

Light Curtain / Type2

SF2B Series

Instruction Manual



(MEMO)

Thank you for purchasing Panasonic Industrial Devices SUNX's Light Curtain, **SF2B** 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 version of this instruction manuals 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**

- Do not use this device as a 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 30.5m by using the exclusive cable.
- 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 type) / +24V side (NPN output type).

◆ **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 2), EN 55011, EN IEC 63000, EN ISO 13849-1: 2015 (Category 2, PLc)

<International Standards>

IEC 61496-1/2 (Type 2), ISO 13849-1: 2015 (Category 2, PLc), IEC 61508-1~7 (SIL1)

<Japanese Industrial Standards (JIS)>

JIS B 9704-1/2 (Type 2), JIS B 9705-1 (Category 2), JIS C 0508 (SIL1)

<Standards in US / Canada>

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

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

<Regulations in US>

OSHA 1910.212, OSHA 1910.217(C) (Note), 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.

Note: In case of using the bottom cap cable (**SF2B-CB05-A**) (optional), this device does not conform to OSHA.

<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

1-4 Confirmation of Packed Contents

- | | |
|--|-------------|
| <input type="checkbox"/> Sensor: Emitter, Receiver | 1 pc. each |
| <input type="checkbox"/> Test Rod | 1 pc. |
| SF2B-H : SF2B-TR27 (ø27 × 220mm) | |
| <input type="checkbox"/> Intermediate Supporting Bracket (MS-SF2B-2) | 0 to 3 sets |
| Note: The intermediate support bracket (MS-SF2B-2) is enclosed with the following devices. The quantity differs depending on the device as shown below: | |
| 1 set: SF2B-H ... 40 to 56 beam channels, SF2B-A ... 20 to 28 beam channels | |
| 2 sets: SF2B-H ... 64 to 80 beam channels, SF2B-A ... 32 to 40 beam channels | |
| 3 sets: SF2B-H ... 88 to 96 beam channels, SF2B-A ... 44 to 48 beam channels | |
| <input type="checkbox"/> Instruction Manual (this 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.
- Beam-axis alignment indicators which make beam-axis alignment easy are incorporated.
- IP65 and IP67 are used as the protective construction.
- Synchronization system is different depending on the type bottom cap cable to be used.
- Wiring synchronization using 8-core cable (sensing range: 0.2 to 13m)
- Beam synchronization using 4-core cable (sensing range: 0.2 to 5m)
- Output and functions are different depending on the type of bottom cap cable (optional) to be used.

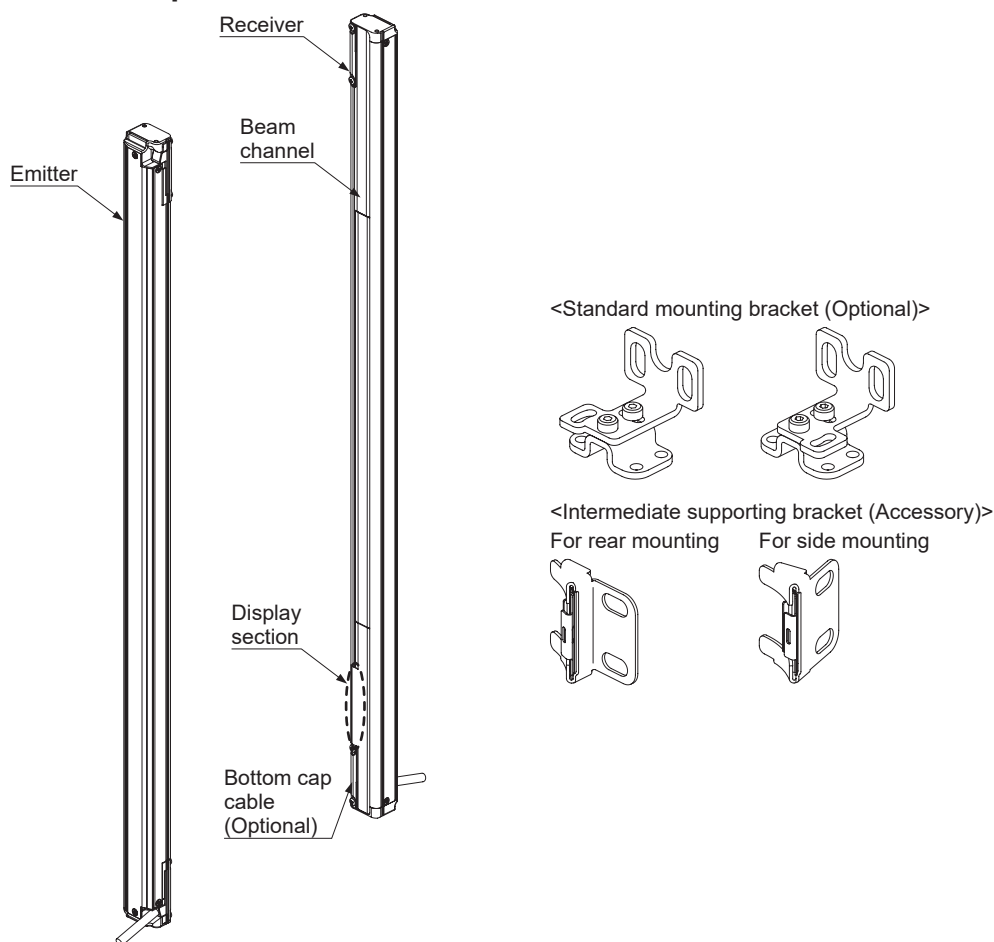
<Function list available by bottom cap cable>

Bottom cap cable Item		8-core cable		4-core cable
		SF2B-CCB□, SF2B-CC□	SF2B-CB05-A	SF2B-CB05-B
Control output	OSSD 1	○	○	○
	OSSD 2	○	—	○
Auxiliary output	Safety	—	○	—
	Non-safety	○	—	—
External device monitor function		○	—	—
Sync. stsyem	Wiring	○	○	—
	beam	—	—	○
Interference prevention function (up to two sets) (wiring required)		—	—	○

○: Valid, —: Invalid

- 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.

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

<Beam channel>

The light emitting elements of the emitter and the light receiving elements of the receiver are placed at the following intervals, 20mm (SF2B-H□), and 40mm (SF2B-A□).

<Standard mounting bracket (optional)>

This bracket is to be used for mounting the emitter / receiver. It enables to adjust the horizontal mounting angle using the standard mounting bracket.

<Intermediate supporting bracket>

This bracket is to be used for mounting the device having 40 beam channels or more for SF2B-H□, 20 beam channels or more for SF2B-A□.

<Display section>

Emitter

Beam-axis alignment indicator
[RECEPTION]



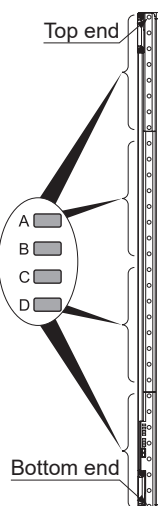
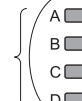
Operation indicator [OSSD]
Emission halt indicator [HALT]
Fault indicator [FAULT]



Setting indicator [SETTING]



Beam-axis
alignment
indicator
[RECEPTION]



Receiver

Beam-axis alignment indicator
[RECEPTION]



OSSD indicator [OSSD]
Incident light intensity indicator [STB.]
Fault indicator [FAULT]



Digital error indicator



Description	Function
Beam-axis alignment indicator (Red / Green) [RECEPTION]	A <Wiring synchronization using 8-core cable> 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 <Beam synchronization using 4-core cable> Always OFF
	B <Wiring synchronization using 8-core cable> When device upper middle receives light: lights up in red When control output (OSSD 1 / 2) is ON: lights up in green <Beam synchronization using 4-core cable> Always OFF
	C <Wiring synchronization using 8-core cable> When device lower middle receives light: lights up in red When control output (OSSD 1 / 2) is ON: lights up in green <Beam synchronization using 4-core cable> Always OFF
	D <Wiring synchronization using 8-core cable> 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 <Beam synchronization using 4-core cable> Always OFF
Operator indicator (Red / Green) [OSSD] (Note 1)	<Wiring synchronization using 8-core cable> When control output (OSSD 1 / 2) is OFF: lights up in red When control output (OSSD 1 / 2) is ON: lights up in green <Beam synchronization using 4-core cable> When an error occurs in emitter: lights up in red When emitter operates normally: lights up in green
Emission halt indicator (Orange) [HALT]	When light emission is halt: lights up When light is emitted: turns OFF
Fault indicator (Yellow) [FAULT]	When fault occurs in the device: lights up or blinks
Setting indicator (Red) [SETTING]	<Wiring synchronization using 8-core cable> Always OFF <Beam synchronization using 4-core cable> When frequency 1 is set: One bar lights up When frequency 2 is set: Two bars light up

Description	Function
Beam-axis alignment indicator (Red / Green) [RECEPTION]	A <Wiring synchronization using 8-core cable> 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 <Beam synchronization using 4-core cable> Always OFF
	B <Wiring synchronization using 8-core cable> When device upper middle receives light: lights up in red When control output (OSSD 1 / 2) is ON: lights up in green <Beam synchronization using 4-core cable> Always OFF
	C <Wiring synchronization using 8-core cable> When device lower middle receives light: lights up in red When control output (OSSD 1 / 2) is ON: lights up in green <Beam synchronization using 4-core cable> Always OFF
	D <Wiring synchronization using 8-core cable> 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 <Beam synchronization using 4-core cable> Always OFF
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 light is stably received (incident light: 115 to 130%) (Note 2): OFF When light is unstably 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)	<Wiring synchronization using 8-core cable> When device goes into lockout condition, error contents are indicated. <Beam synchronization using 4-core cable> When device goes into lockout condition, error contents are indicated. When frequency 1 is set: The middle bar lights up When frequency 2 is set: The middle bar and the bottom bar light up

- 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 description given in [] is marked on the device.

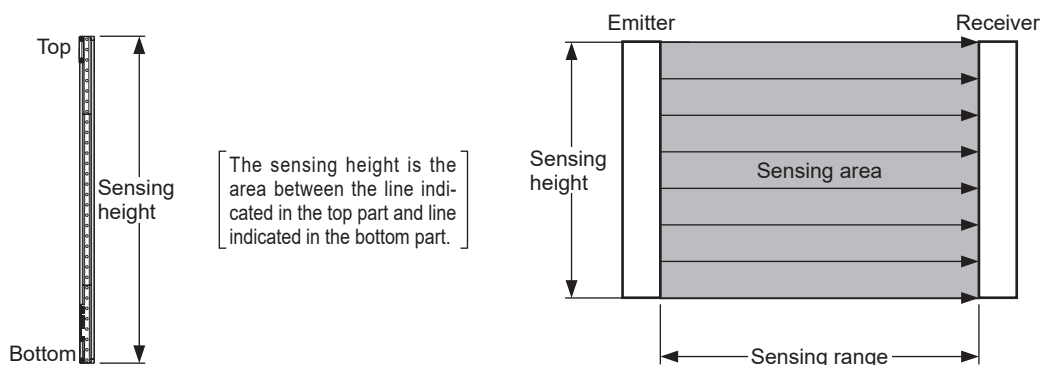
2-3 Protection Area

2-3-1 Sensing Area

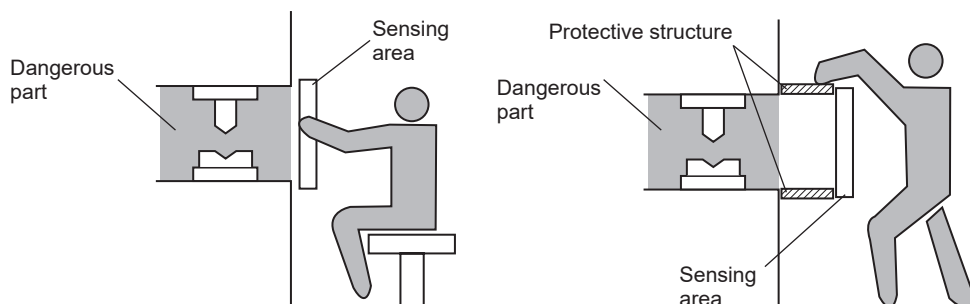
WARNING

- 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.

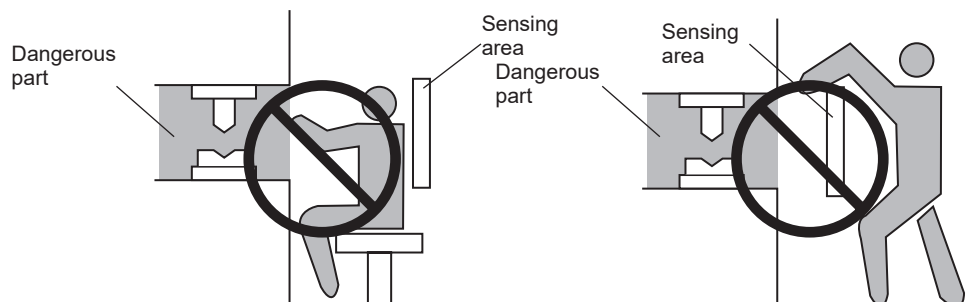
The sensing area is the zone formed by the sensing height of the device and the sensing range between the emitter and the receiver. The sensing height is determined by the number of beam channels. The sensing range can be 0.2 to 13m for the wiring synchronization using 8-core cable and 0.2 to 5m for the beam synchronization using 4-core cable. Take care that the sensing range becomes short after mounting either protection cover (FC-SF2BH-□) (optional). Take care that if the sensing range is under 0.2m, malfunction may occur due to the optical structure.



<Example of Correct Installation>



<Example of Incorrect Installation>



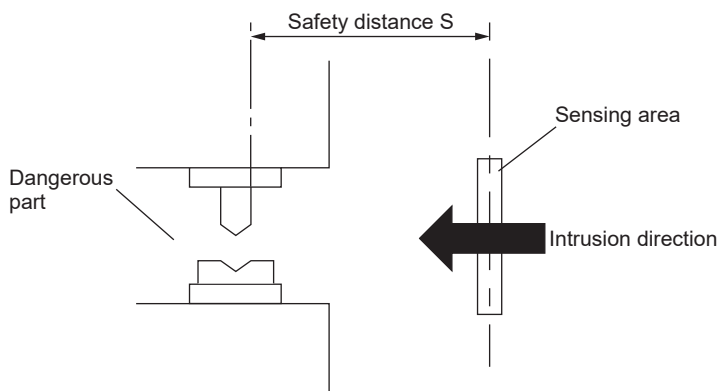
2-3-2 Safety Distance

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.

[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 (SF2B-H□)>

- 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.)
 $T = T_m + TSF2B$
T_m: Maximum halting time of machine (sec.)
TSF2B: 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.
 $C = 8 \times (d - 14)$
C: SF2B-H□ ... 104 (mm)
d: SF2B-H□ ... 27 (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 ≤ S ≤ 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 ≤ 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 (SF2B-A□)>

- 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.)
 $T = T_m + TSF2B$
T_m: Maximum halting time of machine (sec.)
TSF2B: 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: 15ms or less, minimum sensing object diameter: 27mm)

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

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

$$\begin{aligned} &= K \times (T_m + T_{SF2B}) + 8 \times (d - 14) \\ &= 2,000 \times (T_m + 0.015) + 8 \times (27 - 14) \\ &= 2,000 \times T_m + 2,000 \times 0.015 + 104 \\ &= 2,000 \times T_m + 134 \end{aligned}$$

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 $2,000 \times T_m + 134$ (mm)

- 3) In case $S > 500$ (mm)

$$\begin{aligned} S &= K' \times (T_m + T_{SF2B}) + 8 \times (d - 14) \\ &= 1,600 \times (T_m + 0.015) + 8 \times (27 - 14) \\ &= 1,600 \times T_m + 1,600 \times 0.015 + 104 \\ &= 1,600 \times T_m + 128 \end{aligned}$$

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 $1,600 \times T_m + 128$ (mm)

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

$$\begin{aligned} S &= 2,000 \times T_m + 134 \\ &= 2,000 \times 0.1 + 134 \\ &= 334 \end{aligned}$$

Since this value matches with Case 2) above, S is 334 (mm).

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

$$\begin{aligned} S &= 2,000 \times T_m + 134 \\ &= 2,000 \times 0.4 + 134 \\ &= 934 \end{aligned}$$

Since this value matches with Case 3) above,

$$\begin{aligned} S &= 1,600 \times T_m + 128 \\ &= 1,600 \times 0.4 + 128 \\ &= 768 \end{aligned}$$

Since this value matches with Case 5) above, S is 768 (mm).

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

- Equation 2 $Ds = K \times (Ts + Tc + TSF2B + Tbm) + Dpf$

- 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.) [$\approx 1,600$ (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.)
- TSF2B** : 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)
- SF2B-H□** $Dpf = 2.676$ (inch) ≈ 68 (mm)
- SF2B-A□** $Dpf = 5.355$ (inch) ≈ 136 (mm)
- $Dpf = 3.4 \times (d - 0.276)$ (inch)
 $\approx 3.4 \times (d - 7)$ (mm)
- d: Minimum sensing object diameter 1.063 (inch) ≈ 27 (mm) **SF2B-H□**
Minimum sensing object diameter 1.851 (inch) ≈ 47 (mm) **SF2B-A□**

<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: 15ms or less, minimum sensing object diameter: 1.063 (inch) ≈ 27 (mm)]

$$\begin{aligned} Ds &= K \times (Ts + Tc + TSF2B + Tbm) + Dpf \\ &= 63 \times (Ta + 0.015) + 3.4 \times (d - 0.276) \text{ (inch)} \\ &= 63 \times (Ta + 0.015) + 3.4 \times (1.063 - 0.276) \\ &= 63 \times Ta + 63 \times 0.015 + 3.4 \times 0.787 \\ &= 63 \times Ta + 3.6208 \\ &\approx 63 \times Ta + 3.62 \text{ (inch)} \end{aligned}$$

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

$$\begin{aligned} Ds &= 63 \times Ta + 3.62 \\ &= 63 \times 0.1 + 3.62 \\ &= 9.92 \text{ (inch)} \\ &\approx 251.968 \text{ (mm)} \\ &\approx 252 \text{ (mm)} \end{aligned}$$

Hence, as per the calculations Ds is 252 (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.

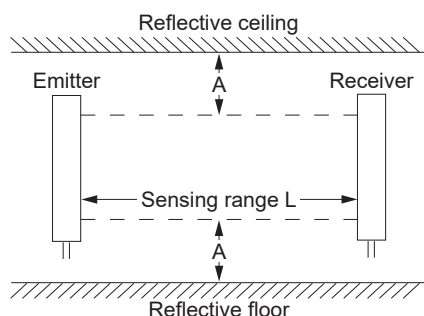
2-3-3 Influence of Reflective Surfaces

⚠ WARNING

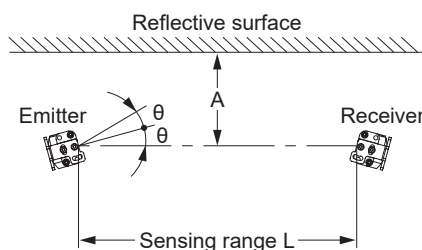
If there exists a reflective surface in the place where this device is to be installed, make sure to install this device so that reflected light from the reflective surface does not enter into the receiver, or take countermeasures such as painting, masking, roughening, or changing the material of the 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>



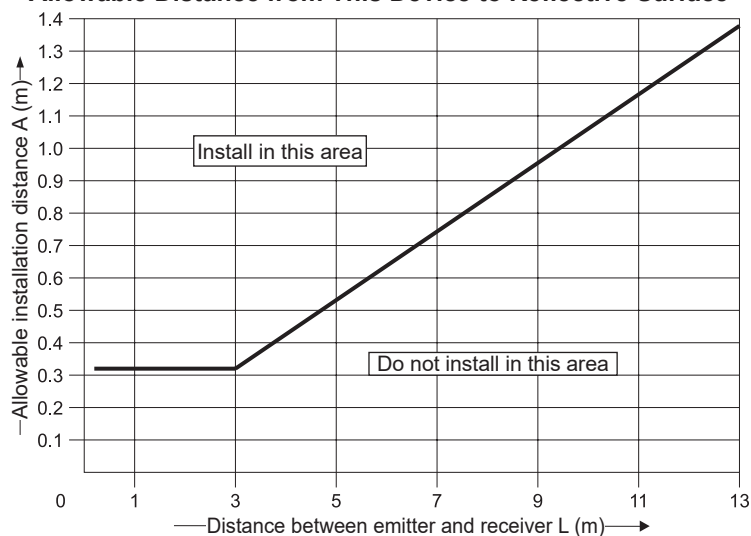
<Top View>



Distance between emitter and receiver (Sensing range L)	Allowable installation distance A
$0.2\text{m} \leq L \leq 3\text{m}$	0.32m
$3\text{m} < L \leq 13\text{m}$ (Note 1)	$L/2 \times \tan 2\theta = L/2 \times 0.213 \text{ (m)} (\theta = 6^\circ)$

- Notes: 1) The sensing range L is applicable to the wiring synchronization using 8-core cable. For the beam synchronization using the 4-core cable, the distance between emitter and receiver is 0.2 to 5m.
 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



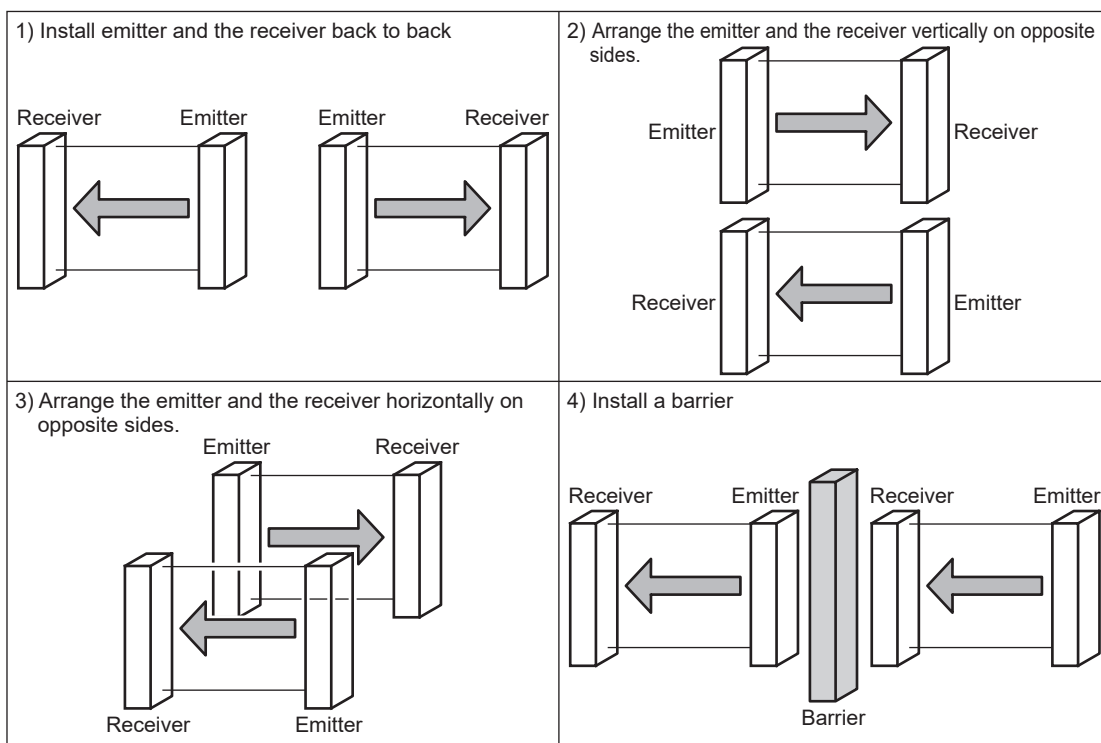
2-3-4 Device Placement

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>

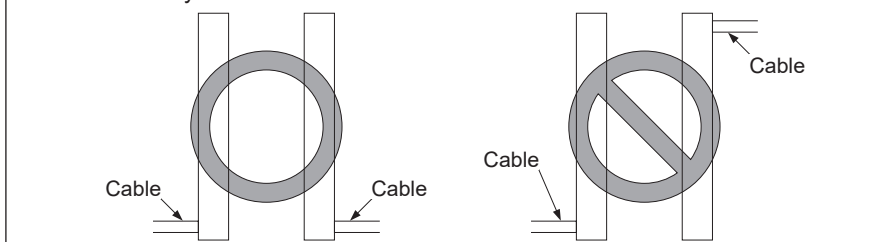


<Reference>

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.

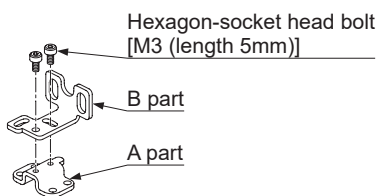
<Reference>

- Mount the emitter and the receiver at the same level and parallel to each other. The effective aperture angle of this device is $\pm 5^\circ$ 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."

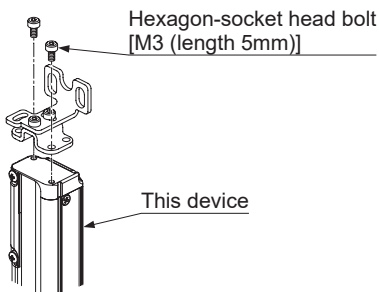
<When the standard mounting bracket (MS-SF2B-1) (optional) is used>

Configuration

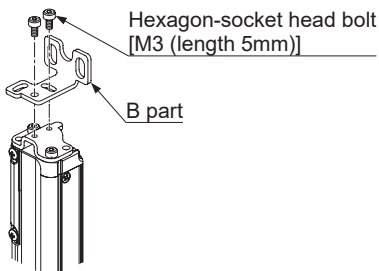
The standard mounting bracket (**MS-SF2B-1**) (optional) configures as follows.



1. Fix the standard mounting bracket with two hexagon-socket head bolts [M3 (length: 5mm)]. The tightening torque should be 0.6N·m or less.

