Narrow-beam Photoelectric Sensor with Built-in Amplifier

E3Z-L

Small 2.5-mm-diameter Spot Ideal for Detecting Small Workpieces

- Tiny workpieces as little as 0.1 mm in diameter can be detected with the 2.5-mm-dia. spot.
- The narrow beam enables sensing from small slots or holes.
- The small spot of light enables visual checking of sensing spot position.
- IP67 degree of protection, mutual interference prevention, and EN standard compliance.

CE

⚠ Be sure to read *Safety Precautions* on page 4.

Ordering Information

Sensors

Infrared light

Sensing method	Appearance	Connection method	Sensing distance	Model	
				NPN output	PNP output
Narrow-beam reflective		Pre-wired	90±30 mm	E3Z-L61 *	E3Z-L81
		Connector (M8, 4pins)		E3Z-L66	E3Z-L86

* The following table shows the model numbers of e-CON Pre-wired Connectors that are available.
The Ratings and Specifications are the same as those for the E3Z-L61.

Cable length	Model
0.3 m	E3Z-L61-ECON 0.3M
0.5 m	E3Z-L61-ECON 0.5M
2 m	E3Z-L61-ECON 2M

Accessories (Order Separately)

Mounting Brackets

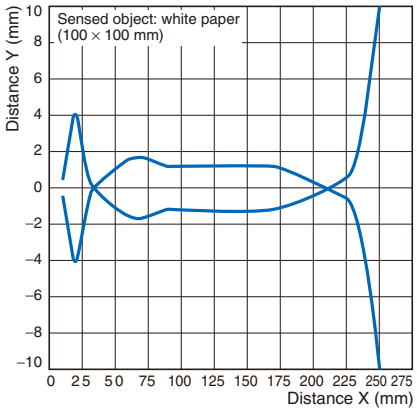
Sensor I/O Connectors

Ratings and Specifications

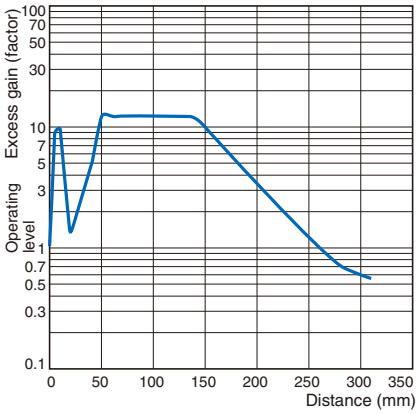
Item	Model	Narrow-beam reflective	
Sensing method		Narrow-beam reflective	
	NPN output	E3Z-L61	E3Z-L66
	PNP output	E3Z-L81	E3Z-L86
Sensing distance		White paper (100 × 100 mm): 90±30 mm	
Spot diameter (typical)		2.5-mm dia. min. (at sensing distance of 90 mm)	
Minimum detectable object (typical)		0.1-mm dia. (copper wire)	
Differential travel (typical)		Refer to *Differential Travel vs. Sensing Distance* on page 2.	
Light source (wavelength)		Red LED (650 nm)	
Power supply voltage		12 to 24 VDC ±10%, ripple (p-p): 10% max.	
Current consumption		30 mA max.	
Control output		Load power supply voltage: 26.4 V max.; Load current: 100 mA max. Residual voltage: Load current of less than 10 mA: 1 V max. Load current of 10 to 100 mA: 2 V max. Open collector output (NPN or PNP depending on model) Light-ON/Dark-ON selectable	
Protection circuits		Power supply reverse polarity protection, Output short-circuit protection, Mutual interference prevention, Reverse output polarity protection	
Response time		Operate or reset: 1 ms max.	
Sensitivity adjustment		One-turn adjuster	
Ambient illumination (Receiver side)		Incandescent lamp: 3,000 lx max., Sunlight: 10,000 lx max.	
Ambient temperature range		Operating: –25 to 55°C, Storage: –40 to 70°C (with no icing or condensation)	
Ambient humidity range		Operating: 35 to 85%, Storage: 35 to 95% (with no 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: 500m/s^2 3 times each in the X, Y, and Z directions	
Degree of protection		IP67 (IEC 60529)	
Connection method		Pre-wired (standard length: 2 m and 0.5 m)	Connector (M8, 4 pins)
Indicators		Operation indicator (orange), Stability indicator (green)	
Weight (packed state)		Pre-wired type, 2 m: Approx. 65 g	Approx. 20 g
Material	Case	PBT (polybutylene terephthalate)	
	Lens	Modified polyarylate	
Accessories		Instruction manual (Mounting Brackets must be ordered separately.)	

