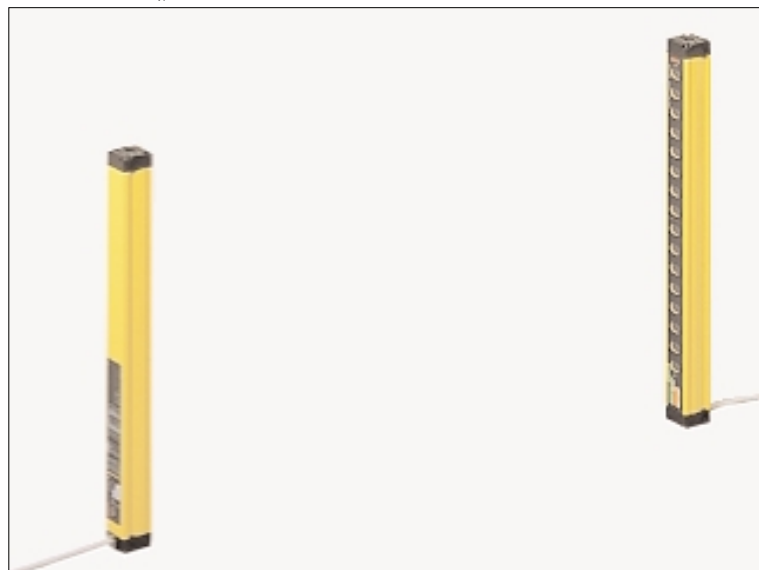


SF2-EH SERIES

Robust Light Curtain Type 4



Passes global safety standards!



Conforming to
OSHA / ANSI

Global safety

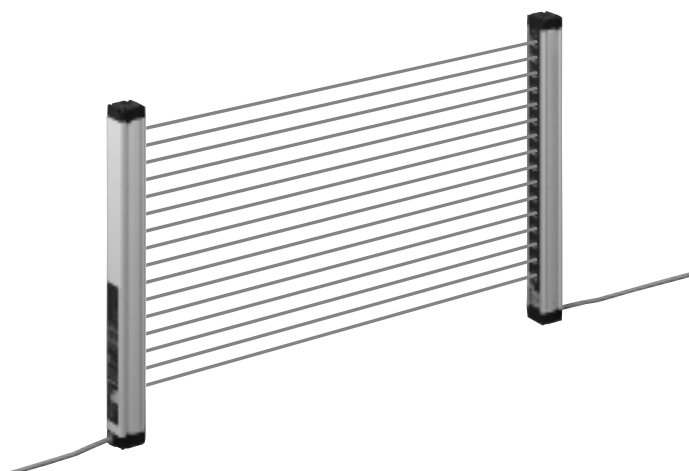
The **SF2-EH** series complies with the IEC 61496-1/2 international standards, so that it can be used in different countries throughout the world.

- CE marking based on Machine Directive and EMC Directive has been obtained.
[Type 4 based on IEC 61496-1/2, EN 61496-1, and Control Category 4 based on EN 954-1]
- C-UL US listings (UL 61496-1/2) which are required for use in the United States and Canada have been obtained.
- This series is also compatible with equipment conforming to OSHA (1910.212/217), ANSI (B11.1~B11.20) and ANSI / RIA 15.06 regulations.

Pursuit of safety

It uses two independent CPUs, which mutually check the safety conditions. High reliability fail-safe design is realized by incorporating dual circuits for signal processing and output.

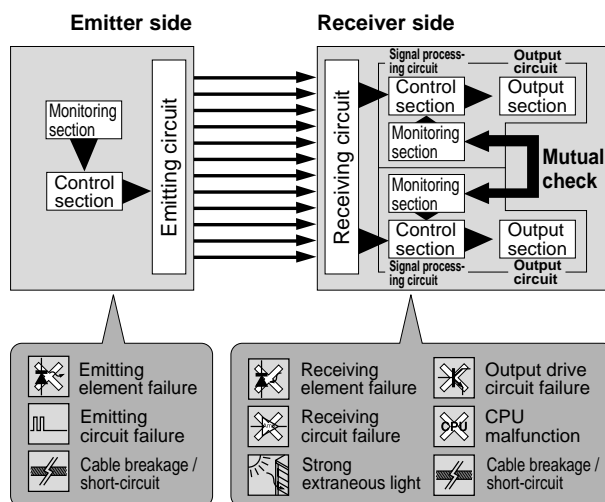
Further, in order to ensure safety, FMEA (Failure Mode & Effects Analysis) has been used to prove safe operation.



Safety design of the SF2-EH series

The sensor unit continually performs self-checking on its internal circuitry, its cable integrity and even checks for interference from extraneous light.

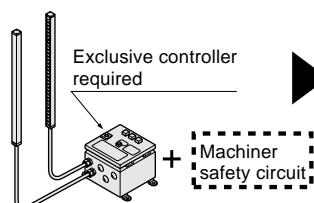
In the event of any fault or malfunction, the sensor outputs the same signal (OFF signal) as is produced during actual beam detection operation.



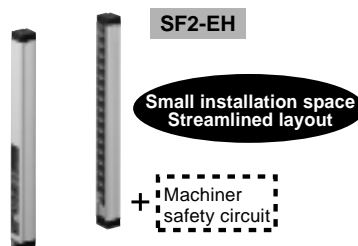
Exclusive controller not required

Since an exclusive controller is not required, there is no need to provide space for it. Further, the PNP output equivalent type can be combined with an optional safety relay unit (**SF-AC**) to create an intrusion detection system.

Conventional model



SF2-EH

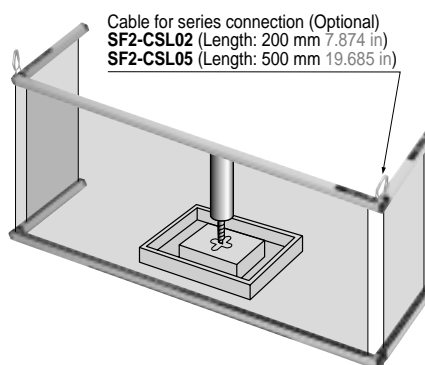
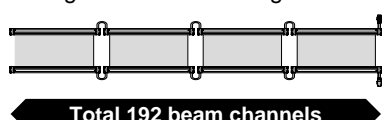


Wide area: 1,580 mm X 10 m 62.205 in X 32.808 ft

It realizes a wide sensing area with a protective height of 1,580 mm 62.205 in max. (80 beam channels) and a long operating range of 10 m 32.808 ft. Just one sensor can cover an area where previously 2 sensors had to be used.

Sensors connectable in series

Using the optional cable (**SF2-CSL**) for series connection, maximum 4 sets of sensors with a total of 192 beam channels can be connected in series. For example, in case of mounting the sensors on the front, as well as, both the sides of a danger region, previously separate wiring was required for 3 sets of sensors. But now, wiring equivalent to that for only 1 set is required, thus saving troublesome wiring and cost.