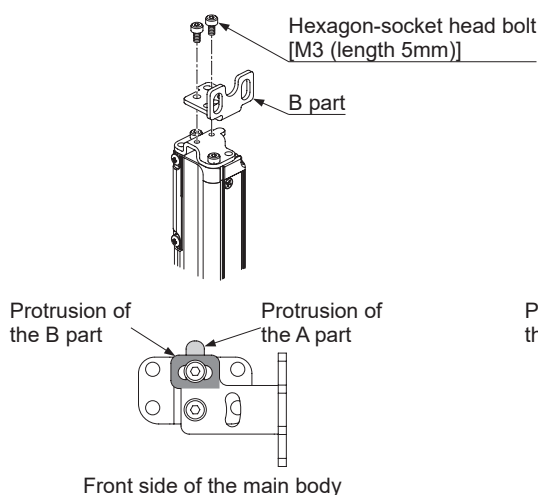


2. For side mounting, remove the B part.

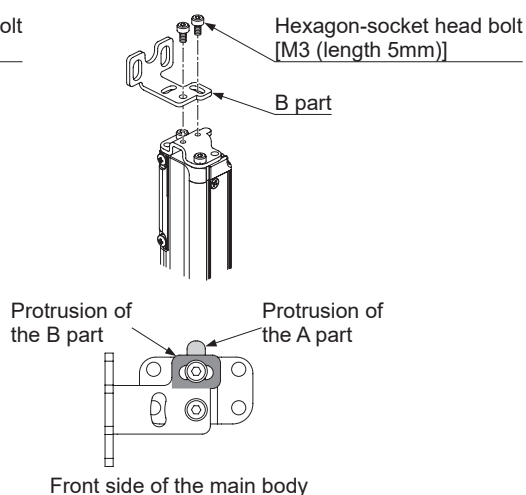


3. Mount the brackets so that the protrusion of the A part and the B part are overlapped.
B part to be attached to the top or bottom side of this device differs depending on the direction of mounting described as the following chart.

When mounting at the right side of the front surface

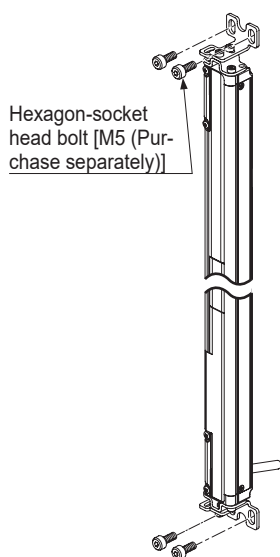


When mounting at the left side of the front surface

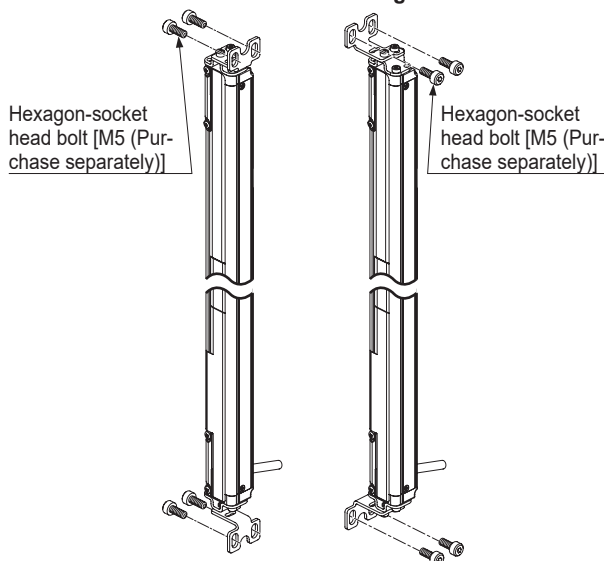


4. Mount the mounting bracket on to the mounting surface with two hexagon-socket head bolts [M5 (purchase separately)] temporarily.
5. Adjust the height of the emitter and the receiver to level with the elongate holes and then tighten the hexagon-socket head bolts.

<For rear mounting>



<For side mounting>

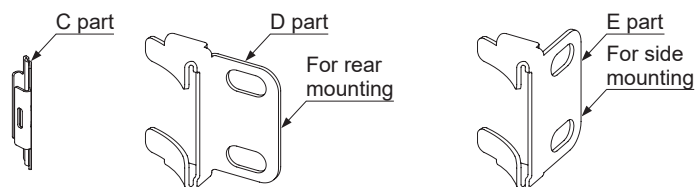


Note: For the models that the intermediate supporting bracket (**MS-SF2B-2**) is enclosed with, be sure to use the intermediate supporting bracket (**MS-SF2B-2**). For details, refer to <When the intermediate mounting bracket (**MS-SF2B-2**) (accessory) is used>.

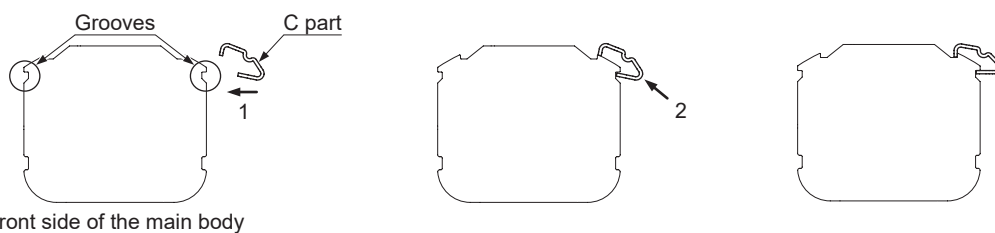
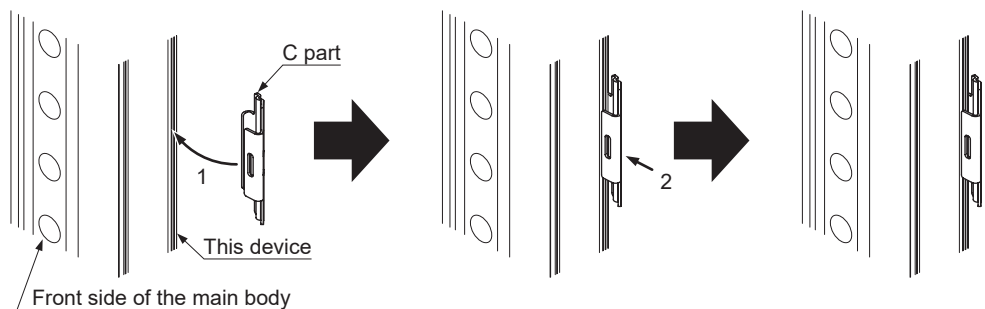
<When the intermediate mounting bracket (MS-SF2B-2) (accessory) is used>

Configuration

The intermediate mounting bracket (accessory) configures as follows.

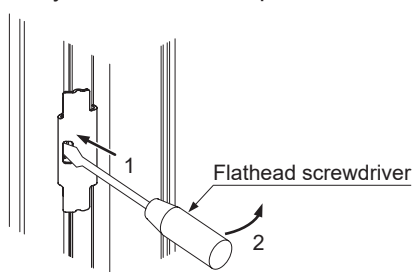


1. Hook the C part into the groove on the side of the body and press it.
Note that the position to fit the C part onto the main body differs from the surface where the intermediate mounting bracket is fit.



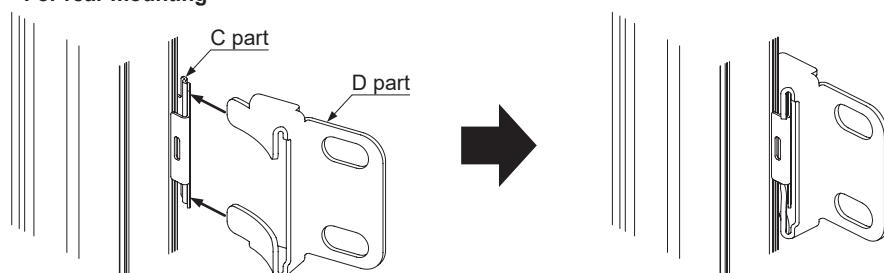
<How to remove the bracket>

Insert a flathead screwdriver into the hole located on the rear side of the C part and tilt it to the rear side of the main body to remove the C part.

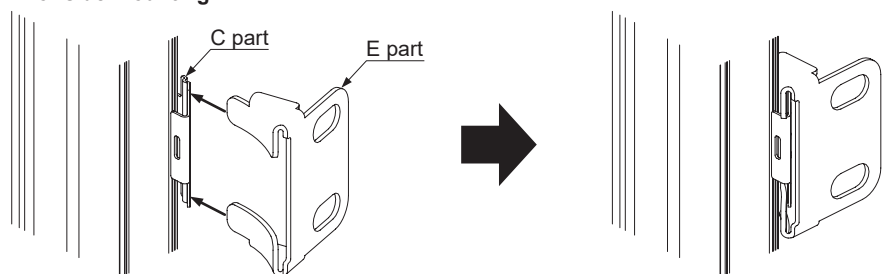


2. Insert the D part or E part into the C part in the step 1 condition.

<For rear mounting>

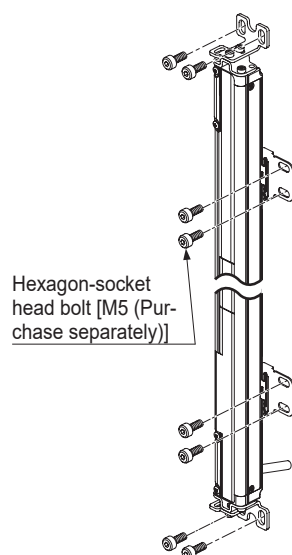


<For side mounting>

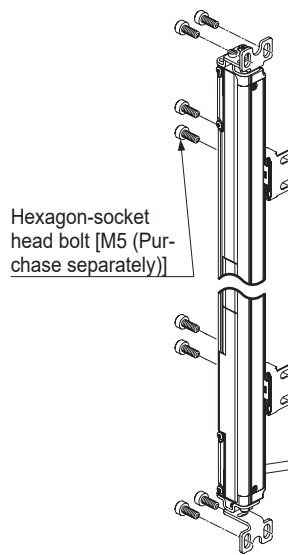


3. Mount the D part or E part on to the mounting surface with the two hexagon-socket head bolts [M5 (purchase separately)].

<For rear mounting>



<For side mounting>



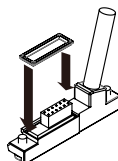
2-4-2 Mounting of the Bottom Cap Cable (Optional)

The cable is not enclosed with this device.

Mount the bottom cap cable (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>

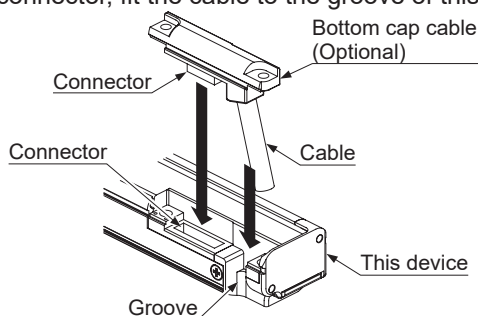
There are two types of the bottom cap cable, 8-core type and 4-core type, and in addition to these types, two more types are available for the bottom cap cable, discrete wire type and connector type. Select the bottom cap cable as usage.

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

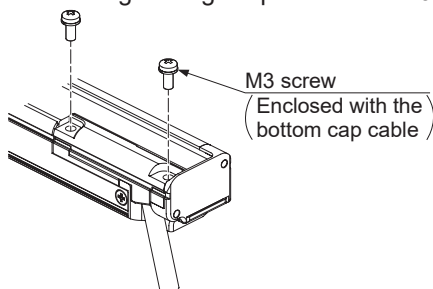
Type	Model No.	Cable length (m)
8-core	Discrete wire type	SF2B-CCB3
		SF2B-CCB7
		SF2B-CCB10
		SF2B-CCB15
	Connector type	SF2B-CB05
		SF2B-CB5
		SF2B-CB10
		SF2B-CB05-A
4-core	Connector type	SF2B-CB05-C
		SF2B-CB05-B

<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 M3 screws. The tightening torque should be 0.3N·m or less.



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

For constructing the series connection, optional sub sensor exclusive for series connection (**SF2B-□SL**) and the cable for series connection (**SF2B-CSL□**) are required.

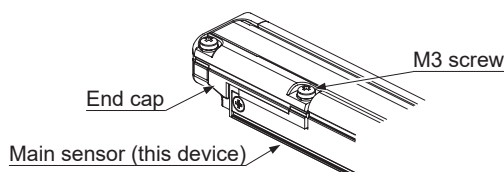
For constructing the series connection, the following procedure is required.

CAUTION

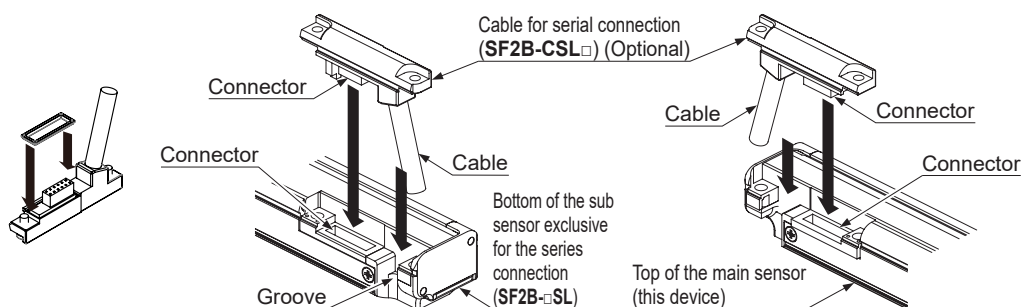
- Do not lose any screws during extension / dismantling work.
- Furthermore, do not mix emitters and receivers to mount in series connection.
- The packing is attached to the connector of the cable for a series connection. If the packing is not attached correctly, reattach the packing as shown in the figure below, and mount to this device. (2.)

<Constructing method for the series connection>

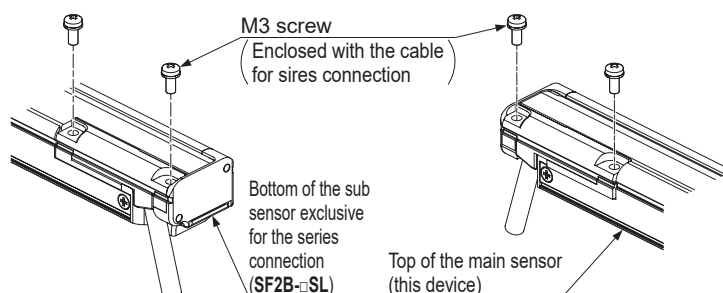
1. Loosen the two M3 screws of the end cap on the main sensor (this device), and then remove the end cap from the device.



2. Insert the cable for series connection (**SF2B-CSL□**) into the connector of the main sensor (this device) and the sub sensor exclusive for series connection (**SF2B-□SL**). When inserting the connector, fit the cable into the groove of the main sensor (this device) and the sub sensor exclusive for series connection (**SF2B-□SL**).



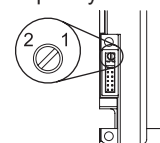
3. Tighten each two M3 screws. The tightening torque should be 0.3N·m or less.



CAUTION

When using the bottom cap cable (**SF2B-CB05-B**) (optional), make sure that the frequency selector at the insertion slot of bottom cap cable on this device is set to '1' position (on both emitter and receiver). If they are in the position other than the above, the device may not operate properly.

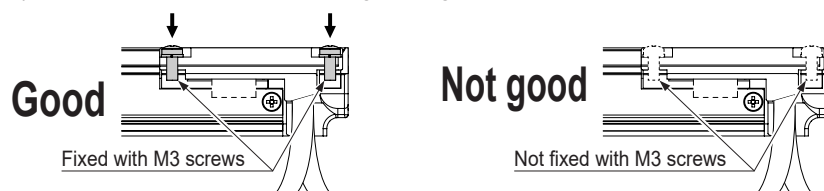
Frequency selector



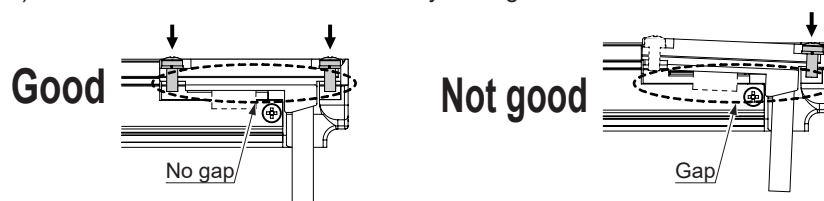
⚠ CAUTION

- The cable for series connection (**SF2B-CSL□**) cannot be extended.
- When the cable for series connection (**SF2B-CSL□**) is inserted to the main sensor (this device) and the sub sensor exclusive for series connection (**SF2B-□SL**), take care of the following. If inserted without care, the connector pins may bend.

1) Do not pull the cables before tightening the M3 screws.



2) Do not insert the connector incorrectly and tighten the M3 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)
SF2B-CSL01	100
SF2B-CSL05	500

<Dismantling the cable for series connection>

1. For dismantling the cable for series connection, follow the above procedure of **<Constructing method for the series connection>** in reverse.

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 type) / +24V side (NPN output type).

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 and Connection

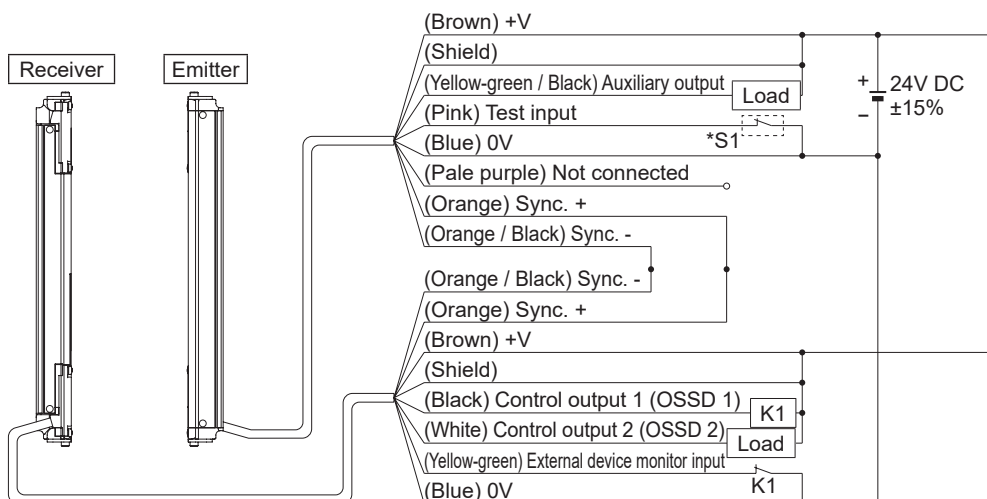
Refer to “I/O circuit” and “Connection” of the specification to be applied.

Bottom cap cable	Output	External device monitor function	Reference page
SF2B-CCB □ SF2B-CB □	NPN	Valid	29
		Invalid	30
	PNP	Valid	31
		Invalid	32
SF2B-CB05-A	NPN	—	33
	PNP	—	34
SF2B-CB05-B	NPN	—	35
	PNP	—	36

WARNING

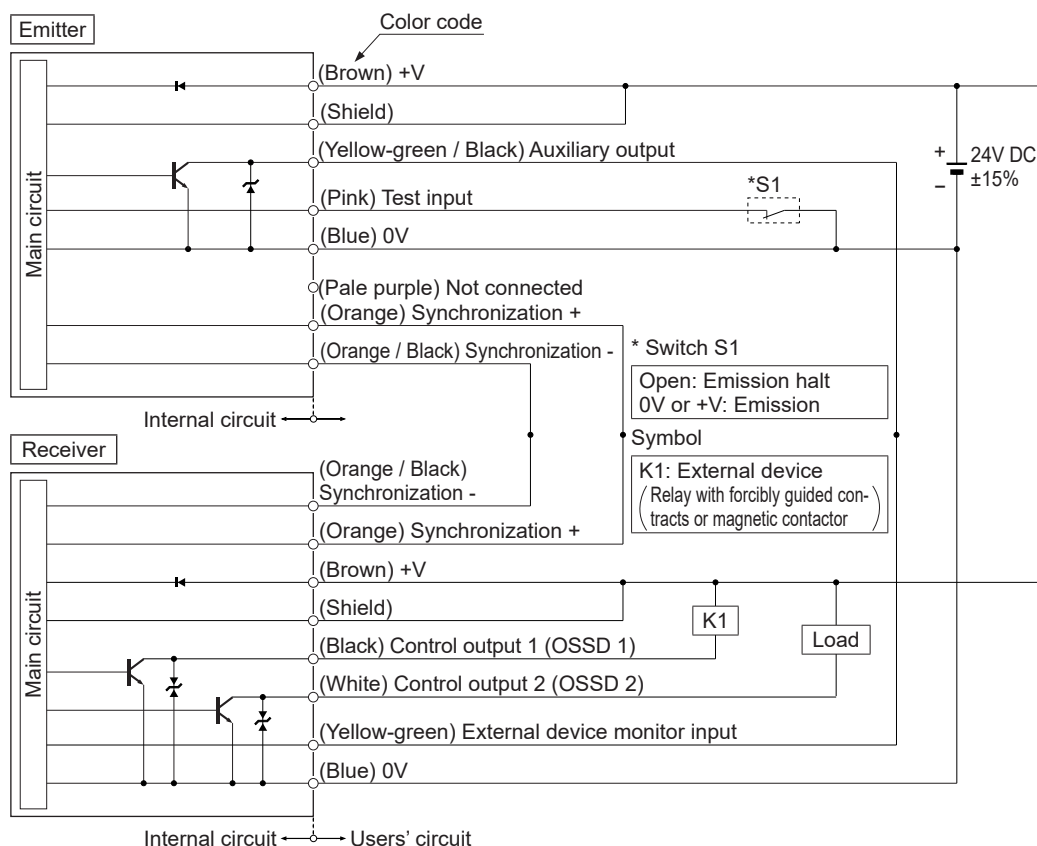
- In case of conforming to OSHA, connect the external device to the two types of control output (OSSD 1 / 2) respectively, to halt the device. In case of not conforming to OSHA, it is possible to connect the external device only to the one type of output. However, be sure to connect the other output to the control equipment.
- In case of using the bottom cap cable (**SF2B-CB05-A**) (optional), it does not conform to OSHA.

- I/O Circuit Diagram

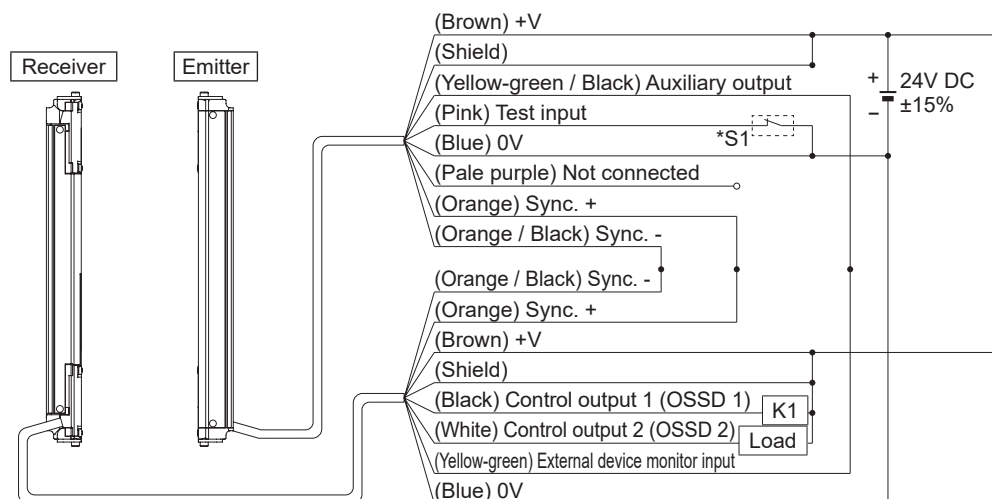


<NPN output type (with SF2B-CCB□ or SF2B-CB□ / external device monitor: invalid)>

• I/O Circuit Diagram



• Wiring Diagram

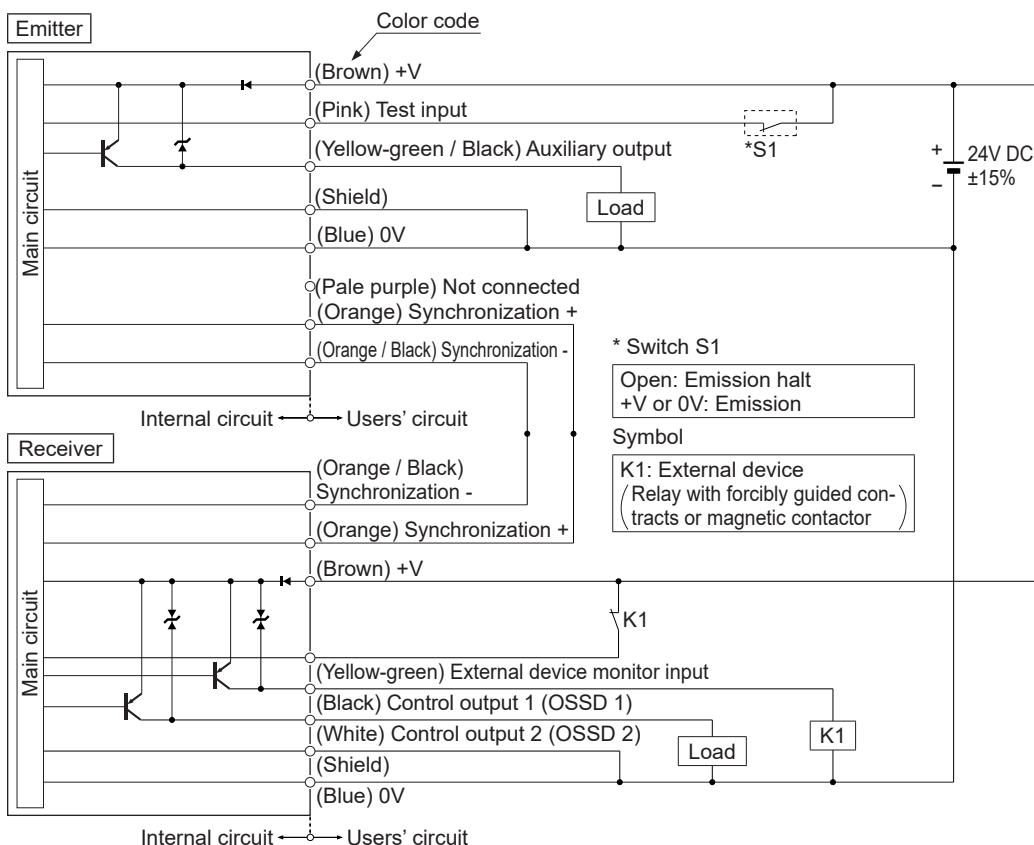


WARNING

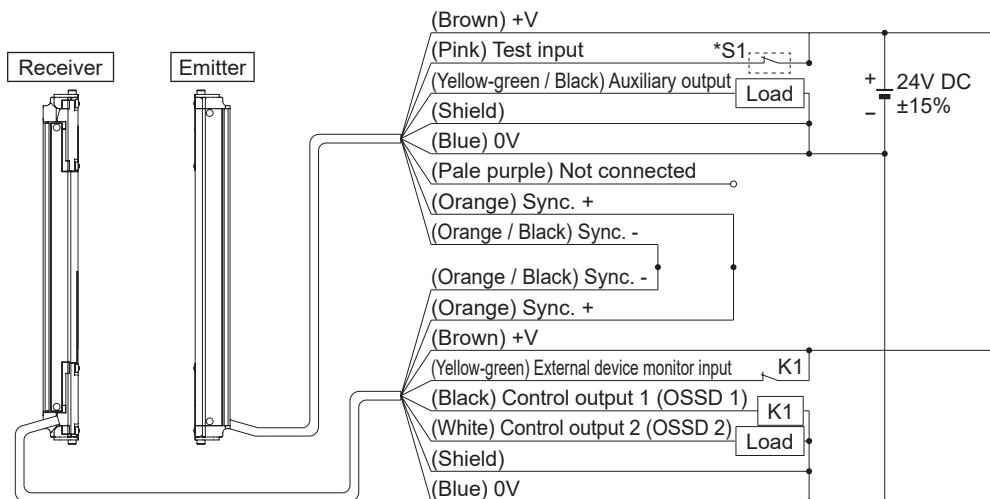
Connect the auxiliary output to the external device monitor input to disable the external device monitor function. Do not connect the load to the auxiliary output when the function is invalid.

