

Ramco Innovations 800-280-6933

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\*FASTUS is a product brand of OPTEX FA.

Digital Fiber Amplifier

D4RF Series

## **User's Manual**

Before using this product, read this manual carefully.

Keep this manual at hand so that it can be used whenever necessary.

Store the manual in a secure location.





**OPTEX FA CO., LTD.** 

## Introduction

Thank you for purchasing this Digital Fiber Amplifier D4RF Series.

This manual contains the information necessary for operating and configuring the D4RF Series.

Read this manual thoroughly before using the product to ensure correct use with full understanding of its functions and performance. After you have finished reading this manual, store it safely for future reference.

## **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

The safety precaution symbols used and their meanings are listed below.

<b>!</b> 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.
<b>∴</b> Caution	Indicates that any improper operation or handling may result in minor injury or property damage.

#### Precautions

	<u></u>
	Do not disassemble, repair, modify, deform under pressure, or 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 sunlight.
$\bigcirc$	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.
$\bigcirc$	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.
$\bigcirc$	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.

## **.** 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 product enclosure 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.

## <u>∕</u>!\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.
- Avoid using the transient state while the power is on (300 ms). Output could become unstable, causing unexpected operation.
- Do not place wires with this product near a high voltage cable or power line. 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.
- 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.
- Detection characteristics and digital display values may vary depending on the state of the target object and variations among individual products.

## **Expressions Used in This Manual**

This section explains the expressions used in this manual.

#### **CAUTION**

Indicates an item that requires special attention during use.



Indicates information that is useful to know during use.

## **Manual Composition**

1

This manual is composed of the following contents.

3

1. Read This First

This section explains the package contents of the D4RF (hereinafter referred to as this product) and the names of its parts.

4

2. Installation and Connection

This section explains how to install and wire this product.

5

This section explains the necessary functions when using this product.

3. Basic Usage

This section explains the necessary functions when using this product.

• Display screens and operating procedures

Display screens and operating proceduresParameters that must be set first

Useful and frequently used functions

6

4. Settings Menu

This section explains the setting parameters of this product in menu order.

5. Troubleshooting

This section explains how to respond to error displays and trouble.

6. Appendix

This section explains the specifications of this product and other information.

## **Contents**

Introd	uction	i
Safety	/ Precautions	ii
Expre	ssions Used	in This Manual iv
Manua	al Compositio	on <b>v</b>
1	Read	d This First
1-1	Package C	contents
	1-1-1	Options
1-2	Part Name	s
	1-2-1	Sensor Amplifier
	1-2-2	Display and Operation Section 1-3
2	Insta	allation and Connection
2-1	Installation	2-2
	2-1-1	Mounting the Fiber Unit
	2-1-2	Attaching to/Removing from a DIN-rail
	2-1-3	Mounting on a Wall
	2-1-4	Installing Inter-connection Main/Expansion Units 2-4
2-2	Wiring the	Fiber Amplifier
	2-2-1	I/O Circuit Diagrams in IO-Link Mode
	2-2-2	I/O Circuit Diagrams in SIO Mode (Standard I/O Mode) 2-7
	ъ.	••
3	Basi	c Usage
0.4	D: 1 C	
3-1	Display Sc	reens
_		Ramco Innovations www.ramcoi.com

	3-1-1	Screen Types	3-2
	3-1-2	Operations on the Setting Screen	3-3
3-2	Setup or	n First Startup	3-4
3-3	Detection	n Method	3-5
3-4	Setting tl	he Threshold (Teach Function)	3-7
	3-4-1	Threshold	3-7
	3-4-2	Teach Mode	3-9
	3-4-3	1 point	3-10
	3-4-4	2 points	3-13
	3-4-5	Auto	3-16
	3-4-6	Through	3-19
	3-4-7	1-point Zone	3-21
	3-4-8	2-point Zone	3-24
3-5	Manual A	Adjustment of the Threshold	3-27
3-6	Shortcut	Function	3-29
	3-6-1	Received Light Amount Display Modes	3-29
	3-6-2	Switching to the Hold Display	3-30
	3-6-3	Lock Function	3-31
	3-6-4	Switching the Display between Output 1 and 2	3-33
3-7	Frequent	tly Used Functions	3-34
	3-7-1	[S1] Output Mode (N.O./N.C.)	3-35
	3-7-2	[S3] Response Time	3-37
	3-7-3	[P2] Hold Display	3-40
	3-7-4	[P9] Stretch Mode	3-45
	3-7-5	[S7] - [D2] Threshold Mode "Edge height"	3-47
	3-7-6	[SC] Reset	3-57
4	Set	tings Menu	
4-1	List of Se	etting Options	4-2
Rar	nco Inn	novations www.ramcoi.com	
		933 neales@ramcoi.com	_
		Contents	vii

4-2	[S1] Output mode (N.O./N.C.)				
4-3	[S3] Respo	nse time	4-6		
4-4	[S4] Timer		4-7		
4-5	[S6] Displa	у	4-9		
	4-5-1	[S6] - [P1] Display mode	4-9		
	4-5-2	[S6] - [P2] Hold display	4-11		
	4-5-3	[S6] - [P3] Brightness	4-11		
	4-5-4	[S6] - [P4] Rotate display	4-11		
	4-5-5	[S6] - [P5] Invert display	4-12		
	4-5-6	[S6] - [P6] Alarm display	4-12		
	4-5-7	[S6] - [P7] Zeroing	4-13		
	4-5-8	[S6] - [P8] Eco mode	4-13		
	4-5-9	[S6] - [P9] Stretch mode	4-13		
	4-5-10	[S6] - [PA] Language	4-14		
4-6	[S7] Detect	ion	4-15		
	4-6-1	[S7] - [D1] Hysteresis	4-15		
	4-6-2	[S7] - [D2] Threshold mode	4-16		
	4-6-3	[S7] - [D3] APC	4-17		
	4-6-4	[S7] - [D4] ASC	4-17		
	4-6-5	[S7] - [D5] Emitter power	4-18		
	4-6-6	[S7] - [D6] Counter	4-19		
	4-6-7	[S7] - [D7] Set count	4-21		
	4-6-8	[S7] - [D8] Edge direction	4-21		
	4-6-9	[S7] - [D9] Edge offset	4-22		
	4-6-10	[S7] - [DA] Edge hys.	4-22		
4-7	[S8] I/O		4-24		
	4-7-1	[S8] - [O1] I/O polarity	4-24		
	4-7-2	[S8] - [O2] Pin 2 setting	4-25		
	4-7-3	[S8] - [O3] Pin 5 setting	4-26		
	4-7-4	[S8] - [O4] Pin 2 setting	4-26		
	4-7-5	[S8] - [O5] Lock mode	4-27		
	4-7-6	[S8] - [O6] Preset setting	4-27		

	4-7-7	[S8] - [O7] Load preset	. 4-28
4-8	[S9] Inform	ation	. 4-29
4-9	[SA] All dev	rices	. 4-30
	4-9-1	[SA] - [A1] Copy to all	. 4-30
	4-9-2	[SA] - [A2] Zeroing all	. 4-30
	4-9-3	[SA] - [A3] Zero reset all	. 4-31
	4-9-4	[SA] - [A4] Set reset all	. 4-31
	4-9-5	[SA] - [A5] Fct. reset all	. 4-31
	4-9-6	[SA] - [A6] All teach	. 4-31
4-10	[SC] Reset		. 4-32
5	Trou	bleshooting	
5-1	Error Displa	ays	5-2
5-2	·	Countermeasures	
J <b>-</b> Z	LITOIS AIIG	Countermeasures	5-4
6	Appe	endix	
6.1	Chaoifiactia		6.2
0-1	6-1-1	Sangar Amplifiar Specifications	
		Sensor Amplifier Specifications  Dimensions	
	6-1-2	Differisions	6-4
6-2	Index List .		6-7
	6-2-1	Communication Specifications	6-7
	6-2-2	Process Data Format	6-7
	6-2-3	Service Data	6-8
	6-2-4	Events	. 6-13
6-3	Initial Settir	ngs List	. 6-14



## **Read This First**

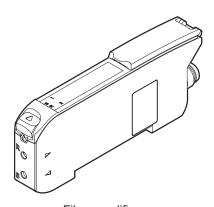
This section explains the accessories and the names of this product's parts.

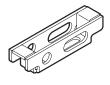
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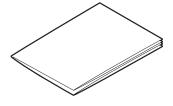
## 1-1 Package Contents

Before using this product, confirm that all of the following are contained in the package.

If you find a defective or damaged item, contact OPTEX FA (with the information at the back of this user's manual).





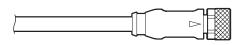


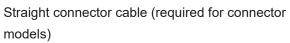
Fiber amplifier

Mounting bracket

Instruction manual

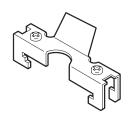
## 1-1-1 Options





M84CN-2S: 2 mM84CN-5S: 5 mM84CN-10S: 10 m

Minimum bending radius (Stationary position): 24 mm

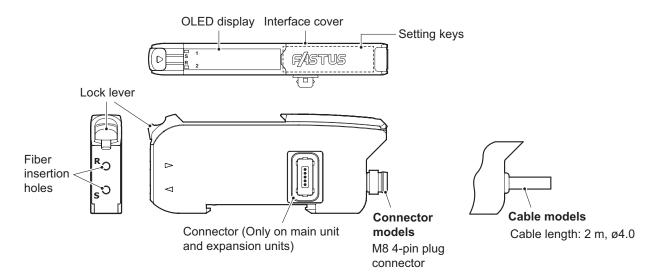


End plate

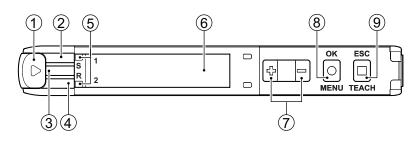
BEF-EB01-W190
 (2 piece set)

## 1-2 Part Names

## 1-2-1 Sensor Amplifier



## 1-2-2 Display and Operation Section



No.	Name	Description
1	Lock lever	Locks and releases the fiber unit.
2	Output 1 indicator (orange)	Illuminates in orange when output 1 is ON.
3	Power indicator (green)	Illuminates in green when the power is turned on, and blinks during IO-Link communication.
4	Output 2 indicator (orange)	Illuminates in orange when output 2 is ON.
(5)	Fiber insertion indicator	Indicates the insertion status of the fiber unit.
6	OLED display	Displays the present value and threshold of the received light amount and the parameters during setting.
7	Selection keys (+/- keys)	Manually adjusts the threshold, and select menu during setting.
8	OK/MENU key	Selects a setting menu and sets the parameters.
9	ESC/TEACH key	Performs teach and exits menus during setting.



## **Installation and Connection**

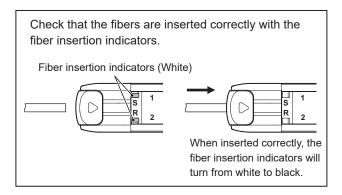
This section explains how to install and wire this product.

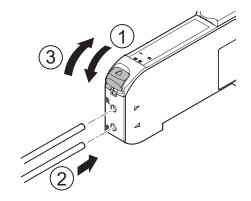
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### 2-1 Installation

## 2-1-1 Mounting the Fiber Unit

- 1) Slide the lock lever down.
- 2)Insert the fiber wires in the holes to the end.

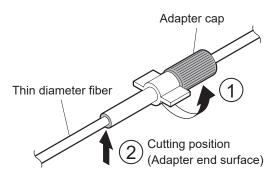




3 Raise the lock lever to the stop position.

# How to Use the Fiber Adapter (Included with the Thin Fiber Units)

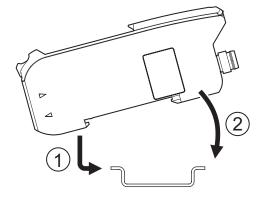
- ①Turn the adapter cap fully counterclockwise to unlock, and then align the ends of the adapter pipe and fiber. Turn the cap fully clockwise to lock the adapter.
- ②Cut the fiber to the desired length, using the fiber cutter included with the free-cut fiber unit.



## 2-1-2 Attaching to/Removing from a DIN-rail

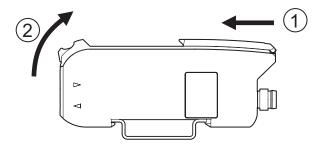
### Installing the Amplifier

- 1) Place the groove on the side of the fiber unit holes on the DIN-rail.
- <sup>2</sup>Press down until the hook locks.



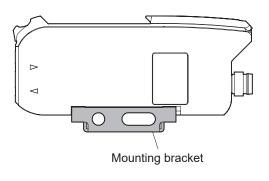
### ■ Removing the Amplifier

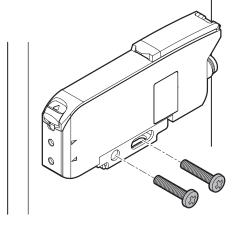
- ①Push the amplifier toward the side of the fiber unit holes.
- ②Lift up the side of the fiber unit holes and remove it.



## 2-1-3 Mounting on a Wall

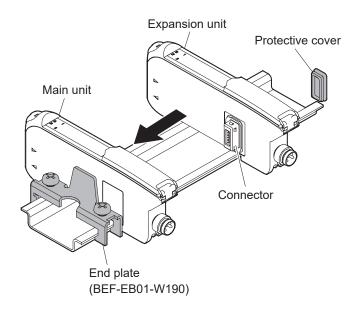
Attach the mounting bracket to the amplifier, using the same method as for mounting on a DIN rail, and then fix the mounting bracket on the wall using two M4 screws, as shown on the drawings below.





### 2-1-4 Installing Inter-connection Main/Expansion Units

- 1. Mount each amplifier on the DIN-rail.
- 2. Slide the expansion unit and connect it to the inter-connection connector on the main unit.
- 3. Use the end plates on both sides to secure the amplifiers.



#### **CAUTION**

- Be sure to turn off the power before performing this work.
- · When connecting amplifier units, be sure to use a DIN-rail and end plates.
- To operate inter-connection main and expansion units, make sure that the ambient temperature is within the specified range.
- To prevent a short circuit on the connector, be sure to attach the protective cover to the connector that is not in use.
- · Do not remove amplifiers from the DIN-rail while connected.

## 2-2 Wiring the Fiber Amplifier

#### **CAUTION**

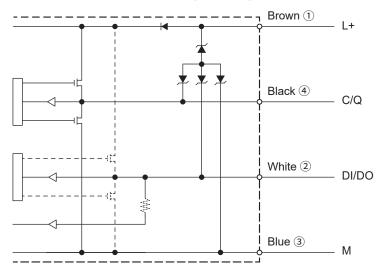
- Be sure to turn off the power before connecting/disconnecting connectors or wiring.
- Cut lead wires that are not used, wrap them individually with insulating tape, and do not allow them to come into contact with other terminals.

Model	Connector models Cable models				models				
	Stand- alone unit	Inter- connection main unit	Inter- connection expansion unit	Stand- alone unit	Inter- connection main unit	Stand- alone unit	Inter- connection main unit	Inter- connection expansion unit	Inter- connection expansion unit
	D4RF-TC4	D4RF-TMC4	D4RF-TSC4	D4RF-T	D4RF-TM	D4RF-TD	D4RF-TDM	D4RF-TS	D4RF-TDS
Connection, \ etc.		M8, 4-pin		4 w	ires	5 w	ires	2 wires	3 wires
Brown ①	+	V	_		+	V		_	_
White ②	External input/control output 2		output 2	External input/control E output 2		Externa	External input		External input
(IO-Link)	DI/DO switch	_	_	DI/DO switch	_	DI	_	_	_
Blue ③	0	V	_	0	V	0	V	_	_
Black ④				C	Control output	1			
(IO-Link)	C/Q	_	_	C/Q	_	C/Q	_	_	_
Gray	_	_	_	_	_	Control	output 2	_	Control output 2
(IO-Link)	_	_	_	_	_	DO	_	_	_
Connector/ cable	200	(4) (3)							
Reference I/O circuit diagram	1-output and 1-switchable-out			put/input mode	els		and 1-input dels	1-output and 1-switchable- output/input models	2-outputs and 1-input models

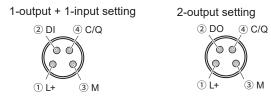
## 2-2-1 I/O Circuit Diagrams in IO-Link Mode

The circuit diagram by I/O model is shown below.

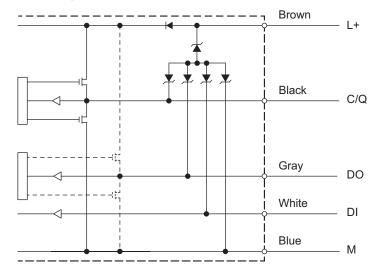
### ■ 1-Output and 1-Switchable-Output/Input Models



#### M8 connector pin layout



### 2-Output and 1-Input Models

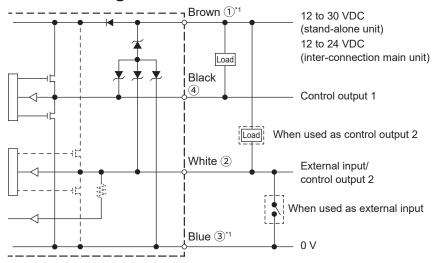


### 2-2-2 I/O Circuit Diagrams in SIO Mode (Standard I/O Mode)

The circuit diagram by I/O model is shown below.

### 1-Output and 1-Switchable-Output/Input Models

### NPN setting



\*1: Power supply wires (Brown ①, Blue ③) are not equipped on the inter-connection expansion units.

#### M8 connector pin layout

1-output + 1-input setting

② External input ④ Control output

(3) 0 V

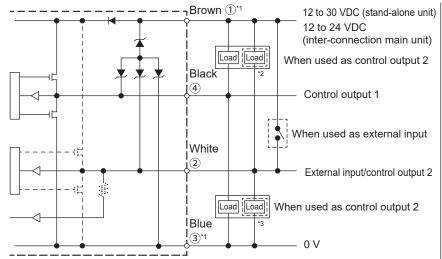
- 1) 12 to 30 VDC (stand-alone unit)
- 1) 12 to 24 VDC (inter-connection main unit)

#### 2-output setting

② Control output 2 ④ Control output 1

- ① 12 to 30 VDC (stand-alone unit)
- 1) 12 to 24 VDC (inter-connection main unit)

### PNP or Push-pull setting



- \*1: Power supply wires (Brown ①, Blue ③) are not equipped on the inter-connection expansion units.
- \*2: When I/O polarity is set to Push-pull and the sensor is connected with plus common circuits.
- \*3: When I/O polarity is set to Push-pull or PNP and the sensor is connected with minus common circuits.

#### M8 connector pin layout

1-output + 1-input setting

2 External input 4 Control output

- ① 12 to 30 VDC (stand-alone unit)
- 1) 12 to 24 VDC (inter-connection main unit)

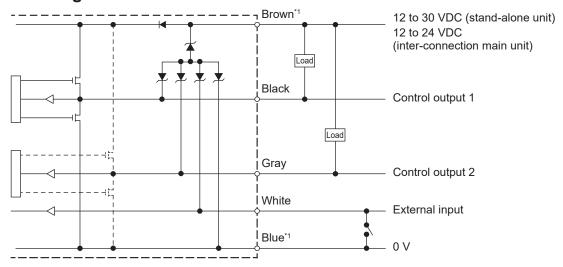
#### 2-output setting

② Control output 2 ④ Control output 1

- $\stackrel{\textcircled{1}}{\phantom{}}$  12 to 30 VDC (stand-alone unit)
- 1) 12 to 24 VDC (inter-connection main unit)

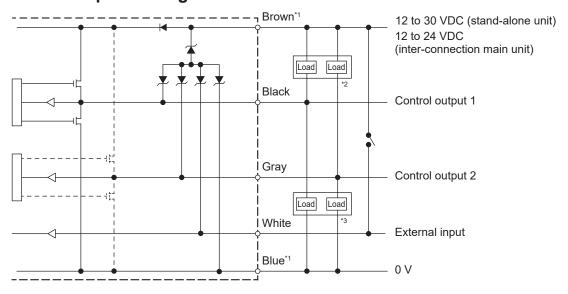
### 2-Output and 1-Input Models

#### NPN setting



<sup>\*1:</sup> Power supply wires (Brown, Blue) are not equipped on the inter-connection expansion units.

### PNP or Push-pull setting



- \*1: Power supply wires (Brown, Blue) are not equipped on the inter-connection expansion units.
- \*2: When I/O polarity is set to Push-pull and the sensor is connected with plus common circuits.
- \*3: When I/O polarity is set to Push-pull or PNP and the sensor is connected with minus common circuits.



# **Basic Usage**

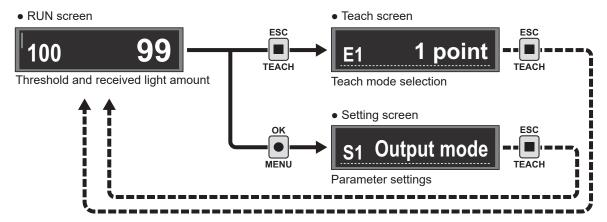
This section explains the types of display screens and transitions.

## **Display Screens**

This section explains the types of display screens and transitions.

#### **Screen Types** 3-1-1

There are three types of screens: RUN, Teach, and Settings.



### RUN Screen

Displays the threshold and the present received light amount.

The vertical line indicates the displayed channel (output 1/ output 2).



#### **Teach Screen**

Press to display this screen.

For details on the teach function settings, refer to 43-4 Setting the Threshold (Teach Function)" (page 3-7).



### **Setting Screen**

Press to display this screen.

**Display Screens** 

For details on setting operations, refer to 43-1-2 Operations on the Setting Screen" (page 3-3).

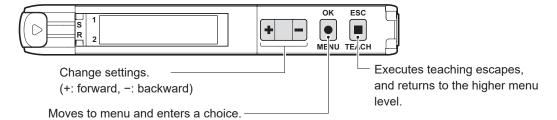


### 3-1-2 Operations on the Setting Screen

This section explains operations on the setting screen.

### Operation Keys

The following keys are used when configuring settings.

