

# Compact Photoelectric Sensor with Built-in Amplifier E3Z-F

## A Visible Spot That Simplifies the Usage of Photoelectric Sensors

- E3Z-F is added to the E3Z Series of Photoelectric Sensors that boasts annual worldwide sales of 1.5 million units.
- Many different sensing distances  
Diffuse-reflective: 100 mm, 300 mm, 500 mm, 1 m  
Through-beam: 20 m  
Retro-reflective: 4 m
- Models with infrared LEDs are also available.



For the most recent information on models that have been certified for safety standards, refer to your OMRON website.



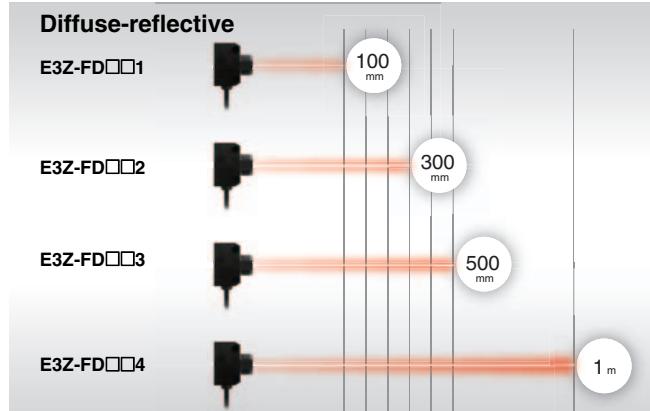
Refer to the *Safety Precautions* on page 9.

## Features

### Visible spot for easy installation

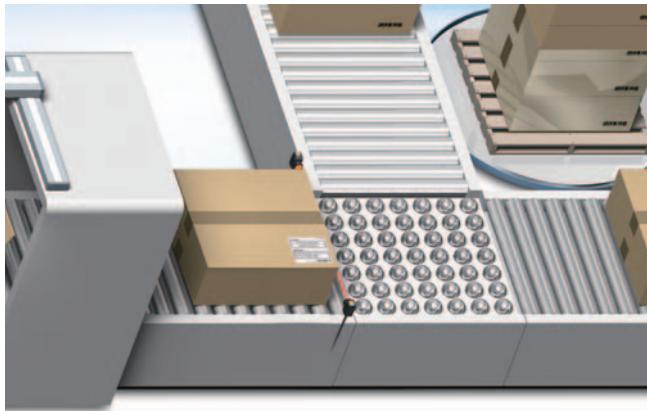


### Many different sensing distances are available, so you can select the best model for your application distance.

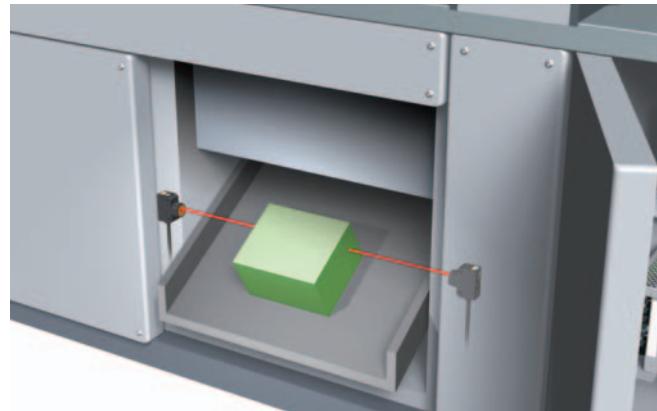


## Application

### Materials handling: detect passing cardboard boxes

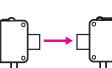
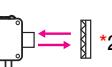