<PNP output type (with SF2B-CCB□ or SF2B-CB□ / external device monitor: valid)>

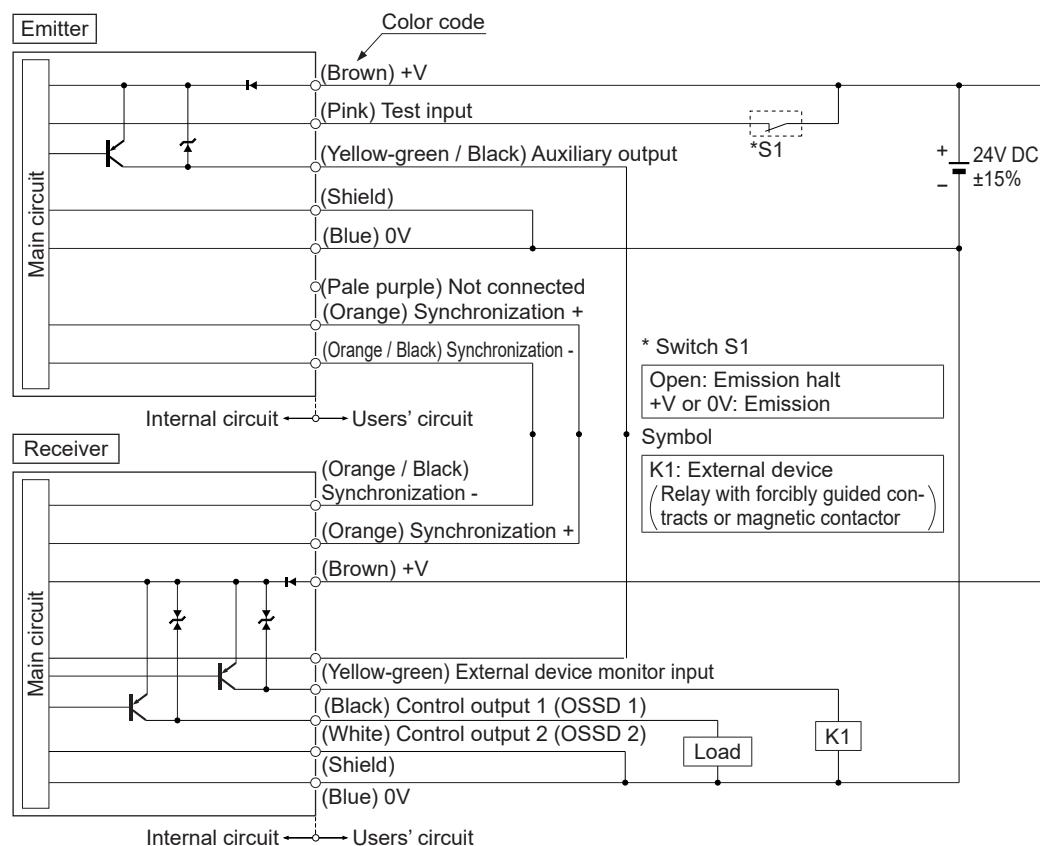
● I/O Circuit Diagram



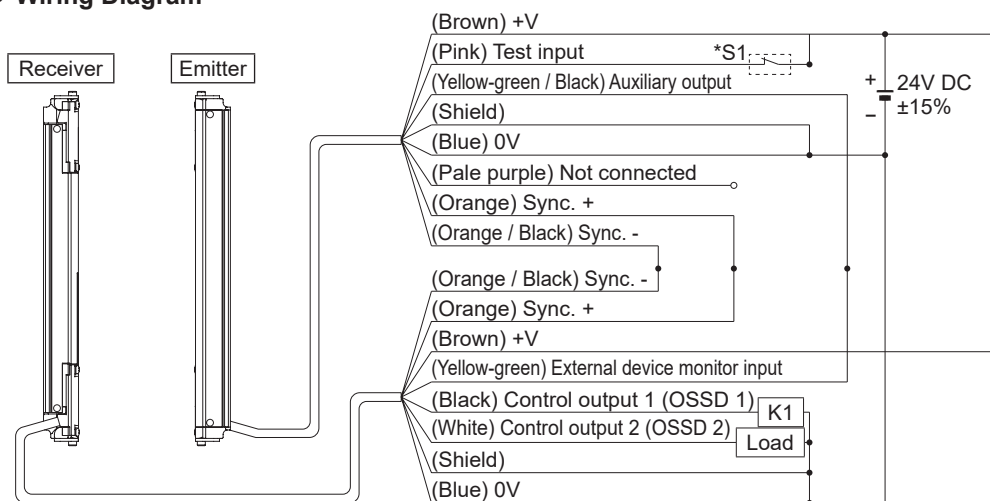
● Wiring Diagram



<PNP output type (with SF2B-CCB□ or SF2B-CB□ / external device monitor: invalid)>
 • I/O Circuit Diagram



• Wiring Diagram

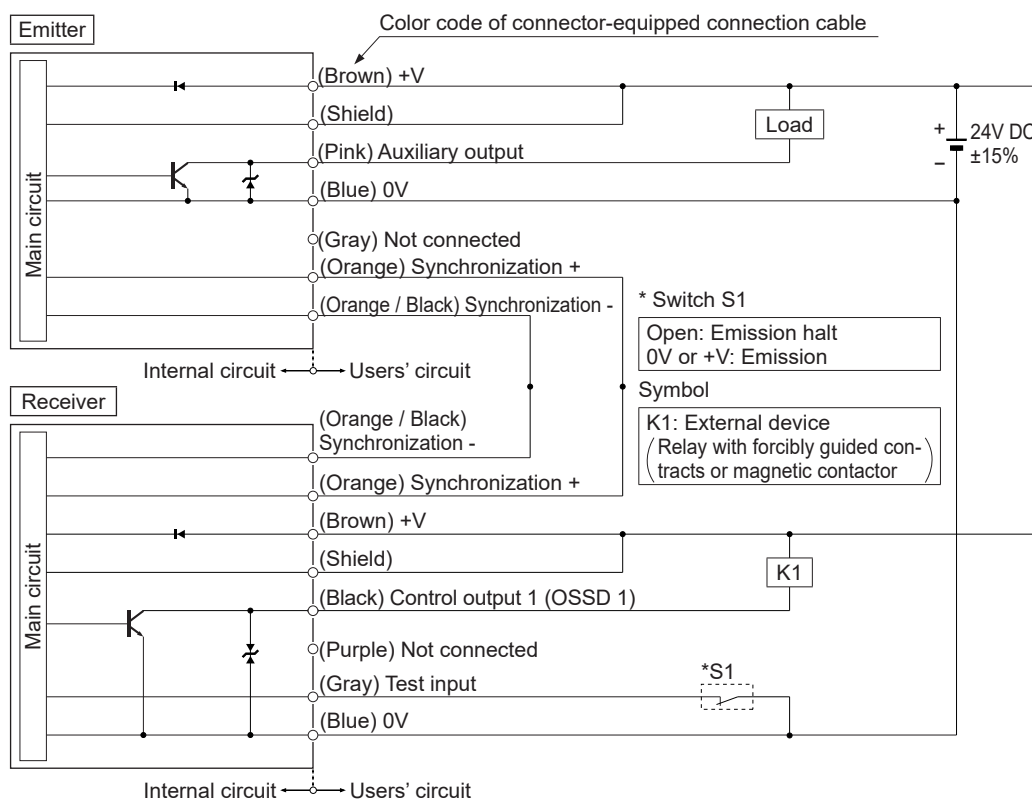


WARNING

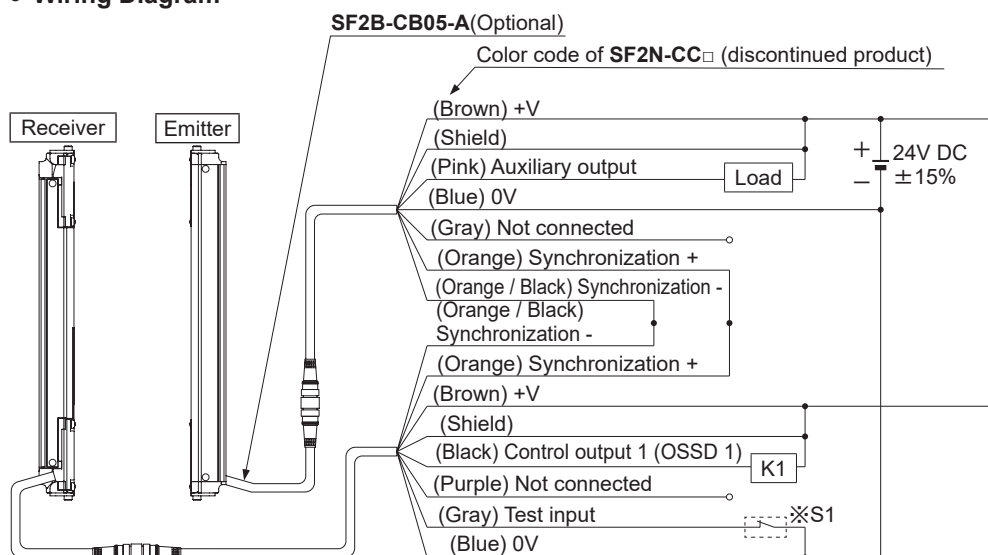
Connect the auxiliary output to the external device monitor input to disable the external device monitor function. Do not connect the load to the auxiliary output when the function is invalid.

<NPN output type (with SF2B-CB05-A)>

● I/O Circuit Diagram



● Wiring Diagram

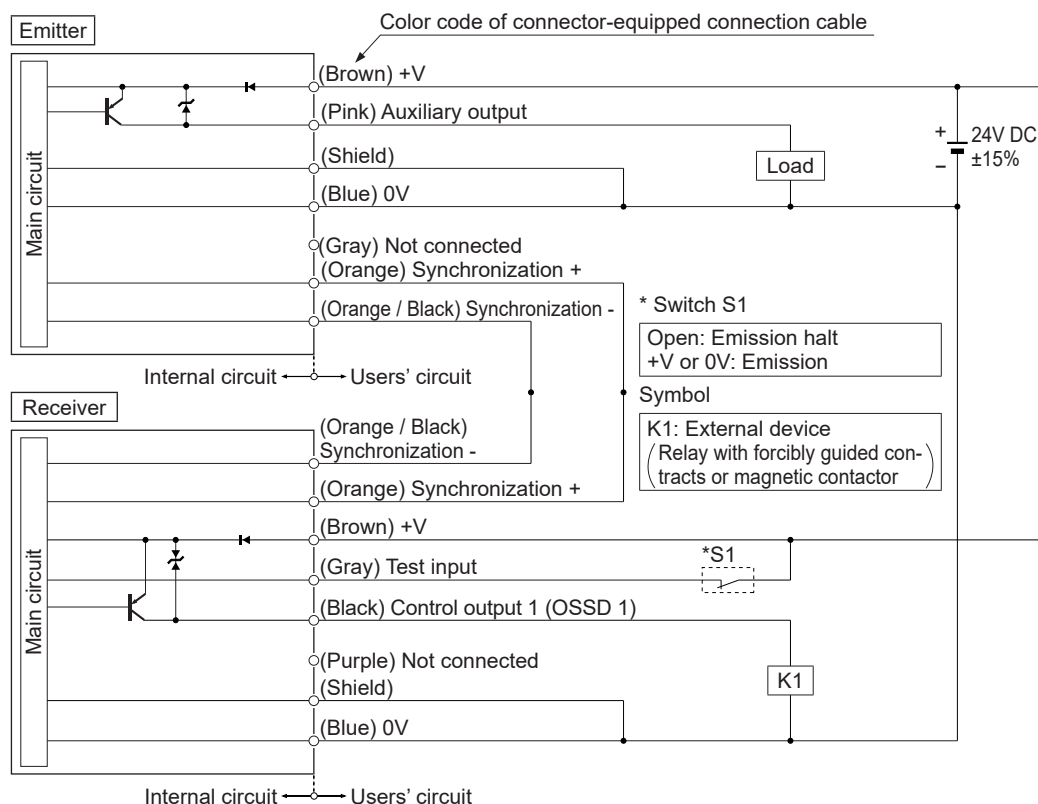


WARNING

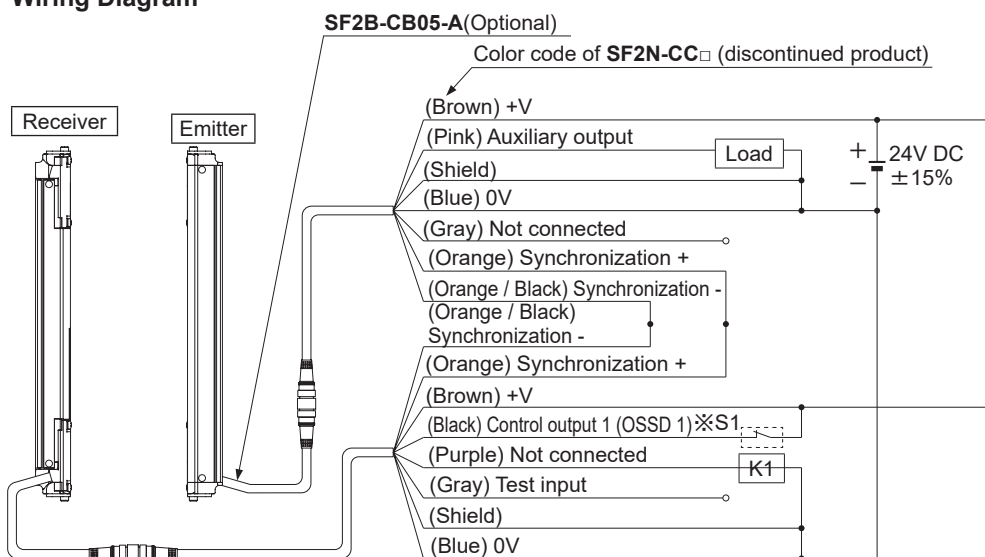
Make sure to use the auxiliary output to transmit any kind of failure in this device to the control device.

<PNP output type (with SF2B-CB05-A)>

● I/O Circuit Diagram



● Wiring Diagram

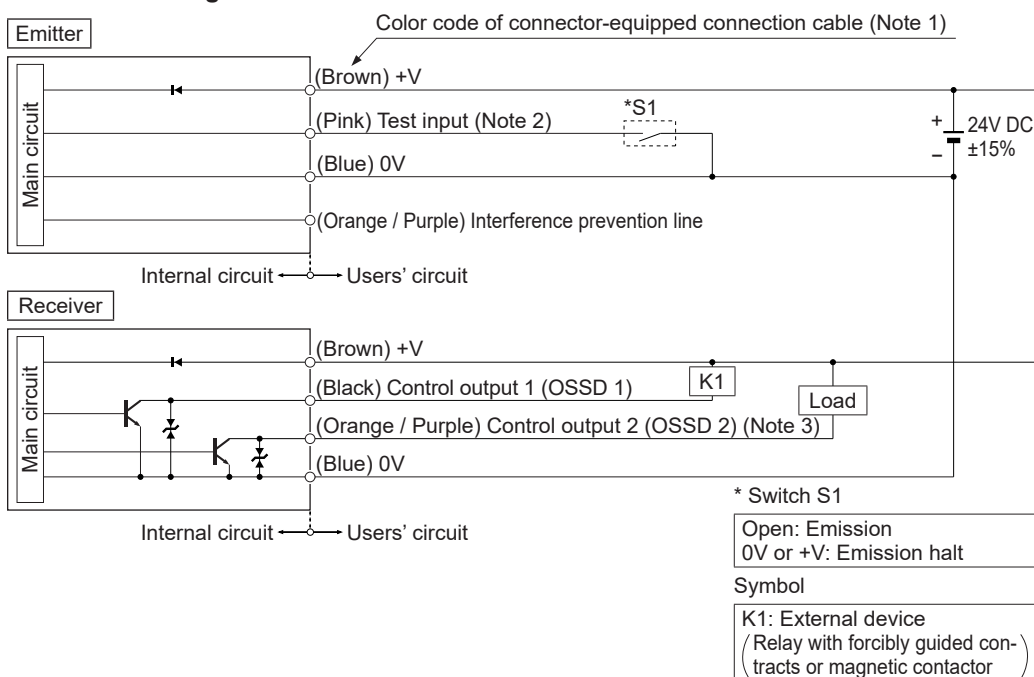


WARNING

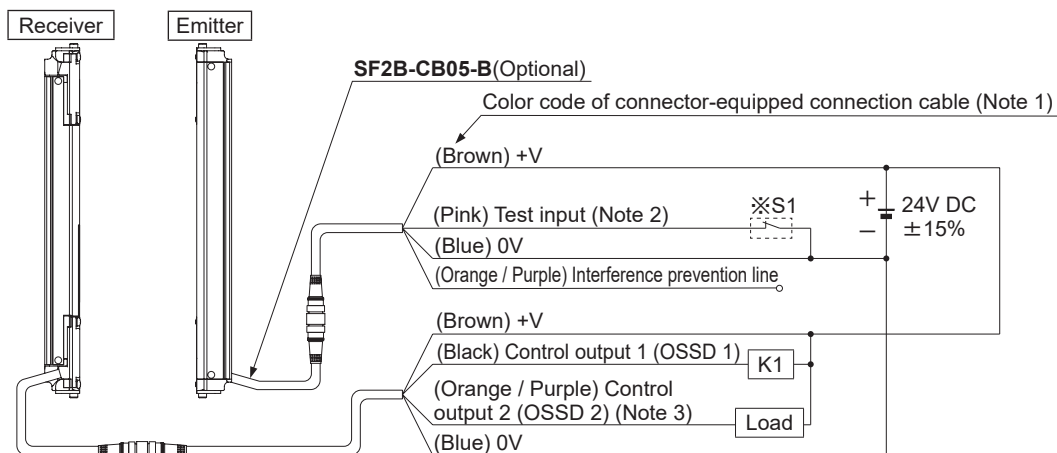
Make sure to use the auxiliary output to transmit any kind of failure in this device to the control device.

<NPN output type (with SF2B-CB05-B)>

• I/O Circuit Diagram



• Wiring Diagram



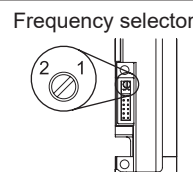
Notes: 1) The figure above shows the connection pattern for the connector-equipped connection cable **SF1-CC□A** (discontinued product). The wiring pattern differs when **NA40-CC□** (optional) is used.

2) If the connection pattern for the connector-equipped connection cable **NA40-CC□** (optional) is used The pink cable is not used.

3) If the connection pattern for the connector-equipped connection cable **NA40-CC□**. The orange cable is used.

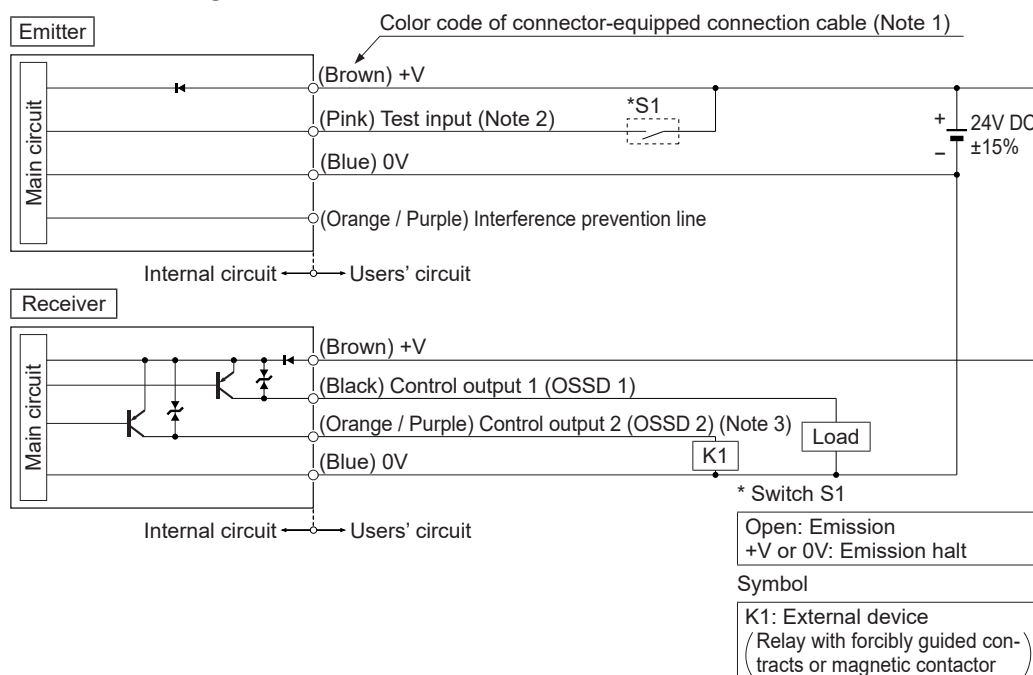
⚠ CAUTION

Make sure that the frequency selector at the insertion slot of bottom cap cable on this device is set to "1" position for master side sensor, "2" for slave side sensor (on both emitter and receiver). If they are in the position other than the above, the device may not operate properly.

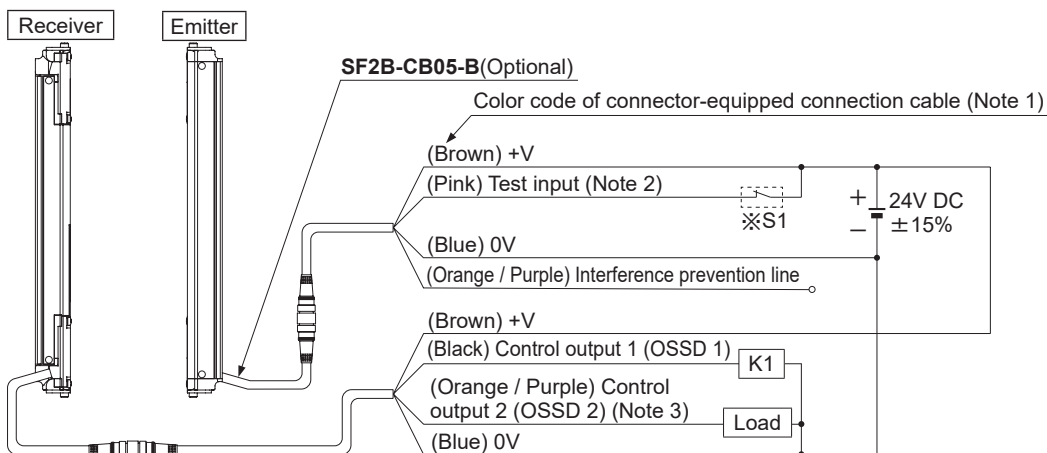


<PNP output type (with SF2B-CB05-B)>

• I/O Circuit Diagram



• Wiring Diagram

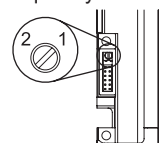


- Notes: 1) The figure above shows the connection pattern for the connector-equipped connection cable **SF1-CC□A** (discontinued product). The wiring pattern differs when **NA40-CC□** (optional) is used.
- 2) If the connection pattern for the connector-equipped connection cable **NA40-CC□** (optional) is used The pink cable is not used.
- 3) If the connection pattern for the connector-equipped connection cable **NA40-CC□**. The orange cable is used.

CAUTION

Make sure that the frequency selector at the insertion slot of bottom cap cable on this device is set to "1" position for master side sensor, "2" for slave side sensor (on both emitter and receiver). If they are in the position other than the above, the device may not operate properly.

Frequency selector



2-5-3 Cable Specification

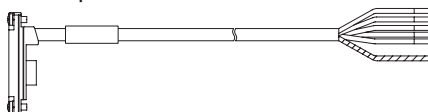
Connect the mating cable (with connector on one end, or connector on both ends) to the connector of the bottom cap cable which is mounted on this device (emitter and receiver).

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

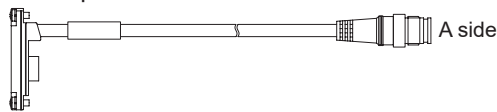
⚠ WARNING

- When extending the cable, use the exclusive cable up to the total length of 30.5m (for emitter / receiver). Extending the cable longer than 30.5m may cause malfunction, which can result in death or serious injury.
- When the synchronization cable is extended with a cable other than exclusive cable, use a $\phi 0.2\text{mm}^2$ or more shielded twist pair cable.

