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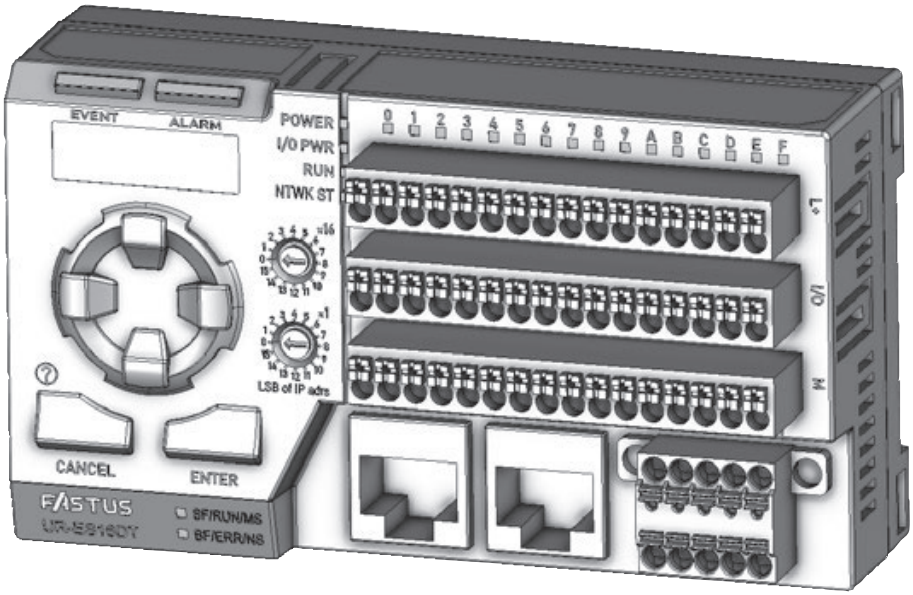
IO-Link Master

UR-ES16DT

User's Manual
EtherCAT Edition



OPTEX FA CO., LTD.

Ramco Innovations www.optex-ramco.com (800) 280-6933

Introduction

Thank you for purchasing the IO-Link Master UR-ES16DT.
This manual contains the information required when using “EtherCAT” as the field network.
Please read this manual carefully before use, and fully understand the functions and performance before using this product correctly. Also, keep this manual in a safe place after reading it, and always keep it handy.

- Trademarks and registered trademarks appearing in this manual are the property of their respective owners.
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Safety Precautions

This manual uses the following symbols to display safety precautions for ensuring safe operation of the UR-ES16DT IO-Link Master (hereafter, “this product”).
Precautions listed here describe important information about safety. Make sure to follow them accordingly.

Safety Symbols

The indications and their meanings are as follows.

⚠WARNING	Indicates that any improper operation or handling may result in moderate or minor injury, and in rare cases, serious injury or death. Also indicates a risk of serious property damage.
⚠CAUTION	Indicates that any improper operation or handling may sometimes result in moderate or minor injury or property damage.

Notes

For common product functions, see the common edition (UR-ES_UM-XXX-XXXX) (below, the Common Edition).

Related Manuals

Manuals related to this manual are as follows. Reference them as needed.

Common edition of this product

Describes common functions not related to the network type used.

Manual number	Manual name	Details
UR-ES_UM-XXX-XXXX	IO-Link Master UR-ES16DT User's Manual Common Edition (Referred to herein as the "Common Edition.")	Describes this product's common functions and performance as well as operation. Be sure to read these documents.

Manual Structure

This manual's content is structured as follows.

1. Overview	Describes the overview when using “EtherCAT” as the field network.
2. Initial setting of this product with regard to EtherCAT	Describes initial settings for this product's EtherCAT node address setting, communication connection, and front panel operation.
3. Communication	Describes the initial settings for EtherCAT communication and IO-Link communication, the configuration of the data to be handled, and communication examples.
4. Specifications	Describes the specifications related to EtherCAT for this product.
5. Troubleshooting	Describes methods of troubleshooting related to EtherCAT communication.
6. Appendix	Describes the values for this product's master settings, its object dictionary, and how to interact with the EtherCAT Master of each company.

Index

3 Communication

4 Specifications

5 Troubleshooting

6 Appendix

Notations Used in this Manual

These are the notations used in this manual.

CAUTION
This indicates particularly important points to observe during operation.

MEMO
This information is useful for operation.

Trademarks

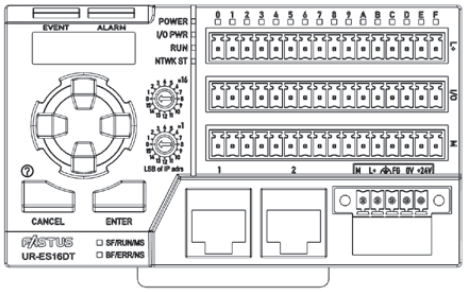
- EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

- Other company, system and product names in this manual are the trademarks or registered trademarks of their respective companies.

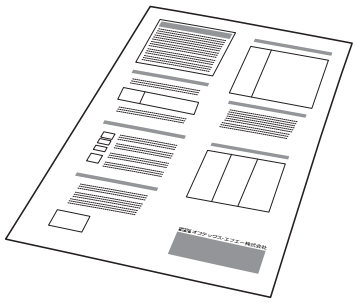
Confirmation of Bundled Items

Before use, confirm the product packaging. If there are any defective or damaged items, please contact OPTEX FA's customer support center (refer to the end of this manual).

Product Packaging



• UR-ES16DT unit



• Instruction manual

- I/O terminal block: three pieces
- Power terminal block: one piece
- RJ45 connector protective cap (attached to unit) : two pieces

Other Required Items

Cables

This product uses the following cables.

Type	Specifications
Ethernet cable	Ethernet cables that fulfill the following specifications • Socket connector: RJ45 plug socket connector • Cable: Use a category 5 or higher Ethernet cable that complies with the standards (100 BASE-TX). Refer to the manual of the EtherCAT Master for more information.

Switching Hub

Use the following industrial switching hubs.

Type	Specifications
Switching Hub	Layer 2 switch For details on usable switching hub, refer to the EtherCAT Master manual and the materials on operation confirmation devices.

Terminology List

This explains the terminology used in this document.

Terminology	Description
EtherCAT Master	Nodes that control the EtherCAT network.
ESI file	An XML file that contains information about the settings for the EtherCAT Slave. Installing the ESI file for this product in the EtherCAT Master side configuration software is required in order to control this product from the EtherCAT Master.
PDO communication	A type of EtherCAT cyclic communication that employs Process Data Objects (PDO) to exchange real-time data on a regular basis.
Extended access function	A function that reads and writes the product's set values and IO-Link devices, including sensor units connected to the UC2-IOL, using PDO communication. It is possible to streamline the EtherCAT Master side program.
SDO communication	Acyclic communication over EtherCAT that sends data at any timing using Service Data Objects (SDO).
PDO	When performing cyclic communication, it is referred to in EtherCAT as a (software) communication path. Which slave unit object to enter is specified here. One can be used for transmission and one for reception in this product.
Receive PDO	Process data object received by the EtherCAT Slave.
Transmit PDO	Process data object transmitted from the EtherCAT Slave.
PDO entry	A slave device's object that has been added to (and is intended for cyclic communication with) the PDO. When PDO is editable, objects from slave units can be added to or removed from PDO.
Object dictionary	A data structure that includes descriptions of communication, application, and data type objects. This product is divided into two categories: a parameter type and a service type.
Index (EtherCAT)	Address of the EtherCAT object in this product.
Sub-Index (EtherCAT)	Sub-address of the EtherCAT object in this product.
Index (IO-Link)	Address of the service data of the IO-Link device
Sub-Index (IO-Link)	Sub-address of the service data of the IO-Link device
First index number for offset	When reading the service data of the IO-Link device, the index number's starting point that is predetermined in the unit. In addition to specifying the target index number, it also specifies an offset value that will be added to this value during the actual reading.

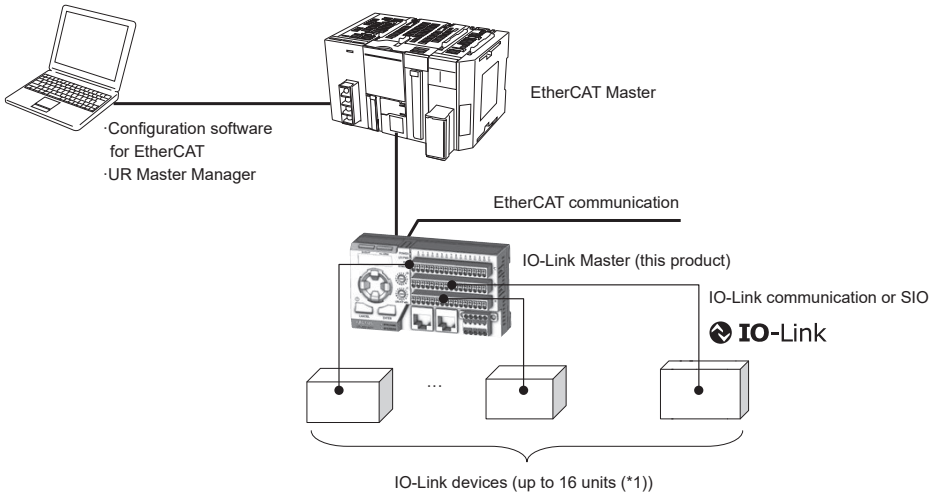
Overview

This chapter describes the overview when using “EtherCAT” as the field network.

1-1 Product Overview

This product performs cyclic communication with the EtherCAT communication master as a slave unit of EtherCAT communication when the network type is set to "EtherCAT," and concurrently performs IO-Link process data communication with the connected IO-Link device.
The EtherCAT Master can use SDO communication to read and write the parameters of this product or connected IO-Link devices during acyclic communication.

Configuration Example of EtherCAT and IO-Link System



*1: To connect a maximum of 16 IO-Link devices to this product, the following conditions are required.
Product process data size with the connected IO-Link device group:
Input: All channel total max. is 32 words
Output: All channel total max. is 32 words

Features

- The field network can be switched among the followings in the setting menu.
  - EtherNet/IP (default value)
  - EtherCAT
  - PROFINET (under development)
  - Ethernet and Modbus/TCP
  - CC-Link IE Field Basic
- PDO communication is permitted as cyclic communication and SDO communication is permitted as acyclic communication on the "EtherCAT" network type.
- PDO communication enables input/output with up to 16 IO-Link devices (for default values, 2 words each input/output per device). Further, reading and writing with partial cyclic communication, without using acyclic communication, is possible for settings of this product, IO-Link device designated index/sub-index values, or "specific data" of sensor units connected to the OPTEX FA IO-Link gateway UC2-IOL (this is called extended access).
- A timestamp can also be added to the process input data. As a result, it is possible to read the time when the process input data was taken from this product, synchronized with the network time, at a resolution of 15.26 µs. Additionally, adding parity information calculated from process input data and time information, it is possible to ensure the integrity of process input data and time (data integrity: DI).

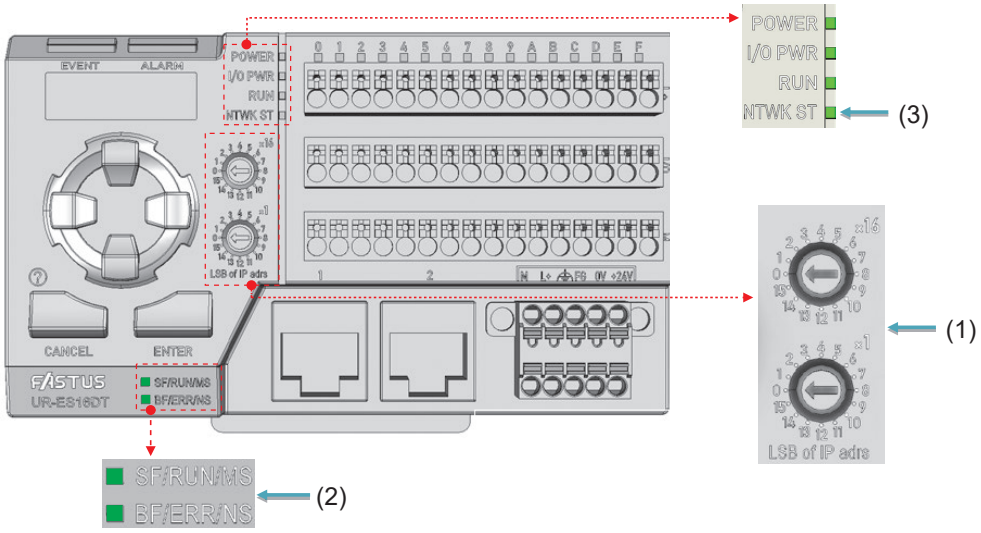
As well, the time when a parameter is read from an IO-Link device is saved in this product, then to be read from the host PLC.

- When required, it is also possible to read and write the specified index/sub-index values of IO-Link devices or the set values for this product via SDO communication.
- The front keys of this product can be remotely controlled from a touch panel display using SDO communication.

1-2 Part Names and Functions

1-2-1 Part Names and Functions

The part names and functions after assembling the terminal block, when using “EtherCAT” as the field network, are as follows.
Refer to Common Edition for other part names and functions.



(1) Node address setting switch

Set this product's EtherCAT node address if the network type is "EtherCAT." Multiply the value of the upper switch by 16, then add it to the value of lower switch.
The front panel setting rotary switch's factory setting is "1."
Note 1: Set the master setting value "M83. Station number" by operating the front panel of this product if the network type is "EtherCAT" and you want to set the EtherCAT node address in a different way than with this front rotary switch.
Turning the front rotary switches while the power is on automatically switches to "M83. Station number".
Note 2: The network type must be set to "EtherNet/IP" when installing the IODD data to this product. When the network type is "EtherNet/IP" and this front rotary switch is set to "n", this product's IP address is "192.168.0.n" (the factory setting is 192.168.0.1 because the front setting rotary switch is set to "1").

(2) SF/RUN/MS LED, BF/ERR/NS LED

Displays the status of the field network.
For EtherCAT it is as follows.

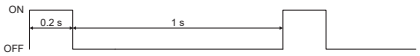
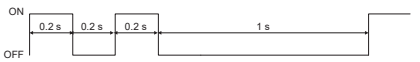
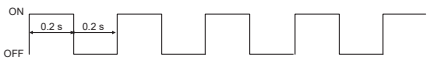
- SF/RUN/MS: Indicates EtherCAT communication transition state of this product.
  - Off :INIT state
  - Blinking : PRE-OPERATIONAL state
  - Single flash : SAFE-OPERATIONAL state
  - Lit : OPERATIONAL state
- BF/ERR/NS: Indicates abnormal EtherCAT communication status for this product.
  - Off : No error
  - Flickering : Boot error
  - Single flash : Communication data error
  - Double flash : Application watchdog timeout
  - Blinking : Communication setting error
  - Lit : PDI watchdog timeout

(3) NTWK ST LED (green)

Displays the status of the field network communication.

- Lit: Normal communication
- Blinking: Communication interruption
- Off: Not communicating

Note: LED blinking state

Flashing state name	Blinking timing
Flickering	
Single flash	
Double flash	
Blinking	

1-3 Inputting/Outputting IO-Link Devices and Process Data

This section explains how to input/output process data of IO-Link devices connected to the product.

The input/output methods are as below.

Method	Description		Reference
1) Input/output via cyclic communication	IO-Link device process data is assigned to the EtherCAT Master cyclic communication area.		-
	For default value	• Input (IO-Link device → EtherCAT Master): 2 words/device • Output (EtherCAT Master → IO-Link device): 2 words/device	"3-3 Cyclic Communication (PDO)"
	For other than default value	The following manual or auto assignments are possible.	Common Edition "Chapter 4: Product Functions"
		Manual assignment: With the following master parameters for this product, the assignment size is set to other than default values for each channel. • Input: “M40. Process input data words allocation”: 0 to 16 words per channel (default value: 2 words) • Output: M41. Process output data words allocation: 0 to 16 words per channel (default value: 2 words)	
		Auto assignment: In accordance with the actual IO-Link device specifications, the above master parameter word assignment is automatically set. This depends on setting "M42. Automatic word assignment of process data" to "Yes" (1).	
2) Confirmation with front panel operations	Confirmation is done with product front panel operation.		Common Edition "Chapter 5 Front Panel Operations"

1-4 Setting/Monitoring Product Master Parameters

This section describes how to set/monitor product master parameters.

As shown below, there are three setting/monitoring methods.

Method	Description	Reference
1) Setting with front panel operations	Setting is done with product front panel operation.	Common Edition "Chapter 5 Front Panel Operations"
2) Setting via cyclic communication extended access	Specific master parameters can be read/written by cyclic communication operation alone (via extended access).	"3-3 Cyclic Communication (PDO)"

1-5 IO-Link Device Service Data Setting/Monitoring

This section explains how to set service data inside IO-Link devices connected to the product.

As shown below, there are three setting/monitoring methods.

Method	Description	Reference
1) Setting/monitoring via cyclic communication extended access	Specific service data can be read/written by cyclic communication operation alone (via extended access).	"3-3 Cyclic Communication (PDO)"
2) Setting/monitoring with front panel operations	Setting/monitoring is possible with front panel operations.	Common Edition "5-1-5 Device identification display"

1-6 Setting/Monitoring Data from UC2-IOL Connected Sensor Unit

Setting/monitoring methods for data from the target sensor unit interconnected with OPTEX FA IO-Link gateway UC2-IOL are shown here.

As shown below, there are setting/monitoring methods.

Method	Description	Reference
1) Setting/monitoring via cyclic communication extended access	Specific data from the target sensor unit can be read/written by cyclic communication operation alone (via extended access).	"3-3 Cyclic Communication (PDO)"

Note: EtherCAT is unable to set or monitor the target sensor unit's data when it is connected to the UC2-IOL via acyclic communication.

1-7 Basic Procedure

The process from installing and setting this product through establishment of EtherCAT and IO-Link communication is described below.

Procedure	Details	References
Prior confirmation	System configuration decision: • IO-Link device types and number used In particular, calculate the number of connectable IO-Link devices based on the total process data size of each IO-Link device • (Related to the above) Determine whether to automatically allocate process data from the actual IO-Link device or manually set the number of input or output words for the IO-Link device for each channel • Each channel I/O assignment settings	1-1 Product Overview 3-3 Cyclic Communication (PDO) Common Edition
	Data I/O design: • Whether to access settings with cyclic communication data operation, using cyclic communication (whether to use extended access) • What to read and write to this product or IO-Link device using acyclic communication	3-3 Cyclic Communication (PDO) 3-4 SDO (Mailbox) Communication
↓	↓	
Hardware installation and wiring	Install the EtherCAT Master.	Manual of the EtherCAT Master being used
↓	↓	
Transferring of IO-Link device profiles of devices connected to this product	(When using other companies' IO-Link device *1) Using IODD Converter.exe in UR Master Manager, choose "EtherNet/IP" as the network type for IODD data transfer, and transfer (install) from your computer with the "Network type" setting of this product set to the default value "EtherNet/IP." *1: Upon the transfer, the IO-Link device process data and settings can be monitored with names and can be changed.	Common Edition
↓	↓	
Initial settings through front panel operations	Set the "Network type" setting to "EtherCAT"	2-2 Initial Settings through Front Panel Operations
	↓	
	Setting the EtherCAT node address of this product	2-2-5 Setting the EtherCAT Node Address of This Product
↓	↓	

Procedure		Details	References
Initial setting by the master side configuration software	Register this product to the EtherCAT network	Load the ESI file into the master side configuration software	3-2 Initial Setting of This Product Via Software
		↓	
		Register this product to the EtherCAT network configuration on the master side configuration software	3-2-2 Summary of Steps
		↓	
		Configuring the EtherCAT network between this product and the EtherCAT Master (the master side configuration software for this product allows node address setting and input/output assignment)	
		↓	
		Write the settings to the EtherCAT Master	3-2-2 Summary of Steps
		↓	
		Establish EtherCAT (NTWK ST LED on the front of this product lights green.)	1-2 Part Names and Functions
↓		↓	
This product's parameter setting		Setting via front panel operations on this product	Common Edition
		For SDO communication of EtherCAT Master	3-4 SDO (Mailbox) Communication
↓		↓	
IO-Link device service data setting		Setting via front panel operations on this product	Common Edition
		For SDO communication of EtherCAT Master	
↓		↓	
Starting communication		Start system (power ON)	
		↓	
		Start EtherCAT Start IO-Link communication	Manual of the EtherCAT Master being used
↓		↓	
Checking operation		Check the display of the EtherCAT Master and this product/ IO-Link device	Manual of the EtherCAT Master being used 1-2 Part Names and Functions, and 5-1 Troubleshooting Each IO-Link device manual
		Check read and write of data between this product and IO-Link devices	Each IO-Link device manual
		↓	
		Data read/write confirmation via cyclic communication between this product and the EtherCAT Master	3-3 Cyclic Communication (PDO) Manual of the EtherCAT Master being used
		↓	
		(When required) Reading/writing of this product or IO-Link device by acyclic (SDO) communication	3-4 SDO (Mailbox) Communication
↓		↓	
Troubleshooting		Check the display of IO-Link devices on EtherCAT Master and this product, acyclic (SDO) communication response check	Chapter 5 Troubleshooting

MEMO

The master parameter of this product and the parameters of the connected IO-Link device can be changed using any of the following two methods.
The applications of each are as follows.

