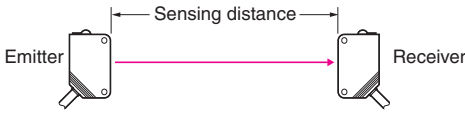
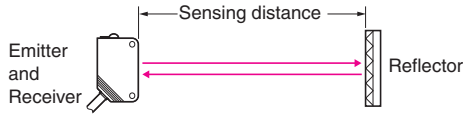
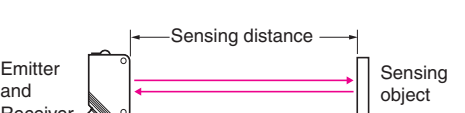
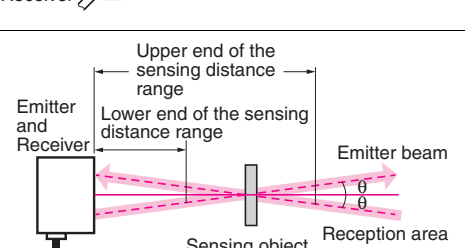
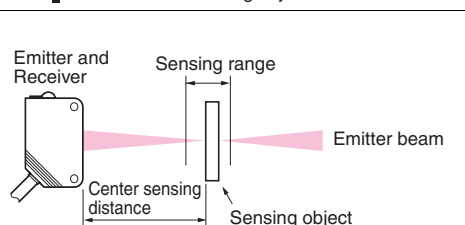
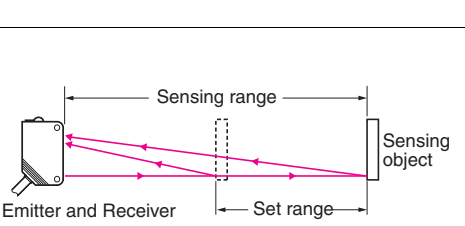
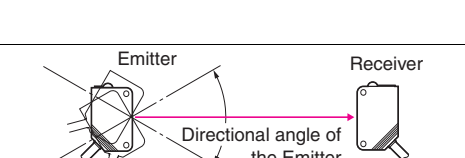
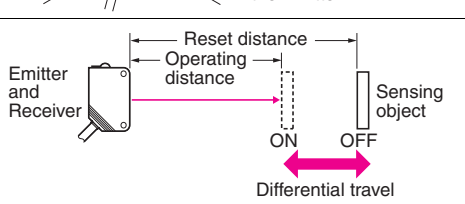
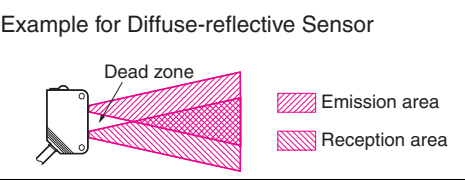
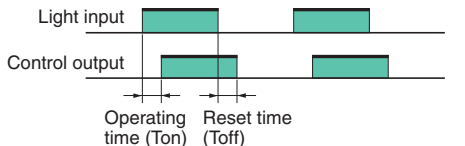


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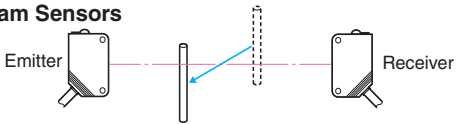
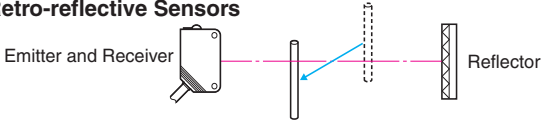
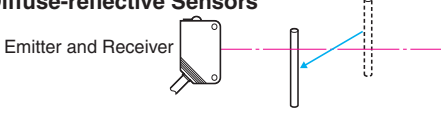
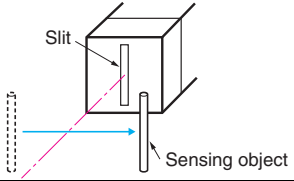
Explanation of Terms

