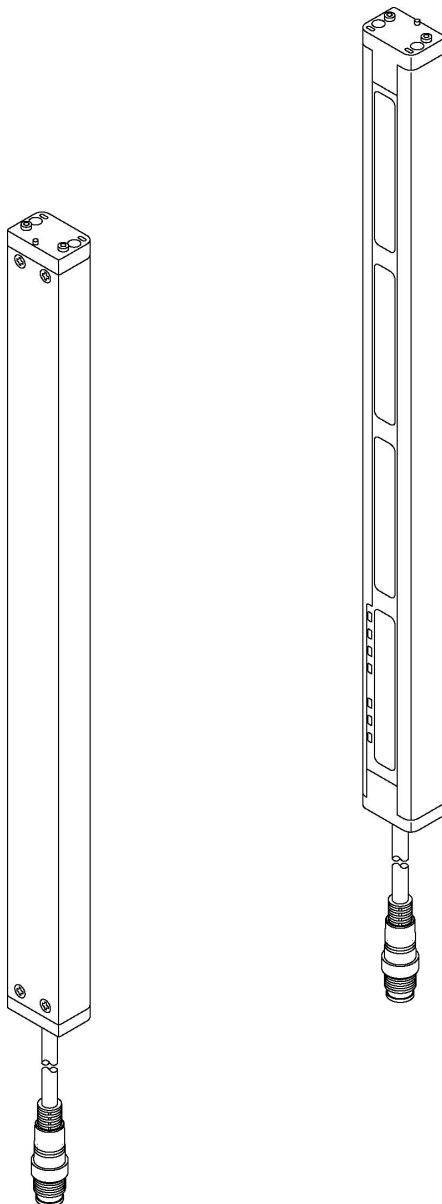


**INSTRUCTION MANUAL**

Light Curtain    Type 2

**SF2-N Series**

- Memo -

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## Notes

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

# Chapter 1 Introduction

## 1.1 Before Using This Product

Thank you for purchasing SUNX's Compact•Global Light Curtain, **SF2-N** Series (hereinafter called 'this device').

Please read this instruction manual carefully and thoroughly for the correct and optimum use of this product. Kindly keep this manual in a convenient place for quick reference.

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

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



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

## 1.2 Safety Precautions

### General Cautions

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

## Attention Marks

This instruction manual employs the following attention marks  ,  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.



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



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.

### WARNING

#### • Machine designer, installer, employer and operator

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

#### • Engineer

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

#### • 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 sensor 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 direct sunlight
  - 2) Areas with high humidity where condensation is likely to occur
  - 3) Areas exposed to corrosive or explosive gases
  - 4) Areas exposed to vibration or shock of levels higher than that specified
  - 5) Areas exposed to contact with water
  - 6) Areas exposed to too much steam or dust
  - 7) Areas where the beam-receiving part of this device is directly exposed to light from high-frequency fluorescent lamp (inverter type) or rapid starter fluorescent lamp.

#### • Installation

- Always keep the correctly calculated safety distance between this device and the dangerous parts of the machine.
- Install extra protection structure around the machine so that the operator must pass through the sensing area of this device to reach the dangerous parts of the machine.
- Install this device such that some part of the operator's body always remains in the sensing area when operation is done with the dangerous parts of the machine.
- Do not install this device at a location where it can be affected by wall reflections.
- When installing multiple sets of this device, connect the sets and, if necessary, install some barriers such that mutual interference does not occur.
- Do not use this device in a reflective configuration.
- The corresponding emitters and receivers must be correctly oriented and connected.

## WARNING

### • Equipment in which this device is installed

- Do not use this device in the 'PSDI Mode', functioning as the starter of the equipment in which this device is installed.
- This device is the Type 2 electro-sensitive protective equipment that is designed to be used with a system that requires the satisfaction of the requirements of Safety Category (control system safety related categories) 2, 1 or B of European Standard EN 954-1. Never use this device with a system requiring the satisfaction of the requirements of Safety Category 4, such as a press, or Safety Category 3.
- Do not install this device with a machine whose operation cannot be stopped immediately in the middle of an operation cycle by an emergency stop equipment.
- This device starts the performance after 2 seconds from the power ON. Have the control system started to function with this timing.

### • Wiring

- Be sure to carry out the wiring in the power supply off condition.
- All electrical wiring should conform to the regional electrical regulations and laws. The wiring should be done by engineer(s) having the special electrical knowledge.
- Do not run the sensor cable together with high-voltage lines or power lines or put them together in the same raceway.
- In case of extending the cable of the emitter or the receiver, each can be extended by 20.5m or less.

### • Maintenance

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

### • Others

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


## 1.3 Applicable Standards

This device corresponds to the following standards.

Corresponding Territory	Standard No.	Authorizing Organization
Europe (EU)	EN 61496-1 (Type 2) IEC 61496-1/2 (Type 2) EN 954-1 (Category 2)	TÜV (Rheinland)
United States of America, Canada	IEC 61496-1/2 (Type 2) UL 1998	UL

### <Reference>

In Canada, the  mark has the same validity as the CSA mark.

This product conforms to the EMC directive and the Machinery directive. The  mark on the sensor main body indicates that this product conforms to the EMC directive.

## WARNING

In Japan, never use this device as a safety equipment for any press machine or shearing machine.

# Chapter 2 General Outline

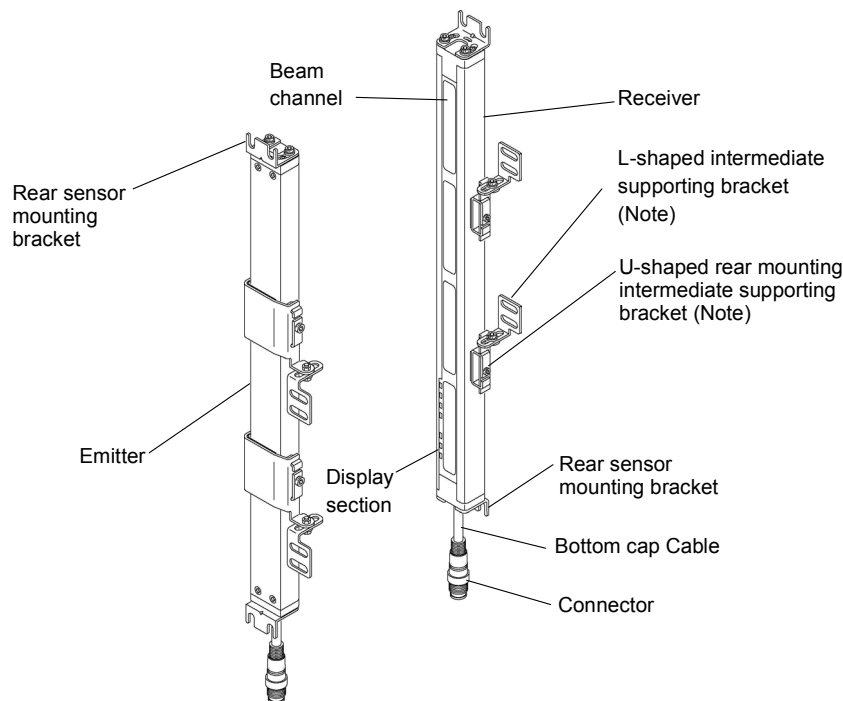
This chapter gives the system construction, part description, dimensions, etc., of this device.

## 2.1 Features

This device is a light curtain with the following features.

- It requires no special controller.
- The control output (OSSD) is available in two types, PNP output type and NPN output type.
- It has a beam pitch of 20mm (min. sensing object: 30mm) and can have a sensing height from 190mm to 1,310mm, 40mm (detection capability of 50mm) and can have a sensing height from 190mm to 1,630mm.
- Beam-axis alignment indicators which make beam-axis alignment easy are incorporated.
- It incorporates a Test input.

## 2.2 Part Description



### <Reference>

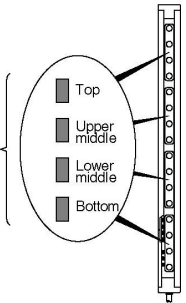
• Contents of packing			
Sensor	SF2-N□(-PN) (-H)	Emitter	1 pc.
		Receiver	1 pc.
	MS-SF2N-1		1 set
Rear sensor mounting bracket			
Rear sensor mounting bracket: 4 pcs., Hexagon-socket-head bolt: 8 pcs.			
U-shaped rear mounting intermediate supporting bracket	MS-SF2N-2 (MS-SF4A-H2 for 'H' type)	0 to 5 sets	
One set consists of U-shaped rear mounting supporting bracket: 2 pcs., Retaining plate: 2 pcs.			
L-shaped intermediate supporting bracket	MS-SF2N-L	0 to 5 sets	
One set consists of L-shaped intermediate supporting bracket: 2 pcs., Hexagon-socket-head bolt: 2 pcs., Pan head screw: 2 pcs., Nut: 2 pcs.			
Note: MS-SF2N-2 or MS-SF4A-H2 (U-shaped rear mounting intermediate supporting bracket) and MS-SF2N-L (L-shaped intermediate supporting bracket) are attached with the following sensors. The number attached is different depending on the sensor as follows.			
1 set: SF2-NH36□, SF2-NH40□, SF2-NA18□, SF2-NA20□			
2 sets: SF2-NH48□, SF2-NA24□			
3 sets: SF2-NH56□, SF2-NH64□, SF2-NA28□, SF2-NA32□, SF2-NA36□			
4 sets: SF2-NA40□			
Test rod	SF2-NH□: SF2-NH-TR (ø 30×220mm)···attached		1 pc.
	SF2-NA□: SF2-NA-TR (ø 50×220mm)···option		
Instruction Manual			1 pc.

Emitter:	It emits light to the receiver facing it. Further, the status of the emitter and the receiver is indicated in its display section.
Receiver:	It receives light from the emitter facing it, and turns the control output (OSSD) to ON when light is received from the emitter for all beam channels, and to OFF when light is blocked even for one beam channel. Further, the receiver status is indicated in its display section.
Beam channel:	The light emitting elements of the emitter and the light receiving elements of the receiver are placed at an interval of 20mm ( <b>SF2-NH□</b> ) or an interval of 40mm ( <b>SF2-NA□</b> ).
Rear sensor mounting: bracket	This bracket is to be used for mounting the emitter/receiver from the rear. It enables the mounting angle to be adjusted. The rear sensor mounting brackets included in the packing are designed specifically for rear mounting. If side mounting is required, please place an order for the optional side sensor mounting brackets ( <b>MS-SF2N-3</b> ).
U-shaped rear mounting: intermediate supporting bracket	These brackets are to be used to attach the sensor with its total length of the sensor be 36 beams channels or more ( <b>SF2-NA□</b> : 18 beams channels or more) to the place where is attached by intense vibration.
L-shaped intermediate supporting bracket	Please note that the enclosed U-shaped rear intermediate supporting brackets are designed specifically for rear mounting. If side mounting is required, please place an order for the optional side intermediate supporting brackets ( <b>MS-SF2N-4</b> or <b>MS-SF4A-H4</b> for 'H' type). The L-shaped intermediate supporting bracket is used for rear mounting and side mounting in common.

#### <Display Section>

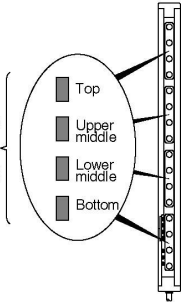
##### Emitter

Beam-axis alignment indicator [RECEPTION]	Top	red/green	when sensor top receives light: lights up in red when sensor top, upper middle, lower middle and bottom receives light: lights up in green
	Upper middle	red/green	when sensor upper middle receives light: lights up in red when sensor top, upper middle, lower middle and bottom receives light: lights up in green
	Lower middle	red/green	when sensor lower middle receives light: lights up in red when sensor top, upper middle, lower middle and bottom receives light: lights up in green
	Bottom	red/green	when sensor bottom receives light: lights up in red when sensor top, upper middle, lower middle and bottom receives light: lights up in green
Operation indicator [OSSD] (Note 1)		red/green	lights up during sensor operation as follows: lights up in red when OSSD is OFF. lights up in green when OSSD is ON.
Emission halt indicator [HALT]		orange	lights up when light emission is halted
Fault indicator [FAULT]		yellow	lights up or blinks when a fault occurs in the sensor



##### Receiver

Beam-axis alignment indicator [RECEPTION]	Top	red/green	when sensor top receives light: lights up in red when sensor top, upper middle, lower middle and bottom receives light: lights up in green
	Upper middle	red/green	when sensor upper middle receives light: lights up in red when sensor top, upper middle, lower middle and bottom receives light: lights up in green
	Lower middle	red/green	when sensor lower middle receives light: lights up in red when sensor top, upper middle, lower middle and bottom receives light: lights up in green
	Bottom	red/green	when sensor bottom receives light: lights up in red when sensor top, upper middle, lower middle and bottom receives light: lights up in green
OSSD indicator [OSSD]		red/green	lights up in red when OSSD is OFF. lights up in green when OSSD is ON.
Unstable incident beam indicator [STB.]		orange	lights up when light received is unstable
Fault indicator [FAULT]		yellow	lights up or blinks when a fault occurs in the sensor



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

2) The description given in [ ] is marked on the sensor.

## 2.3 Specifications

### Model-wise specifications

Type		20mm beam pitch type						
Item	Model No.	SF2-NH8 (-PN) (-H)	SF2-NH12 (-PN) (-H)	SF2-NH16 (-PN) (-H)	SF2-NH20 (-PN) (-H)	SF2-NH24 (-PN) (-H)	SF2-NH28 (-PN) (-H)	SF2-NH32 (-PN) (-H)
No. of beam channels		8	12	16	20	24	28	32
Beam pitch		20mm						
Protective height (Sensing height)		190mm	270mm	350mm	430mm	510mm	590mm	670mm
Current consumption		Emitter: 60mA or less, Receiver: 100mA or less					Emitter: 90mA or less Receiver: 150mA or less	
Weight (total of the emitter and the receiver)	SF2-NH□(-PN)	390g approx.	490g approx.	580g approx.	680g approx.	790g approx.	870g approx.	980g approx.
	SF2-NH□(-PN)-H	440g approx.	590g approx.	730g approx.	890g approx.	1,000g approx.	1,200g approx.	1,300g approx.

Type		20mm beam pitch type				
Item	Model No.	SF2-NH36 (-PN) (-H)	SF2-NH40 (-PN) (-H)	SF2-NH48 (-PN) (-H)	SF2-NH56 (-PN) (-H)	SF2-NH64 (-PN) (-H)
No. of beam channels		36	40	48	56	64
Beam pitch		20mm				
Protective height (Sensing height)		750mm	830mm	990mm	1,150mm	1,310mm
Current consumption		Emitter: 90mA or less Receiver: 150mA or less			Emitter: 120mA or less Receiver: 220mA or less	
Weight (total of the emitter and the receiver)	SF2-NH□(-PN)	1,070g approx.	1,160g approx.	1,370g approx.	1,550g approx.	1,800g approx.
	SF2-NH□(-PN)-H	1,500g approx.	1,600g approx.	1,900g approx.	2,200g approx.	2,500g approx.

Type		40mm beam pitch type						
Item	Model No.	SF2-NA4 (-PN) (-H)	SF2-NA6 (-PN) (-H)	SF2-NA8 (-PN) (-H)	SF2-NA10 (-PN) (-H)	SF2-NA12 (-PN) (-H)	SF2-NA14 (-PN) (-H)	SF2-NA16 (-PN) (-H)
No. of beam channels		4	6	8	10	12	14	16
Beam pitch		40mm						
Protective height (Sensing height)		190mm	270mm	350mm	430mm	510mm	590mm	670mm
Current consumption		Emitter: 60mA or less, Receiver: 100mA or less					Emitter: 90mA or less Receiver: 150mA or less	
Weight (total of the emitter and the receiver)	SF2-NA□(-PN)	390g approx.	490g approx.	580g approx.	680g approx.	790g approx.	870g approx.	980g approx.
	SF2-NA□(-PN)-H	440g approx.	590g approx.	730g approx.	890g approx.	1,000g approx.	1,200g approx.	1,300g approx.

Type Model No.		40mm beam pitch type						
		SF2-NA18 (-PN) (-H)	SF2-NA20 (-PN) (-H)	SF2-NA24 (-PN) (-H)	SF2-NA28 (-PN) (-H)	SF2-NA32 (-PN) (-H)	SF2-NA36 (-PN) (-H)	SF2-NA40 (-PN) (-H)
Item								
No. of beam channels		18	20	24	28	32	36	40
Beam pitch		40mm						
Protective height (Sensing height)		750mm	830mm	990mm	1,150mm	1,310mm	1,470mm	1,630mm
Current consumption		Emitter: 90mA or less Receiver: 150mA or less			Emitter: 120mA or less, Receiver: 220mA or less			
Weight (total of the emitter and the receiver)	SF2-NA□(-PN)	1,070g approx.	1,160g approx.	1,370g approx.	1,550g approx.	1,800g approx.	1,940g approx.	2,130g approx.
	SF2-NA□(-PN)-H	1,500g approx.	1,600g approx.	1,900g approx.	2,200g approx.	2,500g approx.	2,800g approx.	3,000g approx.

## MODEL No.

SF2 – N	*	*	*	*
				Nil : Normal case type -H : With spatter protection hood
				Nil : NPN output type -PN: PNP output type
				Number of beam channels
				H: beam pitch 20mm A: beam pitch 40mm

Example:

**SF2-NH48**

Beam pitch: 20mm

No. of beam channels: 48ch

Output: NPN output type

Case: Normal case type

## Common specifications

Type		NPN output type		PNP output type	
Item	Model No.	SF2-NH□(-H)	SF2-NA□(-H)	SF2-NH□-PN(-H)	SF2-NA□-PN(-H)
Operating range (Sensing range)		0.3 to 7m			
Detection capability (Min. sensing object)		Ø 30mm opaque object	Ø 50mm opaque object	Ø 30mm opaque object	Ø 50mm opaque object
Effective aperture angle (EAA)		±5 ° or less [for a sensing range exceeding 3m (as required IEC 61496-2)]			
Supply voltage		24V DC±15% Ripple P-P 10% or less			
Output (OSSD)		NPN open-collector transistor • Max. sink current: 200mA • Applied voltage: same as supply voltage (between OSSD and 0V) • Residual voltage: 2.0V or less (at 200mA sink current)		PNP open-collector transistor • Max. source current: 200mA • Applied voltage: same as supply voltage (between OSSD and +V) • Residual voltage: 2.5V or less (at 200mA source current)	
	Operation mode	ON when all beams are received, OFF when one or more beams are interrupted (OFF also in case of any abnormality in the sensor or the synchronization signal)			
	Protection circuit	Incorporated			
Response time		OFF response: 15ms or less, ON response: 28ms or less (when light received is stable)			
Output (Alarm output)		NPN open-collector transistor • Max. sink current: 60mA • Applied voltage: same as supply voltage (between alarm output and 0V) • Residual voltage: 2.0V or less (at 60mA sink current)		PNP open-collector transistor • Max. source current: 60mA • Applied voltage: same as supply voltage (between alarm output and +V) • Residual voltage: 2.5V or less (at 60mA source current)	
	Operation mode	Normal operation: Alarm output ON Failure resulting in emission halt, or when test input is applied: Alarm output OFF			
	Protection circuit	Incorporated			
Indicators	Emitter	Beam-axis alignment indicator: 2-color (Red/Green) LED×4 (Lights up in red when the respective area receives light, lights up in green when all beams are received) Operation indicator: 2-color (Red/Green) LED (Note 1) (Lights up in red when OSSD is OFF, lights up in green when OSSD is ON) Emission halt indicator: Orange LED (lights up when light emission is halted) Fault indicator: Yellow LED (lights up or blinks when a fault occurs in the sensor)			
	Receiver	Beam-axis alignment indicator: 2-color (Red/Green) LED×4 (Lights up in red when the respective area receives light, lights up in green when all beams are received) OSSD indicator: 2-color (Red/Green) LED (Lights up in red when OSSD is OFF, lights up in green when OSSD is ON) Unstable incident beam indicator: Orange LED (Lights up when light received is unstable) Fault indicator: Yellow LED (lights up or blinks when a fault occurs in the sensor)			

Item \ Model No.		Type	NPN output type		PNP output type	
		SF2-NH□(-H)	SF2-NA□(-H)	SF2-NH□-PN(-H)	SF2-NA□-PN(-H)	
Interference prevention function		Incorporated (Series connection: 3 sets max., parallel connection: 2 sets max.) Series connection of 3 sets max. and parallel connection of 2 sets max. are simultaneously possible. Max. beam channels for series connection: <b>SF2-NH□</b> : 128 <b>SF2-NA□</b> : 64 <b>SF2-NH□</b> and <b>SF2-NA□</b> cannot be combined together in series connection.				
Emission halt function		Incorporated				
Test input function		0 to +1.5V: normal operation (at 2mA or less sink current) Open, or 4V to Vs (Note 2): Test (self-diagnosis)·emission halt are carried out.				
Master/Slave switching input		Connection to 0V: master mode operation Open: slave mode operation				
Environmental specifications	Degree of protection	IP65 (IEC)				
	Ambient temperature	-10 to +55°C (No dew condensation or icing allowed), Storage: -25 to +70°C				
	Ambient humidity	30 to 85% RH, Storage: 30 to 95% RH				
	Ambient illuminance	Sunlight: 20,000lx at the light-receiving face, Incandescent light: 3,500lx at the light-receiving face				
	Dielectric strength voltage	1,000V AC for one min. (between all supply terminals connected together and enclosure) (Note 3)				
	Insulation resistance	20MΩ, or more, with 500V DC megger (between all supply terminals connected together and enclosure) (Note 3)				
	Vibration resistance	10 to 55Hz frequency, 0.75mm amplitude in X, Y and Z directions for two hours each				
	Shock resistance	300m/s <sup>2</sup> acceleration (30G approx.) in X, Y and Z directions for three times each				
Emitting element		Infrared LED (Peak emission wavelength: 870nm)				
Cable		Emitter : 6-core (0.3mm <sup>2</sup> × 4-core, 0.2mm <sup>2</sup> x 2-core) shielded cable, 0.5m long, with a connector at the end Receiver : 7-core (0.3mm <sup>2</sup> × 5-core, 0.2mm <sup>2</sup> x 2-core) shielded cable, 0.5m long, with a connector at the end				
Material		Enclosure: Aluminum, Front face: ABS, Lens: Polycarbonate Cable: Oil-resistant PVC, Cap: PBT				
Accessories		<b>MS-SF2N-1</b> (Rear sensor mounting bracket): 1 set <b>MS-SF2N-2</b> (U-shaped rear mounting intermediate supporting bracket, <b>MS-SF4A-H2</b> for ‘H’ type): (Note 4) <b>MS-SF2N-L</b> (L-shaped intermediate supporting bracket): (Note 4) <b>SF2-AH-TR</b> (Test rod): 1 No. (enclosed in <b>SF2-AH□</b> )				
Applicable standard		EN 954-1 Category 2 (IEC 61496-1/2 Type 2)				

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

2) Vs is the same voltage as the voltage of the power supply to be used.

