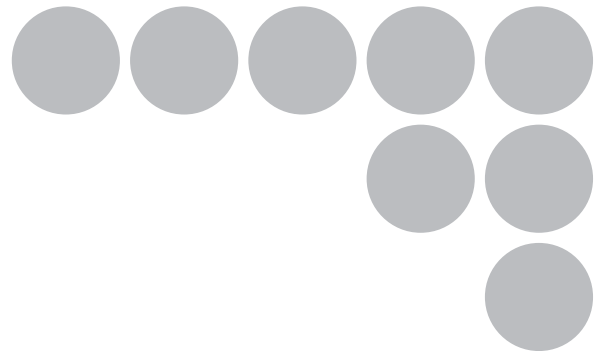


NEW

OMRON

Safety Light Curtain F3SR-B



Three Intuitive, Easy-to-use Indicators

Ease of Use

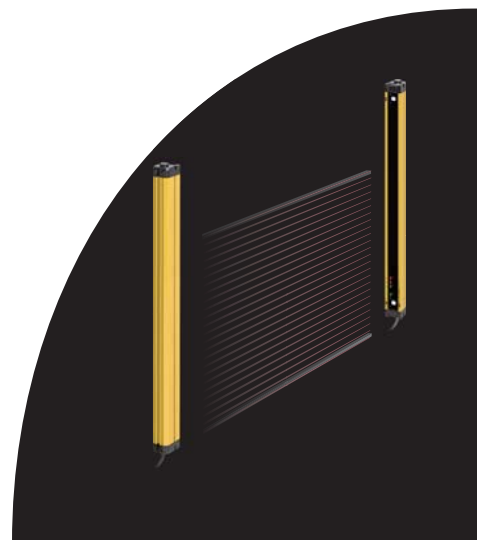
Robust

Long Distance Detection

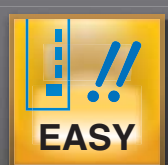
Reliable



realizing



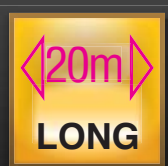
Intuitively Recognizable Understanding the Indicators at a Glance



Ease of Use



Robust and Reliable



Long Distance Detection



Dependable Usability

For Safety Light Curtain

Robust & Basic

New Lineup

Easy to Use



User friendly functions. No set-up tools are required.

Easy to Select



Cost-effective. The detection capability is standardized at 30 mm diameter to detect user hands and arms.
One lineup make it easy for users to select models.

Previously light curtains only offered status indicators.

The three types of indicators on the F3SR-B are not only status indicators but enable the user to completely understand the status at a glance, further enhancing usability.

The three intuitively recognizable indicators along with easy-to-adjust mounting brackets allow for easy installation and maintenance.

Can be used in severe work environments.
Thick, impact-resistant body housing.
IP67 degree of protection.

Long operating range of 0.3 to 20 m.
Can be used in large-scale applications.

ISO 13849-1 and PLe compliant.
Authenticated under major safety standards.
Provides secure functions that can be used globally.



Alignment is easy to check.

World's First

Large High-Intensity Top/Bottom beam status indicators

9mm
Industry's Largest
63mm²
7mm

* Research as of August 2009

< Receiver >

Intuitively recognizable:
Error Indicators

Fine-tuning adjustment by way of a photoelectric sensor:
Stable-state Indicator

Three
Informative
Indicators



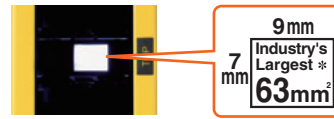
Ease of Use

Three intuitively recognizable indicators

Easy Beam Alignment

Large-size top/bottom-beam-state indicators (high intensity white LED) allows coarse adjustment.

***World's First**



* Research as of August 2009

- 1** Adjust beam position until the TOP (Top-beam-state indicator) turns ON.
- 2** Adjust beam position until the BTM (Bottom-beam-state indicator) turns ON.
- 3** Coarse adjustment of the beam complete when the TOP and BTM indicators turn ON.

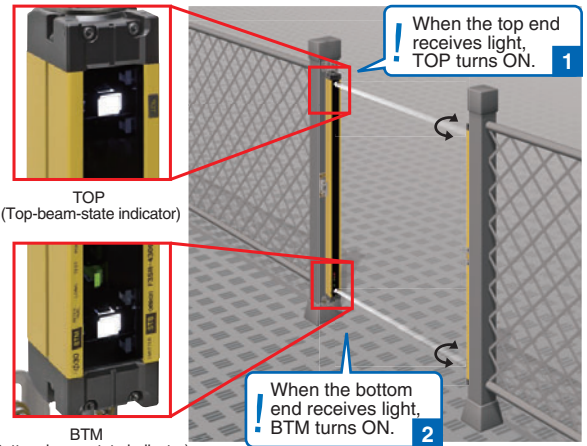
Sensitive fine-adjustment by way of a photoelectric sensor is made using the stable-state indicator. (Green LED)

- 4** Perform fine adjustment until the STB (Stable-state indicator) turns ON.
- 5** Fine adjustment of the beam completes when the stable-state indicator turns ON.

5 The STB turns ON when all beams receive light of more than 170% of ON threshold value.



STB (Stable-state indicator)



TOP (Top-beam-state indicator)

BTM (Bottom-beam-state indicator)

New accessories for clean installation



Top/bottom mounting bracket (sold separately)

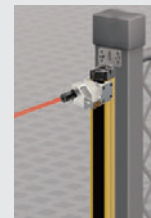


Intermediate mounting bracket (sold separately)



Free-location mounting bracket (sold separately)

Newly designed top/bottom mounting bracket for simpler mounting and adjustment.



F39-PTR

Laser pointer for F3SR (sold separately)

Easily identify the direction and the amount of deviation at a glance even for a long distance beam adjustment.

Easy Maintenance

Intuitively recognizable error indicators

Users can easily recognize an error from simply seeing a blinking LED.

External device monitoring error



Communication error

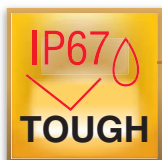


* For details on errors, refer to page 20.

Easy Safety Distance Design

Response time of 15 ms fixed for all models

Calculation of the safety distances is now simple.



Robust and Reliable

Can be used in severe work environments.

Thick, impact-resistant body housing



The F3SR-B inherited MS4800's established robust, break-proof body housing structure.

IP67 degree of protection increases resistance to the environment.

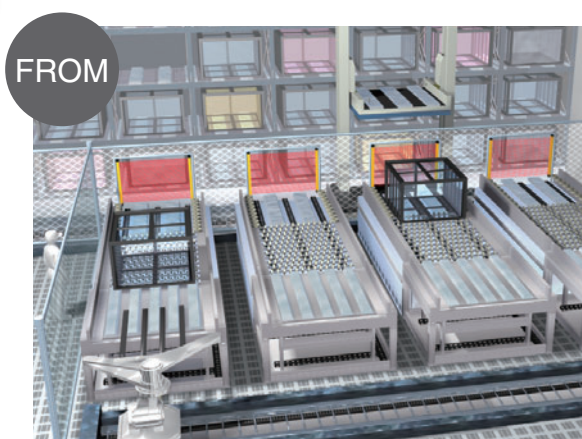


IP67 degree of protection. NBR rubber is used for sealing.



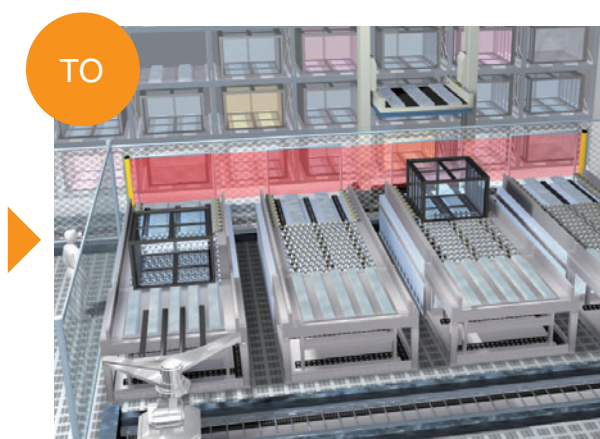
Long Distance Detection

Up to 20 meters of operating range



FROM

Four sets of safety light curtains are used.



TO

One set of F3SR-Bs is used.

Operating Range is selected by a simple wiring configuration.

Two range settings: long distance (5 to 20 m) and short distance (0.3 to 7 m).

Switching of operating range can be easily set with a single input line (operating range select input).

This saves the work time for switching.

Cable installation can be as long as 100m.

It covers a wider range of applications with its easy wiring design.



Dependable

Usable Reliability in One Package

Reliability with a power supply range of 24 VDC $\pm 20\%$

The F3SR-B resists momentary power interruptions and voltage drops, for reliable application.

Resistant to mutual interference

F3SR-B inherited F3SJ's highly reliable interference protection algorithm, capable of preventing mutual interference on up to three sets.

Authenticated under major safety standards including ISO 13849-1 and PLe.

Authenticated under major safety standards including European standards.




Dependable support with global network




F3SR-B

Ordering Information

Main Unit

Safety Light Curtain F3SR-430B (Type 4/PNP output)

 Infrared light

Application	Detection capability	Beam gap	Appearance	Operating range			Number of beams	Protective height (mm)	Model
Hand/arm protection	30-mm-dia.	20 mm			Long range * 5 to 20 m		8 to 112	190 to 2270	F3SR-430B□□□□
					Short range * 0.3 to 7 m				

Note: Connection cable is not included in the product. You must purchase optional connector cable.

*Range is selectable via easy wiring.

Safety Light Curtain Model List

F3SR-430B Series (Detection capability: 30 mm diameter/PNP output)


Model	Number of beams	Protective height (mm) *
F3SR-430B0190	8	190
F3SR-430B0270	12	270
F3SR-430B0350	16	350
F3SR-430B0430	20	430
F3SR-430B0510	24	510
F3SR-430B0590	28	590
F3SR-430B0670	32	670
F3SR-430B0750	36	750
F3SR-430B0830	40	830
F3SR-430B0910	44	910
F3SR-430B0990	48	990
F3SR-430B1150	56	1150
F3SR-430B1310	64	1310
F3SR-430B1470	72	1470
F3SR-430B1630	80	1630
F3SR-430B1790	88	1790
F3SR-430B1950	96	1950
F3SR-430B2110	104	2110
F3SR-430B2270	112	2270

* Protective height (mm)= Total sensor length

Accessories (sold separately)


Single-end Connector Cable (2 cables per set, for emitter and receiver)

For wiring with safety circuit such as single safety relay, safety relay unit, and safety controller



Appearance	Cable length	Specifications	Model
	3 m	M12 connector (8-pin)- 8-wire + Shield	F39-JD3A
	7 m		F39-JD7A
	10 m		F39-JD10A
	15 m		F39-JD15A
	20 m		F39-JD20A

Double-end Connector Cable (2 cables per set, for emitter and receiver)


Control unit for connection with F3SP-B1P and cable extension

Appearance	Cable length	Specifications	Model
	0.5 m	M12 connector (8-pin)- M12 connector (8-pin)	F39-JDR5B
	1 m		F39-JD1B
	3 m		F39-JD3B
	5 m		F39-JD5B
	7 m		F39-JD7B
	10 m		F39-JD10B
	15 m		F39-JD15B
	20 m		F39-JD20B

Relays with Forcibly Guided Contacts

Type	Appearance	Specifications	Model	Remarks
G7SA Relays with Forcibly Guided Contacts		<ul style="list-style-type: none"> Number of poles: 4 Contact type: 2NO+2NC Rated load: 250 VAC at 6 A, 30 VDC at 6 A 	G7SA-2A2B	For details on other models and socket models, refer to Safety Components Series catalog (Cat. No. Y106).
		<ul style="list-style-type: none"> Number of poles: 4 Contact type: 3NO+1NC Rated load: 250 VAC at 6 A, 30 VDC at 6 A 	G7SA-3A1B	
G7S-□-E Relays with Forcibly Guided Contacts		<ul style="list-style-type: none"> Number of poles: 6 Contact type: 4NO+2NC Rated load: 250 VAC at 10 A, 30 VDC at 10 A 	G7S-4A2B-E	For details on other models and socket models, refer to Safety Components Series catalog (Cat. No. Y106).
		<ul style="list-style-type: none"> Number of poles: 6 Contact type: 3NO+3NC Rated load: 250 VAC at 10 A, 30 VDC at 10 A 	G7S-3A3B-E	

Control Unit

Appearance	Output	Model	Remarks
	Relay, 3NO+1NC	F3SP-B1P	For connection with F3SR-B, use an F39-JD□B double-end connector cable.


Various types of safety application controllers are available to establish safety circuits.

Test rod


Diameter	Model
14mm dia.	F39-TRD14
20mm dia.	F39-TRD20
25mm dia.	F39-TRD25
30mm dia.	F39-TRD30

F3SR-B

Laser Pointer


Appearance	Applicable sensor	Model	Remarks
	F3SR-430B series	F39-PTR	Laser pointer for long distance beam adjustment

Spatter Protection Cover (2 covers per set, for emitter and receiver) (Each unit reduces the operating range by 10%)


Appearance	Applicable sensor	Model
	F3SR-430B series	F39-HRB□□□□ *

* The same 4-digit numbers as the protective heights of F3SR-B (□□□□ in the light curtain type names) are substituted by □□□□ in the model names.
Note: When a spatter protection cover is mounted, the operating range of the F3SR-B is reduced by approximately 10%.


Top/Bottom Mounting Bracket (Not included with the product.)

