

OMRON

Omron

Micro Sensing Device Data Book

MICRO SENSING DEVICE DATA BOOK

Photomicrosensors
Microphotonic Devices



realizing

To the customer who buys Omron products

Warranty and Limited Warranty

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(EC300E)

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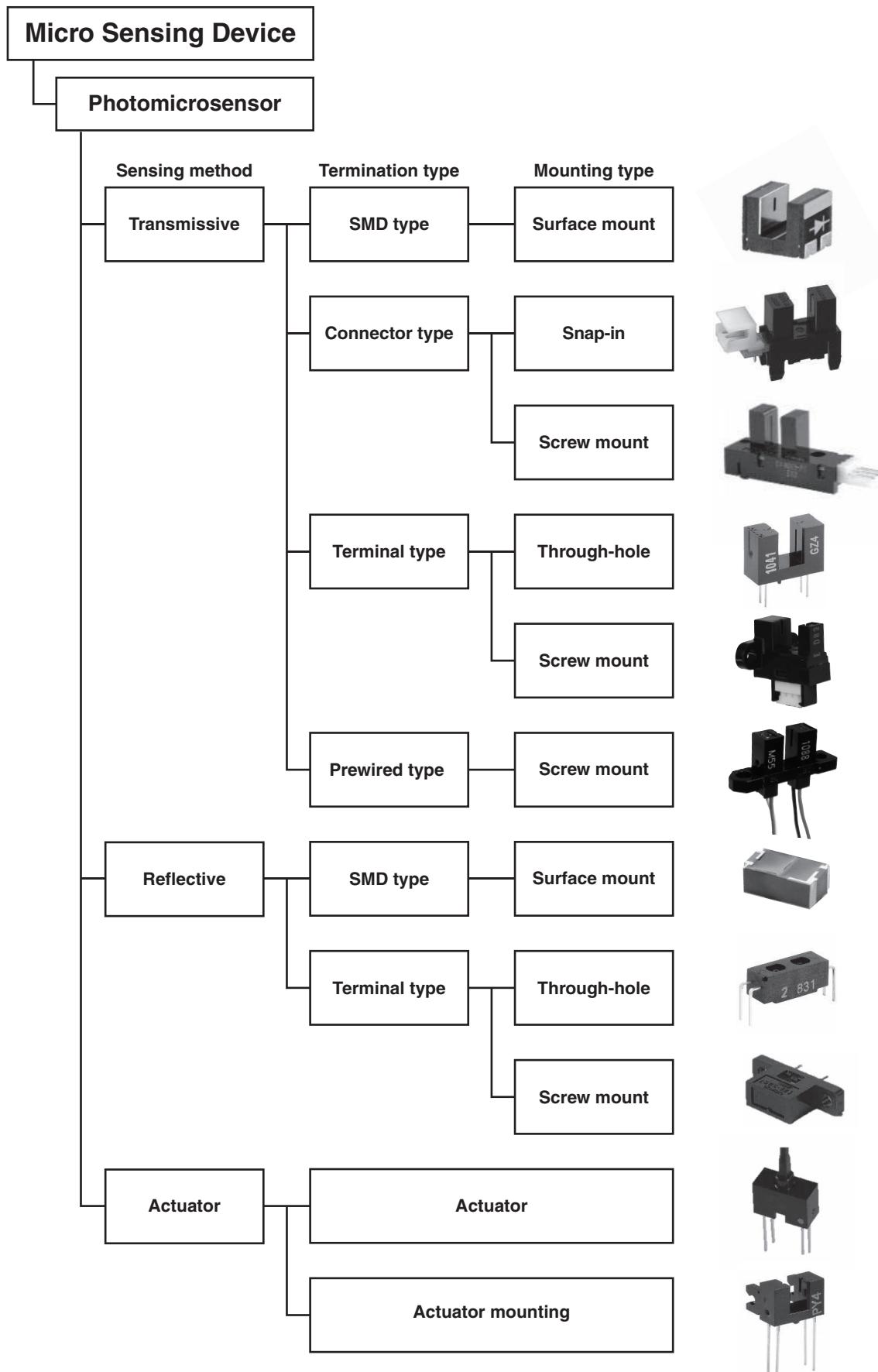
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Selection Guide



Selection Guide

■ Transmissive

Termination type	Mounting type	Sensing distance	Output configuration	Model	Features	Page	
SMD type	Surface mount	1.0 mm	Phototransistor	EE-SX1107	Ultra compact	28	
		2.0 mm	Phototransistor	EE-SX1108	Ultra compact	32	
				EE-SX1131	Ultra compact, 2CH Output	36	
		3.0 mm	Photo-IC	EE-SX4134	Ultra compact, Light-ON	40	
Connector type	Snap-in	5.0 mm	Phototransistor	EE-SX1235A-P2	General purpose	48	
			Photo-IC	EE-SX3239-P2	Dark-ON	50	
				EE-SX4235A-P2	Light-ON	52	
		15.0 mm	Photo-IC	EE-SX460-P1	Light-ON, Easy to mount	54	
	Screw mount	3.6 mm	Photo-IC	EE-SX3148-P1	Light-ON, Easy to mount	56	
		5.0 mm	Photo-IC	EE-SX3009-P1	Dark-ON	58	
				EE-SX4009-P1	Light-ON	60	
				EE-SX3157-P1	Dark-ON	62	
Terminal type	Through-hole	2.0 mm	Phototransistor	EE-SX1018	Compact	64	
				EE-SX1049	Compact, with a positioning boss	66	
				EE-SX1103	Ultra compact	68	
				EE-SX1105	Ultra compact	70	
			Photo-IC	EE-SX493	High-resolution, Light-ON	72	
		2.8 mm	Phototransistor	EE-SX1055	Compact	74	
		3.0 mm	Phototransistor	EE-SX1046	Horizontal aperture	76	
				EE-SX1106	Compact	78	
				EE-SX198	General purpose	80	
				EE-SX199	With a positioning boss	82	
		3.4 mm	Photo-IC	EE-SX301	Dark-ON	84	
				EE-SX401	Light-ON	86	
		3.5 mm	Phototransistor	EE-SX1071	General purpose	88	
		3.6 mm		EE-SX384	Dark-ON	90	
				EE-SX484	Light-ON	92	
		4.2 mm	Phototransistor	EE-SJ3-C	High power	94	
				EE-SJ3-D	High-resolution	96	
				EE-SJ3-G	Horizontal aperture	98	
				EE-SX1057	Dustproof	100	
		5.0 mm	Phototransistor	EE-SX1128	Horizontal aperture	102	
				EE-SJ5-B	General purpose	104	
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		8.0 mm	Photo-IC	EE-SX1137	With a positioning boss	114	
				EE-SX3081	Dark-ON	116	
		5.2 mm	Phototransistor	EE-SX4081	Light-ON	118	
				EE-SX1035	Compact	120	
		14.0 mm	Phototransistor	EE-SX1070	Wide slot, with a positioning boss	122	
				EE-SX3070	Wide slot, with a positioning boss, Dark-ON	124	
				EE-SX4070	Wide slot, with a positioning boss, Light-ON	126	

Termination type	Mounting type	Sensing distance	Output configuration	Model	Features	Page
Terminal type	Through-hole/ Screw mount	3.0 mm 3.4 mm	Phototransistor Photo-IC	EE-SX129	High-resolution	120
				EE-SH3/B	High-resolution	122
				EE-SH3-CS/C	High power	
				EE-SH3-DS/D	High-resolution	
				EE-SH3-GS/G	Horizontal aperture	
				EE-SV3/B	High-resolution	124
				EE-SV3-CS/C	High power	
				EE-SV3-DS/D	High-resolution	
				EE-SV3-GS/G	Horizontal aperture	
				EE-SX138	General purpose	126
				EE-SX153	Horizontal aperture	128
				EE-SX1088	General purpose	130
				EE-SX1096	Horizontal aperture	132
				EE-SX3088	Dark-ON	134
Prewired type	Screw mount	3.2 mm	Phototransistor Photo-IC	EE-SX4088	Light-ON	
				EE-SG3/-B	Dustproof	136
				EE-SX1161-W11	Dustproof	138
		3.4 mm	Phototransistor Photo-IC	EE-SX3161-W11	Dustproof, Dark-ON	140
				EE-SX4161-W11	Dustproof, Light-ON	
				EE-SX1088-W11	General purpose	142
			Phototransistor Photo-IC	EE-SX3088-W11	Dark-ON	144
				EE-SX4088-W11	Light-ON	
			Phototransistor Photo-IC	EE-SX1096-W11	Horizontal aperture	146
				EE-SX3096-W11	Horizontal aperture, Dark-ON	148
		9.5 mm	Phototransistor Photo-IC	EE-SX4096-W11	Horizontal aperture, Light-ON	
				EE-SX1160-W11	Wide slot	150
				EE-SX3160-W11	Wide slot, Dark-ON	152
				EE-SX4160-W11	Wide slot, Light-ON	

■ Reflective

Termination type	Mounting type	Sensing distance	Output configuration	Model	Features	Page
SMD type	Surface mount	1.0 mm/ 4.0 mm	Phototransistor	EE-SY1200	Ultra compact	154
Terminal type	Through-hole	3.5 mm	Phototransistor	EE-SY171	Thin	158
		4.0 mm	Phototransistor	EE-SY169	Red LED	160
				EE-SY169A	General purpose	162
				EE-SY169B	High power, Red LED	164
		4.4 mm	Phototransistor	EE-SY113	Dustproof	166
			Photo-IC	EE-SY313	Dustproof, Dark-ON	168
				EE-SY413	Dustproof, Light-ON	
		5.0 mm	Phototransistor	EE-SY110	General purpose	170
			Photo-IC	EE-SF5-/B	Dustproof	172
				EE-SY310	Dark-ON	174
				EE-SY410	Light-ON	
	Through-hole/ Screw mount	5.0 mm	Phototransistor	EE-SB5-/B	Dustproof	176

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Termination type	Mounting type	Sensing distance	Output configuration	Model	Features	Page
Actuator	Through-hole	-	Phototransistor	EE-SA105	Low operating force	178
				EE-SA113	Low operating force	180
Actuator mounting	Through-hole	3.0 mm	Phototransistor	EE-SA102	Top attachment	182
				EE-SA103	Side attachment	184
				EE-SA104	Top attachment	186
	Snap-in	3.6 mm	Phototransistor	EE-SA107-P2	Top attachment	188
				EE-SA407-P2	Top attachment, Light-ON	190

MEMO

Technical Information

Features of Photomicrosensors

The Photomicrosensor is a compact optical sensor that senses objects or object positions with an optical beam. The transmissive Photomicrosensor and reflective Photomicrosensor are typical Photomicrosensors.

The transmissive Photomicrosensor incorporates an emitter and a transmissive that face each other as shown in Figure 1. When an object is located in the sensing position between the emitter and the detector, the object intercepts the optical beam of the emitter, thus reducing the amount of optical energy reaching the detector.

The reflective Photomicrosensor incorporates an emitter and a detector as shown in Figure 2. When an object is located in the sensing area of the reflective Photomicrosensor, the object reflects the optical beam of the emitter, thus changing the amount of optical energy reaching the detector. "Photomicrosensor" is an OMRON product name. Generally, the Photomicrosensor is called a photointerrupter.

Figure 1. Transmissive Photomicrosensor

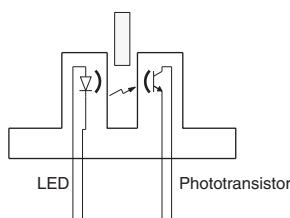
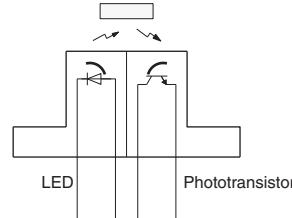


Figure 2. Reflective Photomicrosensor



Datasheet

Absolute Maximum Ratings and Electrical and Optical Characteristics

The datasheets of Photomicrosensors include the absolute maximum ratings and electrical and optical characteristics of the Photomicrosensors as well as the datasheets of transistors and ICs. It is necessary to understand the difference between the absolute maximum ratings and electrical and optical characteristics of various Photomicrosensors.

Absolute Maximum Ratings

The absolute maximum ratings of Photomicrosensors and other products with semiconductors specify the permissible operating voltage, current, temperature, and power limits of these products. The products must be operated absolutely within these limits. Therefore, when using any Photomicrosensor, do not ignore the absolute maximum ratings of the Photomicrosensor, or the Photomicrosensor will not operate precisely. Furthermore, the Photomicrosensor may be deteriorate or become damaged, in which case OMRON will not be responsible. Practically, Photomicrosensors should be used so that there will be some margin between their absolute maximum ratings and actual operating conditions.

Electrical and Optical Characteristics

The electrical and optical characteristics of Photomicrosensors indicate the performance of Photomicrosensors under certain conditions. Most items of the electrical and optical characteristics are indicated by maximum or minimum values. OMRON usually sells Photomicrosensors with standard electrical and optical characteristics. The electrical and optical characteristics of Photomicrosensors sold to customers may be changed upon request. All electrical and optical characteristic items of Photomicrosensors indicated by maximum or minimum values are checked and those of the Photomicrosensors indicated by typical values are regularly checked before shipping so that OMRON can guarantee the performance of the Photomicrosensors.

In short, the absolute maximum ratings indicate the permissible operating limits of the Photomicrosensors and the electrical and optical characteristics indicate the maximum performance of the Photomicrosensors.

Terminology

The terms used in the datasheet of each Photomicrosensor with a phototransistor output circuit or a photo IC output circuit are explained below.

■ Phototransistor Output Photomicrosensor

Symbol	Item	Definition
I_{FP}	Pulse forward current	The maximum pulse current that is allowed to flow continuously from the anode to cathode of an LED under a specified temperature, a repetition period, and a pulse width condition.
I_C	Collector current	The current that flows to the collector junction of a phototransistor.
P_C	Collector dissipation	The maximum power that is consumed by the collector junction of a phototransistor.
I_D	Dark current	The current leakage of the phototransistor when a specified bias voltage is imposed on the phototransistor so that the polarity of the collector is positive and that of the emitter is negative on condition that the illumination of the Photomicrosensor is 0 lx.
I_L	Light current	The collector current of a phototransistor under a specified input current condition and at a specified bias voltage.
$V_{CE(\text{sat})}$	Collector-emitter saturated voltage	The ON-state voltage between the collector and emitter of a phototransistor under a specified bias current condition.
I_{LEAK}	Leakage current	The collector current of a phototransistor under a specified input current condition and at a specified bias voltage when the phototransistor is not exposed to light.
t_r	Rising time	The time required for the leading edge of an output waveform of a phototransistor to rise from 10% to 90% of its final value when a specified input current and bias condition is given to the phototransistor.
t_f	Falling time	The time required for the trailing edge of an output waveform of a phototransistor to decrease from 90% to 10% of its final value when a specified input current and bias condition is given to the phototransistor.
V_{CEO}	Collector-emitter voltage	The maximum positive voltage that can be applied to the collector of a phototransistor with the emitter at reference potential.
V_{ECO}	Emitter-collector voltage	The maximum positive voltage that can be applied to the emitter of a phototransistor with the collector at reference potential.

■ Phototransistor/Photo IC Output Photomicrosensor

Symbol	Item	Definition
I_F	Forward current	The maximum DC voltage that is allowed to flow continuously from the anode of the LED to the cathode of the LED under a specified temperature condition.
V_R	Reverse voltage	The maximum negative voltage that can be applied to the anode of the LED with the cathode at reference potential.
V_{CC}	Supply voltage	The maximum positive voltage that can be applied to the voltage terminals of the photo IC with the ground terminal at reference potential.
V_{OUT}	Output voltage	The maximum positive voltage that can be applied to the output terminal with the ground terminal of the photo IC at reference potential.
I_{OUT}	Output current	The maximum current that is allowed to flow in the collector junction of the output transistor of the photo IC.
P_{OUT}	Output permissible dissipation	The maximum power that is consumed by the collector junction of the output transistor of the photo IC.
V_F	Forward voltage	The voltage drop across the LED in the forward direction when a specified bias current is applied to the photo IC.
I_R	Reverse current	The reverse leakage current across the LED when a specified negative bias is applied to the anode with the cathode at reference potential.
V_{OL}	Output low voltage	The voltage drop in the output of the photo IC when the IC output is turned ON under a specified voltage and output current applied to the photo IC.
V_{OH}	Output high voltage	The voltage output by the photo IC when the IC output is turned OFF under a specified supply voltage and bias condition given to the photo IC.
I_{CC}	Current consumption	The current that will flow into the sensor when a specified positive bias voltage is applied from the power source with the ground of the photo IC at reference potential.
$I_{FT} (I_{FT \text{ OFF}})$	LED current when output is turned OFF	The forward LED current value that turns OFF the output of the photo IC when the forward current to the LED is increased under a specified voltage applied to the photo IC.
$I_{FT} (I_{FT \text{ ON}})$	LED current when output is turned ON	The forward LED current value that turns ON the output of the photo IC when the forward current to the LED is increased under a specified voltage applied to the photo IC.
ΔH	Hysteresis	The difference in forward LED current value, expressed in percentage, calculated from the respective forward LED currents when the photo IC is turned ON and when the photo IC is turned OFF.
f	Response frequency	The number of revolutions of a disk with a specified shape rotating in the light path, expressed by the number of pulse strings during which the output logic of the photo IC can be obtained under a specified bias condition given to the LED and photo IC (the number of pulse strings to which the photo IC can respond in a second).

Design

The following explains how systems using Photomicrosensors must be designed.

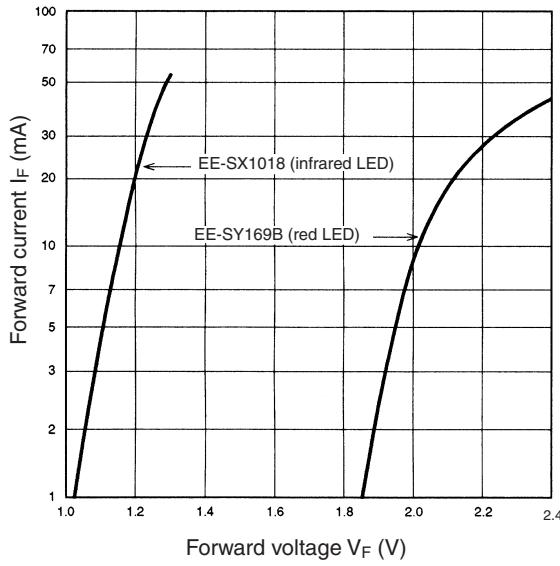
■ Emitter

Characteristics of Emitter

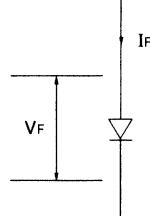
The emitter of each Photomicrosensor has an infrared LED or red LED. Figure 3 shows how the LED forward current characteristics of the EE-SX1018, which has an emitter with an infrared LED, and those of the EE-SY169B, which has an emitter with a red LED, are changed by the voltages imposed on the EE-SX1018 and EE-SY169B. As shown in this figure, the LED forward current characteristics of the EE-SX1018 greatly differ from those of the EE-SY169B. The LED forward current characteristics of any Photomicrosensor indicate how the voltage drop of the LED incorporated by the emitter of the Photomicrosensor is changed by the LED's forward current (I_F) flowing from the anode to cathode. Figure 3 shows that the forward voltage (V_F) of the red LED is higher than that of the infrared LED.

The forward voltage (V_F) of the infrared LED is approximately 1.2 V and that of the red LED is approximately 2 V provided that the practical current required by the infrared LED and that required by the red LED flow into these LEDs respectively.

Figure 3. LED Forward Current vs. Forward Voltage Characteristics (Typical)



Forward Voltage V_F



Driving Current Level

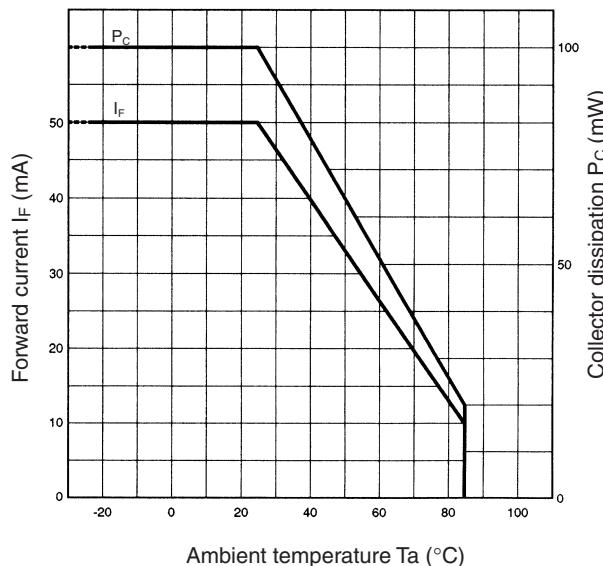
It is especially important to decide the level of the forward current (I_F) of the emitter incorporated by any Photomicrosensor. The forward current must not be too large or too small.

Before using any Photomicrosensor, refer to the absolute maximum ratings in the datasheet of the Photomicrosensor to find the emitter's forward current upper limit. For example, the first item in the absolute maximum ratings in the datasheet of the EE-SX1018 shows that the forward current (I_F) of its emitter is 50 mA at a T_a (ambient temperature) of 25°C. This means the forward current (I_F) of the emitter is 50 mA maximum at a T_a of 25°C. As shown in Figure 4, the forward current must be reduced according to changes in the ambient temperature.

Figure 4 indicates that the forward current (I_F) is approximately 27 mA maximum if the EE-SX1018 is used at a T_a of 60°C. This means that a current exceeding 27 mA must not flow into the emitter incorporated by the EE-SX1018 at a T_a of 60°C.

As for the lower limit, a small amount of forward current will be required because the LED will not give any output if the forward current I_F is zero.

Figure 4. Temperature Characteristics (EE-SX1018)



In short, the forward current lower limit of the emitter of any Photomicrosensor must be 5 mA minimum if the emitter has an infrared LED and 2 mA minimum if the emitter has a red LED. If the forward current of the emitter is too low, the optical output of the emitter will not be stable. To find the ideal forward current value of the Photomicrosensor, refer to the light current (I_L) shown in the datasheet of the Photomicrosensor. The light current (I_L) indicates the relationship between the forward current (I_F) of the LED incorporated by the Photomicrosensor and the output of the LED. The light current (I_L) is one of the most important characteristics. If the forward current specified by the light current (I_L) flows into the emitter, even though there is no theoretical ground, the output of the emitter will be stable. This characteristic makes it possible to design the output circuits of the Photomicrosensor easily. For example, the datasheet of EE-SX1018 indicates that a forward current (I_F) of 20 mA is required.

Design Method

The following explains how the constants of a Photomicrosensor must be determined. Figure 5 shows a basic circuit that drives the LED incorporated by a Photomicrosensor.

The basic circuit absolutely requires a limiting resistor (R). If the LED is imposed with a forward bias voltage without the limiting resistor, the current of the LED is theoretically limitless because the forward impedance of the LED is low. As a result the LED will burn out.

Users often ask OMRON about the appropriate forward voltage to be imposed on the LED incorporated by each Photomicrosensor model that they use. There is no upper limit of the forward voltage imposed on the LED provided that an appropriate limiting resistor is connected to the LED. There is, however, the lower limit of the forward voltage imposed on the LED. As shown in Figure 3, the lower limit of the forward voltage imposed on the LED must be at least 1.2 to 2 V, or no forward current will flow into the LED. The supply voltage of a standard electronic circuit is 5 V minimum. Therefore, a minimum of 5 V should be imposed on the LED. A system incorporating any Photomicrosensor must be designed by considering the following.

1. Forward current (I_F)
2. Limiting resistor (R) (refer to Figure 5)

As explained above, determine the optimum level of the forward current (I_F) of the LED. The forward current (I_F) of the EE-SX1018, for example, is 20 mA. Therefore, the resistance of the limiting resistor connected to the LED must be decided so that the forward current of the LED will be approximately 20 mA. The resistance of the limiting resistor is obtained from the following.

$$R = \frac{V_{CC} - V_F}{I_F}$$

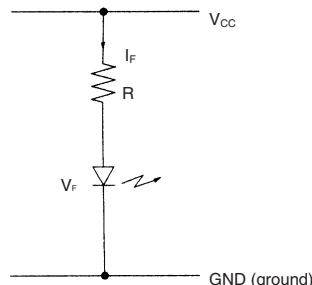
In this case 5 V must be substituted for the supply voltage (V_{CC}). The forward voltage (V_F) obtained from Figure 3 is approximately 1.2 V when the forward current (I_F) of the LED is 20 mA. Therefore, the following resistance is obtained.

$$R = \frac{V_{CC} - V_F}{I_F} = \frac{5 - 1.2}{20 \text{ mA}} = 190 \Omega$$

= approx. 180 to 220 Ω

The forward current (I_F) varies with changes in the supply voltage (V_{CC}), forward voltage (V_F), or resistance. Therefore, make sure that there is some margin between the absolute maximum ratings and the actual operating conditions of the Photomicrosensor.

Figure 5. Basic Circuit



The positions of the limiting resistor (R) and the LED in Figure 5 are interchangeable. If the LED is imposed with reverse voltages including noise and surge voltages, add a rectifier diode to the circuit as shown in Figure 6. LEDs can be driven by pulse voltages, the method of which is, however, rarely applied to Photomicrosensors. In short, the following are important points required to operate any Photomicrosensor.

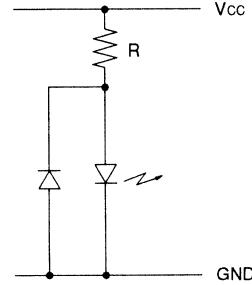
A forward voltage (V_F) of approximately 1.2 V is required if the Photomicrosensor has an infrared LED and a forward voltage (V_F) of approximately 2 V is required if the Photomicrosensor has a red LED.

The most ideal level of the forward current (I_F) must flow into the LED incorporated by the Photomicrosensor.

Decide the resistance of the limiting resistor connected to the LED after deciding the value of the forward current (I_F).

If the LED is imposed with a reverse voltage, connect a rectifier diode to the LED in parallel with and in the direction opposite to the direction of the LED.

Figure 6. Reverse Voltage Protection Circuit



■ Design of Systems Incorporating Photomicrosensors (1)

Phototransistor Output

Characteristics of Detector Element

The changes in the current flow of the detector element with and without an optical input are important characteristics of a detector element. Figure 7 shows a circuit used to check how the current flow of the phototransistor incorporated by a Photomicrosensor is changed by the LED with or without an appropriate forward current (I_F) flow, provided that the ambient illumination of the

Photomicrosensor is ideal (i.e., 0 lx). When there is no forward current (I_F) flowing into the LED or the optical beam emitted from the LED is intercepted by an opaque object, the ammeter indicates several nanoamperes due to a current leaking from the phototransistor. This current is called the dark current (I_D). When the forward current (I_F) flows into the LED with no object intercepting the optical beam emitted from the LED, the ammeter indicates several milliamperes. This current is called the light current (I_L).

The difference between the dark current and light current is 10^6 times larger as shown below.

- When optical beam to the phototransistor is interrupted

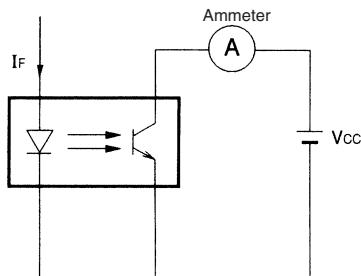
Dark current I_D : 10^{-9} A

- When optical beam to the phototransistor is not interrupted

Light current I_L : 10^{-3} A

The standard light current of a phototransistor is 10^6 times as large as the dark current of the phototransistor. This difference in current can be applied to the sensing of a variety of objects.

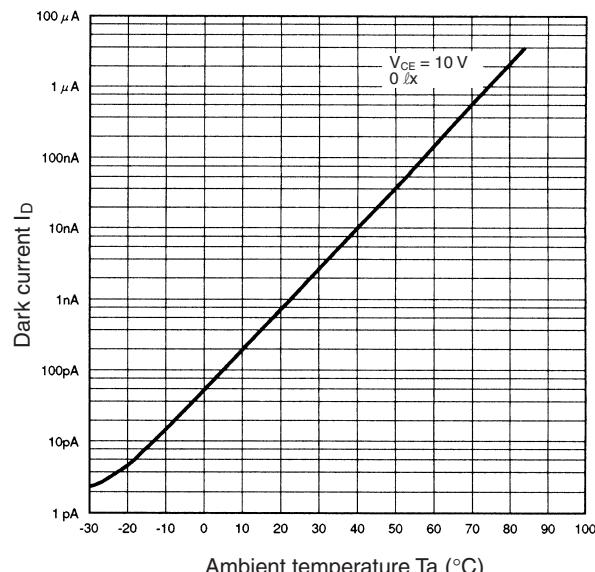
Figure 7. Measuring Circuit



The ambient illumination of the LED and phototransistor incorporated by the Photomicrosensor in actual operation is not 0 lx. Therefore, a current larger than the dark current of the phototransistor will flow into the phototransistor when the optical beam emitted from the LED is interrupted. This current is rather large and must not be ignored if the Photomicrosensor has a photoelectric Darlington transistor, which is highly sensitive, as the detector element of the Photomicrosensor. The dark current of the phototransistor incorporated by any reflective Photomicrosensor flows if there is no reflective object in the sensing area of the reflective Photomicrosensor. Furthermore, due to the structure of the reflective Photomicrosensor, a small portion of the optical beam emitted from the LED reaches the phototransistor after it is reflected inside the reflective Photomicrosensor. Therefore, the dark current and an additional current will flow into the phototransistor if there is no sensing object in the sensing area. This additional current is called leakage current (I_{LEAK}). The leakage current of the phototransistor is several hundred nanoamperes and the dark current of the phototransistor is several nanoamperes.

The dark current temperature and light current temperature dependencies of the phototransistor incorporated by any Photomicrosensor must not be ignored. The dark current temperature dependency of the phototransistor increases when the ambient temperature of the Photomicrosensor in operation is high or the Photomicrosensor has a photoelectric Darlington transistor as the detector element of the Photomicrosensor. Figure 8 shows the dark current temperature dependency of the phototransistor incorporated by the EE-SX1018.

Figure 8. Dark Current vs. Ambient Temperature Characteristics (Typical) (EE-SX1018)



Due to the temperature dependency of the phototransistor, the light current (I_L) of the phototransistor as the detector element of the Photomicrosensor increases according to a rise in the ambient temperature. As shown in Figure 9, however, the output of the LED decreases according to a rise in the ambient temperature due to the temperature dependency of the LED. An increase in the light current of the phototransistor is set off against a decrease in the output of the LED and consequently the change of the output of the Photomicrosensor according to the ambient temperature is comparatively small. Refer to Figure 10 for the light current temperature dependency of the phototransistor incorporated by the EE-SX1018.

The light current temperature dependency shown in Figure 10 is, however, a typical example. The tendency of the light current temperature dependency of each phototransistor is indefinite. This means the temperature compensation of any Photomicrosensor is difficult.

Figure 9. LED and Phototransistor Temperature Characteristics (Typical)

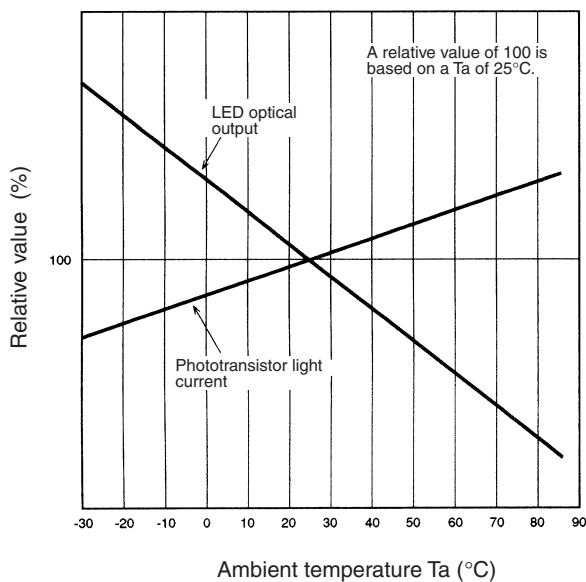
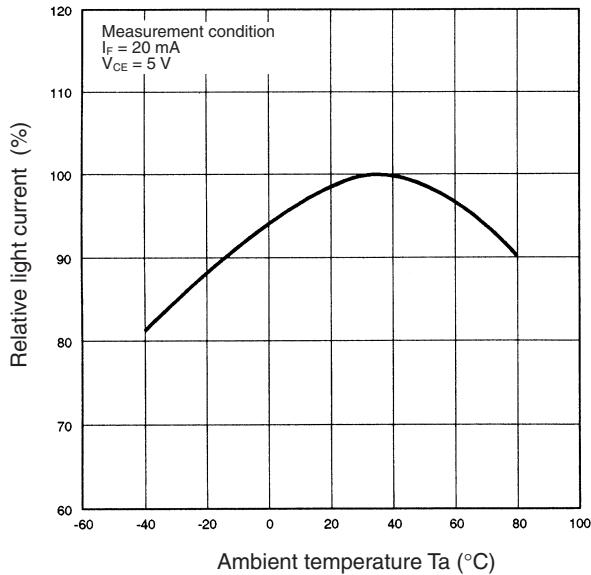


Figure 10. Relative Light Current vs. Ambient Temperature Characteristics (EE-SX1018)



Changes in Characteristics

The following explains the important points required for the designing of systems incorporating Photomicrosensors by considering worst case design technique. Worst case design technique is a method to design systems so that the Photomicrosensors will operate normally even if the characteristics of the Photomicrosensors are at their worst. A system incorporating any Photomicrosensor must be designed so that they will operate even if the light current (I_L) of the phototransistor is minimal and the dark current (I_D) and leakage current of the phototransistor are maximal. This means that the system must be designed so that it will operate even if the difference in the current flow of the phototransistor between the time that the Photomicrosensor senses an object and the time that the Photomicrosensor does not sense the object is minimal.

The worst light current (I_L) and dark current (I_D) values of the phototransistor incorporated by any Photomicrosensor is specified in the datasheet of the Photomicrosensor. (These values are specified in the specifications either as the minimum value or maximum value.)

Table 1 shows the dark current (I_D) upper limit and light current (I_L) lower limit values of the phototransistors incorporated by a variety of Photomicrosensors.

Systems must be designed by considering the dark current (I_D) upper limit and light current (I_L) lower limit values of the phototransistors. Not only these values but also the following factors must be taken into calculation to determine the upper limit of the dark current (I_D) of each of the phototransistors.

- External light interference
- Temperature rise
- Power supply voltage
- Leakage current caused by internal light reflection if the systems use reflective Photomicrosensors.

The above factors increase the dark current (I_D) of each phototransistor.

As for the light current (I_L) lower limit of each phototransistor, the following factors must be taken into calculation.

- Temperature change
- Secular change

The above factors decrease the light current (I_L) of each phototransistor.

Table 2 shows the increments of the dark current (I_D) and the decrements of the light current (I_L) of the phototransistors.

Therefore, if the EE-SX1018 is operated at a T_a of 60°C maximum and a V_{CC} of 10 V for approximately 50,000 hours, for example, the dark current (I_D) of the phototransistor incorporated by the EE-SX1018 will be approximately 4 μA and the light current (I_L) of the phototransistor will be approximately 0.5 mA because the dark current (I_D) of the phototransistor at a T_a of 25°C is 200 nanoamperes maximum and the light current (I_L) of the phototransistor at a T_a of 25°C is 0.5 mA minimum.

Table 3 shows the estimated worst values of a variety of Photomicrosensors, which must be considered when designing systems using these Photomicrosensors.

The dispersion of the characteristics of the Photomicrosensors must be also considered, which is explained in detail later. The light current (I_L) of the phototransistor incorporated by each reflective Photomicrosensor shown in its datasheet was measured under the standard conditions specified by OMRON for its reflective Photomicrosensors. The light current (I_L) of any reflective Photomicrosensor greatly varies with its sensing object and sensing distance.

Table 1. Rated Dark Current (I_D) and Light Current (I_L) Values

Model	Upper limit (I_D)	Lower limit (I_L)	Condition
EE-SG3(-B)	200 nA	2 mA	$I_F = 15 \text{ mA}$
EE-SX1018, -SX1055 EE-SX1041, -SX1042 EE-SX1070, -SX1071 EE-SX198, -SX199	200 nA	0.5 mA	$I_F = 20 \text{ mA}$
EE-SB5(-B) EE-SF5(-B) EE-SY110	200 nA	0.2 mA	$I_F = 20 \text{ mA}$ (see note)
Condition	$V_{CE} = 10 \text{ V}, 0 \text{ lux}$ $T_a = 25^\circ\text{C}$	$V_{CE} = 10 \text{ V}$ $T_a = 25^\circ\text{C}$	---

Note: These values were measured under the standard conditions specified by OMRON for the corresponding Photomicrosensors.

Table 2. Dependency of Detector Elements on Various Factors

Elements		Phototransistor	Photo-Darlington transistor
Dark current I_D	External light interference	To be checked using experiment	To be checked using experiment
	Temperature rise	Increased by approximately 10 times with a temperature rise of 25°C .	Increased by approximately 28 times with a temperature rise of 25°C .
	Supply voltage	See Figure 11.	See Figure 12.
Light current I_L	Temperature change	Approximately -20% to 10%	Approximately -20% to 10%
	Secular change (20,000 to 50,000 hours)	Decreased to approximately one-half of the initial value considering the temperature changes of the element.	Decreased to approximately one-half of the initial value considering the temperature changes of the element.
	Note: For an infrared LED.		

Figure 11. Dark Current Imposed Voltage Dependency (Typical) (EE-SX1018)

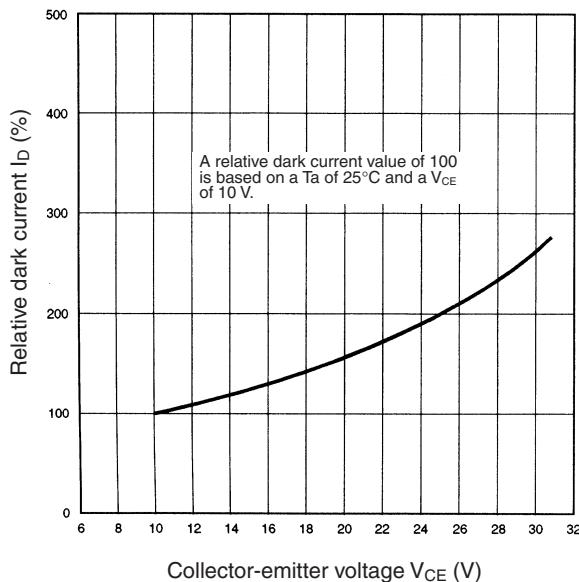


Table 3. Estimated Worst Values of a Variety of Photomicrosensors

Model	Estimated worst value (I_D)	Estimated worst value (I_L)	Condition
EE-SG3(-B)	4 nA	1 mA	$I_F = 15 \text{ mA}$
EE-SX1018, -SX1055 EE-SX1041, -SX1042 EE-SX1070, -SX1071 EE-SX198, -SX199	4 nA	0.25 mA	$I_F = 20 \text{ mA}$
EE-SB5(-B) EE-SF5(-B) EE-SY110	4 nA	0.1 mA	$I_F = 20 \text{ mA}$ (see note)
Condition	$V_{CE} = 10 \text{ V}, 0 \text{ lx}$ $T_a = 60^\circ\text{C}$	$V_{CE} = 10 \text{ V},$ Operating hours = 50,000 to 100,000 hrs $T_a = T_{opr}$	---

Note: These values were measured under the standard conditions specified by OMRON for the corresponding Photomicrosensors with an Infrared LED.

Design of Basic Circuitry

The following explains the basic circuit incorporated by a typical Photomicrosensor and the important points required for the basic circuit.