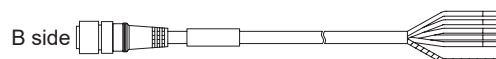
Bottom cap cable / discrete wire



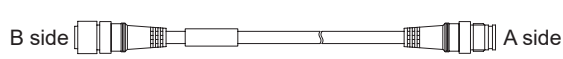
Bottom cap cable / connector



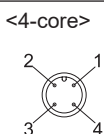
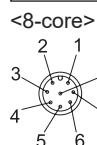
Extension cable with connector on one end



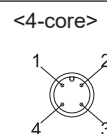
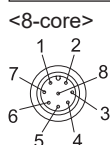
Extension cable with connector on both ends



Connector at A side (for emitter / receiver)



Connector at B side (for emitter / receiver)



<8-core cable (SF2B-CCB□, SF2B-CB□)>

	Cable / connector color	Connector Pin No.	Color code for SF2B-CCB□	Description
Emitter	Gray / Gray	1	Pale purple	Not connected
		2	Brown	+V
		3	Pink	Test input
		4	Yellow-green / Black	Auxiliary output (AUX)
		5	Orange	Synchronization +
		6	Orange / Black	Synchronization -
		7	Blue	0V
		8	(Shield)	—
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)	—

<8-core compatible cable (SF2B-CB05-A)>

	Cable / connector color	Connector Pin No.	Description
Emitter	Gray / Gray	1	Not connected
		2	+V
		3	Auxiliary output (AUX)
		4	Not connected
		5	Synchronization +
		6	Synchronization -
		7	0V
		8	—
Receiver	Gray (with black stripe) /Black	1	Not connected
		2	+V
		3	Control output 1 (OSSD 1)
		4	Test input
		5	Synchronization +
		6	Synchronization -
		7	0V
		8	—

<4-core compatible cable (SF2B-CB05-B)>

	Cable / connector color	Connector Pin No.	Description
Emitter	Gray / Gray	1	+V
		2	Interference prevention
		3	0V
		4	Test input
Receiver	Gray (with black stripe) /Black	1	+V
		2	Control output 2 (OSSD 2)
		3	0V
		4	Control output 1 (OSSD 1)

<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 Series Connection

SF2B-H□: Connectable up to 3 sets of the devices (128 beam channels max.).

SF2B-A□: Connectable up to 3 sets of the devices (64 beam channels max., however, when 2 sets are connected, 96 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.

CAUTION

When **SF2B-H□** and **SF2B-A□** are combined in series connection, double the number of the beam channels of **SF2B-A□** to calculate the total number of beam channels, which should be 128 or less.

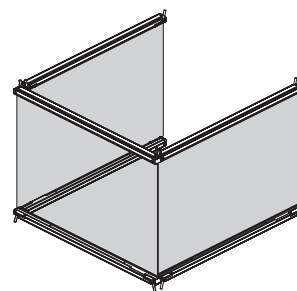
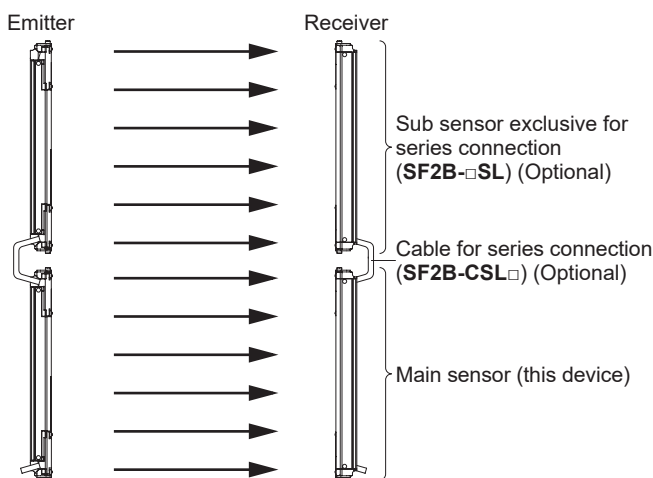
<e.g.> The total number of beam channels for **SF2B-H36** and **SF2B-A44SL** is 124.

The number of beam channels of **SF2B-H36** + (the number of beam channels of **SF2B-A44SL** x 2) = Total number of beam channels
36 beam channels + (44 beam channels x 2) = 124 beam channels

For series connection, the sub sensor exclusive for series connection (**SF2B-□SL**) and the cable for series connection (**SF2B-CSL□**) are required separately.

WARNING

Connect the emitter of the main sensor (this device) and the emitter of the sub sensor exclusive for series connection (**SF2B-□SL**), the receiver of the main sensor (this device) and the receiver of the sub sensor exclusive for series connection (**SF2B-□SL**) respectively using the cable for series connection (**SF2B-CSL□**). Wrong connection could generate the non-sensing area, resulting in death or serious injury.



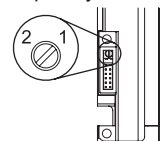
<Reference>

The wiring method depends on the type of bottom cap cable. Refer to “2-5-2 I/O Circuit and Connection” for the details of wiring.

CAUTION

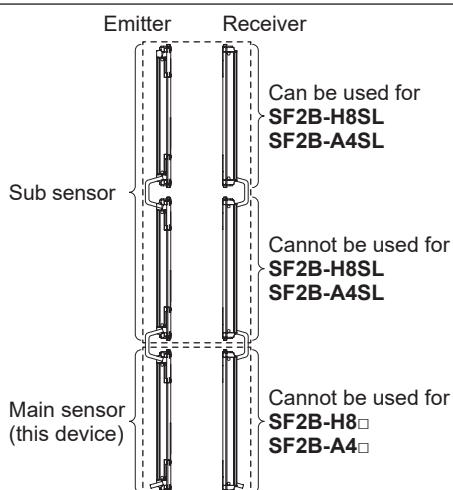
When using the bottom cap cable (**SF2B-CB05-B**) (optional), make sure that the frequency selector at the insertion slot of bottom cap cable on this device is set to “1” position (on both emitter and receiver). If they are in the position other than the above, the device may not operate properly.

Frequency selector



CAUTION

- As the connector for series connection is not incorporated in the main sensor such as **SF2B-H8□** or **SF2B-A4□**, it cannot be connected in series.
- The connector for series connection is not incorporated in the sub sensors exclusive for series connection such as **SF2B-H8SL** or **SF2B-A4SL**.
In case of connecting three sets of sensors in series, it cannot be used in the middle position.



2-5-5 Parallel Connection

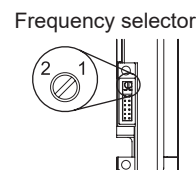
[Connectable up to 2 sets of the devices]

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. For the control output (OSSD 1 / 2), only the set of which light is blocked turns OFF.

Connect the interference prevention lines using the bottom cap cable **SF2B-CB05-B** (4-core) (optional) on the parallel connection side.

CAUTION

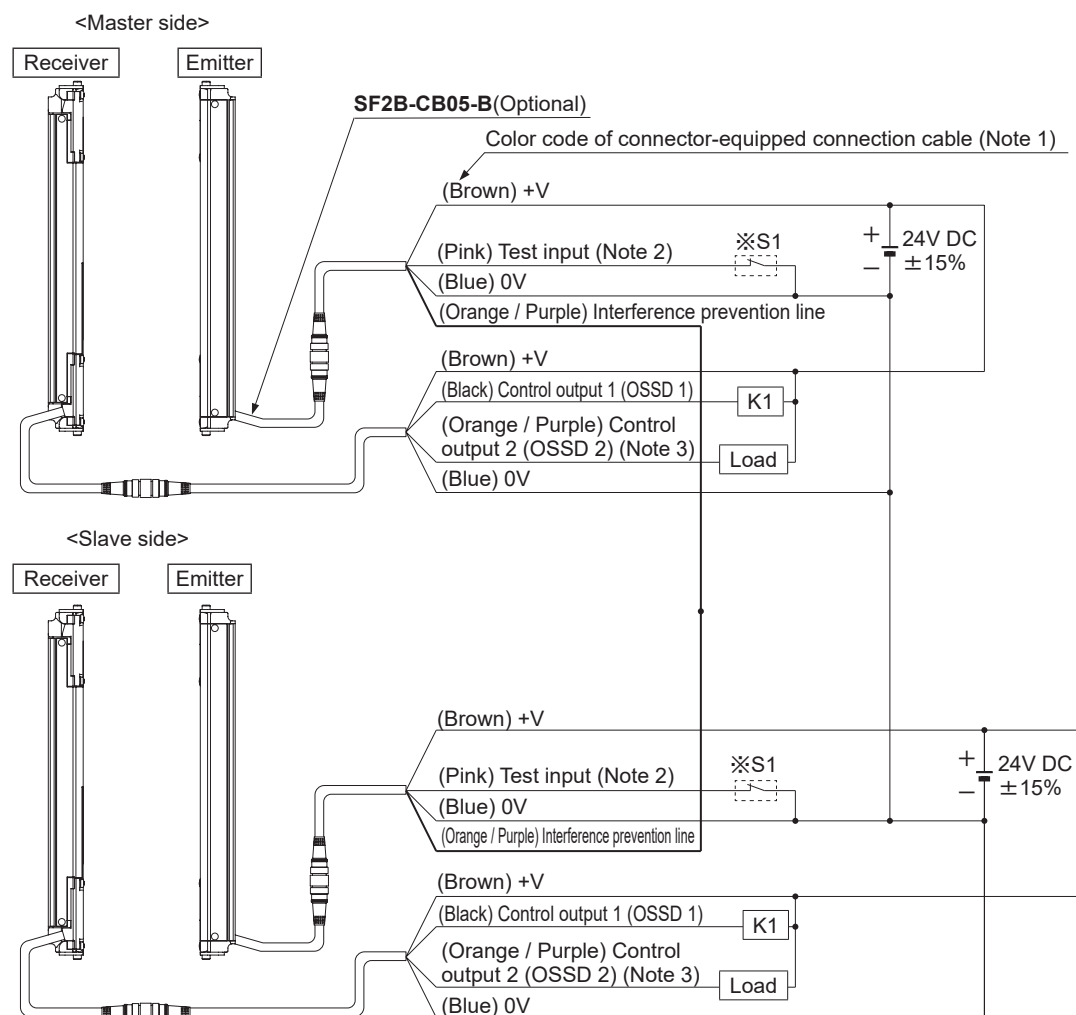
- Make sure that the frequency selector at the insertion slot of bottom cap cable on this device is set at the "1" position for master side sensor, "2" for slave side sensor (on both emitter and receiver). If they are in the position other than the above, the device may not operate properly.
- If the master side sensor breaks due to any reason, the slave side sensor goes into an operation halt state. In order to check the operation of the slave side sensor, set the frequency selector to "1". If only the slave side sensor breaks, the master side sensor operates correctly.



WARNING

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

<For NPN output>



* Symbols

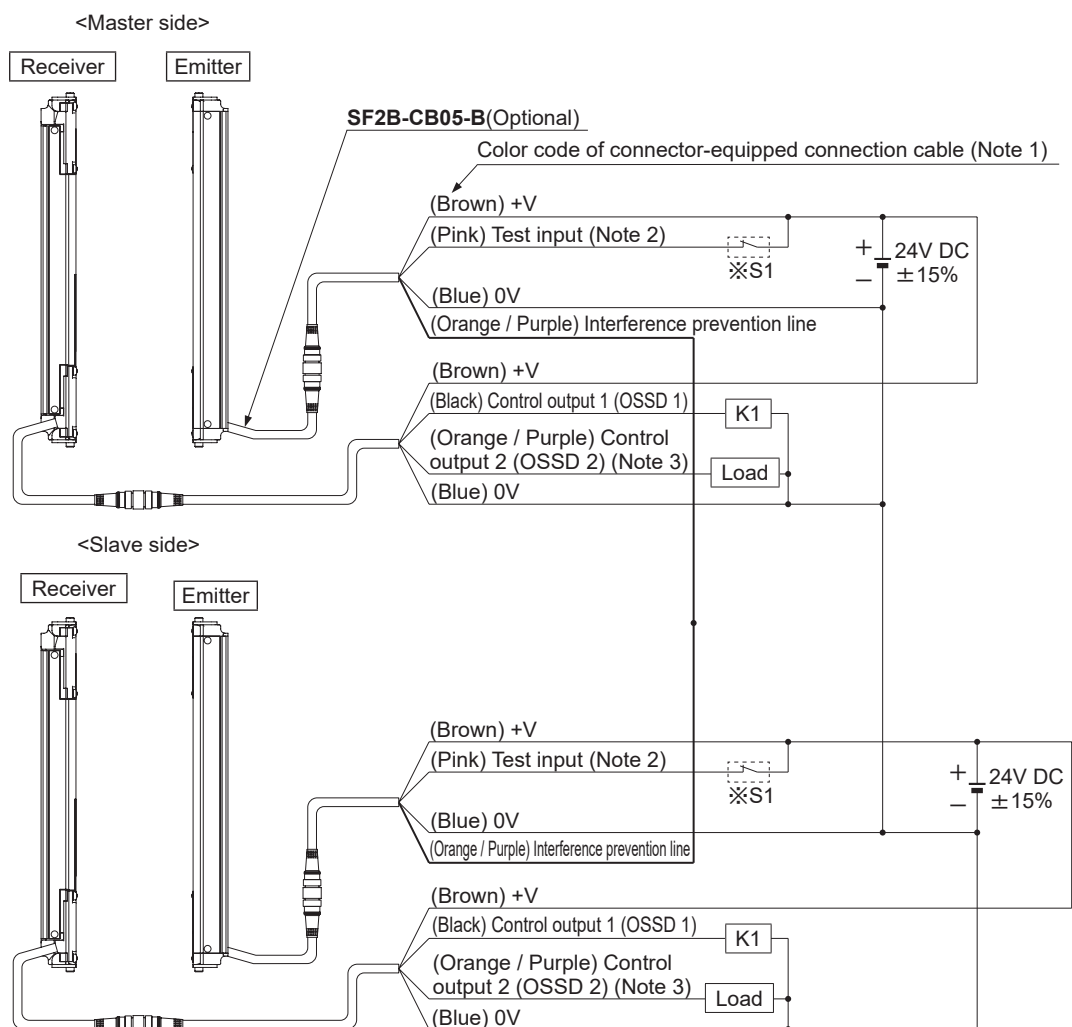
Switch S1

Open: Emission, 0V or +V: Emission halt

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

- Notes: 1) The figure above shows the connection pattern for the connector-equipped connection cable **SF1-CC□A** (discontinued product). The wiring pattern differs when **NA40-CC□** (optional) is used.
- 2) If the connection pattern for the connector-equipped connection cable **NA40-CC□** (optional) is used The pink cable is not used.
- 3) If the connection pattern for the connector-equipped connection cable **NA40-CC□**. The orange cable is used.

<For PNP output>



* Symbols

Switch S1
Open: Emission, +V or 0V: Emission halt
K1, K2: External device (Forced guided relay or magnetic contactor)

- Notes: 1) The figure above shows the connection pattern for the connector-equipped connection cable **SF1-CC□A** (discontinued product). The wiring pattern differs when **NA40-CC□** (optional) is used.
- 2) If the connection pattern for the connector-equipped connection cable **NA40-CC□** (optional) is used The pink cable is not used .
- 3) If the connection pattern for the connector-equipped connection cable **NA40-CC□**. The orange cable is used.

2-5-6 Series and parallel mixed connection

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 for the series connection and up to two sets of the devices for the parallel connection can be connected in combination.

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

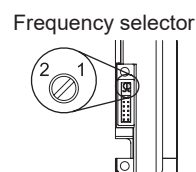
In case of parallel connection, for the control output (OSSD 1 / 2), only the set of which light is blocked turns OFF.

For series connection side, the sub sensor exclusive for series connection (**SF2B-□SL**) and the cable for series connection (**SF2B-CSL□**) are required separately.

Connect the interference prevention lines using the bottom cap cable SF2B-CB05-B (4-core) (optional) on the parallel connection side.

CAUTION

- Make sure that the frequency selector at the insertion slot of bottom cap cable on this device is set at the "1" position for master side sensor, "2" for slave side sensor (on both emitter and receiver). If they are in the position other than the above, the device may not operate properly.
- If the master side sensor breaks due to any reason, the slave side sensor goes into an operation halt state. In order to check the operation of the slave side sensor, set the frequency selector to "1". If only the slave side sensor breaks, the master side sensor operates correctly.

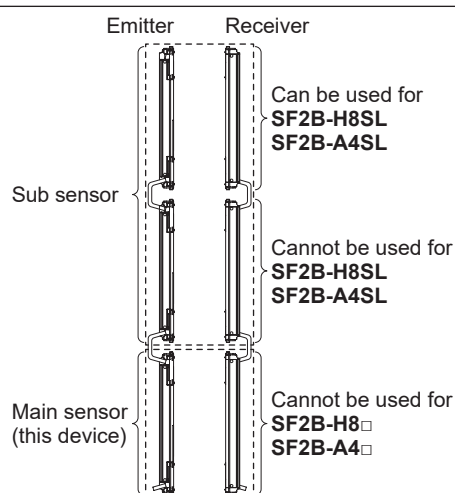


WARNING

- Connect the emitter of the main sensor (this device) and the emitter of the sub sensor exclusive for series connection (**SF2B-□SL**), the receiver of the main sensor (this device) and the receiver of the sub sensor exclusive for series connection (**SF2B-□SL**) respectively using the cable for series connection (**SF2B-CSL□**). 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 next page. Wrong connection could generate the non-sensing area, resulting in death or serious injury.

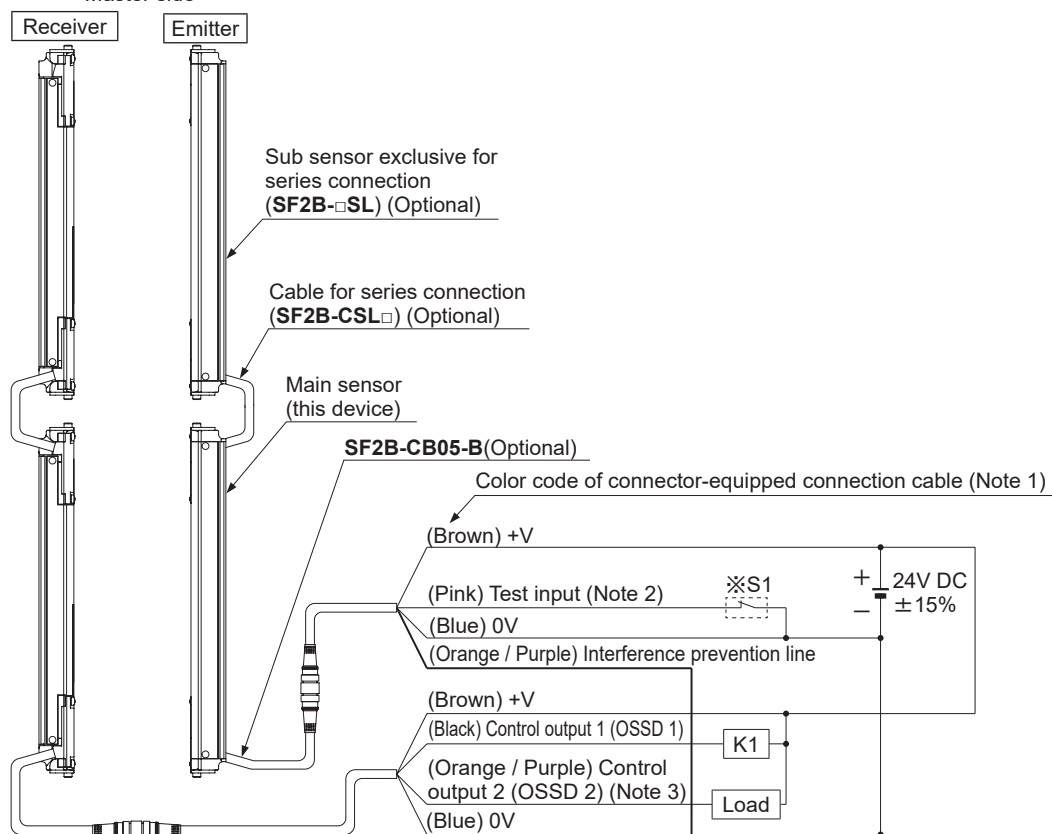
CAUTION

- As the connector for series connection is not incorporated in the main sensor such as **SF2B-H8□** or **SF2B-A4□**, it cannot be connected in series.
- The connector for series connection is not incorporated in the sub sensors exclusive for series connection such as **SF2B-H8SL** or **SF2B-A4SL**.
In case of connecting three sets of sensors in series, it cannot be used in the middle position.

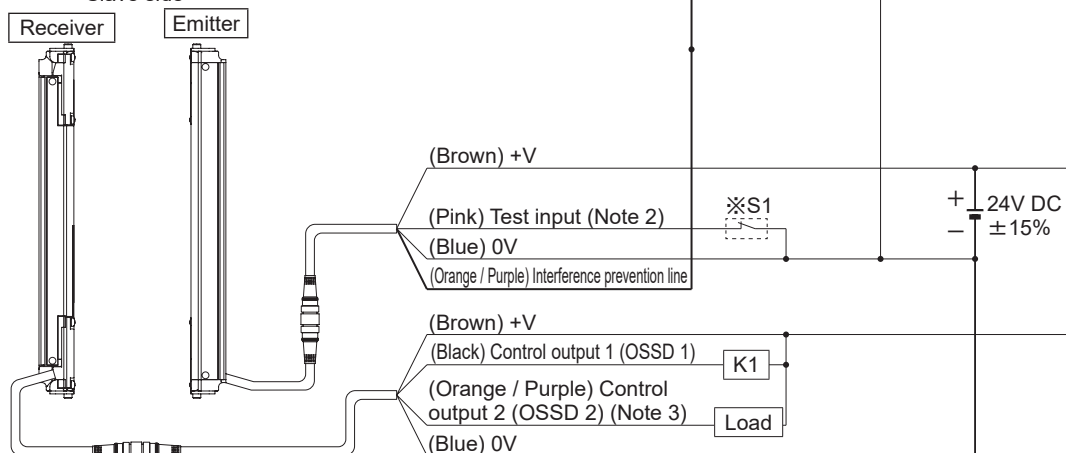


<For NPN output>

<Master side>



<Slave side>



* Symbols

Switch S1

Open: Emission, 0V or +V: Emission halt

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

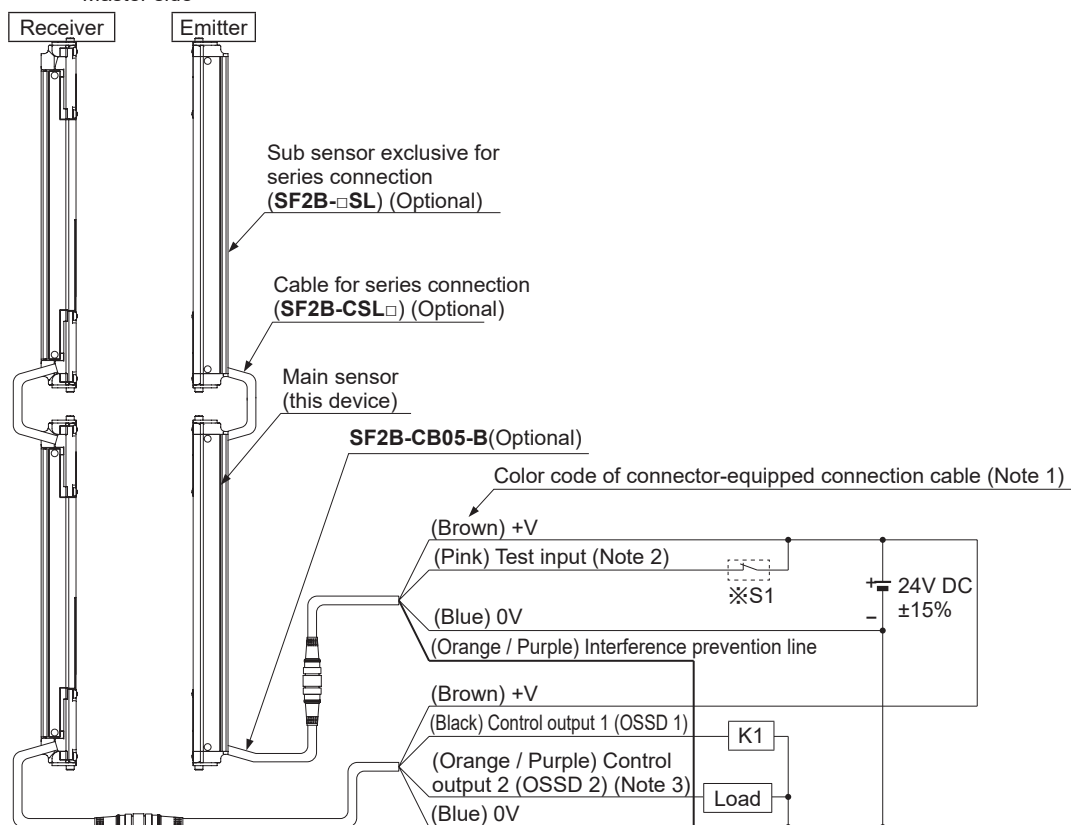
Notes: 1) The figure above shows the connection pattern for the connector-equipped connection cable **SF1-CC□A** (discontinued product). The wiring pattern differs when **NA40-CC□** (optional) is used.

2) If the connection pattern for the connector-equipped connection cable **NA40-CC□** (optional) is used The pink cable is not used .

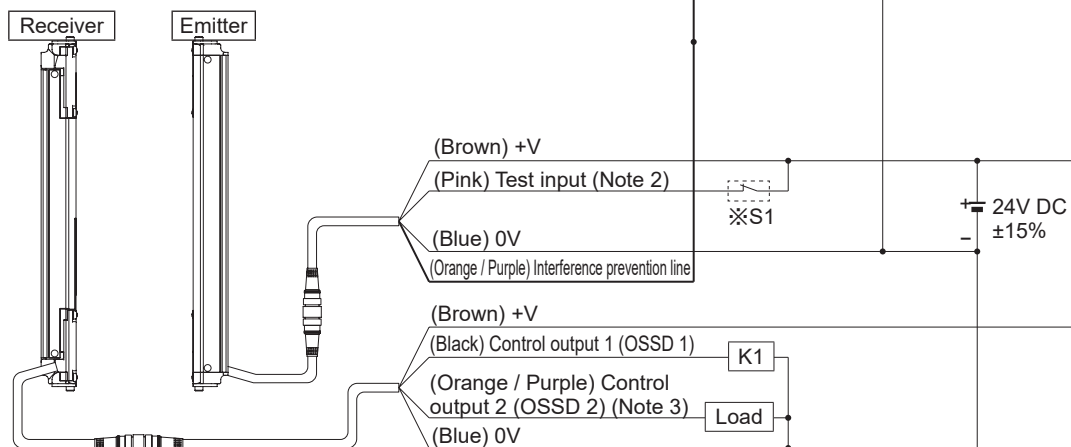
3) If the connection pattern for the connector-equipped connection cable **NA40-CC□**. The orange cable is used.