Item		Explanatory diagram	Meaning
Sensing distance	Through-beam Sensors		The maximum sensing distance that can be set with stability for Through-beam and Retro-reflective Sensors, taking into account product deviations and temperature fluctuations. Actual distances under standard conditions will be longer than the rated sensing distances for both types of Sensor.
	Retro-reflective Sensors		
	Diffuse-reflective Sensors		
	Limited-reflective Sensors		As shown in the diagram at left, the optical system for the Limited-reflective Sensors is designed so that the Emitter axis and the Receiver axis intersect at the surface of the detected object at an angle θ . With this optical system, the distance range in which regular-reflective light from the object can be detected consistently is the sensing distance. As such, the sensing distance can range from 10 to 35 mm depending on the upper and lower limits. (See page 7.)
	Mark Sensors (Contrast scanner)		
Set range/ Sensing range	Distance-settable Sensors		Limits can be set on the sensing position of objects with Distance-settable Sensors. The range that can be set for a standard sensing object (white paper) is called the "set range." The range with the set position limits where a sensing object can be detected is called the "sensing range." The sensing range depends on the sensing mode that is selected. The BGS mode is used when the sensing object is on the Sensor side of the set position and the FGS mode is used when the sensing object is on the far side of the set position. (See page 6.)
Directional angle			Through-beam Sensors, Retro-reflective Sensors The angle where operation as a Photoelectric Sensor is possible.
Differential travel			Diffuse-reflective and Distance-settable Sensors The difference between the operating distance and the reset distance. Generally expressed in catalogs as a percentage of the rated sensing distance.
Dead zone			The dead zone outside of the emission and reception areas near the lens surface in Mark Sensors, Distance-settable Sensors, Limited-reflective Sensors, Diffuse-reflective Sensors, and Retro-reflective Sensors. Detection is not possible in this area.
Response time			The delay time from when the light input turns ON or OFF until the control output operates or resets. In general for Photoelectric Sensors, the operating time (Ton) $\approx$ reset time (Toff).