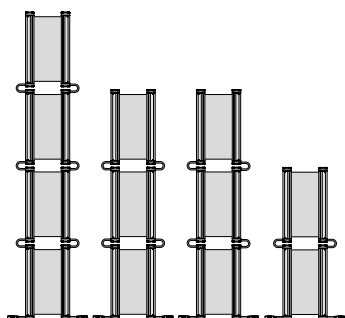
Wide variety

There are 13 models of sensors having a protective height ranging from 220 mm 8.661 in to 1,580 mm 62.205 in (12 to 80 beam channels). The sensors can be selected to suit the monitoring area of the used equipment. Further, PNP output equivalent type, as well as, NPN output equivalent type are available.

No interference

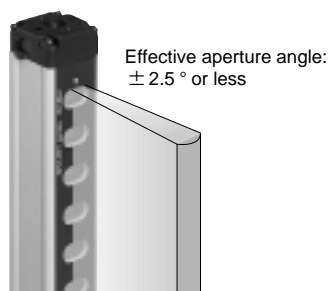
• Up to 12 sets of sensors can be mounted close together

In case of series connection or parallel connection, interference can be prevented for up to 4 sets, respectively. Further, in case of series and parallel mixed connection, up to 12 sets (total 192 beam channels) can be mounted close together.



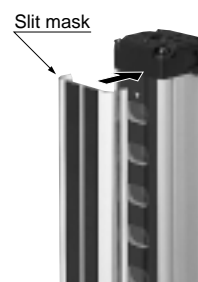
• Effective aperture angle $\pm 2.5^\circ$ or less

Since the effective aperture angle is narrow ($\pm 2.5^\circ$ or less), it reduces the effect of reflection from walls, etc., and interference from extraneous light.



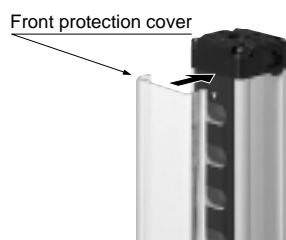
• Convenient slit mask available

By using the optional slit mask (**OS-SF2-H**), the amount of beam emitted or received can be restrained to reduce the effect of extraneous light from other sensors, etc.



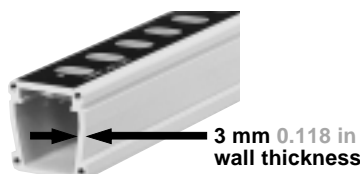
Easy maintenance

An optional front protection cover (**FC-SF2-H**) is available, so that the sensing face of the sensor can be protected in an adverse environment.



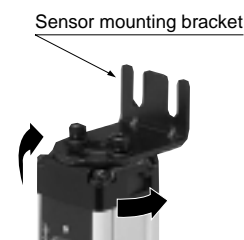
Solid aluminum case

All models have a solid aluminum case with a thickness of 3 mm 0.118 in. This case is much stronger than previous cases, so that the sensors can be used with even greater confidence.



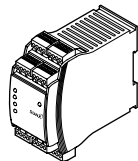
Mounting bracket enables easy beam alignment

The beam alignment is easy since angle adjustment is possible with the sensor mounting bracket (**MS-SF2-1**).



ORDER GUIDE

Safety relay unit

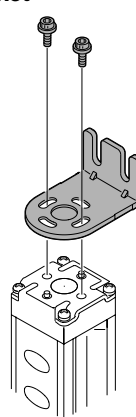
Type	Appearance	Model No.	Description
Safety relay unit (For PNP output type light curtain)		SF-AC (Note)	Safety relay unit for PNP output type • Complies with Control Categories up to 4 based on EN 954-1

Note: Refer to p.500~ for further details.

Spare parts (Accessories for sensor)

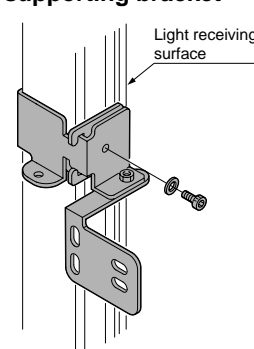
Designation	Model No.	Description
Sensor mounting bracket	MS-SF2-1	One set of two brackets for both the emitter and the receiver
Intermediate supporting bracket	MS-SF2-2	One set of two brackets for both the emitter and the receiver
Test rod	SF2-EH-TR	Sensing object ($\phi 30$ mm $\phi 1.181$ in) for daily check

Sensor mounting bracket



Four bracket set
Eight M4 (length 10 mm 0.394 in) hexagon-socket-head bolts with washers.

Intermediate supporting bracket



Set of 2 pcs. each of U-shaped intermediate supporting bracket and L-shaped intermediate supporting bracket
Two M4 (length 6 mm 0.236 in) hexagon-socket-head bolts, two M4 (length 10 mm 0.394 in) hexagon-socket-head bolts with washers, two nuts and two plain washers are attached.

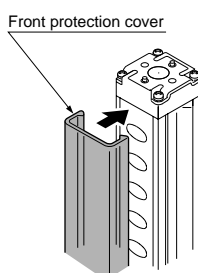
OPTIONS

Applicable beam channels		For 12 beam channels	For 16 beam channels	For 20 beam channels	For 24 beam channels	For 28 beam channels	For 32 beam channels	For 36 beam channels	For 40 beam channels	For 48 beam channels	For 56 beam channels	For 64 beam channels	For 72 beam channels	For 80 beam channels
Front protection cover	Model No.	FC-SF2-H12	FC-SF2-H16	FC-SF2-H20	FC-SF2-H24	FC-SF2-H28	FC-SF2-H32	FC-SF2-H36	FC-SF2-H40	FC-SF2-H48	FC-SF2-H56	FC-SF2-H64	FC-SF2-H72	FC-SF2-H80
Slit mask	Model No.	OS-SF2-H12	OS-SF2-H16	OS-SF2-H20	OS-SF2-H24	OS-SF2-H28	OS-SF2-H32	OS-SF2-H36	OS-SF2-H40	OS-SF2-H48	OS-SF2-H56	OS-SF2-H64	OS-SF2-H72	OS-SF2-H80
Front protection bracket	Model No.	MC-SF2EH-12	MC-SF2EH-16	MC-SF2EH-20	MC-SF2EH-24	MC-SF2EH-28	MC-SF2EH-32	MC-SF2EH-36	MC-SF2EH-40	MC-SF2EH-48	MC-SF2EH-56	MC-SF2EH-64	MC-SF2EH-72	MC-SF2EH-80

Note: The model Nos. given above denote a single unit, not a pair of units.

Front protection cover

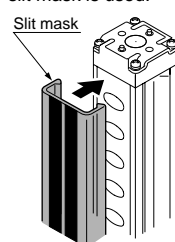
It protects front lens.