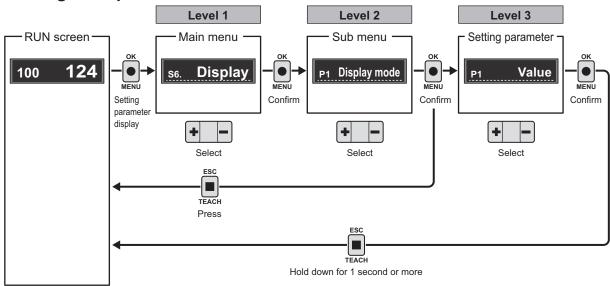


### Setting Operations

The settings menu is separated into two levels of the main menu and sub menu and is configured on the third level.

A unique number is assigned to each setting.

### Setting examples



## 3-2 Setup on First Startup

The first time you turn the product on or reset it, the following initial settings menu appears. Configure the settings in the order they appear.

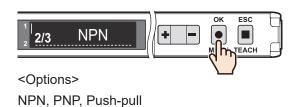


### 1 Select the language.

Press to select the language, and then press .



### 2 Select the output polarity.



# 3 Select the display mode of the received light amount.

Press to select the display mode, and then press .

(To return to the previous menu, press = .)



<Options>

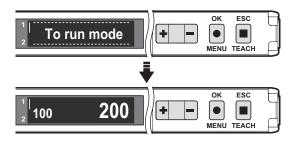
한국어

Std. display, Hold display

The hold display is a function that maintains and displays the peak and bottom values of the detected received light amount. → Refer to 4-5-2 [S6] - [P2] Hold display" (page 4-11).

### **4** This completes the initial settings.

The RUN screen will automatically appear.



### 3-3 Detection Method

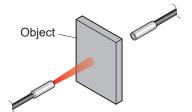
The main detection methods available are through-beam and diffuse reflective, which detect the object as shown below.

### Through-beam

Two fiber units are installed so that one emits and one receives light, and the object passes between the units. Light is received when no object is present and is not received when an object blocks the light axis. Detection is performed according to the received light amount.



Light is received when no object is present.



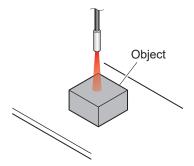
The light axis is blocked and light is not received when an object is present.

### Diffuse Reflective

Diffuse reflective fiber units contain both a light emitter and receiver. They perform detection by receiving reflected light from an object.



Light is not received (or the received light amount is low) when no object is present.



The received light amount is high and light is determined to be received when an object is present.

<sup>\*</sup>If the object is a dark color and the background is a bright color, light being received/not received may occur in the opposite manner as described here.

### Detection Method Features

The features of the different detection methods are shown below.

 $\bigcirc$ : Excellent  $\bigcirc$ : Normal  $\triangle$ : Poor

	_ ,					
		Features				
Туре	General description	Detection stability	Long range detection	Installation workload		
Through- beam	With this type, detection is performed by installing two fiber units so that one emits and one receives light.	0	0	$\triangle$		
	<ul> <li>Not affected by the color, tilt, or uneven surfaces of the object</li> <li>Capable of long-distance detection</li> </ul>					
	$\triangle$ Necessary to install fiber units in two locations to emit and receive light					
Diffuse reflective	With this type, there is no need to install items such as a fiber unit or a reflector behind the object.			0		
	<ul><li>Only requires installation in one location, reducing the workload</li><li>Small object detection possible with fiber unit types on</li></ul>					
	which optional lenses can be installed on the tips  △Easily affected by the color, tilt, or uneven surfaces of the object					
Limited diffuse reflective	This type is the same as the diffuse reflective type, in that there is no need to install items such as a fiber unit or a reflector behind the object.	0	Δ	0		
	<ul> <li>○Effect of the background is minimal because detection can be performed with a limit on the distance</li> <li>○More resistant to the effects of object color and tilt than the diffuse reflective type</li> <li>△Shortest sensing distance</li> </ul>					
Retro- reflective	With this type, detection is performed by installing a fiber unit and a reflector so that the light reflects off of the reflector.	0	0	$\triangle$		
	ONot affected by the color, tilt, or uneven surfaces of the object					
	○Suited to detection of transparent objects △Large installation space required for reflector					

## 3-4 Setting the Threshold (Teach Function)

Set judgment criteria used by this product to judge whether an object is present.

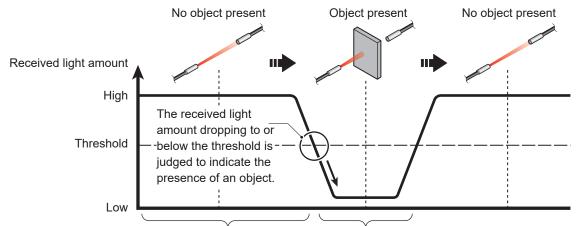
### 3-4-1 Threshold

Set according to the received light amount, the threshold is the standard value used to judge whether an object is present.

The method for easy setting of this threshold with key operations and an external input on the fiber amplifier is referred to as the teach function.

Example) Received light amount and threshold with a through-beam fiber unit

When the object blocks the light beam, the received light amount decreases. This level dropping below the threshold is judged to indicate the presence of an object.

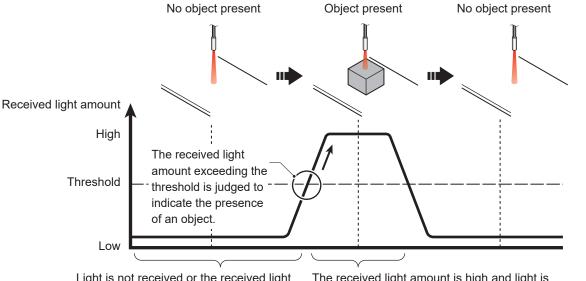


When no object is present, light can be received, so the received light amount is high.

When an object is present, the light is blocked, so the received light amount is low.

Example) Received light amount and threshold of a diffuse reflective fiber unit

When the light hits an object, light is reflected, increasing the received light amount. This level exceeding the threshold is judged to indicate the presence of an object.



Light is not received or the received light amount is low when no object is present.

The received light amount is high and light is determined to be received when an object is present.

<sup>\*</sup>If the background is a bright color and the object is a dark color, the increasing and decreasing of the received light amount may occur in the opposite manner as described here.

#### 3-4-2 **Teach Mode**

The teach function, which requires the threshold to be set, has the following modes (types). Select the optimal mode for the fiber unit and the type of object to detect.

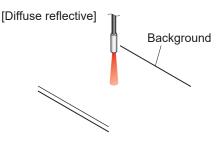
○: Effective ×: Not effective

		Detection method				
Teach mode		Selection criteria	Through- beam/ retro- reflective	Diffuse reflective	Sample object to teach	Description
Standard	1 point	<ul> <li>When a sample object is not available.</li> <li>When it is difficult to execute the teach function with the actual object present and not present.</li> </ul>	×	0	Not required	Page 3-10
	2 points	When it is possible to execute the teach function with the actual object present and not present.	0	0	Required	Page 3-13
	Auto	<ul> <li>When the threshold must be set according to moving objects on a line that cannot be stopped.</li> <li>When it is difficult to execute the teach function with the actual object present and not present. (Such as with small objects and objects that move at high speeds)</li> <li>When the threshold must be set considering the effect of the worksite environment.</li> </ul>	0	0	Required	Page 3-16
	Through	<ul> <li>When a sample object is not available.</li> <li>When detecting a plastic sheet, film, and other transparent/semitransparent objects.</li> <li>When detecting small objects.</li> </ul>	0	×	Not required	Page 3-19
Expansion	1-point Zone	When the threshold must be set to a specific range.     When detecting objects of certain sizes with a screen/array fiber unit. The threshold can be set as a percentage of the received light amount set by teaching.	0	0	Required	Page 3-21
	2-point Zone	<ul> <li>When the threshold must be set to a specific range, the same as for the 1-point Zone mode.</li> <li>When detecting objects of certain sizes with a screen/array fiber unit.</li> <li>The upper and lower limits of the threshold can be set by the teach function with objects at upper and lower limits.</li> </ul>	0	0	Required	Page 3-24

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Setting the Threshold (Teach Function) 800-280-6933

### 3-4-3 1 point

The teach function is executed with no object present. The threshold is set to a value that does not detect the background. The threshold can be set easily with a single teach operation.



Setup for 1-point teach

Through-beam/ retro-reflective	Diffuse reflective	Object
×	✓	Not required

### Operation Procedure

\*To cancel the setting of the teach function, press the key.

\*To select the channel to teach (output 1 or output 2) in advance, hold down the key for 1 second or more.

Press for less than 1 second.

The teach mode selection screen appears.

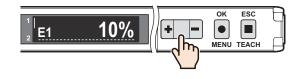
\_\_\_\_\_\_\_

- 2 Use to display "1 point", and then press .
- E1 1 point
- 3 Use + to adjust the detection margin to set the thresholds.

As a percentage (0 to 99%), set how high the received light amount must increase from the background level (when no object is present) to judge the presence of the object.

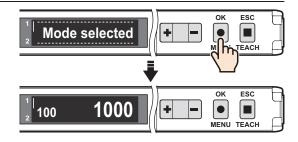
A small value will lead to detection when the received light amount increases even slightly. A larger value reduces the influence of vibrations, fluctuations, etc.

\*With the default value (10%) the threshold is set to a value of +10% compared to the background received light amount (when no object is present).



4 Press to set the teach mode and the detection margin.

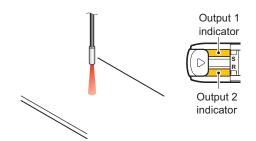
The OLED display returns to the RUN screen and the received light amount appears.



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### With no object present, hold down for 1 second or more.

The output indicator of the channel (output 1 or output 2) for which the teach function is being executed blinks once in orange.

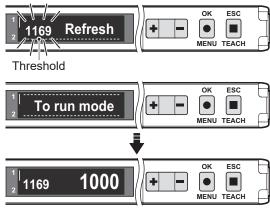


Execute the teach function with the background.

#### 6 The threshold is set and its display blinks.

This completes the execution of the teach function. The OLED display automatically returns to the RUN screen.

\*If the received light amount does not meet the conditions required for the teach function, "Teach error" will be displayed. If this error is displayed, refer to 45-1 Error Displays" (page 5-2) for troubleshooting.



RUN screen



#### Operations when executing the teach function again

After executing the teach function, to reset the teaching with the same mode again, simply hold down the key for



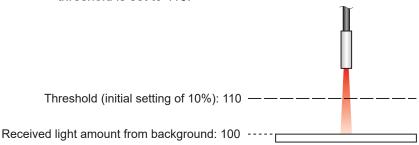
1 second or more. (The operations in steps 1 to 4 of the operation procedure are not necessary.) In this situation, the teach function is executed with the previously set mode and detection margin.

### Mechanism of the Threshold Setting

The threshold is set to the value obtained by adding the specified percentage to the received light amount during execution of the teach function (with no object present).

Example) When the received light amount during execution of the teach function is 100 and the detection margin is 10%

If the received light amount when no object is present (the level for the background) is 100, the threshold is set to 110.



\*Due to the addition of a hysteresis value with detection margin, actual threshold differs slightly from this example.

#### **CAUTION**

If the background is a bright color and the object is a dark color, detection may not be possible with the 1-point teach function. This occurs when the received light amount from the object is lower than (or equal to) the received light amount from the background.

If objects cannot be detected well with the 1-point teach function, try other modes such as the 2-point teach function.

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## 3-4-4 2 points

In this mode, the teach function is executed at two points: with an object present and without an object present. The threshold is set to the median of the received light amounts for the first and second points, enabling the most stable detection.

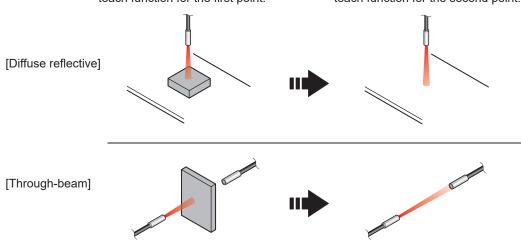
This is the standard teach function that can be used with all detection methods.

Setup for 2-point teach

Through-beam/ retro-reflective	Diffuse reflective	Object	
<b>✓</b>	✓	Required	

With an object present, execute the teach function for the first point.

Without an object present, execute the teach function for the second point.



<sup>\*</sup>The teach function can also be executed with the object not present for the first point and present for the second point.

#### Operation Procedure

\*To cancel the setting of the teach function, press the key.

\*To select the channel to teach (output 1 or output 2) in advance, hold down the key for 1 second or more.

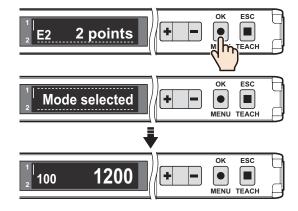
1 Press for less than 1 second.

The teach mode selection screen appears.

2 Use to display "2 points", and then press .

The teach mode is set.

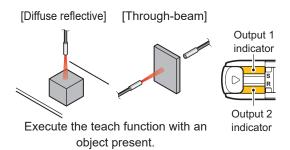
The OLED display returns to the RUN screen and the received light amount appears.



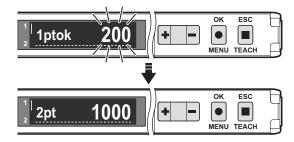
## With an object present, hold down for 1 second or more.

The output indicator of the channel (output 1 or output 2) for which the teach function is being executed blinks in orange.

\*Steps 3 and 5 can be performed in any order.

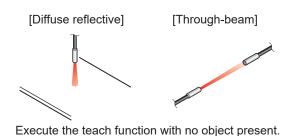


4 When the product is taught the received light amount of the first point, the numeric value blinks, then the product is set for the execution of the teach function at the second point.



With no object present, hold down for 1 second or more.

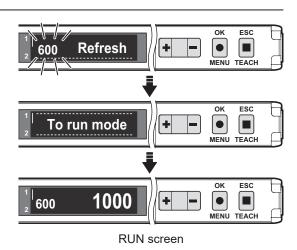
\*If approximately 30 seconds elapse with lead not being held down, the teach function will be canceled, and the threshold will not be set.



The product is taught the received light amount of the second point, and the threshold blinks.

This completes the execution of the teach function. The OLED display automatically returns to the RUN screen.

\*If the received light amount does not meet the conditions required for the teach function, "Teach error" will be displayed. If this error is displayed, refer to (5-1 Error Displays" (page 5-2) for troubleshooting.





#### Operations when executing the teach function again

After executing the teach function, to reset the teaching with the same mode again, simply hold down the key for 1 second or more. (The operations in steps 1 and 2 of the operation procedure are not necessary.)

In this situation, the teach function is executed with the previously set mode.

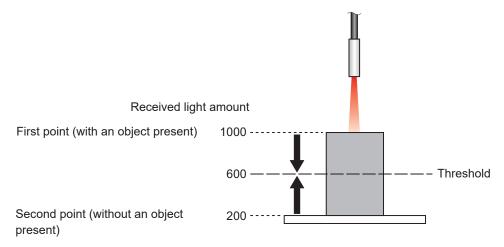
#### ■ Mechanism of the Threshold Setting

The threshold is set to the value in the middle of the received light amounts of the first and second points.

#### Example) Diffuse reflective fiber unit

Executing the teach function with an object present and without an object present results in the following results, the threshold is set to the median value, 600.

- Received light amount when the teach function is executed for the first point (with an object present): 1000
- Received light amount when the teach function is executed for the second point (with no object present): 200

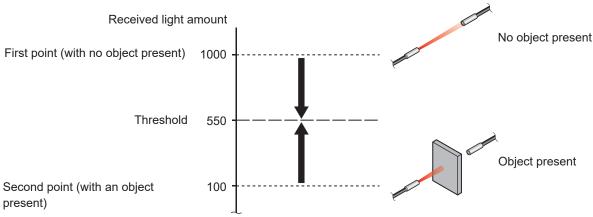


\*If the object is a dark color and the background is a bright color, the high/low received light amounts may occur in the opposite manner as described here.

#### Example) Through-beam fiber unit

Executing the teach function with an object present and without an object present results in the following results, so the threshold is set to the median value, 550.

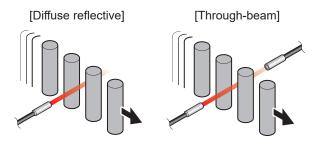
- Received light amount when the teach function is executed for the first point (with no object present): 1000
- Received light amount when the teach function is executed for the second point (with an object present): 100



#### 3-4-5 Auto

The threshold is set by executing the teach function with moving objects.

This threshold can be set with the optimal sensitivity when the objects are small, making it difficult for them to block the light or when it is not possible to stop the production operations.



Setup for Auto teach

Through-beam/ retro-reflective	Diffuse reflective	Object	
✓	✓	Required	

#### Operation Procedure

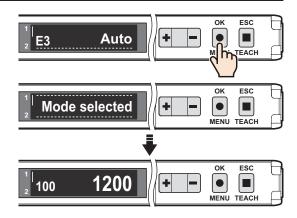
- \*To cancel the setting of the teach function, press the key.
- \*To select the channel to teach (output 1 or output 2) in advance, hold down the key for 1 second or more.
- 1 Press for less than 1 second.

The teach mode selection screen appears.

Use ★ to display "Auto", and then press .

The teach mode is set.

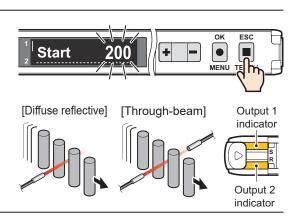
The OLED display returns to the RUN screen and the received light amount appears.



With objects moving, hold down for 1 second or more.

The numeric value blinks, and the monitoring of the received light amount starts.

The output indicator of the channel (output 1 or output 2) for which the teach function is being executed blinks in orange.

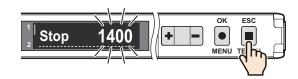


Continued on next page

After a certain amount of time has passed (less than 30 seconds), hold down for 1 second or more.

> This completes the measurement of the received light amount.

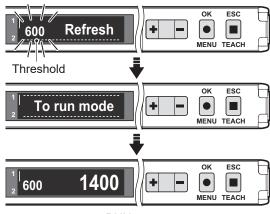
\*If approximately 30 seconds elapse with \_\_\_ not being held down, the teach function will be canceled, and the threshold will not be set.



#### 5 The confirmed threshold blinks.

This completes the execution of the teach function. The OLED display automatically returns to the RUN screen.

\*If the received light amount does not meet the conditions required for the teach function, "Teach error" will be displayed. If this error is displayed, refer to 4 "5-1 Error Displays" (page 5-2) for troubleshooting.



RUN screen

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#### Operations when executing the teach function again

After executing the teach function, to reset the teaching with the same mode again, simply hold down the Leg key for



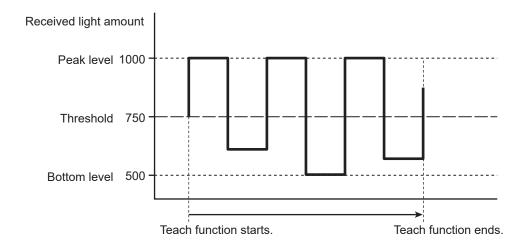
1 second or more. (The operations in steps 1 and 2 of the operation procedure are not necessary.) In this situation, the teach function is executed with the previously set mode.

#### Mechanism of the Threshold Setting

The peak and bottom amounts of received light monitored during auto teach are extracted, and the threshold is set to the median value.

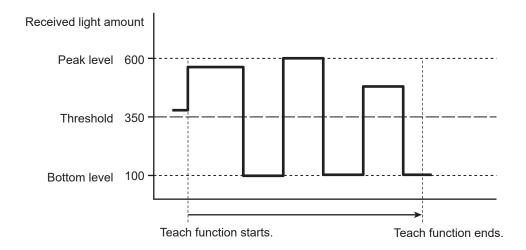
#### Example) Through-beam fiber unit

If the highest amount of received light is 1000 and the lowest is 500, the threshold is set to the median value, 750.



#### Example) Diffuse reflective

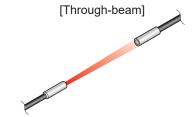
If the highest amount of received light is 600 and the lowest is 100, the threshold is set to the median value, 350.



## 3-4-6 Through

The threshold is set to the lowest value required for detection on the basis of the received light amount when no object is present.

This teach function is suitable for detection of targets such as small or transparent objects such as glass and film when using a through-beam/retro-reflective fiber unit.



Setup for Through teach

Through-beam/ retro-reflective	Diffuse reflective	Object	
$\checkmark$	×	Not required	

Execute the teach function once with no object present.

#### Operation Procedure

\*To cancel the setting of the teach function, press the key.

\*To select the channel to teach (output 1 or output 2) in advance, hold down the key for 1 second or more.

1 Press for less than 1 second.

The teach mode selection screen appears.

Use to display "Through", and then press .

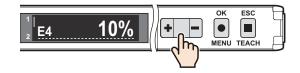


3 Use to adjust the detection margin to set the thresholds.

As a percentage (0 to 99%), the threshold is set at a lower amount than the received light amount without an object present.

A smaller value will lead to detection when the received light amount decreases even slightly. A larger value reduces the influence of vibrations, fluctuations, etc.

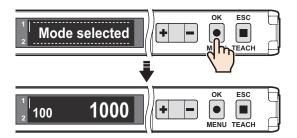
\*With the default value (10%) the threshold is set to an amount lower by 10% than the received light amount when no object is present.



Continued on next page

## Press • to set the teach mode and the detection margin.

The OLED display returns to the RUN screen and the received light amount appears.



#### 5 With no object present, hold down for 1 second or more.

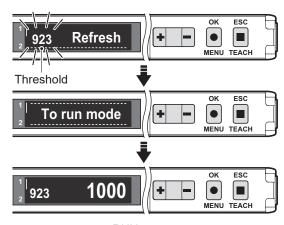
The output indicator of the channel (output 1 or output 2) for which the teach function is being executed blinks once in orange.



#### 6 The threshold is set and its display blinks.

This completes the execution of the teach function. The OLED display automatically returns to the RUN screen.

\*If the received light amount does not meet the conditions required for the teach function, "Teach error" will be displayed. If this error is displayed, refer to 4 "5-1 Error Displays" (page 5-2) for troubleshooting.



RUN screen



#### Operations when executing the teach function again

After executing the teach function, to reset the teaching with the same mode again, simply hold down the key for



1 second or more. (The operations in steps 1 to 4 of the operation procedure are not necessary.) In this situation, the teach function is executed with the previously set mode and detection margin.