Appearance	Specification	Model	Application	Remarks
	Top/bottom mounting bracket	F39-LR1	Top/bottom mounting bracket for F3SR-B. For side mounting and backside mounting.	2 for emitter, 2 for receiver (total of 4 per set)

Intermediate Mounting Bracket (Not included with the product. Purchase this bracket according to the sensor length.)

Appearance	Specification	Model	Application	Remarks
	Intermediate mounting bracket	F39-LR2	Use this bracket in combination with F3SR-B's top/bottom mounting bracket. For side mounting and backside mounting.	1 set with 2 pieces (For the number of brackets needed, see the table below.)

Free-Location Mounting Bracket (Not included with the product. Purchase this bracket according to the sensor length.)

Appearance	Specification	Model	Application	Remarks
	Free-location mounting bracket	F39-LR3	Use this bracket for mounting on any place without using top/bottom mounting bracket.	1 set with 2 pieces (For the number of brackets needed, see the table below.)

* Number of intermediate mounting brackets needed

- Using top/bottom mounting bracket + intermediate mounting bracket (F39-LR2).

Protective height (mm)	No. of top/bottom mounting brackets	No. of intermediate mounting brackets
0190 to 0990	2	0
1070 to 1950	2	1
2030 to 2270	2	2

- Using Free-location mounting bracket (F39-LR3).

Protective height (mm)	No. of free-location mounting brackets
0190 to 0750	2
0830 to 1470	3
1630 to 2110	4
2270	5

Specifications (For details, refer to the instruction manual and/or user's manual.)

Main Unit

Item	Model	F3SR-430B *1
Sensor type		Type 4 safety light curtain
Applicable safety category		Category 4, 3, 2, 1, or B
Detection capability		Opaque objects 30 mm in diameter
Beam gap		20 mm
Number of beams		8 to 112
Protective height		190 to 2,270 mm
Lens diameter		7 mm x 12 mm
Operating range *2		For long distance wiring: 5 to 20 m For short distance wiring: 0.3 to 7 m
Response time		ON to OFF: 15 ms max., OFF to ON: 60 ms max.
Startup waiting time		2 s max.
Power supply voltage (Vs)		24 VDC \pm 20 % (ripple p-p 10% max.)
Current consumption (no load)		Refer to "List of Models/Current Consumption" on page 10.
Light source (emitted wavelength)		Infrared LED (870 nm)
Effective aperture angle (EAA)		Based on IEC61496-2. Within $\pm 2.5^\circ$ for the emitter and receiver when the operating range is 3 m or over.
Safety output (OSSD)		Two PNP transistor outputs, load current 500 mA max., residual voltage 2 V max. (except for voltage drop due to cable extension), leak current 1 mA max. Allowable capacity load differs depending on the total cable length as shown below. *3 100 m max.: 0.05 μ F max. 70 m max.: 0.5 μ F max. 50 m max.: 1.0 μ F max.
Output operation mode		ON when receiving light
Input voltage		Test input, reset input, external device monitoring input, and function selection input are all ON voltage: 11 to 24 V OFF voltage: 0 to 5 V, or open Operating range selection input ON voltage: 11 to 24 V OFF voltage: 0 to 5 V
Input current		Test input, reset input, function selection input: 1.5 to 3 mA Operating range selection input: 1.5 to 4 mA External device monitoring input: 10 to 20 mA
Indicators		Refer to "Indicators" on page 18.
Mutual interference prevention function		Interference prevention algorithm prevents mutual interference for up to three sets .
Test functions		<ul style="list-style-type: none"> Self test (when power is turned ON and while power is supplied) External test (emission stop function by test input)
Safety functions		<ul style="list-style-type: none"> External device monitor Start interlock, restart interlock
Connection type		Connectors (M12, 8-pin)
Protection circuits		Output short-circuit protection, and power supply reverse polarity protection
Ambient temperature		Operating: -10 to 55°C (no icing), Storage: -25 to 70°C
Ambient humidity		Operating: 35% to 85% (no condensation), Storage: 35% to 95%
Ambient operating light intensity		Incandescent lamp: 3,000 lx max. (light intensity on the receiver surface), Sunlight: 10,000 lx max. (light intensity on the receiver surface)

*1. In the type names in this table, the contain the □□□□ 4 digits indicating the protective height (mm).

*2. Use of the Spatter Protection Cover causes a 10% maximum operating range attenuation.

*3. These values should be considered when additionally connecting elements such as capacitor that contains capacitive load.

F3SR-B

Item	Model	F3SR-430B *1
Insulation resistance		20 MΩ (at 500 VDC)
Dielectric strength		1,000 VAC 50/60 Hz, 1 min
Degree of protection		IP65, IP67 (IEC60529)
Vibration resistance		Malfunction: 10 to 55 Hz, 0.7-mm double amplitude, 20 sweeps in X, Y, and Z directions
Shock resistance		Malfunction: 100 m/s ² , 1,000 times each in X, Y, and Z directions
Power supply cable		6-mm-dia., allowable bending radius R5 mm
Extension cable		6.6-mm-dia., 8-pin (0.3 mm ² × 4P, resistance 0.058 Ω/m) with braided shield, allowable bending radius R36 mm Total cable length: 100 m max. For details on twisted pairs, refer to "Single-end Connector Cable" on page 16. Refer to "Double-end Connector Cable" on page 16.
Materials		Casing: Aluminum, zinc die-cast Optical cover: PMMA resin (acrylic), cable: Oil resistant PVC
Weight		Model: F3SR-430B □□□□ (□: protective height) Equation: Weight (g) = (protective height) × 4 + α The values for α are as follows: Protected height 190 mm : 1,100 Protected height 270 mm to 510 mm : 1,500 Protected height 590 mm to 1,070 mm : 2,000 Protected height 1,150 mm to 2,270 mm : 2,500
Accessories		User's Manual
Applicable standards		EN61496-1 (Type 4 ESPE), CLC/TS61496-2 (Type 4 AOPD), EN61508-1 to 3 (SIL3), EN62061 (SIL3), EN61000-6-4 ISO13849-1 (PL/Safety Category 4), IEC61496-1 (Type 4 ESPE), IEC61496-2 (Type 4 AOPD), IEC61508-1 to 3 (SIL3), IEC62061 (SIL3), UL application in process (as of August 1, 2009)

List of Models/Current Consumption

Model	Number of beams	Protective height (mm)	Current consumption			
			Emitter		Receiver (no load)	
			Operating range (Short)	Operating range (Long)	Operating range (Short)	Operating range (Long)
F3SR-430B0190	8	190	38 mA	44 mA	57 mA	64 mA
F3SR-430B0270	12	270	40 mA	47 mA	59 mA	66 mA
F3SR-430B0350	16	350	42 mA	50 mA	60 mA	67 mA
F3SR-430B0430	20	430	43 mA	53 mA	62 mA	69 mA
F3SR-430B0510	24	510	45 mA	57 mA	63 mA	70 mA
F3SR-430B0590	28	590	47 mA	60 mA	65 mA	72 mA
F3SR-430B0670	32	670	48 mA	63 mA	66 mA	73 mA
F3SR-430B0750	36	750	50 mA	66 mA	68 mA	75 mA
F3SR-430B0830	40	830	52 mA	69 mA	69 mA	76 mA
F3SR-430B0910	44	910	53 mA	73 mA	71 mA	78 mA
F3SR-430B0990	48	990	55 mA	76 mA	72 mA	79 mA
F3SR-430B1150	56	1150	58 mA	82 mA	75 mA	82 mA
F3SR-430B1310	64	1310	61 mA	89 mA	78 mA	85 mA
F3SR-430B1470	72	1470	65 mA	95 mA	81 mA	88 mA
F3SR-430B1630	80	1630	68 mA	102 mA	84 mA	91 mA
F3SR-430B1790	88	1790	71 mA	108 mA	87 mA	94 mA
F3SR-430B1950	96	1950	74 mA	114 mA	91 mA	98 mA
F3SR-430B2110	104	2110	78 mA	121 mA	94 mA	101 mA
F3SR-430B2270	112	2270	81 mA	127 mA	97 mA	104 mA

Accessories

Control Unit

Item	Model	F3SP-B1P
Power supply voltage		24 VDC \pm 10%
Power consumption		DC1.7 W max. (not including sensor's current consumption)
Operation time		100 ms max. (not including sensor's response time)
Response time		10 ms max. (not including sensor's response time)
Relay output	Number of contacts	3NO+1NC
	Rated load	25 VAC, 5 A ($\cos\phi = 1$), 30 VAC, 5 A L/R = 0 ms
	Rated current	5 A
Connection type	Between sensors	M12 connector (8-pin)
	Others	Terminal block
Weight (packed state)		Approx. 280 g
Accessories		Instruction manual

Laser Pointer

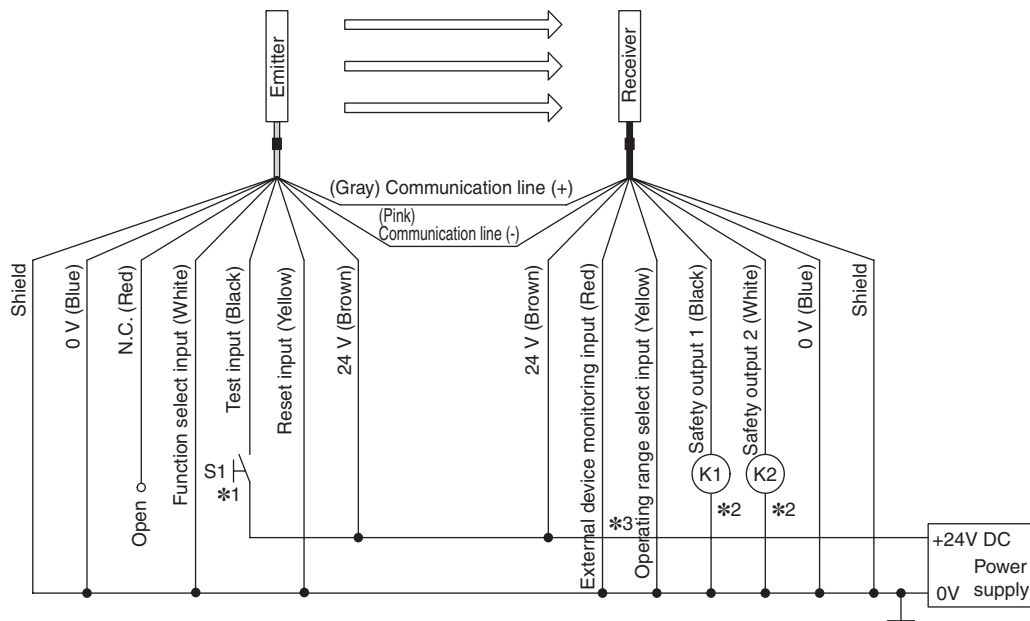
Item	Model	F3SP-B1P
Applicable sensor		F3SR series
Power supply voltage		4.65 VDC or 4.5 VDC
Battery		Button cell battery (SR44 or LR44)
Battery life *		SR44: approx. 10 continuous hours, LR44: approx. 6 continuous hours
Light source		Red LED laser (wavelength 650 nm, 1 mW max., JIS class 2, EN/IEC CLASS 2, FDA CLASS 2)
Spot diameter (typical)		6.5 mm (at 10 m)
Ambient temperature		Operating: 0 to 40°C (no icing) Storage: -15 to 60°C (with no icing or condensation)
Ambient humidity		Operating and storage: 35% to 85% (with no condensation)
Material		Laser module case: aluminum Mounting part: aluminum, stainless steel
Weight		Approx. 250 g (packed state)
Accessories		Laser labels (EN: 1, FDA: 3), button cell battery (SR44: 3), instruction Sheet

*Varies on battery type.

Connections

Basic Connection

- Operating range setting: Short
- Auto reset mode
- External device monitor will not be used.



S1 : External test /lockout reset switch (connect to 0V if a switch is not required)

K1,K2 : Relay or other device that controls hazardous parts of the machine

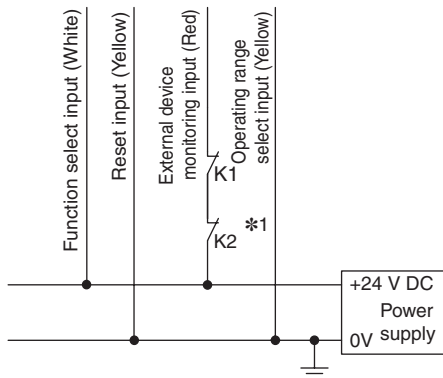
*1. Use a switch for micro loads (Input specifications: 24 V, 2.5 mA).

*2. F3SR-B can operate even if K1 and K2 are not connected.

*3. To change the operating range setting to Long, connect the operating range select input line to 24 V.

Wiring for auto reset mode

- Operating range setting: Short
- Auto reset mode
- External device monitoring function will be used.

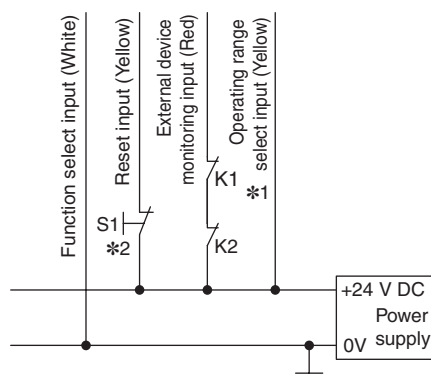


K1, K2: Relay or other device that controls hazardous parts of the machine

*1. To change the operating range setting to Long, connect the operating range select input line to 24 V.

Wiring for manual reset mode

- Operating range setting: Long
- Manual reset mode
- External device monitoring function will be used.



