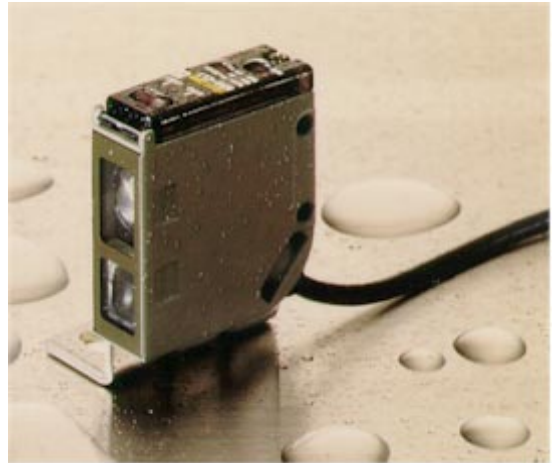


## Distance-settable Photoelectric Sensor

## E3S-CL

### Stable Detection Regardless of Color, Material, or Size. New Optical System to Eliminate Background Influences

- Background influences are eliminated by a unique optical system for setting the detection distance: 2% or less differential travel at 20 cm.
- Solves traditional problems in diffuse reflective sensors: No distance change for colors or materials; 2% or less black/white error at 20 cm.
- New optical system resists the effect of dirty lenses.
- Easy distance adjustments with 6-turn adjustment with indicator.
- Compact and with a long detection distance of 50 cm (E3S-CL2).
- Solid metallic body with excellent water and oil resistivity (E3S-CL2).
- NPN/PNP output (switch selectable) for easy application anywhere.
- Conforms to relevant EN/IEC standards.



### Ordering Information

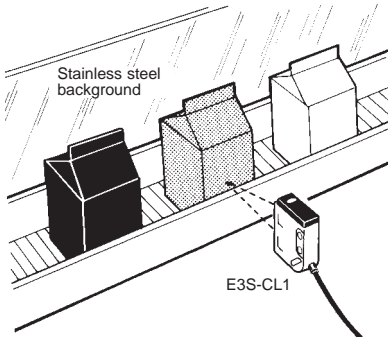
Appearance	Detecting/Setting range	Operating mode	Output configuration	Model
		Light-ON Dark-ON (selectable)	NPN PNP (selectable)	E3S-CL1
				E3S-CL2

# Application Examples

## E3S-CL1

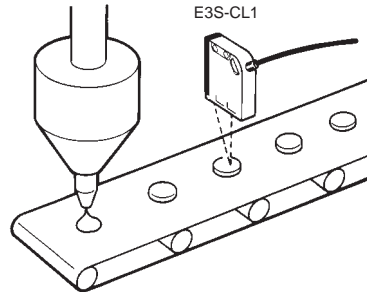
### Detecting Milk Cartons

Stable detection is not affected by stainless steel background or carton colors.



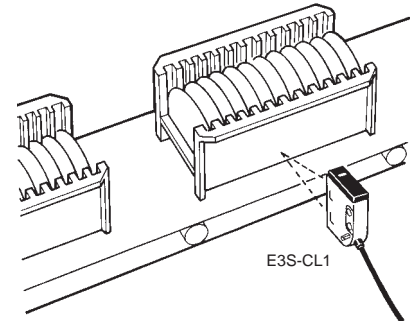
### Detecting Food Products on Conveyors

Overhead detection is possible.



### Detecting Wafer Cassettes

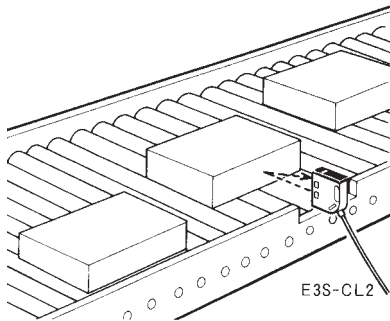
Easy distance setting with 6-turn adjustment and indicator.



## E3S-CL2

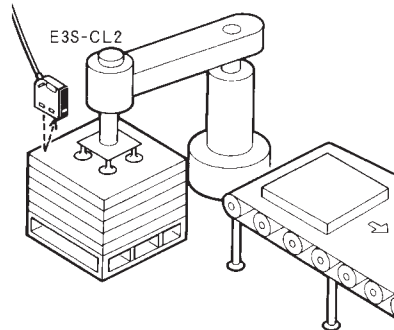
### Detecting Boxes

Stably detecting boxes regardless of box position.



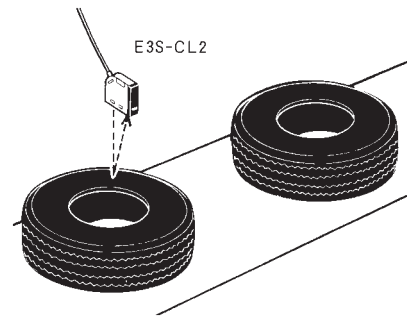
### Detecting Construction Materials (Boards) Remaining on a Pallet

Detecting construction materials with the sensor located above the construction materials.



### Detection Tires on a Conveyor Line

Stably detecting black objects such as tires.



