

Light Curtain / Type4 / Heavy-duty

SF4B-□G<V2>

Instruction Manual



(MEMO)

Thank you for purchasing Panasonic Industrial Devices SUNX's Light Curtain, **SF4B-□G<V2>** series.

Please read this instruction manual carefully and thoroughly for the correct and optimum use of this device.

Kindly keep this manual in a convenient place for quick reference.

This device is a light curtain for protecting a person from dangerous parts of a machine which can cause injury or accident.

This manual has been written for the following personnel who have undergone suitable training and have knowledge of light curtains, as well as, safety systems and standards.

- who are responsible for the introduction of this device
- who design the system using this device
- who install and connect this device
- who manage and operate a plant using this device

Notes

- 1) All the contents of this instruction manual are the copyright of the publishers, and may not be reproduced (even extracts) in any form by any electronic or mechanical means (including photocopying, recording, or information storage and retrieval) without permission in writing from the publisher.
- 2) The contents of this instruction manual may be changed without prior notice for further improvement of the device.
- 3) Though we have carefully drawn up the contents of this instruction manual, if there are any aspects that are not clear, or any error that you may notice, please contact our local Panasonic Industrial Devices SUNX office of the nearest distributor.
- 4) English and Japanese are original instructions.



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Chapter 1 Introduction

1-1 Attention Marks

This instruction manual employs the following attentions marks  **WARNING**,  **CAUTION** depending on the degree of the danger to call operator's attention to each particular action. Read the following explanation of these marks thoroughly and observe these notices without fail.

 **WARNING** If you ignore the advice with this mark, death or serious injury could result.

 **CAUTION** If you ignore the advice with this mark, injury or material damage could result.

<Reference> It gives useful information for better use of this device.

1-2 Safety Precautions

- Use this device as per its specifications. Do not modify this device since its functions and capabilities may not be maintained and it may malfunction.
- This device has been developed / produced for industrial use only.
- This device is suitable for indoor use only.
- Use of this device under the following conditions or environments is not presupposed. Please consult us if there is no other choice but to use this device in such an environment.
 - 1) Operating this device under conditions or environments not described in this manual.
 - 2) Using this device in the following fields: nuclear power control, railroad, aircraft, auto mobiles, combustion facilities, medical systems, aerospace development, etc.
- When this device is to be used for enforcing protection of a person from any danger occurring around an operating machine, the user should satisfy the regulations established by national or regional security committees (Occupational Safety and Health Administration: OSHA, the European Standardization Committee, etc.). Contact the relative organization(s) for details.
- In case of installing this device to a particular machine, follow the safety regulations in regard to appropriate usage, mounting (installation), operation and maintenance. The users including the installation operator are responsible for the introduction of this device.
- Use this device by installing suitable protection equipment as a countermeasure for failure, damage, or malfunction of this device.
- Before using this device, check whether the device performs properly with the functions and capabilities as per the design specifications.
- In case of disposal, dispose this device as an industrial waste.

WARNING

◆ **Machine designer, installer, employer and operator**

- The machine designer, installer, employer and operator are solely responsible to ensure that all applicable legal requirements relating to the installation and the use in any application are satisfied and all instructions for installation and maintenance contained in the instruction manual are followed.
- Whether this device functions as intended to and systems including this device comply with safety regulations depends on the appropriateness of the application, installation, maintenance and operation. The machine designer, installer, employer and operator are solely responsible for these items.

◆ **Engineer**

- The engineer would be a person who is appropriately educated, has widespread knowledge and experience, and can solve various problems which may arise during work, such as a machine designer, or a person in charge of installation or operation etc.

◆ **Operator**

- The operator should read this instruction manual thoroughly, understand its contents, and perform operations following the procedures described in this manual for the correct operation of this device.
- In case this device does not perform properly, the operator should report this to the person in charge and stop the machine operation immediately. The machine must not be operated until correct performance of this device has been confirmed.

◆ **Environment**

- Do not use a mobile phone or a radio phone near this device.
- If there exists a reflective surface in the place where this device is to be installed, make sure to install this device so that reflected light from the reflective surface does not enter into the receiver, or take countermeasures such as painting, masking, roughening, or changing the material of the reflective surface, etc. Failure to do so may cause the device not to detect, resulting in death or serious injury.
- Do not install this device in the following environments.
 - 1) Areas exposed to intense interference (extraneous) light such as high-frequency fluorescent lamp (inverter type), rapid starter fluorescent lamp, stroboscopic lights or direct sunlight.
 - 2) Areas with high humidity where condensation is likely to occur
 - 3) Areas exposed to corrosive or explosive gases
 - 4) Areas exposed to vibration or shock of levels higher than that specified
 - 5) Areas exposed to contact with water
 - 6) Areas exposed to too much steam or dust

◆ **Installation**

- Always keep the correctly calculated safety distance between this device and the dangerous parts of the machine.
- Install extra protection structure around the machine so that the operator must pass through the sensing area of this device to reach the dangerous parts of the machine.
- Install this device such that some part of the operator's body always remains in the sensing area when operator is done with the dangerous parts of the machine.
- Do not install this device at a location where it can be affected by wall reflection.
- When installing multiple sets of this device, connect the sets and, if necessary, install some barriers such that mutual interference does not occur. For details, refer to "**2-3-4 Device Placement**" and "**3-4 Interference Prevention Function**."
- Do not use this device in a reflective configuration.
- The corresponding emitter and receiver must have the same serial No. and be correctly oriented.

WARNING

◆ **Machine in which this device is installed**

- When this device is used in the “PSDI Mode,” an appropriate control circuit must be configured between this device and the machinery. For details, be sure to refer to the standards or regulations applicable in each region or country.
- In Japan and Korea, do not use this device as safety equipment for a press machine.
- Do not install this device with a machine whose operation cannot be stopped immediately in the middle of an operation cycle by an emergency stop equipment.
- This device starts the performance after 2 seconds from the power ON. Have the control system started to function with this timing.

◆ **Wiring**

- Be sure to carry out the wiring in the power supply OFF condition.
- All electrical wiring should conform to the regional electrical regulations and laws. The wiring should be done by engineer(s) having the special electrical knowledge.
- Do not run the wires together with high-voltage lines or power lines or put them in the same raceway. This can cause malfunction due to induction.
- In case of extending the cable of the emitter or the receiver, each can be extended up to 50m by using the exclusive cable. Furthermore, if the cable is extended in the state that the device is in series connection, or the muting lamp is used, the total extendable length of the cable depends on the number of the devices in series connection. For details, refer to “**2-5-3 Wiring · Connecting Procedure and Connector Pin Arrangement.**”
- Do not control the device only at one control output (OSSD 1 / 2).
- In order that the output is not turned to ON due to earth fault of the control output (OSSD 1 / 2) wires, be sure to ground to 0V side (PNP output) / +24V side (NPN output).

◆ **Maintenance**

- When replacement parts are required, always use only genuine supplied replacement parts. If substitute parts from another manufacturer are used, the device may not come to detect, result in death or serious injury.
- The periodical inspection of this device must be performed by an engineer having the special knowledge.
- After maintenance or adjustment, and before starting operation, test this device following the procedure specified in “**Chapter 4 Maintenance.**”
- Clean this device with a clean cloth. Do not use any volatile chemicals.

◆ **Others**

- Never modify this device. Modification may cause the device not to detect, resulting in death or serious injury.
- Do not use this device to detect objects flying over the sensing area.
- Do not use this device to detect transparent objects, translucent objects or objects smaller than the specified minimum sensing objects.

1-3 Applicable Standards / Regulations

This device complies with the following standards / regulations.

<EU Directives>

EU Machinery Directive 2006/42/EC

EMC Directive 2014/30/EU

RoHS Directive 2011/65/EU

<European Standards>

EN 61496-1 (Type 4), EN 55011, EN 61000-6-2, EN IEC 63000

EN ISO 13849-1: 2015 (Category 4, PLe)

<International Standards>

IEC 61496-1/2 (Type 4), ISO 13849-1: 2015 (Category 4, PLe), IEC 61508-1~7 (SIL3)

<Japanese Industrial Standards (JIS)>

JIS B 9704-1/2 (Type 4), JIS B 9705-1 (Category 4), JIS C 0508 (SIL3)

<Standards in US / Canada>

ANSI/UL 61496-1/2 (Type 4), ANSI/UL 508, UL 1998 (Class 2)

CAN/CSA C22.2 No.14, CAN/CSA C22.2 No.0.8

<Regulations in US>

OSHA 1910.212, OSHA 1910.217(C), ANSI B11.1 to B11.19, ANSI/RIA 15.06

Regarding EU Machinery Directive, a Notified Body, TÜV SÜD, has certified with the type examination certificate.

With regard to the standards in US / Canada, a NRTL, UL (Underwriters Laboratories Inc.) has certified for cULus Listing Mark.


<Regulations in China>

GB 4584

<Reference>

The conformity to JIS, OSHA and ANSI for this device has been evaluated by ourselves.

The cULus Listing Mark  indicates compliance with both Canadian and US requirements.

This device conforms to the EMC Directive and the Machinery Directive. The  mark on the main body indicates that this device conforms to the EMC Directive.

WARNING

- In Japan, never use this device as a safety equipment for any press machine or shearing machine.
- When this device is used in a place other than the places shown above, be sure to confirm the standards or regulations applicable in each region or country before use

Before the use of this device, construct the control system that satisfies the following requirements to secure the safety of the whole system.

To use for Category 4 or 3

- **To prevent the loss of the safety function due to a single fault.**
Always use two types of control output (OSSD 1 / 2).
 - **To prevent the loss of the safety function due to the accumulation of the faults.**
Construct the control system that can stop a device if discrepancy between control outputs (OSSD 1 / 2) is detected.
- <The example of the way to detect the discrepancy of control outputs>**
 (Example 1) Use the relay unit or the controller for the light curtain.
 (Example 2) Monitor of the control outputs (OSSD 1 / 2) with the safety PLC.
 (Example 3) Monitor of the contact point welding in case the safety relay is used.

To use for Category 2

If one type of control output (OSSD) is used, the auxiliary output connects to PLC to monitor the operation of this device, and construct the control system that can stop a device if discrepancy between the control output (OSSD) and the auxiliary output is detected. It is possible to use another type of control output (OSSD) .

1-4 Confirmation of Packed Contents

- Sensor: Emitter, Receiver 1 pc. each
 - Test Rod 1 pc.
 - SF4B-F□G<V2>: SF4B-TR14** (ø14 × 220mm)
 - SF4B-H□G<V2>: SF4B-TR25** (ø25 × 220mm)
 - Intermediate Supporting Bracket (**MS-SF4BG-2**) 0 to 3 sets
- Note: The intermediate support bracket (**MS-SF4BG-2**) is enclosed with the following devices. The quantity differs depending on the device as shown below:
- 1 set: **SF4B-F□G<V2>** ... 79 to 127 beam channels
 - SF4B-H□G<V2>** ... 40 to 64 beam channels
 - SF4B-A□G<V2>** ... 20 to 32 beam channels
 - 2 sets: **SF4B-H□G<V2>** ... 72 to 96 beam channels
 - SF4B-A□G<V2>** ... 36 to 48 beam channels
 - Quick Instruction Manual 1 pc.

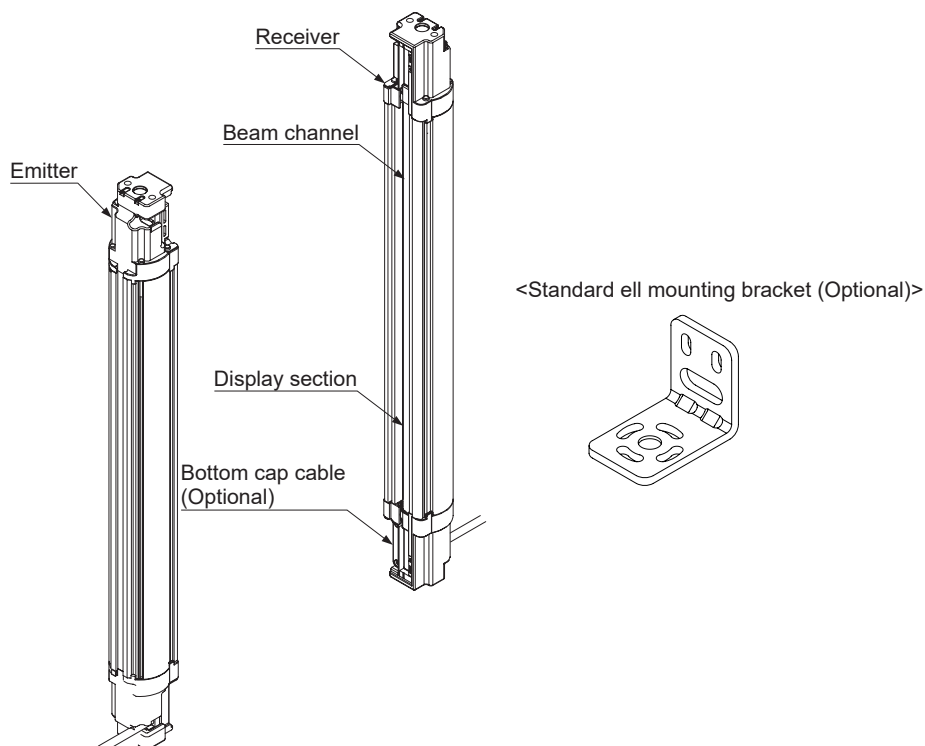
Chapter 2 Before Using This Device

2-1 Features

This device is the light curtain with the following features.

- No special controller is required.
- The control output (OSSD 1 / 2) is PNP / NPN output switching type.
- Beam-axis alignment indicators which make beam-axis alignment easy are incorporated.
- Each function setting is available by using the handy controller (**SFB-HC**) (optional). Refer to “**3-9 Functions Using Handy Controller (SFB-HC) (Optional)**” for details.
- Refer to “**6-2 Options**” for details of options.

2-2 Part Description



<Emitter>

It emits light to the receiver facing it. Furthermore, the status of the emitter and the receiver is indicated on its display section.

<Receiver>

It receives light from the emitter facing it. Simultaneously, it turns ON the control output (OSSD 1 / 2) when the all beam channels receive light from emitter, and it turns OFF the control output (OSSD 1 / 2) when one or more beam channels are blocked light.

[Exclude when using the muting function (Note 1) or the blanking function (Note 2).]

Besides, the receiver displays its status on the display section.

Notes: 1) In case of using the muting function, the following items, 12-core bottom cap cable (**SFB-CB05-MU**, **SFB-CCB□-MU**) (optional), muting sensor and muting lamp are required. Please purchase 12-core bottom cap cable, muting sensor, and muting lamp separately.

2) The blanking function is set by using the handy controller (**SFB-HC**) (optional). Please purchase the handy controller separately.

<Beam channel>

The light emitting elements of the emitter and the light receiving elements of the receiver are placed at the following intervals, 10mm (**SF4B-F□G<V2>**), 20mm (**SF4B-H□G<V2>**), and 40mm (**SF4B-A□G<V2>**).

<Sensor mounting bracket (optional)>

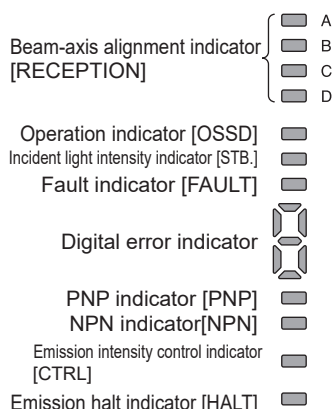
This bracket is to be used when mounting the emitter or the receiver on back or side.

<Intermediate supporting bracket>

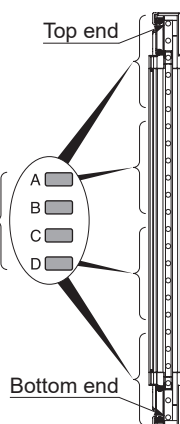
This bracket is to be used for mounting the device having 79 beam channels or more for **SF4B-F□G<V2>**, 40 beam channels or more for **SF4B-H□G<V2>**, 20 beam channels or more for **SF4B-A□G<V2>**.

<Display section>

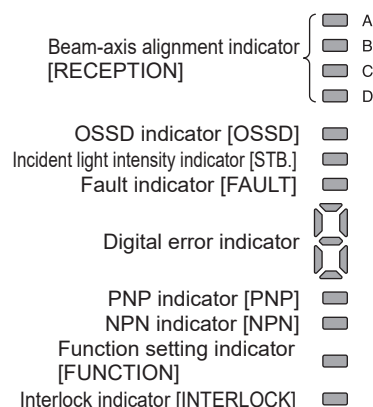
Emitter



Beam-axis alignment indicator [RECEPTION]



Receiver



Description	Function
Beam-axis alignment indicator (Red / Green) [RECEPTION]	A When device top receives light: lights up in red When device top end receives light: blinks in red When control output (OSSD 1 / 2) is ON: lights up in green
	B When device upper middle receives light: lights up in red When control output (OSSD 1 / 2) is ON: lights up in green
	C When device lower middle receives light: lights up in red When control output (OSSD 1 / 2) is ON: lights up in green
	D When device bottom receives light: lights up in red When device bottom end receives light: blinks in red When control output (OSSD 1 / 2) is ON: lights up in green
Operator indicator (Red / Green) [OSSD] (Note 1)	Lights up while device operation is as follows [sequential operation control output (OSSD1 / 2)] When control output (OSSD 1 / 2) is OFF: lights up in red When control output (OSSD 1 / 2) is ON: lights up in green
Incident light intensity indicator (Orange / Green) [STB.]	When sufficient light is received (Incident light: 130% or more) (Note 2): lights up in green When stable light is received (Incident light: 115 to 130%) (Note 2): OFF When unstable light is received (Incident light : 100 to 115%) (Note 2): lights up in orange When light is blocked: OFF (Note 3)
Fault indicator (Yellow) [FAULT]	When fault occurs in the device: lights up or blinks
Digital error indicator (Red)	When device is lockout, error contents are indicated. When the sensors are connected in parallel, the bottom of the digital error indicator on the slave side sensors lights up in red.
PNP indicator (Orange) [PNP]	When PNP output is set: lights up
NPN indicator (Orange) [NPN]	When NPN output is set: lights up
Emission intensity control indicator (Orange) [CTRL]	When light is emitted under short mode: lights up When light is emitted under normal mode: OFF
Emission halt indicator (Orange) [HALT]	When light emission is halt: lights up When light is emitted: OFF

Description	Function
Beam-axis alignment indicator (Red / Green) [RECEPTION]	A When device top receives light: lights up in red When device top end receives light: blinks in red When control output (OSSD 1 / 2) is ON: lights up in green
	B When device upper middle receives light: lights up in red When control output (OSSD 1 / 2) is ON: light up in green
	C When device lower middle receives light: lights up in red When control output (OSSD 1 / 2) is ON: lights up in green
	D When device bottom receives light: lights up in red When device bottom end receives light: blinks in red When control output (OSSD 1 / 2) is ON: lights up in green
OSSD indicator (Red / Green) [OSSD]	When control output (OSSD 1 / 2) is OFF: lights up in red When control output (OSSD 1 / 2) is ON: lights up in green
Incident light intensity indicator (Orange / Green) [STB.]	When sufficient light is received (Incident light: 130% or more) (Note 2): lights up in green When stable light is received (Incident light: 115 to 130%) (Note 2): OFF When unstable light is received (Incident light : 100 to 115%) (Note 2): lights up in orange When light is blocked: OFF (Note 3)
Fault indicator (Yellow) [FAULT]	When fault occurs in the device: light up or blinks
Digital error indicator (Red)	When device is lockout, error contents are indicated. When the sensors are connected in parallel, the bottom of the digital error indicator on the slave side sensors lights up in red.
PNP indicator (Orange) [PNP]	When PNP output is set: light up
NPN indicator (Orange) [NPN]	When NPN output is set: lights up
Function setting indicator (orange) [FUNCTION]	When blanking function is used: lights up (Note 4) When connecting the handy controller: brinks
Interlock indicator (Yellow) [INTERLOCK]	When device is interlocked: lights up Other cases: OFF

- Notes: 1) Since the color of the operation indicator changes according to ON / OFF status of the control output (OSSD 1 / 2), the operation indicator is marked as "OSSD" on the device.
- 2) The threshold where the control output (OSSD 1 / 2) changes from OFF to ON is applied as "100% incident light intensity".
- 3) "When light is blocked" refers to the status that there exists any object blocking light in the sensing area.
- 4) The blanking function is set by using the handy controller (SFB-HC) (optional). Please purchase the handy controller separately.
- 5) The description given in [] is marked on the device.

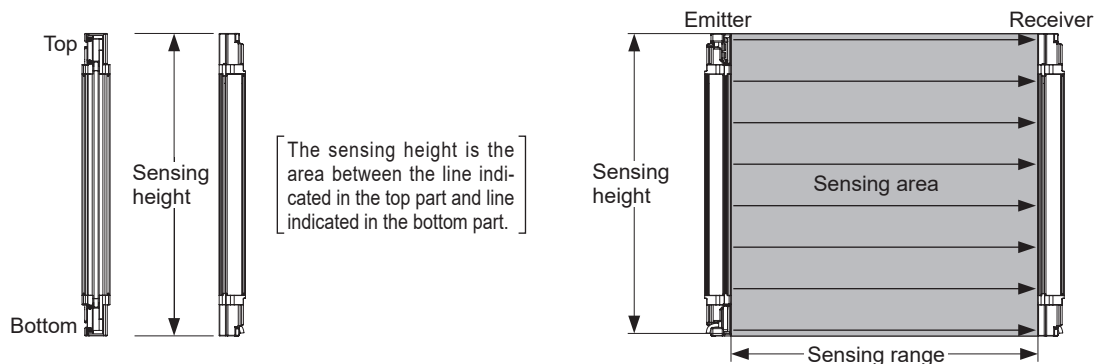
2-3 Protection Area

2-3-1 Sensing Area

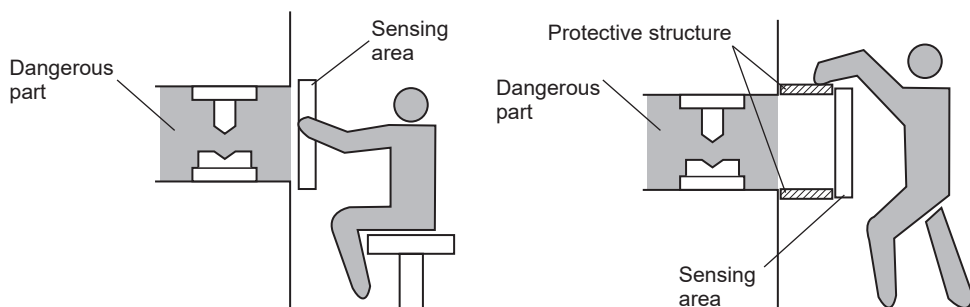
WARNING

- Be sure to install protection structure around the machine so that the operator must pass through the sensing area of this device to reach the dangerous parts of the machine. Furthermore, ensure that some part of the operator's body always remains in the sensing area when operation is done with the dangerous parts of the machine. Failure to do so can result in death or serious injury.
- Do not use any reflection type or recursive reflection type arrangement.
- Furthermore, facing several receivers towards one emitter, or vice versa, could produce a non-sensing area or cause mutual interference, which may result in death or serious injury.

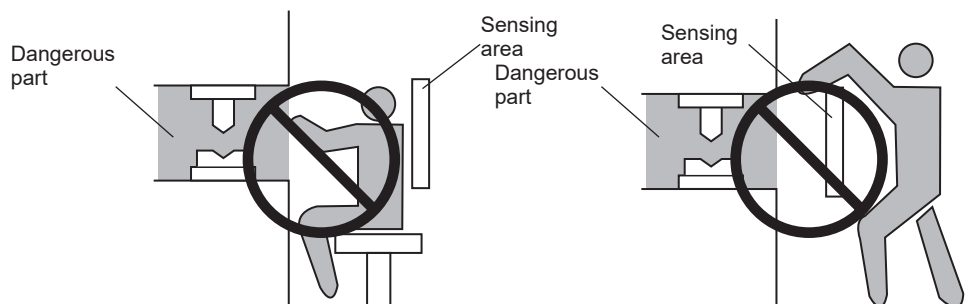
The sensing area is the zone formed by the sensing height of the device and the sensing range between the emitter and the receiver. The sensing height is determined by the number of beam channels. Furthermore, the sensing range can be 0.3 to 9m for **SF4B-H□G<V2>** (12 to 64 beam channels) and **SF4B-A□G<V2>** (6 to 32 beam channels), 0.3 to 7m for **SF4B-F□G<V2>** and **SF4B-H□G<V2>** (72 to 96 beam channels) and **SF4B-A□G<V2>** (36 to 48 beam channels).



<Example of Correct Installation>



<Example of Incorrect Installation>



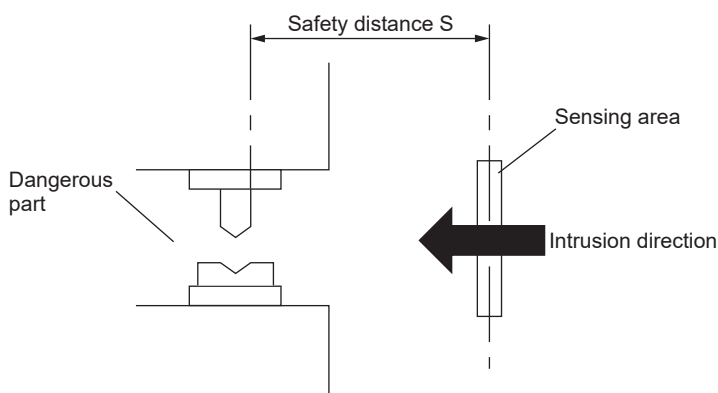
2-3-2 Safety Distance

⚠ WARNING

Calculate the safety distance correctly, and always maintain the distance which is equal to or greater than the safety distance, between the sensing area of this device and the dangerous parts of the machine. If the safety distance is miscalculated or if sufficient distance is not maintained, the machine will not stop quickly before reaching to the dangerous parts, which can result in death or serious injury.

The safety distance is the minimum distance that must be maintained between the device and the dangerous parts of the machine so that the machine can be stopped before a human body or an object can reach the dangerous parts.

The safety distance is calculated based on the equation described in the next page when a person moves perpendicular (normal intrusion) to the sensing area of the device.



⚠ WARNING

Before designing the system, refer to the relevant standards of the region where this device is to be used, and then install this device.

Furthermore, the equation described in the next pages is to be used only in case the intrusion direction is perpendicular to the sensing area. In case the intrusion direction is not perpendicular to the sensing area, be sure to refer to the relevant standard (regional standard, specification of the machine, etc.) for details of the calculation.

⚠ WARNING

The max. response time of the machine is from the point that the machine receives the halt signal from this device to the point that the dangerous parts of the machine stops. The max. response time of the machine should be timed with the machine to be actually used.

⚠ WARNING

The size of the minimum sensing object for this device varies depending on the case whether the floating blanking function is applied or not. Calculate the safety distance with the proper size of the minimum sensing object and appropriate equation.

<Size of minimum sensing object when applying floating blanking function>

	Floating blanking function			
	Invalid	Setting (Note)		
		1 beam channel	2 beam channels	3 beam channels
SF4B-F□G<V2> (10mm-beam channel pitch type)	ø14mm	ø24mm	ø34mm	ø44mm
SF4B-H□G<V2> (20mm-beam channel pitch type)	ø25mm	ø45mm	ø65mm	ø85mm
SF4B-A□G<V2> (40mm-beam channel pitch type)	ø45mm	ø85mm	ø125mm	ø165mm

Note: Refer to "3-9 Functions Using Handy Controller (SFB-HC) (Optional)" for details of the floating blanking function.

[For use in Europe (EU) (as EN 999)] (Also applicable to ISO 13855)

(For intrusion direction perpendicular to the sensing area)

<In case that the minimum sensing object is ø40mm or less>

- Equation 1 $S = K \times T + C$

S : Safety distance (mm)

Minimum required distance between the sensing area surface and the dangerous parts of the machine

K : Intrusion velocity of operator's body or object (mm/sec.)

Taken as 2,000 (mm/sec.) for calculation

T : Response time of total equipment (sec.)

$T = T_m + TSF4B$

T_m : Maximum halting time of machine (sec.)

TSF4B: Response time of this device (sec.)

C : Additional distance calculated from the size of the minimum sensing object of the device (mm)

However, the value of C cannot be under 0.

$C = 8 \times (d - 14)$

d: Minimum sensing object diameter (mm)

<Reference>

- For calculating the safety distance S, there are the following five cases.
First calculate by substituting the value $K = 2,000$ (mm/sec.) in the equation above. Then, classify the obtained value of S into three cases, 1) $S < 100$, 2) $100 \leq S \leq 500$, and 3) $S > 500$.
For Case 3) $S > 500$, recalculate by substituting the value $K = 1,600$ (mm/sec.). After that, classify the calculation result into two cases, 4) $S \leq 500$ and 5) $S > 500$. For details, refer to "Calculation Example 1 For use in Europe."
• When this device is used in the "PSDI Mode," an appropriate safety distance S must be calculated. For details, be sure to refer to the standards or regulations applicable in each region or country.

<In case that the minimum sensing object is over ø40mm>

- Equation $S = K \times T + C$

S : Safety distance (mm)

Minimum required distance between the sensing area surface and the dangerous parts of the machine

K : Intrusion velocity of operator's body or object (mm/sec.)

Taken as 1,600 (mm/sec.) for calculation

T : Response time of total equipment (sec.)

$T = T_m + TSF4B$

T_m : Maximum halting time of machine (sec.)

TSF4B: Response time of this device (sec.)

C : Additional distance calculated from the size of the minimum sensing object of the device (mm)

$C = 850$ (mm)

<Calculation Example>

- Calculation Example 1: For use in Europe
(OFF response time: 14ms or less, minimum sensing object diameter: 14mm)

First, calculate with $K = 2,000$.

$$\begin{aligned} S &= K \times T + C \\ &= K \times (T_m + TSF4B) + 8 \times (d - 14) \\ &= 2,000 \times (T_m + 0.014) + 8 \times (14 - 14) \\ &= 2,000 \times T_m + 2,000 \times 0.014 \\ &= 2,000 \times T_m + 28 \end{aligned}$$

If the result is:

- 1) In case $S < 100$ (mm)
Safety distance S is taken as 100 (mm)
- 2) In case $100 \leq S \leq 500$ (mm)
Safety distance S is taken as $2,000 \times T_m + 28$ (mm)
- 3) In case $S > 500$ (mm)
$$\begin{aligned} S &= K' \times (T_m + TSF4B) + 8 \times (d - 14) \\ &= 1,600 \times (T_m + 0.014) + 8 \times (14 - 14) \\ &= 1,600 \times T_m + 1,600 \times 0.014 \\ &= 1,600 \times T_m + 22.4 \end{aligned}$$

then, calculate again.

If the result is:

- 4) In case $S \leq 500$ (mm)
Safety distance S is taken as 500 (mm)
- 5) In case $S > 500$ (mm)
Safety distance S is taken as $1,600 \times T_m + 22.4$ (mm)

In case this device is installed in a system with a maximum halting time of 0.1 (sec.)

$$\begin{aligned} S &= 2,000 \times T_m + 28 \\ &= 2,000 \times 0.1 + 28 \\ &= 228 \end{aligned}$$

Since this value matches with Case 2) above, S is 228 (mm).

In case this device is installed in a system with a maximum halting time of 0.4 (sec.)

$$\begin{aligned} S &= 2,000 \times T_m + 28 \\ &= 2,000 \times 0.4 + 28 \\ &= 828 \end{aligned}$$

Since this value matches with Case 3) above,

$$\begin{aligned} S &= 1,600 \times T_m + 22.4 \\ &= 1,600 \times 0.4 + 22.4 \\ &= 662.4 \end{aligned}$$

Since this value matches with Case 5) above, S is 662.4 (mm).

