Built-in Power Supply Photoelectric Sensor

E3JM/E3JK

Two Models Contribute to Overall Cost Reduction

E3JM Terminal Block Models

■ Easy to wire and adjust.

E3JK Pre-wired Models

■ Slim body is economically priced and full of functions.

⚠ Be sure to read *Safety Precautions* on page 10.

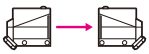
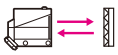
CE

Ordering Information

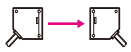
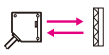
Sensors

E3JM

Red light Infrared light

Sensing method	Appearance	Connection method	Sensing distance	Operation mode	Output configuration	Functions	Model
Through-beam		Terminal block	10 m	Light-ON Dark-ON (switch selectable)	Relay	---	E3JM-10M4
						Timer	E3JM-10M4T
					DC SSR	---	E3JM-10S4
						Timer	E3JM-10S4T
Retro-reflective with MSR function			4 m		Relay	---	E3JM-R4M4
						Timer	E3JM-R4M4T
					DC SSR	---	E3JM-R4S4
						Timer	E3JM-R4S4T
Diffuse-reflective			700 mm		Relay	---	E3JM-DS70M4
						Timer	E3JM-DS70M4T
					DC SSR	---	E3JM-DS70S4
						Timer	E3JM-DS70S4T

E3JK

Sensing method	Appearance	Connection method	Sensing distance	Operation mode	Output configuration	Model
Through-beam		Pre-wired	5 m	Light-ON	Relay	E3JK-5M1
				Dark-ON		E3JK-5M2
				Light-ON / Dark-ON (Both selectable)	DC SSR	E3JK-5S3
Retro-reflective with MSR function			* 2.5 m (3 m)	Light-ON	Relay	E3JK-R2M1
				Dark-ON		E3JK-R2M2
				Light-ON / Dark-ON (Both selectable)	DC SSR	E3JK-R2S3
Retro-reflective without MSR function			* 4 m (5 m)	Light-ON	Relay	E3JK-R4M1
				Dark-ON		E3JK-R4M2
				Light-ON / Dark-ON (Both selectable)	DC SSR	E3JK-R4S3
Diffuse-reflective			300 mm	Light-ON	Relay	E3JK-DS30M1
				Dark-ON		E3JK-DS30M2
				Light-ON / Dark-ON (Both selectable)	DC SSR	E3JK-DS30S3

Note: UL-listed models have the -US suffix. (Example: E3JM-10M4-US). Tightening nuts, washers, and rubber bushings are not provided with these models.
Change: Shape of the E3JM conduit socket
Note, however, that DC-type E3JK SSR Output Models are not UL-listed.

* Values in parentheses indicate the sensing distance when using E39-R2 Reflectors.

Accessories (Order Separately)

Slit

Slit width	Sensing distance		Minimum detectable object (typical)	Model	Quantity	Remarks
1 mm × 20 mm	E3JM-10□4(T)	1.2 m	1-mm dia.	**E39-S39**	1 Slit each for the Emitter and Receiver (2 Slits total)	(Seal-type long slit) Can be used with the E3JM-10□4(T) and E3JK-5□□ Through-beam Models.
	E3JK-5□□	0.7 m				

Reflectors

Name	Sensing distance (typical)		Model	Quantity	Remarks
Reflectors	E3JM-R4□4(T)	4 m (rated value)	**E39-R1**	1	Provided with the E3JM-R4□4(T) Provided with the E3JK-R2□□ Provided with the E3JK-R4□□
	E3JK-R2□□	2.5 m (rated value)			
	E3JK-R4□□	4 m (rated value)			
	E3JK-R2□□	3 m	**E39-R2**	1	---
	E3JK-R4□□	5 m			
Small Reflectors	E3JM-R4□4(T)	3.5 m	**E39-R3**	1	---
	E3JK-R2□□	1 m (5 mm) *			
Tape Reflectors	E3JM-R4□4(T)	1 m (200 mm) *	**E39-RS1**	1	Enables MSR function.
	E3JK-R2□□	750 mm (200 mm) *			
	E3JM-R4□4(T)	1.6 m (200 mm) *	**E39-RS2**	1	
	E3JK-R2□□	1.2 m (200 mm) *			
	E3JM-R4□4(T)	2 m (200 mm) *	**E39-RS3**	1	
	E3JK-R2□□	1.5 m (200 mm) *			

Note: When using any reflector other than the provided one, use a sensing distance of approximately 0.7 times the typical value as a guide.
* Values in parentheses are the minimum required distance between the Sensor and Reflector.

Mounting Bracket

Appearance	Model	Quantity	Remarks
	**E39-L53**	1	Provided with the E3JM.
	**E39-L40**	1	Provided with the E3JK.
	**E39-L51**	1	Mounting Bracket designed for changing from he E3A-M, E3A2, E3A3, OA-5, or OA-5N to the E3JM.

Note: If a Through-beam Model is used, order two Mounting Brackets, one for the Emitter and one for the Receiver.

Ratings and Specifications

E3JM

Item \ Sensing method	Model	Through-beam model	Retro-reflective model (with MSR function)	Diffuse-reflective model
		E3JM-10□4(T)	E3JM-R4□4(T)	E3JM-DS70□4(T)
Sensing distance		10 m	4 m (When using E39-R1)	White paper (200 × 200 mm): 700 mm
Standard sensing object		Opaque: 14.8-mm dia. min.	Opaque: 75-mm dia. min.	---
Differential travel		---		20% max. of sensing distance
Directional angle		Both Emitter and Receiver 3° to 20°	1° to 5°	---
Light source (wavelength)		Infrared LED (950 nm)	Red LED (660 nm)	Infrared LED (950 nm)
Power supply voltage		12 to 240 VDC±10%, ripple (p-p): 10% max. 24 to 240 VAC±10%, 50/60 Hz		
Power consumption	DC	3 W max. (Emitter 1.5 W max. Receiver 1.5 W max.)	2 W max.	
	AC	3 W max. (Emitter 1.5 W max. Receiver 1.5 W max.)	2 W max.	
Control output		Relay output (E3JM-□□M4 (T) model): SPDT, 250 VAC, 3A (cosϕ=1) max., 5 VDC, 10 mA min. DC SSR output (E3JM-□□S4 (T) model): 48 VDC, 100 mA max. (residual voltage: 2 V max.) Light-ON/Dark-ON selectable		
Life expectancy (relay output)	Mechanical	50,000,000 times min. (switching frequency: 18,000 times/h)		
	Electrical	100,000 times min. (switching frequency: 1,800 times/h)		
Response time	Relay output	(E3JM-□□M4 (T) models) Operate or reset: 30 ms max.		
	DC SSR output	(E3JM-□□S4 (T) models) Operate or reset: 5 ms max.		
Sensitivity adjustment		---		One-turn adjuster
Timer function *		ON-delay/OFF-delay/One-shot delay switch selectable Delay time: 0.1 to 5 s (adjustable), only for E3JM-□□□4T		
Ambient illumination (Receiver side)		Incandescent lamp: 3,000 lx max.		
Ambient temperature range		Operating: –25°C to 55°C, Storage: –30°C to 70°C (with no icing or condensation)		
Ambient humidity range		Operating: 45% to 85% (with no condensation), Storage: 35% to 95% (with no condensation)		
Insulation resistance		20 MΩ min. at 500 VDC		
Dielectric strength		2,000 VAC, 50/60 Hz for 1 min.		
Vibration resistance	Destruction	10 to 55 Hz, 1.5-mm double amplitude for 2 hours each in X, Y, and Z directions		
	Malfunction	10 to 55 Hz, 1.5-mm double amplitude for 2 hours each in X, Y, and Z directions		
Shock resistance	Destruction	500 m/s^2 3 times each in X, Y, and Z directions		
	Malfunction	100 m/s^2 3 times each in X, Y, and Z directions		
Degree of protection		IEC 60529: IP66		
Connection method		Terminal block		
Weight (packed state)		Approx. 270 g	Approx. 160 g	
Material	Case	ABS (Acrylonitril Butadiene Styrene)		
	Lens	Methacrylic resin		
	Cover	Polycarbonate		
	Mounting Bracket	Iron		
Accessories		Mounting Bracket (with screw), Nuts, Terminal Protection Cover, One set of cable connection nuts (excluding -US Models), Instruction manual, Reflector (E39-R1: only for Retro-reflective Sensors)		

* The timer cannot be disabled for models with timer functions (E3JM-□□□4T).

