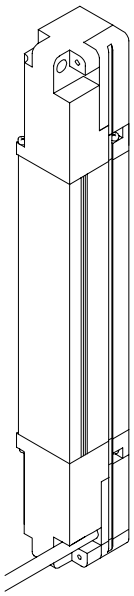
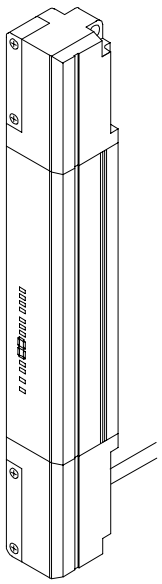
INSTRUCTION MANUAL

Light Curtain

Type 4
SF4B Series





(MEMO)

Thank you for purchasing SUNX's Light Curtain, **SF4B** series (hereinafter called 'this device').
Please read this instruction manual carefully and thoroughly for the correct and optimum use of this product.
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

Note

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 product.
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 SUNX office of the nearest distributor.

Contents

Introduction

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.

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.
- Use of this device under the following conditions or environment 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 and environment not described in this manual.
  2) Using this device in the following fields: nuclear power control, railroad, aircraft, automobiles, 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 applying this device to particular equipment, 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 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 product functions as intended to and systems including this product 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.

⚠WARNING

◎ 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.
- Install the sensor by considering the effect of nearby reflective surfaces, and take countermeasures, such as painting, masking, roughening, or changing the material of the reflective surfaces, etc. Failure to do so may cause the sensor not to detect, resulting in death or serious body injury.
- Do not install this device in the following environments.
  1) Areas exposed to intense interference (extraneous) light such as 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
  7) Areas where the beam-receiving part of this device is directly exposed to light from high-frequency fluorescent lamp (inverter type) or rapid starter fluorescent lamp.

◎ 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.
- Do not use this device in a reflective configuration.
- The corresponding emitter and receiver must have the same serial No. and be correctly oriented.

◎ Equipment in which this device is installed

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

⚠WARNING

◎ **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 sensor cable together with high-voltage lines or power lines or put them together in the same raceway.
- In case of extending the cable of the emitter or the receiver, each can be extended up to 50m by using the exclusive cable. Furthermore, if the cable is extended in the state that the sensor is in series connection, or the muting lamp is used, the total extendable length of the cable depends on the number of the sensors in series connection. For details, refer to '**1-5-3 Wiring･Connecting procedure**'.
- Do not control the device only at one control output (OSSD 1, OSSD 2).

◎ **Maintenance**

- When replacement parts are required, always use only genuine supplied replacement parts. If substitute parts from another manufacturer are used, the sensor may not come to detect, result in death or serious body 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 evice following the procedure specified in '**Chapter 3　Maintenance**'.
- Clean this device with a clean cloth. Do not use any volatile chemical.

◎ **Others**

- Never modify this device. Modification may cause the sensor not to detect, resulting in death or serious body 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.

Applicable Standards

This device corresponds to the following standards.

Corresponding Territory	Standard No.	Authorizing Organization
Japan	JIS B 9704-1/2 (Type 4) JIS B 9705-1 (ISO 13849-1) (Category 4)	—
Europe (EU)	EN 61496-1 (Type 4) IEC 61496-1/2 (Type 4) EN 954-1 (Category 4)	DEMKO
United States of America Canada	IEC 61496-1/2 (Type 4) UL 61496-1/2 (Type 4) UL 1998	UL
	OSHA 1910.212 OSHA 1910.217(C) ANSI B11.1 to B11.19 ANSI/RIA 15.06	—

<Reference>

Since JIS, OSHA and ANSI are not the authorizing organization for this device, the conformity to there standards has been evaluated by ourselves.

In Canada, the c(UL)us mark has the same validity as the CSA mark.

This device conforms to the EMC directive and the Machinery directive. The CE mark on the sensor main body indicates that this product 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 in the table above, be sure to confirm the standards or regulations applicable in each region or country before use.

Confirmation of Packed Contents

☐Sensor: Emitter, Receiver — each 1pc.

☐Test Rod — 1 pc.

For **SF4B-F**☐: **SFB-TR14** (ϕ14×220mm), For **SF4B-H**☐: **SFB-TR25** (ϕ25×220mm)

☐Intermediate Supporting Bracket (**MS-SFB-2**) — 0 to 3 sets

Note: The intermediate support bracket (**MS-SBF-2**) is enclosed with the following products. The quantity differs depending on the product as shown below:

1 set: **SF4B-F**☐・・・Sensor with 79 to 111 beam channels
SF4B-H☐・・・Sensor with 40 to 56 beam channels
SF4B-A☐・・・Sensor with 20 to 28 beam channels

2 sets: **SF4B-F127**, **SF4B-H**☐・・・Sensor with 64 to 80 beam channels
SF4B-A☐・・・Sensor with 32 to 40 beam channels

3 sets: **SF4B-H**☐・・・Sensor with 88 to 96 beam channels
SF4B-A☐・・・Sensor with 44 to 48 beam channels

☐Instruction Manual (this manual) — 1 pc.

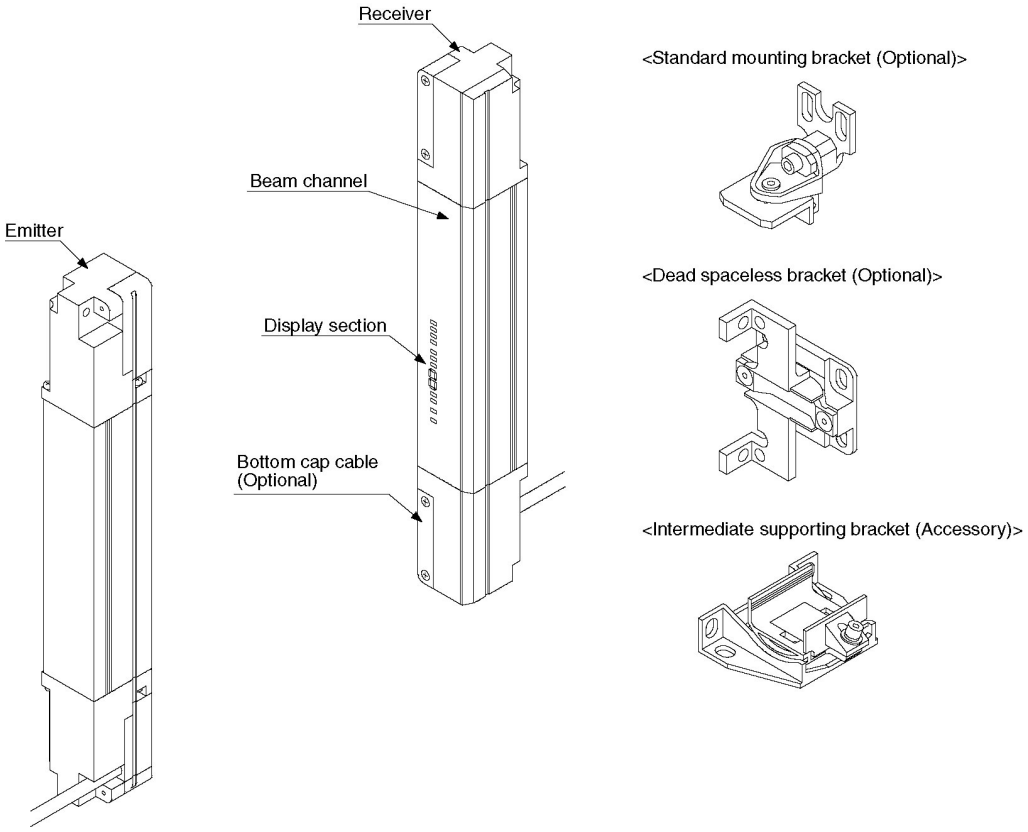
Chapter 1 Before Using This Device

1-1 Features

This device is the light curtain with the following features.

- No special controller is required.
- The control output (OSSD 1, OSSD 2) is PNP/NPN output switching type.
- Beam-axis alignment indicators which make beam-axis alignment easy are incorporated.
- Each function setting is available by using the handy controller (**SFB-HC**) (available soon). Refer to '**2-9 Function Using Handy Controller (SFB-HC) (Available Soon)**' for details.
- Refer to '**5-2 Options**' for details of options.

1-2 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.

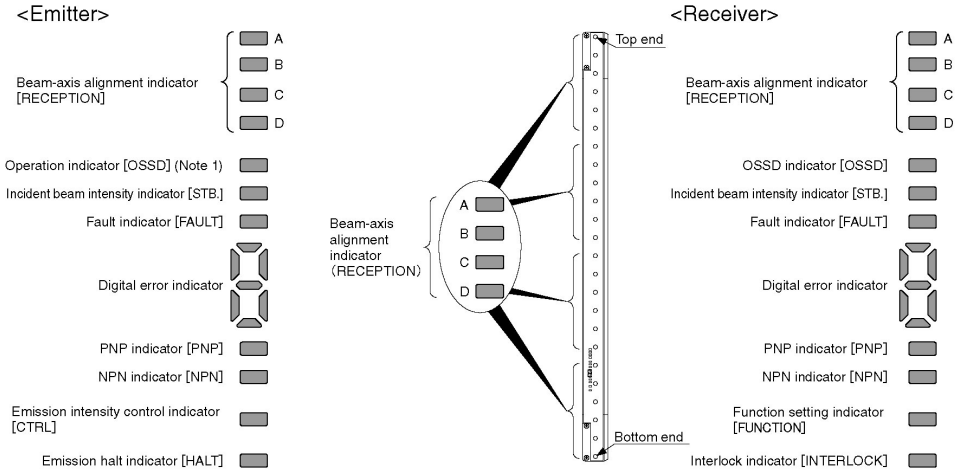
Receiver : It receives light from the emitter facing it. Simultaneously, it turns ON the control output (OSSD 1, OSSD 2) when the all beam channels receive light from emitter, and it turns OFF the control output (OSSD1, OSSD2) when one or more beam channels are blocked light [except when the muting function (Note 1) and blanking function (Note 2) are used]. Besides, the receiver displays its status on the display section.

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

2) The blanking function is set by using the handy controller (**SFB-HC**) (optional). Please purchase the handy controller separately. Besides, in case of using the 12-core cable, the handy-controller connection cable (**SFB-CCJ02-HC**) (optional) is also required. Please purchase it separately as well.

Beam channel	:	The light emitting elements of the emitter and the light receiving elements of the receiver are placed at the following intervals, 10mm (**SF4B-F□**), 20mm (**SF4B-H□**), and 40mm (**SF4B-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.
Dead spaceless bracket (optional)	:	This dead spaceless bracket is used for mounting both emitter and receiver. This bracket is useful for mounting the sensor to the limited mounting space.
Intermediate supporting bracket (optional)	:	This bracket is to be used for mounting the sensor having 79 beam channels or more for **SF4B-F□,** 40 beam channels or more for **SF4B-H□**, 20 beam channels or more for **SF4B-A□** in places where vibration is intense. If the intermediate supporting bracket is not used for mounting, the condition for type4 is not satisfied. Be sure to use the intermediate supporting bracket for mounting.

Display section:



Description		Function
Beam-axis alignment indicator (Red / Green) [RECEPTION]	A	When sensor top receives light: lights up in red When sensor top end receives light: blinks in red When control output (OSSD 1, OSSD 2) is ON: lights up in green
	B	When sensor upper middle receives light: lights up in red When control output (OSSD 1, OSSD 2) is ON: lights up in green
	C	When sensor lower middle receives light: lights up in red When control output (OSSD 1, OSSD 2) is ON: lights up in green
	D	When sensor bottom receives light: lights up in red When sensor bottom end receives light: blinks in red When control output (OSSD 1, OSSD 2) is ON: lights up in green
Operation indicator (Red / Green) [OSSD] (Note 1)		Lights up while sensor operation is as follows [sequential operation (OSSD 1, OSSD 2)]: When control output (OSSD 1, OSSD 2) is OFF: lights up in red When control output (OSSD 1, OSSD 2) is ON: lights up in green
Incident beam intensity indicator (Orange / Green) [STB.]		When sufficient light is received (incident beam: 130% or more) (Note 2): lights up in green When stable light is received (incident beam: 115 to 130%) (Note 2): OFF When unstable light is received (incident beam: 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 sensor: lights up or blink
Digital error indicator (Red)		When device is lockout: lights up for indicating error content
PNP indicator (Orange) [PNP]		When PNP output is set: lights up
NPN indicator (Orange) [NPN]		When NPN output is set: lights up
Emission intensity control indicator (Orange) [CTRL]		When light is emitted under short mode: lights up When light is emitted under normal mode: lights off
Emission halt indicator (Orange) [HALT]		When light emission is halt: lights up When light is emitted: lights off

Description		Function
Beam-axis alignment indicator (Red / Green) [RECEPTION]	A	When sensor top receives light: lights up in red When sensor top end receives light: blinks in red When control output (OSSD 1, OSSD 2) is ON: lights up in green
	B	When sensor upper middle receives light: lights up in red When control output (OSSD 1, OSSD 2) is ON: lights up in green
	C	When sensor lower middle receives light: lights up in red When control output (OSSD 1, OSSD 2) is ON: lights up in green
	D	When sensor bottom receives light: lights up in red When sensor bottom end receives light: blinks in red When control output (OSSD 1, OSSD 2) is ON: lights up in green
OSSD indicator (Red / Green) [OSSD]		When control output (OSSD 1, OSSD 2) is OFF: lights up in red When control output (OSSD 1, OSSD 2) is ON: lights up in green
Incident beam intensity indicator (Orange / Green) [STB.]		When sufficient light is received (incident beam: 130% or more) (Note 2): lights up in green When stable light is received (incident beam: 115 to 130%) (Note 2): OFF When unstable light is received (incident beam: 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 sensor: lights up or blinks
Digital error indicator (Red)		When device is lockout: lights up for indicating error content
PNP indicator (Orange) [PNP]		When PNP output is set: lights up
NPN indicator (Orange) [NPN]		When NPN output is set: lights up
Function setting indicator (Orange) [FUNCTION]		When blanking function is used: lights up (Note 4) When handy controller is connected: blinks
Interlock indicator (Yellow) [INTERLOCK]		When device is interlocked: lights up other cases: OFF

Notes: 1) Since the color of the operation indicator changes according to the ON/OFF status of the control output (OSSD 1, OSSD 2), the operation indicator is marked as 'OSSD' on the sensor.
2) The threshold where the control output (OSSD 1, OSSD 2) changes from OFF to ON is applied as '100% incident beam intensity'.
3) The status 'when light is blocked' refers to the status that the some obstacle is existed in the sensing area.
4) The blanking function is set by using the handy controller (**SFB-HC**) (optional). Please purchase the handy controller separately. Besides, in case of using the 12-core cable, the handy controller connection cable (**SFB-CCJ02-HC**) (optional) is also required. Please purchase it separately as well.
5) The description given in [ ] is marked on the sensor.

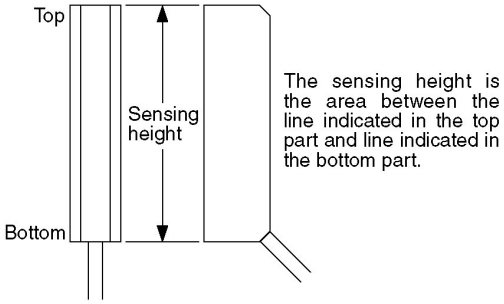
1-3 Protection Area

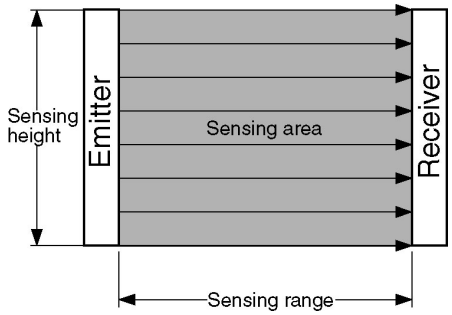
1-3-1 Sensing Area

⚠WARNING

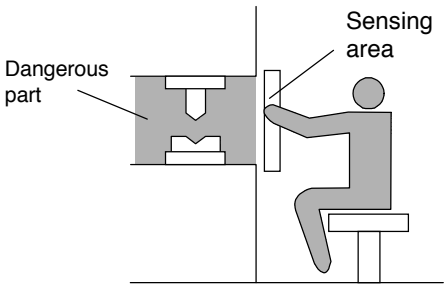
- Be sure to install protection structure around the machine so that the operator must pass through the sensing area of this device to reach the dangerous parts of the machine. Furthermore, ensure that some part of the operator's body always remains in the sensing area when operation is done with the dangerous parts of the machine. Failure to do so can result in serious injury or death.
- Do not use any reflection type or recursive reflection type arrangement.
- When connecting the sensor, use the correct combination of emitter and receiver (same beam pitch and number of beam channels) and match their top-bottom orientation. Combining different types of emitter and receiver could produce a non-sensing area, which may result in serious injury or death.
- Furthermore, facing several receivers towards one emitter, or vice versa, could produce a non-sensing area or cause mutual interference, which may result in serious injury or death.

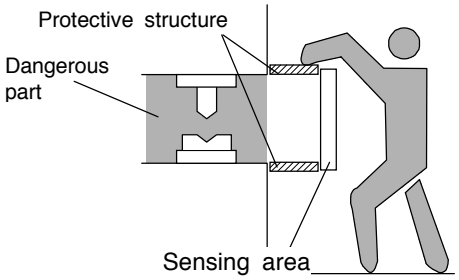
The sensing area is the zone formed by the sensing height of the sensor and the sensing range between the emitter and the receiver. The sensing height is determined by the number of beam channels. Furthermore, the sensing range can be 0.3 to 9m for **SF4B-H□** (12 to 64 beam channels) and **SF4B-A□** (6 to 32 beam channels), 0.3 to 7m for **SF4B-F□** and **SF4B-H□** (72 to 96 beam channels) and **SF4B-A□** (36 to 48 beam channels). Take care that the sensing range becomes short after mounting either protection cover (**FC-SFBH-□**) (optional) or slit (**OS-SFBH-□**) (optional). Take care that if the sensing range is less than 0.3m, malfunction may occur due to the optical structure.



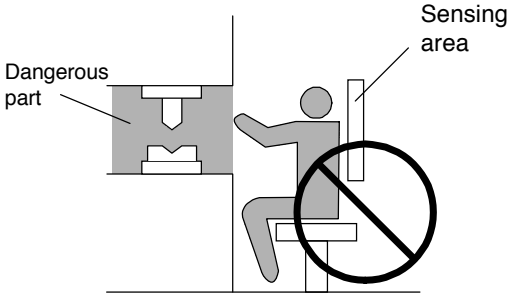


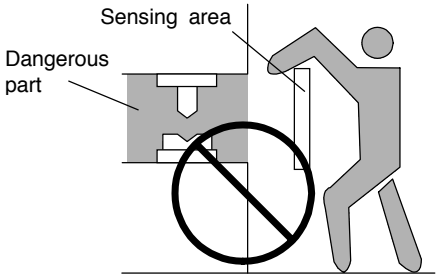
<Example of Correct Installation>





<Example of Incorrect Installation>



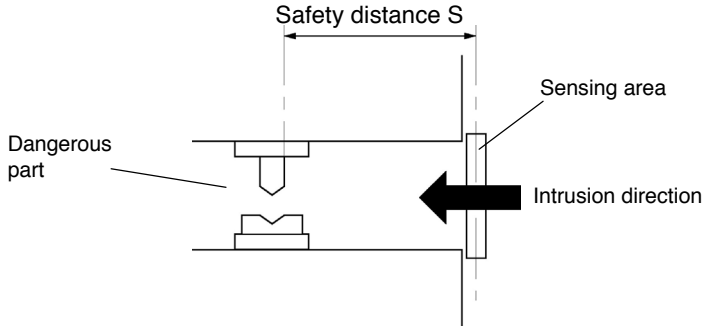


1-3-2 Safety Distance

⚠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 serious injury or death.

The safety distance is the minimum distance that must be maintained between the light curtain 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 area sensor.



⚠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 part of the machine stops. The max. response time of the machine should be timed with the machine to be actually used.

⚠WARNING

The applicable pitch of the beam channel for this device varies depending on the case whether the floating blanking function is applied or not, and the size of the minimum sensing object is also changed. The equation differs depending on the case whether the minimum sensing object is larger than ϕ40mm or not. Calculate the safety distance with the proper size of the minimum sensing object and appropriate equation.
<Size of minimum sensing object when applying floating blanking function>

	Floating blanking function			
	Invalid	Setting (Note)		
		1 beam channel	2 beam channels	3 beam channels
SF4B-F□ (10mm beam channel pitch type)	ϕ14mm	ϕ24mm	ϕ34mm	ϕ44mm
SF4B-H□ (20mm beam channel pitch type)	ϕ25mm	ϕ45mm	ϕ65mm	ϕ85mm
SF4B-A□ (40mm beam channel pitch type)	ϕ45mm	ϕ85mm	ϕ125mm	ϕ165mm

Note: Refer to '**2-9 Functions Using Handy Controller (SFB-HC) (Available Soon)**' for details of the floating blanking function.

[For use in Europe (EU) (as EN 999)] (Also applicable to ISO 13855)
(For intrusion direction perpendicular to the sensing area)
<In case that the minimum sensing object is ϕ 40mm or less>

- Equation ① $S=K\times T+C$

S: Safety distance (mm)

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

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

Taken as 2,000 (mm/s) for calculation

T: Response time of total equipment (s)

$T=T_m+T_{SF4B}$

T_m: Maximum halting time of device (s)

T_{SF4B}: Response time of this device (s)

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

However, the value of C cannot be 0 or less.

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

d: Minimum sensing object diameter (mm)

<Reference>

- For calculating the safety distance S, there are the following five cases.
  First calculate by substituting the value K=2,000 (mm/s) 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/s). 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**'.
  For calculating T_m (maximum halt time of the device), use a special device called a 'brake monitor'.
- 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 the case that the minimum sensing object is ϕ 40mm or less>

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

S: Safety distance (mm)

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

Taken as 1,600 (mm/s) for calculation

T: Response time of total equipment (s)

$T=T_m+T_{SF4B}$

T_m: Maximum halting time of device (s)

T_{SF4B}: Response time of this device (s)

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

C=850 (mm)

<Calculation Example>

・ Calculation Example ① For use in Europe
(OFF response time: 14ms or less, minimum sensing object diameter: 14mm)
First, calculate with K=2,000.

