox of "Pre->OP->Safe-Op" is selected. All settings, except the new one, will be defined in the ESI file of the SubDevice.	—
Detailed setting	Complete access	Downloads or uploads all the subindex information in a batch to/from the initialization command by selecting the checkbox. ■Default When a new initialization command is added, the checkbox is not selected. All settings, except the new one, will be defined in the ESI file of the SubDevice.	• Not selected • Selected (Default: Refer to the left description.)
	Validate value	Validates the value to be used for the initialization command and the actual read value by selecting the checkbox. Note that this setting can be set only when "Direction" is "Upload". ■Default When a new initialization command is added, the checkbox is not selected. All settings, except the new one, depend on the initialization command.	• Not selected • Selected (Default: Refer to the left description.)

Item	Description	Setting range
Direction	Set the direction of the initialization command. • Download: Write to the SubDevice. • Upload: Read from the SubDevice.	• Download • Upload (Default: Download)
CoE object dictionary	Displays the lists of the CoE object dictionary. In the list, "Index", "Object name", "Flag", "Data type", and "Value" are displayed from the ESI file information of the SubDevice. Selecting the object in the CoE object dictionary automatically changes the settings of the initialization command. Also, click the [▶] button to display the list of the subindex. 	—
[Filter by setting flag] button	Displays only items with setting flags from the list of the CoE object dictionary by clicking the [Filter by setting flag] button. For the setting flags, refer to the manual for the SubDevice to be used. In addition, when selecting "Complete access", the [Filter by setting flag] button cannot be clicked.	—

[CoE object dictionary] tab

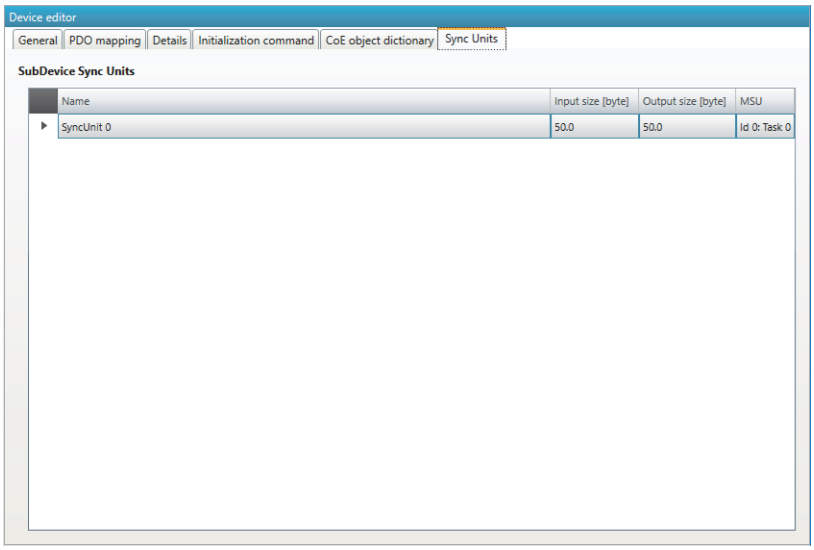
The following table lists the settings on the [CoE object dictionary] tab.

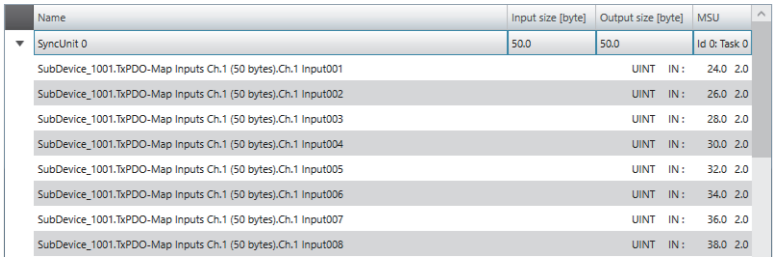


Item	Description
Value list	Displays the list of the CoE object dictionary. In the list, "Index", "Object name", "Value", "Data type" and "Flag" are displayed from the ESI file information of the SubDevice. Click the [▶] button to display the list of the subindex. 
[Filter by setting flag] button	Displays only items with setting flags from the list of the CoE object dictionary by clicking the [Filter by setting flag] button. For the setting flags, refer to the manual of the SubDevice to be used.
Edit value	Changes the value. Click the [Confirm] button to reflect the set value. Click the [Dec] button to input decimal numbers. Click the [Hex] button to input hexadecimal numbers. Clicking the [Restore default] button restores the default values defined in the ESI file.

[Sync Units] tab

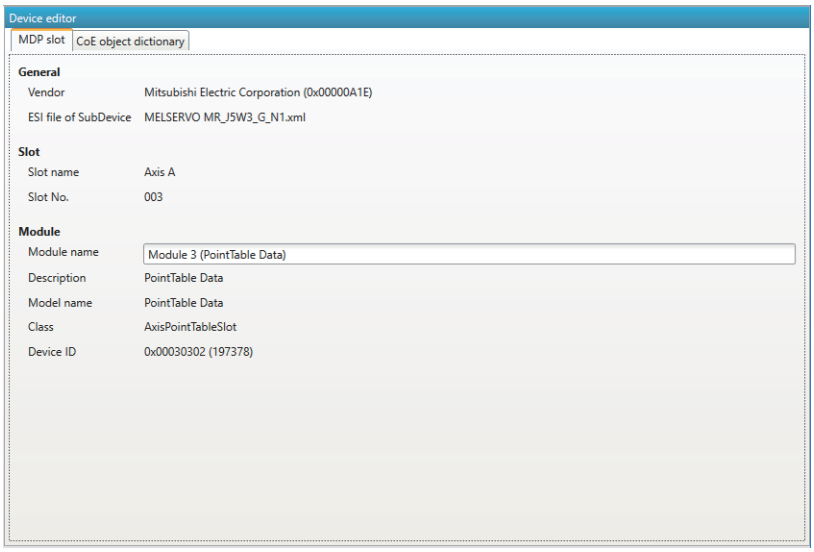
The following table lists the settings on the [Sync Units] tab.



Item	Description
SubDevice Sync Units	Displays the setting list of the SubDevice sync units. The settings in the [PDO mapping] tab is reflected as sync units. ■Name The name and number of the sync unit are displayed. (Fixed to "SyncUnit 0") ■Input size [byte] The Input data size of the sync unit is displayed. (Unit: byte) ■Output size [byte] The Output data size of the sync unit is displayed. (Unit: byte) ■MSU The MSU assigned to the sync units is displayed. The MSU is displayed as [MSU ID]: [MSU name] is displayed and the registered MSU can be selected by clicking this button. Set the MSU from [Task + Sync Units] tab of the controller. (☞ Page 126 [Task + Sync Units] tab) ■[▶] button Clicking the [▶] button displays the detail list of the sync units. 

[MDP slot] tab

The following table lists the settings on the [MDP slot] tab.



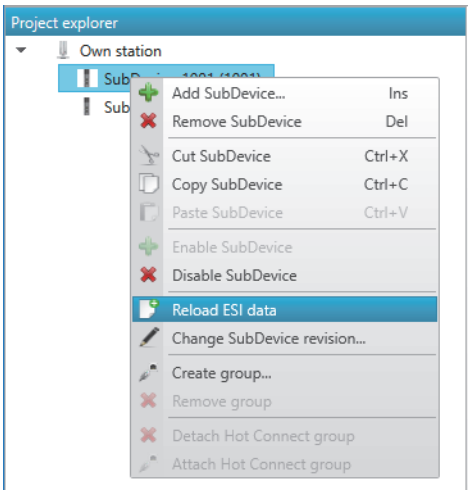
Item		Description
General	Vendor	Displays the vendor of the module.
	ESI file of SubDevice	Displays the ESI file name of the module source SubDevice.
Slot	Slot name	Displays the slot name of the module.
	Slot No.	Displays the slot number of the module.
Module	Module name	Displays the module name.
	Description	Displays the description of the module.
	Model name	Displays the model name of the module.
	Class	Displays the class of the module.
	Device ID	Displays the device ID of the module.

9.7 Updating ESI Data

This section describes how to update the information of the ESI data for the SubDevice for which parameters are set.

1. Select the SubDevice to be updated and update the ESI data.

"Project explorer" window ⇨ Select SubDevices ⇨ Right-click ⇨ "Reload ESI data"



Point

When the ESI data information is updated to the SubDevices with modules, the information of the modules can be updated together.

9.8 PDO Settings

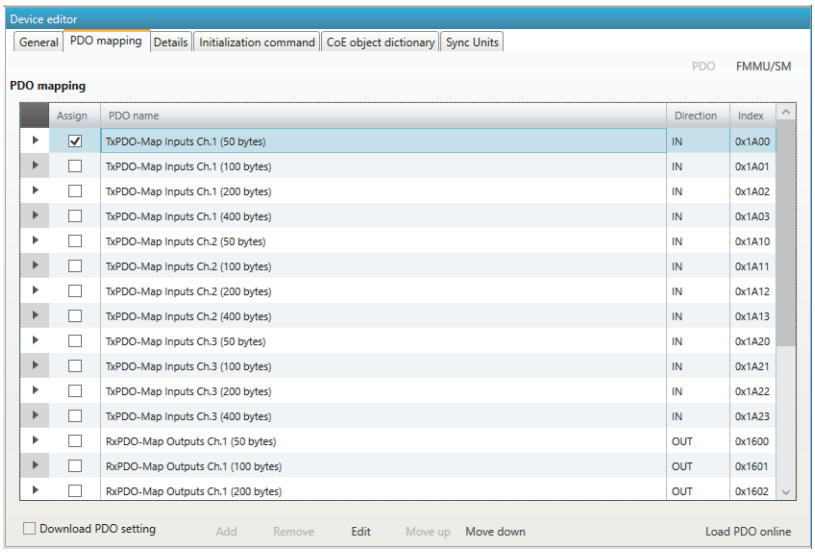
This section describes the PDO setting procedures for the controller.

When setting parameters using the registered PDO

When using the PDO registered in SubDevice, perform the following procedures.

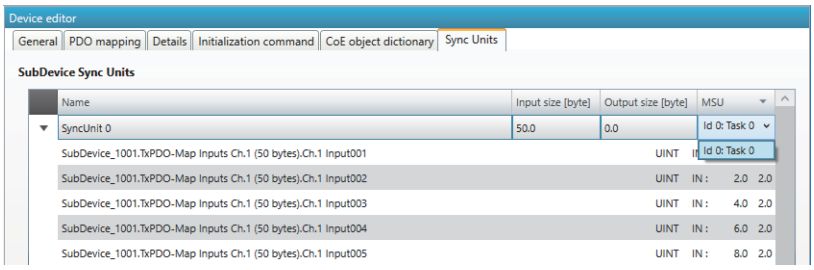
1. Select the checkboxes of "Assign" for PDOs to be used from the PDO mapping of the SubDevice.

SubDevice ⇨ "Device editor" window ⇨ [PDO mapping] tab



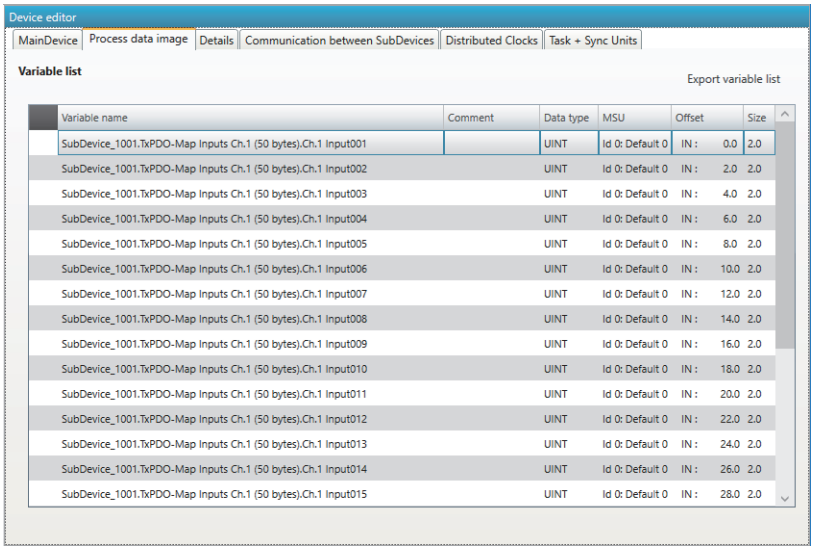
2. Set the MSU to the sync units.

SubDevice ⇨ "Device editor" window ⇨ [Sync Units] tab



3. Variable names of the controller are registered.

Own station ⇨ "Device editor" window ⇨ [Process data image] tab

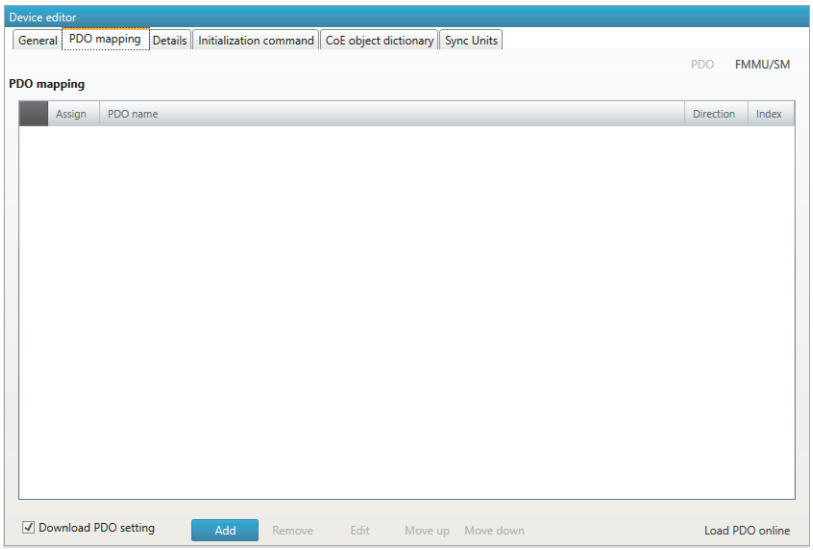


When creating and setting a new PDO

When creating and setting a new PDO, perform the following procedures.

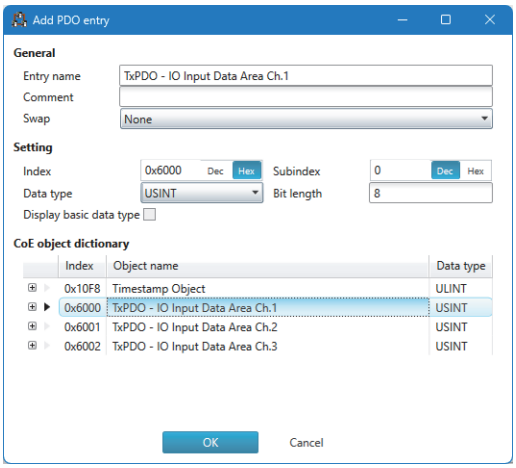
1. From the [PDO mapping] tab of the SubDevice, select the "Download PDO setting" checkbox and click the [Add] button to create the PDO for input.

SubDevice ⇨ "Device editor" window ⇨ [PDO mapping] tab



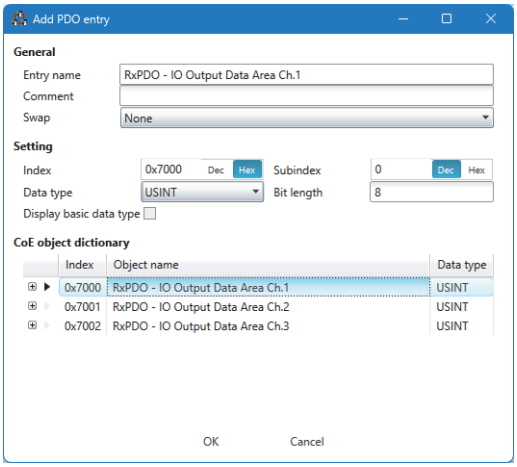
2. Click the [Add] button to create the PDO entry.

3. Set the PDO entry and click the [OK] button.

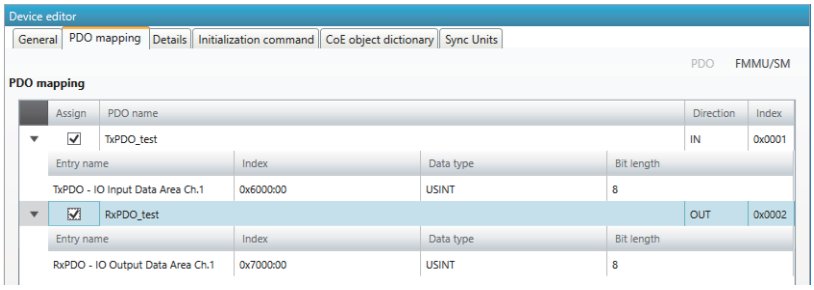


4. Set the PDO and click the [OK] button.

5. Create a PDO for output in the same way as a PDO for input.

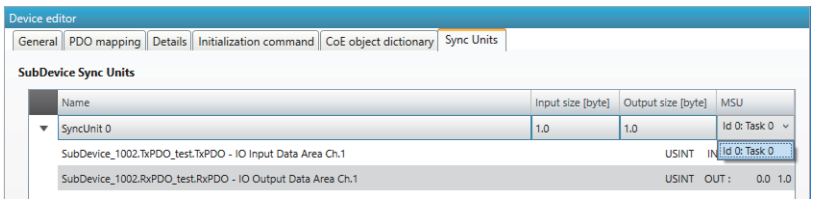


6. Select the checkboxes of "Assign" for the created PDOs from the PDO mapping of the SubDevice.



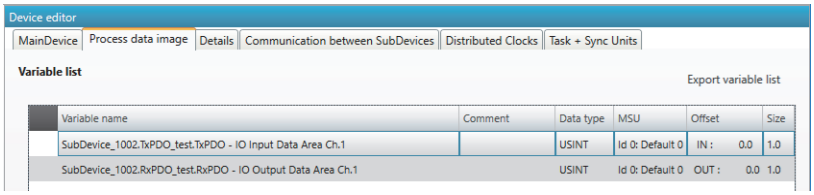
7. Set the MSU to the sync units.

SubDevice ⇨ "Device editor" window ⇨ [Sync Units] tab



8. Variable names of the controller are registered.

Own station ⇨ "Device editor" window ⇨ [Process data image] tab



9.9 Creating a Group

The multiple SubDevices registered in the MainDevice can be controlled in a batch by creating a group.
Also, the created group can be applied for pin group and Hot Connect group.

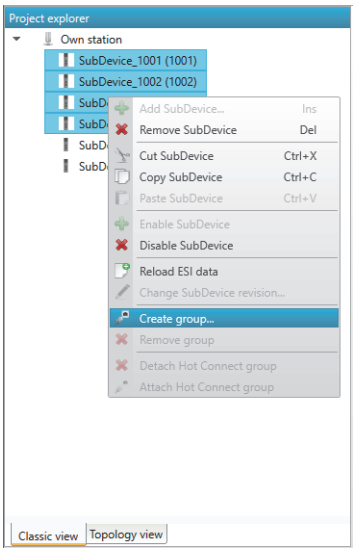
Item	Description
Pin group	Fixes the values of the Input offset and Output offset when the pin group is selected.
Hot Connect group	A group of master sync units that can continue the network even if SubDevices are connected or disconnected. To support the Hot Connect group, set the device ID.

Group setting procedure

This section describes group setting procedures.

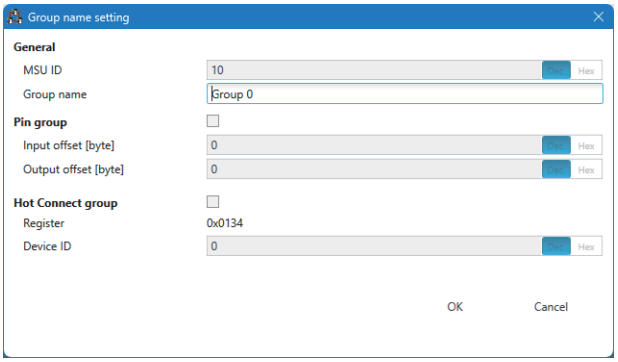
1. Select SubDevices to be grouped and create a group.

"Project explorer" window ⇨ Select SubDevices ⇨ Right-click ⇨ "Create group"



2. Create a group name on the following window. For the settings, refer to the following.

☞ Page 135 [Group] tab



3. Click the [OK] button to end.

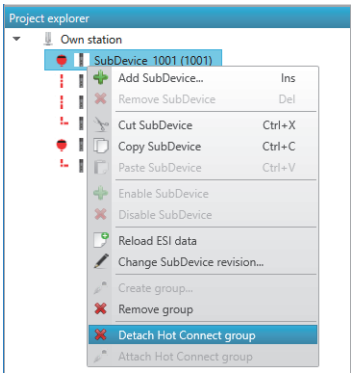
Detach/attach Hot Connect group

■Detach Hot Connect group

Detaching the set Hot Connect group from the group is called "Detach".

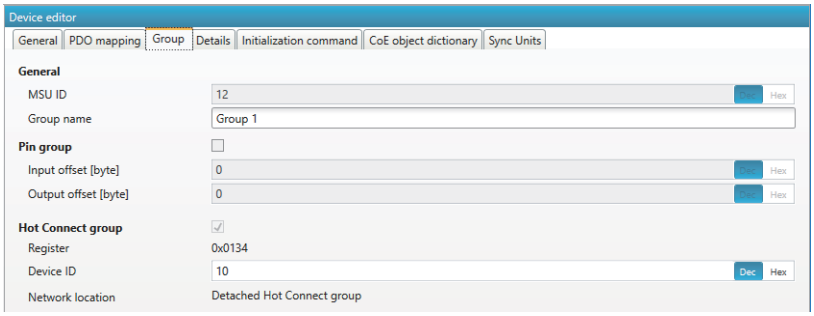
1. Perform this procedure from the grouped SubDevice.

"Project explorer" window ⇨ Select SubDevices ⇨ Right-click ⇨ "Detach Hot Connect group"



2. The detached group can be checked from the following "Network location" window.

"Device editor" window ⇨ [Group] tab

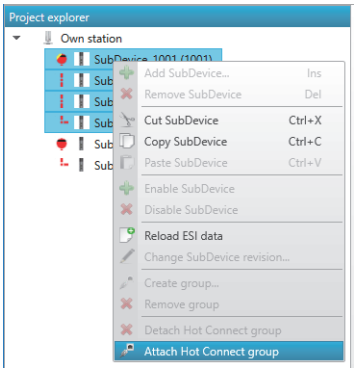


■Attach Hot Connect group

Reattaching the detached SubDevice to the Hot Connect group is called "Attach".

1. Perform this procedure from the detached SubDevice.

"Project explorer" window ⇨ Select SubDevices ⇨ Right-click ⇨ "Attach Hot Connect group"



Precautions

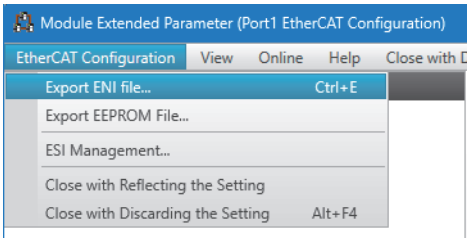
Hot Connect group is a group in which SubDevices can be connected or disconnected during the system operating.
When a detaching error occurs, check whether any SubDevices that cannot be connected or disconnected to the Hot Connect group destination exist.

9.10 Exporting ENI File

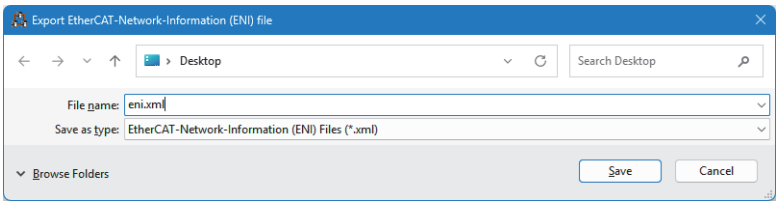
This section describes how to export the parameters, which are set in the module extended parameter (EtherCAT configuration) window, to the ENI file.

1. Click "Export ENI file" in the module extended parameter (EtherCAT configuration) window.

[EtherCAT Configuration] ⇨ [Export ENI file]



2. Set the file name and click the [Save] button.

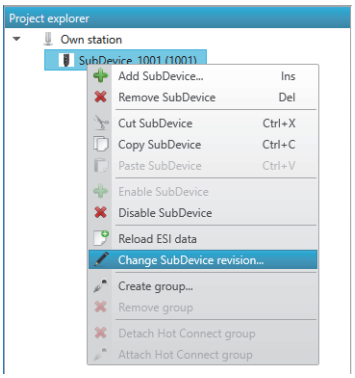


9.11 Changing SubDevice Revision

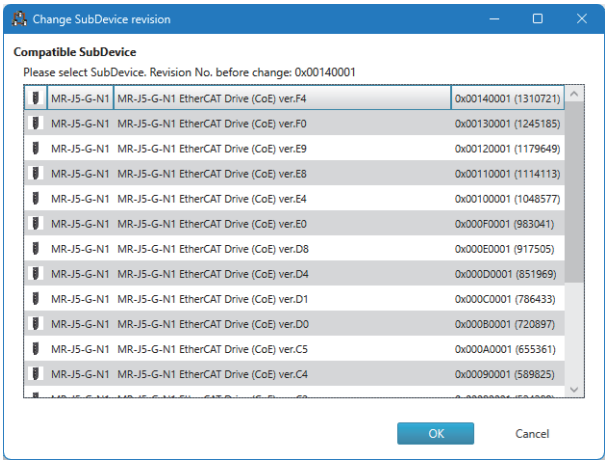
To ensure compatibility with other SubDevices to be configured with EtherCAT, the SubDevice revision may be changed. The following shows the revision changing methods of the SubDevice set in the module extended parameter (EtherCAT configuration) window.