Engineering Data

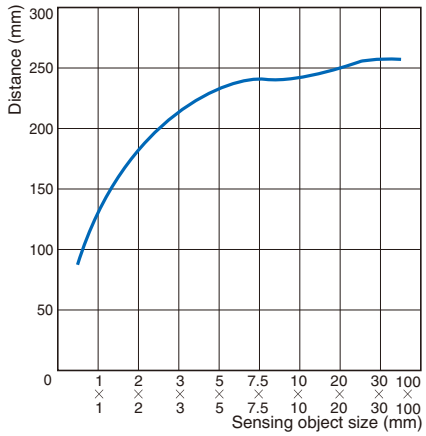
Operating Range



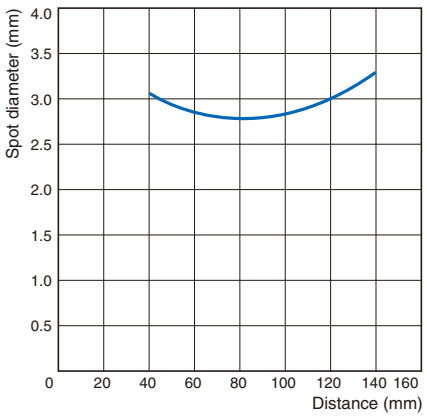
Excess Gain vs. Sensing Distance



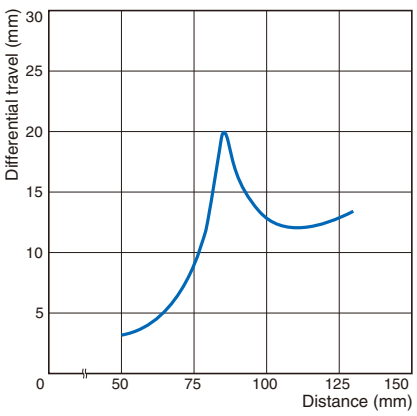
Sensing Object Size vs. Sensing Distance



Spot Diameter vs. Sensing Distance

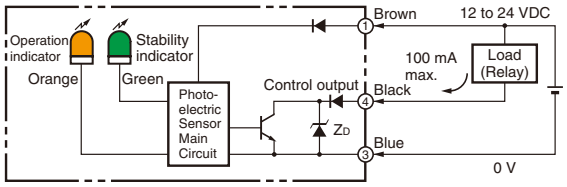
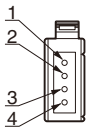


Differential Travel vs. Sensing Distance

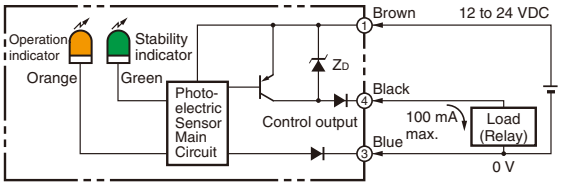


I/O Circuit Diagrams

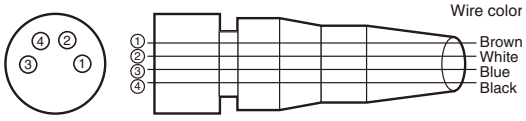
NPN Output

Model	Operation mode	Timing charts	Operation selector	Output circuit
E3Z-L61 E3Z-L66	Light-ON	Incident light No incident light Operation indicator (orange) ON OFF Output transistor ON OFF Load (e.g., relay) Operate Reset (Between brown and black leads)	L side (LIGHT ON)	Narrow-beam Reflective Models  Connector Pin Arrangement  Pin 2 is not used. e-CON Connector Pin Arrangement 
	Dark-ON	Incident light No incident light Operation indicator (orange) ON OFF Output transistor ON OFF Load (e.g., relay) Operate Reset (Between brown and black leads)	D side (DARK ON)	

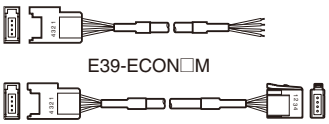
PNP Output

Model	Operation mode	Timing charts	Operation selector	Output connector
E3Z-L81 E3Z-L86	Light-ON	Incident light No incident light Operation indicator (orange) OFF ON Output transistor OFF Operate Load (e.g., relay) Reset (Between brown and black leads)	L side (LIGHT ON)	Narrow-beam Reflective Models  Connector Pin Arrangement  Pin 2 is not used.
	Dark-ON	Incident light No incident light Operation indicator (orange) ON OFF Output transistor ON OFF Load (e.g., relay) Operate Reset (Between brown and black leads)	D side (DARK ON)	

Plugs (Sensor I/O Connectors)



XS3F-M421-402-A
XS3F-M421-405-A
XS3F-M422-402-A
XS3F-M422-405-A



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: Pin 2 is not used.

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.