[For use in the United States of America (as per ANSI B11.19)]

- Equation 2 $Ds = K \times (Ts + Tc + TSF4B + Tbm) + Dpf$

- Ds** : Safety distance (mm)
Minimum required distance between the sensing area surface and the dangerous parts of the machine
- K** : Intrusion speed {Recommended value in OSHA is 63 (inch/sec.) [≈ 1,600 (mm/sec.)] }
ANSI B11.19 does not define the intrusion speed "K". When determining K, consider possible factors including physical ability of operators.
- Ts** : Halting time calculated from the operation time of the control element (air valve, etc.) (sec.)
- Tc** : Maximum response time of the control circuit required for functioning the brake (sec.)
- TSF4B** : Response time of this device (sec.)
- Tbm** : Additional halting time tolerance for the brake monitor (sec.)
The following equation holds when the machine is equipped with a brake monitor.
 $Tbm = Ta - (Ts + Tc)$
Ta: Setting time of brake monitor (sec.)
When the machine is not equipped with a brake monitor, it is recommended that 20% or more of (Ts + Tc) is taken as additional halting time.
- Dpf** : Additional distance calculated from the size of the minimum sensing object of the device (mm)
- SF4B-F□G<V2>** Dpf = 23.8mm
SF4B-H□G<V2> Dpf = 61.2mm
SF4B-A□G<V2> Dpf = 129.2mm
- $Dpf = 3.4 \times (d - 0.276)$ (inch)
 $\approx 3.4 \times (d - 7)$ (mm)
- d**: Minimum sensing object diameter 0.552 (inch) ≈ 14 (mm) **SF4B-F□G<V2>**
 Minimum sensing object diameter 0.985 (inch) ≈ 25 (mm) **SF4B-H□G<V2>**
 Minimum sensing object diameter 1.772 (inch) ≈ 45 (mm) **SF4B-A□G<V2>**

<Reference>

When the floating blanking function is applied, the minimum sensing object becomes large. According to ANSI B11.1, Dpf = 900mm (3ft) when d > 64mm (2.5 inches).

<Reference>

Since the calculation above is performed by taking 1 (inch) = 25.4 (mm), there is a slight difference between the representation in (mm) and that in (inch). Refer to the relevant standard for the details.

<Calculation Example>

- Calculation Example 2 For use in the United States of America

[OFF response time: 14ms or less, minimum sensing object diameter: 0.552 (inch) ≈ 14 (mm)]

$$\begin{aligned}
 Ds &= K \times (Ts + Tc + TSF4B + Tbm) + Dpf \\
 &= 63 \times (Ta + 0.014) + 3.4 \times (d - 0.276) \text{ (inch)} \\
 &= 63 \times (Ta + 0.014) + 3.4 \times (0.552 - 0.276) \\
 &= 63 \times Ta + 63 \times 0.014 + 3.4 \times 0.276 \\
 &= 63 \times Ta + 1.8204 \\
 &\approx 63 \times Ta + 1.82 \text{ (inch)}
 \end{aligned}$$

In case this device is installed in a system with a maximum halting time 0.1 (sec.)

$$\begin{aligned}
 Ds &= 63 \times Ta + 1.82 \\
 &= 63 \times 0.1 + 1.82 \\
 &= 8.12 \text{ (inch)} \\
 &\approx 206.248 \text{ (mm)}
 \end{aligned}$$

Hence, as per the calculations Ds is 206.2 (mm).

<Reference>

Since the calculation above is performed by taking 1 (inch) = 25.4 (mm), there is a slight difference between the representation in (mm) and that in (inch). Refer to the relevant standard for the details.

[In Chinese standard (GB 4584)]

In case slide of press machine can be stopped where you would like to, safety distance S can be calculate by calculating formula 1.

• Equation 1 $S = K \times T + C$

- S** : Safety distance (mm)
Minimum required distance between the sensing area surface and the dangerous parts of the machine.
- K** : Intrusion velocity of operator's body or object (mm/sec.)
In case the intrusion direction is horizontal to the sensing area, calculate at 1,600 (mm/sec.). In case the intrusion direction is perpendicular to the sensing area, calculate at 2,000 (mm/sec.) when the safety distance $S \leq 500\text{mm}$ and calculate at 1,600 (mm/sec.) when safety distance $S > 500\text{mm}$.
- T** : Response time of total equipment (sec.)
 $T = T_m + \text{TSF4B}$
 T_m : Maximum halting time of machine (sec.)
 TSF4B : Response time of this device (sec.)
- C** : Distance from entering hand to the sensing area to this product sensing it. (mm)
Calculate based on table below in case not using interlock function (start-restart interlock) of this device or safety controller in press machine.

Minimum sensing object	Additional distance C	Stroke starting by this device or safety controller etc.
$\leq 14\text{mm}$	0mm	Possible
$> 14 \text{ to } 20\text{mm}$	80mm	
$> 20 \text{ to } 30\text{mm}$	130mm	
$> 30 \text{ to } 40\text{mm}$	240mm	Not possible
$> 40\text{mm}$	850mm	

In case using interlock function (start-restart interlock) of this device or safety controller etc. in press machine, C equals 0.

In case the slide of press machine can not be stopped in your desire point, the safety distance S can be calculated from formula 2.

• Equation 1 $S = K \times T + C$

- S** : Safety distance (mm)
Minimum required distance between the sensing area surface and the dangerous parts of the machine.
- K** : Intrusion velocity of operator's body or object (mm/sec.)
In case the intrusion direction is horizontal to the sensing area, calculate at 1,600 (mm/sec.). In case the intrusion direction is perpendicular to the sensing area, calculate at 2,000 (mm/sec.) when the safety distance $S \leq 500\text{mm}$ and calculate at 1,600 (mm/sec.) when safety distance $S > 500\text{mm}$.
- Ts** : Time from entering hand to this device to slide reaching bottom dead point. (s)
 $T_s = [(1 / 2) + (1 / N)] \times T_n$
 N : Number of chases of clutch
 T_n : Time of going into a 360-degree roll (s)
- C** : Distance from entering hand to the sensing area to this product sensing it. (mm)
Calculate based on table below in case not using interlock function (start-restart interlock) of this device or safety controller in press machine.

Minimum sensing object	Additional distance C	Stroke starting by this device or safety controller etc.
$\leq 14\text{mm}$	0mm	Possible
$> 14 \text{ to } 20\text{mm}$	80mm	
$> 20 \text{ to } 30\text{mm}$	130mm	
$> 30 \text{ to } 40\text{mm}$	240mm	Not possible
$> 40\text{mm}$	850mm	

In case using interlock function (start-restart interlock) of this device or safety controller etc. in press machine, C equals 0.

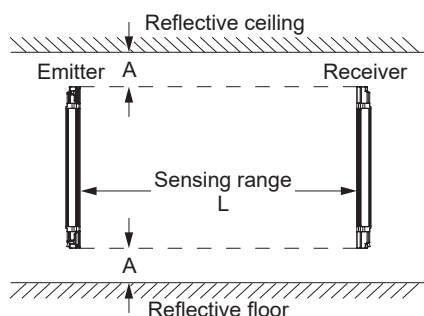
2-3-3 Influence of Reflective Surfaces

⚠ WARNING

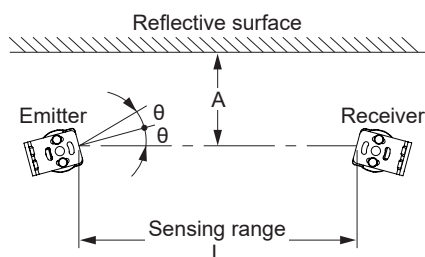
If there exists a reflective surface in the place where this device is to be installed, make sure to install this device so that reflected light from the reflective surface does not enter into the receiver, or take countermeasures such as painting, masking, roughening, or changing the material of the reflective surface, etc. Failure to do so may cause the device not to detect, resulting in death or serious injury.

Install this device at a distance of at least A (m) (given below) away from reflective surfaces such as metal walls, floors, ceilings, workpieces, covers, panels or glass surfaces.

<Side View>



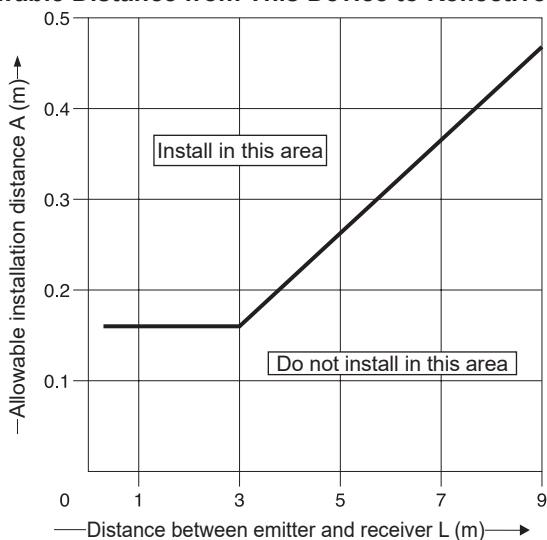
<Top View>



Distance between emitter and receiver (Sensing range L)	Allowable installation distance A
0.3 to 3m	0.16m
3 to 9m (Note 1)	$L/2 \times \tan 2\theta = L/2 \times 0.105 \text{ (m) } (\theta = 3^\circ)$

- Notes: 1) The sensing range L is applicable to **SF4B-H□G<V2>** (12 to 64 beam channels) and **SF4B-A□G<V2>** (6 to 32 beam channels). For **SF4B-F□<V2>** and **SF4B-H□<V2>** (72 to 96 beam channels) and **SF4B-A□G<V2>** (36 to 48 beam channels), the distance between emitter and receiver is 3 to 7m.
- 2) The effective aperture angle for this device is $\pm 2.5^\circ$ or less (when $L > 3\text{m}$) as required by IEC 61496-2, ANSI/UL 61496-2. However, install this device away from reflective surfaces considering an effective aperture angle of $\pm 3^\circ$ to take care of beam misalignment, etc. during installation.

Allowable Distance from This Device to Reflective Surface



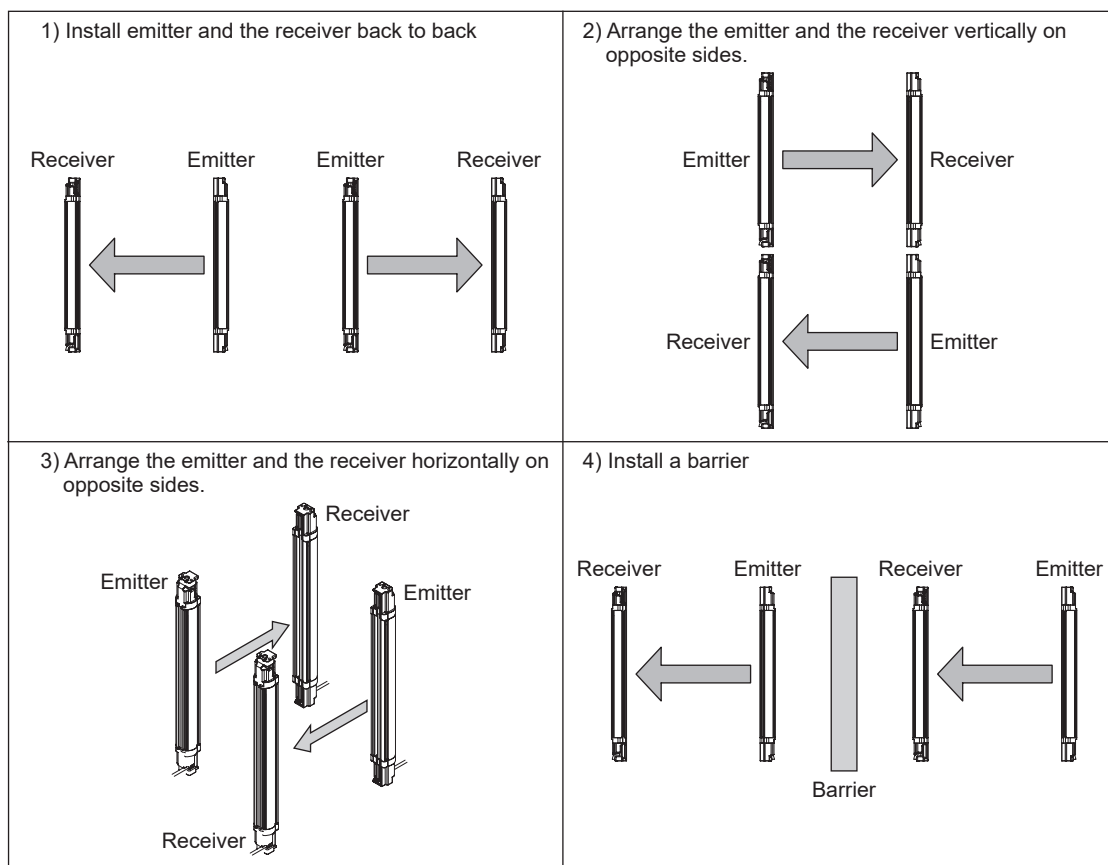
2-3-4 Device Placement

This is the configuration when two or more sets of emitter and receiver facing each other are placed without series or parallel connection between them. It is used for the case that there is a problem in wiring or for system evaluation in case of addition of equipment. Perform an operation test by referring to "2-6-2 Operation Test."

WARNING

- Refer to the examples of device placement given below and understand them thoroughly before installing the devices. Improper sensor placement could cause device malfunction, which can result in death or serious injury.
- If this device is used in multiple sets, arrange them to avoid mutual interference. If mutual interference occurs, it can result in death or serious injury.

<Example of device placement>

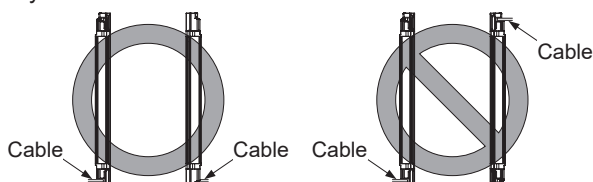


<Reference>

The above figures are just examples of device placement. If there are any questions or problems, please contact our office.

WARNING

Position the emitter and receiver so that their cables are aligned. Failure to do so will cause the system to malfunction.



2-4 Mounting

2-4-1 Mounting of the Mounting Bracket

CAUTION

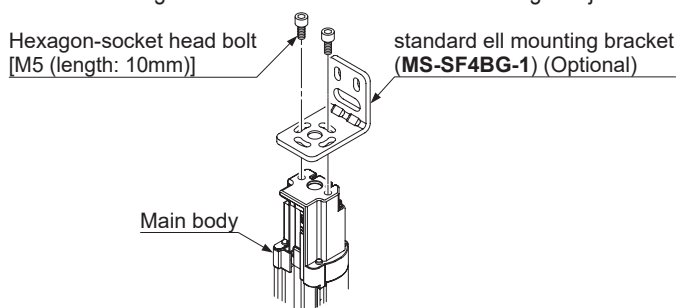
- For selecting the appropriate mounting bracket matched to the installation environment, the mounting bracket is not incorporated in this device. Please purchase the optional mounting bracket to fit on the mounting environment.
- Do not apply the load such as forced bending to the cable of this device. Applying improper load could cause the wire breakage.
- The minimum bending radius of the cable is R6mm. Mount the device considering the cable bending radius.

<Reference>

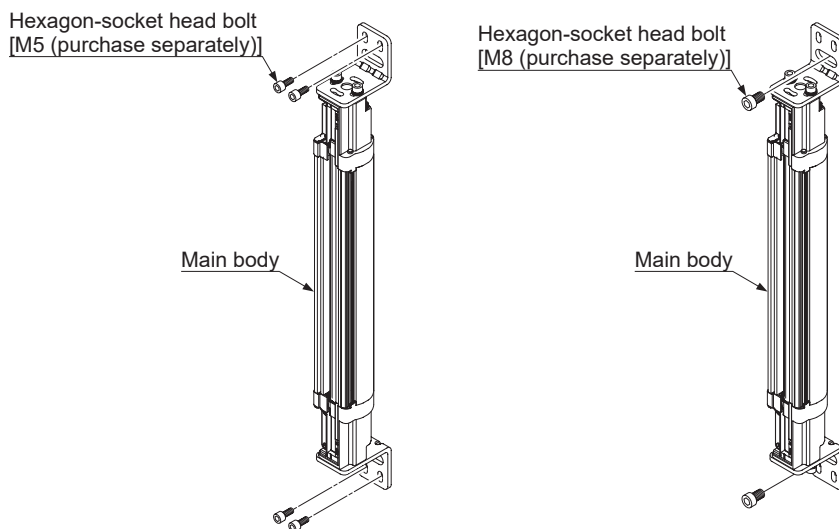
- Mount the emitter and the receiver at the same level and parallel to each other. The effective aperture angle of this device is $\pm 2.5^\circ$ or less for a sensing distance of 3m or more.
- Unless otherwise specified, the following mounting procedure is common for both emitter and receiver. For the preparation of the mounting, prepare the mounting holes on the mounting surface by referring to “6-3 Dimensions.”

<In case of using standard ell mounting bracket (MS-SF4BG-1) (optional)>

1. Temporary joint with two of hexagon-socket head bolts for horizontal angle adjustment [M5 (length: 10mm)]



2. Mount the standard ell mounting bracket on mounting surface with two of hexagon-socket head bolts [M5 (purchase separately)] or one of [M8 (purchase separately)].

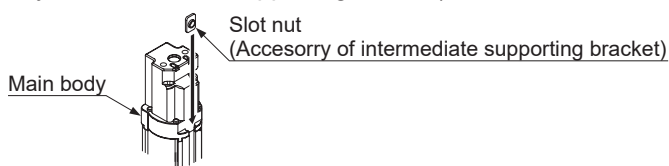


3. After light axis adjustment, tighten two of hexagon-socket head bolts for horizontal angle adjustment [M5 (length: 10mm)]
The tightening torque should be 3N·m or less.

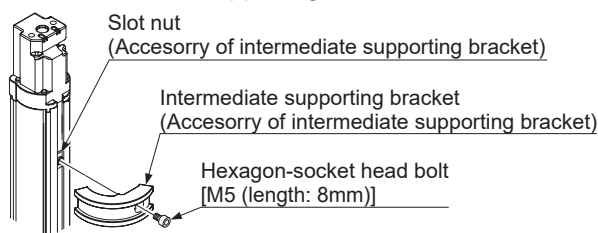
Note: For the models that the intermediate supporting bracket (MS-SF4BG-2) is enclosed with, be sure to use the intermediate supporting bracket (MS-SF4BG-2). For details, refer to <In case of using intermediate supporting bracket (MS-SF4BG-2) (accessory)>.

<In case of using intermediate supporting bracket (MS-SF4BG-2) (accessory)>

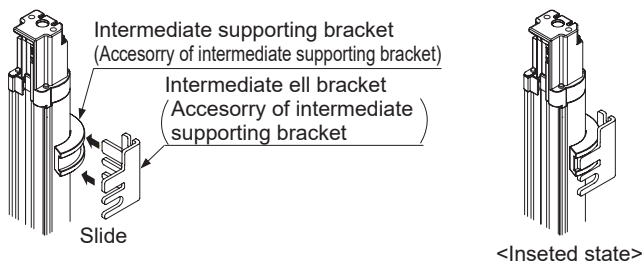
1. Insert a slot nut (accessory of intermediate supporting bracket) to back side of this product.



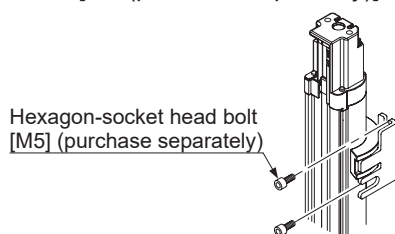
2. Fix the slot nut inserted on back side of this product and the intermediate supporting bracket with a hexagon-socket head bolt [M5 (length: 8mm)].
The tightening torque should be 3N·m or less.
About mounting position of intermediate supporting bracket, refer to “6-3 DIMENSIONS”.



3. Insert and fit the intermediate ell mounting bracket to concave portion of intermediate supporting bracket.

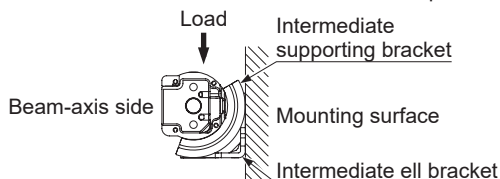


4. Mount the intermediate ell bracket on the mounting surface with two of hexagon-socket head bolts [M5 (purchase separately)] or one of [M8 (purchase separately)].



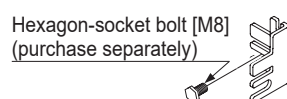
<Example>

In case the wight is on side of this product shown below, mount the intermediate ell bracket to hold this product.

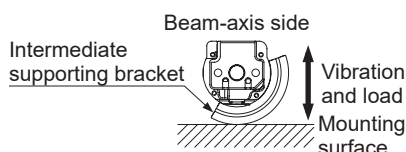


<Reference>

- In case using hexagon-socket head bolts [M8] to mount the Intermediate ell bracket. Temporary joint the Intermediate ell bracket before conduct step 3.



- In case the wight is on the mounting surface vertically or vibrated vertically, the mounting of the intermediate ell bracket is not required.



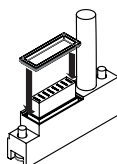
2-4-2 Mounting of the Bottom Cap Cable (Optional)

The cable is not enclosed with this device.

Mount the bottom cap cable (**SFB-CB□**,**SFB-CCB□**) (optional) in accordance with the following procedure.

CAUTION

- Do not lose any screws during extension / dismantling.
- The bottom cap cables are distinguished with the color of the connectors, the color of the connector for emitter is gray and that of the receiver is black. Connect the cable to emitter and receiver without fail using their colors as the guide.
- The packing is attached to the connector of the bottom cap cable. If the packing is not attached correctly, reattach the packing as shown in the figure below, and mount to this device.



<Reference>

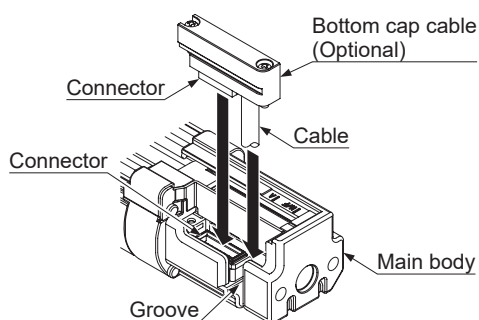
There are two types of the bottom cap cable, 8-core type and 12-core type, and in addition to these types, two more types are available for the bottom cap cable, discrete wire type and connector type. Select the bottom cap cable as usage.

The length of the bottom cap cable differs depending on the model No.

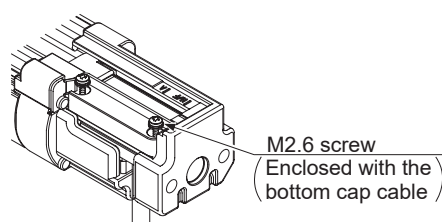
Type		Model No.	Cable length (m)
8-core	Discrete wire type	SFB-CCB3	3
		SFB-CCB7	7
		SFB-CCB10	10
		SFB-CCB15	15
	Connector type	SFB-CB05	0.5
		SFB-CB5	5
		SFB-CB10	10
12-core	Discrete wire type	SFB-CCB3-MU	3
		SFB-CCB7-MU	7
	Connector type	SFB-CB05-MU	0.5

Mounting method>

1. Insert the connector of the bottom cap cable (optional) into the connector of this device.
When inserting the connector, fit the cable to the groove of this device.

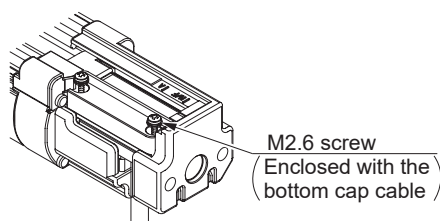


2. Tighten the two M2.6 screws. The tightening torque should be 0.3N·m or less.

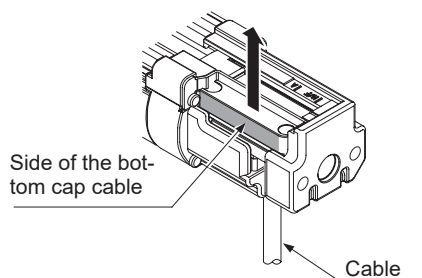


<Removing method>

1. Loosen and remove the two M2.6 screws.



2. Push up the side of the bottom cap cable (optional) together with the cable to remove the bottom cap cable. Do not use any tools such as a screwdriver to remove the cable.

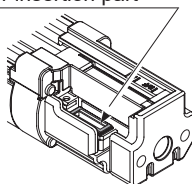


⚠ CAUTION

- The bottom cap cable (optional) cannot be extended.
- When inserting the bottom cap cable to the sensor, take care of the following points. If inserted without care, the connector pins may bend.

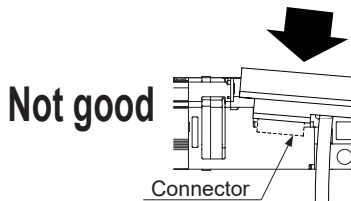
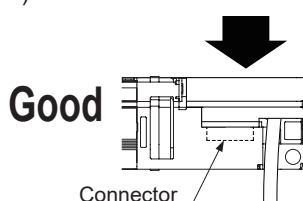
1) Do not damage the top surface of the connector insertion part. Otherwise, a gap will be created between the part and the packing and liquid may enter the gap to cause product failure.

Top surface of the connector insertion part

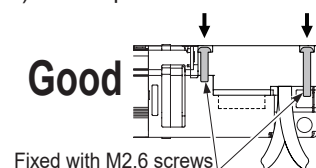


- When inserting the connector, be careful not to strike the connector edge against the top surface of the connector insertion part.
- Do not use any tools to remove the connector.

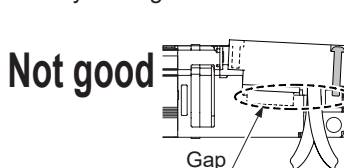
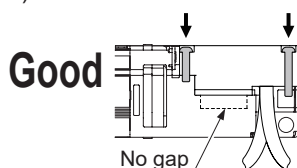
1) Do not insert the connector part aslant.



2) Do not pull the cables before tightening the M2.6 screws.



3) Do not insert the connector incorrectly and tighten the M2.6 screws.

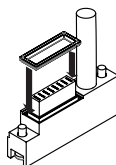


2-4-3 Extension and Dismantling of Sensor (Series Connection)

This section describes the extension method of the series connection using the options.
For constructing the series connection, the following procedure is required.

CAUTION

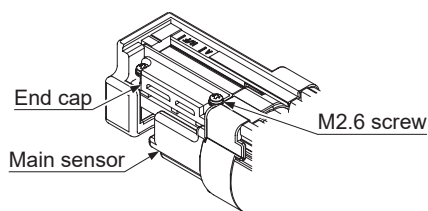
- Do not lose any screws during extension / dismantling work.
- Furthermore, do not mix emitters and receivers to mount in series connection.
- The packing is attached to the connector of the cable (**SFB-CSL□**) for a series connection. If the packing is not attached correctly, reattach the packing as shown in the figure below, and mount to this device.



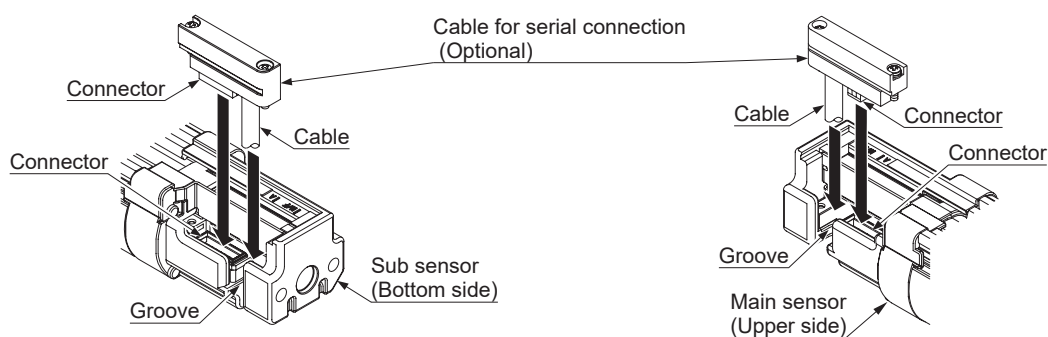
<Mounting method of cable for series connection>

Replace the cable for series connection

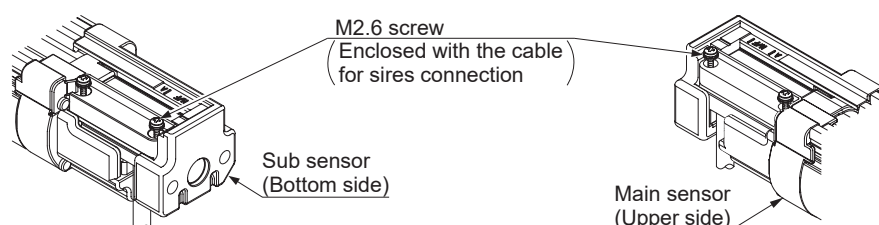
1. Loosen the two M2.6 screws of the end cap on the main sensor (emitter and receiver to which the synchronization line has been connected), and then remove the end cap from the device.



2. Insert the connector of the cable for series connection (optional) into the connector. When inserting the connector, fit the cable into the groove of this device.

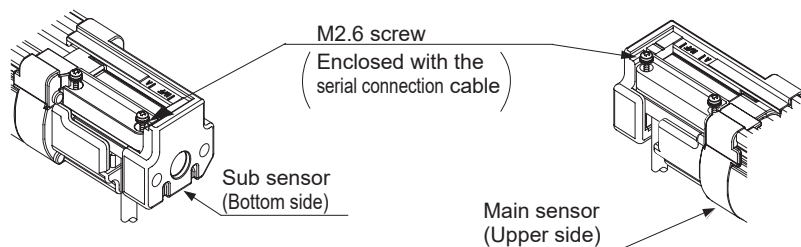


3. Tighten each two M2.6 screws. The tightening torque should be 0.3N·m or less.

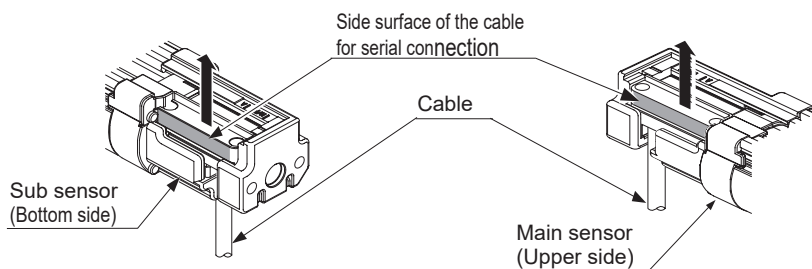


<Dismantling the cable for series connection>

1. Loosen and remove the two M2.6 screws.



2. Push up the side of the cable for series connection (optional) together with the cable to remove the cable for series connection. Do not use any tools such as a screwdriver to remove the cable.

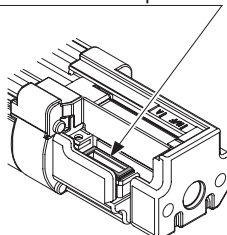


⚠ CAUTION

- Take care that the shape of the connectors for the bottom side and for the end cap side on the cable (optional) for series connection is different.
- The cable for series connection cannot be extended.
- When the cable for series connection is inserted to the sensor, take care of the following. If inserted without care, the connector pins may bend.

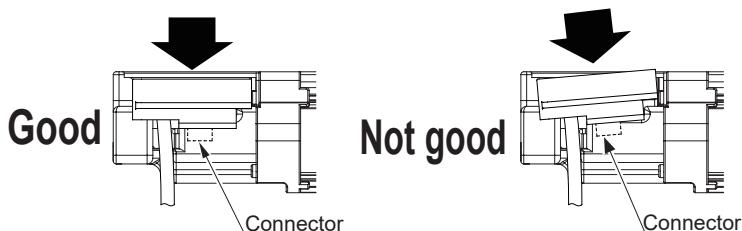
1) Do not damage the top surface of the connector insertion part. Otherwise, a gap will be created between the part and the packing and liquid may enter the gap to cause product failure.

Top surface of the connector insertion part



- When inserting the connector, be careful not to strike the connector edge against the top surface of the connector insertion part.
- Do not use any tools to remove the connector.

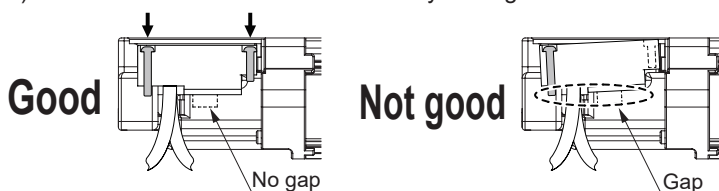
2) Do not insert the connector part aslant.