3) Surge absorber is connected between the main body case and the supply terminals, to avoid faulty operation due to surge.

For this reason, the values for dielectric strength voltage and insulation resistance are given for the condition when the surge absorber has been removed.

4) **MS-SF2N-2** or **MS-SF4A-H2** (U-shaped rear mounting intermediate supporting bracket) and **MS-SF2N-L** (L-shaped intermediate supporting bracket) are attached with the following sensors. The number of attached brackets is different depending on the sensor as follows.

1 set: **SF2-NH36□**, **SF2-NH40□**, **SF2-NA18□**, **SF2-NA20□**

2 sets: **SF2-NH48□**, **SF2-NA24□**

3 sets: **SF2-NH56□**, **SF2-NH64□**, **SF2-NA28□**, **SF2-NA32□**, **SF2-NA36□**

4 sets: **SF2-NA40□**

### <Reference>

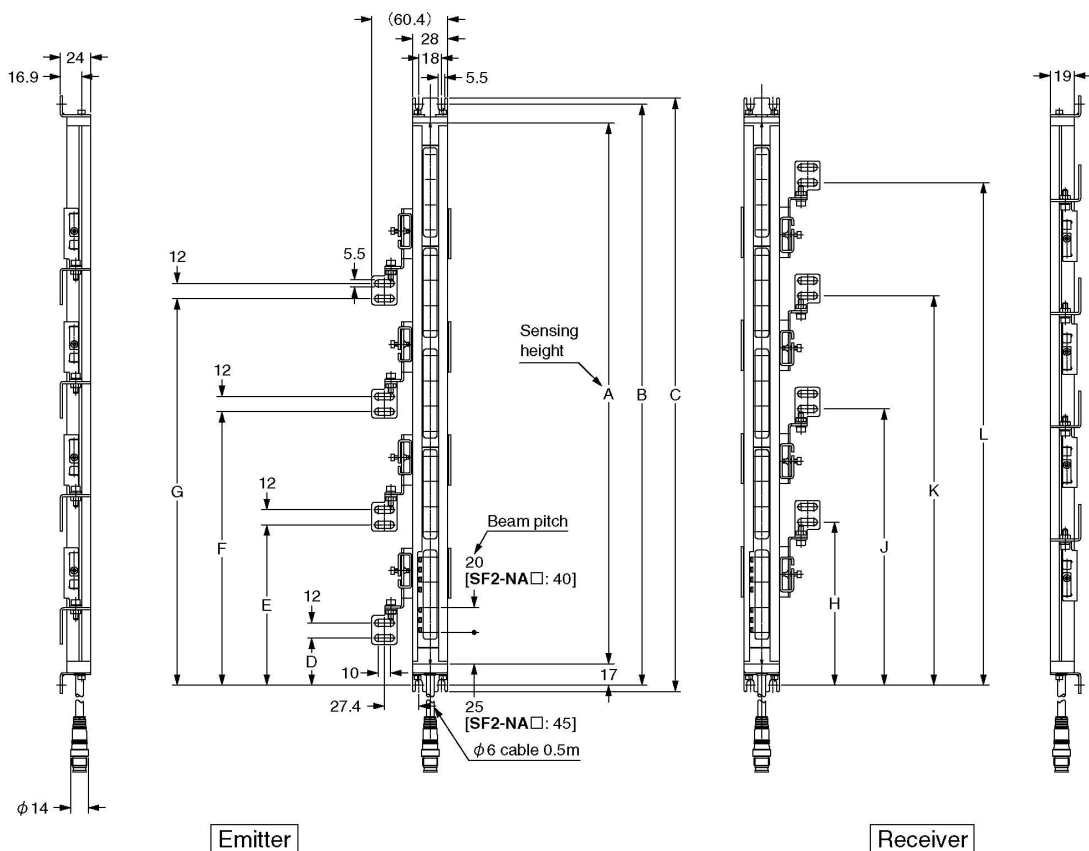
Be sure to use a set of the emitter and receiver having the same serial No. since they have been adjusted as a set at the time of factory shipment.

The serial No. is indicated in each name plate of the emitter and receiver.

## 2.4 Dimensions

### 2.4.1 Rear Mounting

#### SF2-N□



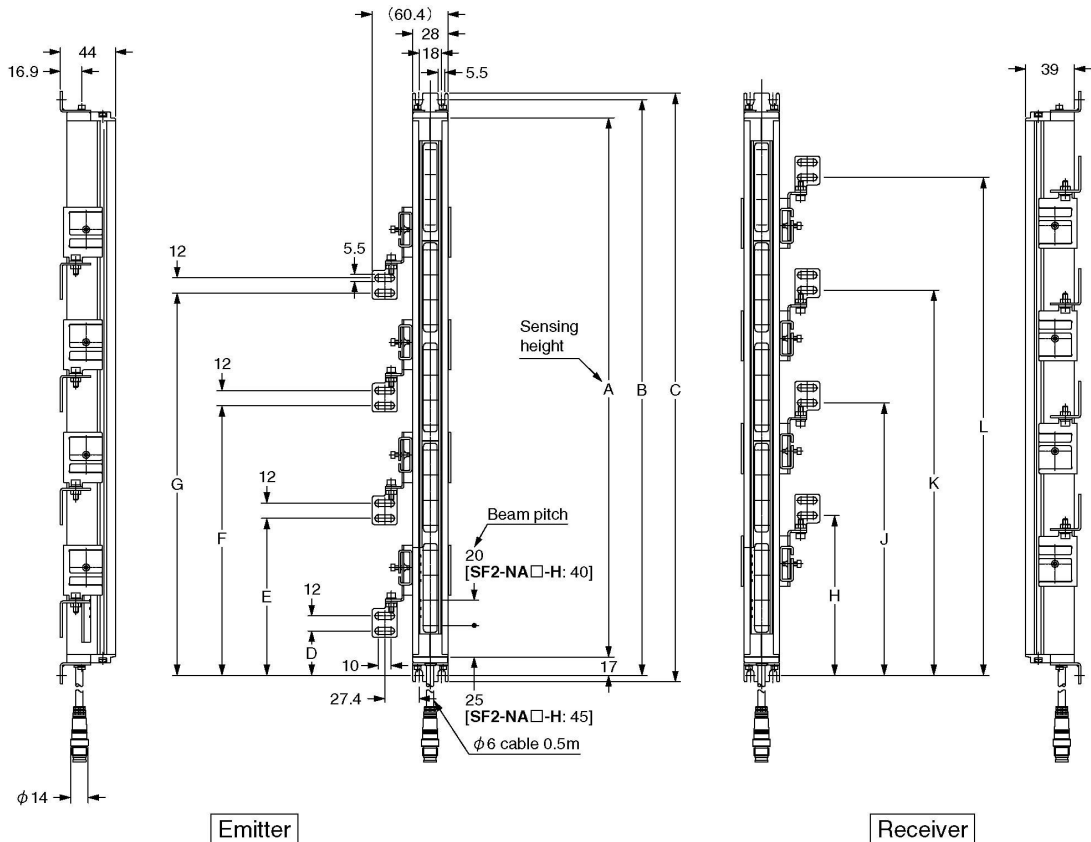
(Unit: mm)

#### <Reference>

SF2-NH□ (Unit: mm)												SF2-NA□ (Unit: mm)											
Model No.	A	B	C	D	E	F	G	H	J	K	L	Model No.	A	B	C	D	E	F	G	H	J	K	L
SF2-NH8□	190	222	232	—	—	—	—	—	—	—	—	SF2-NA4□	190	222	232	—	—	—	—	—	—	—	—
SF2-NH12□	270	302	312	—	—	—	—	—	—	—	—	SF2-NA6□	270	302	312	—	—	—	—	—	—	—	—
SF2-NH16□	350	382	392	—	—	—	—	—	—	—	—	SF2-NA8□	350	382	392	—	—	—	—	—	—	—	—
SF2-NH20□	430	462	472	—	—	—	—	—	—	—	—	SF2-NA10□	430	462	472	—	—	—	—	—	—	—	—
SF2-NH24□	510	542	552	—	—	—	—	—	—	—	—	SF2-NA12□	510	542	552	—	—	—	—	—	—	—	—
SF2-NH28□	590	622	632	—	—	—	—	—	—	—	—	SF2-NA14□	590	622	632	—	—	—	—	—	—	—	—
SF2-NH32□	670	702	712	—	—	—	—	—	—	—	—	SF2-NA16□	670	702	712	—	—	—	—	—	—	—	—
SF2-NH36□	750	782	792	337	—	—	—	433	—	—	—	SF2-NA18□	750	782	792	337	—	—	—	433	—	—	—
SF2-NH40□	830	862	872	377	—	—	—	473	—	—	—	SF2-NA20□	830	862	872	377	—	—	—	473	—	—	—
SF2-NH48□	990	1,022	1,032	377	537	—	—	473	633	—	—	SF2-NA24□	990	1,022	1,032	377	537	—	—	473	633	—	—
SF2-NH56□	1,150	1,182	1,192	377	537	697	—	473	633	793	—	SF2-NA28□	1,150	1,182	1,192	377	537	697	—	473	633	793	—
SF2-NH64□	1,310	1,342	1,352	457	617	777	—	553	713	873	—	SF2-NA32□	1,310	1,342	1,352	457	617	777	—	553	713	873	—
												SF2-NA36□	1,470	1,502	1,512	537	697	857	—	633	793	953	—
												SF2-NA40□	1,630	1,662	1,672	537	697	857	1,017	633	793	953	1,113

Notes: 1) MS-SF2N-2 (U-shaped rear mounting intermediate supporting bracket) and MS-SF2N-L (L-shaped intermediate supporting bracket) are attached with the sensors. The number of attached brackets is different depending on the sensor.  
2) The minimum bending radius of the cable is R30mm. Mount the sensor considering the cable bending radius.

## SF2-N□-H



(Unit: mm)

### <Reference>

#### SF2-NH□-H (Unit: mm)

Model No.	A	B	C	D	E	F	G	H	J	K	L
SF2-NH8□-H	190	222	232	—	—	—	—	—	—	—	—
SF2-NH12□-H	270	302	312	—	—	—	—	—	—	—	—
SF2-NH16□-H	350	382	392	—	—	—	—	—	—	—	—
SF2-NH20□-H	430	462	472	—	—	—	—	—	—	—	—
SF2-NH24□-H	510	542	552	—	—	—	—	—	—	—	—
SF2-NH28□-H	590	622	632	—	—	—	—	—	—	—	—
SF2-NH32□-H	670	702	712	—	—	—	—	—	—	—	—
SF2-NH36□-H	750	782	792	337	—	—	—	433	—	—	—
SF2-NH40□-H	830	862	872	377	—	—	—	473	—	—	—
SF2-NH48□-H	990	1,022	1,032	377	537	—	—	473	633	—	—
SF2-NH56□-H	1,150	1,182	1,192	377	537	697	—	473	633	793	—
SF2-NH64□-H	1,310	1,342	1,352	457	617	777	—	553	713	873	—

#### SF2-NA□-H (Unit: mm)

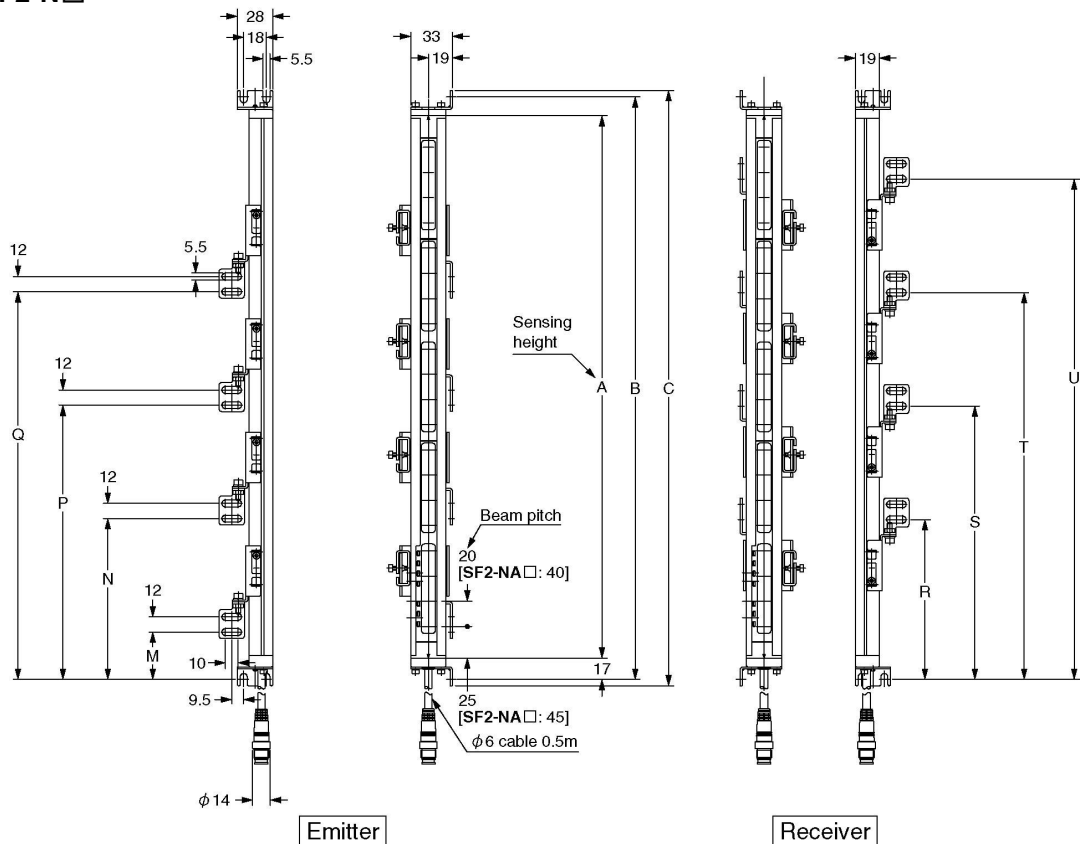
Model No.	A	B	C	D	E	F	G	H	J	K	L
SF2-NA4□-H	190	222	232	—	—	—	—	—	—	—	—
SF2-NA6□-H	270	302	312	—	—	—	—	—	—	—	—
SF2-NA8□-H	350	382	392	—	—	—	—	—	—	—	—
SF2-NA10□-H	430	462	472	—	—	—	—	—	—	—	—
SF2-NA12□-H	510	542	552	—	—	—	—	—	—	—	—
SF2-NA14□-H	590	622	632	—	—	—	—	—	—	—	—
SF2-NA16□-H	670	702	712	—	—	—	—	—	—	—	—
SF2-NA18□-H	750	782	792	337	—	—	—	433	—	—	—
SF2-NA20□-H	830	862	872	377	—	—	—	473	—	—	—
SF2-NA24□-H	990	1,022	1,032	377	537	—	—	473	633	—	—
SF2-NA28□-H	1,150	1,182	1,192	377	537	697	—	473	633	793	—
SF2-NA32□-H	1,310	1,342	1,352	457	617	777	—	553	713	873	—
SF2-NA36□-H	1,470	1,502	1,512	537	697	857	—	633	793	953	—
SF2-NA40□-H	1,630	1,662	1,672	537	697	857	1,017	633	793	953	1,113

Notes: 1) **MS-SF4A-H2** (U-shaped rear mounting intermediate supporting bracket) and **MS-SF2N-L** (L-shaped intermediate supporting bracket) are attached with the sensors. The number of attached brackets is different depending on the sensor.  
2) The minimum bending radius of the cable is R30mm. Mount the sensor considering the cable bending radius.

## 2.4.2 Side Mounting

Using the side sensor mounting bracket, **MS-SF2N-3**, and the side mounting intermediate supporting bracket, **MS-SF2N-4** (**MS-SF4A-H4** for 'H' type), which are optionally available, ensures easy side mounting. The number of side mounting intermediate supporting brackets required differs according to the sensing height. When ordering them, please refer to the table in the **<Reference>** box below.

### SF2-N□



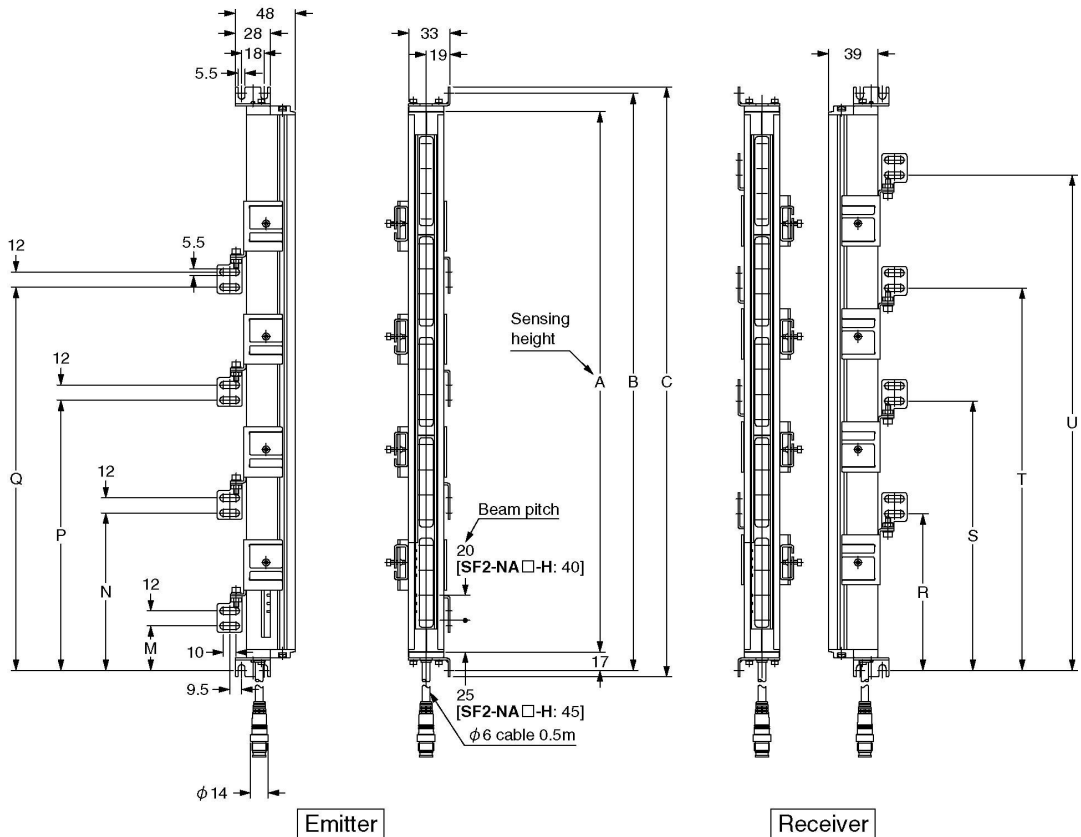
(Unit: mm)

### <Reference>

SF2-NH□												(Unit: mm)												SF2-NA□												(Unit: mm)											
Model No.	A	B	C	M	N	P	Q	R	S	T	U	Model No.	A	B	C	M	N	P	Q	R	S	T	U	Model No.	A	B	C	M	N	P	Q	R	S	T	U												
SF2-NH8□	190	222	232	—	—	—	—	—	—	—	—	SF2-NA4□	190	222	232	—	—	—	—	—	—	—	—	SF2-NA6□	270	302	312	—	—	—	—	—	—	—	—												
SF2-NH12□	270	302	312	—	—	—	—	—	—	—	—	SF2-NA8□	350	382	392	—	—	—	—	—	—	—	—	SF2-NA10□	430	462	472	—	—	—	—	—	—	—	—												
SF2-NH16□	350	382	392	—	—	—	—	—	—	—	—	SF2-NA12□	510	542	552	—	—	—	—	—	—	—	—	SF2-NA14□	590	622	632	—	—	—	—	—	—	—	—												
SF2-NH20□	430	462	472	—	—	—	—	—	—	—	—	SF2-NA16□	670	702	712	—	—	—	—	—	—	—	—	SF2-NA18□	750	782	792	340	—	—	—	430	—	—	—												
SF2-NH24□	510	542	552	—	—	—	—	—	—	—	—	SF2-NA20□	830	862	872	380	—	—	—	—	470	—	—	SF2-NA24□	990	1,022	1,032	380	540	—	—	470	630	—	—												
SF2-NH28□	590	622	632	—	—	—	—	—	—	—	—	SF2-NA28□	1,150	1,182	1,192	380	540	700	—	470	630	790	—	SF2-NA32□	1,310	1,342	1,352	460	620	780	—	550	710	870	—												
SF2-NH32□	670	702	712	—	—	—	—	—	—	—	—	SF2-NA36□	1,470	1,502	1,512	540	700	860	—	630	790	950	—	SF2-NA40□	1,630	1,662	1,672	540	700	860	1,020	630	790	950	1,110												
SF2-NH36□	750	782	792	340	—	—	—	430	—	—	—																																				
SF2-NH40□	830	862	872	380	—	—	—	470	—	—	—																																				
SF2-NH48□	990	1,022	1,032	380	540	—	—	470	630	—	—																																				
SF2-NH56□	1,150	1,182	1,192	380	540	700	—	470	630	790	—																																				
SF2-NH64□	1,310	1,342	1,352	460	620	780	—	550	710	870	—																																				

Notes: 1) The number of the **MS-SF2N-4** (U-shaped side mounting intermediate supporting bracket) and **MS-SF2N-L** (L-shaped intermediate supporting bracket) to be used differs depending on the sensor.  
2) The minimum bending radius of the cable is R30mm. Mount the sensor considering the cable bending radius.

## SF2-N□-H



(Unit: mm)

### <Reference>

#### SF2-NH□-H (Unit: mm)

Model No.	A	B	C	M	N	P	Q	R	S	T	U
SF2-NH8□-H	190	222	232	—	—	—	—	—	—	—	—
SF2-NH12□-H	270	302	312	—	—	—	—	—	—	—	—
SF2-NH16□-H	350	382	392	—	—	—	—	—	—	—	—
SF2-NH20□-H	430	462	472	—	—	—	—	—	—	—	—
SF2-NH24□-H	510	542	552	—	—	—	—	—	—	—	—
SF2-NH28□-H	590	622	632	—	—	—	—	—	—	—	—
SF2-NH32□-H	670	702	712	—	—	—	—	—	—	—	—
SF2-NH36□-H	750	782	792	340	—	—	—	430	—	—	—
SF2-NH40□-H	830	862	872	380	—	—	—	470	—	—	—
SF2-NH48□-H	990	1,022	1,032	380	540	—	—	470	630	—	—
SF2-NH56□-H	1,150	1,182	1,192	380	540	700	—	470	630	790	—
SF2-NH64□-H	1,310	1,342	1,352	460	620	780	—	550	710	870	—

#### SF2-NA□-H (Unit: mm)

Model No.	A	B	C	M	N	P	Q	R	S	T	U
SF2-NA4□-H	190	222	232	—	—	—	—	—	—	—	—
SF2-NA6□-H	270	302	312	—	—	—	—	—	—	—	—
SF2-NA8□-H	350	382	392	—	—	—	—	—	—	—	—
SF2-NA10□-H	430	462	472	—	—	—	—	—	—	—	—
SF2-NA12□-H	510	542	552	—	—	—	—	—	—	—	—
SF2-NA14□-H	590	622	632	—	—	—	—	—	—	—	—
SF2-NA16□-H	670	702	712	—	—	—	—	—	—	—	—
SF2-NA18□-H	750	782	792	340	—	—	—	430	—	—	—
SF2-NA20□-H	830	862	872	380	—	—	—	470	—	—	—
SF2-NA24□-H	990	1,022	1,032	380	540	—	—	470	630	—	—
SF2-NA28□-H	1,150	1,182	1,192	380	540	700	—	470	630	790	—
SF2-NA32□-H	1,310	1,342	1,352	460	620	780	—	550	710	870	—
SF2-NA36□-H	1,470	1,502	1,512	540	700	860	—	630	790	950	—
SF2-NA40□-H	1,630	1,662	1,672	540	700	860	1,020	630	790	950	1,110

Notes: 1) The number of the **MS-SF4A-H4** (U-shaped side mounting intermediate supporting bracket) and **MS-SF2N-L** (L-shaped intermediate supporting bracket) to be used differs depending on the sensor.

