Panasonic

Ultraslim Light Curtain / Type4

SF4C Series <Ver. 3.0>

Instruction Manual

WUME-SF4C-17

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(MEMO)

Thank you for purchasing Panasonic Industry's Ultraslim Light Curtain, **SF4C** series.
Please read this instruction manual carefully and thoroughly for the correct and optimum use of this device.
Kindly keep this manual in a convenient place for quick reference.

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

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

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

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This product uses software including open source software (OSS).
For details of the open software used, refer to "1- 4 Open Source Software (OSS)."

Notes

1) The contents of this instruction manual may be changed without prior notice for further improvement of the device.
2) Though we have carefully drawn up the contents of this instruction manual, if there are any aspects that are not clear, or any error that you may notice, please contact our local Panasonic Industry office of the nearest distributor.
3) English and Japanese are original instructions.

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Chapter 1 Introduction

1-1 Attention Marks

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

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

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

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

1-2 Safety Precautions

- Use this device as per its specifications. Do not modify this device since its functions and capabilities may not be maintained and it may malfunction.
- This device has been developed / produced for industrial use only.
- This device is suitable for indoor use only.
- Use of this device under the following conditions or 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 or environments 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 installing this device to a particular machine, follow the safety regulations in regard to appropriate usage, mounting (installation), operation and maintenance. The users including the installation operator are responsible for the introduction of this device.
- Be sure not applying strong shock to this device. It may break this device.
- Use this device by installing suitable protection equipment as a countermeasure for failure, damage, or malfunction of this device.
- Before using this device, check whether the device performs properly with the functions and capabilities as per the design specifications.
- In case of disposal, dispose this device as an industrial waste.
- Do not use this product with mobile equipment such as an automated guided vehicle (AGV).

⚠ WARNING

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

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

♦ **Engineer**

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

♦ **Operator**

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

♦ **Environment**

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

♦ **Installation**

- Always keep the correctly calculated safety distance between this device and the dangerous parts of the machine.
- Install extra protection structure around the machine so that the operator must pass through the sensing area of this device to reach the dangerous parts of the machine.
- Install this device such that some part of the operator's body always remains in the sensing area when operator is done with the dangerous parts of the machine.
- Do not install this device at a location where it can be affected by wall reflection.
- If this device is used in multiple sets, arrange them to avoid mutual interference.
  For details, refer to "**2-3-4 Device Placement**."
- Do not use any reflection type or recursive reflection type arrangement.
- The corresponding emitter and receiver must have the same serial No. and be correctly oriented.

⚠ WARNING

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

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

♦ **Wiring**

- Be sure to carry out the wiring in the power supply OFF condition.
- All electrical wiring should conform to the regional electrical regulations and laws. The wiring should be done by engineer(s) having the special electrical knowledge.
- Do not run the wires together with high-voltage lines or power lines or put them in the same raceway. This can cause malfunction due to induction.
- In case of extending the cable of the emitter or the receiver, each can be extended up to 30 m by using the exclusive cable.
- Do not control the device only at one control output (OSSD 1 / 2).
- In order that the output is not turned ON due to earth fault of the control output (OSSD 1 / 2) wires, be sure to ground to 0 V side (PNP output) / +V side (NPN output).
- When using this device in Korea with KCs mark, be sure to ground to 0V side (PNP output).

♦ **Maintenance**

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

♦ **Others**

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

1-3 Applicable Standards / Regulations

This device complies with the following standards / regulations.

<Conformity Directives / Conforming Regulations>

EU Law: Machinery Directive 2006/42/EC, EMC Directive 2014/30/EU
British Legislation: Machinery Regulations 2008/1597, EMC Regulations 2016/1091

– Applicable Standards

EN 61496-1/2 (Type 4), EN 55011, EN 61000-6-2, EN ISO 13849-1 (Category 4, PLe)

<International Standards>

IEC 61496-1/2 (Type 4), IEC 61508-1 to 3 (SIL3), ISO 13849-1 (Category 4, PLe)

<Japanese Industrial Standards (JIS)>

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

<Standards in US / Canada)>

ANSI/UL 61496-1/2 (Type 4), ANSI/UL 508, UL 1998 (Class 2)
CAN/CSA 61496-1/2 (Type 4), CAN/CSA C22.2 No.14

<Regulations in US>

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

Regarding EU Machinery Directive, a Notified Body, TÜV SÜD, has certified with the type examination certificate.
With regard to the standards in US / Canada, TÜV SÜD, has certified for cTÜVus Mark.

<Standards in Korea>

Performance Standard of Protective Devices for Industrial Robot
KCs Certified according to Korea Occupational Safety and Health Act.

<Reference>

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

⚠ WARNING

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

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1-4 Open Source Software (OSS)

This product includes the open source software listed below.

- CMSIS (Apache-2.0)
- CMSIS compiler ICCARM (Apache-2.0)

1.4.1 Copyright · License

The license information of the open source software used in this product is as follows:

CMSIS

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SPDX-License-Identifier: Apache-2.0

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Compilateur CMSIS ICCARM

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1-5 Confirmation of Packed Contents

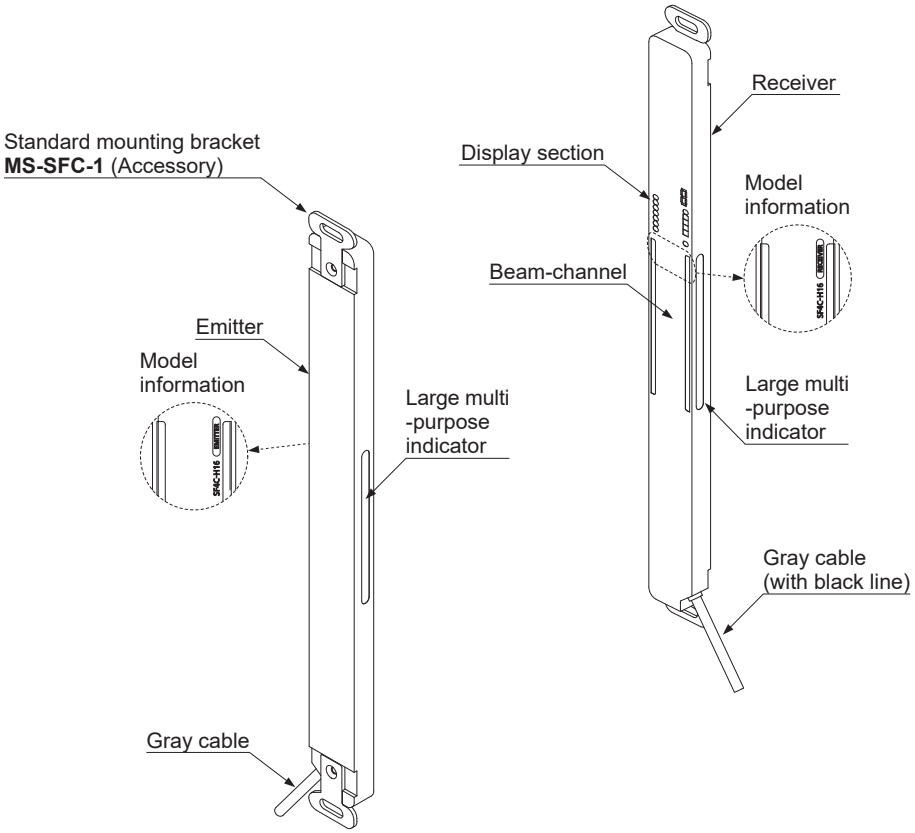
□ Sensor: Emitter, Receiver 1 pc. each
□ Test rod 1 pc.
SF4C-F□: **SF4C-TR14** (ø14 × 220 mm), **SF4C-H□**: **SF4C-TR25** (ø25 × 220 mm)
□ Abridged Instruction Manual 1 pc.
□ General Information for Safety, Compliance, and Instructions 1 pc.

2-1 Features

This device is the light curtain with the following features.

- No special controller is required.
- Cable type or pigtailed type is available.
- The control output (OSSD 1 / 2) is PNP / NPN output switching type.
- Large multi-purpose indicators (red, green) which are bright and easy-to-see are incorporated.
- This device enables to set each function by using the handy controller **SFC-HC** (optional).
  For details, refer to "**3-10 Functions Using Handy Controller SFC-HC (optional)**."
- Refer to "**6-2 Options**" for details of options.

2-2 Part Description



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

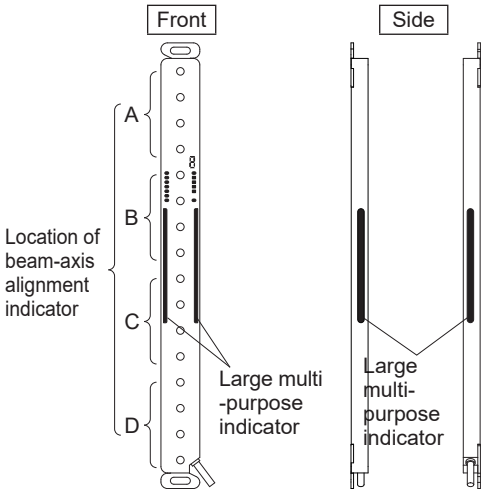
<Receiver>
It receives light from the emitter facing it. Simultaneously, it turns ON the control output (OSSD 1 / 2) when the all beam channels receive light from emitter, and it turns OFF the control output (OSSD 1 / 2) when one or more beam channels are blocked light. [Except when using the muting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

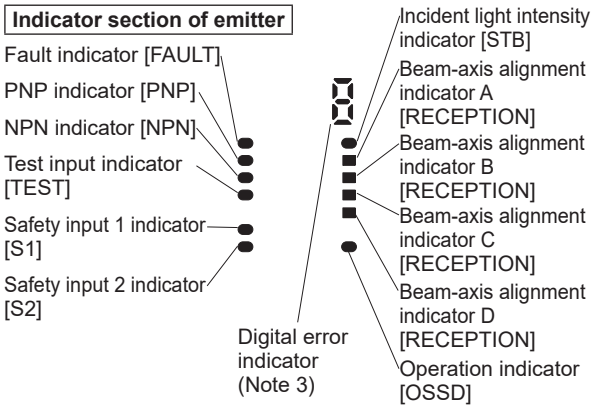
Notes: 1) In case of using the muting function, muting sensors are required. Furthermore, in case desiring muting lamp, arrange them separately.
2) The blanking function is set by using the handy controller **SFC-HC** (optional).
For detail, refer to "**3-10 Functions using Handy Controller SFC-HC (optional**)".

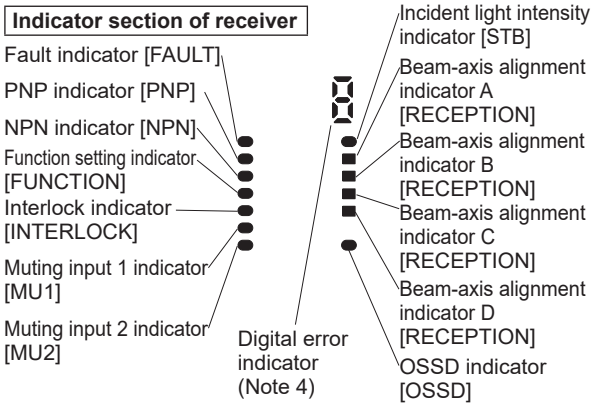
<Beam channel>
The light emitting elements of the emitter and the light receiving elements of the receiver are placed at the intervals, 10 mm (**SF4C-F**□), 20 mm (**SF4C-H**□).

<Standard mounting bracket MS-SFC-1 (Accessory)>
The mounting brackets are attached to this device.
This brackets are to be used for mounting both emitter and receiver.

<Indicator section>







<Common to emitter and receiver>

Description		Function
Large multi-purpose indicator (Red / Green) (Note 1)		Lights up in red when the large multi-purpose indicator input is valid. Lights up in green when the large multi-purpose indicator input is valid. Turns OFF when the input is invalid.
Incident light intensity indicator (Green / Orange) [STB]		Lights up in green when stable light is received. Lights up in orange when unstable light is received. Turns OFF when light is blocked. (Note 2)
Beam-axis alignment indicator (Red / Green) [RECEPTION]	A	Lights up in red when device top receives light. Blinks in red when device top end receives light. Lights up in green when control output (OSSD 1 / 2) is ON.
	B	Lights up in red when device upper middle receives light. Lights up in green when control output (OSSD 1 / 2) is ON.
	C	Lights up in red when device lower middle receives light. Lights up in green when control output (OSSD 1 / 2) is ON.
	D	Lights up in red when device bottom receives light. Blinks in red when device bottom end receives light. Lights up in green when control output (OSSD 1 / 2) is ON.
Digital error indicator (Red) (Note 3)		Error contents are indicated when device is lockout.
Fault indicator (Yellow) [FAULT]		Lights up or blinks when fault occurs in the device.
PNP indicator (Orange) [PNP]		Lights up when PNP output is set.
NPN indicator (Orange) [NPN]		Lights up when NPN output is set.

<Emitter>

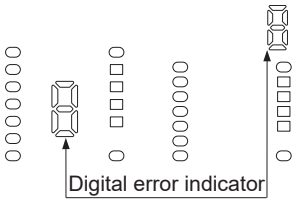
Description	Function
Operation indicator (Red / Green) [OSSD] (Note 5)	Lights up when device operation is as follows. [Sequential operation to control output (OSSD 1 / 2).] Lights up in red when control output (OSSD 1 / 2) is OFF. Lights up in green when control output (OSSD 1 / 2) is ON.
Test input indicator (Orange) [TEST]	Lights up when test input is valid. Turns OFF when test input is invalid.
Safety input 1 indicator (Orange) [S1]	Lights up when safety input 1 is valid. Turns OFF when safety input 1 is invalid.
Safety input 2 indicator (Orange) [S2]	Lights up when the safety input 2 is valid. Turns OFF when the safety input 2 is invalid.

<Receiver>

Description	Function
OSSD indicator (Red / Green) [OSSD]	Lights up in red when control output (OSSD 1 / 2) is OFF. Lights up in green when control output (OSSD 1 / 2) is ON.
Function setting indicator (Orange) [FUNCTION]	Blinks when the handy controller is connected. Lights up when blanking function is valid. (Note 6)
Interlock indicator (Yellow) [INTERLOCK]	Lights up when interlock is valid. Turns OFF when interlock is invalid.
Muting input 1 indicator (Orange) [MU1]	Lights up when muting input 1 is valid. Turns OFF when muting input 1 is invalid.
Muting input 2 indicator (Orange) [MU2]	Lights up when muting input 2 is valid. Turns OFF when muting input 2 is invalid.

Notes: 1) The operation of the large multi-purpose indicator (lights up, blinks or turns OFF) can be set by using the handy controller **SFC-HC** (optional).
For details, refer to "**3-10 Functions Using Handy Controller SFC-HC (optional)**."
2) "When light is blocked" refers to the status that there exists any object blocking light in the sensing area.
3) In case of **SF4C-H8**□ and **SF4C-F15**□ are not provided with digital error indicator (red).
4) The above shows Ver. 3.0. In case of Ver. 2.1 or earlier, digital error indicator (red) is located at different position as shown at right.
5) Since the color of the operation indicator changes according to ON / OFF status of the control output (OSSD 1 / 2), the operation indicator is marked as "OSSD" on the device.
6) The blanking function is set by using the handy controller **SFC-HC** (optional).
Also, incident light indicator turns off when setting blanking.
For details, refer to "**3-10 Functions Using Handy Controller SFC-HC (optional)**."
7) The description given in [ ] is marked on the device.

<SF4C-H□> **<SF4C-F□>**

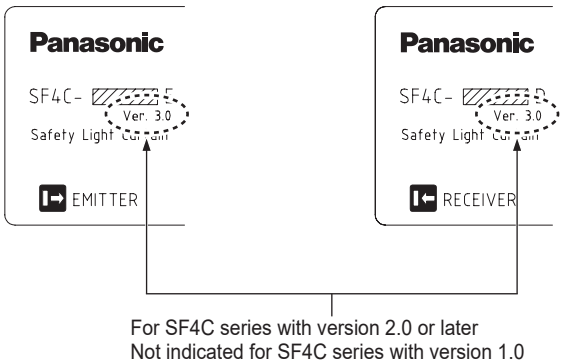


- How to check the product version

The product version can be found on the nameplate attached to the back of the product.

SF4C series version indication location

< Nameplate on the emitter > < Nameplate on the receiver >



For SF4C series with version 2.0 or later
Not indicated for SF4C series with version 1.0

⚠ WARNING

Do not use the product with version 3.0 in combination with an emitter or receiver with version 2.1 or earlier.
When replacing products, be sure to replace the emitter and receiver as a set. Otherwise, it may cause death or serious injury to the worker.
Also use a pair of emitter and receiver, located opposite to each other, with the same serial number.

⚠ CAUTION

When using the **SF4C** series with version 2.1 or later together with the handy controller **SFC-HC** (optional), use the **SFC-HC** with version 2.0.

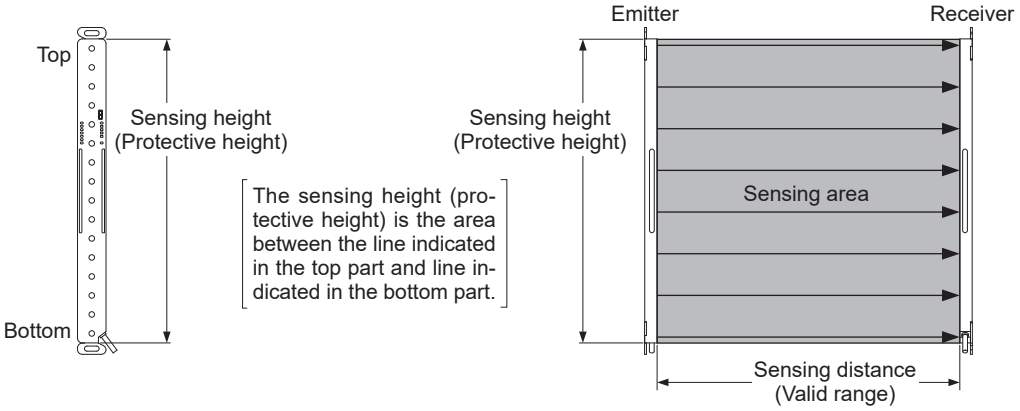
2-3 Protection Area

2-3-1 Sensing Area

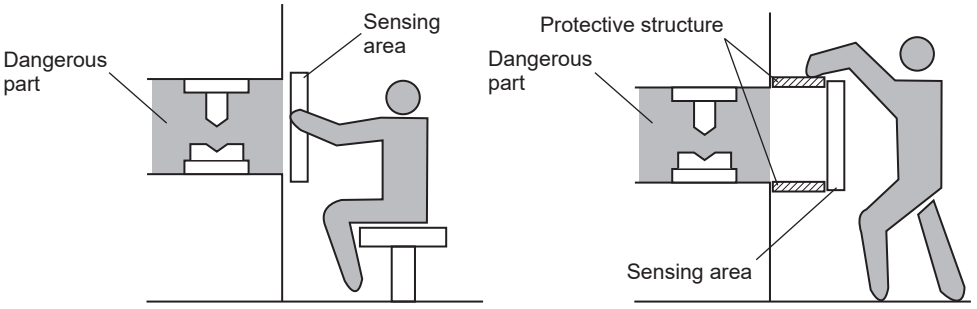
⚠ WARNING

- Be sure to install protection structure around the machine so that the operator must pass through the sensing area of this device to reach the dangerous parts of the machine.
  Furthermore, ensure that some part of the operator's body always remains in the sensing area when operation is done with the dangerous parts of the machine. Failure to do so can result in death or serious injury.
- Do not use any reflection type or recursive reflection type arrangement.
- Furthermore, never use this device facing several receivers towards one emitter or vice versa.

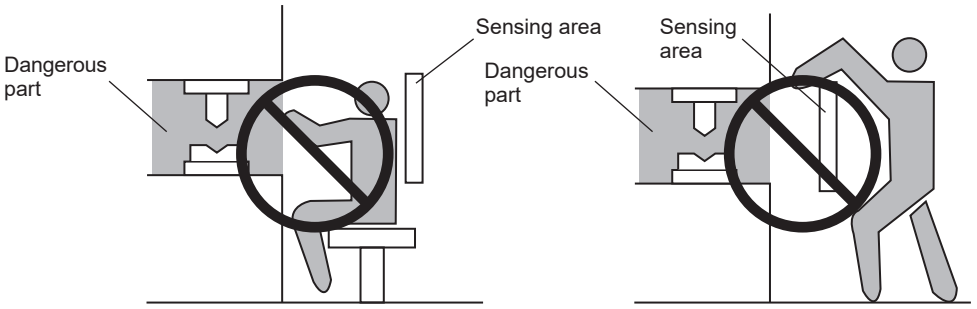
The sensing area is the zone formed by the sensing height (protective height) of the device and the valid range between the emitter and the receiver. The sensing height (protective height) is determined by the number of beam channels. Furthermore, the valid range can be 0.1 to 3 m.
Take care that if the valid range is under 0.1 m, malfunction may occur due to the optical structure.



<Example of correct installation>



<Example of incorrect installation>

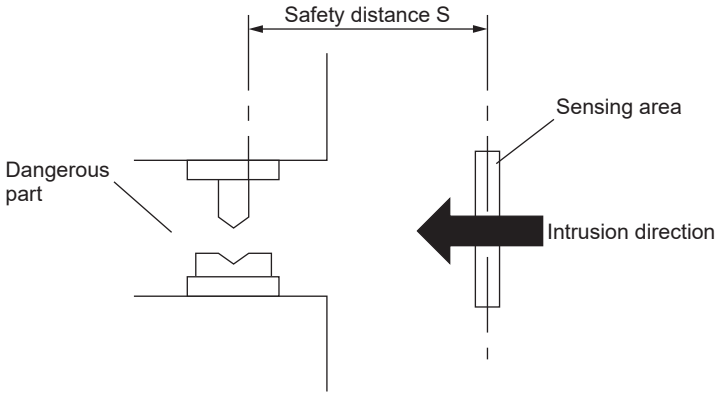


2-3-2 Safety Distance

⚠ WARNING

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

The safety distance is the minimum distance that must be maintained between this device and the dangerous parts of the machine so that the machine can be stopped before a human body or an object can reach the dangerous parts.
The safety distance is calculated based on the equation described in the next page when a person moves perpendicular (normal intrusion) to the sensing area of the device.



⚠ WARNING

Before designing the system, refer to the relevant standards of the region where this device is to be used, and then install this device.
Furthermore, the equation described in the next pages is to be used only in case the intrusion direction is perpendicular to the sensing area. In case the intrusion direction is not perpendicular to the sensing area, be sure to refer to the relevant standard (regional standard, specification of the machine, etc.) for details of the calculation.

⚠ WARNING

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

⚠ WARNING

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

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

	Floating blanking function			
	Invalid	Setting (Note)		
		1 beam channel	2 beam channels	3 beam channels
SF4C-F□ (10 mm-beam channel pitch type)	ø14 mm	ø24 mm	ø34 mm	ø44 mm
SF4C-H□ (20 mm-beam channel pitch type)	ø25 mm	ø45 mm	ø65 mm	ø85 mm

Note: For details of the floating blanking function, refer to "**3-10 Functions Using Handy Controller SFC-HC (option)**."

[For use in Europe (EU) (as EN 999)] (Also applicable to ISO 13855 / JIS B 9715)
(For intrusion direction perpendicular to the sensing area)
<In case that the minimum sensing object is ø40 mm or less>

● Equation 1 $S = K \times T + C$

S : Safety distance (mm)
Minimum required distance between the sensing area surface and the dangerous parts of the machine

K : Intrusion velocity of operator's body or object (mm/sec.)
Taken as 2,000 (mm/sec.) for calculation.

T : Response time of total equipment (sec.)
$T = T_m + T_{SF4C}$
T_m: Maximum halting time of machine (sec.)
T_{SF4C}: Response time of this device (sec.)

C : Additional distance calculated from the size of the minimum sensing object of the device (mm)
However, the value of C cannot be under 0.
$C = 8 \times (d - 14)$
d: Minimum sensing object diameter (mm)

<Reference>

● For calculating the safety distance S, there are the following five cases.
First, calculate by substituting the value K = 2,000 (mm/sec.) in the equation above. Then, classify the obtained value of S into three cases, 1) S < 100, 2) 100 ≤ S ≤ 500, and 3) S > 500. For Case 3) S > 500, recalculate by substituting the value K = 1,600 (mm/sec.). After that, classify the calculation result into two cases, 4) S ≤ 500 and 5) S > 500.
For details, refer to "Calculation example 1 For use in Europe."

● When this device is used in the "PSDI mode," an appropriate safety distance S must be calculated.
For details, be sure to refer to the standards or regulations applicable in each region or country.

<In case that the minimum sensing object is over ø40 mm>

● Equation 1 $S = K \times T + C$

S : Safety distance (mm)
Minimum required distance between the sensing area surface and the dangerous parts of the machine

K : Intrusion velocity of operator's body or object (mm/sec.)
Taken as 1,600 (mm/sec.) for calculation.

T : Response time of total equipment (sec.)
$T = T_m + T_{SF4C}$
T_m: Maximum halting time of machine (sec.)
T_{SF4C}: Response time of this device (sec.)

C : Additional distance calculated from the size of the minimum sensing object of the device (mm)
$C = 850$ (mm)

<Calculation example>

● Calculation example 1: For use in Europe
(OFF response time: 7 ms or less, minimum sensing object diameter: 25 mm)

First, calculate with K = 2,000.

$S = K \times T + C$
$= K \times (T_m + T_{SF4C}) + 8 \times (d - 14)$
$= 2{,}000 \times (T_m + 0.007) + 8 \times (25 - 14)$
$= 2{,}000 \times T_m + 2{,}000 \times 0.007 + 8 \times 11$
$= 2{,}000 \times T_m + 14 + 88$
$= 2{,}000 \times T_m + 102$

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 $2{,}000 \times T_m + 102$ (mm)

3) In case S > 500 (mm)

$S = K' \times (T_m + T_{SF4C}) + 8 \times (d - 14)$
$= 1{,}600 \times (T_m + 0.007) + 8 \times (25 - 14)$
$= 1{,}600 \times T_m + 1{,}600 \times 0.007 + 8 \times 11$
$= 1{,}600 \times T_m + 11.2 + 88$
$= 1{,}600 \times T_m + 99.2$

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 $1{,}600 \times T_m + 99.2$ (mm)

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

$S = 2{,}000 \times T_m + 102$
$= 2{,}000 \times 0.1 + 102$
$= 302$

Since this value matches with the case 2) above, S is 302 (mm).

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

$S = 2{,}000 \times T_m + 102$
$= 2{,}000 \times 0.4 + 102$
$= 902$

Since this value matches with the case 3) above,

$S = 1{,}600 \times T_m + 99.2$
$= 1{,}600 \times 0.4 + 99.2$
$= 739.2$

Since this value matches with the case 5) above, S is 739.2 (mm).

[For use in the United States of America (as per ANSI/RIA 15.06)]

● Equation 2 $D_S = K \times (T_S + T_C + T_{SF4C} + T_{bm}) + D_{pf}$

D_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/sec.) [≈ 1,600 (mm/sec.)]}
ANSI/RIA 15.06 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.) (sec.)

T_C : Maximum response time of the control circuit required for functioning the brake (sec.)

T_{SF4C}: Response time of this device (sec.)

T_{bm} : Additional halting time tolerance for the brake monitor (sec.)
The following equation holds when the machine is equipped with a brake monitor.
$T_{bm} = T_a - (T_S + T_C)$
Ta: Setting time of brake monitor (sec.)
When the machine is not equipped with a brake monitor, it is recommended that 20% or more of $(T_S + T_C)$ is taken as additional halting time.

D_{pf} : Additional distance calculated from the size of the minimum sensing object of the device (mm)
$D_{pf} = 61.2$ mm
$D_{pf} = 3.4 \times (d - 0.276)$ (inch)
$\approx 3.4 \times (d - 7)$ (mm)
d: Minimum sensing object diameter 0.985 (inch) ≈ 25 (mm)

<Reference>

When the floating blanking function is applied, the minimum sensing object becomes large. According to ANSI/RIA 15.06, Dpf = 900 mm (3ft) when d > 64 mm (2.5 inches).

<Reference>

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

<Calculation example>

● Calculation example 2: For use in the United States of America
[OFF response time: 7 ms or less, minimum sensing object diameter: 0.985 (inch) ≈ 25 (mm)]

$D_S = K \times (T_S + T_C + T_{SF4C} + T_{bm}) + D_{pf}$
$= 63 \times (T_a + 0.007) + 3.4 \times (d - 0.276)$ (inch)
$= 63 \times (T_a + 0.007) + 3.4 \times (0.985 - 0.276)$
$= 63 \times T_a + 63 \times 0.007 + 3.4 \times 0.709$
$= 63 \times T_a + 0.441 + 2.4106$
$= 63 \times T_a + 2.8516$
$\approx 63 \times T_a + 2.85$ (inch)

In case this device is installed in a system with a maximum halting time 0.1 (sec.)
$D_S = 63 \times T_a + 2.85$
$= 63 \times 0.1 + 2.85$
$= 9.15$ (inch)
≈ 232.41 (mm)

Hence, as per the calculations Ds is 232.4 (mm).

<Reference>

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

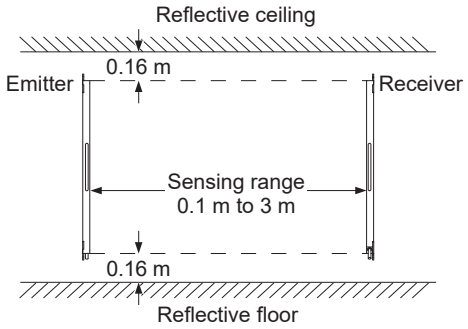
2-3-3 Influence of Reflective Surfaces

⚠ WARNING

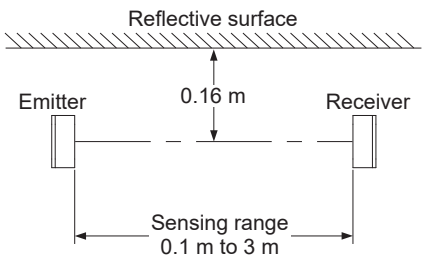
If there exists a reflective surface in the place where this device is to be installed, make sure to install this device so that reflected light from the reflective surface does not enter into the receiver, or take countermeasures such as painting, masking, roughening, or changing the material of the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

Install this device at a distance of at 0.16 m or more from reflective surfaces such as metal walls, floors, ceilings, sensing objects, covers, panels or glass surfaces.

<Side view>



<Top view>



2-3-4 Device Placement

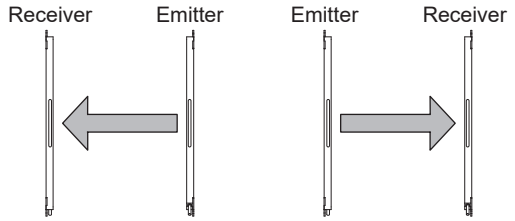
This is the configuration when two or more sets of emitter and receiver facing each other are placed. It is used for system evaluation in case of addition of equipment. Perform an operation test by referring to "**2-6-2 Operation Test**."

⚠ WARNING

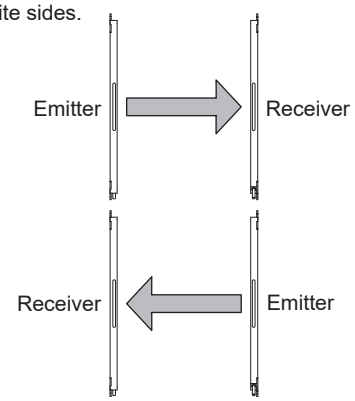
- Refer to the examples of device placement given below and understand them thoroughly before installing the devices.
  Improper sensor placement could cause device malfunction, which can result in death or serious injury.
- If this device is used in multiple sets, arrange them to avoid mutual interference.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

<Example of device placement>

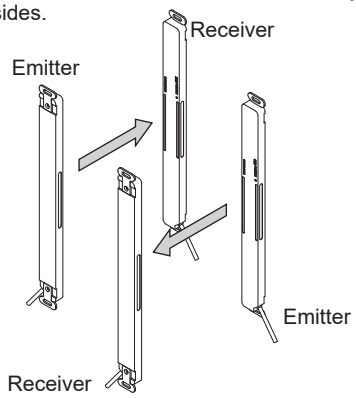
1) Install the emitter and the receiver back to back.



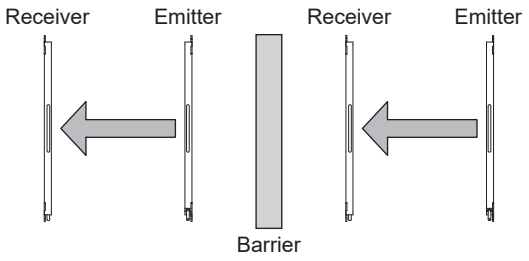
2) Arrange the emitter and the receiver vertically on opposite sides.



3) Arrange the emitter and the receiver horizontally on opposite sides.



4) Install a barrier

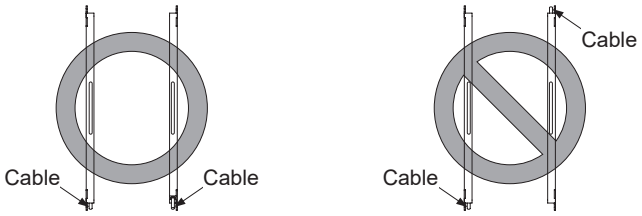


<Reference>

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

⚠ WARNING

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



2-4 Mounting

2-4-1 Mounting of the Mounting Bracket

⚠ CAUTION

- 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 R6 mm. Mount the device with considering the cable bending radius.

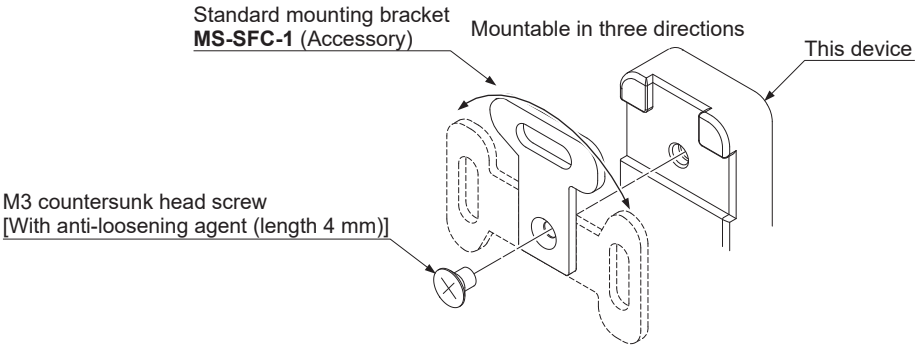
<Reference>

- 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 at a sensing distance of 3 m.
- Unless otherwise specified, the following mounting procedure is common for both emitter and receiver. For the preparation of the mounting, prepare the mounting holes on the mounting surface by referring to "**6-3 Dimensions**."