3) Do not pull the cables before tightening the M2.6 screws.



4) Do not insert the connector incorrectly and tighten the M2.6 screws.



<Reference>

There is no difference in the cable for series connection for the emitter and the receiver.
The length of the cable for series connection differs depending on the model No.

Model No.	Cable Length (mm)
SFB-CSL01	100
SFB-CSL05	500
SFB-CSL1	1,000
SFB-CSL5	5,000

2-5 Wiring

WARNING

- Earth the machine or the support where the device is mounted on to frame ground (F.G.). Failure to do so could cause the malfunction of the device by noise, resulting in death or serious injury.
Furthermore, the wiring should be done in a metal box connected to the frame ground (F.G.).
- Take countermeasure against the system to be applied for this device so as not to carry out the dangerous performance caused by the earth failure. Failure to do so could cause invalid for the system stop, resulting in death or serious injury.
- In order that the output is not turned ON due to earth fault of control output (OSSD 1 / 2) wires, be sure to ground to 0V side (PNP output) / +24V side (NPN output).

CAUTION

Make sure to insulate the ends of the unused lead wires.

<Reference>

Use a safety relay unit or an equivalent control circuit in safety for FSD.

2-5-1 Power Supply Unit

WARNING

Wire correctly using a power supply unit which conforms to the laws and standards of the region where this device is to be used. If the power supply unit is non-conforming or the wiring is improper, it can cause damage or malfunction of this device.

<Reference>

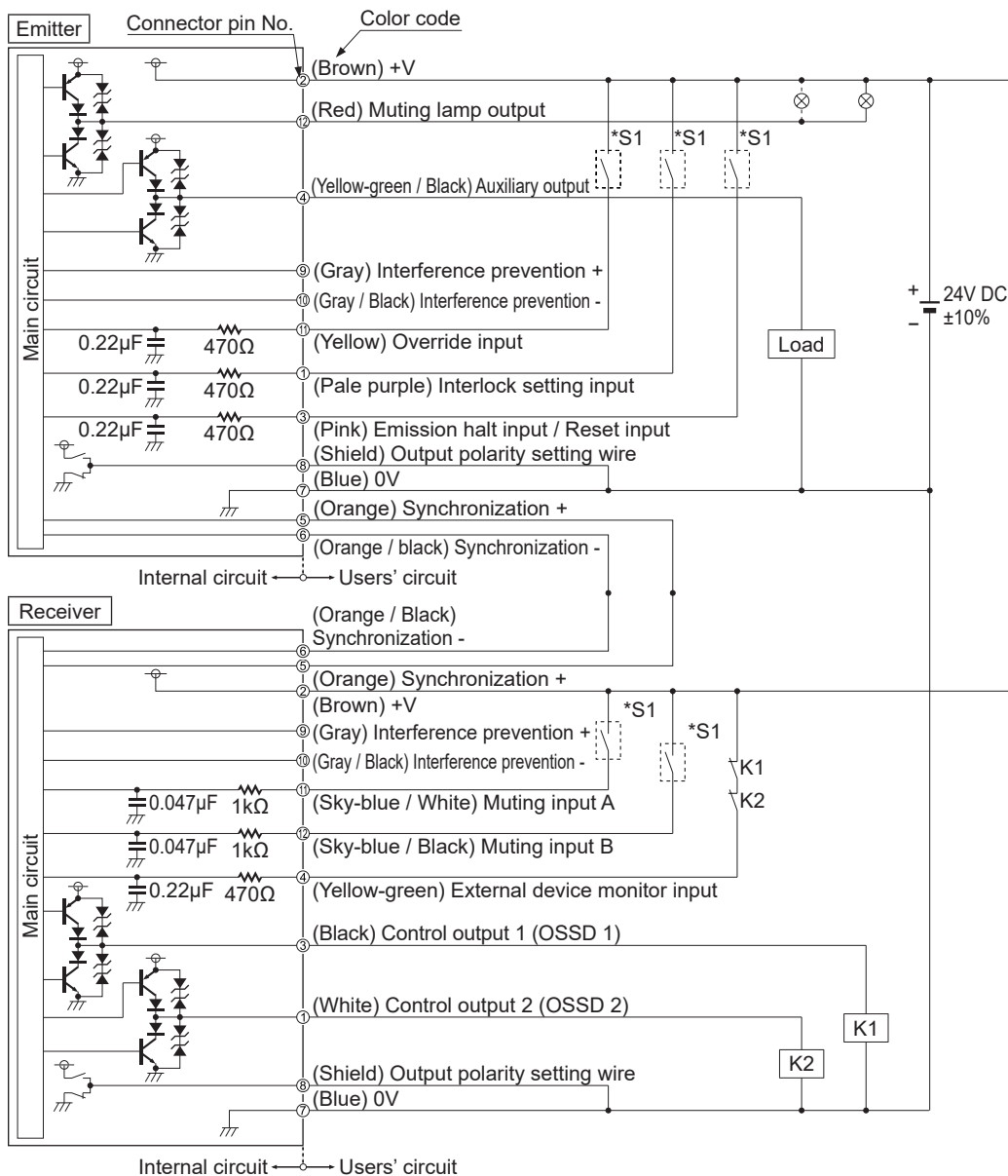
A specialist who has the required electrical knowledge should perform the wiring.

The power supply unit must satisfy the conditions given below.

- 1) Power supply unit authorized in the region where this device is to be used.
- 2) Power supply unit SELV (safety extra low voltage) / PELV (protected extra low voltage) conforming to EMC Directive and Low-voltage Directive (only for requiring CE marking conformation).
- 3) Power supply unit conforming to the Low-voltage Directive and with an output of 100VA or less.
- 4) The frame ground (F.G.) terminal must be connected to ground when using a commercially available switching regulator.
- 5) Power supply unit with an output holding time of 20ms or more.
- 6) In case a surge is generated, take countermeasures such as connecting a surge absorber to the origin of the surge.
- 7) Power supply unit corresponding to CLASS 2 (only for requiring cULus Mark conformation).

2-5-2 I/O Circuit Diagrams and Output Waveform

<In case of using I/O circuit for PNP output>



*S1

Switch S1

- Emission halt input / Reset input
For manual reset: Vs to Vs - 2.5V (sink current 5mA or less) : Emission halt (Note 1), Open: Emission
For auto-reset: Vs to Vs - 2.5V (sink current 5mA or less) : Emission (Note 1), Open: Emission halt
- Interlock setting input, Override input, Muting input A / B, External device monitor input
Vs to Vs - 2.5V (sink current 5mA or less): Valid (Note 1), Open: Invalid

Notes: 1) Vs is the applying supply voltage.

2) The circuit diagram shown above is for 12-core cable to be used. For 8-core cable, red, yellow, gray, gray / black, sky-blue / white, sky-blue / black, there is no lead wire.

<Reference>

K1, K2: External device (Forced guided relay or magnetic contactor)

Emitter

Connector pin No.

Color code

(Brown) +V

(Shield) Output polarity setting wire

(Yellow) Override input

(Pale purple) Interlock setting input

(Pink) Emission halt input / Reset input

(Gray) Interference prevention +

(Gray / Black) Interference prevention -

(Yellow-green / Black) Auxiliary output

(Red) Muting lamp output

(Blue) 0V

(Orange) Synchronization +

(Orange / black) Synchronization -

Internal circuit

Users' circuit

Load

24V DC ±10%

*S1

*S1

*S1

Receiver

Main circuit

(Orange / Black) Synchronization -

(Orange) Synchronization +

(Brown) +V

(Shield) Output polarity setting wire

(Black) Control output 1 (OSSD 1)

(White) Control output 2 (OSSD 2)

(Gray) Interference prevention +

(Gray / Black) Interference prevention -

(Yellow-green) External device monitor input

(Sky-blue / White) Muting input A

(Sky-blue / Black) Muting input B

(Blue) 0V

Internal circuit

Users' circuit

K1

K2

*S1

*S1

*S1

Switch S1

- Emission halt input / Reset input
For manual reset: 0 to +1.5V (source current 5mA or less): Emission halt, Open: Emission
For auto-reset: 0 to +1.5V (source current 5mA or less): Emission, Open: Emission halt
- Interlock setting input, Override input, Muting input A / B, External device monitor input
0 to +1.5V (source current: 5mA or less): Valid, Open: Invalid

<Reference>

K1, K2: External device (Forced guided relay or magnetic contactor)

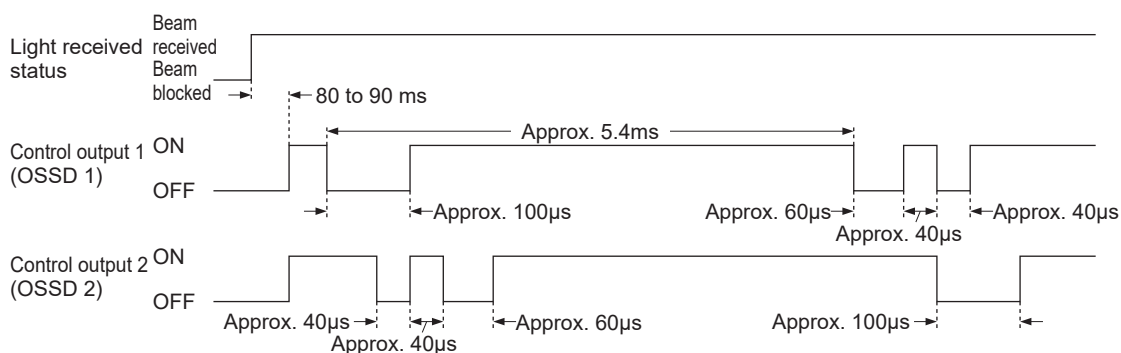
<Output waveform [control output (OSSD 1 / 2) ON]>

Since the receiver performs the self-diagnosis of the output circuit when the device is in light receiving status (ON status), the output transistor becomes OFF status periodically. (Refer to the figure below.) When the OFF signal is fed back, the receiver judges the output circuit as normal. When the OFF signal is not fed back, the receiver judges either the output circuit or wiring as error, and the control output (OSSD 1 / 2) maintains OFF status.

CAUTION

Perform the wiring with paying attention to the input response time of the machine to be connected to this device, since the OFF signal of this device might cause malfunction.

<Timing chart>



2-5-3 Wiring · Connecting Procedure and Connector Pin Arrangement

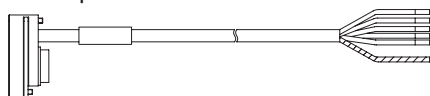
Connect the mating cable (with connector on one end or connector on both ends) to the connector of the bottom cap cable which is mounted on this device (emitter and receiver).

Wire the other side of the mating cable according to the customer's application referring to the connector pin arrangement given below.

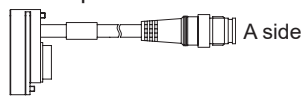
WARNING

- When extending the cable, use the exclusive cable up to the total length of 50m (for each emitter / receiver). Extending the cable longer than 50m may cause malfunction, which can result in death or serious injury. Besides, if two sets of the devices are connected in series, up to total length of 30m (for each emitter / receiver) is allowed for use, and if three sets of the devices are connected, up to total length of 20m (for each emitter / receiver) is allowed for use. Extending the cable longer than the length specified may cause malfunction, which can result in death or serious injury.
- In case the muting lamp is used, a total length should be 40m or less (for each emitter / receiver).
- When the synchronization + wire (orange) and synchronization - wire (orange / black) is extended with a cable other than exclusive cable, use a 0.2mm² or more shielded twisted pair cable.

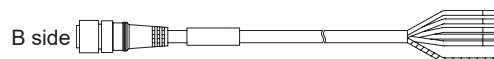
Bottom cap cable / discrete wire



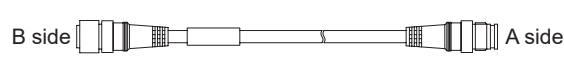
Bottom cap cable / connector



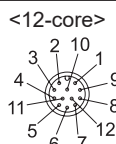
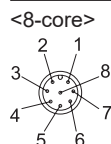
Extension cable with connector on one end



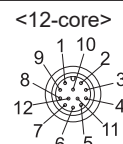
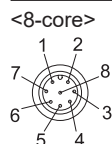
Extension cable with connector on both ends



Connector at A side (for emitter / receiver)



Connector at B side (for emitter / receiver)



<8-core cable (SFB-CC□)>

	Cable / connector color	Connector Pin No.	Color code	Description
Emitter	Gray / Gray	1	Pale purple	Interlock setting input
		2	Brown	+V
		3	Pink	Emission halt input / Reset input
		4	Yellow-green / Black	Auxiliary output
		5	Orange	Synchronization +
		6	Orange / Black	Synchronization -
		7	Blue	0V
		8	(Shield)	Output polarity setting wire
Receiver	Gray (with black stripe) / Black	1	White	Control output 2 (OSSD 2)
		2	Brown	+V
		3	Black	Control output 1 (OSSD 1)
		4	Yellow-green	External device monitor input
		5	Orange	Synchronization +
		6	Orange / Black	Synchronization -
		7	Blue	0V
		8	(Shield)	Output polarity setting wire

<12-core cable (SFB-CC□-MU)>

	Cable / connector color	Connector Pin No..	Color code	Description
Emitter	Gray / Gray	1	Pale purple	Interlock setting input
		2	Brown	+V
		3	Pink	Emission halt input / Reset input
		4	Yellow-green / Black	Auxiliary output
		5	Orange	Synchronization +
		6	Orange / Black	Synchronization -
		7	Blue	0V
		8	(Shield)	Output polarity setting wire
		9	Gray	Interference prevention +
		10	Gray / Black	Interference prevention -
		11	Yellow	Override input
		12	Red	Muting lamp output
Receiver	Gray (with black stripe) / Black	1	White	Control output 2 (OSSD 2)
		2	Brown	+V
		3	Black	Control output 1 (OSSD 1)
		4	Yellow-green	External device monitor input
		5	Orange	Synchronization +
		6	Orange / Black	Synchronization -
		7	Blue	0V
		8	(Shield)	Output polarity setting wire
		9	Gray	Interference prevention +
		10	Gray / Black	Interference prevention -
		11	Sky-blue / White	Muting input A
		12	Sky-blue / Black	Muting input B

<Reference>

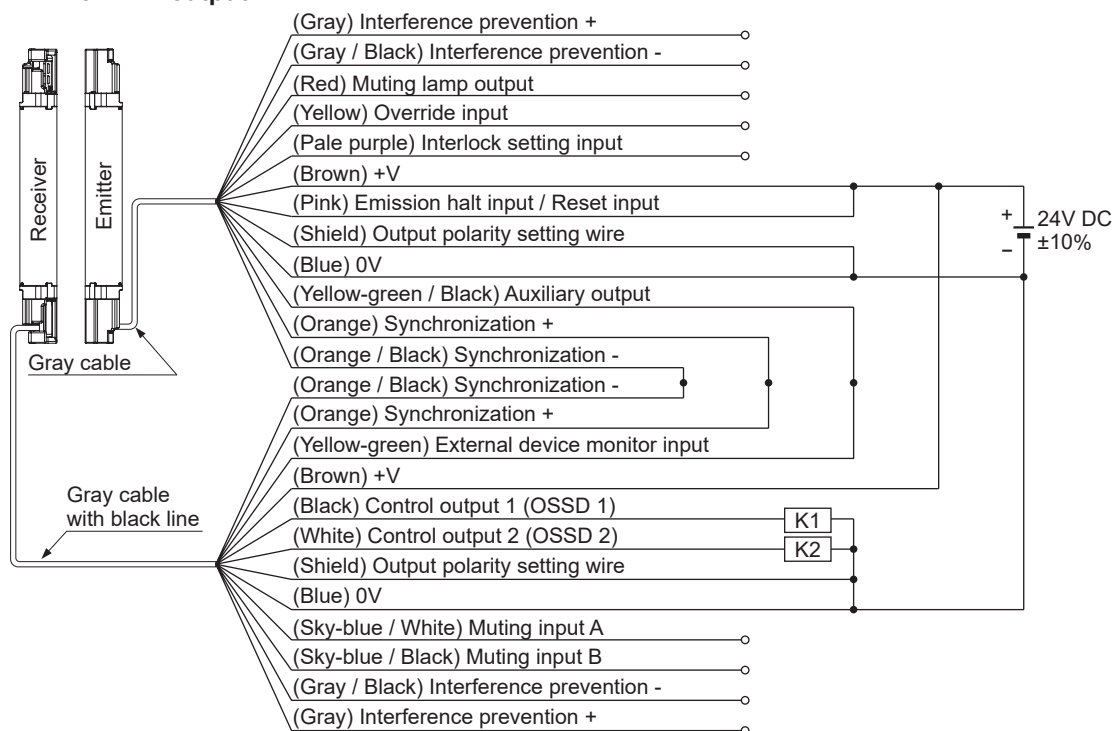
- The connectors can be distinguished from their colors as follows:
Connector for emitter: gray, connector for receiver: black
- For details of the bottom cap cable, the cable with connector on one end, and the cable with connector on both ends, refer to “6-2 Options.”

2-5-4 Basic Wiring

This is the general configuration using one set of the emitter and receiver facing each other. The control output (OSSD 1 / 2) turns OFF if the light is blocked, while it automatically turns ON if it receives the light.

The auxiliary output is used to invalid the external device monitor function. At this time, set the auxiliary output with “negative logic of the control output” (factory setting). The auxiliary output cannot be connected to external devices.

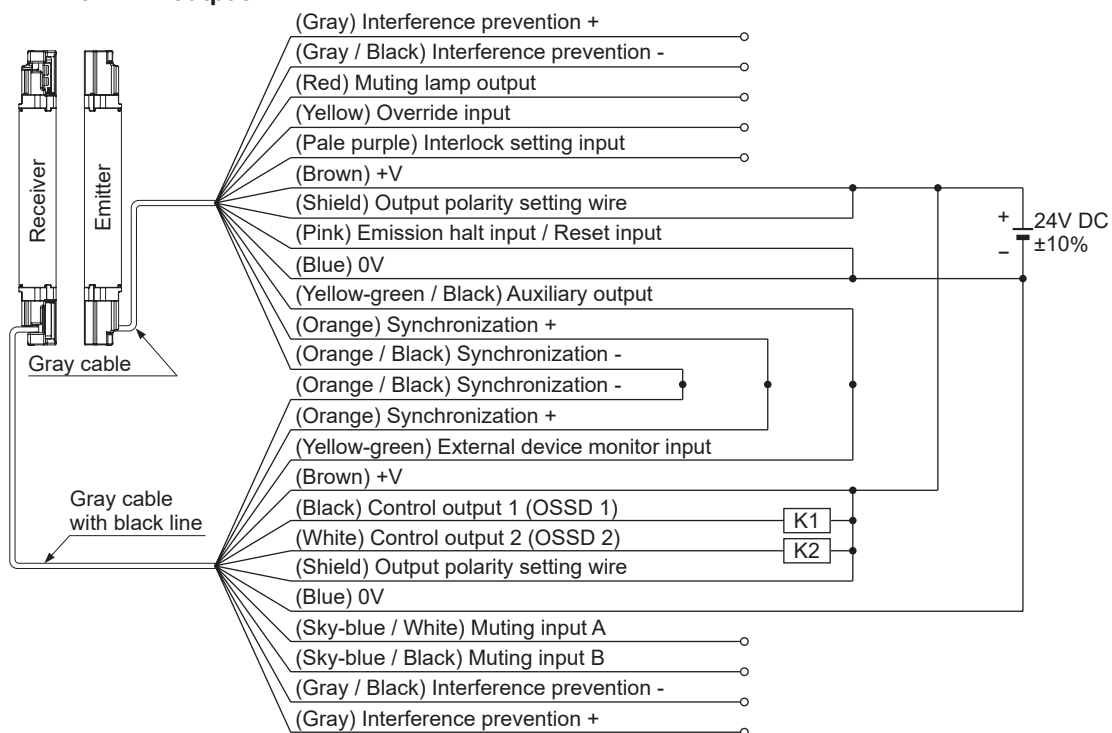
<For PNP output>



Interlock function	Invalid (Auto-reset)
External device monitor function	Invalid
Auxiliary output	Cannot be used

Note: The circuit diagram shown above is for 12-core cable to be used. For 8-core cable, red, yellow, gray, gray / black, sky-blue / white, sky-blue / black, there is no lead wire.

<For NPN output>



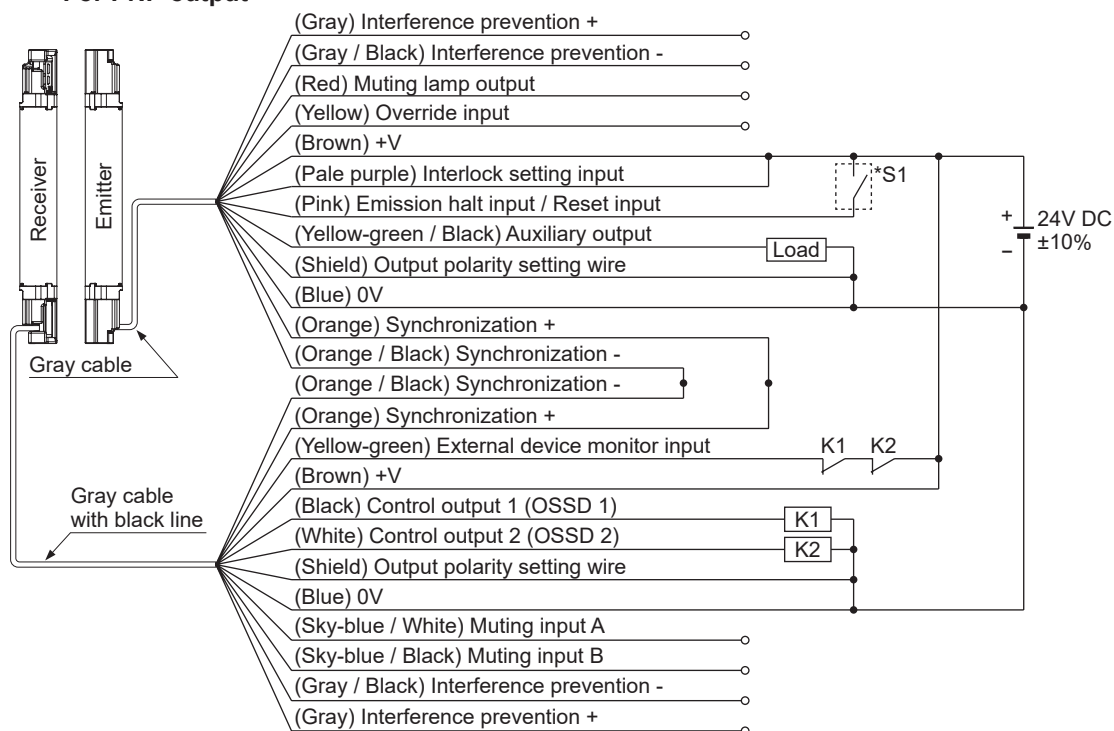
Interlock function	Invalid (Auto-reset)
External device monitor function	Invalid
Auxiliary output	Cannot be used

Note: The circuit diagram shown above is for 12-core cable to be used. For 8-core cable, red, yellow, gray, gray / black, sky-blue / white, sky-blue / black, there is no lead wire.

2-5-5 Wiring for Manual Reset (Interlock is Valid) (Wiring Example of the Control Category 4)

This is the general configuration using one set of the emitter and receiver facing each other. The control output (OSSD 1 / 2) turns OFF if the light is blocked.

<For PNP output>



Interlock function	Valid (Manual reset)
External device monitor function	Valid
Auxiliary output	Can be used

The device output is selected depending on the connecting state of the output polarity setting wire (shield). Incorrect wiring may cause the lockout state.

* Symbols

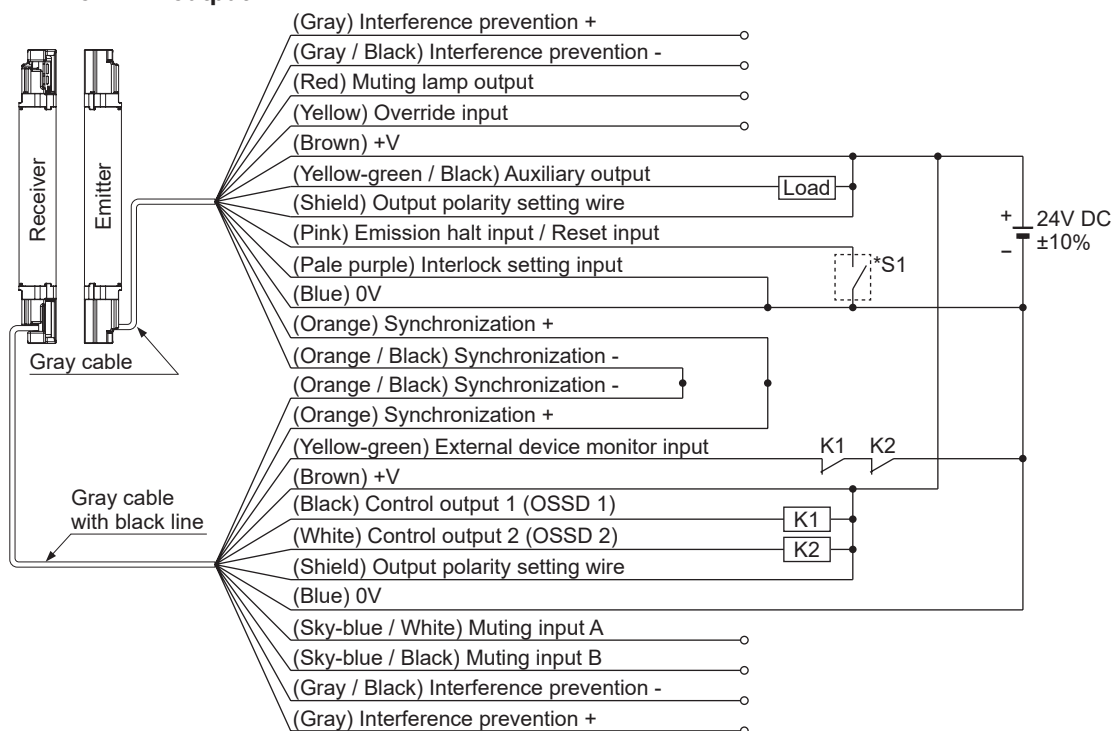
Switch S1
Vs to Vs - 2.5V (sink current 5mA or less): Emission halt (Note 1), Open: Emission
K1, K2: External device (Forced guided relay or magnetic contactor)

Notes: 1) Vs is the applying supply voltage.

2) The circuit diagram shown above is for 12-core cable to be used. For 8-core cable, red, yellow, gray, gray / black, sky-blue / white, sky-blue / black, there is no lead wire.

3) For resetting, refer to "3-2 Interlock Function."

<For NPN output>



Interlock function	Valid (Manual reset)
External device monitor function	Valid
Auxiliary output	Can be used

The device output is selected depending on the connecting state of the output polarity setting wire (shield). Incorrect wiring may cause the lockout state.

* Symbols

Switch S1
 0 to +1.5V (source current 5mA or less): Emission halt, Open: Emission
 K1, K2: External device (Forced guided relay or magnetic contactor)

- Notes: 1) The circuit diagram shown above is for 12-core cable to be used. For 8-core cable, red, yellow, gray, gray / black, sky-blue / white, sky-blue / black, there is no lead wire.
 2) For resetting, refer to “3-2 Interlock Function.”

2-5-6 Series Connection (Wiring Example of the Control Category 4)

[Connectable up to 3 sets of the devices (however, 192 beam channels max.)]

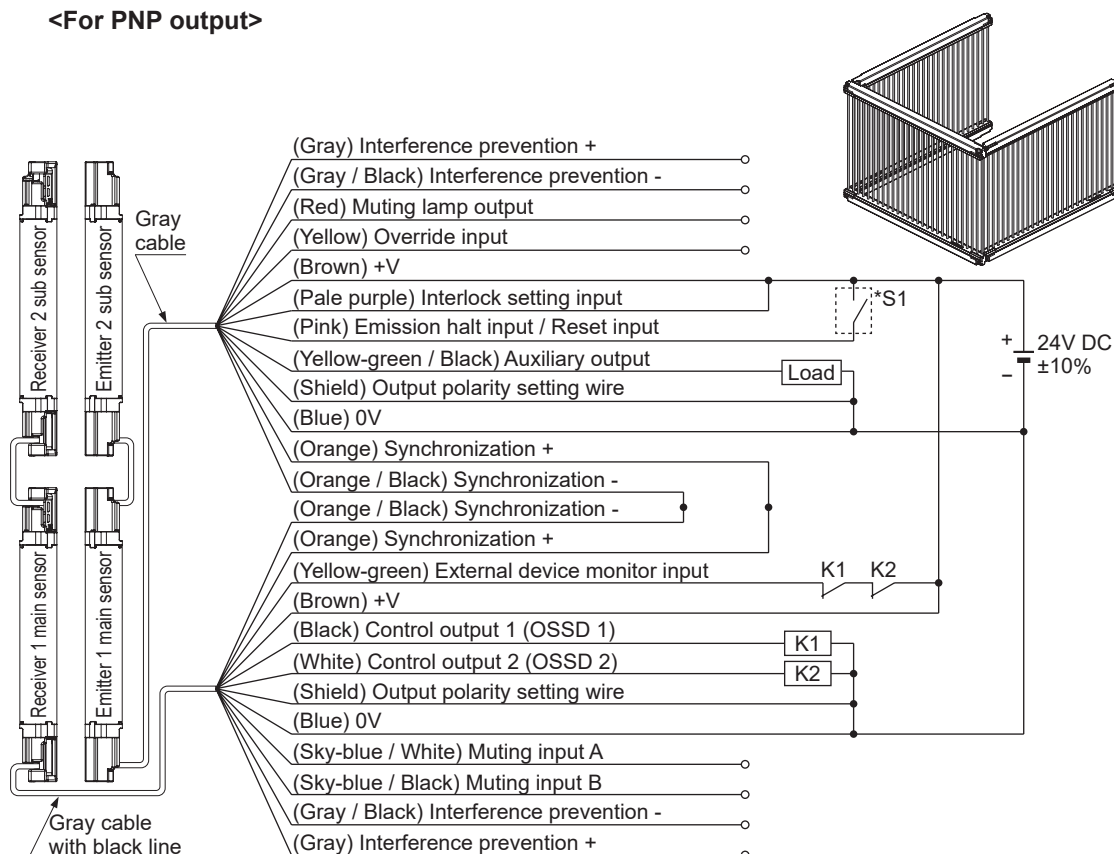
This is the configuration for connecting multiple sets of emitters and receivers facing each other in series. It is used when the dangerous part can be entered from two or more directions. If any of the sets is in light blocked status, the control output (OSSD 1 / 2) turns OFF.



WARNING

For series connection, connect the emitter and emitter, receiver and receiver respectively using the exclusive cable (**SFB-CSL□**) for series connection. Wrong connection could generate the non-sensing area, resulting in death or serious injury.

<For PNP output>



Interlock function	Valid (Manual reset)
External device monitor function	Valid
Auxiliary output	Can be used

The device output is selected depending on the connecting state of the output polarity setting wire (shield). Incorrect wiring may cause the lockout state.