<For PNP output>

<Master side>



<Slave side>



* Symbols

Switch S1

Open: Emission, +V or 0V: Emission halt

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

Notes: 1) The figure above shows the connection pattern for the connector-equipped connection cable **SF1-CC□A** (discontinued product). The wiring pattern differs when **NA40-CC□** (optional) is used.

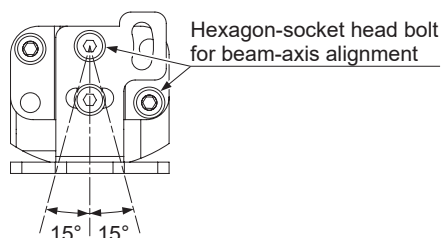
2) If the connection pattern for the connector-equipped connection cable **NA40-CC□** (optional) is used The pink cable is not used .

3) If the connection pattern for the connector-equipped connection cable **NA40-CC□**. The orange cable is used.

2-6 Adjustment

2-6-1 Beam-axis Alignment

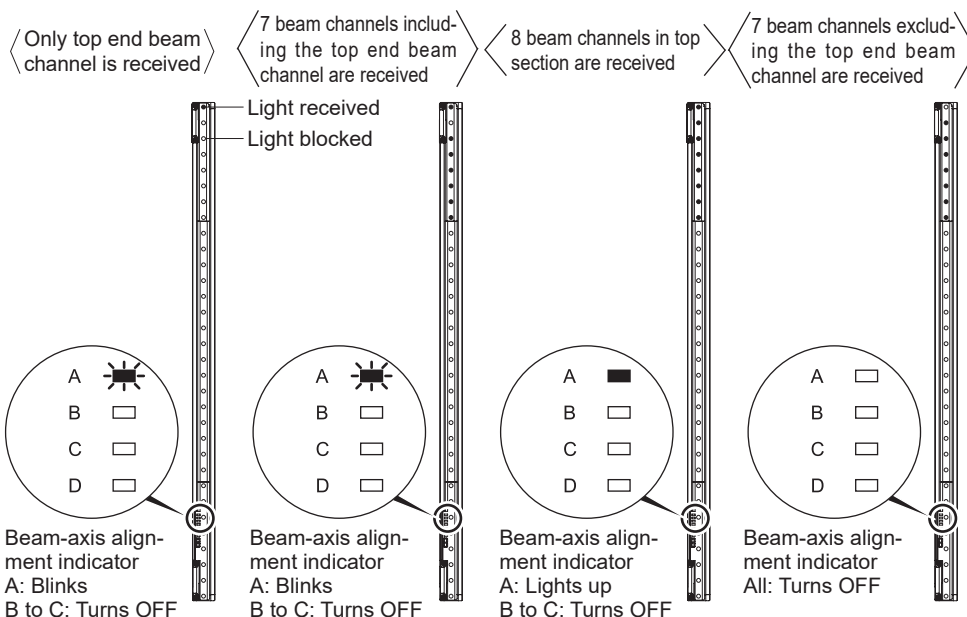
1. Turn ON the power supply unit of this device.
2. Check that the digital error indicator (red) and the fault indicator (yellow) of the emitter and receiver are OFF respectively.
If the digital error indicator (red) or the fault indicator (yellow) lights up or blinks, refer to "**Chapter 5 Troubleshooting**," and report the symptoms to the maintenance in charge.
3. Loosen the hexagon-socket head bolts of the standard mounting bracket (**MS-SF2B-1**) (optional), and align the emitter and receiver to the position where the beam-axis alignment indicator lights up. The angle of the emitter / receiver can be adjusted $\pm 15^\circ$.



<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 32-beam channel device, there are 8 beam channels per section (i.e., $32/4=8$). When the top end (bottom end) beam channel is received, the A (D) of the beam-axis alignment indicator blinks in red. (Example) 32 beam channels

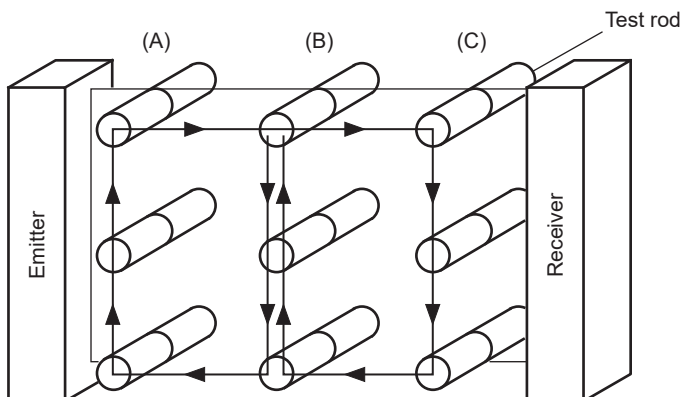


All the 8 beam channels divided into each section are received, the beam-axis alignment indicator lights up in red. The indicators corresponding to the different sections light up in red, one by one, when the beam channels of the respective sections are received. When all the beam channels are received 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.

4. After the adjustment, tighten the hexagon-socket head bolts of the standard mounting bracket. The tightening torque should be 0.6N·m or less.

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. Check that the indicators show reception of the light.
4. Move the test rod ($\phi 27\text{mm}$ for **SF2B-H** \square , $\phi 47\text{mm}$ for **SF2B-A** \square) 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).



5. During Step 4 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, : Turns OFF

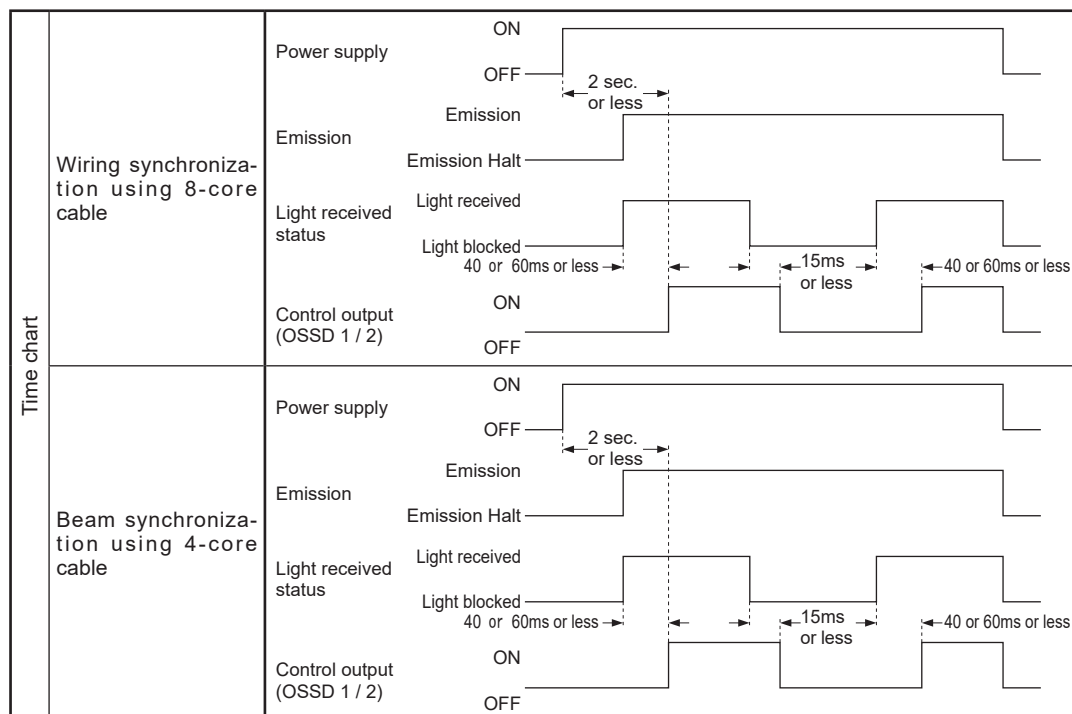
Device status		Indicators		Control output	
		Emitter	Receiver	OSSD 1	OSSD 2
Light received status (all beams received)	Wiring synchronization using 8-core cable	Beam-axis alignment indicator (Green)  Operation indicator (Green)  Emission halt indicator  Fault indicator  Setting indicator 	Beam-axis alignment indicator (Green)  OSSD indicator (Green)  Incident light intensity indicator (Green)  Fault indicator  Digital error indicator 	ON	
	Beam synchronization using 4-core cable	Beam-axis alignment indicator  Operation indicator (Green)  Emission halt indicator  Fault indicator  Setting indicator (Red) (Note) 	Beam-axis alignment indicator (Green)  OSSD indicator (Green)  Incident light intensity indicator (Green)  Fault indicator  Digital error indicator (Red) (Note) 		
Light blocked status	One or more lights blocked	Beam-axis alignment indicator (Red)  Operation indicator (Red)  Emission halt indicator  Fault indicator  Setting indicator 	Beam-axis alignment indicator (Red)  OSSD indicator (Red)  Incident light intensity indicator  Fault indicator  Digital error indicator 	OFF	
	Beam synchronization using 4-core cable	Beam-axis alignment indicator  Operation indicator (Green)  Emission halt indicator  Fault indicator  Setting indicator (Red) (Note) 	Beam-axis alignment indicator (Red)  OSSD indicator (Red)  Incident light intensity indicator  Fault indicator  Digital error indicator (Red) (Note) 		

Note: The status of the setting indicators (red) of the emitter and the digital error indicators of the receiver shown above is when the frequency selector is set to "2". Only one of the setting indicators of the emitter lights up and only the middle bar of the digital error indicators of the receiver lights up in red when the selector is set to "1". (This is not an error.)

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

Device status			Indicators		Control output	
			Emitter	Receiver	OSSD 1	OSSD 2
Light blocked status	Lights other than the top end blocked	Wiring synchronization using 8-core cable	Beam-axis alignment indicator (Red)  Operation indicator (Red)  Emission halt indicator  Fault indicator  Setting indicator 	Beam-axis alignment indicator (Red)  OSSD indicator (Red)  Incident light intensity indicator  Fault indicator  Digital error indicator 	OFF	
		Beam synchronization using 4-core cable	Beam-axis alignment indicator  Operation indicator (Green)  Emission halt indicator  Fault indicator  Setting indicator (Red) (Note) 	Beam-axis alignment indicator (Red)  OSSD indicator (Red)  Incident light intensity indicator  Fault indicator  Digital error indicator (Red) (Note) 		
	Lights other than the bottom end blocked	Wiring synchronization using 8-core cable	Beam-axis alignment indicator (Red)  Operation indicator (Red)  Emission halt indicator  Fault indicator  Setting indicator 	Beam-axis alignment indicator (Red)  OSSD indicator (Red)  Incident light intensity indicator  Fault indicator  Digital error indicator 		
		Beam synchronization using 4-core cable	Beam-axis alignment indicator  Operation indicator (Green)  Emission halt indicator  Fault indicator  Setting indicator (Red) (Note) 	Beam-axis alignment indicator (Red)  OSSD indicator (Red)  Incident light intensity indicator  Fault indicator  Digital error indicator (Red) (Note) 		

Note: The status of the setting indicators (red) of the emitter and the digital error indicators of the receiver shown above is when the frequency selector is set to "2". Only one of the setting indicators of the emitter lights up and only the middle bar of the digital error indicators of the receiver lights up in red when the selector is set to "1". (This is not an error.)



<For series connection>

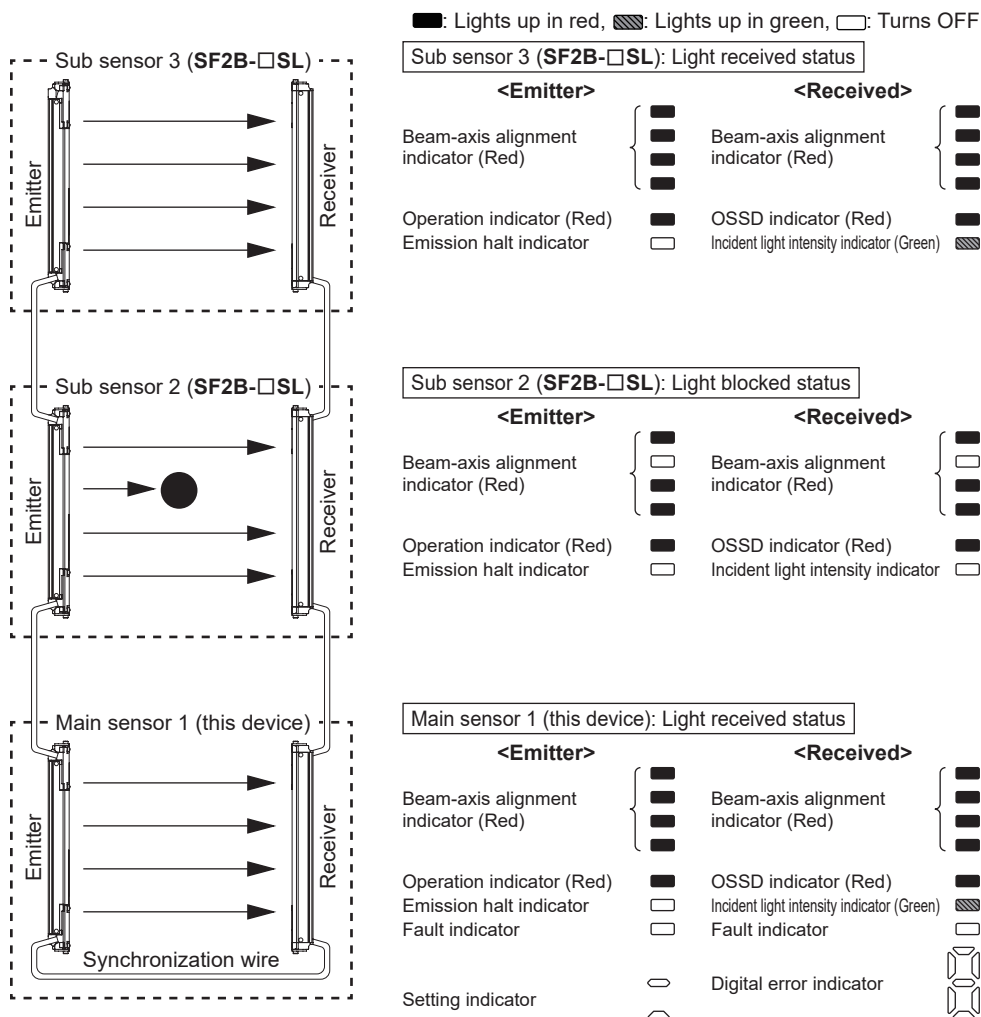
In case of series connection, if any of the sets is in light blocked status, the control output (OSSD 1 / 2) turns OFF.

<Reference>

The emitter / receiver indicators indicates the output status.

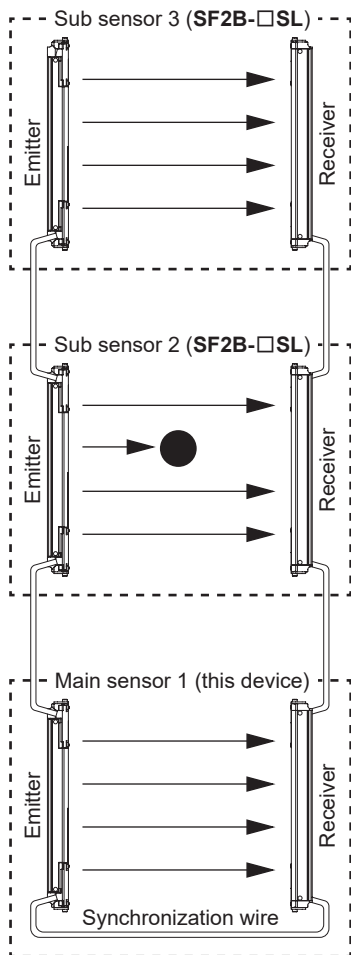
The following figure shows the status of the indicators with Sub Sensor 2 (SF2B-□SL) in light blocked status.

Wiring synchronization using 8-core cable / When sufficient light is received



Beam synchronization using 4-core cable / When sufficient light is received

■: Lights up in red, ▨: Lights up in green, □: Turns OFF



Sub sensor 3 (SF2B-□SL): Light received status

<Emitter>		<Received>	
Beam-axis alignment indicator	<div>□</div> <div>□</div> <div>□</div> <div>□</div>	Beam-axis alignment indicator (Red)	<div>■</div> <div>■</div> <div>■</div> <div>■</div>
Operation indicator (Green)	▨	OSSD indicator (Red)	■
Emission halt indicator	□	Incident light intensity indicator (Green)	▨

Sub sensor 2 (SF2B-□SL): Light blocked status

<Emitter>		<Received>	
Beam-axis alignment indicator	<div>□</div> <div>□</div> <div>□</div> <div>□</div>	Beam-axis alignment indicator (Red)	<div>■</div> <div>□</div> <div>■</div> <div>■</div>
Operation indicator (Green)	▨	OSSD indicator (Red)	■
Emission halt indicator	□	Incident light intensity indicator	□

Main sensor 1 (this device): Light received status

<Emitter>		<Received>	
Beam-axis alignment indicator	<div>□</div> <div>□</div> <div>□</div> <div>□</div>	Beam-axis alignment indicator (Red)	<div>■</div> <div>■</div> <div>■</div> <div>■</div>
Operation indicator (Green)	▨	OSSD indicator (Red)	■
Emission halt indicator	□	Incident light intensity indicator (Green)	▨
Fault indicator	□	Fault indicator	□
Setting indicator (Red)	■	Digital error indicator (Red)	<div>□</div> <div>□</div>

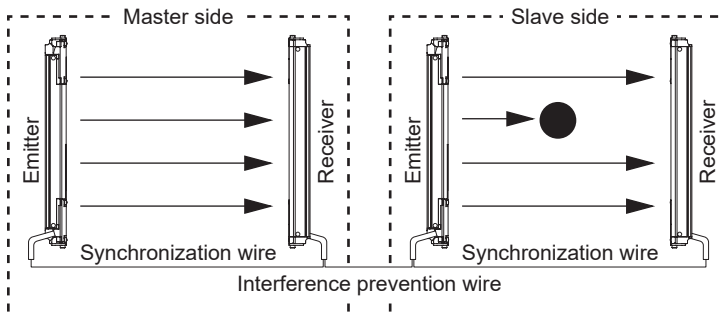
<For parallel connection>

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 in light blocked status.



■: Lights up in red, ▨: Lights up in green, □: Turns OFF

Master side: Light received status

<Emitter>

Beam-axis alignment indicator { □
□
□
□ }

Operation indicator (Green) ▨
Emission halt indicator □
Fault indicator □

Setting indicator (Red) (Note 1) ■
□

<Received>

Beam-axis alignment indicator (Red) { ▨
▨
▨
▨ }

OSSD indicator (Red) ▨
Incident light intensity indicator (Green) ▨
Fault indicator □

Digital error indicator (Red) (Note 1) □
□

Slave side: Light blocked status

<Emitter>

Beam-axis alignment indicator { □
□
□
□ }

Operation indicator (Green) ▨
Emission halt indicator □
Fault indicator □

Setting indicator (Red) (Note 2) ■
■

<Received>

Beam-axis alignment indicator (Red) { ■
□
■
■ }

OSSD indicator (Red) ■
Incident light intensity indicator □
Fault indicator □

Digital error indicator (Red) (Note 2) □
□

- Notes: 1) The frequency selector on the master side is set to "1". Only one of the setting indicators of the emitter lights up and only the middle bar of the digital error indicators lights up in red. (This is not an error.)
2) The frequency selector on the slave side is set to "2". Both of the setting indicators of the emitter light up and the middle and bottom bars of the digital error indicators of the receiver light up in red. (This is not an error.)









































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 test input is kept open (for the wiring synchronization using a 8-core cable, connect to 0V or +V for the beam synchronization using a 4-core cable), the emitter stops emission. In this condition, if this device operates properly, the control output (OSSD 1 / 2) of the receiver turns OFF.

■: 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	Wiring synchronization using 8-core cable Before power is ON Connect the emission halt input to 0V or +V	Beam-axis alignment indicator  Operation indicator  Emission halt indicator  Fault indicator  Setting indicator 	Beam-axis alignment indicator  OSSD indicator  Incident light intensity indicator  Fault indicator  Digital error indicator 	OFF	
	Beam synchronization using 4-core cable Before power is ON Open the emission halt input	Beam-axis alignment indicator  Operation indicator  Emission halt indicator  Fault indicator  Setting indicator 	Beam-axis alignment indicator  OSSD indicator  Incident light intensity indicator  Fault indicator  Digital error indicator 		
2	Wiring synchronization using 8-core cable After power is ON Receiver's control output (OSSD 1 / 2) ON (Normal operation)	Beam-axis alignment indicator (Green)  Operation indicator (Green)  Emission halt indicator  Fault indicator  Setting indicator 	Beam-axis alignment indicator (Green)  OSSD indicator (Green)  Incident light intensity indicator (Green)  Fault indicator  Digital error indicator 	ON	
	Beam synchronization using 4-core cable After power is ON Receiver's control output (OSSD 1 / 2) ON (Normal operation)	Beam-axis alignment indicator  Operation indicator (Green)  Emission halt indicator  Fault indicator  Setting indicator (Red) (Note) 	Beam-axis alignment indicator  OSSD indicator (Green)  Incident light intensity indicator (Green)  Fault indicator  Digital error indicator (Red) (Note) 		

Note: The status of the setting indicators (red) of the emitter and the digital error indicators of the receiver shown above is when the frequency selector is set to "2". Only one of the setting indicators of the emitter lights up and only the middle bar of the digital error indicators of the receiver lights up in red when the selector is set to "1". (This is not an error.)

■: Lights up in red, ■: Lights up in green, ■: Lights up in orange, □: Turns OFF

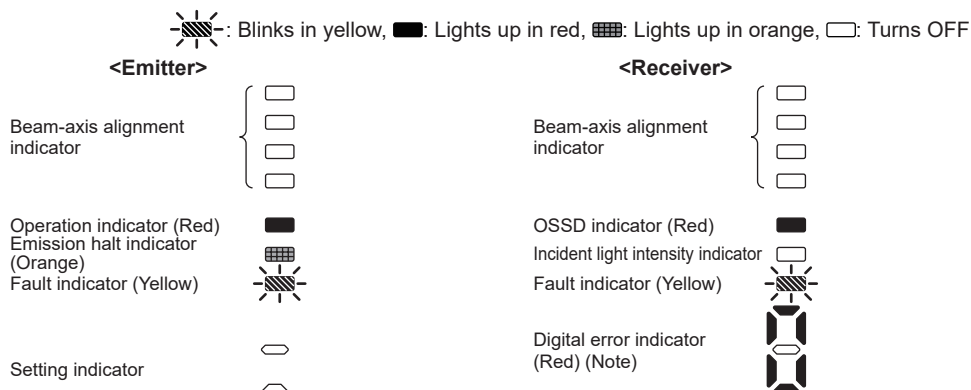
Setting procedure and check items		Indicators		Control output	
		Emitter	Receiver	OSSD 1	OSSD 2
3	Wiring synchronization using 8-core cable Open the emission halt input Receiver's control output (OSSD 1 / 2) is OFF (Emission halt) (Normal operation)	Beam-axis alignment indicator { □ □ □ □ Operation indicator (Red) ■ Emission halt indicator (Orange) ■ Fault indicator □ Setting indicator □	Beam-axis alignment indicator { □ □ □ □ OSSD indicator (Red) ■ Incident light intensity indicator □ Fault indicator □ Digital error indicator □	OFF	
	Beam synchronization using 4-core cable Connect the emission halt input to 0V or +V Receiver's control output (OSSD 1 / 2) is OFF (Emission halt) (Normal operation)	Beam-axis alignment indicator { □ □ □ □ Operation indicator (Green) ■ Emission halt indicator (Orange) ■ Fault indicator □ Setting indicator (Red) (Note) ■	Beam-axis alignment indicator { □ □ □ □ OSSD indicator (Red) ■ Incident light intensity indicator □ Fault indicator □ Digital error indicator (Red) (Note) ■		
4	Wiring synchronization using 8-core cable Connect the emission halt input to 0V or +V Receiver's control output (OSSD 1 / 2) is ON (Normal operation)	Beam-axis alignment indicator (Green) { ■ ■ ■ ■ Operation indicator (Green) ■ Emission halt indicator □ Fault indicator □ Setting indicator □	Beam-axis alignment indicator (Green) { ■ ■ ■ ■ OSSD indicator (Green) ■ Incident light intensity indicator (Green) ■ Fault indicator □ Digital error indicator □	ON	
	Beam synchronization using 4-core cable Open the emission halt input Receiver's control output (OSSD 1 / 2) is ON (Normal operation)	Beam-axis alignment indicator { □ □ □ □ Operation indicator (Green) ■ Emission halt indicator □ Fault indicator □ Setting indicator (Red) (Note) ■	Beam-axis alignment indicator { ■ ■ ■ ■ OSSD indicator (Green) ■ Incident light intensity indicator (Green) ■ Fault indicator □ Digital error indicator (Red) (Note) ■		

Note: The status of the setting indicators (red) of the emitter and the digital error indicators of the receiver shown above is when the frequency selector is set to "2". Only one of the setting indicators of the emitter lights up and only the middle bar of the digital error indicators of the receiver lights up in red when the selector is set to "1". (This is not an error.)

3) When an error occurs

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

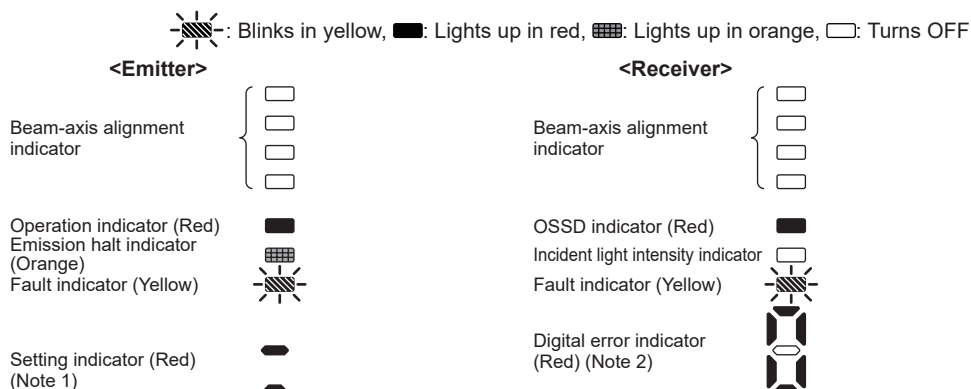
Wiring synchronization using 8-core cable



- 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.

