Laser Photoelectric Sensor with Built-in Amplifier

E3Z-LT/LR/LL

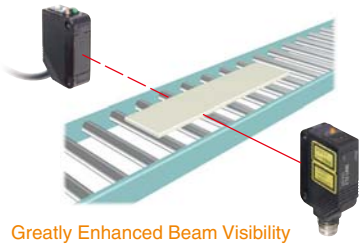
The Most Compact Laser Sensor
The Most Reliable E3Z

- Excellent quality of E3Z such as the maximum ambient operating temperate of 55°C, IP67 degree of protection is inherited.
- Safe and reliable class 1 (JIS/IEC) laser used
- Excellent detection performance supporting long distance and low hysteresis
- Complete Compliance with RoHS
- Spot diameters can be customized.
  Increasing the spot diameter makes optical axis adjustment easier.

⚠ Be sure to read *Safety Precautions* on page 9.

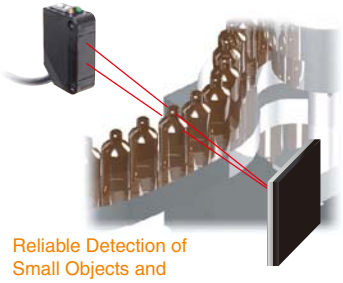
Applications

Detect the sides of large tiles.



Greatly Enhanced Beam Visibility
for Easier Optical Axis Adjustment of Sensors

Count bottles.

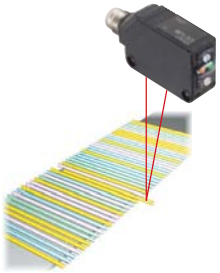


Reliable Detection of
Small Objects and
Narrow Gaps with the Small Spot

Detect chip components on tape.

Long-distance Sensing
at 300 mm (White Paper)

Detect protruding straws.



A Low Black/White Error for
Applications with Mixed Colors

Optical Customization for E3Z Lasers That Fit the Application!

The E3Z laser system has an original modular structure. Spot diameters can be customized, as shown in the examples below.
For example, when a through-beam model is used at far range, the optical axis can be easily adjusted by widening the spot, and minute objects can be easily detected by minimizing the spot at close range. These applications improve product value.

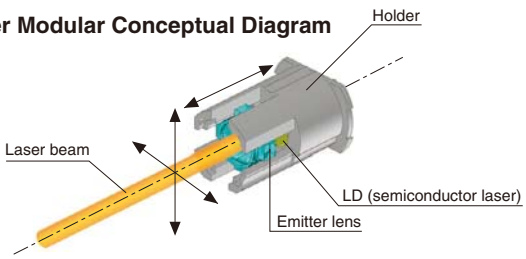
Advanced Optical Technology of the E3Z Laser

Laser beam directional deviation can be suppressed and spot diameters can be freely customized.

This is achieved through high-precision alignment technology based on LD and emitter lens modularization.

The lens position can be adjusted inline. (Patent pending.)

Laser Modular Conceptual Diagram

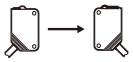
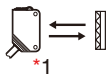


By precisely adjusting the emitter lens in the vertical, horizontal, and depth directions, alignment can be achieved with minimal directional deviation (to ±1 degree).

Ordering Information

Sensors

Red light

Sensing method	Appearance	Connection method	Response time	Sensing distance	Model	
					NPN output	PNP output
Through-beam		Pre-wired (2 m)*3	1 ms	*4 60 m	E3Z-LT61	E3Z-LT81
		Connector (M8, 4 pins)			E3Z-LT66	E3Z-LT86
Retro-reflective with MSR function	 *1	Pre-wired (2 m)*3		*2 15 m (300 mm) (Using E39-R1) 7 m (200 mm) (Using E39-R12) 7 m (200 mm) (Using E39-R6)	E3Z-LR61	E3Z-LR81
		Connector (M8, 4 pins)			E3Z-LR66	E3Z-LR86
Distance-settable (BGS Models)		Pre-wired (2 m)*3		20 to 40 mm (Min. distance set) 20 to 300 mm (Max. distance set)	E3Z-LL61	E3Z-LL81
		Connector (M8, 4 pins)			E3Z-LL66	E3Z-LL86
		Pre-wired (2 m)*3	0.5 ms	25 to 40 mm (Min. distance set) 25 to 300 mm (Max. distance set)	E3Z-LL63	E3Z-LL83
		Connector (M8, 4 pins)			E3Z-LL68	E3Z-LL88

*1. The Reflector is sold separately. Select the Reflector model most suited to the application.
*2. Values in parentheses indicate the minimum required distance between the Sensor and Reflector.
*3. Pre-wired Models with a 0.5-m cable are also available for these products. When ordering, specify the cable length by adding "0.5M" to the end of the model number (e.g., E3Z-LT61 0.5M).
M12 Pre-wired Connector Models are also available. When ordering, add "-M1J" to the end of the model number (e.g., E3Z-LT61-M1J). The cable is 0.3 m long.
The following connection forms are also available. Ask your OMRON representative for details.
• Pre-wired Models with 1-m or 5-m cables
• Pre-wired Connector Models with M8 4-pin connectors, M8 3-pin connectors, or e-CON connectors.
*4. Consult with your OMRON representative if a distance of more than 10 m is required. Models with large custom-size spots can be produced. These make optical axis adjustment easier and allow the beam to be received more stably by the Receiver even if vibration is present.

Accessories

Slits (for E3Z-LT□□)

Slit width	Sensing distance	Minimum detectable object (typical)	Model	Contents
0.5 mm dia.	3 m	0.1 mm dia.	E39-S65A	One set (contains Slits for both the Emitter and Receiver)

Reflectors (for E3Z-LR□□)

Name	Sensing distance (typical)	Model	Remarks
Reflector	15 m (300 mm)	E39-R1	• Retro-reflective models are not provided with Reflectors. • Separate the Sensor and the Reflector by at least the distance given in parentheses. • The MSR function is enabled.
	7 m (200 mm)	E39-R12	
	7 m (200 mm)	E39-R6	

Mounting Brackets

Appearance	Model	Quantity	Remarks	Appearance	Model	Quantity	Remarks
	**E39-L153**	1	Mounting Brackets		**E39-L98**	1	Metal Protective Cover Bracket *
	**E39-L104**	1			**E39-L150**	1 set	(Sensor adjuster) Easily mounted to the aluminum frame rails of conveyors and easily adjusted. For left to right adjustment
	**E39-L43**	1	Horizontal Mounting Bracket *		**E39-L151**	1 set	
	**E39-L142**	1	Horizontal Protective Cover Bracket *				
	**E39-L44**	1	Rear Mounting Bracket		**E39-L144**	1	Compact Protective Cover Bracket (For E3Z only) *

Note: When using Through-beam models, order one bracket for the Receiver and one for the Emitter.
* Cannot be used for Standard Connector models.