# Specifications

Item	Distance-settable Photoelectric Sensor	
	E3S-CL1	E3S-CL2
LED for emitter	Red LED (wavelength: 700 nm)	Infrared LED (wavelength: 860 nm)
Sensitivity adjustment	Six-turn endless adjuster with an indicator	
Connection method	Pre-wired	
Output configuration	NPN or PNP (selectable) open collector current output	
Control output	Light-ON or Dark-ON (selectable)	
Circuit protection	Load short-circuit protection, reversed connection protection, and mutual interference prevention function	
Indicator	Light indicator (orange), stability indicator (green)	
Materials	Case: Zinc die-cast Operation panel: Sulfonated polyether Lens: Acrylic Mounting bracket: Stainless	
Weight	Approx. 120 g (with 2-mm cable)	
Attachments	Mounting bracket, screwdriver for adjustment, M4 hexagonal bolts, and instruction sheet	

## ■ Ratings/Characteristics

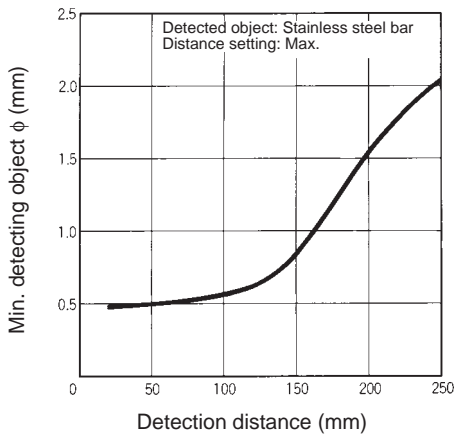
Item	E3S-CL1	E3S-CL2
Power supply voltage	10 to 30 VDC; ripple: 10% max.	
Current consumption	35 mA max.	50 mA max.
Setting distance	4 to 20 cm (white paper: 20 x 20 cm)	5 to 50 cm (white paper: 20 x 20 cm)
Detection distance	0.5 to 20 cm (white paper: 20 x 20 cm, setting distance: 20 cm)	0.5 to 50 cm (white paper: 20 x 20 cm, setting distance: 50 cm)
Hysteresis	2% max. of detection distance	10% max. of detection distance (5% for white paper)
Reflectivity characteristics (black/white error) (see note 1)	2% max. (at 20-cm detection distance)	10% max. of detection distance
Spot size	20-mm diameter or less (at 20-cm detection distance)	30-mm diameter or less (at 20-cm detection distance)
Repeat accuracy	Perpendicular to optical axis: 0.5 mm max.; In direction of optical axis: 1 mm max.	Perpendicular to optical axis: 0.5 mm max.; In direction of optical axis: 10 mm max.
Response time	1 ms max. for both operation and release	
Control output	100 mA max. at 30 VDC (residual voltage; NPN output: 1.2 V max., PNP output: 2.0 V max.) (NPN/PNP output selectable)	
Ambient illumination	Incandescent lamp: illumination on optical spot: 5,000 lx max. Sunlight: illumination on optical spot: 10,000 lx max.	
Ambient temperature	Operating: -25°C to 55°C (with no icing)	
Ambient humidity	Operating: 35% to 85%	
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, or 300 m/s <sup>2</sup> (approx. 30G) for 2 hrs each in X, Y, and Z directions	
Shock resistance	Destruction: 500 m/s <sup>2</sup> (approx. 50G) 3 times each in X, Y, and Z directions	
Enclosure ratings	IEC: IP67, NEMA: 6P (indoors only) (see note 2)	IEC: IP67 (JEM: IP67G), NEMA: 6P (indoors only) (see note 2)

**Note:** 1. Detection distance error for standard white (90% reflective) and black (5% reflective) paper.  
2. NEMA: National Electrical Manufacturers Association