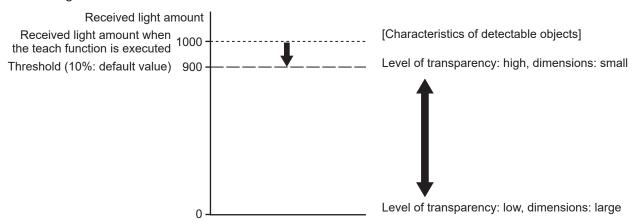
#### Mechanism of the Threshold Setting

The threshold is set to the value obtained by subtracting the specified percentage from the received light amount during execution of the teach function (with no object present).

Setting the percentage used as a margin to the threshold to a smaller value allows for detection of highly transparent objects and small objects. Setting the percentage to a larger value reduces the effect of vibrations, etc.

Example) When the received light amount during execution of the teach function is 1000 and the detection margin is 10%

The threshold is set to 900, obtained by subtracting the detection margin of 10% from the received light amount of 1000.

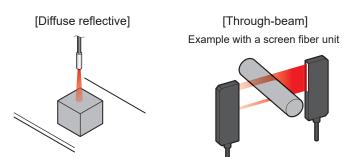


<sup>\*</sup>Due to the addition of a hysteresis value with detection margin, actual threshold differs slightly from this example.

## 3-4-7 1-point Zone

The upper and lower limits of the threshold are set with the percentage (default value: 10%) in relation to the received light amount obtained with a single teach action.

The thresholds can be set to a fixed range of received light amounts, so this method can be used in judging whether the object distance, position, and dimensions are within the set range.



Setup for 1-point Zone teach

Through-beam/ retro-reflective	Diffuse reflective	Object	
√ (some limitations)	<b>√</b>	Required	

#### Operation Procedure

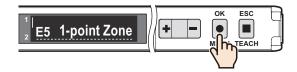
\*To cancel the setting of the teach function, press the \_\_\_ key.

<sup>\*</sup>To select the channel to teach (output 1 or output 2) in advance, hold down the key for 1 second or



The teach mode selection screen appears.

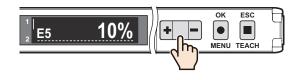
Use + to display "1-point Zone", and then press ... to display "1-point Zone", and



3 Use + - to adjust the detection margin to set the thresholds.

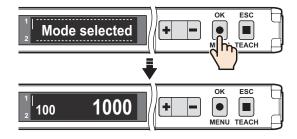
Use the percentage related to the received light amount during execution of the teach function to set the upper and lower limits that specify the threshold range.

\*With the default value (10%), the received light amount during execution of the teach function is used as a reference point, the upper threshold is set at +10% and the lower threshold is set at -10%.



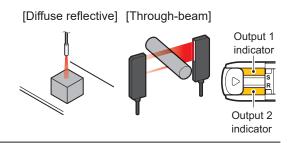
4 Press to set the teach mode and the detection margin.

The OLED display returns to the RUN screen and the received light amount appears.



With an object present, hold down for 1 second or more.

The output indicator of the channel (output 1 or output 2) for which the teach function is being executed blinks once in orange.

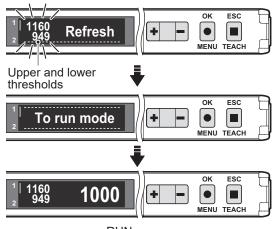


Continued on next page

#### The threshold is set and its display blinks.

This completes the execution of the teach function. The OLED display automatically returns to the RUN screen.

\*If the received light amount does not meet the conditions required for the teach function, "Teach error" will be displayed. If this error is displayed, refer to 45-1 Error Displays" (page 5-2) for troubleshooting.



RUN screen



#### Operations when executing the teach function again

After executing the teach function, to reset the teaching with the same mode again, simply hold down the Leach key for 1 second or more. (The operations in steps 1 to 4 of the operation procedure are not necessary.)

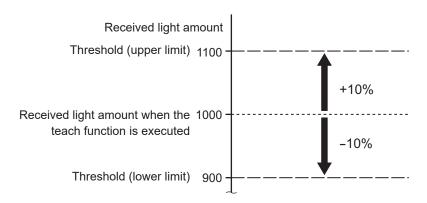
In this situation, the teach function is executed with the previously set mode and detection margin.

#### Mechanism of the Threshold Setting

The values obtained by adding the set percentage to and subtracting the set percentage from the received light amount during the execution of the teach function are set, respectively, as upper and lower thresholds.

Example) When the received light amount during execution of the teach function is 1000 and the detection margin is 10%

The upper and lower thresholds are set to the values obtained by, respectively, adding 10% to and subtracting 10% from the received light amount, so detection occurs when the received light amount is in the range of 900 to 1100.



\*Due to the addition of a hysteresis value with detection margin, actual threshold differs slightly from this example.

## **3-4-8 2-point Zone**

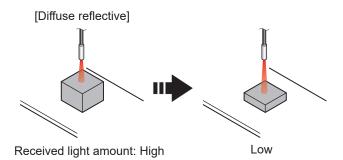
The teach function is executed twice to set the upper and lower limits of the threshold.

As with the "1-point Zone" teach mode, the threshold can be set to a fixed range of received light amount, so this method can be used to judge whether the object distance, position, and dimensions are within the set range.

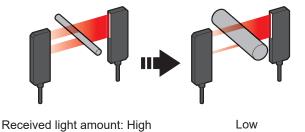
The thresholds are not set by percentage but are set with an actual object, so the upper and lower thresholds can be set separately during the execution of the teach function, which differs from the "1-point Zone" mode.

Setup for 2-point Zone teach

Through-beam/ retro-reflective	Diffuse reflective	Object
√ (some limitations)	<b>√</b>	Required



[Through-beam] Example with a screen fiber unit



### Operation Procedure

\*To cancel the setting of the teach function, press the leave.

\*To select the channel to teach (output 1 or output 2) in advance, hold down the key for 1 second or more.

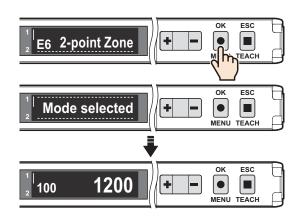
## 1 Press Frach for less than 1 second.

The teach mode selection screen appears.

# Use + to display "2-point Zone", and then press ...

The teach mode is set.

The OLED display returns to the RUN screen and the received light amount appears.

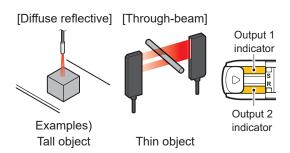


Continued on next page

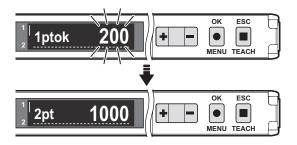
## With an object present, hold down for 1 second or more.

The output indicator of the channel (output 1 or output 2) for which the teach function is being executed blinks once in orange.

\*Steps 3 and 5 can be performed in any order.

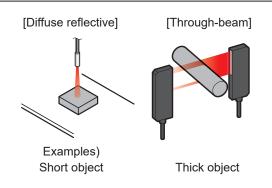


When the product is taught the received light amount of the first point, the numeric value blinks, then the product is set for the execution of the teach function at the second point.



Place the other object, and then hold down for 1 second or more.

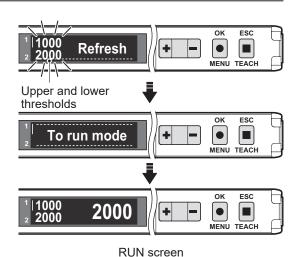
\*If approximately 30 seconds elapse with being held down, the teach function will be canceled, and the threshold will not be set.



The product is taught the received light amount of the second point, and the threshold blinks.

This completes the execution of the teach function. The OLED display automatically returns to the RUN screen.

\*If the received light amount does not meet the conditions required for the teach function, "Teach error" will be displayed. If this error is displayed, refer to 45-1 Error Displays" (page 5-2) for troubleshooting.





Operations when executing the teach function again

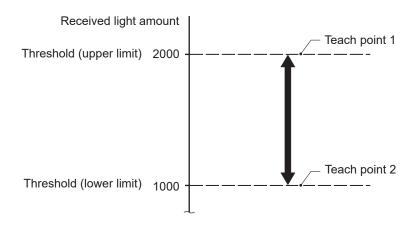
After executing the teach function, to reset the teaching with the same mode again, simply hold down the Learning wey for

1 second or more. (The operations in steps 1 and 2 of the operation procedure are not necessary.) In this situation, the teach function is executed with the previously set mode.

#### Mechanism of the Threshold Setting

The received light amounts obtained during the two actions of the teaching are set as the upper and lower thresholds.

Example) When the received light amounts during the two actions of the teaching are 2000 and 1000. The threshold is set with an upper limit of 2000 and a lower limit of 1000, so detection occurs when the received light amount is in the range of 1000 to 2000.



# 3-5 Manual Adjustment of the Threshold

The threshold set with the teach function can be changed manually.

Use this operation to make adjustments to the threshold when actual detection is unstable, when the detection conditions change, and other similar situations.

This operation can also be used to set the threshold directly without executing the teach function.

#### Operation Procedure

(1 point, 2 points, Auto, and Through modes)

1 On the RUN screen, press + -.

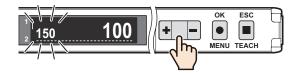
A line appears at the bottom of the OLED display, and the upper section threshold blinks.



2 Press + to change the threshold.

Pressing [+] increases the threshold and pressing [-] decreases it.

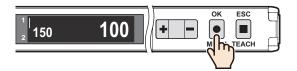
\*If no adjustment is necessary, press encel.



3 Press <sup>oκ</sup> .

The line at the bottom of the OLED display disappears. This completes the threshold adjustment.

\*Even if is not held down, the threshold will be set to the changed value if approximately 30 seconds elapse, and the OLED display will return to the RUN screen.

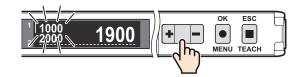


#### Operation Procedure

(1-point Zone and 2-point Zone modes)

1 On the RUN screen, press + -.

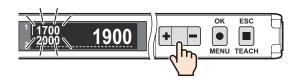
A line appears at the bottom of the OLED display, and the threshold blinks.



Press to change the upper row threshold.

Pressing [+] increases the threshold and pressing [-] decreases it.

- \*If no adjustment is necessary, press to
- \*The threshold will be set to the changed value if approximately 30 seconds elapse, and the OLED display will return to the RUN screen.



**3** Press ...

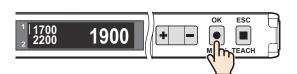
The lower row threshold blinks, so change it in the same way as the one in the upper row.



4 Press ...

This completes the settings.

\*Even if is not held down, the threshold will be set to the changed value if approximately 30 seconds elapse.



## 3-6 Shortcut Function

The shortcut function makes it possible to immediately call the useful functions explained in the following four display modes with one or two key operations.

- · Received Light Amount Display Modes
- Switching to the Hold Display
- Lock Function
- · Switching the Display between Output 1 and 2

## 3-6-1 Received Light Amount Display Modes

The display of the threshold and received light amount can be changed from "Value" (received light amount display) to "Percentage".

(Percentage display: A function that displays the present received light amount as a percentage, where the received light amount during the execution of the teach function is 100%.)

The threshold and received light amount are both displayed as percentages, so the threshold margin in relation to the present received light amount is easy to understand.

For a detailed description of the display, refer to 4-5-1 [S6] - [P1] Display mode" (page 4-9).

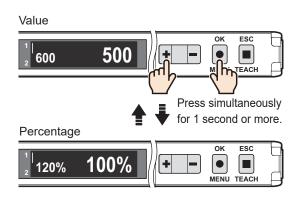


Setting the display mode to "Percentage" makes it easy to understand the relationship between the threshold and received light amount, which makes it easy to understand information such as differences in received light amounts between multiple amplifiers and daily changes in the received light amounts.

#### Operation Procedure

## Simultaneously hold down 🛨 and 🗓 for 1 second or more.

The values displayed on the screen change between the "Value" and "Percentage" settings each time these keys are pressed.



## 3-6-2 Switching to the Hold Display

You can switch the display of the received light amount from the present value display to the hold display (where the peak and bottom received light amounts are displayed).

Multiple hold display modes are available.

For details on the hold display, refer to 43-7-3 [P2] Hold Display" (page 3-40).



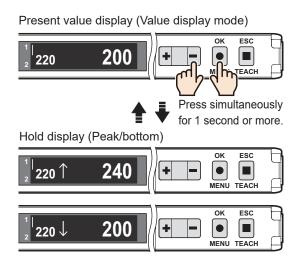
This makes it easier to check the received light amounts when the object is present and not present, so switching to the hold display is useful when making adjustments to the threshold.

#### Operation Procedure

## Simultaneously hold down and and for 1 second or more.

The values displayed on the screen change between the "Present value display" and "Hold display" modes each time these keys are pressed.

- \*The display settings are applied to the display details that are switched with this function.
  - →Refer to 4-5-1 [S6] [P1] Display mode" (page 4-9).
  - ightarrowRefer to ightharpoonup "3-7-3 [P2] Hold Display" (page 3-40).



### 3-6-3 Lock Function

This function locks the operations of this product to prevent incorrect operations.

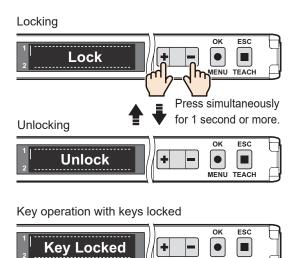
You can select to lock only key operations or key and external input operations.

#### Operation Procedure

## Simultaneously hold down 🛨 and 🖃 for 1 second or more.

Operations are locked.

Operations switch between locked and unlocked each time these keys are pressed.



The message "Key Locked" blinks three times.

#### Lock Mode Setting

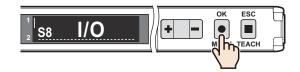
You can change the lock modes.

#### • [S8] - [O5] Lock modes

Selectable option	Function description	
Lock all (default value)	Locks operations performed via the product's keys and external input.	
Lock keys	Locks product key operations. Operations can still be performed via the external input.	

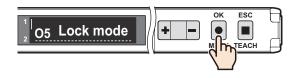
Press ok and then use to select the menu.

Display "I/O" on the main menu.

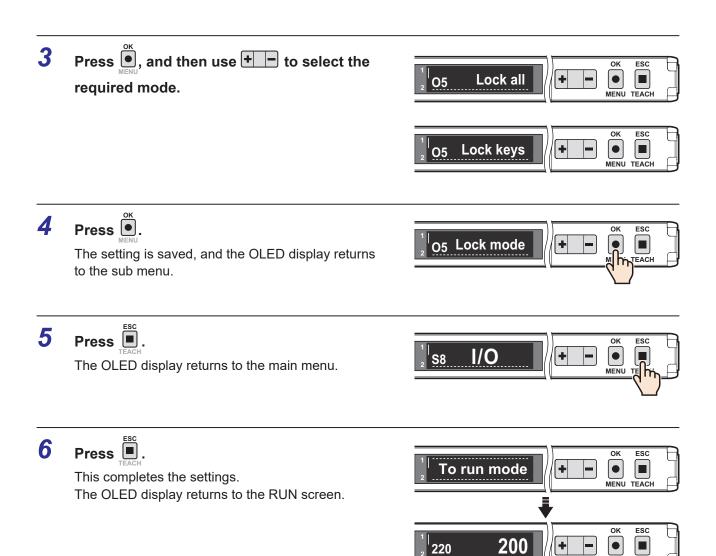


Press , and then use to select the menu.

Display "Lock mode" on the sub menu.



Continued on next page



## 3-6-4 Switching the Display between Output 1 and 2

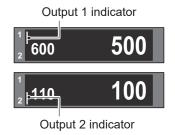
This function switches the display between output 1 (channel 1) and output 2 (channel 2). Doing so allows you to configure settings for output 1 and 2 separately.

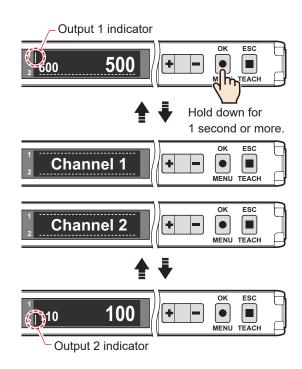
#### Operation Procedure

## Hold down of for 1 second or more.

The display switches between output 1 and output 2 each time this key is pressed.

The currently displayed output is indicated by the vertical line on the right side of output numbers.





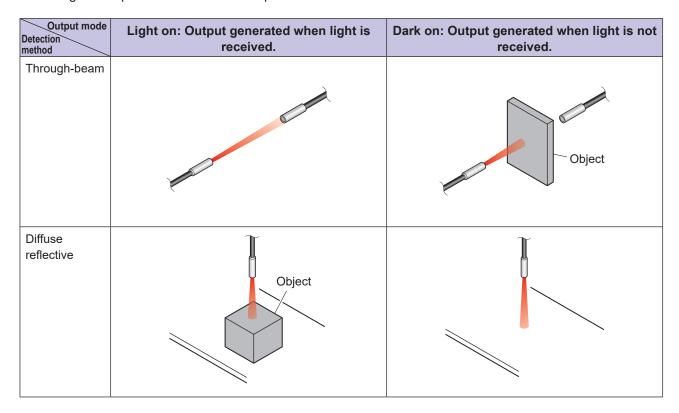
## 3-7 Frequently Used Functions

This section explains functions that are frequently used with this product.

General description	Function name	Details	Description
Changing the output mode	[S1] Output mode	Select the output mode from light on (on when light is received) and dark on (on when light is not received).  Change this setting if an output is generated when an object is present or not present to match application requirements.	Page 3-35
Changing the response time and sensing distance	[S3] Response time	<ul> <li>Changing the response time may affect detection results.</li> <li>Adjust the response time, referring to the following conditions.</li> <li>Detecting small objects or objects that are transferred at high speed.</li> <li>→ Set a shorter response time.</li> <li>Extending the sensing distance</li> <li>→ Set a longer response time.</li> </ul>	Page 3-37
Monitoring only peak and bottom amounts of received light	[P2] Hold display	The peak (highest) value and bottom (lowest) value of the received light amounts that have been measured are saved and displayed.  With reference to the peak and bottom values, manual adjustment of the threshold can be made at the correct values.	Page 3-40
Stretching the received light amount to check the margin of the set threshold	[P9] Stretch mode	e A stretched (magnified) amount of received light is displayed.  In situations such as when the value of the received light amount is low, this function makes it easy to check the margin of the received light amount in relation to the set threshold.	
Generating output only when the received light amount changes suddenly	[D2] Threshold mode (Edge height)	Generates output only when the received light amount increases or decreases suddenly. Use this in situations such as when performing differentiation detection.	
Initialization	[SC] Reset	Reset the product to the factory settings.	Page 3-57

#### 3-7-1 [S1] Output Mode (N.O./N.C.)

Set the output mode to light on (on when light is received) or dark on (on when light is not received). Switching the output mode inverts the output.



#### Selectable Options with 1-point, 2-point, Auto, and Through **Teach Modes**

Selectable option	Function description	
Light on (default value)	Sets the output mode to light on (on when light is received).  Output is generated when the received light amount exceeds the threshold.	
Dark on	Sets the output mode to dark on (on when light is not received).  Output is generated when the received light amount drops below the threshold.	

#### Operations of dark on and light on

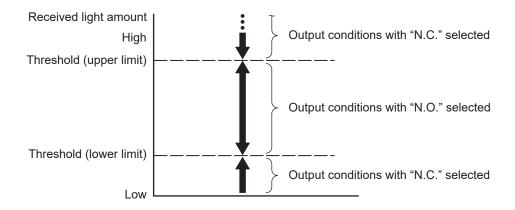
Select the mode according to whether objects are present, the detection method of the fiber unit, etc. as shown below.

Ohioot muoonno	Detection method			
Object presence	Through-beam	Retro-reflective	Diffuse reflective	
Output when object present	Dari	Light on		
Output when no object present	Light on		Dark on	

## ■ Selectable Options with 1-point Zone and 2-point Zone Teach Modes, and Edge Height Threshold Mode

With these setting options, the display becomes "N.O." (normally open) or "N.C." (normally closed), which causes output to be generated according to the following conditions pertaining to the threshold.

Selectable option	Function description
N.O. (default value)	Output is generated when the received light amount is within the set range of the thresholds.
N.C.	Output is generated when the received light amount is outside the set range of the thresholds.



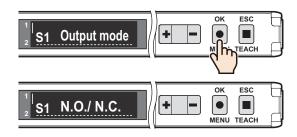
#### Operation Procedure

\*To cancel the setting, press the key.

Press ok and then use to select the menu.

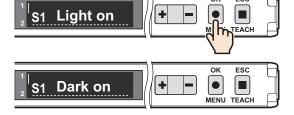
Display "Output mode".

\*When the "1-point Zone" or "2-point Zone" teach mode is selected, "N.O./N.C." is displayed.

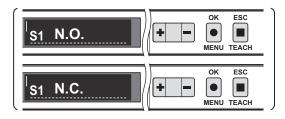


Continued on next page

Press ok and then use to select the required mode.

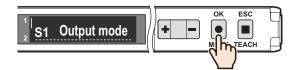


\*When the teach function is set to "1-point Zone" or "2-point Zone", "N.O." or "N.C." is displayed.



3 Press OK

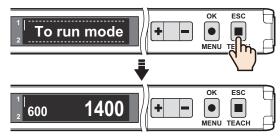
The setting is saved, and the OLED display returns to the main menu.



4 Press ESC

This completes the settings.

The OLED display returns to the RUN screen.



RUN screen

## 3-7-2 [S3] Response Time

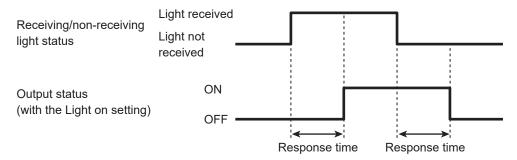
This subsection describes how to change the response time of this product.

The response time is the time from when the received light amount changes due to the presence or absence of an object until the sensor output is inverted.



Depending on the response time setting, it is possible to detect fast-moving objects or objects that are at long range. Select a suitable response time, according to the detection conditions.