Sensor I/O Connectors

Size	Cable	Appearance	Cable type		Model
M8	Standard	Straight 	2 m	4-wire	**XS3F-M421-402-A**
			5 m		**XS3F-M421-405-A**
		L-shaped 	2 m		**XS3F-M422-402-A**
			5 m		**XS3F-M422-405-A**
M12 (For -M1J models)		Straight 	2 m	3-wire	**XS2F-D421-DC0-A**
			5 m		**XS2F-D421-GC0-A**
		L-shaped 	2 m		**XS2F-D422-DC0-A**
			5 m		**XS2F-D422-GC0-A**
e-CON		Connector on One End 	2 m	4-wire	**E39-ECON2M**
			5 m		**E39-ECON5M**
		Connectors of Both Ends 	0.5 to 1 m		**E39-ECONW□M** Replace the box (□) in the model number by the cable length in increments of 0.1 m.
			1.1 to 1.5 m		
			1.6 to 2 m		

Ratings and Specifications

Item		Sensing method	Through-beam	Retro-reflective with MSR function	Distance-settable (BGS models)	
		Response	Standard response			High-speed response
Model		NPN output	E3Z-LT61/-LT66	E3Z-LR61/-LR66	E3Z-LL61/-LL66	E3Z-LL63/-LL68
		PNP output	E3Z-LT81/-LT86	E3Z-LR81/-LR86	E3Z-LL81/-LL86	E3Z-LL83/-LL88
Sensing distance			60 m *	0.3 to 15 m (when using E39-R1) 0.2 to 7 m (when using E39-R12) 0.2 to 7 m (when using E39-R6)	White paper (100 × 100 mm): 20 to 300 mm Black paper (100 × 100 mm): 20 to 160 mm	White paper (100 × 100 mm): 25 to 300 mm Black paper (100 × 100 mm): 25 to 100 mm
Set distance range			---		White paper (100 × 100 mm): 40 to 300 mm Black paper (100 × 100 mm): 40 to 160 mm	White paper (100 × 100 mm): 40 to 300 mm Black paper (100 × 100 mm): 40 to 100 mm
Spot diameter (typical)			5-mm dia. at 3 m		0.5-mm dia. at 300 mm	
Standard sensing object			Opaque: 12-mm dia. min.	Opaque: 75-mm dia. min.	---	
Minimum detectable object (typical)			6-mm-dia. opaque object at 3 m		0.2-mm-dia. stainless-steel pin gauge at 300 mm	
Differential travel			---		5% max. of set distance	
Black/white error			---		5% at 160 mm	5% at 100 mm
Directional angle			Receiver: 3 to 15°	---		
Light source (wavelength)			Red LD (655 nm), JIS CLass 1, IEC Class 1, FDA Class II			
Power supply voltage			12 to 24 VDC±10%, ripple (p-p): 10% max.			
Current consumption			35 mA (Emitter 15 mA, Receiver 20 mA)	30 mA max.		
Control output			Load power supply voltage: 26.4 VDC max., Load current: 100 mA max., Open collector output			
Residual output voltage			Load current of less than 10 mA: 1 V max. Load current of 10 to 100 mA: 2 V max.			
Output mode switching			Switch to change between light-ON and dark-ON			
Protection circuits			Reversed power supply polarity protection, Output short-circuit protection, and Reversed output polarity protection	Reversed power supply polarity protection, Output short-circuit protection, Mutual interference prevention, and Reversed output polarity protection		
Response time			Operate or reset: 1 ms max.			Operate or reset: 0.5 ms max.
Sensitivity adjustment			One-turn adjuster		Five-turn endless adjuster	
Ambient illumination (Receiver side)			Incandescent lamp: 3,000 lx max. Sunlight: 10,000 lx max.			
Ambient temperature range			Operating: –10 to 55°C, Storage: –25 to 70°C (with no icing or condensation)			
Ambient humidity range			Operating: 35% to 85%, Storage: 35% to 95% (with no icing or condensation)			
Insulation resistance			20 MΩ min. at 500 VDC			
Dielectric strength			1,000 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			
Shock resistance			Destruction: 500 m/s² 3 times each in X, Y, and Z directions			
Degree of protection			IP67 (IEC 60529)			
Connection method			Pre-wired cable (standard length: 2 m): E3Z-L□□1/-L□□3 Standard M8 Connector: E3Z-L□□6/-L□□8			
Indicator			Operation indicator (orange) Stability indicator (green) Emitter for Through-bream Models has power indicator (orange) only.			
Weight (packed state)	Pre-wired cable (2 m)		Approx. 120 g	Approx. 65 g		
	Standard Connector		Approx. 30 g	Approx. 20 g		
Material	Case		PBT (polybutylene terephthalate)			
	Lens		Modified polyarylate resin	Methacrylic resin	Modified polyarylate resin	
Accessories			Instruction manual (Neither Reflectors nor Mounting Brackets are provided with any of the above models.)			

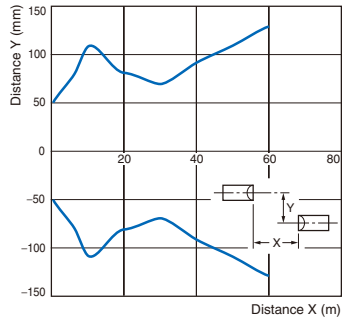
Note: An emission stop function can be added to Through-beam Models as a custom function. Ask your OMRON representative for details.

* Consult with your OMRON representative if a distance of more than 10 m is required. Models with large custom-size spots can be produced. These make optical axis adjustment easier and allow the beam to be received more stably by the Receiver even if vibration is present.

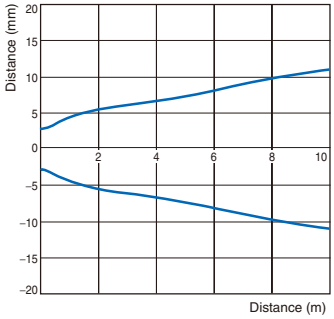
Engineering Data (Typical)

Parallel Operating Range

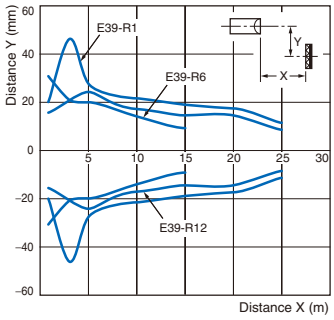
Through-beam Models
E3Z-LT□□



Through-beam Models
E3Z-LT□□ + E39-65A

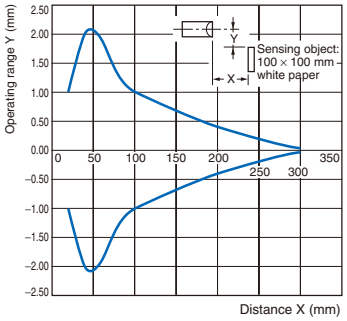


Retro-reflective Models
E3Z-LR□□



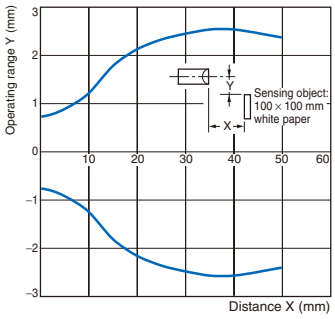
Operating Range at a Set Distance of 300 mm

BGS Models
E3Z-LL□□



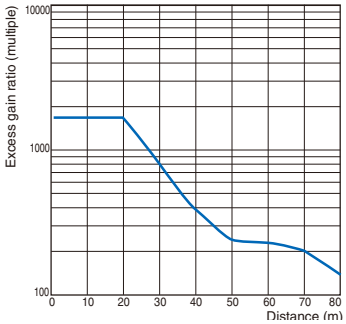
Operating Range at a Set Distance of 40 mm