Method	Main application	References
1) Unit front panel operation	During startup or maintenance	• "2-2 Initial Settings through Front Panel Operations"
2) Acyclic communication from the EtherCAT Master	Controlled operation	• "3-4 SDO (Mailbox) Communication" • "Appendix-1 List of Product Master Parameters"

CAUTION

- If more than 32 words are used on either the input or the output in total, the excess process data will not be assigned to the EtherCAT Master (and will be ignored).
  To connect a maximum of 16 IO-Link devices to this product, the following conditions are required.
  Product process data size with the connected IO-Link device group:
  Input: All channel total max. is 32 words
  Output: All channel total max. is 32 words
- To add a particular IO-Link device type for connection after installing IODD data on this product, use IODD_Converter.exe to install the IO-Link device. Recreate the included IODD data and install it again. Change this product's network type to "EtherNet/IP" at that point, then install it. After installation, be sure to return to "EtherCAT".
- While the IO-Link ready flag is ON, perform read and write of process data.

Initial Settings of This Product Related to EtherCAT

Describes initial settings for this product's EtherCAT node address setting, communication connection, and front panel operation.

2-1 Ethernet Connection

Shown here is the Ethernet connection configuration when using EtherCAT as the field network.

2-1-1 Socket Connector and Cable

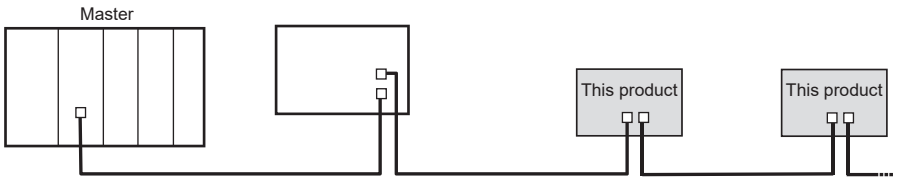
Make sure to connect the Ethernet cable to the RJ45 connector on this product's left side in the order that is closest to the EtherCAT Master.
For the cable, use an Ethernet cable that complies with the standard (100 BASE-TX).
Refer to the manual of each EtherCAT Master for more information.

2-1-2 Connection Form of Ethernet

Connect socket connectors/cables depending on the Ethernet connection type.
This product supports the following connection types.
• Daisy chain configuration
• Branch wiring configuration
• Ring type
Refer to the manual of each EtherCAT Master for more information.

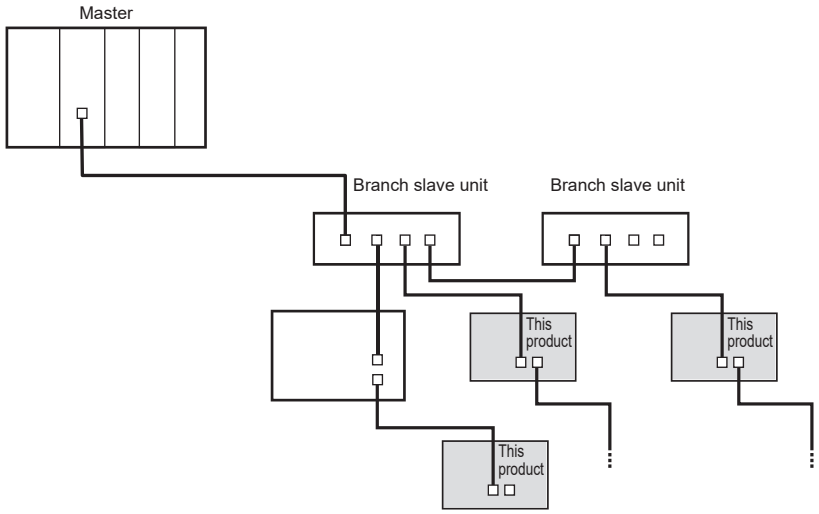
Daisy chain configuration

The standard EtherCAT connection type for connecting devices in a row is called daisy chain configuration.
Connect the downstream side to PORT2 and the upstream side (master side) to PORT1.
(EtherCAT communication will not be established if it is reversed.)



Branch wiring configuration

The branch wiring configuration is a form of connection where the daisy chain is split off into separate branches by the branch slave unit.
Connect the downstream side to PORT2 and the upstream side (master side) to PORT1.
(EtherCAT communication will not be established if it is reversed.)



Ring type

If the EtherCAT Master supports it, then this connection type is possible. Follow the corresponding EtherCAT Master manual when wiring.

2-2 Initial Settings through Front Panel Operations

Shown here is the initial setting method via product front panel operations when using "EtherCAT" as the field network.

2-2-1 Powering on the EtherCAT Master

When available, apply power to the EtherCAT Master in advance.
This makes it possible to check whether the master is connected correctly.

2-2-2 Language Selection

After turning the product on for the first time, select the language setting.

2-2-3 Installing IODD data

Install the IODD data using IODD Converter.exe when using an IO-Link device made by a different company, leaving the network type of this product set to "EtherNet/IP" by default.
Now, using the computer's IODD Converter.exe program, this product's IP address must be entered. Enter "192.168.0.1" to use the factory default setting (since the front setting rotary switch is set to "1").
Note: If the rotary switch for front setting is "n", enter "192.168.0.n".

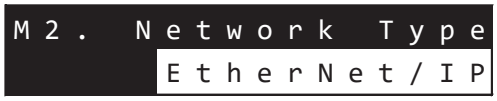
When the "Installation Completed" dialog box appears after downloading the IODD data, move on to the "Network Type Setting" that is shown in the following section.

CAUTION

- Install with "EtherNet/IP" to support Ethernet communication when installing IODD data from a PC (IODD Converter.exe) to this product. As a result, only at that time do you need to set the network type of this product to its initial value, "EtherNet/IP."

2-2-4 Network Type Setting

Subsequently, the display automatically switches to the network type setting screen shown below.



The factory default network type setting is "EtherNet/IP".

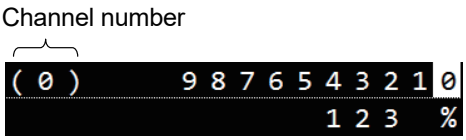
Change the network type setting to "EtherCAT" here if you want to set the upper industrial network to "EtherCAT".

Regarding "M2. Network Type", refer to Common Edition "5-1-4 Master Parameter List with Product Front Panel Operation"
Press the [↑] key once. "EtherCAT" is displayed as shown below.

Press the [ENTER] key. The network type switches to "EtherCAT". Wait about twenty seconds while the network chip firmware rewrites.
When rewriting is complete, this product will reboot automatically.

After the reboot, the process data display will appear (if language selection is completed).

The following display is an example of the start display of process data when turning the power on after selecting the language.



Refer to Common Edition "5-1 Front Panel Operations" for details of settings.

2-2-5 Setting the EtherCAT Node Address of This Product

One of the following operations will set the EtherCAT node address.
- Front rotary switch
- Setting with "M83. Station number" (*1)

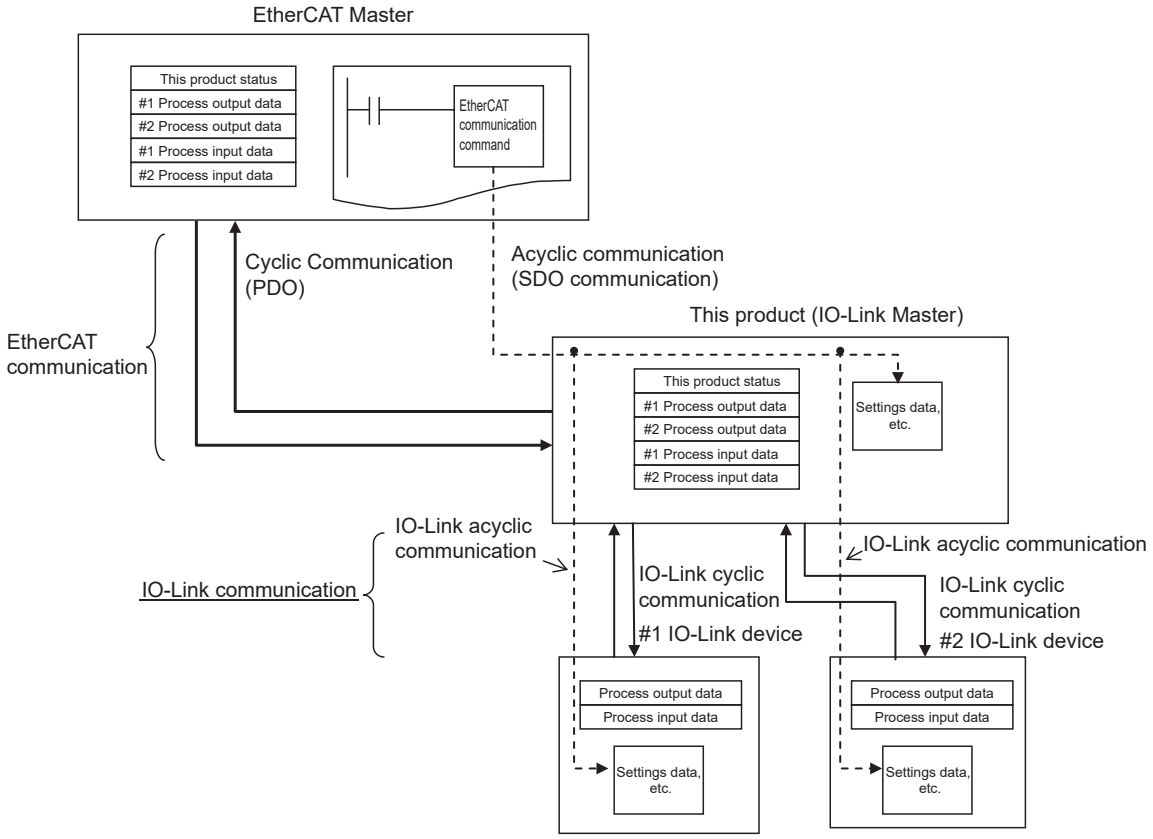
*1: Turning the front rotary switches of this product while the power is on automatically switches to "M83. Station number".

Communication

Describes the initial settings for EtherNet/IP communication and IO-Link communication, the configuration of the data to be handled, and communication examples.

3-1 Communication System Overview

This product performs IO-Link cyclic communication with the connected IO-Link devices. Each of these IO-Link devices' data is condensed, and Cyclic Communication (PDO) with the EtherCAT Master is carried out with each device's unique status and set.
Additionally, it is possible to carry out acyclic communication (SDO communication) for each service data of IO-Link devices connected to this product as well as the master setting values of this product from the communication program on the EtherCAT Master.



3-2 Initial Setting of This Product Via Software

To configure this product initially, use the free UR Master Manager software and your EtherCAT Master side configuration software.

3-2-1 Required software

- EtherCAT Master side configuration software:
  Master side configuration software (tool for this product's EtherCAT Slave)
- For import/download from IODD file (device definition) group:
  UR Master Manager
  *IODD files are provided from each IO-Link device manufacturer.

MEMO

Download UR Master Manager from the OPTEX FA website below.
https://www.optex-fa.com/
When importing or downloading IODD files, UR Master Manager is necessary (device definition).
Additionally, only when installing the IODD data from a computer (UR Master Manager) to this product does the network type of this product need to be changed to "EtherNet/IP."
Refer to "Common Edition" for further information.
Also, for UR Master Manager operation, see its user's manual.

3-2-2 Summary of Steps

1 **Download the ESI file for this product from the OPTEX FA website below:**
https://www.optex-fa.com/

2 **Install the ESI file for this product in the EtherCAT Master side configuration software.**

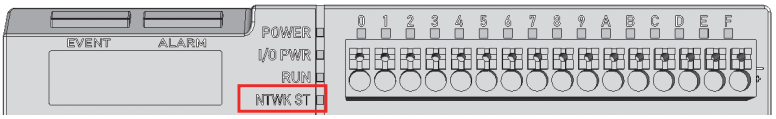
3 **Register this product to the EtherCAT network configuration on the EtherCAT Master side configuration software.**

4 **Enter the settings for the EtherCAT communication between this product and the EtherCAT Master, and then write those settings to the EtherCAT Master.**

5 **Reset the EtherCAT Master.**
Confirm that this product's SF/RUN/MS LED and NTWK ST LED are lit to confirm that EtherCAT communication has been established and that the EtherCAT communication status has changed to operational.

MEMO

- After completing the settings, double-check the settings you made with the master side configuration software and this product's settings if the NTWK ST LED on the front of this product does not light green (indicating normal communication).



- If communication is not possible even after all the confirmation above, refer to the manuals for the used EtherCAT Master.

3-3 Cyclic Communication (PDO)

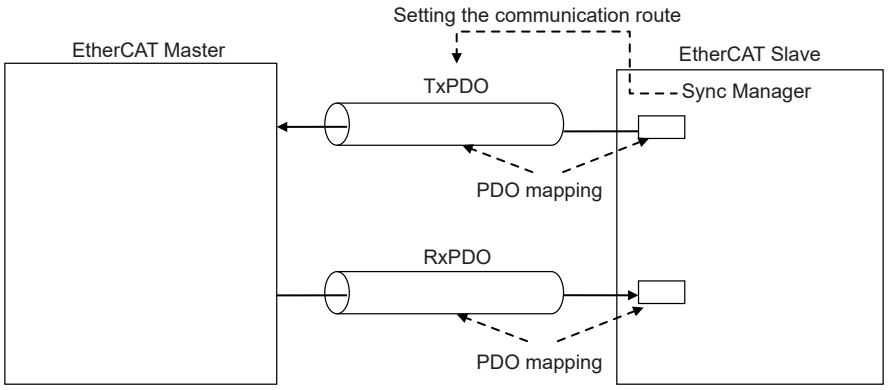
Along with the EtherCAT Master's Cyclic Communication (PDO) area, this product periodically transmits the following data.

- Digital input/digital output in SIO mode and product status/operation flags
- IO-Link device I/O maximum 32 bytes of process data

It also supports extended access.

3-3-1 How PDO Communication Works

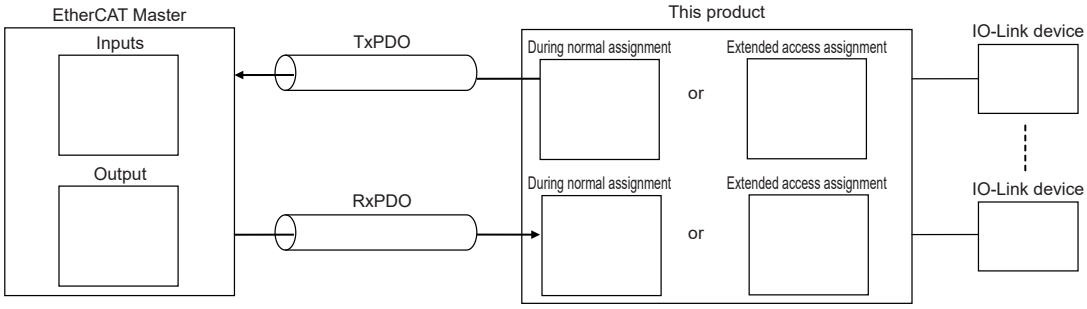
EtherCAT uses Sync Manager to configure the communication path. The PDO mapping determines which data is passed to the path.



3-3-2 PDO Mapping of This Product

PDO mapping of this product is performed as follows.

- Each PDO (fixed) is used to transmit from this product to the master and receive from the master to this product.
  On the PDO (communication path), all the data (PDO entries) are pre-assigned by default (factory default).



Using the configuration software on the master side, unnecessary data (particularly process data for channels without connected IO-Link devices) can also be removed.

Details of PDO mapping of this product to the EtherCAT Master are as follows.

Default Values (Factory Settings)

The following data of this product are assigned.

PDO mapping	PDO entry	Assigned data	Size (Bit)	Object dictionary's index, sub-index (*1)
Transmit PDO mapping (1A00 h)	PDO entry 1	Process data input	16	6000.01 h
	PDO entry 2	Assignment status data	16	6000.02 h
	PDO entry 3	Process input data channel 0	32	6000.03 h
	PDO entry 4	Process input data channel 1	32	6000.04 h
	PDO entry 5	Process input data channel 2	32	6000.05 h
	PDO entry 6	Process input data channel 3	32	6000.06 h
	PDO entry 7	Process input data channel 4	32	6000.07 h
	PDO entry 8	Process input data channel 5	32	6000.08 h
	PDO entry 9	Process input data channel 6	32	6000.09 h
	PDO entry 10	Process input data channel 7	32	6000.0A h
	PDO entry 11	Process input data channel 8	32	6000.0B h
	PDO entry 12	Process input data channel 9	32	6000.0C h
	PDO entry 13	Process input data channel A	32	6000.0D h
	PDO entry 14	Process input data channel B	32	6000.0E h
	PDO entry 15	Process input data channel C	32	6000.0F h
	PDO entry 16	Process input data channel D	32	6000.10 h
	PDO entry 17	Process input data channel E	32	6000.11 h
	PDO entry 18	Process input data channel F or extended access read data	32	6000.12 h
Receive PDO mapping (1600 h)	PDO entry 1	Process data output	16	7000.01 h
	PDO entry 2	Allocated operation data	16	7000.02 h
	PDO entry 3	Process output data channel 0	32	7000.03 h
	PDO entry 4	Process output data channel 1	32	7000.04 h
	PDO entry 5	Process output data channel 2	32	7000.05 h
	PDO entry 6	Process output data channel 3	32	7000.06 h
	PDO entry 7	Process output data channel 4	32	7000.07 h
	PDO entry 8	Process output data channel 5	32	7000.08 h
	PDO entry 9	Process output data channel 6	32	7000.09 h
	PDO entry 10	Process output data channel 7	32	7000.0A h
	PDO entry 11	Process output data channel 8	32	7000.0B h
	PDO entry 12	Process output data channel 9	32	7000.0C h
	PDO entry 13	Process output data channel A	32	7000.0D h
	PDO entry 14	Process output data channel B	32	7000.0E h
	PDO entry 15	Process output data channel C	32	7000.0F h
	PDO entry 16	Process output data channel D	32	7000.10 h
	PDO entry 17	Process output data channel E or extended access specified data	32	7000.11 h
	PDO entry 18	Process output data channel F or extended access write data	32	7000.12 h

*1: 1For more information about object dictionary indexes and sub-indexes, refer to "Appendix-2-3 Object Dictionary (parameter type) List for Cyclic Communication".

3-3-3 Assignment Method on This Product

The unit can be switched between using either of the following two assignment methods.
It is specified by "extended access enable/disable flag" of bit 0 of the PDO entry "Control bit".

- Normal assignment : When "extended access enable/disable flag" is set to 0, assignment method where everything is cyclic data shared type.
- Extended access enabled assignment : When "extended access enable/disable flag" is set to 1, in addition to normal cyclic data-sharing type assignment, this is an assignment method that allows setting value access without using SDO communication.
  The following can be accessed.
  - Any service data in any connected IO-Link device
  - Product master parameters
  - Specific data in a sensor unit interconnected with UC2-IOL

The following is shown when both the "M40. Process input data words allocation" and "M41. Process output data words allocation" master parameters are the default values.
Refer to “3-3-6 Assignment methods other than process data default value” for uses other than the default value.

3-3-4 Normal Assignment (extended access disabled)

When “Extended access enable flag” (bit 0 of <Control bit>) is set to 0 (OFF: Extended access disabled), the product assignment to the EtherCAT Master cyclic communication area is as shown below.

