Photomicrosensors

DATA BOOK

realizing

OMRON

Photomicrosensor
Data Book

- Photomicrosensor with Cable (Non-light-modulated)
- Slot-type Photomicrosensor (Non-light-modulated)
- Slot-type Photomicrosensor with Connector (Light-modulated)
- Slot-type Photomicrosensor with Cable
- Broad Slot-type Photomicrosensor
- Long-distance Through-beam Photomicrosensor
- Photomicrosensor with Amplifier and Cable
- Slot-type Reflective Photomicrosensor
- Light Convergent Reflective Photomicrosensor
- Reflective Photomicrosensor with Sensitivity Adjuster (Non-light-modulated)
- Retroreflective Photomicrosensor with Lens
- Pipe-mounting Liquid Level Photomicrosensor with Built-in Amplifier
- Wafer-carrier Mounting Photomicrosensors

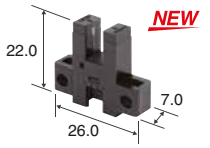
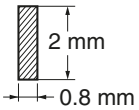
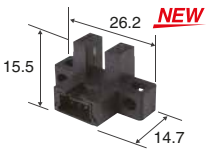
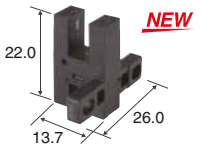
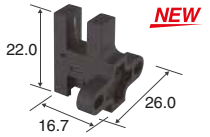
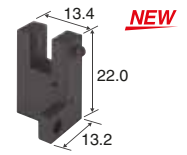
Photomicrosensors

Classified According to Product Model

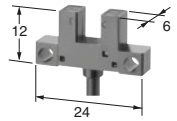
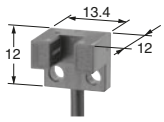
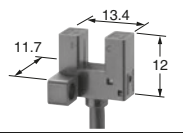
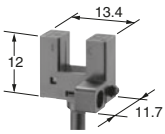
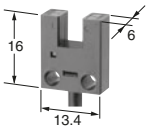
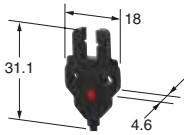
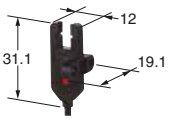
Through-beam Type (with Slot)

* Indicates models with indicators that light red when the light is interrupted.

Infrared light

Appearance	Sensing distance	Optical modulation	Features	Output configuration	Indicator*	Model		Page
						NPN output	PNP output	
 NEW	5 mm (slot width)	Non-modulated light	Built-in connectors Emitter/receiver window 	Dark-ON/ Light-ON (2 outputs)	---	EE-SX970-C1	EE-SX970P-C1	33
 NEW					---	EE-SX971-C1	EE-SX971P-C1	
 NEW					---	EE-SX972-C1	EE-SX972P-C1	
 NEW					---	EE-SX974-C1	EE-SX974P-C1	
 NEW					---	EE-SX975-C1	EE-SX975P-C1	
 NEW					---	EE-SX976-C1	EE-SX976P-C1	
 NEW					---	EE-SX977-C1	EE-SX977P-C1	

Note: The table includes only basic specifications. Be sure to check the detailed specifications and precautions on the page given in the right column before using the Photomicrosensor.

Appearance	Sensing distance	Optical modulation	Features	Output configuration	Indicator*	Model		Page
						NPN output	PNP output	
	5 mm (slot width)	Non-modulated light	Ultracompact pre-wired models Emitter/receiver window 	Light-ON Dark-ON (2 outputs)	---	EE-SX910-R	EE-SX910P-R	41
						EE-SX911-R	EE-SX911P-R	
						EE-SX912-R	EE-SX912P-R	
						EE-SX913-R	EE-SX913P-R	
						EE-SX914-R	EE-SX914P-R	
			Miniature, slim, pre-wired models Emitter/receiver window 	Dark-ON	---	EE-SX770	EE-SX770P	49
					●	EE-SX770A	EE-SX770R	
				Light-ON	---	EE-SX870	EE-SX870P	
					●	EE-SX870A	EE-SX870R	
				Dark-ON	---	EE-SX771	EE-SX771P	
					●	EE-SX771A	EE-SX771R	
				Light-ON	---	EE-SX871	EE-SX871P	
					●	EE-SX871A	EE-SX871R	
				Dark-ON	---	EE-SX772	EE-SX772P	
					●	EE-SX772A	EE-SX772R	
				Light-ON	---	EE-SX872	EE-SX872P	
					●	EE-SX872A	EE-SX872R	

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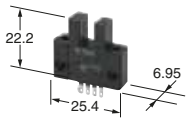
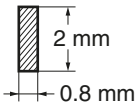
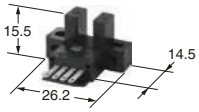
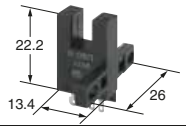
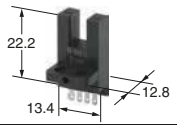
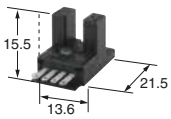
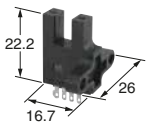
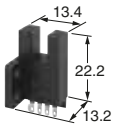
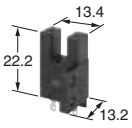
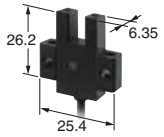
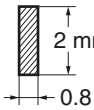
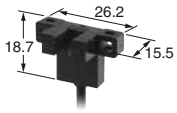
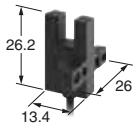
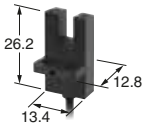
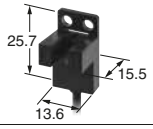
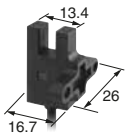
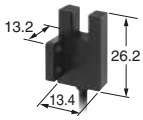
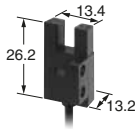
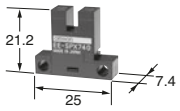
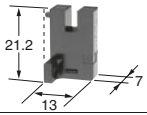
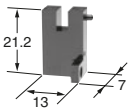
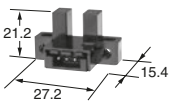
Appearance	Sensing distance	Optical modulation	Features	Output configuration	Indicator*	Model		Page
						NPN output	PNP output	
	5 mm (slot width)	Non-modulated light	General-purpose models with connectors Emitter/receiver window 	Dark-ON Light-ON (selectable)	---	**EE-SX670**	**EE-SX670P**	**55**
					●	**EE-SX670A**	**EE-SX670R**	
				Light-ON	---	**EE-SX470**	**EE-SX470P**	
				Dark-ON Light-ON (selectable)	---	**EE-SX671**	**EE-SX671P**	
					●	**EE-SX671A**	**EE-SX671R**	
				Light-ON	---	**EE-SX471**	**EE-SX471P**	
				Dark-ON Light-ON (selectable)	---	**EE-SX672**	**EE-SX672P**	
					●	**EE-SX672A**	**EE-SX672R**	
				Light-ON	---	**EE-SX472**	**EE-SX472P**	
				Dark-ON Light-ON (selectable)	---	**EE-SX673**	**EE-SX673P**	
					●	**EE-SX673A**	**EE-SX673R**	
				Light-ON	---	**EE-SX473**	**EE-SX473P**	
				Dark-ON Light-ON (selectable)	---	**EE-SX674**	**EE-SX674P**	
					●	**EE-SX674A**	**EE-SX674R**	
				Light-ON	---	**EE-SX474**	**EE-SX474P**	
				Dark-ON Light-ON (selectable)	---	**EE-SX675**	**EE-SX675P**	
					---	**EE-SX676**	**EE-SX676P**	
					---	**EE-SX677**	**EE-SX677P**	

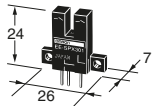
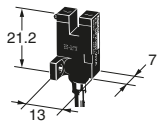
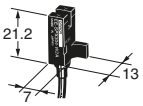
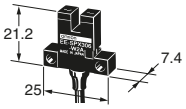
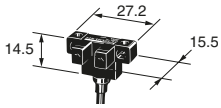
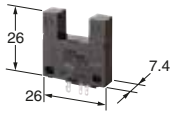
Note: The table includes only basic specifications. Be sure to check the detailed specifications and precautions on the page given in the right column before using the Photomicrosensor.

Appearance	Sensing distance	Optical modulation	Features	Output configuration	Indicator*	Model		Page
						NPN output	PNP output	
	5 mm (slot width)	Non-modulated light	General-purpose pre-wired models Emitter/receiver window 	Dark-ON Light-ON (selectable)	---	**EE-SX670 -WR**	**EE-SX670P -WR**	**55**
					---	**EE-SX671 -WR**	**EE-SX671P -WR**	
					---	**EE-SX672 -WR**	**EE-SX672P -WR**	
					--	**EE-SX673 -WR**	**EE-SX673P -WR**	
					---	**EE-SX674 -WR**	**EE-SX674P -WR**	
					---	**EE-SX675 -WR**	**EE-SX675P -WR**	
					---	**EE-SX676 -WR**	**EE-SX676P -WR**	
					---	**EE-SX677 -WR**	**EE-SX677P -WR**	
	3.6 mm (slot width)	Modulated light	Models with connectors Emitter/receiver window 	Dark-ON	---	**EE-SPX740**	---	**65**
				Light-ON	---	**EE-SPX840**	---	
				Dark-ON	---	**EE-SPX742**	---	
				Light-ON	---	**EE-SPX842**	---	
				Dark-ON	---	**EE-SPX743**	---	
				Light-ON	---	**EE-SPX843**	---	
	5 mm (slot width)		Models with connectors Emitter/receiver window 	Dark-ON	---	**EE-SPX741**	---	
				Light-ON	---	**EE-SPX841**	---	

Note: The table includes only basic specifications. Be sure to check the detailed specifications and precautions on the page given in the right column before using the Photomicrosensor.

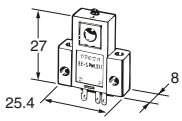
Classified According to Product Model
Through-beam Type (with Slot)

Infrared light

Appearance	Sensing distance	Optical modulation	Features	Output configuration	Model	Page
	3.6 mm (slot width)	Modulated light	Models with connectors Emitter/receiver window 1 mm × 0.5 mm	Dark-ON	**EE-SPX301**	**87**
				Light-ON	**EE-SPX401**	
			Pre-wired models Emitter/receiver window 1 mm × 0.5 mm	Dark-ON	**EE-SPX302-W2A**	**71**
				Light-ON	**EE-SPX402-W2A**	
				Dark-ON	**EE-SPX304-W2A**	
				Light-ON	**EE-SPX404-W2A**	
				Dark-ON	**EE-SPX306-W2A**	
				Light-ON	**EE-SPX406-W2A**	
	5 mm (slot width)		Pre-wired models Emitter/receiver window 2 mm × 0.8 mm	Dark-ON	**EE-SPX305-W2A**	
				Light-ON	**EE-SPX405-W2A**	
	13 mm (slot width)		2.2 × 0.5	Dark-ON	**EE-SPX303N**	**75**
				Light-ON	**EE-SPX403N**	

Through-beam Type

Infrared light

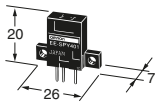
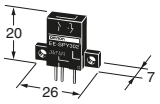
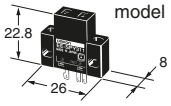
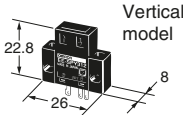
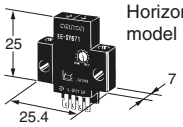
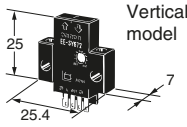
Appearance	Sensing distance	Optical modulation	Features	Output configuration	Model	Page
	1 m	Modulated light	• Compact size • Bright, easy-to-see, light (ON-state) indicator	Dark-ON	**EE-SPW311 (set including emitter and receiver)**	**79**
				Light-ON	**EE-SPW411 (set including emitter and receiver)**	
	300 mm		• Compact, slim profile • Excellent space efficiency	Dark-ON	**EE-SPW321** **EE-SPW321-A**	**83**
				Light-ON	**EE-SPW421** **EE-SPW421-A**	

Note: The table includes only basic specifications. Be sure to check the detailed specifications and precautions on the page given in the right column before using the Photomicrosensor.

Classified According to Product Model

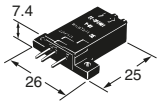
Reflective Type

Infrared light

Appearance	Sensing distance	Sensing method	Optical modulation	Features	Output configuration	Model	Page
 	5 mm	Diffuse-reflective	Modulated light	Resistant to external light interference	Dark-ON	**EE-SPY301**	**87**
					Light-ON	**EE-SPY401**	
					Dark-ON	**EE-SPY302**	
					Light-ON	**EE-SPY402**	
Horizontal model  Vertical model 	2 to 5 mm	Conver-gent reflec-tive		Resistant to background interference	Dark-ON	**EE-SPY311**	**93**
					Light-ON	**EE-SPY411**	
					Dark-ON	**EE-SPY312**	
					Light-ON	**EE-SPY412**	
Horizontal model  Vertical model 	1 to 5 mm	Diffuse-reflective	Non-modulated light	Equipped with sensitivity adjuster	Dark-ON Light-ON (selectable)	**EE-SY671**	**97**
						EE-SY672	

Retroreflective Type

Infrared light

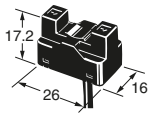
Appearance	Sensing distance	Optical modulation	Features	Output configuration	Model	Page
	200 mm	Modulated light	Modulated light	Dark-ON	**EE-SPZ301-A**	**103**
				Light-ON	**EE-SPZ401-A**	

Note: The table includes only basic specifications. Be sure to check the detailed specifications and precautions on the page given in the right column before using the Photomicrosensor.

Liquid Level Photomicrosensors

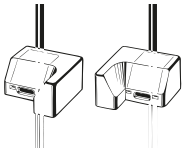
Classified According to Product Model

Infrared light

Appearance	Outer diameter of mounting pipe	Optical modulation	Features	Output configuration	Model	Page
EE-SPX613 	6 to 13 mm dia., thickness: 1 mm Transparent pipe	Modulated light	• Easy mounting • Equipped with sensitivity selector	Dark-ON/ Light-ON (selectable)	**EE-SPX613**	**107**

Photomicrosensors to Detect Wafer-carrier Mounting

Classified According to Product Model

Appearance	Sensing distance	Sensing method	Features	Output configuration	Model	Page
EE-SPY801/802 	0 to 3 mm (wafer carrier)	Reflective (modulated light)	Wafer-carrier mounting detection	Turns ON when wafer carrier is present	**EE-SPY80□**	**111**

Pushbutton Type

Appearance	Sensing method	Features	Output configuration	Model		Page
				NPN output	PNP output	
EE-SA701/801 	Pushbutton	Long service life (5 million operations) with combination of mechanical and optical sensors	ON with no load	**EE-SA801A** **EE-SA801A-R**	**EE-SA801R** **EE-SA801R-R**	**115**
			OFF with no load	**EE-SA701-R**	**EE-SA701P-R**	

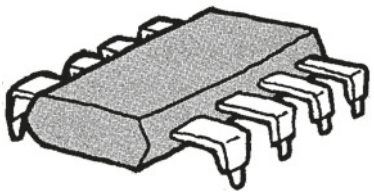
Note: The table includes only basic specifications. Be sure to check the detailed specifications and precautions on the page given in the right column before using the Photomicrosensor.

Application Examples

More Applications Than Ever with High-Accuracy, Low-Cost Sensing

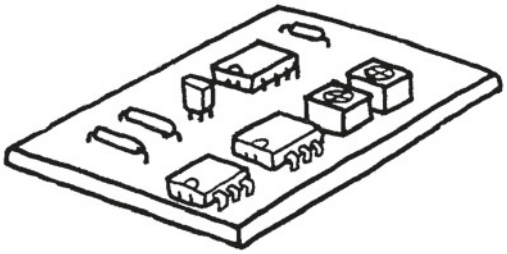
1. Semiconductor Equipment

Accurate position detection in ever phase of semiconductor production like die and wire bonding.



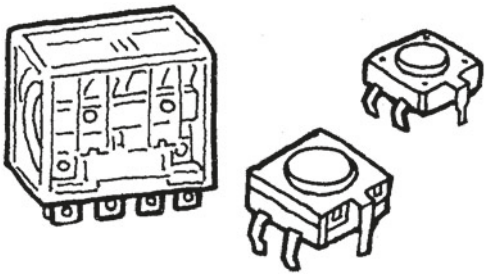
2. Component Mounting

Ultimate efficiency and positioning accuracy in chip mounting, including component edge detection and X-Y table limit detection.



3. Component-Assembly Robots

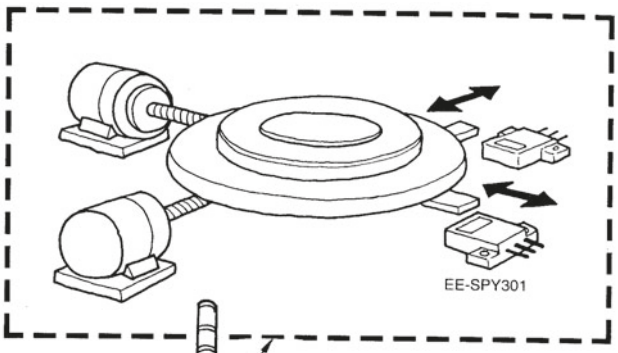
Optimum performance for cam positioner timing detection and upper/lower limit detection in assembly work, where vertical positioning is ultimately important.

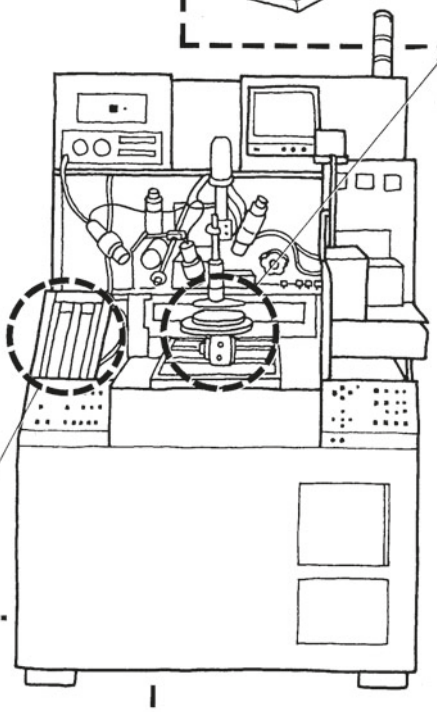


1. Semiconductor Equipment

1-1. Die Bonders

Die bonders lift semiconductor chips of precut semiconductor wafers with a suction nozzle and bond then to reed frames.



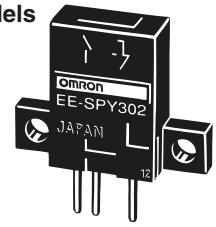


Position Detection on X-Y Tables

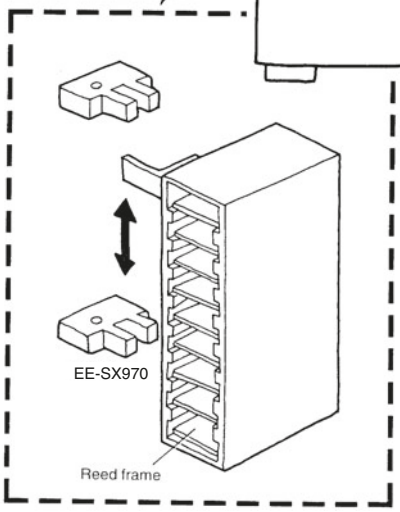
Mechanical problems are prevented by detecting the limits along the X and Y axes.

Applicable Models

EE-SPY301/401
EE-SPY302/402
EE-SY671/672



Modulated Light for Applications Subject to External Light Interference
EE-SPY302



Position Detection for Reed Frame Cases

First a Sensor detects the lower limit of the case in which reed frames are set. The reed frames are then taken out one at a time as the case rises unit another Sensor detects the upper limit and the next case is moved into place.

Applicable Models

EE-SX67/47 Series
EE-SX77/87 Series
EE-SX91 Series
EE-SX97 Series

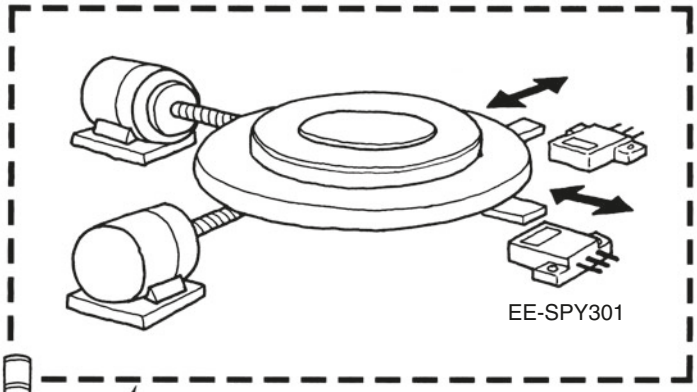
Built-in Connector for Downsizing and Easier Connection
EE-SX970

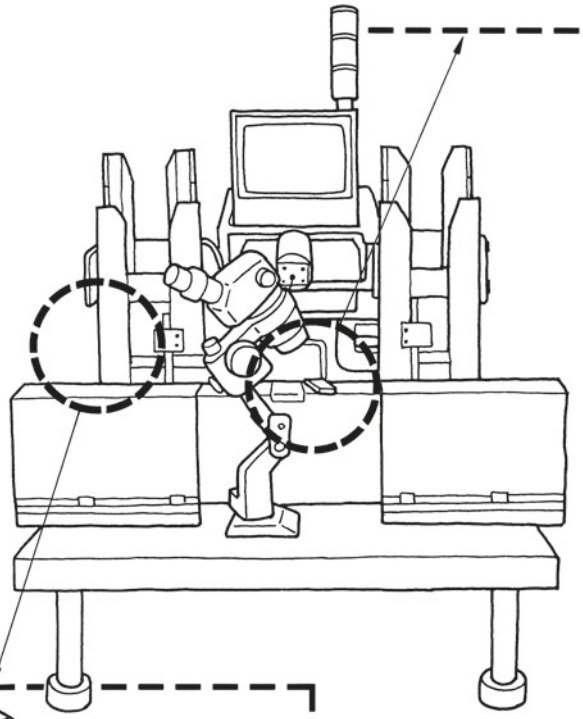
EE-SX770

EE-SX910-R

1-2. Wire Bonders

When die bonding is completed, a wire bonder connects gold wires between the semiconductor chips and reed frames.



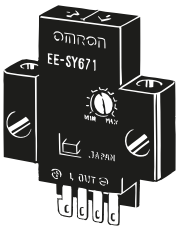


Position Detection on X-Y Tables

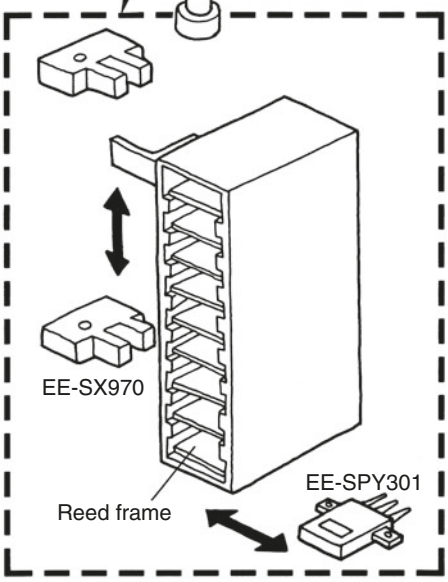
Mechanical problems are prevented by detecting the limits along the X and Y axes.

Applicable Models

EE-SPY301/401
EE-SPY302/402
EE-SY671/672



Reflective Sensor with Sensitivity Adjustment
EE-SY671



Position Detection for Reed Frame Cases

First, a Sensor at the bottom detects when the reed frame case has reached the proper position. Two other Sensors detect the start and stop points of the case as it rises up and reed frames are taken out.

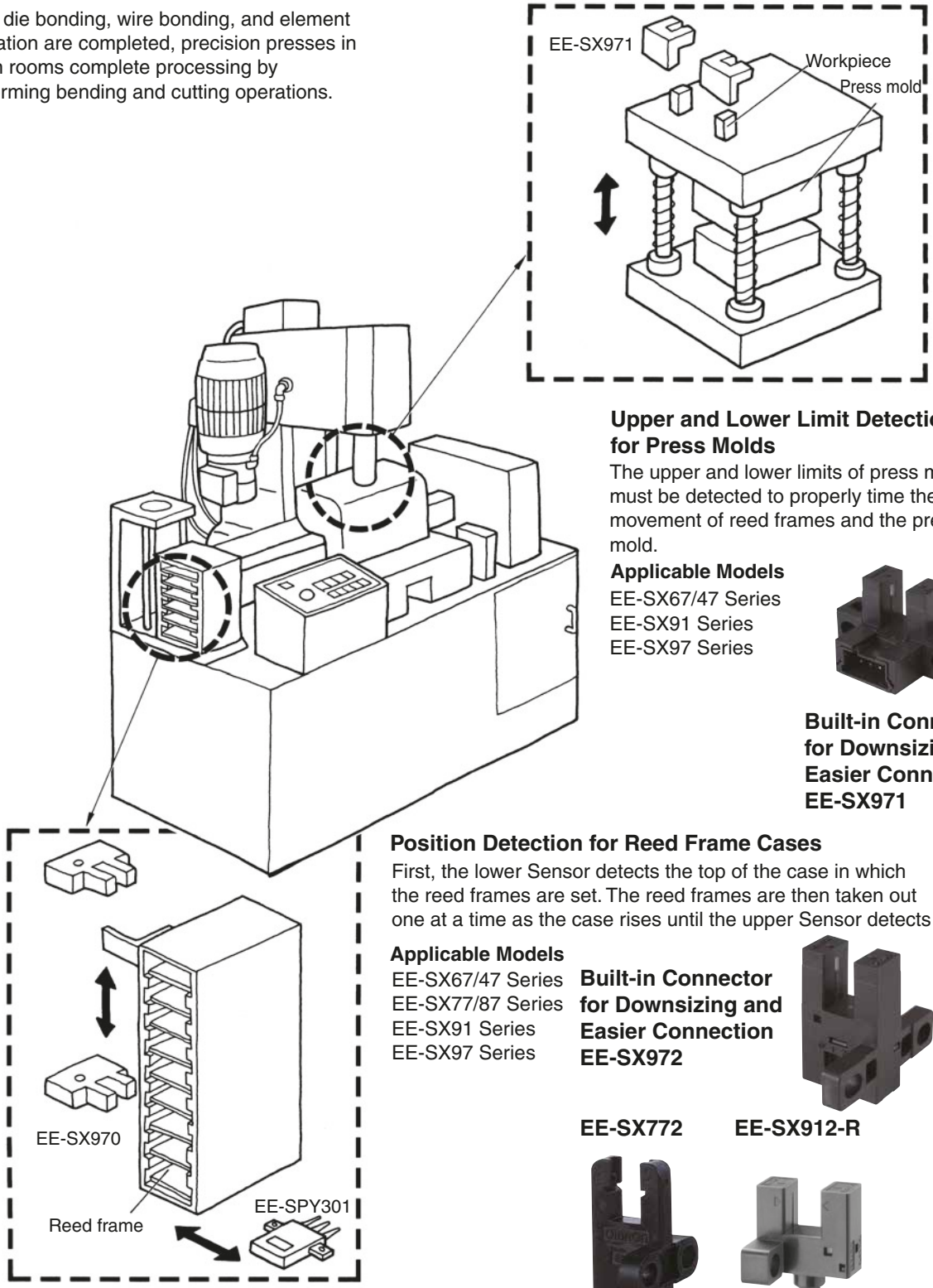
Applicable Models

EESX67/47 Series
EESX77/787 Series
EESX91 Series
EE-SPY301/401
EE-SY671/672
EE-SX97 Series

Built-in Connector for Downsizing and Easier Connection
EE-SX970

1-3. Precision Presses

After die bonding, wire bonding, and element formation are completed, precision presses in clean rooms complete processing by performing bending and cutting operations.



Upper and Lower Limit Detection for Press Molds

The upper and lower limits of press molds must be detected to properly time the movement of reed frames and the press mold.

Applicable Models

EE-SX67/47 Series
EE-SX91 Series
EE-SX97 Series

Built-in Connector for Downsizing and Easier Connection EE-SX971

Position Detection for Reed Frame Cases

First, the lower Sensor detects the top of the case in which the reed frames are set. The reed frames are then taken out one at a time as the case rises until the upper Sensor detects

Applicable Models

EE-SX67/47 Series
EE-SX77/87 Series
EE-SX91 Series
EE-SX97 Series

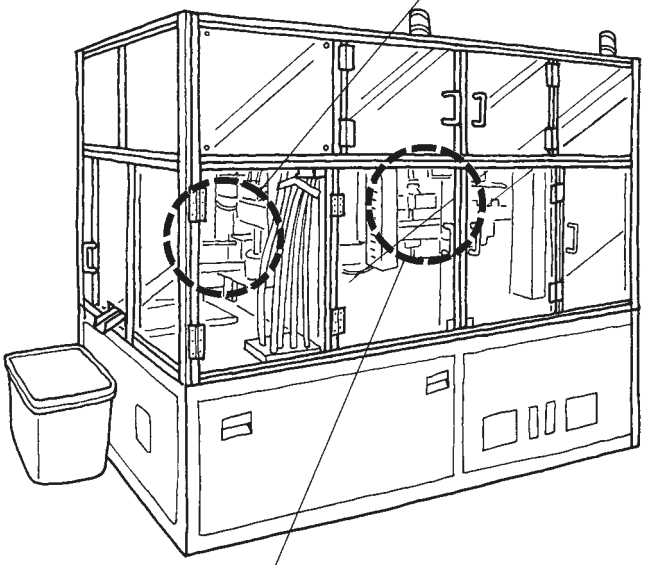
Built-in Connector for Downsizing and Easier Connection EE-SX972

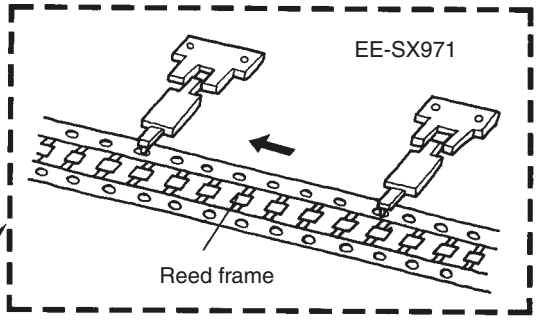
EE-SX772

EE-SX912-R

1-4. Precision Presses

These presses are specially designed for semiconductor production and are generally enclosed in glass to ensure optimum environmental conditions.



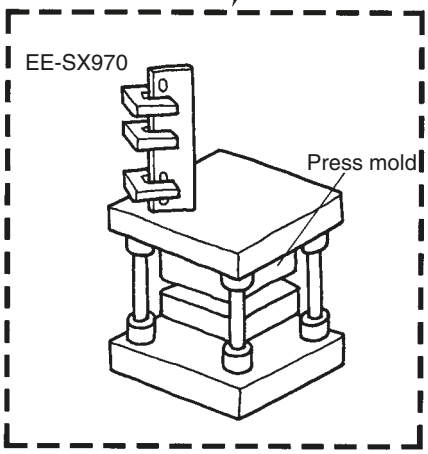


Confirmation of Reed Frame Case Conveyors

Pilot holes are used to move reed frames. Here, Slot-type Photomicrosensors are used to confirm that the tips of the conveyor mechanism are properly engaged with the holes.

Applicable Models
EE-SX67/47 Series
EE-SX77/87 Series
EE-SX91 Series
EE-SX97 Series

Built-in Connector for Downsizing and Easier Connection
EE-SX972



Upper and Lower Limit Detection for Press Molds

The upper and lower limits of press molds must be detected to properly time the movement of reed frames and the press mold.

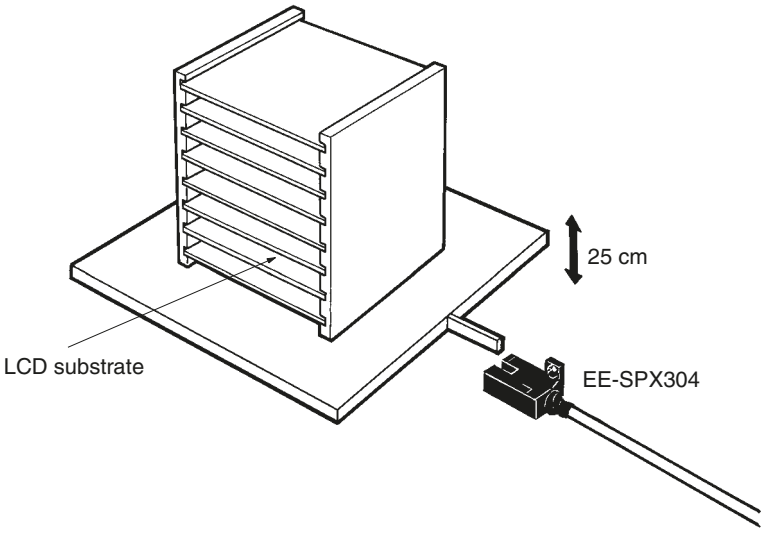
Applicable Models
EE-SX67/47 Series
EE-SX77/87 Series
EE-SX91 Series
EE-SX97 Series

Built-in Connector for Downsizing and Easier Connection
EE-SX970

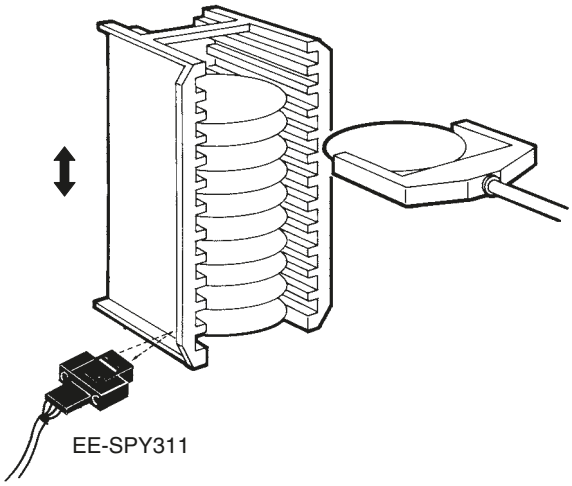
EE-SX770

EE-SX910-R

1-5. Sensing LCD Casette Vertical Position



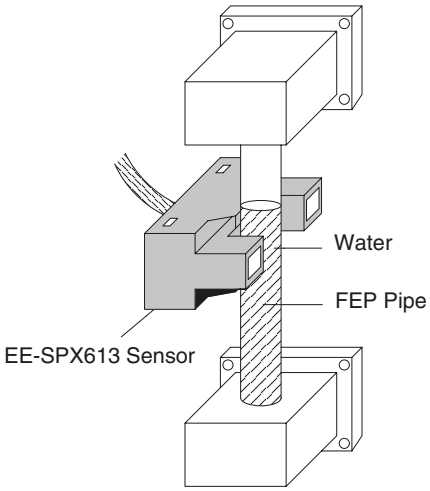
1-6. Checking Wafer Casettes



1-7. Detecting Fluid

Application

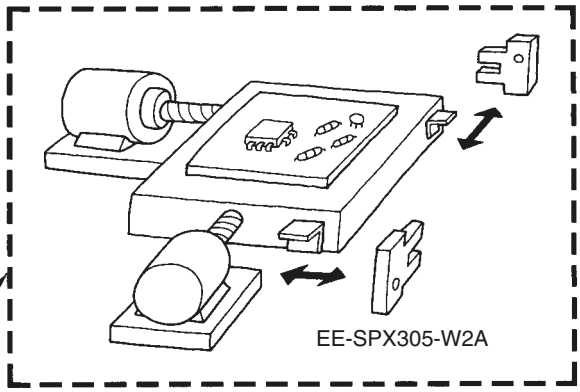
Water contained within a tank is pressurized to create water vapor. Liquid water rises in a FEP tube for water level monitoring. EE-SPX613 Sensors are used to detect the water levels.



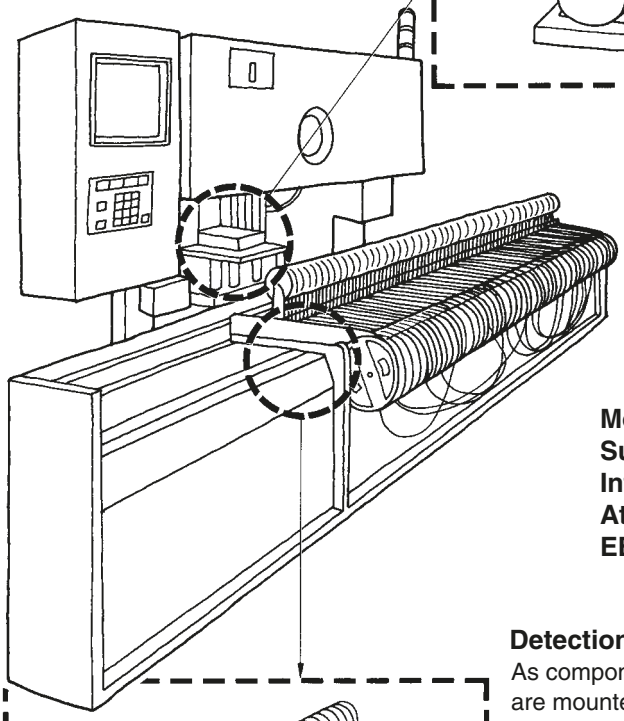
2. PCB Component Mounters

2-1. Chip Mounters

Chip mounters accurately position and attach electronic component chips to printed wiring boards.

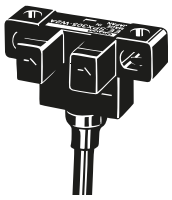


Position Detection on X-Y Tables
Mechanical problems are prevented by detecting the limits along the X and Y axes.

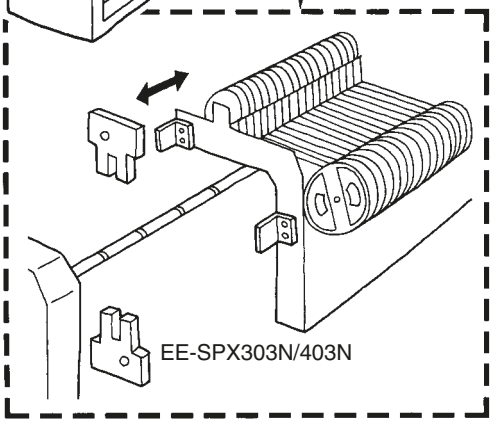


Applicable Models
EE-SX67/47 Series
EE-SX77/87 Series
EE-SX91 Series
EE-SPX303N/403N
EE-SPX302/402-W2A
EE-SPX304/404-W2A
EE-SPX305/405-W2A
EE-SX97 Series

Modulated Light for Applications Subject to External Light Interference with Attached Cable
EE-SPX305-W2A



Detection of Chip Case Ends
As component cases are fed and the components are mounted, Sensors are waiting to detect when the case has completed processing.



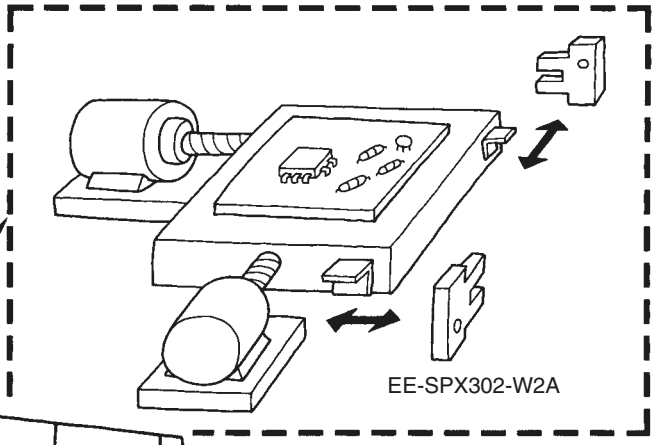
Applicable Models

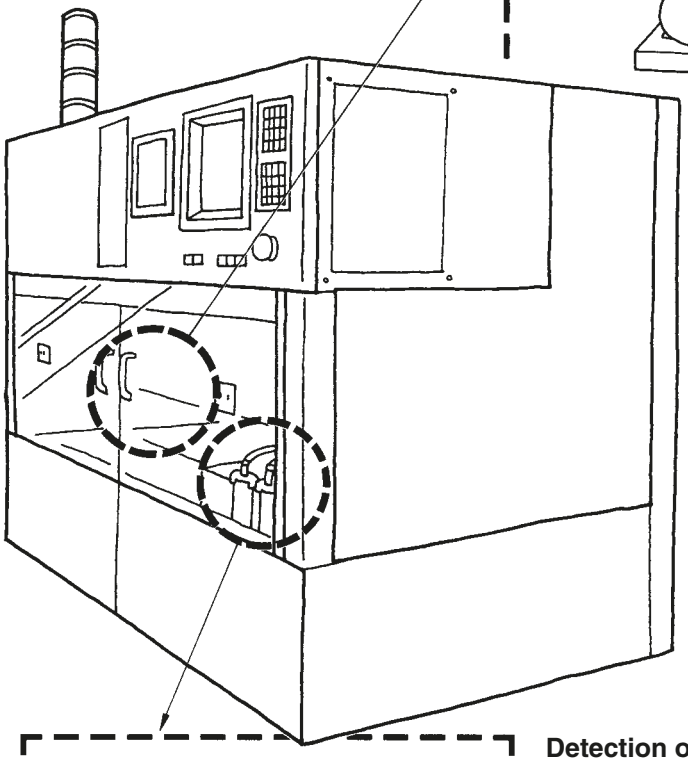
EE-SX67/47 Series	EE-SPX303N/403N
EE-SX77/87 Series	EE-SPX302/402-W2A
EE-SX91 Series	EE-SPX304/404-W2A
EE-SX97 Series	EE-SPX305/405-W2A

Modulated Light for Applications Subject to External Light Interference with 13-mm Slot
EE-SPX303N/403N

2-2. Adhesive Dispensers

Adhesive dispensers apply an adhesive to hold components on a printed wiring board in position before they are soldered.





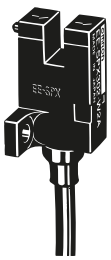
Position Detection on X-Y Tables

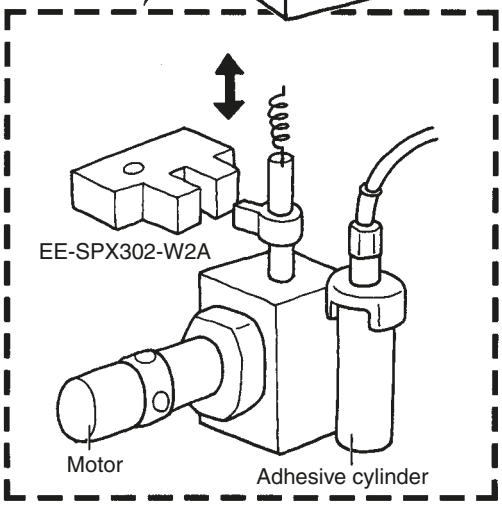
Mechanical problems are prevented by detecting the limits along the X and Y axes.

Applicable Models

EE-SX67/47 Series	EE-SPX303/403
EE-SX77/87 Series	EE-SPX302/402-W2A
EE-SX91 Series	EE-SPX304/404-W2A
	EE-SPX305/405-W2A

Modulated Light for Applications Subject to External Light Interference with Attached Cable EE-SPX302-W2A





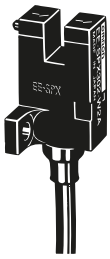
Detection of Valve Operation

A Sensor detects the number of times the valve is opened so that the amount o adhesive remaining can be determined.

Applicable Models

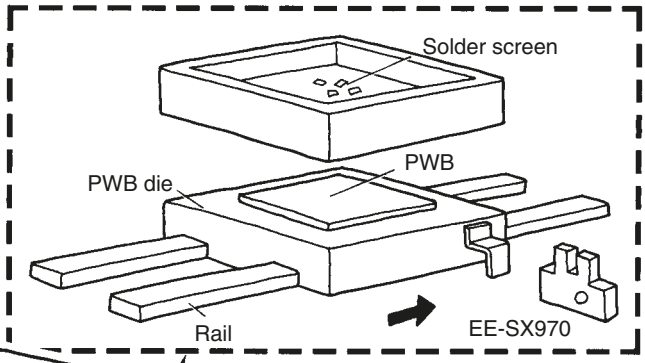
EE-SX67/47 Series	EE-SPX302/402-W2A
EE-SX91 Series	EE-SPX304/404-W2A
	EE-SPX305/405-W2A

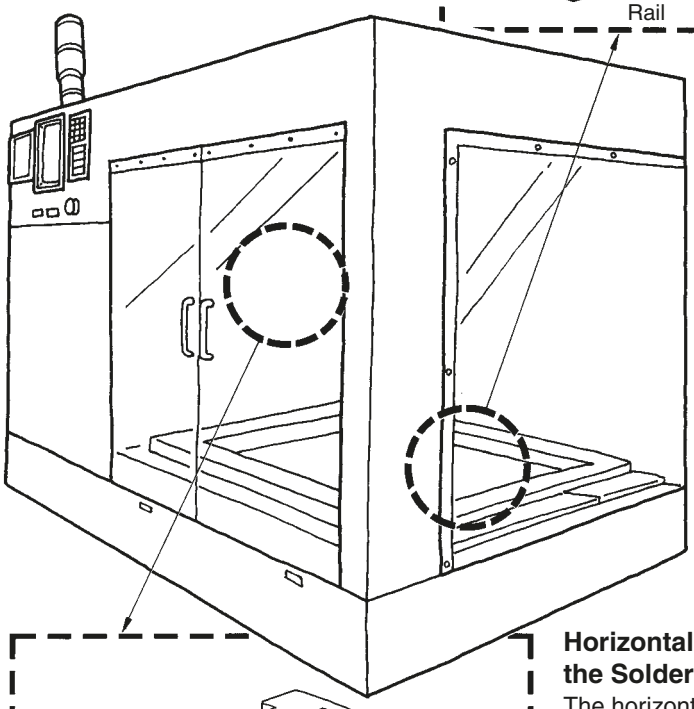
Modulated Light for Applications Subject to External Light Interference with Attached Cable EE-SPX302-W2A



2-3. Cream Solder Printers

These devices print a cream solder onto printer wiring boards before components are mounted.





