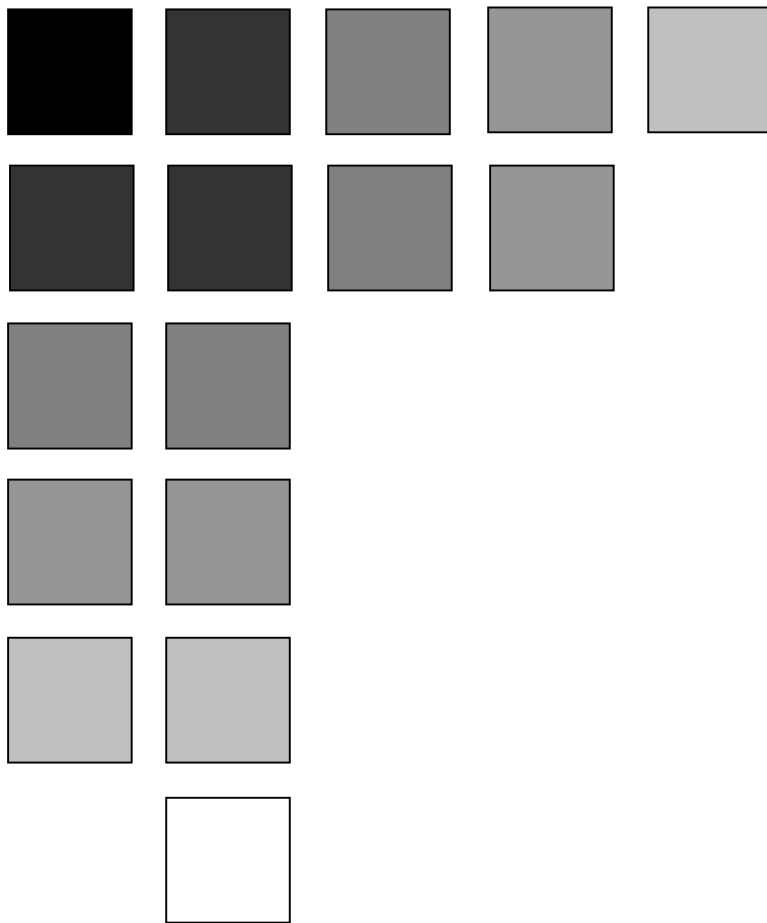


F3SH-A09P03 Series

Multi-beam Safety Sensor

Instruction Manual



TYPE 4
PNP Output Type

Introduction

Thank you for purchasing the F3SH-A Series Multi-beam Safety Sensor (hereinafter referred to as "the F3SH-A").

This is the Instruction Manual describing the use of the F3SH-A.

Always heed the following points when using the F3SH-A:

- Read this manual thoroughly and be sure you understand the information provided before attempting to operate the F3SH-A.
- It is assumed that the F3SH-A will be used properly according to the installation environment, performance and function of the machine. Qualified personnel should conduct risk assessment on the machine and determine the suitability of this product before installation.
- Make sure that the personnel operating the F3SH-A are knowledgeable about its' operation and the machine on which it is installed.
- Keep the manual in a secure and convenient location and refer to it as necessary.

Regulations and Standards

1. Application of sensor alone can not receive type approval provided by Article 44-2 of the Labour Safety and Health Law of Japan. It is necessary to apply with system. Therefore, when using the F3SH-A in Japan as a safety system for pressing or shearing machines provided by article 42 of that law, the system must receive type approval.
 2. (1) The F3SH-A is electro-sensitive protective equipment (ESPE) in accordance with European Union (EU) Machinery Directive Annex IV, B, Safety Components, Item 1.
(2) The F3SH-A complies with the following regulations and standards:
 1. EU regulations
 - Machinery Directive: Directive 98/37/EC
 - EMC Directive: Directive 89/336/EEC
 2. European standard: EN61496-1 (TYPE 4 ESPE), prEN61496-2(TYPE 4 AOPD)
 3. International standard: IEC61496-1 (TYPE 4 ESPE), IEC61496-2 (TYPE 4 AOPD)
 4. North American standard: UL61496-1 (TYPE 4 ESPE), UL61496-2 (TYPE 4 AOPD) ,UL1998, UL508
CAN/CSA 22.2 No. 14, CAN/CSA 22.2 No. 0.8
 5. JIS standard: JIS B 9704-1 (TYPE 4 ESPE), JIS B 9704-2 (TYPE 4 AOPD)
 - (3) The F3SH-A received the following approvals from the EU accredited body DEMKO A/S:
 - EC Type-Examination in accordance with the EU Machinery Directive
TYPE 4 ESPE (EN61496-1), TYPE 4 AOPD (prEN61496-2)
 - Certificate of a Competent Body for EMC
 - DEMKO Type Approval TYPE 4 ESPE (EN61496-1), TYPE 4 AOPD (prEN61496-2)
 - (4) The F3SH-A received the following approvals from the Third Party Assessment Body UL:
 - Certificate of UL listing for US and Canadian safety standards
Both of which are: TYPE 4 ESPE (UL61496-1), TYPE 4 AOPD (UL61496-2)
 - (5) The F3SH-A received the following approvals from the BG test and certification body BG-PRÜFZERT:
 - BG Test and Certification Mark License
TYPE 4 ESPE (EN61496-1), TYPE 4 AOPD (prEN61496-2)
3. The F3SH-A is designed according to the following standards. To make sure that the final system complies with the following standards and regulations, you are asked to design and use it as provided by any other related standards, laws, and regulations.
Consult UL or other standardization bodies if you have any questions.
 - European standard EN415-4
 - Occupational safety and health standards OSHA 29 CFR 1910.212
 - American national standard ANSI/RIA 15.06

Notice

Give sufficient safety considerations and make enough allowance with regard to ratings and functions of the system when using the F3SH-A under following conditions:

- (1) Conditions or environment not specified in this manual
- (2) Applications to devices and facilities requiring special safety precautions, such as; nuclear energy control, railway, aircraft, vehicles, combustion facility, medical system, space development, large amusement machines, etc.)

Precaution on Safety

● General conventions for safe use

The following conventions are used for precautionary items in this manual in order to ensure safe and proper use of the F3SH-A. Items listed here are critical for safety and must be heeded at all times.



WARNING

Indicates a potentially hazardous situation, which, if not avoided, could result in death or serious injury.



Indicates prohibited actions.



WARNING

Do not use the F3SH-A on machines that cannot be stopped by electrical control in case of an emergency, such as a pressing machine with full-rotation clutch system. Serious injury may result if the machine does not stop before someone reaches the hazardous part. (Chapter 2-1)

Install protective structures around the machine so that you must pass through the detection zone of the F3SH-A to reach a hazardous part of the machine. Failure to do so will cause serious injury. (Chapter 2-1)

If an operator can enter into the area between the F3SH-A and a hazardous part of a machine, configure the system to prevent a machine from automatically starting to operate. (Chapter 2-1)

The switch to reset the interlock condition must be installed so that the entire hazardous area is visible and free of personnel, also the switch must not be able to be operated from within the hazardous area. (Chapter 2-1)

Do not use the F3SH-A in flammable or explosive environments. Failure to do this may cause an explosion. (Chapter 2-1)

The F3SH-A does not offer protection to the operator's body from projectiles exiting the hazardous area. Proper means of mechanical guarding must be provided to ensure protection from these potentially hazardous projectiles. (Chapter 2-1)

Always maintain the safe calculated distance between the F3SH-A and the hazardous part of a machine to avoid serious injury that may be caused by reaching the hazard before the machine has stopped. (Chapter 2-1)

Do not install the F3SH-A in a location where it can be affected by wall reflections to avoid detection failure which may result in serious injury. (Chapter 2-1)

Use the emitter and receiver in proper arrangement to avoid creation of undetectable zones. The set type of the emitter and receiver must be the same. (Chapter 2-1)

Be sure to securely fasten the F3SH-A to the machine and tighten the cable connector. (Chapter 2-1)

When using multiple sets of F3SH-A, arrange them to prevent mutual interference. (Chapter 2-1)

Do not short-circuit the outputs to the +24V. Doing so will cause the output to be always ON, creating a hazardous situation. Connect the 0V line of the power supply directly to protective earth to prevent the earth fault. Otherwise the earth fault causes the outputs to be ON. (Chapter 2-4)

Connect loads between the output and 0V line. (PNP output)

Connecting loads between the output and +24V line will reverse the operation mode and the machine will be ON when it is light-interrupted. (Chapter 2-4)

Always use the two OSSD outputs to configure the safety system.

Using only one OSSD of the safety system may result in serious injury when there is an output circuit failure. (Chapter 2-4)

Do not connect any of the F3SH-A lines to a DC power supply with more than 24VDC+10% or to an AC power supply to avoid the danger of electric shock. (Chapter 2-4)



WARNING

DC power supply units must satisfy all of the conditions so that the F3SH-A can comply with the applicable standards IEC 61496-1, and UL 508.

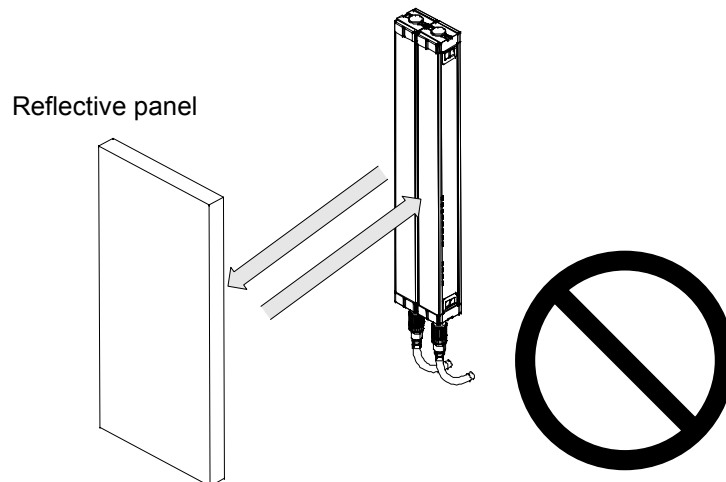
- The power supply voltage must be within specified ratings (24 VDC \pm 10 %).
- The power supply is connected only to the F3SH-A and to the devices related to the electro-sensitive protective function of the F3SH-A, such as a safety controller and muting sensors, and it has enough rated current for all the devices. The power supply must not be connected to other devices or machines.
- The power supply uses double or reinforced insulation between the primary and secondary circuits
- The power supply automatically resets overcurrent protection characteristics (voltage drop).
- The power supply maintains an output holding time of at least 20 ms.
- The power supply must have output characteristics of Class 2 Circuit of Limited Voltage-Current Circuit as defined in UL508 (see "2-4-1 Remark").
- The power supply must conform to regulatory requirements and standards, regarding EMC and electrical equipment safety, of the country where the F3SH-A is installed and where machinery will be operated. Example: The EMC Directive (industrial environment) and the Low Voltage Directive in EU.

FG (frame ground terminal) must be connected to PE (protective earth) when using a commercially available switching regulator.

A qualified person must confirm that installation, inspection and maintenance of the F3SH-A are implemented correctly as determined by local regulations where the equipment is installed and used.

Do not disassemble, repair or modify the F3SH-A.

Do not use the F3SH-A in a reflective configuration, otherwise detection may fail. (Chapter 2-1)



Notice

For your safety, always heed the followings:

- (1) The procedures of installation, inspection and maintenance in this manual should be read carefully.
- (2) Loads must satisfy all the conditions below:
 - Is not short-circuited.
 - Is not used with current higher than the rating.
- (3) All input lines and output lines of the F3SH-A should insulate against hazardous voltage levels (230 VAC, etc.), not simply against 24 VDC, with double or reinforced insulation to protect against electrical shock. In case of the combination with the F3SP-B1P, all relay output terminals (13-14, 23-24, 33-34, and 41-42) should insulate against hazardous voltage levels with basic insulation.
- (4) Be sure to dispose of the F3SH-A as industrial waste.

Correct Usage

For your safety, always heed the following:

■ Installation Environment

- Do not install the F3SH-A in the following environments:
 - Areas exposed to intense interference light, such as direct sunlight
 - Areas with high-humidity where condensation is likely to occur
 - Areas exposed to corrosive gases
 - Areas exposed to vibration or shock levels higher than specification provisions.
 - Areas where the sensor may come in direct contact with water.
- Do not use radio equipment, such as cellular phones, walkie-talkies, or transceivers with high power, near the F3SH-A.

■ Wiring and Mounting

- Be sure to turn OFF the power prior to wiring, otherwise the diagnostic function may prevent the sensor from operating.
- Use shielded twisted pair cable (cross-sectional area: $\phi 0.3\text{mm}^2$ or more) when extending the communication lines with a cable other than the dedicated cable (F39-JC□), and connect the shield to the 0V line.
- When replacing the cable connector with other connectors (e.g. resin connectors), make sure the connector is rated IP54 or higher.
- When the distance between the emitter and the receiver is less than 0.2m, there is a possibility of the malfunction that the F3SH-A goes to the OFF-state momentarily. Be sure to install the F3SH-A within the rated operating range.
- Check the signal name of all terminals for correct wiring.
- Devise a measure to protect against mutual interference when using two or more sets of F3SH-A beside one another.
- Do not operate the control system until one second or more after turning ON the power of the F3SH-A.
- Be sure to route the F3SH-A cable separate from high-potential power lines or through an exclusive conduit.
- The emitter and receiver are to be mounted in parallel and facing one another.

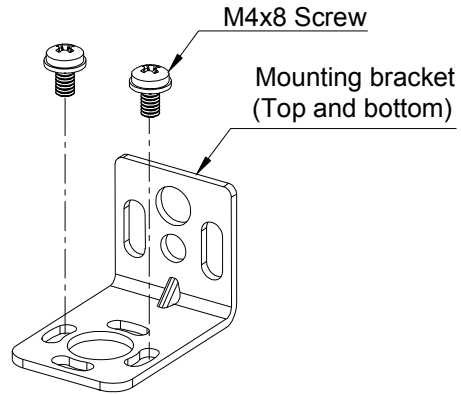
- Do not use any solvents such as paint thinners, benzine or acetone to clean the F3SH-A because it will dissolve resin and paint.

- The F3SH-A cannot detect transparent or semi-transparent materials.

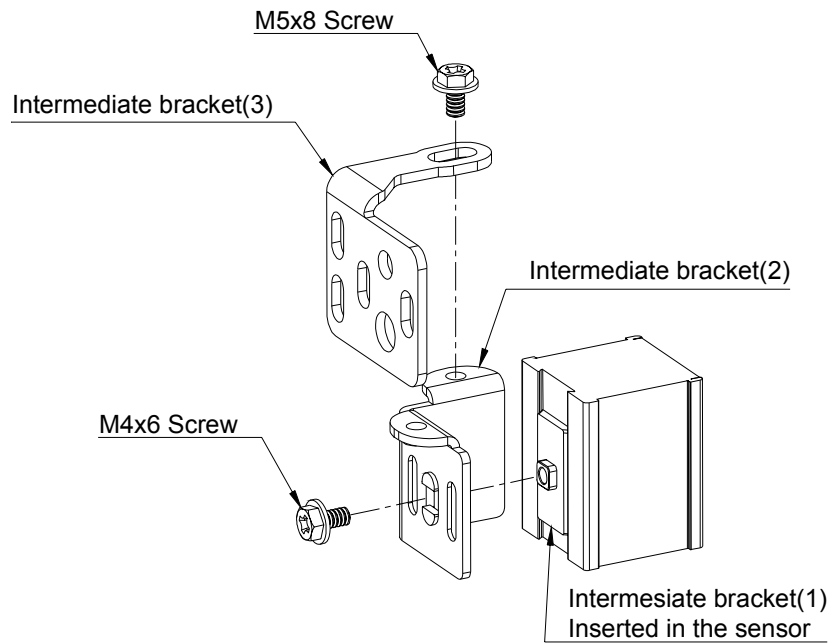
PRIOR TO USE

Verify the following items are supplied with each F3SH-A, contact your nearest OMRON representative or distributor if any item is missing.

- F3SH-A09P03 unit (emitter qty. 1, receiver qty. 1)
- Mounting brackets (top and bottom) qty. 4



- Mounting brackets (intermediate) qty. 2



- Error mode label qty. 1
- Instruction manual (this manual) qty. 1

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Section 1 Description

1-1 Features

Operating range of 10 m.

Beam gap 300mm, 4 beams

Indication of light intensity

Received light intensity is indicated by a 5-bar LED display to aid in beam alignment.

Indication of error mode

Error mode is indicated by a separate 3-bar LED display.

Safety-related functions:

- External test function (Emission stop function)
- EDM (External device monitoring function)
- Interlock function

Auxiliary output (Non-safety output)

Allows the sensor status to be transmitted to a PLC or other device.

Control Unit: F3SP-B1P (Optional accessory)

Allows for quick connection of the sensor into the safety circuit.

Setting Console: F39-MC11 (Optional accessory)

By connecting this handheld console to the sensor, various functions of the sensor can be accessed.

Degree of protection : IP65 (for sensor only)

Series connectable models

The series-connection type allows multiple units to be connected together to protect against mutual interference, or an external indicator can be connected to indicate the sensor status.

1-2 Functions

1-2-1 Interlock function

After the power is turned ON and none of the beams are interrupted the OSSD (Output Signal Switching Device) outputs will go to their ON-state.