1. Select the SubDevice which changes the revision.

"Project explorer" window ⇨ Select SubDevices ⇨ Right-click ⇨ "Change SubDevice revision"



2. Select the revision to be changed and click the [OK] button.



9.12 Online

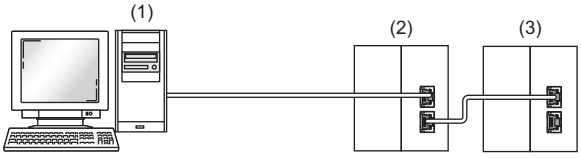
This function detects and monitors SubDevices from a personal computer.

Reading the SubDevice configuration simplifies parameter settings, and SubDevice diagnostics can check the status.

System configuration

Connect the In port of the SubDevice, which is the nearest module to the MainDevice, to the personal computer with an Ethernet cable.

Because EtherCAT Configuration operates as the MainDevice, a controller is not used.



(1) Personal computer with GX Works3 and EtherCAT Configuration installed
(2) EtherCAT SubDevice
(3) EtherCAT SubDevice

Point

The ESI file of the SubDevice connected to the EtherCAT network needs to be registered beforehand. (☞ Page 116 Registering ESI files)

Reading the SubDevice configuration

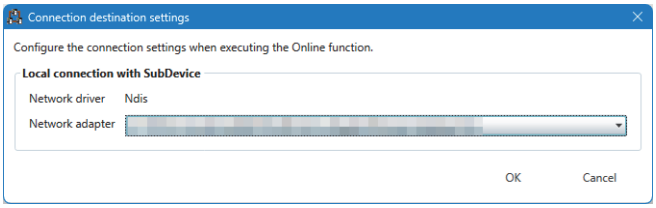
Detect the SubDevice in the EtherCAT network from a personal computer.

1. Connect the personal computer to the SubDevice with an Ethernet cable, and apply the power.
2. Open the module extended parameter window from the engineering tool.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port1: EtherCAT)] ⇨ [Module Extended Parameter]

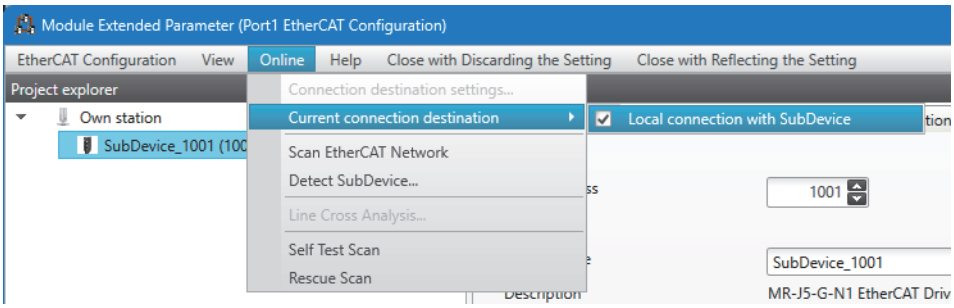
3. Set "Local connection with SubDevice".

[Online] ⇨ [Connection destination settings]



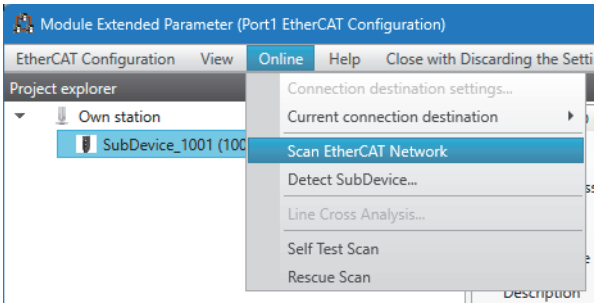
4. Select "Local connection with SubDevice" set.

[Online] ⇨ [Current connection destination]

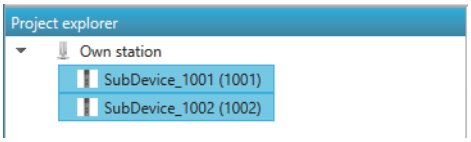


5. Perform EtherCAT network scan.

[Online] ⇨ [Scan EtherCAT Network]



6. EtherCAT Configuration is read and displayed.



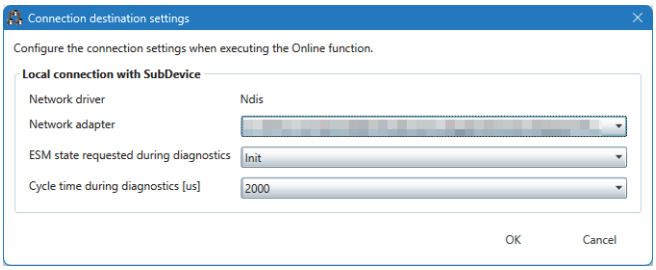
SubDevice diagnostics

Monitor the SubDevices in the EtherCAT network from a personal computer.

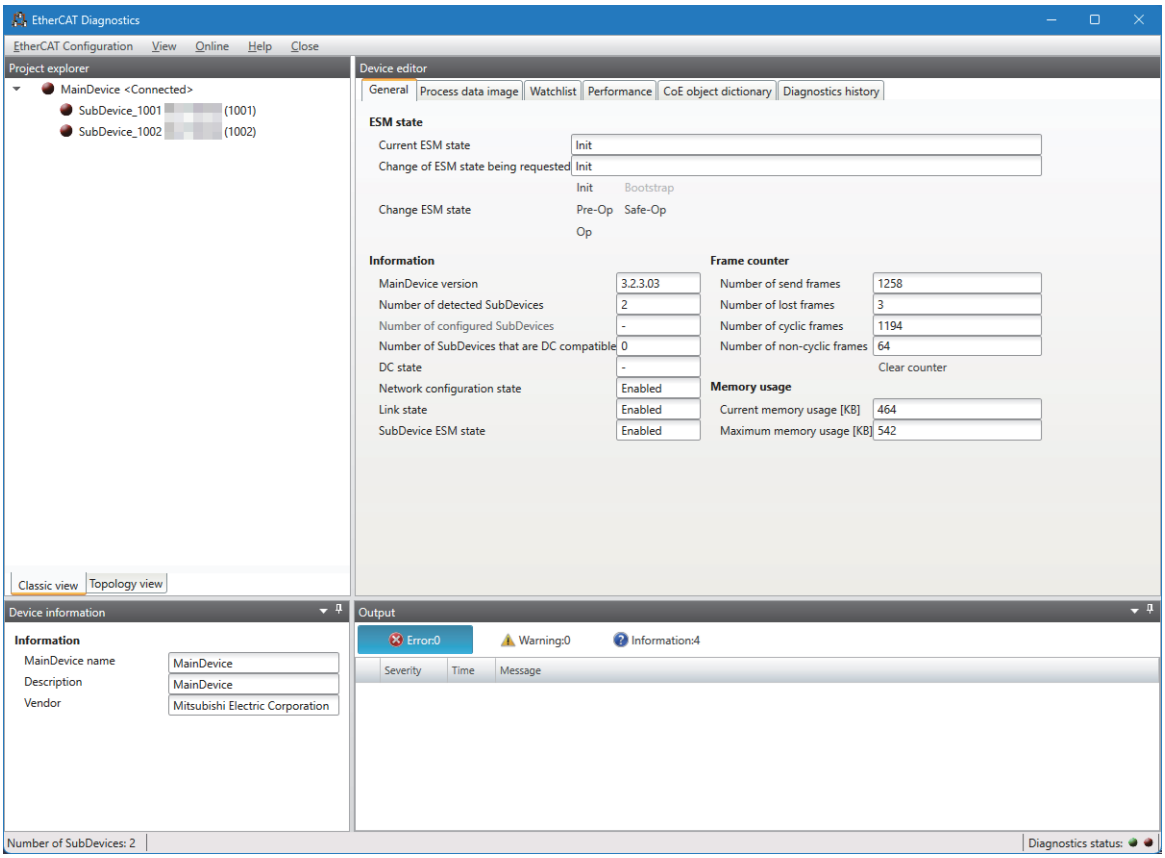
1. Connect the personal computer to the SubDevice with an Ethernet cable, and apply the power.
2. Open the "EtherCAT Diagnostics" window from the engineering tool.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ Right-click [Module Parameter (Port1: EtherCAT)]. ⇨ [EtherCAT Diagnostics]

3. Set "Local connection with SubDevice" in the displayed "Connection destination settings" window, then click "OK".



4. SubDevice diagnostics are automatically started in the "EtherCAT Diagnostics" window and the result of the diagnostics will be displayed.



Precautions

- SubDevice diagnostics are automatically stopped after an hour and a message will be displayed. If the diagnostics are to be continued, start the SubDevice diagnostics again.
- SubDevice settings cannot be changed during SubDevice diagnostics. The detected SubDevice operates with the initial value of the ESI file, use it as is.
- The redundancy function, Hot Connect function, communication between SubDevices function, and distributed clock function cannot be used during SubDevice diagnostics.
- The ESM state may not transition to OP depending on the SubDevice when an error occurs.
- The network adapter used in the online function may switch due to plugging or unplugging cables, changing the computer settings, or other computer-related factors. In that case, uncheck "Current connection destination" first. Check or change the specification of the network adapter in "Connection destination settings", then execute the online function again.

10 TROUBLESHOOTING PROCEDURE

This chapter describes errors that may occur during system operation, error causes, and actions to be taken.
Identify the causes based on the error status or symptoms of the controller.

1. Check the LED status of the controller. (☞ Page 18 PART NAMES, ☞ Page 163 Troubleshooting with LED Indicators)
2. Check the LED status of the module. (📖 User's manual for the module used)
3. Check the status of the module using the system monitor with an engineering tool. (☞ Page 165 Checking the Module Status)
4. Check the network status using Intelligent Function Module Monitor of the engineering tool. (☞ Page 166 Checking the Network Status)
5. If the error cause cannot be identified in steps 1 to 4, perform troubleshooting by symptom. (☞ Page 167 TROUBLESHOOTING BY SYMPTOM)

10.1 Troubleshooting with LED Indicators

Use the LED indicators specific to the MX-F Model (Support EtherCAT) in troubleshooting.

For troubleshooting with other LED indicators, refer to the following.

📖 MELSEC MX Controller MX-F Model User's Manual

When the ECRN LED turns off

When the ECRN LED turns off, check the following items.

Check item	Action
Does any error occur in the module diagnostics?	Take the actions displayed on the module diagnostics window.
Is the Ethernet cable wired correctly?	Wire the Ethernet cable correctly.
Is 'Configuration state' (U40\G16385) set to 0001H (Executed)?	Check if the correct parameter is set.
Is 'Communication state' (U40\G16386) set to 0001H (Communicating)?	Check the network status, and remove the error factor of the device that causes the error.
Has the MainDevice ESM state been changed to Init?	If the MainDevice ESM state has been changed to Init, 'MainDevice ESM state' (U40\G0) will be 0001H (Init). Change the MainDevice ESM state to the appropriate ESM state.
Is the appropriate cycle time set?	If any of the following conditions are met, set a longer cycle time. • When the send/receive data size is large • When the number of configuration devices is large • When SDO communication is frequently performed • When the distributed clock (DC) is used • When multiple sync units are used • When inter-SubDevice communication is used • When Cable Redundancy is used

When the ECER LED turns on

When the ECER LED turns on, check the following.

Check item	Action
Has any stop error occurred in the MainDevice?	Check the error on the MainDevice, using LEDs and module diagnostics. If a stop error has occurred, take the actions described in the manual or in the module diagnostics window. (☞ Page 165 Checking the Module Status)

When the ECER LED is flashing

When the ECER LED is flashing, check the following.

Flashing type	Check item	Action
BL (Blinking)[*1]	Are the type, settings, and wiring of the SubDevice connected to the MainDevice different from the configuration?	Check whether a configuration mismatch is detected in SubDevice configuration mismatch (bit 1) of 'MainDevice error status' (U40\G16387) of the buffer memory. If the configuration mismatch has been detected, check the line structure and take appropriate action. (☞ Page 167 The bus scan cannot be completed., Page 167 The bus scan fails.)
SF (Single Flash)[*1]	Is the controller (program) in the STOP state?	Check the program operating status using the LEDs and module diagnostics. If the program is in the STOP state, change it to the RUN state.
	Is the SubDevice in an unintended ESM state for the MainDevice?	Check whether a SubDevice under an unintended ESM state is detected in SubDevice in an unintended ESM state detected (bit 10) of 'MainDevice error status' (U40\G16387) of the buffer memory. If such a SubDevice has been detected, identify the SubDevice that is in an unintended ESM state. If the applicable SubDevice is identified, change the SubDevice or all SubDevices to the desired ESM state.
DF (Double Flash)[*1]	Has a WKC error occurred?	Check whether a WKC error is detected in SubDevice with invalid input data detected (bit 6)/SubDevice with invalid output data detected (bit 7) of 'MainDevice error status' (U40\G16387) of the buffer memory. If the WKC error has been detected, identify the SubDevice where the error occurred. Check whether any of the applicable SubDevices meet the following conditions and take appropriate action. ■The ESM state is Pre-OP or lower. • Change the ESM state of the SubDevice to Safe-OP or higher. (When the ESM state is intentionally controlled with an application (a program on the controller), take appropriate action as required.) ■An error or other problem has occurred. • Refer to the manual of the SubDevice, diagnose the status, and take appropriate action.
	Has a frame loss occurred?	Check whether a frame lost occurs in Cyclic frame lost (bit 8) of 'MainDevice error status' (U40\G16387) of the buffer memory. If frame loss has occurred, check the status of the SubDevice and Ethernet cables, as well as the presence of the source of noise, and take appropriate action.

*1 For the flashing operation, refer to the following.
☞ Page 18 PART NAMES

When the L/A LED turns on

When the L/A LED turns on, check the following.

Check item	Action
Has any stop error occurred in the MainDevice?	Check the error on the MainDevice, using LEDs and module diagnostics. If a stop error has occurred, take the actions described in the manual or in the module diagnostics window. (☞ Page 165 Checking the Module Status)
Are the parameters appropriate?	Set the "Cycle Time" and "ERTT" parameters to allow surplus time. The setting may be too short, preventing the MainDevice from sending packets.

When the L/A LED turns off

When the L/A LED turns off, check the following.

Check item	Action
Is a cable connected to the port?	• Check whether the cable is broken. If it is broken, replace it. • Securely connect the cable to the port.
Is the SubDevice connected to the cable?	• Check whether the SubDevice is connected to one end of the cable connected to the port. If not, connect the SubDevice. • Securely connect the cable to the SubDevice.
Is the SubDevice in a communication-ready status?	Check the manual of the SubDevice and the LEDs to determine that the SubDevice is in a communication-ready status. If it is not in a communication-ready status, prepare it to enable communication. If the SubDevice is faulty, replace it.

10.2 Checking the Module Status

This section describes troubleshooting to check the status of the module by performing diagnostics and operation tests using the engineering tool. For details on each function, refer to the following.

GX Works3 Operating Manual
MELSEC MX Controller MX-F Model User's Manual

Function	Description
System monitor	This function displays the module configuration, and detailed information and error status of each module. For the error module identified, the module diagnostics function can be executed from this window.
Module diagnostics	This function diagnoses the target module. (The current error and its details can be checked.) Information required for troubleshooting, such as the current error, details and cause of the error, and action to be taken, are displayed.
Event history	This function displays event information such as errors that have occurred in each module, executed operations, and network errors. Since information collected before power-off or reset can also be displayed, the error cause can be identified based on the past operations and errors.

10.3 Checking Status of Motion Function

For errors and warnings that occur in the motion function, refer to the following.

MELSEC MX Controller MX-F Model User's Manual

10.4 Checking the Network Status

This section describes troubleshooting to check the network status.

Use the following methods to check the network status of the MainDevice.

- Intelligent function module monitor (☞ Page 166 Intelligent function module monitor)
- Checking with the buffer memory (☞ Page 166 Checking with the buffer memory)

Intelligent function module monitor

"Intelligent Function Module Monitor" of the engineering tool can be used for checking the EtherCAT network status.

For details, refer to the following.

📖 GX Works3 Operating Manual

Checking with the buffer memory

The connection status of process data communication and error details can be checked in the buffer memory areas shown below.

For details on the buffer memory, refer to the following.

☞ Page 188 Buffer Memory

Item			Buffer memory address
MainDevice information	Communication Status		U40\G16386
	MainDevice error status		U40\G16387
	DC/DCM error status		U40\G16389
	Frame lost counter		U40\G16514 to U40\G16515
	DC Sync error counter		U40\G16516 to U40\G16517
	DCM Sync error counter		U40\G16518 to U40\G16519
	Current ESM state	MainDevice ESM state	U40\G0
		SubDevice ESM state	U40\G1 to U40\G72
SubDevice information	Node address		U40\G1 to U40\G72
	SubDevice error status		U40\G20481
	SubDevice actual configuration diagnostic information		Starting from U40\G1048576
	Bus mismatch information		Starting from U40\G1081344

11 TROUBLESHOOTING BY SYMPTOM

This chapter describes troubleshooting for each symptom of the EtherCAT function.
For troubleshooting by symptom for other functions, refer to the following.
MELSEC MX Controller MX-F Model User's Manual

The bus scan cannot be completed.

When the bus scan by the MainDevice does not complete, check the following items.

Check item	Action
Is "Connection Retry Method at Startup" of the controller set to "Retry Endlessly"? (☞ Page 106 Connection Retry Setting at Startup)	When the MainDevice starts up, it endlessly continues to retry the bus scan. During the retry, the controller (MainDevice) does not detect errors such as bus mismatches. To enable detection of errors such as bus mismatches, change "Connection Retry Method at Startup" to "Retry for the Specified Period".

The bus scan fails.

When the bus scan fails (a bus mismatch occurs), check the following items.

Check item	Action
Is a device that does not support EtherCAT connected?	Installing an Ethernet device that does not support EtherCAT (such as an industrial switch) on the EtherCAT network is not recommended. Remove the device that does not support EtherCAT from the EtherCAT network.
Is the Ethernet port (P1) of the controller connected to the IN port of the communication counterpart (SubDevice)?	The Ethernet port (P1) of the controller must be connected to the IN port of the communication counterpart (SubDevice). Connect it to the IN port of the communication counterpart (SubDevice).
Can the Ethernet port (P1) of the controller perform communication?	Check that the L/A LED on the Ethernet port (P1) of the controller is flashing. If it is not flashing, the port is not linked up. Check the following: • If the cable is broken, replace it. Also, securely connect the cable. • Refer to the manual of the SubDevice and prepare the SubDevice for communication. If the SubDevice is faulty, replace it.
Has an error occurred in the module diagnostics window?	If an error has occurred, take the actions displayed on the module diagnostics window. If a bus mismatch has occurred, 'Bus mismatch information' (U40\G1081344 to U40\G1081373) stores information on the SubDevice in which the bus mismatch has occurred. Therefore, check whether the settings of the module extended parameters (ENI file) match the actual network configuration.

PDO communication fails.

Check the following items if the bus scan succeeds but PDO communication fails.

Check item	Action
Has an error occurred in the module diagnostics window?	If an error has occurred, take the actions displayed on the module diagnostics window.
Is the ESM state of the target SubDevice to which to perform PDO communication set to Operational?	In 'SubDevice ESM state' (U40\G1 to U40\G72), check that the ESM state of the target SubDevice to which to perform PDO communication is set to Operational (0008H). If the state is other than Operational, PDO communication input and output will be restricted. Change the ESM state of the target SubDevice to Operational.
When communication is performed between SubDevices that have both Input and Output PDOs, is the same cycle method used?	When communication is performed between SubDevices that have both Input and Output PDOs, use the next cycle method.

SDO communication fails.

Check the following items if the bus scan succeeds but SDO communication fails.

Check item	Action
Has an error occurred in the module diagnostics window?	If an error has occurred, take the actions displayed on the module diagnostics window.
As a result of executing SDO communication, is an error code stored in 'SDO error code' (U40\G90924) and 'SDO detail error code' (U40\G90926 to U40\G90927)?	When an error code is stored in 'SDO error code' (U40\G90924), take action according to the error code. An SDO abort code is stored in 'SDO detail error code' (U40\G90926 to U40\G90927). For details on actions to be taken for SDO abort codes, refer to the manual for the SubDevice.
Is the ESM state of the target SubDevice to which to perform SDO communication set to Pre-Operational or higher?	In 'SubDevice ESM state' (U40\G1 to U40\G72), check that the ESM state of the target SubDevice to which to perform SDO communication is set to Pre-Operational (0002H) or higher. If the state is other than Pre-Operational or higher, SDO communication cannot be executed. Change the ESM state of the target SubDevice to Pre-Operational.

Distributed clock synchronization fails.

If synchronous accuracy decreases or synchronization loss occurs during the distributed clock synchronization, check the following.

Check item	Action
Has Ethernet been disconnected or restored while the distributed clock synchronization is being used?	When using the distributed clock synchronization, do not use Cable Redundancy or Hot Connect. If the distributed clock synchronization is used, a decrease in synchronous accuracy or synchronization loss may occur when Ethernet is disconnected or restored.

Online function is unavailable.

If the online function (reading SubDevice or SubDevice diagnostics) is unavailable, check the following.

Check item	Action
Have the SubDevice diagnostics been running for more than an hour?	SubDevice diagnostics are automatically stopped after an hour and a message will be displayed. If the diagnostics are to be continued, start the SubDevice diagnostics again.
Have the SubDevice settings changed?	SubDevice settings cannot be changed during SubDevice diagnostics. The detected SubDevice operates with the default value of the ESI file, use it as is.
Are the following functions used during SubDevice diagnostics? • Redundancy function • Hot Connect function • Communication between SubDevices function • Distributed clock function	The left functions cannot be used during SubDevice diagnostics. Set the relevant functions to be disabled, and then execute the SubDevice diagnostics again.
Has an error occurred in a SubDevice?	The ESM state may not transition to OP depending on the SubDevice when an error occurs. Resolve any errors in the SubDevice, and then execute the SubDevice diagnostics again.
Is the status of the network adapter of the personal computer changing?	The network adapter used in the online function may switch due to plugging or unplugging cables, changing the computer settings, or other computer-related factors. In that case, uncheck "Current connection destination" on "Online" in the "EtherCAT Configuration" or "EtherCAT Diagnostics" window first. Check or change the specification of the network adapter in "Connection destination settings", then execute the online function again.

EtherCAT function is not used.

■Avoiding registering errors such as communication errors

When the EtherCAT function is not used, registering errors such as communication errors can be avoided by configuring the following settings.

- [Module Parameter] ⇨ [Advanced setting] ⇨ [Connection Retry Setting at Startup] ⇨ Set [Connection Retry Method at Startup] to "Retry Endlessly.
- Add a SubDevice to the project explorer with the module extended parameter.

12 ERROR CODES

This chapter describes error codes that may occur on the MX-F Model (Support EtherCAT).
For error codes not listed in this chapter, refer to the following.
MELSEC MX Controller MX-F Model User's Manual

12.1 List of Error Codes

The following table lists error codes that may occur on the MX-F Model (Support EtherCAT).