E3JK

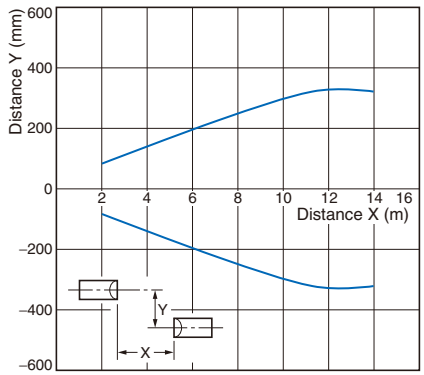
Item		Through-beam model		Retro-reflective model (with MSR function)		Retro-reflective model (without MSR function)		Diffuse-reflective model	
Sensing method / Model		E3JK -5M□	E3JK -5S3	E3JK -R2M□	E3JK -R2S3	E3JK -R4M□	E3JK -R4S3	E3JK -DS30M□	E3JK -DS30S3
Sensing distance		5 m		2.5 m (When using E39-R1)		4 m (When using E39-R1)		White paper (100 × 100 mm): 300 mm	
Standard sensing object		Opaque: 14.8-mm dia. min.		Opaque: 75-mm dia. min.				---	
Differential travel		---						20% max. of sensing distance	
Directional angle		Both Emitter and Receiver 3° to 20°		1° to 5°				---	
Light source (wavelength)		Infrared LED (950 nm)		Red LED (660 nm)				Infrared LED (950 nm)	
Power supply voltage		12 to 240 VDC±10%, ripple (p-p): 10% max. 24 to 240 VAC±10%, 50/60 Hz							
Power consumption	DC	3 W max. (Emitter 1.5 W max. Receiver 1.5 W max.)		2 W max.					
	AC	3 W max. (Emitter 1.5 W max. Receiver 1.5 W max.)		2 W max.					
Control output		Relay output SPDT, 250 VAC, 3 A max. (cosϕ= 1) 5 VDC, 10 mA min.	DC SSR output, Negative: common 48 VDC, 100 mA max. Leakage current: 0.1 mA max. With load short-circuit protection	Relay output SPDT, 250 VAC, 3 A max. (cosϕ= 1) 5 VDC, 10 mA min.	DC SSR output, Negative: common 48 VDC, 100 mA max. Leakage current: 0.1 mA max. With load short-circuit protection	Relay output SPDT, 250 VAC, 3 A max. (cosϕ= 1) 5 VDC, 10 mA min.	DC SSR output, Negative: common 48 VDC, 100 mA max. Leakage current: 0.1 mA max. With load short-circuit protection	Relay output SPDT, 250 VAC, 3 A max. (cosϕ= 1) 5 VDC, 10 mA min.	DC SSR output, Negative: common 48 VDC, 100 mA max. Leakage current: 0.1 mA max. With load short-circuit protection
Life expectancy (relay output)	Mechanical	50,000,000 times min. (switching frequency: 18,000 times/h)							
	Electrical	100,000 times min. (switching frequency: 1,800 times/h)							
Response time		30 ms max.	10 ms max.	30 ms max.	5 ms max.	30 ms max.	5 ms max.	30 ms max.	5 ms max.
Sensitivity adjustment		---						One-turn adjuster	
Ambient illumination (Receiver side)		Incandescent lamp: 3,000 lx max.							
Ambient temperature range		Operating: −25°C to 55°C, Storage: −30°C to 70°C (with no icing or condensation)							
Ambient humidity range		Operating: 45% to 85% (with no condensation), Storage: 35% to 95% (with no condensation)							
Insulation resistance		20 MΩ min. at 500 VDC							
Dielectric strength		1,500 VAC, 50/60 Hz for 1 min.							
Vibration resistance	Destruction	10 to 55 Hz, 1.5-mm double amplitude for 2 hours each in X, Y, and Z directions							
	Malfunction	10 to 55 Hz, 1.5-mm double amplitude for 2 hours each in X, Y, and Z directions							
Shock resistance	Destruction	500 m/s² 3 times each in X, Y, and Z directions							
	Malfunction	100 m/s² 3 times each in X, Y, and Z directions	500 m/s² 3 times each in X, Y, and Z directions	100 m/s² 3 times each in X, Y, and Z directions	500 m/s² 3 times each in X, Y, and Z directions	100 m/s² 3 times each in X, Y, and Z directions	500 m/s² 3 times each in X, Y, and Z directions	100 m/s² 3 times each in X, Y, and Z directions	500 m/s² 3 times each in X, Y, and Z directions
Degree of protection		IEC 60529 IP64							
Connection method		Pre-wired (standard length: 2 m)							
Weight (packed state)		Approx. 420 g		Approx. 250 g					
Material	Case	ABS (Acrylonitril Butadiene Styrene)							
	Lens	Methacrylic resin							
	Mounting Bracket	Iron							
Accessories		Mounting Bracket (with screws), Nuts, Instruction manual, Reflector (Retro-reflective Models only)							

Engineering Data (Typical)

Parallel Operating Range

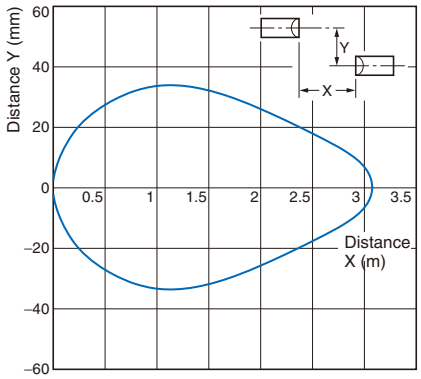
Through-beam

E3JM-10□4(T)



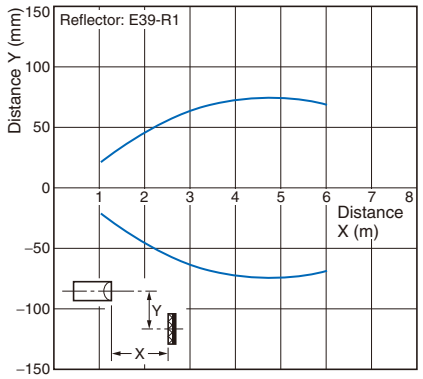
Through-beam

E3JM-10□4(T) + E39-S39 (Optional Slit)



Retro-reflective

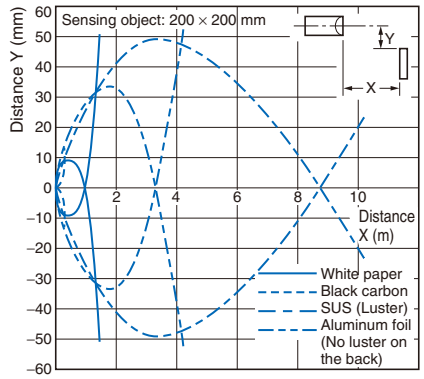
E3JM-R4□4(T) + E39-R1 (Supplied Reflector)



Operating Range

Diffuse-reflective

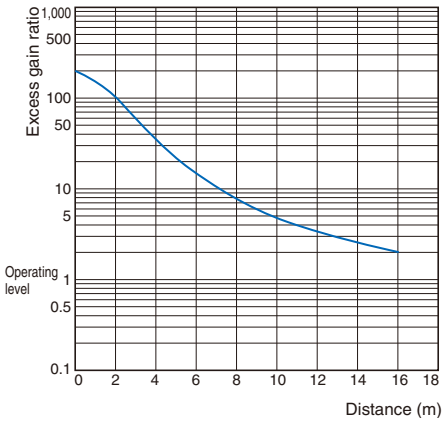
E3JM-DS70□4(T)