$S=K\times T+C$
$=K\times(T_m+T_{SF4B})+8\times(d-14)$
$=2,000\times(T_m+0.014)+8\times(14-14)$
$=2,000\times T_m+2,000\times 0.014$
$=2,000\times T_m+28$

If the result is:

1) In case S<100 (mm)
Safety distance S is taken as 100 (mm)
2) In case 100≦S≦500 (mm)
Safety distance S is taken as $2,000\times T_m+20$ (mm)
3) In case S>500 (mm)

$S=K'\times(T_m+T_{SF4B})+8\times(d-14)$
$=1,600\times(T_m+0.014)+8\times(14-14)$
$=1,600\times T_m+1,600\times 0.014$
$=1,600\times T_m+22.4$

then, calculate again.
If the result is:

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

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

$S=2,000\times T_m+28$
$=2,000\times 0.1+28$
$=228$

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

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

$S=2,000\times T_m+28$
$=2,000\times 0.4+28$
$=828$

Since this value matches with Case 3) above,

$S=1,600\times T_m+22.4$
$=1,600\times 0.4+22.4$
$=662.4$

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

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

- Equation ② $S=K\times(T_s+T_c+T_{SF4B}+T_{bm})+Dpf$

S : 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/s) [≒1,600 (mm/s)]}
ANSI B11.19 does not define the intrusion speed 'K'. When determining K, consider possible factors including physical ability of operators.

T_s : Halting time calculated from the operation time of the control element (air valve, etc.) (s)

T_c : Maximum response time of the control circuit required for functioning the brake (s)

T_{SF4B} : Response time of this device (s)

T_{bm} : Additional halting time tolerance for the brake monitor (s)
The following equation holds when the machine is equipped with a brake monitor.

$T_{bm}=T_a-(T_s+T_c)$

T_a: Setting time of brake monitor (s)
When the machine is not equipped with a brake monitor, it is recommended that 20% or more of (T_s+T_c) is taken as additional halting time.

Dpf : Additional distance calculated from the size of the minimum sensing of the sensor (mm)
SF4B-F□ Dpf=23.8mm
SF4B-H□ Dpf=61.2mm
SF4B-A□ Dpf=129.2mm

Dpf = 3.4×(d−0.276) (inch)
≒3.4×(d−7) (mm)
d: Minimum sensing object diameter 0.552 (inch)≒14 (mm) **SF4B-F**□
Minimum sensing object diameter 0.985 (inch)≒25 (mm) **SF4B-H**□
Minimum sensing object diameter 1.772 (inch)≒45 (mm) **SF4B-A**□
Note that the value of Dpf cannot be 0 or less.

<Reference>

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

<Calculation Example>

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

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

$S=K\times(T_s+T_c+T_{SF4B}+T_{bm})+Dpf$
$=63\times(T_a+0.014)+3.4\times(d-0.276)$ (inch)
$=63\times(T_a+0.014)+3.4\times(0.552-0.276)$
$=63\times T_a+63\times0.014+3.4\times0.276$
$=63\times T_a+1.8204$
≒$63\times T_a+1.82$ (inch)

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

$S=63\times T_a+1.82$
$=63\times0.1+1.82$
=8.12 (inch)
≒206.248 (mm)

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

<Reference>

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

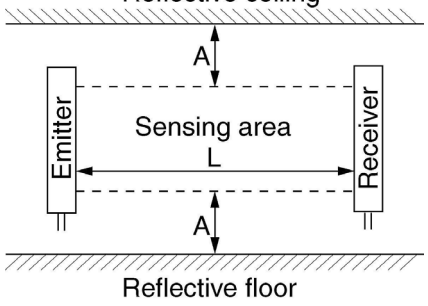
1-3-3 Influence of Reflective Surfaces

⚠WARNING

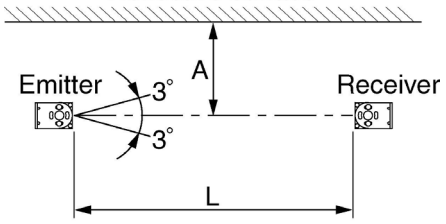
Install the sensor by considering the effect of nearby reflective surfaces, and take countermeasures such as painting, masking, or changing the material of the reflective surface, etc. Failure to do so may cause the sensor not to detect, resulting in death or serious body

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

<Side View>



<Top View>

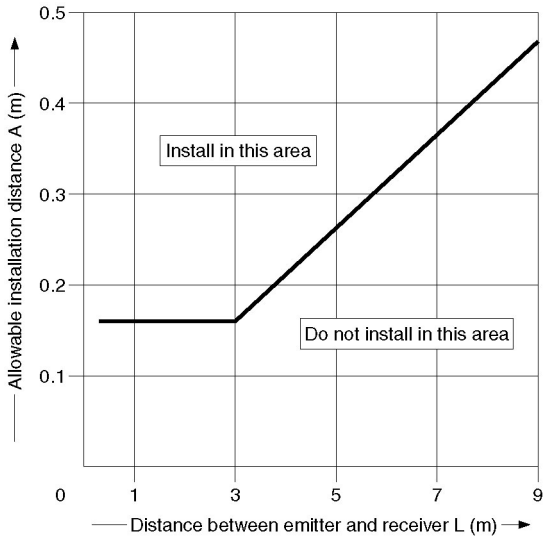


Distance between emitter and receiver (Sensing range L)	Allowable installation distance A
0.3 to 3m	0.16m
3 to 9m (Note 1)	$L \times \tan\theta = L \times 0.052$ (m) ($\theta = 3^\circ$)

Notes: 1) The sensing range L is applicable to **SF4B-H**□ (12 to 64 beam channels) and **SF4B-A**□ (6 to 32 beam channels). For **SF4B-F**□ and **SF4B-H**□ (72 to 96 beam channels) and **SF4B-A**□ (36 to 48 beam channels), the distance between emitter and receiver is 3 to 7m.

2) The effective aperture angle for this device is ±2.5° (when L>3m) as required by IEC 61496-2 / UL 61496-2. However, install this device away from reflective surfaces considering an effective aperture angle of ±3° to take care of beam misalignment, etc. during installation.

Allowable Distance from Sensor Beam Channel to Reflective Surface



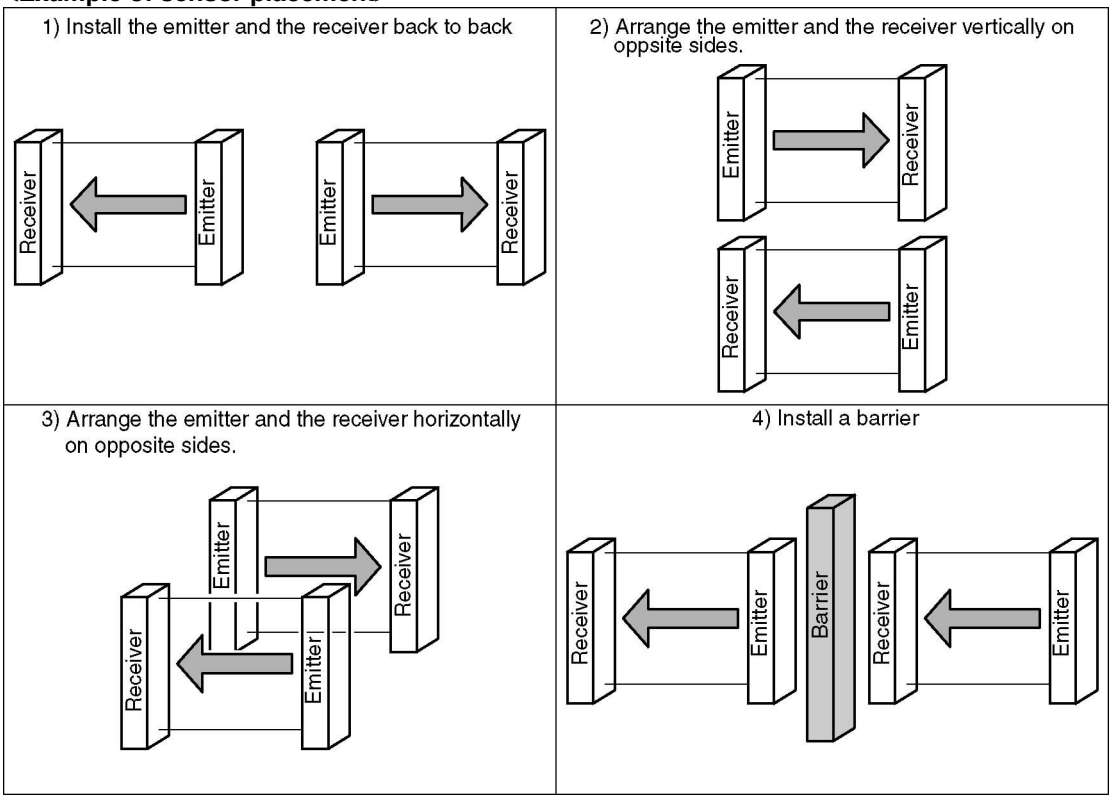
1-3-4 Sensor Placement

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 '**1-6-2 Operation Test**'.

⚠WARNING

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

<Example of sensor placement>



<Reference>

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

1-4 Mounting

1-4-1 Mounting of the Mounting Bracket

⚠CAUTION

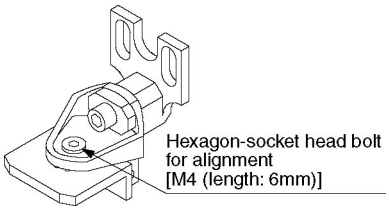
- For selecting the appropriate mounting bracket matched to the installation environment, the mounting bracket is not incorporated in this device. Please purchase the optional mounting bracket to fit on the mounting environment.
- Do not apply the load such as forced bending to the cable of this device. Applying improper load could cause the wire breakage.
- The minimum bending radius of the cable is R30mm. Mount the sensor considering the cable bending radius.

<Reference>

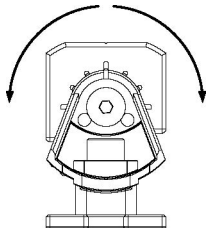
- Mount the emitter and the receiver at the same level and parallel to each other. The effective aperture angle of this device is ±2.5° or less for a sensing distance exceeding 3m.
- Unless otherwise specified, the following mounting procedure is common for both emitter and receiver. For the preparation of the mounting, prepare the mounting holes on the mounting surface by referring to '**5-3 Dimensions**'.

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

1. Loosen the hexagon-socket head bolt for alignment [M4 (length: 6mm)] of the standard mounting bracket.

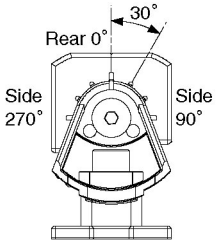


2. As shown in the figure below, adjust the direction of this device and that of installation surface by declining the bracket, and tighten and fix the hexagon-socket head bolt for alignment. The tightening torque should be 2N·m or less.

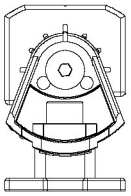


The marks are engraved on the standard mounting bracket so as to adjust the direction of this sensor by 30 degrees. Set and fix both emitter and receiver using the marks so that they face to each other.

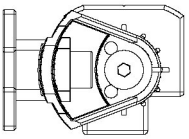
Refer to '**1-6-1 Beam-axis Alignment**' for details of the beam-axis alignment.



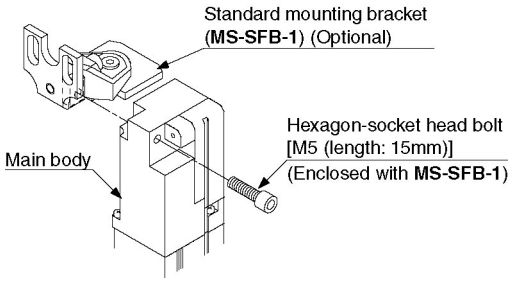
<In case of rear mounting>



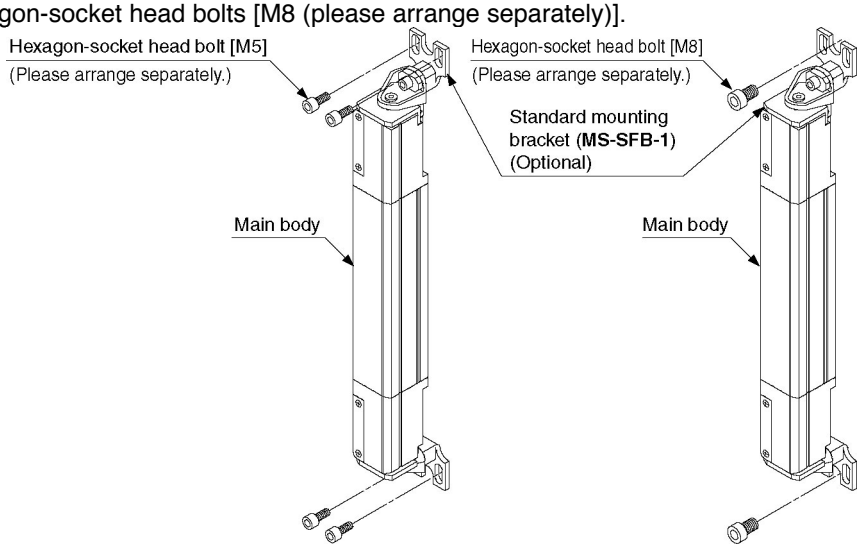
<In case of side mounting>



3. Set the device with its mounting hole on the side just overlapping with the mounting hole of the standard mounting bracket, and fix the standard mounting bracket with the accessory hexagon-socket head bolt [M5 (length: 15mm)]. The tightening torque should be 1.2N·m or less.



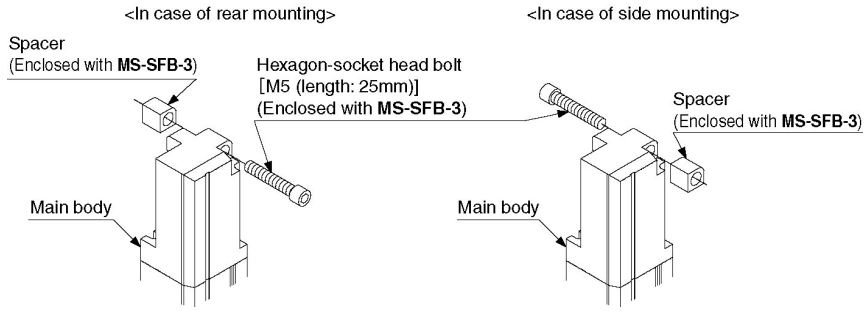
4. Set the standard mounting bracket that is ready for setting to the mounting surface using either four hexagon-socket head bolts [M5 (please arrange separately)] or two hexagon-socket head bolts [M8 (please arrange separately)].



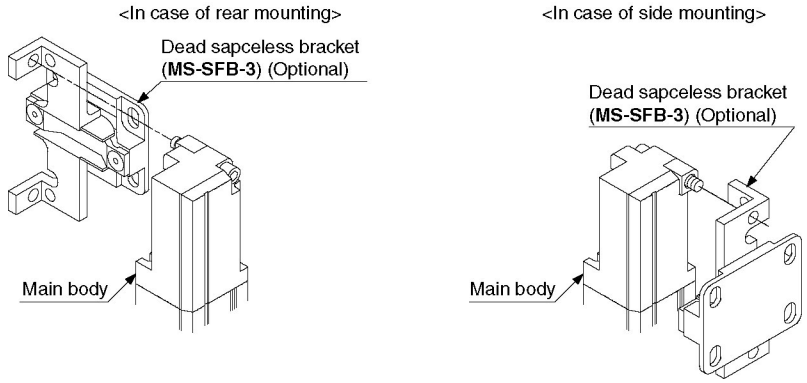
Note: For the models that the intermediate supporting bracket (**MS-SFB-2**) is enclosed with, be sure to use the intermediate supporting bracket (**MS-SFB-2**). For details, refer to **<In case of using intermediate supporting bracket (MS-SFB-2) (Accessory)>**

<In case of using dead spaceless bracket (MS-SFB-3) (Optional)>

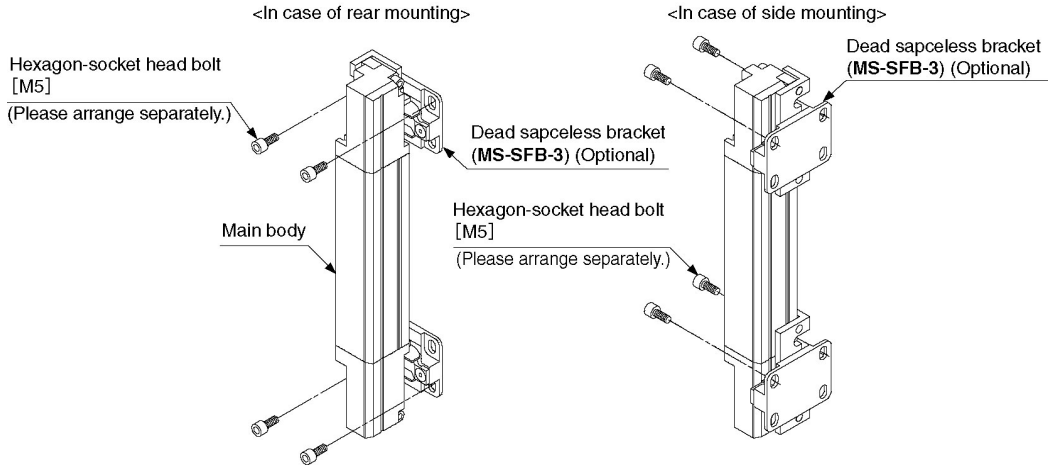
1. Set the spacer attached to the dead spaceless bracket (**MS-SFB-3**) onto the mounting hole on the side of the top (bottom) end part of this device, and insert the hexagon-socket head bolt [M4 (length: 25mm)] into the hole.



2. Adjust the hexagon-socket head bolt with the status described in Step 1 to the mounting hole of the dead spaceless bracket, and tighten and fix the bracket. The tightening torque should be 1.2N·m or less.



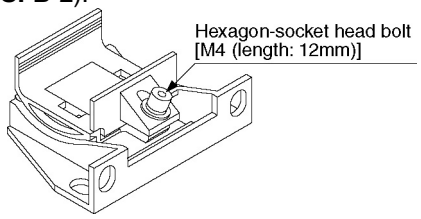
3. Set the dead spaceless bracket that is ready for setting to the mounting surface using four hexagon-socket head bolts [M5 (please arrange separately)].



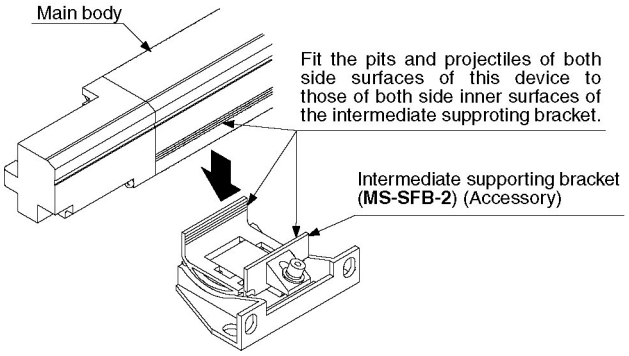
Note: For the models that the intermediate supporting bracket (**MS-SFB-2**) is enclosed with, be sure to use the intermediate supporting bracket (**MS-SFB-2**). For details, refer to **<In case of using intermediate supporting bracket (MS-SFB-2) (Accessory)>**

<In case of using intermediate supporting bracket (MS-SFB-2) (Accessory)>

1. Loosen the hexagon-socket head bolt [M4 (length:12mm)] screw of the intermediate supporting bracket (**MS-SFB-2**).

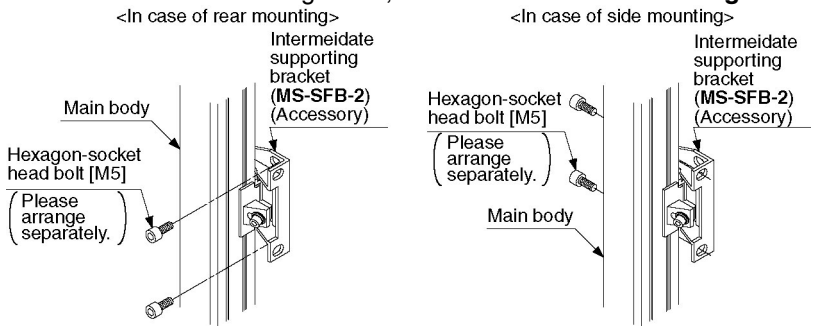


2. Insert the side of this device into the intermediate supporting bracket, and fix it with the hexagon-socket head bolt [M4 (length: 12mm)]. The tightening torque should be 1.2N·m or less.
   Refer to '**5-3 Dimensions**' for the mounting position of the intermediate supporting bracket.



   When setting the intermediate supporting bracket on both side surfaces of this device, fit the four pits and projectiles of both side surfaces of the main body to those of both side surfaces (inner surfaces) of the intermediate supporting bracket.

3. After aligning the beam axis, mount the intermediate supporting bracket to the mounting surface using two hexagons-socket head bolts [M5 (please arrange separately)].
   For the details of beam axis alignment, refer to '**1-6-1 Beam-axis Alignment**'.



1-4-2 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.

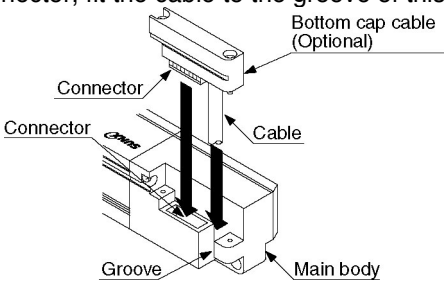
<Reference>

There are two types of the bottom cap cable, 8-core type and 12-core type, and in addition to these types, two more types are available for the bottom cap cable, discrete wire type and connector type. Select the bottom cap cable as usage.
The length of the bottom cap cable differs depending on the model No.

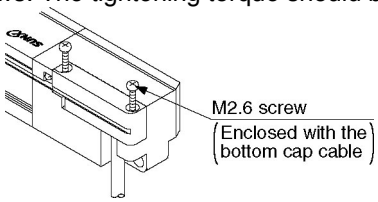
Type		Model No.	Cable length (m)
8-core	Discrete wire type	**SFB-CCB3**	3
		SFB-CCB7	7
	Connector type	**SFB-CB05**	0.5
		SFB-CB5	5
		SFB-CB10	10
12-core	Discrete wire type	**SFB-CCB3-MU**	3
		SFB-CCB7-MU	7
	Connector type	**SFB-CB05-MU**	0.5

<Mounting method>

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



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



1-4-3 Extension and Dismantling of Sensor (Series Connection)

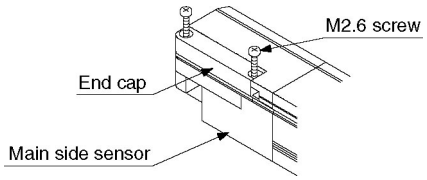
This section describes the extension method of the series connection using the options.
For constructing the series connection, the following procedure is required.

