0809861

FASTUS
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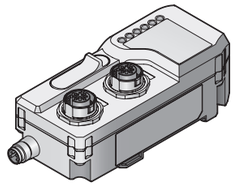
INSTRUCTION MANUAL

EtherNet/IP Communication Unit

UC1-EP



CE UKCA

OPTEX FA CO.,LTD.

- Thank you for purchasing this UC1-EP EtherNet/IP communication unit.
- Before using this product, please read this manual carefully to ensure proper use.
- Read this manual thoroughly, and then keep this manual at hand so that it can be used whenever necessary.
- The warranty period of this product is one year after delivery. However, any fault attributable to natural disasters or any other similar disasters or modification or repair will be excluded from the scope of the warranty.

Safety Precautions

Safety precautions for ensuring safe operation of this product are displayed as follows with the following symbols.
Precautions listed here describe important information about safety. Make sure to follow them accordingly.

Safety Symbols

⚠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 result in minor injury or property damage.

⚠WARNING

	Do not disassemble, repair, modify, deform under pressure, or attempt to incinerate this product. Doing so may cause injury or fire.
	This product is not explosion-proof and should not be used around flammable or explosive gases or liquids. Doing so may cause ignition resulting in an explosion or fire.
	Do not use air dusters or any spray that uses flammable gas around the product or on the inside of the product. Doing so may cause ignition resulting in an explosion or fire.
	Do not install this product in any of the following locations. Doing so may cause a fire, damage, or a malfunction. 1. Locations where dust, salt, iron powders, or vapor (steam) is present. 2. Locations subjected to corrosive gases or flammable gases. 3. Locations where oil or chemical splashes may occur. 4. Locations where heavy vibrations or impacts may occur. 5. Locations where the ambient temperature exceeds the rated range. 6. Locations subject to rapid temperature changes (or where condensation occurs). 7. Locations with strong electric or magnetic fields. 8. Outdoor locations or locations subject to direct light.
	This is a class A product. In a domestic environment this product may cause radio interference, in which case the user may be required to take adequate measures.
	This product is not intended for use with nuclear power, railways, aviation, vehicles, medical equipment, food-handling equipment, or any application where particular safety measures are required. Absolutely do not use this product for any of these fields.
	This product cannot be used in applications that directly or indirectly detect human bodies for the purpose of ensuring safety. Do not use this product as a detection device for protecting the human body.
	What to do in the event of a malfunction such as smoke being emitted from the product If you detect any malfunction including emission of smoke, abnormal smells or sounds, or the body becoming very hot, immediately stop operating the product and turn off the sensor power. Failure to do so may cause a fire. Repairing the product is dangerous and should in no way be performed by the customer. Contact an OPTEX FA sales representative for repairs.

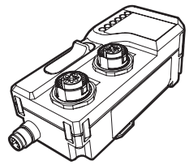
⚠CAUTION

- Make sure to turn the power off before wiring the cable or connecting/disconnecting the connector. Connecting or disconnecting while energized may damage the product or cause electric shock.
- Do not wire with high voltage cables or power lines. Doing so may cause malfunction or damage by induction.
- Do not bend the cable when below the freezing point. This may cause the cable to break.
- Do not drop the product or subject the product to strong impacts. Doing so may damage the product.
- Follow the instructions in this manual or the specified instruction manual when wiring the product or the dedicated controller for the correct wiring method. Incorrect wiring can damage the product or the controller, or cause a malfunction.
- When disconnecting the connector, be careful not to touch the terminals inside the connector, and do not allow foreign objects to enter the connector.
- Install this product as far away as possible from high-voltage equipment, power equipment, equipment that generates large switching surges, inverter motors, welders, or any equipment that can be a source of noise.
- When connecting or disconnecting the cable, make sure to hold it by the connector portion, and do not apply excessive force to the cable.

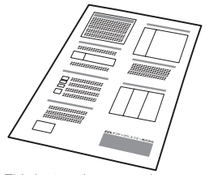
NOTICE

- After carefully considering the intended use, required specifications, and usage conditions, install and use the product within the specified ranges.
- All specifications may be changed without notice.
- When using this product, it is the responsibility of the customer to ensure necessary safety designs in hardware, software, and systems in order to prevent any threat to life, physical health, and property due to product malfunction or failure.
- Do not use this product for the development of weapons of mass destruction, for military use, or for any other military application. Moreover, if this product is to be exported, comply with all applicable export laws and regulations, including the "Foreign Exchange and Foreign Trade Act" and the "Export Administration Regulations," and carry out the necessary procedures pursuant to the provisions therein.
- For more details on conformity to the Restriction of Hazardous Substances Directive for this product, please contact an OPTEX FA sales representative. Before using this product, fully examine the applicable environmental laws and regulations, and operate the product in conformity to such laws and regulations. OPTEX FA does not assume any responsibility for damages or losses occurring as a result of noncompliance with applicable laws and regulations.

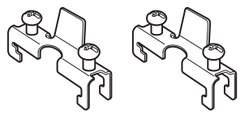
1. Included Accessories



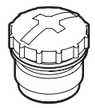
UC1-EP



This instruction manual

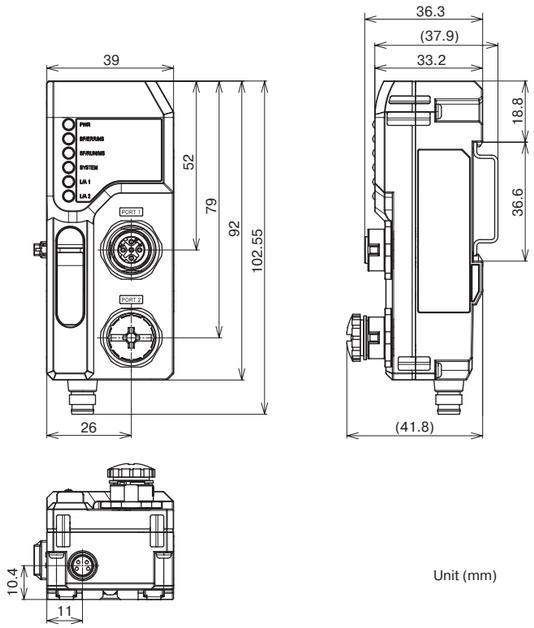


End plates (2)



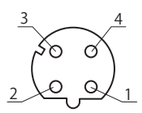
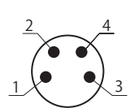
Protective cap (1)

2. Dimensions



Unit (mm)

3. Connector Pin Layout

	Ethernet connector (M12)	Power connector (M8)
1	Tx+	12 to 24 VDC
2	Rx+	Not used
3	Tx−	GND
4	Rx−	Not used
		

Connect this unit with no voltage applied (0 V).

4. Installation

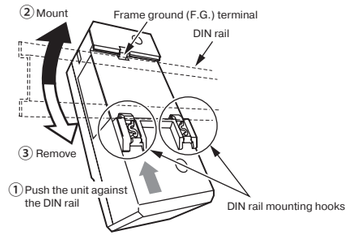
Installing to DIN rail

Install the unit on a grounded DIN rail whose surface can transmit power, and in the same way, install the fiber amplifiers and connect them.

Tips

Remove the power cable before proceeding with installation. In particular, make sure there is no power being transmitted when connecting and disconnecting the unit and devices that can be connected to it.

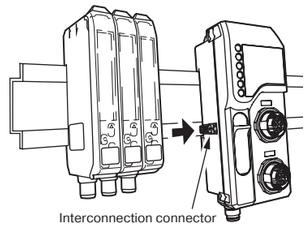
Align the DIN rail mounting hooks on the lower part of the back of the unit with the bottom of the DIN rail, and while pushing against the DIN rail in the direction indicated in ① below, set the unit onto the rail as indicated in ②.



Tips

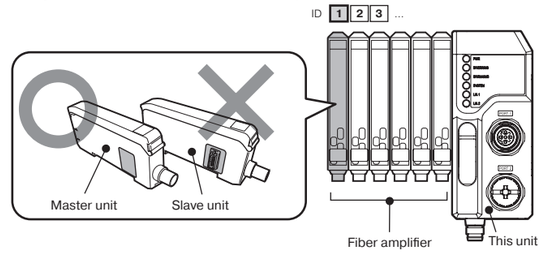
- If the installation on the DIN rail is incomplete, defects may occur in the connections with supported sensors and in the connection to the FG terminal.
  Check whether the DIN rail mounting hooks are firmly locked and whether the unit is securely mounted on the DIN rail.
- To remove the unit from the DIN rail, push the unit against the DIN rail in the direction indicated with ① and tilt the unit in the direction indicated with ③.

Mount the fiber amplifiers on the DIN rail in the same way, and connect them to the unit.

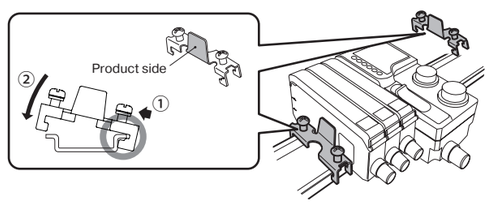


Tips

When connecting the unit to digital fiber amplifiers, make sure to connect a master unit on the left end (ID = 1). If a slave unit is connected on the left end, the interconnection connector will be exposed, causing interference with the end plate. Also, fouling or damage on the interconnection connector may damage the fiber amplifiers.

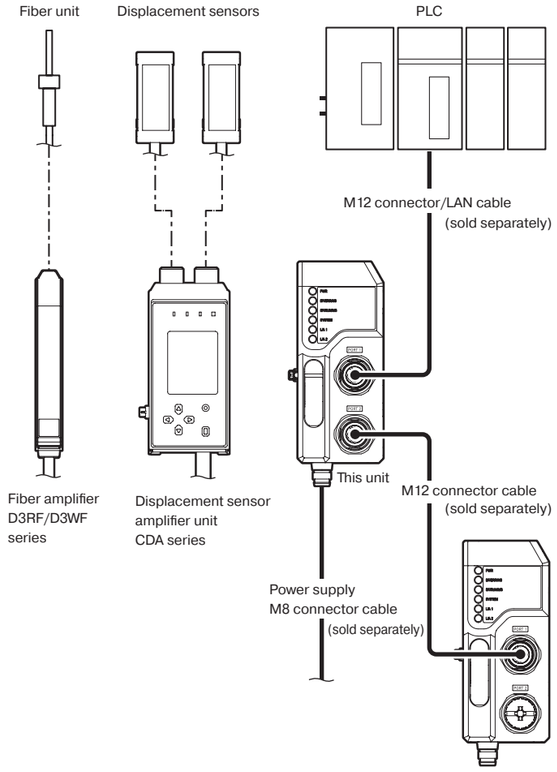


Attach end plates so as to sandwich the interconnected units, and secure with screws.
The tightening torque should be 0.9 N·m or less.
Orient the end plates so that the product side is against the unit and the fiber amplifiers, making sure to attach the left and right sides in opposite orientations. Attach the end plates by hooking the notched side on the DIN rail first, as shown in the following diagram.



5. System Configuration Diagram

To use this unit, connect it to D3RF/D3WF series fiber amplifiers or CDA series displacement sensor amplifier units.



- This unit can be connected to up to a total of 16 sensors and fiber units. (Up to 16 fiber amplifiers and up to 8 displacement sensor amplifier units)
- The power supply connections vary between the devices that are connected.
  See **6. Connecting** for details.

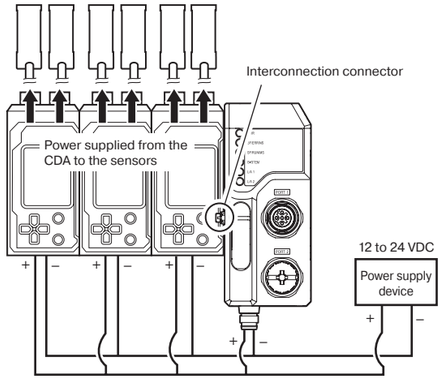
* When not connecting to another slave device, connect the protective cap to PORT 2.

6. Connecting

Connecting power cables

The unit (UC1-EP) operates with power (12 to 24 VDC) connected to the external power connector.
Make sure to check the wiring to the power supply device because incorrect wiring may cause a fire or damage the product

Power supply when using the UC1-EP + CDA combination



The power for the UC1-EP and all of the interconnected CDAs must be supplied from the same power supply.

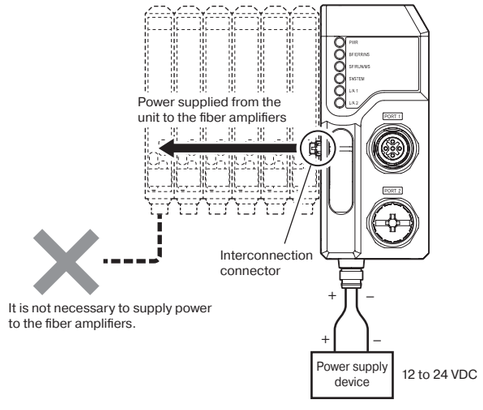
An external power supply separate from that for the unit (UC1-EP) must be connected to the CDA. In this situation, the interconnection connector of the unit is used only for communication.
Also, power is supplied to the displacement sensors from the CDA. The unit can be connected to CDA master units and slave units. When connecting the unit to CDA units, make sure to connect the master unit on the left end. If a slave unit is connected on the left end, the interconnection connector will be exposed, damaging the product.

⚠ CAUTION

Connect all the power supply wires (brown/blue) of the connected CDA to the same power supply device. Wiring the external power supply to the UC1-EP with the factory default status (in which the wires are bundled) without wiring the external power supply to the CDA (when connected to the UC1-EP) will short-circuit the CDA.
To prevent short-circuits, wire the external power supply in the following order: 1) CDA, 2) UC1-EP.

- The external power supply to the UC1-EP can be omitted.
- Ensure that the length of the power cable to the unit (UC1-EP) and to the CDA series is 30 m or less.

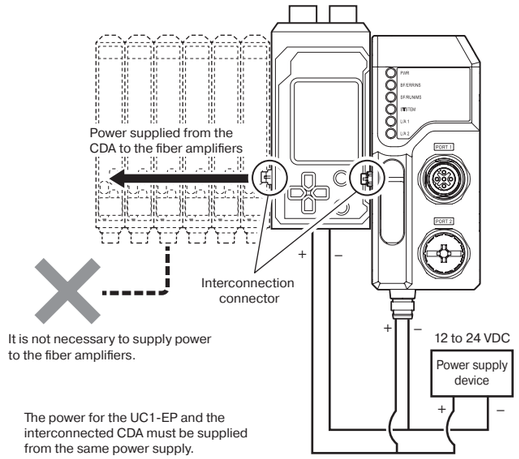
Power supply when using the UC1-EP + fiber amplifier combination



⚠ CAUTION

- It is not necessary to supply power to the fiber amplifiers.
- Do not use the cable type for the fiber amplifier master unit.
- Ensure that the length of the power cable to the unit (UC1-EP) is 30 m or less.

UC1-EP + CDA + fiber amplifier combination



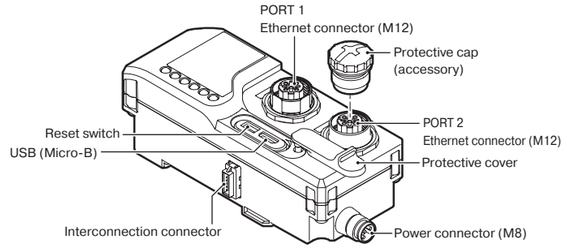
The power for the UC1-EP and the interconnected CDA must be supplied from the same power supply.

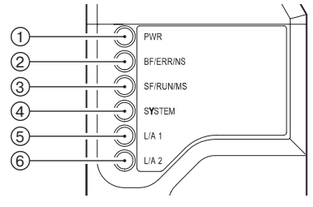
When connecting the unit (UC1-EP) to fiber amplifiers and a CDA unit, make sure to connect all the fiber amplifiers as a group on the left of the CDA unit. For the CDA, only the slave unit (CDA-S) is required. Also, one fiber amplifier master unit must be connected on the left end.

⚠ CAUTION

- Provide the external power supply to the CDA from the same power supply device as the unit (UC1-EP).
- Regardless of the connection configuration, it is not necessary to supply power to the fiber amplifiers.
- Do not use the cable type for the fiber amplifier master unit.
- Ensure that the length of the power cable to the unit (UC1-EP) and to the CDA series is 30 m or less.

7. Part Names





	Name	Indication		Details
①	PWR	Green	●	Power supply on
			○	Power supply off
②	NS (network status)	Red/Green	○	Power supply off or IP address not set
		Red/green (alternating)	◐	Self-test when power supply turned on
		Red	◐	Connection timeout
			●	IP address duplication
		Green	◐	Not connected
			●	Connected
③	MS (module status)	Red/green (alternating)	◐	Self-test when power supply turned on
		Red	●	Error (no device operation)
			◐	Warning (device operation in progress)
		Green	◐	No IP address assigned with device in standby status
			◐	Device in operation
④	SYSTEM	Green	○	Device not configured
			●	Device is running
⑤	L/A1 (Link/Activity 1)	Green	○	No network connection at connection 1
			●	Network connection at connection 1
⑥	L/A2 (Link/Activity 2)	Green	○	No network connection at connection 2
			●	Network connection at connection 2

8. Error Codes

All device errors are stored in a Service Data Object.

9. Specifications

Model		UC1-EP
EtherNet/IP specifications	Supported version	EtherNet/IP adapter
	Certification version	CT16
	Regulatory compliance	IEEE802.3u
	Distance between nodes	100 m max.
	Baud rate	10/100 Mbps
	Cable	STP Category 5 or higher
	Supported functions	Implicit message (Class 1) Explicit message (Class 3, UCMM) ACD (Address Conflict Detection) DLR (Device Level Ring) IP address setting (fixed IP, DHCP, BOOTP)
	No. of connections	8
	Packet interval (RPI)	1-3200 ms
Connected devices	Connectable models	D3RF/D3WF series inter-connection master unit and slave unit CDA series master unit and slave unit
	No. of connectable units	Up to 16 units*1 (One CDA unit requires two spaces)
	Connection type	5-pin connector for linking (functions as a linking end unit)
Indicators		Power indicator, green (PWR)
		Network status indicator, red/green (NS)
		Module status indicator, red/green (MS)
		Operation indicator, green (SYSTEM)
		PORT 1 indicator, green (L/A 1)
		PORT 2 indicator, green (L/A 2)
Data		Implicit message (sending: max. 40 bytes, receiving: 4 bytes) Explicit message
Ratings	Supply voltage	12 to 24 VDC, including ±10% ripple (p-p)
	Power consumption	Max. 3 W
Protection circuit		Reverse connection protection
Warm-up time		1.5 s or less
Environmental resistance	Ambient temperature/ humidity	−25 to +55°C/35 to 85%RH (no freezing or condensation)
	Storage temperature/ humidity	−40 to +70°C/35 to 85%RH (no freezing or condensation)
	Vibration resistance	10 to 55 Hz; double amplitude 1.5 mm; 2 hours in each of the X, Y, and Z directions
	Shock resistance	500 m/s² (approx. 50 G), 3 times in each of the X, Y, and Z directions
	Degree of protection	IP50
Applicable regulations	EMC	EMC Directive (2014/30/EU)
	Environment	RoHS Directive (2011/65/EU), China RoHS (MIIT Order No.32)
Applicable standards		EN 61000-6-2, EN 55011
Company standards		Noise resistance: Feilen Level 3 cleared
Installation		35 mm DIN rail (whose surface should be conductive)
Material		PC
Included accessories		Instruction manual, Protective cap, End plates (2)

Ambient temperature	−25 to +55°C	−25 to +50°C	−25 to +45°C
Number of connectable fiber amplifiers	1 to 3	4 to 8	9 to 16

*1: The maximum number of connectable fiber amplifiers varies depending on the ambient temperature.

UL Satisfaction Ratings

*The total control output current and ambient temperature will be restricted as follows depends on the number of the sensor amplifiers and units connected to this unit.

Up to 3 units
Input : 12 - 24Vdc, Max. 1.02A Class 2
Output : 12 - 24Vdc, Max. 0.8A Class 2
Maximum Surrounding Air Temperature +55℃

Up to 8 units
Input : 12 - 24Vdc, Max. 1.02A Class 2
Output : 12 - 24Vdc, Max. 0.8A Class 2
Maximum Surrounding Air Temperature +50℃

Up to 16 units
Input : 12 - 24Vdc, Max. 1.02A Class 2
Output : 12 - 24Vdc, Max. 0.8A Class 2
Maximum Surrounding Air Temperature +45℃

This device complies with part 15 of the FCC Rules.
Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

*This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

- Support for the China RoHS directive

For details on the support for the China RoHS (the Administrative Measure on the Control of Pollution Caused by Electronic Information Products), see the following website.
https://www.optex-fa.com/rohs_cn/

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https://www.optex-fa.com

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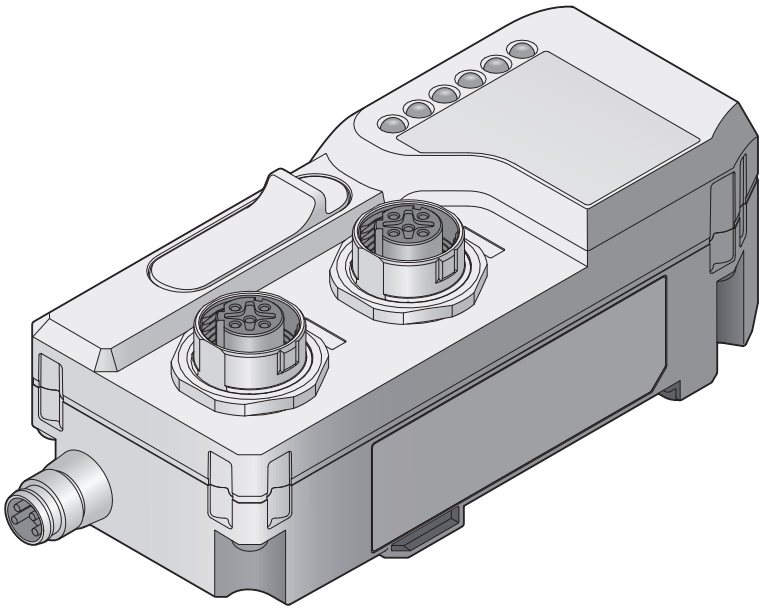
FASTUS

*FASTUS is a product brand of Optex FA.

EtherCAT Communication Unit

UC1-EC

User's Manual



OPTEX FA CO., LTD.

Introduction

Thank you for purchasing the UC1-EC EtherCAT Communication Unit.
This manual contains the information necessary for using the UC1-EC EtherCAT Communication Unit. Read this manual thoroughly before using the product to ensure correct product use with full understanding of the functions and performance of the product. Also, after you have finished reading this manual, store it safely for future reference.

• Trademarks and registered trademarks appearing in this manual are the property of their respective owners.
• The copyright of this user's manual is owned by Optex FA Co., Ltd. All the contents contained herein are protected by copyright law. Unauthorized copying of this manual is strictly prohibited.

Safety Precautions

This manual uses the following symbols to display safety precautions for ensuring safe operation of the UC1-EC EtherCAT Communication Unit.
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

⚠Warning	
	Do not disassemble, repair, modify, deform under pressure, or attempt to incinerate this product. Doing so may cause injury or fire.
	Do not use this product in water or in a location where it may be exposed to water. Do not use this product if wet. Doing so may cause a fire or damage the product.
	This product is not explosion-proof and should not be used around flammable or explosive gases or liquids. Doing so may cause ignition resulting in an explosion or fire.
	Do not use air dusters or any spray that uses flammable gas around the product or on the inside of the product. Doing so may cause ignition resulting in an explosion or fire.
	Do not use this product in environments other than industrial environments. If used in other environments, it may cause induction and radiation interference.
	Do not install this product or its cables in any of the following locations. Doing so may cause a fire, damage, or a malfunction. 1. Locations where dust, salt, iron powders, or vapor (steam) is present. 2. Locations subjected to corrosive gases or flammable gases. 3. Locations where water, oil, or chemical splashes may occur. 4. Locations where heavy vibrations or impacts may occur. 5. Locations where the ambient temperature exceeds the rated range. 6. Locations subject to rapid temperature changes (or where condensation occurs). 7. Locations with strong electric or magnetic fields. 8. Outdoor locations or locations subject to direct light.
	Do not use the product at voltages or with AC power supplies that exceed the rated voltage. Doing so may cause a fire or damage the product.

⚠Warning

	What to do in the event of a malfunction such as smoke being emitted from the product If you detect any malfunction including emission of smoke, abnormal smells or sounds, or the body becoming very hot, immediately stop operating the product and turn off the power. Failure to do so can cause fire. Repairing the product is dangerous and should in no way be performed by the customer. Contact an Optex FA sales representative for repairs.
	What to do if water enters the product If water or any other liquid enters the product or the cable, immediately stop operating the product and turn off the power. Using the product in this condition may cause a fire.

⚠Caution

	Do not touch this product or the cable with wet hands. Doing so may damage the product.
	When wiring this product, do so properly according to this manual and specified instruction manuals. Incorrect wiring can cause product failure or malfunction.
	Connect only specified cables to this product. Use of cables other than those specified can cause malfunction.
	Keep wiring separate from high voltage and motor circuits. Using the same wiring can cause malfunction or failure. If this is unavoidable, shield with a conductor such as an earthed conduit.
	Install this product as far away as possible from high-voltage equipment, equipment that generates large switching surges and equipment that generates noise, such as welding machines or inverter motors.
	Use this product with the included end plate mounted to the DIN rail. Make sure locking mechanisms are locked before use.
	Tighten mounting screws with the torque values specified in this manual.
	Do not apply torsional stress to cables. Doing so can cause cables and connectors to malfunction. Secure the communications cable drawn out of this product within lengths of 30 cm to ensure no load is applied to the product.
	Do not drop this product or subject it to strong impact or vibrations. Doing so can cause malfunction.
	This product generates heat during operation, so do not maintain physical contact for long periods of time. Doing so can cause low-temperature burns, etc.
	Use this product within the rated range.

⚠Caution	
	Do not cut power during communication.
	Changing the ID number for the addition of the sensor-amplifier requires changing the variables and programs on the master side. If there is a change in the ID number after you add a sensor-amplifier, make sure to change the variables or programs on the master side.
	Set the correct module configuration (i.e., sensor-amplifier and sensor configuration) in the master-side configuration software and download it to this unit. If this has not been downloaded, even if configured differently, this unit can be operated in OPERATIONAL status as long as the number of sensor-amplifiers and sensors in the actual configuration accidentally matches the number of those in the module configuration set in the master.
	Make sure to connect D3□F to the left of CDA. If D3□F is connected to the right side of CDA, EtherCAT communication can be executed in OPERATIONAL status, but the current CDA value sent to the master and the CDA value set by master will be invalid.
	To add an applicable sensor-amplifier to this unit after the system is operational, turn OFF the power of this unit.
	Make sure to turn OFF the power before connecting or disconnecting cables and connectors. Connection or disconnection while running can cause malfunction.
	Always hold the connector when connecting or disconnecting cables and do not apply excessive force to cables.
	When removing a connector, do not touch the terminals inside the connector or allow foreign objects to get inside.
	Use conductive type DIN rail because the frame ground (FG) is grounded via the DIN rail.
	When using power cables or commercially available switching regulators, make sure the frame ground (FG) is grounded.
	Wait until after transient state (approx. 2 sec.) when power is turned ON before use.
	Make sure to attach the protective cap when the connector of this unit is not attached to a cable.
	Make sure to use an isolation transformer for DC power supply.
	If a surge occurs in the power supply used, use a surge absorber for the source of generation.

Maintenance

Do not use thinner, benzene, acetone or kerosene to clean devices.

Handling Precautions

(1) After carefully considering the intended use, required specifications, and usage conditions, install and use the product within the specified ranges.
(2) Due to advances in technology, published content, including the hardware, software, and system information published in this user's manual, is subject to change without notice.
(3) When using this product, it is the responsibility of the customer to ensure necessary safety designs in hardware, software, and systems in order to prevent any threat to life, physical health, and property due to product malfunction or failure.
(4) This product is not intended for use with nuclear power, railways, aviation, vehicles, medical equipment, food-handling equipment, or any application where particular safety measures are required. Absolutely do not use this product for any of these fields.
(5) This product cannot be used in applications that directly or indirectly detect human bodies for the purpose of ensuring safety. Do not use this product as a detection device for ensuring human safety.
(6) Do not use this product for the development of weapons of mass destruction, for military use, or for any other military application. Moreover, if this product is to be exported, comply with all applicable export laws and regulations, including the "Foreign Exchange and Foreign Trade Act" and the "Export Administration Regulations," and carry out the necessary procedures pursuant to the provisions therein.
(7) For more details on conformity to the Restriction of Hazardous Substances Directive for this product, please contact an Optex FA sales representative.
Before using this product, fully examine the applicable environmental laws and regulations, and operate the product in conformity to such laws and regulations.
Optex FA does not assume any responsibility for damages or losses occurring as a result of noncompliance with applicable laws and regulations.

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.

Notes on overseas regulations and standards

CE Marking

This product complies with the following EN standards of the EMC directive.

Emission

EN 55011:2009+A1:2010 (Group 1, Class A, ≤ 20 kVA)
EN 61131-2:2007
EN 61000-6-4:2007+A1:2011

Immunity

EN 61131-2:2007

EN 61000-6-2:2005

To use this product as an EN standard compliant product, make sure to observe the following installation specifications.

- Install in a conductive enclosure (control panel, etc.).
- Use a power supply cable of 30 m or less.

Related Manuals

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

Manual name	Details
Digital Fiber Sensor D3RF Series Instruction Manual	Instruction manual included with digital fiber sensor, D3RF series (inter-connection type). Reference when interconnecting this unit with the D3RF series.
Digital Fiber Sensor D3WF Series Instruction Manual	Instruction manual included with digital fiber sensor, D3WF series (inter-connection type). Reference when interconnecting this unit with the D3WF series.
General-purpose Amplifier Unit CDA Series Instruction Manual	Instruction manual included with the general-purpose amplifier unit, CDA series. Reference when interconnecting this unit with the CDA series.
General-purpose Amplifier Unit CDA Series User's Manual	User's manual for the general-purpose amplifier unit, CDA series. Reference this instruction manual when interconnecting this unit with the general-purpose amplifier unit, CDA series.
Compact laser displacement sensor CD22 Series Instruction Manual	Instruction manual included with compact laser displacement sensor, CD22 series (RS-485 communication type). Reference when connecting the CD22 series with the CDA series.
Through-beam Edge Sensor TD1 Series Instruction Manual	The instruction manual included with the through-beam edge sensor, TD1 series. Reference when connecting the TD1 series with the CDA series.
Through-beam Edge Sensor TD1 Series User's Manual	The user's manual for the through-beam edge sensor, TD1 series. Reference this user's manual when interconnecting this unit with the through-beam edge sensor, TD1 series.

Manual Structure

Manual Configuration

This document consists of the following chapters.

1 Overview	This chapter describes an overview of the EtherCAT Communication Unit (hereafter referred to as “this unit”).
2 Installation and Wiring	This chapter describes inter-connection between this unit and applicable sensor-amplifier units, connection for EtherCAT communication, and wiring to the power supply.
3 Communication	This chapter describes the data configurations that this unit handles for EtherCAT communication, and provides examples of communication.
4 Specifications	This chapter describes the specifications of this unit.
5 Troubleshooting	This chapter describes troubleshooting methods for specific errors.
6 Appendix	This chapter describes how to install additional applicable sensor-amplifier units.

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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.

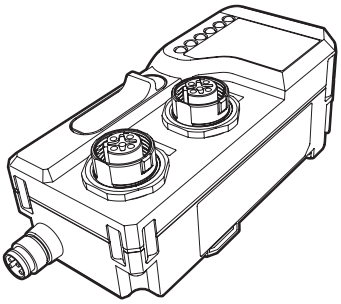
Generic term for the D3RF and D3WF fiber amplifiers

D3□F is used to indicate both D3RF and D3WF fiber amplifiers.

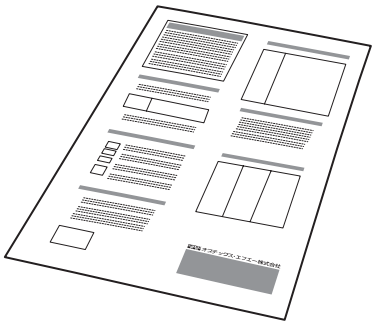
Checking the Included Items

Before you use this unit, check the items included with it. If there are any defective or damaged items, please contact our customer support center.

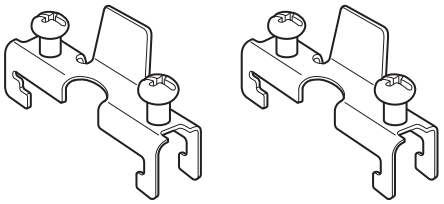
Items Included with This Unit



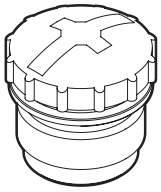
• UC1-EC



• Instruction manual



• End plate × 2



• Protective cap × 1

Other Required Items

Cables

The following cables are used with this unit.

Type	Specifications
EtherCAT cable	CAT5e or higher Ethernet cables that fulfill the following specifications • Upstream master EtherCAT cable: M12 connector / LAN cable • Downstream slave EtherCAT cable: M12 connector cable
Power supply cable	M8 connector cable for power supply M84CN-2S: 2 m, M84CN-5S: 5 m, M84CN-10S: 10 m

1

Overview

This chapter describes an overview of the EtherCAT Communication Unit (hereafter referred to as “this unit”).

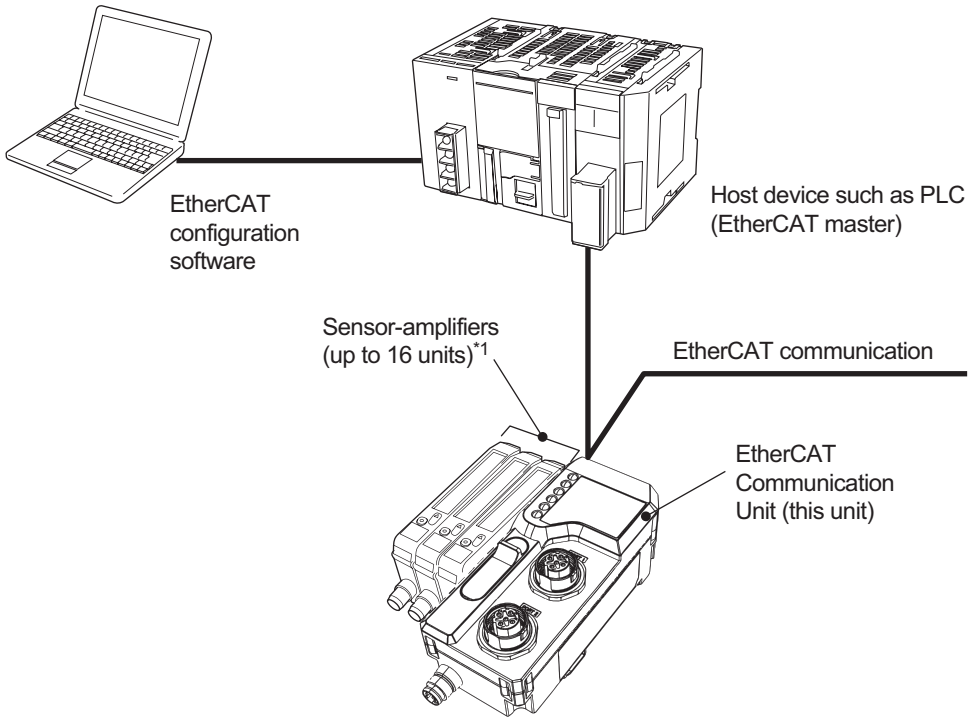
1-1 Product Overview

This unit is an EtherCAT communication slave used for communication between our sensor-amplifiers (hereafter referred to as the “applicable sensor-amplifiers”) and an EtherCAT master (e.g. PLC) manufactured by another company for ON/OFF output, monitoring of the detection amount, writing parameters, and performing operations of the sensors connected to the sensor-amplifiers.
Both PDO (cyclic) and SDO (mailbox) communications are supported.
This unit can be interconnected with up to 16*1 of the following applicable sensor-amplifiers.

- Fiber amplifier (inter-connection type)
- General-purpose amplifier unit

*1: The general-purpose amplifier can connect two sensors, thus occupying two sensors in one unit.

EtherCAT System Configuration Example



*1: The general-purpose amplifier can connect two sensors, thus occupying two sensors in one unit.

Type / Number of Applicable Sensor-Amplifier Units That Can Be Connected

The following applicable sensor-amplifier units can be connected to the EtherCAT system by interconnecting to this unit.

MEMO

For precautions on the configuration of this unit and applicable sensor-amplifiers and sensors, refer to “2-1 Configuration of This Unit and Applicable Sensor-amplifiers and Sensors” (Page 2-2).

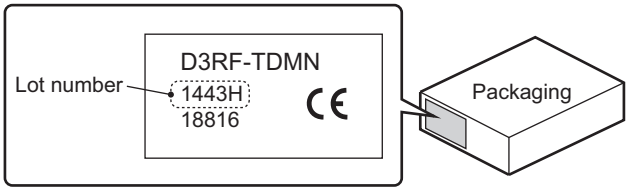
● D3RF / D3WF Fiber Amplifiers

Any combination of masters and slaves can be used between the D3RF and D3WF fiber amplifiers.
Hereafter, D3☐F is used to indicate both the D3RF and D3WF fiber amplifiers.

Product and series name	Type	Model*1	Number of occupied IDs per unit	Max. no. of interconnectable units
Digital fiber sensor, inter-connection type D3RF series*2	Connector type*3	• Interconnected master unit / 1 output: D3RF-TMC☐4 • Interconnected master unit / 2 outputs: D3RF-TDMC☐4 • Interconnected slave unit / 1 output: D3RF-TSC☐4 • Interconnected slave unit / 2 outputs: D3RF-TDSC☐4	1	16 *4
Digital fiber sensor, inter-connection type D3WF series	Connector type*3	• Interconnected master unit / 1 output: D3WF-TMC☐4 • Interconnected master unit / 2 outputs: D3WF-TDMC☐4 • Interconnected slave unit / 1 output: D3WF-TSC☐4 • Interconnected slave unit / 2 outputs: D3WF-TDSC☐4		

*1: The model in the ☐ is N for NPN specifications and P for PNP specifications. Some models listed here may not be supported depending on release date. Contact our sales office for more information.

*2: This unit is compatible with lot numbers after 1443■ (■: letter at the end is unrelated). Products with earlier lot numbers only support some functions. The D3RF lot number is indicated on the packaging as follows.



*3: This unit cannot be used with a cable type D3RF master unit or a D3WF master unit.

*4: The maximum number of units that can be interconnected depends on the maximum ambient temperature and the voltage flowing to the control output, as follows.

Maximum ambient temperature (°C)	55°C	50°C	45°C
Number of units that can be interconnected to the D3☐F (inter-connection type)	Up to 3	Up to 8	Up to 16

Voltage that flows to the D3☐F control output	Max.100 mA	Max.50 mA	Max. 0 mA (control output disabled)
Number of units that can be interconnected to the D3☐F (inter-connection type)	0 - 3	4 - 8	9 - 16

● CDA General-purpose Amplifier Units

When connecting a displacement sensor, connect a general-purpose amplifier unit to this unit.

Product and series name	Type	Model	Number of occupied IDs per unit	Max. no. of interconnectable units
General-purpose amplifier unit CDA series	Cable type	• Interconnected master unit: CDA-M / DM2 *1 • Interconnected slave unit: CDA-S	2	8*2

*1: The CDA-M / DM2 inter-connected master unit is only used when configured with only the CDA general-purpose amplifier units. When connecting the D3☐F fiber amplifier, make sure to select the CDA-S interconnected slave unit.

*2: Up to two displacement sensors can be connected to the general-purpose amplifier unit. Even if only one displacement sensor is connected, it will be recognized as two.

The following sensors can be connected to the CDA general-purpose amplifier unit (current as of August, 2019).

Product and series name	Type	Model
Compact laser displacement sensor CD22 series	RS-485 communication type and pig tail type	• CD22-15-485M12 • CD22-35-485M12 • CD22-100-485M122
Through-beam edge sensor TD1 series	-	• TD1-010M8 • TD1-010M8J

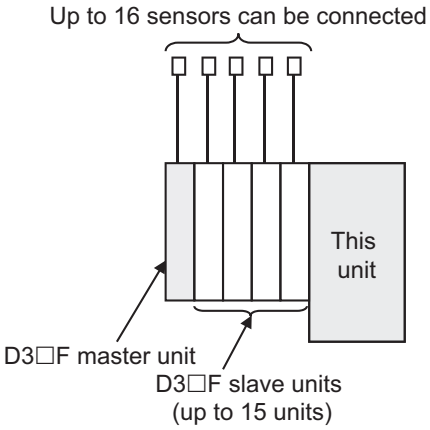
Note: Ultra high-accuracy laser displacement sensor CDX series cannot be connect to the CDA.

■ Interconnectable Configurations

The following configuration is valid when connecting applicable sensor-amplifier units.
Refer to “2-1 Configuration of This Unit and Applicable Sensor-amplifiers and Sensors” (Page 2-2) for further information.

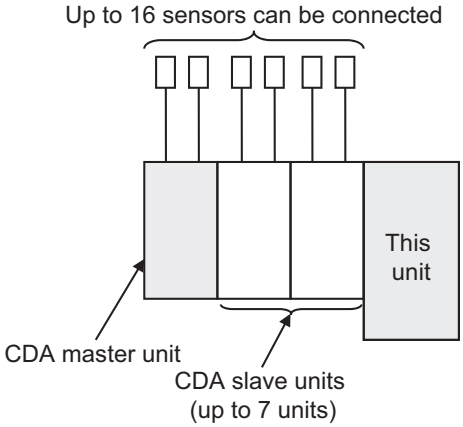
● When Only D3□F Fiber Amplifiers Are Interconnected

• When there are multiple D3□F, one D3□F master unit and up to 15 D3□F slave units can be connected.



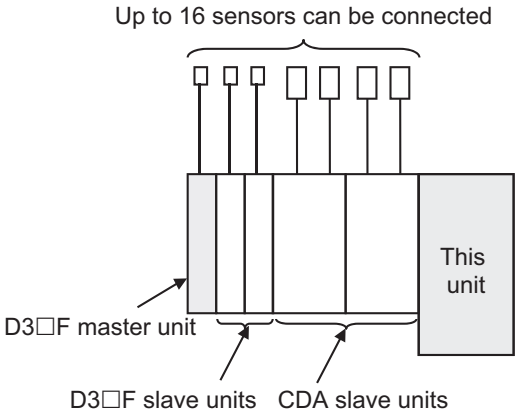
■ When Only CDA General-Purpose Amplifiers Are Interconnected

• When there are multiple CDA, one CDA master unit and up to seven CDA slave units can be connected.



When Both D3□F Fiber Amplifiers and CDA General-purpose Amplifiers Are Interconnected

- Connect all D3□F on the left side and all CDA on the right.
- Connect the D3□F master unit on end terminal on the left end.
- CDA slave units can be connected. CDA master units cannot be connected.
- Up to 16 sensors can be connected. The CDA occupies two D3□F slave units because two sensors can be connected.



MEMO

Sensor-amplifiers are assigned ID numbers starting from the left in order of interconnection position. The ID numbers are used to identify the sensor-amplifiers in PDO and SDO communication. Therefore, consider the configuration of applicable sensor-amplifier units by interconnection position, which is the ID number, particularly if future expansion is planned.
Refer to “2-1 Configuration of This Unit and Applicable Sensor-amplifiers and Sensors” (Page 2-2) for more information on ID numbers as well as applicable sensor-amplifier and sensor configuration limitations.
Refer to “6-1 Installing Additional Applicable Sensor-amplifier Units” (Page 6-2) for more information on limitations when adding applicable sensor-amplifier units.

Registration of Sensor-amplifier and Sensor Configuration

This unit supports the EtherCAT MDP (Modular Device Profile) function. MDP is a mechanism for managing the configuration of a modular (i.e., building block) slave as an EtherCAT slave of the combined module (in this case, the “sensor-amplifier” or “sensor”).
To use this unit, the configuration of sensor-amplifiers and sensors must be edited using EtherCAT master-side configuration software then downloaded to this unit. By doing this, the configuration can be registered, enabling EtherCAT communication with the master.

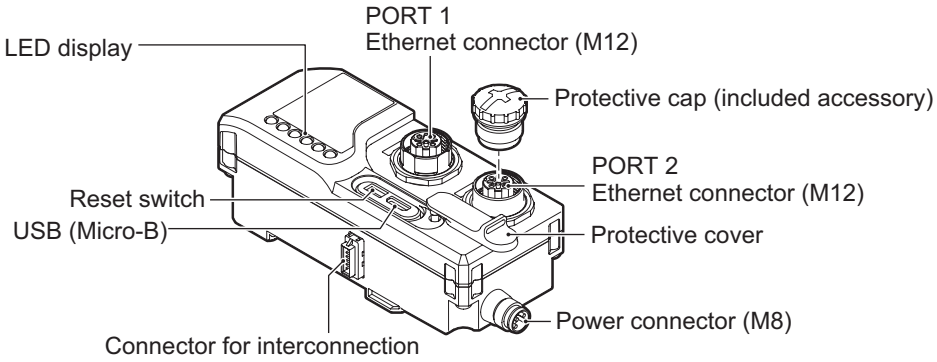
MEMO

Refer to “3-4-5 Data Stored in This Unit When Sensor-amplifier and Sensor Configuration is Downloaded” (Page 3-10) for further information.

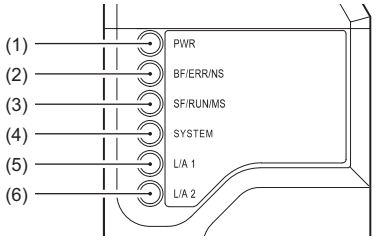
1-2 Part Names and Functions

The following is a description of the names of the parts of this unit and their functions.

UC1-EC Unit



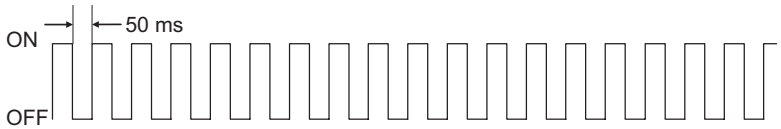
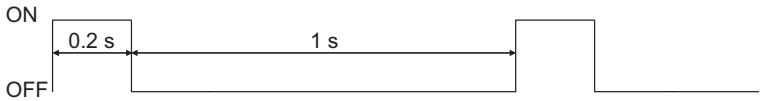
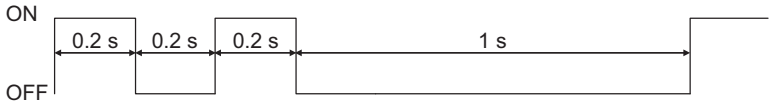
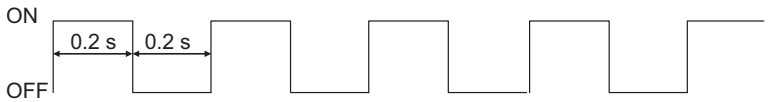
LED Display



Above figure number	LED	Details	Display		Meaning
(1)	PWR	Indicates whether or not power is being supplied to this unit.	Green	Lit	Voltage supply on
				Off	Voltage supply off
(2)	ERR (error)	Indicates abnormal EtherCAT communication status for this unit.	Red	Off	No error
				Flickering	Boot error
				Single flash	Synchronize error, communication data error
				Double flash	Application watchdog timeout
				Blinking	Communication settings error (refer to the memo below for further information)
				Lit	PDI watchdog timeout
(3)	RUN (communicating)	Indicates EtherCAT communication transition state of this unit.	Green	Off	INIT status
				Blinking	PRE-OPERATIONAL status
				Single flash	SAFE-OPERATIONAL status
				Lit	OPERATIONAL status
(4)	SYSTEM (communication ready)	Indicates communication status of this unit.	Green	Off	Not ready for communication (cannot connect)
				Lit	Ready for communication (able to connect)

Above figure number	LED	Details	Display		Meaning
(5)	L/A1 (Link / Activity 1)	Indicates PORT1 (IN) communication status.	Green	Off	PORT1 is not connected to the network
				Lit	PORT1 can be connected to the network but is not communicating
				Flickering	Connected to network and communicating
(6)	L/A2 (Link / Activity 2)	Indicates PORT1 (OUT) communication status.	Green	Off	PORT2 is not connected to the network
				Lit	PORT2 can be connected to the network but is not communicating
				Flickering	Connected to network and communicating

Note: LED blinking state

Name of blinking state	Blinking timing
Flickering	
Single flash	
Double flash	
Blinking	

Refer to “5-4 Troubleshooting List” (Page 5-6) in “Chap. 5 Troubleshooting” for troubleshooting based on blinking state of LED.

MEMO

A communication settings error is one of the following:

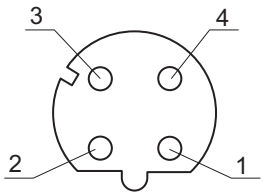
- If a module configuration (i.e., sensor-amplifier and sensor configuration) has already been downloaded to this unit using the master-side configuration software, the downloaded module configuration information does not match the actual configuration.
- If it has not been downloaded to this unit, the number of sensor-amplifiers and sensors actually configured differs from that of the module configuration set in the master.

EtherCAT Connectors (PORT1, PORT2)

Connect the M12 connector / LAN cable to the M12 connection 4 pin.

Connect a network cable from the EtherCAT master side to PORT1 of this unit.

When connecting other slave units, connect a network cable to PORT2 of this unit. When other slave units are not connected, put on the M12 protective cap.



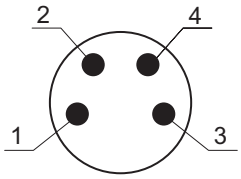
Pin	Terminal name	Function
1	Tx+	Transmitted data: +
2	Rx+	Received data: +
3	Tx-	Transmitted data: -
4	Rx-	Received data: -

MEMO

The EtherCAT node address of this unit is set from the master-side configuration software.

Power Connector

Pin arrangement of the power connector is as follows. Connect this unit when no voltage (0 V) is being supplied.