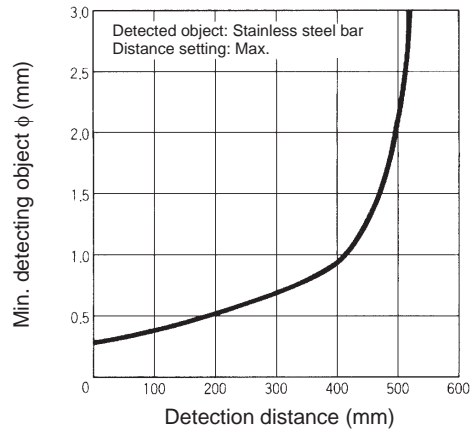
# Engineering Data

## Detection Distance vs. Object Size

E3S-CL1

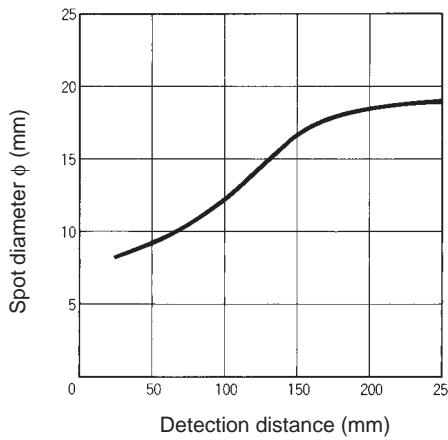


E3S-CL2

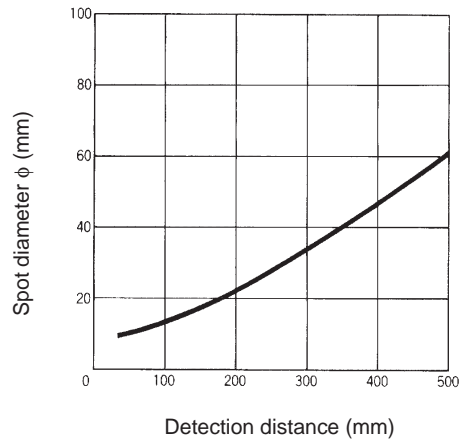


## Spot Diameter vs. Detection Distance

E3S-CL1

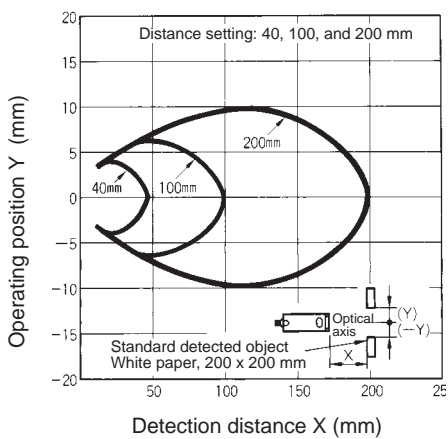


E3S-CL2

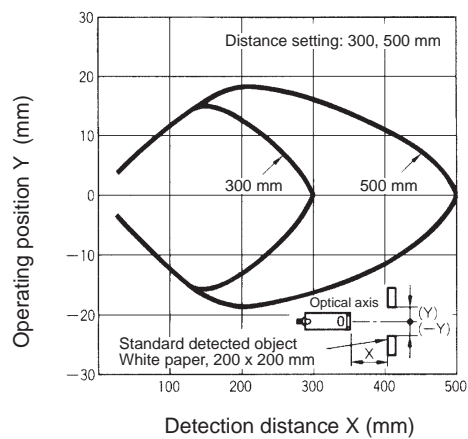


## Operating Range

E3S-CL1

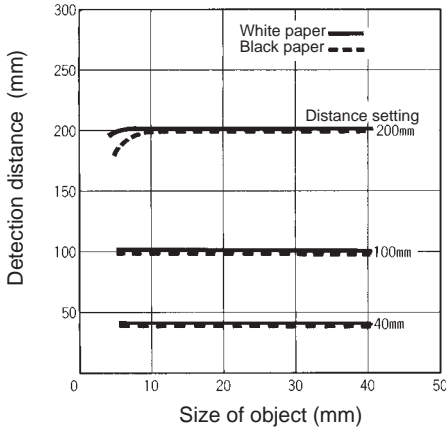


E3S-CL2

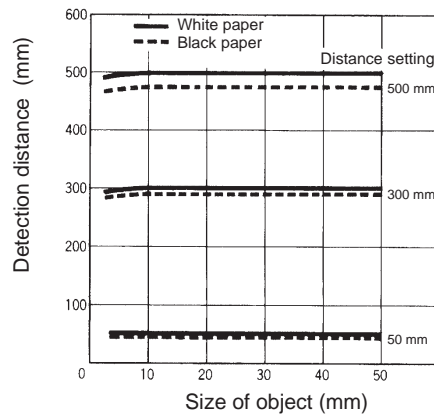


Detection Distance vs. Object Size

E3S-CL1



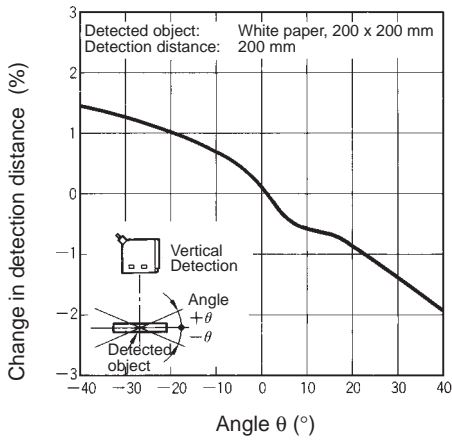
E3S-CL2



Angle Characteristic