⚠CAUTION

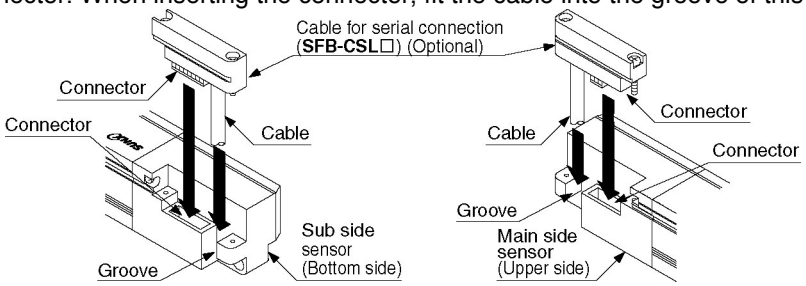
Do not lose any screws during extension / dismantling.
Furthermore, do not mix emitters and receivers to mount in series connection.

<Mounting method of cable for series connection>
Replace the cable for series connection (**SFB-CSL□**).

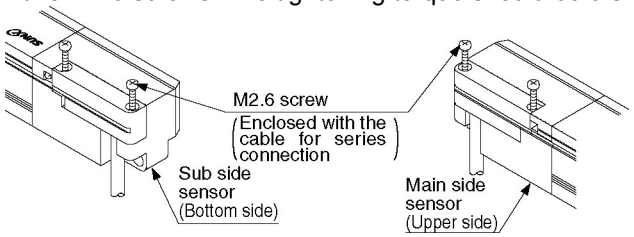
1. Loosen the two M2.6 screws of the end cap on the main side sensor (emitter and receiver to which the synchronization line has been connected), and then remove the end cap from the sensor.



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



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



⚠CAUTION

- Take care that the shape of the connectors for the bottom side and for the end cap side on the cable for series connection (**SFB-CSL□**) is different.
- The cable for series connection (**SFB-CSL□**) cannot be extended.

<Reference>

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

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

<Dismantling the cable for series connection>

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

1-5 Wiring

⚠WARNING

- Earth the machine or the support where the sensor is mounted on to frame ground (F.G.). Failure to do so could cause the malfunction of the product by noise, resulting in serious injury or death.
  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 serious body injury or death.

⚠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.

1-5-1 Power Supply Unit

⚠CAUTION

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.

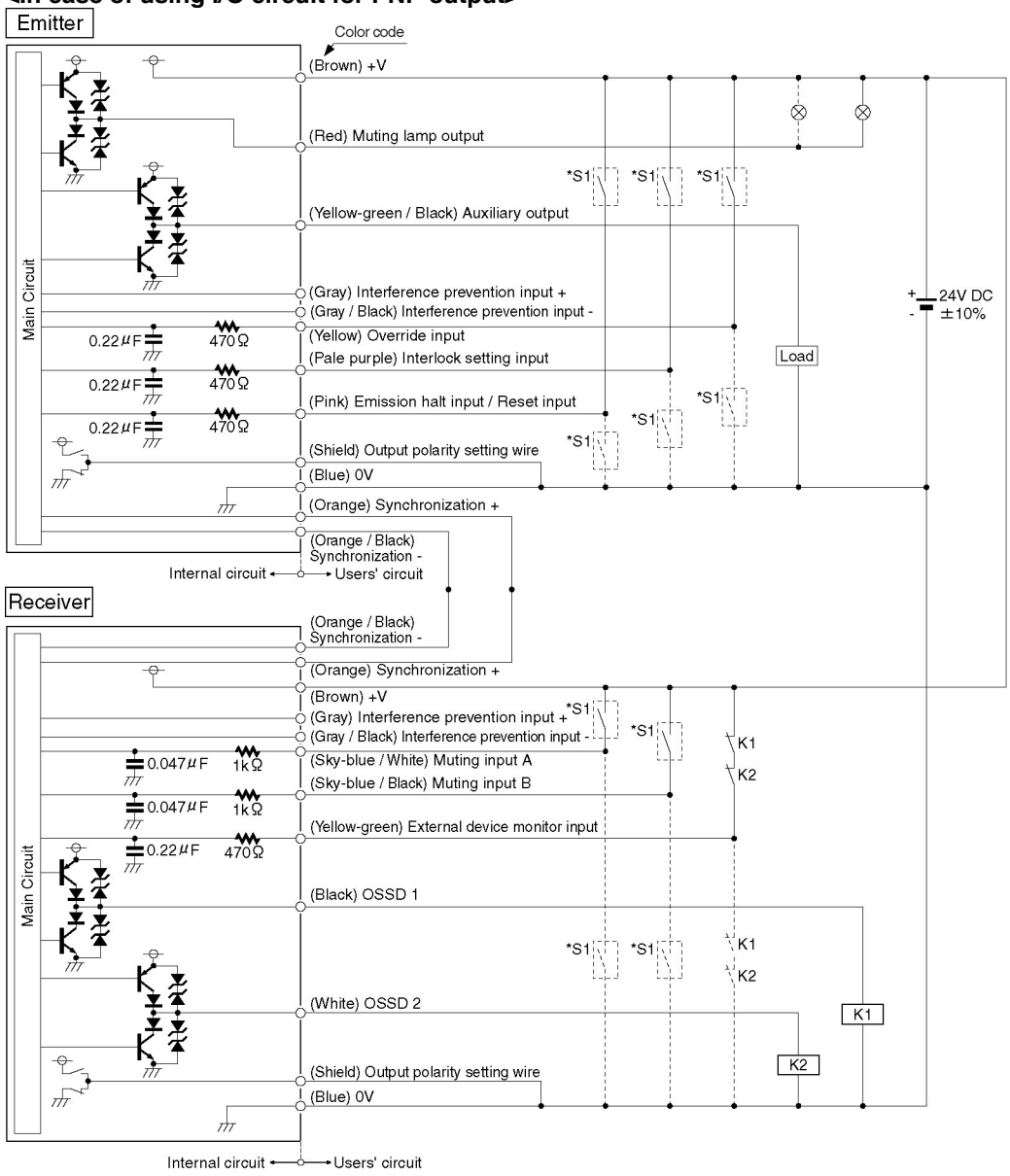
<Reference>

A specialist who has the required electrical knowledge should perform the wiring.
The DC 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 conforming to EMC Directive and Low-voltage Directive (only for requiring CE 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, tale countermeasures such as connecting a surge absorber to the origin of the surge.
7) Power supply unit corresponding to CLASS 2 (only for requiring C-UL conformation)
   《Additional information》 As provided in IEC 60536 (CLASS: Protection against Electric Shock), this power supply should require no ground earth and satisfy the insulation distance called double insulation or reinforced insulation.
   〔In case the power supply conforms to Low-voltage directive and has an output of 100VA or less, it can be used as a suitable product.〕

1-5-2 I/O Circuit Diagrams

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



*S1

Switch S1 (connectable either to +V or 0V)

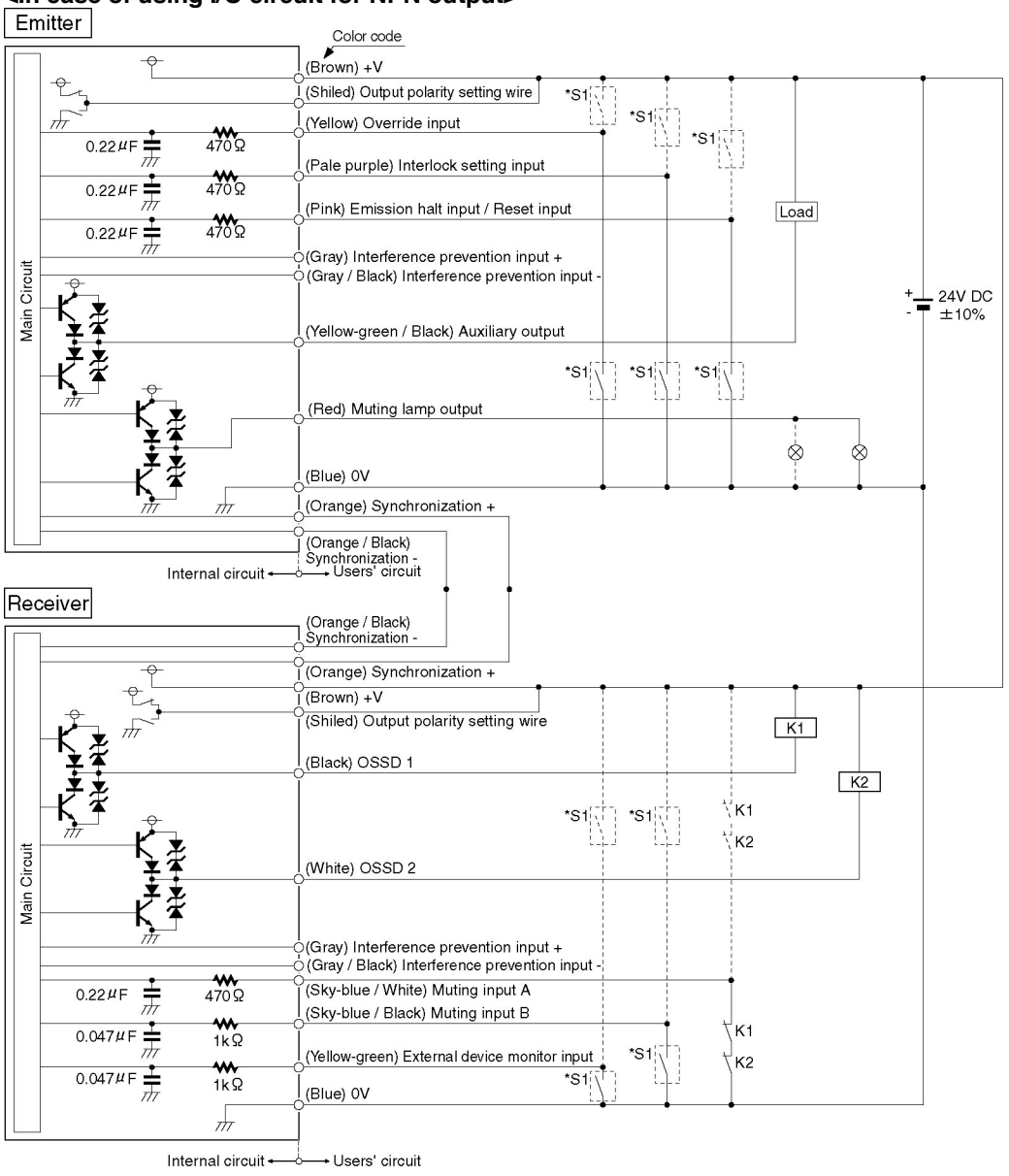
- Emission halt input / Reset input
  For manual reset: 0 to +1.5V or Vs to Vs−2.5V: Emission halt (sink current 5mA or less) (Note), Open: Emission
  For auto-reset: 0 to +1.5V or Vs to Vs−2.5V: Emission (sink current 5mA or less) (Note), Open: Emission halt
- Interlock setting input, Override input, Muting input A / B, External device monitor input
  0 to +1.5V or Vs to Vs−2.5V: Valid (sink current 5mA or less) (Note), Open: Invalid

Note: Vs is the applying supply voltage.

<Reference>

K1, K2: External device

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



*S1

Switch S1 (connectable either to +V or 0V)

- Emission halt input / Reset input
  For manual reset: 0 to +1.5V or Vs to Vs−2.5V: Emission halt (source current 5mA or less) (Note),
  Open: Emission
  For auto-reset: 0 to +1.5V or Vs to Vs−2.5V: Emission (source current 5mA or less) (Note),
  Open: Emission halt
- Interlock setting input, Override input, Muting input A / B, External device monitor input
  0 to +1.5V or Vs to Vs−2.5V: Valid (source current 5mA or less) (Note), Open: Invalid

Note: Vs is the applying supply voltage.

<Reference>

K1, K2: External device

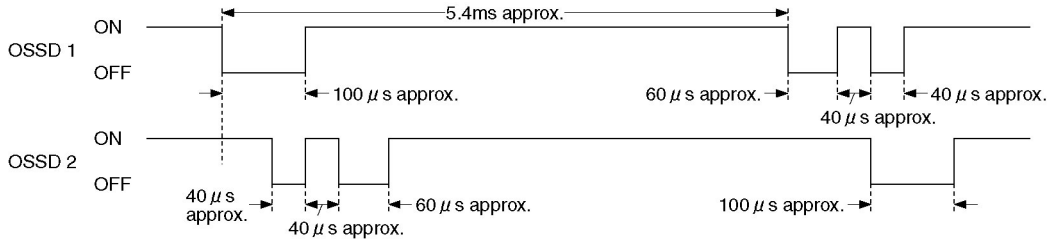
<Output waveform [control output (OSSD 1, OSSD 2) ON]>

Since the receiver performs the self-diagnosis of the output circuit when the sensor is in light receiving status (ON status), the output transistor becomes OFF status periodically. (Refer to the figure below.)

When the OFF signal is fed back, the receiver judges the output circuit as normal. When the OFF signal is not fed back, the receiver judges either the output circuit or wiring as error, and the control output (OSSD 1, OSSD 2) maintains OFF status.

⚠CAUTION

Since the OFF signal of this device might cause malfunction, perform the connecting paying attention to the input response time of the machine to be connected to this device.



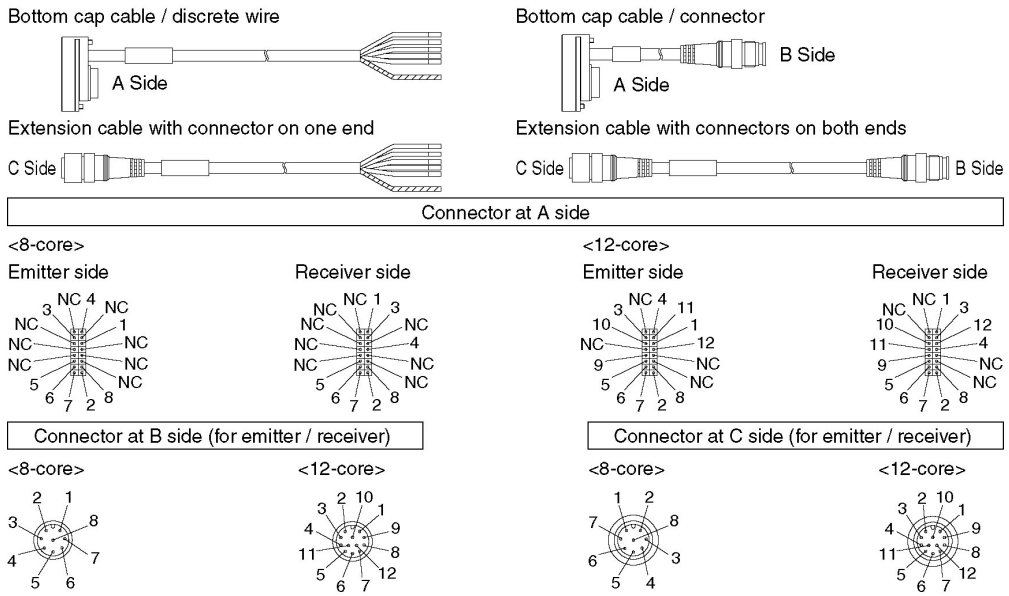
1-5-3 Wiring・Connecting Procedure

Connect the mating cable (with connector on one end, or connector on both ends) to the connector of the sensor main body (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 and to '**1-5-4 Wiring for Manual Reset (Interlock is Valid)**'.

⚠WARNING

- When extending the cable, use the exclusive cable up to the total length of 50m (for emitter / receiver). Extending the cable longer than 50m may cause malfunction, which can result in serious injury or death. Besides, if the 2 sets of the sensors are connected in series, up to total length of 30m (for emitter / receiver) is allowed for use, and if the 3 sets of the sensors are connected, up to total length of 20m (for emitter / receiver) is allowed for use. Extending the cable longer than the length specified may cause malfunction, which can result in serious injury or death.
- In case the muting indicator is used, a total length should be 40m or less. (for emitter / receiver)
- When the synchronization cable is extended with a cable other than exclusive cable, use a ϕ0.2mm^2 or more shielded twist pare cable.



<8-core cable (SFB-CC□)>

	Cable / connector color	Pin No.	Lead wire color	Description
Emitter	Gray / Gray	1	Pale purple	Interlock setting input
		2	Brown	24V DC
		3	Pink	Emission halt input / Reset input
		4	Yellow-green / Black	Auxiliary output
		5	Orange	Synchronization +
		6	Orange / Black	Synchronization -
		7	Blue	0V
		8	(Shield)	Output polarity setting wire
Receiver	Gray (with black stripe) / Black	1	White	Control output 2 (OSSD 2)
		2	Brown	24V DC
		3	Black	Control output 1 (OSSD 1)
		4	Yellow-green	External device monitor input
		5	Orange	Synchronization +
		6	Orange / Black	Synchronization −
		7	Blue	0V
		8	(Shield)	Output polarity setting wire

<12-core cable (SFB-CC□-MU)>

	Cable / connector color	Pin No.	Lead wire color	Description
Emitter	Gray / Gray	1	Pale purple	Interlock setting input
		2	Brown	24V DC
		3	Pink	Emission halt input / Reset input
		4	Yellow-green / Black	Auxiliary output
		5	Orange	Synchronization +
		6	Orange / Black	Synchronization -
		7	Blue	0V
		8	(Shield)	Output polarity setting wire
		9	Gray	Interference prevention +
		10	Gray / Black	Interference prevention -
		11	Yellow	Override input
		12	Red	Muting lamp output
Receiver	Gray (with black stripe) / Black	1	White	Control output 2 (OSSD 2)
		2	Brown	24V DC
		3	Black	Control output 1 (OSSD 1)
		4	Yellow-green	External device monitor input
		5	Orange	Synchronization +
		6	Orange / Black	Synchronization -
		7	Blue	0V
		8	(Shield)	Output polarity setting wire
		9	Gray	Interference prevention +
		10	Gray / Black	Interference prevention -
		11	Sky-blue / White	Muting input A
		12	Sky-blue / Black	Muting input B

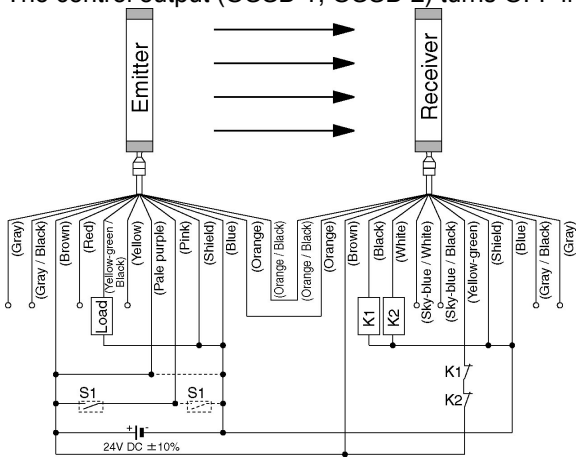
<Reference>

- The connectors can be distinguished from their color 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 '**5-2 Options**'.

1-5-4 Wiring for Manual Reset (Interlock is Valid)

<For PNP output>

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



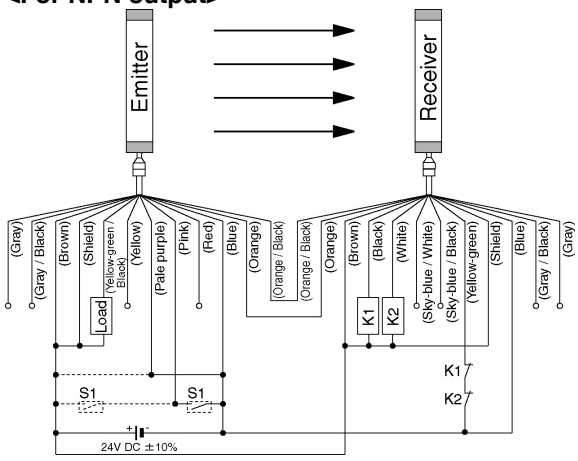
The sensor output is selected depending on the connecting state of the shield wire Incorrect wiring may cause the lockout state.

*Symbols

Switch S1
(Connectable either to +V or 0V)
0 to +1.5V or Vs to Vs−2.5V: Emission halt
(sink current 5mA or less) (Note 1)
Open: Emission
K1, K2: External device

Notes: 1) Vs is the applying supply voltage.
2) For resetting, refer to '**2-5 Interlock Function**'.

<For NPN output>



The sensor output is selected depending on the connecting state of the shield wire. Incorrect wiring may cause the lockout state.

*Symbols

Switch S1
(Connectable either to +V or 0V)
0 to +1.5V or Vs to Vs−2.5V: Emission halt
(source current 5mA or less) (Note 1)
Open: Emission
K1, K2: External device

Notes: 1) Vs is the applying supply voltage.
2) For resetting, refer to '**2-5 Interlock Function**'.

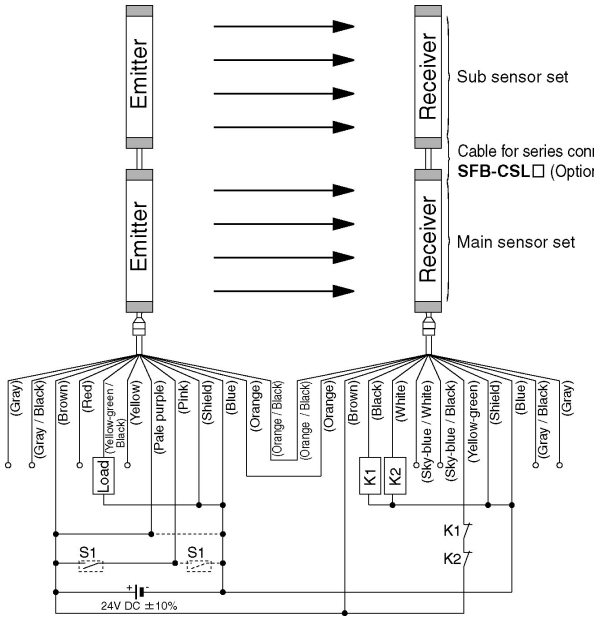
<Series connection (for PNP output)>

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

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

⚠WARNING

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



The sensor output is selected depending on the connecting state of the shield wire. Incorrect wiring may cause the lockout state.