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Item	Explanatory diagram	Meaning																																				
Dark-ON operation (DARK ON)	Through-beam, Retro-reflective Sensors Diffuse-reflective Sensors	The "Dark-ON" operating mode is when a Through-beam Sensor produces an output when the light entering the Receiver is interrupted or decreases.																																				
Light-on operation (LIGHT ON)	Through-beam, Retro-reflective Sensors Diffuse-reflective Sensors	The "Light-ON" operating mode is when a Diffuse-reflective Sensor produces an output when the light entering the Receiver increases.																																				
Ambient operating illumination	Difference between Ambient Operating Illumination and Operating Illumination Limit Received Illumination	The ambient operating illumination is expressed in terms of the Receiver surface illuminance and is defined as the illuminance when there is a $\pm 20\%$ change with respect to the value at a light reception output of 200 lx. This is not sufficient to cause malfunction at the operating illuminance limit.																																				
Standard sensing object	Through-beam Sensors Retro-reflective Sensors Diffuse-reflective Sensors	The standard sensing object for both Through-beam Sensors and Retro-reflective Sensors is an opaque rod with a diameter larger than the length of a diagonal line of the optical system. In general, the diameter of the standard sensing object is the length of the diagonal line of the Emitter/Receiver lens for Through-beam Sensors, and the length of a diagonal line of the Reflector for Retro-reflective Sensors. Size of Standard Sensing Object Using Reflector <table border="1"> <thead> <tr> <th>Reflector models</th><th>Diagonal line of optical system</th><th>Sensing object</th></tr> </thead> <tbody> <tr> <td>E39-R1/R1S/R1K</td><td>72.2 mm</td><td>75-mm dia.</td></tr> <tr> <td>E39-R2</td><td>100.58 mm</td><td>105-mm dia.</td></tr> <tr> <td>E39-R3</td><td>41.44 mm</td><td>45-mm dia.</td></tr> <tr> <td>E39-R4</td><td>26.77 mm</td><td>30-mm dia.</td></tr> <tr> <td>E39-R6</td><td>56.57 mm</td><td>60-mm dia.</td></tr> <tr> <td>E39-R9</td><td>43.7 mm</td><td>45-mm dia.</td></tr> <tr> <td>E39-R10</td><td>66.47 mm</td><td>70-mm dia.</td></tr> <tr> <td>E39-RS1</td><td>36.4 mm</td><td>40-mm dia.</td></tr> <tr> <td>E39-RS2</td><td>53.15 mm</td><td>55-mm dia.</td></tr> <tr> <td>E39-RS3</td><td>106.3 mm</td><td>110-mm dia.</td></tr> <tr> <td>E39-R37</td><td>13.4 mm</td><td>15-mm dia.</td></tr> </tbody> </table> For Diffuse-reflective Sensors, the standard sensing object is a sheet of white paper larger than the diameter of the emitted beam.	Reflector models	Diagonal line of optical system	Sensing object	E39-R1/R1S/R1K	72.2 mm	75-mm dia.	E39-R2	100.58 mm	105-mm dia.	E39-R3	41.44 mm	45-mm dia.	E39-R4	26.77 mm	30-mm dia.	E39-R6	56.57 mm	60-mm dia.	E39-R9	43.7 mm	45-mm dia.	E39-R10	66.47 mm	70-mm dia.	E39-RS1	36.4 mm	40-mm dia.	E39-RS2	53.15 mm	55-mm dia.	E39-RS3	106.3 mm	110-mm dia.	E39-R37	13.4 mm	15-mm dia.
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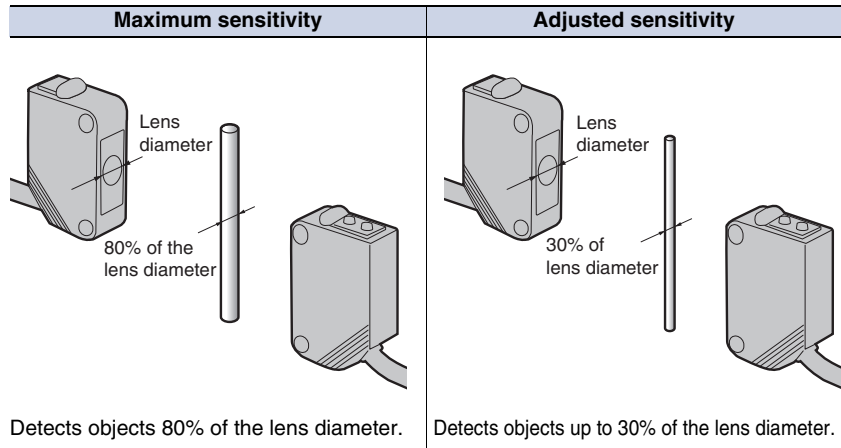
Item	Explanatory diagram	Meaning
Minimum sensing object	Through-beam Sensors  Retro-reflective Sensors  Diffuse-reflective Sensors 	Typical examples are given of the smallest object that can be detected using Through-beam and Retro-reflective Sensors with the sensitivity correctly adjusted to the light-ON operation level at the rated sensing distance. For Diffuse-reflective Sensors, typical examples are given of the smallest objects that can be detected with the sensitivity set to the highest level.
Minimum sensing object with slit attached		Through-beam Sensors Typical examples are given of the smallest object that can be detected using Through-beam Sensors with a Slit attached to both the Emitter and the Receiver as shown in the figure. The sensitivity is correctly adjusted to the Light-ON operating level at the rated sensing distance and the sensing object is moved along the length and parallel to the slit.