Pin	Terminal name	Function
1	24 V	Terminal for external power input from12 to 24 VDC. Allowable current is 2 A or under.
2	Not used	-
3	0 V	Terminal for external power input of 0 V.
4	Not used	-

Reset Switch

Press and hold for three seconds or more to restore the factory settings.

MEMO

The settings initialized with the reset switch are as follows. Refer to “3-6-2 Object Dictionary List for This Unit” (Page 3-17) for further information.

- Emergency message notification enabled/disabled (10F3 h sub-index 05 h)
- Unit error notification control (F200 h sub-index 01 h)

USB (Micro-B)

Not used. Do not connect anything to this port.

1-3 Basic Procedures

The procedures to install and configure this unit and start the EtherCAT communication are shown below.

Procedure	Details	References
Prior confirmation	• Check the model number and number of units for applicable sensor-amplifier units to be interconnected to this model (including ambient temperature range, which limits the number of units).	"Chap. 1 Overview" "Chap. 4 Specifications"
	• Check the position of interconnection with applicable sensor-amplifier units. (Changing the interconnection position affects the variables and programs on the master side, so consideration should be given to the possibility of future expansion.)	"2-1 Configuration of This Unit and Applicable Sensor-amplifiers and Sensors" (Page 2-2) "6-1 Installing Additional Applicable Sensor-amplifier Units" (Page 6-2)
	• Calculate power consumption • Connect power supply cable	"2-3-2 Wiring with the Power Supply Cable" (Page 2-8)
	• Whether or not the received light levels or measured values are read out with PDO (cyclic) communication (This is related to whether or not PDO mapping is used with default values.) • What to read and write with SDO (mailbox) communication	"Chap. 3 Communication"
↓	↓	
Hardware installation and wiring	Install the EtherCAT master.	Manual of the EtherCAT master being used
	↓	
	Install this unit and applicable sensor-amplifiers to the DIN rail.	"2-2 Installing on a DIN Rail" (Page 2-6)
	↓	
	Wire the EtherCAT communication cable.	"2-3-1 Connecting the Communication Cable" (Page 2-8)
	↓	
	Wire the external power supply.	"2-3-2 Wiring with the Power Supply Cable" (Page 2-8)
	↓	
	Wire sensors to sensor-amplifiers.	Manuals of the applicable sensor-amplifiers
↓	↓	
Operation to communicate with the EtherCAT master	Install the ESI file for this unit.	"3-4 Operations Required for This Unit to Communicate with the EtherCAT Master" (Page 3-8) Manual of the EtherCAT master being used Configuration software manual for the master being used
	↓	
	Add this unit to the EtherCAT system and set module configuration (i.e., sensor-amplifier and sensor configuration) in the master-side configuration software.	
	↓	
	PDO communication: Assign PDO on the master-side configuration software. SDO communication: Create communication program.	
	↓	
	Download slave settings and module configuration (i.e., sensor-amplifier and sensor configuration) information to this unit.	
↓	↓	

Procedure	Details	References
Starting communication	Start system (power ON).	Same as above
	↓	
	Start the EtherCAT communication.	
↓	↓	
Checking operation	Check the displays of the master, this unit, and the sensor-amplifiers.	Manual of the EtherCAT master being used “1-2 Part Names and Functions” (Page 1-6) “5-4 Troubleshooting List” (Page 5-6) sensor-amplifiers / sensors
	↓	
	Verify that the EtherCAT master reads and writes data.	Manual of the EtherCAT master being used
	↓	
	Set the parameters of this unit with SDO communication (if needed).	“3-6 Object Dictionary of This Unit” (Page 3-14) “3-7 Parameter for Each Connected Sensor-amplifier and Sensor” (Page 3-25)
↓	↓	
Troubleshooting	Check the displays of the master, this unit, and the sensor-amplifiers. Check the error codes on the sensor-amplifier and sensor configuration and the device specific error codes with SDO communication.	“Chap. 5 Troubleshooting”

CAUTION
When you use this unit, make sure to add this unit to the EtherCAT system in the master-side configuration software, set the correct module configuration (i.e., sensor-amplifier and sensor configuration) and download the slave settings and the module configuration information into this unit.

2

Installation and Wiring

This chapter describes inter-connection between this unit and applicable sensor-amplifier units, connection for EtherCAT communication, and wiring to the power supply.

2-1 Configuration of This Unit and Applicable Sensor-amplifiers and Sensors

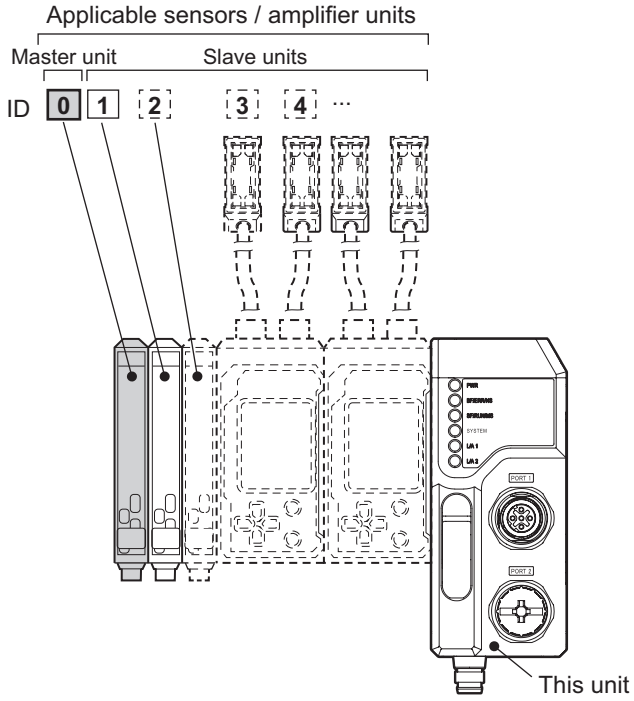
This section describes the configuration of this unit and applicable sensor-amplifiers and sensors.

2-1-1 Assigning ID Numbers for Applicable Sensor-amplifier Units

ID numbers are used to identify connected sensor-amplifiers in PDO and SDO communication.
The ID numbers are 0 - 15 (0 - F in hexadecimal values).
ID = 0 is set for the leftmost amplifier unit (the one furthest from this unit), with subsequent IDs assigned in ascending order toward this unit.
The number of occupied ID numbers differs depending on the type of sensor-amplifier. Details are provided below.

Type of sensor-amplifier	Occupied ID numbers	Notes
D3RF fiber amplifier	1	
D3WF fiber amplifier	1	
CDA general-purpose amplifier unit	2	A single unit occupies two because the unit can be connected to two sensors.

Connection of Sensor-amplifiers



MEMO

- As indicated above, ID numbers are assigned in ascending order from the left. When an applicable sensor-amplifier unit is added to the left of existing applicable sensor-amplifier units, the ID numbers of the existing applicable sensor-amplifier units change. Therefore, consider the configuration of applicable sensor-amplifier units by interconnection position, which is the ID number, if future expansion is planned. Refer to “6-1 Installing Additional Applicable Sensor-amplifier Units” (Page 6-2) later in this manual for more information on limitations when adding applicable sensor-amplifier units.
- The order of the ID numbers matches the order of the connection positions (slots) of the devices (sensor-amplifier units or sensors) when module configuration is set using the MDP (Modular Device Profile) function of EtherCAT and the element order of the product codes (modular device identification codes in the MDP function) of the devices that are written as an array in the object dictionary of this unit.

2-1-2 Configuration Limitations of Applicable Sensor-amplifiers and Sensors

Limitations in the configuration of applicable sensor-amplifiers and sensors are as follows.

The following three types of inter-connection configurations are used.

- Configurations in which only the D3□F fiber amplifiers are Interconnected
- Configurations in which only the CDA general-purpose amplifiers are interconnected
- Configurations in which both the D3□F fiber amplifiers and CDA general-purpose amplifiers are interconnected

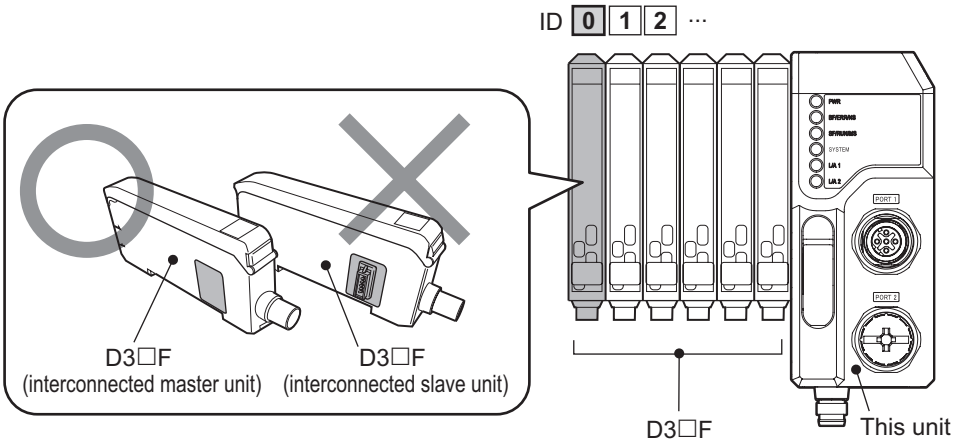
MEMO

- If more than the maximum number of applicable sensor-amplifier units (16) are connected, the count of the connected units automatically recognized by this unit returns to 1 (the 17th unit is “1”, the 18th is “2”, etc.). This causes a “sensor-amplifier and sensor configuration error” or “un-downloaded sensor-amplifier and sensor configuration and mismatches in the number of sensor-amplifiers and sensors”. The system reverts to the PRE-OPERATIONAL status and communication is not possible.

■ Configurations in Which Only the D3□F Fiber Amplifiers Are Interconnected

Please be aware of the following points when using configurations in which only the D3□F fiber amplifier is interconnected with this unit.

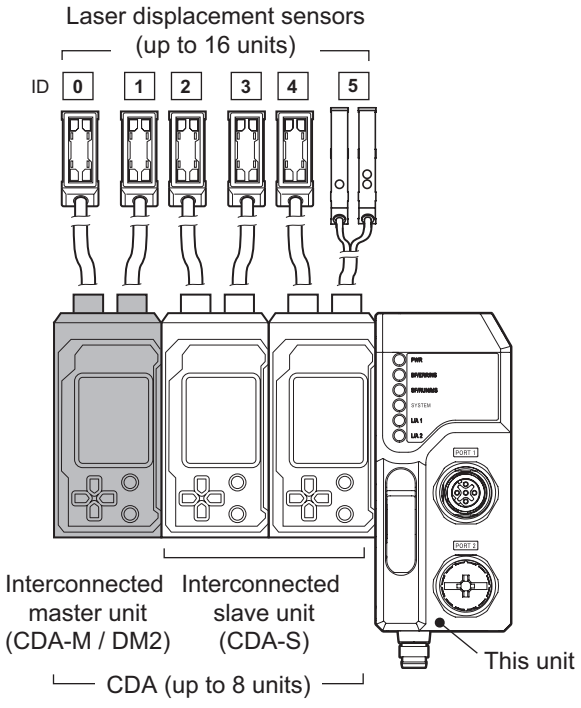
- Make sure to interconnect the D3□F master unit in the leftmost position (ID = 0). The cable type D3□F master unit cannot be used. If a D3□F slave unit is placed in the leftmost position, the connector for interconnection is exposed, causing interference from the end plate. D3□F may also malfunction as a result of soiling or breakage of the connector for interconnection.
- Do not connect an external power supply to the D3□F master unit or slave units. Refer to “2-3-2 Wiring with the Power Supply Cable” (Page 2-8) for further information.



Configurations in Which Only the CDA General-purpose Amplifiers Are Interconnected

Please be aware of the following points when using configurations in which only the general-purpose amplifier unit CDA is interconnected with this unit.

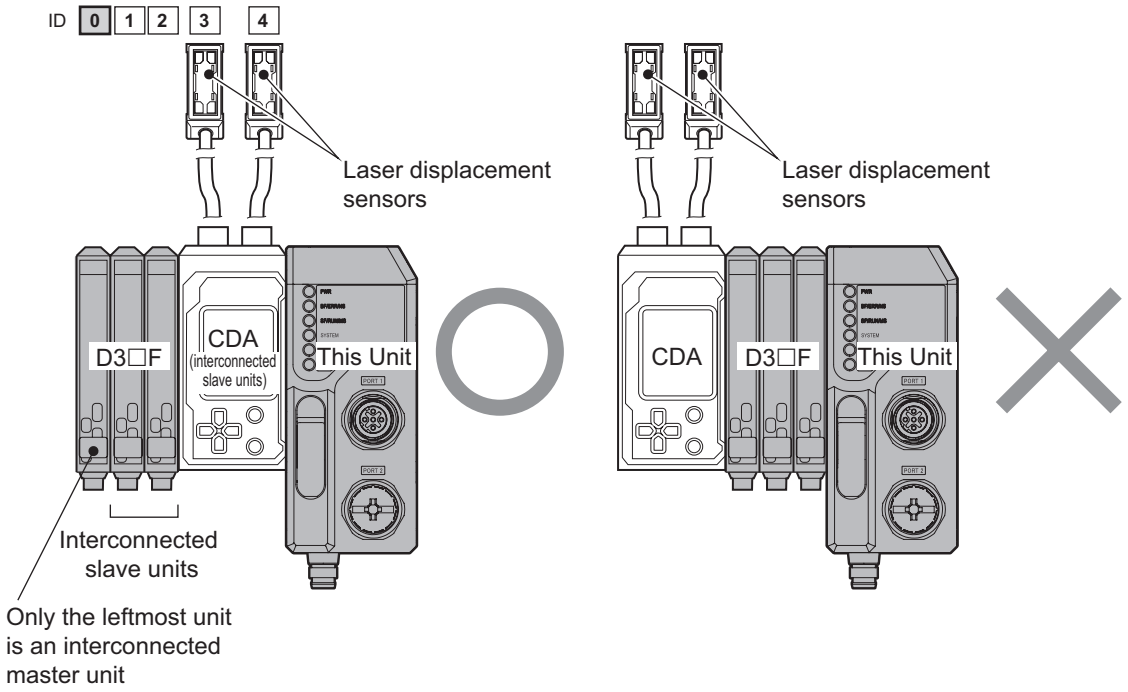
- Make sure to interconnect the CDA master unit as the leftmost CDA unit. If a CDA slave unit is placed in the leftmost position, the connector for interconnection is exposed, causing interference from the end plate. CDA may also malfunction as a result of soiling or breakage of the connector for interconnection.
- Up to two sensors can be connected to each CDA unit (master unit or slave unit). CDA units (master units and slave units) occupy two sensor unit IDs even when only one sensor is connected.
- An external power supply needs to be connected to the CDA master unit and slave units. Refer to “2-3-2 Wiring with the Power Supply Cable” (Page 2-8) for further information.
- When connecting the Through-beam Edge Sensor, TD1 series to CDA, use a Y branch cable (TDCN-Y2-M8) to connect sensors to each channel of the CDA.



Configurations in Which Both the D3□F Fiber Amplifiers and CDA General-purpose Amplifiers are Interconnected

Please be aware of the following points when using configurations in which both the D3□F fiber amplifier and CDA general-purpose amplifier unit are interconnected with this unit.

- Make sure to place all the D3□F units on the left when interconnecting. This is because the internal processing data size of D3□F differs from that of CDA. Refer to the CAUTION provided later.
- Make sure to connect one D3□F master unit in the leftmost position (ID = 1) among the D3□F units on the left. The cable type D3□F master unit cannot be used.
- For CDA, only CDA slave units can be used. CDA master units cannot be used.
- Up to two sensors can be connected to each CDA slave unit. CDA slave units occupy two sensor unit IDs even when only one sensor is connected.
- Do not connect an external power supply to the D3□F master unit or slave units. However, an external power supply needs to be connected to CDA. Refer to “2-3-2 Wiring with the Power Supply Cable” (Page 2-8) for further information.



CAUTION

Connect all D3□F units to the left of CDA.

Current values and setting values in D3□F are limited to 14 bits. Current values and setting values in CDA are processed as 16 bits.

This means that if CDA units are interconnected to the left of D3□F units, EtherCAT communication can be executed in the OPERATIONAL status, however, the current values sent from the CDA to the left of the D3□F to the master will be incorrect, as will the setting value set by the master.

Invalid connection order errors can be checked by reading the operation error history using SDO communication from the master (error code: 0008E000 h). Refer to “5-2 Sensor-amplifier and Sensor Configuration Error Codes” (Page 5-3) for further information.

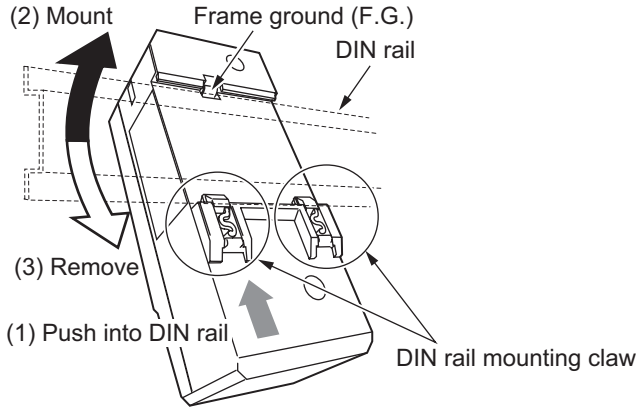
2-2 Installing on a DIN Rail

Install this unit on a DIN rail. Install the applicable sensor-amplifier units in the same way when interconnecting.

MEMO

- Remove the power supply cable during installation. In particular, make sure this unit and the applicable sensor-amplifier units are not powered when interconnecting or removing them.
- In this example, only D3□F units (inter-connection type) are interconnected with this unit, but CDA can be interconnected in the same way.

1 **Align the DIN rail mounting claw at the bottom of this unit with the bottom of the DIN rail, push this unit onto the DIN rail in the direction indicated by (1) and then collapse it in the direction indicated by (2).**

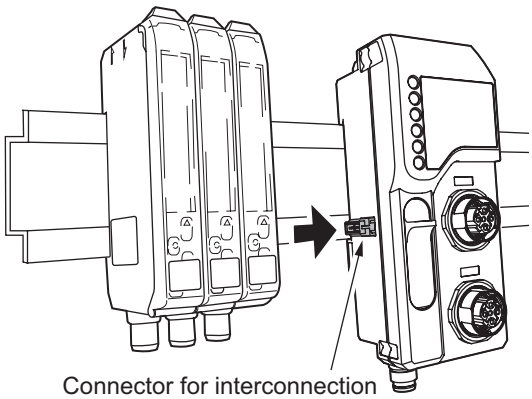


*If this unit is not properly attached to the DIN rail, faults may occur when interconnecting with the applicable sensor-amplifier units or connecting FGs. Make sure the DIN rail mounting claw is fully locked and this unit is securely mounted.

MEMO

To remove this unit from the DIN rail, push this unit onto the DIN rail in the direction indicated by (1) and collapse it in the direction of (3).

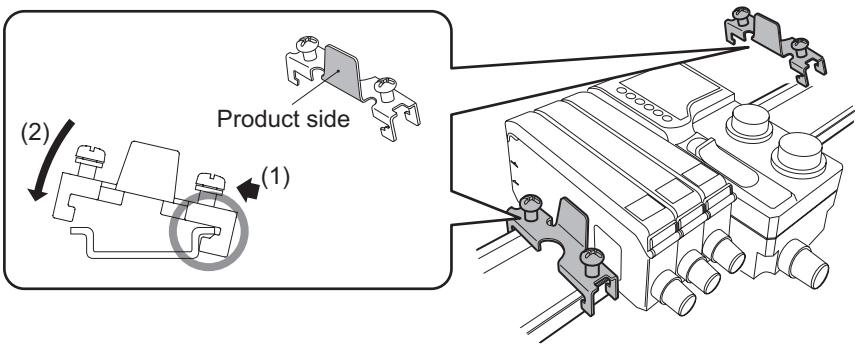
2 **Mount the applicable sensor-amplifier units on the DIN rail in the same way and interconnect them with this unit.**



CAUTION
Interconnect this unit securely with the applicable sensor-amplifier units using the connectors for interconnection. If the connectors for interconnection are slanted or are not inserted all the way in, this unit or the applicable sensor-amplifier unit may be damaged when powered.

3 **Mount the end plates on both sides of the interconnected units and secure them with screws.**

The tightening torque must be 0.9 N·m or less.
Mount the end plates to both sides of this unit and the applicable sensor-amplifier units with the product side (refer to the diagram below) facing this unit or the applicable amplifier unit. Mount the end plates by catching the notch on the DIN rail as shown in the diagram below.

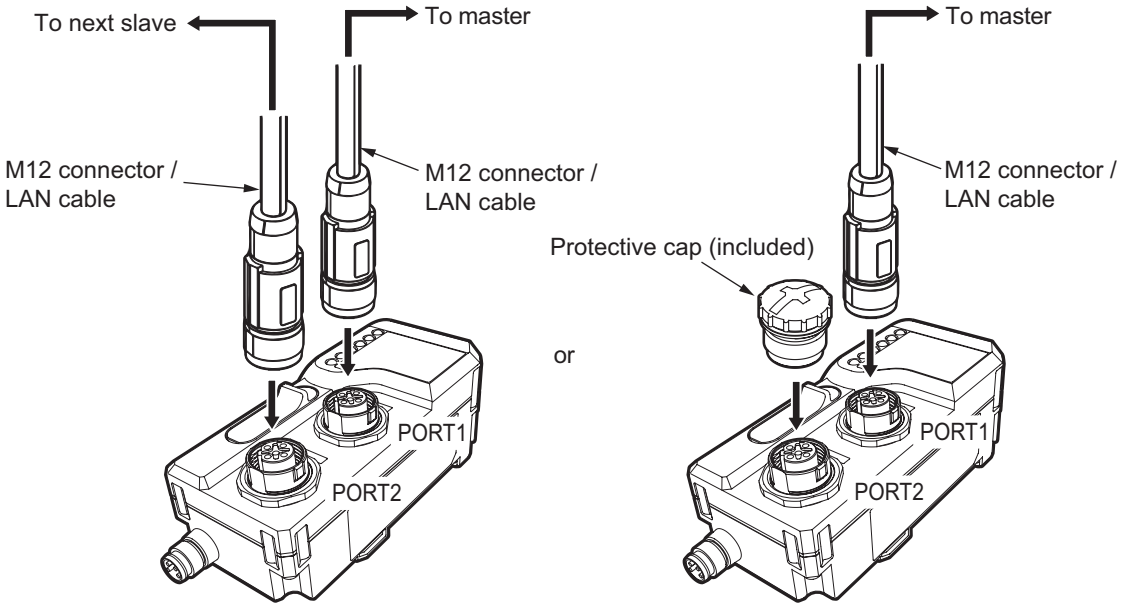


2-3 Wiring

This section describes wiring with the EtherCAT cable and power supply cable.

2-3-1 Connecting the Communication Cable

Connect the M12 connector or LAN cable PORT1 of this unit and connect the other cable upstream (on the master side) of this unit.
If there are slaves downstream from this unit, connect the M12 connector or LAN cable to PORT2 of this unit.
If there are no slaves downstream from this unit, connect the included protective cap to PORT2 of this unit.



2-3-2 Wiring with the Power Supply Cable

This unit runs on an external power input (12 - 24 VDC / 2 A or less). Make sure the input voltage and current are correct. Incorrect wiring to the power source can cause fire or malfunction.

This unit uses the following dedicated M8 power supply connector cables (sold separately) for external power input.

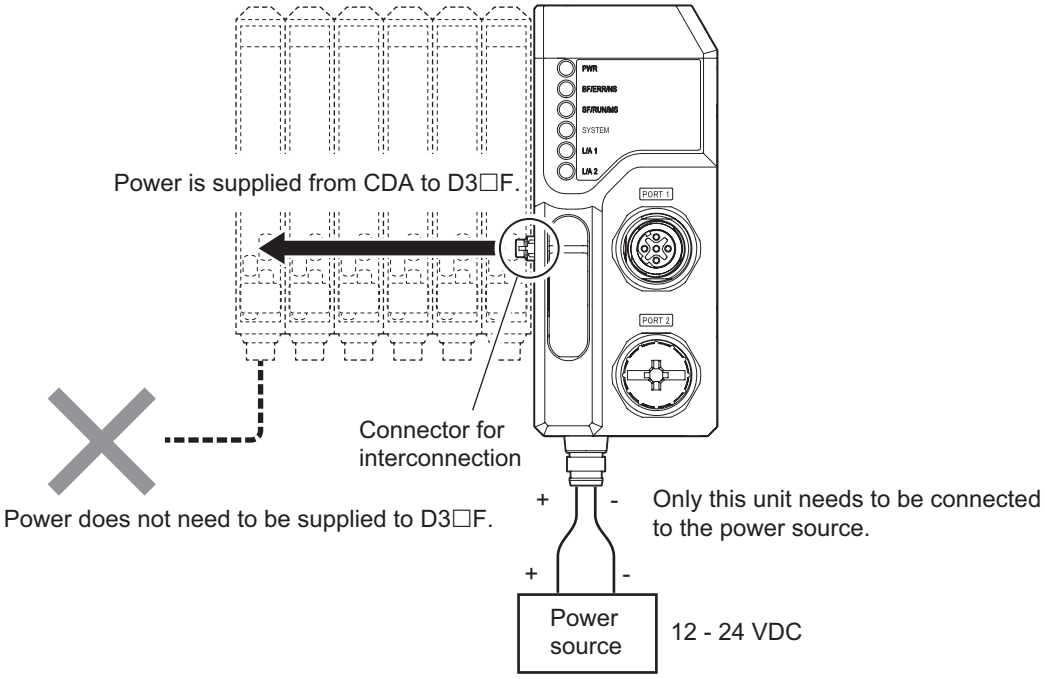
M84CN-2S: 2 m, M84CN-5S: 5 m, M84CN-10S: 10 m

This section describes wiring with the power supply cable when setting up each interconnection.

■ Supplying Power

● When Only D3☐F is Interconnected

Connect only this unit to the external power supply as shown in the diagram below. D3☐F is powered by this unit (and thus does not need to be connected to a power supply).



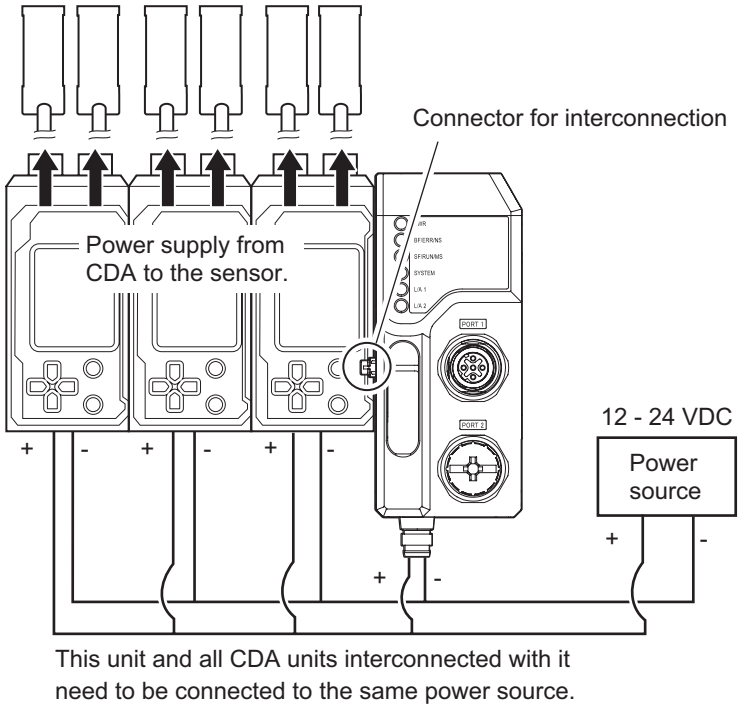
MEMO

- D3☐F is powered by this unit. Do not connect an external power supply to D3☐F. Normal communication may not be possible if the GND is not the same. Overvoltage may also occur in some conditions.
- The cable length of the power supply cable connected to this unit must be 30 m or less. If it is longer than 30 m, noise from the power supply cable can affect this unit and its peripheral devices.

When Only CDA is Interconnected

Connect this unit and CDA to the external power supply as shown in the diagram below. Devices such as displacement sensors are powered by CDA.

In this case, this unit's connector for interconnection is only used for communication.

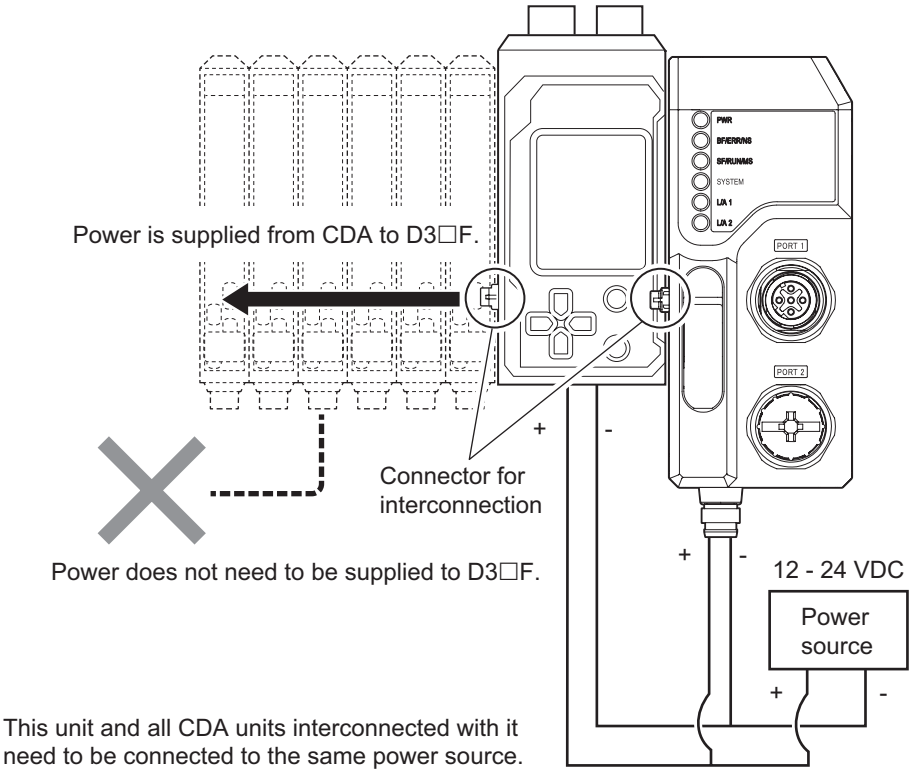


MEMO

- All interconnected CDA units must be powered by the same external power source as this unit. Normal communication may not be possible if a different power source is used.
- To prevent short circuits, wire CDA to the external power supply first, then this unit.
  CDA will short circuit if UC1 is wired to an external power supply while CDA is in its factory default state (with the wires bundled) and not wired to an external power supply (when interconnected with this unit).
- The system can be operated without wiring this unit to an external power supply.
- The cable length of the power supply cable connected to this unit and the CDA Series must be 30 m or less. If it is longer than 30 m, noise from the power supply cable can affect this unit and its peripheral devices.

● When Both D3☐F and CDA are Interconnected

Connect this unit and CDA to the external power supply as shown in the diagram below. D3☐F does not need to be connected to a power supply.



MEMO

- D3☐F is powered by this unit, including in cases where both D3☐F and CDA are interconnected. Do not connect an external power supply to D3☐F. Normal communication may not be possible if the GND is not the same. Overvoltage may also occur in some conditions.
- CDA units must be powered by the same external power source as this unit. Normal communication may not be possible if a different power source is used.
- The cable length of the power supply cable connected to this unit and the CDA Series must be 30 m or less. If it is longer than 30 m, noise from the power supply cable can affect this unit and its peripheral devices.

Calculating Power Consumption

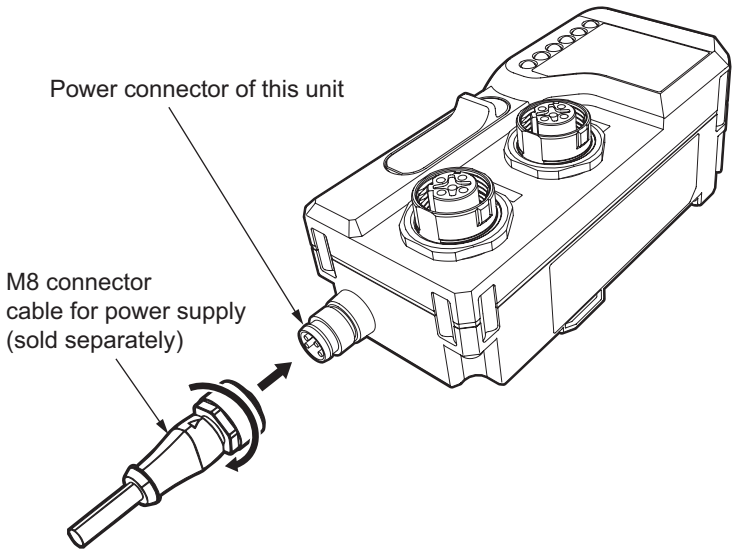
Calculate the power consumed by this unit and the connected sensor-amplifiers and sensors as follows.

Type		Maximum power consumption per unit	Number of units
This unit		3 W	1
Sensor amplifiers	D3RF	Single output type: 0.864 W Double output type: 0.936 W	× number of units connected
	D3WF	0.864 W	× number of units connected
	CDA	1.2 W	× number of units connected
Sensors	CD22 RS-485 communication type	1.68 W	× number of units connected
	TD1	1.68 W	× number of units connected

Connecting Cables

1 **Insert the connector of an M8 power supply connector cable (sold separately) to the power connector of this unit.**

2 **Tighten the fixture sufficiently by hand.**



3

Communication

This chapter describes the data configurations that this unit handles for EtherCAT communication, and provides examples of communication.

3-1 EtherCAT Communication Using This Unit

This section describes the communication that this unit can perform with the EtherCAT master when used as an EtherCAT slave.
This unit can perform the following PDO (cyclic) communication and SDO (mailbox) communication with an EtherCAT master.

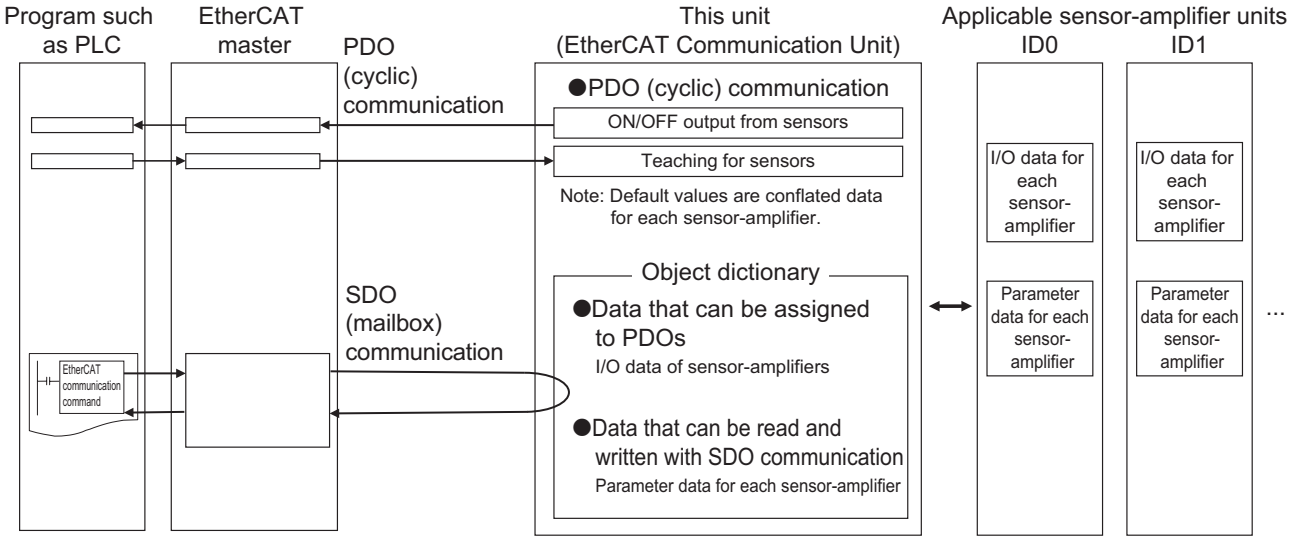
● PDO (Cyclic) Communication

At regular intervals, the pre-determined data in this unit is exchanged with the EtherCAT master.
The process data objects (PDO) in this unit are exchanged.
By default (factory settings), only the bit data collected from the interconnected sensor-amplifiers, such as the sensor ON/OFF outputs and teaching instructions, is assigned.

Note: Periodic communication of word data such as received light levels or measured values is possible by adding a PDO (communication path) using the configuration software on the master side.

● SDO (Mailbox) Communication

Specific data for this unit is read and written by the EtherCAT master when necessary at the desired timing.
All data located in this unit's object dictionary can be read and written.
This method is mainly used to set parameter data for each sensor-amplifier.



MEMO

This unit supports Free Run Mode (i.e., asynchronous) and DC Mode 1 (i.e., synchronized to the output cycle of the Sync0 signal) as EtherCAT synchronization modes. Settings can be configured with the EtherCAT master. Refer to the manual of your EtherCAT master for instructions on configuring the settings.

3-2 PDO (Cyclic) Communication

This unit can input and output the following data from/to the interconnected sensors with the EtherCAT master cyclically:

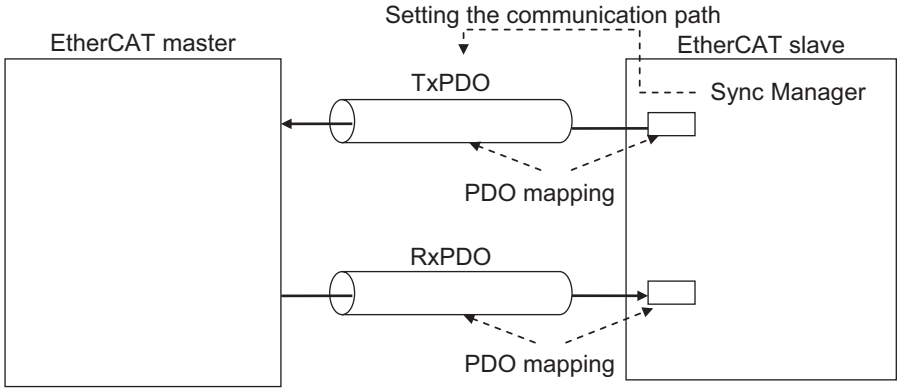
- Output to the Master:
  Bit data: sensor ON/OFF output signals, external input signals, and error status
  Word data: received light level and measured values of sensors

Note: Word data is not assigned in the default PDO mapping.
A PDO can be added using the configuration software of the master.

- Input from the Master:
  Bit data: teaching and error-clearing

3-2-1 Mechanism of PDO Communication

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



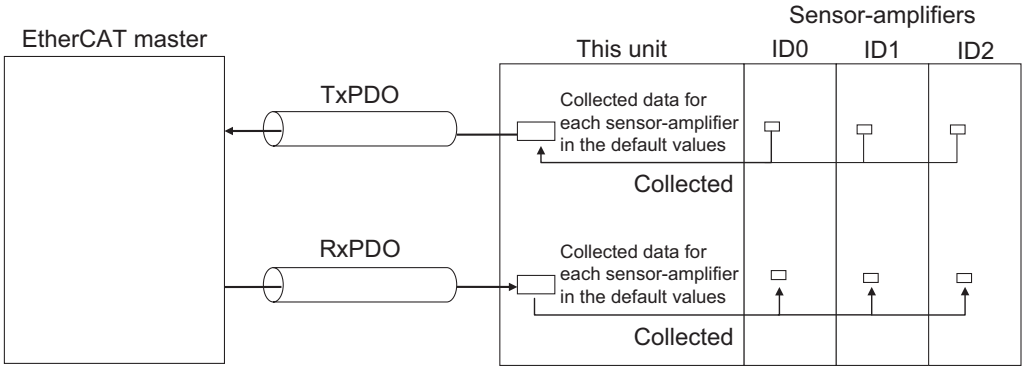
■ Overview of PDO Mapping

PDO mapping of this unit is performed as follows.

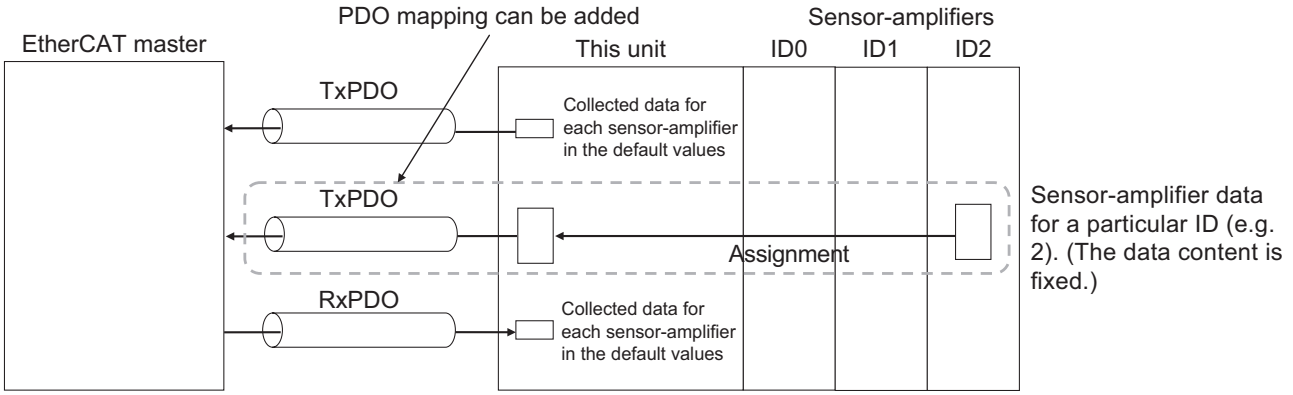
- By default, each PDO is used to transmit from this unit to the master and receive from the master to this unit.

Collected data*1 from the connected sensor-amplifiers is sent to the master and received from the master on each communication path.

*1: Data conflated into 16 bits (1 word) in order of sensor-amplifier's ID.



- Other PDO (communication paths) can be added for a specified ID number using the configuration software of the master. A connection sensor-amplifier with the specified ID number is assigned in advance to the PDO corresponding to the specified ID number. However, the data content to be communicated cannot be changed (it is fixed).
  This is mainly necessary when you want to perform PDO communication with the received light level or measured value of the specified sensor-amplifier.



■ Details of PDO Mapping

Details of PDO mapping of this unit to the EtherCAT master are as follows.

● Default Values (Factory Settings)

The following data from the connected sensor-amplifiers is collected and assigned in 16-bit order by sensor-amplifier ID.

PDO mapping	Assigned data	Value		Size	Index / subindex of object dictionary
PDO mapping for 255th transmission (1AFF h)	D3RF: Sensor output 1 D3WF: Sensor output 1 CDA + CD22: Hi output CDA + TD1: Hi output	Each bit corresponds to a sensor-amplifier 0: OFF 1: ON	Sensor-amplifier IDs correspond to a bit address	2 bytes (16 bits)	F600.01 h
	D3RF: Sensor output 2 D3WF: Sensor output 2 CDA + CD22: Lo output CDA + TD1: Lo output	Each bit corresponds to a sensor-amplifier 0: OFF 1: ON		2 bytes (16 bits)	F600.02 h
	D3RF: External input D3WF: External input CDA + CD22: Go output CDA + TD1: Go output	Each bit corresponds to a sensor-amplifier 0: OFF 1: ON		2 bytes (16 bits)	F600.03 h
	D3RF: Error status D3WF: Error status CDA + CD22: Error status CDA + TD1: Error status	Each bit corresponds to a sensor-amplifier 0: No error 1: Error		2 bytes (16 bits)	F600.04 h
PDO mapping for 255th receipt (16FF h)	D3RF: Execution of teaching D3WF: Execution of teaching CDA + CD22: Execution of teaching CDA + TD1: Execution of teaching	Each bit corresponds to a sensor-amplifier 0→1: First teaching 1→0: Second teaching		2 bytes (16 bits)	F700.01 h
	D3RF: Error clearing D3WF: Error clearing CDA + CD22: Error clearing CDA + TD1: Error clearing	Each bit corresponds to a sensor-amplifier 0→1: Error cleared		2 bytes (16 bits)	F700.02 h

- **PDO mapping for 255th transmission (this unit→master)**

Sensor output 1 or Hi output (depending on type of sensor-amplifier)

Offset (bytes) ↓	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0	ID7	ID6	ID5	ID4	ID3	ID2	ID1	ID0
+1	ID15	ID14	ID13	ID12	ID11	ID10	ID9	ID8

Sensor output 2 or Lo output (depending on type of sensor-amplifier)

Offset (bytes) ↓	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
+2	ID7	ID6	ID5	ID4	ID3	ID2	ID1	ID0
+3	ID15	ID14	ID13	ID12	ID11	ID10	ID9	ID8

External input or Go output (depending on type of sensor-amplifier)

Offset (bytes) ↓	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
+4	ID7	ID6	ID5	ID4	ID3	ID2	ID1	ID0
+5	ID15	ID14	ID13	ID12	ID11	ID10	ID9	ID8

Error status (all types of sensor-amplifier)

Offset (bytes) ↓	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
+6	ID7	ID6	ID5	ID4	ID3	ID2	ID1	ID0
+7	ID15	ID14	ID13	ID12	ID11	ID10	ID9	ID8

- **PDO mapping for 255th receipt (master→this unit)**

Execution of teaching (all types of sensor-amplifier)

Offset (bytes) ↓	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0	ID7	ID6	ID5	ID4	ID3	ID2	ID1	ID0
+1	ID15	ID14	ID13	ID12	ID11	ID10	ID9	ID8

Error clearing (all types of sensor-amplifier)

Offset (bytes) ↓	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
+2	ID7	ID6	ID5	ID4	ID3	ID2	ID1	ID0
+3	ID15	ID14	ID13	ID12	ID11	ID10	ID9	ID8

Other values

If you want to perform PDO communication for the received light levels, measured values (or calculated values), or all data for each ID number before collection, you must add the following PDO corresponding to the target sensor-amplifier that you want to communicate with using the master-side configuration software.

PDO mapping	Assigned data	Value	Size	Index / subindex of object dictionary
PDO mapping for 1st - 16th transmission (assignment to PDO of each connected sensor-amplifier) 1A0n Note: n = ID (0 - F)	D3RF: Sensor output 1 D3WF: Sensor output 1 CDA + CD22: Hi output CDA + TD1: None	00 h: OFF 01 h: ON	1 byte (8 bits)	60n0 Note: n = ID (0 - F)
	D3RF: Sensor output 2 D3WF: Sensor output 2 CDA + CD22: Lo output CDA + TD1: None	00 h: OFF 01 h: ON	1 byte (8 bits)	
	D3RF: External input D3WF: External input CDA + CD22: Go output CDA + TD1: None	00 h: OFF 01 h: ON	1 byte (8 bits)	
	D3RF: Error status D3WF: Error status CDA + CD22: Error status CDA + TD1: Error status	00 h: No error 01 h: Error	1 byte (8 bits)	
	D3RF: Alarm status D3WF: Alarm status CDA + CD22: Alarm status CDA + TD1: Alarm status	00 h: Data enabled 01 h: Data disabled	1 byte (8 bits)	
	D3RF: Received light level D3WF: Received light level CDA + CD22: Measurement values or calculation values CDA + TD1: Measurement values or calculation values	0000 - FFFF h	2 bytes (16 bits)	
PDO mapping for 1st - 16th receipt (assignment to PDO of each connected sensor-amplifier) 160n Note: n = ID (0 - F)	D3RF: Execution of teaching D3WF: Execution of teaching CDA + CD22: Execution of teaching	00 h → 01 h: First teaching 01 h → 00 h: Second teaching	1 byte (8 bits)	70n0 Note: n = ID (0 - F)
	D3RF: Error clearing D3WF: Error clearing CDA + CD22: Error clearing CDA + TD1: Error clearing	00 h → 01 h: Error cleared	1 byte (8 bits)	

3-3 SDO (Mailbox) Communication

The EtherCAT master can read or write the following data using SDO (mailbox) communication when necessary.

- Parameter setting values for each sensor-amplifier
- Sensor ON/OFF output, received light levels, measurement values, etc.
- Sensor-amplifier and sensor connection configuration error codes
- Latest error codes specific to each device

You can read or write data by specifying an index and sub-index of this unit's object dictionary using the EtherCAT communication command on the EtherCAT master.

MEMO

The following malfunctions in sensor-amplifier and sensor connection configurations can be read as error codes from the operation error history using SDO communication. Refer to "5-2 Sensor-amplifier and Sensor Configuration Error Codes" (Page 5-3) for further information.

- Change in the number of connected sensor-amplifiers or sensors
- Configuration error
- Invalid connection order

3-4 Operations Required for This Unit to Communicate with the EtherCAT Master

This section describes the operations required on the EtherCAT master side for this unit to communicate with EtherCAT.
For more information, refer to the manual of the EtherCAT master or that of the master-side configuration software.

3-4-1 Downloading and Installing the ESI File for This Unit

1. **Download the ESI file for this unit from the Optex FA website below:**
   https://www.optex-fa.com/
2. **Install the ESI file for this unit in the master-side configuration software**
   Copy the ESI file for this unit (EtherCAT Slave Information file) to the folder specified by the master-side configuration software

3-4-2 Settings for This Unit on the Master-side Configuration Software

This unit supports the EtherCAT MDP (Modular Device Profile) function. Therefore, the module configuration (i.e., correct configuration of the sensor-amplifiers and sensors) must be set up after adding this unit to the EtherCAT system on the master-side configuration software.

There are generally two ways to do this. Add and configure this unit in one of the following ways.
- Offline: Manually add and set the module configuration (i.e., sensor-amplifier and sensor configuration)
- Online: Connect to an actual device and automatically add and set the module configuration (i.e., sensor-amplifier and sensor configuration)

For information on setting the module configuration (i.e., sensor-amplifier and sensor configuration) as a slave supporting MDP, refer to the section on MDP slaves in the manual of your master or the manual of the configuration software for your master.

3-4-3 Configuring EtherCAT Communication on This Unit

■ PDO Communication: Assigning PDO on The Master-Side Configuration Software

If you use the PDO communication, use the master-side configuration software to assign this unit's PDO to inputs and outputs for the host program.