*Symbols

Switch S1
(Connectable either to +V or 0V)
0 to +1.5V or Vs to Vs−2.5V: Emission halt
(sink current 5mA or less) (Note 1)
Open: Emission
K1, K2: External device

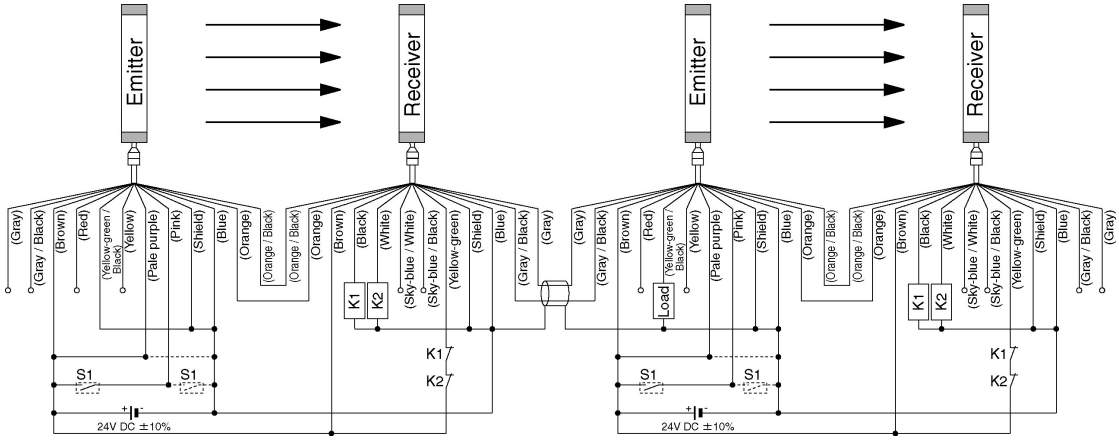
Notes: 1) Vs is the applying supply voltage.
2) For resetting, refer to '**2-5 Interlock Function**'.

<Parallel connection (for PNP output)>

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

⚠WARNING

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



The sensor output is selected depending on the connecting state of the shield wire. Incorrect wiring may cause the lockout state.

*Symbols

Switch S1
(Connectable either to +V or 0V)
0 to+1.5V or Vs to Vs−2.5V: Emission halt (sink current 5mA or less) (Note 2), Open: Emission
K1, K2: External device

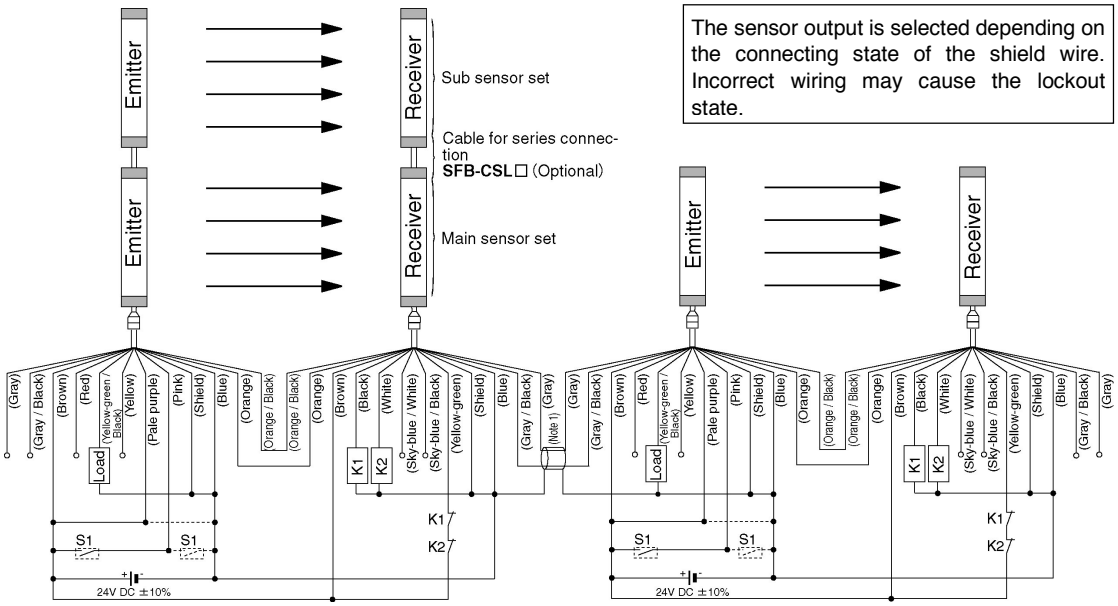
Notes: 1) If the interference prevention wire is extended, use a ϕ0.2mm^2, or more, shielded twist pair-cable.
2) Vs is the applying supply voltage.
3) For resetting, refer to '**2-5 Interlock Function**'.

<Series and parallel mixed connection (for PNP output)>

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 sensors in total of the series connection and parallel connection can be connected in combination. However, max. 192 beam channels for each series connection are allowed. The control output (OSSD 1, OSSD 2) turns only its output to OFF if the light is blocked.

⚠WARNING

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



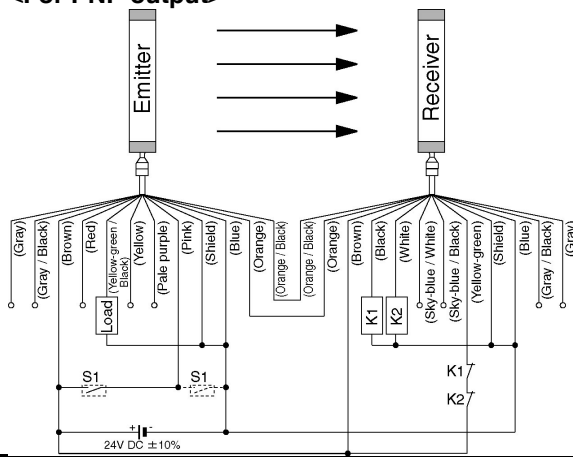
*Symbols

Switch S1 (Connectable either to +V or 0V)
0 to+1.5V or Vs to Vs−2.5V: Emission halt (sink current 5mA or less) (Note 2), Open: Emission
K1, K2: External device

Notes: 1) If the interference prevention wire is extended, use a ϕ0.2mm^2, or more, shielded twisted pair cable.
2) Vs is the applying supply voltage.
3) For resetting, refer to '**2-5 Interlock Function**'.

1-5-5 Wiring for Auto-reset (Interlock is Invalid)

<For PNP output>



The sensor output is selected depending on the connecting state of the shield wire. Incorrect wiring may cause the lockout state.

*Symbols

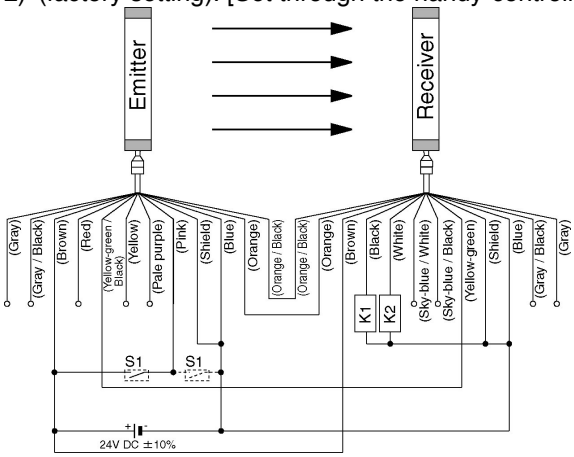
Switch S1
(Connectable either to +V or 0V)
0 to+1.5V or Vs to Vs−2.5V: Emission
(source current 5mA or less)
(Note)
Open: Emission halt

Note: Vs is the applying supply voltage.

1-5-6 Wiring Configuration for Invalid External Device Monitor Function

<For PNP output>

This is the configuration for connecting auxiliary output and external device monitor input. At this time, set the auxiliary output with 'negative logic of the control output (OSSD 1, OSSD 2)' (factory setting). [Set through the handy-controller (**SFB-HC**) (optional)]



The sensor output is selected depending on the connecting state of the shield wire. Incorrect wiring may cause the lockout state.

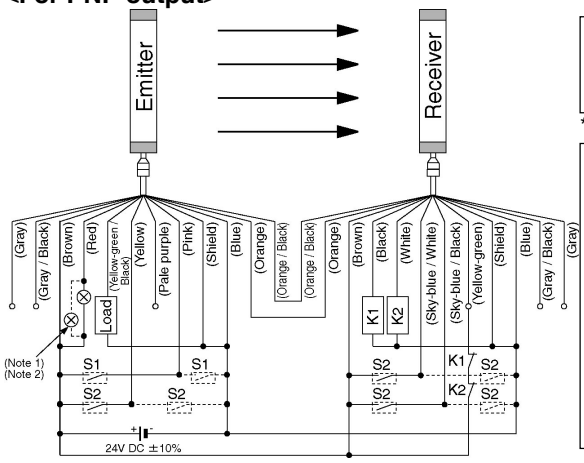
*Symbols

Switch S1
(Connectable either to +V or 0V)
0 to +1.5V or Vs to Vs−2.5V: Emission halt
(sink current 5mA or less) (Note 1)
Open: Emission
K1, K2: External device

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

1-5-7 Connection Configuration When Using Muting Function

<For PNP output>



The sensor output is selected depending on the connecting state of the shield wire. Incorrect wiring may cause the lockout state.

*Symbols

Switch S1:
(Connectable either to +V or 0V)
0 to+1.5V or Vs to Vs−2.5V: Emission
(sink current 5mA or less) (Note 3)
Open: Emission halt
Switch S2:
The muting input, the override input
(Connectable either to +V or 0V)
0 to+1.5V or Vs to Vs−2.5V: Valid
(sink current 5mA or less) (Note 3)
Open: Invalid

Notes: 1) Be sure to connect the muting lamp. If the muting lamp is not connected, the muting function does not operate.
2) In case of using this connection configuration for NPN output, connect the muting lamp output (red) to 0V (blue).
3) Vs is the applying supply voltage.

1-6 Adjustment

1-6-1 Beam-axis Alignment

1. Turn ON the power supply unit of this device.

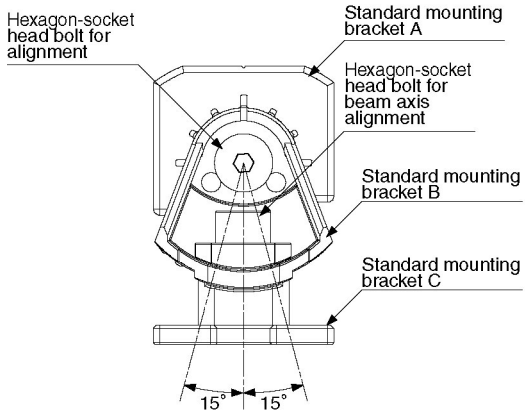
2. Check that the digital error indicator (red) and the fault indicator (yellow) of the emitter and receiver are off respectively.
   - If the digital error indicator (red) or the fault indicator (yellow) light up or blinks, refer to '**Chapter 4 Troubleshooting**', and report the contents to the maintenance in charge.

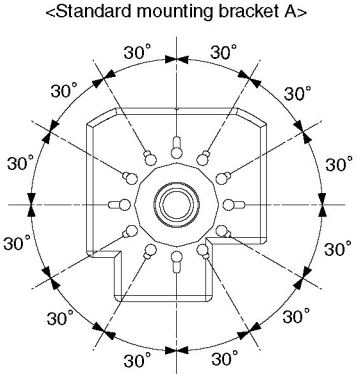
3. In case of using the intermediate supporting bracket (**MS-SFB-2**), loosen the two hexagon-socket head bolt [M5 (please arrange separately)].

4. In case of using the standard mounting bracket (**MS-SFB-1**) (otional) for mounting this sensor, loosen the two hexagon-socket head bolt for alignment of the standard mounting bracket so that the emitter and receiver face to each other.
   The marks are engraved on the standard mounting bracket A, which enables the angle of the emitter / receiver to be adjusted by 30 degrees.

5. Tighten the hexagon-socket head bolt for alignment of the standard mounting bracket. The tightening torque should be 2N·m or less.

6. Loosen the hexagon-socket head bolt for beam axis alignment of the standard mounting bracket, and adjust the emitter / receiver so that the beam-axis alignment indicators in the display of the emitter and receiver light up.
   The emitter and the receiver can be fine-adjusted by ±15 degrees.

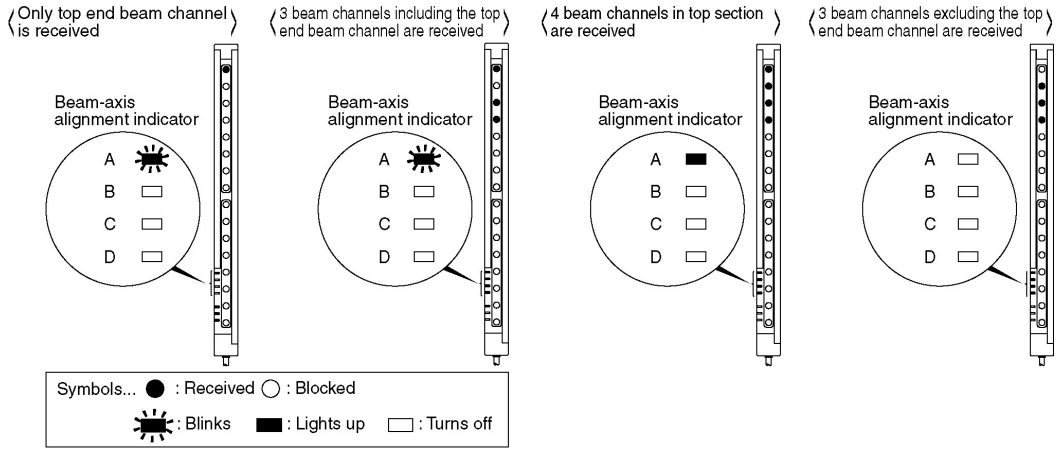




<Reference>

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

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



All the 6 beam channels divided into each section are received, the bam-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 bam channels are received and the control output (OSSD 1, OSSD 2) turns ON, all the four indicators of the beam-axis alignment indicator turn into green.
Refer to '**1-6-3 Operation**' for details.

7. After the adjustment, tighten the hexagon-socket head bolt for beam axis alignment of the standard mounting bracket. The tightening torque should be 2N·m or less.

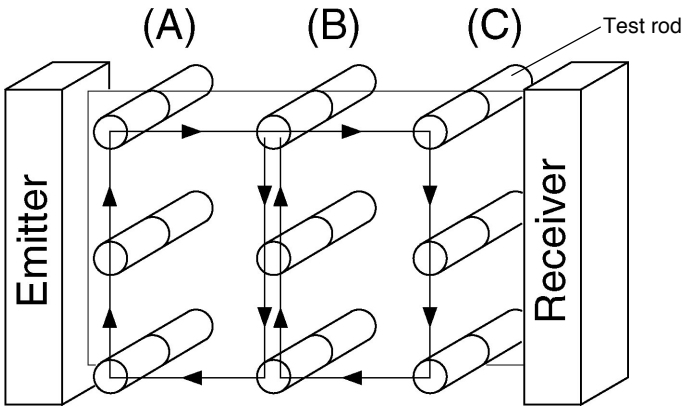
8. Tighten the two intermediate supporting brackets [M5 (please arrange separately)].
   Check, once again, that the beam-axis alignment indicators in the display of the emitter and receiver do light up.

1-6-2 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 4 Troubleshooting**', and report the contents to the maintenance in charge.

3. Move the test rod up and down at three positions, just in front of the emitter (A), between the emitter and receiver (B), and just in front of the receiver (C).



4. During Step 3 above, check that the control output (OSSD 1, OSSD 2) is in OFF status, 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, OSSD 2) and the turning ON/OFF of the emitter / receiver indicators do not correspond to the movement of the test rod, refer to '**Chapter 4 Troubleshooting**', and report the contents 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.

1-6-3 Operation

1) Normal Operation

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

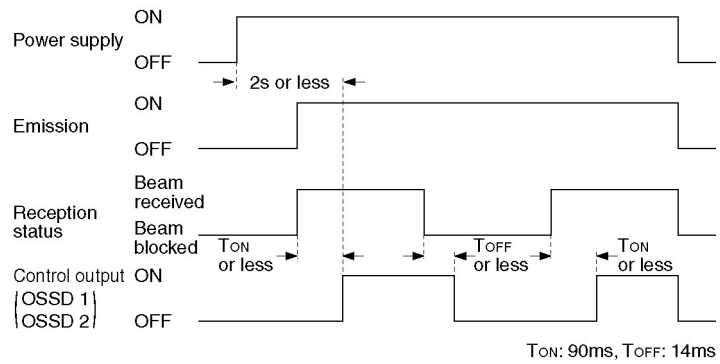
: Blinks in red　: Lights up in red　: Lights up in green　: Lights up in orange　: Turns off

Device Status		Indicators		OSSD	
		Emitter	Receiver	OSSD 1	OSSD 2
Reception status (all beams received)		Lights up in green Beam-axis alignment indicator [RECEPTION] (Green) Operation indicator [OSSD] (Green) (Note 1) Incident beam intensity indicator [STB.] Fault indicator [FAULT] Digital error indicator PNP indicator [PNP] (Orange) (Note 2) NPN indicator [NPN] Emission intensity control indicator [CTRL] Emission halt indicator [HALT]	Lights up in green Beam-axis alignment indicator [RECEPTION] (Green) OSSD indicator [OSSD] (Green) Incident beam intensity indicator [STB.] Fault indicator [FAULT] Digital error indicator PNP indicator [PNP] (Orange) (Note 2) NPN indicator [NPN] Function setting indicator [FUNCTION] Interlock indicator [INTERLOCK]	ON	
Beam blocked status	One or more beams blocked	Lights up in red (OFF for beam blocked channels) Beam-axis alignment indicator [RECEPTION] (Red) Operation indicator [OSSD] (Red) (Note 1) Incident beam intensity indicator [STB.] Fault indicator [FAULT] Digital error indicator PNP indicator [PNP] (Orange) (Note 2) NPN indicator [NPN] Emission intensity control indicator [CTRL] Emission halt indicator [HALT]	Lights up in red (OFF for beam blocked channels) Beam-axis alignment indicator [RECEPTION] (Red) OSSD indicator [OSSD] (Red) Incident beam intensity indicator [STB.] Fault indicator [FAULT] Digital error indicator PNP indicator [PNP] (Orange) (Note 2) NPN indicator [NPN] Function setting indicator [FUNCTION] Interlock indicator [INTERLOCK]	OFF	

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

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

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

<table>
<tr><th colspan="2" rowspan="2">Device Status</th><th colspan="2">Indicators</th><th colspan="2">OSSD</th></tr>
<tr><th>Emitter</th><th>Receiver</th><th>OSSD 1</th><th>OSSD 2</th></tr>
<tr><td rowspan="2">Beam blocked status</td><td>Beams other than the top end blocked</td><td>The top most beam-axis alignment indicator: blinks in red
Operation indicator: lights up in red
Beam-axis alignment indicator [RECEPTION] (Red)
Operation indicator [OSSD] (Red) (Note 1)
Incident beam intensity indicator [STB.]
Fault indicator [FAULT]
Digital error indicator
PNP indicator [PNP] (Orange) (Note 2)
NPN indicator [NPN]
Emission intensity control indicator [CTRL]
Emission halt indicator [HALT]</td><td>The top most beam-axis alignment indicator: blinks in red
Operation indicator: lights up in red
Beam-axis alignment indicator [RECEPTION] (Red)
OSSD indicator [OSSD] (Red)
Incident beam intensity indicator [STB.]
Fault indicator [FAULT]
Digital error indicator
PNP indicator [PNP] (Orange) (Note 2)
NPN indicator [NPN]
Function setting indicator [FUNCTION]
Interlock indicator [INTERLOCK]</td><td colspan="2" rowspan="2">OFF</td></tr>
<tr><td>Beams other than the bottom end blocked</td><td>The bottom most beam -axis alignment indicator: blinks in red
Operation indicator: Lights up in red
Beam-axis alignment indicator [RECEPTION] (Red)
Operation indicator [OSSD] (Red) (Note 1)
Incident beam intensity indicator [STB.]
Fault indicator [FAULT]
Digital error indicator
PNP indicator [PNP] (Orange) (Note 2)
NPN indicator [NPN]
Emission intensity control indicator [CTRL]
Emission halt indicator [HALT]</td><td>The bottom most beam -axis alignment indicator: blinks in red
Operation indicator: lights up in red
Beam-axis alignment indicator [RECEPTION] (Red)
OSSD indicator [OSSD] (Red)
Incident beam intensity indicator [STB.]
Fault indicator [FAULT]
Digital error indicator
PNP indicator [PNP] (Orange) (Note 2)
NPN indicator [NPN]
Function setting indicator [FUNCTION]
Interlock indicator [INTERLOCK]</td></tr>
<tr><td colspan="2">Time chart</td><td colspan="4"> 
</td></tr>
</table>

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

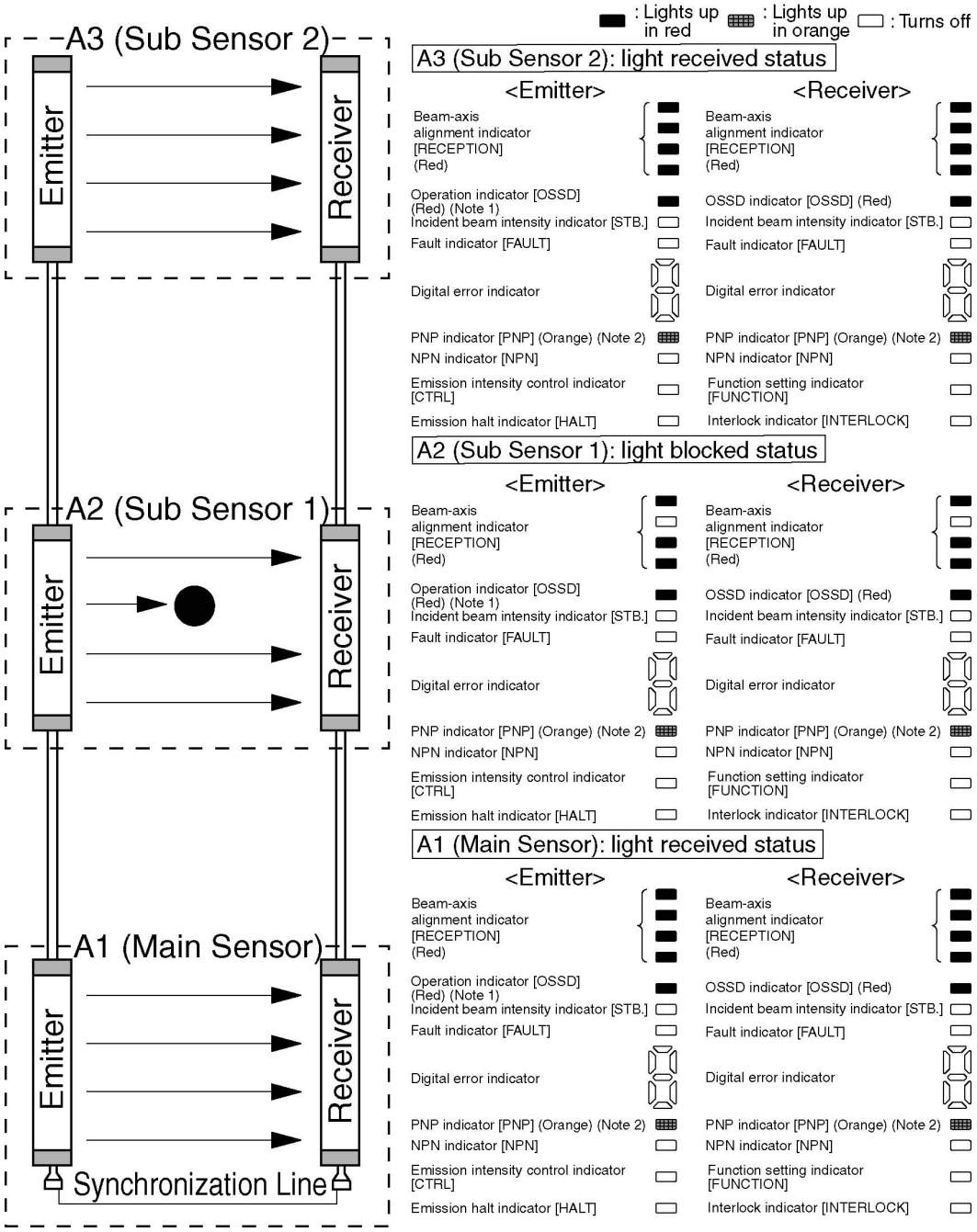
<For series connection>

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

<Reference>

The emitter / receiver indicators indicate the output status.