K1, K2 : Relay or other device that controls hazardous parts of the machine

S1 : Interlock reset switch

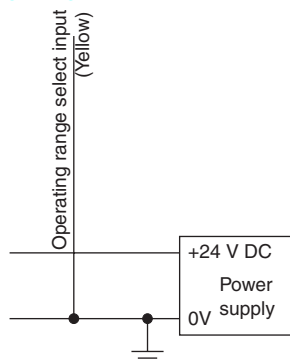
*1. To change the operating range setting to Long, connect the operating range select input line to 24 V.

*2. Use a switch for micro loads (Input specifications: 24 V, 2.5 mA).

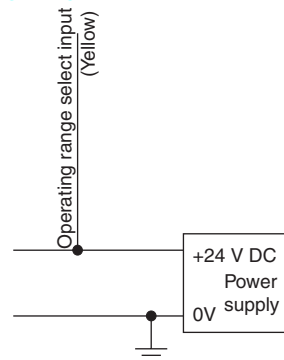
Operating range selection function

This function allows the user to select an operating range according to wiring at startup.
The operating range can be selected from two types, Short (0.3 to 7 m) and Long (5 to 20 m).

Short: Operating range 0.3 to 7 m



Long: Operating range 5 to 20 m



Make sure to connect the operating range select input line to 24 V or 0 V according to the distance used. Leaving the wiring open without connection will result in wiring error and the F3SR-B will enter lockout. If the wiring at startup is open or wiring is switched during operation, the F3SR-B enters lockout.

Availability of functions based on input line status

The F3SR-B determines operation mode of the external device monitoring and interlock functions (manual reset and auto reset) based on the wiring status of the three input lines at startup (reset input/external device monitoring input/function select input). Any combinations other than the table below will result in wiring errors leading to lockout state.

Using the F3SR-B with external device monitoring disabled and auto reset

Input line	Wiring
Reset input	0 V or open
External device monitoring input	
Function select input	

Using the F3SR-B with external device monitoring enabled and auto reset

Input line	Wiring
Reset input	0 V or open
External device monitoring input	24V *
Function select input	24V

Using the F3SR-B with external device monitoring enabled and manual reset

Input line	Wiring
Reset input	24 V
External device monitoring input	24 V *
Function select input	0 V or open

* Apply voltage of 24 V via normally closed (N.C.) contact of the external relay (or contactor) that controls hazardous parts of machines.

Wiring Examples

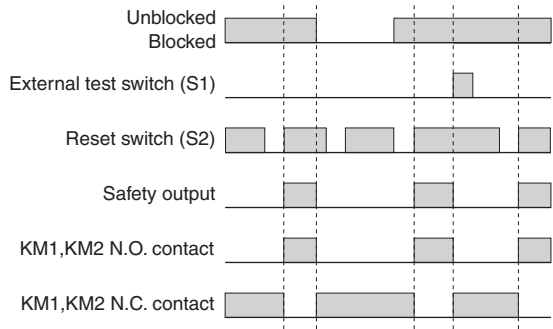
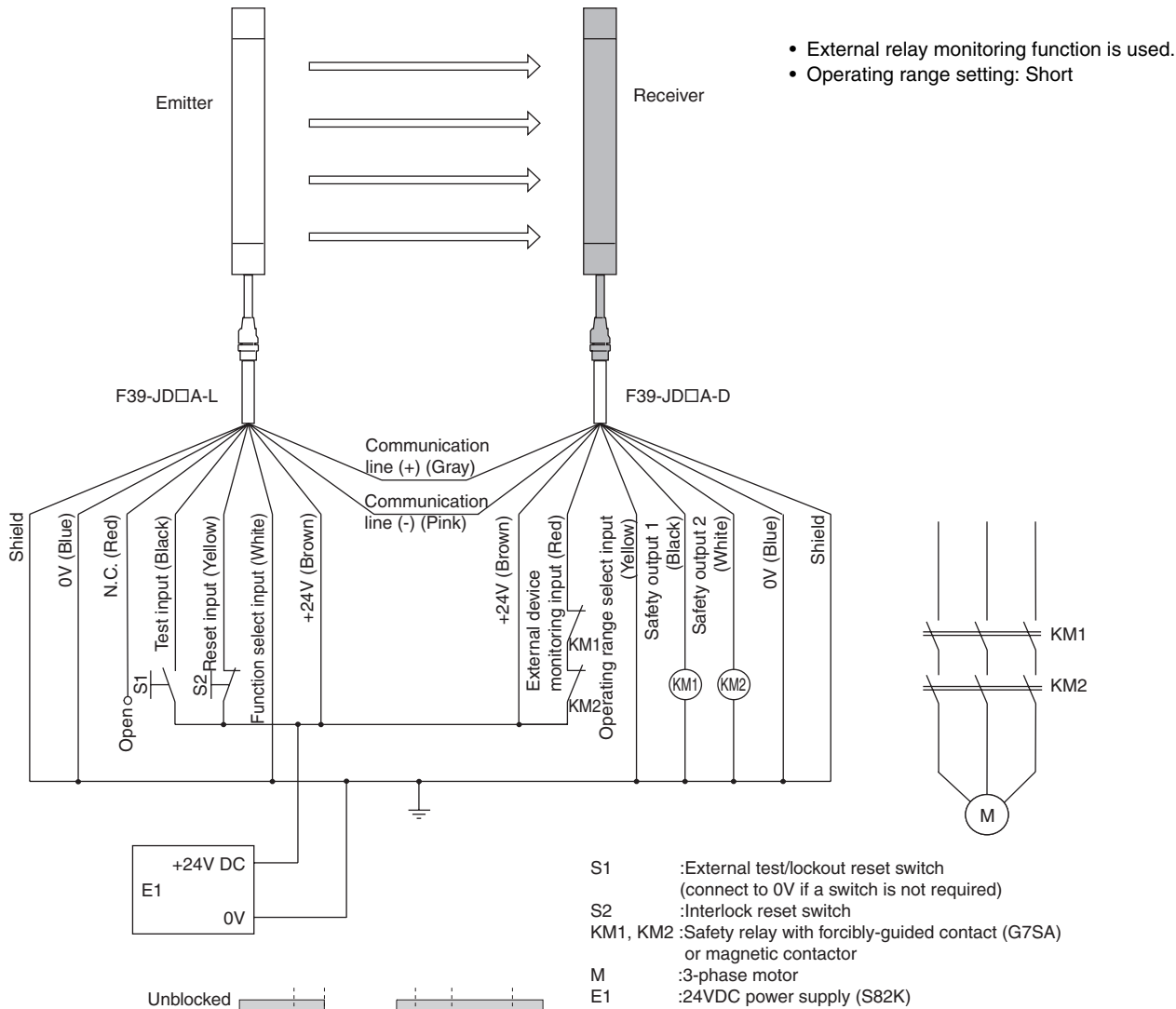
Using F3SR-B alone

PL/safety category	Model	Stop category	Reset
PLe/4 equivalent	Safety Light Curtain F3SR-430B□□□□ Safety Relay G7SA	0	Manual

Note: The above PL is only the evaluation result of the example. The PL must be evaluated in an actual application by the customer after confirming the usage conditions.

●Application Overview

- The power supply to the motor M is turned OFF when the beam is blocked.
- The power supply to the motor M is kept OFF until the beams are unblocked and the reset switch S2 is pressed.



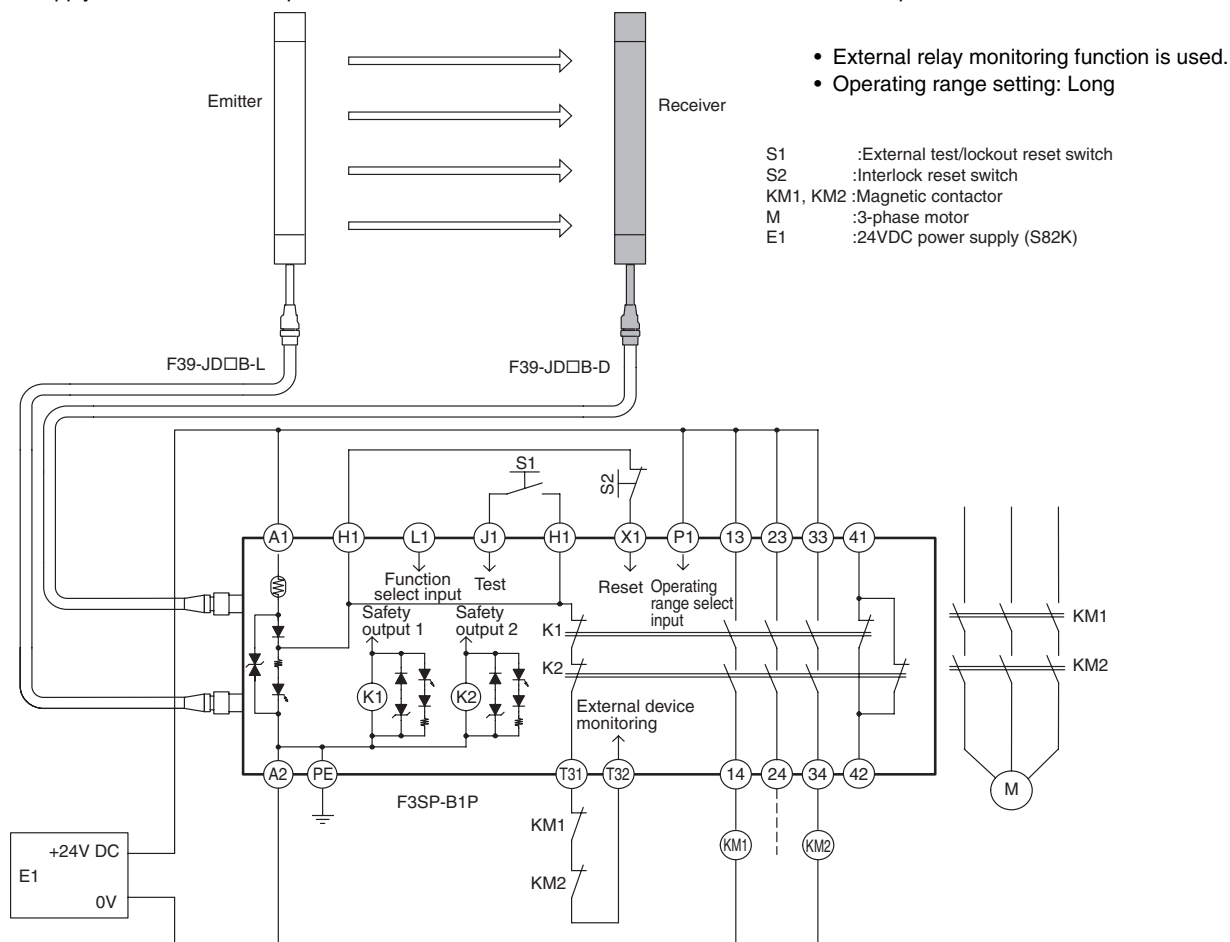
Connecting to an F3SP-B1P controller

PL/safety category	Model	Stop category	Reset
PLe/4 equivalent	Safety Light Curtain F3SR-430B□□□□ Control Unit F3SP-B1P	0	Manual

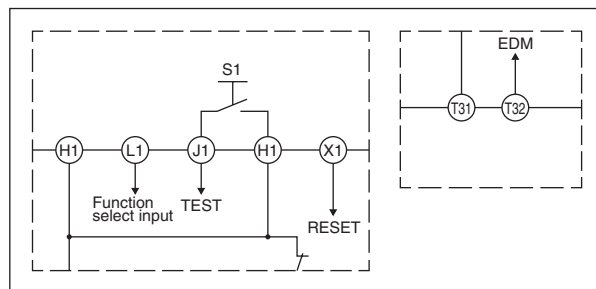
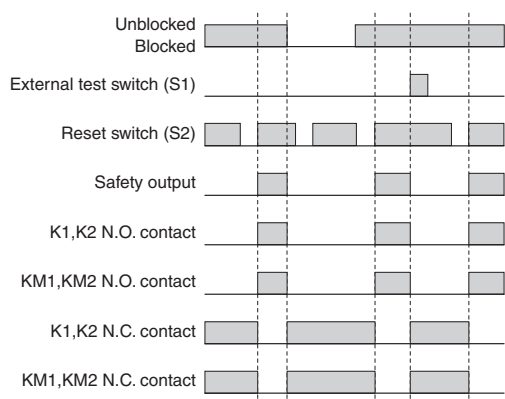
Note: The above PL is only the evaluation result of the example. The PL must be evaluated in an actual application by the customer after confirming the usage conditions.

●Application Overview

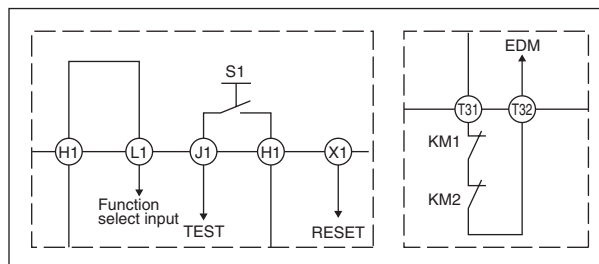
- The power supply to the motor M is turned OFF when the beam is blocked.
- The power supply to the motor M is kept OFF until the beams are unblocked and the reset switch S2 is pressed.