* Symbols

Switch S1

Vs to Vs - 2.5V (sink current 5mA or less): Emission halt (Note 1), Open: Emission

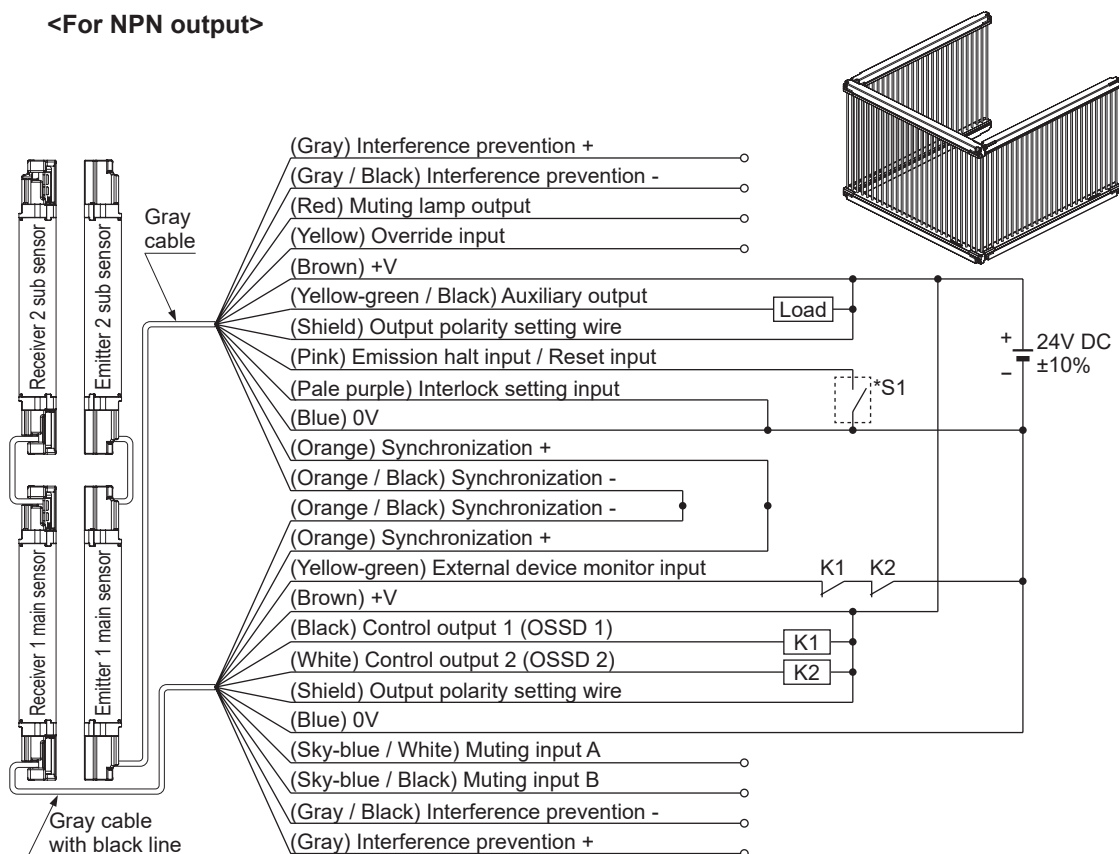
K1, K2: External device (Forced guided relay or magnetic contactor)

Notes: 1) Vs is the applying supply voltage.

2) The circuit diagram shown above is for 12-core cable to be used. For 8-core cable, red, yellow, gray, gray / black, sky-blue / white, sky-blue / black, there is no lead wire.

3) For resetting, refer to "3-2 Interlock Function."

<For NPN output>



Interlock function	Valid (Manual reset)
External device monitor function	Valid
Auxiliary output	Can be used

The device output is selected depending on the connecting state of the output polarity setting wire (shield) wire. Incorrect wiring may cause the lockout state.

* Symbols

Switch S1
 0 to +1.5V (source current 5mA or less): Emission halt, Open: Emission
 K1, K2: External device (Forced guided relay or magnetic contactor)

Notes: 1) The circuit diagram shown above is for 12-core cable to be used. For 8-core cable, red, yellow, gray, gray / black, sky-blue / white, sky-blue / black, there is no lead wire.
 2) For resetting, refer to "3-2 Interlock Function."

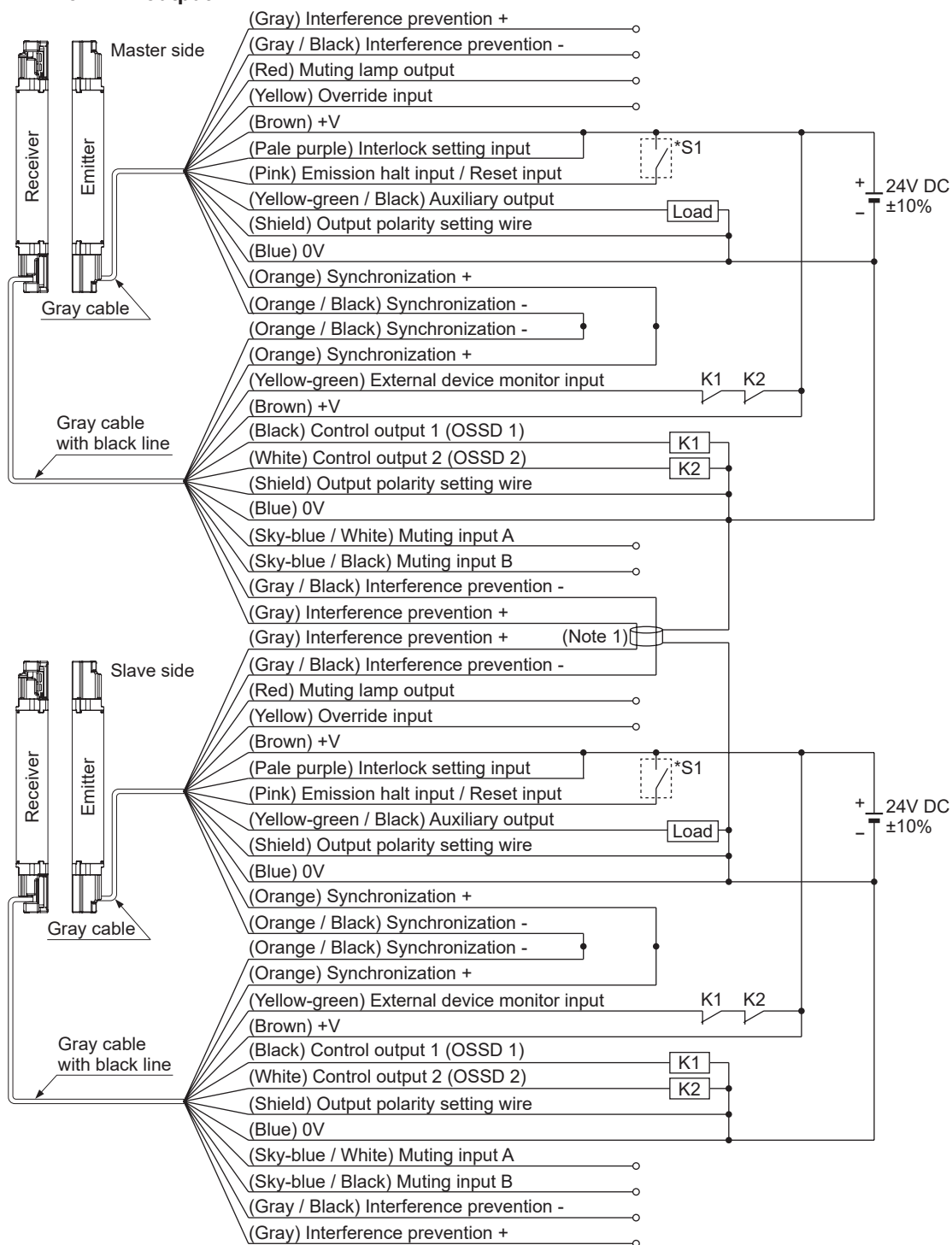
2-5-7 Parallel Connection (Wiring Example of the Control Category 4)

This is the configuration for connecting multiple sets of emitter and receiver facing each other in parallel. It is used when there are two dangerous parts and each dangerous part can be entered from only one direction. By connecting the interference prevention line, up to three sets of the devices can be connected. For the control output (OSSD 1 / 2), only the set of which light is blocked turns OFF.



For parallel connection, connect the one receiver to the other connection using the interference prevention line as shown in the figure on the next page. Wrong connection could generate the non-sensing area, resulting in death or serious injury.

<For PNP output>



Interlock function	Valid (Manual reset)
External device monitor function	Valid
Auxiliary output	Can be used

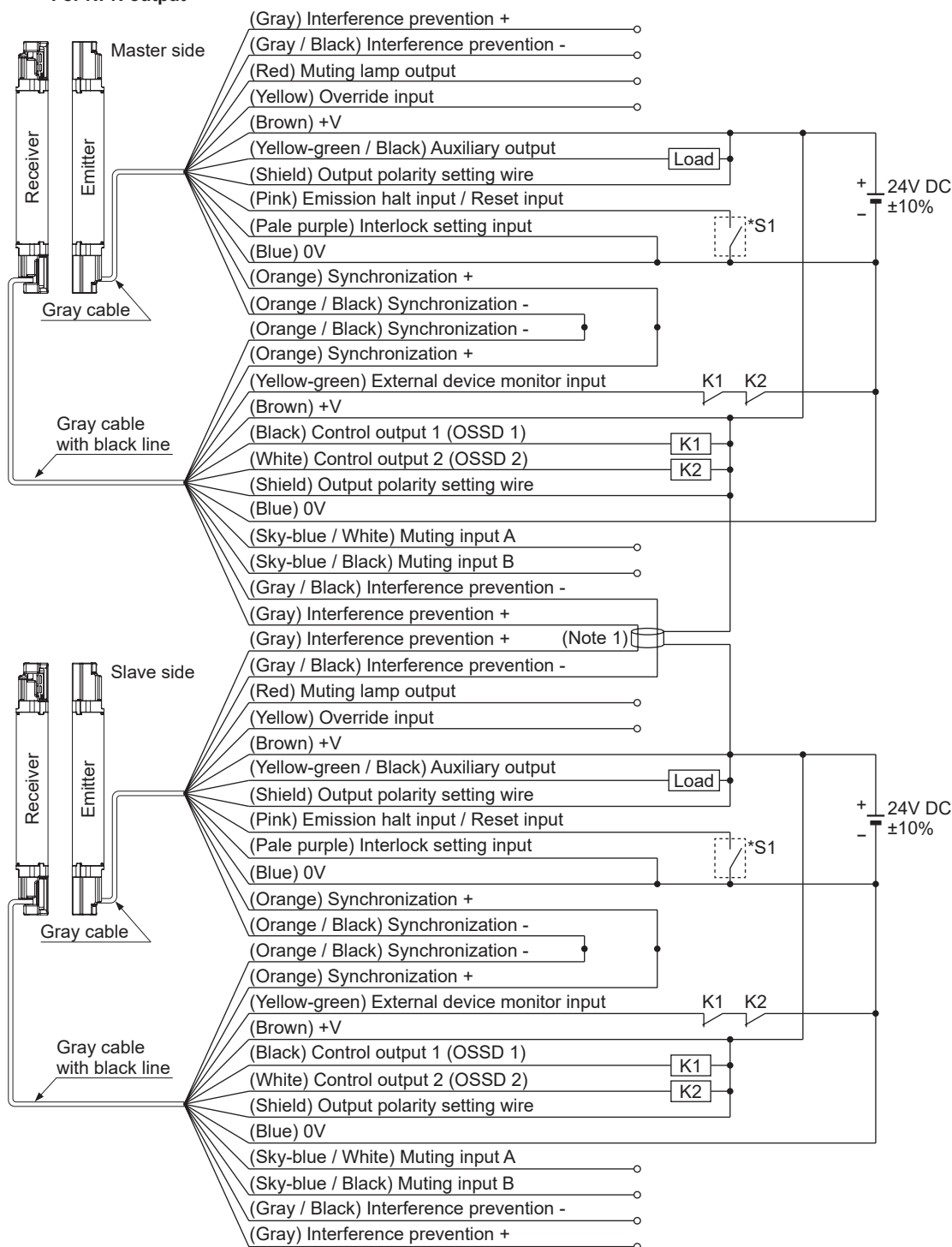
The device output is selected depending on the connecting state of the output polarity setting wire (shield).
Incorrect wiring may cause the lockout state.

* Symbols

Switch S1
Vs to Vs - 2.5V (sink current 5mA or less): Emission halt (Note 2), Open: Emission
K1, K2: External device (Forced guided relay or magnetic contactor)

Notes: 1) If the interference prevention wire is extended, use a 0.2mm² or more, shielded twisted pair cable.
2) Vs is the applying supply voltage.
3) For resetting, refer to “**3-2 Interlock Function.**”

<For NPN output>



Interlock function	Valid (Manual reset)
External device monitor function	Valid
Auxiliary output	Can be used

The device output is selected depending on the connecting state of the output polarity setting wire (shield).
Incorrect wiring may cause the lockout state.

* Symbols

Switch S1
0 to +1.5V (source current 5mA or less): Emission halt, Open: Emission
K1, K2: External device (Forced guided relay or magnetic contactor)

Notes: 1) If the interference prevention wire is extended, use a 0.2mm² or more, shielded twisted pair cable.
2) For resetting, refer to “3-2 Interlock Function.”

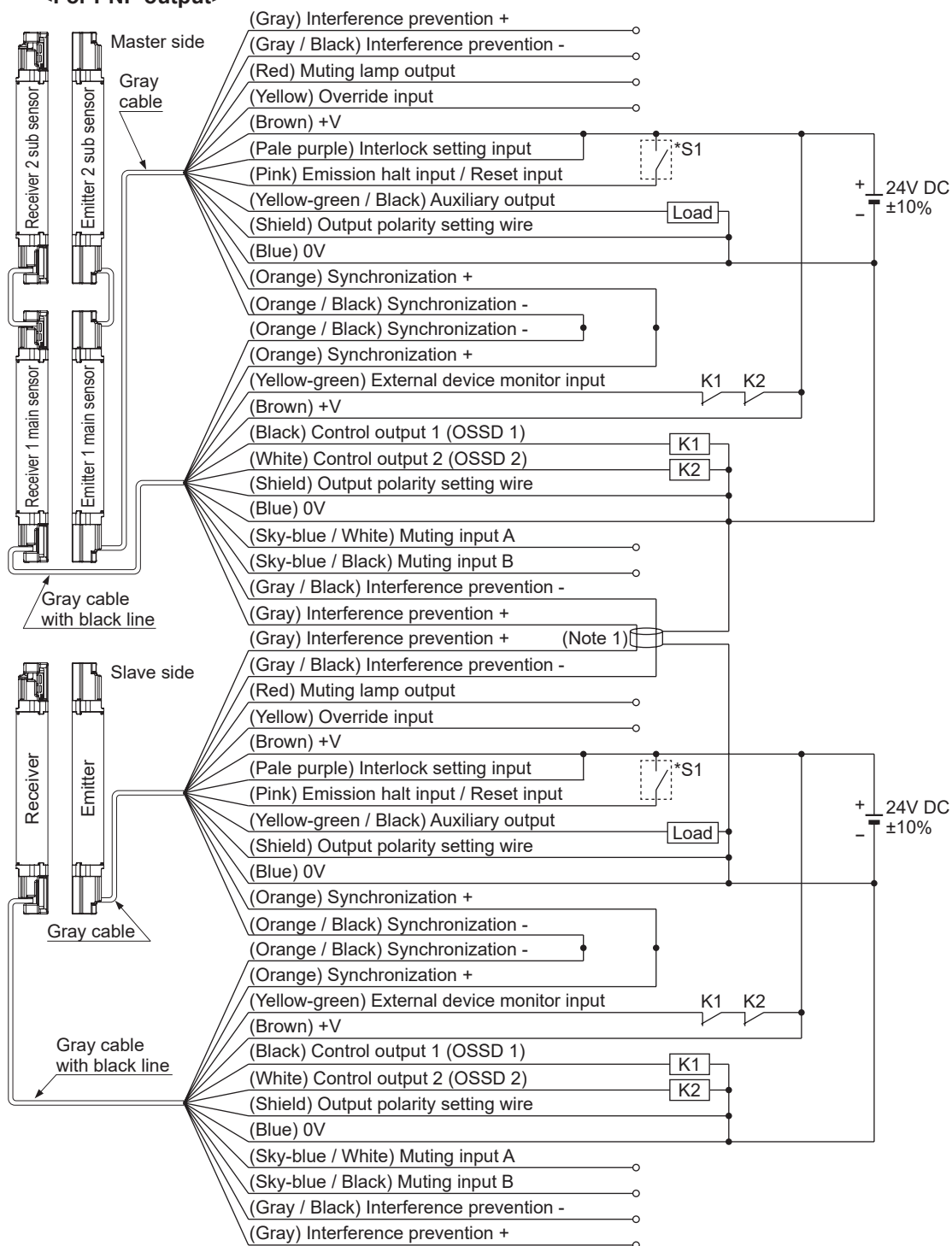
2-5-8 Series and Parallel Mixed Connection (Wiring Example of the Control Category 4)

This is the configuration for connecting multiple sets of emitter and receiver facing each other in mixed series and parallel combination. It is used when there are two or more dangerous parts that can be entered from two or more directions. Up to three sets of the devices in total of the series connection and parallel connection can be connected in combination. However, the total number of beam channels available is 192. In case of series connection, if any of the sets is in light blocked status, the control output (OSSD 1 / 2) turns OFF. In case of parallel connection, for the control output (OSSD 1 / 2), only the set of which light is blocked turns OFF.

WARNING

- For series connection, connect the emitter and emitter, receiver and receiver respectively using the exclusive cable (**SFB-CSL□**) for series connection as shown in the figure on the next page. Wrong connection could generate the non-sensing area, resulting in death or serious injury.
- For parallel connection, connect the one receiver to the other connection using the interference prevention line as shown in the figure on the next page. Wrong connection could generate the non-sensing area, resulting in death or serious injury.

<For PNP output>



Interlock function	Valid (Manual reset)
External device monitor function	Valid
Auxiliary output	Can be used

The device output is selected depending on the connecting state of the output polarity setting wire (shield).
Incorrect wiring may cause the lockout state.

* Symbols

Switch S1

Vs to Vs - 2.5V (sink current 5mA or less): Emission halt (Note 2), Open: Emission

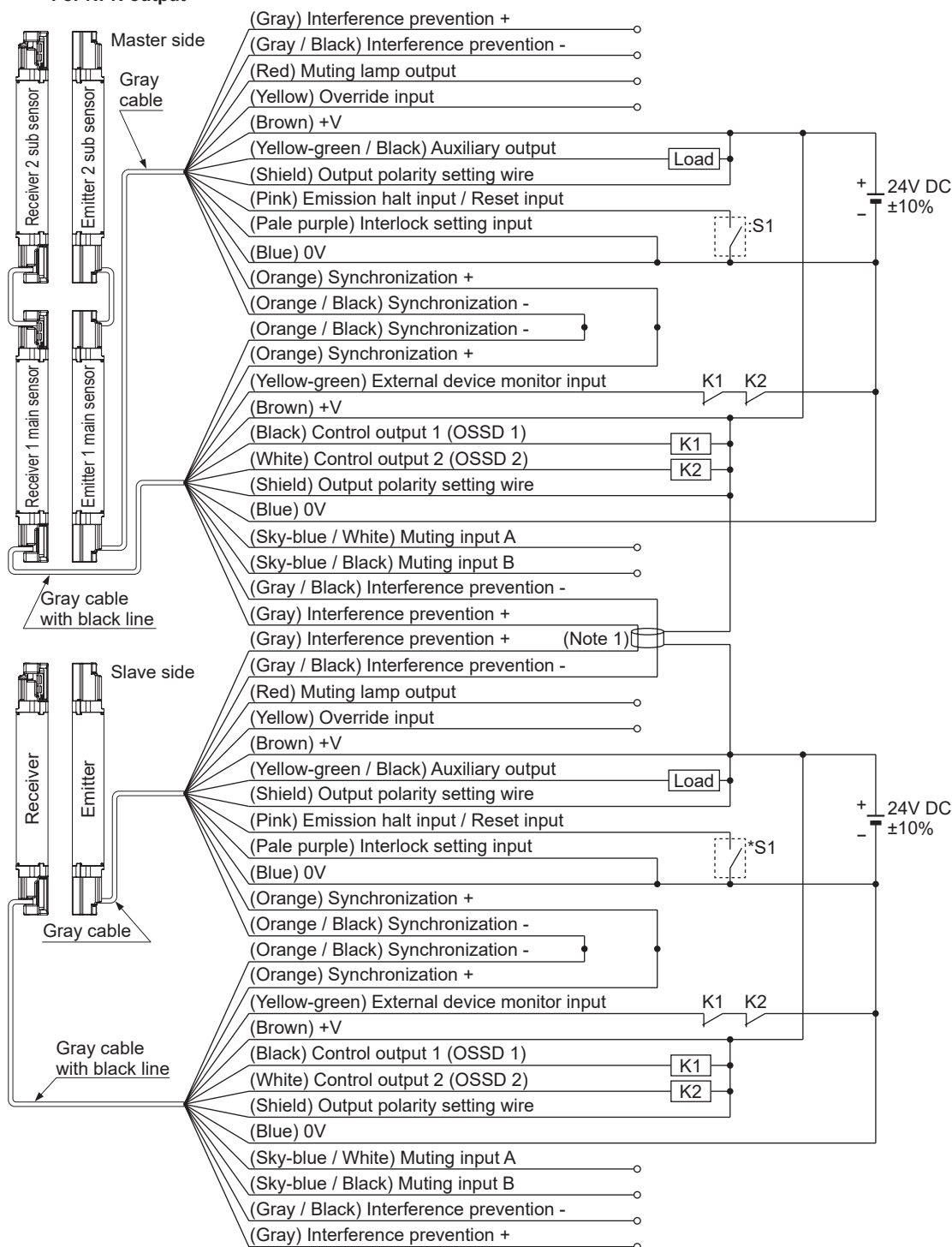
K1, K2: External device (Forced guided relay or magnetic contactor)

Notes: 1) If the interference prevention wire is extended, use a 0.2mm² or more, shielded twisted pair cable.

2) Vs is the applying supply voltage.

3) For resetting, refer to “**3-2 Interlock Function.**”

<For NPN output>



Interlock function	Valid (Manual reset)
External device monitor function	Valid
Auxiliary output	Can be used

The device output is selected depending on the connecting state of the output polarity setting wire (shield).
Incorrect wiring may cause the lockout state.

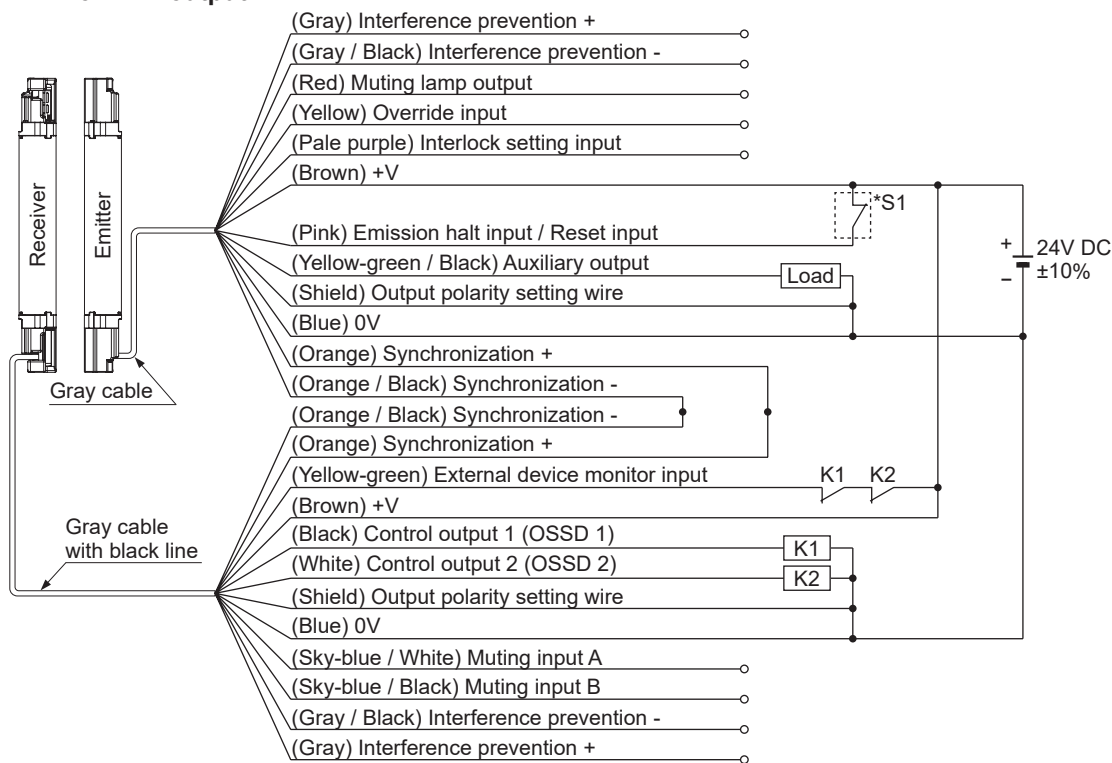
* Symbols

Switch S1
0 to +1.5V (source current 5mA or less): Emission halt, Open: Emission
K1, K2: External device (Forced guided relay or magnetic contactor)

Notes: 1) If the interference prevention wire is extended, use a 0.2mm² or more, shielded twisted pair cable.
2) For resetting, refer to "**3-2 Interlock Function.**"

2-5-9 Wiring for Auto-reset (Interlock is Invalid) (Wiring Example of the Control Category 4)

<For PNP output>



Interlock function	Invalid (Auto-reset)
External device monitor function	Valid
Auxiliary output	Can be used

The device output is selected depending on the connecting state of the output polarity setting wire (shield). Incorrect wiring may cause the lockout state.

* Symbols

Switch S1

Vs to Vs - 2.5V (sink current 5mA or less): Emission (Note 1), Open: Emission halt

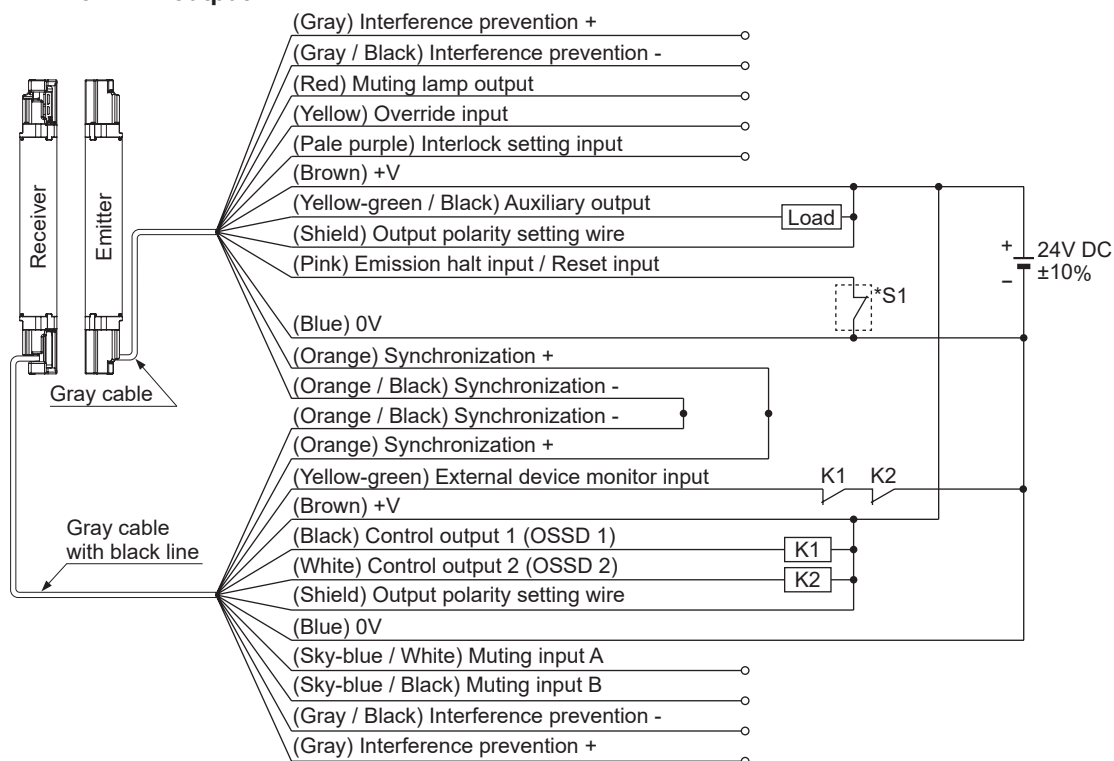
K1, K2: External device (Forced guided relay or magnetic contactor)

Notes: 1) Vs is the applying supply voltage.

2) The circuit diagram shown above is for 12-core cable to be used. For 8-core cable, red, yellow, gray, gray / black, sky-blue / white, sky-blue / black, there is no lead wire.

3) For resetting, refer to "3-2 Interlock Function."

<For NPN output>



Interlock function	Invalid (Auto-reset)
External device monitor function	Valid
Auxiliary output	Can be used

The device output is selected depending on the connecting state of the output polarity setting wire (shield). Incorrect wiring may cause the lockout state.

* Symbols

Switch S1
 0 to +1.5V (source current 5mA or less): Emission, Open: Emission halt
 K1, K2: External device (Forced guided relay or magnetic contactor)

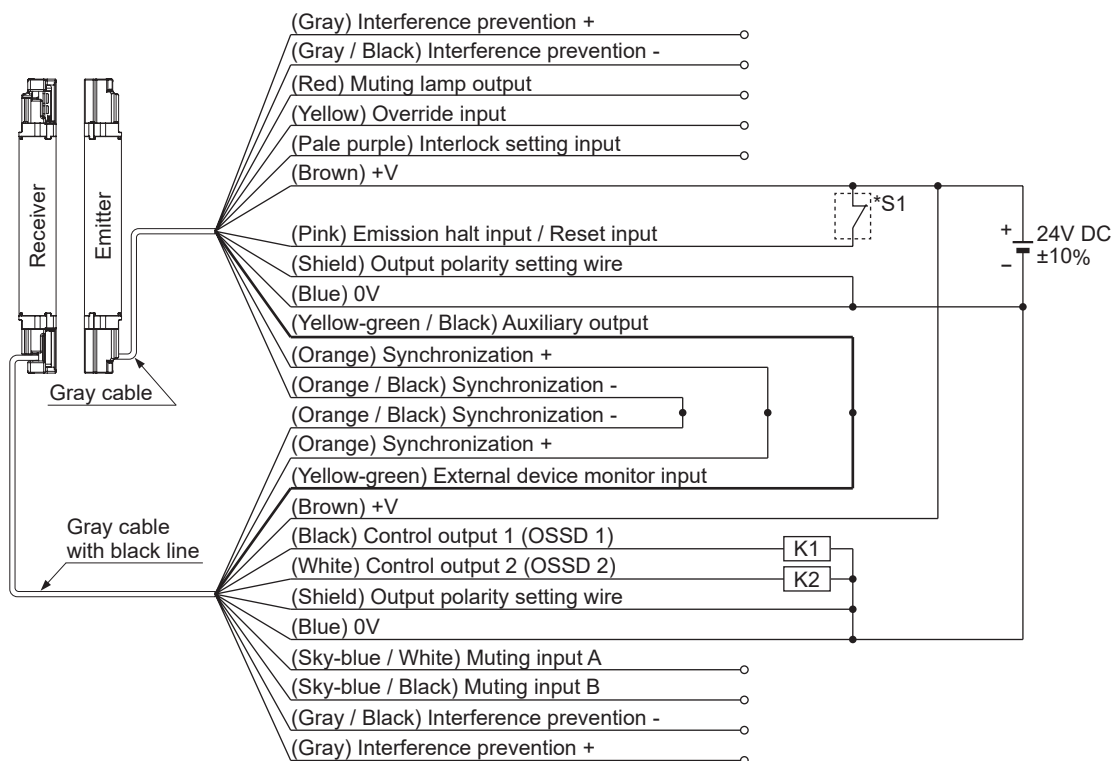
- Notes: 1) The circuit diagram shown above is for 12-core cable to be used. For 8-core cable, red, yellow, gray, gray / black, sky-blue / white, sky-blue / black, there is no lead wire.
 2) For resetting, refer to "3-2 Interlock Function."

2-5-10 Wiring Configuration for Invalid External Device Monitor Function (Wiring Example of the Control Category 4)

This is the configuration for connecting auxiliary output and external device monitor input. At this time, set the auxiliary output with “negative logic of the control output (OSSD 1 / 2)” (factory setting). [Set through the handy controller (**SFB-HC**) (optional).] The auxiliary output cannot be connected to external devices.

It also enables the external device monitor function to be set at invalid by using the handy controller (**SFB-HC**) (optional).

<For PNP output>



Interlock function	Invalid (Auto-reset)
External device monitor function	Invalid
Auxiliary output	Cannot be used

The device output is selected depending on the connecting state of the output polarity setting wire (shield). Incorrect wiring may cause the lockout state.