The following figure shows the status of the indicators with A2 (Sub Sensor1) in light blocked status.



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

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

2) In case of using emission halt function

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

<Reference>

When the emission halt input is kept open or connected to 0 to +1.5V, the emitter stops emitting light. In this condition, if this device operates properly, the control output (OSSD 1, OSSD 2) of the receiver turns OFF.

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

Setting procedure and check items		Indicators		OSSD	
		Emitter	Receiver	OSSD 1	OSSD 2
1	Before power is ON Connect the emission halt input to Vs (Note 3)	Beam-axis alignment indicator [RECEPTION] Operation indicator [OSSD] (Note 1) Incident beam intensity indicator [STB.] Fault indicator [FAULT] Digital error indicator PNP indicator [PNP] (Orange) (Note 2) NPN indicator [NPN] Emission intensity control indicator [CTRL] Emission halt indicator [HALT]	Beam-axis alignment indicator [RECEPTION] OSSD indicator [OSSD] Incident beam intensity indicator [STB.] Fault indicator [FAULT] Digital error indicator PNP indicator [PNP] (Orange) (Note 2) NPN indicator [NPN] Function setting indicator [FUNCTION] Interlock indicator [INTERLOCK]	OFF	
2	After power is ON Receiver's control output (OSSD 1, OSSD 2) ON (Normal operation)	Beam-axis alignment indicator [RECEPTION] (Green) Operation indicator [OSSD] (Note 1) Incident beam intensity indicator [STB.] Fault indicator [FAULT] Digital error indicator PNP indicator [PNP] (Orange) (Note 2) NPN indicator [NPN] Emission intensity control indicator [CTRL] Emission halt indicator [HALT]	Beam-axis alignment indicator [RECEPTION] (Green) OSSD indicator [OSSD] (Green) Incident beam intensity indicator [STB.] Fault indicator [FAULT] Digital error indicator PNP indicator [PNP] (Orange) (Note 2) NPN indicator [NPN] Function setting indicator [FUNCTION] Interlock indicator [INTERLOCK]	ON	

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

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

3) Vs is the applying supply voltage.

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

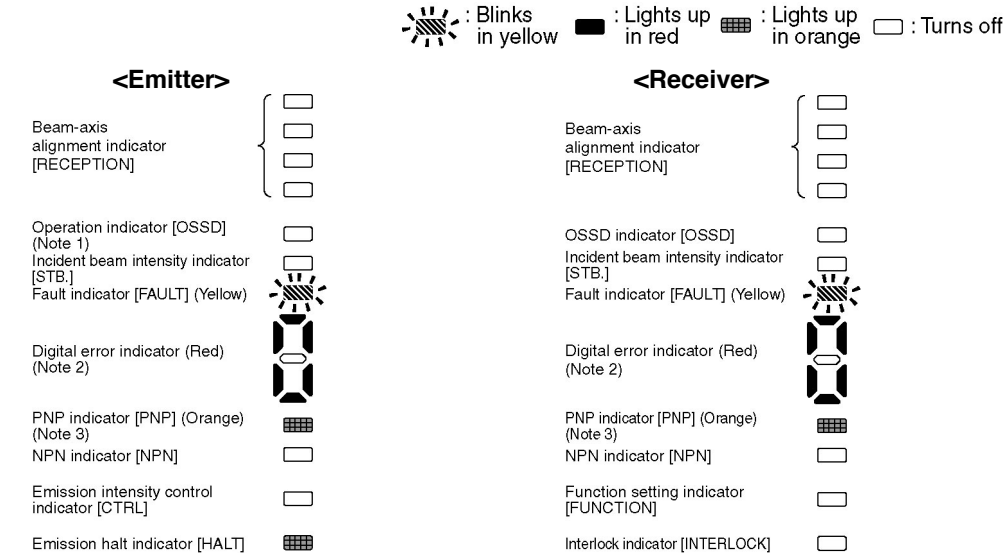
Setting procedure and check items		Indicators		OSSD	
		Emitter	Receiver	OSSD 1	OSSD 2
3	Open the emission halt input Receiver's control output (OSSD 1, OSSD 2) is OFF (Emission halt) (Normal operation)	Beam-axis alignment indicator [RECEPTION] Operation indicator [OSSD] (Red) (Note 1) Incident beam intensity indicator [STB.] Fault indicator [FAULT] Digital error indicator PNP indicator [PNP] (Orange) (Note 2) NPN indicator [NPN] Emission intensity control indicator [CTRL] Emission halt indicator [HALT] (Orange)	Beam-axis alignment indicator [RECEPTION] OSSD indicator [OSSD] (Red) Incident beam intensity indicator [STB.] Fault indicator [FAULT] Digital error indicator PNP indicator [PNP] (Orange) (Note 2) NPN indicator [NPN] Function setting indicator [FUNCTION] Interlock indicator [INTERLOCK]	OFF	
4	Connect the emission halt input to Vs (Note 3) Receiver's control output (OSSD 1, OSSD 2) is ON (Normal operation)	Beam-axis alignment indicator [RECEPTION] (Green) Operation indicator [OSSD] (Note 1) Incident beam intensity indicator [STB.] Fault indicator [FAULT] Digital error indicator PNP indicator [PNP] (Orange) (Note 2) NPN indicator [NPN] Emission intensity control indicator [CTRL] Emission halt indicator [HALT]	Beam-axis alignment indicator [RECEPTION] (Green) OSSD indicator [OSSD] (Green) Incident beam intensity indicator [STB.] Fault indicator [FAULT] Digital error indicator PNP indicator [PNP] (Orange) (Note 2) NPN indicator [NPN] Function setting indicator [FUNCTION] Interlock indicator [INTERLOCK]	ON	

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

3) In case of abnormal operation

If a sensor error is detected, the sensor will turn the control output (OSSD 1, OSSD 2) off and the digital error indicator (red) lights up and the fault indicator (yellow) lights up or blinks.

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



Notes: 1) Since the color of the operation indicator changes according to the ON/OFF state of the control output (OSSD 1, OSSD 2), the operation indicator is marked as OSSD on the sensor.
2) Refer to '**Chapter 4 Troubleshooting**' for details of the digital error indicator.
3) The status of the emitter / receiver indicators during operation above shows the case in PNP output setting mode. In case of NPN output setting mode, the NPN indicator (orange) lights up.

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

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

Refer to '**Chapter 4 Troubleshooting**' and remove the source of error.

Chapter 2 Functions

2-1 Self-diagnosis Function

This device is equipped with the self-diagnosis function. The self-diagnosis is carried out when the power is turned ON and while the operation periodically.
In case an abnormality is detected during self-diagnosis, the device is put in the lockout state at that instant, and the control output (OSSD 1, OSSD 2) is fixed at the OFF state. Refer to '**Chapter 4 Troubleshooting**' and remove the cause of the abnormality.

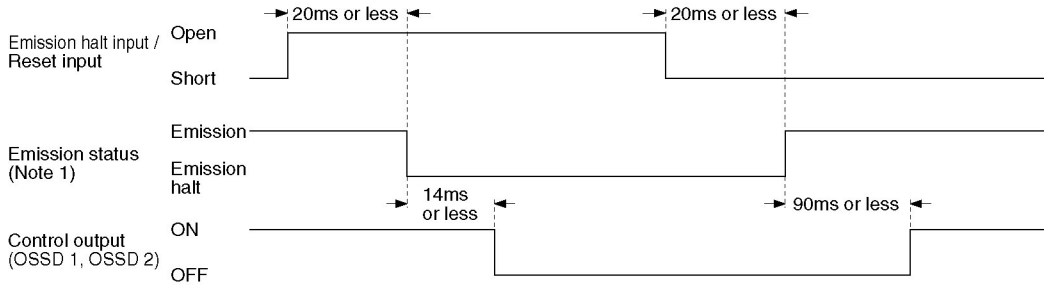
2-2 Emission Halt Function

This function stops the emission process of the emitter.
With the emission halt input line state, it enables to select either emission or emission halt.

Setting status of interlock function	Emission halt input	Emission status
Auto reset	Open	Emission halt
	0V, +V connection	Emission
Manual reset	Open	Emission
	0V, +V connection	Emission halt

During emission halt, the control output (OSSD 1, OSSD 2) becomes OFF status.
By using this function, malfunction due to extraneous noise or abnormality in the control output (OSSD 1, OSSD 2) and the auxiliary output can be determined even from the equipment side.
Normal operation is restored when the emission halt input / reset input is connected to 0V (+V for NPN output).

<Timing Chart>



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

⚠WARNING

Do not use the emission halt function for the purpose of stopping the device. Failure to do so could result in serious injury or death.

2-3 Interference Prevention Function

It is possible to construct the system to prevent malfunction due to interference of the light between **SF4B** series devices.
The interference prevention system can construct max. three sets of series connection.
The max. number of the beam channels in series connection is 192.

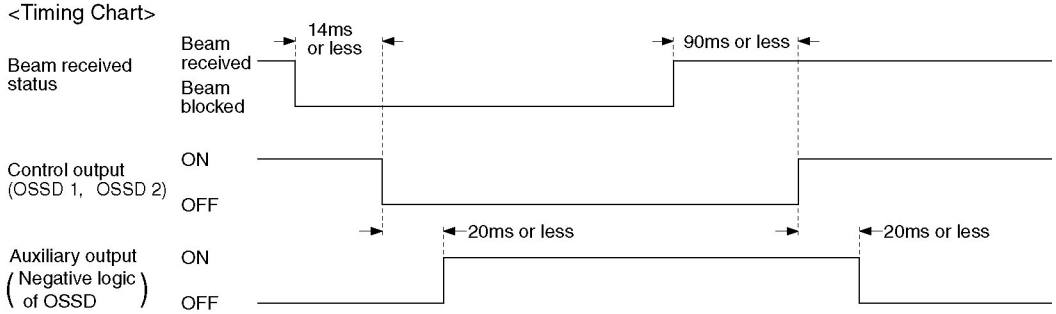
Refer to '**1-5 Wiring**' for details of the connecting method.

2-4 Auxiliary Output (Non-safety Output)

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

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

<Timing Chart>



⚠WARNING Do not use the auxiliary output for the purpose of stopping the device. Failure to do so could result in serious injury or death.

<Reference>

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

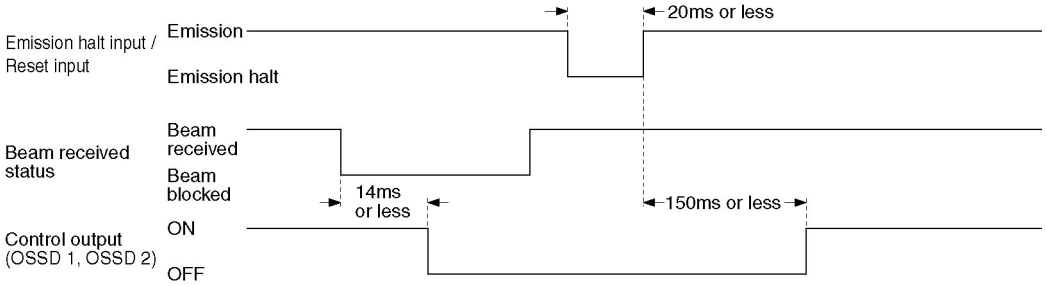
2-5 Interlock Function

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

Input status / Interlock setting	Setting for interlock function
Open	Auto reset
0V, +V connection	Manual reset

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

<Timing Chart>



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

⚠WARNING

In case that this device is used under auto-reset mode, set the system not to be auto reset by the safety relay unit, etc. (conforming to EN 60204-1)

<Reference>

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

2-6 External Device Monitor Function

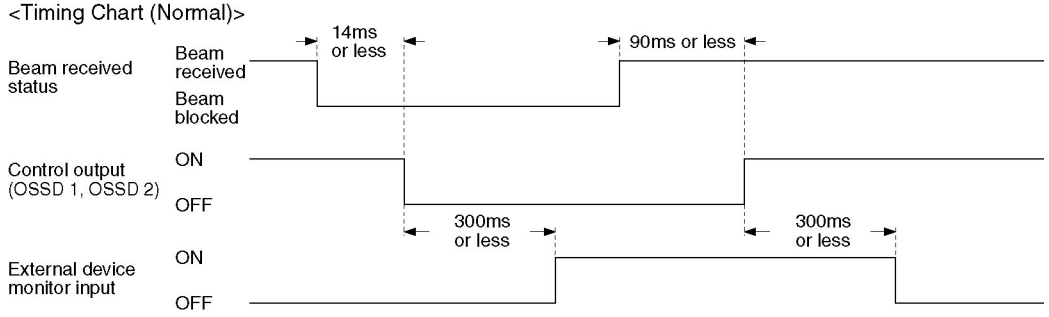
This is the function for checking whether the external safety relay connected to the control output (OSSD 1, OSSD 2) performs normally in accordance with the control output (OSSD 1, OSSD 2) or not. Monitor the contacting point 'b' of the external safety relay, and if any abnormality such as deposit of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

- **In case of setting the external device monitor function into valid:**
  Connect the external device monitor input line to the external safety relay connected the control output (OSSD 1, OSSD 2).
- **In case of not using the external device monitor function:**
  Connect the external device monitor input line to the auxiliary output line. At this time, the auxiliary output is set as [negative logic of control output (OSSD 1, OSSD 2)] (factory setting) [Set through the handy controller (**SFB-HC**) (optional)]

<Reference>

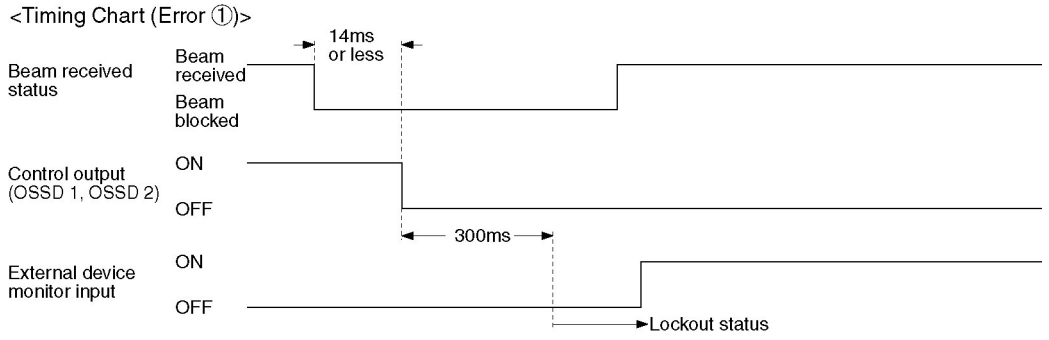
It is also possible to set the external device monitor function into invalid by using the handy controller (**SFB-HC**) (optional).

<Timing Chart (Normal)>

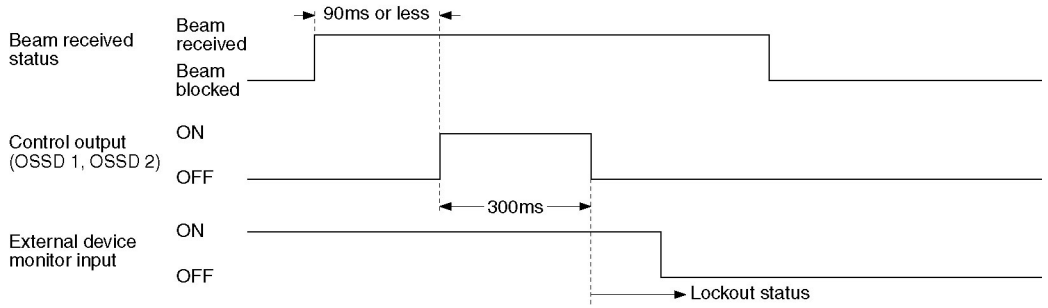


The setting time of the device monitor is 300ms or less. Exceeding 300ms turns the device into lockout status. It can be set within 100 to 600ms (unit: 10ms) by using the handy controller (**SFB-HC**)(optional).

<Timing Chart (Error ①)>



<Timing Chart (Error ②)>



2-7 Muting Function

⚠WARNING

- Incorrect using of the muting control may cause any accident. Please understand the muting control fully, and use it. As for the muting control, the following international standards define the requirements.
  ISO 13849-1 (EN 954-1 / JIS B 9705-1):
  'Safety of machinery -- Safety-related parts of control systems -- Part 1: General principles for design, Article 5.9 Muting'
  IEC 61496-1 (UL 61496 / JIS B 9704-1):
  'Safety of machinery -- Electro sensitive protective equipment -- Part 1: General requirements and tests' Annex A, A.7 Muting
  IEC 60204-1 (JIS B 9960-1):
  'Safety of machinery -- Electrical equipment of machines - Part 1: General requirements, 9.2.4 Overriding safeguards'
  EN 415-4:
  'Safety of packaging machines part 4. Palletizers and depalletizers' Annex A, A2.2 Muting'
  ANSI B11.19-1990:
  'for Machine Tools-Safeguarding When Referenced by the Other B11 Machine Tool Safety Standards-Performance Criteria for the Design, Construction, Care, and Operation' 4.2.3 Presence-Sensing Devices: Electro-Optical and Radio Frequency (R.F.)
  ANSI/RIA R15.06-1999:
  'for Industrial Robots and Robot Systems - Safety Requirements, 10.4.5 Muting'
- Use the muting control while the machine cycle is not in danger mode. Maintain safety with the other measure while the muting control is activated.
- For the application that the muting control is activated when a workpiece passes through the sensor, place the muting sensor so that the conditions for the muting control cannot be satisfied by intrusion of personnel when the workpiece is passing through the sensor or the workpiece is not passing through it.
- The muting lamp should be installed in a position where it can always be seen by operators who set or adjust the machine.
- Be sure to check the operation of the muting function before its use. Furthermore, check the state of the muting lamp (cleanliness or brightness etc.)

This function turns the safety function of this device into invalid temporarily. When the control output (OSSD 1, OSSD 2) is ON, this function is available for passing the workpiece through the sensing area of the sensor without stopping the device.

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

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

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

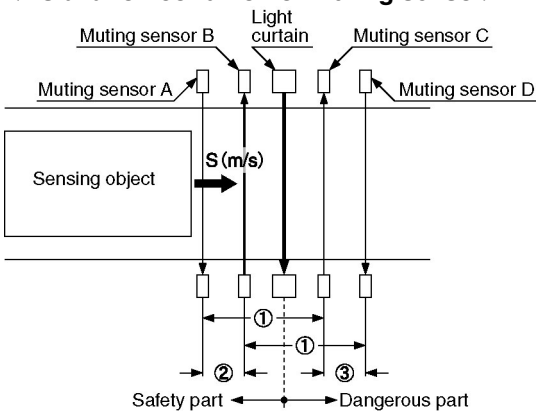
<Specification for muting sensor>

	Performance with ON status	Performance with OFF status
ON with beam non-received status (photoelectric sensor, etc.) ON with object approaching status (proximity sensor, etc.) ON with object contacted status (position switch, etc.)	Output 0V (+V for selected NPN output)	Open

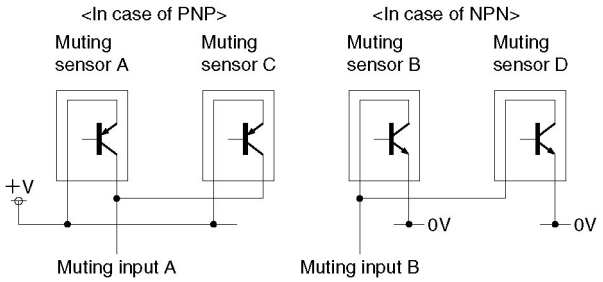
⚠WARNING

- Be sure to use the muting sensor that satisfies the <Specification for muting sensor> above. If the other muting sensor not satisfying the specification above, the muting function might become valid with the timing that the machine designer cannot expect and could result in serious injury or death.
- The muting lamp shall be connected without fail. The muting function is invalid for activating with the muting lamp not connected.