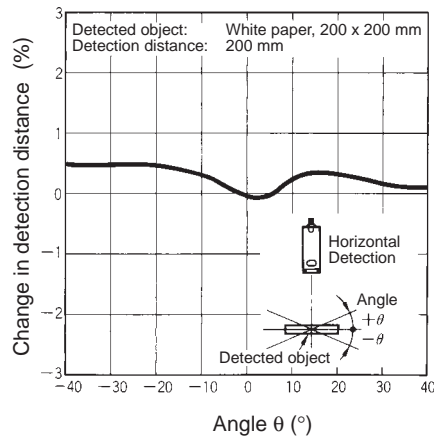
E3S-CL1

Vertical Detection



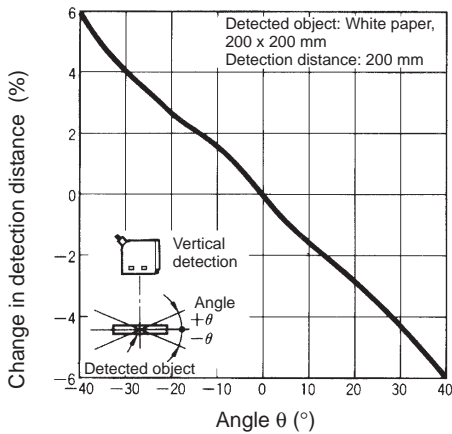
E3S-CL1

Horizontal Detection



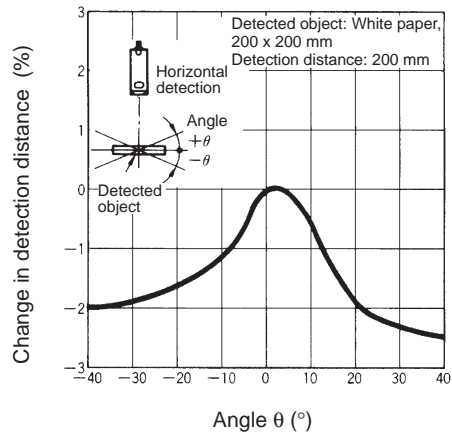
E3S-CL2

Vertical Detection



E3S-CL2

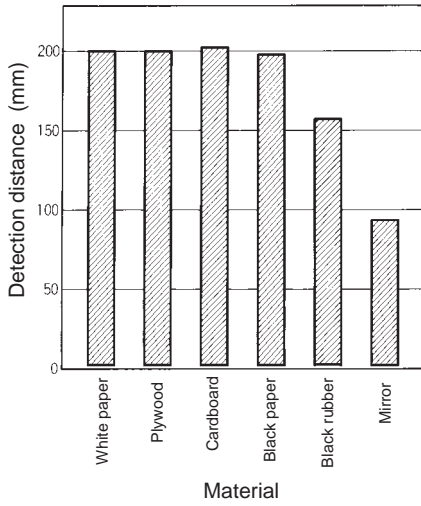
Horizontal Detection



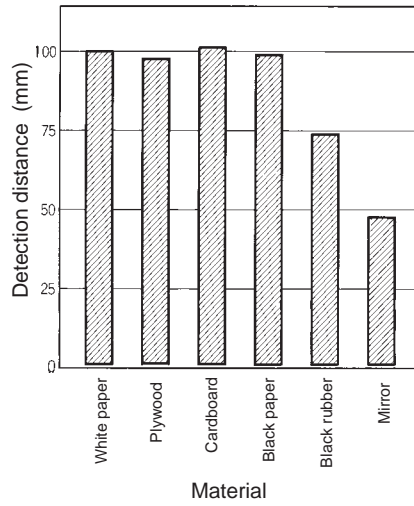
Detection Distance vs. Material

E3S-CL1

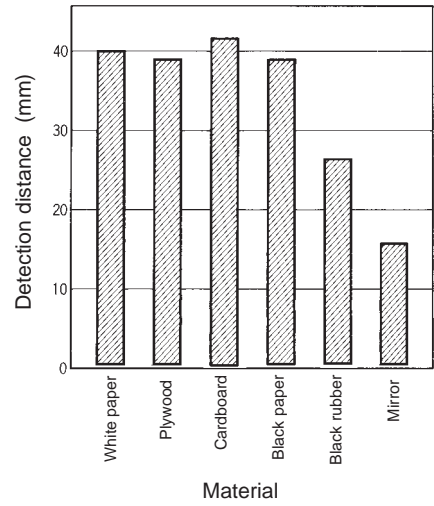
(Setting Distance Set to 200 mm using White Paper)



(Setting Distance Set to 100 mm using White Paper)

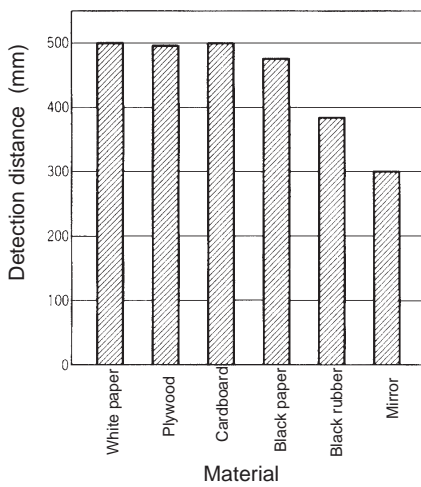


(Setting Distance Set to 40 mm using White Paper)