Application and Data

(1) Relationship of Lens Diameter and Sensitivity to the Smallest Detectable Object

- With a Through-beam Sensor, the lens diameter determines the size of the smallest object that can be detected.
- With a Through-beam Sensor, a small object can be more easily detected midway between the Emitter and the Receiver that it can be off center between the Emitter and Receiver.
- As a rule of thumb, an object 30% to 80% of the lens diameter can be detected by varying the sensitivity level.
- Check the **Ratings and Specifications** of the Sensor for details.

The size given for the smallest object that can be detected with a Reflective Photoelectric Sensor is the value for detection with no objects in the background and the sensitivity set to the maximum value.



(2) Detecting Height Differences

Selecting Sensors Based on Detectable Height Differences and Set Distances (Typical Examples)

Appearance					
	0.27 to 0.45 mm	2mm	0.8 to 1.0 mm	4 to 20 mm min.	0.8 to 4 mm
Features	Optical Fiber Sensors	• Built-in Amplifier Sensors • Microsensors	Separate Amplifier Sensors	Built-in Amplifier Sensors	Built-in Amplifier Sensors
Model	E32-L25L	E3T-SL1□	E3C-LS3R	E3Z-LS	E3S-CL1

(3) MSR (Mirror Surface Rejection) Function

[Principles]

This function and structure uses the characteristics of the Retroreflector and the polarizing filters built into the Retro-reflective Sensors to receive only the light reflected from the Retroreflector.

- The waveform of the light transmitted through a polarizing filter in the Emitter changes to polarization in a horizontal orientation.
- The orientation of the light reflected from the triangular pyramids of the Retroreflector changes from horizontal to vertical.
- This reflected light passes through a polarizing filter in the Receiver to arrive at the Receiver.

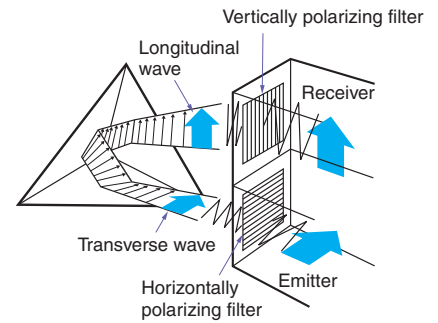
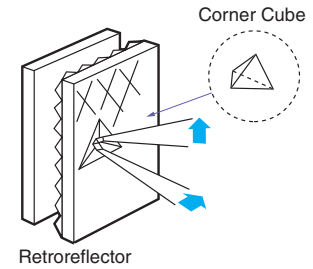
[Purpose]

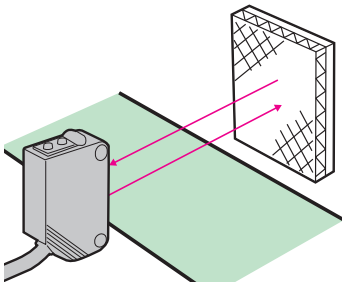
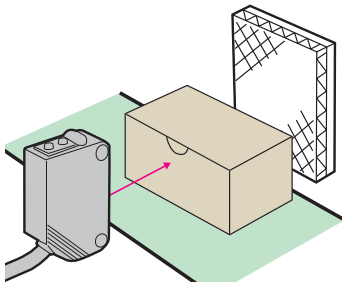
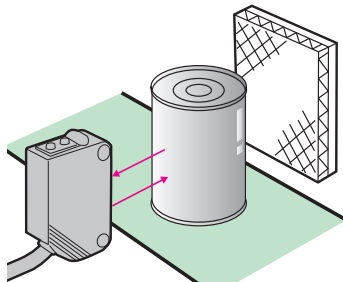
This method enables stable detection of objects with a mirror-like surface.

Light reflected from these types of objects cannot pass through the polarizing filter on the Receiver because the orientation of polarization is kept horizontal.

[Examples]

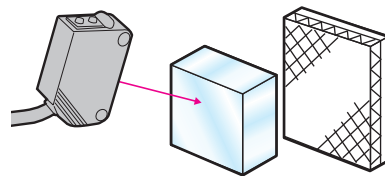
A sensing object with a rough, matte surface (example (2)) can be detected even without the MSR function. If the sensing object has a smooth, glossy surface on the other hand (example (3)), it cannot be detected with any kind of consistency without the MSR function.