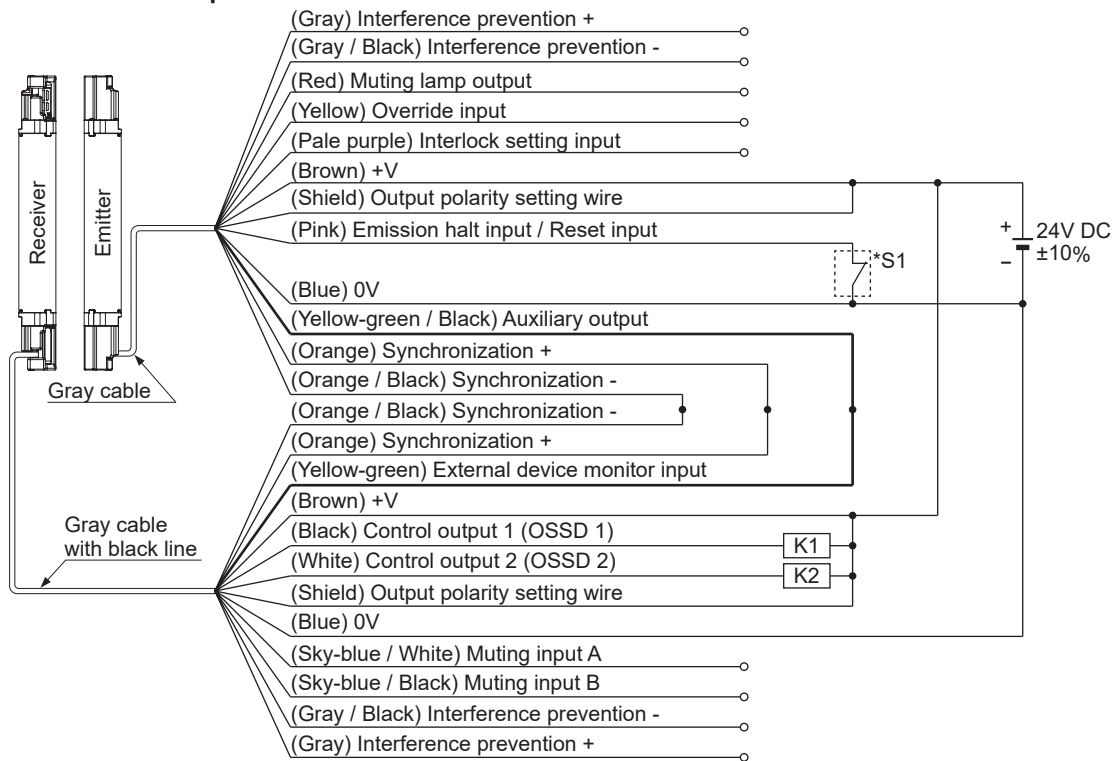
* Symbols

Switch S1
Vs to Vs - 2.5V (sink current 5mA or less): Emission (Note 1), Open: Emission halt
K1, K2: Safety relay unit etc.

Notes: 1) V_s is the applying supply voltage.

2) The circuit diagram shown above is for 12-core cable to be used. For 8-core cable, red, yellow, gray, gray / black, sky-blue / white, sky-blue / black, there is no lead wire.

<For NPN output>



Interlock function	Invalid (Auto-reset)
External device monitor function	Invalid
Auxiliary output	Cannot be used

The device output is selected depending on the connecting state of the output polarity setting wire (shield). Incorrect wiring may cause the lockout state.

* Symbols

Switch S1

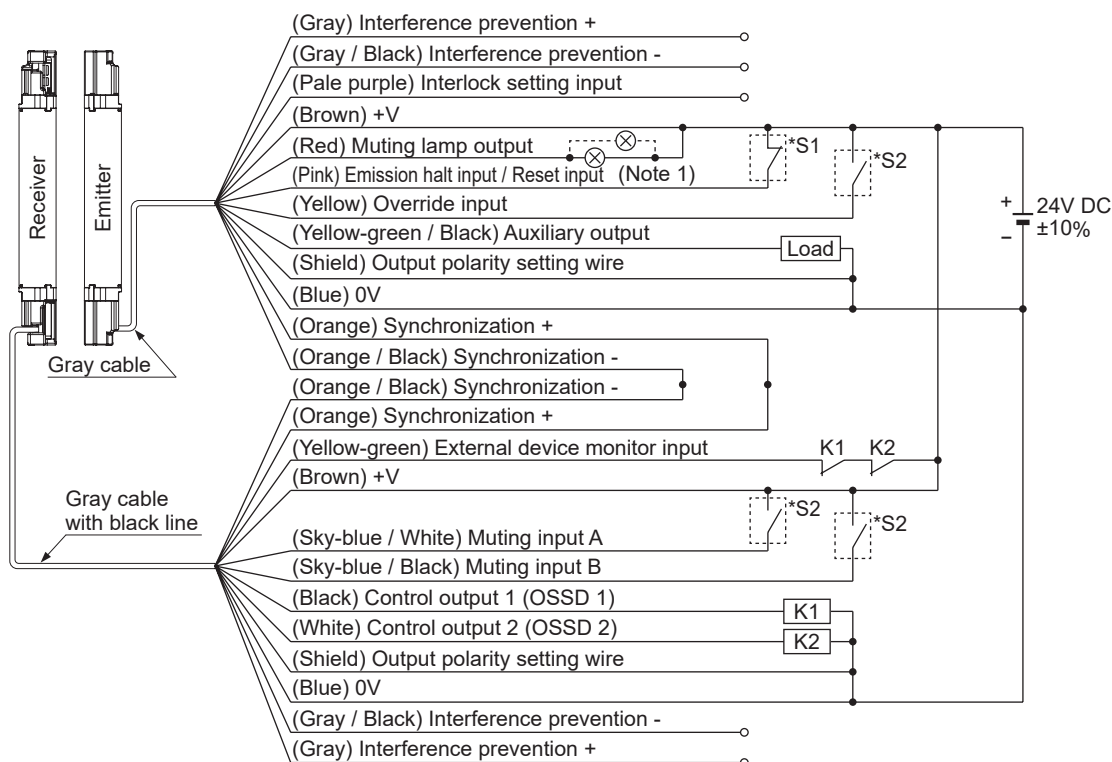
0 to +1.5V (source current 5mA or less): Emission, Open: Emission halt

K1, K2: Safety relay unit etc.

Note: The circuit diagram shown above is for 12-core cable to be used. For 8-core cable, red, yellow, gray, gray / black, sky-blue / white, sky-blue / black, there is no lead wire.

2-5-11 Wiring Configuration for Valid Muting Function (Wiring Example of the Control Category 4)

<For PNP output>



Interlock function	Invalid (Auto-reset)
External device monitor function	Valid
Auxiliary output	Can be used

The device output is selected depending on the connecting state of the output polarity setting wire (shield). Incorrect wiring may cause the lockout state.

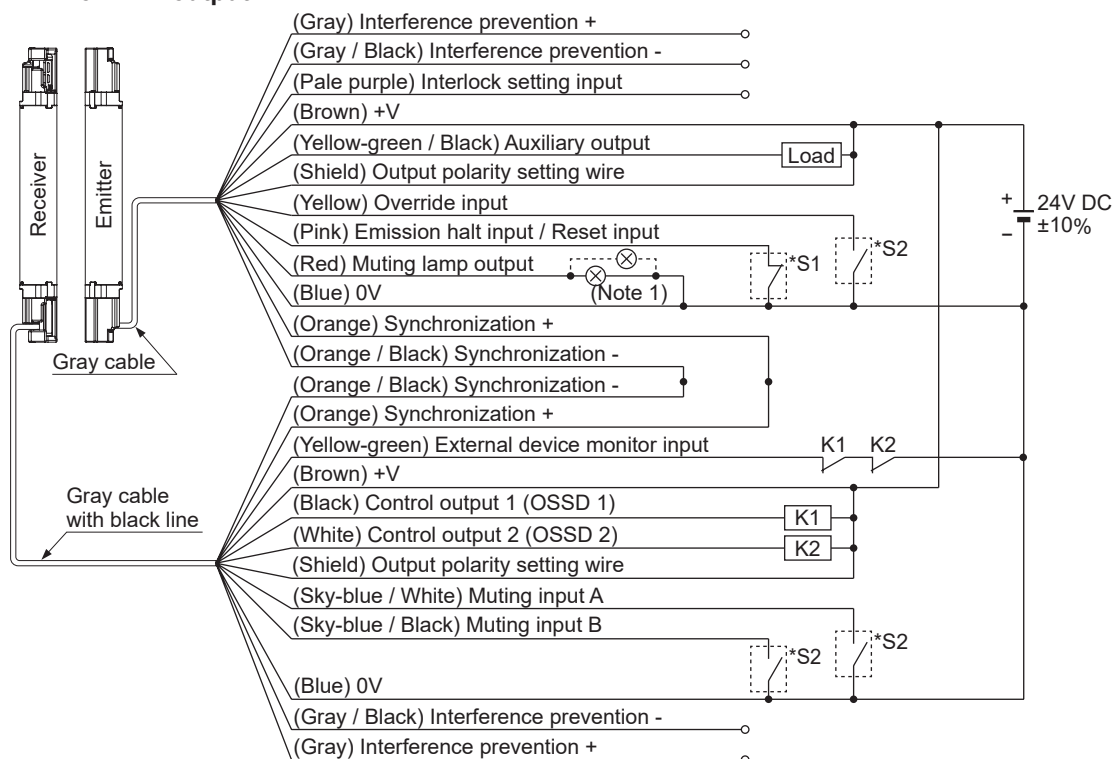
* Symbols

Switch S1
Vs to Vs - 2.5V (sink current 5mA or less): Emission (Note 2), Open: Emission halt
Switch S2
The muting input, the override input
Vs to Vs - 2.5V (sink current 5mA or less): Valid (Note 2), Open: Invalid
K1, K2: External device (Forced guided relay or magnetic contactor)

Notes: 1) The incandescent lamp with 3 to 10W shall be connected to the muting lamp output. If the muting lamp is not connected, the muting function does not operate.

2) Vs is the applying supply voltage.

<For NPN output>



Interlock function	Invalid (Auto-reset)
External device monitor function	Valid
Auxiliary output	Can be used

The device output is selected depending on the connecting state of the output polarity setting wire (shield). Incorrect wiring may cause the lockout state.

* Symbols

Switch S1
0 to +1.5V (source current 5mA or less): Emission, Open: Emission halt
Switch S2
The muting input, the override input
0 to +1.5V (source current 5mA or less): Valid, Open: Invalid
K1, K2: External device (Forced guided relay or magnetic contactor)

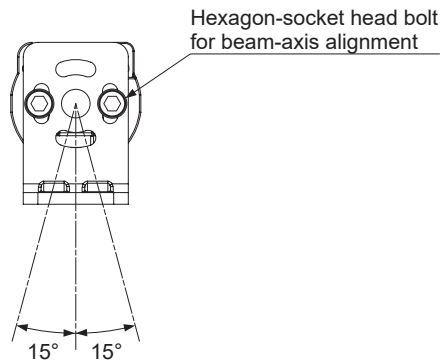
Note: The incandescent lamp with 3 to 10W shall be connected to the muting lamp output. If the muting lamp is not connected, the muting function does not operate.

2-6 Adjustment

2-6-1 Beam-axis Alignment

1. Turn ON the power supply unit of this device.
2. Check that the digital error indicator (red) and the fault indicator (yellow) of the emitter and receiver are OFF respectively.
If the digital error indicator (red) or the fault indicator (yellow) lights up or blinks, refer to **"Chapter 5 Troubleshooting,"** and report the symptoms to the maintenance in charge.
3. Loosen the hexagon-socket head bolt for beam axis alignment of the mounting bracket, and adjust the emitter / receiver so that the beam-axis alignment indicators in the display of the emitter and receiver light up.

The emitter and the receiver can be fine-adjusted by ± 15 degrees.



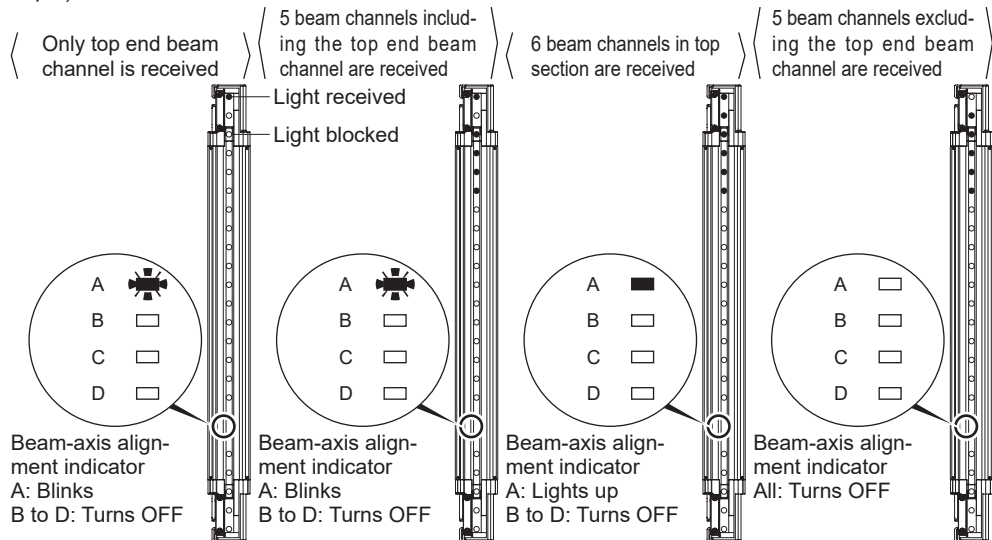
<Reference>

The beam-axis alignment indicator indicates the reception status for each section of the device which is divided into 4 sections.

Also, the A (D) of the beam-axis alignment indicates the light-receiving status of the device top end (bottom end).

For example, when using a 24-beam channel device, there are 6 beam channels per section (i.e., $24/4=6$). When the top end (bottom end) beam channel is received, the A (D) of the beam-axis alignment indicator blinks in red.

(Example) 24 beam channels



All the 6 beam channels divided into each section are received, the beam-axis alignment indicator lights up in red.

The indicators corresponding to the different sections light up in red, one by one, when the beam channels of the respective sections are received. When all the beam channels are received and the control output (OSSD 1 / 2) turns ON, all the four indicators of the beam-axis alignment indicator turn into green.

Refer to “**2-6-3 Operation**” for details.

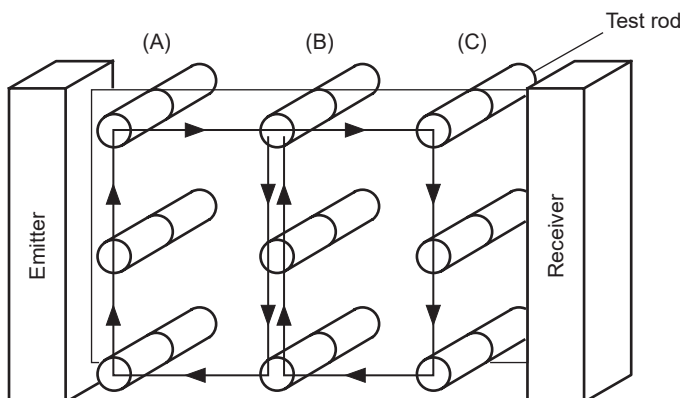
- After the adjustment, tighten the hexagon-socket head bolt for beam-axis alignment of the mounting bracket. The tightening torque should be 3N·m or less.

⚠ CAUTION

After the beam-axis alignment is finished, make sure to confirm that all the bolts are tightened by the specified torque. For the tightening torque of each bolt, refer to “**2-4 Mounting.**”

2-6-2 Operation Test

1. Turn ON the power supply unit of this device.
2. Check that the digital error indicator (red) and the fault indicator (yellow) of the emitter and the receiver are OFF respectively.
If the digital error indicator (red) or the fault indicator (yellow) lights up or blinks, refer to “**Chapter 5 Troubleshooting**,” and report the symptoms to the maintenance in charge.
3. Move the test rod ($\varnothing 14\text{mm}$ for **SF4B-F□G<V2>**, $\varnothing 25\text{mm}$ for **SF4B-H□G<V2>**, $\varnothing 45\text{mm}$ for **SF4B-A□G<V2>**) up and down less than 1,600mm/sec. at three positions, just in front of the emitter (A), between the emitter and receiver (B), and just in front of the receiver (C).



4. During Step 3 above, check that the control output (OSSD 1 / 2) is in OFF state, and both the OSSD indicator (red) of the receiver and the operation indicator (red) of the emitter light up as long as the test rod is present within the sensing area.
If the behavior of the control output (OSSD 1 / 2) and the turning ON / OFF of the emitter / receiver indicators do not correspond to the movement of the test rod, refer to “**Chapter 5 Troubleshooting**,” and report the symptoms to the maintenance in charge.

<Reference>





































If the indicators show reception of the light even though the test rod blocks the light, check whether there is any reflective object or extraneous light source near this device or not.

2-6-3 Operation

1) Normal Operation

The status of the emitter / receiver indicators during normal operation is as described below.





































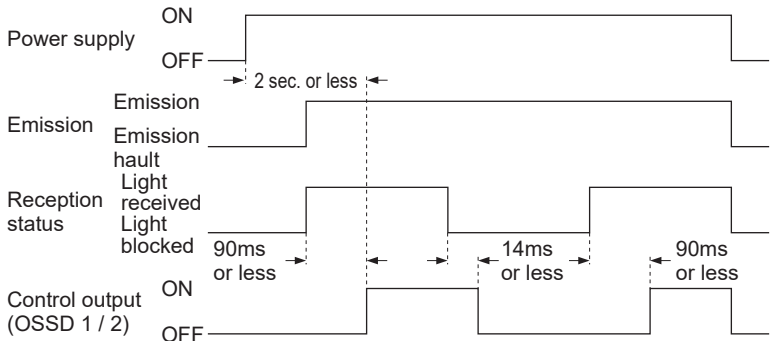
 : Blinks in red
  : Lights up in red
  : Lights up in green
  : Lights up in orange
  : Turns OFF

Device status		Indicators		Control output	
		Emitter	Receiver	OSSD 1	OSSD 2
Light received status (all beams received)		Beam-axis alignment indicator (Green)  Operation indicator (Green) (Note 1)  Incident light intensity indicator (Green)  Fault indicator  Digital error indicator  PNP indicator (Orange) (Note 2)  NPN indicator  Emission intensity control indicator  Emission halt indicator 	Beam-axis alignment indicator (Green)  OSSD indicator (Green)  Incident light intensity indicator (Green)  Fault indicator  Digital error indicator  PNP indicator (Orange) (Note 2)  NPN indicator  Function setting indicator  Interlock indicator 	ON	
Light blocked status	One or more lights blocked	Beam-axis alignment indicator (Red)  Operation indicator (Red) (Note 1)  Incident light intensity indicator  Fault indicator  Digital error indicator  PNP indicator (Orange) (Note 2)  NPN indicator  Emission intensity control indicator  Emission halt indicator 	Beam-axis alignment indicator (Red)  OSSD Indicator (Red)  Incident light intensity indicator  Fault indicator  Digital error indicator  PNP indicator (Orange) (Note 2)  NPN indicator  Function setting indicator  Interlock indicator 	OFF	

Notes: 1) Since the color of the operation indicator changes according to the ON / OFF state of the control output (OSSD 1 / 2), the operation indicator is marked as OSSD on the device.

2) The status of the emitter / receiver indicators during operation above shows the case in PNP output setting mode. In case of NPN output setting mode, the NPN indicator (orange) lights up.

 : Blinks in red
  : Lights up in red
  : Lights up in green
  : Lights up in orange
  : Turns OFF

Device status		Indicators		Control output			
		Emitter		Receiver		OSSD 1	OSSD 2
Light blocked status	Lights other than the top end blocked	Beam-axis alignment indicator (Red) 		Beam-axis alignment indicator (Red) 		OFF	
	Operation indicator (Red) (Note 1) Incident light intensity indicator Fault indicator Digital error indicator PNP indicator (Orange) (Note 2) NPN indicator Emission intensity control indicator Emission halt indicator	       		OSSD indicator (Red) Incident light intensity indicator Fault indicator Digital error indicator PNP indicator (Orange) (Note 2) NPN indicator Function setting indicator Interlock indicator	       		
Light blocked status	Lights other than the bottom end blocked	Beam-axis alignment indicator (Red) 		Beam-axis alignment indicator (Red) 		OFF	
	Operation indicator (Red) (Note 1) Incident light intensity indicator Fault indicator Digital error indicator PNP indicator (Orange) (Note 2) NPN indicator Emission intensity control indicator Emission halt indicator	       		OSSD indicator (Red) (Note 1) Incident light intensity indicator Fault indicator Digital error indicator PNP indicator (Orange) (Note 2) NPN indicator Function setting indicator Interlock indicator	       		
Time chart							

Notes: 1) Since the color of the operation indicator changes according to the ON / OFF state of the control output (OSSD 1 / 2), the operation indicator is marked as "OSSD" on the device.

2) The status of the emitter / receiver indicators during operation above shows the case in PNP output setting mode. In case of NPN output setting mode, the NPN indicator (orange) lights up.

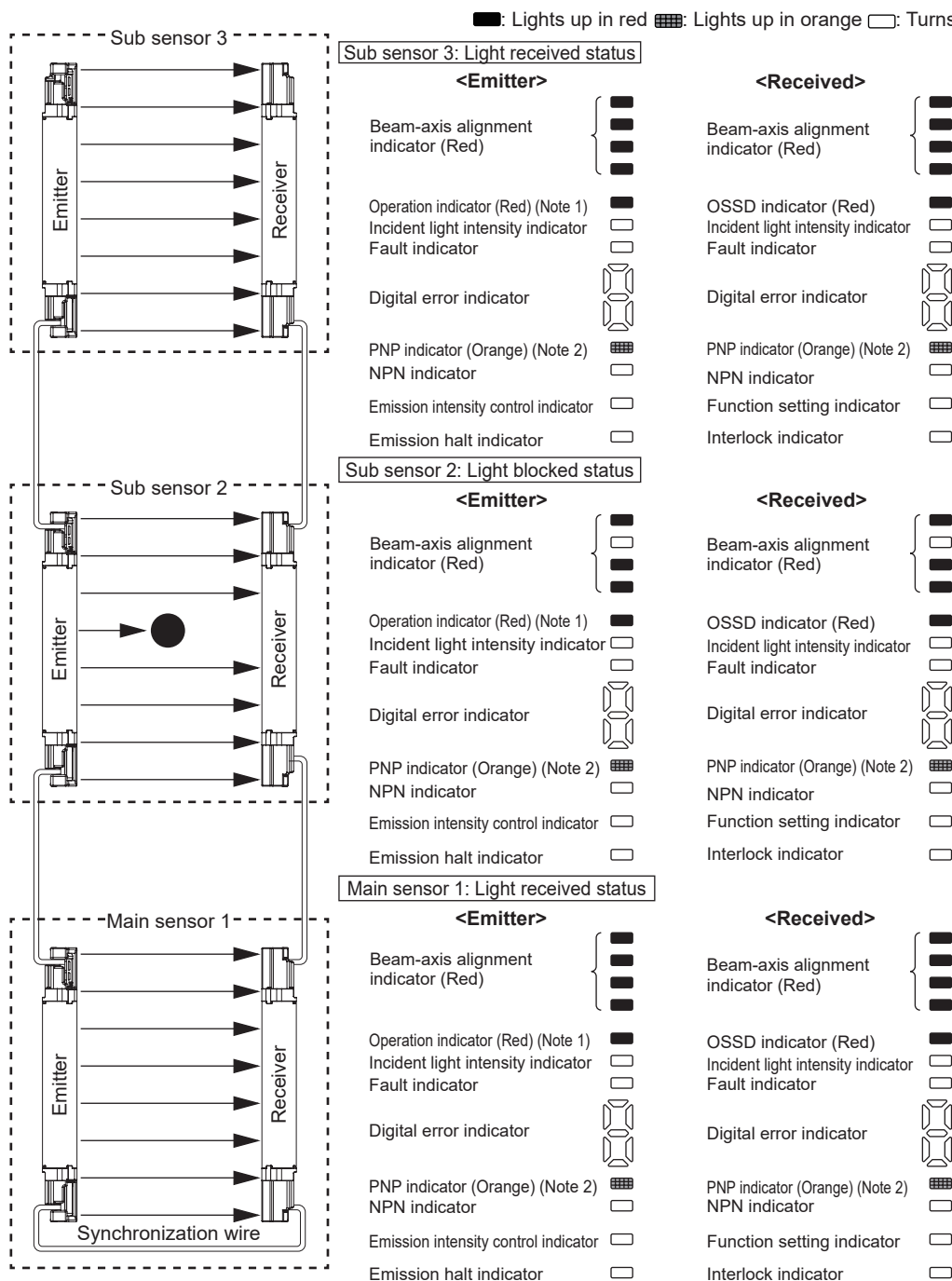
<For series connection>

In case of series connection, if any of the sets is in light blocked status, the control output (OSSD 1 / 2) turns OFF.

<Reference>

The emitter / receiver indicators indicates the output status.

The following figure shows the status of the indicators with Sub sensor 2 in light blocked status.



Notes: 1) Since the color of the operation indicator changes according to the ON / OFF state of the control output (OSSD 1 / 2), the operation indicator is marked as "OSSD" on the device.

2) The status of the emitter / receiver indicators during operation above shows the case in PNP output setting mode. In case of NPN output setting mode, the NPN indicator (orange) lights up.

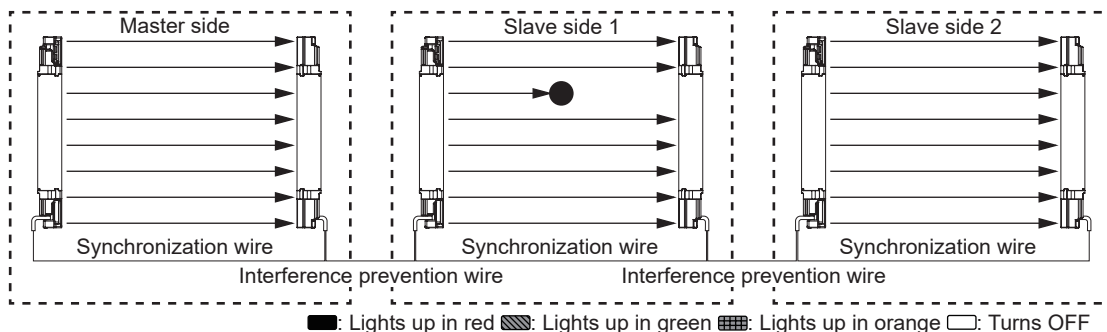
<For parallel connection>

In case of parallel connection, for the control output (OSSD 1 / 2), only the set of which light is blocked turns OFF.

<Reference>

The emitter / receiver indicators indicate the output status.

The following figure shows the status of the indicators with Slave side 1 in light blocked status.



Master side: Light received status

<Emitter>

Beam-axis alignment indicator (Green)	▨
Operation indicator (Green) (Note 1)	▨
Incident light intensity indicator (Green)	▨
Fault indicator	□
Digital error indicator	▤
PNP indicator (Orange) (Note 3)	▤
NPN indicator	□
Emission intensity control indicator	□
Emission halt indicator	□

<Receiver>

Beam-axis alignment indicator (Green)	▨
OSSD indicator (Green)	▨
Incident light intensity indicator	▨
Fault indicator	□
Digital error indicator	▤
PNP indicator (Orange) (Note 3)	▤
NPN indicator	□
Function setting indicator	□
Interlock indicator	□

Slave side 1: Light blocked status

<Emitter>

Beam-axis alignment indicator (Red)	■
Operation indicator (Red) (Note 1)	■
Incident light intensity indicator	□
Fault indicator	□
Digital error indicator (Red) (Note 2)	▤
PNP indicator (Orange) (Note 3)	▤
NPN indicator	□
Emission intensity control indicator	□
Emission halt indicator	□

<Receiver>

Beam-axis alignment indicator (Red)	■
OSSD indicator (Red)	■
Incident light intensity indicator	□
Fault indicator	□
Digital error indicator (Red) (Note 2)	▤
PNP indicator (Orange) (Note 3)	▤
NPN indicator	□
Function setting indicator	□
Interlock indicator	□

Slave side 2: Light received status

<Emitter>

Beam-axis alignment indicator (Red)	▨
Operation indicator (Green) (Note 1)	▨
Incident light intensity indicator (Green)	▨
Fault indicator	□
Digital error indicator (Red) (Note 2)	▤
PNP indicator (Orange) (Note 3)	▤
NPN indicator	□
Emission intensity control indicator	□
Emission halt indicator	□

<Receiver>

Beam-axis alignment indicator (Red)	▨
OSSD indicator (Green)	▨
Incident light intensity indicator	▨
Fault indicator	□
Digital error indicator (Red) (Note 2)	▤
PNP indicator (Orange) (Note 3)	▤
NPN indicator	□
Function setting indicator	□
Interlock indicator	□

Notes: 1) Since the color of the operation indicator changes according to the ON / OFF state of the control output (OSSD 1 / 2), the operation indicator is marked as "OSSD" on the device.

2) When the devices are connected in parallel, the bottom of the digital error indicator on the slave side lights up in red. However, when the slave side is connected in series, only the indicator of the main sensor lights up.

3) The status of the emitter / receiver indicators during operation above shows the case in PNP output setting mode. In case of NPN output setting mode, the NPN indicator (orange) lights up.



































2) When using emission halt function

This device incorporates the emission halt function. Using this function, it is possible to simulate the light blocked status.

<Reference>





































When the emission halt input is kept open (for manual reset: connected to 0V, +V), the emitter stops emitting light. In this condition, if this device operates properly, the control output (OSSD 1 / 2) of the receiver turns OFF.

 Blinks in orange
  Lights up in red
  Lights up in green
  Lights up in orange
  Turns OFF

Setting procedure and check items		Indicators		Control output	
		Emitter	Receiver	OSSD 1	OSSD 2
1	Before power is ON, Connect the emission halt input / reset input to Vs. (Note 3)	Beam-axis alignment indicator	 Beam-axis alignment indicator		OFF
		Operation indicator (Note 1)	 OSSD indicator		
		Incident light intensity indicator	 Incident light intensity indicator		
		Fault indicator	 Fault indicator		
		Digital error indicator	 Digital error indicator		
		PNP indicator	 PNP indicator		
		NPN indicator	 NPN indicator		
		Emission intensity control indicator	 Function setting indicator		
2	After power is ON, Receiver's control output (OSSD 1 / 2) is ON. (Normal operation)	Beam-axis alignment indicator (Green)	 Beam-axis alignment indicator (Green)		ON
		Operation indicator (Green) (Note 1)	 OSSD indicator (Green)		
		Incident light intensity indicator (Green)	 Incident light intensity indicator (Green)		
		Fault indicator	 Fault indicator		
		Digital error indicator	 Digital error indicator		
		PNP indicator (Orange) (Note 2)	 PNP indicator (Orange) (Note 2)		
		NPN indicator	 NPN indicator		
		Emission intensity control indicator	 Function setting indicator		
		Emission halt indicator	 Interlock indicator		

- Notes: 1) Since the color of the operation indicator changes according to the ON / OFF state of the control output (OSSD 1 / 2), the operation indicator is marked as "OSSD" on the device.
- 2) The status of the emitter / receiver indicators during operation above shows the case in PNP output setting mode. In case of NPN output setting mode, the NPN indicator (orange) lights up.
- 3) Vs is the applying supply voltage.

: Blinks in orange
 : Lights up in red
 : Lights up in green
 : Lights up in orange
 : Turns OFF

Setting procedure and check items		Indicators		Control output	
		Emitter	Receiver	OSSD 1	OSSD 2
3	Open the emission halt input / Reset output. Receiver's control output (OSSD 1 / 2) is OFF. (Emission halt) (Normal operation)	Beam-axis alignment indicator 	Beam-axis alignment indicator 	OFF	
		Operation indicator (Red) (Note 1) 	OSSD indicator (Red) 		
		Incident light intensity indicator 	Incident light intensity indicator 		
		Fault indicator 	Fault indicator 		
		Digital error indicator 	Digital error indicator 		
		PNP indicator (Orange) (Note 2) 	PNP indicator (Orange) (Note 2) 		
		NPN indicator 	NPN indicator 		
		Emission intensity control indicator 	Function setting indicator 		
4	Connect the emission halt input to Vs. (Note 3) Receiver's control output (OSSD 1 / 2) is ON. (Normal operation)	Emission halt indicator (Orange) 	Interlock indicator 	ON	
		Beam-axis alignment indicator (Green) 	Beam-axis alignment indicator (Green) 		
		Operation indicator (Green) (Note 1) 	OSSD indicator (Green) 		
		Incident light intensity indicator (Green) 	Incident light intensity indicator (Green) 		
		Fault indicator 	Fault indicator 		
		Digital error indicator 	Digital error indicator 		
		PNP indicator (Orange) (Note 2) 	PNP indicator (Orange) (Note 2) 		
		NPN indicator 	NPN indicator 		
		Emission intensity control indicator 	Function setting indicator 		
		Emission halt indicator 	Interlock indicator 		

Notes: 1) Since the color of the operation indicator changes according to the ON / OFF state of the control output (OSSD 1 / 2), the operation indicator is marked as "OSSD" on the device.