● Adding PDO Mapping (If Required)

Generally, the default values (factory settings) can be used for PDO mapping.
Add the PDO using the master-side configuration software only when you want to assign the received light levels, measured values, or alarms.

● Assigning PDOs to Variables or Addresses for the Host Program

Assign this unit's PDO to the host program's inputs and outputs.
Specifically, assign them to variables or addresses. For variables, arrays or structures are typically used.

■ SDO Communication: Create a Communication Program

If you are using SDO communication, create a communication program.

3-4-4 Downloading Slave Settings and Module Configuration (Sensor-amplifier and Sensor Configuration) Information to This Unit

Use the master-side configuration software to download slave settings and module configuration (i.e., the configuration of sensor-amplifiers and sensors) to this unit.

CAUTION
When you use this unit, make sure to add this unit to the EtherCAT system in the master-side configuration software, set the correct module configuration (i.e., sensor-amplifier and sensor configuration) and download the slave settings and the module configuration information into this unit.
Even if the download itself has not been made, if the number of sensor-amplifiers and sensors in the actual configuration accidentally matches the number of those in the module configuration set in the master, this unit can operate in the OPERATIONAL state, even if the configuration is different. Therefore, it is essential to download the module configuration (i.e., the configuration of sensor-amplifiers and sensors) to this unit.
If the download is completed and the actual sensor-amplifiers and sensors configuration does not match the master configuration, this unit will revert to the PRE-OPERATIONAL state and will be unable to perform cyclic (PDO) communication (both ERR and RUN LEDs on the front of this unit will blink).

3-4-5 Data Stored in This Unit When Sensor-amplifier and Sensor Configuration is Downloaded

When the module configuration information is downloaded to this unit, the sensor-amplifier and sensor configuration set in the master is stored in the following object dictionary in this unit.

Subindex 01 h of index F030 h

The stored data consists of sensor-amplifier unit or sensor[*1] product codes[*2] in order of ID number. The data is stored in 16-element arrays.

It can be read from and written to the master using SDO communication when necessary.

*1: If the sensor-amplifier unit is CDA, the product code of each connected sensor is stored. If only one sensor is connected to CDA and one channel is empty, 00000000 h is stored.

*2: The product code is a code defined in the ESI file for this unit to identify modular devices (sensor-amplifier units and sensors) using the EtherCAT MDP function.

Product codes are as follows.

- Sensor-amplifier units:
  - DR3F product code: 00001301 h
  - DR3W product code: 00001306 h
- Sensors connected to CDA:
  - CD22-15-485 product code: 00001302 h
  - CD22-35-485 product code: 00001303 h
  - CD22-100-485 product code: 00001304 h
  - TD1 product code: 00001305 h
  - Note: 00000000 h is used for channels where no sensor is connected to CDA.

Example: The following array is used if the units from the position furthest left from this unit are D3RF master unit → 2 D3RF slave units → 1 CDA slave unit (sensor head 1: CD22-15-485, sensor head 2: CD22-35-485) → 1 CDA slave unit (sensor head 1: CD22-100-485, sensor head 2: TD1).

Element number 0: 00001301 h
Element number 1: 00001302 h
Element number 2: 00001303 h
Element number 3: 00001304 h
Element number 4: 00001305 h

3-4-6 Detecting Sensor-amplifier and Sensor Configuration at Power ON

At power ON, the current configuration of sensor-amplifiers and sensors is stored in the following object dictionary in this unit.

Subindex 01 h of index F050 h

The stored data is the product codes of the sensor-amplifiers or sensors[*1] in order of ID number. It is stored as an array with 16 elements. The stored data is similar to the sensor-amplifier and sensor configuration settings set in the master.

*1: If the sensor-amplifier unit is CDA, the product code of each connected sensor is stored.

If necessary, the products codes can be read out from the master using SDO communication.

3-4-7 If the Sensor-amplifier and Sensor Configuration Matches That Registered

If the sensor-amplifier and sensor configuration (index F030 h) set in the master matches the actual sensor-amplifier and sensor configuration (index f050 h) detected at power ON, this unit will be in OPERATIONAL state (in this case, ERR LED off and RUN LED on).

3-4-8 If the Sensor-amplifier and Sensor Configuration Differs from That Registered

If the sensor-amplifier and sensor configuration (index F030 h) set in the master is different from the actual sensor-amplifier and sensor configuration (index F050 h) detected at power ON, this unit generates the “configuration error” (in this case, the ERR and Run LEDs flash) and EtherCAT communication changes to PRE-OPERATIONAL status and cannot enter the SAFE-OPERATIONAL state.
Use the EtherCAT master-side configuration software to edit the sensor-amplifier and sensor configuration again to match the actual configuration and download it to this unit. Or, match the actual configuration to the configuration set in the master, and then cycle the power.
In the event of the “configuration error” described above, it is possible to check the operation error history by reading the error history using SDO communication from the master (error code: 0007E000 h). Refer to “5-2 Sensor-amplifier and Sensor Configuration Error Codes” (Page 5-3) for further information.

3-5 Specific Examples of Communication

This section describes specific examples of communication between this unit and the master.
Communication can be performed with PDO communication or SDO communication.

3-5-1 Cyclic Reading of ON/OFF Output from Sensors

Cyclic reading of ON/OFF output from sensors is performed with PDO communication.
PDO mapping is the default (factory setting).
Collected output data from the sensor-amplifiers is cyclically sent to variables in the master.

Example: The following is an example of a variable in the master.
Variable name: Receive PDO gateway
Data type: ARRAY[0..15] OF BOOL (16-element BOOL type array)
Note: The variable name is an example of a name defined by the user.

3-5-2 Teaching the Sensors

Teaching of the sensors is performed with PDO communication.
PDO mapping is the default (factory setting).
Collected instructions to the sensor-amplifiers are cyclically sent from variables in the master.

Example: The following is an example of a variable in the master.
Variable name: Transmit PDO gateway
Data type: ARRAY[0..15] OF BOOL (16-element BOOL type array)

Note: The variable name is an example of a name defined by the user.

3-5-3 Cyclic Reading of Received Light Levels from Sensors

Cyclic reading of received light levels from sensors is performed with PDO communication.
PDO mapping must be added using the configuration software on the master side.

Example: Cyclic reading of received light level from D3RF corresponding to ID2 (third from the left)
Add a PDO as follows.
Add the index 1A02 h to the PDO mapping using the master-side configuration software
6020 h is assigned to 1A02 h.

The following is set as a variable in the master.
Variable name: 1st Receive PDO Mapping
Data type: The following structure is an example.

Note: The variable name and member name are examples of names defined by the user.

Member name	Size	
OUT1	Bytes (UINT8)	Sensor output 1
OUT2	Bytes (UINT8)	Sensor output 2
EXTERNAL INPUT	Bytes (UINT8)	External input
ERR	Bytes (UINT8)	Error status
ALARM	Bytes (UINT8)	Alarm status
INCIDENT LEVEL	Words (UINT16)	Received light level

The above received light level is specified as follows for the variable.
1st Receive PDO Mapping.INCIDENT LEVEL

3-5-4 Changing Setting Values of Sensors

The setting values of the sensors can be changed with SDO communication.

Example: Changing the lower threshold of D3RF for ID2 (third from the left)
An SDO writing command is issued to the following index of this unit from the master.

Index: 8020 h is assigned (as the ID is 2, 80n0 (n = ID) is set as “8020 h”).
Subindex: 0B h (lower threshold)

3-6 Object Dictionary of This Unit

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 unit’s object dictionary.

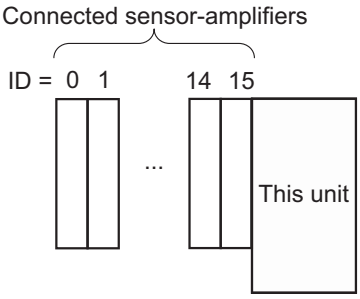
3-6-1 Index Range of Object Dictionary

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

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

Assigning Objects for This Unit

Index numbers of objects for this unit are assigned as follows.



Object type		Collected data for this unit	Data for each connected sensor-amplifier and sensor			
			ID = 0	ID = 1	...	ID = 15
Communication settings area	For TxPDO (slave → master)	1AFF h (factory setting)	1A00 h (PDO needs to be added by user)	1A01 h (PDO needs to be added by user)	...	1A0F h (PDO needs to be added by user)
	For RxPDO (master → slave)	16FF h (factory setting)	1600 h (PDO needs to be added by user)	1601 h (PDO needs to be added by user)	...	160F h (PDO needs to be added by user)
Input process data area (slave → master) Device area (collected data for this unit)		F600 h (assigned to 1AFF h at factory)	6000 h (assigned to 1A00 h at factory)	6010 h (assigned to 1A01 h at factory)	...	600F h (assigned to 1A0F h at factory)
Output process data area (master → slave) Device area (collected data for this unit)		F700 h (assigned to 16FF h at factory)	7000 h (assigned to 1600 h at factory)	7010 h (assigned to 1601 h at factory)	...	700F h (assigned to 160F h at factory)
Settings data area	Setting value information	-	8000 h	8010 h	...	80F0 h
	Operation information	-	80001h	8011h	...	80F1 h
Slave information area		-	9000 h	9010 h	...	90F0 h
Diagnostic information area		-	A000 h	A010 h	...	A0F0 h

Meanings of Arrays in the Object Dictionary List

The meanings of each array are as follows.

Item	Value	Meaning
Index (HEX)	0000 - FFFF	A four-digit hexadecimal number to identify the object
Sub- Index (HEX)	00 - 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 subindex value within members.
Name		The name of the object. For subindexes, this is the subindex name.
Description		A description of the object. For subindexes, this is the subindex description.
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
	R/W	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 (R/W) objects and write-only (WO) objects, this indicates the range of data that can be set.
Default value		The value set at the factory.

3-6-2 Object Dictionary List for This Unit

The object dictionary list for this unit is as follows.

Refer to “3-7 Parameter for Each Connected Sensor-amplifier and Sensor” (Page 3-25) for information on areas dependent on the type of sensor-amplifier or sensor that is connected.

Index (HEX)	Sub-Index (HEX)	Name	Description	Data type	Reading / writing attribute	Assignable to PDO	Value	Default value
1000	None	Device Type	Indicates the device type of this unit. This is the following modular (building block type). 00001389 h: Modular Device	UINT32	RO	No	00001389 h	00001389 h
1008	None	Device Name	Indicates the model of this unit.	STRG(6)	RO	No	“UC1-EC”	“UC1-EC”
1009	None	Hardware Version Number	Indicates the version of this unit’s hardware.	STRG(4)	RO	No	“0001”	“0001”
100A	None	Software Version Number	Indicates the version of this unit’s software.	STRG(4)	RO	No	“0001”	“0001”
1018	00	Identity	Information for identification of this unit	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	00002300 h	00002300 h
	03	Revision	Revision number	UINT32	RO	No	00000001 h	00000001 h
	04	Serial number	Serial number	UINT32	RO	No	xxxxxxxx h	xxxxxxxx h
10F3	00	Diagnosis History	Error history	UINT8	RO	-	15 h	
	01	Maximum Messages	Maximum number of messages	UINT8	RO	No	00 h	
	02	Newest Message	Subindex number of the latest message	UINT8	RO	No		
	03	Newest acknowledged message	Latest confirmation error message	UINT8	R/W	No		
	04	New message available	Latest message status	BOOL	RO	No		
	05	Flags for the transmission and storage of diag-nostic message	Indicates whether there is an emergency message notification	UINT16	RO	No	0000 h: No notification 0001 h: Notification	0000 h
	06	Diagnosis Message 1	Operation error history (error code) 1	UINT32	RO	No		-
	-							
	15	Diagnosis Message 16	Operation error history (error code) 16	UINT32	RO	No		-
160n Note: n = ID (0 - F)	00	1st -16th Receive PDO Mapping	PDO mapping for 1st - 16th receipt (assignment to PDO of each connected sensor-amplifier) 70n0 is preset for 160n (fixed) Note: n = ID (0 - F)	UINT8	RO	-	02 h	00 h
	01		PDO entry 1	UINT32	RO	No	70n0.01 h	-
	02		PDO entry 2	UINT32	RO	No	70n0.02 h	-

Index (HEX)	Sub-Index (HEX)	Name	Description	Data type	Reading / writing attribute	Assignable to PDO	Value	Default value
16FF	00	Receive PDO gateway	PDO mapping for 255th receipt (assigned to PDO of collected data)	UINT8	RO	-	03 h	03 h
	01	PDO entry 1		UINT32	RO	No	F700.01 h	F700.01 h
	02	PDO entry 2		UINT32	RO	No	F700.02 h	F700.02 h
1A0n Note: n = ID (0 - F)	00	1st -16th Transmit PDO Mapping	PDO mapping for 1st - 16th transmission (assignment to PDO of each connected sensor-amplifier) 60n0 is preset for 1A0n (fixed) Note: n = ID (0 - F)		RO	-	06 h	00 h
	01		PDO entry 1	UINT32	RO	No	60n0.01 h	-
	02		PDO entry 2	UINT32	RO	No	60n0.02 h	-
	03		PDO entry 3	UINT32	RO	No	60n0.03 h	-
	04		PDO entry 4	UINT32	RO	No	60n0.04 h	-
	05		PDO entry 5	UINT32	RO	No	60n0.05 h	-
	06		PDO entry 6	UINT32	RO	No	60n0.06 h	-
1AFF	00	Transmit PDO gateway	PDO mapping for 255th transmission (assigned to PDO of collected data)	UINT8	RO	-	04 h	04 h
	01		PDO entry 1	UINT32	RO	No	F600.01 h	F600.01 h
	02		PDO entry 2	UINT32	RO	No	F600.02 h	F600.02 h
	03		PDO entry 3	UINT32	RO	No	F600.03 h	F600.03 h
	04		PDO entry 4	UINT32	RO	No	F600.04 h	F600.04 h
1C00	00	Sync Manager Communication Types	Sync manager communication type	UINT8	RO	-	04 h	04 h
	01	Communication Type Sync Manager 0	Communication type SM0	UINT8	RO	No	01 h	01 h
	02	Communication Type Sync Manager 1	Communication type SM1	UINT8	RO	No	02 h	02 h
	03	Communication Type Sync Manager 2	Communication type SM2	UINT8	RO	No	03 h	03 h
	04	Communication Type Sync Manager 3	Communication type SM3	UINT8	RO	No	04 h	04 h

Index (HEX)	Sub-Index (HEX)	Name	Description	Data type	Reading / writing attribute	Assignable to PDO	Value	Default value
1C12	00	Sync Manager 2 PDO Assignment	Assignment of PDOs for Sync Manager 2	UINT8	RO	-	12 h	12 h
	01	1st PDO Mapping object index of assinged PDO	Receipt PDO mapping Assignment 1	UINT16	RO	No	16FF h	16FF h
	02	2nd PDO Mapping object index of assinged PDO	Receipt PDO mapping Assignment 2	UINT16	RO	No	1600 h	1600 h
	-			-			-	-
	10	16th PDO Mapping object index of assinged PDO	Receipt PDO mapping Assignment 16	UINT16	RO	No	160E h	160E h
	12	17th PDO Mapping object index of assinged PDO	Receipt PDO mapping Assignment 17	UINT16	RO	No	160F h	160F h
1C13	00	Sync Manager 3 PDO Assignment	Assignment of PDOs for Sync Manager 2	UINT8	RO	-	12 h	12 h
	01	1st PDO Mapping object index of assinged PDO	Transmission PDO mapping Assignment 1	UINT16	RO	No	1AFF h	1AFF h
	02	2nd PDO Mapping object index of assinged PDO	Transmission PDO mapping Assignment 2	UINT16	RO	No	1A01 h	1A01 h
	-			-			-	-
	10	16th PDO Mapping object index of assinged PDO	Transmission PDO mapping Assignment 16	UINT16	RO	No	1A0E h	1A0E h
	11	17th PDO Mapping object index of assinged PDO	Transmission PDO mapping Assignment 17	UINT16	RO	No	1A0F h	1A0F h

Index (HEX)	Sub-Index (HEX)	Name	Description	Data type	Reading / writing attribute	Assignable to PDO	Value	Default value
60n0 Note: n = ID (0 - F)	00	Module Transmit PDO	Output from each sensor-amplifier (before collection)	UINT8	RO	-	06 h	06 h
	01	Output 1	D3RF: Sensor output 1 D3WF: Sensor output 1 CDA + CD22: Hi output CDA + TD1: None	UINT8	RO	Yes	00 h: OFF 01 h: ON	00 h
	02	Output 2	D3RF: Sensor output 2 D3WF: Sensor output 2 CDA + CD22: Lo output CDA + TD1: None	UINT8	RO	Yes	00 h: OFF 01 h: ON	00 h
	03	Output 3 / Exit. Entrance	D3RF: External input D3WF: External input CDA + CD22: Go output CDA + TD1: None	UINT8	RO	Yes	00 h: OFF 01 h: ON	00 h
	04	Erorr Status	D3RF: Error status D3WF: Error status CDA + CD22: Error status CDA + TD1: Error status	UINT8	RO	Yes	00 h: No error 01 h: Error	00 h
	05	Process Data Status	Indicates the validity of the process data status data.	UINT8	RO	Yes	00 h: Data disabled 01 h: Data enabled	00 h
	06	Measurement	D3RF: Received light level D3WF: Received light level CDA + CD22: Measurement values or calculation values CDA + TD1: Measurement values or calculation values	UINT16	RO	Yes	0000 - FFFF h	0000 h
70n0 Note: n = ID (0 - F)	00	Module Receive PDO	Instructions to each sensor-amplifier (before collection)	UINT8	RO	-	02 h	02 h
	01	Teach Request	D3RF: Execution of teaching D3WF: Execution of teaching CDA + CD22: Execution of teaching CDA + TD1: Execution of teaching	UINT8	R/W	Yes	00 h → 01 h: First teaching 01 h → 00 h: Second teaching	00 h
	02	Error Clear	D3RF: Error clearing D3WF: Error clearing CDA + CD22: Error clearing CDA + TD1: Error clearing	UINT8	R/W	Yes	00 h → 01 h: Error cleared	00 h
80n0 Note: n = ID (0 - F)		Module Configuration	Setting value information on connected sensor-amplifiers and sensors (settings data area) Refer to “3-7 Parameter for Each Connected Sensor-amplifier and Sensor” (Page 3-25).		R/W	No	-	-
80n1 Note: n = ID (0 - F)		Module Commands	Operation information on connected sensor-amplifiers and sensors (settings data area) Refer to “3-7 Parameter for Each Connected Sensor-amplifier and Sensor” (Page 3-25).		R/W	No	-	-

Index (HEX)	Sub-Index (HEX)	Name	Description	Data type	Reading / writing attribute	Assignable to PDO	Value	Default value
90n0 Note: n = ID (0 - F)		Module Identification	Identification information for connected sensor-amplifiers and sensors (slave information area) Refer to “3-7 Parameter for Each Connected Sensor-amplifier and Sensor” (Page 3-25).		RO	No	-	-
A0n0 Note: n = ID (0 - F)		Module Diagnostics	Error information for connected sensor-amplifiers and sensors (diagnostic information area) Refer to “3-7 Parameter for Each Connected Sensor-amplifier and Sensor” (Page 3-25).		RO	No	-	-
F000	00	Modular Device Profile	Profile of module (sensor-amplifier or sensor)	UINT8	RO	-	02 h	02 h
	01		Index period of assignment between connected modules (sensor-amplifiers and sensors)	UINT16	RO	No	0010 h	0010 h
	02		Maximum number of modules (sensor-amplifiers and sensors)	UINT16	RO	No	0010 h	0010 h
F030	00	Configured Module Ident list	Sensor-amplifier and sensor configuration set in the master for interconnection with this unit (module configuration set as an MDP slave) Set from the master-side configuration software	UINT8	RO	-	10 h	-
	01		16-element product code array (in order from the unit furthest to the left of this unit, i.e. in order of ID number)	UINT32 array	R/W	No	-	-
F050	00	Detected Module Ident list	Detected sensor-amplifier and sensor configuration	UINT8	RO	-	10 h	-
	01		16-element product code array (in order from the unit furthest to the left of this unit, i.e. in order of ID number). Automatically stored when the power is turned ON.	UINT32 array	RO	No	-	-

Index (HEX)	Sub-Index (HEX)	Name	Description	Data type	Reading / writing attribute	Assignable to PDO	Value	Default value
F100	00	Gateway Status	Status of this unit	UINT8	RO	-	03 h	-
	01		Operation status of this unit 0000 h: Idle 0002 h: Operating	UINT16	RO	No	0000 - 0003 h	-
	02		The number of sensor-amplifiers interconnected with this unit that are detected by the function for automatic recognition of the number of connected units when the power is turned ON (Note: If more than the maximum number of applicable sensor-amplifier units (16) are connected, the count of the connected units automatically recognized by this unit returns to 1 (the 17th unit is “1”, the 18th is “2”, etc.).)	UINT16	RO	No	0000 - 000Fh	0000 h
	03		Latest error code for this unit	UINT16	R/W	No	Error code (refer to “5-3 List of Error Codes for Each Device” (Page 5-4))	0000 h
F200	00	Gateway Control	Unit error notification control It is possible to enable or disable the error history function and emergency message function of this unit.	UINT8	RO	-	01 h	-
	01		Set 00001 h to enable these functions. 0000 h: Disabled 0001 h: Enabled	UINT16	R/W	No	0000 h	0000 h

Index (HEX)	Sub-Index (HEX)	Name	Description	Data type	Reading / writing attribute	Assignable to PDO	Value	Default value
F600	00	Gateway Transmit PDO	Output from each sensor-amplifier (after collection)	UINT8	RO	-	04 h	04 h
	01	Output 1	D3RF: Sensor output 1 D3WF: Sensor output 1 CDA + CD22: Hi output CDA + TD1: Hi output	UINT16	RO	Yes	Each bit corresponds to a sensor-amplifier 0: OFF 1: ON	Each bit corresponds to a sensor-amplifier 0: OFF 1: ON
	02	Output 2	D3RF: Sensor output 2 D3WF: Sensor output 2 CDA + CD22: Lo output CDA + TD1: Lo output	UINT16	RO	Yes	Each bit corresponds to a sensor-amplifier 0: OFF 1: ON	Each bit corresponds to a sensor-amplifier 0: OFF 1: ON
	03	Outpu 3/ Exit. Entrance	D3RF: External input D3WF: External input CDA + CD22: Go output CDA + TD1: Go output	UINT16	RO	Yes	Each bit corresponds to a sensor-amplifier 0: OFF 1: ON	Each bit corresponds to a sensor-amplifier 0: OFF 1: ON
	04	Erorr Status	D3RF: Error status D3WF: Error status CDA + CD22: Error status CDA + TD1: Error status	UINT16	RO	Yes	Each bit corresponds to a sensor-amplifier 0: No error 1: Error	Each bit corresponds to a sensor-amplifier 0: No error 1: Error
F700	00	Gateway Receive PDO	Instructions to each sensor-amplifier and sensor (after collection)	UINT8	RO	-	02 h	02 h
	01	Teach Request	D3RF: Execution of teaching D3WF: Execution of teaching CDA + CD22: Execution of teaching CDA + TD1: Execution of teaching	UINT16	R/W	Yes	Each bit corresponds to a sensor-amplifier or sensor 0→1: First teaching 1→0: Second teaching	Each bit corresponds to a sensor-amplifier or sensor 0→1: First teaching 1→0: Second teaching
	02	Error Clear	D3RF: Error clearing D3WF: Error clearing CDA + CD22: Error clearing CDA + TD1: Error clearing	UINT16	R/W	Yes	Each bit corresponds to a sensor-amplifier or sensor 0→1: Error cleared	Each bit corresponds to a sensor-amplifier or sensor 0→1: Error cleared

Index (HEX)	Sub-Index (HEX)	Name	Description	Data type	Reading / writing attribute	Assignable to PDO	Value	Default value
F800	00	Gateway Configuration	Identification information for this unit	UINT16	RO	-	FFh	-
	01		Product series	UINT16	RO	No	2508 h	2508 h
	02		Product type	UINT16	RO	No	0001 h	0001 h
	03		Firmware version	UINT16	RO	No	0001 h	0001 h
	04		Product version	UINT16	RO	No	0001 h	0001 h
	05		Product revision	UINT16	RO	No	0001 h	0001 h
	06		Provider name	STRG(7)	RO	No	“OPTEX FA”	“OPTEX FA”
	07		Product name	STRG(6)	RO	No	“UC1-EC”	“UC1-EC”
	08		Product ID	UINT32	R/W	No	0020281 h	0020281 h
	09		User ID (maximum 32 characters)	STRG(32)	RO	No	“String”	All FF h
	C9		Application firmware version	STRG(4)	RO	No	“1003” or greater	“1003”
	CA		Transmission firmware version	STRG(10)	R/W	No	“EC4704.NXF”	“EC4704.NXF”
	CB		Self search	UINT16	R/W	No	0000 h = stop, 0001 h = execute	0000 h
	D5		Reset to factory settings	UINT16	R/W	No	0003 h = execute	0000 h

3-7 Parameter for Each Connected Sensor-amplifier and Sensor

Below is the object dictionary for the settings data area, slave information area and diagnostic information area of this unit when each sensor-amplifier or sensor is connected to this unit.

3-7-1 Parameters of D3RF Sensor-amplifier (Inter-connection Type)

This table indicates the parameters related to the settings, operations, and status confirmation for the D3RF sensor-amplifier.
Refer to the instruction manual of D3RF (inter-connection type) for further information on each parameter.

■ Settings Data Area

Index (HEX)	Sub-Index (HEX)	Name	Description	Data type	Reading / writing attribute	Assignable to PDO	Setting value range
80n0 Note: n = ID (0 - F)	00	Module Configuration	Settings information on connected sensor-amplifiers	UINT8	RO	-	1C h
	01	Display	Display settings	UINT16	R/W	No	0: Number display 1: Bar display 2: Percentage display
	03	Teach-in Mode CH1	Output 1 teaching mode	UINT16	R/W	No	0: Two-point teaching 1: One-point teaching 2: Through teaching 3: Zone teaching 4: Auto-teaching 5: Percentage teaching 6: Zero percentage teaching
	04	Teach-in Mode CH2	Output 2 teaching mode	UINT16	R/W	No	
	05	Response Speed	Response speed setting	UINT16	R/W	No	0: 1-HS (22 µs) 1: 2-FS (85 µs) 2: 3-ST (250 µs) 3: 4-LG (1 ms) 4: 5-PL (2 ms) 5: 6-UL (4 ms) 6: 7-EL (8 ms)
	06	Gain	Emitting power setting	UINT16	R/W	No	0: Low power 1: Medium power 2: High power
	07	MF-Input	External input setting	UINT16	R/W	No	0: External teaching input 1: Test input 2: Synchronization input 3: Counter reset input 4: External all teaching input 5: No function
	08	Key Lock	Lock level setting	UINT16	R/W	No	0: Unlocked 1: Lock level 1 (fully locked) 2: Lock level 2 (half locked)
	09	Operation Mode CH1	Output 1 operation mode	UINT16	R/W	No	0: L-on (light on) 1: D-on (dark on)
	0A	Operation Mode CH2	Output 2 operation mode	UINT16	R/W	No	

Index (HEX)	Sub-Index (HEX)	Name	Description	Data type	Reading / writing attribute	Assignable to PDO	Setting value range
80n0 Note: n = ID (0 - F)	0B	Threshold Level CH1 Lower Limit	Lower threshold (Far) setting for output 1	UINT16	R/W	No	-999 - 9999 The range that can be written differs depending on the operation mode.
	0C	Threshold Level CH1 Upper Limit	Upper threshold (Near) setting for output 1	UINT16	R/W	No	-999 - 9999 Can only be accessed in zone teaching mode.
	0D	Threshold Level CH2 Lower Limit	Lower threshold (Far) setting for output 2	UINT16	R/W	No	-999 - 9999 The range that can be written differs depending on the operation mode.
	0E	Threshold Level CH2 Upper Limit	Upper threshold (Near) setting for output 2	UINT16	R/W	No	-999 - 9999 Can only be accessed in zone teaching mode.
	0F	Timer setting CH1	One-shot timer specification for output 1	UINT16	R/W	No	0: Off delay time 1: One-shot timer
	10	Timer setting CH2	One-shot timer specification for output 2	UINT16	R/W	No	
	11	Off delay time	Off delay timer time for output 1	UINT16	R/W	No	0 - 9999: 0 - 9999 ms -1 - -9: 0.1 - 0.9 ms
	12	On delay time	On delay timer time for output 1	UINT16	R/W	No	
	13	Off delay time	Off delay timer time for output 2	UINT16	R/W	No	
	14	On delay time	On delay timer time for output 2	UINT16	R/W	No	
	18	Hysteresis	Hysteresis setting	UINT16	R/W	No	1 - 40
	1A	ASC (Automatic Switching threshold tracking)	ASC setting (automatic sensitivity correction)	UINT16	R/W	No	0: None 1: Normal correction 2: High-speed correction 3: Maximum-speed correction
	1B	Energy Saving	Eco mode setting	UINT16	R/W	No	0: Standard 1: Automatically turn OFF indicators 2: 2x emitting cycle 3: Display and emitting cycle
	1C	Reverse Display	Reverse display setting	UINT16	R/W	No	0: Standard 1: Reverse display
80n1 Note: n = ID (0 - F)	00	Module Commands	Operation information on connected sensor-amplifiers	UINT8	RO	-	0D h
	01	Store Zero-reset	Execute zero reset	UINT16	WO	No	0 - 65535: Execute
	02	Cancel Zero-reset	Clear zero reset	UINT16	WO	No	0 - 65535: Execute
	03	Teach in 1 Point	First teaching	UINT16	WO	No	1: Teaching for output 1 2: Teaching for output 2
	04	Teach in 2 Point	Second teaching	UINT16	WO	No	
	0B	Warm start Reset	Restart instruction	UINT16	WO	No	3: Execute restart
	0C	Go back to Top Menu Operation	Back to top menu	UINT16	WO	No	Execute by writing values
	0D	Factory setting initialization	Initialize setting values	UINT16	WO	No	3: Execute initialization (only allowed when unlocked)

Slave Information Area

Index (HEX)	Sub-Index (HEX)	Name	Description	Data type	Reading / writing attribute	Assignable to PDO	Setting value range
90n0 Note: n = ID (0 - F)	00	Module Identification	Identification information on connected sensor-amplifiers	UINT8	RO	-	09 h
	01	Product Series	Product series	UINT16	RO	No	2101 h: Fiber amplifier 1 output 2102 h: Fiber amplifier 2 output
	02	Product Type	Product type	UINT16	RO	No	0017 h
	03	Firmware Version	Firmware version	UINT16	RO	No	0100h
	04	Protocol Version	Protocol version	UINT16	RO	No	0000 h
	05	Product Revision	Version number of product hardware	UINT16	RO	No	0000 h
	06	Vender Name	Vendor name	STRG (7)	RO	No	“OPTEX FA”
	07	Product Name	Product name	STRG (4)	RO	No	“D3RF”
	08	Product ID	Product ID	UINT16	RO	No	-
	09	User ID	User ID (maximum 32 characters)	STRG (32)	RO	No	All 20 h

Diagnostic Information Area

Index (HEX)	Sub-Index (HEX)	Name	Description	Data type	Reading / writing attribute	Assignable to PDO	Setting value range
A0n1 Note: n = ID (0 - F)	00	Module Diagnoses	Status of D3RF unit	UINT8	RO	-	02 h
	01	Operation Status	Operation status of D3RF 0000 h: Initializing 0001 h: Idle 0002 h: Operating 0003 h: Key operation in progress by user	UINT16	RO	No	0000 h
	02	Error code	Latest error code for D3RF	UINT16	R/W	No	Error code (refer to “5-3 List of Error Codes for Each Device” (Page 5-4))

3-7-2 Parameters of D3WF Sensor-amplifier (Inter-connection Type)

This table indicates the parameters related to the settings, operations, and status confirmation for the D3WF sensor-amplifier.
Refer to the instruction manual of D3WF (inter-connection type) for further information on each parameter.

Settings Data Area

Index (HEX)	Sub-Index (HEX)	Name	Description	Data type	Reading / writing attribute	Assignable to PDO	Setting value range
80n0 Note: n = ID (0 - F)	00	Module Configuration	Settings information on connected sensor-amplifiers	UINT8	RO	-	1C h
	01	Display	Display settings	UINT16	R/W	No	0: Number display 1: Bar display 2: Percentage display
	03	Teach-in Mode CH1	Output 1 teaching mode	UINT16	R/W	No	0: One-point teaching 1: Two-point teaching 2: Dynamic teaching
	04	Teach-in Mode CH2	Output 2 teaching mode	UINT16	R/W	No	
	05	Response Speed	Response speed setting	UINT16	R/W	No	0: 16 µs 1: 200 µs
	06	Gain	Emitting power setting	UINT16	R/W	No	0: Low power 1: Standard power 2: High power 3: Automatic power
	07	MF-Input	External input setting	UINT16	R/W	No	0: Extended input 1: All teaching (master only) 2: Toggle between light on and dark on 3: Test input 4: Off
	08	Key Lock	Lock level setting	UINT16	R/W	No	0: Cancel 1: Lock 2: Lock except extended input
	09	Operation Mode CH1	Output 1 operation mode	UINT16	R/W	No	0: Automatic 1: L-on (light on) 2: D-on (dark on)
	0A	Operation Mode CH2	Output 2 operation mode	UINT16	R/W	No	
	0B	Threshold Level CH1 Lower Limit	Lower threshold (Far) setting for output 1	UINT16	R/W	No	-999 - 9999 The range that can be written differs depending on the operation mode.
	0D	Threshold Level CH2 Lower Limit	Lower threshold (Far) setting for output 2	UINT16	R/W	No	-999 - 9999 The range that can be written differs depending on the operation mode.
	0F	Timer setting CH1	One-shot timer specification for output 1	UINT16	R/W	No	0: Delay out 1: Individual
	10	Timer setting CH2	One-shot timer specification for output 2	UINT16	R/W	No	

Index (HEX)	Sub-Index (HEX)	Name	Description	Data type	Reading / writing attribute	Assignable to PDO	Setting value range
80n0 Note: n = ID (0 - F)	11	Off delay time	Off delay timer time for output 1	UINT16	R/W	No	0 - 9999: 0 - 9999 ms -1 - -9: 0.1 - 0.9 ms
	12	On delay time	On delay timer time for output 1	UINT16	R/W	No	
	13	Off delay time	Off delay timer time for output 2	UINT16	R/W	No	
	14	On delay time	On delay timer time for output 2	UINT16	R/W	No	
	16	Synchronisation	Synchronization	UINT16	R/W	No	0: Asynchronous 1: Synchronous
	18	Sensitivity	Sensitivity	UINT16	R/W	No	0: 10% 1: 20% 2: 0%
	1A	ASC (Automatic Switching threshold tracking)	ASC setting (automatic sensitivity correction)	UINT16	R/W	No	0: Off 1: On
	1B	Energy Saving	Eco mode setting	UINT16	R/W	No	0: Off 1: On
	1C	Reverse Display	Reverse display setting	UINT16	R/W	No	0: Normal display 1: Reverse display
80n1 Note: n = ID (0 - F)	00	Module Commands	Operation command for connected sensor-amplifiers	UINT8	RO	-	0D h
	01	Store Zero-reset	Execute zero reset	UINT16	WO	No	Execute with writing operation
	02	Cancel Zero-reset	Clear zero reset	UINT16	WO	No	Execute with writing operation
	03	Teach in 1 Point	First teaching	UINT16	WO	No	1: Teaching for output 1 2: Teaching for output 2
	04	Teach in 2 Point	Second teaching	UINT16	WO	No	
	0B	Warm start Reset	Restart instruction	UINT16	WO	No	3: Execute restart
	0C	Go back to Top Menu Operation	Back to top menu	UINT16	WO	No	Execute with writing operation
	0D	Factory setting initialization	Initialize setting values	UINT16	WO	No	3: Execute initialization (only allowed when unlocked)

Slave Information Area

Index (HEX)	Sub-Index (HEX)	Name	Description	Data type	Reading / writing attribute	Assignable to PDO	Setting value range
90n0 Note: n = ID (0 - F)	00	Module Identification	Identification information on connected sensor-amplifiers	UINT8	RO	-	09 h
	01	Product Series	Product series	UINT16	RO	No	2101 h: Fiber amplifier 1 output 2102 h: Fiber amplifier 2 output
	02	Product Type	Product type	UINT16	RO	No	0012 h
	03	Firmware Version	Firmware version	UINT16	RO	No	0100 h
	04	Protocol Version	Protocol version	UINT16	RO	No	0001 h
	05	Product Revision	Version number of product hardware	UINT16	RO	No	0001 h
	06	Vender Name	Vendor name	STRG(7)	RO	No	“OPTEX FA”
	07	Product Name	Product name	STRG(8)	RO	No	“D3WFxxxx”
	08	Product ID	Product ID	UINT16	RO	No	-
	09	User ID	User ID (maximum 32 characters)	STRG(32)	R/W	No	All 20 h

Diagnostic Information Area

Index (HEX)	Sub-Index (HEX)	Name	Description	Data type	Reading / writing attribute	Assignable to PDO	Setting value range
A0n1	00	Module Diagnoses	Status of D3WF unit	UINT8	RO	-	02 h
	01	Operation Status	Operation status of D3WF 0000 h: Initializing 0001 h: Idle 0002 h: Operating 0003 h: Key operation in progress by user	UINT16	RO	No	0000 h
	02	Error code	Latest error code for D3WF	UINT16	R/W	No	Error code (refer to “5-3 List of Error Codes for Each Device” (Page 5-4))

3-7-3 Parameters of CDA Sensor-amplifier

This table indicates the parameters related to the settings, operations, and status confirmation for the CDA sensor-amplifier.

The parameters that can be assigned differ depending on the connected sensor as follows.

- Compact laser displacement sensor, CD22 series (RS-485 communication type)
- Through-beam edge sensor, TD1 series

Refer to the instruction manual of CD22, TD1 and CDA for further information on each parameter.

■ CD22 Series (RS-485 Communication Type)

● Settings Data Area

• Settings of CDA Sensor-amplifier

Index (HEX)	Sub-Index (HEX)	Name	Description	Data type	Reading / writing attribute	Assignable to PDO	Setting value range
80n0 Note: n = ID (0 - F)	00	Module Configuration	Settings information on connected sensor-amplifiers and sensors	UINT8	RO	-	38 h
	01	Threshold Near	External output threshold (Near)	UINT16	R/W	No	-32768 - 32767
	02	Threshold Far	External output threshold (Far)	UINT16	R/W	No	
	03	Hysteresis Exit	External output hysteresis setting	UINT16	R/W	No	0 - 32767
	04	Calculation Flags	Calculation flag (setting value for each connected sensor)	UINT16	R/W	No	0: No calculation 1: Calculation
	05	Calculation Coefficient Addition	Sensor measurement addition coefficient (A) (setting value for each connected sensor)	UINT16	R/W	No	-10000 - 10000
	06	Calculation Coefficient Multiplication	Sensor measurement multiplication coefficient (M) (setting value for each connected sensor)	UINT16	R/W	No	-10000 - 10000
	07	Calculation Coefficient Division	Sensor measurement division coefficient (D) (setting value for each connected sensor)	UINT16	R/W	No	1 - 32767
	08	Monitor Calculation Values	Calculation result monitor	UINT16	R/W	No	0: Measurement value for sensor 2 1: Calculation result

Index (HEX)	Sub-Index (HEX)	Name	Description	Data type	Reading / writing attribute	Assignable to PDO	Setting value range
80n0 Note: n = ID (0 - F)	09	Calculation Values Head1	Calculation of measurement values for sensor 1	UINT16	R/W	No	0: None 1: Addition 2: Subtraction 3: Absolute difference
	0A	Calculation Values Head2	Calculation of measurement values for sensor 2	UINT16	R/W	No	
	0B	Calculation Values Unit left Head1	Calculation of measurement values for left sensor 1	UINT16	R/W	No	
	0C	Calculation Values Unit left Head2	Calculation of measurement values for left sensor 2	UINT16	R/W	No	
	0D	I/O polarity	I/O polarity	UINT16	R/W	No	0: PNP (N.O.) 1: NPN (N.O.) 2: PNP (N.C.) 3: NPN (N.C.)
	0E	Selection Exit Out1	Select function for external output 1	UINT16	R/W	No	0: No output 1: Within threshold range for calculation results (GO) 2: Outside near range for calculation results (LO) 3: Outside far range for calculation results (HI) 4: Within threshold range for sensor 1 (GO) 5: Outside near range for sensor 1 (LO) 6: Outside far range for sensor 1 (HI) 7: Within threshold range for sensor 2 (GO) 8: Outside near range for sensor 2 (LO) 9: Outside far range for sensor 2 (HI)
	0F	Selection Exit Out2	Select function for external output 2	UINT16	R/W	No	
	10	Selection Exit Out3	Select function for external output 3	UINT16	R/W	No	
	11	Selection of external Entrance	Select external input	UINT16	R/W	No	0: No function 1: Teaching (rising on far side, falling on near side) 2: BGS/FGS teaching 3: Zero reset 4: Laser emitting off
	12	Selection Analog Exit	Select analog output	UINT16	R/W	No	0: None 1: Calculation results 2: Sensor 1 3: Sensor 2
	13	Analog Scaling	Analog scaling	UINT16	R/W	No	0: No scaling 1: Scaling
	14	Analog Scaling (max.) 10 V / 20 mA	Max analog scaling	UINT16	R/W	No	-32768 - 32767
	15	Analog Scaling (min.) 0 V / 4 mA	Min analog scaling	UINT16	R/W	No	
	16	Baudrate	Sensor head communication speed (setting value for each connected sensor)	UINT16	R/W	No	0: No connection (unit for values below: bps) 1: 9.6k, 2: 19.2k, 3: 38.4k, 4: 57.6k, 5: 115.2k, 6: 230.4k, 7: 312.5k, 8: 468.75k, 9: 500k, 10: 625k, 11: 833.3k, 12: 937.5k, 13: 1250k

● Settings data area (continued)

• **Settings of Connected CD22 Sensor**

Index (HEX)	Sub-Index (HEX)	Name	Setting value name	Data type	Reading / writing attribute	Assignable to PDO	Setting value range		
							CD22 -15-485	CD22 -35-485	CD22 -100-485
80n0 Note: n = ID (0 - F)	1F	Leap Point Close	Output judgment Near threshold	UINT16	R/W	No	-7499 - 7499 (1 µm increments)	-2249 - 2249 (10 µm increments)	-7499 - 7499 (1 µm increments)
	20	Leap Point Away	Output judgment Far threshold	UINT16	R/W	No			
	21	Background ObSB	Output judgment Distance set for FGS2	UINT16	R/W	No			
	22	Tolerance ObSB	Output judgment Operation range for FGS2	UINT16	R/W	No			
	23	Average Number	Number of averaging operations	UINT16	R/W	No	0: 1, 1: 8, 2: 64, 3: 512		
	24	Teach-in-Mode	Teach mode	UINT16	R/W	No	0: Two-point teaching 1: One-point teaching 2: FGS2		
	25	Sampling rate	Sampling period	UINT16	R/W	No	0: 500 µs, 1: 1 ms, 2: 2 ms, 3: 4 ms, 4: Automatic		
	26	Keylock	Key lock function	UINT16	R/W	No	0: No lock 1: Lock		
	27	Switching Behaviour	Select output polarity	UINT16	R/W	No	0: Light on (on within range) 1: Dark on (on outside range)		
	28	Calibration Distance close	Actual measurement values on near side	UINT16	R/W	No	-7499 - 7499 (1 µm increments)	-2249 - 2249 (10 µm increments)	-7499 - 7499 (1 µm increments)
	29	Calibration distance Away	Actual measurement values on far side	UINT16	R/W	No			
	2A	Error Behaviour	Select alarm operation	UINT16	R/W	No	0: Output clamp error value (H7FFF) 1: Retain last valid measurement value before hold		
	2B	Clamp holding time	Alarm hold count	UINT16	R/W	No	0 - 9999		
	2D	Zeroing Value	Zero reset value	UINT16	R/W	No	-7499 - 7499 (1 µm increments)	-2249 - 2249 (10 µm increments)	-7499 - 7499 (1 µm increments)
	31	Barycenter	Select receiving light waveform	UINT16	R/W	No	0: Waveform with strongest received light level 1: Closest point to sensor 2: Second closest point to sensor 3: Third closest point to sensor 4: Fourth closest point to sensor 5: Fifth closest point to sensor		
	34	Hysteresis Value	Hysteresis	UINT16	R/W	No	-7499 - 7499 (1 µm increments)	-2249 - 2249 (10 µm increments)	-7499 - 7499 (1 µm increments)
	35	Sensitivity	Sensitivity	UINT16	R/W	No	0: Automatic adjustment, 1: Minimum, 2 Low, 3: Medium, 4: Medium high, 5: High, 6: Maximum		
	36	Light Threshold	Waveform threshold	UINT16	R/W	No	0: Lowest surface, 1: Low position, 2: Center position, 3: High position		
	38	Keylock active	Display indicators	UINT16	R/W	No	0: Continue displaying when locked 1: Turn off when locked		

Index (HEX)	Sub-Index (HEX)	Name	Setting value name	Data type	Reading / writing attribute	Assignable to PDO	Setting value range		
							CD22 -15-485	CD22 -35-485	CD22 -100-485
80n1 Note: n = ID (0 - F)	00	Module Commands	Operation information on connected sensors	UINT8	RO	-	0D h		
	01	Save Zero Reposition	Execute zero reset	UINT16	R/W	No	Execute by writing values		
	02	Cancel Zero Reset	Clear zero reset	UINT16	R/W	No	Execute by writing values		
	03	Teach in 1 Point	One-point teaching	UINT16	R/W	No	Execute by writing values		
	04	Teach in 2 Point	Two-point teaching	UINT16	R/W	No	Execute by writing values		
	05	Teach in ObSB	FGS2 teaching	UINT16	R/W	No	Execute by writing values		
	0B	Reset	Restart instruction	UINT16	R/W	No	3: Execute restart		
	0C	Go back to Top Menu Operation	Back to top menu	UINT16	R/W	No	0,1, 2: Execute		
	0D	Reset to Factory Settings	Initialize setting values	UINT16	R/W	No	3: Execute initialization		

● Slave Information Area

Index (HEX)	Sub-Index (HEX)	Name	Description	Data type	Reading / writing attribute	Assignable to PDO	Setting value range
90n0 Note: n = ID (0 - F)	00	Module Identification	Identification information on connected sensors	UINT8	RO	-	0A h
	01	Product Range	Product series	UINT16	RO	No	1301 h: CD22-15-485 1302 h: CD22-35-4853 1303 h: CD22-100-485
	02	Product Type	Product type	UINT16	RO	No	0011 h
	03	Firmware Version	Firmware version	UINT16	RO	No	0100 h
	04	Protocol Version	Protocol version	UINT16	RO	No	0000 h
	05	Product Revision	Version number of product hardware	UINT16	RO	No	0000 h
	06	Vender Name	Vendor name	STRG (7)	RO	No	“OPTEX FA”
	07	Product Name	Product name	STRG (11)	RO	No	“CD22-XX-XXX”
	08	Product ID	Product ID	UINT16	RO	No	-
	09	User ID	User ID (maximum 32 characters)	STRG (32)	R/W	No	All 20 h

Diagnostic Information Area

Index (HEX)	Sub-Index (HEX)	Name	Description	Data type	Reading / writing attribute	Assignable to PDO	Setting value range		
							CD22 -15-485	CD22 -35-485	CD22 -100-485
A0n1 Note: n = ID (0 - F)	00	Module Diagnoses	Status of connected CD22	UINT8	RO	-	02 h		
	01	Status	Operation status of connected CD22 0000 h: Initializing 0001 h: Teaching 0002 h: Operating 0003 h: Key operation in progress by user	UINT16	RO	No	0000 - 003 h		
	02	Error code	Latest error code for connection CD22	UINT16	R/W	No	Error code (refer to “5-3 List of Error Codes for Each Device” (Page 5-4))		

TD1 Series

Settings Data Area

- **Settings of CDA Sensor-amplifier**

Index (HEX)	Sub-Index (HEX)	Name	Description	Data type	Reading / writing attribute	Assignable to PDO	Setting value range
80n0 Note: n = ID (0 - F)	00	Module Configuration	Settings information on connected sensor-amplifiers and sensors	UINT8	RO	-	38 h
	01	Threshold Near	External output threshold (Near)	UINT16	R/W	No	-32768 - 32767
	02	Threshold Far	External output threshold (Far)	UINT16	R/W	No	
	03	Hysteresis Exit	External output hysteresis setting	UINT16	R/W	No	0 - 32767
	04	Calculation Flags	Calculation flag (setting value for each connected sensor)	UINT16	R/W	No	0: No calculation 1: Calculation
	05	Calculation Coefficient Addition	Sensor measurement addition coefficient (A) (setting value for each connected sensor)	UINT16	R/W	No	-10000 - 10000
	06	Calculation Coefficient Multiplication	Sensor measurement multiplication coefficient (M) (setting value for each connected sensor)	UINT16	R/W	No	-10000 - 10000
	07	Calculation Coefficient Division	Sensor measurement division coefficient (D) (setting value for each connected sensor)	UINT16	R/W	No	1 - 32767
	08	Monitor Calculation Values	Calculation result monitor	UINT16	R/W	No	0: Measurement value for sensor 2 1: Calculation result

Index (HEX)	Sub-Index (HEX)	Name	Description	Data type	Reading / writing attribute	Assignable to PDO	Setting value range
80n0 Note: n = ID (0 - F)	09	Calculation Values Head1	Calculation of measurement values for sensor 1	UINT16	R/W	No	0: None 1: Addition 2: Subtraction 3: Absolute difference
	0A	Calculation Values Head2	Calculation of measurement values for sensor 2	UINT16	R/W	No	
	0B	Calculation Values Unit left Head1	Calculation of measurement values for left sensor 1	UINT16	R/W	No	
	0C	Calculation Values Unit left Head2	Calculation of measurement values for left sensor 2	UINT16	R/W	No	
	0D	I/O polarity	I/O polarity	UINT16	R/W	No	0: PNP (N.O.) 1: NPN (N.O.) 2: PNP (N.C.) 3: NPN (N.C.)
	0E	Selection Exit Out1	Select function for external output 1	UINT16	R/W	No	0: No output 1: Within threshold range for calculation results (GO) 2: Outside near range for calculation results (LO) 3: Outside far range for calculation results (HI) 4: Within threshold range for sensor 1 (GO) 5: Outside near range for sensor 1 (LO) 6: Outside far range for sensor 1 (HI) 7: Within threshold range for sensor 2 (GO) 8: Outside near range for sensor 2 (LO) 9: Outside far range for sensor 2 (HI)
	0F	Selection Exit Out2	Select function for external output 2	UINT16	R/W	No	
	10	Selection Exit Out3	Select function for external output 3	UINT16	R/W	No	
	11	Selection of external Entrance	Select external input	UINT16	R/W	No	0: No function 1: Teaching (rising on far side, falling on near side) 2: BGS/FGS teaching 3: Zero reset 4: Laser emitting off
	12	Selection Analog Exit	Select analog output	UINT16	R/W	No	0: None 1: Calculation results 2: Sensor 1 3: Sensor 2
	13	Analog Scaling	Analog scaling	UINT16	R/W	No	0: No scaling 1: Scaling
	14	Analog Scaling (max.) 10 V / 20 mA	Max analog scaling	UINT16	R/W	No	-32768 - 32767
	15	Analog Scaling (min.) 0 V / 4 mA	Min analog scaling	UINT16	R/W	No	
	16	Baudrate	Sensor head communication speed (setting value for each connected sensor)	UINT16	R/W	No	0: No connection (unit for values below: bps) 1: 9.6k, 2: 19.2k, 3: 38.4k, 4: 57.6k, 5: 115.2k, 6: 230.4k, 7: 312.5k, 8: 468.75k, 9: 500k, 10: 625k, 11: 833.3k, 12: 937.5k, 13: 1250k

Settings Data Area (continued)

• **Settings of Connected TD1 Sensor**

Index (HEX)	Sub-Index (HEX)	Name	Setting value name	Data type	Reading / writing attribute	Assignable to PDO	Setting value range
80n0 Note: n = ID (0 - F)	23	Average Number	Number of averaging operations	UINT16	R/W	No	1 - 128
	24	Teach-in-Mode	Measurement type	UINT16	R/W	No	0: Edge positive 1: Edge negative 2: Gap / external diameter
	25	Sampling rate	Sampling period	UINT16	R/W	No	0: 500 µs (fixed value)
	2C	Measuring Direction	Measurement direction	UINT16	R/W	No	0: Top to bottom 1: Bottom to top
	2D	Zeroing Value	Offset value	UINT16	R/W	No	-9.999 - 5.000
	35	Sensitivity	Sensitivity	UINT16	R/W	No	0: Minimum value 1: Second 2: Third 3: Fourth 4: Maximum value 5: Adjusted value
80n1 Note: n = ID (0 - F)	00	Module Commands	Operation information on connected sensors	UINT8	RO	-	0D h
	01	Save Zero Reposition	Execute zero reset	UINT16	R/W	No	Execute with writing operation
	02	Cancel Zero Reset	Clear zero reset	UINT16	R/W	No	Execute with writing operation
	0D	Reset to Factory Settings	Initialize setting values	UINT16	R/W	No	3: Execute initialization

Slave Information Area

Index (HEX)	Sub-Index (HEX)	Name	Description	Data type	Reading / writing attribute	Assignable to PDO	Setting value range
90n0 Note: n = ID (0 - F)	00	Module Identification	Identification information on connected sensors	UINT8	RO	-	0A h
	01	Product Range	Product series	UINT16	RO	No	2321 h: TD1 2302 h: TD1-K
	02	Product Type	Product type	UINT16	RO	No	0011 h
	03	Firmware Version	Firmware version	UINT16	RO	No	1011 h
	04	Protocol Version	Protocol version	UINT16	RO	No	0000 h
	05	Product Revision	Version number of product hardware	UINT16	RO	No	0000 h
	06	Vender Name	Vendor name	STRG(7)	RO	No	“OPTEX FA”
	07	Product Name	Product name	STRG(9)	RO	No	“TD1-xxxxx”
	08	Product ID	Product ID	UINT16	RO	No	-
	09	User ID	User ID (maximum 32 characters)	STRG(32)	R/W	No	All 20 h
	0A	Product Series Amplifier	Amplifier product series	UINT16	RO	No	0002 h
	0F	Serial Number	Serial number (set in ASCII code)	UINT16	RO	No	-

Diagnostic Information Area

Index (HEX)	Sub-Index (HEX)	Name	Description	Data type	Reading / writing attribute	Assignable to PDO	Setting value range
A0n1 Note: n = ID (0 - F)	00	Module Diagnoses	Status of connected TD1	UINT8	RO	-	02 h
	01	Status	Operation status of connected TD1 0000 h: Initializing 0001 h: Teaching 0002 h: Operating 0003 h: Key operation in progress by user	UINT16	RO	No	0000 - 003 h
	02	Error code	Latest error code for connection TD1	UINT16	R/W	No	Error code (refer to “5-3 List of Error Codes for Each Device” (Page 5-4))

4

Specifications

This chapter describes the specifications of this unit.