Error code	Error name	Error definition and cause	Action	Stop/ continue	Detailed information
1960H	Bus mismatch (Inconsistency between the module extended parameter and connection status)	• The Ethernet cable is disconnected or broken. • The Ethernet cable is connected to the incorrect port. • The connection order of the SubDevices differs from the order specified on the module extended parameter. • A SubDevice assigned to module extended parameter is not connected, or a SubDevice not assigned to module extended parameter is connected. • If "Check Device ID" is checked in the module extended parameter, Device ID specified in module extended parameter does not match Device ID actually set for the SubDevice. • There is a SubDevice that is not booting properly. • Module extended parameter is not the right one.	• Check that the Ethernet cable is connected properly. • Check that the port to which the Ethernet cable is connected is correct for both the MainDevice and the SubDevice. • Connect the SubDevices in the order specified on the module extended parameter. • If the SubDevice specified on the module extended parameter is not connected, connect it. Remove any SubDevice connected that is not specified on the module extended parameter. • If "Check Device ID" is checked in the module extended parameter, check that Device ID set in the SubDevice is the value specified in the module extended parameter. • If there is a SubDevice that is not running, start it. If an error or other problem occurs in the SubDevice, refer to the SubDevice manual and resolve the error. • Delete the module extended parameter from the controller and write it again. Then restart the controller.	Continue	Node address of the SubDevice immediately before the mismatch Node address of the unconnected SubDevice Node address of the SubDevice in an unexpected state
1961H	DC sync start failure	DC synchronization failed to start during ESM state change (INIT → POP) or topology change (cable plugged or unplugged). The following are the possible causes. • The reference clock is not present. • The reference clock is behind the DC synchronous station.	• Connect the reference clock. • Return Link to normal. • Place the reference clock and reference clock candidates in front (on the MainDevice side) of the other DC synchronous stations on the module extended parameter. It is also recommended to place it before the branch SubDevice.	Continue	Detail error code
1962H	Mailbox transmission working counter error	A working counter error occurred in response to the mailbox write command.	• If an error or other problem occurs in the SubDevice, refer to the SubDevice manual and resolve the error. • Check the EtherCAT communication cable for any errors. • Take measures to reduce noise.	Continue	Address Working counter setting value Working counter measured value
1963H	Initialization command error	The SubDevice did not properly respond to initialization commands from the MainDevice.	• If an error or other problem occurs in the SubDevice, refer to the SubDevice manual and resolve the error. • Check the EtherCAT communication cable for any errors. • Take measures to reduce noise.	Continue	Error type Node address

Error code	Error name	Error definition and cause	Action	Stop/ continue	Detailed information
1964H	SDO abort error	SDO transfer was aborted while sending an initialization command.	The reason for this error depends on the SubDevice. Based on the SDO abort code, index number, and sub-index number shown in the detailed information, refer to the SubDevice documentation and EtherCAT specifications to determine the conditions and actions to be taken to notify of this error.	Continue	SDO abort code Node address where the error occurred Index number Subindex number
1965H	PDI watchdog timeout	The PDI watchdog timeout has occurred. (No response from SubDevice)	• Increase the value of "Overwrite watchdog" → "Set PDI watchdog (Register 0410H)" in the "Details" window of the corresponding SubDevice in the module extended parameter. For details on appropriate values, refer to the manual of the corresponding SubDevice. • Check the EtherCAT communication cable for any errors. • Take measures to reduce noise.	Continue	Node address
1966H	Connection error	The port connected to the MainDevice or SubDevice is incorrect.	• Check and, if necessary, revise the wiring of the SubDevice displayed on detailed information 2. If detailed information 2 auto increment address is 1, the port connected to the MainDevice may be incorrect. Check and, if necessary, revise the MainDevice wiring. • If the above does not solve the problem, review the wiring from the MainDevice to SubDevice.	Continue	Node address Auto increment address Port number
1967H	Controller stop error	A controller stop error was detected.	Check the error details of the controller by executing the module diagnostics of the engineering tool, and take actions.	Continue	—
1968H	Communication start failure	The request failed due to a duplicated request to start communication.	After the previous request has completed, request the next one.	Continue	—
1969H	Communication start failure	Communication startup failed because communication startup was requested during communication. The following are the possible causes. • An error has occurred in the controller. • The controller is faulty.	• Check whether a communication error has occurred in the controller, and take appropriate action referring to the manual or other documents. • Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a controller failure. Please contact your local Mitsubishi Electric representative.	Continue	—
196AH	Communication start failure	Communication startup failed because the module extended parameter could not be acquired. The following are the possible causes. • The engineering tool and others were accessing the module extended parameter in the controller. • The controller was updating the module extended parameter. • The module extended parameter stored in the controller is not a parameter of the controller. • The module extended parameter stored in the controller is not supported by the controller. • The module extended parameter stored in the controller is broken. • The module extended parameter is not set in EtherCAT Configuration. • No SubDevices are registered in the module extended parameter.	Remove the cause as follows, then restart the controller. • Stop access to the module extended parameter in the controller from the engineering tool and others. • Wait for the module extended parameter to update. • Check the versions of the engineering tool and controller and modify either version to make them work. • Write the module extended parameter for the controller. • Configure the module extended parameter in EtherCAT Configuration. • Register the SubDevice in the module extended parameter.	Continue	Cause of parameter communication error

Error code	Error name	Error definition and cause	Action	Stop/ continue	Detailed information
196BH	Communication start failure	Communication startup failed because a parameter setting error was detected. The following are the possible causes. • The parameter contains a setting that is not supported by the controller. • The combination of the engineering tool and controller versions is not available. • The intended module extended parameter is not reflected in the controller. • The parameter is corrupt.	Check the following, set the parameter again, then restart the controller. • Refer to the detailed information and review the cause parameters. Then write the revised parameters (module parameter and module extended parameter). • Refer to the manual to see if the engineering tool and controller versions are in a valid combination. If the combination is invalid, update one or both versions to make it available. • If the above does not resolve the issue, delete the module extended parameter from the controller and write it again. Then restart the controller.	Continue	Group of parameters Parameter items
196CH	Communication start failure	Communication failed to start because a parameter error or EtherCAT function error was detected. The following are the possible causes. • The parameter is corrupt. • An error has occurred in the controller. • The controller is faulty.	• Write the parameter to the controller again. Then restart the controller. • If the same error is displayed repeatedly, a hardware error may have occurred in the module. Please contact your local Mitsubishi Electric representative.	Continue	Failed action EtherCAT function error code
196DH	Communication start failure	Communication failed to start because module extended parameter analysis failed. The following are the possible causes. • The module extended parameter has a configuration that is not supported by the controller. • The intended module extended parameter is not reflected in the controller. • The combination of the engineering tool and controller versions is not available. • The module extended parameter is broken.	Check the following, set the parameter again, then restart the controller. • Review the module extended parameter. Then, write the correct module extended parameter. • Refer to the manual to see if the engineering tool and controller versions are in a valid combination. If the combination is invalid, update one or both versions to make it available. • If the above does not resolve the issue, delete the module extended parameter from the controller and write it again. Then restart the controller.	Continue	EtherCAT function error code

Error code	Error name	Error definition and cause	Action	Stop/ continue	Detailed information
196EH	Communication start failure	The bus scan timed out. The following are the possible causes. • The module extended parameter and the network configurations do not match. • One of the SubDevices is not ready to communicate. (Example: Not activated, setting error, and fault) • The intended module extended parameter is not reflected in the controller. • The cycle time and ERTT settings do not match the actual configuration, and a communication error occurred.	Remove the cause as follows, then restart the controller. • Check that the Ethernet cable is connected correctly and the port to which the cable is connected is correct for both the MainDevice and the SubDevices. • Connect the SubDevices in the order specified on the module extended parameter. • If the SubDevice specified on the module extended parameter is not connected, connect it. Remove any SubDevice connected that is not specified on the module extended parameter. • If "Check Device ID" is checked in the module extended parameter, check that Device ID set in the SubDevice is the value specified in the module extended parameter. • If there is a SubDevice that is not running, start it. If an error or other problem occurs in the SubDevice, refer to the SubDevice manual and resolve the error. • Increase the "Connection Retry Period at Startup" value for the module parameter. • Delete the module extended parameter from the controller and write it again. • Check whether a communication error has occurred in the controller, and take appropriate action referring to the manual or other documents.	Continue	Node address of the SubDevice immediately before the mismatch Node address of the unconnected SubDevice Node address of the SubDevice in an unexpected state EtherCAT function error code
196FH	Communication start failure	An error was detected in the MainDevice ESM state transition at the start of communication. The following are the possible causes. • After the bus scan, a bus configuration mismatch occurred due to disconnection or other reason. • The cycle time and ERTT settings do not match the actual configuration, and a communication error occurred. • SubDevice initialization failed. • DC synchronization initialization failed during the DC synchronization setup. • A SubDevice error occurred. • An error occurred in the controller	Remove the cause as follows, then restart the controller. • Check whether a network configuration mismatch has occurred due to a disconnection after a bus scan or other reasons, and correct the configuration. • Check whether a communication error has occurred in the controller, and take appropriate action referring to the manual or other documents. • Check the SubDevice for any errors. If an error has occurred, refer to the user's manual or related documentation of the SubDevice and take appropriate action. • Check if any abnormality other than this error has occurred in the controller, and take appropriate action referring to the manual or other documents.	Continue	ESM state of the MainDevice before transition ESM state of the MainDevice after transition Target ESM state of the MainDevice EtherCAT function error code
1970H	Communication start failure	An error was detected in the MainDevice ESM state transition at the start of communication. The following are the possible causes. • The parameter is corrupt. • An error has occurred in the controller. • The controller is faulty.	• Delete the module extended parameter from the controller and write it again. Then restart the controller. • If the same error is displayed repeatedly, a hardware error may have occurred in the module. Please contact your local Mitsubishi Electric representative.	Continue	Target ESM state of the MainDevice

Error code	Error name	Error definition and cause	Action	Stop/ continue	Detailed information
1971H	Communication start failure	Communication failed to start because some settings cannot be used with Cable Redundancy.	Review one of the following module extended parameters: • Check "Disable LRW" for each SubDevice. • Disable "Cable Redundancy". (The LRW command cannot be used in the Cable Redundancy state.)	Continue	EtherCAT function error code
1972H	MainDevice ESM state change failed	The request failed because a duplicate request was made to change the ESM state of the MainDevice.	After the previous request has completed, request the next one.	Continue	Target ESM state of the MainDevice
1973H	MainDevice ESM state change failed	The ESM state change for the MainDevice or SubDevice is abnormal and the ESM state change for the MainDevice fails. The following are the possible causes. • A bus mismatch has occurred. • The SubDevice is malfunctioning. • There is an error in the module extended parameter setting.	The ESM state of the MainDevice or SubDevice could not be changed. The main measures are the following: • A bus mismatch has occurred. Resolve the bus mismatch. • An error has occurred in the SubDevice. Refer to the user's manual or related documentation of the SubDevice to resolve the error. • Review the module extended parameter because the error is in the module extended parameter configuration.	Continue	ESM state of the MainDevice before transition ESM state of the MainDevice after transition Target ESM state of the MainDevice EtherCAT function error code
1974H	MainDevice transmission error	Failed to transmit data because the MainDevice could not complete transmission within the ERTT time.	The ERTT length is insufficient. Revise one of the following parameters: • Extend "ERTT" of the module extended parameter. Extend "Cycle Time" as necessary. • Reduce the number of process data communication points in the module extended parameter.	Continue	—
1976H	MainDevice communication cycle error	The MainDevice failed to start processing for the current cycle.	Processing could not be started by the time ERTT started. The ERTT is too long for the cycle time or the cycle time length is insufficient. Revise one of the following parameters: • Shorten "ERTT" in the module extended parameter. • Extend "Cycle Time" in the module extended parameter. • Reduce the number of process data communication points in the module extended parameter. • Disable redundancy in "Cable Redundancy" in the module extended parameter.	Continue	—
1977H	MainDevice reception data corruption	Failed to receive data because the data received by the MainDevice was corrupted.	Take anti-noise measures around the MainDevice. If the same error is displayed repeatedly, a hardware error may have occurred in the module. Please contact your local Mitsubishi Electric representative.	Continue	—
1978H	MainDevice reception overflow	Failed to receive some EtherCAT frames because the MainDevice received a large amount of EtherCAT frames that exceeded its capacity.	The number of EtherCAT frames on the network may be increasing due to the configuration or wiring of the devices on the network, or due to the devices being faulty. Check the following: • Check that there is no device on the network that transmits or amplifies EtherCAT frames, such as a MainDevice other than the controller. • Check whether any device on the network is faulty.	Continue	—

Error code	Error name	Error definition and cause	Action	Stop/ continue	Detailed information
1979H	MainDevice lack of cycle time	The MainDevice failed to complete processing within the cycle time.	The cycle time length is insufficient. Revise one of the following parameters: • Extend "Cycle Time" in the module extended parameter. • Reduce the number of connected devices in the module extended parameter. • Reduce the number of process data communication points in the module extended parameter. • Disable redundancy in "Cable Redundancy" in the module extended parameter.	Continue	Insufficient time [μs]
1980H	MainDevice ESM state change failed under motion function part	The MainDevice ESM state change was canceled because the motion function part failed to initialize the SubDevice under motion control. The following are the possible causes. • The motion function part is initializing the SubDevice. • The motion function part failed to initialize the SubDevice. • In the axis parameter settings of the motion settings, "Axis Emulation Enabled" is set to enabled for a SubDevice existing in EtherCAT Configuration.	The ESM state of the SubDevice could not be changed. The main measures are the following: • Change the ESM state again after a while. • Change the ESM state of the target SubDevice to INIT once, then change the ESM state of the MainDevice again. • Check the motion control status. • If "Axis Emulation enabled" is set to enabled in the axis parameter settings of the motion settings, specify an address that does not exist in EtherCAT Configuration, such as leaving the station address setting blank.	Continue	Node address ESM state of the SubDevice before transition ESM state of the SubDevice after transition Target ESM state of the SubDevice EtherCAT function error code
199CH	Communication start failure	The request failed because a duplicate request was made to change the ESM state of the MainDevice.	After the previous request has completed, request the next one.	Continue	Target ESM state of the MainDevice
33A0H	Parameter error	Some parameters cannot be handled.	• Match the module version with the engineering tool version. • Since the maximum data size of the module extended parameter that the module can handle may be exceeded, adjust the number of SubDevice settings, PDO settings, and other items in the module extended parameter.	Stop	—
33A3H	Module extended parameter open failure	The open processing of the module extended parameter in the controller failed.	• Delete the module extended parameter from the controller and write it again. Then restart the controller. • If the same error is displayed again, a hardware error may have occurred in the module. Please contact your local Mitsubishi Electric representative.	Stop	—
33A5H	Stop cycle processing	Communication has stopped because processing for each communication cycle cannot be executed. The following are the possible causes. • The cycle time and ERTT settings do not match the actual configuration. • The module is faulty.	Processing per cycle time is stopped. Check the following: • If a bus mismatch occurs, resolve the bus mismatch. • Review "Cycle Time" and "ERTT" in the module extended parameter. • If the same error is displayed again regardless of the actual network configuration or parameter settings, a hardware error may have occurred in the module. Please contact your local Mitsubishi Electric representative.	Stop	—
33A6H	Parameter error	• Parameters that the firmware version of the controller does not support were written. • A parameter value is corrupt.	• Check the firmware version of the controller and use a supported product. Then, write parameters again. • If the same error is displayed again, a hardware error may have occurred in the module. Please contact your local Mitsubishi Electric representative.	Stop	—

Error code	Error name	Error definition and cause	Action	Stop/ continue	Detailed information
3C00H 3C01H 3C02H 3C10H 3C11H 3C2FH 3ED0H 3ED1H 3EC6H 3EC7H	Refer to the following. MELSEC MX Controller MX-F Model User's Manual				
6000H	MainDevice ESM state change failed	The request failed because a duplicate request was made to change the ESM state of the MainDevice.	After the previous request has completed, request the next one.	Continue	—
6001H	MainDevice ESM state change failed	The state change failed because a request was made to change the ESM state of the MainDevice while communication is stopped.	Check that the ESM state of the MainDevice is INIT, PREOP, SAFEOP, or OP, and try again.	Continue	—
6002H	MainDevice ESM state change failed	The state change failed because a value specified for the MainDevice ESM state change request was outside the allowed specifications.	Specify the correct value for the MainDevice ESM state change request.	Continue	—
6003H	MainDevice ESM state change failed	The ESM state change for the MainDevice or SubDevice is abnormal and the ESM state change for the MainDevice fails. The following are the possible causes. • A bus mismatch has occurred. • The SubDevice is malfunctioning. • There is an error in the module extended parameter setting.	The ESM state of the MainDevice or SubDevice could not be changed. The main measures are the following: • A bus mismatch has occurred. Resolve the bus mismatch. • An error has occurred in the SubDevice. Refer to the user's manual or related documentation of the SubDevice to resolve the error. • Review the module extended parameter because the error is in the module extended parameter configuration.	Continue	—
6004H	SubDevice ESM state change failed	The ESM state change failed because a request was made to change the ESM state of the SubDevice that is out of the management scope.	SubDevices not registered in the module extended parameter are out of the management scope. Therefore, their ESM state cannot be changed.	Continue	nth SubDevice Target ESM state of the SubDevice
6005H	SubDevice ESM state change failed	The request failed because a duplicate request was made to change the ESM state of the SubDevice.	After the previous request has completed, request the next one.	Continue	nth SubDevice Target ESM state of the SubDevice
6006H	SubDevice ESM state change failed	The state change failed because a request was made to change the ESM state of the SubDevice while communication is stopped.	Check that the ESM state of the MainDevice is INIT, PREOP, SAFEOP, or OP, and try again.	Continue	—
6007H	SubDevice ESM state change failed	The state change failed because a value specified for the SubDevice ESM state change request was outside the allowed specifications.	Specify the correct value for the SubDevice ESM state change request.	Continue	Node address Target ESM state of the SubDevice

Error code	Error name	Error definition and cause	Action	Stop/ continue	Detailed information
6008H	SubDevice ESM state change failed	The ESM state change for the SubDevice is abnormal and the ESM state change fails. The following are the possible causes. • The target SubDevice is not present. • The target SubDevice is malfunctioning. • Specify the ESM state higher than that of the MainDevice. • The target SubDevice does not support the specified ESM state.	The ESM state of the SubDevice could not be changed. The main measures are the following: • Connect the SubDevice that corresponds to the module extended parameter. • If an error has occurred in the SubDevice, refer to the user's manual or related documentation of the SubDevice to resolve the error. • The SubDevice cannot be set to the ESM state higher than that of the MainDevice. Specify the ESM state that is equal to or lower than that of the MainDevice. • Specify the ESM state supported by the SubDevice.	Continue	Node address ESM state of the SubDevice before transition ESM state of the SubDevice after transition Target ESM state of the SubDevice EtherCAT function error code
6009H	SubDevice ESM state change failed	A SubDevice ESM state change timeout has occurred.	• If an error or other problem occurs in the SubDevice, refer to the SubDevice manual to resolve it. • Check the EtherCAT communication cable for any errors. • Take measures to reduce noise.	Continue	Node address ESM state of the SubDevice before transition ESM state of the SubDevice after transition Target ESM state of the SubDevice Timeout period [ms] Number of retries
600AH	SubDevice ESM state change failed	The ESM state change has been canceled because the presence/absence of the target SubDevice changed during the request to change the ESM state of the SubDevice.	After checking the state of the target SubDevice, issue a request to change the ESM state of the SubDevice again.	Continue	nth SubDevice Target ESM state of the SubDevice
600BH	ESM state setting error at SubDevice connection	The setting failed because the number of specified SubDevices exceeded the maximum number of connectable stations for the request to set the ESM state at SubDevice connection.	Correctly specify the target SubDevices.	Continue	—
600CH	ESM state setting error at SubDevice connection	The setting failed because a value outside the specifications was specified in the request to set the ESM state at SubDevice connection.	Specify the correct value for the request to set the ESM state at SubDevice connection.	Continue	—
600DH	SDO communication failure	The specified SDO control command was out of the range.	Specify an SDO control command that can be set, and execute the SDO communication again.	Continue	—
600EH	SDO communication failure	The request failed due to a duplicated request to perform SDO communication.	Make the request using the correct procedure. After the previous request has completed, request the next one.	Continue	—
600FH	SDO communication failure	SDO communication failed because SDO communication was requested while communication is already stopped.	Check that the ESM state is PREOP, SAFEOP, or OP, and try again.	Continue	—
6010H	SDO communication failure	SDO communication failed because the SDO communication data size exceeded the upper limit.	Specify the SDO communication data size that can be set, and execute the SDO communication again.	Continue	—
6011H	SDO communication failure	An error was detected in SDO communication.	Remove the cause by referring to the stored value of the SDO detail error code, and try again.	Continue	—

Error code	Error name	Error definition and cause	Action	Stop/ continue	Detailed information
6012H	MainDevice ESM state change failed due to an initialization failure in the motion function part	The MainDevice ESM state change was canceled because the motion function part failed to initialize the SubDevice under motion control. The following are the possible causes. • The motion function part is initializing the SubDevice. • The motion function part failed to initialize the SubDevice. • In the axis parameter settings of the motion settings, "Axis Emulation Enabled" is set to enabled for a SubDevice existing in EtherCAT Configuration.	The ESM state of the SubDevice could not be changed. The main measures are the following: • Change the ESM state again after a while. • Change the ESM state of the target SubDevice to INIT once, then change the ESM state of the MainDevice again. • Check the motion control status. • If "Axis Emulation enabled" is set to enabled in the axis parameter settings of the motion settings, specify an address that does not exist in EtherCAT Configuration, such as leaving the station address setting blank.	Continue	—
6013H	SubDevice ESM state change failed due to an initialization failure in the motion function part	The MainDevice ESM state change was canceled because the motion function part failed to initialize the SubDevice under motion control. The following are the possible causes. • The motion function part is initializing the SubDevice. • The motion function part failed to initialize the SubDevice. • In the axis parameter settings of the motion settings, "Axis Emulation Enabled" is set to enabled for a SubDevice existing in EtherCAT Configuration.	The ESM state of the SubDevice could not be changed. The main measures are the following: • Change the ESM state again after a while. • Change the ESM state of the target SubDevice to INIT once, then change the ESM state of the MainDevice again. • Check the motion control status. • If "Axis Emulation enabled" is set to enabled in the axis parameter settings of the motion settings, specify an address that does not exist in EtherCAT Configuration, such as leaving the station address setting blank.	Continue	—

12.2 List of SDO Abort Codes

The following table lists the SDO abort codes defined in the EtherCAT Specification (ETG.1000.6) issued by the ETG (EtherCAT Technology Group).
SDO abort codes are stored in the buffer memory area 'SDO detail error code' (U40\G90926 to U40\G90927). (☞ Page 207 'SDO detail error code' (U40\G90926 to U40\G90927))

Abort code	Meaning
05030000H	The toggle bit has not changed.
05040000H	SDO protocol timeout
05040001H	The client/server command specifier is invalid or unknown.
05040005H	The memory is out of range.
06010000H	Access to an object is not supported.
06010001H	Read operation was performed for a write-only object.
06010002H	Write operation was performed for a read-only object.
06010003H	Write operation cannot be performed on a subindex. To perform write access, Subindex 0 must be 0.
06010004H	SDO complete access is not supported for variable length objects such as those in the ENUM object type.
06010005H	The object length exceeds the mailbox size.
06010006H	The object was mapped to RxPDO, and the SDO download was blocked.
06020000H	The object is not present in the object dictionary.
06040041H	The object cannot be mapped to PDO.
06040042H	The number and length of the object to be mapped may exceed the PDO length.
06040043H	General parameter mismatch
06040047H	General device internal mismatch
06060000H	Access failed due to a hardware error.
06070010H	The data type does not match, and the service parameter length does not match.
06070012H	The data type does not match, and the service parameter is too long.
06070013H	The data type does not match, and the service parameter is too short.
06090011H	The subindex does not exist.
06090030H	The parameter value is out of the range. (Only for write access)
06090031H	The value of the written parameter is too large.
06090032H	The value of the written parameter is too small.
06090036H	The maximum value is smaller than the minimum value.
08000000H*1	This code indicates a general error. For example, the following causes may be possible: • The SubDevice is absent due to power-off, Ethernet cable disconnection, or other reasons. • The SubDevice cannot respond to SDO communication due to a failure or other reasons. • Since the ESM state of the SubDevice is lower than Pre-Operational, the SubDevice cannot respond to SDO communication.
08000020H	Data cannot be transferred to or stored in an application.
08000021H	Data cannot be transferred to or stored in an application due to local control.
08000022H	Data cannot be transferred to or stored in an application in the current device status (ESM state).
08000023H	Dynamic generation of the object dictionary failed, or the object dictionary does not exist.

*1 Errors that cannot be classified as error codes other than 08000000H will be registered.

12.3 List of Detail Error Codes

The following table lists detail error codes for the MX-F Model (Support EtherCAT).

For details on 'SDO detail error code' (U40\G90926 to U40\G90927), refer to the list of buffer memory addresses. (☞ Page 207 'SDO detail error code' (U40\G90926 to U40\G90927))

Detail error code	Meaning
98110000H	Any other error
98110001H	The function is not supported. (Example: The SubDevice does not support Bootstrap in the ESM state.)
9811000EH	Invalid ESM state (Example: Specifying the ESM state higher than that of the MainDevice)
98110010H	A timeout has occurred.
9811001EH	Bus mismatch (The ENI file and the actual network configuration do not match.)
98110024H	A SubDevice error has been detected.
9811002DH	An Ethernet cable is not connected.
98110031H	Mailbox communication is not supported.
9811010EH	The SubDevice does not exist. (Example: Ethernet cable disconnection, SubDevice power-off)
98110127H	An EtherCAT command that cannot be used with Cable Redundancy is present in the ENI file. (Example: LRW command)
98110139H	The reference clock was not detected.
98110178H	A SubDevice with DC set exists before the reference clock.

13 EVENT LIST

The following table lists events that may occur on the MX-F Model (Support EtherCAT).

System (00000H to 03FFFH)

Event code	Overview	Cause	Detailed information
00100H	Link-up	Link-up has occurred when the network cable connected to the external device was connected.	Connection port
00650H	ESM state transition	The ESM state of the MainDevice has transitioned.	ESM state before transition ESM state after transition
00651H	Ethernet is connected	If Cable Redundancy is disabled, P1 is connected. If Cable Redundancy is enabled, P1, P2, or both are connected.	—
00652H	Distributed Clock initialization	DC synchronization was configured and started for the current topology due to an ESM state change (INIT → POP) or topology change (cable plugged or unplugged).	—
00653H	DC SubDevice synchronization deviation notification	The SubDevice is in or out of sync with the system time. ("SubDevice node address not synchronized" in the detailed information = 0 refers to all SubDevices.)	DC SubDevice synchronization status SubDevice node address not synchronized
00654H	DCM error status change	The MainDevice is in or out of sync with the system time.	DCM synchronization status
00655H	Normal completion of SubDevice status transition	The SubDevice is in the ESM state requested by the MainDevice.	ESM state after transition Node address
00656H	Disappearance/appearance of SubDevice	The SubDevice appears on or disappears from the line.	Node address Appearance status
00657H	Disappearance/appearance of reference clock	• A SubDevice that serves as the reference clock appears on or disappears from the line. • The reference clock has been changed to another SubDevice.	Node address Appearance status
00658H	MainDevice init command: Working counter error	—	—
00659H	SubDevice init command: Working counter error	—	—
0065AH	No response to the sent Ethernet frame	—	—
0065BH	No response to the sent ecat MainDevice init command	—	—
0065CH	Timeout waiting for mailbox init command response	—	—
0065DH	Ethernet is not connected.	If Cable Redundancy is disabled, P1 is not connected. Both P1 and P2 are not connected when Cable Redundancy is enabled.	—
0065EH	Cable redundancy disconnection	A disconnection in Cable Redundancy was detected.	Number of SubDevices connected to the Main port Number of SubDevices connected to the Redundancy port
0065FH	SubDevice error status information	A SubDevice error occurred. For details on the error, refer to the "AL Status Code" in the "Detailed Information" section of the SubDevice manual.	Node address AL status AL status code
00660H	Cable redundancy restoration	Cable Redundancy, which was disconnected, has been restored.	—
00661H	Invalid mailbox data received	—	—
00662H	Unsupported SubDevice (Redundancy is enabled and the automatic close is not completely supported by SubDevice.)	—	—
00663H	SubDevice in an unexpected state	The SubDevice is in an unintended ESM state for the MainDevice. The following are the possible causes. • A SubDevice error occurred. • A SubDevice is connected.	Node address Current ESM state Expected ESM state

Event code	Overview	Cause	Detailed information
00664H	EEPROM checksum error detected	An EEPROM checksum error of a SubDevice was detected.	—
00665H	Hot Connect group return detection completion notification	After returning the Hot Connect group, detection was completed.	—
00666H	Hot Connect group disconnection detection completion notification	After disconnecting the Hot Connect group, detection was completed.	—
00668H	Event history save restriction*1	Saving to the event history was restricted.	—
00669H	Junction redundancy disconnection	A disconnection in Junction Redundancy was detected.	Node address Auto increment address Port number
0066AH	Junction redundancy restoration	Junction Redundancy has been restored.	Node address Auto increment address Port number
00800H	Link-down	Link-down has occurred when the network cable connected to the external device was disconnected.	Connection port

*1 The event history of the controller displays "HST LOSS".