To enable auto reset mode:

- ① Leave the interlock selection input line open or connect it to 0VDC.
- ② Connect the Reset input line to 24VDC. (9VDC to Vs, nominal 24VDC)
- ③ Turn ON the power to the F3SH-A.

2) Manual reset mode

There are 3 options for manual reset:

- Start/restart interlock
After the power is turned ON, or when at least one beam is interrupted, the sensor enters the interlock condition.
- Start interlock
Only after power ON, the sensor enters the interlock condition.
- Restart interlock
Only when at least one beam is interrupted, the sensor enters the interlock condition.

For the factory setting, the start/restart interlock is selected in the manual reset mode. Other options are selected by the setting console, F39-MC11 (optional). When the sensor enters the interlock condition, it keeps the OSSD outputs in the OFF-state. Even if all beams become free, the OSSD outputs will not go to the ON-state. When none of the beams are interrupted in the detection zone, applying the reset input^(*) resets the interlock condition and the OSSD outputs go to the ON-state.

- *1. Apply a voltage of 24VDC (9VDC to Vs, nominal 24VDC) to the reset input line for 100 ms or more, then remove power to the reset input line or apply a voltage of 0 VDC.

Section 1 Description

To enable manual reset mode:

- ① Connect the Interlock selection input line to 24VDC (9VDC to V_s , nominal 24VDC)
- ② Connect the reset input line to 24VDC (9VDC to V_s , nominal 24VDC) via a reset switch (normally open contact).
- ③ Turn on the power to the sensor while the reset switch contact remains open.

[Note1]: The switch to reset the interlock condition has to be installed out of the hazardous area. Before the start/restart interlock is reset, the hazardous area must be visibly free of personnel.

[Note2]: Prevent short-circuiting of unconnected wires of the sensor with other wires.

1-2-2 Test function

1) Self-test

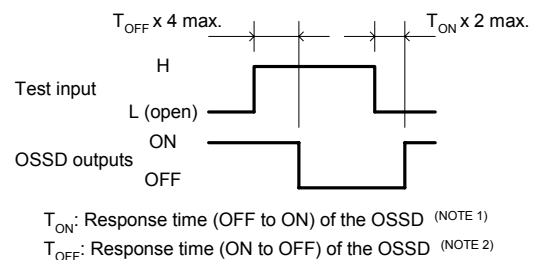
After power ON, the F3SH-A performs a complete self-test within 1 second. In addition, it performs a self-test (within response time) periodically during operation.

2) External test

This function will stop the light-emitting of the sensor at any time to confirm the output is turned OFF normally. Applying a voltage of 24VDC (9V to V_s , nominal 24VDC) ^(NOTE1) to the test input line of the emitter makes the emitter stop emitting.

[Note1]: Applied time should be more than four times of T_{OFF} .

[Note2]: For T_{ON} and T_{OFF} , refer to "1-3 Ratings and Performance."



3) Error detection and restoration (Lockout condition)

If an error is detected by the self-test the sensor enters the lockout condition, keeps the OSSD outputs in their OFF-state and displays the error mode^(*1).

Turning the power ON again, or applying the reset input^(*2) to the sensor, resets the lockout condition (For noise, eliminating the noise automatically resets the lockout condition.)

*1. Refer to "1-2-10 Indicators" for the indicating patterns.

*2. In case of manual reset mode: Apply a voltage of 24VDC (9VDC to V_s , nominal 24VDC) to the reset input line for 100 ms or more, then remove power to the reset input line or apply a voltage of 0VDC.

In case of auto reset mode: Open the reset input line or connect it to 0VDC for 100ms or more, then re-apply a voltage of 24VDC (9VDC to V_s , nominal 24VDC).

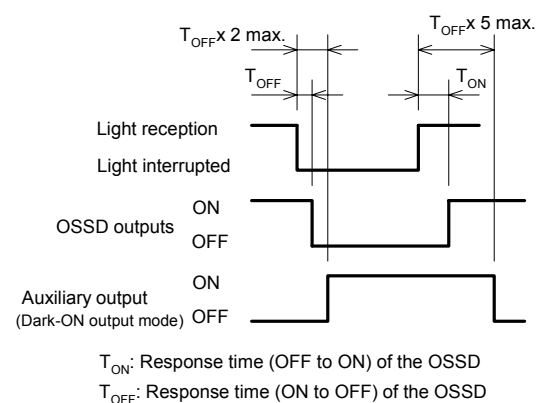
1-2-3 Auxiliary Output (Non-safety output)

The default of this output is the reverse signal of the safety outputs (Dark-ON output). This output can be used for monitoring purposes by connecting it to a device such as a PLC.

The auxiliary output can be selected to give one of the following output operation modes by the F39-MC11.

- Dark-ON output mode
- Light-ON output mode
- Light diagnosis mode
- Lockout mode
- Outermost-beam monitoring mode
- Specified-beam mode

The diagram on the right shows the timing chart for the Dark-ON output mode. For detailed information, refer to the instruction manual of the F39-MC11.

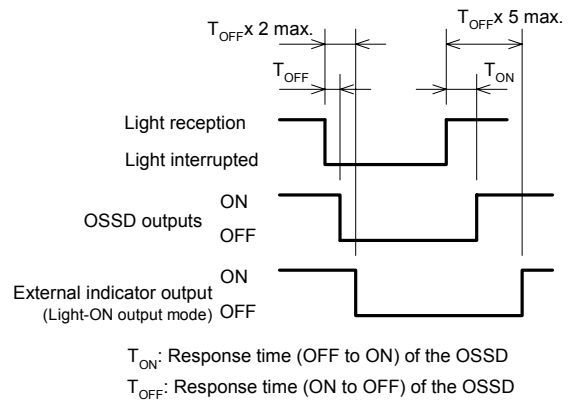


1-2-4 External indicator output (Non-safety output, available for the series-connection type only)

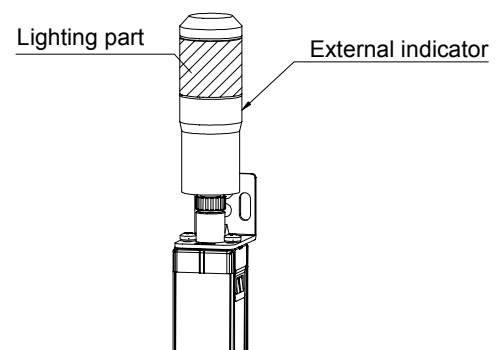
This output can be connected to an external indicator to display one of the operation modes as selected by the F39-MC11. The default of this output is Light-ON output. Selectable output modes are as follows.

- Dark-ON output mode
- Light-ON output mode
- Light diagnosis mode
- Lockout mode

The diagram on the right shows the timing chart for the Light-ON output mode. For detailed information, refer to the instruction manual for the F39-MC11.



The large indicator can be directly attached to the sensor by using the external indicator F39-A01P□-□, as shown in the figure on the right, for use with series-connection types only.



1-2-5 EDM (External device monitoring)

This function makes it possible to monitor the state of the NC contacts of the MPCEs^{(*)1}, so that a malfunction of a MPCE, such as a welded contact, can be detected. Connect^{(*)2} the NC contact of the MPCEs to the EDM input line of the receiver. If the correct logical relationship between the OSSD outputs and the EDM input is not kept, the sensor immediately enters the lockout condition and the OSSD outputs will go to their OFF-state. The sensor's normal operation is up to 300ms max.^{(*)3}, this allows for the delay time caused by the release of the MPCEs. To ensure the correct usage of this function, the MPCEs must be safety-approved types with forcibly-guided contacts.

[When the EDM is not used]

In the case the EDM input is not used, connect the auxiliary output in the Dark-ON output mode to the EDM input line, or disable the EDM with the F39-MC11 setting console.

- *1. MPCEs (Machine Primary Control Elements) are usually relays or contactors used to control hazardous movement directly.
- *2. Connect the wires such that 24VDC (9VDC to V_s , nominal 24VDC) is applied to the EDM input via the series connected NC contacts (Refer to 2-4 Wiring).
- *3. The value can be changed by the F39-MC11.

Section 1 Description

1-2-6 Detection zone

[Outermost-beam gap]

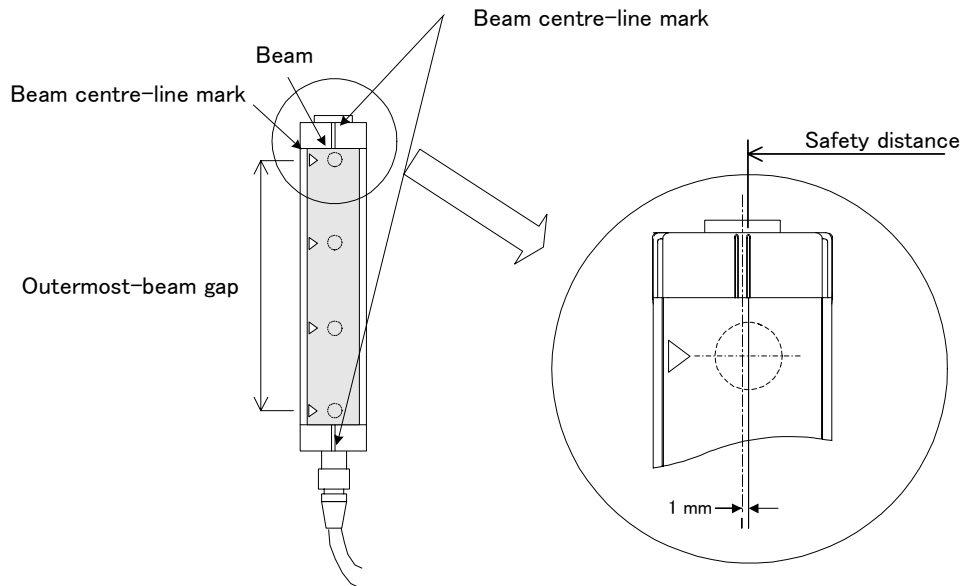
The distance between the centre of the top and bottom beams of the sensor.

[Beam centre-line mark(lines on the cap)]

The two lines marked at the centre of the cap indicate the centre of the beam (See the figure shown below). This position is a reference line for measuring safety distance. Use the line closer to the hazardous area as a reference line for the safety distance.

[Beam centre-line mark (Δmark)]

Indicates the location of individual beam.

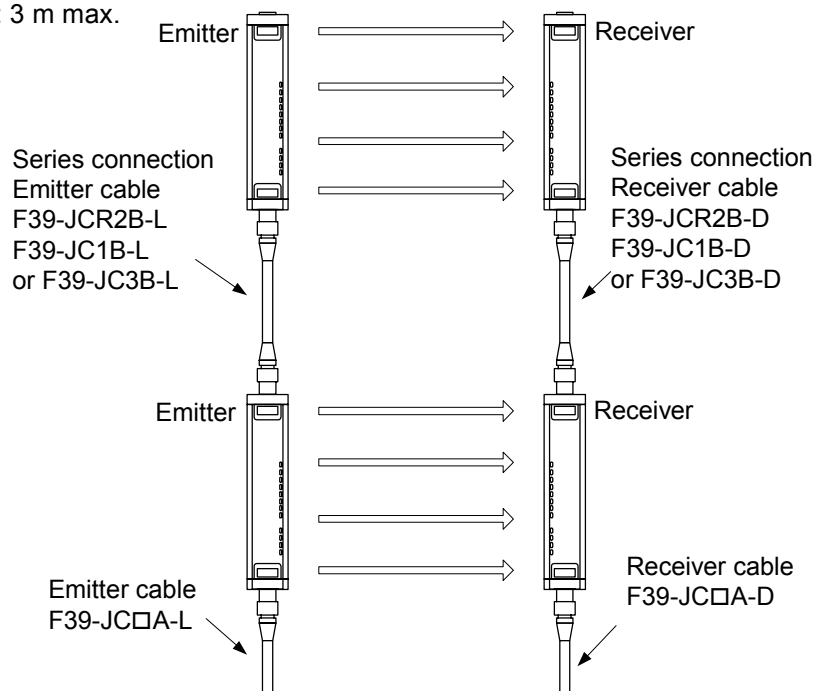


1-2-7 Series connection

Sensors can be connected in series using the types supplied with the connector for the series connection as shown in the figure below. Both the stand-alone type and the series connection type can be used for the sensors located at the top end. (The F3SH-A09P03 series can connect with the F3SH-A09P03 series only.)

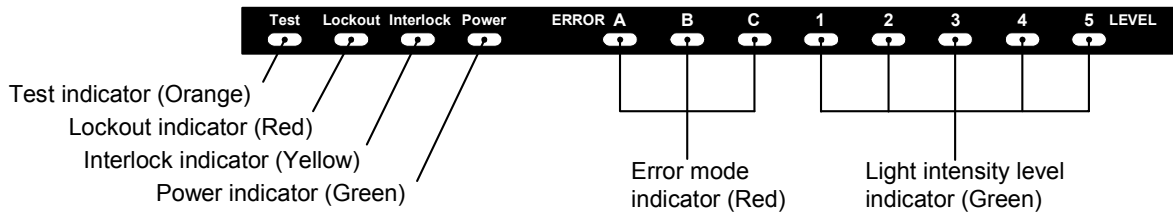
When any beam of the sensors connected in series is interrupted, both the OSSD outputs go to the OFF-state. The LED indicators for each sensor are individually lit.

- No. of series connected sensors: Up to 3 sets
- Length of the series connection cable: 3 m max.

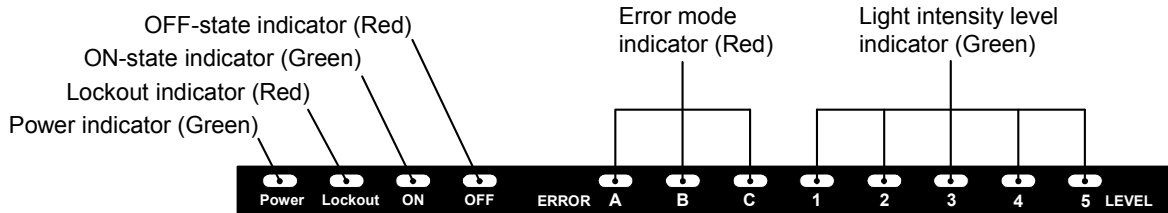


1-2-8 Indicators

[Emitter]



[Receiver]



- Power indicator : Lit when power is supplied
- Power indicator(Receiver) : Lit when power is supplied, flashing when the F39-MC11 is connected
Flashing after a lapse of 30000 hours
- Interlock indicator : Lit during interlock condition
- Lockout indicator : Flashing during lockout condition
- Test indicator : Lit during external test, Flashing after a lapse of 30000 hours
- ON-state indicator : Lit when OSSD outputs are in ON-state
- OFF-state indicator : Lit when OSSD outputs are in OFF-state
- Light intensity level indicator : Lit according to light intensity (See the table shown below)
- Error mode indicator : Flashing to indicate error mode (Flashing pattern varies depending on the error condition. See the table shown below)

	1	2	3	4	5	Light intensity level
Light intensity level indicator Lit Not lit						200% and above of ON threshold level
						150 to 200% of ON threshold level
						100 to 150% of ON threshold level
						75 to 100% of ON threshold level
						50 to 75% of ON threshold level
						less than 50% of ON threshold level

	A	B	C	Cause of error
Error mode indicator Flashing Not lit				The Interlock selection input line or the reset input line is not wired correctly or became open.
				Relay contact is welded. Releasing time of the relay takes too long. The EDM input line is not wired correctly or became open.
				Communication line (RS-485) is not wired correctly, became open, or causes other errors.
				One of the OSSD outputs is shorted or is not wired correctly.
				Mutual interference. Interference light is received.
				Numbers of the receiver and emitter connected in series are not the same.
				External noise. Internal hardware failure of the receiver or the emitter.

* Attaching the supplied error mode label near the sensor facilitates diagnosis of the cause of errors.