### Molding machines: detect falling molded objects



## Ordering Information

Sensors [Refer to *Dimensions on page 10.*]
 Red light
  Infrared light

Sensing method	Appearance	Connecting method	Sensing distance		Model	
			NPN output	PNP output		
Through-beam (Emitter + Receiver)		Pre-wired (2 m)		20 m	E3Z-FTN11 2M *1 Emitter E3Z-FTN11-L 2M Receiver E3Z-FTN11-D 2M	E3Z-FTP11 2M *1 Emitter E3Z-FTP11-L 2M Receiver E3Z-FTP11-D 2M
		Connector (M12)			E3Z-FTN21 *1 Emitter E3Z-FTN21-L Receiver E3Z-FTN21-D	E3Z-FTP21 *1 Emitter E3Z-FTP21-L Receiver E3Z-FTP21-D
		Pre-wired (2 m)		20 m	E3Z-FTN12 2M *1 Emitter E3Z-FTN12-L 2M Receiver E3Z-FTN12-D 2M	E3Z-FTP12 2M *1 Emitter E3Z-FTP12-L 2M Receiver E3Z-FTP12-D 2M
		Connector (M12)			E3Z-FTN22 *1 Emitter E3Z-FTN22-L Receiver E3Z-FTN22-D	E3Z-FTP22 *1 Emitter E3Z-FTP22-L Receiver E3Z-FTP22-D
Retro-reflective with MSR function	 *2	Pre-wired (2 m)	4 m *3 (100 mm)		E3Z-FRN11 2M	E3Z-FRP11 2M
		Connector (M12)			E3Z-FRN21	E3Z-FRP21
Diffuse- reflective		Pre-wired (2 m)	100 mm		E3Z-FDN11 2M	E3Z-FDP11 2M
		Connector (M12)			E3Z-FDN21	E3Z-FDP21
		Pre-wired (2 m)	300 mm		E3Z-FDN12 2M	E3Z-FDP12 2M
		Connector (M12)			E3Z-FDN22	E3Z-FDP22
		Pre-wired (2 m)	500 mm		E3Z-FDN13 2M	E3Z-FDP13 2M
		Connector (M12)			E3Z-FDN23	E3Z-FDP23
		Pre-wired (2 m)	1 m		E3Z-FDN14 2M	E3Z-FDP14 2M
		Connector (M12)			E3Z-FDN24	E3Z-FDP24
		Pre-wired (2 m)	100 mm		E3Z-FDN15 2M	E3Z-FDP15 2M
		Connector (M12)			E3Z-FDN25	E3Z-FDP25
		Pre-wired (2 m)	300 mm		E3Z-FDN16 2M	E3Z-FDP16 2M
		Connector (M12)			E3Z-FDN26	E3Z-FDP26
		Pre-wired (2 m)	500 mm		E3Z-FDN17 2M	E3Z-FDP17 2M
		Connector (M12)			E3Z-FDN27	E3Z-FDP27
		Pre-wired (2 m)	1 m		E3Z-FDN18 2M	E3Z-FDP18 2M
		Connector (M12)			E3Z-FDN28	E3Z-FDP28

\*1. Through-beam Sensors are normally sold in sets that include both the Emitter and Receiver. An order for the Emitter or Receiver alone cannot be accepted.

\*2. The Reflector is sold separately. Select the Reflector model most suited to the application.

\*3. Values in parentheses indicate the minimum required distance between the Sensor and Reflector.

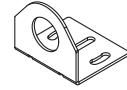
## Accessories (Sold Separately)

**Reflector** (Required for Retro-reflective Sensors) A Reflector is not provided with the Sensor. It must be ordered separately.  
 [Refer to *Dimensions on page 11.*]

Appearance	Sensing distance*		Model	Quantity	Remarks
	Rated value	Reference value			
	4 m (100 mm)	---	E39-R1S	1	for E3Z-FR□

\* Values in parentheses indicates the minimum required distance between the Sensor and Reflector.

**Mounting Brackets** A Mounting Bracket is not provided with the Sensor. It must be ordered separately as required.  
 [Refer to *Dimensions on page 11.*]

Applicable Sensors	Mounting method	Appearance	Model	Quantity
All models	M3 screw mounting		E39-L189	1
	M18 nut side mounting		E39-L183	1

Note: 1. When using Through-beam models, order one bracket for the Receiver and one for the Emitter.

### Sensor I/O Connectors (Sockets on One Cable End)

(Required for models for Connectors) A Connector is not provided with the Sensor. It must be ordered separately.

Applicable Sensors	Size	Cable	Appearance	Cable type	Model
Connector (M12)	M12	Standard	Straight	2 m	XS2F-M12PVC4S2M
				5 m	XS2F-M12PVC4S5M
			L-shaped	2 m	XS2F-M12PVC4A2M
				5 m	XS2F-M12PVC4A5M

Note: When using Through-beam models, order one sensor I/O connector for the Receiver and one for the Emitter.