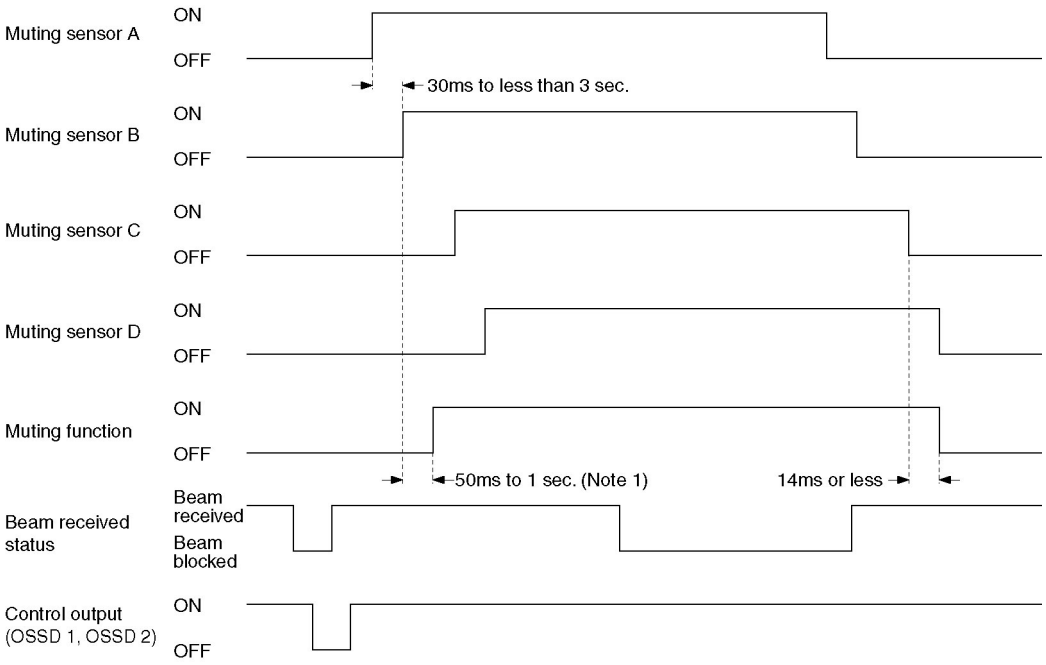
<Installation condition of muting sensor>



① Shorten the distances between muting sensors A to C and between B to D than the whole length of the sensing object.
② The moving speed of the sensing object to be passed through the muting sensors A to B shall be 30ms to 3 sec.
Distance between A and B: S × 3 (s)
③ The moving speed of the sensing object to be passed through the muting sensors C to D shall be under 3 sec.
Distance between C and D: S × 3 (s)



<Timing Chart>



Note: In case the muting lamp does not light up even after more than 1 sec. passed, the muting function becomes invalid.

<Reference>

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

2-8 Override Function

⚠WARNING

- Incorrect using of the muting control may cause any accident. Please understand the muting control fully, and use it. As for the muting control, the following international standards define the requirements.
  ISO 13849-1(EN 954-1 / JIS B 9705-1):
  'Safety of machinery -- Safety-related parts of control systems -- Part 1: General principles for design, Article 5.9 Muting'
  IEC 61496-1 (UL 61496 /JIS B 9704-1):
  'Safety of machinery -- Electro sensitive protective equipment -- Part 1: General requirements and tests' Annex A, A.7 Muting
  IEC 60204-1 (JIS B 9960-1)
  'Safety of machinery -- Electrical equipment of machines - Part 1: General requirements, 9.2.4 Overriding safeguards'
  EN 415-4:
  'Safety of packaging machines part 4. Palletizers and depalletizers' Annex A, A2.2 Muting
  ANSI B11.19-1990:
  'for Machine Tools-Safeguarding When Referenced by the Other B11 Machine Tool Safety Standards-Performance Criteria for the Design, Construction, Care, and Operation' 4.2.3 Presence-Sensing Devices: Electro-Optical and Radio Frequency (R.F.)
  ANSI/RIA R 15.06-1999:
  'for Industrial Robots and Robot Systems - Safety Requirements, 10.4.5 Muting'
- Use the muting control while the machine cycle is not in danger mode. Maintain safety with the other measure while the muting control is activating.
- For the application that the muting control is activated when a workpiece passes through the sensor, place the muting sensor so that the conditions for the muting control cannot be satisfied by intrusion of personnel when the workpiece is passing through the sensor or the workpiece is not passing through it.
- The muting lamp should be installed in a position where it can always be seen by operators who set or adjust the machine.
- Be sure to check the operation of the muting function before its use. Furthermore, check the state of the muting lamp (cleanliness or brightness etc.)

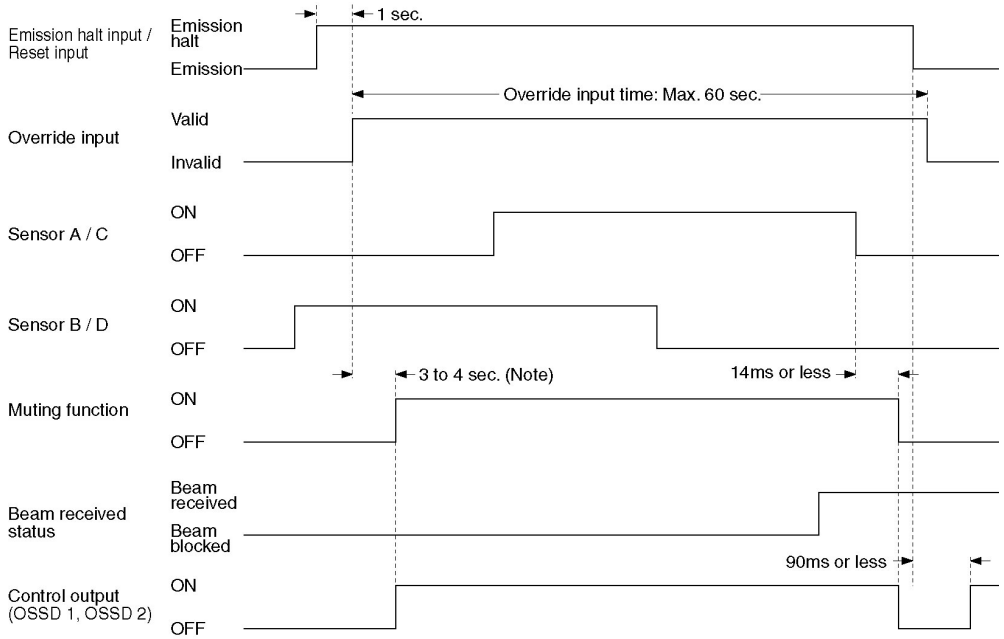
This function sets the safety function of this device invalid forcibly. This function is used for the following cases: when the customer who uses the muting function needs to start the device with the control output (OSSD 1, OSSD 2) be OFF status, when the device is required to continue operating even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

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

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

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

<Timing Chart>



Note: In case the muting lamp does not light up even after more than 4 sec. passed, the muting function becomes invalid.

2-9 Functions Using Handy Controller (SFB-HC) (Available soon)

This device enables to set each function using the handy controller (**SFB-HC**) (optional). The settable functions are as follows.
Refer to the instruction manual enclosed with the handy controller for details of the function settings.

⚠WARNING

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

- **Fixed blanking function**
  This function enables to protect the control output (OSSD 1, OSSD 2) from turning into OFF even though the specific beam channel is blocked.
  The factory setting is set to invalid for the fixed blanking function.
- **Floating blanking function**
  This function enables to protect the control output (OSSD 1, OSSD 2) from turning into OFF even though the number of the blocked beam channels are lower than that of the setting beam channels. 1, 2, or 3 beam channels are settable as the blocking beam channels.

Both fixed blanking function and floating blanking function are settable simultaneously.
The factory setting is set to invalid for the floating blanking function.

- **Emission intensity control function**
  The two modes, normal mode and short mode, can be set / changed by controlling the emission intensity.
  The factory setting is set to the normal mode for the emission intensity control function.
- **Auxiliary output switching function (non-safety output)**
  The following outputs are switchable as the auxiliary output.
  0. Negative logic of the control output (OSSD 1, OSSD 2) (factory setting)
  1. Positive logic of the control output (OSSD 1, OSSD 2)
  2. For emission: output OFF, For non-emission: output ON
  3. For emission: output ON, For non-emission: output OFF
  4. For unstable incident beam: OFF (Note 1)
  5. For unstable incident beam: ON (Note 1)
  6. For muting: ON
  7. For muting: OFF
  8. For beam reception: ON, For beam blocked: OFF (Note 2)
  9. For beam reception: OFF, For beam blocked: ON (Note 2)

Notes: 1) The output cannot be used while the fix blanking function, floating blanking function or the muting function is activated.
2) This device outputs the beam reception / blocked state under activating the auxiliary output switching function using the handy controller irrespective of activating other functions, fixed blanking function, floating function, floating blanking function, and muting function.
<e.g.>
In case of activating the fixed blanking function, the control output (OSSD 1, OSSD 2) becomes ON with the shielded object existed in the setting range and other ranges are in beam receiving status. If the auxiliary output switching function activates in No. 8 output, this device becomes OFF because the sensor itself detects the object.

- **Interlock setting changing function**
  It is selectable one interlock state among the following three interlock settings.
  - **Start interlock**
    The sensor goes into the interlock state when the power supply is turned on. Once this interlock is reset, the device does not go into the interlock state.
  - **Restart interlock**
    The sensor does not go into the interlock state when turning on the power supply. Only when the control output (OSSD 1, OSSD 2) becomes ON and the light is blocked after the power is turned on and this device receives the light, the sensor goes into the interlock state.

- **Start / Restart interlock**
  The sensor goes into the interlock state after the power is turned on, and the light is blocked.

The factory setting is start / restart interlock.

- **External device monitor setting changing function**
  The setting of the external device monitor is changeable.
  1. Allowable time for response time: 100 to 600ms (Unit: 10ms)
     Factory setting is 300ms.
  2. The external device monitor function can be selected to valid or invalid.
     The factory setting is set to valid for the external device monitor function.

- **Muting setting changing function**
  The setting of the muting function is changeable.
  1. When the muting function becomes valid, the output order of the muting sensors A and B are possible to be specified.
     Either of muting sensors A or B is valid as the factory setting.
  2. The muting function can be selected to valid / invalid per beam channel. (Note)
     The factory setting of the muting function is set to valid for all beam channels.

  Note: When the light is blocked on the beam channel set as the muting function invalid while the muting function is active, the control output (OSSD 1, OSSD 2) is turned off and the muting function becomes invalid.

- **Protect function**
  Unless the password is not input, any setting change of the sensor cannot be allowed.
  The factory setting is set to invalid for the protect function.

Chapter 3 Maintenance

<Reference>

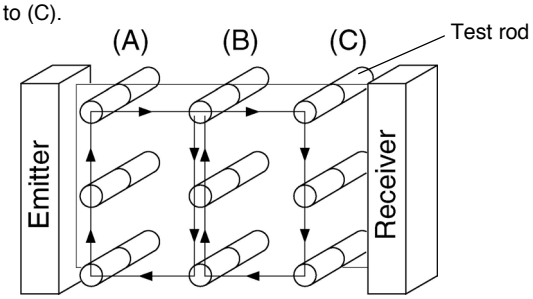
When any abnormality is found, refer to '**Chapter 4 Troubleshooting**' and report the contents to the maintenance in charge. If the rectification method is not clear, please contact our office.
Please make a copy of this checklist, check each inspection item in the respective square, and file the list for record.

3-1 Daily Inspection

⚠WARNING

Be sure to inspect the following items prior to operation and confirm that there is no abnormality. Operating this device without inspection or in an abnormal condition can result in serious injury or death.

Check list (Daily inspection)

Check column	Inspection item
☐	Dangerous parts of the machine cannot be reached without passing through the sensing area of this device.
☐	Some part of operator's body remains in the sensing area when operation is done with dangerous parts.
☐	The calculated safety distance has been maintained or exceeded during installation.
☐	There is no damage to the safety guard or protective structure.
☐	There is no defect, fold, or damage in the wiring.
☐	The corresponding connectors have been connected securely.
☐	No dirt or scratches exist on the light emitting surface.
☐	The test rod is not deformed or defective.
☐	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, OSSD 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 re-inspect.
☐	The test rod can be detected 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) continues to light up as long as the test rod is present in the sensing area from (A) to (C). 
☐	With the machine in the operating condition, the dangerous parts operate normally when no object is present in the sensing area.
☐	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).
☐	The dangerous parts remain stopped as long as the test rod is present in the sensing area.
☐	The dangerous parts stop immediately when the power supply of this device is turned OFF.
☐	The control output (OSSD 1, OSSD 2) must turn OFF when the emission halt input / reset 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 re-inspect.
☐	Be sure to check the operation of the muting function before its use. Furthermore, check the state of the muting lamp (cleanliness or brightness etc.)

3-2 Periodic Inspection (Every Six Months)

⚠WARNING

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

Check list (Period inspection)

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

3-3 Inspection after Maintenance

Under the following situations, perform all the inspection items mentioned in '**3-1 Daily Inspection**' and '**3-2 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.

<Reference>

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

4-1 Troubleshooting of Emitter

Symptoms	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.	Set the supply voltage correctly.
	Connector is not connected securely.	Connect the connector securely.
Fault indicator (yellow) lights or blinks.	**[Digital error indicator: 0]** Setting data of this device error	Check the noise status around this device. In case the handy controller (**SFB-HC**) (optional) is applied, re-set the function. Even if the error is not cleared, contact SUNX.
	[Digital error indicator: 1] System between emitter and receiver error	Set the same value to the Nos. of emitter and receiver and that of beam channel, and the shielded wires.
	[Digital error indicator: 2] Series connection error	Connect the series connection cable correctly. Check the error content of the upper sensor.
	[Digital error indicator: 3] Total unit No. / total beam channel No. error	Set the condition of the series connection within the specification.
	[Digital error indicator: 4] Interlock setting error	Wire the interlock setting input line and emitter halt input line correctly.
	[Digital error indicator: 5, 9] Muting lamp error	Wire the muting lamp correctly.
	[Digital error indicator: 6] Shielded wire error	Wire the shielded wire correctly. Wire the shielded wire for receiver correctly.
	[Digital error indicator: 8] Parallel system error	Wire the interference prevention input line correctly.
	[Digital error indicator: F] Effect from noise / power supply or failure of internal circuit	Check the noise status around this device. Check the wiring status, supply voltage, and power source capacity. Even if the error is not cleared, contact SUNX.
Emission halt indicator (orange) lights up.	Emission is in halt condition.	Wire the emission halt input / reset input line correctly. The logic differs depending on the interlock setting status.
All beam-axis adjustment indicators (red) lights up.	The beam channel with its fixed blanking function set into valid receives light.	Turn on the power supply after checking the installation status.
Operation indicator remains lit in red (light is not received). (Note)	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, OSSD 2), the operation indicator is marked as 'OSSD' on the sensor.

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

4-2 Troubleshooting of Receiver

Symptoms	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 output of the specified range.	Set the supply voltage correctly.
	Connector is not connected securely.	Connect the connector securely.
Fault indicator (yellow) lights or blinks.	**[Digital error indicator: 0]** Setting data of the sensor error	Check the noise status around the sensor. In case the handy controller (**SFB-HC**) (optional) is applied, re-set the function. Even if the error is not cleared, contact SUNX.
	[Digital error indicator: 1] System between emitter and receiver error	Set the same value to the Nos. of emitter and receiver and that of beam channel, and the shielded wires.
	[Digital error indicator: 2] Series connection error	Connect the series connection cable correctly. Check the error content of the upper sensor.
	[Digital error indicator: 3] Total unit No. / total beam channel No. error	Set the condition of the series connection within the specification.
	[Digital error indicator: 4] Extraneous light error	Prevent any extraneous light from entering the receiver. If the extraneous light is coming from this product, take interference prevention measures.
	[Digital error indicator: 5, 9] Control output (OSSD 1, OSSD 2) error	Wire the control output (OSSD 1, OSSD 2) correctly.
	[Digital error indicator: 6] Shielded wire error	Wire the shielded wire correctly. Wire the shielded wire of the receiver correctly.
	[Digital error indicator: 7] External device error	Wire the external device monitor input line correctly. Replace the relay. Replace the relay with proper response time. Change the relay monitoring time using the handy controller (**SFB-HC**) (optional).
	[Digital error indicator: F] Effect from noise / power supply or failure of internal circuit	Check the noise status around this device. Check the wiring status, supply voltage, and power source capacity. Even if the error is not cleared, contact SUNX.
Emission halt indicator (orange) lights up.	Emission is in halt condition.	Wire the emission halt input / reset input line correctly. The logic differs depending on the interlock setting status.
All beam-axis adjustment indicators (red) lights up.	The beam channel with its fixed blanking function set into valid receives light	Turn on the power supply after checking the installation status.
Operation indicator remains lit in red (light is not received).	The beam channels of the emitter and the receiver are not correctly aligned.	Align the beam channels.

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

Chapter 5 Specifications・Dimensions

5-1 Specifications

Model

SF4B- ＊ ＊＊

＊＊: No. of beam channels

＊: **F**: Beam pitch 10mm
H: Beam pitch 20mm
A: Beam pitch 40mm

Example: **SF4B-F55**
Beam pitch: 10mm
No. of beam channels: 55 ch

Model-wise specifications

<10mm pitch type>

Type / Item / Model No.	10mm pitch type					
	SF4B-F23	**SF4B-F31**	**SF4B-F39**	**SF4B-F47**	**SF4B-F55**	**SF4B-F63**
No. of beam channel	23	31	39	47	55	63
Sensing range	0.3 to 7m					
Beam pitch	10mm					
Protective height	230mm	310mm	390mm	470mm	550mm	630mm
Current consumption	Emitter: 80mA or less, Receiver: 120mA or less			Emitter: 100mA or less, Receiver: 160mA or less		
Weight (total of emitter and receiver)	570g approx.	680g approx.	800g approx.	920g approx.	1,030g approx.	1,150g approx.

Type / Item / Model No.	10mm pitch type				
	SF4B-F71	**SF4B-F79**	**SF4B-F95**	**SF4B-F111**	**SF4B-F127**
No. of beam channel	71	79	95	111	127
Sensing range	0.3 to 7m				
Beam pitch	10mm				
Protective height	710mm	790mm	950mm	1,110mm	1,270mm
Current consumption	Emitter: 100mA or less Receiver: 160mA or less	Emitter: 115mA or less Receiver: 190mA or less		Emitter: 135mA or less Receiver: 230mA or less	
Weight (total of emitter and receiver)	1,260g approx.	1,380g approx.	1,620g approx.	1,850g approx.	2,090g approx.

<20mm pitch type>

Item \ Type	20mm pitch type					
Model No.	**SF4B-H12**	**SF4B-H16**	**SF4B-H20**	**SF4B-H24**	**SF4BH28**	**SF4B-H32**
No. of beam channel	12	16	20	24	28	32
Sensing range	0.3 to 9m					
Beam pitch	20mm					
Protective height	230mm	310mm	390mm	470mm	550mm	630mm
Current consumption	Emitter: 70mA or less, Receiver: 95mA or less			Emitter: 80mA or less, Receiver: 115mA or less		
Weight (total of emitter and receiver)	570g approx.	680g approx.	800g approx.	920g approx.	1,030g approx.	1,150g approx.

Item \ Type	20mm pitch type					
Model No.	**SF4B-H36**	**SF4B-H40**	**SF4B-H48**	**SF4BH56**	**SF4B-H64**	**SF4B-H72**
No. of beam channel	36	40	48	56	64	72
Sensing range	0.3 to 9m					0.3 to 7m
Beam pitch	20mm					
Protective height	710mm	790mm	950mm	1,110mm	1,270mm	1,430mm
Current consumption	Emitter: 80mA or less Receiver: 115mA or less	Emitter: 90mA or less Receiver: 140mA or less		Emitter: 100mA or less Receiver: 160mA or less		Emitter: 110mA or less Receiver: 180mA or less
Weight (total of emitter and receiver)	1,260g approx.	1,380g approx.	1,620g approx.	1,850g approx.	2,090g approx.	2,320g approx.

Item \ Type	20mm pitch type		
Model No.	**SF4B-H80**	**SF4B-H88**	**SF4B-H96**
No. of beam channel	80	88	96
Sensing range	0.3 to 7m		
Beam pitch	20mm		
Protective height	1,590mm	1,750mm	1,910mm
Current consumption	Emitter: 110mA or less Receiver: 180mA or less	Emitter: 120mA or less Receiver: 200mA or less	
Weight (total of emitter and receiver)	2,540g approx.	2,780g approx.	3,010g approx.

<40mm pitch type>

Item \ Type	40mm pitch type					
Model No.	**SF4B-A6**	**SF4B-A8**	**SF4B-A10**	**SF4B-A12**	**SF4B-A14**	**SF4B-A16**
No. of beam channel	6	8	10	12	14	16
Sensing range	0.3 to 9m					
Beam pitch	40mm					
Protective height	230mm	310mm	390mm	470mm	550mm	630mm
Current consumption	Emitter: 65mA or less, Receiver: 85mA or less			Emitter: 70mA or less, Receiver: 95mA or less		
Weight (total of emitter and receiver)	570g approx.	680g approx.	800g approx.	920g approx.	1,030g approx.	1,150g approx.

Item \ Type	40mm pitch type					
Model No.	**SF4B-A18**	**SF4B-A20**	**SF4B-A24**	**SF4B-A28**	**SF4B-A32**	**SF4B-A36**
No. of beam channel	18	20	24	28	32	36
Sensing range	0.3 to 9m					
Beam pitch	40mm					
Protective height	710mm	790mm	950mm	1,110mm	1,270mm	1,430mm
Current consumption	Emitter: 70mA or less Receiver: 95mA or less	Emitter: 75mA or less Receiver: 105mA or less		Emitter: 80mA or less Receiver: 120mA or less		Emitter: 85mA or less Receiver: 130mA or less
Weight (total of emitter and receiver)	1,260g approx.	1,380g approx.	1,620g approx.	1,850g approx.	2,090g approx.	2,320g approx.

Item \ Type	40mm pitch type		
Model No.	**SF4B-A40**	**SF4B-A44**	**SF4B-H48**
No. of beam channel	40	44	48
Sensing range	0.3 to 7m		
Beam pitch	40mm		
Protective height	1,590mm	1,750mm	1,910mm
Current consumption	Emitter: 85mA or less Receiver: 130mA or less	Emitter: 95mA or less Receiver: 140mA or less	
Weight (total of emitter and receiver)	2,540g approx.	2,780g approx.	3,010g approx.