BGS Models
E3Z-LL□□

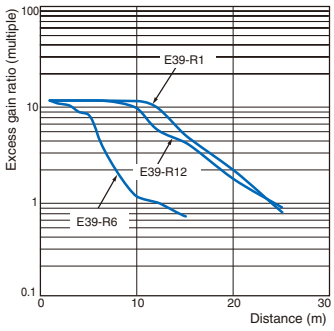


Excess Gain vs. Set Distance

Through-beam Models
E3Z-LT□□

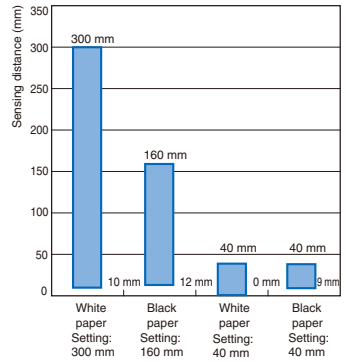


Retro-reflective Models
E3Z-LR□□

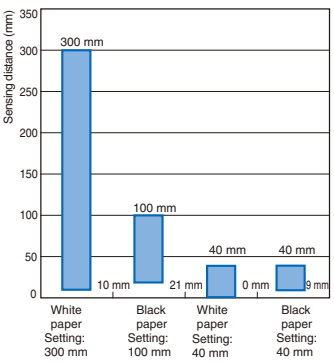


Close Range Characteristics

BGS Models
E3Z-LL□1/-LL□6



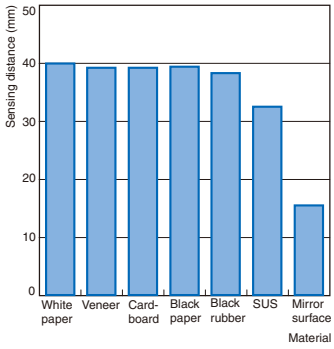
E3Z-LL□3/-LL□8



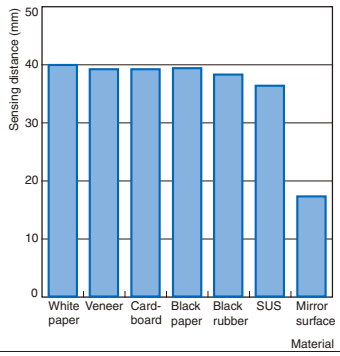
Sensing Distance vs. Sensing Object Material

BGS Models

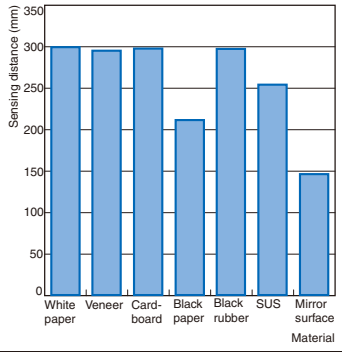
E3Z-LL□1/-LL□6
White Paper with a Set Distance of 40 mm



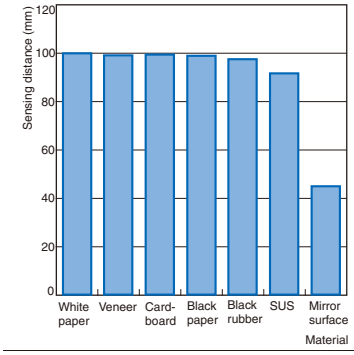
E3Z-LL□3/-LL□8
White Paper with a Set Distance of 40 mm



E3Z-LL□1/-LL□6
White Paper with a Set Distance of 300 mm



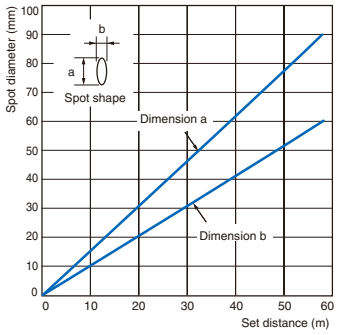
E3Z-LL□3/-LL□8
White Paper with a Set Distance of 100 mm



Emission Spot Diameter vs. Distance

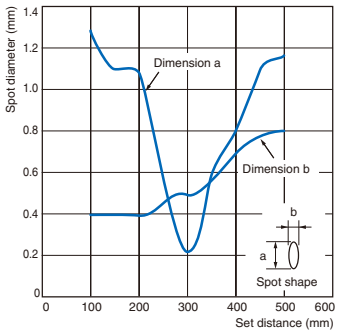
Through-beam and Retro-reflective Models (Same for All Models)

E3Z-LT□□, E3Z-LR□□



BGS Models (Same for All Models)

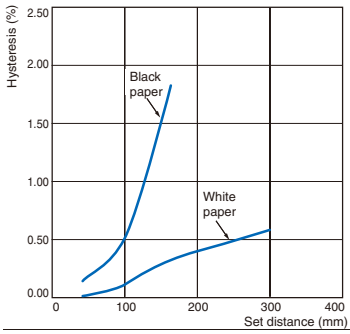
E3Z-LL□□



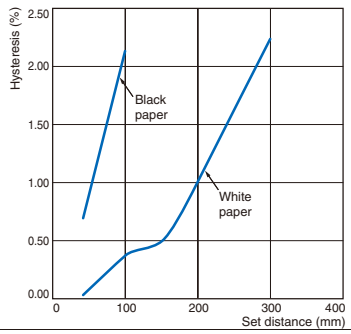
Hysteresis vs. Distance

BGS Models

E3Z-LL□1 (LL□6)



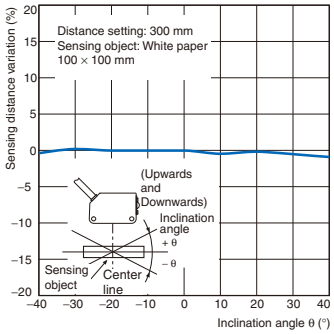
E3Z-LL□3 (LL□8)



Inclination Characteristics (Vertical)

BGS Models

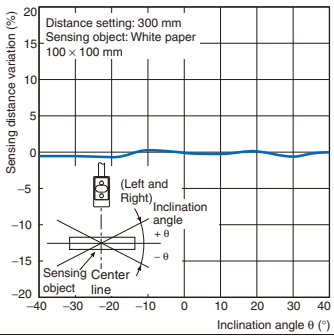
E3Z-LL□□



Inclination Characteristics (Horizontal)

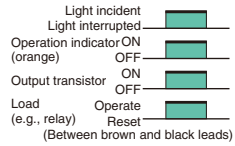
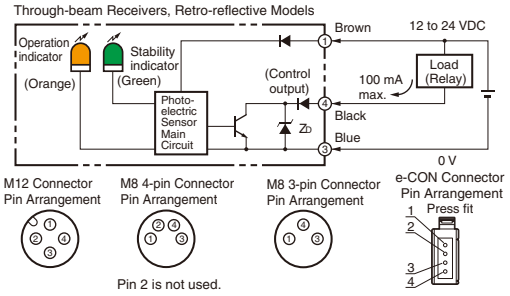
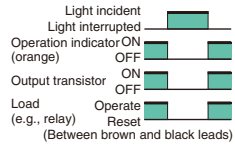
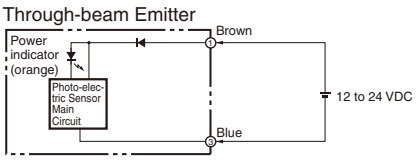
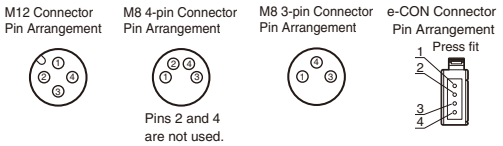
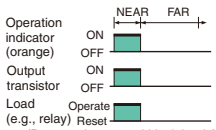
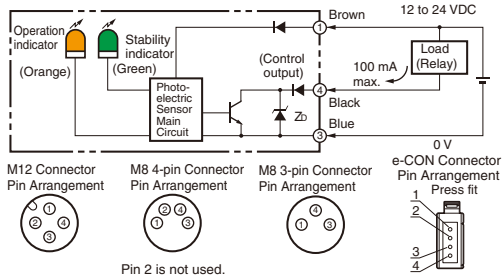
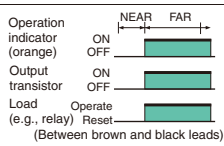
BGS Models