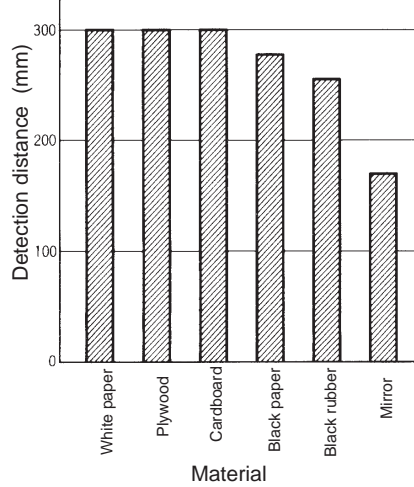


E3S-CL2

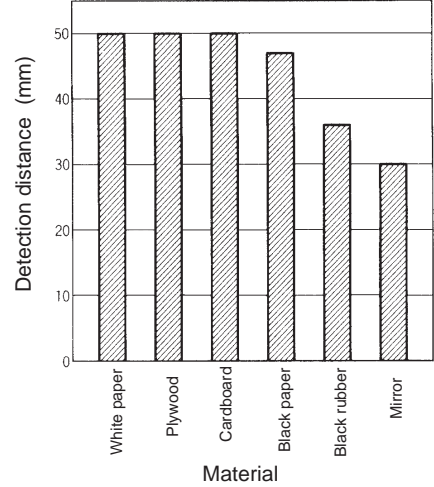
(Setting Distance Set to 500 mm using White Paper)



(Setting Distance Set to 300 mm using White Paper)

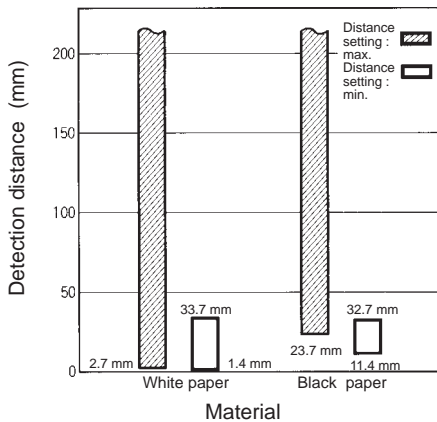


(Setting Distance Set to 50 mm using White Paper)

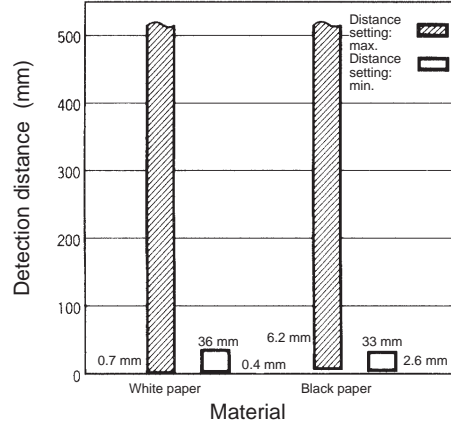


Short Range Characteristic

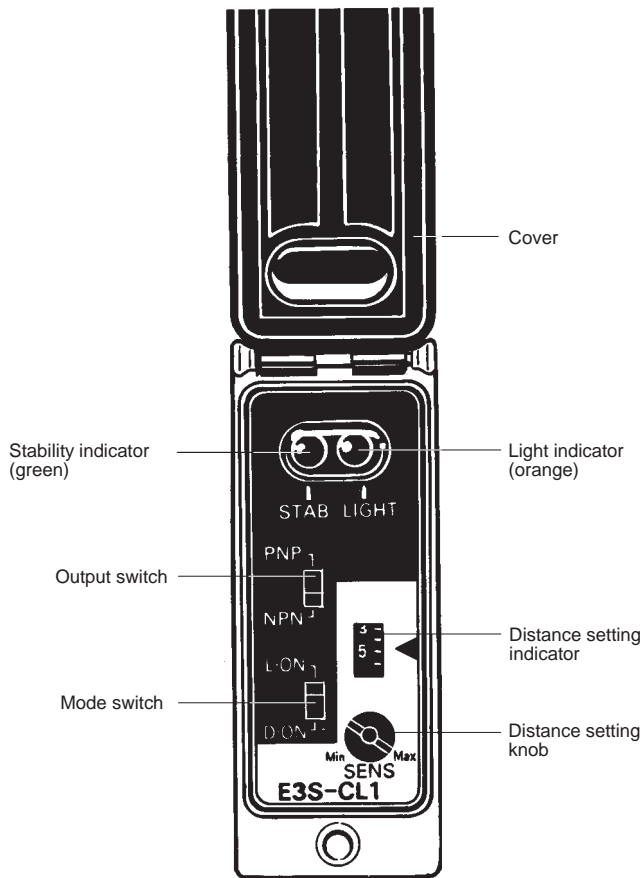
E3S-CL1



E3S-CL2



# Nomenclature



### Output Switch

1. Set the switch to NPN for NPN output.
2. Set the switch to PNP for PNP output.

### Mode Switch

1. Set the switch to L-ON for ON light-ON operation.
2. Set the switch to D-ON for ON dark-ON operation.

### Distance Setting Knob

1. The detection distance will increase when the knob is turned clockwise (toward Max.) and will decrease when the knob is turn counterclockwise.
2. The adjustment can be turned up to 6 times clockwise or counterclockwise to set the detection distance. The number of turns will be displayed by the indicator.