Transmit PDO Mapping Input (this product → EtherCAT Master)

Data name (= object name)*1	Data type	Offset (bytes)	Bit							
			7	6	5	4	3	2	1	0
Input bit	WORD	+0	Digital input (Channels 0 to 7: Corresponds to bit 0 to 7)							
		+1	Digital input (Channels 8 to F: Corresponds to bit 8 to F)							
Status bit	WORD	+0	Event flag	I/O power supply flag	Output overcurrent flag	Reserved	Channel with the latest event			
		+1	Error flag	IO-Link ready flag	Synchronization establishment flag	Reserved	Channel with the latest error			
pdin 0	DWORD	+0	Process input data Channel 0 (4 bytes)							
		+1								
		+2								
		+3								
pdin 1	DWORD	+0	Process input data Channel 1 (4 bytes)							
		+1								
		+2								
		+3								
…		…	…							

Data name (= object name)*1	Data type	Offset (bytes)	Bit							
			7	6	5	4	3	2	1	0
pdin E	DWORD	+0	Process input data Channel E (4 bytes)							
		+1								
		+2								
		+3								
pdin F	DWORD	+0	Process input data Channel F (4 bytes)							
		+1								
		+2								
		+3								

*1: The data name mapped to the aforementioned PDO is enclosed in < > in the explanation that follows.

Receive PDO Mapping Output (EtherCAT Master → this product)

Data name (= object name)*1	Data type	Offset (bytes)	Bit							
			7	6	5	4	3	2	1	0
Output bit	WORD	+0	Digital output (Channels 0 to 7: Corresponds to bit 0 to 7)							
		+1	Digital output (Channels 8 to F: Corresponds to bit 8 to F)							
Control bit	WORD	+0	Clear the latest event	Reset encoder counter	Reserved					0 (Expansion access disabled)
		+1	Clear the latest error	Reserved						
pdout 0	DWORD	+0	Process output data Channel 0 (4 bytes)							
		+1								
		+2								
		+3								
pdout 1	DWORD	+0	Process output data Channel 1 (4 bytes)							
		+1								
		+2								
		+3								
…		…	…							
pdout E	DWORD	+0	Process output data Channel E (4 bytes)							
		+1								
		+2								
		+3								
pdout F	DWORD	+0	Process output data Channel F (4 bytes)							
		+1								
		+2								
		+3								

*1: The data name mapped to the aforementioned PDO is enclosed in < > in the explanation that follows.

(During Normal Assignment) Content of Each Assigned Data

Digital input/digital output (SIO mode), and product status/operation flags

• Input from this product to the EtherCAT Master

Assignment	Category	Data name	Description	Address of PDO entry
Input cyclic communication area for EtherCAT Master	Digital input in SIO mode	Digital input (Channels 0 to 7 / 8 to F)	Digital input data in SIO mode (PNP input or NPN input). In IO-Link mode, the least-significant value of the bit data defined in process input data format is reflected (note, this function does not exist on the process output data side).	Bits 0 to 7 / 8 to 15 of <Input bit>
	This product status	Channel with the latest event	Channel number of the latest generated event. When accessing the "Event data read by channel" through SDO communication, specify the channel based on this value.	Bits 0 to 3 of <Status bit>
		Output overcurrent flag	This flag turns to 1 (ON), when overcurrent is generated in SIO (output).	Bit 5 of <Status bit>
		I/O power supply flag	This flag turns to 1 (ON), when power is supplied from the I/O power supply.	Bit 6 of <Status bit>
		Event flag	This flag turns to 1 (ON), when an event is occurring in one of the connected IO-Link devices. When this flag is 1 (on), access the "Event data read by channel" data through SDO communication. For "Latest event data read by channel", refer to “Appendix-1-2 Data for Access from PLC”.	Bit 7 of <Status bit>
		Channel with the latest error	Channel number of the latest generated error. When accessing the "Latest error code read by channel" through SDO communication, specify the channel based on this value.	Bits 8 to 11 of <Status bit>
		Synchronization establishment flag	Turns to 1 (ON) when I/O synchronization (master setting menu number: M21) is set to any of 2/3/4/5/6 (0.4 ms/0.8 ms/1.6 ms/3.2 ms/6.4 ms cycle), while the internal timer in this product is synchronized (within ±20 µs) with the network time.	Bit 13 of <Status bit>
		IO-Link ready flag	When communication is established with all IO-Link devices and cyclic communication with the EtherCAT Master, if this flag is at 1 (ON), execute read and write with the IO-Link devices through cyclic or SDO communication. Note: This flag will be set to 1 (ON) even when not all channels' I/O setting assignments are in IO-Link mode.	Bit 14 of <Status bit>
		Error flag	This flag turns to 1 (ON) when an error is generated in this product. When this flag is 1 (on), access the "Latest error code read by channel" through SDO communication. For "Latest error code read by channel" data, refer to “Appendix-1-2 Data for Access from PLC.”	Bit 15 of <Status bit>

• Output from EtherCAT Master to this product

Assignment	Category	Data name	Description	Address of PDO entry
Output cyclic communication area for EtherCAT Master	Digital output in SIO mode	Digital output (Channels 0 to 7 / 8 to F)	Digital output data in SIO mode (PNP output or NPN output).	Bits 0 to 7 / 8 to 15 of <Output bit>
	Unit operation flag	Extended access enable flag	Specify extended access disabled (normal) assignment as the assignment method for the cyclic communication area. 0 (OFF): Extended access disabled	Bit 0 of <Control bit>
		Reset encoder counter	For SIO device as encoder, when rising from 0 (OFF) to 1 (ON), reset the fastest counter in this product.	Bit 6 of <Control bit>
		Clear the latest event	When rising from 0 (OFF) to 1 (ON), clear the latest event.	Bit 7 of <Control bit>
		Clear the latest error	When rising from 0 (OFF) to 1 (ON), clear the latest error.	Bit 15 of <Control bit>

Process data

• Input from this product to the EtherCAT Master

Type and direction	Assignment	Data name	Description	Address of PDO entry
Input from IO-Link devices	Input cyclic communication area for EtherCAT Master	Process input data Channels 0 to F	Process input data in IO-Link communication mode. If the master parameter “M40. Process input data words allocation” is the default value, 4 bytes are assigned to applicable channel. • 00000000 h is kept in the corresponding channel's <pdin> if the channel is not in use (without assigning the next used channel). • If the process input data for the IO-Link device connected to the channel is less than 4 bytes, then 00 h is stored in the open byte at the topmost address within the 4 bytes. • The following process input data names won't match the channel number and will be assigned in a different way if the master setting value "M40. Process input data words allocation" is not the initial value for any channel.	<pdin 0> to <pdin F>

• Output from EtherCAT Master to this product

Type and direction	Assignment	Data name	Description	Address of PDO entry
Output to IO-Link devices	Output cyclic communication area for EtherCAT Master	Process output data Channels 0 to F	Process output data in IO-Link communication mode. If the master parameter “M41. Process output data words allocation” is the default value, 4 bytes are assigned to applicable channel. • 00000000 h is kept in the corresponding channel's <pdout> if the channel is not in use (without assigning the next used channel). • If the process output data for the IO-Link device connected to the channel is less than 4 bytes, then the open byte at the topmost address within the 4 bytes is not sent to the IO-Link device. • If the process output data for the IO-Link device connected to the channel exceeds 4 bytes, then all the data for the excessive part is sent to the IO-Link device as 00 h. • The following process output data names won't match the channel number and will be assigned in a different way if the master setting value "M41. Process output data words allocation" is not the initial value for any channel.	<pdout 0> to <pdout F>

In this product, the process data for the IO-Link device is converted into little endian format at the default value. The "M43 Process data LSB" master parameter can be used to change this to big-endian format for each channel.

3-3-5 Extended Access Enabled Assignment

When “Extended access enable flag” (bit 0 of <Control bit>) is set to 1 (ON: Extended access enabled), the master cyclic communication area is as shown below.
The area in yellow below is data only when extended access is enabled.

Transmit PDO Mapping Input (this product → EtherCAT Master)

Data name (= object name)*1	Data type	Offset (bytes)	Bit 7	6	5	4	3	2	1	0
Input bit	WORD	+0	Digital input (Channels 0 to 7: Corresponds to bit 0 to 7)							
		+1	Digital input (Channels 8 to F: Corresponds to bit 8 to F)							
Status bit	WORD	+0	Event flag	I/O power supply flag	Output overcurrent flag	Access completed	Channel with the latest event			
		+1	Error flag	IO-Link ready flag	Synchronization establishment flag	Access error	Channel with the latest error			
pdin 0	DWORD	+0	Process input data Channel 0 (4 bytes)							
		+1								
		+2								
		+3								
pdin 1	DWORD	+0	Process input data Channel 1 (4 bytes)							
		+1								
		+2								
		+3								
		…	…							
pdin E	DWORD	+0	Process input data Channel E (4 bytes)							
		+1								
		+2								
		+3								
pdin F	DWORD	+0	Extended access read data (4 bytes)							
		+1								
		+2								
		+3								

*1: The data name mapped to the aforementioned PDO is enclosed in < > in the explanation that follows.

Receive PDO Mapping Output (EtherCAT Master → this product)

Data name (= object name)*1	Data type	Offset (bytes)	Bit 7	6	5	4	3	2	1	0
Output bit	WORD	+0	Digital output (Channels 0 to 7: Corresponds to bit 0 to 7)							
		+1	Digital output (Channels 8 to F: Corresponds to bit 8 to F)							
Control bit	WORD	+0	Clear the latest event	Reset encoder counter	Reserved			Write request	Read request	1 (Extended access enabled)
		+1	Clear the latest error	Reserved	Little endian flag	UR-ES16 DT unit flag	Channel No. of IO-Link to access (0 to F)			

Data name (= object name)*1	Data type	Offset (bytes)	Bit							
			7	6	5	4	3	2	1	0
pdout 0	DWORD	+0	Process output data Channel 0 (4 bytes)							
		+1								
		+2								
		+3								
pdout 1	DWORD	+0	Process output data Channel 1 (4 bytes)							
		+1								
		+2								
		+3								
		…	…							
pdout D	DWORD	+0	Process output data Channel D (4 bytes)							
		+1								
		+2								
		+3								
pdout E	DWORD	+0	Index number or setting value number specification							
		+1								
		+0	(Index number or setting menu number (lower byte))							
		+1	Unit No. of sensor unit connected to UC2-IOL							
		+2	Subindex number or target number							
		+3	Reserved						Byte length or target selection to access	
pdout F	DWORD	+0	Extended access write data (4 bytes)							
		+1								
		+2								
		+3								

*1: The data name mapped to the aforementioned PDO is enclosed in < > in the explanation that follows.

Assignment Data Details (when extended access is enabled)

Digital input/digital output (SIO mode), and product status/operation flags

• Input from this product to the EtherCAT Master

Assignment	Category	Data name	Description	Address of PDO entry
Input cyclic communication area for EtherCAT Master	Digital input in SIO mode	Digital input (Channels 0 to 7 / 8 to F)	Digital input data in SIO mode (PNP input or NPN input). In IO-Link mode, the least-significant value of the bit data defined in process input data format is reflected. (This function does not exist on the process output data side.)	Bits 0 to 7 / 8 to 15 of <Input bit>
	This product status	Channel with the latest event	Channel number of the latest generated event. When accessing the "Event data read by channel" through SDO communication, specify the channel based on this value.	Bits 0 to 3 of <Status bit>
		Access completed (Extended access enabled assignment only)	Turns ON when reading/writing has completed. If the read/write request bit turns OFF, this bit will turn OFF also.	Bit 4 of <Status bit>
		Output overcurrent flag	This flag turns to 1 (ON) when overcurrent is generated in SIO (output).	Bit 5 of <Status bit>
		I/O power supply flag	This flag turns to 1 (ON) when power is supplied from the I/O power supply.	Bit 6 of <Status bit>

Assignment	Category	Data name	Description	Address of PDO entry
Input cyclic communication area for EtherCAT Master	This product status	Event flag	This flag turns to 1 (ON) when an event is occurring in one of the connected IO-Link devices. When this flag is 1 (ON), access the "Event data read by channel" data through SDO communication. For "Latest event data read by channel", refer to “Appendix-1-2 Data for Access from PLC.”	Bit 7 of <Status bit>
		Channel with the latest error	Channel number of the latest generated error. When accessing the "Latest error code read by channel" through SDO communication, specify the channel based on this value.	Bits 8 to 11 of <Status bit>
		Access error (Extended access enabled assignment only)	If an error occurs when requesting reading/ writing, this turns on along with the access completed bit.	Bit 12 of <Status bit>
		Synchronization establishment flag	If the I/O synchronization (master setting menu number: M21) is set to any of 2/3/4/5/6 (0.4 ms/0.8 ms/1.6 ms/3.2 ms/ 6.4 ms cycle), it will be 1 (ON) while the built-in timer of this product is synchronizing with the network time (within ±20 µs).	Bit 13 of <Status bit>
		IO-Link ready flag	When communication is established with all IO-Link devices and cyclic communication with the EtherCAT Master, if this flag is at 1 (ON), execute read and write with the IO-Link devices through cyclic or SDO communication. Note: This flag will be set to 1 (ON) even when not all channels' I/O setting assignments are in IO-Link mode.	Bit 14 of <Status bit>
		Error flag	This flag turns to 1 (ON) when an error is generated in this product. When this flag is 1 (ON), access the "Latest error code read by channel" through SDO communication. For the "Latest error code read by channel" data, refer to "Appendix-1-2 Data for Access from PLC".	Bit 15 of <Status bit>

• Output from EtherCAT Master to this product

Assignment	Category	Data name	Description	Address of PDO entry
Output cyclic communication area for EtherCAT Master	Digital output in SIO mode	Digital output (Channels 0 to 7 / 8 to F)	Digital output data in SIO mode (PNP output or NPN output).	Bits 0 to 7 / 8 to 15 of <Output bit>
	Unit operation flag	Extended access enable flag	Specify extended access enabled assignment as the assignment method for the cyclic communication area. 1 (ON): Extended access enabled	Bit 0 of <Control bit>
		Read request (Extended access enabled assignment only)	With this bit rising, the specified data read is started.	Bit 1 of <Control bit>
		Write request (Extended access enabled assignment only)	With this bit rising, the specified data write is started.	Bit 2 of <Control bit>
		Reset encoder counter	For SIO device as encoder, when rising from 0 (OFF) to 1 (ON), reset the fastest counter in this product.	Bit 6 of <Control bit>
		Clear the latest event	When rising from 0 (OFF) to 1 (ON), clear the latest event.	Bit 7 of <Control bit>
		Channel No. of IO-Link to access (0 to F) (Extended access enabled assignment only)	If UR-ES16DT parameters is set to 0 (OFF), specify the IO-Link device channel number to access.	Bits 8 to 11 of <Control bit>
		To access UR-ES16DT parameters (Extended access enabled assignment only)	Specifies whether to set the extended access destination to this product, or to the IO-Link device (including sensor units connected to UC2-IOL). 1 (ON): Specifies access to the product master parameters. Note: Master parameter data of this product will be read and written in little-endian format (fixed). 0 (OFF): Specify to access service data in the IO-Link device, or access "specific data" from a sensor unit connected to UC2-IOL.	Bit 12 of <Control bit>
		Little endian flag (Extended access enabled assignment only)	Specify the byte unit order for "Extended access read data" or "Extended access write data". 1 (ON): Read and write service data (parameters, etc.) in the IO-Link device in little endian format. Set to 1 (ON) when reading and writing general service data in the IO-Link device. 0 (OFF): Read and write service data (parameters, etc.) in the IO-Link device in big endian format.	Bit 13 of <Control bit>
		Clear the latest error	When rising from 0 (OFF) to 1 (ON), clear the latest error.	Bit 15 of <Control bit>

Process data / Extended access-related data

• Input from this product to the EtherCAT Master

Assignment	Category	Data name	Description	Address of PDO entry
Input cyclic communication area for EtherCAT Master	Input from IO-Link devices	Process input data Channel 0 to E	Process input data in IO-Link communication mode. Channels 0 to E are given 4 bytes if the master setting value "M40. Process input data words allocation" is the initial value (channel F is not assigned). • 00000000 h is kept in the corresponding channel's <pdin> if the channel is not in use (without assigning the next used channel). • If the process output data for the IO-Link device connected to the channel is less than 4 bytes, then 00 h is stored in the open byte at the topmost address within the 4 bytes. • The following process input data names won't match the channel number and will be assigned in a different way if the master setting value "M40. Process input data words allocation" is not the initial value for any channel.	<pdin 0> to <pdin E>
	Extended access read data		The value read during extended access. 4 bytes. If "Little endian access" is set to 1 (ON), the byte address +500 will be the lowest-order byte. • Upon a read request, the data read from the target (this product, the IO-Link device, or the target sensor unit connected to UC2-IOL) is stored. • For a write request, a value of 0 will be stored when the operation is complete. • If there is an access error the extended access error code will be stored. For details on extended access error codes, refer to “Extended access error code list”.	<pdin F>

• Output from EtherCAT Master to this product

Assignment	Category	Data name	Description	Address of PDO entry
Output cyclic communication area for EtherCAT Master	Output to IO-Link devices	Process Output Data Channel 0 to D	Process output data in IO-Link communication mode. If the master parameter “M41. Process output data words allocation” is the default value, 4 bytes are assigned to each channel for 0 to D. • 00000000 h is kept in the corresponding channel's <pdout> if the channel is not in use (without assigning the next used channel). • If the process output for the channel is less than 4 bytes, then the open byte at the topmost address within the 4 bytes is not sent to the IO-Link device. • If the process output for the channel exceeds 4 bytes, then all the data for the excessive part is sent to the IO-Link device as 00 h. • The following process output data names won't match the channel number and will be assigned in a different way if the master setting value "M41. Process output data words allocation" is not the initial value for any channel.	<pdout 0> to <pdout D>
	Extended access specified data	Index number or setting value number specification	When byte length or target selection to access is 1 to 4 (read and write of 1 to 4 byte data), the sub-index number for service data in the corresponding IO-Link device (setting value, etc.) and the master setting menu number of the product master parameter are specified.	Bits 0 to 15 of <pdout E>
		Unit No. of sensor unit connected to UC2-IOL	If "Byte length or target selection to access" is set to 0 (UC2-IOL mode), specify the connection order as 0 through F, beginning from the left edge of the target sensor unit interconnected with OPTEX FA IO-Link gateway UC2-IOL.	Bits 8 to 15 of <pdout E>
		Sub-index number or target number flag	When byte length or target selection to access is 1 to 4 (read and write of 1 to 4 byte data), the sub-index number for service data in the corresponding IO-Link device (setting value, etc.) and the target number of the product master parameter are specified.	Bits 16 to 23 of <pdout E>
		Byte length or target selection to access	Specifies the read and write target to be set to a target sensor unit interconnected with the OPTEX FA IO-Link gateway UC2-IOL, to an IO-Link device connected to a given channel, or to the product master parameters (in such case, the data size for read and write is also specified at the same time). 0: Read and write target is the "specific data" of a target sensor unit interconnected with UC2-IOL (2-byte data) 1 to 4: Read and write of 1 to 4 byte data (the read and write target is the connected IO-Link device or the product master parameters)	Bits 24 to 26 of <pdout E>
	Extended access write data		Specify the setting value to write via extended access. 4 bytes. Value at time of write request is sent to the target (the target sensor unit interconnected with this product, an IO-Link device, or UC2-IOL). If "Little endian access" is set to 1 (ON), the byte address +64 will be the lowest-order byte.	Bits 0 to 31 of <pdout F>

In this product, the process data for the IO-Link device is converted into little endian format at the default value. The "M43. Process data LSB/MSB" master parameter can be used to change this to big-endian format for each channel.

Extended access error code list

The following error codes are stored in the front byte (bits 0 to 7 of <pdin F>) of the extended access read data when an access error occurs during extended access.

Error code	Details
11 h	The specified index number does not exist in the IO-Link device for which reading was attempted.
23 h	Failed to write setting value (attempted to write a read-only setting value).
30 h	Outside the range of setting value write data.
33 h	The setting value data for which writing was attempted is too long.
34 h	The read setting value data length is 0 (read error).
80 h	The channel number to be accessed is out of range.
81 h	The IO-Link device for which setting value writing was attempted is not connected.
82 h	The IO-Link device for which setting value writing was attempted does not support ISDU communication.
90 h	IODD installation data format error.
91 h	IODD installation checksum error.
92 h	IODD installation address error.
93 h	IODD installation address discontinuous error.
94 h	Cannot be executed when the storage function is BUSY.