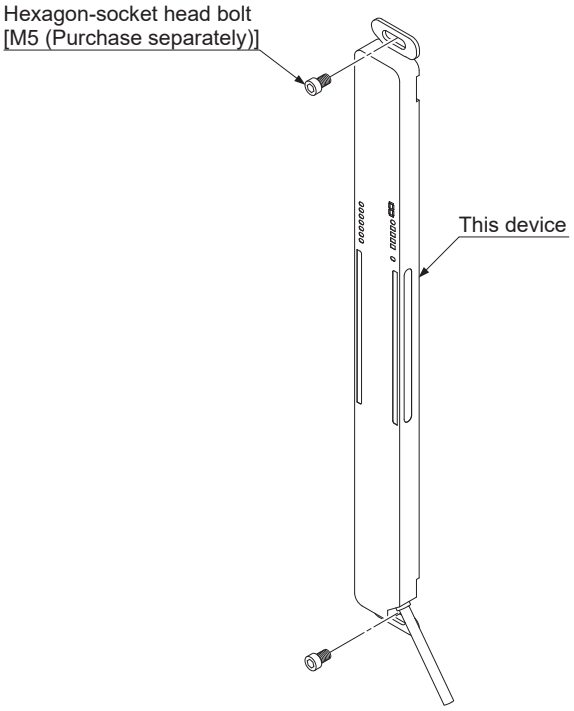
<In case of using standard mounting bracket MS-SFC-1 (accessory)>

- Direction of the standard mounting bracket **MS-SFC-1** which is attached to this device can be changed depending on the mounting position of the device.

1. Remove the M3 countersunk head screw [with anti-loosening agent (length 4 mm)] which is attached to the back of the device.
2. Decide the direction of the standard mounting bracket.
3. Tighten with the M3 countersunk head screw [with anti-loosening agent (length 4 mm)]. The tightening torque should be 0.3 N·m.



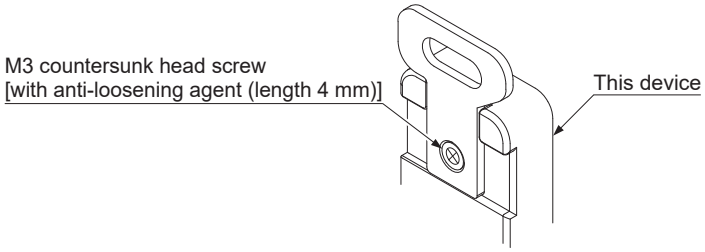
- Install the standard mounting brackets in the mounting surface with two hexagon-socket head bolts [M5 (purchase separately)].



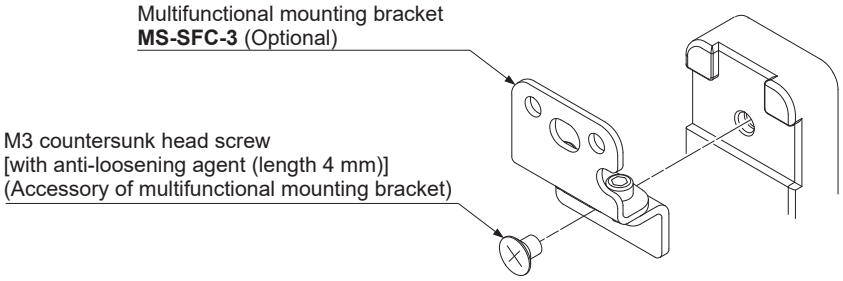
Note: The case of the product is made of resin so the longitudinal dimension is subject to expansion and contraction. When drilling mounting holes, check the drilling locations by positioning the actual product at the installation location.

<In case of using multifunctional mounting bracket MS-SFC-3 (optional)

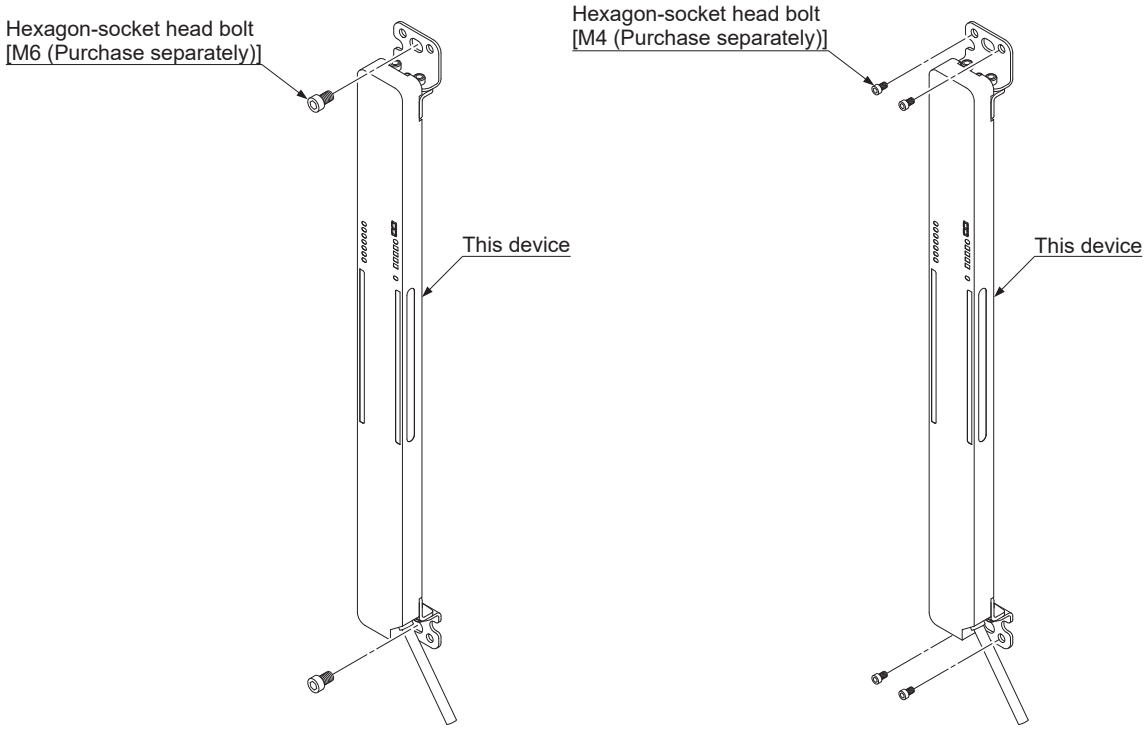
Step 1 Removing the M3 countersunk head screw [with anti-loosening agent (length 4 mm)] which is attached to the back of the device. And remove the standard mounting bracket **MS-SFC-1** (accessory)



Step 2 Mount the multifunctional mounting bracket using the M3 countersunk head screw [with anti-loosening agent (length 4 mm)] (accessory of multifunctional mounting bracket). The tightening torque should be 0.3 N·m.



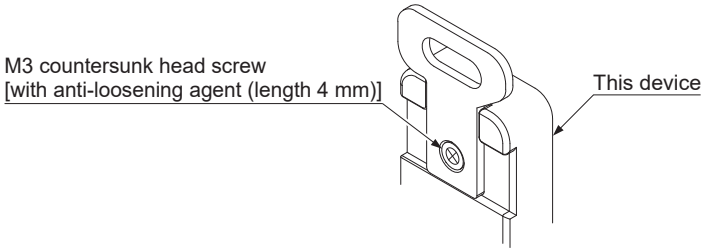
Step 3 Set the multifunctional mounting bracket on the mounting surface using either two hexagon-socket head bolts [M6 (purchase separately)] or four hexagon-socket head bolts [M4 (purchase separately)].



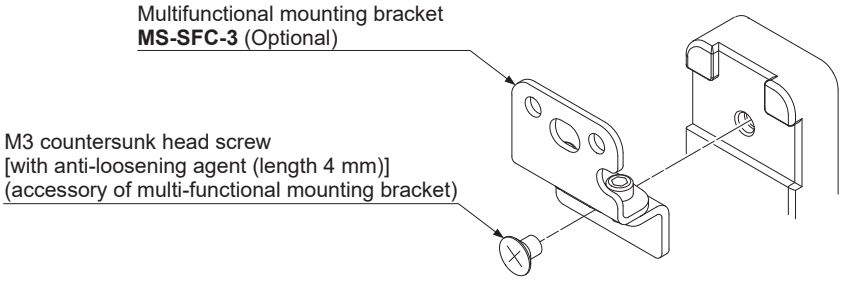
Note: **SF4C-H28**□ ,**SF4C-H32**□, **SF4C-F55**□ and **SF4C-F63**□ require multifunctional intermediate supporting bracket **MS-SFC-4** (optional).
Refer to **<In case using multifunctional intermediate supporting bracket MS-SFC-4 (Optional)>** for the mounting method.

<In case of using multifunctional mounting bracket MS-SFC-3 (optional) as dead space less mounting bracket>

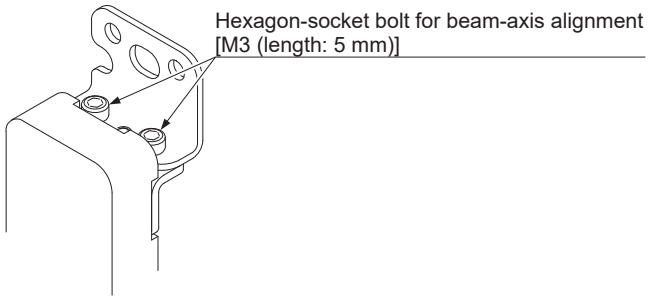
Step 1 Remove the M3 countersunk head screw [with anti-loosening agent (length 4 mm)] which is attached to the back of the device.



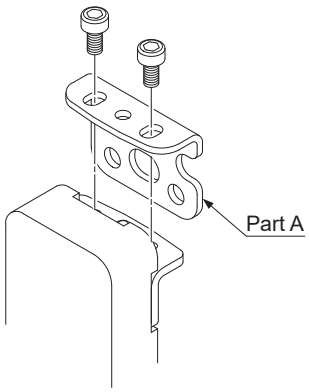
Step 2 Mount the multifunctional mounting bracket using the M3 countersunk head screw [with anti-loosening agent (length 4 mm)] (accessory of multifunctional mounting bracket). The tightening torque should be 0.3 N·m.



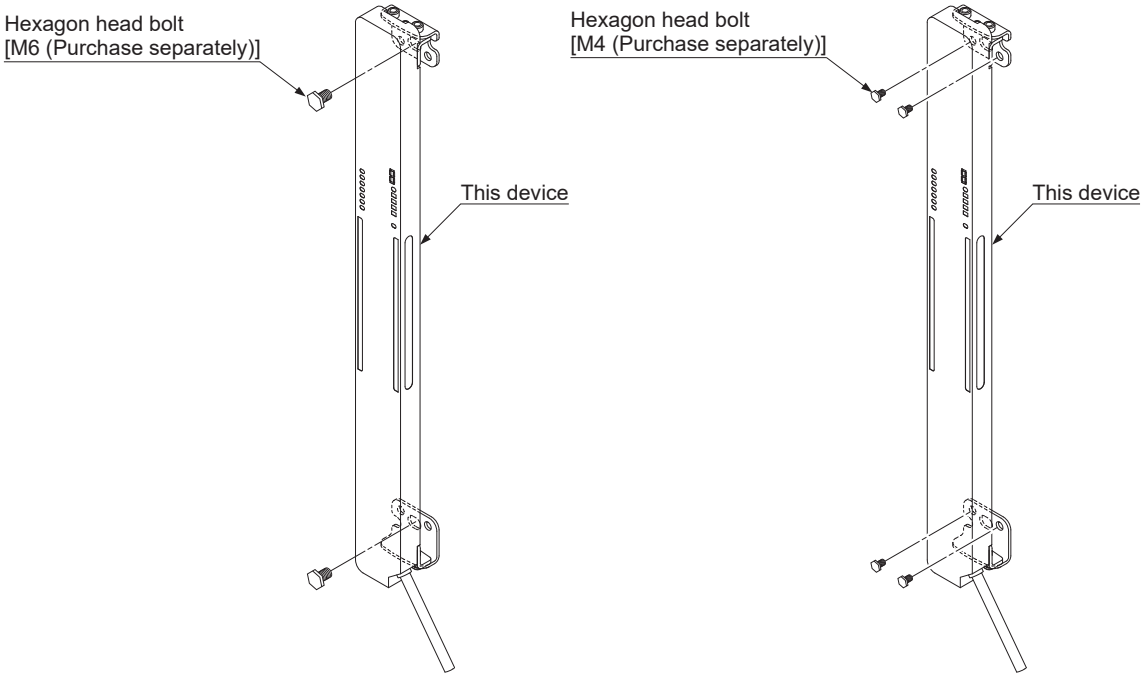
Step 3 Remove two of hexagon-socket head bolts for beam-axis alignment M3 (length 5 mm)]



Step 4 Change direction of the part A of multifunctional mounting bracket. And tighten the two of hexagon-socket head bolts for beam-axis alignment M3 (length 5 mm)]. The tightening torque should be 2 N·m.



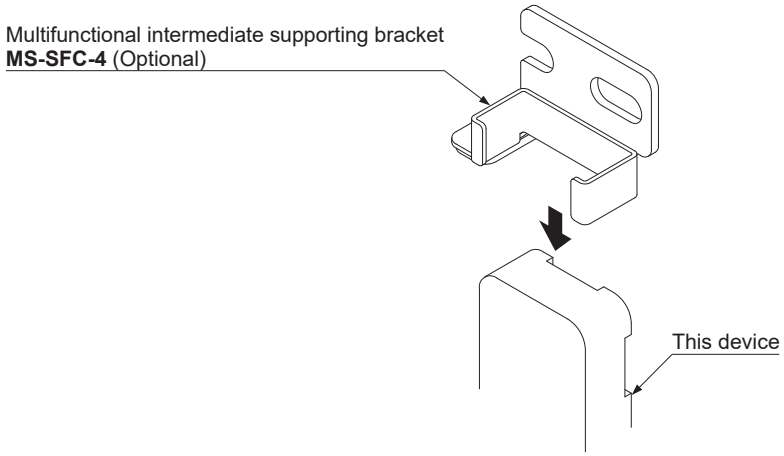
Step 5 Set the multifunctional mounting bracket on the mounting surface using either two hexagon head bolts [M6 (purchase separately)] or four hexagon head bolts [M4 (purchase separately)].



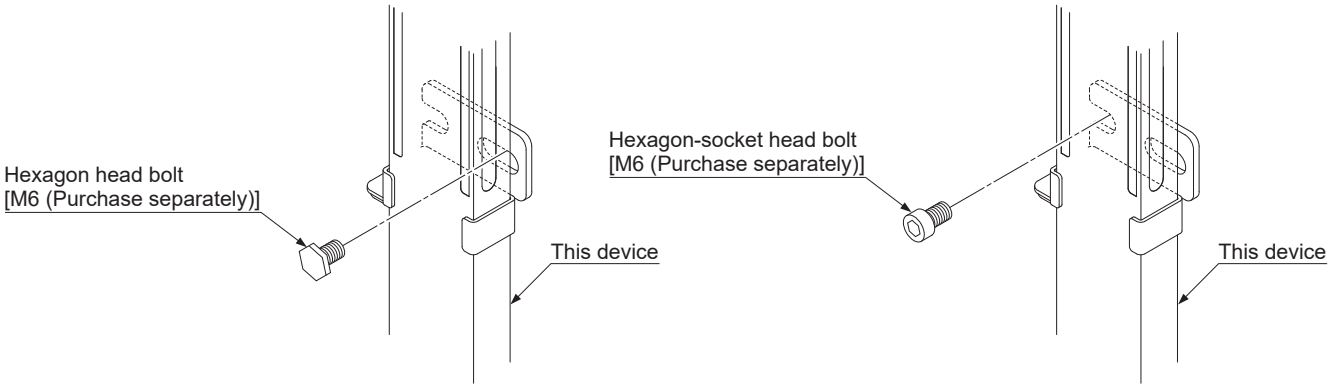
Note: **SF4C-H28**□ ,**SF4C-H32**□, **SF4C-F55**□ and **SF4C-F63**□ require multifunctional intermediate supporting bracket **MS-SFC-4** (optional).
Refer to **<In case using multifunctional intermediate supporting bracket MS-SFC-4 (optional)>** for the mounting method.

<In case of using multifunctional intermediate supporting bracket MS-SFC-4 (optional)>

Step 1 Be sure mounting bracket is not mounted on this device. And set in the multifunctional intermediate supporting bracket **MS-SFC-4** (optional) from top or end of this device.



Step 2 Set the multifunctional intermediate supporting bracket on the mounting surface using a hexagon head bolt [M6 (purchase separately)] or a hexagon-socket head bolt [M6 (purchase separately)].



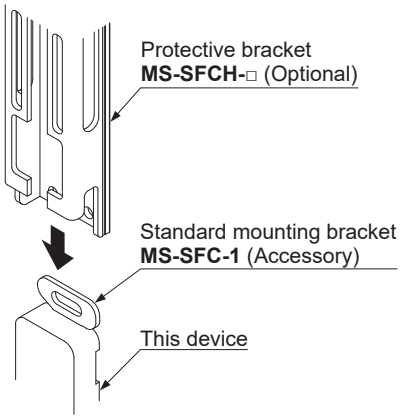
Note: Refer to **<In case of using multifunctional mounting bracket MS-SFC-3 (optional)>** or **<In case of using multifunctional mounting bracket MS-SFC-3 (optional) as dead space less mounting bracket>** for details of the mounting method of the multifunctional mounting bracket **MS-SFC-3** (optional).

⚠ CAUTION

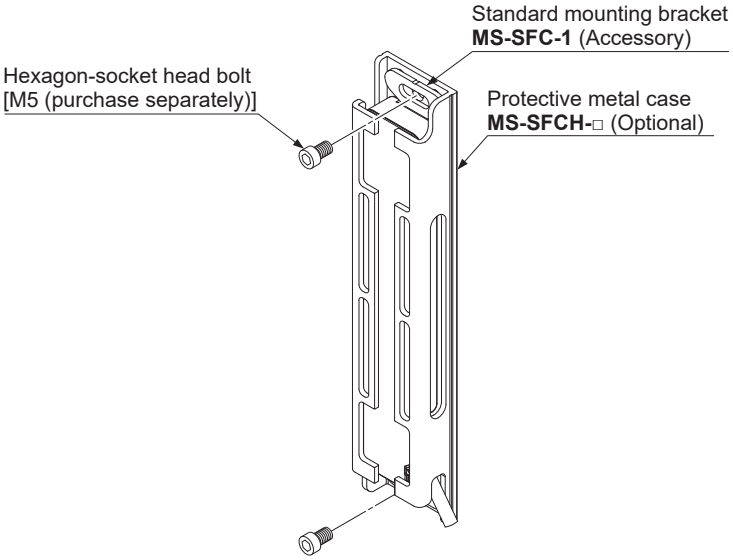
Use the multifunctional intermediate supporting bracket **MS-SFC-4** (optional) in combination with the multifunctional mounting bracket **MS-SFC-3** (optional). It cannot be mounted in combination the standard mounting bracket **MS-SFC-1** (accessory).

<In case of using protective metal case MS-SFCH-□ (optional)>

Step 1 Confirm a state that the standard mounting bracket **MS-SFC-1** (accessory), mounted to this device, is center mounting. And set in protective metal Case from top of this device.



Step 2 Position mounting holes of protective metal Case and standard mounting bracket. And, tighten with two hexagon-socket head bolts [M5 (purchase separately)] on the mounting surface.



⚠ CAUTION

- Use the protective metal case **MS-SFCH-**□ (optional) in combination with the standard mounting bracket **MS-SFC-1** (accessory). It cannot be mounted in combination with the multifunctional mounting bracket **MS-SFC-3** (optional).
- When mounting the protective metal case **MS-SFCH-**□ (optional) to this device, make sure the state that the standard mounting bracket **MS-SFC-1** (accessory) is mounted in center of this device. When the standard mounting bracket **MS-SFC-1** (accessory) is mounted as the dead space less mounting, the protective metal case **MS-SFCH-**□ (optional) can not be mounted to this device.

2-5 Wiring

⚠ WARNING

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

⚠ CAUTION

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

<Reference>

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

2-5-1 Power Supply Unit

⚠ 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 not match or the wiring is improper, it may cause damage or malfunction of this device.

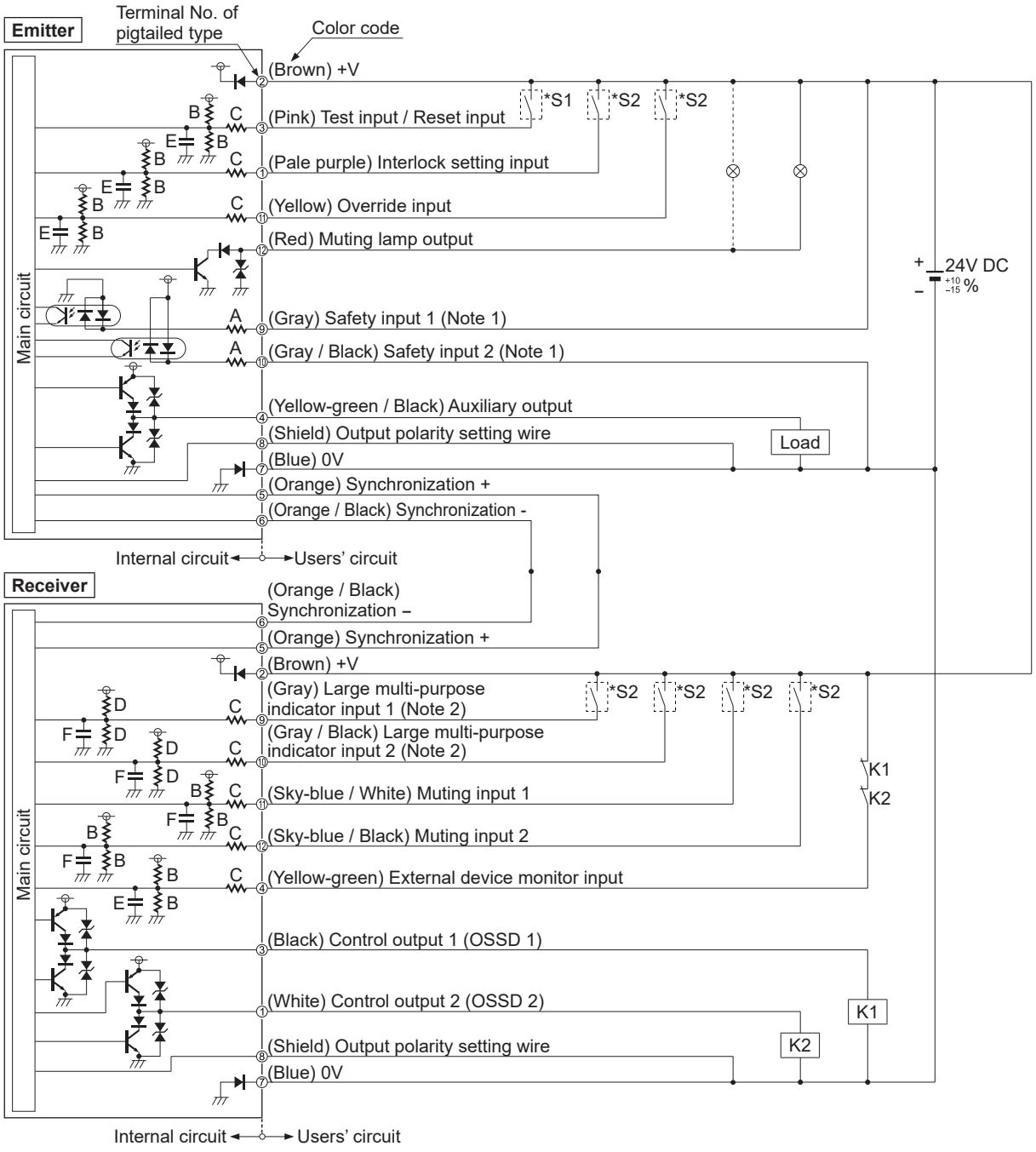
<Reference>

A specialist who has the required electrical knowledge should perform the wiring.
The power supply unit must satisfy the conditions given below.

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

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

<For PNP output>



<Reference>

K1, K2: External device
(Forced guided relay or magnetic contactor)
Resistance A: 3 kΩ, Resistance B: 6.8 kΩ
Resistance C: 470 Ω, Resistance D: 47 kΩ
Condenser E: 0.47 µF
Condenser F: 0.1 µF

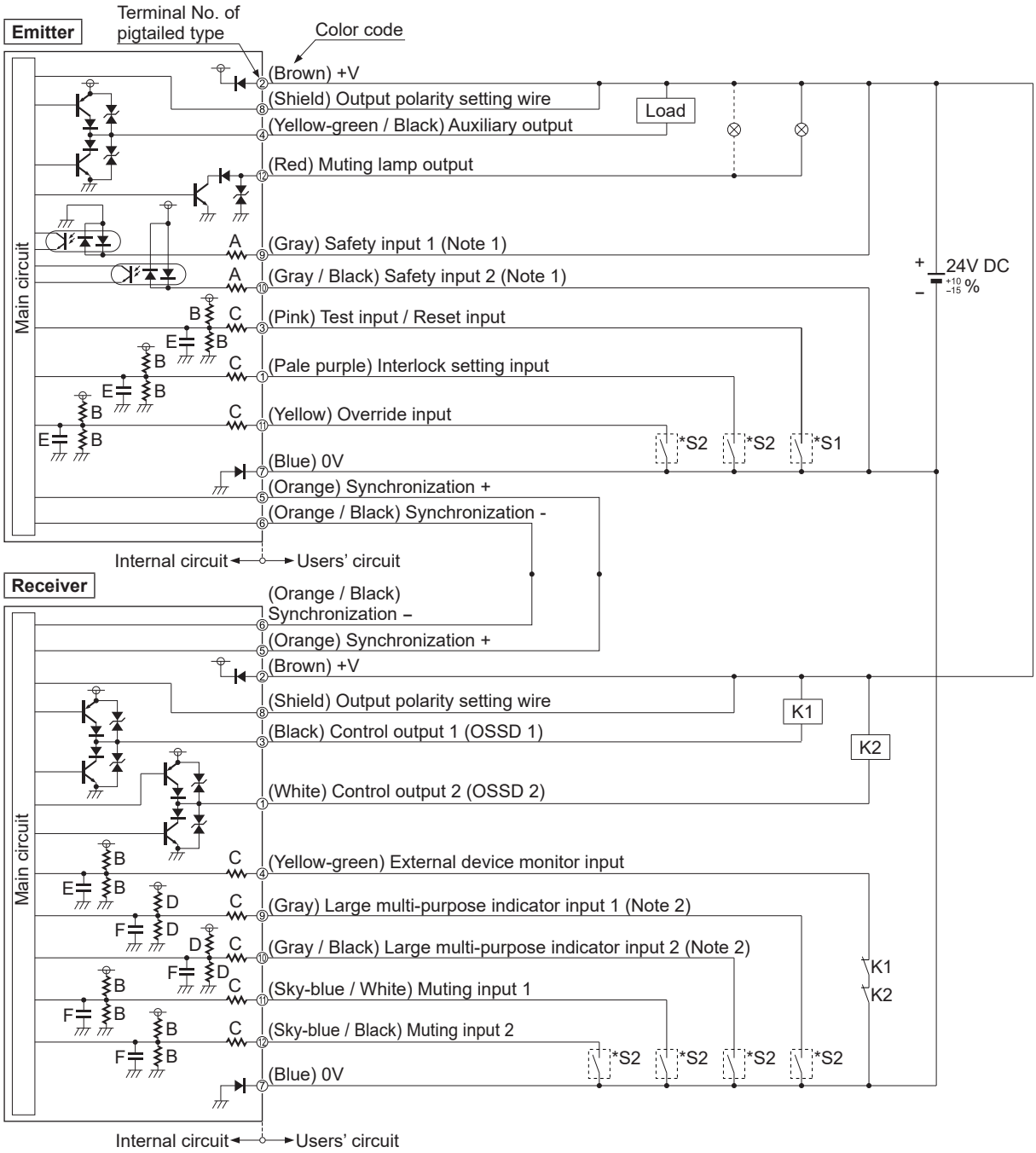
*S1, S2

Switch S1
- Test input / Reset input
  For manual reset: Vs to Vs - 3.5 V (sink current 5 mA or less): OFF (Note 3)
  Open: ON
  For auto reset: Vs to Vs - 3.5 V (sink current 5 mA or less): ON (Note 3)
  Open: OFF

Switch S2
- Override input, Interlock setting input, Large multi-purpose indicator input 1 / 2, Muting input 1 / 2 and External device monitor input
  Vs to Vs - 3.5 V (sink current 5 mA or less): Valid (Note 3), Open: Invalid

Notes 1) For wiring of the safety input 1 wire (gray) and the safety input 2 wire (gray / black), refer to "**2-5-7 Wiring Configuration for Valid Safety Input Function**."
2) Large multi-purpose indicator lights up in red when connecting large multi-purpose indicator input 1 wire (gray) and +V, and large multi-purpose indicator lights up in green when connecting large multi-purpose indicator input 2 wire (gray / black) and +V.
3) Vs is the applying supply voltage.

<For NPN output>



<Reference>

K1, K2: External device
(Forced guided relay or magnetic contactor)
Resistance A: 3 kΩ, Resistance B: 6.8 kΩ
Resistance C: 470 Ω, Resistance D: 47 kΩ
Condenser E: 0.47 µF
Condenser F: 0.1 µF

*S1, S2

Switch S1
- Test input / Reset input
  For manual reset: 0 V to +2.5 V (source current 5 mA or less): OFF, Open: ON
  For auto reset: 0 V to +2.5 V (source current 5 mA or less): ON, Open: OFF

Switch S2
- Override input, Interlock setting input, Large multi-purpose indicator input 1 / 2, Muting input 1 / 2 and External device monitor input
  0 V to +2.5 V (source current 5 mA or less): Valid, Open: Invalid

Notes 1) For wiring of the safety input 1 wire (gray) and the safety input 2 wire (gray / black), refer to "**2-5-7 Wiring Configuration for Valid Safety Input Function**."
2) Large multi-purpose indicator lights up in red when connecting large multi-purpose indicator input 1 wire (gray) and 0 V, and large multi-purpose indicator lights up in green when connecting large multi-purpose indicator input 2 wire (gray / black) and 0 V.

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

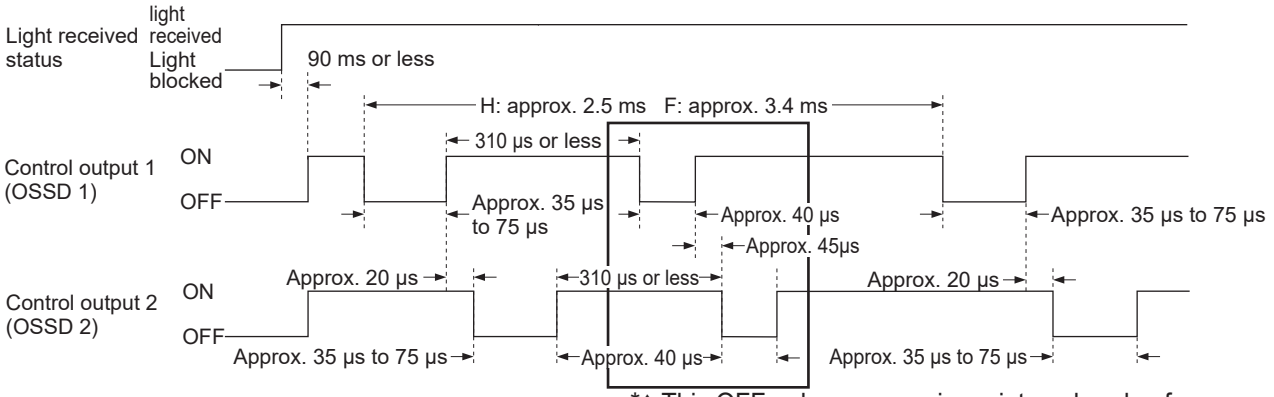
Since the receiver performs the self-diagnosis of the output circuit when the device is in light receiving status (ON status), the output transistor becomes OFF status periodically. (Refer to the figure below.)

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

⚠ CAUTION

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

<Time chart>



*↑ This OFF pulse appears in an interval cycle of approx. 5 seconds for F type and approx. 3 seconds for H type.

2-5-3 Wiring / Connecting Procedures and Terminal Arrangement

Connect the mating cable (with connector on one end or connector on both ends) to the pigtailed type of this device (emitter and receiver) according to the customer's application referring to the terminal arrangement given below. In addition, in case of the cable type (emitter and receiver) as well, wire the cables according to the customer's application referring to the terminal arrangement given below.

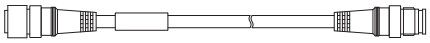
⚠ WARNING

- When extending the cable, use the exclusive cable up to the total length of 30 m or less (for each emitter / receiver). Extending the cable longer than 30 m may cause malfunction, which can result in death or serious injury.
- When the synchronization + wire (orange) and synchronization - wire (orange / black) is extended with a cable other than exclusive cable, use a 0.2 mm^2 or more shielded twisted pair cable.