• Wiring for Auto-reset mode and the EDM function disabled



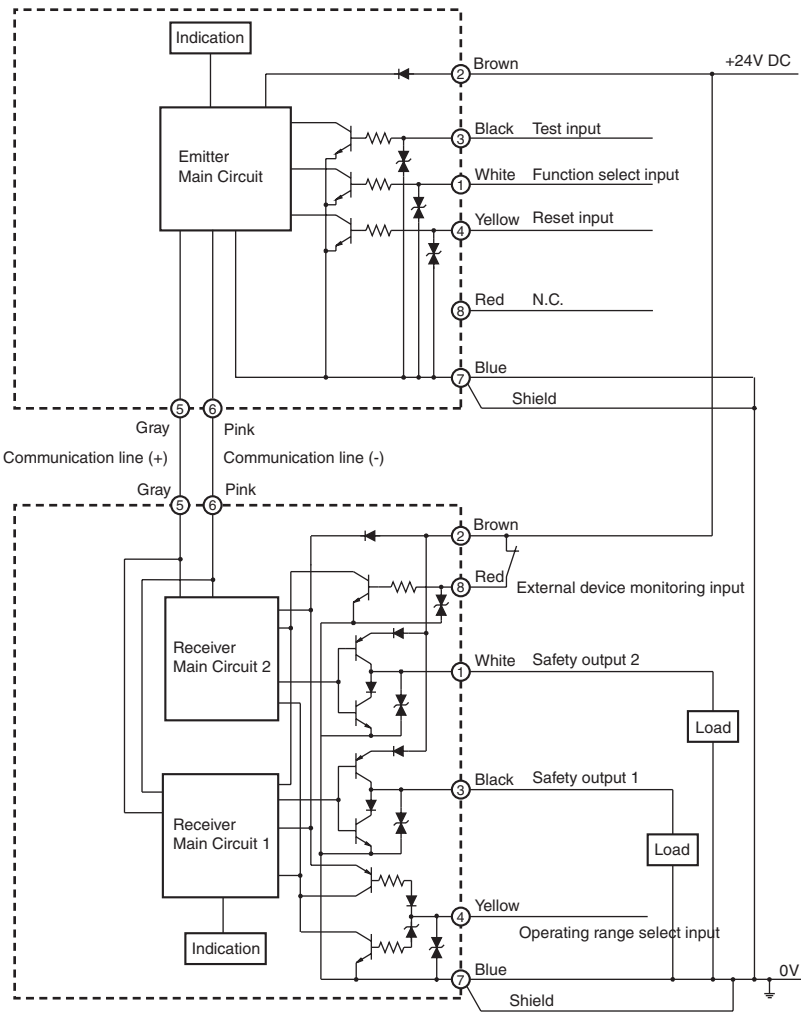
• Wiring for Auto-reset mode and the EDM function enabled



F3SR-B

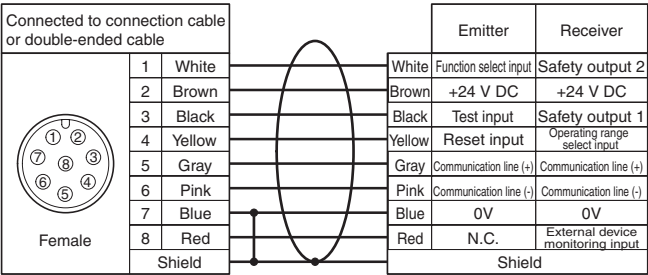
I/O Circuit Diagram

The numbers in circles indicate the connector's pin numbers.



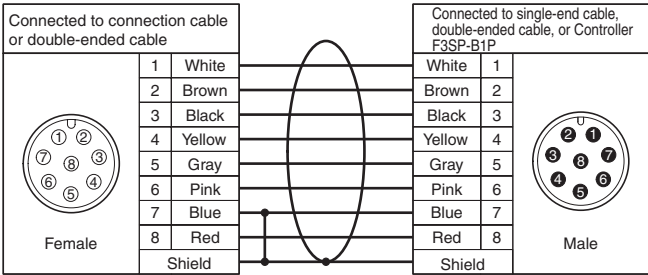
Single-end Connector Cable

Internal wiring diagram (F39-JD□A)



Double-end Connector Cable

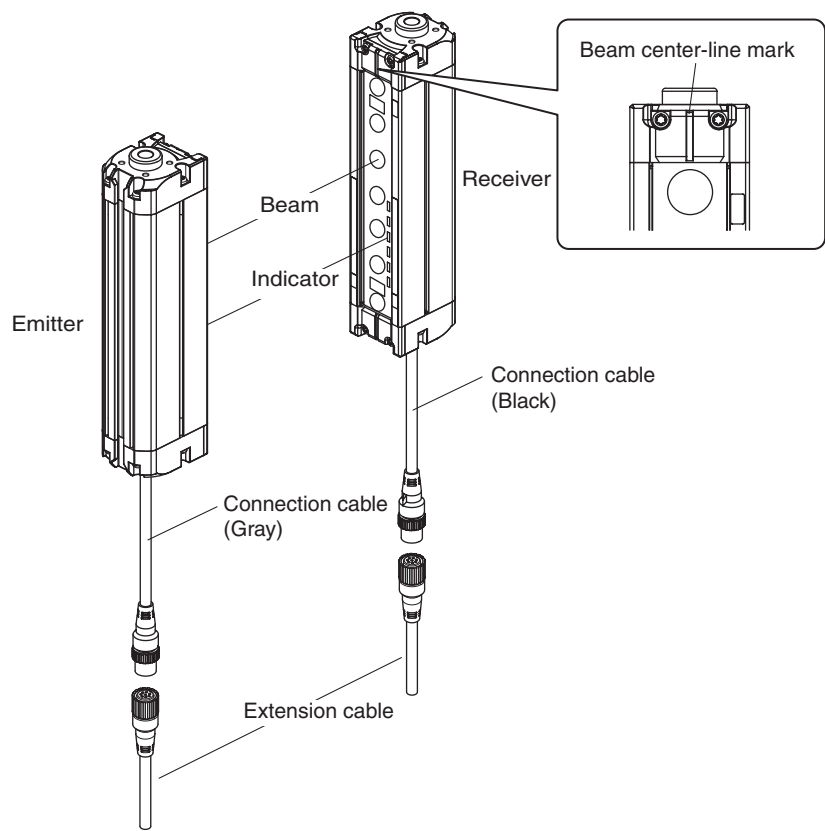
Internal wiring diagram (F39-JD□B)



- Note:** 1. Twisted pair wires are white and red, brown and blue, black and yellow, and gray and pink.
2. If the length of the F39-JD□A single-end connector cable is insufficient, use 1 or more F39-JD□B double-end connector cables to extend the length, as required. Limit the total length of the cable to not more than 100 m.

Name of Parts

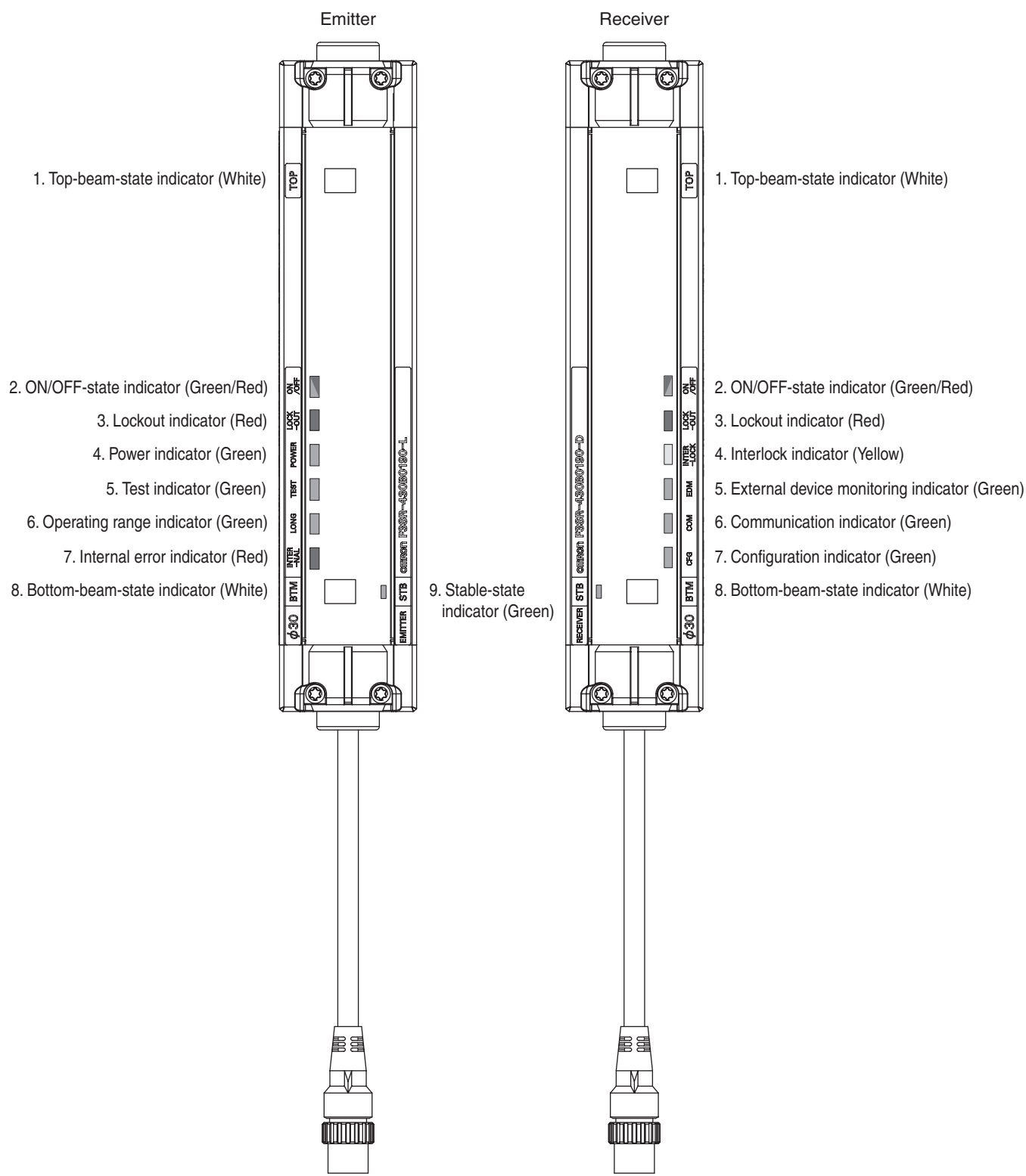
Main Unit and Cables



Component	Model	Description
Emitter, receiver	F3SR-430B□□□□	Select a model based on the required protective height. The meaning of the model name is shown below. <div>F3SR-430B□□□□</div> <div>1 2</div> <div>1: Detection capability (mm) 2: Protective height (mm)</div>

Note: To distinguish between the emitter and receiver, find the labels attached to the front of the F3SR-B. The label on the emitter reads “EMITTER” and the label on the receiver reads “RECEIVER”.

Indicators



Emitter

No.	Indicators	Labels	ON	Blinking
1	Top-beam-state indicator	TOP	Turns ON when the top beam is receiving light.	—
2	ON/OFF-state indicator	ON/OFF	Green indicator turns ON when safety output is ON. Red indicator turns ON when safety output is OFF.	Red indicator blinks when the F3SR-B enters lockout due to a safety output error.
3	Lockout indicator	LOCK OUT	Turns ON when the F3SR-B enters lockout due to an error on the receiver.	Blinks when the F3SR-B enters lockout due to an error on the emitter.
4	Power indicator	POWER	Turns ON while the emitter is ON.	Blinks when the F3SR-B enters lockout due to power voltage or noise.
5	Test indicator	TEST	Turns ON while light emission stops.	—
6	Operating range indicator	LONG	Turns ON when the operating mode of operating range is LONG by the operating range select input.	Blinks when the F3SR-B enters lockout due to an operating range select input error.
7	Internal error indicator	INTERNAL	—	Blinks when the F3SR-B enters lockout due to an internal error.
8	Bottom-beam-state indicator	BTM	Turns ON when the bottom beam is receiving light.	—
9	Stable-state indicator	STB	Turns on when the unit is in a stable operation (when each receiver beam is detecting at least 170% of the ON-threshold light level). We recommend using the indicator for installing the unit to ensure stable operation.	Blinks when safety output turns OFF due to ambient light or vibration.

Receiver

No.	Indicators	Labels	ON	Blinking
1	Top-beam-state indicator	TOP	Turns ON when the top beam is receiving light.	—
2	ON/OFF-state indicator	ON/OFF	Green indicator turns ON when safety output is ON. Red indicator turns ON when safety output is OFF.	Red indicator blinks when the F3SR-B enters lockout due to a safety output error.
3	Lockout indicator	LOCK OUT	Turns ON when the F3SR-B enters lockout due to an error on the emitter.	Blinks when the F3SR-B enters lockout due to an error on the receiver.
4	Interlock indicator	INTERLOCK	Turns ON when the receiver enters interlock.	Blinks when the F3SR-B enters lockout due to a wiring error of reset, function select, or external device monitoring inputs.
5	External device monitoring Indicator	EDM	Turns ON when an input is given to external device monitoring input.	Blinks when the F3SR-B enters lockout due to an external device monitoring error.
6	Communication indicator	COM	Turns ON when communication between emitter and receiver is established.	Blinks when the F3SR-B enters lockout due to a communication error between receiver and emitter.
7	Configuration indicator	CFG	—	Blinks when the emitter enters lockout due to a model difference error between emitter and receiver.
8	Bottom-beam-state indicator	BTM	Turns ON when the bottom beam is receiving light.	—
9	Stable-state indicator	STB	Turns on when the unit is in a stable operation (when each receiver beam is detecting at least 170% of the ON-threshold light level). We recommend using the indicator for installing the unit to ensure stable operation.	Blinks when safety output turns OFF due to ambient light or vibration.