3-3-6 Assignment methods other than process data default value

- Both process input and output data are blocks of 32 words (64 bytes) each.
  When the master setting "M40. Process input data words allocation" is set to the default value of 2 words (4 bytes) for all channels, the channel number "N" is represented by "N" in the <pdin N> array.
  The relationship between "N" and the channel number will not match if the set value is different from the initial value (increased or decreased).
  When the master setting "M41. Process output data words allocation" is set to the default value of 2 words (4 bytes) for all channels, the channel number "N" is represented by "N" in the <pdout N> array.
  The relationship between "N" and the channel number will not match if the setting value differs from the initial value (increased or decreased).
- The following procedure will be followed if the set value of "M40. Process input data words allocation" or "M41. Process output data words allocation (for each channel)" of the master setting value is different from the initial value.
  - If the above setting value for channel number N exceeds the initial value of 2 words (4 bytes), it occupies <pdin N+1 to> or <pdout N+1 to> after channel number N+1 (Example: If a byte is larger than 8 bytes, it can take up to N+2 bytes).
  - If the above setting value for channel number N is smaller than the initial value of 2 words (4 bytes), <pdin N+1 to> or <pdout N+1 to> after the next channel number N+1 will be assigned in a shortened manner.
  - The data for the following channel number won't be assigned, even if a particular channel number is empty. The above settings are enabled even in unused channels.

Note: Open regions in used channels will be high-order byte side unrelated to the “M43 Process data LSB/MSB” settings.

3-3-7 Example of Process Data Words Assignment

When an IO-Link device is connected to this product, the example below demonstrates automatic assignment to this product and assignment to the EtherCAT Master (up to channel A for simplification).

This product channel number	Sample size of IO-Link device process data		This product auto assignment results		EtherCAT Master	
	Process input data byte count	Process output data byte count	Process input data words	Process output data words	PDO input	PDO output
0	2	0	1	0	Bits 0 to 15 of <pdin 0>	-
1	0	2	0	1	-	Bits 0 to 15 of <pdout 0>
2	Not used		0	0		
3	4	4	2	2	Bits 16 to 31 of <pdin 0> Bits 0 to 15 of <pdin 1>	Bits 16 to 31 of <pdout 0> Bits 0 to 15 of <pdout 1>
4	3	0	2	0	Bits 16 to 31 of <pdin 1> Bits 0 to 15 of <pdin 2>	-
5	16	0	8	0	Bits 16 to 31 of <pdin 2> Bits 0 to 31 of <pdin 3> Bits 0 to 31 of <pdin 4> Bits 0 to 31 of <pdin 5> Bits 0 to 15 of <pdin 6>	-
6	0	1	0	1	-	Bits 16 to 31 of <pdout 1>
7	4	0	2	0	Bits 16 to 31 of <pdin 6> Bits 0 to 15 of <pdin 7>	-
8	0	4	0	2	-	Bits 0 to 31 of <pdout 2>

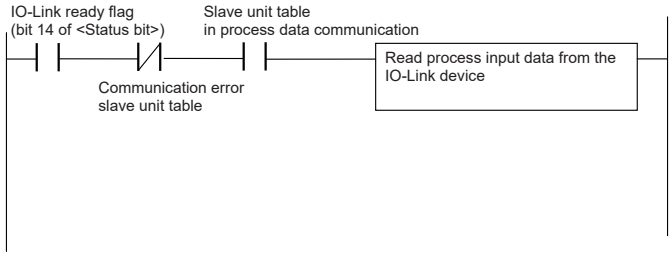
This product channel number	Sample size of IO-Link device process data		This product auto assignment results		EtherCAT Master	
	Process input data byte count	Process output data byte count	Process input data words	Process output data words	PDO input	PDO output
9	8	8	4	4	Bits 16 to 31 of <pdin 7> Bits 0 to 31 of <pdin 8> Bits 0 to 15 of <pdin 9>	Bits 0 to 31 of <pdout 3> Bits 0 to 31 of <pdout 4>
A	4	4	2	2	Bits 16 to 31 of <pdin 9> Bits 0 to 15 of <pdin A>	Bits 0 to 31 of <pdout 5>

CAUTION

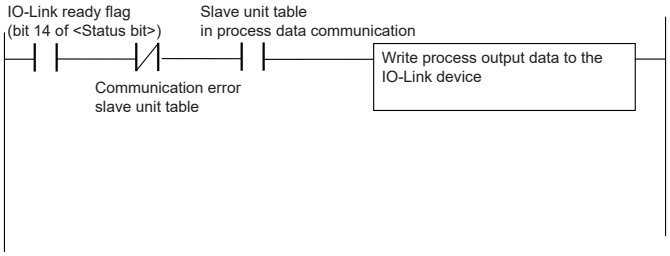
- When either input or output exceeds a total of 32 words (64 bytes), the process data exceeding the total will not be assigned to the EtherCAT Master (it will be ignored).
  To connect a maximum of 16 IO-Link devices to this product, the following conditions are required.
  Product process data size with the connected IO-Link device group:
  Input: Total of 32 words (64 bytes) over all channels
  Output: Total of 32 words (64 bytes) over all channels

3-3-8 Process data reading and writing methods

When the process data communication status (*1) between the EtherCAT Master and this product is normal and the IO-Link ready flag is ON, read the process data.
*1: Depends on the flag on the EtherCAT Master side (example: communication error slave unit table, slave unit table in process data communication).
Ex.) When reading process input data from any of the channel IO-Link devices
Reading takes place with the communication error slave unit table OFF, the bit (bit 14 of <Status bit>) corresponding to this product's node address in the process data communication slave unit table ON, and the bit to which the IO-Link ready flag is assigned ON as input requirements.



When the process data communication status (*1) between the EtherCAT Master and this product is normal and the IO-Link ready flag is ON, write the process data.
*1: Depends on the flag on the EtherCAT Master side (example: communication error slave unit table, slave unit table in process data communication).
Ex.: Writing process output data to an IO-Link device on a given channel
Writing takes place with the communication error slave unit table OFF, the bit (bit 14 of <Status bit>) corresponding to this product's node address in the process data communication slave unit table ON, and the bit to which the IO-Link ready flag is assigned ON as input requirements.
Because there is a communication abnormality when the IO-Link Ready flag is 0 (OFF), handle data transfer destinations suitably.



CAUTION
While the IO-Link Ready flag is set to 1 (ON), perform read and write of process data.

3-3-9 Assignment data list by objective with extended access enabled

Assigned data / PDO entry's address / When this happens	Extended access	Byte length or target selection to access	Channel No. of IO-Link to access	Little-endian access	To access UR-ES16DT parameters	Index number or master setting menu number	Sub-index number or target number	Connection in order from left edge of target sensor unit	Write	Read	Read and write size specification
	Bit 0 of <Control bit>	Bit of <pdout F> 24 to 26	Bit of <Control bit> 8 to 11	Bit 13 of <Control bit>	Bit 12 of <Control bit>	Bit of <pdout E> 0 to 15	Bits 16 to 23 of <pdout E>	Bit of <pdout E> 8 to 15	Bit 2 of <Control bit>	Bit 1 of <Control bit>	Depends on byte length or target selection to access
When using cyclic data to perform read and write of the product master parameters	1 (ON)	1 to 4 (Specify the byte count)	Unrelated	Irrelevant (little endian fixed)	1 (ON)	IO-Link device setting or product master parameter setting menu number	Master parameter target channel	Unrelated	1 (ON) or 0 (OFF) flag		Depends on byte length or target selection to access (1 to 4 bytes)
When specifying index/sub-index within a specified IO-Link device, for cyclic reading and writing of data		1 to 4	Specification	1 (ON): Little endian format	0 (OFF)	Index number	Sub-index number	Unrelated			Depends on byte length or target selection to access (1 to 4 bytes)
When cyclically reading and writing “specific data” in a target sensor unit interconnected with UC2-IOL		0				Setting menu number of sensor unit (at bits 0 to 7)	Unrelated	Specification			No designation (2-byte fixed)

MEMO
An example of the "specific data" in sensor units connected to UC2-IOL, as an extended access target, is below (as of April 2022).

- For Digital Fiber Amplifier D3RF Series
  Index number 110 (6E h): Lower threshold (Far) setting for output 1
- For White Light LED Digital Fiber Amplifier D3WF Series
  Index number 110 (6E h): Lower threshold (Far) setting for output 1
- For CDA Series displacement sensor-amplifier unit
  When the connected sensor is CD22 or TD1, set 108 (6Ch): near threshold and 109 (6Dh): far threshold

MEMO

When the target selection to access is set to a sensor unit interconnected with UC2-IOL, the user must grasp to which channel UC2-IOL is connected, and which sensor unit is interconnected at which position.

3-3-10 Actual access extension methods

Please read and write the specific address that is specifically targeted in extended access when the IO-Link Ready flag is set to 1 (ON) and the process data communication status between the EtherCAT Master and this machine is normal.

When Using Extended Access to Write to the IO-Link Device Service Data

- Extended access (<Control bit> bit 0) = 1 (ON).
- Specify the target channel by specifying channel No. of IO-Link to access (bits 8 to 11 of <Control bit>).
- Both the index number (bits 0 to 15 of <pdout E>) and the sub-index number (bits 16 to 23 of <pdout E>) specify the index number.
- Designate the target IO-Link device service data in little endian format, and set the little endian access (bit 13 of <Control bit>) to 1 (ON).
- Set the data to be written in the extended access write data (bits 0 to 31 of <pdout F>). When setting little endian flag (bit 13 of <Control bit>) to 1 (ON) as above, write data will be stored in little endian format. The lowest order bytes in <pdout F> are bits 0 to 7, and the highest order bytes are bits 24 to 31.
- Enter 1 to 4 bytes in the byte length or target selection to access to be written (bits 24 to 26 of <pdout E>).
- The write request bit (Control bit> bit 2) is raised from 0 (OFF) to 1 during writing (ON).
- With access complete = 1 (ON), write is completed. However, when access error = 1 (ON) at the same time, an error has occurred. Check the extended access read data (bit 0 to 7 of <pdin F>) error code list.

When Extended Access is Used to Write to the Target Sensor Unit Interconnected with OPTEX FA IO-Link Gateway UC2-IOL

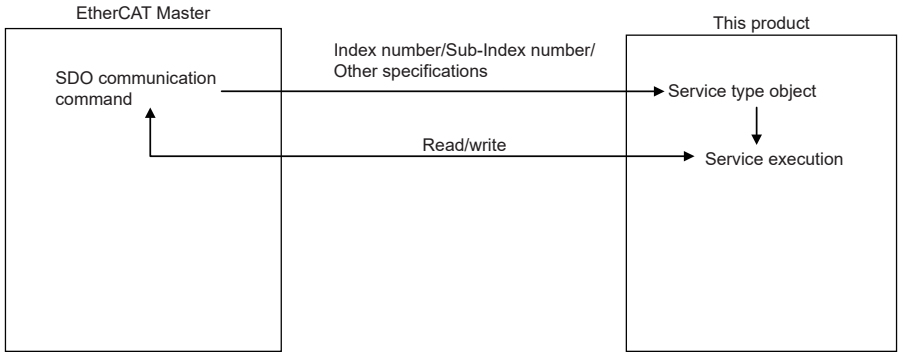
- Extended access (<Control bit> bit 0) = 1 (ON).
- Set the channel No. of IO-Link to access to the channel to which the UC2-IOL is connected to the apparatus (bits 8 to 11 of <Control bit>).
- Designate the connection order of target sensor units connected to UC2-IOL from the left end, using target sensor unit flag (bits 8 to 15 of <pdout E>). For example, if the left edge module is specified, store 0.
  Note: The target "specified data" within the target sensor unit includes, if the sensor unit is, for example, the Digital Fiber Amplifier D3RF Series, the index number 110 (6E h) output 1 lower threshold (Far) setting, etc.
- Set the data to be written in the extended access write data (bits 0 to 31 of <pdout F>). If converting as below to little endian format, the write data is stored in the little endian format. The lowest order bytes in <pdout F> are bits 0 to 7, and the highest order bytes are bits 24 to 31.
- UC2-IOL data is in big endian format, so when converting to little endian format, set the little endian access (bit 13 of <Control bit>) to 1 (ON).
- Store "0" and designate UC2-IOL as the read/write target with the byte length or target selection to access (bits 24 to 26 of <pdout E>).
- Raise the write request bit (bit 2 of <Control bit>) from 0 (OFF) to 1 when writing (ON)

When Using Extended Access to Write to the Product Master Parameters

- Extended access (<Control bit> bit 0) = 1 (ON).
- By specifying the UR-ES16DT main unit (bit 12 of <Control bit>), the master setting value can be specified for this product.
- Specify the master setting menu number with the master setting menu number (bits 0 to 15 of <pdout E>), and specify the target number with the target channel (bits 8 to 11 of <control bit>).
- Set the data to be written in the extended access write data (bits 0 to 31 of <pdout F>). Store write data in little endian format. The lowest order bytes in <pdout F> are bits 0 to 7, and the highest order bytes are bits 24 to 31.
- Specify the number of bytes to be written in the byte length or target selection to access (bits 24 to 26 of <pdout E>).
- The write request bit (Control bit> bit 2) is raised from 0 (OFF) to 1 during writing (ON).
- With access complete = 1 (ON), write is completed. However, if at the same time there is access error=1 (ON), as this means that an error has occurred, please check the extended access read data error code.

3-4 SDO (Mailbox) Communication

Reading/writing are carried out for the service type object that this product has instead of the typical parameter type object during SDO (mailbox) communication from the EtherCAT Master to this product.



3-4-1 Service Type and Index Number of the Service Type Object

When necessary, it's possible to read and write the master setting of this product or the service data of the connected IO-Link device by reading and writing the index number of the next service type object from the SDO communication command of the EtherCAT Master.

Service type	Index number	Service details
Reading and writing master setting values in this product	2400 h to 25FF h	Reads the master set values in this product.
	3400 h to 35FF h	Writes the master set values in this product.
Reading and writing service data of the IO-Link device	3300 h	The first index number for offset should be written to this product in advance when reading the service data of the IO-Link device. Note: It is necessary if the target index number of the connected IO-Link device exceeds 00 h to FF h.
	5000 h to 5FFF h	Reads out the service data of the connection IO-Link device.
	3800 h to 380F h or 3810 h to 381F h	Writes the service data of the connected IO-Link device. • 3800 h to 380F h: When handling IO-Link device data converted to little endian format • 3810 h to 381F h: When handling IO-Link device data directly as big endian

3-4-2 How SDO Communication Reads and Writes

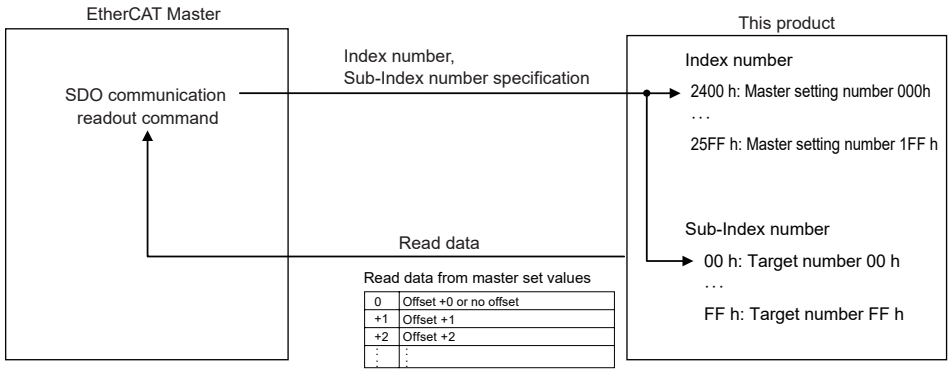
The master setting value in this product and the connected IO-Link device's service data are read and written to using different mechanisms.

Reading and Writing Master Setting Values in this Product

Based on the target master setting value number, directly specify the corresponding index number for the master setting menu number for this product.

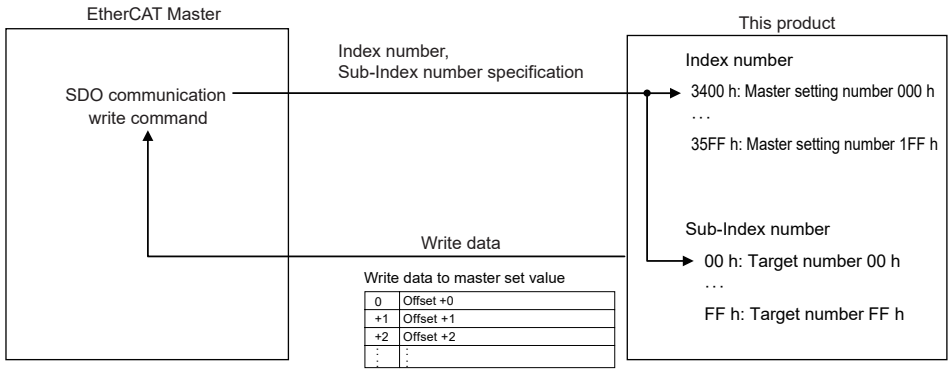
Reading master set values in this product

Set the Sub-Index number to the target number and the Index number to 2400 h + master setting menu number.



Writing Master Set Values in this Product

Set the Sub-Index number to the target number and the Index number to 3400 h + master setting menu number.



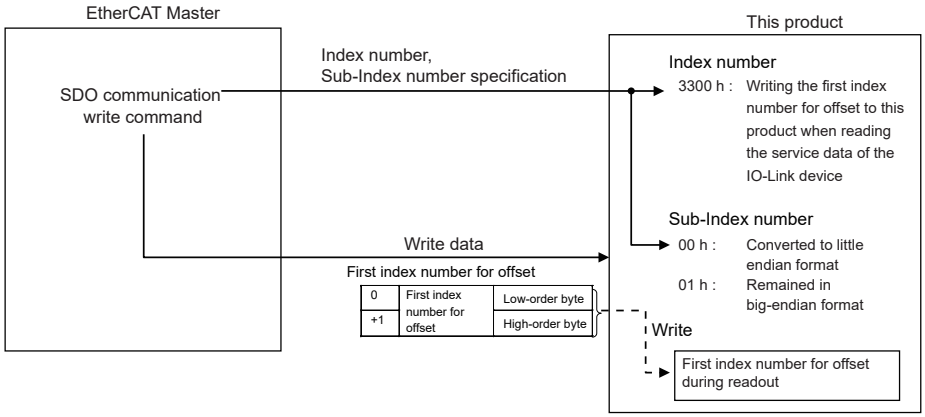
Reading and Writing Service Data of the IO-Link Device

When reading from and writing to the connected IO-Link device, the service data is accessed in different ways.

- The target index number of the service data should be specified by specifying the offset value to be added to it when actually reading. This product should be written with the index number for starting point (first index number for offset) in advance.
- Directly specify the service data's target index number along with the write data when writing.

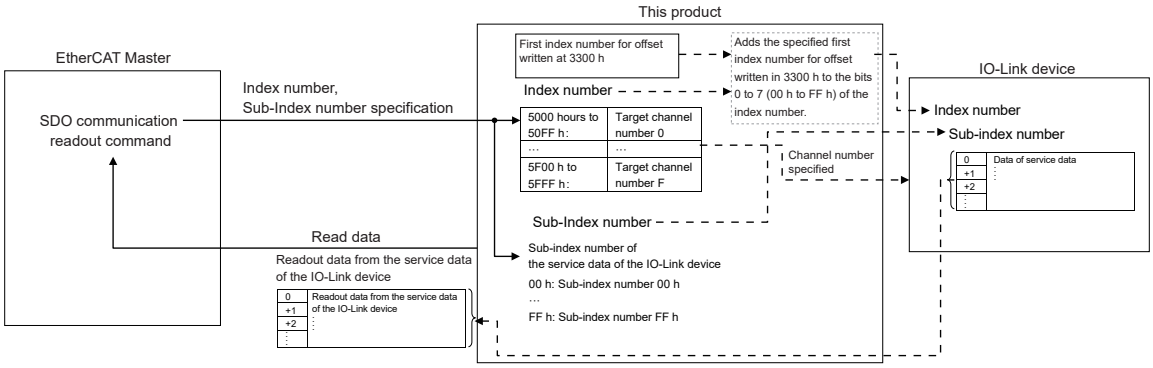
Pre-specifying (writing) the first index number for offset to this product when reading the service data of the IO-Link device

Write down the index number for starting point (first index number for offset) at 3300 h before actual reading.
When reading, specify the Sub-Index number using the endian format.