E3Z-LL□□

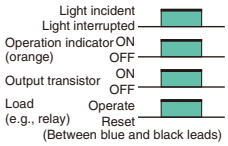
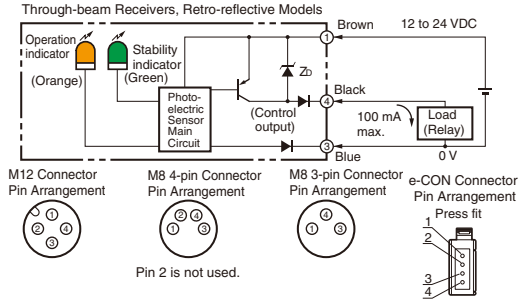
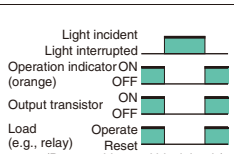
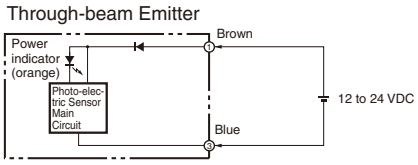
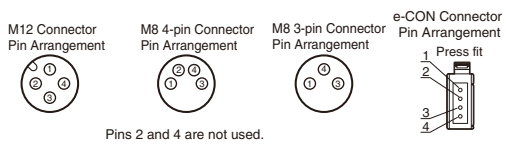
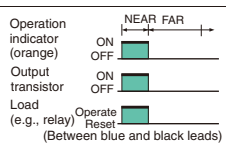
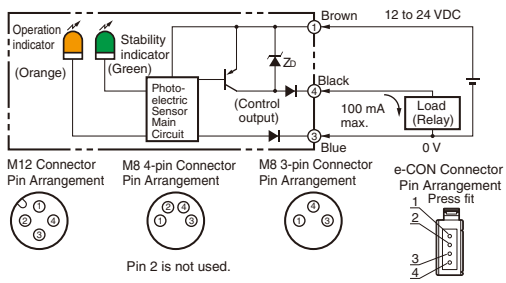
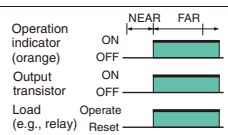


I/O Circuit Diagrams

NPN Output

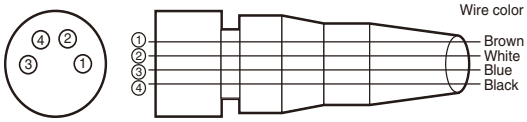
Model	Operation mode	Timing charts	Operation selector	Output circuit
E3Z-LT61 E3Z-LT66 E3Z-LR61 E3Z-LR66	Light-ON		L side (LIGHT ON)	
	Dark-ON		D side (DARK ON)	
				
E3Z-LL61 E3Z-LL66 E3Z-LL63 E3Z-LL68	Light-ON		L side (LIGHT ON)	
	Dark-ON		D side (DARK ON)	

PNP Output

Model	Operation mode	Timing charts	Operation selector	Output circuit
E3Z-LT81 E3Z-LT86 E3Z-LR81 E3Z-LR86	Light-ON		L side (LIGHT ON)	
	Dark-ON		D side (DARK ON)	
				
E3Z-LL81 E3Z-LL86 E3Z-LL83 E3Z-LL88	Light-ON		L side (LIGHT ON)	
	Dark-ON		D side (DARK ON)	

Plugs (Sensor I/O Connectors)

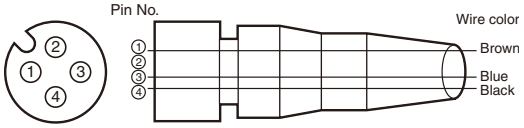
M8 4-pin Connectors



XS3F-M421-402-A
XS3F-M421-405-A

XS3F-M422-402-A
XS3F-M422-405-A

M12 Connectors



XS2F-D421-DC0-A
XS2F-D421-GC0-A

XS2F-D422-DC0-A
XS2F-D422-GC0-A

e-CON Connector

E39-ECON□M

E39-ECONW□M

Classification	Wire color	Connector pin No.	Application
DC	Brown	1	Power supply (+V)
	White	2	---
	Blue	3	Power supply (0 V)
	Black	4	Output

Note: 1. Pin 2 is not used.
2. The above M8 and M12 Connectors made by OMRON are IP67.

Nomenclature

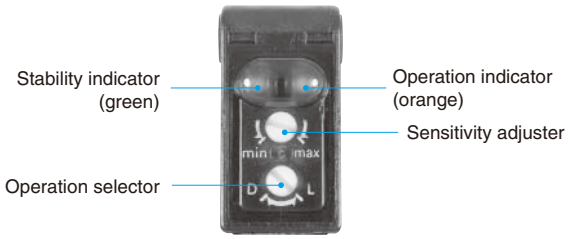
Sensors with Sensitivity Adjustment and Mode Selector Switch

Through-beam Models

E3Z-LT□□ (Receiver)

Retro-reflective Models

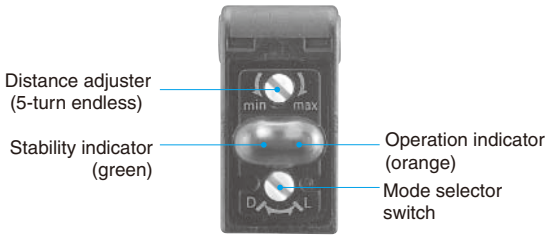
E3Z-LR□□



Distance-settable Sensor

BGS Models

E3Z-LL□□



Safety Precautions

Refer to *Warranty and Limitations of Liability*.

⚠ WARNING

This product is not designed or rated for ensuring safety of persons. Do not use it for such purpose.

To ensure safe use of laser products, do not allow the laser beam to enter your eye. Direct exposure may adversely affect your eyesight.

⚠ CAUTION

Do not connect an AC power supply to the Sensor. If AC power (100 VAC or more) is supplied to the Sensor, it may explode or burn.

Precautions for Safe Use

Be sure to abide by the following precautions for the safe operation of the Sensor.

● Operating Environment

Do not use the Sensor in locations with explosive or flammable gas.

● Wiring

Power Supply Voltage and Output Load Power Supply Voltage

Make sure that the power supply to the Sensor is within the rated voltage range. If a voltage exceeding the rated voltage range is supplied to the Sensor, it may explode or burn.

Power Supply Voltage

The maximum power supply voltage is 26.4 VDC. Applying a voltage exceeding the rated range may damage the Sensor or cause burning.

Load

Do not use a load that exceeds the rated load.

Load Short-circuiting

Do not short-circuit the load, otherwise the Sensor may be damaged or it may burn.