## Ratings and Specifications

Sensing method		Through-beam	Retro-reflective with MSR function	Diffuse-reflective									
Model	NPN output	Pre-wired	E3Z-FTN11	E3Z-FRN11	E3Z-FDN11	E3Z-FDN12	E3Z-FDN13	E3Z-FDN14					
	PNP output	Connector (M12)	E3Z-FTN21	E3Z-FRN21	E3Z-FDN21	E3Z-FDN22	E3Z-FDN23	E3Z-FDN24					
Item	NPN output	Pre-wired	E3Z-FTP11	E3Z-FRP11	E3Z-FDP11	E3Z-FDP12	E3Z-FDP13	E3Z-FDP14					
	PNP output	Connector (M12)	E3Z-FTP21	E3Z-FRP21	E3Z-FDP21	E3Z-FDP22	E3Z-FDP23	E3Z-FDP24					
<b>Sensing distance</b>		20 m	4 m (100 mm) <sup>*1</sup> (when using E39-R1S)	100 mm (white paper: 300 × 300 mm)	300 mm (white paper: 300 × 300 mm)	500 mm (white paper: 300 × 300 mm)	1 m (white paper: 300 × 300 mm)						
<b>Spot diameter (reference value)</b>		---	---	40 × 45 mm (at sensing distance of 100 mm)	40 × 50 mm (at sensing distance of 300 mm)	45 × 50 mm (at sensing distance of 500 mm)	120 × 150 mm (at sensing distance of 1 m)						
<b>Standard sensing object</b>		Opaque: 7 mm dia. min.	Opaque: 75 mm dia. min.	---									
<b>Differential travel</b>		---	---	20% max. of sensing distance									
<b>Directional angle</b>		2° min.	---	---									
<b>Light source (wavelength)</b>		Red LED (624 nm)											
<b>Power supply voltage</b>		10 to 30 VDC (including voltage ripple of 10% (p-p) max.)											
<b>Current consumption</b>		40 mA max. (Emitter: 25 mA max., Receiver: 15 mA max.)	25 mA max.	---									
<b>Control output</b>		Load power supply voltage: 30 VDC max., Load current: 100 mA max. (Residual voltage: 3 V max.) Open collector output (NPN (negative common)/PNP (positive common) depending on model) Light-ON/Dark-ON cable connection selectable											
<b>Indicators</b>		Operation indicator (orange) Stability indicator (green) Through-beam Emitter has only power indicator (green).											
<b>Protection circuits</b>		Power supply reverse polarity protection, Output short-circuit protection, and Output reverse polarity protection											
<b>Response time</b>		Operate or reset: 0.5 ms max.											
<b>Sensitivity adjustment</b>		One-turn adjuster											
<b>Ambient illumination (Receiver side)</b>		Incandescent lamp: 3,000 lx max. Sunlight: 10,000 lx max.											
<b>Ambient temperature range</b>		Operating: -25 to 55°C, Storage: -40°C to 70°C (with no icing or condensation)											
<b>Ambient humidity range</b>		Operating: 35% to 85%, Storage: 35% to 95% (with no condensation)											
<b>Insulation resistance</b>		20 MΩ min. (at 500 VDC)											
<b>Dielectric strength</b>		1,000 VAC, at 50/60 Hz for 1 min											
<b>Vibration resistance (destruction)</b>		10 to 55 Hz with a 1.5 mm double amplitude for 2 hours each in X, Y, and Z directions											
<b>Shock resistance (destruction)</b>		500 m/s <sup>2</sup> for 3 times each in X, Y, and Z directions											
<b>Degree of protection<sup>*2</sup></b>		IEC IP67, DIN40050-9 standard IP69K											
<b>Connecting method</b>		Pre-wired (standard length: 2 m), Connector (M12, 4-Pin)											
Weight (packed state/ Sensor only)	Pre-wired	Approx. 120 g/ Approx. 105 g	Approx. 70 g/ Approx. 55 g	---									
	Connector	Approx. 35 g/ Approx. 20 g	Approx. 25 g/ Approx. 10 g	---									
Materials	Case	ABS											
	Lens	Methacrylic resin (PMMA)											
	Display	Methacrylic resin (PMMA)											
	Sensitivity adjuster	Polyacetal (POM)											
	Cable <sup>*3</sup>	Vinyl chloride (PVC)											
	Nuts	ABS											
<b>Accessories</b>		Nuts (2 pcs), Instruction manual	Nut (1 pcs), Instruction manual	---									

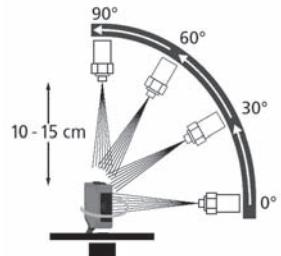
\*1. Values in parentheses indicate the minimum required distances between the Sensors and Reflectors.

\*2. IP69K Degree of Protection Specifications.

IP69K is a protection specification stipulated by DIN 40050 Part 9 of the German standards.  
The test item is sprayed with 80°C water from a nozzle of a specified shape at a water pressure of 80 to 100 bar. The amount of water is 14 to 16 liters per minute.

The distance between the test item and the nozzle is 10 to 15 cm. The water is discharged at angles of 0°, 30°, 60°, and 90° from the horizontal plane for 30 seconds at each angle while the test item is rotated horizontally.

\*3. Only for Pre-wired models.