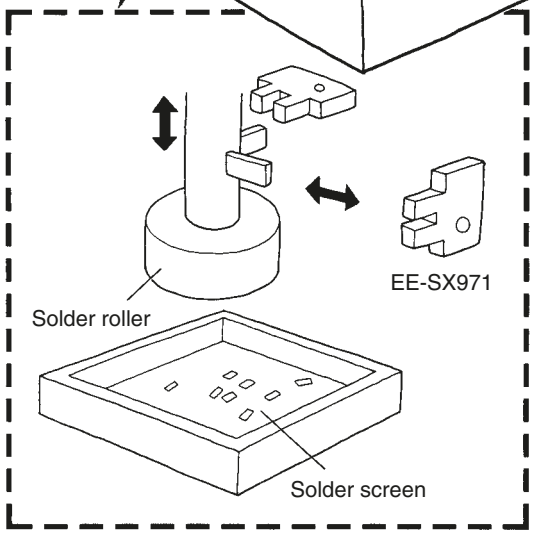
Detection of the Screen Die End

The position of the die is detected so that the screen can be accurately positioned onto it.

Applicable Models

EE-SX67/47 Series
EE-SX77/87 Series
EE-SX91 Series
EE-SX97 Series

100-mA Direct Switching for Build-in Application EE-SX770



Horizontal and Vertical Positioning of the Solder Roller

The horizontal and vertical position of the solder roller is detected so that solder can be coated without waste.

Applicable Models

EE-SX67 Series
EE-SX91 Series
EE-SX97 Series

Built-in Connector for Downsizing and Easier Connection EE-SX971

2-4. Lead Component Inserters

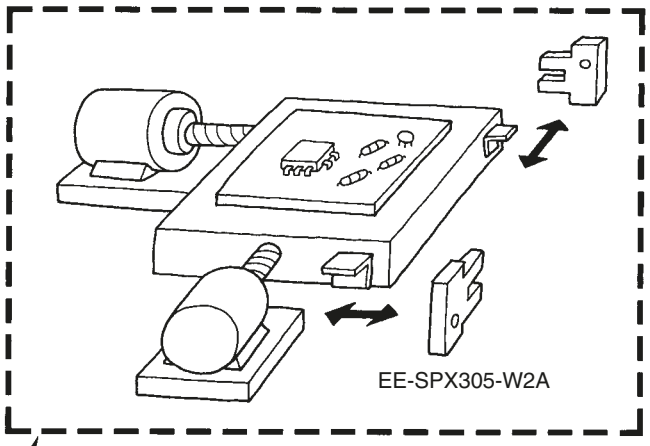
This device automatically inserts radial or axial lead components onto the printed wiring boards.

Position Detection on X-Y Tables

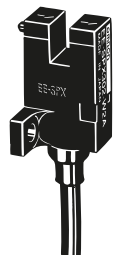
Mechanical problems are prevented by detecting the limits along the X and Y axes.

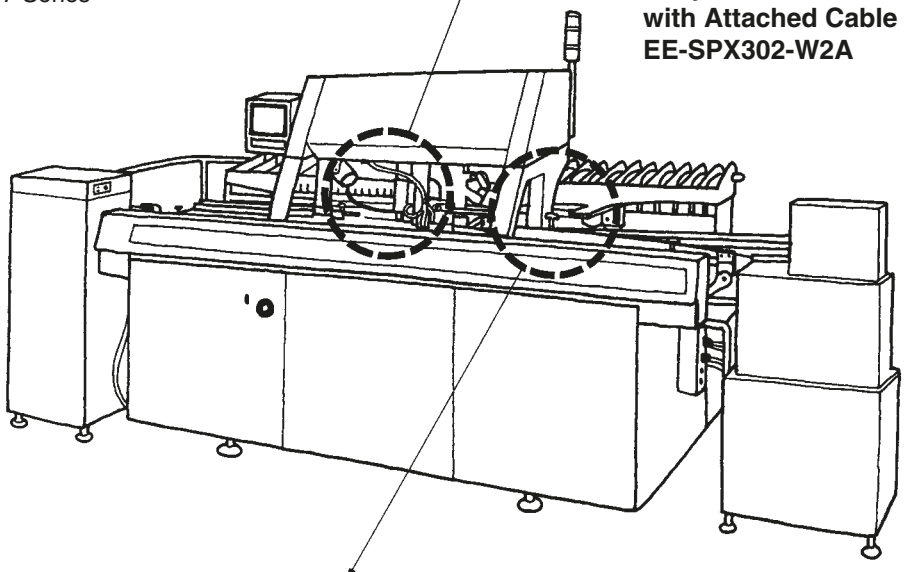
Applicable Models

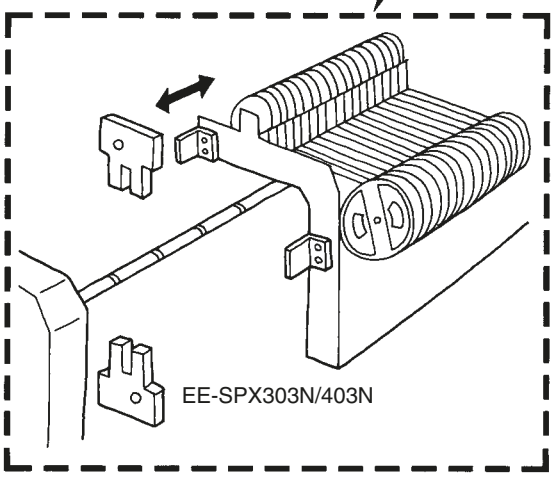
EE-SX67/47 Series
EE-SX91 Series
EE-SPX303N/403N
EE-SPX302/402-W2A
EE-SPX304/404-W2A
EE-SPX305/405-W2A
EE-SX97 Series



Modulated Light for Applications Subject to External Light Interference with Attached Cable
EE-SPX302-W2A







Detection of Chip Case Ends

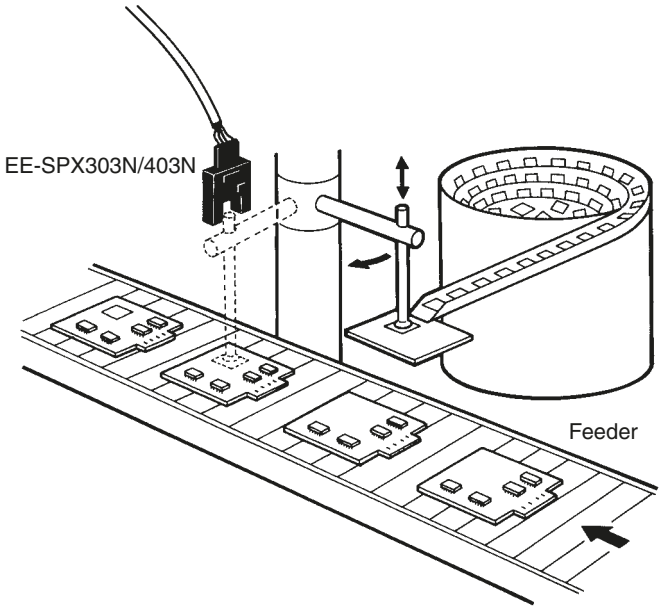
As component cases are fed and the components are mounted, Sensors are waiting to detect when the case has completed processing.

Applicable Models

EE-SX67/47 Series	EE-SPX303N/403N
EE-SX91 Series	EE-SPX302/402-W2A
EE-SX97 Series	EE-SPX304/404-W2A
	EE-SPX305/405-W2A

Modulated Light for Applications Subject to External Light Interference with 13-mm Slot
EE-SPX303N/403N

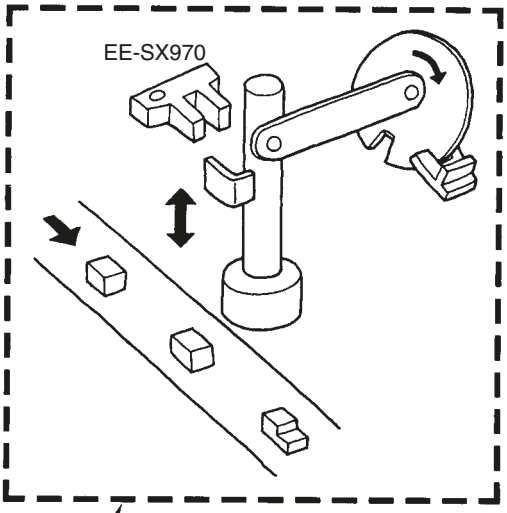
2-5. Sensing an Arm's Starting Point



3. Electronic Component Manufacturing Equipment

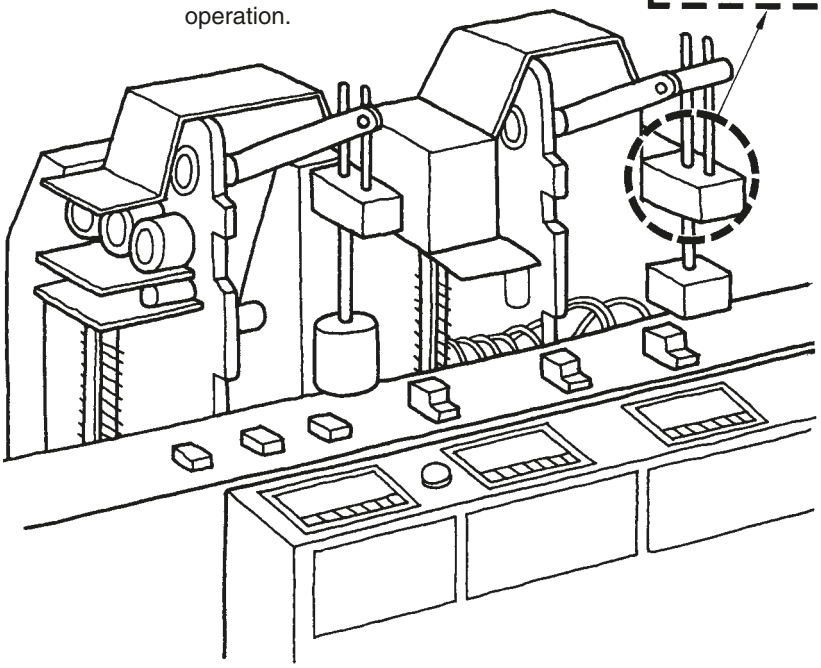
3-1. Assembly Robots

Robots are used to manufacture relays, switches, and other electronic components. The work performed in assembly is based on vertical movement. Completed parts are automatically moved to pallets.



Detection of Motor Rotation and Workpiece Position

Cams are used to detect motor rotation, while the bottom limit of the workpiece is detected to ensure accurate operation.



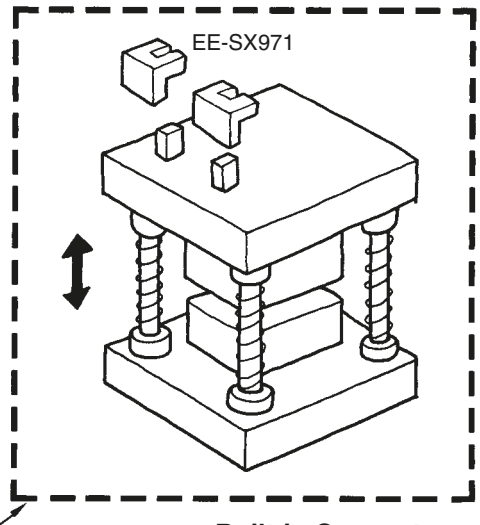
Applicable Models

EE-SX67/47 Series
EE-SX77/87 Series
EE-SX91 Series
EE-SX97 Series

Built-in Connector for Downsizing and Easier Connection
EE-SX970

3-2. Sequential Presses

A series of different types of presses are aligned to sequentially produce relays, switches, and other components containing contacts.

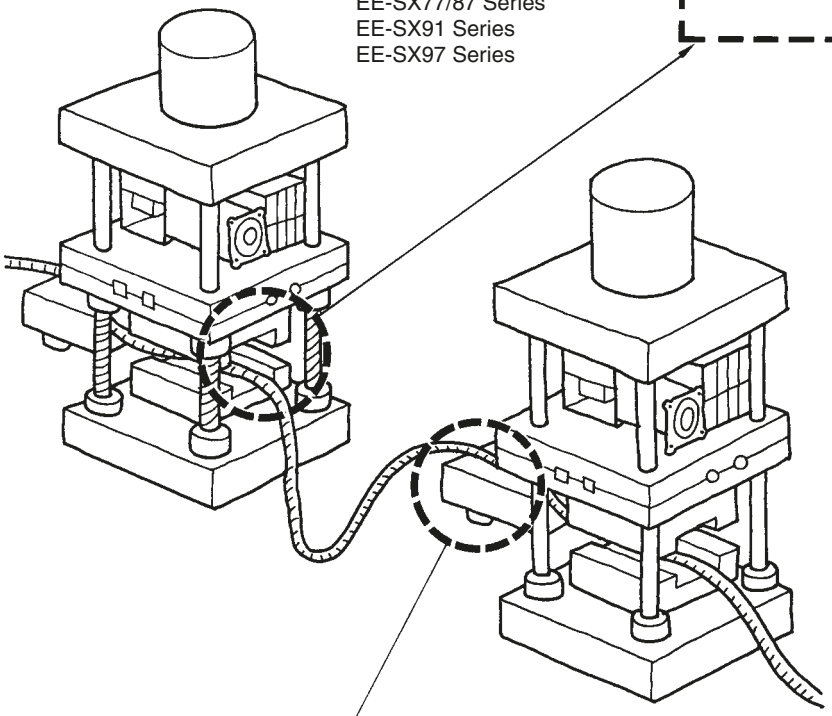


Upper and Lower Limit Detection for Press Molds

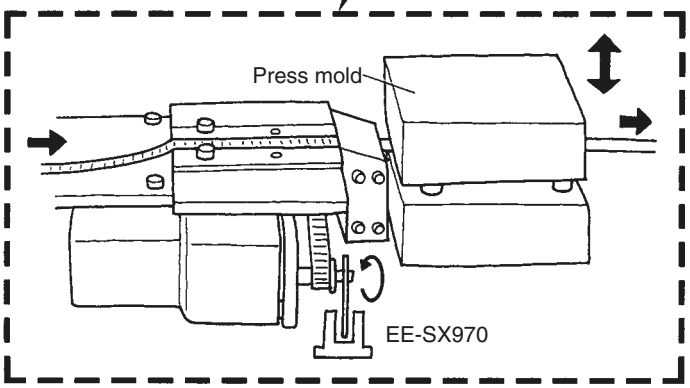
The upper and lower limits of press molds must be detected to properly time the movement of reed frames and the press mold.

Applicable Models

EE-SX67/47 Series
EE-SX77/87 Series
EE-SX91 Series
EE-SX97 Series



Built-in Connector for Downsizing and Easier Connection EE-SX971



Detection of Motor Rotation for Sequential Parts Feeders

A cam is used with a Sensor to detect motor rotation and thus feed the hoop material at set intervals.

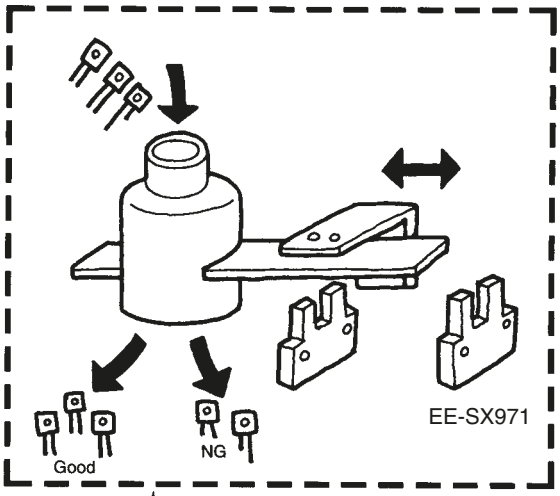
Applicable Models

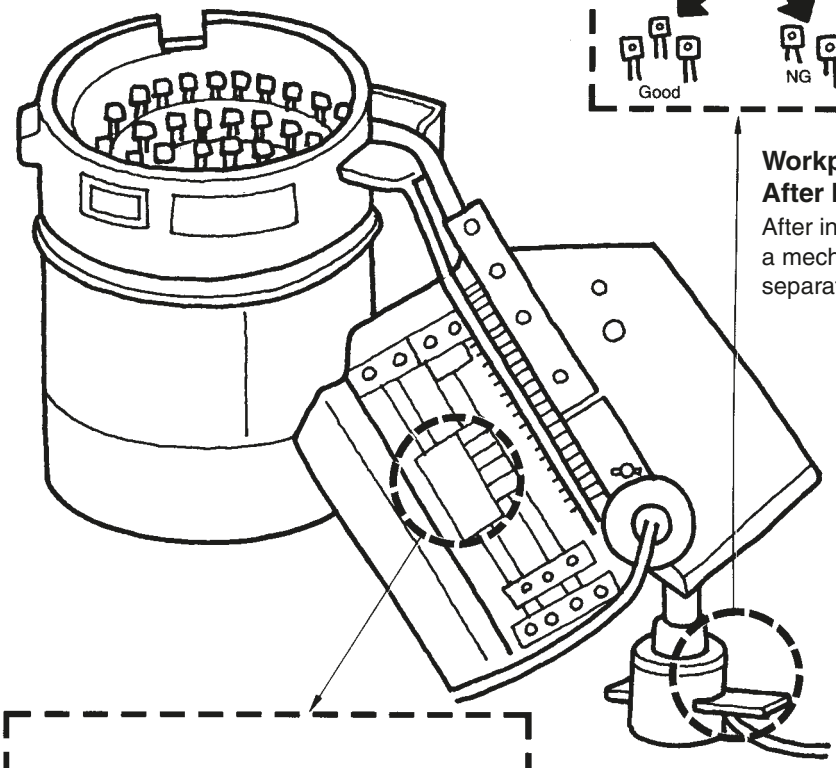
EE-SX67/47 Series
EE-SX77/87 Series
EE-SX91 Series
EE-SX97 Series

Built-in Connector for Downsizing and Easier Connection EE-SX970

3-3. Component Inspectors

These inspectors check all optical components, such as LEDs and phototransistors, and consist of both a parts feeder and devices that distinguish good components from no-good ones.





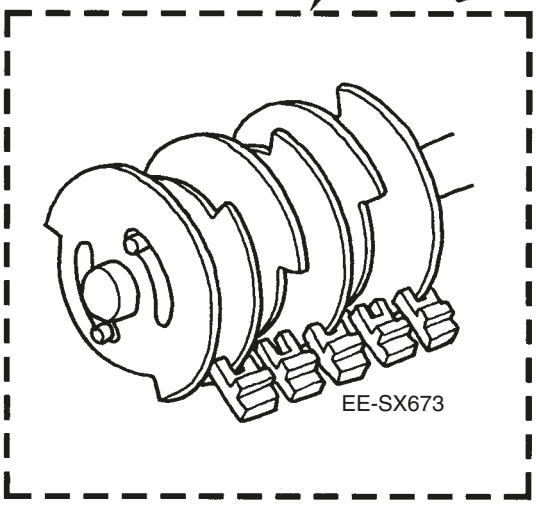
Workpiece Position Detection After Inspection

After inspection, a Sensor activates a mechanism when necessary to separate out no-good components.

Applicable Models

EE-SX67/47 Series
EE-SX77/87 Series
EE-SX91 Series
EE-SX97 Series

Built-in Connector for Downsizing and Easier Connection
EE-SX971



Cam Position Detection

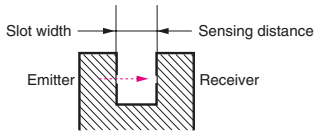
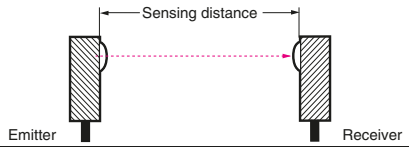
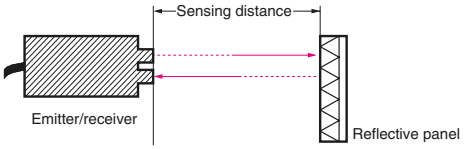
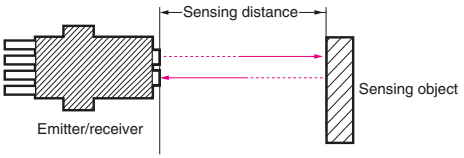
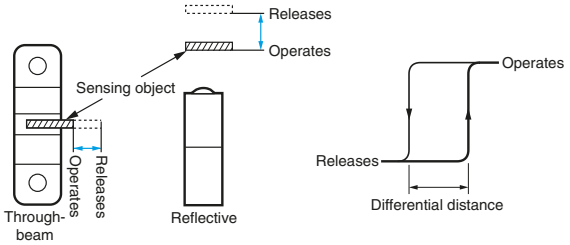
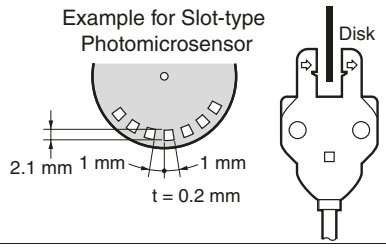
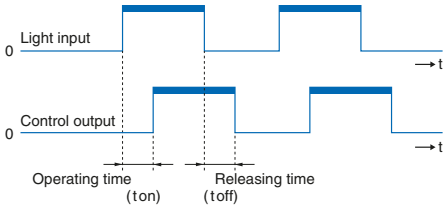
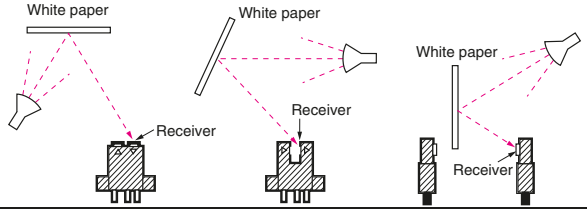
Photomicrosensors detect various cams to ensure proper timing of various operations.

Applicable Models

EE-SX67/47 Series
EE-SX77/87 Series
EE-SX91 Series
EE-SX97 Series

100-mA Direct Switching for Built-in Application
EE-SX673

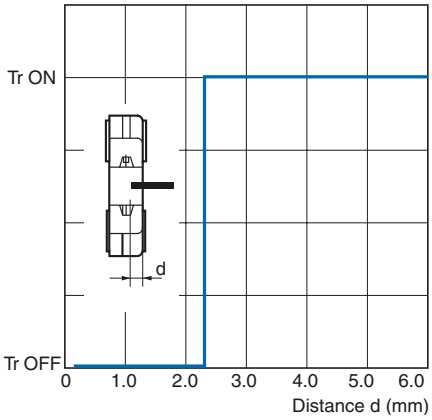
Definition of Terms

Term		Reference diagram	Explanation
Non-modulated light		---	Method used to detect light steadily emitted by the emitter element.
Light modulation		---	Method used to detect light emitted in pulses by the emitter element.
Sensing distance	Through-beam (with slot)		The slot width, i.e., the distance between the opposing faces of the emitter and receiver.
	Through-beam		The minimum distance that can be set considering factors such as the variation between products and fluctuations in temperature. **Note:** The actual value under standard conditions for each method is longer than the rated sensing distance.
	Retro-reflective		
	Diffuse-reflective		The minimum distance that can be set for a standard sensing object (white paper) considering factors such as the variation between products and fluctuations in temperature. **Note:** The actual value under standard conditions for each method is longer than the rated sensing distance.
Differential distance			The difference in distance between the operating point and releasing point.
Response frequency			The frequency at which an object satisfying specified conditions (size, transparency rate, reflection factor, sensing distance, and power supply voltage) can be repeatedly detected.
Response time			The delay from the light input turning ON/OFF until the control output operation or release operation. The following equation generally applies. Operating time (Ton) ≈ Releasing time (Toff)
Ambient illumination			The level of illumination on the sensing surface that enables stable operation of the Sensor.

Interpreting Engineering Data

Sensing Position Characteristics

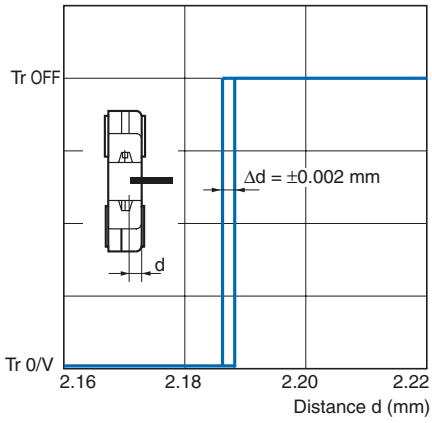
Example for the EE-SX770



The graph shows the position of the edge of the sensing object where the Sensor will respond.

Repeated Sensing Position Characteristics

Example for the EE-SX770

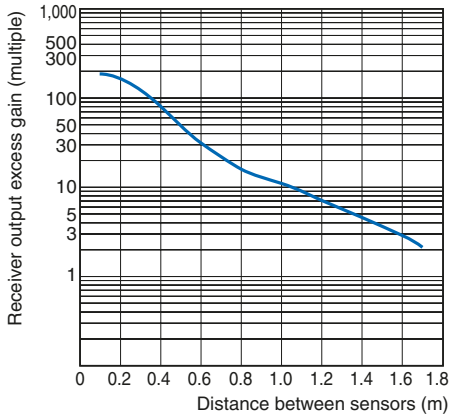


Vcc = 24 V, No. of repetitions: 20, Ta = 25˚C

The graph shows the fluctuation in the position of the edge of the sensing object where the Sensor operates. Use this as a rough guide for the positioning accuracy of the sensing object.

Receiver Output Excess Gain vs. Sensing Distance Characteristics

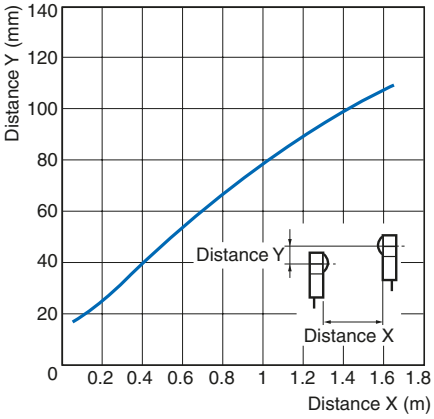
Example for the EE-SPW311/411



- The receiver output excess gain shows values when setting the maximum sensitivity.
- The values above are typical for models with a rated sensing distance of 1 m. It can be seen that the receiver output excess gain is increased by a factor of approximately ten at the rated sensing distance.

Parallel Movement Characteristics

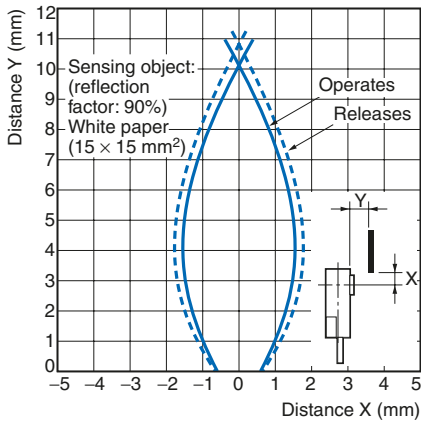
Example for the EE-SPW311/411



- Through-beam Sensor: The graph shows the position of the sensing limit of the receiver when the position of the emitter is constant.
- Retroreflective Sensor: The graph shows the position of the sensing limit of the Reflector when the position of the Sensor is constant.
- Multiple Through-beam Sensors: A range of 1.5 times the amount shown in the graph is required to prevent mutual interference.

Operating Range Characteristics

Example for the EE-SPY301 and EE-SPY401



- The graph shows the point where sensing starts when a standard sensing object is moved perpendicular to the optical axis. The curved line on the right in the graph shows values for when the sensing object is approaches from the right side.

Note: These values are for standard sensing objects. If the sensing object changes, the operating range and sensing distance will also change.

General Precautions

*Refer to *Precautions* section for individual models for specific precautions for each model.

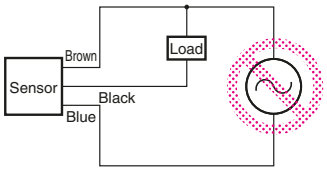
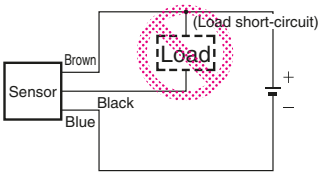
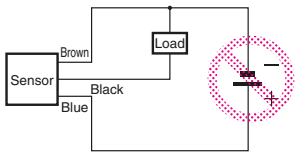
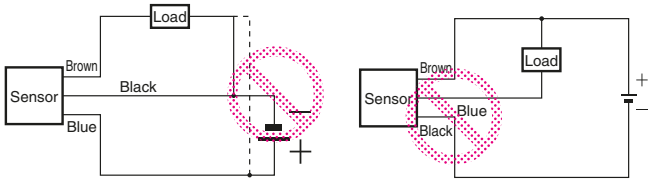
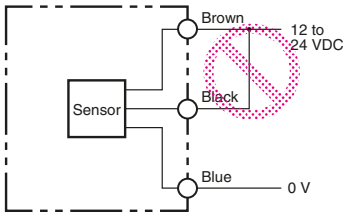
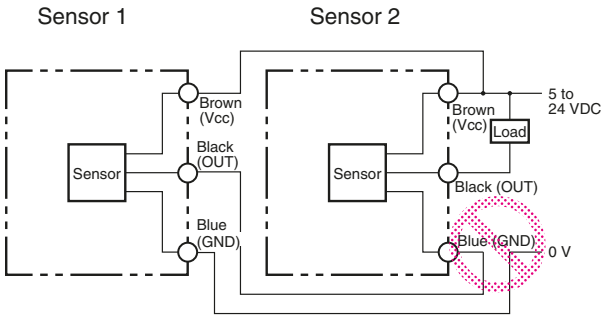
⚠ Warning

These products cannot be used in safety devices for presses or other safety devices used to protect human life.
This product is designed for use in applications for sensing workpieces and workers that will not affect levels of safety.

Precautions for Safe Use

Be sure to use the product safely according to the following precautions.

● Wiring

Item	Examples
Power Supply Do not apply any voltage exceeding the rated voltage range. Applying any excessive voltage or supplying AC power (100 VAC or higher) to a DC-type sensor may cause the Sensor to explode or burn.	· DC 3-wire NPN output sensor 
Load Short-circuit Do not short-circuit the load. Doing so may cause the Sensor to explode or burn.	· DC 3-wire NPN output sensor 
Wiring Be sure to wire the Sensor correctly and be careful not to connect the polarities incorrectly, otherwise the Sensor may explode or burn.	· DC 3-wire NPN output sensor (Example) Wrong polarity  · DC 3-wire NPN output sensor (Example) Wrong polarity or wrong wiring 
Connection with No Load If connected to the power supply without any load, internal elements may explode or burn. Make sure that a proper load is connected to the Sensor.	· DC 3-wire NPN output sensor 
AND Connections Do not use AND connections such as in the example shown in the diagram here. Voltage will be applied to the Vcc terminal without the GND terminal of Sensor 2 being securely grounded, and may cause the Sensor to malfunction. Depending on the model used, inrush current to Sensor 2 when Sensor 1 is turned ON may result in malfunction.	

Precautions for Correct Use

● Installation

- The Sensors without light modulation (i.e., EE-SX, EE-SY) are built into the device being used and are, therefore, not equipped to deal with interference from an external light source. When using a Sensor without light modulation in an area exposed to an incandescent light or other external light interference, install so as to minimize the effects of external light sources.
- Mount the Sensors securely on a flat surface.
- Mount the Sensor with two M3 screws, using a spring washer to ensure the screws will not become loose. Use a tightening force of 6 kgf·cm (0.59 N·m) max.

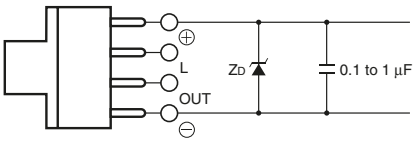
Note: Be sure to read the precautions for the model being used before tightening the screws.

- Install so that nothing can collide with the sensing section of the Sensor. Damage to the sensing surface will result in inferior performance.
- Before using the Sensor, check to be sure that it has not become loose due to vibration or shock.

● Wiring

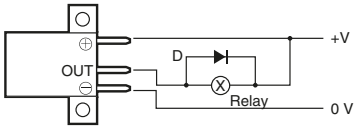
Surge

- If there is surge in the power supply, try connecting a capacitor (with a capacitance of 0.1 to 1 μF) or a Zener diode (Z_D in the diagram below, with a rated voltage of 30 to 35 V). Use the Sensor only after confirming that the surge has been removed.



Z_D: Zener diode

- When driving a small inductive load, such as a relay, wire as shown below. (Be sure to connect a diode to absorb the reverse voltage.)

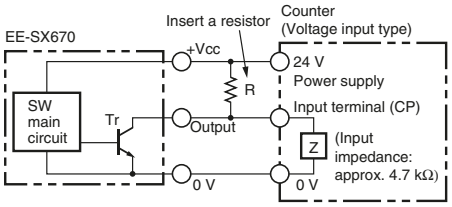


- Separate the wiring for the Sensor from high-tension lines or power lines. If the wiring is routed in the same conduit or duct as such lines, the Sensor will be damaged or its operation will be affected by inductive interference.
- Make sure that the connectors (either dedicated or commercially available) are securely locked.

Voltage Output

- A Sensor with an open-collector output can be connected to a counter with a voltage input by connecting a resistor between the power source and output. Select a resistor with reference to the following example. The resistance of the resistor is generally 4.7 kΩ and its wattage is 1/2 W for a supply voltage of 24 V and 1/4 W for 12 V.

Example:



If resistance R = 4.7 kΩ for the EE-SX670, the input voltage at the high level is as follows:

$$\text{Input voltage } V_H = \frac{Z}{R+Z} V_{CC} = \frac{4.7\text{ k}}{4.7\text{ k} + 4.7\text{ k}} \times 24\text{ V}$$
$$= 12\text{ V}$$

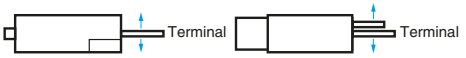
And the input voltage and load current at the low level are as follows:
Input voltage $V_L \leq 0.4$ V
(Residual voltage for 40-mA load current)

$$\text{Residual voltage IC} = \frac{V_{CC}}{R} = \frac{V_{CC}}{R} = 5.1\text{ mA} \leq 40\text{ mA}$$

Note: Refer to the ratings of the Sensor for the residual voltage of the load current.

Terminals

- Make sure that the terminals are not subjected to stress (external force). Stress will cause damage to the terminals.



● Design Considerations

Influence of Power Supply and Cable Length (EE-SP Models)

When using a Sensor with a model number beginning with EE-SP with light modulation, make sure that the power and cable length are considered in the design. These models are more easily influenced than models with direct light modulation (i.e., Sensors with model numbers beginning with EE-SX or EE-SY).

- Sensors with light modulation that are easily affected:
  EE-SPX301/401, EE-SPY30□/40□,
  EE-SPZ301□/401□, EE-SPY31□/41□
  EE-SPX303/403, EE-SPW311/411,
  EE-SPX74□/84□, EE-SPX□□□-W

- Sensors with light modulation that are not easily affected:
  EE-SPX613, EE-SPY801/802
  ∗ All Sensors with model numbers beginning with EE-SX and EE-SY without light modulation are not easily influenced by power or cable length.

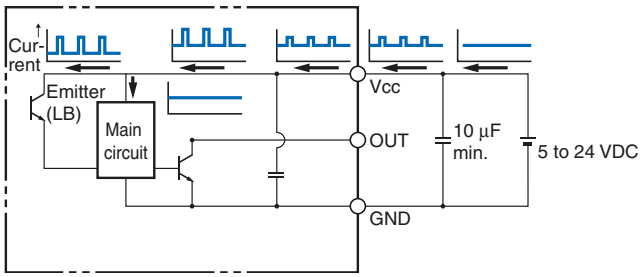
Reasons for Interference from Power and Cable Length on Models with Light Modulation

The emitter LED is lit using pulses for models with light modulation. As a result, the large current required to emit light from the LED will produce pulsation in the current consumption. Photoelectric Sensors have built-in capacitors with sufficient capacity. Therefore, these Sensors are not influenced by pulsating current consumption. Incorporating built-in capacitors with sufficient capacity in compact Photomicrosensors, however, is difficult, thereby resulting in pulsating current consumption. Operation may not be able to keep up with the pulsation in the current consumption depending on the cable length and the type of power supply used, and this may result in unstable operation.

Countermeasures

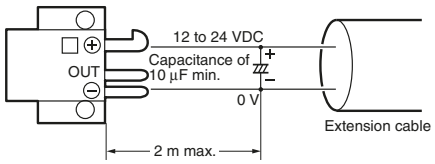
Adding a Capacitor

Attach a capacitor (e.g., film capacitor) of 10 μF min. to the wires as close as possible to the Sensor. (Use a capacitor with a dielectric strength that is at least twice the Sensor's power supply voltage. Do not use tantalum capacitors. Short-circuit malfunctions may result in the capacitor igniting due to the large current flow.)



Cable Length

- Design the configuration using a total cable length of 2 m max. for the Sensor.
- To use a cable longer than 2 m, attach a capacitor with a capacitance of approximately 10 μF to the wires as shown below (the distance between the terminal and the capacitor must be within 2 m). Make sure that the total cable length is no longer than approximately 5 m. To use a cable length longer than 5 m, use a PLC or other means to read the sensor output and then transmit the signals using a PLC with communications functions. Although cables can be extended longer than 5 m, performance will be affected by the noise interference from adjacent cables and other devices and the influence of cable specifications. Voltage drops due to resistance in wiring materials will also influence performance. Therefore, factors, such as the difference in voltage between the end of the cable and the sensor and noise levels, must be given full consideration.

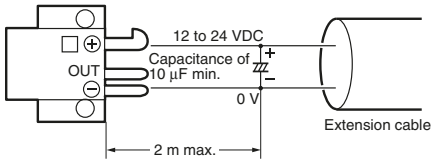


Note: Refer to the precautions for the Sensor being used before extending cables. The length that cables can be extended depends on the Sensor model and cable specifications. EE-SX, EE-SY, and all other Sensors without light modulation are not easily affected by cable length (effective extension from 20 to 50 m is possible).

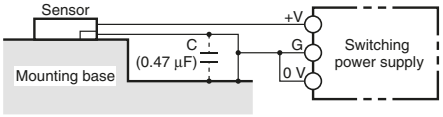
Using a Switching Power Supply

- Take either of the following countermeasures as required if connecting a Sensor with optical modulation to a switching power supply.

1. Attach a capacitor of 10 μF min to the wires as close as possible to the Sensor. (Use a capacitor with a dielectric strength that is at least twice the Sensor's power supply voltage. Do not use tantalum capacitors. Short-circuit malfunction may result in the capacitor igniting due to the large current flow.)



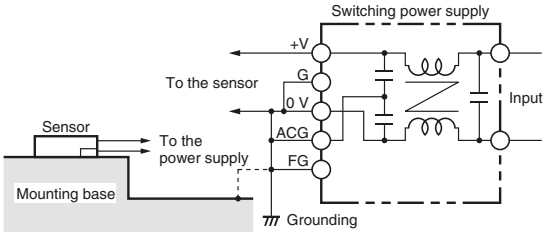
2. Connect to the 0-V line of the power source or connect to the power source via a capacitor of approximately 0.47 μF to reduce the impedance of the mounting base to prevent inductive noise from entering the mounting base.



3. Connect the noise filter terminal (neutral terminal to ACG) of the switching power supply to the case (FG) and 0-V terminal of the power supply.

Note: The line connected as mentioned above should be grounded or connected to the mounting base to ensure stable operation.

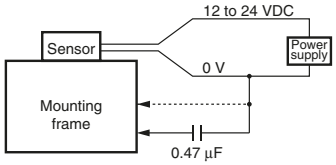
Countermeasures to Handle Inductive Noise



4. Insert a plastic insulator of approximately 10 mm between the Sensor and the mounting base.

Effects of Inductive Noise

- When there is inductive noise in the Sensor mounting frame (metal), the output of the Sensor may be affected. In this case, ensure that there is no electrical potential difference between the Sensor 0-V terminal and the Sensor mounting frame, or put a 0.47-μF capacitor between the 0-V terminal and the frame.



Output Signal Processing

- Set a processing speed slower than 100 ms to prevent noise interference.

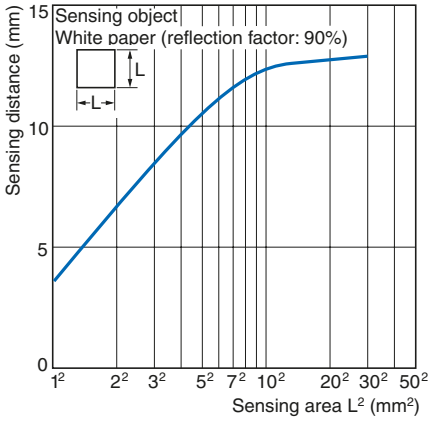
Reflective Photomicrosensors

Sensing Distance

- The maximum sensing distance of each Reflective Photomicrosensor model is based on sensing a sheet of white paper with a reflection factor of 90%. The sensing distance varies with the other conditions of the objects being detected.

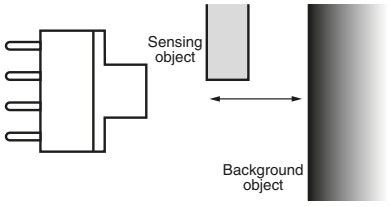
Typical Example

EE-SPY30/40 Series



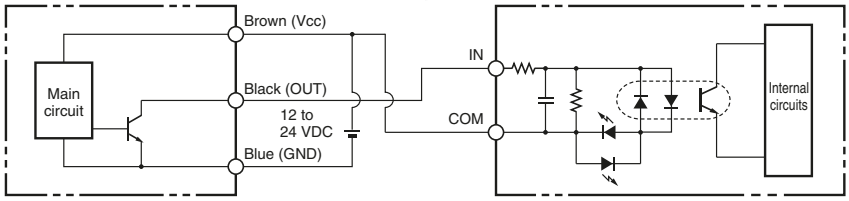
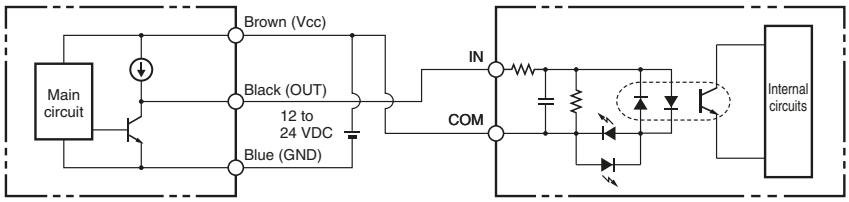
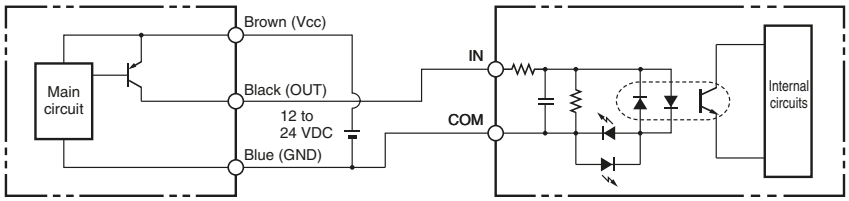
Background Objects

- The Reflective Photomicrosensor detects objects by sensing the difference in the reflection factor between the object and the background, therefore the background objects should not be glossy.

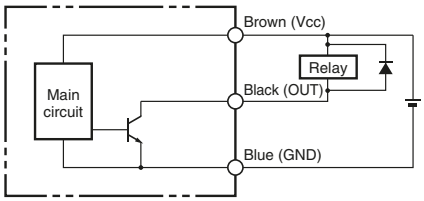
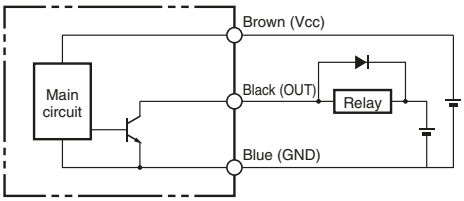


Decrease reflection from the background object, e.g., by providing a sufficient distance to the background or by using a black sponge as the background.