2) The minimum bending radius of the cable is R30mm. Mount the sensor considering the cable bending radius.

The following figure shows the dimensions of the device mounted with the optional bottom cap cable for series connection (**SF2N-CB05**).

Technical drawings of the SF2-NA sensor assembly, showing front, side, and detail views with dimensions and labels.

**Front View (Left):** Shows the overall dimensions of the sensor assembly. Key dimensions include a total width of 24, a mounting bracket width of 16.9, and a central cable diameter of  $\phi 14$ . The sensor head is labeled with a diameter of 28 and a mounting bracket width of 18. The sensing height is indicated as 5.5.

**Side View (Right):** Shows the profile of the sensor assembly. Key dimensions include a total height of 19, a mounting bracket height of 12, and a central cable diameter of  $\phi 6$  cable 0.5m. The sensing height is indicated as 5.5.

**Detail View (Bottom):** Shows the internal components of the sensor assembly. Key dimensions include a total width of 24, a mounting bracket width of 16.9, and a central cable diameter of  $\phi 14$ . The sensor head is labeled with a diameter of 28 and a mounting bracket width of 18. The sensing height is indicated as 5.5.

**Labels:**

- Sensing height
- Beam pitch
- 20 [SF2-NA□: 40]
- 25 [SF2-NA□: 45]
- $\phi 6$  cable 0.5m

### <Reference>

SF2-NH□

(Unit: mm)

Model No.	A	V	W	X	Y	Z	a	c	d	e	f
SF2-NH8□	190	237	247	—	—	—	—	—	—	—	—
SF2-NH12□	270	317	327	—	—	—	—	—	—	—	—
SF2-NH16□	350	397	407	—	—	—	—	—	—	—	—
SF2-NH20□	430	477	487	—	—	—	—	—	—	—	—
SF2-NH24□	510	557	567	—	—	—	—	—	—	—	—
SF2-NH28□	590	637	647	—	—	—	—	—	—	—	—
SF2-NH32□	670	717	727	—	—	—	—	—	—	—	—
SF2-NH36□	750	797	807	345	—	—	—	441	—	—	—
SF2-NH40□	830	877	887	385	—	—	—	481	—	—	—
SF2-NH48□	990	1,037	1,047	385	545	—	—	481	641	—	—
SF2-NH56□	1,150	1,197	1,207	385	545	705	—	481	641	801	—
SF2-NH64□	1,310	1,357	1,367	465	625	785	—	561	721	881	—

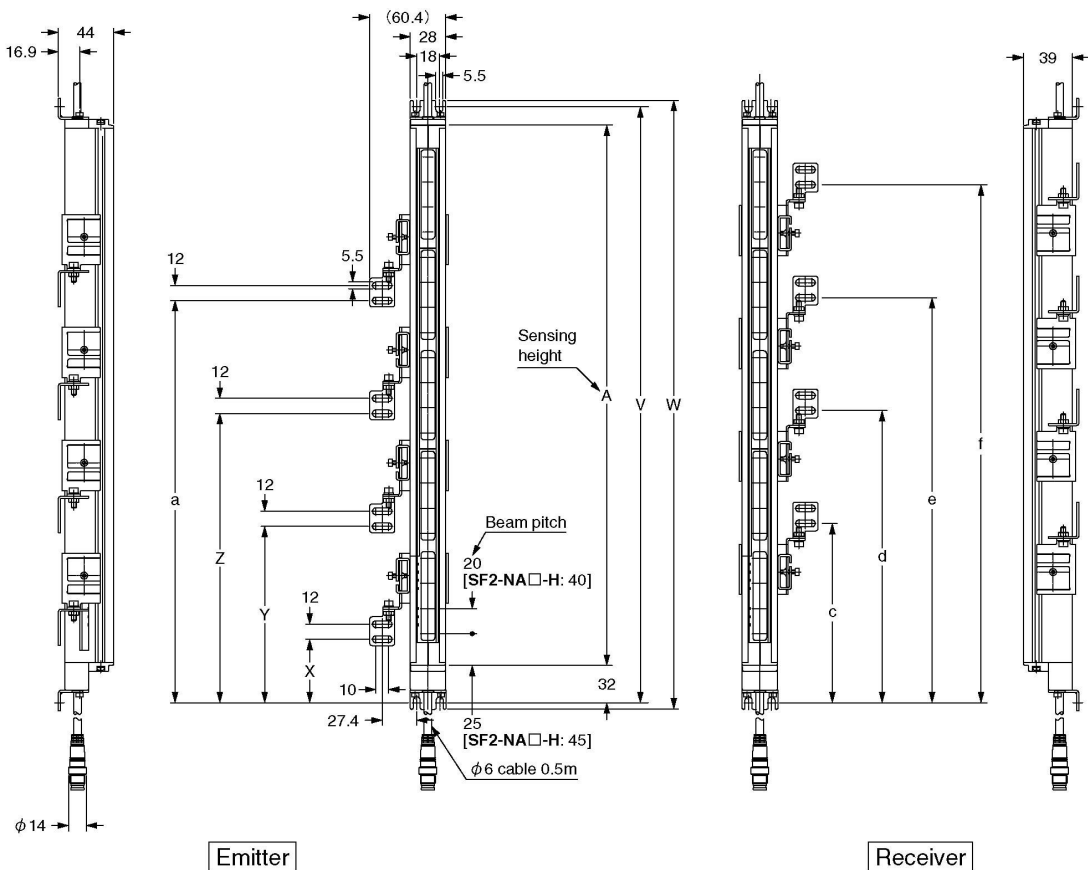
SF2-NA□

(Unit: mm)

Model No.	A	V	W	X	Y	Z	a	c	d	e	f
SF2-NA4□	190	237	247	—	—	—	—	—	—	—	—
SF2-NA6□	270	317	327	—	—	—	—	—	—	—	—
SF2-NA8□	350	397	407	—	—	—	—	—	—	—	—
SF2-NA10□	430	477	487	—	—	—	—	—	—	—	—
SF2-NA12□	510	557	567	—	—	—	—	—	—	—	—
SF2-NA14□	590	637	647	—	—	—	—	—	—	—	—
SF2-NA16□	670	717	727	—	—	—	—	—	—	—	—
SF2-NA18□	750	797	807	345	—	—	—	441	—	—	—
SF2-NA20□	830	887	877	385	—	—	—	481	—	—	—
SF2-NA24□	990	1,037	1,047	385	545	—	—	481	641	—	—
SF2-NA28□	1,150	1,197	1,207	385	545	705	—	481	641	801	—
SF2-NA32□	1,310	1,357	1,367	465	625	785	—	561	721	881	—
SF2-NA36□	1,470	1,517	1,527	545	705	865	—	641	801	961	—
SF2-NA40□	1,630	1,677	1,687	545	705	865	1,025	641	801	961	1,121

Notes: 1) **MS-SF2N-2** (U-shaped rear mounting intermediate supporting bracket) and **MS-SF2N-L** (L-shaped intermediate supporting bracket) are attached with the sensors. The number of attached brackets is different depending on the sensor.  
2) The minimum bending radius of the cable is R30mm. Mount the sensor considering the cable bending radius.

**SF2-N□-H**



(Unit: mm)

**-<Reference>**

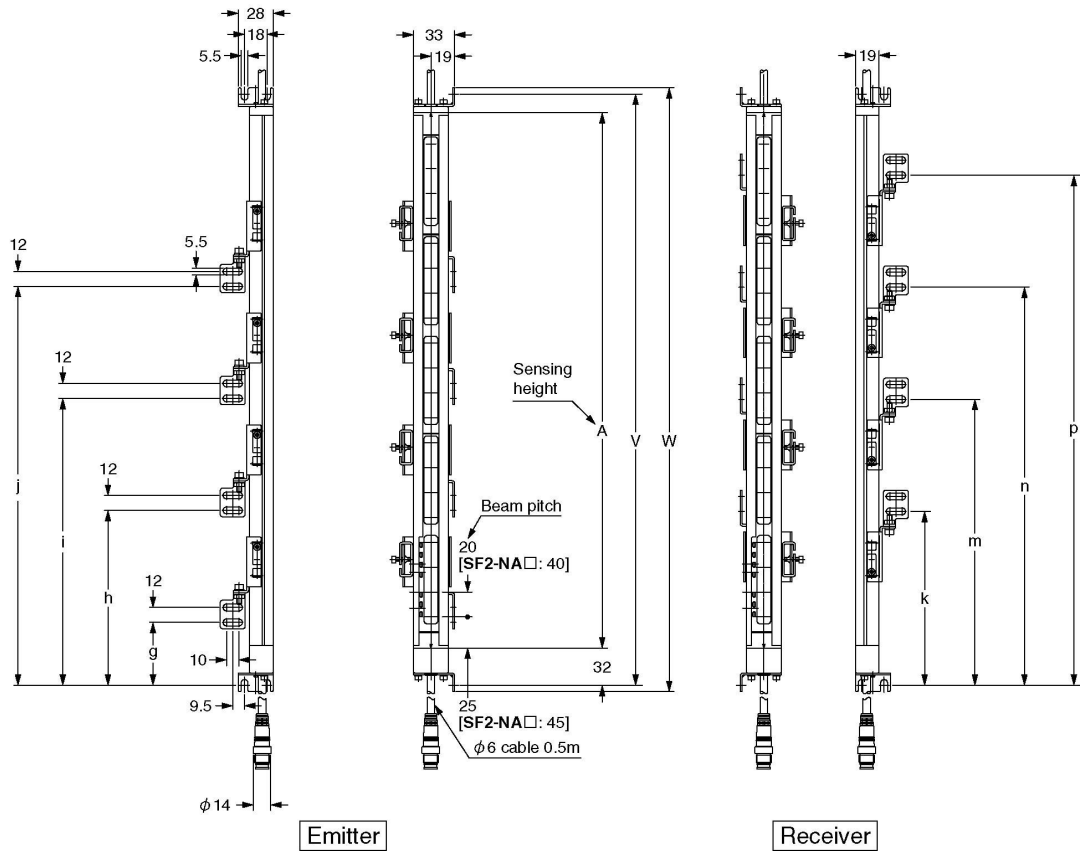
SF2-NH□-H												(Unit: mm)										SF2-NA□-H												(Unit: mm)									
Model No.	A	V	W	X	Y	Z	a	c	d	e	f	Model No.	A	V	W	X	Y	Z	a	c	d	e	f	Model No.	A	V	W	X	Y	Z	a	c	d	e	f								
SF2-NH8□-H	190	237	247	—	—	—	—	—	—	—	—	SF2-NA4□-H	190	237	247	—	—	—	—	—	—	—	—	SF2-NA6□-H	270	317	327	—	—	—	—	—	—	—	—								
SF2-NH12□-H	270	317	327	—	—	—	—	—	—	—	—	SF2-NA8□-H	350	397	407	—	—	—	—	—	—	—	—	SF2-NA10□-H	430	477	487	—	—	—	—	—	—	—	—								
SF2-NH16□-H	350	397	407	—	—	—	—	—	—	—	—	SF2-NA12□-H	510	557	567	—	—	—	—	—	—	—	—	SF2-NA14□-H	590	637	647	—	—	—	—	—	—	—	—								
SF2-NH20□-H	430	477	487	—	—	—	—	—	—	—	—	SF2-NA16□-H	670	717	727	—	—	—	—	—	—	—	—	SF2-NA18□-H	750	797	807	345	—	—	—	441	—	—	—								
SF2-NH24□-H	510	557	567	—	—	—	—	—	—	—	—	SF2-NA20□-H	830	887	877	385	—	—	—	481	—	—	—	SF2-NA24□-H	990	1,037	1,047	385	545	—	—	481	641	—	—								
SF2-NH28□-H	590	637	647	—	—	—	—	—	—	—	—	SF2-NA28□-H	1,150	1,197	1,207	385	545	705	—	481	641	801	—	SF2-NH56□-H	1,150	1,197	1,207	385	545	705	—	481	641	801	—								
SF2-NH32□-H	670	717	727	—	—	—	—	—	—	—	—	SF2-NA32□-H	1,310	1,357	1,367	465	625	785	—	561	721	881	—	SF2-NH64□-H	1,310	1,357	1,367	465	625	785	—	561	721	881	—								
SF2-NH36□-H	750	797	807	345	—	—	—	441	—	—	—	SF2-NA36□-H	1,470	1,517	1,527	545	705	865	—	641	801	961	—	SF2-NA40□-H	1,630	1,677	1,687	545	705	865	1,025	641	801	961	1,121								

Notes: 1) **MS-SF4A-H2** (U-shaped rear mounting intermediate supporting bracket) and **MS-SF2N-L** (L-shaped intermediate supporting bracket) are attached with the sensors. The number of attached brackets is different depending on the sensor.  
2) The minimum bending radius of the cable is R30mm. Mount the sensor considering the cable bending radius.

## 2.4.4 Side Mounting for Series Connection

The following figure shows the dimensions of the device mounted with the optional bottom cap cable for series connection (**SF2N-CB05**).

### SF2-N□



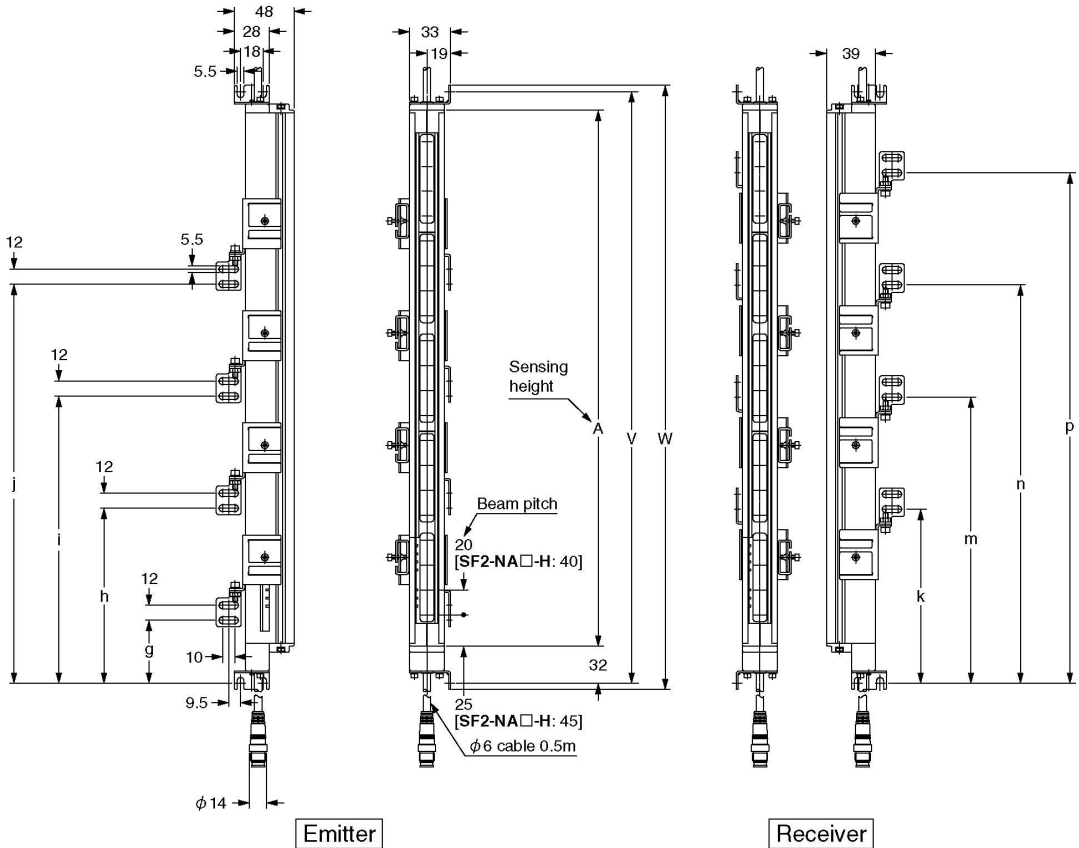
(Unit: mm)

#### <Reference>

SF2-NH□ (Unit: mm)												SF2-NA□ (Unit: mm)											
Model No.	A	V	W	g	h	i	j	k	m	n	p	Model No.	A	V	W	g	h	i	j	k	m	n	p
SF2-NH8□	190	237	247	—	—	—	—	—	—	—	—	SF2-NA4□	190	237	247	—	—	—	—	—	—	—	—
SF2-NH12□	270	317	327	—	—	—	—	—	—	—	—	SF2-NA6□	270	317	327	—	—	—	—	—	—	—	—
SF2-NH16□	350	397	407	—	—	—	—	—	—	—	—	SF2-NA8□	350	397	407	—	—	—	—	—	—	—	—
SF2-NH20□	430	477	487	—	—	—	—	—	—	—	—	SF2-NA10□	430	477	487	—	—	—	—	—	—	—	—
SF2-NH24□	510	557	567	—	—	—	—	—	—	—	—	SF2-NA12□	510	557	567	—	—	—	—	—	—	—	—
SF2-NH28□	590	637	647	—	—	—	—	—	—	—	—	SF2-NA14□	590	637	647	—	—	—	—	—	—	—	—
SF2-NH32□	670	717	727	—	—	—	—	—	—	—	—	SF2-NA16□	670	717	727	—	—	—	—	—	—	—	—
SF2-NH36□	750	797	807	348	—	—	—	438	—	—	—	SF2-NA18□	750	797	807	348	—	—	—	438	—	—	—
SF2-NH40□	830	877	887	388	—	—	—	478	—	—	—	SF2-NA20□	830	877	887	388	—	—	—	478	—	—	—
SF2-NH48□	990	1,037	1,047	388	548	—	—	478	638	—	—	SF2-NA24□	990	1,037	1,047	388	548	—	—	478	638	—	—
SF2-NH56□	1,150	1,197	1,207	388	548	708	—	478	638	798	—	SF2-NA28□	1,150	1,197	1,207	388	548	708	—	478	638	798	—
SF2-NH64□	1,310	1,357	1,367	468	628	788	—	558	718	878	—	SF2-NA32□	1,310	1,357	1,367	468	628	788	—	558	718	878	—
												SF2-NA36□	1,470	1,517	1,527	548	708	868	—	638	798	958	—
												SF2-NA40□	1,630	1,677	1,687	548	708	868	1,028	638	798	958	1,118

- Notes: 1) The number of the **MS-SF2N-4** (U-shaped side mounting intermediate supporting bracket) and **MS-SF2N-L** (L-shaped intermediate supporting bracket) to be used differs depending on the sensor.  
 2) The minimum bending radius of the cable is R30mm. Mount the sensor considering the cable bending radius.

**SF2-N□-H**



(Unit: mm)

### <Reference>

SF2-NH□-H											(Unit: mm)	SF2-NA□-H											(Unit: mm)
Model No.	A	V	W	g	h	i	j	k	m	n	p	Model No.	A	V	W	g	h	i	j	k	m	n	p
SF2-NH8□-H	190	237	247	—	—	—	—	—	—	—	—	SF2-NA4□-H	190	237	247	—	—	—	—	—	—	—	—
SF2-NH12□-H	270	317	327	—	—	—	—	—	—	—	—	SF2-NA6□-H	270	317	327	—	—	—	—	—	—	—	—
SF2-NH16□-H	350	397	407	—	—	—	—	—	—	—	—	SF2-NA8□-H	350	397	407	—	—	—	—	—	—	—	—
SF2-NH20□-H	430	477	487	—	—	—	—	—	—	—	—	SF2-NA10□-H	430	477	487	—	—	—	—	—	—	—	—
SF2-NH24□-H	510	557	567	—	—	—	—	—	—	—	—	SF2-NA12□-H	510	557	567	—	—	—	—	—	—	—	—
SF2-NH28□-H	590	637	647	—	—	—	—	—	—	—	—	SF2-NA14□-H	590	637	647	—	—	—	—	—	—	—	—
SF2-NH32□-H	670	717	727	—	—	—	—	—	—	—	—	SF2-NA16□-H	670	717	727	—	—	—	—	—	—	—	—
SF2-NH36□-H	750	797	807	348	—	—	—	438	—	—	—	SF2-NA18□-H	750	797	807	348	—	—	—	438	—	—	—
SF2-NH40□-H	830	877	887	388	—	—	—	478	—	—	—	SF2-NA20□-H	830	877	887	388	—	—	—	478	—	—	—
SF2-NH48□-H	990	1,037	1,047	388	548	—	—	478	638	—	—	SF2-NA24□-H	990	1,037	1,047	388	548	—	—	478	638	—	—
SF2-NH56□-H	1,150	1,197	1,207	388	548	708	—	478	638	798	—	SF2-NA28□-H	1,150	1,197	1,207	388	548	708	—	478	638	798	—
SF2-NH64□-H	1,310	1,357	1,367	468	628	788	—	558	718	878	—	SF2-NA32□-H	1,310	1,357	1,367	468	628	788	—	558	718	878	—
												SF2-NA36□-H	1,470	1,517	1,527	548	708	868	—	638	798	958	—
												SF2-NA40□-H	1,630	1,677	1,687	548	708	868	1,028	638	798	958	1,118

Notes: 1) The number of the **MS-SF4A-H4** (U-shaped side mounting intermediate supporting bracket) and **MS-SF2N-L** (L-shaped intermediate supporting bracket) to be used differs depending on the sensor.

2) The minimum bending radius of the cable is R30mm. Mount the sensor considering the cable bending radius.

## 2.5 Functions

### ⚠ WARNING

In order to maintain safety, carry out the self-diagnosis at least once a day. If the self-diagnosis is not carried out periodically, discovery of an unexpected abnormality may get delayed, increasing the danger of this device malfunctioning, which can result in serious injury or death.

### 2.5.1 Test Input (Self-diagnosis Function)

This device is equipped with a test input.

If the test input wire is made open for 28ms, or more, or connected to +4V to Vs, detailed diagnosis, in addition to the internal self-diagnosis being done during normal operation, is carried out.