Model		Sensing method	Through-beam		Diffuse-reflective		
			NPN out-put	Pre-wired	E3Z-FTN12	E3Z-FDN15	E3Z-FDN16
Item	PNP out-put	Connector (M12)	E3Z-FTN22	E3Z-FDN25	E3Z-FDN26	E3Z-FDN27	E3Z-FDN28
	Pre-wired	Connector (M12)	E3Z-FTP12	E3Z-FDP15	E3Z-FDP16	E3Z-FDP17	E3Z-FDP18
Sensing distance		20 m	100 mm (white paper: 300 × 300 mm)	300 mm (white paper: 300 × 300 mm)	500 mm (white paper: 300 × 300 mm)	1 m (white paper: 300 × 300 mm)	
Spot diameter (reference value)					---		
Standard sensing object		Opaque: 7 mm dia. min.			---		
Differential travel		---	20% max. of sensing distance				
Directional angle		2° min.			---		
Light source (wavelength)		Infrared LED ( 850 nm)					
Power supply voltage		10 to 30 VDC (including voltage ripple of 10% (p-p) max.)					
Current consumption		40 mA max. (Emitter: 25 mA max., Receiver:15 mA max.)	25mA max.				
Control output		Load power supply voltage: 30 VDC max., Load current: 100 mA max. (Residual voltage: 3 V max.) Open collector output (NPN (negative common)/PNP (positive common) depending on model) Light-ON/Dark-ON cable connection selectable					
Indicators		Operation indicator (orange) Stability indicator (green) Through-beam Emitter has only power indicator (green).					
Protection circuits		Power supply reverse polarity protection, Output short-circuit protection, and Output reverse polarity protection					
Response time		Operate or reset: 0.5 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°C 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, at 50/60 Hz for 1 min					
Vibration resistance (destruction)		10 to 55 Hz with a 1.5 mm double amplitude for 2 hours each in X, Y, and Z directions					
Shock resistance (destruction)		500 m/s <sup>2</sup> for 3 times each in X, Y, and Z directions					
Degree of protection *1		IEC IP67, DIN40050-9 standard IP69K					
Connecting method		Pre-wired (standard length: 2 m), Connector (M12, 4-Pin)					
Weight (packedstate/ Sensor only)	Pre-wired	Approx. 120 g/ Approx. 105 g	Approx. 70 g/ Approx. 55 g				
	Connector	Approx. 35 g/ Approx. 20 g	Approx. 25 g/ Approx. 10 g				
Materials	Case	ABS					
	Lens	Methacrylic resin (PMMA)					
	Display	Methacrylic resin (PMMA)					
	Sensitivity adjuster	Polyacetal (POM)					
	Cable *2	Vinyl chloride (PVC)					
	Nuts	ABS					
Accessories		Nuts (2 pcs), Instruction manual	Nut (1 pcs), Instruction manual				

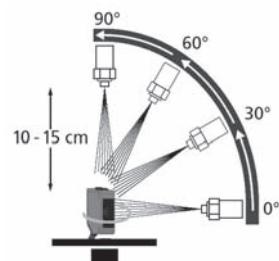
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The distance between the test item and the nozzle is 10 to 15 cm. The water is discharged at angles of 0°, 30°, 60°, and 90° from the horizontal plane for 30 seconds at each angle while the test item is rotated horizontally.

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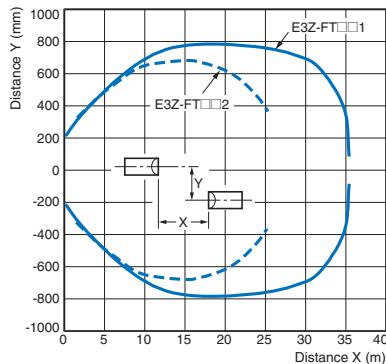