(1) No Object The light from the Emitter hits the Reflector and returns to the Receiver. 	(2) Non-glossy Object Light from the Emitter is intercepted by the object, does not reach the Reflector, and thus does not return to the Receiver. 	(3) Object with a Smooth, Glossy Surface (Example: battery, can, etc.) Light from the Emitter is reflected by the object and returns to the Receiver. 
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[Caution]

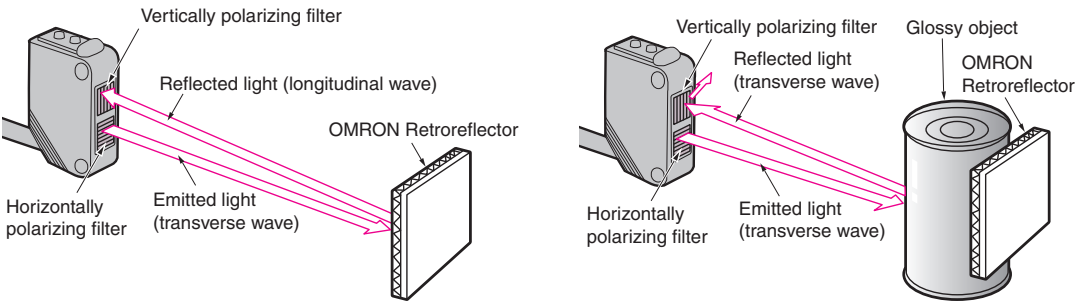
Stable operation is often impossible when detecting objects with high gloss or objects covered with glossy film. If this occurs, install the Sensor so that it is at an angle off perpendicular to the sensing object.



Retro-reflective Sensors with MSR function

Retro-reflective Sensors with MSR function	
Classification by Configuration	Model
Optical Fiber Sensors	E32-R21, E32-R16
	E3Z-R61/R66/R81/R86
	E3ZM-R61/R66/R81/R86/B61/B66/B81/B86
	E3ZM-CR61(-M1TJ)/CR81(-M1TJ)
	E3S-CR11(-M1J)/CR61(-M1J)
Separate Amplifier Sensors	E3C-LR11/LR12
Built-in Power Supply Sensors	E3JM-R4□4(T), E3JK-R□12

Note: When using a Sensor with the MSR function, be sure to use an OMRON Reflector



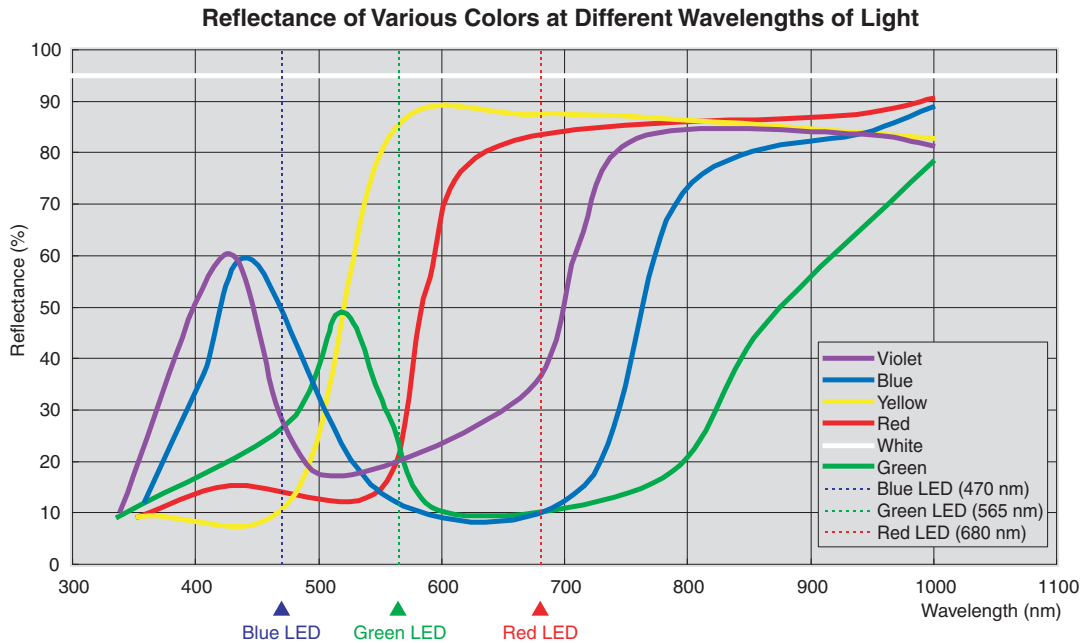
Retro-reflective Sensors without MSR Function