Combination of Indicators and Error Description

ON

Blinking

 OFF

Lockout indicator	Power indicator	Error indicator	Description
LOCKOUT <div><div></div><div></div></div>	POWER <div><div></div></div>	ON/OFF <div><div></div></div>	Safety output error
		INTERLOCK <div><div></div></div>	Input wiring error
		EDM <div><div></div></div>	External device monitoring error
		COM <div><div></div></div>	Communication error
		LONG <div><div></div></div>	Operating range wiring error
		INTERNAL <div><div></div></div>	Internal error
		STB <div><div></div></div>	Ambient light error
Note: Lockout indicators turn ON or blink by the following combinations. Emitter: ON, Receiver: Blinking or Emitter: Blinking, Receiver: ON	POWER <div><div></div></div>	ON/OFF <div><div></div></div>	Error due to power supply voltage or noise
		COM <div><div></div></div>	Communication error due to power supply voltage or noise
		INTERNAL <div><div></div></div>	Internal error
LOCKOUT <div><div></div></div>	POWER <div><div></div></div>	STB <div><div></div></div>	Malfunction due to ambient light or vibration

Safety Functions

Interlock Function

The F3SR-B turns the safety output OFF when its power is turned ON or its beam is blocked, and holds this state until a reset input is applied. This state is called "interlock".

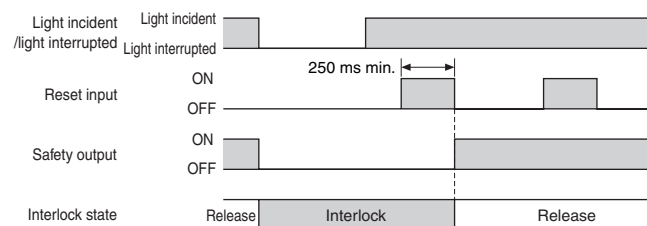
Two methods can be used to reset the interlock state: auto reset and manual reset.

Auto Reset

When the blocking object is removed from the detection zone, the safety outputs automatically turn ON. Auto reset is convenient when applying an interlock with another device within the same system.

Manual Reset

Even when an blocking object has been removed in a detection zone, the safety outputs keep OFF state until the reset signal is input. This allows the machine to be restarted using a reset switch after verifying the safety, preventing unexpected startup (EN 1037).



A sensor enters interlock state when:

- The power is turned ON (start interlock). This is useful if you want to keep the machine stopped until a start inspection is completed after the power is turned ON.
- F3SR-B is blocked (restart interlock).
- After the F3SR-B is blocked and the machine stops, the machine can be restarted after safety is ensured.

The procedure for manual reset is shown below.

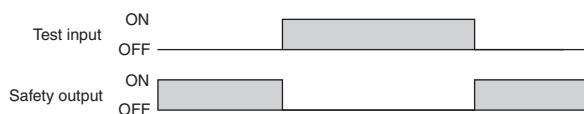
1. Short-circuit the reset input line (Yellow) to 24 V.
2. Open the reset input line (Yellow), or short-circuit it to 0 V. (250 ms min.)
3. Short-circuit the reset input line (Yellow) to 24 V.

Note: A reset switch must be installed outside of the hazardous area in a location that provides a clear view of the hazardous area.

External Test Function

This function stops emission by test input. It creates a state in which the F3SR-B is blocked using external signals so that whether or not the safety system stops properly can be verified.

To stop the emission, apply voltage of 24 V to the emitter's test input line.

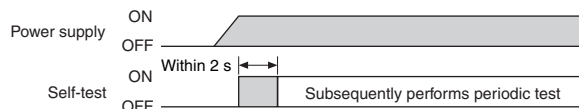


Status of Indicators When External Test Function is Performed

Test indicator turns ON when voltage is applied to the test input.

Self-Test Function

The F3SR-B performs the self-test when power is turned ON (within 2 seconds) to check for errors. Also, it regularly performs self-tests (within the response time) while operating.



If an error is found in the self-test, the F3SR-B enters lockout state, keeping the safety outputs in the OFF state, indicating the error at the same time.

Self-test Details

The self-test detects the types of errors described below.

Emitter

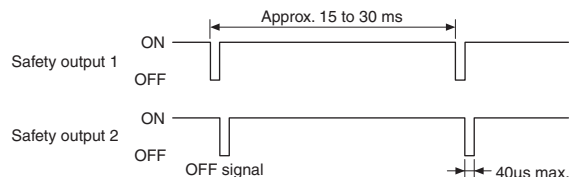
- Failure of emitter element or circuit
- MPU failure
- Cable break or short-circuit

Receiver

- External power supply voltage error
- Failure of internal power supply circuit
- Failure of receiver element or detection circuit
- MPU failure
- Memory failure
- Ambient light
- Failure of safety output circuit
- Cable break or short-circuit

Waveform of Safety Outputs

When the F3SR-B is receiving light, the safety outputs periodically turn OFF as shown below to test the output circuit. When this OFF signal is fed back, the output circuit is diagnosed as normal. If the output signal does not include an OFF pulse signal, the receiver will diagnose as a failure in output circuit or wiring and enter lockout state.



Lockout Reset Function

When the cause of the lockout is removed, the lockout condition can be released by using one of the following methods.

- Cycle the power back ON
- Lockout reset by test input

Lockout can be reset by the test input when the sensor is in lockout state. The procedure for lockout reset is shown below.

1. Open the reset input line (Black), or short-circuit it to 0 V. (1 s or longer)
2. Short-circuit the test input line (Black) to 24 V. (1 s or longer)
3. Open the test input line (Black), or short-circuit it to 0 V.

External Device Monitoring Function

This function detects malfunctions, such as welding, in external relays (or contactors) that control the hazardous area of a machine.

This function constantly monitors feedback signals from a relay, which are input to the receiver's external device monitoring input line, and brings the F3SR-B into a lockout state when an error occurs. The relay's operational delay can be up to 0.3 s without being evaluated as an error.

For example, if the signal from the relay does not change within 0.3 s after the safety outputs turn from ON to OFF and, it is evaluated as an error and enters a lockout state.

To utilize this function properly, use safety relays and contactors that have forcibly guided or mechanically linked contact structure.

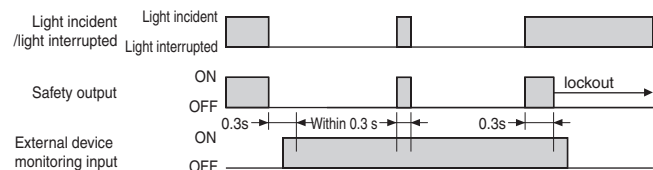
Wiring

Perform wiring so that 24 V is applied to the external device monitoring line via the external relay's normally closed (NC) contact. For wiring when using or not using external device monitoring, refer to "Connections" on page 12 to select "used" or "not used" of the function.

Timing Chart

The F3SR-B verifies the status of the external device monitoring input 0.5 s or later after the power of the F3SR-B is turned ON. If the status of the safety outputs is switched again within 0.3 s as the following timing chart, the F3SR-B will not enter the lockout state even if the status of the external device monitoring input does not change.

When the external device monitoring input does not change within 0.3 s after the safety outputs turn from ON to OFF or OFF to ON, it is evaluated as an error and the F3SR-B enters lockout.



Status of Indicators When External Monitoring Function is Performed

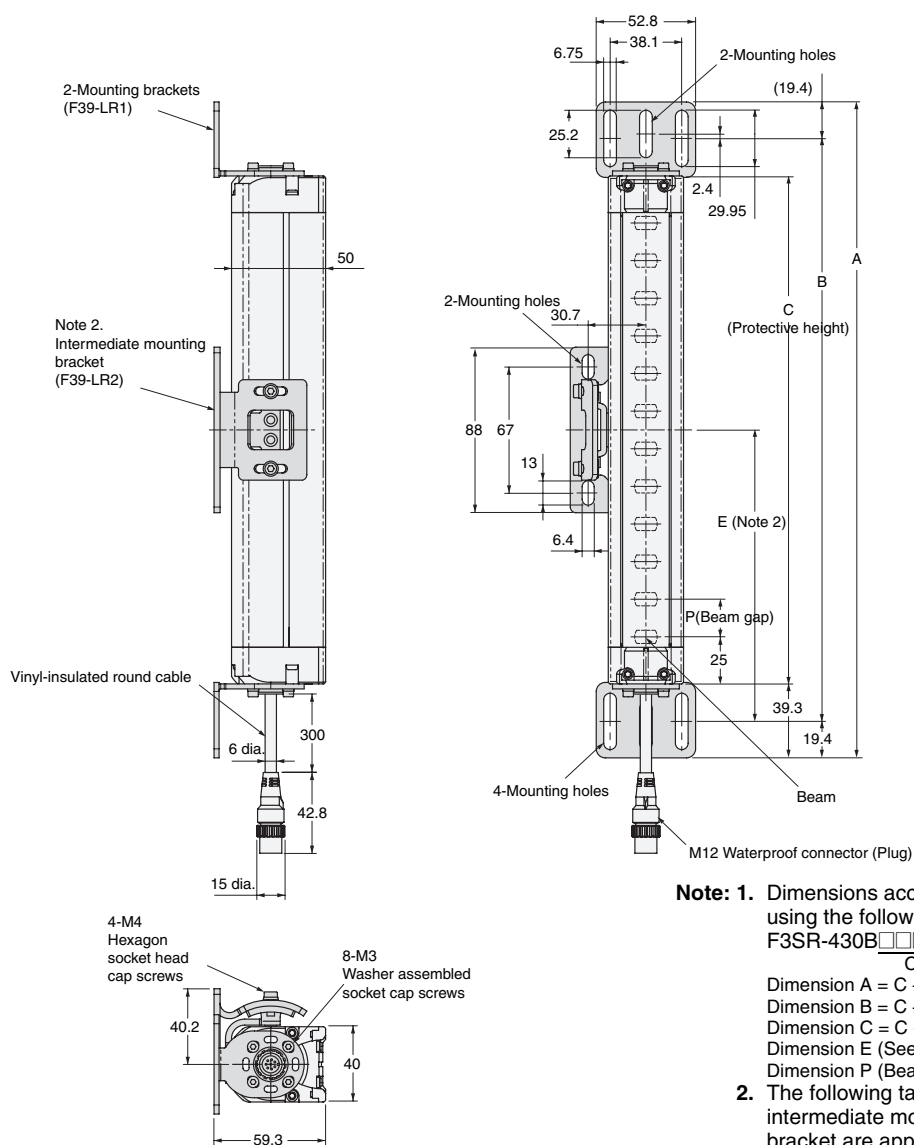
When an input is applied to the external device monitoring input, the receiver's external device monitoring indicator (EDM) turns ON.

Dimensions

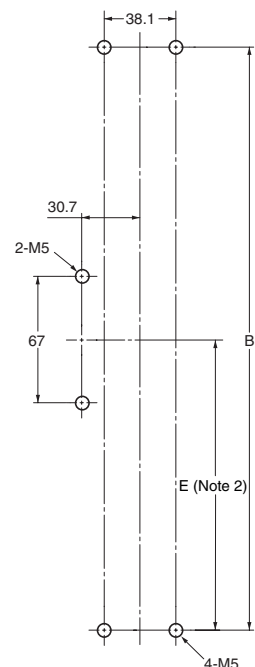
Main Unit

Using Standard Mounting Brackets

Backside mounting



Hole size for mounting



Note: 1. Dimensions according to the model can be calculated by using the following equations.

F3SR-430B□□□□-L: 0190 to 2270 = C (protective height)

Dimension A = C + 78.6

Dimension B = C + 39.8

Dimension C = C - 50

Dimension E (See Note 2 below.)

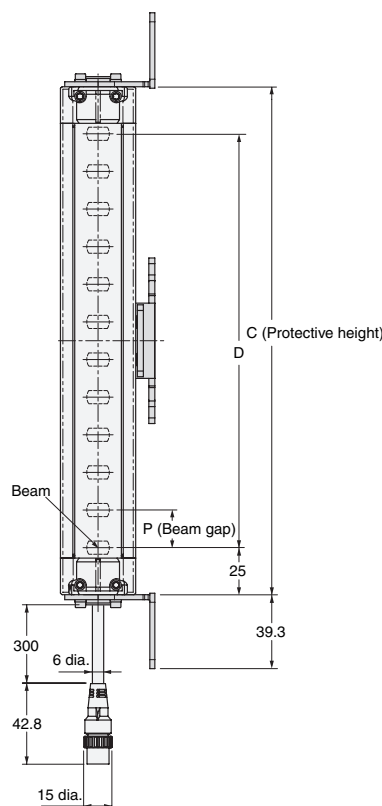
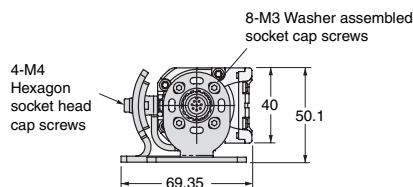
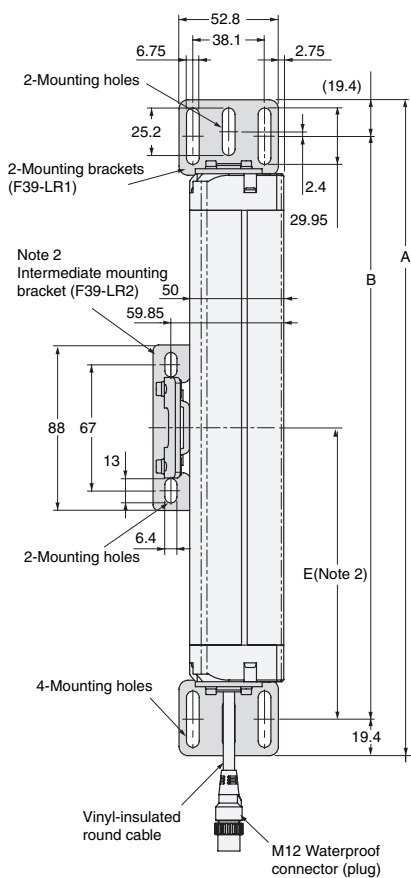
Dimension P (Beam gap) = 20

2. The following table shows protective heights on which intermediate mounting bracket and mounting hole for the bracket are applied.