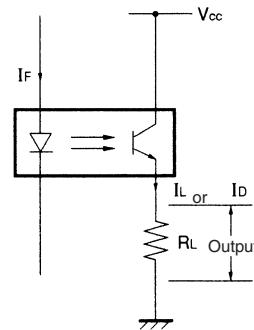
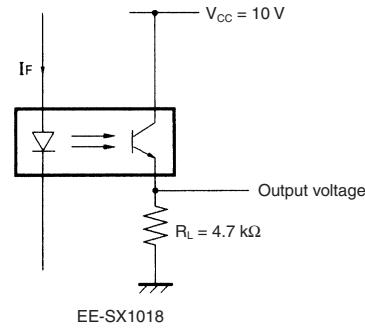
The flowing currents (i.e., I_L and I_D) of the phototransistor incorporated by the Photomicrosensor must be processed to obtain the output of the Photomicrosensor. Refer to Figure 13 for the basic circuit. The light current (I_L) of the phototransistor will flow into the resistor (R_L) if the phototransistor receives an optical input and the dark current (I_D) and leakage current of the phototransistor will flow into the resistor (R_L) if the phototransistor does not receive any optical input. Therefore, if the phototransistor receives an optical input, the output voltage imposed on the resistor (R_L) will be obtained from the following.

$$I_L \times R_L$$

If the phototransistor does not receive any optical input, the output voltage imposed on the resistor (R_L) will be obtained from the following.

$$(I_D + \text{leakage current}) \times R_L$$

The output voltage of the phototransistor is obtained by simply connecting the resistor (R_L) to the phototransistor. For example, to obtain an output of 4 V minimum from the phototransistor when it is ON and an output of 1 V maximum when the phototransistor is OFF on condition that the light current (I_L) of the phototransistor is 1 mA and the leakage current of the phototransistor is 0.1 mA, and these are the worst light current and leakage current values of the phototransistor, the resistance of the resistor (R_L) must be approximately 4.7 kΩ. Then, an output of 4.7 V (i.e., 1 mA × 4.7 kΩ) will be obtained when the phototransistor is ON and an output of 0.47 V (i.e., 0.1 mA × 4.7 kΩ) will be obtained when the phototransistor is OFF. Practically, the output voltage of the phototransistor will be more than 4.7 V when the phototransistor is ON and less than 0.47 V when the phototransistor is OFF because the above voltage values are based on the worst light current and leakage current values of the phototransistor. The outputs obtained from the phototransistor are amplified and input to ICs to make practical use of the Photomicrosensor.

Figure 13. Basic Circuit**Figure 14. Output Example**

Design of Applied Circuit

The following explains the designing of the applied circuit shown in Figure 15. The light current (I_L) of the phototransistor flows into R_1 and R_2 when the phototransistor receives the optical beam emitted from the LED. Part of the light current (I_L) will flow into the base and emitter of Q_1 when the voltage imposed on R_2 exceeds the bias voltage (i.e., approximately 0.6 to 0.9 V) imposed between the base and emitter of the transistor (Q_1). The light current flowing into the base turns Q_1 ON. A current will flow into the collector of Q_1 through R_3 when Q_1 is ON. Then, the electric potential of the collector will drop to a low logic level. The dark current and leakage current of the phototransistor flow when the optical beam emitted from the LED is intercepted. The electric potential of the output of the phototransistor (i.e., $(I_D + \text{leakage current}) \times R_2$) is, however, lower than the bias voltage between the base and emitter of Q_1 . Therefore, no current will flow into the base of Q_1 and Q_1 will be OFF. The output of Q_1 will be at a high level. As shown in Figure 16, when the phototransistor is ON, the phototransistor will be seemingly short-circuited through the base and emitter of the Q_1 , which is equivalent to a diode, and if the light current (I_L) of the phototransistor is large and R_1 is not connected to the phototransistor, the light current (I_L) will flow into Q_1 and the collector dissipation of the phototransistor will be excessively large.

The following items are important when designing the above applied circuit:

- The voltage output (i.e., $I_L \times R_2$) of the phototransistor receiving the optical beam emitted from the LED must be much higher than the bias voltage between the base and emitter of Q_1 .
- The voltage output (i.e., $(I_D + \text{leakage current}) \times R_2$) of the phototransistor not receiving the optical beam emitted from the LED must be much lower than the bias voltage between the base and emitter of Q_1 .

Therefore, it is important to determine the resistance of R_2 . Figure 17 shows a practical applied circuit example using the EE-SX1018 Photomicrosensor at a supply voltage (V_{CC}) of 5V to drive a 74-series TTL IC. This applied circuit example uses R_1 and R_2 with appropriate resistance values.

Figure 15. Applied Circuit

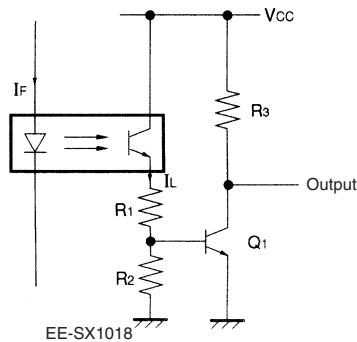


Figure 16. Equivalent Circuit

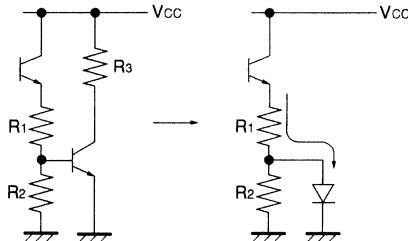
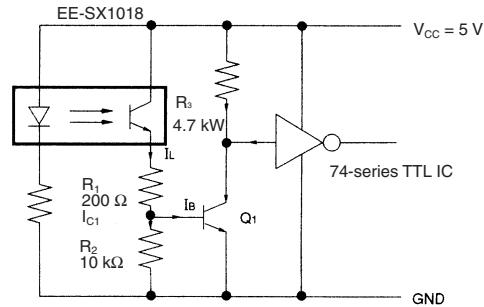


Figure 17. Applied Circuit Example



Calculation of R_2

The resistance of R_2 should be decided using the following so that the appropriate bias voltage ($V_{BE(ON)}$) between the base and emitter of the transistor (Q_1) to turn Q_1 ON will be obtained.

$$\begin{aligned} I_{C1} \times R_2 &> V_{BE(ON)} \\ I_{C1} &= I_L - I_B \\ \therefore (I_L - I_B) \times R_2 &> V_{BE(ON)} \\ \therefore R_2 &> \frac{V_{BE(ON)}}{I_L - I_B} \end{aligned}$$

The bias voltage ($V_{BE(ON)}$) between the base and emitter of Q_1 is approximately 0.8 V and the base current (I_B) of Q_1 is approximately 20 μA if Q_1 is a standard transistor controlling small signals. The estimated worst value of the light current (I_L) of the phototransistor is 0.25 mA according to Table 3.

Therefore, the following is obtained.

$$R_2 > \frac{0.8 \text{ V}}{0.25 \text{ mA} - 20 \mu\text{A}} = \text{approx. } 3.48 \text{ k}\Omega$$

R_2 must be larger than the above result. Therefore, the actual resistance of R_2 must be two to three times as large as the above result. In the above applied circuit example, the resistance of R_2 is 10 kΩ.

Verification of R_2 Value

The resistance of R_2 obtained from the above turns Q_1 ON. The following explains the way to confirm whether the resistance of R_2 obtained from the above can turn Q_1 OFF as well. The condition required to turn Q_1 OFF is obtained from the following.

$$\begin{aligned} (I_D + \alpha) \times R_2 &< V_{BE(OFF)} \\ \text{Substitute } 10 \text{ k}\Omega \text{ for } R_2, 4 \mu\text{A} \text{ for the dark current } I_D \text{ according to} \\ \text{Table 3, and } 10 \mu\text{A} \text{ for the leakage current on the assumption that} \\ \text{the leakage current is } 10 \mu\text{A in formula 3. The following is obtained.} \end{aligned}$$

$$\begin{aligned} (I_D + \alpha) \times R_2 &> V_{BE(ON)} \\ (4 \mu\text{A} + 10 \mu\text{A}) \times 10 \text{ k}\Omega &= 0.140 \text{ V} \\ V_{BE(OFF)} &= 0.4 \text{ V} \\ \therefore 0.140 \text{ V} &< 0.4 \text{ V} \end{aligned}$$

The above result verifies that the resistance of R_2 satisfies the condition required to turn Q_1 OFF.

If the appropriateness of the resistance of R_2 has been verified, the design of the circuit is almost complete.

R₁

As shown in Figure 16, when the phototransistor is ON, the phototransistor will be seemingly short-circuited through the base and emitter of the Q₁, and if the light current (I_L) of the phototransistor is large and R₁ is not connected to the phototransistor, the light current will flow into Q₁ and the collector dissipation of the phototransistor will be excessively large. The resistance of R₁ depends on the maximum permissible collector dissipation (P_C) of the phototransistor, which can be obtained from the datasheet of the Photomicrosensor. The resistance of R₁ of a phototransistor is several hundred ohms. In the above applied circuit example, the resistance of R₁ is 200 Ω.

If the resistance of R₁ is determined, the design of the circuit is complete.

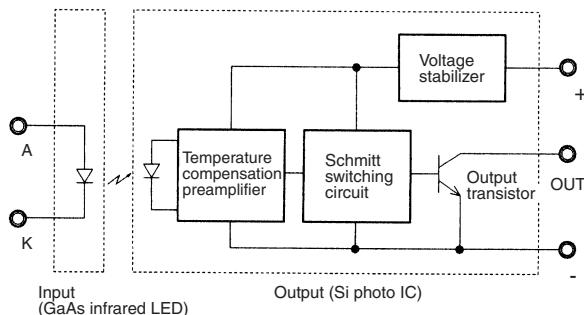
It is important to connect a transistor to the phototransistor incorporated by the Photomicrosensor to amplify the output of the phototransistor, which increases the reliability and stability of the Photomicrosensor. Such reliability and stability of the Photomicrosensor cannot be achieved if the output of the phototransistor is not amplified. The response speed and other performance characteristics of the circuit shown in Figure 15 are far superior to those of the circuit shown in Figure 13 because the apparent impedance (i.e., load resistance) of the Photomicrosensor is determined by R₁, the resistance of which is comparatively small. Recently, Photomicrosensors that have photo IC amplifier circuits are increasing in number because they are easy to use and make it possible to design systems using Photomicrosensors without problem.

■ Design of Systems Incorporating Photomicrosensors (2)

Photo IC Output

Figure 18 shows the circuit configuration of the EE-SX301 or EE-SX401 Photomicrosensor incorporating a photo IC output circuit. The following explains the structure of a typical Photomicrosensor with a photo IC output circuit.

Figure 18. Circuit Configuration



LED Forward Current (I_F) Supply Circuit

The LED in the above circuitry is an independent component, to which an appropriate current must be supplied from an external power supply. This is the most important item required by the Photomicrosensor.

It is necessary to determine the appropriate forward current (I_F) of the LED that turns the photo IC ON. If the appropriate forward current is determined, the Photomicrosensor can be easily used by simply supplying power to the detector circuitry (i.e., the photo IC). Refer to the datasheet of the Photomicrosensor to find the current of the LED turning the photo IC ON. Table 4 is an extract of the datasheet of the EE-SX301/EE-SX401.

Table 4. Abstract of Characteristics

Item	Symbol	EE-SX301, -SX401	
		Value	Condition
LED current when output is turned OFF (EE-SX301)	I _{FOFF}	8 mA max.	V _{CC} = 4.5 to 16 V Ta = 25°C
LED current when output is turned ON (EE-SX401)	I _{FON}		

To design systems incorporating EE-SX301 or EE-SX401 Photomicrosensors, the following are important points.

- A forward current equivalent to or exceeding the I_{FOFF} value must flow into the LED incorporated by each EE-SX301 Photomicrosensors.
- A forward current equivalent to or exceeding the I_{FON} value must flow into the LED incorporated by the EE-SX401 Photomicrosensors.

The I_{FON} value of the EE-SX301 is 8 mA maximum and so is the I_{FON} value of the EE-SX401. The forward current (I_F) of LED incorporated by the EE-SX301 in actual operation must be 8 mA or more and so must the actual forward current of (I_F) the LED incorporated by the EE-SX401 in actual operation. The actual forward currents of the LEDs incorporated by the EE-SX301 and EE-SX401 are limited by their absolute maximum forward currents respectively. The upper limit of the actual forward current of the LED incorporated by the EE-SX301 and that of the LED incorporated by the EE-SX401 must be decided according Figure 19, which shows the temperature characteristics of the EE-SX301 and EE-SX401. The forward current (I_F) of the EE-SX301 must be as large as possible within the absolute maximum forward current and maximum ambient temperature shown in Figure 19 and so must be the forward current (I_F) of the EE-SX401. The forward current (I_F) of the EE-SX301 or that of the EE-SX401 must not be close to 8 mA, otherwise the photo IC of the EE-SX301 or that of the EE-SX401 may not operate if there is any ambient temperature change, secular change that reduces the optical output of the LED, or dust sticking to the LED. The forward current (I_F) values of the EE-SX301 and the EE-SX401 in actual operation must be twice as large as the I_{FOFF} values of the EE-SX301 and EE-SX401 respectively. Figure 20 shows the basic circuit of a typical Photomicrosensor with a photo IC output circuit. If the Photomicrosensor with a photo IC output circuit is used to drive a relay, be sure to connect a reverse voltage absorption diode (D) to the relay in parallel as shown in Figure 21.

Detector Circuit

Supply a voltage within the absolute maximum supply voltage to the positive and negative terminals of the photo IC circuit shown in Figure 18 and obtain a current within the I_{OUT} value of the output transistor incorporated by the photo IC circuit.

Figure 19. Forward Current vs. Ambient Temperature Characteristics (EE-SX301/-SX401)

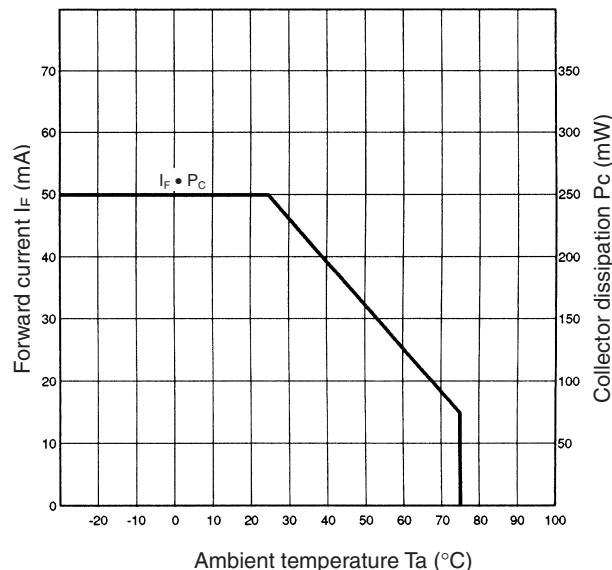


Figure 20. Basic Circuit

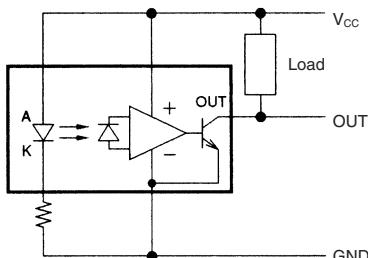
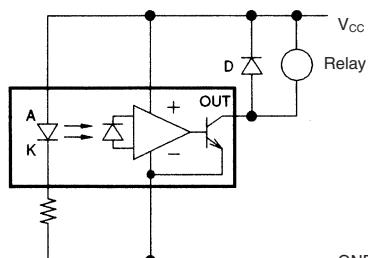


Figure 21. Connected to Inductive Load



Precautions

The following provides the instructions required for the operation of Photomicrosensors.

■ Transmissive Photomicrosensor Incorporating Phototransistor Output Circuit

When using a transmissive Photomicrosensor to sense the following objects, make sure that the transmissive Photomicrosensor operates properly.

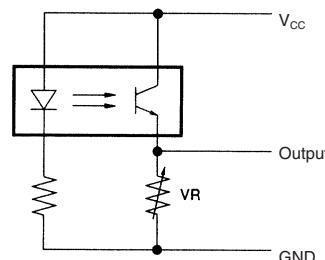
- Highly permeable objects such as paper, film, and plastic
- Objects smaller than the size of the optical beam emitted by the LED or the size of the aperture of the detector.

The above objects do not fully intercept the optical beam emitted by the LED. Therefore, some part of the optical beam, which is considered noise, reaches the detector and a current flows from the phototransistor incorporated by the detector. Before sensing such type of objects, it is necessary to measure the light currents of the phototransistor with and without an object to make sure that the transmissive Photomicrosensor can sense objects without being interfered by noise. If the light current of the phototransistor sensing any one of the objects is $I_L(N)$ and that of the phototransistor sensing none of the objects is $I_L(S)$, the signal-noise ratio of the phototransistor due to the object is obtained from the following.

$$S/N = I_L(S)/I_L(N)$$

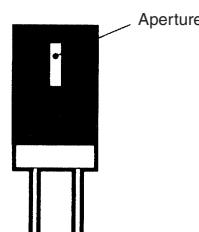
The light current (I_L) of the phototransistor varies with the ambient temperature and secular changes. Therefore, if the signal-noise ratio of the phototransistor is 4 maximum, it is necessary to pay utmost attention to the circuit connected to the transmissive Photomicrosensor so that the transmissive Photomicrosensor can sense the object without problem. The light currents of phototransistors are different to one another. Therefore, when multiple transmissive Photomicrosensors are required, a variable resistor must be connected to each transmissive Photomicrosensor as shown in Figure 22 if the light currents of the phototransistors greatly differ from one another.

Figure 22. Sensitivity Adjustment



The optical beam of the emitter and the aperture of the detector must be as narrow as possible. An aperture each can be attached to the emitter and detector to make the optical beam of the emitter and the aperture of the detector narrower. If apertures are attached to both the emitter and detector, however, the light current (I_L) of the phototransistor incorporated by the detector will decrease. It is desirable to attach apertures to both the emitter and detector. If an aperture is attached to the detector only, the transmissive Photomicrosensor will have trouble sensing the above objects when they pass near the emitter.

Figure 23. Aperture Example



When using the transmissive Photomicrosensor to sense any object that vibrates, moves slowly, or has highly reflective edges, make sure to connect a proper circuit which processes the output of the transmissive Photomicrosensor so that the transmissive Photomicrosensor can operate properly, otherwise the transmissive Photomicrosensor may have a chattering output signal as shown in Figure 24. If this signal is input to a counter, the counter will have a counting error or operate improperly. To protect against this, connect a 0.01- to 0.02- μF capacitor to the circuit as shown in Figure 25 or connect a Schmitt trigger circuit to the circuit as shown in Figure 26.

Figure 24. Chattering Output Signal

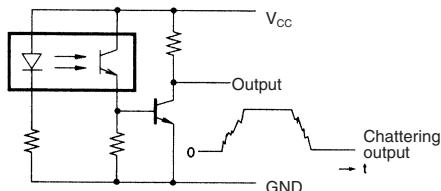


Figure 25. Chattering Prevention (1)

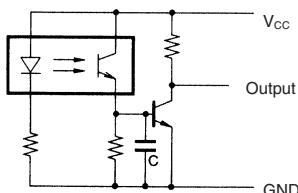
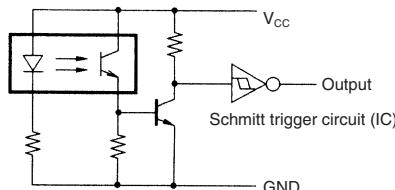


Figure 26. Chattering Prevention (2)



■ Reflective Photomicrosensor Incorporating Phototransistor Output Circuit

When using a reflective Photomicrosensor to sense objects, pay attention to the following so that the reflective Photomicrosensor operates properly.

- External light interference
- Background condition of sensing objects
- Output level of the LED

The reflective Photomicrosensor incorporates a detector element in the direction shown in Figure 27. Therefore, it is apt to be affected by external light interference. The reflective Photomicrosensor, therefore, incorporates a filter to intercept any light, the wavelength of which is shorter than a certain wavelength, to prevent external light interference. The filter does not, however, perfectly intercept the light. Refer to Figure 28 for the light interception characteristics of filters.

A location with minimal external light interference is best suited for the reflective Photomicrosensor.

Figure 27. Configuration of Reflective Photomicrosensor

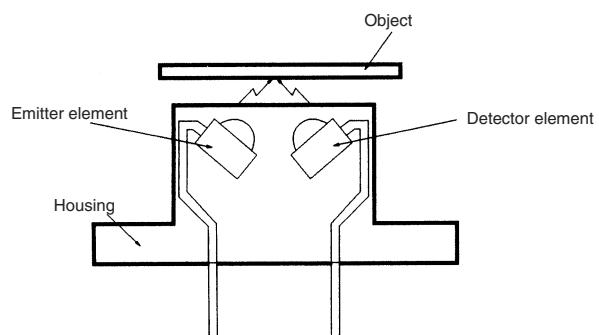


Figure 28. Light Interception Characteristics of Filters

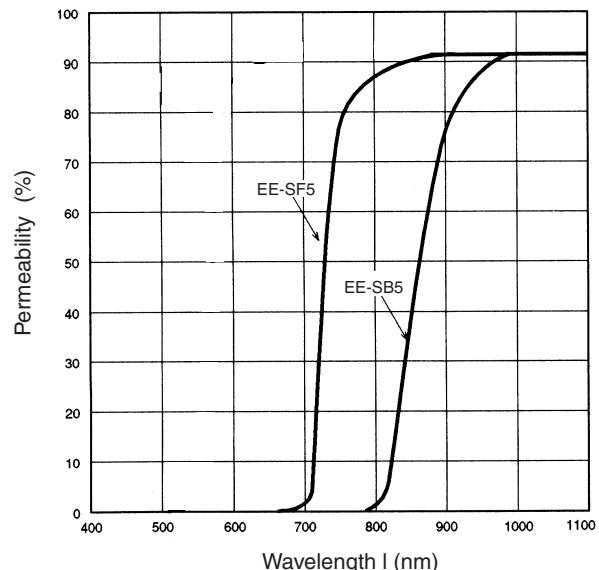
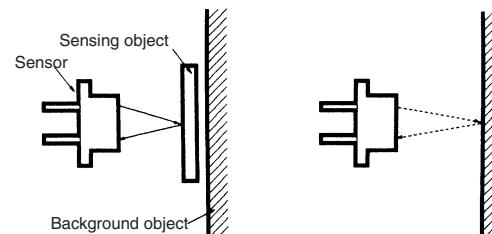


Figure 29. Influence of Background Object



With regard to the background conditions, the following description is based on the assumption that the background is totally dark.

Figure 29 shows that the optical beam emitted from the LED incorporated by a reflective Photomicrosensor is reflected by a sensing object and background object. The optical beam reflected by the background object and received by the phototransistor incorporated by the detector is considered noise that lowers the signal-noise ratio of the phototransistor. If any reflective Photomicrosensor is used to sense paper passing through the sensing area of the reflective Photomicrosensor on condition that there is a stainless steel or zinc-plated object behind the paper, the light current ($I_L(N)$) of the phototransistor not sensing the paper may be larger than the light current ($I_L(S)$) of phototransistor sensing the paper, in which case remove the background object, make a hole larger than the area of the sensor surface in the background object as shown in Figure 30, coat the surface of the background object with black lusterless paint, or roughen the surface of the background. Most malfunctions of a reflective Photomicrosensor are caused by an object located behind the sensing objects of the reflective Photomicrosensor.

Unlike the output (i.e., I_L) of any transmissive Photomicrosensor, the

light current (I_L) of a reflective Photomicrosensor greatly varies according to sensing object type, sensing distance, and sensing object size.

Figure 30. Example of Countermeasure

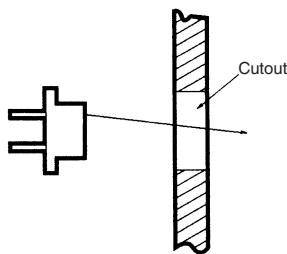
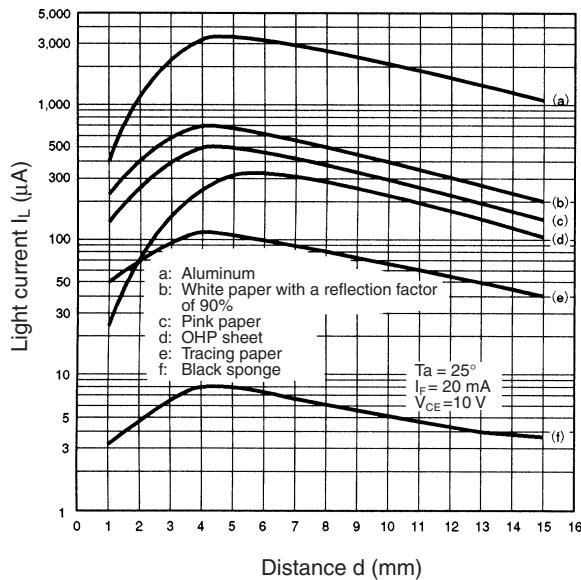


Figure 31. Sensing Distance Characteristics (EE-SF5)



The light current (I_L) of the phototransistor incorporated by the transmissive Photomicrosensor is output when there is no sensing object in the sensing groove of the transmissive Photomicrosensor. On the other hand, the light current (I_L) of the phototransistor incorporated by the reflective Photomicrosensor is output when there is a standard object specified by OMRON located in the standard sensing distance of the reflective Photomicrosensor. The light current (I_L) of the phototransistor incorporated by the reflective Photomicrosensor varies when the reflective Photomicrosensor senses any other type of sensing object located at a sensing distance other than the standard sensing distance. Figure 31 shows how the output of the phototransistor incorporated by the EE-SF5(-B) varies according to varieties of sensing objects and sensing distances. Before using the EE-SF5(-B) to sense any other type of sensing objects, measure the light currents of the phototransistor in actual operation with and without one of the sensing objects as shown in Figure 32. After measuring the light currents, calculate the signal-noise ratio of the EE-SF5(-B) due to the sensing object to make sure if the sensing objects can be sensed smoothly. The light current of the reflective Photomicrosensor is, however, several tens to hundreds of microamperes. This means that the absolute signal levels of the reflective Photomicrosensor are low. Even if the reflective Photomicrosensor in operation is not interfered by external light, the dark current (I_D) and leakage current (I_{LEAK}) of the reflective Photomicrosensor, which are considered noise, may amount to several to ten-odd microamperes due to a rise in the ambient temperature. This noise cannot be ignored. As a result, the signal-noise ratio of the reflective Photomicrosensor will be extremely low if the reflective Photomicrosensor senses any object with a low reflection ratio.

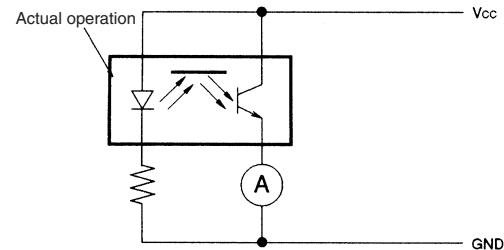
Pay utmost attention when applying the reflective Photomicrosensor to the sensing of the following.

- Marked objects (e.g., White objects with a black mark each)
- Minute objects

The above objects can be sensed if the signal-noise ratio of the reflective Photomicrosensor is not too low.

The reflective Photomicrosensor must be used with great care, otherwise it will not operate properly.

Figure 32. Output Current Measurement



MEMO

Precautions

■ Correct Use

⚠ WARNING

Do not use this product in sensing devices designed to provide human safety.



Precautions for Safe Use

- Use the product within the rated voltage range.
Applying voltages beyond the rated voltage ranges may result in damage or malfunction to the product.
- Wire the product correctly and be careful with the power supply polarities.
Incorrect wiring may result in damage or malfunction to the product.
- Connect the loads to the power supply. Do not short-circuit the loads.
Short-circuiting the loads may result in damage or malfunction to the product.

Precautions for Correct Use

● Structure and Materials

The emitter and detector elements of conventional

Photomicrosensors are fixed with transparent epoxy resin and the main bodies are made of polycarbonate. Unlike ICs and transistors, which are covered with black epoxy resin, Photomicrosensors are subject to the following restrictions.

1. Low Heat Resistivity

The storage temperature of standard ICs and transistors is approximately 150°C. The storage temperature of highly resistant Photomicrosensors is 100°C maximum. The heat resistance of the EE-SY169 Series which use ABS resin in the case, is particularly low (80°C maximum).

2. Low Mechanical Strength

Black epoxy resin, which is used for the main bodies of ICs and transistors, contains additive agents including glass fiber to increase the heat resistivity and mechanical strength of the main bodies. Materials with additive agents cannot be used for the bodies of Photomicrosensors because Photomicrosensors must maintain good optical permeability. Unlike ICs and transistors, Photomicrosensors must be handled with utmost care because Photomicrosensors are not as heat or mechanically resistant as ICs and transistors. No excessive force must be imposed on the lead wires of Photomicrosensors.

● Mounting

Screw Mounting

If Photomicrosensors have screw mounting holes, the Photomicrosensors can be mounted with screws. Unless otherwise specified, refer to the following when tighten the screws.

Hole diameter	Screw size	Tightening torque
1.5 dia.	M1.4	0.20 N・m
2.1 dia.	M2	0.34 N・m
3.2 dia.	M3	0.54 N・m
4.2 dia.	M4	0.54 N・m

Read the following before tightening the screws.

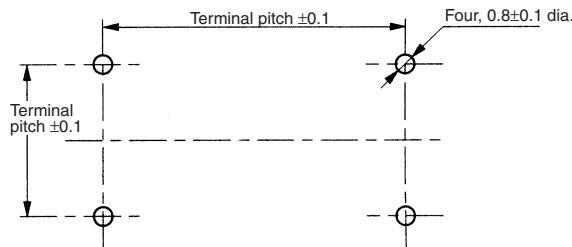
1. The use of a torque screwdriver is recommended to tighten each of the screws so that the screws can be tightened to the tightening torque required.
2. The use of a screw with a spring washer and flat washer for the mounting holes of a Photomicrosensor is recommended. If a screw with a spring washer but without a flat washer is used for any mounting hole, the part around the mounting hole may crack.

3. Do not mount Photomicrosensors to plates stained with machining oil, otherwise the machining oil may cause cracks on the Photomicrosensors.
4. Do not impose excessive forces on Photomicrosensors mounted to PCBs. Make sure that no continuous or instantaneous external force exceeding 500 g (4.9 N) is imposed on any lead wire of the Photomicrosensors.

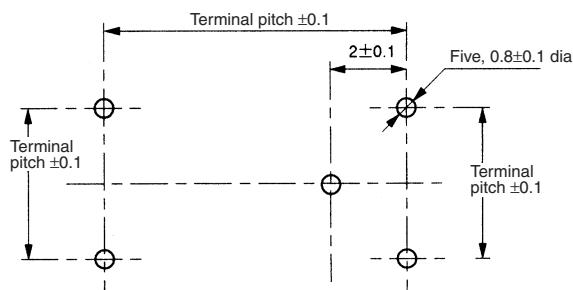
PCB Mounting Holes

Unless otherwise specified, the PCB to which a Photomicrosensor is mounted must have the following mounting holes.

Four Terminals



Five Terminals



● Soldering

Lead Wires

Make sure to solder the lead wires of Photomicrosensors so that no excessive force will be imposed on the lead wires. If an excessive force is likely to be imposed on the lead wires, hold the bases of the lead wires.

Soldering Temperature

Regardless of the device being soldered, soldering should be completed quickly so that the devices are not subjected to thermal stress. Care is also required in the processing environment for processes other than soldering so that the devices are not subject to thermal stress or other external force.

1. Manual Soldering

Unless otherwise specified, the lead wires of Photomicrosensors can be soldered manually under the following conditions. These conditions must also be maintained when using lead-free solder, i.e., soldering with lead-free solder is possible as long as the following conditions are maintained.

Soldering temperature: 350°C max. (The temperature of the tip of a 30-W soldering iron is approximately 320°C when the soldering iron is heated up.)

Soldering time: 3 s max.

Soldering position: At least 1.5 mm away from the bases of the lead wires.

The temperature of the tip of any soldering iron depends on the shape of the tip. Check the temperature with a thermometer before soldering the lead wires. A highly resistive soldering iron incorporating a ceramic heater is recommended for soldering the lead wires.

2. Dip Soldering

The lead wires of Photomicrosensors can be dip-soldered under the following conditions unless otherwise specified.

Preheating temperature: Must not exceed the storage temperature of the Photomicrosensors.

Soldering temperature: 260°C max. (the lead wires)

Soldering time: 10 s max.

Soldering position: At least 0.3 mm away from the bases of the housing.

The soldering temperature is specified as the temperature applied to the lead terminals. Do not subject the cases to temperatures higher than the maximum storage temperature. It is also possible for the sensor case to melt due to residual heat of the PCB. When using a PCB with a high thermal capacity (e.g., those using fiber-glass reinforced epoxy substrates), confirm that the case is not deformed and install cooling devices as required to prevent distortion. Particular care is required for the EE-SY169 Series, which use ABS resin in the case.

Do not use non-washable flux when soldering EE-SA-series Photomicrosensors, otherwise the Photomicrosensors will have operational problems. For other Photomicrosensors, check the case materials and optical characteristics carefully to be sure that residual flux does not adversely affect them.

3. Reflow Soldering

The reflow soldering of Photomicrosensors is not possible except for the EE-SX1107, -SX1108, -SX1109, -SX1131, -SX4134 and EE-SY1200. The reflow soldering of these products must be performed carefully under the conditions specified in the datasheets of these products, respectively. Before performing the reflow soldering of these products, make sure that the reflow soldering equipment satisfies the conditions.

Compared to general ICs, optical devices have a lower resistance to heat. This means the reflow temperature must be set to a lower temperature. Observe the temperature provides provided in the specifications when mounting optical devices.

4. External Forces Immediately Following Soldering

The heat resistance and mechanical strength of Photomicrosensors are lower than those of ICs or transistors due to their physical properties. Care must thus be exercised immediately after soldering (particularly for dip soldering) so that external forces are not applied to the Photomicrosensors.

External Forces

The heat resistivity and mechanical strength of Photomicrosensors are lower than those of ICs or transistors. Do not impose external force on Photomicrosensors immediately after the

Photomicrosensors are soldered. Especially, do not impose external force on Photomicrosensors immediately after the Photomicrosensors are dip-soldered.

● Cleaning Precautions

Cleaning

Photomicrosensors except the EE-SA105 and EE-SA113 can be cleaned subject to the following restrictions.

1. Types of Detergent

Polycarbonate is used for the bodies of most Photomicrosensors. Some types of detergent dissolve or crack polycarbonate. Before cleaning Photomicrosensors, refer to the following results of experiments, which indicate what types of detergent are suitable for cleaning Photomicrosensors other than the EE-SA105 and EE-SA113.

Observe the law and prevent against any environmental damage when using any detergent.

Results of Experiments

Ethyl alcohol: OK

Methyl alcohol: OK

Isopropyl alcohol: OK

Trichlene: NG

Acetone: NG

Methylbenzene: NG

Water (hot water): The lead wires corrode depending on the conditions

2. Cleaning Method

Unless otherwise specified, Photomicrosensors other than the EE-SA105 and EE-SA113 can be cleaned under the following conditions. Do not apply an unclean detergent to the Photomicrosensors.

DIP cleaning: OK

Ultrasonic cleaning: Depends on the equipment and the PCB size. Before cleaning Photomicrosensors, conduct a cleaning test with a single Photomicrosensor and make sure that the Photomicrosensor has no broken lead wires after the Photomicrosensor is cleaned.

Brushing:

The marks on Photomicrosensors may be brushed off. The emitters and detectors of reflective Photomicrosensors may have scratches and deteriorate when they are brushed. Before brushing Photomicrosensors, conduct a brushing test with a single Photomicrosensor and make sure that the Photomicrosensor is not damaged after it is brushed.

● Operating and Storage Temperatures

Observe the upper and lower limits of the operating and storage temperature ranges for all devices and do not allow excessive changes in temperature. As explained in the restrictions given in *Structure and Materials*, elements use clear epoxy resin, giving them less resistance to thermal stress than normal ICs or transistors (which are sealed with black epoxy resin). Refer to reliability test results and design PCBs so that the devices are not subjected to excessive thermal stress.

Even for applications within the operating temperature range, care must also be taken to control the humidity. As explained in the restrictions given in *Structure and Materials*, elements use clear epoxy resin, giving them less resistance to humidity than normal ICs or transistors (which are sealed with black epoxy resin). Refer to reliability test results and design PCBs so that the devices are not subjected to excessive thermal stress. Photomicrosensors are designed for application under normal humidities. When using them in humidified or dehumidified, high-humidity or low-humidity, environments, test performance sufficiently for the application.

● LED Drive Currents

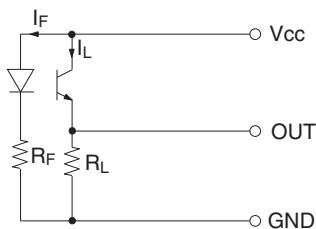
Photomicrosensors consist of LEDs and light detectors. Generally speaking, temporal changes occur to LEDs when power is supplied to them (i.e., the amount of light emitted diminishes). With less light, the photoelectric current is reduced for a sensor with a phototransistor output or the threshold current is increased for a sensor with a photo-IC output. Design circuits with sufficient consideration to the decline in the emitted light level. The reduction in emitted light is far greater for red LEDs than for infrared LEDs. Also, with red LEDs that contain aluminum, aluminum oxide will form if they are powered under high humidities, calling for a greater need for consideration of the decline in the emitted light level.

● Light Interceptors

Select a material for the light interceptor with superior interception properties. If a material with inferior light interception properties, such as a plastic that is not black, is used, light may penetrate the interceptor and cause malfunction. With Photomicrosensors, most of which use infrared LEDs, a material that appears black to the human eye (i.e., in the visible light range) may be transparent to infrared light. Select materials carefully.

Guideline for Light Interceptors

When measuring the light interception properties of the light interceptor, use 0.1% maximum light transmission as a guideline.



Criteria

Where,

I_{L1} is the I_L for light reception

I_{L2} is the I_L for light interception by the interceptor

V_{TH} is the threshold voltage

I_{F1} is the I_F for measurement of I_L given in product specifications

I_{F2} is the I_F in actual application ($= (V_{CC} - V_F)/R_F = (V_{CC} - 1.2)/R_F$)

I_{LMAX} is the standard upper limit of the optical current I_L

Then,

$$\text{Light transmission} = I_{L2}/I_{L1} = \alpha$$

Here there should be no problems if the following equation is satisfied.

$$V_{TH} \geq (I_{F2}/I_{F1}) \times I_{LMAX} \times R_L \times \alpha$$

Caution is required, however, because there are inconsistencies in light transmission.

● Reflectors

The reflectors for most Photomicrosensors are standardized to white paper with a reflection ratio of 90%. Design the system to allow for any differences in the reflection ratio of the detection object. With Photomicrosensors, most of which use infrared LEDs, a material that appears black to the human eye (i.e., in the visible light range) may have a higher reflection ratio. Select materials carefully. Concretely, marks made with dye-based inks or marks made with petroleum-based magic markers (felt pens) can have the same reflection ratio for infrared light as white paper.

The reflectors for most Photomicrosensors are standardized to white paper with a reflection ratio of 90%. Paper, however, disperses light relatively easily, reducing the effect of the detection angle. Materials with mirrored surfaces, on the other hand, show abrupt changes in angle characteristics. Check the reflection ratio and angles sufficiently for the application.

The output from most Photomicrosensors is determined at a specified distance. Characteristics will vary with the distance. Carefully check characteristics at the specific distance for the application.

● Output Stabilization Time

Photomicrosensors with photo-IC outputs require 100 ms for the internal IC to stabilize. Set the system so that the output is not read for 100 ms after the power supply is turned ON. Also be careful if the power supply is turned OFF in the application to save energy when the Photomicrosensor is not used.