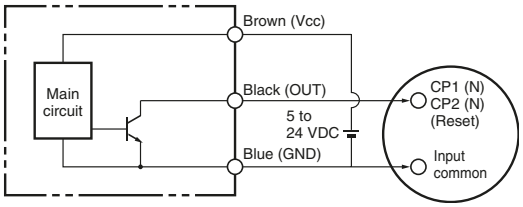
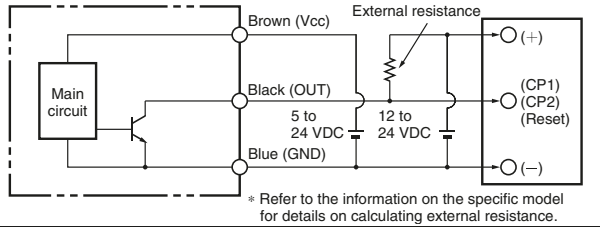
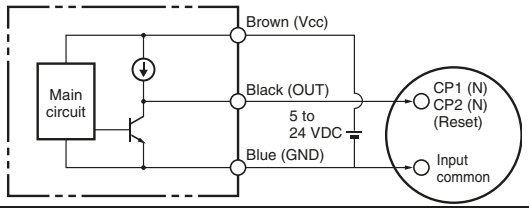
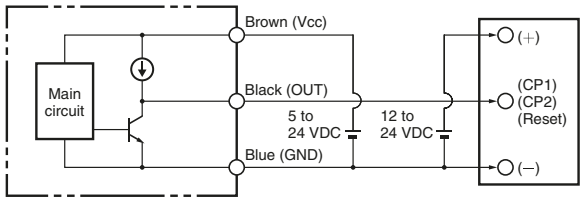
PLC Connections

NPN open collector output	
NPN voltage output	
PNP open collector output	

Relay Connections

	Operating from same power supply	Operating from different power supplies
NPN open collector output		

Counter Connections

	No-voltage Input	Transistor input (voltage input)
NPN open collector output		 ∗ Refer to the information on the specific model for details on calculating external resistance.
NPN voltage output		

● **Other Precautions**

- Do not disconnect the Connector from the Sensor when power is supplied to the Sensor, or Sensor damage could result.
- Avoid installing the Sensor in the following places to prevent malfunction or trouble:

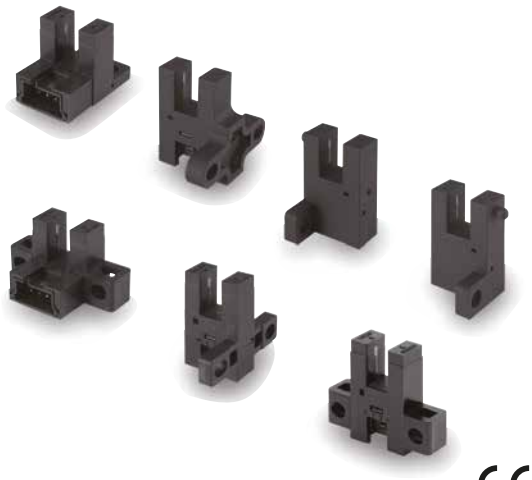
1. Places exposed to dust
2. Places exposed to corrosive gases
3. Places exposed to water, oil, or chemicals
4. Outdoor or places exposed to intensive light, such as direct sunlight

- Be sure to use the Sensor under the rated ambient temperature.
- The Sensor may be dissolved by exposure to organic solvents, acids, alkali, or aromatic hydrocarbons, causing deterioration in characteristics. Do not expose the Sensor to such chemicals.

Slot-type Photomicrosensor

EE-SX97

Built-in connector enables downsizing and easier connection. Protective circuit for safe operation.



- **A built-in connector minimizes the shape and dimensional requirements.**
- **Two outputs: light-ON and dark-ON.**
- **Complete lineup including seven different shapes.**
- **Safer operation with built-in power supply reverse polarity protection.**
- **Output overcurrent protection with a thermal shutdown circuit (patent pending).** *1
- **The indicator can be seen from many directions to enable installation in more locations.**
- **Connector with lock that mates with commercially available connectors.** *2

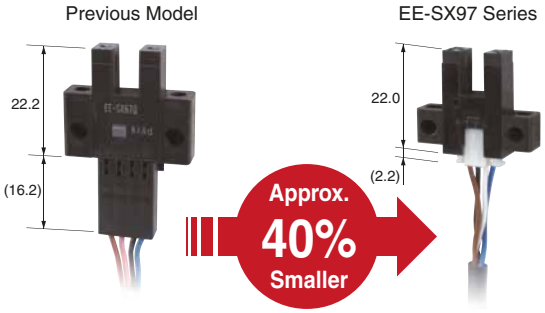
*1. Output overcurrent protection is provided only on output 2 (OUT2) on NPN models.
*2. Recommended connector:
J.S.T. Mfg. Co., Ltd. Contacts: SPHD-001T-P0.5, Housing: PAP-04V-S
Ask the manufacturer of the connector for details.

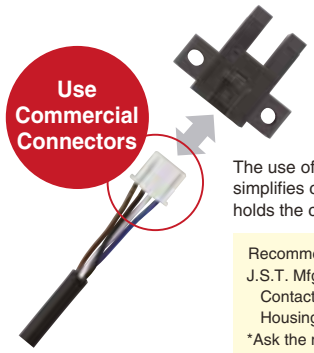
⚠ **Be sure to read the *Safety Precautions* on page 37.**

Features

Built-in Connector for Downsizing and Easier Connection

A built-in connector minimizes the shape and dimensional requirements. And wiring costs can be reduced by using commercially available connectors.



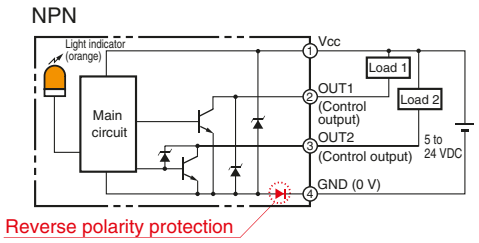


The use of a commercially available connector simplifies connections and the positive lock holds the connector in place.

Recommended Connector:
J.S.T. Mfg. Co., Ltd.
Contacts: SPHD-001T-P0.5,
Housing: PAP-04V-S
*Ask the manufacturer of the connector for details.

Safer Operation with Built-in Power Supply Reverse Polarity Protection

The built-in power supply reverse polarity protection protects against reverse connection of the power supply or outputs for safer operation at the assembly site.

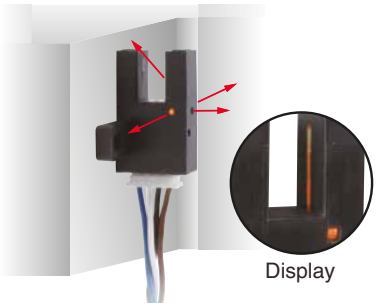


Built-in Thermal Shutdown Circuit

Control output 2 on models with NPN outputs is protected from output overcurrents by a built-in thermal shutdown circuit.

Easy-to-see Indicator

The indicator can be seen from up to four directions to enable installation in more locations.



Two Outputs: Light-ON and Dark-ON

All models provide both a light-ON and dark-ON output so that the output can be switched according to the application simply by changing the wiring.

EE-SX97

Ordering Information

Sensors

Infrared light

Appearance	Sensing method	Connecting method	Sensing distance		Operating mode	Indicator mode	Model	
							NPN output	PNP output
Standard 	Through-beam type (with slot)	Connector model (4 poles)		5 mm (slot width)	Dark-ON/ Light-ON (selectable)	Incident light	**EE-SX970-C1**	**EE-SX970P-C1**
L-shaped 							**EE-SX971-C1**	**EE-SX971P-C1**
T-shaped, slot center 7 mm 							**EE-SX972-C1**	**EE-SX972P-C1**
Close-mounting 							**EE-SX974-C1**	**EE-SX974P-C1**
T-shaped, slot center 10 mm 							**EE-SX975-C1**	**EE-SX975P-C1**
F-shaped 							**EE-SX976-C1**	**EE-SX976P-C1**
R-shaped 							**EE-SX977-C1**	**EE-SX977P-C1**

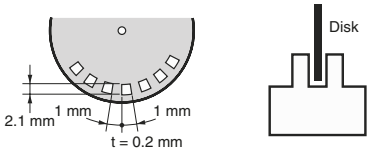
Accessories (Order Separately)

Type	Cable length	Model
Connector with Cable	1 m	**EE-1017 1M**
	3 m	**EE-1017 3M**
Connector with Robot Cable	1 m	**EE-1017-R 1M**
	3 m	**EE-1017-R 3M**

Ratings and Specifications

Item	Type	Standard	L-shaped	T-shaped, slot center 7 mm	Close-mounting	T-shaped, slot center 10 mm	F-shaped	R-shaped
	NPN	EE-SX970-C1	EE-SX971-C1	EE-SX972-C1	EE-SX974-C1	EE-SX975-C1	EE-SX976-C1	EE-SX977-C1
	PNP	EE-SX970P-C1	EE-SX971P-C1	EE-SX972P-C1	EE-SX974P-C1	EE-SX975P-C1	EE-SX976P-C1	EE-SX977P-C1
Sensing distance		5 mm (slot width)						
Sensing object		Opaque: 2 × 0.8 mm min.						
Differential distance		0.025 mm max. *1						
Light source (Peak wavelength)		Infrared LED with a peak wavelength of 940 nm						
Indicator		Light indicator (orange LED)						
Supply voltage		5 to 24 VDC ±10%, ripple (p-p): 10% max.						
Current consumption		21 mA max.						
Control output		Load power supply voltage: 5 to 24 VDC, Load current: 50 mA max., Off-state current : 0.5mA max, 50 mA load current with a residual voltage of 1.0 V max., 5 mA load current with a residual voltage of 0.4 V max.						
Protection circuit		Power supply reverse polarity protection; output reverse polarity protection; overcurrent protection (only OUT2 on models with NPN output)						
Response frequency		1 kHz min. (3 kHz average) *2						
Ambient illumination		1,000 lx max. with fluorescent light on the surface of the receiver						
Ambient temperature range		Operating: –25 to 55°C Storage: –30 to 80°C (with no icing or condensation)						
Ambient humidity range		Operating: 5% to 85% Storage: 5% to 95% (with no icing or condensation)						
Vibration resistance (Destruction)		10 to 2,000 Hz 0.75-mm single amplitude (15-min periods, 10 cycles) each in X, Y, and Z directions						
Shock resistance (Destruction)		Destruction: 500 m/s² for 3 times each in X, Y, and Z directions						
Degree of protection		IEC 60529 IP50						
Connecting method		Connector						
Weight (Packed state)		Approx. 3 g						
Material	Case/Cover	Polybutylene terephthalate (PBT)						
	Emitter/receiver	Polycarbonate (PC)						

*1. The differential distance is the value when a sensing object is moved in a lateral direction to the slot.
*2. The response frequency was measured by detecting the following rotating disk.



Connector

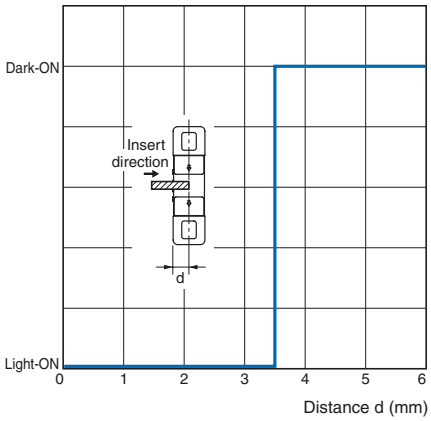
Item		Product	Connector with Cable	Connector with Robot Cable
		Model	EE-1017	EE-1017-R
		Appearance		
Contact resistance			25 mΩ max. (at 10 mA DC and 20 mV max.)	
Insertion strength			20 N max.	
Surplus strength			1.5 N min.	
Cable length			1 m, 3 m	
Ambient temperature range			–10 to +60°C	
Materials	Housing		Nylon	
	Contact		Phosphor bronze	

EE-SX97

Engineering Data (Typical)

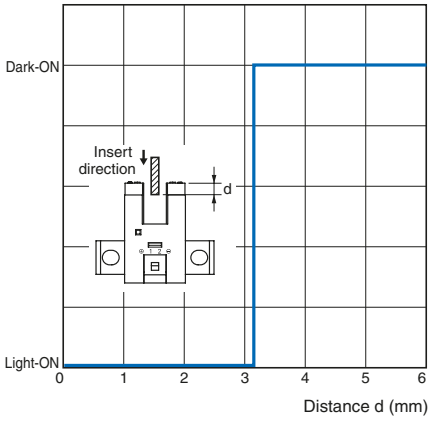
Sensing Position Characteristics

EE-SX970



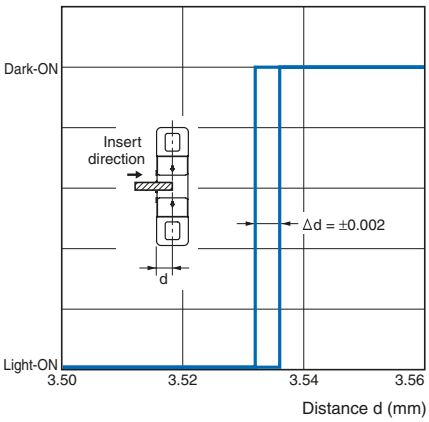
Sensing Position Characteristics

EE-SX970



Repeated Sensing Position Characteristics

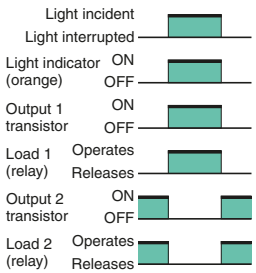
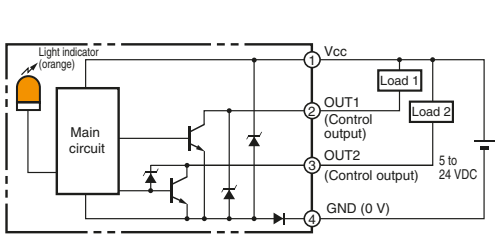
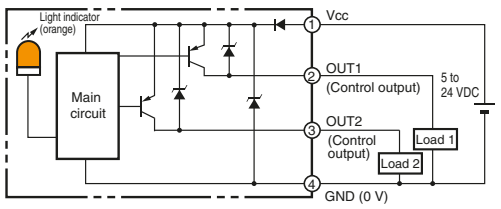
EE-SX970



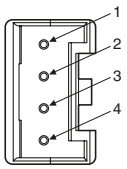
Vcc = 24 V, No. of repetitions: 20, Ta = 25°C
Differential distance = 0.025 mm max.

Note: Data is provided for dark conditions. Light interference and the translucence of the sensing object can affect operation.

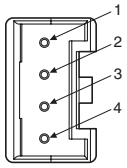
I/O Circuit Diagrams

Output configuration	Model	Output transistor operation status	Timing charts	Output circuit
NPN output	EE-SX970-C1 EE-SX971-C1 EE-SX972-C1 EE-SX974-C1 EE-SX975-C1 EE-SX976-C1 EE-SX977-C1	OUT1: Light-ON OUT2: Dark-ON		
PNP output	EE-SX970P-C1 EE-SX971P-C1 EE-SX972P-C1 EE-SX974P-C1 EE-SX975P-C1 EE-SX976P-C1 EE-SX977P-C1			

Connector pin arrangement



Connector pin arrangement



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 Safe Use

● Operating Environment

These Photomicrosensors have an IP50 (conforms to IEC) enclosure and do not have a water-proof or dust-proof structure. Therefore, do not use them in applications in which the sensor will be subjected to splashes from water, oil, or any other liquid. Liquid entering the Sensor may result in malfunction.

Precautions for Correct Use

Make sure that this product is used within the rated ambient environment conditions.

● Installation

- Mount the Sensor with two M3 screws, using plain washers and spring washers to ensure the screws will not become loose. Use a tightening force of 0.54 N·m max.

● Wiring

Unused Output Lines

Be sure to isolate output lines that are not going to be used.

Wiring method

Connection is made using a connector. Do not solder to the pins (leads). The pins (leads) are soldered to the internal board of the Sensor. Therefore, direct soldering of the pins (leads) may result in an internal disconnection causing malfunction.

● Others

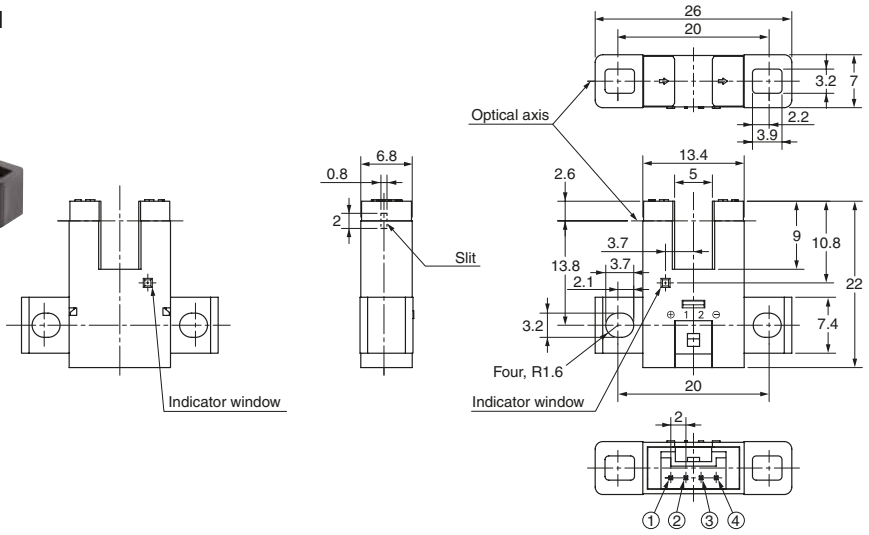
- The power cable connected to the Sensor must not be more than 10 m in length.
- Only output 2 (OUT2) on NPN models is provided with overcurrent protection.
  If an overcurrent occurs, heat generated by the output transistor will activate the thermal shutdown circuit and OUT2 will turn OFF. Check the wiring and load current and cycle the power supply. If there is no overcurrent, normal operation will be resumed. (The thermal shutdown circuit will be activated again if there is an overcurrent.)
  This function does not provide protection against load short circuits. If the electric power of the output transistor increases due to a load short-circuit or near load short-circuit, the Sensor may be damaged.
- An output pulse may occur when the power supply is turned ON depending on the power supply and other conditions. The operation of the Sensor will be stable 100 ms after turning ON the power supply.

Dimensions

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

Sensors

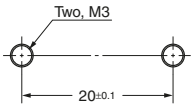
EE-SX970-C1
EE-SX970P-C1



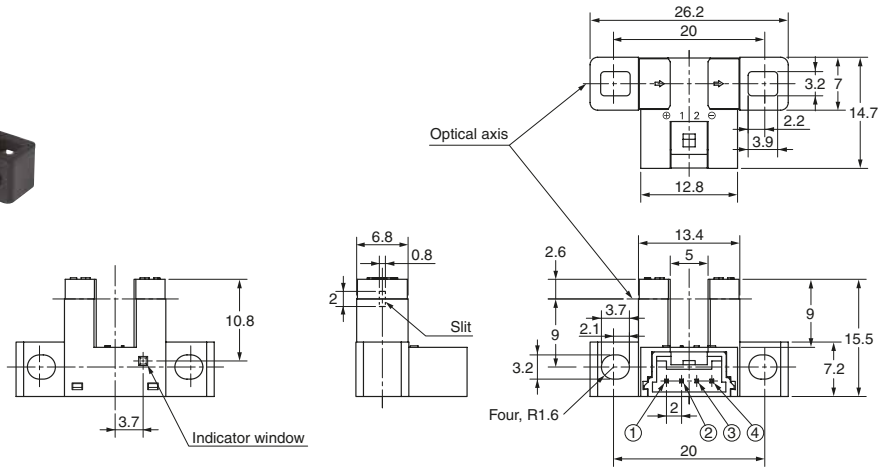
Terminal Arrangement

①	+	Vcc
②	1	OUTPUT1
③	2	OUTPUT2
④	–	GND (0 V)

Mounting screw holes



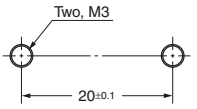
EE-SX971-C1
EE-SX971P-C1



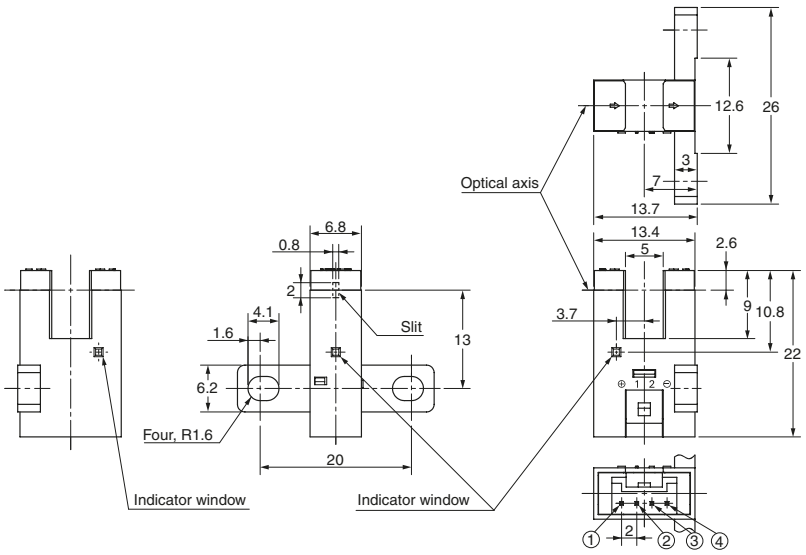
Terminal Arrangement

①	+	Vcc
②	1	OUTPUT1
③	2	OUTPUT2
④	–	GND (0 V)

Mounting screw holes



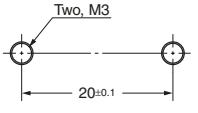
EE-SX972-C1
EE-SX972P-C1



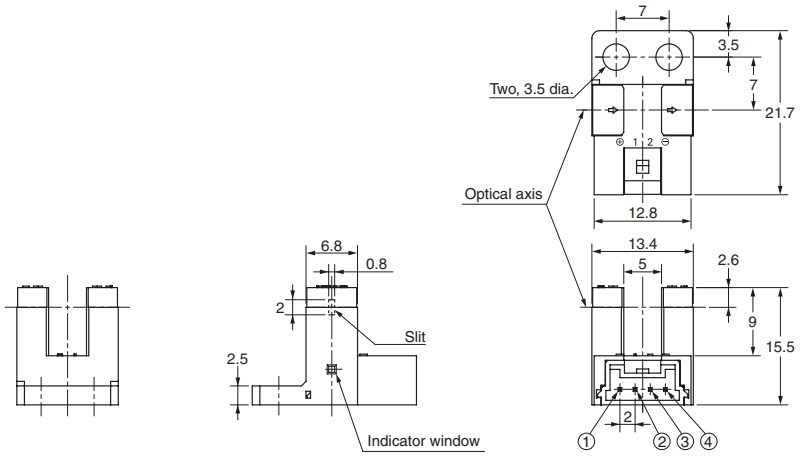
Terminal Arrangement

①	+	Vcc
②	1	OUTPUT1
③	2	OUTPUT2
④	–	GND (0 V)

Mounting screw holes



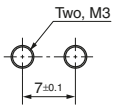
EE-SX974-C1
EE-SX974P-C1



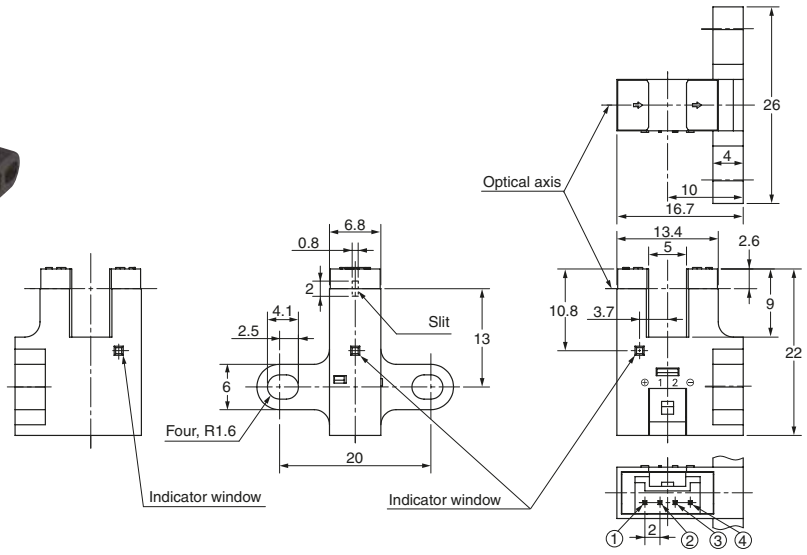
Terminal Arrangement

①	+	Vcc
②	1	OUTPUT1
③	2	OUTPUT2
④	–	GND (0 V)

Mounting screw holes



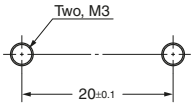
EE-SX975-C1
EE-SX975P-C1



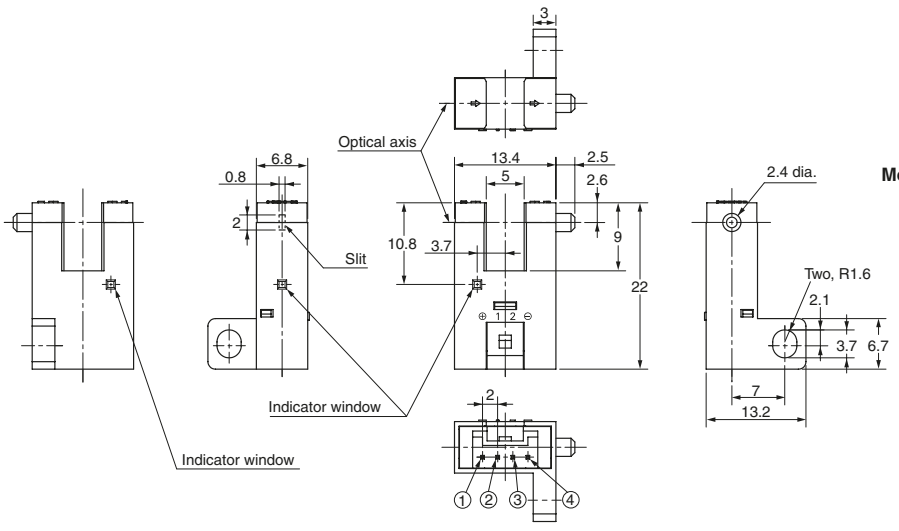
Terminal Arrangement

①	+	Vcc
②	1	OUTPUT1
③	2	OUTPUT2
④	–	GND (0 V)

Mounting screw holes



EE-SX976-C1
EE-SX976P-C1

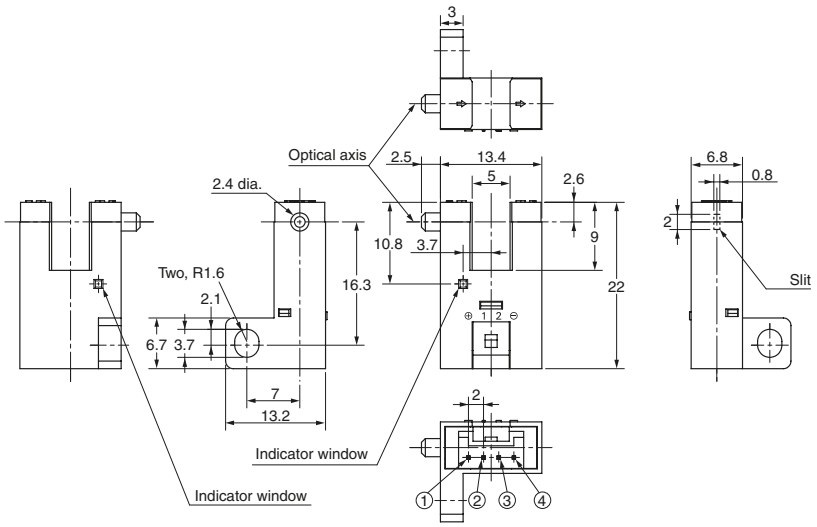


Terminal Arrangement

①	+	Vcc
②	1	OUTPUT1
③	2	OUTPUT2
④	–	GND (0 V)

Mounting screw holes

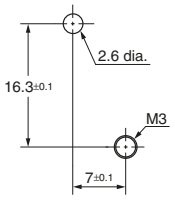
EE-SX977-C1
EE-SX977P-C1



Terminal Arrangement

①	+	Vcc
②	1	OUTPUT1
③	2	OUTPUT2
④	–	GND (0 V)

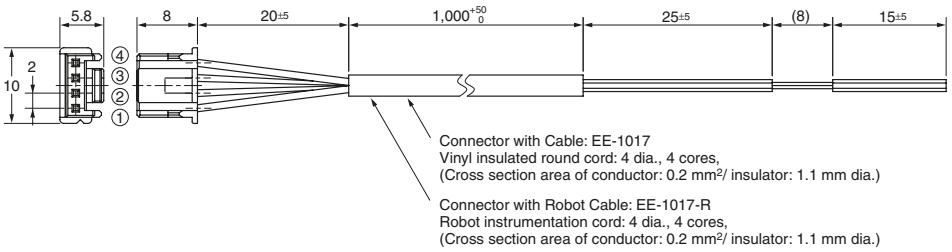
Mounting screw holes



Accessories (Order Separately)

Connector

Connector with Cable
EE-1017
Connector with Robot Cable
EE-1017-R



Terminal Arrangement

①	+	Brown
②	1	Black
③	2	White
④	–	Blue

Compact Pre-wired Photomicrosensor with Built-in Amplifier (Non-modulated)

EE-SX91

Meeting Customer Needs with Compact Sensors that Mount with M3 Screws

- Both light-ON and dark-ON outputs provided.
- A compact size and choice of five models for a wide range of applications.
- Compact NPN and PNP output models.
- Mount using M3 or M2 screws.
- Indicator is visible in many directions for installation in any location.
- Maximum load current of 100 mA.
- Flexible robot cables are standard on all models.

⚠ Be sure to read *Safety Precautions* on page 46.

CE

Features

A Compact Size and Choice of Five Models for a Wide Range of Applications

Select any of five models to minimize the space required.

Compact NPN and PNP Output Models

Both NPN and PNP output models are available for use according to system requirements.

Maximum Load Current of 100 mA

Output control of up to 100 mA is supported for either NPN or PNP outputs.

Flexible Robot Cables: Standard on All Models

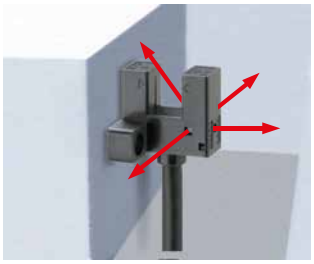
Robot Cables are effective for moving parts, and are provided as standard equipment with all models.

Both Light-ON and Dark-ON Outputs

Both light-ON and dark-ON outputs are provided on all models, allowing outputs to be switched by simply changing the wiring according to the application.

Indicator Visible from Many Directions for Installation in Any Location

The light indicator can be checked from up to four directions.



Mount Using M3 or M2 Screws

The EE-SX91 can be mounted using M3 or M2 screws, so it can easily replace an existing compact sensor mounted with M2 screws.

EE-SX91

Ordering Information

List of Models

Models with Robot Cables

Infrared light

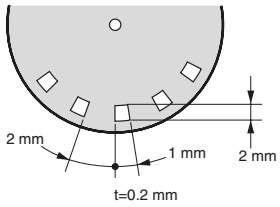
Appearance	Sensing method	Sensing distance	Output configuration	Indicator mode	Connecting method (Cable length)	Model	
						NPN output	PNP output
Standard 	Through-beam type (with slot)	5 mm (slot width)	Light-ON Dark-ON (2 outputs)	Lit when light is incident	Pre-wired models (1 m)	**EE-SX910-R 1M** *	**EE-SX910P-R 1M** *
L-shaped 						**EE-SX911-R 1M** *	**EE-SX911P-R 1M** *
F-shaped 						**EE-SX912-R 1M** *	**EE-SX912P-R 1M** *
R-shaped 						**EE-SX913-R 1M** *	**EE-SX913P-R 1M** *
U-shaped 						**EE-SX914-R 1M** *	**EE-SX914P-R 1M** *

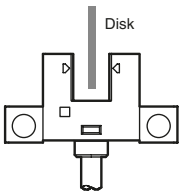
* Prewired models with a 3-m cable are also available. When ordering, specify the cable length by adding “3M” for the end of the model number (e.g., EE-SX910-R 3M).

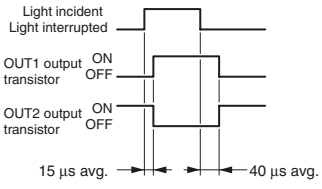
Ratings and Specifications

Item			Type	Standard	L-shaped	F-shaped	R-shaped	U-shaped
	NPN models	Pre-wired models		EE-SX910-R	EE-SX911-R	EE-SX912-R	EE-SX913-R	EE-SX914-R
	PNP models	Pre-wired models		EE-SX910P-R	EE-SX911P-R	EE-SX912P-R	EE-SX913P-R	EE-SX914P-R
Sensing distance				5 mm (slot width)				
Sensing object				Opaque: 1.2 × 0.8 mm min.				
Differential distance				0.025 mm max.				
Light source				GaAs infrared LED with a peak wavelength of 940 nm				
Indicator				Light indicator (red LED)				
Supply voltage				5 to 24 VDC ±10%, ripple (p-p): 10% max.				
Current consumption				15 mA max.				
Control output				Load power supply voltage: 5 to 24 VDC Load current: 100 mA max. OFF current: 0.5 mA max. 100 mA load current with a residual voltage of 1.0 V max. 5 mA load current with a residual voltage of 0.4 V max.				
Protection circuits				Power supply reverse polarity protection; output reverse polarity protection				
Response frequency				3 kHz min. (8 kHz average) Light incident: 15 μs average; light interrupted: 40 μs average*				
Ambient illumination				1,000 lx max. with fluorescent light on the surface of the receiver				
Ambient temperature range				Operating: –25 to 55°C Storage: –30 to 80°C (with no icing or condensation)				
Ambient humidity range				Operating: 5% to 85% Storage: 5% to 95% (with no icing or condensation)				
Vibration resistance (Destruction)				10 to 2,000 Hz 0.75-mm single amplitude for 2.5 h (15-min periods, 10 cycles) each in X, Y, and Z directions				
Shock resistance (Destruction)				500 m/s^2 for 3 times each in X, Y, and Z directions				
Degree of protection				IEC60529 IP50				
Connecting method				Pre-wired Models (standard cable length: 1 m)				
Weight (packed state)			Pre-wired Models	Approx. 17 g				
			Models with Connectors	Approx. 7 g				
Materials	Case/cover			Polybutylene phthalate (PBT)				
	Emitter/receiver			Polycarbonate (PC)				

* The response frequency was measured by detecting the following rotating disk. The response times for light incidence and light interruption are shown in the timing chart.





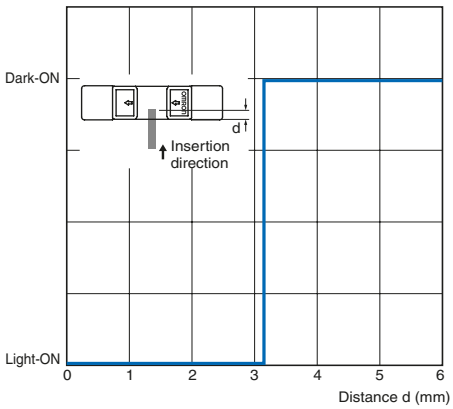


EE-SX91

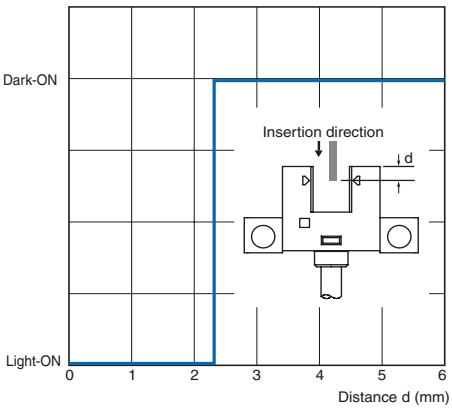
Engineering Data (Typical)

Sensing Position Characteristics

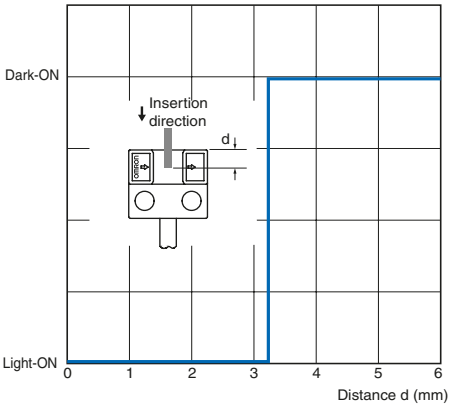
EE-SX910



EE-SX910

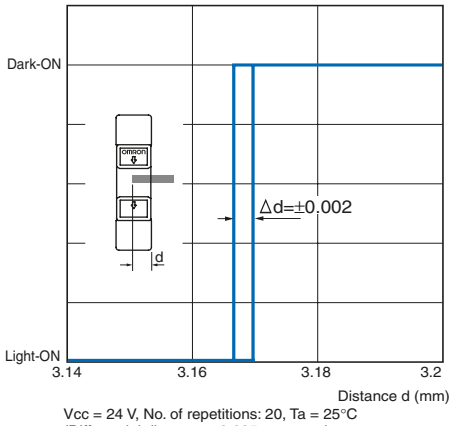


EE-SX911



Repeated Sensing Position Characteristics

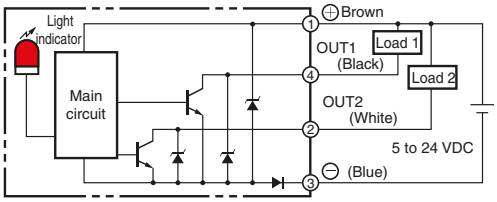
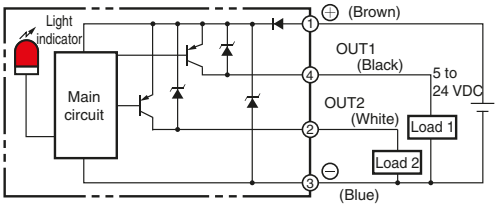
EE-SX910



Vcc = 24 V, No. of repetitions: 20, Ta = 25°C
(Differential distance = 0.025 mm max.)

Note: The data applies to dark status. Operation may be affected by external light interference or light coming through the sensing object.

I/O Circuit Diagrams

Output type	Model	Output transistor operation status	Timing charts	Output circuit
NPN output	EE-SX910-R EE-SX911-R EE-SX912-R EE-SX913-R EE-SX914-R	OUT1: Light-ON OUT2: Dark-ON	Light incident Light interrupted Light indicator (red) ON OFF Output 1 transistor ON OFF Load 1 (e.g., relay) Operates Releases Output 2 transistor ON OFF Load 2 (e.g., relay) Operates Releases	
PNP output	EE-SX910P-R EE-SX911P-R EE-SX912P-R EE-SX913P-R EE-SX914P-R			

Safety Precautions

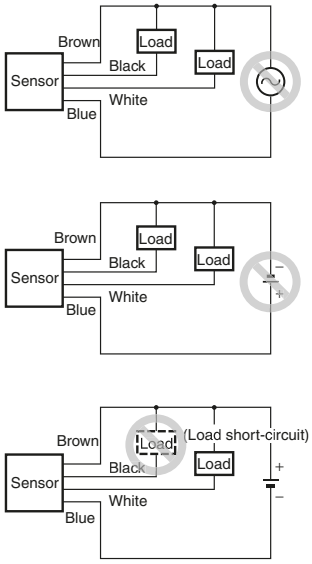
Refer to *Warranty and Limitations of Liability*.

⚠ 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 Safe Use

- Power Supply Voltage
  Do not exceed the voltage range indicated in the specifications. Applying a voltage exceeding the specifications or using an AC power supply may result in rupture or burning.
- Faulty Wiring
  Do not reverse the power supply polarity. Doing so may result in rupture or burning.
- Do not short-circuit the load. (Do not connect to the power supply.)
  Doing so may result in rupture or burning.
- Dispose of this product as industrial waste.



Precautions for Correct Use

● Installation

- It is assumed that EE-SX91 Sensors will be built into a device. These Sensors use non-modulated light and are not equipped to deal with interference from an external light source. When they are used in locations subject to external light interference, such as near a window or under an incandescent light, install them to minimize the effects of external light interference.
- Mount the Sensors securely on a flat surface.
- Use M3 or M2.0 screws to secure the Photomicrosensor. (The stronger M3 screws are recommended. In addition, use flat washers and spring washers to prevent the screws from loosening.) Refer to the following table for the correct tightening torque.

Screw diameter	Tightening torque
M2.0	0.15 N·m max.
M3	0.54 N·m max.

- If the Sensor is to be used on a moving part, secure the cable connection point so that it is not directly subjected to stress.

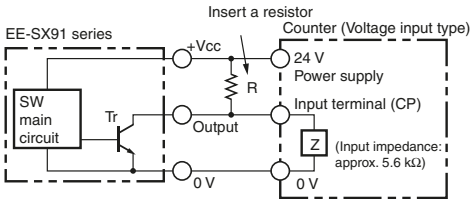
● Wiring

Unused Output Lines

Be sure to isolate output lines that are not going to be used.

Connecting to Devices with Voltage Input Specifications

A Sensor with an open-collector output can be connected to a counter with a voltage input by connecting a resistor between the power source and output. Select a resistor with reference to the following example. The resistance of the resistor is generally 4.7 kΩ and its wattage is 1/2 W for a supply voltage of 24 V and 1/4 W for 12 V.



Example: EE-SX91 Series
Load Resistance of 4.7 kΩ Connected in a Counter

Counter Specifications

Input impedance	5.6 KΩ
Voltage judged as high level (input ON)	4.5 to 30 VDC
Voltage judged as low level (input OFF)	0 to 2 VDC

The high and low levels are found using the following formulas. The input device specifications must satisfy both formulas.

High level:

$$\text{Input voltage } V_H = \frac{Z}{R+Z} \quad Vcc = \frac{5.6\text{ k}}{4.7\text{ k}+5.6\text{ k}} \times 24\text{ V} = 13\text{ V}$$

Low level:

$$\text{Load current } Ic = \frac{Vcc}{R} = \frac{24\text{ V}}{R} = 5.1\text{ mA} \leq 100\text{ mA}$$

Input voltage $V_L \leq 1.0$ V (Residual voltage for 100-mA load current)

Note: Refer to the ratings of the Sensor for the residual voltage of the load current.

● Other Precautions

- Do not disconnect the Connector from the Sensor when power is supplied to the Sensor, or Sensor damage could result.
- Do not install the Sensor in the following places to prevent malfunction or trouble:
  1. Places exposed to dust or oil mist
  2. Places exposed to corrosive gas
  3. Places directly or indirectly exposed to water, oil, or chemicals
  4. Outdoor or places exposed to intensive light, such as direct sunlight
- Be sure to use the Sensor under the rated ambient temperature.
- The Sensor may be dissolved by exposure to organic solvents, acids, alkali, or aromatic hydrocarbons, aliphatic chloride hydrocarbons causing deterioration in characteristics. Do not expose the Sensor to such chemicals.
- Make sure the total length of the power cable connected to the product is less than 10 m.

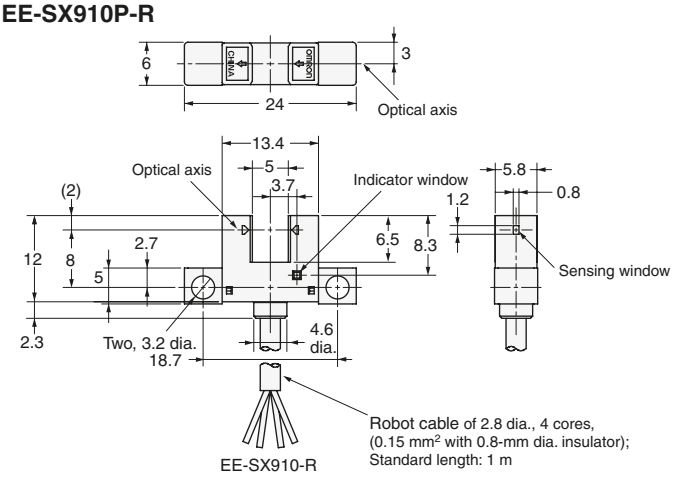
EE-SX91

Dimensions (Unit: mm)

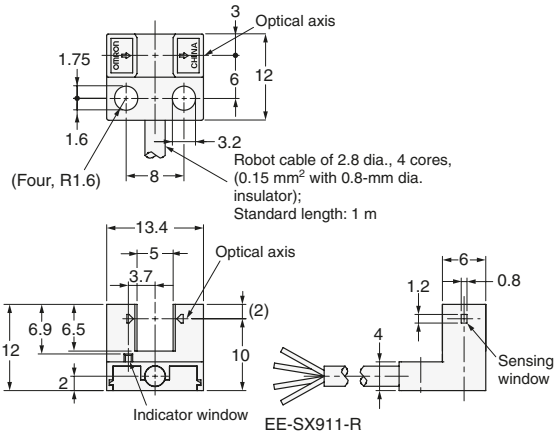
Tolerance class IT16 applies to dimensions in this datasheet unless otherwise specified.