Operation (20000H to 2FFFFH)

Event code	Overview	Cause	Detailed information
24B82H	Event information cleared	Event information was cleared by accessing buffer memory.	—
24B83H	Module extended parameter is updated	A write operation from the engineering tool updates the module extended parameter in the controller.	—
24B88H	MainDevice ESM state change request completed	A MainDevice ESM state change request was completed by buffer memory access.	—
24B89H	SubDevice ESM state change request completed	A SubDevice ESM state change request was completed by buffer memory access.	Node address

APPENDICES

Appendix 1 Standards

Compliance with EU Directive (CE marking)

This product complies with EU Directive, however, this does not guarantee that a mechanical system including this product will comply with EU Directive.
Compliance with EMC Directive and LVD (Low Voltage Directive) of the entire mechanical module should be checked by the user/manufacturer. For details, please contact your local Mitsubishi Electric representative.

Requirement for compliance with EMC Directive

The following products have shown compliance through direct testing (of the identified standards below) and design analysis (through the creation of a technical construction file) with the European Directive for Electromagnetic Compatibility (2014/30/EU) when used as directed by the appropriate documentation.

Product compatibility

Target products: MXF100-8-N32-EC, MXF100-16-N32-EC

Electromagnetic compatibility (EMC) directive	Remarks
EN 61131-2:2007 Programmable controllers • Equipment requirements and tests	Compliance with all relevant aspects of the standard. ■EMI • Radiated emission • Conducted emission ■EMS • Radiated electromagnetic field • Fast transient burst • Electrostatic discharge • High-energy surge • Voltage drops and interruptions • Conducted RF • Power frequency magnetic field

Control panel

- The controller system is an open-type device and must be installed inside a conductive control panel. Secure the control panel lid to the control panel (for conduction). Installing the controller system inside the control panel ensures safety as well as effective shielding of electromagnetic noise emitted from the controller system.
- Use the controller system while installed in conductive shielded control panels under a general industrial environment.
- For the control panel, use the product having sufficient strength, fire protectiveness and shielding property to an installation environment.
- Keep the diameter of the holes on the control panel to 10cm or less. If the diameter is larger than 10cm, electromagnetic wave may leak. Because radio waves leak through a clearance between the control panel and its door, reduce the clearance as much as possible. The leakage of radio waves can be suppressed by directly applying an EMI gasket on the paint surface.
- The tests were conducted by Mitsubishi Electric Corporation using a control panel having damping characteristics of 41.1dB (maximum) and 19.5dB (average) (measured at 10m distance, 30 to 1000MHz).

■Power cable

Keep each DC power (including I/O power supply) cable length to 30m or less.

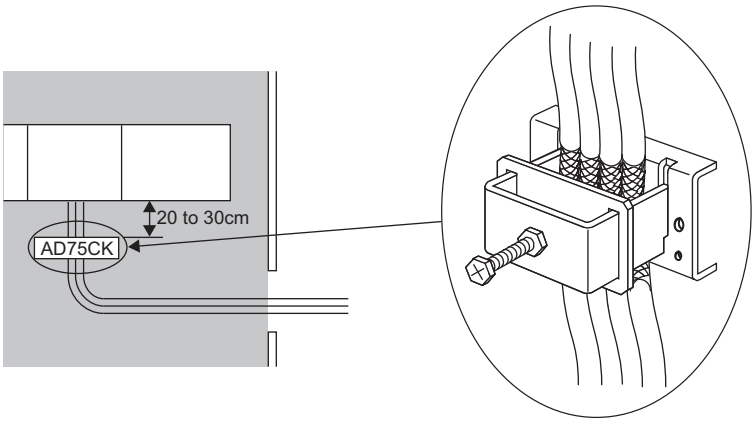
■DIN rails

DIN rails may have insulation films. Ensure conductivity between the DIN rail and the controller by using a conductive DIN rail or other method.

■Grounding cables with a cable clamp

Use a shielded cable for an I/O signal line (including a common line) or communications. If a shielded cable is not used or not grounded properly, the noise immunity will not meet the requirement.

When a cable clamp is used, strip a part of the jacket as shown below and ground the exposed shield to the control panel using AD75CK cable clamp manufactured by Mitsubishi Electric. Ground the shields within 20 to 30cm from the module.



For details on the AD75CK, refer to the following.

AD75CK-type Cable Clamping Instruction Manual

External power supply

For the external power supply, supply power from the DC power supply in the same control panel and always ground the FG terminal.

- External power supply used for the tests conducted by Mitsubishi Electric: PS5R-VF24 manufactured by IDEC Corporation

Each module

■Controller

- For an input circuit, set the digital filter. (When tests are conducted by Mitsubishi Electric: [X00-X0F] 10ms)

Point

For the intelligent function modules, I/O modules, extension power supply modules, and expansion adapters, refer to the user's manual for each product.

Requirements for Low Voltage Directive (LVD) compliance

The following products have shown compliance through direct testing (of the identified standards below) and design analysis (through the creation of a technical construction file) with the European Low Voltage Directive (2014/35/EU) when used as directed by the appropriate documentation.

Product compatibility

■Product compatibility

Target product: MXF100-Y16R

Compliance with LVD (Low Voltage Directive)	Remarks
EN IEC 61010-2-201, EN 61010-1 Safety of electrical equipment for measurement, control, and test	The equipment has been assessed as a component for fitting in a suitable control panel which meets the requirements of EN IEC 61010-2-201 and EN 61010-1.

Precautions

- When dealing with hazardous voltage (30VAC (execution value)/42.4VAC (peak value)) and a voltage less than 30VAC/DC between adjacent common relay output terminals, do not handle the output terminals used for less than 30VAC/DC as touchable parts.
- Do not wire two or more wires or ferrules to one terminal. (If the wiring with two or more wires is needed, take an appropriate action such as adding an external terminal block.)
- For wires or ferrules to be used for the wiring applied with 30VAC or higher, use the products with insulating sleeves.
- Cutoff device such as a breaker or a circuit protector should be installed in accordance with the following precautions.
  - Use EN60947-1 or EN60947-3 standards.
  - Place the cutoff device so that it can be operated easily.
  - Specify that the cutoff device is for this equipment.
- For external connection ports other than the AC output terminal, use an external power supply that complies with the SELV defined by EN IEC 61010-2-201.
- Use the controller system while grounded in conductive shielded control panels under a general industrial environment. For the control panel, use the product having sufficient strength, fire protectiveness, and protection degree IP20 or higher to an installation environment.

Compliance with the UL and cUL standards

Products compliant with the UL and cUL standards

For products compliant with the UL and cUL standards, contact your local Mitsubishi Electric representative.

Requirements for compliance with the UL and cUL standards

The requirements for complying with UL and cUL are the same as those for complying with the Low Voltage Directive of the EU Directive (CE marking).

In addition, external connection ports other than the AC output terminal must be powered from a SELV circuit and a LIM (Limited Energy Circuit) or a circuit that complies with UL 1310 Class 2.

EU battery regulation

This section describes the precautions for disposing of waste batteries in EU member states and exporting batteries and/or devices with built-in batteries to EU member states.

Disposal precautions

In EU member states, there is a separate collection system for waste batteries.
Dispose of batteries properly at the local community waste collection/recycling center.
The symbol shown in the following figure is printed on the batteries and packaging of batteries and devices with built-in batteries.

(1) (2)

Symbol (1) indicates that batteries need to be disposed of separately from other wastes.
If a chemical symbol is printed below symbol (1), it indicates that heavy metals of the following concentration or more are contained.

- Hg: Mercury (0.0005%)
- Cd: Cadmium (0.002%)
- Pb: Lead (0.004%)

Restriction

These symbols are based on the following regulations.
(1) EU Battery Directive (2006/66/EC) (repealed on August 18, 2025)
(1)(2) EU Battery Regulation (EU 2023/1542)

Exportation precautions

The following measures are required when marketing or exporting batteries and/or devices with built-in batteries to EU member states.

- To print the symbol on batteries (if not possible, on their manual or packaging)
- To explain the symbol in the manuals of the products

■Labeling

To adhere to EU Battery Regulation (EU 2023/1542), print symbol (1) (separate collection symbol) and symbol (2) (CE marking) described in "Disposal precautions" on the batteries or their manual and packaging.

■Explaining the symbol in the manuals

To export devices incorporating Mitsubishi Electric controllers to EU member states, provide the latest manuals that include the explanation of symbol (1) (separate collection symbol) and symbol (2) (CE marking). If no Mitsubishi Electric manuals are provided, or if the manuals are old and do not include the explanation of the symbols (1) and (2), separately attach an explanatory note regarding the symbols (1) and (2) to each manual of the devices.

Point

The requirements apply to batteries and/or devices with built-in batteries manufactured before the enforcement date of the EU Battery Directive (2006/66/EC) and EU Battery Regulation (EU 2023/1542).

Appendix 2 I/O Signals

This section describes the I/O signals of EtherCAT.
For the I/O signals of the motion function, refer to the following.
MELSEC MX Controller MX-F Model User's Manual

List of I/O signals (EtherCAT)

List of input signals

Device No.	Signal name
X400 to X40E	Use prohibited
X40F	EtherCAT function READY
X410 to X41F	Use prohibited

List of output signals

Device No.	Signal name
Y400 to Y41F	Use prohibited

Point

Do not use (turn on) any "use prohibited" signals as an input or output signal to the controller. Doing so may cause malfunction of the system.

Details of input signals

EtherCAT function READY (X40F)

This signal indicates that the controller is running. When this signal is on, the controller can be controlled and monitored using a buffer memory area.

- Off: The controller is stopped or a major error has occurred, and the buffer memory cannot be used.
- On: The controller is starting, and the buffer memory can be used.

■Operation

1. This signal is off when the controller power is turned off and on or the controller is reset.
2. This signal is on when the controller starts and the buffer memory becomes available.
3. This signal is off when a major error occurs in the controller.

■Precaution

Check that this signal is on before accessing the buffer memory areas. If it is off, control and monitoring by the buffer memory cannot be guaranteed.

Appendix 3 Buffer Memory

Buffer memory is memory used for data exchange between the MainDevice (controller) and the SubDevice. Buffer memory values are reset to default (initial values) when the controller is reset or powered off.

List of buffer memory addresses

Address		Application	Name		Read, write
Decimal	Hexadecimal				
0	0000H	Current ESM state	MainDevice ESM state		Read
1	0001H		SubDevice ESM state		Read
4096	1000H	ESM state change	MainDevice	MainDevice ESM state change request	Read, write
4097	1001H			MainDevice ESM state change response	Read
4098	1002H			MainDevice ESM state change error code	Read
4100	1004H			MainDevice ESM state change detail error code	Read
4112	1010H		SubDevice (1st SubDevice)	SubDevice ESM state change request	Read, write
4113	1011H			SubDevice ESM state change response	Read
4114	1012H			SubDevice ESM state change error code	Read
4116	1014H			SubDevice ESM state change detail error code	Read
4118	1016H			ESM state setting at SubDevice connection	Read
4128 to 4132	1020H to 1024H		SubDevice (2nd SubDevice)		—
⋮			⋮		
5248 to 5252	1480H to 1484H		SubDevice (72nd SubDevice)		—
10350	286EH	Port information storage area (P1)	Network type		—
10351	286FH		Station type		—
10352	2870H		Network setting information		—
10353	2871H		Network number		—
10354	2872H		Station number		—
10355	2873H		Transient transmission group number		—
10356	2874H		IP address	Own node IP address (+0)	—
10357	2875H			Own node IP address (+1)	—
10366	287EH		MAC address	Own node MAC address (5th byte, 6th byte)	—
10367	287FH			Own node MAC address (3rd byte, 4th byte)	—
10368	2880H			Own node MAC address (1st byte, 2nd byte)	—

Address		Application	Name		Read, write
Decimal	Hexadecimal				
16384	4000H	MainDevice information	Number of SubDevices		Read
16385	4001H		Configuration state		Read
16386	4002H		Communication state		Read
16387	4003H		MainDevice error status		Read
16389	4005H		DC/DCM error status		Read
16448	4040H		Current reference clock supply node address		Read
16450	4042H		DC system time update completion		Read
16452	4044H		DC system time (lower bits)		Read
16454	4046H		DC system time (upper bits)		Read
16456	4048H		DC system time update start		Read
16458	404AH		DCM Sync0 offset		Read
16462	404EH		Cycle time		Read
16463	404FH		ERTT		Read
16512	4080H		Count information (basic cycle)	Communication cycle counter	Read
16514	4082H			Frame lost counter	Read
16516	4084H			DC Sync error counter	Read
16518	4086H			DCM Sync error counter	Read
20480	5000H	SubDevice information (1st SubDevice)	Node address		Read
20481	5001H		SubDevice error state		Read
20560	5050H	SubDevice information (2nd to 72nd SubDevices)			—
86016	15000H	ARTT/surplus time information	ARTT/surplus time control command		Read, write
86017	15001H		ARTT/surplus time control command response		Read
86020	15004H		ARTT (current)		Read
86022	15006H		ARTT (average)		Read
86024	15008H		ARTT (maximum)		Read
86026	1500AH		ARTT (minimum)		Read
86028	1500CH		ARTT error counter		Read
86030	1500EH		Surplus time (current)		Read
86032	15010H		Surplus time (average)		Read
86034	15012H		Surplus time (maximum)		Read
86036	15014H		Surplus time (minimum)		Read
86038	15016H		Surplus time error counter		Read
90112	16000H	SDO communication area	SDO control command		Read, write
90113	16001H		SDO transmit node address		Read, write
90114	16002H		SDO transmit index number		Read, write
90115	16003H		SDO transmit subindex number		Read, write
90116	16004H		SDO transmit data size		Read, write
90118	16006H		SDO transmit data		Read, write
90518	16196H		SDO executed control command		Read
90519	16197H		SDO receive node address		Read
90520	16198H		SDO receive index number		Read
90521	16199H		SDO receive subindex number		Read
90522	1619AH		SDO receive data size		Read
90524	1619CH		SDO receive data		Read
90924	1632CH		SDO error code		Read
90926	1632EH		SDO detail error code		Read

Address		Application	Name	Read, write
Decimal	Hexadecimal			
917504	E0000H	SubDevice setting detail information (1st SubDevice)	Storage result	Read
917505	E0001H		SubDevice number	Read
917506	E0002H		Auto increment address	Read
917507	E0003H		Node address	Read
917508	E0004H		Vendor ID	Read
917510	E0006H		Product code	Read
917512	E0008H		Revision number	Read
917514	E000AH		Serial number	Read
917516	E000CH		Node address of upstream node	Read
917517	E000DH		Connection port number of upstream node	Read
917520	E0010H		SubDevice name	Read
917548	E002CH		Reference clock supply node	Read
917549	E002DH		Reference clock candidate	Read
917632	E0080H	SubDevice setting detail information (2nd to 72nd SubDevices)		—
1048576	100000H	SubDevice actual configuration diagnostic information (1st SubDevice)	Storage result	Read
1048577	100001H		SubDevice number	Read
1048578	100002H		Auto increment address	Read
1048579	100003H		Node address	Read
1048580	100004H		SubDevice diagnostic number	Read
1048582	100006H		Diagnostic numbers (ports 0 to 3) for SubDevices connected to the ports	Read
1048591	10000FH		Line cross detection status	Read
1048592	100010H		Vendor ID	Read
1048594	100012H		Product code	Read
1048596	100014H		Revision number	Read
1048598	100016H		Serial number	Read
1048602	10001AH		Alias address	Read
1048606	10001EH		Difference in system time	Read
1048612	100024H		Number of WKC errors	Read
1048614	100026H		Number of absent SubDevices	Read
1048616	100028H		Number of times of unintended ESM state changes	Read
1048618	10002AH		EtherCAT processing module detection error counter	Read
1048619	10002BH		PDI error counter	Read
1048620	10002CH		Invalid frame counter	Read
1048624	100030H		RX error counter	Read
1048628	100034H		Transferred invalid frame counter	Read
1048632	100038H		Lost link counter	Read
1048640	100040H	SubDevice actual configuration diagnostic information (2nd to 72nd SubDevices)		—

Address		Application	Name	Read, write
Decimal	Hexadecimal			
1081344	108000H	Bus mismatch information	Bus mismatch information update completion counter	Read
1081345	108001H		Bus mismatch information storage result	Read
1081346	108002H		Node address of the SubDevice immediately before mismatch	Read
1081347	108003H		Port number that connects the mismatch part to the SubDevice immediately before mismatch	Read
1081348	108004H		Auto increment address of the SubDevice immediately before mismatch	Read
1081349	108005H		Auto increment address of the mismatched SubDevice	Read
1081350	108006H		Vendor ID of the mismatched SubDevice	Read
1081352	108008H		Product code of the mismatched SubDevice	Read
1081354	10800AH		Revision number of the mismatched SubDevice	Read
1081356	10800CH		Serial number of the mismatched SubDevice	Read
1081358	10800EH		Node address of the mismatched SubDevice	Read
1081359	10800FH		Mismatched SubDevice device ID acquisition error	Read
1081360	108010H		Device ID setting register address of the mismatched SubDevice	Read
1081361	108011H		Acquired device ID of the mismatched SubDevice	Read
1081362	108012H		Expected device ID of the mismatched SubDevice	Read
1081363	108013H		Auto increment address on ENI settings	Read
1081364	108014H		Vendor ID on ENI settings	Read
1081366	108016H		Product code on ENI settings	Read
1081368	108018H		Revision number on ENI settings	Read
1081370	10801AH		Serial number on ENI settings	Read
1081372	10801CH		Node address on ENI settings	Read
1081373	10801DH		Bus mismatch information update start counter	Read

Point

Do not write any data to the system area. Doing so may cause malfunction of the system.

Details of buffer memory addresses

This section describes the buffer memory areas of the controller.

Current ESM state

■'MainDevice ESM state' (U40\G0)

This area is used to acquire the current ESM state of the MainDevice.

Value range	Controller write timing	Interlock when the program reads
• 0000H: MainDevice stop/starting • 0001H: INIT • 0002H: PREOP • 0004H: SAFEOP • 0008H: OP	• The ESM state of the MainDevice changed. • The MainDevice started/stopped.	EtherCAT function READY (X40F) = On

■'SubDevice ESM state' (U40\G1 to U40\G72)

This area is used to acquire the current ESM state of the SubDevice. It stores each word in sequence, starting from the first SubDevice.

Value range	Controller write timing	Interlock when the program reads
• 0000H: ESM state unknown (such as when the SubDevice is not present) • 0001H: INIT • 0002H: PREOP • 0003H: BOOT • 0004H: SAFEOP • 0008H: OP	• The ESM state of the SubDevice changed. • The SubDevice was detected or was not detected.	EtherCAT function READY (X40F) = On

Precautions

- The order of the SubDevices is the same as that of the node addresses.
- When the MainDevice is stopped, the ESM state cannot be acquired, so all SubDevices will be 0H (ESM state unknown).

ESM state change (MainDevice)

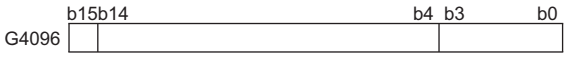
■'MainDevice ESM state change request' (U40\G4096)

This area is used to change the ESM state of the MainDevice or SubDevice.

When the ESM state setting bit at SubDevice connection is turned off, the ESM state of the current MainDevice and all SubDevices will be changed.

When the ESM state setting bit at SubDevice connection is turned on, the ESM state at SubDevice connection will be set for all SubDevices.

The current ESM state is not changed.



Value range	Interlock when writing from a program
■bit0 to bit3: ESM state • 0000H: No request/Clear request for this area • 0001H: INIT • 0002H: PREOP • 0004H: SAFEOP • 0008H: OP • Other than the above: Not supported ■bit4 to bit14: System area This area is used by the system and must not be changed by the user. ■bit15: ESM state setting bit at SubDevice connection • Off: Do not set • On: Set	• EtherCAT function READY (X40F) = On • 'Configuration state' (U40\G16385) = Executed • 'MainDevice ESM state change request' (U40\G4096) = 'MainDevice ESM state change response' (U40\G4097)

Precautions

- The MainDevice changes its own ESM state after the ESM state of all SubDevices are changed. Therefore, if the ESM state of some SubDevices fails to change, the ESM state of the remaining SubDevices will be changed, while the state of the failed SubDevices and MainDevice may not change.
- To execute the same request (value) consecutively, execute 0H (clear request for this area) beforehand. To execute a request (value) different from the previous one, the clear request is not required. However, when the same area is used for multiple programs, it is recommended that the clear request be executed for exclusion. (Since the programs interlock with each other, requests from each program should only be executed in the cleared status.)

■'MainDevice ESM state change response' (U40\G4097)

This area notifies the execution status of 'MainDevice ESM state change request' (U40\G4096).

After the request is completed, check 'MainDevice ESM state change error code' (U40\G4098) for the result.

Value range	Controller write timing	Interlock when reading from the program
• Same value as 'MainDevice ESM state change request' (U40\G4096): The request has been completed. (Regardless of normal completion or error) • Other than the above: The request is being executed.	This area is written when the request is completed.	EtherCAT function READY (X40F) = On

■'MainDevice ESM state change error code' (U40\G4098)

This area notifies the error code of the error that occurred during the execution of 'MainDevice ESM state change request' (U40\G4096).

The error code is retained from the time the request is completed with 'MainDevice ESM state change response' (U40\G4097) until the next request is executed with 'MainDevice ESM state change request' (U40\G4096).

Value range	Controller write timing	Interlock when reading from the program
Refer to the following. ☞ Page 169 List of Error Codes	This area is written when the request is completed.	• EtherCAT function READY (X40F) = On • 'MainDevice ESM state change request' (U40\G4096) = 'MainDevice ESM state change response' (U40\G4097)

Precautions

- After the ESM states of all SubDevices are changed, the ESM state of the MainDevice is finally changed.
- When the ESM state is changed to a higher state, it will be changed by one level at a time. If an error occurs, the ESM state may be set to an intermediate state.
- When the ESM state is changed to a higher state, if any SubDevice fails to change its ESM state, the MainDevice will not change its ESM state. In this case, some SubDevices may be in an ESM state higher than that of the MainDevice.
- When the ESM state is changed to a lower state, it will directly be changed.
- When the ESM state is changed to a lower state, the MainDevice will change the ESM state even if any SubDevice fails to change its ESM state.

■'MainDevice ESM state change detail error code' (U40\G4100 to U40\G4101)

This area notifies the detail error code that supplements 'MainDevice ESM state change error code' (U40\G4098).

For the content of the detail error code, refer to the following.

☞ Page 169 List of Error Codes

ESM state change (1st SubDevice)

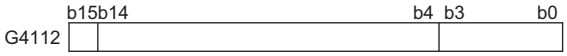
■'SubDevice ESM state change request' (U40\G4112)

This area is used to change the ESM state of the SubDevice.

If the SubDevice start ESM state setting bit is turned off, the ESM state of the current SubDevice is changed.

When the SubDevice start ESM state setting bit is turned on, the SubDevice start ESM state of the SubDevice is set.

The current ESM state is not changed.



Value range	Controller write timing	Interlock when writing from a program
■bit0 to bit3: ESM state • 0000H: No request/Clear request for this area • 0001H: INIT • 0002H: PREOP • 0003H: BOOT • 0004H: SAFEOP • 0008H: OP • Other than the above: Not supported ■bit4 to bit14: System area This area is used by the system and must not be changed by the user. ■bit15: SubDevice start ESM state setting bit • Off: Do not set • On: Set	—	• EtherCAT function READY (X40F) = On • 'SubDevice ESM state change request' (U40\G4112) (nth SubDevice) = 'SubDevice ESM state change response' (U40\G4113) (nth SubDevice)

Precautions

- The order of the SubDevices is the same as that of the node addresses.
- The SubDevice cannot be changed to the ESM state higher than that of the MainDevice.
- Some SubDevices do not support the "BOOT" state. If it is requested, an error may occur in the SubDevice. Check the specification in the SubDevice manual.
- To execute the same request (value) consecutively for the same SubDevice, execute a clear request (0000H: Clear for this area) beforehand. To execute a request (value) different from the previous one, the clear request is not required. However, when the same area is used for multiple programs, it is recommended that the clear request be executed for exclusion. (Since the programs interlock with each other, requests from each program should only be executed in the cleared status.)