When using a Photomicrosensor with a phototransistor output outside of the saturation region, stabilization time is required to achieve thermal balance. Care is required when using a variable resistor or other adjustment.

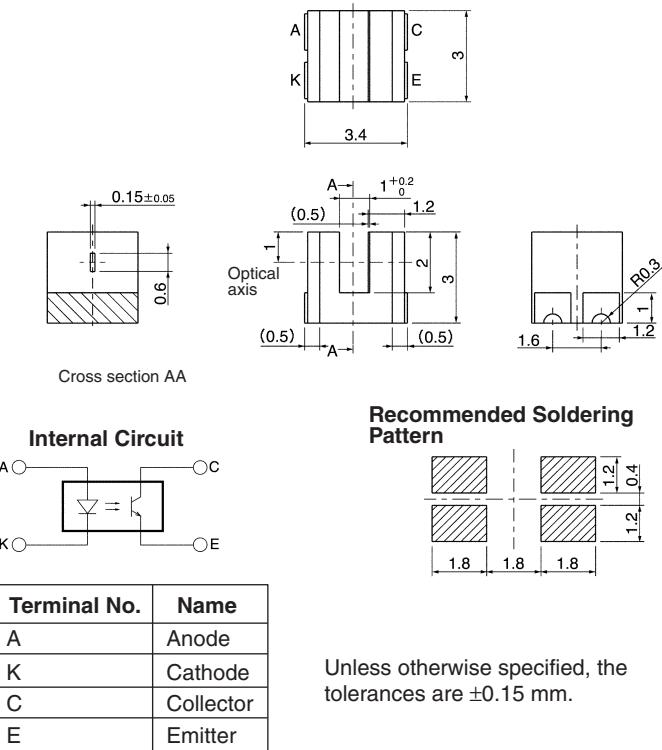
MEMO

Photomicrosensor (Transmissive) EE-SX1107

⚠ Be sure to read *Precautions* on page 24.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Unless otherwise specified, the tolerances are ± 0.15 mm.

■ Features

- Ultra-compact with a 3.4-mm-wide sensor and a 1-mm-wide slot.
- PCB surface mounting type.
- High resolution with a 0.15-mm-wide aperture.

■ Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	25 mA (see note 1)
	Pulse forward current	I_{FP}	100 mA (see note 2)
	Reverse voltage	V_R	5 V
Detector	Collector-Emitter voltage	V_{CEO}	20 V
	Emitter-Collector voltage	V_{ECO}	5 V
	Collector current	I_C	20 mA
	Collector dissipation	P_C	75 mW (see note 1)
Ambient temperature	Operating	T_{opr}	-30°C to 85°C
	Storage	T_{stg}	-40°C to 90°C
	Reflow soldering	T_{sol}	255°C (see note 3)
	Manual soldering	T_{sol}	350°C (see note 3)

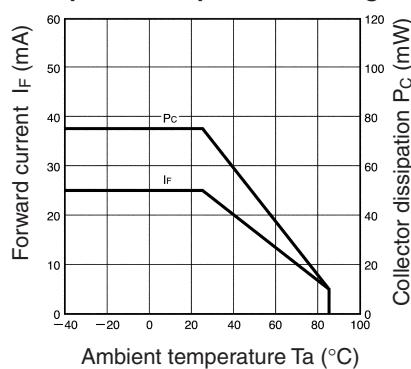
- Note:**
- Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 - Duty: 1/100; Pulse width: 0.1 ms
 - Complete soldering within 10 seconds for reflow soldering and within 3 seconds for manual soldering.

■ Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

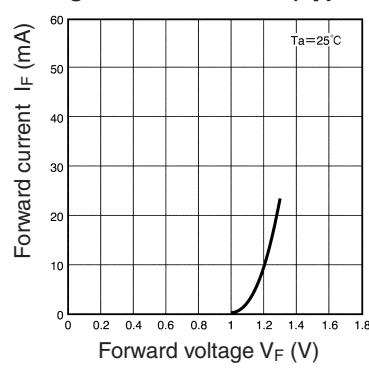
	Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.1 V typ., 1.3 V max.	$I_F = 5 \text{ mA}$
	Reverse current	I_R	10 μA max.	$V_R = 5 \text{ V}$
	Peak emission wavelength	λ_P	940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L	50 μA min., 150 μA typ., 500 μA max.	$I_F = 5 \text{ mA}, V_{CE} = 5 \text{ V}$
	Dark current	I_D	100 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lx}$
	Leakage current	I_{LEAK}	---	---
	Collector-Emitter saturated voltage	$V_{CE}(\text{sat})$	0.1 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 50 \mu\text{A}$
	Peak spectral sensitivity wavelength	λ_P	900 nm typ.	---
Rising time		t_r	10 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 1 \text{ k}\Omega, I_L = 100 \mu\text{A}$
Falling time		t_f	10 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 1 \text{ k}\Omega, I_L = 100 \mu\text{A}$

■ Engineering Data

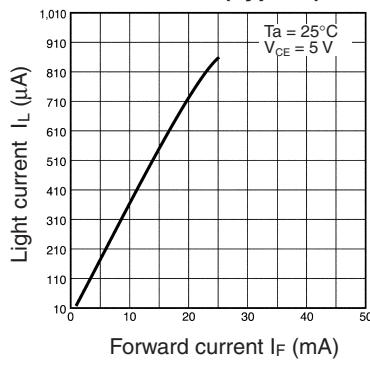
Forward Current vs. Collector Dissipation Temperature Rating



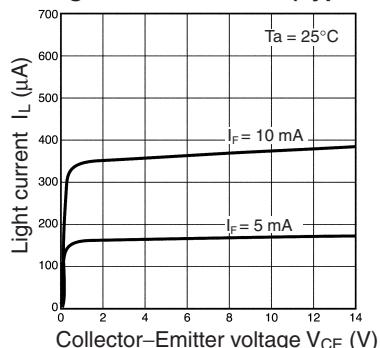
Forward Current vs. Forward Voltage Characteristics (Typical)



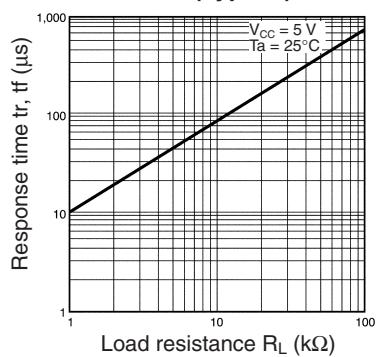
Light Current vs. Forward Current Characteristics (Typical)



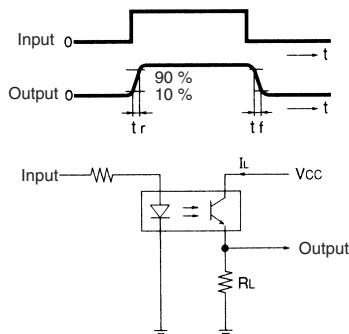
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



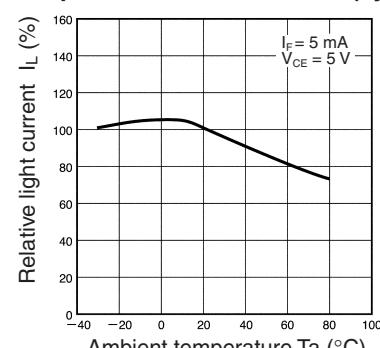
Response Time vs. Load Resistance Characteristics (Typical)



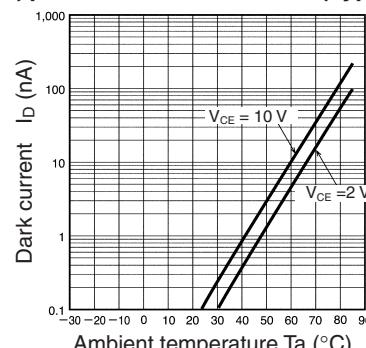
Response Time Measurement Circuit



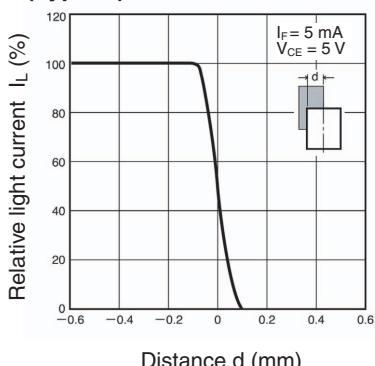
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



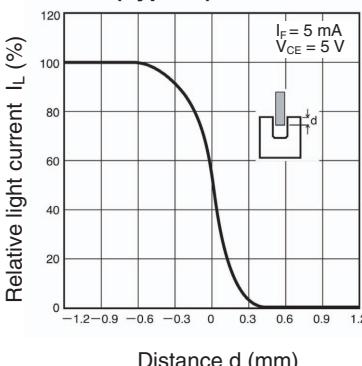
Dark Current vs. Ambient Temperature Characteristics (Typical)



Sensing Position Characteristics (Typical)



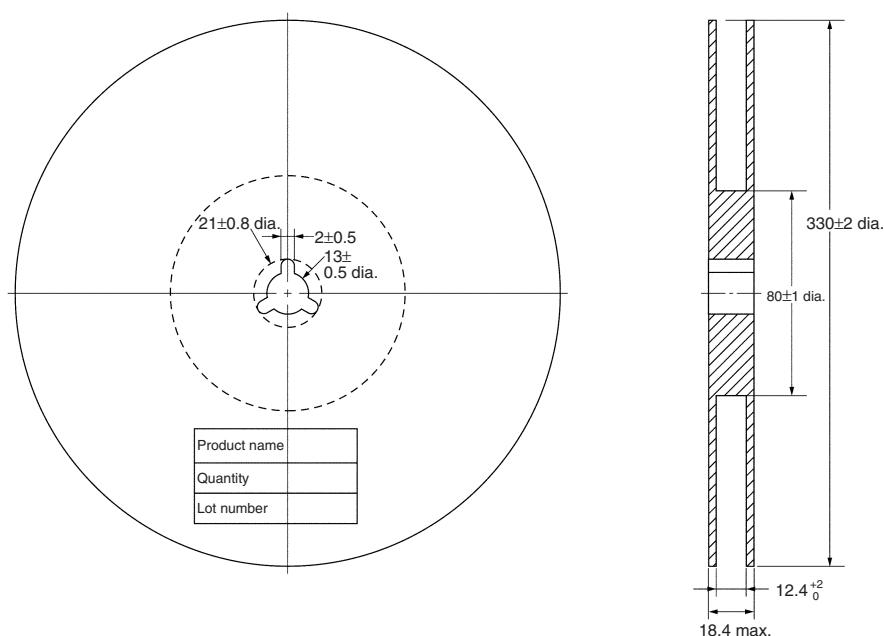
Sensing Position Characteristics (Typical)



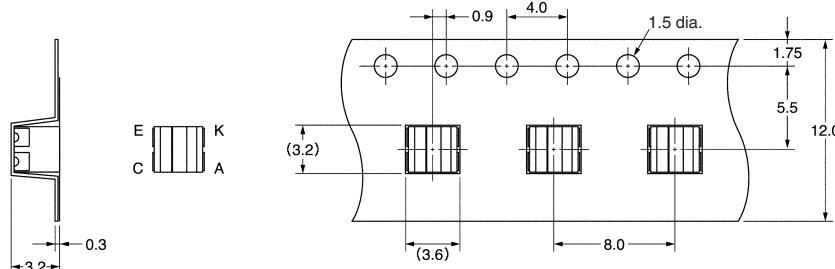
Unit: mm (inch)

■ Tape and Reel

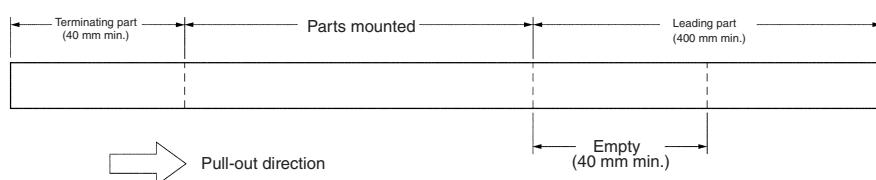
Reel



Tape



Tape configuration



Tape quantity

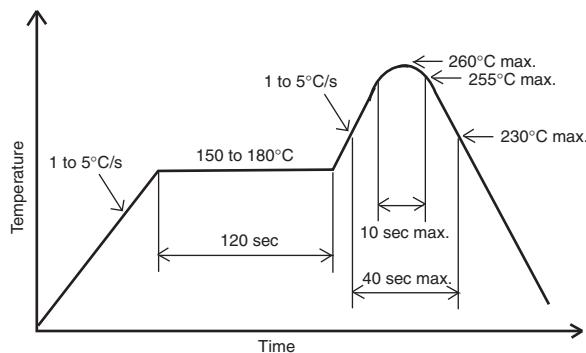
2,500 pcs./reel

Precautions

■ Soldering Information

Reflow soldering

- The following soldering paste is recommended:
 - Melting temperature: 216 to 220°C
 - Composition: Sn 3.5 Ag 0.75 Cu
- The recommended thickness of the metal mask for screen printing is between 0.2 and 0.25 mm.
- Set the reflow oven so that the temperature profile shown in the following chart is obtained for the upper surface of the product being soldered.



Manual soldering

- Use "Sn 60" (60% tin and 40% lead) or solder with silver content.
- Use a soldering iron of less than 25 W, and keep the temperature of the iron tip at 350°C or below.
- Solder each point for a maximum of three seconds.
- After soldering, allow the product to return to room temperature before handling it.

Storage

To protect the product from the effects of humidity until the package is opened, dry-box storage is recommended. If this is not possible, store the product under the following conditions:

Temperature: 10 to 30°C

Humidity: 60% max.

The product is packed in a humidity-proof envelope. Reflow soldering must be done within 48 hours after opening the envelope, during which time the product must be stored under 30°C at 80% maximum humidity.

If it is necessary to store the product after opening the envelope, use dry-box storage or reseal the envelope.

Baking

If a product has remained packed in a humidity-proof envelope for six months or more, or if more than 48 hours have lapsed since the envelope was opened, bake the product under the following conditions before use:

Reel: 60°C for 24 hours or more

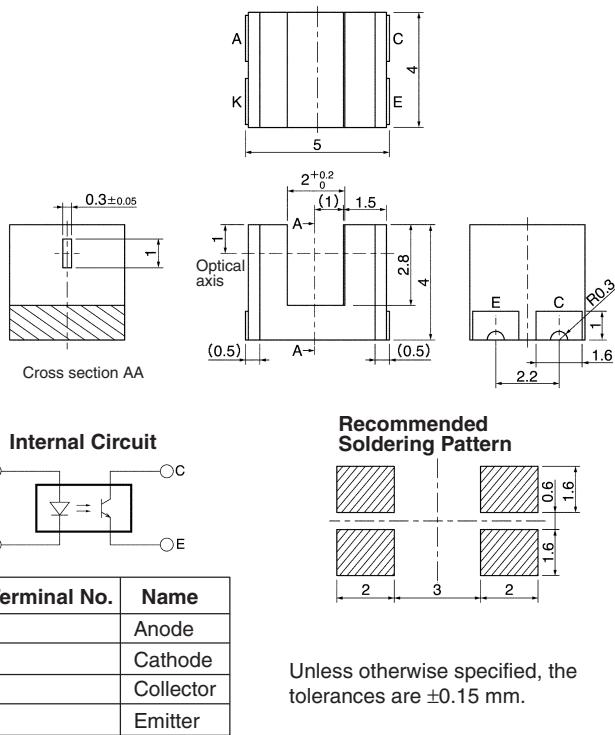
Bulk: 80°C for 4 hours or more

Photomicrosensor (Transmissive) EE-SX1108

⚠ Be sure to read *Precautions* on page 24.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Unless otherwise specified, the tolerances are ± 0.15 mm.

■ Features

- Ultra-compact with a 5-mm-wide sensor and a 1-mm-wide slot.
- PCB surface mounting type.
- High resolution with a 0.3-mm-wide aperture.

■ Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	25 mA (see note 1)
	Pulse forward current	I_{FP}	100 mA (see note 2)
	Reverse voltage	V_R	5 V
Detector	Collector-Emitter voltage	V_{CEO}	20 V
	Emitter-Collector voltage	V_{ECO}	5 V
	Collector current	I_C	20 mA
	Collector dissipation	P_C	75 mW (see note 1)
Ambient temperature	Operating	T_{opr}	-30°C to 85°C
	Storage	T_{stg}	-40°C to 90°C
	Reflow soldering	T_{sol}	255°C (see note 3)
	Manual soldering	T_{sol}	350°C (see note 3)

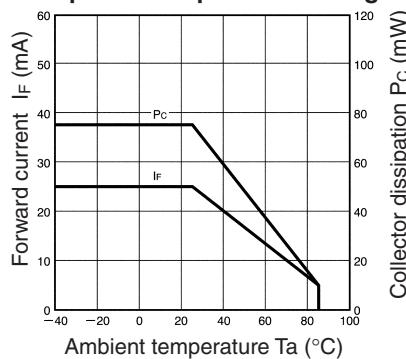
- Note:**
- Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 - Duty: 1/100; Pulse width: 0.1 ms
 - Complete soldering within 10 seconds for reflow soldering and within 3 seconds for manual soldering.

■ Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

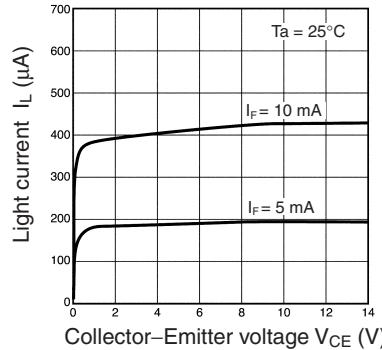
	Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.1 V typ., 1.3 V max.	$I_F = 5$ mA
	Reverse current	I_R	10 μA max.	$V_R = 5$ V
	Peak emission wavelength	λ_P	940 nm typ.	$I_F = 20$ mA
Detector	Light current	I_L	50 μA min., 150 μA typ., 500 μA max.	$I_F = 5$ mA, $V_{CE} = 5$ V
	Dark current	I_D	100 nA max.	$V_{CE} = 10$ V, 0 lx
	Leakage current	I_{LEAK}	---	---
	Collector-Emitter saturated voltage	V_{CE} (sat)	0.1 V typ., 0.4 V max.	$I_F = 20$ mA, $I_L = 50$ μA
	Peak spectral sensitivity wavelength	λ_P	900 nm typ.	---
Rising time		t_r	10 μs typ.	$V_{CC} = 5$ V, $R_L = 1$ k Ω , $I_L = 100$ μA
Falling time		t_f	10 μs typ.	$V_{CC} = 5$ V, $R_L = 1$ k Ω , $I_L = 100$ μA

■ Engineering Data

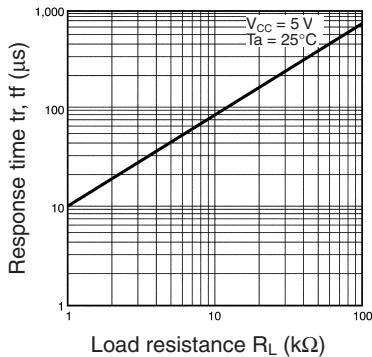
Forward Current vs. Collector Dissipation Temperature Rating



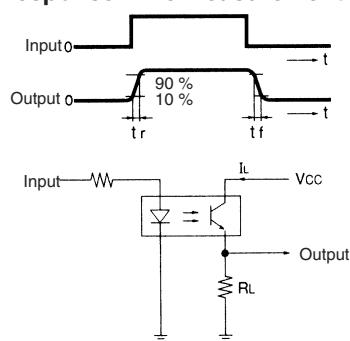
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



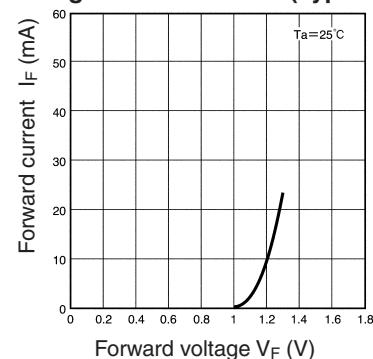
Response Time vs. Load Resistance Characteristics (Typical)



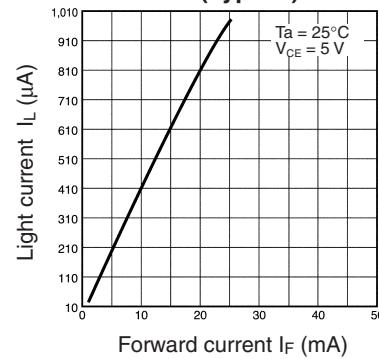
Response Time Measurement Circuit



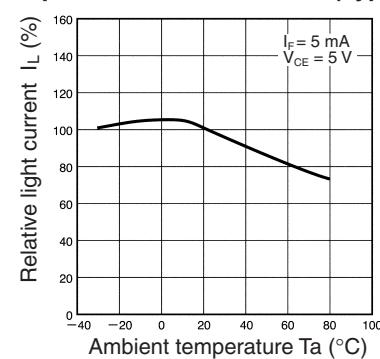
Forward Current vs. Forward Voltage Characteristics (Typical)



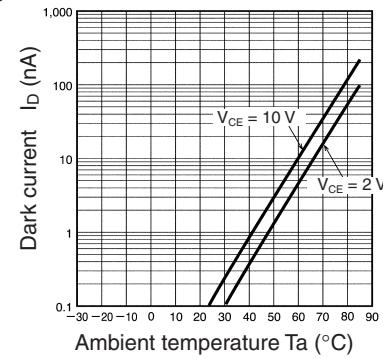
Light Current vs. Forward Current Characteristics (Typical)



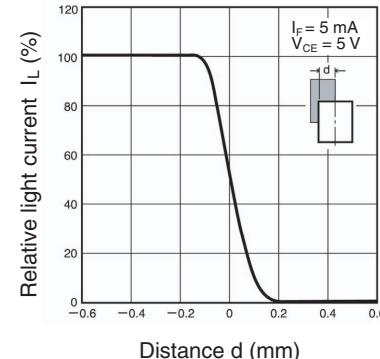
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



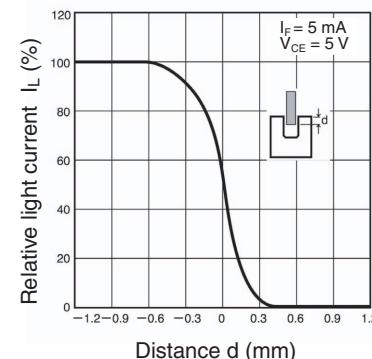
Dark Current vs. Ambient Temperature Characteristics (Typical)



Sensing Position Characteristics (Typical)



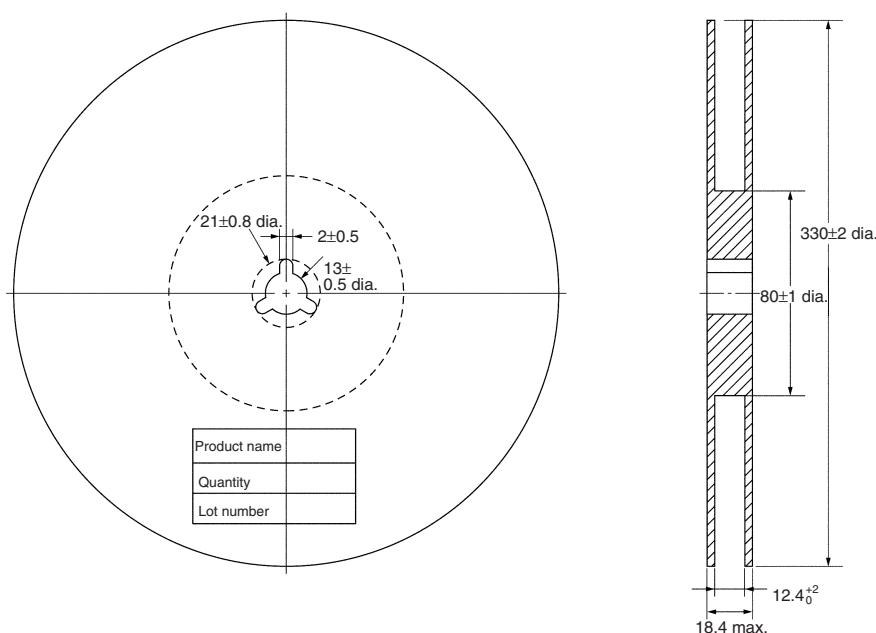
Sensing Position Characteristics (Typical)



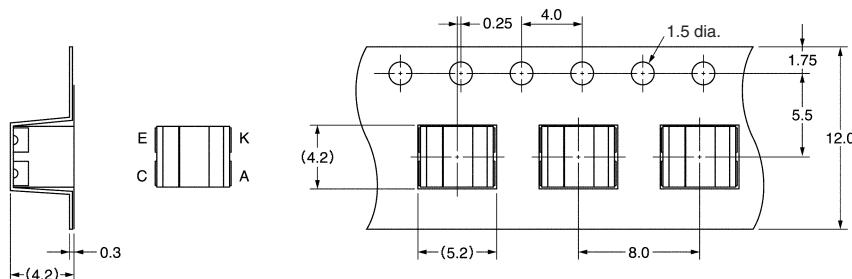
Unit: mm (inch)

■ Tape and Reel

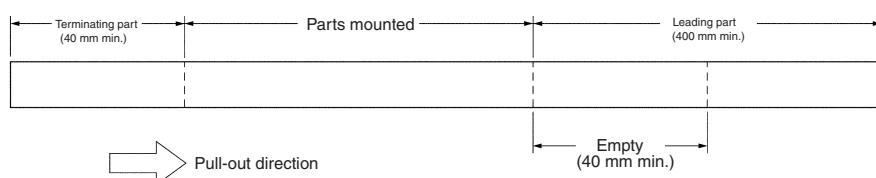
Reel



Tape



Tape configuration



Tape quantity

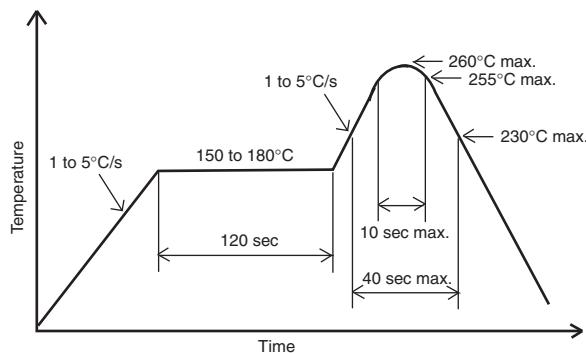
2,000 pcs./reel

Precautions

■ Soldering Information

Reflow soldering

- The following soldering paste is recommended:
 - Melting temperature: 216 to 220°C
 - Composition: Sn 3.5 Ag 0.75 Cu
- The recommended thickness of the metal mask for screen printing is between 0.2 and 0.25 mm.
- Set the reflow oven so that the temperature profile shown in the following chart is obtained for the upper surface of the product being soldered.



Manual soldering

- Use "Sn 60" (60% tin and 40% lead) or solder with silver content.
- Use a soldering iron of less than 25 W, and keep the temperature of the iron tip at 300°C or below.
- Solder each point for a maximum of three seconds.
- After soldering, allow the product to return to room temperature before handling it.

Storage

To protect the product from the effects of humidity until the package is opened, dry-box storage is recommended. If this is not possible, store the product under the following conditions:

Temperature: 10 to 30°C

Humidity: 60% max.

The product is packed in a humidity-proof envelope. Reflow soldering must be done within 48 hours after opening the envelope, during which time the product must be stored under 30°C at 80% maximum humidity.

If it is necessary to store the product after opening the envelope, use dry-box storage or reseal the envelope.

Baking

If a product has remained packed in a humidity-proof envelope for six months or more, or if more than 48 hours have lapsed since the envelope was opened, bake the product under the following conditions before use:

Reel: 60°C for 24 hours or more

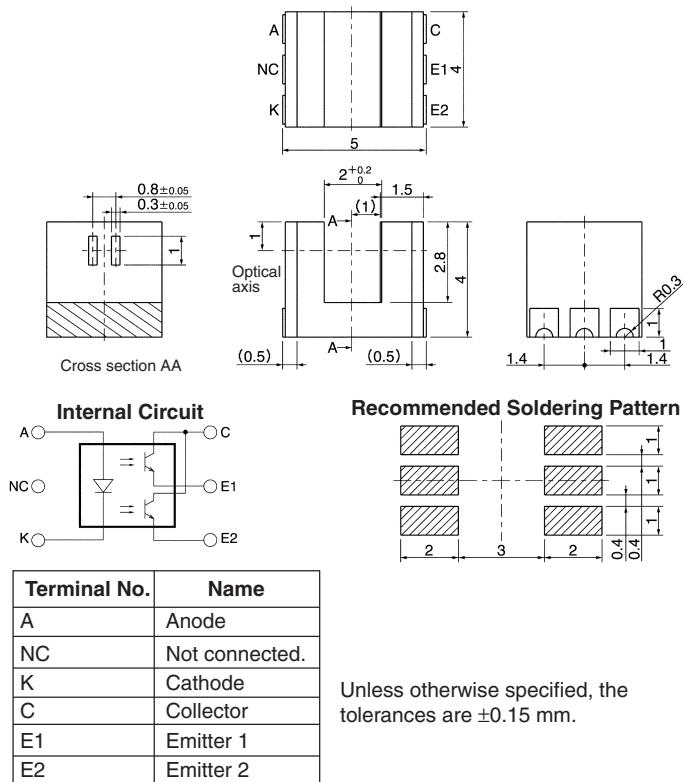
Bulk: 80°C for 4 hours or more

Photomicrosensor (Transmissive) EE-SX1131

⚠ Be sure to read *Precautions* on page 24.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



■ Features

- Ultra-compact with a 5-mm-wide sensor and a 2-mm-wide slot.
- PCB surface mounting type.
- High resolution with a 0.3-mm-wide aperture.
- Dual-channel output.

■ Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	25 mA (see note 1)
	Pulse forward current	I_{FP}	100 mA (see note 2)
	Reverse voltage	V_R	5 V
Detector	Collector-Emitter voltage	V_{CEO}	20 V
	Emitter-Collector voltage	V_{ECO}	5 V
	Collector current	I_C	20 mA
	Collector dissipation	P_C	75 mW (see note 1)
Ambient temperature	Operating	T_{opr}	-30°C to 85°C
	Storage	T_{stg}	-40°C to 90°C
	Reflow soldering	T_{sol}	255°C (see note 3)
	Manual soldering	T_{sol}	350°C (see note 3)

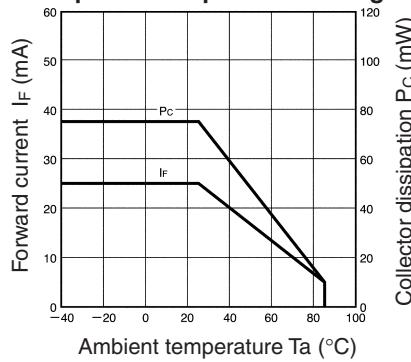
- Note:**
- Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 - Duty: 1/100; Pulse width: 0.1 ms
 - Complete soldering within 10 seconds for reflow soldering and within 3 seconds for manual soldering.

■ Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

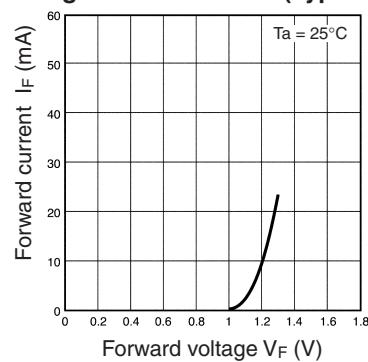
	Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.1 V typ., 1.3 V max.	$I_F = 5 \text{ mA}$
	Reverse current	I_R	10 μA max.	$V_R = 5 \text{ V}$
	Peak emission wavelength	λ_p	940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_{L1}/I_{L2}	50 μA min., 150 μA typ., 500 μA max.	$I_F = 5 \text{ mA}, V_{CE} = 5 \text{ V}$
	Dark current	I_D	100 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lx}$
	Leakage current	I_{LEAK}	---	---
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$	0.1 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 50 \mu\text{A}$
	Peak spectral sensitivity wavelength	λ_p	900 nm typ.	---
Rising time		t_r	10 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 1 \text{ k}\Omega, I_L = 100 \mu\text{A}$
Falling time		t_f	10 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 1 \text{ k}\Omega, I_L = 100 \mu\text{A}$

■ Engineering Data

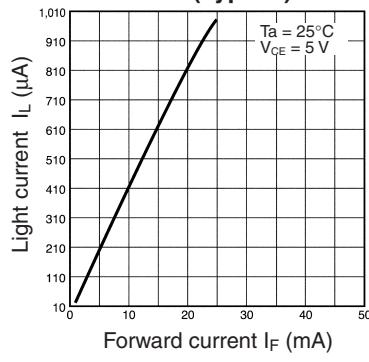
Forward Current vs. Collector Dissipation Temperature Rating



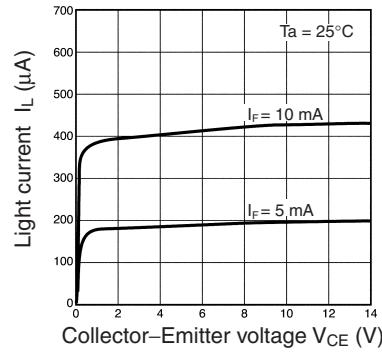
Forward Current vs. Forward Voltage Characteristics (Typical)



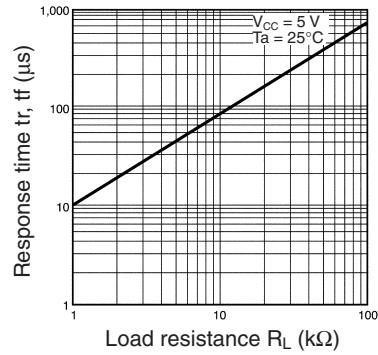
Light Current vs. Forward Current Characteristics (Typical)



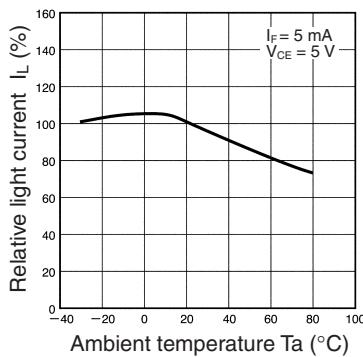
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



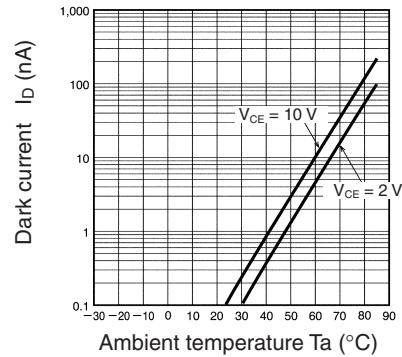
Response Time vs. Load Resistance Characteristics (Typical)



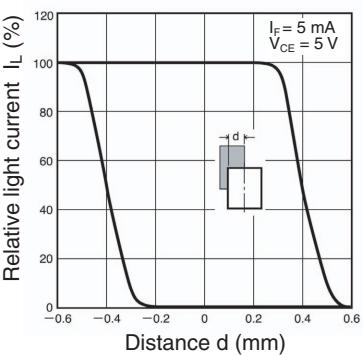
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



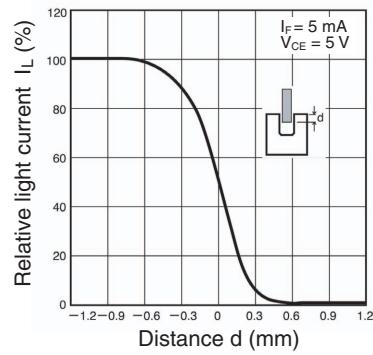
Dark Current vs. Ambient Temperature Characteristics (Typical)



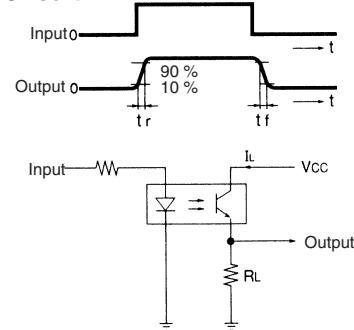
Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)



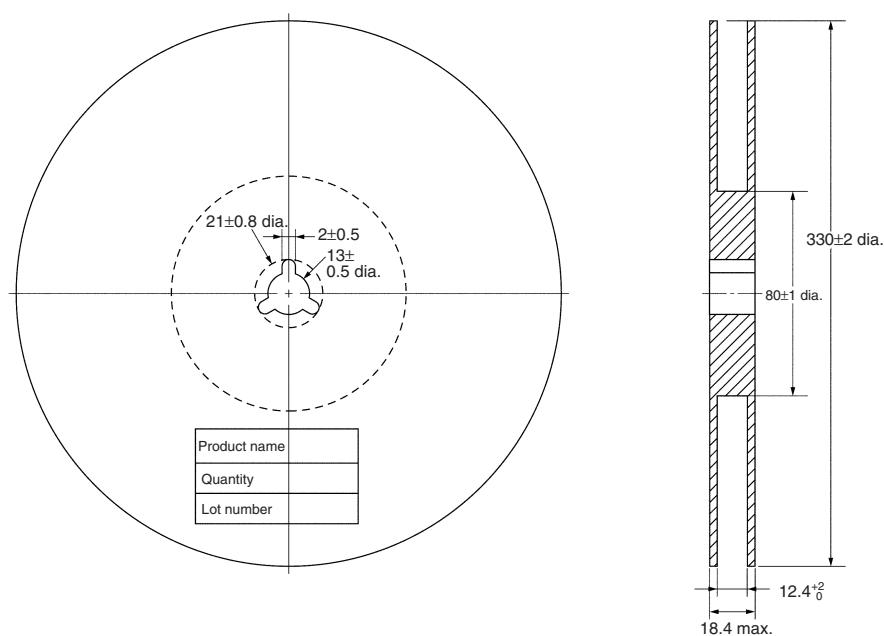
Response Time Measurement Circuit



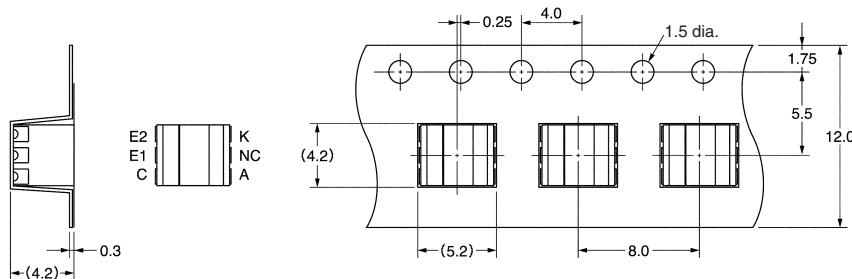
Unit: mm (inch)

■ Tape and Reel

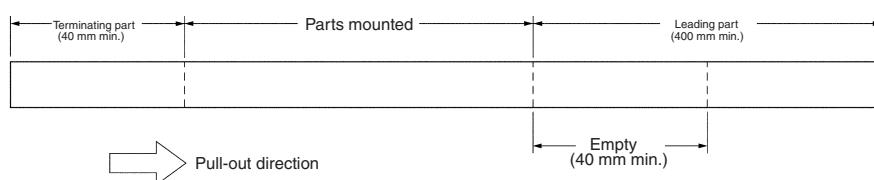
Reel



Tape



Tape configuration



Tape quantity

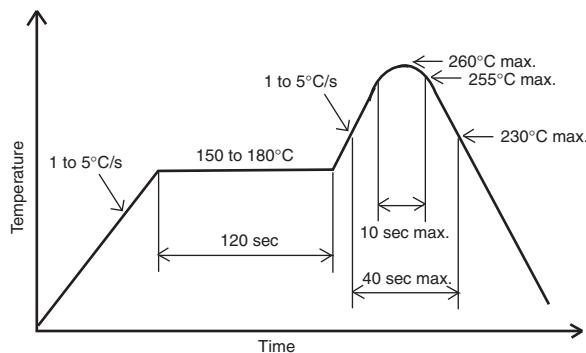
2,000 pcs./reel

Precautions

■ Soldering Information

Reflow soldering

- The following soldering paste is recommended:
 - Melting temperature: 216 to 220°C
 - Composition: Sn 3.5 Ag 0.75 Cu
- The recommended thickness of the metal mask for screen printing is between 0.2 and 0.25 mm.
- Set the reflow oven so that the temperature profile shown in the following chart is obtained for the upper surface of the product being soldered.