Section 1 Description

1-3 Ratings and Performance

1-3-1 Specification

Type		F3SH-A09P03	F3SH-A09P03-01
Item			
Beam gap		300 mm	
No. of beams		4	
Outermost-beam gap		900 mm	
Operating range		0.2 to 10.0 m	
Response time		ON to OFF: 10ms max. OFF to ON: 40ms max. (under stable light incident condition), See 1-3-2 for the response time under series connection.	
Startup waiting time		1 s max.	
Supply voltage (Vs)		24 VDC \pm 10% (ripple p-p 10% max.)	
Current consumption (under no-load conditions)	Emitter	140 mA max.	
	Receiver	100 mA max.	
Light source		Infrared LED (870 nm wavelength)	
Effective aperture angle (EAA)		Within $\pm 2.5^\circ$ for the emitter and receiver at a detection distance of at least 3 m according to IEC 61496-2	
OSSD *1		Two PNP transistor outputs, load current 300 mA max., residual voltage 2 V max. (except for voltage drop due to cable extension)	
Auxiliary output (Non-safety output)		One PNP transistor output, load current 50 mA max., residual voltage 2 V max. (except for voltage drop due to cable extension)	
External indicator output (Non-safety output)		-	One PNP transistor output, load current 50 mA max., residual voltage 2 V max. (except for voltage drop due to cable extension)
Output operation mode *1		OSSD output: Light-ON Auxiliary output: Dark-ON (can be changed by the F39-MC11)	OSSD output: Light-ON Auxiliary output: Dark-ON (can be changed by the F39-MC11) External indicator output: Light-ON (can be changed by the F39-MC11)
Input voltage		Test input, Interlock selection input, Reset input, EDM input: ON voltage : 9 to 24 VDC (3 mA max. sink current) OFF voltage : 0 to 1.5 VDC or open	
Indicators	Emitter	Light intensity level indicator (Green LED x5) : Lit according to light intensity Error mode indicator (Red LED x3) : Flashing to indicate error mode Power indicator (Green LED) : Lit when power is supplied Interlock indicator (Yellow LED) : Lit during interlock condition Lockout indicator (Red LED) : Flashing during lockout condition Test indicator (Orange LED) : Lit during external test *2	
	Receiver	Light intensity level indicator (Green LED x5) : Lit according to light intensity Error mode indicator (Red LED x3) : Flashing to indicate error mode OFF-state indicator (Red LED) : Lit when OSSDs are in OFF-state ON-state indicator (Green LED) : Lit when OSSDs are in ON-state Lockout indicator (Red LED) : Flashing during lockout condition Power indicator (Green LED) : Lit when power is supplied *2	
Mutual interference prevention function		-	<ul style="list-style-type: none"> Number of series connected sensors: Up to 3 sets Length of the series connection cable: 3 m max.
Test		<ul style="list-style-type: none"> Self-test (After power ON, and during operation) External test (Light emission stop function by test input) 	
Safety-related functions		<ul style="list-style-type: none"> Auto reset / manual reset (Interlock function) *3 EDM (External device monitoring) 	
Connection method		M12 connector, 8 pins	
Protection mode		Output short-circuit protection, Reverse polarity protection	

Section 1 Description

Type	F3SH-A09P03	F3SH-A09P03-01
Item		
Ambient temperature	During operation : -10 to 55°C (with no freezing) During storage : -30 to 70°C	
Ambient humidity	During operation : 35 to 95% RH (with no condensation) During storage : 35 to 95% RH	
Ambient 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)	
Insulation resistance	20 MΩ min. (at 500 VDC)	
Dielectric strength voltage	1000 VAC 50/60 Hz 1 minute	
Degree of protection	IP65(IEC60529)	
Vibration resistance	Normal operation : 10 to 55 Hz, double amplitude 0.7 mm, X, Y and Z directions 20 sweeps	
Shock resistance	Normal operation : 100 m/s ² , X,Y and Z directions 1000 times	
Cable (optional) *4	UL20276 (flame-resistant:), 8 cores (0.3 mm ² x 4pairs), external diameter 6.6 mm, with braided wire shield, allowable bending radius: R36 mm	
Materials	Case : Aluminum Cap : Zinc die-cast Optical cover : PMMA (acrylic resin) Cable : Oil-proof PVC	
Weight *Packaged	3.9 kg	
Accessories	Instruction manual, Mounting brackets (top and bottom), Mounting brackets (intermediate), Error mode label	
Applicable standard	IEC61496-1, EN61496-1 Type4 ESPE (Electro-Sensitive Protective Equipment) IEC61496-2 Type4 AOPD (Active Opto-electronic Protective Devices)	

- *1. Please note that the operation may differ from conventional ON/OFF switching because of the safety circuit.
- *2. Flashing after a lapse of 30000 hours as an indicator of preventive maintenance.
- *3. For the factory setting, the manual reset mode is set to the start/restart interlock.
Using the F39-MC11 can select the start interlock or the restart interlock.
- *4. When extending the cable, be sure to use a cable with at least same performance. Do not extend the cable more than the length below. Be sure to route the F3SH-A cable separated from high-potential power lines or through an exclusive conduit.
 - In the case of no series connection: 100 m max.
 - In the case of 2 sensors connected in series: 80 m max.
 - In the case of 3 sensors connected in series: 30 m max.

1-3-2 Response time

- **Response time for series connected types is calculated as follows:**

For 2 sets:

Response time (ON to OFF): Response time of Sensor 1 + Response time of Sensor 2 + 3 ms

Response time (OFF to ON): Response time of Sensor 1 + Response time of Sensor 2 + 12 ms

For 3 sets:

Response time (ON to OFF): Response time of Sensor 1 + Response time of Sensor 2
+ Response time of Sensor 3 + 4 ms

Response time (OFF to ON): Response time of Sensor 1 + Response time of Sensor 2
+ Response time of Sensor 3 + 16 ms


- **Response time of F3SP-B1P is 10 ms, operation time is 100 ms.**

[Note]: If the controller is included in the set, calculate safety distance by adding the controller response time to the F3SH response time.

Section 2 Wiring and Mounting

2-1 Installation Conditions

2-1-1 Detection Zone and Intrusion Path

 WARNING
Do not use the F3SH-A on machines that cannot be stopped by electrical control in case of an emergency, such as a pressing machine with full-rotation clutch system. Serious injury may result if the machine does not stop before someone reaches the hazardous part.
Install protective structures around the machine so that you must pass through the detection zone of the F3SH-A to reach a hazardous part of the machine. Failure to do so will cause serious injury.
If an operator can enter into the area between the F3SH-A and a hazardous part of a machine, configure the system to prevent a machine from automatically starting to operate.
The switch to reset the interlock condition must be installed so that the entire hazardous area is visible and free of personnel, also the switch must not be able to be operated from within the hazardous area
Do not use the F3SH-A in flammable or explosive environments. Failure to do this may cause an explosion.
The F3SH-A does not offer protection to the operator's body from projectiles exiting the hazardous area. Proper means of mechanical guarding must be provided to ensure protection from these potentially hazardous projectiles.
Be sure to securely fasten the F3SH-A to the machine and tighten the cable connector.

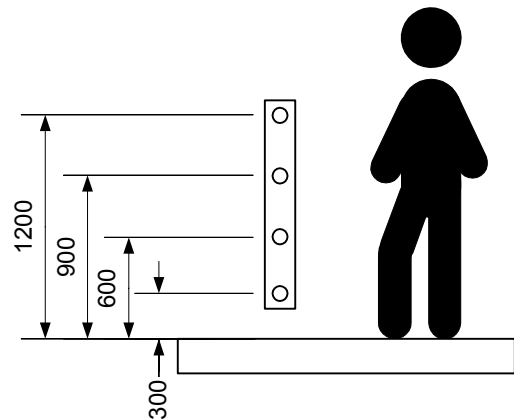
The F3SH-A can be used for an application to detect a whole body intruded in the detection zone rather than hands or fingers.

For installation, evaluate the following risk of intrusions to determine the proper installation position.

- Intrusion from underneath the bottom beam
- Intrusion from over the top beam
- Intrusion squeezed through beams

In EN999 standard, the values shown below are recommended as the most effective values in terms of each beam's height from a reference surface for 4-beam multi-beam sensor.

No. of beams	Height from the reference surface (such as a floor) (mm)
4	300, 600, 900, 1200



2-1-2 Safety Distance



WARNING

Always maintain a safe distance (S) between the F3SH-A and a hazardous part of a machine.
 Serious injury may result if the machine does not stop before someone reaches the hazardous part.

The "Safety distance" is the minimum distance that must be maintained between the F3SH-A and a hazardous part of a machine in order to stop the machine before someone or something reaches it. The safety distance is calculated based on the following equation when a person moves perpendicular to the detection zone of a sensor.

Safety distance (S) = Intrusion speed into the detection zone (K) x Total response time for the machine and sensor (T) + Additional distance calculated based on the detection capability of the sensor (C) ... (1)

The safety distance varies with national standards and individual machine standards. Be sure to refer to related standards.

The equation is also different if the direction of intrusion is not perpendicular to the detection zone of the sensor.

<Reference> Method for calculating safety distance as provided by European Norm EN999 (for intrusion perpendicular to the detection zone)

Substitute K = 1,600 mm/s and C = 850 in equation (1) and calculate as shown below.

$$S = 1,600 \text{ mm/s} \times (T_m + T_s) + 850 \dots(2)$$

Where: S = Safety distance (mm)

T_m = Machine response time (s) *1

T_s = Sensor response time (s) *2

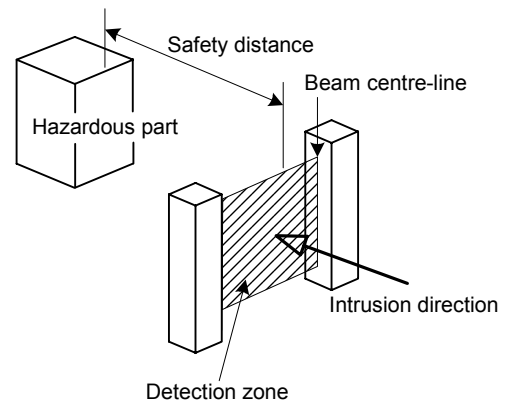
e.g.:

$$T_m = 0.05\text{s}, T_s = 0.01\text{s}:$$

$$S = 1,600 \text{ mm/s} \times (0.05\text{s} + 0.01\text{s}) + 850\text{mm} \\ = 946 \text{ mm}$$

- *1. The machine response time refers to the maximum time from the moment the machine receives a stop signal to the moment the hazardous part of the machine stops. The machine response time should be measured on actual machines. The machine response time should be measured and confirmed periodically.

- *2. The sensor response time refers to the time required for output to change from ON to OFF.



<Reference> Method for calculating the safety distance as provided by ANSI R15.06 (US) (for intrusion perpendicular to the detection zone)

Safety distance (S) = Intrusion speed into the detection zone (K) x Response time ($T_s + T_c + T_r$) + Additional distance (Dpf) ... (4)

Where: K = Intrusion speed: 1,600 mm/s or more

T_s = Maximum time required for machine/equipment to stop (s)

T_r = F3SH-A response time (s) *1

T_c = Maximum time required for control system to stop(s)

Dpf = Additional distance (mm)

When the sensor is installed so that the bottom beam positioned at a height of 300mm above floor; top beam, 1200mm, Dpf = 900mm is obtained.

e.g.:

For intrusion perpendicular to the detection zone

Where: K = 1,600 mm/s, $T_s + T_c = 0.06\text{s}$, $T_r = 0.01\text{s}$, Dpf = 900mm,

From equation (4):

$$S = 1,600 \times (0.06+0.01)+900 = 1,012\text{mm}$$

- *1. The sensor response time refers to the time required for output to change from ON to OFF.

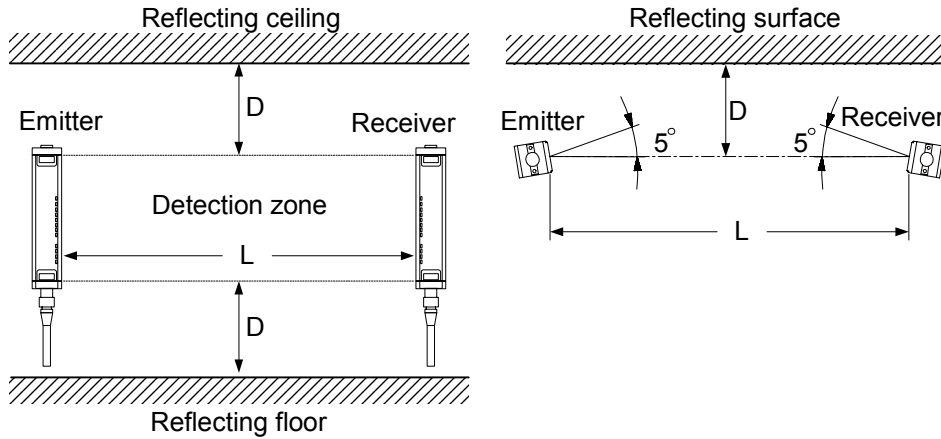
Section 2 Wiring and Mounting

2-1-3 Distances from Reflective Surfaces

WARNING

Be sure to install the F3SH-A to minimize the effects of reflection from nearby surfaces. Failure to do so may cause detection to fail and may result in serious injury.

Install the F3SH-A with minimum Distance D shown below from reflective surfaces (highly reflective surfaces) such as metal walls, floors, ceilings, and work pieces.



Distance between emitter and receiver (Operating range L)	Minimum installation distance D
0.2 to 3m	0.13m
over 3m	$L/2 \times \tan 5^\circ = L \times 0.044$ (m)

2-1-4 How to Prevent Mutual Interference



WARNING

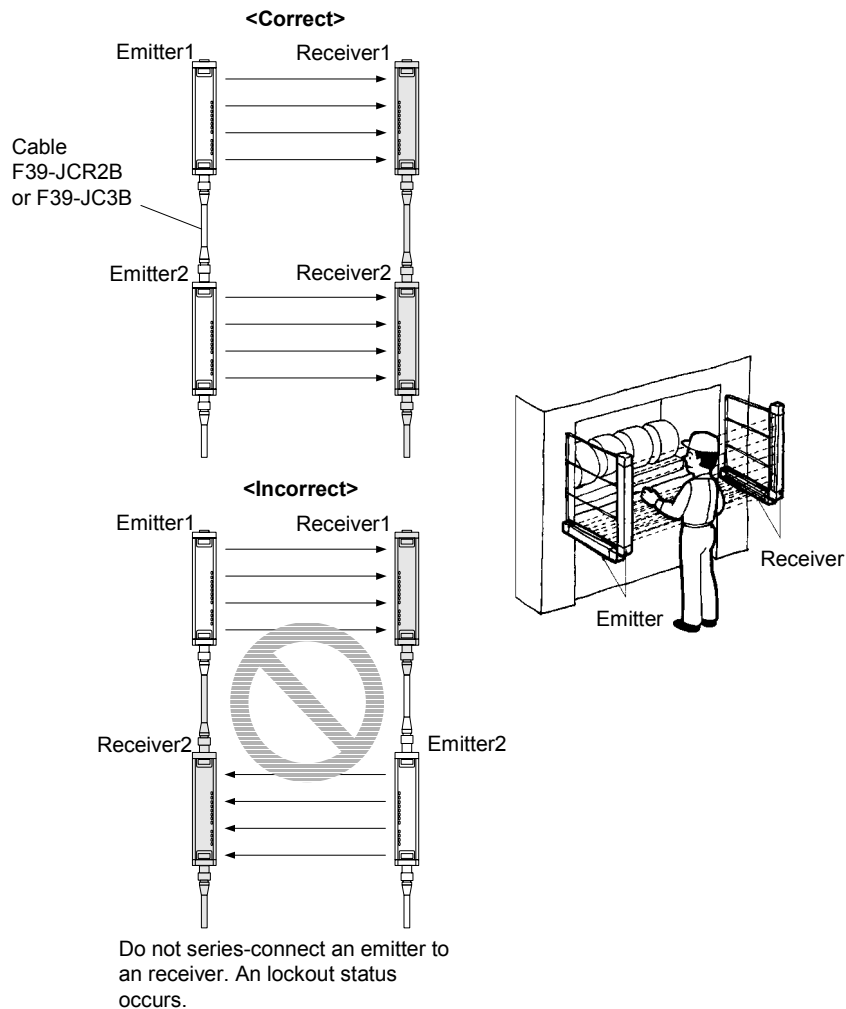
The set type of the emitter and receiver must be the same.

Do not use the F3SH-A in a reflective configuration. Otherwise detection may fail.

When using multiple sets of F3SH-A, connect them and/or use light interruption panels to prevent mutual interference.

1) Series connection (Up to 3 sets, the series connection type is required for connection)

Multiple sets of the F3SH-A can be connected in series.

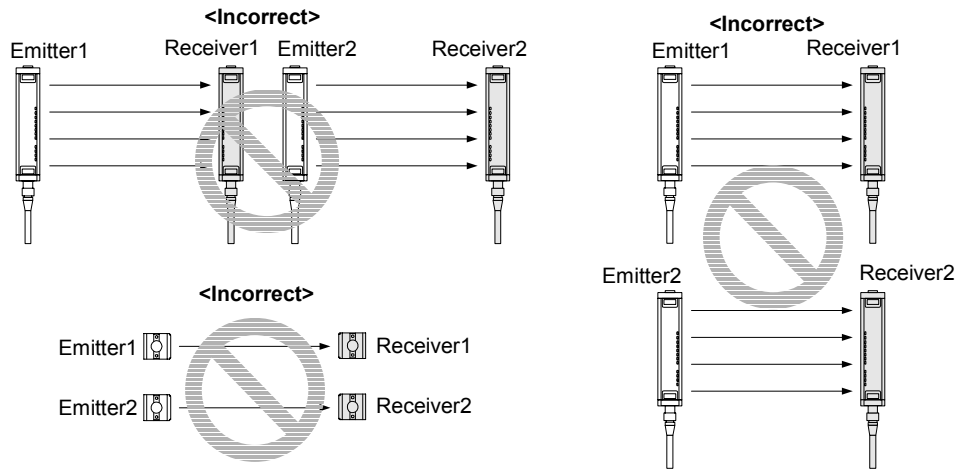


Section 2 Wiring and Mounting

2) When not connected

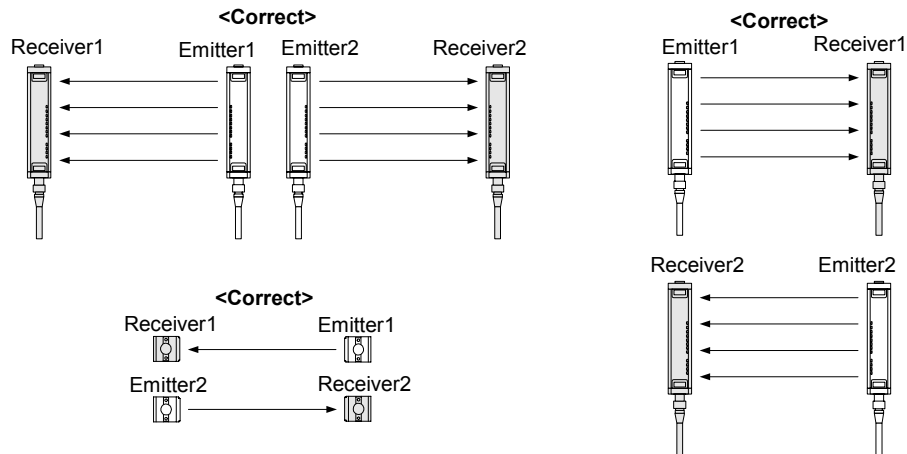
When installing two or more sensors without connecting them to each other due to wiring conditions, considerations must be made to prevent mutual interference. Failure to do so may cause the F3SH-A to go into a lockout condition.