■'SubDevice ESM state change response' (U40\G4113)

This area notifies the execution status of 'SubDevice ESM state change request' (U40\G4112).

After the request is completed, check 'SubDevice ESM state change error code' (U40\G4114) for the result.

Value range	Controller write timing	Interlock when reading from the program
• Same value as 'SubDevice ESM state change request' (U40\G4112) (nth SubDevice): The request has been completed. (Regardless of normal completion or error) • Other than the above: The request is being executed.	This area is written when the request is completed.	EtherCAT function READY (X40F) = On

Precautions

The order of the SubDevices is the same as that of the node addresses.

■'SubDevice ESM state change error code' (U40\G4114)

This area notifies the error code of the error that occurred during the execution of 'SubDevice ESM state change request' (U40\G4112).

The error code is retained from the time the request is completed with 'SubDevice ESM state change response' (U40\G4113) (nth SubDevice) until the next request is executed with 'SubDevice ESM state change request' (U40\G4112) (nth SubDevice).

Value range	Controller write timing	Interlock when reading from the program
—	This area is written when the request is completed.	• EtherCAT function READY (X40F) = On • 'SubDevice ESM state change request' (U40\G4112) (nth SubDevice) = 'SubDevice ESM state change response' (U40\G4113) (nth SubDevice)

Precautions

- When the ESM state is changed to a higher state, it will be changed by one level at a time. If an error occurs, the ESM state may be set to an intermediate state.
- When the ESM state is changed to a lower state, it will directly be changed.

■'SubDevice ESM state change detail error code' (U40\G4116 to U40\G4117)

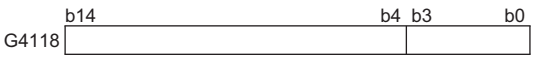
This area notifies the detail error code that supplements the 'SubDevice ESM state change error code' (U40\G4114).

For the content of the detail error code, refer to the following.

☞ Page 169 List of Error Codes

■'ESM state setting at SubDevice connection' (U40\G4118)

The current value of the SubDevice start ESM state, which has been set with 'MainDevice ESM state change request' (U40\G4096) or 'SubDevice ESM state change request' (U40\G4112), can be checked.



Value range	Controller write timing	Interlock when reading from the program
■bit0 to bit3: ESM state • 0000H: Disables this setting. • 0001H: Starts in INIT state. • 0002H: Starts in PREOP state. • 0004H: Starts in SAFEOP state. • 0008H: Starts in OP state. ■bit4 to bit14: System area This area is used by the system and must not be changed by the user.	• This area is initialized when the module starts up (before X0 turns on). • This area is written when the SubDevice start ESM state is successfully set with 'MainDevice ESM state change request' (U40\G4096) or 'SubDevice ESM state change request' (U40\G4112).	EtherCAT function READY (X40F) = On

Precautions

- The setting value at the time the SubDevice is connected is used.
- The ESM state at the time the SubDevice is connected will be determined by the SubDevice specifications.

ESM state change (2nd SubDevice and later)

The operation of each address from U40\G4128 onwards is the same as that of the 1st SubDevice.

Port information function

■Port 1 network type (U3E0\G10350)

Address	Name	Details
U3E0\G10350	Port 1 network type	Stores the network type of P1. 8H: EtherCAT

■Port 1 station type (U3E0\G10351)

Address	Name	Details
U3E0\G10351	Port 1 station type	Stores the station type of P1. 999: Not used

■Port 1 network setting information (U3E0\G10352)

Address	Name	Details
U3E0\G10352	Port 1 network setting information	Stores the operating status of the network setting change function of P1. 0: Operation according to the parameter settings

■Port 1 network number (U3E0\G10353)

Address	Name	Details
U3E0\G10353	Port 1 network number	Stores the network number of P1. 999: Not used

■Port 1 station number (U3E0\G10354)

Address	Name	Details
U3E0\G10354	Port 1 station number	Stores the station number of P1. 999: Not used

■Port 1 transient transmission group number (U3E0\G10355)

Address	Name	Details
U3E0\G10355	Port 1 transient transmission group number	Stores the transient transmission group number of P1. 999: Not used

■Port 1 own node IP address (U3E0\G10356 to U3E0\G10357)

Address	Name	Details
U3E0\G10356	Port 1 own node IP address	Stores 0 because it does not have an IP address.
U3E0\G10357		

■Port 1 MAC address (U3E0\G10366 to U3E0\G10368)

Address	Name	Details
U3E0\G10366	Port 1 MAC address (5th byte, 6th byte)	Stores the MAC address of port 1. G10366: 5th byte, 6th byte G10367: 3rd byte, 4th byte G10368: 1st byte, 2nd byte (Example) The MAC address is 123456789ABC.
U3E0\G10367	Port 2 MAC address (3rd byte, 4th byte)	
U3E0\G10368	Port 3 MAC address (1st byte, 2nd byte)	

	b15 b8	b7 b0
G10366	$9A_H$	BC_H
G10367	56_H	78_H
G10368	12_H	34_H

MainDevice information

■'Number of SubDevices' (U40\G16384)

The number of SubDevices registered in the ENI file is stored.

Value range	Controller write timing	Interlock when reading from the program
0000H to 0072H	This area is written when the EtherCAT function is started. However, the value will be invalid while the EtherCAT function is stopped.	• EtherCAT function READY (X40F) = On • 'Configuration state' (U40\G16385) = Executed

■'Configuration state' (U40\G16385)

This area notifies that the 'Number of SubDevices' (U40\G16384) and 'Configuration state' (U40\G16385) can be read.

Value range	Controller write timing	Interlock when reading from the program
• 0000H: Not executed (Configuration information cannot be read because EtherCAT is stopped or is starting.) • 0001H: Executed (EtherCAT starts and configuration information can be read.)	• When EtherCAT starts, the value is updated to Executed. • When EtherCAT stops, the value is updated to Not executed.	EtherCAT function READY (X40F) = On

■'Communication state' (U40\G16386)

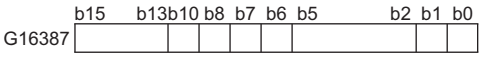
This area notifies the communication status of process data.

Value range	Controller write timing	Interlock when reading from the program
• 0000H: Communication not executed (The ESM state of the controller is INIT or lower (such as communication start in progress).) • 0001H: Communicating (The ESM state of the controller is PREOP or higher, and one or more ports are linked up.) • 0002H: Disconnecting (The ESM state of the controller is PREOP or higher, and all the ports are linked down.)	• This area is written during each communication cycle from when the MainDevice starts until it stops. • When the MainDevice stops, this area is written as Communication not executed.	EtherCAT function READY (X40F) = On

■'MainDevice error status' (U40\G16387)

This area is used to check the error status of the MainDevice. The following table lists the description of each bit.

Value range	Controller update timing	Interlock when reading from the program
Refer to the following.	• This area is initialized when the MainDevice starts. • If the DC synchronization settings are enabled, this area is updated during every cycle while the MainDevice is running.	• EtherCAT function READY (X40F) = On (Controller in operation) • 'Configuration state' (U40\G16385) = Executed (The MainDevice is running.)



Bit	Name	Value range	Description
0	Configuration not completed	• Off: Configuration completed successfully • On: Configuration not completed or completed with an error	Allows checking whether the configuration with module extended parameters has been completed in the MainDevice. For the main causes of Configuration not completed (on) and measures, refer to the following. ☞ Page 216 Error causes that can be checked using the buffer memory and countermeasures
1	SubDevice configuration mismatch	• Off: Configuration matched • On: Configuration not matched	Allows checking whether the current required SubDevice configuration matches the ENI file. For the main causes of Configuration not matched (on) and measures, refer to the following. ☞ Page 216 Error causes that can be checked using the buffer memory and countermeasures

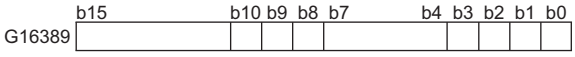
Bit	Name	Value range	Description
2	ESM state	• Off: Initialization completed (ESM state = INIT, PREOP, SAFEOP, or OP) • On: Initialization not completed	Allows checking whether the network initialization is completed. This bit turns on in the following cases: • The MainDevice is stopped. • The ESM state of the MainDevice is lower than INIT.
3		• Off: Message communication possible (ESM state = PREOP, SAFEOP, or OP) • On: Message communication not possible	Allows checking whether message communication with the SubDevice is possible. This bit turns on in the following cases: • The MainDevice is stopped. • The ESM state of the MainDevice is lower than SOP.
4		• Off: Process data communication (input) possible (ESM state = SAFEOP or OP) • On: Process data communication (input) not possible	Allows checking whether process data communication (input) with the SubDevice is possible. This bit turns on in the following cases: • The MainDevice is stopped. • The ESM state of the MainDevice is lower than SOP.
5		• Off: Process data communication (output) possible (ESM state = OP) • On: Process data communication (output) not possible	Allows checking whether process data communication (output) with the SubDevice is possible. This bit turns on in the following cases: • The MainDevice is stopped. • The ESM state of the MainDevice is lower than OP.
6	SubDevice with invalid input data detected	• Off: Input data from all SubDevices has been received. • On: Input data could not be received from one or more SubDevices.	Allows checking that input data from all SubDevices has been received in the latest cycle process data communication. This bit turns on in the following cases: ■Input data from one or more valid SubDevices is invalid. • This case applies to valid SubDevices where 'SubDevice error state' (U40\G20481) (bit0.SubDevice not registered) is set to off. • 'SubDevice error state' (U40\G20481) (bit6: Input data valid) is set to on for one or more valid SubDevices.
7	SubDevice with invalid output data detected	• Off: Output data has been received by all SubDevices. • On: Reception of output data could not be checked for one or more SubDevices.	Allows checking that output data has been received by all SubDevices in the latest cycle process data communication. This bit turns on in the following cases: ■Output data of one or more SubDevices is invalid. • This case applies to valid SubDevices where 'SubDevice error state' (U40\G20481) (bit0.SubDevice not registered) is set to off. • 'SubDevice error state' (U40\G20481) (bit7: Output data valid) is set to on for one or more valid SubDevices.
8	Cyclic frame lost	• Off: No cyclic frame is lost. • On: A cyclic frame was lost.	Allows checking if a cyclic frame was lost in the latest cycle. This bit turns on in the following cases: • A cyclic frame could not be received due to cable disconnection or noise. • A cyclic frame could not be sent due to a MainDevice processing delay or other reasons.
10	SubDevice in an unintended ESM state detected	• Off: All SubDevices are in the ESM state intended by the MainDevice. • On: One or more SubDevices are not in the ESM state intended by the MainDevice.	Allows checking if all SubDevices are in the ESM state intended by the MainDevice. This bit turns on in the following cases: One or more SubDevices*1 are not in the ESM state intended by the MainDevice. ('SubDevice error state' (U40\G20481) (bit10.Unintended ESM state) is set to on.)
13 to 15	System area	This bit cannot be used.	This area is unallocated. Mask it after reading it so that it is not used.

*1 This case applies to SubDevices registered in the MainDevice (SubDevices whose (bit0.SubDevice not registered) of 'SubDevice error status' (U40\G20481) is set to off).

■'DC/DCM error status' (U40\G16389)

This area is used to check the error status of the DC/DCM function of the MainDevice. The following table lists the description of each bit.

Value range	Controller update timing	Interlock when reading from the program
Refer to the following.	• This area is initialized when the MainDevice starts. • If the DC synchronization settings are enabled, this area is updated during every cycle while the MainDevice is running.	• EtherCAT function READY (X40F) = On (Controller in operation) • 'Configuration state' (U40\G16385) = Executed (The MainDevice is running.)



Bit	Name	Value range	Description
0	DC synchronization setting disabled	• Off: Setting enabled • On: Setting disabled	Allows checking whether the DC synchronization settings of the MainDevice are enabled. For the main causes of Setting disabled (on) and measures, refer to the following. ☞ Page 216 Error causes that can be checked using the buffer memory and countermeasures
1	DC system time disabled	• Off: Successfully acquired the latest system time. • On: Failed to acquire the latest system time.	Allows checking whether the latest system time is acquired from the reference clock. The acquired system time is stored in "DC system time". For the main causes of acquisition failure (on) and measures, refer to the following. ☞ Page 216 Error causes that can be checked using the buffer memory and countermeasures
2	DC Sync stopped	• Off: DC synchronization working • On: DC synchronization being stopped	Allows checking whether the DC synchronization function of the MainDevice is working. For the main causes of the DC synchronization function being stopped (on) and measures, refer to the following. ☞ Page 216 Error causes that can be checked using the buffer memory and countermeasures
3	DC SubDevice Sync error	• Off: No SubDevice is in synchronization loss. • On: There is a SubDevice in synchronization loss, or synchronization loss detection stopped.	Allows checking that DC synchronization has synchronized[*1] SubDevices with the system time. When "Synchronization window diagnosis" is enabled[*2], monitoring continues even after synchronization is completed once. This bit turns on when a SubDevice currently communicating[*3] and subject to DC synchronization is in synchronization loss even for a single node. For the main causes of being in synchronization loss (on) and measures, refer to the following. ☞ Page 216 Error causes that can be checked using the buffer memory and countermeasures
4 to 7	System area	This bit cannot be used.	This area is unallocated. Mask it after reading it so that it is not used.
8	DCM setting disabled	• Off: Setting enabled • On: Setting disabled	Allows checking whether the DCM synchronization settings of the MainDevice are enabled. For the main causes of setting disabled (on) and the measures, refer to the following. ☞ Page 216 Error causes that can be checked using the buffer memory and countermeasures
9	DCM Sync error	• Off: Synchronizing • On: Synchronization loss	Allows checking whether the MainDevice is synchronized[*5] with the system time. For the main causes of being in synchronization loss (on) and measures, refer to the following. ☞ Page 216 Error causes that can be checked using the buffer memory and countermeasures
10 to 15	System area	This bit cannot be used.	This area is unallocated. Mask it after reading it so that it is not used.

*1 In the controller, synchronization means that the deviation in time between each SubDevice and the system is smaller than ±2048ns.
*2 Use the module extended parameters to enable or disable "Synchronization window diagnosis".
*3 SubDevices that are not present are excluded.
*4 Detected only when the "Synchronization window diagnosis" function is enabled.
*5 In the controller, synchronization means that the deviation in time between the MainDevice and the system is smaller than ±20% of the cycle time.

■'Current reference clock supply node address' (U40\G16448)

The node address of the SubDevice serving as the reference clock for the current DC synchronization is stored.

Value range	Controller write timing	Interlock when reading from the program
• 0000H: The reference clock supply node is not present. • Other than the above: Node address	• This area is initialized when the MainDevice starts. • If the DC synchronization settings are enabled, this area is updated during every cycle while the MainDevice is running.	• EtherCAT function READY (X40F) = On (Controller in operation) • 'Configuration state' (U40\G16385) = Executed (The MainDevice is running.)

Precautions

If the DC synchronization settings are disabled, the value will be "Reference clock supply node not present" (0).

■'DC system time update start' (U40\G16456) and 'DC system time update completion' (U40\G16450)

These areas are used for interlocking to prevent data inconsistency when 'DC system time (lower bits)' (U40\G16452 to U40\G16453) to 'DC system time (upper bits)' (U40\G16454 to U40\G16455) are read. For the interlock procedure, refer to the following.

☞ Page 201 'DC system time (upper bits)' (U40\G16454 to U40\G16455) and 'DC system time (lower bits)' (U40\G16452 to U40\G16453)

Value range	Controller write timing	Interlock when reading from the program
0 to FFFFH (common to all areas): The value is counted up every time "DC system time" is updated. After FFFFH, the value returns to 0.	• This area is initialized when the MainDevice starts. • If the DC synchronization settings are enabled, this area is updated during every cycle while the MainDevice is running.	• EtherCAT function READY (X40F) = On (Controller in operation) • 'Configuration state' (U40\G16385) = Executed (The MainDevice is running.)

■'DC system time (upper bits)' (U40\G16454 to U40\G16455) and 'DC system time (lower bits)' (U40\G16452 to U40\G16453)

These areas store the latest DC system time acquired from the reference clock.

The valid size (synchronous size) changes depending on the parameter settings.

· "Display 64-bit system time" is disabled: Only the lower bits are valid (32 bits in total). For the upper bits, the time is measured by the MXF-EC and stored.

· "Display 64-bit system time" is enabled: Both upper and lower bits are enabled (64 bits in total).

Value range	Controller write timing	Interlock when reading from the program
0 to FFFFFFFFFFFFFFFFH [unit: ns] (Range including upper and lower bits): The areas are reset to 0 each time DC synchronization is initialized (when the reference clock supply node is lost or when the MainDevice changes from INIT to PREOP). The DC system time synchronized to each node in the previous communication cycle is acquired and stored during each communication cycle. Therefore, the value is the time immediately after the ERTT start of the previous communication cycle.	"DC system time disabled" is enabled.	• EtherCAT function READY (X40F) = On (Controller in operation) • 'Configuration state' (U40\G16385) = Executed (The MainDevice is running). Also, to check whether the latest (previous cycle) DC system time has been acquired, check the following and read the data. • "DC system time disabled" of 'DC/DCM error status' (U40\G16389) is enabled. To acquire the time data without causing data inconsistency, read the data using the following procedure. • When 32-bit is enabled: Use a DMOV instruction or other methods to collectively read the 32 bits. • When 64-bit is enabled: Read the bits using the following procedure. ❶Read 'DC system time update completion' (U40\G16450). ❷Read "DC system time". ❸Read 'DC system time update start' (U40\G16456). ❹The procedure is successful if the values in Steps 1 and 3 above match. If the values do not match, retry from Step 1.

Precautions

If the DC synchronization settings are disabled, the value will be "Reference clock supply node not present" (0).

■'DCM Sync0 offset' (U40\G16458 to U40\G16459)

The time offset from "DC system time" until the DC synchronization timing (Sync0) of the SubDevice is stored.

Value range	Controller write timing	Interlock when reading from the program
0 to FFFFFFFFH [ns] (common to all areas)	This area is initialized when the MainDevice starts.	• EtherCAT function READY (X40F) = On (Controller in operation) • 'Configuration state' (U40\G16385) = Executed (The MainDevice is running.)

Precautions

The value is the offset up to Sync0 when the shift time is 0.

■'Cycle time' (U40\G16462)

This area is the cycle time setting value set in the module extended parameters. (Value range: 250 to 16000 [μs])

The area is updated when the ESM state of the controller becomes INIT or higher.

■'ERTT' (U40\G16463)

This area is the ERTT setting value set in the module extended parameters. (Value range: 1 to 16000 [μs])

The area is updated when the ESM state of the controller becomes INIT or higher.

■'Communication cycle counter' (U40\G16512 to U40\G16513)

This counter indicates the number of communication cycles after the MainDevice is started.

Value range	Controller write timing	Interlock when reading from the program
0 to FFFFFFFFH: The count returns to 0 after FFFFFFFFH.	• This area is initialized when the MainDevice starts. • The value counts up during each communication cycle.	• EtherCAT function READY (X40F) = On (Controller in operation) • 'Configuration state' (U40\G16385) = Executed (The MainDevice is running.)

Precautions

To prevent data inconsistency, collectively read the 32 bits using a DMOV instruction or other methods.

■'Frame lost counter' (U40\G16514 to U40\G16515)

This counter indicates the number of frame losses that occur after the MainDevice is started.

Value range	Controller write timing	Interlock when reading from the program
0 to FFFFFFFFH: The count returns to 0 after FFFFFFFFH.	• This area is initialized when the MainDevice starts. • The value counts up each time a cyclic frame loss occurs. (Up to once per communication cycle)	• EtherCAT function READY (X40F) = On (Controller in operation) • 'Configuration state' (U40\G16385) = Executed (The MainDevice is running.)

Precautions

To prevent data inconsistency, collectively read the 32 bits using a DMOV instruction or other methods.

■'DC Sync error counter' (U40\G16516 to U40\G16517)

This counter indicates the number of times a SubDevice has lost synchronization with the system time. It counts the number of times one or more SubDevices lose synchronization from a state where all SubDevices are synchronized.

Value range	Controller write timing	Interlock when reading from the program
0 to FFFFFFFFH: The count returns to 0 after FFFFFFFFH.	• This area is initialized when the MainDevice starts. • The value counts up each time one or more SubDevices lose synchronization from a state where all SubDevices are synchronized with the system time. (Counting up is limited to once per communication cycle.)	• EtherCAT function READY (X40F) = On (Controller in operation) • 'Configuration state' (U40\G16385) = Executed (The MainDevice is running.)

Precautions

- To prevent data inconsistency, collectively read the 32 bits using a DMOV instruction or other methods.
- The value also counts up when the DC synchronization function itself stops (the MainDevice is less than POP) from a synchronized status. (Because devices will no longer be in sync)
- The value does not change when DC synchronization temporarily stops from a synchronized status (such as when the network topology has changed). (Excluding cases where synchronization is lost)

■'DCM Sync error counter' (U40\G16518 to U40\G16519)

This counter indicates the number of times the MainDevice has lost synchronization with the system time. It counts the number of times the MainDevice has lost synchronization from the synchronized status.

Value range	Controller write timing	Interlock when reading from the program
0 to FFFFFFFFH: The count returns to 0 after FFFFFFFFH.	• This area is initialized when the MainDevice starts. • The value counts up each time the MainDevice has lost synchronization with the system time. (Counting up is limited to once per communication cycle.)	• EtherCAT function READY (X40F) = On (Controller in operation) • 'Configuration state' (U40\G16385) = Executed (The MainDevice is running.)

Precautions

- To prevent data inconsistency, collectively read the 32 bits using a DMOV instruction or other methods.
- This area will not be counted up when DC synchronization stops. ('U40\G16389.2' (DC Sync stopped) and 'U40\G16389.9' (DC Sync error) turn on simultaneously.)

SubDevice information (1st SubDevice)

■'Node address' (U40\G20480)

The configured station address (Configured Station Address) of each SubDevice is stored.

SubDevices are arranged in the order of their connection to the MainDevice as set in the module extended parameter.

Value range	Controller write timing	Interlock when reading from the program
0 to FFFFH	This area is written when the EtherCAT function is started.	• EtherCAT function READY (X40F) = On • 'Configuration state' (U40\G16385) = Executed

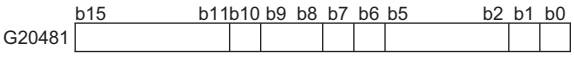
Precautions

This behavior applies to Junction SubDevices (branch SubDevices) and stations that do not have I/O data as well.

■'SubDevice error state' (U40\G20481)

This area is used to check the error status of each SubDevice. The following table lists the description of each bit.

Value range	Controller update timing	Interlock when reading from the program
Refer to the following.	• This area is initialized when the MainDevice starts. • This area is updated during each cycle while the MainDevice is running.	• EtherCAT function READY (X40F) = On (Controller in operation) • 'Configuration state' (U40\G16385) = Executed (The MainDevice is running.)



Bit	Name	Value range	Description
0	Not registered	• Off: Registered • On: Not registered	Allows checking whether the target SubDevice is registered in module extended parameters. For the main causes of non-registration (on) and measures, refer to the following. ☞ Page 216 Error causes that can be checked using the buffer memory and countermeasures
1	Not present	• Off: Present • On: Not present	Allows checking whether the target SubDevice is present on the line. For the main causes of being not present (on) and measures, refer to the following. ☞ Page 216 Error causes that can be checked using the buffer memory and countermeasures
2	ESM state*1	• Off: Initialization completed (ESM state = INIT, PREOP, SAFEOP, or OP) • On: Initialization not completed	Allows checking whether the communication initialization of the target SubDevice is completed. This bit turns on in the following cases: • The MainDevice is stopped. • The target SubDevice is not present. (bit1: Not present is on.) • The ESM state of the target SubDevice is lower than INIT.
3		• Off: Message communication possible (ESM state = PREOP, SAFEOP, or OP) • On: Message communication not possible	Allows checking whether the target SubDevice can perform message communication. This bit turns on in the following cases: • The MainDevice is stopped. • The target SubDevice is not present. (bit1: Not present is on.) • The ESM state of the target SubDevice is lower than POP.
4		• Off: Process data communication (input) possible (ESM state = SAFEOP or OP) • On: Process data communication (input) not possible	Allows checking whether the target SubDevice can perform process data communication (input). This bit turns on in the following cases: • The MainDevice is stopped. • The target SubDevice is not present. (bit1: Not present is on.) • The ESM state of the target SubDevice is lower than SOP.
5		• Off: Process data communication (output) possible (ESM state = OP) • On: Process data communication (output) not possible	Allows checking whether the target SubDevice can perform process data communication (output). This bit turns on in the following cases: • The MainDevice is stopped. • The target SubDevice is not present. (bit1: Not present is on.) • The ESM state of the target SubDevice is lower than OP.
6	Invalid input data	• Off: Valid input data has been received. • On: Valid input data could not be received.	Allows checking that the MainDevice has received the input data from the target SubDevice in the latest cycle process data communication. • This bit will be updated every cycle. • It is not synchronized with input data refresh. • Since the ESM state is subject to detection delay, this bit may turn off or on before detection occurs. • Input data that was not received normally will be discarded. The input data in the module will hold the most recently received valid input data for each MSU. For the main causes of not receiving valid input data (on) and measures, refer to the following. ☞ Page 216 Error causes that can be checked using the buffer memory and countermeasures

Bit	Name	Value range	Description
7	Invalid output data	• Off: Output data has been received. • On: Reception of output data could not be confirmed.	Allows checking that the target SubDevice has received the output data from the MainDevice in the previous cycle process data communication. • This bit will be updated every cycle. • It is not synchronized with output data refresh. • Even when this bit is set to on, the target SubDevice may have received the output data. (Such as when an error occurs on the line after the target SubDevice has received the data) • Since the ESM state is subject to detection delay, this bit may turn off or on before detection occurs. • In the SOP state, the SubDevice does not perform output, but receives the output data. For the main causes of failing to receive output data (on) and measures, refer to the following. ☞ Page 216 Error causes that can be checked using the buffer memory and countermeasures
8 to 9	System area	This bit cannot be used.	This area is unallocated. Mask it after reading it so that it is not used.
10	Unintended ESM state	• Off: ESM state intended by the MainDevice • On: ESM state not intended by the MainDevice	Allows checking that the target SubDevice is in the ESM state intended by the MainDevice. The "intended ESM state" refers to the ESM state most recently instructed with any of the following functions for the target SubDevice. • Starting the MainDevice • Changing the ESM state when the SubDevice is connected • Changing the ESM state when the controller stops or a stop error occurs • Changing the ESM state of the MainDevice • Changing the ESM state of the SubDevice For the main causes of not entering the intended ESM state (on) and measures, refer to the following. ☞ Page 216 Error causes that can be checked using the buffer memory and countermeasures
11 to 15	System area	This bit cannot be used.	This area is unallocated. Mask it after reading it so that it is not used.