When detecting a glossy object using a Retro-reflective Sensor without the MSR function, mount the Sensor diagonally to the object so that reflection is not received directly from the front surface.

Retro-reflective Sensors without MSR Function	
Classification by Configuration	Model
Transparent Object Sensors	E3Z-B61/B62/B66/B67/B81/B82/B86/B87

(4) Surface Color and Light Source Reflectance

Surface Color Reflectance



Identifiable Color Marks

Sensor Light Color : Blue

	White	Red	Yellow	Green	Blue	Violet	Black
White		5	5	3		3	8
Red	5				3	2	
Yellow	5			2	4	2	
Green	3		2		2		3
Blue		3	4	2			6
Violet	3	2	2				4
Black	8			3	6	4	

Sensor Light Color : Green

	White	Red	Yellow	Green	Blue	Violet	Black
White		8			3	5	10
Red	8		5	5	3		
Yellow		5			3	6	
Green		5			3	6	
Blue	3	3				4	
Violet	5		3	3		3	
Black	10		6	6	4	3	

Sensor Light Color : Red

	White	Red	Yellow	Green	Blue	Violet	Black
White				5	6	3	9
Red				4	4	2	7
Yellow				5	5	3	8
Green	5	4	5			2	
Blue	6	4	5			2	
Violet	3	2	3	2	2		4
Black	9	7	8			4	

The numbers express the degree of margin (percentage of received light for typical examples).
Models with an RGB light source support all combinations.

Sensor light color	Product classification	Model
Red light source 	Optical Fiber Sensors	E3X-HD
		E3X-SD
		E3X-NA
		E3X-DA-S
		E3X-MDA
	Separate Amplifier Sensors	E3C-VS3R E3C-VM35R E3C-VS7R
Blue light source 	Optical Fiber Sensors	E3X-DAB-S
Green light source 	Optical Fiber Sensors	E3X-DAG-S E3X-NAG
	Separate Amplifier Sensors	E3C-VS1G
White light source 	Optical Fiber Sensors	E3X-DAC-S

(5) Self-diagnosis Functions

The self-diagnosis function checks for margin with respect to environmental changes after installation, especially temperature, and informs the operator of the result through indicators and outputs. This function is an effective means of early detection of product failure, optical axis displacement, and accumulation of dirt on the lens over time.

[Principles]

These functions alert the operator when the Sensor changes from a stable state to an unstable state. The functions can be broadly classified into display functions and output functions.

Display function

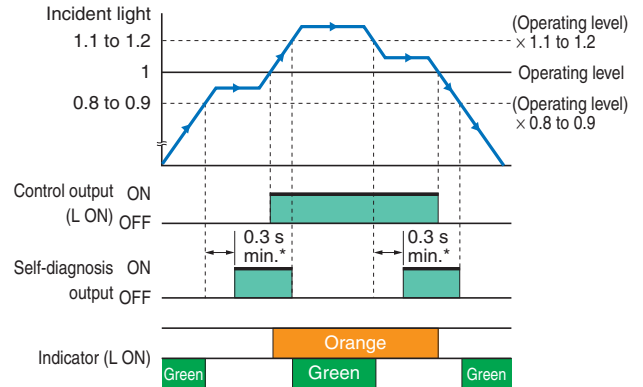
- **Stability Indicator (green LED)**
The amount of margin with respect to environmental changes (temperature, voltage, dust, etc.) after installation is monitored by the self-diagnosis function and indicated by an indicator. (Illuminates steadily when there are no problems.)
- **Operation Indicator (Orange LED)**
Indicates the output status.