Slit mask

The slit mask restrains the amount of beam emitted or received and hence reduces the interference between neighbouring sensors. It is also used in cases when the beam intensity is too strong penetrating through the sensing object.

However, the operating range reduces when the slit mask is used.

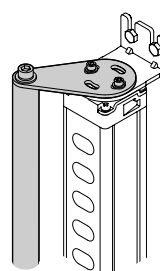


Operating range

- Slit on the emitter side: 4 m 13.123 ft
- Slit on the receiver side: 5 m 16.404 ft
- Slit on both sides: 2 m 6.562 ft

Front protection bracket

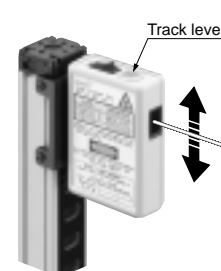
It protects front face from damage due to striking of an object.



Laser alignment tool

• SF-LAT-2E

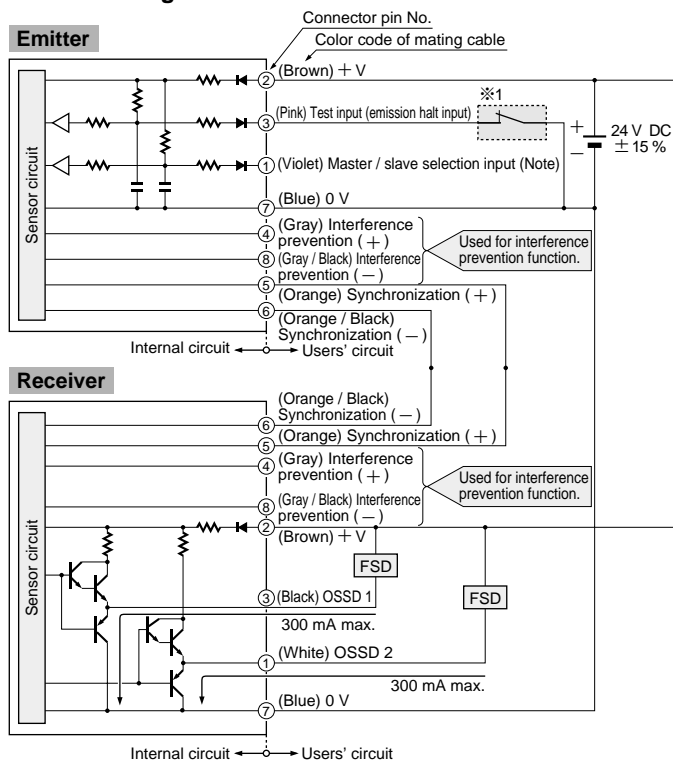
Easy to align the beam axis with the visible laser beam.



I/O CIRCUIT AND WIRING DIAGRAMS

NPN output
equivalent type

I/O circuit diagram



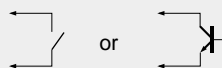
Note: Refer to p.496 for master / slave selection input.

CAUTION

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

※1

Non-voltage contact or NPN open-collector transistor



- Test input (emission halt input)
Low (0 V): Emission
High (+ V or open): Emission halt

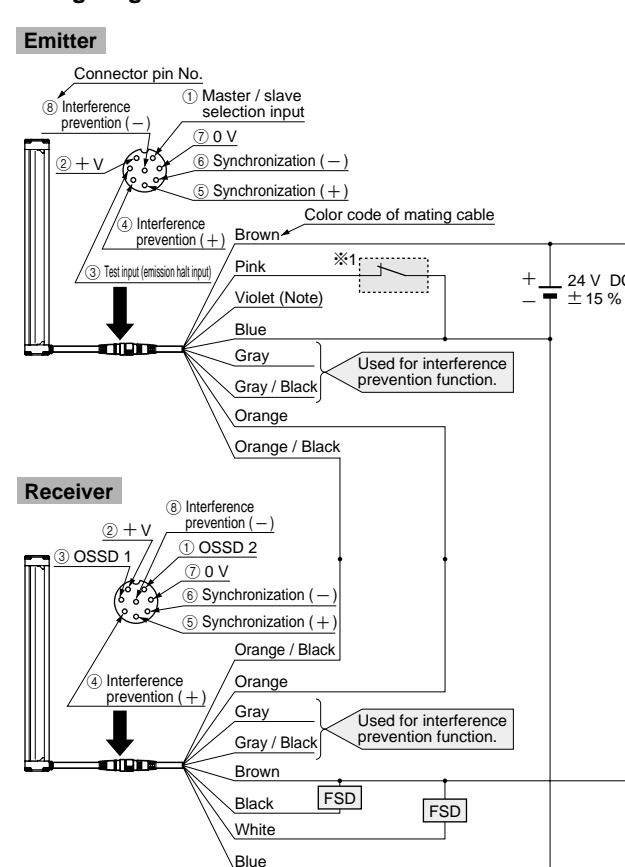
Output waveform (when output is ON)

- When the sensor is in the light received condition (ON state), the receiver self-diagnoses the output circuit. For this purpose, the output transistor goes to the OFF state periodically. (Refer to the figure of output condition given at the right.)
If the OFF signal is fed back, the receiver judges the output circuit as normal. If the OFF signal is not fed back, the receiver judges that the output circuit or the wiring is abnormal, and the output is maintained in the OFF state.
The frequency or the period for which the output transistor turns OFF does not change even for the maximum connected set No. of 4 sets connected in series.

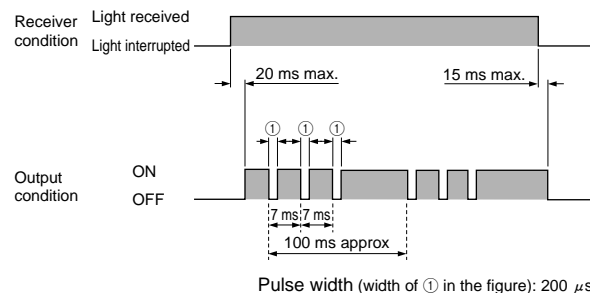


Take care of the input response time of the equipment connected to the sensor, since there is a possibility of the equipment malfunctioning due to the sensor OFF signal.

Wiring diagram



Note: Refer to p.496 for master / slave selection input.