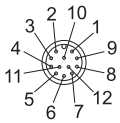
<Cable with connector on one end>

A side

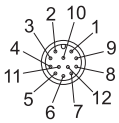
<Cable with connector on both ends>

A side  B side

<Terminal arrangement of A side>



<Terminal arrangement of A side>



<Terminal arrangement of B side>

	Cable / Connector color	Terminal No.	Color code	Description
Emitter	Gray / Gray	1	Pale purple	Interlock setting input
		2	Brown	+V
		3	Pink	Test input / Reset input
		4	Yellow-green / Black	Auxiliary output
		5	Orange	Synchronization +
		6	Orange / Black	Synchronization –
		7	Blue	0 V
		8	(Shield)	Output polarity setting wire
		9	Gray	Safety input 1
		10	Gray / Black	Safety input 2
		11	Yellow	Override input
		12	Red	Muting lamp output
Receiver	Gray (with black line) / Black	1	White	Control output 2 (OSSD 2)
		2	Brown	+V
		3	Black	Control output 1 (OSSD 1)
		4	Yellow-green	External device monitor input
		5	Orange	Synchronization +
		6	Orange / Black	Synchronization –
		7	Blue	0 V
		8	(Shield)	Output polarity setting wire
		9	Gray	Large multi-purpose indicator input 1
		10	Gray / Black	Large multi-purpose indicator input 2
		11	Sky-blue / White	Muting input 1
		12	Sky-blue / Black	Muting input 2

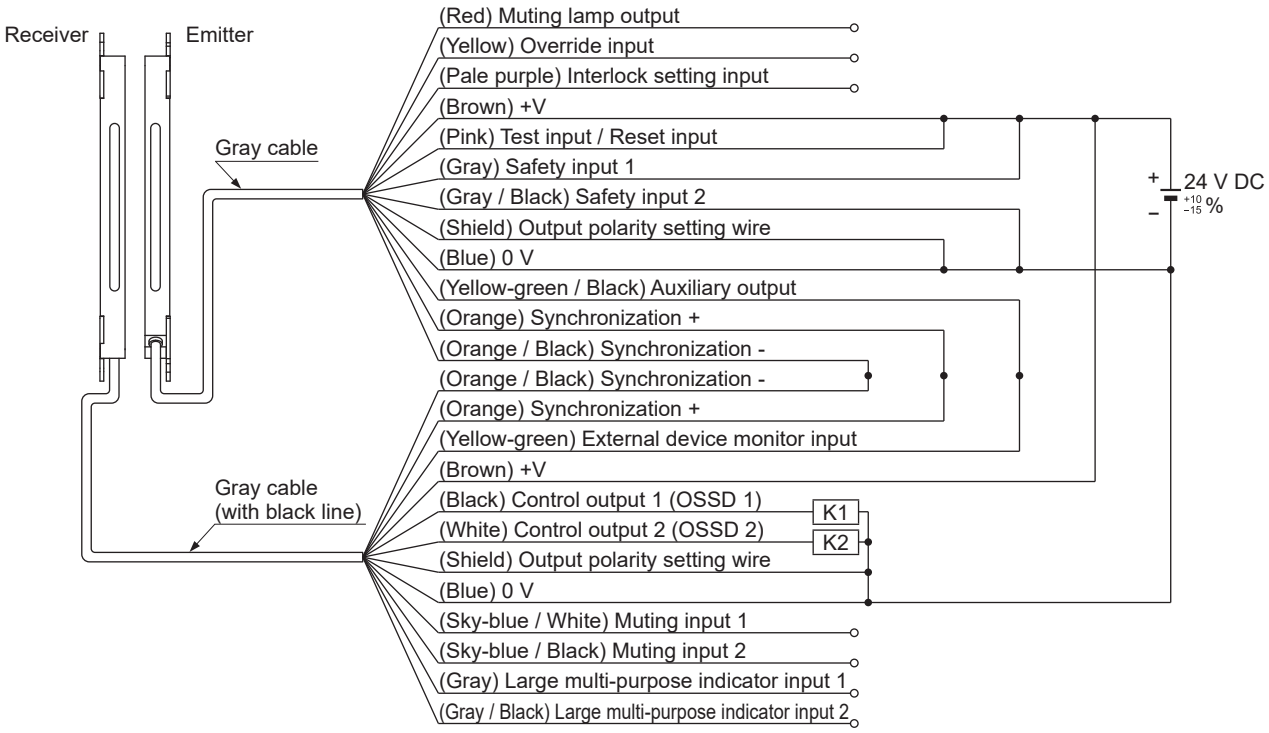
<Reference>

- The connectors can be distinguished from their colors as follows:
  Connector for emitter: Gray, connector for receiver: Black
- For details of the cable with connector on one end and the cable with connector on both ends, refer to "**6-2 Options**."

2-5-4 Basic Wiring

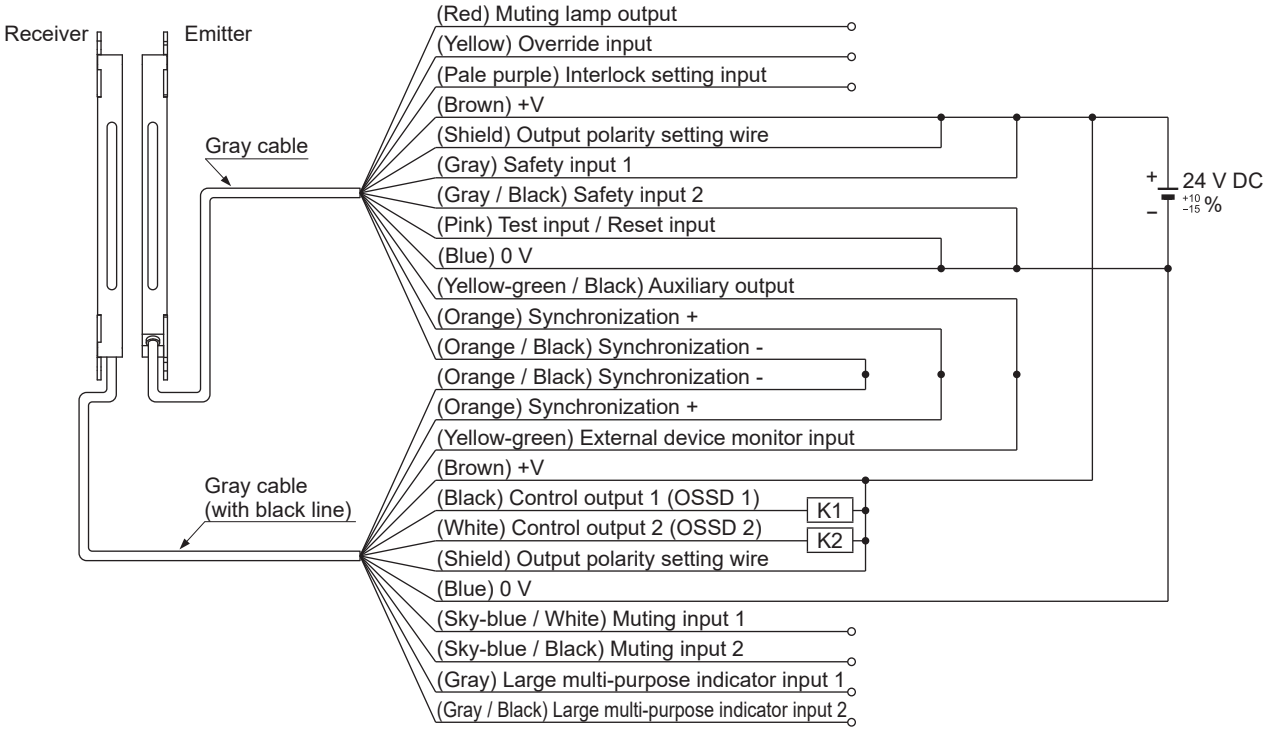
This is the general configuration using one set of the emitter and receiver facing each other. The control output (OSSD 1 / 2) turns OFF if the light is blocked, while it automatically turns ON if receives the light.
The auxiliary output is used to invalid the external device monitor function. At this time, set the auxiliary output with “negative logic of the control output” (factory setting). The auxiliary output cannot be connected to external devices.

<For PNP output>



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

<For NPN output>

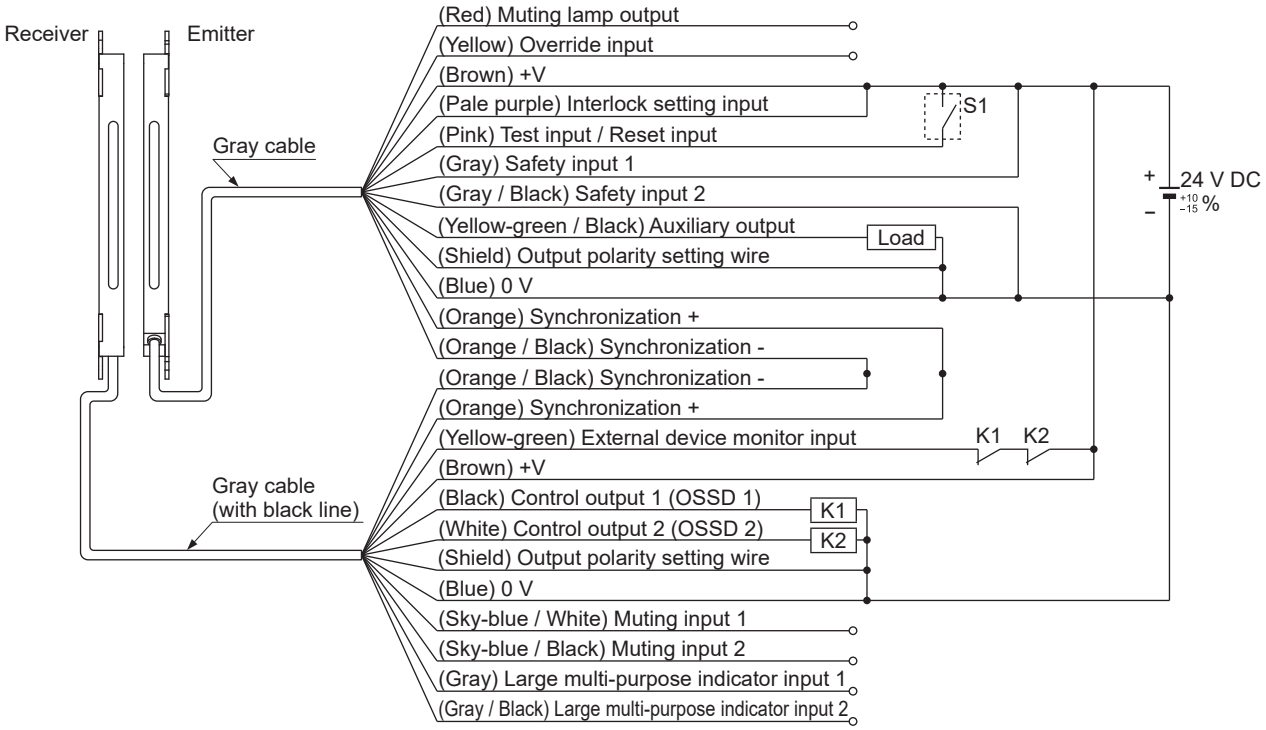


Interlock function	Invalid (Auto-reset)
External device monitor function	Invalid
Auxiliary output	Cannot be used

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

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

<For PNP output>



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

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

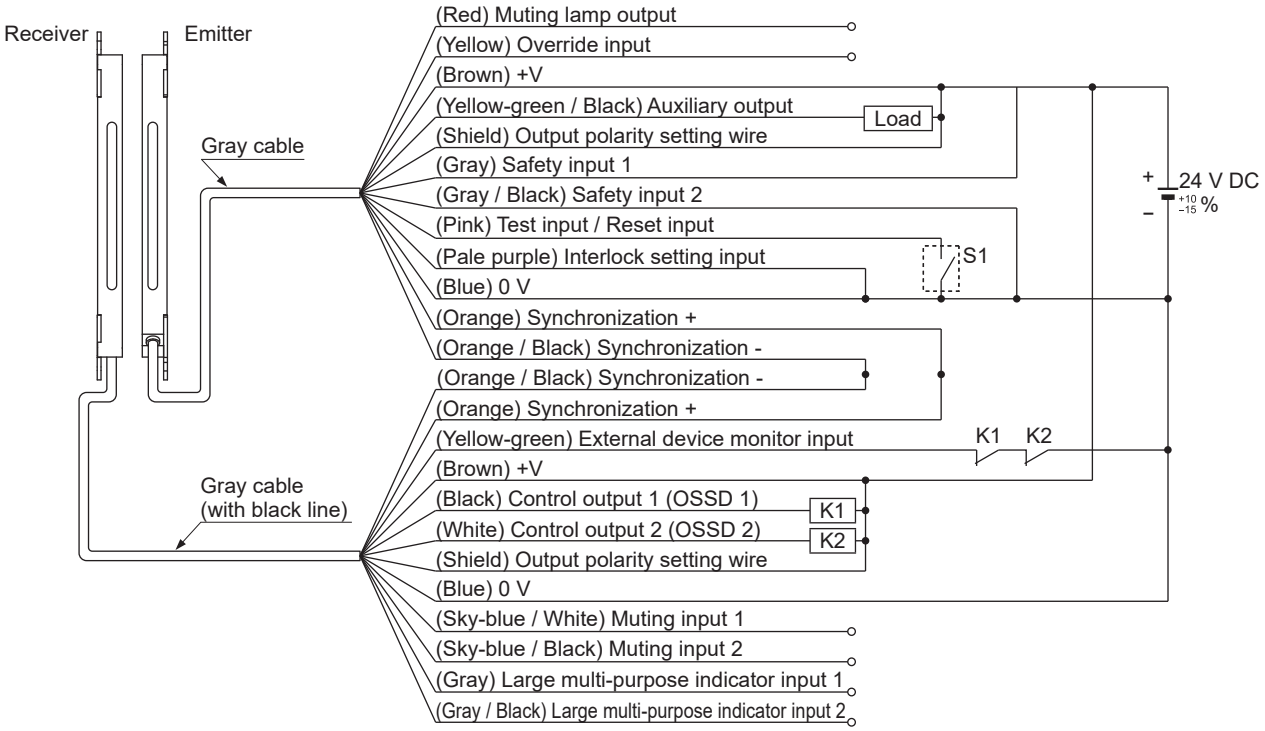
* Symbols

Switch S1
- Test input / Reset input
  Vs to Vs - 3.5 V (sink current 5 mA or less): OFF (Note 1), Open: ON

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

Notes: 1) Vs is the applying supply voltage.
2) For resetting, refer to "**3-2 Interlock Function**."

<For NPN output>



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

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

* Symbols

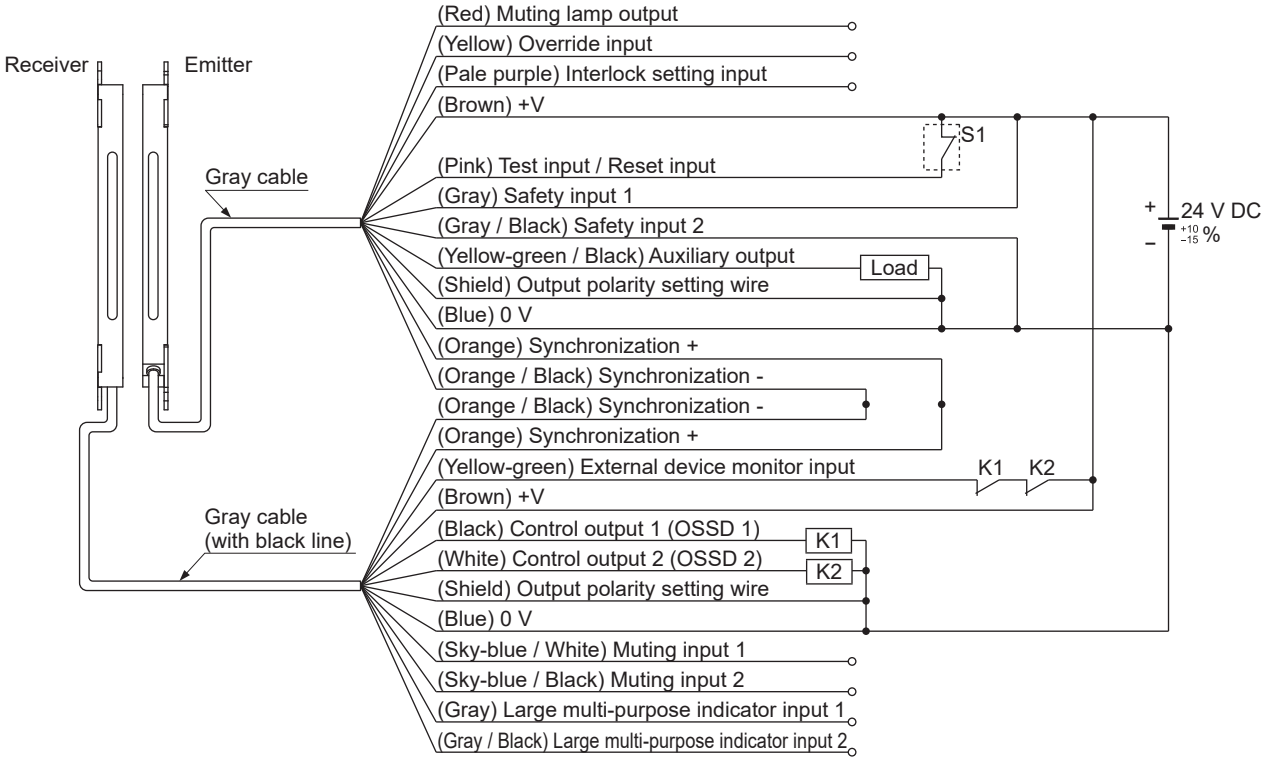
Switch S1
- Test input / Reset input
  0 V to +2.5 V (source current 5 mA or less): OFF, Open: ON

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

Note: For resetting, refer to "**3-2 Interlock Function**."

2-5-6 Wiring for Auto Reset (Interlock is Invalid) (Wiring Example of the Control Category 4)

<For PNP output>



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

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

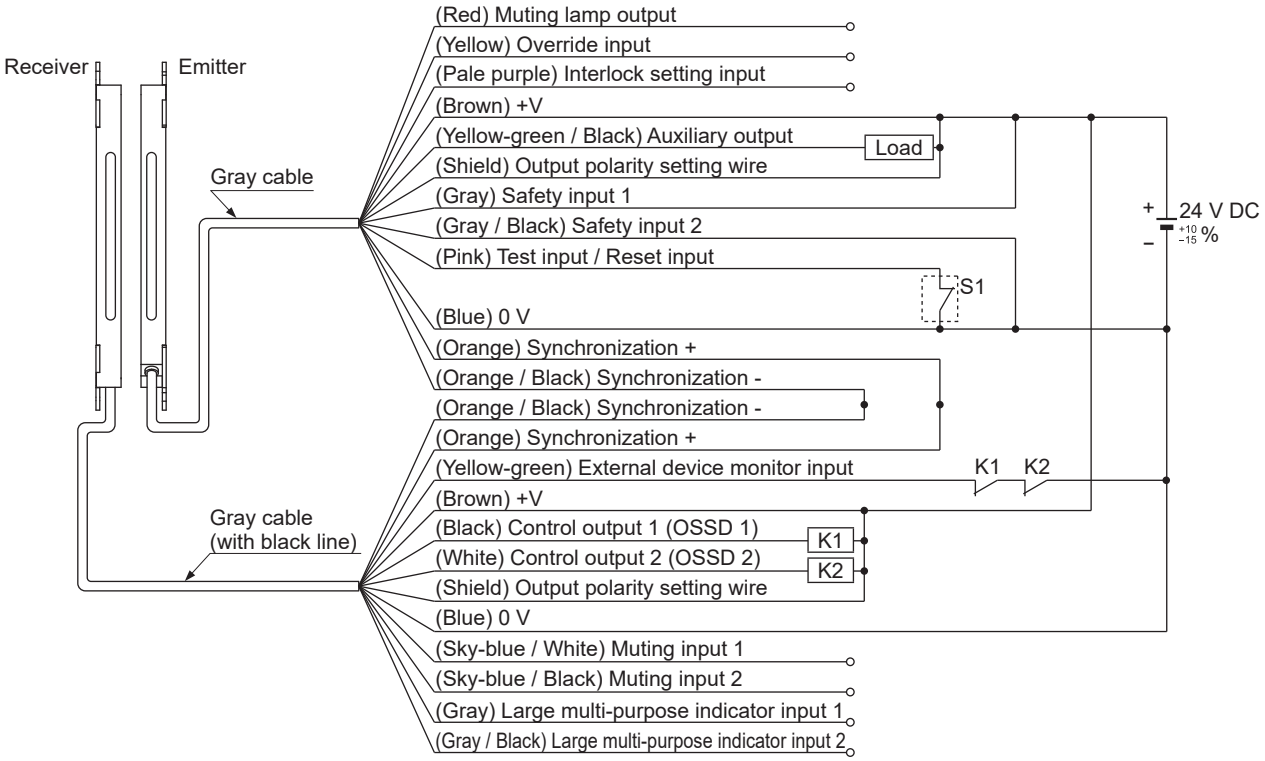
* Symbols

Switch S1
- Test input / Reset input
  Vs to Vs - 3.5 V (sink current 5 mA or less): ON (Note 1), Open: OFF

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

Notes: 1) Vs is the applying supply voltage.
2) For resetting, refer to "**3-2 Interlock Function**."

<For NPN output>



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

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

* Symbols

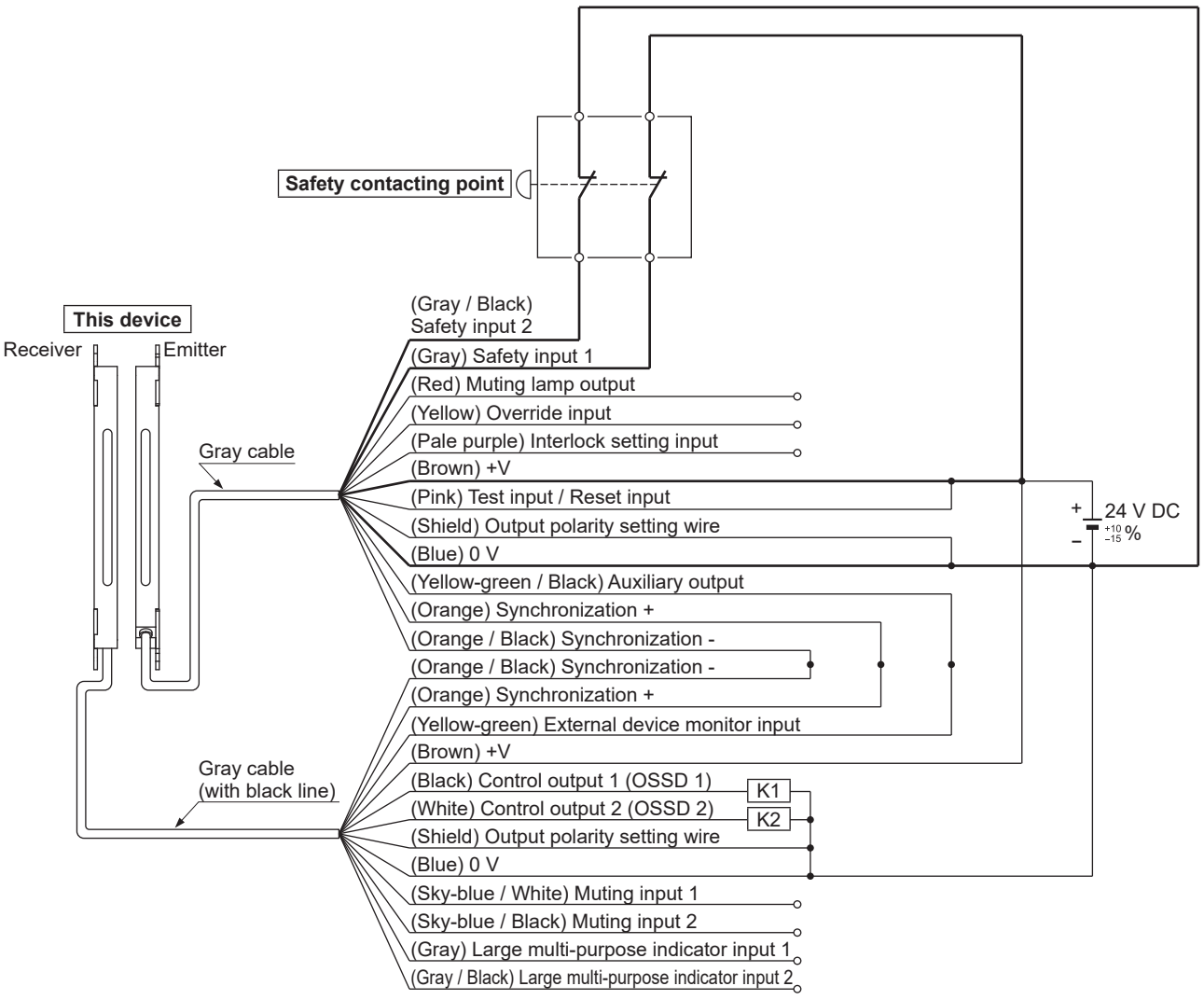
Switch S1
● Test input / Reset input
0 V to +2.5 V (source current 5 mA or less): ON, Open: OFF
K1, K2: External device (Forced guided relay or magnetic contactor)

Note: For resetting, refer to "**3-2 Interlock Function**."

2-5-7 Wiring Configuration for Valid Safety Input Function (Wiring Example of the Control Category 4)

The safety contacting point can be connected to safety input 1 wire (gray) and the safety input 2 wire (gray / black) of the emitter.
Refer to "**3-4 Safety Input Function**" for detail of safety input function.
In addition, a safety sensor can be connected by using the handy controller **SFC-HC** (optional). And, by connecting safety sensor to the safety input 1 (gray) and the safety input 2, this device and the safety sensor can be used as series connection
For details, refer to "**3-10 Functions Using Handy Controller SFC-HC (optional)**."

<For PNP output>



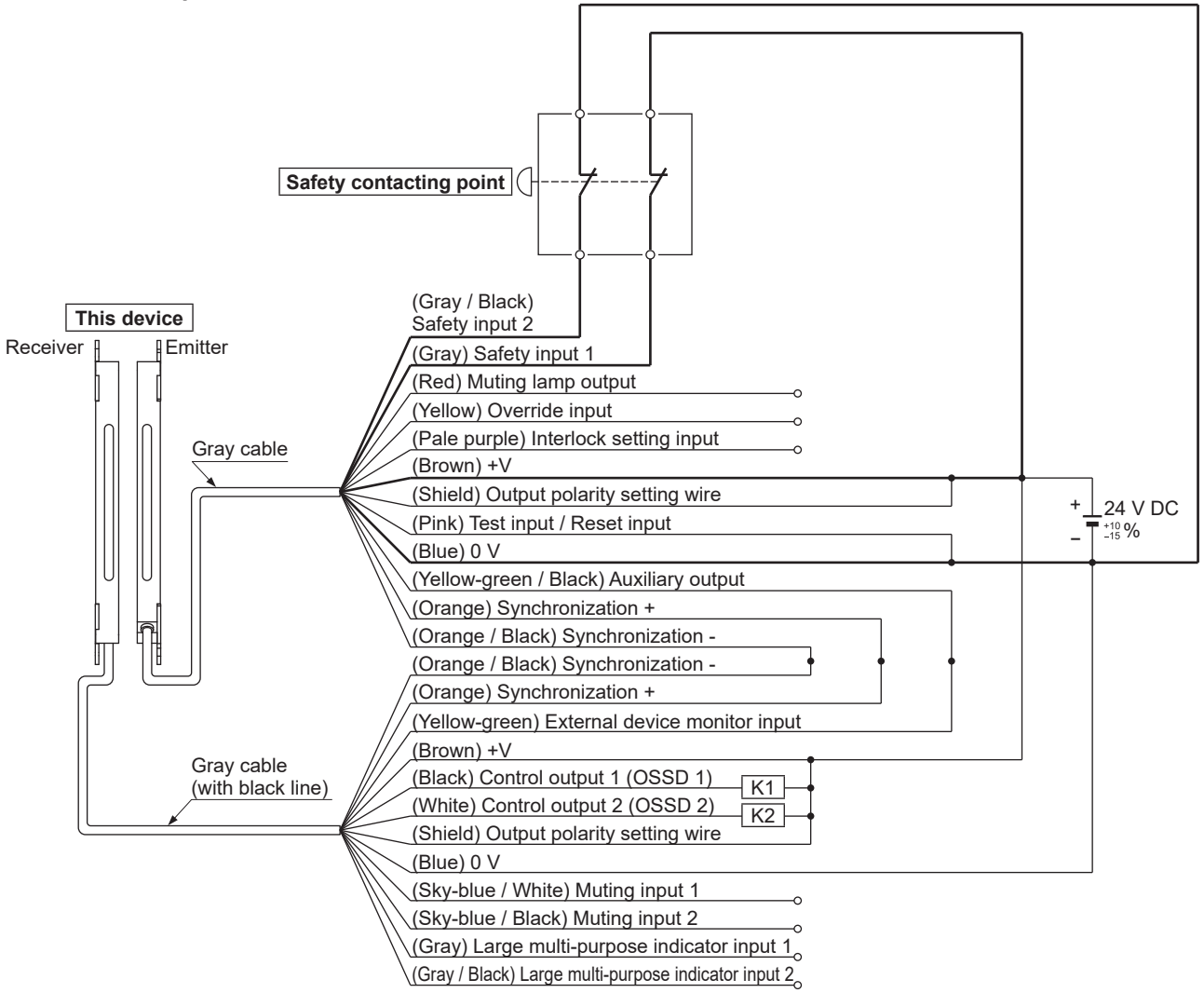
Interlock function	Invalid (Auto-reset)
External device monitor function	Invalid
Auxiliary output	Cannot be used

- Safety input
  Short-circuit (sink current 5 mA to 10 mA), Source current 5 mA to 10 mA: Valid
  Open: Invalid

* Symbols

K1, K2: Safety relay unit etc.

<For NPN output>



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

- Safety input
  Short-circuit (sink current 5 mA to 10 mA), Source current 5 mA to 10 mA: Valid
  Open: Invalid

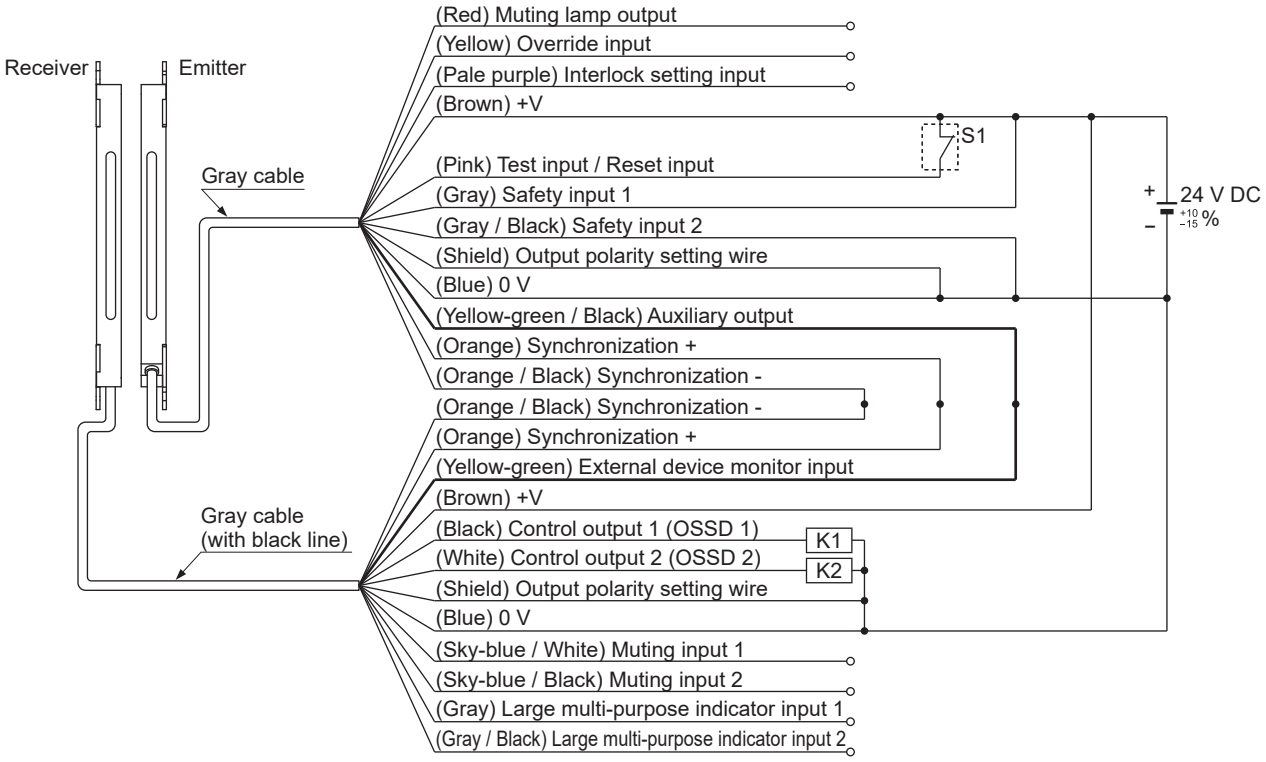
* Symbols

K1, K2: Safety relay unit etc.

2-5-8 Wiring Configuration for Invalid External Device Monitor Function (Wiring Example of the Control Category 4)

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

<For PNP output>



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

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

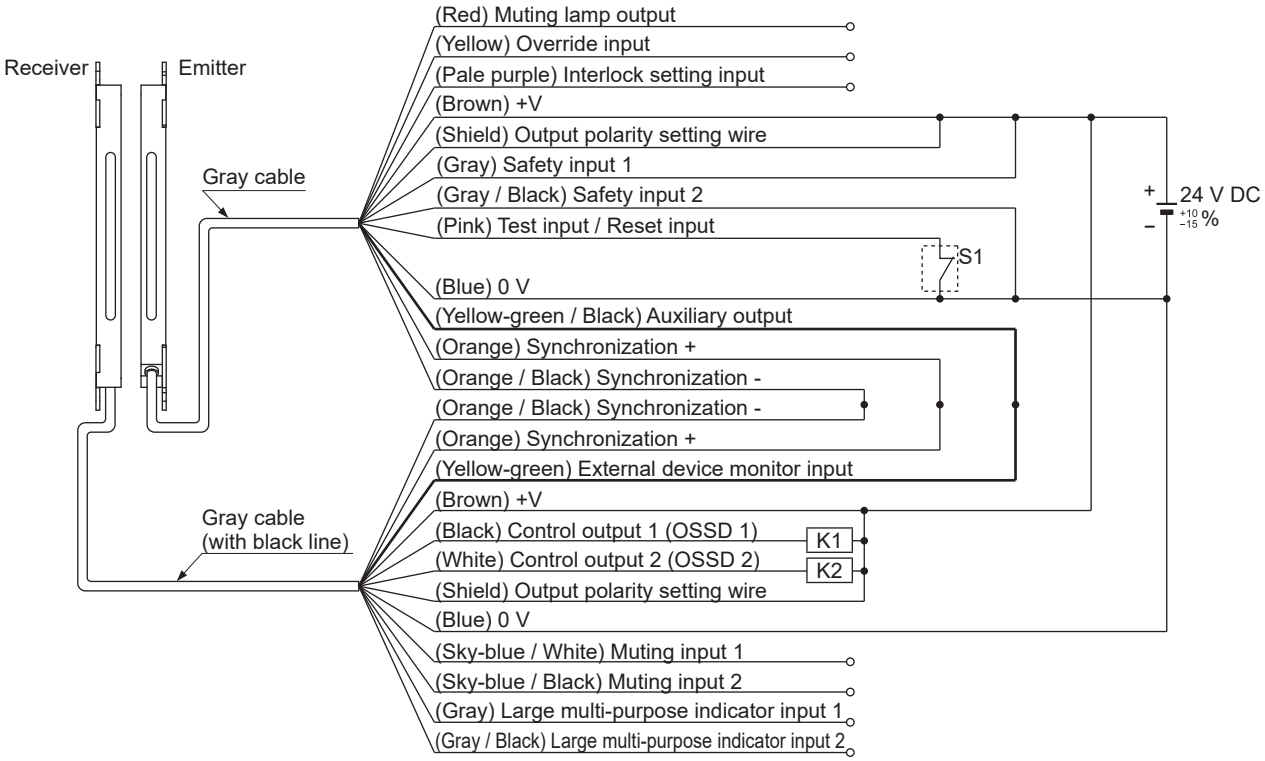
* Symbols

Switch S1
- Test input / Reset input
  Vs to Vs - 3.5 V (sink current 5 mA or less): ON (Note), Open: OFF

K1, K2: Safety relay unit etc.

Note: Vs is the applying supply voltage.