Photomicrosensors

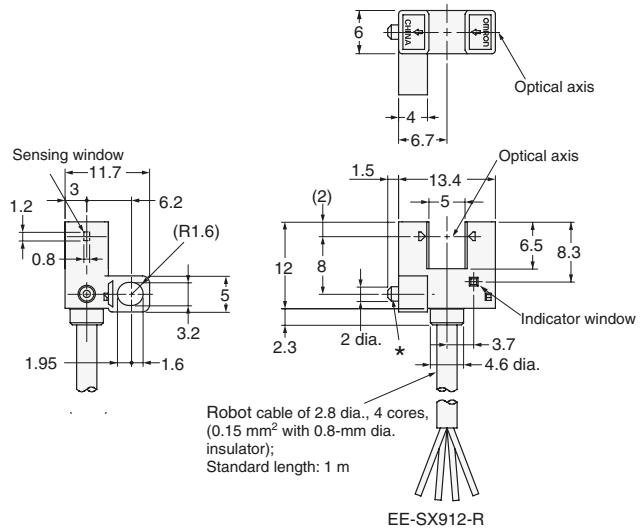
EE-SX910-R
EE-SX910P-R



EE-SX911-R
EE-SX911P-R

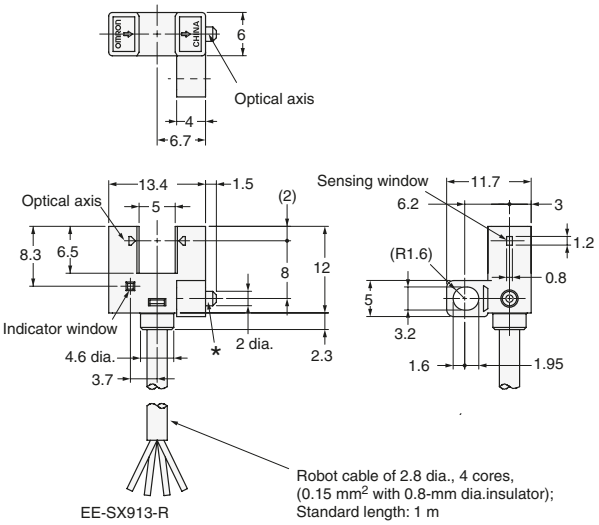


EE-SX912-R
EE-SX912P-R



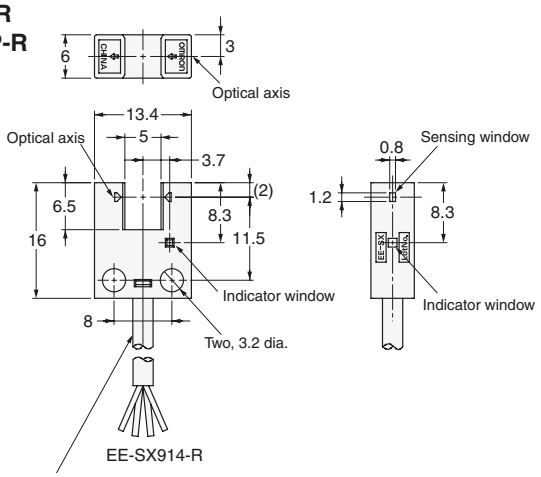
* The lug is used to prevent turning. When installing, make a fixed hole of 2.1 to 2.3 mm dia.

EE-SX913-R
EE-SX913P-R



* The lug is used to prevent turning. When installing, make a fixed hole of 2.1 to 2.3 mm dia.

EE-SX914-R
EE-SX914P-R



EE-SX77/87

Slim, Compact Photomicrosensor that is still easy to use.

- Compact, thin profile enables dense mounting.
- Indicator is visible from both sides.
- Wide operating voltage range: 5 to 24 VDC

⚠ Be sure to read *Safety Precautions* on page 52.

Ordering Information

Pre-wired Models

Infrared light

Appearance	Sensing method	Cable length	Sensing distance	Output configuration	Indicator mode	Model	
						NPN output*	PNP output
Standard 	Through-beam type (with slot)	2 m	5 mm (slot width)	Dark-ON	Incident light	EE-SX770 2M	EE-SX770P 2M
					No incident light	EE-SX770A 2M	EE-SX770R 2M
				Light-ON	Incident light	EE-SX870 2M	EE-SX870P 2M
					No incident light	EE-SX870A 2M	EE-SX870R 2M
L-shaped 				Dark-ON	Incident light	EE-SX771 2M	EE-SX771P 2M
					No incident light	EE-SX771A 2M	EE-SX771R 2M
				Light-ON	Incident light	EE-SX871 2M	EE-SX871P 2M
					No incident light	EE-SX871A 2M	EE-SX871R 2M
T-shaped 				Dark-ON	Incident light	EE-SX772 2M	EE-SX772P 2M
					No incident light	EE-SX772A 2M	EE-SX772R 2M
				Light-ON	Incident light	EE-SX872 2M	EE-SX872P 2M
					No incident light	EE-SX872A 2M	EE-SX872R 2M

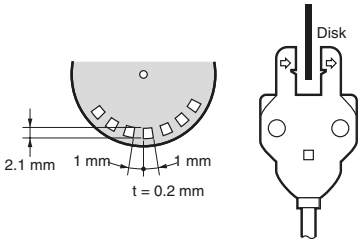
* Models with NPN outputs are available with pre-wired e-CON connectors. Specify an NPN output by adding "-ECON" and the cable length (0.3 m or 2 m) to the end of the model number. (Example: EE-SX770-ECON 0.3M)

EE-SX77/87

Ratings and Specifications

Item	Type	Standard	L-shaped	T-shaped
	NPN models	EE-SX770/EE-SX870 EE-SX770A/EE-SX870A	EE-SX771/EE-SX871 EE-SX771A/EE-SX871A	EE-SX772/EE-SX872 EE-SX772A/EE-SX872A
	PNP models	EE-SX770P/EE-SX870P EE-SX770R/EE-SX870R	EE-SX771P/EE-SX871P EE-SX771R/EE-SX871R	EE-SX772P/EE-SX872P EE-SX772R/EE-SX872R
Sensing distance		5 mm (slot width)		
Sensing object		Opaque: 2 × 0.8 mm min.		
Differential distance		0.025 mm		
Light source		GaAs infrared LED with a peak wavelength of 940 nm		
Indicator		Light indicator (red) (turns ON when light is interrupted for models with A or R suffix)		
Supply voltage		5 to 24 VDC ±10%, ripple (p-p): 10% max.		
Current consumption		35 mA max. (NPN models), 30 mA max. (PNP models)		
Control output		NPN open collector: 5 to 24 VDC, 100 mA max. 100 mA load current with a residual voltage of 0.8 V max. 40 mA load current with a residual voltage of 0.4 V max. OFF current (leakage current): 0.5 mA max. PNP open collector: 5 to 24 VDC, 50 mA max. 50 mA load current with a residual voltage of 1.3 V max. OFF current (leakage current): 0.5 mA max.		
Response frequency *		1 kHz min. (3 kHz average)		
Ambient illumination		1,000 lx max. with fluorescent light on the surface of the receiver		
Ambient temperature range		Operating: −25 to +55°C Storage: −30 to +80°C (with no icing)		
Ambient humidity range		Operating: 5% to 85% Storage: 5% to 95% (with no condensation)		
Vibration resistance		Destruction: 20 to 2,000 Hz (peak acceleration: 100 m/s^2) 1.5-mm double amplitude for 2 h (4-min periods) each in X, Y, and Z directions		
Shock resistance		Destruction: 500 m/s^2 for 3 times each in X, Y, and Z directions		
Degree of protection		IEC60529 IP60		
Connecting method		Pre-wired (standard cable length: 2 m)		
Weight (packaged)		Approx. 20 g		
Material		Case: Polybutylene phthalate (PBT)		

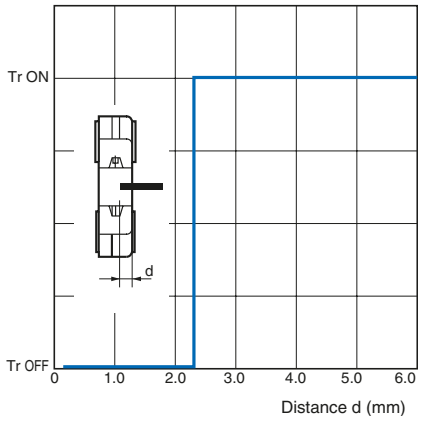
* The response frequency was measured by detecting the following rotating disk.



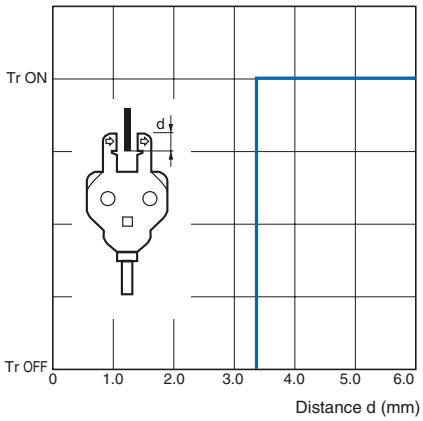
Engineering Data (Typical)

Sensing Position Characteristics

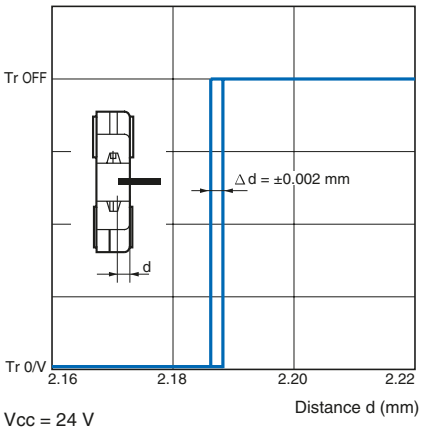
EE-SX770



Sensing Position Characteristics



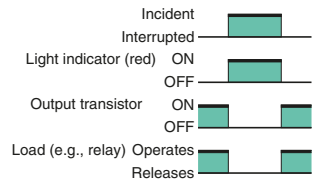
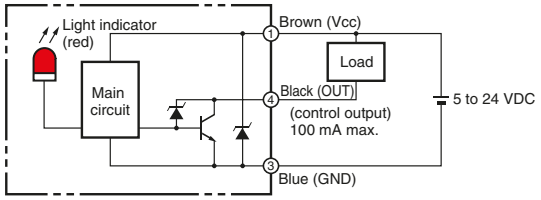
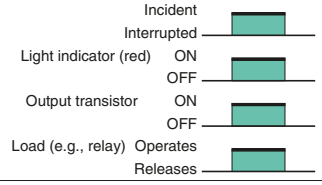
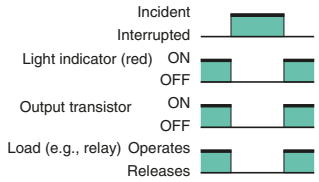
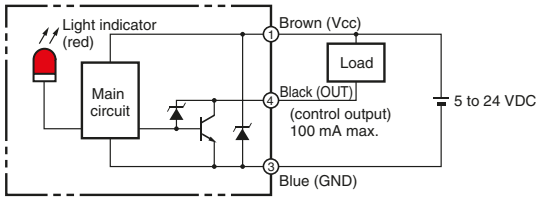
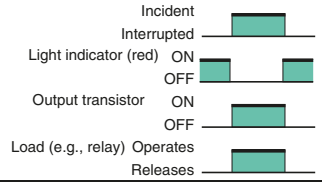
Repeated Sensing Position Characteristics



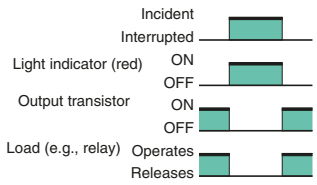
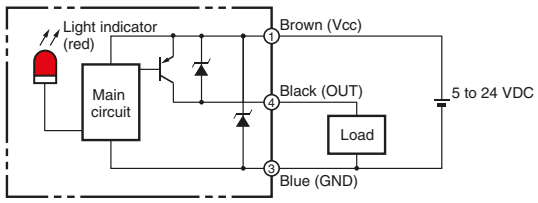
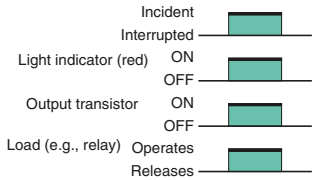
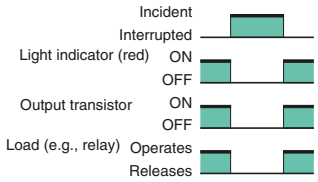
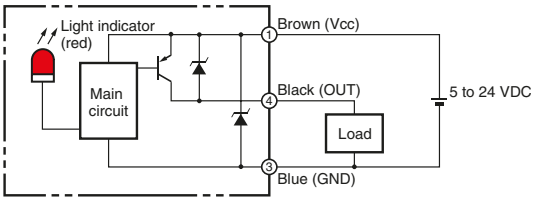
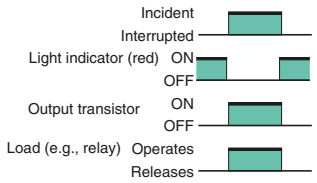
Vcc = 24 V
No. of repetitions: 20, Ta = 25°C
Note: The data applies to dark status. Operation may be affected by external light interference or light coming through the sensing object.

I/O Circuit Diagrams

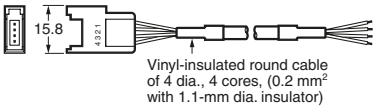
NPN Output

Model	Output configuration	Timing charts	Output circuit
EE-SX770 EE-SX771 EE-SX772	Dark-ON		
EE-SX870 EE-SX871 EE-SX872	Light-ON		
EE-SX770A EE-SX771A EE-SX772A	Dark-ON		
EE-SX870A EE-SX871A EE-SX872A	Light-ON		

PNP Output

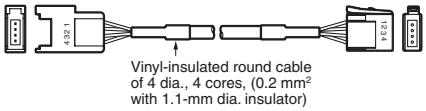
Model	Output configuration	Timing chart	Output circuit
EE-SX770P EE-SX771P EE-SX772P	Dark-ON		
EE-SX870P EE-SX871P EE-SX872P	Light-ON		
EE-SX770R EE-SX771R EE-SX772R	Dark-ON		
EE-SX870R EE-SX871R EE-SX872R	Light-ON		

Applicable Connectors



E39-ECON□M

Note: The □ symbol is used to indicate the cable length. The cable length is 2 m or 5 m.



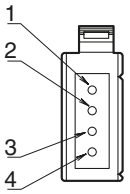
E39-ECONW□M

Note: The □ symbol is used to indicate the cable length. The cable length is 0.5 to 2 m in increments of 0.1 m.

Shield color	Pin No.	Use
Brown	(1)	Power supply (+V)
White	(2)	---
Blue	(3)	Power supply (0 V)
Black	(4)	Output

Note: Pin 2 is not used.

Pre-wired e-CON Connector Pin Arrangement



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

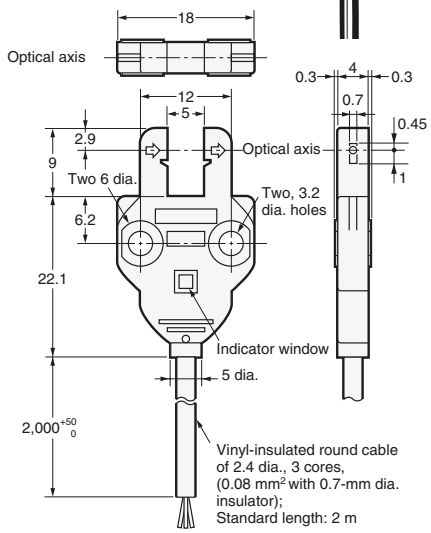
Make sure that this product is used within the rated ambient environment conditions.

(Unit: mm)

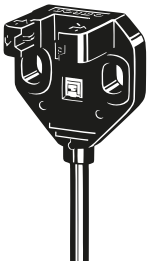
Dimensions

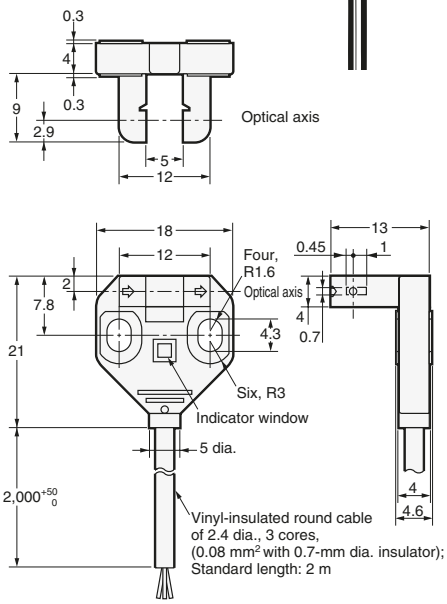
Tolerance class IT16 applies to dimensions in this datasheet unless otherwise specified.

Standard
EE-SX770/770P
EE-SX870/870P
EE-SX770A/770R
EE-SX870A/870R

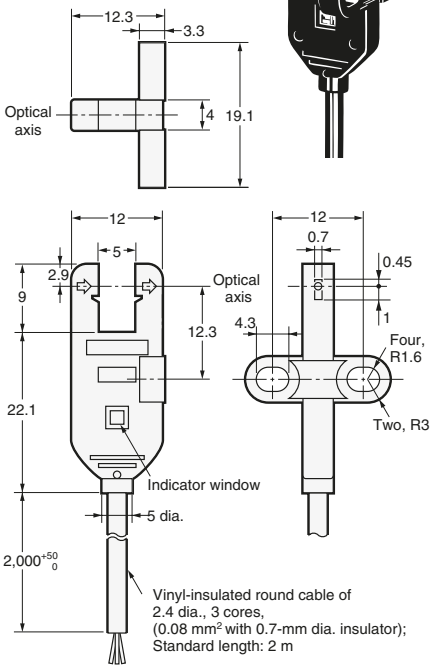


L-shaped
EE-SX771/771P
EE-SX871/871P
EE-SX771A/771R
EE-SX871A/871R





T-shaped
EE-SX772/772P
EE-SX872/872P
EE-SX772A/772R
EE-SX872A/872R



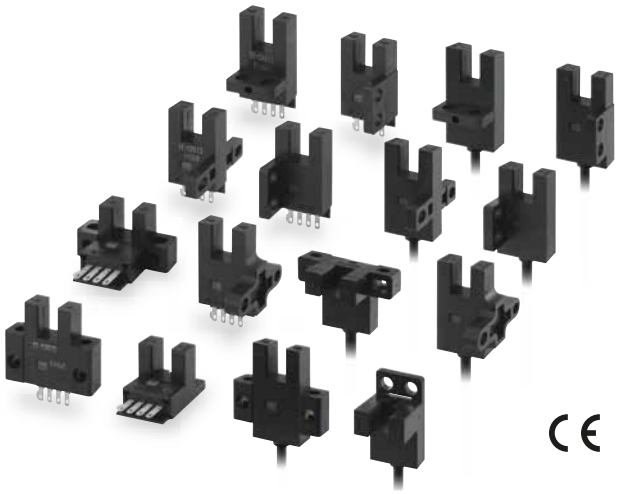
MEMO

Slot-type Photomicrosensor (Non-modulated) *1

EE-SX47/67

Global Standard Slot-type photomicrosensors with 50- to 100-mA direct switching capacity.

- Series includes models that enable switching between dark-ON and light-ON operation.
- Response frequency as high as 1 kHz.
- Easy operation monitoring with bright light indicator.
- Wide operating voltage range: 5 to 24 VDC
- Models in which the light indicator turns ON for dark-ON operation are also available.
- A wide range of variations in eight different shapes.
- Flexible robot cable is provided as a standard feature. *2



⚠ Be sure to read *Safety Precautions* on page 59.

*1. Pre-wired Models are available only in the EE-SX67 Series.
*2. Only for Pre-wired Models.

Ordering Information

Connector

Infrared light

Appearance	Sensing method	Connecting method	Sensing distance	Output configuration	Indicator mode	Model	
						NPN output	PNP output
Standard 	Through-beam type (with slot)	Connector (4 poles)	5 mm (slot width)	Dark-ON/Light-ON (selectable) *3	Incident light	EE-SX670	EE-SX670P
					No incident light	EE-SX670A	EE-SX670R
				Light-ON	Incident light	EE-SX470	EE-SX470P
L-shaped 				Dark-ON/Light-ON (selectable) *3	Incident light	EE-SX671	EE-SX671P
					No incident light	EE-SX671A	EE-SX671R
				Light-ON	Incident light	EE-SX471	EE-SX471P
T-shaped, slot center 7 mm 				Dark-ON/Light-ON (selectable) *3	Incident light	EE-SX672	EE-SX672P
					No incident light	EE-SX672A	EE-SX672R
				Light-ON	Incident light	EE-SX472	EE-SX472P
Close-mounting 				Dark-ON/Light-ON (selectable) *3	Incident light	EE-SX673	EE-SX673P
					No incident light	EE-SX673A	EE-SX673R
				Light-ON	Incident light	EE-SX473	EE-SX473P
Close-mounting 				Dark-ON/Light-ON (selectable) *3	Incident light	EE-SX674	EE-SX674P
					No incident light	EE-SX674A	EE-SX674R
				Light-ON	Incident light	EE-SX474	EE-SX474P
T-shaped, slot center 10 mm 				Dark-ON/Light-ON (selectable) *3	Incident light	EE-SX675	EE-SX675P
F-shaped 				Dark-ON/Light-ON (selectable) *3	Incident light	EE-SX676	EE-SX676P
R-shaped 				Dark-ON/Light-ON (selectable) *3	Incident light	EE-SX677	EE-SX677P

*3. Dark-ON when the L terminal of the connector is opened, and light-ON when the L terminal and positive (+) terminal are connected. Do not connect the L terminal to 0 V when using dark-ON operation. When using light-ON, it is useful to select the connector EE-1001-1. The L terminal and positive (+) terminal of this connector are connected in advance.

Pre-wired Models

Infrared light

Appearance	Sensing method	Sensing distance		Output configuration	Indicator mode	Connecting method	Model	
							NPN output	PNP output
Standard 	Through-beam type (with slot)		5 mm (slot width)	Dark-ON/ Light-ON (selectable) *	Incident light	Pre-wired Models (1m)	**EE-SX670-WR 1M**	**EE-SX670P-WR 1M**
L-shaped 							**EE-SX671-WR 1M**	**EE-SX671P-WR 1M**
T-shaped, slot center 7 mm 							**EE-SX672-WR 1M**	**EE-SX672P-WR 1M**
Close-mounting 							**EE-SX673-WR 1M**	**EE-SX673P-WR 1M**
Close-mounting 							**EE-SX674-WR 1M**	**EE-SX674P-WR 1M**
T-shaped, slot center 10 mm 							**EE-SX675-WR 1M**	**EE-SX675P-WR 1M**
F-shaped 							**EE-SX676-WR 1M**	**EE-SX676P-WR 1M**
R-shaped 							**EE-SX677-WR 1M**	**EE-SX677P-WR 1M**

* Dark-ON operation can be used when the L terminal is left unconnected or Light-ON operation can be used when the L terminal and positive (+) terminal are connected to each other. Do not connect the L terminal to 0 V when using dark-ON operation.

Accessories (Order Separately) Connector Models

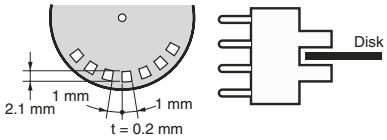
Type		Cable length	Model	Remarks
Connector			**EE-1001**	
			EE-1001-1	L terminal and positive (+) terminal are already short-circuited.
			EE-1009	
	Connector with Cable	1 m	**EE-1006**	
			EE-1010	
		2 m	**EE-1006**	
			EE-1010	
	Connector with Robot Cable	1 m	**EE-1010-R**	
		2 m	**EE-1010-R**	
Connector Hold-down Clip			**EE-1006A**	For EE-1006 only.

* Refer to *Accessories* for details.

Ratings and Specifications

Item		Type	Standard	L-shaped	T-shaped, slot center 7 mm	Close-mounting		T-shaped, slot center 10 mm	F-shaped	R-shaped
	NPN models	Connector models	EE-SX670 EE-SX670A EE-SX470	EE-SX671 EE-SX671A EE-SX471	EE-SX672 EE-SX672A EE-SX472	EE-SX673 EE-SX673A EE-SX473	EE-SX674 EE-SX674A EE-SX474	EE-SX675	EE-SX676	EE-SX677
		Pre-wired models	EE-SX670-WR	EE-SX671-WR	EE-SX672-WR	EE-SX673-WR	EE-SX674-WR	EE-SX675-WR	EE-SX676-WR	EE-SX677-WR
	PNP models	Connector models	EE-SX670P EE-SX670R EE-SX470P	EE-SX671P EE-SX671R EE-SX471P	EE-SX672P EE-SX672R EE-SX472P	EE-SX673P EE-SX673R EE-SX473P	EE-SX674P EE-SX674R EE-SX474P	EE-SX675P	EE-SX676P	EE-SX677P
		Pre-wired models	EE-SX670P-WR	EE-SX671P-WR	EE-SX672P-WR	EE-SX673P-WR	EE-SX674P-WR	EE-SX675P-WR	EE-SX676P-WR	EE-SX677P-WR
Sensing distance			5 mm (slot width)							
Sensing object			Opaque: 2 × 0.8 mm min.							
Differential distance			0.025 mm							
Light source			GaAs infrared LED with a peak wavelength of 940 nm							
Indicator *1			Light indicator (red) (turns ON when light is interrupted for models with A or R suffix)							
Supply voltage			5 to 24 VDC ±10%, ripple (p-p): 10% max.							
Current consumption			35 mA max. (NPN models), 30 mA max. (PNP models)							
Control output			NPN open collector: 5 to 24 VDC, 100 mA max. 100 mA load current with a residual voltage of 0.8 V max. 40 mA load current with a residual voltage of 0.4 V max. OFF current (leakage current): 0.5 mA max. PNP open collector: 5 to 24 VDC, 50 mA max. 50 mA load current with a residual voltage of 1.3 V max. OFF current (leakage current): 0.5 mA max.							
Response frequency *2			1 kHz min. (3 kHz average)							
Ambient illumination			1,000 lx max. with fluorescent light on the surface of the receiver.							
Ambient temperature range			Operating: −25 to +55°C, Storage: −30 to +80°C (with no icing or condensation)							
Ambient humidity range			Operating: 5% to 85%, Storage: 5% to 95% (with no icing or condensation)							
Vibration resistance			Destruction: 20 to 2,000 Hz (peak acceleration: 100 m/s^2) 1.5-mm double amplitude for 2 h (4-min periods) each in X, Y, and Z directions							
Shock resistance			Destruction: 500 m/s^2 for 3 times each in X, Y, and Z directions							
Degree of protection			IEC60529 IP50							
Connecting method			Connector Models (direct soldering possible), Pre-wired Models (Standard cable length: 1 m), Models with Connectors (Standard cable length: 0.1 m)							
Weight	Connector models		Approx. 3.1 g	Approx. 3 g	Approx. 2.4 g	Approx. 2.3 g	Approx. 3 g	Approx. 2.7 g	Approx. 2.2 g	Approx. 2.2 g
	Pre-wired models		Approx. 18.9 g	Approx. 17.3 g	Approx. 17.8 g	Approx. 16.8 g	Approx. 17.1 g	Approx. 18.3 g	Approx. 16.9 g	Approx. 16.9 g
Material	Case		Polybutylene phthalate (PBT)							
	Cover		Polycarbonate							
	Emitter/receiver									

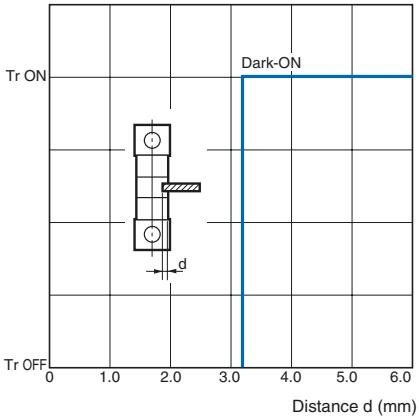
*1. The indicator is a GaP red LED (peak wavelength: 690 nm).
*2. The response frequency was measured by detecting the rotating disk shown at the right.



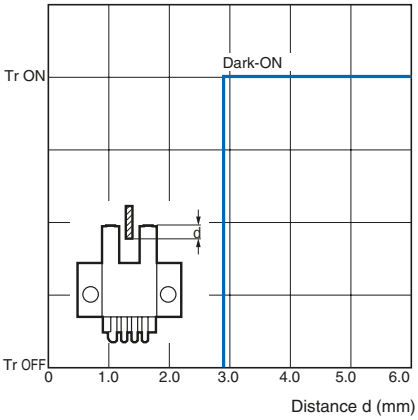
EE-SX47/67

Engineering Data (Typical)

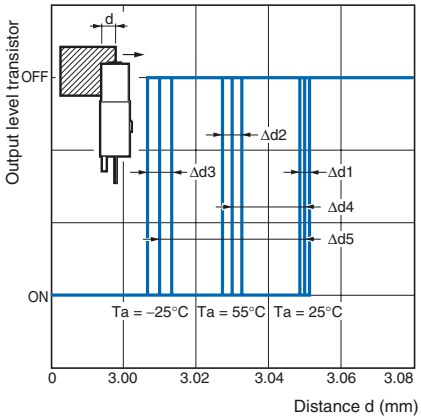
Sensing Position Characteristics



Sensing Position Characteristics



Repeated Sensing Position Characteristics

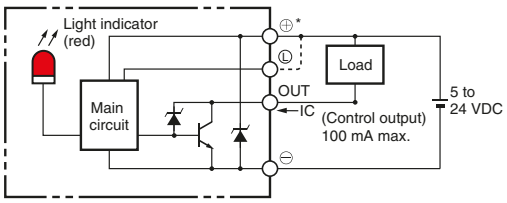
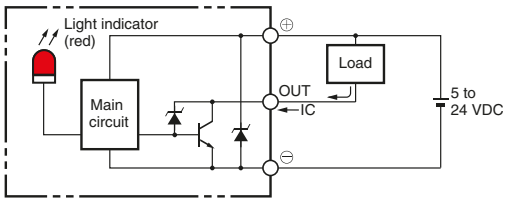


Vcc =12 V, No. of repetitions: 20, Δd1 = 0.002 mm, Δd2 = 0.004 mm, Δd3 = 0.005 mm, Δd4 = 0.02 mm, Δd5 = 0.04 mm

Note: The data applies to dark status. Operation may be affected by external light interference or light coming through the sensing object.

I/O Circuit Diagrams

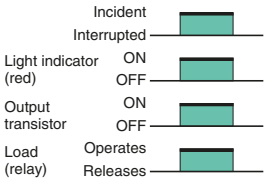
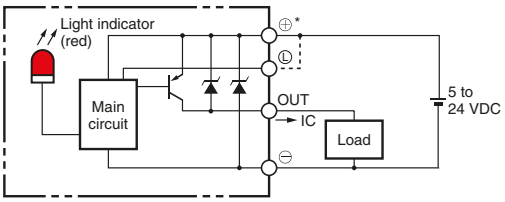
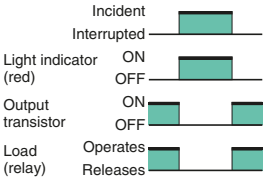
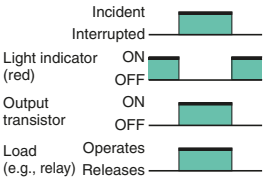
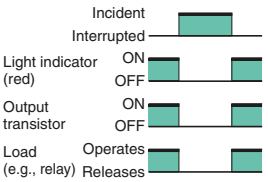
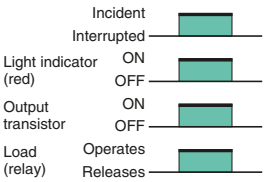
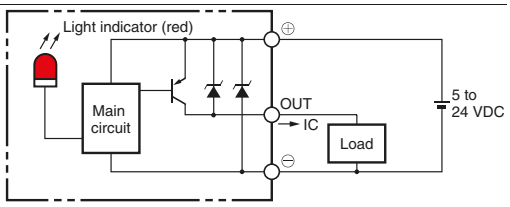
NPN Output

Model	Output configuration	Timing charts	Terminal connections	Output circuit
EE-SX67□ EE-SX67□-WR	Light-ON	Incident / Interrupted Light indicator (red): ON / OFF Output transistor: ON / OFF Load (e.g., relay): Operates / Releases	Short-circuited between Ⓛ terminal and positive ⊕ terminal	
	Dark-ON	Incident / Interrupted Light indicator (red): ON / OFF Output transistor: ON / OFF Load (e.g., relay): Operates / Releases	Open between Ⓛ terminal and positive ⊕ terminal *1	
EE-SX670A EE-SX671A EE-SX672A EE-SX673A EE-SX674A	Light-ON	Incident / Interrupted Light indicator (red): ON / OFF Output transistor: ON / OFF Load (e.g., relay): Operates / Releases	Short-circuited between Ⓛ terminal and positive ⊕ terminal	
	Dark-ON	Incident / Interrupted Light indicator (red): ON / OFF Output transistor: ON / OFF Load (e.g., relay): Operates / Releases	Open between Ⓛ terminal and positive ⊕ terminal *1	
EE-SX470 EE-SX471 EE-SX472 EE-SX473 EE-SX474	Light-ON	Incident / Interrupted Light indicator (red): ON / OFF Output transistor: ON / OFF Load (relay): Operates / Releases	---	

*The terminal arrangement depends on the model. Check the dimensional diagrams.

*1. Do not connect the L terminal to 0 V when using dark-ON operation.

PNP Output

Model	Output configuration	Timing charts	Terminal connections	Output circuit
EE-SX67□P EE-SX67□P-WR	Light-ON		Short-circuited between Ⓛ terminal and positive ⊕ terminal	
	Dark-ON		Open between Ⓛ terminal and positive ⊕ terminal *1	
EE-SX670R EE-SX671R EE-SX672R EE-SX673R EE-SX674R	Light-ON		Short-circuited between Ⓛ terminal and positive ⊕ terminal	*The terminal arrangement depends on the model. Check the dimensional diagrams.
	Dark-ON		Open between Ⓛ terminal and positive ⊕ terminal *1	
EE-SX470P EE-SX471P EE-SX472P EE-SX473P EE-SX474P	Light-ON		---	

*1. Do not connect the L terminal to 0 V when using dark-ON operation.

Safety Precautions

Refer to *Warranty and Limitations of Liability*.

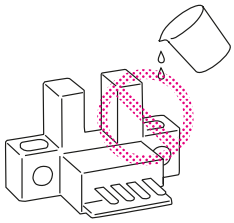
⚠ WARNING

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 Safe Use

● Operating Environment

These Photomicrosensors have an IP50 (conforms to IEC) enclosure and do not have a water-proof or dust-proof structure. Therefore, do not use them in applications in which the sensor will be subjected to splashes from water, oil, or any other liquid. Liquid entering the Sensor may result in malfunction.



Precautions for Correct Use

Make sure that this product is used within the rated ambient environment conditions.

● Installation

- When direct soldering to the terminals, use the following guidelines.

Soldering Conditions

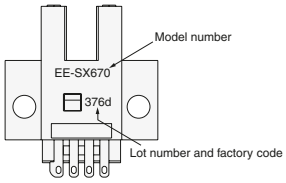
Item	Temperature	Permissible time	Remarks
Soldering iron	350°C max.	3 s max.	The portion between the base of the terminals and the position 1.5 mm from the terminal base must not be soldered.

- The terminal base uses a polycarbonate resin, which could be deformed by excessive soldering heat, resulting in damage to the product's functionality.

● Lot Number and Model Number Legend

In the following diagrams, 376d indicates the lot number and factory where the product was manufactured. Do not include this code with the model number when ordering.

EE-SX□70□



(Unit: mm)

Dimensions

Tolerance class IT16 applies to dimensions in this datasheet unless otherwise specified.

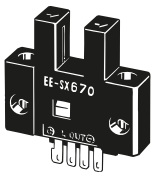
Sensors

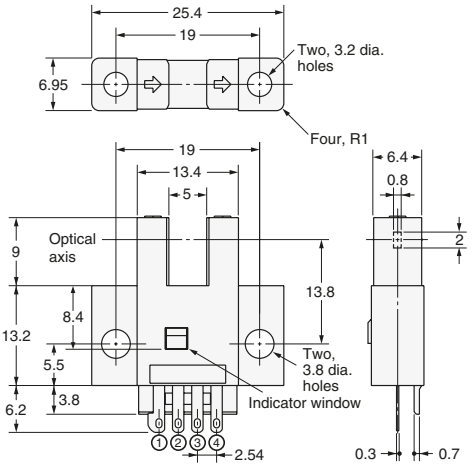
EE-SX670/670P
EE-SX670A/670R
EE-SX470/470P

Terminal Arrangement

(1)	⊕	Vcc
(2)	L	L*
(3)	OUT	OUTPUT
(4)	⊖	GND (0 V)

* Pin 2 is not used for the EE-SX470.



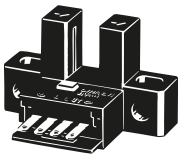


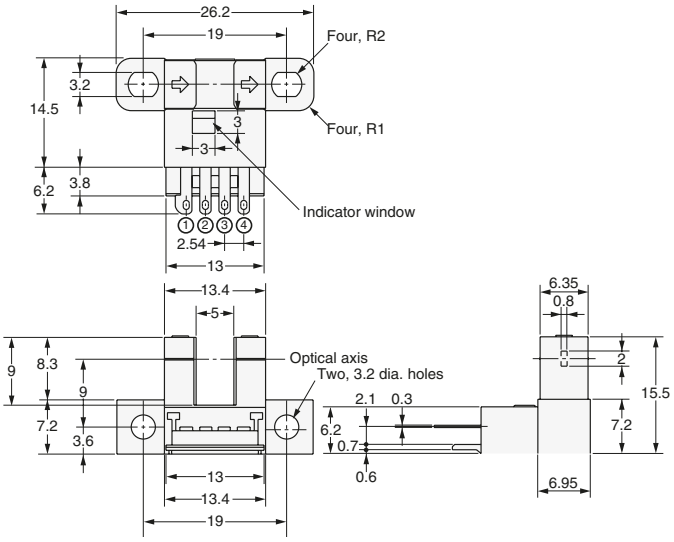
EE-SX671/671P
EE-SX671A/671R
EE-SX471/471P

Terminal Arrangement

(1)	⊕	Vcc
(2)	L	L*
(3)	OUT	OUTPUT
(4)	⊖	GND (0 V)

* Pin 2 is not used for the EE-SX471.



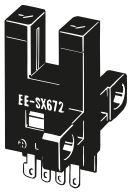


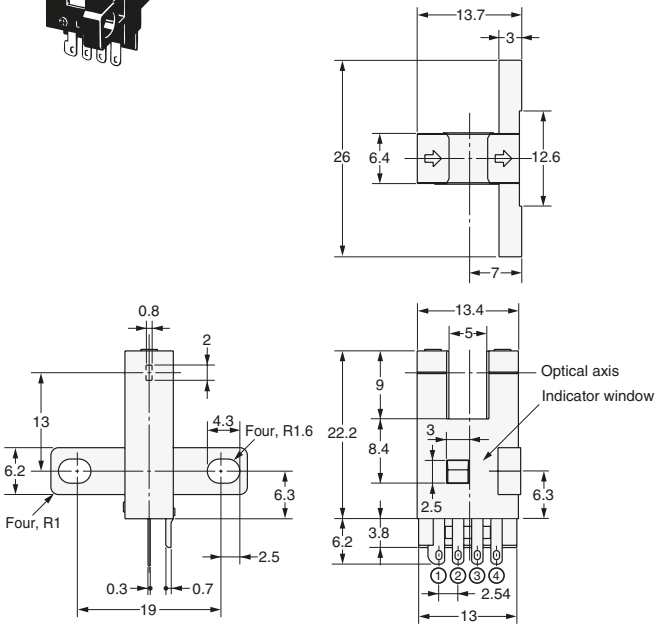
EE-SX672/672P
EE-SX672A/672R
EE-SX472/472P

Terminal Arrangement

(1)	⊕	Vcc
(2)	L	L*
(3)	OUT	OUTPUT
(4)	⊖	GND (0 V)

* Pin 2 is not used for the EE-SX472.



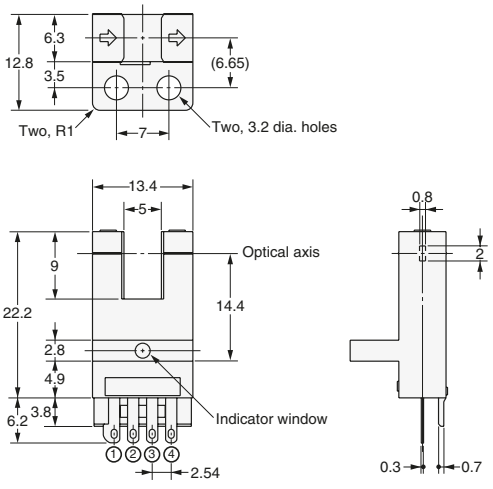


EE-SX673/673P
EE-SX673A/673R
EE-SX473/473P

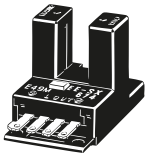
Terminal Arrangement

(1)	⊕	Vcc
(2)	L	L*
(3)	OUT	OUTPUT
(4)	⊖	GND (0 V)

* Pin 2 is not used for the EE-SX473.



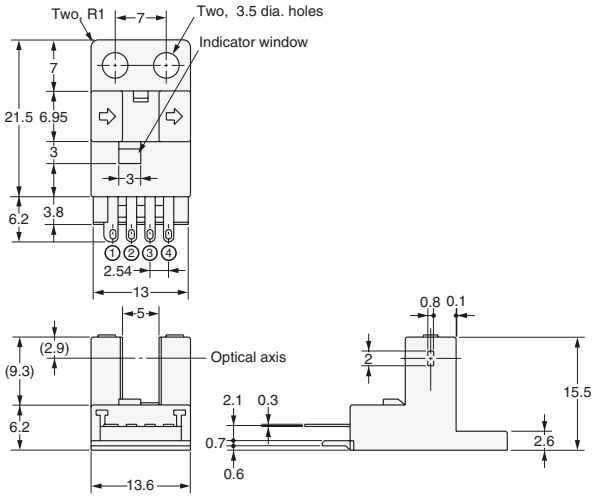
EE-SX674/674P
EE-SX674A/674R
EE-SX474/474P



Terminal Arrangement

(1)	⊕	Vcc
(2)	L	L*
(3)	OUT	OUTPUT
(4)	⊖	GND (0 V)

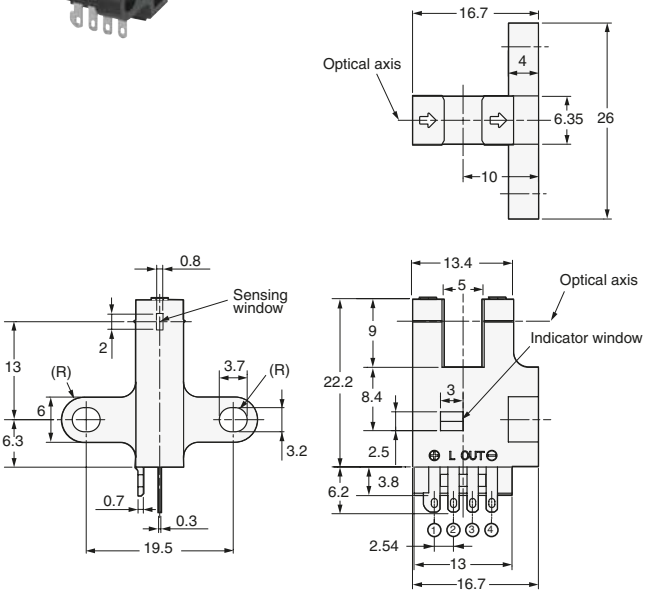
* Pin 2 is not used for the EE-SX474.