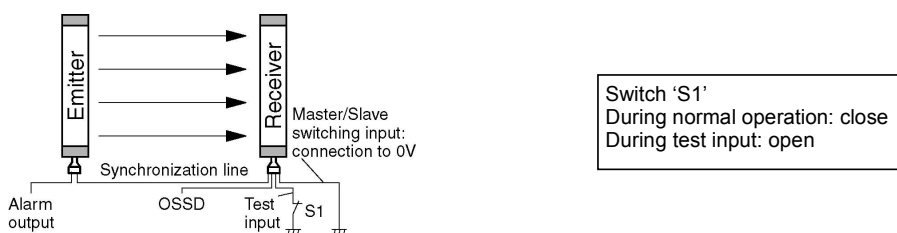
The self-diagnosis is carried out approximately 28ms after the test input wire is made open, or connected to +4V to Vs.

The maximum time taken for the self-diagnosis is 150ms. In case no abnormality is discovered during self-diagnosis, and if the test input is continued to be kept open after that, emission halt state is continued. In case an abnormality is discovered during self-diagnosis, the device is put in the lockout state at that instant, and the OSSD and alarm outputs are fixed at the OFF state. Refer to 'Chapter 5 Troubleshooting', and rectify the cause of the abnormality.

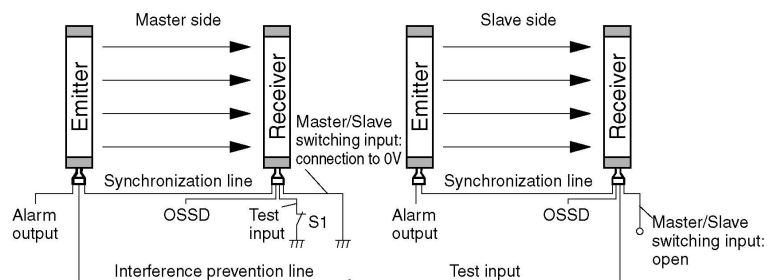
Note: Vs is the same voltage as the voltage of the power supply to be used.

#### <Wiring of test input>

##### Connection of one set of sensor or series connection of multiple sets of sensors



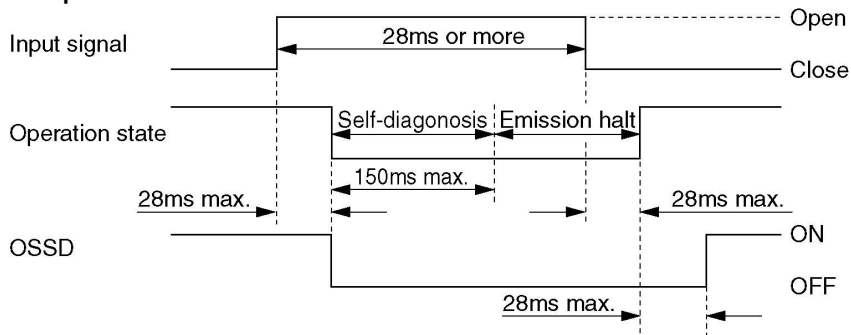
##### Parallel connection



#### <Reference>

In case of parallel connection, if the master side test input is made open, self-diagnosis and emission halt is carried out for both master and slave sensors. Self-diagnosis and emission halt cannot be carried out separately for master and slave.

### <Timing of test input>



### <Operation state>

	Normal operation (Light received)	Normal operation (Light blocked)	Self-diagnosis (Test input: open)	Emission halt (Test input: open)	Lockout (in abnormal state)
OSSD	ON	OFF	OFF	OFF	Fixed at OFF
Alarm output	ON	ON	OFF	OFF	Fixed at OFF
Emission halt indicator (Orange)	Turns off	Turns off	Lights up	Lights up	Lights up
Fault indicator (Yellow)	Turns off	Turns off	Turns off	Turns off	Lights up or blinks

## 2.5.2 Emission Halt Function

This function stops the emission process of the emitter.

Emission halt state is achieved when no abnormality is detected during self-diagnosis in '**2.5.1 Test Input**' and the test input is continued to be kept open after that.

During emission halt, OSSD and alarm output become OFF.

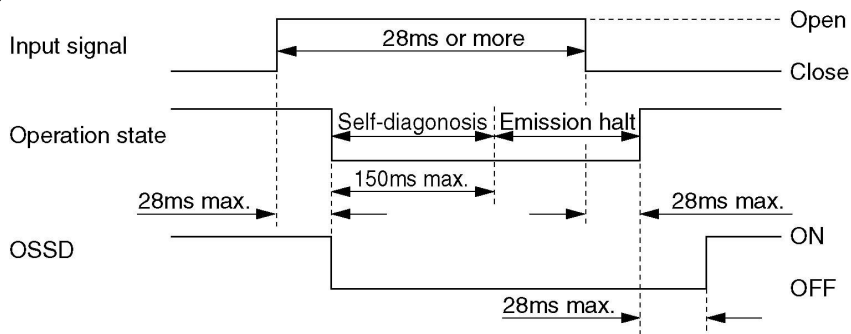
By using this function, malfunction due to extraneous noise, or abnormality in OSSD and alarm output, can be determined even from the equipment side.

Normal operation is restored when the test input wire is connected to 0 to +1.5V.

### ⚠ WARNING

Do not use the self-diagnosis function / emission halt function for the purpose of stopping the equipment. There is a danger of serious injury or death.

### <Time chart>



### 2.5.3 Alarm Output

#### ⚠ WARNING

Be sure to use the alarm output incorporated in this device.  
If it is not used, the equipment may not be stopped when a fault occurs during an unexpected OSSD damage, which can result in serious injury or death.

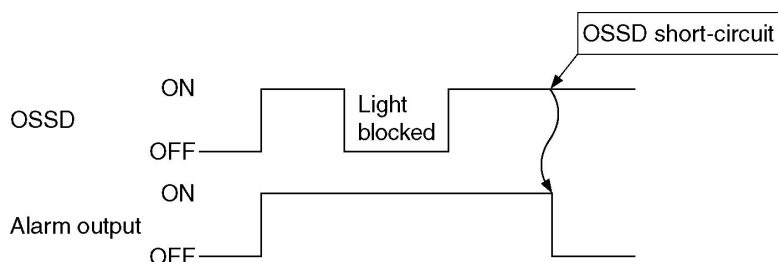
In addition to the OSSD output, this device incorporates an alarm output. The alarm output is incorporated on the emitter.

Since the occurrence of a fault, such as that due to an external short-circuit, cannot be conveyed to the equipment side by OSSD only, the alarm output generates a warning signal.

Design a system such that the equipment side can be stopped when either OSSD or alarm output is OFF output.

The alarm output is ON during normal operation and turns off in the following cases.

- When a fault resulting in emission halt condition occurs. (Example: In case of abnormality due to OSSD short-circuit etc.)
- When the test input is being applied.



### 2.5.4 Interference Prevention Function

It is possible to construct a system to prevent malfunction due to interference of light between **SF2-N** series devices.

An interference prevention system for 3 sets max. connected in series or 2 sets max. connected in parallel can be constructed. Further, it is possible for the system to simultaneously have 3 sets in series connection and 2 sets in parallel connection.

There is a limitation on the number of the beam channels in one series connection set as follows.

**SF2-NH□**: 128 beam channels max.

**SF2-NA□**: 64 beam channels max.

Refer to '3.2 Connection Configuration', and '3.4 Wiring' for the details of the method of connection and wiring.

#### ⚠ WARNING

- Do not connect **SF2-NH□** and **SF2-NA□** together in series.
- In case of series connection with **SF2-NH□**, if the number of connected sets is three or the total number of beam channels exceeds 48, replace the bottom cap cable with the optional **SF2N-CB05** (bottom cap cable for series connection).  
In case of **SF2-NA□**, carry out the replacement if the number of beam channels exceeds 24.

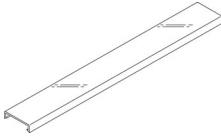
#### Example for bottom cap cable replacement

Product used	No. of sets	Total No. of beam channels	Bottom cap
<b>SF2-NH64</b>	1 set	64	Use attached bottom cap cable as it is.
<b>SF2-NH24</b> <b>SF2-NH24</b>	2 sets	48	Use attached bottom cap cable as it is.
<b>SF2-NH24</b> <b>SF2-NH28</b>	2 sets	52	Replace the bottom cap cable with optional bottom cap cable for series connection ( <b>SF2N-CB05</b> ).
<b>SF2-NH24</b> <b>SF2-NH12</b> <b>SF2-NH12</b>	3 sets	48	Replace the bottom cap cable with optional bottom cap cable for series connection ( <b>SF2N-CB05</b> ).

Refer to '3.2 Connection Configuration', and '3.4 Wiring' for the details of the method of connection and wiring. Further, the mounting dimensions in case of the accessory bottom cap cable and the optional bottom cap cable for series connection are different. Refer to '2.4 Dimensions' for details.

## 2.6 Options

### ● Front protection cover: 1 pc.



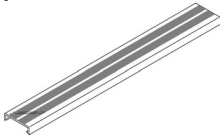
Model No.	Applicable beam channel No.	Remarks
FC-SF2N-A4	SF2-NH8□/NA4□	Protects the sensing surface of the sensor from dirt, etc.
FC-SF2N-A6	SF2-NH12□/NA6□	
FC-SF2N-A8	SF2-NH16□/NA8□	
FC-SF2N-A10	SF2-NH20□/NA10□	
FC-SF2N-A12	SF2-NH24□/NA12□	
FC-SF2N-A14	SF2-NH28□/NA14□	
FC-SF2N-A16	SF2-NH32□/NA16□	
FC-SF2N-A18	SF2-NH36□/NA18□	
FC-SF2N-A20	SF2-NH40□/NA20□	
FC-SF2N-A24	SF2-NH48□/NA24□	
FC-SF2N-A28	SF2-NH56□/NA28□	
FC-SF2N-A32	SF2-NH64□/NA32□	
FC-SF2N-A36	SF2-NA36□	
FC-SF2N-A40	SF2-NA40□	

The sensing range reduces when the front protection cover is used.

<Sensing range>

- Front protection cover on emitter side: 7m
- Front protection cover on receiver side: 6m
- Front protection covers on both sides: 5m

### ● Slit mask: 1 pc.



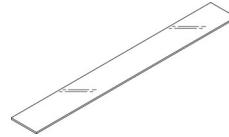
Model No.	Applicable beam channel No.	Remarks
OS-SF2N-A4	SF2-NH8□/NA4□	Restrains the amount of beam emitted or received and hence reduces the interference between neighboring sensors
OS-SF2N-A6	SF2-NH12□/NA6□	
OS-SF2N-A8	SF2-NH16□/NA8□	
OS-SF2N-A10	SF2-NH20□/NA10□	
OS-SF2N-A12	SF2-NH24□/NA12□	
OS-SF2N-A14	SF2-NH28□/NA14□	
OS-SF2N-A16	SF2-NH32□/NA16□	
OS-SF2N-A18	SF2-NH36□/NA18□	
OS-SF2N-A20	SF2-NH40□/NA20□	
OS-SF2N-A24	SF2-NH48□/NA24□	
OS-SF2N-A28	SF2-NH56□/NA28□	
OS-SF2N-A32	SF2-NH64□/NA32□	
OS-SF2N-A36	SF2-NA36□	
OS-SF2N-A40	SF2-NA40□	

The sensing range reduces when the slit is used.

<Sensing range>

- Slit on emitter side: 2.6m
- Slit on receiver side: 2.6m
- Slits on both sides: 1.2m

### ● Front protection cover for spatter protection hood: 1 pc.



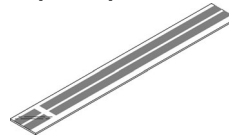
Model No.	Applicable beam channel No.	Remarks
FC-SF4A-H8-H	SF2-NH8□-H/NA4□-H	Protects the sensing surface of the sensor from dirt, etc.
FC-SF4A-H12-H	SF2-NH12□-H/NA6□-H	
FC-SF4A-H16-H	SF2-NH16□-H/NA8□-H	
FC-SF4A-H20-H	SF2-NH20□-H/NA10□-H	
FC-SF4A-H24-H	SF2-NH24□-H/NA12□-H	
FC-SF4A-H28-H	SF2-NH28□-H/NA14□-H	
FC-SF4A-H32-H	SF2-NH32□-H/NA16□-H	
FC-SF4A-H36-H	SF2-NH36□-H/NA18□-H	
FC-SF4A-H40-H	SF2-NH40□-H/NA20□-H	
FC-SF4A-H48-H	SF2-NH48□-H/NA24□-H	
FC-SF4A-H56-H	SF2-NH56□-H/NA28□-H	
FC-SF4A-H64-H	SF2-NH64□-H/NA32□-H	
FC-SF4A-H72-H	SF2-NA36□-H	
FC-SF4A-H80-H	SF2-NA40□-H	

The sensing range reduces when the front protection cover is used.

<Sensing range>

- Front protection cover on emitter side: 7m
- Front protection cover on receiver side: 6m
- Front protection covers on both sides: 5m

### ● Slit mask for spatter protection hood: 1 pc.



Model No.	Applicable beam channel No.	Remarks
OS-SF4A-H8-H	SF2-NH8□-H/NA4□-H	Restrains the amount of beam emitted or received and hence reduces the interference between neighboring sensors
OS-SF4A-H12-H	SF2-NH12□-H/NA6□-H	
OS-SF4A-H16-H	SF2-NH16□-H/NA8□-H	
OS-SF4A-H20-H	SF2-NH20□-H/NA10□-H	
OS-SF4A-H24-H	SF2-NH24□-H/NA12□-H	
OS-SF4A-H28-H	SF2-NH28□-H/NA14□-H	
OS-SF4A-H32-H	SF2-NH32□-H/NA16□-H	
OS-SF4A-H36-H	SF2-NH36□-H/NA18□-H	
OS-SF4A-H40-H	SF2-NH40□-H/NA20□-H	
OS-SF4A-H48-H	SF2-NH48□-H/NA24□-H	
OS-SF4A-H56-H	SF2-NH56□-H/NA28□-H	
OS-SF4A-H64-H	SF2-NH64□-H/NA32□-H	
OS-SF4A-H72-H	SF2-NA36□-H	
OS-SF4A-H80-H	SF2-NA40□-H	

The sensing range reduces when the slit is used.

<Sensing range>

- Slit on emitter side: 2.6m
- Slit on receiver side: 2.6m
- Slits on both sides: 1.2m

● **Mating cable with connector on one end: 2 pcs./set**

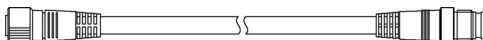
[1 pc. for emitter (connector: gray), 1 pc. for receiver (connector: black)]



Model No.	Cable length	Remarks
<b>SF2N-CC3</b>	3m	There is a connector on one end of the cable and separate wires protrude from the other end. The latter are used for wiring. For emitter: 6-core shielded cable For receiver: 7-core shielded cable With connector on one end
<b>SF2N-CC7</b>	7m	
<b>SF2N-CC10</b>	10m	

● **Extension cable with connector on both ends: 2 pcs./set**

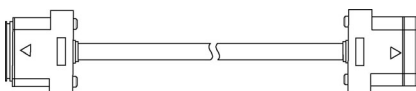
[1 pc. for emitter (connector: gray), 1 pc. for receiver (connector: black)]



Model No.	Cable length	Remarks
<b>SF2N-CCJ10</b>	10m	Each end of the cable is equipped with a connector. This cable is used for cable extension. For emitter: 6-core shielded cable For receiver: 7-core shielded cable With connector on both ends

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

(common for emitter and receiver)

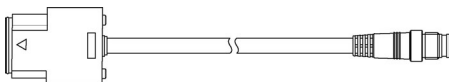


Model No.	Cable length	Remarks
<b>SF2N-CSL02</b>	200mm	Used to connect sensors in series. (Note) Common for emitter and receiver With caps
<b>SF2N-CSL05</b>	500mm	

Note: In case of series connection, if the number of connected sets is three or the total number of beam channels exceeds 48 (SF2-NA□: 24), replace the bottom cap cable with the optional bottom cap cable for series connection (SF2N-CB05).

● **Bottom cap cable for series connection: 2 pcs./set**

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

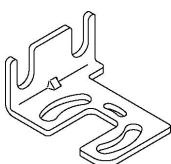


Model No.	Cable length	Remarks
<b>SF2N-CB05</b>	0.5m	Used to connect sensors in series. (Note) For emitter: 6-core shielded cable For receiver: 7-core shielded cable With caps

Notes: 1) In case of series connection, if the number of connected sets is three or the total number of beam channels exceeds 48 (SF2-NA□: 24), replace the bottom cap cable with the optional bottom cap cable for series connection (SF2N-CB05).

2) In case the bottom cap cable series connection for (SF2N-CB05) is used, the mounting dimensions are changed. For details, refer to '2-4 Dimensions'.

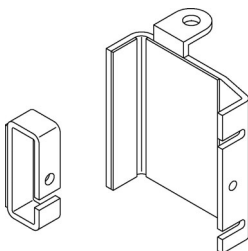
● **Side sensor mounting bracket: 4 pcs./set**



Model No.	Remarks
<b>MS-SF2N-3</b>	Used for side mounting of sensors.

● **U-shaped side mounting intermediate supporting bracket: 2 pcs./set**

[U-shaped side mounting supporting bracket, retaining plate, 2 pcs. each]



Model No.	Applicable beam channel No.	Remarks
<b>MS-SF2N-4</b>	<b>SF2-NH□/NA□</b>	Used to hold the sensor at the intermediate position for side mounting.
<b>MS-SF4A-H4</b>	<b>SF2-NH□-H/NA□-H</b>	

Note: When installing this device having (SF2-NH□: 36 beam channels or more, SF2-NA□: 18 beam channels or more) at places where vibration is intense, use the necessary number of intermediate supporting brackets at the specified positions.

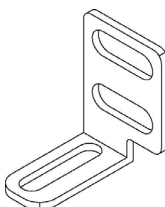
1 set: **SF2-NH36□**, **SF2-NH40□**, **SF2-NA18□**, **SF2-NA20□**

2 sets: **SF2-NH48□**, **SF2-NA24□**

3 sets: **SF2-NH56□**, **SF2-NH64□**, **SF2-NA28□**, **SF2-NA32□**, **SF2-NA36□**

4 sets: **SF2-NA40□**

● **L-shaped intermediate supporting bracket: 2 pcs./set**



M4 (length 10mm)  
hexagon-socket-head bolt: 2  
pcs., M3 (length 10 mm), pan  
head screw: 2 pcs., Nut: 2 pcs

Model No.	Remarks
<b>MS-SF2N-L</b>	Used to install the U-shaped rear (side) mounting intermediate supporting bracket on the wall side, etc.

Notes: 1) The same quantity of the intermediate supporting bracket as the U-shaped side mounting intermediate supporting bracket is required.

1 set: **SF2-NH36□**, **SF2-NH40□**, **SF2-NA18□**, **SF2-NA20□**

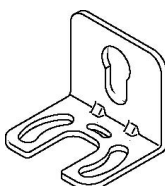
2 sets: **SF2-NH48□**, **SF2-NA24□**

3 sets: **SF2-NH56□**, **SF2-NH64□**, **SF2-NA28□**, **SF2-NA32□**, **SF2-NA36□**

4 sets: **SF2-NA40□**

2) Since L-shaped intermediate supporting bracket is common for rear mounting and side mounting, in case of side mounting of sensor, the enclosed **MS-SF2N-L** can be used.

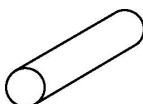
● **Center sensor mounting bracket: 4 pcs./set**



Model No.	Remarks
<b>MS-SF2N-5</b>	Used for one-point rear mounting. Convenient for mounting on an aluminum frame.

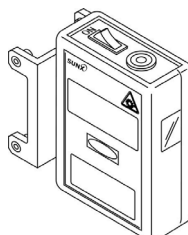
Note: When using the intermediate supporting bracket, it is not possible to mount this center sensor mounting bracket to the aluminum frame.

● **Test rod: 1 pc.**



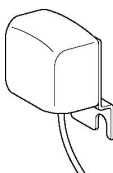
Model No.	Remarks
<b>SF2-AA-TR</b>	φ 50×220mm

● **Laser alignment tool for light curtain: 1 pc.**



Model No.	Remarks
<b>SF-LAT-2N</b>	Convenient for aligning the beam channel.

● **Large display unit for light curtain: 1 pc.**



Model No.	Remarks
<b>SF-IND-2</b>	With the large indicators put on the light curtain, the operation is easily observable from various directions.

## Chapter 3 Wiring and Mounting

This chapter describes the wiring and mounting of this device.

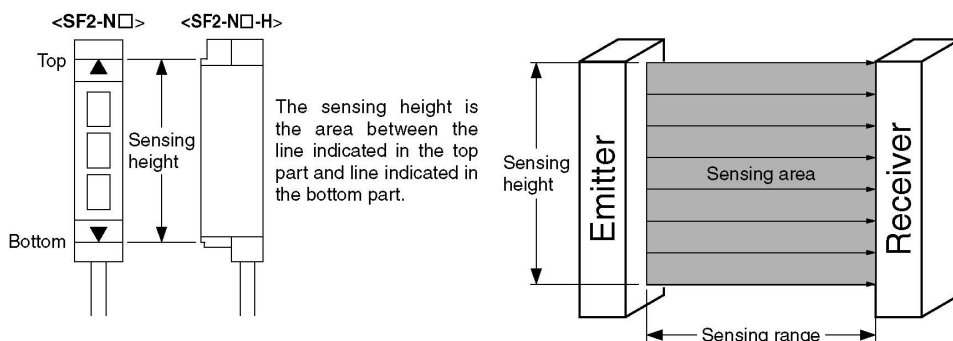
### 3.1 Protection Area

#### 3.1.1 Sensing Area

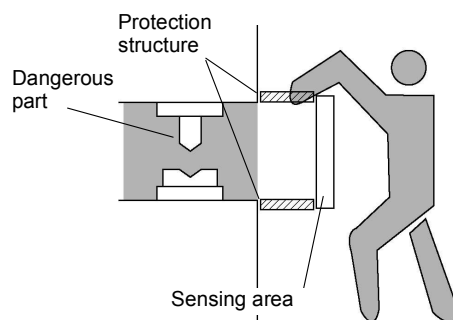
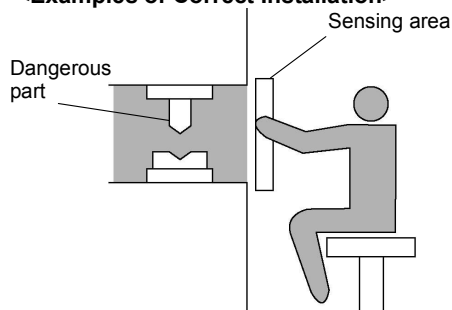
##### **⚠ WARNING**

- 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. Further, ensure that some part of the operator's body always remains in the sensing area when operation is done with the dangerous parts of the machine. Failure to do so can result in serious injury or death.
- Do not use any reflection type or recursive reflection type arrangement.