Light Curtain

SF2-N

SF2-A

SF2-EH

SF-AC

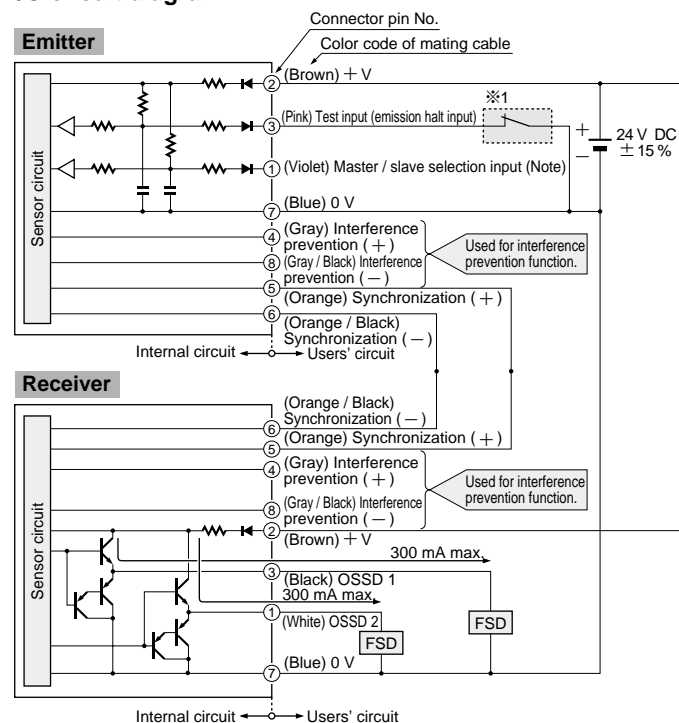
Safety Relay Unit

SF2-EH

I/O CIRCUIT AND WIRING DIAGRAMS

PNP output equivalent type

I/O circuit diagram



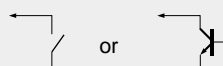
Note: Refer to p.496 for master / slave selection input.

CAUTION

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

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Non-voltage contact or NPN open-collector transistor



- Test input (emission halt input)
Low (0 V): Emission
High (+ V or open): Emission halt

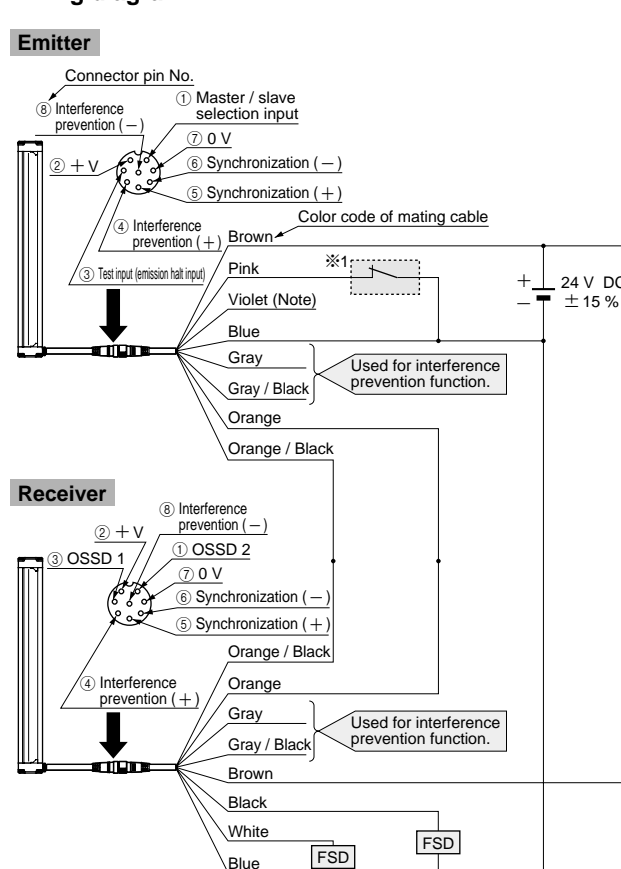
Output waveform (when output is ON)

- When the sensor is in the light condition (ON state), the receiver self-diagnoses the output circuit. For this purpose, the output transistor goes to the OFF state periodically. (Refer to the figure of output condition given at the right.)
If the OFF signal is fed back, the receiver judges the output circuit as normal. If the OFF signal is not fed back, the receiver judges that the output circuit or the wiring is abnormal, and the output is maintained in the OFF state.
The frequency or the period for which the output transistor turns OFF does not change even for the maximum connected set No. of 4 sets connected in series.

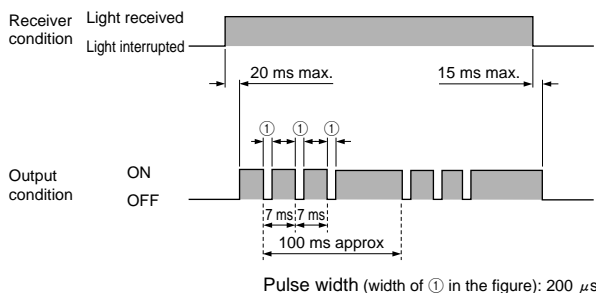


Take care of the input response time of the equipment connected to the sensor, since there is a possibility of the equipment malfunctioning due to the sensor OFF signal.

Wiring diagram



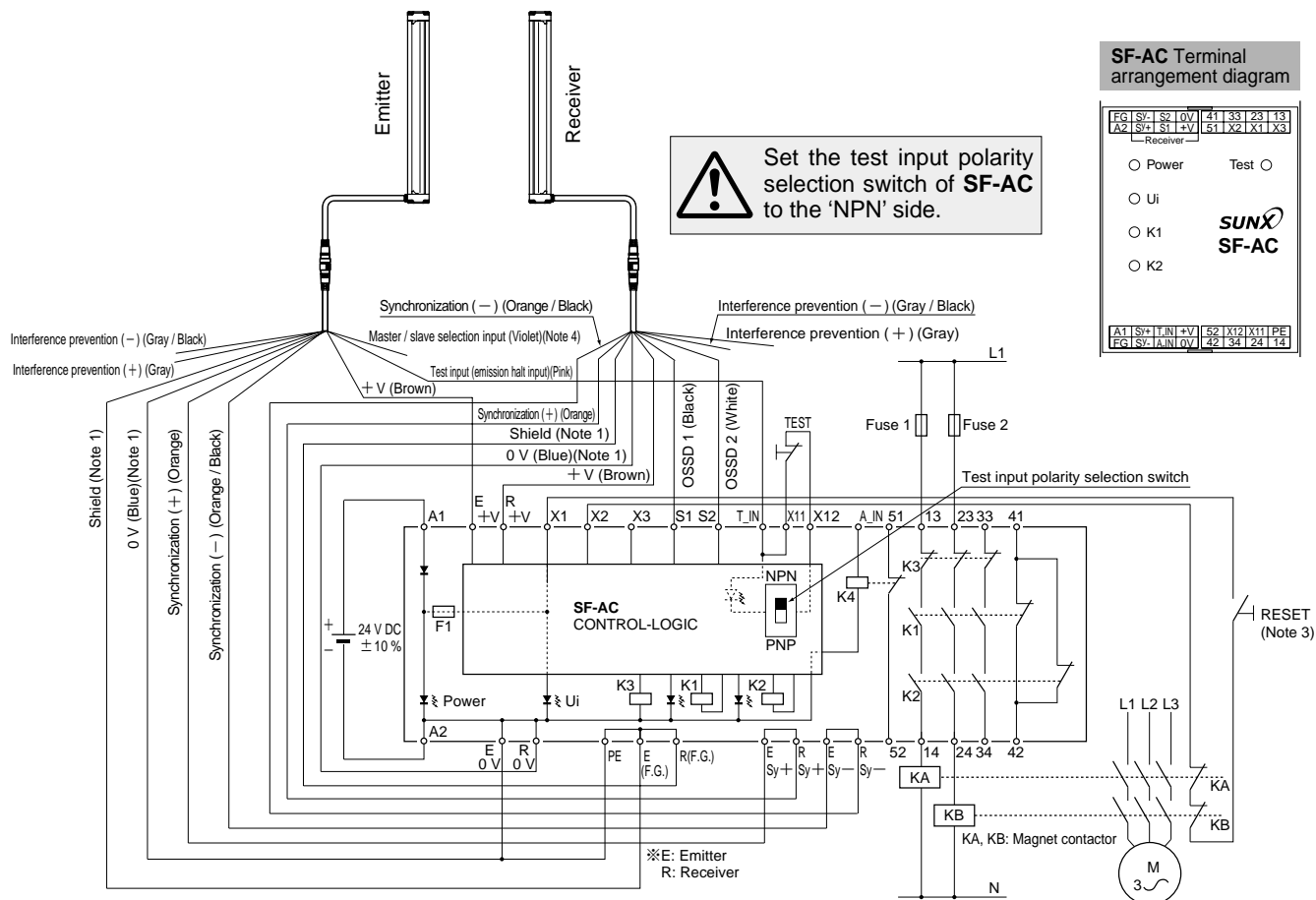
Note: Refer to p.496 for master / slave selection input.