EE-SX675/675P

Terminal Arrangement

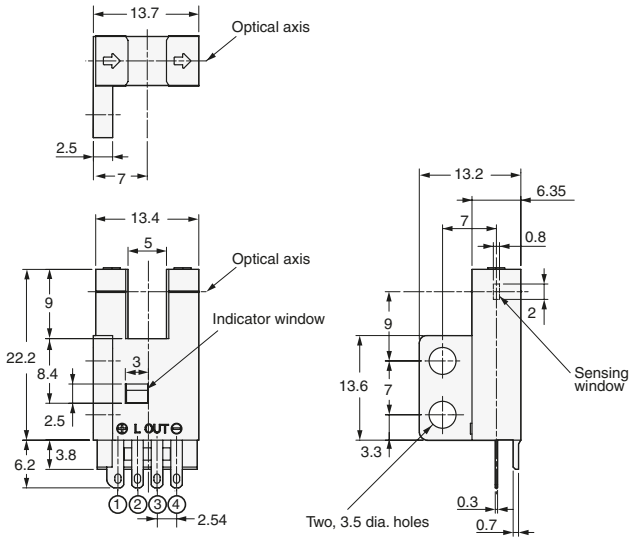
(1)	⊕	Vcc
(2)	L	L
(3)	OUT	OUTPUT
(4)	⊖	GND (0 V)



EE-SX676/676P

Terminal Arrangement

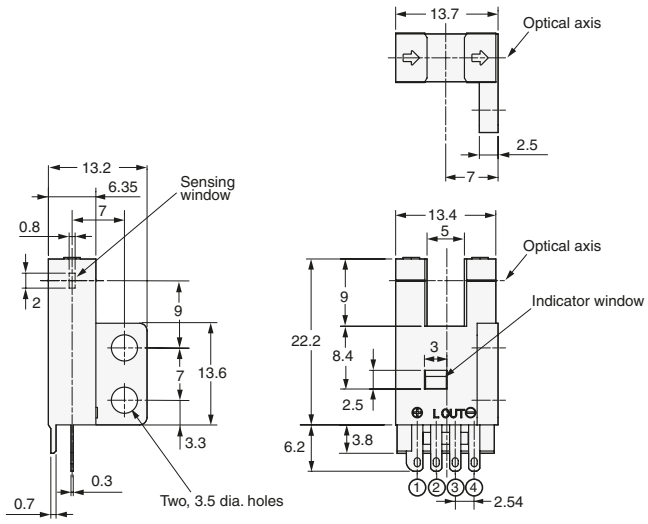
(1)	⊕	Vcc
(2)	L	L
(3)	OUT	OUTPUT
(4)	⊖	GND (0 V)



EE-SX677/677P

Terminal Arrangement

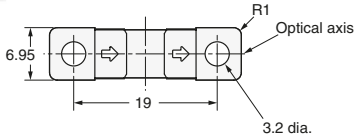
(1)	⊕	Vcc
(2)	L	L
(3)	OUT	OUTPUT
(4)	⊖	GND (0 V)

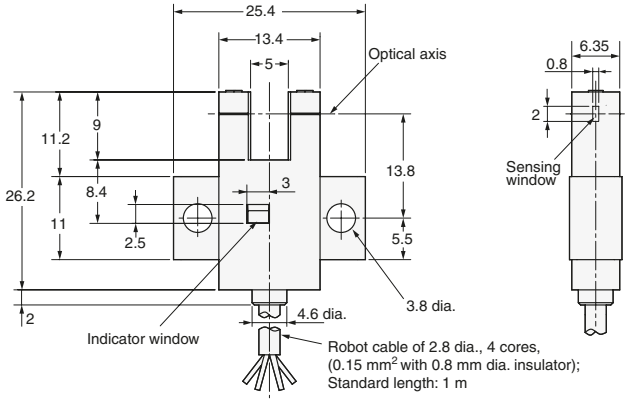


EE-SX670-WR/670P-WR

Terminal Arrangement

Brown	Vcc
Pink	L
Blue	GND (0 V)
Black	OUTPUT

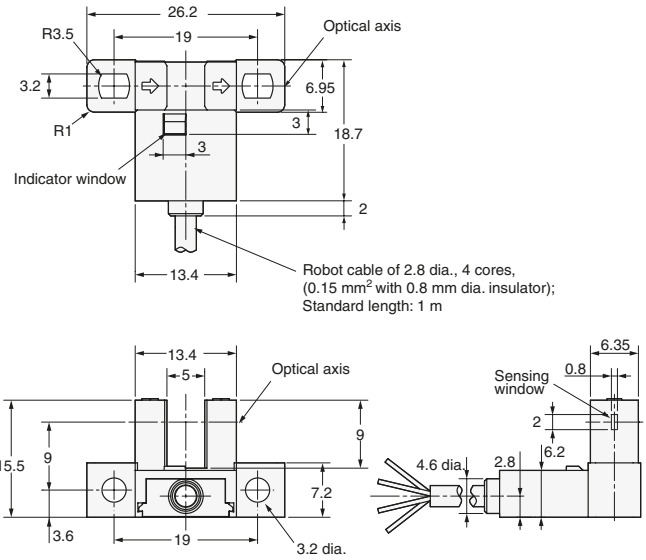




EE-SX671-WR/671P-WR

Terminal Arrangement

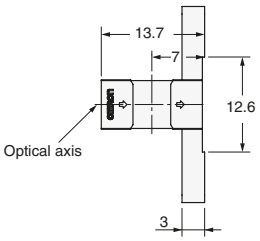
Brown	Vcc
Pink	L
Blue	GND (0 V)
Black	OUTPUT

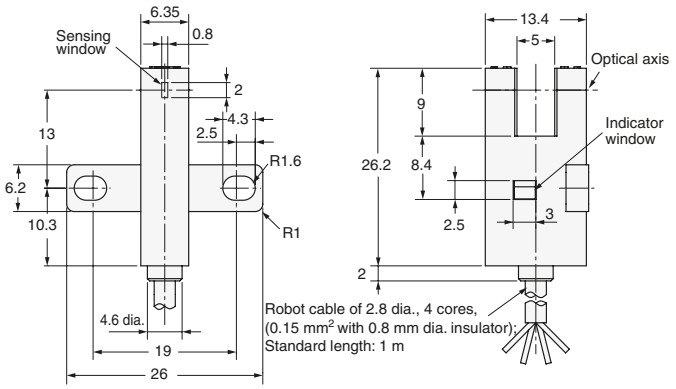


EE-SX672-WR/672P-WR

Terminal Arrangement

Brown	Vcc
Pink	L
Blue	GND (0 V)
Black	OUTPUT

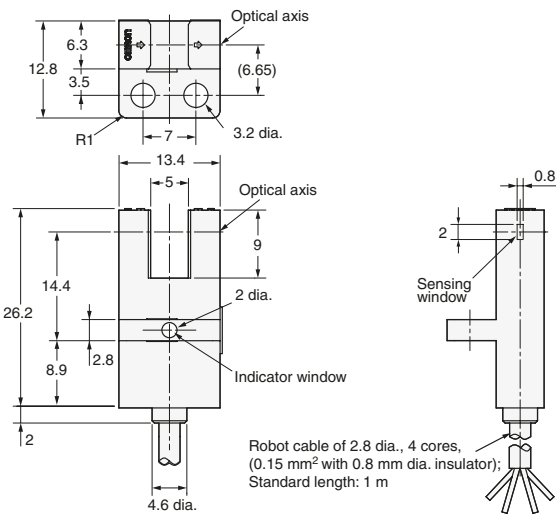




EE-SX673-WR/673P-WR

Terminal Arrangement

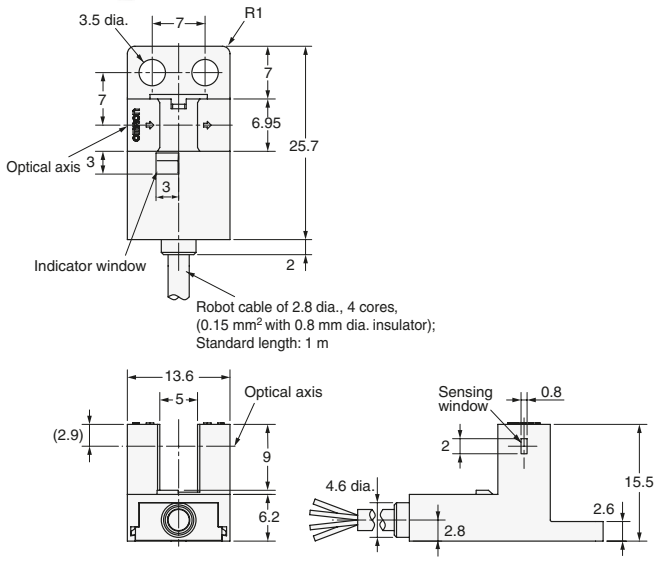
Brown	Vcc
Pink	L
Blue	GND (0 V)
Black	OUTPUT



EE-SX674-WR/674P-WR

Terminal Arrangement

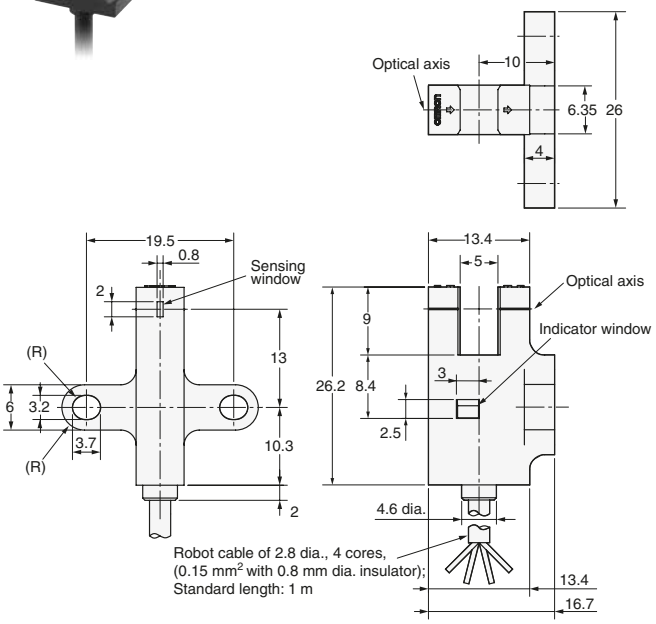
Brown	Vcc
Pink	L
Blue	GND(0V)
Black	OUTPUT



EE-SX675-WR/675P-WR

Terminal Arrangement

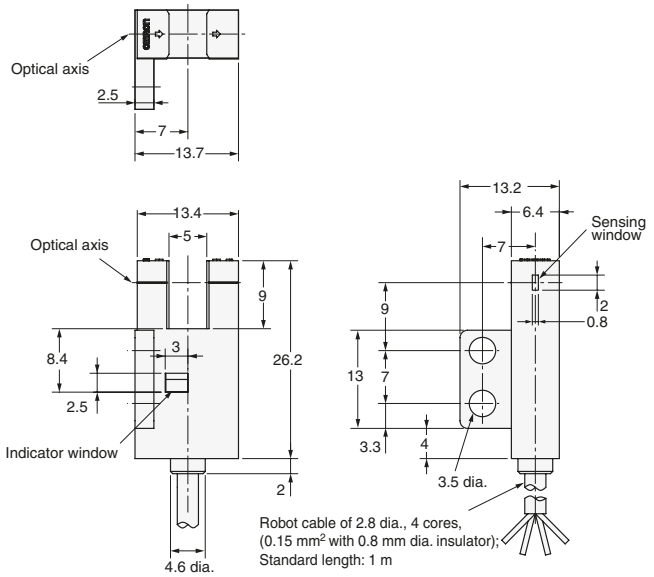
Brown	Vcc
Pink	L
Blue	GND(0V)
Black	OUTPUT



EE-SX676-WR/676P-WR

Terminal Arrangement

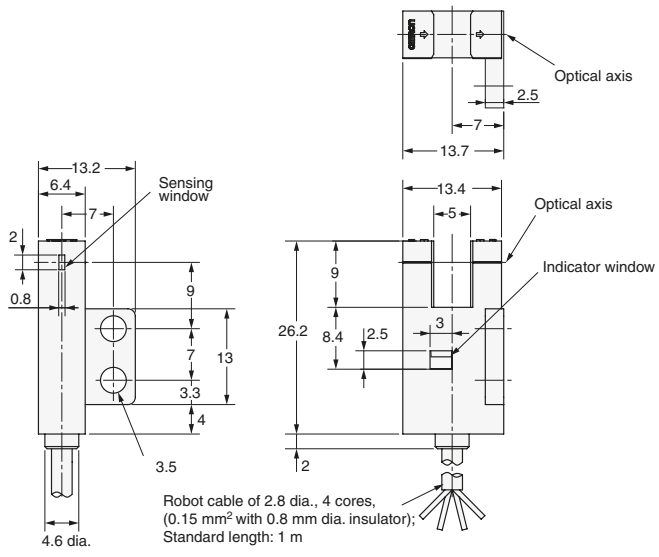
Brown	Vcc
Pink	L
Blue	GND(0V)
Black	OUTPUT



EE-SX677-WR/677P-WR

Terminal Arrangement

Brown	Vcc
Pink	L
Blue	GND(0V)
Black	OUTPUT



MEMO

EE-SPX74/84

Photomicrosensor with light modulation for reduced external light interference and a connector for easy maintenance.

- Built-in connectors
- Select from four easy-to-use shapes for efficient space utilization.
- Connectors with locks for safety against vibration.
- Convenient mounting method using M3 screws.
- Wide operating voltage range: 5 to 24 VDC

CE

⚠ Be sure to read *Safety Precautions* on page 68.

Ordering Information

Sensors

Infrared light

Appearance	Sensing method	Sensing distance	Output type	Output configuration	Model
	Through-beam type (with slot)	3.6 mm (slot width)	NPN output	Dark-ON	**EE-SPX740**
				Light-ON	**EE-SPX840**
				Dark-ON	**EE-SPX742**
				Light-ON	**EE-SPX842**
				Dark-ON	**EE-SPX743**
				Light-ON	**EE-SPX843**
		5 mm (slot width)		Dark-ON	**EE-SPX741**
				Light-ON	**EE-SPX841**

Accessories (Order Separately)

Connector with Cable

Type	Cable length	Model
Connector	1 m	**EE-1013**

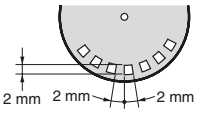
* Refer to *Accessories* for details.

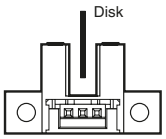
EE-SPX74/84

Ratings and Specifications

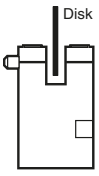
Item \ Models		EE-SPX740, EE-SPX840 EE-SPX742, EE-SPX842 EE-SPX743, EE-SPX843	EE-SPX741 EE-SPX841
Sensing distance		3.6 mm (slot width)	5 mm (slot width)
Sensing object		Opaque: 1 × 0.5mm min.	Opaque: 2 × 0.8 mm min.
Differential distance		0.05 mm max.	
Light source		GaAs infrared LED (pulse lighting) with a peak wavelength of 940 nm	
Indicator *1		Light indicator (red)	
Supply voltage		5 to 24 VDC ±10%, ripple (p-p): 5% max.	
Current consumption		Average: 15 mA max.; Peak: 50 mA max.	
Control output		NPN voltage output: Load power supply voltage: 5 to 24 VDC Load current: 50 mA max. OFF current: 0.5 mA max. 50 mA load current with a residual voltage of 1.0 V max. 10 mA load current with a residual voltage of 0.4 V max.	
Response frequency *2		500 Hz min.	
Ambient illumination		3,000 lx max. with incandescent light or sunlight on the surface of the receiver	
Ambient temperature range		Operating: −10 to +55°C Storage: −25 to +65°C	
Ambient humidity range		Operating: 5% to 85% Storage: 5% to 95%	
Vibration resistance		Destruction: 10 to 55 Hz, 1.5-mm double amplitude for 2 h each in X, Y, and Z directions	
Shock resistance		Destruction: 500 m/s^2 for 3 times each in X, Y, and Z directions	
Degree of protection		IEC IP50	
Connecting method		Special connector	
Weight		Approx. 2.4 g	
Material	**Case**	Polycarbonate	
	Holder		

*1. The indicator is a GaAlAs red LED (peak wavelength: 660 nm).
*2. The response frequency was measured by detecting the following rotating disk.

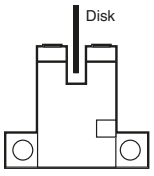




EE-SPX741/841



EE-SPX742/842
EE-SPX743/843

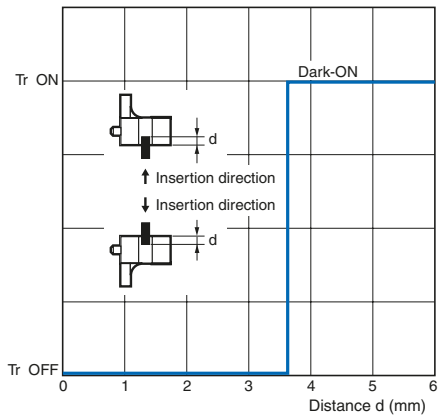


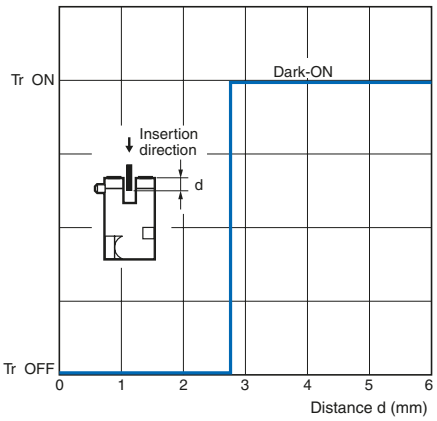
EE-SPX740/840

Engineering Data (Typical)

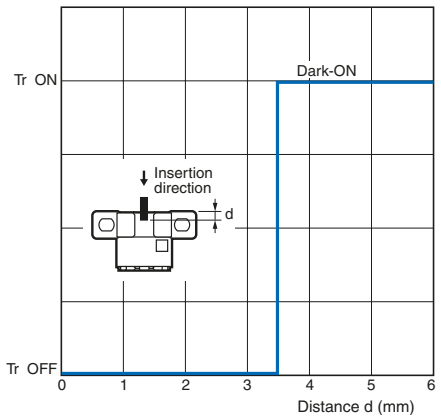
Sensing Position Characteristics

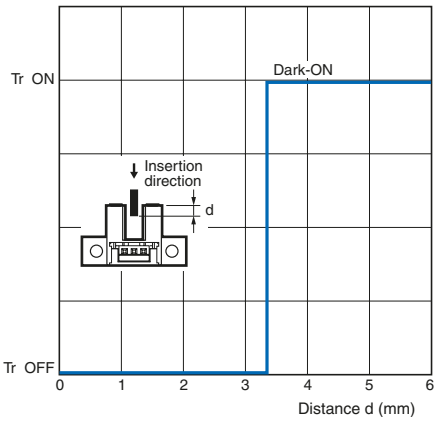
EE-SPX740/742/743





EE-SPX741

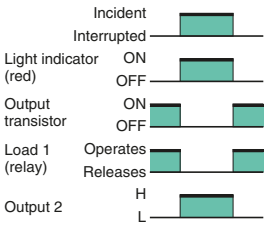
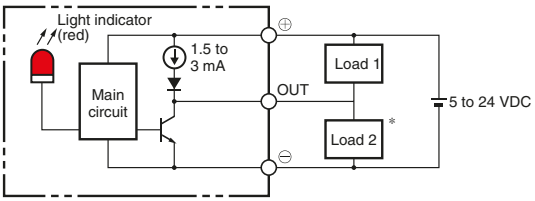
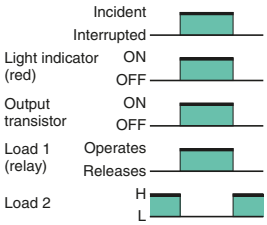




EE-SPX74/84

I/O Circuit Diagrams

NPN Output

Model	Output configuration	Timing charts	Output circuit
EE-SPX740 EE-SPX741 EE-SPX742 EE-SPX743	Dark-ON		
EE-SPX840 EE-SPX841 EE-SPX842 EE-SPX843	Light-ON		

* Voltage output (when the sensor is connected to a transistor circuit)

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.

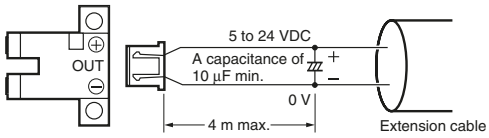
Precautions for Correct Use

Make sure that this product is used within the rated ambient environment conditions.

● Design

Cable Extension

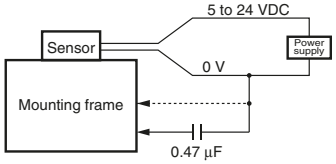
- When extending the cable, use an extension cable with conductors having a total cross-section area of 0.15 mm^2. The total cable length must be 4 m maximum.
- To use a cable length longer than 4 m, attach a capacitor with a capacitance of approximately 10 μF to the wires as shown below. The distance between the terminal and the capacitor must be within 4 m. (Use a capacitor with a dielectric strength that is at least twice the Sensor's power supply voltage.)



- Make sure the total length of the power cable connected to the product is less than 10 m even if a capacitor is inserted.

Effects of Inductive Noise

When there is inductive noise in the Sensor mounting frame (metal), the output of the Sensor may be affected. In this case, ensure that there is no electrical potential difference between the Sensor 0-V terminal and the Sensor mounting frame, or attach a 0.47 μF capacitor between the 0-V terminal and the frame.



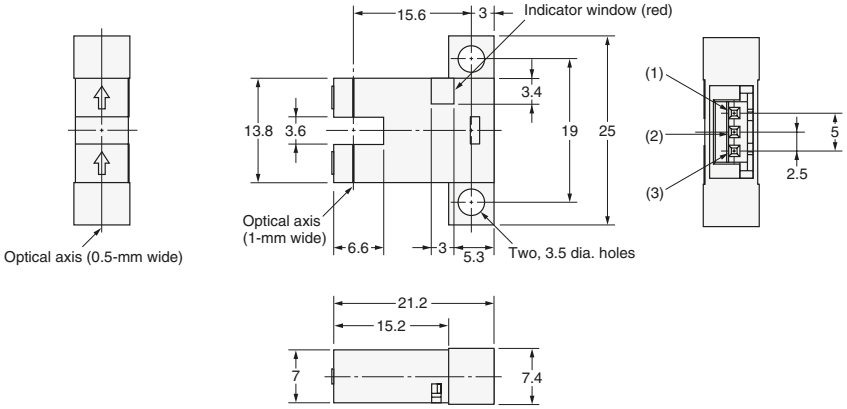
(Unit: mm)

Dimensions

Tolerance class IT16 applies to dimensions in this datasheet unless otherwise specified.

Sensors

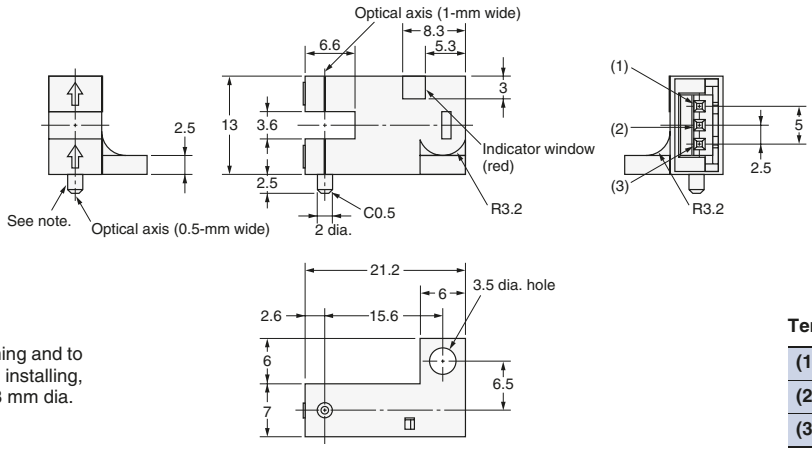
EE-SPX740
EE-SPX840



Terminal Arrangement

(1)	–	GND(0 V)
(2)	**OUT**	OUTPUT
(3)	+	Vcc

EE-SPX742
EE-SPX842

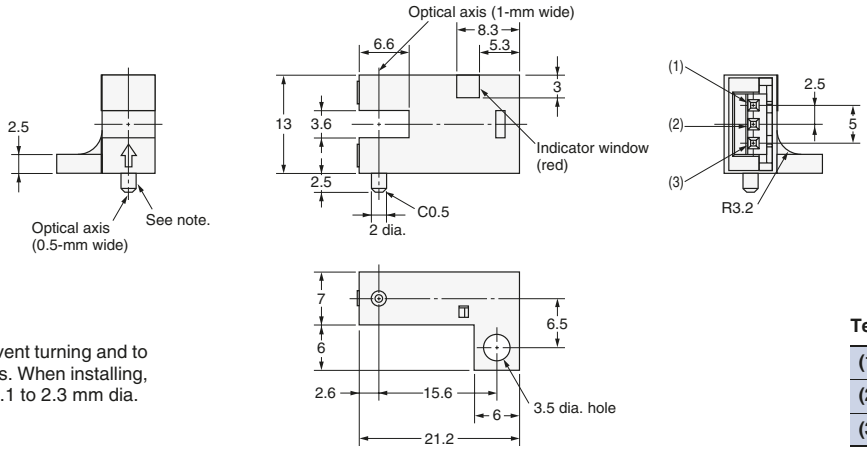


Note: The lug is used to prevent turning and to indicate the optical axis. When installing, make a fixed hole of 2.1 to 2.3 mm dia.

Terminal Arrangement

(1)	–	GND(0 V)
(2)	**OUT**	OUTPUT
(3)	+	Vcc

EE-SPX743
EE-SPX843

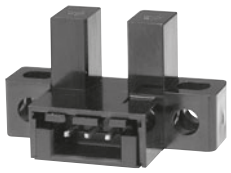


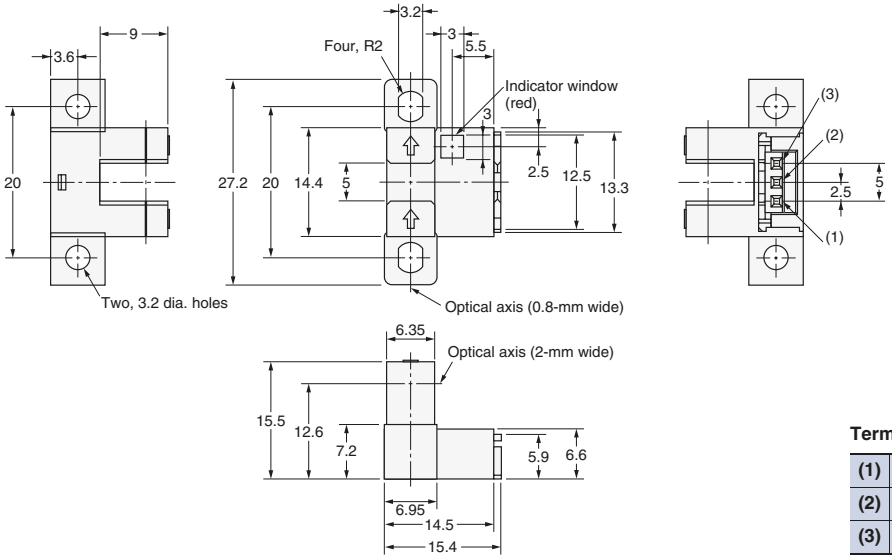
Note: The lug is used to prevent turning and to indicate the optical axis. When installing, make a fixed hole of 2.1 to 2.3 mm dia.

Terminal Arrangement

(1)	–	GND(0 V)
(2)	**OUT**	OUTPUT
(3)	+	Vcc

EE-SPX741
EE-SPX841



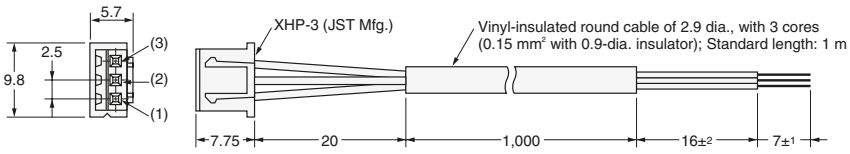


Terminal Arrangement

(1)	–	GND (0 V)
(2)	**OUT**	OUTPUT
(3)	+	Vcc

Accessories (Connector with Cable)

EE-1013



Terminal Arrangement

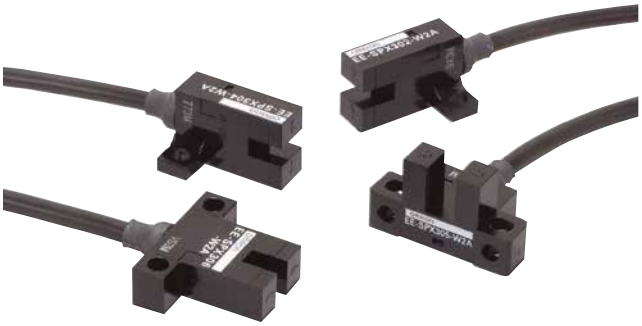
(1)	**Blue**	GND (0 V)
(2)	**Black**	OUTPUT
(3)	**Brown**	Vcc

Slot-type Photomicrosensor with Cable

EE-SPX-W

Photomicrosensor with built-in amplifier and attached cable reduces external light interference.

- Light modulation effectively reduces external light interference.
- Wide operation voltage range: 5 to 24 VDC
- Easy operation monitoring with bright light indicator.

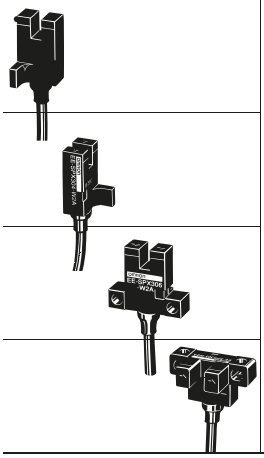


CE

⚠ Be sure to read *Safety Precautions* on page 73.

Ordering Information

Infrared light

Appearance	Sensing method	Sensing distance (slot width)	Output type	Output configuration	Cable length	Model
	Through-beam type	3.6 mm	NPN output	Dark-ON	1 m	**EE-SPX302-W2A 1M**
				Light-ON		**EE-SPX402-W2A 1M**
		3.6 mm		Dark-ON		**EE-SPX304-W2A 1M**
				Light-ON		**EE-SPX404-W2A 1M**
		3.6 mm		Dark-ON		**EE-SPX306-W2A 1M**
				Light-ON		**EE-SPX406-W2A 1M**
		5 mm		Dark-ON		**EE-SPX305-W2A 1M***
				Light-ON		**EE-SPX405-W2A 1M***

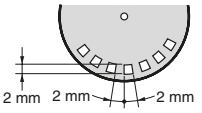
* These models (EE-SPX305/405-W2A only) are not conformed to CE standards.

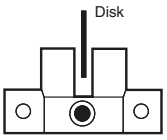
EE-SPX-W

Ratings and Specifications

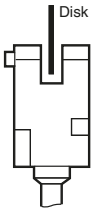
Item \ Models	EE-SPX302-W2A, EE-SPX402-W2A EE-SPX304-W2A, EE-SPX404-W2A EE-SPX306-W2A, EE-SPX406-W2A	EE-SPX305-W2A EE-SPX405-W2A
Sensing distance	3.6 mm (slot width)	5 mm (slot width)
Sensing object	Opaque: 1 × 0.5 mm min.	Opaque: 2 × 0.8 mm min.
Differential distance	0.05 mm max.	
Light source	GaAs infrared LED (pulse lighting) with a peak wavelength of 940 nm	
Indicator *1	Light indicator (red)	
Supply voltage	5 to 24 VDC ±10%, ripple (p-p): 5% max.	
Current consumption	Average: 15 mA max.; Peak: 50 mA max.	
Control output	NPN voltage output: Load power supply voltage: 5 to 24 VDC Load current: 80 mA max. OFF current: 0.5 mA max. 80 mA load current with a residual voltage of 1.0 V max. 10 mA load current with a residual voltage of 0.4 V max.	
Response frequency *2	500 Hz min.	
Ambient illumination	3,000 lx max. with incandescent light or sunlight on the surface of the receiver	
Ambient temperature range	Operating: −10 to +55°C Storage: −25 to +65°C	
Ambient humidity range	Operating: 5% to 85% Storage: 5% to 95%	
Vibration resistance	Destruction: 10 to 55 Hz, 1.5-mm double amplitude for 2 h each in X, Y, and Z directions	
Shock resistance	Destruction: 500 m/s² for 3 times each in X, Y, and Z directions	
Degree of protection	IEC IP50	
Connecting method	Pre-wired (standard cable length: 1 m)	
Weight	18.5 g	
Material Case	Polycarbonate	
Material Holder		

*1. The indicator is a GaP red LED (peak wavelength: 700 nm).
*2. The response frequency was measured by detecting the following rotating disk.

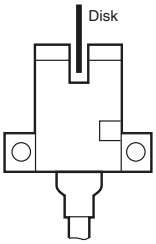




EE-SPX305-W2A



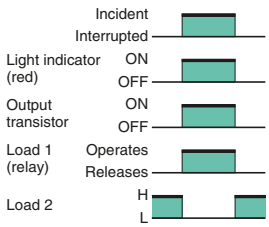
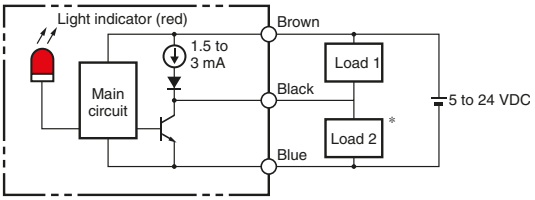
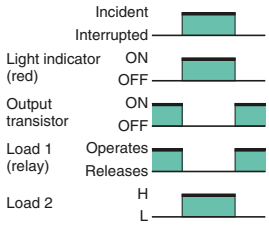
EE-SPX302-W2A



EE-SPX306-W2A

I/O Circuit Diagrams

NPN Output

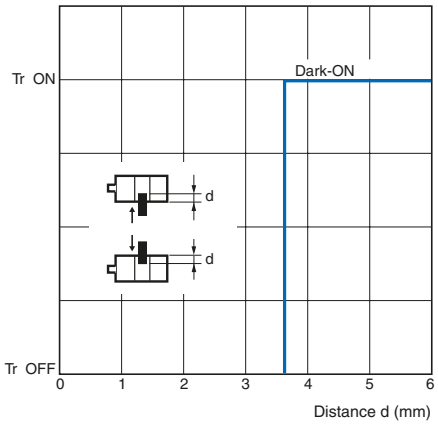
Model	Output configuration	Timing charts	Output circuit
EE-SPX402-W2A EE-SPX404-W2A EE-SPX405-W2A EE-SPX406-W2A	Light-ON		
EE-SPX302-W2A EE-SPX304-W2A EE-SPX305-W2A EE-SPX306-W2A	Dark-ON		

* Voltage output (when the sensor is connected to a transistor circuit)

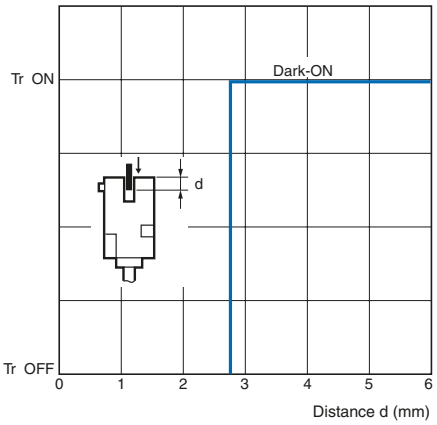
Engineering Data (Typical)

Sensing Position Characteristics

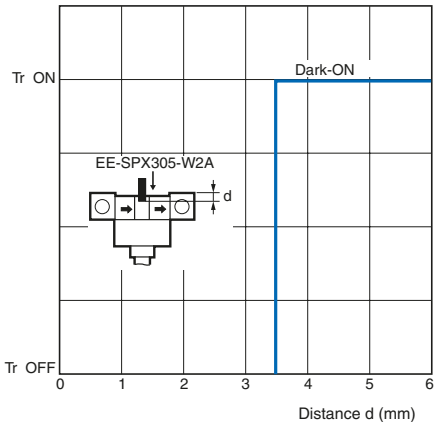
EE-SPX302-W2A
EE-SPX304-W2A
EE-SPX306-W2A



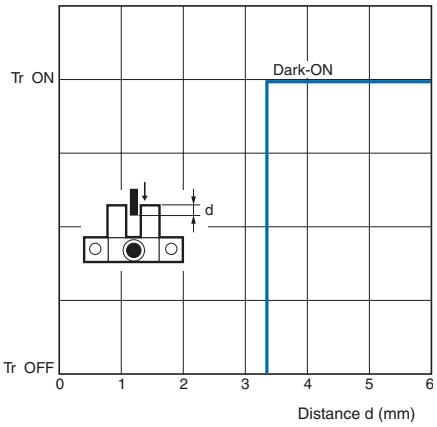
EE-SPX302-W2A
EE-SPX304-W2A
EE-SPX306-W2A



EE-SPX305-W2A



EE-SPX305-W2A



Safety Precautions

Refer to *Warranty and Limitations of Liability*.

⚠ WARNING

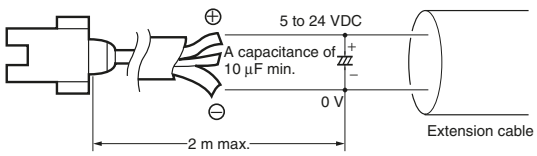
This product is not designed or rated for ensuring safety of persons either directly or indirectly. Do not use it for such purposes.

Precautions for Correct Use

Make sure that this product is used within the rated ambient environment conditions.

● Wiring

- When extending the cable, use an extension cable with conductors having a total cross-section area of 0.3 mm^2. The total cable length must be 2 m maximum.
- To use a cable length longer than 2 m, attach a capacitor with a capacitance of approximately 10 μF to the wires as shown below. The distance between the terminal and the capacitor must be within 2 m. (Use a capacitor with a dielectric strength that is at least twice the Sensor's power supply voltage.)



- Make sure the total length of the power cable connected to the product is less than 10 m even if a capacitor is inserted.

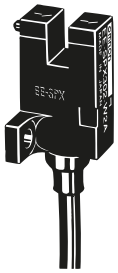
EE-SPX-W

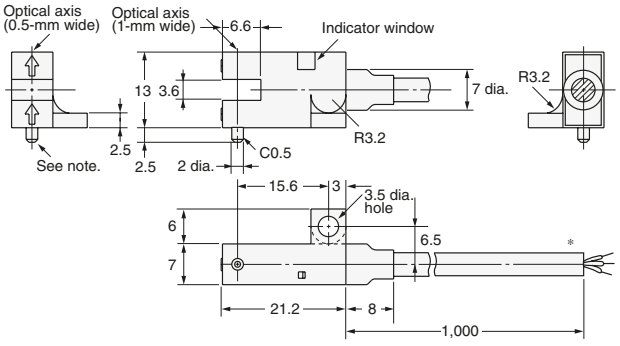
(Unit: mm)

Dimensions

Tolerance class IT16 applies to dimensions in this datasheet unless otherwise specified.

EE-SPX302-W2A
EE-SPX402-W2A

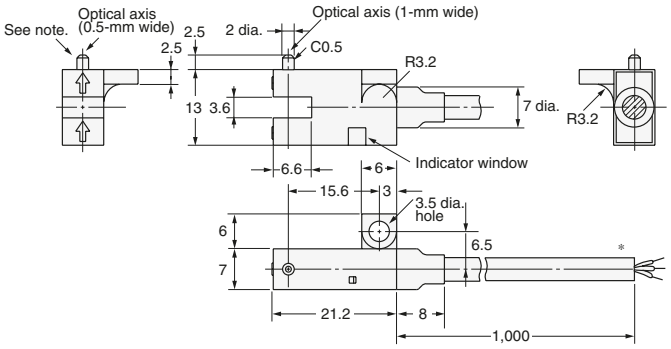




* Vinyl-insulated round cable of 3.5 dia., 3 cores, (0.14 mm² with 1.0-dia. insulator); Standard length: 1 m

Note: The lug is used to prevent turning and to indicate the optical axis.
When installing, make a fixed hole of 2.1 to 2.3 mm dia.

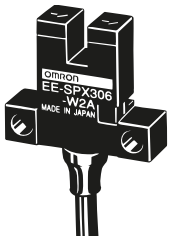
EE-SPX304-W2A
EE-SPX404-W2A

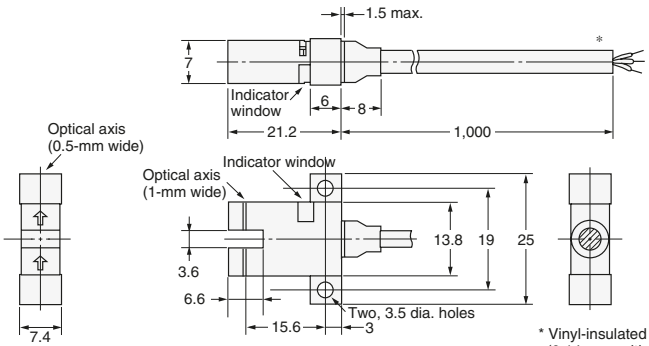


* Vinyl-insulated round cable of 3.5 dia., 3 cores, (0.14 mm² with 1.0-dia. insulator); Standard length: 1 m

Note: The lug is used to prevent turning and to indicate the optical axis.
When installing, make a fixed hole of 2.1 to 2.3 mm dia.

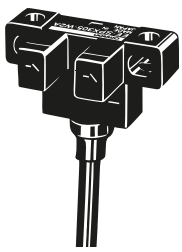
EE-SPX306-W2A
EE-SPX406-W2A

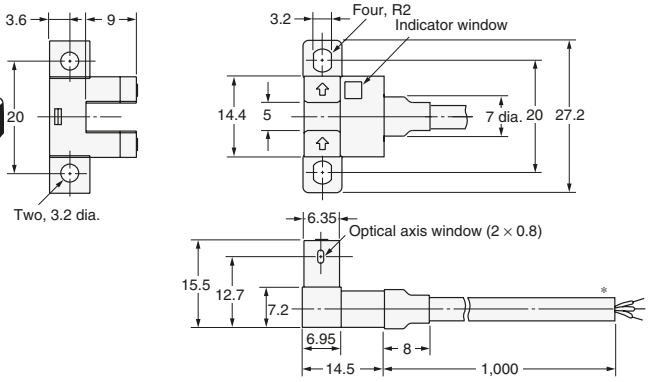




* Vinyl-insulated round cable of 3.5 dia., 3 cores, (0.14 mm² with 1.0-dia. insulator); Standard length: 1 m

EE-SPX305-W2A
EE-SPX405-W2A





* Vinyl-insulated round cable of 3.5 dia., 3 cores, (0.14 mm² with 1.0-dia. insulator); Standard length: 1 m

Broad Slot-type Photomicrosensor

EE-SPX303N/403N

A Wide Slot Width of 13 mm and Superior Resistance to Light Interference and Noise.

- Noise resistance equivalent to photomicrosensors with built-in amplifiers.
- Resistance to common noise at least 30 times that of previous models.
- Resistance to inverter noise at least 10 times that of previous models.
- Reverse polarity protection built in.

⚠ Be sure to read *Safety Precautions* on page 77.

CE

Ordering Information

Sensors

Infrared light

Appearance	Sensing method	Sensing distance (slot width)	Output type	Output configuration	Model
	Through-beam type (with slot)	13 mm (slot width)	NPN output	Dark-ON	**EE-SPX303N**
				Light-ON	**EE-SPX403N**

Accessories (Order Separately)

Type		Cable length	Model
Connector			**EE-1001**
			EE-1009
	Connector with Cable	1 m	**EE-1006**
			EE-1010
		2 m	**EE-1006**
			EE-1010
	Connector with Robot Cable	1 m	**EE-1010-R**
		2 m	**EE-1010-R**
NPN/PNP Conversion Connector		0.46 m (total length)	**EE-2002**

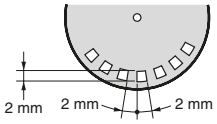
* Refer to *Accessories* for details.

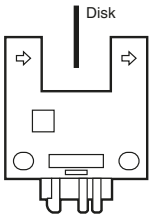
EE-SPX303N/403N

Ratings and Specifications

Item / Models	EE-SPX303N, EE-SPX403N
Sensing distance	13 mm (slot width)
Sensing object	Opaque: 2.2 × 0.5 mm min.
Differential distance	0.05 mm max.
Light source	Infrared LED (pulse lighting) with a peak wavelength of 940 nm
Indicator	Light indicator (red)
Supply voltage	12 to 24 VDC ±10%, ripple (p-p): 5% max.
Current consumption	15 mA max.
Control output	NPN voltage output: Load power supply voltage: 12 to 24 VDC Load current: 80 mA max. OFF current: 0.5 mA max. 80 mA load current with a residual voltage of 2.0 V max. 10 mA load current with a residual voltage of 1.0 V max.
Protection circuits	Power supply reverse polarity protection, Output reverse polarity protection
Response frequency *	100 Hz min.
Ambient illumination	3,000 lx max. with incandescent light or sunlight on the surface of the receiver.
Ambient temperature range	Operating: −10 to +55°C Storage: −25 to +65°C
Ambient humidity range	Operating: 5% to 85% Storage: 5% to 95%
Vibration resistance	Destruction: 10 to 55 Hz, 1.5-mm double amplitude for 2 h each in X, Y, and Z directions
Shock resistance	Destruction: 500 m/s^2 for 3 times each in X, Y, and Z directions
Degree of protection	IEC IP50
Connecting method	Special connector (soldering not possible)
Weight	Approx. 4 g
Material	Polycarbonate

* The response frequency was measured by detecting the following rotating disk.