Manual soldering

- Use "Sn 60" (60% tin and 40% lead) or solder with silver content.
- Use a soldering iron of less than 25 W, and keep the temperature of the iron tip at 300°C or below.
- Solder each point for a maximum of three seconds.
- After soldering, allow the product to return to room temperature before handling it.

Storage

To protect the product from the effects of humidity until the package is opened, dry-box storage is recommended. If this is not possible, store the product under the following conditions:

Temperature: 10 to 30°C

Humidity: 60% max.

The product is packed in a humidity-proof envelope. Reflow soldering must be done within 48 hours after opening the envelope, during which time the product must be stored under 30°C at 80% maximum humidity.

If it is necessary to store the product after opening the envelope, use dry-box storage or reseal the envelope.

Baking

If a product has remained packed in a humidity-proof envelope for six months or more, or if more than 48 hours have lapsed since the envelope was opened, bake the product under the following conditions before use:

Reel: 60°C for 24 hours or more

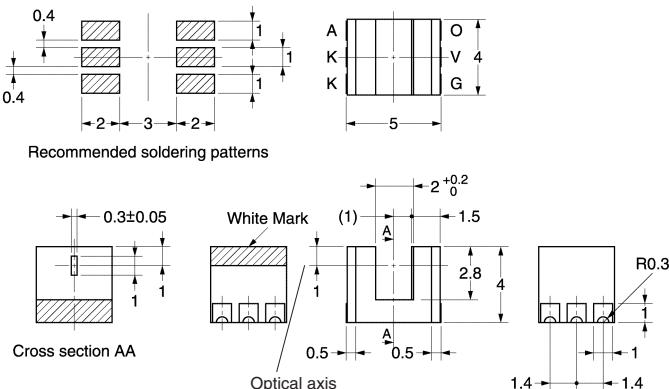
Bulk: 80°C for 4 hours or more

Photomicrosensor (Transmissive) EE-SX4134

⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Unless otherwise specified, the tolerances are ± 0.15 mm.

Terminal No.	Name
A	Anode
K	Cathode
V	Supply voltage (V _{CC})
O	Output (OUT)
G	Ground (GND)

Features

- Ultra-compact model.
- Photo IC output model.
- Operates at a V_{CC} of 2.2 to 7 V.
- PCB surface mounting type.

Absolute Maximum Ratings (Ta = 25°C)

	Item	Symbol	Rated value
Emitter	Forward current	I _F	25 mA (see note 1)
	Reverse voltage	V _R	5 V
Detector	Supply voltage	V _{CC}	9 V
	Output voltage	V _{OUT}	17 V
	Output current	I _{OUT}	8 mA
	Permissible output dissipation	P _{OUT}	80 mW (see note 1)
	Operating	T _{opr}	-25°C to 85°C
Ambient temperature	Storage	T _{stg}	-40°C to 90°C
	Reflow soldering	T _{sol}	255°C (see note 2)
	Manual soldering	T _{sol}	350°C (see note 2)

Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

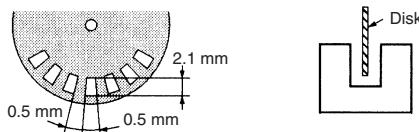
2. Complete soldering within 10 seconds for reflow soldering and within 3 seconds for manual soldering.

Electrical and Optical Characteristics (Ta = 25°C)

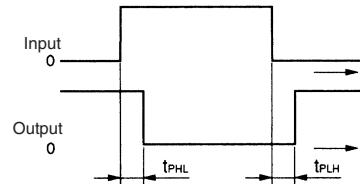
	Item	Symbol	Value	Condition
Emitter	Forward voltage	V _F	1.2 V typ., 1.4 V max.	I _F = 20 mA
	Reverse current	I _R	0.01 μA typ., 10 μA max.	V _R = 5 V
	Peak emission wavelength	λ _P	940 nm typ.	I _F = 20 mA
Detector	Power supply voltage	V _{CC}	2.2 V min., 7 V max.	---
	Low-level output voltage	V _{OL}	0.12 V typ., 0.4 V max.	V _{CC} = 2.2 to 7 V, I _{OL} = 8 mA, I _F = 7 mA
	High-level output current	I _{OH}	10 μA max.	V _{CC} = 2.2 to 7 V, I _F = 0 mA, V _{OUT} = 17 V
	Current consumption	I _{CC}	2.8 mA typ., 4 mA max.	V _{CC} = 7 V
	Peak spectral sensitivity wavelength	λ _P	870 nm typ.	V _{CC} = 2.2 to 7 V
LED current when output is ON	I _{FT}		2.0 mA typ., 3.5 mA max.	V _{CC} = 2.2 to 7 V
Hysteresis	ΔH		21% typ.	V _{CC} = 2.2 to 7 V (see note 1)
Response frequency	f		3 kHz min.	V _{CC} = 2.2 to 7 V, I _F = 5 mA, I _{OL} = 8 mA (see note 2)
Response delay time	t _{PHL}		7 μs typ.	V _{CC} = 2.2 to 7 V, I _F = 5 mA, I _{OL} = 8 mA (see note 3)
Response delay time	t _{PLH}		18 μs typ.	V _{CC} = 2.2 to 7 V, I _F = 5 mA, I _{OL} = 8 mA (see note 3)

Note: 1. Hysteresis denotes the difference in forward LED current value, expressed in percentage, calculated from the respective forward LED currents when the photo IC is turned from ON to OFF and when the photo IC is turned from OFF to ON.

2. The value of the response frequency is measured by rotating the disk as shown below.

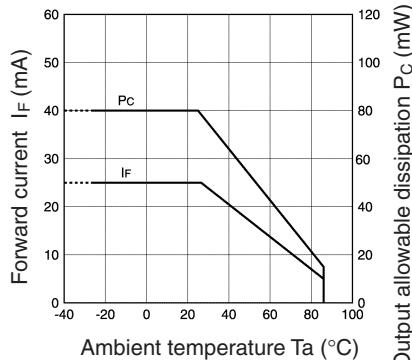


3. The following illustrations show the definition of response delay time.

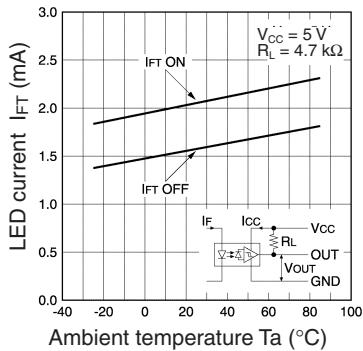


■ Engineering Data

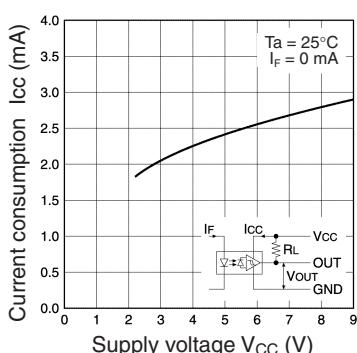
Forward Current vs. Collector Dissipation Temperature Rating



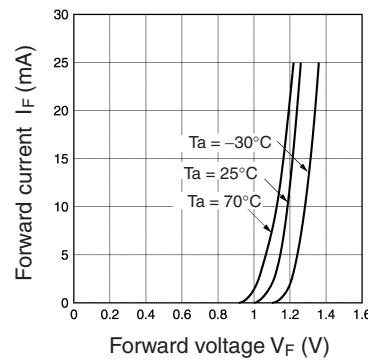
LED Current vs. Ambient Temperature Characteristics (Typical)



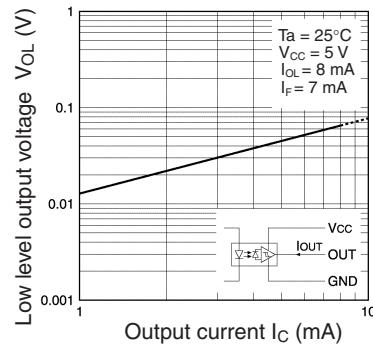
Current Consumption vs. Supply Voltage (Typical)



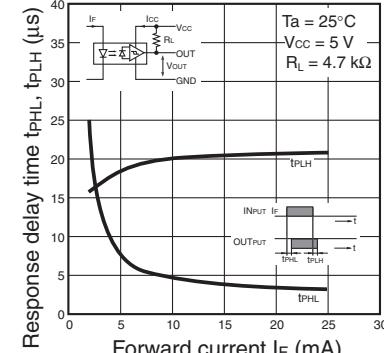
Forward Current vs. Forward Voltage Characteristics (Typical)



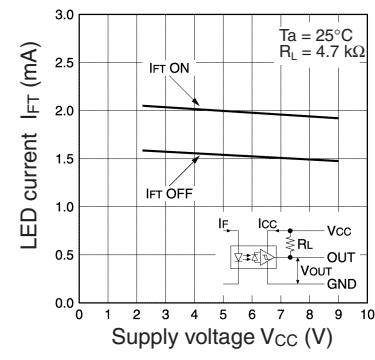
Low-level Output Voltage vs. Output Current (Typical)



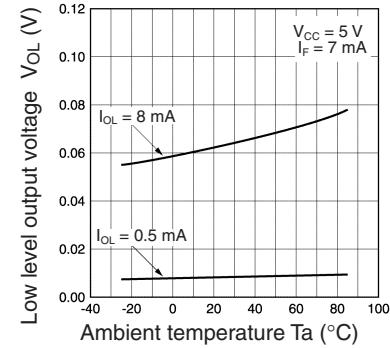
Response Delay Time vs. Forward Current (Typical)



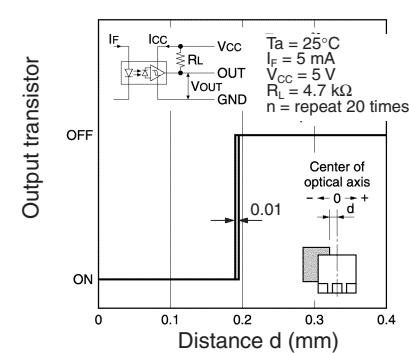
LED Current vs. Supply Voltage (Typical)



Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



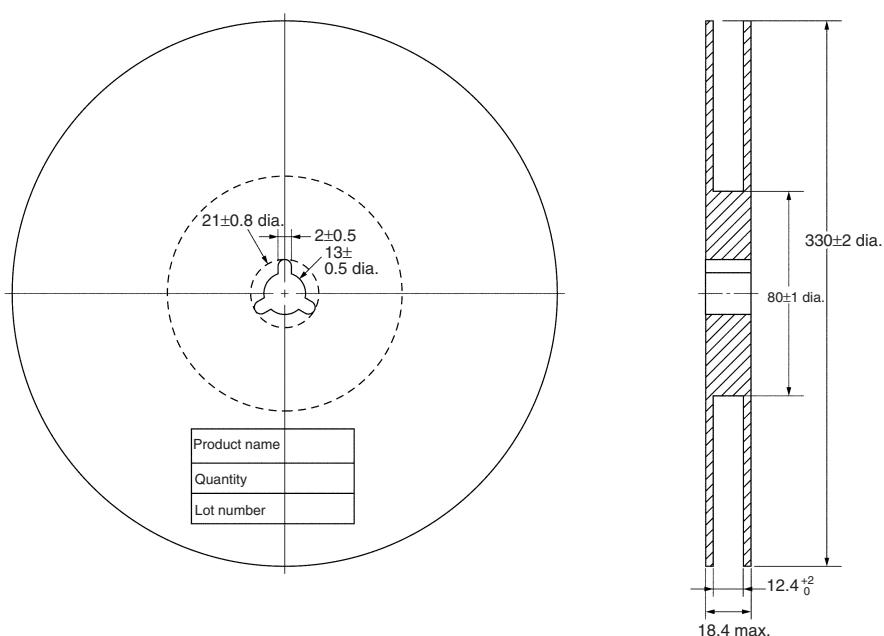
Repeat Sensing Position Characteristics (Typical)



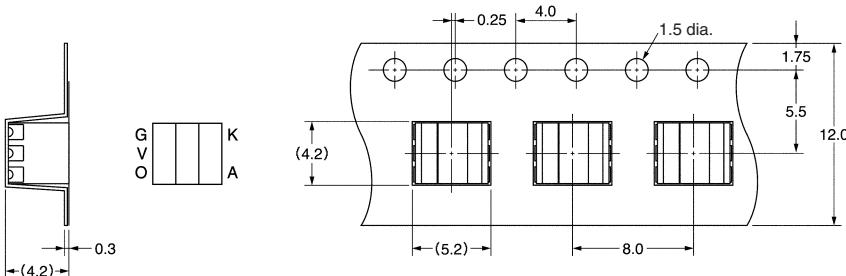
Unit: mm (inch)

■ Tape and Reel

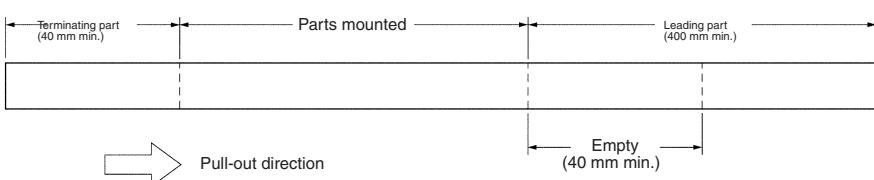
Reel



Tape



Tape configuration



Tape quantity

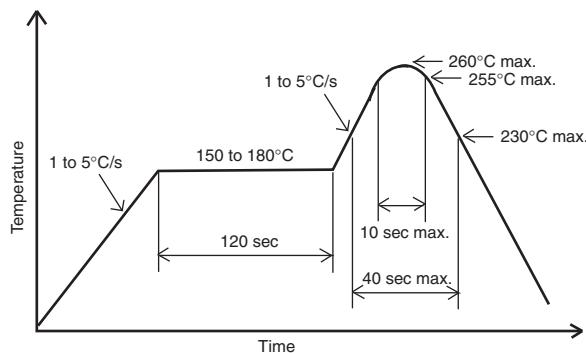
2,000 pcs./reel

Precautions

■ Soldering Information

Reflow soldering

- The following soldering paste is recommended:
 - Melting temperature: 216 to 220°C
 - Composition: Sn 3.5 Ag 0.75 Cu
- The recommended thickness of the metal mask for screen printing is between 0.2 and 0.25 mm.
- Set the reflow oven so that the temperature profile shown in the following chart is obtained for the upper surface of the product being soldered.



Manual soldering

- Use "Sn 60" (60% tin and 40% lead) or solder with silver content.
- Use a soldering iron of less than 25 W, and keep the temperature of the iron tip at 300°C or below.
- Solder each point for a maximum of three seconds.
- After soldering, allow the product to return to room temperature before handling it.

Storage

To protect the product from the effects of humidity until the package is opened, dry-box storage is recommended. If this is not possible, store the product under the following conditions:

Temperature: 10 to 30°C

Humidity: 60% max.

The product is packed in a humidity-proof envelope. Reflow soldering must be done within 48 hours after opening the envelope, during which time the product must be stored under 30°C at 80% maximum humidity.

If it is necessary to store the product after opening the envelope, use dry-box storage or reseal the envelope.

Baking

If a product has remained packed in a humidity-proof envelope for six months or more, or if more than 48 hours have lapsed since the envelope was opened, bake the product under the following conditions before use:

Reel: 60°C for 24 hours or more

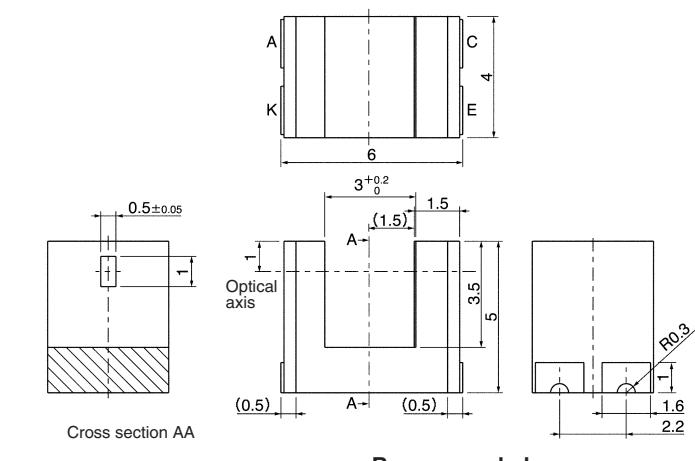
Bulk: 80°C for 4 hours or more

Photomicrosensor (Transmissive) EE-SX1109

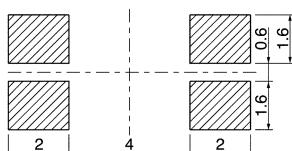
⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Recommended
Soldering Pattern



Unless otherwise specified, the tolerances are ± 0.15 mm.

Features

- Ultra-compact with a 6-mm-wide sensor and a 3-mm-wide slot.
- PCB surface mounting type.
- High resolution with a 0.5-mm-wide aperture.

Absolute Maximum Ratings (Ta = 25°C)

	Item	Symbol	Rated value
Emitter	Forward current	I _F	25 mA (see note 1)
	Pulse forward current	I _{FP}	100 mA (see note 2)
	Reverse voltage	V _R	5 V
Detector	Collector-Emitter voltage	V _{CEO}	20 V
	Emitter-Collector voltage	V _{ECO}	5 V
	Collector current	I _C	20 mA
	Collector dissipation	P _C	75 mW (see note 1)
	Operating	T _{opr}	-30°C to 85°C
Ambient temperature	Storage	T _{stg}	-40°C to 90°C
	Reflow soldering	T _{sol}	255°C (see note 3)
	Manual soldering	T _{sol}	350°C (see note 3)

Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

2. Duty: 1/100; Pulse width: 0.1 ms

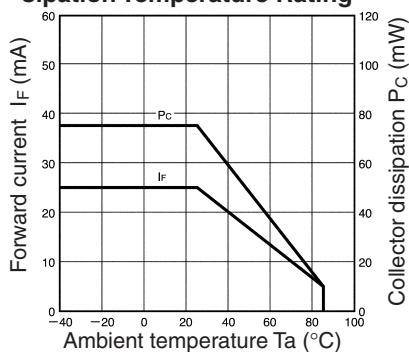
3. Complete soldering within 10 seconds for reflow soldering and within 3 seconds for manual soldering.

Electrical and Optical Characteristics (Ta = 25°C)

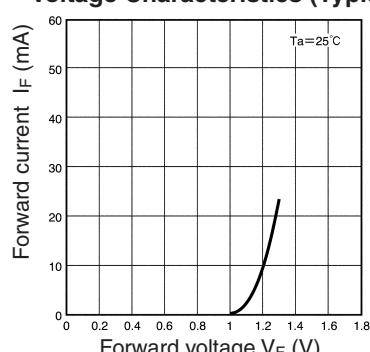
	Item	Symbol	Value	Condition
Emitter	Forward voltage	V _F	1.1 V typ., 1.3 V max.	I _F = 5 mA
	Reverse current	I _R	10 μA max.	V _R = 5 V
	Peak emission wavelength	λ _P	940 nm typ.	I _F = 20 mA
Detector	Light current	I _L	50 μA min., 150 μA typ., 500 μA max.	I _F = 5 mA, V _{CE} = 5 V
	Dark current	I _D	100 nA max.	V _{CE} = 10 V, 0 lx
	Leakage current	I _{LEAK}	---	---
	Collector-Emitter saturated voltage	V _{CE} (sat)	0.1 V typ., 0.4 V max.	I _F = 20 mA, I _L = 50 μA
	Peak spectral sensitivity wavelength	λ _P	900 nm typ.	---
Rising time	tr		10 μs typ.	V _{CC} = 5 V, R _L = 1 kΩ, I _L = 100 μA
Falling time	tf		10 μs typ.	V _{CC} = 5 V, R _L = 1 kΩ, I _L = 100 μA

■ Engineering Data

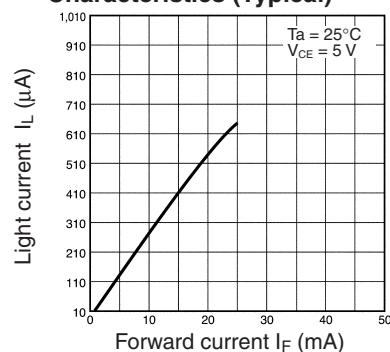
Forward Current vs. Collector Dissipation Temperature Rating



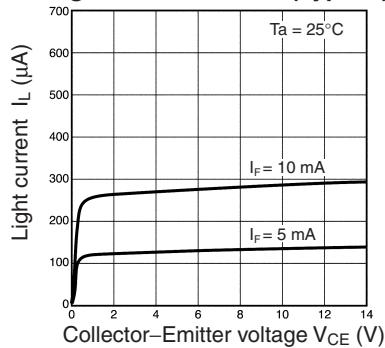
Forward Current vs. Forward Voltage Characteristics (Typical)



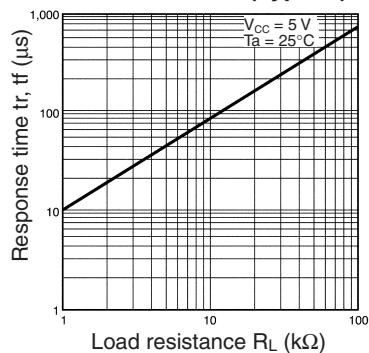
Light Current vs. Forward Current Characteristics (Typical)



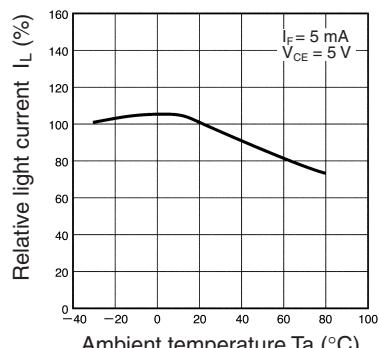
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



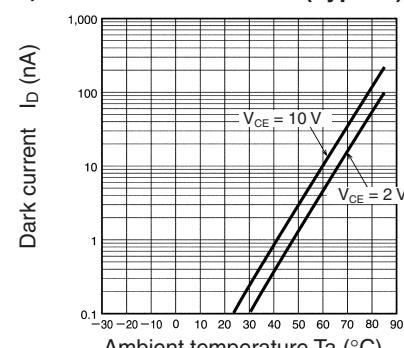
Response Time vs. Load Resistance Characteristics (Typical)



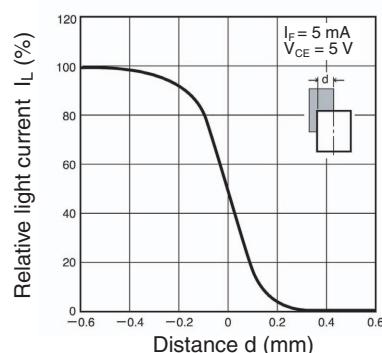
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



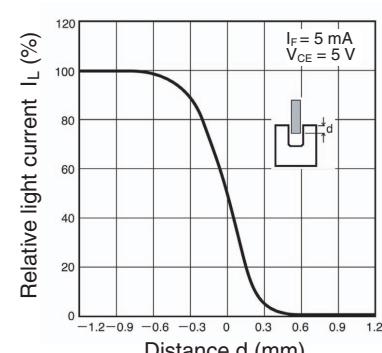
Dark Current vs. Ambient Temperature Characteristics (Typical)



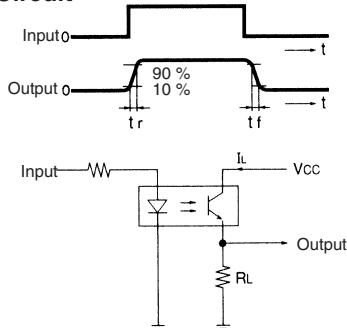
Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)



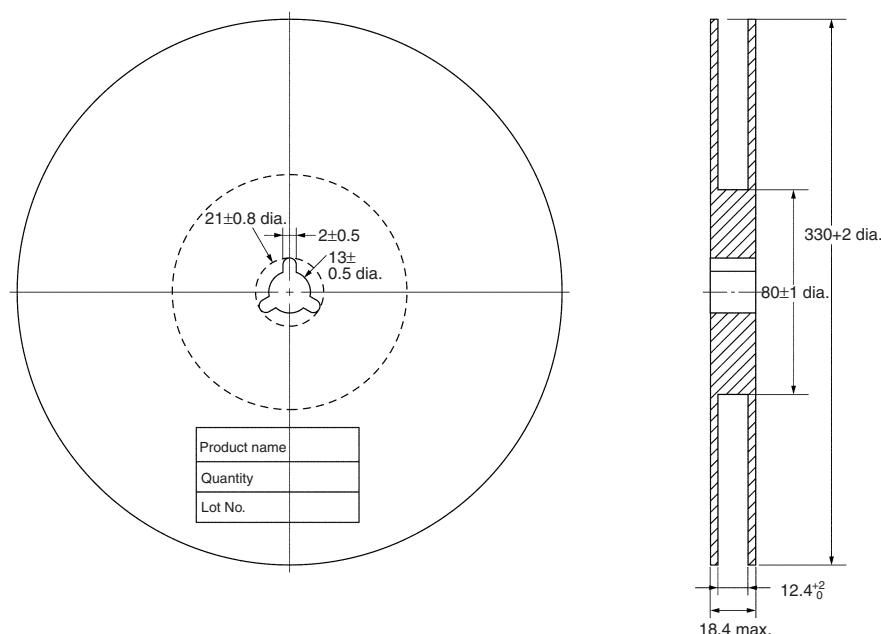
Response Time Measurement Circuit



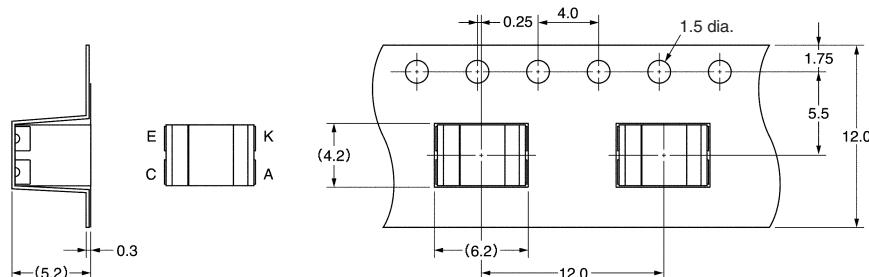
Unit: mm (inch)

■ Tape and Reel

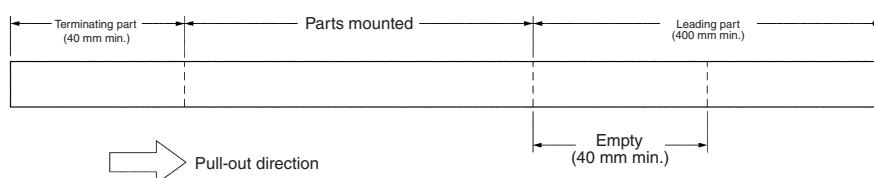
Reel



Tape



Tape configuration



Tape quantity

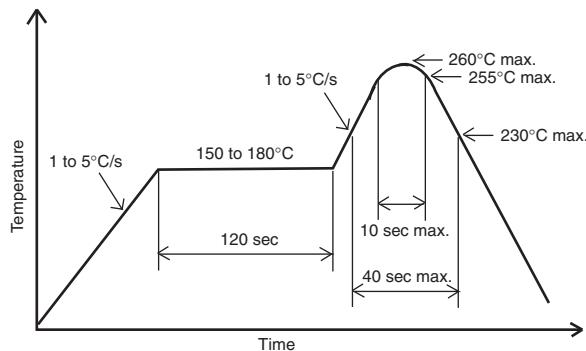
1,000 pcs./reel

Precautions

■ Soldering Information

Reflow soldering

- The following soldering paste is recommended:
 - Melting temperature: 216 to 220°C
 - Composition: Sn 3.5 Ag 0.75 Cu
- The recommended thickness of the metal mask for screen printing is between 0.2 and 0.25 mm.
- Set the reflow oven so that the temperature profile shown in the following chart is obtained for the upper surface of the product being soldered.



Manual soldering

- Use "Sn 60" (60% tin and 40% lead) or solder with silver content.
- Use a soldering iron of less than 25 W, and keep the temperature of the iron tip at 300°C or below.
- Solder each point for a maximum of three seconds.
- After soldering, allow the product to return to room temperature before handling it.

Storage

To protect the product from the effects of humidity until the package is opened, dry-box storage is recommended. If this is not possible, store the product under the following conditions:

Temperature: 10 to 30°C

Humidity: 60% max.

The product is packed in a humidity-proof envelope. Reflow soldering must be done within 48 hours after opening the envelope, during which time the product must be stored under 30°C at 80% maximum humidity.

If it is necessary to store the product after opening the envelope, use dry-box storage or reseal the envelope.

Baking

If a product has remained packed in a humidity-proof envelope for six months or more, or if more than 48 hours have lapsed since the envelope was opened, bake the product under the following conditions before use:

Reel: 60°C for 24 hours or more

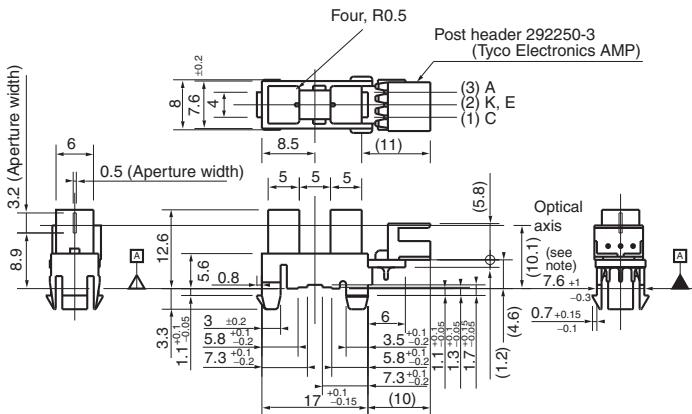
Bulk: 80°C for 4 hours or more

Photomicrosensor (Transmissive) EE-SX1235A-P2

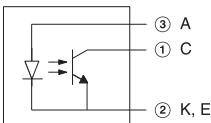
⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Note: The asterisked dimension is specified by datum A only.

Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	± 0.3
$3 < \text{mm} \leq 6$	± 0.375
$6 < \text{mm} \leq 10$	± 0.45
$10 < \text{mm} \leq 18$	± 0.55
$18 < \text{mm} \leq 30$	± 0.65

Terminal No.	Name
A	Anode
C	Collector
K, E	Cathode, Emitter

Recommended Mating Connectors:

Tyco Electronics AMP 173977-3 (press-fit connector)
175778-3 (crimp connector)
179228-3 (crimp connector)

Features

- Snap-in mounting model.
- Mounts to 1.0-, 1.2- and 1.6-mm-thick PCBs.
- High resolution with a 0.5-mm-wide aperture.
- 5-mm-wide slot.
- Connects to Tyco Electronics AMP's CT-series connectors.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rated value
Emitter	Forward current	I_F 50 mA (see note)
	Pulse forward current	I_{FP} ---
	Reverse voltage	V_R 4 V
Detector	Collector-Emitter voltage	V_{CEO} 30 V
	Emitter-Collector voltage	V_{ECO} 5 V
	Collector current	I_C 20 mA
	Collector dissipation	P_C 100 mW (see note)
Ambient temperature	Operating	T_{opr} -25°C to 95°C
	Storage	T_{stg} -40°C to 100°C
Soldering temperature	T_{sol}	---

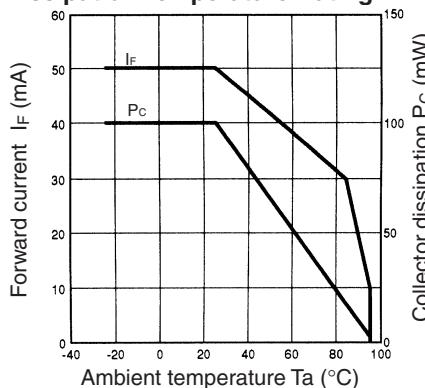
Note: Refer to the temperature rating chart if the ambient temperature exceeds 25°C .

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

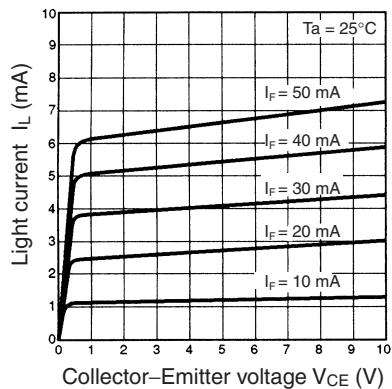
Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F 1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R 0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P 940 nm typ.	$I_F = 30 \text{ mA}$
Detector	Light current	I_L 0.6 mA min., 14 mA max.	$I_F = 20 \text{ mA}, V_{CE} = 5 \text{ V}$
	Dark current	I_D 200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lux}$
	Leakage current	I_{LEAK} ---	---
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$ 0.1 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 0.3 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_P 850 nm typ.	$V_{CE} = 5 \text{ V}$
Rising time	t_r	8 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 1 \text{ mA}$
Falling time	t_f	8 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 1 \text{ mA}$

■ Engineering Data

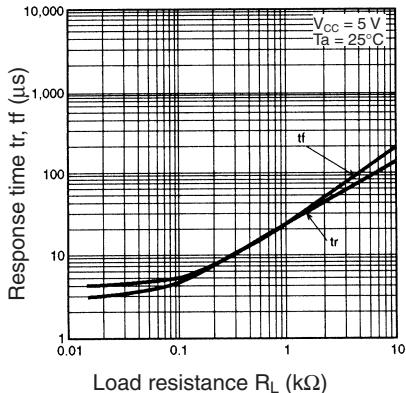
Forward Current vs. Collector Dissipation Temperature Rating



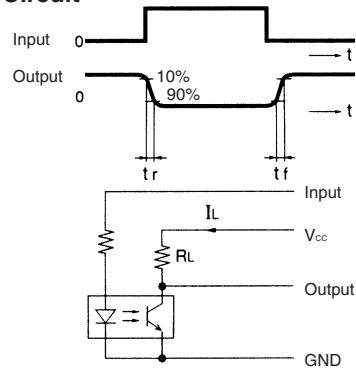
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



Response Time vs. Load Resistance Characteristics (Typical)

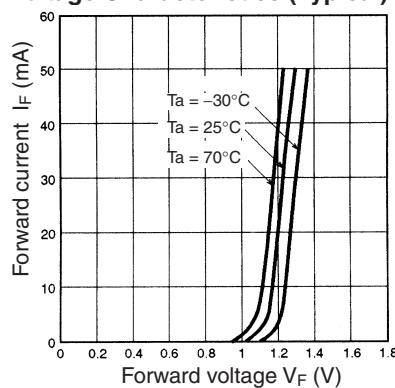


Response Time Measurement Circuit

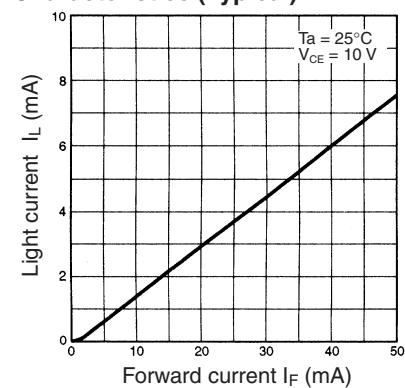


Refer to EE-SX4235A-P2 on page 52.

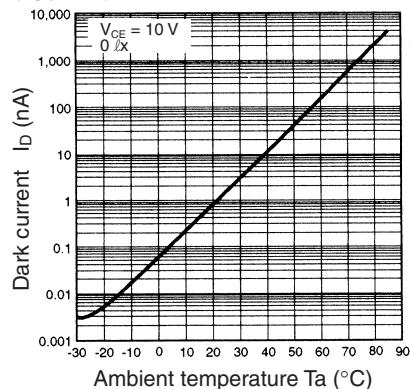
Forward Current vs. Forward Voltage Characteristics (Typical)



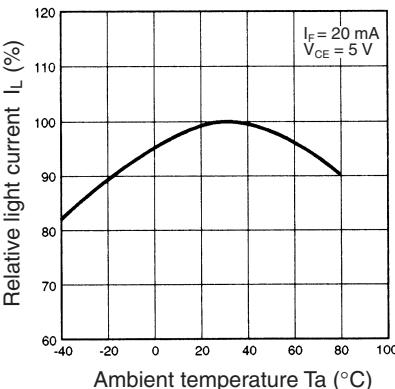
Light Current vs. Forward Current Characteristics (Typical)



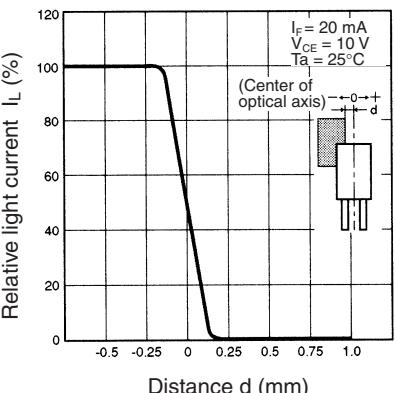
Dark Current vs. Ambient Temperature Characteristics (Typical)



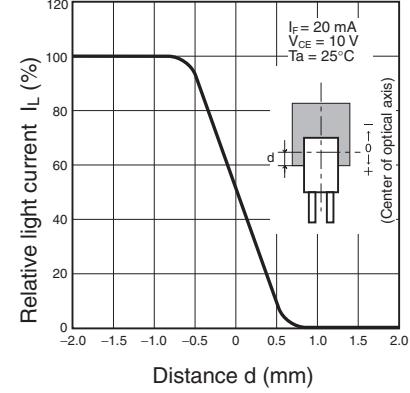
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)

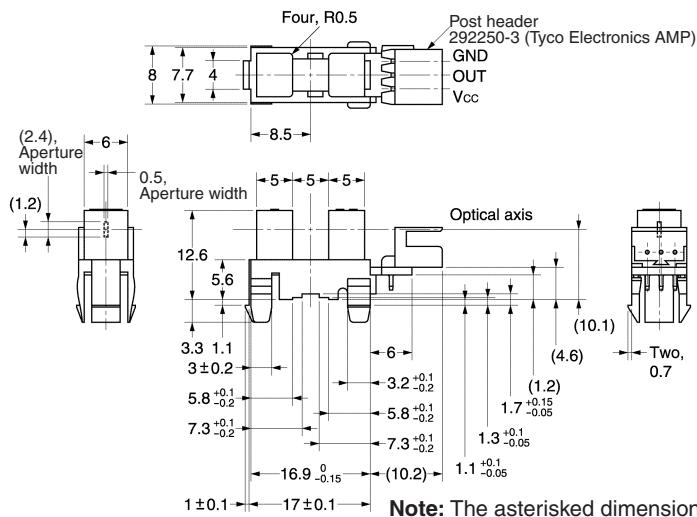


Photomicrosensor (Transmissive) EE-SX3239-P2

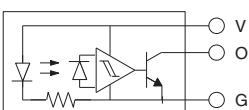
⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Terminal No.	Name
V	Power supply (V _{CC})
O	Output (OUT)
G	Ground (GND)

Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

Recommended Mating Connectors:

Tyco Electronics AMP 175778-3 (crimp connector)
173977-3 (press-fit connector)
179228-3 (crimp connector)

Features

- Snap-in mounting model.
- Mounts to 1.0-, 1.2- and 1.6-mm-thick panels.
- High resolution with a 0.5-mm-wide sensing aperture.
- With a 5-mm-wide slot.
- Photo IC output signals directly connect with C-MOS and TTL.
- Connects to Tyco Electronics AMP's CT-series connectors.