*1 Detection of changes in the ESM state of the SubDevice takes several cycles.

Precautions

The order of the SubDevices is the same as that of the node addresses.

ARTT/surplus time information

■'ARTT/surplus time control command' (U40\G86016)

This area indicates a control command for ARTT/surplus time information.

Value	Command	Details
0000H	No command	—
0001H	Measurement stop request	Stops the measurement of ARTT/surplus time information. Keeps the measurement result when the measurement is stopped.
0002H	Measurement restart request	Restarts the measurement of ARTT/surplus time information. Does not generate any action if the measurement is in progress.
0003H	Measurement result cleared	Clears ARTT/surplus time information to 0. If this area is changed to no command (0000H, 0004H to FFFFH), the measurement state before the measurement result was cleared will be restored. If the state before the measurement result was cleared is in a measurement stop state due to 0001H (measurement stop request), the measurement stop state will be restored. Regarding the state before the measurement result was cleared, if 0001H (measurement stop request) is not used or 0002H (measurement restart request) is used and measurement is in progress, the measuring state will be restored.
0004H to FFFFH	No command	—

■'ARTT/surplus time control command response' (U40\G86017)

When the execution of the control command for ARTT/surplus time information is completed, the same value as the ARTT/surplus time control command is stored.

■'ARTT (Current)' (U40\G86020 to U40\G86021)

This area indicates the current ARTT value in the cycle time. (Unit: ns)

■'ARTT (average)' (U40\G86022 to U40\G86023)

This area indicates the average ARTT value in the cycle time. (Unit: ns)

■'ARTT (Maximum)' (U40\G86024 to U40\G86025)

This area indicates the maximum ARTT value in the cycle time. (Unit: ns)

■'ARTT (minimum)' (U40\G86026 to U40\G86027)

This area indicates the minimum ARTT value in the cycle time. (Unit: ns)

■'ARTT error counter' (U40\G86028 to U40\G86029)

In the ARTT measurement in the cycle time, the counter increments by one if the processing has not been executed in the order from the measurement start point to the measurement end point.

■'Surplus time (current)' (U40\G86030 to U40\G86031)

This area indicates the current surplus time in the cycle time. (Unit: ns)

■'Surplus time (average)' (U40\G86032 to U40\G86033)

This area indicates the average surplus time in the cycle time. (Unit: ns)

■'Surplus time (maximum)' (U40\G86034 to U40\G86035)

This area indicates the maximum surplus time in the cycle time. (Unit: ns)

■'Surplus time (minimum)' (U40\G86036 to U40\G86037)

This area indicates the minimum surplus time in the cycle time. (Unit: ns)

■'Surplus time error counter' (U40\G86038 to U40\G86039)

This area is unused. (It contains a fixed value of 0.)

SDO communication area

■'SDO control command' (U40\G90112)

This area indicates a command to be requested to the send destination.

- 0000H: No command
- 0001H: SDO communication UPLOAD
- 0002H: SDO communication DOWNLOAD

■'SDO transmit node address' (U40\G90113)

This area indicates the node address of the SubDevice that performs SDO communication.

■'SDO transmit index number' (U40\G90114)

This area indicates the index number used to perform SDO communication.

■'SDO transmit subindex number' (U40\G90115)

This area indicates the subindex number used to perform SDO communication.

■'SDO transmit data size' (U40\G90116 to U40\G90117)

This area indicates the size of data to be sent in SDO communication. (Unit: Byte)

■'SDO transmit data' (U40\G90118 to U40\G90517)

This area indicates the data to be sent in SDO communication.

■'SDO executed control command' (U40\G90518)

- Same value as 'SDO control command' (U40\G90112): SDO control command execution completed
- Other than the above: SDO control command execution in progress

■'SDO reception node address' (U40\G90519)

This area indicates the node address of the SubDevice that performed SDO communication.

■'SDO reception index number' (U40\G90520)

This area indicates the index number used to perform SDO communication.

■'SDO reception subindex number' (U40\G90521)

This area indicates the subindex number used to perform SDO communication.

■'SDO reception data size' (U40\G90522 to U40\G90523)

This area indicates the size of data received in SDO communication. (Unit: Byte)

■'SDO reception data' (U40\G90524 to U40\G90923)

This area indicates the data received in SDO communication.

■'SDO error code' (U40\G90924)

This area indicates the error code of the error that occurred in SDO communication.

If no error has occurred, 0H is stored.

For the content of the error code, refer to the following.

☞ Page 169 List of Error Codes

■'SDO detail error code' (U40\G90926 to U40\G90927)

This area indicates the detail error code that supplements 'SDO error code' (U40\G90924).

For the content of the detail error code, refer to the following.

☞ Page 169 List of Error Codes

SubDevice setting detail information (1st SubDevice)

■'Storage result' (U40\G917504)

Allows acquisition of the storage results for SubDevice diagnostic information.

- 0000H: Not stored/No applicable SubDevice
- 0001H: Stored
- Other than the above: Invalid value

■'SubDevice number' (U40\G917505)

This area indicates the number assigned to the SubDevices registered in the MainDevice (registered with the module extended parameter) in the order of registration.

- 0 to 127: SubDevice number
- FFFFH: No applicable SubDevice
- Other than the above: Invalid value

Precautions

The numbers are assigned starting from 0, based on the sorting order of the node addresses.

■'Auto increment address' (U40\G917506)

This area stores the auto increment address (Auto Increment Address) of the SubDevice. (Value range: 0 to FFFFH)
The SubDevice diagnostic information will be stored in connection order from the MainDevice (Auto Increment Address order).

Precautions

- The auto increment address starts from 0 and is decremented by 1 for each SubDevice. (0, FFFFH, FFFEH···)
- This behavior applies to Junction SubDevices (branch SubDevices) and stations that do not have I/O data as well.

■'Node address' (U40\G917507)

This area stores the node address (Configured Station Address) of the SubDevice. (Value range: 0 to FFFFH)

Precautions

This information is compatible with register area 0010H of the SubDevice.

■'Vendor ID' (U40\G917508 to U40\G917509)

Allows acquisition of the vendor ID of the SubDevice. (Value range: 00000000H to FFFFFFFFH)

Precautions

This information is compatible with offset 0008H of the SubDevice EEPROM.

■'Product code' (U40\G917510 to U40\G917511)

Allows acquisition of the product code of the SubDevice. (Value range: 00000000H to FFFFFFFFH)

Precautions

This information is compatible with offset 000AH of the SubDevice EEPROM.

■'Revision number' (U40\G917512 to U40\G917513)

Allows acquisition of the revision number of the SubDevice. (Value range: 00000000H to FFFFFFFFH)

Precautions

This information is compatible with offset 000CH of the SubDevice EEPROM.

■'Serial number' (U40\G917514 to U40\G917515)

Allows acquisition of the serial number of the SubDevice. (Value range: 00000000H to FFFFFFFFH)

Precautions

This information is compatible with offset 000CH of the SubDevice EEPROM.

■'Node address of upstream node' (U40\G917516)

Allows acquisition of "node address" of upstream node[*1] in the settings. (Value range: 0 to FFFFH)

*1 A SubDevice that is one position closer to the MainDevice on the EtherCAT communication path

■'Connection port number of upstream node' (U40\G917517)

Allows acquisition of "port number of upstream node" to which this SubDevice connects in the settings.

- 0000H to 0003H
- Other than the above: Invalid value (including cases where the MainDevice is the upstream node)

■'SubDevice name' (U40\G917520 to U40\G917547)

Allows acquisition of the SubDevice name defined with the setting file in ASCII.

■'Reference clock supply node' (U40\G917548)

Allows acquisition of the information on whether the SubDevice is the reference clock supply source.

- Off: Not the reference clock
- On: The reference clock supply source SubDevice

■'Reference clock candidate' (U40\G917549)

Allows acquisition of the information on whether the SubDevice is a reference clock candidate.

- Off (0000H): Not a reference clock candidate
- On (0001H): A reference clock candidate

SubDevice setting detail information (2nd to 72nd SubDevices)

The operation of each address is the same as that of the 1st SubDevice.

SubDevice actual configuration diagnostic information (1st SubDevice)

■'Storage result' (U40\G1048576)

Allows acquisition of the storage results for SubDevice diagnostic information.

- 0000H: Not stored/No applicable SubDevice
- 0001H: Stored
- Other than the above: Invalid value

■'SubDevice number' (U40\G1048577)

This area indicates the number assigned to the SubDevices registered in the MainDevice (registered with the module extended parameter) in the order of registration.

- 0 to 127: SubDevice number
- FFFFH: No applicable SubDevice
- Other than the above: Invalid value

Precautions

The numbers are assigned starting from 0, based on the sorting order of the node addresses.

■'Auto increment address' (U40\G1048578)

Same as below

☞ Page 208 'Auto increment address' (U40\G917506)

■'Node address' (U40\G1048579)

Same as below

☞ Page 208 'Node address' (U40\G917507)

■'SubDevice diagnostic number' (U40\G1048580 to U40\G1048581)

This area indicates the diagnostic number assigned to the SubDevice actually connected to the MainDevice.

- 0 to 127: SubDevice diagnostic number
- Other than the above: Invalid value

Precautions

Since the numbers are reassigned when the actual configuration changes, the same diagnostic number will not necessarily be assigned to the same SubDevice.

■'Diagnostic number (ports 0 to 3) for SubDevices connected to the ports' (U40\G1048582 to U40\G1048589)

Indicates the devices connected to the port.

- 0 to 127: SubDevice (The SubDevice diagnostic number is stored.)
- 00010000H: Main port of the MainDevice
- 00020000H: Redundant port of the MainDevice
- 00030000H: Terminal device (such as EL9010)
- 00040000H: Frame loss occurred
- FFFFFFFFH: No connected device
- Other than the above: Invalid value

Precautions

- When a SubDevice is connected to the port, the information on the applicable SubDevice can be acquired from "SubDevice diagnostic information". When acquiring the information, search for the SubDevice whose "SubDevice diagnostic number" matches.
- If the previous SubDevice is connected to port 0 or if there is a SubDevice not connected to the MainDevice, the cable connection order may not necessarily match the auto increment addresses.

■'Line cross detection status' (U40\G1048591)

Allows acquisition of the line cross status.

- bit0: Port 0 is not connected.
- bit1: Two or more ports are connected, but the port with the highest priority is not connected upstream.
- bit2: The redundant port of the Junction SubDevice (branch SubDevice) is connected, which differs from the settings.
- bit3: There is a port where the connection attempt has not been completed.
- bit4: There is a port connected to an unknown node.
- bit5: One of the ports is connected to an inappropriate physical port.
- bit6: The connection order is incorrect.

■'Vendor ID' (U40\G1048592 to U40\G1048593)

Same as below

☞ Page 208 'Vendor ID' (U40\G917508 to U40\G917509)

■'Product code' (U40\G1048594 to U40\G1048595)

Same as below

☞ Page 208 'Product code' (U40\G917510 to U40\G917511)

■'Revision number' (U40\G1048596 to U40\G1048597)

Same as below

☞ Page 208 'Revision number' (U40\G917512 to U40\G917513)

■'Serial number' (U40\G1048598 to U40\G1048599)

Same as below

☞ Page 209 'Serial number' (U40\G917514 to U40\G917515)

■'Alias address' (U40\G1048602)

This area stores the alias (Configured Station Alias) of the SubDevice. (Value range: 0000H to FFFFH)

Precautions

This information is acquired from register area 0012H of the SubDevice.

■'Difference in system time' (U40\G1048606 to U40\G1048607)

Allows acquisition of the system time difference between a SubDevice and the bus. The following table lists the description of each bit.

Bit	Name	Value range
0 to 30	Difference in system time (absolute value)	Absolute value of the difference in system time between a SubDevice and the bus
31	Difference in system time (sign)	• Off: The system time of the SubDevice is greater than or equal to the bus time. • On: The system time of the bus is greater.

Precautions

This information is acquired from register area 092CH of the SubDevice.

■'Number of WKC errors' (U40\G1048612 to U40\G1048613)

This area indicates the number of WKC errors that occurred. (Value range: 00000000H to FFFFFFFFH)

Precautions

When the count reaches the upper limit (FFFFFFFFH), it stops.

■'Number of absent SubDevices' (U40\G1048614 to U40\G1048615)

This area indicates the number of times the SubDevice was not present. (Value range: 00000000H to FFFFFFFFH)

Precautions

When the count reaches the upper limit (FFFFFFFFH), it resets to 0.

■'Number of times of unintended ESM state changes' (U40\G1048616 to U40\G1048617)

This area indicates the number of times the ESM state of the SubDevice was changed in a way not intended by the MainDevice. (Value range: 00000000H to FFFFFFFFH)

Precautions

When the count reaches the upper limit (FFFFFFFFH), it resets to 0.

■'EtherCAT processing module detection error counter' (U40\G1048618)

This area indicates the number of times a frame error is detected in the EtherCAT processing module of the target SubDevice. (Value range: 0 to 00FFH)

Precautions

- This information is acquired from register area 030CH of the SubDevice.
- The target frames include those detected by 'Invalid frame counter' (U40\G1048620 to U40\G1048623) and 'Transferred invalid frame counter' (U40\G1048628 to U40\G1048631).
- When the count reaches or exceeds the maximum value (00FFH), it stops.

■'PDI error counter' (U40\G1048619)

This area indicates the number of times a frame error is detected in the EtherCAT processing module of the target SubDevice. (Value range: 0 to 00FFH)

Precautions

- This information is acquired from register area 030DH of the SubDevice.
- The target frames include those detected by 'Invalid frame counter' (U40\G1048620 to U40\G1048623) and 'Transferred invalid frame counter' (U40\G1048628 to U40\G1048631).
- When the count reaches or exceeds the maximum value (00FFH), it stops.

■'Invalid frame counter' (U40\G1048620 to U40\G1048623)

This area indicates the number of invalid frames detected by the target SubDevice during reception. (Value range: 0 to 00FFH)

Precautions

- This information is acquired from register areas 0300H, 0302H, 0304H, and 0306H of the SubDevice.
- 'Transferred invalid frame counter' (U40\G1048628 to U40\G1048631) counts the invalid frames detected by the SubDevice before the target SubDevice, and 'Invalid frame counter' (U40\G1048620 to U40\G1048623) counts the invalid frames detected by the target SubDevice.
- When the count reaches or exceeds the maximum value (FFH), it stops.

■'RX error counter' (U40\G1048624 to U40\G1048627)

This area indicates the number of times an error was detected in the physical layer during reception. (Value range: 0 to FFH)

Precautions

- This information is acquired from register areas 0301H, 0303H, 0305H, and 0307H of the SubDevice.
- When the count reaches or exceeds the maximum value (FFH), it stops.

■'Transferred invalid frame counter' (U40\G1048628 to U40\G1048631)

This area indicates the number of receptions of invalid frames[*1] detected by other SubDevices. (Value range: 0 to FFH)

*1 A frame detected as "Invalid frame" by the SubDevices positioned before this port on the communication path

Precautions

- This information is acquired from register areas 0308H to 030BH of the SubDevice.
- The "reception error transfer counter" counts invalid frames detected by other SubDevices, and the "Invalid frame counter" counts invalid frames detected by the SubDevice itself.

■'Lost link counter' (U40\G1048632 to U40\G1048635)

This area indicates the number of link-down events that occurred for the port. (Value range: 0 to FFH)

Precautions

- This information is acquired from register areas 0310H to 0313H of the SubDevice.
- This counter counts only when the port is in "automatic" or "automatic close" mode.
- When the count reaches or exceeds the maximum value (FFH), it stops.

SubDevice actual configuration diagnostic information (2nd to 72nd SubDevices)

The operation of each address is the same as that of the 1st SubDevice.

Bus mismatch information

■'Bus mismatch information update completion counter' (U40\G1081344)

This area is used for interlocking to prevent data inconsistency when 'Bus mismatch information update completion counter' (U40\G1081344) to 'Bus mismatch information update start counter' (U40\G1081373) are read by a program.
When reading it using a program, follow the procedure below.

1. Read 'Bus mismatch information update completion counter' (U40\G1081344).
2. Read the desired area of bus mismatch information.
3. Read 'Bus mismatch information update start counter' (U40\G1081373).
4. The procedure is successful if the values in Steps 1 and 3 above match. If the values do not match, retry from Step 1.

■'Bus mismatch information storage result' (U40\G1081345)

This area shows whether bus mismatch information is stored due to a bus mismatch.

- 0000H: Bus mismatch information is invalid because no bus mismatch occurred.
- 0001H: Bus mismatch information is stored because a bus mismatch occurred.

■'Node address of the SubDevice immediately before mismatch' (U40\G1081346)

This area indicates the node address of the SubDevice immediately before the mismatch.

- 0000H: The MainDevice is immediately before mismatch.
- Other than the above: Node address

■'Port number that connects the mismatch part to the SubDevice immediately before bus mismatch' (U40\G1081347)

This area indicates the port number of the port that connects the mismatch part to the SubDevice immediately before a bus mismatch.

- 00FFH: The MainDevice is immediately before mismatch.
- Other than the above: Port number

■'Auto increment address of the SubDevice immediately before mismatch' (U40\G1081348)

This area indicates the auto increment address of the SubDevice immediately before a mismatch.

- 0001H: The MainDevice is immediately before mismatch.
- Other than the above: Auto increment address

■'Auto increment address of the mismatched SubDevice' (U40\G1081349)

This area indicates the auto increment address of the mismatched SubDevice.

- 0001H: A SubDevice is not connected.
- Other than the above: Auto increment address

■'Vendor ID of the mismatched SubDevice' (U40\G1081350 to U40\G1081351)

This area indicates the vendor ID of the mismatched SubDevice.
When a SubDevice is not connected, 0000H is stored.

■'Product code of the mismatched SubDevice' (U40\G1081352 to U40\G1081353)

This area indicates the product code of the mismatched SubDevice.
When a SubDevice is not connected, 0000H is stored.

■'Revision number of the mismatched SubDevice' (U40\G1081354 to U40\G1081355)

This area indicates the revision number of the mismatched SubDevice.
When a SubDevice is not connected, 0000H is stored.

■'Serial number of the mismatched SubDevice' (U40\G1081356 to U40\G1081357)

This area indicates the serial number of the mismatched SubDevice.
When a SubDevice is not connected, 0000H is stored.

■'Node address of the mismatched SubDevice' (U40\G1081358)

This area indicates the node address of the mismatched SubDevice.

- 0000H: A SubDevice is not connected.
- Other than the above: Node address

■'Device ID acquisition error of the mismatched SubDevice' (U40\G1081359)

This area indicates a device ID acquisition error of the mismatched SubDevice.

- H0000: Device ID acquisition failed.*1
- H0001: Device ID acquisition has succeeded.

*1 This result indicates an error in acquiring the device ID. Therefore, a value will not be stored in the expected device ID of the mismatched SubDevice.

■'Device ID setting register address of the mismatched SubDevice' (U40\G1081360)

This area indicates the device ID setting register address of the mismatched SubDevice.

When a SubDevice is not connected, 0000H is stored.

■'Acquired device ID of the mismatched SubDevice' (U40\G1081361)

This area indicates the acquired device ID of the mismatched SubDevice.

When a SubDevice is not connected, 0000H is stored.

■'Expected device ID of the mismatched SubDevice' (U40\G1081362)

This area indicates the expected device ID of the mismatched SubDevice.

Check whether the acquisition is successful by referring to the device ID acquisition error of the mismatched SubDevice.

■'Auto increment address on ENI settings' (U40\G1081363)

This area indicates the auto increment address on the module extended parameter (ENI file) settings.

- 0001H: No SubDevice exists in the settings.
- Other than the above: Auto increment address

■'Vendor ID on ENI settings' (U40\G1081364 to U40\G1081365)

This area indicates the vendor ID on the module extended parameter (ENI file) settings.

When a SubDevice is not connected, 0000H is stored.

■'Product code on ENI settings' (U40\G1081366 to U40\G1081367)

This area indicates the product code on the module extended parameter (ENI file) settings.

When a SubDevice is not connected, 0000H is stored.

■'Revision number on ENI settings' (U40\G1081368 to U40\G1081369)

This area indicates the revision number on the module extended parameter (ENI file) settings.

When a SubDevice is not connected, 0000H is stored.

■'Serial number on ENI settings' (U40\G1081370 to U40\G1081371)

This area indicates the serial number on the module extended parameter (ENI file) settings.

When a SubDevice is not connected, 0000H is stored.

■'Node address on ENI settings' (U40\G1081372)

This area indicates the node address on the module extended parameter (ENI file) settings.

- 0000H: No SubDevice exists in the settings.
- Other than the above: Node address

■'Bus mismatch information update start counter' (U40\G1081373)

Refer to the following.

☞ Page 214 'Bus mismatch information update completion counter' (U40\G1081344)

Error causes that can be checked using the buffer memory and countermeasures

The following tables list causes that turn on each bit and the countermeasures for error information that can be checked using the buffer memory.

'MainDevice error status' (U40\G16387)

Name	Cause	Countermeasure
Configuration not completed	The MainDevice is starting.	Wait until the MainDevice is completely started.
	The MainDevice is stopped due to startup failure.	Eliminate the cause of the startup failure and restart the MainDevice.
SubDevice configuration mismatch	MainDevice configuration is not completed. (bit0 is on.)	Successfully complete the configuration of the MainDevice.
	A device that does not support EtherCAT is connected to the line.	Remove the device that does not support EtherCAT from the line.
	The MainDevice settings differ from the SubDevice configuration.	Match the module extended parameters with the SubDevice configuration.
	An Ethernet cable is disconnected.	Connect the MainDevice and SubDevices with cables in the set order.
	A cable is not connected to the appropriate port.	Connect the SubDevice ports with cables according to the settings.
	MainDevice communication has failed.	Set the cycle time and ERTT of the module extended parameters to a sufficient duration.

'DC/DCM error status' (U40\G16389)

Name	Cause	Countermeasure
DC synchronization setting disabled	The DC synchronization settings are disabled.	Set DC synchronization with the module extended parameter.
DC system time disabled	DC synchronization is stopped. (bit2: DC Sync stopped is on.)	Operate DC synchronization.
	The reference clock is not present.	Connect the reference clock.
	A frame loss has occurred.	Eliminate the line error.
DC Sync stopped	The DC synchronization settings are disabled. (bit0: DC synchronization setting disabled is on.)	Set DC synchronization.
	The ESM state of the MainDevice is lower than POP.	DC synchronization is stopped. Change the status to POP or higher.
	An error has occurred at the start of DC synchronization.	Eliminate the error cause (such as the inappropriate connection order of the reference clock).
	The network topology has been changed (such as connection or disconnection of a cable).	DC synchronization is temporarily stopped to reset it according to the topology. After the reset, DC synchronization will automatically start operating.
DC SubDevice Sync error	DC synchronization is stopped. (bit2: DC synchronization being stopped is on.)	Operate DC synchronization.
	ESM of the MainDevice is lower than SOP.	Synchronization loss detection is stopped. Change the status to SOP or higher.
	The SubDevice has lost synchronization with the system time*1.	One or more SubDevices have lost synchronization due to powering on or off of the SubDevices, changes in the topology, or communication setting issues. The synchronization loss will automatically be resolved. However, if it persists, is slow to resolve, or occurs frequently, correct the configuration and settings.
DCM setting disabled	The DC synchronization settings are disabled. (bit0: DC synchronization setting disabled is on.)	Set DC synchronization.
	The DCM synchronization settings are disabled.	Enable DCM synchronization with the module extended parameter.
DCM Sync error	The DCM synchronization settings are disabled. (bit8: DCM setting disabled is on.)	Enable DCM synchronization.
	DC synchronization is stopped. (bit2: DC Sync stopped is on.)	Operate DC synchronization.
	The MainDevice has lost synchronization with the system time.	A synchronization loss has occurred. The synchronization loss will automatically be resolved. However, if it persists, is slow to resolve, or occurs frequently, correct the configuration and settings.

*1 Detection is only possible when the Synchronization window diagnosis function is enabled.