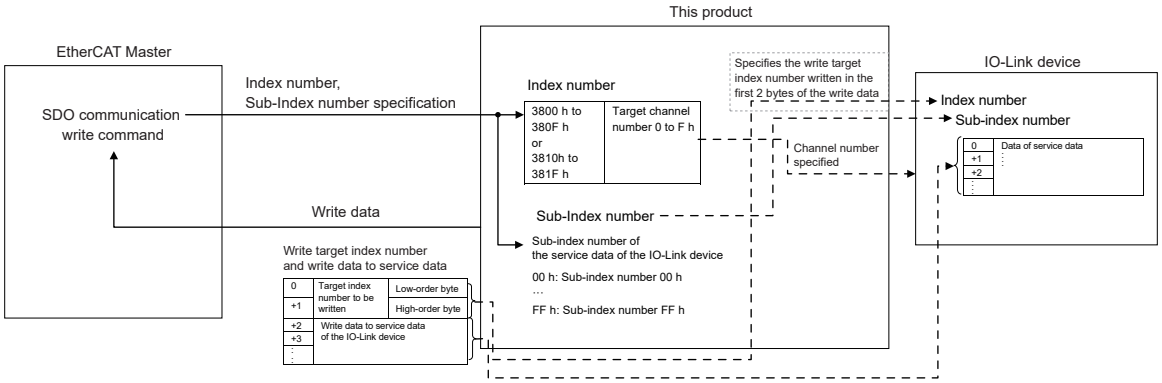
Reading the service data of the IO-Link device

Specify the index number in accordance with the IO-Link device's offset (addition) value and channel number.
Specify the Sub-Index number in accordance with the service data's index number.
As the index number for the service data, add the offset (addition) value to the first index number for the offset written in advance with 3300 h.



IO-Link Device Service Data Writing

Specify the Index number in accordance with the IO-Link device's channel number and endian format.
Specify the Sub-Index number in accordance with the service data's index number.
Both the write data itself and the write data's corresponding index number are written.



For details of each index number of the service type object, refer to "Appendix-2-4 List of Service Type Objects for Acyclic Communication".
Also, refer to "Appendix-3 Method of Communicating with Each Company's EtherCAT Master" for an example of reading and writing with the SDO communication command of the actual EtherCAT Master.

3-5 Examples of Specific Communication

3-5-1 Example of Cyclic Communication

Below is an example of combining IO-Link communication and SIO for cyclic communication.

Example Combining IO-Link Communication and SIO

Process input data (4 bytes) from the channel 0 IO-Link device is read from the lower direction (default value).
Process output data (4 bytes) to the channel 1 IO-Link device is written from the upper direction.
Reads bit input data from the channel 2 SIO device (NPN type presence sensor).

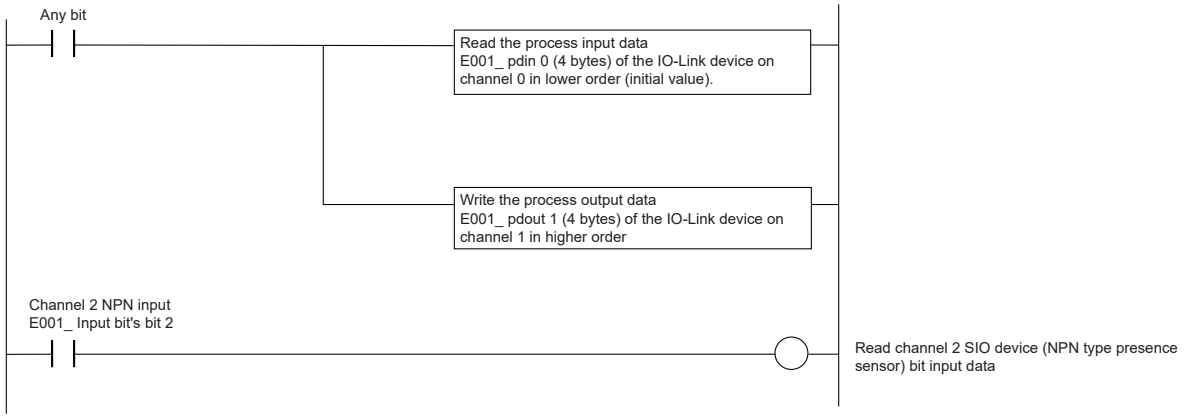
Settings on the EtherCAT Master side
Examples:

Data	Size	PDO data	→	Variable
Process input data of IO-Link device on channel 0	4 bytes (2 words)	<pdin 0>		E001_ pdin 0
Process output data of IO-Link device on channel 1	4 bytes (2 words)	<pdout 1>		E001_ pdout 1
Bit input data of SIO device on channel 2	1 bits	Bit 2 of <Input bit>		Bit 2 of E001_ Input bit

EtherCAT node address (station number) of this product: Example) 1
Product master settings:

- I/O assignment function setting (master setting menu number: M10):
  Channel 0: IO-Link, channel 1: IO-Link, channel 2: NPN input
- Process data LSB/MSB (master setting menu number: M43):
  Channel 1: Big-endian

EtherCAT Master side program example:



3-5-2 Example of Acyclic Communication

The IO-Link device's service data and the master setting value for this product are read and written using SDO communication in the example below.
For details of services supported by object in this product, refer to "3-4 SDO (Mailbox) Communication".

IO-Link Device Service Data Writing

Ex) The IO-Link compatible compact photoelectric sensor Z4 series connected to channel number 2 should have its index number 128 (80 h) "L-on/D-on switching" set to 0 (the default) to 1 or 2 below with the SDO communication command of the EtherCAT Master.
0: Setting via main body L/D selection knob (default value)
1: L-on (light on)
2: D-on (dark on)

For channel number 2, enter the following information in Index number 3802 h and Sub-Index number 00 h.

Byte	Data	Details
0	Target index number of the service data of the IO-Link device	80 h
+1		00 h
+2	Write data to service data of the IO-Link device	01 h or 02 h

Read of Event Code When Event Occurs

Use the EtherCAT Master's SDO communication command to read the following when the event flag (<Status bit> bit 7 of the process input data) is ON.
- Latest event occurrence channel (bits 0 to 3 of <Status bit> of the process input data) = n
- Master setting menu number 101 h, target number n, offset +0: event flag, offset +1: event #1 type, offset +2 to +3: event code

The following data should be read to Index number 2501 h and Sub-Index number n because the target number is n in order to read the master setting menu number 101 h of this product.

Byte	Data	Details
0	Read data from master set values	Offset +0: Event flag
+1		Offset +1: Event #1 type
+2		Offset +2 to +3: Event code
+3		

Read of Error Code When Error Occurs

Use the EtherCAT Master's SDO communication command to read the following when the error flag (<Status bit> bit 15 of the process input data) is ON.
- Latest error occurrence channel (bits 8 to 11 of <Status bit> of process input data) = n
- Master setting menu number 100 h, target number n, offset +0 to +1 of the master set value of this product: Latest error code of channel n

The following data should be read to Index number 2500 h and Sub-Index number n because the target number is n in order to read the master setting menu number 100 h of this product.

Byte	Data	Details
0	Read data from master set values	Error code lower
+1		Error code upper

4

Specifications

This section describes the specifications of this product.

4-1 Specifications

4-1-1 Communication Specifications

Item		Specifications
Field network communication protocol		EtherCAT*1
Master/slave		EtherCAT Slave
Conforming standard		IEEE802.3u
Transmission speed		100 Mbps (100BASE-TX)
Cable		Twisted pair cable (STP) Category 5, 5e and above
Network topology		Daisy chain configuration, branch wiring configuration, ring type (*1) *1: Possible if the EtherCAT Master is compatible
Supported functions		Process data communication, mailbox communication (CoE supported)
Communication port		2× RJ45 socket
Distance between nodes		Within 100 m
Data communication	Cyclic communication	PDO communication (transmit: 72 byte, receive: 72 byte)
	Acyclic communication	SDO communication
Extended access function		This function uses PDO communication (cyclic communication) to read and write settings for this product and IO-Link devices (including sensor units connected to UC2-IOL). EtherCAT Master side programs can be simplified.
Synchronization mode		Free Run mode (asynchronous) only

*1: EtherCAT is a registered trademark of Beckhoff.

4-2 Data Processing Time

4-2-1 Process data response time calculation

The process data response time from the EtherCAT Master and through IO-Link is indicated as follows.

MEMO

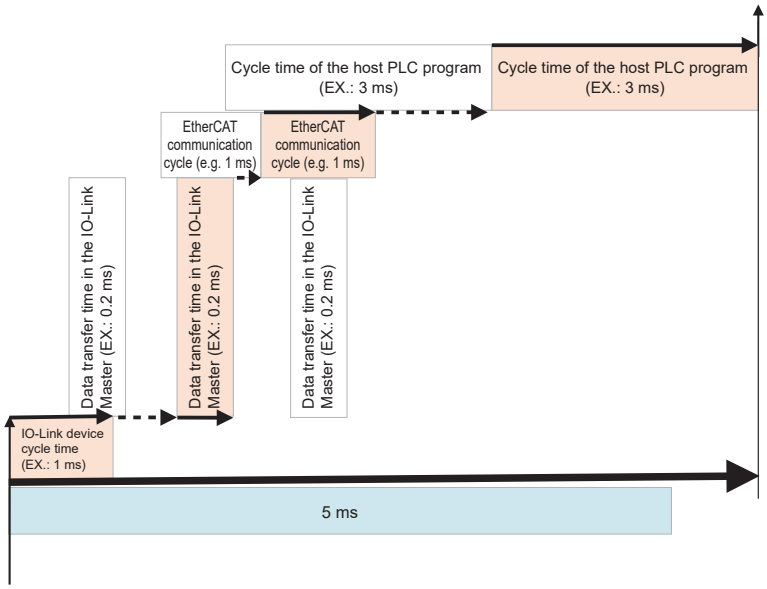
Refer to the EtherCAT Master manual for more information on how to calculate the EtherCAT communication cycle.

When EtherCAT and IO-Link are Not Synchronized

Process input data

(IO-Link cycle time) x 1 to 2 + (EtherCAT communication cycle) x 1 to 2 + (High order PLC program cycle time) x 1 to 2

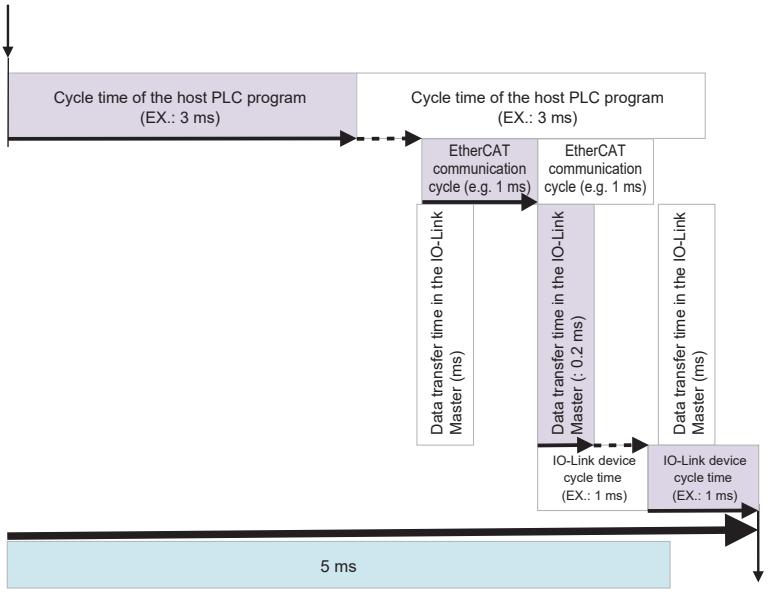
Examples:



Process output data

(High order PLC program cycle time) + (EtherCAT communication cycle) x 1 to 2 + (IO-Link cycle time) x 1 to 2

Examples:



Response Time of IO-Link Communication

The minimum cycle time for IO-Link devices is defined by individual device.

- Minimum cycle time of "0": The fastest cycle time supported by this product will be used.
- Minimum cycle time specified: This product will communicate with the IO-Link device at the specified cycle time.

The actual cycle time of IO-Link communication can be confirmed in the "master parameters (Actual cycle time)" for this product.

Note: This product performs IO-Link communication using hardware logic rather than software, so the fastest time is 0.3 ms.

The cycle time can be specified on this product. This is set in "master parameters M50. Specified cycle time" in this product. However, it cannot be set faster than the minimum cycle time of the IO-Link device.

Example of Cycle Time for IO-Link

Conditions: Process input data bytes: 2, process output data bytes: 0, on-request data bytes: 1
Minimum 0.35 ms: Add the command, checksum and reserve bytes, and then multiply by 0.05 ms.
COM3: 0.4 ms (time under 0.1 ms rounded up)
COM2: 2.4 ms
COM1: 19.2 ms

Synchronization Function Between IO-Link Communication and Digital I/O

For EtherCAT, if the master parameter "M21. I/O synchronization" is set to "Synchronous timer 0.8/1.6/3.2/6.4 ms" in this product, the internal timer of this product will be used to synchronize IO-Link communication or digital I/O transfer between multiple channels set to the same setting value at a cycle of 0.8/1.6/3.2/6.4 ms. (This can also be confirmed in master parameter "Actual cycle time").
However, in order to suppress noise generated by the communication signal. IO-Link communication delays each channel 0.56 µs instead of sending at the exact same time.

Internal Data Transfer Processing Time for This Product

IO-Link device process input data is first rearranged through software in this product, and then transferred to the EtherCAT processing chip.
The processing time depends on the number of process data bytes for the IO-Link devices on all channels. It will be transferred at a speed of approximately 0.1 to 0.4 ms.

4-2-2 I/O response time example

In the following example, the I/O response time is calculated for a system where 16 OPTEX FA Z4 Series miniature photoelectric sensors (IO-Link-compatible) are connected to this product using IO-Link communication.
Note that the minimum cycle time for Z4 Series sensors (IO-Link-compatible) is 0.5 ms.

Conditions: EtherCAT's communication cycle must be set to 1 ms and be functional.
Z4 Series photoelectric sensor process data: Averaged received light level (bit 15 - 1) + output (bit 0) (default value)
The time required for output to pass from the 16 Z4 Series sensors, through this product, into the host PLC, and then to be program processed is as follows.

IO-Link device cycle time 0.5 ms × 1 to 2 + EtherCAT communication cycle 1 ms × 1 to 2 + High order PLC program cycle time 1 ms × 1 to 2 = 4.5 to 9.0 ms

Troubleshooting

Describes methods of troubleshooting related to EtherCAT communication.

5-1 Troubleshooting

5-1-1 Troubleshooting based on LEDs

Front LEDs (on this product)		Details	EtherCAT communication state	Cause	Procedure
SF/RUN/ MS	BF/ERR/ NS				
Lit green	Off	Normal state	OPERATIONAL status	A state where PDO communication, or both PDO and SDO communication, is being executed.	-
Off	Off	Power failure	-	Power is not supplied to this product correctly.	Check the power supply to this product, and restart this product according to the specifications of the connected EtherCAT Master.
Off	Flickering red or steady green	Hardware error	PRE-OPERATIONAL status	A hardware error may have occurred in this product.	If the problem is not resolved even after resetting the power, there is a hardware malfunction. Replace this product.
-	Blinking red	Configuration setting error	INIT status	There is an error in the configuration of the EtherCAT Master.	Change to the correct setting.
-	Red double flash	Application watchdog timeout	-	A communication error has occurred.	Restart this product in accordance with the specifications of the connected EtherCAT Master after examining the condition of this product's power supply and communication cable.
			-	There was a malfunction caused by noise.	Take countermeasures against noise in the communication cable.
-	Lit red	PDI watchdog timeout	INIT status	Timeout occurred in the process communication.	If the problem is not resolved even after resetting the power, there is a hardware malfunction. Replace this product.
Green single flash	-	State transition command from EtherCAT Master	SAFE-OPERATIONAL status	The EtherCAT Master sent out a transition command to the SAFE-OPERATIONAL state.	Check the status of the connected EtherCAT Master if this happens while the EtherCAT system is operating.
Blinking green	-		PRE-OPERATIONAL status	The EtherCAT Master sent out a transition command to the PRE-OPERATIONAL state.	
Off	Off		INIT status	The EtherCAT Master sent out a transition command to the INIT state.	

Front LEDs (on this product)	Status	Procedure
L/A1 or L/A2 LED		
Off	Network cable is disconnected	Check whether the L/A1 or L/A2 LAN cables are disconnected.

Front LEDs (on this product)		Status	Details	Procedure
RUN	NTWK ST			
Lit green	-	Internal IC activation of EtherCAT	The EtherCAT network chip is starting up.	-
Off	-		Network chip for EtherCAT is not operating.	If the RUN LED does not stay ON (green) even though the power is ON, check the POWER LED. If the RUN LED is unlit even though the POWER LED is lit, the power voltage may be extremely low, or the network type switching may have failed, preventing startup.
Flashing green	-	Network chip firmware transferring	The EtherCAT network chip firmware is undergoing internal transfer.	-
Lit green	Lit green	Communication status of EtherCAT	Communication with the EtherCAT Master is normal.	-
Lit green	Flashing green		Communication disconnection	• Confirm the EtherCAT Master status (for details, refer to the manual of the EtherCAT Master in use). • Confirm the status of the EtherCAT cable. • In branch wiring configuration, confirm the condition of the branch slave unit between the EtherCAT Master and this product. • Confirm the following if no problems are found. • Reset the CPU module of the host PLC. • Replace this product.

-	Off		Not communicating	• Confirm the following.
				  • Communication wiring with the EtherCAT Master
				  • Confirm that port 1 (this product's left RJ45 connector) is connected to the connection from the EtherCAT Master. (Communication is not established on the right)
				  • EtherCAT node address setting on the front of this product
				  • State of EtherCAT Master
				• Reset the CPU module of the host PLC.

5-1-2 Troubleshooting based on symptoms

Symptom	Front LEDs (on this product)	Cyclic communication flag	Error code (hexadecimal)	Probable cause	Procedure
In IO-Link communication with a specific IO-Link device, EtherCAT is unable to correctly read/ write data that has been sent or received.	ALARM LED flashing red	Error flag ON	FFFA	EtherCAT communication stops	Confirm the status of the field network (EtherCAT).

5-1-3 Error Code List

Code (hexadecimal)	Message	Conditions	Procedure
1000	No Service generated in ISDU handling	This occurs when the start code of the ISDU handling response used to access the parameters of the IO-Link device is "0" (No Service).	A setting value that is not supported by the IO-Link device is being accessed in this case. Confirm what you are trying to access (index number, etc.). This ISDU handling error may occur when the power supply to the IO-Link device is unstable. Use a power supply with sufficient capacity.
1001	IO-Link communication has stopped	This occurs when communication is established with an IO-Link device but then is disconnected. This error does not occur if the I/O power supply is shutdown. The error is also automatically cleared if IO-Link communication is restored.	Check the wiring between the IO-Link device and this product. Check the I/O power supply. Confirm whether the issue is resolved after changing the connection to another channel for this product or replacing the IO-Link device and cable.
1100	Timeout generated in ISDU handling	When using ISDU handling to access an IO-Link device setting value, no ISDU handling response is received even after five seconds have passed.	Confirm what you are trying to access on the IO-Link device (index number, write data, etc.).
5600	Checksum error generated in ISDU handling	When using ISDU handling to access an IO-Link device setting value, a mismatch occurs when calculating the checksum of the ISDU handling response.	This could be caused by noise between the IO-Link device and this product. Resolve this through such means as using a separate conduit for the power line, or maintaining distance between the C/Q wires of other IO-Link devices (do not bundle wires together). Confirm that the cable between the IO-Link device and this product is not too long (over 20 m).
5700	Unregulated ISDU handling data length	This occurs when the data length of the ISDU handling response is either "0" or too long, when using ISDU handling to access an IO-Link device setting value.	
6001	Revision ID validation error	The revision ID registered in this product does not match the revision ID of the connected IO-Link device. Process data is not transferred and parameters are not accessed.	Change the setting value for device validation (master setting menu number: M30) to "None".
8033	Setting value is too long	This occurs when the data length is too long, when using ISDU handling to access an IO-Link device setting value.	Write data using the data length specified for the IO-Link device.
FF23	Storage data does not match the connected device vendor ID or device ID	This occurs when the value of the vendor ID or device ID of the connected IO-Link device differs from the stored storage data, when device validation (master setting menu number: M30) is set to "None" and storage data exists (however, this only occurs when power is turned ON).	If an IO-Link device with a vendor ID or device ID that differs from the storage data is connected, connect the correct IO-Link device. If it is safe to delete the storage data stored on this product by channel, write with device parameter backup/restore (master setting menu number: M32) set to "Delete".
FF24	Storage buffer overload	This occurs when parameters data is too long and cannot be stored, when backing up parameters from an IO-Link device. The data length stored during backup will be "16 bytes + index 18 (model name) length + number of parameters to backup × 4 + total data length of parameters to backup". This can be stored as long as it is 4,032 bytes or less.	Backup cannot be performed for the connected IO-Link device because the storage data is too large.