Absolute Maximum Ratings (Ta = 25°C)

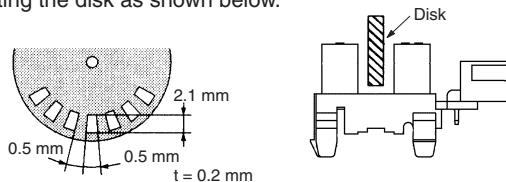
Item	Symbol	Rated value
Power supply voltage	V _{CC}	7 V
Output voltage	V _{OUT}	28 V
Output current	I _{OUT}	16 mA
Permissible output dissipation	P _{OUT}	250 mW (see note)
Ambient temper- ature	Operating	T _{opr} -20°C to 75°C
	Storage	T _{stg} -40°C to 85°C
Soldering temperature	T _{sol}	---

Note: Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

Electrical and Optical Characteristics (Ta = 25°C, V_{CC} = 5 V ±10%)

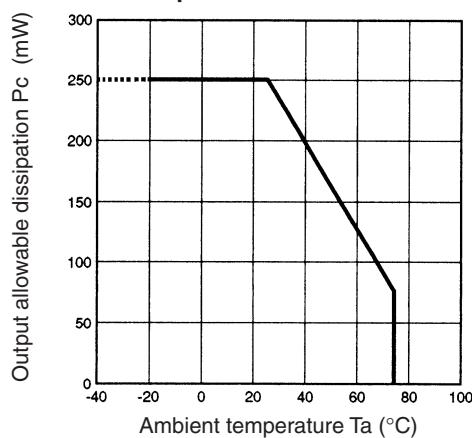
Item	Symbol	Value	Condition
Current consumption	I _{CC}	16.5 mA max.	With and without incident
Low-level output voltage	V _{OL}	0.35 V max.	I _{OUT} = 16 mA without incident (EE-SX3239-P2)
High-level output voltage	V _{OH}	(V _{CC} × 0.9) V min.	V _{OUT} = V _{CC} with incident (EE-SX3239-P2), R _L = 47 kΩ
Response frequency	f	3 kHz min.	V _{OUT} = V _{CC} , R _L = 47 kΩ (see note)

Note: The value of the response frequency is measured by rotating the disk as shown below.

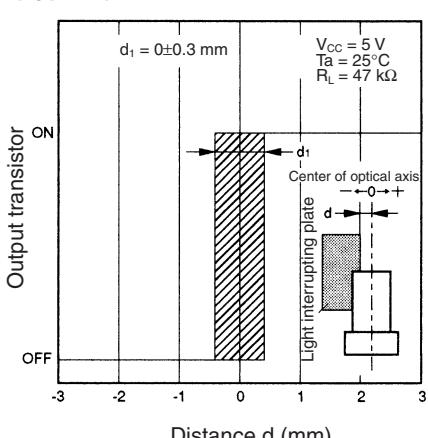


■ Engineering Data

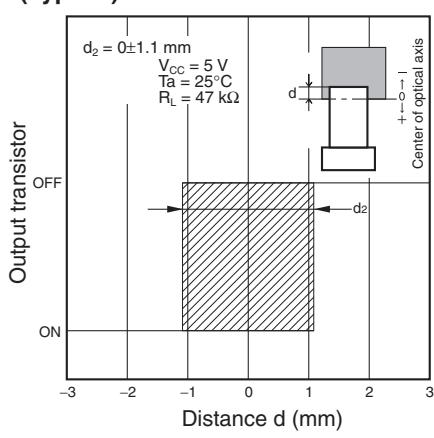
Output Allowable Dissipation vs. Ambient Temperature Characteristics



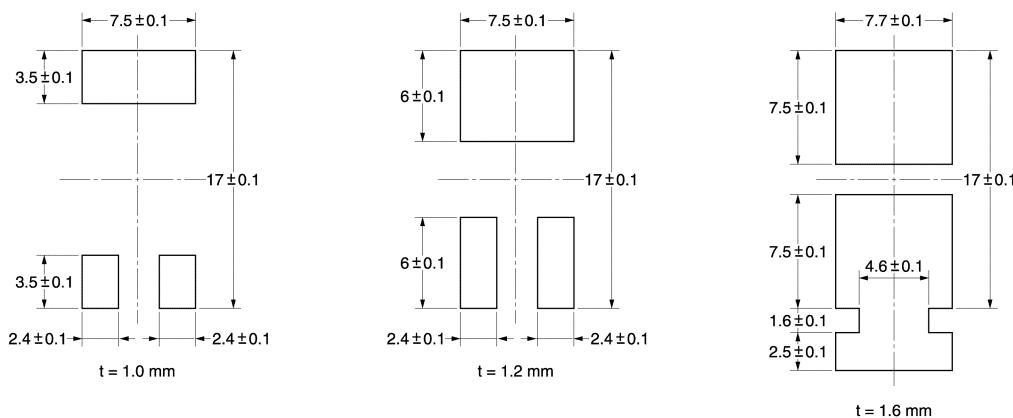
Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)



■ Recommended Mounting Holes



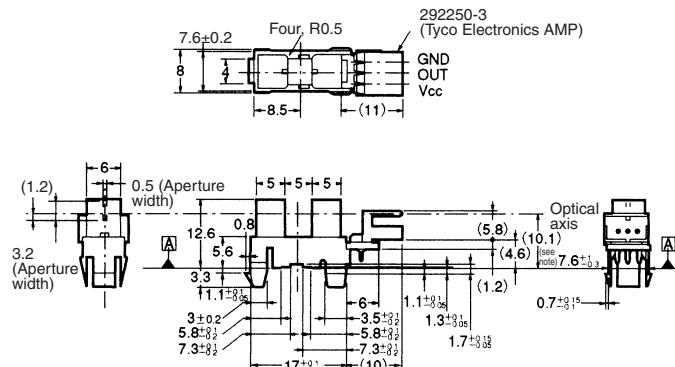
- When mounting the Photomicrosensor to a panel with a hole opened by pressing, make sure that the hole has no burrs. The mounting strength of the Photomicrosensor will decrease if the hole has burrs.
- When mounting the Photomicrosensor to a panel with a hole opened by pressing, be sure to mount the Photomicrosensor on the pressing side of the panel.
- The mounting strength of the Photomicrosensor will increase if the Photomicrosensor is mounted to a panel with a hole that is only a little larger than the size of the Photomicrosensor, in which case, however, it will be difficult to mount the Photomicrosensor to the panel. The mounting strength of the Photomicrosensor will decrease if the Photomicrosensor is mounted to a panel with a hole that is comparatively larger than the size of the Photomicrosensor, in which case, however, it will be easy to mount the Photomicrosensor to the panel. When mounting the Photomicrosensor to a panel, open an appropriate hole for the Photomicrosensor according to the application.
- After mounting the Photomicrosensor to any panel, make sure that the Photomicrosensor does not wobble.
- When mounting the Photomicrosensor to a molding with a hole, make sure that the edges of the hole are sharp enough, otherwise the Photomicrosensor may fall out.

Photomicrosensor (Transmissive) EE-SX4235A-P2

⚠ Be sure to read *Precautions* on page 24.

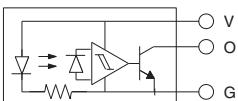
Dimensions

Note: All units are in millimeters unless otherwise indicated.



Note: The dimension is specified by datum A only.

Internal Circuit



Terminal No.	Name
V	Power supply (V _{CC})
O	Output (OUT)
G	Ground (GND)

Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

Recommended Mating Connectors:

Tyco Electronics AMP 179228-3 (crimp connector)
175778-3 (crimp connector)
173977-3 (press-fit connector)

Features

- Snap-in mounting model.
- Mounts to 1.0-, 1.2- and 1.6-mm-thick panels.
- High resolution with a 0.5-mm-wide sensing aperture.
- With a 5-mm-wide slot.
- Photo IC output signals directly connect with C-MOS and TTL.
- Connects to Tyco Electronics AMP's CT-series connectors.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

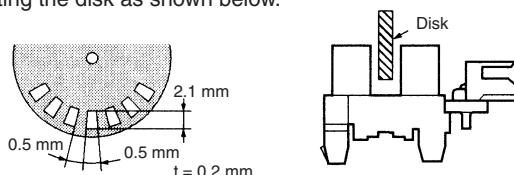
Item	Symbol	Rated value
Power supply voltage	V_{CC}	7 V
Output voltage	V_{OUT}	28 V
Output current	I_{OUT}	16 mA
Permissible output dissipation	P_{OUT}	250 mW (see note)
Ambient temperature	Operating	$T_{opr} = -25^\circ\text{C}$ to 75°C
	Storage	$T_{stg} = -40^\circ\text{C}$ to 85°C
Soldering temperature	T_{sol}	---

Note: Refer to the temperature rating chart if the ambient temperature exceeds 25°C .

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$, $V_{CC} = 5 \text{ V} \pm 10\%$)

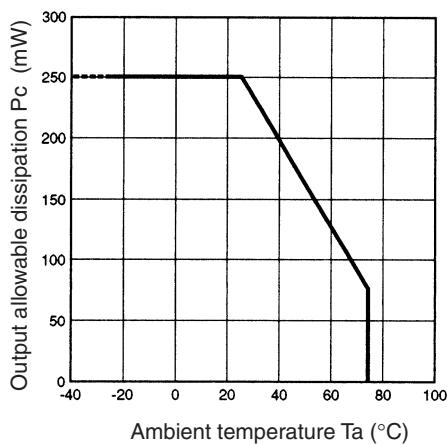
Item	Symbol	Value	Condition
Current consumption	I_{CC}	16.5 mA max.	With and without incident
Low-level output voltage	V_{OL}	0.35 V max.	$I_{OUT} = 16 \text{ mA}$ with incident
High-level output voltage	V_{OH}	$(V_{CC} \times 0.9) \text{ V}$ min.	$V_{OUT} = V_{CC}$ without incident, $R_L = 47 \text{ k}\Omega$
Response frequency	f	3 kHz min.	$V_{OUT} = V_{CC}$, $R_L = 47 \text{ k}\Omega$ (see note)

Note: The value of the response frequency is measured by rotating the disk as shown below.

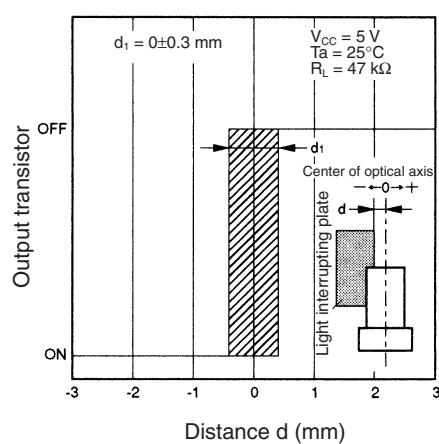


■ Engineering Data

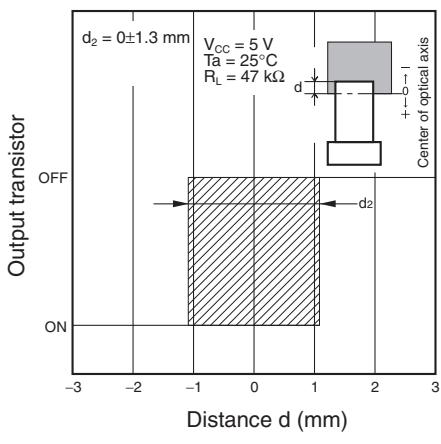
**Output Allowable Dissipation vs.
Ambient Temperature Characteristics**



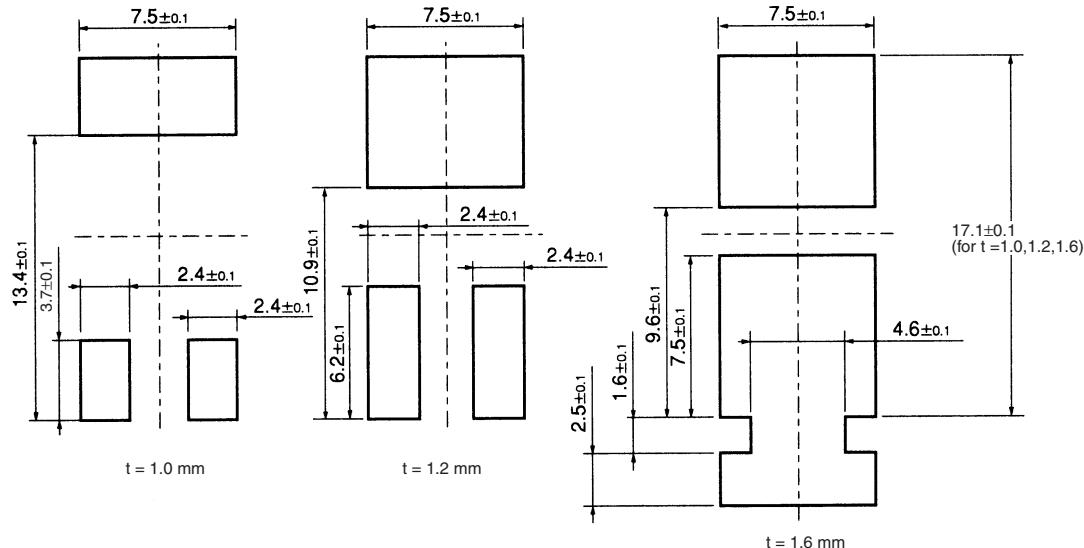
**Sensing Position Characteristics
(Typical)**



**Sensing Position Characteristics
(Typical)**



■ Recommended Mounting Holes



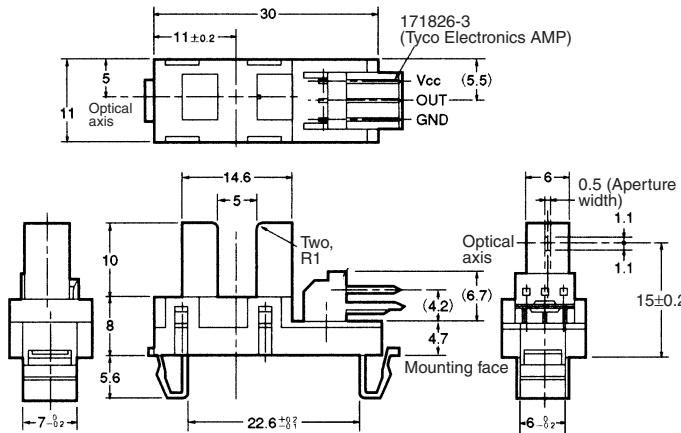
- When mounting the Photomicrosensor to a panel with a hole opened by pressing, make sure that the hole has no burrs. The mounting strength of the Photomicrosensor will decrease if the hole has burrs.
- When mounting the Photomicrosensor to a panel with a hole opened by pressing, be sure to mount the Photomicrosensor on the pressing side of the panel.
- The mounting strength of the Photomicrosensor will increase if the Photomicrosensor is mounted to a panel with a hole that is only a little larger than the size of the Photomicrosensor, in which case, however, it will be difficult to mount the Photomicrosensor to the panel. The mounting strength of the Photomicrosensor will decrease if the Photomicrosensor is mounted to a panel with a hole that is comparatively larger than the size of the Photomicrosensor, in which case, however, it will be easy to mount the Photomicrosensor to the panel. When mounting the Photomicrosensor to a panel, open an appropriate hole for the Photomicrosensor according to the application.
- After mounting the Photomicrosensor to any panel, make sure that the Photomicrosensor does not wobble.
- When mounting the Photomicrosensor to a molding with a hole, make sure that the edges of the hole are sharp enough, otherwise the Photomicrosensor may fall out.

Photomicrosensor (Transmissive) EE-SX460-P1

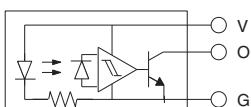
⚠ Be sure to read *Precautions* on page 24.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

Recommended Mating Connectors:

Tyco Electronics AMP 171822-3 (crimp connector)
172142-3 (crimp connector)
OMRON EE-1005 (with harness)

■ Features

- Snap-in mounting model.
- Mounts to 0.8- to 1.6-mm-thick panels.
- High resolution (aperture width of 0.5 mm)
- With a 5-mm-wide slot.
- Photo IC output signals directly connect with C-MOS and TTL.
- Connects to Tyco Electronics AMP's EI-series connectors.

■ Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rated value
Power supply voltage	V_{CC}	10 V
Output voltage	V_{OUT}	28 V
Output current	I_{OUT}	16 mA
Permissible output dissipation	P_{OUT}	250 mW (see note)
Ambient temperature	Operating	$T_{opr} = -20^\circ\text{C to } 75^\circ\text{C}$
	Storage	$T_{stg} = -40^\circ\text{C to } 85^\circ\text{C}$
Soldering temperature	T_{sol}	---

Note: Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

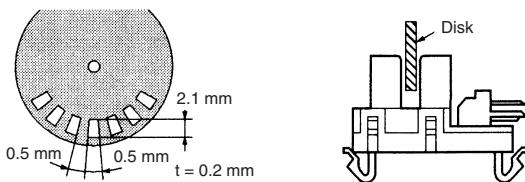
Terminal No.	Name
V	Power supply (V_{CC})
O	Output (OUT)
G	Ground (GND)

Recommended Mating Connectors:
Tyco Electronics AMP 171822-3 (crimp connector)
172142-3 (crimp connector)
OMRON EE-1005 (with harness)

■ Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$, $V_{CC} = 5 \text{ V} \pm 10\%$)

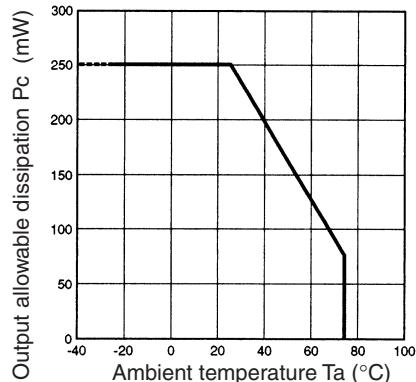
Item	Symbol	Value	Condition
Current consumption	I_{CC}	30 mA max.	With and without incident
Low-level output voltage	V_{OL}	0.3 V max.	$I_{OUT} = 16 \text{ mA}$ with incident
High-level output voltage	V_{OH}	$(V_{CC} \times 0.9) \text{ V}$ min.	$V_{OUT} = V_{CC}$ without incident, $R_L = 47 \text{ k}\Omega$
Response frequency	f	3 kHz min.	$V_{OUT} = V_{CC}$, $R_L = 47 \text{ k}\Omega$ (see note)

Note: The value of the response frequency is measured by rotating the disk as shown below.

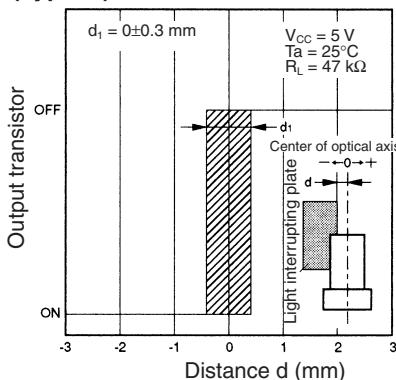


■ Engineering Data

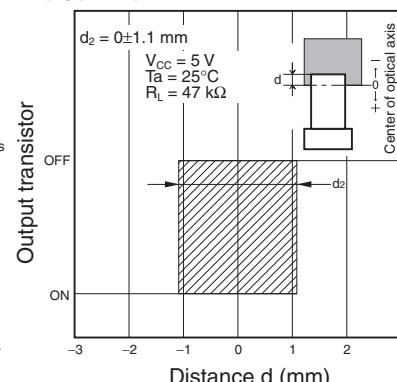
Output Allowable Dissipation vs. Ambient Temperature Characteristics



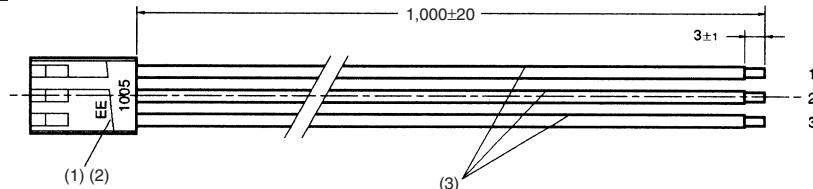
Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)



EE-1005 Connector



No.	Name	Model	Quantity	Maker
1	Receptacle housing	171822-3	1	Tyco Electronics AMP
2	Receptacle contact	170262-1	3	Tyco Electronics AMP
3	Lead wire	UL1007 AWG24	3	---

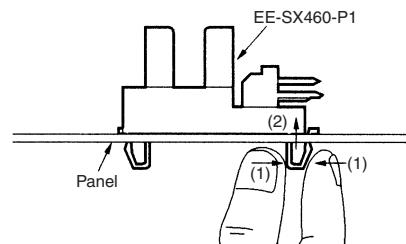
Wiring

Connector circuit no.	Lead wire color	Output when connected to EE-SX460-P1
1	Red	V _{cc}
2	Orange	OUT
3	Yellow	GND

■ Recommended Mounting Hole Dimensions and Mounting and Dismounting Method

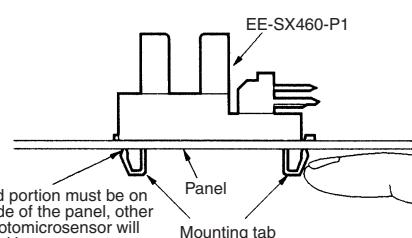
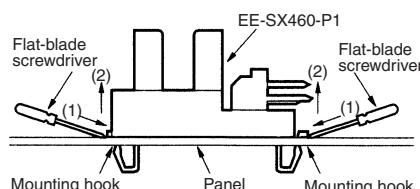
Dismounting by Hand

Squeeze the mounting tabs as shown in the following illustration and press the mounting tabs upwards.



Pressed mounting holes are ideal for mounting the Photomicrosensor. When mounting the Photomicrosensor to a panel that has pressed mounting holes for the Photomicrosensor, be sure to mount the Photomicrosensor on the pressing side of the panel, otherwise it may be difficult to mount the Photomicrosensor and an insertion force of five to six kilograms may be required.

When mounting the Photomicrosensor to a panel that has mounting holes opened by pressing, make sure that the mounting holes have no burrs, otherwise the lock mechanism of the Photomicrosensor will not work perfectly. After mounting the Photomicrosensor to a panel, be sure to check if the lock mechanism is working perfectly.

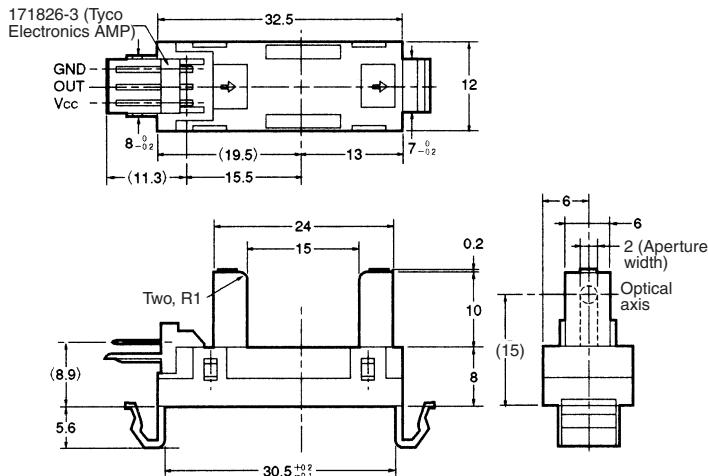


Photomicrosensor (Transmissive) EE-SX461-P11

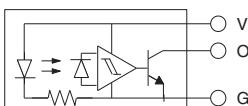
⚠ Be sure to read *Precautions* on page 24.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are as shown below.

Terminal No.	Name
V	Power supply (V _{CC})
O	Output (OUT)
G	Ground (GND)

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

Recommended Mating Connectors:

Tyco Electronics AMP 171822-3 (crimp connector)
172142-3 (crimp connector)
OMRON EE-1005 (with harness)

■ Features

- Snap-in-mounting model.
- Mounts to 0.8- to 1.6-mm-thick panels.
- With a 15-mm-wide slot.
- Photo IC output signals directly connect with C-MOS and TTL.
- Connects to Tyco Electronics AMP's EI-series connectors.

■ Absolute Maximum Ratings (Ta = 25°C)

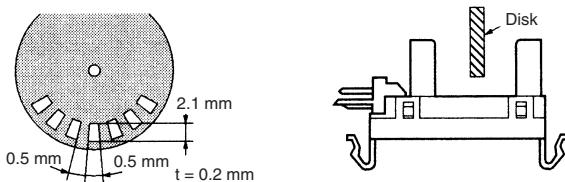
Item	Symbol	Rated value
Power supply voltage	V _{CC}	7 V
Output voltage	V _{OUT}	28 V
Output current	I _{OUT}	16 mA
Permissible output dissipation	P _{OUT}	250 mW (see note)
Ambient temper- ature	Operating	Topr -20°C to 75°C
	Storage	Tstg -40°C to 85°C
Soldering temperature	Tsol	---

Note: Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

■ Electrical and Optical Characteristics (Ta = 25°C, V_{CC} = 5 V ± 10%)

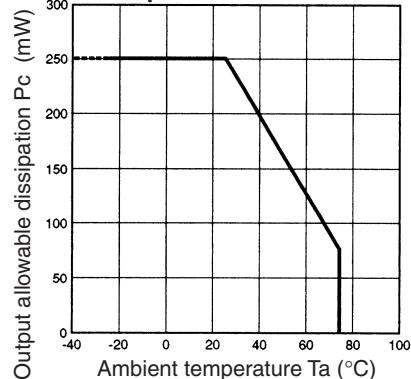
Item	Symbol	Value	Condition
Current consumption	I _{CC}	35 mA max.	With and without incident
Low-level output voltage	V _{OL}	0.3 V max.	I _{OUT} = 16 mA with incident
High-level output voltage	V _{OH}	(V _{CC} × 0.9) V min.	V _{OUT} = V _{CC} without incident, R _L = 47 kΩ
Response frequency	f	3 kHz min.	V _{OUT} = V _{CC} , R _L = 47 kΩ (see note)

Note: The value of the response frequency is measured by rotating the disk as shown below.

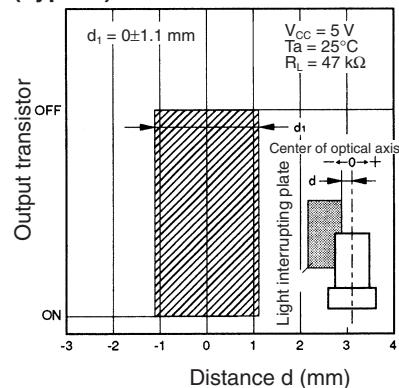


■ Engineering Data

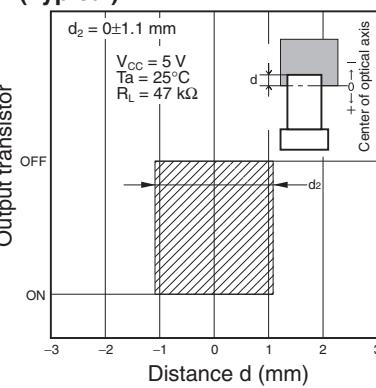
Output Allowable Dissipation vs. Ambient Temperature Characteristics



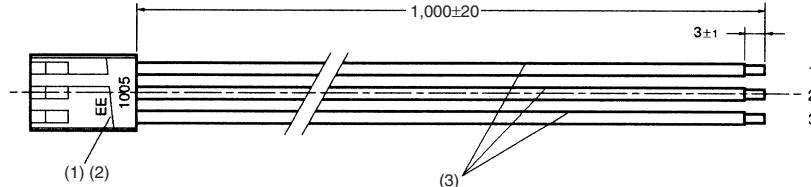
Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)



EE-1005 Connector



No.	Name	Model	Quantity	Maker
1	Receptacle housing	171822-3	1	Tyco Electronics AMP
2	Receptacle contact	170262-1	3	Tyco Electronics AMP
3	Lead wire	UL1007 AWG24	3	---

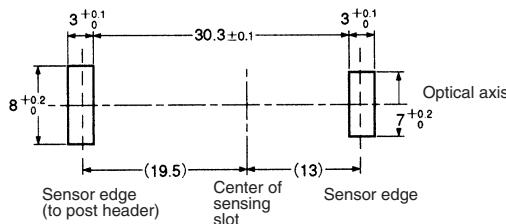
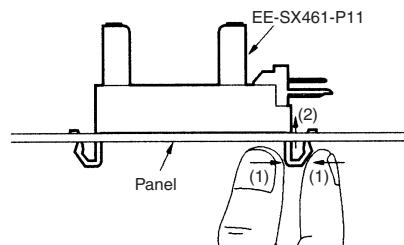
Wiring

Connector circuit no.	Lead wire color	Output when connected to EE-SX461-P11
1	Red	V _{CC}
2	Orange	OUT
3	Yellow	GND

■ Recommended Mounting Hole Dimensions and Mounting and Dismounting Method

Dismounting by Hand

Squeeze the mounting tabs as shown in the following illustration and press the mounting tabs upwards.



The Photomicrosensor can be mounted to 0.8- to 1.6-mm-thick panels.

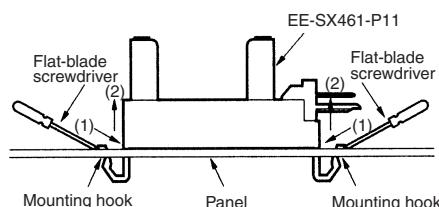
Refer to the above mounting hole dimensions and open the mounting holes in the panel to which the Photomicrosensor will be mounted.

Insert into the holes the Photomicrosensor's mounting portions with a force of three to five kilograms but do not press in the Photomicrosensor at one time. The Photomicrosensor can be easily mounted by inserting the mounting portions halfway and then slowly pressing the Photomicrosensor onto the panel.

There are two ways to dismount the Photomicrosensor. Refer to the following.

Dismounting with Screwdriver

Press the mounting hooks of the Photomicrosensor with a flat-blade screwdriver as shown in the following illustration and pull up the Photomicrosensor.



Pressed mounting holes are ideal for mounting the Photomicrosensor. When mounting the Photomicrosensor to a panel that has pressed mounting holes for the Photomicrosensor, be sure to mount the Photomicrosensor on the pressing side of the panel, otherwise it may be difficult to mount the Photomicrosensor and an insertion force of five to six kilograms may be required.

When mounting the Photomicrosensor to a panel that has mounting holes opened by pressing, make sure that the mounting holes have no burrs, otherwise the lock mechanism of the Photomicrosensor will not work perfectly. After mounting the Photomicrosensor to a panel, be sure to check if the lock mechanism is working perfectly.

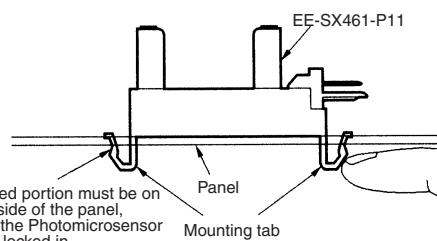
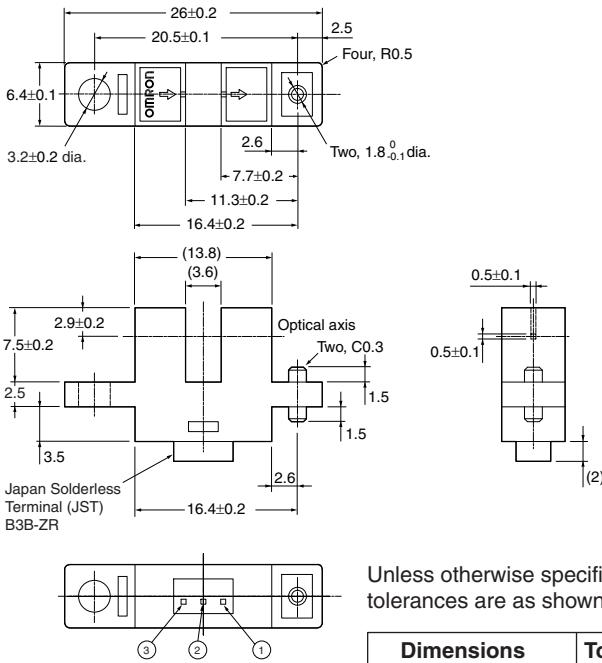


Photo IC Output Photomicrosensor (Transmissive) EE-SX3148-P1

⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.200
3 < mm ≤ 6	±0.240
6 < mm ≤ 10	±0.290
10 < mm ≤ 18	±0.350
18 < mm ≤ 30	±0.420

Recommended Mating Connectors:
JST (Japan Solderless Terminal) ZHR-3 Series (crimp connector)
03ZR Series (press-fit connector)

Features

- A boss on one side enables securing the Sensor with one M2 or M3 screw.
- Sensor can be installed from either top or bottom of mounting plate.
- High resolution both vertically and horizontally (slot dimensions: 0.5 x 0.5 mm)
- 3.6-mm-wide slot.
- Photo-IC output connects directly to CMOS and TTL devices.
- Applicable to the ZH and ZR Connector Series from JST (Japan Solderless Terminal).

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rated value
Power supply voltage	V_{CC}	6 VDC
Output voltage	V_{OUT}	28 V
Output current	I_{OUT}	16 mA
Permissible output dissipation	P_{OUT}	250 mW (see note)
Ambient temperature	Operating	$T_{opr} = -20^\circ\text{C to } 75^\circ\text{C}$
	Storage	$T_{stg} = -40^\circ\text{C to } 85^\circ\text{C}$
Soldering temperature	T_{sol}	---

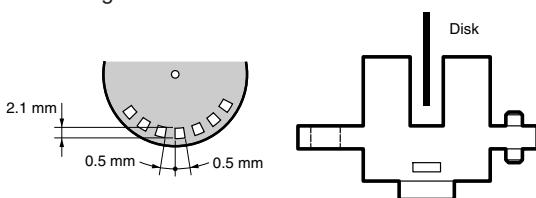
Note: Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

Terminal No.	Name
1	Power supply (V_{CC})
2	Output (OUT)
3	Ground (GND)

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$, $V_{CC} = 5 \text{ V} \pm 10\%$)

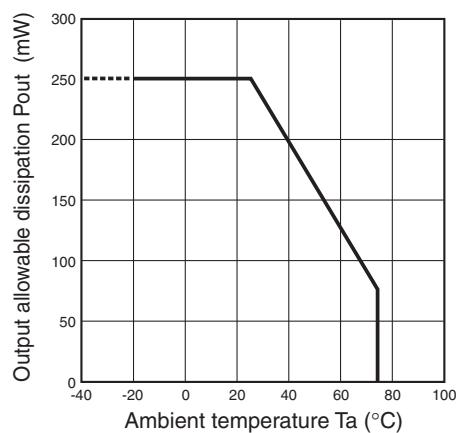
Item	Symbol	Value	Condition
Current consumption	I_{CC}	30 mA max.	With and without incident
Low-level output voltage	V_{OL}	0.3 V max.	$I_{OUT} = 16 \text{ mA}$ without incident
High-level output voltage	V_{OH}	$(V_{CC} \times 0.9) \text{ V min.}$	$V_{OUT} = V_{CC}$ with incident $R_L = 47 \text{ k}\Omega$
Response frequency	f	3 kHz min.	$V_{OUT} = V_{CC}$, $R_L = 47 \text{ k}\Omega$ (see note)

Note: The value of the response frequency is measured by rotating the disk as shown below.

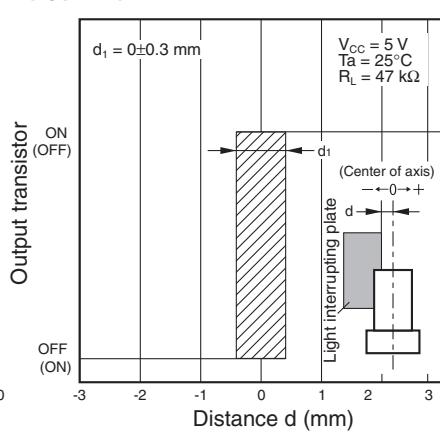


■ Engineering Data

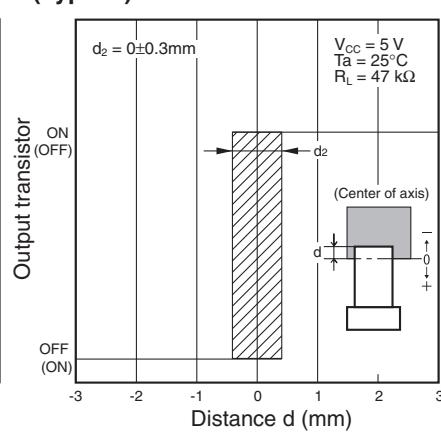
**Output Allowable Dissipation vs.
Ambient Temperature Characteristics**



**Sensing Position Characteristics
(Typical)**



**Sensing Position Characteristics
(Typical)**

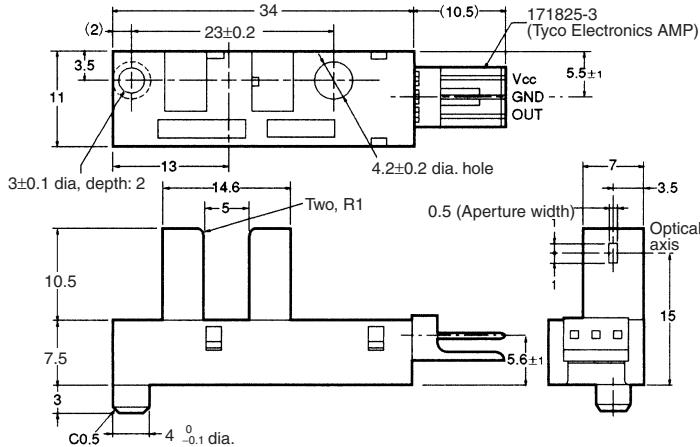


Photomicrosensor (Transmissive) EE-SX3009-P1/-SX4009-P1

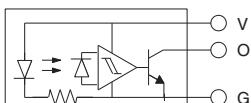
⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are as shown below.

Terminal No.	Name
V	Power supply (Vcc)
O	Output (OUT)
G	Ground (GND)

Dimensions	Tolerance
4 mm max.	±0.2
4 < mm ≤ 16	±0.3
16 < mm ≤ 63	±0.5

Recommended Mating Connectors:

Tyco Electronics AMP 171822-3 (crimp connector)
172142-3 (crimp connector)
OMRON EE-1005 (with harness)

Features

- Screw-mounting model.
- High resolution with a 0.5-mm-wide sensing aperture.
- With a 5-mm-wide groove.
- Photo IC output signals directly connect with C-MOS and TTL.
- Connects to Tyco Electronics AMP's EI-series connectors.
- Dark ON model (EE-SX3009-P1)
- Light ON model (EE-SX4009-P1)

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

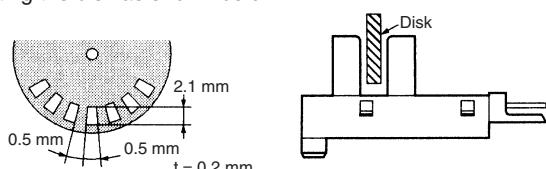
Item	Symbol	Rated value
Power supply voltage	V_{CC}	10 V
Output voltage	V_{OUT}	28 V
Output current	I_{OUT}	16 mA
Permissible output dissipation	P_{OUT}	250 mW (see note)
Ambient temperature	Operating	$T_{OPR} = -25^\circ\text{C} \text{ to } 75^\circ\text{C}$
	Storage	$T_{STG} = -40^\circ\text{C} \text{ to } 85^\circ\text{C}$
Soldering temperature	T_{SOL}	---

Note: Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$, $V_{CC} = 5 \text{ V} \pm 10\%$)

Item	Symbol	Value	Condition
Current consumption	I_{CC}	30 mA max.	With and without incident
Low-level output voltage	V_{OL}	0.3 V max.	$I_{OUT} = 16 \text{ mA}$ Without incident (EE-SX3009-P1) With incident (EE-SX4009-P1)
High-level output voltage	V_{OH}	$(V_{CC} \times 0.9) \text{ V min.}$	$V_{OUT} = V_{CC}$ With incident (EE-SX3009-P1) Without incident (EE-SX4009-P1), $R_L = 47 \text{ k}\Omega$
Response frequency	f	3 kHz min.	$V_{OUT} = V_{CC}$, $R_L = 47 \text{ k}\Omega$ (see note)

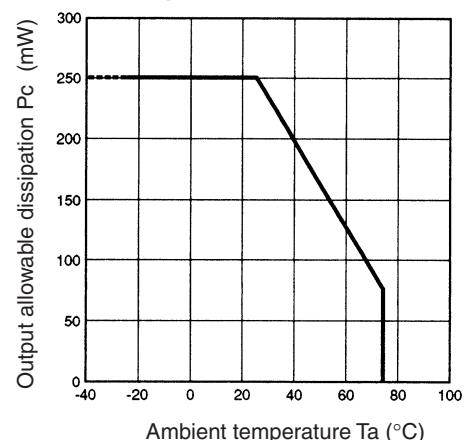
Note: The value of the response frequency is measured by rotating the disk as shown below.