Example) Relationship between receiving/non-receiving light status and output timing



#### Selectable Options

Selectable option	Function description
16 μs <sup>*1</sup> (22 μs <sup>*2</sup> )	The response time can be selected from seven parameters.
70 μs	
250 μs (default value)	
500 µs	
1 ms	
2 ms	
8 ms	

- \*1: Displayed only on a stand-alone unit and inter-connection main unit with stand-alone use.
- \*2: Displayed only on main and expansion units when connected.

#### Operation Procedure

\*To cancel the setting, press the key.

- Press on and then use to select the menu.
  - Display "Response time".



Press .

The currently set response time and received light amount are displayed.



- **3** Press + to select the response time from the seven options.
  - \*The shorter the response time is, the less the received light amount becomes. The longer the response time is, the greater the received light amount becomes. The received light amount increases and decreases, so execute the teach function again or make manual adjustment of the threshold (page 3-27).



<Options>

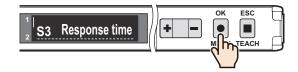
16  $\mu s^{*1}$  (22  $\mu s^{*2}$ ), 70  $\mu s$ , 250  $\mu s$ , 500  $\mu s$ , 1 ms, 2 ms, 8 ms

- \*1: Stand-alone unit and inter-connection main unit with stand-alone use only
- \*2: Main and expansion units only when connected

Continued on next page



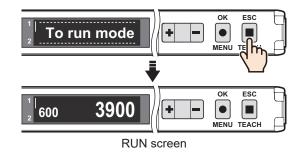
The setting is saved, and the OLED display returns to the main menu.





This completes the settings.

The OLED display returns to the RUN screen.



#### Response Time Setting Examples

Setting the response time provides the following advantages.

#### Setting a longer response time

A larger amount of received light increases the sensitivity, which allows for detection at longer distances. Example) Response time and sensing distance

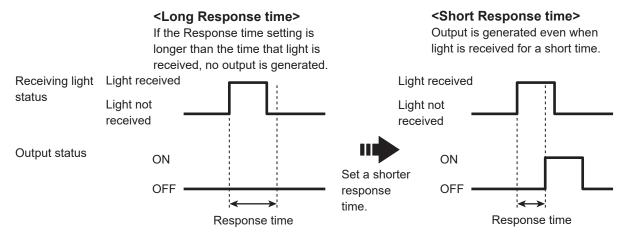
Response time Model	16 μs (22 μs)	70 μs	250 µs	500 µs	1 ms	2 ms	8 ms
NF-TB01	605 mm	1,855 mm	2,845 mm	3,425 mm	3,600 mm	3,600 mm	3,600 mm
(through-beam)							
NF-DB01	120 mm	300 mm	500 mm	600 mm	700 mm	800 mm	1,250 mm
(diffuse reflective)							

#### Setting a shorter response time

With a short response time, the product can respond to generate output even when objects block the light axis for a short period of time.

This is effective in detecting, for example, small objects travelling at high speeds.

Example) Setting a shorter response time to allow for detection of, for example, small objects.



### Number of Connectable Units with Cross Talk Prevention Affected by Response Time Setting

When the inter-connection main unit and expansion units are connected, the cross talk prevention function activates to prevent errors due to light from adjacent fiber units.

The number of main and expansion units that can be connected while still preventing cross talk varies depending on the response time setting, so refer to the following table to set the response time.

Response time	22 µs	70 µs	250 µs	500 µs	1 ms	2 ms	8 ms
Number of connectable units with cross talk prevention	2	3	4	9	9	12	14

#### [P2] Hold Display 3-7-3

Maintains and displays the peak level (highest value) and bottom level (lowest value) of received light amounts after exceeding or falling below the thresholds.

The peak level/bottom value is displayed, instead of the present received light amount.





#### Hold function characteristics

- · Even when the received light amount fluctuates greatly, the peak and bottom levels are displayed, making it possible to determine the difference between the received light amount and the threshold at all times.
- · The received light amount with an object present and with no object present can be checked, making it easier to determine if the set threshold is appropriate.
- · Even when the hold display is in use, detection results are output with the same timing as for the standard display.

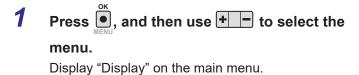
#### Selectable Options

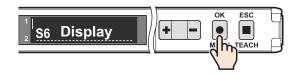
You can select from the following hold display modes.

Selectable option	Function description
Off (default value)	The hold display is not used.
Peak/bottom	Continuously displays the peak level from times when the received light amount exceeded the threshold and the bottom level from times when the received light amount dropped below the threshold. (Refer to page 3-42.)
Peak	Continuously displays only the peak level from times when the received light amount exceeded the threshold. (Refer to page 3-43.)
Bottom	Continuously displays only the bottom level from times when the received light amount dropped below the threshold. (Refer to page 3-43.)
Time	Displays the peak level from times when the received light amount exceeded the threshold and the bottom level from times when the received light amount dropped below the threshold. The display switches between these values once per second. (Refer to page 3-44.)

#### Operation Procedure

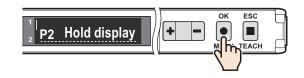
\*To cancel the setting, press the key.





Press , and then use to select the menu.

Display "Hold display" on the sub menu.



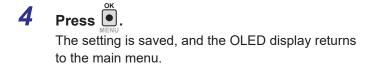
Press ♠, and then use + to select the option to set.

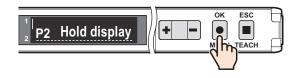


<Options>

Peak/bottom, Peak, Bottom, Time, Off, On\*

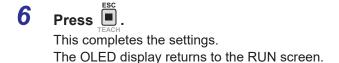
\*Displayed only when "Edge height" is selected in "[D2] Threshold mode".

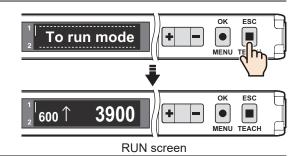












#### Mechanisms of Hold Display

This section explains the display mechanism for each type of hold display.

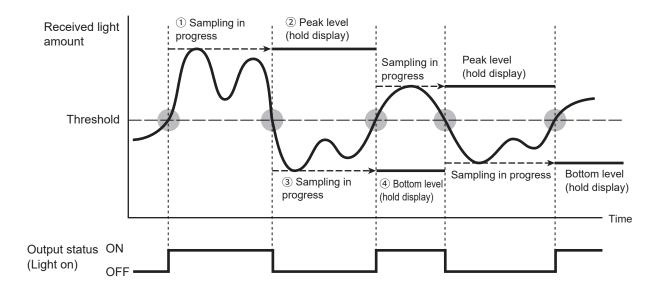
#### OSO MEMO OSO

- The peak and bottom levels displayed with the hold display are numeric values resulting from sampling over a period of time. Therefore, there is a minor time lag compared to the present received light amount and output status.
- · Even when the hold display is in use, detection results are output in real time, the same as with the standard display.

#### Peak/bottom

This mode displays the peak value from times when the received light amount exceeds the threshold and the bottom value from times when the received light amount falls below the threshold.

The peak and bottom values are updated each time the received light amount exceeds or falls below the threshold, respectively.



- ①When the received light amount exceeds the threshold, peak level sampling starts.
- When the received light amount returns to the threshold, the peak level is displayed.
- When the received light amount drops below the threshold, bottom level sampling starts.
- When the received light amount returns to the threshold, the bottom level is displayed.

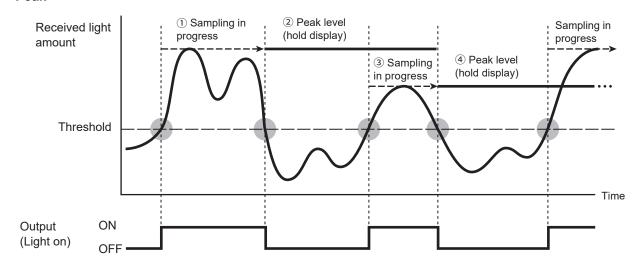
The peak and bottom values are updated each time the received light amount exceeds or drops below the threshold, respectively.

#### Peak or Bottom

These modes display either the peak value from times when the received light amount exceeds the threshold or the bottom value from times when the received light amount drops below the threshold.

The peak or bottom level is updated each time the received light amount exceeds or drops below the threshold, respectively.

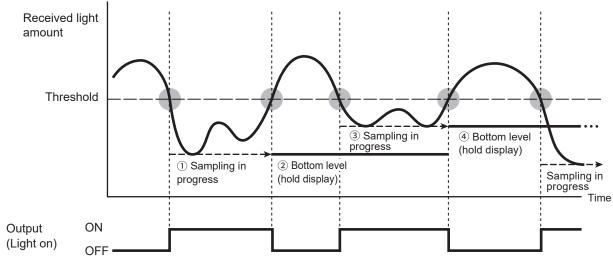
#### <Peak>



- ①When the received light amount exceeds the threshold, peak level sampling starts.
- ②When the received light amount returns to the threshold, the peak level is displayed.
- ③When the received light amount exceeds the threshold again, peak level sampling starts.
- (4) When the received light amount returns to the threshold, the peak level is updated.

The peak level is updated each time the received light amount exceeds the threshold.

#### <Bottom>



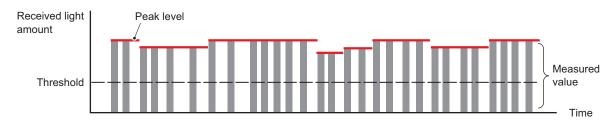
- ①When the received light amount drops below the threshold, bottom level sampling starts.
- ②When the received light amount returns to the threshold, the bottom level is displayed.
- ③When the received light amount drops below the threshold again, bottom level sampling starts.
- (4) When the received light amount returns to the threshold, the bottom level is updated.

The bottom level is updated each time the received light amount drops below the threshold.

#### OSO MEMO OSO

The "Peak" or "Bottom" hold display is useful for detection of small objects, for which the detection time is short, and thus it is difficult to monitor detection values.

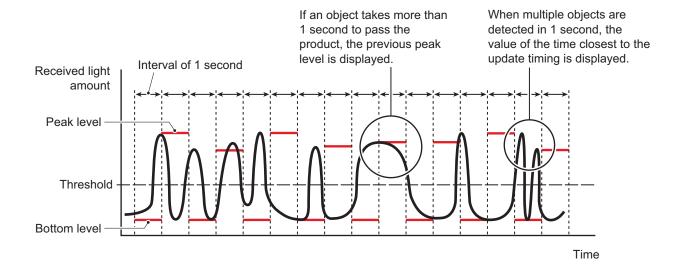
As only the "Peak" or "Bottom" is displayed, it is easy to read only the required values.



#### Time

This mode displays the peak value from times when the received light amount exceeded the threshold and the bottom level from times when the received light amount dropped below the threshold. Each level is displayed for one second.

The peak and bottom values can each be monitored for one second at a time, allowing the received light amounts to be checked even in cases where objects pass the product irregularly and at high speed.



## 3-7-4 [P9] Stretch Mode

This mode displays the received light amount multiplied by the set factor.

No multiplication (difference between threshold and received light amount: 10) x 10 (difference between threshold and received light amount: 100)

x 50 (difference between threshold and received light amount: 500)

100 90 III Received light

amount

1000 900



5000 **4500** 

The values displayed for the received light amount and threshold increase. The larger the multiplication factor, the easier it is to check the difference between the displayed threshold and received light amount.



- If the numeric values of the received light amount and threshold are close, this function can be used to display these
  values multiplied by factors of 10 or 50. This makes it easy to check whether there is a sufficient difference between
  the threshold and received light amount.
- This mode only magnifies the displayed numeric values. It does not amplify the actually detected received light amount.

The value of the received light amount that is transfered via IO-Link communication is also not affected.

#### Selectable Options

You can select from the following stretch factors.

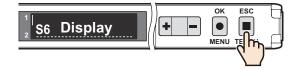
Selectable option	Function description	
Off (default value)	Displays values without multiplication.	
On - x10	Displays the values multiplied by 10.	
On - x50	Displays the values multiplied by 50.	

#### Operation Procedure

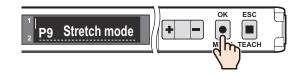
\*To cancel the setting, press the key.

Press ok and then use to select the menu.

Display "Display" on the main menu.

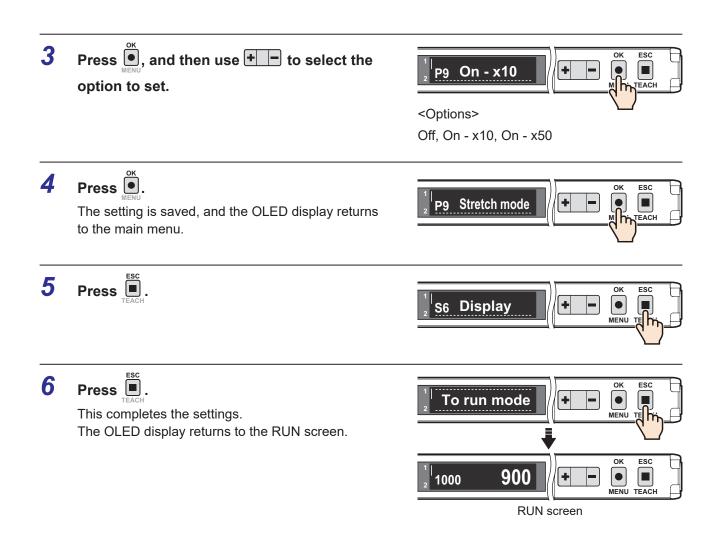


Press , and then use to select the menu.



Display "Stretch mode" on the sub menu.

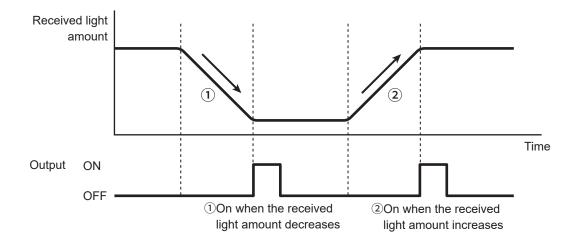
Continued on next page



## 3-7-5 [S7] - [D2] Threshold Mode "Edge height"

Threshold mode of "Edge height" generates outputs when there are sudden changes in the received light amount.

The operating principle is differentiation detection. The received light amount is monitored for the cycle set with "Response time" (default value:  $250~\mu s$ ), and the sensor activates with the difference between the received light amounts for the time set with Edge offset (default value:  $1250~\mu s$ ) and the present value. This mode is applicable for detections such as when the difference in the received light amounts is minimal when detecting small objects and there are slow changes in the received light amounts due to the surrounding environment.





When Threshold mode is set to "Standard", output continues while the received light amount exceeds the threshold. However, with the "Edge height" setting, output is only generated when the received light amount changes.

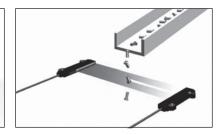
[Detection of transparent film meandering]



[Detection of chips/cracks in liquid crystal glass]



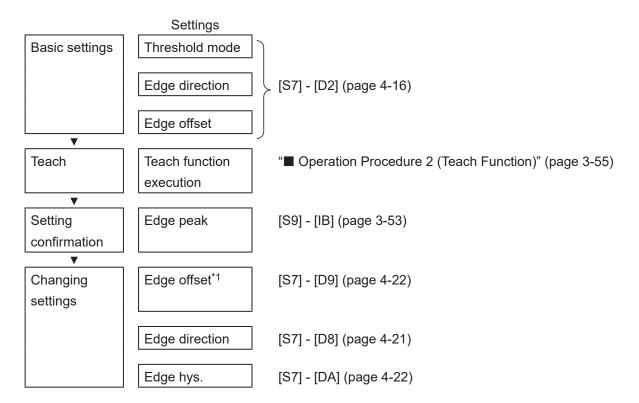
[Detection of small objects dropping]



#### Setup Flow

For the Edge height setting, configure the basic settings with "[S7] - [D2] Threshold mode", and then execute the teach function.

Then, configure the setting parameters related to Edge height as necessary.



<sup>\*1:</sup> To adjust the received light amount for object detection, also change the "[S3] Response time" and "[S7] - [D5] Emitter power" settings as necessary.

#### ■ Threshold Mode ([S7] - [D2])

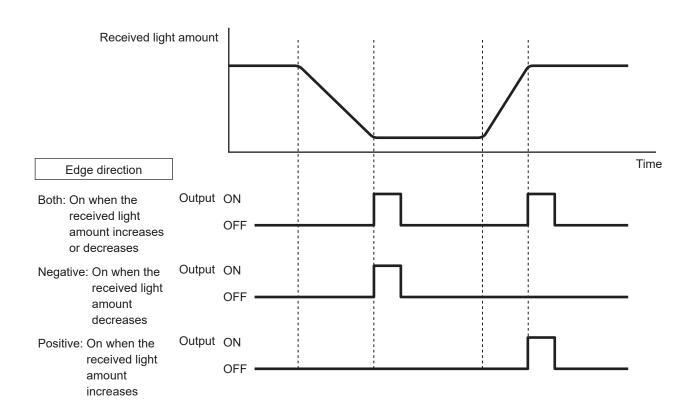
Selecting "Edge height" displays its parameters.

Selectable option	Function description
Standard (default value)	This is the standard threshold mode. Output is generated when the received light amount exceeds the threshold.
Edge height	Select Edge height when detecting with edges (differentiation operation).  Output is generated only when sudden changes in the received light amount occur.
Not used	Disables the control output, preventing output regardless of the received light amount or threshold.

### Edge Direction ([S7] - [D2], [S7] - [D8])

Select a direction of detection with Edge height.

Selectable option	Function description
Both (default value)	Output is generated when the received light amount increases or decreases.
Negative	Output is generated when the received light amount decreases.
Positive	Output is generated when the received light amount increases.



#### · Edge direction criteria

Set Edge direction to match the conditions and methods of detection, as shown below.

(When [S1] "N.O./N.C." is set to N.O.)

Detection condition	Detection method	Edge direction
Detection when object is present	Through-beam	Negative
	Reflective	Positive
Detection when object is not	Through-beam	Positive
present	Reflective	Negative
Detection when object is present and is not present	Reflective, through-beam	Both

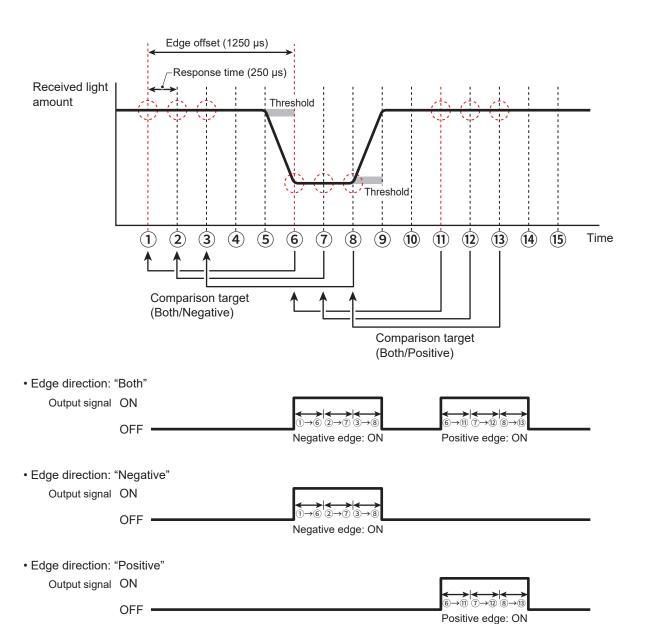
### Edge Offset ([S7] - [D2], [S7] - [D9])

Edge offset sets the length of time to compare for changes to the received light amount. Set it as follows together with "Response time".

- · Edge offset: Sets the length of time to compare the present received light amount and the monitored received light amount.
- Response time: Sets the cycle time (interval) to monitor the received light amount.

Example) With Response time set to 250 μs and Edge offset set to 1250 μs

The received light amount is monitored for the cycle set with Response time (an interval of 250 μs), and then the received light amount from the time set with Edge offset (1250 μs) before is compared with the present received light amount.



#### Setting Description

The Edge offset that can be set varies depending on the "[S3] Response time" setting. Before setting Edge offset, set "[S3] Response time" appropriately.

Selectable option	Function description
16 μs to 4080 μs (default value: 160 μs)	Selectable when "Response time" is set to 16 μs <sup>*1</sup>
22 μs to 5610 μs (default value: 220 μs)	Selectable when "Response time" is set to 22 μs <sup>*2</sup>
70 μs to 17850 μs (default value: 700 μs)	Selectable when "Response time" is set to 70 μs
250 μs to 63750 μs (default value: 2500 μs)	Selectable when "Response time" is set to 250 μs
0.5 ms to 127.5 ms (default value: 5.0 ms)	Selectable when "Response time" is set to 500 μs
1 ms to 255 ms (default value: 10 ms)	Selectable when "Response time" is set to 1 ms
2 ms to 510 ms (default value: 20 ms)	Selectable when "Response time" is set to 2 ms
8 ms to 2040 ms (default value: 80 ms)	Selectable when "Response time" is set to 8 ms

<sup>\*1:</sup> Stand-alone unit and inter-connection main unit with stand-alone use

<sup>\*2:</sup> Main and expansion units connected



The default value of Edge offset is set to 10 times the value of Response time (the received light amounts at present and at the time before multiplying response time by 10 are compared). Changing Edge offset adjusts the duration to compare as follows.

- Shorter Edge offset
   Performs comparison with the recent received light amount.

   Setting the shortest time performs the comparison with the previous received light amount.
- Longer Edge offset
   Performs comparison with a received light amount from a longer time before the present value.

   Setting the longest time possible compares with the data from 255 times before the present received light amount.

### Edge hys. ([S7] - [DA])

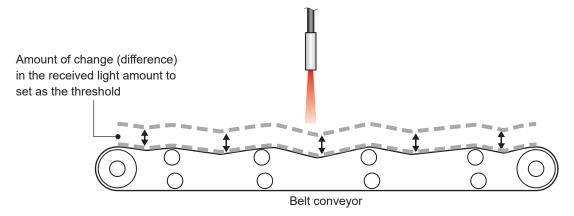
Change this setting to adjust the hysteresis to turn the output on and off with the Edge height mode. For details, refer to 4-6-10 [S7] - [DA] Edge hys." (page 4-22).

### ■ Teach for Edge height (🗓)

When setting Edge height mode, execute the teach function with no object present.