Code (hexadecimal)	Message	Conditions	Procedure
FF25	Storage data access was blocked	This occurs when access to storage data is locked on the IO-Link device.	If this is required, release the lock setting (index number 12) on the IO-Link device.
FFEB	Timeout generated in conflict with ISDU handling	While attempting to perform ISDU handling on the same IO-Link channel, ISDU handling was being used elsewhere and communication could not be performed within a time 330 times the cycle time.	Storage takes some time, so wait a short while and try ISDU handling again (access by index number to IO-Link device).
FFEC	EEPROM write protection signal abnormality	The write protection signal is always permitted for the EEPROM used for saving parameters, etc.	This will not cause any immediate issues with operation. However, this indicates a hardware error and the hardware will need to be replaced.
FFED	Failure in EEPROM writing	Setting value, storage data and operation time writing failed.	There is something wrong with the connection to the EEPROM, or the EEPROM has reached its maximum number of writes. It can be rewritten 1,000,000 times.
FFEE	IO-Link trace has stopped automatically	This is a notification indicating that IO-Link tracing has stopped due to an error occurring or the buffer being full.	Read the IO-Link trace data and confirm communication information.
FFEF	Storage was interrupted	An error response was received from the IO-Link device while backing up to or restoring from storage, and the storage stopped operating. Backed up data will not be saved. The data being restored may have partially been transferred to the IO-Link device.	Perform the storage operation (backup or restore) again. If this occurs again, it may be due to noise. If so, resolve this through such means as using a separate conduit for the power line, or maintaining distance between the C/Q wires of other IO-Link devices (do not bundle wires together). Confirm that the cable between the IO-Link device and this product is not too long (over 20 m). If this still occurs, it may be caused by the firmware of the IO-Link device or this product. If so, update or replace the firmware of the IO-Link device or this product.
FFF0	Invalid data in setting value information	There is an invalid character in the setting value information provided by the IO-Link device or in installed IODD data information, or a value exceeding the permitted value was specified.	This is caused by the firmware of the IO-Link device or this product. Update or replace the firmware of the IO-Link device or this product.
FFF1	Writing firmware data is abnormal	An attempt to write invalid data was made when updating the firmware.	Firmware data to write is not correct. Reacquire the file and try again.
FFF3	The revision ID of the IO-Link device to validate is not registered in this product.	This occurs when the revision ID registered to this product is "00 h", when device validation (master setting menu number: M30) is set to a value other than "None".	Change the setting value for device validation (master setting menu number: M30) to "None". Or, register the revision ID of the IO-Link device to validate.

Code (hexadecimal)	Message	Conditions	Procedure
FFF4	IO-Link device model name is different	This occurs when the model name (index number 18 [product name] character string) of the registered IO-Link device differs from the model name of the device that is actually connected, when device validation (master setting menu number: M30) is set to "Type name". Cyclic communication is not performed with the applicable IO-Link device.	Change the setting value for device validation (master setting menu number: M30) to a value other than "Type name". Or, connect the correct IO-Link device.
FFF5	Unsupported setting value version	The version of the setting value data restored to setting value memory is new, and it may not be possible to recognize some of it.	Update the firmware of this product.
FFF6	Internal temperature is too high	This occurs when the temperature of the main CPU exceeds 85°C. The error occurs every 10 minutes.	Lower the operating temperature of this product, install a cooling fan, or lower the output load current (for example, by using a separate relay).
FFF7	EEPROM write frequency is too high	The setting value write count occurs under the following conditions. • The count is cleared if nothing is written for 450 seconds. • When writing 2 times with a frequency of once in less than 1 seconds. • When writing 20 times with a frequency of once in less than 10 seconds. • When writing 200 times with a frequency of once in less than 110 seconds.	Confirm whether setting value write operations are being performed frequently from the host PLC. Confirm whether IO-Link device parameters are frequently rewritten, with automatic device parameter backup (master setting menu number: M31) set to "Backup" or "Both".
FFF8	Software version does not match	There is version incompatibility with the main firmware, field network communication firmware or IO-Link communication logic, and some functions may not operate normally.	Update the FPGA data of this product and the network chip firmware.
FFF9	Network chip is not operating	This occurs when there is no communication between the main CPU and the chip that is performing field network processing.	The network chip may have failed, or power may have turned OFF while the network chip firmware was being updated.
FFFA	Network communication has stopped	This occurs when host EtherCAT communication is established but then is disconnected. The error will be automatically cleared when the status is restored.	Check whether the Ethernet cable is disconnected, the host PLC has been reset, or the power has turned OFF. Confirm the host PLC parameters. This product may stop being recognized on the network if host PLC network settings are changed.

Code (hexadecimal)	Message	Conditions	Procedure
FFFB	IO-Link device is not connected	This occurs when the IO-Link device is not connected under the following conditions. • The IO-Link device is not connected when running storage functions (manual or automatic backup/ restore of IO-Link device) • Ten seconds elapse without the IO-Link device connecting after the I/O power supply is turned ON, when device validation (master setting menu number: M30) is set to a value other than "None" • The IO-Link device is not connected when confirming device information or reading/writing a master setting menu number from the device parameters window • The user switched to the device identification display when connected to a device that does not support ISDU handling	Connect the IO-Link device properly. Or, change the setting value for device validation (master setting menu number: M30) to "None". Or, set the I/O assignment settings (master setting menu number: M10) to a value other than "IO-Link" for any channels not connected to an IO-Link device.
FFFC	Serial number validation error	This occurs when the registered serial number differs from the serial number of the connected IO-Link device, when device validation (master setting menu number: M30) is set to "Serial number". Cyclic communication is not performed with the applicable IO-Link device.	Change the setting value for device validation (master setting menu number: M30) to a value other than "Serial number". Or, connect the correct IO-Link device.
FFFD	No backup data	This occurs when storage data is not saved in this product, when restoring storage data to an IO-Link device.	A backup must be performed in order to perform a restore. Select "Backup" in device backup/restore of parameters (master setting menu number: M32) and perform a backup.
FFFE	IO-Link device type ID is different	This occurs when the registered vendor ID or device ID differs from the value of the connected IO-Link device, when device validation (master setting menu number: M30) is set to a value other than "None". Cyclic communication is not performed with the applicable IO-Link device.	Change the setting value for device validation (master setting menu number: M30) to "None". Or, connect the correct IO-Link device.
FFFF	Type ID of the device to restore is different	This occurs when the vendor ID or device ID differs when storage data is restored (manual restore or automatic restore) to an IO-Link device.	Connect the correct IO-Link device.

*Errors will be ignored if the same error code occurs within one second on the same channel.
*Up to 20 entries will be stored across all channels in the buffer used to store error information. Error information will begin being discarded beginning with the oldest entry when the number of entries exceeds 20.

Appendix

Describes the values for this product's master settings, its object dictionary, and how to interact with the EtherCAT Master of each company.

Appendix-1 List of Product Master Parameters

This section lists the master parameters of this product that can be set or monitored via SDO communication. For the setting/monitor in front panel operation, refer to Common Edition "5-1-4 Master parameter list with product front panel operation".

The master parameters are classified as below.
- User Settings
- Data for Access from PLC

Note that this product's master parameters are handled as little endian (beginning from the low-order byte).

Appendix-1-1 User Settings

For SDO communication, specify the master setting menu number and target number in the table below.
Note: In the right column of the table below, items that can be accessed via product front panel operation or SDO communication are marked with ● .

Master setting menu number	Target number	Data name	R/W	Value		Front panel operation (Master setting menu number)	SDO communication
1 (1 h)	0 (This product)	Initialize master parameters	RW	0 (default value)	None	● (M1)	●
				1	Initialize I/O assignment for all channels in IO-Link mode. (Storage data, display language, network type, and network No. will not be initialized)		
				2	As above, initialize I/O assignment for all channels in PNP input mode.		
				3	As above, initialize I/O assignment for all channels in NPN input mode.		
				4	As above, initialize I/O assignment for all channels in PNP output mode.		
				5	As above, initialize I/O assignment for all channels in NPN output mode.		
				6	As above, initialize I/O assignment for all channels as unused.		
				7	Delete the installed IODD data.		
				8	Initialize including network setting and language as well. I/O assignment is unused. IODD data is not deleted.		
2 (2 h)	0 (This product)	Network type	RW	Specify the field network type.		● (M2)	●
				2 (default value)	EtherCAT		
				3	EtherCAT		
				4 (planned)	PROFINET (planned)		
				5	Ethernet and Modbus/TCP		
				6	EtherCAT		
4 (4 h)	0 (This product)	Display brightness	RW	1 to 20 (default value: 7)	Display brightness Values multiplied by 5 are equivalent to % display.	● (M4)	●

Master setting menu number	Target number	Data name	R/W	Value		Front panel operation (Master setting menu number)	SDO communication
5 (5 h)	0 (This product)	Language selection	RW	0 (default value)	English	● (M5)	●
				1	Japanese		
				2	German		
				3	Chinese (Simplified)		
				4	French		
				5	Spanish		
				6	Portuguese		
				7	Italian		
				9	Korean		
				10	Chinese (Traditional)		
6 (6 h)	0 (This product)	Time difference	RW	-96 to 96 (default value: 0)	Set the time zone (in 15-minute increments) for the displayed network time (setting menu number: M65). If the network time set from the host is based on UTC, setting the time zone as 9 x 4 = 36 will display Japan Standard Time (JST).	● (M6)	●
8 (8 h)	0 (This product)	Unit tag name	RW	Up to 32 characters	Set the product user tag name up to 32 characters.	● (M8)	●
9 (9 h)	0 (This product)	I/O assignment batch change	RW	0 (default value)	None	● (M9)	●
				1	Change I/O assignment settings for all channels to IO-Link mode.		
				2	Change I/O assignment for all channels to PNP input mode.		
				3	Change I/O assignment for all channels to NPN input mode.		
				4	Change I/O assignment for all channels to PNP output mode.		
				5	Change I/O assignment for all channels to NPN output mode.		
				6	Change I/O assignment for all channels to unused.		
10 (A h)	0 to 15 (Channel number)	I/O assignment setting	RW	0	IO-Link mode	● (M10)	●
				1	PNP input mode: Internal pull-down resistance is enabled.		
				2	NPN input mode: Internal pull-up resistance is enabled.		
				3	PNP output mode		
				4	NPN output mode		
				5 (default value)	Not used		
11 (B h)	0 to 15 (Channel number)	Input filter time	RW	0 (default value)	None	● (M11)	●
				1	0.1 ms		
				2	1 ms		
				3	5 ms		
				4	10 ms		
				5	20 ms		

Master setting menu number	Target number	Data name	R/W	Value		Front panel operation (Master setting menu number)	SDO communication
12 (C h)	0 to 15 (Channel number)	Input hold time	RW	0 (default value)	None	● (M12)	●
				1	1 ms		
				2	15 ms		
				3	100 ms		
13 (D h)	0 to 15 (Channel number)	Handling of IO-Link communication and network error generation	RW	0 (default value)	Clear	● (M13)	●
				1	Input hold		
				2	Output hold		
				3	All hold		
14 (E h)	0 (This product)	UC2-IOL direct output start channel	RW	0 (default value)	The UC2 direct output function is not used.	● (M14)	●
				1 to 16	Output signals of sensor units connected with OPTEX FA IO-Link gateway, UC2-IOL, can be output as PNP/NPN directly from the I/O terminals of this product. Specified values 1 through 16 correspond to channel numbers 0 through F on which to "start" output.		
15 (F h)	0 (This product)	Encoder input (ABZ)	RW	0 (default value)	The encoder input is not used.	● (M15)	●
				1 to 14	Connect phase A, phase B, and phase Z of the encoder to the following channels (SIO mode digital input). Phase A: Any channel from 0 to D (corresponds to 1 to 14) Phase B: Any channel from 1 to E (corresponds to 1 to 14) Phase Z: Any channel from 2 to F (corresponds to 1 to 14)		
				15, 16	Reserved. Do not set.		
				17 to 31	Connect phase A and phase B of the encoder to the following channels (SIO mode digital input). Phase A: Any channel from 0 to E (corresponds to 17 to 31) Phase B: Any channel from 1 to F (corresponds to 17 to 31) Phase Z: No assignment		
				32	Reserved. Do not set.		
				33 to 48	Phase A: Any channel from 0 to F (33 to 48 supported) Phase B, phase Z: No assignment		

Master setting menu number	Target number	Data name	R/W	Value		Front panel operation (Master setting menu number)	SDO communication
16 (10 h)	0 to 15 (Channel number)	For reflection to high order master cyclic communication area Specific bit specification of process input data	RW	0 to 255 Default value: 0	Specify which bit of the process input data in bit units (*1) of the corresponding channel (IO-Link mode) of the IO-Link device is reflected in the corresponding bit of the digital input data <Input bit t> of PDO communication. Usage example: Confirm a particular bit of process input data coming from a particular IO-Link device over the network in the high-order master's cyclic communication area. *1: If the IO-Link device's process input data is in a data format other than bit units, it cannot be specified (e.g. Integer, etc.). Installing the IODD data is required to use the "M16" function with a device other than OPTEX FA's IO-Link device.	● (M16)	●
		For transfer to the digital output in "M17" Specific bit specification of process input data			The bit position of the process input data bit that should be transferred to the digital output in "M17" is specified here.		
17 (11 h)	0 to 15 (Channel number)	Specification of the transfer source channel when transferring specific bits of process input data to the digital output	RW	0 Default value: 0	Turns on/off the digital output of the corresponding channel (SIO mode) in the usual manner.	● (M17)	●
				1 to 16: Specify channel number 0 to F	The bit status of the position indicated by "M16" of the process input data of the IO-Link device of the specified channel (IO-Link mode) is transferred to the channel's digital output (SIO mode). Usage example: If the IO-Link device is a presence/absence sensor of the IO-Link type and has the specified channel number, it is used when outputting the on/off signal indicating presence/absence to the outside as a digital output of another channel directly, bypassing the network.		
21 (15 h)	0 to 15 (Channel number)	I/O synchronization	RW	0 (default value)	Asynchronous IO-Link communication is made at the fastest communication time of each device. The digital I/O status is also continually updated.	● (M21)	●
				2	Using the product's internal timer, at an 0.4 ms cycle, synchronize IO-Link communication or digital I/O transfer between multiple channels with the same setting (I/O synchronization).		
				3	As above, synchronization at 0.8 ms cycle		
				4	As above, synchronization at 1.6 ms cycle		
				5	As above, synchronization at 3.2 ms cycle		
				6	As above, synchronization at 6.4 ms cycle		
				7 to 1003	Specify the IO-Link communication cycle time at 0.4 ms to 100.0 ms.		

Master setting menu number	Target number	Data name	R/W	Value		Front panel operation (Master setting menu number)	SDO communication
29 (1D h)	0 to 15 (Channel number)	Device ID	RW	0x0 - 0xFFFFFF (default value: 0x 0)	This is the device ID used for validation with IO-Link devices. Refer to "M29. Device ID" in Common Edition "5-1-4 Master parameter list with product front panel operation" for details.	● (M29)	●
30 (1E h)	0 to 15 (Channel number)	Device validation	RW	0 (default value)	None Note: Even for "None," if storage data is already saved in the product, when turning on the power (unit and I/O power), the IO-Link device type ID and storage data type ID will be validated. An error (FF23 h) will occur if the type ID does not match. The revision ID is not validated.	● (M30)	●
				1	Validation of type ID (vendor ID and device ID) If the registered type ID and connected device type ID are different, an error (FFFE h: type ID validation error) is generated and the process data with the relevant IO-Link device is treated as invalid. As well, if IO-Link communication is not established within 10 seconds of turning on the I/O power, an error (FFFB h: IO-Link device not connected) is generated. At the same time, the revision ID is also validated.		
				2	Type ID + serial number validation Even if the type IDs (vendor ID and device ID) match, if the serial number is different, an error (FFFC h: serial number validation error) is generated, and the process data with the relevant IO-Link device is invalidated. Other operations are the same as Parameter 1.		
				3	Type ID + device model name validation Even if the type IDs (vendor ID and device ID) match, if the device model name is different, an error (FFF4 h: model name validation error) is generated, and the process data with the relevant IO-Link device is invalidated. Other operations are the same as Parameter 1.		

Master setting menu number	Target number	Data name	R/W	Value		Front panel operation (Master setting menu number)	SDO communication
31 (1F h)	0 to 15 (Channel number)	Automatic device parameter backup	RW	0 (default value)	None	● (M31)	●
				1	Automatic backup When IO-Link device Parameters are changed, they are automatically backed up in this product. If IO-Link device parameters are changed from this product, the backup operation will automatically start 10 seconds after the last change. Note: When a device with a different vendor ID or device ID is connected, backup is executed at every startup, so reset "Device validation" (setting menu number: M30) to correct the validation error (FFFE h) as soon as possible.		
				2	Automatic restore Automatically restore (download parameters from this product to the IO-Link device) if the IO-Link device parameters differ from the data stored on this product during startup. In this case, note that even if the IO-Link device parameter is changed, it will be overwritten at the next startup with the data saved in this product.		
				3	Perform auto backup and auto restoration as above together The storage data stored on this product will always match the IO-Link device parameters. In other words, IO-Link device parameters are backed up to this product whenever they are changed. If any parameter is different from the IO-Link device during startup, the parameters stored in this product will be restored.		
32 (20 h)	0 to 15 (Channel number)	Backup/ restore of parameters	RW	0 (default value)	None	● (M32)	●
				1	Execute backup (uploading set values from devices to this product) manually		
				2	Execute restoration (downloading set values from the product to devices) manually		
				3	Delete backup data saved in the product manually		
33 (21 h)	0 to 15 (Channel number)	Conditions for applying IODD data	RW	0	Device priority	● (M33)	●
				1 (default value)	IODD data priority		
40 (28 h)	0 to 15 (Channel number)	Process input data words allocation	RW	0 to 16 (default value: 2)	Process input data words allocated to input cyclic communication area If the parameter is 0 words, it will be assigned in a packed manner.	● (M40)	●

Master setting menu number	Target number	Data name	R/W	Value			Front panel operation (Master setting menu number)	SDO communication
41 (29 h)	0 to 15 (Channel number)	Process output data words allocation	RW	0 to 16 (default value: 2)	Process output data words allocated to output cyclic communication area If the parameter is 0 words, it will be assigned in a packed manner.		● (M41)	●
42 (2A h)	0 (This product)	Automatic word assignment of process data	RW	0 (default value)	None		● (M42)	●
				1	Auto assignment			
43 (2B h)	0 to 15 (Channel number)	Process data LSB/ MSB	RW	0 (default value)	Little endian		● (M43)	●
				1	Big endian			
44 (2C h)	0 (This product)	Timestamp	RW	0 (default value)	None	Refer to "M44. Timestamp" in Common Edition "5-1-4 Master parameter list with product front panel operation" for details.	● (M44)	●
				1	Serial			
				2	Time			
				3	Serial + Parity			
				4	Time + Parity			
51 (33 h)	0 to 15 (Channel number)	Actual cycle time	R	1 to 1000	0.1 ms increments		● (M51)	●
52 (34 h)	0 to 15 (Channel number)	IO-Link communication speed	R	0	Not communicating		● (M52)	●
				1	COM1			
				2	COM2			
				3	COM3			
53 (35 h)	0 to 15 (Channel number)	IO-Link communication error	R	0 to 255	To clear data, write 1 in offset +0 of parameter 114 h.		● (M53)	●
54 (36 h)	0 to 15 (Channel number)	IO-Link ISDU checksum error count	R	0 to 255	To clear data, write 1 in offset +0 of parameter 114 h.		● (M54)	●
55 (37 h)	0 to 15 (Channel number)	IO-Link transmission rate error	R	-1000 to 1000	IO-Link transmission rate error (0.1% unit, signed)		● (M55)	●
56 (38 h)	0 to 15 (Channel number)	IO-Link signal width error	R	-1000 to 1000	IO-Link transmission signal width error (0.1% unit, signed)		● (M56)	●

Master setting menu number	Target number	Data name	R/W	Value			Front panel operation (Master setting menu number)	SDO communication
57 (39 h)	0 to 15 (Channel number)	IO-Link communication mode	R	0 to 7	0: NOCOM 1: STARTUP 2: PREOPERATE 3: OPERATE 5: STARTUP (Rev.1.0) 6: PREOPERATE (Rev.1.0) 7: OPERATE (Rev.1.0)	Refer to "M57. Communication mode" in Common Edition "5-1-4 Master parameter list with product front panel operation" for details.	● (M57)	●
58 (3A h)	0 to 15 (Channel number)	Storage backup time	R	00:00:00 00/01/01 to 23:59:59 99/12/31	The storage data backup time is displayed as below. Time and date (ex.: 18:59:00 20/02/29)		● (M58)	●
60 (3C h)	0 (This product)	Version number	R	P.PPNNLLFF	Displays the data version of the program, etc. P.PP: Firmware, NN: Network chip, LL: Logic, FF: Font 4 bytes in decimal.		● (M60)	●
61 (3D h)	0 (This product)	Operating time	R	0 to 2097151 (239 years)	Product cumulative operating time information (unit: hours)		● (M61)	●
62 (3E h)	0 (This product)	Display driven hours	R	0 to 262143 (30 years)	Product display operating time information (unit: hours)		● (M62)	●
63 (3F h)	0 (This product)	Input/output power supply voltage	R	0 to 308	Voltage supplied to product I/O power supply (unit: 0.1 V)		● (M63)	●
64 (40 h)	0 (This product)	Internal temperature	R	-2739 to 10457	Product internal temperature (unit: 0.1°C)		● (M64)	●
65 (41 h)	0 (This product)	Network time	R	00:00:00 00/01/01 to 23:59:59 99/12/31	Time and date (ex.: 18:59:00 20/2/29) Returns as a character string.		● (M65)	●
67 (43 h)	0 (This product)	Network timeout	R/W	0 to 30000	If Ethernet communication stops and the predetermined amount of time has passed when the network type is “Ethernet & Modbus/TCP," a network communication stop error (FFFA h) will occur. The specified time can be specified from 0 to 30000 (300 seconds) in 10 ms increments. If it set to the default value of 0, even if Ethernet communication is interrupted, it is considered that the data has been updated internally at a cycle of about 10 ms and no error occurs. Even in this case, an error will occur if the Ethernet cable is disconnected.		● (M67)	●
83 (53 h)	0 (This product)	Station number	R/W	0 to 255	Sets the EtherCAT node address of this product. Turning the front rotary switches while the power is on automatically switches to "M83. Station number" setting window.		● (M83)	

Appendix-1-2 Data for Access from PLC

For SDO communication, specify the master setting menu number and target number in the table below.
Note: In the right column of the table below, items that can be accessed via product front panel operation or SDO communication are marked with ● .