# Operation

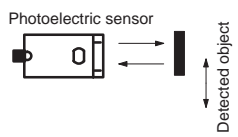
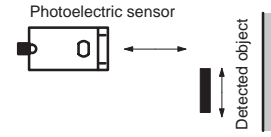
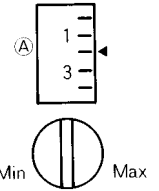
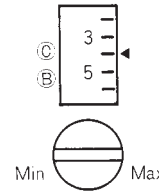
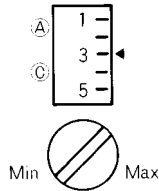
## Output Circuits

Output configuration	Mode switch	Output transistor	Output circuits
NPN	Light-ON	ON when light is received.	
	Dark-ON	ON when light is not received.	
PNP	Light-ON	ON when light is received.	
	Dark-ON	ON when light is not received.	

■ Timing Chart

Output configuration	Mode switch	Output transistor	Timing chart
NPN	Light-ON	ON when light is received.	Light received Light not received Light indicator (Orange) ON OFF Output transistor ON OFF Load (relay) Operate Release
	Dark-ON	ON when light is not received.	Light received Light not received Light indicator (Orange) ON OFF Output transistor ON OFF Load (relay) Operate Release
PNP	Light-ON	ON when light is received.	Light received Light not received Light indicator (Orange) ON OFF Output transistor ON OFF Load (relay) Operate Release
	Dark-ON	ON when light is not received.	Light received Light not received Light indicator (Orange) ON OFF Output transistor ON OFF Load (relay) Operate Release

■ Sensitivity Adjustment

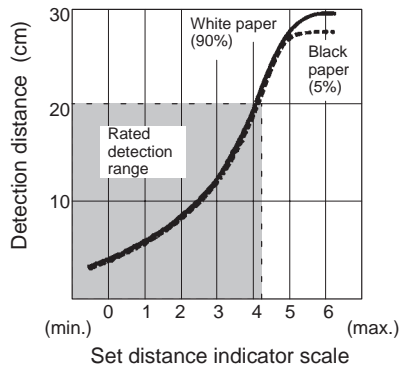
Item	Position A	Position B and C	Setting
<b>Adjustment procedure</b>	Place the detected object at the desired location and turn the adjustment knob clockwise until the LIGHT indicator (orange) lights. This is position A.	<b>Background Object</b> Remove the detected object and turn the adjustment knob clockwise until the LIGHT indicator (orange) lights. This is position B. Then turn the adjustment knob counterclockwise until the LIGHT indicator (orange) goes out. This is position C.  <b>No Background Object</b> The maximum adjustment setting is used as position C.	Set the adjustment to halfway between A and C. Confirm that the STAB indicator (green) remains lit both with the detected object present and not present. If the STAB indicator does not remain lit, reconsider the detection method to enable stable operation.
<b>Detecting condition</b>			---
<b>Status of distance setting knob and distance setting indicator</b>			
<b>Indicators</b>	OFF STABILITY (green) ON LIGHT (orange)	OFF STABILITY (green) OFF LIGHT (orange)	ON STABILITY (green) OFF LIGHT (orange)

**Note:** The sensor must be set to within the rated detection range for application (see diagrams on next page). Background interference can be a problem if the distance is set near the maximum value (5 to 6 on the scale). Factory settings are as follows:  
 E3S-CL1: 20 cm (on white paper)  
 E3S-CL2: 50 cm (on white paper)

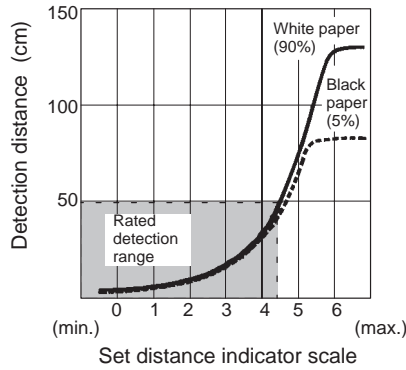


**Set Distance Indicator Scale vs. Detection Distance Characteristic (Typical)**

**E3S-CL1**



**E3S-CL2**



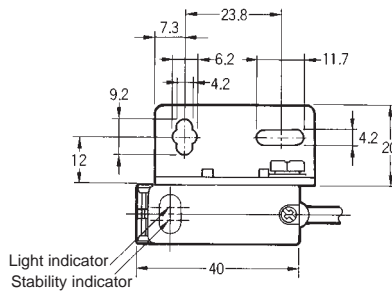
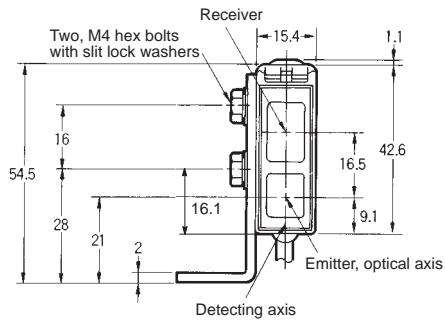
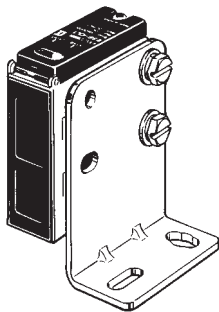
**Note:** Reflection rates are given in parentheses.