Note: Refer to “Chapter 5 Troubleshooting” for details of the digital error indicator.

Beam synchronization using 4-core cable



- 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. The emitter, however, continues normal operation if no error exist on it.
- In case of parallel connection, if a master side error is detected, the slave side will be an emission halt state.

Notes: 1) The status of the setting indicators (red) of the emitter do not change if an error is detected. The status shown above is when the frequency selector is set to “2”

2) Refer to “Chapter 5 Troubleshooting” for details of the digital error indicator.

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.

In case an error 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 error.

⚠ WARNING

- In order to maintain safe condition of device, inspect the light blocked status of the device once a day or more.
- Failure to do so could delay the detection of unexpected error and increase the degree of hazard, which may cause the malfunction of device, resulting in death or serious injury.
- In order to check all errors in the OSSD 1, OSSD 2 and auxiliary output, the light blocked status of device must be checked. Perform either of two below to inspect the device under light blocked condition.
 - Emission halt by test input (Emission halt function)
 - Light blocking by test rod (Excluding the cable **SF2B-CB05-A**)

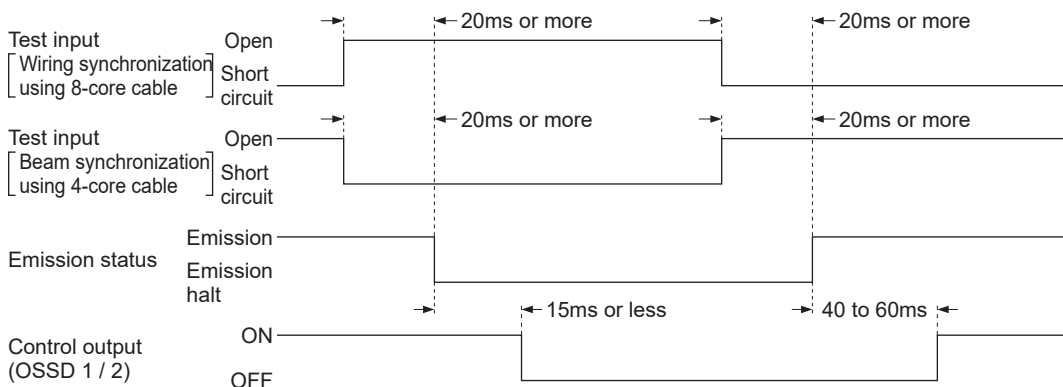
3-2 Test Input (Emission Halt Function)

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.

	Test input	Emission status
Wiring synchronization using 8-core cable	Open	Emission halt
	0V and +V connected	Emission
Beam synchronization using 4-core cable	Open	Emission
	0V and +V connected	Emission halt

<Timing chart>



⚠ WARNING

Do not use the test input (emission halt function) for the purpose of stopping the device on which the **SF2B** series is mounted. Failure to do so could result in death or serious injury.

3-3 Auxiliary Output (Non-safety Output)

Auxiliary output is incorporated into the emitter and its operation varies depending on the type of bottom cap cable (optional) to be used.

Bottom cap cable	Auxiliary output operation
SF2B-CCB□, SF2B-CB□, SF2B-CB05-C	At OSSD ON: OFF / At OSSD OFF: ON
SF2B-CB05-A	At normal operation: ON When an error which needs emission halt status occurs / when test input is open: OFF
SF2B-CB05-B	Cannot be used.

Bottom cap cable	Normal operation			Lockout
	Emission halt	Control output (OSSD 1 / 2) status		
		Light received	Light blocked	
SF2B-CCB□, SF2B-CB□, SF2B-CB05-C	ON	OFF	ON	ON
SF2B-CB05-A	OFF	ON	ON	OFF

<When bottom cap cable SF2B-CCB□, SF2B-CB□ or SF2B-CB05-C (optional) is used>

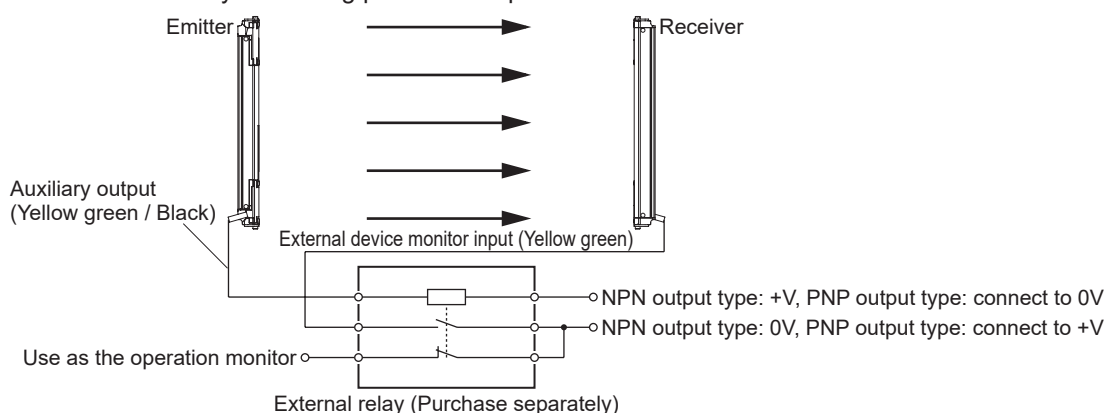
The auxiliary output is incorporated in the emitter. It is OFF when the control output (OSSD 1 / 2) is ON and vice versa.

The auxiliary output can be used as an operation monitor of the device.

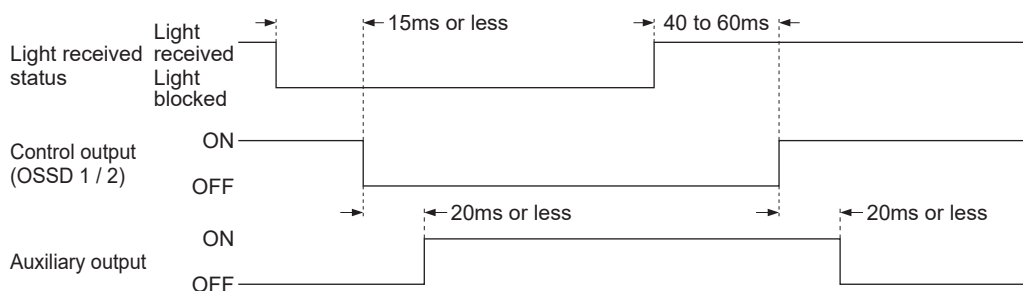
When the external device monitor function is not used, connect the external device monitor input line to the auxiliary output line to disable the function (except for SF2B-CB05-C).

In this case, do not connect the load to the auxiliary output. For details, refer to “3-5 External Device Monitor Function” and “2-5-2 I/O Circuit and Connection”.

When the external device monitor function is used to disable, do not directly use the auxiliary output as the operation monitor of this device. When the external device monitor is used to disable and the auxiliary output is used to monitor the operation of device, connect the auxiliary output and the external device monitor input to the external relay (purchase separately) to use the external relay contacting point as an operation monitor of this device.



<Timing chart>



<When bottom cap cable SF2B-CB05-A (optional) is used>

WARNING

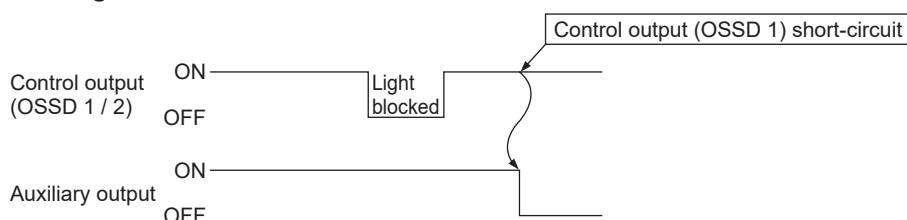
Make sure to use the auxiliary output when using the bottom cap cable **SF2B-CB05-A** (optional). Set the device so the control machine can be stopped when either the control output (OSSD 1) or auxiliary output turns to OFF. If the auxiliary output is should not be used, the device can not stop operation when an unexpected error occurs during control output (OSSD 1) failure, which may result in death or serious injury.

The auxiliary output is incorporated in the emitter. It outputs ON at the normal operation of device. It outputs OFF in the following cases:

- When an error which needs emission halt status occurs
[for example, the control output (OSSD 1) short-circuit and an error occurs.]
- While test input has been input

The error cannot be transmitted to the control machine. The alarm signal is output from the auxiliary output.

<Timing chart>



<When bottom cap cable SF2B-CB05-B (optional) is used>

The auxiliary output cannot be utilized by using the bottom cap cable **SF2B-CB05-B** (optional).

3-4 Interference Prevention Function

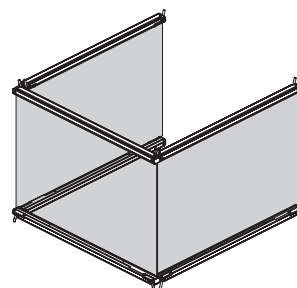
It is possible to construct the system to prevent malfunction due to interference of the light between **SF2B** series devices.

The interference prevention system can construct max. three sets for series connections (the max. number of the beam channels of **SF2B-H** is 128 and that of **SF2B-A** is 64, however, when two sets of **SF2B-A** are constructed, the max. is 96) and max. two sets for parallel connections.

For constructing the series connections, the sub sensor exclusive for series connections (**SF2B- \square SL**) and the cable for series connections (**SF2B-CSL \square**) are required separately.

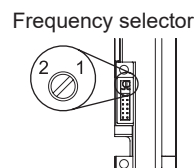
For constructing parallel connections, use the bottom cap cable **SF2B-CB05-B** (optional).

Refer to "2-5 Wiring" for details of the connecting method.



CAUTION

- Make sure that the frequency selector at the insertion slot of bottom cap cable on this device is set at the "1" position for master side sensor, "2" for slave side sensor (on both emitter and receiver). If they are in the position other than the above, the device may not operate properly.
- If the master side sensor breaks due to any reason, the slave side sensor goes into an operation halt state. In order to check the operation of the slave side sensor, set the frequency selector to "1". If only the slave side sensor breaks, the master side sensor operates correctly.



3-5 External Device Monitor Function

This function is available when the bottom cap cable **SF2B-CCB□** or **SF2B-CB□** (optional) is used.

It 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 error 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:**

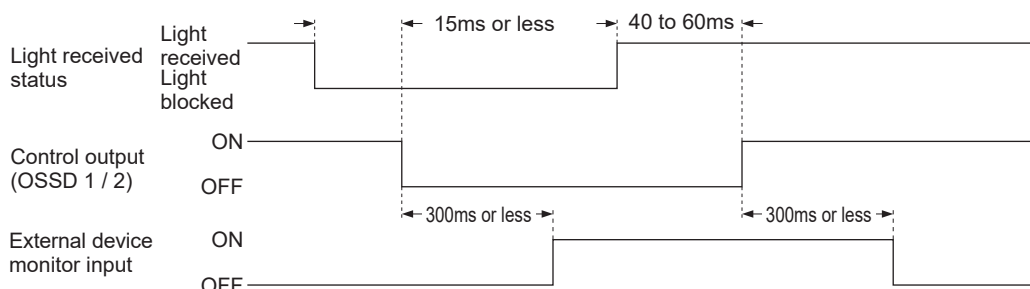
Connect the external device monitor input line to the contacting point "b" of external safety relay connected the control output (OSSD 1 / 2).

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

Connect the external device monitor input line to the auxiliary output line.

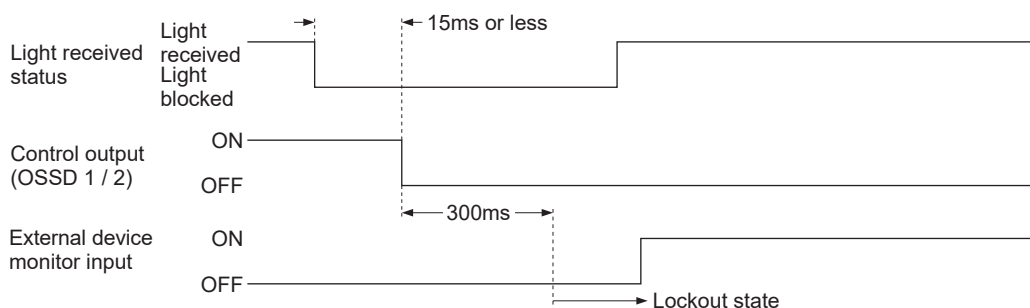
Refer to "2-5 Wiring" for details of the connecting method.

<Timing chart (Normal)>

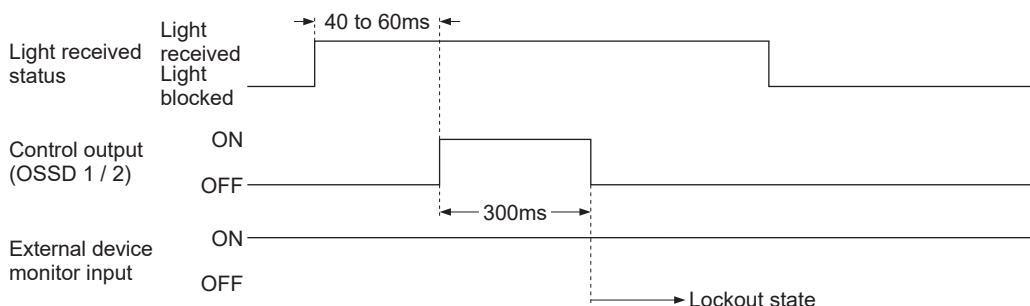


The setting time of the device monitor is 300ms or less. Exceeding 300ms turns the device into lockout status.

<Timing chart (Error 1)>



<Timing chart (Error 2)>



3-6 Compatibility

This function is used to replace other series of light curtains or area sensors with this device. The type of bottom cap cable and sensor mounting bracket varies depending on the series to be replaced.

<Replacement of SF2-A series>

Designation	Model No.
Bottom cap cable	SF2B-CB05-A
Sensor mounting bracket	MS-SF2B-5

Connect the shielded line to +V in the NPN output type. Connect the shielded line to 0V in the PNP output type.

The connecting cable **SF2N-CC**□ (optional) can be used without change.

<Replacement of SF2-N series>

Designation	Model No.
Bottom cap cable	SF2B-CB05-A
Sensor mounting bracket	MS-SF2B-5

Connect the shielded line to +V in the NPN output type. Connect the shielded line to 0V in the PNP output type.

The connecting cable **SF2N-CC**□ (optional) can be used without change.

Note that the interference prevention function (parallel connection) becomes unusable.

<Replacement of NA40 series>

Designation	Model No.
Bottom cap cable	SF2B-CB05-B
Sensor mounting bracket	MS-SF2B-4 for MS-NA40-1 , MS-SF2B-6 for direct mounting

The control output (OSSD 2) is provided instead of self-diagnosis output. Note that the self-diagnosis output becomes unusable.

With the connecting cable **NA40-CC**□ (optional) for **NA40** series, the emission halt function is unusable because the emission cable has only three cores. Additionally, note that the operating ambient temperature range of **NA40-CC**□ (optional) for **NA40** series is from -10 to +50°C.

WARNING

Be sure to use both OSSD 1 and OSSD 2 as control outputs.

<Replacement of SF1-N series>

Designation	Model No.
Bottom cap cable	SF2B-CB05-B
Sensor mounting bracket	MS-SF2B-4 for MS-SF1-1 , MS-SF2B-7 for direct mounting

The connecting cable **SF1-CC**□**A** (optional) can be used without change.

The interference prevention line and control output (OSSD 1) are respectively provided instead of the synchronization wire on the emitter and that on the receiver.

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

WARNING

Be sure to use both OSSD 1 and OSSD 2 as control outputs.

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.

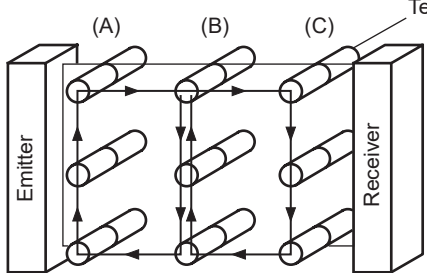
4-1 Daily Inspection

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 ($\phi 27\text{mm}$ for SF2B-H□, $\phi 47\text{mm}$ for SF2B-A□) 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 test input line is open. At this time, the effect of external noise can be inspected. In case external noise affects the operation, remove its cause and reinspect.

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.

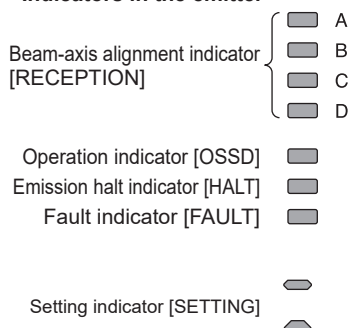
5-1 Troubleshooting of Emitter

Symptom	Cause	Remedy
All indicators are off.	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.	Provide the supply voltage within the specified range.
	Connector is not connected securely.	Connect the connector securely.
Fault indicator (yellow) lights or blinks.	[Blinks once] Number of total units / number of total beam channels error	Connect the end cap properly. Connect the cable for series connection correctly. Check the model (emitter / receiver) of sub sensor exclusive for series connection. Set the number of the sensors in series connection, and a number of total beam channels within the specification.
	[Blinks twice] Auxiliary output error	Connect the auxiliary output wire correctly.
	[Other than the above] Effect from noise / power supply or failure of internal circuit	Check the noise status around this device. Check the wiring, supplied voltage and power supply capacity. When the synchronization cable is extended with a cable other than exclusive cable, use a 0.2mm ² or more shielded twisted pair cable. Even if the error is not eliminated, contact Panasonic Industrial Devices SUNX.
Emission halt indicator (orange) lights up.	Emission is in halt condition.	Connect the test input (emission halt input) wire correctly. The logic varies depending on the cable to be used.
	The synchronization wire error	Connect the synchronization wire correctly.
	The receiver does not work.	Check the operation of the receiver side.
	The interference prevention wire error (Beam synchronization using 4-core cable: slave setting)	Connect the interference prevention wire correctly.
	Master / slave setting error (Beam synchronization using 4-core cable: master setting)	Set the master / slave setting to "master".
	The master sensor does not work.	Check the master side sensor.
Operation indicator remains lit in red (light is not received). (Note)	The beam channels of the emitter and the receiver are not correctly aligned.	Align the beam channels.

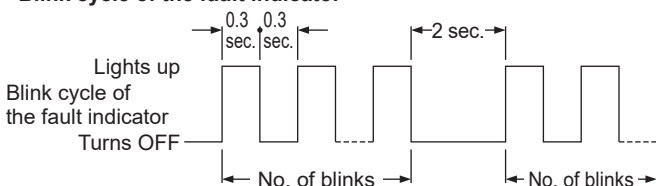
Note: Since the color of the operation indicator changes according to ON / OFF status of the control output (OSSD 1 / 2), the operation indicator is marked as "OSSD" on the device.

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

<Indicators in the emitter>



<Blink cycle of the fault indicator>

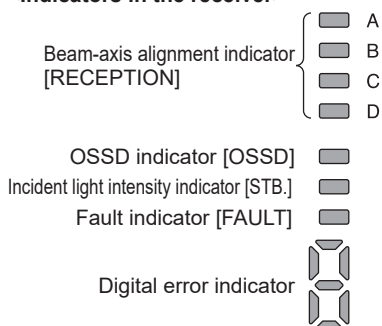


5-2 Troubleshooting of Receiver

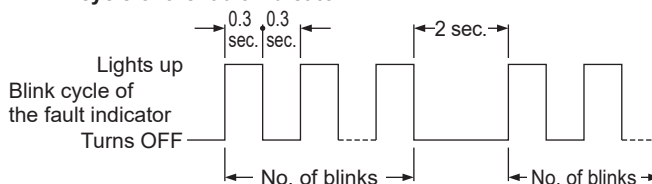
Symptom	Cause	Remedy
All indicators are off.	Power is not being supplied.	Check that the power supply capacity is sufficient. Connect the power supply correctly.
	Supply voltage is out of the specified range.	Provide the supply voltage within the specified range.
	Connector is not connected securely.	Connect the connector securely.
Fault indicator (yellow) lights or blinks.	[Digital error indicator: 1] Number of total units / number of total beam channels error	Connect the end cap properly. Connect the cable for series connection correctly. Check the model (emitter / receiver) of sub sensor exclusive for series connection. Set the same value to the numbers of emitter and receiver.
	[Digital error indicator: 2] Control output (OSSD 1 / 2) error	Connect the control output (OSSD 1 / 2) wire correctly. Check the type of the bottom connector. Cable of the receiver: Grey (with black stripe)
	[Digital error indicator: 4] Extraneous light error	Prevent any extraneous light from entering the receiver.
	[Digital error indicator: 7] External device monitor error	Connect the external device monitor input wire correctly. Replace the relay unit. Replace the relay unit having appropriate response time.
	[Other than the above] Effect from noise / power supply or failure of internal circuit	Check the noise status around this device. Check the wiring, supplied voltage and power supply capacity. When the synchronization cable is extended with a cable other than exclusive cable, use a 0.2mm ² or more shielded twisted pair cable. Even if the error is not eliminated, contact Panasonic Industrial Devices SUNX.
Stable indicator (Orange) lights up	The beam channels of the emitter and the receiver are not correctly aligned.	Align the beam channels.
OSSD indicator remains lit in red (light is not received).	The beam channels of the emitter and the receiver are not correctly aligned.	Align the beam channels.
	Number of total units / number of total beam channels error	Set the same value to the numbers of emitter and receiver.
	The master / slave setting is different. (Beam synchronization using 4-core cable)	Set the setting identically.

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

<Indicators in the receiver>

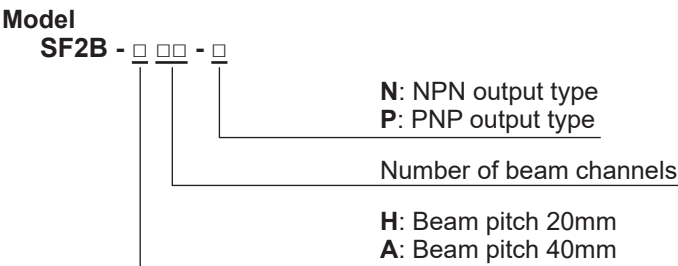


<Blink cycle of the fault indicator>



Chapter 6 Specifications / Dimensions

6-1 Specifications



Example: **SF2B-H56-P**
Beam pitch: 20mm
Number of beam channels: 56 channels
Output: PNP output type

Model-wise specifications

<Min. sensing object ø27mm (20mm pitch) type>

Type		Min. sensing object ø27mm (20mm pitch) type					
Model No.	NPN output	SF2B-H8-N	SF2B-H12-N	SF2B-H16-N	SF2B-H20-N	SF2B-H24-N	SF2B-H28-N
	PNP output	SF2B-H8-P	SF2B-H12-P	SF2B-H16-P	SF2B-H20-P	SF2B-H24-P	SF2B-H28-P
No. of beam channels		8	12	16	20	24	28
Sensing range		Wiring synchronization using 8-core cable: 0.2 to 13m, Beam synchronization using 4-core cable: 0.2 to 5m					
Beam pitch		20mm					
Protective height		168mm	232mm	312mm	392mm	472mm	552mm
Current consumption		Emitter: 40mA or less Receiver: 50mA or less		Emitter: 40mA or less Receiver: 60mA or less		Emitter: 50mA or less Receiver: 70mA or less	
PFHd	NPN output	6.24×10^{-9}	6.44×10^{-9}	6.58×10^{-9}	6.77×10^{-9}	6.91×10^{-9}	7.10×10^{-9}
	PNP output	6.04×10^{-9}	6.23×10^{-9}	6.37×10^{-9}	6.57×10^{-9}	6.71×10^{-9}	6.90×10^{-9}
MTTFd		More than 100 years					
Weight (total of emitter and receiver)		Approx. 170g	Approx. 280g	Approx. 400g	Approx. 510g	Approx. 610g	Approx. 720g

Type		Min. sensing object ø27mm (20mm pitch) type					
Model No.	NPN output	SF2B-H32-N	SF2B-H36-N	SF2B-H40-N	SF2B-H48-N	SF2B-H56-N	SF2B-H64-N
	PNP output	SF2B-H32-P	SF2B-H36-P	SF2B-H40-P	SF2B-H48-P	SF2B-H56-P	SF2B-H64-P
No. of beam channels		32	36	40	48	56	64
Sensing range		Wiring synchronization using 8-core cable: 0.2 to 13m, Beam synchronization using 4-core cable: 0.2 to 5m					
Beam pitch		20mm					
Protective height		632mm	712mm	792mm	952mm	1,112mm	1,272mm
Current consumption		Emitter: 50mA or less Receiver: 80mA or less		Emitter: 60mA or less Receiver: 90mA or less		Emitter: 65mA or less Receiver: 110mA or less	
PFHd	NPN output	7.24×10^{-9}	7.44×10^{-9}	7.58×10^{-9}	7.91×10^{-9}	8.24×10^{-9}	8.58×10^{-9}
	PNP output	7.04×10^{-9}	7.23×10^{-9}	7.37×10^{-9}	7.71×10^{-9}	8.04×10^{-9}	8.37×10^{-9}
MTTFd		More than 100 years					
Weight (total of emitter and receiver)		Approx. 830g	Approx. 930g	Approx. 1,000g	Approx. 1,300g	Approx. 1,500g	Approx. 1,700g

Type		Min. sensing object ø27mm (20mm pitch) type			
Model No.	NPN output	SF2B-H72-N	SF2B-H80-N	SF2B-H88-N	SF2B-H96-N
	PNP output	SF2B-H72-P	SF2B-H80-P	SF2B-H88-P	SF2B-H96-P
No. of beam channels		72	80	88	96
Sensing range		Wiring synchronization using 8-core cable: 0.2 to 13m Beam synchronization using 4-core cable: 0.2 to 5m			
Beam pitch		20mm			
Protective height		1,432mm	1,592mm	1,752mm	1,912mm
Current consumption		Emitter: 70mA or less Receiver: 130mA or less		Emitter: 80mA or less Receiver: 150mA or less	
PFHd	NPN output	8.91×10^{-9}	9.24×10^{-9}	9.58×10^{-9}	9.91×10^{-9}
	PNP output	8.71×10^{-9}	9.04×10^{-9}	9.37×10^{-9}	9.71×10^{-9}
MTTFd		More than 100 years			
Weight (total of emitter and receiver)		Approx. 1,900g	Approx. 2,100g	Approx. 2,300g	Approx. 2,500g