I/O CIRCUIT AND WIRING DIAGRAMS

PNP output
equivalent type

SF-AC wiring diagram (Control category 4)



- Notes: 1) The shielding wire and 0 V (blue) of the **SF2-EH** series are connected in the their bodies.
 2) If using the equipment with the manual reset, wire X1 to X2 as per the illustration above.
 If using with the automatic reset, disconnect X2 wire and connect it to X3. In this case, reset button is not required.
 3) Use a momentary-type switch for the reset button.
 4) Refer to p.496 for master / slave selection input.

PRECAUTIONS FOR PROPER USE

Refer to [p.1135](#) for general precautions.

Refer to the applicable regulations for the region where this device is to be used when setting up the device. In addition, make sure that all necessary measures are taken to prevent possible dangerous operating errors resulting from earth faults.

Wiring

- Make sure that the power supply is off while wiring.
- Verify that the supply voltage variation is within the rating.
- If power is supplied from a commercial switching regulator, ensure that the frame ground (F.G.) terminal of the power supply is connected to an actual ground.
- In case noise generating equipment (switching regulator, inverter motor, etc) is used in the vicinity of this sensor, connect the frame ground (F.G.) terminal of the equipment to an actual ground.
- Do not run the wires together with high-voltage lines or power lines or put them in the same raceway. This can cause malfunction due to induction.

Others

- Do not use during the initial transient time (5 sec.) after the power supply is switched on.
- Avoid dust, dirt and steam.
- Take care that the sensor does not come in direct contact with water, oil, grease, or organic solvents, such as, thinner, etc.
- Take care that the sensor is not directly exposed to fluorescent light from a rapid-starter lamp or a high frequency lighting device, as it may affect the sensing performance.

SF2-EH

PRECAUTIONS FOR PROPER USE

Refer to [p.1135](#) for general precautions.



- Do not utilize this sensor in 'PSDI Mode', in which the sensor is utilized as an activator for machinery.
- To use this product in the U.S.A., refer to OSHA 1910. 212 and OSHA 1910. 217 for installation, and in Europe, refer to EN 999 as well. Observe your national and local requirements before installing this product.

- This catalog is a guide to select a suitable product. Be sure to read the instruction manual attached to the product prior to its use.

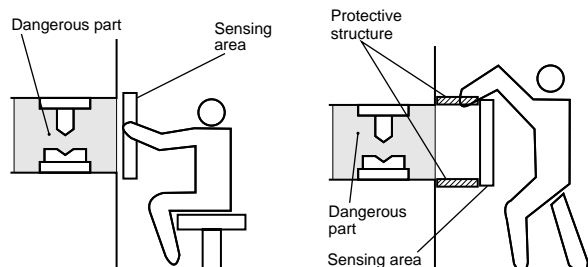
- Make sure to carry out the test run before regular operation.
- This safety system is for use only on machinery in which the dangerous parts can be stopped immediately, either by an emergency stop unit or by disconnecting the power supply. Do not use this system with machinery which cannot be stopped at any point in its operation cycle.

Sensing area

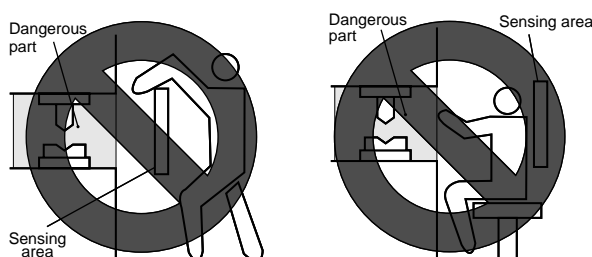


- Make sure to install this product such that any part of the human body that passes through the sensing area is detected before it reaches dangerous machine parts. If the human body is not detected, there is a danger of serious injury or death.
- Do not use any reflective type or retroreflective type arrangement.

Correct mounting method



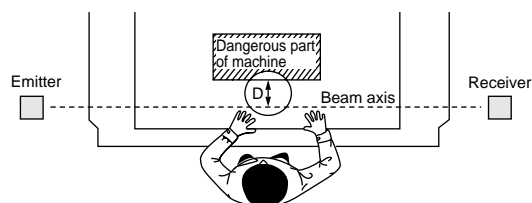
Wrong mounting method



Safety distance



- 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 sensor and the dangerous parts of the machinery. If the safety distance is miscalculated or if sufficient distance is not maintained, there is a danger of serious injury or death.
- Before designing the system, refer to the relevant standards of the region where this device is to be used and then install this device.



- Safety distance is calculated based on the following equation when a person moves perpendicular (normal intrusion) to the sensing area of the sensor. (Please check the latest standards for the equation.)

For use in Europe (as per EN 999)

- Equation ① $D = K \times T + C$

D: Safety distance (mm)

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

K: Intrusion speed of operator's body or objects (mm/sec.)

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

T: Response time of total equipment (sec.)

$T = T_m + T_{SF2}$

T_m : Maximum halt time of device (sec.)

T_{SF2} : Response time of the SF2-EH series 0.015 (sec.)