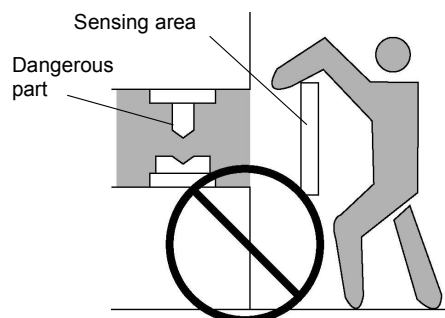
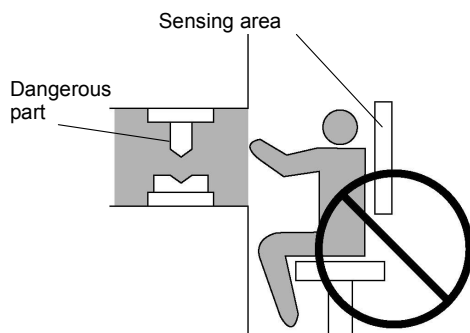
The sensing area is the zone formed by the sensing height of the sensor and the sensing range between the emitter and the receiver. The sensing height is determined by the number of beam channels. Further, the sensing range can be 0.3 to 7m.



#### <Examples of Correct Installation>



#### <Examples of Incorrect Installation>



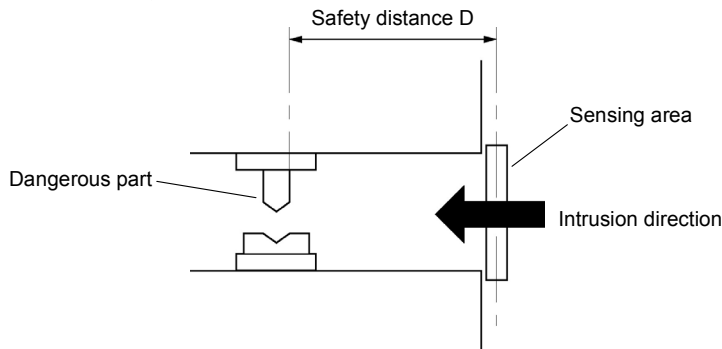
### 3.1.2 Safety Distance

#### ⚠ WARNING

Calculate the safety distance correctly, and always maintain a 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 before its dangerous parts are reached, which can result in serious injury or death.

The safety distance is the minimum distance that must be maintained between the light curtain and the dangerous parts of a 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 following equation when a person moves perpendicular (normal intrusion) to the sensing area of the area sensor.



#### ⚠ WARNING

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

Further, the equation described below 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, make sure to refer to the relevant standard (regional standard, specification of the machine, etc.) for the details of the calculation.

**[For use in Europe (EU) (as EN 999)] (For intrusion direction perpendicular to the sensing area)**

#### <SF2-NH□ (20mm beam pitch type)>

- Equation ①  $D = K \times T + C$

D: 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 (mm/s)

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

T: Response time of total equipment (s)

$T = T_m + T_{SF2}$

$T_m$ : Maximum halting time of device (s)

$T_{SF2}$ : Response time of this device, 0.015 (s)

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

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

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

d: Minimum sensing object diameter, 30 (mm)

#### <Reference>

For calculating the safety distance D, there are the following five cases.

First calculate by substituting the value  $K=2,000$  in the equation above. Then, classify the obtained value of D into three cases, 1)  $D < 100$ , 2)  $100 \leq D \leq 500$ , and 3)  $D > 500$ . For Case 3)  $D > 500$ , recalculate by substituting the value  $K=1,600$ . After that, classify the calculation result into two cases, 4)  $D \leq 500$  and 5)  $D > 500$ .

For details, refer to 'Calculation Example ①' on P. 29.

For calculating  $T_m$  (maximum halt time of the device), use a special device called a brake monitor.

### <SF2-NA□ (40mm beam pitch type)>

- Equation ②  $D=K \times T+C$

D: 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 (mm/s)

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

T: Response time of total equipment (s)

$T=T_m+T_{SF2}$

$T_m$ : Maximum halting time of device (s)

$T_{SF2}$ : Response time of this device, 0.015 (s)

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

C=850 (mm)

### <Reference>

For calculating  $T_m$  (maximum halt time of the device), use a special device called a brake monitor.

### Calculation Example ①

#### <In case of SF2-NH□ (20mm beam pitch type) (d=30mm)>

First calculate with  $K=2,000$ .

$D=K \times T+C$

$$=K \times (T_m+T_{SF2})+8 \times (d-14)$$

$$=2,000 \times (T_m+0.015)+8 \times (30-14)$$

$$=2,000 \times T_m+2,000 \times 0.015+8 \times 16$$

$$=2,000 \times T_m+158$$

1) In case  $D < 100$  (mm)

Safety distance D is taken as 100 (mm)

2) In case  $100 \leq D \leq 500$  (mm)

Safety distance D is taken as  $2,000 \times T_m+158$  (mm)

3) In case  $D > 500$  (mm)

Calculate with  $K=1,600$ .

$$D=K' \times (T_m+T_{SF2})+8 \times (d-14)$$

$$=1,600 \times (T_m+0.015)+8 \times (30-14)$$

$$=1,600 \times T_m+1,600 \times 0.015+8 \times 16$$

$$=1,600 \times T_m+152$$

then, calculate again

If the result is:

4) In case  $D \leq 500$  (mm)

Safety distance D is taken as 500 (mm)

5) In case  $D > 500$  (mm)

Safety distance D is taken as  $1,600 \times T_m+152$  (mm)

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

$$D=2,000 \times T_m+158$$

$$=2,000 \times 0.1+158$$

$$=358$$

Since this value matches with Case 2) above, D is 358 (mm).

In case this device is installed in a system with a maximum halting time of 0.3 (s)

$$D=2,000 \times T_m+158$$

$$=2,000 \times 0.3+158$$

$$=758$$

Since this value matches with Case 3) above,

$$D=1,600 \times T_m+152$$

$$=1,600 \times 0.3+152$$

$$=632$$

Since this value matches with Case 5) above, D is 632 (mm).

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

- Equation ③  $D=K \times (T_s + T_c + T_{SF2} + T_{bm}) + D_{pf}$
- D : Safety distance (mm)  
Minimum required distance between the sensing area surface and the dangerous parts of the machine
- K : Intrusion speed {Recommended value in OSHA is 63 (inch/s) [ $\approx 1,600$  (mm/s)]}  
ANSI B11.19 does not define intrusion speed (K). When determining K, consider possible factors including physical ability of operators.
- T<sub>s</sub> : Halting time calculated from the operation time of the control element (air valve, etc.) (s)
- T<sub>c</sub> : Maximum response time of the control circuit required for functioning the brake (s)
- T<sub>SF2</sub> : Response time of this device, 0.015 (s)
- T<sub>bm</sub> : Additional halting time tolerance for the brake monitor (s)  
The following equation holds when the machine is equipped with a break monitor.  
 $T_{bm} = T_a - (T_s + T_c)$
- T<sub>a</sub> : Setting time of brake monitor (s)  
When the machine is not equipped with a break monitor, it is recommended that 20%, or more, of (T<sub>s</sub>+T<sub>c</sub>) is taken as additional halting time.
- D<sub>pf</sub> : Additional distance calculated from the size of the minimum sensing object of the sensor. (mm)  
**SF2-NH** □ D<sub>pf</sub>=78.2mm  
**SF2-NA** □ D<sub>pf</sub>=146.2mm

$$\begin{aligned} D_{pf} &= 3.4 \times (d - 0.276) \text{ (inch)} \\ &= 3.4 \times (d - 7) \text{ (mm)} \\ d &: \text{Minimum sensing object diameter } 1.2 \text{ (inch)} \approx 30 \text{ (mm)} \text{ **SF2-NH** □} \\ &\quad \text{Minimum sensing object diameter } 2.0 \text{ (inch)} \approx 50 \text{ (mm)} \text{ **SF2-NA** □} \end{aligned}$$

Note that the value of D<sub>pf</sub> cannot be 0 or less.

**<Reference>**

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

**Calculation Example ②**

**<In case of SF2-NH □ (20mm beam pitch type) (d=30mm $\div$ 12inch)>**

$$\begin{aligned} D &= K \times (T_s + T_c + T_{SF2} + T_{bm}) + D_{pf} \\ &= 63 \times (T_a + 0.015) + 3.4 \times (d - 0.276) \text{ (inch)} \\ &= 63 \times (T_a + 0.015) + 3.4 \times (1.2 - 0.276) \\ &= 63 \times T_a + 63 \times 0.015 + 3.4 \times 0.924 \\ &= 63 \times T_a + 4.0866 \text{ (inch)} \\ &\approx 63 \times T_a + 4.09 \text{ (inch)} \end{aligned}$$

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

$$\begin{aligned} D &= 63 \times T_a + 4.09 \\ &= 63 \times 0.1 + 4.09 \\ &= 10.39 \end{aligned}$$

Hence, as per the calculations D is 10.39 (inch) $\approx$ 263.91 (mm).

**<Reference>**

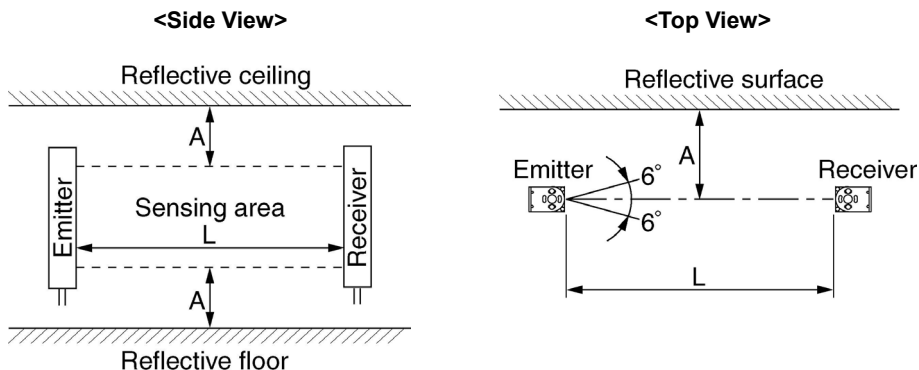
Since the calculation above is performed by taking 1(inch)=25.4(mm), there is a slight difference between the representation in (mm) and that in (inch). Refer to the relevant standard for the details.

### 3.1.3 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 sensor not to detect, resulting in death or serious injury.

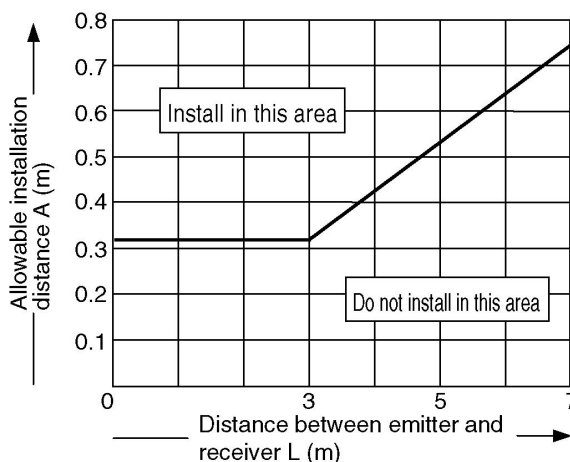
Install this device at a distance of at least A (given below) away from reflective surfaces, such as, metal walls, floors, ceilings, workpieces, covers, panels or glass surfaces.



Distance between emitter and receiver (Sensing range L)	Allowable installation distance A
0.3 to 3m	0.31m
3 to 7m	$L \times \tan \theta$ $= L \times 0.105 \text{ (m)} \text{ } (\theta = 6^\circ)$

Note: The effective aperture angle for this device is  $\pm 5^\circ$  (when  $L > 3\text{m}$ ) as required by IEC 61496-2. However, install this device away from reflective surfaces considering an effective aperture angle of  $\pm 6^\circ$  to take care of beam misalignment, etc., during installation.

Allowable Distance from Sensor to Reflective Surface



## 3.2 Connection Configuration

### ⚠ WARNING

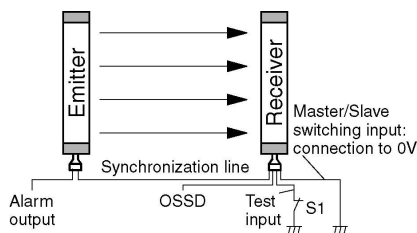
- When connecting the sensor, use the correct combination of emitter and receiver (same beam pitch and number of beam channels) and match their top-bottom orientation. Combining different types of emitter and receiver could produce a non-sensing area, which may result in serious injury or death.
- Further, facing several receivers towards one emitter, or vice versa, could produce a non-sensing area or cause mutual interference, which may result in serious injury or death.

### <Reference>

Refer to '3.4.2 Sensor Wiring Diagrams' for details of the connection (wiring) method.

### 3.2.1 Connection of One Set of Sensor

This is the common configuration using one emitter and one receiver facing each other. It is used when the dangerous area can be entered from one direction only. The output (OSSD) turns OFF if the light is blocked.



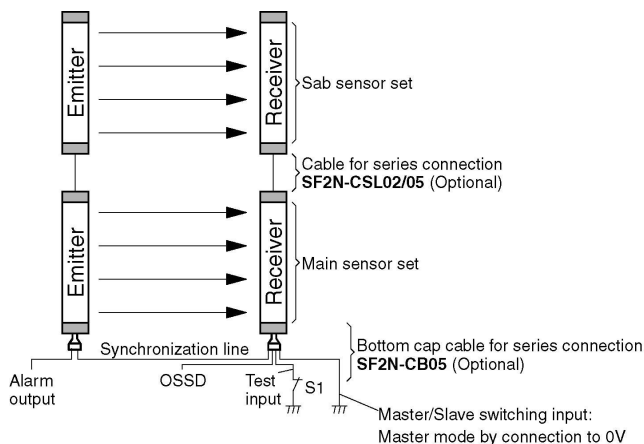
### 3.2.2 Series Connection

(connectable up to 3sets (however, **SF2-NH**□: 128 beam channels max., **SF2-NA**□: 64 beam channels max.))

This is the configuration when multiple sets of emitters and receivers facing each other are connected in series. It is used when the dangerous area can be entered from two or more directions. The output (OSSD) turns OFF if light of any set is blocked.

### ⚠ WARNING

- For sets besides the set for which the synchronization line is to be connected, connect emitter and emitter, receiver and receiver, respectively, using the exclusive cable for series connection (**SF2N-CSL02/05**). Wrong connection could produce a non-sensing area, which can result in serious injury or death.
- If 3 sets are connected in series or the total number of beam channels exceeds 48 (**SF2-NA**□: 24), replace the bottom cap cable of the main sensor set with the exclusive bottom cap cables for series connection (**SP2N-CB05**) for both emitter and receiver. If it is not replaced, the internal protection circuit of **SF2-N** may work causing a breakdown, which can result in serious injury or death.

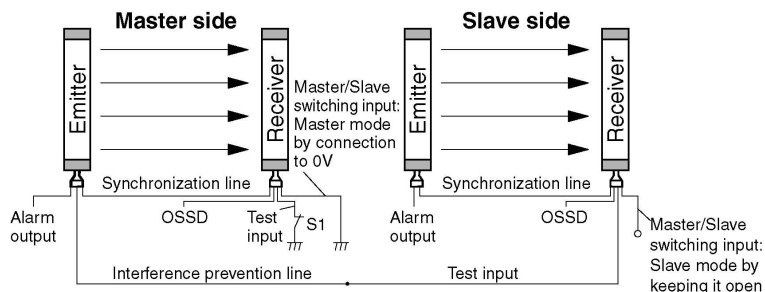


### 3.2.3 Parallel Connection

This is the configuration when 2 sets of emitter and receiver facing each other are connected in parallel. It is used when there are two, or more, dangerous areas and each dangerous area can be entered from one direction only. By connecting the interference prevention line, up to 2 sets of series-connected sets can be connected. The number of outputs is equal to the number of sets connected in parallel. Only the output (OSSD) of the set whose light is blocked turns OFF.

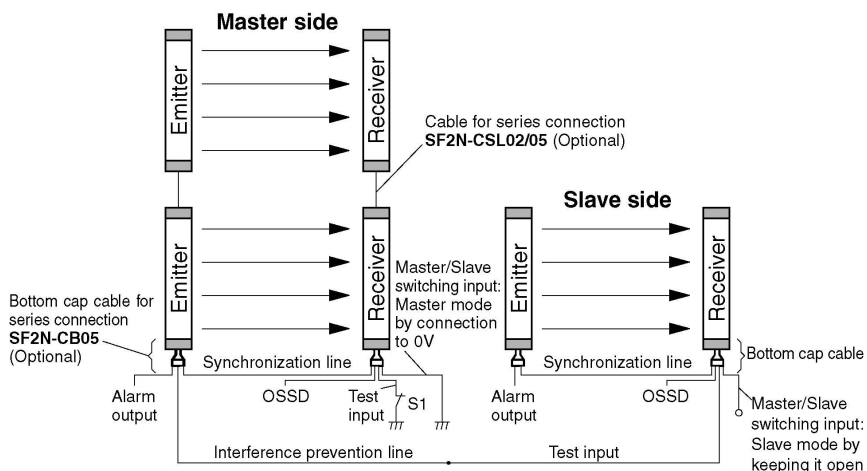
#### **⚠ WARNING**

- Do not connect emitter and emitter, receiver and receiver in parallel using the interference prevention line. Wrong connection could produce a non-sensing area, which can result in serious injury or death.
- Do not connect 3 sets or more in parallel. In addition, be sure to keep the slave's master/slave switching input open. Incorrect connection could cause mutual interference, which can result in serious injury or death.



### 3.2.4 Series and Parallel Mixed Connection

This is the configuration when multiple sets of emitter and receiver facing each other are connected in mixed series and parallel combination. It is used when there are two, or more, dangerous areas that can be entered from two, or more, directions. Depending on the combination, a maximum of 3 series-connected sets and a maximum of 2 parallel-connected sets can be connected. However, please note that the maximum number of beam channels per series connection is 128 for **SF2-NH**□ and 64 for **SF2-NA**□. The number of outputs is equal to the number of sets connected in parallel. If light of any of the sensors connected in series is blocked, only their output (OSSD) turns OFF.



#### <Reference>

Use switch 'S1' shown in the figure in '3.2.2 Series Connection', '3.2.3 Parallel Connection' and '3.2.4 Series and Parallel Mixed Connection' as follows.

During normal operation: close

During test input: open

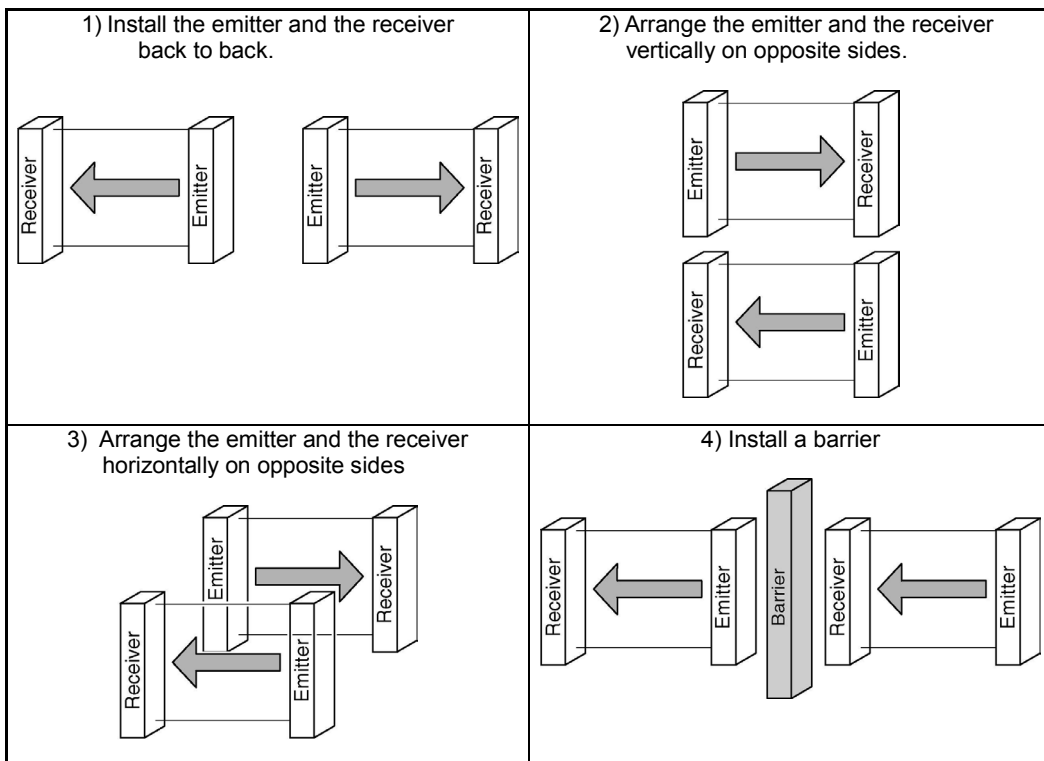
### 3.2.5 Connection without Interference Prevention Line

This is the configuration when two, or more, sets of emitter and receiver facing each other are placed without connection between them, all of them being used as masters. It is used if there is a problem in wiring or for system evaluation in case of addition of equipment. Perform an operation test by referring to '3.5.2 Operation Test'.

#### **⚠ WARNING**

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

#### <Examples of sensor placement>



#### <Reference>

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

## 3.3 Mounting

### 3.3.1 Mounting Procedure

#### ⚠CAUTION

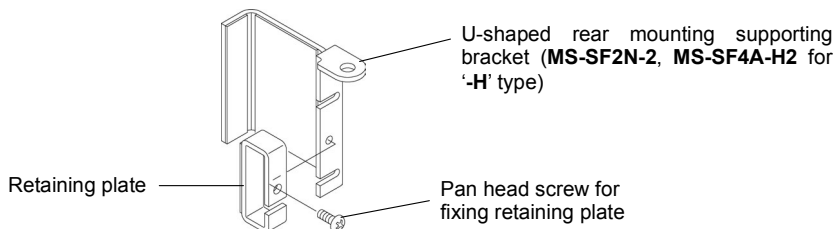
- When installing this product having 36 beam channels, or more (**SF2-NA□**: 18 beam channels, or more), at places where vibration is intense, mount the U-shaped rear (side) mounting intermediate supporting bracket and L-shaped intermediate supporting bracket.
- Wire the cable of this device such that excessive force is not applied to it, and that, after the wiring, it is not subjected to any load. Applying excessive force or any load may cause wire breakage.
- The minimum bending radius of the cable is R30mm. Mount the sensor considering the cable bending radius.