Excess Gain Ratio vs. Set Distance

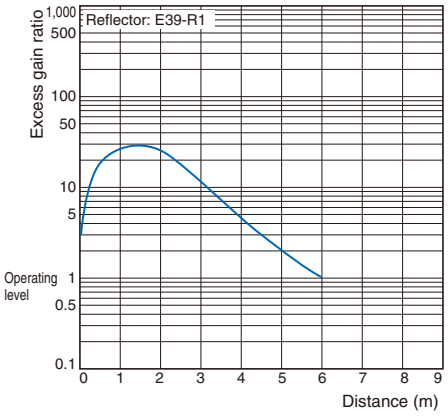
Through-beam

E3JM-10□4(T)

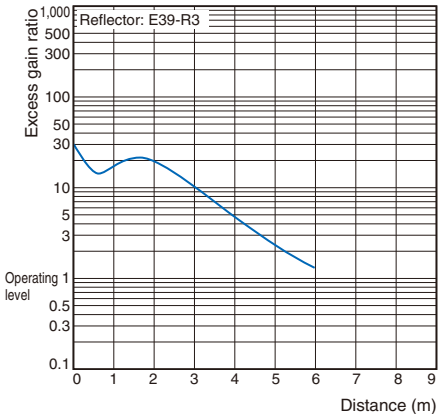


Retro-reflective

E3JM-R4□4(T) + E39-R1 (Supplied Reflector)



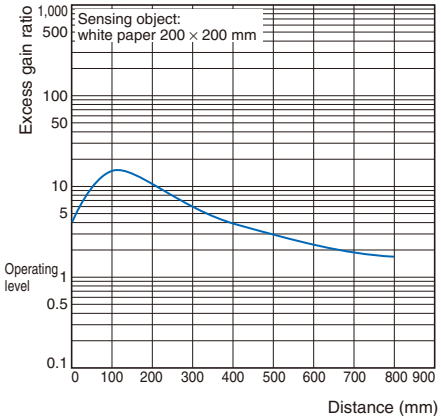
E3JM-R4□4(T) + E39-R3 (Optional Reflector)



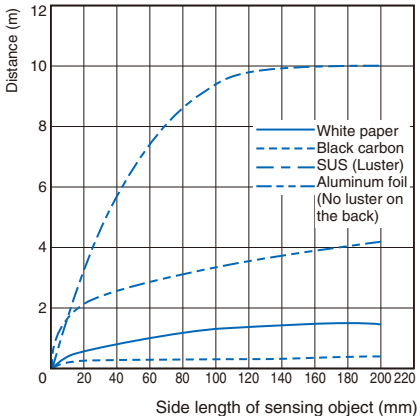
Sensing Object Size vs. Sensing Distance

Diffuse-reflective

E3JM-DS70□4(T)



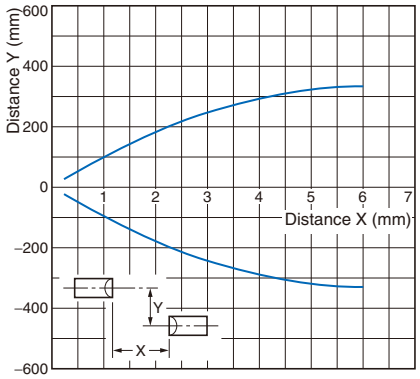
E3JM-DS70□4(T)



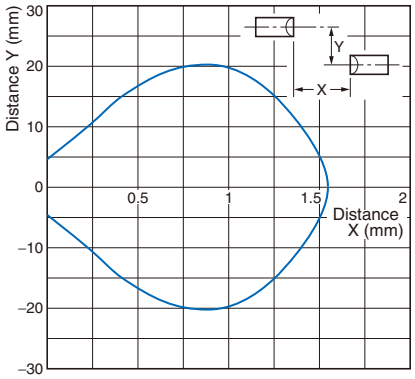
Parallel Operating Range

Through-beam

E3JK-5□□

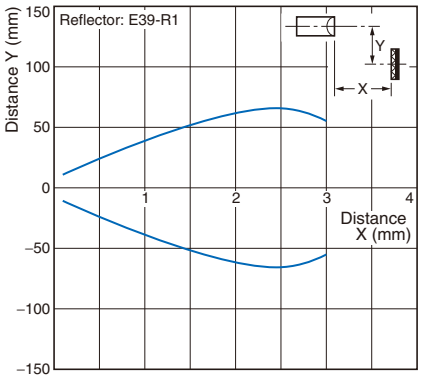


E3JK-5□□ + E39-S39 (Optional Slit)

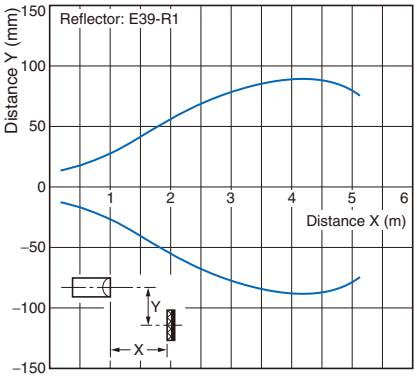


Retro-reflective

E3JK-R2□□ + E39-R1 (Supplied Reflector)



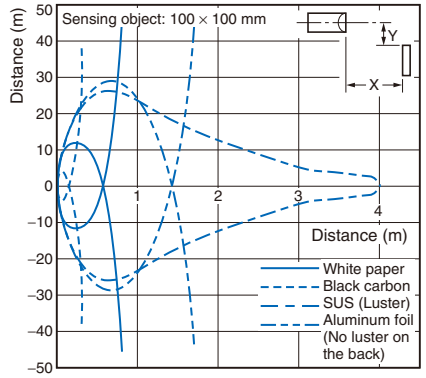
E3JK-R4□□ + E39-R1 (Supplied Reflector)



Operating Range

Diffuse-reflective

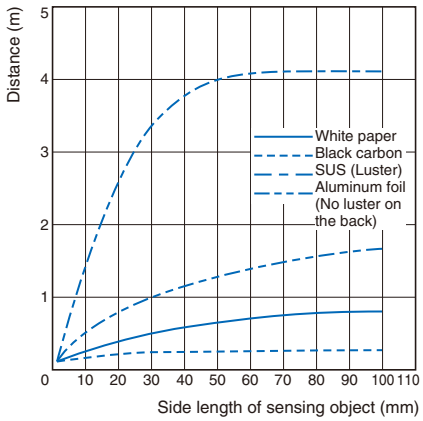
E3JK-DS30□□



Sensing Object Size vs. Sensing Distance

Diffuse-reflective

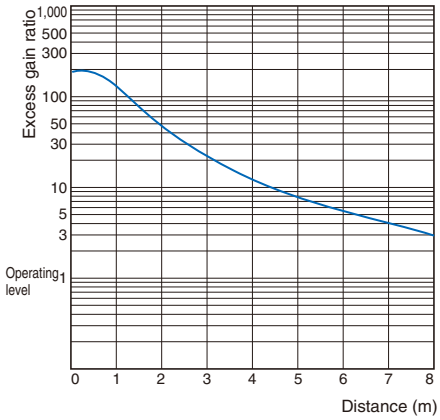
E3JK-DS30□□



Excess Gain Ratio vs. Set Distance

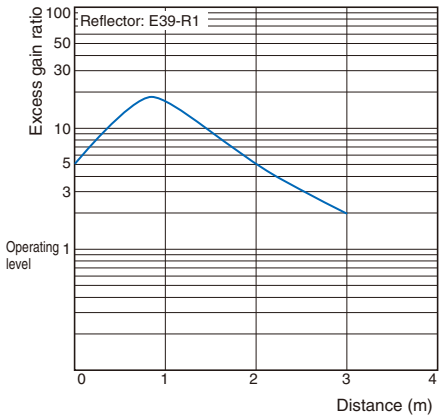
Through-beam

E3JK-5□□

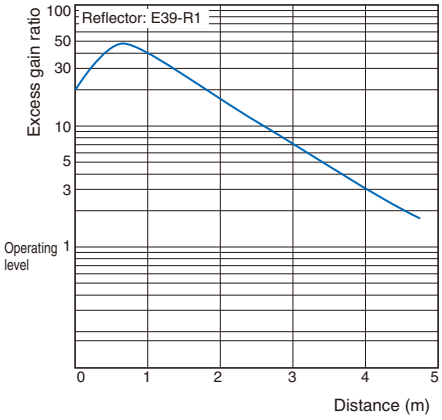


Retro-reflective

E3JK-R2□□ + E39-R1 (Supplied Reflector)