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

Note that the value of C is not less than or equal to 0.

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

d: Minimum sensing object diameter 30 (mm) 1.181 (in)

For use in U.S.A. (as per ANSI B11.19)

- Equation ② $D = K \times (T_s + T_c + T_{SF2} + T_{bm}) + D_{pf}$

D: Safety distance (mm)

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

K: Intrusion speed (Recommended value in OSHA is 63 (inch/sec.) [$\approx 1,600$ (mm/sec.)])

ANSI B11.19 does not define the intrusion speed (K). When determining K, consider possible factors including physical ability of operators.

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

T_c : Maximum response time of the control circuit required for the brake to function. (sec.)

T_{SF2} : Response time of the SF2-EH series 0.015 (sec.)

T_{bm} : Additional halt time tolerance for the brake monitor (sec.)

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

T_a : Setting time of brake monitor (sec.)

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

D_{pf} : Additional distance calculated from the size of the minimum sensing object of the sensor (mm)

$D_{pf} = 78.2 \text{ mm } 3.079 \text{ in}$

$D_{pf} = 3.4 \times (d - 0.276) \text{ (inch)}$

$= 3.4 \times (d - 7) \text{ (mm)}$

d: Minimum sensing object diameter 1.2 (inch) ≈ 30 (mm)

Note that the value of D_{pf} is not less than or equal to 0.

PRECAUTIONS FOR PROPER USE

Refer to p.1135~ for general precautions.

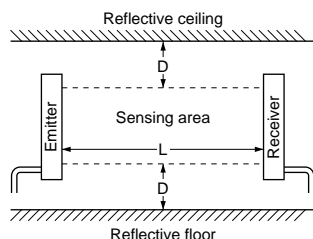
Influence of reflective surface



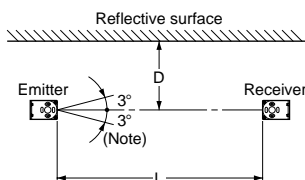
Install the sensor by considering the effect of nearby reflective surfaces and take suitable countermeasures. Failure to do so may cause the sensor not to detect, resulting in serious injury or death.

- Keep the minimum distance given below, between the sensor and a reflective surface.

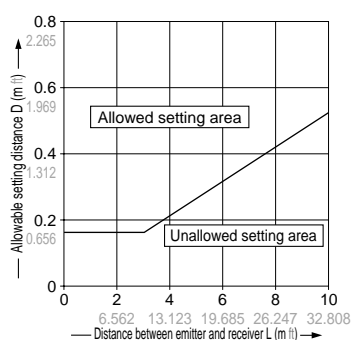
Side view



Top view



Distance between emitter and receiver, L	Allowable setting distance, D
0.3 to 3 m 0.984 to 9.843 ft	0.16 m 0.525 ft
3 to 10 m 9.843 to 32.808 ft	$L \times \tan \theta$ ($\theta = 3^\circ$) $= L \times 0.052$ (m) 0.171 (ft)



Note: The effective aperture angle for this sensor is $\pm 2.5^\circ$ (with $L > 3$ m 9.843 ft) as required by IEC 61496-2 / UL 61496-2. However, install this sensor away from the reflective surfaces, assuming an effective aperture angle of $\pm 3^\circ$ to provide for misalignment, etc., during installation.

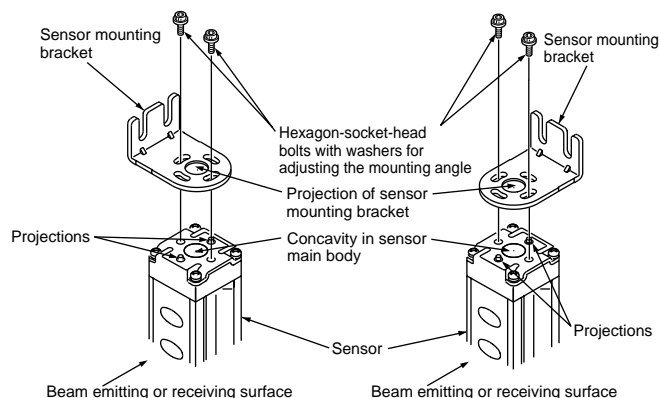
Mounting

- The minimum bending radius of the cable is R35 mm R1.378 in.
- Mount the sensor considering cable bending radius.

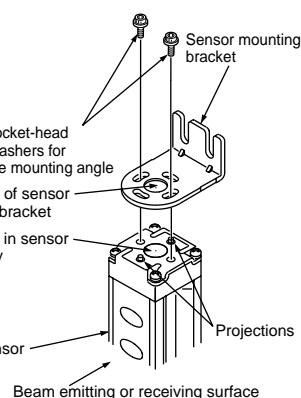
Mounting of sensor mounting bracket (MS-SF2-1)

- Choose the mounting direction for the sensor mounting bracket based on the mounting direction (side or back), and temporarily tighten the brackets with the two hexagon-socket-head bolts with washers for adjusting the mounting angle (M4, length 10 mm 0.394 in). Tighten it securely, after beam alignment. The tightening torque should be 1.2 N·m or less.

<Side mounting>



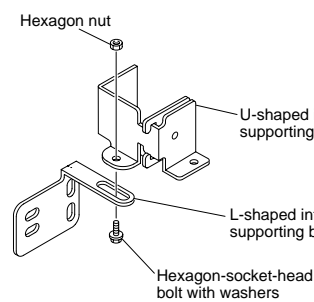
<Back mounting>



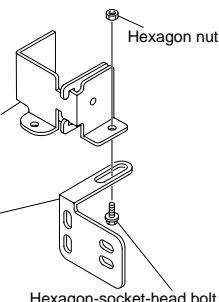
Mounting of intermediate supporting bracket (MS-SF2-2)

- ① Choose the mounting direction for the L- and U-shaped intermediate supporting brackets based on the mounting direction (side or back), and temporarily tighten the mounting brackets with the hexagon-socket-head bolt (M4, length 10 mm 0.394 in). Tighten it securely, after beam alignment. The tightening torque should be 1.2 N·m or less.

<Side mounting>

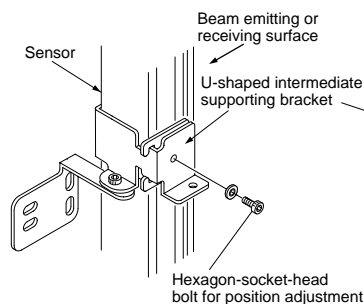


<Back mounting>

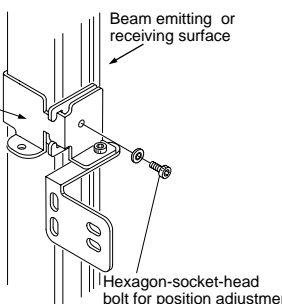


- ② Clasp the body of the sensor with the U-shaped intermediate supporting bracket, and temporarily tighten with the hexagon-socket-head bolt (M4, length 6 mm 0.236 in) for position adjustment. Tighten it securely, after beam alignment. The tightening torque should be 1.2 N·m or less.