Common specifications

Item \ Type	10mm pitch type	20mm pitch type	40mm pitch type
Model No.	**SF4B-F□**	**SF4B-H□**	**SF4B-A□**
Detecting capability (Min. sensing object)	φ14mm opaque object	φ25mm opaque object	φ45mm opaque object
Effective aperture angle (EAA)	±2.5 degree or less [for sensing range exceeding 3m (Required by IEC61496-2 / UL 61496-2)]		
Supply voltage	24V DC±10% Ripple P-P10% or less		
Control output (OSSD 1, OSSD 2)	PNP open collector transistor / NPN open collector transistor (switching type) ▪ In case of selecting PNP output: Max. source current: 200mA In case of selecting NPN output: Max. sink current : 200mA ▪ Applied voltage: same as supply voltage [In case of selecting PNP output: between the control output (OSSD 1, OSSD 2) and +V In case of selecting NPN output: between the control output (OSSD 1, OSSD 2) and 0V] ▪ Residual voltage: 2.5V or less (In case of selecting PNP output: source current 200mA, in case of selecting NPN output: sink current 200mA) (when using 20m length cable)		
Operation mode (Output operation)	ON when all beams are received, OFF when one or more beams are interrupted (Note 1) (Note 2) (OFF when fault occurs in the sensor or the synchronization signal error, too)		
Protection circuit (Short circuit)	Incorporated		
Response time	In case of normal operation···ON→OFF: 14ms or less, OFF→ON: 80 to 90ms or less (IEC 61416-2, Ed2)		
Auxiliary output (Non-safety output)	PNP open collector transistor / NPN open collector transistor (switching type) ▪ In case of selecting PNP output: Max. source current: 60mA In case of selecting NPN output: Max. sink current : 60mA ▪ Applied voltage: same as supply voltage [In case of selecting PNP output: between the auxiliary output and +V In case of selecting NPN output: between the auxiliary output and 0V] ▪ Residual voltage: 2.5V or less (In case of selecting PNP output: source current 60mA, in case of selecting NPN output: sink current 60mA) (when using 20m-length cable)		
Operation mode (Output operation)	When OSSDs are ON: OFF, when OSSDs are OFF: ON (factory setting), [Changeable by using the handy controller (**SFB-HC**) (optional)]		
Protection circuit (Short circuit)	Incorporated		
Indicators – Emitter	Beam-axis alignment indicator: 2-color (red / green) LED × 4 (lights up in red when each beam channel is received, lights up in red when either top-most end or bottom-most end beam channel is received, lights up in green when all beam channels are received.) Operation indicator: 2-color (red / green) LED (Note 3) [lights up in red when the control output (OSSD 1, OSSD 2) is OFF, lights up in green when the control output (OSSD 1, OSSD 2) is ON.] Incident beam intensity indicator: 2-color (orange / green) LED [lights up in green when sufficient light is received (reception intensity 130% or more), OFF when stable beam is received (reception intensity 115 to 130%), lights up in orange when unstable beam is received (reception intensity 100 to 115%), OFF when beam is blocked] (Note 4) Fault indicator: Yellow LED (lights up or blinks when fault occurs in the sensor) Digital error indicator: Red LED (lights up for indicating error content when the device is lockout) PNP indicator: Orange LED (lights up when PNP output is set) NPN indicator: Orange LED (lights up when NPN output is set) Emission intensity control indicator: Orange LED (emission in normal mode: OFF, emission in short mode: lights up) Emission halt indicator: Orange LED (lights up when light emission is halt, and lights off when light is emitted.)		
Indicators – Receiver	Beam-axis alignment indicator: 2-color (red / green) LED × 4 (lights up in red when each beam channel is received, lights up in red when either top-most end or bottom-most end beam channel is received, lights up in green when all beam channels are received.) OSSD indicator: 2-color (red / green) LED [lights up in red when the control output (OSSD1, OSSD2) is OFF, lights up in green when the control output (OSSD1, OSSD2) is ON.] Incident beam intensity indicator: 2-color (orange / green) LED [lights up in green when sufficient light is received (reception intensity 130% or more), OFF when stable beam is received (reception intensity 115 to 130%), lights up in orange when unstable beam is received (reception intensity 100 to 115%), OFF when beam is blocked] (Note 4) Fault indicator: Yellow LED (lights up or blinks when fault occurs in the sensor) Digital error indicator: Red LED (lights up for indicating error content when the device is lockout) PNP indicator: Orange LED (lights up when PNP output is set) NPN indicator: Orange LED (lights up when NPN output is set) Function setting indicator: Orange LED [when the blanking function is used: lights up (Note 5), when the handy controller is connected: blinks] Interlock indicator: Yellow LED (when the device is interlocked: lights up, other cases: OFF)		
Interference prevention function	Incorporated		
Emission halt function	Emission: 0 to +1.5V or Vs to Vs-2.5V (when PNP output is selected: source current 5mA or less, when NPN output is selected: sink current 5mA or less) (Note 6), Emission halt: open		
Interlock function	Manual reset / Auto reset (Note 5) (Note 6)		
External device monitor function	Incorporated (Note 5)		
Override function	Incorporated (Note 5)		
Muting function	Incorporated (Note 5)		

Item \ Type	10mm pitch type	20mm pitch type	40mm pitch type
Model No.	**SF4B-F□**	**SF4B-H□**	**SF4B-A□**
Optional function (Note 5)	Fixed blanking function, floating blanking function, auxiliary output switching function, interlock setting changing function, external relay monitor setting changing function, muting setting changing function, protect function, emission intensity control function		
Protection	IP65 (IEC)		
Ambient temperature	-10 to +55℃ (No dew condensation or icing allowed), Storage: -25 to +70℃		
Ambient illluminance	Incandescent lamp: 3,500ℓx at the light-receiving surface		
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/s² acceleration (30G approx.) in X, Y, and Z directions for three times each		
Emitting element	Infrared LED (Peak emission wavelength: 870nm)		
Connection method	Connection with connectors		
Cable extension	Extension up to total 50m is possible for both emitter and receiver connecting cable (optional) (Note 7)		
Material	Enclosure: Aluminum, Lens cover: PMMA, Cap: Polycarbonate / ABS		
Accessories	**MS-SFB-2** (Intermediate supporting bracket): (Note 8) **SFB-TR14** (Test rod): 1 pc.	**MS-SFB-2** (Intermediate supporting bracket): (Note 8) **SFB-TR25** (Test rod): 1 pc.	**MS-SFB-2** (Intermediate supporting bracket): (Note 8)
Applicable standard	JIS B 9704 1/2 (Type 4), JIS B 9705-1 (ISO 13849-1) (Category 4), EN 954-1 (Category 4), EN 61496-1 (Type 4), IEC 61496-1/2 (Type 4), UL 61496-1/2 (Type 4), UL 1998		

Notes: 1) The beam channel is not turned OFF during muting even if it is blocked.
2) In case the blanking function is valid, the operation mode is changed.
3) Since the color of the operation indicator changes according to the ON / OFF state of the control output (OSSD 1, OSSD 2), the operation indicator is marked as [OSSD] on the sensor.
4) The threshold where the control output (OSSD 1, OSSD 2) changes from OFF to ON is applied as '100% incident beam intensity'.
Besides, 'when beam is blocked' refers to the status that there exists any object blocking beam in the sensing area.
5) In case of using optional function, the handy controller (**SFB-HC**) (optional) is required.
6) The manual reset and auto reset are possible to be switched depending on the wiring status.
7) The cable can be extended within 30m (for emitter / receiver) when two sensors are connected with series connection, within 20m when three sensors are connected with series connection. Furthermore, when the muting lamp is used, the cable can be extended within 40m (for emitter / receiver).
8) The intermediate supporting bracket (**MS-SFB-2**) is enclosed with the following sensors. The quantity of the enclosed bracket differs depending on the sensor as follows:
1 set : **SF4B-F□**・・・Sensor with 79 to 111 beam channels
SF4B-H□・・・Sensor with 40 to 56 beam channels
SF4B-A□・・・Sensor with 20 to 28 beam channels
2 sets: **SF4B-F127**, **SF4B-H□**・・・Sensor with 64 to 80 beam channels
SF4B-A□・・・Sensor with 32 to 40 beam channels
3 sets: **SF4B-H□**・・・Sensor with 88 to 96 beam channels
SF4B-A□・・・Sensor with 44 to 48 beam channels

⚠WARNING

This device enables to set each function by using the handy controller (**SFB-HC**) (optional). The contents related to the safety distance such as the size of the minimum sensing object, response speed, etc. for some functions might be differed. For setting each function, re-calculate the safety distance and keep proper space larger than safety distance. Not keeping enough space around this device might not stop the machine quickly, resulting in serious body injury or death.

<Reference>

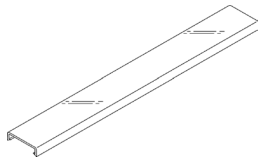
Refer to '**2-9 Functions Using Handy Controller (SFB-HC) (Available soon)**' for details related to the function setting, or to the instruction manual attached to handy controller.

<Reference>

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. (The last 5 digits under the model represents the serial No.)

5-2 Options

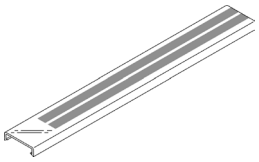
● **Front protection cover: 1 pc.**



Model No.	Applicable beam channel No.	Remarks
FC-SFBH-12	**SF4B-F23/H12/A6**	Protects the sensing surface of the sensor from dirt, etc.
FC-SFBH-16	**SF4B-F31/H16/A8**	
FC-SFBH-20	**SF4B-F39/H20/A10**	
FC-SFBH-24	**SF4B-F47/H24/A12**	
FC-SFBH-28	**SF4B-F55/H28/A14**	
FC-SFBH-32	**SF4B-F63/H32/A16**	
FC-SFBH-36	**SF4B-F71/H36/A18**	
FC-SFBH-40	**SF4B-F79/H40/A20**	
FC-SFBH-48	**SF4B-F95/H48/A24**	
FC-SFBH-56	**SF4B-F111/H56/A28**	
FC-SFBH-64	**SF4B-F127/H64/A32**	
FC-SFBH-72	**SF4B-H72/A36**	
FC-SFBH-80	**SF4B-H80/A40**	
FC-SFBH-88	**SF4B-H88/A44**	
FC-SFBH-96	**SF4B-H96/A48**	

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

● **Slit mask: 1 pc.**



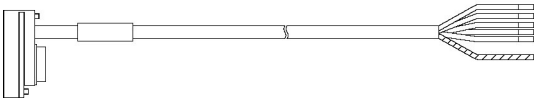
Model No.	Applicable beam channel No.	Remarks
OS-SFBH-12	**SF4B-F23/H12/A6**	Restrains the intensity of beam emitted or received and hence reduces the interference between neighboring sensor. Furthermore, this slit is also used for protecting from too much transmission of the light caused by the strong light.
OS-SFBH-16	**SF4B-F31/H16/A8**	
OS-SFBH-20	**SF4B-F39/H20/A10**	
OS-SFBH-24	**SF4B-F47/H24/A12**	
OS-SFBH-28	**SF4B-F55/H28/A14**	
OS-SFBH-32	**SF4B-F63/H32/A16**	
OS-SFBH-36	**SF4B-F71/H36/A18**	
OS-SFBH-40	**SF4B-F79/H40/A20**	
OS-SFBH-48	**SF4B-F95/H48/A24**	
OS-SFBH-56	**SF4B-F111/H56/A28**	
OS-SFBH-64	**SF4B-F127/H64/A32**	
OS-SFBH-72	**SF4B-H72/A36**	
OS-SFBH-80	**SF4B-H80/A40**	
OS-SFBH-88	**SF4B-H88/A44**	
OS-SFBH-96	**SF4B-H96/A48**	

When the slit mask is fitted, the sensing distance is shortened.

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

[1 pc. for emitter (connector: gray), 1 pc. for receiver (connector: black)]

<Discrete wire>



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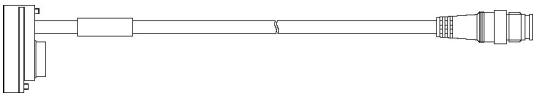
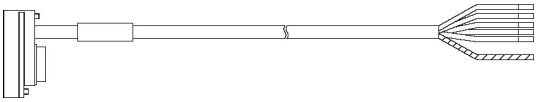


Type	Model No.	Cable length	Remarks
Discrete wire	**SFB-CCB3**	3m	This cable is used for normal operation. For emitter : 8-core shielded cable For receiver: 8-core shielded cable
	SFB-CCB7	7m	
Connector	**SFB-CB05**	0.5m	
	SFB-CB5	5m	
	SFB-CB10	10m	

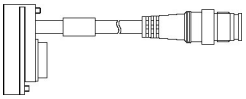
● **12-core bottom cap cable: 2 pcs./set**

[1 pc. for emitter (connector: gray), 1 pc. for receiver (connector: black)]

<Discrete wire>



<Connector>



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

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

[1 pc. for emitter (connector: gray), 1 pc. for receiver (connector: black)]

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

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

[1 pc. for emitter (connector: gray), 1 pc. for receiver (connector: black)]

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

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

[1 pc. for emitter (connector: gray), 1 pc. for receiver (connector: black)]

Type	Model No.	Cable length	Remarks
For emitter	**SFB-CCJ10E**	10m	This cable is used for extending the normal 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**		

● **12-core extension cable with connectors on both ends (separate wire): 1 pc.**

[1 pc. for emitter (connector: gray), 1 pc. for receiver (connector: black)]

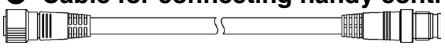
Type	Model No.	Cable length	Remarks
For emitter	**SFB-CCJ10E-MU**	10m	In case of using the muting function, this cable is used for extending the cable. The connector is attached on both ends of the cable. For emitter : 12-core shielded cable For receiver : 12-core shielded cable
For receiver	**SFB-CCJ10D-MU**		

● **Cable for series connection: 2 pcs./set**

(Common for emitter and receiver)

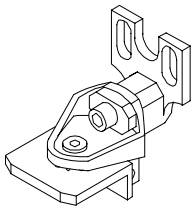
Model No.	Cable length	Remarks
SFB-CSL01	0.1m	Used to connect sensor in series. Common for emitter and receiver.
SFB-CSL05	0.5m	
SFB-CSL10	1m	
SFB-CSL50	5m	

● **Cable for connecting handy controller: 1 pc.**



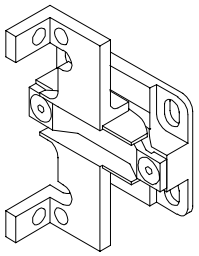
Model No.	Cable length	Remarks
SFB-CCJ02-HC	1m	When the 12-core bottom cap cable (**SFB-CCB□-MU**) (optional) is used, the handy controller (**SFB-HC**) (optional) can be connected. For emitter : 12-core shielded cable For receiver : 12-core shielded cable With connector on both ends

● **Standard mounting bracket: 4 pcs./ set**



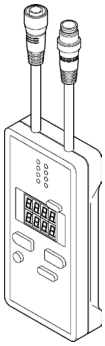
Model No.	Remarks
MS-SFB-1	This is the mounting bracket for adjusting mounting angle easily.

● **Dead spaceless bracket: 4 pcs./set**



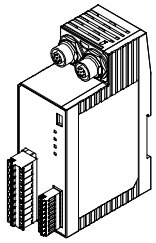
Model No.	Remarks
MS-SFB-3	This is the mounting bracket for reducing the dead space.

● **Handy controller: 1 pc. (available soon)**



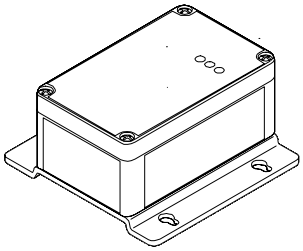
Model No.	Remarks
SFB-HC	Handy controller that enables setting each function.

● **Connector connection type control unit: 1 pc.**



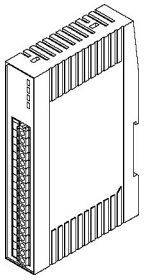
Model No.	Remarks
SF-C11	This is the control unit conforming to European / North American safety standards. Applicable to 8-core cable with connector.

● **Solid type control unit : 1 pc.**



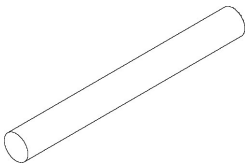
Model No.	Remarks
SF-C12	This is the control unit conforming to European / North American safety standards (IP65). Applicable to 12-core cable with connector.

● **Thin type control unit: 1 pc.**



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

● **Test rod: 1 pc.**

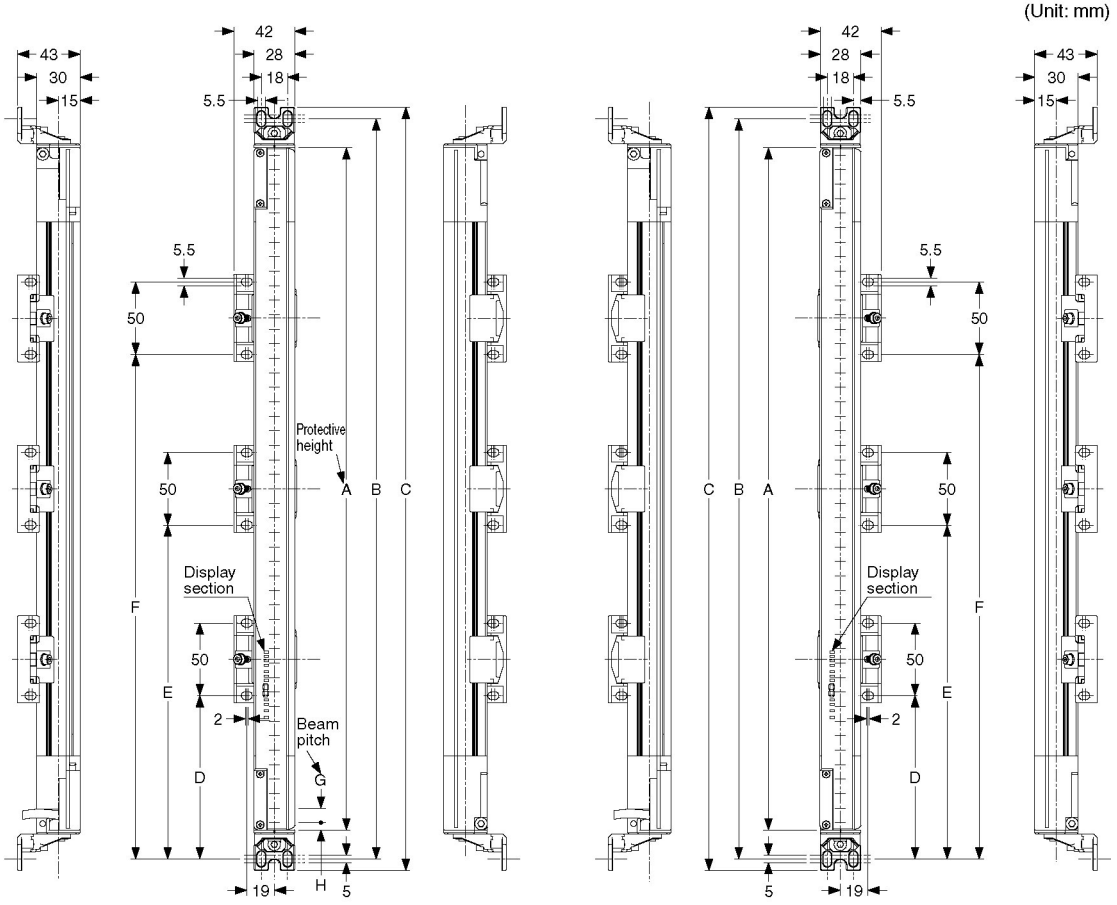


Model No.	Remarks
SFB-TR24	Test rod for **SF4B-F** type 1 beam channel floating. ϕ 24mm
SFB-TR34	Test rod for **SF4B-F** type 2 beam channels floating. ϕ 34mm
SFB-TR45	Test rod for **SF4B-A**. ϕ 45mm It can be also used for **SF4B-H** type 1 beam channel floating.