Master setting menu number	Target number	Data name	R/W	Offset	Value	Front panel operation	SDO communication
100 h	0 to 15 (Channel number)	Latest error code read by channel	R	+0	Error code lower	? -4. Event/ error display	●
				+1	Error code upper		
				+2	Lower designated index number causing error		
				+3	Upper designated index number causing error		
				+4	Designated index number causing error		
				+5 to 26	Error time and date text string (in order of generation) See the form below. HH:MM:SS YY:MN:DD (HH: hour, MM: minute, SS: second, YY: year last two digits, MN: month, DD: day) Ex.: Generated at 18:59:00 on February 19, 2020: 18:59:00 20/02/19 Note: When 100-µs unit data is added, HH:MM:SS:ssss YY:MN:DD (ssss: seconds in 100-µs units).		

Master setting menu number	Target number	Data name	R/W	Offset	Value	Front panel operation	SDO communication
101 h	0 to 15 (Channel number)	Event data read by channel	R	+0	Event flag	? -4. Event/ error display	●
				+1	Event byte order 1 type (*1)		
				+2	Event Code lower		
				+3	Event Code upper		
				+4	00 h (fixed)		
				+5	Event byte order 2 type (*1)		
				+6	Event Code lower		
				+7	Event Code upper		
				+8	00 h (fixed)		
				+9	Event byte order 3 type (*1)		
				+10	Event Code lower		
				+11	Event Code upper		
				+12	00 h (fixed)		
				+13	Event byte order 4 type (*1)		
				+14	Event Code lower		
				+15	Event Code upper		
				+16	00 h (fixed)		
				+17	Event byte order 5 type (*1)		
				+18	Event Code lower		
				+19	Event Code upper		
				+20	00 h (fixed)		
				+21	Event byte order 6 type (*1)		
				+22	Event Code lower		
				+23	Event Code upper		
				+24	00 h (fixed)		
				+25 to 150	The text string for generation times of event byte orders 1 to 6 will be displayed (in order) after the event byte order. Ex. 1: Event byte order 1 only generated at 19:15:32 on June 24, 2020: (1) 19:15:32 20/06/24 Ex. 2: Event byte orders 1 to 6 all generated at different times: (1) 19:15:32 20/06/24 (2) 19:10:18 20/6/24 (3) 18:25:32 20/06/24 (4) 19:05:48 20/6/24 (5) 19:15:32 20/06/24 (6) 19:10:18 20/6/2		

Master setting menu number	Target number	Data name	R/W	Offset	Value	Front panel operation	SDO communication
102 h	0	Set value read time from IO-Link devices (binary data)	R	+0	15.265 µs unit data lower	-	●
				+1	15.265 µs unit data upper		
				+2	Set 0 as January 1, 1970, 00:00:00, counting data every second, least-significant		
				+3	As above 2nd byte		
				+4	As above 3rd byte		
				+5	Same as above, highest-order		
				+6	Lower parity information with read set values as word units with exclusive disjunction (XOR) at 35 AC h		
				+7	Same as above, high-order		
	1	Set value read time from IO-Link devices (CE BCD data)	R	+0	15.265 µs unit data lower		
				+1	15.265 µs unit data upper		
				+2	s		
				+3	min		
				+4	hr		
				+5	day		
				+6	month		
				+7	year		
				+8	Lower parity information with read set values as word units with exclusive disjunction (XOR) at 0 x35AC		
				+9	Same as above, high-order		
	2	Set value readout time from IO-Link devices (text string data)	R		A 27-character text string will be displayed. Ex.: 2020/2/29 18:59:0.1234 parity 8B61 h → 18:59:00.1234 20/02/29 8B61		
103 h	0 (This product)	Event/error message read	R		Executing read switches the display to the event/error display window.	? -4. Event/ error display	●
				+0	Applicable channel (0 to 15)		
				+1	Designated index number causing error/event qualifier		
				+2	Lower index number in error		
				+3	Upper index number in error		
				+4	Error code lower		
				+5	Error code upper		
				+6	Message text string		
				+7	(continues)		

Master setting menu number	Target number	Data name	R/W	Offset	Value		Front panel operation	SDO communication
104 h	0 (This product)	Key operation	R	+0	Returns the status of the currently pressed key. Value is the same as below.		-	●
			W	-	Writes the decimal below. 1: Right key operation 2: Left key operation 4: [↑] key operation 8: [↓] key operation 16: [CANCEL] Key operation 32: [ENTER] Key operation	Remotely operates the product key. Operation is the same as pressing once, not holding. Note: Even if keys are remotely operated here, the display off timer will not be cleared.		
105 h	0	Event/error clear	R	-	Executes operation equivalent to pressing the ENTER, Down, and Up keys on the event/error menu. Executes with read		? -4. Event/ error display	●
	1	Go to next event						
	2	Return to previous event						
106 h	0 (This product)	Operation lock	RW	-	Bit 0: Master parameter write lock	Note: Start up while pressing the CANCEL key to release the lock temporarily.	-	●
					Bit 1: Device Parameter write lock			
					Bit 2: /Event/error clear operation lock			
					Bit 3: All key operation lock			
107 h	0	Read display text string (1st row)	R	+0 to +499	Text string on display Character codes: Japanese: Shift-JIS Simplified Chinese: GB2312 Traditional Chinese: Big-5 Korean: EUC-kr		-	●
	1	Read display text string (2nd row)	R					●

Master setting menu number	Target number	Data name	R/W	Offset	Value	Front panel operation	SDO communication
108 h	1	Right key operation response	R	-	Operation response when remotely operating product keys using the specified target number is stored under the following decimals. Responses are as below. 1: Referencing Parameters 10 to 19: Digit position of set values being edited (equivalent to digits 1 to 10) 100 up: Digit position in text string being edited Values up to 255 are 1-byte responses; values from 256 up are 2-byte responses. Even if keys are remotely operated here, the display off timer will not be cleared. When specifying over 192 values, only 192 will be received. The read values at that point are channel numbers.	-	●
	2	Left key operation response					
	4	Up key operation response					
	8	Down key operation response					
	16	CANCEL key operation response					
	32	ENTER key operation response					
	192	Process data information update operation response					
109 h	0 (This product)	Read of channel numbers displayed	R	+0	When the IO-Link device numbers specified in writing are out of range, an out-of-range error will be generated without switching. The read will return the current channel numbers.	-	●
10A h	0 (This product)	Find Me request	RW	+0	0: Cancel a Find Me request to the product. 1: Send a Find Me request to the product. During Find Me, the event/ error display will blink and the display will show "I am here". Press any key to clear Find Me.	-	●
10D h	0 to 15 (Channel number)	Model name thumb value registration for validation	R	+0 to +1	Write the model name as a text string to calculate and store the thumb value. The read value will be a 16-bit thumb value.	-	●
			W	+0 to +63			
10E h	0 to 15 (Channel number)	Vendor ID and device ID registered for validation	RW	+0 to +1	Registered IO-Link device vendor ID	-	●
				+2 to +4	Registered IO-Link device ID		
				+5	0		
				+6	Registered IO-Link device revision ID Value 10 h indicates that the revision ID is 1.0. Value 11 h indicates that the revision ID is 1.1.		
10F h	0 to 15 (Channel number)	Write serial number to be registered	W	+0 to +15	Writes the serial number used for validation with IO-Link devices.	-	●

Master setting menu number	Target number	Data name	R/W	Offset	Value	Front panel operation	SDO communication
110 h	0 to 15 (Channel number)	Read of vendor ID/ device ID of storage data backed up in this product and registered vendor ID/ device ID and serial number	R	+0 to +1	Vendor ID in product backup data Note: In the case of a vendor ID mismatch, it will be invalid and 0 will be read out.	-	●
				+2 to +4	Device ID in product backup data Note: In the case of a device ID mismatch, it will be invalid and 0 will be read out.		
				+5	0		
				+6 to +7	Storage backup execution times since power on		
				+8 to +9	Storage restoration execution times since power on		
				+10 to +26	Text string of date and time of backup		
111 h	0 (This product)	Diagnostic information	R	+0	Main memory (EEPROM) checksum error count	-	●
				+1	Sub memory (flash) checksum error count		
				+2	Always 0.		
				+3	Bit 0 to 5: Result of pressing switch alone in past		
				+4 to 5	Display device drive power supply voltage (0.1 V unit)		
				+6	Acyclic communication timeout count		
				+7	Main memory (EEPROM) write frequency. Updated every 450 seconds, with an alarm generated at over 200.		
				+8	Maximum value of the internal temperature measured inside the product. (unit: °C)		
				+9	Set value version number (0)		
				+10	Network communication error count		
				+11	Storage function state number (normally 0, changes when storage-related functions operate)		
				+12 to +13	Reserved (Always 0)		
112 h	0 (This product)	Output overcurrent condition	R	+0 to +1	Current output overcurrent condition. Bits 0-15 are equivalent to I/O channels 0 to 9 and A to F.	-	●
				+2 to +17	Output overcurrent count for channels 0 to F. Counted up to 255.		
			W	+0	Write 1 to clear all channels' output overcurrent count. Write 2 to 17 to clear channels 0 to F separately.		

Master setting menu number	Target number	Data name	R/W	Offset	Value	Front panel operation	SDO communication
113 h	0 to 15 (Channel number)	Read vendor ID and device ID of IO-Link device currently connected	R	+0 to +1	Vendor ID	-	●
				+2 to +4	Device ID		
				+5	Always 0.		
				+6	Revision ID		
				+7	Always 0.		
				+8 to +9	Function ID		
114 h	0 to 15 (Channel number)	IO-Link device diagnostic information	R	+0	IO-Link communication error	-	●
			R	+1	IO-Link ISDU sum error count		
			R	+2 to +3	IO-Link transmission rate error (0.1% unit, signed)		
			R	+4 to +5	IO-Link transmission signal width error (0.1% unit, signed)		
			R	+6 to +7	Actual cycle time for IO-Link communication (0.1 ms units)		
			R	+8	IO-Link communication speed (0: no communication, 1: COM1, 2: COM2, 3: COM3)		
			R	+9	Process input data byte count		
			R	+10	Process output data byte count		
			R	+11	IO-Link communication status (0: NOCOM, 1: STARTUP, 2:PREOPERATE, 3:OPERATE, 4 to 7: IO-Link Revision 1.0, same as 0 to 3)		
			R	+12	IO-Link device on-request data byte count		
			R	+13	Process input data invalid (0: valid, 1: invalid)		
	0	Clear IO-Link communication error	W	+0	Write 1 to clear all channels' IO-Link communication error. Write 2 to 17 to clear channels 0 to F separately.		
	1	Clear IO-Link ISDU checksum error count		+0	Write 1 to clear all channels' ISDU checksum error count. Write 2 to 17 to clear channels 0 to F separately.		
123 h	10, 11, 12, 13, 16, 17, 30, 31, 33, 40, 41, or 43	16-channel batch read/ write	RW	+0 to +15	The 16-byte data specified here is linked to each setting on each of the 16 channels (of the master setting value) and is read or written all at once for the master setting value of the setting menu number specified by the target number. The 16-byte data is composed of three channels: channel 0, channel 1, and channel F.	-	●

Master setting menu number	Target number	Data name	R/W	Offset	Value	Front panel operation	SDO communication
1FA h	0 to 7 (Supports 8 type IDs)	Read of vendor IDs and device IDs of installed IODD information	R	-	Returns 8 vendor IDs and device IDs each. Returns 4 digits of vendor IDs and 6 digits of device IDs as hexadecimal text strings. Format : VVVV-DDDDDD, VVVV--DDDDDD, ..., VVVV-DDDDDD Note: Of the part not registered, the - will be stored. Up to 64 types of IODD data can be installed. Target number 0 corresponds to the 1st through 8th, target number 1 to the 9th through 16th, and so on until target number 7 and the 56th through 64th.	-	●
1FE h	0 to 31	Read of IO-Link communication trace data	R	+0 to +127	From the position where the channel number was specified, 128 bytes of trace send/receive data will return as a hexadecimal text string. When it is read out, the trace ends. The specified channel number 31 is the most recent trace data, 30 is the previous one, and 0 is the oldest data. A ">" is inserted at the start of the send data and a ":" at the start of the receive data.	-	●
	0	Start of IO-Link communication trace	W	+0	Bits 3 to 0: IO-Link device channel number Saves the specified IO-Link device send/receive data to buffer memory (4096 bytes). Bit 5: Set to 1 to stop the trace when an IO-Link communication error is generated. Bit 6: Set to 1 to stop the trace when an ISDU handling negative response is generated. Bit 7: Set to 1 to stop the trace when the buffer is full.	-	●
				+1	Bit 0: Set to 1 to add a line break instead of ">" at the start of send data.		
1FF h	0 (This product)	Read of MAC register number and serial number	R	+0 to +5	6-byte MAC register number data	-	●
				+6	I/O voltage measurement calibrated value		
				+7	Internal temperature measurement calibrated value		
				+8 to 23	Product serial number (16 characters)		

*1: Event type details (from IO-Link specifications)

Bits 7 to 6	Event generation type	0: Reservation, 1: Single, 2: Generated, 3: Cleared
Bits 5 to 4	Event type	0: Reservation, 1: Notification, 2: Warning, 3: Error
Bit 3	Event generation source	0: Device, 1: Master
Bits 2 to 0	Event cause	0: Unclear, 1 to 3: Reservation, 4: Application, 5 to 7: Reservation

Appendix-2 Object Dictionary of This Product

The EtherCAT Slave has an internal parameter set called "Object dictionary". The EtherCAT Master reads from and writes to this location to monitor and set parameters.
This section provides details on this product's object dictionary.

Appendix-2-1 Index range of object dictionary

The index range of the object dictionary in EtherCAT is decided as follows for each function.

Index number range (HEX)	Details	Used for this product? ○ = yes, - = no
0000 to 0FFF	Data type area	-
1000 to 1FFF	Communication settings area (identification information, EtherCAT serial interface settings, process data objects, etc.)	○
2000 to 5FFF	Manufacturer-specific data area (objects defined by slave manufacturers) For SDO (mailbox) communication, a service type object is set up in the case of this product.	○
6000 to 6FFF	Input process data area (objects that can be assigned to input process data)	○
7000 to 7FFF	Output process data area (objects that can be assigned to output process data)	○
8000 to 8FFF	Settings data area (objects related to function settings of slaves)	-
9000 to 9FFF	Slave information area (configuration information for module devices, etc.)	-
A000 to AFFF	Diagnostic information area (diagnostic information, status information, statistical information, etc.)	-
B000 to BFFF	Service area	-
C000 to EFFF	Reserved area (cannot be used)	-
F000 to FFFF	Device area (parameters related to devices)	-

Meaning of Each Column in the List of Object Dictionary (profile data and parameter type of this product)

The meanings of each array are as follows.

Item	Value	Meaning
Index (HEX)	0000 to FFFF	A four-digit hexadecimal number to identify the object
Sub-Index (HEX)	00, 01 to FE	A number to specify each member for array type and structure type objects. Not used for basic data types. Note: 00 is the maximum sub-index value within members.
Name		The name of the object. For sub-indexes, this is the sub-index name.
Description		A description of the object. For sub-indexes, this is the sub-index description.

Item	Value	Meaning
Data type	INT16	16-bit signed integer
	UINT8	8-bit unsigned integer
	UINT16	16-bit unsigned integer
	UINT32	32-bit unsigned integer
	UINT64	64-bit unsigned integer
	WORD	16-bit data
	STRG(x)	Character string (x bytes)
	BOOL	BOOL value
Reading/ writing attribute	RO	Read only
	RW	Read/write
	WO	Write only
Assignable to PDO	No	Cannot be assigned to PDO
	Yes	Can be assigned to PDO
Value		For read-only (RO) objects, this indicates the range of data that can be acquired. For read / write (RW) objects and write-only (WO) objects, this indicates the range of data that can be set.
Default value		The value set at the factory.

Appendix-2-2 List of Profile Data of This Product in the Object Dictionary

A list of profile data for this product is shown below.

Index (HEX)	Sub-Index (HEX)	Name	Description	Data type	Reading/ writing attribute	Assignable to PDO	Value	Default value
1000	No	Device type	Indicates the device type of this product. It is as follows. 00001389 h	UINT32	RO	No	00001389 h	00001389 h
1008	No	Device name	Indicates the manufacturer device name of this product.	STRG (6)	RO	No	"OPTEX FA CO., LTD."	"OPTEX FA CO., LTD."
1009	No	Hardware version number	Indicates the version of this product's hardware.	STRG (4)	RO	No	"1"	"1"
100A	No	Software version number	Indicates the version of this product's software.	STRG (4)	RO	No	"1.0"	Differs by version
1018	00	Identity	Information for identification of this product	UINT8	RO	-	04 h	04 h
	01	Vendor ID	Vendor ID	UINT32	RO	No	00000B27 h	00000B27 h
	02	Product code	Product code	UINT32	RO	No	0000250B h	0000250B h
	03	Revision	Revision number	UINT32	RO	No	00000001 h	00000001 h
	04	Serial number	Serial number	UINT32	RO	No	xxxxxxxh	The numerical value of the serial number printed on the rating nameplate of this product

Appendix-2-3 Object Dictionary (parameter type) List for Cyclic Communication

The object dictionary of parameter type in this product for cyclic communication is listed below.
The PDO object's index number in this product is assigned as follows.