4-1 Specifications

Model		UC1-EC
EtherCAT specifications*1	**Master / slave**	EtherCAT slave
	Conforming standard	IEEE802.3u (100BASE-TX)
	Transfer speed	100Mbps (100BASE-TX)
	Cable	STP Category 5 or higher
	Supported functions	Process data communication, mailbox communication (CoE supported)
	Communication ports	M12 connector × 2
	Distance between nodes	Within 100 m
Connected devices	**Connectable models**	Inter-connection masters and slave units in the D3□F series Master units and slave units in the CDA series
	Number of units connected	Maximum 16 units*2 (one CDA unit accounts for two units)
	Connection type	5-pin connector for interconnection (functions as end unit for interconnection)
Indicators		Power indicator - green (PWR)
		Error indicator - red (ERR)
		Communication status indicator - green (RUN)
		Communication available indicator - green (SYSTEM)
		PORT1 operation indicator - green (L/A1)
		PORT2 operation indicator - green (L/A2)
Data		PDO communication (transmission: max 120 bytes, receipt: max 36 bytes)
		SDO communication
Synchronization mode		Free Run mode (asynchronous) or DC mode 1
Rating	**Power supply voltage**	12 to 24 VDC including ripple (p-p) +/-10%
	Power consumption	Maximum 3 W
Protection circuit		Reverse connection protection
Route stabilization time		1.5 s or less
Environmental resistance	**Ambient temperature range / humidity**	-25 to +55°C/35 to 85% RH (no freezing or condensation)
	Storage temperature / humidity	-40 to +70°C/35 to 85% RH
	Vibration resistance	10 to 55 Hz, double amplitude 1.5 mm, 2 hours in X, Y and Z directions
	Shock resistance	500 m/s^2 (approx. 50 G), 3 times in X, Y and Z directions
	Degree of protection	IP50
Applicable laws and regulations	**EMC**	EMC(2014/30/EU)
	Environment	RoHS directive (2011/65/EU), China RoHS (Regulation 32)
Applicable standards		EN 61000-6-2, EN 55011
Company standards		Noise resistance: Passes Feilen Level 3
Mounting		35 mm DIN rail (conductive surface)
Material		Polycarbonate
Included accessories		Instruction manual, M12 protective cap, end plate × 2
Weight		Body around 90 g (including connectors), around 155 g when packaged

*1: EtherCAT is a registered trademark of Beckhoff.

*2: The maximum number of connectable D3□F units differs depending on the ambient temperature.

4-2 Data Processing Time

A processing time (total of the following processing times) is required between detection of the applicable sensor and processing of the data by the EtherCAT master.

- Data processing time of applicable sensors or amplifier units
- Data processing time of this unit
- EtherCAT communication period between the EtherCAT master and this unit
- Internal processing time of EtherCAT master

The data processing time of the applicable sensor or amplifier unit and the data processing time of this unit are as follows.

MEMO

Refer to the manual of the EtherCAT master for information on the EtherCAT communication cycle and the internal processing time of the EtherCAT master.

■ Data Processing Time of Applicable Sensors or Amplifier Units

● Data Processing Time of D3□F

The D3□F fiber amplifier writes setting values requested via this unit to EEPROM before returning a response. As a result, the response time changes depending on the setting value as follows.

- **D3RF**

Index number 80n0 Note: n = ID (0 - F) Subindex	Setting value name	Conditions	Number of words written	Writing time (ms)*1
01	Display settings		1	5
03	Output 1 teaching mode		1	5
04	Output 2 teaching mode		1	5
05	Response speed setting	Single output type	8	40
		Single output zone teaching	10	50
		Double output type	10	50
		One zone of double output	12	60
		Both zones of double output	14	70
06	Emitting power setting		4	20
07	External input setting		3	15
08	Lock level setting		1	5
09	Output 1 operation mode		1	5
0A	Output 2 operation mode		1	5
0B	Lower threshold (Far) setting for output 1	Edge detection	1	5
		Other	2	10

Index number 80n0 Note: n = ID (0 - F) Subindex	Setting value name	Conditions	Number of words written	Writing time (ms)*1
0C	Upper threshold (Near) setting for output 1		2	10
0D	Lower threshold (Far) setting for output 2		2	10
0E	Upper threshold (Near) setting for output 2		2	10
0F	One-shot timer specification for output 1		2	10
10	One-shot timer specification for output 2		2	10
11	Off delay timer time for output 1		2	10
12	On delay timer time for output 2		2	10
13	Off delay timer time for output 2		2	10
14	On delay timer time for output 2		2	10
18	Hysteresis setting	Single output type	2	10
		Single output zone teaching	3	15
		Double output type	3	15
		One zone of double output	4	20
		Both zones of double output	5	25
1A	ASC setting (automatic sensitivity correction)		1	5
1B	Eco mode setting		3	15
1C	Reverse display setting		1	5

*1: The time varies by several ms depending on the EtherCAT communication cycle.

• **D3WF**

Index number 80n0 Note: n = ID (0 - F) Subindex	Setting value name	Conditions	Number of words written	Writing time (ms)*1
01	Display settings		1	5
03	Output 1 teaching mode		1	5
04	Output 2 teaching mode		1	5
05	Response speed setting	Single output type	8	40
		Single output zone teaching	10	50
		Double output type	10	50
		One zone of double output	12	60
		Both zones of double output	14	70
06	Emitting power setting		4	20
07	External input setting		3	15
08	Lock level setting		1	5
09	Output 1 operation mode		1	5
0A	Output 2 operation mode		1	5
0B	Lower threshold (Far) setting for output 1	Edge detection	1	5
		Other	2	10
0D	Lower threshold (Far) setting for output 2		2	10
0F	One-shot timer specification for output 1		2	10
10	One-shot timer specification for output 2		2	10
11	Off delay timer time for output 1		2	10
12	On delay timer time for output 2		2	10
13	Off delay timer time for output 2		2	10
14	On delay timer time for output 2		2	10
16	Synchronization		2	5
18	Sensitivity		2	5
1A	ASC setting (automatic sensitivity correction)		1	5
1B	Eco mode setting		3	15
1C	Reverse display setting		1	5

*1: The time varies by several ms depending on the EtherCAT communication cycle.

● Data Processing Time of CDA

The CDA general-purpose amplifier unit writes CDA parameters requested via this unit to EEPROM before returning a response. The response time is 5 ms.

● Data Processing Time of CD22

The CD22 compact laser displacement sensor writes CD22 parameters requested via this unit to EEPROM before returning a response. The response time changes depending on the communication speed setting for communication between CDA and RS-485 as follows.

Communication speed (bps)	Writing time (ms)
9.6k	20
19.2k	10
Other (38.4k - 1250k)	5

● Data Processing Time of TD1

The TD1 through-beam edge sensor writes TD1 parameters requested via this unit to EEPROM before returning a response. The response time changes depending on the communication speed setting for communication between CDA and RS-485 as follows.

Communication speed (bps)	Writing time (ms)
9.6k	20
19.2k	10
Other (38.4k - 1250k)	5

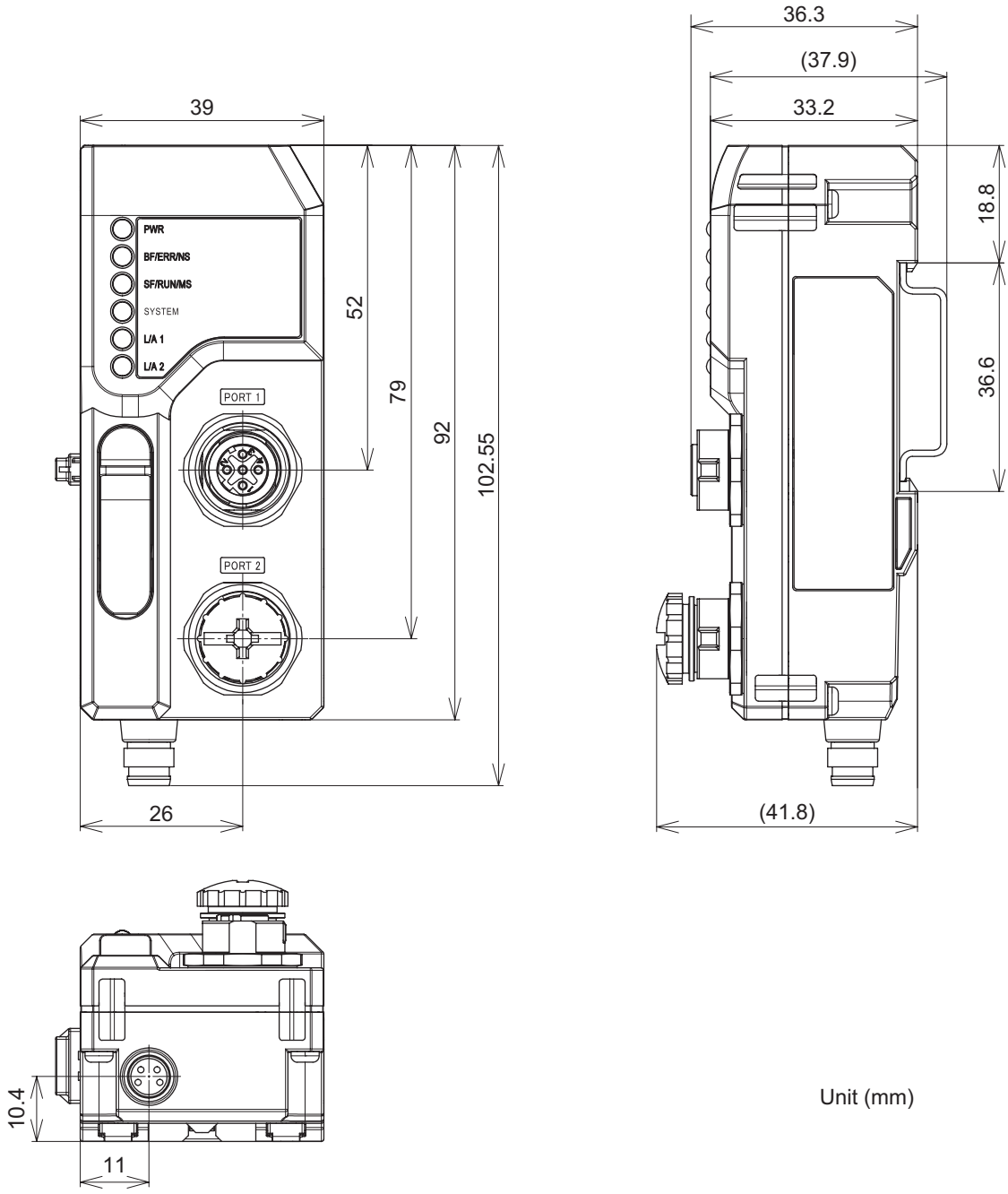
■ Data Processing Time of This Unit

The following processing time is required between detection of the applicable sensor and transmission of data to the EtherCAT master.

Number of units connected	Processing time
1 - 4	160 µs
5 - 8	320 µs
9 - 12	480 µs
13 - 16	640 µs

4-3 Dimensions

UC1-EC



Unit (mm)

5

Troubleshooting

This chapter describes troubleshooting methods for specific errors.

5-1 Types of Error Code

This unit stores the following 2 types of error code in internal storage.

- Sensor-amplifier and sensor connection configuration error codes
- Latest error codes specific to each device

Either type of error code can be read from the master through SDO communication normally or as needed.

Sensor-amplifier and Sensor Configuration Error Codes

When an error occurs in the sensor-amplifier and sensor connection configuration, the error code is stored in this unit's object dictionary index 10F3 h (operation error history).
Stored error codes can be read through SDO communication when "Error notification control of this unit" (index F200 h) is set to 0001 h (enabled).

Item	Storage location in this unit's object dictionary
Sensor-amplifier and sensor connection configuration error codes	Subindex 06 - 15 h of index 10F3 h

Refer to "5-2 Sensor-amplifier and Sensor Configuration Error Codes" (Page 5-3) for more detailed information about each error code.

Latest Error Codes Specific to Each Device

When a device-specific error occurs, the latest error code for each device is stored in this unit's object dictionary index F100 h and A0n1 h as follows.

Item	Storage location in this unit's object dictionary
Latest error code for this unit	Subindex 03 h of index F100 h
Latest error code for D3RF	Subindex 02 h of index A0n1 h Note: n = ID (0 - F)
Latest error code for D3WF	
Latest error code for connection CD22	
Latest error code for connection TD1	

Refer to "5-3 List of Error Codes for Each Device" (Page 5-4) for more information about each error code.

5-2 Sensor-amplifier and Sensor Configuration Error Codes

Sensor-amplifier and sensor configuration error codes are stored in the operation error history (volatile memory).
The storage location is subindex 06 - 15 h of this unit's object dictionary index 10F3 h (Diagnostic History).
Stored error codes can be read through SDO communication when "Error notification control of this unit" (index F200 h) is set to 0001 h (enabled).
Subindex 04h is set to 1 (on) when an error code is stored. Therefore, the stored error code can be read through SDO communication by using this bit as an execution condition.

Error Code	Error type	Error name	Error description	Countermeasure
0006E000 h	Error	Change in the number of connected sensor-amplifiers or sensors	The number of connected sensor-amplifier units or sensors changed (generally decreased) after the power was turned ON.	There may have been a sensor-amplifier unit or sensor failure, or the power supply may have been turned OFF. Check all connected sensor-amplifiers and sensors and their respective power supplies.
0007E000 h	Warning	Configuration error	A configuration error occurred with sensor-amplifier and sensor configuration downloaded to this unit (the current sensor-amplifiers and sensors configuration does not match the configuration set in the master).	Change the sensor-amplifier and sensor configuration on the master-side configuration software to that of the actual device and download it to this unit, or change the configuration of the actual device to match that set in the master and reset the power.
0008E000 h		Invalid connection order	The connection order of the sensor-amplifier unit is incorrect (D3☐F is connected to the right-hand side of CDA). In this case, EtherCAT communication can be executed in the OPERATIONAL state, however, the current values sent from the CDA to the left of the D3☐F to the master will be incorrect, as will the setting value set by the master.	Connect D3☐F to the left of the CDA and reset the power.

MEMO

- Error history data will not be saved to non-volatile memory. Therefore, it will be cleared the next time the power is turned ON.
- "Error notification control of this unit" (index F200 h) must be set to 0001 h (enabled) in order to read the error history. This setting is saved in non-volatile memory, and the setting will be preserved the next time the power is turned ON.

5-3 List of Error Codes for Each Device

The error codes for each device are as follows:

Device	Storage location in this unit's object dictionary
Latest error code for this unit	Subindex 03 h of index F100 h
Latest error code for D3RF	Subindex 02 h of index A0n1 h Note: n = ID (0 - F)
Latest error code for D3WF	
Latest error code for connection CD22	
Latest error code for connection TD1	

Error Codes for This Unit

Error Code	Details
0000 h	No error
0107 h	Configuration error
0108 h	Invalid connection order
0206 h	Change in the number of connected sensor-amplifiers or sensors

Error Codes for Connected Sensor-amplifiers

D3RF / D3WF

Error Code		Details
High-order byte	Low-order byte	
00 h	00 h	No error
Relevant index number*1	01 h	The index number is out of range.
	02 h	The sub index number is not supported.
00 h	03 h	An attempt was made to write setting values to sensors that are all locked, or to initialize while locked.
	04 h	The teaching target output specification value (1 or 2) is incorrect.
	05 h	Teaching mode has no second teaching, or the first has not yet been executed.
	06 h	The execution specification value (3) for restart and initialization is incorrect.
Relevant index number*1	07 h	An attempt was made to write a setting value that is out of range.
	08 h	The setting value write operation failed. (Attempted to write a read-only setting value)
00 h	09 h	Teaching to output 2 was attempted while output 2 was in counter mode.
	0B h	The amount of light received during teaching was too low.
	0C h	The amount of light received during teaching was saturated.
	0D h	There was too little difference in the amount of light received during 2-point teaching.
	0E h	A teaching operation other than auto-teaching was attempted in differential operation mode.
	0F h	A hardware error was detected.

*1: Refer to the respective manual for each device for information regarding the relevant index number.

Error Codes for Connected Sensors

CD22 / TD1

Error Code		Details
High-order byte	Low-order byte	
00 h	00 h	No error
Relevant index number*1	01 h	The index number is out of range.
	02 h	The sub index number is not supported.
	03 h	The ETX code in the command string is invalid.
	04 h	A checksum error was detected.
	05 h	The command code is invalid.
	06 h	A non-regulated parameter was specified.
	07 h	An out of range numeric value was specified.
	08 h	Reserved
	09 h	

*1: Refer to the respective manual for each device for information regarding the relevant index number.

5-4 Troubleshooting List

The following countermeasures should be performed according to the status of the LEDs on the front of this unit and the operation error history.

Phenomenon	Indicators		EtherCAT communication status	Error codes (Error description)	Cause	Countermeasure
	ERR	RUN				
PDO (cyclic) communication cannot be performed	Blinking red	Blinking green	PRE-OPERATIONAL status	0007E000 h (Sensor-amplifier and sensor configuration error)	Module configuration (Sensor-amplifier and sensor configuration) has been downloaded to this unit. The actual sensor-amplifier and sensor configuration does not match the master sensor-amplifier and sensor configuration.*1	Change the sensor-amplifier and sensor configuration on the master-side configuration software to that of the actual device and download it to this unit, or change the configuration of the actual device to match that set in the master and reset the power.
				None (Sensor-amplifier and sensor configuration error)	Module configuration (Sensor-amplifier and sensor configuration) has not been downloaded to this unit. The actual sensor-amplifier and sensor configuration does not match the master sensor-amplifier and sensor configuration.*1	Alter the configuration to match the configuration set in the master and reset the power.
PDO (cyclic) communication can be performed, however, the read / write data is invalid (the read / write data is from an unexpected device)	Off	Lit green	OPERATIONAL status	None (Sensor-amplifier and sensor type mismatch)	Module configuration (Sensor-amplifier and sensor configuration) has not been downloaded to this unit. The model set on the master side is different from the model that is currently connected.	Alter the configuration to match the configuration set in the master and reset the power.
PDO (cyclic) communication can be performed, however, the current value or setting value of the CDA is invalid	Off	Lit green	OPERATIONAL status	0008E000 h (Invalid connection order)	D3□F is connected to the right-hand side of the CDA.	Connect D3□F to the left of the CDA and reset the power.
PDO (cyclic) communication can be performed, however, read / write cannot be performed for some sensor-amplifiers or sensors	Off	Lit green	OPERATIONAL status	0006E000 h (Number of sensor-amplifier units or sensors changed)	Module configuration (Sensor-amplifier and sensor configuration) download is irrelevant. The number of connected sensor-amplifier units or sensors changed (generally decreased) after the power was turned ON.	There may have been a sensor-amplifier unit or sensor failure, or the power supply may have been turned OFF. Check all connected sensor-amplifiers and sensors and their respective power supplies.

*1: Including when the maximum supported number of connected sensor-amplifiers and sensors is exceeding.

Indicators	Cause	Countermeasure
PWR		
Off	Power is not correctly supplied to this unit.	Check and resolve the following potential causes of power interruption, then restart this device according to the specifications of the connected EtherCAT master. • Is the power cable wired correctly? • Is the power cable broken? • Is the power supply voltage within the specified range? • Is the power capacity sufficient? • Is the power supply faulty?

Indicators		Cause	Countermeasure
PWR	ERR		
Lit green	Lit red	A hardware error may have occurred.	If the problem is not resolved even after resetting the power, there is a hardware malfunction. Replace this unit.

5-5 Emergency Message Notifications from EtherCAT Master

The following errors are notified from this unit to the master as emergency messages when they occur.

Emergency error code	Error type	Error description	Countermeasure
8100 h	10 h	The number of connected sensor-amplifier units or sensors changed (generally decreased) after the power was turned ON.	There may have been a sensor-amplifiers unit or sensor failure, or the power supply may have been turned OFF. Check all connected sensor-amplifiers and sensors and their respective power supplies.

Emergency messages can be sent through SDO communication by setting “Error notification control of this unit” (index F200 h) to 0001 h (enabled) and “Emergency message notifications” (subindex 05 h in index 10F3 h) in “Error history” to 0001 h (with notifications).

Configuration of Emergency Messages from This Unit

The emergency message consists of the following 3 bytes of data.

Bit	7	0
0	Emergency error code	
+1		
+2	Error type	

6

Appendix

6-1 Installing Additional Applicable Sensor-amplifier Units

This chapter describes how to install additional applicable sensor-amplifier units.

CAUTION

- Changing the ID number for the addition of the sensor-amplifier requires changing the variables and programs on the master side. If there is a change in the ID number after you add a sensor-amplifier, make sure to change the variables or programs on the master side.
- To add an applicable sensor-amplifier to this unit after the system is operational, turn OFF the power of this unit.

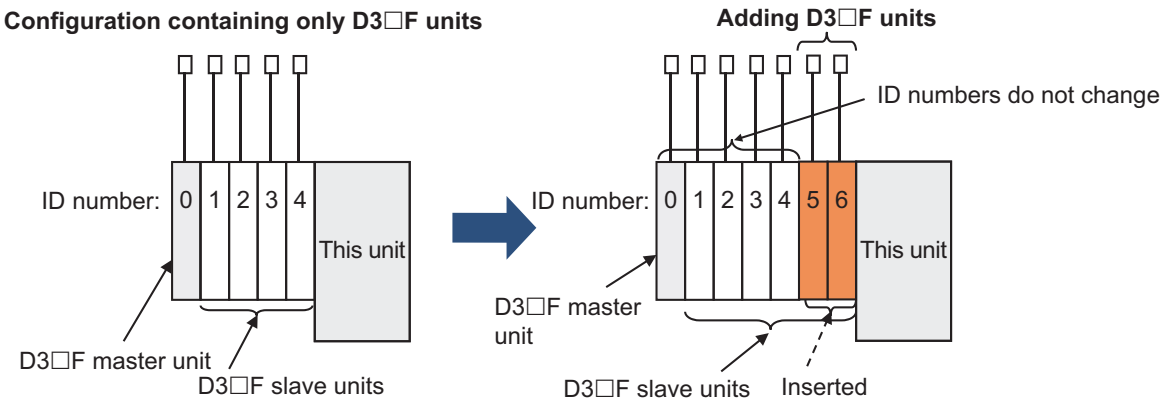
Install additional applicable sensor-amplifier units to the right of existing applicable sensor-amplifier units when possible so that the ID numbers of existing applicable sensor-amplifier units do not change.

The method depends on the situation as follows.

Adding a D3☐F Unit to a Configuration Containing Only D3☐F Units

- Insert a D3☐F slave unit between the existing D3☐F slave units and this unit.
- This means that the ID numbers of the existing D3☐F units will not be changed.

Example:

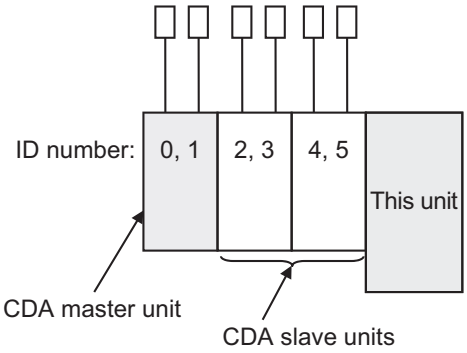


Adding a CDA Unit to a Configuration Containing Only CDA Units

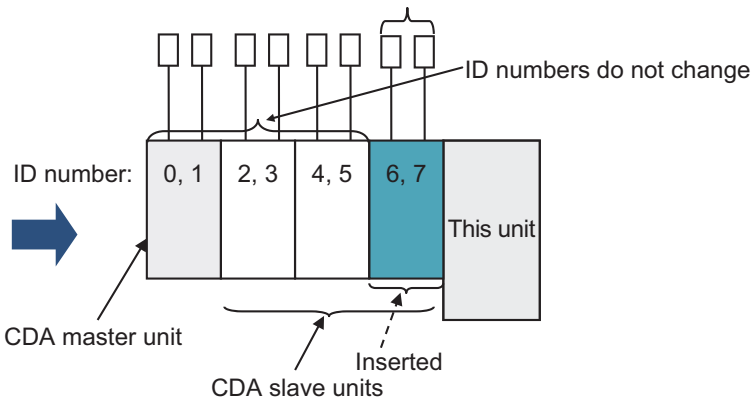
- Insert a CDA slave unit between the existing CDA slave units and this unit.
- This means that the ID numbers of the existing CDA units will not be changed.

Example:

Configuration containing only CDA units



Adding CDA units

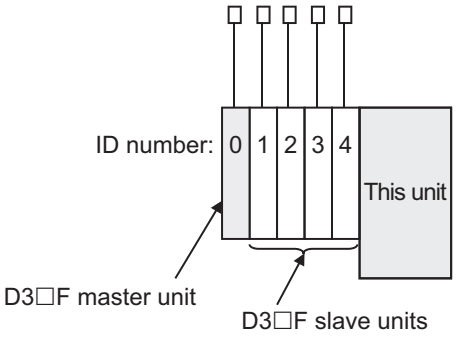


Adding a CDA Unit to a Configuration Containing Only D3☐F Units

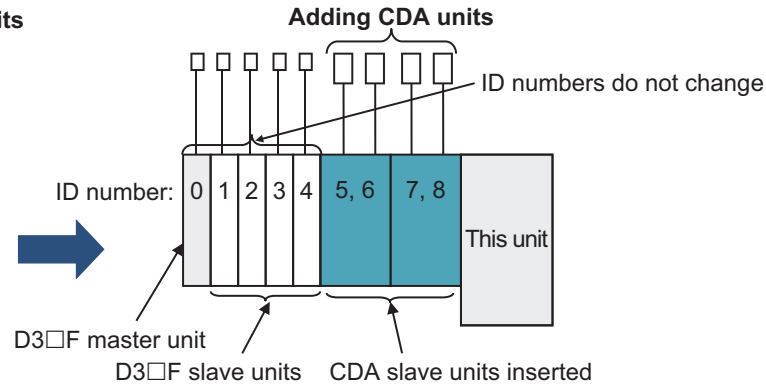
- Insert a CDA slave unit between the existing D3☐F slave units and this unit.
- This means that the ID numbers of the existing D3☐F units will not be changed.

Example:

Configuration containing only D3☐F units



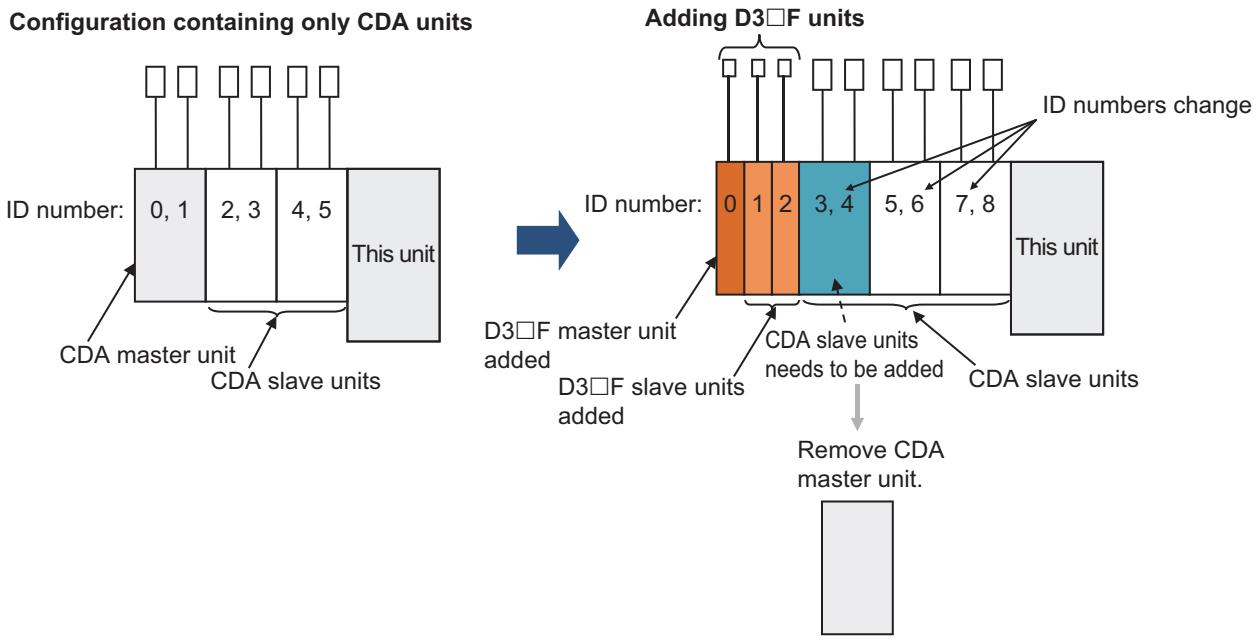
Adding CDA units



Adding a D3□F Unit to a Configuration Containing Only CDA Units

- Add a D3□F master unit in the leftmost position.
- The existing CDA master unit needs to be removed from the interconnection configuration and replaced with a new CDA slave unit.
- If necessary, a D3□F slave unit can be added to the right of the D3□F master unit.
- This means that the ID numbers of the existing CDA slave units will not be changed.

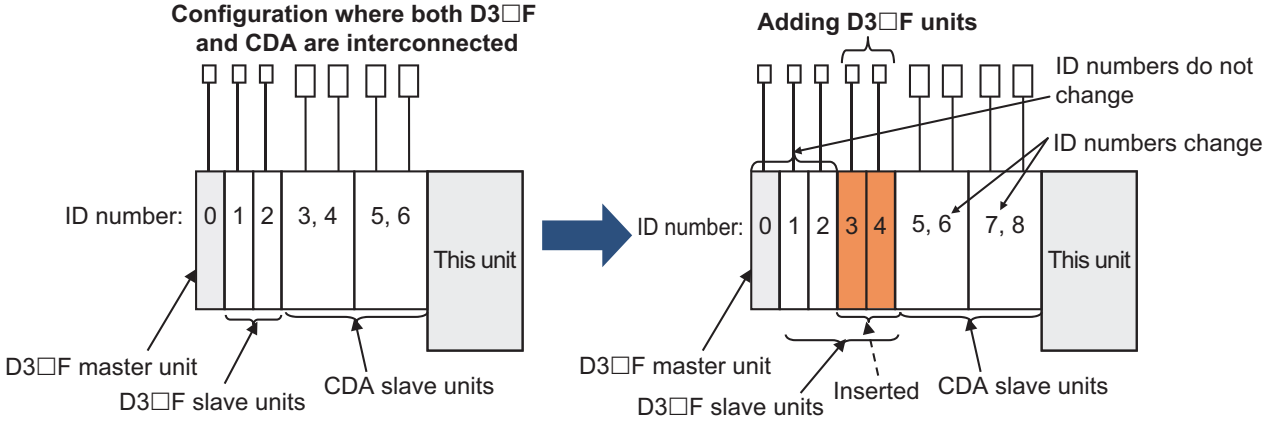
Example:



Adding a D3□F Unit to a Configuration Containing Both D3□F and CDA Units

- Insert a D3□F slave unit between the existing D3□F slave units and the existing CDA slave units.
- This means that the ID numbers of the existing CDA slave units will not be changed.

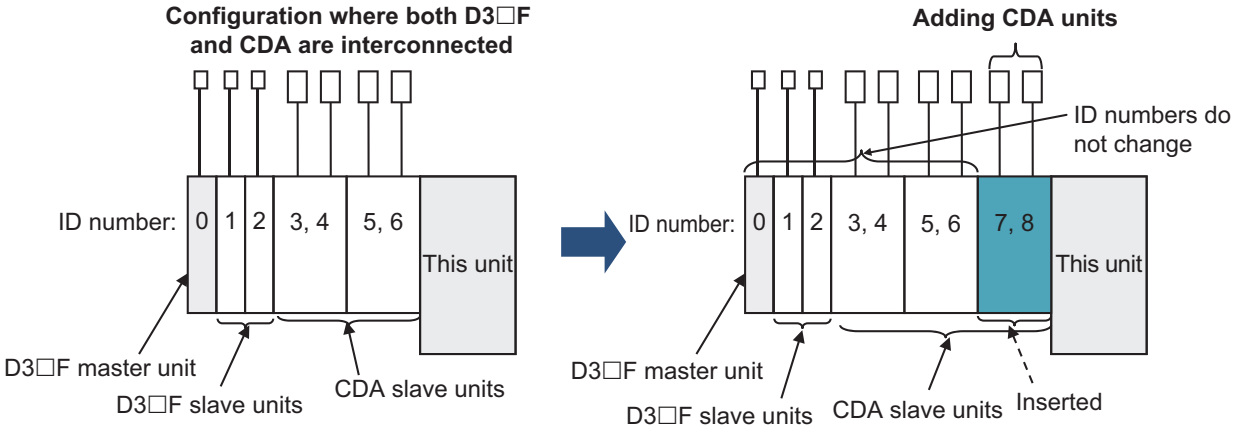
Example:



Adding a CDA Unit to a Configuration Containing Both D3□F and CDA Units

- Insert a CDA slave unit between the existing CDA slave units and this unit.
- This means that the ID numbers of the existing CDA units will not be changed.

Example:



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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.

CE

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The information in this user's manual is correct as of December 2019
UC1EC_UM-E-001-1912

Good Thinking, Good Future

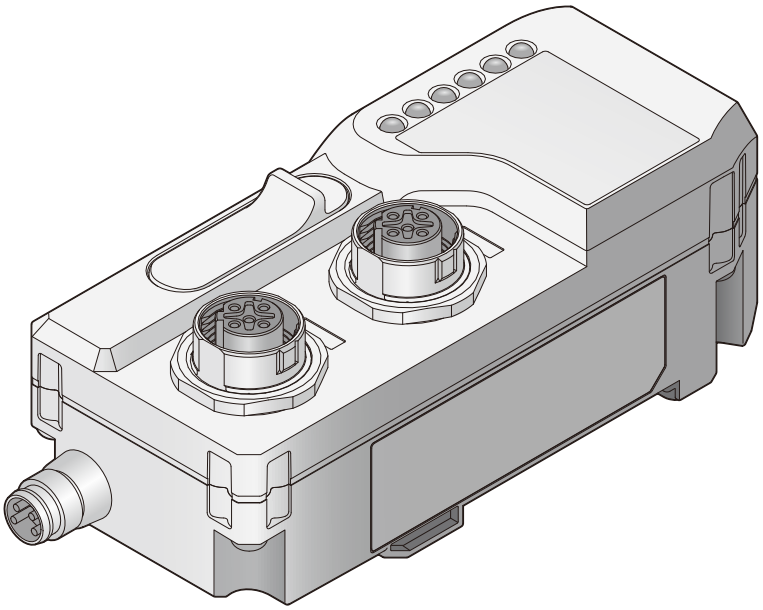
FASTUS

*FASTUS is a product brand of Optex FA.

Ethernet/IP Communication Unit

UC1-EP

User's Manual



OPTEX FA CO., LTD.

Introduction

Thank you for purchasing the UC1-EP Ethernet/IP Communication Unit.
This manual contains the information necessary for using the UC1-EP Ethernet/IP Communication Unit.
Read this manual thoroughly before using the product to ensure correct product use with full understanding of the functions and performance of the product. Also, after you have finished reading this manual, store it safely for future reference.

• Trademarks and registered trademarks appearing in this manual are the property of their respective owners.
• The copyright of this user's manual is owned by Optex FA Co., Ltd. All the contents contained herein are protected by copyright law. Unauthorized copying of this manual is strictly prohibited.

Safety Precautions

This manual uses the following symbols to display safety precautions for ensuring safe operation of the UC1-EP Ethernet/IP Communication Unit.
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. Improper handling can also result in damage to property.
⚠Caution	Indicates that any improper operation or handling may sometimes result in moderate or minor injury or property damage.

■ Notes

⚠Warning	
	Do not disassemble, repair, modify, deform under pressure, or attempt to incinerate this product. Doing so may cause injury or fire.
	Do not use this product in water or in a location where it may be exposed to water. Do not use this product if wet. Doing so may cause a fire or damage the product.
	This product is not explosion-proof and should not be used around flammable or explosive gases or liquids. Doing so may cause ignition resulting in an explosion or fire.
	Do not use air dusters or any spray that uses flammable gas around the product or on the inside of the product. Doing so may cause ignition resulting in an explosion or fire.
	Do not use this product in environments other than industrial environments. If used in other environments, it may cause induction and radiation interference.
	Do not install this product or its cables in any of the following locations. Doing so may cause a fire, damage, or a malfunction. 1. Locations where dust, salt, iron powders, or vapor (steam) is present. 2. Locations subjected to corrosive gases or flammable gases. 3. Locations where water, oil, or chemical splashes may occur. 4. Locations where heavy vibrations or impacts may occur. 5. Locations where the ambient temperature exceeds the rated range. 6. Locations subject to rapid temperature changes (or where condensation occurs). 7. Locations with strong electric or magnetic fields. 8. Outdoor locations or locations subject to direct light.
	Do not use the product at voltages or with AC power supplies that exceed the rated voltage. Doing so may cause a fire or damage the product.

⚠Warning

	What to do in the event of a malfunction such as smoke being emitted from the product If you detect any malfunction including emission of smoke, abnormal smells or sounds, or the body becoming very hot, immediately stop operating the product and turn off the power. Failure to do so can cause fire. Repairing the product is dangerous and should in no way be performed by the customer. Contact an Optex FA sales representative for repairs.
	What to do if water enters the product If water or any other liquid enters the product or the cable, immediately stop operating the product and turn off the power. Using the product in this condition may cause a fire.

⚠Caution

	Do not touch this product or the cable with wet hands. Doing so may damage the product.
	When wiring this product, do so properly according to this manual and specified instruction manuals. Incorrect wiring can cause product failure or malfunction.
	Connect only specified cables to this product. Use of cables other than those specified can cause malfunction.
	Keep wiring separate from high voltage and motor circuits. Using the same wiring can cause malfunction or failure. If this is unavoidable, shield with a conductor such as an earthed conduit.
	Install this product as far away as possible from high-voltage equipment, equipment that generates large switching surges and equipment that generates noise, such as welding machines or inverter motors.
	Use this product with the included end plate mounted to the DIN rail. Make sure locking mechanisms are locked before use.
	Tighten mounting screws with the torque values specified in this manual.
	Do not apply torsional stress to cables. Doing so can cause cables and connectors to malfunction. Secure the communications cable drawn out of this product within lengths of 30 cm to ensure no load is applied to the product.
	Do not drop this product or subject it to strong impact or vibrations. Doing so may damage the product.
	This product generates heat during operation, so do not maintain physical contact for long periods of time. Doing so can cause low-temperature burns, etc.
	Use this product within the rated range.

⚠Caution	
	Do not cut power during communication.
	Changing the slot number for the addition of the sensor-amplifier requires changing the variables and programs on the master side. If there is a change in the slot number after you add a sensor-amplifier, make sure to change the variables or programs on the master side.
	Make sure to connect D3□F to the left of CDA. If D3□F is connected to the right side of CDA, Ethernet/IP communication can be executed, but the current CDA value sent to the master and the CDA value set by master will be invalid.
	To add an applicable sensor-amplifier to this unit after the system is operational, turn OFF the power of this unit.
	Make sure to turn OFF the power before connecting or disconnecting cables and connectors. Connection or disconnection while running can cause malfunction.
	Always hold the connector when connecting or disconnecting cables and do not apply excessive force to cables.
	When removing a connector, do not touch the terminals inside the connector or allow foreign objects to get inside.
	Use conductive type DIN rail because the frame ground (FG) is grounded via the DIN rail.
	When using power cables or commercially available switching regulators, make sure the frame ground (FG) is grounded.
	Wait until after transient state (approx. 2 sec.) when power is turned ON before use.
	Make sure to attach the protective cap when the connector of this unit is not attached to a cable.
	Make sure to use an isolation transformer for DC power supply.
	If a surge occurs in the power supply used, use a surge absorber for the source of generation.

Maintenance

Do not use thinner, benzene, acetone or kerosene to clean devices.

Handling Precautions

(1) After carefully considering the intended use, required specifications, and usage conditions, install and use the product within the specified ranges.
(2) Due to advances in technology, published content, including the hardware, software, and system information published in this user's manual, is subject to change without notice.
(3) When using this product, it is the responsibility of the customer to ensure necessary safety designs in hardware, software, and systems in order to prevent any threat to life, physical health, and property due to product malfunction or failure.
(4) This product is not intended for use with nuclear power, railways, aviation, vehicles, medical equipment, food-handling equipment, or any application where particular safety measures are required. Absolutely do not use this product for any of these fields.
(5) This product cannot be used in applications that directly or indirectly detect human bodies for the purpose of ensuring safety. Do not use this product as a detection device for ensuring human safety.
(6) Do not use this product for the development of weapons of mass destruction, for military use, or for any other military application. Moreover, if this product is to be exported, comply with all applicable export laws and regulations, including the "Foreign Exchange and Foreign Trade Act" and the "Export Administration Regulations," and carry out the necessary procedures pursuant to the provisions therein.
(7) For more details on conformity to the Restriction of Hazardous Substances Directive for this product, please contact an Optex FA sales representative.
Before using this product, fully examine the applicable environmental laws and regulations, and operate the product in conformity to such laws and regulations.
Optex FA does not assume any responsibility for damages or losses occurring as a result of noncompliance with applicable laws and regulations.

Trademarks

- Ethernet/IP is a registered trademark of ODVA.
- Other company, system and product names in this manual are the trademarks or registered trademarks of their respective companies.

Notes on overseas regulations and standards

CE Marking

This product complies with the following EN standards of the EMC directive.

Emission

EN 55011:2009+A1:2010 (Group 1, Class A, ≤ 20 kVA)

EN 61131-2:2007

EN 61000-6-4:2007+A1:2011

Immunity

EN 61131-2:2007

EN 61000-6-2:2005

To use this product as an EN standard compliant product, make sure to observe the following installation specifications.

- Install in a conductive enclosure (control panel, etc.).
- Use a power supply cable of 30 m or less.

Related Manuals

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

Manual name	Details
Digital Fiber Sensor D3RF Series Instruction Manual	Instruction manual included with digital fiber sensor, D3RF series (inter-connection type). Reference when interconnecting this unit with the D3RF series.
Digital Fiber Sensor D3WF Series Instruction Manual	Instruction manual included with digital fiber sensor, D3WF series (inter-connection type). Reference when interconnecting this unit with the D3WF series.
General-purpose Amplifier Unit CDA Series Instruction Manual	Instruction manual included with the general-purpose amplifier unit, CDA series. Reference when interconnecting this unit with the CDA series.
General-purpose Amplifier Unit CDA Series User's Manual	User's manual for the general-purpose amplifier unit, CDA series. Reference this instruction manual when interconnecting this unit with the general-purpose amplifier unit, CDA series.
Compact laser displacement sensor CD22 Series Instruction Manual	Instruction manual included with compact laser displacement sensor, CD22 series (RS-485 communication type). Reference when connecting the CD22 series with the CDA series.
Through-beam Edge Sensor TD1 Series Instruction Manual	The instruction manual included with the through-beam edge sensor, TD1 series. Reference when connecting the TD1 series with the CDA series.
Through-beam Edge Sensor TD1 Series User's Manual	The user's manual for the through-beam edge sensor, TD1 series. Reference this instruction manual when interconnecting this unit with the through-beam edge sensor, TD1 series.

Manual Structure

This manual's content is structured as follows.

1. Overview	An overview for this unit.
2. Installation and Wiring	This chapter describes inter-connection between this unit and applicable sensor-amplifiers, connection for Ethernet/IP communication, and wiring to the power supply.
3. Communication	This chapter describes the data configurations that this unit handles for Ethernet/IP communication, and provides examples of communication.
4. Specifications	This chapter describes the specifications of this unit.
5. Troubleshooting	This chapter describes how to carry out troubleshooting and provides other useful information on using this unit.
6. Appendix	This chapter describes how to install additional applicable sensor-amplifiers and also describes the reset function.

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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.

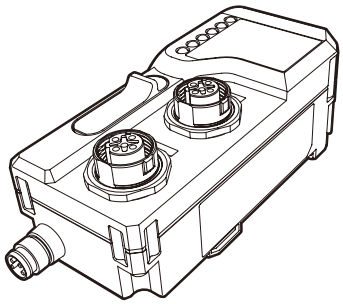
Generic term for the D3RF and D3WF fiber amplifiers

D3□F is used to indicate both the D3RF and D3WF fiber amplifier.

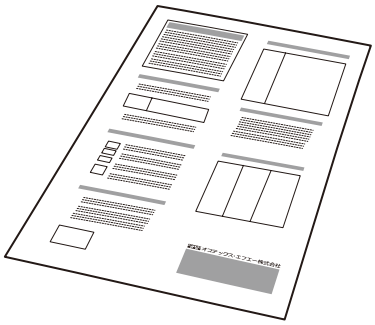
Checking the Included Items

Before you use this unit, check the items included with it. If there are any defective or damaged items, please contact our customer support center.

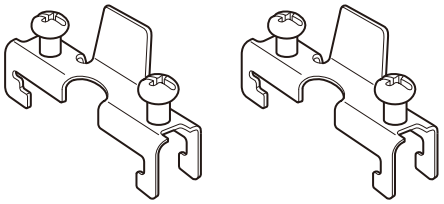
■ Items Included with This Unit



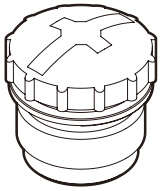
• UC1-EP



• Instruction manual



• End plate x 2



• Protective cap x 1

■ Other Required Items

● Cables

The following cables are used with this unit.