When the teach function is executed, the amount of change (difference) in the received light amount with the background is set as the threshold.

• Teach function execution example of detection on a transfer line with large fluctuation

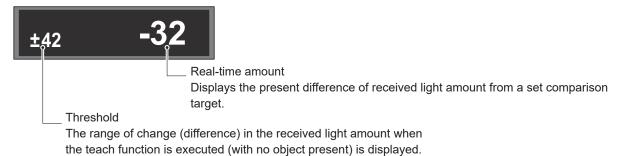


Changes greater than the above range of received light amount are judged as the presence of an object.

· Threshold display

The threshold set with the teach function is displayed on the RUN screen.

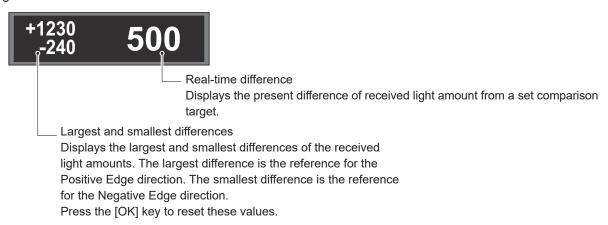
<RUN screen>



### ■ Edge Peak Display ([S9] - [IB])

This displays the the largest, smallest, and present differences between the received light amounts of the measured and set comparison targets.

This function is useful when checking whether objects are detected appropriately with the Edge height setting.



If the Edge peak display is shown as follows, judgments are not performed appropriately with the Edge height setting, so make adjustments according to the following table.

No changes of real-time difference
 No light is received.



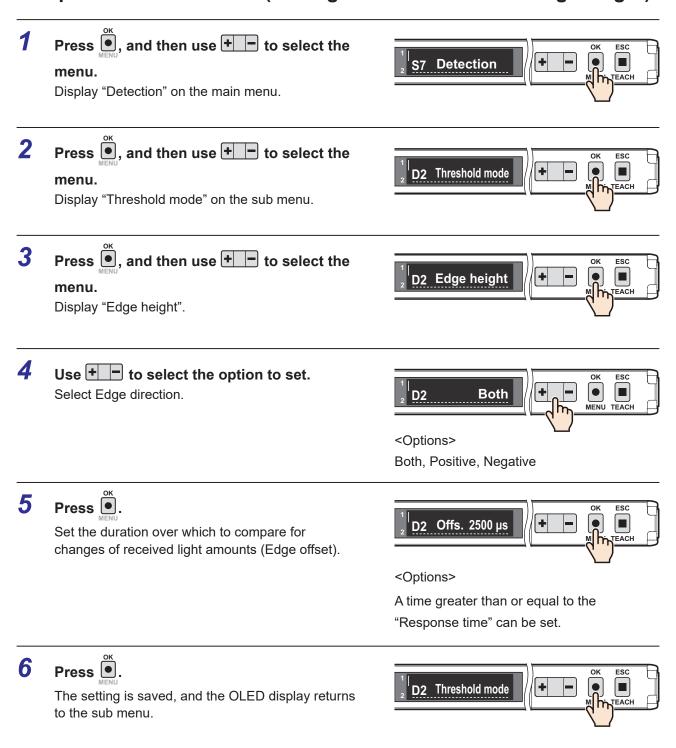
The difference of the received light amounts does not exceed the threshold
 Differences in the received light amounts have been measured. However, the changes are too small to exceed the set thresholds, so no output is generated.





Setting menu	Adjustment procedure
Edge offset/Response time	"Edge offset" or "Response time" is too short, so the differences do not reach the thresholds.
Emitter power	If the received light amounts are too low or too high, it may lead to prevent small objects from being detected or lead to saturation.

### **Operation Procedure 1 (Setting Threshold mode to Edge height)**



Continued on next page

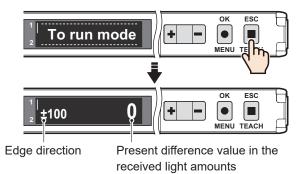
### 7 Hold down for 3 seconds or more.

The OLED display returns to the RUN screen.

The screen switches to the Edge display. The displayed numeric value is the difference in the received light amounts. The sign for the Edge direction(s) are indicated in front of the threshold values.

- +: Positive
- -: Negative
- ±: Both
- \*The display of the RUN screen can be changed to "Value", which displays the numeric value of the received light amount.

Select "Value" for "[S6] Display" - "[P1] Display mode".



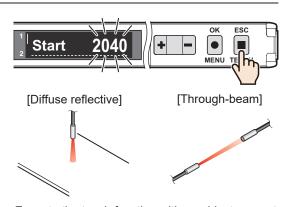
### Operation Procedure 2 (Teach Function)

When setting Edge height, execute the teach function with no object present, regardless of the detection method.

### OSO MEMO OSO

If setting parameters related to Edge height (Response time, Threshold mode, Edge direction, Edge offset, and Edge hys.) have been changed, execute the teach function again.

- \*To cancel the setting of the teach function, press the key.
- \*To select the channel to teach (output 1 or output 2) in advance, hold down the key for 1 second or more.
- With no object present, hold down for 1 second or more.
  - The numeric value blinks, and the measurement of the received light amount starts.
  - The output indicator of the output (output 1 or output 2) that was set with the teach function blinks in orange.



Execute the teach function with no object present.

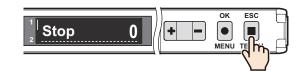
Continued on next page

#### 2 After a certain amount of time has passed (less than 30 seconds), hold down end for 1 second or more.

This completes the measurement of the received light amount.

\*If approximately 30 seconds elapse with end not being held down, the teach function will be canceled, and the threshold will not be set.

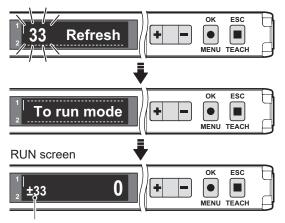
\*For applications with large fluctuations of received light amount, press less quickly (within approximately 30 seconds). Changes in the received light amounts will be included in the threshold setting.



#### The saved threshold blinks.

The OLED display automatically returns to the RUN screen.

This completes the setting of the teach function.



Thresholds, the range of differences of received light amount, set by teaching without an object are displayed.

### 3-7-6 [SC] Reset

Resets the settings of this product.

#### Selectable Options

You can select from the following reset modes.

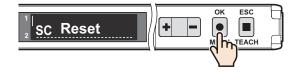
Selectable option	Function description
Setting reset	Returns the settings of this product to the factory defaults. The preset data in which product settings have been registered are excluded.  For details on presets, refer to page 4-27.
Factory reset	Returns all of the settings of this product to the factory defaults.

### Operation Procedure

\*To cancel the setting, press the TEACH key.

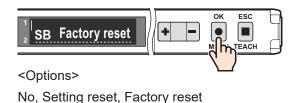
Press on the main menu.

Oisplay "Reset" on the main menu.



Press , and then use to select the option to set.

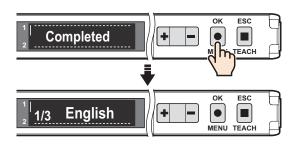
Display the reset mode.



3 Press ok

This completes the reset.

The initial settings screen is displayed, so carry out the procedure in 43-2 Setup on First Startup" (page 3-4) again.



Initial settings screen



# **Settings Menu**

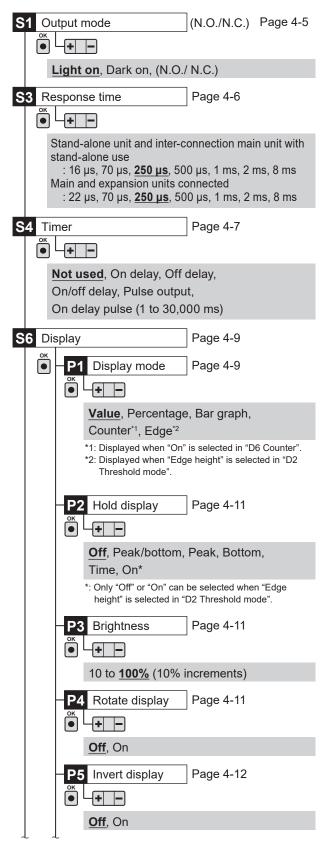
This section explains how to set the parameters of this product.

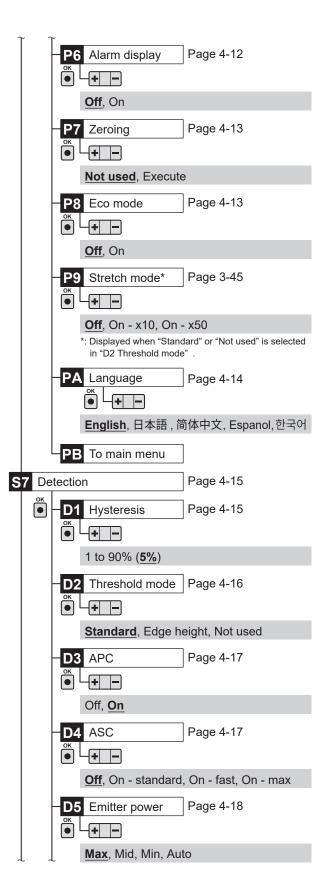
Ramco Innovations www.ramcoi.com 800-280-6933 nsales@ramcoi.com

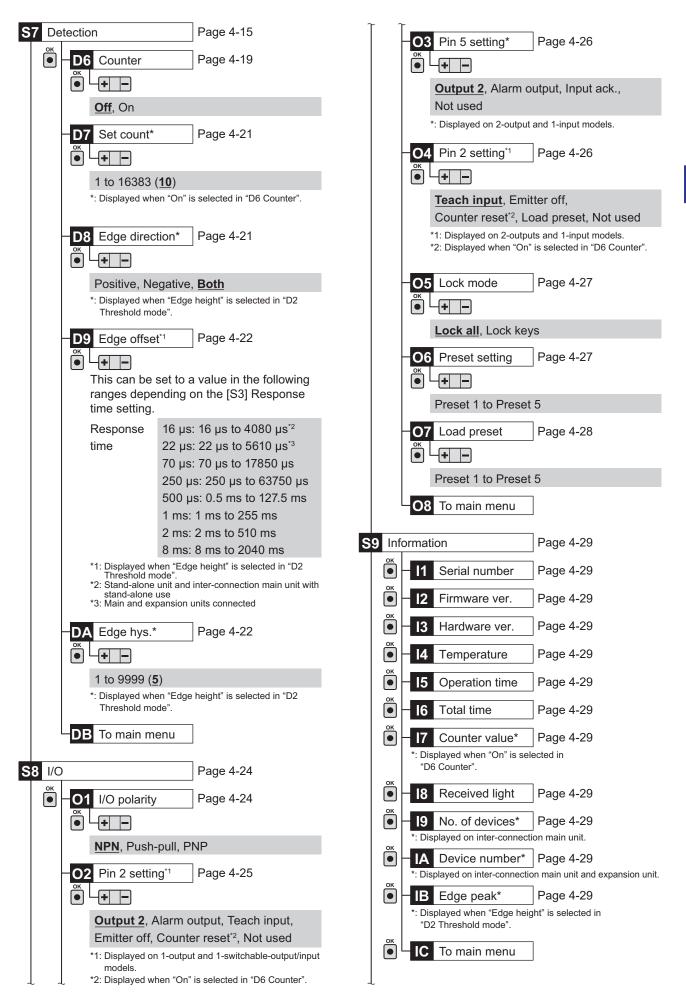
# 4-1 List of Setting Options

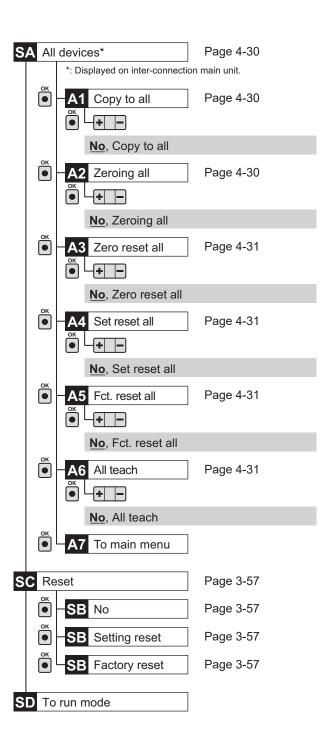
A list of the options that can be set on this product is shown below.

The initial settings are indicated with underlining.









# [S1] Output mode (N.O./N.C.)

Selects the control output mode from light on (on when light is received) and dark on (on when light is not received).

For details on this function and how to set it, refer to 43-7-1 [S1] Output Mode (N.O./N.C.)" (page 3-35).

Ramco Innovations www.ramcoi.com 800-280-6933 nsales@ramcoi.com

# 4-3 [S3] Response time

Selects the response time of this product.

For details on this function and how to set it, refer to 43-7-2 [S3] Response Time" (page 3-37).

## 4-4 [S4] Timer

This function delays the control output of this product.

### Selectable Options

You can select the timer setting from the following six timer modes.

Selectable option	Function description	Setting value
Not used	Do not use the timer function. (Default value)	_
On delay	The output is delayed by the set time after the on judgment.	1 to 30,000 ms (default
Off delay	The output is delayed by the set time after the off judgment.	value: 1 ms)
On/off delay	The On delay and Off delay timers are activated.	
Pulse output	Output turns on for the set period of time after the on judgment.	
On delay pulse	The On delay and Pulse output timers are activated.	

### On delay

After the on judgment, output is not generated until the set timer duration elapses.

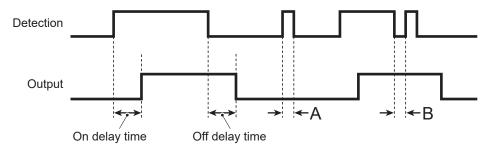
Even if there are detections shorter than the timer duration, no output is generated, preventing the output of fluctuating detection results due to, for example, noise.

### Off delay

This function prevents the output from turning off immediately after detection changes to off, as the output is held for the set timer duration.

This makes it possible to extend the output duration by the set time, even when the detection time is short. This allows for input to input equipment that cannot receive short input signals.

Example) On delay and Off delay timing chart



The detection and output turning on/off differs in the above diagram.

#### <On delay operation>

When detection is made for a duration that exceeds the On delay time, the output turns on. Therefore, even if detection is judged momentarily, as indicated by A, output is not generated.

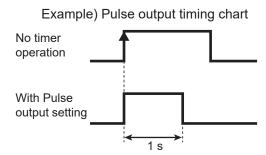
This prevents chattering caused by short noise.

#### <Off delay operation>

The output is turned off at the set timer time after the detection becomes off. Therefore, even if the detection becomes OFF momentarily, as indicated by B, the output does not turn off. This prevents chattering. Furthermore, setting an Off delay can lengthen the output time in cases where the objects are small and the sensor only turns on for brief periods of time. The result is that even slow-speed controllers can capture momentary changes.

### Pulse output

The pulse output is held for the set timer time from the time the detection becomes on. The chart on the right shows the pulse output for 1 second.



### On/off delay

The On delay and Off delay timers both are activated.

The times for the output switching from off to on and from on to off can both be delayed.

The On delay and Off delay times can be set separately.

### On delay pulse

The On delay and Pulse output timers both operate.

The time for the output switching from off to on can be delayed, and the on status can be maintained until the set time elapses.

The On delay and Pulse output times can be set separately.

[S4] Timer

# 4-5 [S6] Display

This section explains how to set the display modes and received light amounts on the OLED display.

## 4-5-1 [S6] - [P1] Display mode

Sets how to show the received light amount on the OLED display.

### Selectable Options

You can select from the following display modes.

Selectable option	Function description
Value (default value)	Displays the received light amount as a numeric value.
Percentage	Displays the received light amount as a percentage (%) of the threshold.  This setting makes it easy to understand information such as differences in received light amount between multiple amplifiers and daily changes.
Bar graph	Displays the received light amount and one or more thresholds on a bar graph.  This setting makes it easy to check the threshold margin in relation to the received light amount.
Counter*1	Displays the set count and the present count in Counter mode.
Edge*2	Displayed when Edge height is selected. Displays the amount of change (difference) when the received light amount changes.

<sup>\*1:</sup> Displayed when "On" is selected in "[S7] - [D6] Counter".

#### Value

Displays the received light amount as a relative numeric value between 0 and 9999.

You can also use 43-7-4 [P9] Stretch Mode" (page 3-45) to display this value in the range of 0 to 99999.

### Percentage

Displays the received light amount as a percentage (%) of the threshold.

The received light amount during the execution of the teach function is set as 100%.

Example) After executing the teach function with the 2-point setting

The higher received light amount from the two times the teach function was executed is set as 100%.



<sup>\*2:</sup> Displayed when "Edge height" is selected in "[S7] - [D2] Threshold mode".

Example) After executing the teach function with the 1-point Zone or 2-point Zone setting The thresholds for the upper and lower limits are displayed.

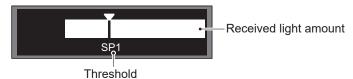


#### Bar graph

Displays the received light amount on a bar graph.

One or more thresholds are also displayed on the bar graph.

Teach mode: 1 point, 2 points, Auto, and Through



Teach mode: 1-point Zone and 2-point Zone



Threshold (upper limit) Threshold (lower limit)

#### Counter

Displays the set count and the present count in Counter mode.

For details on Counter mode, refer to 4-6-6 [S7] - [D6] Counter" (page 4-19).

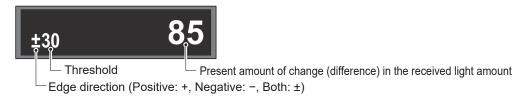


### Edge

This is displayed when Threshold mode is set to Edge height.

When the received light amount changes, the amount of change (difference) is displayed.

For details on Edge height, refer to 43-7-5 [S7] - [D2] Threshold Mode "Edge height" (page 3-47).



#### [S6] - [P2] Hold display 4-5-2

Continuously displays the highest value (peak level) and lowest value (bottom level) among all the times the received light amount exceeds the threshold and drops below the threshold.

For details on the Hold display function and how to set it, refer to 43-7-3 [P2] Hold Display" (page 3-40).

### [S6] - [P3] Brightness

You can set the screen brightness to one of nine levels.

You can extend the service life of the OLED display by setting Brightness to the lowest acceptable value.

### Selectable Options

Selectable option	Function description
Brightness (default value: 100%)	10 to 100% (in increments of 10%)



When Brightness is set to 40 to 100%, it is lowered to 20% to extend the service lifetime of OLED display, if no key of this product is operated for 2 minutes.

#### [S6] - [P4] Rotate display 4-5-4

You can flip the vertical orientation of the OLED display.

Set this mode to match the installation direction of the fiber amplifier.

Selectable option	Function description
Off (default value)	This is the standard display orientation.
On	Flips the vertical orientation of the OLED display.
	Select this option when installing the fiber amplifier with its top and bottom reversed.

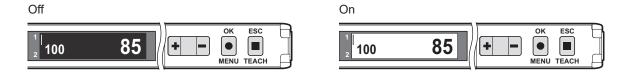
Off 85 100



## 4-5-5 [S6] - [P5] Invert display

You can invert the colors of the text and background on the OLED display.

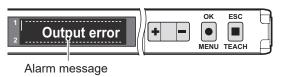
Selectable option	Function description
Off (default value)	This is the standard display with white characters on a black background.
On	Inverts the colors of the text and background. The text becomes black and the background white.



## 4-5-6 [S6] - [P6] Alarm display

Shows the internal diagnosis information of this product as alarms on the OLED display.

Example) Display of a short-circuit on an output line



Selectable option	Function description
Off (default value)	Alarms will not be displayed.
On	The following alarms will be displayed.
	Received light*1: The received light amount diagnosis value drops to 50% or less.  High temp.*1: The internal temperature exceeds the specified temperature.  Low temp.*1: The internal temperature drops below the specified temperature.  Operat. hours*1: The operating time exceeds 40000 hours.  Output error: A short-circuit occurs on an output line.

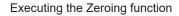
<sup>\*1:</sup> With IO-Link device models, the warning limits can be set via IO-Link. For information on the index corresponding to this diagnosis function of IO-Link communication, refer to the index list.

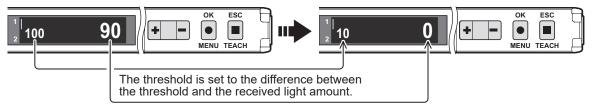
## 4-5-7 [S6] - [P7] Zeroing

Executing the Zeroing function sets the current received light amount as zero.

Use this function when, for example, you want to set the reference received light amount as zero or you want to set no object present as zero but the actual received light amount is not zero.

Selectable option	Function description
Not used (default value)	The Zeroing function will not be used.
Execute	Executes the Zeroing function (displays the received light amount at the time of execution as zero).





The received light amount is set as zero.

## 4-5-8 [S6] - [P8] Eco mode

You can set to turn off the OLED display to reduce power consumption.

When there are no key operations for 2 minutes, this product switches to Eco mode and turns off the OLED display. The display turns on again when any key is operated.

Selectable option	Function description	
Off (default value)	Eco mode will not be used.	
On	Switches to Eco mode.	



## 4-5-9 [S6] - [P9] Stretch mode

The received light amount can be displayed with the value multiplied by 10 or 50.

This function only increases the displayed values, it does not amplify the actual received light amount. For details on the Stretch mode function and how to set it, refer to 43-7-4 [P9] Stretch Mode" (page 3-45).

## 4-5-10 [S6] - [PA] Language

Sets the language of the menu text on the OLED display.

### Selectable Options

You can select from the following five languages.

Selectable option	Function description	
English (default value)	The text is displayed in English.	
日本語	The text is displayed in Japanese.	
简体中文	The text is displayed in Simplified Chinese.	
Espanol	The text is displayed in Spanish.	
한국어	The text is displayed in Korean.	

## 4-6 [S7] Detection

This function is used to configure advanced settings related to detection, such as making adjustments to the reference for detection judgment, the output timing, the emitter power, and the sensitivity.

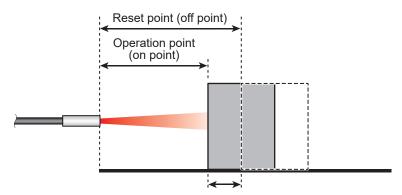
## 4-6-1 [S7] - [D1] Hysteresis

This function adjusts the received light amounts to turn the output on and off (it configures the margin between these levels).