Connection without Load

Do not connect the power supply to the Sensor with no load connected, otherwise the internal elements may explode or burn. Always connect a load when wiring.

Precautions for Correct Use

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

● Laser Warning Labels

Be sure that the correct laser warning label (enclosed) is attached for the country of intended use of the equipment containing the Photoelectric Sensor. Refer to the user's manual for details.

● Usage Environment

Water Resistance

The Sensor is rated IP67. Do not use it in water, in the rain, or outdoors.

Ambient Environment

Do not install the product in the following locations. Doing so may result in product failure or malfunction.

- Locations subject to excess dust and dirt
- Locations subject to direct sunlight
- Locations subject to corrosive gas
- Locations subject to organic solvents
- Locations subject to shock or vibration
- Locations subject to exposure to water, oil, or chemicals
- Locations subject to high humidity or condensation

● Designing

Power Reset Time

The Sensor is ready to operate 100 ms after the Sensor is turned ON. If the load and Sensor are connected to independent power supplies respectively, be sure to turn ON the Sensor before supplying power to the load.

● Wiring

Avoiding Malfunctions

If using the Sensor with an inverter or servomotor, always ground the FG (frame ground) and G (ground) terminals, otherwise the Sensor may malfunction.

● Mounting

Mounting the Sensor

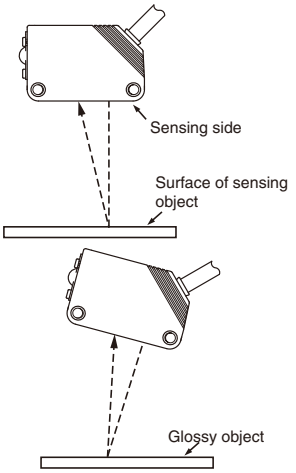
- If Sensors are mounted face-to-face, make sure that the optical axes are not in opposition to each other. Otherwise, mutual interference may result.
- Always install the Sensor carefully so that the aperture angle range of the Sensor will not cause it to be directly exposed to intensive light, such as sunlight, fluorescent light, or incandescent light.
- Do not strike the Photoelectric Sensor with a hammer or any other tool during the installation of the Sensor, or the Sensor will lose its water-resistive properties.
- Use M3 screws to mount the Sensor.
- When mounting the case, make sure that the tightening torque applied to each screw does not exceed 0.54 N·m.

Metal Connectors

- Always turn OFF the power supply to the Sensor before connecting or disconnecting the metal connector.
- Hold the connector cover to connect or disconnect it.
  If the XS3F is used, always tighten the connector cover by hand. Do not use pliers.
  If the tightening is insufficient, the degree of protection will not be maintained and the Sensor may become loose due to vibration.
  The appropriate tightening torque is 0.3 to 0.4 N·m.
  If other commercially available connectors are used, follow the recommended connector application conditions and recommended tightening torque specifications.

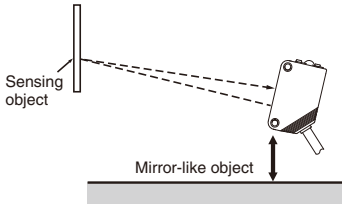
Mounting Direction for Distance-settable Models

- Make sure that the sensing side of the Sensor is parallel with the surface of the sensing objects. Normally, do not incline the Sensor towards the sensing object.

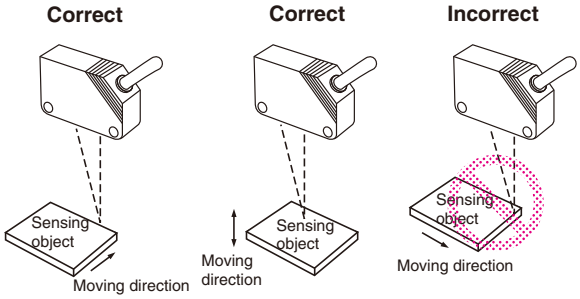


If the sensing object has a glossy surface, however, incline the Sensor by 5° to 10° as shown in the illustration, provided that the Sensor is not influenced by background objects.

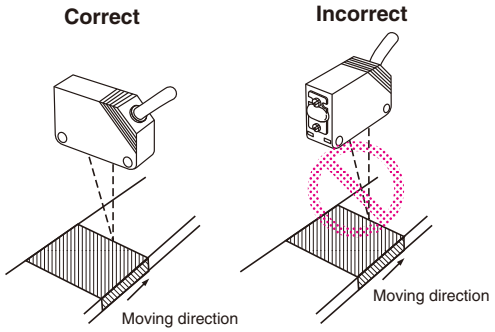
- If there is a mirror-like object below the Sensor, the Sensor may not operate stably. Therefore, incline the Sensor or separate the Sensor from the mirror-like object as shown below.



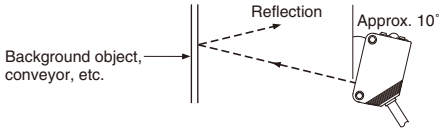
- Do not install the Sensor in the wrong direction. Refer to the following illustration.



Install the Sensor as shown in the following illustration if each sensing object greatly differs in color or material.

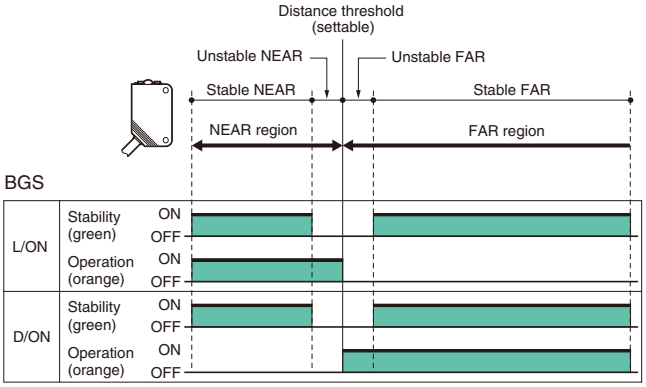


- The stability indicator may turn off in reaction to reflection from background objects. In such cases, incline the Sensor by 10° as shown in the illustration for more stable detection.



● Adjusting Distance-settable Models

Indicator Operation



Note: If the stability indicator is lit, the detection/no detection status is stable within the rated ambient operating temperature (–10 to 55°C).

● Inspection and Maintenance

Cleaning

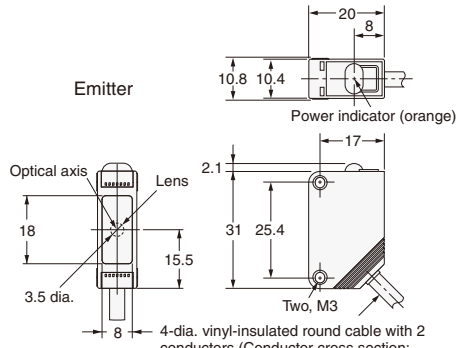
Never use paint thinners or other organic solvents to clean the surface of the product.