## Engineering Data (Reference Value)

### Parallel Operating Range

#### Through-beam

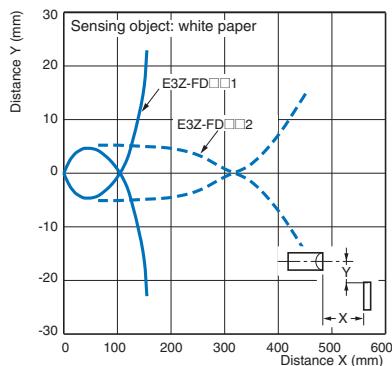
##### E3Z-FT□□1/-FT□□2



### Operating Range

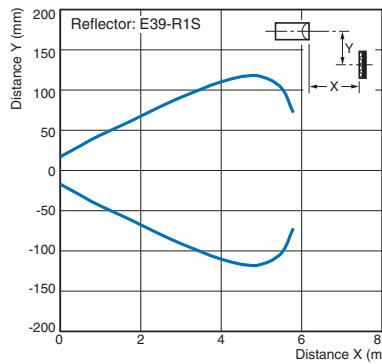
#### Diffuse-reflective

##### E3Z-FD□□1/-FD□□2



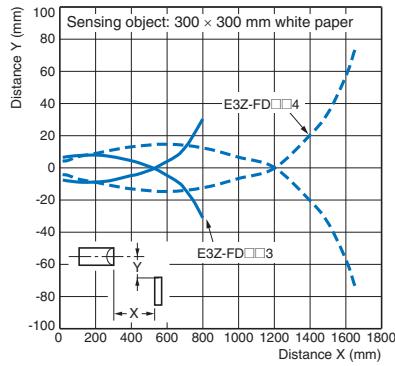
### Retro-reflective

##### E3Z-FR□



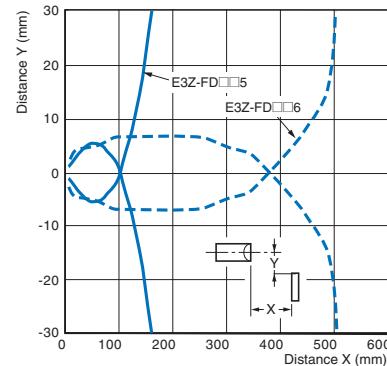
### Diffuse-reflective

##### E3Z-FD□□3/-FD□□4



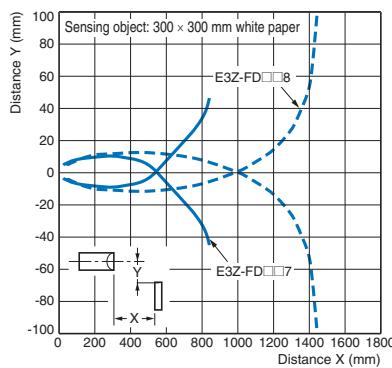
### Diffuse-reflective

##### E3Z-FD□□5/-FD□□6



### Diffuse-reflective

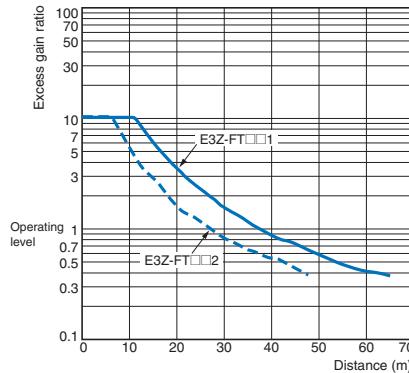
##### E3Z-FD□□7/-FD□□8



### Excess Gain vs. Distance

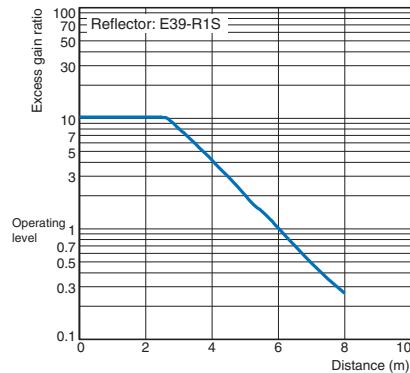
#### Through-beam

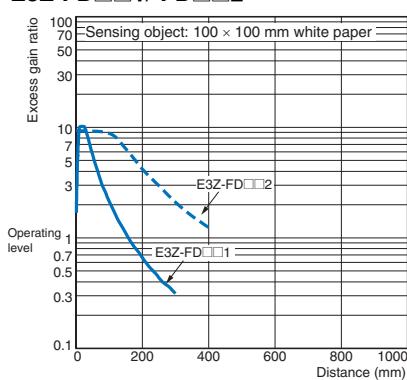
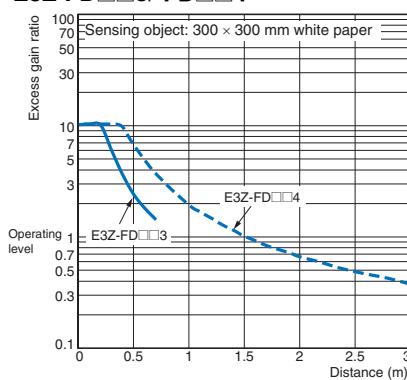
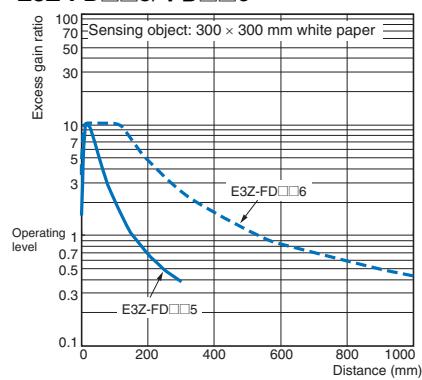
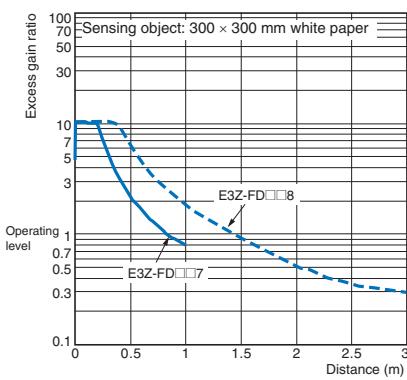
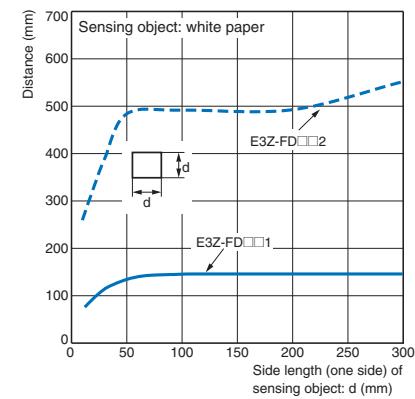
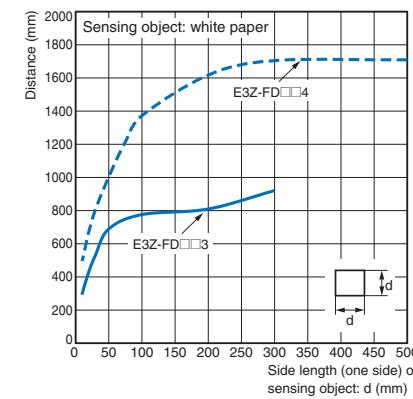
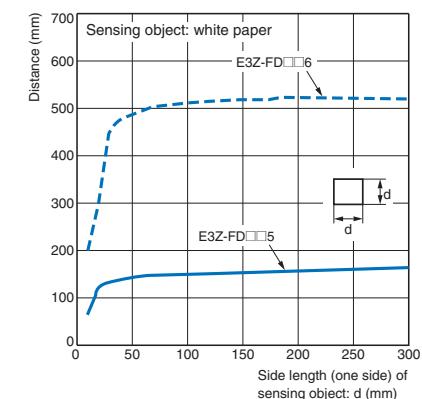
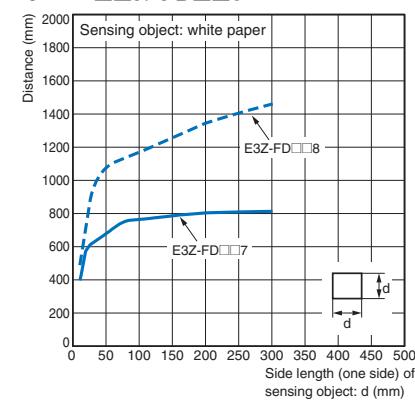
##### E3Z-FT□□1/-FT□□2