Installation which may cause mutual interference

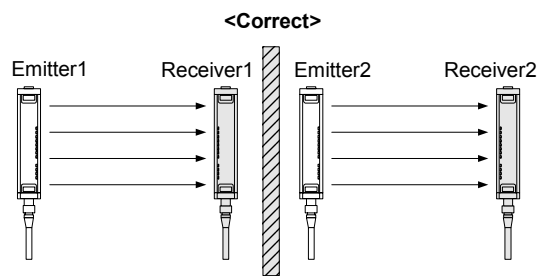


Installation to prevent mutual interference

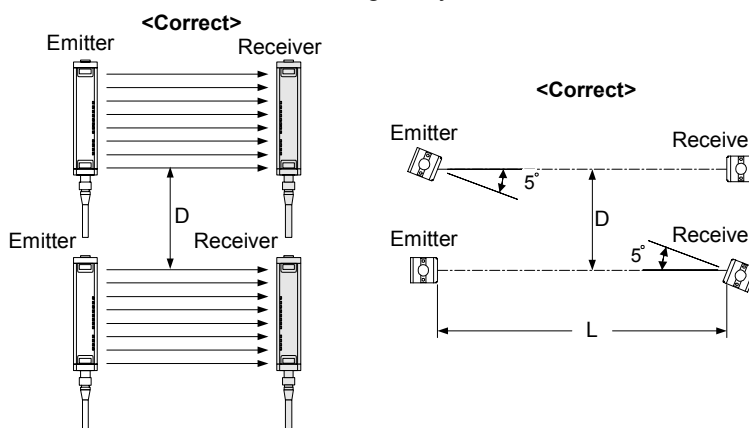
- Install so that the two sensors emit in the opposite directions (staggered).



- Install a light interrupting wall in between sensors.



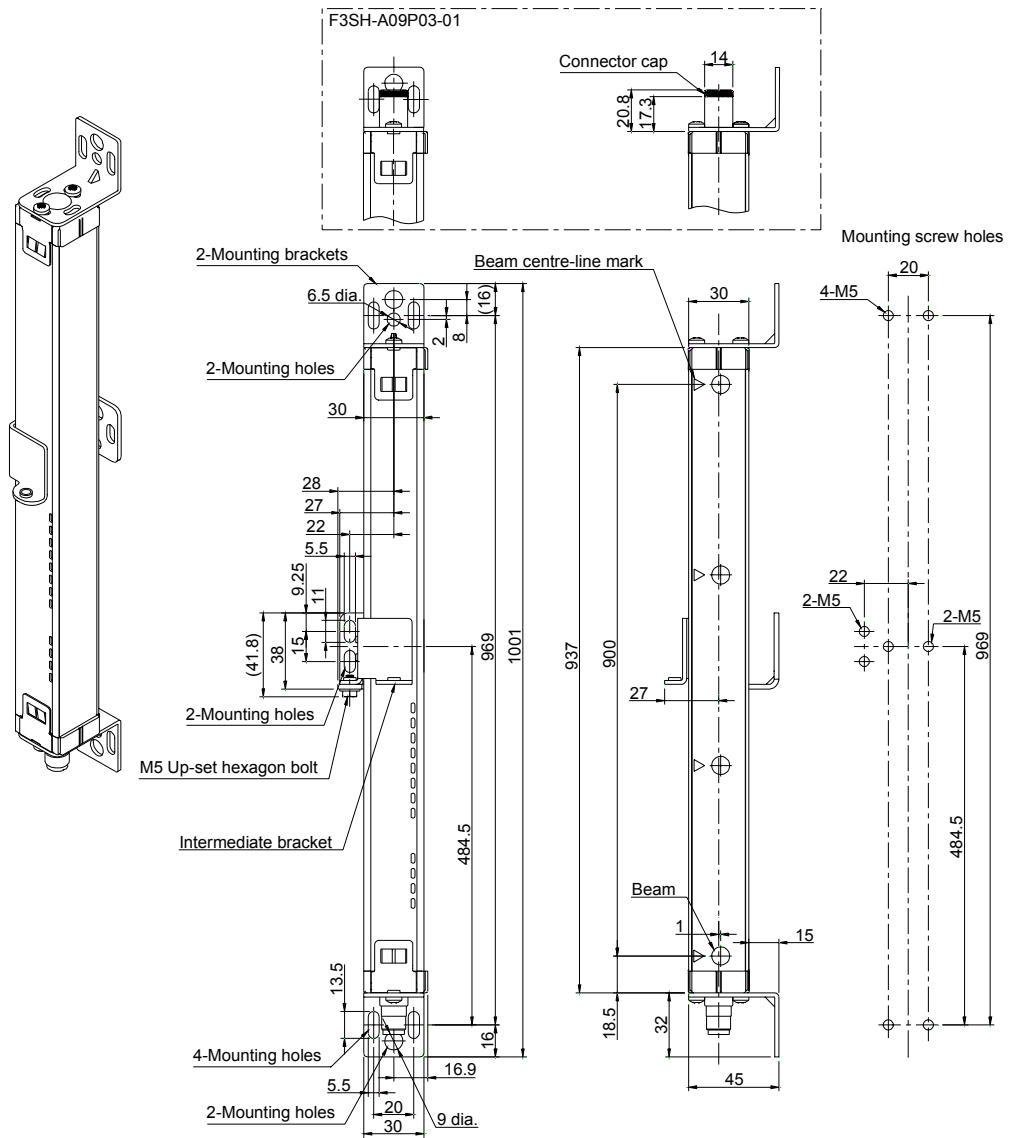
- Install the sensors facing away from the one another to eliminate mutual interference.



Distance between emitter and receiver (Operating range L)	Minimum installation distance D
0.2 to 3m	0.26m
over 3m	$L \times \tan 5^\circ =$ $L \times 0.088$ (m)

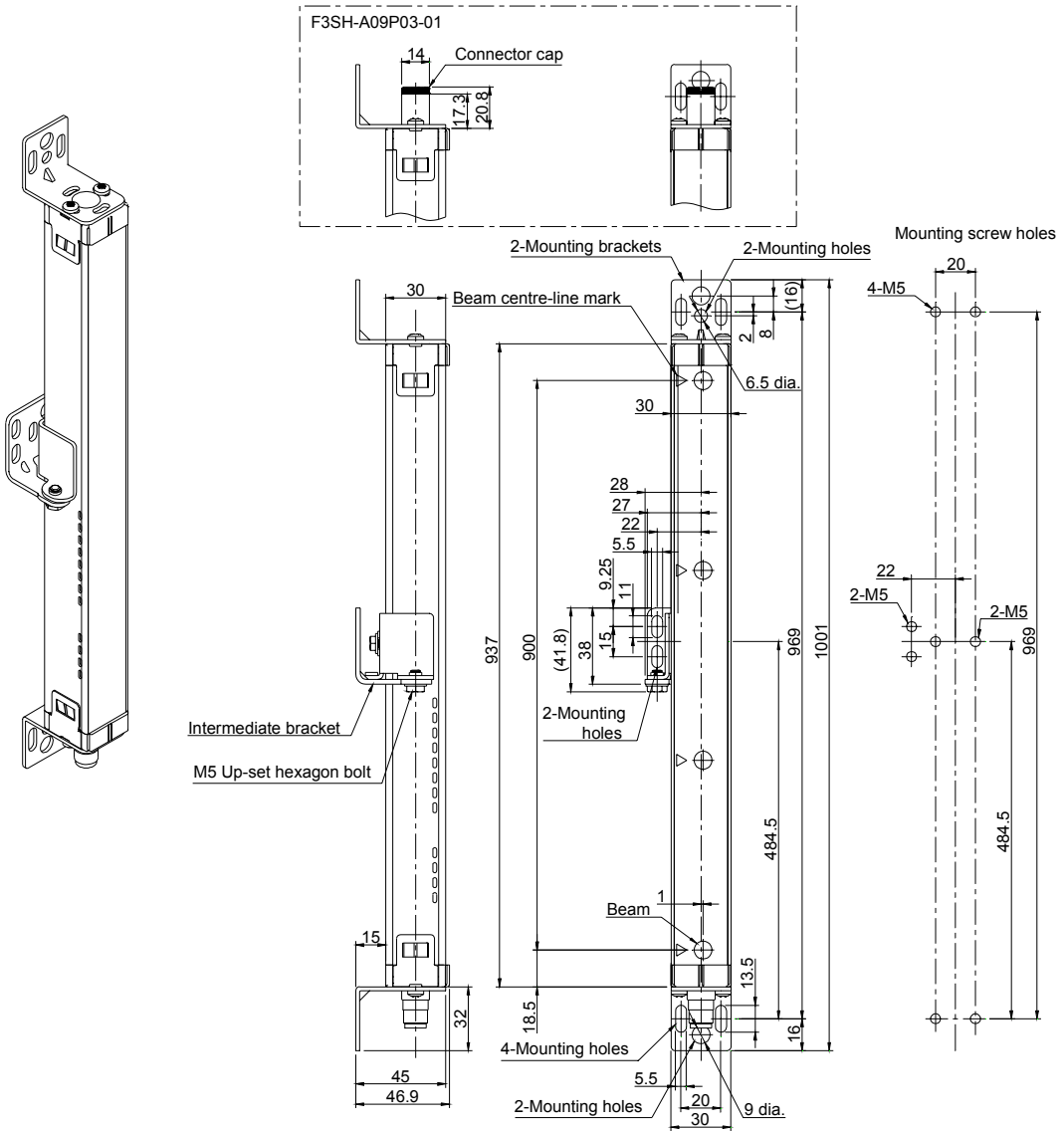
2-2 Dimensional Drawings

- Side mounting (e.g.: emitter)



Section 2 Wiring and Mounting

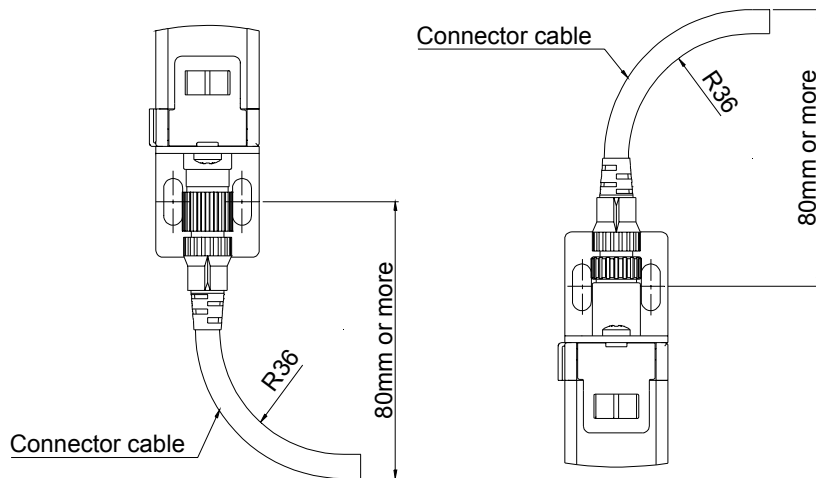
- Rear mounting (e.g.: emitter)



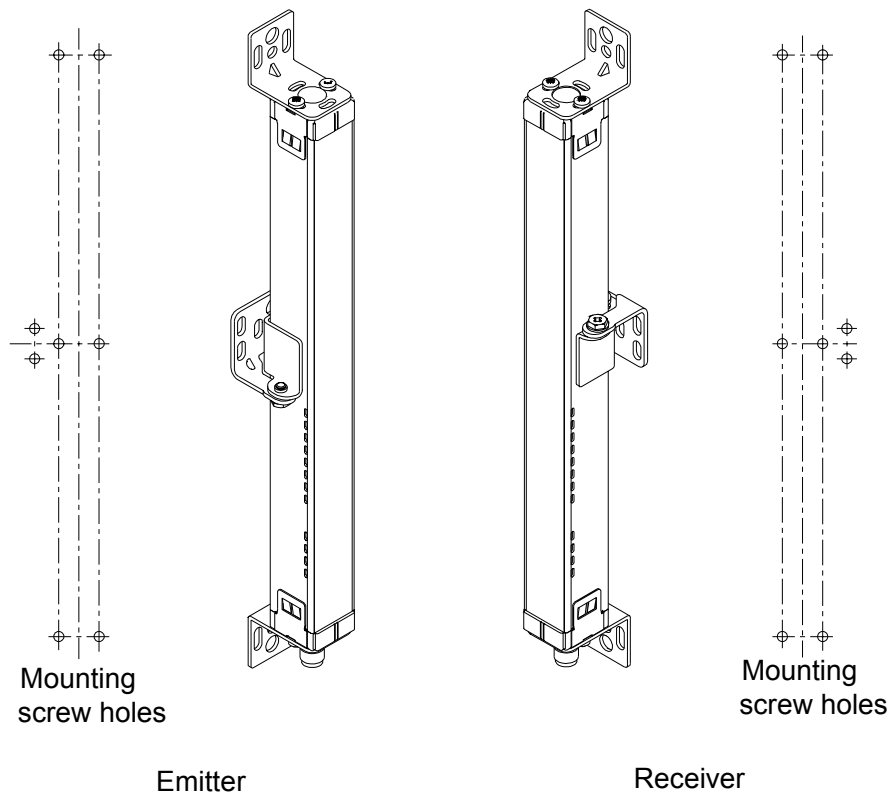
2-3 Mounting

2-3-1 How to Mount the Unit

- Be sure to have a bend radius of the F3SH-A cable of R36 (mm) or more. Eventual failure of the cable may result.



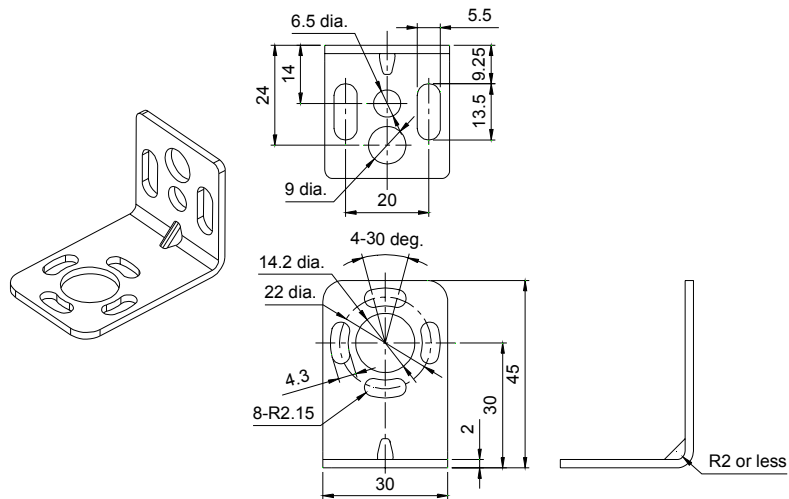
- Shown below with mounting brackets for the emitter and receiver attached. Also shown is how to assemble intermediate mounting bracket and positions where screw holes can be drilled to mount the brackets.