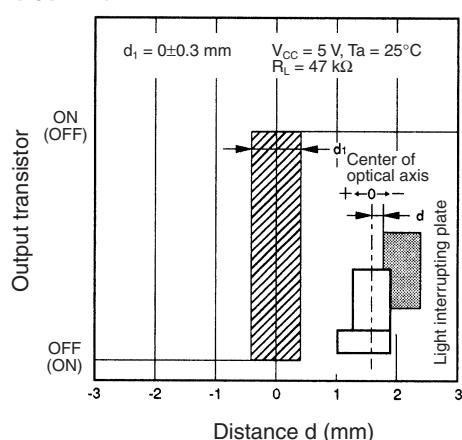
■ Engineering Data

Note: The values in the parentheses apply to the EE-SX4009-P1.

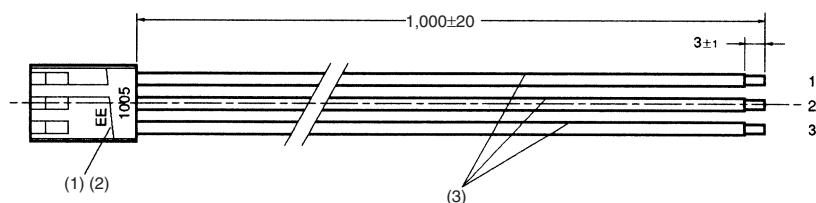
Output Allowable Dissipation vs. Ambient Temperature Characteristics



Sensing Position Characteristics (Typical)



EE-1005 Connector



No.	Name	Model	Quantity	Maker
1	Receptacle housing	171822-3	1	Tyco Electronics AMP
2	Receptacle contact	170262-1	3	Tyco Electronics AMP
3	Lead wire	UL1007 AWG24	3	---

Wiring

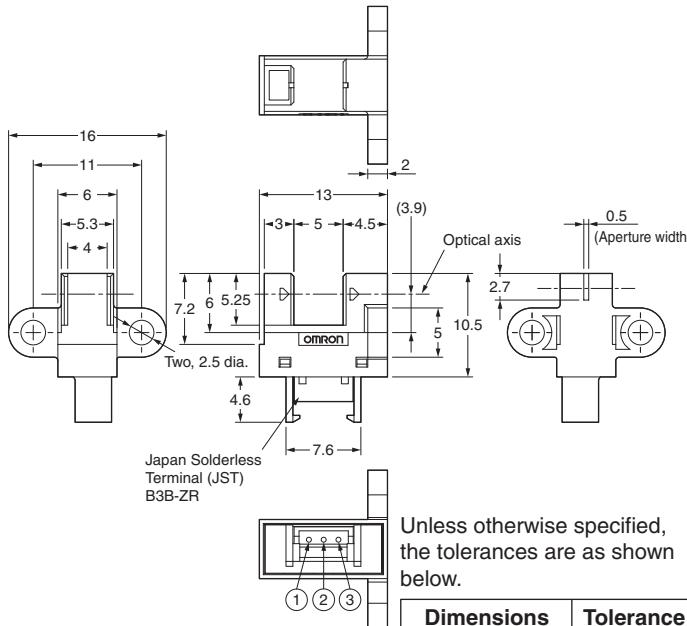
Connector circuit no.	Lead wire color	Output when connected to EE-SX4009-P1/EE-SX3009-P1
1	Red	V _{CC}
2	Orange	GND
3	Yellow	OUT

Photo IC Output Photomicrosensor (Transmissive) EE-SX3157-P1/EE-SX4157E-P1

⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Dimensions

Terminal No.	Name
1	Power supply (Vcc)
2	Output (OUT)
3	Ground (GND)

Unless otherwise specified,
the tolerances are as shown
below.

Dimensions	Tolerance
3 mm max.	± 0.200
$3 < \text{mm} \leq 6$	± 0.240
$6 < \text{mm} \leq 10$	± 0.290
$10 < \text{mm} \leq 18$	± 0.350
$18 < \text{mm} \leq 30$	± 0.420

Recommended Mating Connectors:
JST (Japan Solderless Terminal) ZHR-3

Features

- Through-beam Photomicrosensors with 5-mm slot.
- High resolution (aperture width: 0.5 mm).
- Light-ON operation with open-collector output. (EE-SX4157E-P1)
- Dark-ON operation with open-collector output. (EE-SX3157-P1)
- Screw mounting and connector connection (compatible with ZHR-3 from J.S.T. Mfg. Co., Ltd.).
- Connector lock mechanism.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

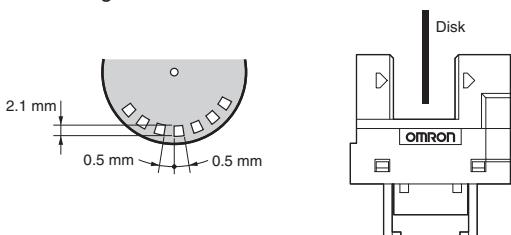
Item	Symbol	Rated value
Power supply voltage	V_{CC}	13.2 VDC
Output voltage	V_{OUT}	13.2 V
Output current	I_{OUT}	16 mA
Permissible output dissipation	P_{OUT}	250 mW (see note)
Ambient temperature	Operating	T_{opr} -20°C to 85°C
	Storage	T_{stg} -30°C to 85°C
Soldering temperature	T_{sol}	---

Note: Refer to the temperature rating chart if the ambient temperature exceeds 25°C .

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$, $V_{CC} = 12 \text{ V} \pm 10\%$)

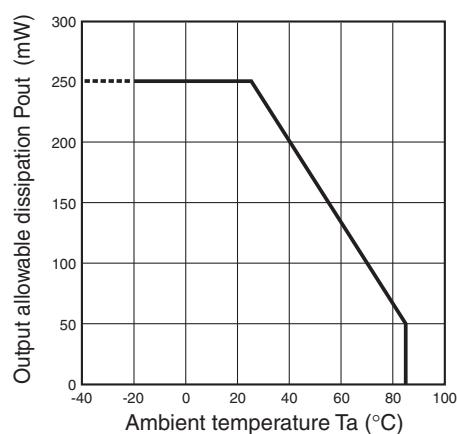
Item	Symbol	Value	Condition
Current consumption	I_{CC}	25 mA max.	With and without incident
Low-level output voltage	V_{OL}	0.3 V max.	$I_{OUT} = 16 \text{ mA}$ without incident (EE-SX3157-P1) with incident (EE-SX4157E-P1)
High-level output voltage	V_{OH}	$(V_{CC} \times 0.9) \text{ V}$ min.	$V_{OUT} = V_{CC}$ $R_L = 47 \text{ k}\Omega$ with incident (EE-SX3157-P1) without incident (EE-SX4157E-P1)
Response frequency	f	3 kHz min.	$V_{OUT} = V_{CC}$ $R_L = 47 \text{ k}\Omega$ (see note)

Note: The value of the response frequency is measured by rotating the disk as shown below.

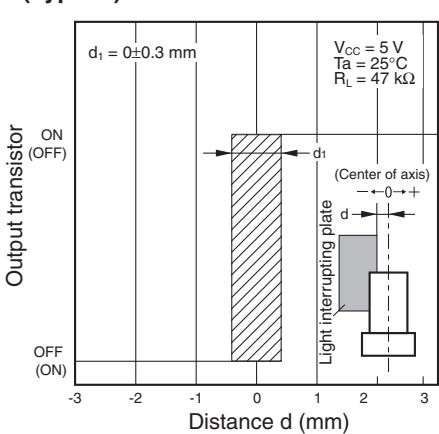


■ Engineering Data

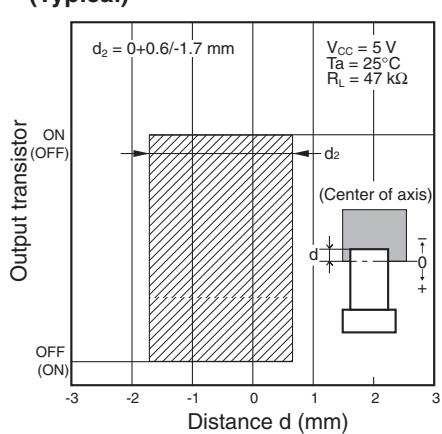
Output Allowable Dissipation vs. Ambient Temperature Characteristics



Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)

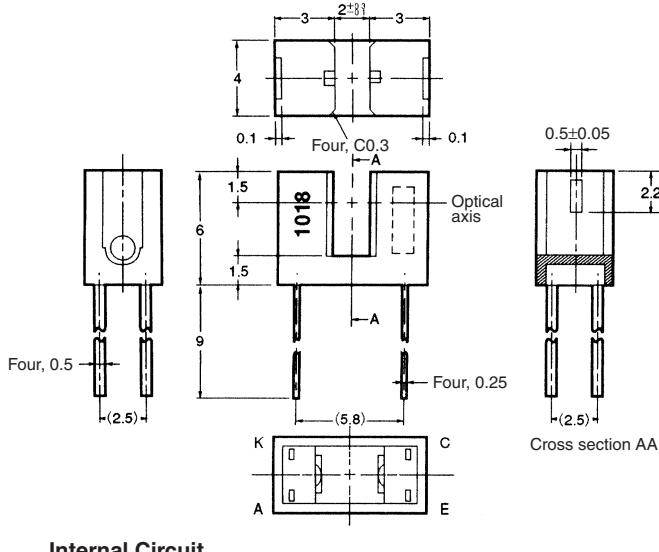


Photomicrosensor (Transmissive) EE-SX1018

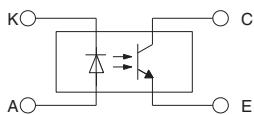
⚠ Be sure to read *Precautions* on page 24.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	± 0.3
$3 < \text{mm} \leq 6$	± 0.375
$6 < \text{mm} \leq 10$	± 0.45
$10 < \text{mm} \leq 18$	± 0.55
$18 < \text{mm} \leq 30$	± 0.65

■ Features

- Compact model with a 2-mm-wide slot.
- PCB mounting type.
- High resolution with a 0.5-mm-wide aperture.

■ Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Pulse forward current	I_{FP}	1 A (see note 2)
	Reverse voltage	V_R	4 V
Detector	Collector-Emitter voltage	V_{CEO}	30 V
	Emitter-Collector voltage	V_{ECO}	---
	Collector current	I_C	20 mA
	Collector dissipation	P_C	100 mW (see note 1)
Ambient tem- perature	Operating	T_{opr}	-25°C to 85°C
	Storage	T_{stg}	-30°C to 100°C
Soldering temperature		T_{sol}	260°C (see note 3)

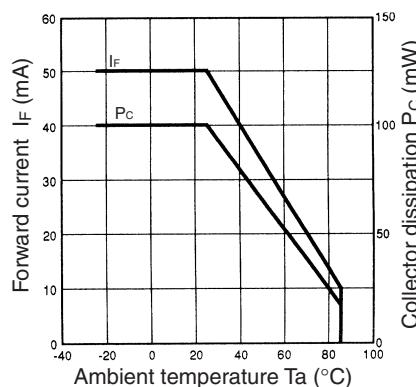
- Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
 3. Complete soldering within 10 seconds.

■ Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

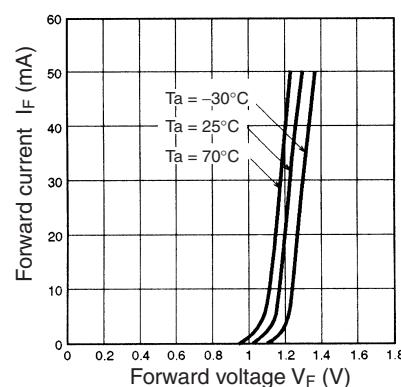
	Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_p	940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L	0.5 mA min., 14 mA max.	$I_F = 20 \text{ mA}, V_{CE} = 10 \text{ V}$
	Dark current	I_D	2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lx}$
	Leakage current	I_{LEAK}	---	---
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$	0.1 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 0.1 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_p	850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time		t_r	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$
Falling time		t_f	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$

■ Engineering Data

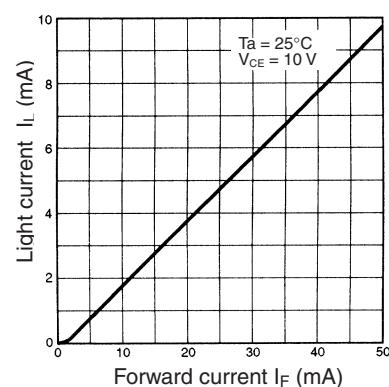
Forward Current vs. Collector Dissipation Temperature Rating



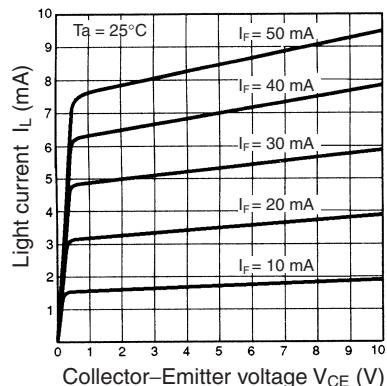
Forward Current vs. Forward Voltage Characteristics (Typical)



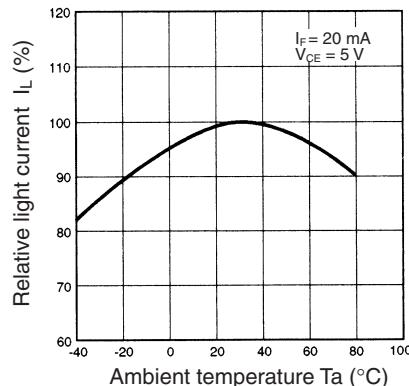
Light Current vs. Forward Current Characteristics (Typical)



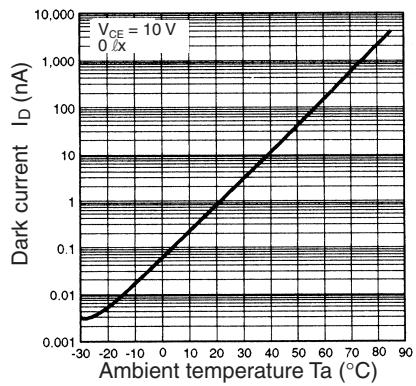
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



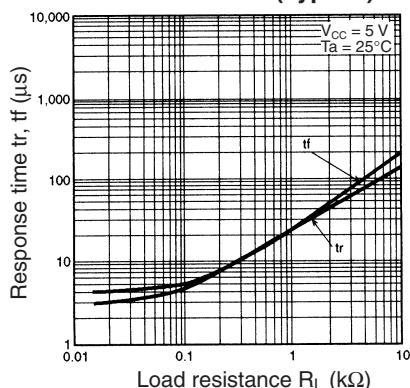
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



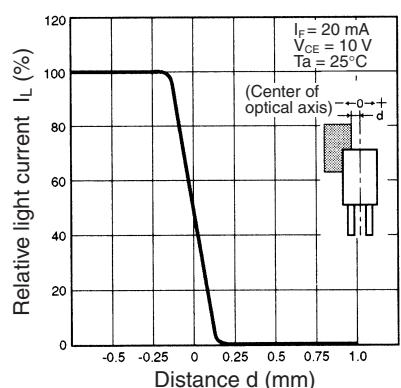
Dark Current vs. Ambient Temperature Characteristics (Typical)



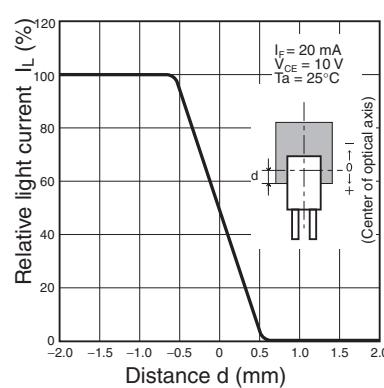
Response Time vs. Load Resistance Characteristics (Typical)



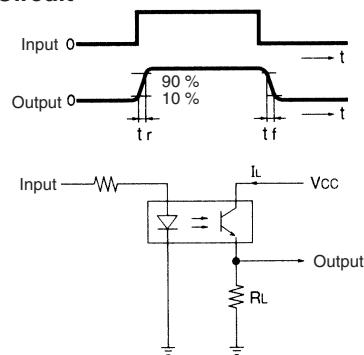
Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)



Response Time Measurement Circuit

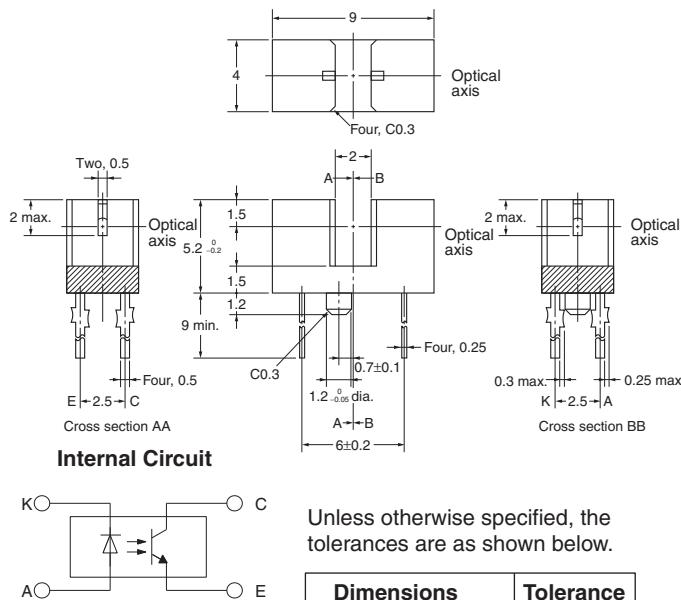


Photomicrosensor (Transmissive) EE-SX1049

⚠ Be sure to read *Precautions* on page 24.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

■ Features

- Compact with a slot width of 2 mm.
- PCB mounting type.
- High resolution with a 0.5-mm-wide aperture.

■ Absolute Maximum Ratings (Ta = 25°C)

Item	Symbol	Rated value
Emitter	Forward current	I _F 50 mA (see note 1)
	Pulse forward current	I _{FP} 1 A (see note 2)
	Reverse voltage	V _R 4 V
Detector	Collector-Emitter voltage	V _{CEO} 30 V
	Emitter-Collector voltage	V _{ECO} ---
	Collector current	I _C 20 mA
	Collector dissipation	P _C 100 mW (see note 1)
Ambient temperature	Operating	T _{opr} -25°C to 85°C
	Storage	T _{stg} -30°C to 100°C
Soldering temperature	T _{sol}	260°C (see note 3)

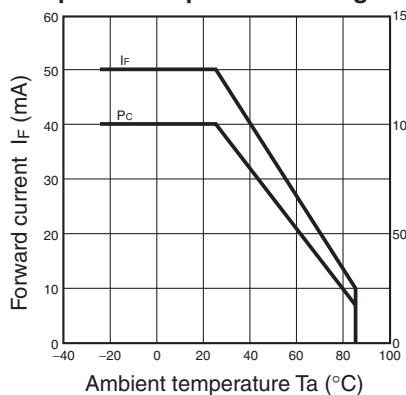
- Note:
1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 2. The pulse width is 10 µs maximum with a frequency of 100 Hz.
 3. Complete soldering within 10 seconds.

■ Electrical and Optical Characteristics (Ta = 25°C)

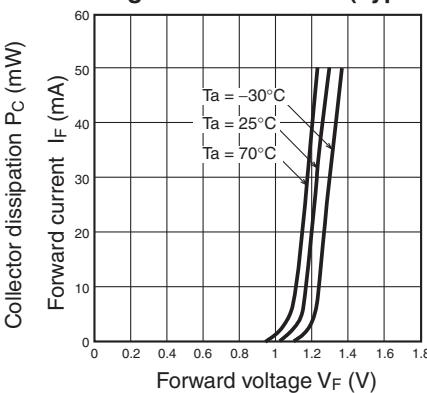
Item	Symbol	Value	Condition
Emitter	Forward voltage	V _F 1.2 V typ., 1.5 V max.	I _F = 30 mA
	Reverse current	I _R 0.01 µA typ., 10 µA max.	V _R = 4 V
	Peak emission wavelength	λ _P 940 nm typ.	I _F = 20 mA
Detector	Light current	I _L 0.5 mA min., 14 mA max.	I _F = 20 mA, V _{CE} = 10 V
	Dark current	I _D 2 nA typ., 200 nA max.	V _{CE} = 10 V, 0 lux
	Leakage current	I _{LEAK} ---	---
	Collector-Emitter saturated voltage	V _{CE} (sat) 0.1 V typ., 0.4 V max.	I _F = 20 mA, I _L = 0.1 mA
	Peak spectral sensitivity wavelength	λ _P 850 nm typ.	V _{CE} = 10 V
Rising time	tr	4 µs typ.	V _{CC} = 5 V, R _L = 100 Ω, I _L = 5 mA
Falling time	tf	4 µs typ.	V _{CC} = 5 V, R _L = 100 Ω, I _L = 5 mA

■ Engineering Data

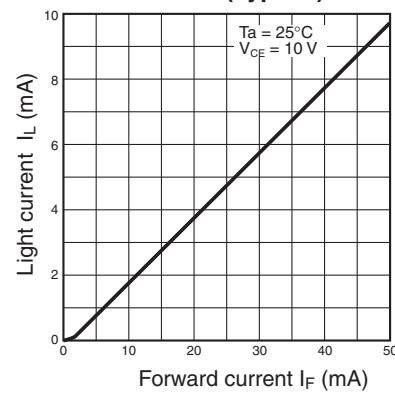
Forward Current vs. Collector Dissipation Temperature Rating



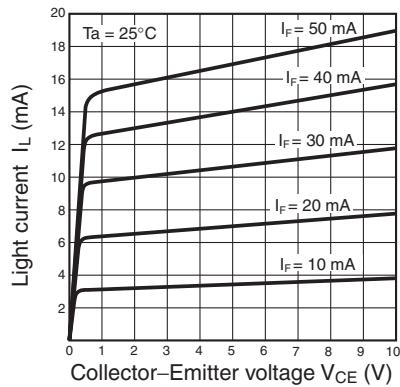
Forward Current vs. Forward Voltage Characteristics (Typical)



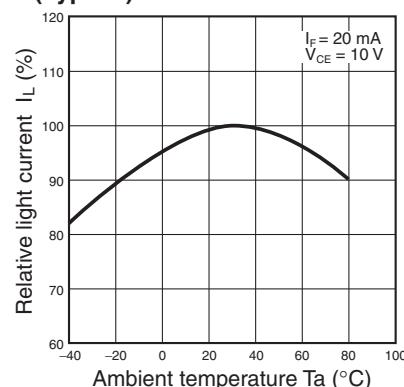
Light Current vs. Forward Current Characteristics (Typical)



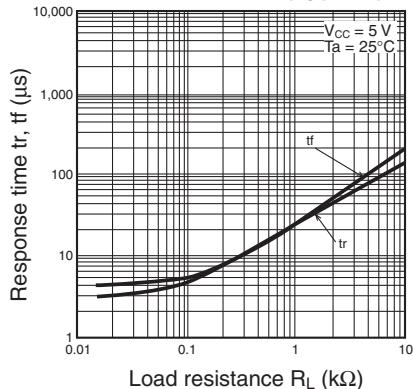
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



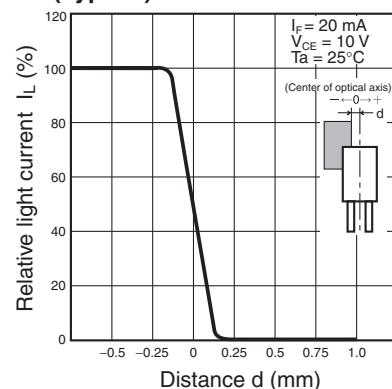
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



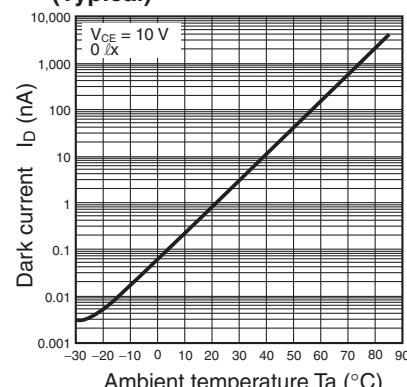
Response Time vs. Load Resistance Characteristics (Typical)



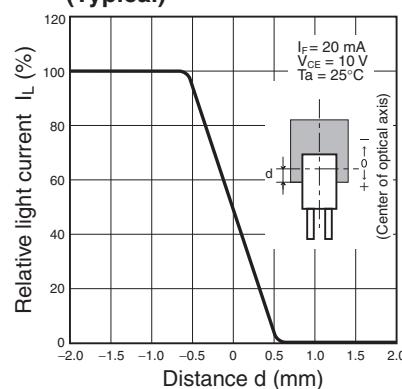
Sensing Position Characteristics (Typical)



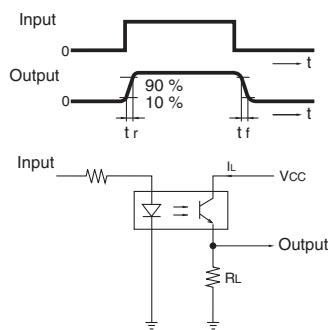
Dark Current vs. Ambient Temperature Characteristics (Typical)



Sensing Position Characteristics (Typical)



Response Time Measurement Circuit

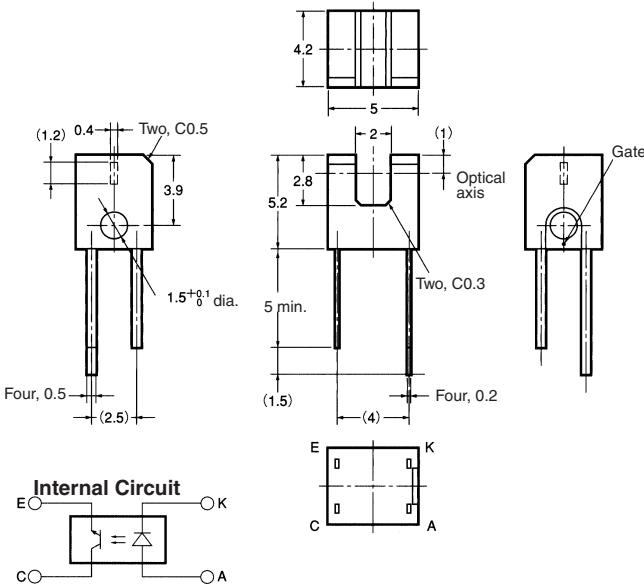


Photomicrosensor (Transmissive) EE-SX1103

⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Unless otherwise specified, the tolerances are ± 0.2 mm.

Features

- Ultra-compact with a sensor width of 5 mm and a slot width of 2 mm.
- PCB mounting type.
- High resolution with a 0.4-mm-wide aperture.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rated value					
Emitter	Forward current	I_F 50 mA (see note 1)					
	Pulse forward current	I_{FP} ---					
	Reverse voltage	V_R 5 V					
Detector	Collector-Emitter voltage	V_{CEO} 30 V					
	Emitter-Collector voltage	V_{ECO} 4.5 V					
	Collector current	I_C 30 mA					
	Collector dissipation	P_c 80 mW (see note 1)					
	Ambient temperature	<table> <tr> <td>Operating</td> <td>T_{opr}</td> <td>-25°C to 85°C</td> </tr> <tr> <td>Storage</td> <td>T_{stg}</td> <td>-30°C to 100°C</td> </tr> </table>	Operating	T_{opr}	-25°C to 85°C	Storage	T_{stg}
Operating	T_{opr}	-25°C to 85°C					
Storage	T_{stg}	-30°C to 100°C					
Soldering temperature	T_{sol}	260°C (see note 2)					

Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

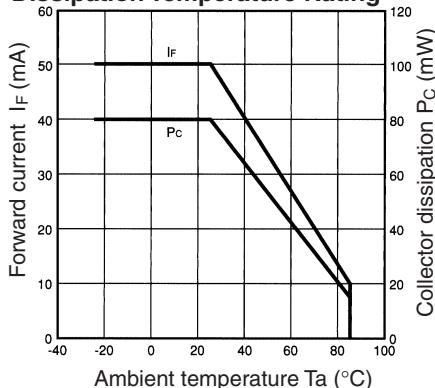
2. Complete soldering within 3 seconds.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

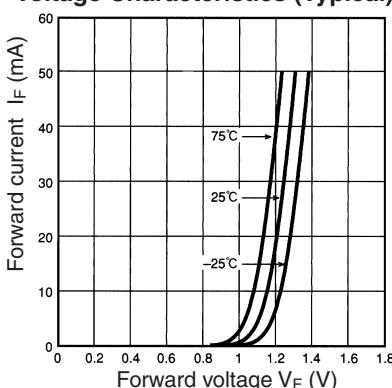
Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F 1.3 V typ., 1.6 V max.	$I_F = 50$ mA
	Reverse current	I_R 10 μA max.	$V_R = 5$ V
	Peak emission wavelength	λ_p 950 nm typ.	$I_F = 50$ mA
Detector	Light current	I_L 0.5 mA min.	$I_F = 20$ mA, $V_{CE} = 5$ V
	Dark current	I_D 500 nA max.	$V_{CE} = 10$ V, 0 lux
	Leakage current	I_{LEAK} ---	---
	Collector-Emitter saturated voltage	$V_{CE}(\text{sat})$ 0.4 V max.	$I_F = 20$ mA, $I_L = 0.3$ mA
	Peak spectral sensitivity wavelength	λ_p 800 nm typ.	$V_{CE} = 5$ V
Rising time	t_r	10 μs typ.	$V_{CC} = 5$ V, $R_L = 100$ Ω , $I_F = 20$ mA
Falling time	t_f	10 μs typ.	$V_{CC} = 5$ V, $R_L = 100$ Ω , $I_F = 20$ mA

■ Engineering Data

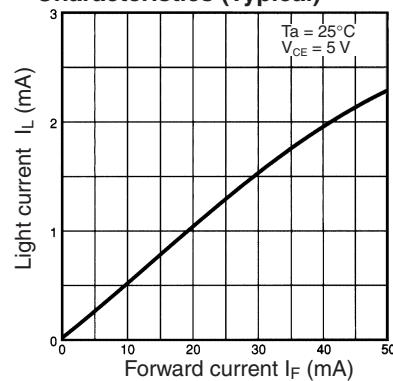
Forward Current vs. Collector Dissipation Temperature Rating



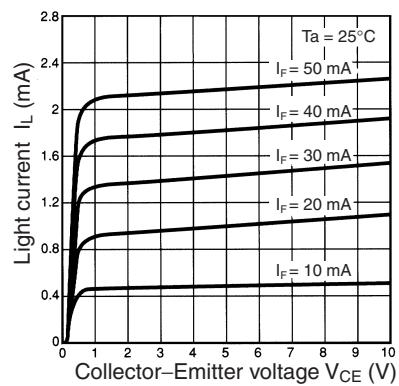
Forward Current vs. Forward Voltage Characteristics (Typical)



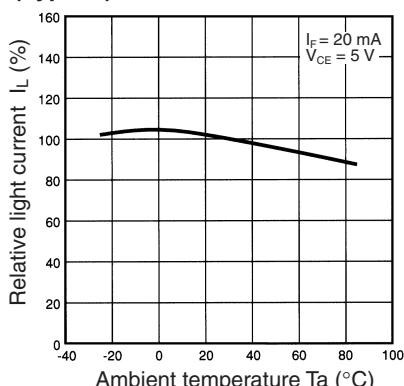
Light Current vs. Forward Current Characteristics (Typical)



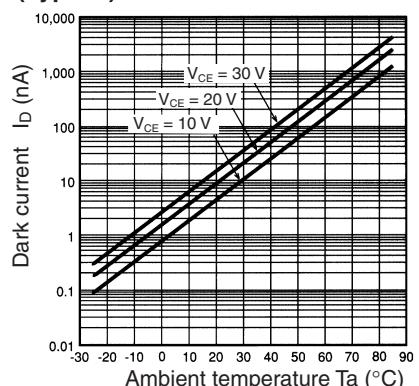
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



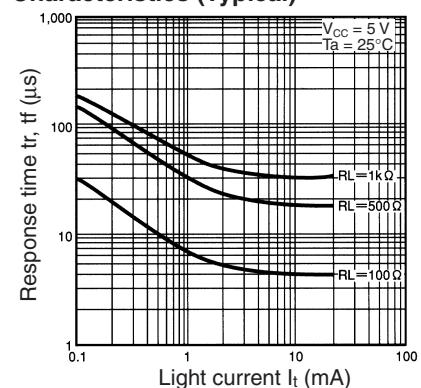
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



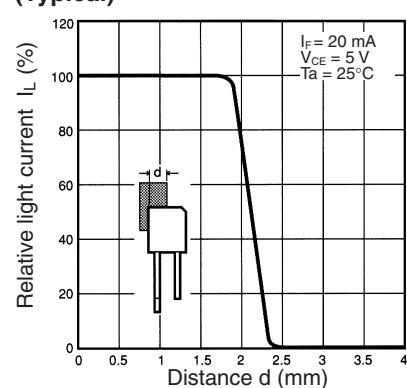
Dark Current vs. Ambient Temperature Characteristics (Typical)



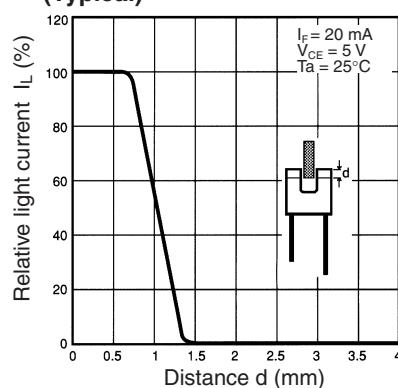
Response Time vs. Light Current Characteristics (Typical)



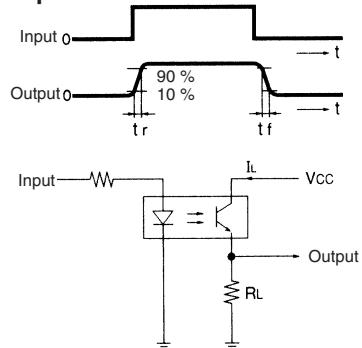
Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)



Response Time Measurement Circuit

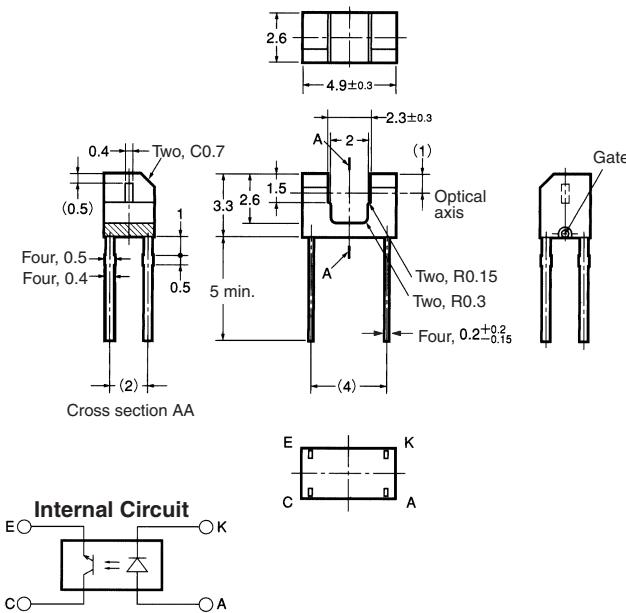


Photomicrosensor (Transmissive) EE-SX1105

⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Unless otherwise specified,
the tolerances are ± 0.2 mm.