#### <Reference>

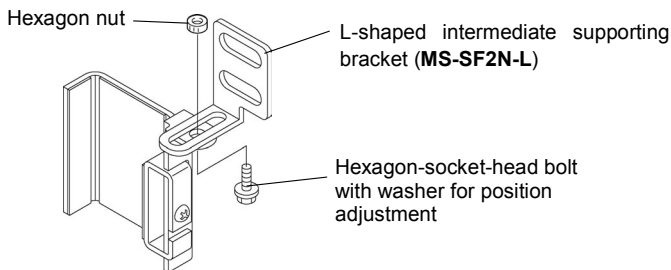
- Mount the emitter and the receiver at the same level and parallel to each other. The effective aperture angle of this device is  $\pm 5^\circ$  or less for a detection distance exceeding 3m.
- Unless otherwise specified, the following mounting procedure is common for both emitter and receiver. For the mounting, prepare the mounting holes on the mounting surface by referring to '**2.4 Dimensions**'.
- For laser alignment, it is useful to use the beam alignment tool for light curtain (**SF-LAT-2N**) (optional).

#### <Mounting of U-shaped rear mounting intermediate supporting bracket and L-shaped intermediate supporting bracket>

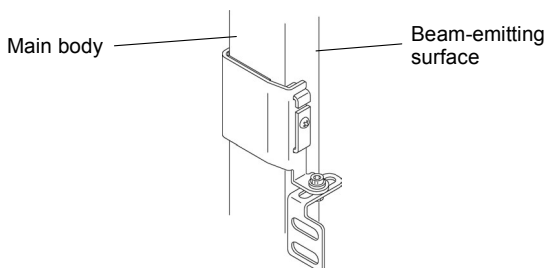
1. Place the retaining plate on the U-shaped rear mounting supporting bracket and temporarily tighten them with the pan head screw [M3 (length 10mm)].



2. Temporarily tighten the L-shaped intermediate supporting bracket to the U-shaped rear mounting supporting bracket with the hexagon-socket-head bolt with washer [M4 (length 10mm)] for position adjustment.



3. Clamp the sensor main body with the U-shaped rear mounting supporting bracket and completely tighten the pan head screw that secures the retaining plate. (Tightening torque: 0.4N·m or less)  
After beam-axis alignment, completely tighten the bolt that secures the U-shaped rear mounting supporting bracket and the L-shaped intermediate supporting bracket. (Tightening torque: 1.8N·m or less)

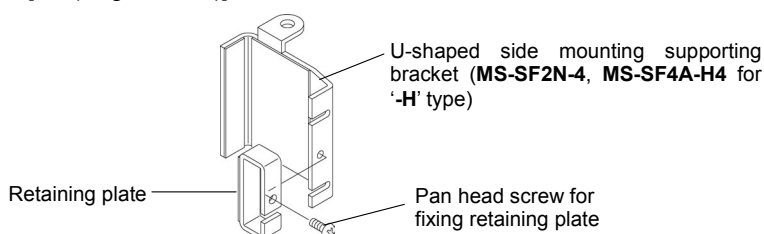


#### <Reference>

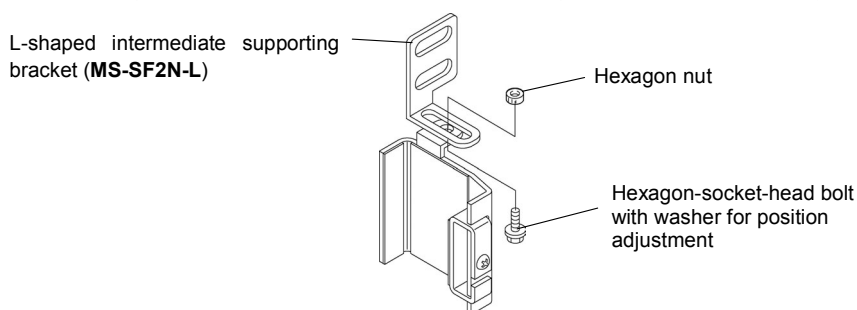
For mounting the receiver, the U-shaped rear mounting intermediate supporting bracket is mounted upside down.

### <Mounting of U-shaped side mounting intermediate supporting bracket and L-shaped intermediate supporting bracket>

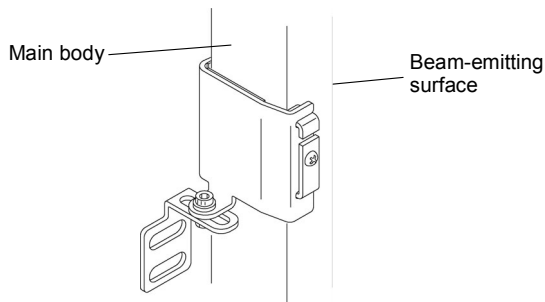
1. Place the retaining plate on the U-shaped side mounting supporting bracket and temporarily tighten them with the pan head screw [M3 (length 10mm)].



2. Temporarily tighten the L-shaped intermediate supporting bracket to the U-shaped side mounting supporting bracket with the hexagon-socket-head bolt with washer [M4 (length 10mm)] for position adjustment.



3. Clamp the sensor main body with the U-shaped side mounting supporting bracket and completely tighten the pan head screw that secures the retaining plate. (Tightening torque: 0.4N·m or less)  
After beam-axis alignment, completely tighten the bolt that secures the U-shaped side mounting supporting bracket and the L-shaped intermediate supporting bracket. (Tightening torque: 1.8N·m or less)



#### <Reference>

For mounting the receiver, the U-shaped rear mounting intermediate supporting bracket is mounted upside down.

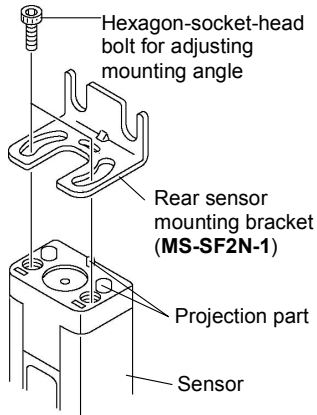
## <Mounting of rear sensor mounting bracket, side sensor mounting bracket and center sensor mounting bracket>

### ⚠CAUTION

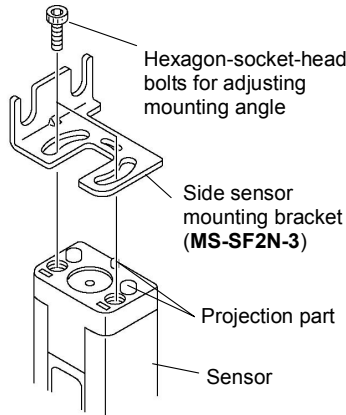
When using the intermediate supporting bracket, it is not possible to mount this center sensor mounting bracket (**MS-SF2N-5**) to the aluminum frame.

1. Choose the sensor mounting bracket to suit the application, and temporarily tighten the two hexagon-socket-head bolts [M3 (length 5mm)] for adjusting the mounting angle. After beam-axis alignment, tighten the bolts completely. (Tightening torque: 0.6N·m or less)

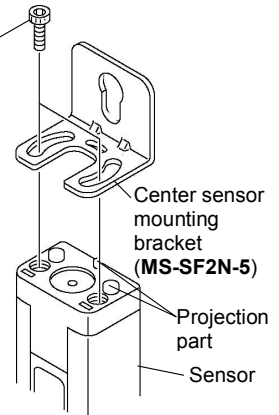
#### <Rear sensor mounting bracket (accessory)>



#### <Side sensor mounting bracket (optional)>



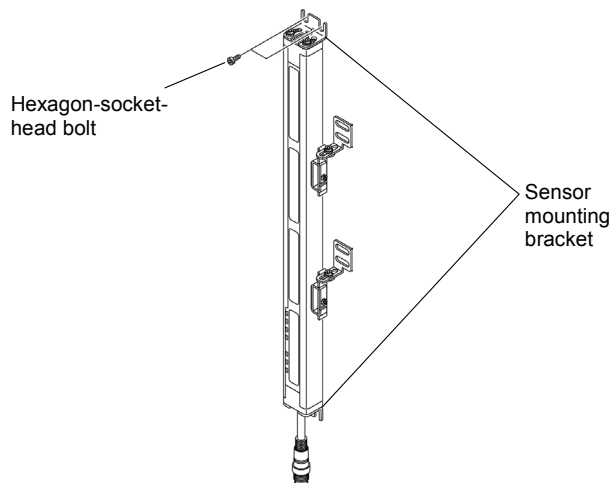
#### <Center sensor mounting bracket (optional)>



### <Reference>

Match the projection of the sensor mounting bracket with the concavity in the sensor main body, and hook the sensor mounting bracket on the projections on the sensor, for easy installation.

2. Temporarily mount the sensor mounting bracket (top and bottom) on the mounting surface with the two hexagon-socket-head bolts [M5 (please arrange separately)].



3. Match the position of the emitter and the receiver (upper surface) to the same height by adjusting within the range of the oblong hole, and then securely tighten the hexagon-socket-head bolts.

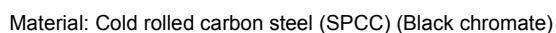
### <Reference>

One method of matching the height is to put a metal plate (which does not bend in the middle) on the upper surface of the emitter and the receiver and then adjust by placing a level gauge at the middle of the metal sheet.

4. Fix the intermediate supporting bracket with the two hexagon-socket-head bolts [M5 (please arrange separately)].

(**SF2-NH**□: 36 or more beam channels, **SF2-NA**□: 18 or more beam channels)

1) Rear sensor mounting bracket / **MS-SF2N-1**



Technical drawing of a mounting bracket (right side) showing isometric, side, and top views with dimensions.

**Isometric View:** Shows the 3D shape of the bracket, including a base plate with two mounting slots and a vertical support arm.

**Side View:** Shows the profile of the bracket with dimensions: 15 (total width), 5.5 (flange width), 18 (flange height), and 10 (base width).

**Top View:** Shows the bracket from above with dimensions: 10 (base width), 14 (flange width), 4.2 (flange thickness), 28 (total height), 20.6 (flange height), 33 (total width), 28 (inner width), 30° (fillet angle), R8.55 (fillet radius), 22 (distance from base to flange), 8.9 (distance from base to flange), 25° (fillet angle), 35° (fillet angle), 14 (flange width), 10 (flange width), 4.2 (flange thickness), and t 1.6 (thickness).

Material: Cold rolled carbon steel (SPCC) (Black chromate)

Technical drawing of a mounting bracket (left side) showing isometric and orthographic views with dimensions:

- Isometric View:** Shows the 3D shape of the bracket, which has a U-shaped base and a vertical mounting arm.
- Orthographic Views:**
  - Top View:** Shows the base of the bracket with a central circular hole. Dimensions include:
    - Overall width: 33
    - Overall height: 28
    - Inner hole diameter: 10
    - Distance from hole center to right edge: 14
    - Radius of the inner hole: R4
    - Radius of the outer hole: R8.55
    - Distance from hole center to bottom edge: 14.2
    - Distance from hole center to right edge: 8.9
    - Angle of the outer hole: 25°
    - Angle of the outer hole: 35°
    - Angle of the outer hole: 30°
    - Distance from hole center to bottom edge: 20.6
    - Distance from hole center to right edge: 22
  - Side View:** Shows the profile of the bracket with dimensions:
    - Overall width: 15
    - Overall height: 28
    - Distance from top edge to hole center: 5.5
    - Distance from hole center to bottom edge: 18
    - Distance from hole center to right edge: 10

Material: Cold rolled carbon steel (SPCC) (Black chromate)

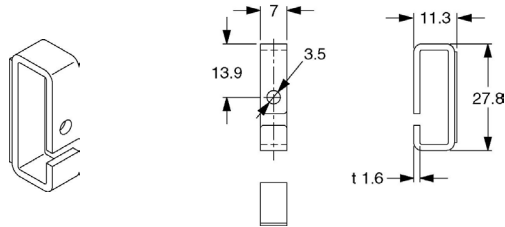
Technical drawing of a capping bracket (part 01-21-2). The drawing includes a 3D perspective view on the left and two 2D orthographic views (front and side) on the right. Dimensions are provided in millimeters.

**Dimensions:**

- Overall width: 29
- Overall height: 24
- Top flange width: 11.9
- Top flange thickness: 5.5
- Top flange height: 12
- Top flange radius: 3-R2
- Top flange hole diameter: 10
- Top flange hole offset: 5.1
- Top flange hole depth: 4.6
- Top flange hole radius: 4.8
- Top flange hole diameter: 12.9
- Top flange hole offset: 11.5
- Top flange hole depth: 4.8
- Top flange hole radius: 3.3
- Top flange hole diameter: 20
- Top flange hole offset: t 2

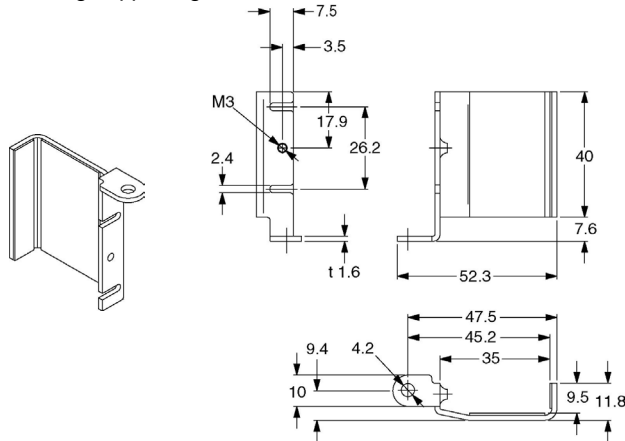
Material: Cold rolled carbon steel (SPCC) (Black chromate)

5) Retaining plate / Enclosed with **MS-SF2N-2** and **MS-SF2N-4**.



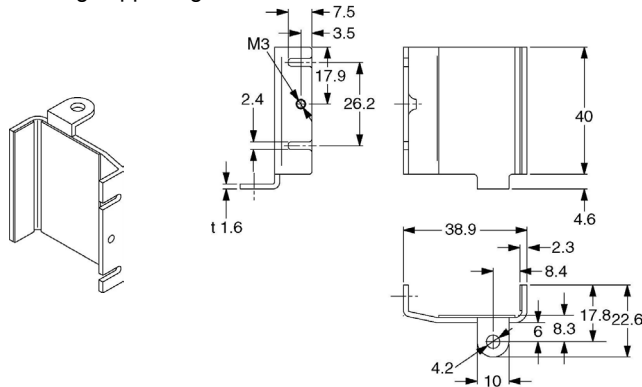
Material: Cold rolled carbon steel (SPCC) (Black chromate)

6) U-shaped rear mounting supporting bracket / Enclosed with **MS-SF2N-2**



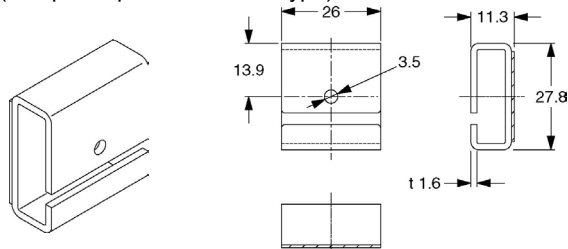
Material: Cold rolled carbon steel (SPCC) (Black chromate)

7) U-shaped side mounting supporting bracket / Enclosed with **MS-SF2N-4**



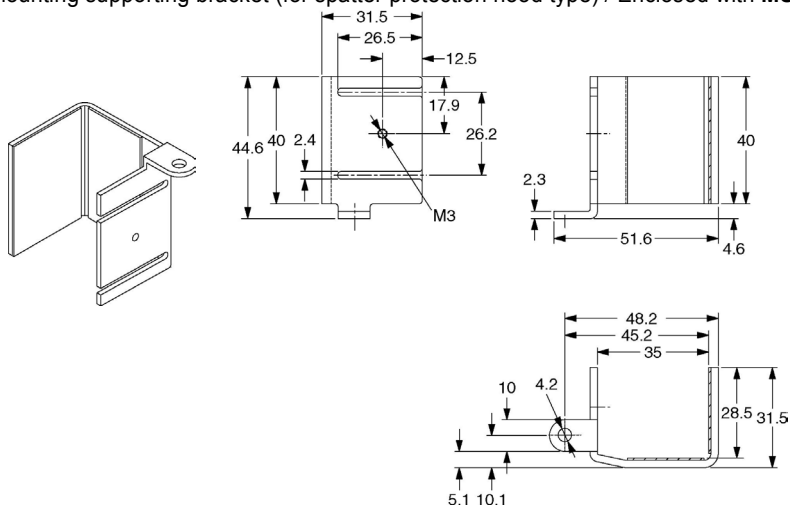
Material: Cold rolled carbon steel (SPCC) (Black chromate)

8) Retaining plate (for spatter protection hood type) / Enclosed with **MS-SF4A-H2** and **MS-SF4A-H4**.



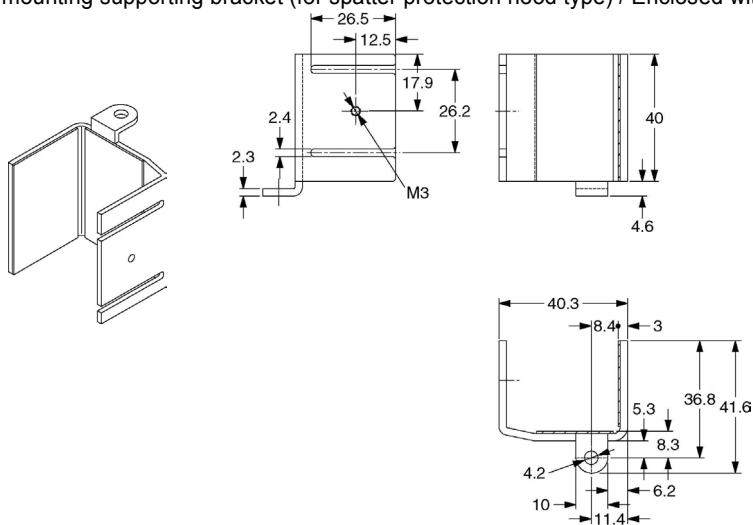
Material: Cold rolled carbon steel (SPCC) (Black chromate)

9) U-shaped rear mounting supporting bracket (for spatter protection hood type) / Enclosed with **MS-SF4A-H2**



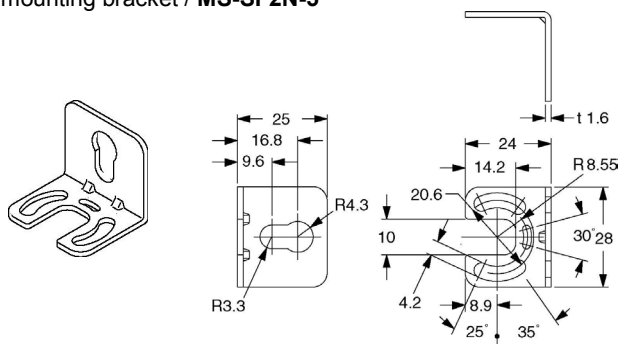
Material: Cold rolled carbon steel (SPCC) (Black chromate)

10) U-shaped side mounting supporting bracket (for spatter protection hood type) / Enclosed with **MS-SF4A-H4**



Material: Cold rolled carbon steel (SPCC) (Black chromate)

11) Center sensor mounting bracket / **MS-SF2N-5**

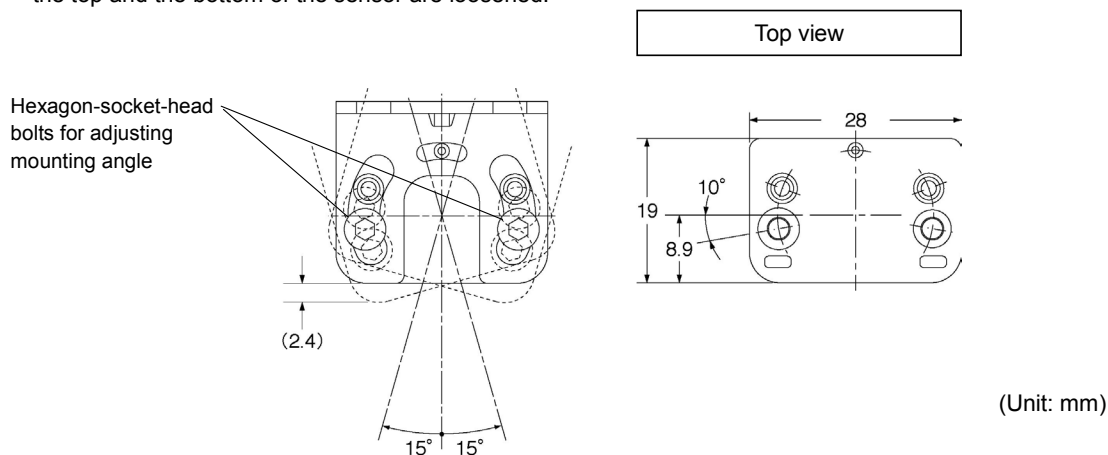


Material: Cold rolled carbon steel (SPCC) (Black chromate)

### 3.3.3 Mounting Angle Adjustment Range

The height adjustment of the emitter and the receiver was described in '**3.3.1 Mounting Procedure**'. This section explains the method of adjusting the horizontal mounting angle with respect to the mounting surface.

1. Confirm that the two hexagon-socket-head bolts [M3 (length 5mm)] for adjusting the mounting angle at the top and the bottom of the sensor are loosened.



2. Adjust the mounting angle so that the emitter and the receiver face each other, and then tighten the hexagon-socket-head bolts. (Tightening torque: 0.6N·m or less)  
Further, firmly tighten the bolts that temporarily hold the U-shaped rear mounting supporting bracket and the L-shaped intermediate supporting bracket. (Tightening torque: 1.8N·m or less)

#### <Reference>

By this procedure, the mounting angle can be adjusted up to  $\pm 15^\circ$ . For accurate positioning, refer to '**3.5.1 Beam-axis Alignment**' for details. The same procedure is to be performed for both side, as well as, rear mounting.

## 3.4 Wiring

### 3.4.1 Power Supply Unit

#### ⚠ CAUTION

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

#### <Reference>

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

The DC power supply unit must satisfy the conditions given below:

- 1) Power supply unit authorized in the region where this device is to be used.
- 2) Power supply unit conforming to EMC Directive and Low-voltage Directive (In case CE marking conformity is required.)
- 3) Power supply unit conforming to the Low-voltage directive and with an output of 100VA or less.
- 4) The frame ground (F.G.) terminal must be connected to ground when using a commercially available switching regulator.
- 5) Power supply unit with an output holding time of 20ms or more.
- 6) Use an isolation transformer for the DC power supply unit.
- 7) In case a surge is generated, take countermeasures such as connecting a surge absorber to the origin of the surge.
- 8) Power supply unit corresponding to CLASS 2 (In case UL / cUL conformity is required.)

《Additional information》 As provided in IEC 60536 (CLASS: Protection against Electric Shock), this power supply should require no ground earth and satisfy the insulation distance called double insulation or reinforced insulation.

( In case the power supply conforms to Low-voltage directive and has an output of 100VA or less, it can be used as a suitable product. )

### 3.4.2 Sensor Wiring Diagrams

#### ⚠ WARNING

- Connect the shield to the frame ground (F.G.) without fail. Failure to do so can cause malfunction due to noise, which can result in serious injury or death. Further, the wiring should be done in a metal box connected to the frame ground.
- Consider that any dangerous malfunction does not occur on the system containing this device due to grounding obstacle. The system cannot be stopped, which may cause serious injury or death.