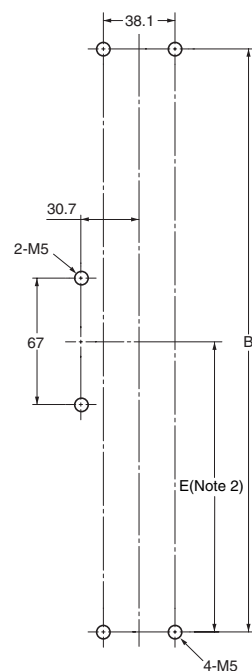
Protective height	No. of intermediate mounting brackets	Dimension E *
0190 to 0990	0	—
1070 to 1950	1	B/2
2030 to 2270	2	B/3

* If value of E calculated by this is not used, E should be 1,000 mm max.

Side mounting



Hole size for mounting



- Note: 1.** Dimensions according to the model can be calculated by using the following equations.
F3SR-430B□□□□-L: 0190 to 2270 = C (protective height)
C
Dimension A = C + 78.6
Dimension B = C + 39.8
Dimension C = C - 50
Dimension E (See Note 2 below.)
Dimension P (Beam gap) = 20
- 2.** The following table shows protective heights on which intermediate mounting bracket and mounting hole for the bracket are applied.

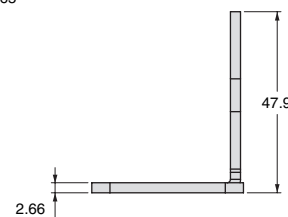
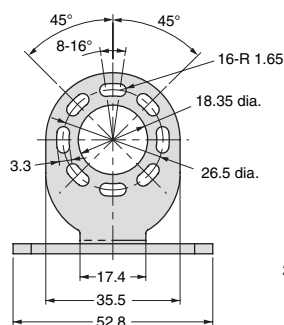
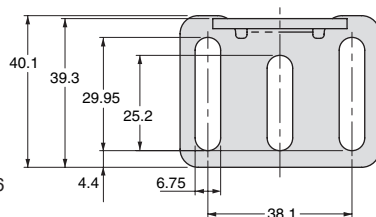
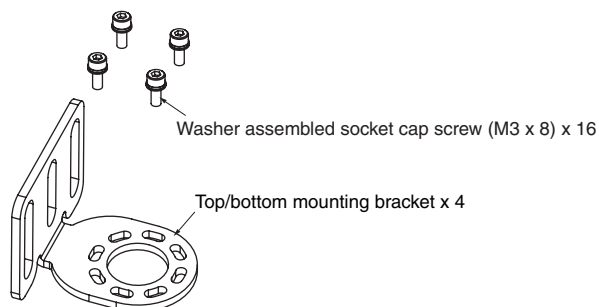
Protective height	No. of intermediate mounting brackets	Dimension E *
0190 to 0990	0	—
1070 to 1950	1	B/2
2030 to 2270	2	B/3

* If value of E calculated by this is not used, E should be 1,000 mm max.

Accessories (sold separately)

Top/bottom Mounting Bracket

F39-LR1



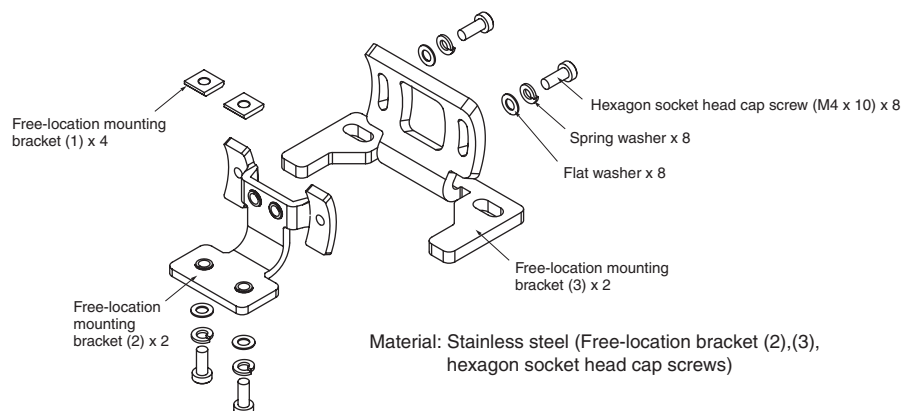
Material: Stainless steel (Top/bottom mounting brackets, hexagon socket head cap screws)

Note: Screws to mount top/bottom mounting brackets to the wall are not included.

Customers are requested to prepare them by themselves.

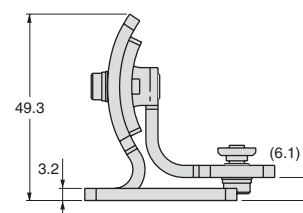
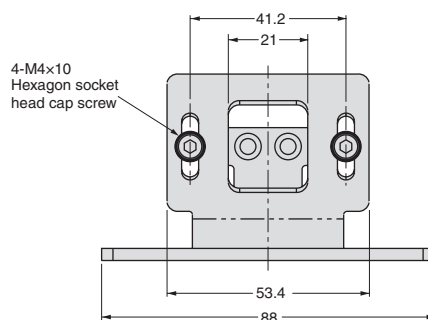
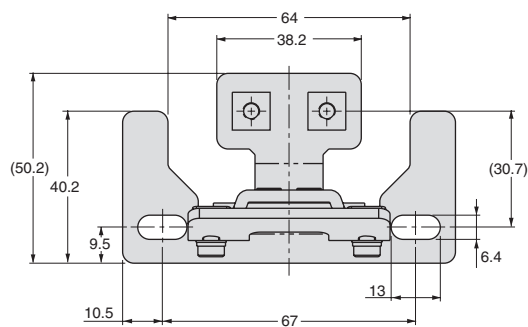
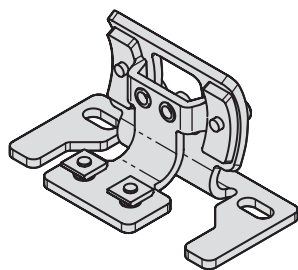
Intermediate Mounting Bracket

F39-LR2

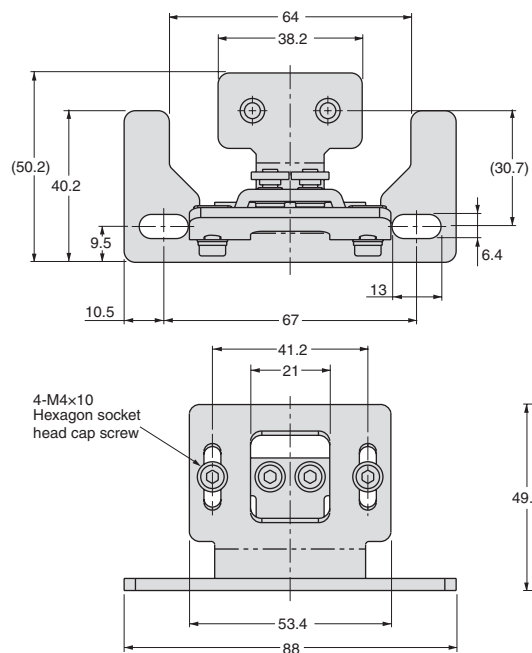
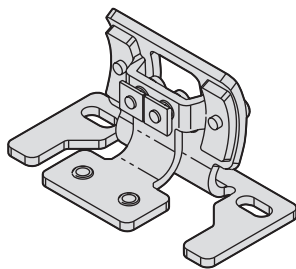


Material: Stainless steel (Free-location bracket (2),(3), hexagon socket head cap screws)

• Backside mounting

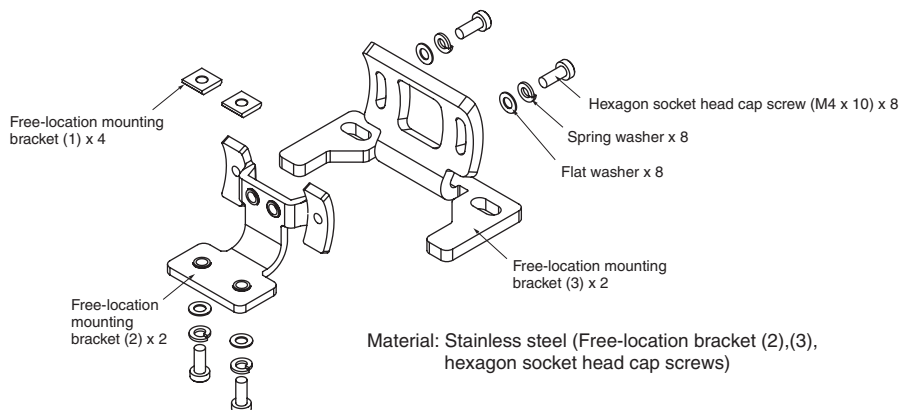


• Side mounting

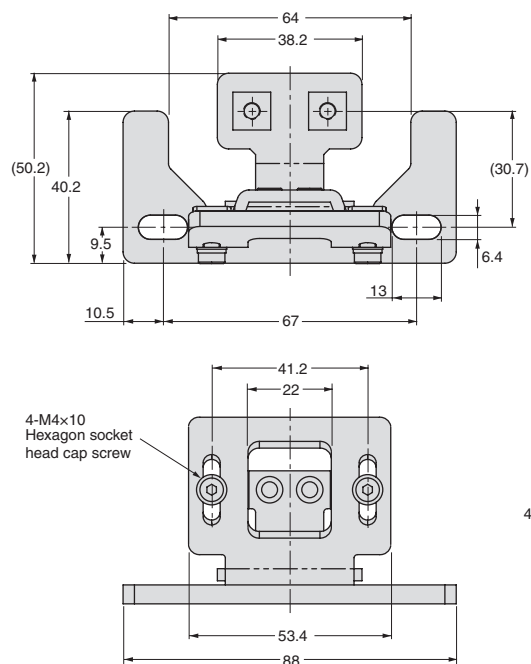
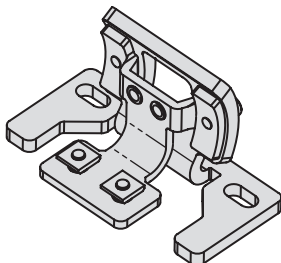


Free-location Mounting Bracket

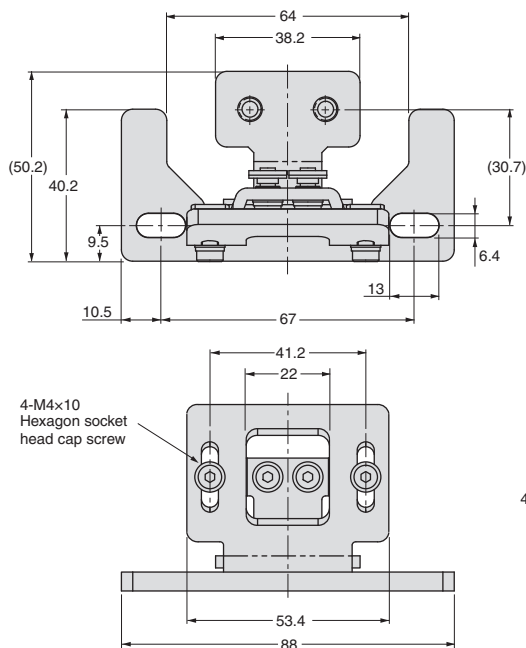
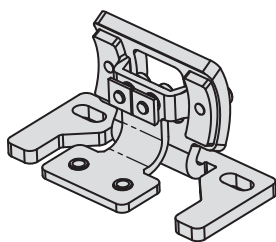
F39-LR3



• Backside mounting



• Side mounting



Number of required mounting brackets

The numbers of brackets required for the protective heights of sensors are as follows:

• Using top/bottom mounting bracket + intermediate mounting bracket (F39-LR2).

Protective height (mm)	No. of top/bottom mounting brackets	No. of intermediate mounting brackets
0190 to 0990	2	0
1070 to 1950	2	1
2030 to 2270	2	2

• Using Free-location mounting bracket (F39-LR3).