**Dimensions**

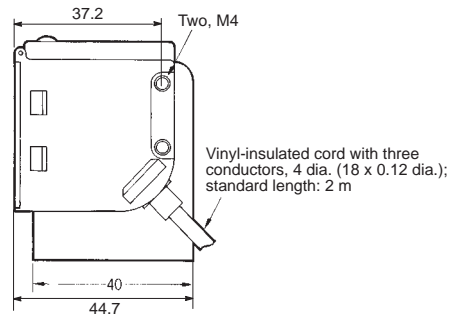
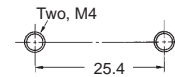
**Note:** All units are in millimeters unless otherwise indicated.

**E3S-CL1**

**E3S-CL2**



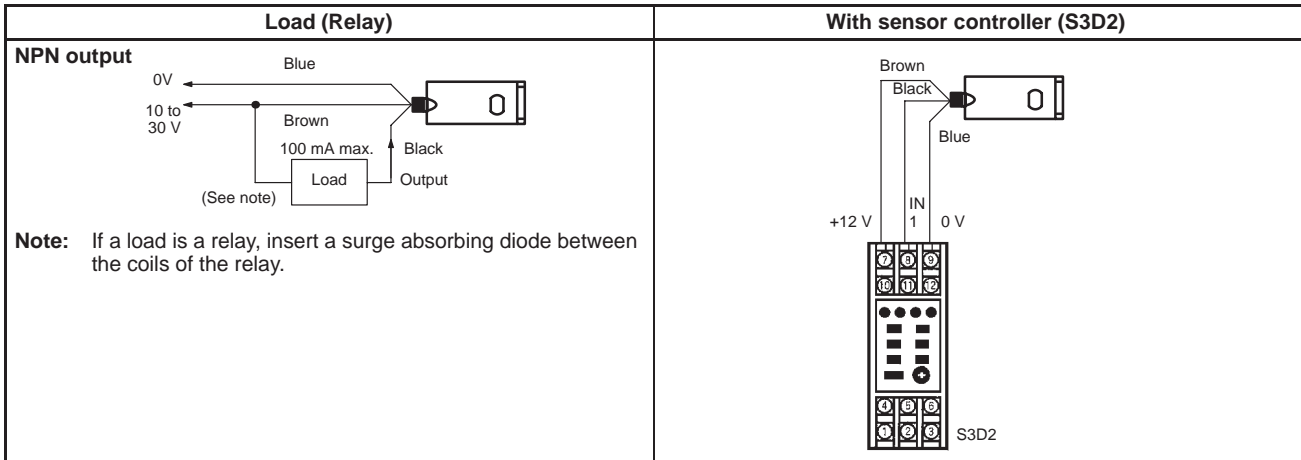
**Mounting Holes**



**Note:** The output switch, mode switch, and distance setting knob can be accessed by removing the cover.

# Installation

## ■ Connections



# Precautions

## Connection

If the input/output lines of the photoelectric sensor are placed in the same conduit or duct as power lines or high-voltage lines, the photoelectric sensor could be induced to malfunction, or even be damaged, by electrical noise. Either separate the wiring or use shielded lines as input/output lines to the photoelectric sensor.

The cord connected to the Sensor can be extended up to 100 m provided that the diameter of each wire of the cord is 0.3 mm<sup>2</sup> minimum.

## Power Supply

If a standard switching regulator is used as a power supply, the frame ground (FG) terminal and the ground (G) terminal must be grounded, otherwise the Sensor may malfunction due to the switching noise of the power supply.

## Startup Operation

A maximum of 100 ms is required from the time power is turned on until the E3S-CL is able to detect objects. If power is supplied to the loads and the E3S-CL from different sources, turn on power to the E3S-CL first.

## Water Resistivity

Do not use the E3S-CL in water, in the rain, or outdoors.

To ensure the water resistivity of the E3S-CL, tighten the screws of the operation panel cover to a torque of 2.5 to 5.0 kgf • cm (0.25 N • m to 0.49 N • m).

## Oil and Chemical Resistivity (E3S-CL2)

Oil	JIS classification	Product name	Kinematic viscosity (mm <sup>2</sup> /s (cst)) at 40°C	PH
Lubricating oil	---	Velocite No.3	2.02	---
Water insoluble machining oil	No. 5, type 2	Daphnecut	10 min. and less than 50	
	No. 11, type 2	Yushiron Oil No. 2 ac	Less than 10	
Water soluble machining oil	No. 1, type W1	Yushiroken EC50T-3	---	7 to 9.5
		Yushiron Lubic HWC68		7 to 9.9
	No. 2, type W1	Griton 1700D		7 to 9.2
	No. 1, type W2	Yushiroken S50N		7 to 9.8

- Note:**
- The E3S-CL2 maintained a minimum insulation resistance of 100 MΩ after the E3S-CL2 was dipped in all the above oils at a temperature of 50°C for 240 hours.
  - When using the E3S-CL2 in a place where an oil other than the ones listed above is sprayed on the E3S-CL2, refer to the above kinematic viscosity and pH values. The location may be suitable for the E3S-CL2 if the kinematic viscosity and pH values of the oil are close to the above kinematic viscosity and pH values, but make sure that the oil does not contain any additive that may have a negative influence on the E3S-CL2.
  - JIS: Japan Industrial Standards

Do not use an E3S-CL2 that has been dipped in oil or chemical liquid.