Type	Specifications

Ethernet/IP cable	CAT5e or higher Ethernet cables that fulfill the following specifications
	• Connector: M12 connector (plug: male)
	• Cable: STP cable (shielded twisted pair cable)
	• Quantity: According to the connection type:
	  • Star configuration: 1
	  • Linear bus configuration: 1 for terminal, 2 for others
	  • Device level ring configuration: 2

Power supply cable	M8 connector cable for power supply M84CN-2S: 2 m, M84CN-5S: 5 m, M84CN-10S: 10 m

1

Overview

This chapter describes an overview of the Ethernet/IP Communication Unit (hereafter referred to as “this unit”).

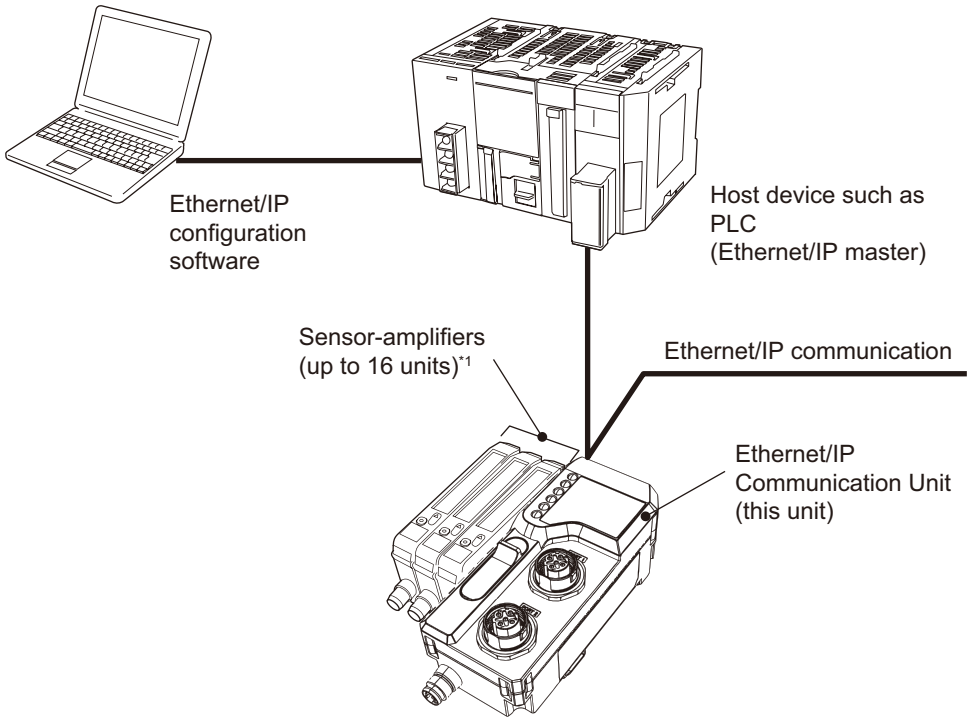
1-1 Product Overview

This unit is an Ethernet/IP communication unit used for communication between our sensor-amplifiers (hereafter referred to as the “applicable sensor-amplifiers”) and an Ethernet/IP master (e.g. PLC) manufactured by another company for ON/OFF output, monitoring of the detection amount, writing parameters, and performing operations of the sensors connected to the sensor-amplifiers.
It supports both cyclic communication and acyclic communication.
This unit can be interconnected with up to 16[*1] of the following applicable sensor-amplifiers.

- Fiber amplifier (inter-connection type)
- General-purpose amplifier unit

*1: A single unit occupies two because a general-purpose amplifier unit can be connected to two sensors.

Ethernet/IP System Configuration Example



*1: A single unit occupies two because a general-purpose amplifier unit can be connected to two sensors.

Type/Number of Applicable Sensor-Amplifier Units That Can Be Connected

The following applicable sensor-amplifiers can be connected to the Ethernet/IP system by interconnecting to this unit.

MEMO

For precautions on the configuration of this unit and applicable sensor-amplifiers and sensors, refer to “2-1 Configuration of This Unit and Applicable Sensor-amplifiers and Sensors” (Page 2-2).

● D3RF/D3WF Fiber Amplifiers

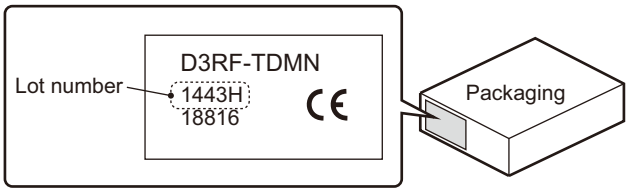
Any combination of masters and slaves can be used between the D3RF and D3WF fiber amplifiers. Hereafter, D3☐F is used to indicate both the D3RF and D3WF fiber amplifiers.

Product and series name	Type	Model*1	Number of occupied IDs per unit	Max. no. of interconnectable units
Digital fiber sensor, inter-connection type D3RF series*2	Connector type*3	• Interconnected master unit / 1 output: D3RF-TMC☐4 • Interconnected master unit / 2 outputs: D3RF-TDMC☐4 • Interconnected slave unit / 1 output: D3RF-TSC☐4 • Interconnected slave unit / 2 outputs: D3RF-TDSC☐4	1	16 *4
Digital fiber sensor, inter-connection type D3WF series	Connector type*3	• Interconnected master unit / 1 output: D3WF-TMC☐4 • Interconnected master unit / 2 outputs: D3WF-TDMC☐4 • Interconnected slave unit / 1 output: D3WF-TSC☐4 • Interconnected slave unit / 2 outputs: D3WF-TDSC☐4		

*1: The model in the ☐ is N for NPN specifications and P for PNP specifications. Some models listed here may not be supported depending on release date. Contact our sales office for more information.

*2: This unit is compatible with lot numbers after 1443■ (■: letter at the end is unrelated). Products with earlier lot numbers only support some functions.

The D3RF lot number is indicated on the packaging as follows.



*3: This unit cannot be used with a cable type D3RF master unit or a D3WF master unit.

*4: The maximum number of units that can be interconnected depends on the maximum ambient temperature and the voltage flowing to the control output, as follows.

Maximum ambient temperature (°C)	55°C	50°C	45°C
D3☐F no. of interconnectable units	Up to 3	Up to 8	Up to 16

Load current of the D3☐F control output	Max.100 mA	Max.50 mA	Max. 0 mA (control output disabled)
D3☐F no. of interconnectable units	0 to 3	4 to 8	9 to 16

● CDA General-purpose Amplifier Units

When connecting a displacement sensor, connect a general-purpose amplifier unit to this unit.

Product and series name	Type	Model	Number of occupied IDs per unit	Max. no. of interconnectable units
General-purpose amplifier unit CDA series	Cable type	• Interconnected master unit: CDA-M/DM2*1 • Interconnected slave unit: CDA-S	2	8*2

*1: The CDA-M/DM2 interconnected master unit is only used when configured with only the CDA general-purpose amplifier units. When connecting the D3☐F fiber amplifier, make sure to select the CDA-S interconnected slave unit.

*2: Up to two displacement sensors can be connected to the general-purpose amplifier unit. Even if only one displacement sensor is connected, it will be recognized as two.

The following sensors can be connected to the CDA general-purpose amplifier unit (current as of January, 2020).

Product and series name	Type	Model
Compact laser displacement sensor CD22 series	RS-485 communication type and pig tail type	• CD22-15-485M12 • CD22-35-485M12 • CD22-100-485M122
Through-beam edge sensor TD1 Series	-	• TD1-010M8 • TD1-010M8J

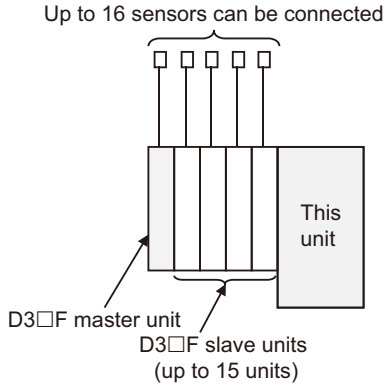
Note: Ultra high-accuracy laser displacement sensor CDX series cannot be connect to the CDA.

■ Interconnectable Configurations

The following configuration is valid when connecting applicable sensor-amplifier units.
Refer to “2-1 Configuration of This Unit and Applicable Sensor-amplifiers and Sensors” (Page 2-2) for further information.

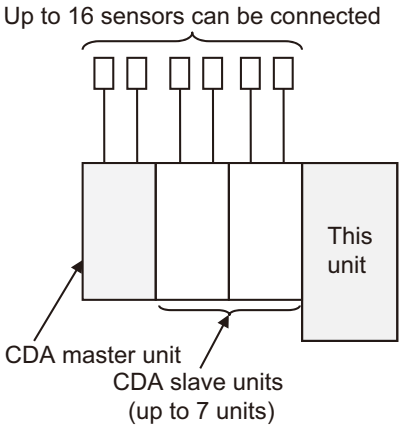
● When Only D3□F Fiber Amplifiers Are Interconnected

• When there are multiple D3□F, one D3□F master unit and up to 15 D3□F slave units can be connected.



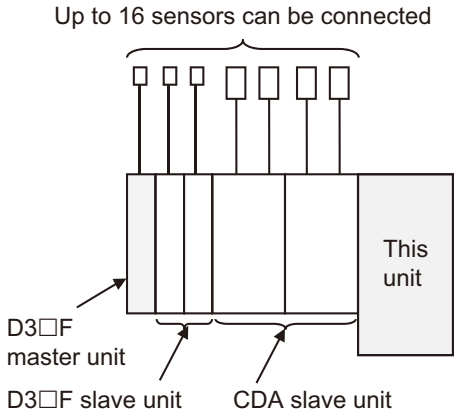
● When Only CDA General-Purpose Amplifiers Are Interconnected

• When there are multiple CDA, one CDA master unit and up to seven CDA slave units can be connected.



When Both D3□F Fiber Amplifiers and CDA General-purpose Amplifiers Are Interconnected

- Connect all D3□F on the left side and all CDA on the right.
- Connect the D3□F master unit on end terminal on the left end.
- CDA slave units can be connected. CDA master units cannot be connected.
- Up to 16 sensors can be connected. The CDA occupies two D3□F slave units because two sensors can be connected.



MEMO

Sensor-amplifiers are assigned slot numbers starting from the left in order of interconnection position. The slot numbers are used to identify the sensor-amplifiers in cyclic and acyclic communication. Therefore, consider the configuration of applicable sensor-amplifier units by interconnection position, which is the slot number, particularly if future expansion is planned.

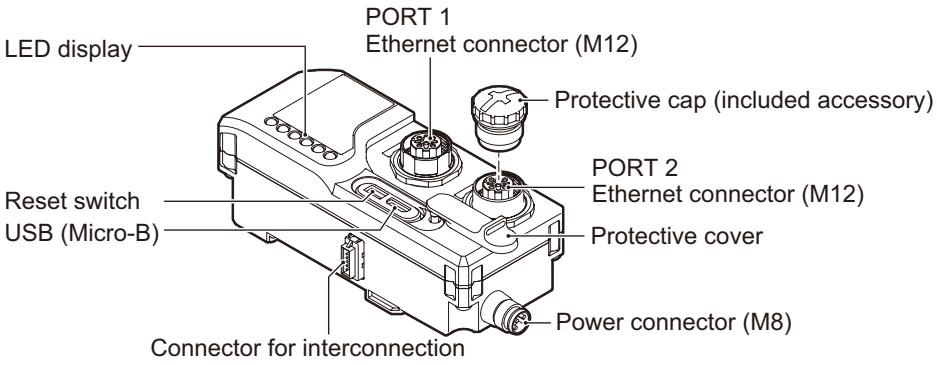
Refer to “2-1 Configuration of This Unit and Applicable Sensor-amplifiers and Sensors” (Page 2-2) for more information on slot numbers as well as applicable sensor-amplifier and sensor configuration limitations.

Refer to “6-1 Installing Additional Applicable Sensor-amplifier Units” (Page 6-2) for more information on limitations when adding applicable sensor-amplifier units.

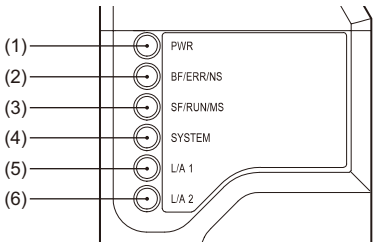
1-2 Part Names and Functions

The following is a description of the names of the parts of this unit and their functions.

UC1-EP Unit



LED Display



Above figure number	LED	Details	Display		Meaning
(1)	PWR	Indicates whether or not power is being supplied to this unit.	Green	Lit	Power ON
				Off	Power OFF
(2)	NS*1	Indicates the network status.	Green	Lit	Connected (some connection established)
				Flashing	Not connected (no connection established)
			Red	Lit	IP address conflict (if Address Conflict Detection [ACD] is enabled)
				Flashing	Connection timeout
			Red/ green	Flashing back and forth	Power-on self-test
			Off		Power is OFF, an IP address is not configured, or there is an IP address conflict (if Address Conflict Detection [ACD] is enabled)
(3)	MS*1	Indicates the module status.	Green	Lit	Device operating
				Flashing	The device is in standby and no IP address has been assigned
			Red	Lit	Error (device not operating)
				Flashing	Warning (device operating)
			Red/ green	Flashing back and forth	Power-on self-test
			Off		Power OFF

Above figure number	LED	Details	Display		Meaning
(4)	SYSTEM (communication ready)	Indicates communication status of this unit.	Green	Off	Not ready for communication (cannot connect)
				Lit	Ready for communication (able to connect)
(5)	L/A1 (Link/Activity 1)	Indicates PORT1 (IN) communication status.	Green	Off	PORT1 is not connected to the network
				Lit	PORT1 is connected to the network
(6)	L/A2 (Link/Activity 2)	Indicates PORT1 (OUT) communication status.	Green	Off	PORT2 is not connected to the network
				Lit	PORT2 is connected to the network

*1: NS/MS LED combinations

Network status (NS)	Module status (MS)	Operation status
Lit green	Lit green	Normal communication status (connection established) Note: Also includes assembly instance conflicts. Refer to “5-2-2 Troubleshooting Other Issues” for further information.
Flashing green	Lit green	No connection established
Lit red	Flashing red	IP address conflict (if Address Conflict Detection [ACD] is enabled)
Flashing red	Lit green	Exclusive Owner connection timeout
Off	Flashing green	IP address conflict (if Address Conflict Detection [ACD] is disabled) or Unable to receive IP address from BOOTP/DHCP server
Off	Off	No power supply

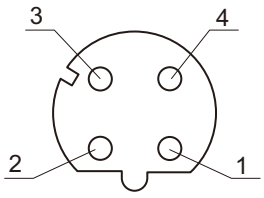
Refer to “5-2 Troubleshooting List” (Page 5-4) in “Chap 5 Troubleshooting” for troubleshooting based on blinking state of LED.

● Ethernet Connectors (PORT1, PORT2)

Connect the M12 connector / LAN cable to the M12 connection 4 pin.

Connect a network cable from the master side to PORT1 of this unit.

When connecting other Ethernet/IP units, connect a network cable to PORT2 of this unit. When other Ethernet/IP units are not connected, put on the M12 protective cap.



Pin	Terminal name	Function
1	Tx+	Transmitted data: +
2	Rx+	Received data: +
3	Tx-	Transmitted data: -
4	Rx-	Received data: -

This unit supports the following connection types. Refer to “2-3-1 Connecting the Communication Cable” for further information.

• Star configuration

Connect a LAN cable to the M12 connector for either PORT 1 or PORT2, and then connect the cable to an industrial switching hub.

• Linear bus configuration

Connect the M12 connector for either PORT1 or PORT2 to the upstream device (the device nearer the master). Connect the other M12 connector to the downstream device (the device further from the master).

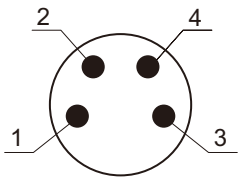
• Device level ring configuration

Connect LAN cables to the M12 connectors on PORT1 and PORT2.

Use a category 5/5e or higher STP cable (shielded twisted pair cable) as the communication cable for both.

● Power Connector

Pin arrangement of the power connector is as follows. Connect this unit when no voltage (0 V) is being supplied.



Pin	Terminal name	Function
1	24 V	Terminal for external power input from12 to 24 VDC. Allowable current is 2 A or under.
2	Not used	-
3	0 V	Terminal for external power input of 0 V.
4	Not used	-

● Reset Switch

Press and hold for three seconds or more to restore the factory settings.

MEMO

Refer to “6-2 Reset Function” for information on the settings initialized with the reset switch.

● USB (Micro-B)

Not used. Do not connect anything to this port.

1-3 Basic Procedures

The procedures to install and configure this unit and start the Ethernet/IP communication are shown below.

Procedure	Details	References
Prior confirmation	• Check the model number and number of units for applicable sensor-amplifier to be interconnected to this unit (including ambient temperature range, which limits the number of units).	Chap 1 Overview Chap 4 Specifications
	• Check the position of interconnection with applicable sensor-amplifier units. (Changing the interconnection position affects the variables and programs on the master side, so consideration should be given to the possibility of future expansion.) Note 1: The user will need to know the slot numbers of applicable sensors for cyclic communication. Note 2: The user will need to know the connection order within the same model code for applicable sensors for acyclic communication.	2-1 Configuration of This Unit and Applicable Sensor-amplifiers and Sensors 6-1 Installing Additional Applicable Sensor-amplifier Units
	• Calculate power consumption.	2-3-2 Wiring with the Power Supply Cable
	• Which Ethernet/IP connection type to use.	2-3-1 Connecting the Communication Cable
	• Prepare a power cable and Ethernet/IP cable(s).	Checking the Included Items
	• How to set the IP address for this unit and what value to use.	3-2 Operations Required for This Unit to Communicate with the Ethernet/IP Master
	• What to read and write with cyclic communication. • What to read and write with acyclic communication.	Chap 3 Communication
↓	↓	
Hardware installation and wiring	Install the Ethernet/IP master.	Manual of the Ethernet/IP master being used
	↓	
	Install this unit and applicable sensor-amplifiers to the DIN rail.	2-2 Installing on a DIN Rail
	↓	
	Wire the Ethernet/IP communication cable.	2-3-1 Connecting the Communication Cable
	↓	
	Wire the external power supply.	2-3-2 Wiring with the Power Supply Cable
	↓	
	Wire sensors to sensor-amplifiers.	Manuals of the applicable sensor-amplifiers
↓	↓	

Procedure	Details	References
Operation to communicate with the Ethernet/IP master	Install the EDS file for this unit.	3-2 Operations Required for This Unit to Communicate with the Ethernet/IP Master Manual of the Ethernet/IP master being used Manual for the Ethernet/IP configuration software being used
	↓	
	Configure the IP address for this unit.	
	↓	
	• Cyclic communication: Add this unit to the Ethernet/IP system in the Ethernet/IP configuration software, configure the connection, and configure the cyclic communication area. • Acyclic communication: Create a communication program.	
	↓	
	Download connection settings to the master.	
↓	↓	
Starting communication	Start Ethernet/IP communication.	Same as above
↓	↓	
Checking operation	Check the displays of the master, this unit, and the sensor-amplifiers.	Manual of the Ethernet/IP master being used 1-2 Part Names and Functions, and 5-2 Troubleshooting List Manuals of the applicable sensor-amplifiers / sensors
	↓	
	Verify that the Ethernet/IP master reads and writes data.	Manual of the Ethernet/IP master being used
	↓	
	Set the parameters of this unit with acyclic communication (if needed).	3-6 List of Information Monitored/ Configured Using Acyclic Communication
↓	↓	
Troubleshooting	Check the displays of the master, this unit, and the sensor-amplifiers. Check the error codes on the sensor-amplifier and sensor configuration and the sensor specific error codes with acyclic communication.	Chap 5 Troubleshooting

2

Installation and Wiring

This chapter describes interconnection between this unit and applicable sensor-amplifiers, connection for Ethernet/IP communication, and wiring to the power supply.

2-1 Configuration of This Unit and Applicable Sensor-amplifiers and Sensors

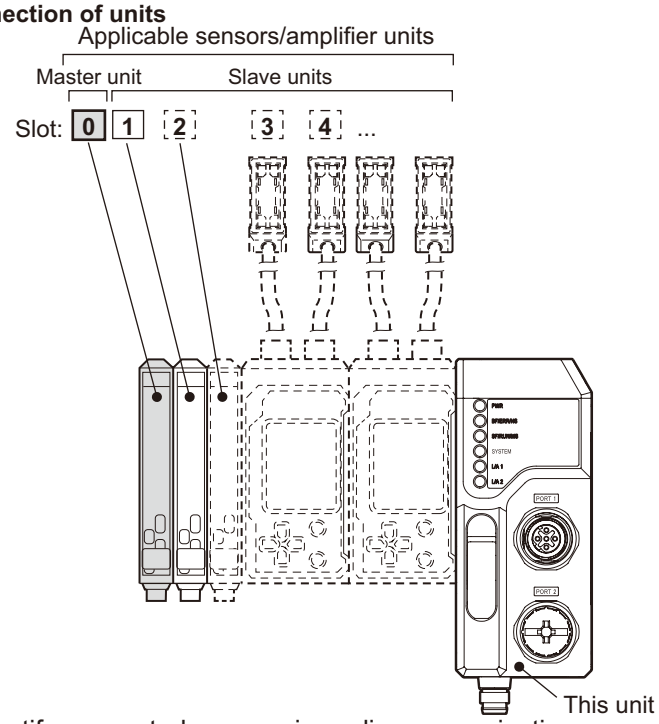
This section describes the configuration of this unit and applicable sensor-amplifiers and sensors.

2-1-1 Assigning Slot Numbers for Applicable Sensors

The slot numbers are 0 to 15 (0 to F in hexadecimal values).
Slot number = 0 is set for the leftmost unit (the one furthest from this unit), with subsequent slot numbers assigned in ascending order toward this unit.
The number of occupied slot numbers differs depending on the type of sensor-amplifier. Details are provided below.

Type of sensor-amplifier	Occupied slot number	Notes
D3RF fiber amplifier	1	
D3WF fiber amplifier	1	
CDA general-purpose amplifier unit	2	A single unit occupies two slot numbers because the unit can be connected to two sensors.

Connection of units



The slot numbers are used to identify connected sensors in cyclic communication.

MEMO

- During acyclic communication, the connected sensor is identified using the “instance ID (the connection order within the model code)” rather than this “slot number.” Refer to “3-4-1 Instance IDs for This Unit and Sensor Objects” for further information on “instance IDs.”
- As indicated above, up to two applicable sensors can be connected to the CDA general-purpose amplifier unit. CDAs occupy two slot numbers for two applicable sensors even when only one applicable sensor is connected. In this case, the slot number that is not connected to an applicable sensor will be configured with a class ID (model code) of 00 h, an instance ID (connection order within model code) of 00 h, and a product code of 0000 h.
- As indicated above, slot numbers are assigned in ascending order from the left. When an applicable sensor-amplifier is added to the left of existing applicable sensor-amplifiers, the slot numbers of the existing applicable sensor-amplifiers change. Therefore, consider the configuration of applicable sensor-amplifiers by interconnection position, which is the slot number, if future expansion is planned. Refer to “6-1 Installing Additional Applicable Sensor-amplifier Units” (Page 6-2) later in this manual for more information on limitations when adding applicable sensor-amplifier units.

2-1-2 Configuration Limitations of Applicable Sensor-amplifiers and Sensors

Limitations in the configuration of applicable sensor-amplifiers and sensors are as follows.

The following three types of inter-connection configurations are used.

- Configurations in which only the D3□F fiber amplifiers are interconnected
- Configurations in which only the CDA general-purpose amplifiers are interconnected
- Configurations in which both the D3□F fiber amplifiers and CDA general-purpose amplifiers are interconnected

MEMO

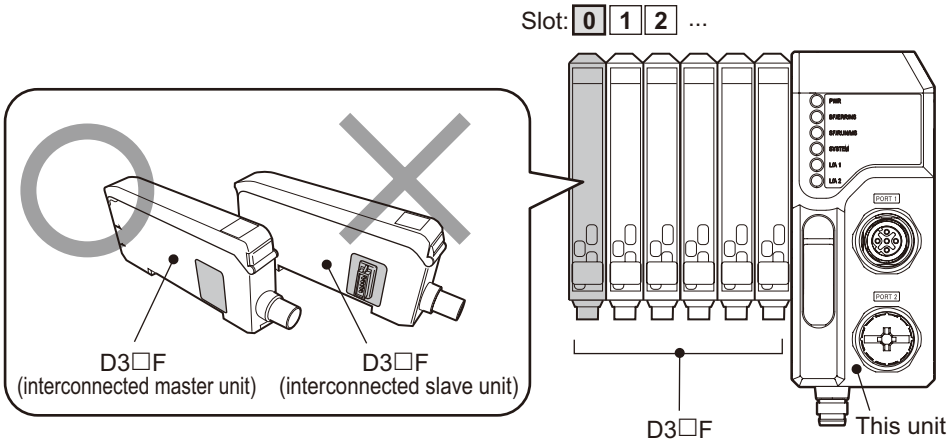
If more than the maximum number of applicable sensor-amplifiers or sensors (16) are connected, the following will occur.

- If 17 applicable sensors are connected, it will no longer be possible to transmit or receive using cyclic communication. The 18th will be recognized as slot 0, the 19th as slot 1, and so on. In this case, cyclic communication cannot be performed with applicable sensors beginning with the 17th.
- If 17 or more are connected and acyclic communication is attempted with a sensor object (class ID: 65 h, 66 h, 67 h, or 68 h), it will cause a “Path destination unknown (09 h)” general error code.

■ Configurations in Which Only the D3□F Fiber Amplifiers are Interconnected

Please be aware of the following points when using configurations in which only the D3□F fiber amplifier is interconnected with this unit.

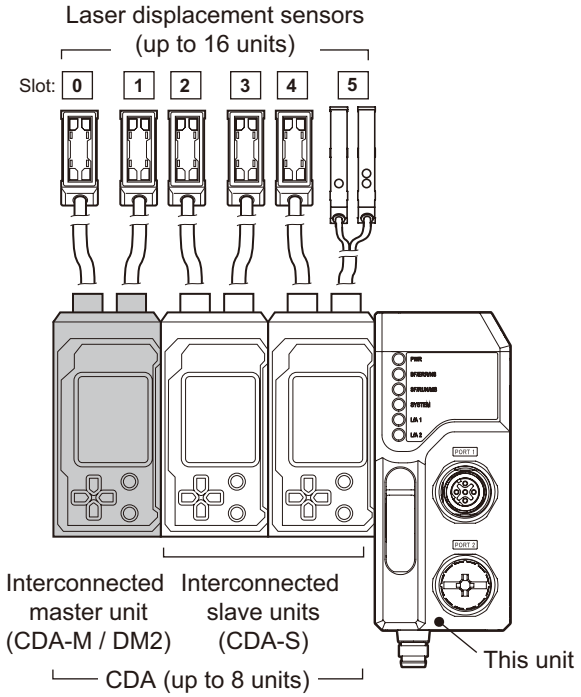
- Make sure to interconnect the D3□F master unit in the leftmost position (ID = 0). The cable type D3□F master unit cannot be used. If a D3□F slave unit is placed in the leftmost position, the connector for interconnection is exposed, causing interference from the end plate. D3□F may also malfunction as a result of soiling or breakage of the connector for interconnection.
- Do not connect an external power supply to the D3□F master unit or slave units. Refer to “2-3-2 Wiring with the Power Supply Cable” (Page 2-10) for further information.



Configurations in Which Only CDA General-Purpose Amplifier Units are Interconnected

Please be aware of the following points when using configurations in which only the CDA general-purpose amplifier unit is interconnected with this unit.

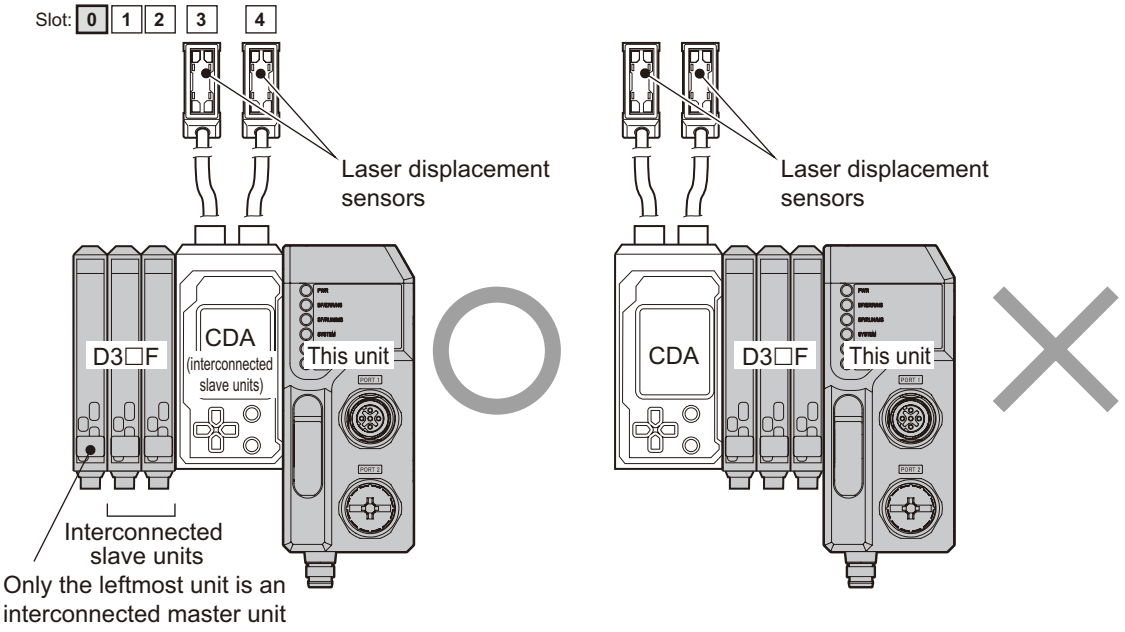
- Make sure to interconnect the CDA master unit as the leftmost CDA unit. If a CDA slave unit is placed in the leftmost position, the connector for interconnection is exposed, causing interference from the end plate. CDA may also malfunction as a result of soiling or breakage of the connector for interconnection.
- Up to two sensors can be connected to each CDA unit (master unit or slave unit). CDA units (master units and slave units) occupy two sensor unit IDs even when only one sensor is connected.
- An external power supply needs to be connected to the CDA master unit and slave units. Refer to “2-3-2 Wiring with the Power Supply Cable” (Page 2-10) for further information.
- When connecting the Through-beam Edge Sensor, TD1 series to CDA, use a Y branch cable (TDCN-Y2-M8) to connect to each channel of the CDA.



Configurations in Which Both the D3□F Fiber Amplifiers and CDA General-purpose Amplifier Units are Interconnected

Please be aware of the following points when using configurations in which both the D3□F fiber amplifier and CDA general-purpose amplifier unit are interconnected with this unit.

- Make sure to place all the D3□F units on the left when interconnecting. This is because the internal processing data size of D3□F differs from that of CDA. Refer to the notes provided later.
- Make sure to connect one D3□F master unit in the leftmost position (ID = 1) among the D3□F units on the left. The cable type D3□F master unit cannot be used.
- For CDA, only CDA slave units can be used. CDA master units cannot be used.
- Up to two sensors can be connected to each CDA slave unit. CDA slave units occupy two sensor unit IDs even when only one sensor is connected.
- Do not connect an external power supply to the D3□F master unit or slave units. However, an external power supply needs to be connected to CDA. Refer to “2-3-2 Wiring with the Power Supply Cable” (Page 2-10) for further information.



CAUTION

Connect all D3□F units to the left of CDA.

Current values and setting values in D3□F are limited to 14 bits. Current values and setting values in CDA are processed as 16 bits.

This means that if CDAs units are interconnected to the left of D3□F units, Ethernet/IP communication can be executed with both cyclic communication and acyclic communication, however, the current values sent from the CDA to the left of the D3□F to the master will be incorrect, as will the setting value set by the master.

Invalid connection order errors can be checked by reading 6A h (Error Code) from this unit's object (class ID: 64 h) using acyclic communication from the master (error code: 0008 h). Refer to "5-1 List of Error Codes for This Unit and Each Sensor" for further information.

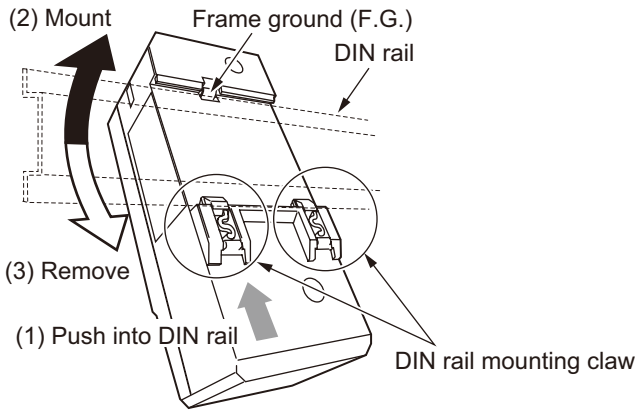
2-2 Installing on a DIN Rail

Install this unit on a DIN rail. Install the applicable sensor-amplifier units in the same way when interconnecting.

MEMO

- Remove the power supply cable during installation. In particular, make sure this unit and the applicable sensor-amplifier units are not powered when interconnecting or removing them.
- In this example, only D3□F units (inter-connection type) are interconnected with this unit, but CDA can be interconnected in the same way.

1 **Align the DIN rail mounting claw at the bottom of this unit with the bottom of the DIN rail, push this unit onto the DIN rail in the direction indicated by (1) and then collapse it in the direction indicated by (2).**

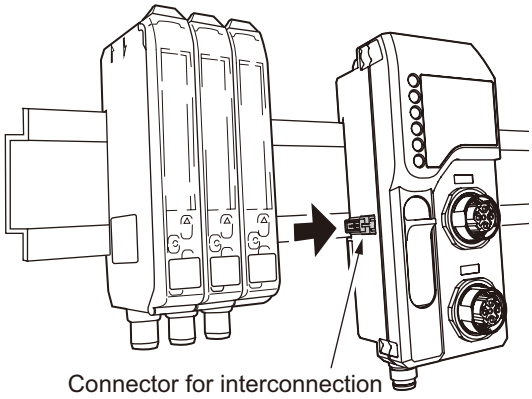


*If this unit is not properly attached to the DIN rail, faults may occur when interconnecting with the applicable sensor-amplifier units or connecting FGs. Make sure the DIN rail mounting claw is fully locked and this unit is securely mounted.

MEMO

To remove this unit from the DIN rail, push this unit onto the DIN rail in the direction indicated by (1) and collapse it in the direction of (3).

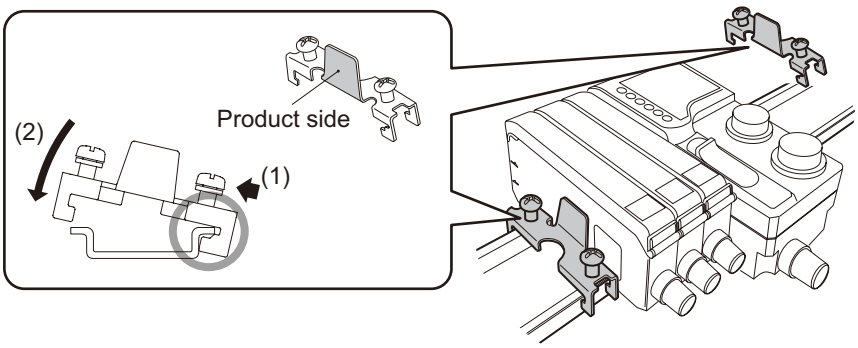
2 **Mount the applicable sensor-amplifier units on the DIN rail in the same way and interconnect them with this unit.**



CAUTION
Interconnect this unit securely with the applicable sensor-amplifier units using the connectors for interconnection. If the connectors for interconnection are slanted or are not inserted all the way in, this unit or the applicable sensor-amplifier unit may be damaged when powered.

3 Mount the end plates on both sides of the interconnected units and secure them with screws.

The tightening torque must be 0.9 N·m or less.
Mount the end plates to both sides of this unit and the applicable sensor-amplifier units with the product side (see the diagram below) facing this unit or the applicable amplifier unit. Mount the end plates by catching the notch on the DIN rail as shown in the diagram below.

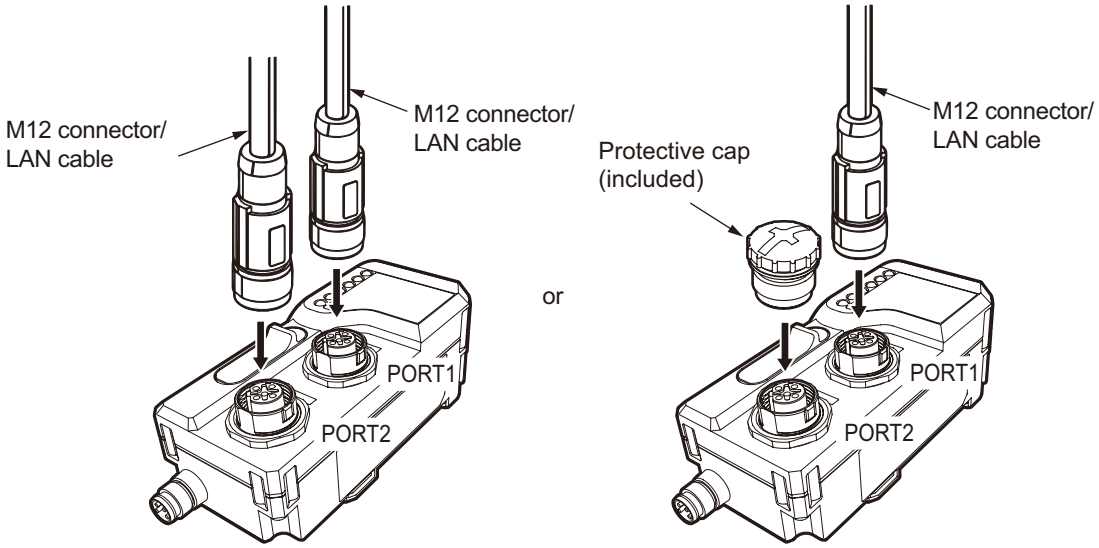


2-3 Wiring

This section describes wiring with the Ethernet/IP cable and power supply cable.

2-3-1 Connecting the Communication Cable

Connect the M12 connector/LAN cable to either PORT1 or PORT2 on this unit.
Attach the included protective cap to either PORT1 or PORT2, whichever is not being used.



■ Ethernet/IP Connection Cable

Prepare a CAT5e or higher Ethernet cable that fulfills the following specifications.

- Connector: M12 connector (plug: male)
- Cable: STP cable (shielded twisted pair cable)

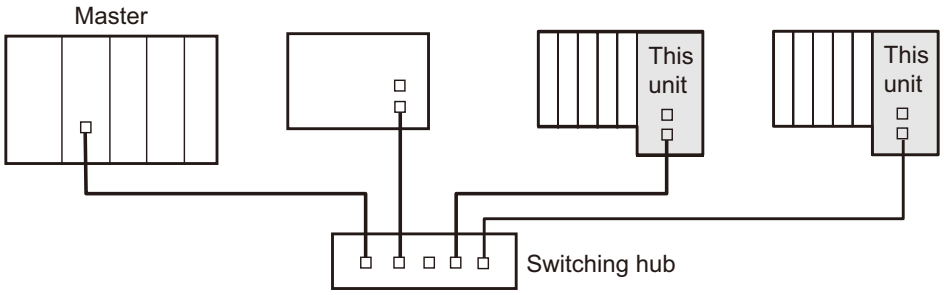
■ Ethernet Connection Types

Connect connectors/cables depending on the Ethernet connection type.
This unit supports the following connection types.

- Star configuration
- Linear bus configuration
- Device level ring configuration

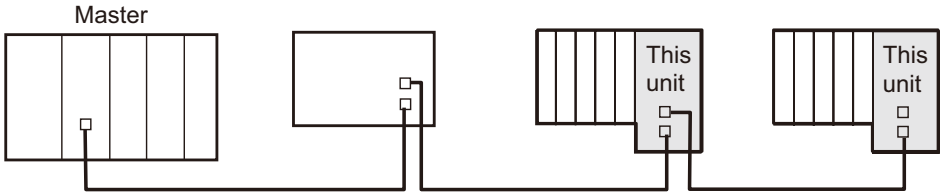
Star Configuration

A star configuration network is a connection type in which various devices are connected through a switching hub.
The network can be connected to either PORT1 or PORT2 on this unit.



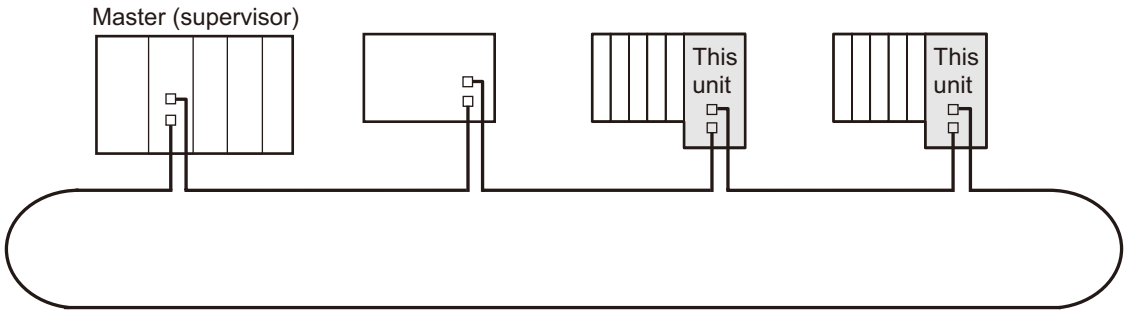
Linear Bus Configuration

A linear bus configuration network is a connection type in which devices are daisy chained together.
This requires no switching hub and can result in a shorter total LAN cable length.
The upstream device (toward the master) and downstream device can be connected to either PORT1 or PORT2 on this unit.



Device Level Ring Configuration

A device level ring (DLR) configuration network is a connection type that provides strong resilience to outages.
The network can be connected to either PORT1 or PORT2 on this unit.
Devices are installed in a ring shape. If a single device fails or is disconnected, the network switches to a linear bus configuration to maintain connectivity.
A managing device called a supervisor is required on the network.
All devices connected to a DLR configuration network must support DLR.



To check status information on the DLR protocol for this unit, use acyclic communication to read the DLR object (class ID: 47 h).

MEMO

This unit supports a function called Device Level Ring Protocol (DLR), which allows the network to be switched quickly if a communication outage occurs. This can only be used when using a device level ring configuration.
This function allows the network to be switched quickly (for example, if there are 50 nodes, switching will take from 1 to 7 ms from detecting the error to recovering connectivity). Refer to the manual of the DLR compatible master for more information.

2-3-2 Wiring with the Power Supply Cable

This unit runs on an external power input (12 to 24 VDC / 2 A or less). Make sure the input voltage and current are correct. Incorrect wiring to the power source can cause fire or malfunction.

This unit uses the following dedicated M8 power supply connector cables (sold separately) for external power input.

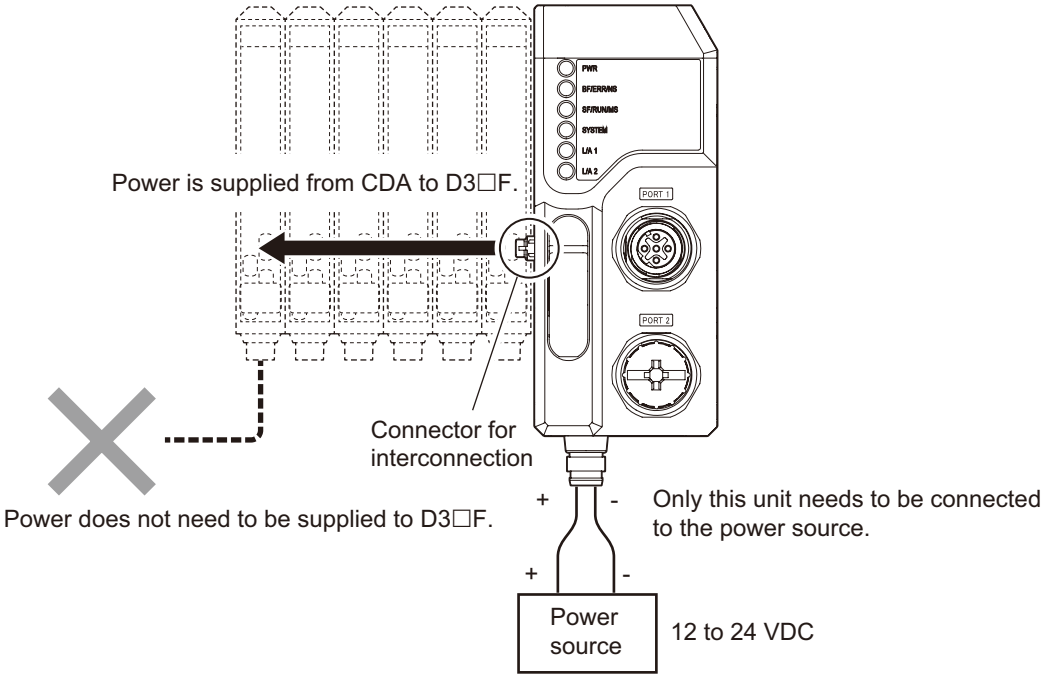
M84CN-2S: 2 m, M84CN-5S: 5 m, M84CN-10S: 10 m

This section describes wiring with the power supply cable when setting up each interconnection.

■ Supplying Power

● When Only D3☐F is Interconnected

Connect only this unit to the external power supply as shown in the diagram below. D3☐F is powered by this unit (and thus does not need to be connected to a power supply).



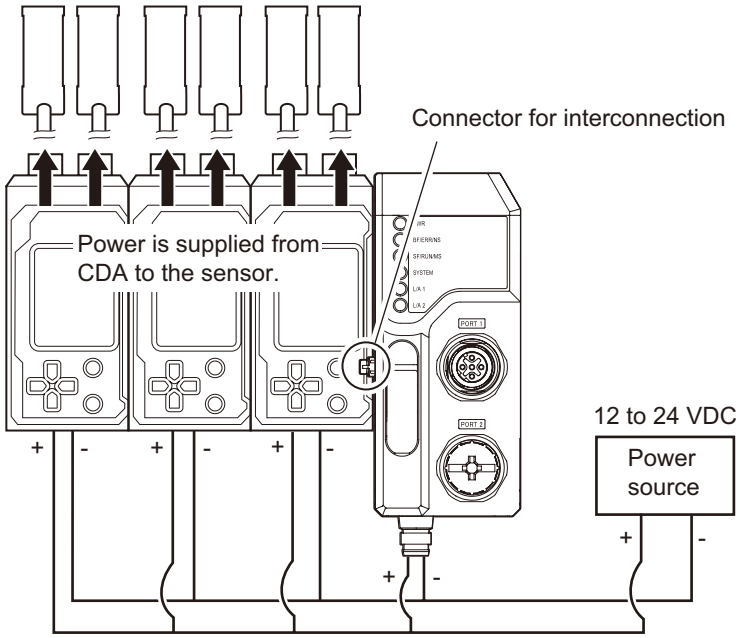
MEMO

- D3☐F is powered by this unit. Do not connect an external power supply to D3☐F. Normal communication may not be possible if the GND is not the same. Overvoltage may also occur in some conditions.
- The cable length of the power supply cable connected to this unit must be 30 m or less. If it is longer than 30 m, noise from the power supply cable can affect this unit and its peripheral devices.

When Only CDA is Interconnected

Connect this unit and CDA to the external power supply as shown in the diagram below. Devices such as displacement sensors are powered by CDA.

In this case, this unit's connector for interconnection is only used for communication.



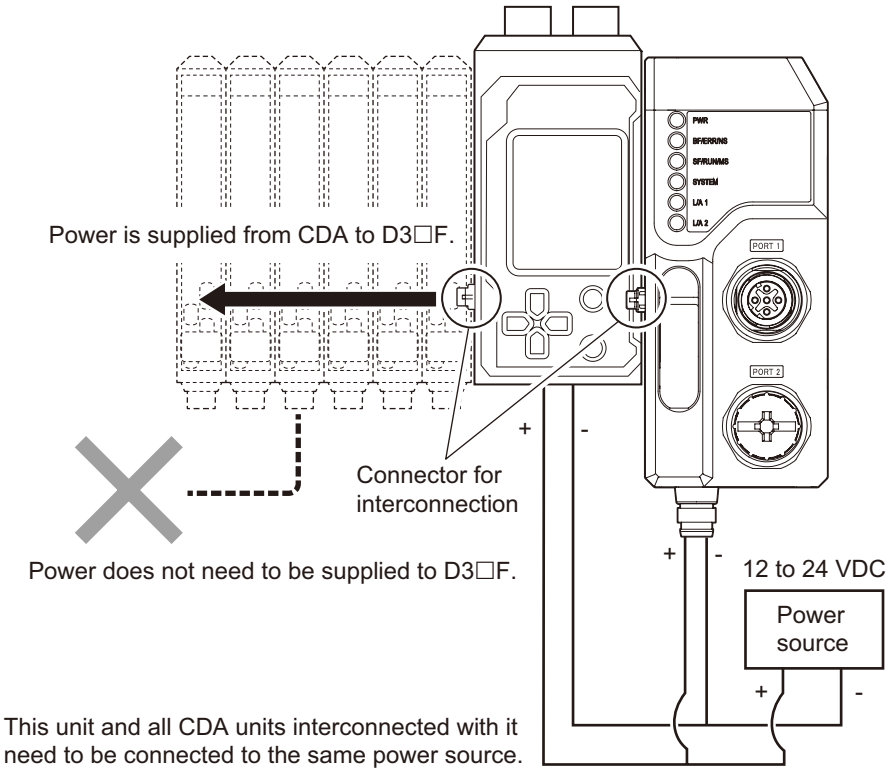
This unit and all CDA units interconnected with it need to be connected to the same power source.