Dimensions

(Unit: mm)

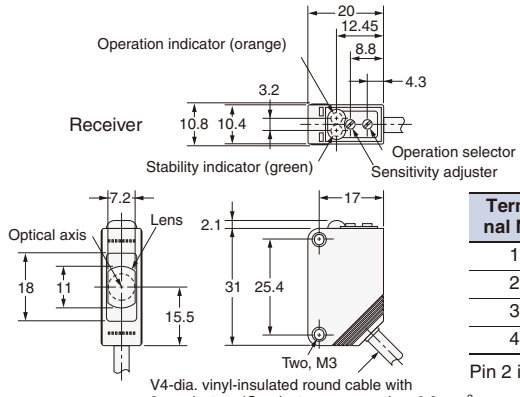
Sensors

Through-beam
Pre-wired Models
E3Z-LT61
E3Z-LT81



Terminal No.	Specifications
1	+V
2	---
3	0 V
4	---

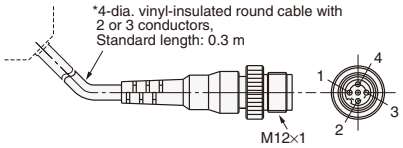
Pins 2 and 4 are not used.



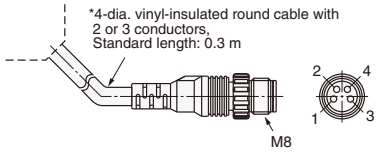
Terminal No.	Specifications
1	+V
2	---
3	0 V
4	Output

Pin 2 is not used.

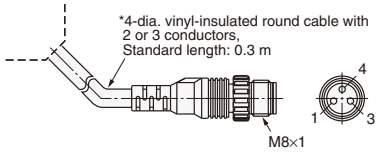
M12 Pre-wired Connector
(E3Z-LT□□-M1J)



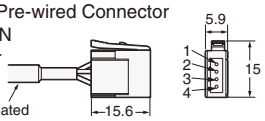
M8 Pre-wired Connector
(Ask your OMRON representative for details.)



M8 3-pin Pre-wired Connector
(Ask your OMRON representative for details.)

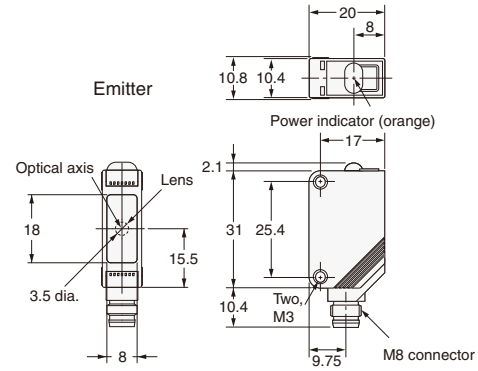


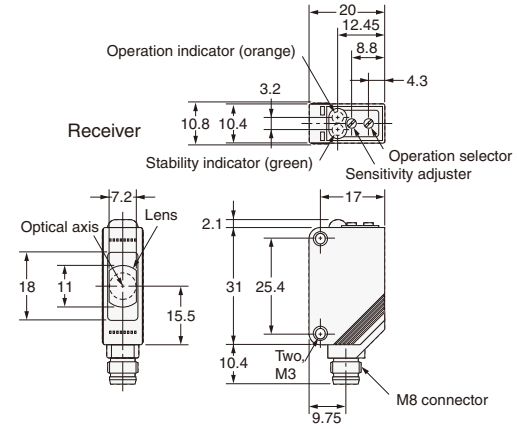
Press-fit e-CON Pre-wired Connector
(Ask your OMRON representative for details.)



* The Emitter cable has two conductors and the Receiver cable has three conductors.

Through-beam
Standard Connector Models
E3Z-LT66
E3Z-LT86

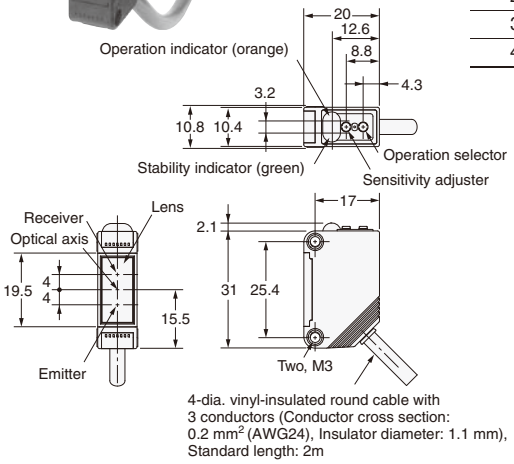




Retro-reflective Models

Pre-wired Models

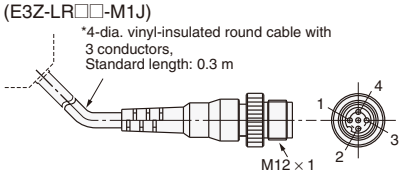
E3Z-LR61
E3Z-LR81



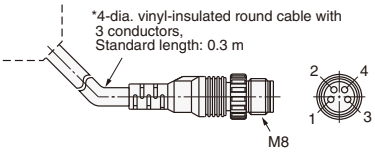
4-dia. vinyl-insulated round cable with 3 conductors (Conductor cross section: 0.2 mm^2 (AWG24), Insulator diameter: 1.1 mm), Standard length: 2m

Terminal No.	Specifications
1	+V
2	---
3	0 V
4	Output

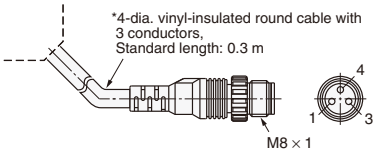
M12 Pre-wired Connector
(E3Z-LR□□-M1J)



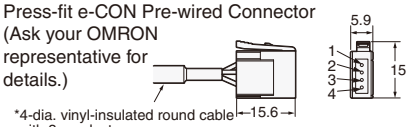
M8 Pre-wired Connector
(Ask your OMRON representative for details.)



M8 3-pin Pre-wired Connector
(Ask your OMRON representative for details.)



Press-fit e-CON Pre-wired Connector
(Ask your OMRON representative for details.)

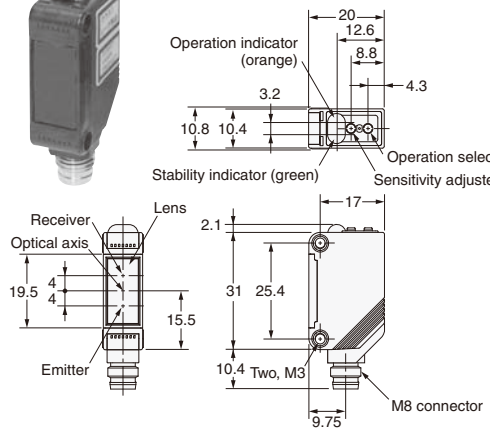


*4-dia. vinyl-insulated round cable with 3 conductors, Standard length: 0.3 m, 2 m

Retro-reflective Models

Standard Connector Models

E3Z-LR66
E3Z-LR86

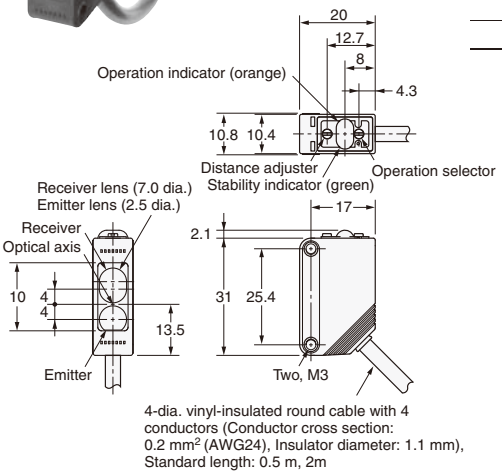


BGS Models

Pre-wired Models

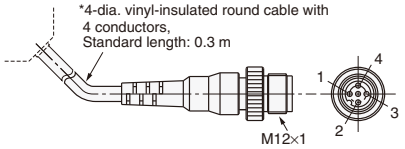
E3Z-LL61
E3Z-LL81
E3Z-LL63
E3Z-LL83

Terminal No.	Specifications
1	+V
2	---
3	0 V
4	Output

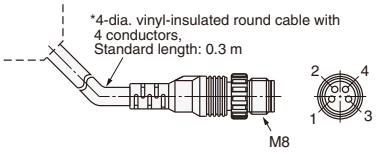


4-dia. vinyl-insulated round cable with 4 conductors (Conductor cross section: 0.2 mm^2 (AWG24), Insulator diameter: 1.1 mm), Standard length: 0.5 m, 2m