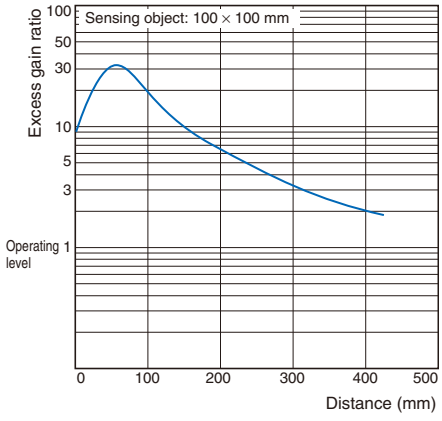


E3JK-R4□□ + E39-R1 (Supplied Reflector)



Diffuse-reflective

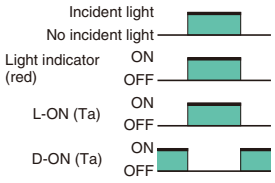
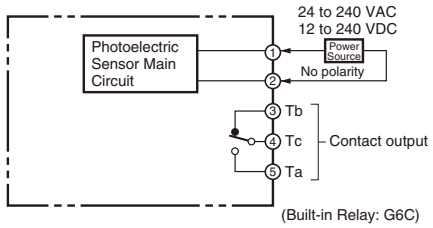
E3JK-DS30□□



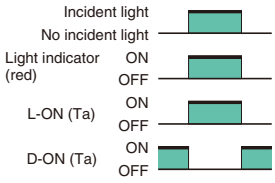
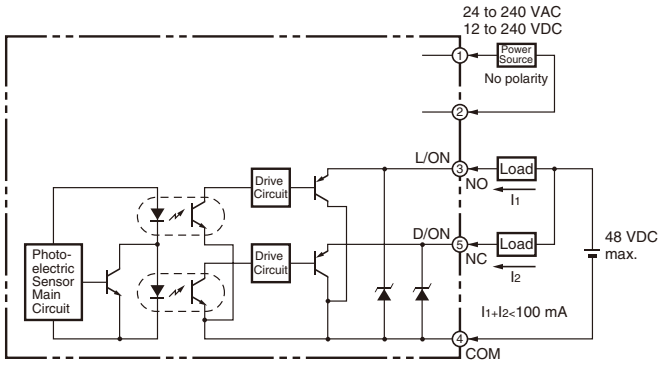
I/O Circuit Diagrams

E3JM

Relay Output Models

Model	Timing chart	Output circuit
E3JM-10M4(T) E3JM-R4M4(T) E3JM-DS70M4(T)		

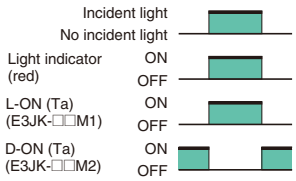
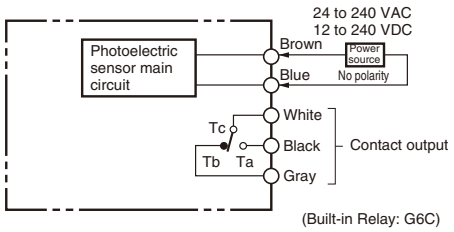
DC SSR Output Models

Model	Timing chart	Output circuit
E3JM-10S4(T) E3JM-R4S4(T) E3JM-DS70S4(T)		

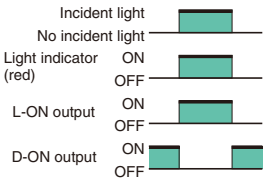
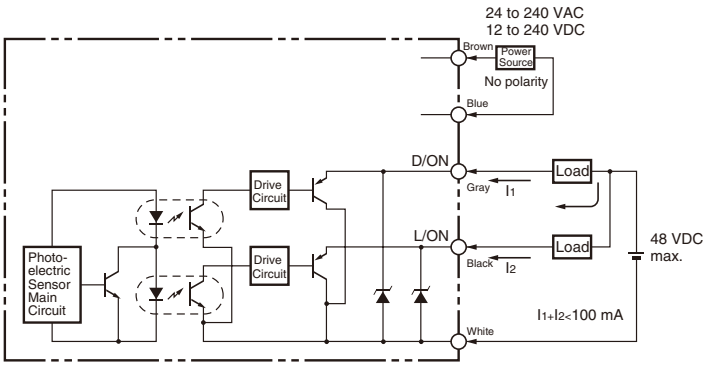
Note: Connect terminal 1 to any polarity and terminal 2 to the power supply because there is no polarity on the Emitter side.

E3JK

Relay Output Models

Model	Timing chart	Output circuit
E3JK-5M1 E3JK-5M2 E3JK-R2M1 E3JK-R2M2 E3JK-R4M1 E3JK-R4M2 E3JK-DS30M1 E3JK-DS30M2		 (Built-in Relay: G6C)

DC SSR Output Models

Model	Timing chart	Output circuit
E3JK-5S3 E3JK-R2S3 E3JK-R4S3 E3JK-DS30S3		 Note: The output stage leakage currents are 0.1 mA max., respectively.

Note: Connect the brown cable to any polarity and the blue cable to the power supply because there is no polarity on the Emitter side.

Safety Precautions

Refer to *Warranty and Limitations of Liability*.

⚠ WARNING

This product is not designed or rated for ensuring safety of persons either directly or indirectly. Do not use it for such purposes.

Precautions for Correct Use

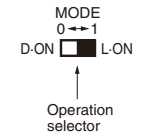
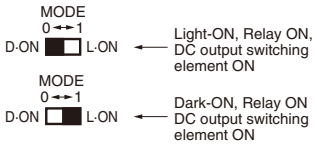
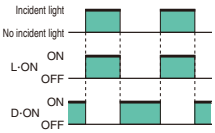
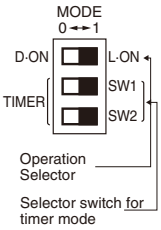
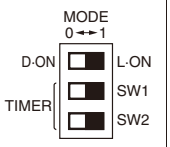
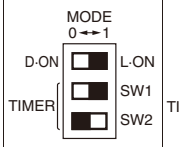
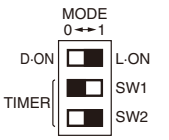
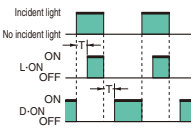
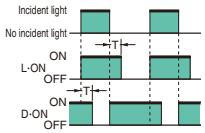
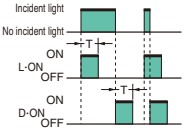
Do not use the product in atmospheres or environments that exceed product ratings.

E3JM

● **Designing**

Operation

Note: ■ The white part of the DIP switch indicates which setting is selected.

	Switch configuration	Switch selection			Timing charts		
Models without timer							
Models with timer		ON-delay	OFF-delay	One-shot delay	ON-delay	OFF-delay	One-shot delay
		 Both SW1 and SW2 at "0."	 Only SW2 at "1."	 Only SW1 at "1," which overrides either setting of SW2.			
		Note: The operation selector is the same as that for models without a timer.					

Output Relay Contact

If E3JM/E3JK is connected to a load with contacts that spark when the load is turned OFF (e.g., a contactor or valve), the normally-closed side may be turned ON before the normally-open side is turned OFF or vice-versa. If both normally-open output and normally-closed output are used simultaneously, apply an surge suppressor to the load.
Refer to *OMRON's PCB Relays Catalog* (X33) for typical examples of surge suppressors.