These received light amounts are referred to as shown below, and this margin in (gap between) the received light amounts is referred to as hysteresis.

Example with Light On Operation

- · Operation point: Received light amount that makes the output turn on, Threshold
- · Reset point: Received light amount that makes the output turn off



Hysteresis (default value is set to -5% of the set threshold)

Adjust the value of Hysteresis to set the margin in the received light amounts of the operation and reset points.

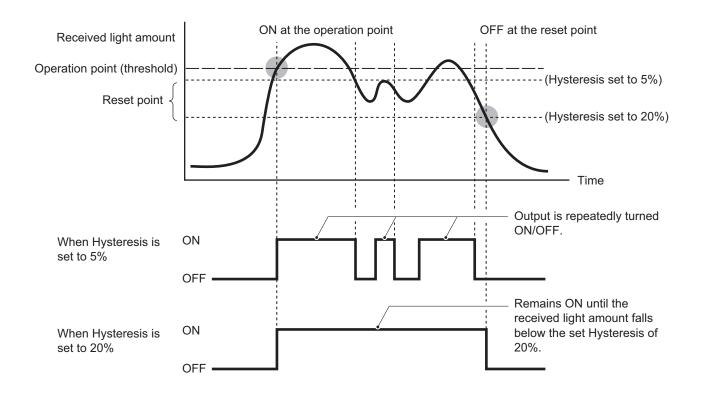
For example, set a larger value to reduce detection instability caused by fluctuation of reflection from an object and a smaller value to detect small height differences.

### Stabilizing Object Detection Near the Threshold

The received light amounts frequently crossing the threshold causes unstable output. In this situation, increasing the Hysteresis value lowers the light amount of the reset point to stabilize the output.

Example) Adjusting the Hysteresis setting from 5% to 20% (diffuse reflective)

Lowering the received light amount of the reset point makes the output more stable when there are small changes of the received light amount.



### Selectable Options

Selectable option	Function description	
Hysteresis (default value:	1 to 90%	
5%)	The reset point is set by subtracting the percentage (%) of Hysteresis from the received	
	light amount of the threshold.	

#### 4-6-2 [S7] - [D2] Threshold mode

Sets the judgment method for object detection.

### **Selectable Options**

Selectable option	Function description
Standard (default value)	This is the standard mode.
	The received light amount exceeding or falling below the threshold is judged to indicate
	that an object is or is not present, and output to an external device is generated.
Edge height	Select Edge height for edge detection based on the differential.
	Output is generated only when the difference of received light amounts exceeds the set
	range.
Not used	Disables the control output, so that it does not operate regardless of the received light
	amount and threshold.

For details on Edge height, refer to 43-7-5 [S7] - [D2] Threshold Mode "Edge height" (page 3-47).

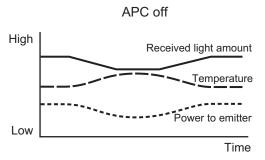
### 4-6-3 [S7] - [D3] APC

This function automatically adjusts the power input to the emitter LED.

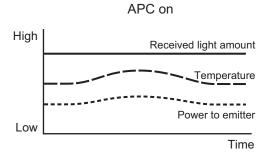
When the emitter power becomes unstable due to the ambient temperature or aging deterioration of the LED, this function stabilizes detection by maintaining the emitter power.



- This function is effective when the difference in the received light amounts with and without an object is small.
- Use of this function for a long time will slightly shorten the service life of the LED.



The power to the emitter changes due to the temperature change, making the received light amount change.



The power to the emitter is adjusted according to the temperature change to maintain a constant received light amount.

#### Selectable Options

Selectable option	Function description	
On (default value)	Enables the APC function.	
Off	The APC function is not used.	

## 4-6-4 [S7] - [D4] ASC

This function monitors the received light amount when no object is present, and correspondingly adjusts the threshold.

Through the use of product, the received light amount may decrease due to factors such as contamination of the optical system, eventually resulting in errors by falling below the threshold. Enabling the ASC function lowers the threshold to match decreases in the received light amount, allowing for long-term stable detection. This function is especially effective when detecting transparent objects.

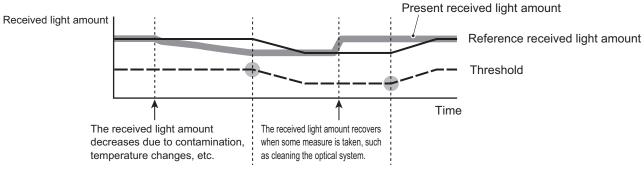
### ■ Before Using This Function

- This function only supports output 1.
- · Before using this function, execute the teach function.
- · This function cannot be used in the following modes.
  - Teach mode: "1-point Zone" or "2-point Zone"
  - Threshold mode: "Edge height"

If the product is changed to one of the above modes while this function is in use, this function will be disabled.

#### Adjustment Example

The threshold is automatically adjusted when the received light amount decreases due to contamination, temperature changes, etc.



The threshold is adjusted correspondingly when the reference received light amount changes following the present received light amount.

#### Selectable Options

Selectable option	Function description	
Off (default value)	The ASC function is not used.	
On - standard	When the received light amount changes, the threshold is adjusted by 1 every 3 seconds.	
On - fast	When the received light amount changes, the threshold is adjusted by 1 every 1 second.	
On - max	When the received light amount changes, the threshold is adjusted by 1 every 0.25 seconds.	

## 4-6-5 [S7] - [D5] Emitter power

This functions adjusts the light emittance level of the LED.

This enables detection by lowering the emitter power, thus lowering the received light amount when, regardless of object presence the detection cannot be made due to saturation by too much of received light amount.

It is effective when the emitter and receiver of a through-beam fiber unit are installed very closely and for diffuse reflective fiber units installed close to the object and background.



Saturation refers to the situation where the object cannot be detected because there is no difference in the light amounts with and without an object due to the received light amounts being too large.

### Selectable Options

Selectable option	Function description
Max (default value)	The emitter power can be selected from three options.
Mid	The received light amount with the selected emitter power is displayed on the right of the
Min	screen.
Auto	The emitter power is automatically adjusted to prevent saturation upon teaching.

### 4-6-6 [S7] - [D6] Counter

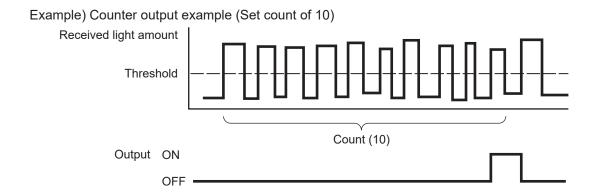
This mode counts the number of times that objects are detected, and generates output when the target count specified with "[S7] - [D7] Set count" is reached.



#### Counter usage example

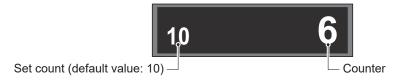
If the number of products to be contained into a package box is set to 10, setting Set count to 10 generates output when the 10th product is detected.

This allows output to be generated once per box.



### Counter Display

In place of the received light amounts, the set count and the present count are displayed.



\*When the counter value reaches the set count, it is reset to 1 when the next object is detected.

### ■ Selectable Options

Selectable option	Function description	
Off (default value)	Counter mode is not used.	
On	Enables Counter mode. Set count is set to 10 as default. It can be set to a value in the range of 1 to 16383.	

### Operation Procedures

\*To cancel the setting, press the key.

Press , and then use to select the menu.

Select "S7 Detection" on the main menu.

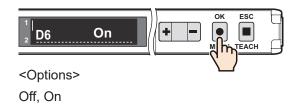


Press, and then use to select the menu.

Select "D6 Counter" on the sub menu.



3 Press ♠ and then use + to select "On".



4 Press ok

The Set count is displayed. (Default value: 10)



5 Use + - to set the Set count.

\*It can be set to a value in the range of 1 to 16383.



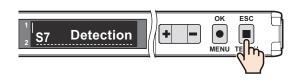
6 Press ok MENU.

The setting is confirmed, and the OLED display returns to the sub menu.



7 Press ...

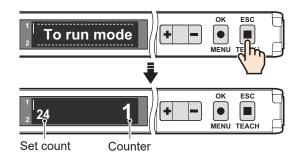
The OLED display returns to the main menu.



Continued on next page



This completes the settings.
The OLED display returns to the RUN screen.



### Related Setting

You can change the Set count ([S7] - [D7]).

In Counter mode, this setting indicates how many objects must be detected (counter) to generate output. This setting parameter is only displayed when Counter ([S7] - [D6]) is enabled.

Setting menu	Function description	
Set count ([S7] - [D7])	In Counter mode, this setting indicates how many objects must be detected (counter) to generate output.  1 to 16383, default value: 10	

### 4-6-7 [S7] - [D7] Set count

This setting parameter is only displayed when Counter ([S7] - [D6]) is enabled.

For details on Counter mode and Set count, refer to 4-6-6 [S7] - [D6] Counter" (page 4-19).

#### Selectable Parameters

Selectable parameter	Function description
Set count (default value: 10)	1 to 16383

# 4-6-8 [S7] - [D8] Edge direction

This menu sets the direction of received light amount to be detected in the Edge mode.

This setting parameter is only displayed when Threshold mode ([S7] - [D2]) is set to Edge height.

For details on Edge height, refer to 43-7-5 [S7] - [D2] Threshold Mode "Edge height" (page 3-47).

#### Selectable Options

Selectable option	Function description	
Positive	Output is generated when the received light amount increases.	
Negative	Output is generated when the received light amount decreases.	
Both (default value)	Output is generated when the received light amount increases or decreases.	

#### [S7] - [D9] Edge offset 4-6-9

This menu sets the interval in which to compare difference in the received light amounts with Edge mode. This setting parameter is only displayed when Threshold mode ([S7] - [D2]) is set to Edge height. For details on Edge height, refer to 43-7-5 [S7] - [D2] Threshold Mode "Edge height" (page 3-47).

#### Selectable Parameters

The Edge offset that can be set varies depending on the "[S3] Response time" setting. Before setting Edge offset, set "[S3] Response time" appropriately.

Selectable parameter	Function description
16 μs to 4080 μs (default value: 160 μs)	Selectable when "Response time" is set to 16 μs <sup>*1</sup>
22 μs to 5610 μs (default value: 220 μs)	Selectable when "Response time" is set to 22 μs*2
70 μs to 17850 μs (default value: 700 μs)	Selectable when "Response time" is set to 70 μs
250 μs to 63750 μs (default value: 2500 μs)	Selectable when "Response time" is set to 250 μs
0.5 ms to 127.5 ms (default value: 5.0 ms)	Selectable when "Response time" is set to 500 μs
1 ms to 255 ms (default value: 10 ms)	Selectable when "Response time" is set to 1 ms
2 ms to 510 ms (default value: 20 ms)	Selectable when "Response time" is set to 2 ms
8 ms to 2040 ms (default value: 80 ms)	Selectable when "Response time" is set to 8 ms

<sup>\*1:</sup> For a stand-alone unit, and inter-connection main unit with stand-alone use

### 4-6-10 [S7] - [DA] Edge hys.

The Edge hys. (edge hysteresis) is a function to set a hysteresis between the amounts of light received when the output is turned on and the output is turned off in the Edge mode.

Each change (difference) in received light amounts is called as follows, and the range between the differences in received light amounts is called hysteresis.

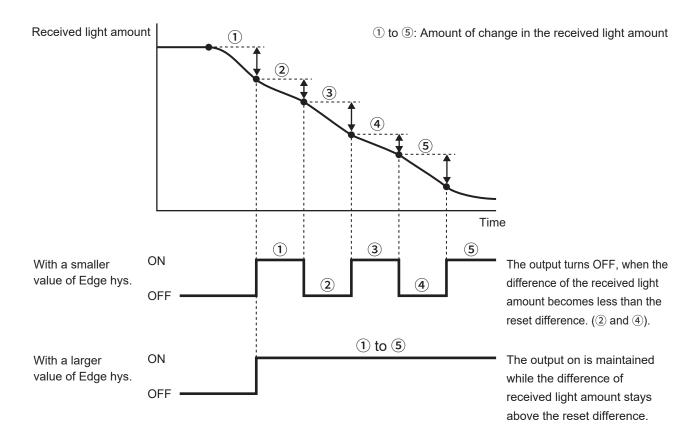
- Operation difference: Turn the output on when the change of received light amount reaches the difference
- Reset difference: Turn the output off, while the output is on, when the change of received light amount falls below the difference

<sup>\*2:</sup> For main and expansion units when connected

Adjust the value of Edge hys. for a range of received light amount below the operation difference to hold the

For example, if you want to reduce the detection fluctuation caused by vibration, set a larger Edge hys., and if you want to detect small objects, set a smaller Edge hys.

Example) Output results using the Edge hys. setting (with a through-beam fiber unit) When the value of Edge hys. is increased, the reset difference of the received light amount becomes smaller, thus the on output is maintained for a larger range of received light amounts compared with the operation difference.



This setting parameter is only displayed when Threshold mode ([S7] - [D2]) is set to Edge height. For details on Edge height, refer to (3-7-5 [S7] - [D2] Threshold Mode "Edge height" (page 3-47).

#### Selectable Parameters

Selectable parameter	Function description
Edge hys. (default value: 5)	1 to 9999 The reset difference set with Edge hys. is set by subtracting the set value from the operation difference.

# 4-7 [S8] I/O

This function configures the settings of external input/output, such as I/O polarity, external input mode, lock mode, read/write of presets, etc.

## 4-7-1 [S8] - [O1] I/O polarity

This menu sets the I/O polarity of this product.

### Selectable Options

Selectable option	Function description
NPN (default value)	Sets the polarity to NPN.
Push-pull	Sets the polarity to push-pull.
PNP	Sets the polarity to PNP.

## 4-7-2 [S8] - [O2] Pin 2 setting

This assigns the (I/O) function of the white wire.

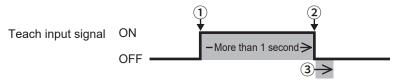
For the setting of pin 2 on analog output types, refer to 4-7-4 [S8] - [O4] Pin 2 setting" (page 4-26).

#### Selectable Options

Selectable option	Function description
Output 2 (default value)	Sets as control output 2.
Alarm output	The received light amount set for output 1 is monitored in the range of 0 to 254%. When the received light amount becomes less than 50%, the alarm output is generated.  For details on received light amount diagnosis, refer to 4-8 [S9] Information" (page 4-29).
Teach input*1	Sets as an external input for teach.
Emitter off	Sets as an external input to turn off the emitter.
Counter reset*2	Sets as an external input to reset the counter.
Not used	Disables this I/O.

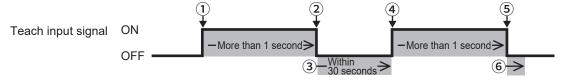
- \*1: To execute the teach function via external input, follow the instructions below.
  - •"1 point", "Through", and "1-point Zone" teach modes

In the teach menu, select a teach mode to execute, and then enter an input at the following timing.



- 1 Enter the teach input for one second or more.
- 2 Turn off the input.
- ③ At the point of input off, teach is executed to set a threshold. (this completes the execution of the teach function).
- •"2 points", "Auto", and "2-point Zone" teach modes

On the teach menu, select the teach mode to execute, and then enter the teach input at the following timing.



- ① Enter the teach input of the first teach point for more than a second.
- 2 Turn off the teach input.
- 3 At the point of input off, the teach is executed to set a threshold of the first teach point.
- ④ Within 30 seconds, enter the teach input of the second point for more than a second.
- 5 Turn off the teach input.
- ⑥ At the point of input off, teach is executed to set a threshold of the second point (this completes the execution of the teach function).
- \*2: Displayed when "On" is selected in "[D6] Counter".

## 4-7-3 [S8] - [O3] Pin 5 setting

This assigns the (output) function of the gray wire.

This setting is applicable to 2-output models, D4RF-TD\*.

### Selectable Options

Selectable option	Function description
Output 2 (default value)	Sets as control output 2.
Alarm output	The received light amount set for output 1 is monitored in the range of 0 to 254%. When the received light amount becomes less than 50%, the alarm output is generated.  For details on received light amount, refer to 4-8 [S9] Information" (page 4-29).
Input ack.	When teach or preset readout is executed by an external input successfully, ON output will be generated for 20 ms or longer within 100 ms as an acknowledgment.  Example) Successful teach execution via external input
	Teach input ON OFF Successful execution Input ack. ON OFF
	100 ms or less Turns ON for 20 ms or longer.
Not used	Disables this I/O.

## 4-7-4 [S8] - [O4] Pin 2 setting

This assigns the (input) function of the white wire.

This setting is applicable to 2-output models, D4RF-TD\*.

### Selectable Options

Selectable option	Function description
Teach input (default value)	Sets as the external teach input.
Emitter off	Sets as an external input to turn off the emitter.
Counter reset	Sets as an external input to reset the counter.
Load preset	Sets to load preset settings. The pulse width of the input signal specifies the preset setting to load as shown below. Preset 1: 50 ms to 100 ms Preset 2: 150 ms to 200 ms Preset 3: 250 ms to 300 ms Preset 4: 350 ms to 400 ms Preset 5: 450 ms to 500 ms
Not used	Disables this I/O.

# 4-7-5 [S8] - [O5] Lock mode

This sets the target settings of this product to be locked.

For details on the Lock function, refer to (3-6-3 Lock Function" (page 3-31).

## 4-7-6 [S8] - [O6] Preset setting

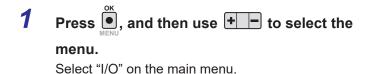
You can register (save) up to five sets of parameters on this product.

Preregistered setting parameters of different operations can be loaded according to operation changes. Settings [S1] to [S8] in the main menu and the thresholds can be registered.

### Operation Procedures

\*To cancel the setting, press the key.

\*Set the threshold and the parameters according to (3-4 Setting the Threshold (Teach Function)" (page 3-7) and the information for [S1] to [S8] on the main menu (Page 4-5 to Page 4-28).





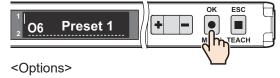
Press , and then use to select the menu.

Select "Preset setting" on the sub menu.



Press , and then use to select the preset number to save.

You can select "Preset 1" to "Preset 5".

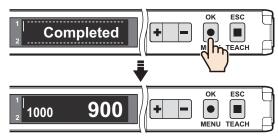


Preset 1, Preset 2, Preset 3, Preset 4, Preset 5



This completes the settings.

The OLED display returns to the RUN screen.



RUN screen

## 4-7-7 [S8] - [O7] Load preset

Loads settings (Preset 1 to Preset 5) saved with [O6] Preset setting.

### CAUTION

Note that executing the Load preset function overwrites the present settings, which cannot be recovered.



When this product is shipped from the factory, the factory defaults are registered to the settings in Preset 1 to Preset 5. Before using this function, use [S8] - [O6] Preset setting to register settings.

### Operation Procedures

\*To cancel the setting, press the key.

Press , and then use to select the menu.

Select "I/O" on the main menu.



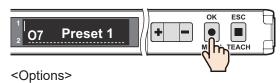
Press ok and then use to select the menu.

Select "Load preset" on the sub menu.



Press on, and then use to select the preset number to load.

You can select "Preset 1" to "Preset 5".

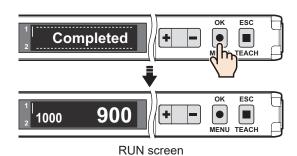


Preset 1, Preset 2, Preset 3, Preset 4, Preset 5

4 Press ok

This completes the settings.
The OLED display returns to the RUN screen.

\*If the Load preset function is executed without first registering settings to Preset 1 to Preset 5, the factory default settings will be loaded. Also, the OLED display will be switched to English.



# [S9] Information

This displays the information of this product.

Selectable option	Function description		
[S9] - [I1] Serial number	Displays manufactured time.		
[S9] - [I2] Firmware ver.	Displays firmware version.		
[S9] - [I3] Hardware ver.	Displays hardware version.		
[S9] - [I4] Temperature	Displays internal temperature of this product in Celsius.		
[S9] - [I5] Operation time	Displays operating time after reset.		
[S9] - [I6] Total time	Displays total operating time of this product.		
[S9] - [I7] Counter value*1	Displays count value of Counter mode.		
[S9] - [I8] Received light	Displays the received light amount set for output 1 (0 to 254%).		
	100 to 254%: Stable detection		
	51 to 99%: Detection possible		
	0 to 50%: Unstable detection (not recommended)  Not supported: Not supported with the set teach mode*2		
	With the alarm display (page 4-12) set to "On," an alarm message will be displayed on the display, when the value of this item falls below 50%.		
[S9] - [I9] No. of devices*3	Displays the total number of connected units including the main unit.		
[S9] - [IA] Device number	Displays the unit number of the product from the main unit (its number is 1).		
[S9] - [IB] Edge peak*4	Displays the edge peak value of Edge mode.		

<sup>\*1:</sup> Displayed when "On" is selected in "[D6] Counter".

<sup>\*2:</sup> This is not available when the teach is set to "2-point Zone" or "1-point Zone" teach mode or Threshold mode is "Edge height".

<sup>\*3:</sup> Displayed only on the main unit.

<sup>\*4:</sup> Displayed when "Edge height" is selected in "[D2] Threshold mode".

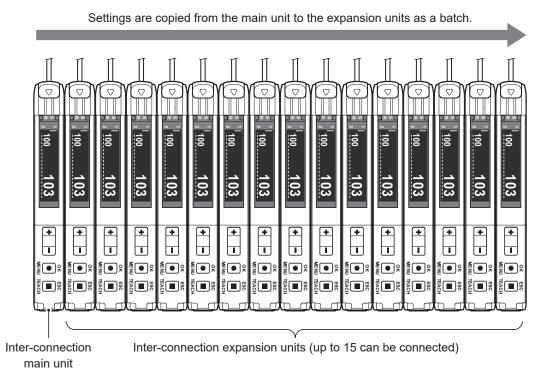
# 4-9 [SA] All devices

Various operations can be performed on the connected main units and expansion units.

This setting menu is displayed when an expansion unit is connected to the inter-connection main unit.

## 4-9-1 [SA] - [A1] Copy to all

This copies the settings of the main unit to all the connected expansion units.