#### ⚠ CAUTION

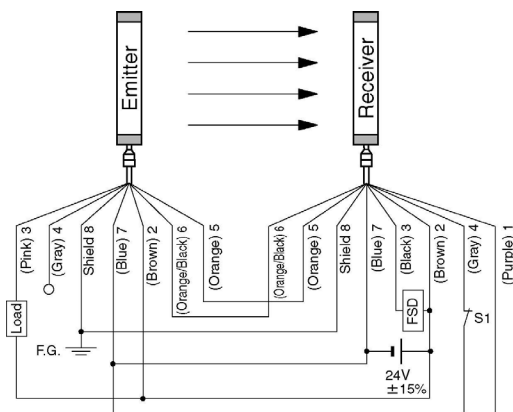
- Make sure to insulate the ends of the unused lead wires.
- Since the pin No. 4 (gray) wire in emitter and pin No. 1 (purple) wire are not used, be sure to insulate them.

#### <Reference>

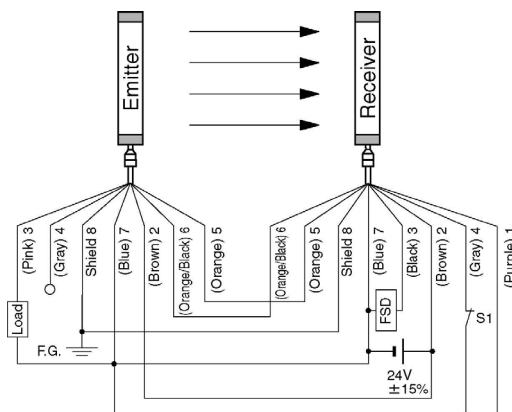
Use a safety relay unit or an equivalent control circuit in safety for FSD.

#### 1) Wiring Diagram for Series Connection of One Set of Sensor

##### • NPN output type

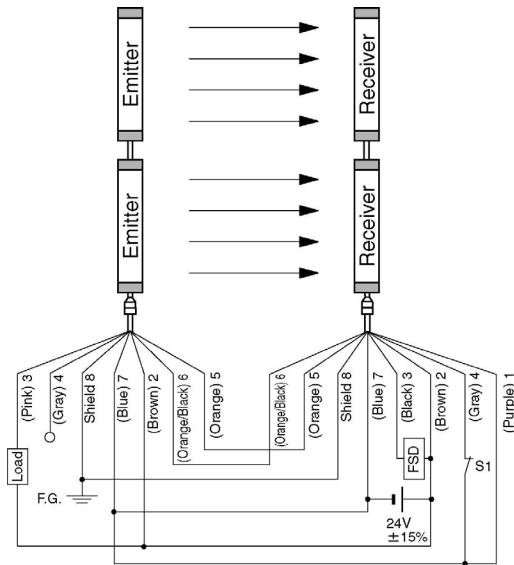


##### • PNP output type



## 2) Wiring Diagram for Series Connection of Multiple Sets of Sensors

### • NPN output type

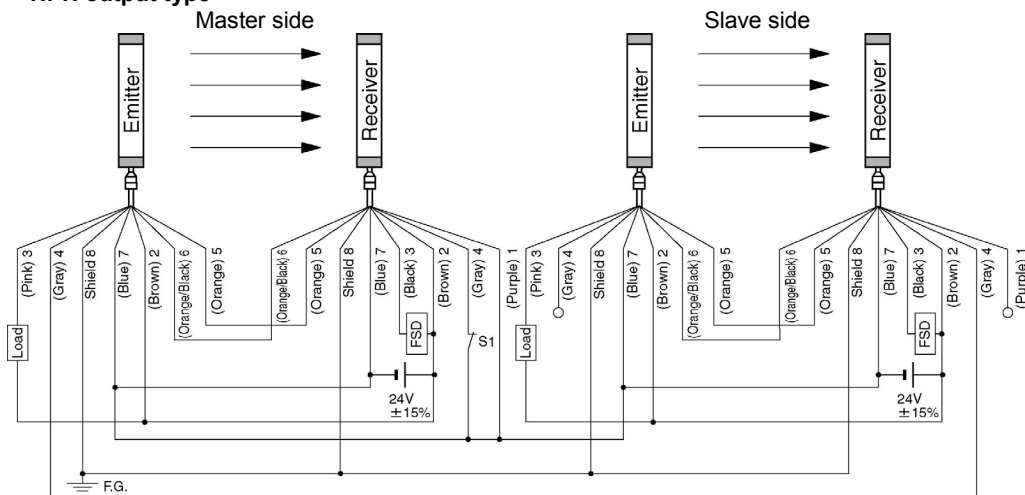


#### <Reference>

In case of the PNP output type, connect Terminal No.3 (black) of the receiver, through a FSD, to Terminal No. 7 (blue) (0V) of the receiver. Further, connect Terminal No.3 (pink) of the emitter, through a load, to Terminal No. 7 (blue) (0V) of the receiver.

## 3) Wiring Diagram for Parallel Connection

### • NPN output type

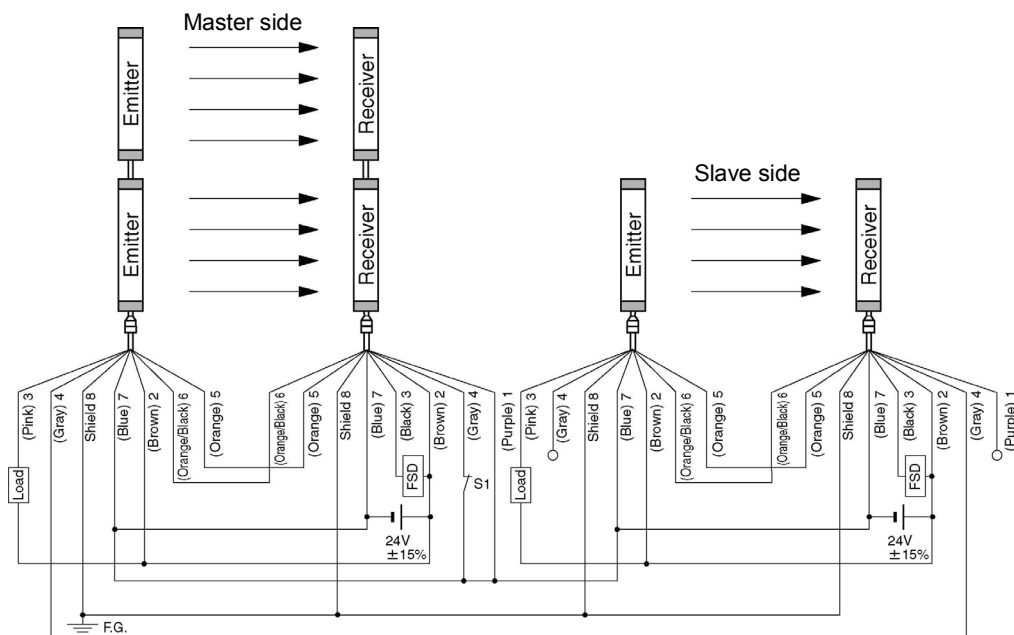


#### <Reference>

- If a separate power supply is used for each sensor, provide common 0V.
- In case of the PNP output type, connect Terminal No.3 (black) of the receiver, through a FSD, to Terminal No. 7 (blue) (0V) of the receiver. Further, connect Terminal No.3 (pink) of the emitter, through a load, to Terminal No. 7 (blue) (0V) of the receiver.

#### 4) Wiring Diagram for Series and Parallel Mixed Connection

##### • NPN output type



##### <Reference>

- If a separate power supply is used for each sensor, provide common 0V.
- In case of the PNP output type, connect Terminal No.3 (black) of the receiver, through a FSD, to Terminal No. 7 (blue) (0V) of the receiver. Further, connect Terminal No.3 (pink) of the emitter, through a load, to Terminal No. 7 (blue) (0V) of the receiver.

##### <Reference>

Switch 'S1' in Fig.1) – 4) of 3.4.2:

During normal operation: close, during test input: open

### 3.4.3 Wiring · Connection Procedure

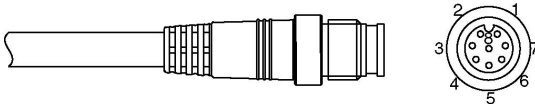
Connect the mating cable (with connector on one end, or connector on both ends) to the connector of the sensor main body (emitter and receiver).

Wire the other side of the mating cable according to your application, by referring to the connector pin arrangement given below and to '3.4.2 Sensor Wiring Diagrams'.

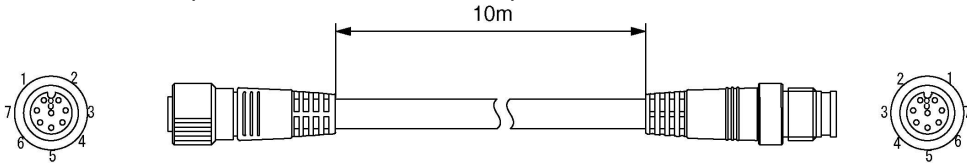
#### ⚠ WARNING

- When extending the cable, up to a total length of 20.5m (for both emitter and receiver) is possible by using an exclusive cable. Extending the cable to more than 20.5m may cause malfunction, which can result in serious injury or death.
- When the synchronization cable is extended with a cable other than the exclusive cable, use a 0.2mm<sup>2</sup>, or more, shielded twist pair cable, and connect the shield to the frame ground (F.G.) of the machine that the sensor is mounted to without fail.

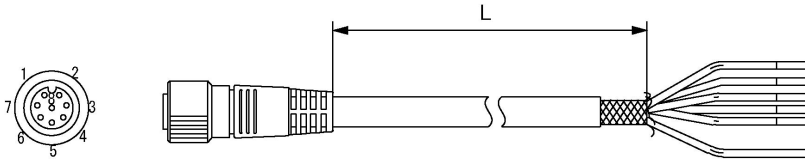
#### Sensor Main Body Side Connector



#### Extension Cable (with connector on both ends)



#### Mating Cable (with connector on one end)



	Cable/Connector color	Pin No.	Lead wire color	Name
Emitter	Gray/Gray	1	-	NC
		2	Brown	24V DC
		3	Pink	Alarm output
		4	Gray	Interference prevention output
		5	Orange	Synchronization + input
		6	Orange/Black	Synchronization - input
		7	Blue	0V
		8	-	Shield
Receiver	Gray (with black stripe)/ Black	1	Purple	Master/Slave switching input
		2	Brown	24V DC
		3	Black	OSSD
		4	Gray	Test input
		5	Orange	Synchronization + output
		6	Orange/Black	Synchronization - output
		7	Blue	0V
		8	-	Shield

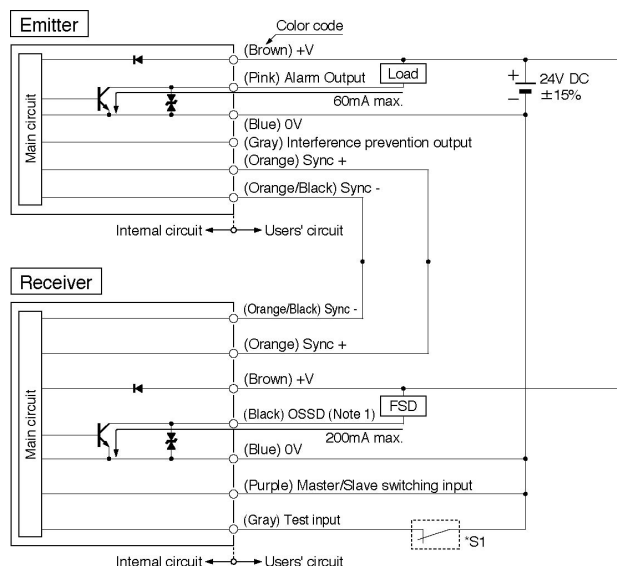
#### <Reference>

- In the table on the previous page, Orange/Black and Gray/Black indicate that the basic wire color is orange and gray, respectively, and they have a black stripe on them.
- The length L of the connection cable is different depending on the model No.
- The connectors can be distinguished from their color as follows.  
Connector for emitter: gray, connector for receiver: black

Model No.	Cable length L (m)
<b>SF2N-CC3</b>	3
<b>SF2N-CC7</b>	7
<b>SF2N-CC10</b>	10

### 3.4.4 I/O Circuits Diagrams

#### <SF2-N□/NPN output type>



\*S1

#### Switch 'S1'

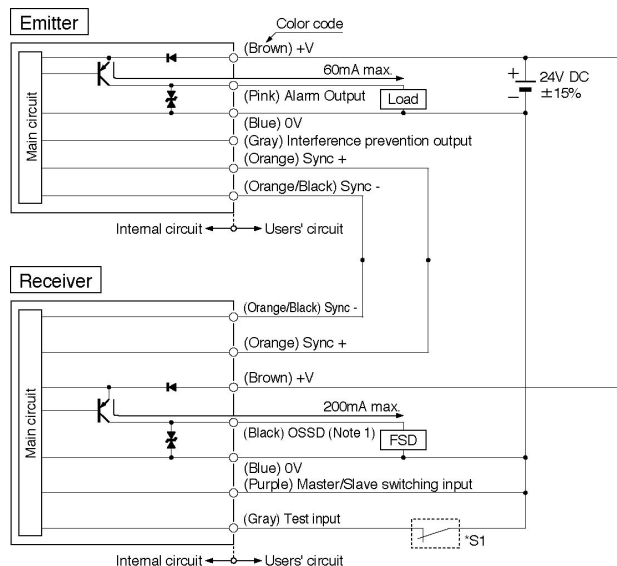
0 to +1.5V: emission (at 2mA or less sink current)  
(Note 2)  
Open, or +4V to Vs: emission halt

- Notes: 1) This device observes the condition of OSSD output circuit as self-diagnosis. Therefore, if connect a device that generates potential difference as follows between the OSSD output and the power supply, this device will regard the OSSD output as in error and the OSSD will be fixed to OFF. In case of connecting to such device, take a countermeasure such as putting the semiconductor relay between the OSSD and the connected device.  
When beam is blocked:  
In case between the light curtain supply voltage (Vs) and the OSSD terminal voltage = 2.8V or more
- 2) Vs is the same voltage as the voltage of the power supply to be used.
- 3) Unused wires must be insulated to ensure that they do not come into contact with wires already in use.

#### <Reference>

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

#### <SF2-N□-PN/PNP output type>



\*S1

#### Switch 'S1'

0 to +1.5V: emission (at 2mA or less sink current)  
(Note 2)  
Open, or +4V to Vs: emission halt

- Notes: 1) This device observes the condition of OSSD output circuit as self-diagnosis. Therefore, if connect a device that generates potential difference as follows between the OSSD output and the power supply, this device will regard the OSSD output as in error and the OSSD will be fixed to OFF. In case of connecting to such device, take a countermeasure such as putting the semiconductor relay between the OSSD and the connected device.  
When beam is blocked:  
In case between the OSSD terminal voltage and the light curtain supply voltage (0V) = 2.3V or more
- 2) Vs is the same voltage as the voltage of the power supply to be used.
- 3) Unused wires must be insulated to ensure that they do not come into contact with wires already in use.

#### <Reference>

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

## 3.5 Adjustment

### 3.5.1 Beam-axis Alignment

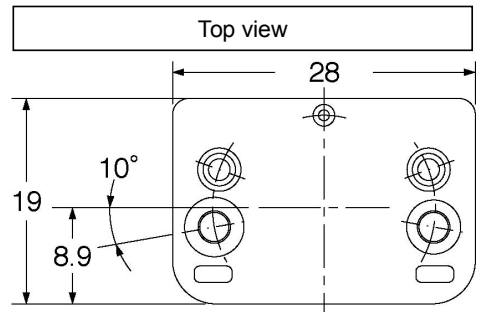
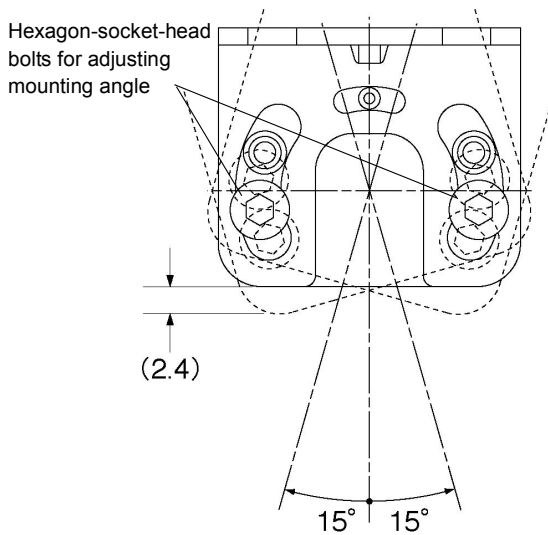
1. Turn ON the power supply unit of this device.
2. Check that the fault indicators (yellow) of the emitter and the receiver are off.
  - If the fault indicator (yellow) lights up or blinks, refer to '**Chapter 5 Troubleshooting**', and report the contents to the maintenance in-charge.

#### <Reference>

Refer to '**3.3.1 Mounting Procedure**' for the operations beyond this.

For laser alignment, it is useful to use the beam alignment tool for light curtain (**SF-LAT-2N**) (optional).

3. Loosen the two hexagon-socket-head bolts [M3 (length 5mm)] for adjusting the mounting angle at the top and the bottom of the emitter.

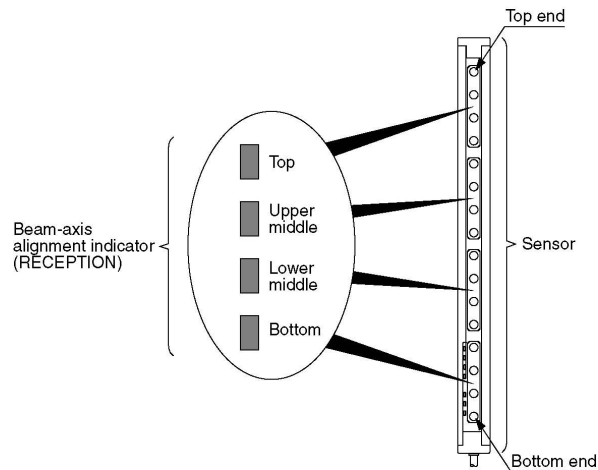


(Unit: mm)

#### <Reference>

If the intermediate supporting bracket has been mounted on the sensor main body, loosen the hexagon-socket-head bolt for position adjustment [M4 (length 10mm)] before alignment.

4. Adjust the emitter/receiver so that the beam-axis alignment indicators in the display of the emitter and receiver light up.



#### <Reference>

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

For example, when using a 32-beam channel sensor, there are 8 beam channels per section (i.e.,  $32/4 = 8$ ). If the 8 beam channels of the top section are received, the 'Top' of the beam-axis alignment indicator will light 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, the OSSD turn ON, and all the four indicators of the beam-axis alignment indicator turn into green.

Further, in series connection, if any other sensors are in the beam blocked status, OSSD will turn OFF and all the four indicators of the beam-axis alignment indicator of the sensor receiving all beam channels will light up in red.

5. Tighten the hexagon-socket-head bolts [M3 (length 5mm)] for adjusting the mounting angle at the top and the bottom of the emitter to fix the emitter. (Tightening torque: 0.6N·m or less)

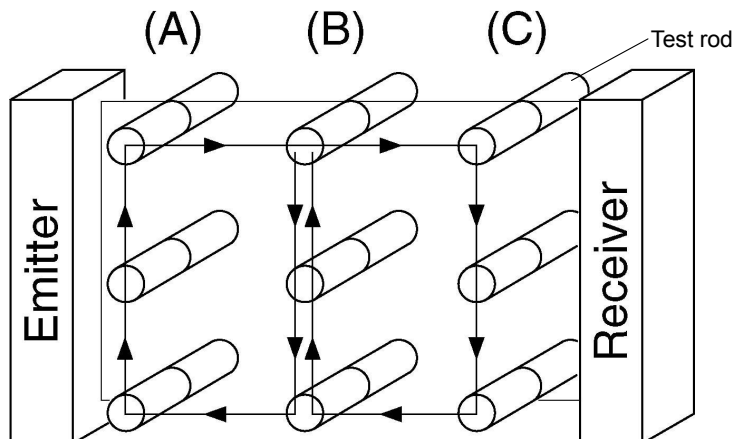
#### <Reference>

If the intermediate supporting bracket has been mounted on the sensor main body, tighten the hexagon-socket-head bolt [M4 (length 10mm)] for position adjustment. (Tightening torque: 1.8N·m or less)

6. Check, once again, that the beam-axis alignment indicators in the display of the emitter and receiver do light up.  
Ensure that the unstable incident beam indicator of the receiver is OFF.

### 3.5.2 Operation Test

1. Turn ON the power supply unit of this device.
2. Check that the fault indicators (yellow) of the emitter and the receiver are off.
  - If the fault indicator (yellow) lights up or blinks, refer to '**Chapter 5 Troubleshooting**', and report the contents to the maintenance in-charge.
3. Move the test rod up and down at three positions, just in front of the emitter (A), between the emitter and receiver (B), and just in front of the receiver (C).



4. During Step 3 above, check that the sensor output is in the 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 output (OSSD) 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 contents to the maintenance in-charge.




#### <Reference>





























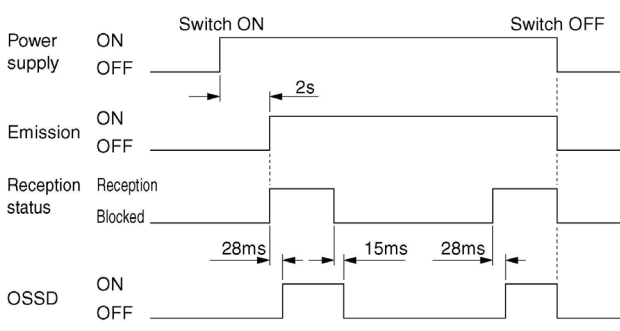
If the indicators show receipt of light, even though the test rod blocks the light, also check if there is any reflective object or extraneous light source near this device.

### 3.5.3 Operation

#### 1) Normal Operation

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

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

Device Status	Indicators		OSSD
	Emitter	Receiver	
Reception status (all beams received)	Lights up in green  Beam-axis alignment indicator (RECEPTION) (Green)    Operation indicator (OSSD) (Green) (Note)  Emission halt indicator (HALT)  Fault indicator (FAULT) 	Lights up in green  Beam-axis alignment indicator (RECEPTION) (Green)    OSSD indicator (OSSD) (Green)  Unstable incident beam indicator (STB.)  Fault indicator (FAULT) 	ON
Beam blocked status (one or more beams blocked)	Lights up in red (OFF for beam blocked channels)  Beam-axis alignment indicator (RECEPTION) (Red)    Operation indicator (OSSD) (Red) (Note)  Emission halt indicator (HALT)  Fault indicator (FAULT) 	Lights up in red (OFF for beam blocked channels)  Beam-axis alignment indicator (RECEPTION) (Red)    OSSD indicator (OSSD) (Red)  Unstable incident beam indicator (STB.)  Fault indicator (FAULT) 	OFF
Time Chart			

Note: Since the color of the operation indicator changes according to the ON/OFF state of OSSD, the operation indicator is marked as OSSD on the sensor.