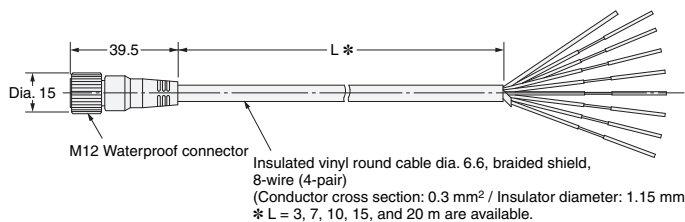
Protective height (mm)	No. of free-location mounting brackets
0190 to 0750	2
0830 to 1470	3
1630 to 2110	4
2270	5

Single-end Connector Cable

F39-JD3A (L = 3 m) F39-JD15A (L = 15 m)
 F39-JD7A (L = 7 m) F39-JD20A (L = 20 m)
 F39-JD10A (L = 10 m)



Cable color: Gray for emitter
 Black for receiver

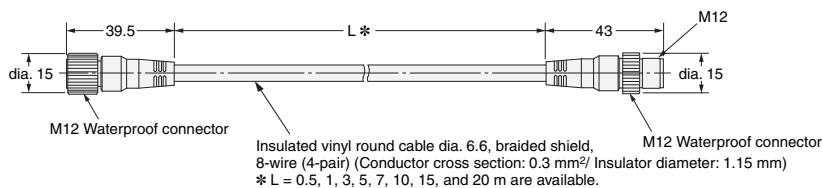


Double-end Connector Cable

F39-JDR5B (L = 0.5 m) F39-JD7B (L = 7 m)
 F39-JD1B (L = 1 m) F39-JD10B (L = 10 m)
 F39-JD3B (L = 3 m) F39-JD15B (L = 15 m)
 F39-JD5B (L = 5 m) F39-JD20B (L = 20 m)

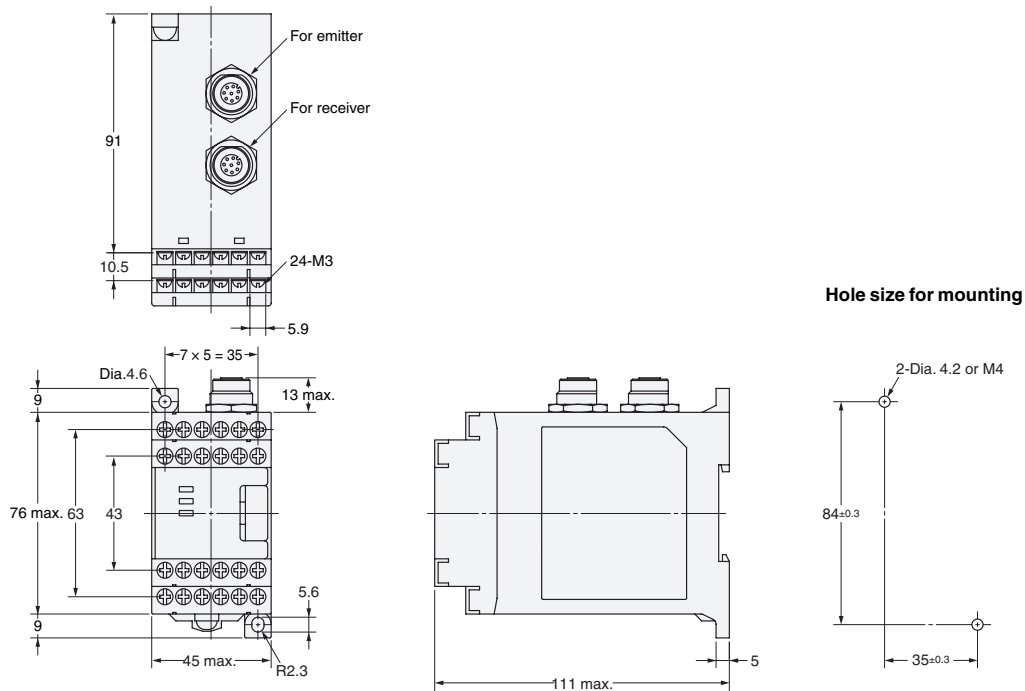


Cable color: Gray for emitter
 Black for receiver

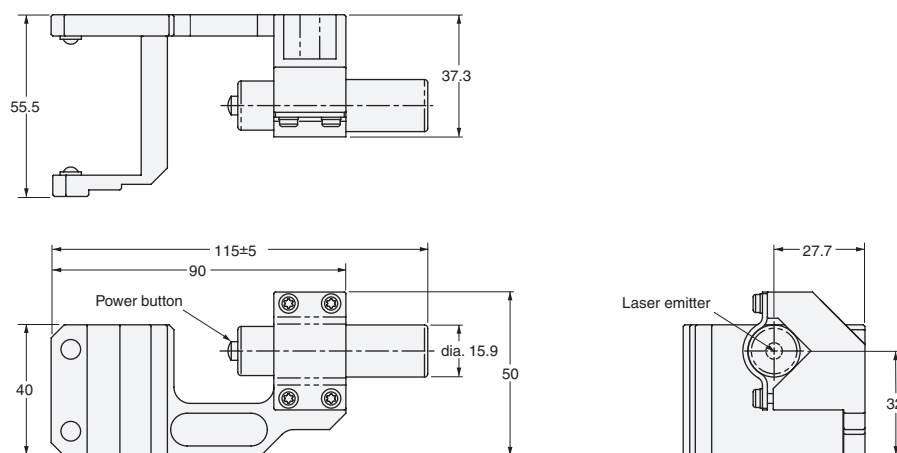


F3SR-B

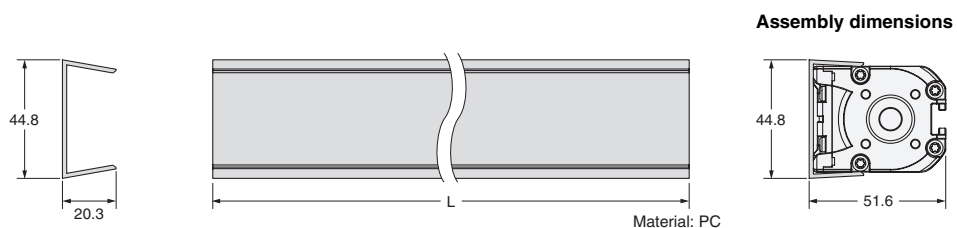
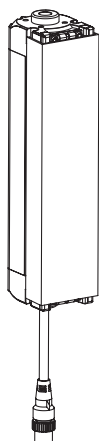
Control Unit F3SP-B1P



Laser Pointer F39-PTR



Spatter Protection Cover F39-F39-HRB□□□□



When protective height is 0190 to 1790 mm: L = □□□□ - 20 mm
When protective height is 1870 to 2270 mm: L = □□□□ - 10 mm

Safety Precautions

This catalog is intended as a guide for product selection. Be sure to use the instruction manual provided with the product for actual operation.

Regulations and Standards


1. An F3SR-B does not receive type approval provided by Article 44-2 of the Labour Safety and Health Law of Japan. Therefore, the F3SR-B cannot be used as a "safety system for pressing or shearing machines" prescribed in Article 42 of that law.
2. The F3SR-B is electro-sensitive protective equipment (ESPE) in accordance with European Union (EU) Machinery Directive Index Annex V, Item 2.
3. The F3SR-B complies with the following legislation and standards:
 - (1) EU Regulations:
Machinery Directive 2006/42/EC
EMC Directive 2004/108/EC
 - (2) European Standards:
EN61496-1 (Type 4 ESPE),
CLC/TS61496-2 (Type 4 AOPD),
EN61508-1 to 3 (SIL3), EN62061 (SIL3),
EN61000-6-4
 - (3) International Standards:
IEC61496-1 (Type 4 ESPE),
IEC61496-2 (Type 4 AOPD),
IEC61508-1 through 3 (SIL3),
IEC62061 (SIL3),
ISO13849-1 (PLe/Safety Category 4)
 - (4) JIS Standards:
JIS B 9704-1 (Type 4 ESPE),
JIS B 9704-2 (Type 4 AOPD)
 - (5) North American Standards:
UL61496-1 (Type 4 ESPE),
UL61496-2 (Type 4 AOPD),
UL508, UL1998,
CAN/CSA 22.2 No.14,
CAN/CSA 22.2 No.0.8
4. The F3SR-B received EC type certification based on the EU Machinery Directive, Type 4 ESPE and Type 4 AOPD from the EU accredited body, TÜV SÜD Product Service GmbH.
5. The F3SR-B is designed according to the standards listed below. To make sure that the final system complies with the following standards and regulations, you are asked to design and use it in accordance with all other related standards, laws, and regulations. If you have any questions, consult with specialized organizations such as the body responsible for prescribing and/or enforcing machinery safety regulations in the location where the equipment is to be used.
 - European Standards: EN 415-4, EN 692, EN 693
 - US Occupational Safety and Health Administration: OSHA 29 CFR 1910.212
 - US Occupational Safety and Health Administration: OSHA 29 CFR 1910.217
 - American National Standard Institute: ANSI B11.1 to B11.19
 - American National Standard Institute ANSI/RIA 15.06
 - Canadian Standards Association CSA Z142, Z432, Z434
 - SEMI Standards SEMI S2
 - Japanese Ministry of Health, Labour and Welfare Announcement: "Guidelines for Comprehensive Safety Standards of Machinery" Announcement No.0731001 July 31, 2007

Precautions for Safe Use

Indication and meaning for safe use

Meaning of Signal Word

To ensure safe use of the F3SR-B, signal words and an alert symbol are used in this catalog to indicate safety-related instructions. Because these instructions describe details very important to your safety, it is extremely important that you understand and follow the instructions. The signal words and alert symbol used in this catalog are shown below.


	WARNING
	Indicates a potentially hazardous situation which, if not avoided, will result in minor or moderate injury, or may result in serious injury or death. Additionally there may be significant property damage.

Definition of Symbol


	Prohibited Indicates prohibited actions.
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Warning Labels

For users

	WARNING
The F3SR-B must be installed, configured, and incorporated into a machine control system by a sufficiently trained and qualified person. An unqualified person may not be able to perform these operations properly, which may cause a person to go undetected, resulting in serious injury.	

For machines

	WARNING
Do not use this sensor for machines that cannot be stopped by electrical control. For example, do not use it for a pressing machine that uses full-rotation clutch. Otherwise, the machine may not stop before a person reaches the hazardous part, resulting in serious injury.	

For mounting

WARNING

Make sure to test the operation of the F3SR-B after installation to verify that the F3SR-B operates as intended. Make sure to stop the machine until the test is complete. Unintended function settings may cause a person to go undetected, resulting in serious injury.

Make sure to install the F3SR-B at the safe distance from the hazardous part of the equipment. Otherwise, the machine may not stop before a person reaches the hazardous part, resulting in serious injury.

Install a protective structure so that the hazardous part of a machine can only be reached by a person that passes through the sensor's detection zone. Install the sensors so that part of the person is always present in the detection zone when working in a machine's hazardous zones. If a person is able to step into the hazardous zone of a machine and remain behind the F3SR-B's detection zone, configure the system with an interlock function that prevents the machine from being restarted. Failure to do so may result in serious injury.

Install the interlock reset switch in a location that provides a clear view of the entire hazardous zone and where it cannot be activated from within the hazardous zone.

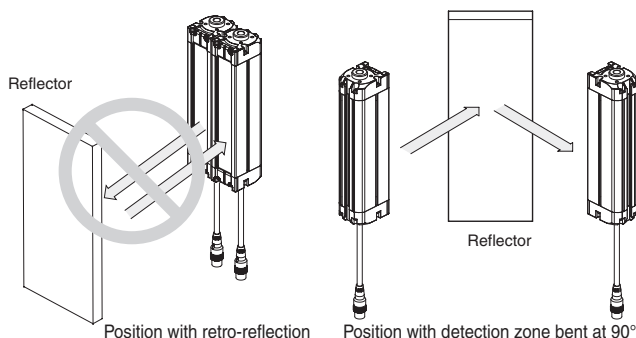
The F3SR-B cannot protect a person from a projectile exiting the hazardous zone. Install protective cover(s) or fence(s).

Install the sensor system so that it is not affected by the reflective surface of the F3SR-B. Failure to do so may hinder detection, resulting in serious injury.

When using more than 1 set of F3SR-B, install them so that mutual interference does not occur, such as by configuring series connections or using physical barriers between adjacent sets.

Make sure that the F3SR-B is securely mounted and its cables and connectors are properly secured.

Do not use the sensor system with mirrors in a retro-reflective configuration as shown below. Doing so may hinder detection. It is possible to use mirrors to "bend" the detection zone to a 90-degree angle.



Perform an inspection for all F3SR-B as described in the User's Manual.

For wiring

WARNING

Connect the load between the output and 0 V line (PNP output). Connecting the load between the output and +24 V line will result in a dangerous condition because operation is reversed to "ON when blocked".

Do not short-circuit the output line to the +24 V line. Otherwise, the output is always ON. Also, the 0 V of the power supply must be grounded so that output does not turn ON due to grounding of the output line.

Configure the system by using the optimal number of safety outputs that satisfy the requirements of the necessary safety category.

Do not connect each line of F3SR-B to a DC power supply of more than 24 V DC + 20 %. Also, do not connect to an AC power supply. Failure to do so may result in electric shock or breakdown of the device.

For the F3SR-B to comply with IEC 61496-1 and UL 508, the DC power supply unit must satisfy all of the following conditions:

- Must be within the rated power voltage (24 V DC \pm 20 %)
- Must have tolerance against the total rated current of devices if it is connected to multiple devices
- Must comply with EMC directives (industrial environment)
- Double or enhanced insulation must be applied between the primary and secondary circuits
- Automatic recovery of overcurrent protection characteristics (reversed L sagging)
- Output holding time must be 20 ms or longer
- Must satisfy output characteristic requirements for class 2 circuit or limited voltage current circuit defined by UL508.
- Must comply with laws and regulations, regarding EMC and electrical equipment safety, of the country or region where the F3SR-B is used (e.g., In EU, the power supply must comply with the EMC Directive and the Low Voltage Directive.)

Double or reinforced insulation from hazardous voltage must be applied to all input and output lines. Failure to do so may result in electric shock.

Extension of the cable must be within a specified length. If it isn't, safety function may not work properly, resulting in danger.

Others

WARNING

To use the F3SR-B in PSDI mode (Reinitiation of cyclic operation by the protective equipment), you must configure an appropriate circuit between the F3SR-B and the machine. For details about PSDI, refer to OSHA1910.217, IEC61496-1, and other relevant standards and regulations.

Do not try to disassemble, repair, or modify this product. Doing so may cause the safety functions to stop working properly.

Do not use the F3SR-B in environments where flammable or explosive gases are present. Doing so may result in explosion.

Perform daily and 6-month inspections for the F3SR-B. Otherwise, the system may fail to work properly, resulting in serious injury.