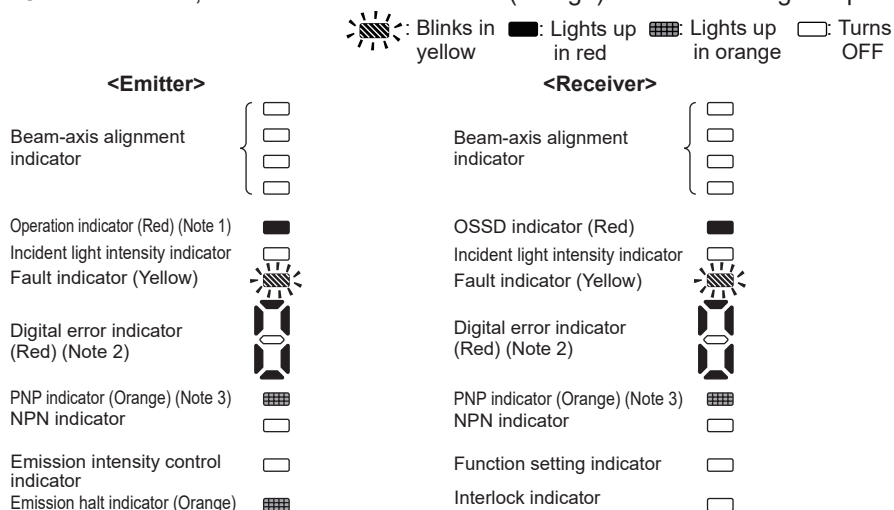
2) The status of the emitter / receiver indicators during operation above shows the case in PNP output setting mode. In case of NPN output setting mode, the NPN indicator (orange) lights up.

3) Vs is the applying supply voltage.

3) When an error occurs

If a device error is detected, the device will turn the control output (OSSD 1 / 2) OFF. Then the digital error indicator (red) on the receiver lights up and the fault indicators (yellow) on the emitter and receiver light up or blink.

- If an emitter error is detected, the emitter will be locked out, stopping its emission, and the control output (OSSD 1 / 2) will be turned OFF.
- If a receiver error is detected, the receiver will be locked out, and the control output (OSSD 1 / 2) will go into OFF state. Also, the emission halt indicator (orange) of the emitter lights up.



Notes: 1) Since the color of the operation indicator changes according to the ON / OFF state of the control output (OSSD 1 / 2), the operation indicator is marked as "OSSD" on the device.

2) Refer to "**Chapter 5 Troubleshooting**" for details of the digital error indicator.

3) The status of the emitter / receiver indicators during operation above shows the case in PNP output setting mode. In case of NPN output setting mode, the NPN indicator (orange) lights up.

Since this device will not return to normal operation automatically after the removal of the source of error, it is necessary to turn the power OFF and ON again.

(Source of error): The control output (OSSD 1 / 2) short-circuit, extraneous light detection, sensor failure, etc.

Refer to "**Chapter 5 Troubleshooting**" and remove the source of error.

Chapter 3 Functions


3-1 Self-diagnosis Function

This device incorporates the self-diagnosis function.
The self-diagnosis is carried out when the power is turned ON and while the operation periodically.
In case an abnormality is detected during self-diagnosis, the device is put in the lockout state at that instant, and the control output (OSSD 1 / 2) is fixed at the OFF state. Refer to “**Chapter 5 Troubleshooting**” and remove the cause of the abnormality.

3-2 Interlock Function

The selection of manual reset / auto reset is available by applying the interlock input wiring. The interlock becomes available by selecting manual reset.

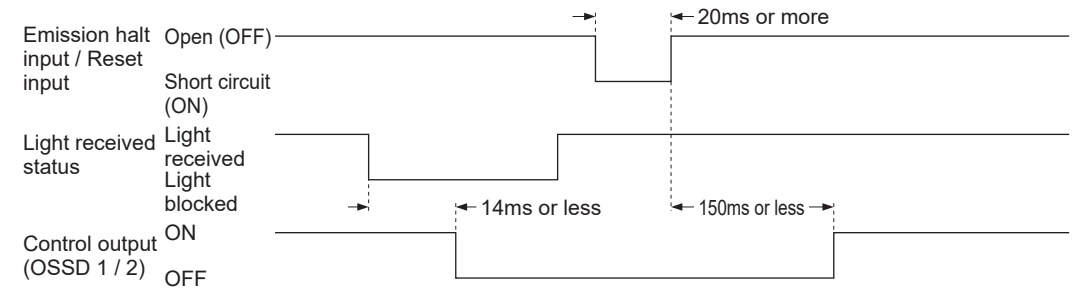
Interlock setting input wire (pale purple)	Setting for interlock function
In case of selecting PNP output: connect to +V In case of selecting NPN output: connect to 0V	Manual reset
Open	Auto reset


 **WARNING**

In case of using the interlock function, be sure there exists no operator inside of the dangerous area. it causes death or serious injury without the confirmation.

Manual reset: The control output (OSSD 1 / 2) is not turned ON automatically even though this device is received the light. When this device is reset in light received state [open the emission halt input / reset input → short-circuit the device to 0V or +V → open], the control output (OSSD 1 / 2) is turned ON.


<Timing chart>



 **WARNING**

The reset switch shall be placed in area where all over the dangerous zone shall be comprehend and out side of the dangerous zone.

Auto-reset: The control output (OSSD 1 / 2) is turned ON automatically when this device receives the light.

 **WARNING**

If this device is used with the auto-reset, avoid an auto-restart after the safety output stop of the system by using a safety relay unit, etc. (EN 60204-1)

<Reference>

It is possible to change the conditions for interlocking by using the handy controller (**SFB-HC**) (optional).

3-3 Emission Halt Function

This function stops the emission process of the emitter.

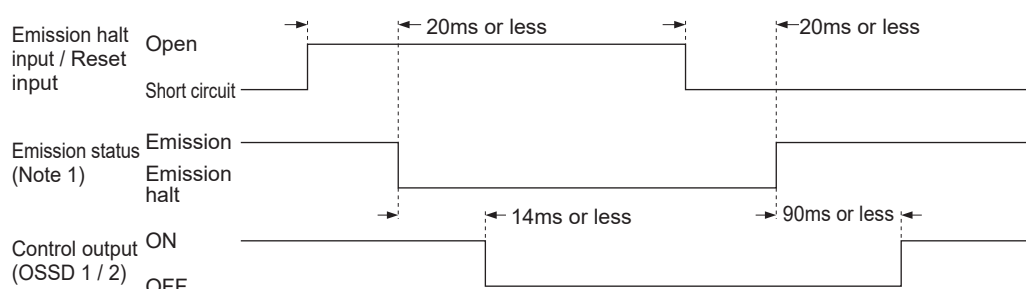
With the emission halt input line state, it enables to select either emission or emission halt.

Setting status of interlock function	Emission halt input / Reset input	Emission halt input	Control output (OSSD 1 / 2) status
Manual reset	Open	Invalid	ON
	When selecting PNP output: connect to +V When selecting NPN output: connect to 0V	Valid	OFF
Auto reset	Open	Valid	OFF
	When selecting PNP output: connect to +V When selecting NPN output: connect to 0V	Invalid	ON

During emission halt, the control output (OSSD 1 / 2) becomes OFF state.

By using this function, malfunction due to extraneous noise or abnormality in the control output (OSSD 1 / 2) and the auxiliary output can be determined even from the equipment side.

Normal operation is restored when the emission halt input / reset input is connected to 0V or +V (for manual reset: open).



Note: This timing chart shows the operation in auto-reset mode. In manual reset mode, the device performs emission under open status and performs emission halt under short-circuit status.



WARNING

Do not use the emission halt function for the purpose of stopping the machine in which the **SF4B-□G<V2>** is installed. Failure to do so could result in death or serious injury.

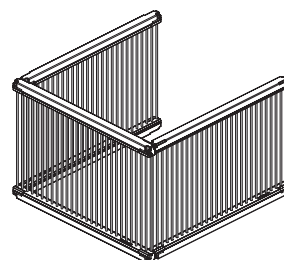
3-4 Interference Prevention Function

It is possible to construct the system to prevent malfunction due to interference of the light between **SF4B-□G<V2>** devices.

The interference prevention system can construct max. three sets of series and parallel mixed connection.

The max. number of the beam channels in series and parallel mixed connection is 192.

Refer to “**2-5 Wiring**” for details of the connecting method.

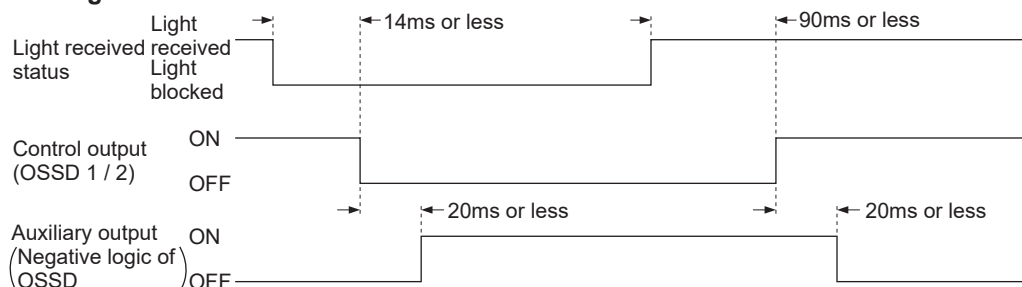


3-5 Auxiliary Output (Non-safety Output)

This device incorporates the auxiliary output for the non-safety output.
The auxiliary output is incorporated in the emitter.

Auxiliary output setting	Normal mode			Lockout
	Emission halt input	Control output (OSSD 1 / 2) status		
		Light received	Light blocked	
Negative logic of OSSD (Factory setting)	ON	OFF	ON	ON

<Timing chart>



WARNING

Do not use the auxiliary output for the purpose of stopping the machine in which the **SF4B-□G<V2>** is installed. Failure to do so could result in death or serious injury.

<Reference>

It is possible to switch the output operation for auxiliary output by using the handy controller (**SFB-HC**) (optional).

3-6 External Device Monitor Function

This is the function for checking whether the external safety relay connected to the control output (OSSD 1 / 2) performs normally in accordance with the control output (OSSD 1 / 2) or not. Monitor the contacting point "b" of the external safety relay, and if any abnormality such as deposit of the contacting point, etc. is detected, change the status of the device into lockout one, and turn OFF the control output (OSSD 1 / 2).

- **When the external device monitor function is set to be valid:**

Connect the external device monitor input wire (yellow-green) to the external safety relay which is connected to the control output 1 (OSSD 1) wire (black) and the control output 2 (OSSD 2) wire (white).

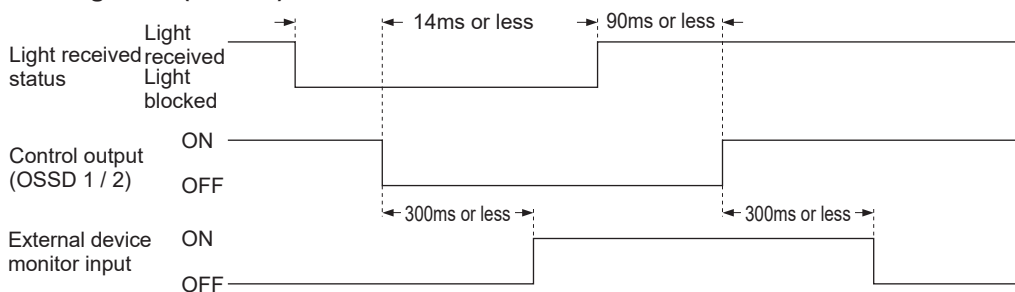
- **When the external device monitor function is set to be invalid:**

Connect the external device monitor input wire (yellow-green) to the auxiliary output wire (yellow-green / black). At this time, the auxiliary output is set as [negative logic of control In case the external device monitor input function is invalid, output (OSSD 1 / 2)] (factory setting) [Set through the handy controller (**SFB-HC**) (optional)]. The auxiliary output cannot be connected to external devices.

<Reference>

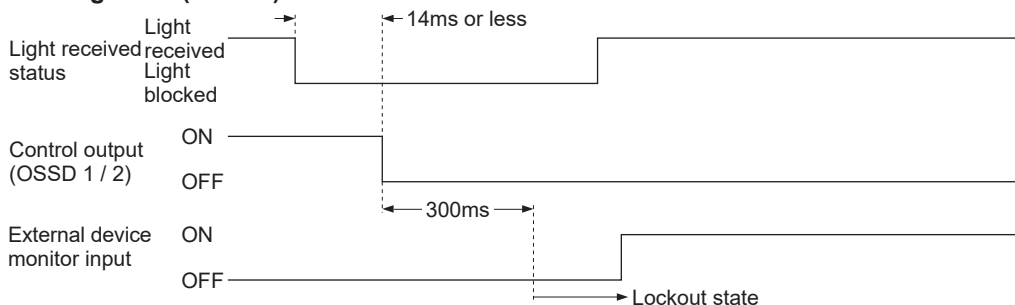
It is also possible to set the external device monitor function into "invalid" by using the handy controller (**SFB-HC**) (optional).

<Timing chart (Normal)>

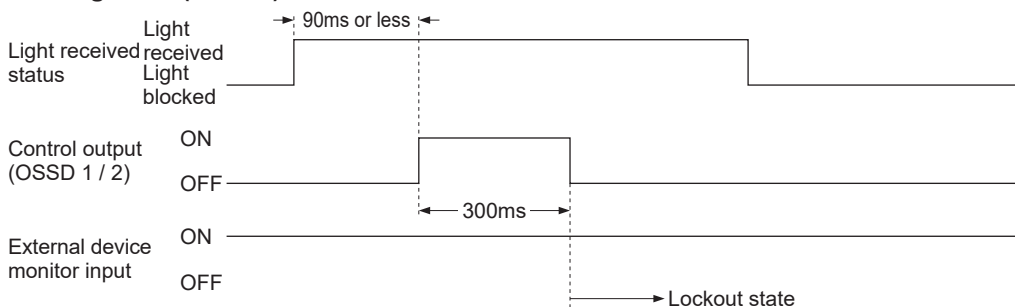


The setting time of the device monitor is 300ms or less. Exceeding 300ms turns the device into lockout status. It can be set within 100 to 600ms (unit: 10ms) by using the handy controller (SFB-HC) (optional).

<Timing chart (Error 1)>



<Timing chart (Error 2)>



3-7 Muting Function

WARNING

- Incorrect using of the muting control may cause any accident. Please understand the muting control fully, and use it. As for the muting control, the following international standards define the requirements
ISO 13849-1 (EN ISO 13849-1 / JIS B 9705-1):
"Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design, Article 5.9 Muting"
IEC 61496-1 (ANSI/UL 61496, JIS B 9704-1):
"Safety of machinery - Electro sensitive protective equipment - Part 1: General requirements and tests, Annex A, A.7 Muting"
IEC 60204-1 (JIS B 9960-1):
"Safety of machinery - Electrical equipment of machines - Part 1: General requirements, 9.2.4 Overriding safeguards"
EN 415-4:
"Safety of packaging machines - Part 4: Palletizers and depalletizers, Annex A, A2.2 Muting"
ANSI B11.19-1990:
"for Machine Tools-Safeguarding When Referenced by the Other B11 Machine Tool Safety Standards-Performance Criteria for the Design, Construction, Care, and Operation" 4.2.3 Presence-Sensing Devices: Electro-Optical and Radio Frequency (R.F.)
ANSI/RIA R15.06-1999:
"For Industrial Robots and Robot Systems - Safety Requirements, 10.4.5 Muting"
- Use the muting control while the machine cycle is not in danger mode. Maintain safety with the other measure while the muting control is activated.
- For the application that the muting control is activated when a workpiece passes through the sensor, place the muting sensor so that the conditions for the muting control cannot be satisfied by intrusion of personnel when the workpiece is passing through the sensor or the workpiece is not passing through it.
- The muting lamp should be installed in a position where it can always be seen by operators who set or adjust the machine.
- Be sure to check the operation of the muting function before its use. Furthermore, check the state of the muting lamp (cleanliness or brightness, etc.)

This function turns the safety function into invalid temporarily.

When the control output (OSSD 1 / 2) is ON, this function is available for passing the workpiece through the sensing area of the device without stopping the device.

The muting function becomes valid when all the conditions listed below are satisfied:

- The control output (OSSD 1 / 2) shall be ON.
- The incandescent lamp with 3 to 10W shall be connected to the muting lamp output. (Note 1)
- Muting input A and B shall be changed from OFF (open) to ON. At this time, the time difference occurred by changing the muting input A and B into ON status shall be 0.03 to 3 sec. (Note 2)

The following devices, photoelectric sensor with semiconductor output, inductive proximity sensor, position switch on NO (Normally Open) contacting point, etc. are available for applying to the muting sensor.

- Notes: 1) The muting lamp diagnosis function can be set with the handy controller Ver. 2 or later (**SFB-HC**) (optional). If the muting lamp diagnosis function is set to be invalid, the muting function is maintained even if a lamp blows or a lamp is not connected.
- 2) 0 to 3 sec. is allowable by using the handy controller Ver. 2.1 (**SFB-HC**) (optional) and connecting NO (Normally Open) type muting sensor to the input A, as well as connecting NC (Normally Closed) type muting sensor to the input B.

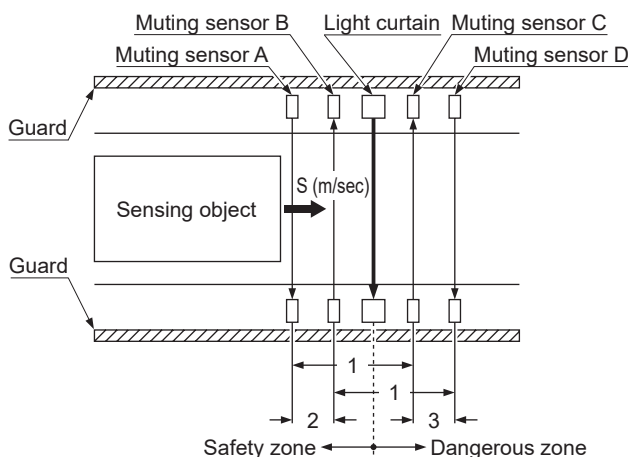
<Output operation of muting sensors>

	Operation at ON state	Operation at OFF state
NO (Normally Open) type ON with light non-received status (photoelectric sensor, etc.) ON with object approaching status (inductive proximity sensor, etc.) ON with object contacted status (position switch, etc.)	Output 0V or +V	Open

WARNING

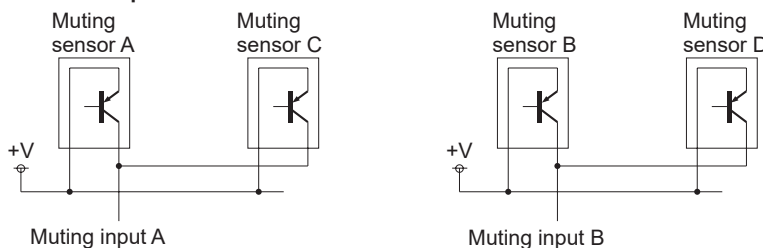
Be sure to use a muting sensor that satisfies the **<Output operation of muting sensors>** above. If the other muting sensor not satisfying the specification above, the muting function might become valid with the timing that the machine designer cannot expect and could result in death or serious injury.

<Installation condition example of muting sensors>

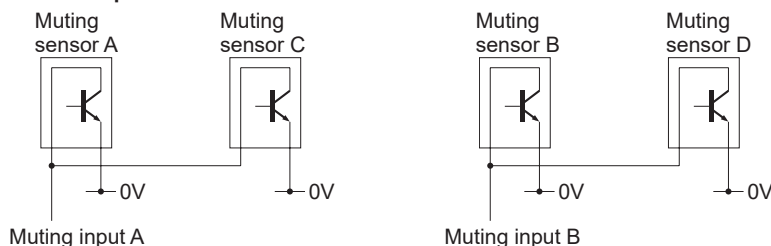


- 1) Shorten the distances between muting sensors A to C and between B to D than the whole length of the sensing object.
- 2) The time of the sensing object to be passed through the muting sensors A to B shall be 0.03 to under 3 sec.
 $\text{Distance between A and B (m)} < S \text{ (m/sec.)} \times 3 \text{ (sec.)}$
 S: The moving speed (m/sec.) of the sensing object
- 3) The time of the sensing object to be passed through the muting sensors C to D shall be under 3 sec.
 $\text{Distance between C and D (m)} < S \text{ (m/sec.)} \times 3 \text{ (sec.)}$
 S: The moving speed (m/sec.) of the sensing object.

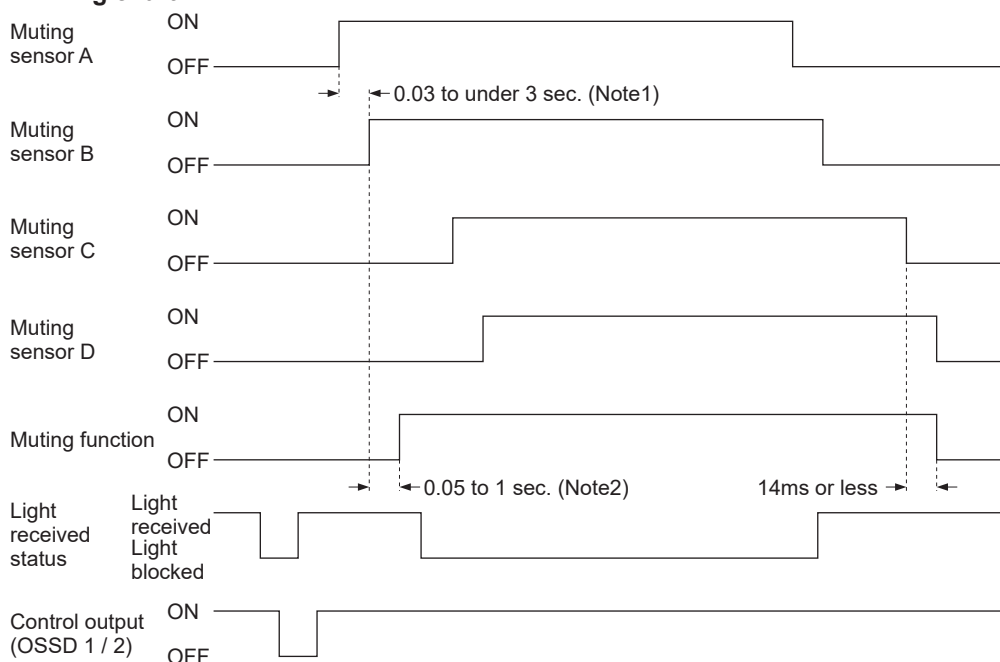
<For PNP output>



<For NPN output>



<Timing chart>



Note: 1) If the permissible input time difference between muting sensors A and B is about 0.03 seconds, the input time fluctuates due to the effect of the input device / circuit configuration, and this may disable the use of the muting function.

2) This is when the muting lamp diagnosis function is valid. If the muting lamp does not light up even if 1 sec. is passed, the muting function becomes invalid. When the muting lamp diagnosis function is invalid, the muting function becomes valid 0.05 sec. after the input conditions of the muting sensor A (C) and B (D) were satisfied.

<Reference>

- It is possible to set the muting function into invalid per beam channel respectively and to specify the input order of the muting input A and B to be set into valid by using the handy controller (**SFB-HC**) (optional).
- It is recommended that two muting lamps should be connected in parallel. In this case, take care not to exceed 10W.

3-8 Override Function

WARNING

- Incorrect using of the muting control may cause any accident. Please understand the muting control fully, and use it. As for the muting control, the following international standards define the requirements
ISO 13849-1 (EN ISO 13849-1, JIS B 9705-1):
"Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design, Article 5.9 Muting"
IEC 61496-1 (ANSI/UL 61496, JIS B 9704-1):
"Safety of machinery - Electro sensitive protective equipment - Part 1: General requirements and tests, Annex A, A.7 Muting"
IEC 60204-1 (JIS B 9960-1):
"Safety of machinery - Electrical equipment of machines - Part 1: General requirements, 9.2.4 Overriding safeguards"
EN 415-4:
"Safety of packaging machines - Part 4: Palletizers and depalletizers, Annex A, A2.2 Muting"
ANSI B11.19-1990:
"for Machine Tools-Safeguarding When Referenced by the Other B11 Machine Tool Safety Standards-Performance Criteria for the Design, Construction, Care, and Operation" 4.2.3 Presence-Sensing Devices: Electro-Optical and Radio Frequency (R.F.)
ANSI/RIA R15.06-1999:
"For Industrial Robots and Robot Systems - Safety Requirements, 10.4.5 Muting"
- Use the muting control while the machine cycle is not in danger mode. Maintain safety with the other measure while the muting control is activated.
- For the application that the muting control is activated when a workpiece passes through the sensor, place the muting sensor so that the conditions for the muting control cannot be satisfied by intrusion of personnel when the workpiece is passing through the sensor or the workpiece is not passing through it.
- The muting lamp should be installed in a position where it can always be seen by operators who set or adjust the machine.
- Be sure to check the operation of the muting function before its use. Furthermore, check the state of the muting lamp (cleanliness or brightness, etc.)

The override function forcibly turns the safety function into invalid. This function is used for the following cases: when the customer who uses the muting function needs to start the device with the control output (OSSD 1 / 2) be OFF status, when the device is required to continue operating even though the muting sensor becomes valid after the muting sensor is turned ON at the starting of line.

The override function becomes valid when all the conditions listed below are satisfied:

- The incandescent lamp with 3 to 10W shall be connected to the muting lamp output. (Note 1)
- The signal shall be input to either muting input A or B, or to both of the inputs.
- The override input shall be short-circuited to 0V or +V, and the emission halt input / reset input shall be opened. (3 sec. continuously)

If one of the three conditions above becomes invalid or timing exceeds 60 sec. (Note 2), the override function becomes invalid.

Notes: 1) The muting lamp diagnosis function can be set with the handy controller Ver. 2 or later (**SFB-HC**) (optional). If the muting lamp diagnosis function is set to be invalid, the muting function is maintained even if a lamp blows or a lamp is not connected.

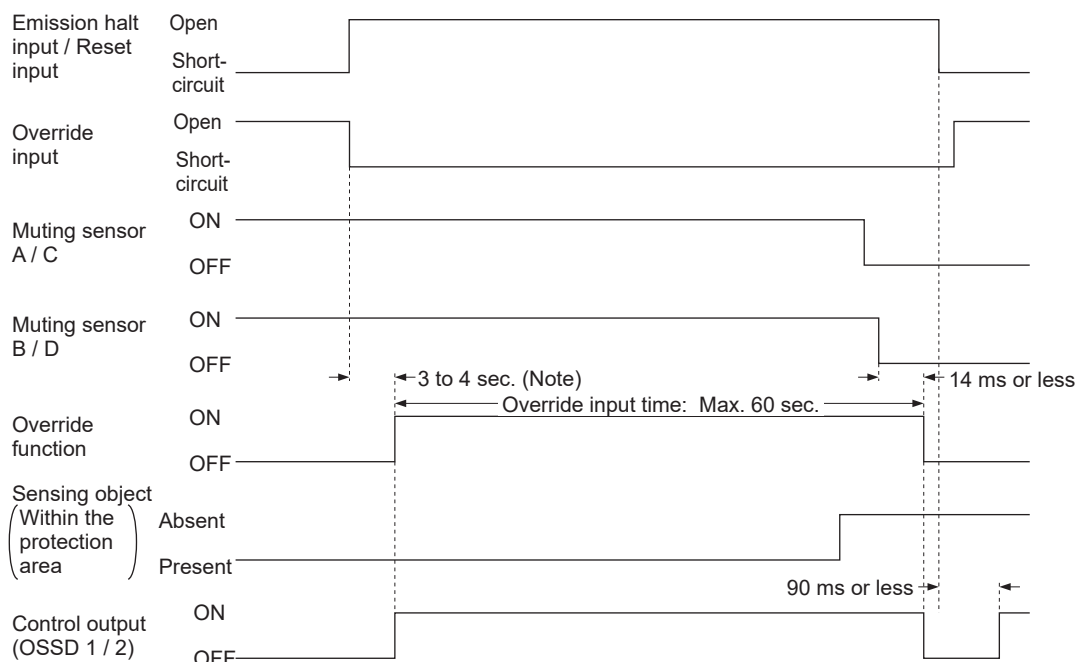
2) By using the handy controller Ver. 2.1 (**SFB-HC**) (optional), the timing can be changed in the range of 60 to 600 sec. in units of 10 sec.

3) The override function operates only when the auto-reset is ON (the interlock is invalid).

WARNING

- Make sure manually to operate system for starting override function. Furthermore, the system shall be placed in area where all over the dangerous zone shall be comprehend and out side of the dangerous zone.
- Using override function, make sure that there exist no operator in the dangerous zone, which may result in death or serious injury.

Timing chart



Note: This is when the muting lamp diagnosis function is valid. If the muting lamp does not light up even if 1 sec. is passed, the override function becomes invalid. When the muting lamp diagnosis function is invalid, the muting function becomes valid 3 sec. after the input conditions of the muting sensor A (C) and B (D) were satisfied.

3-9 Functions Using Handy Controller (SFB-HC) (Optional)

This device enables to set each function using the handy controller (**SFB-HC**) (optional). The settable functions and the factory setting of each function are as follows.

For details, refer to the instruction manual enclosed with the handy controller.

⚠ WARNING

Among the functions, the contents related to the safety distance such as the size of the minimum sensing object are varied depending on the setting condition. When setting each function, re-calculate the safety distance, and make enough space larger than the calculated safety distance. Failure to do so might cause the accident that the device cannot stop quickly before reaching the dangerous area of the device, resulting in the death or serious injury.

● **Fixed blanking function**

This function enables to protect the control output (OSSD 1 / 2) from turning into OFF even though the specific beam channel is blocked.

The factory setting is set to be invalid for the fixed blanking function.

● **Floating blanking function**

This function enables to protect the control output (OSSD 1 / 2) from turning into OFF even though the number of the blocked beam channels are lower than that of the setting beam channels. 1, 2 or 3 beam channels are settable as the blocking beam channels.

The factory setting is set to be invalid for the floating blanking function.

Both fixed blanking function and floating blanking function are settable simultaneously.

● **Emission amount control function**

The two modes, normal mode and short mode, can be set / changed by controlling the emission amount. The factory setting is set to the normal mode for the emission amount control function.

- **Auxiliary output switching function (non-safety output)**

The following outputs are switchable as the auxiliary output.

0. Negative logic of the control output (OSSD 1 / 2) (factory setting)
1. Positive logic of the control output (OSSD 1 / 2)
2. For emission: output ON, For non-emission: output OFF
3. For emission: output OFF, For non-emission: output ON
4. For unstable incident light: OFF (Note 1)
5. For unstable incident light: ON (Note 1)
6. For muting: ON
7. For muting: OFF
8. For light reception: ON, For light blocked: OFF (Note 2)
9. For light reception: OFF, For light blocked: ON (Note 2)

Notes: 1) The output cannot be used while the fix blanking function, floating blanking function or the muting function is activated.

- 2) This device outputs the light received / blocked state under activating the auxiliary output switching function using the handy controller irrespective of activating other functions: fixed blanking function, floating blanking function and muting function.

<e.g.>

In case of activating the fixed blanking function, the control output (OSSD 1 / 2) becomes ON with the shielded object existed in the setting range and other ranges are in light receiving status.

If the auxiliary output switching function activates in No. 8 output, this device becomes OFF because the sensor itself detects the object.