<Side mounting>



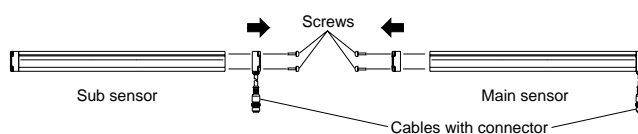
<Back mounting>



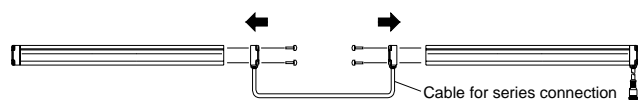
Note: The above drawing shows the intermediate supporting bracket mounted on the emitter. In case of mounting on the receiver, note that the intermediate supporting bracket is upside down.

Mounting of cable for series connection (SF2-CSL□)

- ① Remove four M4 screws (length 10 mm 0.394 in) on the main sensor and the sub sensor as given below.



- ② As shown below, mount the cable for series connection at the place on the main sensor and the sub sensor from where the screws have been removed.



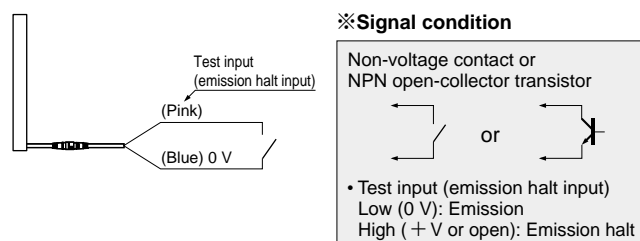
SF2-EH

PRECAUTIONS FOR PROPER USE

Refer to [p.1135](#) for general precautions.

Test input (emission halt) function

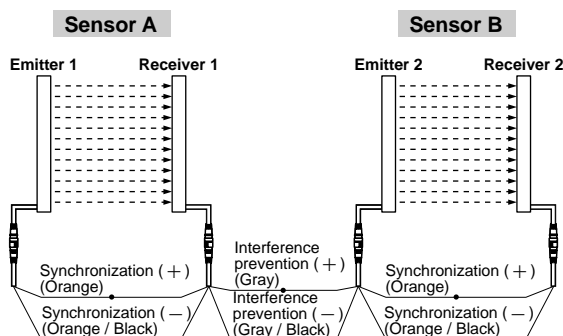
- The emission is halted when the test input (emission halt input) wire (pink) is connected to +V or kept open. The test input (emission halt input) is useful for a start-up check since the sensing output can be switched ON / OFF without the sensing object.



Note: When test input (emission halt) function is not used, make sure to connect the test input (emission halt input) wire (pink) to 0 V.

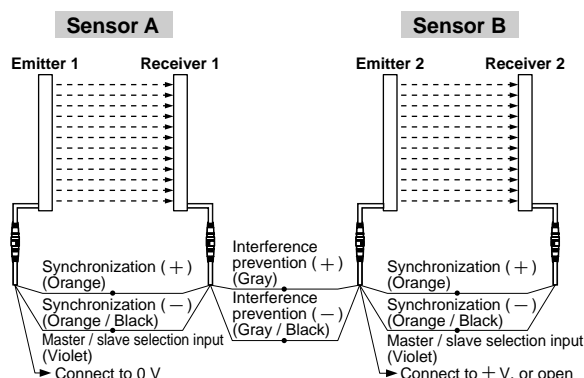
Interference prevention function

- Interference can be prevented between 4 sets max. (192 beam channels max.) for series connection, 4 sets max. (192 beam channels max.) for parallel connection, and 12 sets max. (192 beam channels max.) for series and parallel mixed connection. In this case, connect the respective interference (+) (gray) and interference (-) (gray / black) of the adjacent sensors.



Master / slave selection input

- In case of parallel connection, or series and parallel mixed connection, before switching on the power supply, connect the master / slave selection input (violet) of Sensor A, as master, to 0 V and connect the master / slave selection input (violet) of Sensor B, as slave, to +V or open. The master / slave selection is done only once at the time of switching on of the power supply. If selection is done after switching on of the power supply, it does not change. Further, if the master / slave selection input is kept open when the sensor is set as slave, ensure to insulate it.
- In case of series connection or when using 1 set, connect the master / slave selection input (violet), as master, to 0 V.

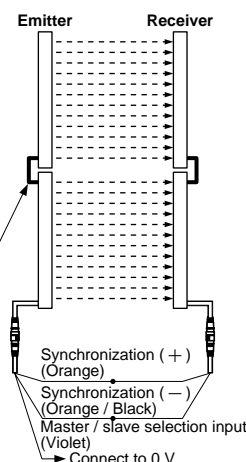


Connection

Series connection [4 sets max. (192 beam channels max.) connectable]

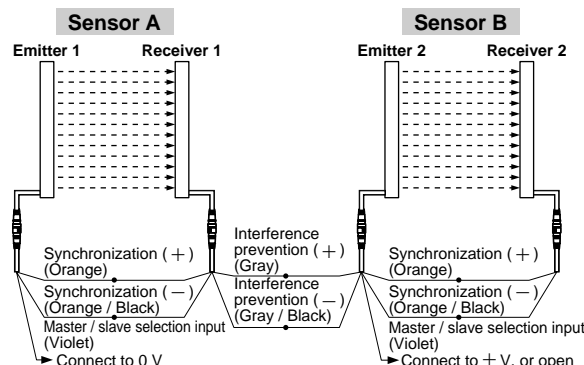
- When the danger region can be approached from two or more directions, multiple sets of emitters and receivers should be connected in series. When a beam of any set is interrupted, the output turns OFF.

Cable for serial connection (optional)
SF2-CSL02 (Length : 200 mm 7.874 in)
SF2-CSL05 (Length : 500 mm 19.685 in)



Parallel connection [4 sets max. (192 beam channels max.) connectable]

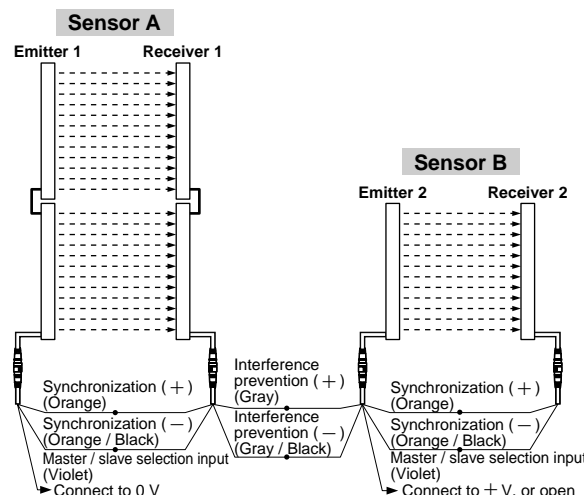
- In case there are two, or more, danger regions which can be approached from a single direction only, multiple sets of emitters and receivers can be connected in parallel by connecting their interference prevention wires to individually monitor the danger regions. Since the outputs are separate, only the output of the sensor whose beams are interrupted is turned OFF.