● Wiring

Connecting and Wiring

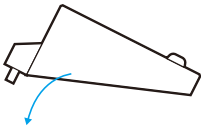
- Recommended outer diameter of cables is from 6 to 8 mm.
- Be sure to firmly tighten the cover in order to maintain waterproof and dustproof properties. The screw size of the conduit sockets is shown in the following table.

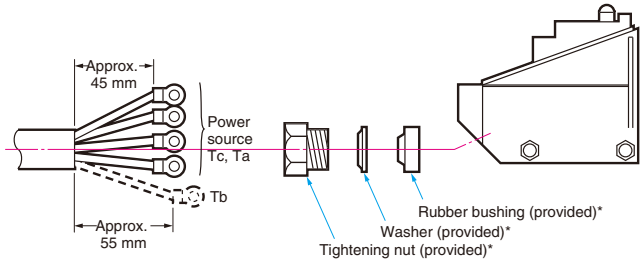
Model	Conduit socket thread size
E3JM-□	PF1/2

Cable End Treatment

Adjust the four wires to the same length when the Ta output is to be used only. If both the Ta and Tb outputs are to be used, treat them as shown in the following diagram.

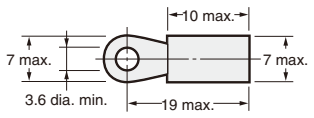
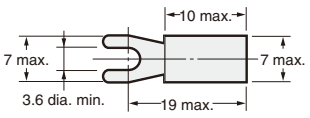
Recommended example





* These parts are not provided with models with a -US suffix.

Recommended Crimp Terminal Dimensions (Unit: mm)

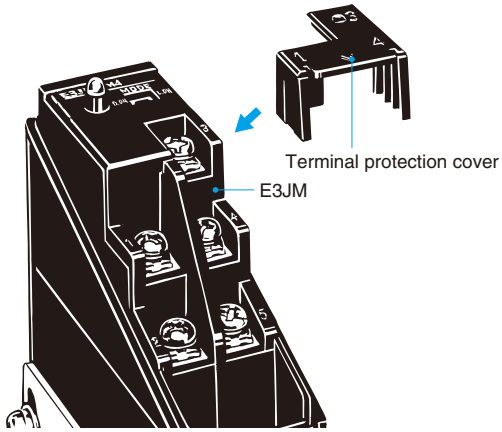
Round type	Fork type
	
(After crimping)	(After crimping)

Note: Use terminals with insulation tube (recommended crimp terminal: 1.25 to 3.5).

● Others

Terminal Protection Cover (Provided)

The terminal protection cover is designed to improve safety by maintaining the sensitivity properties of the product and by preventing any contact with charged sections while it is being operated with the mode set to the timer mode. Mount the product as shown in the following diagram (mount the Through-beam Model on the Receiver side).



E3JK

● Designing

Power Reset Time

The Sensor is ready to detect within 200 ms after it is turned ON. If the Sensor and load are connected to separate power supplies, be sure to turn ON the Sensor first.

Items Common to E3JM and E3JK

● Wiring

Connecting and Wiring DC SSR Output Models

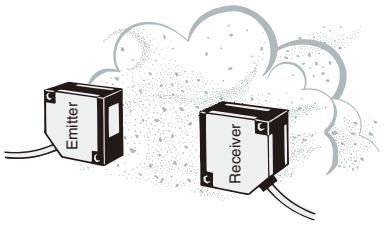
When using the DC SSR output model, the total of the load current for the Light-ON output (NO) and that for the Dark-ON (NC) should be 100 mA max. If the total exceeds 100 mA, the load short-circuit protection function will be activated (this function will be reset when the power of the Photoelectric Sensor is turned OFF).

● Others

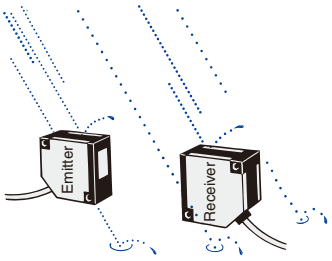
Ambient Conditions (Installation Area)

The E3JM will malfunction if installed in the following places.

- Places where the E3JM is exposed to a dusty environment.
- Places where corrosive gases are produced.



- Places where the E3JM is directly exposed to water, oil, or chemicals.

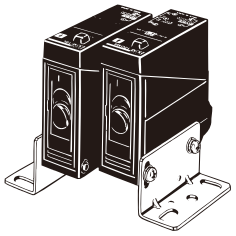


Dimensions

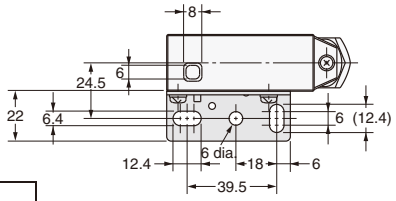
(Unit: mm)

Sensors

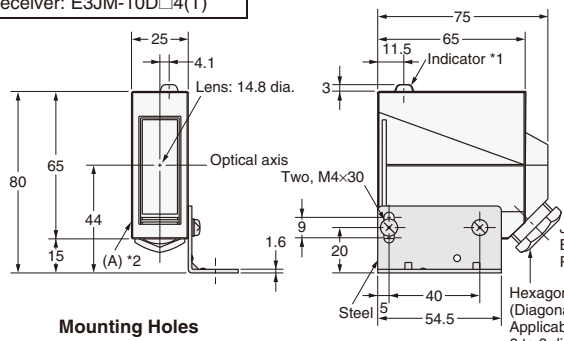
E3JM-10□4(T)



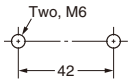
With Mounting Bracket Attached



Emitter: E3JM-10L
Receiver: E3JM-10D□4(T)



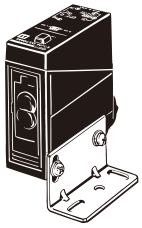
Mounting Holes



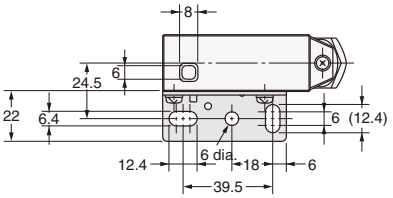
*1. Emitter: Power indicator
Receiver: Light indicator (without timer function)
Operation indicator (with timer function)
*2. Mounting Brackets can be used on the A side.

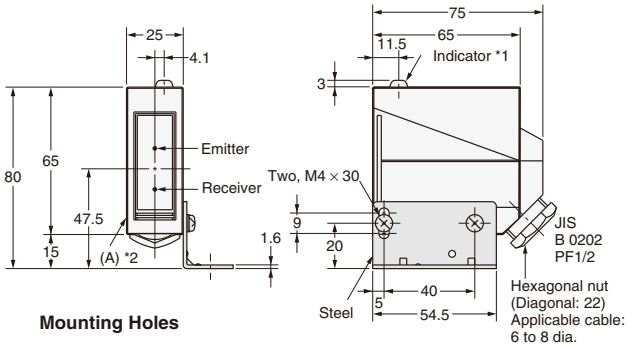
Note: The operating mode switch and timer mode switch are located inside the cover.

E3JM-R4□4(T)
E3JM-DS70□4(T)

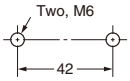


With Mounting Bracket Attached





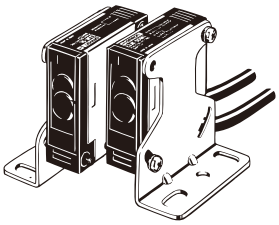
Mounting Holes



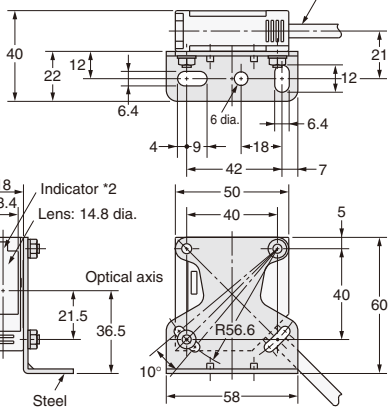
*1. Light indicator (without timer function)
Operation indicator (with timer function)
*2. Mounting Brackets can be used on the A side.