<For NPN output>



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

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

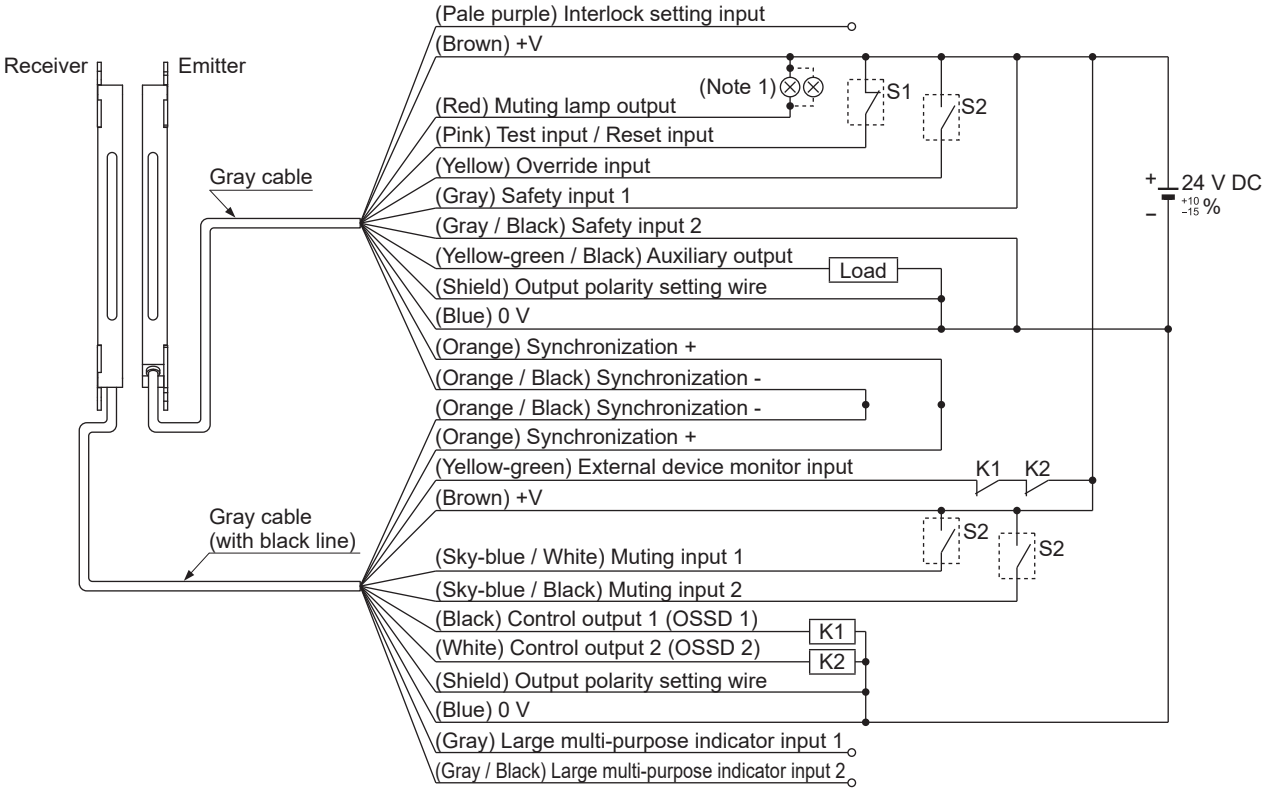
* Symbols

Switch S1
- Test input / Reset input
  0 V to +2.5 V (source current 5 mA or less): ON, Open: OFF

K1, K2: Safety relay unit etc.

2-5-9 Wiring Configuration for Valid Muting Function (Wiring Example of the Control Category 4)

<For PNP output>



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

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

* Symbols

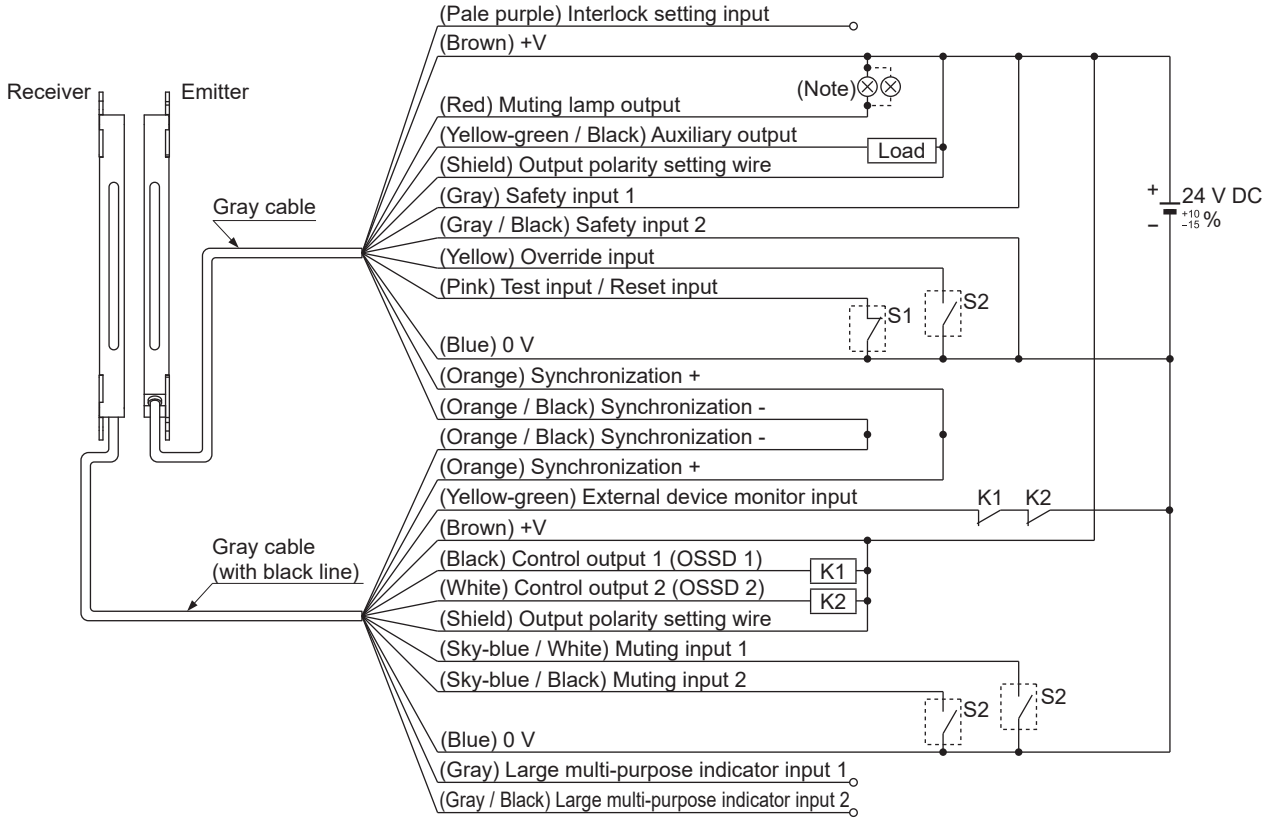
Switch S1
- Test input / Reset input
  Vs to Vs - 3.5 V (sink current 5 mA or less): ON (Note 2), Open: OFF

Switch S2
- Muting input, Override input
  Vs to Vs - 3.5 V (sink current 5 mA or less): Valid (Note 2), Open: Invalid

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

Notes: 1) For the lamp to be connected to the muting lamp output, use an incandescent lamp or LED lamp with a total of 1.5 W to 6 W or less.
2) Vs is the applying supply voltage.

<For NPN output>



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

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

* Symbols

Switch S1
- Test input / Reset input
  0 V to +2.5 V (source current 5 mA or less): ON, Open: OFF

Switch S2
- Muting input, Override input
  0 V to +2.5 V (source current 5 mA or less): Valid, Open: Invalid

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

Note: For the lamp to be connected to the muting lamp output, use an incandescent lamp or LED lamp with a total of 1.5 W to 6 W or less.

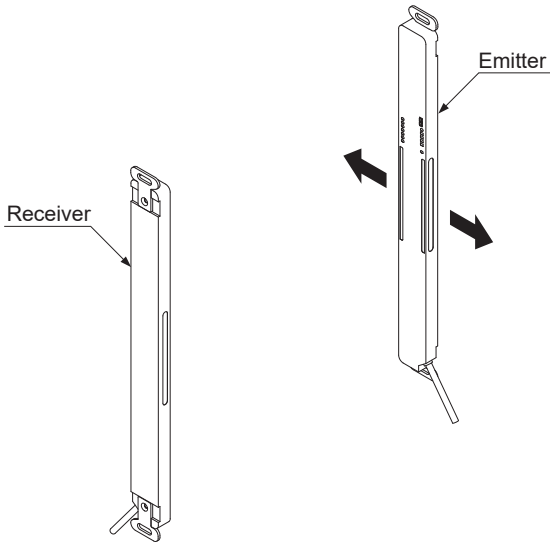
2-6 Adjustment

2-6-1 Beam-axis Alignment

1. Turn ON the power supply unit of this device.
2. Check that the digital error indicator (red) and the fault indicator (yellow) of the emitter and the receiver are OFF respectively.
   - If the digital error indicator (red) or the fault indicator (yellow) lights up or blinks, refer to "**Chapter 5 Troubleshooting**" and report the symptoms to the maintenance in charge.

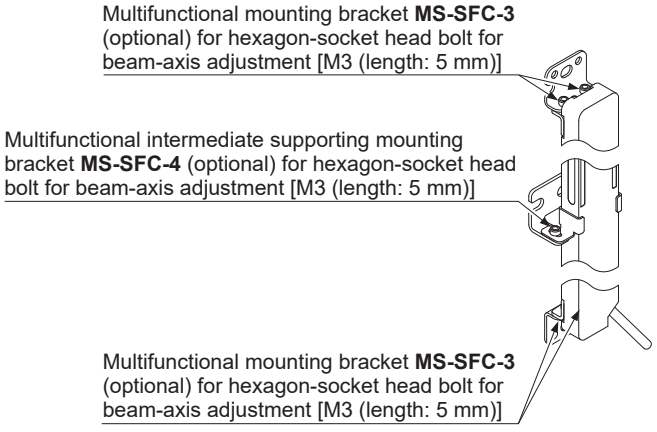
[In case of using the standard mounting bracket MS-SFC-1 (accessory)]

3. Loosen the hexagon-socket head bolts [M5 (purchase separately)] which holds the standard mounting bracket **MS-SFC-1**.
4. Move the emitter in the left and right directions in order to determine the range of the light received condition with the help of the beam-axis alignment indicator (red). Then, set the emitter at the center of this range.
5. Similar to the step 4, perform the beam-axis alignment for the receiver.
6. Tighten the standard mounting bracket **MS-SFC-1** by the hexagon-socket head bolt [M5 (purchase separately)].
7. Confirm that the beam-axis alignment indicators (green) in the display of the emitter and receiver, operation indicator (green) and OSSD indicator (green) light up.

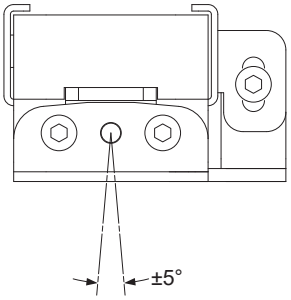


[In case of using the multifunctional mounting bracket MS-SFC-3 (optional) and the multifunctional intermediate supporting bracket MS-SFC-4 (optional)]

3. Loosen the four hexagon-socket head bolts [M3 (length: 5 mm) for beam-axis alignment of multifunctional mounting bracket **MS-SFC-3**.
4. In case of mounting the multifunctional intermediate supporting bracket **MS-SFC-4**, loosen a hexagon-socket head bolt [M3 (length: 5 mm)] for beam-axis alignment of multifunctional intermediate supporting bracket.



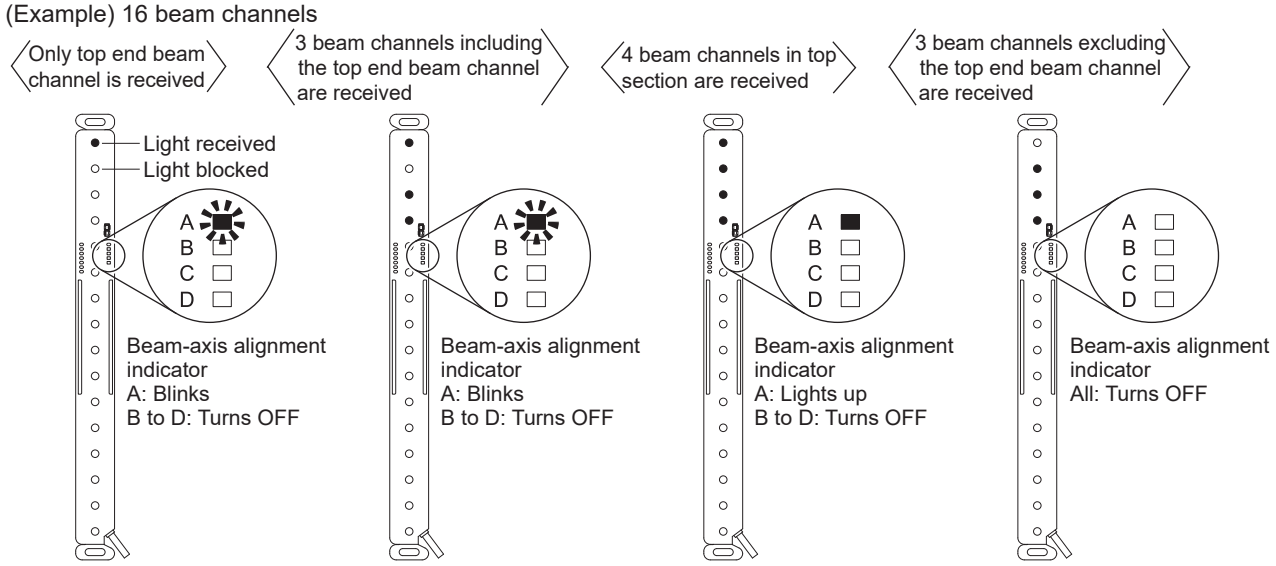
5. Adjust the emitter / receiver so that the beam-axis alignment indicators in the display of the emitter and receiver light up.
   The emitter and the receiver can be fine-adjusted by ±5 degrees.



6. After the adjustment, tighten the hexagon-socket head bolt for beam-axis alignment of the multifunctional mounting bracket.
   The tightening torque should be 2 N·m or less.
7. Tighten the hexagon-socket head bolt of the multifunctional intermediate supporting brackets [M3 (length: 5 mm)].
8. Confirm that the beam-axis alignment indicators (green) in the display of the emitter and receiver, operation indicator (green) and OSSD (green) indicator light up.

<Reference>

The beam-axis alignment indicator indicates the reception status for each section of the device which is divided into 4 sections.
Furthermore, the A (D) of the beam-axis alignment indicates the light-receiving status of the device top end (bottom end).
For example, when using a 16-beam channel device, there are 4 beam channels per section (i.e., 16/4=4).
When the top end (bottom end) beam channel is received, the A (D) of the beam-axis alignment indicator blinks in red.
(Example) 16 beam channels



When all the 4 beam channels divided into each section are received, the beam-axis alignment indicator lights up in red. The indicators corresponding to the different sections light up in red, one by one, when the beam channels of the respective sections are received. When all the beam channels are received and the control output (OSSD 1 / 2) turns ON, all the four indicators of the beam-axis alignment indicator turn into green.
Refer to "**2-6-2 Operation Test**" for details.

⚠ CAUTION

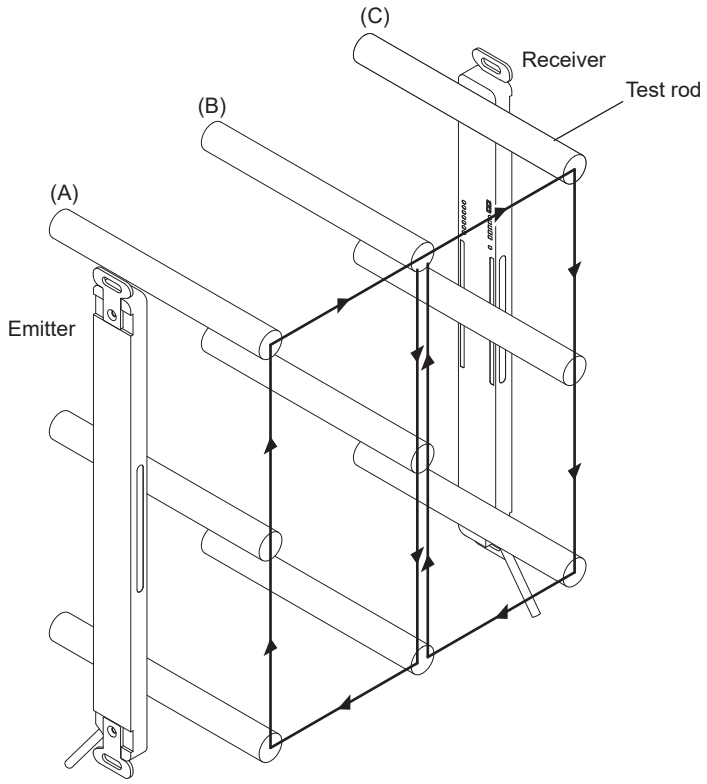
After beam-axis alignment, confirm that all bolts are tightened at stated torque. Refer to "**2-4 Mounting**" for each tightening torque of the bolts.

2-6-2 Operation Test

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

2. Check that the digital error indicator (red) and the fault indicator (yellow) of the emitter and the receiver are OFF respectively.
   - If the digital error indicator (red) or the fault indicator (yellow) lights up or blinks, refer to "**Chapter 5 Troubleshooting**" and report the symptoms to the maintenance in charge.

3. Move the test rod (**SF4C-F**□: ø14 mm, **SF4C-H**□: ø25 mm) up and down 1,600 mm/sec. or less at three positions, just in front of the emitter (A), between the emitter and receiver (B) and just in front of the receiver (C).



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

<Reference>

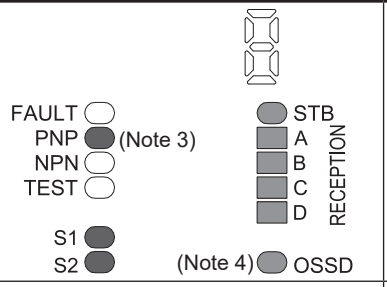
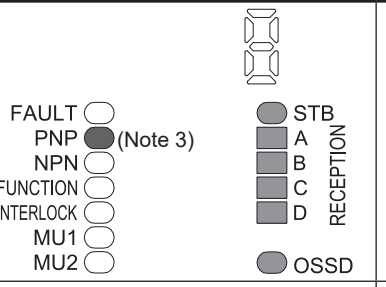
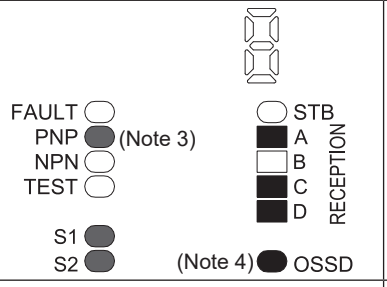
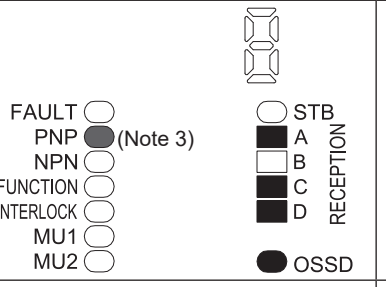
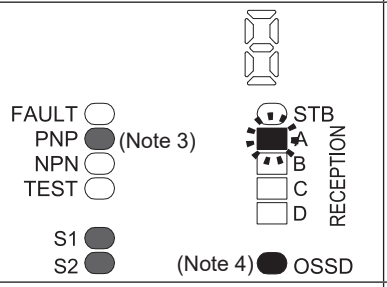
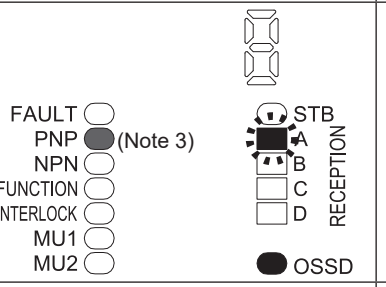
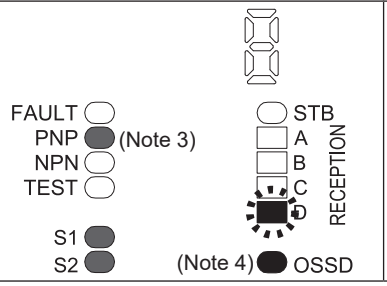
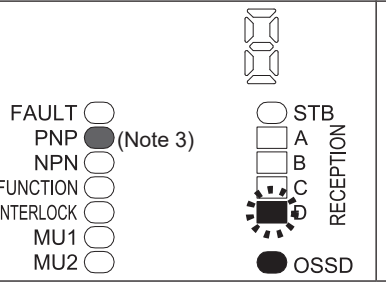
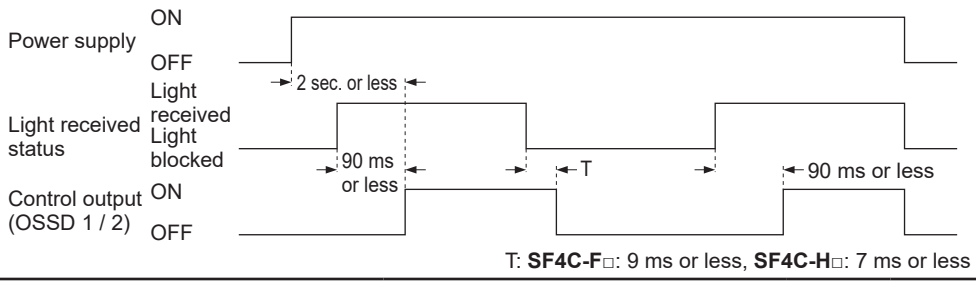
If the indicators show reception of the light even though the test rod blocks the light, check whether there is any reflective object or extraneous light source near this device or not.

2-6-3 Operation

1) Normal Operation

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

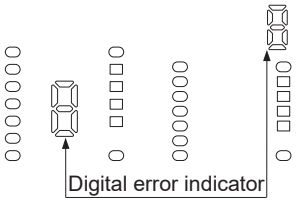
: Blinks in red : Lights up in red : Lights up in orange : Lights up in green : Turns OFF

State of this device		Indicators (Note 1)(Note 2)		Control output	
		Emitter	Receiver	OSSD 1	OSSD 2
Light received status (All beams received)				ON	
Light blocked status	One or more beams blocked			OFF	
	Lights other than the top end blocked			OFF	
	Lights other than the bottom end blocked			OFF	
Timing chart					

T: **SF4C-F**□: 9 ms or less, **SF4C-H**□: 7 ms or less

Notes: 1) **SF4C-H8**□ and **SF4C-F15**□ are not provided with digital error indicator (red).
2) The above shows Ver. 3.0. In case of Ver. 2.1 or earlier, digital error indicator (red) is located at different position as shown at right.
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.
4) Since the color of the operation indicator changes according to the ON / OFF state of the control output (OSSD 1 / 2), the operation indicator is marked as OSSD on the device.

<SF4C-H□> **<SF4C-F□>**



2) When using test input function

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

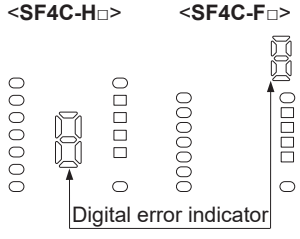
<Reference>

When the test input / reset input is kept open (for manual reset of PNP output: connect to +V, for manual reset of NPN output: connect to 0 V), the test input function will be valid and the receiver will be OFF with the emitting light is received.

●: Lights up in red ●: Lights up in orange ●: Lights up in green ○: Turns OFF

Setting procedure and check items		Indicators (Note 1)(Note 2)		Control output	
		Emitter	Receiver	OSSD 1	OSSD 2
1	Before power is ON Connect the test input / reset input to Vs (Note 3)	FAULT ○ PNP ○ NPN ○ TEST ○ S1 ○ S2 ○ (Note 5) ○ OSSD STB ○ A □ B □ C □ D □ RECEPTION	FAULT ○ PNP ○ NPN ○ FUNCTION ○ INTERLOCK ○ MU1 ○ MU2 ○ OSSD STB ○ A □ B □ C □ D □ RECEPTION	OFF	
2	After power is ON Receiver's control output (OSSD 1 / 2) is ON (Normal operation)	FAULT ○ PNP ● (Note 4) NPN ○ TEST ○ S1 ● S2 ● (Note 5) ● OSSD STB ● A ■ B ■ C ■ D ■ RECEPTION	FAULT ○ PNP ● (Note 4) NPN ○ FUNCTION ○ INTERLOCK ○ MU1 ○ MU2 ○ OSSD STB ● A ■ B ■ C ■ D ■ RECEPTION	ON	
3	Open the test input / reset input Receiver's control output (OSSD 1 / 2) is OFF (Test input valid) (Normal operation)	FAULT ○ PNP ● (Note 4) NPN ○ TEST ○ S1 ● S2 ● (Note 5) ● OSSD STB ○ A ■ B ■ C ■ D ■ RECEPTION	FAULT ○ PNP ● (Note 4) NPN ○ FUNCTION ○ INTERLOCK ○ MU1 ○ MU2 ○ OSSD STB ● A ■ B ■ C ■ D ■ RECEPTION	OFF	
4	Connect the test input / reset input to Vs (Note 2) Receiver's control output (OSSD 1 / 2) is ON (Normal operation)	FAULT ○ PNP ● (Note 4) NPN ○ TEST ○ S1 ● S2 ● (Note 5) ● OSSD STB ● A ■ B ■ C ■ D ■ RECEPTION	FAULT ○ PNP ● (Note 4) NPN ○ FUNCTION ○ INTERLOCK ○ MU1 ○ MU2 ○ OSSD STB ● A ■ B ■ C ■ D ■ RECEPTION	ON	

Notes: 1) **SF4C-H8**□ and **SF4C-F15**□ are not provided with digital error indicator (red).
2) The above shows Ver. 3.0. In case of Ver. 2.1 or earlier, digital error indicator (red) is located at different position as shown at right.
3) Vs is the applying supply voltage.
4) 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.
5) Since the color of the operation indicator changes according to the ON / OFF state of the control output (OSSD 1 / 2), the operation indicator is marked as OSSD on the device.

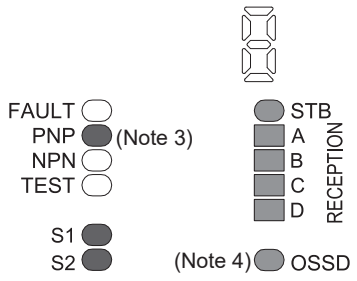
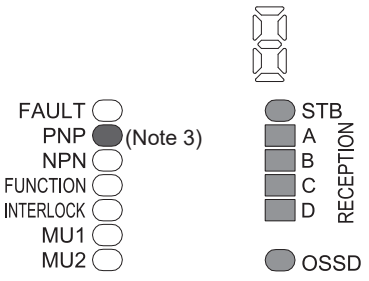
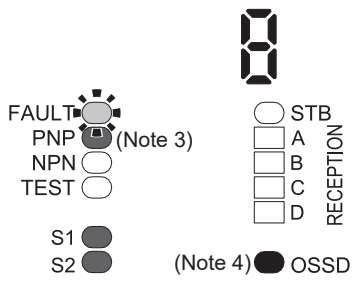
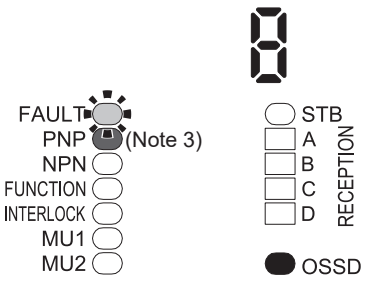


3) When an error occurs

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

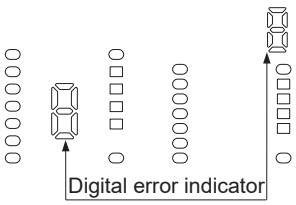
- If an emitter error is detected, the emitter will be locked out, stopping its emission, and the control output (OSSD 1 / 2) will be turned OFF.
- If a receiver error is detected, the receiver will be locked out, and the control output (OSSD 1 / 2) will go into OFF state. Also, the test input indicator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

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

State of this device	Indicators (Note 1)(Note 2)		Control output	
	Emitter	Receiver	OSSD 1	OSSD 2
Normal state			ON	
Error state			OFF	

Notes: 1) **SF4C-H8□** and **SF4C-F15□** are not provided with digital error indicator (red).
2) The above shows Ver. 3.0. In case of Ver. 2.1 or earlier, digital error indicator (red) is located at different position as shown at right.
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.
4) Since the color of the operation indicator changes according to the ON / OFF state of the control output (OSSD 1 / 2), the operation indicator is marked as OSSD on the device.
5) Refer to "**Chapter 5 Troubleshooting**" for details of the digital error indicator.

<SF4C-H□> **<SF4C-F□>**



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

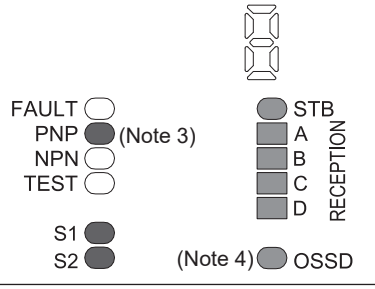
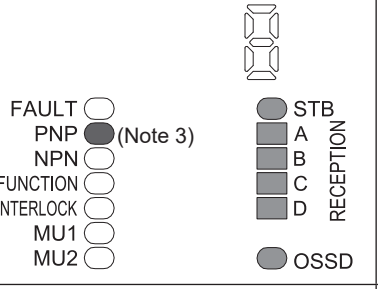
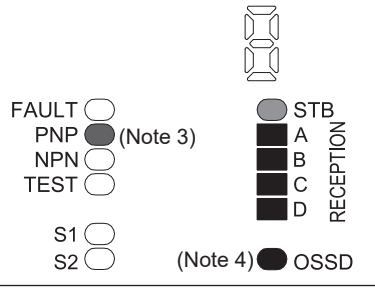
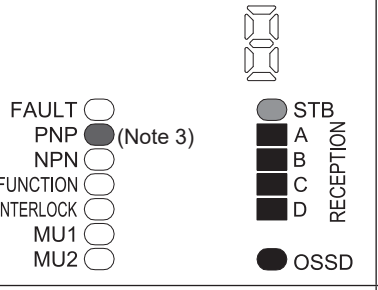
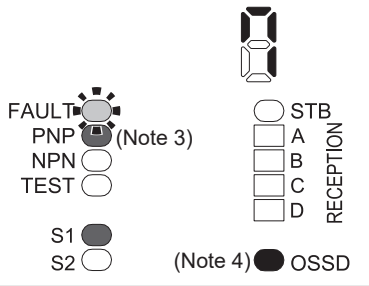
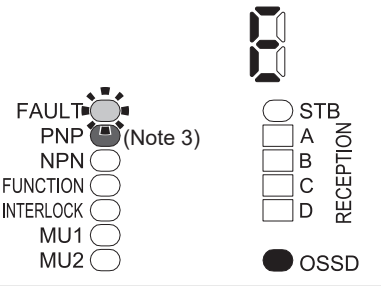
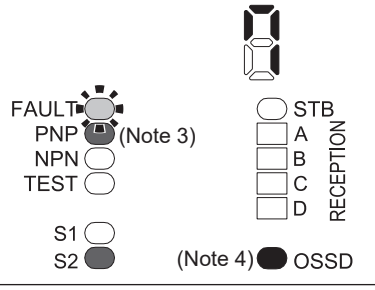
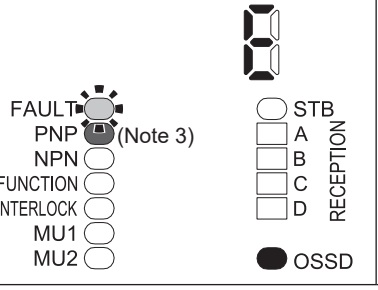
(Source of error): The control output (OSSD 1 / 2) short-circuit, extraneous light detection, sensor failure, etc.

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

4) When using safety input function

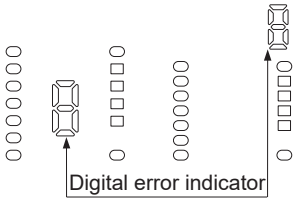
This device incorporates the safety input function. This function controls the control output (OSSD 1 / 2) of this device by receiving detection signal of a safety switch or a safety sensor which is connected to the safety input 1 or 2.

● : Lights up in red ● : Lights up in orange ● : Lights up in green ○ : Turns OFF

Setting procedures and check items	Indicators (Note 1)(Note 2)		Control output	
	Emitter	Receiver	OSSD 1	OSSD 2
Safety input ON			ON	
Safety input OFF			OFF	
Safety input error (Safety input 1: Connected Safety input 2: Not connected)			OFF	
Safety input error (Safety input 1: Not connected Safety input 2: Connected)			OFF	

Notes: 1) **SF4C-H8□** and **SF4C-F15□** are not provided with digital error indicator (red).
2) The above shows Ver. 3.0. In case of Ver. 2.1 or earlier, digital error indicator (red) is located at different position as shown at right.
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.
4) Since the color of the operation indicator changes according to the ON / OFF state of the control output (OSSD 1 / 2), the operation indicator is marked as OSSD on the device.

<SF4C-H□> <SF4C-F□>



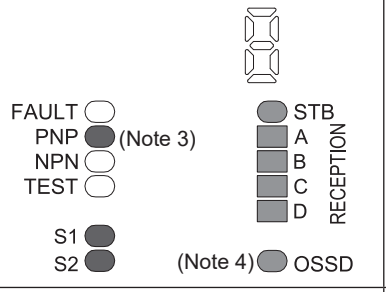
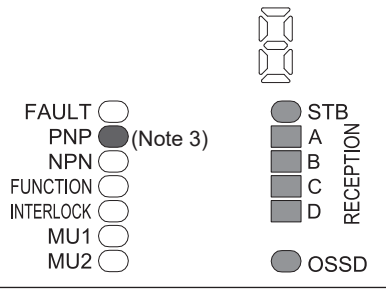
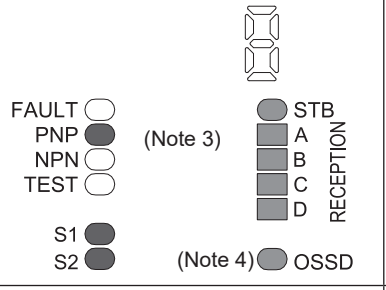
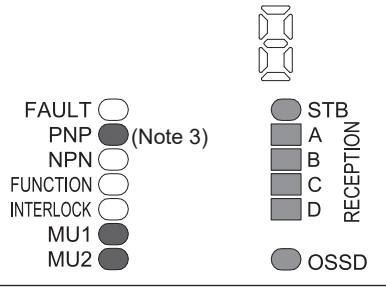
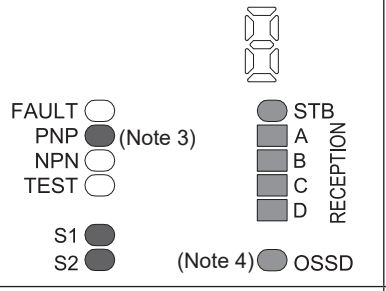
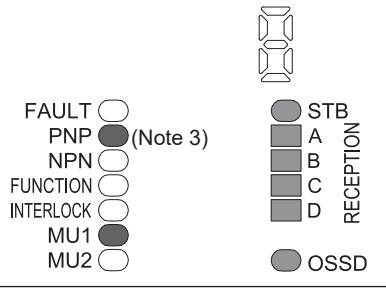
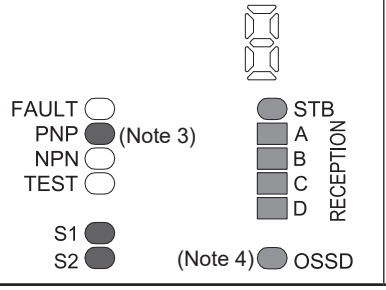
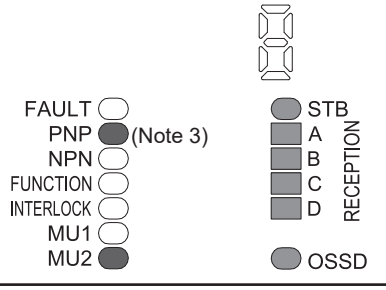
⚠ CAUTION

For safety sensor, use a sensor which incorporates a crossover short-circuit function in the control output and connect both the safety input 1 wire (gray) and the safety input 2 wire (gray / black). Take care that if only one wire is connected, the device may not operate normally.