Output function

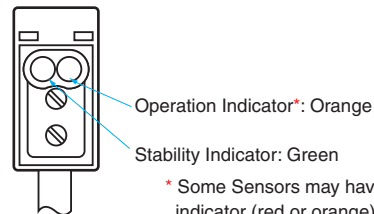
The margin is indicated by an indicator light, and the state is output to alert the operator.

[Purpose]

Self-diagnosis functions are effective in maintaining stable operation, alerting the operator to displacement of the optical axis, dirt on the lens (Sensor surface), the influence from the floor and background, external noise, and other potential failures of the Sensor.

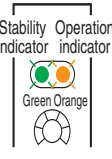
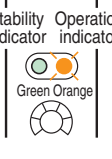
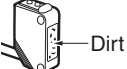
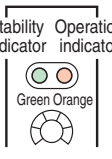
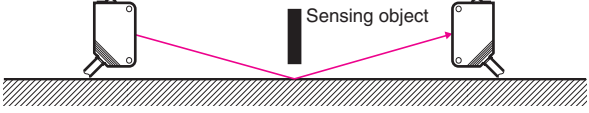
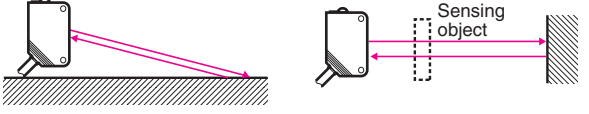
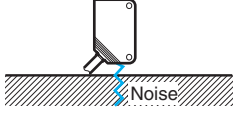
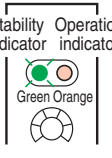


* If the moving speed of sensing object is slow, the Sensor may output a self-diagnosis output. When using the Photoelectric sensor, please install an ON-delay timer circuit etc..



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Example: Light-ON Operation

Indicator state	Light-ON/Dark-ON indicated by the orange indicator	Degree of margin with respect to temperature changes indicated by the green indicator	Self-diagnosis output	Example of diagnosed condition
 Operating level x 1.1 to 1.2	Light Incident (orange indicator ON)	Stable use is possible. (Margin of 10% to 20% or higher) (Stability indicator: ON)	---	---
 Operating level				- Example: Incident light becomes unstable. (1) When the optical axis shifts slightly due to vibration.  (2) When the lens became dirty from adhesion of dust. 
 Operating level x 0.8 to 0.9	Light Interrupted (orange indicator OFF)	The margin is not sufficient. (Green indicator: OFF)	When this state continues for a certain period of time, an output alerts the operator.	- Example: Operation is unstable when light is interrupted. (1) Light has leaked around the sensing object (Through-beam Sensors or Retro-reflective Sensors).  (2) Reflected light from the floor or the background has been received (Diffuse-reflective Sensor).  (3) External noise has influenced operation. 
		Stable use is possible. (Margin of 10% to 20% or higher) (Stability indicator: ON)	---	---

<Applicable Models>

Classification by Configuration	Models	Self-diagnosis function	
		Display function	Output function
Optical Fiber Sensors	E3X-DA-S	Digital display	●
	E3X-MDA	Digital display	---
	E3X-NA	●	---
Separate Amplifier Sensors	E3C-LDA	Digital display	●
	E3C	●	●(E3C-JC4P)
Built-in Amplifier Sensors	E3Z	●	---
	E3ZM(-C)	●	---
	E3T	●	---
	E3S-C	●	---
	E3S-CL	●	---