Installation Conditions

Operating Range and Approach

WARNING

Install a protective structure so that the hazardous part of a machine can only be reached by passing through the sensor's detection zone. Install the sensors so that part of the person is always present in the detection zone when working in a machine's hazardous zones.

If a person is able to step into the hazardous zone of a machine and remain behind the F3SR-B's detection zone, configure the system with an interlock function that prevents the machine from being restarted. Failure to do so may result in serious injury.

Do not use this sensor for machines that cannot be stopped by electrical control. For example, do not use it for a pressing machine that uses a full-rotation clutch. Otherwise, the machine may not stop before a person reaches the hazardous part, resulting in serious injury.

To use the F3SR-B in PSDI mode (Reinitiation of cyclic operation by the protective equipment), you must configure an appropriate circuit between the F3SR-B and the machine. For details about PSDI, refer to OSHA1910.217, IEC61496-1, and other relevant standards and regulations.

Install the interlock reset switch in a location that provides a clear view of the entire hazardous zone and where it cannot be activated from within the hazardous zone.

Do not use the F3SR-B in environments where flammable or explosive gases are present. Doing so may cause an explosion.

The F3SR-B cannot protect a person from an object flying from a hazardous zone. Install protective cover(s) or fence(s).

Make sure that the F3SR-B is securely mounted and its cables and connectors are properly secured.

Correct installation

The hazardous zone of a machine can be reached only by passing through the sensor's detection zone.



While working, a person is inside the sensor's detection zone.



Incorrect installation

It is possible to reach the hazardous zone of a machine without passing through the sensor's detection zone.



A person is between the sensor's detection zone and the hazardous zone of a machine.



Safety Distance

The safety distance is the minimum distance that must be set between the F3SR-B and a machine's hazardous part to stop the hazardous part before a person or object reaches it. The safety distance varies according to the standards of each country and the individual specifications of each machine. Always refer to relevant standards.

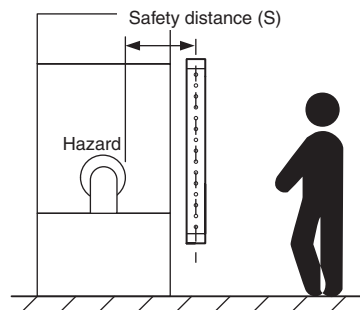
WARNING

Make sure to secure the safety distance (S) between the F3SR-B and the hazardous part. Otherwise, the machine may not stop before a person reaches the hazardous part, resulting in serious injury.

Note: The response time of a machine is the time period from when the machine receives a stop signal to when the machine's hazardous part stops. Measure the response time on the actual system. Also, periodically check that the response time of the machine has not changed.

How to calculate the safety distance specified by International Standard ISO 13855 (European standard EN 999) (Reference)

In case of perpendicular approach of a human body to F3SR-B's detection zone



$S = K \times T + C$. Formula (1)

- S : Safety distance
- K : Approach speed to the detection zone
- T : Total response time of the machine and F3SR-B
- C : Additional distance calculated by the detection capability of the F3SR-B

System that has detection capability of 30 mm or less
Use $K = 2,000 \text{ mm/s}$ and $C = 8 \times (d - 14 \text{ mm})$ in formula (1) for the calculation.

$$S = 2,000 \text{ mm/s} \times (T_m + T_s) + 8 \times (d - 14 \text{ mm})$$

- S = Safety distance (mm)
- T_m = Machine's response time (s)
- T_s = Response time of the F3SR-B from ON to OFF (s)
- d = Detection capability of the F3SR-B (mm)

[Calculation example]

When $T_m = 0.05 \text{ s}$, $T_s = 0.015 \text{ s}$, and $d = 30 \text{ mm}$:

$$S = 2,000 \text{ mm/s} \times (0.05 \text{ s} + 0.015 \text{ s}) + 8 \times (30 \text{ mm} - 14 \text{ mm}) = 258 \text{ mm} \dots \text{formula (2)}$$

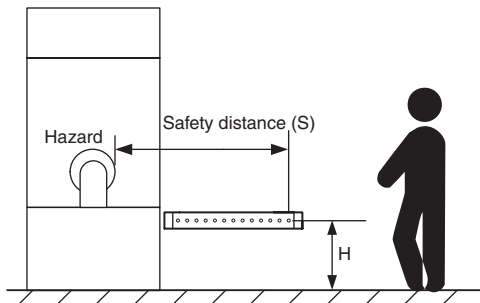
If the result is less than 100 mm, use $S = 100 \text{ mm}$.

If the result exceeds 500 mm, use the following formula where $K = 1,600 \text{ mm/s}$.

$$S = 1,600 \text{ mm/s} \times (T_m + T_s) + 8 \times (d - 14 \text{ mm}) \dots \text{formula (3)}$$

If the result of this formula (3) is less than 500 mm, use $S = 500 \text{ mm}$.

In case of horizontal approach of a human body to F3SR-B's detection zone



Use $K = 1,600 \text{ mm/s}$ and $C = (1200 - 0.4 \times H)$ in formula (1) for calculation.

Note that C must not be less than 850 mm.

$$S = 1,600 \text{ mm/s} \times (T_m + T_s) + 1200 - 0.4 \times H$$

- S = Safety distance (mm)
- T_m = Machine's response time (s)
- T_s = Response time of the F3SR-B from ON to OFF (s)
- H = Installation height (mm)

Note that H must satisfy:

$$1000 \geq H \geq 15 (d - 50 \text{ mm})$$

Also, you must include a hazardous condition under which a person may go through under a detection zone carelessly if the installation height exceeds 300 mm (200 mm for other purpose than industrial use) into risk assessment.

[Calculation example]

When $T_m = 0.05 \text{ s}$, $T_s = 0.015 \text{ s}$, $d = 30 \text{ mm}$, and $H = 500 \text{ mm}$:

$$S = 1,600 \text{ mm/s} \times (0.05 \text{ s} + 0.015 \text{ s}) + 1200 - 0.4 \times 500 \text{ mm} = 1104 \text{ mm}$$

How to calculate the safety distance specified by American standard ANSI B11.19 (reference)

If a person approaches the detection zone of the F3SR-B perpendicularly, calculate the safety distance as shown below.

$$S = K \times (T_s + T_c + T_r + T_{bm}) + D_{pf}$$

- S : Safety distance
- K : Approach speed to the detection zone
(the value recommended by OSHA standard is 1,600 mm/s)

Approach speed K is not specified in the ANSI B.11.19 standard. To determine the value of K to apply, consider all factors, including the operator's physical ability.

- T_s = Machine's stop time (s)
- T_r = Response time of the F3SR-B from ON to OFF (s)
- T_c = Machine control circuit's maximum response time required to activate its brake (s)
- T_{bm} = Additional time (s)

If a machine has a brake monitor, " T_{bm} = Brake monitor setting time - ($T_s + T_c$)". If it has no brake monitor, we recommend using 20% or more of ($T_s + T_c$) as additional time.

- D_{pf} = Additional distance

According to ANSI's formula, D_{pf} is calculated as shown below:

$$D_{pf} = 3.4 \times (d - 7.0):$$

Where d is the detection capability of the F3SR-B (unit: mm)

[Calculation example]

When $K = 1,600 \text{ mm/s}$, $T_s + T_c = 0.06 \text{ s}$,

brake monitor setting time = 0.1 s,

$T_r = 0.015 \text{ s}$, and $d = 30 \text{ mm}$:

$$T_{bm} = 0.1 - 0.06 = 0.04 \text{ s}$$

$$D_{pf} = 3.4 \times (30 - 7.0) = 78.2 \text{ mm}$$

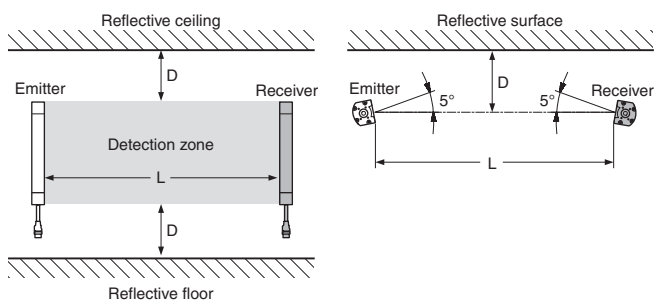
$$S = 1,600 \text{ mm/s} \times (0.06 \text{ s} + 0.015 \text{ s} + 0.04 \text{ s}) + 78.2 \text{ mm} = 262.2 \text{ mm}$$

Distance from Reflective Surfaces

⚠ WARNING

Install the sensor system so that it is not affected by reflection from a glossy surface. Failure to do so may hinder detection, resulting in serious injury.

Install the sensor system at distance D or further from highly reflective surfaces such as metallic walls, floors, ceilings, or workpieces, as shown below.



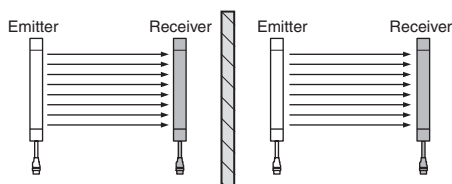
Distance between emitter and receiver (operating range L)	Allowable installation distance D
0.3 m to 3 m	0.13 m
3 m or greater	$L/2 \times \tan 5^\circ = L \times 0.044$ (m)

Mutual Interference Prevention

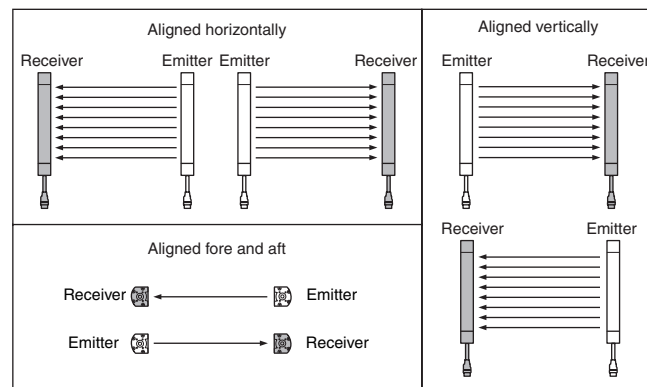
Mutual interference is prevented in up to 3 sets, using interference light detection and cycle shift algorithm.

If 4 or more sets of F3SR-B are installed, arrange them so that mutual interference does not occur. If 2 sets are installed near each other, reflection from the surface of the F3SR-B may cause mutual interference. When mutual interference occurs, the safety outputs are turned OFF momentarily or the F3SR-B enters lockout state. Combining countermeasures 1 to 3 shown below is effective.

1. Install a physical barrier between 2 sets

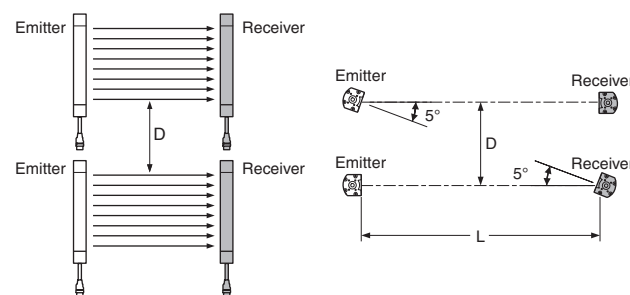


2. Alternate the direction of emission between 2 sets (alternation)



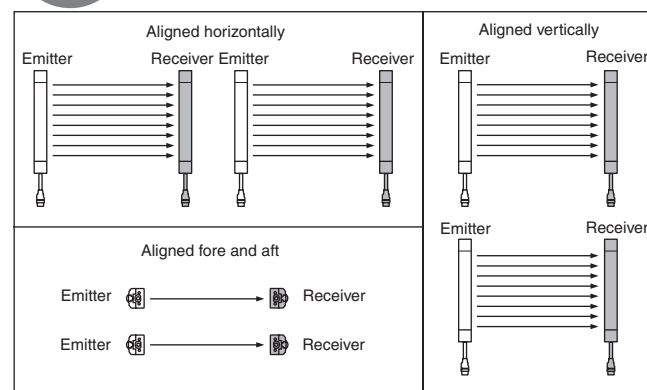
If 2 sets are installed near each other, reflection from the surfaces may cause mutual interference.

3. Keep sufficient distance between the F3SR-Bs so that mutual interference does not occur



Distance between emitter and receiver (operating range L)	Allowable installation distance D
0.3 m to 3 m	0.26 m
3 m or greater	$L \times \tan 5^\circ = L \times 0.088$ (m)

When using 4 or more sets, the installations shown below may cause mutual interference. When mutual interference occurs, the safety outputs are turned OFF momentarily or the F3SR-B enters lockout state.



[illegible]

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OMRON Corporation **Industrial Automation Company**
Tokyo, JAPAN

Contact: www.ia.omron.com

Regional Headquarters

OMRON EUROPE B.V.

Wegalaan 67-69-2132 JD Hoofddorp
The Netherlands

Tel: (31)2356-81-300/Fax: (31)2356-81-388

OMRON SCIENTIFIC TECHNOLOGIES INC.

6550 Dumbarton Circle, Fremont
CA 94555-3605 U.S.A.

Tel: (1) 510-608-3400/Fax: (1) 510-744-1442

OMRON ASIA PACIFIC PTE. LTD.

No. 438A Alexandra Road # 05-05/08 (Lobby 2),
Alexandra Technopark,
Singapore 119967

Tel: (65) 6835-3011/Fax: (65) 6835-2711

OMRON (CHINA) CO., LTD.

Room 2211, Bank of China Tower,
200 Yin Cheng Zhong Road,
PuDong New Area, Shanghai, 200120, China
Tel: (86) 21-5037-2222/Fax: (86) 21-5037-2200

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