Note: The operating mode switch and timer mode switch are located inside the cover.

E3JK-5□□

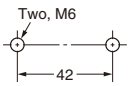


With Mounting Bracket Attached



Emitter: E3JK-5L
Receiver: E3JK-5D□□

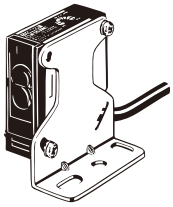
Mounting Holes

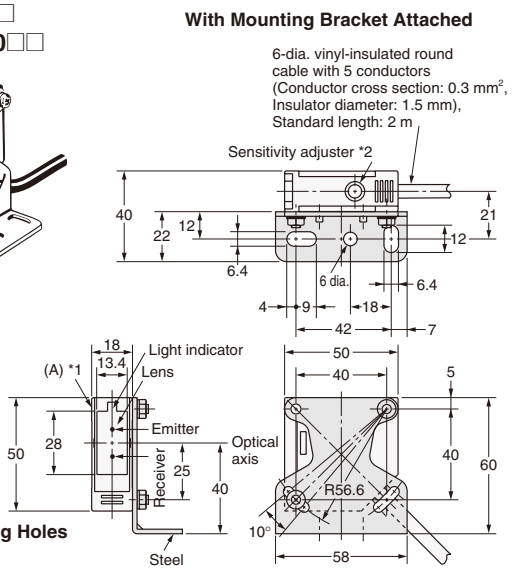


*1. Mounting Brackets can be used on the A side
(M4 × 20 screws: 2 sets provided)
*2. Emitter: Power indicator
Receiver: Light indicator
*3. The Emitter has two conductors.

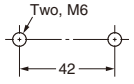
E3JK-R2□□
E3JK-R4□□
E3JK-DS30□□

With Mounting Bracket Attached





Mounting Holes

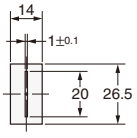


*1. Mounting Brackets can be used on the A side
(M4 × 20 screws: 2 sets provided)
*2. Sensitivity adjusters are not available on
Retro-reflective models.

Accessories (Order separately)

Seal-type Long Slit (For E3JM/E3JK)
E39-S39

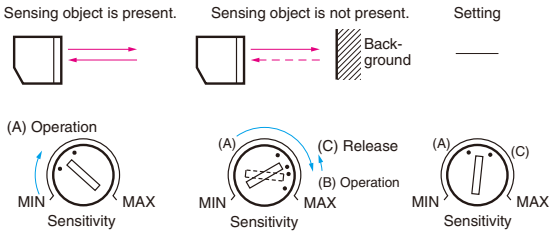
Materials: Polyester
0.1-mm thick



Mounting Brackets

E3JM/E3JK

Adjustment

Item / Model	Through-beam Models	Retro-reflective Models	Diffuse-reflective Models
E3JM	For a E3JM with the timer function, the indicator will be lit when incident light is received while the mode is switched to Light-ON, and the indicator will be lit when light is interrupted while the mode is switched to Dark-ON.	The indicator of the Retro-reflective Model with the timer function is lit in the same way as for the Through-beam Model.	The indicator of the Diffuse-reflective Model with the timer function is lit in the same way as for the Through-beam Model.
E3JM, E3JK Common items	Move the emitter and receiver horizontally and vertically, and locate them to the center of the range in which the receiver indicator is lit.	As with the Through-beam Model, adjust the reflector and Sensor. Since the directional angle of the E3JM and E3JK Retro-reflective Models is 1 to 5 degrees, pay careful attention when adjusting the Sensor.	 (1) If a sensing object is present as shown above, turn the sensitivity adjuster clockwise to increase the sensitivity. Point (A) is where the indicator is lit. (2) Remove the sensing object and turn the adjuster clockwise. Point (B) is where the indicator is lit by background objects. (3) Turn the adjuster counterclockwise to decrease the sensitivity, starting from the point (B). Point (C) is where the indicator is lit. (4) The center point between the point (A) and point (C) is the optimum position. If the indicator is not lit by the background object at the maximum sensitivity, set to the center point between the point (A) and the maximum sensitivity. • The sensitivity adjuster may be damaged if an excessive force is applied.

General Precautions

For precautions on individual products, refer to *Safety Precautions* in individual product information.

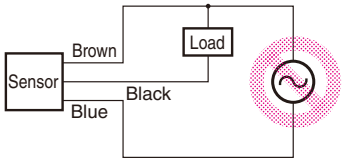
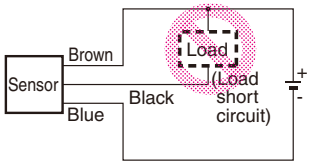
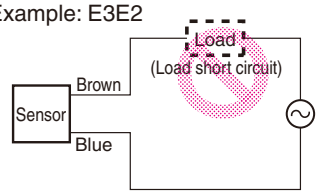
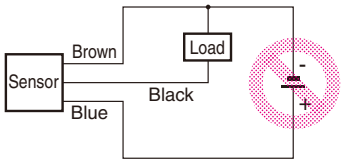
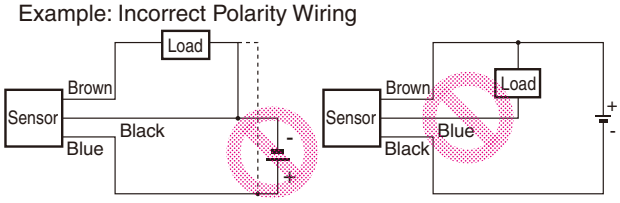
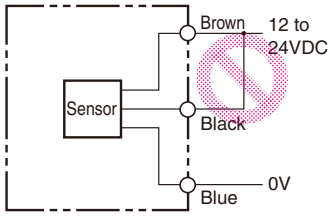
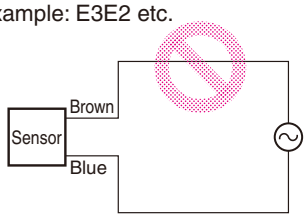
⚠ WARNING

These Sensors cannot be used in safety devices for presses or other safety devices used to protect human life. These Sensors are designed for use in applications for sensing workpieces and workers that do not affect safety.

Precautions for Safe Use

To ensure safety, always observe the following precautions.

● Wiring

Item	Typical examples	
Power Supply Voltage Do not use a voltage in excess of the operating voltage range. Applying a voltage in excess of the operating voltage range, or applying AC power (100 VAC or greater) to a DC Sensor may cause explosion or burning.	• DC Three-wire NPN Output Sensors 	---
Load Short-circuiting Do not short-circuit the load. Doing so may cause explosion or burning.	• DC Three-wire NPN Output Sensor 	• AC Two-wire Sensors Example: E3E2 
Incorrect Wiring Do not reverse the power supply polarity or otherwise wire incorrectly. Doing so may cause explosion or burning.	• DC Three-wire NPN Output Sensors Example: Incorrect Polarity 	• DC Three-wire NPN Output Sensors Example: Incorrect Polarity Wiring 
Connection without a load If the power supply is connected directly without a load, the internal elements may burst or burn. Be sure to insert a load when connecting the power supply.	• DC Three-wire NPN Output Sensors 	• AC 2-wire Sensors Example: E3E2 etc. 

● Operating Environment

(1) Do not use a Sensor in an environment where there are explosive or inflammable gases.
(2) Do not use the Sensor in environments where the cables may become immersed in oil or other liquids or where liquids may penetrate the Sensor. Doing so may result in damage from burning and fire, particularly if the liquid is flammable.

Precautions for Correct Use

● **Design**

Power Reset Time

The Sensor will be ready to detect within approximately 100 ms after the power is turned ON.
If the Sensor and the load are connected to separate power supplies, turn ON the Sensor power before turning ON the load power. Any exceptions to this rule are indicated in *Safety Precautions* in individual product information.