'SubDevice error state' (U40\G20481)

Name	Cause	Countermeasure
Not registered	No module extended parameter is set or a parameter error has occurred.	Write the appropriate module extended parameter.
	The target SubDevice is not registered in the module extended parameter.	Add the target SubDevice to the module extended parameter.
Not present	A SubDevice is disconnected.	Connect the SubDevice and cables from the MainDevice to the target SubDevice.
		Check that the SubDevices and cables from the MainDevice to the target SubDevice can communicate.
	A SubDevice is not communicating.	Set the target SubDevice to be ready for communication. (Refer to the SubDevice manual and take the necessary actions (such as powering on, setting, starting communication, and replacing any faulty parts).
	A bus mismatch has occurred.	Match the network configuration, including the target SubDevice, with the module extended parameters.
Invalid input data/invalid output data	The MainDevice is not sending process data.	If the ESM state of the MainDevice is lower than SOP, change it to SOP or higher.
		If an error has occurred in the MainDevice, eliminate the error (such as by setting the appropriate cycle time and ERTT).
	The MainDevice cannot receive process data.	If the ESM state of the MainDevice is lower than SOP, change it to SOP or higher.
		If a frame loss has occurred in the MainDevice, check whether the line status and ERTT are appropriate and take appropriate action.
	The target SubDevice is not communicating process data. (The WKC error has occurred.)	If the ESM state of the target SubDevice is lower than SOP, change it to SOP or higher.
	One of the SubDevices of the MSU to which the target SubDevice belongs is not communicating process data. (The WKC error has occurred in the MSU.)	Correctly connect all the SubDevices that belong to the same MSU as the target SubDevice to the network.
		Set the ESM state of all the SubDevices that belong to the same MSU as the target SubDevice to SOP or higher.
Unintended ESM state	The ESM state of the target SubDevice is being changed.	Wait until the ESM state is completely changed.
	Changing the ESM state of the target SubDevice has failed.	Change the ESM state of the target SubDevice to the same as or lower than the current status.
		Check the event history and the target SubDevice status. After eliminating the cause of an ESM state change failure, change the ESM state of the target SubDevice.
	The target SubDevice has been disconnected and connected again. (The ESM state immediately after re-connection depends on the SubDevice specifications and status.)	Change the ESM state of the target SubDevice with "MainDevice ESM state change" or "SubDevice ESM state change".
		Apply "SubDevice start ESM state change" to configure the setting so that the ESM state will automatically be changed to a desired status after re-connection.
	An error has occurred in the target SubDevice.	Check the event history and the target SubDevice status. After eliminating the cause of an ESM state change failure, change the ESM state of the target SubDevice.

Appendix 4 Parameter List

This section lists parameters.

Point

For the parameters that are not described in this section, refer to the following and the manuals for each module used.

MELSEC MX Controller MX-F Model User's Manual

Module parameter (EtherCAT)

The following table lists module parameters related to EtherCAT.

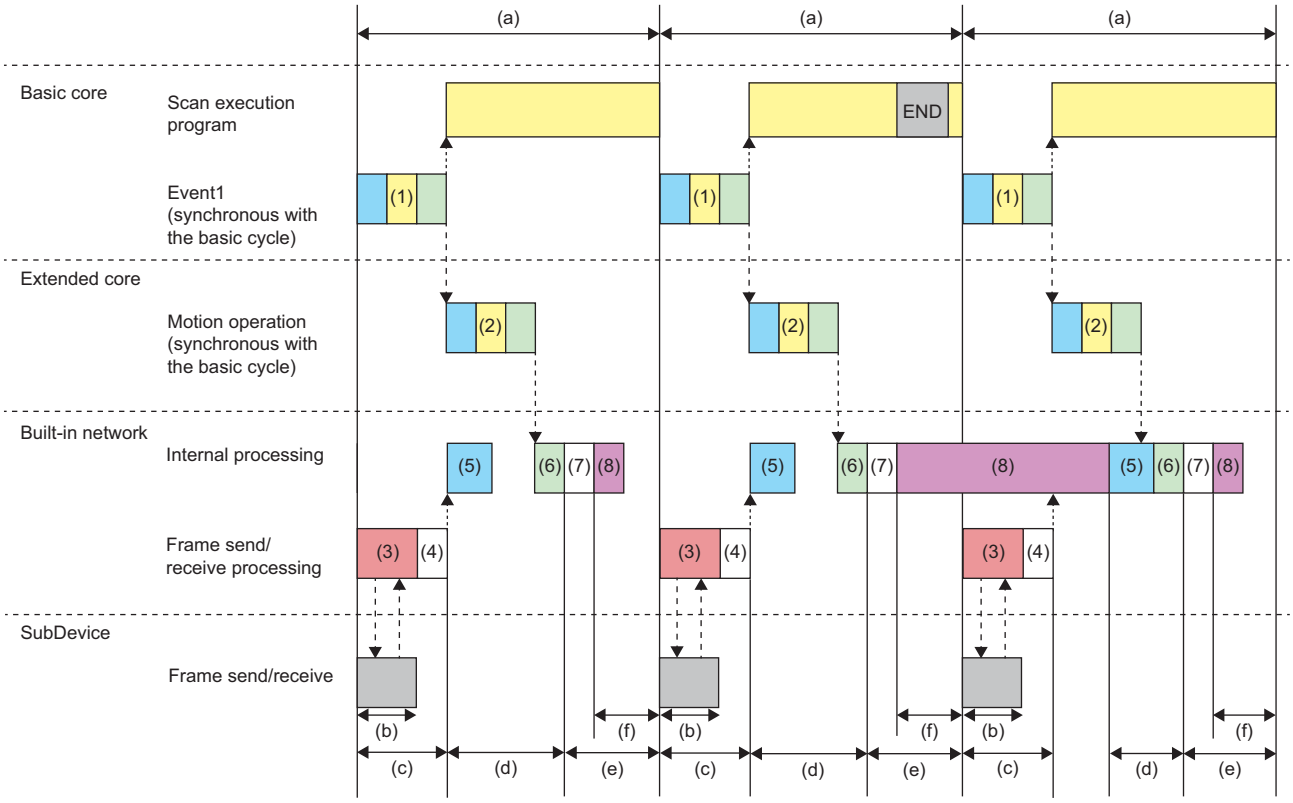
Item			Parameter No.	Reference
Application Settings	I/O Maintenance Settings	Output Hold/Clear Setting during Controller STOP	A140H	Page 105 I/O maintenance settings
		Output Mode Setting upon Controller Error	A140H	
	Connection Retry Setting at Startup	Connection Retry Method at Startup	A140H	Page 106 Connection Retry Setting at Startup
		Connection Retry Period at Startup	A140H	

Appendix 5 Processing Time

Processing time of process data communication (PDO communication)

This section describes the processing time of PDO communication.

The following shows the processes performed by the controller for each cycle and their time in lists with details.



Process list

No.	Details
(1)	After input refresh of the synchronous station (basic cycle), the Event1 program (synchronized with the basic cycle) is executed, and output refresh of the synchronous station is executed.
(2)	After the input processing of the motion operation (basic cycle) is completed, the motion operation processing is executed, and output processing is executed.
(3)	The EtherCAT frame is sent and received. The indicated time is the actual time taken to send and receive the EtherCAT frame. Therefore, the time is the same as that of ARTT.
(4)	In the waiting state before the EtherCAT frame is sent and received.
(5)	Processing is executed on PDO communication receive data.
(6)	Processing is executed on PDO communication send data. If this processing is not completed within the cycle time, a cycle over will occur.
(7)	The cycle processing completion of the built-in network is notified to the cycle program execution function. This notification occurs only when the network communication cycle synchronization function is used. If this processing is not completed within the cycle time, a cycle over will occur.
(8)	Other processing is executed. Processing such as internal processing of SDO communication and network status management is executed.

Time list

Item		Description
(a)	Cycle time	Time per cycle. This value is the "cycle time" value set in the module extended parameter.
(b)	ARTT	The actual time taken to send and receive the EtherCAT frame. This value is stored in the ARTT of the buffer memory. (☞ Page 206 ARTT/surplus time information)
(c)	ERTT	The time reserved for EtherCAT frame transmission and reception. This value is the "ERTT" value set in the module extended parameter.
(d)	PDO data processing time	The time during which processing is executed on PDO communication send and receive data.
(e)	PDO data processing remaining time	The remaining time in the built-in network internal processing when the network communication cycle synchronization function is not used. This value is stored in the remaining time of the buffer memory. (☞ Page 206 ARTT/surplus time information) If this value falls below 0, a cycle over may have occurred.
(f)	Cycle processing remaining time	The remaining time in the built-in network internal processing when the network communication cycle synchronization function is used. This value is stored in the remaining time of the buffer memory. (☞ Page 206 ARTT/surplus time information) If this value falls below 0, a cycle over may have occurred.

Cycle time and ERTT

Set the cycle time and ERTT with the module extended parameter. (☞ Page 121 MainDevice Setting)

■Cycle time

Set the cycle time so that the remaining time is 0 or more.

Set a value equal to or more than the cycle time calculated value displayed in the module extended parameter as a guide, and adjust the setting value by checking the remaining time stored in the buffer memory as necessary.

The following calculation formula provides a guideline.

Connection method	Calculation formula
Line topology	0.212 × EthernetSize + 1.860 × Number of SubDevices + 175 [μs]

■ERTT

Set the ERTT to a value equal to or more than the ARTT so that the EtherCAT communication time is reserved. However, an excessive value causes the PDO data processing time to be insufficient. Set an appropriate value.

Set a value by referring to the ERTT calculated value displayed in the module extended parameter as a guide, and adjust the setting value by checking the ARTT stored in the buffer memory as necessary.

The following calculation formula provides a guideline.

Connection method	Calculation formula
Line topology	0.103 × EthernetSize + 1.750 × Number of SubDevices + 35 [μs]

Point

- Note that these calculation formulas are merely a guideline and that the setting values do not guarantee operation. When building an actual network, conduct sufficient tests before determining the setting values.
- In an event of disconnection, restoration, ESM state change, or SDO communication, cycle time and ERTT will increase. If an impact on PDO communication is undesirable, conduct sufficient tests before determining the setting values.

■Method for testing whether sufficient values are set

The following describes how to test whether sufficient values are set for cycle time and ERTT.

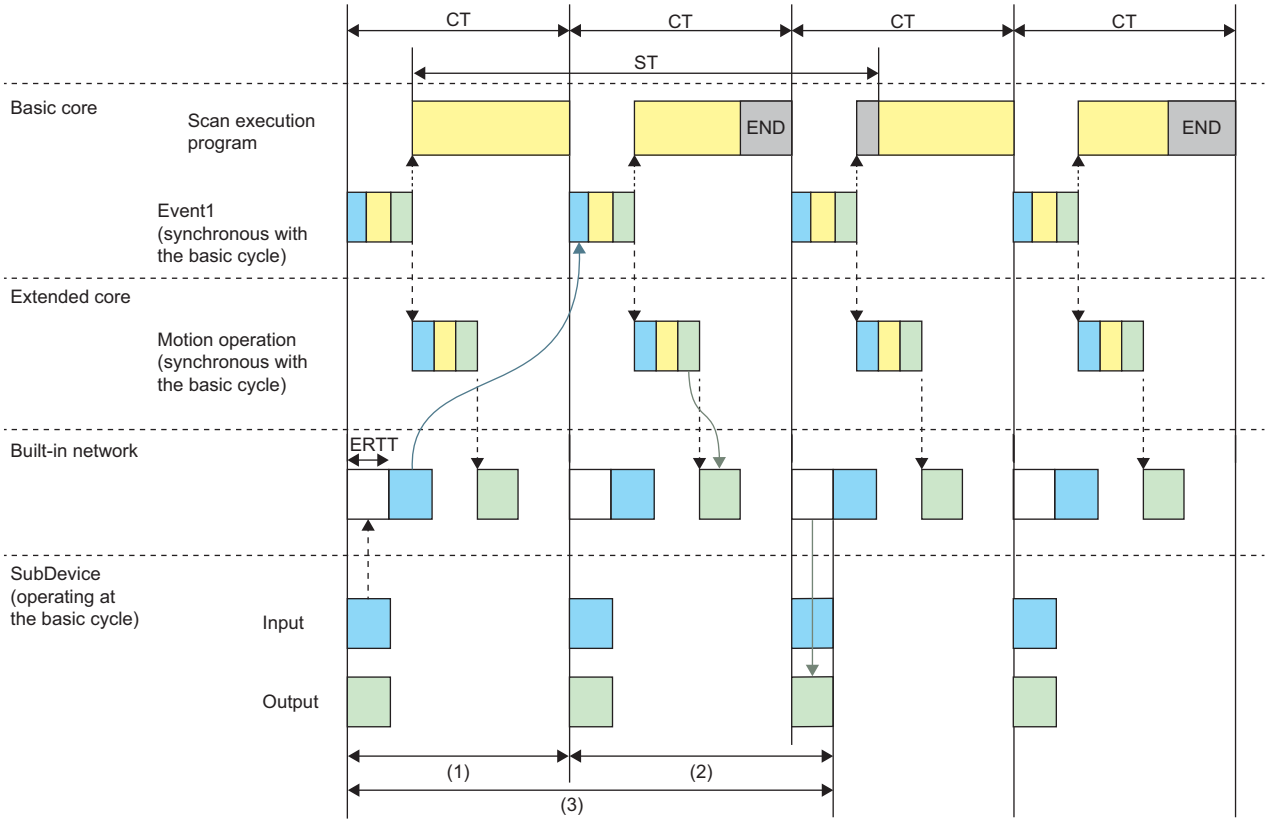
1. Wire each device, write the module extended parameters that are set with the values to be tested, and start the controller.
2. As necessary, unplug and reconnect the Ethernet cable, change the ESM state, and perform SDO communication.
3. Check the value of ARTT/surplus time (U40\G86016 to U40\G86039) to see if there is surplus to the setting values.
4. Check if any of the following events occurs. If any event occurs, review the setting values.

- MainDevice transmission error (error code: 1974H)
- MainDevice transmission error (error code: 1975H)
- MainDevice communication cycle error (error code: 1976H)
- The value of 'Frame lost counter' (U40\G16514 to U40\G16515) counts up.

PDO transmission delay time (Network communication cycle synchronization)

When the network communication cycle synchronization function is used (for synchronization), the calculation formula and data flow for PDO communication transmission delay time are as shown below.

This calculation formula applies to cases where data is sent or received properly. This calculation formula is not feasible if an error occurs.



No.	Calculation formula
(1)	Time from data input to reflection in label = CT*1
(2)	Time from operation to data output = CT + ERTT*2
(3)	Time from data input to data output = CT × 2 + ERTT*1*2

*1 This calculation formula refers to the time from when the SubDevice sends an EtherCAT frame until the data is input to the controller in the EtherCAT network. Therefore, the time does not include the time from when the SubDevice receives an external input until the SubDevice reflects it in the EtherCAT frame (e.g. input on/off response time). For the I/O response time of the SubDevice, refer to the manual for the SubDevice.

*2 This calculation formula refers to the time from when the controller starts operation until it outputs the data to the SubDevice in the EtherCAT network. Therefore, the time does not include the time from when the SubDevice receives an EtherCAT frame until the SubDevice actually outputs the data externally (e.g. output on/off response time). For the I/O response time of the SubDevice, refer to the manual for the SubDevice.

PDO transmission delay time (Network communication cycle asynchronization)

When the network communication cycle synchronization function is used (for asynchronization), the calculation formula for PDO communication transmission delay time is as shown below.

MAX (ST, CT) refers to the larger value of ST or CT.

Calculation formula
Time from data input to reflection in label = MAX (ST, CT) + CT*1
Time from operation to data output = MAX (ST, CT) + CT*2

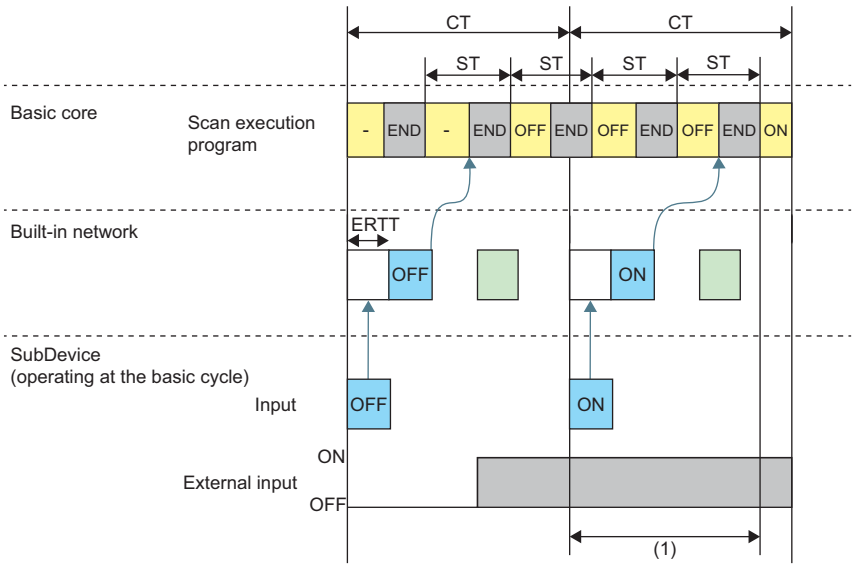
*1 This calculation formula refers to the time from when the SubDevice sends an EtherCAT frame until the data is input to the controller in the EtherCAT network. Therefore, the time does not include the time from when the SubDevice receives an external input until the SubDevice reflects it in the EtherCAT frame (e.g. input on/off response time). For the I/O response time of the SubDevice, refer to the manual for the SubDevice.

*2 This calculation formula refers to the time from when the controller starts operation until it outputs the data to the SubDevice in the EtherCAT network. Therefore, the time does not include the time from when the SubDevice receives an EtherCAT frame until the SubDevice actually outputs the data externally (e.g. output on/off response time). For the I/O response time of the SubDevice, refer to the manual for the SubDevice.

Point

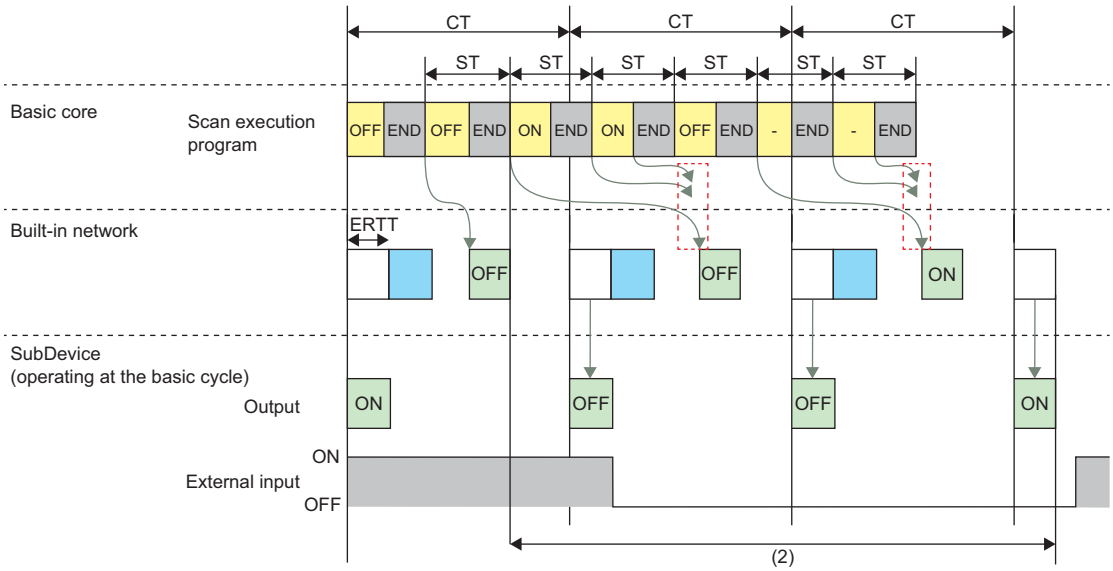
- In asynchronous operation, I/O data is updated to the label in the END processing.
- Whether the END processing is performed before or after the I/O update of the built-in network may change depending on the cycle because the scan execution program and the network communication cycle are not synchronized. Therefore, this calculation formula represents the worst-case scenario.

■If the cycle time is longer than the scan time (ST < CT)



No.	Calculation formula
(1)	Time from data input to reflection in label = CT × 3*1

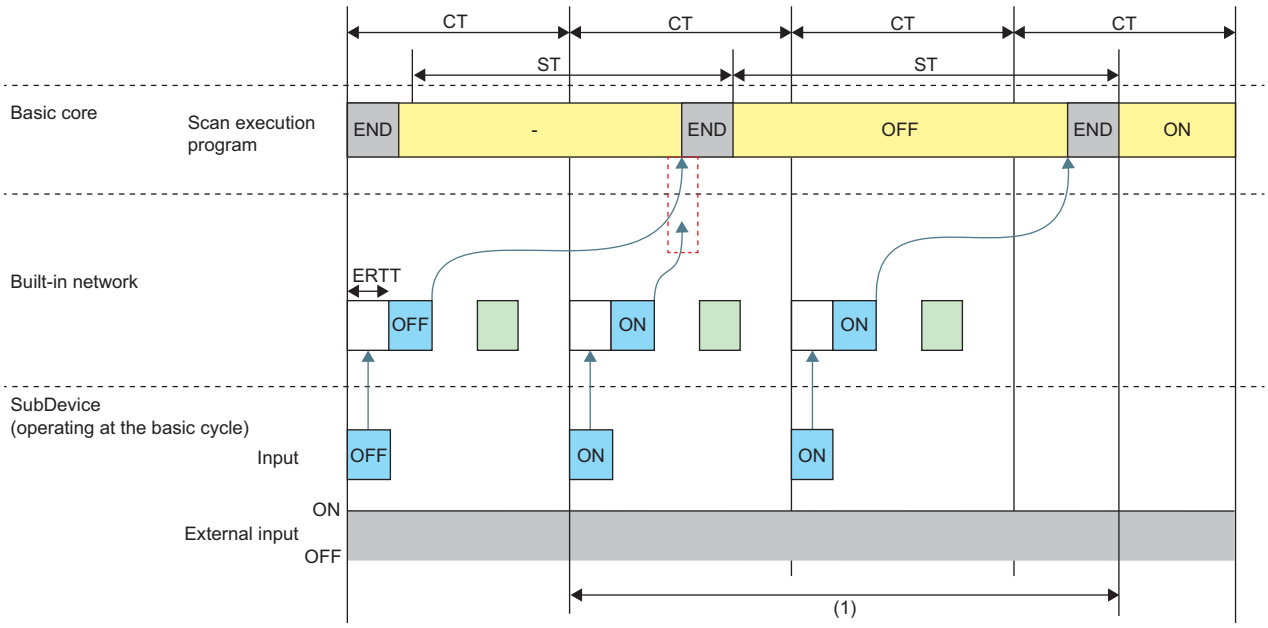
*1 This calculation formula refers to the time from when the SubDevice sends an EtherCAT frame until the data is input to the controller in the EtherCAT network. Therefore, the time does not include the time from when the SubDevice receives an external input until the SubDevice reflects it in the EtherCAT frame (e.g. input on/off response time). For the I/O response time of the SubDevice, refer to the manual for the SubDevice.



No.	Calculation formula
(2)	Time from operation to data output = CT + ERTT*1

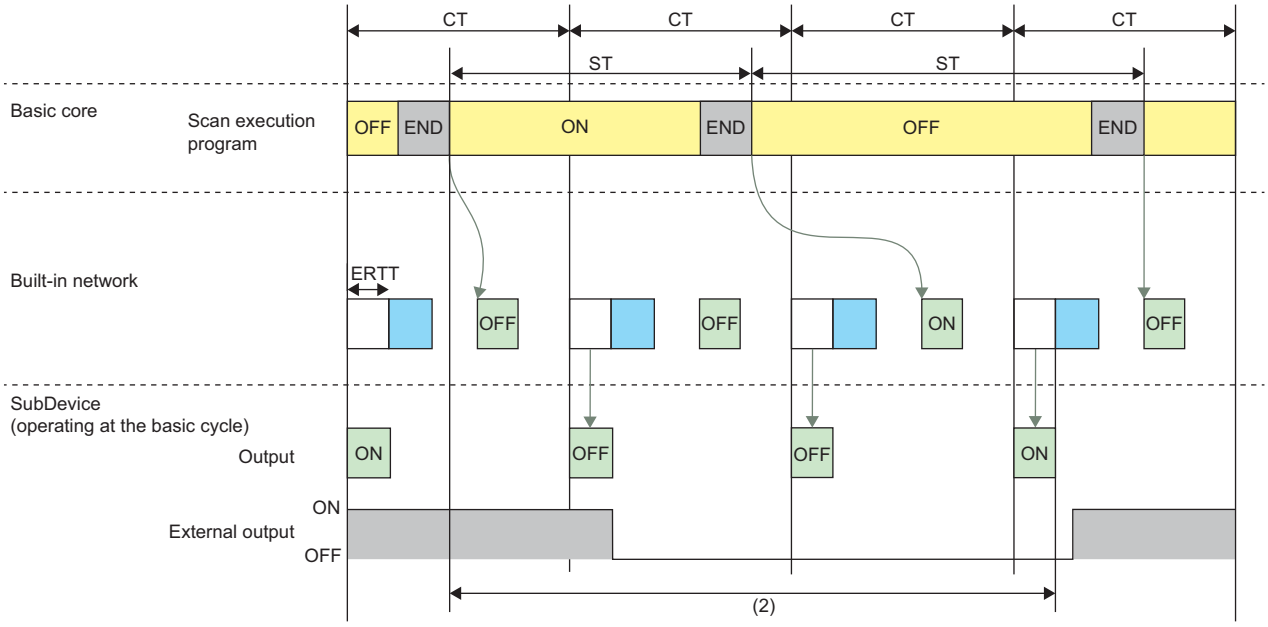
*1 This calculation formula refers to the time from when the controller starts operation until it outputs the data to the SubDevice in the EtherCAT network. Therefore, the time does not include the time from when the SubDevice receives an EtherCAT frame until the SubDevice actually outputs the data externally (e.g. output on/off response time). For the I/O response time of the SubDevice, refer to the manual for the SubDevice.