Section 2 Wiring and Mounting

2-3-2 Dimensional Drawing of the Mounting Bracket

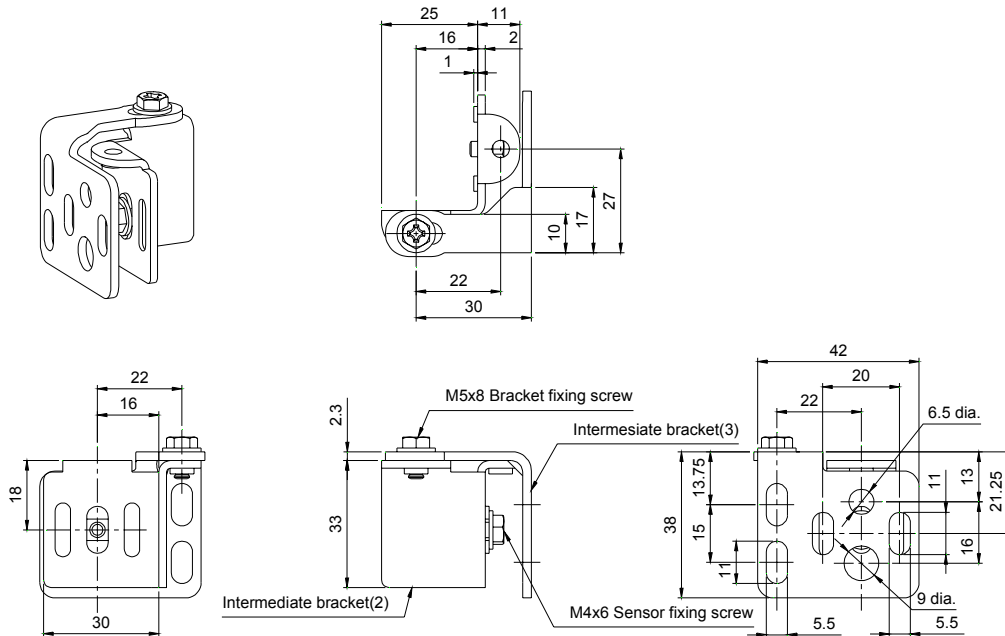
- Mounting bracket (top and bottom)



Material: Carbon steel

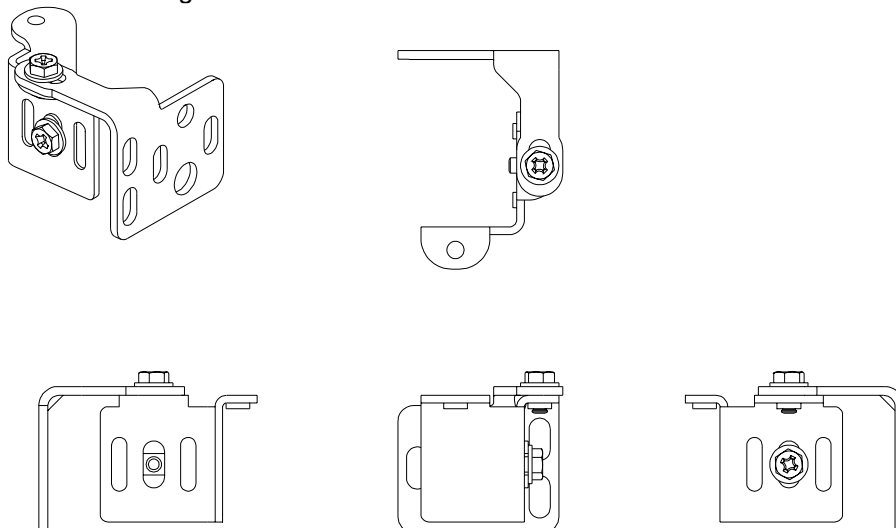
- Mounting bracket (intermediate)

Configuration for rear mounting



Material: Carbon steel

Configuration for side mounting



Section 2 Wiring and Mounting

Setup procedure when the supplied mounting brackets are used

- I. Secure the bottom bracket (power connector side) on a wall or column.
- II. Secure the intermediate bracket (3) on a wall or column.

[Note]: The intermediate bracket(3) of the receiver is mounted upside down compared with that of the emitter.

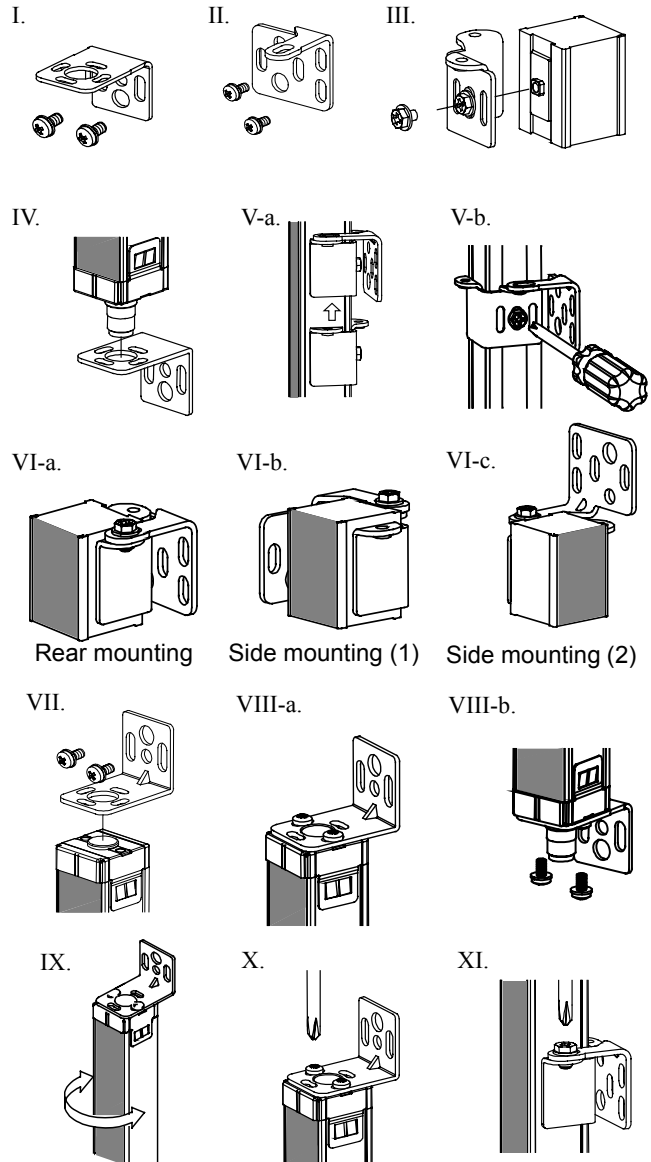
- III. Align the intermediate bracket (2) with the protrusion of intermediate bracket (1) located on the rear side of the sensor, and temporarily tighten the supplied screw (M4x6).

[Note]: Mount the intermediate bracket (2) so that its direction is the same as that of the intermediate bracket (3).

- IV. Insert the cable connector of the sensor into the bottom bracket.
- V. Move the intermediate bracket (2) until its height is aligned with that of the intermediate bracket (3)(V-a), securely tighten the screw (M4x6)(V-b).

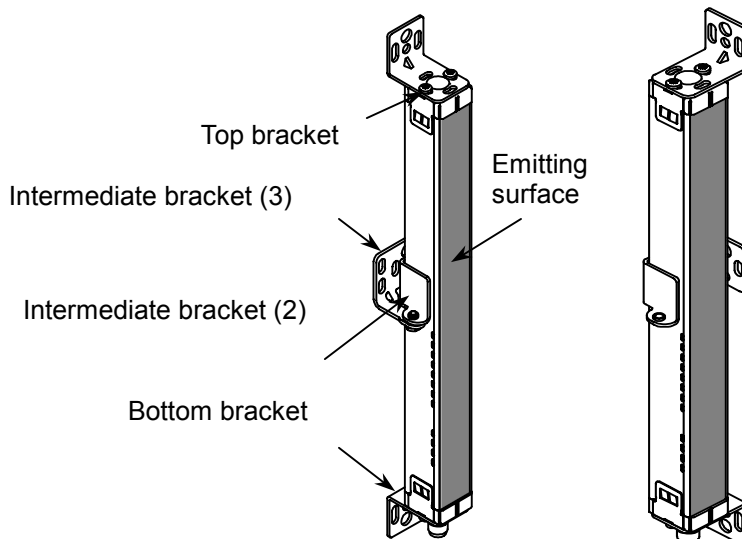
[Note]: Be sure to perform this step prior to mounting the top bracket (cap side).

- VI. After having aligned the intermediate bracket (2) with the intermediate bracket (3) in the direction of mounting the sensor, temporarily tighten the supplied screw (M5x8). Intermediate brackets (2) and (3) are assembled in the following three ways; VI-a, VI-b, VI-c.
- VII. Align the top bracket (cap side) with the round hole on the cap, and secure it on a wall or column.
- VIII. Insert two supplied screws (M4x8) into both top and bottom brackets, and temporary tighten them (VIII-a, VIII-b). (The figure shown below describes the side mounting.)
- IX. Adjust the torsion angle of the sensor in the point where the five light receiving level indicators are lit.
- X. Securely tighten the bottom and top brackets.
- XI. Then, securely tighten the intermediate brackets. The procedure to mount the sensor is now complete.



[Rear mounting]

[Side mounting]



Section 2 Wiring and Mounting

2-4 Wiring



WARNING

Do not short-circuit the outputs to the +24V. Doing so will cause the output to be always ON, creating a hazardous situation. Connect the 0V line of the power supply directly to protective earth to prevent the earth fault. Otherwise the earth fault causes the outputs to be ON.

Connect loads between the output and 0V line. (PNP output)

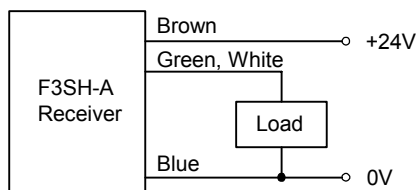
Connecting loads between the output and +24V line will reverse the operation mode and the machine will be ON when it is light-interrupted.

Always use the two OSSD outputs to configure the safety system.

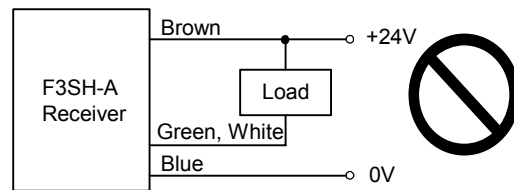
Using only one OSSD of the safety system may result in serious injury when there is an output circuit failure.

Do not connect any of the F3SH-A lines to a DC power supply with more than 24VDC+10% or to an AC power supply to avoid the danger of electric shock.

(Correct)



(Incorrect)



2-4-1 Power Supply Units



WARNING

DC power supply units must satisfy all of the conditions so that the F3SH-A can comply with the applicable standards IEC 61496-1, and UL 508.

- The power supply voltage must be within specified ratings (24 VDC \pm 10 %).
- The power supply is connected only to the F3SH-A and to the devices related to the electro-sensitive protective function of the F3SH-A, such as a safety controller and muting sensors, and it has enough rated current for all the devices. The power supply must not be connected to other devices or machines.
- The power supply uses double or reinforced insulation between the primary and secondary circuits
- The power supply automatically resets overcurrent protection characteristics (voltage drop).
- The power supply maintains an output holding time of at least 20 ms.
- The power supply must have output characteristics of Class 2 Circuit of Limited Voltage-Current Circuit as defined in UL508 (see "Remark").
- The power supply must conform to regulatory requirements and standards, regarding EMC and electrical equipment safety, of the country where the F3SH-A is installed and where machinery will be operated. Example: The EMC Directive (industrial environment) and the Low Voltage Directive in EU.

FG (frame ground terminal) must be connected to PE (protective earth) when using a commercially available switching regulator.

[Remark] The power supply must conform to the following requirement (1) or (2) regarding a secondary circuit, in accordance with UL 508, to avoid a fire.

- 1) The power supply includes a limited voltage/current circuit supplied by an isolating source like the secondary winding of an isolating type transformer. And, in the limited voltage/current circuit,
 - the current available is limited to a value not exceeding 8 A (including the case of short-circuit), or
 - a secondary fuse or other such secondary circuit protective device used to limit the available current shall be rated at not more than a value 4.2 amperes (for the power supply voltage of 24VDC)

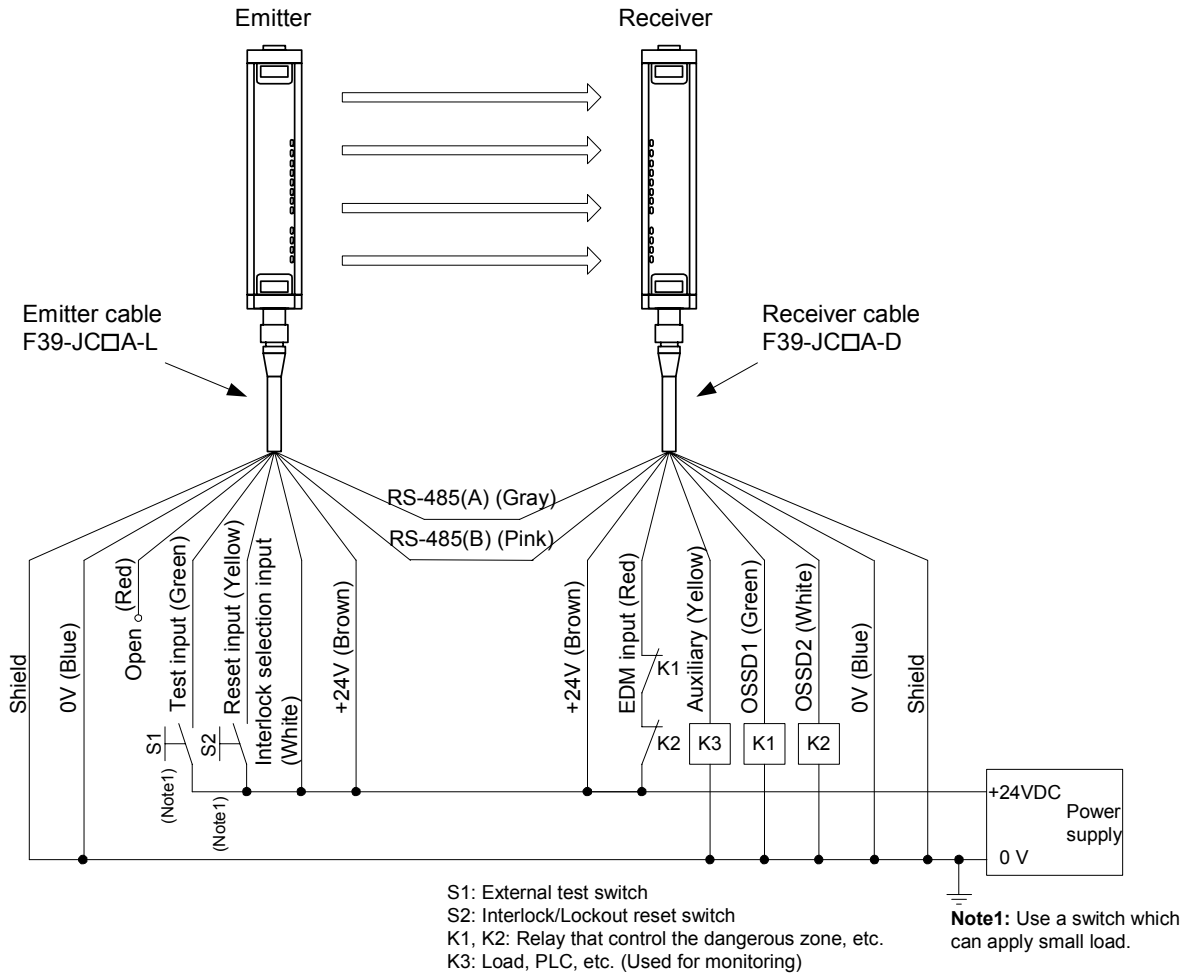
Recommended power supply: S82K (15 W, 30 W, 50 W, 90 W type) made by OMRON.
Certificate of UL Listing (UL508, Class2 Output) and CE Marked (EMC and Low Voltage Directives).

- 2) The power supply includes a Class 2 circuit supplied by an isolating source that complies with the requirement in the Standard for Class 2 Power Units, UL 1310, or the requirements in the Standard for Class 2 and Class 3 Transformers, UL 1585.