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

<Min. sensing object ø47mm (40mm pitch) type>

Type		Min. sensing object ø47mm (40mm pitch) type					
Model No.	NPN output	SF2B-A4-N	SF2B-A6-N	SF2B-A8-N	SF2B-A10-N	SF2B-A12-N	SF2B-A14-N
	PNP output	SF2B-A4-P	SF2B-A6-P	SF2B-A8-P	SF2B-A10-P	SF2B-A12-P	SF2B-A14-P
No. of beam channels		4	6	8	10	12	14
Sensing range		Wiring synchronization using 8-core cable: 0.2 to 13m, Beam synchronization using 4-core cable: 0.2 to 5m					
Beam pitch		40mm					
Protective height		168mm	232mm	312mm	392mm	472mm	552mm
Current consumption		Emitter: 35mA or less Receiver: 45mA or less		Emitter: 35mA or less Receiver: 50mA or less		Emitter: 40mA or less Receiver: 55mA or less	
PFHd	NPN output	6.11×10^{-9}	6.23×10^{-9}	6.30×10^{-9}	6.42×10^{-9}	6.49×10^{-9}	6.62×10^{-9}
	PNP output	5.90×10^{-9}	6.03×10^{-9}	6.10×10^{-9}	6.22×10^{-9}	6.29×10^{-9}	6.41×10^{-9}
MTTFd		More than 100 years					
Weight (total of emitter and receiver)		Approx. 170g	Approx. 280g	Approx. 400g	Approx. 510g	Approx. 610g	Approx. 720g

Type		Min. sensing object ø47mm (40mm pitch) type					
Model No.	NPN output	SF2B-A16-N	SF2B-A18-N	SF2B-A20-N	SF2B-A24-N	SF2B-A28-N	SF2B-A32-N
	PNP output	SF2B-A16-P	SF2B-A18-P	SF2B-A20-P	SF2B-A24-P	SF2B-A28-P	SF2B-A32-P
No. of beam channels		16	18	20	24	28	32
Sensing range		Wiring synchronization using 8-core cable: 0.2 to 13m, Beam synchronization using 4-core cable: 0.2 to 5m					
Beam pitch		40mm					
Protective height		632mm	712mm	792mm	952mm	1,112mm	1,272mm
Current consumption		Emitter: 40mA or less Receiver: 60mA or less		Emitter: 45mA or less Receiver: 65mA or less		Emitter: 50mA or less Receiver: 75mA or less	
PFHd	NPN output	6.69×10^{-9}	6.81×10^{-9}	6.88×10^{-9}	7.08×10^{-9}	7.27×10^{-9}	7.46×10^{-9}
	PNP output	6.48×10^{-9}	6.61×10^{-9}	6.68×10^{-9}	6.87×10^{-9}	7.07×10^{-9}	7.26×10^{-9}
MTTFd		More than 100 years					
Weight (total of emitter and receiver)		Approx. 830g	Approx. 930g	Approx. 1,000g	Approx. 1,300g	Approx. 1,500g	Approx. 1,700g

Type		Min. sensing object ø47mm (40mm pitch) type			
Model No.	NPN output	SF2B-A36-N	SF2B-A40-N	SF2B-A44-N	SF2B-A56-N
	PNP output	SF2B-A36-P	SF2B-A40-P	SF2B-A44-P	SF2B-A56-P
No. of beam channels		36	40	44	56
Sensing range		Wiring synchronization using 8-core cable: 0.2 to 13m Beam synchronization using 4-core cable: 0.2 to 5m			
Beam pitch		40mm			
Protective height		1,432mm	1,592mm	1,752mm	1,912mm
Current consumption		Emitter: 55mA or less Receiver: 85mA or less		Emitter: 60mA or less Receiver: 95mA or less	
PFHd	NPN output	7.66×10^{-9}	7.85×10^{-9}	8.05×10^{-9}	8.24×10^{-9}
	PNP output	7.46×10^{-9}	7.65×10^{-9}	7.84×10^{-9}	8.04×10^{-9}
MTTFd		More than 100 years			
Weight (total of emitter and receiver)		Approx. 1,900g	Approx. 2,100g	Approx. 2,300g	Approx. 2,500g

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

Common specifications

Type	Min. sensing object ø27mm (20mm pitch) type		Min. sensing object ø47mm (40mm pitch) type	
	NPN output	PNP output	NPN output	PNP output
Model No.	SF2B-H□-N	SF2B-H□-P	SF2B-A□-N	SF2B-A□-P
Detecting capability (Min. sensing object)	ø27mm opaque object		ø47mm opaque object	
Effective aperture angle (EAA)	±5 degree or less [for sensing range exceeding 3m (Required by IEC 61496-2, ANSI/UL 61496-2)]			
Supply voltage	24V DC±15% Ripple P-P10% or less			
Control output (OSSD 1 / 2)	<For NPN output> <ul style="list-style-type: none">Maximum sink current: 200mAApplied voltage: Same as supply voltage (between the control output and 0V)Residual voltage: 2.0V or less (sink current 200mA, when using 30.5m 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 PNP output> <ul style="list-style-type: none">Maximum source current: 200mAApplied voltage: Same as supply voltage (between the control output and +V)Residual voltage: 2.5V or less (source current 200mA, when using 30.5m 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	
	Operation mode (Output operation)	ON when all beams are received, OFF when one or more beams are interrupted (OFF when fault occurs in the sensor to the synchronization single error, too)		
	Protection circuit (Short-circuit)	Incorporated		
Response time	OFF response: 15ms or less, ON response: 40 to 60ms			
Auxiliary output (Non-safety output)	Incorporated in the emitter on which the bottom cap cable (SF2B-CCB□, SF2B-CB□ or SF2B-CB05-A) is used (Note 2).			
	<For NPN output> <ul style="list-style-type: none">Maximum sink current: 60mAApplied voltage: Same as supply voltage (between the auxiliary output and 0V)Residual voltage: 2.0V or less (sink current 60mA, when using 30.5m length cable)		<For PNP output> <ul style="list-style-type: none">Maximum source current: 60mAApplied voltage: Same as supply voltage (between the auxiliary output and +V)Residual voltage: 2.5V or less (source current 60mA, when using 30.5m length cable)	
	Operation mode (Output operation)	When OSSDs are ON: OFF, When OSSDs are OFF: ON (SF2B-CCB□ or SF2B-CB□) In normal operation: ON, Abnormal operation in emitter / Emission halt: OFF (SF2B-CB05-A)		
Protection circuit (Short-circuit)	Incorporated			
Synchronization system	Switchable either Wiring synchronization using 8-core cable or Beam synchronization using 4-core cable			
Interference prevention function	<Wiring synchronization using 8-core cable> <ul style="list-style-type: none">Series connection:<ul style="list-style-type: none">SF2B-H□ type... Connectable up to 3 stes of the devices (128 beam channels max.)SF2B-A□ type... Connectable up to 3 stes of the devices (64 beam channels max., however, when 2 sets are connected, 96 beam channels max.)SF2B-H□ type and SF2B-A□ type can be combined (Note 3) <Beam synchronization using 4-core cable> <ul style="list-style-type: none">Series connection:<ul style="list-style-type: none">SF2B-H□ type... Connectable up to 3 stes of the devices (128 beam channels max.)SF2B-A□ type... Connectable up to 3 stes of the devices (64 beam channels max., however, when 2 sets are connected, 96 beam channels max.)Parallel connection: Connectable up to 2 setsSeries and parallel mixed connection: Up to 3 sets of series connection and 2 sets of parallel connection can be connected in combinationSF2B-H□ type and SF2B-A□ type can be combined (Note 3)			
Emission halt function	Incorporated			
External device monitoring function	Incorporated			
Protection	IP65 and IP67 (IEC)			
Degree of pollution	3			
Ambient temperature	-10 to +55°C (No dew condensation ot icing allowed), Storage:-25 to +70°C			
Ambient humidity	30 to 85%RH, Storage: 30 to 95%RH			
Ambient illuminance	Incadescent lamp: 3,500lx or less at the light-receiving surface			
Operating altitude	2,000m or less			
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			

Type	Min. sensing object ø27mm (20mm pitch) type		Min. sensing object ø47mm (40mm pitch) type	
	NPN output	PNP output	NPN output	PNP output
Model No.	SF2B-H□-N	SF2B-H□-P	SF2B-A□-N	SF2B-A□-P
SFF (Safe failure fraction)	99%			
HFT (Hardware failure tolerance)	0			
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 30.5m is possible for both emitter and receiver connecting cable (optional)			
Material	Enclosure: Aluminum, Top / bottom end: Zinc diecasting, Inner case: PC / Polyester resin, Cap: PBT			
Accessory	MS-SF2B-2 (Intermediate supporting bracket): (Note 4) SF2B-TR27 (Test rod): 1 pc.		MS-SF2B-2 (Intermediate supporting bracket): (Note 4)	
Applicable standard	EN 61496-1 (Type 2), EN 55011, EN IEC 63000, EN ISO 13849-1: 2015 (Category 2,PLC) IEC 61496-1/2 (Type 2) ISO 13849-1: 2015 (Category 2, PLC), IEC 61508-1 to 7 (SIL1) JIS B 9704-1/2 (Type 2), JIS B 9705-1 (Category 2), JIS C 0508 (SIL1) ANSI/UL 61496-1/2 (Tvoe 2). UL 1998 (Class 1)			

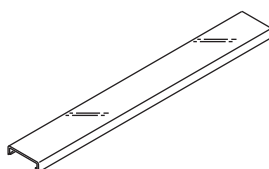
- Notes: 1) The operating ambient temperature is +20°C unless otherwise specified.
- 2) The bottom cap cable (**SF2B-CB05-B**) (optional) cannot be used when the auxiliary output (AUX) is used.
- 3) When **SF2B-H□** and **SF2B-A□** are combined in series connection, double the number of the beam channels of **SF2B-A□** to calculate the total number of beam channels, which should be 128 or less.
 <e.g.>: The total number of beam channels for **SF2B-H36** and **SF2B-A44SL** is 124.
 The number of beam channels of **SF2B-H36** + (the number of beam channels of **SF2B-A44SL** × 2)
 = Total number of beam channels
 36 beam channels + (44 beam channels × 2) = 124 beam channels
- 4) The intermediate supporting bracket (**MS-SF2B-2**) is enclosed with the following devices. The quantity of the enclosed bracket differs depending on the device as follows:
 1 set: **SF2B-H□**...40 to 56 beam channels, **SF2B-A□**...20 to 28 beam channels
 2 sets: **SF2B-H□**...64 to 80 beam channels, **SF2B-A□**...32 to 40 beam channels
 3 sets: **SF2B-H□**...88 to 96 beam channels, **SF2B-A□**...44 to 48 beam channels



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.

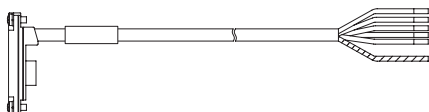


Model No.	Applicable beam channel No.		Remarks
FC-SF2BH-8	SF2B-H8-□	SF2B-A4-□	Protects the sensing surface of the device from dirt, etc. <Sensing range> Attached to the emitter side Wiring synchronization using 8-core cable: 11.5m Beam synchronization using 4-core cable: 4.5m Attached to the receiver side Wiring synchronization using 8-core cable: 11.5m Beam synchronization using 4-core cable: 4.5m Attached to the both side Wiring synchronization using 8-core cable: 10.0m Beam synchronization using 4-core cable: 4.0m
FC-SF2BH-12	SF2B-H12-□	SF2B-A6-□	
FC-SF2BH-16	SF2B-H16-□	SF2B-A8-□	
FC-SF2BH-20	SF2B-H20-□	SF2B-A10-□	
FC-SF2BH-24	SF2B-H24-□	SF2B-A12-□	
FC-SF2BH-28	SF2B-H28-□	SF2B-A14-□	
FC-SF2BH-32	SF2B-H32-□	SF2B-A16-□	
FC-SF2BH-36	SF2B-H36-□	SF2B-A18-□	
FC-SF2BH-40	SF2B-H40-□	SF2B-A20-□	
FC-SF2BH-48	SF2B-H48-□	SF2B-A24-□	
FC-SF2BH-56	SF2B-H56-□	SF2B-A28-□	
FC-SF2BH-64	SF2B-H64-□	SF2B-A32-□	
FC-SF2BH-72	SF2B-H72-□	SF2B-A36-□	
FC-SF2BH-80	SF2B-H80-□	SF2B-A40-□	
FC-SF2BH-88	SF2B-H88-□	SF2B-A44-□	
FC-SF2BH-96	SF2B-H96-□	SF2B-A48-□	

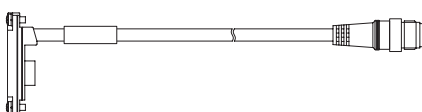
When the front protection cover is fitted, the sensing distance is shortened.

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

<Discrete wire>

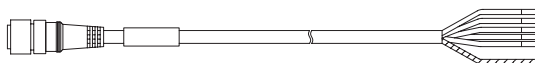


<Connector>



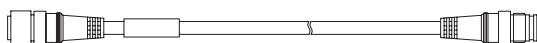
Type	Model No.	Cable length	Remarks
Discrete wire	SF2B-CCB3	3m	This cable is used for wiring synchronization. It is connected to the main unit of light curtain to be used for the connection to the safety relay, contactor, and control unit SF-C13 .
	SF2B-CCB7	7m	
	SF2B-CCB10	10m	
	SF2B-CCB15	15m	
Connector	SF2B-CB05	0.5m	For emitter: 8-core shielded cable For receiver: 8-core shielded cable
	SF2B-CB5	5m	
	SF2B-CB10	10m	

- 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 8-core bottom cap cable. For emitter: 8-core shielded cable For receiver: 8-core shielded cable
	SFB-CC10	10m	

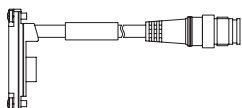
● 8-core extension cable with connectors on both ends: 1 pc.



Type	Model No.	Cable length	Remarks
For emitter	SFB-CCJ10E	10m	This cable is used for extending the 8-core bottom cap cable. The connector is attached on both ends of the cable. For emitter: 8-core shielded cable For receiver: 8-core shielded cable
For receiver	SFB-CCJ10D		

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

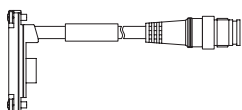
<Connector>



Type		Model No.	Cable length	Remarks
Connector	For SF2-A / SF2-N	SF2B-CB05-A	0.5m	This cable is used for wiring synchronization. For emitter: 8-core cable For receiver: 8-core cable For details, refer to “ 2-5 Wiring ”.

● 4-core bottom cap compatible cable: 2 pcs. /set

<Connector>



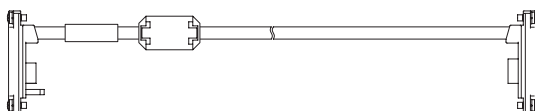
Type		Model No.	Cable length	Remarks
Connector	For NA40 / SF1-N	SF2B-CB05-B	0.5m	This cable is used for beam synchronization. For emitter: 4-core cable For receiver: 4-core cable

● Sub sensor exclusive for series connection: emitter and receiver /set



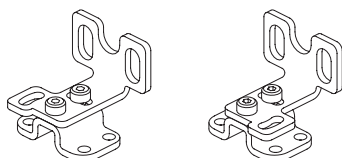
Model No.		Remarks
Min. sensing object ø27mm (20mm pitch) type	Min. sensing object ø47mm (40mm pitch) type	
SF2B-H8SL	SF2B-A4SL	This is used for the series connection of several emitters and receivers.
SF2B-H12SL	SF2B-A6SL	
SF2B-H16SL	SF2B-A8SL	
SF2B-H20SL	SF2B-A10SL	
SF2B-H24SL	SF2B-A12SL	
SF2B-H28SL	SF2B-A14SL	
SF2B-H32SL	SF2B-A16SL	
SF2B-H36SL	SF2B-A18SL	
SF2B-H40SL	SF2B-A20SL	
SF2B-H48SL	SF2B-A24SL	
SF2B-H56SL	SF2B-A28SL	
SF2B-H64SL	SF2B-A32SL	
SF2B-H72SL	SF2B-A36SL	
SF2B-H80SL	SF2B-A40SL	
SF2B-H88SL	SF2B-A44SL	
SF2B-H96SL	SF2B-A48SL	

- Cable for series connection: 2 pcs. /set

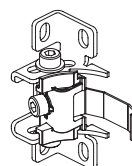


Model No.	Cable length	Remarks
SF2B-CSL01	0.1m	This cable is used for series connection.
SF2B-CSL05	0.5m	Common for emitter and receiver.

- Standard mounting bracket: 4 pcs. /set
- Dead zoneless mounting bracket: 4pcs. /set

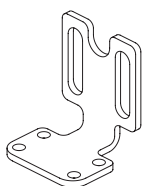


Model No.	Remarks
MS-SF2B-1	This mounting bracket enables easy beam alignment. For two hexagon-socket head bolts [M5].

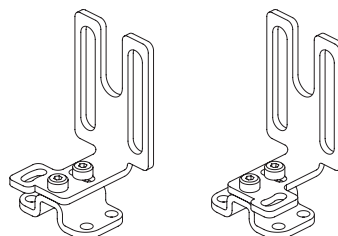


Model No.	Remarks
MS-SF2B-3	This is the mounting bracket for reducing the dead space. As for the mounting procedures, refer to the instruction manual supplied with the dead zoneless mounting bracket (MS-SF2B-3).

- Mounting pitch conversion bracket for NA40 / SF1-N: 4 pcs. /set
- Mounting pitch conversion bracket for SF2-A / SF2-N: 4 pcs. /set

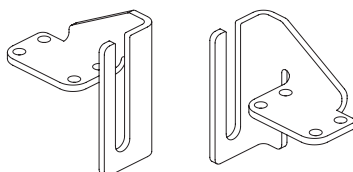


Model No.	Remarks
MS-SF2B-4	This is used for replacing from the NA40 / SF1-N.

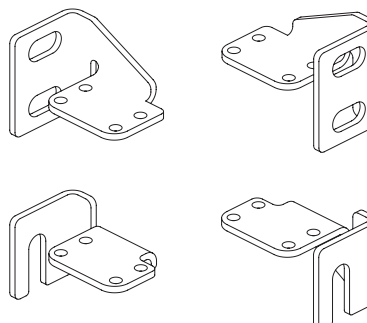


Model No.	Remarks
MS-SF2B-5	This is used for replacing from the SF2-A / SF2-N..

- Mounting pitch conversion bracket for NA40: 4 pcs. /set
- Mounting pitch conversion bracket for SF1-N: 4 pcs. /set

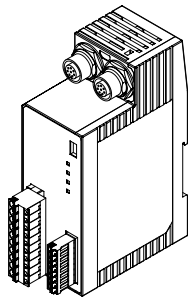


Model No.	Remarks
MS-SF2B-6	This is used for replacing from the NA40.



Model No.	Remarks
MS-SF2B-7	This is used for replacing from the SF1-N.

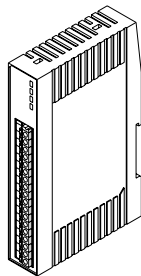
- Connector connection type control unit:
1 pc.



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

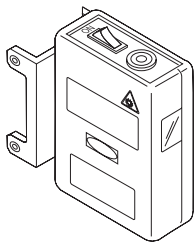
Note: This unit can be used only when the bottom cap cable **SF2B-CCB**□ or **SF2B-CB**□ (optional) is used.

- Thin type control unit: 1 pc.



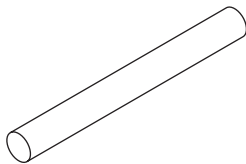
Model No.	Remarks
SF-C13	This is the controller conforming to European / North American safety standards.

- Laser alignment tool for light curtain:
1 pc.



Model No.	Remarks
SF-LAT-2B	Convenient for aligning the beam channels.

- Test rod: 1 pc.

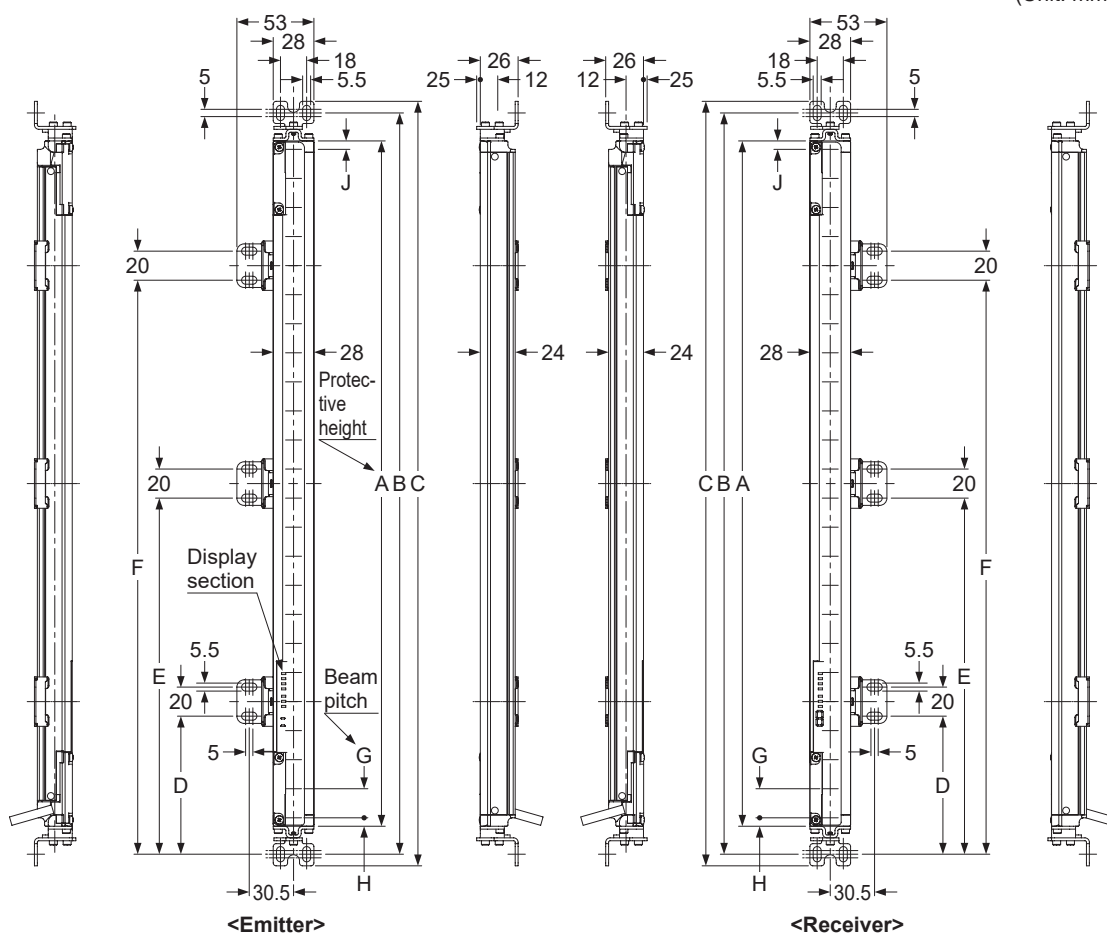


Model No.	Remarks
SF2B-TR47	Test rod for SF2B-A type. $\varnothing 47\text{mm}$.

6-3 Dimensions

6-3-1 Rear Mounting with Standard Mounting Bracket (MS-SF2B-1)

(Unit: mm)



Model No.		A	B	C	D	E	F
SF2B-H8-□	SF2B-A4-□	168	207	223	—	—	—
SF2B-H12-□	SF2B-A6-□	232	270	286	—	—	—
SF2B-H16-□	SF2B-A8-□	312	350	366	—	—	—
SF2B-H20-□	SF2B-A10-□	392	430	446	—	—	—
SF2B-H24-□	SF2B-A12-□	472	510	526	—	—	—
SF2B-H28-□	SF2B-A14-□	552	590	606	—	—	—
SF2B-H32-□	SF2B-A16-□	632	670	686	—	—	—
SF2B-H36-□	SF2B-A18-□	712	750	766	—	—	—
SF2B-H40-□	SF2B-A20-□	792	830	846	390	—	—
SF2B-H48-□	SF2B-A24-□	952	990	1,006	470	—	—
SF2B-H56-□	SF2B-A28-□	1,112	1,150	1,166	550	—	—
SF2B-H64-□	SF2B-A32-□	1,272	1,310	1,326	418	842	—
SF2B-H72-□	SF2B-A36-□	1,432	1,470	1,486	472	948	—
SF2B-H80-□	SF2B-A40-□	1,592	1,630	1,646	525	1,055	—
SF2B-H88-□	SF2B-A44-□	1,752	1,790	1,806	433	870	1,308
SF2B-H96-□	SF2B-A48-□	1,912	1,950	1,966	473	950	1,428

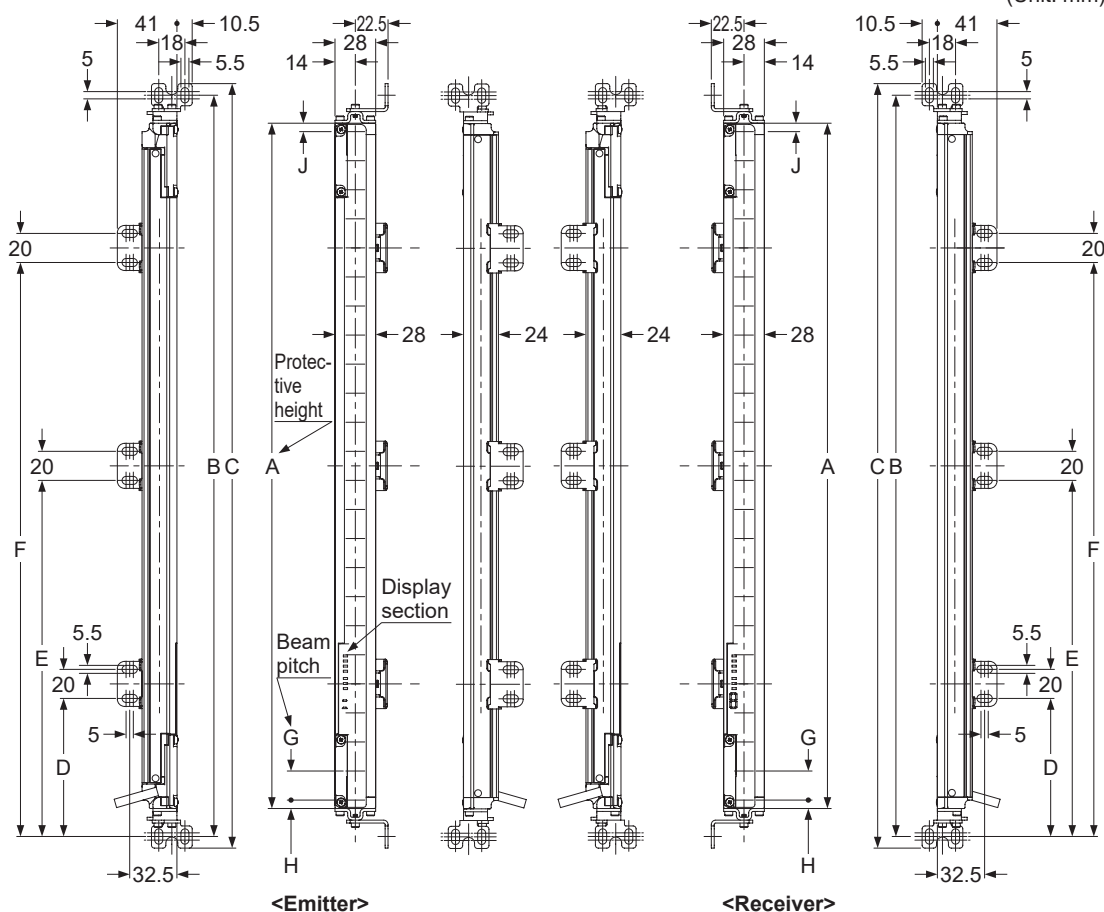
Type	G	H	J
SF2B-H□	20	6	6 (Note 1)
SF2B-A□	40	26	6 (Note 1)

Notes: 1) The distance between the tip of the light curtain and the last beam-axis of the **SF2B-H8-□** and **SF2B-A4-□** is 22mm.