Features

- Ultra-compact with a sensor width of 4.9 mm and a slot width of 2 mm.
- Low-height of 3.3 mm.
- PCB mounting type.
- High resolution with a 0.4-mm-wide aperture.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rated value
Emitter	Forward current	I_F 50 mA (see note 1)
	Pulse forward current	I_{FP} ---
	Reverse voltage	V_R 5 V
Detector	Collector-Emitter voltage	V_{CEO} 30 V
	Emitter-Collector voltage	V_{ECO} 4.5 V
	Collector current	I_C 30 mA
	Collector dissipation	P_C 80 mW (see note 1)
	Operating	T_{opr} -25°C to 85°C
Ambient temperature	Storage	T_{stg} -30°C to 85°C
	Soldering temperature	T_{sol} 260°C (see note 2)

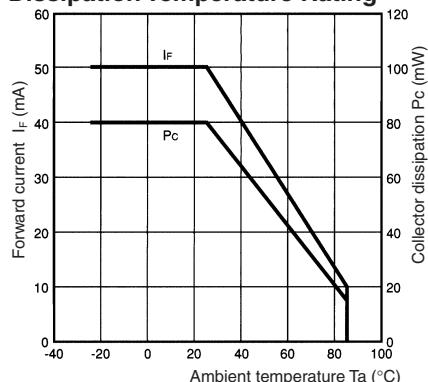
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C .
2. Complete soldering within 3 seconds.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

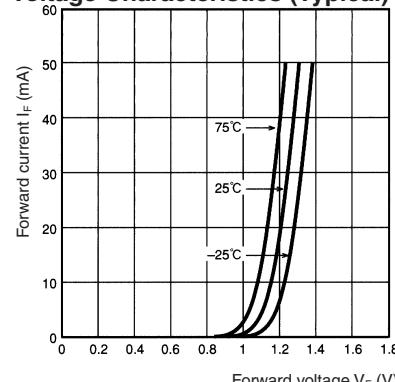
Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F 1.3 V typ., 1.6 V max.	$I_F = 50$ mA
	Reverse current	I_R 10 μA max.	$V_R = 5$ V
	Peak emission wavelength	λ_P 950 nm typ.	$I_F = 50$ mA
Detector	Light current	I_L 0.2 mA min.	$I_F = 20$ mA, $V_{CE} = 5$ V
	Dark current	I_D 500 nA max.	$V_{CE} = 10$ V, 0 lx
	Leakage current	I_{LEAK} ---	---
	Collector-Emitter saturated voltage	V_{CE} (sat) 0.4 V max.	$I_F = 20$ mA, $I_L = 0.1$ mA
	Peak spectral sensitivity wavelength	λ_P 800 nm typ.	$V_{CE} = 5$ V
Rising time	tr	10 μs typ.	$V_{CC} = 5$ V, $R_L = 100 \Omega$, $I_F = 20$ mA
Falling time	tf	10 μs typ.	$V_{CC} = 5$ V, $R_L = 100 \Omega$, $I_F = 20$ mA

■ Engineering Data

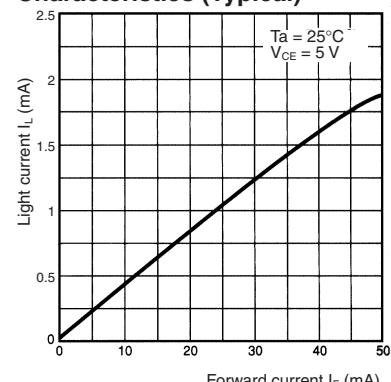
Forward Current vs. Collector Dissipation Temperature Rating



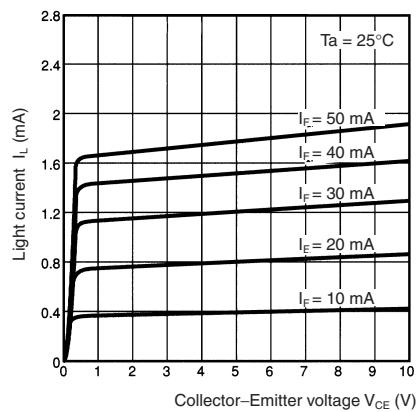
Forward Current vs. Forward Voltage Characteristics (Typical)



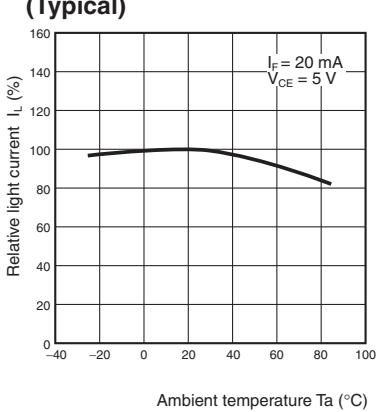
Light Current vs. Forward Current Characteristics (Typical)



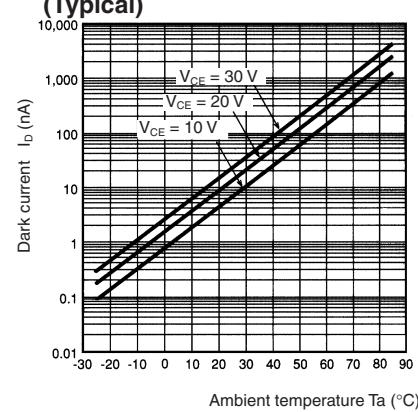
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



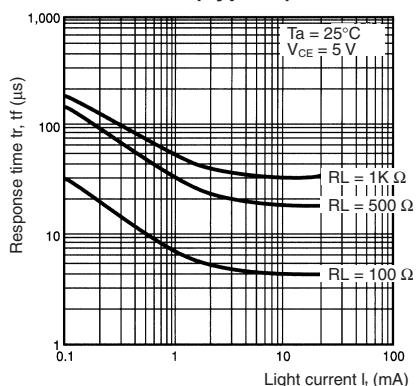
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



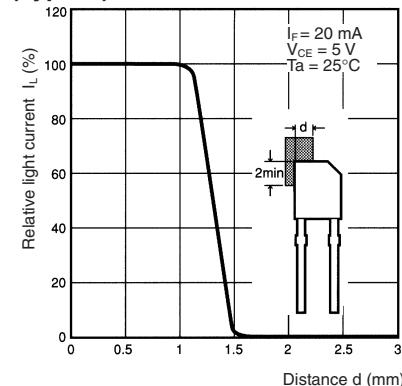
Dark Current vs. Ambient Temperature Characteristics (Typical)



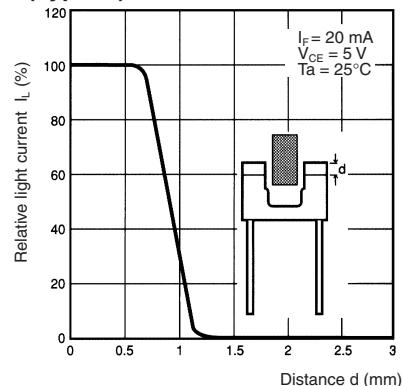
Response Time vs. Light Current Characteristics (Typical)



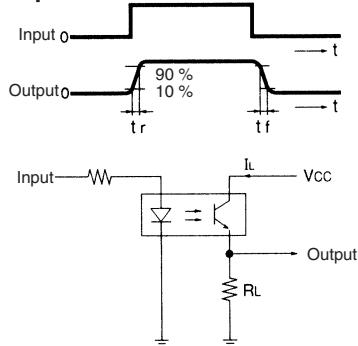
Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)



Response Time Measurement Circuit

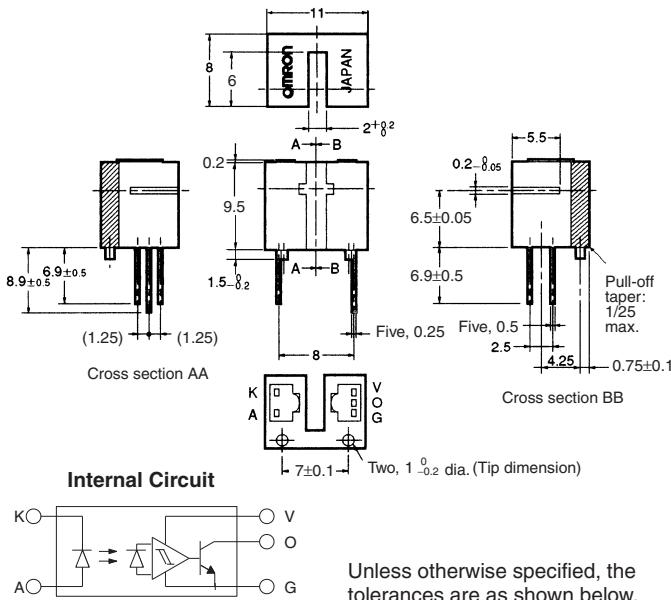


Photomicrosensor (Transmissive) **EE-SX493**

 Be sure to read *Precautions* on page 24.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Unless otherwise specified, the tolerances are as shown below.

Terminal No.	Name
A	Anode
K	Cathode
V	Power supply (Vcc)
O	Output (OUT)
G	Ground (GND)

Dimensions	Tolerance
3 mm max.	± 0.125
$3 < \text{mm} \leq 6$	± 0.150
$6 < \text{mm} \leq 10$	± 0.180
$10 < \text{mm} \leq 18$	± 0.215
$18 < \text{mm} \leq 30$	± 0.260

■ Features

- Incorporates an IC chip with a built-in detector element and amplifier.
 - Incorporates a detector element with a built-in temperature compensation circuit.
 - A wide supply voltage range: 4.5 to 16 VDC
 - Directly connects with C-MOS and TTL.
 - Allows highly precise sensing with a 0.2-mm-wide sensing aperture.

■ Absolute Maximum Ratings (Ta = 25°C)

Item		Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Reverse voltage	V_R	4 V
Detector	Power supply voltage	V_{CC}	16 V
	Output voltage	V_{OUT}	28 V
	Output current	I_{OUT}	16 mA
	Permissible output dissipation	P_{OUT}	250 mW (see note 1)
Ambient temperature	Operating	T_{opr}	-40°C to 60°C
	Storage	T_{stg}	-40°C to 85°C
Soldering temperature		T_{sol}	260°C (see note 2)

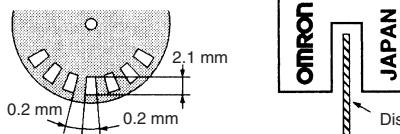
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

■ Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

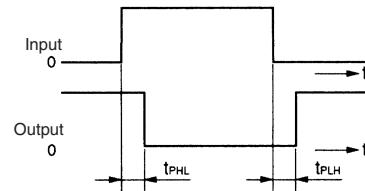
Item		Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.	$I_F = 20 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P	940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Low-level output voltage	V_{OL}	0.12 V typ., 0.4 V max.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_{OL} = 16 \text{ mA}$, $I_F = 15 \text{ mA}$
	High-level output voltage	V_{OH}	15 V min.	$V_{CC} = 16 \text{ V}$, $R_L = 1 \text{ k}\Omega$, $I_F = 0 \text{ mA}$
	Current consumption	I_{CC}	5 mA typ., 10 mA max.	$V_{CC} = 16 \text{ V}$
	Peak spectral sensitivity wavelength	λ_P	870 nm typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$
LED current when output is OFF		I_{FT}	10 mA typ., 15 mA max.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$
LED current when output is ON				
Hysteresis		ΔH	15% typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$ (see note 1)
Response frequency		f	3 kHz min.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_F = 15 \text{ mA}$, $I_{OL} = 16 \text{ mA}$ (see note 2)
Response delay time		t_{PLH} (t_{PHL})	3 μs typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_F = 15 \text{ mA}$, $I_{OL} = 16 \text{ mA}$ (see note 3)
Response delay time		t_{PHL} (t_{PLH})	20 μs typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_F = 15 \text{ mA}$, $I_{OL} = 16 \text{ mA}$ (see note 3)

Note: 1. Hysteresis denotes the difference in forward LED current value, expressed in percentage, calculated from the respective forward LED currents when the photo IC is turned from ON to OFF and when the photo IC is turned from OFF to ON.

2. The value of the response frequency is measured by rotating the disk as shown below.

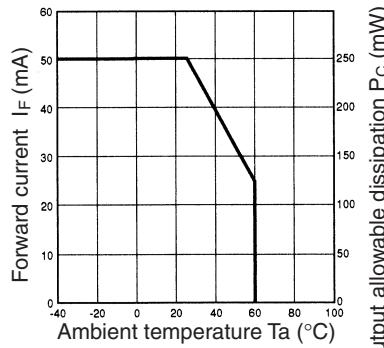


3. The following illustrations show the definition of response delay time.

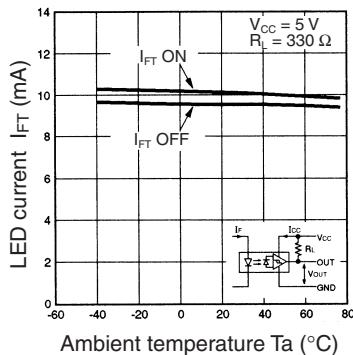


■ Engineering Data

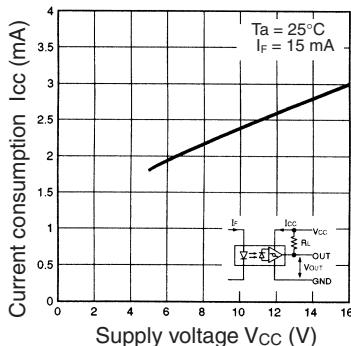
Forward Current vs. Collector Dissipation Temperature Rating



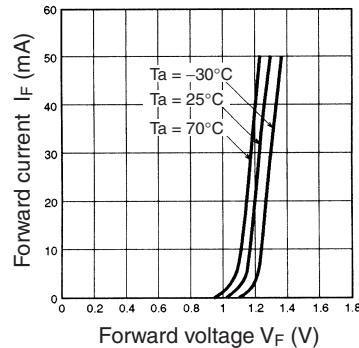
LED Current vs. Ambient Temperature Characteristics (Typical)



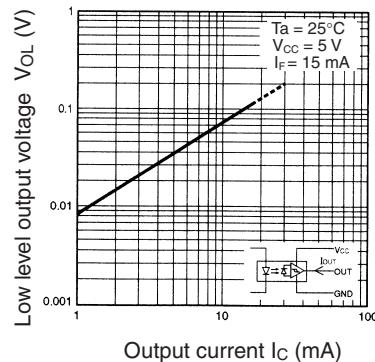
Current Consumption vs. Supply Voltage (Typical)



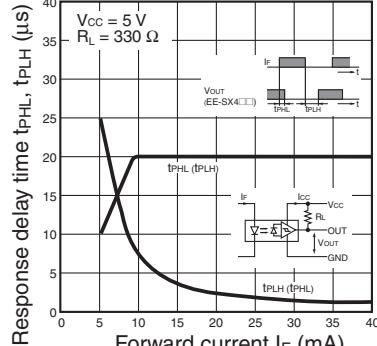
Forward Current vs. Forward Voltage Characteristics (Typical)



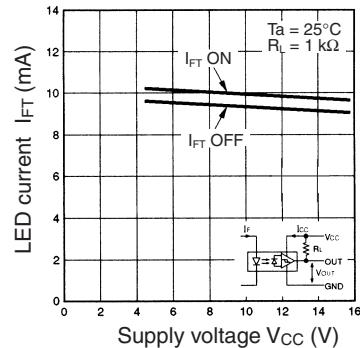
Low-level Output Voltage vs. Output Current (Typical)



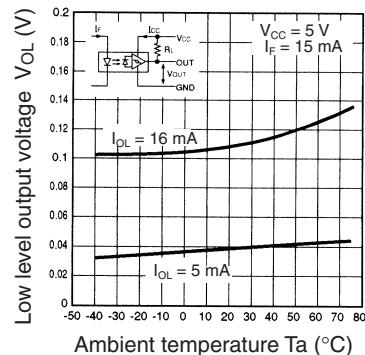
Response Delay Time vs. Forward Current (Typical)



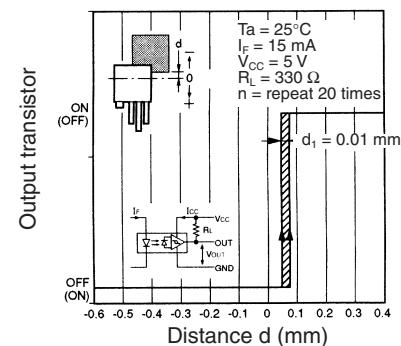
LED Current vs. Supply Voltage (Typical)



Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



Repeat Sensing Position Characteristics (Typical)

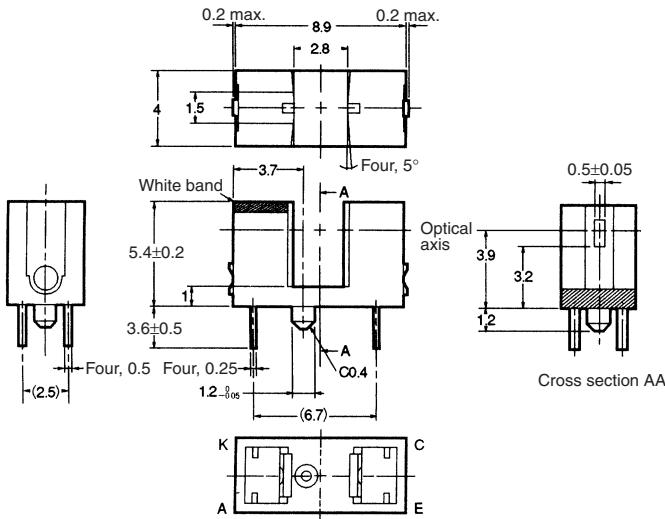


Photomicrosensor (Transmissive) EE-SX1055

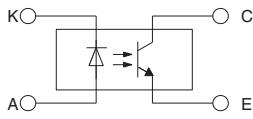
⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	± 0.3
$3 < \text{mm} \leq 6$	± 0.375
$6 < \text{mm} \leq 10$	± 0.45
$10 < \text{mm} \leq 18$	± 0.55
$18 < \text{mm} \leq 30$	± 0.65

Features

- Longer leads allow the sensor to be mounted to a 1.6-mm thick board.
- 5.4-mm-tall compact model.
- PCB mounting type.
- High resolution with a 0.5-mm-wide aperture.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rated value
Emitter	Forward current	I_F 50 mA (see note 1)
	Pulse forward current	I_{FP} 1 A (see note 2)
	Reverse voltage	V_R 4 V
Detector	Collector-Emitter voltage	V_{CEO} 30 V
	Emitter-Collector voltage	V_{ECO} ---
	Collector current	I_C 20 mA
	Collector dissipation	P_C 100 mW (see note 1)
Ambient temperature	Operating	T_{opr} -25°C to 85°C
	Storage	T_{stg} -30°C to 100°C
Soldering temperature	T_{sol}	260°C (see note 3)

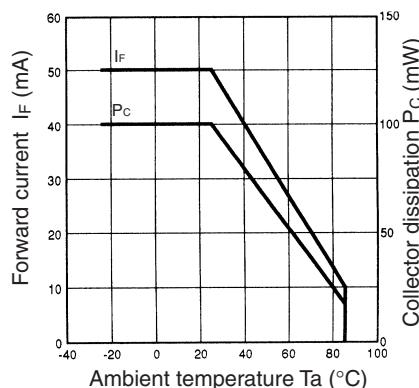
- Note:
- Refer to the temperature rating chart if the ambient temperature exceeds 25°C .
 - The pulse width is 10 μs maximum with a frequency of 100 Hz.
 - Complete soldering within 10 seconds.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

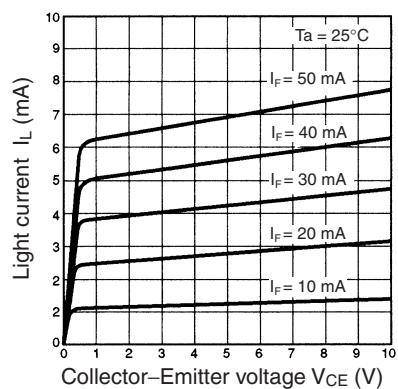
Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F 1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R 0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P 940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L 0.5 mA min., 14 mA max.	$I_F = 20 \text{ mA}, V_{CE} = 10 \text{ V}$
	Dark current	I_D 2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lx}$
	Leakage current	I_{LEAK} ---	---
	Collector-Emitter saturated voltage	$V_{CE}(\text{sat})$ 0.1 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 0.1 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_P 850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time	t_r	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$
Falling time	t_f	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$

■ Engineering Data

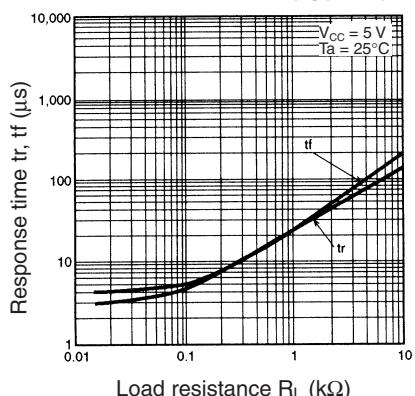
Forward Current vs. Collector Dissipation Temperature Rating



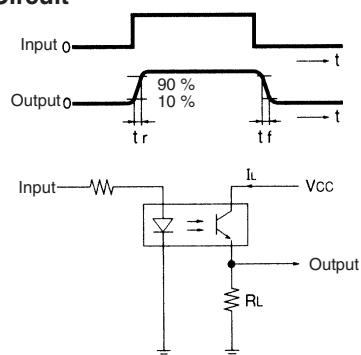
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



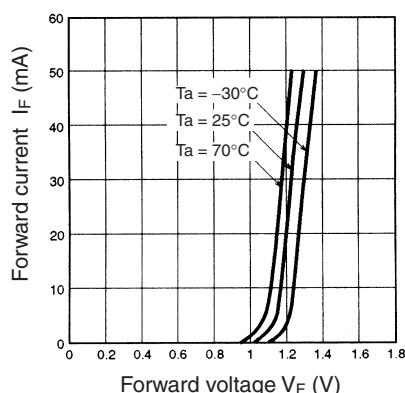
Response Time vs. Load Resistance Characteristics (Typical)



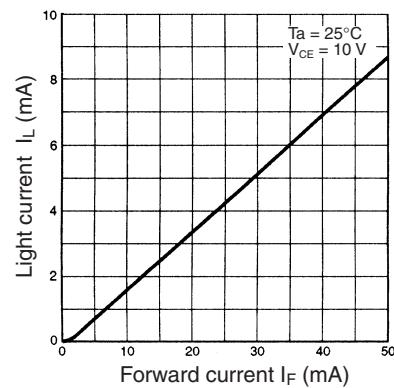
Response Time Measurement Circuit



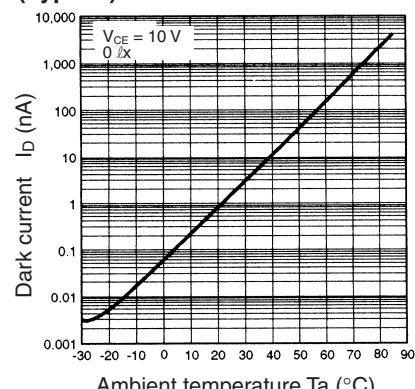
Forward Current vs. Forward Voltage Characteristics (Typical)



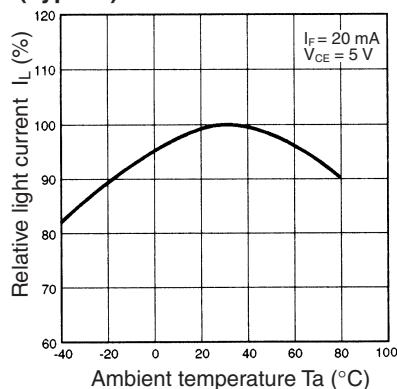
Light Current vs. Forward Current Characteristics (Typical)



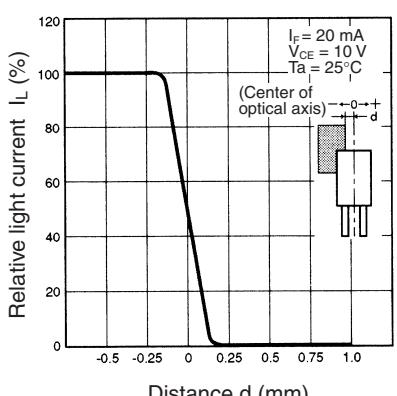
Dark Current vs. Ambient Temperature Characteristics (Typical)



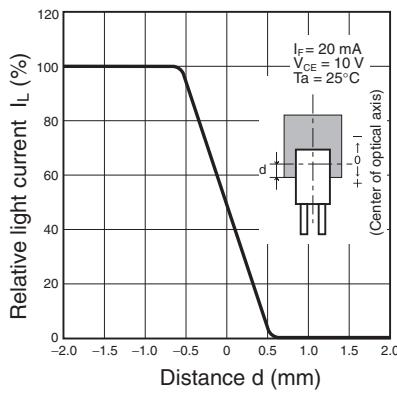
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)

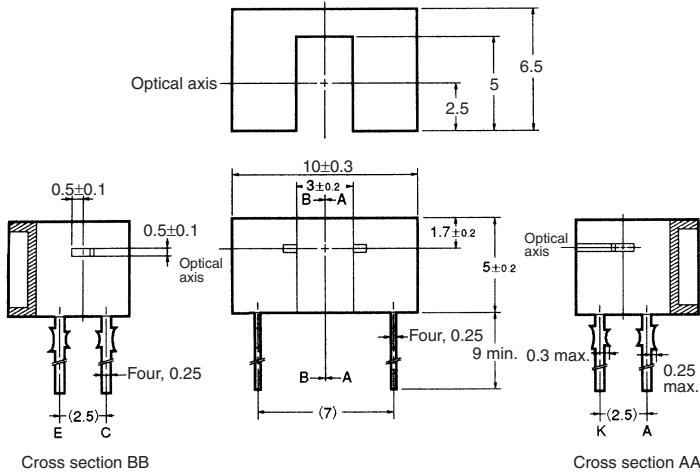


Photomicrosensor (Transmissive) EE-SX1046

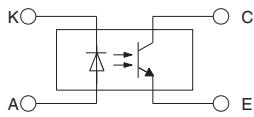
⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

Features

- With a horizontal sensing aperture.
- PCB mounting type.
- High resolution with a 0.5-mm-wide aperture.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Pulse forward current	I_{FP}	1 A (see note 2)
	Reverse voltage	V_R	4 V
Detector	Collector-Emitter voltage	V_{CEO}	30 V
	Emitter-Collector voltage	V_{ECO}	---
	Collector current	I_C	20 mA
	Collector dissipation	P_C	100 mW (see note 1)
Ambient temperature	Operating	T_{opr}	-25°C to 85°C
	Storage	T_{stg}	-30°C to 100°C
Soldering temperature		T_{sol}	260°C (see note 3)

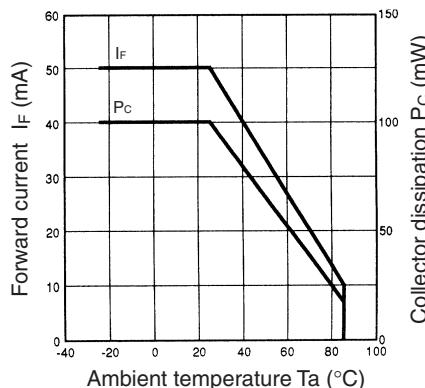
- Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
 3. Complete soldering within 10 seconds.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

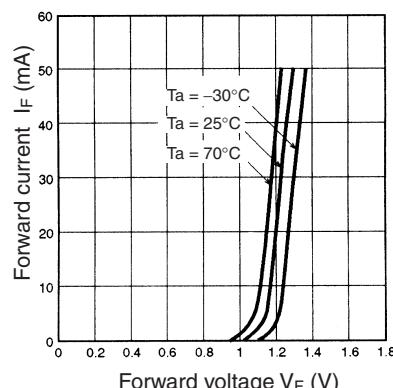
	Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P	920 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L	1.2 mA min., 14 mA max.	$I_F = 20 \text{ mA}, V_{CE} = 5 \text{ V}$
	Dark current	I_D	2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lux}$
	Leakage current	I_{LEAK}	---	---
	Collector-Emitter saturated voltage	$V_{CE}(\text{sat})$	0.1 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 0.1 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time		t_r	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$
Falling time		t_f	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$

■ Engineering Data

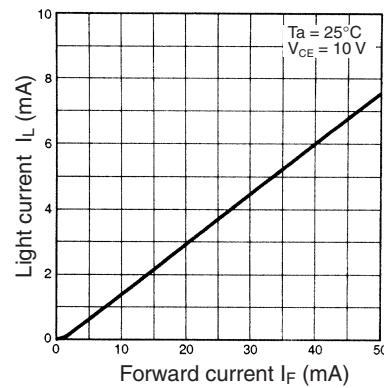
Forward Current vs. Collector Dissipation Temperature Rating



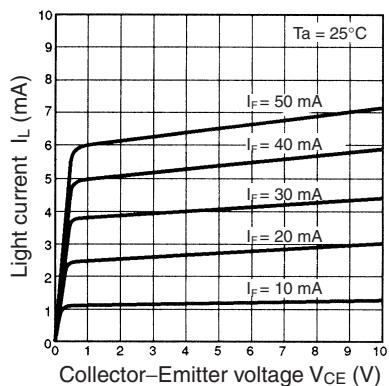
Forward Current vs. Forward Voltage Characteristics (Typical)



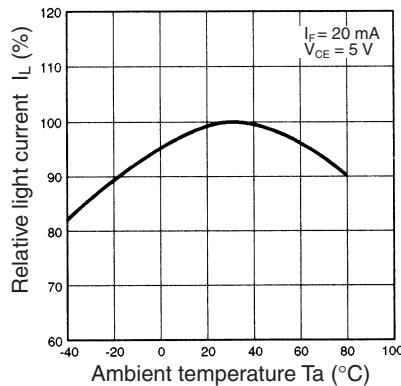
Light Current vs. Forward Current Characteristics (Typical)



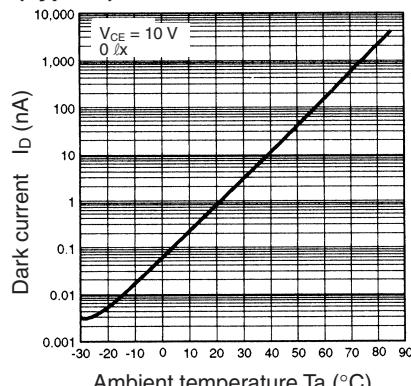
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



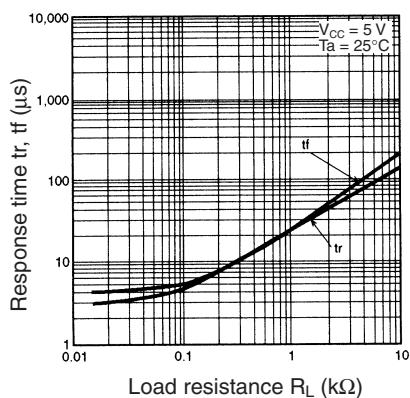
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



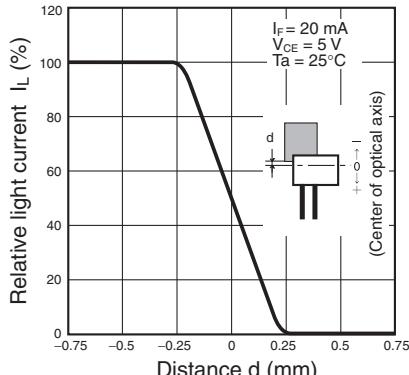
Dark Current vs. Ambient Temperature Characteristics (Typical)



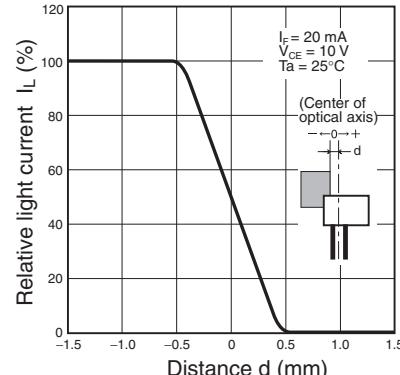
Response Time vs. Load Resistance Characteristics (Typical)



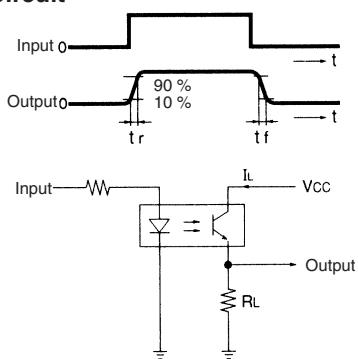
Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)



Response Time Measurement Circuit

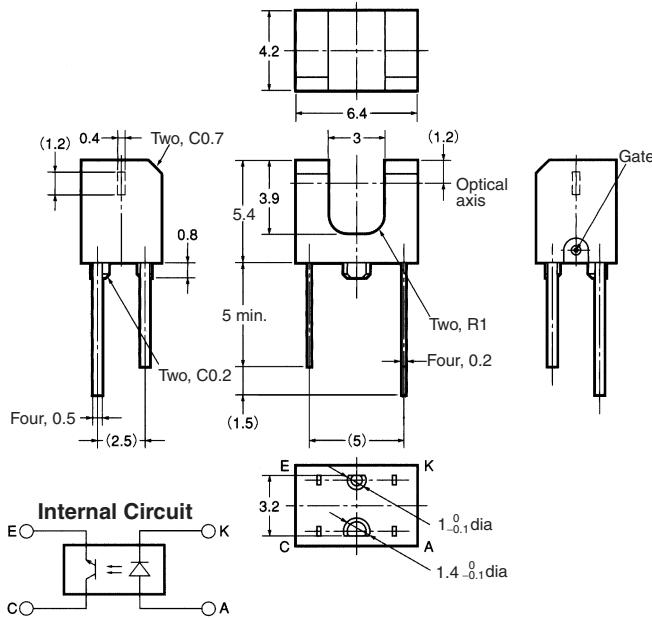


Photomicrosensor (Transmissive) EE-SX1106

⚠ Be sure to read *Precautions* on page 24.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



■ Features

- Ultra-compact with a slot width of 3 mm.
- PCB mounting type.
- High resolution with a 0.4-mm-wide aperture.

■ Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item		Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Pulse forward current	I_{FP}	---
	Reverse voltage	V_R	5 V
Detector	Collector-Emitter voltage	V_{CEO}	30 V
	Emitter-Collector voltage	V_{ECO}	4.5 V
	Collector current	I_C	30 mA
	Collector dissipation	P_C	80 mW (see note 1)
	Ambient temperature	Operating	-25°C to 85°C
Ambient temperature	Storage	T_{STG}	-30°C to 85°C
	Soldering temperature	T_{SOL}	260°C (see note 2)

Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C .

2. Complete soldering within 3 seconds.

Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

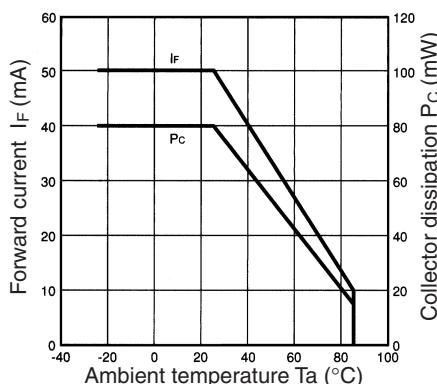
Unless otherwise specified,
the tolerances are ± 0.2 mm.

■ Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

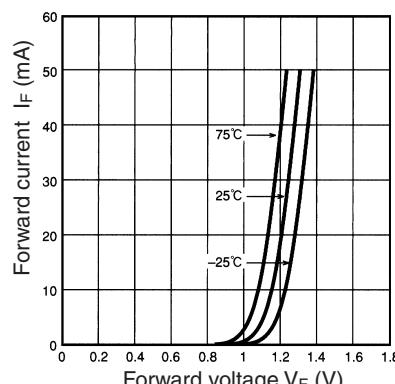
Item		Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.3 V typ., 1.6 V max.	$I_F = 50$ mA
	Reverse current	I_R	10 μA max.	$V_R = 5$ V
	Peak emission wavelength	λ_P	950 nm typ.	$I_F = 50$ mA
Detector	Light current	I_L	0.2 mA min.	$I_F = 20$ mA, $V_{CE} = 5$ V
	Dark current	I_D	500 nA max.	$V_{CE} = 10$ V, 0 lux
	Leakage current	I_{LEAK}	---	---
	Collector-Emitter saturated voltage	V_{CE} (sat)	0.4 V max.	$I_F = 20$ mA, $I_L = 0.1$ mA
	Peak spectral sensitivity wavelength	λ_P	800 nm typ.	$V_{CE} = 5$ V
Rising time		t_r	10 μs typ.	$V_{CC} = 5$ V, $R_L = 100 \Omega$, $I_F = 20$ mA
Falling time		t_f	10 μs typ.	$V_{CC} = 5$ V, $R_L = 100 \Omega$, $I_F = 20$ mA

■ Engineering Data

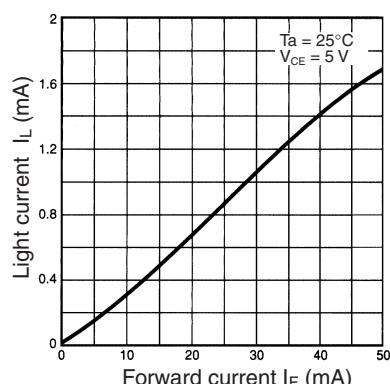
Forward Current vs. Collector Dissipation Temperature Rating



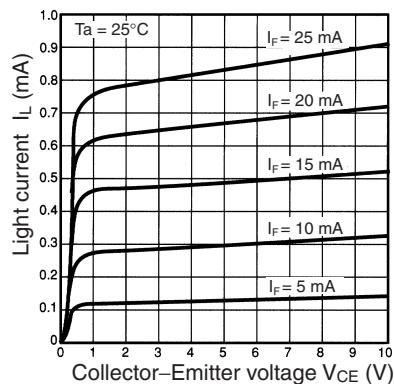
Forward Current vs. Forward Voltage Characteristics (Typical)



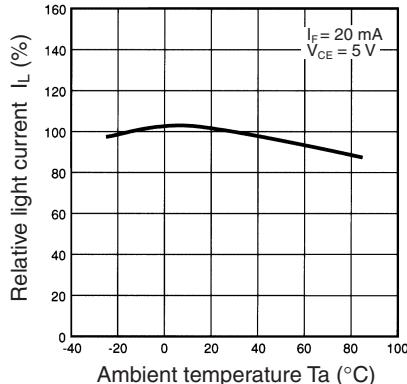
Light Current vs. Forward Current Characteristics (Typical)



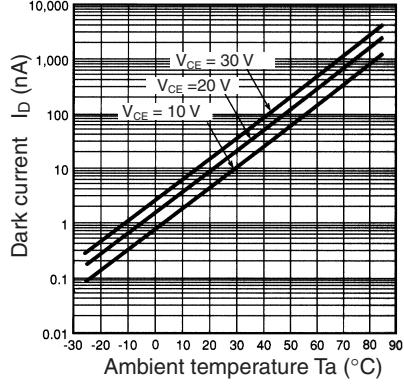
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



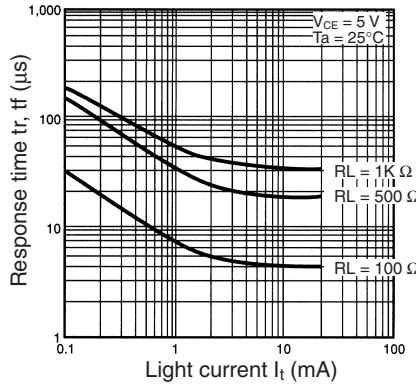
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



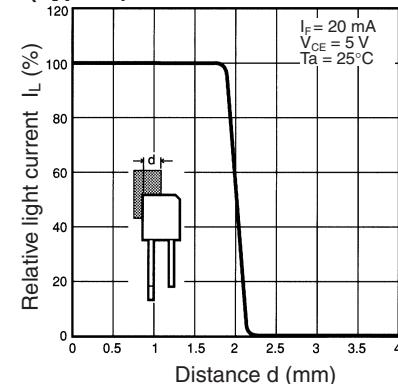
Dark Current vs. Ambient Temperature Characteristics (Typical)



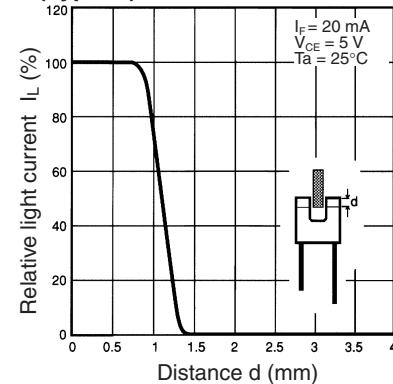
Response Time vs. Light Current Characteristics (Typical)



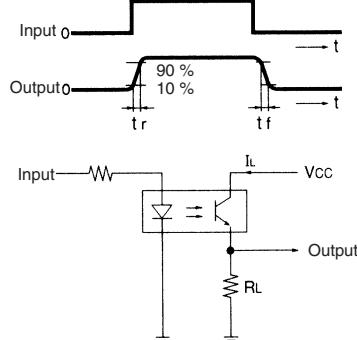
Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)



Response Time Measurement Circuit

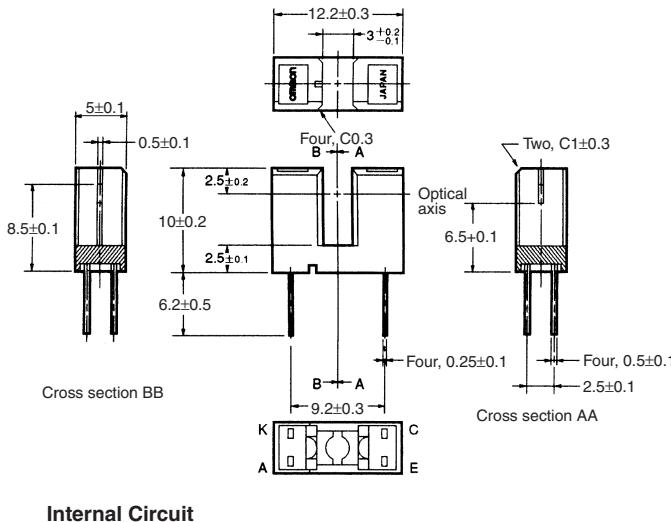


Photomicrosensor (Transmissive) EE-SX198

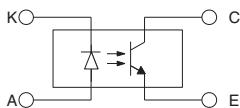
⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Unless otherwise specified,
the tolerances are ± 0.2 mm.