# 4-9-2 [SA] - [A2] Zeroing all

This sets the present received light amount of each connected expansion unit to 0. To cancel the Zeroing all function, execute Zero reset all ([SA] - [A3]).



The received light amount when Zeroing is executed is set to 0, so the threshold and received light amount may be displayed as negative values.

## 4-9-3 [SA] - [A3] Zero reset all

This cancels the Zeroing all function ([SA] - [A2]) executed on all connected expansion units.

# 4-9-4 [SA] - [A4] Set reset all

This initializes all connected expansion units, except for the preset data.

### 4-9-5 [SA] - [A5] Fct. reset all

This resets all connected expansion units to the factory defaults.

### 4-9-6 [SA] - [A6] All teach

This executes the teach on all connected expansion units.

# 4-10 [SC] Reset

This initializes the settings of this product to the factory defaults.

For details on this function and how to set it, refer to 43-7-6 [SC] Reset" (page 3-57).



Troubleshooting
This section describes error displays and countermeasures for errors that occur during product use.

# 5-1 Error Displays

This section provides countermeasures for errors displayed during the execution of the teach function.

Error display	Cause	Countermeasure
Teach error 1 (Output indicator blinks in orange.)	While executing the teach function, the received light amount is too small to set the threshold.	To increase the received light amount, carry out the following countermeasures.  • Check whether the fiber unit has been inserted correctly. (Check that the fiber insertion indicators of the product are off.)  • Select "Response time" to be a longer mode. (page 3-37)  • If using the product with "Emitter power" lowered, increase the power. (page 4-18)  • Reduce the distance between the object and the fiber unit. (When using a diffuse reflective fiber unit.)  • Accurately adjust the light axis of the emitter
Teach error 2 (Output indicator blinks in orange.)	While executing the teach function, the received light amount is too large to set the threshold (the saturated status). Possible causes are as follows. <when a="" diffuse="" fiber="" reflective="" unit="" using=""> The background is too close to the fiber unit.  Too much light is reflected from the background.  "Emitter power" is too high.  <when a="" fiber="" through-beam="" unit="" using=""> The emitter and receiver of the fiber unit are too close.  "Emitter power" is too high.</when></when>	and receiver of the fiber unit. (When using a through-beam fiber unit.)  To avoid the saturated status, lower the received light amount by carrying out the following countermeasures.  • Set "Emitter power" to "Auto" or lower, and then retry the teach. (page 4-18)  • Increase the distance between the object and the fiber unit. (When using a diffuse reflective fiber unit.)  • Increase the distance between the emitter and receiver of the fiber unit. (When using a through-beam fiber unit.)
Teach error 3 (Output indicator blinks in orange.)	While executing the teach function of 2-point mode, the difference between the received light amounts of the first and second points was too small to set the threshold. Possible causes are as follows. <when a="" diffuse="" fiber="" reflective="" unit="" using="">  The difference in received light amounts with the object not present (the background) and present was too small.  <when a="" fiber="" through-beam="" unit="" using="">  With an object present, the received light amount does not decrease because the object does not block the light sufficiently.</when></when>	<ul> <li>Check whether light is received for the first point and is not received for the second point during execution of the teach function. (It is also possible to execute the teach function with light not received for the first point and received for the second point.)</li> <li>To increase the difference in received light amounts for the first and second points, adjust the settings during the execution of the teach function.</li> <li><when a="" diffuse="" fiber="" reflective="" unit="" using=""></when></li> <li>Reduce the distance between the object and the fiber unit.</li> <li>Increase the distance between the background and the fiber unit.</li> <li>Avoid backgrounds that reflect a large amount of light.</li> <li><when a="" fiber="" through-beam="" unit="" using=""></when></li> <li>Adjust the product and the object to block the light sufficiently.</li> </ul>

Error display	Cause	Countermeasure
Teach error 4 (Output indicator blinks in orange.)	While executing the teach function of the 2-point Zone the difference between the received light amount from the first and second teach functions was too small to set the thresholds.	Increase or decrease the distance to the object when setting one of the thresholds. (When using a diffuse reflective fiber unit.)
	While executing the teach function with the 1-point Zone teach mode, the set margin was too small or the received light amount was too small to set the thresholds.	Increase the received light amount by decreasing the distance to the object (when using a diffuse reflective fiber unit).  Alternatively, set the margin to a larger value.
Teach error 5 (Output indicator blinks in orange.)	The execution of the teach function via IO-Link was not carried out in the correct order.	Correct the IO-Link system commands to teach the first and second points in order.

# 5-2 Errors and Countermeasures

This section provides countermeasures for errors that occur during product use.

	Error	Cause	Countermeasure
LED indicator	Power indicator (green) does not illuminate.	The supply voltage is insufficient or unstable.	Check whether the provided supply voltage is stable.
	Power indicator blinks in green.	IO-Link communication is in progress.	This is not an error.
OLED display	Nothing appears on the OLED display. All information that appears on the OLED display disappears.	Power is not being supplied correctly.	Correctly apply the supply voltage to the product.  Brown wire: 12 to 24 VDC (12 to 30 VDC depending on the model), 18 to 30 VDC in IO-Link mode  Blue wire: 0 V
		"Eco mode" is set to "On". (When the power indicator illuminates in green while the OLED display turns off)	Set "Eco mode" to "Off". (page 4-13)
Operation	"Key Locked" appears on the OLED display and operation via keys and external input is not possible.	Key operations are locked by the "Lock" function, preventing the product from accepting operations.	Hold down both the [+] and [-] keys for 1 second or longer. When the "Lock" function is released, "Unlock" is displayed. (page 3-31)
	The output indicator blinks in orange, and key operation is not possible.	Execution of the teach function via external teach input is in progress, preventing the product from accepting operations.	Check for short-circuits or causes of short-circuits on the white wire.
	When an attempt was made to change the threshold with the [+] and [-] keys, "ASC on" was displayed, and the threshold could not be changed.	"ASC" is enabled.	Set "ASC" (page 4-17) to "Off".
Detection	Detection is made (the output indicator illuminates in orange) even though no object is present.	<ul> <li>The threshold setting is too low or the sensing distance is too far. (When using a diffuse reflective fiber unit.)</li> <li>The threshold setting is too high or the sensing distance is too near. (When using a throughbeam fiber unit.)</li> </ul>	<ul> <li>Increase the threshold. (When using a diffuse reflective fiber unit.)</li> <li>Decrease the threshold. (With a through-beam fiber unit.)</li> </ul>
		The background reflects a large amount of light. (With a diffuse reflective fiber unit.)	Prevent excessive light reflected from the background. (For example, change the installation positions, or paint the background black.)
		The manual adjustment of threshold with the [+] and [-] keys is not correct.	Readjust the threshold with the [+] and [-] keys or execute the teach function again to set the threshold to the correct value.

	Error	Cause	Countermeasure
Detection	Detection is made (the output indicator illuminates in orange) even though no object is present.	Light from an adjacent fiber unit is received.	When an inter-connection main unit and expansion units are connected, cross talk prevention eliminates interference between the units. (Response time and number of units with cross talk prevention: page 3-40)     Install adjacent fiber units with sufficient space between them. Also, install the fiber units so that the emitters and receivers alternate. (With a through-beam fiber unit.)
	Detection is not made (the output indicator [orange] turns off) even though an object is present.	<ul> <li>The threshold setting is too high or the sensing distance is too short. (With a diffuse reflective fiber unit.)</li> <li>The threshold setting is too low or, in the case with a transparent object, the transparency is too high. (With a through-beam fiber unit.)</li> </ul>	Decrease the threshold. (With a diffuse reflective fiber unit.)     Increase the threshold. In the case of highly transparent objects, replace the fiber unit with a retro-reflective fiber unit. (With a through-beam fiber unit.)
		The manual adjustment of threshold with the [+] and [-] keys is not correct.	Readjust the threshold with the [+] and [-] keys or execute the teach again to set the threshold to the correct value.
		Reflected light from an object with high reflectivity is oblique to the optical axis, thus it does not reach a receiver. (With a diffuse reflective fiber unit.)	Change the installation position and angle so that the light axis is perpendicular to the object.
		The fiber wires are inserted to the product incorrectly or the fiber cores are broken.	Check the fiber insertion indicators of the product. If a white insertion indicator is displayed, reinsert the fiber to turn off the indicators.  If the fiber wires are broken, replace the fiber unit.
		Light from an adjacent fiber unit is received.	When an inter-connection main unit and expansion units are used, cross talk prevention eliminates interference between the units. (Response time and number of units with cross talk prevention: page 3-40)     Install adjacent fiber units with sufficient space between them. Also, install the emitters and receivers of fiber units alternately. (With a throughbeam fiber unit.)

	Error	Cause	Countermeasure
Detection	Detection is not made (the output indicator [orange] turns off) even though an object is present.	The hysteresis value is too small to maintain on output.	The hysteresis value is too small to maintain on output. (page 4-15)
	When the timer function is not in use, output turns off while an object is present.	The change in the light reflected from the object is larger than the hysteresis value. (With a diffuse reflective fiber unit.)	Increase the "Hysteresis" value. (page 4-15)
	There is a large gap in the received light amounts to turn the output on and off.	The set "Hysteresis" value is too large.	Decrease the "Hysteresis" value. (page 4-15)
Output	Output cannot be sent to a PLC or relay.	The output wiring is not correct.	Refer to the I/O circuit diagrams in this manual and connect the output wire correctly.
		The output pulse width is too short to be recognized by the device to be input. (For example, the "Response time" setting is too short.)	<ul> <li>Set "Response time" to a longer mode. (page 3-37)</li> <li>Use the "Off delay" or "Pulse output" of the "Timer" setting and set the pulse width of the output signal to be recognized by the input device. (page 4-7)</li> </ul>
	Noise, such as short-time changes of received light amount is output.	The product reacts too sensitively to changes in the amount of light received in a very short period of time.	<ul> <li>Set "Response time" to a longer mode. This prevents the product from responding to changes in received light amount in a short time. (page 3-37)</li> <li>Use the "On delay" "Timer" setting so that output is only generated when detection is made for the set time or longer. (page 4-7)</li> </ul>
Received light amount	The received light amount fluctuates.	The received light amount is greatly affected by environmental changes and vibrations. The ambient temperature changes greatly. The received light amount is affected by the surface conditions of the object (such as unevenness). (With a diffuse reflective fiber unit.)	<ul> <li>Adjust the installation environment.</li> <li>Set Response time to a longer mode. (page 3-37)</li> <li>Set "APC" to "On". (page 4-17)</li> </ul>

	Error	Cause	Countermeasure
Received light amount	The received light amount is insufficient.	<ul> <li>The emitter or receiver surfaces of fiber unit gets dirty.</li> <li>The sensing distance (throughbeam: distance between the emitter and receiver of fiber unit, diffuse reflective: distance to the object) is set too far.</li> <li>The light axis is misaligned. (With a through-beam fiber unit.)</li> </ul>	<ul> <li>Clean the dirt without damaging the tip.</li> <li>Review the distance and environment of installation and adjust the light axis.</li> <li>If the emitter power is set to "Min", set it to "Mid". If it is set to "Mid", set it to "Max". (page 4-18)</li> <li>Set "Response time" to a longer mode. (page 3-37)</li> </ul>
	Even when an object blocks the light, the displayed received light amount does not change from the maximum value (such as "9999").	The received light amount is saturated.	<ul> <li>Install the emitter and receiver of the fiber unit at a longer distance. (With a through-beam fiber unit.)</li> <li>Install the fiber unit at a longer distance from the object. Also, set a longer distance between the object and background. (With a diffuse reflective fiber unit.)</li> <li>Set "Emitter power" to "Auto" and execute the teach function again. (page 4-18)</li> <li>Set "Response time" to a shorter mode. (page 3-37)</li> </ul>
	The received light amount does not change regardless of object presence.	"Hold display" is On and the amount of received light is not displayed in real time, but the peak value or bottom value is displayed.	Hold down the [-] key and [OK/MENU] key for 1 second or longer to turn off the "Hold display". (page 3-40)
	The amount of received light is displayed as a negative (-) number.	The "Zeroing" function is enabled.	Set "Zeroing" to "Not used". (page 4-13)
Other	As details of the settings are not known, they need to be reset.	_	Execute the "Factory reset" or "Setting reset" of the Reset to initialize the settings. (page 3-57)



Appendix
This section contains information such as the specifications, IO-Link index list, and factory default settings.

# 6-1 Specifications

# 6-1-1 Sensor Amplifier Specifications

		Туре		Stand-alone unit (IO-Link device)	Inter-connection main unit	Inter-connection expansion unit	
Model	1 output a	and	Cable type	D4RF-T	D4RF-TM	D4RF-TS	
	1 switcha		Connector type	D4RF-TC4	D4RF-TMC4	D4RF-TSC4	
	2 outputs and Cable type 1 input		Cable type	D4RF-TD	D4RF-TDM	D4RF-TDS	
Light so	ource			4-elei	ment Red LED (Wavelength: 66	60 nm)	
Respor	nse time			16 μs, 70 μs, 250 μs, 500 μs, 1 ms, 2 ms, 8 ms	Stand-alone use: 16 μs, 70 μs, 250 μs, 500 μs, 1 ms, 2 ms, 8 ms Inter-connection use: 22 μs, 70 μs, 250 μs, 500 μs,	22 μs, 70 μs, 250 μs, 500 μs, 1 ms, 2 ms, 8 ms	
Ta a ala N	Mada			4 majort 2 majorta Austa Thomason	1 ms, 2 ms, 8 ms	Manual	
Teach I				1 point, 2 points, Auto, 1 nroug	h, 1-point Zone, 2-point Zone, N	vianuai	
Display	' M	ain display	,	Menu languages: Enç	OLED display 128 x 22 pixel glish, Japanese, Korean, Simpli	fied Chinese, Spanish	
	In	dicators		Power indicator (green): Light	2 x Output indicator (orange)  Lights up when power is on (Blinks during IO-Link communication for stand-alone unit)		
Interfac	ce Co	ontrol outp	ut <sup>*1</sup>	NPN/PNP, open collector or Push-pull selectable by setting 1 output: Max. 100 mA, 2 outputs: Max. 50 mA each/30 VDC residual voltage 1.8 V or less			
	E	xternal inpu	ut	Teach, Counter-reset, Emitter off, or Preset loading*2			
	IC	)-Link		Control output 1 is switchable to IO-Link	-	_	
IO-Link	Re	evision		1.1	_		
	Ва	aud rate		COM 3 (230.4 kbps)			
		umber of p ata bytes	rocess input	4 bytes			
	М	inimum cyc	cle time	0.5 ms			
Numbe	r of units w	vith cross ta	alk prevention	_	Response time 22 µs: 2 units, 70 µs: 3 units, 250 µs: 4 unit 500 µs: 9 units, 1 ms: 9 units, 2 ms: 12 units, 8 ms: 14 units (including main unit)		
Timer fo	unction			On delay, Off delay, On/off delay, Pulse output, On delay pulse Adjustable 1 to 30,000 ms			
Output	mode			Ligh	t ON/Dark ON, selectable by se	etting	
Numbe	r of connec	ctable units	3	_	Max. 16 units (in	cluding main unit)	
Connection type		Cable type: 2 m, minimum bending radius: 4 × cable diameter 5 wires with 2-outputs and 1-input models 4 wires with 1-output and 1-switchable-output/input models 3 wires with 2-outputs and 1-input expansion models 2 wires with 1-output and 1-switchable output/input expansion models					
				Connector type: M8 4-pin connector			
Insulati	Insulation resistance			20 Megohm or more (with 500 VDC)			

Туре		Stand-alone unit (IO-Link device)	Inter-connection main unit	Inter-connection expansion unit		
Rating	ating Supply sIO mode voltage		12 to 30 VDC ± 10% including 10% ripple (p-p)	12 to 24 VDC ± 10% including Supplied from mair 10% ripple (p-p) (12 to 24 VDC ± 10% including 10% ripple (p-p) (12 to 24 VDC ± 10% including 10% ripple (p-p) (p-		
		IO-Link mode	18 to 30 VDC ± 10% including 10% ripple (p-p)	_	_	
	Current consumption	Eco mode: Off	52 mA (at 12 VDC), 33 mA (at 24 VDC), 29 mA (at 30 VDC)	52 mA (at 12 VDC),	33 mA (at 24 VDC)	
		Eco mode: On	43 mA (at 12 VDC), 29 mA (at 24 VDC), 26 mA (at 30 VDC)	43 mA (at 12 VDC),	29 mA (at 24 VDC)	
Warm-up time				300 ms		
Applicable regu	ılations	EMC	l .	EU EMC directive (2014/30/EU he Electromagnetic Compatibili	,	
		Environment	EU RoHS directive (2011/65/EU)  UK RoHS (The Restriction of the Use of Certain Hazardous Substances in Electrica Electronic Equipment Regulations 2012)  China RoHS (MIIT Order No.32)			
Applicable stan	ıdards		EN 60947-5-2			
NRTL certificati	ion		UL Listed or Recognized Components Proximity Switch Certified for US and Canada.*3			
Company stand	dards		Noise resistance Feilen Level 4 cleared			
Protection circu	uit		Reverse co	nnection protection, Overcurrer	nt protection	
Environmental resistance	Ambient tem humidity	nperature <sup>*1</sup> /	−25 to 55°C/35 to 85%RH (no freezing or condensation)			
	Ambient illur	minance	Sunlight: 10000 lx or less, incandescent light: 3000 lx or less			
	Vibration resistance		10 to 55 Hz; Double amplitude 1.5 mm; 2 hours in each of the X, Y, and Z directions			
Shock resistance		Approx. 50 G (500 m/s²) 3 times in each of the X, Y, and Z directions				
Degree of protection			IP54			
Material			Housing, cover: PC			
Weight	Neight Cable model: approx. 71 g (including cable), Connector model: approx.			or model: approx. 25 g		
Included acces	sories	·	Mounting bracket, Instruction manual			

\*1: The load current and operating temperature are limited by the number of connected units (including interconnection main unit) as shown in the table below.

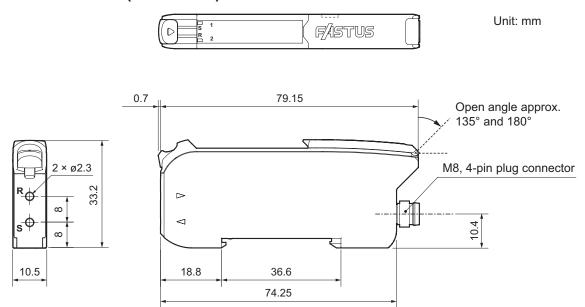
Number of connected units	1 unit		2 units		3 to 5 units		6 to 16 units*4	
Max. input current of main unit	152 mA		144 mA		360 mA		1152 mA	
No. of control output per unit	1	2	1	2	1	2	1	2
Load current per control output	100 mA	50 mA	20 mA	10 mA	20 mA	10 mA	20 mA	10 mA
Ambient temperature	55	°C	55	°C	50	°C	45	°C

- \*2: Preset loading selectable only on 2-output and 1-input models.
- \*3: Products in lot number 2235H and later are UL-certified.
- \*4: When 6 or more units connected and used as UL certified product, use the product under the conditions shown in the table below.

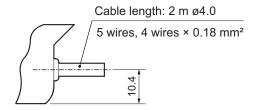
Number of connected units	6 to 8 units		9 to 16 units	
Max. input current of main unit	576	mA	1152	2 mA
No. of control output per unit	1	2	1	2
Max. load current per output	20 mA	10 mA	20 mA	10 mA
Upper limit of ambient temperature	45°C		40	°C

## 6-1-2 Dimensions

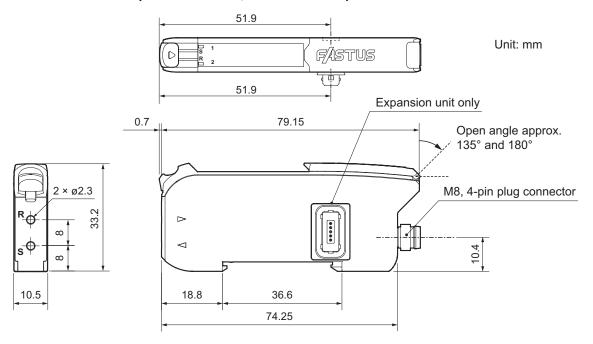
- Stand-alone Unit
- Connector model (D4RF-TC4)



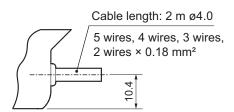
Cable models (D4RF-T, D4RF-TD)



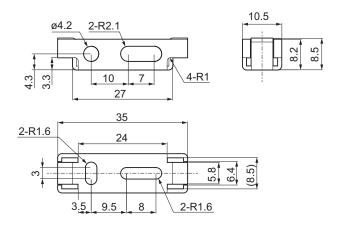
- Inter-connection Unit
- Connector models (D4RF-TMC4, D4RF-TSC4)



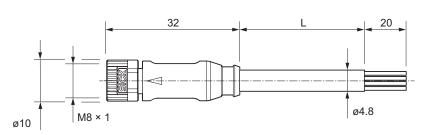
Cable models (D4RF-TM, D4RF-TDM, D4RF-TS, D4RF-TDS)



### Mounting Bracket



# ■ Straight Connector Cable (M84CN-2S, M84CN-5S, M84CN-10S; Optional)

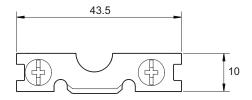


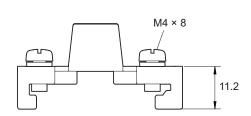
Cable material: PVC, conductor cross-section: 4-wire × 0.25 mm<sup>2</sup>

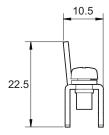
### Unit: mm

- L = 2000 (M84CN-2S)
  - = 5000 (M84CN-5S)
  - = 10000 (M84CN-10S)

### ■ End Plate (BEF-EB01-W190; Optional)







### 6-2 Index List

This information is applicable when using the D4RF-T, D4RF-TC4, and D4RF-TD as IO-Link devices.