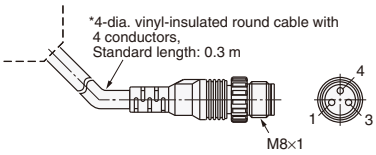
M12 Pre-wired Connector
(E3Z-LL□□-M1J)



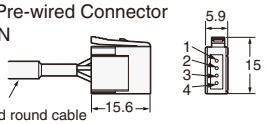
M8 Pre-wired Connector
(Ask your OMRON representative for details.)



M8 3-pin Pre-wired Connector
(Ask your OMRON representative for details.)



Press-fit e-CON Pre-wired Connector
(Ask your OMRON representative for details.)

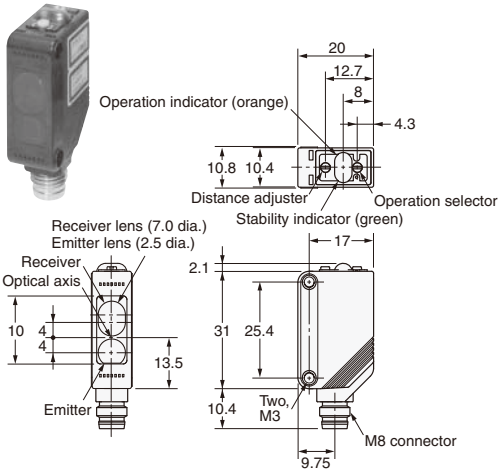


*4-dia. vinyl-insulated round cable with 4 conductors, Standard length: 0.3 m, 2 m

BGS Models

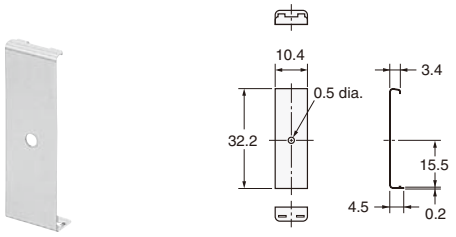
Standard M8 Connector Models

E3Z-LL66
E3Z-LL86
E3Z-LL68
E3Z-LL88



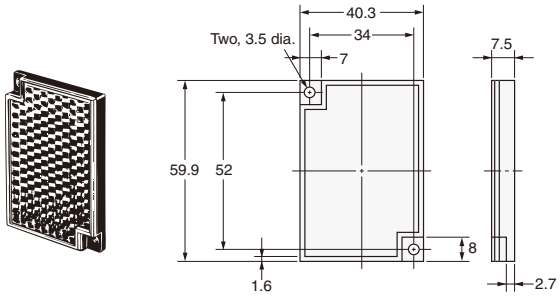
Accessories (Order Separately)

Slit
E39-S65A



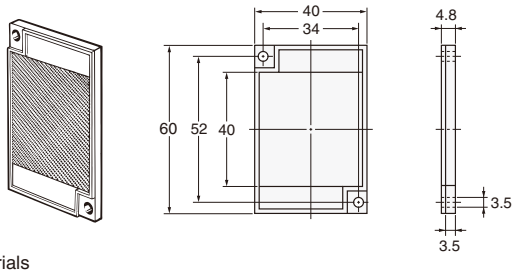
Material
SUS301 stainless steel

Reflector
E39-R1



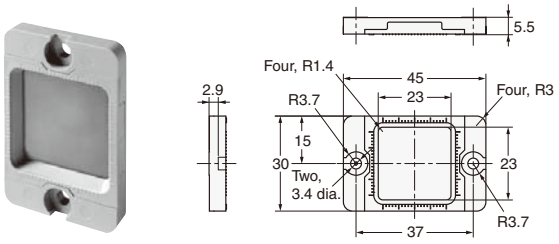
Materials
Reflective surface: Acrylic
Rear surface: ABS

Reflector
E39-R6



Materials
Reflective surface: Acrylic
Rear surface: ABS

Reflector
E39-R12



Materials
Reflector: Polycarbonate (surface)
Acrylic (interior)
Frame: ABS

In the interest of product improvement, specifications are subject to change without notice.

General Precautions

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

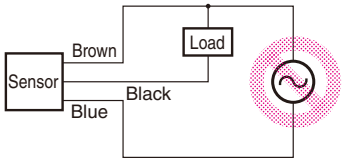
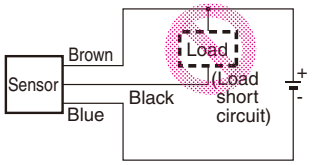
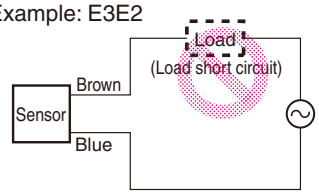
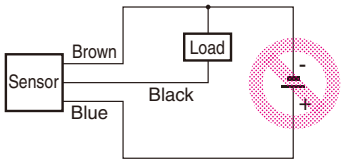
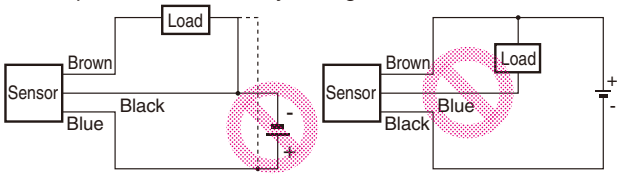
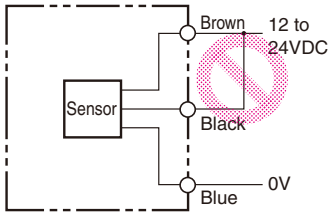
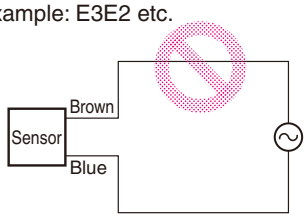
⚠ WARNING

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

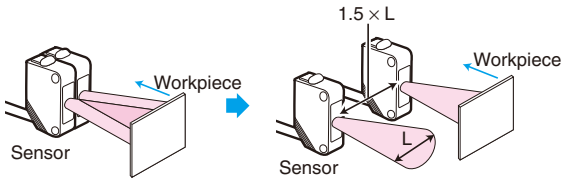
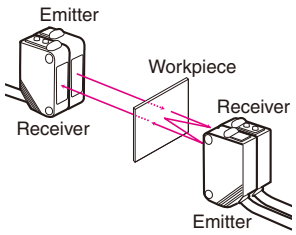
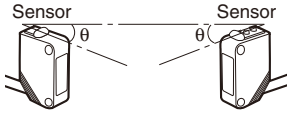
An output pulse may be generated when the power is turned OFF. It is recommended that the load or load line power be turned OFF before the Sensor power is turned OFF.