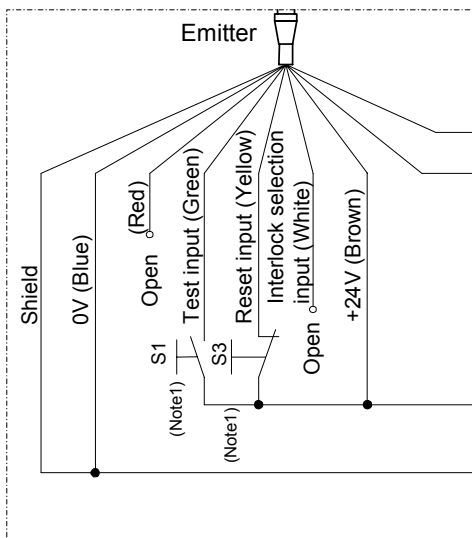
2-4-2 Wiring Diagram

- Sensor only

Wiring for the Manual reset mode and the EDM function



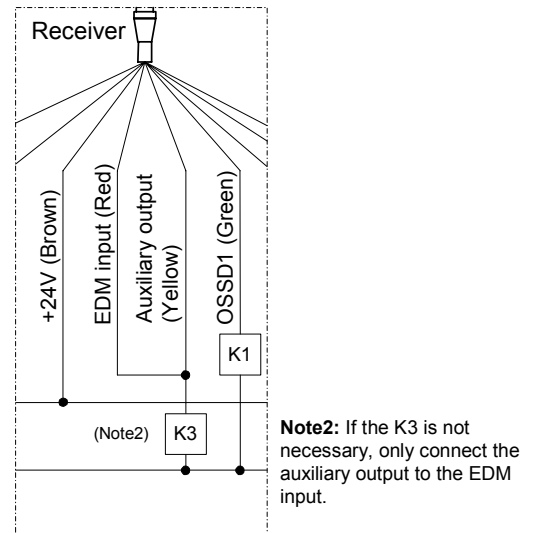
Wiring for the Auto reset mode



Wiring when the EDM is not used

When the EDM is not necessary

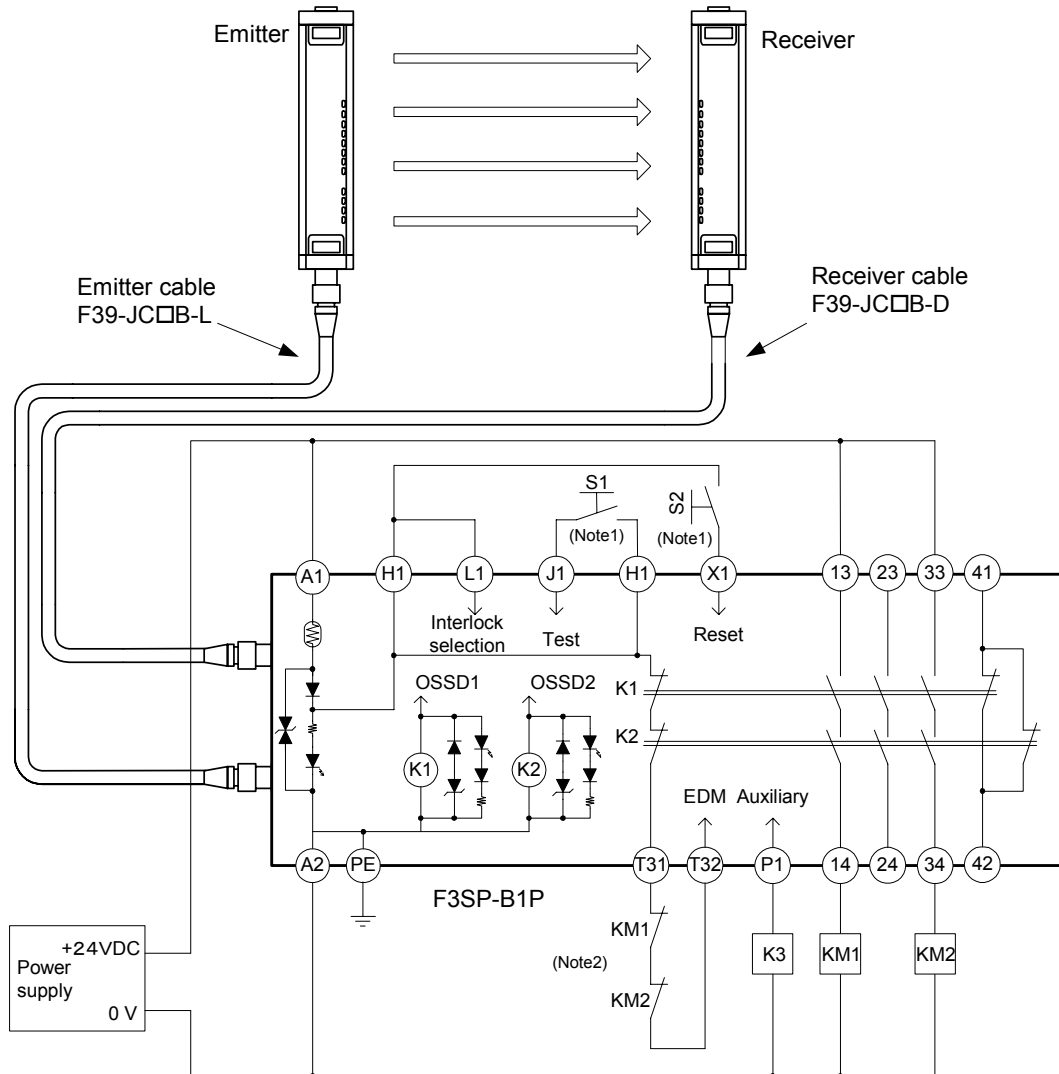
- 1) Use the F39-MC11 to disable the EDM, or
- 2) If the auxiliary output is in the "Dark-ON output mode", wire the lines as shown in the figure below to disable the EDM.



Section 2 Wiring and Mounting

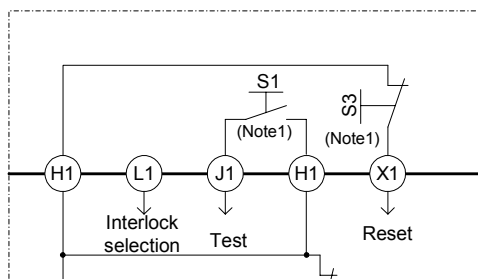
● Combination with the F3SP-B1P

Wiring for the Manual reset mode and the EDM function



S1: External test switch
 S2: Interlock/Lockout reset switch
 KM1, KM2: Relay that control the dangerous zone, etc.
 K3: Load, PLC, etc. (Used for monitoring)

Wiring for the Auto reset mode



S3: Lockout reset switch
 (If the switch is not necessary, connect between X1 and H1.)

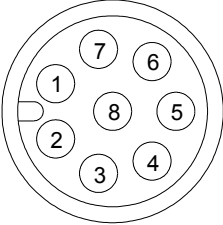
Note1: Use a switch which can apply small load.
Note2: If the EDM is not necessary, short-circuit T31 and T32.

2-4-3 Wiring Procedures

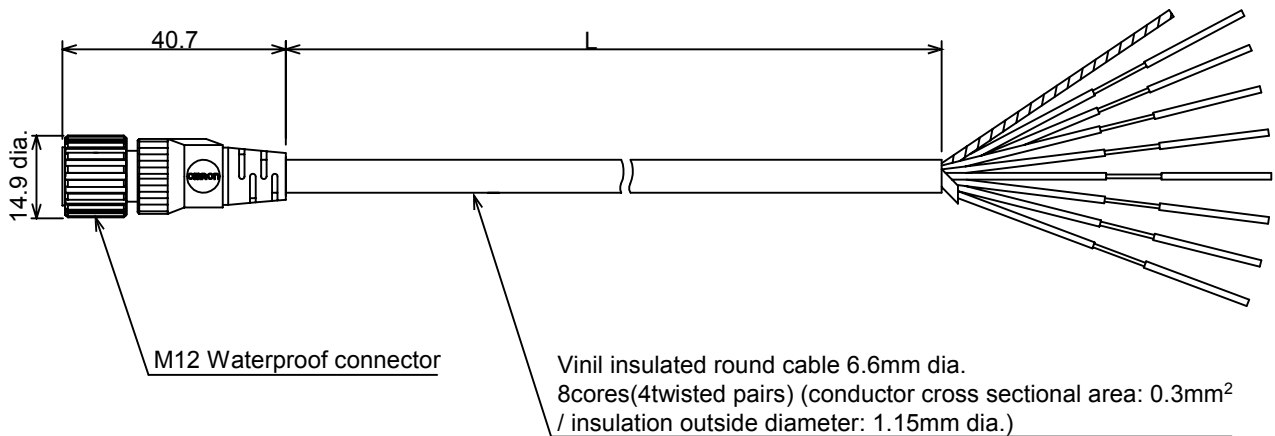
1. Connect the emitter cable (F39-JC□□-L optional, gray color outer jacket) to the emitter.
2. Connect the receiver cable (F39-JC□□-D optional, black color outer jacket) to the receiver.
3. Connect the 0V line of the power supply directly to protective earth (PE).

[Note]: Be sure to wire correctly. Failure to do so may damage the F3SH-A. Confirm the color of cables and outer jackets (emitter: gray, receiver: black). Matching colors prevents incorrect wiring.

● Connector (Main Unit End)

Front View	Pin No.	Signal Name		Wire Color of Optional Cable
		Receiver	Emitter	
	1	OSSD 2	Interlock selection input (INTERLOCK)	White
	2	+24 VDC (24VDC)	+24 VDC (24VDC)	Brown
	3	OSSD 1	Test input	Green
	4	Auxiliary output	Reset input (RESET)	Yellow
	5	RS-485 (A)	RS-485 (A)	Gray
	6	RS-485 (B)	RS-485 (B)	Pink
	7	0 V	0 V	Blue
	8	EDM input	N.C.	Red

● Single-ended connector cable (F39-JC□A Optional)

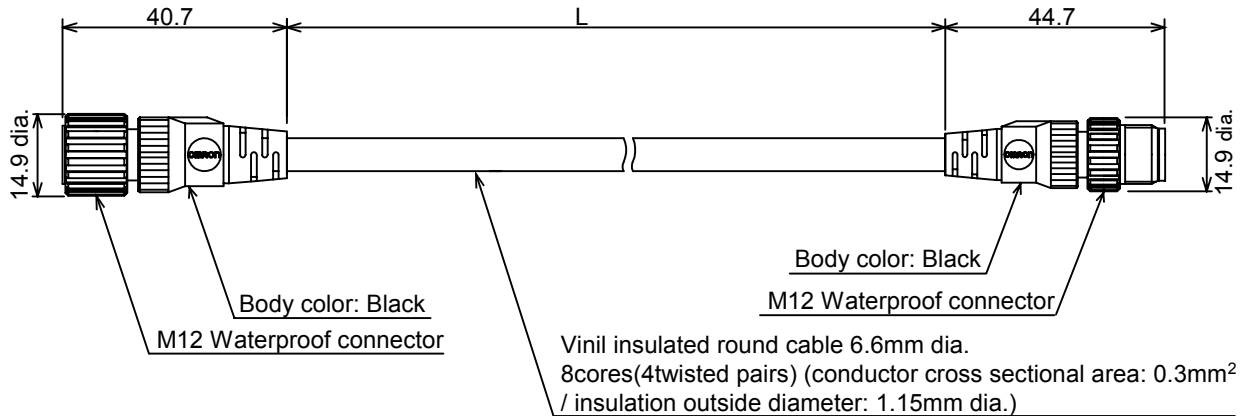


Unit: mm

Type (set name)	For Emitter		For Receiver		L
F39-JC3A	F39-JC3A-L	Gray outer jacket color	F39-JC3A-D	Black outer jacket color	3000
F39-JC7A	F39-JC7A-L		F39-JC7A-D		7000
F39-JC10A	F39-JC10A-L		F39-JC10A-D		10000
F39-JC15A	F39-JC15A-L		F39-JC15A-D		15000

Section 2 Wiring and Mounting

- Double-ended connector cable for Series Connection and Connection to the F3SP-B1P (F39-JC□B Optional)

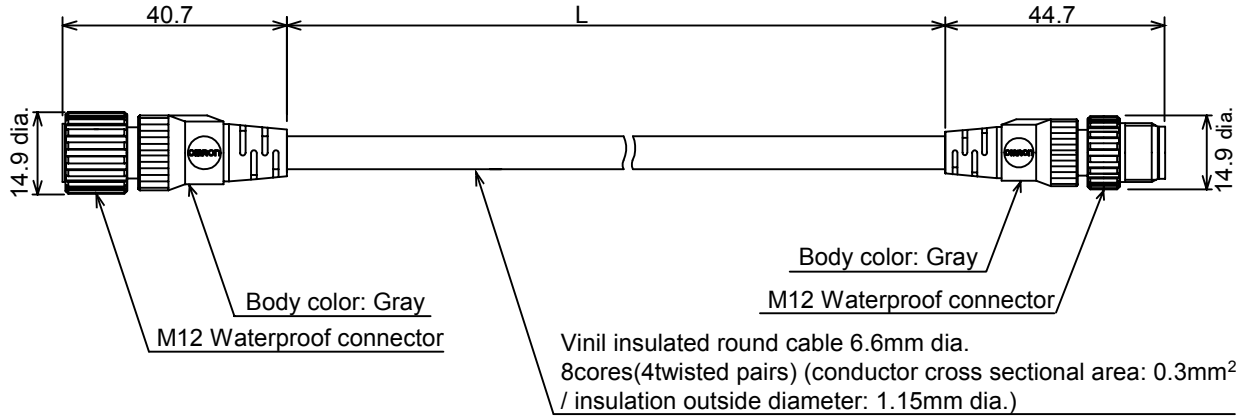


Unit: mm

Type (set name)	For Emitter		For Receiver		L	
F39-JCR2B	F39-JCR2B-L	Gray outer jacket color	F39-JCR2B-D	Black outer jacket color	200	
F39-JC1B	F39-JC1B-L		F39-JC1B-D		1000	
F39-JC3B	F39-JC3B-L		F39-JC3B-D		3000	
F39-JC7B	F39-JC7B-L		F39-JC7B-D		7000	Note
F39-JC10B	F39-JC10B-L		F39-JC10B-D		10000	Note
F39-JC15B	F39-JC15B-L		F39-JC15B-D		15000	Note

[Note]: Can not use for series connection.

- Double-ended connector cable for Connection to the G9SA-300-SC (F39-JC□C Optional)



Unit: mm

Type (set name)	For Emitter		For Receiver		L	
F39-JCR2C	F39-JCR2C-L	Gray outer jacket color	F39-JCR2C-D	Black outer jacket color	200	Note
F39-JC1C	F39-JC1C-L		F39-JC1C-D		1000	Note
F39-JC3C	F39-JC3C-L		F39-JC3C-D		3000	Note
F39-JC7C	F39-JC7C-L		F39-JC7C-D		7000	Note
F39-JC10C	F39-JC10C-L		F39-JC10C-D		10000	Note
F39-JC15C	F39-JC15C-L		F39-JC15C-D		15000	Note

[Note]: Do not use for series connection.

2-4-4 Adjustment Procedures

[Procedures]

1. Ensure the following points.

- The optical surfaces of the emitter and receiver are clean.
- There should be no light-interrupting objects in the F3SH-A detection zone.

2. Adjust the beams of the emitter.

Adjust the torsion angle of the emitter while monitoring the light intensity level indicators and locate the emitter in the point where the light intensity level indicators are lit.

3. Adjust the receiver.

Adjust the torsion angle of the receiver while monitoring the light intensity level indicators and locate the receiver in the point where the light intensity level indicators are lit.

4. Confirm all the light intensity level indicators are lit.

5. When the above adjustments have been completed, tighten all brackets and mounting screws while being careful not to change the beam adjustment for the sensor.

Mounting bracket type	Screw designation and length (mm)	Tightening torque
Mounting bracket (Top and bottom)	M4×8	1.2 N·m
Mounting bracket (Intermediate)	M4×6	1.2 N·m
	M5×8	2.0 N·m

6. If all of the light intensity level indicators are not lit through the above angle adjustment of the receiver, check for parallelism between the emitter mounting surface and the receiver mounting surface and also check if the emitter and receiver are mounted to the same height.

2-5 Check List

A person in charge should check the following check boxes.

Check the following items to make sure the installation is correct.

1. Machine structure does not hinder stop and other safety functions.
2. Intrusion into a hazardous part of the machine is not possible without passing through the F3SH-A detection zone.
3. If an operator can enter into the area between the F3SH-A and a hazardous part of a machine, the system is configured to prevent a machine from automatically starting to operate.
4. The switch to reset the interlock condition has to be installed so that the entire hazardous area is visibly free and the switch can not be operated from within the hazardous area.
5. The safety distance has been calculated. Calculated distance: $S = (\quad)$ mm
6. The actual safety distance is greater than the calculated distance. Actual distance = (\quad) mm
7. Reflective surfaces are not installed in prohibited areas.

Check the following items to make sure wiring is correct before turning ON power.

1. The power supply is connected only to the F3SH-A and to the devices related to the electro-sensitive protective function of the F3SH-A, such as a safety controller and muting sensors, and it has enough rated current for all the devices.
2. The power supply unit is a 24 VDC unit that conforms to the EMC Directive, Low-voltage Directive, and output holding specifications.
3. The polarity of the power supply connection is not reversed.
4. The emitter cable is properly connected to the emitter and the receiver cable is properly connected to the receiver.

Section 2 Wiring and Mounting

5. Double insulation is used between I/O lines and the hazard potential (commercial power supplies, etc.).
6. Outputs are not shorted to the +24V line.
7. Loads are not connected to the +24V line.
8. No lines are connected to a commercial supply line.
9. When two or more units are used, they are connected or installed properly to prevent mutual interference.

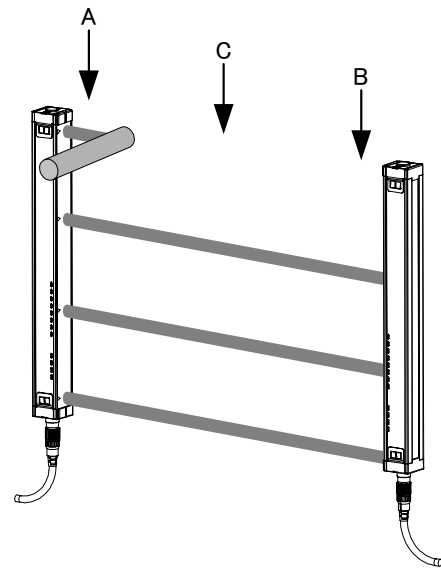
Check the F3SH-A operations with the machine stopped.

1. Prepare a detected material for inspection (non-transparent rod or plate) with a width of 14 mm or more.
2. Nothing is present in the detection zone.
The power indicator and all of the light intensity level indicators are lit within one second after the F3SH-A is turned ON.

3. When a detected material for inspection is inserted along the beam centre-line marks (Δ mark) so as to interrupt beams, the sensor enters the light interrupted condition (all the light incident level indicators go off and the OFF-state indicator remains lit as long as the detected material for inspection is present in the detection zone).