The E3S-CL2 passed oil-resistivity tests with all the oils listed above. Other oils may, however, disrupt the normal operation.

### Cable

The E3S-CL2 uses an oil-resistive cord to ensure oil resistivity.

Do not allow the cable to be repeatedly bent during application.

Do not allow the cable to be bent to a radius of less than 25 mm.

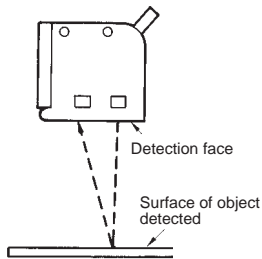
### Malfunctioning

If an inverter motor or servomotor is used with the E3S-CL, the frame ground (FG) terminal and the ground (G) terminal must be grounded, or otherwise the Sensor may malfunction.

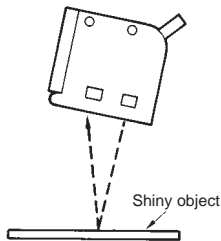
### Mounting

#### Mounting Direction

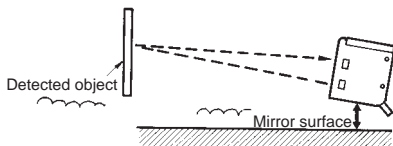
Mount the Sensor so that the detection face runs parallel to the surface of the object being detected as shown below, and not at an angle.



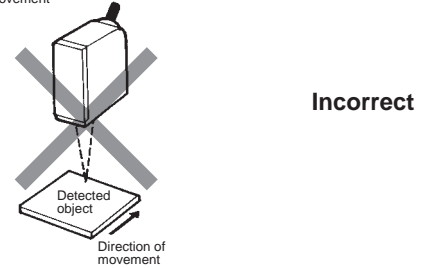
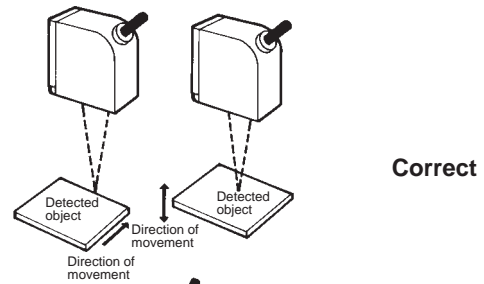
If detecting a shiny object, however, mount the Sensor so that the detection face is at an angle of between  $5^\circ$  and  $10^\circ$  of the surface of the object being detected as shown below, and check to be sure that there is no interference from the background.



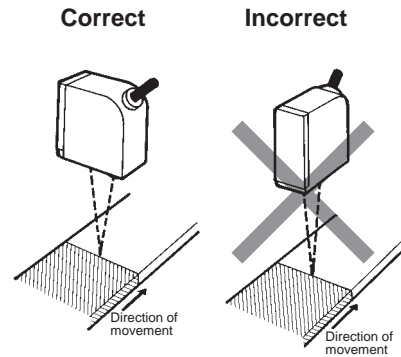
If stable operation is not possible near a mirror surface, mount the Sensor at an angle as shown below, and separate the Sensor as far as possible from the mirror surface.



Mount the Sensor so that it is not aligned with the direction of movement of the detected object, as shown below.



Also, mount the Sensor so that it is not aligned with extreme changes in color or materials, as shown below.



Mount the Sensor so that sunlight, fluorescent light, incandescent light, or other strong sources of light do not enter the directional angle of the Sensor.

**Precautions**

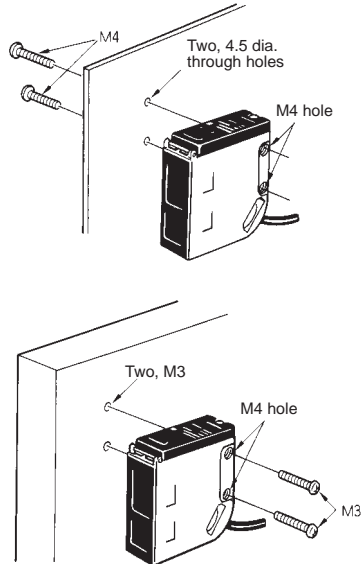
When mounting the Sensor, do not hit the Sensor with a hammer, or the Sensor will lose its watertightness.

Use M4 screws to mount the Sensor.

The tightening torque of each screw must be 12 kgf • m (1.18 N • m) maximum.

**Direct Mounting**

Mount the Sensor as shown in the following illustration.

**! WARNING**

The E3S-CL is not a safety component for ensuring the safety of people which is defined in EC directive (91/368/EEC) and covered by separate European standards or by any other regulations or standards.

**ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.**

To convert millimeters into inches, multiply by 0.03937. To convert grams into ounces, multiply by 0.03527.

Cat. No. E237-E1-2A In the interest of product improvement, specifications are subject to change without notice.

**OMRON Corporation**

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Sensing Devices and Components Division H.Q.  
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Printed in Japan  
1297-1M (0395) a