2) The intermediate supporting bracket (**MS-SF2B-2**) is enclosed with the devices. The number of the brackets varies depending on the device.

6-3-2 Side Mounting with Standard Mounting Bracket (MS-SF2B-1)

(Unit: mm)



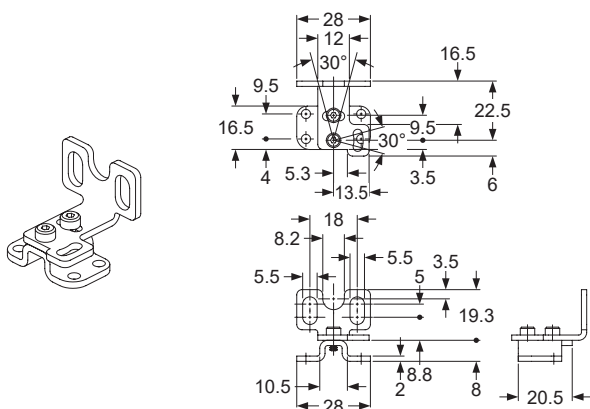
Model No.		A	B	C	D	E	F
SF2B-H8-□	SF2B-A4-□	168	207	223	—	—	—
SF2B-H12-□	SF2B-A6-□	232	270	286	—	—	—
SF2B-H16-□	SF2B-A8-□	312	350	366	—	—	—
SF2B-H20-□	SF2B-A10-□	392	430	446	—	—	—
SF2B-H24-□	SF2B-A12-□	472	510	526	—	—	—
SF2B-H28-□	SF2B-A14-□	552	590	606	—	—	—
SF2B-H32-□	SF2B-A16-□	632	670	686	—	—	—
SF2B-H36-□	SF2B-A18-□	712	750	766	—	—	—
SF2B-H40-□	SF2B-A20-□	792	830	846	390	—	—
SF2B-H48-□	SF2B-A24-□	952	990	1,006	470	—	—
SF2B-H56-□	SF2B-A28-□	1,112	1,150	1,166	550	—	—
SF2B-H64-□	SF2B-A32-□	1,272	1,310	1,326	418	842	—
SF2B-H72-□	SF2B-A36-□	1,432	1,470	1,486	472	948	—
SF2B-H80-□	SF2B-A40-□	1,592	1,630	1,646	525	1,055	—
SF2B-H88-□	SF2B-A44-□	1,752	1,790	1,806	433	870	1,308
SF2B-H96-□	SF2B-A48-□	1,912	1,950	1,966	473	950	1,428

Type	G	H	J
SF2B-H□	20	6	6 (Note 1)
SF2B-A□	40	26	6 (Note 1)

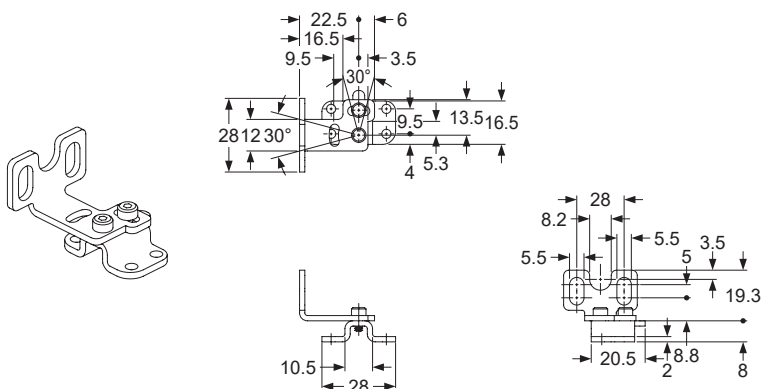
- Notes: 1) The distance between the tip of the light curtain and the last beam-axis of the **SF2B-H8-□** and **SF2B-A4-□** is 22mm.
- 2) The intermediate supporting bracket (**MS-SF2B-2**) is enclosed with the devices. The number of the brackets varies depending on the device.

(Unit: mm)

<For rear mounting>

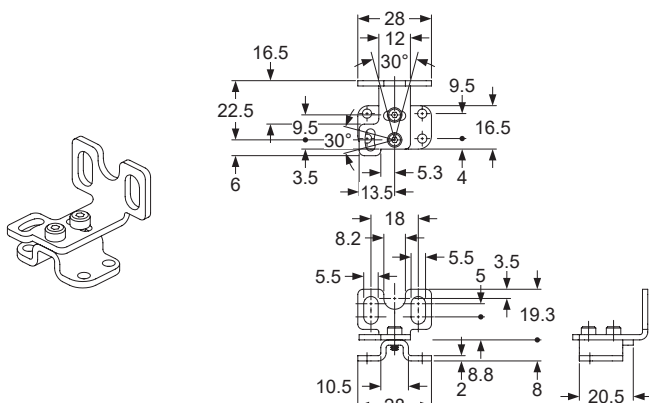


<For side mounting>



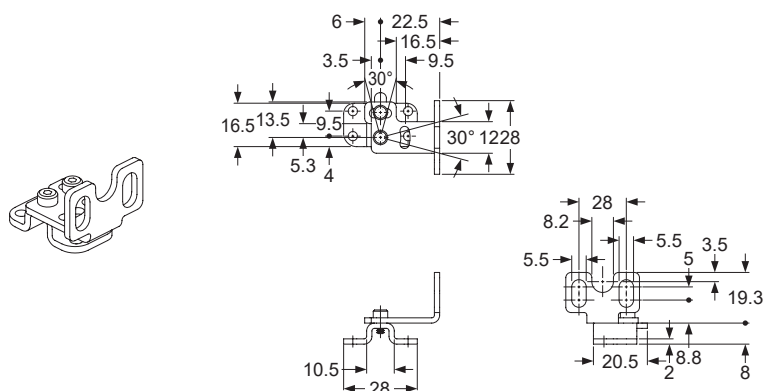
2) Standard mounting bracket / MS-SF2B-1(L)

<For rear mounting>



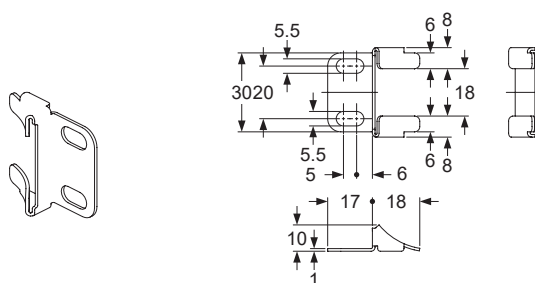
Material: Stainless steel (SUS304)

<For side mounting>



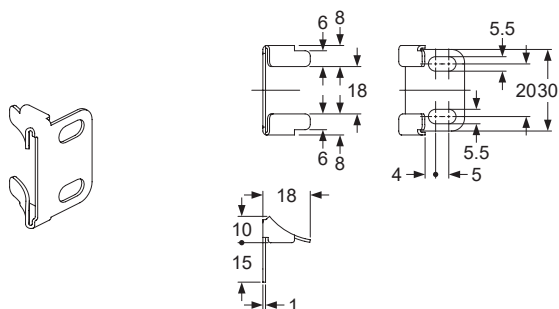
Material: Stainless steel (SUS304)

3) Intermediate supporting bracket / MS-SF2B-2 (For rear mounting)



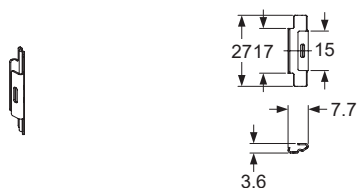
Material: Stainless steel (SUS304)

4) Intermediate supporting bracket / MS-SF2B-2 (For side mounting)



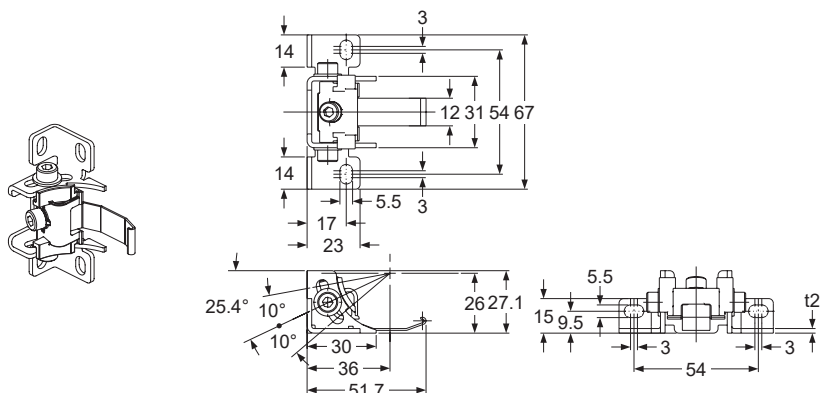
Material: Stainless steel (SUS304)

5) Intermediate supporting bracket / MS-SF2B-2 (For main body mounting)



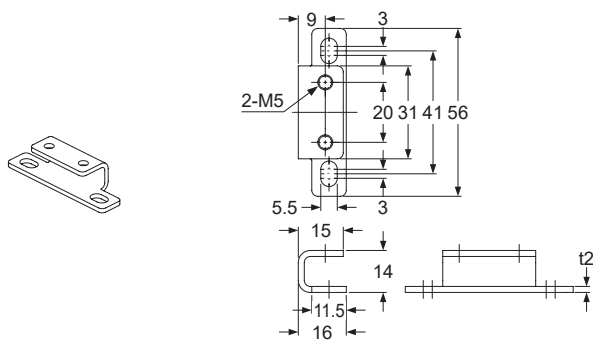
Material: Stainless steel (SUS304)

6) Dead zoneless mounting bracket / MS-SF2B-3



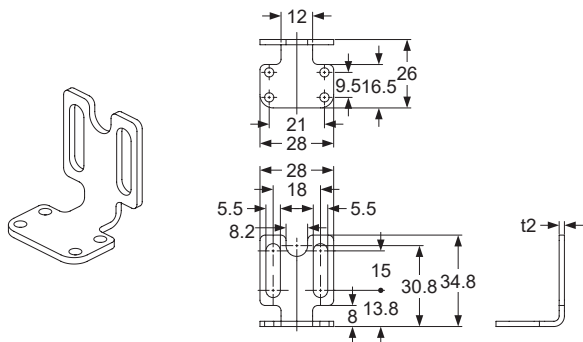
Material: Stainless steel (SUS304)

<Spacer for intermediate supporting bracket>



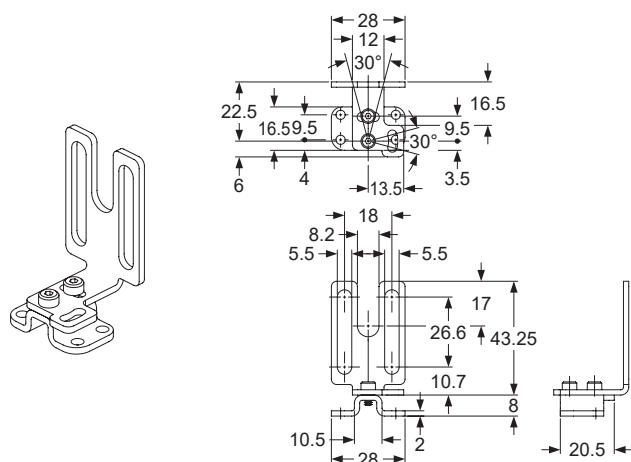
Material: Stainless steel (SUS304)

7) Mounting pitch conversion bracket for NA40 / SF1-N / MS-SF2B-4



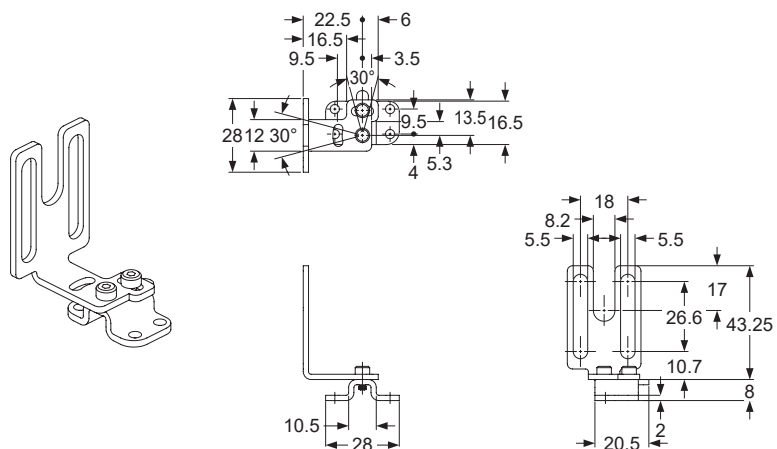
Material: Stainless steel (SUS304)

8) Mounting pitch conversion bracket for SF2-A /SF2-N / MS-SF2B-5 (R) **<For rear mounting>**



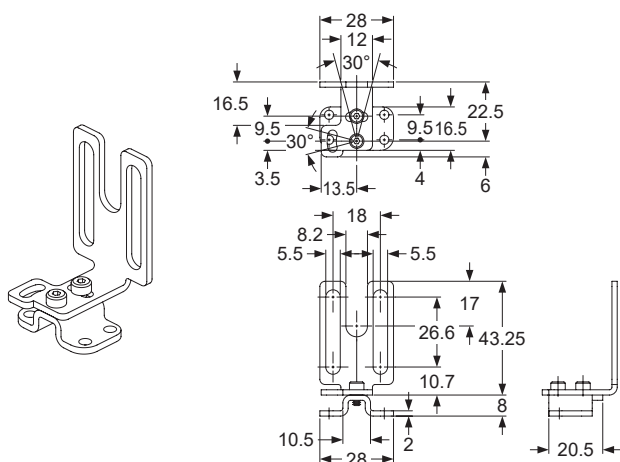
Material: Stainless steel (SUS304)

<For side mounting>



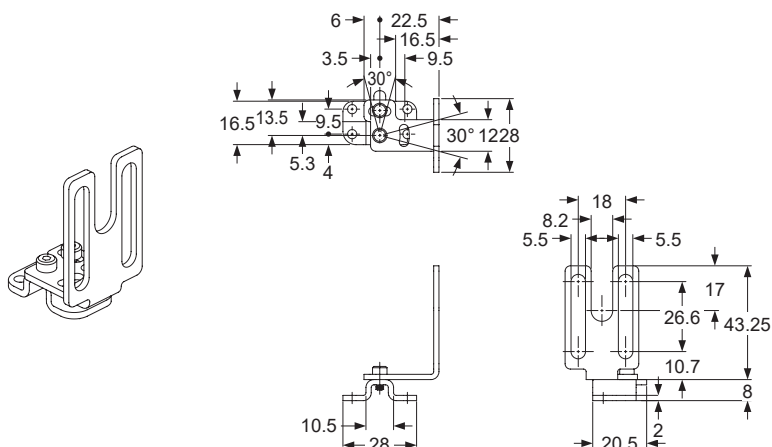
Material: Stainless steel (SUS304)

9) Mounting pitch conversion bracket for SF2-A / SF2-N / MS-SF2B-5 (L) <For rear mounting>



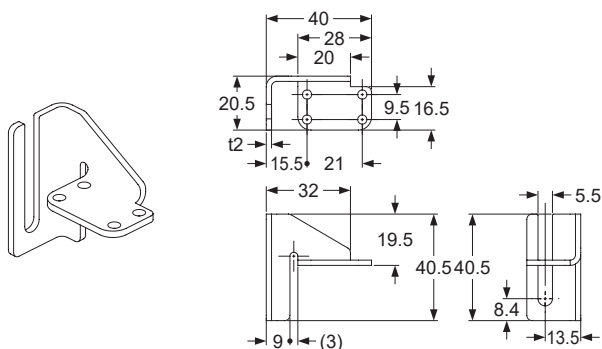
Material: Stainless steel (SUS304)

<For side mounting>



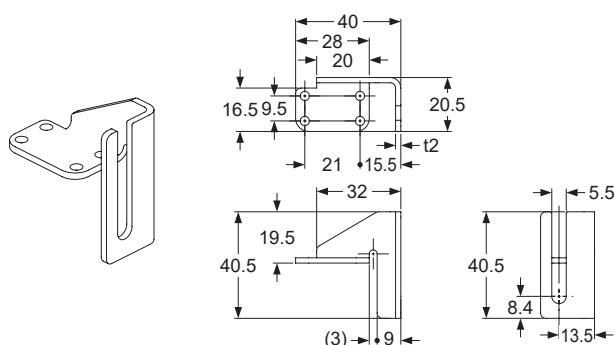
Material: Stainless steel (SUS304)

10) Mounting pitch conversion bracket for NA40 / MS-SF2B-6 (R)



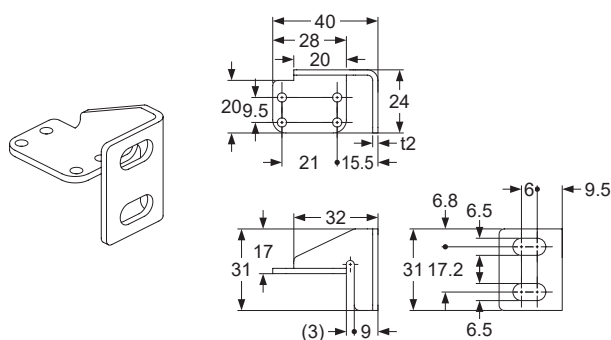
Material: Stainless steel (SUS304)

11) Mounting pitch conversion bracket for NA40 / MS-SF2B-6 (L)



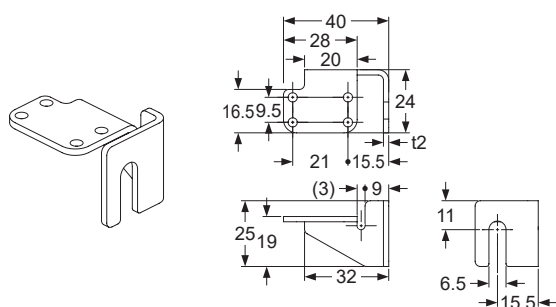
Material: Stainless steel (SUS304)

12) Mounting pitch conversion bracket for SF1-N / MS-SF2B-7 (For mounting on the right side and the top of the main body)



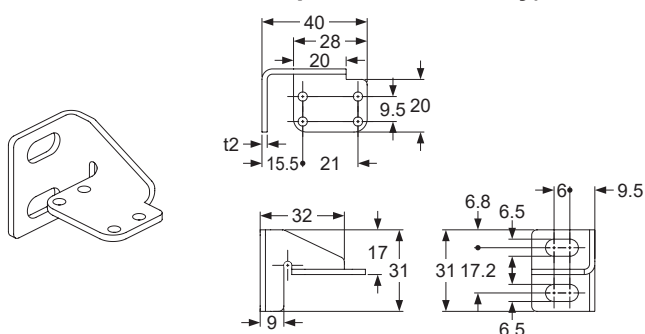
Material: Stainless steel (SUS304)

13) Mounting pitch conversion bracket for SF1-N / MS-SF2B-7 (For mounting on the right side and the bottom of the main body)



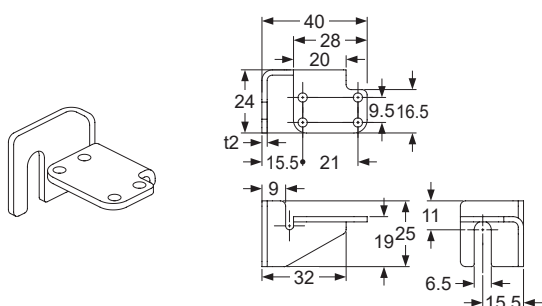
Material: Stainless steel (SUS304)

14) Mounting pitch conversion bracket for SF1-N / MS-SF2B-7 (For mounting on the left side and the top of the main body)



Material: Stainless steel (SUS304)

15) Mounting pitch conversion bracket for SF1-N / MS-SF2B-7 (For mounting on the left side and the bottom of the main body)



Material: Stainless steel (SUS304)

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: 2015 ISO 13849-1: 2015 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.

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	<p>This function enables checking of the receiver operation by turning OFF light emission.</p> <p>Wiring synchronization using 8-core cable: It is possible to halt emission by keeping the terminal open, and to have normal emission by connecting it to 0V or +V.</p> <p>Beam synchronization using 4-core cable: It is possible to halt emission by connecting it to 0V or +V, and to have normal emission by keeping the terminal open.</p>
PSDI	<p>The abbreviation for the Presence Sensing Device Initiation.</p> <p>The safety device that restarts automatically without any operation by the operator after the device detects danger status and halts for a while.</p>

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: SF2B Series

Trade Name: Panasonic

Application of Council Directive:

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

Applicable Standard(s):

- | | |
|------------------------|---------------|
| - EN 61496-1 | - IEC 61496-1 |
| - EN ISO 13849-1: 2015 | - IEC 61496-2 |
| - EN 55011 | - IEC 61508-1 |
| - EN IEC 63000 | - IEC 61508-2 |
| | - IEC 61508-3 |
| | - IEC 61508-4 |

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

Revision history	Revision date	Revision item
1st edition	April , 2006	
2nd edition	June , 2006	—
3rd edition	February , 2007	—
4th edition	October , 2008	—
5th edition	October , 2009	—
6th edition	June , 2010	—
7th edition	December , 2010	—
8th edition	January , 2012	—
9th edition	January , 2013	—
10th edition	March , 2014	—
11th edition	May , 2014	—
12th edition	December , 2014	—
13th edition	October , 2015	—
14th edition	January , 2016	—
15th edition	April , 2021	<ul style="list-style-type: none"> • Corrected errors. • Updated information of connection cable.
16th edition	September , 2021	<ul style="list-style-type: none"> • Changed the Standards.

(MEMO)

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.

2. EXCLUSIONS:

- (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.

3. DISCLAIMERS

- (1) Panasonic Industrial Devices SUNX's sole obligation and liability under this warranty is limited to the repair or replacement, or refund of the purchase price, of a defective Product, at Panasonic Industrial Devices SUNX's option.
- (2) THE REPAIR, REPLACEMENT, OR REFUND IS THE EXCLUSIVE REMEDY OF THE PURCHASER, AND ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF PROPRIETARY RIGHTS, ARE HEREBY EXPRESSLY DISCLAIMED. IN NO EVENT SHALL PANASONIC INDUSTRIAL DEVICES SUNX AND ITS AFFILIATED ENTITIES BE LIABLE FOR DAMAGES IN EXCESS OF THE PURCHASE PRICE OF THE PRODUCTS, OR FOR ANY INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES OF ANY KIND, GENERAL TERMS AND CONDITIONS 4 OR ANY DAMAGES RESULTING FROM LOSS OF USE, BUSINESS INTERRUPTION, LOSS OF INFORMATION, LOSS OR INACCURACY OF DATA, LOSS OF PROFITS, LOSS OF SAVINGS, THE COST OF PROCUREMENT OF SUBSTITUTED GOODS, SERVICES OR TECHNOLOGIES, OR FOR ANY MATTER ARISING OUT OF OR IN CONNECTION WITH THE USE OR INABILITY TO USE THE PRODUCTS.

4. CAUTIONS FOR SAFE USE

- (1) The applications shown in the catalogue are only suggestions, and it is Purchaser's sole responsibility to ascertain the fitness and suitability of the Products for any particular application, as well as to abide by Purchaser's applicable local laws and regulations, if any.
- (2) Never use the Products NOT rated or designated as "SAFETY SENSOR" in any application involving risk to life or property. When such a use is made by Purchaser, such Purchaser shall indemnify and hold harmless Panasonic Industrial Devices SUNX from any liability or damage whatsoever arising out of or in relation to such use.
- (3) In incorporating the Products to any equipment, facilities or systems, it is highly recommended to employ fail-safe designs, including but not limited to a redundant +++design, flame propagation prevention design, and malfunction prevention design so as not to cause any risk of bodily injury, fire accident, or social damage due to any failure of such equipment, facilities or systems.
- (4) The Products are each intended for use only in environments commonly found in manufacturing industry, and, unless expressly allowed in the catalogue, specification or otherwise, shall not be used in, or incorporated into, any equipment, facilities or systems, such as those:
 - (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.

Please contact

Panasonic Corporation

Panasonic Industrial Devices SUNX Co., Ltd.
<https://panasonic.net/id/pidsx/global>

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