Detection checkpoints are:

- Directly in front of the emitter (A)
- Directly in front of the receiver (B)
- Midway between the emitter and receiver (C)

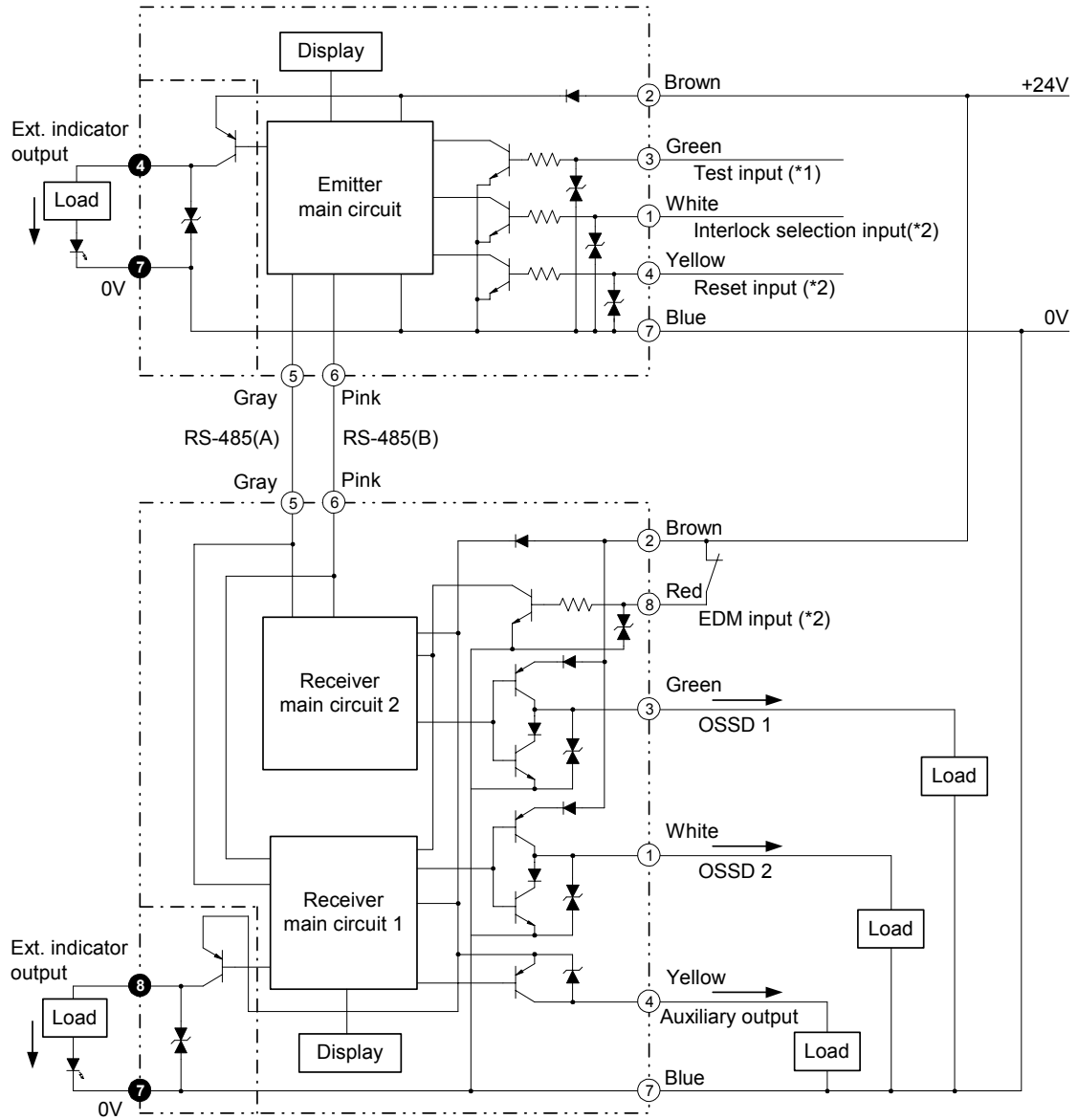


4. In case the external test function is used:
When the test input line is short-circuited to the 9 to 24VDC line, the OFF-state indicator is lit.
5. In case the EDM function is used:
When the sensor is interrupted and the EDM input line becomes open, the sensor enters the lockout condition.
6. In case the start interlock function is used:
Even if the sensor receives light after turning power ON, the OFF-state indicator remains lit. If the reset input is applied, the ON-state indicator is lit.
7. In case the restart interlock function is used:
When the sensor is interrupted, then go back to the light receiving condition, the OFF-state indicator remains lit. If the reset input is applied, the ON-state indicator is lit.

Operate the machine and check to see if a hazardous part stops under the conditions below.

1. The dangerous part stops immediately when each beam is interrupted by the detected material for inspection in the detection zone at 3 points: directly in front of the emitter, directly in front of the receiver, midway between the emitter and receiver.
2. The hazardous part remains stopped as long as the detected material for inspection interrupts the beam.
3. The hazardous part stops when the F3SH-A power supply is turned OFF.
4. The overall measured machine response time is less than the calculated time.

Section 3 I/O Circuit



- *1. Open: normal light emission, Short to the +24VDC: Stops light emission
- *2. Refer to 2-4-2 Wiring Diagram
- *3. The section encircled with the dashed line is applied for F3SH-A09P03-01 only.

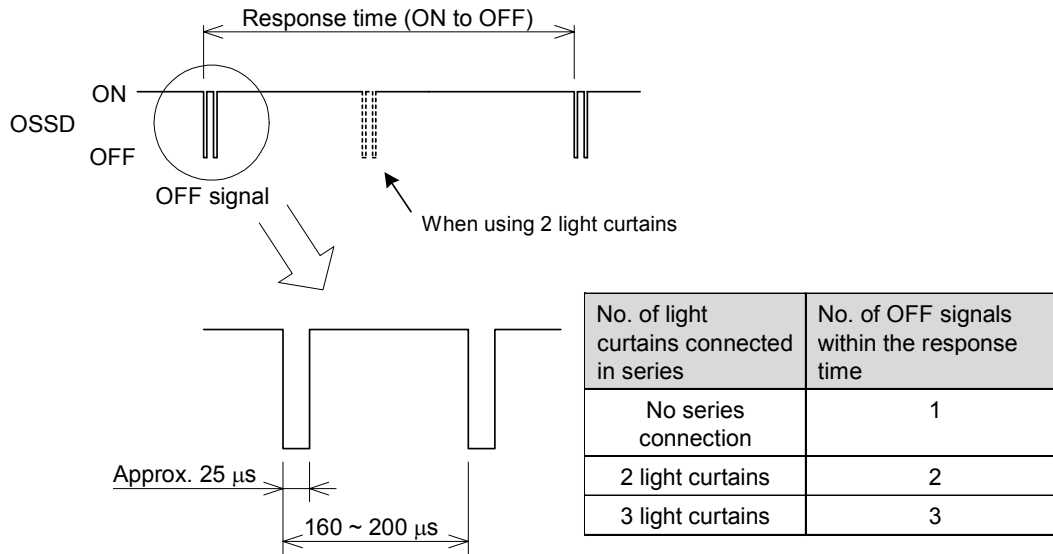
[Note]: The numbers in ○ indicate pin numbers of the connectors.
 The numbers in ● indicate pin numbers of the series connection connectors.

Section 3 I/O Circuit

Output Waveform of the OSSD outputs

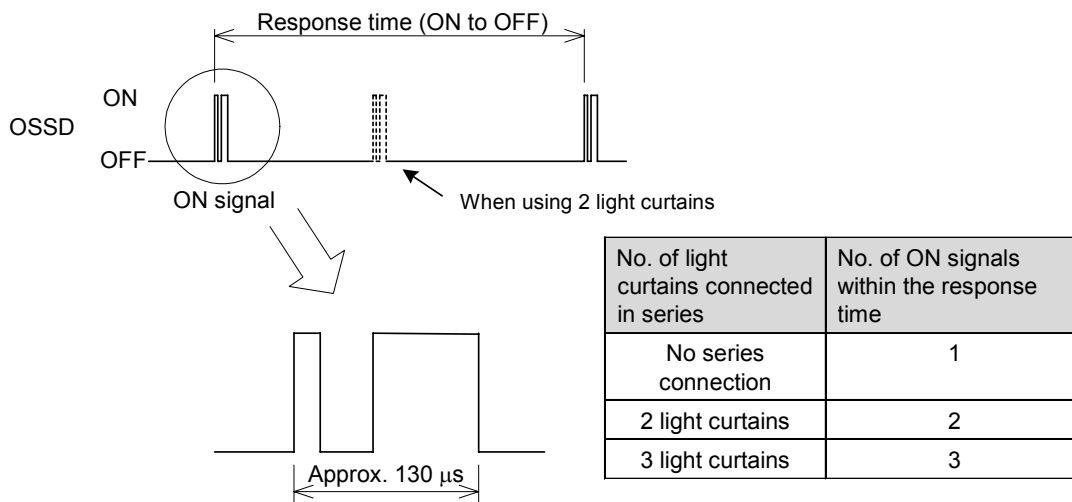
The OSSD outputs will be OFF as shown in the following figure in order to perform the OSSD circuit self-test when the sensor is in the ON-state. The OSSD circuit diagnosis is correct when this OFF signal is fed back. If the output signal does not contain an OFF signal, the receiver determines that there is an output circuit or wiring failure and goes into the lockout condition.

The number of OFF signals depends on the number of sensors connected in series. (See the table below.)



In the same way, the OSSD outputs will be ON as shown in the following figure, to perform the OSSD circuit self-test when the sensor is in the OFF-state.

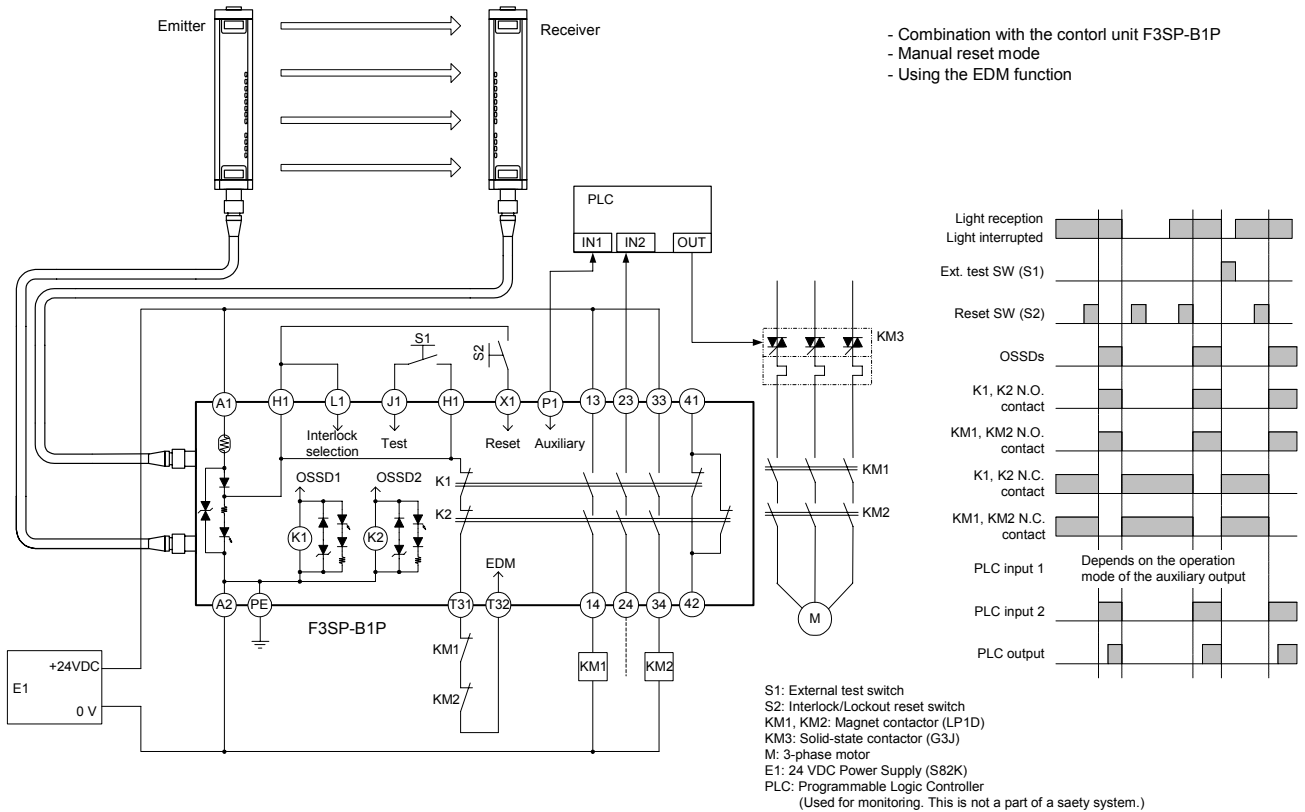
Check the input response time of a machine connected to the F3SH-A carefully to ensure the machine will not malfunction due to the OFF signal.



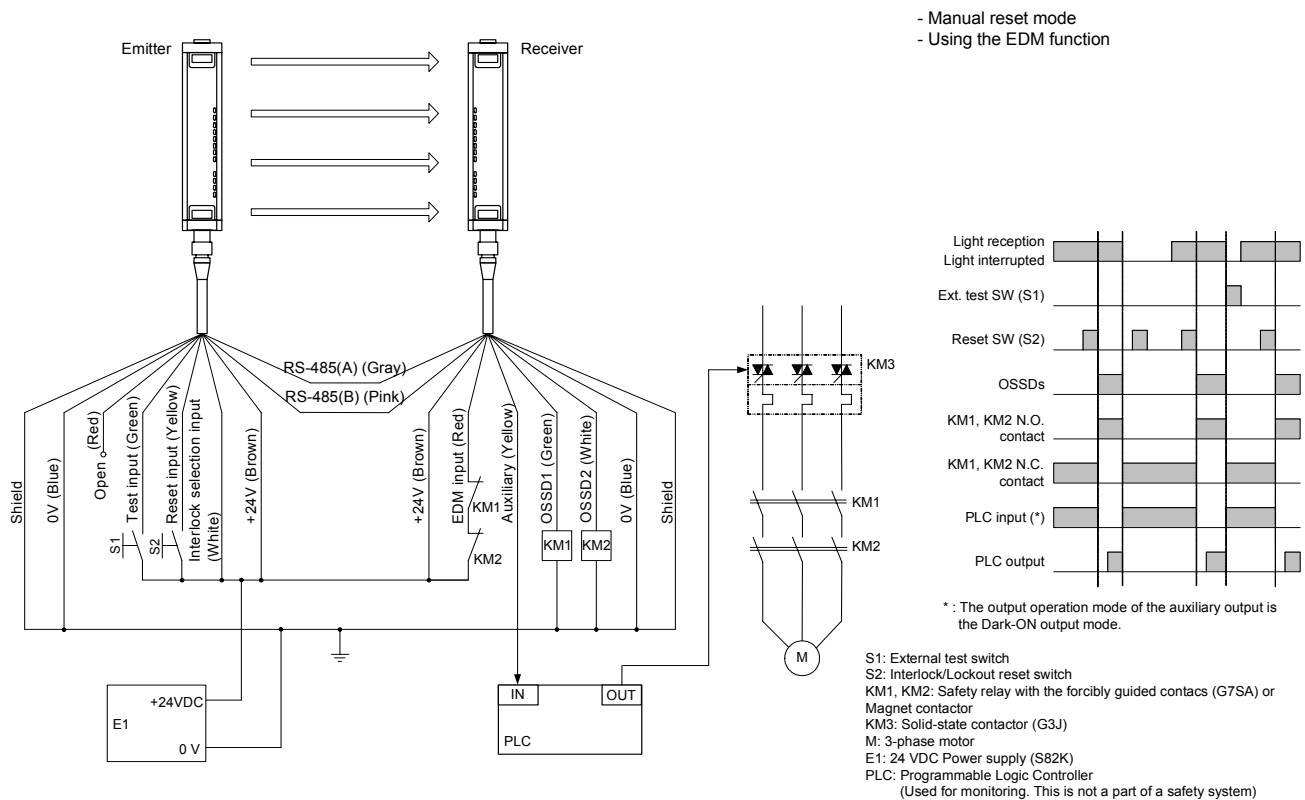
Section 4 Application

This section shows examples of a motor control system that combines an F3SH-A. These are category 4 systems (EN954-1 provision).