5) When using muting function

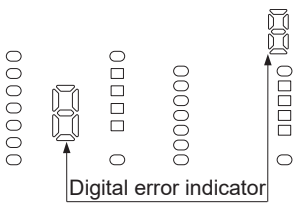
This function turns the safety function into invalid temporarily. When the control output (OSSD 1 / 2) is ON, this function is available for passing the sensing object through the sensing area of the device without stopping the device.

●: Lights up in orange ●: Lights up in green ○: Turns OFF

Setting procedures and check items	Indicators (Note 1)(Note 2)		Control output	
	Emitter	Receiver	OSSD 1	OSSD 2
Muting sensor is OFF			ON	
Muting sensor is ON (Muting input 1: ON, Muting input 2: ON)			ON	
Muting sensor is ON (Muting input 1: ON, Muting input 2: OFF)			ON	
Muting sensor is ON (Muting input 1: OFF, Muting input 2: ON)			ON	

Notes: 1) **SF4C-H8□** and **SF4C-F15□** are not provided with digital error indicator (red).
2) The above shows Ver. 3.0. In case of Ver. 2.1 or earlier, digital error indicator (red) is located at different position as shown at right.
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.
4) Since the color of the operation indicator changes according to the ON / OFF state of the control output (OSSD 1 / 2), the operation indicator is marked as OSSD on the device.

<SF4C-H□> **<SF4C-F□>**



3-1 Self-diagnosis Function

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

3-2 Interlock Function

The selection of manual reset / auto-reset is available by applying the interlock setting input wire (pale purple).
The interlock becomes available by selecting manual reset.

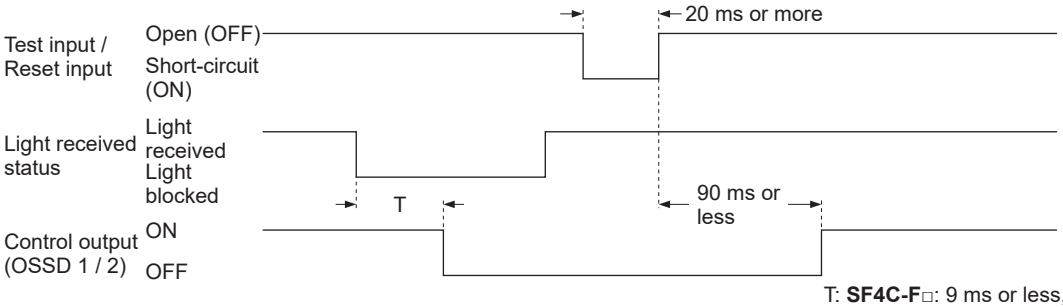
Interlock setting input wire (pale purple)	Setting for interlock function
Connect to +V for PNP output Connect to 0 V for NPN output	Manual reset
Open	Auto-reset

⚠ WARNING Make sure that there exist no operator in the dangerous zone when using the interlock function, which can result in death or serious injury.

3-2-1 Manual Reset

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

<Timing chart>



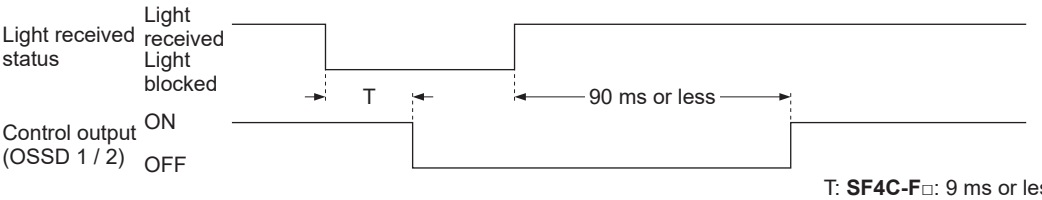
T: **SF4C-F**□: 9 ms or less, **SF4C-H**□: 7 ms or less

⚠ WARNING The reset switch shall be placed in area where all over the dangerous zone shall be comprehend and outside of the dangerous zone.

3-2-2 Auto-Reset

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

<Timing chart>



T: **SF4C-F**□: 9 ms or less, **SF4C-H**□: 7 ms or less

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

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

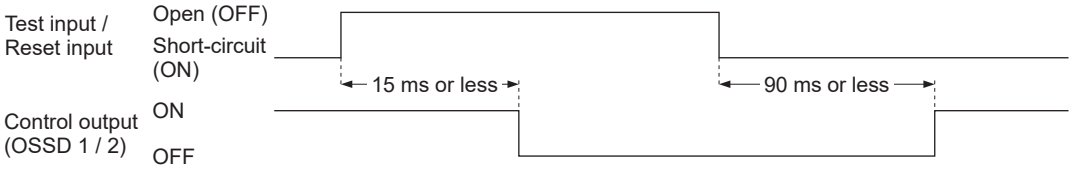
3-3 Test Input Function

This function enables checking of the device operation by forcibly turning ON / OFF the control output (OSSD 1 / 2) of the receiver with the emitting light is received.
The selection of output ON / OFF is available by applying the test input / reset input wire (pink).

Interlock function	Test input / Reset input wire (pink)	Test input	Control output (OSSD1 / 2) status
Manual reset	Open	Invalid	ON
	Connect to +V for PNP output Connect to 0 V for NPN output	Valid	OFF
Auto-reset	Open	Valid	OFF
	Connect to +V for PNP output Connect to 0 V for NPN output	Invalid	ON

When the test input is valid, the control output (OSSD 1 / 2) becomes OFF.
By using this function, malfunction due to extraneous noise or abnormality in the control output (OSSD 1 / 2) and the auxiliary output can be determined even from the equipment side.
In case of PNP output, normal operation is restored when the test input / reset input wire (pink) is connected to +V (for manual reset: open).
In case of NPN output, normal operation is restored when the test input / reset input wire (pink) is connected to 0 V (for manual reset: open).

<Timing chart>



⚠ WARNING

Do not use the test input function for the purpose of stopping the machine in which the **SF4C** series is installed. Failure to do so could result in death or serious injury.

3-4 Safety Input Function

This function controls the control output (OSSD 1 / 2) of this device by receiving detection signal of a safety contacting point or a safety sensor which is connected to the safety input 1 wire (gray) and the safety input 2 wire (gray / black).
The control output (OSSD 1 / 2) forcibly turning OFF when safety input 1 / 2 is OFF.
Temporal difference between OFF to ON and ON to OFF of output operation of the safety input should be 1 sec. or less.
A safety contacting point can be connected at the factory setting of this device.
When connecting a safety sensor, the handy controller **SFC-HC** (optional) is required. Furthermore, the number of safety sensor which be able to connect this device is 2. (Note)
For details, refer to "**3-10 Functions Using Handy Controller SFC-HC (optional)**."
Series connection is also available when connecting other **SF4C** series to the safety input 1 wire (gray) and the safety input 2 wire (gray / black).
The safety contacting points are available for an emergency stop switch with two NC (Normally Closed) contacting points, etc., and the safety sensor is available for a light curtain or a safety switch with semiconductor output etc.

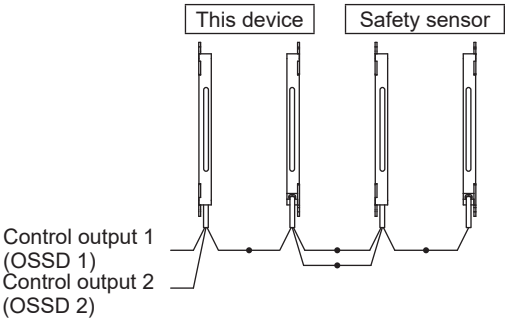
<Output operations of a safety contacting point and a safety sensor>

	NC (Normally Closed) type	Operation at ON state	Operation at OFF state
Safety contacting point	ON: when the status is safety (Emergency stop switch, etc.)	PNP output: Connect to +V NPN output: Connect to 0 V	Open
Safety sensor	ON: when light received status (Light curtain, etc.) ON: when closing by (Safety switch, etc.)		

Note: Possible to set only when this device is version 2.1 or version 3.0.

⚠ WARNING

- Use 0.2 mm^2 or more shielded cable when connecting other **SF4C** series cable to the safety input 1 / 2.
- When extending the cable of other **SF4C** series which is connected to the safety input 1 / 2, use the exclusive cable and the total cable length should be 30 m or less (for each emitter / receiver). If the total cable length is exceeding 30 m, the device may malfunction, resulting in death or serious injury.
- Response time of safety sensor is sum of a response time of this device and safety sensor itself.



Response time of **SF4C-H□**
7 ms

Response time of safety sensor
<Ex.> In case of using **SF4C-H□** as safety sensor.
Response time of safety sensor + response time of this device = 7 ms + 7 ms
= 14 ms

⚠ CAUTION

- When using the device in PNP output (or NPN output), use PNP output (or NPN output) safety sensor. The control output (OSSD 1 / 2) becomes OFF by using wrong output type of sensor.
- Series connection is also available when connecting other **SF4C** series to the safety input 1 / 2. However, this device does not incorporate the interference prevention function. Thus, take sufficient care when installing the devices.
- Use a safety sensor which incorporates a crossover short-circuit function in the control output and connect both the safety input 1 wire (gray) and the safety input 2 wire (gray / black). Take care that if only one wire is connected, the device may not operate normally.
- Use a safety contacting point which incorporates two NC (Normally Closed) contacting points and connect both the safety input 1 wire (gray) and the safety input 2 wire (gray / black). Take care that if only one wire is connected, the device may not operate normally.
- Make sure to connect to +V or 0 V when not using safety input function.

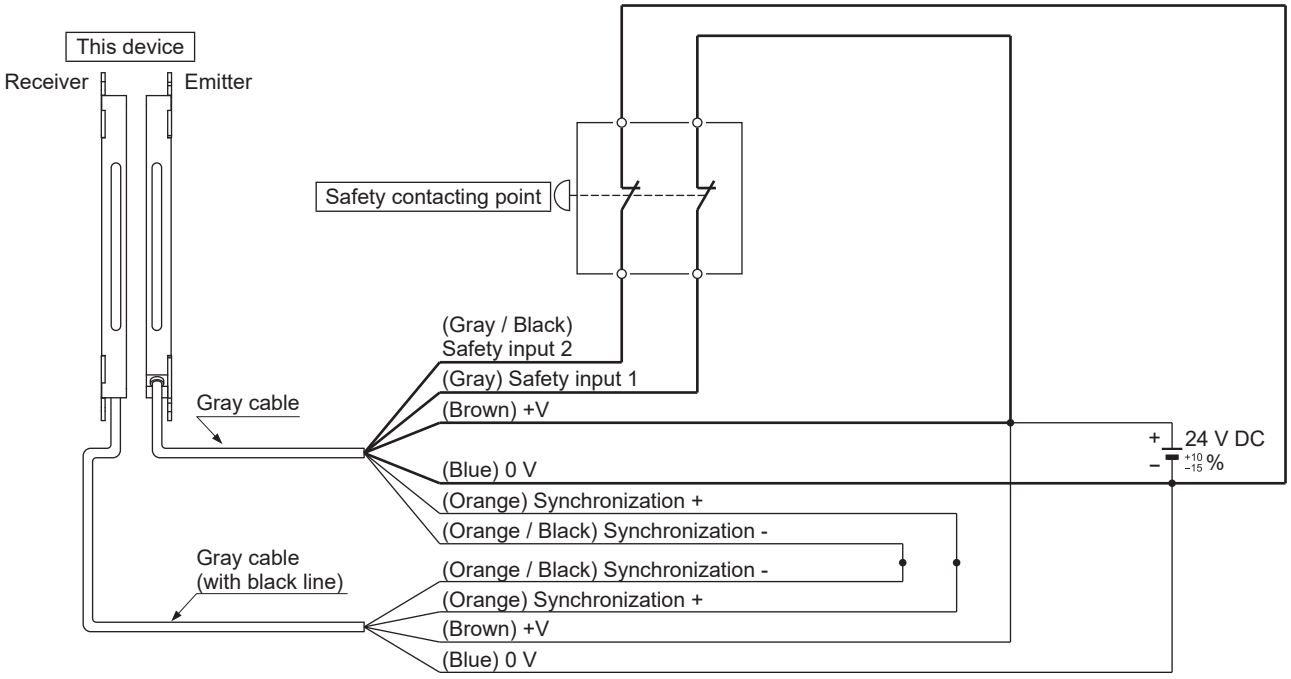
Safety input function	For PNP output		For NPN output	
	Safety input 1 wire (gray)	Safety input 2 wire (gray / black)	Safety input 1 wire (gray)	Safety input 2 wire (gray / black)
Safety contacting point input mode	Connect to +V	Connect to 0 V	Connect to +V	Connect to 0 V
Safety sensor input mode	Connect to +V	Connect to +V	Connect to 0 V	Connect to 0 V

<Reference>

It is possible to change the setting of input mode by using the handy controller **SFC-HC** (optional).

<Wiring example for safety contacting point>

Connect the emitter of this device and the safety contacting point as follows.
In case of using lead wires other than those described below, perform wiring depending on your application.
For details, refer to "**2-5 Wiring**."



- Safety input
  Short-circuit (sink current 5 mA to 10 mA, source current 5 mA to 10 mA): Valid, Open: Invalid

3-5 Large Multi-purpose Indicator Function

The selection of lights up / turns OFF is available by wiring the large multi-purpose indicator input 1 wire (gray) or the large multi-purpose indicator input 2 wire (gray / black).

Large multi-purpose indicator input		Operation of the large multi-purpose indicator
Large multi-purpose indicator input 1 wire (gray)	PNP output: Connect to +V NPN output: Connect to 0 V	Lights up in red
	Open	Turns OFF
Large multi-purpose indicator input 2 wire (gray / black)	PNP output: Connect to +V NPN output: Connect to 0 V	Lights up in green
	Open	Turns OFF

By wiring the large multi-purpose indicator input 1 wire (gray) and the large multi-purpose indicator input 2 wire (gray / black) to the auxiliary output wire (yellow-green / black) or the muting lamp output wire (red), the outputs operate simultaneously with the outputs.

Large multi-purpose indicator input		Operation of the large multi-purpose indicator
Large multi-purpose indicator input 1 wire (gray)	Auxiliary output wire (yellow-green / black)	Lights up in red when the auxiliary output is ON Turns OFF when the auxiliary output is OFF
	Muting lamp output wire (red)	Lights up in red when the muting output is ON Turns OFF when the auxiliary output is OFF
	Open	Turns OFF
Large multi-purpose indicator input 2 wire (gray / black)	Auxiliary output wire (yellow-green / black)	Lights up in green when the auxiliary output is ON Turns OFF when the auxiliary output is OFF
	Muting lamp output wire (red)	Lights up in green when the muting output is ON Turns OFF when the auxiliary output is OFF
	Open	Turns OFF

<Reference>

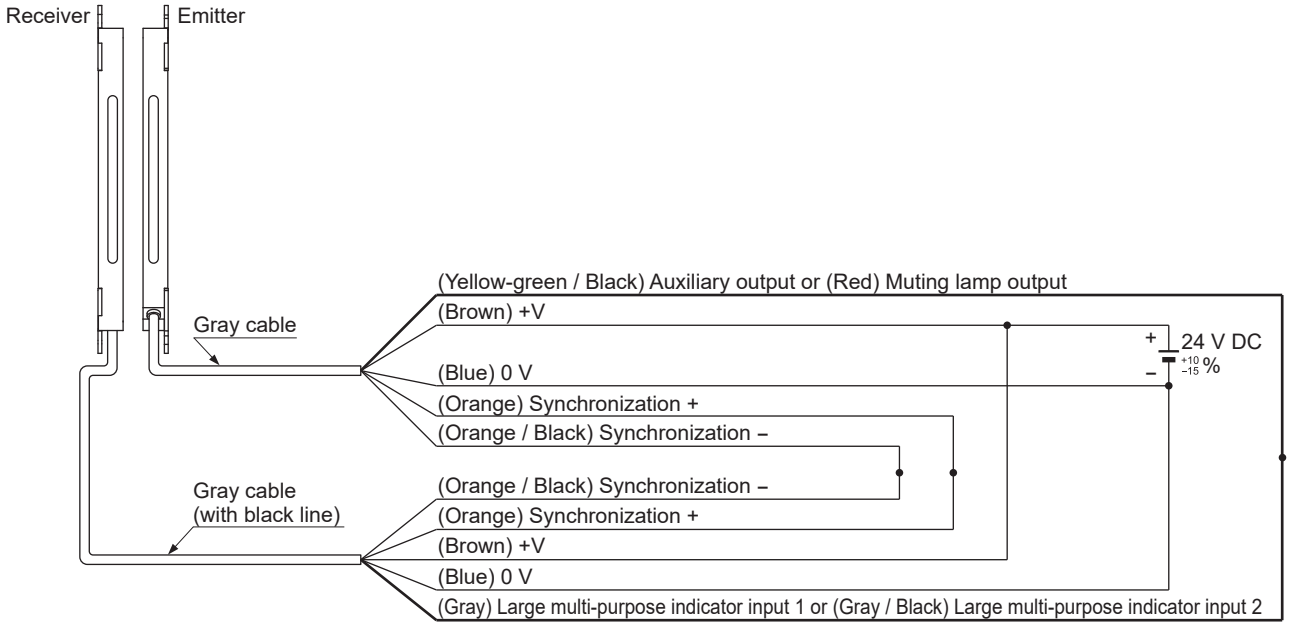
It is possible to change operation of the large multi-purpose indicator (lights up, blinks or turns OFF) by using the handy controller **SFC-HC** (optional).

<Wiring example of the large multi-purpose indicator input 1 / 2 (common to PNP / NPN output)>

Wire the large multi-purpose indicator input 1 wire (gray) or the large multi-purpose indicator input 2 wire (gray / black) as follows.

As for lead wires other than below, perform wiring depending on your application.

For details, refer to "**2-5 Wiring**."

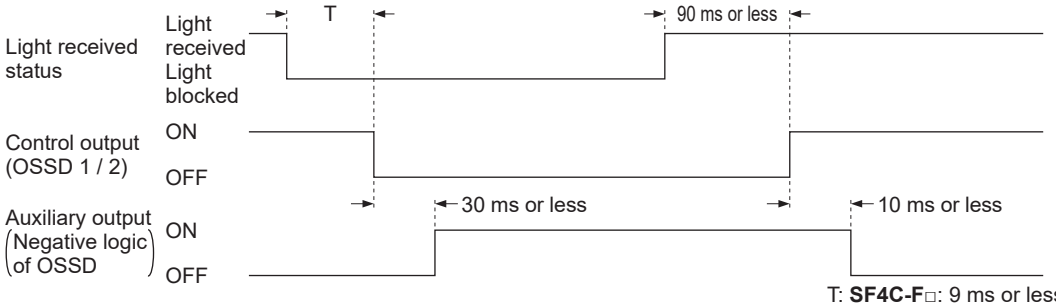


3-6 Auxiliary Output (Non-safety Output)

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

Auxiliary output	Normal mode			Lockout
	Test input valid	Control output (OSSD 1 / 2) status		
		Light received	Light blocked	
Negative logic of the control output (OSSD 1 / 2)	ON	OFF	ON	ON

<Timing chart>



T: **SF4C-F**□: 9 ms or less, **SF4C-H**□: 7 ms or less

⚠ WARNING

Do not use the auxiliary output for the purpose of stopping the machine in which the **SF4C** series is installed. Failure to do so could result in death or serious injury.

<Reference>

It is possible to change auxiliary outputs by using the handy controller **SFC-HC** (optional).

3-7 External Device Monitor Function

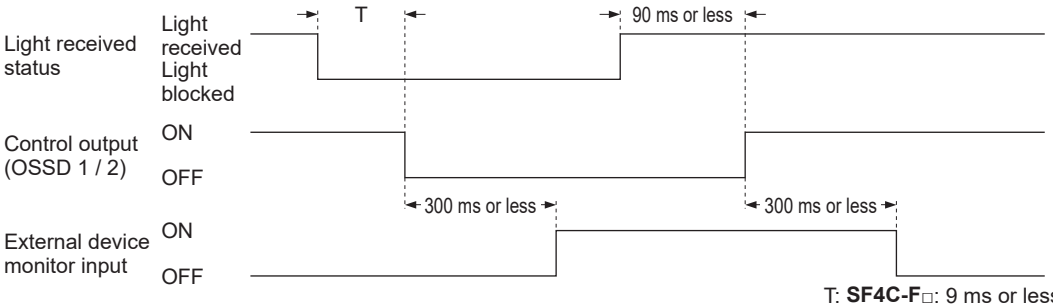
This is the function for checking whether the external safety relay connected to the control output (OSSD 1 / 2) performs normally in accordance with the control output (OSSD 1 / 2) or not. Monitor the contacting point “b” of the external safety relay, and if any abnormality such as deposit of the contacting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

- **When the external device monitor function is set to be valid:**
  Connect the external device monitor input wire (yellow-green) to the external safety relay which is connected to the control output 1 (OSSD 1) wire (black) and the control output 2 (OSSD 2) wire (white).
- **When the external device monitor function is set to be invalid:**
  Connect the external device monitor input wire (yellow-green) to the auxiliary output wire (yellow-green / black). At this time, the auxiliary output is set as “negative logic of the control output (OSSD 1 / 2)” (factory setting). [Set through the handy controller **SFC-HC** (optional)]. The auxiliary output cannot be connected to external devices.

<Reference>

It is also possible to set the external device monitor input into “invalid” by using the handy controller **SFC-HC** (optional).

<Timing chart (normal)>

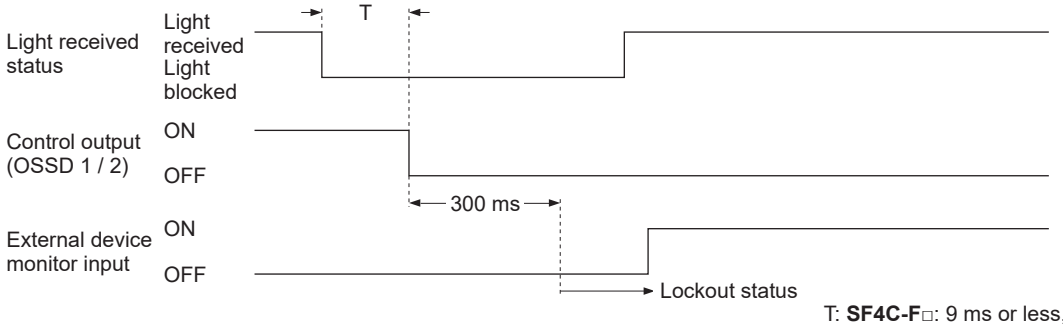


T: **SF4C-F**□: 9 ms or less, **SF4C-H**□: 7 ms or less

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

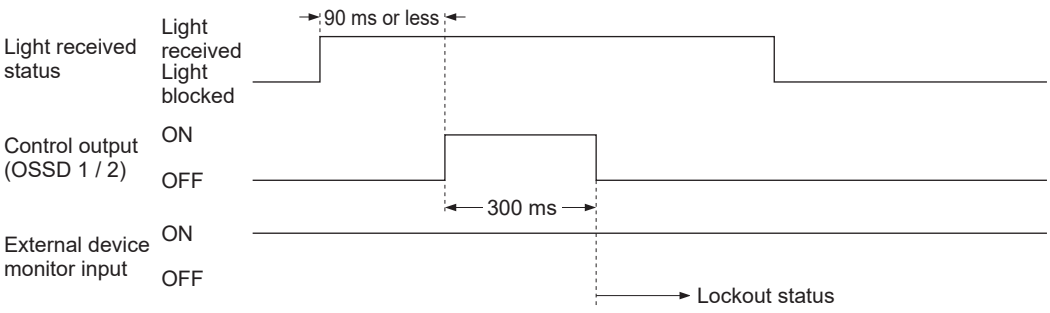
Note: By using handy controller **SFC-HC** (optional), the setting time can be set between 100 ms to 600 ms. (Unit: 10 ms.)

<Timing chart (Error 1)>



T: **SF4C-F**□: 9 ms or less, **SF4C-H**□: 7 ms or less

<Timing chart (Error 2)>



3-8 Muting Function

⚠ WARNING

- Incorrect using of the muting control may cause any accident. Please understand the muting control fully, and use it. As for the muting control, the following international standards define the requirements.
  ISO 13849-1 (EN ISO 13849-1, JIS B 9705-1):
  "Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design, Article 5.2.5 Muting"
  IEC 61496-1 (ANSI / UL 61496, JIS B 9704-1):
  "Safety of machinery - Electro sensitive protective equipment - Part 1: General requirements and tests, Annex A, A.7 Muting"
  IEC 60204-1 (JIS B 9960-1):
  "Safety of machinery - Electrical equipment of machines - Part 1: General requirements, 9.2.4 Overriding safeguards"
  IEC / TS 62046:
  "Safety of machinery - Application of protective equipment to detect the presence of persons"
  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"
- The muting time of **SF4C** is set to "No Limit" as the factory default.
  When using the muting function, be sure to perform risk assessment and change the muting time to an appropriate value.
  Otherwise, there is a risk that the musing sensor error may not be detected, resulting in death or serious injury to the worker.
- 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 sensing object 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 sensing object is passing through the sensor or the sensing object is not passing through it.
- The muting lamp should be installed in a position where it can always be seen by operators who set or adjust the machine.
- Be sure to check the operation of the muting function before its use. Furthermore, check the state of the muting lamp (cleanliness or brightness etc.)

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

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

- The control output (OSSD 1 / 2) shall be ON.
- The safety output 1 / 2 shall be ON.
- Time difference between the time during muting input 1 / 2 becomes ON from OFF (open) and the time during muting input 1 / 2 becomes OFF (open) from ON should be between 0.03 sec. to 3 sec. (Note 1)
- The incandescent lamp with 1.5 W to 6 W shall be connected to the muting lamp output.
  (The muting lamp diagnosis function is invalid at the time of factory setting.) (Note 2)

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

Notes: 1) 0 sec. to 3 sec. is allowable by using the handy controller **SFC-HC** (optional) and connecting NO (Normally Open) type muting sensor to the input 1, as well as connecting NC (Normally Closed) type muting sensor to the input 2.
2) The muting lamp diagnosis function can be set with the handy controller **SFC-HC** (optional).
If the muting lamp diagnosis function is set to be valid and the lamp is not connected or burnt out, the muting function becomes invalid.
3) Although the muting time at the factory setting has no limit, the muting time can be changed in units of 1 sec. in the range of 1 sec. to 600 sec. by the handy controller **SFC-HC** (optional).

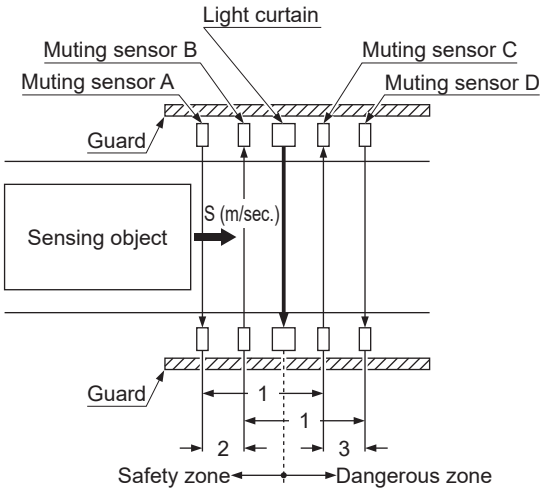
<Output operation of muting sensors>

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

⚠ WARNING

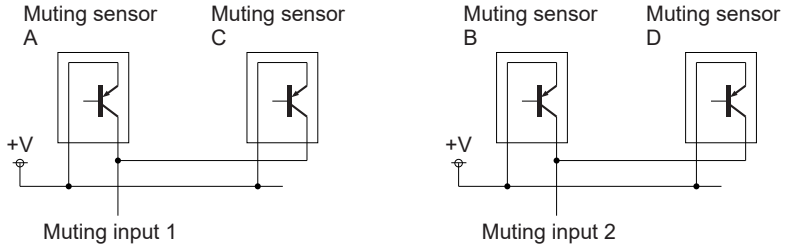
Be sure to use a muting sensor that satisfies the **<Output operation of muting sensors>** above. If the other muting sensor not satisfying the specification above, the muting function might become valid with the timing that the machine designer cannot expect and could result in death or serious injury.

<Installation condition example of muting sensors>

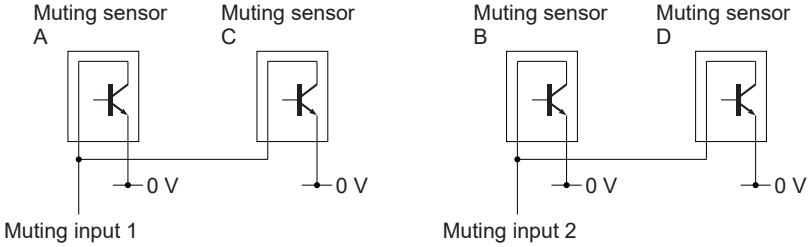


1. Shorten the distances between muting sensors A to C and between B to D than the whole length of the sensing object.
2. The time of the sensing object to be passed through the muting sensors A to B shall be 0.03 sec. to under 3 sec.
   Distance between A and B (m) < S (m/sec.) × 3 (sec.)
   S: The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

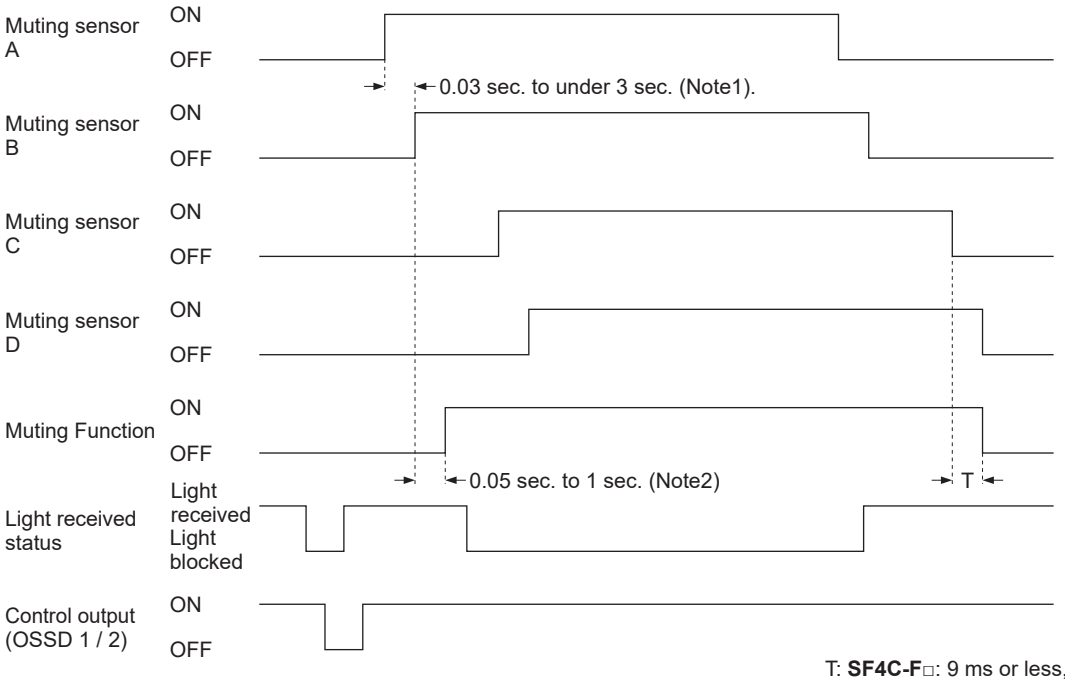
<For PNP output>



<For NPN output>



<Timing chart>



T: **SF4C-F**□: 9 ms or less, **SF4C-H**□: 7 ms or less

Note: 1) If the permissible input time difference between muting sensors A and B is about 0.03 seconds, the input time fluctuates due to the effect of the input device / circuit configuration, and this may disable the use of the muting function.
2) This is when the muting lamp diagnosis function is valid. If the muting lamp does not light up even if 1 sec. is passed, the muting function becomes invalid. When the muting lamp diagnosis function is invalid, the muting function becomes valid within 0.05 sec. the input conditions of the muting sensor A (C) and B (D) were satisfied.

<Reference>

- It is possible to set the muting function into invalid per beam channel respectively and to specify the input order of the muting input 1 and 2 to be set into valid by using the handy controller **SFC-HC** (optional).
- It is recommended that two muting lamps should be connected in parallel. In this case, take care not to exceed total 6W or less.

3-9 Override Function

⚠ WARNING

- Incorrect using of the muting control may cause any accident. Please understand the muting control fully, and use it. As for the muting control, the following international standards define the requirements.
  ISO 13849-1 (EN ISO 13849-1, JIS B 9705-1):
  "Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design, Article 5.2.5 Muting"
  IEC 61496-1 (ANS/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"
  IEC / TS 62046:
  "Safety of machinery - Application of protective equipment to detect the presence of persons"
  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"
- The muting time of **SF4C** is set to "No Limit" as the factory default.
  When using the muting function, be sure to perform risk assessment and change the muting time to an appropriate value.
  Otherwise, there is a risk that the musing sensor error may not be detected, resulting in death or serious injury to the worker.
- 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 sensing object 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 sensing object is passing through the sensor or the sensing object is not passing through it.
- The muting lamp should be installed in a position where it can always be seen by operators who set or adjust the machine.
- Be sure to check the operation of the muting function before its use. Furthermore, check the state of the muting lamp (cleanliness or brightness etc.)

The override function forcibly turns the safety function into invalid. This function is used for the following cases: when the control output (OSSD 1 / 2) is OFF status during using muting function, when the muting sensor is turned ON at the starting of line and when starting the machine is desired.