Object type		Index number
Communication settings area	For TxPDO (slave → master)	1A00 h (User cannot add PDO)
	For RxPDO (master → slave)	1600 h (User cannot add PDO)
Input process data area (slave → master)		6000 h (assigned to 1A00 h at factory)
Output process data area (master → slave)		7000 h (assigned to 1600 h at factory)

Index (HEX)	Sub-Index (HEX)	Name	Description	Data type	Reading/ writing attribute	Assignable to PDO	Value	Default value
1600	00	Receive PDO mapping	Receive PDO mapping 6000 is preset for 1600 (fixed)	UINT8	RO	-	12 h	00 h
	01		PDO entry 1	UINT32	RO	No	-	6000.01 h
	02		PDO entry 2	UINT32	RO	No	-	6000.02 h
	• • •		• • •					
	12		PDO entry 18	UINT32	RO	No	-	6000.12 h
1A00	00	Transmit PDO mapping	Transmit PDO mapping 7000 is preset for 1A00 (fixed)	UINT8	RO	-	12 h	00 h
	01		PDO entry 1	UINT32	RO	No	-	7000.01 h
	02		PDO entry 2	UINT32	RO	No	-	7000.02 h
	• • •		• • •	• • •			• • •	• • •
	12		PDO entry 18	UINT32	RO	No	-	7000.12 h
6000	00	Cyclic communication input data from this product to the EtherCAT Master		UINT8	RO	-	12 h	12 h
	01	Input bit	Process data input	UINT16	RO	Yes		
	02	Status bit	Assignment status data (*1)	UINT16	RO	Yes		
	03	pdin 0	Process input data channel 0	UINT32	RO	Yes		
	04	pdin 1	Process input data channel 1	UINT32	RO	Yes		

Index (HEX)	Sub-Index (HEX)	Name	Description	Data type	Reading/ writing attribute	Assignable to PDO	Value	Default value
6000	05	pdin 2	Process input data channel 2	UINT32	RO	Yes		
	06	pdin 3	Process input data channel 3	UINT32	RO	Yes		
	07	pdin 4	Process input data channel 4	UINT32	RO	Yes		
	08	pdin 5	Process input data channel 5	UINT32	RO	Yes		
	09	pdin 6	Process input data channel 6	UINT32	RO	Yes		
	0A	pdin 7	Process input data channel 7	UINT32	RO	Yes		
	0B	pdin 8	Process input data channel 8	UINT32	RO	Yes		
	0C	pdin 9	Process input data channel 9	UINT32	RO	Yes		
	0D	pdin A	Process input data channel A	UINT32	RO	Yes		
	0E	pdin B	Process input data channel B	UINT32	RO	Yes		
	0F	pdin C	Process input data channel C	UINT32	RO	Yes		
	10	pdin D	Process input data channel D	UINT32	RO	Yes		
	11	pdin E	Process input data channel E	UINT32	RO	Yes		
	12	pdin F	Process input data channel F or extended access read data (*2)	UINT32	RO	Yes		
7000	00	Cyclic communication output data of this product from the EtherCAT Master		UINT8	RO	-	12 h	12 h
	01	Output bit	Process data output	UINT16	RW	Yes		
	02	Control bit	Allocated operation data (*3)	UINT16	RW	Yes		
	03	pdout 0	Process output data channel 0	UINT32	RW	Yes		
	04	pdout 1	Process output data channel 1	UINT32	RW	Yes		
	05	pdout 2	Process output data channel 2	UINT32	RW	Yes		
	06	pdout 3	Process output data channel 3	UINT32	RW	Yes		
	07	pdout 4	Process output data channel 4	UINT32	RW	Yes		

Index (HEX)	Sub-Index (HEX)	Name	Description	Data type	Reading/ writing attribute	Assignable to PDO	Value	Default value
7000	08	pdout 5	Process output data channel 5	UINT32	RW	Yes		
	09	pdout 6	Process output data channel 6	UINT32	RW	Yes		
	0A	pdout 7	Process output data channel 7	UINT32	RW	Yes		
	0B	pdout 8	Process output data channel 8	UINT32	RW	Yes		
	0C	pdout 9	Process output data channel 9	UINT32	RW	Yes		
	0D	pdout A	Process output data channel A	UINT32	RW	Yes		
	0E	pdout B	Process output data channel B	UINT32	RW	Yes		
	0F	pdout C	Process output data channel C	UINT32	RW	Yes		
	10	pdout D	Process output data channel D	UINT32	RW	Yes		
	11	pdout E	Extended access specified data (*4)	UINT32	RW	Yes		
	12	pdout F	Extended access write data (*5)	UINT32	RW	Yes		

*1: Assignment status data

It depends on the extended access enabled/disabled flag value.

- During normal assignment

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Digital input (channels 0 to F)															
Error	IO-Link ready	Synchronization established	Reserved	Channel with the latest error				Event	External power supply	Output overcurrent	Reserved		Channel with the latest event		

- Extended access enabled assignment

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Digital input (channels 0 to F)															
Error	IO-Link ready	Synchronization established	Access error	Channel with the latest error				Event	External power supply	Output overcurrent	Access completed		Channel with the latest event		

*2: Extended access read data (when extended access is enabled)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Extended access read data (low-order word)															

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Extended access read data (high-order word)															

*3: Allocated operation data

It depends on the extended access enabled/disabled flag value.

• During normal assignment

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Clear the latest error	Reserved							Clear the latest event	Reset encoder counter	Reserved					Extended access disabled

• Extended access enabled assignment

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Clear the latest error	Reserved	Little endian	UR-ES16DT unit specification	Channel No. of IO-Link to access (0 to F)				Clear the latest event	Reset encoder counter	Reserved			Write request	Read request	Extended access disabled

*4: Extended access specification data (in extended access)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Index number or setting value number specification															
Unit No. of sensor unit connected to UC2-IOL								(Index number or setting menu number (lower byte))							

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Reserved					Byte length or target selection to access			Subindex number or target number							

*5: Extended access write data (in extended access)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Extended access write data															

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Extended access write data															

Appendix-2-4 List of Service Type Objects for Acyclic Communication

The object dictionary of service type in this product for acyclic communication is listed below.
For the mechanism of reading and writing using this service-type object, please refer to "3-4-2 How SDO Communication Reads and Writes".

Category	SDO read/ write from the EtherCAT Master	Index number		Sub-Index number	Reading/ writing attribute	Service description	Target specification method
Reading and writing the master parameters of this product	Read	2400 h to 25FF h	2400 h: Specify the master setting menu number 000 h 2401 h: Specify the master setting menu number 001 h • • • 25FF h: Specify the master setting menu number 1FF h	00 h to FF h	RO	Specify and read the target of the master setting value of this product. Specify with 2400 h + master setting menu number. Refer to *1 below for the read data.	• The "master setting menu number" of this product is specified by bits 0 to 11 (000 h to 1FF h) of the index number of this service type object. • The Sub-Index number of this service type object should be used to specify the "target number" of the master setting value.
	Write	3400 h to 35FF h	3400 h: Specify the master setting menu number 000 h 3401 h: Specify the master setting menu number 001 h • • • 35FF h: Specify the master setting menu number 1FF h	00 h to FF h	WO	Specify and write the target of the master setting value of this product. Specify with 3400 h + master setting menu number. Refer to *2 below for write data.	• The "master setting menu number" of this product is specified by bits 0 to 11 (000 h to 1FF h) of the index number of this service type object. • The Sub-Index number of this service type object should be used to specify the "target number" of the master setting value. • Specify the master setting value to the write data itself, beginning at the 0th byte of the write data in this service type object.

Category	SDO read/ write from the EtherCAT Master	Index number	Sub-Index number	Reading/ writing attribute	Service description	Target specification method
Pre-specification when reading the service data of the IO-Link device	Write	3300 h Note: The first index number for offset in this 3300 h need not be written in the following situations. • When the target index number does not exceed 00 h to FF h while reading the service data of the IO-Link device and • When converting service data which data length is 4 bytes or less to little endian, or when data length is 5 bytes or more It is advised to write 0 to 3300 h in advance or to double-check that 0 is the first index number for offset.	00 h	WO	Write the first index number for the offset of the IO-Link device's service data in this product. Refer to *3 below for write data. Note: The first index number for offset in this product must be written in the instances below. • When the target index number exceeds 00 h to FF h while reading the service data of the IO-Link device or • When the difference between the value written in the index number 3300 h of the service type object and the target index number exceeds 00h to FFh	• The first index number for offset of the IO-Link device is specified by the two bytes (0th byte and 1st byte) from the start of the write data at Sub-Index number 00h of this service type object. Low-order byte data is contained in the first byte (0th), and high-order byte data is contained in the second byte (1st). • Little endian format is applied to service data with a data length of 4 bytes or less.
			01 h	WO		• Ditto (writing at Sub-Index number 01 h of this service type object) • Regardless of data length, IO-Link device service data is handled as big endian.

Category	SDO read/ write from the EtherCAT Master	Index number		Sub-Index number	Reading/ writing attribute	Service description	Target specification method
Reading and writing service data of the IO-Link device	Read	5000 h to 5FFF h	5000 h to 50FF h: Target channel number 0 5100 h to 51FF h: Target channel number 1 • • • 5F00 h to 5FFF h: Target channel number F	00 h to FF h	RO	Specify and read the target of the service data of the IO-Link device. Specify a value of 5000 h to 5F00 h (channel numbers 0 to F) plus the addition of the index number (offset). Refer to *4 below for read data	• The channel number of the IO-Link device is specified by bits 8 to 11 (n0nn h to nFnn h) of the Index number of this service type object. • In order to specify the "index number to be read" of the service data of the IO-Link device, add bits 0 to 7 (00 h to FF h) of this object's index number as an offset value to the specification of the first index number for offset written in 3300 h. • Specify the "sub-index number" of the service data for the IO-Link device along with the sub-index number of this service type object. • The read data's endian is determined by the endian specification written at 3300 h.

Category	SDO read/ write from the EtherCAT Master	Index number		Sub-Index number	Reading/ writing attribute	Service description	Target specification method
Reading and writing service data of the IO-Link device	Write	3800 h to 380F h or 3810 h to 381F h	• Convert the IO-Link device data to little endian format: 3800 h: Target channel number 0 3801 h: Target channel number 1 • • • 380F h: Target channel number F or • Handle the IO-Link device data as big endian: 3810 h: Target channel number 0 3811 h: Target channel number 1 • • • 381F h: Target channel number F	00 h to FF h	WO	Specify and write the IO-Link device's service data target. Specify 3800 h (or 3810 h) + channel number. Refer to *5 below for write data.	• The channel number of the IO-Link device is specified by bits 0 to 3 (0 h to F h) of the Index number of this service type object. • The first two bytes of the write data in this service type object should be used to specify the "write target index number" of the service data for the IO-Link device. • The "sub-index number" of the service data for the IO-Link device is specified by the Sub-Index number of this service type object. • The endianness of the written data is specified by bit 4 of the Index number of this service type object. • 0: Little endian conversion • 1: Big endian conversion. • After the second byte of the write data in this service type object (beginning, next, next), specify the write data to service data of the IO-Link device.

Reads or writes the data below for each index number above.

*1: Readout data when the index number is 2400 h to 25FF h

Byte	Details	Notes
0	Read data from master set values	Offset +0 or no offset
+1		Offset +1
+2		Offset +2
: :		: :

*2: Write data when the index number is 3400 h to 35FF h

Byte	Details	Notes
0	Write data to master set value	Offset +0
+1		Offset +1
+2		Offset +2
: :		: :

*3: Pre-written data to be read when the index number is 3300 h

Byte	Details		Notes
0	First index number for offset of the service data of the IO-Link device	Low-order byte	When reading service data from an IO-Link device, if the target index number is greater than 00 h to FF h, the left two bytes of the write data itself, which are 3300 h, must be used to specify the first index number for offset in advance.
+1		High-order byte	

*4: Readout data when the index number is 5000 h to 5FFF h

Byte	Details	Notes
0	Readout data from the service data of the IO-Link device	-
+1		
+2		
: :		

*5: Write data when the index number is 3800 h to 380F h or 3810h to 381F h

Byte	Details		Notes
0	Target index number of the service data of the IO-Link device	Low-order byte	-
+1		High-order byte	
+2	Write data to service data of the IO-Link device		-
+3			
: :			

Reference) Target specification method in acyclic communication

What to do when specifying where in SDO communication is listed below.

● For reading and writing the master parameters of this product

Read/write	Target	Specification method
Read	Master setting menu number	Specified by bits 0 to 11 (000 h to 1FF h) of index numbers 2400 h to 25FF h.
	Target numbers	Specified by Sub-Index number from Index number 2400 h to 25FF h.
Write	Master setting menu number	Specified by bits 0 to 11 (000 h to 1FF h) of index numbers 3400 h to 35FF h.
	Target numbers	Specified by Sub-Index number from Index number 2400 h to 25FF h.

For reading and writing service data of the IO-Link device

- When reading the service data of the IO-Link device

Read/write	Target	Specification method
Write (pre-specified for reading)	First index number for offset	Specified at Sub-Index number 00 h or 01 h of Index number 3300 h by 2 bytes (0th byte and 1st byte) from the start of the write data itself.
	Endian specification for the IO-Link device data	• Little endian specification: Sub-Index number 00 h of Index number 3300 h • Big endian specification: Sub-Index number 01 h of Index number 3300 h
Read	IO-Link device channel number	Specified by bits 8 to 11 (n0nn to nFnn) of the index range 5000 to 5FFF (corresponding to channel number 0 to F h).
	Index number of the service data of the IO-Link device	For the offset of the service data of the IO-Link device written with the index number of 3300 h, add bits 0 to 7 (00 h to FF h) of the index number from 5000 h to 5FFF h to the specification of the first index number for offset. Note: When reading service data from an IO-Link device, if the target index number is between 00 and FFh, avoid writing the first index number for offset to 3300 h and proceed as if it were 0. It is advised to write 0 to 3300 h in advance or to double-check that 0 is the first index number for offset.
	Sub-index number of the service data of the IO-Link device	Specified by Sub-Index number from Index number 5000 h to 5FFF h (supports channel number 0 to F h).
	Endian of read data	Follows the endian specification written with the index number 3300 h.

- When writing service data for the IO-Link device

Read/write	Target	Specification method
Write	IO-Link device channel number	Specified by bits 0 to 3 (0 to F h) of the index range 3800 to 380F h (corresponding to channel number 0 to F h).
	Index number of the service data of the IO-Link device	Specified directly in the write data itself. Low-order byte is contained in the first byte (0th), and high-order byte is contained in the second byte (1st).
	Sub-index number of the service data of the IO-Link device	A sub-index number of the index numbers 3800 h to 380F h or 3810 h to 381F h is specified (supports channel number 0 to F h).
	Write data to service data of the IO-Link device	Specified after the second byte (start, next, next) of the write data itself.
	Endian specification of write data	For index numbers 3800 h to 380F h or 3810 h to 381F h, specify "endian of write data" in bit 4. (supports channel numbers 0 to F h). • 0: Little endian conversion • 1: Big endian conversion

Refer to "Appendix-3-1 For Omron EtherCAT Master" for an illustration of how to use the SDO communication instruction in practice with an EtherCAT Master.

Appendix-3 Method of Communicating with Each Company's EtherCAT Master

Here is described an example of a procedure when this product communicates with a representative EtherCAT Master shown below.

- Omron: NX1P2 built-in EtherCAT port

Appendix-3-1 For Omron EtherCAT Master

Configuration of Host Devices

Example of Used Procedure

Actual SDO Communication

The following is a specification example for using the SDO communication command (EC_CoESDORead command, EC_CoESDOWrite command) of OMRON's EtherCAT Master to read and write the master setting value of this product or the service data of the attached IO-Link device.

Reading and writing the master parameters of this product

- Example) When reading the value of channel 5 of this product's master setting value "M10. I/O function setting"

SDO object	Variable name of EC_CoESDORead command of Omron master	Value	Details
Index	SdoObj.Index	240A h	This value is the result of multiplying the index number 2400 h used to read the master setting value of this product by the master setting menu number 10 (0A h).
Sub-Index	SdoObj.Subindex	05 h	Specify channel number 5 as the target number.
Readout data storage destination	ReadDat	(Example) ReadBuf	ReadBuf is a BYTE type array variable. The variable name is one example. Specify the storage destination of the read data.
Read data byte count	ReadSize	---	When the read is complete, the number of bytes of data read is stored.

- Example) When writing value 3 to channel 1 of this product's master setting value "M31. Automatic storage of set values"

SDO object	Variable name of EC_CoESDOWrite command of Omron master	Value	Details
Index	SdoObj.Index	341F h	The master setting value for this product was calculated by adding the master setting menu number 31 (1F h) to the index number 3400 h.
Sub-Index	SdoObj.Subindex	01 h	Specify channel number 1 as the target number.
Write data storage destination	WriteDat	(Example) WriteBuf	WriteBuf is a BYTE type array variable. The variable name is one example. Save the value 3 that will be written beforehand in the array variable WriteBuf[0].
Number of data bytes written	WriteSize	1	Specify 1 because the written data is 1 byte.

Reading and writing service data of the IO-Link device

- Example) When reading the values of index number 64 and sub index number 1 of the service data of the IO-Link device on channel B

SDO object	Variable name of EC_CoESDORead command of Omron master	Value	Details
Index	SdoObj.Index	5B40 h	This value is obtained by adding the service data reading index number 5000 h of the linked IO-Link device to 0B00 h, the channel number B h multiplied by 256, to obtain 5B00 h, and then adding the service data index number 64 (40 h). *The value of the index number of the service data to which the value is added is read if the index number 3300 h of the service type object specifies the first index number for offset. Therefore, write 0 to the index number 3300 h as needed.
Sub-Index	SdoObj. Subindex	01 h	The sub-index number of the service data of the IO-Link device is specified.
Readout data storage destination	ReadDat	(Example) ReadBuf	ReadBuf is a BYTE type array variable. The variable name is one example. Specify the storage destination of the read data.
Read data byte count	ReadSize	---	When the read is complete, the number of bytes of data read is stored.

- Example) When reading the values of index number 1000 and sub index number 10 of the service data of the IO-Link device on channel E

It is required to write the first index number for offset to this product before actually reading in this example since the goal index number 1000 (03E8 h) exceeds 255 (FF h).

SDO object	Variable name of EC_CoESDOWrite command of Omron master	Value	Details
Index	SdoObj.Index	3300 h	This is the first index number for offset while reading the service data from the linked IO-Link device. It comes from the service type object. Specify the first index number for offset with write data.
Sub-Index	SdoObj. Subindex	00 h or 01 h	When handling data that is 4 bytes or less, specify 00 h for little endian conversion and 01 h for big endian conversion.
Write data storage destination	WriteDat	(Example) WriteBuf	WriteBuf is a BYTE type array variable. The variable name is one example. Write the first index number for offset. Example) Store the values below in advance in the array variable WriteBuf. • WriteBuf[0]: Low-order data E8 h of index number 03E8 h of the IO-Link device • WriteBuf[1]: High-order data 03 h of index number 03E8 h of the IO-Link device
Number of data bytes written	WriteSize	2	Specify 2 because the written data is 2 bytes.

Next, perform the actual read.

SDO object	Variable name of EC_CoESDORead command of Omron master	Value	Details
Index	SdoObj.Index	5E00 h	To read the service data of the connected IO-Link device, multiply channel number E h by 256 to get 0E00 h, then add that number to 5000 h to get 5E00 h. The service data's index number 1000 is determined by adding 00 h of bits 0 to 7 of this 5E00 h to the 03E8 h previously established by index number 3300 h.
Sub-Index	SdoObj. Subindex	0A h	Specify the sub-index number 10 (0A h) of the service data of the IO-Link device.
Readout data storage destination	ReadDat	(Example) ReadBuf	ReadBuf is a BYTE type array variable. The variable name is one example. Specify the storage destination of the read data.
Read data byte count	ReadSize	---	When the read is complete, the number of bytes of data read is stored.

- Example) When writing a value of 500 to the service data of index number 1000 and sub-index number 11 of the IO-Link device on channel 3

SDO object	Variable name of EC_CoESDOWrite command of Omron master	Value	Details
Index	SdoObj.Index	3803 h	Add the channel number 3 to the associated IO-Link device's service data write index number 3800 h.
Sub-Index	SdoObj. Subindex	0B h	Specify the service data of the IO-Link device's sub-index number 11 (0B h).
Write data storage destination	WriteDat	(Example) WriteBuf	WriteBuf is a BYTE type array variable. The variable name is one example. Store the values below in advance in the array variable WriteBuf. • WriteBuf[0]: Low-order byte data E8 h of index number 03E8 h of the IO-Link device • WriteBuf[1]: High-order byte data 03 h of index number 03E8 h of the IO-Link device • WriteBuf[2]: Low-order byte data F4 h of the write data 500 (01F4 h) • WriteBuf[3]: High-order byte data 01 h of the write data 500 (01F4 h)
Number of data bytes written	WriteSize	4	Specify 4 because the written data is 4 bytes.

Appendix-4 Index

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FASTUS

Attention: Not to be Used for Personnel Protection.

Never use these products as sensing devices for personnel protection. Doing so could lead to serious injury or death.
These sensors do not include the self-checking redundant circuitry necessary to allow their use in personnel safety applications.
A sensor failure or malfunction can cause either an energized or de-energized sensor output condition.
Please consult our distributors about safety products which meet OSHA, ANSI and IEC standards for personnel protection.

- Specifications are subject to change without prior notice.
- Specifications and technical information not mentioned here are written in Instruction Manual. Or visit our website for details.
- All the warnings and cautions to know prior to use are given in Instruction Manual.

OPTEX FA CO., LTD.

91 Chudoji-Awata-cho Shimogyo-ku Kyoto 600-8815 JAPAN
TEL. +81-75-325-1314 FAX. +81-75-325-2936
https://www.optex-fa.com

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