5-3 Dimensions

5-3-1 Rear Mounting with Standard Mounting Bracket (MS-SFB-1)

(Unit: mm)



<Emitter> <Receiver>

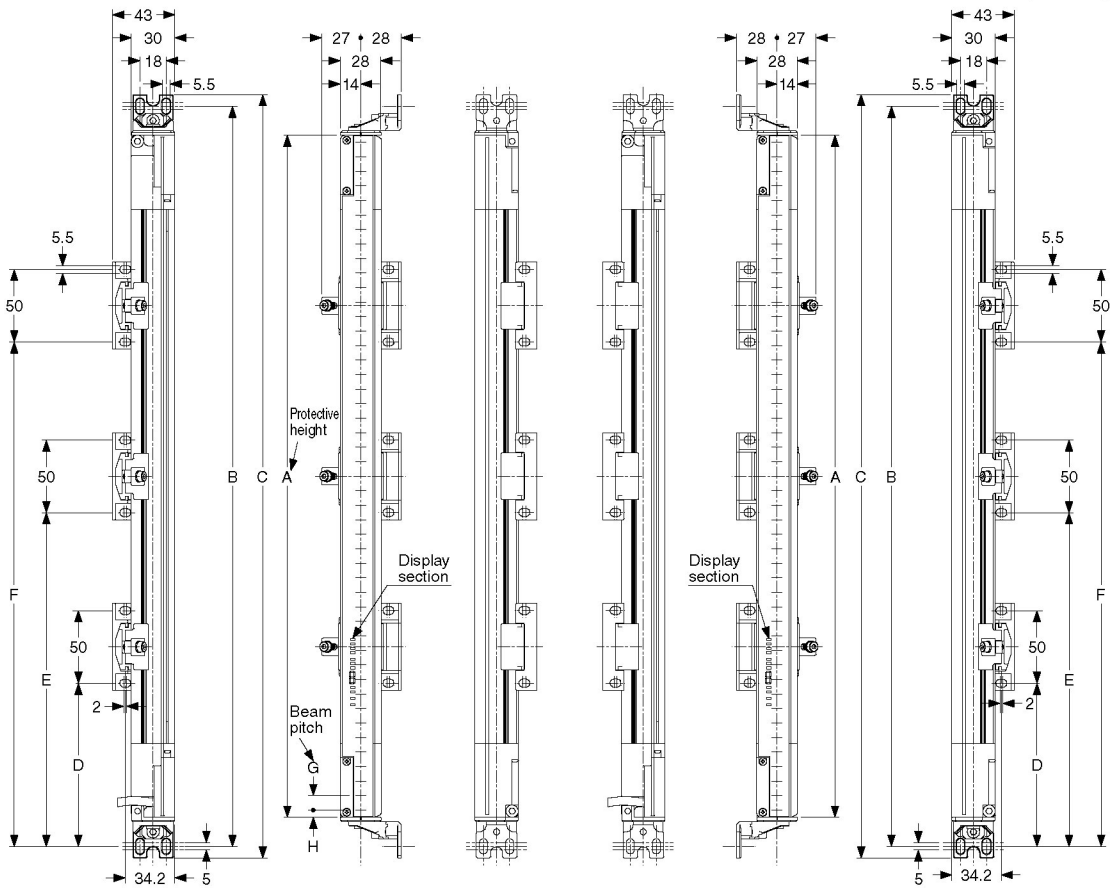
Model No.	A	B	C	D	E	F
SF4B-F23, SF4B-H12, SF4B-A6	230	270	286	—	—	—
SF4B-F31, SF4B-H16, SF4B-A8	310	350	366	—	—	—
SF4B-F39, SF4B-H20, SF4B-A10	390	430	446	—	—	—
SF4B-F47, SF4B-H24, SF4B-A12	470	510	526	—	—	—
SF4B-F55, SF4B-H28, SF4B-A14	550	590	606	—	—	—
SF4B-F63, SF4B-H32, SF4B-A16	630	670	686	—	—	—
SF4B-F71, SF4B-H36, SF4B-A18	710	750	766	—	—	—
SF4B-F79, SF4B-H40, SF4B-A20	790	830	846	390	—	—
SF4B-F95, SF4B-H48, SF4B-A24	950	990	1,006	470	—	—
SF4B-F111, SF4B-H56, SF4B-A28	1,110	1,150	1,166	550	—	—
SF4B-F127, SF4B-H64, SF4B-A32	1,270	1,310	1,326	418	842	—
SF4B-H72, SF4B-A36	1,430	1,470	1,486	472	948	—
SF4B-H80, SF4B-A40	1,590	1,630	1,646	525	1,055	—
SF4B-H88, SF4B-A44	1,750	1,790	1,806	433	870	1,308
SF4B-H96, SF4B-A48	1,910	1,950	1,966	473	950	1,428

Type	G	H
SF4B-F□	10	5
SF4B-H□	20	5
SF4B-A□	40	15

Note: The intermediate supporting bracket (**MS-SFB-2**) is enclosed with the sensors. The number of the brackets varies depending on the sensor.

5-3-2 Side Mounting with Standard Mounting Bracket (MS-SFB-1)

(Unit: mm)



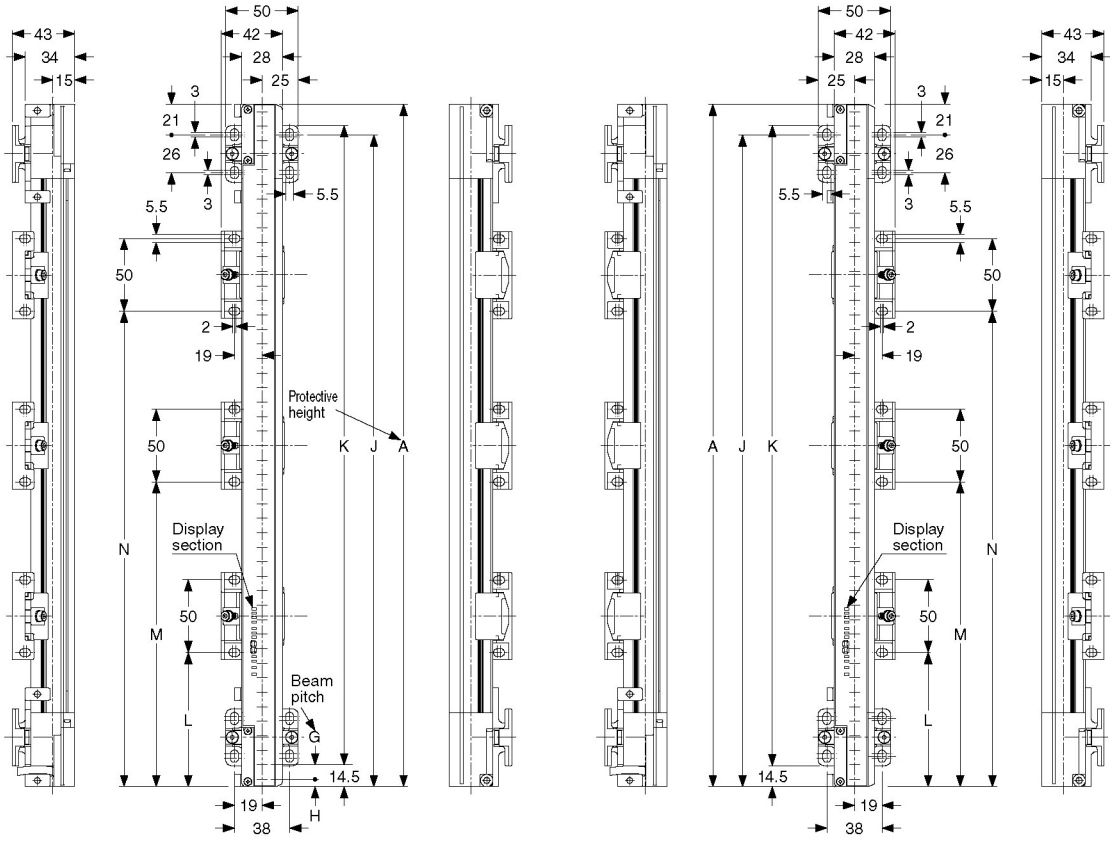
Model No.	A	B	C	D	E	F
SF4B-F23, SF4B-H12, SF4B-A6	230	270	286	—	—	—
SF4B-F31, SF4B-H16, SF4B-A8	310	350	366	—	—	—
SF4B-F39, SF4B-H20, SF4B-A10	390	430	446	—	—	—
SF4B-F47, SF4B-H24, SF4B-A12	470	510	526	—	—	—
SF4B-F55, SF4B-H28, SF4B-A14	550	590	606	—	—	—
SF4B-F63, SF4B-H32, SF4B-A16	630	670	686	—	—	—
SF4B-F71, SF4B-H36, SF4B-A18	710	750	766	—	—	—
SF4B-F79, SF4B-H40, SF4B-A20	790	830	846	390	—	—
SF4B-F95, SF4B-H48, SF4B-A24	950	990	1,006	470	—	—
SF4B-F111, SF4B-H56, SF4B-A28	1,110	1,150	1,166	550	—	—
SF4B-F127, SF4B-H64, SF4B-A32	1,270	1,310	1,326	418	842	—
SF4B-H72, SF4B-A36	1,430	1,470	1,486	472	948	—
SF4B-H80, SF4B-A40	1,590	1,630	1,646	525	1,055	—
SF4B-H88, SF4B-A44	1,750	1,790	1,806	433	870	1,308
SF4B-H96, SF4B-A48	1,910	1,950	1,966	473	950	1,428

Type	G	H
SF4B-F□	10	5
SF4B-H□	20	5
SF4B-A□	40	15

Note: The intermediate supporting bracket (**MS-SFB-2**) is enclosed with the sensors. The number of the brackets varies depending on the sensor.

5-3-3 Rear Mounting with Dead Spaceless Bracket (MS-SFB-3)

(Unit: mm)



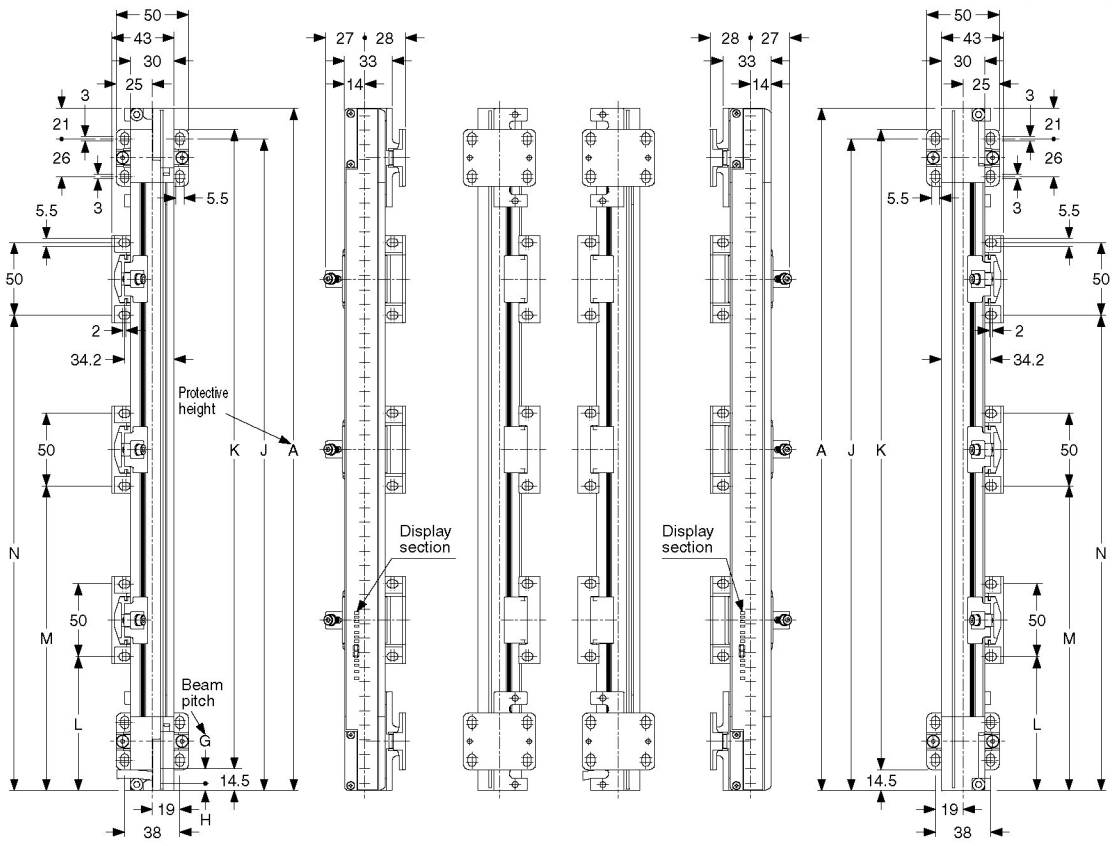
Model No.	A	J	K	L	M	N
SF4B-F23, SF4B-H12, SF4B-A6	230	209	201	—	—	—
SF4B-F31, SF4B-H16, SF4B-A8	310	289	281	—	—	—
SF4B-F39, SF4B-H20, SF4B-A10	390	369	361	—	—	—
SF4B-F47, SF4B-H24, SF4B-A12	470	449	441	—	—	—
SF4B-F55, SF4B-H28, SF4B-A14	550	529	521	—	—	—
SF4B-F63, SF4B-H32, SF4B-A16	630	609	601	—	—	—
SF4B-F71, SF4B-H36, SF4B-A18	710	689	681	—	—	—
SF4B-F79, SF4B-H40, SF4B-A20	790	769	761	370	—	—
SF4B-F95, SF4B-H48, SF4B-A24	950	929	921	450	—	—
SF4B-F111, SF4B-H56, SF4B-A28	1,110	1,089	1,081	530	—	—
SF4B-F127, SF4B-H64, SF4B-A32	1,270	1,249	1,241	398	822	—
SF4B-H72, SF4B-A36	1,430	1,409	1,401	452	928	—
SF4B-H80, SF4B-A40	1,590	1,569	1,561	505	1,035	—
SF4B-H88, SF4B-A44	1,750	1,729	1,721	413	850	1,288
SF4B-H96, SF4B-A48	1,910	1,889	1,881	453	930	1,408

Type	G	H
SF4B-F□	10	5
SF4B-H□	20	5
SF4B-A□	40	15

Note: The intermediate supporting bracket (**MS-SFB-2**) is enclosed with the sensors. The number of the brackets varies depending on the sensor.

5-3-4 Side Mounting with Dead Spaceless Bracket (MS-SFB-3)

(Unit: mm)



<Emitter> <Receiver>

Model No.	A	J	K	L	M	N
SF4B-F23, SF4B-H12, SF4B-A6	230	209	201	—	—	—
SF4B-F31, SF4B-H16, SF4B-A8	310	289	281	—	—	—
SF4B-F39, SF4B-H20, SF4B-A10	390	369	361	—	—	—
SF4B-F47, SF4B-H24, SF4B-A12	470	449	441	—	—	—
SF4B-F55, SF4B-H28, SF4B-A14	550	529	521	—	—	—
SF4B-F63, SF4B-H32, SF4B-A16	630	609	601	—	—	—
SF4B-F71, SF4B-H36, SF4B-A18	710	689	681	—	—	—
SF4B-F79, SF4B-H40, SF4B-A20	790	769	761	370	—	—
SF4B-F95, SF4B-H48, SF4B-A24	950	929	921	450	—	—
SF4B-F111, SF4B-H56, SF4B-A28	1,110	1,089	1,081	530	—	—
SF4B-F127, SF4B-H64, SF4B-A32	1,270	1,249	1,241	398	822	—
SF4B-H72, SF4B-A36	1,430	1,409	1,401	452	928	—
SF4B-H80, SF4B-A40	1,590	1,569	1,561	505	1,035	—
SF4B-H88, SF4B-A44	1,750	1,729	1,721	413	850	1,288
SF4B-H96, SF4B-A48	1,910	1,889	1,881	453	930	1,408

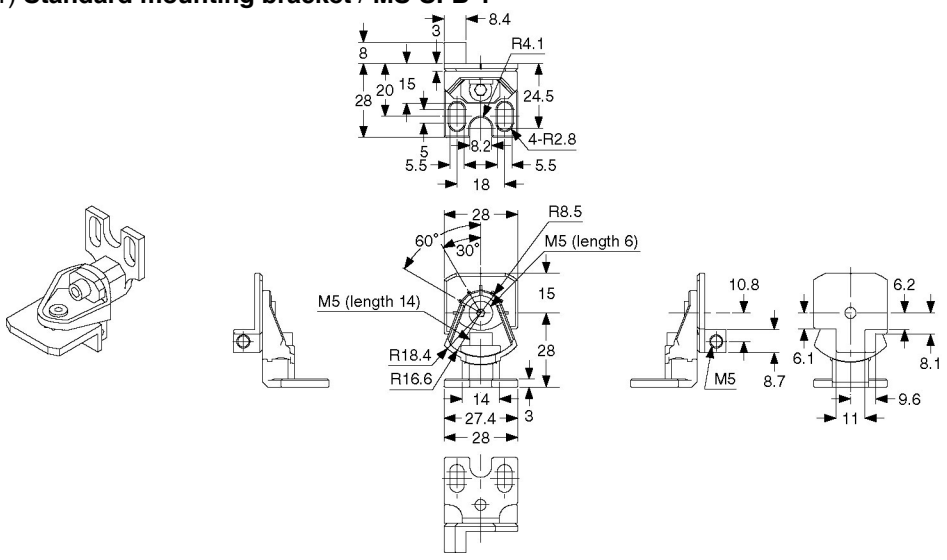
Type	G	H
SF4B-F□	10	5
SF4B-H□	20	5
SF4B-A□	40	15

Note: The intermediate supporting bracket (**MS-SFB-2**) is enclosed with the sensors. The number of the brackets varies depending on the sensor.

5-3-5 Mounting Brackets

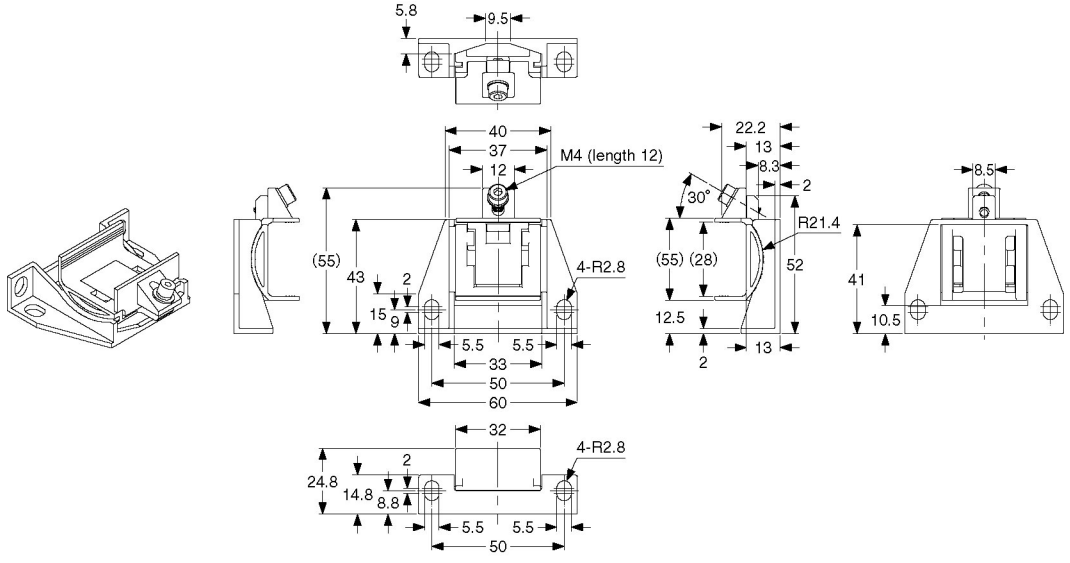
(Unit: mm)

1) **Standard mounting bracket / MS-SFB-1**



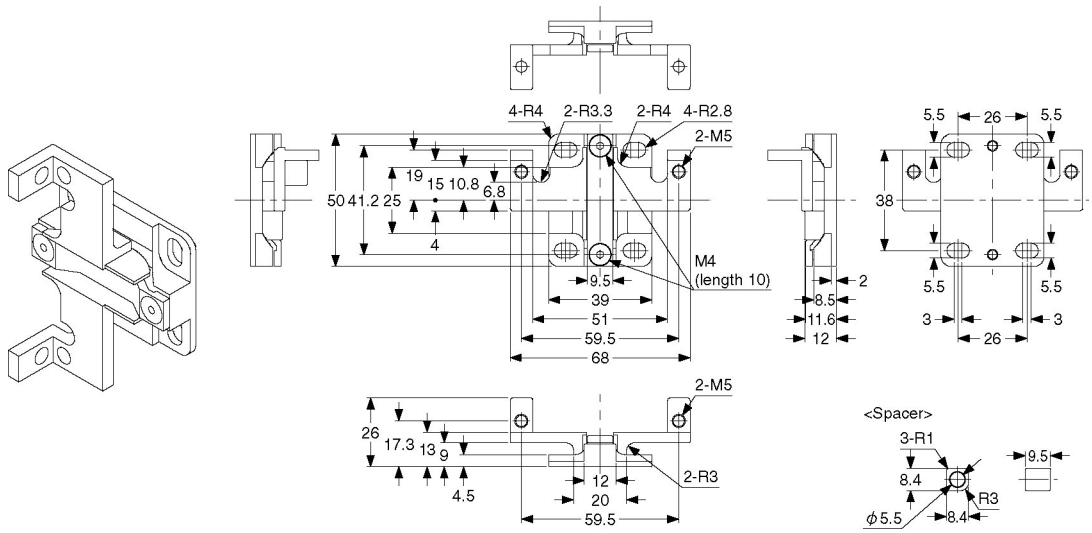
Material: SPCC

2) **Intermediate supporting bracket / MS-SFB-2**



Material: SPCC

3) **Dead spaceless beacket / MS-SFB-3**



Material: SPCC

Chapter 6 Others

6-1 Glossary

EN 61496-1 IEC 61496-1/2 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, UL 61496-1 or JIS B 9704-1 gives general rules or failure mode and effect analysis, EMC requirements, etc. IEC 61496-2, 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).
JIS B 9705-1 (ISO-13849-1)	The standard that specifies the safety-related matters of machine safety / control system.
UL1998	UL standard for safety-related software in programmable components.
ESPE	The abbreviation for Electro-Sensitive Protective Equipment.
Output control (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 side / Sub side	For series connection, the side where the power supply or the output is connected is called the main side, and the others are called the sub 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.
Protective height (Sensing height)	The length of the beam axis direction that the min. sensing object can be detected. The length from the center of the first beam channel to the center of the last beam channel in addition to +14mm (+7mm upward, +7mm downward).
Operating range (Sensing distance)	It is the distance 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 sensor. It is given by the product of the protective height and the operating range.
Emission halt function	This function enables checking of the receiver operation by turning off light emission. It is possible to halt emission by keeping the terminal open, and to have normal emission by connecting it to –V (+V for NPN output).
PSDI	The abbreviation for the Presence Sensing Device Initiation. The safety device that restarts automatically without any operation by the operator after the device detects danger status and halts for a while.

Revision History

First edition: October 27, 2004

[Warning Period]

・ SUNX warrants this product for twelve (12) months from the date of the shipment or delivery to the purchaser's appointed warehouse.

[Scope of Warranty]

・ During the above mentioned period, if a failure of the product occurs under normal use and operation, and if it is found by SUNX that it is responsible for the failure, it shall remedy the defect or tender substitution for exchange at its cost and expense.
However, in no event shall USNX be liable for the failure, damage or loss stipulated below:

(1) Failure caused by instructions, standards, or handling specified by the customer.
(2) Failure caused by modifications done in the structure, capabilities, specifications, etc., without consulting SUNX, after the purchase or the delivery of the product.
(3) Failure caused by a development which could not be foreseen based upon the technology in proactive at the time of purchase or contract.
(4) Failure caused by use which deviates from the conditions/environment given product catalog or specifications.
(5) In case this product is used by being incorporated in the customer's machine, failure which could be avoided if the customer's machine had functions and structure commonly accepted in the industry.
(6) Failure due to Force Majeure

Further, the warranty given here is limited only to this product which has been purchased or delivered. SUNX shall not be responsible for any consequential damage or loss arising out of the failure of this product.

[Scope of Service]

The cost of the delivered product does not include the cost of dispatching an engineer, etc. In case any such service is needed, it should be separately requested.

SUNX株式会社 http://www.sunx.co.jp/

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技術相談FAXサービス　0120-336-394
受付時間：月曜日から金曜日の9時～12時および13時～17時〈但し、祝日、年末年始等を除く〉

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