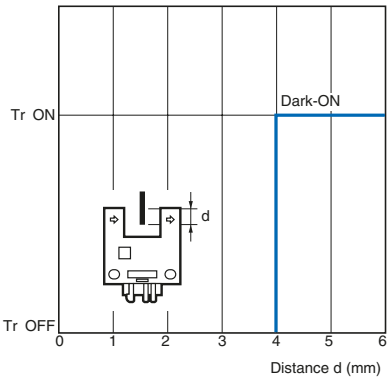


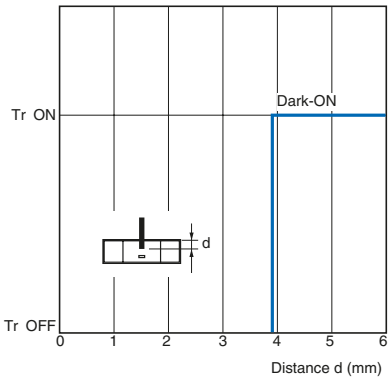


Engineering Data (Typical)

Sensing Position Characteristics

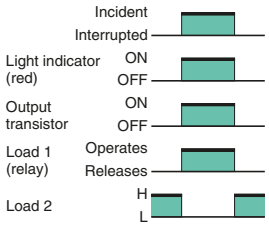
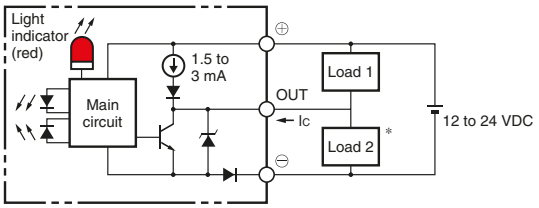
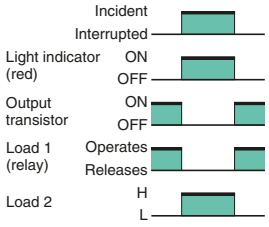
EE-SPX303N





I/O Circuit Diagrams

NPN Output

Model	Output configuration	Timing charts	Output circuit
EE-SPX403N	Light-ON		
EE-SPX303N	Dark-ON		

* Voltage output (when the sensor is connected to a transistor circuit)

Safety Precautions

Refer to *Warranty and Limitations of Liability*.

⚠ WARNING

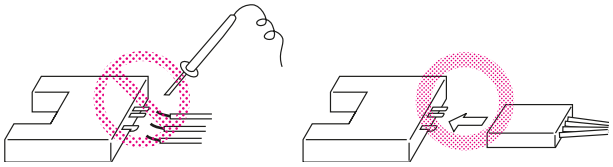
This product is not designed or rated for ensuring safety of persons either directly or indirectly. Do not use it for such purposes.

Precautions for Correct Use

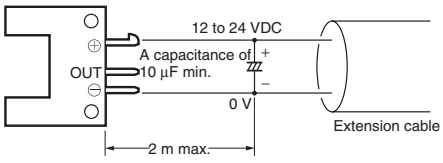
Make sure that this product is used within the rated ambient environment conditions.

● Wiring

- Connection is made using a connector. Do not solder to the pins (leads). The pins (leads) are soldered to the internal board of the Sensor. Therefore, direct soldering of the pins (leads) may result in an internal disconnection causing malfunction.



- When extending the cable, use an extension cable with conductors having a total cross-section area of 0.3 mm^2. The total cable length must be 2 m maximum.
- To use a cable length longer than 2 m, attach a capacitor with a capacitance of approximately 10 μF to the wires as shown below. The distance between the terminal and the capacitor must be within 2 m. (Use a capacitor with a dielectric strength that is at least twice the Sensor's power supply voltage.)



- Make sure the total length of the power cable connected to the product is less than 10 m even if a capacitor is inserted.

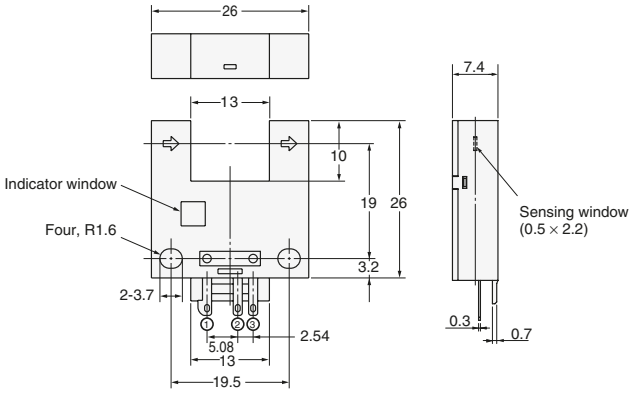
(Unit: mm)

Dimensions

Tolerance class IT16 applies to dimensions in this datasheet unless otherwise specified.

Sensors

EE-SPX303N, EE-SPX403N



Terminal Arrangement

(1)	+	Vcc
(2)	**OUT**	OUTPUT
(3)	–	GND (0 V)

Accessories (Order Separately)

* Refer to *Accessories* for details.

Long-distance Through-beam Photomicrosensor

EE-SPW311/411

Through-beam Photomicrosensor with a sensing distance as long as 1 m.

- Easy operation monitoring with bright light indicator.
- Wide operating voltage range: 5 to 24 VDC
- Light modulation effectively reduces external light interference.
- Easy-to-wire connector assures ease of maintenance.

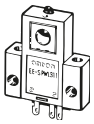
CE

⚠ Be sure to read *Safety Precautions* on page 81.

Ordering Information

Sensors

Infrared light

Appearance	Sensing method	Sensing distance	Output type	Output configuration	Model
	Through-beam type	1m	NPN output	Dark-ON	**EE-SPW311**
				Light-ON	**EE-SPW411**

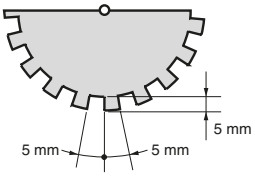
* Both an EE-1006L Connector with Cable for the Emitter and an EE-1006D Connector with Cable for the Receiver are included with the Photomicrosensor. Refer to *Accessories* when using non-standard connectors, including Robot Cables and PNP Adapters.

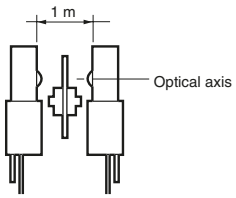
EE-SPW311/411

Ratings and Specifications

Item	Models	EE-SPW311, EE-SPW411
Sensing distance		1 m
Sensing object		Opaque: 5 mm dia. min.
Directional angle		5 to 20°
Light source		GaAs infrared LED (pulse lighting) with a peak wavelength of 940 nm
Indicator *1		Light indicator (red)
Supply voltage		5 (–5%) to 24 (+10%) VDC, ripple (p-p): 5% max.
Current consumption		Emitter: 20 mA max., Receiver: 20 mA max.
Control output		NPN open collector: Load power supply voltage: 5 to 24 VDC Load current: 100 mA max. OFF current: 0.5 mA max. 100 mA load current with a residual voltage of 0.8 V max. 10 mA load current with a residual voltage of 0.4 V max.
Response frequency *2		100 Hz min.
Ambient illumination		3,000 lx max. with incandescent light on the surface of the receiver
Ambient temperature range		Operating: –10 to +55°C Storage: –25 to +65°C
Ambient humidity range		Operating: 5% to 85% Storage: 5% to 95%
Vibration resistance		Destruction: 200 to 2,000 Hz (peak acceleration: 100 m/s^2) 1.5-mm double amplitude for 2 h (4-min periods) each in X, Y, and Z directions
Shock resistance		Destruction: 500 m/s^2 for 3 times each in X, Y, and Z directions
Degree of protection		IEC IP60
Connecting method		Special connector (soldering not possible)
Weight (packaged)		Approx. 8.8 g
Material	Case	Polybutylene phthalate (PBT)
	Lens	Polycarbonate
Accessories		EE-1006L/D Connectors with Cables, Instruction Manual

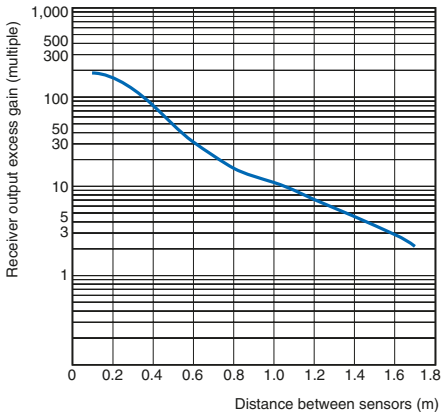
*1. The indicator is a GaP red LED (peak wavelength: 700 nm).
*2. The response frequency was measured by detecting the following rotating disk.



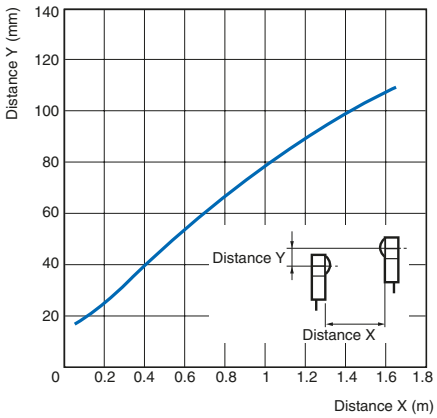


Engineering Data (Typical)

Receiver Output Excess Gain Vs. Sensing Distance Characteristics

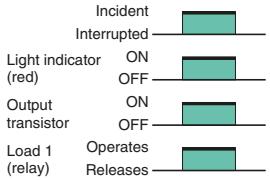
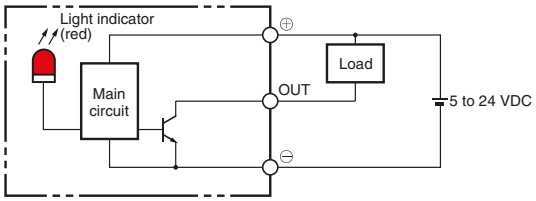
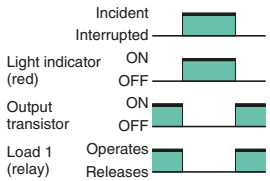


Parallel Movement Characteristics



I/O Circuit Diagrams

NPN Output

Model	Output configuration	Timing charts	Output circuit
EE-SPW411	Light-ON		
EE-SPW311	Dark-ON		

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

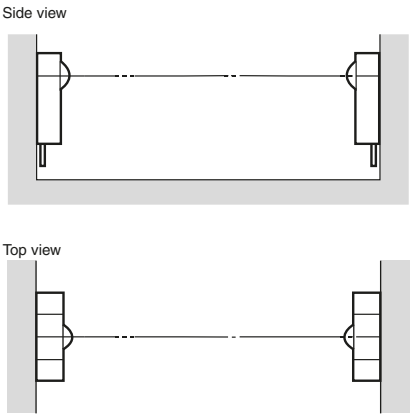
Make sure that this product is used within the rated ambient environment conditions.

● Wiring

- Connection is made using a connector. Do not solder to the pins (leads).
- When extending the cable, use an extension cable with conductors having a total cross-section area of 0.3 mm^2. The total cable length must be less than 10 m.

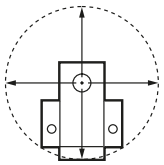
● Axis Adjustment

(1) Tentatively mount the emitter and receiver so that the center of each lens is in a single line.



(2) Turn ON the emitter and receiver after making sure that they have been wired correctly. When power is turned ON, the light indicator on the receiver will light. Make sure that the light indicator is OFF when an object intercepts the optical axis and that the light indicator lights again when the object is removed.

(3) Fix the position of the receiver (or emitter) securely, move the emitter (or receiver) horizontally and vertically to check the range in which the operation indicator is lit. Then locate the emitter (or receiver) in the center of the range and fix the position securely.



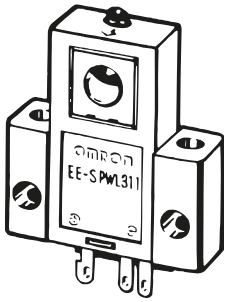
(Unit: mm)

Dimensions

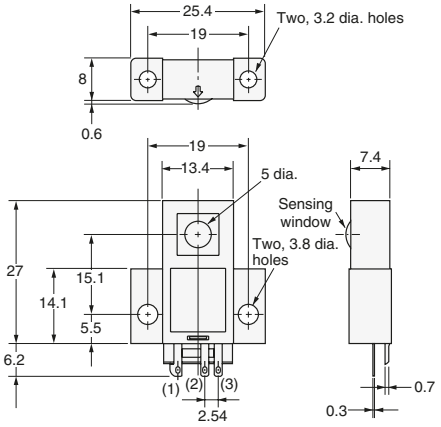
Tolerance class IT16 applies to dimensions in this datasheet unless otherwise specified.

Sensors

EE-SPW311
EE-SPW411



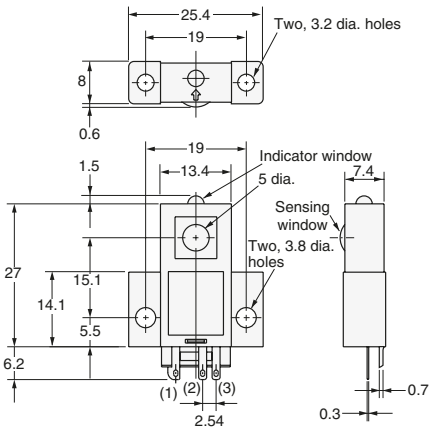
Emitter (EE-SPWL□11)



Terminal Arrangement

(1)	+	Vcc
(2)	**---**	Vacant
(3)	–	GND (0 V)

Receiver (EE-SPWD□11)



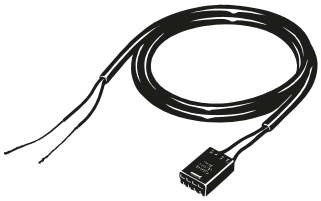
Terminal Arrangement

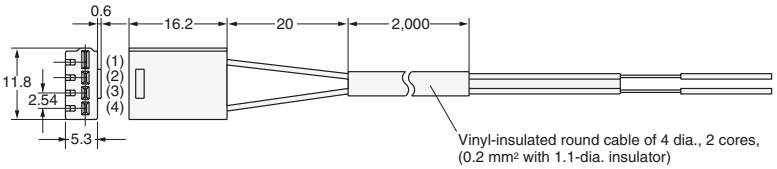
(1)	+	Vcc
(2)	**OUT**	OUTPUT
(3)	–	GND (0 V)

Accessories (Included)

Connector with Cable for Emitter

EE-1006L

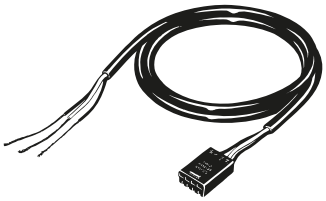


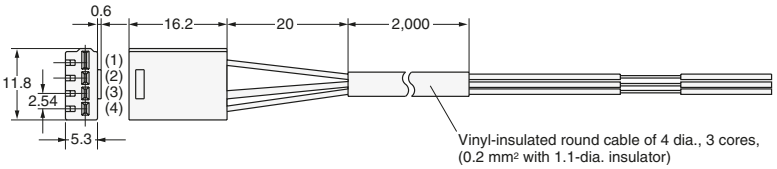


(1)	**Brown**	+
(4)	**Blue**	–

Connector with Cable for Receiver

EE-1006D





(1)	**Brown**	+
(3)	**Black**	OUT
(4)	**Blue**	–

Note: These cables can also be ordered separately.

* Refer to *Accessories* for details.

Pre-wired Photomicrosensor with Amplifier and Cable

EE-SPW321/421

Compact, Thin-profile Photomicrosensor with special amplifier.

- Slim amplifier (50 × 7.5 × 12 mm) can be handled like a cable.
- Provided with two operation indicators, enabling monitoring from the housing and sensor head.
- Simple wiring with a 3-conductor cable.
- Wide operating voltage range: 12 to 24 VDC

⚠ Be sure to read *Safety Precautions* on page 86.

Ordering Information

Sensing method	Sensing distance	Output type	Output configuration	Cable length	Cable length from emitter to amplifier	Model
Through-beam type	300 mm	NPN output	Dark-ON	2 m	0.5 m	**EE-SPW321**
					1 m	**EE-SPW321-A**
			Light-ON		0.5 m	**EE-SPW421**
					1 m	**EE-SPW421-A**

EE-SPW321/421

Ratings and Specifications

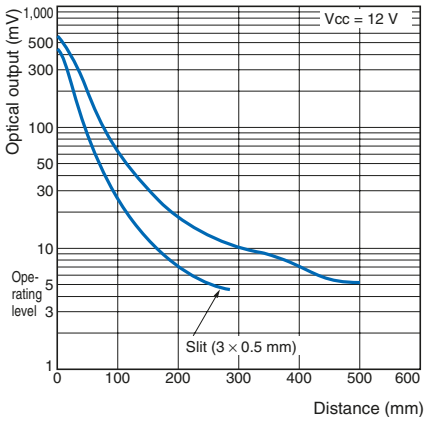
Item	Models	EE-SPW321, EE-SPW421	EE-SPW321-A, EE-SPW421-A
Sensing distance		300 mm *1	
Sensing object		Opaque: 2 mm dia. min. *2	
Directional angle		10° to 40°	
Light source		GaAs infrared LED (pulse lighting) with a peak wavelength of 940 nm	
Indicator		Light indicator (Red LEDs, one each on Sensor and Amplifier)	
Supply voltage		12 to 24 VDC ±10%, ripple (p-p): 5% max.	
Current consumption		Average: 30 mA max.	
Control output		NPN open collector, Load power supply voltage: 12 to 24 VDC, Load current: 100 mA max., OFF current: 0.5 mA max. Residual voltage: 1 V max (at a 100-mA load current)	
Response time		1 ms max. for both detection and reset	
Ambient illumination		3,000 lx max. (incandescent light); 10,000 lx max. (sunlight) on the receiver	
Ambient temperature range		–20 to +55°C	
Ambient humidity range		5% to 85%	
Vibration resistance		Destruction: 10 to 55 Hz, 1.5-mm double amplitude for 2 h each in X, Y, and Z directions	
Shock resistance		500 m/s^2	
Degree of protection		IEC IP64	
Connecting method		Pre-wired (standard cable length: 2 m)	
Cable length from emitter (receiver) to amplifier		0.5 m	1 m
Weight (Packaged)		76 g	
Material	Case	ABS resin	
	Lens	Acrylate resin	
Accessories		Slits: 0.5 × 3 mm, 1 × 3 mm, 3 × 0.5 mm, 3 × 1 mm (one each) Sems screws with spring washers and flat washers: Six M2.6 × 12 Instruction Manual	

*1. Refer to *Receiver Output Vs. Sensing Distance Characteristics* on the next page.
*2. Detection of objects up to 0.5 mm wide is possible by using slit installation.

Engineering Data (Typical)

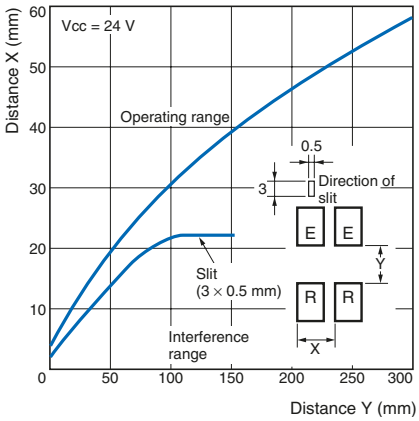
Receiver Output vs. Distance Characteristics

EE-SPW321/421



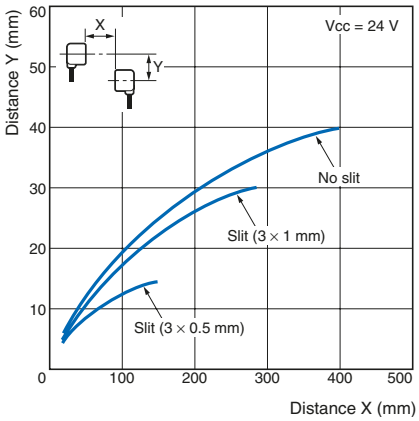
Mutual Interference

EE-SPW321/421



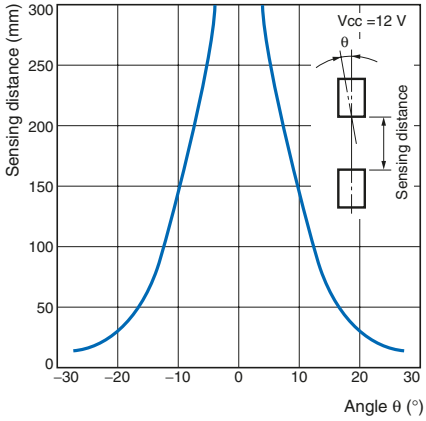
Parallel Movement Characteristics

EE-SPW321/421



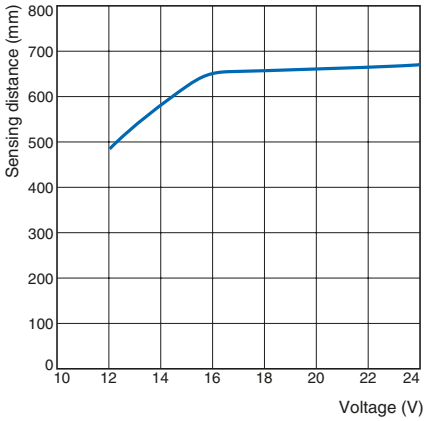
Sensing Angle Characteristics

EE-SPW321/421



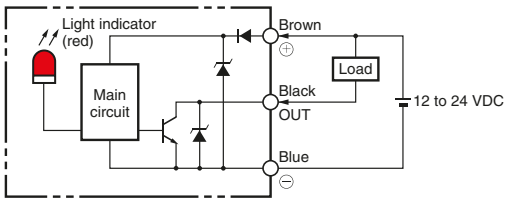
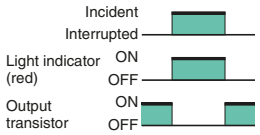
Sensing Distance vs. Input Voltage

EE-SPW321/421



I/O Circuit Diagrams

NPN Output

Model	Output configuration	Timing charts	Output circuit
EE-SPW421(-A)	Light-ON		
EE-SPW321(-A)	Dark-ON		

Sensing Distance with slit installed

Infrared light

Slit type	Sensing distance	Sensing object
None	300 mm	Opaque: 2 mm dia. min.
1 × 3 mm or 3 × 1 mm	200 mm	Opaque: Greater than the slit
0.5 × 3 mm or 3 × 0.5 mm	100 mm	Opaque: Greater than the slit

EE-SPW321/421

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

Make sure that this product is used within the rated ambient environment conditions.

● **Wiring**

Connections

The length of the standard cable is 10 m max. (including the cable attachment, AWG24 min.). When extending the Sensor wires, use a wire greater than AWG 22 in diameter and a cable shorter than 100 m. If the cable length exceeds 10 m, the supply voltage applied at the Sensor terminal will decrease as the impedance of the extended cable increases and the low level output voltage at the cable end will increase. Therefore, take voltage fluctuation into account when extending the Sensor cable.

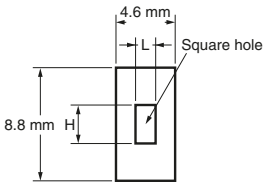
● **Mounting**

Tighten the mounting screws to a torque of 0.54 N·m max.

● **Adjustment**

Aperture Stickers

Two kinds of reticles are attached, the 0.5-mm and the 1.0-mm width types (total of 4 stickers with slit widths A to D as shown in the following diagram).
Use these when the sensing object is 2 mm or smaller or when mutual interference must be reduced.
For each slit of the same type, attach a sticker to the sensing surface of the emitter and receiver.



	Size L (mm)	Size H (mm)
Slit A	0.5	3
Slit B	1	3
Slit C	3	0.5
Slit D	3	1

Note: These are pressure sensitive adhesive-type stickers. Peel off the seal and stick it on the lens.

Optical Axis Adjustment

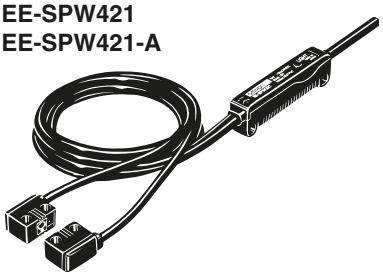
(1)Set the Sensor so that the center of the lens in the emitter and receiver form one line.
(2)Having checked that the Sensor is correctly wired, turn ON the power. The operation indicator on the amplifier of the emitter will light. Check to make sure the light goes ON and OFF when an opaque object is moved in and out between the emitter and receiver.
(3)Move the emitter (or receiver) up and down, left and right and secure the emitter (or receiver) in the center of the range of the operation indicator. Secure the receiver (or emitter) in the same way after adjustment is complete.

(Unit: mm)

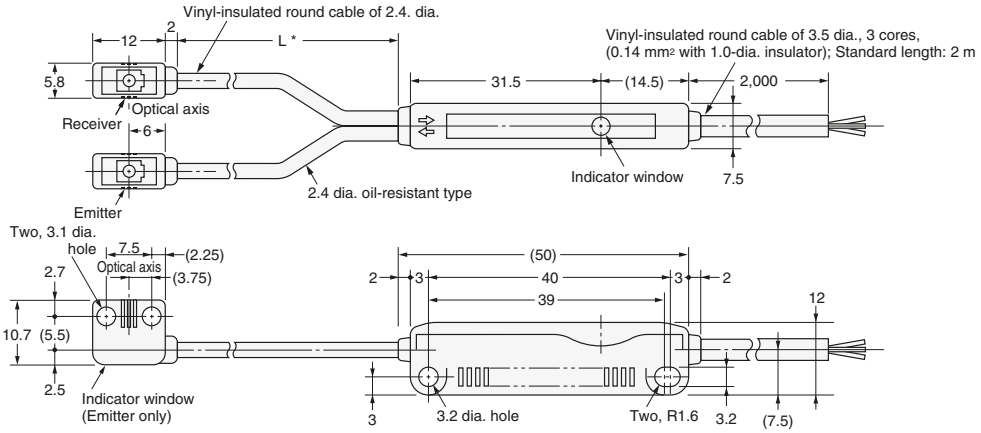
Dimensions

Tolerance class IT16 applies to dimensions in this datasheet unless otherwise specified.

EE-SPW321
EE-SPW321-A
EE-SPW421
EE-SPW421-A



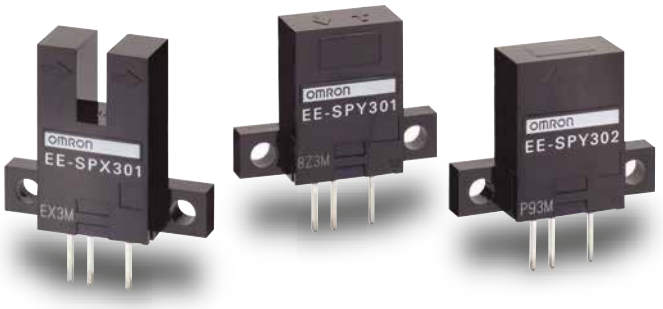
* L = 500 mm
(EE-SPW321, EE-SPW421)
L = 1,000 mm
(EE-SPW321-A, EE-SPW421-A)



EE-SPX301/401
EE-SPY30/40

Photomicrosensor with light modulation is not influenced by external light.

- Voltage-output models with wide operating voltage range (5 to 24 VDC).
- Fitted with an easy-to-adjust optical axis mark.
- Easy adjustment and optical axis monitoring with a light indicator.



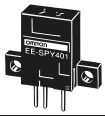
CE

⚠ Be sure to read *Safety Precautions* on page 91.

Ordering Information

Sensors

Infrared light

Appearance	Sensing method	Sensing distance	Output type	Output configuration	Model
	Through-beam type (with slot)	3.6 mm (slot width)	NPN output	Dark-ON	**EE-SPX301**
				Light-ON	**EE-SPX401**
Horizontal type 	Reflective type	5 mm		Dark-ON	**EE-SPY301**
				Light-ON	**EE-SPY401**
Vertical type 	Reflective type	5 mm		Dark-ON	**EE-SPY302**
				Light-ON	**EE-SPY402**

Accessories (Order Separately)

Type		Cable length	Model	Remarks
Connector			**EE-1002**	
	Connector with Cable	1 m	**EE-1003**	
NPN/PNP Conversion Connector		0.46 m (total length)	**EE-2001**	
Connector Hold-down Clip			**EE-1003A**	For EE-1003 only.

* Refer to *Accessories* for details.

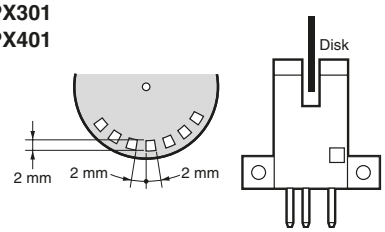
EE-SPX301/401 EE-SPY30/40

Ratings and Specifications

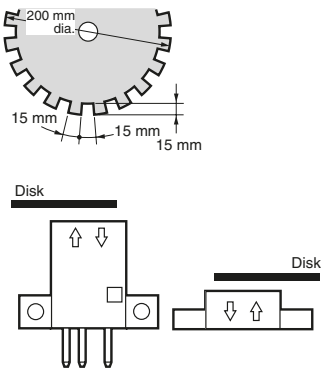
Sensing method / Item / Models		Through-beam type (with slot)	Reflective type
		EE-SPX301, EE-SPX401	EE-SPY301, EE-SPY401 EE-SPY302, EE-SPY402
Sensing distance		3.6 mm (slot width)	5 mm (Reflection factor: 90%; white paper 15 × 15 mm) *1
Sensing object		Opaque: 1 × 0.5 mm min.	---
Differential distance		0.05 mm max.	0.2 mm max. (with a sensing distance of 3 mm, horizontally)
Light source		GaAs infrared LED with a peak wavelength of 940 nm	
Indicator *2		Light indicator (red)	
Supply voltage		5 to 24 VDC ±10%, ripple (p-p): 5% max.	
Current consumption		Average: 15 mA max., Peak: 50 mA max.	
Control output		NPN voltage output: Load power supply voltage: 5 to 24 VDC Load current: 80 mA max. OFF current: 0.5 mA max. 80 mA load current with a residual voltage of 1.0 V max. 10 mA load current with a residual voltage of 0.4 V max.	
Response frequency *3		500 Hz min.	100 Hz min.
Ambient illumination		3,000 lx max. with incandescent light or sunlight on the surface of the receiver	
Ambient temperature range		Operating: −10 to +55°C Storage: −25 to +65°C (with no icing)	
Ambient humidity range		Operating: 5% to 85% Storage: 5% to 95% (with no condensation)	
Vibration resistance		Destruction: 10 to 55 Hz, 1.5-mm double amplitude for 2 h each in X, Y, and Z directions	
Shock resistance		Destruction: 500 m/s^2 for 3 times each in X, Y, and Z directions	
Degree of protection		IEC IP50	
Connecting method		Special connector (soldering not possible)	
Weight		Approx. 2.6 g	
Material	**Case**	Polycarbonate	

*1. Operation may not be possible near the Sensor.
*2. The indicator is a GaP red LED (peak wavelength: 700 nm).
*3. The response frequency was measured by detecting the following rotating disk.

EE-SPX301
EE-SPX401



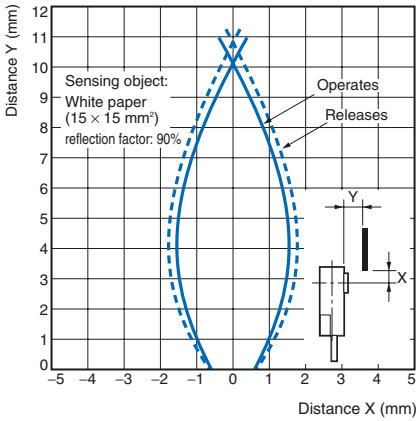
EE-SPY30□
EE-SPY40□



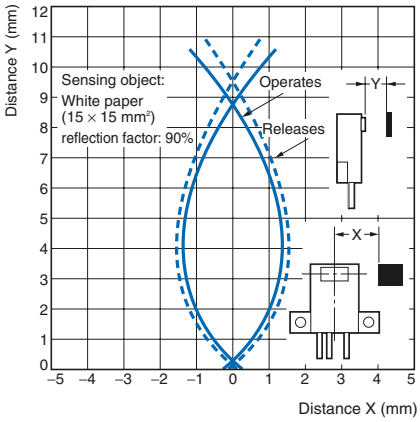
Engineering Data (Typical)

Operating Range Characteristics

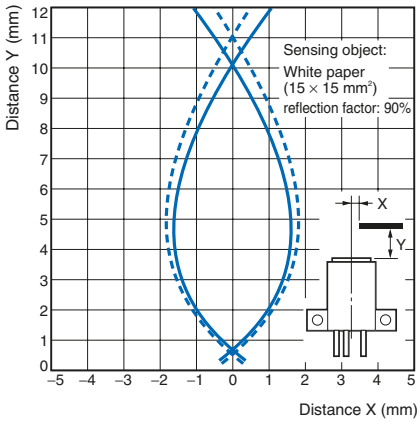
EE-SPY301, EE-SPY401



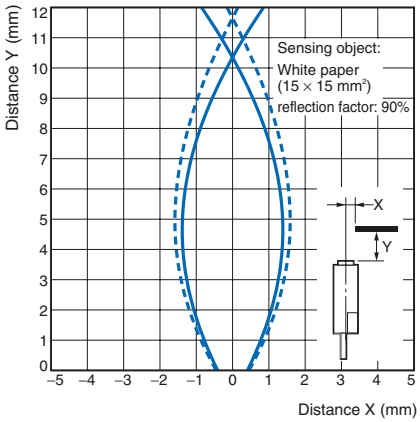
EE-SPY301, EE-SPY401



EE-SPY302, EE-SPY402

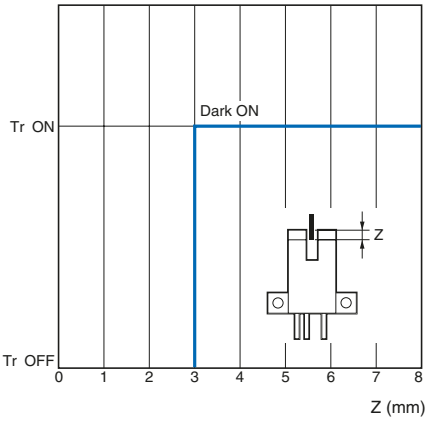


EE-SPY302, EE-SPY402

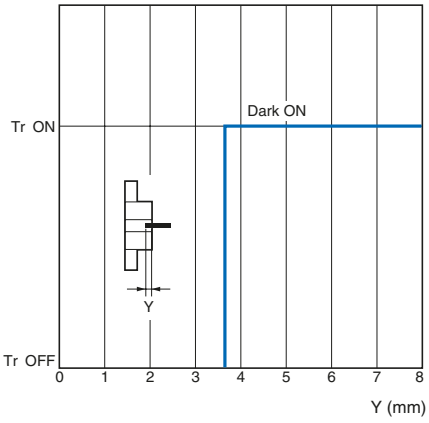


Sensing Position Characteristics

EE-SPX301 (Z Direction)

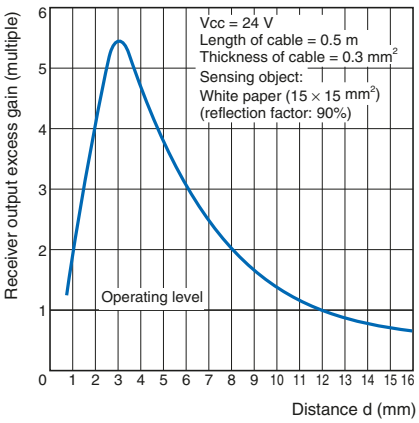


EE-SPX301 (Y Direction)



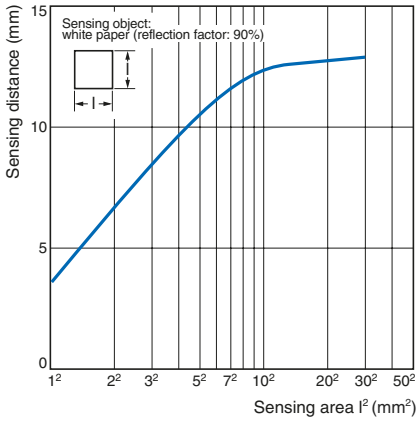
Receiver Output Excess Gain vs. Sensing Distance Characteristics

EE-SPY□□□



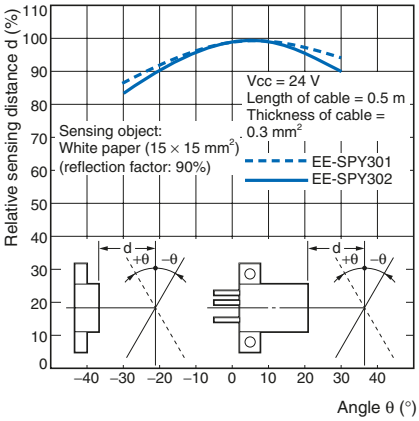
Sensing Distance vs. Object Area Characteristics

EE-SPY□□□



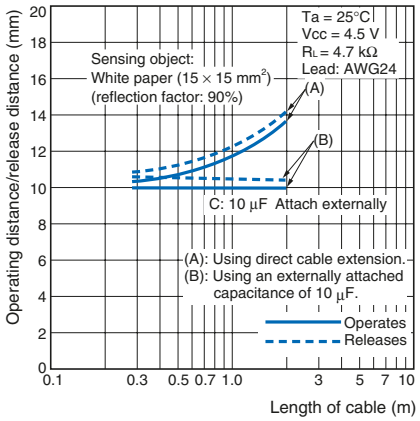
Sensing Angle vs. Sensing Distance Characteristics

EE-SPY□□□



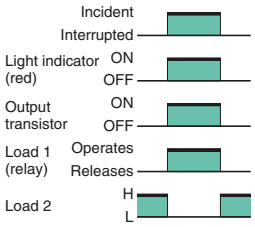
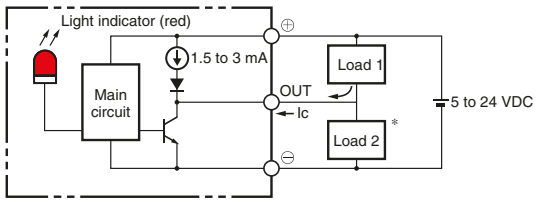
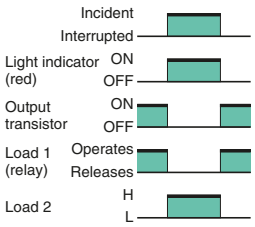
Dependency on Cable Length for Operation Distance/Release Distance

EE-SPY□□□



I/O Circuit Diagrams

NPN Output

Model	Output configuration	Timing charts	Output circuit
EE-SPX401 EE-SPY401 EE-SPY402	Light-ON		 * Voltage output (when the sensor is connected to a transistor circuit)
EE-SPX301 EE-SPY301 EE-SPY302	Dark-ON		

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

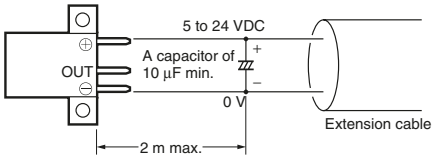
Make sure that this product is used within the rated ambient environment conditions.

● Mounting

The sensing distance for the EE-SPY Reflective-type Photomicrosensor with built-in amplifier varies from 8 to 20 mm depending on the product (90% reflective white paper). Do not place glossy objects in the background of the sensing object.

● Wiring

- Connection is made using a connector. Do not solder to the pins (leads).
- When extending the cable, use an extension cable with conductors having a total cross-section area of 0.3 mm^2. The total cable length must be 2 m maximum.
- To use a cable length longer than 2 m, attach a capacitor with a capacitance of approximately 10 μF to the wires as shown below. The distance between the terminal and the capacitor must be within 2 m.
  (Use a capacitor with a dielectric strength that is at least twice the Sensor's power supply voltage.)



- Make sure the total length of the power cable connected to the product is less than 10 m even if a capacitor is inserted.

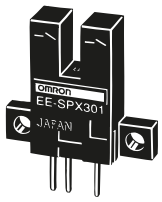
(Unit: mm)

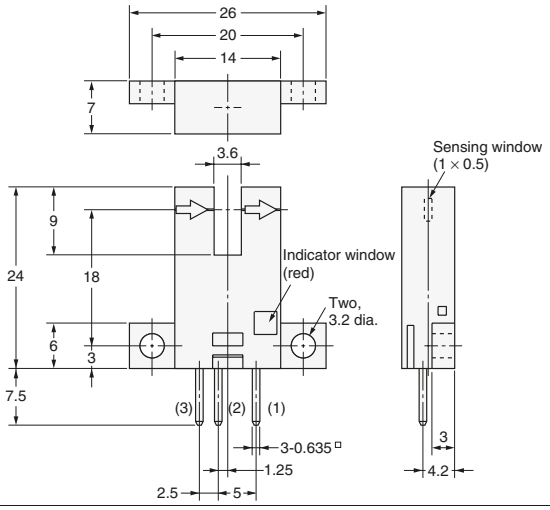
Dimensions

Tolerance class IT16 applies to dimensions in this datasheet unless otherwise specified.

Sensors

EE-SPX301
EE-SPX401

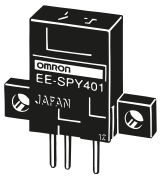


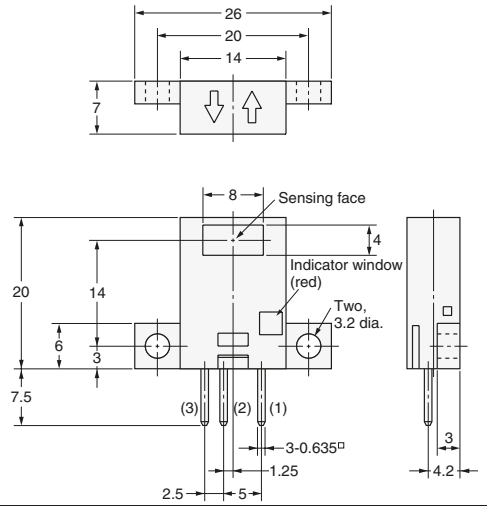


Terminal Arrangement

(1)	⊕	Vcc
(2)	OUT	OUTPUT
(3)	⊖	GND (0 V)

EE-SPY301
EE-SPY401

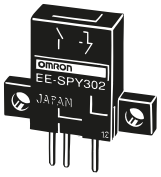


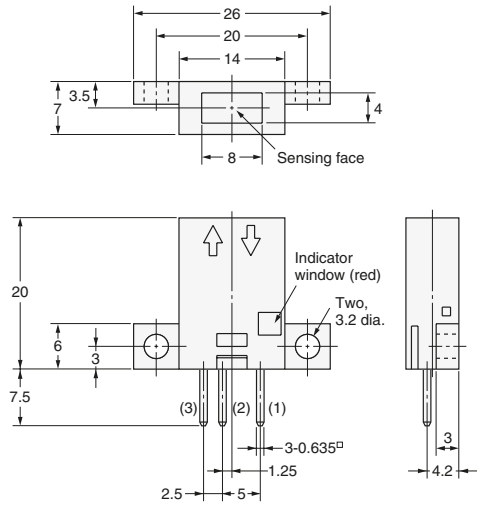


Terminal Arrangement

(1)	⊕	Vcc
(2)	OUT	OUTPUT
(3)	⊖	GND (0 V)

EE-SPY302
EE-SPY402





Terminal Arrangement

(1)	⊕	Vcc
(2)	OUT	OUTPUT
(3)	⊖	GND (0 V)

Accessories (Order Separately)

* Refer to *Accessories* for details.

Light Convergent Reflective Photomicrosensor

EE-SPY31/41

Accurately detects objects placed in front of shiny Background.

- A shiny background can be used as long as the distance between the sensor and the background is 20 mm or more.
- Detects minute objects such as a 0.05-mm-dia. pure copper wire.
- Small dispersion in sensing distance.
- Light modulation effectively reduces external light interference.
- Wide operating voltage range: 5 to 24 VDC

CE

⚠ Be sure to read *Safety Precautions* on page 96.

Ordering Information

Sensors

Infrared light

Appearance	Sensing method	Sensing distance	Output type	Output configuration	Model
Horizontal type 	Convergent reflective type	2 to 5 mm	NPN output	Dark-ON	**EE-SPY311**
				Light-ON	**EE-SPY411**
Vertical type 				Dark-ON	**EE-SPY312**
				Light-ON	**EE-SPY412**

Accessories (Order Separately)

Type		Cable length	Model
Connector			**EE-1001**
			EE-1009
	Connector with Cable	1 m	**EE-1006**
			EE-1010
		2 m	**EE-1006**
			EE-1010
	Connector with Robot Cable	1 m	**EE-1010-R**
		2 m	**EE-1010-R**
NPN/PNP Conversion Connector		0.46 m (total length)	**EE-2002**

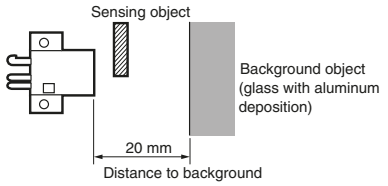
* Refer to *Accessories* for details.