### Retro-reflective

##### E3Z-FR□



**Excess Gain vs. Distance****Diffuse-reflective****E3Z-FD□□1/-FD□□2****Diffuse-reflective****E3Z-FD□□3/-FD□□4****Diffuse-reflective****E3Z-FD□□5/-FD□□6****Diffuse-reflective****E3Z-FD□□7/-FD□□8****Sensing Object Size vs. Distance****Diffuse-reflective****E3Z-FD□□1/-FD□□2****Diffuse-reflective****E3Z-FD□□3/-FD□□4****Diffuse-reflective****E3Z-FD□□5/-FD□□6****Diffuse-reflective****E3Z-FD□□7/-FD□□8**

## I/O Circuit Diagrams

## NPN Output

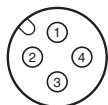
Model	Operation mode	Timing charts	Operation selector	Output circuit
E3Z-FTN□□ E3Z-FRN□□ E3Z-FDN□□	Light-ON	Incident light No incident light Operation indicator (orange) ON Output transistor ON Load Operate (e.g., relay) Reset (Between brown (1) and black (4) leads)	Connect pink lead (2) to brown lead (1) or leave open.	Through-beam Receivers, Retro-reflective, Diffuse-reflective. 
	Dark-ON	Incident light No incident light Operation indicator (orange) ON Output transistor ON Load Operate (e.g., relay) Reset (Between brown (1) and black (4) leads)	Connect pink lead (2) to blue lead (3).	
	Through-beam Emitter			

## PNP Output

Model	Operation mode	Timing charts	Operation selector	Output circuit
E3Z-FTP□□ E3Z-FRP□□ E3Z-FDP□□	Light-ON	Incident light No incident light Operation indicator (orange) ON Output transistor ON Load Operate (e.g., relay) Reset (Between blue (3) and black (4) leads)	Connect pink lead (2) to brown lead (1).	Through-beam Receivers, Retro-reflective, Diffuse-reflective. 
	Dark-ON	Incident light No incident light Operation indicator (orange) ON Output transistor ON Load Operate (e.g., relay) Reset (Between blue (3) and black (4) leads)	Connect pink lead (2) to blue lead (3) or leave open.	
	Through-beam Emitter			

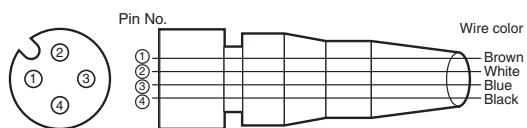
## Connector Pin Arrangement

## M12 Connector Pin Arrangement



## Plugs (Sensor I/O Connectors)

## M12, 4-pin Connectors



## Pin arrangement

Classification	Wire color	Connector pin No.	Application
DC	Brown	1	Power supply (+V)
	White	2	L/on · D/on selectable
	Blue	3	Power supply (0 V)
	Black	4	Output

## Safety Precautions

To ensure safe operation, be sure to read and follow the Instruction Manual provided with the sensor.

### ■ Meanings of Alert symbols

<b>WARNING</b>	Indicates a potentially hazardous situation which, if not avoided, will result in minor or moderate injury, or may result in serious injury or death. Additionally there may be significant property damage.
<b>CAUTION</b>	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or in property damage.
<b>Precautions for Safe Use</b>	Supplementary comments on what to do or avoid doing, to use the product safely.
<b>Precautions for Correct Use</b>	Supplementary comments on what to do or avoid doing, to prevent a failure to operate, or undesirable effect on product performance.

#### **WARNING**

This product is not designed or rated for ensuring safety of persons either directly or indirectly.