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

- The safety output 1 / 2 shall be ON.
- The signal shall be input to either muting input 1 or 2, or to both of the inputs.
- The override input shall be connected to +V (0 V when using NPN output), and the test input / reset input shall be opened (3 sec. continuously).
- The incandescent lamp with 1.5 W to 6 W shall be connected to the muting lamp output.
  (The muting lamp diagnosis function is invalid at the time of factory setting.) (Note 1)

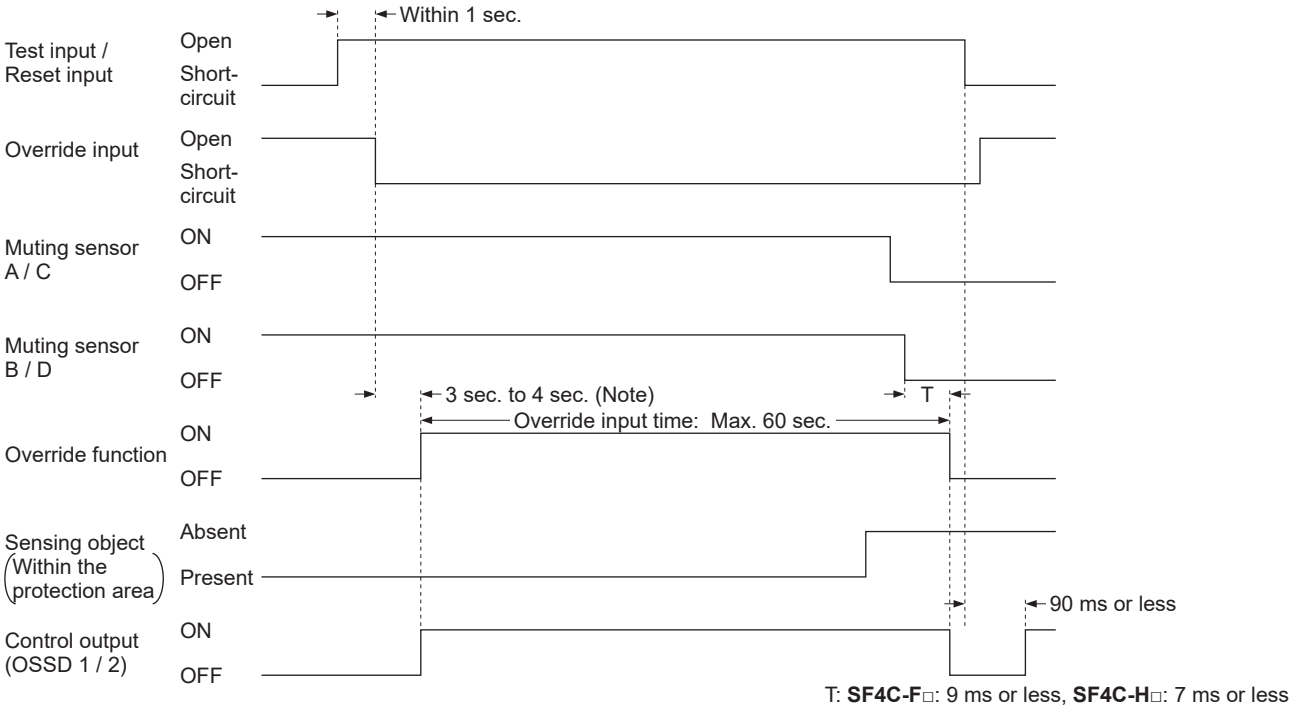
If one of the four conditions above becomes invalid or timing exceeds 60 sec. (Note 2), the override function becomes invalid.

Notes: 1) The muting lamp diagnosis function can be set with the handy controller **SFC-HC** (optional).
If the muting lamp diagnosis function is set to be invalid, the override function is maintained even if a lamp blows or a lamp is not connected.
2) By using the handy controller **SFC-HC** (optional), the timing can be changed in units of 1 sec. in the range of 1 sec. to 600 sec.
3) The override function operates only when the auto reset is ON (the interlock is invalid).

⚠ WARNING

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

<Timing chart>



T: **SF4C-F**□: 9 ms or less, **SF4C-H**□: 7 ms or less

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

3-10 Functions Using Handy Controller SFC-HC (Optional)

This device enables to set each function using the handy controller **SFC-HC** (optional).
When using this product together with **SFC-HC**, there are limitations on the product versions.
For details, refer to “How to check the product version” under “2-2 Part Description”.

⚠ WARNING

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

- **Fixed blanking function**
  This function enables to protect the control output (OSSD 1 / 2) from turning into OFF even though the specific beam channel is blocked.
  The factory setting is set to be invalid for the fixed blanking function.

- **Floating blanking function**
  This function enables to protect the control output (OSSD 1 / 2) from turning into OFF when the number of the blocked beam channels are smaller than the set beam channels. 1, 2 or 3 beam channels are possible to set as the blocking beam channels.
  The factory setting is set to be invalid for the floating blanking function.

Both fixed blanking function and floating blanking function are possible to set simultaneously.

- **Auxiliary output switching function (non-safety output)**
  The following outputs are switchable as the auxiliary output.
  0. Negative logic of the control output (OSSD 1 / 2) (factory setting)
  1. Positive logic of the control output (OSSD 1 / 2)
  2. For test input valid: output OFF, For test input invalid: output ON
  3. For test input valid: output ON, For test input invalid: output OFF
  4. For unstable incident light: OFF (Note 1)
  5. For unstable incident light: ON (Note 1)
  6. For muting: ON
  7. For muting: OFF
  8. For light reception: ON, For light blocked: OFF (Note 2)
  9. For light reception: OFF, For light blocked: ON (Note 2)
  10. For safety input valid: ON
  11. For safety input valid: OFF
  12. For lock out: OFF
  13. For lock out: ON

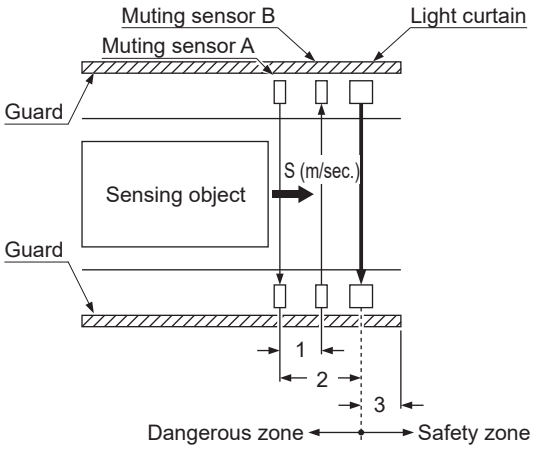
Notes: 1) The output cannot be used while the fix blanking function, floating blanking function or the muting function is activated.
2) This device outputs the light received / blocked state under activating the auxiliary output switching function using the handy controller irrespective of activating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

- **Muting setting changing function**
  The setting of the muting function is changeable with the handy controller **SFC-HC** (optional).
  1. Each beam channel can be set to “valid / invalid” in the muting function respectively. (Note)
     The muting function is valid at the time of factory setting.
  2. Maximum continuous effective time set at the muting function can be changed.
     The maximum continuous effective time can be set in the range of 1 sec. to 600 sec. (in units of 1 sec.) or no limits.
     The factory setting is not limit.

3. Muting function only for the sensing object exit can be set.
   When setting to the muting function only for the sensing object exit, install the muting sensor only in the dangerous zone and the installation in the safety zone is not required.
   Using conditions of the muting function only for the sensing object exit is as follows.
   - The sensing object should move to one side.
     (The sensing object should move from the dangerous zone to the safety zone.)
   - The sensing object should pass through the sensing area within 4 sec. after the muting sensor turns OFF. (Note)

Notes: 1) the time setting can be done from 0 sec. to 4 sec. (unit: 100 ms) by handy controller **SFC-HC** (optional)

<Installation condition example of muting sensors with setting of only for the sensing object exit in the muting function >



1. The time of the sensing object to be passed through the muting sensors A to B shall be 0.03 sec. to under 3 sec.
   Distance between A and B (m) < S (m/sec.) × 3 (sec.)
   S: The moving speed (m/sec.) of the sensing object
2. The time of the sensing object to be passed through the muting sensor A to the light curtain shall be under 4 sec.
   Distance between muting sensor A and the light curtain (m) < S (m/sec.) × 4 (sec.)
   Distance between muting sensor A and the light curtain (m) < Total length of the sensing object (m)
   S: The moving speed (m/sec.) of the sensing object
3. The time of the sensing object to be passed through the light curtain to the end of guard zone shall be under 4 sec.
   Distance between the light curtain and the end of guard zone (m) < S (m/sec.) × 4 (sec.) - 0.2
   S: The moving speed (m/sec.) of the sensing object

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

⚠ CAUTION

In case using the muting function only for the sensing object exit and the floating blanking function in same time, be sure listed below for setting of **SFC-HC** (optional). For the setting method, refer an instruction manual attached on the handy controller.

- Setting number of beam channel for the floating blanking function is 0 or 1 beam channel only.
- In case of making the invalid setting of both end beam channel in the floating blanking function valid, be sure to set the muting function of both end beam channel in each beam channel setting in muting function to valid.

<Reference>

Number of the muting sensor for the muting function and the muting function only for the sensing object exit are different as follows

- 4 sets for the muting function
- 2 sets for the muting function only for the sensing object exit

4. The order for inputting the muting input 1 and 2 can be set and make the muting function valid by the order for inputting the muting input. At factory setting, the muting function is set to be valid whichever comes first to input.

5. Setting of output operation of the muting sensor connected to muting input of this device can be done. (Note 1)

Notes: 1) Only version 2.1 or version 3.0 of this device is possible to set.

- **NONO (Normally open · Normally open)**
  This is factory setting.
- **NONC (Normally open · Normally closed)**
  Wire the muting input 1 to a sensor or a switch whose output operation is NO (normally open) type and wire the muting input 2 to a sensor or a switch whose output operation is NC (normally close) type.
  The condition which makes the muting function valid is that the temporal difference between the time from OFF (open) to ON of muting input 1 and the time from ON to OFF (open) of muting input 2 should be from 0 sec. to 3 sec.

<Output operation of muting sensor (NONC setting)>

	Muting input	Operation at ON state	Operation at OFF state
NO (Normally open) type ON with light non-received status (photoelectric sensor, etc.) ON with object approaching status (inductive proximity sensor, etc.) ON with object contacted status (position switch, etc.)	1	0 V or +V	Open
NC (Normally closed) type ON with light received status (photoelectric sensor, etc.) ON with object non-approaching status (inductive proximity sensor, etc.) ON with object non-contacted status (position switch, etc.)	2		

Notes: 2) If there is difference between muting sensor connected to muting input of this device and output operation set by handy controller, the muting function will be invalid.

- **Override setting changing function**
  Maximum continuous effective time set at the override function can be changed.
  The maximum continuous effective time can be set in the range of 1 to 600 sec. (in units of 1 sec.)

- **Muting lamp diagnosis function**
  Either valid or invalid of the muting lamp diagnosis function can be select. (Note)
  In case using the muting lamp diagnosis function as valid, incandescent lamp is recommended as muting lamp so that easily confirm that the Incandescent lamp is broken or not.
  The muting lamp diagnosis function is valid at the time of factory setting.

Note: If the muting lamp diagnosis function is set to be invalid, the muting function is maintained even if a lamp blows or a lamp is not connected.

Safety input setting changing function

This function enables to select the safety contacting point input mode or the safety sensor input mode with handy controller **SFC-HC** (optional). (Note 1)

Notes: 1) Only version 2.1 or version 3.0 of this device is possible to set.

- **Safety contacting point input mode**
  A safety contacting point can be connected. It is at the time of factory setting.
  For wiring, refer to "**2-5 Wiring**" or "**3-4 Safety Input Function**."
- **Safety sensor input mode**
  A safety sensor can be connected.

<Output operations of a safety contacting point and a safety sensor>

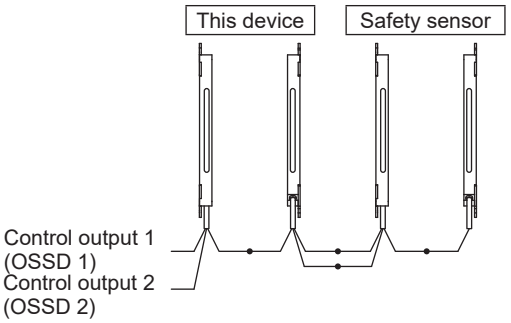
	NC (Normally Closed) type	Operation at ON state	Operation at OFF state
Safety contacting point	ON with object non-contacted status (Emergency stop switch, etc.)	PNP output: Connect to +V NPN output: Connect to 0 V	Open
Safety sensor	ON with light received status (Light curtain, etc.) ON with object non-approaching status (Safety switch, etc.)		

Note: The control output (OSSD 1 / 2) of the device will be OFF if the input mode of the safety switch or the safety contacting point which is connected to the safety input 1 / 2 of the device differs from the one which is set with the handy controller **SFC-HC** (optional).

- **Invalid**
  Safety input function can be set to invalid. In this case, safety contacting point and safety sensor can not be connected.

⚠ WARNING

- Use 0.2 mm^2 or more shielded cable when connecting other **SF4C** series cable to the safety input 1 / 2.
- When extending the cable of other **SF4C** series which is connected to the safety input 1 / 2, use the exclusive cable and the total cable length should be 30 m or less (for each emitter / receiver). If the total cable length is exceeding 30 m, the device may malfunction, resulting in death or serious injury.
- Response time of safety sensor is sum of a response time of this device and safety sensor itself.



Response time of **SF4C-H□**

7 ms

Response time of safety sensor

<Ex.> In case of using **SF4C-H□** as safety sensor.
Response time of safety sensor + response time of this device = 7 ms + 7 ms
= 14 ms

⚠ CAUTION

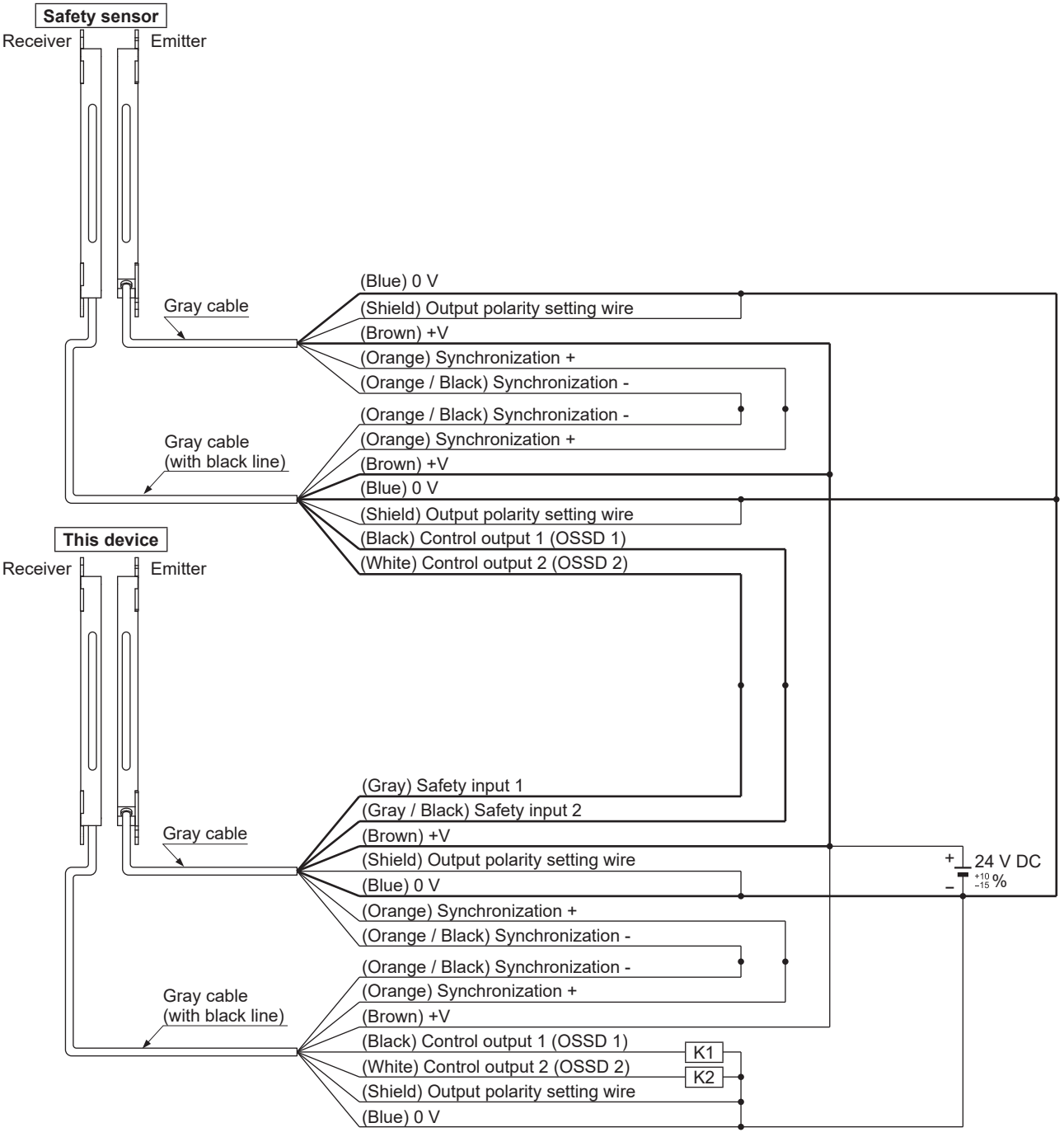
- When using the device in PNP output (or NPN output), use PNP output (or NPN output) safety sensor. The control output (OSSD 1 / 2) becomes OFF by using wrong output type of sensor.
- Series connection is also available when connecting other **SF4C** series to the safety input 1 / 2. However, this device does not incorporate the interference prevention function. Thus, take sufficient care when installing the devices.
- Use a safety sensor which incorporates a crossover short-circuit function in the control output and connect both the safety input 1 wire (gray) and the safety input 2 wire (gray / black). Take care that if only one wire is connected, the device may not operate normally.
- Use a safety contacting point which incorporates two NC (Normally Closed) contacting points and connect both the safety input 1 wire (gray) and the safety input 2 wire (gray / black). Take care that if only one wire is connected, the device may not operate normally.
- In case setting the safety contacting point input mode or the safety sensor input mode, connect to +V or 0 V as a following table when safety input function is not used.

Safety input function	For PNP output		For NPN output	
	Safety input 1 wire (gray)	Safety input 2 wire (gray / black)	Safety input 1 wire (gray)	Safety input 2 wire (gray / black)
Safety contacting point input mode	Connect to +V	Connect to 0 V	Connect to +V	Connect to 0 V
Safety sensor input mode	Connect to +V	Connect to +V	Connect to 0 V	Connect to 0 V

<Wiring example for PNP output>

When using this device with PNP output, connect a PNP output type safety sensor.
Connect the emitter of this device and the receiver of the safety sensor as follows.
In case of using lead wires other than those described below, perform wiring depending on your application.
For details, refer to "**2-5 Wiring**."

Emitter of the device	Receiver of the safety sensor
Safety input 1 wire (gray)	Control output 1 (OSSD 1) wire (black) [or control output 2 (OSSD 2) wire (white)]
Safety input 2 wire (gray / black)	Control output 2 (OSSD 2) wire (white) [or control output 1 (OSSD 1) wire (black)]
+V wire (brown)	+V wire (brown)
0 V wire (blue)	0 V wire (blue)

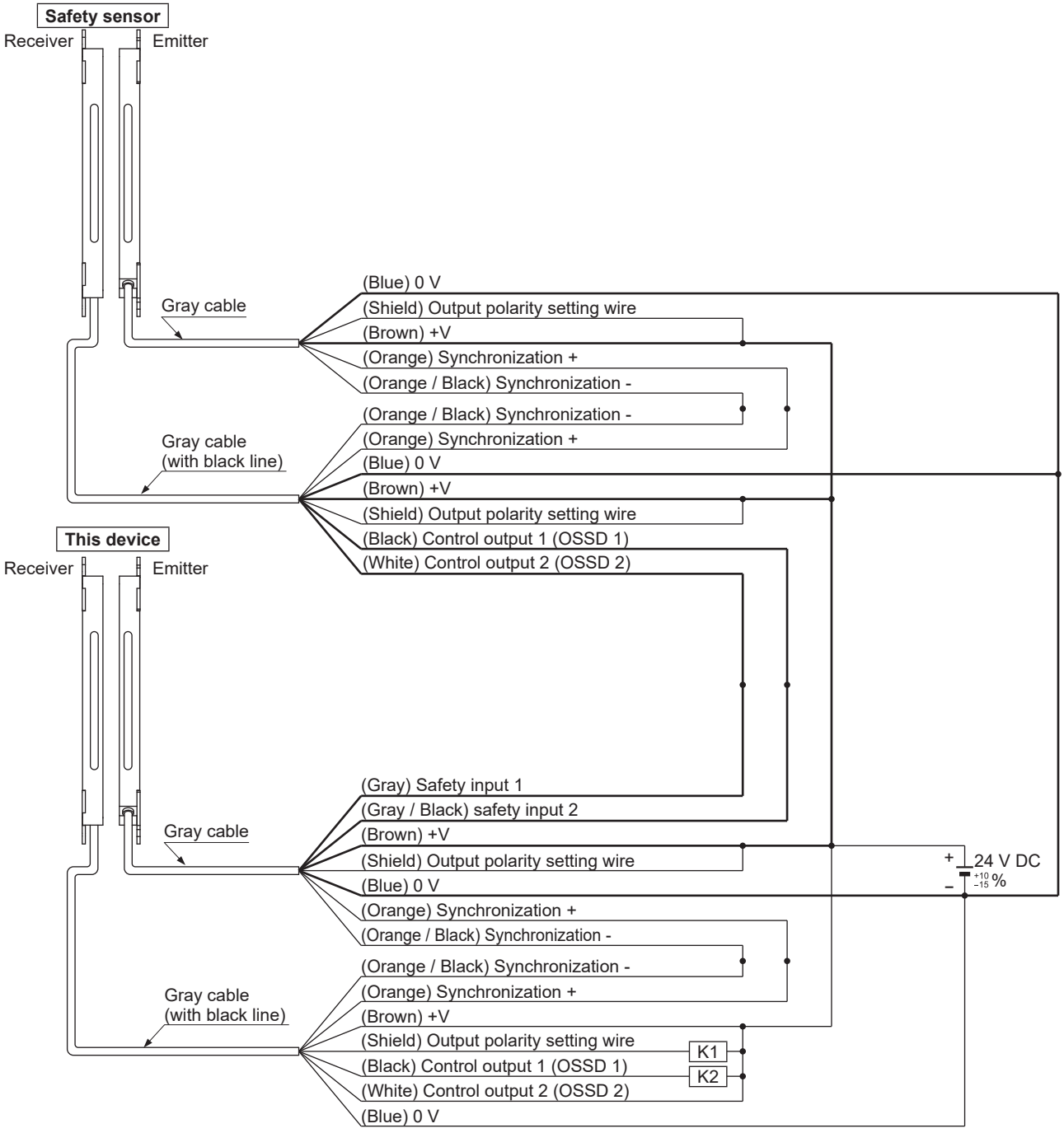


● Safety input
Short-circuit (sink current 5 mA to 10 mA): Valid, Open: Invalid

<Wiring example for NPN output>

When using this device with NPN output, connect a NPN output type safety sensor.
Connect the emitter of this device and the receiver of the safety sensor as follows.
In case of using lead wires other than those described below, perform wiring depending on your application.
For details, refer to "**2-5 Wiring**."

Emitter of the device	Receiver of the safety sensor
Safety input 1 wire (gray)	Control output 1 (OSSD 1) wire (black) [or control output 2 (OSSD 2) wire (white)]
Safety input 2 wire (gray / black)	Control output 2 (OSSD 2) wire (white) [or control output 1 (OSSD 1) wire (black)]
+V wire (brown)	+V wire (brown)
0 V wire (blue)	0 V wire (blue)



- Safety input
  Short-circuit (source current 5 mA to 10 mA): Valid, Open: Invalid

- **Large multi-purpose indicator setting changing function**
  One mode can be selected from the following eight modes with the handy controller **SFC-HC** (optional). Factory setting is mode 0.

Mode	Operation of Large multi-purpose indicator							
	Large multi-purpose indicate input 1 / 2				Control output 1 / 2 (OSSD 1 / 2)		Muting function	Override function
	PNP output: High	NPN output: Low	PNP output: Low	NPN output: High	ON	OFF	Valid	Valid
0	Lights up in red		Lights up in green		–	–	–	–
1	Blinks in red		Blinks in green		–	–	–	–
2	Lights up in red		Blinks up- in green		–	–	–	–
3	Blinks in red		Lights up in green		–	–	–	–
4 (Note 1)	Lights up in red		Blinks in red		–	–	–	–
5 (Note 1)	Blinks in green		Lights up in green		–	–	–	–
6 (Note 1)	–		–		Lights up in green	Lights up in red	Blinks in green	–
7 (Note 1)	Lights up in red		Blinks in red		–	–	Lights up in green	Blinks in green

Notes: 1) Blinking takes precedence in case of same color brinks or light up in the large multi-purpose indicator.
2) The large multi-purpose indicator (red) and the large multi-purpose indicator (green) can be lit up and blinked in same time.

Furthermore, large multi-purpose indicator (red) can be blinked in lockout status.

Lockout blinking display function	Lockout ON
Valid	Blinks in red
Invalid	–

- **Interlock setting changing function**
  It is selectable one interlock state among the following three interlock settings with handy controller **SFC-HC** (optional).
  - **Start / Restart interlock**
    The device goes into the interlock state after the power is turned ON, or when the light is blocked.
    The factory setting is start / restart interlock.
  - **Start interlock**
    The device goes into the interlock state when the power supply is turned ON. Once this interlock is reset, the device does not go into the interlock state.
  - **Restart interlock**
    The device does not go into the interlock state when turning ON the power supply. Only when the control output (OSSD 1 / 2) becomes ON and the light is blocked after the power is turned ON and this device receives the light, the device goes into the interlock state.

- **External device monitor setting changing function**
  The setting of the external device monitor is changeable with the handy controller **SFC-HC** (optional).
  1. Allowable time for response time: 100 ms to 600 ms (Unit: 10 ms)
     Factory setting is 300 ms.
  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.

- **Protective function**
  The functional setting is not allowed to change without input of password.
  The factory setting is set to be invalid for the protective function.

Chapter 4 Maintenance

<Reference>

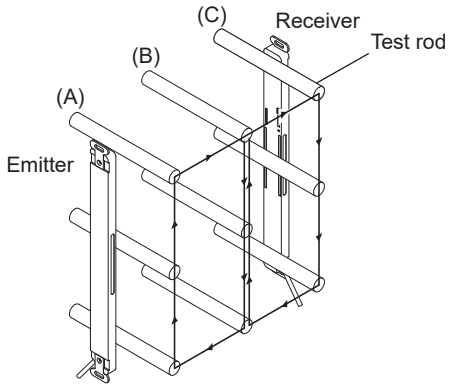
When any errors are found, refer to "**Chapter 5 Troubleshooting**" and report the symptoms to the maintenance in charge.
If the rectification method is not clear, please contact our office.
Please make a copy of this checklist, check each inspection item in the respective square, and file the list for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

4-1 Daily Inspection

⚠ WARNING

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

Check list (Daily inspection)

Check column	Inspection item
□	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 front (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 / 2) is in ON status. At this time, the effect of external noise can be inspected. In case external noise affects the operation, remove its cause and reinspect.
□	The test rod (**SF4C-F**□: ø14 mm, **SF4C-H**□: ø25 mm) moving 1,600 mm/sec. or less 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) of the receiver and the operation indicator (red) of the emitter continue to light up as long as the test rod is present in the sensing area from (A) to (C). 
□	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 (**SF4C-F**□: ø14 mm, **SF4C-H**□: ø25 mm) 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 / 2) must turn OFF when the test input / reset input wire (pink) is open (for manual reset: connected to 0 V or +V). At this time, the effect of external noise can be inspected. In case external noise affects the operation, remove its cause and reinspect.
□	Be sure to check the operation of the muting function before its use. Furthermore, check the state of the muting lamp (cleanliness or brightness etc.)

4-2 Periodic Inspection (Every Six Months)

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

Check list (Periodic inspection)

Check column	Inspection item
□	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.

4-3 Inspection after Maintenance

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

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

Chapter 5 Troubleshooting

<Reference>

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

5-1 Troubleshooting of Emitter

<All indicators are OFF>

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

<Fault indicator (yellow) lights up or blinks>

Cause		Remedy
[Error indicator (yellow) lights up.] Setting data error of this device	Noise is out of the specified range.	Check the noise status around this device. If the handy controller **SFC-HC** (optional) is used, reset the function.
	Internal error	Contact our office.
[Digital error indicator: 1 In case of **SF4C-H8**□ or **SF4C-F15**□, Error indicator (yellow) blinks 1 time.] Number of beam channel error	Internal error	Contact our office.
[Digital error indicator: 3 In case of **SF4C-H8**□ or **SF4C-F15**□, Error indicator (yellow) blinks 3 times.] System error between emitter and receiver	Systems are different between emitter and receiver.	Set the same value to the number of beam channels of emitter and receiver and the output polarity setting wire (shield).
[Digital error indicator: 4 In case of **SF4C-H8**□ or **SF4C-F15**□, Error indicator (yellow) blinks 4 times.] Interlock setting error	Voltage level of interlock setting input wire (pale purple) or test input / reset input wire (pink) is unstable.	Wire the interlock setting input wire (pale purple) and test input / reset input wire (pink) correctly. Refer to "**2-5 Wiring**."
[Digital error indicator: 5 In case of **SF4C-H8**□ or **SF4C-F15**□, Error indicator (yellow) blinks 5 times.] Safety input crossover short-circuit	Safety input 1 wire (gray) or safety input 2 wire (gray / black) is short-circuited.	Wire the safety input 1 wire (gray) or safety input 2 wire (gray / black) correctly. Make sure there is no damage of safety contacting point or safety sensor.
[Digital error indicator: 6 In case of **SF4C-H8**□ or **SF4C-F15**□, Error indicator (yellow) blinks 6 times.] Wiring error of the output polarity setting wire (shield)	Output polarity setting wire (shield) comes down or short-circuits with other I/O wires. Output polarity setting wire (shield) connection of emitter / receiver is incorrect.	Wire the output polarity setting wire (shield) correctly. (0 V: PNP output, +V: NPN output) Wire the output polarity setting wire (shield) of the receiver correctly.
[Digital error indicator: 7 In case of **SF4C-H8**□ or **SF4C-F15**□, Error indicator (yellow) blinks 7 times.] Safety input error	Safety input 1 wire (gray) or safety input 2 wire (gray / black) is not correctly wired.	Wire the safety input 1 wire (gray) and the safety input 2 wire (gray / black) correctly. Refer to "**2-5 Wiring**" or "**3-4 Safety Input Function**."
	Temporal difference of output operation of safety input 1 / 2 is more than 1 sec. Safety input 1 indicator (orange) or safety input 2 indicator (orange) blinks.	Make temporal difference between output operation of safety input 1 and 2 less than 1 sec.
[Digital error indicator: 8 In case of **SF4C-H8**□ or **SF4C-F15**□, Error indicator (yellow) blinks 8 times.] Supply voltage error	Specified voltage is not being supplied.	Check the wiring status, supply voltage, and power supply capacity.
[Digital error indicator: 9 In case of **SF4C-H8**□ or **SF4C-F15**□, Error indicator (yellow) blinks 9 times.] Muting lamp error	Muting lamp output wire (red) short-circuits with 0 V or +V.	Wire the muting lamp output wire (red) correctly. Refer to "**2-5 Wiring**." Current value should be within the specified muting lamp output.
	Muting lamp output short-circuits with other I/O wires.	
	Excessive incoming current flows in the muting lamp output.	
	Output polarity setting wire (shield) and muting lamp output wire (red) are not correctly wired.	Wire the output polarity setting wire (shield) correctly. (0 V: PNP output, +V: NPN output) Wire the muting lamp output wire (red) to +V. Refer to "**2-5 Wiring**."
	Output circuit error.	Output circuit is damaged. Replace this device.

Cause		Remedy
[Digital error indicator: ۴ In case of **SF4C-H8**□ or **SF4C-F15**□, Error indicator (yellow) blinks more than 10 times.] Effect from noise or failure of internal circuit	Affected by noise. Internal circuit is broken down.	Check the noise status around this device. When the synchronization + wire (orange) and synchronization - wire (orange / black) is extended with a cable other than exclusive cable, use a 0.2 mm^2 or more shielded twisted pair cable. If this device still does not work, confirm number of blinks of the error indicator and call to our local office.
[Digital error indicator: ۳ In case of **SF4C-H8**□ or **SF4C-F15**□, Error indicator (yellow) blinks 31 times.] Receiver error	Receiver is in lockout state.	Check an digital error indicator (red) of receiver.

<Digital error indicator " ٤ " lights up (excluding SF4C-H8□ and SF4C-F15□)>

Cause	Remedy
Synchronization + wire (orange) or synchronization – wire (orange / black) error. Synchronization + wire (orange) or synchronization – wire (orange / black) is short-circuited or disconnected.	Connect the synchronization + wire (orange) and synchronization – wire (orange / black) properly. Refer to "**2-5 Wiring**."
Receiver error.	Check the operation of the receiver side.

<Test input indicator (orange) lights up>

Cause		Remedy
The device is in the test input condition. (Device error or interlock setting error)	Error indicator (yellow) lights up or blinks.	Check the error contents of the digital error indicator.
	Test input / reset input wire (pink) is open when selecting auto reset.	Wire the test input / reset input wire (pink) to 0 V or +V. Refer to "**2-5 Wiring**."
	Test input / reset input wire (pink) is connected to 0 V or +V when selecting manual reset.	Open the test input / reset input wire (pink). Refer to "**2-5 Wiring**."

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

Cause	Remedy
The beam channel with its fixed blanking function set into valid receives light.	Turn ON the power supply after checking the installation status.
The safety input 1 wire (gray) and the safety input 2 wire (gray / black) is not wired.	Wire the safety input 1 wire (gray) and the safety input 2 wire (gray / black) correctly.