EE-SPY31/41

Ratings and Specifications

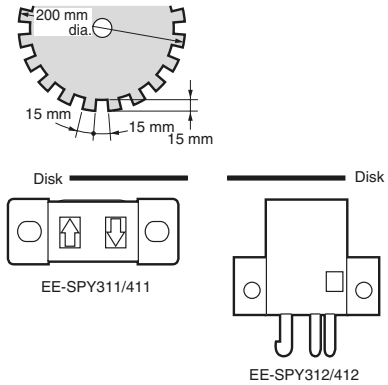
Item	Models	EE-SPY311, EE-SPY411, EE-SPY312, EE-SPY412
Sensing distance		2 to 5 mm (Reflection factor: 90%; white paper 15 × 15 mm)
Minimum sensing object		Pure copper wire (0.05 mm dia.)
Distance to background *1		20 mm max. (glass with aluminum deposition)
Differential distance		0.2 mm (with a sensing distance of 3 mm, horizontally)
Light source		GaAs infrared LED with a peak wavelength of 940 nm
Indicator *2		Light indicator (red)
Supply voltage		5 to 24 VDC ±10%, ripple (p-p): 5% max.
Current consumption		Average: 15 mA max., Peak: 50 mA max.
Control output		NPN voltage output: Load power supply voltage: 5 to 24 VDC Load current: 80 mA max. OFF current: 0.5 mA max. 80 mA load current with a residual voltage of 1.0 V max. 10 mA load current with a residual voltage of 0.4 V max.
Response frequency *3		100 Hz min.
Ambient illumination		3,000 lx max. with incandescent light or sunlight on the surface of the receiver
Ambient temperature range		Operating: −10 to +55°C Storage: −25 to +65°C
Ambient humidity range		Operating: 5% to 85% Storage: 5% to 95%
Vibration resistance		Destruction: 10 to 50 Hz, 1.5-mm double amplitude for 2 h each in X, Y, and Z directions
Shock resistance		Destruction: 500m/s^2 for 3 times each in X, Y, and Z directions
Degree of protection		IEC IP50
Connecting method		Special connector (soldering not possible)
Weight		Approx. 2.6 g
Material	Case	Polycarbonate
	Holder	Polybutylene phthalate (PBT)

*1.



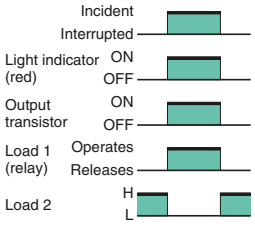
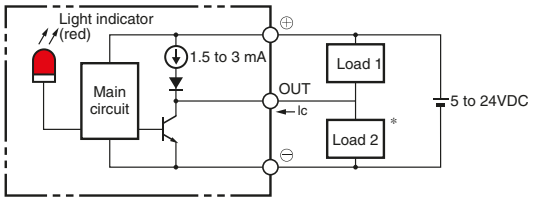
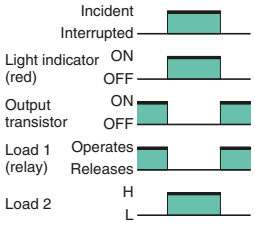
*2. The indicator is a GaP red LED (peak wavelength: 700 nm).

*3. The response frequency was measured by detecting the following rotating disk.



I/O Circuit Diagrams

NPN Output

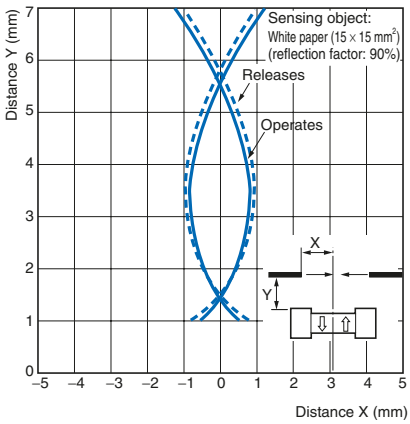
Model	Output configuration	Timing charts	Output circuit
EE-SPY411 EE-SPY412	Light-ON		
EE-SPY311 EE-SPY312	Dark-ON		

* Voltage output (when the sensor is connected to a transistor circuit)

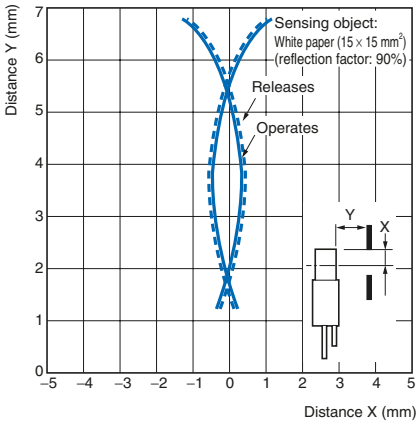
Engineering Data (Typical)

Operating Range Characteristics

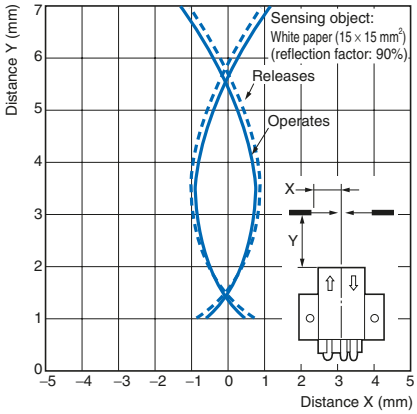
EE-SPY311/411



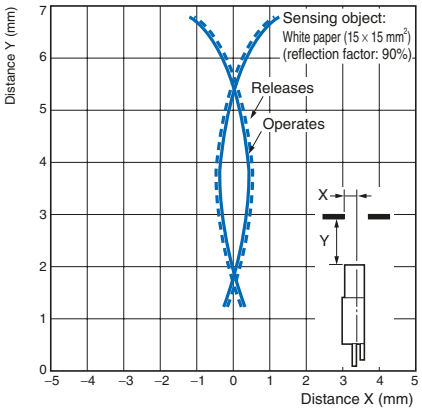
EE-SPY311/411



EE-SPY312/412

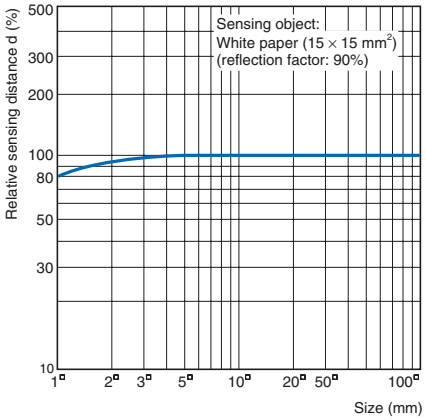


EE-SPY312/412



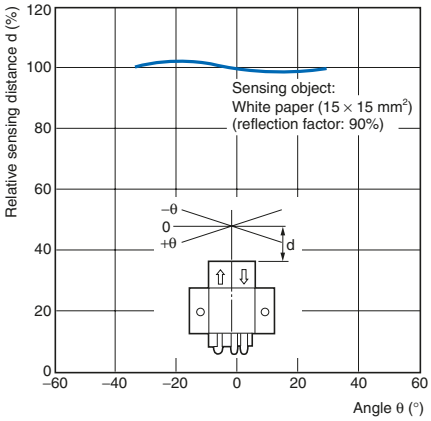
Sensing Distance vs. Object Area Characteristics

EE-SPY□□□



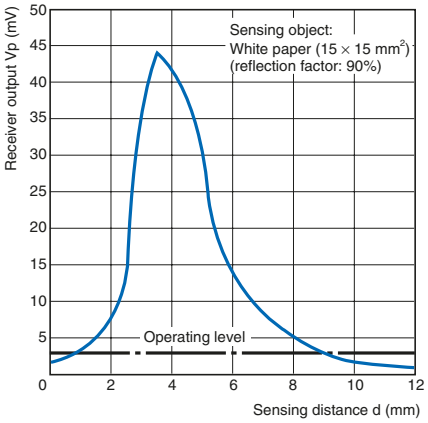
Sensing Angle vs. Sensing Distance Characteristics

EE-SPY312/412



Receiver Output vs. Sensing Distance Characteristics

EE-SPY□□□



EE-SPY31/41

Safety Precautions

Refer to *Warranty and Limitations of Liability*.

⚠ WARNING

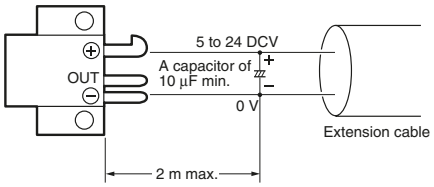
This product is not designed or rated for ensuring safety of persons either directly or indirectly. Do not use it for such purposes.

Precautions for Correct Use

Make sure that this product is used within the rated ambient environment conditions.

● Wiring

- Connection is made using a connector. Do not solder to the pins (leads).
- When extending the cable, use an extension cable with conductors having a total cross-section area of 0.3 mm^2. The total cable length must be 2 m maximum.
- To use a cable length longer than 2 m, attach a capacitor with a capacitance of approximately 10 μF to the wires as shown below. The distance between the terminal and the capacitor must be within 2 m. (Use a capacitor with a dielectric strength that is at least twice the Sensor's power supply voltage.)



- Make sure the total length of the power cable connected to the product is less than 10 m even if a capacitor is inserted.

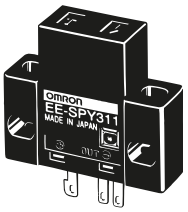
(Unit: mm)

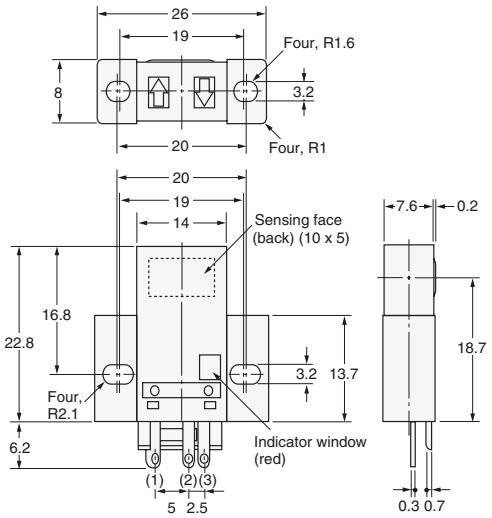
Dimensions

Tolerance class IT16 applies to dimensions in this datasheet unless otherwise specified.

Sensors

EE-SPY311
EE-SPY411

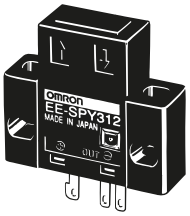


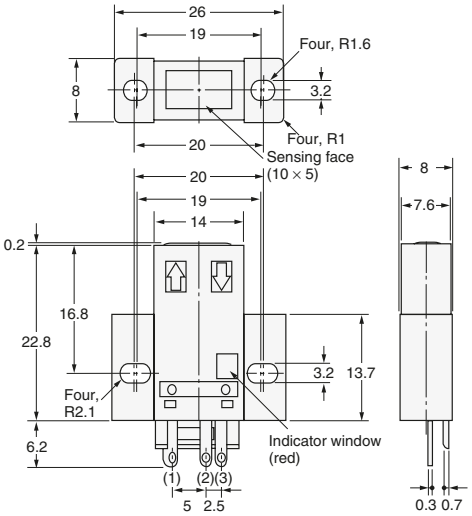


Terminal Arrangement

(1)	+	Vcc
(2)	OUT	OUTPUT
(3)	–	GND (0 V)

EE-SPY312
EE-SPY412





Terminal Arrangement

(1)	+	Vcc
(2)	OUT	OUTPUT
(3)	–	GND (0 V)

Accessories (Order Separately)

* Refer to *Accessories* for details.

Reflective Photomicrosensor with Sensitivity Adjuster (Non-modulated)

EE-SY671/672

Photomicrosensor with sensitivity adjuster.

- Easy adjustment with a built-in sensitivity adjuster.
- Easy optical axis monitoring with a bright light indicator.
- Compact design incorporating a built-in amplifier and special IC enables direct switching capacity of up to 100 mA.
- Wide operating voltage range: 5 to 24 VDC
- Connection possible with a range of ICs, relays, and Programmable Controllers (PLCs).

CE

⚠ Be sure to read *Safety Precautions* on page 100.

Ordering Information

Sensors

Infrared light

Appearance	Sensing method	Sensing distance	Output type	Output configuration	Model
Horizontal type 	Reflective type	1 to 5 mm	NPN output	Dark-ON or Light-ON (Selectable) *	**EE-SY671**
Vertical type 					**EE-SY672**

* The Dark-ON/Light-ON (selectable) models are normally used as dark-ON models. To use them as light-ON models, short-circuit the L terminal and positive (+) terminal.
An EE-1001-1 Connector with the terminals already short-circuited is also available.

Accessories (Order Separately)

Type		Cable length	Model	Remarks
Connector			**EE-1001**	
			EE-1001-1	L terminal and positive (+) terminal are already short-circuited.
			EE-1009	
	Connector with Cable	1 m	**EE-1006**	
			EE-1010	
		2 m	**EE-1006**	
			EE-1010	
	Connector with Robot Cable	1 m	**EE-1010-R**	
		2 m	**EE-1010-R**	

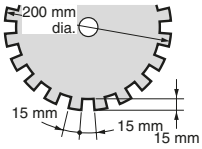
* Refer to *Accessories* for details.

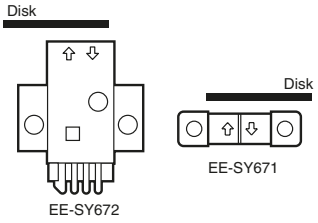
EE-SY671/672

Ratings and Specifications

Item	Models	EE-SY671, EE-SY672
Sensing distance		1 to 5 mm (Reflection factor: 90%; white paper 15 × 15 mm)
Sensing object		Transparent or opaque: 15 × 15 mm min.
Differential distance		0.5 max. (with a sensing distance of 3 mm, horizontally)
Light source		GaAs infrared LED with a peak wavelength of 940 nm
Indicator *1		Light indicator (red)
Supply voltage		5 to 24 VDC ±10%, ripple (p-p): 10% max.
Current consumption		40 mA max.
Control output		NPN open collector: Load power supply voltage: 5 to 24 VDC Load current: 100 mA max. OFF current: 0.5 mA max. 100 mA load current with a residual voltage of 0.8 V max. 40 mA load current with a residual voltage of 0.4 V max.
Response frequency *2		50 Hz min. (Average: 500 Hz)
Ambient illumination *3		1,500 lx max. with fluorescent light on the surface of the receiver
Ambient temperature range		Operating: –25 to +55°C Storage: –30 to +80°C
Ambient humidity range		Operating: 5% to 85% Storage: 5% to 95%
Vibration resistance		Destruction: 20 to 2,000 Hz (peak acceleration: 100 m/s^2) 1.5-mm double amplitude for 2 h (4-min periods) each in X, Y, and Z directions
Shock resistance		Destruction: 500m/s^2 for 3 times each in X, Y, and Z directions
Degree of protection		IEC IP50
Connecting method		Special connector (direct soldering possible)
Weight		Approx. 3.5 g (including screwdriver for adjustment)
Material	Case	Polybutylene phthalate (PBT)
	Emitter/ receiver	Polycarbonate
Accessories		Screwdriver for adjustment

*1. The indicator is a GaP red LED (peak wavelength: 690 nm).
*2. The response frequency was measured by detecting the following rotating disk.



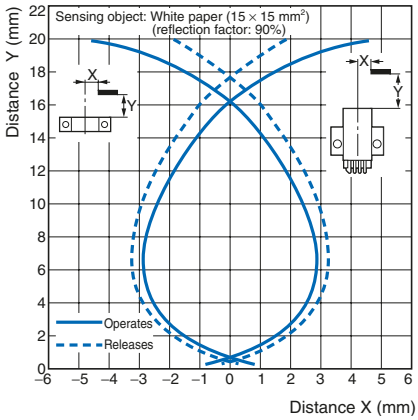


*3. The ambient illuminance is measured on the surface of the receiver.

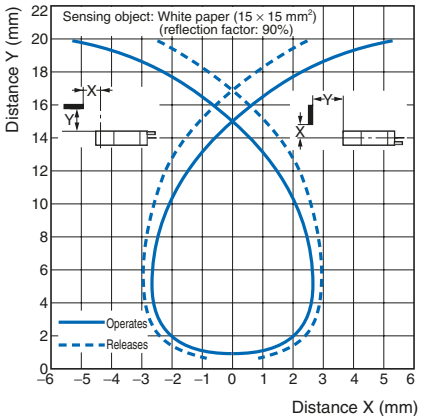
Engineering Data (Typical)

Operating Range Characteristics (Max. Sensitivity)

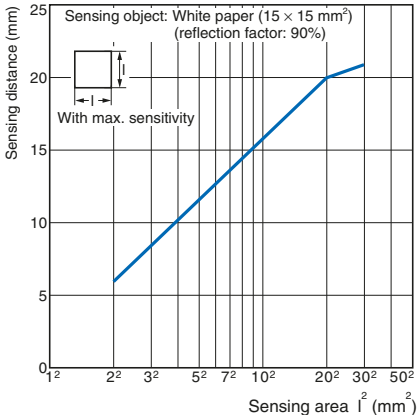
EE-SY67□



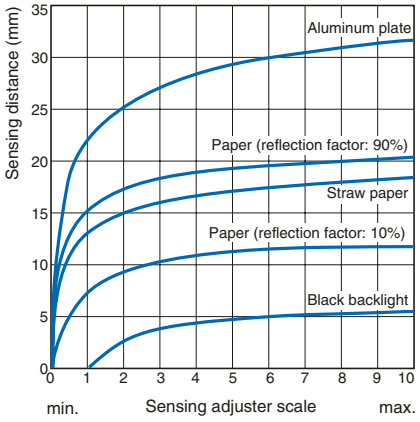
EE-SY67□



Sensing Distance vs. Object Area Characteristics

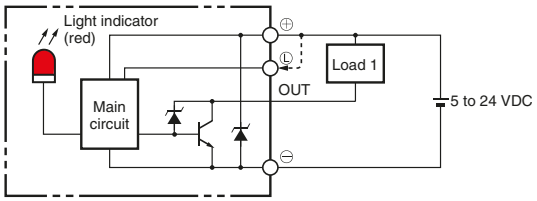


Sensing Distance vs. Sensitivity Volume



I/O Circuit Diagrams

NPN Output

Model	Output configuration	Timing charts	Terminal connections	Output circuit
EE-SY671 EE-SY672	Light-ON	Incident Interrupted Light indicator (red) ON / OFF Output transistor ON / OFF Load 1 (relay) Operates / Releases	Short-circuited between Ⓛ terminal and positive ⊕ terminal	
	Dark-ON	Incident Interrupted Light indicator (red) ON / OFF Output transistor ON / OFF Load 1 (relay) Operates / Releases	Open between Ⓛ terminal and positive ⊕ terminal	

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

Make sure that this product is used within the rated ambient environment conditions.

● Wiring

Soldering

- When direct soldering to the terminal, use the following guidelines.

Soldering Conditions

Item	Temperature	Permissible time	Remarks
Soldering iron	350°C max.	3 s max.	The portion between the base of the terminals and the position 1.5 mm from the terminal base must not be soldered.

- The terminal base uses a polycarbonate resin, which could be deformed by excessive soldering heat, resulting in damage to the product's functionality.

Cable Extension

- When extending the cable, use an extension cable with conductors having a total cross-section area of 0.3 mm^2. The total cable length must be less than 10 m.

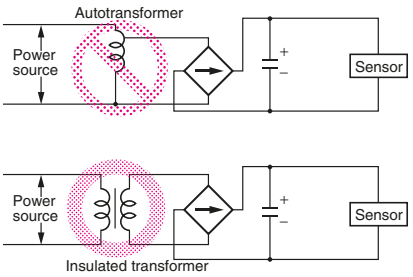
● Installation

The photomicrosensor is built into the device being used and so is not equipped to deal with interference from an external light source. When using the sensor in an area exposed to an incandescent lamp, install so as to minimize the effects of external light sources.

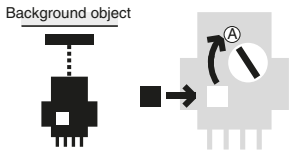
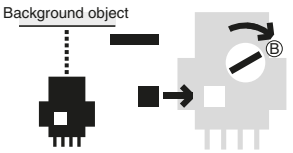
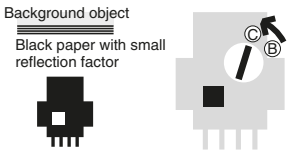
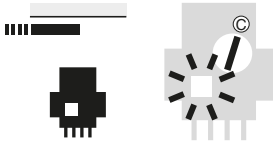
● Sensitivity Adjustment

Use the special screwdriver (sold together) for sensitivity adjustment.

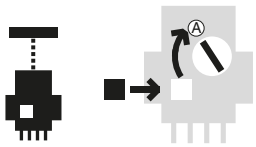
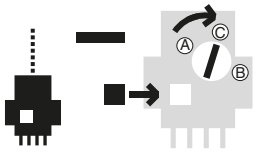
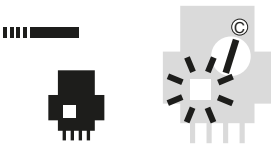
- When an excessive force is applied to sensitivity adjuster, it may be damaged.
- The shaft of the sensitivity adjuster is charged. Connect a DC power supply incorporating an insulated transformer to the photomicrosensor. Do not connect a DC power supply incorporating an autotransformer or the user may receive an electric shock when adjusting the sensitivity.



Sensitivity Adjustment with Background Object

	Point A	Point B	Setting	Check
Sensing conditions / Adjuster indicator				
Adjustment Procedure	1. Set the sensitivity of the photomicrosensor to minimum, place the sensing object in the sensing position, turn the sensitivity adjuster clockwise slowly until the light indicator is lit (point A).	2. Remove the sensing object, at which time the light indicator will be OFF. Further turn the sensitivity adjuster clockwise slowly until the light indicator is lit again (point B). The operation indicator will not light again if the background object does not reflect light, in which case refer to 'Sensitivity Adjustment with No Background Object".	3. Set the sensitivity adjuster at the center (point C) between point A and B. Points A and B will be very close if the sensor is influenced by excessive light reflected by the background object, in which case take the following preventive measures. (1) Separate the sensor and the background object by a distance of 20 mm min. (2) Cover the surface of the background object with a material with a small reflection factor, such as black sponge.	4. After setting the sensitivity adjuster to point C, check if the light indicator is lit on placing the sensing object at the sensing position and not lit on removing the sensing object.

Sensitivity Adjustment with No Background Object

	Point A	Point B	Check
Sensing conditions / Adjuster indicator			
Adjustment Procedure	1. Set the sensitivity of the photomicrosensor to minimum, place the sensing object at the sensing position, turn the sensitivity adjuster clockwise slowly until the light indicator is lit (point A).	2. Set the sensitivity adjuster at the center (point C) between points A and B (the point where the sensitivity is maximum).	3. After setting the sensitivity adjuster to point C, check if the light indicator is not lit on removing the sensing object.

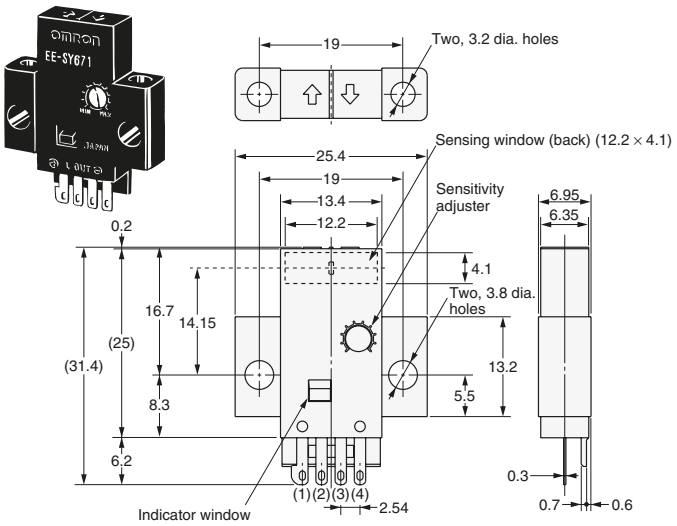
(Unit: mm)

Dimensions

Tolerance class IT16 applies to dimensions in this datasheet unless otherwise specified.

Sensors

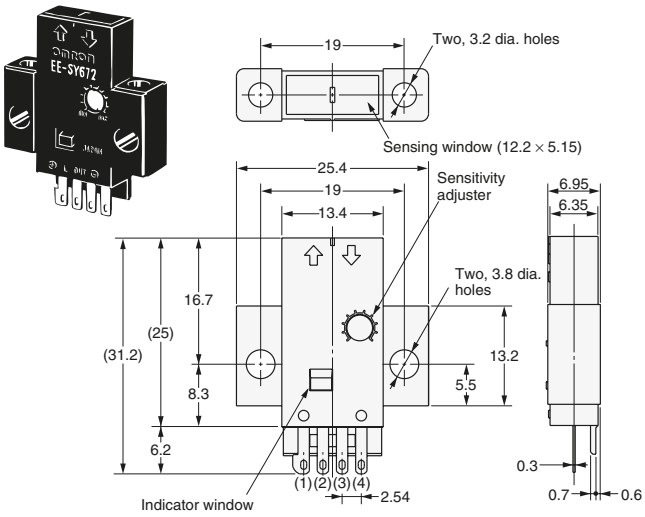
EE-SY671



Terminal Arrangement

(1)	+	Vcc
(2)	**L**	L
(3)	**OUT**	OUTPUT
(4)	–	GND (0 V)

EE-SY672



Terminal Arrangement

(1)	+	Vcc
(2)	**L**	L
(3)	**OUT**	OUTPUT
(4)	–	GND (0 V)

Accessories (Order Separately)

* Refer to *Accessories* for details.

Retroreflective Photomicrosensor with Lens

EE-SPZ-A

Photomicrosensor with light modulation for reduced external light interference.

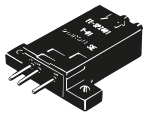
- Easy adjustment and optical axis monitoring with a light indicator.
- Wide operating voltage range: 5 to 24 VDC
- Supports connection with Programmable Controllers (PLCs).
- Easy-to-wire connectors assure easy maintenance.

⚠ Be sure to read *Safety Precautions* on page 105.

Ordering Information

Sensors

Infrared light

Appearance	Sensing method	Sensing distance	Output type	Output configuration	Model
	Retroreflective type	200 mm	NPN output	Dark-ON	**EE-SPZ301-A**
				Light-ON	**EE-SPZ401-A**

Accessories (Order Separately)

Type		Cable length	Model	Remarks
Connector			**EE-1002**	
	Connector with Cable	1 m	**EE-1003**	
NPN/PNP Conversion Connector		0.46 m (total length)	**EE-2001**	
Connector Hold-down Clip			**EE-1003A**	For EE-1003 only.
Reflector			**E39-R1**	

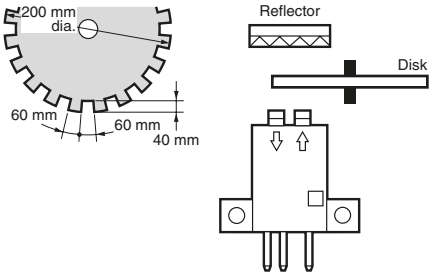
* Refer to *Accessories* for details.
* Refer to the *E39-L/F39-L/E39-S/E39-R Datasheet* for information on Reflectors.

EE-SPZ-A

Ratings and Specifications

Item	Models	EE-SPZ301-A, EE-SPZ401-A
Sensing distance *1		200 mm (using E39-R1 reflector)
Light source		GaAs infrared LED (pulse lighting) with a peak wavelength of 940 nm
Indicator *2		Light indicator (red)
Supply voltage		5 to 24 VDC ±10%, ripple (p-p): 5% max.
Current consumption		Average: 15 mA max., Peak: 50 mA max.
Control output		NPN voltage output Load power supply voltage: 5 to 24 VDC Load current: 80 mA max. OFF current: 0.5 mA max. 80 mA load current with a residual voltage of 1.0 V max. 10 mA load current with a residual voltage of 0.4 V max.
Response frequency *3		100 Hz min.
Ambient illumination		3,000 lx max. with incandescent light or sunlight on the surface of the receiver
Ambient temperature range		Operating: −10 to +55°C Storage: −25 to +65°C
Ambient humidity range		Operating: 5% to 85% Storage: 5% to 95%
Vibration resistance		Destruction: 10 to 55 Hz, 1.5-mm double amplitude for 2 h each in X, Y, and Z directions
Shock resistance		Destruction: 500 m/s^2 for 3 times each in X, Y, and Z directions
Degree of protection		IEC IP50
Connecting method		Special connector (soldering not possible)
Weight (packaged)		Approx. 3 g
Material	Case	Polycarbonate
	Lens	

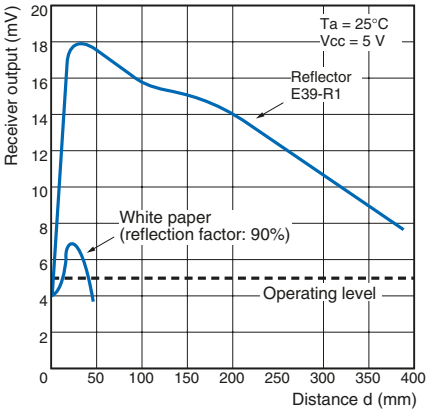
*1. Operation may not be possible near the sensor.
*2. The indicator is a GaP red LED (peak wavelength: 700 nm).
*3. The response frequency was measured by detecting the following rotating disk.



Engineering Data (Typical)

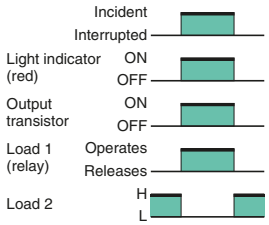
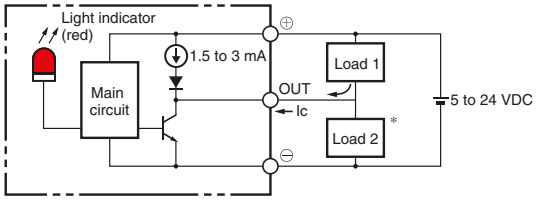
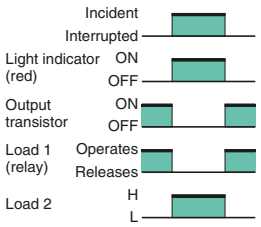
Receiver Output Excess Gain vs. Sensing Distance Characteristics

EE-SPZ301-A
EE-SPZ401-A } **+ E39-R1 Reflector**



I/O Circuits

NPN Output

Model	Output configuration	Timing charts	Output circuit
EE-SPZ401-A	Light-ON		
EE-SPZ301-A	Dark-ON		

* Voltage output (when the sensor is connected to a transistor circuit)

Safety Precautions

Refer to *Warranty and Limitations of Liability*.

⚠ WARNING

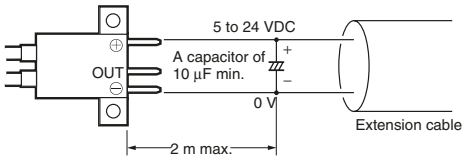
This product is not designed or rated for ensuring safety of persons either directly or indirectly. Do not use it for such purposes.

Precautions for Correct Use

Make sure that this product is used within the rated ambient environment conditions.

● Wiring

- Connection is made using a connector. Do not solder to the pins (leads).
- When extending the cable, use an extension cable with conductors having a total cross-section area of 0.3 mm^2. The total cable length must be 2 m maximum.
- To use a cable length longer than 2 m, attach a capacitor with a capacitance of approximately 10 μF to the wires as shown below. The distance between the terminal and the capacitor must be within 2 m. (Use a capacitor with a dielectric strength that is at least twice the Sensor's power supply voltage.)



- Make sure the total length of the power cable connected to the product is less than 10 m even if a capacitor is inserted.

EE-SPZ-A

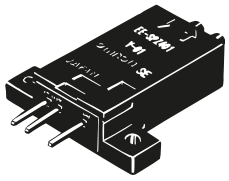
(Unit: mm)

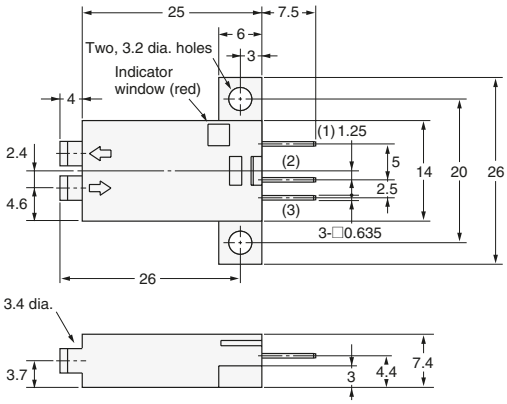
Dimensions

Tolerance class IT16 applies to dimensions in this datasheet unless otherwise specified.

Sensors

EE-SPZ301-A
EE-SPZ401-A





Terminal Arrangement

(1)	⊕	Vcc
(2)	**OUT**	OUTPUT
(3)	⊖	GND (0 V)

* Refer to *Accessories* for details.
* Refer to the *E39-L/F39-L/E39-S/E39-R Datasheet* for information on Reflectors.

Pipe-mounting Liquid Level Photomicrosensor with Built-in Amplifier

EE-SPX613

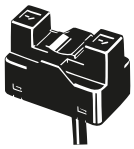
Liquid Level Photomicrosensor with operation mode and sensitivity selectors for easy application.

- Operation mode selector allows modes to be switched easily.
- Sensitivity selector is suitable for any 6- to 13-mm-diameter transparent or semi-transparent pipe with a wall thickness of 1 mm.
- Uses a clean (with no powder parting agent) cable.
- Operating voltage range: 12 to 24 VDC

CE

⚠ Be sure to read *Safety Precautions* on page 109.

Ordering Information

Appearance	Sensing method	Output type	Output configuration	Cable length	Model
	Through-beam type	NPN output	Dark-ON or Light-ON (selectable)	1 m	**EE-SPX613 1M**

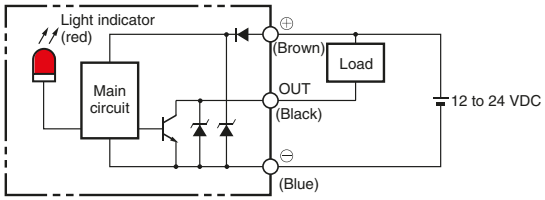
EE-SPX613

Ratings and Specifications

Item / Models		EE-SPX613
Applicable pipe		Any 6- to 13-mm-diameter pipe with a wall thickness of 1 mm that is made of FEP or any other material as transparent as FEP.
Sensing object		Liquids in pipes (High-viscosity liquids or liquids with floating materials may not be detected.)
Light source		GaAs infrared LED with a peak wavelength of 940 nm
Indicator		Light indicator GaP (Red LED: Peak wavelength of 700 nm)
Supply voltage		12 to 24 VDC ±10%, ripple (p-p): 5% max.
Current consumption		Average: 30 mA max., Peak: 80 mA max.
Control output		NPN open collector: Load power supply voltage: 5 to 24 VDC Load current: 100 mA max. OFF current: 0.5 mA max. 100 mA load current with a residual voltage of 0.8 V max. 40 mA load current with a residual voltage of 0.4 V max.
Ambient illumination		3,000 lx max. with incandescent light or sunlight on the surface of the receiver
Ambient temperature range		Operating: −10 to +55°C Storage: −25 to +65°C (with no icing or condensation)
Ambient humidity range		Operating: 5% to 85% Storage: 5% to 95% (with no condensation)
Vibration resistance		Destruction: 10 to 500 Hz, 1.0-mm single amplitude or 150 m/s^2 in X, Y, and Z directions 3 times and for 11 min each
Shock resistance		Destruction: 500 m/s^2 for 3 times each in X, Y, and Z directions
Degree of protection		IEC 60529 IP50
Connecting method		Pre-wired (Standard length: 1 m)
Weight (packed state)		Approx. 55 g
Material	Case	Polycarbonate
	Cover	
Accessories		Support belt (2), slip protection tube (2), Instruction Manual

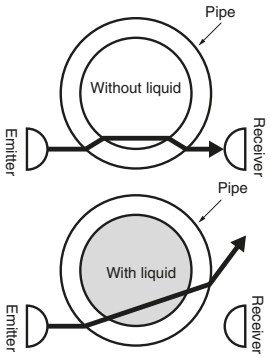
I/O Circuit Diagrams

NPN Output

Model	Output configuration	Timing charts	Operation mode selector	Output circuit
EE-SPX613	Dark-ON	Incident (with no liquid) Interrupted (with liquid) Light indicator (red): ON / OFF Output transistor: ON / OFF Load (relay): Operates / Releases	D·ON (DARK ON)	
	Light-ON	Incident (with no liquid) Interrupted (with liquid) Light indicator (red): ON / OFF Output transistor: ON / OFF Load (relay): Operates / Releases	L·ON (LIGHT ON)	

Operation

The EE-SPX613 detects the level of liquid by detecting the difference in refractive index between the air and liquid.



1. If there is no liquid in the pipe, the emitted beam will reach the receiver after it is refracted by the pipe. (Light incident.)

2. If there is liquid in the pipe, the emitted beam will pass through the liquid and not reach the receiver. (Light interrupted.)

Sensitivity selector (available only with EE-SPX613)

If the diameter of the pipe is close to 6 mm, some of the emitted beam may reach the receiver because the angle of refraction is small, thus making the stable operation of the EE-SPX613 difficult.
In such cases, set the sensitivity selector to Low and check that EE-SPX613 operation is stable.
If there are floating materials on the surface on the liquid, some of the emitted beam may reach the receiver after it is reflected by the floating materials, thus making the stable operation of the EE-SPX613 difficult. In such cases, set the sensitivity selector to Low to stabilize operation.
For normal use, set the sensitivity selector to High to account for reduced sensitivity caused by deterioration of the emitter due to age and stains on the pipe.

Safety Precautions

Refer to *Warranty and Limitations of Liability*.

⚠ WARNING

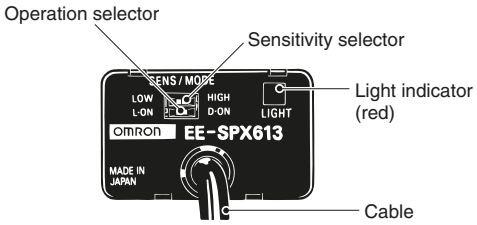
**This product is not designed or rated for ensuring safety of persons either directly or indirectly.
Do not use it for such purposes.**

Precautions for Correct Use

Make sure that this product is used within the rated ambient environment conditions.

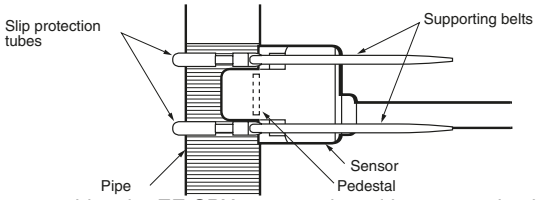
● Nomenclature

EE-SPX613



● Mounting

- The EE-SPX613 may not operate correctly if it is attached to an unsuitable pipe (e.g., opaque pipe).
- Always use the supporting belts and slip protection tubes that are provided with the EE-SPX613 when attaching the EE-SPX613 to a pipe, as shown in the following illustration, and make sure that the pipe is in the center of the sensor slot and not separated from the pedestal. When tightening the supporting belts, make sure that the pipe will not be deformed.



- When attaching the EE-SPX613 to a pipe with a supporting belt, make sure that the pipe will not be deformed.

● Wiring

- Do not impose any excessive force on the cable. Do not pull the cable with any tractive force exceeding 30 N.
- When extending the cable, use an extension cable with conductors having a total cross-section area of 0.15 mm^2. The total cable length must be 5 m maximum.

● Adjustment

- The EE-SPX613 requires 10 ms to be in stable operation after power is supplied.
  If separate power supplies are used for the EE-SPX613 and load, be sure to supply power to the EE-SPX613 before supplying power to the load.
- Make sure that smoke, air bubbles, or water droplets are not able to form either inside or outside the pipe. Otherwise, a malfunction may occur.
- Do not impose any force exceeding 5 N on the operation mode selector or sensitivity selector.

● Others

Operating Environment

- Do not use the EE-SPX613 outdoors.
- Do not use the EE-SPX613 in places where water, oil, or chemical may be sprayed onto the EE-SPX613.
  The exterior coverings of the EE-SPX613 are made of polycarbonate. Keep the coverings away from any alkaline, aromatic hydrocarbon, or aliphatic chloride hydrocarbon solvents, all of which will damage the coverings.
- Do not use the EE-SPX613 in places where the EE-SPX613 is subject to direct sunlight, corrosive gas or salt air.

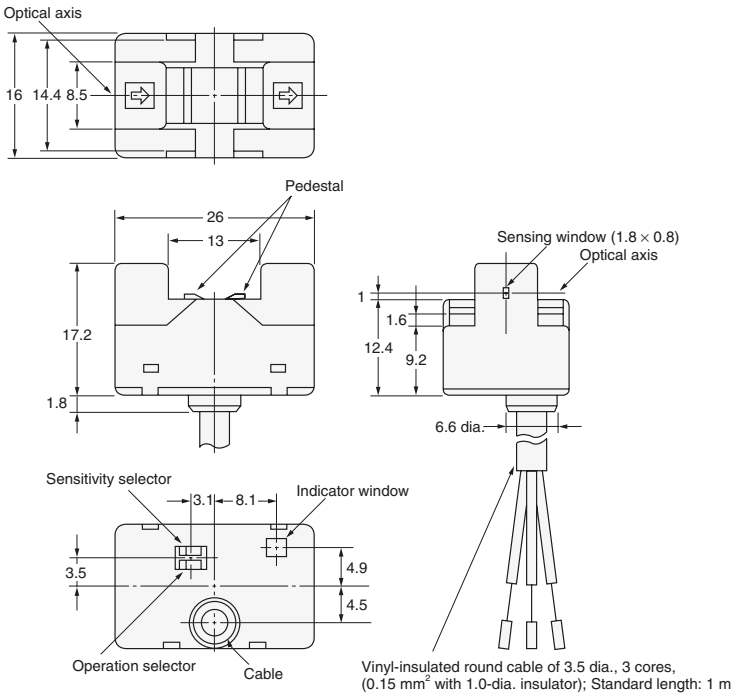
EE-SPX613

(Unit: mm)

Dimensions

Tolerance class IT16 applies to dimensions in this datasheet unless otherwise specified.

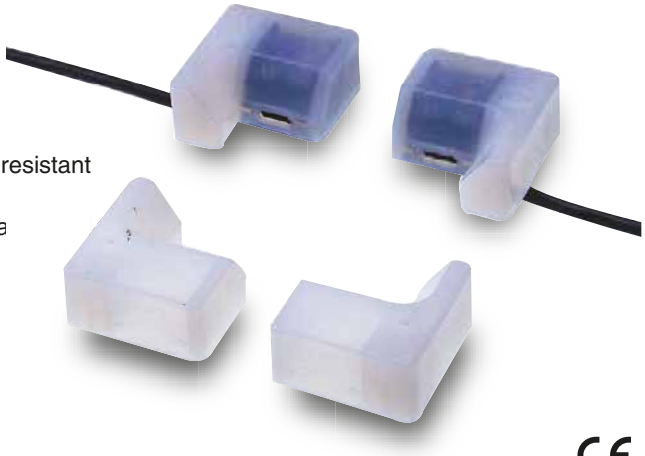
EE-SPX613



Wafer-carrier Mounting Photomicrosensors

EE-SPY801/802

Photomicrosensors for detecting wafer-carrier mounting.



- The mounting position is set with a pedestal.
- The contact surface with the wafer carrier uses a special chemical-resistant fluororesin.
- The unique optical system enables stable detection of almost all wa
- Light modulation effectively reduces external light interference.
- Utilizes talc-free clean cables.

CE

⚠ Be sure to read *Safety Precautions* on page 113.

Ordering Information

Sensors

Infrared light

Appearance	Sensing method	Sensing distance	Output configuration	Cable length	Model
	Reflective type	0 to 3 mm	Turns ON when wafer carrier is present.	2 m	**EE-SPY801 2M**
					**EE-SPY802 2M**

Accessories (Order Separately)

Item	Model
Pedestal	**EE9-C01**
	EE9-C02

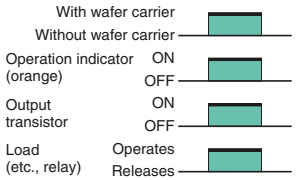
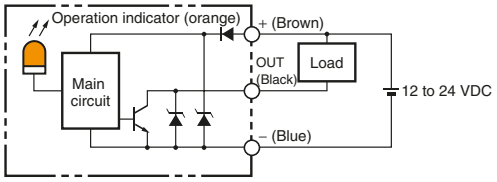
Note: There are no sensor functions provided.