MEMO

- All interconnected CDA units must be powered by the same external power source as this unit. Normal communication may not be possible if a different power source is used.
- To prevent short circuits, wire CDA to the external power supply first, then this unit.
  CDA will short circuit if UC1 is wired to an external power supply while CDA is in its factory default state (with the wires bundled) and not wired to an external power supply (when interconnected with this unit).
- The system can be operated without wiring this unit to an external power supply.
- The cable length of the power supply cable connected to this unit and the CDA Series must be 30 m or less. If it is longer than 30 m, noise from the power supply cable can affect this unit and its peripheral devices.

When Both D3□F and CDA are Interconnected

Connect this unit and CDA to the external power supply as shown in the diagram below. D3□F does not need to be connected to a power supply.



MEMO

- D3□F is powered by this unit, including in cases where both D3□F and CDA are interconnected. Do not connect an external power supply to D3□F. Normal communication may not be possible if the GND is not the same. Overvoltage may also occur in some conditions.
- CDA units must be powered by the same external power source as this unit. Normal communication may not be possible if a different power source is used.
- The cable length of the power supply cable connected to this unit and the CDA Series must be 30 m or less. If it is longer than 30 m, noise from the power supply cable can affect this unit and its peripheral devices.

Calculating Power Consumption

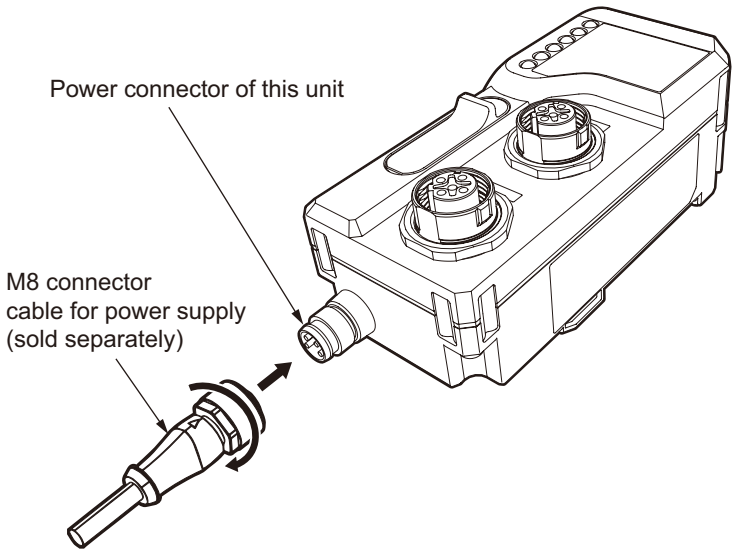
Calculate the power consumed by this unit and the connected sensor-amplifiers and sensors as follows.

Type		Maximum power consumption per unit	Number of units
This unit		3 W	1
Sensor-amplifiers	D3RF	Single output type: 0.864 W Double output type: 0.936 W	× number of units connected
	D3WF	0.864 W	× number of units connected
	CDA	1.2 W	× number of units connected
Sensors	CD22 RS-485 communication type	1.68 W	× number of units connected
	TD1	1.68 W	× number of units connected

Connecting Cables

1 **Insert the connector of an M8 power supply connector cable (sold separately) to the power connector of this unit.**

2 **Tighten the fixture sufficiently by hand.**



Communication

This chapter describes the data configurations that this unit handles for Ethernet/IP communication, and provides examples of communication.

3-1 Ethernet/IP Communication Using This Unit

This section describes the communication that this unit can perform with the Ethernet/IP master.
This unit is capable of the following cyclic and acyclic communication with the Ethernet/IP master.

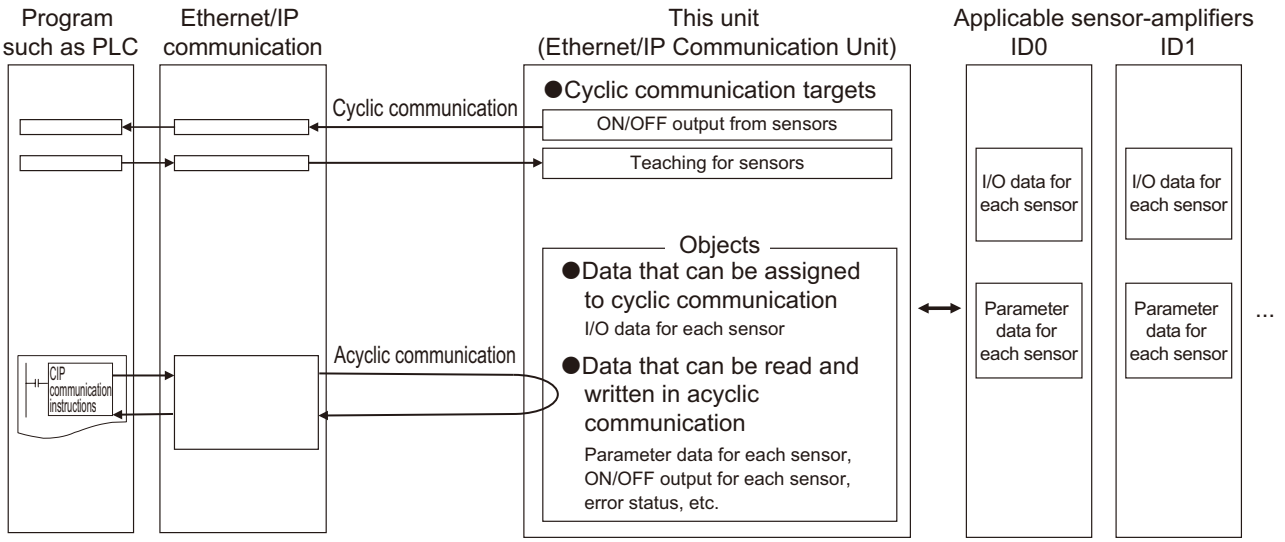
● Cyclic Communication

At regular intervals, the pre-determined data in this unit is exchanged with the Ethernet/IP master.
The following data is exchanged.

- Connected sensor output 1
- Connected sensor output 1, output 2, external input or output 3, and teaching error status
- Teaching execution and error-clearing
- Received light levels or measurement values of connected sensor

● Acyclic Communication

Specific data for this unit is read and written by the Ethernet/IP master when necessary at the desired timing.
All data objects in this unit can be read and written.
This method is mainly used to set parameter data for each sensor, read error statuses, perform reset operations, and read connected sensor configurations.



3-1-1 Configuring the Cyclic Communication Mechanism in This Unit

During cyclic communication, a device opens a logical communication line called a “connection” with another device. Data communication begins once this is successfully opened.
The device that opens the connection is called the “originator” and other device is called the “target.”
Generally, a device that has the originator function is called a “scanner” while a device with only the target function is called an “adapter.”
This unit is an “adapter.”
Note that a “scanner” can function as either an originator or target.

Connections Supported by This Unit

The three following connections are provided in the EDS file of this unit.

Connection	Connection I/O type
Connection 1	Exclusive Owner
Connection 2	Exclusive Owner
Connection 3	Input Only

Exclusive Owner is a connection I/O type that allows both the input instance*1 and output instance*1 to be configured. Input Only is a connection I/O type that allows only the input instance*1 to be configured.

*1: These are instances for the Assembly object.

The assembly instances assigned to each connection are as follows.

Connection	Connection I/O type	Assigned assembly instances	
		Input	Output
Connection 1	Exclusive Owner	Either of the following can be assigned. • 101: Connected sensor output 1 (size: 2 bytes) • 102: Connected sensor output 1, output 2, external input or output 3, and teaching error status (size: 8 bytes) • 104: Received light levels or measurement values of connected sensor (size: 32 bytes)	103: Teaching execution and error-clearing (size: 4 bytes)
Connection 2	Exclusive Owner		103: Teaching execution and error-clearing (size: 4 bytes)
Connection 3	Input Only		None

The user determines which type of connection to use ahead of time. The user then assigns the assembly instance to input or output to that connection.

However, the same assembly instance cannot be assigned among multiple connections. Doing so will prevent cyclic communication.

Assembly instance 103 is assigned to connection 1 and 2 and cannot be changed, so connection 1 and connection 2 cannot be used at the same time.

The following connection patterns allow for simultaneous use.

- Either connection 1 or 2, and connection 3
- Connection 1 only
- Connection 2 only
- Connection 3 only

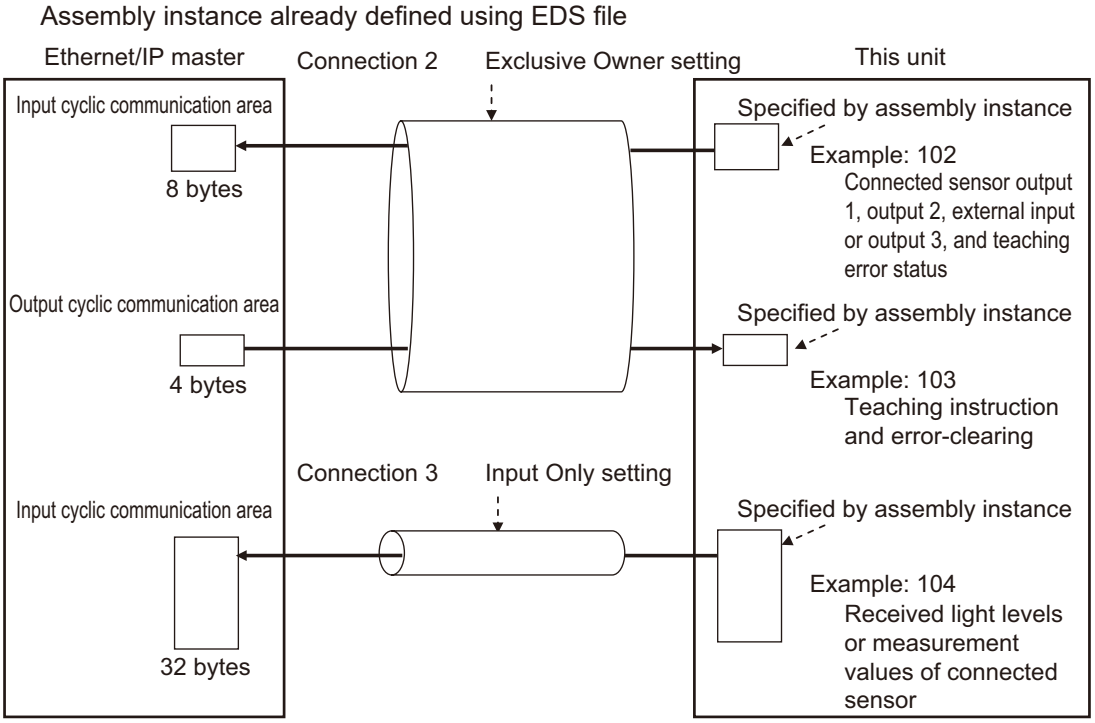
CAUTION

If the same assembly instance is configured for multiple connections during cyclic communication, it will no longer be possible to establish cyclic communication. For example, if connection 1 and connection 2 are used at the same time, assembly instance 103 will be assigned to the outputs of both. This will cause a conflict error and prevent cyclic communication.

Note that it may not be possible to assign an assembly instance to a connection, depending on the master. In this case, cyclic communication will be performed for the following assembly instances already defined in the EDS file.

Connection	Connection I/O type	Assembly instance already defined using EDS file	
		Input	Output
Connection 1	Exclusive Owner	101: Connected sensor output 1 (size: 2 bytes)	103: Teaching execution and error-clearing (size: 4 bytes)
Connection 2	Exclusive Owner	102: Connected sensor output 1, output 2, external input or output 3, and teaching error status (size: 8 bytes)	103: Teaching execution and error-clearing (size: 4 bytes)
Connection 3	Input Only	104: Received light levels or measurement values of connected sensor (size: 32 bytes)	None

Example: When using connection 2 and 3



MEMO

- To configure this unit to enable error code diagnosis when a connection is established, Enable the Global Diagnosis configuration assembly instance (100) in the connection settings (on the target device) of the Ethernet/IP configuration software. Refer to “5-1-1 Error Codes for This Unit” for more information about the error codes of this unit.

Examples of Using Connections

Periodically Read Output 1 and the Received Light Level from the Connected Sensor

Use connection 1 (Exclusive Owner) and connection 3 (Input Only).

Assign assembly instance 101 to the input of connection 1, and assembly instance 104 to the input of connection 3.

● Periodically Read Connected Sensor Output 1, Output 2, External Input or Output 3, Teacher Error Status, and Received Light Level

Use connection 2 (Exclusive Owner) and connection 3 (Input Only).

Assign assembly instance 102 to the input of connection 2, and assembly instance 104 to the input of connection 3.

MEMO

- It may not be possible to use multiple connections at the same time, depending on the master.
- To specify a memory area in the cyclic communication area of the master, specify an area that will retain memory even if the operation mode of the master changes. Otherwise, the information in the memory area performing cyclic communication will be cleared when then operation mode of the master is changed.

■ Available Connection Types

The following connection types can be selected for each assembly instance of this unit.

Assembly instance	Connection type	
	Multicast (Multi-castconnection)	Unicast (Point to Point connection)
101: Connected sensor output 1	Can be selected	
102: Connected sensor output 1, output 2, external input or output 3, and teaching error status	Can be selected	
103: Teaching execution and error-clearing	Cannot be used	Fixed and cannot be changed
104: Received light levels or measurement values of connected sensor	Can be selected	

3-1-2 Acyclic Communication Mechanism in This Unit

During acyclic communication, the following information is specified using communication instructions from the master.

- Service code
- Class ID
- Instance ID
- Attribute ID

For this unit, specify the instance ID of the sensor object to specify the sensor to access. The instance ID is the connection order within the same model. Refer to “3-4-1 Instance IDs for This Unit and Sensor Objects” for further information on sensor object instance IDs.

3-2 Operations Required for This Unit to Communicate with the Ethernet/IP Master

This section describes the operations required on the Ethernet/IP master for this unit to perform Ethernet/IP communication.
For more information, refer to the manual of the Ethernet/IP master or that of the Ethernet/IP configuration software being used.

3-2-1 Downloading and Installing the EDS File for This Unit

1 **Download the EDS file for this unit from the Optex FA website below:**
https://www.optex-fa.com/

2 **Install the EDS file for this unit in the Ethernet/IP configuration software.**
Copy the EDS file for this unit (Electronic Date Sheets file) to the folder specified by the Ethernet/IP configuration software.

3-2-2 Configuring the IP Address for This Unit

Use a commercial configuration tool or the TCP/IP Interface object (class ID: F5 h) for acyclic communication to configure the IP address of this unit.
By default, the IP address is configured using a “static IP address.” The default IP address is “192.168.0.1.”
The method used to configure the IP address can be changed to BOOTP or DHCP. To change this, send a CIP message to the TCP/IP Interface object (class ID: F5 h).
Refer to “3-6-8 TCP/IP Interface Object (Class ID: F5 h)” for further information on the TCP/IP Interface object.

3-2-3 Configuring Ethernet/IP Communication on the Master and This Unit

The settings required differ depending on whether cyclic communication or acyclic communication is being used.

■ Cyclic Communication

If using the cyclic communication function, design and configure by following the procedure below.

● Design

1 **Determine which data in this unit to use with cyclic communication**
There are multiple types of internal data (assembly instances) for cyclic communication in this unit.
Determine which data to transmit periodically.

2 **Determine the connection I/O type to use**
Determine which connection I/O type to use from types 1 through 3.

3 **Confirm the assembly instance and size of each type of data**

Each type of data uses a predetermined assembly instance and size, as shown below. Confirm this information ahead of time.

Cyclic communication internal data	Assembly instance	Size	Data direction
Connected sensor output 1	101 (65 h)	2 byte	From target (this unit) to originator (master)
Connected sensor output 1, output 2, external input or output 3, and teaching error status	102 (66 h)	8 byte	
Received light levels or measurement values of connected sensor	104 (68 h)	32 byte	From target (this unit) to originator (master)
Teaching execution and error-clearing	103 (67 h)	4 byte	From originator (master) to target (this unit)

● Configuration

Use the Ethernet/IP configuration software to configure the following.

1 **Register this unit on the Ethernet/IP network in the configuration software, and then enter the IP address of this unit (configured in "3-2-2 Configuring the IP Address for This Unit").**

2 **Create a cyclic communication area on the master for which to assign data from this unit.**

3 **Select the connection I/O type (from types 1 through 3) of this unit (target).**

4 **Assign the assembly instance of this unit to the input/output of the selected connection.**

5 **Select the cyclic communication area on the master to assign.**

6 **Configure the RPI, timeout value, and connection type for the connection parameters.**

7 **To enable error code diagnosis for this unit when a connection is established, enable the Global Diagnosis configuration assembly instance (100) in the connection settings (on the target device) of the Ethernet/IP configuration software. Note that error codes can be read with acyclic communication. Refer to "5-1 List of Error Codes for This Unit and Each Sensor" for more information about error codes.**

8 **To use two or more connections, repeat steps 3 through 7 above.**

■ Acyclic Communication

If you are using acyclic communication, create a communication program on the master.

3-2-4 Downloading Connection Settings to the Master

Use the Ethernet/IP configuration software to download the configured connection to the master.

Cyclic communication will automatically start.

3-3 Cyclic Communication

This unit can input and output the following data from/to our sensors compatible with communication connected to this unit with the Ethernet/IP master cyclically.

- Output to the Master:
  Bit data: sensor ON/OFF output signals, external input signals, and error statuses
  Word data: received light levels and measured values of sensors
- Input from the Master:
  Bit data: Teaching execution and error-clearing

MEMO

- When using cyclic communication, the user must know which model is connected with which slot.

3-3-1 Cyclic Communication Data in This Unit

The assembly instance and size of internal data (Assembly object) for cyclic communication for this unit are as follows.

● From Target (This Unit) to Originator (Master)

Assembly instance	Cyclic communication internal data	Size
101 (65 h)	Connected sensor output 1	2 byte
102 (66 h)	Connected sensor output 1, output 2, external input or output 3, and teaching error status	8 byte
104 (68 h)	Received light levels or measurement values of connected sensor	32 byte

● From Originator (Master) to Target (This Unit)

Assembly instance	Cyclic communication internal data	Size
103 (67 h)	Teaching execution and error-clearing	4 byte

■ Memory Assignment

The memory assignment for cyclic communication data in this unit is shown below.

Note: In the following explanation, the corresponding relationship between the slot and bit when “bit 0 to 15: slot 0 to 15” is indicated is as follows.

Bit / Word	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Slot 15	Slot 14	Slot 13	Slot 12	Slot 11	Slot 10	Slot 9	Slot 8	Slot 7	Slot 6	Slot 5	Slot 4	Slot 3	Slot 2	Slot 1	Slot 0

From Target (This Unit) to Originator (Master)

- **Instance ID 101: Connected sensor output 1 (total: 2 bytes)**

Word \ Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
+0	Bit 0 to 15: Output 1 ON/OFF for connected sensor in slot 0 to 15.															

“Connected sensor output 1” indicates the following.

· D3RF: Sensor output 1

· D3WF: Sensor output 1

· CDA + CD22: Hi output

· CDA + TD1: None

For example, if either output 1 of the connected sensor is ON for slot 0 and 9 only, bit 0 and bit 9 from the start of the word data will be ON and the value will be as follows.

0201 h

- **Instance ID 102: Connected sensor output 1, output 2, external input or output 3, and teaching error status (total: 8 bytes)**

Word \ Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
+0	Bit 0 to 15: Output 1 ON/OFF for connected sensor in slot 0 to 15.															
+1	Bit 0 to 15: Output 2 ON/OFF for connected sensor in slot 0 to 15.															
+2	Bit 0 to 15: External input or output 3 ON/OFF for connected sensor in slot 0 to 15.															
+3	Bit 0 to 15: Teaching error status ON/OFF for connected sensor in slot 0 to 15.															

“Connected sensor output 1” for +0 word (0 to 1 bytes) indicates the following.

· D3RF: Sensor output 1

· D3WF: Sensor output 1

· CDA + CD22: Hi output

· CDA + TD1: None

“Connected sensor output 2” for +1 word (2 to 3 bytes) indicates the following.

· D3RF: Sensor output 2

· D3WF: Sensor output 2

· CDA + CD22: Lo output

· CDA + TD1: None

“Connected sensor external input or output 3” for +2 word (4 to 5 bytes) indicates the following.

· D3RF: External input

· D3WF: External input

· CDA + CD22: Go output

· CDA + TD1: None

“Connected sensor teaching error status” for +3 word (6 to 7 bytes) indicates the following.

· D3RF: Error status

· D3WF: Error status

· CDA + CD22: Error status

· CDA + TD1: Error status

For example, if either output 1, 2, or 3 is ON for slot 0 and 9 only and there is an error for only slot 0 and slot 9, the values will be as follows.

0201 0201 0201 0201 h

- **Instance ID 104: Received light levels or measurement values of connected sensor (total: 32 bytes)**

Word \ Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
+0	Received light levels or measurement values of connected sensor for slot 0															
+1	Received light levels or measurement values of connected sensor for slot 1															
+2	Received light levels or measurement values of connected sensor for slot 2															
+3	Received light levels or measurement values of connected sensor for slot 3															
+4	Received light levels or measurement values of connected sensor for slot 4															
+5	Received light levels or measurement values of connected sensor for slot 5															
+6	Received light levels or measurement values of connected sensor for slot 6															
+7	Received light levels or measurement values of connected sensor for slot 7															
+8	Received light levels or measurement values of connected sensor for slot 8															
+9	Received light levels or measurement values of connected sensor for slot 9															
+10	Received light levels or measurement values of connected sensor for slot 10															
+11	Received light levels or measurement values of connected sensor for slot 11															
+12	Received light levels or measurement values of connected sensor for slot 12															
+13	Received light levels or measurement values of connected sensor for slot 13															
+14	Received light levels or measurement values of connected sensor for slot 14															
+15	Received light levels or measurement values of connected sensor for slot 15															

“Received light levels or measurement values of connected sensor” indicates the following.

· D3RF: Received light level

· D3WF: Received light level

· CDA + CD22: Measurement values or calculation values

· CDA + TD1: Measurement values or calculation values

For example, if the received light level for slot 0 is 0123 h, the received light level for slot 9 is 0345 h, and the received light level for other sensors is 0000 h, the values will be as follows.

0000 0000 0000 0000 0000 0000 0345 0000 0000 0000 0000 0000 0000 0000 0000 0123 h

● From Originator (Master) to Target (This Unit)

- **Instance ID 103: Teaching execution and error-clearing (total: 4 bytes)**

Word \ Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
+0	Bit 0 to 15: Teaching execution ON/OFF for connected sensor in slot 0 to 15.															
+1	Bit 0 to 15: Error-clearing ON/OFF for connected sensor in slot 0 to 15.															

[0 to 1 bytes]: “Connected sensor teaching execution” indicates the following.

All models: Execution of teaching

[2 to 3 bytes]: “Connected sensor error-clearing” indicates the following.

All models: Error-clearing

For example, to execute teaching for slot 0 and 9 only, turn only bit 0 and bit 9 from the start of the word data ON and set the following values.

0000 0201h

3-4 Acyclic Communication

The Ethernet/IP master can read or write the following data using acyclic communication when necessary.

- Reading and writing setting values from each sensor

- Reading ON/OFF output, external input, and teaching error information from all sensors connected to this unit
- Teaching execution and error-clearing for all sensors connected to this unit
- Reading sensor ON/OFF output, received light levels, measurement values, etc. for each sensor
- Teaching execution and other instructions for each sensor
- Reading the latest error codes specific to each device for each sensor

- Reading configurations of sensors connected to this unit
- Reading the number of sensors connected to this unit

Etc.

Ethernet/IP communication instructions from the Ethernet/IP master can be used to specify the class ID, instance ID, and attribute ID of a given object, to read and write data.

Refer to “3-6-1 Services Supported by Objects in This Unit” for information on supported objects.

3-4-1 Instance IDs for This Unit and Sensor Objects

The instance IDs for this unit’s object and sensor objects are used as identification codes that indicate the connection order within the same class ID (model code).
If using acyclic communication to access each sensor object, specify the sensor to access by specifying this instance ID.

MEMO

If accessing a sensor object with acyclic communication, the user will need to know the “instance ID of the sensor object” for the connection order within this same class ID (model code).

Instance ID of This Unit

The instance ID of this unit is set to 01 h and cannot be changed.

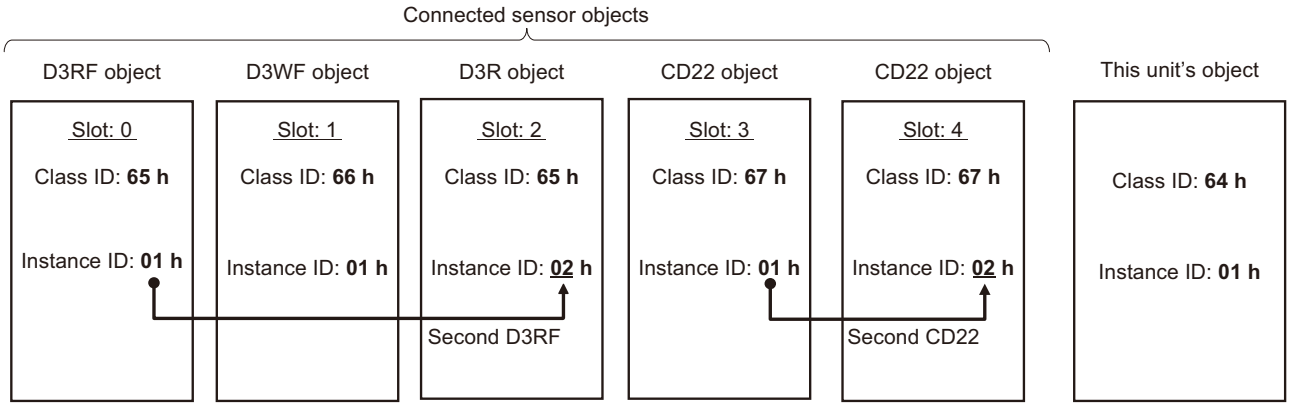
Object	Class ID (model code)	Instance ID
This unit’s object	64 h	Fixed to 01 h and cannot be changed

Assigning Instance IDs to Sensor Objects

The instance IDs assigned to each of the following sensor objects connected to this unit are determined by the connection order in the same class ID (model code). The numbers are assigned to each class ID (model code) in order starting from 01 h.

Sensor object	Class ID (model code)	Instance ID
D3RF object	65 h	Numbers are assigned in connection order starting from 01 h within the same class ID (model code) to the left.
D3WF object	66 h	
CD22 object	67 h	
TD1 object	68 h	

In the following example, D3RF in slot 2 (the third from the left) is the second D3RF, so the instance ID is 02 h. Therefore, to access the D3RF object in slot 2 using acyclic communication, specify an instance ID of 02 h. Similarly, CD22 in slot 4 (the fifth from the left) is the second CD22, so the instance ID is 02 h. Therefore, to access the CD22 object in slot 4 using acyclic communication, specify an instance ID of 02 h.



MEMO

- Note that instance IDs for sensor objects differ from slot numbers.
- Instance IDs for sensor objects in each slot can be read with acyclic communication to the Module Configuration object (class ID: 80 h).

3-4-2 List of Class IDs (Model Codes) and Product Codes

The class IDs (model codes) and product codes for this unit and applicable sensors connected to this unit are listed below.

The following class IDs (model codes) and product codes can both be used to identify the model of a device.

This unit, or applicable sensor connected to this unit	Class ID (model code)	Product code	Model
This unit	64 h	2509 h	UC1-EP
D3RF	65 h	2101 h: Fiber amplifier 1 output	Interconnected master unit / 1 output: D3RF-TMC□4 Interconnected slave unit / 1 output: D3RF-TSC□4
		2102 h: Fiber amplifier 2 output	Interconnected master unit / 2 output: D3RF-TDMC□4 Interconnected slave unit / 2 output: D3RF-TDSC□4
D3WF	66 h	2101 h: Fiber amplifier 1 output	Interconnected master unit / 1 output: D3WF-TMC□4 Interconnected slave unit / 1 output: D3WF-TSC□4
		2102 h: Fiber amplifier 2 output	Interconnected master unit / 2 output: D3WF-TDMC□4 Interconnected slave unit / 2 output: D3WF-TDSC□4
CD22	67 h	1301 h: CD22-15-485	CD22-15-485M12
		1302 h: CD22-35-485	CD22-35-485M12
		1303 h: CD22-100-485	CD22-100-485M122
TD1	68 h	2321 h	TD1-010M8 TD1-010M8J

3-4-3 Confirming Class IDs (Model Codes), Product Codes, and Instance IDs for Each Slot

The class ID (model code) and product code of the sensors connected to each slot, as well as the instance ID assigned to each sensor, can be read with acyclic communication to the Module Configuration object (class ID: 80 h).

Refer to “3-6-15 Module Configuration Object (Class ID: 80 h)” for further information on the Module Configuration object.

3-5 Specific Examples of Communication

This section describes specific examples of communication between this unit and the master.
Communication can be performed with cyclic communication or acyclic communication.

3-5-1 Cyclic Reading of ON/OFF Output from Sensors

Cyclic reading of ON/OFF output from sensors is performed with cyclic communication.
Select the assembly instance for either of the internal data items (Assembly object) below.

Application	Internal data (Assembly object)	Assembly instance	Size
Read output 1 only	Connected sensor output 1	101 (65 h)	2 byte
Read output 2, external input or output 3, or teaching error status, other than output 1	Connected sensor output 1, output 2, external input or output 3, and teaching error status	102 (66 h)	8 byte

For example, to read output 1 and 2 of sensor D3RF in slot 0, select connection 2 (connection I/O type: Exclusive Owner) and assign 102 (66 h) to its input.
Leave the variable in the master as the cyclic communication area.
The variable in the master has a data size of 8 bytes. Only four bytes are used in this case, so use a 64-element BOOL type array variable.
Output data from the sensor is cyclically sent to the variable in the master.

The following is an example of a variable in the master.
Variable name: ABC (*)
Data type: ARRAY[0..63] OF BOOL (64-element BOOL type array)

*: The variable name is an example of a name defined by the user.

Then, read bit 0 in the above array variable for output 1. Read bit 16 in the above array variable for output 2.

3-5-2 Teaching the Sensors

Teaching of the sensors is performed with cyclic communication.
Collected instructions to the sensor-amplifiers are cyclically sent from variables in the master.
Select the assembly instance for the internal data (Assembly object) below.

Application	Internal data (Assembly object)	Assembly instance	Size
Execute teaching cyclically	Teaching execution and error-clearing	103 (67 h)	4 byte

For example, to cyclically execute teaching for sensor D3RF in slot 0, select connection 1 (connection I/O type: Exclusive Owner) and assign 103 (67 h) to its output.
Leave the variable in the master as the cyclic communication area.

The variable in the master has a data size of 4 bytes. Only 2 bytes are used in this case, so use a 32-element BOOL type array variable.
Master variable data is cyclically sent as input data to the sensor.

The following is an example of a variable in the master.
Variable name: DEF (*)
Data type: ARRAY[0..31] OF BOOL (16-element BOOL type array)

*: The variable name is an example of a name defined by the user.

Then, turn bit 0 of the above array variable ON.

3-5-3 Cyclic Reading of Received Light Levels from Sensors

Cyclic reading of received light levels from sensors is performed with cyclic communication.
Use the Ethernet/IP configuration software to assign the assembly instance for the internal data (Assembly object) below to the connection.

Application	Internal data (Assembly object)	Assembly instance	Size
Cyclically read the received light levels or measurement values of a sensor	Received light levels or measurement values of connected sensor	104 (68 h)	32 byte

For example, to read the received light level of sensor D3RF in slot 0, select connection 3 (connection I/O type: Input Only) and assign 104 (68 h) to its input.
Leave the variable in the master as the cyclic communication area.
The variable in the master has a data size of 16 words. Only one word is used in this case, so use a 16-element UINT type array variable.
Output data from the sensor-amplifier is cyclically sent to the variable in the master.

The following is an example of a variable in the master.
Variable name: GHI (*)
Data type: ARRAY[0..15] OF UINT (16-element UINT type array)

*: The variable name is an example of a name defined by the user.

Then, read the first word in the above variable.

3-5-4 Reading ON/OFF Output for All Sensors Connected to This Unit as Needed

Use acyclic communication when reading the ON/OFF output for all sensors connected to this unit as needed.
For example, to read ON/OFF output 1 for all sensors, send a CIP message from the master to the following class ID object in this unit.

- Service code: 0E h (Get_Attribute_Single)
- Class ID: 64 h (this unit's object)
- Instance ID: 01 h
- Instance attribute ID: 01 h (ON/OFF output 1 for all sensors)

3-5-5 Changing Setting Values of Sensors

The setting values of the sensors can be changed with acyclic communication.
For example, to change the lower threshold setting for output 1 for D3RF in slot 2 (third sensor from the left), send a CIP message from the master to the following class ID object in this unit.

- Service code: 10 h (Set_Attribute_Single)
- Class ID: 65 h (D3RF object)
- Instance ID: In this case, slot 0 and 1 are the same with model D3RF, so this is the third D3RF and therefore the ID is 03 h
- Instance attribute ID: 76 h (lower threshold setting for output 1)
- Write parameter: 100 (when using a lower threshold setting for output 1 of 100)

3-5-6 Reading the Sensor Configuration for All Slots Connected to This Unit

To read the configuration of the sensors connected to this unit, use acyclic communication.
For example, read the product code, class ID (model code), and instance ID (connection order within the model code) for all slots. Send a CIP message from the master to the following class ID object in this unit.
Use service code “01 h” (Get_Attributes_All) when reading the sensor configuration in all slots.

- Service code: 01 h (Get_Attributes_All)
- Class ID: 80 h (Module Configuration object)
- Instance ID: 01 h

3-5-7 Changing the Method to Configure the IP Address of This Unit to BOOTP or DHCP

To change how the IP address of this unit is configured from a static IP address to using BOOTP or DHCP, use acyclic communication.
For example, to change to obtaining an IP address using BOOTP, send a CIP message from the master to the following class ID object in this unit.

- Service code: 10 h (Set_Attribute_Single)
- Class ID: F5 h (TCP/IP Interface object)
- Instance ID: 01 h
- Change instance attribute ID “03 h” (IP address configuration method) to “1” (obtain IP address using BOOTP function)

3-6 List of Information Monitored/ Configured Using Acyclic Communication

This section describes information monitored and configured using acyclic communication.
This unit contains sets of parameters called “objects.” The Ethernet/IP master reads from and writes to this location to monitor and set parameters.

3-6-1 Services Supported by Objects in This Unit

The following table lists services supported by objects in this unit.

Object name	Class ID	Details	Application
Identity object	01 h	This object provides identification information and general information on this unit.	Confirm the vendor ID of this unit, perform a reset operation, etc.
Message Router object	02 h	This object is located within the node and is used to distribute explicit message requests to the appropriate application objects. It has no class attributes or instance attributes.	-
Assembly object	04 h	This object binds the attributes of multiple objects. This allows data between each object to be sent and received using a single connection.	• Acyclically execute functions similar to cyclic communication • Read whether error diagnosis is enabled or disabled
Connection Manager object	06 h	This object assigns and manages internal resources associated with both cyclic communication and acyclic communication.	-
DLR object	47 h	This object provides a status information interface for the Device Level Ring Protocol (DLR) when using a ring configuration network environment. Note: The DLR protocol is used to switch the network quickly when a communication outage occurs.	Read the network topology, network status, Supervisor IP address, etc. when using the DLR function
QoS object	48 h	This object manages all data and activity related to the Quality of Service (QoS) function of a device. It includes the DSCP setting in the IP header.	Configure QoS-related settings Note: This is used for time-critical applications such as DLR.
TCP/IP Interface object	F5 h	This object writes and reads settings such as the IP address, subnet mask, and default gateway.	Configure/monitor TCP/IP-related settings; specifically: • Change how the IP address of this unit is configured, from a static IP address to using BOOTP or DHCP • Configure the IP address of this unit using a CIP message • Enable/disable the Address Conflict Detection (ACD) function

Object name	Class ID	Details	Application
Ethernet Link object	F6 h	This object provides setting parameters, error counters, and status information for the Ethernet IEEE 802.3 communication interface.	Confirm the current communication speed
This unit's object	64 h	This object reads and writes data from this unit.	• Read ON/OFF output, external input, and teaching error information from all sensors connected to this unit • Perform teaching execution and error-clearing for all sensors connected to this unit • Read the number of sensors connected to this unit
D3RF object	65 h	This object reads and writes data from the D3RF sensor object.	• Read and write setting values from the sensor • Read ON/OFF output, received light levels, measurement values, etc. from each sensor • Provide instructions to the sensor, such as teaching execution
D3WF object	66 h	This object reads and writes data from the D3WF sensor object.	
CD22 object	67 h	This object reads and writes data from the CD22 sensor object.	
TD1 object	68 h	This object reads and writes data from the TD1 sensor object.	
Module Configuration object	80 h	This object reads the configuration of the sensor connected to this unit.	Read configurations of sensors connected to this unit

3-6-2 Identity Object (Class ID: 01 h)

This object provides identification information and general information on this unit.

Instance/Attribute Range

Instance ID	Attribute ID
01 h	01 h - 09 h

Service Codes

Service Code	Service name	Details
01 h	Get_Attributes_All	Read the values of all attributes.
05 h	Reset	Soft reset this unit, or return it to factory settings and then soft reset it. Set the following reset types for the parameter. Reset type 0: Restart Reset type 1: Return to factory settings and then restart
0E h	Get_Attribute_Single	Read the value of the specified attribute.

Attribute ID List

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Default value
01 h	Vendor ID	Vendor ID	Read	UINT	05F6 h
02 h	Device Type	Device type	Read	UINT	000C h (communication adapter)
03 h	Product Code	Product code	Read	UINT	2509 h
04 h	Revision	Identity object revision	Read	Struct	-
	Major Revision	Major revision	Read	USINT	01 h
	Minor Revision	Minor revision	Read	USINT	01 h
05 h	Status	Device status	Read	WORD	Value varies depending on device status. Refer to “*1. Device status” for further information.
06 h	Serial Number	Serial number	Read	UDINT	Device serial number
07 h	Product Name	Product name	Read	SHORT_ STRING	“UC1-EP”
08 h	State	Device operation state	Read	USINT	Value varies depending on device operation state. Refer to “*2. Device operation state” for further information.
09 h	Configuration Consistency Value	Configuration value applied	Read	UINT	0000 h

*1. Device status

Bit	Name	Description
0	Owned by master	ON when connection with master complete
1	Reserved	Always 0
2	Configured	ON when configuration complete
3	Reserved	Always 0
4 to 7	Extended device status	Indicates extended information on the device status. 0: Not used 1: Not used 2: Status when at least one I/O connection failure has occurred 3: Status when I/O connection is not established 4: Not used 5: Status when critical fault has occurred (MS error) 6: Status when at least one I/O connection is established, and at least one is in the RUN status 7: Status when at least one I/O connection is established, and all are in the idle status 8 to 15: Not used
8	Minor Recoverable Fault	Recoverable minor error
9	Minor Unrecoverable Fault	Unrecoverable minor error
10	Major Recoverable Fault	Recoverable major error
11	Major Unrecoverable Fault	Unrecoverable major error
12 to 15	Reserved	Always 0

*2. Device operation state

Value	Description
00 h	Nonexistent
01 h	Self-test
02 h	Standby
03 h	Operating
04 h	Recoverable major error
05 h	Unrecoverable major error
FF h	Default value

■ Reset Service Parameters

Specify the reset type when the service code is 05 h (Reset).

Data	Parameter name	Details	Attribute
0	Reset type 0	Restart.	Write
1	Reset type 1	Return to factory settings and then restart. Refer to “6-2 Reset Function” for information on the settings initialized by “reset type 1.”	Write

3-6-3 Message Router Object (Class ID: 02 h)

This object is located within the node and is used to distribute explicit message requests to the appropriate application objects. It has no class attributes or instance attributes.

3-6-4 Assembly Object (Class ID: 04 h)

This object binds the attributes of multiple objects. This allows data between each object to be sent and received using a single connection.

■ Instance/Attribute Range

Instance ID		Attribute ID
Default value for Global Diagnosis when connection is established	64 h (100)	03 h, 04 h
Connected sensor output 1	65 h (101)	
Connected sensor output 1, output 2, external input or output 3, and teaching error status	66 h (102)	
Teaching execution and error-clearing	67 h (103)	
Received light levels or measurement values of connected sensor	68 h (104)	

■ Service Codes

Service Code	Service name	Details
0E h	Get_Attribute_Single	Read the value of the specified attribute

Attribute ID List

- **For instance ID 64 h (100)**

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Default value
03 h	Data	Default value for Global Diagnosis when connection is established 00 h: Global Diagnosis disabled 01 h: Global Diagnosis enabled Use only one byte in the front. The other 15 bytes are reserved. This indicates the default value of Global Diagnosis (attribute ID: D3 h [error diagnosis enabled/disabled]) for this unit's object (class ID: 64 h) when a connection is established. It is configured using the connection settings (for the target device) in the Ethernet/IP configuration software.	Read	ARRAY of BYTE	0000 h 0000 h 0000 h 0000 h 0000 h 0000 h 0000 h 0000 h
04 h	Size	Size (bytes)	Read	UINT	0010 h

- **For instance ID 65 h (101)**

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Default value
03 h	Data	Connected sensor output 1 • D3RF: Sensor output 1 • D3WF: Sensor output 1 • CDA + CD22: Hi output • CDA + TD1: None	Read	ARRAY of BYTE	0000 h Each bit 0: OFF 1: ON
04 h	Size	Size (bytes)	Read	UINT	0002 h

- **For instance ID 66 h (102)**

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Default value
03 h	Data	Connected sensor output 1, output 2, external input or output 3, and teaching error status 0 to 1 bytes: • D3RF: Sensor output 1 • D3WF: Sensor output 1 • CDA + CD22: Hi output • CDA + TD1: None 2 to 3 bytes: • D3RF: Sensor output 2 • D3WF: Sensor output 2 • CDA + CD22: Lo output • CDA + TD1: None 4 to 5 bytes: • D3RF: External input • D3WF: External input • CDA + CD22: Go output • CDA + TD1: None 6 to 7 bytes: All models: Error status	Read	ARRAY of BYTE	0000 h 0000 h 0000 h 0000 h Each bit 0: OFF 1: ON
04 h	Size	Size (bytes)	Read	UINT	0008 h

- **For instance ID 67 h (103)**

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Default value
03 h	Data	Teaching execution and error-clearing 0 to 1 bytes: All models: Execution of teaching 2 to 3 bytes: All models: Error-clearing	Read	ARRAY of BYTE	0000 h 0000 h Each bit 0 to 1 bytes: 0: No execution of teaching 1: Execution of teaching 2 to 3 bytes: 0: No error-clearing 1: Error-clearing
04 h	Size	Size (bytes)	Read	UINT	0004 h

- **For instance ID 68 h (104)**

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Default value
03 h	Data	Received light levels or measurement values of connected sensor	Read	ARRAY of BYTE	0000 0000 h 0000 0000 h 0000 0000 h 0000 0000 h 0000 0000 h 0000 0000 h 0000 0000 h 0000 0000 h
04 h	Size	Size (bytes)	Read	UINT	0020 h

3-6-5 Connection Manager Object (Class ID: 06 h)

This object assigns and manages internal resources associated with both cyclic communication and acyclic communication. There are no instances.

3-6-6 DLR Object (Class ID: 47 h)

This object provides a status information interface for the Device Level Ring Protocol (DLR) when using a ring configuration network environment. The DLR protocol is used to switch the network quickly when a communication outage occurs.

Instance/Attribute Range

Instance ID	Attribute ID
01 h	01 h, 02 h, 0A h, 0C h

Service Codes

Service Code	Service name	Details
01 h	Get_Attributes_All	Read the values of all attributes.
0E h	Get_Attribute_Single	Read the value of the specified attribute.

Attribute ID List

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Default value
01 h	Network Topology	Network topology 0: Linear bus topology 1: Ring topology	Read	USINT	00 h

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Default value
02 h	Network Status	Network status Bit 0: Indicates normal status Bit 1: Indicates that a ring fault was detected Bit 2: Indicates that an invalid loop was detected Bit 3: Indicates that an error occurred in some part of the network Bit 4: Not used (Supervisor Only)	Read	USINT	00 h
0A h	Active Supervisor Address	Supervisor IP and MAC address	Read	Struct	
	IP Address	Supervisor IP address	Read	UDINT	00000000 h
	Mac Address	Supervisor MAC address	Read	ARRAY of 6 USINTs	000000000000 h
0C h	Capability Flags	List of functions supported by the DLR object Bit 0: Not used Bit 1: Indicates that Beacon-based rings are supported Bit 5: Not used Bit 6: Not used Bit 7: Indicates that the Flush_table is supported.	Read	DWORD	00000082 h

3-6-7 QoS Object (Class ID: 48 h)

This object manages all data and activity related to the Quality of Service (QoS) function of a device. It includes the DSCP setting in the IP header. It is required for time-critical applications, such as using DLR.

Instance/Attribute Range

Instance ID	Attribute ID
01 h	01 h, 04 h - 08 h

Service Codes

Service Code	Service name	Details
0E h	Get_Attribute_Single	Read the value of the specified attribute
10 h	Set_Attribute_Single	Write the value to the specified attribute.

Attribute ID List

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Default value
01 h	802.1Q Tag Enable DSCP Urgent	802.1Q frame enabled/disabled setting 0: Disabled (default value) 1: Enabled	Read/ write	USINT	0 (00 h)
04 h	DSCP Urgent	Differentiated Services Code Point (DSCP) value of Urgent Priority message in cyclic communication (Valid range: 0 to 63)	Read/ write	USINT	55 (37 h)
05 h	DSCP Scheduled	DSCP value of Scheduled Priority message in cyclic communication (Valid range: 0 to 63)	Read/ write	USINT	47 (2F h)
06 h	DSCP High	DSCP value of High Priority message in cyclic communication (Valid range: 0 to 63)	Read/ write	USINT	43 (2B h)
07 h	DSCP Low	DSCP value of Low Priority message in cyclic communication (Valid range: 0 to 63)	Read/ write	USINT	31 (1F h)
08 h	DSCP Explicit	DSCP value of message (Class3 or UCMM) in acyclic communication (Valid range: 0 to 63)	Read/ write	USINT	27 (1B h)

3-6-8 TCP/IP Interface Object (Class ID: F5 h)

This object writes and reads settings such as the IP address, subnet mask, and default gateway.

Instance/Attribute Range

Instance ID	Attribute ID
01 h	01 h - 0D h

Service Codes

Service Code	Service name	Details
01 h	Get_Attributes_All	Read the values of all attributes.
0E h	Get_Attribute_Single	Read the value of the specified attribute.
10 h	Set_Attribute_Single	Write the value to the specified attribute.

Attribute ID List

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Default value
01 h	Interface status	Interface status Bit 0 to 3: 0=IP address not set 1=Address applied (either by DHCP/ BOOTP or a static address) 2=Setting applied by hardware (not supported by UC1-EP) Bit 4: Indicates that a new TTL or Mcast Config value was set. The value will be applied upon reset. Bit 5: Indicates that a new value is pending for Interface Configuration. This bit is not switched on, as it is reset when the value is set via UC1-EP. Bit 6: Indicates that an address conflict was detected in the network by the ACD function. Bit 7: Indicates that an address conflict was detected in the network by the ACD function, and that the port cannot currently be used.	Read	DWORD	Depends on device operation state
02 h	Configuration Capability	List of functions supported by the TCPIP object Bit 0: BOOTP client Bit 1: DNS client (unsupported) Bit 2: DHCP client Bit 3: DHCP/DNS client (unsupported) Bit 4: Configurable via configuration Bit 5: Configurable via hardware (unsupported) Bit 6: Reset required to change Interface Configuration Bit 7: ACD function support	Read	DWORD	000095 h
03 h	Configuration Control	IP address configuration method Bit 0 to 3: 0=Set static IP address 1=Obtain address using BOOTP function 2=Obtain address using DHCP function Bit 4: DNS function support (unsupported)	Read/ write	DWORD	00000000 h
04 h	Physical Link Object	The path to the link object in the physical layer	Read	Struct	None
	Path size	Path size (set to 0 and cannot be changed for models with Multi Port)		UINT	0000 h
	Path	The path to the link object in the physical layer		Padded EPATH	None

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Default value
05 h	Interface Cofiguration	Ethernet/IP unit settings	Read/ write	Struct	-
	IP Address	IP address		UDINT	192.168.0.1
	Network Mask	Subnet mask		UDINT	255.255. 255.0
	Gateway Address	Default gateway		UDINT	0.0.0.0
	Nama Server	Primary name server		UDINT	0.0.0.0
	Nama Server2	Secondary name server		UDINT	0.0.0.0
	Domain Name	Domain name		STRING	""
06 h	Host Name	Host name	Read/ write	STRING	""
07 h	Safety Network Number	Safety network	Read	6 octets	No support
08 h	TTL Value	TTL value for multicast packets (valid range: 1 to 255)	Read/ write	USINT	1
09 h	Mcast Config	Multicast address settings	Read/ write	Struct	
	Alloc Control	Multicast determination method 0=The multicast address and number of addresses are determined automatically (default value) 1=The multicast address and number of addresses are determined by the user		USINT	00 h
	Reserved	Reserved	-	USINT	-
	Num Mcast	Number of multicast addresses		UINT	Assigned automatically
	Mcast Start Addr	Starting multicast address		UDINT	Assigned automatically
0A h	SelectAcd	Address Conflict Detection (ACD) function enabled/disabled 0=Disabled 1=Enabled (default value) Specify whether to enable or disable the function that searches for IP address conflicts with other devices on the network.	Read/ write	BOOL	01 h
0B h	LastConflictDetected	Information on the address conflict that was last detected	Read/ write	Struct	
	AcdActivity	ACD status when a conflict is detected 0=No conflict detected (default value) 1=Conflict while generating an IPV4 address 2=Conflict during operation 3=Conflict during semi-active probe		USINT	00 h
	Remote MAC	MAC address of the device with a conflicting IP address detected by ARP		Array of 6 USINT	0
	ArpPdu	Copy of the IP address conflict information from ARP		ARRAY of 28 USINTs	0

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Default value
0C h	EtherNet/IP Quick Connect	Quick Connect enabled/disabled 0 = Disabled 1 = Enabled	Read/ write	BOOL	00 h
0D h	Encapsulation Inactivity Timeout	Timeout during packet generation. The TCP socket will be closed if the specified time is exceeded. 0=Function disabled Default value: 120 seconds (valid range: 1 to 3600 seconds, 0001 - 0E10 h)	Read/ write	UINT	0078 h (120 seconds)

3-6-9 Ethernet Link Object (Class ID: F6 h)

This object provides setting parameters, error counters, and status information for the Ethernet IEEE 802.3 communication interface.