# **6-2-1 Communication Specifications**

Minimum cycle tim	e	0.5 ms		
Baud rate		COM 3 (230.4 kbps)		
M-Sequence code	n Pre-operate mode	0		
M-Sequence code i	n Operate mode	4		
ISDU support		Yes		
IO-Link revision		1.1		
Number of process	input data bytes	4 bytes		
Number of process	output data bytes	0 bytes		
Vender ID		DEC: 1076 HEX: 0434		
Device ID (20529)		DEC: 65546	HEX: 1000A	
Device ID	(20530, 20531)	DEC: 65545	HEX: 10009	

### 6-2-2 **Process Data Format**

With the D4RF series, the content of process input data transmitted via IO-Link communication can be selected from the following two formats.

The format of process input data can be switched by using Index 120.

#	Descri	otion	Byte No.				В	it							
#	Descri	otion	Буш но.	7	6	5	4	3	2	1	0				
1	When value of	Receiving	n+0				Receiving	light level							
	Index 120 is	light level and	n+1		(no units)										
	0x00	output	n+2	Reserved											
	* Default setting		n+3		Reserved Qint. 2 Qint. 1 QL 2 QL 1										
2	When value of	Counter value	n+0				Counte	r value							
	Index 120 is	and output	n+1												
	0x12		n+2	Reserved											
			n+3		Rese	erved		Qint. 2	Qint. 1	QL 2	QL 1				

### Word Assignment

Example: When using the IO-Link master of OPTEX FA (default setting: little endian)

Word	Ву	yte
No.	Higher order byte	Lower order byte
N+0	Process data n+2	Process data n+3
N+1	Process data n+0	Process data n+1

	Word		Bit										
۱	No.	15	15   14   13   12   11   10   9   8   7   6   5   4   3   2   1   0										
	N+0		Reserved Qint. 2 Qint. 1 QL 2 QL 1										
ſ	N+1		Receiving light level (no units)										

## 6-2-3 Service Data

Category	Name	Index No. DEC (HEX)	Sub index No.	Read/ Write <sup>*1</sup>	Backup	Format	Length in bytes	Default	Setting details	Remarks (Unit)
System	System command	2 (0x02)	0	W		UINT	1		0x41: 1-point teach (threshold 1) 0x42: 1-point teach (threshold 2) 0x43: 2-point teach (teach point 1) 0x44: 2-point teach (teach point 2) 0x45: Through teach 0x47: Auto teach start 0x48: Auto Teach stop 0x48: Zone teach 0x81: Setting reset 0x82: Restore factory settings 0xC0: Reset counter 0xC1: Preset counter 0xD1: Save to preset number 0xD6: Zero set of measurement value 0xD7: Zero reset of measurement value 0xD7: Zero reset of measurement value 0xE4: Reset diagnostics parameter	
General Settings	Access Lock	12 (0x0C)	0	R/W	<b>√</b>	UINT	2	0	Bit 01: Storage lock Bit 02: Parameter lock Bit 03: Key lock	
Identification	Vendor Name	16 (0x10)	0	R		STRING	8	OPTEX FA		
	Product Name	18 (0x12)	0	R		STRING	8	D4RF-TD D4RF-T D4RF-TC4		
	Product ID	19 (0x13)	0	R		STRING	5	20529 20530 20531		
	Product Text	20 (0x14)	0	R		STRING	26	Photoelectric Fiber Sensor		
	Serial number	21 (0x15)	0	R		STRING	8	YYWWNNNN		Y=Year, W=CW, N=Number
	Hardware Version	22 (0x16)	0	R		STRING	4			
	Firmware Version	23 (0x17)	0	R		STRING	6			
	Application Specific Tag	24 (0x18)	0	R/W	✓	STRING	32	*****		
Observation	Device Status	36 (0x24)	0	R		UINT	1		0x00: Device is OK 0x01: Maintenance required 0x02: Out of specification 0x04: Failure	
	Detailed Device Status	37 (0x25)	1	R		UINT	9		Expressed in 3 bytes per set of EVENT information currently occurring  Event #1 n+0, n+1: Event code 0x1800: High temperature (depends on high temperature setting of index 179, subindex 1) 0x1801: Low temperature (depends on low temperature setting of index 179, subindex 2) 0x1802: Operating hours (depends on operating hours setting of index 179, subindex 3) 0x1802: Operating hours (depends on operating hours setting of index 179, subindex 3) 0x1803: Receiving light level diagnostic 0x1804: Short-circuit on output n+2: Event details Bit 00 to 02: Source (0: Unknown, 4: On application) Bit 03: Reserved Bit 04 to 05: Type (1: Notification, 2: Warning, 3: Failure) Bit 06 to 07: Mode (1: One-off, 2: Resolved, 3: Occurred) Same format as above for events #23 thereafter.	
Detection Setting	Teach channel	58 (0x3A)	0	R/W		UINT	1	0	0x00: default = Qint.1 0x01: Qint.1 0x02: Qint.2	

Category	Name	Index No. DEC (HEX)	Sub index No.	Read/ Write*1	Backup	Format	Length in bytes	Default	Setting details	Remarks (Unit)
Detection Setting	Teach status	59 (0x3B)	0	R		UINT	1		Bit 0 to 3: Teach status O: IDLE 1: 1-PT SUCCESS 2: 2-PT SUCCESS 3: 1/2-PT SUCCESS 4: WAITING FOR COMMAND 5: BUSY 7: ERROR Bit 4: Teach status 1-PT TP1 O: Teach point 2 not taught 1: Teach point 2 successfully taught Bit 5: Teach flag SP1 TP2 O: Teach point 2 not taught 1: Teach point 2 successfully taught Bit 6: Teach flag SP2 TP1 O: Teach point 2 not taught 1: Teach point 2 successfully taught Bit 6: Teach flag SP2 TP1 O: Teach point 2 not taught 1: Teach point 2 not taught 1: Teach point 2 successfully taught	
Detection Settings	Qint. 1 SP1/SP2: Qint. 1 threshold 1	60 (0x3C)	1	R/W	<b>✓</b>	INT	2	100	taagiii	
	Qint. 1 SP1/SP2: Qint. 1 threshold 2		2	R/W	<b>√</b>	INT	2	200		
	Qint. 1 configuration: Qint. 1 switchpoint logic	61 (0x3D)	1	R/W	<b>√</b>	UINT	1	0	0x00: Light on/N.O. 0x01: Dark on/N.C.	
	Qint. 1 configuration: Qint. 1 switchpoint mode		2	R/W	✓	UINT	1	1	0x00: Not used 0x01: 1-point mode 0x02: 2-point zone mode 0x80: Edge height jump	
	Qint. 1 configuration: Qint. 1 switchpoint hysteresis		3	R/W	<b>√</b>	UINT	2	5	1 to 99	Unit: %
	Qint. 2 SP1/SP2: Qint. 2 threshold 1	62 (0x3E)	1	R/W	<b>✓</b>	INT	2	100		
	Qint. 2 SP1/SP2: Qint. 2 threshold 2		2	R/W	✓	INT	2	200		
	Qint. 2 configuration: Qint. 1 switchpoint logic	63 (0x3F)	1	R/W	<b>✓</b>	UINT	1	0	0x00: Light on/N.O. 0x01: Dark on/N.C.	
	Qint. 2 configuration: Qint. 2 switchpoint mode		2	R/W	<b>✓</b>	UINT	1	1	0x00: Not used 0x01: 1-point mode 0x02: 2-point zone mode 0x80: Edge height jump	
	Qint. 2 configuration: Qint. 2 switchpoint hysteresis		3	R/W	<b>✓</b>	UINT	2	5	1 to 99	Unit: %
Identification	Device/function name	64 (0x40)	0	R/W	✓	STRING	32	*****		
Detection Settings	Teach offset	90 (0x5A)	0	R/W	✓	INT	1	10	0 to 99	Unit: %
Settings	Setup edge height jump Qint. 1: Cycle offset Setup edge height jump	93 (0x5D)	2	R/W	✓ ✓	UINT	2	100	1 to 255 0 to 9999	
	Qint. 1: Minimum height jump								0.50 0000	
	Setup edge height jump Qint. 1: Maximum height jump		3	R/W	✓	UINT	2	9999	0 to 9999	
	Setup edge height jump Qint. 1: Hysteresis		4	R/W	<b>✓</b>	UINT	2	5	1 to 9999	
	Setup edge height jump Qint. 1: Jump direction		5	R/W	<b>√</b>	UINT	1	2	0x00: Positive edge 0x01: Negative edge 0x02: Positive and negative edge	
	Setup edge height jump Qint. 2: Cycle offset	94 (0x5E)	1	R/W	<b>✓</b>	UINT	1	10	1 to 255	
	Setup edge height jump Qint. 2: Min. height jump		2	R/W	<b>✓</b>	UINT	2	100	0 to 9999	
	Setup edge height jump Qint. 2: Max. height jump		3	R/W	<b>✓</b>	UINT	2	9999	0 to 9999	
	Setup edge height jump Qint. 2: Hysteresis		4	R/W	<b>✓</b>	UINT	2	5	1 to 9999	
	Setup edge height jump Qint. 2: Jump direction		5	R/W	✓ <b>.</b>	UINT	1	2	0x00: Positive edge 0x01: Negative edge 0x02: Positive and negative edge	

Category	Name	Index No. DEC (HEX)	Sub index No.	Read/ Write <sup>*1</sup>	Backup	Format	Length in bytes	Default	Setting details	Remarks (Unit)
Detection Settings	Response time	95 (0x5F)	0	R/W	✓	UINT	1	4	0x00: 8000 µs 0x01: 2000 µs 0x02: 1000 µs 0x03: 500 µs 0x04: 250 µs 0x05: 70 µs 0x06: 16 µs	
General Settings	Emitter setting: Emitter status	97 (0x61)	1	R/W		UINT	1	0	0x00: Emitter on 0x01: Emitter off	
	Emitter setting: Emitter power		2	R/W	✓	UINT	1	0	0x00: Maximum 0x01: Middle 0x02: Minimum 0x0A: Auto	
	Emitter setting: Emitter APC		3	R/W	✓	UINT	1	1	0x00: Off 0x01: On	
	ASC	112 (0x70)	0	R/W	<b>✓</b>	UINT	1	0	0x00: Off 0x01: On - standard 0x02: On - fast 0x03: On - max	
IO-Link	Process data select	120 (0x78)	0	R/W	<b>√</b>	UINT	1	0	0x00: AO = Present receiving light level live 0x12: AO = Smart Task analog value Counter	
I/O Settings	Pin 2 setting	121 (0x79)	0	R/W	✓	UINT	1	17	D4RF-TD 0x00: Not used 0x01: External input 0x10: Emitter off 0x11: Teach input 0x03: Load preset D4RF-T, D4RF-TC4 0x00: Not used 0x01: External input 0x10: Emitter off 0x11: Teach input 0x21: Receiving light level alarm output 0x22: Switching signal QL2 0x23: Detection output Qint. 1 0x24: Detection output Qint. 2 0x27: Switching signal QL1 0x28: Switching signal QL1	
	Pin 5 setting	122 (0x7A)	0	R/W	✓	UINT	1	34	0x00: Not used 0x21: Receiving light level alarm output 0x22: Switching signal QL2 0x23: Detection output Qint. 1 0x24: Detection output Qint. 2 0x27: Switching signal QL1 0x28: Switching signal QL1 0x28: Switching signal QL1/ 0x02: Acknowledge	Only D4RF-TD
Diagnosis	Temperature: Present temperature	153 (0x99)	1	R		INT	1		o.to_i.v.to.tatomougo	
	Temperature: Highest temperature all time		2	R		INT	1			
	Temperature: Lowest temperature all time		3	R		INT	1			
	Temperature: Highest temperature since last reset		4	R		INT	1			
	Temperature: Lowest temperature since last reset		5	R		INT	1			
	Receiving light level diagnostic	175 (0xAF)	0	R		UINT	1		0 to 254 255 (not available)	Unit: %
	Receiving light level threshold	176 (0xB0)	0	R/W	<b>√</b>	UINT	1	<u> </u>	0 to 90	
	Alarm limit for diagnostic parameters: High temperature	179 (0xB3)	1	R/W	<b>√</b>	INT	1		-128 to 127	
	Alarm limit for diagnostic parameters: Low temperature		2	R/W	√ 	INT	1		-128 to 127	
	Alarm limit for diagnostic parameters: Operating hours		3	R/W	<b>√</b>	UINT	4		0 to 1000000	
Observation	Present receiving light level (live)	180 (0xB4)	0	R		UINT	2			
	Upper Threshold (switch-on) dynamic	181 (0xB5)	0	R		UINT	2			

Category	Name	Index No. DEC (HEX)	Sub index No.	Read/ Write <sup>*1</sup>	Backup	Format	Length in bytes	Default	Setting details	Remarks (Unit)
Diagnosis	Operating hours: Total operating hours	190 (0xBE)	1	R		UINT	4			
	Operating hours: Operating hours since last reset		2	R		UINT	4			
Identification	Find me*2	204 (0xCC)	0	R/W		UINT	1	0	0x00: Find me deactivated 0x01: Find me activated	
General Settings	Preset number	222 (0xDE)	0	R/W		UINT	1	1	1 to 5	
Observation	System status	226 (0xE2)	0	R		UINT	2		Bit 6: Received light alarm output 0: Alarm not active 1: Alarm active Bit 7: Input signal status Pin 2 0: External input OFF 1: External input ON	
General Settings	Notification handling	227 (0xE3)	0	R/W	<b>✓</b>	UINT	1	0	0x00: All enabled 0x01: All disabled 0x02: Events enabled, PD invalid flag disabled 0x03: Events disabled, PD invalid flag enabled	
	Display setting: Display mode, channel 1	234 (0xEA)	1	R/W	✓	UINT	1	0	0x00: Value (absolute) 0x01: Bar graph 0x02: Percentage value 0x03: Counter value 0x04: Edge value	
	Display setting: Display mode, channel 2		2	R/W	<b>√</b>	UINT	1	0	0x00: Value (absolute) 0x01: Bar graph 0x02: Percentage value 0x03: Counter value 0x04: Edge value	
	Display setting: Display brightness		3	R/W	✓	UINT	1	100	10 to 100	
	Display setting: Eco mode		4	R/W	<b>√</b>	UINT	1	0	0x00: Off 0x01: On	
	Display setting: Rotate display		5	R/W	<b>√</b>	UINT	1	0	0x00: Off 0x01: On	
	Display setting: Invert display		6	R/W	<b>√</b>	UINT	1	0	0x00: Off 0x01: On	
	Display setting: Alarm display		7	R/W	<b>√</b>	UINT	1	0	0x00: Off 0x01: On	
	Display setting: Language		8	R/W	✓	UINT	1	1	0x01: English 0x06: Spanish 0x07: Simplified Chinese 0x08: Japanese 0x0A: Korean	
	Display hold setting: Hold mode, channel 1	235 (0xEB)	1	R/W	✓	UINT	1	0	0x00: Off 0x01: Peak/bottom 0x02: Peak 0x03: Bottom 0x04: Time	
	Display hold setting: Hold mode, channel 2		2	R/W	✓	UINT	1	0	0x00: Off 0x01: Peak/bottom 0x02: Peak 0x03: Bottom 0x04: Time	
Smart task	Counter mode	1001 (0x3E9)	0	R/W	<	UINT	1	2	0x00: Up 0x01: Down 0x02: OFF	
	Preset mode	1002 (0x3EA)	0	R/W	<b>√</b>	UINT	1	0	0x00: Preset internal disabled 0x01: Preset internal enabled	
	Preset value	1003 (0x3EB)	0	R/W	<b>√</b>	UINT	2	0	0 to 16383	
	Comparator value low	1004 (0x3EC)	0	R/W	✓	UINT	2	10	0 to 16383	
	Comparator value high	1005 (0x3ED)	0	R/W	<b>√</b>	UINT	2	10	0 to 16383	
	Counter value	1006 (0x3EE)	0	R		UINT	2			
	Filtering time 1	1033 (0x409)	0	R/W	<b>√</b>	UINT	4	0	0 to 30000000	
	Received light level D1	1034 (0x40A)	0	R		UINT	2			
	Filtering time 2	1035 (0x40B)	0	R/W	<b>√</b>	UINT	4	0	0 to 30000000	
	Received light level D2	1036 (0x40C)	0	R		UINT	2			
	Input selector 1	1081 (0x439)	0	R/W	<b>√</b>	UINT	1	0	0x00: Qint. 1 0x01: Qint. 2 0x64: Ext. input 1	

Category	Name	Index No. DEC (HEX)	Sub index No.	Read/ Write*1	Backup	Format	Length in bytes	Default	Setting details	Remarks (Unit)
Smart task	Input selector 2	1082 (0x43A)	0	R/W	<b>√</b>	UINT	1	1	0x00: Qint. 1 0x01: Qint. 2 0x40: Ext. input 1	
	Logic 1	1083 (0x43B)	0	R/W	<b>√</b>	UINT	1	0	0x00: DIRECT 0x03: Window Mode 0x04: Hysteresis	
	Logic 2	1084 (0x43C)	0	R/W	<b>√</b>	UINT	1	0	0x00: DIRECT 0x03: Window Mode 0x04: Hysteresis	
	Timer 1 mode	1085 (0x43D)	0	R/W	<b>√</b>	UINT	1	0	0x00: Deactivated 0x01: On-delay timer 0x02: Off-delay timer 0x03: On/Off-delay timer 0x04: Pulse (one shot) 0x05: On-delay pulse timer	
	Timer 2 mode	1086 (0x43E)	0	R/W	✓	UINT	1	0	0x00: Deactivated 0x01: On-delay timer 0x02: Off-delay timer 0x03: On/Off-delay timer 0x04: Pulse (one shot) 0x05: On-delay pulse timer	
	Timer 1 setup	1087 (0x43F)	0	R/W	✓	UINT	2	1	1 to 30000	Unit: ms
	Timer 2 setup	1088 (0x440)	0	R/W	<b>√</b>	UINT	2	1	1 to 30000	Unit: ms
	Output mode 1	1089 (0x441)	0	R/W	<b>✓</b>	UINT	1	0	0x00: Not inverted 0x01: Inverted	
	Output mode 2	1090 (0x442)	0	R/W	<b>✓</b>	UINT	1	0	0x00: Not inverted 0x01: Inverted	
	Timer 1.1 setup	1091 (0x443)	0	R/W	<b>√</b>	UINT	2	1	1 to 30000	Unit: ms
	Timer 2.1 setup	1092 (0x444)	0	R/W	<b>√</b>	UINT	2	1	1 to 30000	Unit: ms
I/O Settings	Ext. input for input mode	1093 (0x445)	0	R/W	<b>√</b>	UINT	1	0	0x00: Not inverted 0x01 Inverted	
Main interface	Device display	3584 (0x0E00)	0	R		STRING	75			Format: Display 1, Display 2, Display 3, Display 4, Display 5 <sup>*3</sup>
	Device buttons	3585 (0x0E01)	0	W		UINT	1		0: Release 1: Push	Bit 0: Plus button Bit 1: Minus button Bit 2: Menu/OK button Bit 3: Teach/ESC button
	Device LEDs - Power LED	3586 (0x0E02)	1	R		UINT	1		0: off 1: on 2: blink 1 (1 Hz 50:50) 3: blink 2 (6 Hz 50:50) 4: blink 3 (4 Hz 25:75) 5: blink 4 (1 Hz 50:50) 6: blink 5 (1 Hz 90:10)	
	Device LEDs - Q1 LED		2	R		UINT	1		0: off 1: on 2: blink 1 (1 Hz 50:50) 3: blink 2 (6 Hz 50:50) 4: blink 3 (4 Hz 25:75) 5: blink 4 (1 Hz 50:50) 6: blink 5 (1 Hz 90:10)	
	Device LEDs - Q2 LED		3	R		UINT	1		0: off 1: on 2: blink 1 (1 Hz 50:50) 3: blink 2 (6 Hz 50:50) 4: blink 3 (4 Hz 25:75) 5: blink 4 (1 Hz 50:50) 6: blink 5 (1 Hz 90:10)	

<sup>\*1:</sup> R: Read only, W: Write only, R/W: Read/Write

\*3: The display will be in one of the following formats.

<sup>\*2:</sup> Executes a Find Me request for this product.

During the execution of operation due to a Find Me command, the Output 1 and Output 2 indicators blink in orange.

# 6-2-4 Events

Co	ode	Description
DEC	HEX	Description
4227	0x1083	Received light amount diagnostic
6144	0x1800	High temperature (depends on high temperature setting of index 179, subindex 1)
6145	0x1801	Low temperature (depends on low temperature setting of index 179, subindex 2)
6146	0x1802	Operating hours (depends on Operating hours setting of index 179, subindex 3)
30480	0x7710	Short-circuit on output

# 6-3 Initial Settings List

This section describes the factory default settings of this product.

When this product is reset ([SC] Reset - [SB] Factory reset/Setting reset), the settings return to the parameters listed below.

	Main menu		Sub menu	Default value	Description
S1	Output mode (N.O./ N.C.)		_	Light on	Page 4-5
S3	Response time			250 µs	Page 4-6
S4	Timer			Not used	Page 4-7
S6	Display	P1	Display mode	Value	Page 4-9
		P2	Hold display	Off	Page 4-11
		P3	Brightness	100%	Page 4-11
		P4	Rotate display	Off	Page 4-11
		P5	Invert display	Off	Page 4-12
		P6	Alarm display	Off	Page 4-12
		P7	Zeroing	Not used	Page 4-13
		P8	Eco mode	Off	Page 4-13
		P9	Stretch mode	Off	Page 4-13
		PA	Language	English	Page 4-14
S7	Detection	D1	Hysteresis	5%	Page 4-15
		D2	Threshold mode	Standard	Page 4-16
		D3	APC	On	Page 4-17
		D4	ASC	Off	Page 4-17
		D5	Emitter power	Max	Page 4-18
		D6	Counter	Off	Page 4-19
		D7	Set count	10	Page 4-21
		D8	Edge direction	Both	Page 4-21
		D9	Edge offset	2500 μs	Page 4-22
		DA	Edge hys.	5	Page 4-22
S8	I/O	01	I/O polarity	NPN	Page 4-24
		O2	Pin 2 setting	Output 2	Page 4-25
		О3	Pin 5 setting	Output 2	Page 4-26
		04	Pin 2 setting	Teach input	Page 4-26
		O5	Lock mode	Lock all	Page 4-27
		O6	Preset setting	_	Page 4-27
		07	Load preset	_	Page 4-28



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### 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.