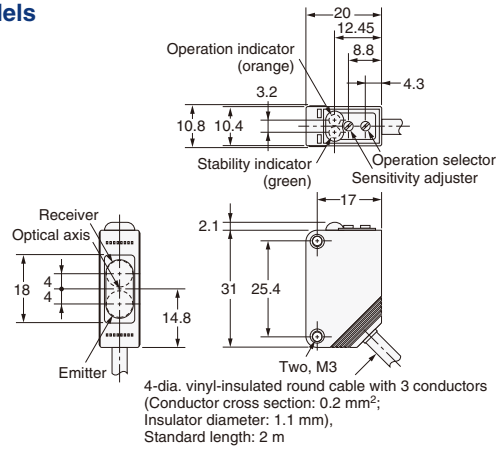
Dimensions

(Unit: mm)

Sensors

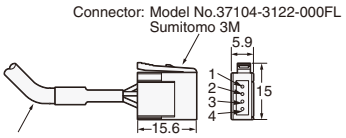
Pre-wired Models

E3Z-L61
E3Z-L81



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

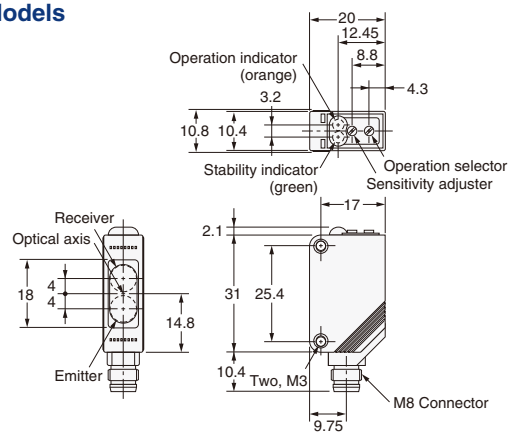
e-CON Pre-wired Connector



* 4-dia. vinyl-insulated round cable with 3 conductors, Standard lengths: 0.3 m, 0.5 m, and 2 m

Connector Models

E3Z-L66
E3Z-L86



Accessories (Order Separately)

Mounting Brackets

General Precautions

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

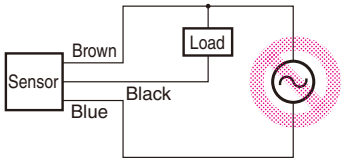
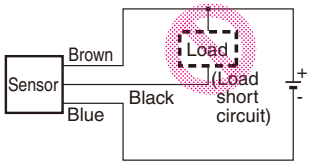
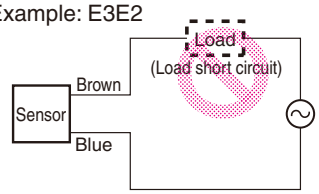
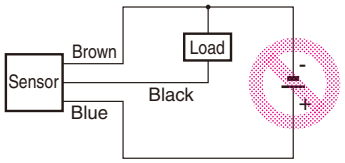
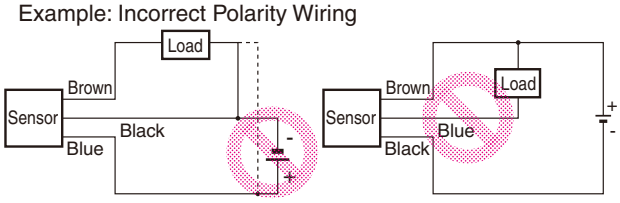
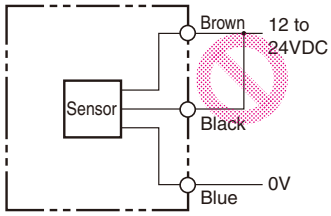
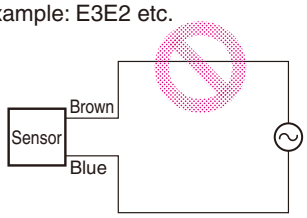
⚠ WARNING

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

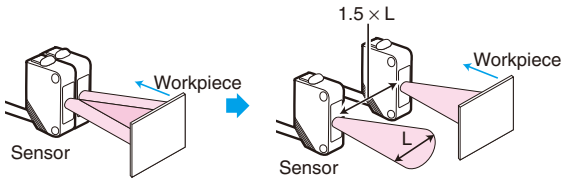
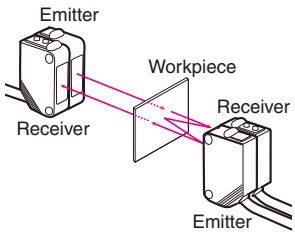
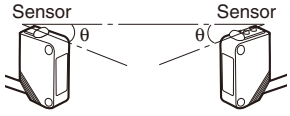
An output pulse may be generated when the power is turned OFF. It is recommended that the load or load line power be turned OFF before the Sensor power is turned OFF.