Instance/Attribute Range

Instance ID		Attribute ID
Port1	01 h	01 h - 0B h
Port2	02 h	

Service Codes

Service Code	Service name	Details
01 h	Get_Attributes_All	Read the values of all attributes.
0E h	Get_Attribute_Single	Read the value of the specified attribute.
10 h	Set_Attribute_Single	Write the value to the specified attribute.
4C h	Get And Clear	Reset and read the specified attribute.

Attribute ID List

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Default value
01 h	Interface Speed	Interface communication speed 0=0M Speed 10=10M Speed 100=100M Speed	Read	UDINT	The set communication speed
02 h	Interface Flags	Interface status flag Bit 0: Link status Bit 1: Half-duplex (0) or full-duplex (1) Bits 2 to 4: 0: Performing auto negotiation 1: Failed to perform auto negotiation and detect speed 2: Failed to perform auto negotiation but detected speed successfully 3: Successfully performed auto negotiation 4: Auto negotiation not attempted Bit 5: Reset required to apply settings Bit 6: Hardware fault (always 0)	Read	DWORD	Value varies depending on settings
03 h	Physical Address	Device MAC address	Read	ARRAY of 6 USINTs	Device MAC address
04 h	Interface Counters	Counter value related to packets received on interface	Read/ read and clear	Struct	0
	In Octets	Octets received on interface		UDINT	0
	In Ucast Packets	Unicast packets received on interface		UDINT	0
	In NUcast Packets	Packets other than unicast packet received on interface		UDINT	0
	In Discards	Inbound packets discarded after receipt		UDINT	0
	In Errors	Inbound packets including errors (not including those discarded)		UDINT	0
	In Unknown Protos	Inbound packets received via unknown protocol		UDINT	0
	Out Octets	Octets sent on interface		UDINT	0
	Out Ucast Packets	Unicast packets sent on interface		UDINT	0
	Out Nucast Packets	Packets other than unicast packet sent on interface		UDINT	0
	Out Discards	Discarded outbound packets		UDINT	0
	Out Errors	Outbound packets including errors		UDINT	0

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Default value
05 h	Media Counters	Counter values related to Ethernet media	Read/ read and clear	Struct	0
	Alignment Errors	Received frames not composed of octets where the data length is an integer value		UDINT	0
	FCS Errors	Received frames that did not pass through FCS check		UDINT	0
	Single Collisions	Frames successfully sent for which a collision was predicted		UDINT	0
	Multiple Collisions	Frames successfully sent for which at least one collision was predicted		UDINT	0
	SQE Test Errors	Number of SQE test error messages generated		UDINT	0
	Deferred Transmissions	Frames where the initial transmission was delayed due to busy status		UDINT	0
	Late Collisions	Number of times where a collision was detected after the 512-bit time when sending a packet		UDINT	0
	Excessive Collisions	Frames for which sending failed due to excessive collisions		UDINT	0
	MAC Transmit Errors	Frames for which sending failed due to an internal MAC sublayer transmission error		UDINT	0
	Carrier Sense Errors	Time where assertion was not performed due to loss of carrier detection function for frame transmission		UDINT	0
	Frame Too Long	Frames received exceeding the maximum size allowed		UDINT	0
	MAC Receive Errors	Frames for which receipt failed due to an internal MAC sublayer receive error		UDINT	0
06 h	Interface Control	Physical layer interface settings	Read/ write	Struct	0
	Control Bits	Interface management bit Bit 0: Auto negotiation status (1: Yes, 0: No [fixed setting]) Bit 1: Type of fixed setting (0: Half-duplex, 1: Full-duplex)		WORD	0001 h (auto negotiation)
	Forced Interface Speed	Interface speed 10 Mbps: 000A h 100 Mbps: 0064 h Set to 0 (0000 h) for auto negotiation.		UINT	0000 h
07 h	Interface Type	Interface type Bit 0: Unknown interface type Bit 1: Device dedicated interface Bit 2: Twisted pair Bit 3: Optical fiber	Read	USINT	02 h

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Default value
08 h	Interface State	Interface status Bit 0: Unknown status Bit 1: Normal Bit 2: Interface disabled Bit 3: Interface test status	Read	USINT	Value varies depending on interface status
09 h	Admin State	Administrator permissions enabled/ disabled 1=Enabled (default value) 2=Disabled	Read/ write	USINT	01 h
0A h	Interface Label	Label name for each interface	Read	SHORT_ STRING	Instance 1: “port1” Instance 2: “port2”
0B h	Interface Capability	Functions supported by interface	Read	Struct	
	Capability Bits	Functions supported by interface Bit 0: Reset required to apply manual settings Bit 1: Auto negotiation support Bit 2: Auto MDIX support Bit 3: Manual speed/communication method can be configured		DWORD	0000000F h
	Speed/Duplex Options	List of communication speeds/ communication methods supported by interface	Read	Struct	
		Number of component elements		USINT	04 h
		Communication speed/communication method		ARRAY of Struct	
		Communication speed 1 000A h =10M Speed 0064 h =100M Speed		UINT	000A h
		Communication method 1 00 h = Half-duplex 01 h = Full-duplex		USINT	00 h
		Communication speed 2		UINT	000A h
		Communication method 2		USINT	01 h
		Communication speed 3		UINT	0064 h
		Communication method 3		USINT	00 h
		Communication speed 4		UINT	0064 h
		Communication method 4		USINT	01 h

3-6-10 This Unit's Object (Class ID: 64 h)

This object reads and writes data from this unit.

Instance/Attribute Range

Instance ID	Attribute ID
01 h	01 h - DC h *Includes reserved attributes

Service Codes

Service Code	Service name	Details
0E h	Get_Attribute_Single	Read the value of the specified attribute.
10 h	Set_Attribute_Single	Write the value of the specified attribute.

Attribute ID List

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Default value
01 h	Q1 of all connected modules	ON/OFF output 1 for all sensors	Read	UINT	0000 h
02 h	Q2 of all connected modules	ON/OFF output 2 for all sensors	Read	UINT	0000 h
03 h	Q3 of all connected modules	External input for all sensors	Read	UINT	0000 h
04 h	Error Infomation of all connected modules	Teaching error information for all sensors	Read	UINT	0000 h
05 h	Reserved	Reserved	-	-	-
06 h	Teach of all connected modules	Teaching execution for all sensors	Read/ write	UINT	0000 h
07 h	Error clear of all connected modules	Error-clearing for all sensors	Read/ write	UINT	0000 h
08 h	Product Code	Product code	Read	UINT	2509 h
09 h	Product Type	Product type	Read	UINT	0001 h
0A h	Firmware Version	Firmware version	Read	UINT	0001 h
0B h	Protocol Version	Protocol version	Read	UINT	0001 h
0C h	Product Revision	Version number of product hardware	Read	UINT	0001 h
0D h	Vendor Name	Vendor name	Read	STRING: 7 bytes	"OPTEX FA"
0E h	Product Name	Product name	Read	STRING: 9 bytes	“UC1-EP”
0F h	Product ID	Product ID	Read	STRING: 7 bytes	"0020282"

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Default value
10 h	User Tag Name	User ID (maximum 32 characters)	Read/ write	STRING: 32 bytes	""
11 h	Operation Status	Operation status of this unit	Read	UINT	0 (Idle) 2 (Run)
12 h	Vendor ID	Vendor ID	Read	UINT	05F6 h
13 h	Network Profile	Network profile	Read	STRING: 19 bytes	"Ethernet/IP Coupler"
67 h	Product Serial Number	Serial number	Read	DWORD	Serial number
69 h	Number of connected Modules	Number of connected sensors	Read	UINT	0 - 10 h
6A h	Error Code	Read error codes Refer to “5-1-1 Error Codes for This Unit” for information on the error codes of this unit. Note: If attribute D3 h (Global Diagnosis) is set to “Enabled” for this object, the latest error code for this unit will be stored automatically. Note that the error code can be cleared by writing 0 h as the value.	Read/ write	UINT	0 h
D0 h	Host CPU firmware version	Host CPU version	Read	STRING: 4 bytes	"1001"
D1 h	LFW firmware version	Loadable firmware version	Read	STRING: 12 bytes	"EI21400.NXF"
D2 h	Find me	Self search	Read/ write	UINT	1: Self search ON 0: Self search OFF (default value)
D3 h	Global Diagnosis	Error code diagnosis enabled/ disabled for this unit If set to “Enabled,” the latest error code for this unit will be stored automatically in attribute 6A h (Error Code) in this object. Note: This setting is saved in non-volatile memory, and the setting will be preserved the next time the power is turned ON.	Read/ write	UINT	0: Disabled (default value*1) 1: Enabled
DC h	Factory Reset	Initialize to factory settings	Write	UINT	3: Execute

*1: To set Global Diagnosis (error diagnosis enabled/disabled) to the default value when a connection is established, configure Disable/Enable for Global Diagnosis in the configuration assembly instance (100), in the connection settings (on the target device) of the Ethernet/IP configuration software.
When the connection is established, a CIP message is sent to the above attribute ID: D3 h (Global Diagnosis), allowing the enabled/disabled setting to be changed for error code diagnosis in this unit.

3-6-11 D3RF Object (Class ID: 65 h)

This object reads and writes data from the D3RF sensor object.

Instance/Attribute Range

Instance ID	Attribute ID
01 h - 10 h *Depends on the number of connected units. Refer to “3-4-1 Instance IDs for This Unit and Sensor Objects” for further information.	01 h - DC h *Includes reserved attributes.

Service Codes

Service Code	Service name	Details
0E h	Get_Attribute_Single	Read the value of the specified attribute.
10 h	Set_Attribute_Single	Write the value of the specified attribute.

Attribute ID List

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Value
01 h	Q1 Status	Output 1	Read	BOOL	0
02 h	Q2 Status	Output 2	Read	BOOL	0
03 h	External Input Status	External input	Read	BOOL	0
04 h	Error Information	Error information	Read	BOOL	0
05 h	Light Level	Received light level	Read	UINT	0000 h
06 h	Teach-in request	Execution of teaching	Read/ write	BOOL	0
07 h	Error Clear	Error-clearing	Read/ write	BOOL	0
08 h	Product Code	Product code	Read	UINT	2101 h: Fiber amplifier 1 output 2102 h: Fiber amplifier 2 output
09 h	Product Type	Product type	Read	UINT	0012 h
0A h	Firmware Version	Firmware version	Read	UINT	0200 h or above
0B h	Protocol Version	Protocol version	Read	UINT	0001 h
0C h	Product Revision	Version number of product hardware	Read	UINT	0001 h
0D h	Vendor Name	Vendor name	Read	STRING: 2 - 16 bytes	"OPTEX FA"
0E h	Product Name	Product name	Read	STRING: 2 - 32 bytes	Product name

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Value
0F h	Product ID	Product ID	Read	STRING: 2 to 16 bytes	Product ID
10 h	User Tag Name	User ID (maximum 32 characters)	Read/ write	STRING: 2 to 32 bytes	""
11 h	Operation Status	Operation status of D3RF	Read	UINT	0: Initialize 1: Idle 2: Execute 3: Use by user
6A h	Error Code	Latest error code for D3RF Refer to “5-1 List of Error Codes for This Unit and Each Sensor” for information on the error codes for D3RF.	Read/ write	UINT	• Read: Last error code • Write arbitrary value: Delete last error code
6C h	Display	Display settings	Read/ write	UINT	0: Number display 1: Bar display 2: Percentage display
6E h	Teach-in mode CH1	Output 1 teaching mode	Read/ write	UINT	0: Two-point teaching 1: One-point teaching 2: Through teaching 3: Zone teaching 4: Auto-teaching 5: Percentage teaching 6: Zero percentage teaching
6F h	Teach-in mode CH2	Output 2 teaching mode	Read/ write	UINT	
70 h	Response Speed	Response speed setting	Read/ write	UINT	0: 1-HS (22 µs) 1: 2-FS (85 µs) 2: 3-ST (250 µs) 3: 4-LG (1 ms) 4: 5-PL (2 ms) 5: 6-UL (4 ms) 6: 7-EL (8 ms)
71 h	Gain	Emitting power setting	Read/ write	UINT	0: Low power 1: Medium power 2: High power
72 h	MF-Input	External input setting	Read/ write	UINT	0: External teaching input 1: Test input 2: Synchronization input 3: Counter reset input 4: External all teaching input 5: No function

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Value
73 h	Key Lock	Lock level setting	Read/ write	UINT	0: Unlocked 1: Lock level 1 (fully locked) 2: Lock level 2 (half locked)
74 h	Operation mode CH1	Output 1 operation mode	Read/ write	UINT	0: L-on (light on) 1: D-on (dark on)
75 h	Operation mode CH2	Output 2 operation mode	Read/ write	UINT	
76 h	Threshold level CH1 Lower Limit	Lower threshold (Far) setting for output 1	Read/ write	UINT	-999 to 9999 The range that can be written differs depending on the operation mode.
77 h	Threshold level CH1 Upper Limit	Upper threshold (Near) setting for output 1	Read/ write	UINT	-999 to 9999 Can only be accessed in zone teaching mode.
78 h	Threshold level CH2 Lower Limit	Lower threshold (Far) setting for output 2	Read/ write	UINT	-999 to 9999 The range that can be written differs depending on the operation mode.
79 h	Threshold level CH2 Upper Limit	Upper threshold (Near) setting for output 2	Read/ write	UINT	-999 to 9999 Can only be accessed in zone teaching mode.
7A h	Timer setting CH1	One-shot timer specification for output 1	Read/ write	UINT	0: Off delay time 1: One-shot timer
7B h	Timer setting CH2	One-shot timer specification for output 2	Read/ write	UINT	
7C h	CH1 Off delay time	Off delay timer time for output 1	Read/ write	UINT	0 to 9999: 0 to 9999 ms -1 to -9: 0.1 to 0.9 ms
7D h	CH1 On delay time	On delay timer time for output 1	Read/ write	UINT	
7E h	CH2 Off delay time	Off delay timer time for output 2	Read/ write	UINT	
7F h	CH2 On delay time	On delay timer time for output 2	Read/ write	UINT	
83 h	Hysteresis	Hysteresis setting	Read/ write	UINT	1 to 40
85 h	ASC (Automatic Switching threshold tracking)	ASC setting (automatic sensitivity correction)	Read/ write	UINT	0: None 1: Normal correction 2: High-speed correction 3: Maximum-speed correction
86 h	Energy Saving	Eco mode setting	Read/ write	UINT	0: Standard 1: Automatically turn OFF indicators 2: 2x emitting cycle 3: Display and emitting cycle

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Value
87 h	Reverse display	Reverse display setting	Read/ write	UINT	0: Standard 1: Reverse display
D0 h	Store zero-reset	Execute zero reset	Write	Byte	0 to 65535: Execute
D1 h	Cancel zero-reset	Clear zero reset	Write	Byte	0 to 65535: Execute
D2 h	Teach-in 1-point	First teaching	Write	UINT	1: Teaching for output 1 2: Teaching for output 2
D3 h	Teach-in 2-point	Second teaching	Write	UINT	
DA h	Warm start Reset	Restart instruction	Write	UINT	3: Execute restart
DB h	Return to top menu	Back to top menu	Write	Byte	Execute by writing values
DC h	Factory Reset	Initialize setting values	Write	UINT	3: Execute initialization (only allowed when unlocked)

3-6-12 D3WF Object (Class ID: 66 h)

This object reads and writes data from the D3WF sensor object.

Instance/Attribute Range

Instance ID	Attribute ID
01 h - 10 h *Depends on the number of connected units. Refer to “3-4-1 Instance IDs for This Unit and Sensor Objects” for further information.	01 h - DC h *Includes reserved attributes.

Service Codes

Service Code	Service name	Details
0E h	Get_Attribute_Single	Read the value of the specified attribute.
10 h	Set_Attribute_Single	Write the value of the specified attribute.

Attribute ID List

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Value
01 h	Q1 Status	Output 1	Read	BOOL	0
02 h	Q2 Status	Output 2	Read	BOOL	0
03 h	External Input Status	External input	Read	BOOL	0
04 h	Error Information	Error information	Read	BOOL	0
05 h	Light Level	Received light level	Read	UINT	0000 h
06 h	Teach-in request	Execution of teaching	Read/ write	BOOL	0

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Value
07 h	Error Clear	Error-clearing	Read/ write	BOOL	0
08 h	Product Code	Product code	Read	UINT	2101 h: Fiber amplifier 1 output 2102 h: Fiber amplifier 2 output
09 h	Product Type	Product type	Read	UINT	0012 h
0A h	Firmware Version	Firmware version	Read	UINT	0100 h
0B h	Protocol Version	Protocol version	Read	UINT	0001 h
0C h	Product Revision	Version number of product hardware	Read	UINT	0001 h
0D h	Vendor Name	Vendor name	Read	STRING: 2 to 16 bytes	"OPTEX FA"
0E h	Product Name	Product name	Read	STRING: 2 to 32 bytes	Product name
0F h	Product ID	Product ID	Read	STRING: 2 to 16 bytes	Product ID
10 h	User Tag Name	User ID (maximum 32 characters)	Read/ write	STRING: 2 to 32 bytes	User ID (maximum 32 characters)
11 h	Operation Status	Operation status of D3WF	Read	UINT	0: Initialize 1: Idle 2: Execute 3: Use by user
6A h	Error Code	Latest error code for D3WF Refer to “5-1 List of Error Codes for This Unit and Each Sensor” for information on the error codes for D3WF.	Read/ write	UINT	• Read: Last error code • Write arbitrary value: Delete last error code
6C h	Display	Display settings	Read/ write	UINT	0: Number display 1: Bar display 2: Percentage display
6E h	Teach-in mode CH1	Output 1 teaching mode	Read/ write	UINT	0: One-point teaching 1: Two-point teaching 2: Dynamic teaching
6F h	Teach-in mode CH2	Output 2 teaching mode	Read/ write	UINT	
70 h	Response speed	Response speed setting	Read/ write	UINT	0: 16 µs 1: 200 µs
71 h	Gain	Emitting power setting	Read/ write	UINT	0: Low power 1: Standard power 2: High power 3: Automatic power
72 h	MF Input	External input setting	Read/ write	UINT	0: Extended input 1: All teaching (master only) 2: Toggle between light on and dark on 3: Test input 4: Off

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Value
73 h	Key Lock	Lock level setting	Read/ write	UINT	0: Cancel 1: Lock 2: Lock except extended input
74 h	Operation mode CH1	Output 1 operation mode	Read/ write	UINT	0: Automatic 1: L-on (light on) 2: D-on (dark on)
75 h	Operation mode CH2	Output 2 operation mode	Read/ write	UINT	
76 h	Threshold level CH1 Lower Limit	Lower threshold (Far) setting for output 1	Read/ write	UINT	-999 to 9999 The range that can be written differs depending on the operation mode.
78 h	Threshold level CH2 Lower Limit	Lower threshold (Far) setting for output 2	Read/ write	UINT	
7A h	Timer setting CH1	One-shot timer specification for output 1	Read/ write	UINT	0: Delay out 1: Individual
7B h	Timer setting CH2	One-shot timer specification for output 2	Read/ write	UINT	
7C h	CH1 Off delay time	Off delay timer time for output 1	Read/ write	UINT	0 - 9999: 0 - 9999 ms -1 to -9: 0.1 to 0.9 ms
7D h	CH1 On delay time	On delay timer time for output 1	Read/ write	UINT	
7E h	CH2 Off delay time	Off delay timer time for output 2	Read/ write	UINT	
7F h	CH2 On delay time	On delay timer time for output 2	Read/ write	UINT	
81 h	Synchronisation	Synchronization	Read/ write	UINT	0: Asynchronous 1: Synchronous
83 h	Sensitivity	Sensitivity	Read/ write	UINT	0: 10% 1: 20% 2: 50%
85 h	Automatic sensitivity control	ASC setting (automatic sensitivity correction)	Read/ write	UINT	0: Off 1: On
86 h	Eco mode	Eco mode setting	Read/ write	UINT	0: Off 1: On
87 h	Reverse display	Reverse display setting	Read/ write	UINT	0: Normal display 1: Reverse display
D0 h	Store zero-reset	Execute zero reset	Write	Byte	Execute with writing operation
D1 h	Cancel zero-reset	Clear zero reset	Write	Byte	Execute with writing operation
D2 h	Teach-in 1-Point	First teaching	Write	UINT	1: Teaching for output 1 2: Teaching for output 2
D3 h	Teach-in 2-Point	Second teaching	Write	UINT	
DA h	Warm start Reset	Restart instruction	Write	UINT	3: Execute restart
DB h	Return to top menu	Back to top menu	Write	Byte	Execute with writing operation
DC h	Factory Reset	Initialize setting values	Write	UINT	3: Execute initialization (only allowed when unlocked)

3-6-13 CD22 Object (Class ID: 67 h)

This object reads and writes data from the CD22 sensor object.

Instance/Attribute Range

Instance ID	Attribute ID
01 h - 10 h *Depends on the number of connected units. Refer to “3-4-1 Instance IDs for This Unit and Sensor Objects” for further information.	01 h - DC h *Includes reserved attributes.

Service Codes

Service Code	Service name	Details
0E h	Get_Attribute_Single	Read the value of the specified attribute.
10 h	Set_Attribute_Single	Write the value of the specified attribute.

Attribute ID List

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Value
01 h	Q1 Status	Hi output	Read	BOOL	0
02 h	Q2 Status	Lo output	Read	BOOL	0
03 h	External Input Status	Go output	Read	BOOL	0
04 h	Error Information	Error information	Read	BOOL	0
05 h	Measurement value	Received light level	Read	UINT	0000 h
06 h	Teach-in request	Execution of teaching	Read/ write	BOOL	0
07 h	Error Clear	Error-clearing	Read/ write	BOOL	0
08 h	Product Code	Product code	Read	UINT	1301 h: CD22-15-485 1302 h: CD22-35-485 1303 h: CD22-100-485
09 h	Product Type	Product type	Read	UINT	0011 h
0A h	Firmware Version	Firmware version	Read	UINT	0011 h
0B h	Protocol Version	Protocol version	Read	UINT	0000 h
0C h	Product Revision	Version number of product hardware	Read	UINT	0000 h
0D h	Vendor Name	Vendor name	Read	STRING: 2 to 16 bytes	"OPTEX FA"
0E h	Product Name	Product name	Read	STRING: 2 to 32 bytes	Product name

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Value
0F h	Product ID	Product ID	Read	STRING: 2 to 32 bytes	Product ID
10 h	User Tag Name	User ID (maximum 32 characters)	Read/ write	STRING: 2 to 32 bytes	""
11 h	Operation Status	Operation status of connected CD22	Read	UINT	0: Initialize 1: Idle 2: Execute 3: Use by user
6A h	Error Status	Latest error code for connection CD22 Refer to “5-1 List of Error Codes for This Unit and Each Sensor” for information on the error codes for CD22.	Read/ write	UINT	• Read: Last error code • Write arbitrary value: Delete last error code
6C h	Threshold Near	External output threshold (Near)	Read/ write	UINT	-32768 to 32767
6D h	Threshold Far	External output threshold (Far)	Read/ write	UINT	
6E h	Output hysteresis	External output hysteresis setting	Read/ write	UINT	0 to 32767
6F h	Calculation flags	Calculation flag (setting value for each connected sensor)	Read/ write	UINT	0: No calculation 1: Calculation
70 h	Calculation coefficient Add	Sensor measurement addition coefficient (A) (setting value for each connected sensor)	Read/ write	UINT	-10000 to 10000
71 h	Calculation coefficient Multiply	Sensor measurement multiplication coefficient (M) (setting value for each connected sensor)	Read/ write	UINT	
72 h	Calculation coefficient Divide	Sensor measurement division coefficient (D) (setting value for each connected sensor)	Read/ write	UINT	1 to 32767
73 h	Monitor Calculation Values	Calculation result monitor	Read/ write	UINT	0: Measurement value for sensor 2 1: Calculation result
74 h	Calculation Values Head1	Calculation of measurement values for sensor 1	Read/ write	UINT	0: None 1: Addition 2: Subtraction 3: Absolute difference
75 h	Calculation Values Head2	Calculation of measurement values for sensor 2	Read/ write	UINT	
76 h	Calculation Values Unit left Head1	Calculation of measurement values for left sensor 1	Read/ write	UINT	
77 h	Calculation Values Unit left Head2	Calculation of measurement values for left sensor 2	Read/ write	UINT	
78 h	I/O polarity	I/O polarity	Read/ write	UINT	0: PNP (N.O.) 1: NPN (N.O.) 2: PNP (N.C.) 3: NPN (N.C.)

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Value
79 h	Output Selection CH1	Select function for external output 1	Read/ write	UINT	0: No output 1: Within threshold range for calculation results (GO) 2: Outside near range for calculation results (LO) 3: Outside far range for calculation results (HI) 4: Within threshold range for sensor 1 (GO) 5: Outside near range for sensor 1 (LO) 6: Outside far range for sensor 1 (HI) 7: Within threshold range for sensor 2 (GO) 8: Outside near range for sensor 2 (LO) 9: Outside far range for sensor 2 (HI)
7A h	Output Selection CH2	Select function for external output 2	Read/ write	UINT	
7B h	Output Selection CH3	Select function for external output 3	Read/ write	UINT	
7C h	External input selection	Select external input	Read/ write	UINT	0: No function 1: Teaching (rising on far side, falling on near side) 2: BGS/FGS teaching 3: Zero reset 4: Laser emitting off
7D h	Analog output selection	Select analog output	Read/ write	UINT	0: None 1: Calculation result 2: Sensor 1 3: Sensor 2
7E h	Analog scaling	Analog scaling	Read/ write	UINT	0: No scaling 1: Scaling
7F h	Analog Scaling (max.) 10 V /20 mA	Max analog scaling	Read/ write	UINT	-32768 to 32767
80 h	Analog Scaling (min.) 0 V / 4 mA	Min analog scaling	Read/ write	UINT	
81 h	Baud rate	Sensor head communication speed (setting value for each connected sensor)	Read/ write	UINT	0: No connection (unit for values below: bps) 1: 9.6k, 2: 19.2k, 3: 38.4k, 4: 57.6k, 5: 115.2k, 6: 230.4k, 7: 312.5k, 8: 468.75k, 9: 500k, 10: 625k, 11: 833.3k, 12: 937.5k, 13: 1250k
89 h	Amplifier product code	Product code for connected sensor-amplifier	Read	UINT	2503 h

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Value
8A h	Switching point Near Leap Point Close	Output judgment Near threshold	Read/ write	UINT	CD22-15-485: -7499 to 7499 (1 µm increments) CD22-35-485: -2249 to 2249 (10 µm increments) CD22-100-485: -7499 to 7499 (1 µm increments)
8B h	Switching point Far Leap Point Away	Output judgment Far threshold	Read/ write	UINT	
8C h	Background ObSB	Output judgment Distance set for FGS2	Read/ write	UINT	
8D h	Tolerance ObSB	Output judgment Operation range for FGS2	Read/ write	UINT	CD22-15-485: 0 to 7499 (1 µm increments) CD22-35-485: 0 to 2249 (10 µm increments) CD22-100-485: 0 to 7499 (1 µm increments)
8E h	Average Numbe	Number of averaging operations	Read/ write	UINT	0: 1 1: 8 2: 64 3: 512
8F h	Teaching mode	Teach mode	Read/ write	UINT	0: Two-point teaching 1: One-point teaching 2: FGS2
90 h	Sampling rate	Sampling period	Read/ write	UINT	0: 500 µs 1: 1 ms 2: 2 ms 3: 4 ms 4: Automatic
91 h	Keylock	Key lock function	Read/ write	UINT	0: No lock 1: Lock
92 h	Switching behaviour	Select output polarity	Read/ write	UINT	0: Light on (on within range) 1: Dark on (on outside range)
93 h	Calibration Distance close	Actual measurement values on near side	Read/ write	UINT	CD22-15-485: -7499 to 7499 (1 µm increments) CD22-35-485: -2249 to 2249 (10 µm increments) CD22-100-485: -7499 to 7499 (1 µm increments)
94 h	Calibration distance Away	Actual measurement values on far side	Read/ write	UINT	
95 h	Error Behaviour	Select alarm operation	Read/ write	UINT	0: Output clamp error value (H7FFF) 1: Retain last valid measurement value before hold
96 h	Clamp holding time	Alarm hold count	Read/ write	UINT	0 to 9999

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Value
98 h	Zeroing Value	Zero reset value	Read	UINT	CD22-15-485: -7499 to 7499 (1 µm increments) CD22-35-485: -2249 to 2249 (10 µm increments) CD22-100-485: -7499 to 7499 (1 µm increments)
9C h	Barycenter	Select receiving light waveform	Read/ write	UINT	0: Waveform with strongest received light level 1: Closest point to sensor 2: Second closest point to sensor 3: Third closest point to sensor 4: Fourth closest point to sensor 5: Fifth closest point to sensor
9F h	Hysteresis value	Hysteresis	Read/ write	UINT	CD22-15-485: 0 to 7499 (1 µm increments) CD22-35-485: 0 to 2249 (10 µm increments) CD22-100-485: 0 to 7499 (1 µm increments)
A0 h	Sensitivity	Sensitivity	Read/ write	UINT	0: Automatic adjustment, 1: Minimum, 2 Low, 3: Medium, 4: Medium high, 5: High, 6: Maximum
A1 h	Light threshold	Waveform threshold	Read/ write	UINT	0: Lowest surface, 1: Low position, 2: Center position, 3: High position
A3 h	Keylock active	Display indicators	Read/ write	UINT	0: Continue displaying when locked 1: Turn off when locked
D0 h	Save Zero Reposition	Execute zero reset	Write	Byte	Execute by writing values
D1 h	Cancel zero-reset	Clear zero reset	Write	Byte	Execute by writing values
D2 h	Teach in 1 Point	One-point teaching	Write	UINT	Execute by writing values
D3 h	Teach in 2 Point	Two-point teaching	Write	UINT	Execute by writing values
D4 h	Teach-in ObSB	FGS2 teaching	Write	UINT	Execute by writing values
DA h	Warm start Reset	Restart instruction	Write	UINT	3: Execute restart
DB h	Return to top menu	Back to top menu	Write	Byte	0,1, 2: Execute
DC h	Factory Reset	Initialize setting values	Write	UINT	3: Execute initialization

3-6-14 TD1 Object (Class ID: 68 h)

This object reads and writes data from the TD1 sensor object.

Instance/Attribute Range

Instance ID	Attribute ID
01 h - 10 h *Depends on the number of connected units. Refer to “3-4-1 Instance IDs for This Unit and Sensor Objects” for further information.	01 h - DC h *Includes reserved attributes.

Service Codes

Service Code	Service name	Details
0E h	Get_Attribute_Single	Read the value of the specified attribute.
10 h	Set_Attribute_Single	Write the value of the specified attribute.

Attribute ID List

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Value
01 h	Reserved	Reserved	-	-	-
02 h	Reserved	Reserved	-	-	-
03 h	Reserved	Reserved	-	-	-
04 h	Error Information	Error information	Read	BOOL	0
05 h	Measurement value	Received light level	Read	UINT	0000
06 h	Reserved	Reserved	-	-	-
07 h	Error Clear	Error information clear	Read/ write	BOOL	0
08 h	Product Code	Product code	Read	UINT	2321 h: TD1
09 h	Product Type	Product type	Read	UINT	0011 h
0A h	Firmware Version	Firmware version	Read	UINT	1011 h
0B h	Protocol Version	Protocol version	Read	UINT	0
0C h	Product Revision	Version number of product hardware	Read	UINT	Firmware version of this product
0D h	Vendor Name	Vendor name	Read	STRING: 2 to 16 bytes	"OPTEX FA"
0E h	Product Name	Product name	Read	STRING: 2 to 32 bytes	Product name
0F h	Product ID	Product ID	Read	STRING: 2 to 32 bytes	Product ID

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Value
10 h	User Tag Name	User ID (maximum 32 characters)	Read/ write	STRING: 2 to 32 bytes	User ID (maximum 32 characters)
11 h	Operation Status	Operation status of connected TD1	Read	UINT	0: Initialize 1: Idle 2: Execute 3: Use by user
16 h	Serial Number	Serial number	Read	STRING: 2 to 32 bytes	Set in ASCII code
6A h	Error Status	Latest error code for connection TD1: None Refer to “5-1 List of Error Codes for This Unit and Each Sensor” for information on the error codes for TD1.	Read/ write	UINT	• Read: Last error code • Write arbitrary value: Delete last error code
6C h	Threshold Near	External output threshold (Near)	Read/ write	UINT	-32768 to 32767
6D h	Threshold Far	External output threshold (Far)	Read/ write	UINT	
6E h	Output hysteresis	External output hysteresis setting	Read/ write	UINT	0 to 32767
6F h	Calculation flags	Calculation flag (setting value for each connected sensor)	Read/ write	UINT	0: No calculation 1: Calculation
70 h	Calculation coefficient Add	Sensor measurement addition coefficient (A) (setting value for each connected sensor)	Read/ write	UINT	-10000 to 10000
71 h	Calculation coefficient Multiply	Sensor measurement multiplication coefficient (M) (setting value for each connected sensor)	Read/ write	UINT	
72 h	Calculation coefficient Divide	Sensor measurement division coefficient (D) (setting value for each connected sensor)	Read/ write	UINT	1 to 32767
73 h	Monitor accumulations	Calculation result monitor	Read/ write	UINT	0: Measurement value for sensor 2 1: Calculation result
74 h	Calculation Values Head1	Calculation of measurement values for sensor 1	Read/ write	UINT	0: None 1: Addition 2: Subtraction 3: Absolute difference
75 h	Calculation Values Head2	Calculation of measurement values for sensor 2	Read/ write	UINT	
76 h	Calculation Values Unit left Head1	Calculation of measurement values for left sensor 1	Read/ write	UINT	
77 h	Calculation Values Unit left Head2	Calculation of measurement values for left sensor 2	Read/ write	UINT	
78 h	I/O polarity	I/O polarity	Read/ write	UINT	0: PNP (N.O.) 1: NPN (N.O.) 2: PNP (N.C.) 3: NPN (N.C.)

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Value
79 h	Output Selection CH1	Select function for external output 1	Read/ write	UINT	0: No output 1: Within threshold range for calculation results (GO) 2: Outside near range for calculation results (LO) 3: Outside far range for calculation results (HI) 4: Within threshold range for sensor 1 (GO) 5: Outside near range for sensor 1 (LO) 6: Outside far range for sensor 1 (HI) 7: Within threshold range for sensor 2 (GO) 8: Outside near range for sensor 2 (LO) 9: Outside far range for sensor 2 (HI)
7A h	Output Selection CH2	Select function for external output 2	Read/ write	UINT	
7B h	Output Selection CH3	Select function for external output 3	Read/ write	UINT	
7C h	External input selection	Select external input	Read/ write	UINT	0: No function 1: Teaching (rising on far side, falling on near side) 2: BGS/FGS teaching 3: Zero reset 4: Laser emitting off
7D h	Analog output selection	Select analog output	Read/ write	UINT	0: None 1: Calculation result 2: Sensor 1 3: Sensor 2
7E h	Analog scaling	Analog scaling	Read/ write	UINT	0: No scaling 1: Scaling
7F h	Analog Scaling (max.) 10 V / 20 mA	Max analog scaling	Read/ write	UINT	-32768 to 32767
80 h	Analog Scaling (min.) 0 V / 4 mA	Min analog scaling	Read/ write	UINT	
81 h	Baud rate	Sensor head communication speed (setting value for each connected sensor)	Read/ write	UINT	0: No connection (unit for values below: bps) 1: 9.6k, 2: 19.2k, 3: 38.4k, 4: 57.6k, 5: 115.2k, 6: 230.4k, 7: 312.5k, 8: 468.75k, 9: 500k, 10: 625k, 11: 833.3k, 12: 937.5k, 13: 1250k
89 h	Amplifier product code	Product code for connected sensor-amplifier	Read	UINT	2503 h

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Value
8E h	Average Number	Number of averaging operations	Read/ write	UINT	1 to 128
8F h	Measurement Type	Measurement type	Read/ write	UINT	0: Edge positive 1: Edge negative 2: Gap/external diameter
90 h	Sampling rate	Sampling period	Read/ write	UINT	0: 500 µs (fixed value)
97 h	Measuring direction	Measurement direction	Read/ write	UINT	0: Top to bottom 1: Bottom to top
98 h	Zeroing value	Offset value	Read	UINT	-9999 to 5000
A0 h	Sensitivity	Sensitivity	Read/ write	UINT	0: Minimum value 1: Second 2: Third 3: Fourth 4: Maximum value 5: Adjusted value
D0 h	Save zero-reset	Execute zero reset	Write	Byte	Execute with writing operation
D1 h	Cancel zero-reset	Clear zero reset	Write	Byte	Execute with writing operation
DC h	Factory Reset	Initialize to factory settings	Write	UINT	3: Execute initialization

3-6-15 Module Configuration Object (Class ID: 80 h)

This object reads the configuration of the sensor connected to this unit.
It reads the product code, class ID (model code), and instance ID for the sensor in each slot (attribute ID=1 to 16: slot 0 to 15).
To read information from sensors in all slots, use “Get_Attributes_All” as the service code.
Note that the instance ID indicates the connection order within the same model. Refer to “3-4-1 Instance IDs for This Unit and Sensor Objects” for further information.

■ Instance/Attribute Range

Instance ID	Attribute ID
01 h	01 h - 10 h

■ Service Codes

Service Code	Service name	Details
01 h	Get_Attributes_All	Read the values (information from sensors in all slots) of all attributes.
0E h	Get_Attribute_Single	Read the values (information from the sensor in the specified slot) of the specified attribute.

Attribute ID List

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Default value
01 h	Module Information Slot0	Information from the sensor object in slot 0	Read	Struct	
	Product Code	Product code	Read	UINT	0000 h
	Class ID	Class ID (model code)	Read	BYTE	00 h
	Instance ID	Instance ID (connection order within model code)	Read	BYTE	00 h
02 h	Module Information Slot1	Information from the sensor object in slot 1	Read	Struct	
	Product Code	Product code	Read	UINT	0000 h
	Class ID	Class ID (model code)	Read	BYTE	00 h
	Instance ID	Instance ID (connection order within model code)	Read	BYTE	00 h
03 h	Module Information Slot2	Information from the sensor object in slot 2	Read	Struct	
	Product Code	Product code	Read	UINT	0000 h
	Class ID	Class ID (model code)	Read	BYTE	00 h
	Instance ID	Instance ID (connection order within model code)	Read	BYTE	00 h
04 h	Module Information Slot3	Information from the sensor object in slot 3	Read	Struct	
	Product Code	Product code	Read	UINT	0000 h
	Class ID	Class ID (model code)	Read	BYTE	00 h
	Instance ID	Instance ID (connection order within model code)	Read	BYTE	00 h
05 h	Module Information Slot4	Information from the sensor object in slot 4	Read	Struct	
	Product Code	Product code	Read	UINT	0000 h
	Class ID	Class ID (model code)	Read	BYTE	00 h
	Instance ID	Instance ID (connection order within model code)	Read	BYTE	00 h
06 h	Module Information Slot5	Information from the sensor object in slot 5	Read	Struct	
	Product Code	Product code	Read	UINT	0000 h
	Class ID	Class ID (model code)	Read	BYTE	00 h
	Instance ID	Instance ID (connection order within model code)	Read	BYTE	00 h
07 h	Module Information Slot6	Information from the sensor object in slot 6	Read	Struct	
	Product Code	Product code	Read	UINT	0000 h
	Class ID	Class ID (model code)	Read	BYTE	00 h
	Instance ID	Instance ID (connection order within model code)	Read	BYTE	00 h

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Default value
08 h	Module Information Slot7	Information from the sensor object in slot 7	Read	Struct	
	Product Code	Product code	Read	UINT	0000 h
	Class ID	Class ID (model code)	Read	BYTE	00 h
	Instance ID	Instance ID (connection order within model code)	Read	BYTE	00 h
09 h	Module Information Slot8	Information from the sensor object in slot 8	Read	Struct	
	Product Code	Product code	Read	UINT	0000 h
	Class ID	Class ID (model code)	Read	BYTE	00 h
	Instance ID	Instance ID (connection order within model code)	Read	BYTE	00 h
0A h	Module Information Slot9	Information from the sensor object in slot 9	Read	Struct	
	Product Code	Product code	Read	UINT	0000 h
	Class ID	Class ID (model code)	Read	BYTE	00 h
	Instance ID	Instance ID (connection order within model code)	Read	BYTE	00 h
0B h	Module Information Slot10	Information from the sensor object in slot 10	Read	Struct	
	Product Code	Product code	Read	UINT	0000 h
	Class ID	Class ID (model code)	Read	BYTE	00 h
	Instance ID	Instance ID (connection order within model code)	Read	BYTE	00 h
0C h	Module Information Slot11	Information from the sensor object in slot 11	Read	Struct	
	Product Code	Product code	Read	UINT	0000 h
	Class ID	Class ID (model code)	Read	BYTE	00 h
	Instance ID	Instance ID (connection order within model code)	Read	BYTE	00 h
0D h	Module Information Slot12	Information from the sensor object in slot 12	Read	Struct	
	Product Code	Product code	Read	UINT	0000 h
	Class ID	Class ID (model code)	Read	BYTE	00 h
	Instance ID	Instance ID (connection order within model code)	Read	BYTE	00 h
0E h	Module Information Slot13	Information from the sensor object in slot 13	Read	Struct	
	Product Code	Product code	Read	UINT	0000 h
	Class ID	Class ID (model code)	Read	BYTE	00 h
	Instance ID	Instance ID (connection order within model code)	Read	BYTE	00 h

Attribute ID	Parameter name	Details	Attribute	Data	
				Data type	Default value
0F h	Module Information Slot14	Information from the sensor object in slot 14	Read	Struct	
	Product Code	Product code	Read	UINT	0000 h
	Class ID	Class ID (model code)	Read	BYTE	00 h
	Instance ID	Instance ID (connection order within model code)	Read	BYTE	00 h
10 h	Module Information Slot15	Information from the sensor object in slot 15	Read	Struct	
	Product Code	Product code	Read	UINT	0000 h
	Class ID	Class ID (model code)	Read	BYTE	00 h
	Instance ID	Instance ID (connection order within model code)	Read	BYTE	00 h

Note: If 17 or more sensors are connected, the attribute IDs from 01 h to 0F h will all be 0.

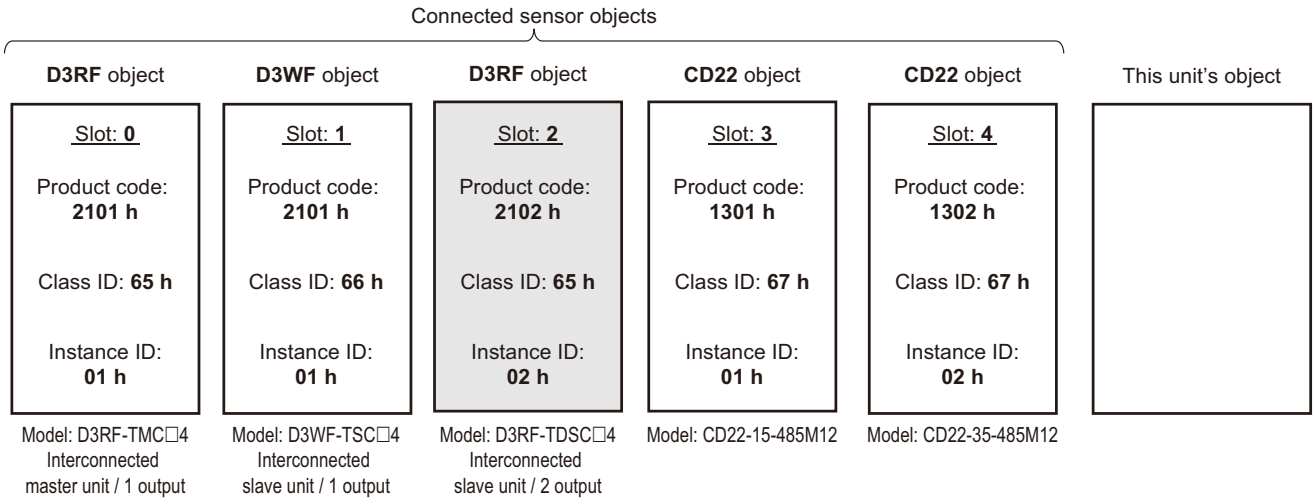
- **List of class IDs (model codes) and product codes**

The class IDs (model codes) and product codes for this unit and applicable sensors connected to this unit are listed below.

This unit, or applicable sensor connected to this unit	Class ID (model code)	Product code	Model
This unit	64 h	2509 h	UC1-EP
D3RF	65 h	2101 h: Fiber amplifier 1 output	Interconnected master unit / 1 output: D3RF-TMC□4 Interconnected slave unit / 1 output: D3RF-TSC□4
		2102 h: Fiber amplifier 2 output	Interconnected master unit / 2 output: D3RF-TDMC□4 Interconnected slave unit / 2 output: D3RF-TDSC□4
D3WF	66 h	2101 h: Fiber amplifier 1 output	Interconnected master unit / 1 output: D3WF-TMC□4 Interconnected slave unit / 1 output: D3WF-TSC□4
		2102 h: Fiber amplifier 2 output	Interconnected master unit / 2 output: D3WF-TDMC□4 Interconnected slave unit / 2 output: D3WF-TDSC□4
CD22	67 h	1301 h: CD22-15-485	CD22-15-485M12
		1302 h: CD22-35-485	CD22-35-485M12
		1303 h: CD22-100-485	CD22-100-485M122
TD1	68 h	2321 h	TD1-010M8 TD1-010M8J

Example: In the following case, obtaining attribute ID 03 h (i.e. slot 2) (sensor object information in the shaded area below) will allow you to obtain the following four-byte data in order from byte 0.

- 2102 h (product code)
- 65 h (class ID)
- 02 h (instance ID)



4

Specifications

This chapter describes the specifications of this unit.

4-1 Specifications

Model		UC1-EP
EtherNet/IP Specifications[*1]	Applicable version	Ethernet/IP adapter
	Authentication version	CT16
	Conforming standard	IEEE802.3u
	Distance between nodes	Within 100 m
	Transfer speed	10 M (10BASE-T), 100 Mbps (100BASE-TX)
	Cable	Twisted pair cable (STP) Category 5/5e or higher
	Communication ports	M12 connector (plug: male) x2
	IP address configuration	Static IP address, DHCP, or BOOTP
	Cyclic communication (Implicit Message)	• Class1 service
	Acyclic communication (Explicit Message)	• Class3 message • UCMM
	Support objects	• Identity object • Message Router object • Assembly object • Connection Manager object • DLR object • QoS object • TCP/IP Interface object • Ethernet Link object • This unit's object • D3RF object • D3WF object • CD22 object • TD1 object • Module Configuration object
	Reset service	• Type0 • Type1
	Maximum no. of connections	8 (including cyclic connections and acyclic connections)
	Packet interval (RPI)	1 to 3200 ms
	Other functions	• ACD (Address Conflict Detection) • DLR (Device Level Ring) • Auto Negotiation • Auto MDIX • Quick Connect
Connected devices	Connectable models	Inter-connection masters and slave units in the D3□F series Master units and slave units in the CDA series
	Number of units connected	Maximum 16 units[*2] (one CDA unit accounts for two units)
	Connection type	5-pin connector for interconnection (functions as end unit for interconnection)
Indicators		Power indicator - green (PWR)
		Module status - red/green (MS)
		Network status - red/green (NS)
		Operation indicator - green (SYSTEM)
		PORT1 indicator - green (L/A1)
		PORT2 indicator - green (L/A2)

Model		UC1-EP
Data		Cyclic communication (transmission: max 40 bytes, receipt: max 4 bytes)
		Acyclic communication
Rating	Power supply voltage	12 to 24 VDC including ripple (p-p) +/-10%
	Power consumption	Maximum 3 W
Protection circuit		Reverse connection protection
Route stabilization time		1.5 s or less
Environmental resistance	Ambient temperature range/humidity	-25 to +55°C/35 to 85% RH (no freezing or condensation)
	Storage temperature/ humidity	-40 to +70°C/35 to 85% RH (no freezing or condensation)
	Vibration resistance	10 to 55 Hz, double amplitude 1.5 mm, 2 hours in X, Y and Z directions
	Shock resistance	500 m/s^2 (approx. 50 G), 3 times in X, Y, and Z directions
	Degree of protection	IP50
Conforming laws and regulations	EMC	EMC (2014/30/EU)
	Environment	RoHS directive (2011/65/EU), China RoHS (Regulation 32)
Conforming standards		EN61000-6-2, EN55011
Company standards		Noise resistance: Passes Feilen Level 3
Mounting		35 mm DIN rail (conductive surface)
Material		Polycarbonate
Included accessories		Instruction manual, M12 protective cap, end plate x 2
Weight		Body around 90 g (including connectors), around 155 g when packaged

*1: Ethernet/IP is a registered trademark of ODVA (Open DeviceNet Vendor Association Inc.).

*2: The maximum number of connectable D3☐F units differs depending on the ambient temperature.

4-2 Data Processing Time

A processing time (total of the following processing times) is required between detection of the applicable sensor and processing of the data by the Ethernet/IP master.

- Data processing time of applicable sensors or amplifier units
- Data processing time of this unit
- Ethernet/IP communication period between the Ethernet/IP master and this unit
- Internal processing time of Ethernet/IP master

The data processing time of the applicable sensor or amplifier unit and the data processing time of this unit are as follows.

MEMO

Refer to the manual of the Ethernet/IP master for information on the Ethernet/IP communication cycle and the internal processing time of the Ethernet/IP master.

■ Data Processing Time of Applicable Sensors or Amplifier Units

● Data Processing Time of D3□F

The D3□F fiber amplifier writes setting values requested via this unit to EEPROM before returning a response. As a result, the response time changes depending on the setting value as follows.