● Application 1

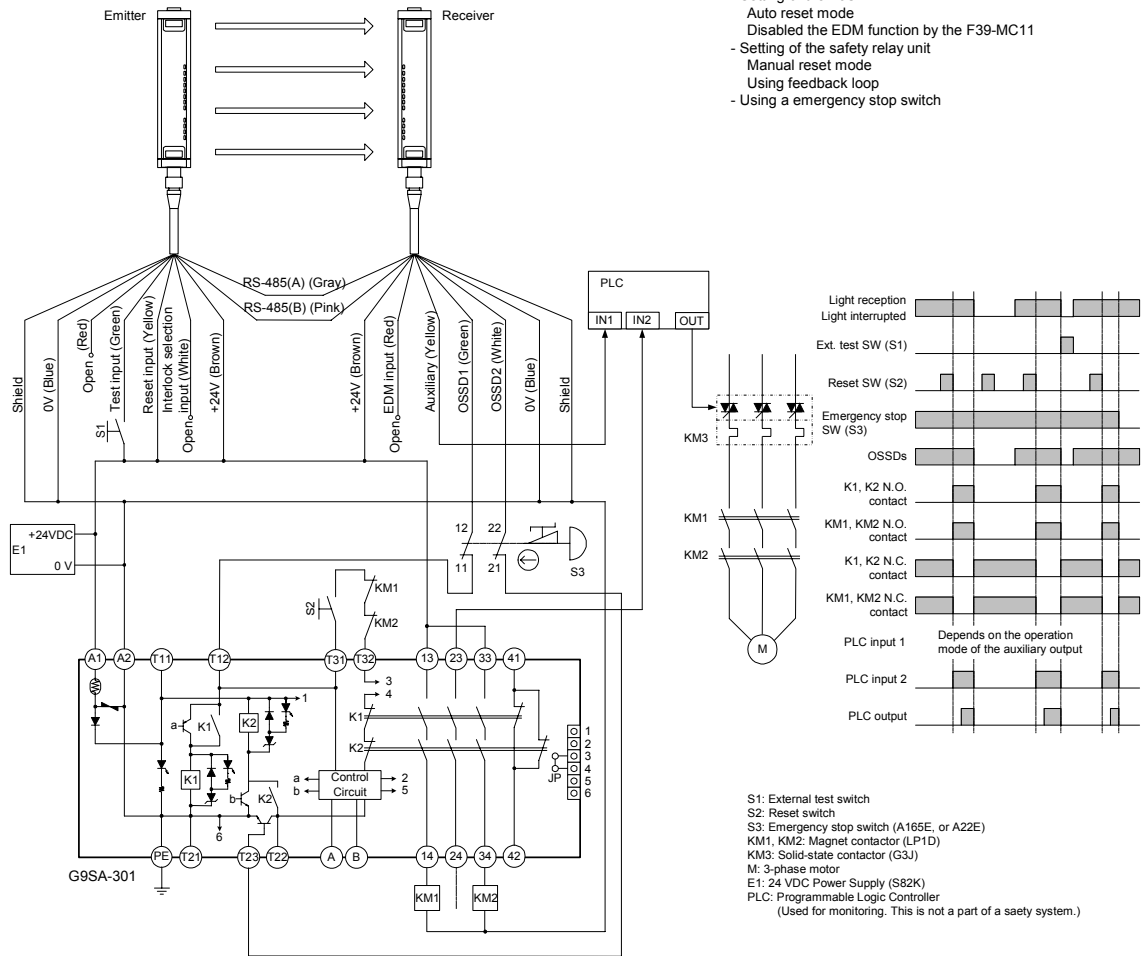


● Application 2

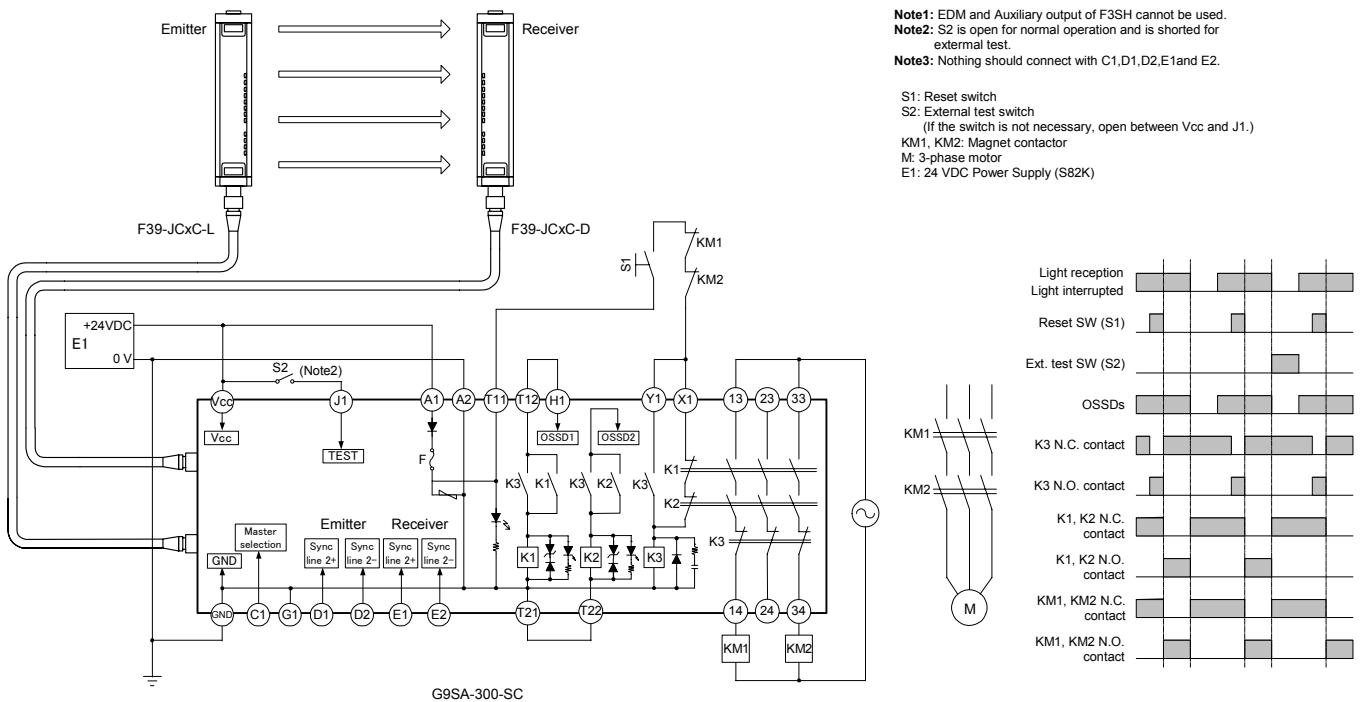


Section 4 Application

● Application 3



● Application 4



Section 5 Maintenance



WARNING

Do not use the F3SH-A until the following inspections are completed. Failure to do so may result in loss of life or serious injury.

Do not disassemble, repair or modify the F3SH-A.

[Note]: For safety, be sure to record and store inspection results.

Make sure you are thoroughly familiar with the F3SH-A and the machine prior to conduction an inspection.

If the installer, design technician and user are different individuals, make sure the user has adequate guidelines for performing maintenance.

5-1 Daily Inspections

Be sure to inspect the following items at the start of work or after a shift change.

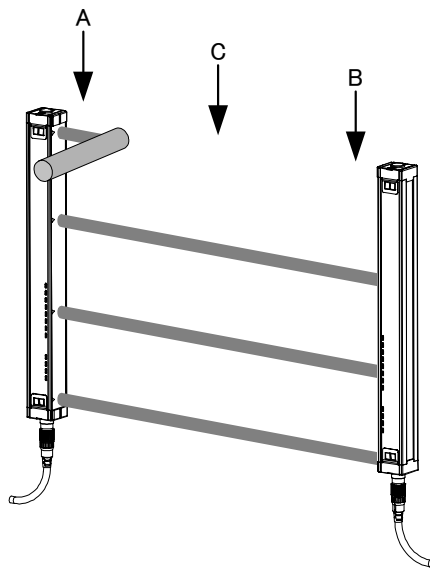
1. No instruction paths into dangerous machine parts expect through the F3SH-A detection zone.
2. If an operator can enter into the area between the F3SH-A and a hazardous part of a machine, the system is configured to prevent a machine from automatically starting to operate.
3. The actual safety distance is greater than the calculated distance.
4. No dirt or scratches on the optical surface or the spatter protection cover (the F39-HH, optional) of the F3SH-A.
5. A detected material for inspection is not deformed.
6. Confirm nothing is present in the detection zone, then turn on the power of F3SH-A.

When the start interlock is not used: The power indicator and the ON-state indicator are lit within one second after turning ON the power.

When the start interlock is used: The power indicator and the OFF-state indicator are lit within one second after turning ON the power.

7. The detected material for inspection can be detected directly in front of the emitter (A), directly in front of the receiver (B) and midway between the emitter and receiver (C).

When a detected material for inspection is inserted along the beam centre-line marks (Δ mark) so as to interrupt beams, the sensor enters the light interrupted condition (all the light intensity level indicators go off and the OFF-state indicator remains lit as long as the detected material for inspection is present in the detection zone).



Operate the machine and check to see if the dangerous part stops under the conditions below.

8. The dangerous part moves when there is nothing in the detection zone.
9. The dangerous part stops immediately when each beam is interrupted by the detected material for inspection in the detection zone at 3 points: Directly in front of the emitter, Directly in front of the receiver, Midway between the emitter and receiver.

Section 5 Maintenance

- 10. The dangerous part remains stopped as long as the detected material for inspection interrupts the beam.
- 11. The dangerous part remains stopped when the F3SH-A power supply is turned OFF.

5-2 Inspections Every Six Months

Inspect the following items every six months or when a machine setting is changed.

- 1. Machine structure does not hinder stop and other safety functions.
- 2. There is no machine modification or connection change that will adversely affect the control system.
- 3. F3SH-A outputs are correctly wired to the machine.
- 4. The actual overall response time of the machine is less than the calculated response time.
- 5. The control relay and/or contactor are good condition.
- 6. The screws for brackets are secured tightly.
- 7. There is no interference light.






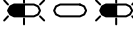

Section 6 Troubleshooting



6-1 Lockout condition

When the sensor enters the lockout condition, the error content will be displayed by a flashing pattern of the Error mode indicator.

Devise a countermeasure in accordance with the following table.

[Note]: For some error conditions, either only the emitter or receiver will flash.

Error mode indicator	Cause		Remedy
A B C 	Wiring error for interlock function setting	1) The reset input line and the interlock selection input line are not wired correctly. 2) The interlock selection input line became open or shorted during power-on.	1)-2) Confirms the wiring for the auto reset mode or the manual reset mode.
A B C 	Error of the EDM function	1) One of the external relay contacts is welded. 2) The EDM input line is not wired correctly to the external relays. 3) The setting value of relay monitoring time is lower than the relay response time. 4) In the case of connecting the EDM input line to the auxiliary output line in order to make the EDM function inactive, lines are open or shorted to the 0 V line.	1) Replace the relay. 2) Check connection of the relay monitoring input line. 3) Replace with a relay of proper release time, or change the setting value of the relay monitoring time by the F39-MC11. 4) Check the EDM input line and the auxiliary output line for error. Then, confirm that the operation mode for the auxiliary output is in the Dark-ON output mode.
A B C 	RS-485 communication line error	1) The RS-485 communication line is open or shorted to the other I/O line. 2) Communication error by noises. 3) When the sensors are connected in series, the connector of the series connection cable is disconnected. 4) Failure of the CPU.	1) Check connection of the RS-485 lines. 2) Check noise environment around the RS-485 communication lines. 3) Check the cable connection between the sensors connected in series. 4) Replace the sensor
A B C 	OSSD error	1) OSSD outputs are shorted together 2) At least one OSSD output is shorted to the +24V line, 0V line, or the other I/O line. 3) Failure of OSSD output circuit	1)-2) Rewire the OSSD outputs correctly. 3) Replace the receiver.
A B C 	Error by interference light	1) Interference light is received. 2) The emission light of the other photoelectric sensor is received.	1)-2) Interrupt the interference light. (Refer to 2-1-4)
A B C 	Incorrect configuration on the sensor connection	1) The number of the receiver connected in series is different from that of the emitter.	1) Correct the number of the sensor connected in series.
A B C 	Error by noises or Destruction of the sensor	1) Influenced by significant noise. 2) Internal hardware failure of the receiver or the emitter.	1) Check noise environment around the sensor. 2) Replace the receiver or the emitter.



 Flashing Not lit

Section 6 Troubleshooting

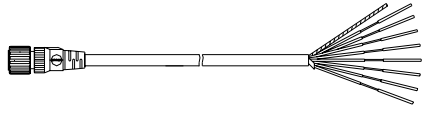
6-2 Other trouble

In case the sensor does not work, even if the lockout indicator and the error mode indicator are not flashing, devise a countermeasure in accordance with the following table.


Phenomenon	Cause	Remedy
The light intensity level indicator does not lit although any beams are not interrupted.	<ul style="list-style-type: none">1) RS-485 communication lines are not connected.2) RS-485 communication lines are influenced by significant noise.3) Auxiliary output is connected to + 24V line.	<ul style="list-style-type: none">1) Reconnect the RS-485 line correctly.2) Check noise environment around the RS-485 lines.3) Open the auxiliary output line, or connect to the 0V line via a load.

Section 7 Optional Accessory


- Single-ended connector cable (For emitter and for receiver, set of 2)

Appearance	Type	Length	Specification
	F39-JC3A	3m	M12 connector (8pins)
	F39-JC7A	7m	
	F39-JC10A	10m	
	F39-JC15A	15m	

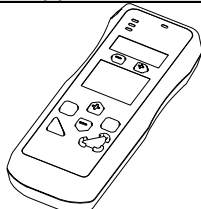
- Double-ended connector cable (For emitter and for receiver, set of 2)

Appearance	Type	Length	Specification
	F39-JCR2B	0.2m	M12 connector (8pins)
	F39-JC1B	1m	
	F39-JC3B	3m	
	F39-JC7B	7m	
	F39-JC10B	10m	
	F39-JC15B	15m	

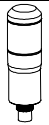
- Control unit

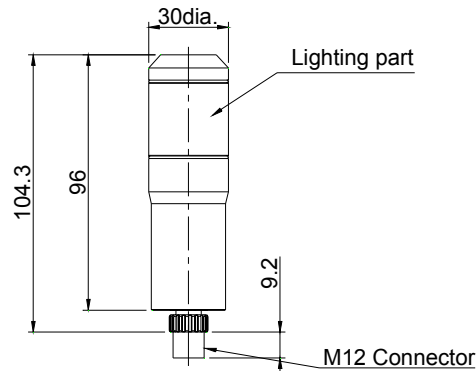
Appearance	Type	Output
	F3SP-B1P	Relay (3NO + 1NC)

- Setting console

Appearance	Type	Accessory
	F39-MC11	Branching connector, Connector cap, Cable

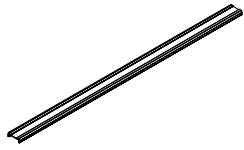
- External indicator *Series connection type is required for connection

Appearance	Type	Applicable sensor	Indicator color	Specification
	F39-A01PR-L	Emitter	Red	M12 connector
	F39-A01PG-L		Green	
	F39-A01PR-D	Receiver	Red	
	F39-A01PG-D		Green	



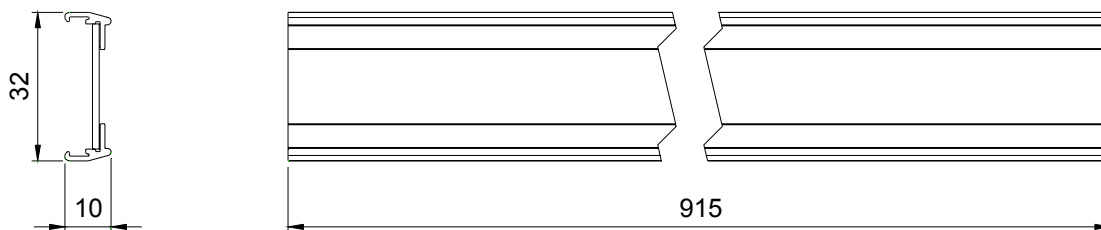
Section 7 Optional Accessory

- Spatter protection cover (for both emitter and receiver, set of 2)

Appearance	Type	Applicable sensor
	F39-HH09-03	F3SH-A09P03 / P03-01

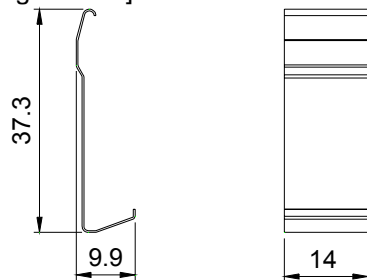
*1. The operating range of the sensor will decrease by 10% when using the spatter protection cover.

[Spatter protection cover]



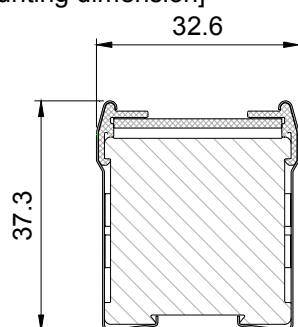
Material:
PC (transparent area)
ABS (non-transparent area)

[Fixing bracket]



Material:
Stainless steel

[Mounting dimension]



Section 8 Referenced standards

International Standards

- IEC61496-1 Safety of Machinery: Electro-sensitive Protective Equipment – Part 1: General Requirements and Tests
- IEC61496-2 Safety of Machinery: Electro-sensitive Protective Equipment – Part 2: Particular Requirements for Equipment Using Active Opto-electronic Protective Devices

European Standards

- EN61496-1 Safety of Machinery: Electro-sensitive Protective Equipment – Part 1: General Requirements and Tests
- prEN61496-2 Safety of Machinery: Electro-sensitive Protective Equipment – Part 2: Particular Requirements for Equipment Using Active Opto-electronic Protective Devices
- EN954-1 Safety of Machinery: Safety-related Parts of Control Systems – Part 1: General Principles for Design
- EN415-4 Palletizers and depalletizers

U.S. Federal regulations

- OSHA 29 CFR 1910.212 General Requirements of All Machines

U.S. Standards

- ANSI/RIA 15.06 Safety Requirements for Industrial Robots and Robot Systems
- UL1998 Safety-related Software
- UL508 Industrial control equipment
- UL61496-1 Electro-sensitive Protective Equipment – Part 1: General Requirements and Tests
- UL61496-2 Electro-sensitive Protective Equipment – Part 2: Particular Requirements for Equipment Using Active Opto-electronic Protective Devices

Canadian Standards

- CAN/CSA 22.2 No. 14, the Standard for Industrial Control Equipment
- CAN/CSA 22.2 No. 0.8, the Standard for Safety Functions Incorporating Electronic Technology