Do not use it for such purposes.



#### **CAUTION**

Explosion, fire, or product malfunction may occur.

Never use the product with an AC power supply.

Do not use the product with voltage in excess of the rated voltage.

Do not use the product with incorrect wiring.



#### Precautions for Safe Use

Be sure to follow the safety precautions below for added safety.

1. Do not use the product in atmospheres or environments that exceed product ratings.
2. Do not use the product in an environment where it may be exposed to inflammable or explosive gas.
3. Do not use the product in an environment where it may be exposed to oil or chemicals.
4. Do not use the product in water, in rain, or outdoors.
5. Do not use the product in locations subject to condensation due to high humidity.
6. Do not use the product in any other environment that exceeds the ratings.
7. Do not use the product in a location subject to direct sunlight.
8. Do not use the product in a location subject to direct vibration or shock.
9. Do not use organic solvents (such as thinners or alcohol).
10. Do not attempt to disassemble, repair, or modify the product.
11. Dispose of the product as industrial waste.
12. The E3Z-F devices shall be used with Class2 power supply in the United States.

The ampere rating of the current protection shall be 1A for 26AWG, 2A for 24AWG, 3A for 22AWG, 5A for 20AWG.

#### Precautions for Correct Use

1. Laying Sensor wiring in the same conduit or duct as high-voltage wires or power lines may result in malfunction or damage due to conduit or use shielded cable. Separate the Sensor wiring or use a shielded cable.
2. Do not pull on the cable with excessive force.
3. If a commercial switching regulator is used, ground the FG (frame ground) terminal.
4. The sensor will be available 100 ms after the power supply is tuned ON. Start to use the sensor 100 ms or more after turning ON the power supply. If the load and the sensor are connected to separate power supplies, be sure to turn ON the sensor first.
5. Output pulses may be generated even when the power supply is OFF. Therefore, it is recommended to first turn OFF the power supply for the load or the load line.
6. Do not tighten nuts or screws with excessive force. To secure the Sensor with nuts, use the nuts that are included with the Sensor, and tighten the nuts to a torque of 0.3 to 0.4 N·m (2.0 N·m max.). To secure the Sensor with M3 screws, tighten the screws to a torque of 0.6 N·m max..

# E3Z-F

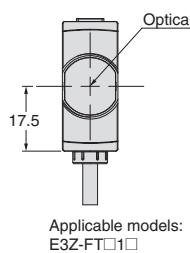
## Dimensions

(Unit: mm)  
Tolerance class IT16 applies to dimensions in this data sheet unless otherwise specified.