- **Interlock setting changing function**

It is selectable one interlock state among the following three interlock settings

- **Start / Restart interlock**

The device goes into the interlock state after the power is turned ON, or when the light is blocked.

The factory setting is start / restart interlock.

- **Start interlock**

The device goes into the interlock state when the power supply is turned ON. Once this interlock is reset, the device does not go into the interlock state.

- **Restart interlock**

The device does not go into the interlock state when turning ON the power supply. Only when the control output (OSSD 1 / 2) becomes ON and the light is blocked after the power is turned ON and this device receives the light, the device goes into the interlock state.

- **External device monitor setting changing function**

The setting of the external device monitor is changeable.

1. Allowable time for response time: 100 to 600ms (Unit: 10ms)

Factory setting is 300ms.

2. The external device monitor function can be selected to valid or invalid.

The factory setting is set to valid for the external device monitor function.

● Muting setting changing function

The setting of the muting function is changeable.

1. Input order of the muting input A and B can be specified so that the muting function will be valid.

The muting function will be valid either the muting input A or B comes first to input at the time of factory setting.

2. Select either to validate or invalidate the muting function per beam channel. (Note 1)

The muting function is valid in all beam channels at the time of factory setting.

3. Select either to validate or invalidate the muting lamp diagnosis function. (Note 2)

The muting lamp diagnosis function is valid at the time of factory setting.

4. Output operation of a muting sensor which is to be connected to the muting input of this device can be set with the handy controller (**SFB-HC**) (optional). (Note 3, 4)

● **NONO (Normally Open, Normally Open)**

It is at the time of factory setting.

● **NONC (Normally Open, Normally Closed)**

Connect a sensor or switch whose output operation is NO (Normally Open) type to the muting input A and connect a sensor or switch whose output operation is NC (Normally Closed) type to the muting input B.

To make the muting function valid, time difference between the time during muting input A becomes ON from OFF (Open) and the time during muting input B becomes OFF (Open) from ON should be within 3 sec.

<Output operations of muting sensors (when setting to NONC)>

	Muting input	Operation at ON state	Operation at OFF state
NO (Normally Open) type ON with light non-received status (photoelectric sensor, etc.) ON with object approaching status (inductive proximity sensor, etc.) ON with object contacted status (position switch, etc.)	A	0V or +V	Open
NC (Normally Closed) type ON with light received status (photoelectric sensor, etc.) ON with object non-approaching status (inductive proximity sensor, etc.) ON with object non-contacted status (position switch, etc.)	B		

Notes: 1) If a beam channel whose muting function is set to be invalid is blocked during the muting, the control output (OSSD 1 / 2) will be turned OFF and the muting function will be released.

- 2) Selectable with the handy controller Ver. 2 or later (**SFB-HC**) (optional). If the muting lamp diagnosis function is set to be invalid, the muting function is maintained even if a lamp blows or a lamp is not connected.

- 3) Selectable with the handy controller Ver. 2.1 (**SFB-HC**) (optional).

- 4) The muting function will be invalid if the muting sensor which is connected to the muting input of this device differs from the output operation which is set with the handy controller (**SFB-HC**) (optional).

● Override setting changing function (Note)

Maximum continuous effective time set at the override function can be changed.

The maximum continuous effective time can be set in the range of 60 to 600 sec. (in units of 10 sec.).

Note: Selectable with the handy controller Ver.2.1 (**SFB-HC**) (optional).

● Protective function

Unless the password is inputted, any change in setting of the device is not allowed.

The factory setting is set to be invalid for the protective function.

Chapter 4 Maintenance

<Reference>

When any errors are found, refer to “**Chapter 5 Troubleshooting**” and report the symptoms to the maintenance in charge. If the rectification method is not clear, please contact our office.
Please make a copy of this checklist, check each inspection item in the respective square, and file the list for record.

4-1 Daily Inspection

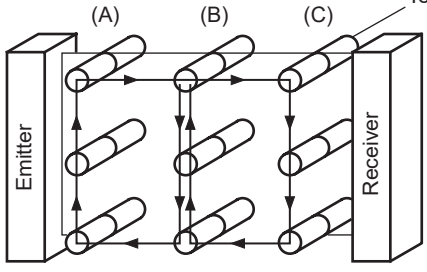


WARNING

Be sure to inspect the following items prior to operation and confirm that there is no error.

Operating this device without inspection or in an error condition can result in death or serious injury.

Check list (Daily inspection)

Check column	Inspection item
<input type="checkbox"/>	Dangerous parts of the machine cannot be reached without passing through the sensing area of this device.
<input type="checkbox"/>	Some part of operator's body remains in the sensing area when operation is done with dangerous parts of the machine.
<input type="checkbox"/>	The calculated safety distance has been maintained or exceeded during installation.
<input type="checkbox"/>	There is no damage to the safety guard or protective structure.
<input type="checkbox"/>	There is no defect, fold, or damage in the wiring.
<input type="checkbox"/>	The corresponding connectors have been connected securely.
<input type="checkbox"/>	No dirt or scratches exist on the light emitting surface.
<input type="checkbox"/>	The test rod is not deformed or defective.
<input type="checkbox"/>	The operation indicator (green) of the emitter and the OSSD indicator (green) of the receiver light up when no object is present in the sensing area. The control output (OSSD 1 / 2) is in ON status. At this time, the effect of external noise can be inspected. In case external noise affects the operation, remove its cause and reinspect.
<input type="checkbox"/>	<p>The test rod (ø14mm for SF4B-F□G<V2>, ø25mm for SF4B-H□G<V2>, ø45mm for SF4B-A□G<V2>) can be detected less than 1,600mm/sec. at three positions, directly in front of the emitter (A), midway between the emitter and the receiver (B), and directly in front of the receiver (C). The OSSD indicator (red) of the receiver and the operation indicator (red) of the emitter continue to light up as long as the test rod is present in the sensing area from (A) to (C).</p> 
<input type="checkbox"/>	With the machine in the operating condition, the dangerous parts operate normally when no object is present in the sensing area.
<input type="checkbox"/>	With the machine in the operating condition, the dangerous parts stop immediately when the test rod is inserted into the sensing area at any of the three positions, directly in front of the emitter (A), midway between the emitter and the receiver (B), and directly in front of the receiver (C).
<input type="checkbox"/>	The dangerous parts remain stopped as long as the test rod is present in the sensing area.
<input type="checkbox"/>	The dangerous parts stop immediately when the power supply of this device is turned OFF.
<input type="checkbox"/>	The control output (OSSD 1 / 2) must turn OFF when the emission halt input / reset input wire (pink) is open (for manual reset: connected to 0V, +V). At this time, the effect of external noise can be inspected. In case external noise affects the operation, remove its cause and reinspect.
<input type="checkbox"/>	Be sure to check the operation of the muting function before its use. Furthermore, check the state of the muting lamp (cleanliness or brightness etc.).

4-2 Periodic Inspection (Every Six Months)



WARNING

Be sure to inspect the following items every six months and confirm that there is no error. Operating this device without inspection or in an error condition can result in death or serious injury.

Check list (Periodic inspection)

Check column	Inspection item
<input type="checkbox"/>	The structure of the machine does not obstruct any safety mechanism for stopping operation.
<input type="checkbox"/>	No modification has been made in the machine controls which obstructs the safety mechanisms.
<input type="checkbox"/>	The output of this device is correctly detected.
<input type="checkbox"/>	The wiring from this device is correct.
<input type="checkbox"/>	The overall response time of the complete machine is equal or less than the calculated value.
<input type="checkbox"/>	The actual number of operation cycle (time) of the limited lifetime parts (relay, etc.) is less than their rated operation cycles (time).
<input type="checkbox"/>	No screws or connectors of this device are loose.
<input type="checkbox"/>	No extraneous light source or reflective object has been added near this device.

4-3 Inspection after Maintenance

Under the following situations, perform all the inspection items mentioned in “4-1 Daily Inspection” and “4-2 Periodic Inspection (Every Six Months).”

- 1) When any parts of this device are replaced.
- 2) When some abnormality is felt during operation.
- 3) When beam-axis alignment of the emitter and receiver is done.
- 4) When the device installation place or environment is changed.
- 5) When the wiring method or wiring layout is changed.
- 6) When FSD (Final Switching Device) parts are replaced.
- 7) When FSD (Final Switching Device) setting is changed.

Chapter 5 Troubleshooting

<Reference>

- Check the wiring.
- Check the power supply voltage and the power supply capacity.

5-1 Troubleshooting of Emitter

<All indicators are OFF>

Cause	Remedy
Power is not being supplied	Check that the power supply capacity is sufficient. Connect the power supply correctly.
Supply voltage is out of the specified range.	Set the supply voltage correctly.
Connector is not connected securely.	Connect the connector securely.

<Fault indicator (yellow) lights or blinks>

Cause	Remedy
[Digital error indicator: 0] Setting data error of this device	Series connection is incorrect.
	Noise is out of the specified range.
	Internal error
[Digital error indicator: 1] System error between emitter and receiver	Systems are different between emitter and receiver.
[Digital error indicator: 2] Series connection error	The serial signal short-circuits or comes down.
	Any of the main / sub sensor is in error.
[Digital error indicator: 3] No. of total units / No. of total beam channels error	No. of total units / No. of total beam channels is out of the specified range.
[Digital error indicator: 4] Interlock setting error	Voltage level of interlock setting input wire (pale purple), or emission halt input / reset input wire (pink) is unstable.
[Digital error indicator: 5, 6] Muting lamp error	Muting lamp output wire (red) short-circuits with 0V or +V.
	Muting lamp output wire (red) short-circuits with other I/O wires.
	Excessive incoming current flows in the muting lamp output.
	Output polarity setting wire (shield) and muting lamp output wire (red) are not correctly wired.
	Output circuit error

Cause		Remedy
[Digital error indicator: \bar{L}] Output polarity setting wire (shield) error	Output polarity setting wire (shield) comes down or short-circuits with other I/O wires.	Wire the output polarity setting wire (shield) correctly. (0V: PNP output, +V: NPN output)
	Output polarity setting wire (shield) connection of emitter / receiver is incorrect.	Wire the output polarity setting wire (shield) of the receiver correctly.
[Digital error indicator: \bar{F}] Effect from noise / power supply or failure of internal circuit	Affected by noise / power supply.	Check the noise status around this device. Check the wiring status, supply voltage, and power supply capacity.
	Internal circuit is broken down.	When the synchronization + wire (orange) and synchronization - wire (orange / black) is extended with a cable other than exclusive cable, use a 0.2mm ² or more shielded twisted pair cable. If this device still does not work, confirm number of blinks of the error indicator and call to our local office.

<Digital error indicator “ \bar{L} ” lights up>

Cause		Remedy
Synchronization + wire (orange) or synchronization - wire (orange / black) error. Synchronization + wire (orange) or synchronization - wire (orange / black) comes down or short-circuits.		Connect synchronization + wire (orange) or synchronization + wire (orange / black) properly. Refer to “ 2-5 Wiring. ”
	Receiver error	Check the operation of the receiver side.

<Emission halt indicator (orange) lights up>

Cause		Remedy
Emission is in halt condition (Device error or interlock setting error)	Error indicator (yellow) lights or blinks.	Check the contents of the digital error indicator.
	Emission halt input / reset input wire (pink) is open when selecting auto-reset.	Wire the emission halt input / reset input (pink) wire to 0V or +V. Refer to “ 2-5 Wiring. ”
	Emission halt input / reset input wire (pink) is connected to 0V or +V when selecting manual reset.	Open the emission halt input / reset input (pink) wire. Refer to “ 2-5 Wiring. ”

<All beam-axis adjustment indicators (red) light up>

Cause	Remedy
The beam channel with its fixed blanking function set into valid receives light.	Turn ON the power supply after checking the installation status.

<Operation indicator remains lit in red (light is not received) (Note)>

Cause	Remedy
The beam channels are not correctly aligned.	Align the beam channels. Refer to “ 2-6 Adjustment. ” Align the top / bottom direction of the beam channel between emitter and receiver.
Sensing range is shortened because of the emission amount control function.	Reset to factory default (CLR) by the handy controller (SFB-HC) (optional).

Note: Since the color of the operation indicator changes according to ON / OFF status of the control output (OSSD 1 / 2), the operation indicator is marked as “OSSD” on the device.

If the device does not work normally after checking the items above, please consult Panasonic Industrial Devices SUNX.

<Reference>

About counting blinks of the error indicator, count blinks from 2 seconds of no blinking.

5-2 Troubleshooting of Receiver

<All indicators are OFF>

Cause	Remedy
Power is not being supplied.	Check that the power supply capacity is sufficient. Connect the power supply correctly.
Supply voltage is out of the specified range.	Set the supply voltage correctly.
Connector is not connected securely.	Connect the connector securely.

<Fault indicator (yellow) lights or blinks>

Cause	Remedy
[Digital error indicator: 0] Setting data error of this device	Series connection is incorrect.
	Noise is out of the specified range.
	Internal error
[Digital error indicator: 1] System error between emitter and receiver	Systems are different between emitter and receiver.
[Digital error indicator: 2] Series connection error	The serial signal short-circuits or comes down.
	Any of the main / sub sensor is in error.
[Digital error indicator: 3] No. of total units / No. of total beam channels error	No. of total units / No. of total beam channels is out of the specified range.
[Digital error indicator: 4] Extraneous light error	Extraneous light is entering or light from other model is entering.
[Digital error indicator: 5, 6] Control output (OSSD 1 / 2) error	Control output 1 (OSSD 1) wire (black) and control output 2 (OSSD 2) wire (white) short-circuits with 0V or +V.
	Control output 1 (OSSD 1) wire (black) or control output 2 (OSSD 2) wire (white) short-circuit respectively, or short-circuits with other I/O wires.
	Excessive incoming current flows in the Control output 1 (OSSD 1) wire (black) and control output 2 (OSSD 2) wire (white).
	Output polarity setting wire (shield) and control output 1 (OSSD 1) wire (black) and control output 2 (OSSD 2) wire (white) are not correctly wired.
	Output circuit error
[Digital error indicator: 5] Output polarity setting wire (shield) error	Output polarity setting wire (shield) comes down or short-circuits with other I/O wires. Output polarity setting wire (shield) connection of emitter / receiver is incorrect.

Cause			Remedy
[Digital error indicator: ∇] External device error	When using safety relay	Relay contact is welded.	Replace the relay.
		Response time of the relay is slow.	Replace the relay with proper response time. Setting by the handy controller (SFB-HC) (optional) is also possible. Refer to “ 3-6 External Device Monitor Function. ”
		Contacting point “b” of the relay is not wired.	Wire correctly to the relay.
	When setting the external device monitor function to “invalid.”	Auxiliary output wire (yellow-green / black) and external device monitor input wire (yellow-green) are not wired.	Connect the auxiliary output wire (yellow-green / black) and the external device monitor input wire (yellow-green). Set the external device monitor function to “invalid” using the handy controller (SFB-HC) (optional).
		Auxiliary output is not correctly operated.	Check if the auxiliary output wire (yellow-green / black) is disconnected or short-circuited. Reset to factory default (mode 0) by the handy controller (SFB-HC) (optional).
	Bottom cap cables are adversely connected between emitter and receiver.		Check the connecting locations of the bottom cap cables.
[Digital error indicator: ∇] Effect from noise / power supply or failure of internal circuit	Affected by noise / power supply. Internal circuit is broken down.		Check the noise status around this device. Check the wiring status, supply voltage, and power supply capacity. When the synchronization + wire (orange) and synchronization - wire (orange / black) is extended with a cable other than exclusive cable, use a 0.2mm ² or more shielded twisted pair cable. If this device still does not work, confirm number of blinks of the error indicator and call to our local office.

<Digital error indicator “ ∇ ” lights up>

Cause	Remedy
Synchronization + wire (orange) or synchronization - wire (orange / black) error.	Connect synchronization + wire (orange) or synchronization - wire (orange / black) properly. Refer to “ 2-5 Wiring. ”
Synchronization + wire (orange) or synchronization - wire (orange / black) comes down or short-circuits.	
Emitter error	Check the operation of the emitter side.

<All beam-axis adjustment indicators (red) light up>

Cause	Remedy
The beam channel with its fixed blanking function set into valid receives light.	Turn ON the power supply after checking the installation status.

<OSSD indicator remains lit in red (light is not received)>

Cause	Remedy
The beam channels are not correctly aligned.	Align the beam channels. Refer to “ 2-6 Adjustment. ” Align the top / bottom direction of the beam channel between emitter and receiver.

If the device does not work normally after checking the items above, please consult Panasonic Industrial Devices SUNX.

<Reference>

About counting blinks of the error indicator, count blinks from 2 seconds of no blinking.

Chapter 6 Specifications / Dimensions

6-1 Specifications

Model

SF4B - □ □ G<V2>

Number of beam channels

F: Beam pitch 10mm

H: Beam pitch 20mm

A: Beam pitch 40mm

Example: **SF4B-F55G<V2>**

Beam pitch: 10mm

Number of beam channels: 55 channels

Model-wise specifications <10mm pitch type>

Type	10mm pitch type					
Model No.	SF4B-F23G<V2>	SF4B-F31G<V2>	SF4B-F39G<V2>	SF4B-F47G<V2>	SF4B-F55G<V2>	SF4B-F63G<V2>
No. of beam channels	23	31	39	47	55	63
Sensing range	0.3 to 7m					
Beam pitch	10mm					
Protective height	244mm	324mm	404mm	484mm	564mm	644mm
When using as safety equipment for press machines in China (Note)	220mm	300mm	380mm	460mm	540mm	620mm
Current consumption	Emitter: 80mA or less, Receiver: 120mA or less			Emitter: 100mA or less, Receiver: 160mA or less		
PFHd	2.4×10^{-9}	2.8×10^{-9}	3.2×10^{-9}	3.6×10^{-9}	4.0×10^{-9}	4.4×10^{-9}
MTTFd	More than 100 years					
Weight (total of emitter and receiver)	Approx. 490g	Approx. 670g	Approx. 850g	Approx. 1,000g	Approx. 1,200g	Approx. 1,400g

Type	10mm pitch type				
Model No.	SF4B-F71G<V2>	SF4B-F79G<V2>	SF4B-F95G<V2>	SF4B-F111G<V2>	SF4B-F127G<V2>
No. of beam channels	71	79	95	111	127
Sensing range	0.3 to 7m				
Beam pitch	10mm				
Protective height	724mm	804mm	964mm	1,124mm	1,284mm
When using as safety equipment for press machines in China (Note)	700mm	780mm	940mm	1,100mm	1,260mm
Current consumption	Emitter: 100mA or less Receiver: 160mA or less	Emitter: 115mA or less Receiver: 190mA or less		Emitter: 135mA or less Receiver: 230mA or less	
PFHd	4.8×10^{-9}	5.2×10^{-9}	6.0×10^{-9}	6.8×10^{-9}	7.6×10^{-9}
MTTFd	More than 100 years				
Weight (total of emitter and receiver)	Approx. 1,600g	Approx. 1,700g	Approx. 2,100g	Approx. 2,500g	Approx. 2,800g

PFHd: Probability of dangerous failure per hour, MTTFd: Mean time to dangerous failure.

Note: In Japan, do not use this device as safety equipment for a press machine. Please use the model **SF4B-□-01<V2>** for press machines or shears (paper shears) in Japan.

<20mm pitch type>

Type	20mm pitch type					
Model No.	SF4B-H12G<V2>	SF4B-H16G<V2>	SF4B-H20G<V2>	SF4B-H24G<V2>	SF4B-H28G<V2>	SF4B-H32G<V2>
No. of beam channels	12	16	20	24	28	32
Sensing range	0.3 to 9m					
Beam pitch	20mm					
Protective hight	244mm	324mm	404mm	484mm	564mm	644mm
When using as safety equipment for press machines in China (Note)	220mm	300mm	380mm	460mm	540mm	620mm
Current consumption	Emitter: 70mA or less, Receiver: 95mA or less			Emitter: 80mA or less, Receiver: 115mA or less		
PFHd	1.8×10^{-9}	2.0×10^{-9}	2.2×10^{-9}	2.4×10^{-9}	2.6×10^{-9}	2.8×10^{-9}
MTTFd	More than 100 years					
Weight (total of emitter and receiver)	Approx. 490g	Approx. 670g	Approx. 850g	Approx. 1,000g	Approx. 1,200g	Approx. 1,400g

Type	20mm pitch type					
Model No.	SF4B-H36G<V2>	SF4B-H40G<V2>	SF4B-H48G<V2>	SF4B-H56G<V2>	SF4B-H64G<V2>	SF4B-H72G<V2>
No. of beam channels	36	40	48	56	64	72
Sensing range	0.3 to 9m					0.3 to 7m
Beam pitch	20mm					
Protective hight	724mm	804mm	964mm	1,124mm	1,284mm	1,444mm
When using as safety equipment for press machines in China (Note)	700mm	780mm	940mm	1,100mm	1,260mm	1,420mm
Current consumption	Emitter: 80mA or less Receiver: 115mA or less	Emitter: 90mA or less Receiver: 140mA or less		Emitter: 100mA or less Receiver: 160mA or less		Emitter: 110mA or less Receiver: 180mA or less
PFHd	3.0×10^{-9}	3.2×10^{-9}	3.6×10^{-9}	4.0×10^{-9}	4.4×10^{-9}	4.8×10^{-9}
MTTFd	More than 100 years					
Weight (total of emitter and receiver)	Approx. 1,600g	Approx. 1,700g	Approx. 2,100g	Approx. 2,500g	Approx. 2,800g	Approx. 3,200g

Type	20mm pitch type		
Model No.	SF4B-H80G<V2>	SF4B-H88G<V2>	SF4B-H96G<V2>
No. of beam channels	80	88	96
Sensing range	0.3 to 7m		
Beam pitch	20mm		
Protective hight	1,604mm	1,764mm	1,924mm
When using as safety equipment for press machines in China (Note)	1,580mm	1,740mm	1,900mm
Current consumption	Emitter: 110mA or less Receiver: 180mA or less	Emitter: 120mA or less Receiver: 200mA or less	
PFHd	5.2×10^{-9}	5.6×10^{-9}	6.0×10^{-9}
MTTFd	More than 100 years		
Weight (total of emitter and receiver)	Approx. 3,500g	Approx. 3,900g	Approx. 4,200g

PFHd: Probability of dangerous failure per hour, MTTFd: Mean time to dangerous failure.

Note: In Japan, do not use this device as safety equipment for a press machine. Please use the model **SF4B-□-01<V2>** for press machines or shears (paper shears) in Japan.

<40mm pitch type>

Type	40mm pitch type					
Model No.	SF4B-A6G<V2>	SF4B-A8G<V2>	SF4B-A10G<V2>	SF4B-A12G<V2>	SF4B-A14G<V2>	SF4B-A16G<V2>
No. of beam channels	6	8	10	12	14	16
Sensing range	0.3 to 9m					
Beam pitch	40mm					
Protective hight	244mm	324mm	404mm	484mm	564mm	644mm
When using as safety equipment for press machines in China (Note)	200mm	280mm	360mm	440mm	520mm	600mm
Current consumption	Emitter: 65mA or less, Receiver: 85mA or less			Emitter: 70mA or less, Receiver: 95mA or less		
PFHd	1.5×10^{-9}	1.6×10^{-9}	1.7×10^{-9}	1.8×10^{-9}	1.9×10^{-9}	2.0×10^{-9}
MTTFd	More than 100 years					
Weight (total of emitter and receiver)	Approx. 490g	Approx. 670g	Approx. 850g	Approx. 1,000g	Approx. 1,200g	Approx. 1,400g

Type	40mm pitch type					
Model No.	SF4B-A18G<V2>	SF4B-A20G<V2>	SF4B-A24G<V2>	SF4B-A28G<V2>	SF4B-A32G<V2>	SF4B-A36G<V2>
No. of beam channels	18	20	24	28	32	36
Sensing range	0.3 to 9m					0.3 to 7m
Beam pitch	40mm					
Protective hight	724mm	804mm	964mm	1,124mm	1,284mm	1,444mm
When using as safety equipment for press machines in China (Note)	680mm	760mm	920mm	1,080mm	1,240mm	1,400mm
Current consumption	Emitter: 70mA or less Receiver: 95mA or less	Emitter: 75mA or less Receiver: 105mA or less		Emitter: 80mA or less Receiver: 120mA or less		Emitter: 85mA or less Receiver: 130mA or less
PFHd	2.1×10^{-9}	2.2×10^{-9}	2.4×10^{-9}	2.6×10^{-9}	2.8×10^{-9}	3.0×10^{-9}
MTTFd	More than 100 years					
Weight (total of emitter and receiver)	Approx. 1,600g	Approx. 1,700g	Approx. 2,100g	Approx. 2,500g	Approx. 2,800g	Approx. 3,200g

Type	40mm pitch type		
Model No.	SF4B-A40G<V2>	SF4B-A44G<V2>	SF4B-A48G<V2>
No. of beam channels	40	44	48
Sensing range	0.3 to 7m		
Beam pitch	40mm		
Protective hight	1,604mm	1,764mm	1,924mm
When using as safety equipment for press machines in China (Note)	1,560mm	1,720mm	1,880mm
Current consumption	Emitter: 85mA or less Receiver: 130mA or less	Emitter: 90mA or less Receiver: 140mA or less	
PFHd	3.2×10^{-9}	3.4×10^{-9}	3.6×10^{-9}
MTTFd	More than 100 years		
Weight (total of emitter and receiver)	Approx. 3,500g	Approx. 3,900g	Approx. 4,200g

PFHd: Probability of dangerous failure per hour, MTTFd: Mean time to dangerous failure.

Note: In Japan, do not use this device as safety equipment for a press machine. Please use the model **SF4B-□-01<V2>** for press machines or shears (paper shears) in Japan.

Common specifications

Type	10mm pitch type	20mm pitch type	40mm pitch type
Model No.	SF4B-F□G<V2>	SF4B-H□G<V2>	SF4B-A□G<V2>
Detecting capability (Min. sensing object)	ø14mm opaque object	ø25mm opaque object	ø45mm opaque object
Effective aperture angle (EAA)	±2.5 degree or less [for sensing range exceeding 3m (Required by IEC 61496-2, ANSI/UL 61496-2)]		
Supply voltage	24V DC±10% Ripple P-P10% or less		
Control output (OSSD 1 / 2)	PNP open-collector / NPN open-collector transistor (switching type)		
	<For PNP output> <ul style="list-style-type: none"> • Maximum source current: 200mA • Applied voltage: Same as supply voltage (between the control output and +V) • Residual voltage: 2.5V or less (source current 200mA, when using 20m length cable) • Leakage current: 0.1mA or less (Including power supply OFF condition) • Maximum load capacity: 0.22μF (No load to maximum output current) • Load wiring resistance: 3Ω or less 		<For NPN output> <ul style="list-style-type: none"> • Maximum sink current: 200mA • Applied voltage: Same as supply voltage (between the control output and 0V) • Residual voltage: 2.5V or less (sink current 200mA, when using 20m length cable) • Leakage current: 0.1mA or less (Including power supply OFF condition) • Maximum load capacity: 0.22μF (No load to maximum output current) • Load wiring resistance: 3Ω or less
	ON when all beams are received, OFF when one or more beams are interrupted (Note 1, 2) (OFF when fault occurs in the sensor to the synchronization single error, too)		
	Incorporated		
Response time	In normal operation...OFF response: 14ms or less, ON response: 80 to 90ms		
Auxiliary output (Non-safety output)	PNP open-collector transistor / NPN open-collector transistor (switching type)		
	<For PNP output> <ul style="list-style-type: none"> • Maximum source current: 60mA • Applied voltage: Same as supply voltage (between the auxiliary output and +V) • Residual voltage: 2.5V or less (source current 60mA, when using 20m length cable) 		<For NPN output> <ul style="list-style-type: none"> • Maximum sink current: 60mA • Applied voltage: Same as supply voltage (between the auxiliary output and 0V) • Residual voltage: 2.5V or less (sink current 60mA, when using 20m length cable)
	When OSSDs are ON: OFF, when OSSDs are OFF: ON (factory setting) [Changeable by using the handy controller (SFB-HC) (optional).]		
	Incorporated		
Protection	IP65 and IP67(IEC)		
Degree of pollution	3		
Ambient temperature	-10 to +55°C(No dew condensation or icing allowed), Storage:-25 to +70°C		
Ambient humidity	30 to 85%RH, Strage: 30 to 95%RH		
Ambient illuminance	Incandescent lamp: 3,500lx or less at the light-receiving surface		
Altitude for use	2000m or less above sea level (Note 3)		
Voltage withstandability	1,000V AC for one min. (between all supply terminals connected together and enclosure)		
Insulation resistance	20MΩ or more with 500V DC mega (between all supply terminals connected together and enclosure)		
Vibration resistance	10 to 55Hz frequency, 0.75mm amplitude in X, Y, and Z directions for two hours each		
Shock resistance	300m/s ² acceleration (Approx. 30G) in X, Y and Z directions for three times each		
SFF (Safe failure fraction)	99%		
HFT (Hardware failure tolerance)	1		
Sub system type	Type B (IEC 61508-2)		
Mission time	20 years		
Emitting element	Infrared LED (Peak emission wavelength: 870nm)		
Connection method	Connection with connectors		
Cable extension	Extension up to total 50m is possible for both emitter and receiver connecting cable (optional) (Note 4)		
Material	Enclosure: Aluminum, Upper / lower case: Aluminum, Sensing surface: PC / Polyester resin, Cap: PBT		
Accessory	MS-SFB-2 (Intermediate supporting bracket): (Note 5) SF4B-TR14 (Test rod): 1 pc.	MS-SFB-2 (Intermediate supporting bracket): (Note 5) SF4B-TR25 (Test rod): 1	MS-SFB-2 (Intermediate supporting bracket): (Note 5)
Applicable standard	EN 61496-1 (Type 4), EN 55011, EN 61000-6-2, EN IEC 63000, EN ISO 13849-1: 2015 (Category 4, PLe) IEC 61496-1/2 (Type 4) ISO 13849-1: 2015 (Category 4, PLe), IEC 61508-1 to 7 (SIL3) JIS B 9704-1/2 (Type 4), JIS B 9705-1 (Category 4), JIS C 0508 (SIL3) ANSI/UL 61496-1/2 (Type 4), UL 1998 (Class 2)		

- Notes: 1) The beam channel is not turned OFF during muting even if it is blocked.
 2) In case the blanking function is valid, the operation mode is changed.
 3) Do not use or storage in environment of atmospheric pressure or more.
 4) The cable can be extended within 30m (for emitter / receiver) when two devices are connected in series connection, within 20m when three devices are connected in series connection. Furthermore, when the muting lamp is used, the cable can be extended within 40m (for emitter / receiver).
 5) The intermediate supporting bracket (**MS-SF4BG-2**) is enclosed with the following devices. The quantity of the enclosed bracket differs depending on the device as follows:
- 1 set: **SF4B-F□G<V2>** ... 79 to 127 beam channels
SF4B-H□G<V2> ... 40 to 64 beam channels
SF4B-A□G<V2> ... 20 to 32 beam channels
 - 2 sets: **SF4B-H□G<V2>** ... 72 to 96 beam channels
SF4B-A□G<V2> ... 36 to 48 beam channels

WARNING

This device enables to set each function by using the handy controller (**SFB-HC**) (optional). Among the functions, the contents related to the safety distance such as the size of the minimum sensing object are varied depending on the setting condition. When setting each function, re-calculate the safety distance, and make enough space larger than the calculated safety distance. Failure to do so might cause the accident that the device cannot stop quickly before reaching the dangerous area of the device, resulting in the death or serious injury.

<Reference>

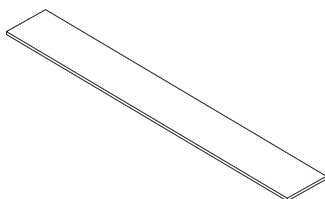
Refer to “**3-9 Functions Using Handy Controller (SFB-HC) (Optional)**” for details related to the function setting, or to the instruction manual attached to handy.

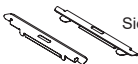


WARNING

Both emitter and receiver are adjusted before shipment, please apply both emitter and receiver with the same serial No. The serial No. is indicated on the plates of both emitter and receiver. (Under the model represents the serial No.)