■If the scan time is longer than the cycle time (CT < ST)



No.	Calculation formula
(1)	Time from data input to reflection in label = ST × 2*1

*1 This calculation formula refers to the time from when the SubDevice sends an EtherCAT frame until the data is input to the controller in the EtherCAT network. Therefore, the time does not include the time from when the SubDevice receives an external input until the SubDevice reflects it in the EtherCAT frame (e.g. input on/off response time). For the I/O response time of the SubDevice, refer to the manual for the SubDevice.



No.	Calculation formula
(2)	Time from operation to data output = ST + CT × 2*1

*1 This calculation formula refers to the time from when the controller starts operation until it outputs the data to the SubDevice in the EtherCAT network. Therefore, the time does not include the time from when the SubDevice receives an EtherCAT frame until the SubDevice actually outputs the data externally (e.g. output on/off response time). For the I/O response time of the SubDevice, refer to the manual for the SubDevice.

Appendix 6 Connection with MELSERVO

This section describes settings and usage when connecting the controller to MELSERVO.
For details on the wiring and the servo parameters, refer to the manual for each device used.

MR-J5(W)-G-N1 (cyclic synchronous mode) connection method

For the module extended parameters and the motion setting procedure, refer to the following.
☞ Page 26 PARAMETER SETTINGS

Servo parameter settings

Set the parameters of the MR-J5(W)-G-N1 as shown below.

No.	Name	Initial value	Setting value
PA06	Electronic gear - Numerator	1	■MR-J5(W)-G-N1 (version A3) or earlier Set 1 or 2^n when using for position control.*1 Set 1 when using for other than position control. ■MR-J5(W)-G-N1 (version A4) or later Set 1 or 2^n when using for position control.*1 Set as follows when using for other than position control. • If Speed/acceleration/deceleration unit selection (PT01.1) is set to 0H, the setting value is 1. • If Speed/acceleration/deceleration unit selection (PT01.1) is set to 1H, the setting value is 1 or 2^n.
PA07	Electronic gear - Denominator	1	■MR-J5(W)-G-N1 (version A3) or earlier Set 1 or 2^n when using for position control.*1 Set 1 when using for other than position control. ■MR-J5(W)-G-N1 (version A4) or later Set 1 or 2^n when using for position control.*1 Set as follows when using for other than position control. • If Speed/acceleration/deceleration unit selection (PT01.1) is set to 0H, the setting value is 1. • If Speed/acceleration/deceleration unit selection (PT01.1) is set to 1H, the setting value is 1 or 2^n.
PC29.5	[AL.0E3 Absolute position counter warning] selection	1H	When the absolute position system is used, set 0H (Available for infinite feed function).
PT01.1	Speed/acceleration/deceleration unit selection*2*3	1H	Any setting value can be used for position control. Set as follows when using for other than position control. • When Electronic gear - Numerator (PA06) and Electronic gear - Denominator (PA07) are other than 1:1, set 1H (Velocity command unit: command unit/s, acceleration/deceleration unit: command unit/s2). • When Electronic gear - Numerator (PA06) and Electronic gear - Denominator (PA07) are 1:1, set any value.
PT01.2	Position data unit*4	3H	3H (pulse)
PT15	Software position limit +*5	0	0
PT17	Software position limit -*5	0	0
PV23	Speed unit conversion electronic gear - numerator*2	1	1
PV24	Speed unit conversion electronic gear - denominator*2	1	1

*1 Set 1 when the resolution of the encoder connected with the MR-J5(W)-G-N1 is not multiple of 2^n.
*2 Available since the MR-J5(W)-G-N1 (version A4)
*3 When Speed/acceleration/deceleration unit selection (PT01.1) is set to 0H, the object data "VelActualValue" cannot be acquired correctly if 1:1 is not set for the electronic gear.
*4 Available since the MR-J5(W)-G-N1 (version B6)
*5 This function is the same as the software stroke limit function of the motion system. Use the function of the motion system to restrict the command position.

For the following parameters, the setting values of the table below are recommended.

No.	Name	Initial value	Setting value (recommended)
PD01	Input signal automatic on selection 1	00000000H	00000000H
PD41.2	Limit switch enabled status selection	0H	1H (Enabled only in homing mode)*1
PD41.3	Sensor input method selection	0H	1H (Input from controller (FLS/RLS/DOG))*2
PT29.0	Device input polarity 1	0H	1H (Dog detection with on) when Sensor input method selection (PD41.3) is set to 1H (Input from controller (FLS/RLS/DOG))

*1 When 0H is set, the command of the motion system is ignored and the motor stops if the limit is detected in the MR-J5(W)-G-N1 during control. Consider any of the following to stop the system safely.
· Disable the signal detection of the MR-J5(W)-G-N1, and detect the limit by the hardware stroke limit function of the motion system.
· Enable Driver Command Discard Detection Setting (AxisName.Pr.StopOption_DriverTargetIgnored) to stop the command of the motion system when the motor is stopped due to the signal detection of the MR-J5(W)-G-N1.

*2 When 1H is set, wire the limit switch to the controller because the input to the MR-J5(W)-G-N1 becomes invalid. When wired to the MR-J5(W)-G-N1, the motor does not stop even if the limit is detected.

Method for operating external signals

This section describes how to operate the external signals of the MR-J5(W)-G-N1 from the motion system via communication.

1. Preparation

Generate the network label of the required object. (☞ Page 36 Setting Network Labels)

The external signals of the MR-J5(W)-G-N1 are assigned to the following objects.

Object	
Input	Control DI1 to Control DI10
Output	Status DO1 to Status DO10

Also, when using functions of each external signal, some parameters should be changed. For details, refer to the manuals for the MR-J5(W)-G-N1.

2. How to use

Operating/referencing the external signals of the MR-J5(W)-G-N1 are allowed by changing/referencing the values of generated labels from the program or watch. A sample program to execute gain switching using the network label is shown below. (Generate the label previously as Control DI1 and Status DO1 are used for gain switching.)

```
[Global label]
bGainChange //Bit type label
```

```
[ST program]
//Issue the gain switching request to the MR-J5-G-N1
SubDevice_1001MR_J5_G_N1_RxPDO_ControlDI1.4 : = bGainChange;

//check the gain of the MR-J5-G-N1 is switched or not
IF(SubDevice_1001MR_J5_G_N1_TxPDO_StatusDO1.4 = TRUE) THEN
                //describes the process after the gain switching
END_IF;
```

The bit 4 of ControlDI1 is the gain switching request.
This program switches the gain of the MR-J5-G-N1 by operating bit 4 of ControlDI1 with bGain Change.

The bit 4 of StatusDO1 is the gain switching status.
The process which is performed only during the gain switching can be created by checking the bit 4 status.

Method for capturing LSP/LSN/DOG signals in motion systems

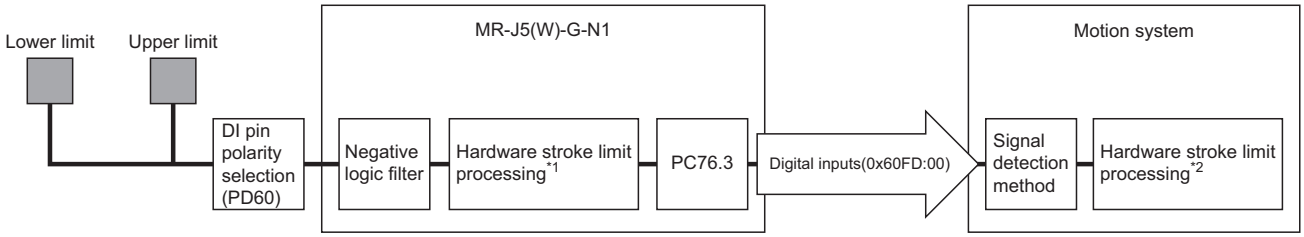
The input signals (LSP/LSN/DOG) of the MR-J5(W)-G-N1 can be used as the FLS/RLS and home position switch signals of the motion system by setting the object (Digital inputs (0x60FD: 00)) to the TxPDO of the MR-J5(W)-G-N1 and creating the network label.

Precautions

- Assign LSP/LSN/DOG signals to Input device selection 1 to 3 (PD03 to PD05) of the MR-J5(W)-G-N1 to use the signals in the motion system.
- The polarities of Bit 0 (Negative limit switch) and Bit 1 (Positive limit switch) of the object (Digital inputs (0x60FD: 00)) are determined according to the setting of Travel direction selection (PA14) of the MR-J5(W)-G-N1. For details, refer to the manuals for the MR-J5(W)-G-N1.
- Set Limit switch status read selection (PC76.3) of the MR-J5(W)-G-N1 so that the signal detection method of the motion system side is the same polarity of Bit 0 (Negative limit switch) and Bit 1 (Positive limit switch) of the object (Digital inputs (0x60FD: 00)). If the setting is different, unintended operation may occur.

Setting value of Limit switch status read selection (PC76.3)	Setting value of AxisName.PrConst.HwStrokeLimit_FlsSignal.Detection, AxisName.PrConst.HwStrokeLimit_RlsSignal.Detection
0 (Initial value)	1: Detection at FALSE
1	0: Detection at TRUE

• The data flow of the object (Digital inputs (0x60FD: 00)) is shown below when 0 (Input from servo amplifier) is set in Sensor input method selection (PD41.3) of the MR-J5(W)-G-N1.



Signal input	MR-J5(W)-G-N1			PC76.3*4		Motion system	
	DI pin polarity selection (PD60)	External input signal logic	Hardware stroke limit error detection*1	Digital inputs (0x60FD: 00) Bit 0, 1		External input signal logic setting	Hardware stroke limit error detection*2
On	0	Negative logic	Not detect	0	TRUE	Negative logic (1: Detection at FALSE)	Not detect
						Positive logic (0: Detection at TRUE)	Detect*3
	1		Detect		FALSE	Negative logic (1: Detection at FALSE)	Detect
						Positive logic (0: Detection at TRUE)	Not detect*3
Off	0		Detect		FALSE	Negative logic (1: Detection at FALSE)	Detect
						Positive logic (0: Detection at TRUE)	Not detect*3
	1		Not detect		TRUE	Negative logic (1: Detection at FALSE)	Not detect
						Positive logic (0: Detection at TRUE)	Detect*3
On	0		Not detect	1	FALSE	Negative logic (1: Detection at FALSE)	Detect*3
						Positive logic (0: Detection at TRUE)	Not detect
	1		Detect		TRUE	Negative logic (1: Detection at FALSE)	Not detect*3
						Positive logic (0: Detection at TRUE)	Detect
Off	0		Detect		TRUE	Negative logic (1: Detection at FALSE)	Not detect*3
						Positive logic (0: Detection at TRUE)	Detect
	1		Not detect		FALSE	Negative logic (1: Detection at FALSE)	Detect*3
						Positive logic (0: Detection at TRUE)	Not detect

*1 When Limit switch enabled status selection (PD41.2) of the MR-J5(W)-G-N1 is set to 0 (Stroke limit always enabled), the error stop is executed in the MR-J5(W)-G-N1 not even during homing.

*2 The error stop is executed even in the motion system during homing. The hardware stroke limit error detection in homing can be temporarily disabled by setting AxisName.Cd.HwStrokeLimit_Override.

*3 Do not configure the setting as the detection operation will differ on the motion system and MR-J5(W)-G-N1 sides.

*4 It can be set in the MR-J5(W)-G-N1 that supports Limit switch status read selection (PC76.3) of the MR-J5(W)-G-N1. For details, refer to the manuals for the MR-J5(W)-G-N1. (If not supported, the behavior is the same as 0.)

■When detecting a limit signal in the MR-J5(W)-G-N1

Depending on the setting of Limit switch enabled status selection (PD41.2) of the MR-J5(W)-G-N1, the operation differs at LSP/FLS or LSN/RLS signal detection.

Setting of Limit switch enabled status selection (PD41.2)	Operation when the signal is detected
0: Limit switch always enabled	The MR-J5(W)-G-N1 side executes the stop processing, and then turns to servo-lock status (Statusword Bit12: off) and the MR-J5(W)-G-N1 will ignore the motion system command. Also, the motion system stops the command by enabling Driver Command Discard Detection Setting (AxisName.Pr.StopOption_DriverTargetIgnored).
1: Enabled only in homing mode	When the MR-J5(W)-G-N1 is in Homing mode, the stop processing is executed on the MR-J5(W)-G-N1 side. When the MR-J5(W)-G-N1 is not in Homing mode, the signal will be ignored. Therefore, configure the motion system to stop control using the hardware stroke limit function.

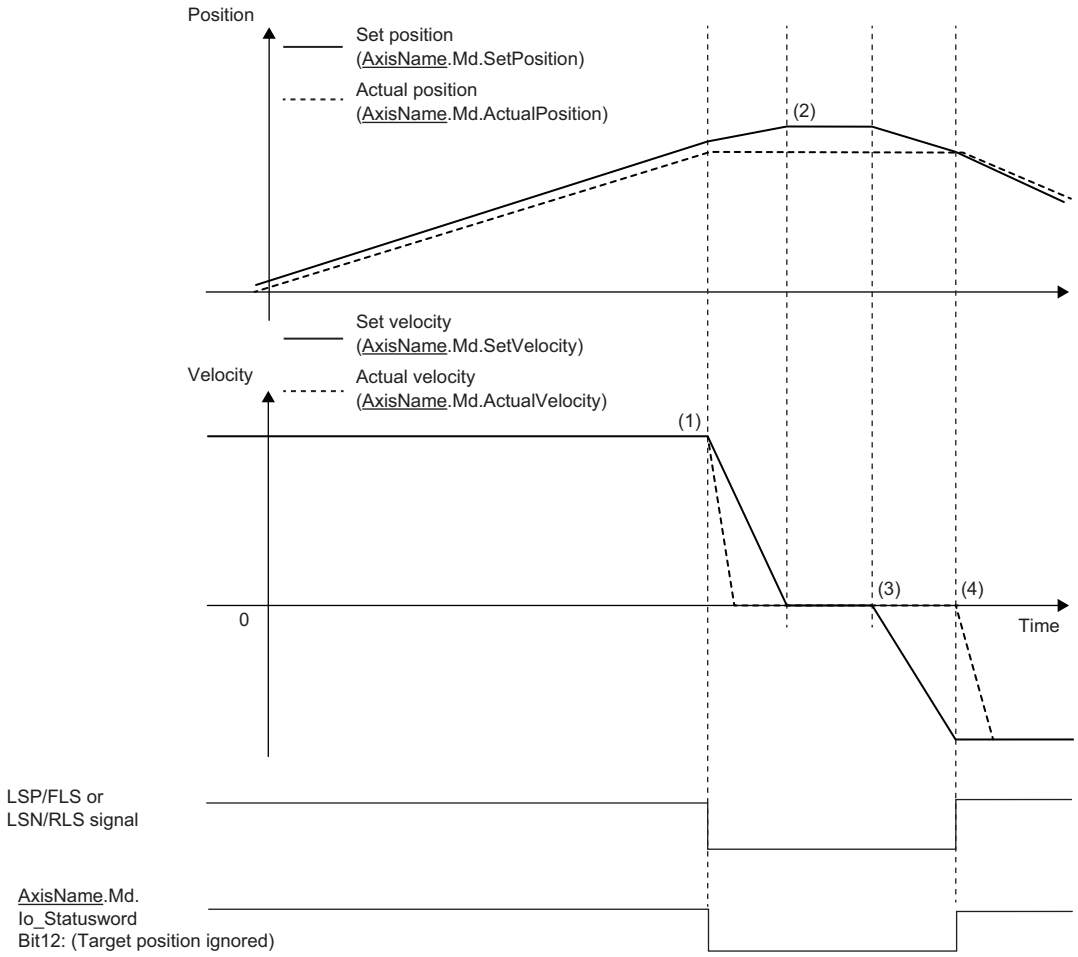
Point

When Limit switch enabled status selection (PD41.2) of the MR-J5(W)-G-N1 is set to 0 (Limit switch always enabled), the stop will be executed ignoring the command from the motion system at limit switch detection. Therefore, when using the MR-J5(W)-G-N1, it is recommended to configure the following settings.

- Limit switch enabled status selection (PD41.2): 1 (Enabled only in homing mode)
- Sensor input method selection (PD41.3): 1 (Input from controller)

When Limit switch enabled status selection (PD41.2) of the MR-J5(W)-G-N1 is set to 0 (Limit switch always enabled), the command on the motion system side needs to be stopped. Be sure to enable Driver Command Discard Detection Setting (AxisName.Pr.StopOption_DriverTargetIgnored).

Ex.



(1) When the LSP/FLS or LSN/RLS signal is detected, the MR-J5(W)-G-N1 executes the stop processing. When Driver Command Discard Detection Setting (AxisName.Pr.StopOption_DriverTargetIgnored) is enabled, the motion system will detect Driver command discard detection error and stop the command.

(2) After completion of the stop processing on the motion system side, control is stopped with the status where AxisName.Md.ActualPosition (actual position) deviates from AxisName.Md.SetPosition (set position). (The position command from the motion system to the outside of the stroke limit is ignored in the MR-J5(W)-G-N1.)

(3) After stopped and when axis control is performed to the direction toward the inside of the stroke limit, the position command (the set position and machine feed value) and command velocity of the motion system are updated. However, the servo motor does not operate.

(4) When the position command from the motion system becomes the command position where the LSP/FLS or LSN/RLS signal is detected, the servo motor starts the operation to the inside of the stroke limit.

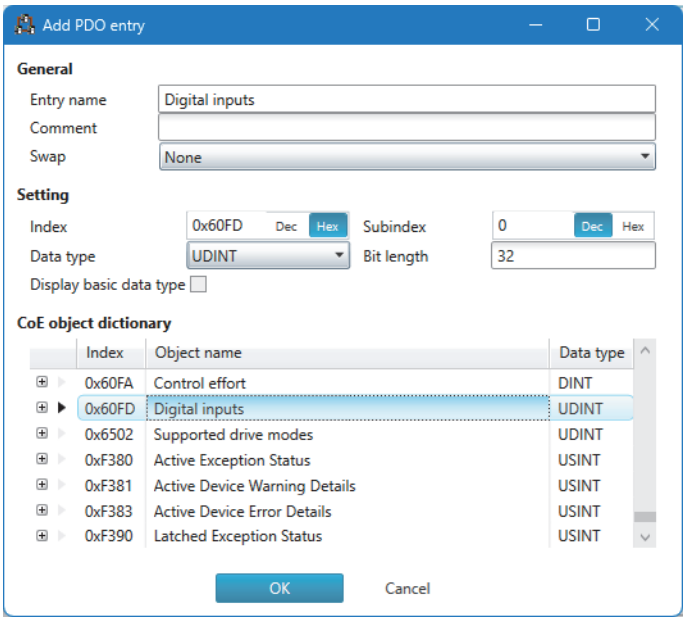
Point

- To stop while holding the relation between the master axis and the slave axis of the axes group and the synchronous control when the MR-J5(W)-G-N1 detects the stroke limit, set Limit switch enabled status selection (PD41.2) of the MR-J5(W)-G-N1 to 1 (Enabled only in homing mode).
- When the signal is turned on (limit signal OFF) in the status where the actual position deviates from the position command with the stop by the stroke limit detection of the MR-J5(W)-G-N1, the motor makes rapid movement to the position command of the motion system. Restore the deviation between the actual position and the position command by axis control to the inside of the stroke limit. (Set the servo OFF status, so that restoring the position command to the actual position by follow up is possible. After the restoration, set the servo ON again and move the motor to the inside of the stroke limit with the axis control.)
- When the command position of the motion system stops at the stroke limit side closer than the actual position by the stroke limit detection of the MR-J5(W)-G-N1 and the axis control is performed to the inside of the stroke limit, the operation of the actual position follows the command position from the motion system.

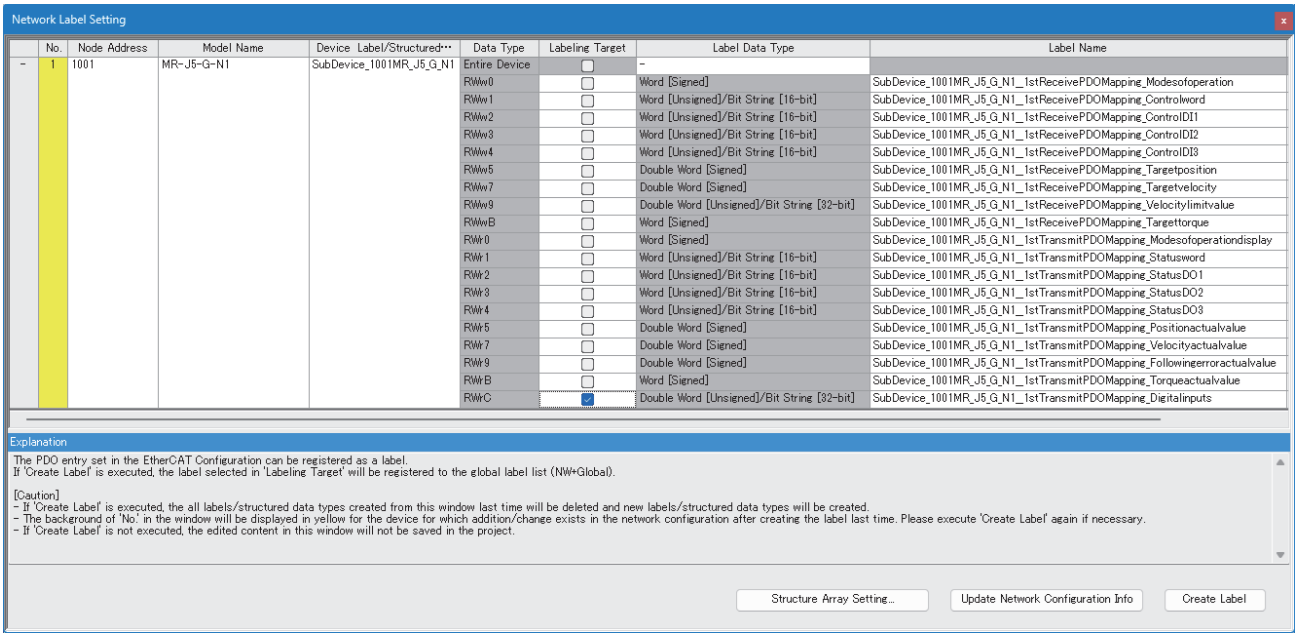
Setting data

1. Set Digital inputs (0x60FD: 00) for PDO mapping.

Edit the TxPDO of the target MR-J5(W)-G-N1 with the module extended parameter, and add Digital inputs (0x60FD: 00).



2. Set Digital inputs (0x60FD: 00) as a network label.



Point

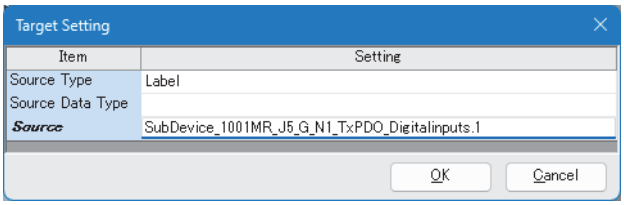
If the label name is long, it may not be set in the axis parameter. Change the label name as needed.

3. Specify the network label to the home position switch of FLS/RLS or MC_Home.

• Upper limit/lower limit settings

Set the upper limit signal target/lower limit signal target in the axis parameter.

Navigation window ⇨ [Axis] ⇨ [Real Drive Axis] ⇨ [Limit Parameter]



Variable name	Setting value (when Travel direction selection (PA14) is 0)
AxisName.PrConst.HwStrokeLimit_FlsSignal.Source.Target	[VAR]SubDevice_1001MR_J5_G_N1_TxPDO_Digitalinputs Mapping_Digitalinputs.1
AxisName.PrConst.HwStrokeLimit_RlsSignal.Source.Target	[VAR]SubDevice_1001MR_J5_G_N1_TxPDO_Digitalinputs Mapping_Digitalinputs.0

• Specifying the DOG signal at homing*1*2

Specify the following to the home position switch to be input to MC_Home.

Variable name	Setting value (when Travel direction selection (PA14) is 0)
MC_INPUT_REF.Signal.Source.Target	[VAR]SubDevice_1001MR_J5_G_N1_TxPDO_Digitalinputs Mapping_Digitalinputs.2

*1 This setting is not required if 0 (Input from servo amplifier (LSP/LSN/DOG)) is selected in Sensor input method selection (PD41.3). Directly input the DOG signal to the MR-J5(W)-G-N1.

*2 Set 1 (Dog detection with on) to Device input polarity 1 (PT29.0) if 1 (Input from controller (FLS/RLS/DOG)) is selected in Sensor input method selection (PD41.3).

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MEMO

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MEMO

REVISIONS

*The manual number is given on the bottom left of the back cover.

Revision date	*Manual number	Revision
April 2026	SH(NA)-082746ENG-A	First edition

Japanese manual number: SH-082745-A

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However, if repairs are required onsite at domestic or overseas location, expenses to send an engineer will be solely at the customer's discretion. Mitsubishi shall not be held responsible for any re-commissioning, maintenance, or testing on-site that involves replacement of the failed module.

[Gratis Warranty Term]

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[Gratis Warranty Range]

(1) The range shall be limited to normal use within the usage state, usage methods and usage environment, etc., which follow the conditions and precautions, etc., given in the instruction manual, user's manual and caution labels on the product.

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