Turning OFF Power

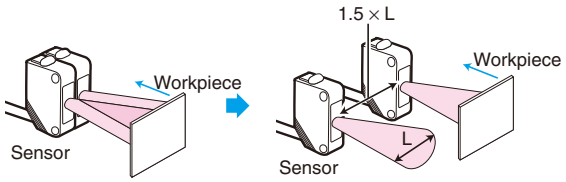
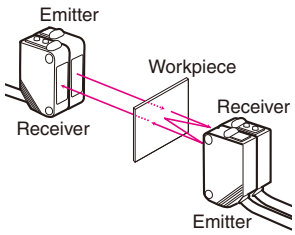
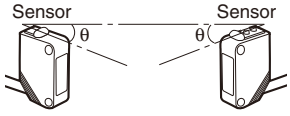
An output pulse may be generated when the power is turned OFF. It is recommended that the load or load line power be turned OFF before the Sensor power is turned OFF.

Power Supply Types

An unsmoothed full-wave or half-wave rectifying power supply cannot be used.

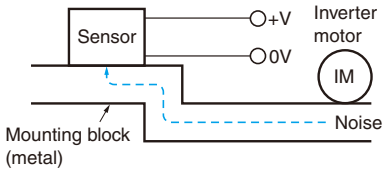
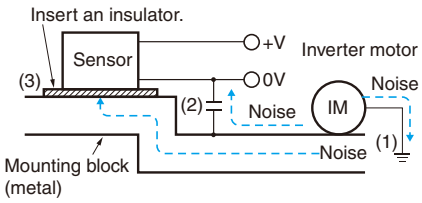
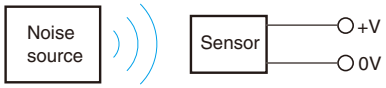
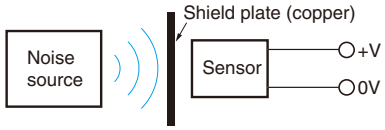
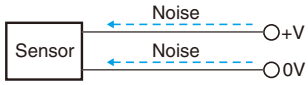
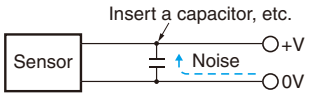
Mutual Interference

Mutual interference is a state where an output is unstable because the Sensors are affected by light from the adjacent Sensors.
The following measures can be taken to avoid mutual interference.

Counter-measure	Concept	Through-beam Sensors	Reflective Sensors
1	Use a Sensor with the interference prevention function.	If Sensors are mounted in close proximity, use Sensors with the interference prevention function. 10 or fewer Sensors: E3X-DA□-S, E3X-MDA, E3C-LDA Fiber Sensors Performance, however, will depend on conditions. Refer to pages E3X-DA-S/E3X-MDA and E3C-LDA. 5 or fewer Sensors: E3X-NA Fiber Sensors 2 or fewer Sensors: E3T, E3Z, E3ZM, E3ZM-C, E3S-C, E3G-L1/L3, or E3S-C Built-in Amplifier Photoelectric Sensors (except Through-beam Sensors) E3C Photoelectric Sensor with separate amplifier	
2	Install an inference prevention filter.	A mutual interference prevention polarizing filter can be installed on only the E3Z-TA to allow close-proximity mounting of up to 2 Sensors. Mutual Interference Prevention Polarizing Filter: E39-E11	---
3	Separate Sensors to distance where interference does not occur.	Check the parallel movement distance range in the catalog, verify the set distance between adjacent Sensors, and install the Sensors accordingly at a distance at least 1.5 times the parallel movement distance range.	If the workpieces move from far to near, chattering may occur in the vicinity of the operating point. For this type of application, separate the Sensors by at least 1.5 times the operating range. 
4	Alternate Emitters and Receivers.	Close mounting of Sensors is possible by alternating the Emitters with the Receivers in a zigzag fashion (up to two Sensors). However, if the workpieces are close to the Photoelectric Sensors, light from the adjacent Emitter may be received and cause the Sensor to change to the incident light state. 	---
5	Offset the optical axes.	If there is a possibility that light from another Sensor may enter the Receiver, change the position of the Emitter and Receiver, place a light barrier between the Sensors, or take other measures to prevent the light from entering the Receiver. (Light may enter even if the Sensors are separated by more than the sensing distance.)	If Sensors are mounted in opposite each other, slant the Sensors as shown in the following diagram. (This is because the Sensors may affect each other and cause output chattering even if separated by more than the Sensor sensing distance.) 
6	Adjust the sensitivity.	Lowering the sensitivity will generally help.	

Noise

Countermeasures for noise depend on the path of noise entry, frequency components, and wave heights. Typical measures are as given in the following table.

Type of noise	Noise intrusion path and countermeasure	
	Before countermeasure	After countermeasure
Common mode noise (inverter noise) Common noise applied between the mounting board and the +V and 0-V lines, respectively.	Noise enters from the noise source through the frame (metal). 	(1) Ground the inverter motor (to 100 Ω or less) (2) Ground the noise source and the power supply (0-V side) through a capacitor (film capacitor, 0.22 μF, 630 V). (3) Insert an insulator (plastic, rubber, etc.) between the Sensor and the mounting plate (metal). 
Radiant noise Ingress of high-frequency electromagnetic waves directly into Sensor, from power line, etc.	Noise propagates through the air from the noise source and directly enters the Sensor. 	• Insert a shield (copper) plate between the Sensor and the noise source e.g., a switching power supply). • Separate the noise source and the Sensor to a distance where noise does not affect operation. 
Power line noise Ingress of electromagnetic induction from high-voltage wires and switching noise from the switching power supply	Noise enters from the power line. 	• Insert a capacitor (e.g., a film capacitor), noise filter (e.g., ferrite core or insulated transformer), or varistor in the power line. 

● Wiring

Cable

Unless otherwise indicated, the maximum length of cable extension is 100 m using wire that is 0.3 mm^2 or greater.
Exceptions are indicated in ***Safety Precautions*** in individual product information.

Cable Tensile Strength

When wiring the cable, do not subject the cable to a tension greater than that indicated in the following table.

Cable diameter	Tensile strength
Less than 4 mm	30 N max.
4 mm or greater	50 N max.

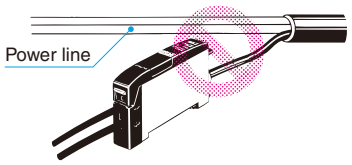
Note: Do not subject a shielded cable or coaxial cable to tension.

Repeated Bending

Normally, the Sensor cable should not be bent repeatedly.
(For bending-resistant cable, see ***Attachment to Moving Parts*** on page **C-4**.)

Separation from High Voltage (Wiring Method)

Do not lay the cables for the Sensor together with high-voltage lines or power lines. Placing them in the same conduit or duct may cause damage or malfunction due to induction interference. As a general rule, wire the Sensor in a separate system, use an independent metal conduit, or use shielded cable.



Work Required for Unconnected Leads

Unused leads for self-diagnosis outputs or other special functions should be cut and wrapped with insulating tape to prevent contact with other terminals.

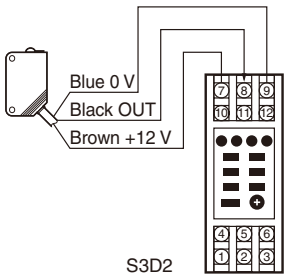
Power Supply

When using a commercially available switching regulator, ground the FG (frame ground) and G (ground) terminals.
If not grounded, switching noise in the power supply may cause malfunction.

Example of Connection with S3D2 Sensor Controller

DC Three-wire NPN Output Sensors

Reverse operation is possible using the signal input switch on the S3D2.



● Mounting

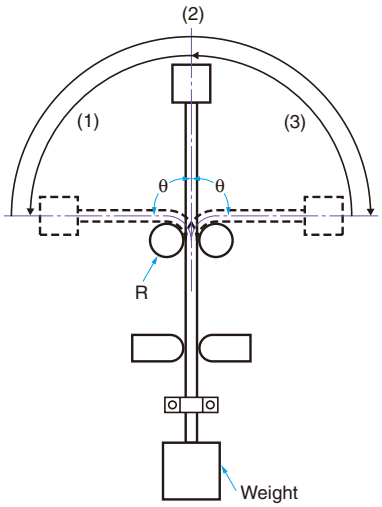
Attachment to Moving Parts

To mount the Photoelectric Sensor to a moving part, such as a robot hand, consider using a Sensors that uses a bending-resistant cable (robot cable).