6-2 Options

- Front protection cover: 1 pc

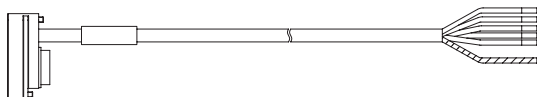


Model No.	Applicable beam channel No.			Remarks
FC-SFBG-H12	SF4B-F23G<V2>	SF4B-H12G<V2>	SF4B-A6G<V2>	Protects the sensing surface of the device from dirt, etc.
FC-SFBG-H16	SF4B-F31G<V2>	SF4B-H16G<V2>	SF4B-A8G<V2>	
FC-SFBG-H20	SF4B-F39G<V2>	SF4B-H20G<V2>	SF4B-A10G<V2>	<Accessory>
FC-SFBG-H24	SF4B-F47G<V2>	SF4B-H24G<V2>	SF4B-A12G<V2>	
FC-SFBG-H28	SF4B-F55G<V2>	SF4B-H28G<V2>	SF4B-A14G<V2>	 Side stopper (Note)
FC-SFBG-H32	SF4B-F63G<V2>	SF4B-H32G<V2>	SF4B-A16G<V2>	
FC-SFBG-H36	SF4B-F71G<V2>	SF4B-H36G<V2>	SF4B-A18G<V2>	 Top stopper
FC-SFBG-H40	SF4B-F79G<V2>	SF4B-H40G<V2>	SF4B-A20G<V2>	
FC-SFBG-H48	SF4B-F95G<V2>	SF4B-H48G<V2>	SF4B-A24G<V2>	 Bottom stopper
FC-SFBG-H56	SF4B-F111G<V2>	SF4B-H56G<V2>	SF4B-A28G<V2>	
FC-SFBG-H64	SF4B-F127G<V2>	SF4B-H64G<V2>	SF4B-A32G<V2>	Note: Number of the side stopper included depends on type of product.
FC-SFBG-H72	<input type="checkbox"/>	SF4B-H72G<V2>	SF4B-A36G<V2>	
FC-SFBG-H80	<input type="checkbox"/>	SF4B-H80G<V2>	SF4B-A40G<V2>	
FC-SFBG-H88	<input type="checkbox"/>	SF4B-H88G<V2>	SF4B-A44G<V2>	
FC-SFBG-H96	<input type="checkbox"/>	SF4B-H96G<V2>	SF4B-A48G<V2>	

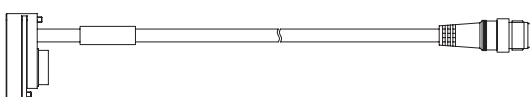
When the front protection cover is fitted, the sensing distance is shortened.

- 8-core bottom cap cable: 2 pcs./set

<Discrete wire>



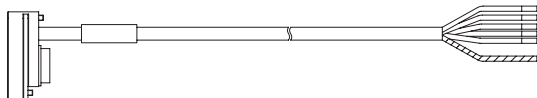
<Connector>



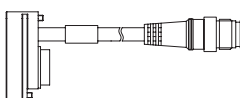
Type	Model No.	Cable length	Remarks
Discrete wire	SFB-CCB3	3m	This cable is used for normal operation. For emitter: Gray connector, 8-core shielded cable For receiver: Black connector, 8-core shielded cable
	SFB-CCB7	7m	
	SFB-CCB10	10m	
	SFB-CCB15	15m	
Connector	SFB-CB05	0.5m	
	SFB-CB5	5m	
	SFB-CB10	10m	

- 12-core bottom cap cable: 2 pcs./set

<Discrete wire>

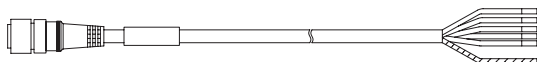


<Connector>



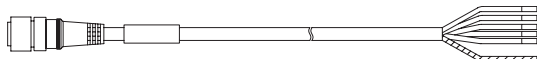
Type	Model No.	Cable length	Remarks
Discrete wire	SFB-CCB3-MU	3m	This 12-core bottom cap cable is used when the muting function is applied. For emitter: Gray connector, 12-core shielded cable For receiver: Black connector, 12-core shielded cable
	SFB-CCB7-MU	7m	
Connector	SFB-CB05-MU	0.5m	

8-core extension cable with connector on one end: 2 pcs./set



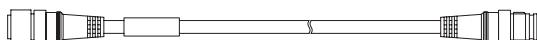
Type	Model No.	Cable length	Remarks
Discrete wire	SFB-CC3	3m	This cable is used for extending the normal cable. For emitter: Gray connector, 8-core shielded cable For receiver: Black connector, 8-core shielded cable
	SFB-CC10	10m	

• 12-core extension cable with connector on one end: 2 pcs./set



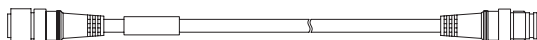
Type	Model No.	Cable length	Remarks
Discrete wire	SFB-CC3-MU	3m	In case of using the muting function, this cable is used for extending the cable. For emitter: Gray connector, 12-core shielded cable For receiver: Black connector, 12-core shielded cable
	SFB-CC7-MU	7m	
	SFB-CC10-MU	10m	

• 8-core extension cable with connectors on both ends: 1 pc.



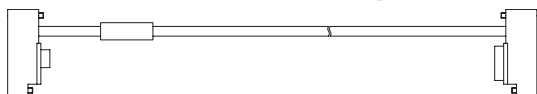
Type	Model No.	Cable length	Remarks
For emitter	SFB-CCJ3E	3m	This cable is used for extending the normal cable. The connector is attached on both ends of the cable. For emitter: Gray connector, 8-core shielded cable For receiver: Black connector, 8-core shielded cable
	SFB-CCJ10E	10m	
For receiver	SFB-CCJ3D	3m	
	SFB-CCJ10D	10m	

• 12-core extension cable with connectors on both ends: 1 pc.



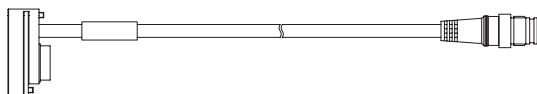
Type	Model No.	Cable length	Remarks
For emitter	SFB-CCJ3E-MU	3m	In case of using the muting function, this cable is used for extending the cable. The connector is attached on both ends of the cable. For emitter: Gray connector, 12-core shielded cable For receiver: Black connector, 12-core shielded cable
	SFB-CCJ10E-MU	10m	
For receiver	SFB-CCJ3D-MU	3m	
	SFB-CCJ10D-MU	10m	

• Cable for series connection: 2 pcs./set



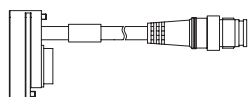
Model No.	Cable length	Remarks
SFB-CSL01	0.1m	This cable is used for connecting the devices in series. Common for emitter and receiver.
SFB-CSL05	0.5m	
SFB-CSL1	1m	
SFB-CSL5	5m	

● Connecting cable exclusive for the application expansion unit **SF-C14EX**: 2 pcs./set



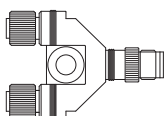
Type	Model No.	Cable length	Remarks
Connector	SFB-CB05-EX	0.5m	This cable is used for connecting the device to the application expansion unit SF-C14EX (optional). For emitter: Gray connector, 8-core shielded cable For receiver: Black connector, 8-core shielded cable
	SFB-CB5-EX	5m	
	SFB-CB10-EX	10m	


● Compatible cable: 2 pcs./set



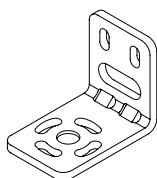
Type	Model No.	Cable length	Remarks
Connector	SFB-CB05-A-P	0.5m	This cable is compatible with, PNP output of SF4-AH series.
	SFB-CB05-A-N		This cable is compatible with, NPN output of SF4-AH series.
	SFB-CB05-B-P		This cable is compatible with, PNP output of SF2-EH series.
	SFB-CB05-B-N		This cable is compatible with, NPN output of SF2-EH series.

● Wire-saving Y type connector: 1 pcs



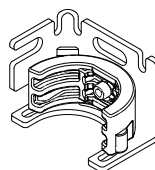
Model No.	Remarks
SFB-WY1	<p>This device is connector which can organize a emitter and a receiver cables of intermediate when connecting to a control unit SF-C13 or a safety PLC, it is allowed to connect as wire-saving.</p> <p>use it with a cable shown below.</p> <ul style="list-style-type: none"> Cable with connector on one end WY1-CCN3, WY1-CCN10: 1 pc. 

● Standard ell mounting bracket: 4 pcs./set



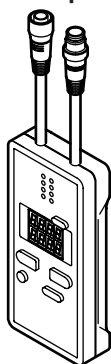
Model No.	Remarks
MS-SF4BG-1	For two hexagon-socket head bolts [M5] or one hexagon-socket head bolt [M8].

● Dead zoneless mounting bracket: 4 pcs./set



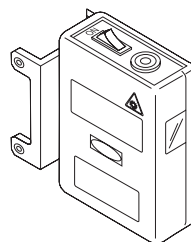
Model No.	Remarks
MS-SFBG-3	This is the mounting bracket for reducing the dead space.

- Handy controller: 1 pc.



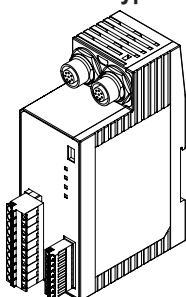
Model No.	Remarks
SFB-HC	Handy controller that enables setting each function.

- Laser alignment tool for light curtain: 1 pc.



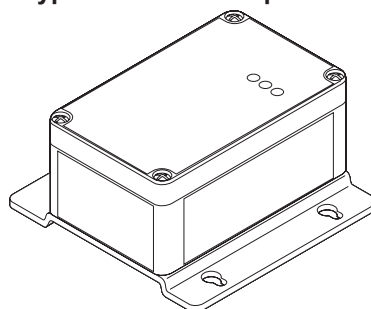
Model No.	Remarks
SF-LAT-4BG	Convenient for aligning the beam channels.

- Connector connection type control unit: 1 pc.



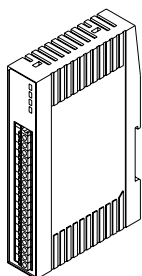
Model No.	Remarks
SF-C11	This is the control unit conforming to European / North American safety standards. Applicable to 8-core cable with connector.

- Solid type control unit: 1 pc.



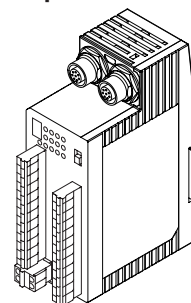
Model No.	Remarks
SF-C12	This is the control unit conforming to European / North American safety standards (IP65). Applicable to 12-core cable with connector.

- Thin type control unit: 1 pc.



Model No.	Remarks
SF-C13	This is the controller conforming to European / North American safety standards.

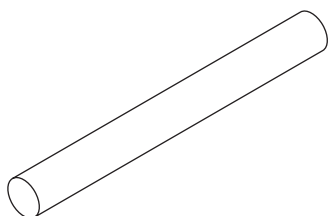
- Application expansion unit: 1 pc.



Model No.	Remarks
SF-C14EX	This is the controller conforming to European / North American safety standards.
SF-C14EX-01 (Note)	The muting control function and the emergency stop input etc., are incorporated, which expand the applications of the light curtain.

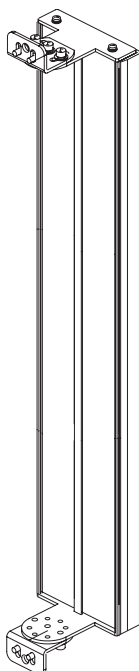
Note: **SF-C14EX-01** cannot be used in combination with the handy controller (**SFB-HC**) (optional).

- Test rod: 1 pc.



Model No.	Remarks
SF4B-TR24	Test rod for SF4B-F□G<V2> type 1 beam channel floating. ø24mm
SF4B-TR34	Test rod for SF4B-F□G<V2> type 2 beam channels floating. ø34mm
SF4B-TR45	Test rod for SF4B-A□G<V2> . ø45mm It can be also used for SF4B-H□G<V2> type 1 beam channel floating.

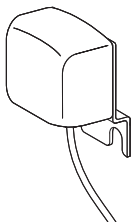
- Conner mirror: 1 pc



Model No.	Applicable beam channel No.			Remarks
RF-SFBH-12	SF4B-F23G<V2>	SF4B-H12G<V2>	SF4B-A6G<V2>	Normally for L-shaped or U-shaped installation, 2 or 3 sets of light curtains are needed. With the use of a corner mirror reflecting the light, 1 set of light curtain is possible for L-shaped or U-shaped installation
RF-SFBH-16	SF4B-F31G<V2>	SF4B-H16G<V2>	SF4B-A8G<V2>	
RF-SFBH-20	SF4B-F39G<V2>	SF4B-H20G<V2>	SF4B-A10G<V2>	
RF-SFBH-24	SF4B-F47G<V2>	SF4B-H24G<V2>	SF4B-A12G<V2>	
RF-SFBH-28	SF4B-F55G<V2>	SF4B-H28G<V2>	SF4B-A14G<V2>	
RF-SFBH-32	SF4B-F63G<V2>	SF4B-H32G<V2>	SF4B-A16G<V2>	
RF-SFBH-36	SF4B-F71G<V2>	SF4B-H36G<V2>	SF4B-A18G<V2>	
RF-SFBH-40	SF4B-F79G<V2>	SF4B-H40G<V2>	SF4B-A20G<V2>	
RF-SFBH-48	SF4B-F95G<V2>	SF4B-H48G<V2>	SF4B-A24G<V2>	
RF-SFBH-56	SF4B-F111G<V2>	SF4B-H56G<V2>	SF4B-A28G<V2>	
RF-SFBH-64	SF4B-F127G<V2>	SF4B-H64G<V2>	SF4B-A32G<V2>	
RF-SFBH-72	<input type="checkbox"/>	SF4B-H72G<V2>	SF4B-A36G<V2>	
RF-SFBH-80	<input type="checkbox"/>	SF4B-H80G<V2>	SF4B-A40G<V2>	
RF-SFBH-88	<input type="checkbox"/>	SF4B-H88G<V2>	SF4B-A44G<V2>	
RF-SFBH-96	<input type="checkbox"/>	SF4B-H96G<V2>	SF4B-A48G<V2>	

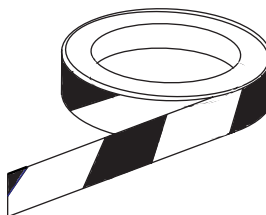
The sensing distance will be shorter with the corner mirror.

- Large display unit of light curtain



Model No.	Remarks
SF-IND-2	by connecting to auxiliary output of light curtain, we can check the sensing condition from wide angle

- Caution tape

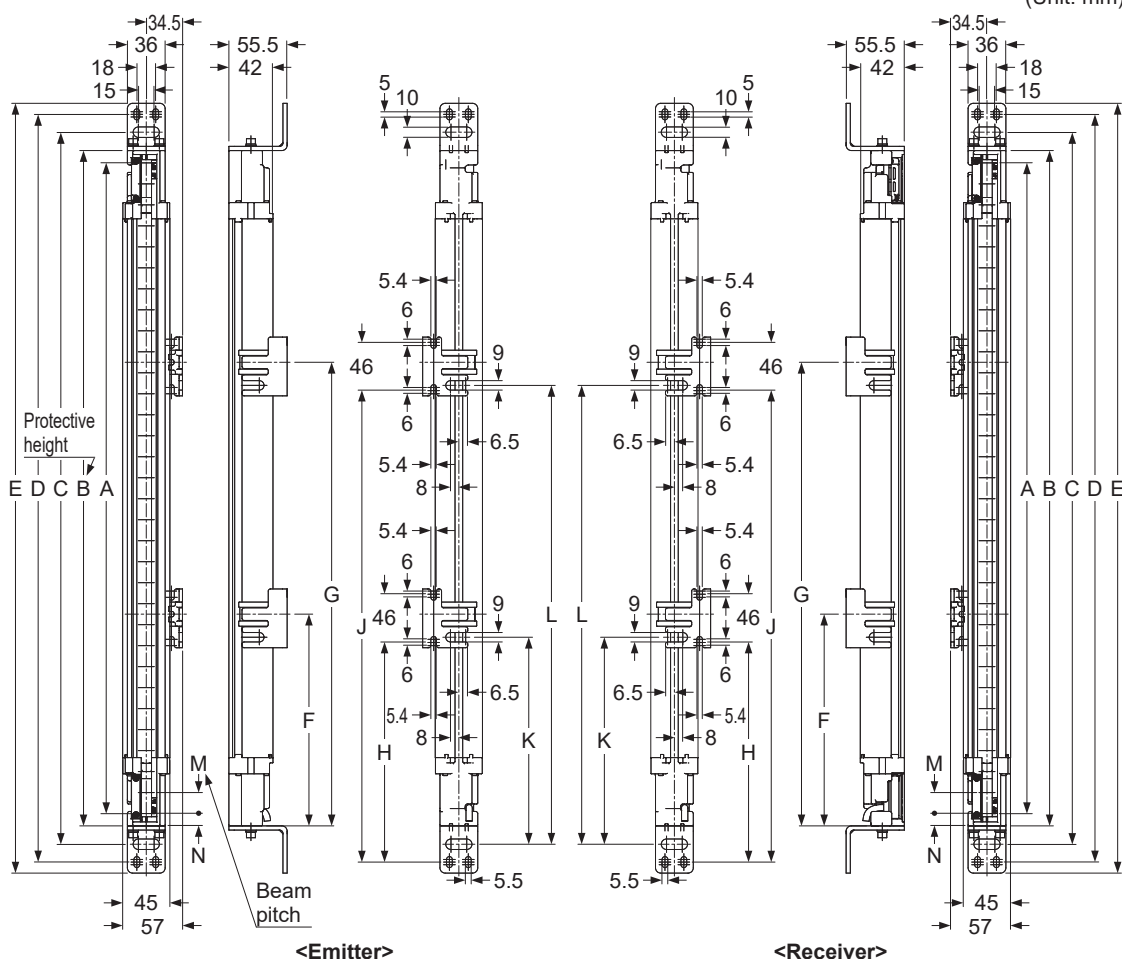


Model No.	Remarks
SF-TP-BG10	Put a side of light curtain to ask attentions of operator for hazard source. Length: 10m

6-3 Dimensions

6-3-1 When Using Standard EII Mounting Bracket (MS-SF4BG-1)

(Unit: mm)



Model No.			A		B	C	D	E	F	G	H	J	K	L
			SF4B-A-G<V2>	SF4B-H-G<V2> SF4B-F-G<V2>										
SF4B-F23G<V2>	SF4B-H12G<V2>	SF4B-A6G<V2>	200	220	244	279	313	334	—	—	—	—	—	—
SF4B-F31G<V2>	SF4B-H16G<V2>	SF4B-A8G<V2>	280	300	324	359	393	414	—	—	—	—	—	—
SF4B-F39G<V2>	SF4B-H20G<V2>	SF4B-A10G<V2>	360	380	404	439	473	494	—	—	—	—	—	—
SF4B-F47G<V2>	SF4B-H24G<V2>	SF4B-A12G<V2>	440	460	484	519	553	574	—	—	—	—	—	—
SF4B-F55G<V2>	SF4B-H28G<V2>	SF4B-A14G<V2>	520	540	564	599	633	654	—	—	—	—	—	—
SF4B-F63G<V2>	SF4B-H32G<V2>	SF4B-A16G<V2>	600	620	644	679	713	734	—	—	—	—	—	—
SF4B-F71G<V2>	SF4B-H36G<V2>	SF4B-A18G<V2>	680	700	724	759	793	814	—	—	—	—	—	—
SF4B-F79G<V2>	SF4B-H40G<V2>	SF4B-A20G<V2>	760	780	804	839	873	894	441	—	414	—	419	—
SF4B-F95G<V2>	SF4B-H48G<V2>	SF4B-A24G<V2>	920	940	964	999	1,033	1,054	521	—	494	—	499	—
SF4B-F111G<V2>	SF4B-H56G<V2>	SF4B-A28G<V2>	1,080	1,100	1,124	1,159	1,193	1,214	601	—	574	—	579	—
SF4B-F127G<V2>	SF4B-H64G<V2>	SF4B-A32G<V2>	1,240	1,260	1,284	1,319	1,353	1,374	681	—	654	—	659	—
—	SF4B-H72G<V2>	SF4B-A36G<V2>	1,400	1,420	1,444	1,479	1,513	1,534	520	1,001	493	974	498	979
—	SF4B-H80G<V2>	SF4B-A40G<V2>	1,560	1,580	1,604	1,639	1,673	1,694	573	1,108	546	1,081	551	1,086
—	SF4B-H88G<V2>	SF4B-A44G<V2>	1,720	1,740	1,764	1,799	1,833	1,854	627	1,215	600	1,188	605	1,193
—	SF4B-H96G<V2>	SF4B-A48G<V2>	1,880	1,900	1,924	1,959	1,993	2,014	680	1,321	653	1,294	658	1,289

Model No.	M	N
SF4B-F□G<V2>	10	11.8
SF4B-H□G<V2>	20	11.8
SF4B-A□G<V2>	40	21.8

Note: The intermediate supporting bracket (**MS-SF4BG-2**) is enclosed with the devices. The number of the brackets varies depending on the device.

(Unit: mm)



<Receiver>

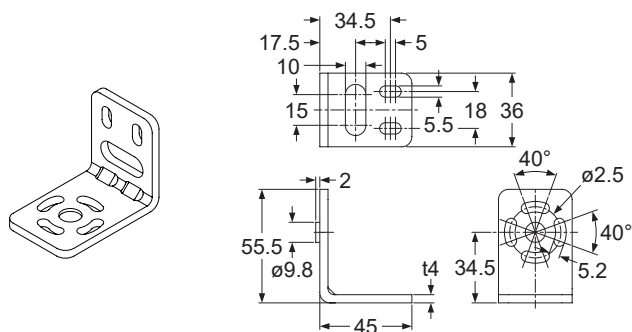
Model No.	M	N
SF4B-F□G<V2>	10	11.8
SF4B-H□G<V2>	20	11.8
SF4B-A□G<V2>	40	21.8

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6-3-3 Mounting Brackets

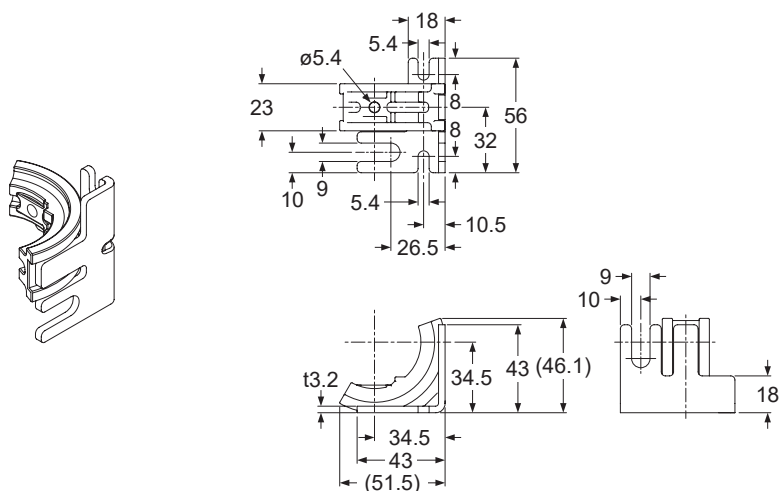
(Unit: mm)

1) Standard ell bracket / MS-SF4BG-1



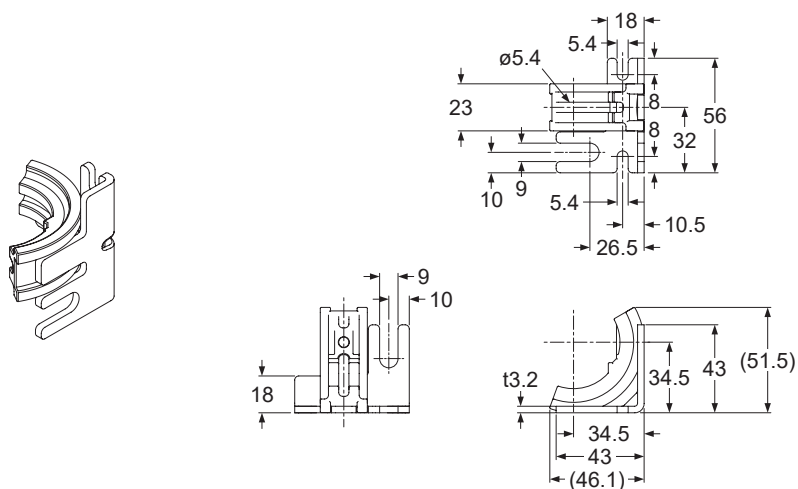
Material: Iron steel (trivalent chromate coating)

2) Intermediate supporting bracket / MS-SF4BG-2 (Mounting on rear)



Material: Intermediate ell bracket ... Iron steel (trivalent chromate coating), Intermediate supporting bracket ... PPS

3) Intermediate supporting bracket / MS-SF4BG-2 (Mounting on side)



Material: Intermediate ell bracket ... Iron steel (trivalent chromate coating), Intermediate supporting bracket ... PPS

Chapter 7 Others

7-1 Glossary

Machinery Directive	This directive is for an assembly of linked parts or components, energized by an electricity, compressed air or oil pressure, etc. and at least one of which moves, and a component which fulfills a safety function and is released into the market by itself.
EMC Directive	The directives is to any electric or electronic devices which will create more than a limited amount of RF interference, or will withstand a certain amount of Electro Magnetic fields while operating as intended within specifications.
EN 61496-1 IEC 61496-1/2 ANSI/UL 61496-1/2 JIS B 9704-1/2	The standards that pertain to machine safety, especially electro-sensitive protective equipment (ESPE). EN 61496-1, IEC 61496-1, ANSI/UL 61496-1 or JIS B 9704-1 gives general rules or failure mode and effect analysis, EMC requirements, etc. IEC 61496-2, ANSI/UL 61496-2 or JIS B 9704-2 specifies effective aperture angle, protection against extraneous light sources, etc, for Active Opto-electronic Protective Devices (AOPDs).
EN 55011	Specifies the limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment.
EN ISO 13849-1 ISO 13849-1 JIS B 9705-1	The standard that specifies the safety-related matters of machine safety / control system. They give roles for level (category) of structure and fault detection reliability, and for level of safety future performance capability (PL: Performance Level).
UL 1998	UL standard for safety-related software in programmable components.
ESPE	The abbreviation for Electro-Sensitive Protective Equipment.
Control output (OSSD)	The abbreviation for Output Signal Switching Device. A component of the light curtain that turns OFF when light of the light curtain is blocked.
FSD	The abbreviation for Final Switching Device. The component of the machine's safety related control system that open-circuits the MPCE circuit when the OSSD operates due to the light from the light curtain being blocked.
Test rod	This is a rod for checking the detection capability of this device. It has dimensions corresponding to the minimum sensing object for this device.
Main sensor / Sub sensor	For series connection, the sensor to which the power supply or the output is connected is called main sensor, and the others are called sub sensor.
Master side / Slave side	For parallel connection, the side where the emission / reception process timings are controlled is called master side, and the others are called slave side.
Lockout	It is one of the safe status of this device. Operation is stopped if the self-diagnosis function determines that an irrecoverable failure (OSSDs do not operate normally, etc.) has occurred. If an emitter is in lockout condition, it will stop emitting light. If a receiver is in lockout condition, OSSDs are turned OFF.
Safety distance	It is the minimum distance that must be maintained between the light curtain and the dangerous parts of a machine so that the machine can be stopped before a human body or an object can reach the dangerous parts.
Sensing height (Protective height)	The length of the beam-axis direction that the min. sensing object can be detected. The length from the center of the first beam channel to the center of the last beam channel in addition to +10mm (+5mm upward, +5mm downward).

Sensing range	It is the range between the facing emitter and receiver.
Sensing area	It is the area over which intrusion by people or objects can be detected by one set of the device. It is given by multiplying the sensing height (protective height) by the sensing range.
Emission halt function	This function enables checking of the receiver operation by turning OFF light emission. It is possible to halt emission by keeping the terminal open, and to have normal emission by connecting it to 0V (+V for NPN output).
PSDI	The abbreviation for the Presence Sensing Device Initiation. The safety device that restarts automatically without any operation by the operator after the device detects danger status and halts for a while.

7-2 CE Marking Declaration of Conformity

Itemized Essentials of EU Declaration of Conformity

Manufacturer's Name: Panasonic Industrial Devices SUNX Co., Ltd.

Manufacturer's Address:

2431-1, Ushiyama-cho, Kasugai, Aichi 486-0901, Japan

EU Representative's Name:

Panasonic Marketing Europe GmbH Panasonic Testing Center

EU Representative's Address: Winsbergring 15, 22525 Hamburg, Germany

Product: Active Opto-electronic Protective Device (Light Curtain)

Model Name: SF4B Series

Trade Name: Panasonic

Application of Council Directive:

- 2006/42/EC Machinery Directive
- 2014/30/EU EMC Directive
- 2011/65/EU RoHS Directive

Harmonized standards:

- EN 61496-1
- EN ISO 13849-1
- EN 55011
- EN 61000-6-2
- EN IEC 63000

Type Examination: Certified by TÜV SÜD Product Service GmbH Ridlerstrasse
65 80339 München Germany

Revision history	Revision date	Revision item
1st edition	November,2010	
2nd edition	November , 2010	—
3rd edition	August , 2011	—
4th edition	October , 2012	—
5th edition	June , 2013	—
6th edition	September , 2013	—
7th edition	May , 2014	—
8th edition	October , 2015	—
9th edition	January , 2016	—
10th edition	May , 2017	Added notes to “3-7 Muting Function”.
11th edition	October , 2020	<ul style="list-style-type: none"> ● Added description on removing method and caution notes to “2-4-2 Mounting of the Bottom Cap Cable (Optional)”. ● Added description on removing method and caution notes to “2-4-3 Extension and Dismantling of Sensor (Series Connection)”. ● Corrected errors.
12th edition	March , 2021	<ul style="list-style-type: none"> ● Changed the Standards. ● Corrected errors.

1. WARRANTIES:

- (1) Subject to the exclusions stated in 2 (EXCLUSIONS) herein below, Panasonic Industrial Devices SUNX warrants the Products to be free of defects in material and workmanship for a period of one (1) year from the date of shipment under normal usage in environments commonly found in manufacturing industry.
- (2) Any Products found to be defective must be shipped to Panasonic Industrial Devices SUNX with all shipping costs paid by Purchaser or offered to Panasonic Industrial Devices SUNX for inspection and examination. Upon examination by Panasonic Industrial Devices SUNX, Panasonic Industrial Devices SUNX will, at its sole discretion, repair or replace at no charge, or refund the purchase price of, any Products found to be defective.

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- (1) This warranty does not apply to defects resulting from any cause:
 - (i) which was due to abuse, misuse, mishandling, improper installation, improper interfacing, or improper repair by Purchaser;
 - (ii) which was due to unauthorized modification by Purchaser, in part or in whole, whether in structure, performance or specification;
 - (iii) which was not discoverable by a person with the state-of-the-art scientific and technical knowledge at the time of manufacture;
 - (iv) which was due to an operation or use by Purchaser outside of the limits of operation or environment specified by Panasonic Industrial Devices SUNX;
 - (v) which was due to normal wear and tear;
 - (vi) which was due to Force Majeure; and
 - (vii) which was due to any use or application expressly discouraged by Panasonic Industrial Devices SUNX in 4 (CAUTIONS FOR SAFE USE) hereunder.
- (2) This warranty extends only to the first purchaser for application, and is not transferable to any person or entity which purchased from such purchaser for application.

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 - (a) which are used for the protection of human life or body parts;
 - (b) which are used outdoors or in environments subject to any likelihood of chemical contamination or electromagnetic influence;
 - (c) which are likely to be used beyond the limits of operations or environments specified by Panasonic Industrial Devices SUNX in the catalogue or otherwise;
 - (d) which may cause risk to life or property, such as nuclear energy control equipment, transportation equipment (whether on rail or land, or in air or at sea), and medical equipment;
 - (e) which are operated continuously each day for 24 hours; and
 - (f) which otherwise require a high level of safety performance similar to that required in those equipment, facilities or systems as listed in (a) through (e) above.

5. EXPORT CONTROL LAWS

In some jurisdictions, the Products may be subject to local export laws and regulations. If any diversion or re-export is to be made, Purchaser is advised to abide by such local export laws and regulations, if any, at its own responsibility.

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Panasonic Corporation

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March , 2021 PRINTED IN JAPAN WUME-SF4BGV2-12