### <For series connection>

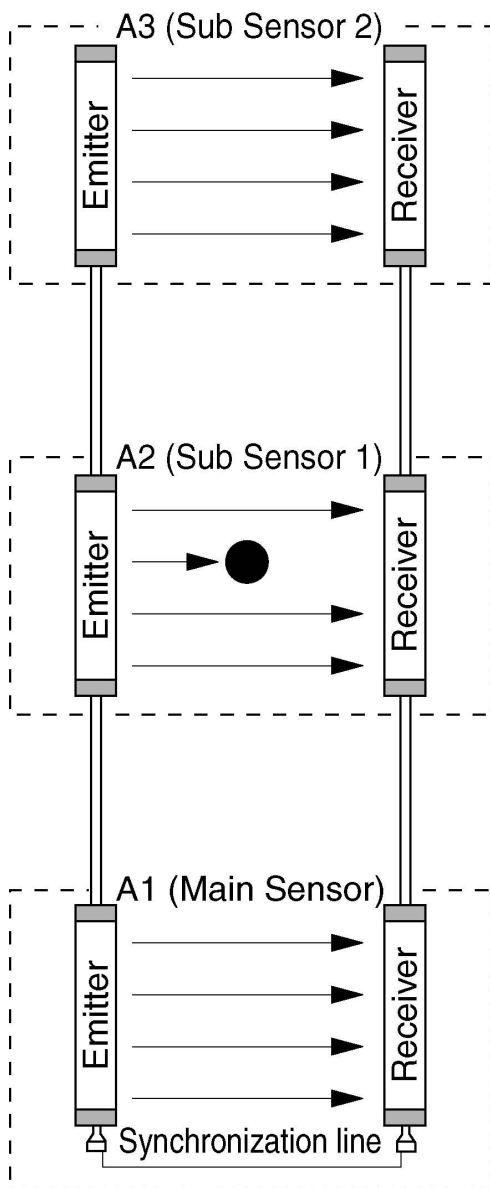
In case of series connection, if any of the sets is in the beam blocked state, OSSD turns OFF.

### <Reference>

The emitter/receiver indicators indicate the output status.

The following figures show the state of the indicators with A2 (Sub Sensor 1) in beam blocked state.

■ : Lights up in red □ : Turns off



A3 (Sub Sensor 2): light received status

<Emitter>	<Receiver>
Beam-axis alignment indicator (RECEPTION) (Red)	Beam-axis alignment indicator (RECEPTION) (Red)
Operation indicator (OSSD) (Red) (Note)	OSSD indicator (OSSD) (Red)
Emission halt indicator (HALT)	Unstable incident beam indicator (STB.)
Fault indicator (FAULT)	Fault indicator (FAULT)

A2 (Sub Sensor 1): light blocked status

<Emitter>	<Receiver>
Beam-axis alignment indicator (RECEPTION) (Red)	Beam-axis alignment indicator (RECEPTION) (Red)
Operation indicator (OSSD) (Red) (Note)	OSSD indicator (OSSD) (Red)
Emission halt indicator (HALT)	Unstable incident beam indicator (STB.)
Fault indicator (FAULT)	Fault indicator (FAULT)

A1 (Main Sensor): light received status

<Emitter>	<Receiver>
Beam-axis alignment indicator (RECEPTION) (Red)	Beam-axis alignment indicator (RECEPTION) (Red)
Operation indicator (OSSD) (Red) (Note)	OSSD indicator (OSSD) (Red)
Emission halt indicator (HALT)	Unstable incident beam indicator (STB.)
Fault indicator (FAULT)	Fault indicator (FAULT)

Note: Since the color of the operation indicator changes according to the ON/OFF state of OSSD, the operation indicator is marked as OSSD on the sensor.

## 2) In Case of Emission Halt

In case of carrying out self-diagnosis function by using the test input or in case of incorrect wiring, the emission will come to a halt.

### **WARNING**

Do not use the self-diagnosis function or the emission halt function to bring the equipment to a stop. This may cause serious injury or death.

The emitter's emission halt indicator (orange) lights up.

After removal of the source of error, the machine will return to normal operation automatically without restarting it.

However, the machine may operate immediately after its automatic recovery. Hence, we recommend turning the power off and then removing the source of error.

Example: Synchronization signal disconnection, incorrect wiring, short-circuit, etc.

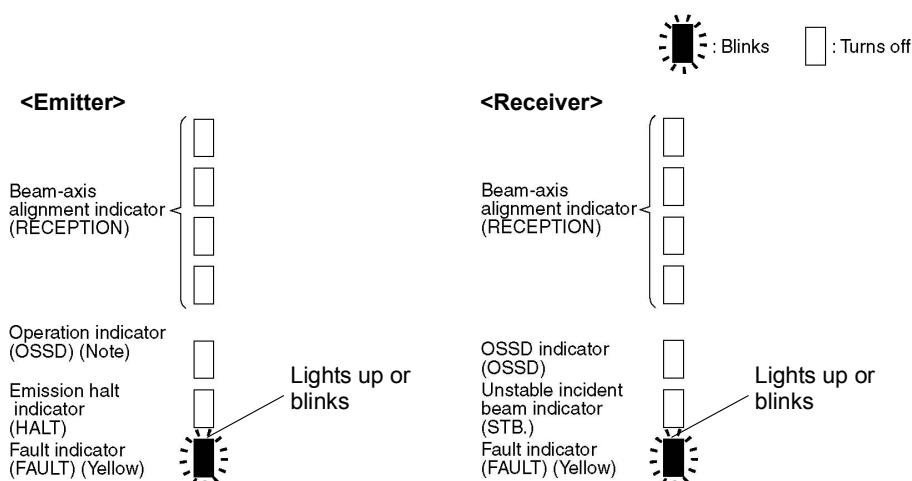
Refer to '**Chapter 5 Troubleshooting**' and remove the source of error.

## 3) In case of Abnormal Operation

If a sensor error is detected, the sensor will turn OSSD off and the fault indicator (yellow) will light up or blink.

Further, if an error occurs resulting in an emission halt condition, the alarm output is also turned OFF.

- If an emitter error is detected, the emitter will be locked out, stopping its emission, and OSSD will turn OFF.
- If a receiver error is detected, the receiver will be locked out, and OSSD will turn OFF.



Note: Since the color of the operation indicator changes according to the ON/OFF state of OSSD, the operation indicator is marked as OSSD on the sensor.

Since the machine will not return to normal operation automatically after the removal of the source of error, it is necessary to restart it.

Source of error: OSSD short-circuit, extraneous light detection, sensor failure, etc.

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

## 4) When light reception is unstable

If the unstable incident beam indicator (orange) lights up, it indicates an unstable incident beam condition, such as the sensor's sensing surface being dirty or the beam channels being slightly misaligned, etc.

Clean the sensor or realign the beam channels.

## Chapter 4 Maintenance

This chapter explains the method of maintenance and replacement for the proper operation of this device.

### <Reference>

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

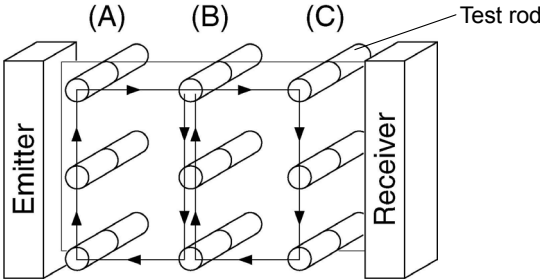
## 4.1 Inspection

### 4.1.1 Daily Inspection

#### ⚠ WARNING

- Be sure to inspect the following items prior to operation and confirm that there is no abnormality. Operating this device without inspection or in an abnormal condition can result in serious injury or death.
- After maintenance or adjustment, and before starting operation, daily inspection this device following the specified procedures.

#### Check List (Daily Inspection)

Check Column	Inspection Item
<input type="checkbox"/>	Dangerous parts of the machine cannot be reached without passing through the sensing area of this device.
<input type="checkbox"/>	Some part of operator's body remains in the sensing area when operation is done with dangerous parts.
<input type="checkbox"/>	The calculated safety distance has been maintained or exceeded during installation.
<input type="checkbox"/>	There is no damage to the safety guard or protective structure.
<input type="checkbox"/>	There is no defect, fold, or damage in the wiring.
<input type="checkbox"/>	The corresponding connectors have been connected securely.
<input type="checkbox"/>	No dirt or scratches exist on the light emitting surface.
<input type="checkbox"/>	The test rod is not deformed or defective.
<input type="checkbox"/>	The emission indicator (green) of the emitter and the OSSD indicator (green) of the receiver light up when no object is present in the sensing area. At this time, the effect of external noise can be inspected. In case external noise affects the operation, remove its cause and re-inspect.
<input type="checkbox"/>	<p>The test rod can be detected at three positions, directly in front of the emitter (A), midway between the emitter and the receiver (B), and directly in front of the receiver (C). The OSSD indicator (red) continues to light up as long as the test rod is present in the sensing area from (A) to (C).</p> 
<input type="checkbox"/>	With the machine in the operating condition, the dangerous parts operate normally when no object is present in the sensing area.
<input type="checkbox"/>	With the machine in the operating condition, the dangerous parts stop immediately when the test rod is inserted into the sensing area at any of the three positions, directly in front of the emitter (A), midway between the emitter and the receiver (B), and directly in front of the receiver (C).
<input type="checkbox"/>	The dangerous parts remain stopped as long as the test rod is present in the sensing area.
<input type="checkbox"/>	The dangerous parts stop immediately when the power supply of this device is turned OFF.
<input type="checkbox"/>	Test input and alarm output must work. OSSD and alarm output must turn OFF when the test input line is open, or connected to +4Vs to Vs. At this time, the effect of external noise can be inspected. In case external noise affects the operation, remove its cause and re-inspect.

Note: Vs is the same voltage as the voltage of the power supply to be used.

### 4.1.2 Periodic Inspection (Every Six Months)

#### WARNING

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

Check List (Periodic Inspection)

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

### 4.1.3 Inspection after Maintenance

Under the following situations, perform all the inspection items mentioned in '4.1.1 Daily Inspection' and '4.1.2 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 parts are replaced.
- 7) When FSD setting is changed.

## 4.2 Extension and Dismantling of Sensor

There are three types of connection methods for extending the sensor: series connection, parallel connection, and series and parallel mixed connection. For details, refer to '3.2 Connection Configuration'.

This section explains the connection method for series connection using optional parts.

To establish series connection, it is necessary to follow the procedure given below.

### <Extension of Sensor>

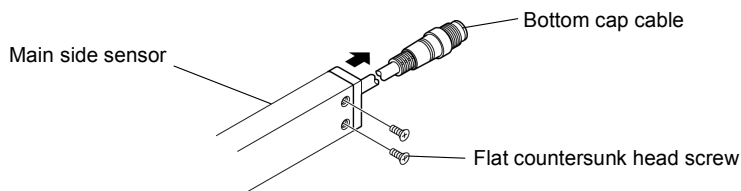
#### ⚠ CAUTION

Do not lose any screws during extension/dismantling.  
Further, do not mix emitters and receivers during mounting.

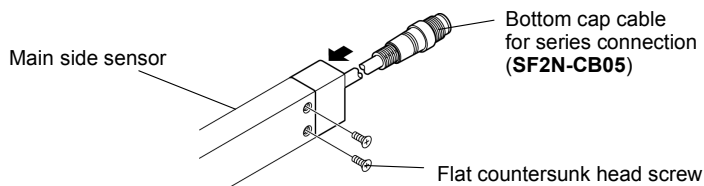
- (1) Replace the main side sensor's bottom cap cable with the bottom cap cable for series connection (**SF2N-CB05**).

The replacement with the series connection bottom cap cable may be unnecessary depending on the number of sets of the sensor and a total beam channels.

1. Remove two flat countersunk head screws [M3 (length 5mm)] to detach the bottom cap cable from the main side sensor (emitter and receiver to which the synchronization line has been connected).

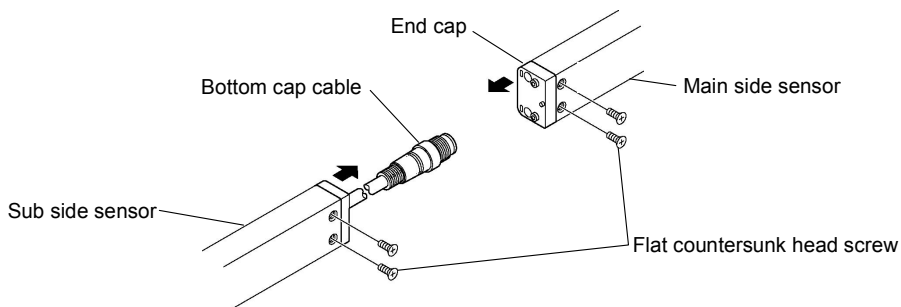


2. Attach the bottom cap cable for series connection (**SF2N-CB05**) at the place from which the cable was removed in Step 1, using two flat countersunk head screws [M3 (length 5mm)].  
(Tightening torque: 0.5N·m or less)

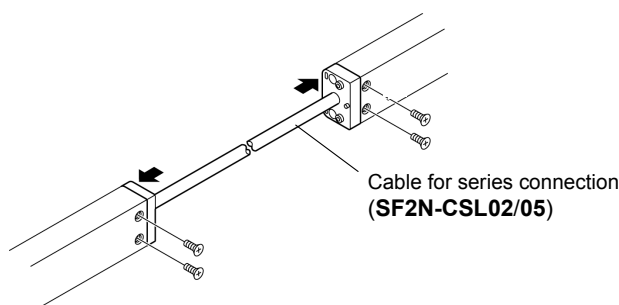


- (2) Connect the cable for series connection (**SF2N-CSL02/05**).

1. Remove two flat countersunk head screws [M3 (length 5mm)] to detach the end cap from the main side sensor (emitter and receiver to which the synchronization line has been connected).
2. Remove two flat countersunk head screws [M3 (length 5mm)] to detach the bottom cap cable from the sub side sensor.

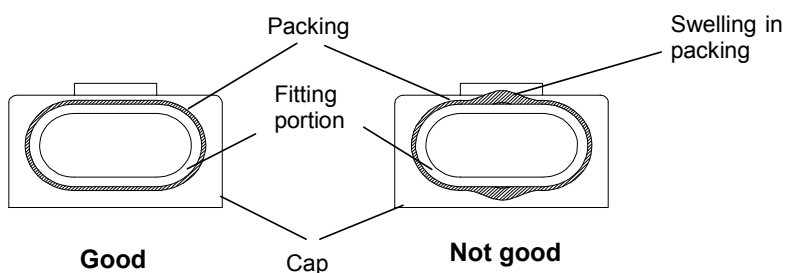


3. Connect the cable for series connection with four flat countersunk head screws [M3 (length 5mm)] at the place from which the parts were removed in Steps 1 and 2 above.  
(Tightening torque: 0.5N·m or less)



#### ⚠ CAUTION

- When connecting, take care that the cable for series connection has a main side and a sub side. The connector on the main side is male type (pin side). Please don't extend the length of cable for series connection.
- When the bottom cap cable for series connection (SF2N-CB05) and the cable for series connection (SF2N-CSL02/05) are connected, make sure that the packing is correctly fitted. (Refer to the figure below.)  
If the packing is not correctly fitted, rotate it to the correct position.



#### <Reference>

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

Model No.	Cable Length (m)
SF2N-CSL02	0.2
SF2N-CSL05	0.5

#### <Dismantling of Sensor>

For dismantling the cable for series connection, follow the above procedure of <Extension of Sensor> in reverse.

## Chapter 5 Troubleshooting

### <Reference>

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

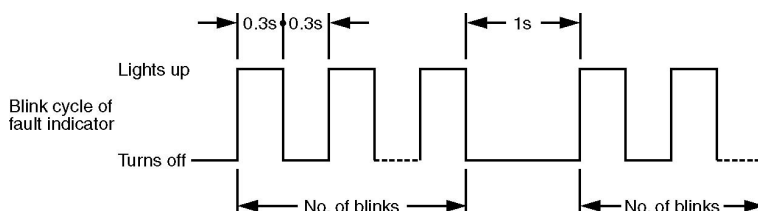
### 5.1 Troubleshooting of Emitter

Symptom	Cause	Remedy
All indicators are off.	Power is not being supplied.	Check that the power supply capacity is sufficient. Connect the power supply correctly.
	Power supply voltage is out of the specified range.	Set the power supply voltage correctly.
	Connector is not connected securely.	Connect the connector securely.
Fault indicator (yellow) lights up. (For Sub sensor only)	Abnormality of the series connection.	Check the abnormal state on the following sensors.
Fault indicator (yellow) blinks.	[1 blink] Beam channel No. error	Connect the end cap correctly.
	[2 blinks] Series connection error	Connect the cable for series connection correctly.
	[3 blinks] Total unit No./Total beam channel No. error	Set the number of series connection to 3 sets or less. Set the total number of beam channels for series connection to 128 or less. (SF2-NA□: Max. 64 beam channels)
	[4 blinks or more]	Consult SUNX.
Emission halt indicator lights up (orange). (Fault indicator (yellow) is off.)	Emission halt condition is set. (Test input of the master's receiver is open.)	Connect the test input of the master's receiver to 0 to +1.5V.
	Synchronization line wiring fault	Wire the synchronization line correctly.
	Interference prevention line wiring fault	Wire the interference prevention line correctly.
	Receiver not in operation	Check the receiver for abnormality.
Operation indicator remains lit in red (light is not received). (Note)	The beam channels of the emitter and the receiver are not correctly aligned.	Align the beam channels.

Note: Since the color of the operation indicator changes according to the ON/OFF state of OSSD, the operation indicator is marked as OSSD on the sensor.

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

In case of series connection, the fault indicator may blink nine times. In this case, first check for a fault in the other sensors.

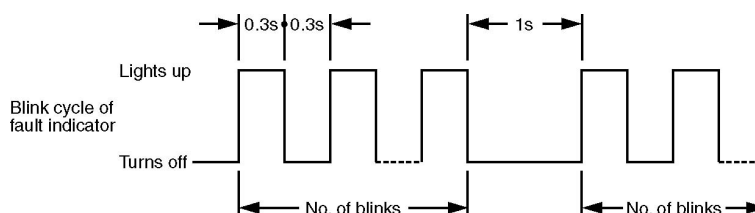


## 5.2 Troubleshooting of Receiver

Symptom		Cause	Remedy
All indicators are off.		Power is not being supplied.	Check that the power supply capacity is sufficient. Connect the power supply correctly.
		Power supply voltage is out of the specified range.	Set the power supply voltage correctly.
		Connector is not connected securely.	Connect the connector securely.
Fault indicator (yellow) lights up.	Master/Slave sensor	Incorrect OSSD wiring	Wire OSSD correctly.
	Sub sensor	Abnormality of the series connection.	Check the abnormal state on the following sensors.
Fault indicator (yellow) blinks.	[1 blink] Beam channel No. error		Connect the end cap correctly.
	[2 blinks] Series connection error		Connect the cable for series connection correctly.
	[3 blinks] Total unit No./Total beam channel No. error		Set the number of series connection to 3 sets or less. Set the total number of beam channels for series connection to 128 or less. (SF2-NA□: Max. 64 beam channels)
	[4 blinks] Extraneous light error		Extraneous light was detected. Prevent any extraneous light from entering the receiver. If the extraneous light is coming from another SF2-N series sensor, take interference preventive measures.
	[5 blinks or more]		Consult SUNX.  In case of series connection, the fault indicator may blink 9 times. In this case, first check the abnormal state on the other sensors.
Unstable incident beam indicator (orange) lights up.		The beam channels of the emitter and the receiver are not correctly aligned.	Align the beam channels.
OSSD indicator remains lit in red (light is not received).		The beam channels of the emitter and the receiver are not correctly aligned.	Align the beam channels.
		Emitter is not emitting light.	Check the emitter for abnormality.

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

In case of series connection, the fault indicator may blink nine times. In this case, first check for a fault in the other sensors.



## Chapter 6 Others

This section gives additional information for the effective use of this instruction manual.

### 6.1 Glossary

EN 61496-1 IEC 61496-1/2	The European standard that pertains to machine safety, especially electro-sensitive protective equipment (ESPE). EN 61496-1 or IEC 61496-1 gives general rules for failure mode and effect analysis, EMC requirements, etc. IEC 61496-2 specifies effective aperture angle, protection against extraneous light sources, etc., for active opto-electronic protective devices (AOPD).
UL 1998	UL standard for safety-related software with regard to programmable components.
ESPE	The abbreviation for Electro-Sensitive Protective Equipment.
OSSD	The abbreviation for Output Signal Switching Device. A component of the area sensor which turns off when light of the sensor unit 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 sensor unit being blocked.
MPCE	The abbreviation for Machine Primary Control Element.
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.
Master side/ Slave side	For parallel connection, the sensor set whose master/slave input is connected to 0V to control the timing of the light emission/reception process for the whole system is called the master side, and the others are called the slave side.
Master/Slave input	It is possible to switch to the slave mode by keeping the terminal open, and to the master mode by connecting it to 0V.
Main side/ Sub side	For series connection, the side where the power supply or the output is connected is called the main side, and the others are called the sub side.
Lockout	It is one of the safe states of this device. Operation is stopped if the self-diagnosis function determines that an irrecoverable failure (OSSD does 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, OSSD is turned OFF.
Safety distance	It is the minimum distance that must be maintained between the light curtain and the dangerous parts of a machine so that the machine can be stopped before a human body or an object can reach the dangerous parts.
Protective height (Sensing height)	The length of the beam axis direction that the min. sensing object can be detected. <b>SF2-NH□</b> : The length from the center of the first beam channel to the center of the last beam channel in addition to 50mm (25mm upward + 25mm downward). <b>SF2-NA□</b> : The length from the center of the first beam channel to the center of the last beam channel in addition to 70mm (25mm upward + 45mm 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 sensor. It is given by the product of the protective height and the operating range.
Self-diagnosis function	It enables even more detailed self-diagnosis, in addition to the self-diagnosis under normal operating conditions.
Test input (Emission halt Function)	This function enables checking of the receiver operation by turning off light emission. It is switchable either emission stop, when the test input is open, or connected to +4V to Vs, or normal emission stop, when the test input is connected to 0 to +1.5V.
PSDI	The abbreviation for Presence Sensing Device Initiation. This is a safety device that the system re-starts automatically after the system was forcibly stopped due to a detection.

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## ■ Warranty Period

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

## ■ Scope of Warranty

During the above mentioned period, if a failure of the product occurs under normal use and operation, and if it is found by SUNX that it is responsible for the failure, it shall remedy the defect or tender substitution for exchange at its cost and expense.

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- 3) Failure caused by a development which could not be foreseen based upon the technology in practice at the time of purchase or contract
- 4) Failure caused by use which deviates from the conditions/environment given in the product catalog or specifications
- 5) In case this product is used by being incorporated in the customer's machine, failure which could be avoided if the customer's machine had functions and structure commonly accepted in the industry
- 6) Failure due to happening of Force Majeure

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