Although the bending repetition tolerance of a standard cable is approximately 13,000 times, robot cable has an excellent bending tolerance of approximately 500,000 times.

Cable Bending Destruction Test (Tough Wire Breaking Test)

With current flowing, bending is repeated to check the number of bends until the current stops.



Test / Specimen		Standard cable VR (H) 3 x18/0.12	Robot cable: Strong, conductive electrical wire 2 x 0.15 mm², shielded
Description/conditions	Bending angle (θ)	Left/right 90° each	Left/right 45° each
	Bending repetitions	---	60 bends/minute
	Weight	300g	200g
	Operation per bending	(1) through (3) in figure once	(1) through (3) in figure once
	Bending radius of support points (R)	5 mm	2.5 mm
Result		Approx. 13,000 times	Approx. 500,000 times

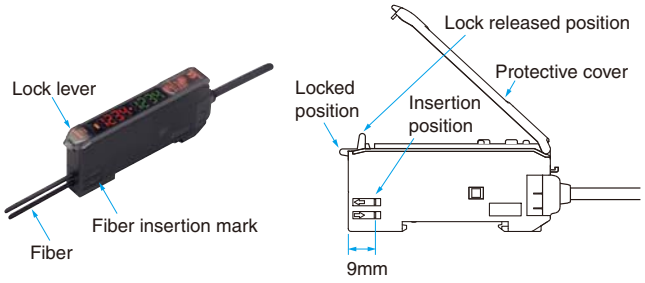
The testing conditions of the standard cable and robot cable are different.
Refer to the values in the above table to check bend-resistant performance under actual working conditions.

Securing Fibers

The E3X Fiber Unit uses a one-touch locking mechanism. Use the following methods to attach and remove Fiber Units.

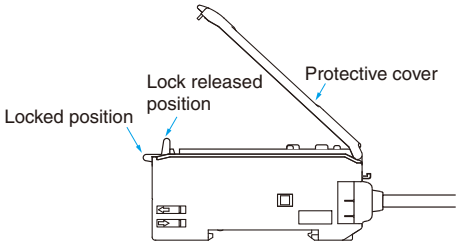
(1) Attaching Fibers

Open the protective cover, insert the fiber up to the insertion mark on the side of the Fiber Unit, and then lower the lock lever.



(2) Removing Fibers

Open the protective cover, lift up the lock lever, and pull out the fibers.

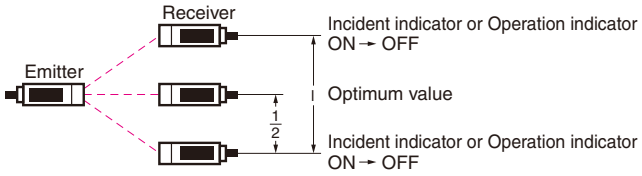


Note: 1. To maintain the fiber characteristics, make sure that the lock is released before removing the fibers.
2. Lock and unlock the fibers at an ambient temperature of −10 to 40°C.

● Adjustments

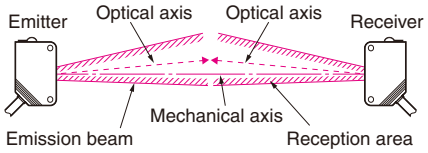
Optical Axis Adjustment

Move the Photoelectric Sensor both vertically and horizontally and set it in the center of the range in which the operation indicator is lit or not lit. For the E3S-C, the optical axis and the mechanical axis are the same, so the optical axis can be easily adjusted by aligning the mechanical axis.



Optical axis: The axis from the center of the lens to the center of the beam for the Emitter and the axis from the center of the lens to the center of the reception area for the Receiver.

Mechanical axis: The axis perpendicular to the center of the lens.



● Operating Environment

Water Resistance

Do not use in water, in rain, or outside.

Ambient Conditions

Do not use this Sensor in the following locations. Otherwise, it may malfunction or fail.

(1) Locations exposed to excessive dust and dirt
(2) Locations exposed to direct sunlight
(3) Locations with corrosive gas vapors
(4) Locations where organic solvents may splash onto the Sensor
(5) Locations subject to vibration or shock
(6) Locations where there is a possibility of direct contact with water, oil, or chemicals
(7) Locations with high humidity and where condensation may result

Environmentally Resistive Sensors

The E32-T11F/T12F/T14F/T81F-S/D12F/D82F and E3HQ can be used in locations (3) and (6) above.

Optical Fiber Photoelectric Sensors in Explosive Gas Atmospheres

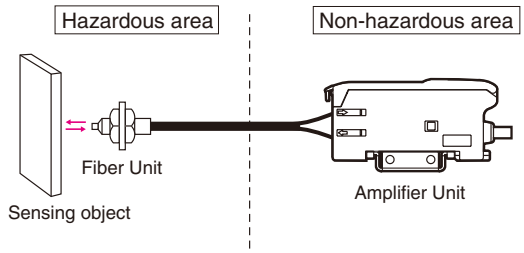
The Fiber Unit can be installed in the hazardous area, and the Amplifier Unit can be installed in a non-hazardous area.

<Reason>

For explosion or fire due to electrical equipment to occur, both the hazardous atmosphere and a source of ignition must be in the same location. Optical energy does not act as an ignition source, thus there is no danger of explosion or fire. The lens, case, and fiber covering are made of plastic, so this setup cannot be used if there is a possibility of contact with solvents that will corrode or degrade (e.g., cloud) the plastic.

<Ignition Source>

Electrical sparks or high-temperature parts that have sufficient energy to cause explosion in a hazardous atmosphere are called ignition sources.



Influence from External Electrical Fields

Do not bring a transceiver near the Photoelectric Sensor or its wiring, because this may cause incorrect operation.

● Maintenance and Inspection

Points to Check When the Sensor Does Not Operate

- If the Sensor does not operate, check the following points.

(1) Are the wiring and connections correct?
(2) Are any of the mounting screws loose?
(3) Are the optical axis and sensitivity adjusted correctly?
(4) Do the sensing object and the workpiece speed satisfy the ratings and specifications?
(5) Are any foreign objects, such as debris or dust, adhering to the Emitter lens or Receiver lens?
(6) Is strong light, such as sunlight (e.g., reflected from a wall), shining on the Receiver?
(7) Do not attempt to disassemble or repair the Sensor under any circumstances.
(8) If you determine that the Sensor clearly has a failure, immediately turn OFF the power supply.

Lens and Case

The lens and case of the Photoelectric Sensor are primarily made of plastic. Dirt should be gently wiped off with a dry cloth. Do not use thinner or other organic solvents.

- The case of the E3ZM, E3ZM-C and E3S-C is metal. The lens, however, is plastic.

● Accessories

Using a Reflector (E39-R3/R37/RS1/RS2/RS3)

During Application

(1) When using adhesive tape on the rear face, apply it after washing away oil and dust with detergent. The Reflector cannot be mounted if there is any oil or dirt remaining.
(2) Do not press on the E39-RS1/RS2/RS3 with metal or a fingernail.This may weaken performance.
(3) This Sensor cannot be used in locations where oil or chemicals may splash on the Sensor.

M8 and M12 Connectors

- Be sure to connect or disconnect the connector after turning OFF the Sensor.
- Hold the connector cover to connect or disconnect the connector.
- Secure the connector cover by hand. Do not use pliers, otherwise the connector may be damaged.
- If the connector is not connected securely, the connector may be disconnected by vibration or the proper degree of protection of the Sensor may not be maintained.

● Others

Values Given in Typical Examples

The data and values given as typical examples are not ratings and performance and do not indicate specified performance. They are rather values from samples taken from production lots, and are provided for reference as guidelines. Typical examples include the minimum sensing object, engineering data, step (height) detection data, and selection list for specifications.

Cleaning

- Keep organic solvents away from the Sensor. Organic solvents will dissolve the surface.
- Use a soft, dry cloth to clean the Sensor.

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