- **D3RF**

D3RF object (class ID: 65 h) instance attribute ID	Setting value name	Conditions	Number of words written	Writing time (ms)*1
6C h	Display settings		1	5
6E h	Output 1 teaching mode		1	5
6F h	Output 2 teaching mode		1	5
70 h	Response speed setting	Single output type	8	40
		Single output zone teaching	10	50
		Double output type	10	50
		One zone of double output	12	60
		Both zones of double output	14	70
71 h	Emitting power setting		4	20
72 h	External input setting		3	15
73 h	Lock level setting		1	5
74 h	Output 1 operation mode		1	5
75 h	Output 2 operation mode		1	5
76 h	Lower threshold (Far) setting for output 1	Edge detection	1	5
		Other	2	10

77 h	Upper threshold (Near) setting for output 1		2	10
78 h	Lower threshold (Far) setting for output 2		2	10
79 h	Upper threshold (Near) setting for output 2		2	10
7A h	One-shot timer specification for output 1		2	10
7B h	One-shot timer specification for output 2		2	10
7C h	Off delay timer time for output 1		2	10
7D h	On delay timer time for output 2		2	10
7E h	Off delay timer time for output 2		2	10
7F h	On delay timer time for output 2		2	10
83 h	Hysteresis setting	Single output type	2	10
		Single output zone teaching	3	15
		Double output type	3	15
		One zone of double output	4	20
		Both zones of double output	5	25
85 h	ASC setting (automatic sensitivity correction)		1	5
86 h	Eco mode setting		3	15
87 h	Reverse display setting		1	5

*1: The time varies by several ms depending on the Ethernet/IP communication cycle.

- **D3WF**

D3WF object (class ID: 66 h) instance attribute ID	Setting value name	Conditions	Number of words written	Writing time (ms)*1
6C h	Display settings		1	5
6E h	Output 1 teaching mode		1	5
6F h	Output 2 teaching mode		1	5
70 h	Response speed setting	Single output type	8	40
		Single output zone teaching	10	50
		Double output type	10	50
		One zone of double output	12	60
		Both zones of double output	14	70

71 h	Emitting power setting		4	20
72 h	External input setting		3	15
73 h	Lock level setting		1	5
74 h	Output 1 operation mode		1	5
75 h	Output 2 operation mode		1	5
76 h	Lower threshold (Far) setting for output 1	Edge detection	1	5
		Other	2	10
78 h	Lower threshold (Far) setting for output 2		2	10
7A h	One-shot timer specification for output 1		2	10
7B h	One-shot timer specification for output 2		2	10
7C h	Off delay timer time for output 1		2	10
7D h	On delay timer time for output 2		2	10
7E h	Off delay timer time for output 2		2	10
7F h	On delay timer time for output 2		2	10
81 h	Synchronization		2	5
83 h	Sensitivity		2	5
85 h	ASC setting (automatic sensitivity correction)		1	5
86 h	Eco mode setting		3	15
87 h	Reverse display setting		1	5

*1: The time varies by several ms depending on the Ethernet/IP communication cycle.

● Data Processing Time of CDA

The CDA general-purpose amplifier unit writes CDA parameters requested via this unit to EEPROM before returning a response. The response time is 5 ms.

● Data Processing Time of CD22

The CD22 compact laser displacement sensor writes CD22 parameters requested via this unit to EEPROM before returning a response. The response time changes depending on the communication speed setting for communication between CDA and RS-485 as follows.

Communication speed (bps)	Writing time (ms)
9.6 k	20
19.2 k	10
Other (38.4 k - 1250 k)	5

● Data Processing Time of TD1

The TD1 through-beam edge sensor writes TD1 parameters requested via this unit to EEPROM before returning a response. The response time changes depending on the communication speed setting for communication between CDA and RS-485 as follows.

Communication speed (bps)	Writing time (ms)
9.6 k	20
19.2 k	10
Other (38.4 k - 1250 k)	5

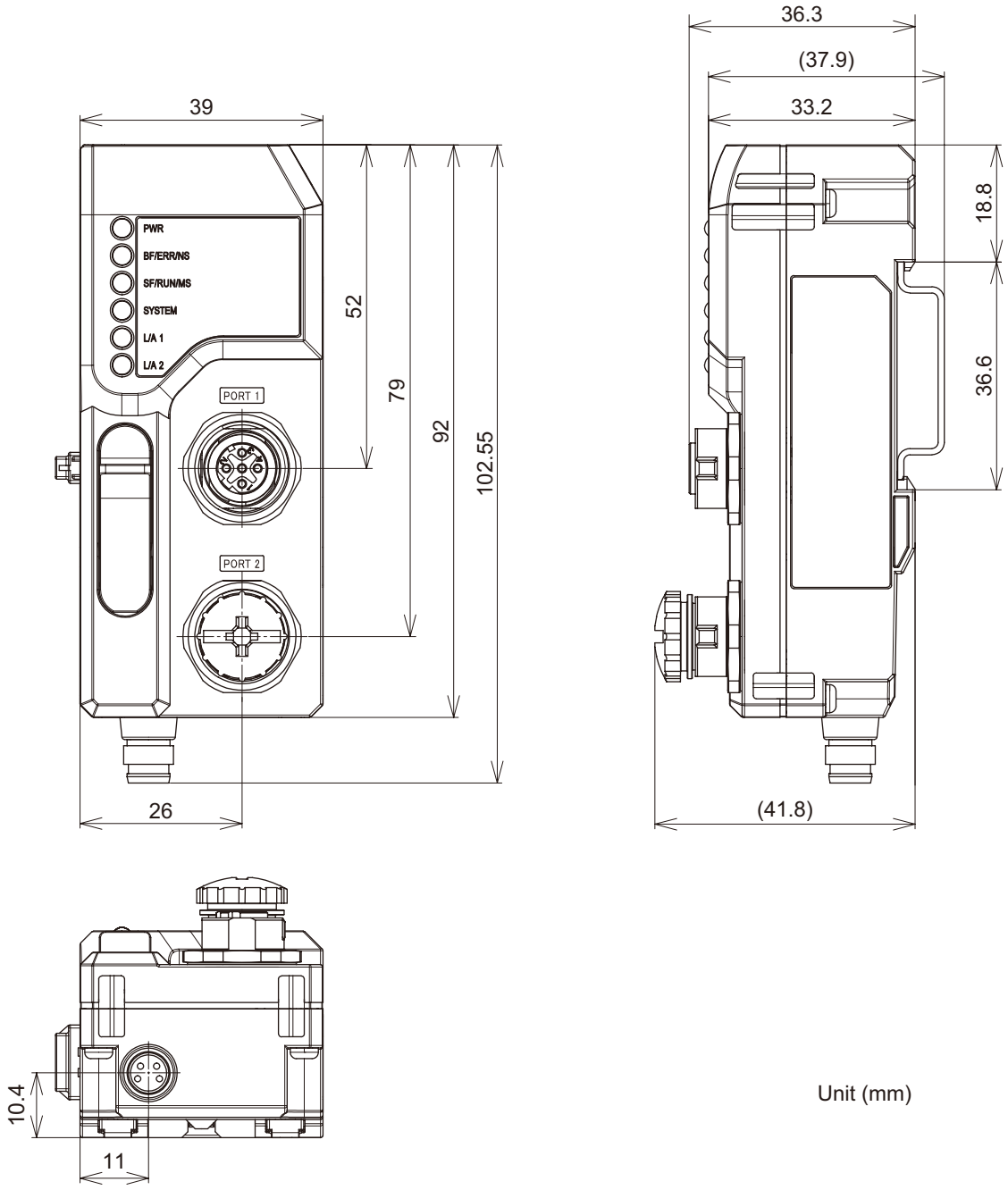
■ Data Processing Time of This Unit

The following processing time is required between detection of the applicable sensor and transmission of data to the Ethernet/IP master.

Number of units connected	Processing time
1 to 4	160 µs
5 to 8	320 µs
9 to 12	480 µs
13 to 16	640 µs

4-3 Dimensions

UC1-EP



Unit (mm)

5

Troubleshooting

This chapter describes troubleshooting methods for specific errors.

5-1 List of Error Codes for This Unit and Each Sensor

Error codes for this unit and each sensor are stored in this unit.
Error code types, storage locations, and storage conditions for this unit and each sensor are as follows.
Error codes can be read using acyclic communication from the master when needed.

Device	Storage location in this unit	Storage conditions
Latest error code for this unit	This unit's object (class ID: 64 h) attribute ID: 6A h (Error Code)	This unit's object (class ID: 64 h) attribute ID: D3 h (Global Diagnosis) set to 1 (Enabled)
Latest error code for D3RF	D3RF object (class ID: 65 h) attribute ID: 6A h (Error Code)	Always
Latest error code for D3WF	D3WF object (class ID: 66 h) attribute ID: 6A h (Error Code)	
Latest error code for connection CD22	CD22 object (class ID: 67 h) attribute ID: 6A h (Error Code)	
Latest error code for connection TD1	CD22 object (class ID: 68 h) attribute ID: 6A h (Error Code)	

MEMO

- Error code data for this unit and each sensor will not be saved to non-volatile memory. Therefore, it will be cleared the next time the power is turned ON.

Each error code is shown below.

5-1-1 Error Codes for This Unit

Error code	Error name	Details
0006 h	Change in the number of connected sensor-amplifiers or sensors	The number of connected sensor-amplifier units or sensors changed (generally decreased) after the power was turned ON.
0008 h	Invalid connection order	The connection order of the sensor-amplifier unit is incorrect (D3☐F is connected to the right-hand side of CDA). In this case, Ethernet/IP communication can be executed, however, the current values sent from the CDA to the left of the D3☐F to the master will be incorrect, as will the setting value set by the master.

Note: Error codes will not be stored if more sensors than the maximum number of applicable sensors are connected (17 or more applicable sensors). Refer to "5-2 Troubleshooting List" for further information.

MEMO

- To enable error code diagnosis for this unit when a connection is established, Enable the Global Diagnosis configuration assembly instance (100) in the connection settings (on the target device) of the Ethernet/IP configuration software.
  When the connection is established, a CIP message is sent to the attribute ID: D3 h (Global Diagnosis) for this unit's object, allowing the enabled/disabled setting to be changed for error code diagnosis in this unit.

5-1-2 Error Codes for Connected Sensor-amplifiers

● D3RF/D3WF

Error code		Details
High-order byte	Low-order byte	
00 h	00 h	No error
Applicable index number*1	01 h	The index number is out of range.
	02 h	The sub index number is not supported.
00 h	03 h	An attempt was made to write setting values to sensors that are all locked, or to initialize while locked.
	04 h	The teaching target output specification value (1 or 2) is incorrect.
	05 h	Teaching mode has no second teaching, or the first has not yet been executed
	06 h	The execution specification value (3) for restart and initialization is incorrect.
Applicable index number*1	07 h	An attempt was made to write a setting value that is out of range.
	08 h	The setting value write operation failed. (Attempted to write a read-only setting value)
00 h	09 h	Teaching to output 2 was attempted while output 2 was in counter mode.
	0B h	The amount of light received during teaching was too low.
	0C h	The amount of light received during teaching was saturated.
	0D h	There was too little difference in the amount of light received during 2-point teaching.
	0E h	A teaching operation other than auto-teaching was attempted in differential operation mode.
	0F h	A hardware error was detected.

*1: Refer to the respective manual for each device for information regarding the relevant index number.

5-1-3 Error Codes for Connected Sensors

● CD22/TD1

Error code		Details
High-order byte	Low-order byte	
00 h	00 h	No error
Applicable index number*1	01 h	The index number is out of range.
	02 h	The sub index number is not supported.
	03 h	The ETX code in the command string is invalid.
	04 h	A checksum error was detected.
	05 h	The command code is invalid.
	06 h	A non-regulated parameter was specified.
	07 h	An out of range numeric value was specified.
	08 h	Reserved
	09 h	

*1: Refer to the respective manual for each device for information regarding the relevant index number.

5-2 Troubleshooting List

This section provides information on the LEDs on the front of this unit, as well as on troubleshooting other issues.

5-2-1 Troubleshooting Based on LED Status

The following countermeasures should be performed according to the status of the LEDs on the front of this unit.

■ PWR LED

PWR	Cause	Countermeasure
Off	Power is not correctly supplied to this unit	Check and resolve the following potential causes of power interruption. Then, restart this unit according to the specifications of the connected master. • Is the power cable wired correctly? • Is the power cable broken? • Is the power supply voltage within the specified range? • Is the power capacity sufficient? • Is the power supply faulty?

■ NS/MS LED

NS	MS	Cause		Countermeasure
Lit red	Flashing red	IP address conflict within the network	Address Conflict Detection (ACD) enabled*1	Ensure that the IP address does not conflict with another device.
Off	Flashing green	IP address conflict within the network	Address Conflict Detection (ACD) disabled*1	Ensure that the IP address does not conflict with another device.
		Unable to receive IP address from BOOTP/DHCP server		It may not be possible to receive an IP address from the BOOTP/DHCP server. Confirm that the BOOTP/DHCP server in the network is operating normally.
Flashing green	Lit green	No connection established	Device file is incorrect	Confirm that the device file for this unit is being used on the master.
			Master configuration is invalid	• Confirm that the IP address for the device is configured correctly on the master. • Ensure that the network portion of the IP address is the same for the master and this unit. Example: For a subnet mask of 255.255.255.0: Master: 192.168.0.2 This unit: 192.168.0.1 the underlined portion is the network address.
Flashing red	Lit green	Exclusive Owner connection timeout		• Reset the power on this unit. • Reconnect the Exclusive Owner connection on the master.

*1: This depends on the TCP/IP Interface object (class ID: F5 h) attribute ID: 0A h (ACD function) (default value: enabled).

SYSTEM LED

SYSTEM	Cause	Countermeasure
Off	Hardware error	Press the reset button to reset the power. If the SYSTEM LED still does not turn on, there is a hardware failure. Replace this unit.

L/A1 or L/A2 LED

L/A1 or L/A2	Cause	Countermeasure
Off	The LAN cable is unplugged	Confirm that the L/A1 or L/A2 LAN cable is not unplugged.

5-2-2 Troubleshooting Other Issues

All issues described here occur only when communication has been established.
Therefore, the NS/MS LEDs on the front of this unit will both stay on both stay green.

Phenomenon	Error code for this unit	Error description	Cause	Countermeasure
One connection is unable to use cyclic communication when using multiple connections.	None	Assembly instance conflict	The same instance ID is configured for multiple connections during cyclic communication. Note: One connection will be established, so the LED will behave the same as during normal communication.	Ensure that the same instance ID is not configured for multiple connections.
Unable to use cyclic communication with sensors in all slots.	None	Maximum number of connected applicable sensors exceeded	17 applicable sensors are connected.	Connect 16 sensors or less.
Cyclic communication can be performed, however, the read/write data is invalid (the read/write data is from an unexpected device).	None		18 or more applicable sensors are connected. The 18th will be recognized as slot 0, the 19th as slot 1, and so on. Cyclic communication cannot be performed with applicable sensors beginning with the 17th.	
Cannot perform acyclic communication to an applicable sensor object. The CIP error response indicates the general error code “Path destination unknown” (09 h).	None		Acyclic communication was performed with a sensor object (class ID: 65 h, 66 h, 67 h, or 68 h) with 17 or more connected.	

Phenomenon	Error code for this unit	Error description	Cause	Countermeasure
Cyclic communication can be performed, however, the current value and setting value of the CDA is invalid	0008 h	Invalid connection order	D3□F is connected to the right-hand side of the CDA	Connect D3□F to the left of the CDA and reset the power.
Cyclic communication can be performed, however, read/write cannot be performed for some sensors.	0006 h	Change in the number of connected sensor-amplifiers or sensors	The number of connected sensor-amplifier units or sensors changed (generally decreased) after the power was turned ON.	There may have been a sensor-amplifier unit or sensor failure, or the power supply may have been turned OFF. Check all connected sensor-amplifiers and sensors and their respective power supplies.

5-2-3 Notes on Communication Method and Communication Speed

- Ensure that the communication method and communication speed of this unit matches that of the other device (master, hub, etc.).
- Packet loss will occur if the communication method differs. The devices will be unable to communicate if the communication speed differs.
- This unit is set to auto negotiation by default. It is recommended to set the other device to auto negotiation as well.
- The communication method and communication speed of this unit can be set and confirmed using the Ethernet Link object (class ID: F6 h) attribute ID: 06 h. Refer to “3-6-10 This Unit’s Object (Class ID: 64 h)” for further information.

Appendix

6-1 Installing Additional Applicable Sensor-amplifier Units

This chapter describes how to install additional applicable sensor-amplifier units.

CAUTION

- Changing the slot number for the addition of the sensor-amplifier requires changing the variables and programs on the master side. If there is a change in the slot number after you add a sensor-amplifier, make sure to change the variables or programs on the master side.
- To add an applicable sensor-amplifier to this unit after the system is operational, turn OFF the power of this unit.

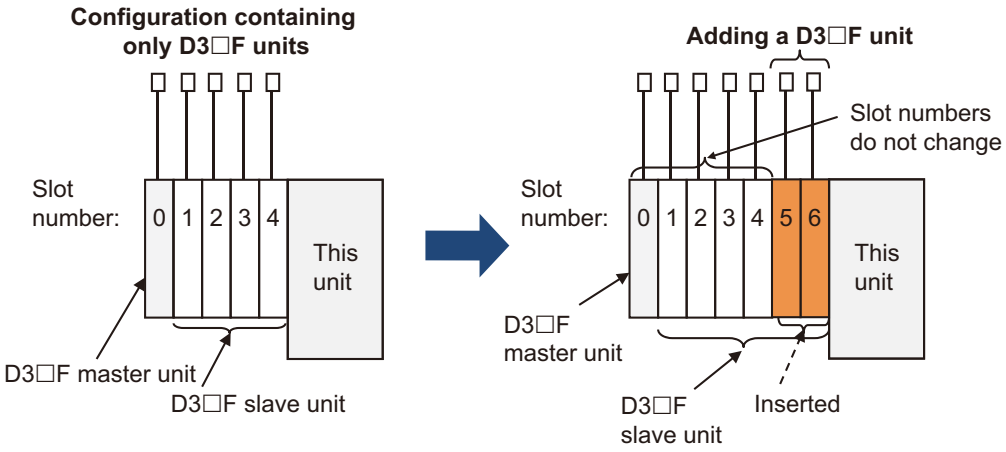
Install additional applicable sensor-amplifiers to the right of existing applicable sensor-amplifiers when possible so that the slot numbers of existing applicable sensor-amplifiers do not change.

The method depends on the situation as follows.

Adding a D3□F Unit to a Configuration Containing Only D3□F Units

- Insert a D3□F slave unit between the existing D3□F slave units and this unit.
- This means that the slot numbers of the existing D3□F units will not be changed.

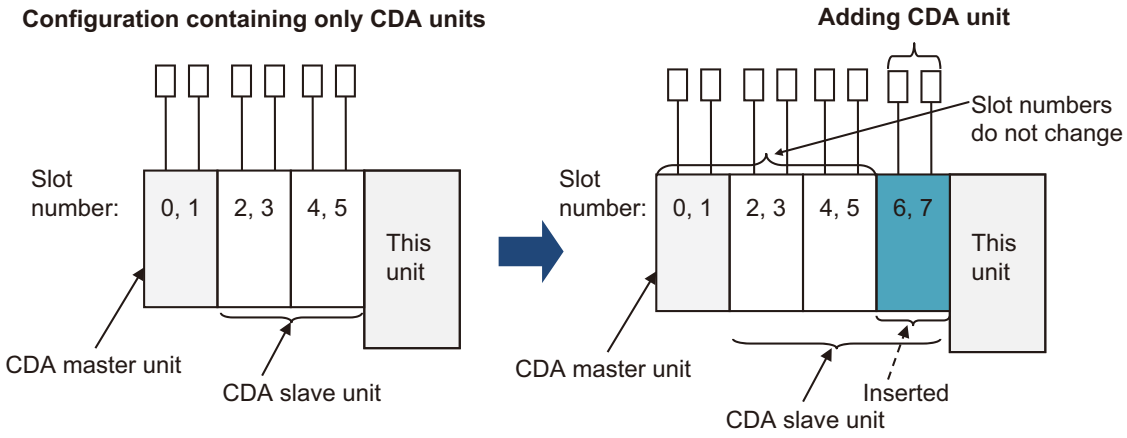
Example:



Adding a CDA Unit to a Configuration Containing Only CDA Units

- Insert a CDA slave unit between the existing CDA slave units and this unit.
- This means that the slot numbers of the existing CDA slave units will not be changed.

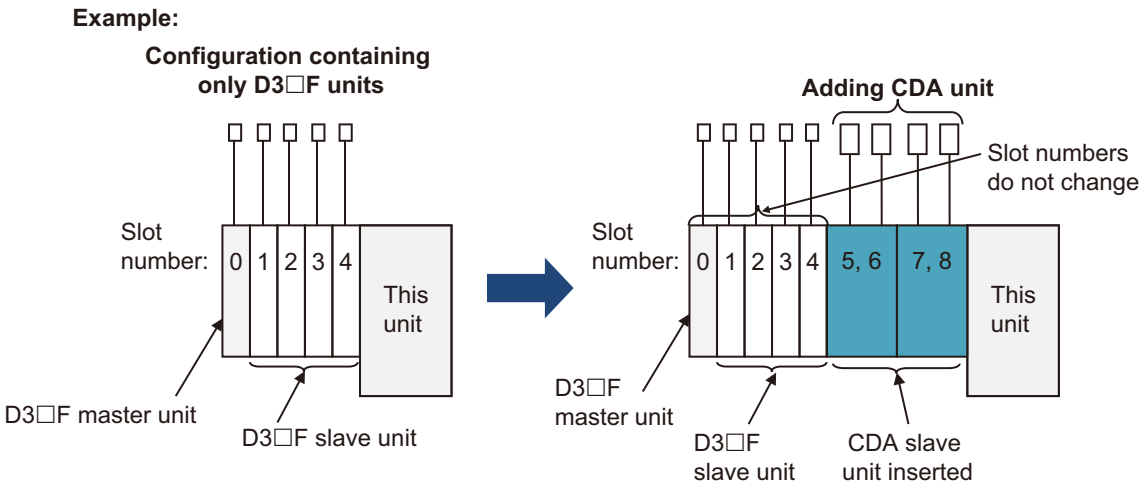
Example:



Adding a CDA Unit to a Configuration Containing Only D3☐F Units

- Insert a CDA slave unit between the existing D3☐F slave units and this unit.
- This means that the slot numbers of the existing D3☐F units will not be changed.

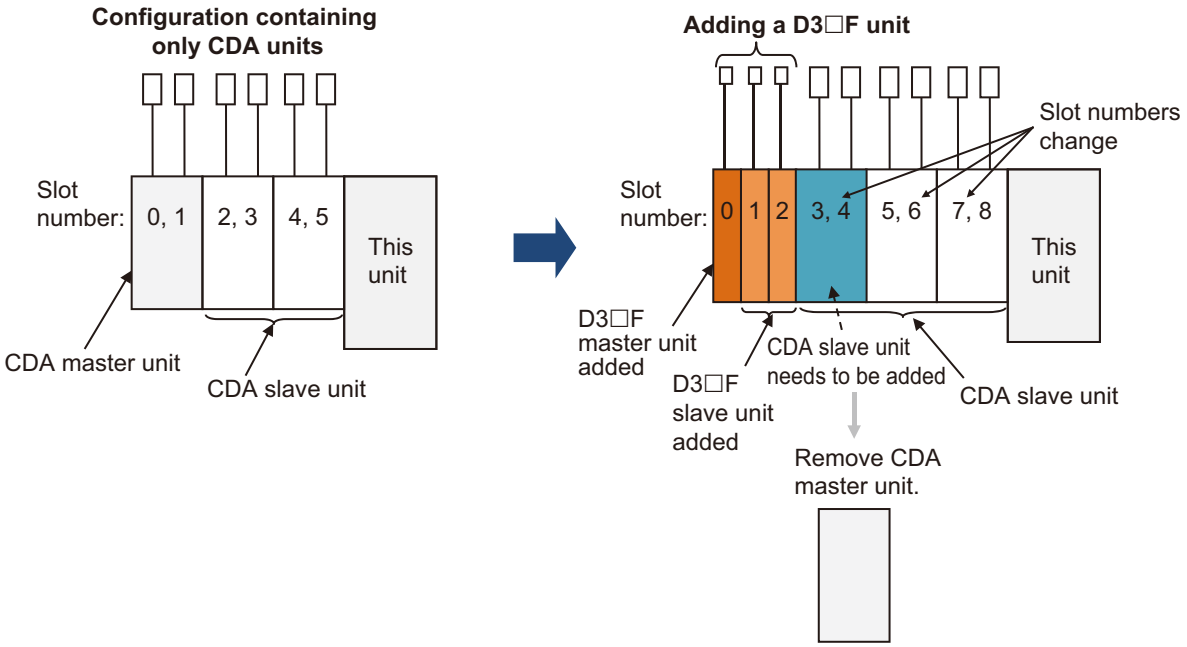
Example:



Adding a D3□F Unit to a Configuration Containing Only CDA Units

- Add a D3□F master unit in the leftmost position.
- The existing CDA master unit needs to be removed from the interconnection configuration and replaced with a new CDA slave unit.
- If necessary, a D3□F slave unit can be added to the right of the D3□F master unit.
- This will change the slot numbers of the existing CDA slave units.

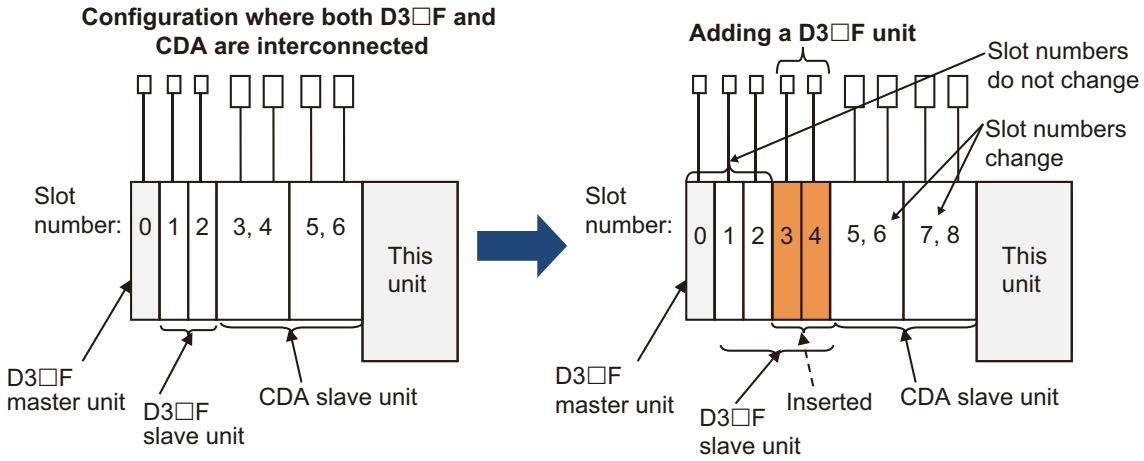
Example:



Adding a D3□F Unit to a Configuration Containing Both D3□F and CDA Units

- Insert a D3□F slave unit between the existing D3□F slave units and the existing CDA slave units.
- This will change the slot numbers of the existing CDA slave units.

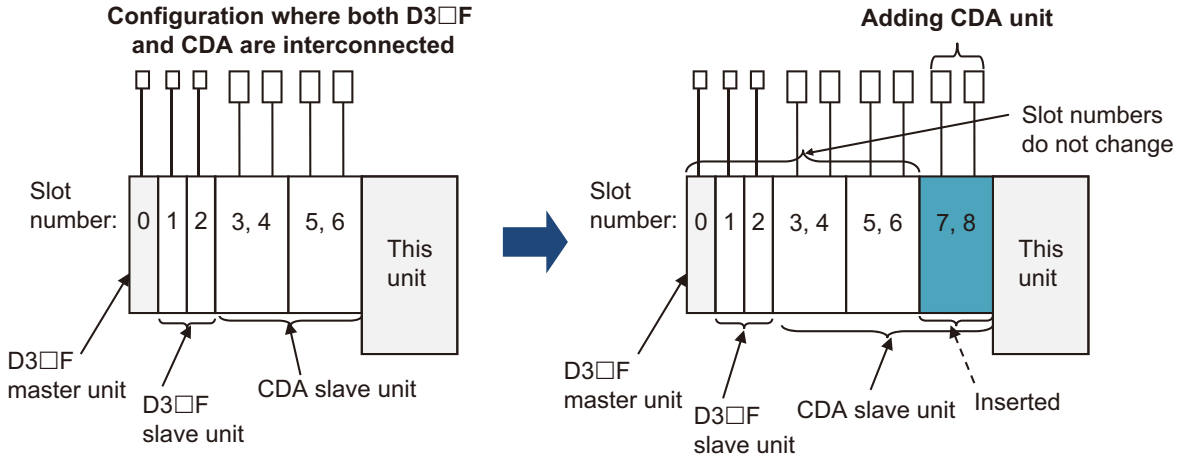
Example:



Adding a CDA Unit to a Configuration Containing Both D3□F and CDA Units

- Insert a CDA slave unit between the existing CDA slave units and this unit.
- This means that the slot numbers of the existing CDA slave units will not be changed.

Example:



6-2 Reset Function

This section describes how to reset this unit.

This unit can be reset (in order to reconnect with the master) or reset to factory settings.

■ Resetting to Reconnect with Master

This unit can be reconnected with the same setting values by executing service code 05 h (Reset) and parameter “0” (Reset type 0) from the Identity object (class ID: 01 h).

■ Resetting to Factory Settings

Doing any of the following will reset this unit to factory settings.

- Press and hold the reset button on the front of this unit for at least three seconds.
- Execute service code 05 h (Reset) and parameter “1” (Reset type 1) from the Identity object (class ID: 01 h)
- Write “3” to Factory Reset in this unit’s object (class ID: 64 h) attribute ID: DC h (Initialize to factory settings)
  The following parameters will be initialized if any of the above methods are used to reset this unit to its factory settings.

Object	Instance attribute ID
QoS object (class ID: 48 h)	01 h: 802.1Q Tag Enable 04 h: DSCP Urgent 05 h: DSCP Scheduled 06 h: DSCP High 07 h: DSCP Low 08 h: DSCP Explicit
TCP/IP Interface object (class ID: F5 h)	03 h: Configuration Control 05 h: Interface Configuration 06 h: Host Name 08 h: TTL Value 09 h: Mcast Config 0A h: Select ACD 0B h: LastConflictDetected 12: Quick Connect 13: Encapsulation Inactivity Timeout
Ethernet Link object (class ID: F6 h)	06 h: Interface Control 09 h: Admin State
This unit’s object (class ID: 64 h)	D3 h: Global Diagnosis

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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.

CE

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The information in this user's manual is correct as of March 2020
UC1EP_UM-E-001-2003

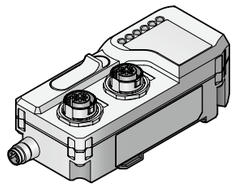
0808820

FASTUS
Good Thinking, Good Future

INSTRUCTION MANUAL

EtherCAT Communication Unit

UC1-EC



OPTEX FA CO.,LTD.

- Thank you for purchasing this UC1-EC EtherCAT communication unit.
- Before using this product, please read this manual carefully to ensure proper use.
- Read this manual thoroughly, and then keep this manual at hand so that it can be used whenever necessary.
- The warranty period of this product is one year after delivery. However, any fault attributable to natural disasters or any other similar disasters or modification or repair will be excluded from the scope of the warranty.

Safety Precautions

Safety precautions for ensuring safe operation of this product are displayed as follows with the following symbols.
Precautions listed here describe important information about safety. Make sure to follow them accordingly.

Safety Symbols

⚠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 result in minor injury or property damage.

⚠WARNING

	Do not disassemble, repair, modify, deform under pressure, or attempt to incinerate this product. Doing so may cause injury or fire.
	This product is not explosion-proof and should not be used around flammable or explosive gases or liquids. Doing so may cause ignition resulting in an explosion or fire.
	Do not use air dusters or any spray that uses flammable gas around the product or on the inside of the product. Doing so may cause ignition resulting in an explosion or fire.
	Do not install this product in any of the following locations. Doing so may cause a fire, damage, or a malfunction. 1. Locations where dust, salt, iron powders, or vapor (steam) is present. 2. Locations subjected to corrosive gases or flammable gases. 3. Locations where oil or chemical splashes may occur. 4. Locations where heavy vibrations or impacts may occur. 5. Locations where the ambient temperature exceeds the rated range. 6. Locations subject to rapid temperature changes (or where condensation occurs). 7. Locations with strong electric or magnetic fields. 8. Outdoor locations or locations subject to direct light.
	This is a class A product. In a domestic environment this product may cause radio interference, in which case the user may be required to take adequate measures.
	This product is not intended for use with nuclear power, railways, aviation, vehicles, medical equipment, food-handling equipment, or any application where particular safety measures are required. Absolutely do not use this product for any of these fields.
	This product cannot be used in applications that directly or indirectly detect human bodies for the purpose of ensuring safety. Do not use this product as a detection device for protecting the human body.
	What to do in the event of a malfunction such as smoke being emitted from the product If you detect any malfunction including emission of smoke, abnormal smells or sounds, or the body becoming very hot, immediately stop operating the product and turn off the sensor power. Failure to do so may cause a fire. Repairing the product is dangerous and should in no way be performed by the customer. Contact an OPTEX FA sales representative for repairs.

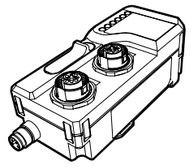
⚠CAUTION

- Make sure to turn the power off before wiring the cable or connecting/disconnecting the connector. Connecting or disconnecting while energized may damage the product or cause electric shock.
- Do not wire with high voltage cables or power lines. Doing so may cause malfunction or damage by induction.
- Do not bend the cable when below the freezing point. This may cause the cable to break.
- Do not drop the product or subject the product to strong impacts. Doing so may damage the product.
- Follow the instructions in this manual or the specified instruction manual when wiring the product or the dedicated controller for the correct wiring method. Incorrect wiring can damage the product or the controller, or cause a malfunction.
- When disconnecting the connector, be careful not to touch the terminals inside the connector, and do not allow foreign objects to enter the connector.
- Install this product as far away as possible from high-voltage equipment, power equipment, equipment that generates large switching surges, inverter motors, welders, or any equipment that can be a source of noise.
- When connecting or disconnecting the cable, make sure to hold it by the connector portion, and do not apply excessive force to the cable.

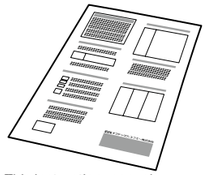
NOTICE

- After carefully considering the intended use, required specifications, and usage conditions, install and use the product within the specified ranges.
- All specifications may be changed without notice.
- When using this product, it is the responsibility of the customer to ensure necessary safety designs in hardware, software, and systems in order to prevent any threat to life, physical health, and property due to product malfunction or failure.
- Do not use this product for the development of weapons of mass destruction, for military use, or for any other military application. Moreover, if this product is to be exported, comply with all applicable export laws and regulations, including the "Foreign Exchange and Foreign Trade Act" and the "Export Administration Regulations," and carry out the necessary procedures pursuant to the provisions therein.
- For more details on conformity to the Restriction of Hazardous Substances Directive for this product, please contact an OPTEX FA sales representative. Before using this product, fully examine the applicable environmental laws and regulations, and operate the product in conformity to such laws and regulations. OPTEX FA does not assume any responsibility for damages or losses occurring as a result of noncompliance with applicable laws and regulations.

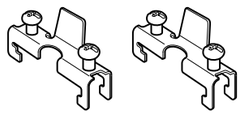
1. Included Accessories



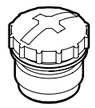
UC1-EC



This instruction manual

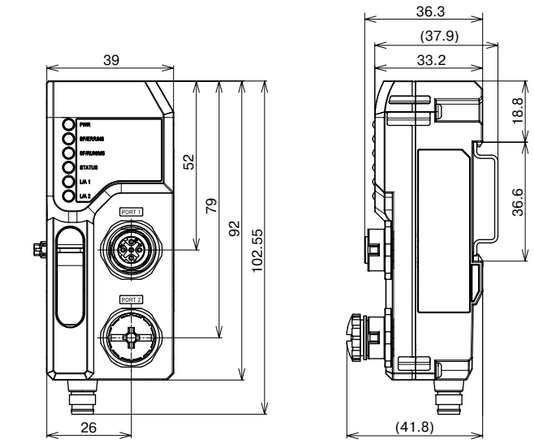


End plates (2)



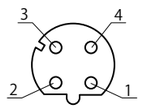
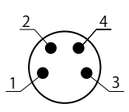
Protective cap (1)

2. Dimensions



Unit (mm)

3. Connector Pin Layout

	Ethernet connector (M12)	Power connector (M8)
1	Tx+	12 to 24 VDC
2	Rx+	Not used
3	Tx−	GND
4	Rx−	Not used
		

Connect this unit with no voltage applied (0 V).

4. Installation

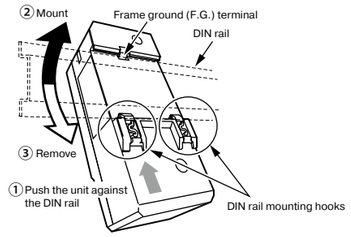
Installing to DIN rail

Install the unit on a grounded DIN rail whose surface can transmit power, and in the same way, install the fiber amplifiers and connect them.

Tips

Remove the power cable before proceeding with installation. In particular, make sure there is no power being transmitted when connecting and disconnecting the unit and devices that can be connected to it.

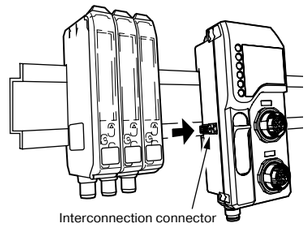
Align the DIN rail mounting hooks on the lower part of the back of the unit with the bottom of the DIN rail, and while pushing against the DIN rail in the direction indicated in ① below, set the unit onto the rail as indicated in ②.



Tips

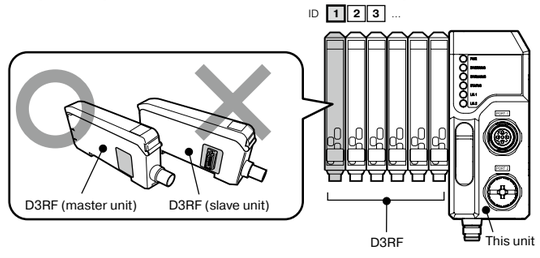
- If the installation on the DIN rail is incomplete, defects may occur in the connections with supported sensors and in the connection to the FG terminal.
  Check whether the DIN rail mounting hooks are firmly locked and whether the unit is securely mounted on the DIN rail.
- To remove the unit from the DIN rail, push the unit against the DIN rail in the direction indicated with ① and tilt the unit in the direction indicated with ③.

Mount the fiber amplifiers on the DIN rail in the same way, and connect them to the unit.

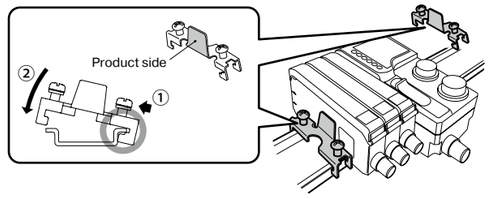


Tips

When connecting the unit to D3RF digital fiber amplifiers, make sure to connect a master unit on the left end (ID = 1). If a slave unit is connected on the left end, the interconnection connector will be exposed, causing interference with the end plate. Also, fouling or damage on the interconnection connector may damage the fiber amplifiers.

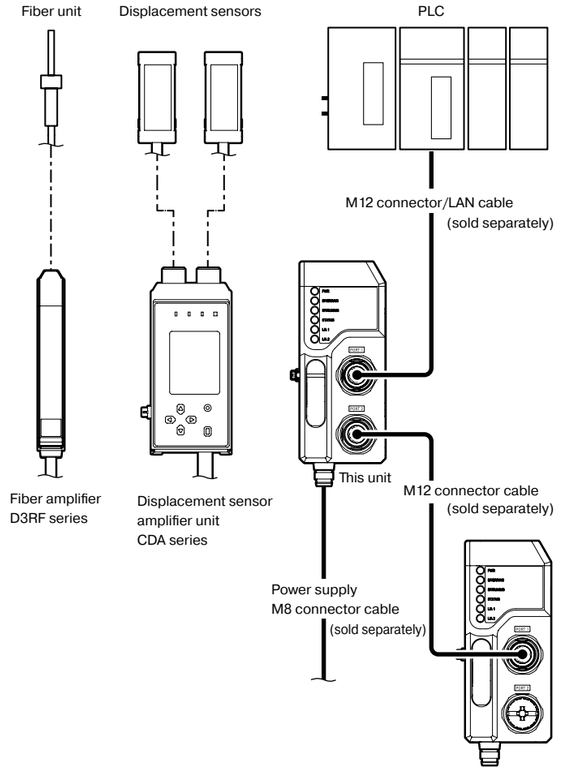


Attach end plates so as to sandwich the interconnected units, and secure with screws.
The tightening torque should be 0.9 N·m or less.
Orient the end plates so that the product side is against the unit and the fiber amplifiers, making sure to attach the left and right sides in opposite orientations. Attach the end plates by hooking the notched side on the DIN rail first, as shown in the following diagram.



5. System Configuration Diagram

To use this unit, connect it to D3RF series fiber amplifiers or CDA series displacement sensor amplifier units.



- This unit can be connected to up to a total of 16 sensors and fiber units. (Up to 16 fiber amplifiers and up to 8 displacement sensor amplifier units)
- The power supply connections vary between the devices that are connected.
  See **6. Connecting** for details.
- Connect the network cable from the master side to PORT 1 on this unit. To connect to another slave device, connect its network cable to PORT 2 on this unit.

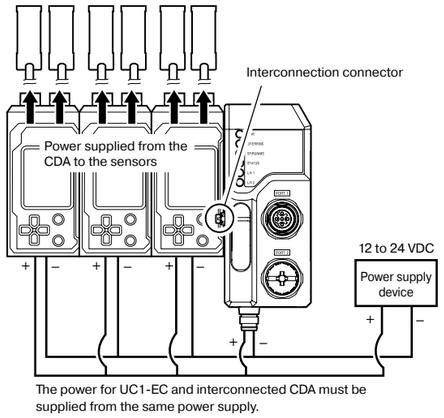
* When not connecting to another slave device, connect the protective cap to PORT 2.

6. Connecting

Connecting power cables

The unit (UC1-EC) operates with power (12 to 24 VDC) connected to the external power connector.
Make sure to check the wiring to the power supply device because incorrect wiring may cause a fire or damage the product

Power supply when using the UC1-EC + CDA combination



The power for UC1-EC and interconnected CDA must be supplied from the same power supply.

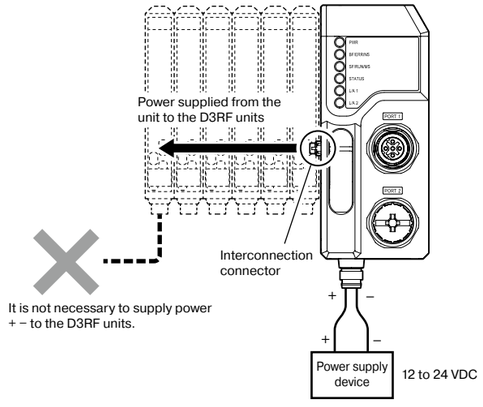
An external power supply separate from that for the unit (UC1-EC) must be connected to the CDA. In this situation, the interconnection connector of the unit is used only for communication.
Also, power is supplied to the displacement sensors from the CDA. The unit can be connected to CDA master units and slave units. When connecting the unit to CDA units, make sure to connect the master unit on the left end. If a slave unit is connected on the left end, the interconnection connector will be exposed, damaging the product.

⚠ CAUTION

Connect all the power supply wires (brown/blue) of the connected CDA to the same power supply device. Wiring the external power supply to the UC1-EC with the factory default status (in which the wires are bundled) without wiring the external power supply to the CDA (when connected to the UC1-EC) will short-circuit the CDA.
To prevent short-circuits, wire the external power supply in the following order: 1) CDA, 2) UC1-EC.

- The external power supply to the UC1-EC can be omitted.
- Ensure that the length of the power cable to the unit (UC1-EC) and to the CDA series is 30 m or less.

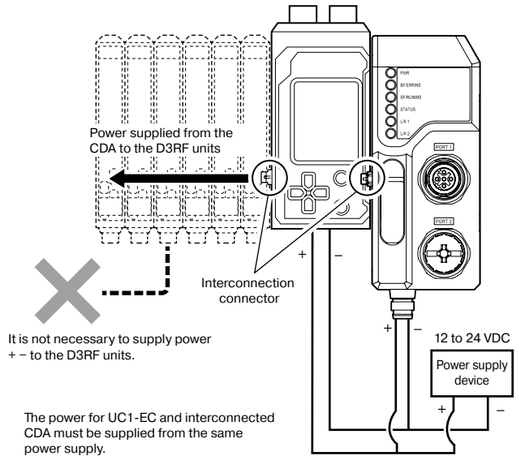
Power supply when using the UC1-EC + D3RF combination



⚠ CAUTION

- It is not necessary to supply power to the D3RF units.
- Do not use the cable type for the D3RF master unit.
- Ensure that the length of the power cable to the unit (UC1-EC) is 30 m or less.

UC1-EC + CDA + D3RF combination

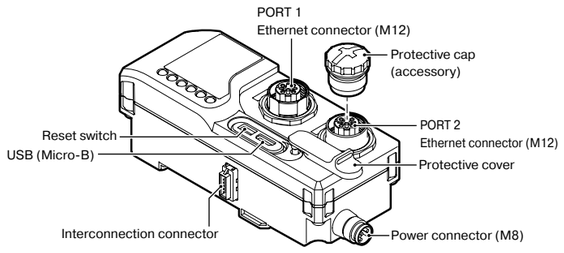


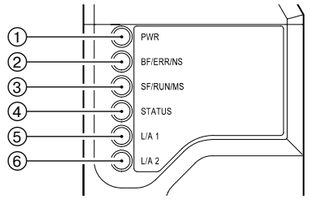
When connecting the unit (UC1-EC) to D3RF units and a CDA unit, make sure to connect all the D3RF units as a group on the left of the CDA unit. For the CDA, only the slave unit (CDA-S) is required. Also, one D3RF master unit must be connected on the left end.

⚠ CAUTION

- Provide the external power supply to the CDA from the same power supply device as the unit (UC1-EC).
- Regardless of the connection configuration, it is not necessary to supply power to the D3RF units.
- Do not use the cable type for the D3RF master unit.
- Ensure that the length of the power cable to the unit (UC1-EC) and to the CDA series is 30 m or less.

7. Part Names





	Name	Indication		Details
①	PWR	Green	●	Voltage supply on
			○	Voltage supply off
②	ERR (error)	Red	○	No error
			Single flash	Local error in the device
			Double flash	Timeout in the device
			●	Application controller fault
			☼●	Invalid configuration
③	RUN (operation)	Green	○	Device initializes
			●	Device has OPERATIONAL status
			☼●	Device has PRE-OPERATIONAL status
④	STATUS	Green	○	Device not configured
			●	Device is running
⑤	L/A1 (Link/Activity 1)	Green	○	No network connection at connection 1
			●	Network connection at connection 1 available, no communication
			☼●	Network connection, communication active
⑥	L/A2 (Link/Activity 2)	Green	○	No network connection at connection 2
			●	Network connection at connection 2 available, no communication
			☼●	Network connection, communication active

8. Error Codes

All data pertaining to the device status and errors is sent to a Service Data Object.

9. Specifications

Model		UC1-EC
EtherCAT specifications*1	Supported version	EtherCAT Slave
	Regulatory compliance	IEEE802.3u
	Distance between nodes	100 m max.
	Baud rate	100 MBaud
	Cable	STP Category 5 or higher
	Supported functions	Process data communication, mailbox communication (supports CoE)
Connected devices	Connectable models	D3RF series inter-connection master unit and slave unit CDA series master unit and slave unit
	No. of connectable units	Up to 16 units*2 (One CDA unit requires two spaces)
	Connection type	5-pin connector for linking (functions as a linking end unit)
Indicators		Power indicator, green (PWR)
		Error indicator, red (ERR)
		Run indicator, green (RUN)
		Operation indicator, green (STATUS)
		PORT 1 indicator, green (L/A 1)
		PORT 2 indicator, green (L/A 2)
Data		PDO communication (sending: max. 120 bytes, receiving: max. 36 bytes)
		SDO communication
Ratings	Supply voltage	12 to 24 VDC, including ±10% ripple (p-p)
	Power consumption	Max. 3 W
Protection circuit		Reverse connection protection
Warm-up time		1.5 s or less
Environmental resistance	Ambient temperature/ humidity	−25 to +55°C/35 to 85%RH (no freezing or condensation)
	Storage temperature/ humidity	−40 to +70°C/35 to 85%RH (no freezing or condensation)
	Vibration resistance	10 to 55 Hz; double amplitude 1.5 mm; 2 hours in each of the X, Y, and Z directions
	Shock resistance	500 m/s² (approx. 50 G), 3 times in each of the X, Y, and Z directions
	Degree of protection	IP50
Applicable regulations	EMC	EMC Directive (2014/30/EU)
	Environment	RoHS Directive (2011/65/EU), China RoHS (MIIT Order No.32)
Applicable standards		EN 61000-6-2, EN 55011
Company standards		Noise resistance: Feilen Level 3 cleared
Installation		35 mm DIN rail (whose surface should be conductive)
Material		PC
Included accessories		Instruction manual, Protective cap, End plates (2)

Ambient temperature	−25 to +55°C	−25 to +50°C	−25 to +45°C
Number of connectable D3RF units	1 to 3	4 to 8	9 to 16

*1: EtherCAT is a registered trademark of Beckhoff Automation GmbH & Co. KG.
*2: The maximum number of connectable D3RF units varies depending on the ambient temperature.

This device complies with part 15 of the FCC Rules.
Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

*This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

- Support for the China RoHS directive

For details on the support for the China RoHS (the Administrative Measure on the Control of Pollution Caused by Electronic Information Products), see the following website.
https://www.optex-fa.com/rohs_cn/

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