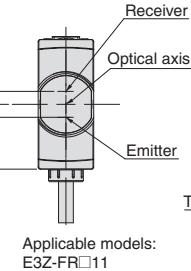
### Sensors

#### Pre-wired

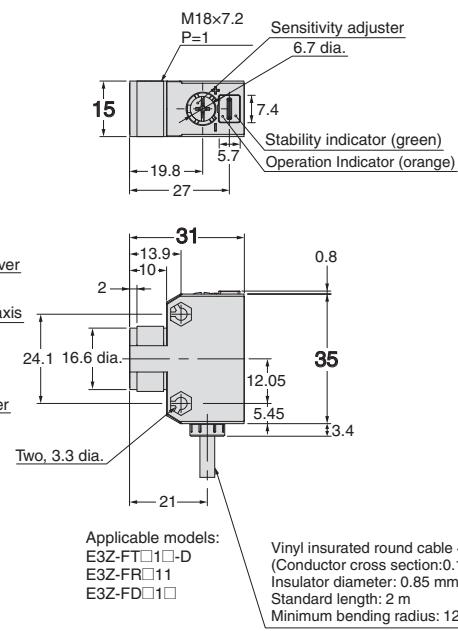
E3Z-FT□1□  
E3Z-FR□11  
E3Z-FD□1□



Applicable models:  
E3Z-FT□1□

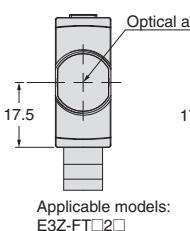


Applicable models:  
E3Z-FR□11  
E3Z-FD□1□

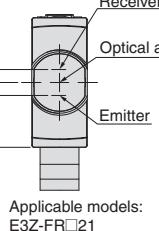


### Connector (M12)

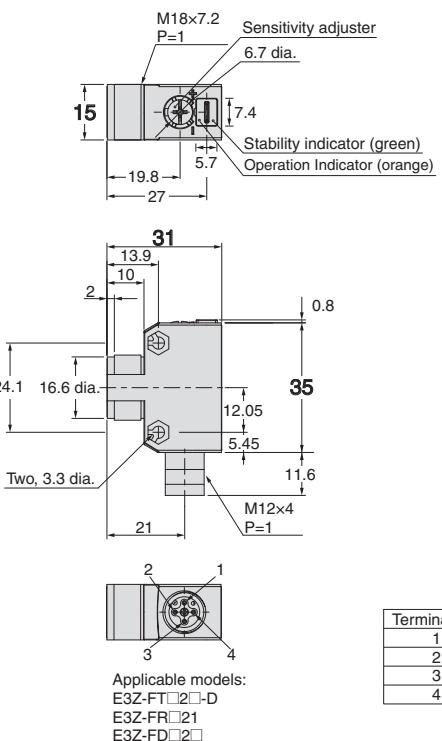
E3Z-FT□2□  
E3Z-FR□21  
E3Z-FD□2□



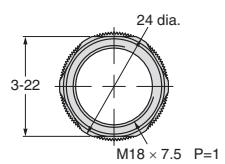
Applicable models:  
E3Z-FT□2□



Applicable models:  
E3Z-FR□21  
E3Z-FD□2□



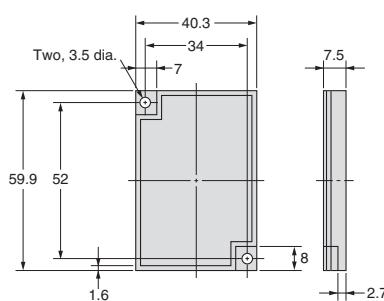
### Tightening Nuts



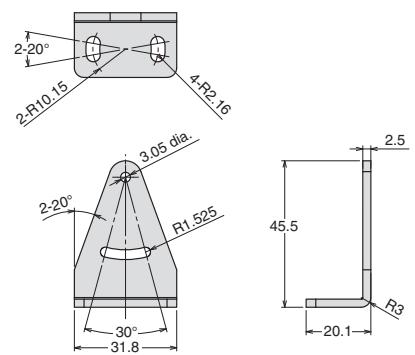
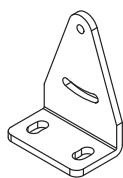
Material: ABS

### Accessories (Sold Separately)

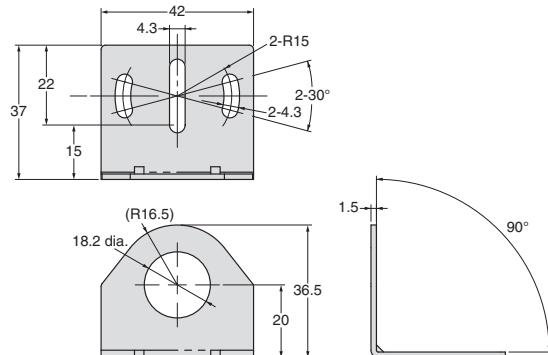
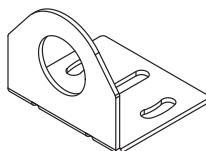
#### Reflector E39-R1S

Material: <Reflective surface> Acrylic  
<Rear surface> ABS

#### Mounting Brackets E39-L189



#### Mounting Brackets E39-L183



## E3Z-F

Compact Photoelectric Sensor with Built-in Amplifier

# E3Z

The Standard for Photoelectric Sensors  
with a Secure Track Record of  
1.5 Million Sold Yearly.

- Long sensing distance of 30 m for Through-beam Models, 4 m for Retro-reflective Models, and 1 m for Diffuse-reflective Models.
- Mechanical axis and optical axis offset of less than  $\pm 2.5^\circ$  simplifies optical axis adjustment.
- High stability with unique algorithm that prevents interference of external light.



Compact Laser Photoelectric Sensor with Built-in Amplifier

# E3Z-LT/LR/LL

Compact and Reliable  
Laser Photoelectric Sensor

- Safety and reliability with laser class 1 (JIS and IEC).
- Product lineup includes models with distance setting without influence of color.
- Maximum ambient operating temperature of 55°C and waterproof construction (IP67) in E3Z class.



Grooved-type Photoelectric Sensor with Built-in Amplifier

# E3Z-G

Photoelectric Sensor with  
Grooved Design and Easy Settings

- Grooved-type Sensor with groove width of 25 mm.
- Models are available with one or two light axes.
- Models are available with M8 pre-wired connectors.



Compact Photoelectric Sensor with Stainless Steel Housing

# E3ZM

CE

Stainless Steel Housing Ideal for Food Industry  
(SUS316L)

- Strong resistance against detergents, disinfectants, and jet liquid flow.
- Product lineup includes BGS reflective models and through-beam models with built-in slits.
- Certified by Ecolab Europe.



Color Mark Detection Compact Photoelectric Sensor

# E3ZM-V

CE

Industry's Smallest Color Mark Sensor



Transparent Object (PET Bottle) Detection Compact Photoelectric Sensor

# E3ZM-B

CE

Excellent PET Bottle Detection



Oil-resistant, Robust, Compact Photoelectric Sensor

# E3ZM-C

CE

Photoelectric Sensor for the Automotive and  
Machine Tool Industries

- Oil-resistant, rugged body made of stainless steel.
- Spot visibility improved to as far as 1 m away.  
Product lineup includes through-beam models with orange spot.
- Product lineup includes M12 Smartclick pre-wired connector models.



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