Power Supply Types

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

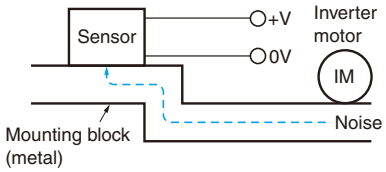
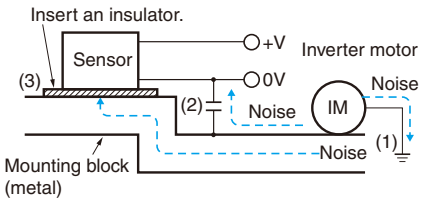
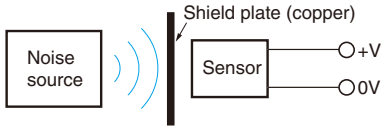
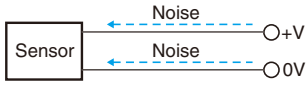
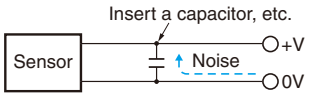
Mutual Interference

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.

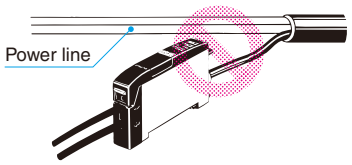
Note: Do not subject a shielded cable or coaxial cable to tension.

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.

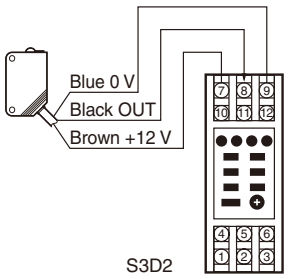
Power Supply

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

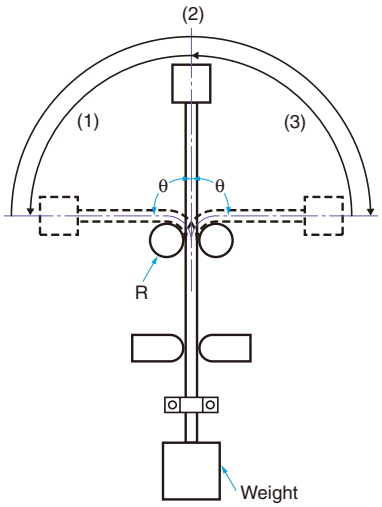
Attachment to Moving Parts

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

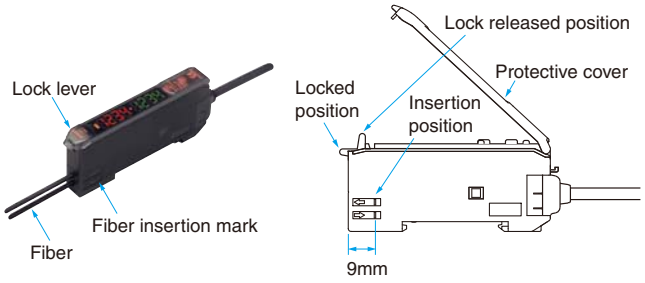
The testing conditions of the standard cable and robot cable are different.
Refer to the values in the above table to check bend-resistant performance under actual working conditions.

Securing Fibers

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

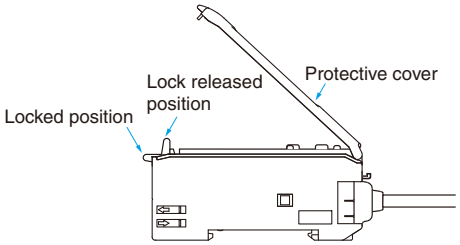
(1) Attaching Fibers

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.

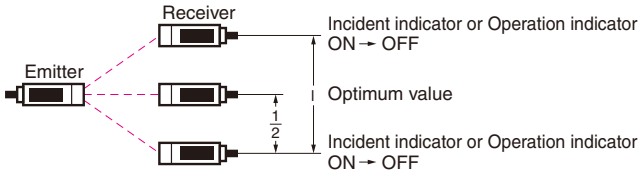


Note: 1. To maintain the fiber characteristics, make sure that the lock is released before removing the fibers.
2. Lock and unlock the fibers at an ambient temperature of −10 to 40°C.

● Adjustments

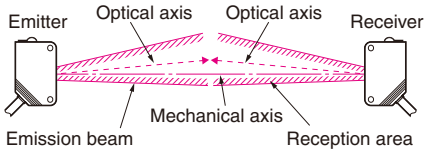
Optical Axis Adjustment

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

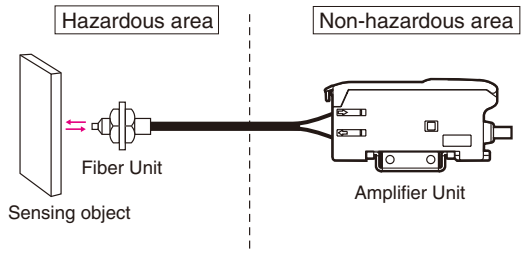
The Fiber Unit can be installed in the hazardous area, and the Amplifier Unit can be installed in a non-hazardous area.

<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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