Serial / parallel mixed connection

[12 sets max. (192 beam channels max.) connectable]

- In case there are two, or more, danger regions which can be approached from two or more directions, multiple sets of emitters and receivers can be connected in series and parallel mixed connection. For the sensors connected in series, the output turns OFF if the beams of any of these sensors are interrupted. For the sensors connected in parallel, the output of only the sensor whose beams are interrupted turns OFF.



DIMENSIONS (Unit: mm in)

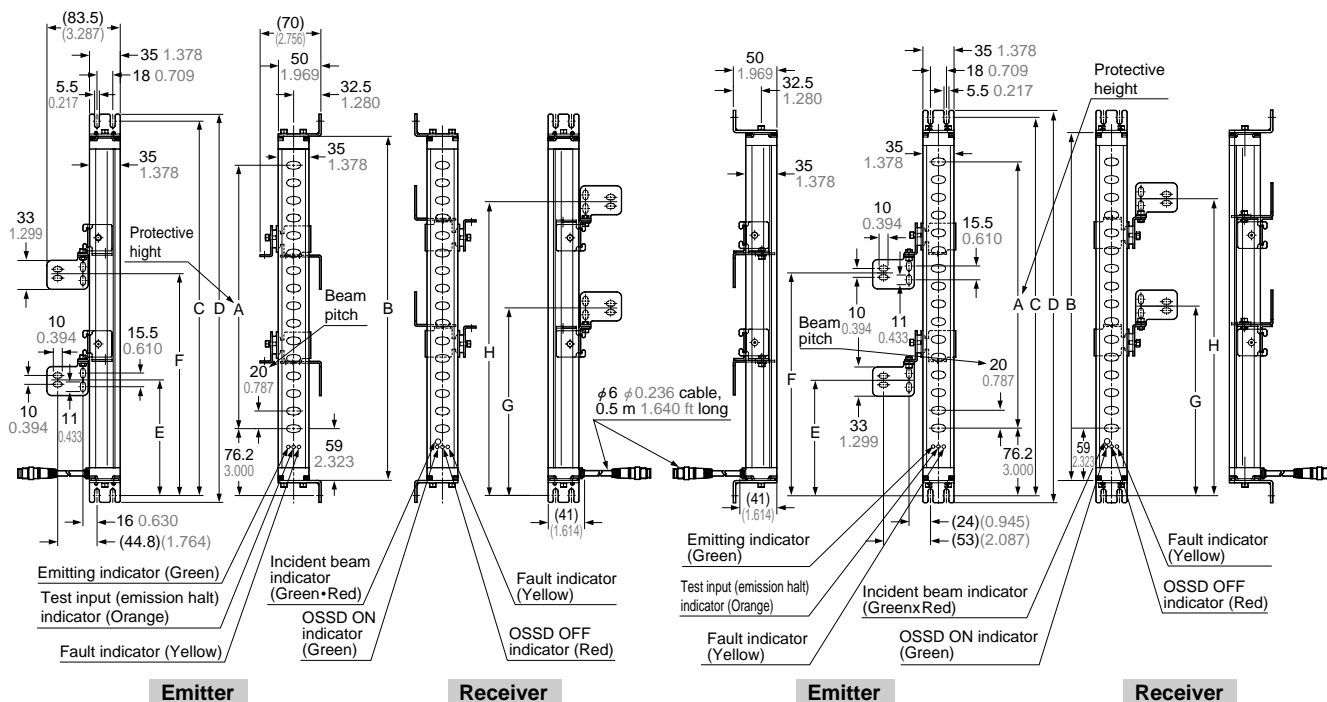
SF2-EH□(-N) Sensor

Assembly dimensions

Mounting drawing for the sensor on which the sensor mounting brackets and the intermediate supporting brackets are mounted

<Side mounting>

<Back mounting>



Model No.	A		B		C		D		E		F		G		H	
SF2-EH12(-N)	220	8.661	312	12.283	342	13.465	362	14.252	—	—	—	—	—	—	—	—
SF2-EH16(-N)	300	11.811	392	15.433	422	16.614	442	17.402	—	—	—	—	—	—	—	—
SF2-EH20(-N)	380	14.961	472	18.583	502	19.764	522	20.551	—	—	—	—	—	—	—	—
SF2-EH24(-N)	460	18.110	552	21.732	582	22.913	602	23.701	322	12.677	—	—	280	11.024	—	—
SF2-EH28(-N)	540	21.260	632	24.882	662	26.063	682	26.850	362	14.252	—	—	320	12.598	—	—
SF2-EH32(-N)	620	24.409	712	28.031	742	29.213	762	30.000	402	15.827	—	—	360	14.173	—	—
SF2-EH36(-N)	700	27.559	792	31.181	822	32.362	842	33.150	442	17.402	—	—	400	15.748	—	—
SF2-EH40(-N)	780	30.709	872	34.331	902	35.512	922	36.299	482	18.976	—	—	440	17.323	—	—
SF2-EH48(-N)	940	37.008	1,032	40.630	1,062	41.811	1,082	42.598	562	22.126	—	—	520	20.472	—	—
SF2-EH56(-N)	1,100	43.307	1,192	46.929	1,222	48.110	1,242	48.898	642	25.276	—	—	600	23.622	—	—
SF2-EH64(-N)	1,260	49.606	1,352	53.228	1,382	54.409	1,402	55.197	488	19.213	976	38.425	446	17.559	892	35.118
SF2-EH72(-N)	1,420	55.905	1,512	59.527	1,542	60.709	1,562	61.496	542	21.339	1,084	42.677	500	19.685	1,000	39.370
SF2-EH80(-N)	1,580	62.205	1,672	65.827	1,702	67.008	1,722	67.795	595	23.425	1,190	46.850	574	22.598	1,148	45.197

Note: MS-SF2-2 (intermediate supporting bracket) is attached with sensors having 24, or more, beam channels.

The number of attached intermediate supporting brackets is different depending on the sensor as follows.

SF2-EH24(-N), SF2-EH28(-N), SF2-EH32(-N), SF2-EH36(-N), SF2-EH40(-N), SF2-EH48(-N), SF2-EH56(-N): 1 set

SF2-EH64(-N), SF2-EH72(-N), SF2-EH80(-N): 2 sets

Light Curtain

SF4-AH

SF2-A

SF2-N

SF2-EH

Safety Relay Unit

SF-AC