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

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

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

<Reference>

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

5-2 Troubleshooting of Receiver

<All indicators are OFF>

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

<Fault indicator (yellow) lights up or blinks>

Cause			Remedy
[Error indicator (yellow) lights up.] Setting data error of this device	Noise is out of the specified range.		Check the noise status around this device. If the handy controller **SFC-HC** (optional) is used, reset the function.
	Internal error		Contact our office.
[Digital error indicator: 1 In case of **SF4C-H8**□ or **SF4C-F15**□, Error indicator (yellow) blinks 1 time.] Number of beam channel error	Internal error		Contact our office.
[Digital error indicator: 3 In case of **SF4C-H8**□ or **SF4C-F15**□, Error indicator (yellow) blinks 3 times.] System error between emitter and receiver	Systems are different between emitter and receiver.		Set the same value to the number of beam channels of emitter and receiver and the output polarity setting wire (shield).
[Digital error indicator: 4 In case of **SF4C-H8**□ or **SF4C-F15**□, Error indicator (yellow) blinks 4 times.] Extraneous light error	Extraneous light is entering or light from other model is entering.		When the power is ON, prevent any extraneous light from entering the receiver. If the extraneous light is coming from other model, conduct "**2-3-4 Device Placement**."
[Digital error indicator: 5, 9 In case of **SF4C-H8**□ or **SF4C-F15**□, Error indicator (yellow) blinks 5 or 9 times.] Control output (OSSD 1 / 2) data error	Control output 1 (OSSD 1) wire (black) or control output 2 (OSSD 2) wire (white) is short-circuited.		Wire the control output 1 (OSSD 1) wire (black) and the control output 2 (OSSD 2) wire (white) correctly. Refer to "**2-5 Wiring**." Current value should be within the specified the control output 1 (OSSD 1) wire (black) and the control output 2 (OSSD 2) wire (white). Refer to "**6-1 Specification**."
	Control output 1 (OSSD 1) wire (black) or control output 2 (OSSD 2) wire (white) is wired or is wired with other I/O wires.		
	Excessive incoming current flows in control output 1 (OSSD 1) wire (black) or control output 2 (OSSD 2) wire (white).		
	Output polarity setting wire (shield), control output 1 (OSSD 1) wire (black) or control output 2 (OSSD 2) wire (white) is not correctly wired.		Wire the output polarity setting wire (shield) correctly. (0 V: PNP output, +V: NPN output) Wire the control output 1 (OSSD 1) wire (black) and the control output 2 (OSSD 2) wire (white) correctly. (0 V: PNP output, +V: NPN output) Refer to "**2-5 Wiring**."
	Output circuit error		Output circuit is damaged. Replace this device.
[Digital error indicator: 6 In case of **SF4C-H8**□ or **SF4C-F15**□, Error indicator (yellow) blinks 6 times.] Wiring error of the output polarity setting wire (shield)	Output polarity setting wire (shield) comes down or short-circuits with other I/O wires. Output polarity setting wire (shield) connection of emitter / receiver is incorrect.		Wire the output polarity setting wire (shield) correctly. (0 V: PNP output, +V: NPN output) Wire the output polarity setting wire (shield) of the receiver correctly.
[Digital error indicator: 7 In case of **SF4C-H8**□ or **SF4C-F15**□, Error indicator (yellow) blinks 7 times.] External device error	When using safety relay.	Relay contact is welded.	Replace the relay.
		Response time of the relay is slow.	Replace the relay with proper response time. Setting by the handy controller **SFC-HC** (optional) is also possible. Refer to "**3-6 External Device Monitor Function**."
		Contacting point "b" of the relay is not wired.	Wire correctly to the relay.
	When setting the external device monitor function to "invalid."	Auxiliary output wire (yellow-green / black) and external device monitor input wire (yellow-green) are not wired.	Connect the auxiliary output wire (yellow-green / black) and the external device monitor input wire (yellow-green). Set the external device monitor function to "invalid" by using the handy controller **SFC-HC** (optional).
		Auxiliary output is not correctly operated.	Check if the auxiliary output wire (yellow-green / black) is disconnected or short-circuited. Reset to factory default (mode 0) by using the handy controller **SFC-HC** (optional).

Cause		Remedy
Digital error indicator: 8 In case of **SF4C-H8**□ or **SF4C-F15**□, Error indicator (yellow) blinks 8 times. Supply voltage error	Specified voltage is not being supplied.	Check the wiring status, supply voltage and power supply capacity.
Digital error indicator: E In case of **SF4C-H8**□ or **SF4C-F15**□, Error indicator (yellow) blinks 31 times. Emitter error	Emitter is in lockout state.	Check a digital error indicator (red) of emitter.
Digital error indicator: F In case of **SF4C-H8**□ or **SF4C-F15**□, Error indicator (yellow) blinks more than 10 times. Effect from noise or failure of internal circuit	Affected by noise. Internal circuit is broken down.	Check the noise status around this device. When the synchronization + wire (orange) and synchronization - wire (orange / black) is extended with a cable other than exclusive cable, use a 0.2 mm^2 or more shielded twisted pair cable. If this device still does not work, confirm number of blinks of the error indicator and call to our local office.

<Digital error indicator " c " lights up (excluding SF4C-H8□ and SF4C-F15□)>

Cause	Remedy
Synchronization + wire (orange) or synchronization – wire (orange / black) error. Synchronization + wire (orange) or synchronization – wire (orange / black) is short-circuited or disconnected.	Connect the synchronization + wire (orange) and synchronization – wire (orange / black) properly. Refer to "**2-5 Wiring**."
Emitter error.	Check the operation of the emitter side.

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

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

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

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

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

<Reference>

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

Chapter 6 Specifications / Dimensions

6-1 Specifications

Model No.

SF4C - □ □□ - □

<Cable specifications>
No mark: Cable type, With suffix "**J05**": Pigtailed type

<Number of beam channels>

<Beam pitch>
F : Beam pitch 10 mm
H : Beam pitch 20 mm

Example: **SF4C-H32-J05**
Number of beam channels: 32 channels
Cable specifications: Pigtailed connector type

Model-wise specifications
<Cable type>

Type		10 mm pitch type			
Model No.		**SF4C-F15**	**SF4C-F23**	**SF4C-F31**	**SF4C-F39**
Number of beam channels		15	23	31	39
Sensing height (Protective height)		160 mm	240 mm	320 mm	400 mm
Current consumption	Large multi-purpose indicator OFF	Emitter: 70 mA or less Receiver: 80 mA or less	Emitter: 75 mA or less, Receiver: 85 mA or less		Emitter: 80 mA or less Receiver: 90 mA or less
	Large multi-purpose indicator ON	Emitter: 105 mA or less Receiver: 110 mA or less	Emitter: 110 mA or less, Receiver: 115 mA or less		Emitter: 115 mA or less Receiver: 120 mA or less
PFH		1.21×10^{-9}	1.65×10^{-9}	2.09×10^{-9}	2.54×10^{-9}
$MTTF_D$		345	305	273	246
Weight (total of emitter and receiver)		Approx. 600 g	Approx. 670 g	Approx. 730 g	Approx. 800 g

Type		10 mm pitch type		
Model No.		**SF4C-F47**	**SF4C-F55**	**SF4C-F63**
Number of beam channels		47	55	63
Sensing height (Protective height)		480 mm	560 mm	640 mm
Current consumption	Large multi-purpose indicator OFF	Emitter: 80 mA or less Receiver: 90 mA or less	Emitter: 85 mA or less, Receiver: 95 mA or less	
	Large multi-purpose indicator ON	Emitter: 115 mA or less Receiver: 120 mA or less	Emitter: 120 mA or less, Receiver: 125 mA or less	
PFH		2.98×10^{-9}	3.42×10^{-9}	3.86×10^{-9}
$MTTF_D$		225	207	192
Weight (total of emitter and receiver)		Approx. 860 g	Approx. 930 g	Approx. 1,000 g

Type		20 mm pitch type			
Model No.		**SF4C-H8**	**SF4C-H12**	**SF4C-H16**	**SF4C-H20**
Number of beam channels		8	12	16	20
Sensing height (Protective height)		160 mm	240 mm	320 mm	400 mm
Current consumption	Large multi-purpose indicator OFF	Emitter: 70 mA or less Receiver: 85 mA or less	Emitter: 70 mA or less, Receiver: 90 mA or less		Emitter: 75 mA or less Receiver: 95 mA or less
	Large multi-purpose indicator ON	Emitter: 120 mA or less Receiver: 135 mA or less	Emitter: 120 mA or less, Receiver: 140 mA or less		Emitter: 120 mA or less Receiver: 145 mA or less
PFH		8.26×10^{-10}	1.07×10^{-9}	1.27×10^{-9}	1.52×10^{-9}
$MTTF_D$		391	360	339	316
Weight (total of emitter and receiver)		Approx. 610 g	Approx. 680 g	Approx. 740 g	Approx. 800 g

Type		20 mm pitch type		
Model No.		**SF4C-H24**	**SF4C-H28**	**SF4C-H32**
Number of beam channels		24	28	32
Sensing height (Protective height)		480 mm	560 mm	640 mm
Current consumption	Large multi-purpose indicator OFF	Emitter: 75 mA or less Receiver: 95 mA or less	Emitter: 80 mA or less, Receiver: 100 mA or less	
	Large multi-purpose indicator ON	Emitter: 120 mA or less Receiver: 145 mA or less	Emitter: 120 mA or less, Receiver: 150 mA or less	
PFH		1.72×10^{-9}	1.97×10^{-9}	2.22×10^{-9}
$MTTF_D$		299	281	265
Weight (total of emitter and receiver)		Approx. 850 g	Approx. 930 g	Approx. 990 g

<Pigtailed type>

Type		10 mm pitch type			
Model No.		**SF4C-F15-J05**	**SF4C-F23-J05**	**SF4C-F31-J05**	**SF4C-F39-J05**
Number of beam channels		15	23	31	39
Sensing height (Protective height)		160 mm	240 mm	320 mm	400 mm
Current consumption	Large multi-purpose indicator OFF	Emitter: 70 mA or less Receiver: 80 mA or less	Emitter: 75 mA or less, Receiver: 85 mA or less		Emitter: 80 mA or less Receiver: 90 mA or less
	Large multi-purpose indicator ON	Emitter: 105 mA or less Receiver: 110 mA or less	Emitter: 110 mA or less, Receiver: 115 mA or less		Emitter: 115 mA or less Receiver: 120 mA or less
PFH		1.21×10^{-9}	1.65×10^{-9}	2.09×10^{-9}	2.54×10^{-9}
$MTTF_D$		345	305	273	246
Weight (total of emitter and receiver)		Approx. 210 g	Approx. 270 g	Approx. 340 g	Approx. 400 g

Type		10 mm pitch type		
Model No.		**SF4C-F47-J05**	**SF4C-F55-J05**	**SF4C-F63-J05**
Number of beam channels		47	55	63
Sensing height (Protective height)		480 mm	560 mm	640 mm
Current consumption	Large multi-purpose indicator OFF	Emitter: 80 mA or less Receiver: 90 mA or less	Emitter: 85 mA or less, Receiver: 95 mA or less	
	Large multi-purpose indicator ON	Emitter: 115 mA or less Receiver: 120 mA or less	Emitter: 120 mA or less, Receiver: 125 mA or less	
PFH		2.98×10^{-9}	3.42×10^{-9}	3.86×10^{-9}
$MTTF_D$		225	207	192
Weight (total of emitter and receiver)		Approx. 470 g	Approx. 540 g	Approx. 600 g

Type		20 mm pitch type			
Model No.		**SF4C-H8-J05**	**SF4C-H12-J05**	**SF4C-H16-J05**	**SF4C-H20-J05**
Number of beam channels		8	12	16	20
Sensing height (Protective height)		160 mm	240 mm	320 mm	400 mm
Current consumption	Large multi-purpose indicator OFF	Emitter: 70 mA or less Receiver: 85 mA or less	Emitter: 70 mA or less, Receiver: 90 mA or less		Emitter: 75 mA or less Receiver: 95 mA or less
	Large multi-purpose indicator ON	Emitter: 120 mA or less Receiver: 135 mA or less	Emitter: 120 mA or less, Receiver: 140 mA or less		Emitter: 120 mA or less Receiver: 145 mA or less
PFH		8.26×10^{-10}	1.07×10^{-9}	1.27×10^{-9}	1.52×10^{-9}
$MTTF_D$		391	360	339	316
Weight (total of emitter and receiver)		Approx. 220 g	Approx. 280 g	Approx. 340 g	Approx. 400 g

Type		20 mm pitch type		
Model No.		**SF4C-H24-J05**	**SF4C-H28-J05**	**SF4C-H32-J05**
Number of beam channels		24	28	32
Sensing height (Protective height)		480 mm	560 mm	640 mm
Current consumption	Large multi-purpose indicator OFF	Emitter: 75 mA or less Receiver: 95 mA or less	Emitter: 80 mA or less, Receiver: 100 mA or less	
	Large multi-purpose indicator ON	Emitter: 120 mA or less Receiver: 145 mA or less	Emitter: 120 mA or less, Receiver: 150 mA or less	
PFH		1.72×10^{-9}	1.97×10^{-9}	2.22×10^{-9}
$MTTF_D$		299	281	265
Weight (total of emitter and receiver)		Approx. 460 g	Approx. 530 g	Approx. 600 g

PFH: Probability of dangerous failure per hour, $MTTF_D$: Mean time to dangerous failure

Specifications

Common specifications

Type	Cable type		Pigtailed type	
	10 mm pitch type	20 mm pitch type	10 mm pitch type	20 mm pitch type
Model No.	**SF4C-F□**	**SF4C-H□**	**SF4C-F□-J05**	**SF4C-H□-J05**
Sensing range	0.1 m to 3 m			
Beam pitch	10 mm	20 mm	10 mm	20 mm
Detecting capability (Min. sensing object)	ø14 mm opaque object	ø25 mm opaque object	ø14 mm opaque object	ø25 mm opaque object
Effective aperture angle (EAA)	±2.5 degree or less [for sensing range at 3 m (Required by IEC 61496-2, ANSI / UL 61496-2)]			
Supply voltage	24 V DC $^{+10}_{-15}$% Ripple P-P 10% or less			
Control output (OSSD 1 / 2) (Note 1)	PNP open-collector transistor / NPN open-collector transistor (switching type) **<For PNP output>** • Maximum source current: 200 mA • Applied voltage: same as supply voltage (between the control output and +V) • Residual voltage: 2.5 V or less (source current 200 mA, when using 10 m length cable) • Leakage current: 200 µA or less (power supply OFF condition) • Maximum load capacity: 1µF (No load to maximum output current) • Load wiring resistance: 3 Ω or less		**<For NPN output>** • Maximum sink current: 200 mA • Applied voltage: same as supply voltage (between the control output and 0 V) • Residual voltage: 2.5 V or less (sink current 200 mA, when using 10 m length cable) • Leakage current: 200 µA or less (power supply OFF condition) • Maximum load capacity: 1µF (No load to maximum output current) • Load wiring resistance: 3 Ω or less	
Operation mode (Output operation)	ON when all beams are received, OFF when one or more beams are interrupted (Note 2, 3) (OFF when fault occurs in the sensor or the synchronization signal error, too)			
Protection circuit (Short-circuit protection)	Incorporated			
Response time	OFF: 9 ms or less ON: 90 ms or less	OFF: 7 ms or less ON: 90 ms or less	OFF: 9 ms or less ON: 90 ms or less	OFF: 7 ms or less ON: 90 ms or less
Auxiliary output (Non-safety output)	PNP open-collector transistor / NPN open-collector transistor (switching type) **<For PNP output>** • Maximum source current: 100 mA • Applied voltage: same as supply voltage (between the auxiliary output and +V) • Residual voltage: 2.5 V or less (source current 100 mA, when using 10 m length cable)		**<For NPN output>** • Maximum sink current: 100 mA • Applied voltage: same as supply voltage (between the auxiliary output and 0 V) • Residual voltage: 2.5 V or less (sink current 100 mA, when using 10 m length cable)	
Operation mode (Output operation)	When OSSDs are ON: OFF, when OSSDs are OFF: ON (factory setting) [Changeable by using the handy controller **SFC-HC** (optional).]			
Protection circuit (Short-circuit protection)	Incorporated			
Protection	IP65, IP67 (IEC)			
Degree of pollution	3			
Ambient temperature	–10 °C to +55 °C (No dew condensation or icing allowed), Storage: -25 °C to +60 °C			
Ambient humidity	30 % RH to 85 % RH, Storage: 30 % RH to 85 % RH			
Ambient illuminance	Incandescent lamp: 5,000 ℓx or less at the light-receiving surface			
Operating altitude	2,000 m or less (Note 4)			
Withstand voltage	1,000 V AC for one min. (between all supply terminals connected together and enclosure)			
Insulation resistance	20 MΩ or more with 500 V DC mega (between all supply terminals connected together and enclosure)			
Vibration resistance	10 Hz to 55 Hz frequency, 0.75 mm amplitude in X, Y and Z directions for two hours each			
Shock resistance	300 m/s^2 acceleration (approx. 30 g) in X, Y and Z directions for three times each			
SFF (Safe failure fraction)	99 %			
HFT (Hardware failure tolerance)	1			
Sub system type	Type B (IEC 61508-2)			
Mission time	20 years			
Emitting element	Infrared LED (Peak emission wavelength: 855 nm)			
Connection method	Connection with connectors (intermediate connector type)			
Cable	0.15 mm^2 12-core heat-resistant PVC cable, 5 m long		0.15 mm^2 12-core heat-resistant PVC cable with connector, 0.5 m long	
Cable extension	Extension up to total 30 m is possible for 0.2 mm^2 or more, cable (Note 5)			
Material	Enclosure: Polycarbonate alloy, Sensing surface cover: Polycarbonate alloy, **MS-SFC-1** (Standard mounting bracket): Stainless steel			
Accessory	**MS-SFC-1** (Standard mounting bracket): 1 set **SF4C-TR14** (Test rod): 1 pc.	**MS-SFC-1** (Standard mounting bracket): 1 set **SF4C-TR25** (Test rod): 1 pc.	**MS-SFC-1** (Standard mounting bracket): 1 set **SF4C-TR14** (Test rod): 1 pc.	**MS-SFC-1** (Standard mounting bracket): 1 set **SF4C-TR25** (Test rod): 1 pc.

Notes: 1) When large multi-purpose indicator is used, allowable upper-limit ambient temperature is +50 °C and control output (OSSD 1/2) must not exceed 100 mA.
2) The beam channel is not turned OFF during muting even if it is blocked.
3) In case the blanking function is valid, the operation mode is changed.
4) Do not use or storage in environment of more than atmospheric pressure at sea level.
5) When extending the cables of emitter and receiver, make sure total measured length of all cables (main unit cables and connection cables) is no more than 30 m.

⚠ WARNING

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

<Reference>

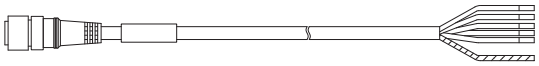
For details of the function setting by using the handy controller **SFC-HC** (optional), refer to "**3-10 Functions Using Handy Controller SFC-HC (optional)**."

⚠ CAUTION

The corresponding emitter and receiver must have the same serial NO. and be correctly oriented. The serial No. is indicated on the plates of both emitter and receiver. (Under the model represents the serial No.)

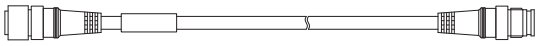
6-2 Options

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



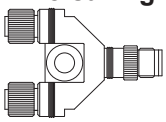
Model No.	Cable length	Remarks
SFB-CC3-MU	3 m	Used for wiring. The connector is attached on one end of the cable and the other end is discrete wire. For emitter: Gray connector, 12-core shield cable For receiver: Black connector, 12-core shield cable
SFB-CC7-MU	7 m	
SFB-CC10-MU	10 m	

● **12-core extending cable with connectors on both ends: 1 pc.**



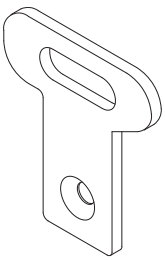
Model No.	Cable length	Remarks
SFB-CCJ3E-MU	3 m	Used for extending cable. The connectors are attached on both ends of the cable. For emitter: Gray connector, 12-core shield cable For receiver: Black connector, 12-core shield cable
SFB-CCJ3D-MU		
SFB-CCJ10E-MU	10 m	
SFB-CCJ10D-MU		

● **Wire-saving Y type connector: 1 pcs**



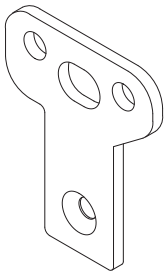
Model No.	Remarks
SFC-WY1	This device is connector which can organize a emitter and a receiver cables of intermediate connector type of the light curtain **SF4C-H□-J05 / SF4C-F□-J05**. when connecting to a control unit **SF-C13** or a safety PLC, it is allowed to connect as wire-saving. use it with a cable shown below. • Cable with connector on one end **WY1-CCN3**, **WY1-CCN10**: 1 pc.

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



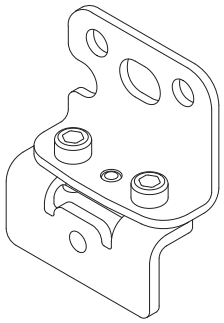
Model No	Remarks
MS-SFC-1	For one hexagon-socket head bolt [M5]

● **NA2-N compatible mounting bracket: 4 pc./set**



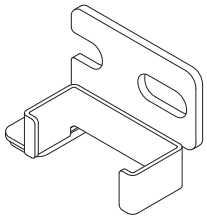
Model No	Remarks
MS-SFC-2	This mounting bracket is for replacing the other Panasonic Industry area sensor **NA2-N** series. With two M4 screws and one hexagon-socket head bolt [M6].

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



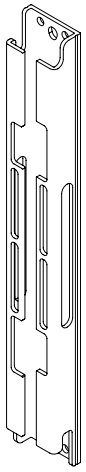
Model No.	Remarks
MS-SFC-3	can adjust light axis can be used as dead space less bracket. For a hexagon-socket head bolts [M5] or two hexagon-socket head bolts [M3]

● **Multifunctional intermediate supporting bracket: 2 pcs./set**



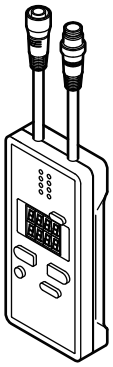
Model No.	Remarks
MS-SFC-4	Prevent spring when using multifunctional mounting bracket **MS-SFC-3** (optional). When mounting multifunctional bracket **MS-SFC-3** (optional) to **SF4C-H28-□** / **SF4C-F55-□** or **SF4C-H32-□** / **SF4C-F63-□**, you must use.

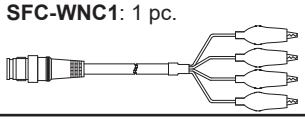
● **Protective metal case: 2 pcs./set**



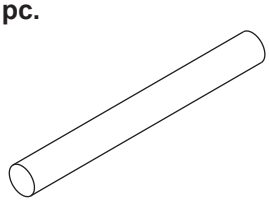
Model No.	Applicable model				Remarks
MS-SFCH-8	**SF4C-H8**	**SF4C-H8-J05**	**SF4C-F15**	**SF4C-F15-J05**	Protect this device from shocks and vibrations
MS-SFCH-12	**SF4C-H12**	**SF4C-H12-J05**	**SF4C-F23**	**SF4C-F23-J05**	
MS-SFCH-16	**SF4C-H16**	**SF4C-H16-J05**	**SF4C-F31**	**SF4C-F31-J05**	
MS-SFCH-20	**SF4C-H20**	**SF4C-H20-J05**	**SF4C-F39**	**SF4C-F39-J05**	
MS-SFCH-24	**SF4C-H24**	**SF4C-H24-J05**	**SF4C-F47**	**SF4C-F47-J05**	
MS-SFCH-28	**SF4C-H28**	**SF4C-H28-J05**	**SF4C-F55**	**SF4C-F55-J05**	
MS-SFCH-32	**SF4C-H32**	**SF4C-H32-J05**	**SF4C-F63**	**SF4C-F63-J05**	

● **Handy controller: 1 pc.**



Model No	Remarks
SFC-HC	Handy controller that enables setting each function. In case using it to cable type **SF4C-H□ / SF4C-F□**, using cable shown below is useful. • Cable with connector on one end **SFC-WNC1**: 1 pc. 

● **Test rod: 1 pc.**

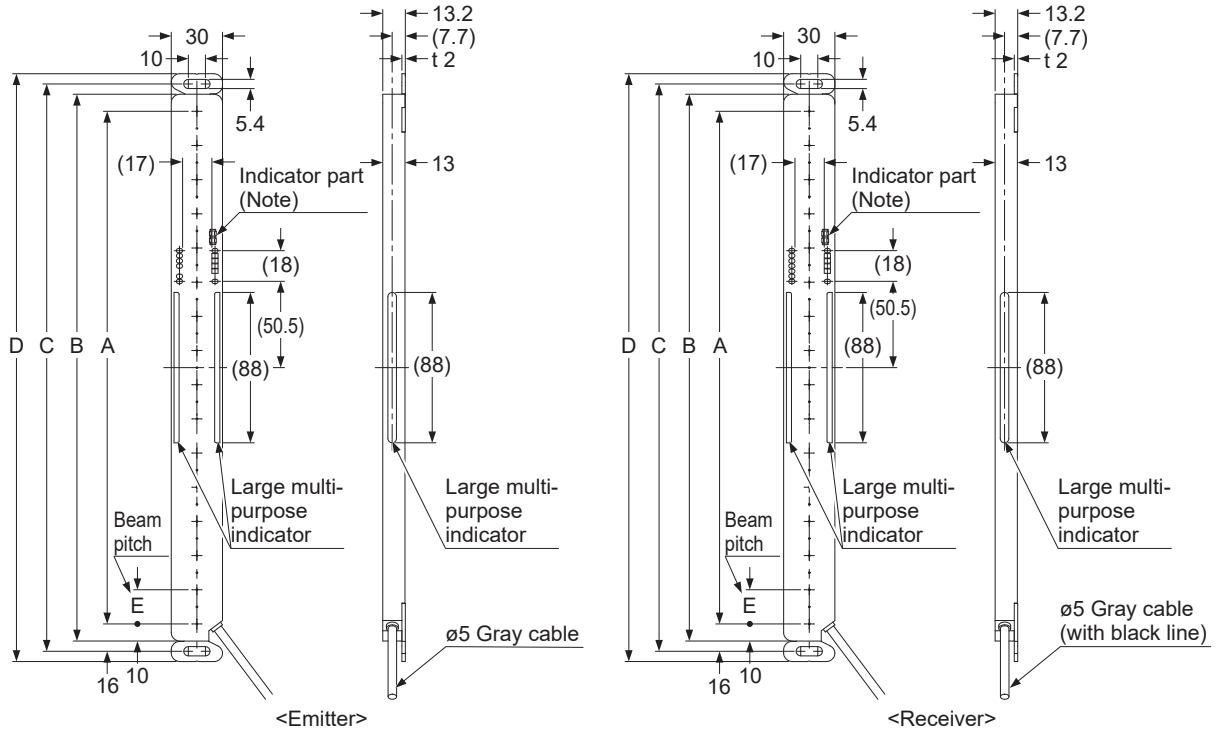


Model No	Remarks
SF4B-TR45	use when applying floating blanking function. ø45 mm.

6-3 Dimension

6-3-1 In Case Mounting on the Center with Standard Mounting Brackets

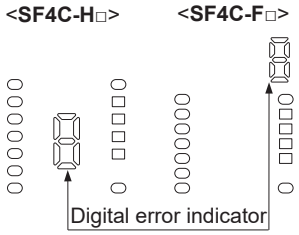
(Unit: mm)



Model No.				A	B	C	D
SF4C-F15	**SF4C-H8**	**SF4C-F15-J05**	**SF4C-H8-J05**	140	160	172	184
SF4C-F23	**SF4C-H12**	**SF4C-F23-J05**	**SF4C-H12-J05**	220	240	252	264
SF4C-F31	**SF4C-H16**	**SF4C-F31-J05**	**SF4C-H16-J05**	300	320	332	344
SF4C-F39	**SF4C-H20**	**SF4C-F39-J05**	**SF4C-H20-J05**	380	400	412	424
SF4C-F47	**SF4C-H24**	**SF4C-F47-J05**	**SF4C-H24-J05**	460	480	492	504
SF4C-F55	**SF4C-H28**	**SF4C-F55-J05**	**SF4C-H28-J05**	540	560	572	584
SF4C-F63	**SF4C-H32**	**SF4C-F63-J05**	**SF4C-H32-J05**	620	640	652	664

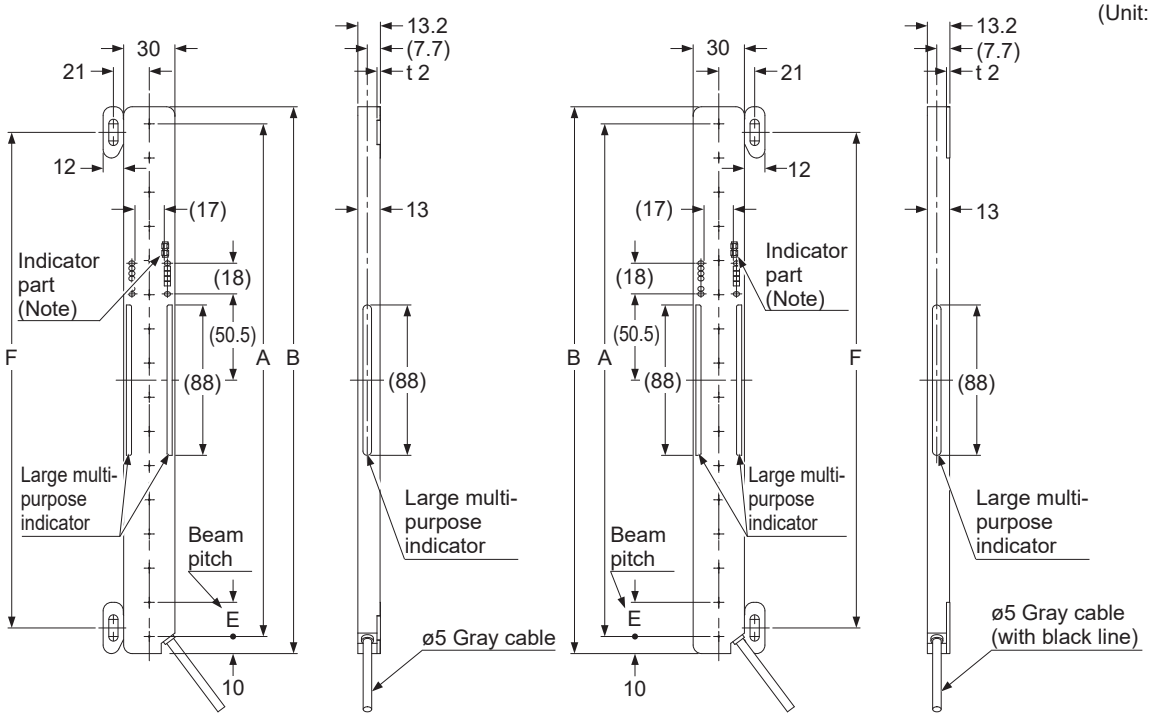
Model No.	E
SF4C-F□	10
SF4C-H□	20

Notes: 1) Measurement of drawing above is indicator part of **SF4C-H□**
SF4C-H8□ and **SF4C-F15□** are not provided with digital error indicator (red).
2) The above shows Ver. 3.0. In case of Ver. 2.1 or earlier, digital error indicator (red) is located at different position as shown at right.



6-3-2 In Case Mounting with Standard Mounting Brackets without Dead Space

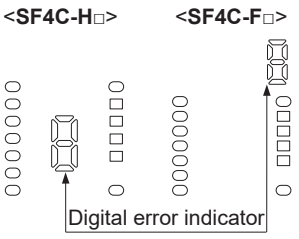
(Unit: mm)



Model No.				A	B	F
SF4C-F15	**SF4C-H8**	**SF4C-F15-J05**	**SF4C-H8-J05**	140	160	130
SF4C-F23	**SF4C-H12**	**SF4C-F23-J05**	**SF4C-H12-J05**	220	240	210
SF4C-F31	**SF4C-H16**	**SF4C-F31-J05**	**SF4C-H16-J05**	300	320	290
SF4C-F39	**SF4C-H20**	**SF4C-F39-J05**	**SF4C-H20-J05**	380	400	370
SF4C-F47	**SF4C-H24**	**SF4C-F47-J05**	**SF4C-H24-J05**	460	480	450
SF4C-F55	**SF4C-H28**	**SF4C-F55-J05**	**SF4C-H28-J05**	540	560	530
SF4C-F63	**SF4C-H32**	**SF4C-F63-J05**	**SF4C-H32-J05**	620	640	610

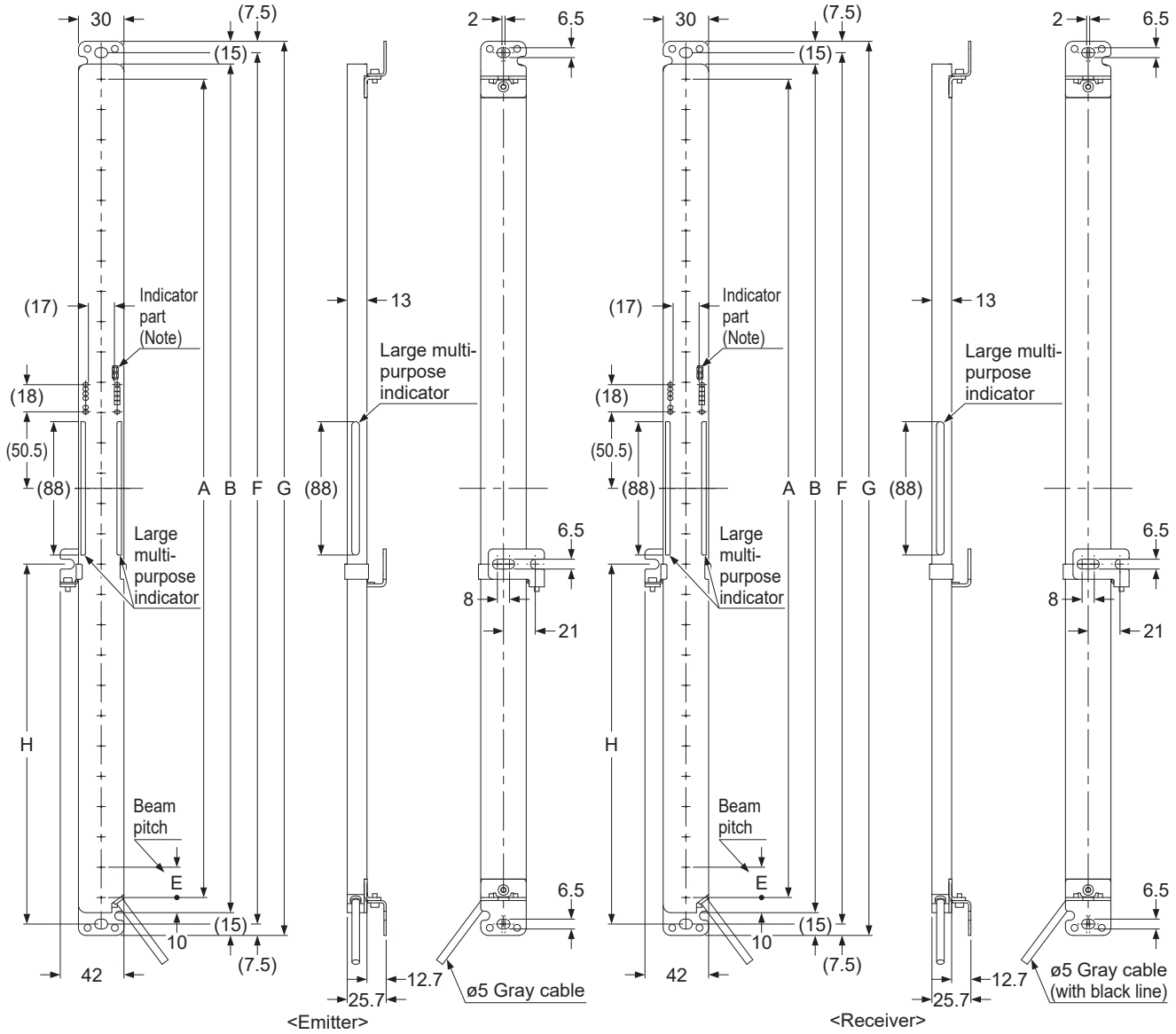
Model No.	E
SF4C-F□	10
SF4C-H□	20

Notes: 1) Measurement of drawing above is indicator part of **SF4C-H□**
SF4C-H8□ and **SF4C-F15□** are not provided with digital error indicator (red).
2) The above shows Ver. 3.0. In case of Ver. 2.1 or earlier, digital error indicator (red) is located at different position as shown at right.