Power Supply Types

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

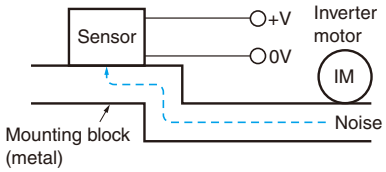
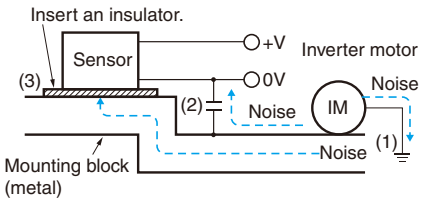
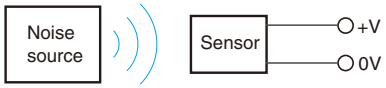
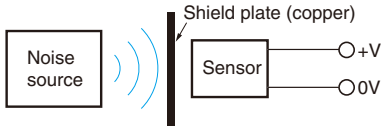
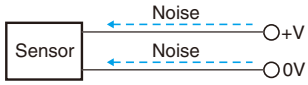
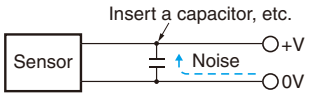
Mutual Interference

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.

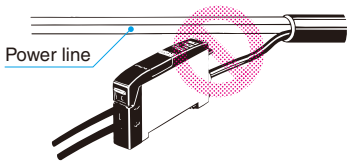
Note: Do not subject a shielded cable or coaxial cable to tension.

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.

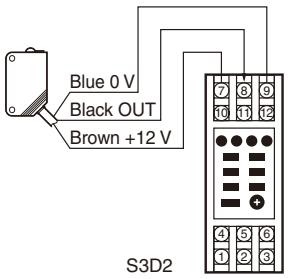
Power Supply

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

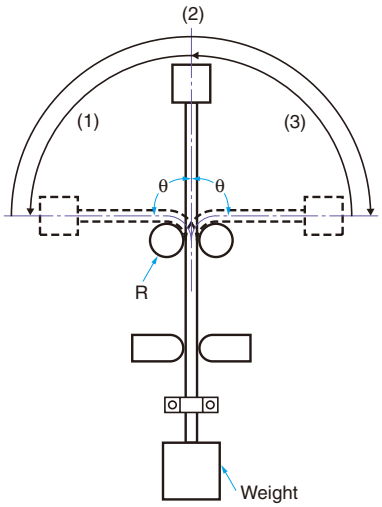
Attachment to Moving Parts

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

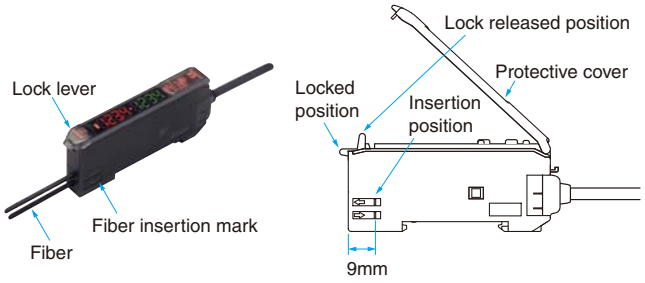
The testing conditions of the standard cable and robot cable are different.
Refer to the values in the above table to check bend-resistant performance under actual working conditions.

Securing Fibers

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

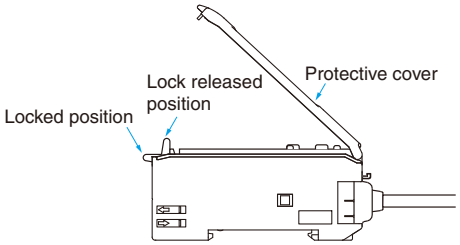
(1) Attaching Fibers

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.

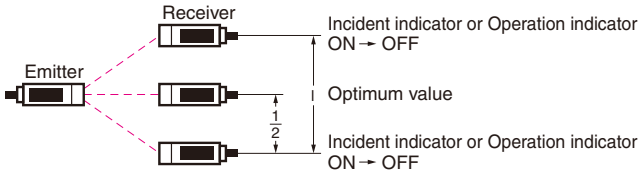


Note: 1. To maintain the fiber characteristics, make sure that the lock is released before removing the fibers.
2. Lock and unlock the fibers at an ambient temperature of −10 to 40°C.

● Adjustments

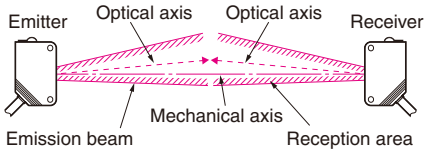
Optical Axis Adjustment

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

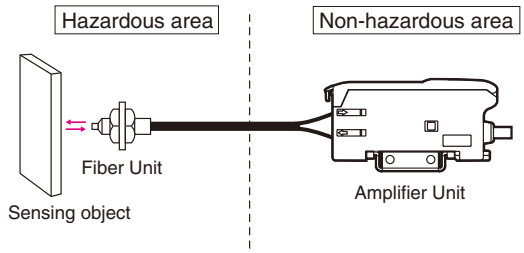
The Fiber Unit can be installed in the hazardous area, and the Amplifier Unit can be installed in a non-hazardous area.

<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.

Read and Understand This Catalog

Please read and understand this catalog before purchasing the products. Please consult your OMRON representative if you have any questions or comments.

Warranty and Limitations of Liability

WARRANTY

OMRON's exclusive warranty is that the products are free from defects in materials and workmanship for a period of one year (or other period if specified) from date of sale by OMRON.

OMRON MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, REGARDING NON-INFRINGEMENT, MERCHANTABILITY, OR FITNESS FOR PARTICULAR PURPOSE OF THE PRODUCTS. ANY BUYER OR USER ACKNOWLEDGES THAT THE BUYER OR USER ALONE HAS DETERMINED THAT THE PRODUCTS WILL SUITABLY MEET THE REQUIREMENTS OF THEIR INTENDED USE. OMRON DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED.

LIMITATIONS OF LIABILITY

OMRON SHALL NOT BE RESPONSIBLE FOR SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS, OR COMMERCIAL LOSS IN ANY WAY CONNECTED WITH THE PRODUCTS, WHETHER SUCH CLAIM IS BASED ON CONTRACT, WARRANTY, NEGLIGENCE, OR STRICT LIABILITY.

In no event shall responsibility of OMRON for any act exceed the individual price of the product on which liability is asserted.

IN NO EVENT SHALL OMRON BE RESPONSIBLE FOR WARRANTY, REPAIR, OR OTHER CLAIMS REGARDING THE PRODUCTS UNLESS OMRON'S ANALYSIS CONFIRMS THAT THE PRODUCTS WERE PROPERLY HANDLED, STORED, INSTALLED, AND MAINTAINED AND NOT SUBJECT TO CONTAMINATION, ABUSE, MISUSE, OR INAPPROPRIATE MODIFICATION OR REPAIR.

Application Considerations

SUITABILITY FOR USE

OMRON shall not be responsible for conformity with any standards, codes, or regulations that apply to the combination of products in the customer's application or use of the product.

At the customer's request, OMRON will provide applicable third party certification documents identifying ratings and limitations of use that apply to the products. This information by itself is not sufficient for a complete determination of the suitability of the products in combination with the end product, machine, system, or other application or use.

The following are some examples of applications for which particular attention must be given. This is not intended to be an exhaustive list of all possible uses of the products, nor is it intended to imply that the uses listed may be suitable for the products:

- Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this catalog.
- Nuclear energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations.
- Systems, machines, and equipment that could present a risk to life or property.

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