EE-SPY801/802

Ratings and Specifications

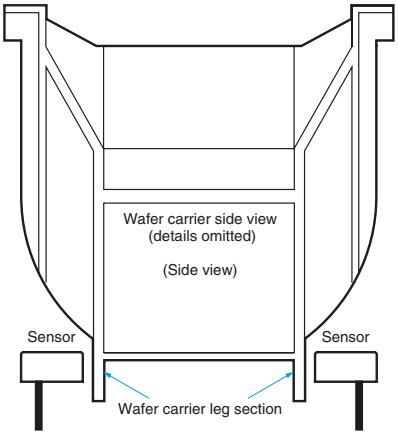
Item / Models		EE- SPY801/802
Sensing distance (Standard sensing object)		0 to 5 mm (White paper: 15 × 15 mm², reflection factor: 90%) 0 to 3 mm (Black paper: 15 × 15 mm², reflection factor: 10%)
Sensing object		Transparent or opaque wafer carriers
Operation indicator		Lit orange when object is detected.
Light source		GaAs infrared LED with a peak wavelength of 940 nm
Supply voltage		12 to 24 VDC ±10%, ripple (p-p): 5% max.
Current consumption		30 mA max.
Control output		NPN open collector: Load power supply voltage: 5 to 24 VDC Load current: 100 mA max. OFF current: 0.5 mA max. 100 mA load current with a residual voltage of 0.8 V max. 40 mA load current with a residual voltage of 0.4 V max.
Response time		5 ms max.
Ambient illumination		3,000 lx max. with incandescent light or sunlight on the surface of the receiver
Ambient temperature range		Operating: −10 to +55°C Storage: −25 to +65°C (with no icing)
Ambient humidity range		Operating: 5% to 85% Storage: 5% to 95% (with no condensation)
Vibration resistance		Destruction: 1 to 500 Hz, 1.0-mm single amplitude or 150 m/s² each in X, Y, and Z directions 3 times and for 11 min. each
Shock resistance		Destruction: 500 m/s² for 3 times each in X, Y, and Z directions
Degree of protection		IEC IP30
Connecting method		Pre-wired (Standard length: 2 m)
Weight (packaged)		Sensor: Approx. 43 g; Accessory (Pedestal): Approx. 9 g
Material	Case	Ethylene tetrafluoro ethylene (ETFE)
	Base plate	Polybutylene phthalate (PBT)
Accessories		Instruction Manual

I/O Circuit Diagrams

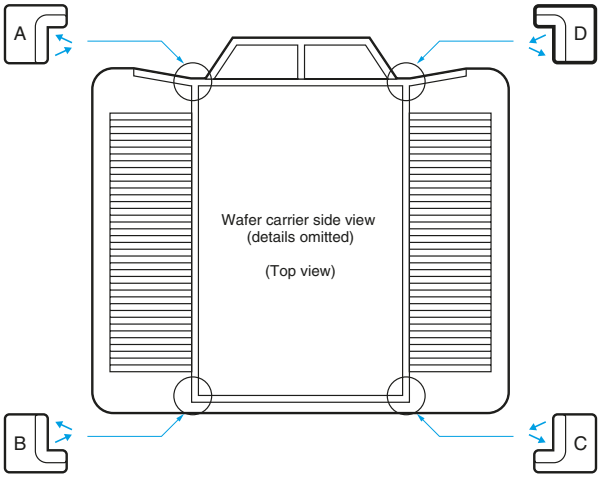
Model	Output configuration	Timing charts	Output circuit
EE-SPY801 EE-SPY802	Turns ON when wafer carrier is present.		

Standard Usage

This sensor is designed to detect wafer-carrier mountings. The bottom of the wafer carrier has a ribbed construction for the leg section, as shown in the following diagram. The EE-SPY801/802 detects the wafer-carrier mounting using a reflective optical sensor that detects the leg section of the wafer-carrier.



Install a Sensor (or Pedestal) at each of the four corners indicated by a circle in the following diagram.



A and C	EE-SPY801 or EE9-C01
B and D	EE-SPY802 or EE9-C02

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

Make sure that this product is used within the rated ambient environment conditions.

● Wiring

When extending the cable, use an extension cable with conductors having a total cross-section area of 0.15 mm^2 (AWG26 equivalent). The total cable length must be 5 m maximum.
To use a cable length longer than 5 m, attach a capacitor with a capacitance of approximately 10 μF to the wires as shown below. The distance between the terminal and the capacitor must be within 5 m.

● Mounting

Mount the Photomicrosensors securely on a flat surface, and tighten the mounting screws using a tightening force of 0.30 N·m max. (Using a spring washer is recommended to prevent the screws from becoming loose.)

● Adjustment

The EE-SPY801/802 requires 10 ms to be in stable operation after power is supplied.
If separate power supplies are used for the EE-SPY801/802 and load, be sure to supply power to the EE-SPY801/802 before supplying power to the load.

● Operating Environment

Do not use the EE-SPY801/802 in locations subject to salty air or corrosive gases, such as hydrogen chloride gas.

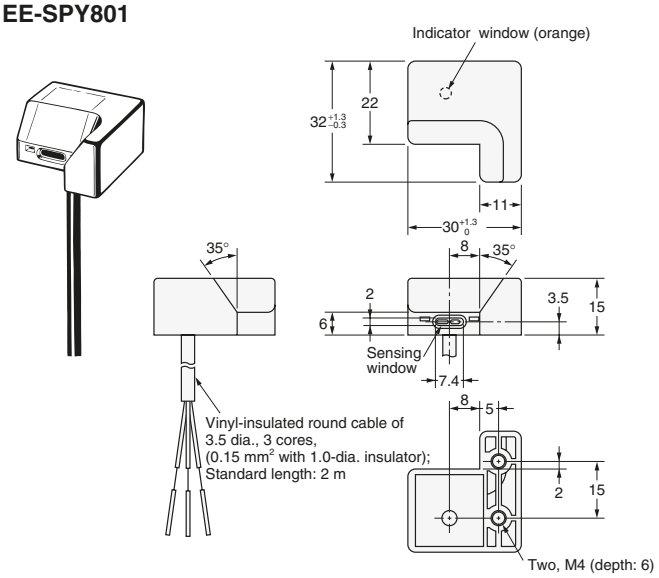
(Unit: mm)

Dimensions

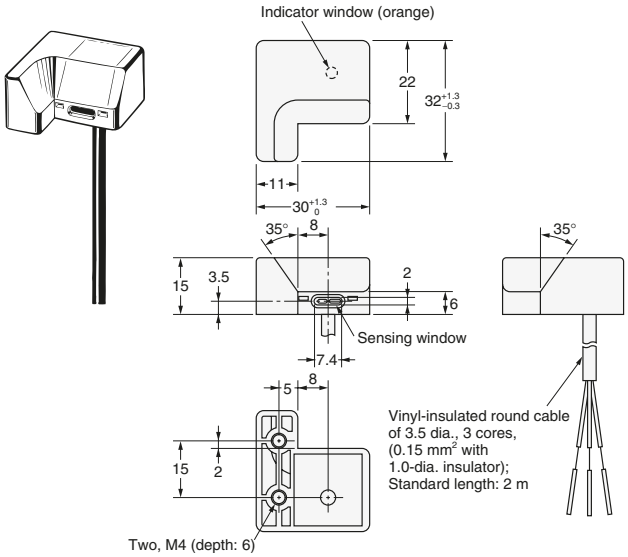
Tolerance class IT16 applies to dimensions in this datasheet unless otherwise specified.

Sensors

EE-SPY801



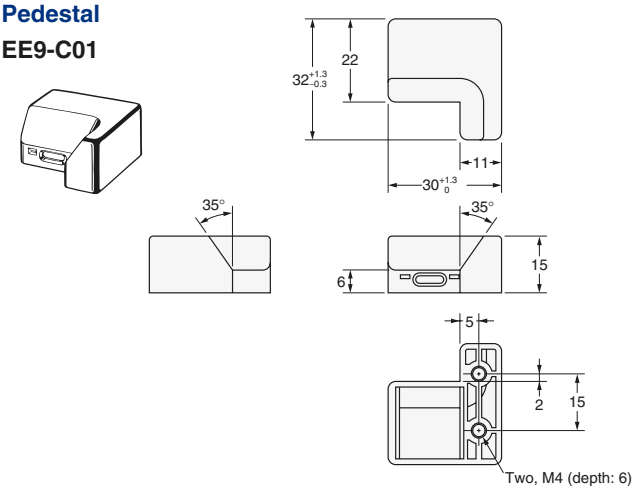
EE-SPY802



Accessories (Order Separately)

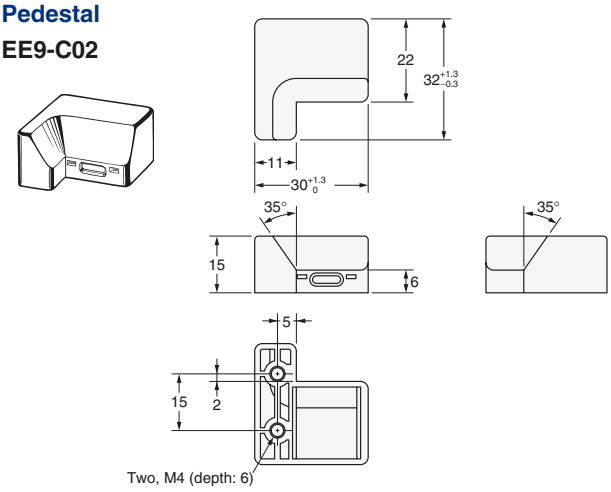
Pedestal

EE9-C01



Pedestal

EE9-C02



Pushbutton-type Photomicrosensor

EE-SA701/801

Using a pushbutton enables accurately detecting difficult-to-detect objects.

- Conforms to standards for semiconductor FOUP cassettes to enable accurately detecting FOUP cassettes without being affected by the material, color, or reflectance of the bottoms of the cassettes.
- Thin design enables mounting in a wider range of applications, e.g., on transfer arms.
- Increased visibility with 4-direction indicator.
- Optical detection of actuator operation provides a long life (mechanical life: 5 million operations min.).
- Models available with PNP or NPN output.
- Models are available with very flexible robot cable.

⚠ Be sure to read *Safety Precautions* on page 119.

Ordering Information

List of Models

Appearance	Sensing distance	Sensing method	Operation mode	Cable length	Model	
					NPN output	PNP output
	[ ] (See note 2.) 0 to 3.5 mm (pressed position) (See note 1.)	Pushbutton	ON with no load	1 m	**EE-SA801A 1M**	**EE-SA801R 1M**
				1 m (robot cable)	**EE-SA801A-R 1M**	**EE-SA801R-R 1M**
			OFF with no load		**EE-SA701-R 1M**	**EE-SA701P-R 1M**

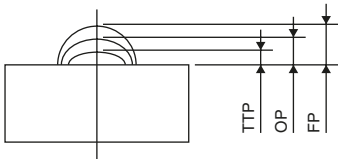
Note: 1. Distance from the top surface of the housing to the top of the actuator.
2. Output reverses between 3.5 and 4.5 mm.

EE-SA701/801

Ratings and Specifications

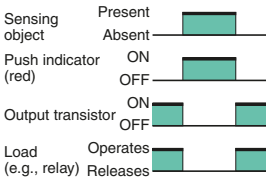
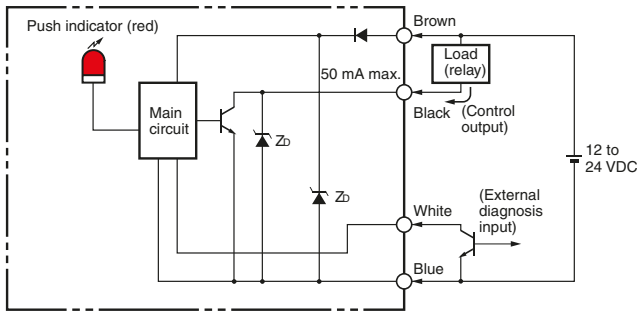
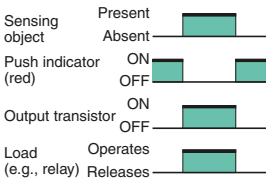
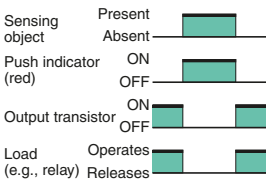
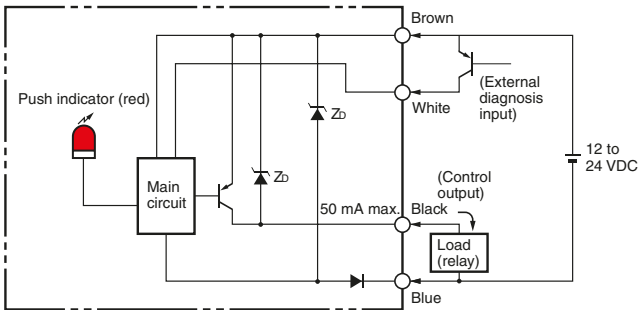
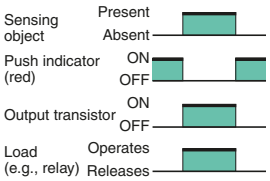
Item	Model	NPN output / PNP output	EE-SA801A / EE-SA801R	EE-SA801A-R / EE-SA801R-R	EE-SA701-R / EE-SA701P-R
Indicator			Lights red when actuator is pressed.		Lit red while there is no load on actuator
Operation Specifications (See note 1.)	Free position (FP)		5.0±0.4 mm		
	Operating position (OP)		3.5 to 4.5 mm (See note 2.)		
	Total travel position (TTP)		0 mm max.		
Operating load (See note 3.)			3 N max. (typical: 0.5 N)		
Supply voltage			12 to 24 VDC±10%, ripple (p-p): 10% max.		
Current consumption			35 mA max.		
Control output			NPN Models: NPN open collector, 5 to 24 VDC, 50 mA max.; residual voltage of 0.4 V max. at 50-mA load current OFF current: 0.5 mA max. PNP Models: PNP open collector, 5 to 24 VDC, 50 mA max.; residual voltage of 0.4 V max. at 50-mA load current OFF current: 0.5 mA max.		
External diagnosis input		Input	NPN Models Emission OFF: Shorted to 0 V or 0.5 V max. (source current: 30 mA max.) Emission ON: Open (leakage current: 0.4 mA max.) PNP Models Emission OFF: Shorted to +DC or +DC-0.5 V max. (sink current: 30 mA max.) Emission ON: Open (leakage current: 0.4 mA max.)		
		Response time	1 ms max.		
Protection circuits			Reversed power supply polarity protection		
Ambient temperature range			Operating: −25 to +55°C Storage: −30 to +60°C (with no icing or condensation)		
Ambient humidity range			Operating: 5% to 85% Storage: 5% to 95% (with no condensation)		
Mechanical durability			5,000,000 operations min. (One operation is from the free position to operating position and back to the free position.)		
Vibration resistance			Destruction: 10 to 500 Hz, 1.0-mm single amplitude or 150 m/s² 3 times each in X, Y, and Z directions for 11 min. each		
Shock resistance			Destruction: 500 m/s² for 3 times each in X, Y, and Z directions		
Degree of protection			IEC IP40		
Connecting method			Pre-wired (standard cable length: 1 m)	Pre-wired (robot cable length: 1 m)	
Weight			Approx. 16.1 g		
Material	Case		Polycarbonate		
	Actuator		Polyacetal		
Accessories			Instruction Manual		

Note: 1. Free position (FP): The position of the top of the actuator when no force is being applied to the actuator.
Operating position (OP): The position of the top of the actuator when the actuator is pressed and the output transistor changes from OFF to ON for the EE-SA701-R/-SA701P-R and from ON to OFF for all other models.
Total travel position (TTP): The position of the top of the actuator when the actuator is pressed as far as it can be pressed.



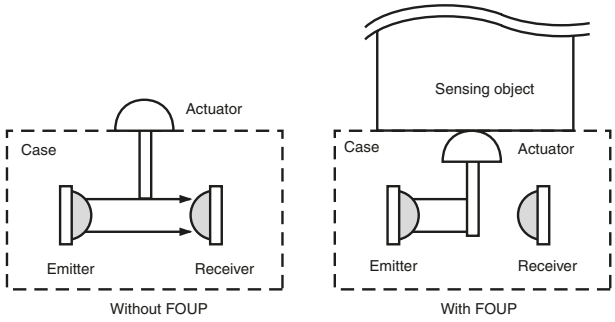
2. This does not indicate that the output will be ON from 3.5 to 4.5 mm, but rather that the output will change from ON to OFF at some point between 3.5 and 4.5 mm.
3. The force required to press the actuator from the FP to the OP.

I/O Circuit Diagrams

Model	Operating Mode	Timing chart	Output circuit
EE-SA801A EE-SA801A-R	ON with no load		
EE-SA701-R	OFF with no load		
EE-SA801R EE-SA801R-R	ON with no load		
EE-SA701P-R	OFF with no load		

Operating Principles

This is a pushbutton-type sensor. An emitter (GaAs infrared LED) and receiver (Si photo IC) are positioned across from each other inside the sensor and light is received when there is no sensing object. When the sensing object presses the actuator, the light path between the emitter and receiver is broken so that the receiver no longer receives light.

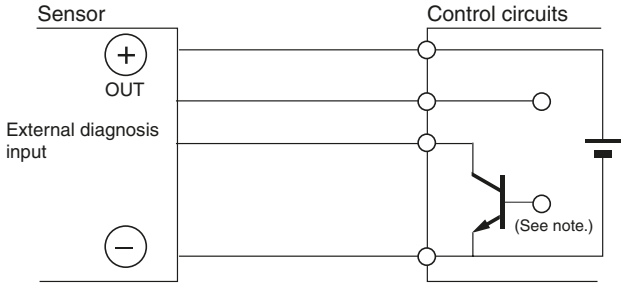


This Sensor provides an external diagnosis function and stability checking function.

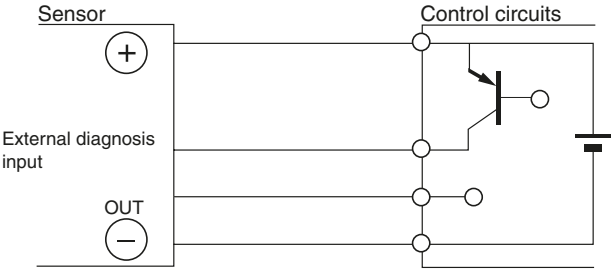
(1) External Diagnosis Function

The light emission from the LED can be stopped by using the following circuit configuration. This enables checking the operation of the receiver by turning the LED ON and OFF when there is no load.

EE-SA801A/-SA-801A-R/-SA701-R



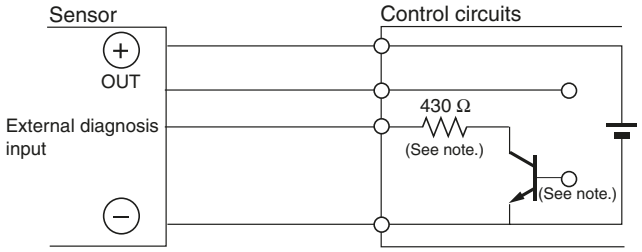
EE-SA801R/-SA-801R-R/-SA701P-R



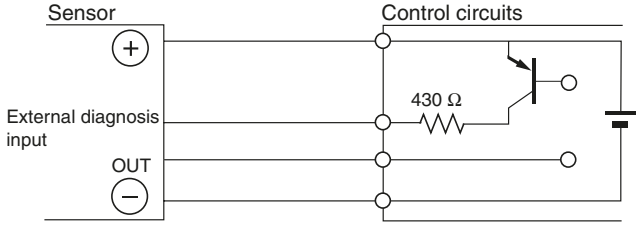
(2) Stability Checking Function

The light intensity emitted by the LED can be reduced by 20% by using the following circuit configuration. By doing so, the light reception operation at 80% light intensity with no sensing object (same as 100%, i.e., the output transistor should turn ON) can be tested in advance to check for malfunctions caused by deterioration of LED light intensity.

EE-SA801A/-SA-801A-R/-SA701-R



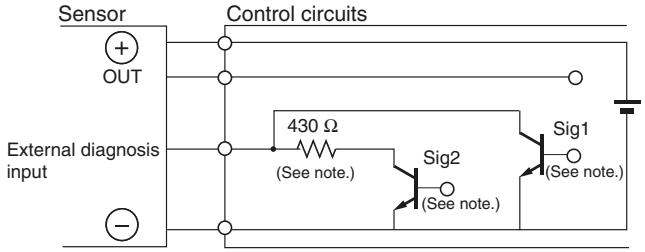
EE-SA801R/-SA-801R-R/-SA701P-R



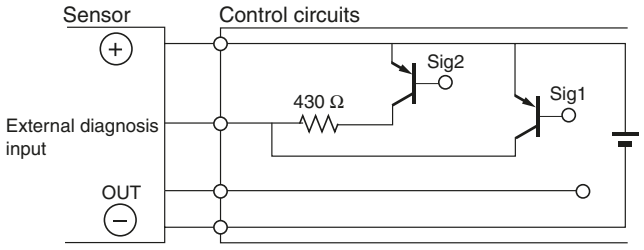
(3) Using Both Functions Simultaneously

Use the following circuit configuration when both the external diagnosis function (Sig1) and the stability checking function (Sig2) are required.

EE-SA801A/-SA-801A-R/-SA701-R



EE-SA801R/-SA-801R-R/-SA701P-R



Note: Use a transistor that is capable of switching 50 mA at 10 V. The resistor must have a power rating of 1/8 W min.

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

Make sure that the Photomicrosensor is used within the rated ambient environment conditions.

● Mounting

Mount the Photomicrosensor securely on a flat surface using M3 pan head screws, and tighten the mounting screws using a tightening force of 0.59 N·m max.

Adjustment

The EE-SA801 requires 10 ms to be in stable operation after power is supplied. If separate power supplies are used for the EE-SA801 and load, be sure to supply power to the EE-SA801 before supplying power to the load.

Operating Environment

- The EE-SA801 is not watertight. Do not use the EE-SA801 outdoors.
- Do not use the EE-SA801 in places where water, oil, or chemical may be sprayed onto the EE-SA801. The exterior coverings of the EE-SA801 are made of polycarbonate. Keep the coverings away from any alkaline, aromatic hydrocarbon, or aliphatic chloride hydrocarbon solvents, all of which will damage the coverings.

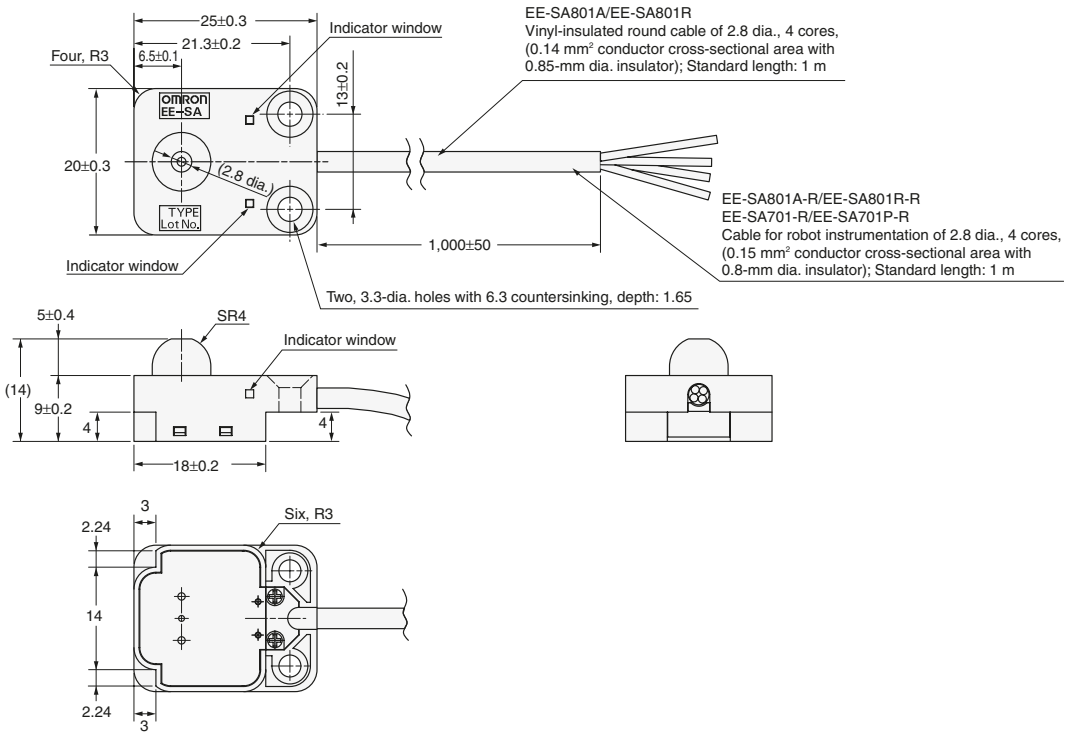
(Unit: mm)

Dimensions

Tolerance class IT16 applies to dimensions in this datasheet unless otherwise specified.

Sensor

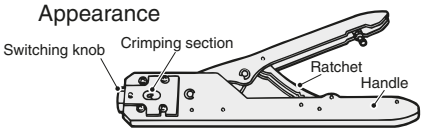
EE-SA801A/-SA801A-R
EE-SA801R/-SA801R-R
EE-SA701-R
EE-SA701P-R



Accessories (Order Separately)

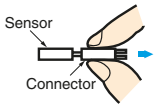
Ordering Information
Connectors and Connector Hold-down Clips

Applicable Sensor models
EE-SX67□ (A, P, R), EE-SX47□, EE-SY67□, EE-SPY31□/41□, EE-SPX303N/403N, EE-SPW311/411

Type		Cable length	Model	Remarks
Connector			EE-1001	
			EE-1001-1	L terminal and positive (+) terminal are already short-circuited.
			EE-1009 *1	
	Connector with Cable	1 m	EE-1006	4 conductors
			EE-1010 *1	
		2 m	EE-1006	4 conductors
			EE-1006D	3 conductors
			EE-1006L	2 conductors
			EE-1010 *1	
	Connector with Robot Cable	1 m	EE-1010-R *1	
		2 m	EE-1010-R *1	
NPN/PNP Conversion Connector		0.46 m (total length)	EE-2002	
Connector Hold-down Clip			EE-1006A	For EE-1006, EE-SX670□, 470, EE-SY671, and 672 only.
Connector Parts *2	Case (housing)		EE-1006H	100 per carton
	Dispersion Pins		EE-1006C	500 per carton
	Special Crimping Tool		EE-1006T	Appearance 

*1. EE-1009- or EE-1010-series Connectors have a builtin locking mechanism to prevent cable disconnection when only the cable is pulled. To remove the Connector from the Sensor, grip the top and bottom of the Connector firmly and push into the Sensor once before pulling out. The locking mechanism prevents the Connector from being removed by pulling on the cable only and enables removal only when the Connector (housing) is pulled.

*2. The case (housing) and dispersion pins (for hand-crimping) for EE-1006 Connectors can be ordered separately. Use the EE-1006T Special Crimping Tool to prepare the Connector.



Applicable Sensor models
EE-SX97□-C1, EE-SX97□P-C1

Item	Cable length	Model	Remarks
Connector with Cable	1 m	EE-1017 1M	
	3 m	EE-1017 3M	
Connector with Robot Cable	1 m	EE-1017-R 1M	
	3 m	EE-1017-R 3M	

Applicable Sensor models
EE-SX91□□-C1J-R (Pre-wired Connector)

Item	Cable length	Model	Remarks
Connector with Cable	2 m	EE-1016-R	The robot cable is standard for all models.

Applicable Sensor models
EE-SX67□□-C1J-R (Pre-wired Connector)

Item	Cable length	Model	Remarks
Connector with Cable	2 m	EE-1016-R-1	The robot cable is standard for all models.

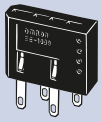
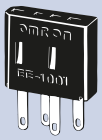
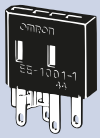
Applicable Sensor models
EE-SPX74□/84□

Item	Cable length	Model	Remarks
Connector with Cable	1 m	EE-1013	

Applicable Sensor models
EE-SPX301/401, EE-SPY30□/40□, EE-SPZ301□/401□

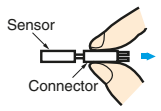
Item		Cable length	Model	Remarks
Connector			EE-1002	
	Connector with Cable	1 m	EE-1003	
NPN/PNP Conversion Connector		0.46 m (total length)	EE-2001	
Connector Hold-down Clip			EE-1003A	For EE-1003 only.

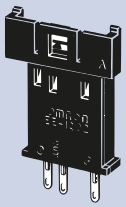
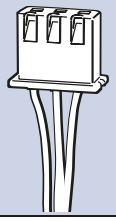
Ratings and Specifications

Item \ Product	Connector *1	Connector with Cable *1	Connector with Robot Cable *1	Connector	Connector (short-circuited between positive (+) and L terminals) *2	Connector with Cable
Model	EE-1009	EE-1010	EE-1010-R	EE-1001	EE-1001-1	EE-1006
Appearance						
Contact resistance	20 mΩ max. (at 20 mV max., 100 mA max.)			15 mΩ max. (at 100 VDC max.)		10 mΩ max. (100 VDC max.)
Insertion/removal durability	50 times min.			---		
Insertion strength	No. of poles × 6 N max.			50 N max.		
Surplus strength (housing holding strength)	No. of poles × 0.4 N max.			---		20 N max.
Standard cable length	---	2 m		---		2 m
Lock strength	No. of poles × 29 N min.			---		
Ambient humidity	–10 to +60°C			–10 to +75°C		–10 to 60°C
Material: Housing	Polybutylene phthalate (PBT)					
Material: Contact	Phosphor bronze (solder plating)					
Applicable Photomicrosensors	EE-SX67□ (A,P,R) (Connector Models only), EE-SX47□, EE-SY67□, EE-SPY31□/41□, EE-SPX303N/403N, EE-SPW311/411					

*1. The Connector has a built-in locking mechanism. To remove the Connector from the Sensor, grip the top and bottom of the Connector housing, as shown in the following diagram, and then pull out the Connector.

*2. EE-SX67□ and EE-SY67□ are the best used in the light-ON state.



Item \ Product	Connector	Connector with Cable	Connector with Cable	Connector with Cable	Connector with Robot Cable	Connector with Robot Cable	
Model	EE-1002	EE-1003	EE-1013	EE-1017	EE-1017-R	EE-1016-R	EE-1016-R-1
Appearance							
Contact resistance	10 mΩ max. (at 10 mADC and 1 ADC)	20 mΩ max. (at minute current of 1 kHz and 500 VDC)		25 mΩ max. (at 10 mA DC and 20 mV max.)			
Insertion strength	20 N max.	23.5 N max.	40 N max.	20 N max.			
Surplus strength (housing holding strength)	15 N min. (initial) 10 N min. (ten times)	3.5 N min.	10 N min.	1.5 N min.		15 N min.	
Cable length	---	1 m		1 m, 3 m		2 m	
Ambient humidity	–10 to +75°C	–10 to +60°C	–10 to +55°C	–10 to +60°C		–25 to +85°C	
Material: Housing	Nylon						
Material: Contact	Phosphor bronze (solder plating)						
Applicable Photomicrosensors	EE-SPX301/401, EE-SPY30□/40□, EE-SPZ301□/401□		EE-SPX74□/84□	EE-SX97□C1, EE-SX97□P-C1		EE-SX91□-C1J-R (Pre-wired Connector)	EE-SX67□-C1J-R (Pre-wired Connector)

(Unit: mm)

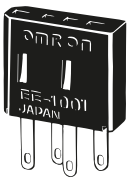
Dimensions

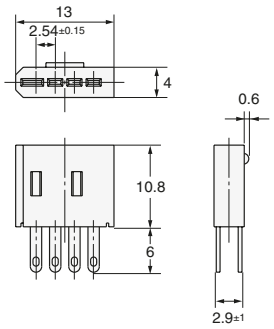
Tolerance class IT16 applies to dimensions in this datasheet unless otherwise specified.

Photomicrosensor Connectors and Connector Hold-down Clips

Connector

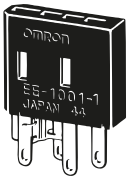
EE-1001

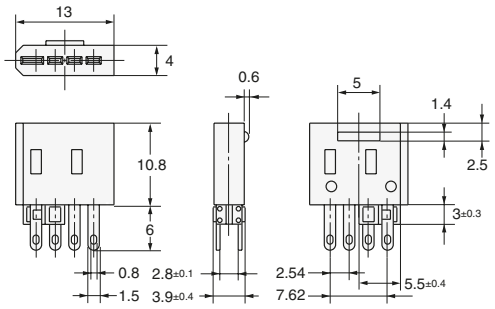




Connector (short-circuited between positive (+) and L terminals)

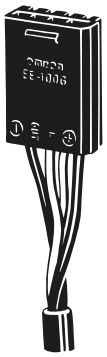
EE-1001-1

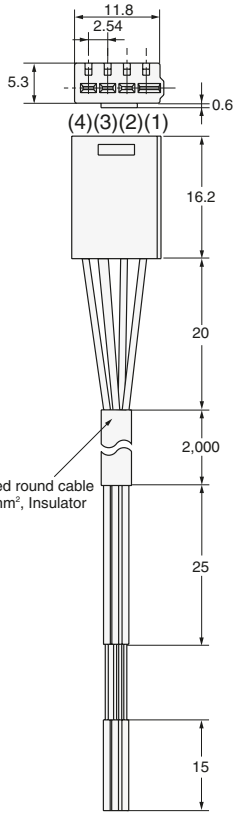




Connector with Cable

EE-1006





Cable:
4-dia. 4-conductor vinyl-insulated round cable
(Conductor cross section: 0.2 mm², Insulator diameter: 1.1 mm).

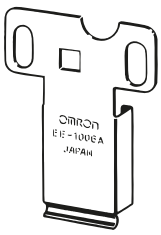
Terminal Arrangement

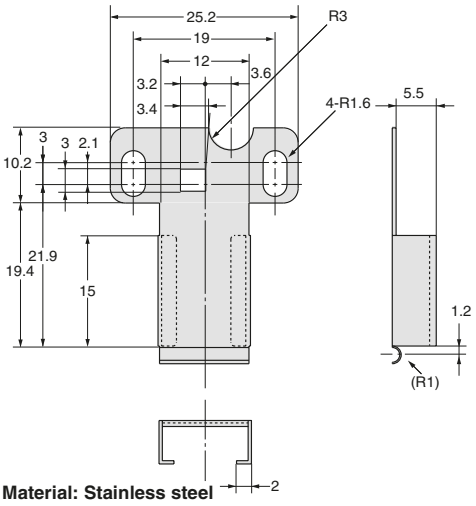
(1)	⊕	Brown
(2)	L	Pink
(3)	OUT	Black
(4)	⊖	Blue

Connector Hold-down Clip

EE-1006A

(Can be used only with EE-1006 Connectors for the Photomicrosensors listed below.)





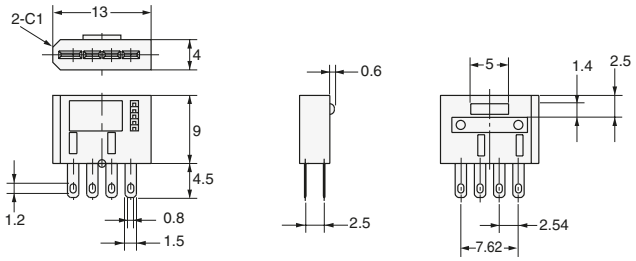
Material: Stainless steel

Applicable Photomicrosensors	EE-SX67□ (A,P,R) (Connector Models only), EE-SX47□, EE-SY67□, EE-SPY31□/41□, EE-SPX303N/403N, EE-SPW311/411	For EE-SX670□, 470□, EE-SY671, and 672 only.

Photomicrosensor Connectors

Connectors

EE-1009

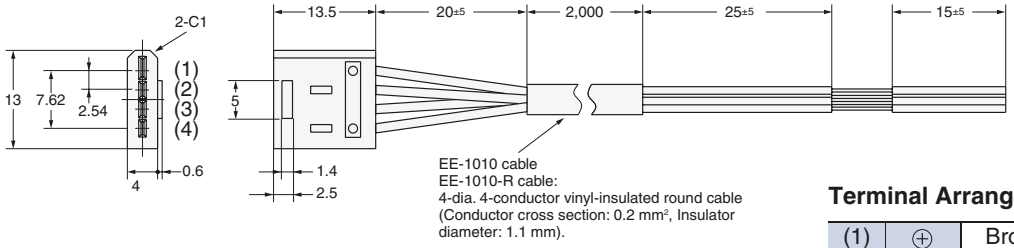


Connector with Cable

EE-1010

Connector with Robot Cable

EE-1010-R



Terminal Arrangement

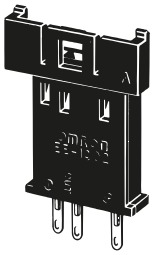
(1)	⊕	Brown
(2)	L	Pink
(3)	OUT	Black
(4)	⊖	Blue

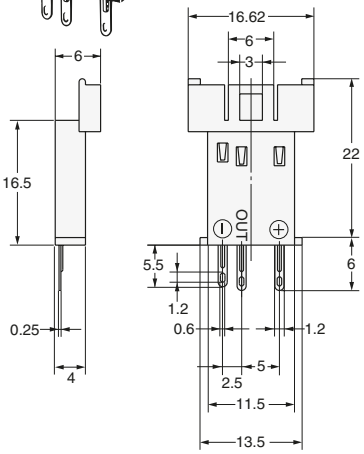
Applicable Photomicrosensors	EE-SX67□ (A,P,R) (Connector Models only), EE-SX47□, EE-SY67□, EE-SPY31□/41□ EE-SPX303N/403N, EE-SPW311/411

Photomicrosensor Connectors and Connector Hold-down Clips

Connector

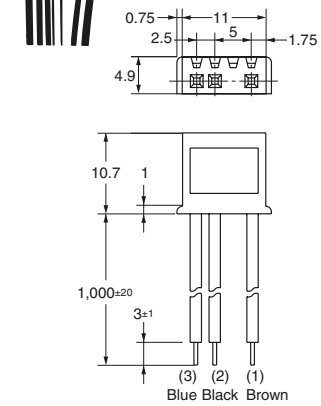
EE-1002





Connector with Cable

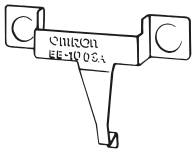
EE-1003

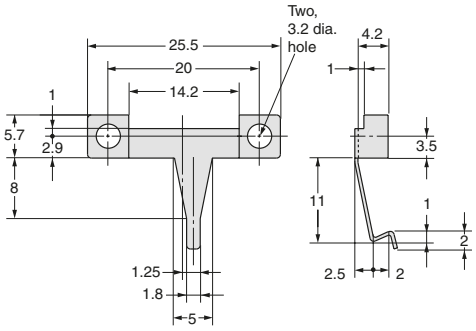


Cable:
1.61-dia. 1-conductor vinyl-insulated round cable
(Conductor cross section: 0.33 mm²).

Connector Hold-down Clips (For EE-1003 only)

EE-1003A

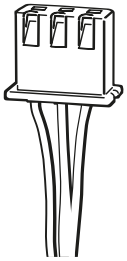


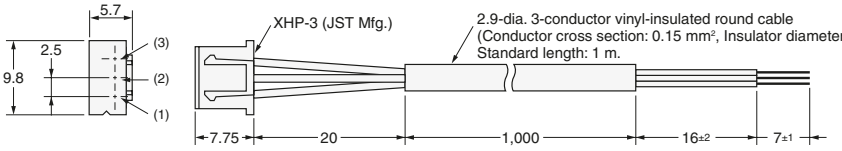


Applicable Photomicrosensors	EE-SPX301/401, EE-SPY30□/40□, EE-SPZ301□/401□

Connector with Cable

EE-1013





Terminal Arrangement

(1)	Blue	GND(0V)
(2)	Black	OUTPUT
(3)	Brown	Vcc

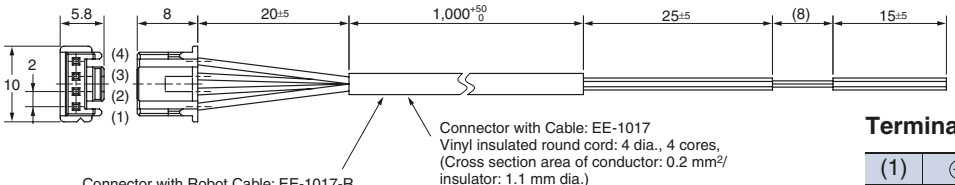
Applicable Photomicrosensors	EE-SPX74□/84□

Connector with Cable

EE-1017

Connector with Robot Cable

EE-1017-R



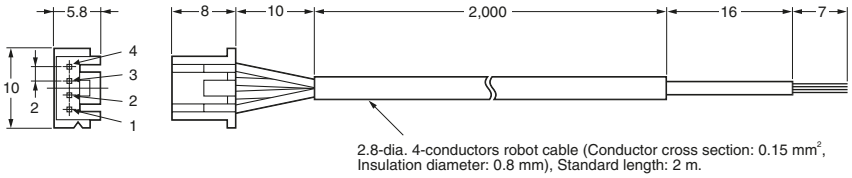
Terminal Arrangement

(1)	⊕	Brown
(2)	1	Black
(3)	2	White
(4)	⊖	Blue

Applicable Photomicrosensors	EE-SX97□-C1, EE-SX97□P-C1

Connector with Robot Cable

EE-1016-R



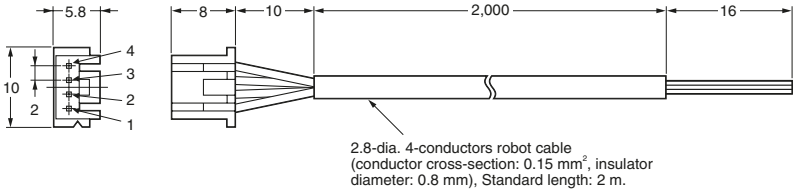
Terminal Arrangement

(1)	⊕	Brown
(2)	OUT2	White
(3)	⊖	Blue
(4)	OUT1	Black

Applicable Photomicrosensors	EE-SX91□-C1J-R (Models with Junction Connectors)

Connector with Cable (Connection with Robot Cable)

EE-1016-R-1



Terminal Arrangement

(1)	⊕	Brown
(2)	L	Pink
(3)	⊖	Blue
(4)	OUT	Black

Applicable Photomicrosensors	EE-SX67□-C1J-R EE-SX67□P-C1J-R

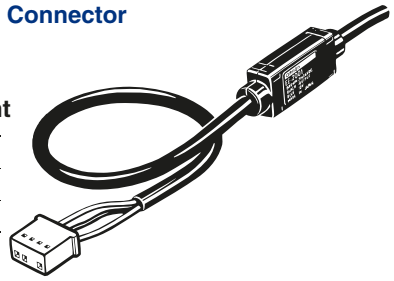
NPN to PNP Transistor Output Conversion Connectors

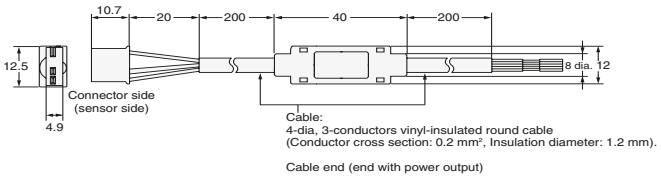
NPN/PNP Conversion Connector

EE-2001

Terminal Arrangement

(1)	⊕	Brown
(2)	OUT	Black
(3)	⊖	Blue



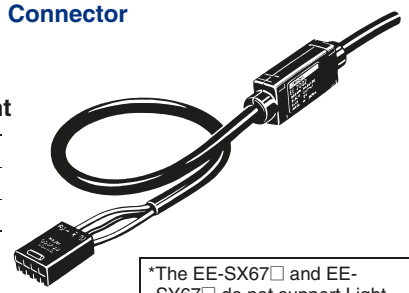


NPN/PNP Conversion Connector

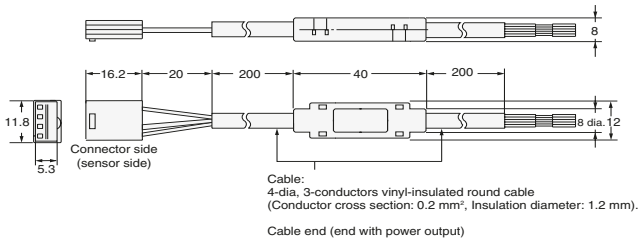
EE-2002 *

Terminal Arrangement

(1)	⊕	Brown
(2)	OUT	Black
(3)	⊖	Blue



*The EE-SX67□ and EE-SY67□ do not support Light-ON mode.



Applicable Photomicrosensors	EE-SPX301/401, EE-SPY30□/40□, EE-SPZ301□/401□	EE-SX67□ (A,P,R) (Connector Models only), EE-SX47□, EE-SY67□, EE-SPY31□/41□, EE-SPX303N/403N, EE-SPW311/411

MEMO

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