6-3-3 In Case Mounting with Multifunctional Mounting Bracket

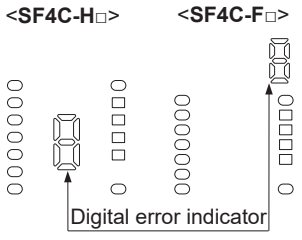
(Unit: mm)



Model No.				A	B	F	G	H
SF4C-F15	**SF4C-H8**	**SF4C-F15-J05**	**SF4C-H8-J05**	140	160	175	190	–
SF4C-F23	**SF4C-H12**	**SF4C-F23-J05**	**SF4C-H12-J05**	220	240	255	270	–
SF4C-F31	**SF4C-H16**	**SF4C-F31-J05**	**SF4C-H16-J05**	300	320	335	350	–
SF4C-F39	**SF4C-H20**	**SF4C-F39-J05**	**SF4C-H20-J05**	380	400	415	430	–
SF4C-F47	**SF4C-H24**	**SF4C-F47-J05**	**SF4C-H24-J05**	460	480	495	510	–
SF4C-F55	**SF4C-H28**	**SF4C-F55-J05**	**SF4C-H28-J05**	540	560	575	590	238/338
SF4C-F63	**SF4C-H32**	**SF4C-F63-J05**	**SF4C-H32-J05**	620	640	655	670	278/378

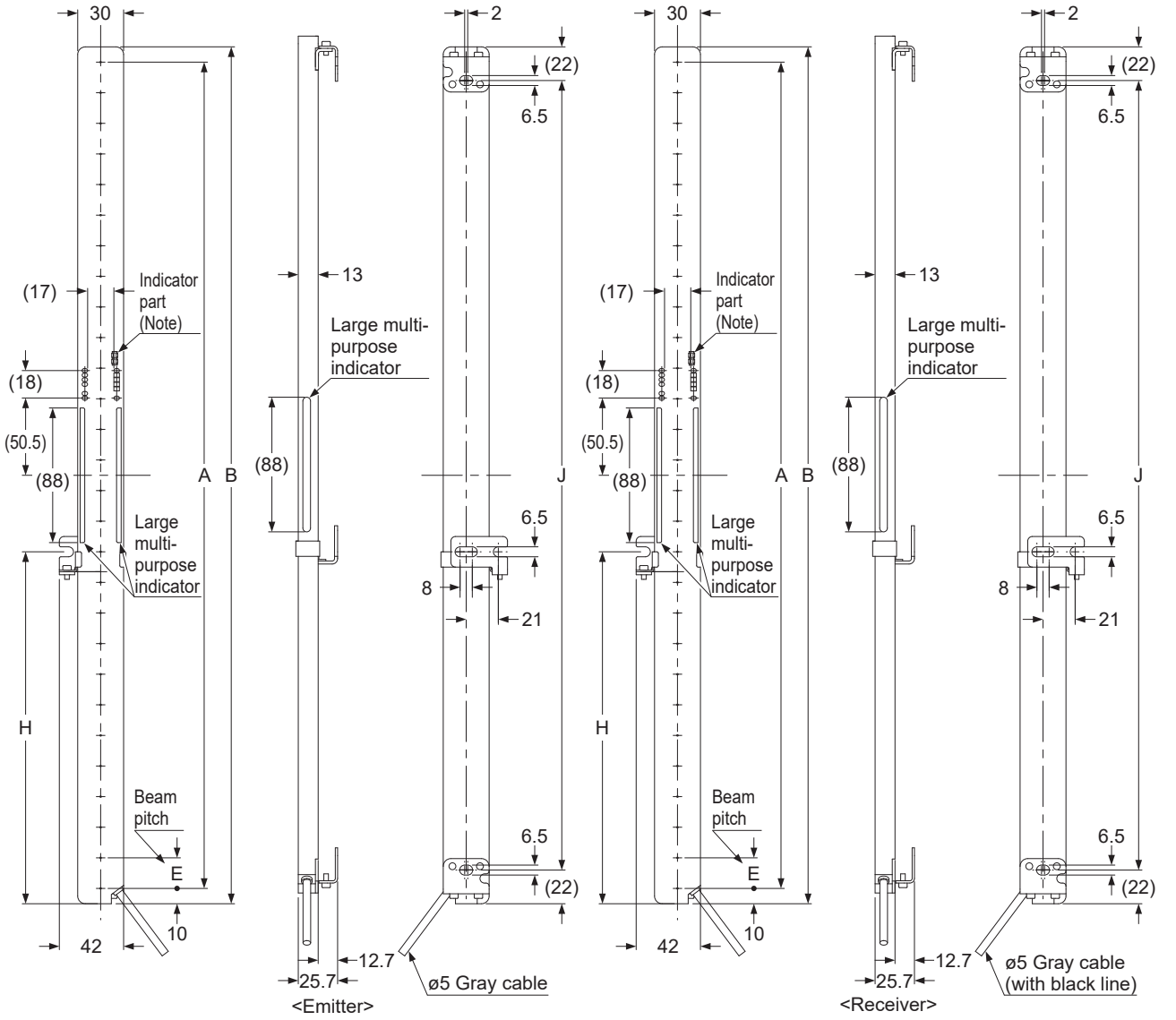
Model No.	E
SF4C-F□	10
SF4C-H□	20

Notes: 1) Measurement of drawing above is indicator part of **SF4C-H□**
SF4C-H8□ and **SF4C-F15□** are not provided with digital error indicator (red).
2) The above shows Ver. 3.0. In case of Ver. 2.1 or earlier, digital error indicator (red) is located at different position as shown at right.



6-3-4 In Case Mounting as Dead Space Mounting With Multifunctional Mounting bracket

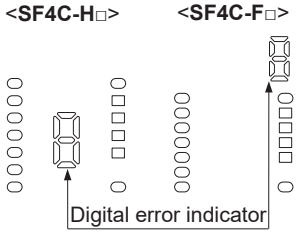
(Unit: mm)



Model No.				A	B	H	J
SF4C-F15	**SF4C-H8**	**SF4C-F15-J05**	**SF4C-H8-J05**	140	160	–	116
SF4C-F23	**SF4C-H12**	**SF4C-F23-J05**	**SF4C-H12-J05**	220	240	–	196
SF4C-F31	**SF4C-H16**	**SF4C-F31-J05**	**SF4C-H16-J05**	300	320	–	276
SF4C-F39	**SF4C-H20**	**SF4C-F39-J05**	**SF4C-H20-J05**	380	400	–	356
SF4C-F47	**SF4C-H24**	**SF4C-F47-J05**	**SF4C-H24-J05**	460	480	–	436
SF4C-F55	**SF4C-H28**	**SF4C-F55-J05**	**SF4C-H28-J05**	540	560	238/338	516
SF4C-F63	**SF4C-H32**	**SF4C-F63-J05**	**SF4C-H32-J05**	620	640	278/378	596

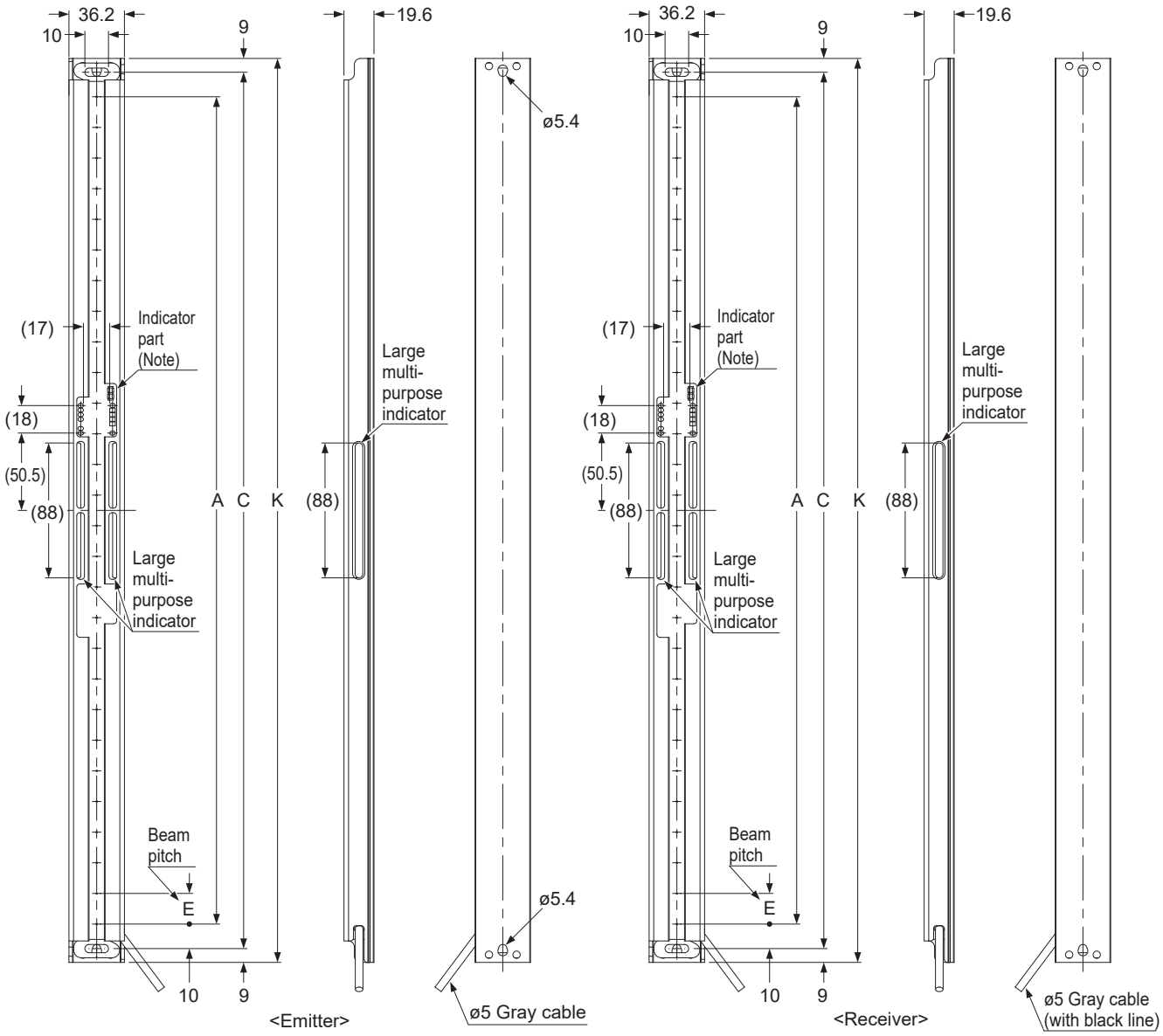
Model No.	E
SF4C-F□	10
SF4C-H□	20

Notes: 1) Measurement of drawing above is indicator part of **SF4C-H□**
SF4C-H8□ and **SF4C-F15□** are not provided with digital error indicator (red).
2) The above shows Ver. 3.0. In case of Ver. 2.1 or earlier, digital error indicator (red) is located at different position as shown at right.



6-3-5 In Case Mounting with Protective Metal Case

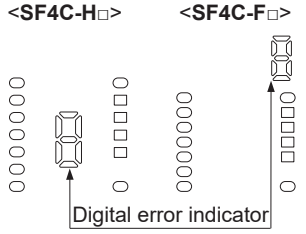
(Unit: mm)



Model No.				A	C	K
SF4C-F15	**SF4C-H8**	**SF4C-F15-J05**	**SF4C-H8-J05**	140	172	190
SF4C-F23	**SF4C-H12**	**SF4C-F23-J05**	**SF4C-H12-J05**	220	252	270
SF4C-F31	**SF4C-H16**	**SF4C-F31-J05**	**SF4C-H16-J05**	300	332	350
SF4C-F39	**SF4C-H20**	**SF4C-F39-J05**	**SF4C-H20-J05**	380	412	430
SF4C-F47	**SF4C-H24**	**SF4C-F47-J05**	**SF4C-H24-J05**	460	492	510
SF4C-F55	**SF4C-H28**	**SF4C-F55-J05**	**SF4C-H28-J05**	540	572	590
SF4C-F63	**SF4C-H32**	**SF4C-F63-J05**	**SF4C-H32-J05**	620	652	670

Model No.	E
SF4C-F□	10
SF4C-H□	20

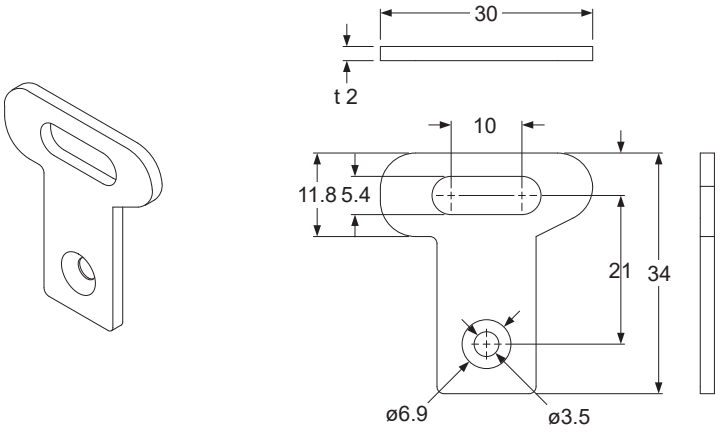
Notes: 1) Measurement of drawing above is indicator part of **SF4C-H□**
SF4C-H8□ and **SF4C-F15□** are not provided with digital error indicator (red).
2) The above shows Ver. 3.0. In case of Ver. 2.1 or earlier, digital error indicator (red) is located at different position as shown at right.



6-3-6 Mounting Bracket

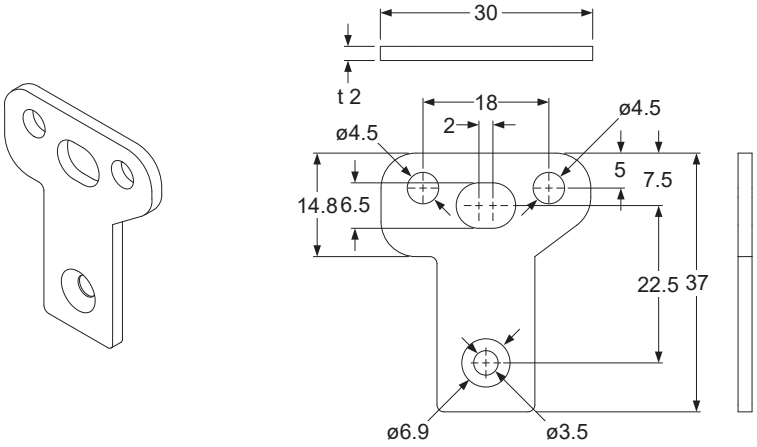
(Unit: mm)

1) Standard mounting bracket / MS-SFC-1



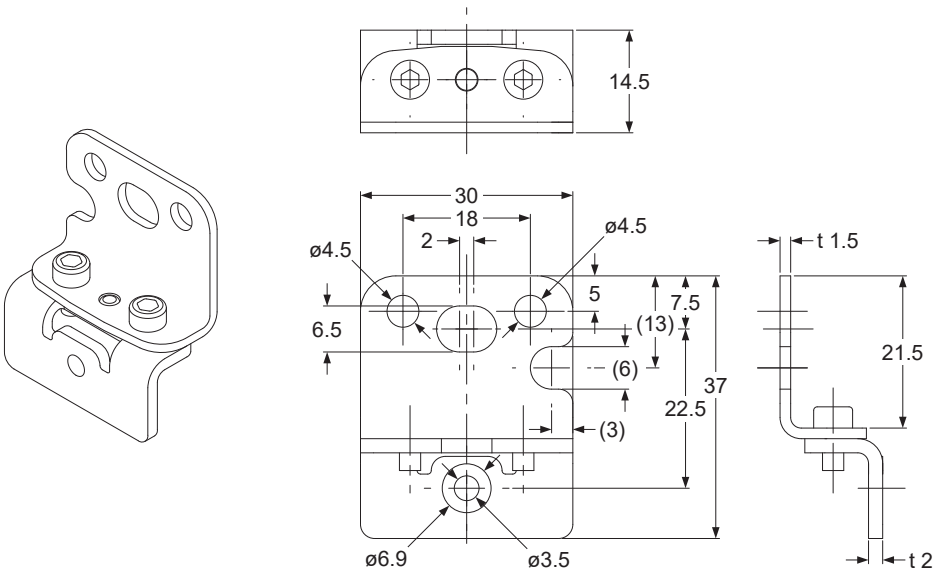
Material: Stainless steel

2) NA2-N compatible mounting bracket / MS-SFC-2



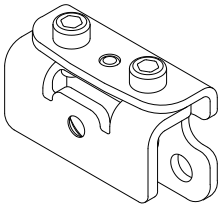
Material: Stainless steel

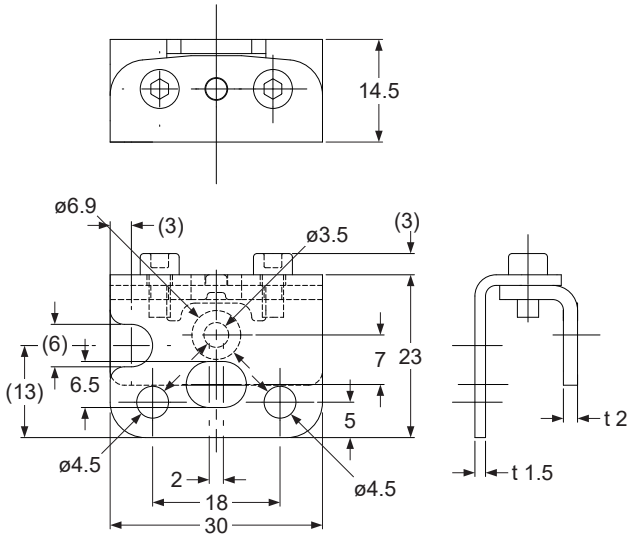
3) Multifunctional mounting bracket / MS-SFC-3



Material: Stainless steel

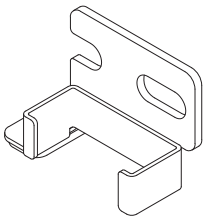
4) Multifunctional mounting bracket / MS-SFC-3 (in case dead space less mounting)

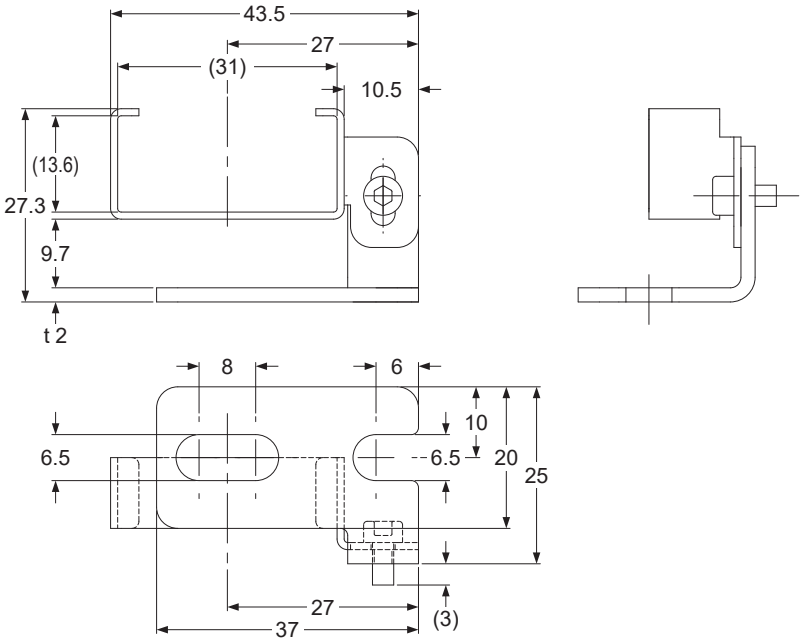




Material: Stainless steel

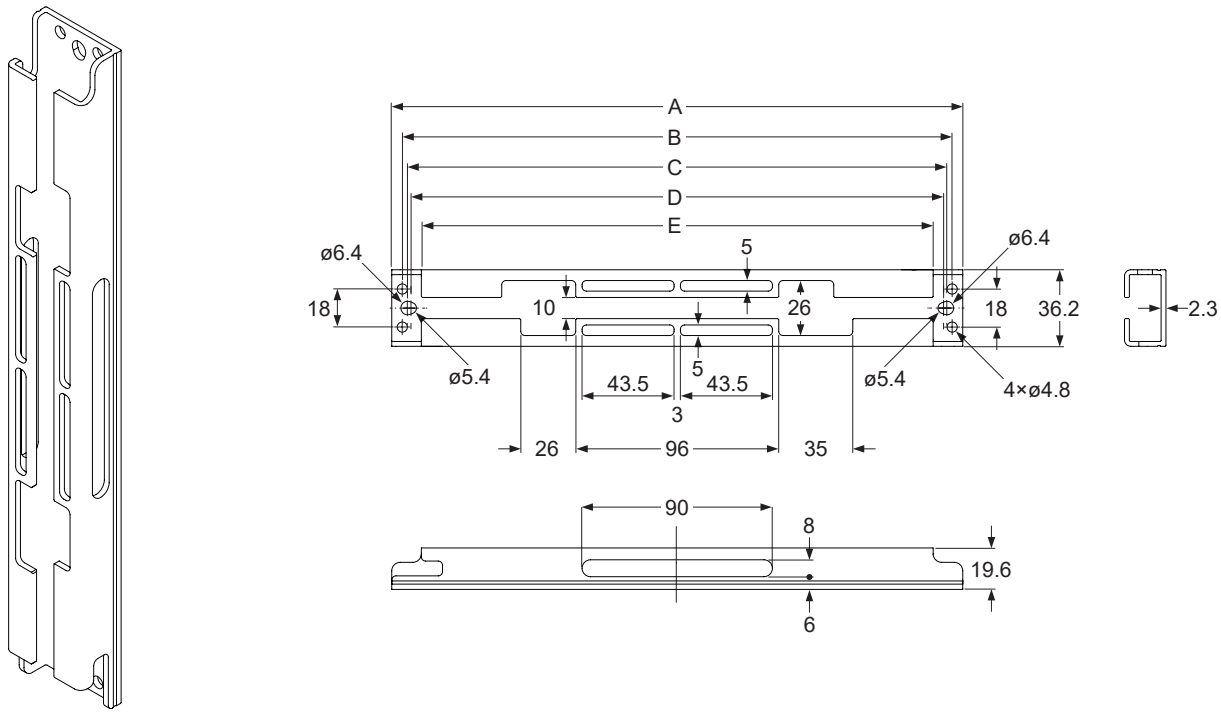
5) Multifunctional intermediate supporting bracket / MS-SFC-4





Material: Stainless steel

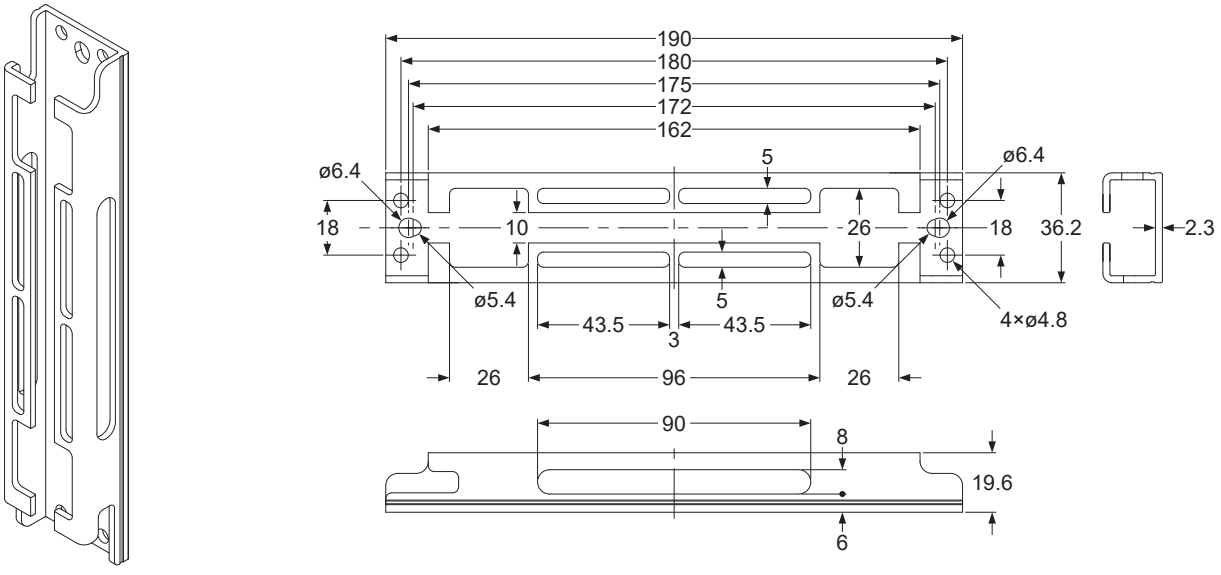
6) Protective metal case / MS-SFCH-□ (Except **MS-SFCH-8**)



Model No.	A	B	C	D	E
MS-SFCH-12	270	260	255	252	242
MS-SFCH-16	350	340	335	332	322
MS-SFCH-20	430	420	415	412	402
MS-SFCH-24	510	500	495	492	482
MS-SFCH-28	590	580	575	572	562
MS-SFCH-32	670	660	655	652	642

Material: Aluminum

Protective metal case / MS-SFCH-8



Material: Aluminum

Chapter 7 Others

7-1 Glossary

Machinery Directive / Machinery Regulations	This directive is for an assembly of linked parts or components, energized by an electricity, compressed air or oil pressure, etc. and at least one of which moves, and a component which fulfills a safety function and is released into the market by itself.
EMC Directive / EMC Regulations	The directives is to any electric or electronic devices which will create more than a limited amount of RF interference, or will withstand a certain amount of Electro Magnetic fields while operating as intended within specifications.
EN 61496-1/2 IEC 61496-1/2 ANSI/UL 61496-1/2 JIS B 9704-1/2	The standards that pertain to machine safety, especially electro-sensitive protective equipment (ESPE). EN 61496-1, IEC 61496-1, ANS/UL 61496-1 or JIS B 9704-1 gives general rules or failure mode and effect analysis, EMC requirements, etc. EN 61496-2, IEC 61496-2, ANSI/UL 61496-2 or JIS B 9704-2 specifies effective aperture angle, protection against extraneous light sources, etc, for Active Opto-electronic Protective Devices (AOPDs).
IEC 61508-1 to 3 JIS C 0508-1 to 3	The standards that pertain to electrical / electronic / programmable electronic safety-related systems. They give roles for methods of reducing RISK to be acceptable and safety integrity level (SIL).
EN 55011	Specifies the limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment.
EN ISO 13849-1 ISO 13849-1 JIS B 9705-1	The standard that specifies the safety-related matters of machine safety / control system. They give roles for level (category) of structure and fault detection reliability, and for level of safety future performance capability (PL: Performance Level).
UL1998	UL standard for safety-related software in programmable components.
ESPE	The abbreviation for Electro-Sensitive Protective Equipment.
Control output (OSSD)	The abbreviation for Output Signal Switching Device. A component of the light curtain that turns OFF when light of the light curtain is blocked.
FSD	The abbreviation for Final Switching Device. The component of the machine's safety related control system that open-circuits the MPCE circuit when the OSSD operates due to the light from the light curtain being blocked.
Test rod	This is a rod for checking the detection capability of this device. It has dimensions corresponding to the minimum sensing object for this device.
Lockout	It is one of the safe status of this device. Operation is stopped if the self-diagnosis function determines that an irrecoverable failure (OSSDs do not operate normally, etc.) has occurred. If an emitter is in lockout condition, it will stop emitting light. If a receiver is in lockout condition, OSSDs are turned OFF.
Safety distance	It is the minimum distance that must be maintained between the light curtain and the dangerous parts of a machine so that the machine can be stopped before a human body or an object can reach the dangerous parts.
Sensing height (Protective height)	The length of the beam-axis direction that the min. sensing object can be detected. The length from the center of the first beam channel to the center of the last beam channel in addition to +20 mm (10 mm upward, 10 mm downward).
Sensing range	It is the range between the facing emitter and receiver.
Sensing area	It is the area over which intrusion by people or objects can be detected by one set of the device. It is given by multiplying the protective height (sensing height) by the sensing range.
Test input function	This function enables checking of the device operation by forcibly turning ON / OFF the control output (OSSD 1 / 2) of the receiver with the emitting light is received.
PSDI	The abbreviation for the Presence Sensing Device Initiation. The safety device that restarts automatically without any operation by the operator after the device detects danger status and halts for a while.

7-2 CE Marking Declaration of Conformity

Itemized Essentials of EU Declaration of Conformity

Manufacturer's Name: Panasonic Industry Co., Ltd.
Manufacturer's Address: 1006, Oaza Kadoma, Kadoma-shi, Osaka 571-8506, Japan

Product: Active Opto-electronic Protective Device (Light Curtain)
Model Name: SF4C Series
Trade Name: Panasonic

Application of Council Directives:
- 2006/42/EC Machinery
- 2014/30/EU EMC
- 2011/65/EU RoHS

Applicable Standards:
- EN ISO 13849-1
- EN 55011
- EN 61000-6-2
- EN IEC 63000
- IEC 61496-1
- IEC 61496-2
- IEC 61508-1
- IEC 61508-2
- IEC 61508-3

Authorised Representative:
Panasonic Marketing Europe GmbH, Panasonic Testing Centre
Winsbergring 15, 22525 Hamburg, Germany

7-3 UKCA Marking Declaration of Conformity

Itemized Essentials of UK Declaration of Conformity

Manufacturer's Name: Panasonic Industry Co., Ltd.
Manufacturer's Address: 1006, Oaza Kadoma, Kadoma-shi, Osaka 571-8506, Japan

Product Name: Active Opto-electronic Protective Device (Light Curtain)
Trade Name: Panasonic
Model Name: SF4C Series

Statutory Instruments:
- 2008/1597 Machinery
- 2016/1091 EMC
- 2012/3032 RoHS

Designated Standards:
- EN ISO 13849-1
- EN 55011
- EN 61000-6-2
- EN IEC 63000
- IEC 61496-1
- IEC 61496-2
- IEC 61508-1
- IEC 61508-2
- IEC 61508-3

Panasonic UK, a branch of Panasonic Marketing Europe GmbH
Maxis 2, Western Road, Bracknell, Berkshire, RG12 1RT

Revision history	Revision date	Revision item
1st edition	April , 2009	
2 Nd edition	April , 2009	—
3rd edition	November , 2009	—
4th edition	October , 2010	—
5th edition	January , 2011	—
6th edition	January , 2013	—
7th edition	March , 2014	—
8th edition	May , 2014	—
9th edition	January , 2015	—
10th edition	October , 2015	—
11th edition	January , 2016	—
12th edition	May , 2017	—
13th edition	March , 2023	● Added notes. ● Corrected errors.
14th edition	September , 2023	● Changed the Standards.
15th edition	June , 2023	● Revision to reflect change of standards. ● Addition of note regarding UKCA ● Added notes.
16th edition	April , 2024	● Company name change. ● Revision to reflect change of standards. ● Corrected errors.
17th edition	November , 2024	● Changed the product version (from version 2.1 to version 3.0) ● Changed the standard (addition of KCs mark) ● Corrected errors.

(MEMO)

1. WARRANTIES:

(1) Subject to the exclusions stated in 2 (EXCLUSIONS) herein below, Panasonic Industry warrants the Products to be free of defects in material and workmanship for a period of one (1) year from the date of shipment under normal usage in environments commonly found in manufacturing industry.

(2) Any Products found to be defective must be shipped to Panasonic Industry with all shipping costs paid by Purchaser or offered to Panasonic Industry for inspection and examination. Upon examination by Panasonic Industry, Panasonic Industry will, at its sole discretion, repair or replace at no charge, or refund the purchase price of, any Products found to be defective.

2. EXCLUSIONS:

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

(2) This warranty extends only to the first purchaser for application, and is not transferable to any person or entity which purchased from such purchaser for application.

3. DISCLAIMERS

(1) Panasonic Industry's sole obligation and liability under this warranty is limited to the repair or replacement, or refund of the purchase price, of a defective Product, at Panasonic Industry's option.

(2) THE REPAIR, REPLACEMENT, OR REFUND IS THE EXCLUSIVE REMEDY OF THE PURCHASER, AND ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF PROPRIETARY RIGHTS, ARE HEREBY EXPRESSLY DISCLAIMED. IN NO EVENT SHALL PANASONIC INDUSTRY AND ITS AFFILIATED ENTITIES BE LIABLE FOR DAMAGES IN EXCESS OF THE PURCHASE PRICE OF THE PRODUCTS, OR FOR ANY INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES OF ANY KIND, GENERAL TERMS AND CONDITIONS 4 OR ANY DAMAGES RESULTING FROM LOSS OF USE, BUSINESS INTERRUPTION, LOSS OF INFORMATION, LOSS OR INACCURACY OF DATA, LOSS OF PROFITS, LOSS OF SAVINGS, THE COST OF PROCUREMENT OF SUBSTITUTED GOODS, SERVICES OR TECHNOLOGIES, OR FOR ANY MATTER ARISING OUT OF OR IN CONNECTION WITH THE USE OR INABILITY TO USE THE PRODUCTS.

4. CAUTIONS FOR SAFE USE

(1) The applications shown in the catalogue are only suggestions, and it is Purchaser's sole responsibility to ascertain the fitness and suitability of the Products for any particular application, as well as to abide by Purchaser's applicable local laws and regulations, if any.

(2) Never use the Products NOT rated or designated as “SAFETY SENSOR” in any application involving risk to life or property. When such a use is made by Purchaser, such Purchaser shall indemnify and hold harmless Panasonic Industry from any liability or damage whatsoever arising out of or in relation to such use.

(3) In incorporating the Products to any equipment, facilities or systems, it is highly recommended to employ fail-safe designs, including but not limited to a redundant +++design, flame propagation prevention design, and malfunction prevention design so as not to cause any risk of bodily injury, fire accident, or social damage due to any failure of such equipment, facilities or systems.

(4) The Products are each intended for use only in environments commonly found in manufacturing industry, and, unless expressly allowed in the catalogue, specification or otherwise, shall not be used in, or incorporated into, any equipment, facilities or systems, such as those:
- (a) which are used for the protection of human life or body parts;
- (b) which are used outdoors or in environments subject to any likelihood of chemical contamination or electromagnetic influence;
- (c) which are likely to be used beyond the limits of operations or environments specified by Panasonic Industry in the catalogue or otherwise;
- (d) which may cause risk to life or property, such as nuclear energy control equipment, transportation equipment (whether on rail or land, or in air or at sea), and medical equipment;
- (e) which are operated continuously each day for 24 hours; and
- (f) which otherwise require a high level of safety performance similar to that required in those equipment, facilities or systems as listed in (a) through (e) above.

5. EXPORT CONTROL LAWS

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

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Please visit our website for inquiries and about our sales network.

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