Features

- General-purpose model with a 3-mm-wide slot.
- PCB mounting type.
- High resolution with a 0.5-mm-wide aperture.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Pulse forward current	I_{FP}	1 A (see note 2)
	Reverse voltage	V_R	4 V
Detector	Collector-Emitter voltage	V_{CEO}	30 V
	Emitter-Collector voltage	V_{ECO}	---
	Collector current	I_C	20 mA
	Collector dissipation	P_C	100 mW (see note 1)
Ambient temperature	Operating	T_{opr}	-25°C to 85°C
	Storage	T_{stg}	-30°C to 100°C
Soldering temperature		T_{sol}	260°C (see note 3)

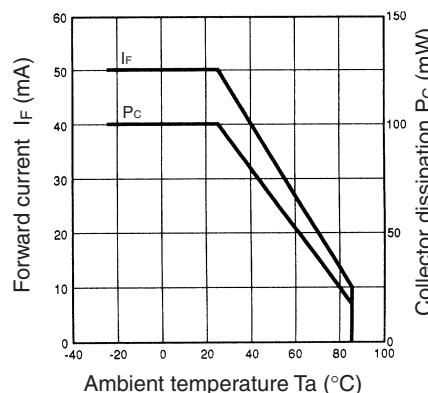
- Note:
- Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 - The pulse width is 10 μs maximum with a frequency of 100 Hz.
 - Complete soldering within 10 seconds.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

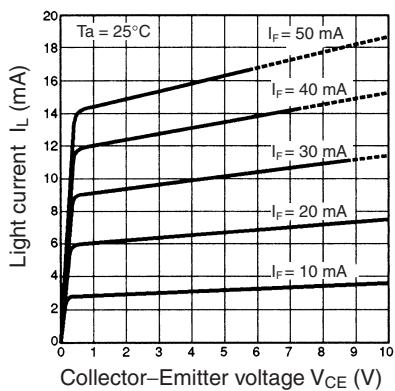
Item		Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.4 V max.	$I_F = 30$ mA
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 4$ V
	Peak emission wavelength	λ_P	940 nm typ.	$I_F = 20$ mA
Detector	Light current	I_L	0.5 mA min., 14 mA max.	$I_F = 20$ mA, $V_{CE} = 5$ V
	Dark current	I_D	2 nA typ., 200 nA max.	$V_{CE} = 20$ V, 0 lux
	Leakage current	I_{LEAK}	---	---
	Collector-Emitter saturated voltage	V_{CE} (sat)	0.1 V typ., 0.4 V max.	$I_F = 40$ mA, $I_L = 0.5$ mA
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.	$V_{CE} = 10$ V
Rising time		tr	4 μs typ.	$V_{CC} = 5$ V, $R_L = 100 \Omega$, $I_L = 5$ mA
Falling time		tf	4 μs typ.	$V_{CC} = 5$ V, $R_L = 100 \Omega$, $I_L = 5$ mA

■ Engineering Data

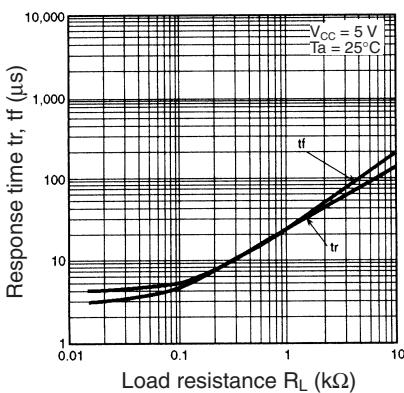
Forward Current vs. Collector Dissipation Temperature Rating



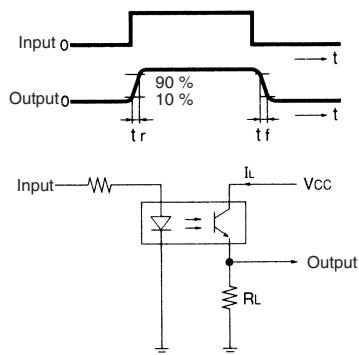
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



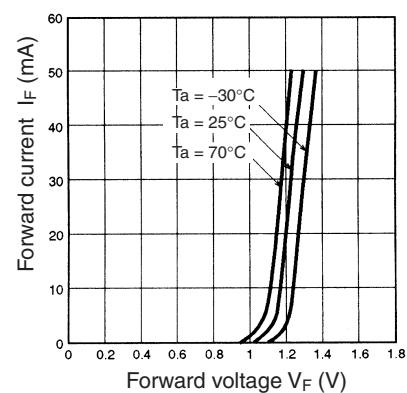
Response Time vs. Load Resistance Characteristics (Typical)



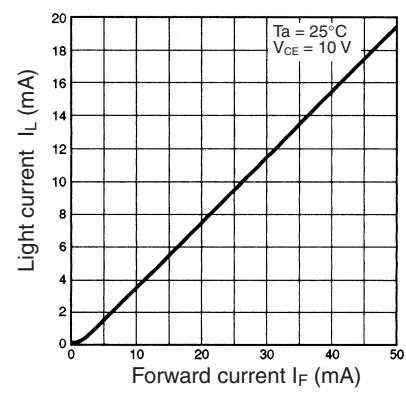
Response Time Measurement Circuit



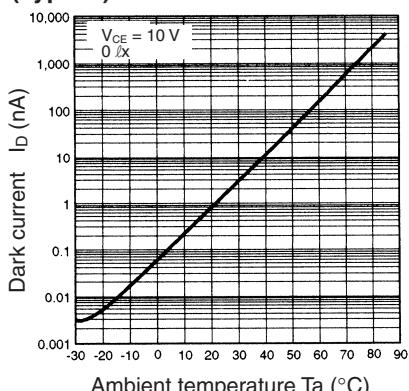
Forward Current vs. Forward Voltage Characteristics (Typical)



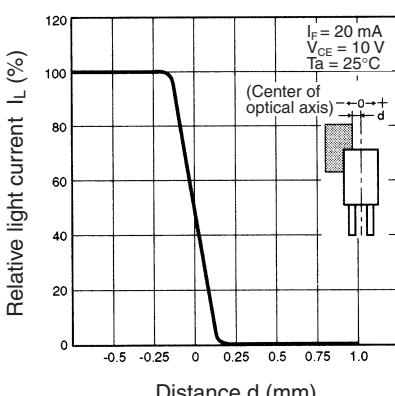
Light Current vs. Forward Current Characteristics (Typical)



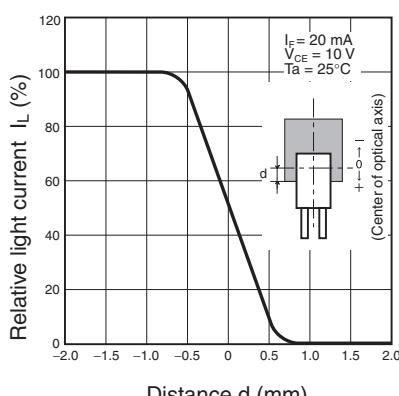
Dark Current vs. Ambient Temperature Characteristics (Typical)



Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)

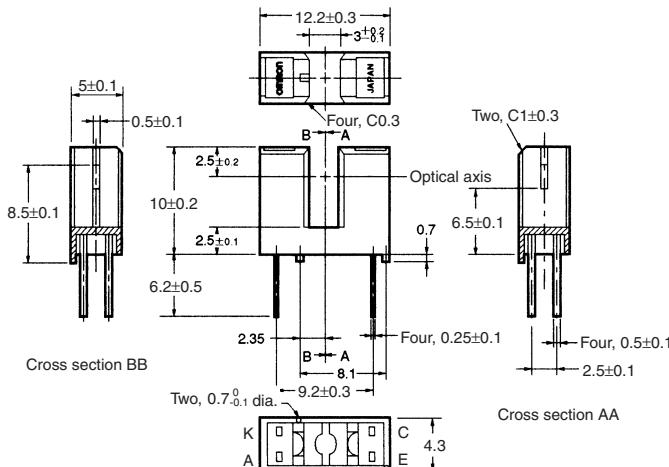


7Photomicrosensor (Transmissive) EE-SX199

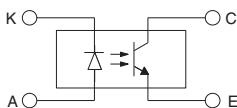
⚠ Be sure to read *Precautions* on page 24.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Unless otherwise specified,
the tolerances are ± 0.2 mm.

■ Features

- General-purpose model with a 3-mm-wide slot.
- PCB mounting type.
- High resolution with a 0.5-mm-wide aperture.
- With a positioning boss.

■ Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Pulse forward current	I_{FP}	1 A (see note 2)
	Reverse voltage	V_R	4 V
Detector	Collector-Emitter voltage	V_{CEO}	30 V
	Emitter-Collector voltage	V_{ECO}	---
	Collector current	I_C	20 mA
	Collector dissipation	P_C	100 mW (see note 1)
Ambient temperature	Operating	T_{opr}	-25°C to 85°C
	Storage	T_{stg}	-40°C to 100°C
Soldering temperature		T_{sol}	260°C (see note 3)

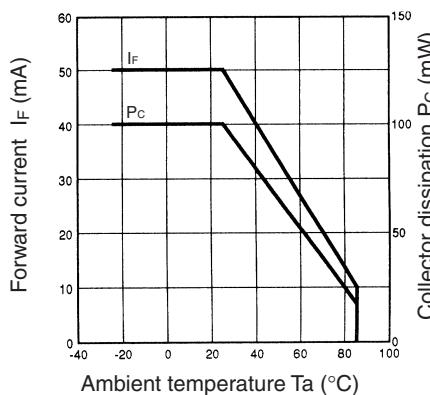
- Note:**
- Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 - The pulse width is 10 μs maximum with a frequency of 100 Hz.
 - Complete soldering within 10 seconds.

■ Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

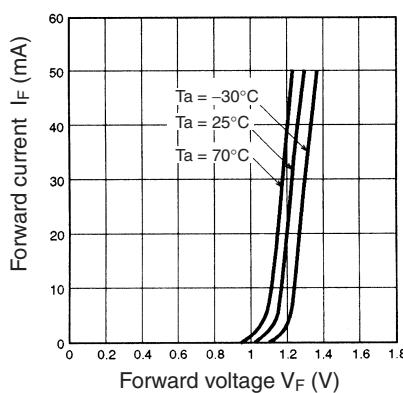
Item		Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.4 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P	940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L	0.5 mA min., 14 mA max.	$I_F = 20 \text{ mA}, V_{CE} = 5 \text{ V}$
	Dark current	I_D	2 nA typ., 200 nA max.	$V_{CE} = 20 \text{ V}, 0 \text{ lux}$
	Leakage current	I_{LEAK}	---	---
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$	0.1 V typ., 0.4 V max.	$I_F = 40 \text{ mA}, I_L = 0.5 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time		t_r	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$
Falling time		t_f	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$

■ Engineering Data

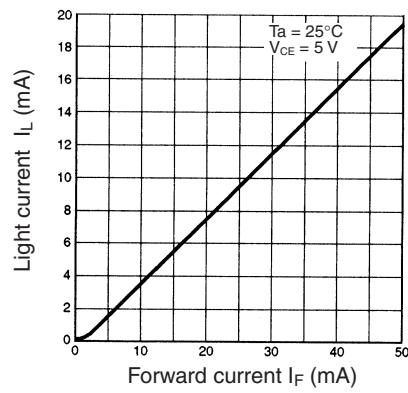
Forward Current vs. Collector Dissipation Temperature Rating



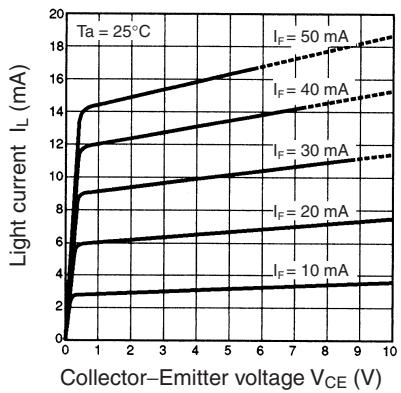
Forward Current vs. Forward Voltage Characteristics (Typical)



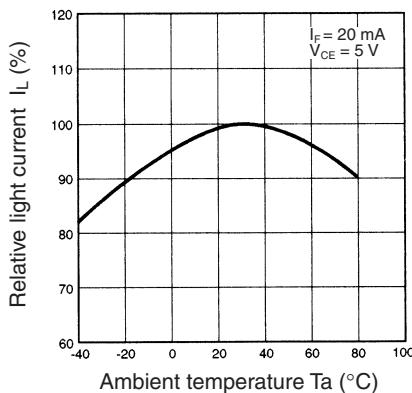
Light Current vs. Forward Current Characteristics (Typical)



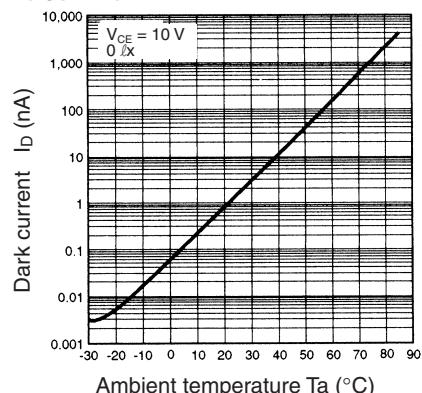
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



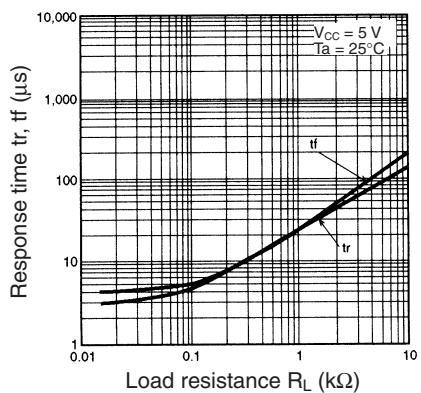
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



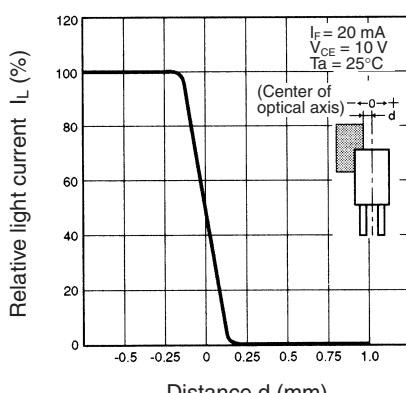
Dark Current vs. Ambient Temperature Characteristics (Typical)



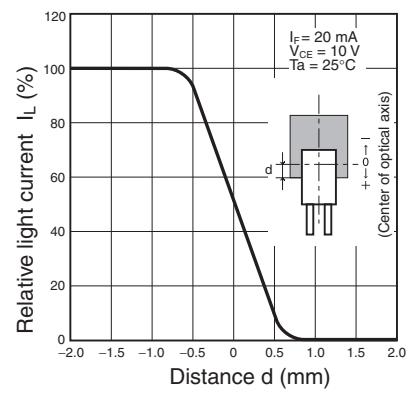
Response Time vs. Load Resistance Characteristics (Typical)



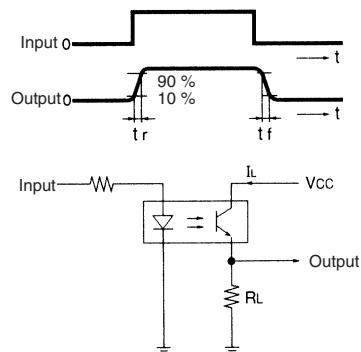
Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)



Response Time Measurement Circuit

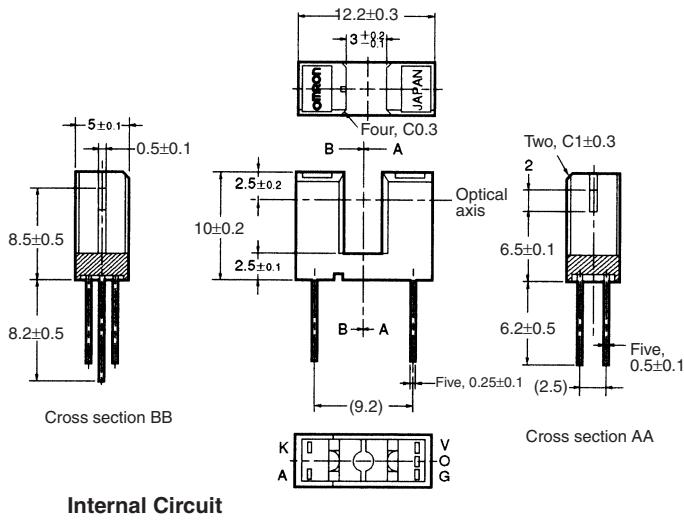


Photomicrosensor (Transmissive) EE-SX398/498

⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

Features

- Incorporates an IC chip with a built-in detector element and amplifier.
- Incorporates a detector element with a built-in temperature compensation circuit.
- A wide supply voltage range: 4.5 to 16 VDC
- Directly connects with C-MOS and TTL.
- High resolution with a 0.5-mm-wide sensing aperture.
- Dark ON model (EE-SX398)
- Light ON model (EE-SX498)

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Reverse voltage	V_R	4 V
Detector	Power supply voltage	V_{CC}	16 V
	Output voltage	V_{OUT}	28 V
	Output current	I_{OUT}	16 mA
	Permissible output dissipation	P_{OUT}	250 mW (see note 1)
Ambient temperature	Operating	T_{OPR}	-40°C to 75°C
	Storage	T_{STG}	-40°C to 85°C
Soldering temperature		T_{SOL}	260°C (see note 2)

Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

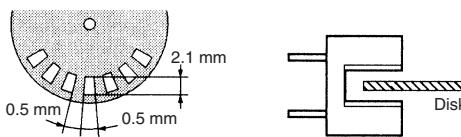
2. Complete soldering within 10 seconds.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.	$I_F = 20 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P	940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Low-level output voltage	V_{OL}	0.12 V typ., 0.4 V max.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_{OL} = 16 \text{ mA}$, $I_F = 0 \text{ mA}$ (EE-SX398), $I_F = 5 \text{ mA}$ (EE-SX498)
	High-level output voltage	V_{OH}	15 V min.	$V_{CC} = 16 \text{ V}$, $R_L = 1 \text{ k}\Omega$, $I_F = 5 \text{ mA}$ (EE-SX398), $I_F = 0 \text{ mA}$ (EE-SX498)
	Current consumption	I_{CC}	3.2 mA typ., 10 mA max.	$V_{CC} = 16 \text{ V}$
	Peak spectral sensitivity wavelength	λ_P	870 nm typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$
LED current when output is OFF	I_{FT}		2 mA typ., 5 mA max.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$
LED current when output is ON				
Hysteresis	ΔH		15% typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$ (see note 1)
Response frequency	f		3 kHz min.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_F = 15 \text{ mA}$, $I_{OL} = 16 \text{ mA}$ (see note 2)
Response delay time	t_{PLH} (t_{PHL})		3 μs typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_F = 15 \text{ mA}$, $I_{OL} = 16 \text{ mA}$ (see note 3)
Response delay time	t_{PHL} (t_{PLH})		20 μs typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_F = 15 \text{ mA}$, $I_{OL} = 16 \text{ mA}$ (see note 3)

Note: 1. Hysteresis denotes the difference in forward LED current value, expressed in percentage, calculated from the respective forward LED currents when the photo IC is turned from ON to OFF and when the photo IC is turned from OFF to ON.

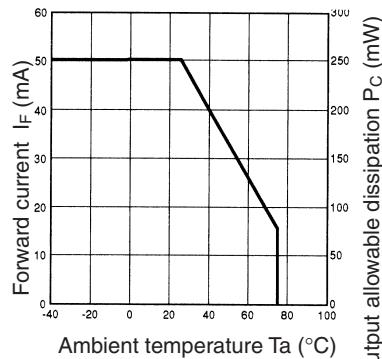
2. The value of the response frequency is measured by rotating the disk as shown below.



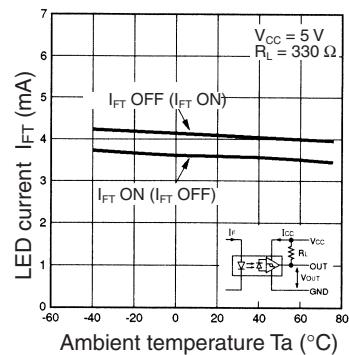
■ Engineering Data

Note: The values in the parentheses apply to the EE-SX498.

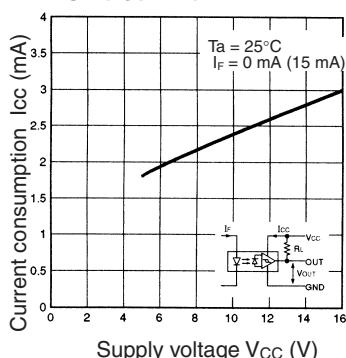
Forward Current vs. Collector Dissipation Temperature Rating



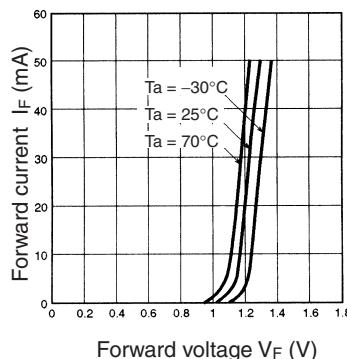
LED Current vs. Ambient Temperature Characteristics (Typical)



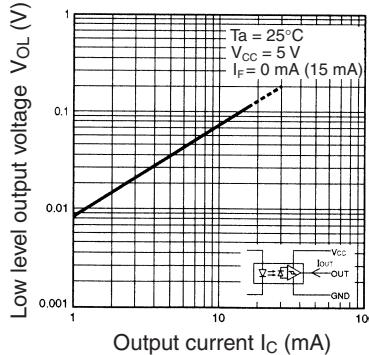
Current Consumption vs. Supply Voltage (Typical)



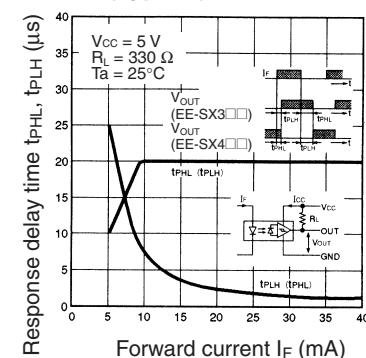
Forward Current vs. Forward Voltage Characteristics (Typical)



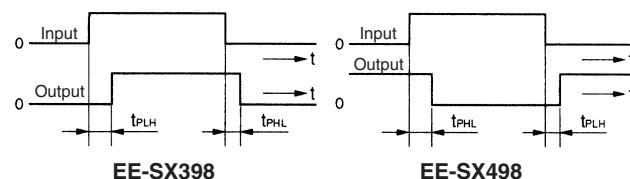
Low-level Output Voltage vs. Output Current (Typical)



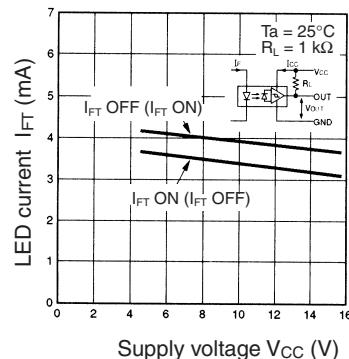
Response Delay Time vs. Forward Current (Typical)



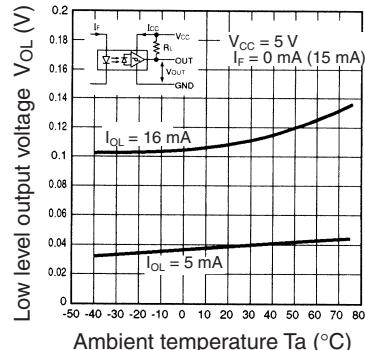
3. The following illustrations show the definition of response delay time. The value in the parentheses applies to the EE-SX498.



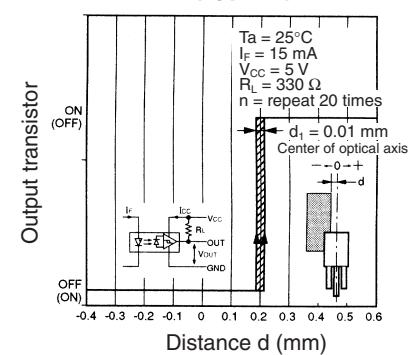
LED Current vs. Supply Voltage (Typical)



Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



Repeat Sensing Position Characteristics (Typical)

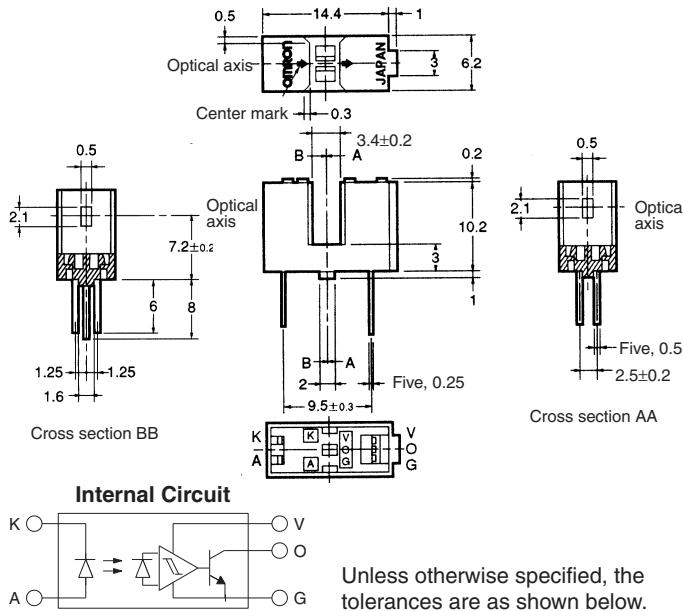


Photomicrosensor (Transmissive) EE-SX301/-SX401

⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Unless otherwise specified, the tolerances are as shown below.

Terminal No.	Name
A	Anode
K	Cathode
V	Power supply (Vcc)
O	Output (OUT)
G	Ground (GND)

Dimensions	Tolerance
3 mm max.	± 0.3
$3 < \text{mm} \leq 6$	± 0.375
$6 < \text{mm} \leq 10$	± 0.45
$10 < \text{mm} \leq 18$	± 0.55
$18 < \text{mm} \leq 30$	± 0.65

Features

- Incorporates an IC chip with a built-in detector element and amplifier.
- Incorporates a detector element with a built-in temperature compensation circuit.
- A wide supply voltage range: 4.5 to 16 VDC
- Directly connects with C-MOS and TTL.
- High resolution with a 0.5-mm-wide sensing aperture.
- Dark ON model (EE-SX301)
- Light ON model (EE-SX401)

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

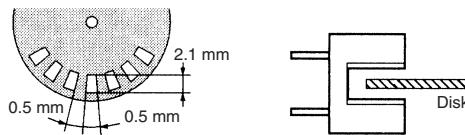
Item	Symbol	Rated value
Emitter	Forward current	I_F 50 mA (see note 1)
	Reverse voltage	V_R 4 V
Detector	Power supply voltage	V_{CC} 16 V
	Output voltage	V_{OUT} 28 V
	Output current	I_{OUT} 16 mA
	Permissible output dissipation	P_{OUT} 250 mW (see note 1)
Ambient temperature	Operating	T_{OPR} -40°C to 75°C
	Storage	T_{STG} -40°C to 85°C
Soldering temperature		T_{SOL} 260°C (see note 2)

Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C .
2. Complete soldering within 10 seconds.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F 1.2 V typ., 1.5 V max.	$I_F = 20 \text{ mA}$
	Reverse current	I_R 0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P 940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Low-level output voltage	V_{OL} 0.12 V typ., 0.4 V max.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_{OL} = 16 \text{ mA}$, $I_F = 0 \text{ mA}$ (EE-SX301), $I_F = 8 \text{ mA}$ (EE-SX401)
	High-level output voltage	V_{OH} 15 V min.	$V_{CC} = 16 \text{ V}$, $R_L = 1 \text{ k}\Omega$, $I_F = 8 \text{ mA}$ (EE-SX301), $I_F = 0 \text{ mA}$ (EE-SX401)
	Current consumption	I_{CC} 3.2 mA typ., 10 mA max.	$V_{CC} = 16 \text{ V}$
	Peak spectral sensitivity wavelength	λ_P 870 nm typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$
LED current when output is OFF	I_{FT}	3 mA typ., 8 mA max.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$
LED current when output is ON			
Hysteresis	ΔH	15% typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$ (see note 1)
Response frequency	f	3 kHz min.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_F = 15 \text{ mA}$, $I_{OL} = 16 \text{ mA}$ (see note 2)
Response delay time	t_{PLH} (t_{PHL})	3 μs typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_F = 15 \text{ mA}$, $I_{OL} = 16 \text{ mA}$ (see note 3)
Response delay time	t_{PHL} (t_{PLH})	20 μs typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_F = 15 \text{ mA}$, $I_{OL} = 16 \text{ mA}$ (see note 3)

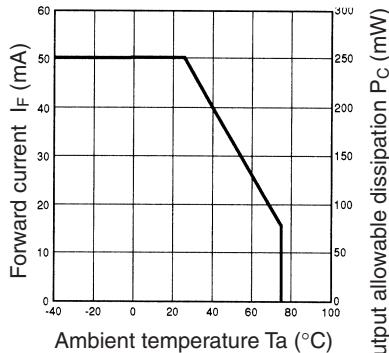
- Note:**
1. Hysteresis denotes the difference in forward LED current value, expressed in percentage, calculated from the respective forward LED currents when the photo IC is turned from ON to OFF and when the photo IC is turned from OFF to ON.
 2. The value of the response frequency is measured by rotating the disk as shown below.



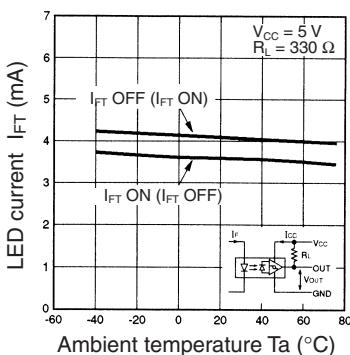
■ Engineering Data

Note: The values in the parentheses apply to the EE-SX401.

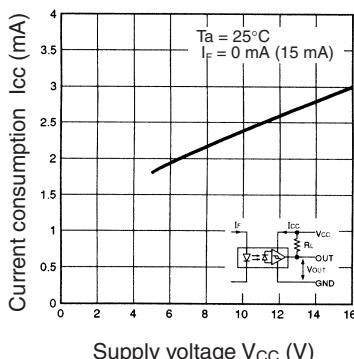
Forward Current vs. Collector Dissipation Temperature Rating



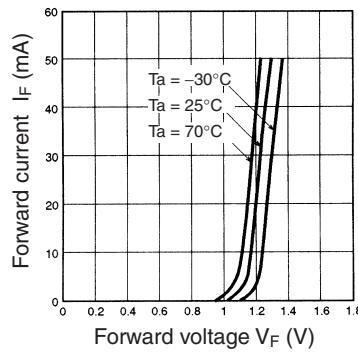
LED Current vs. Ambient Temperature Characteristics (Typical)



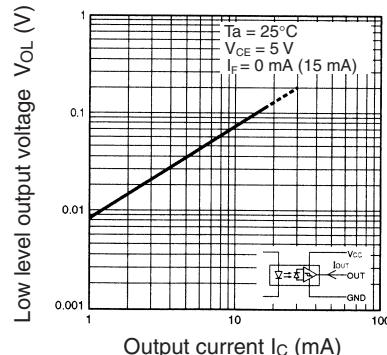
Current Consumption vs. Supply Voltage (Typical)



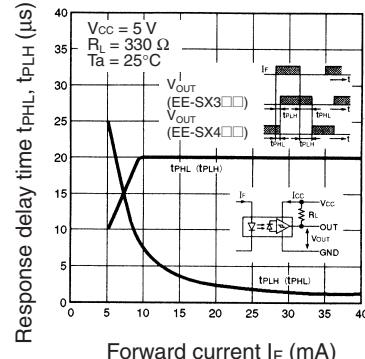
Forward Current vs. Forward Voltage Characteristics (Typical)



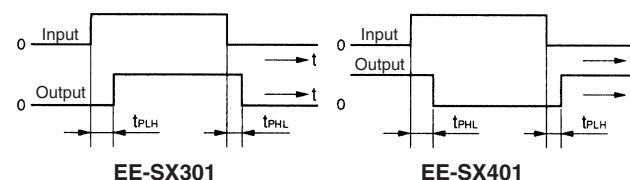
Low-level Output Voltage vs. Output Current (Typical)



Response Delay Time vs. Forward Current (Typical)



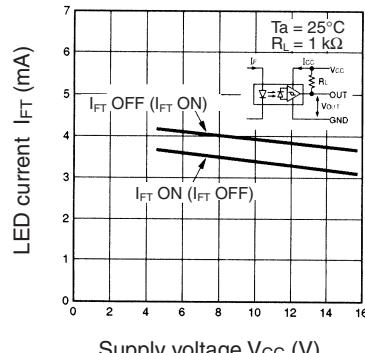
3. The following illustrations show the definition of response delay time. The value in the parentheses applies to the EE-SX401.



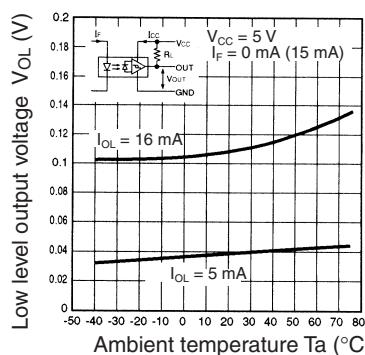
EE-SX301

EE-SX401

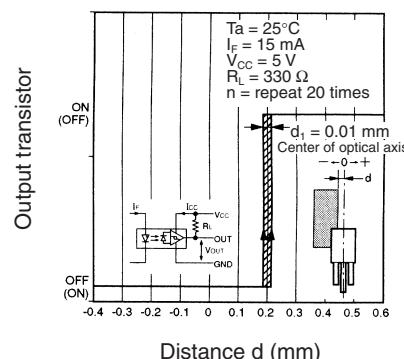
LED Current vs. Supply Voltage (Typical)



Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



Repeat Sensing Position Characteristics (Typical)

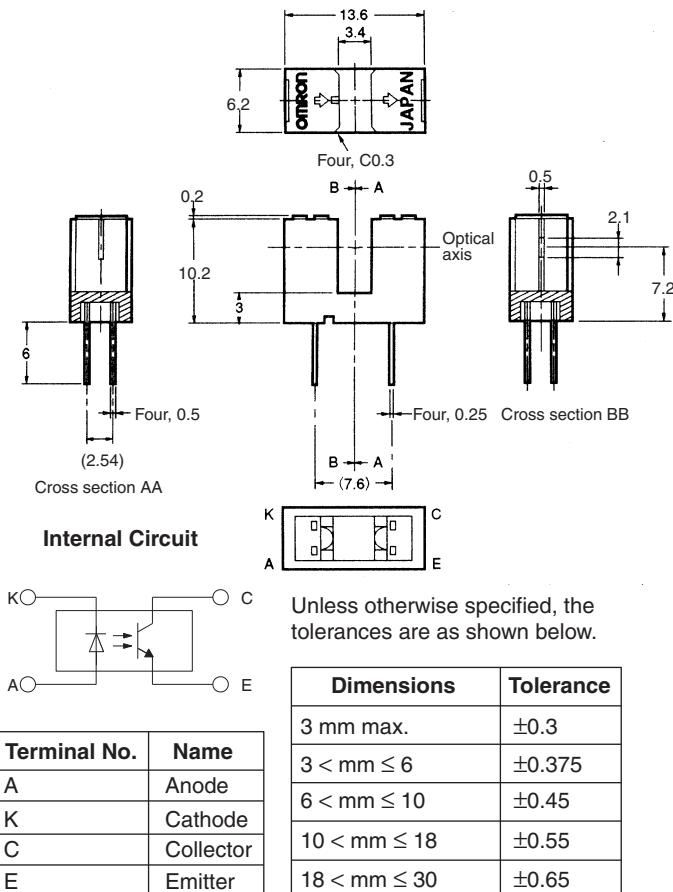


Photomicrosensor (Transmissive) EE-SX1071

⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Features

- General-purpose model with a 3.4-mm-wide slot.
- PCB mounting type.
- High resolution with a 0.5-mm-wide aperture.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Pulse forward current	I_{FP}	1 A (see note 2)
	Reverse voltage	V_R	4 V
Detector	Collector-Emitter voltage	V_{CEO}	30 V
	Emitter-Collector voltage	V_{ECO}	---
	Collector current	I_C	20 mA
	Collector dissipation	P_C	100 mW (see note 1)
Ambient temperature	Operating	T_{opr}	-25°C to 85°C
	Storage	T_{stg}	-30°C to 100°C
Soldering temperature		T_{sol}	260°C (see note 3)

- Note:**
- Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 - The pulse width is 10 μs maximum with a frequency of 100 Hz.
 - Complete soldering within 10 seconds.

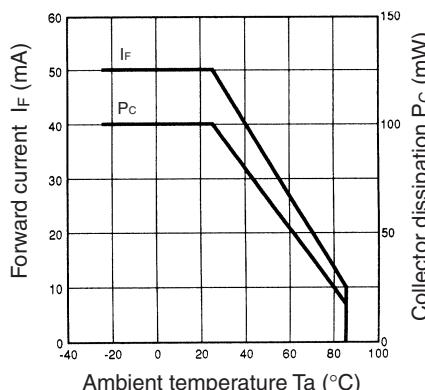
Dimensions	Tolerance
3 mm max.	± 0.3
$3 < \text{mm} \leq 6$	± 0.375
$6 < \text{mm} \leq 10$	± 0.45
$10 < \text{mm} \leq 18$	± 0.55
$18 < \text{mm} \leq 30$	± 0.65

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

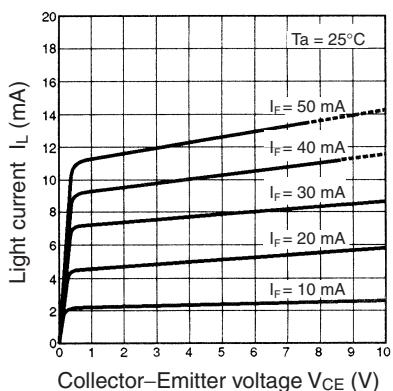
	Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P	940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L	0.5 mA min., 14 mA max.	$I_F = 20 \text{ mA}, V_{CE} = 10 \text{ V}$
	Dark current	I_D	2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lux}$
	Leakage current	I_{LEAK}	---	---
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$	0.1 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 0.1 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time		tr	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$
Falling time		tf	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$

■ Engineering Data

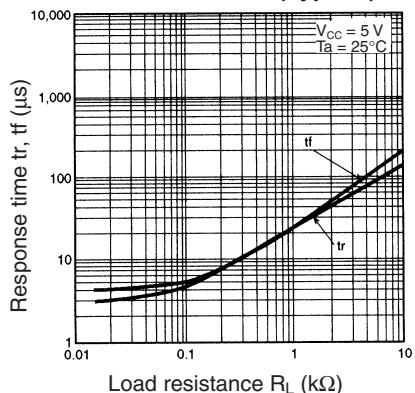
Forward Current vs. Collector Dissipation Temperature Rating



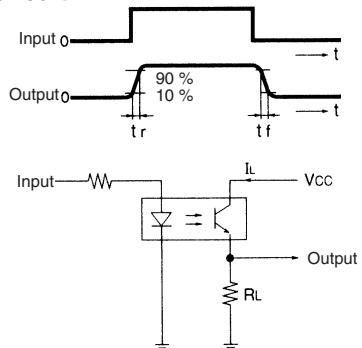
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



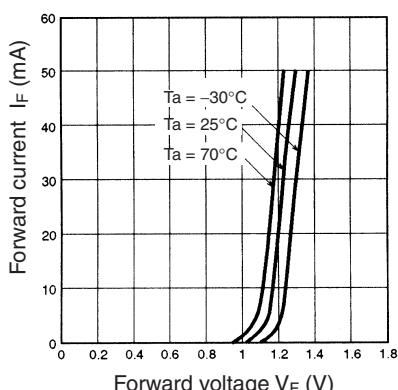
Response Time vs. Load Resistance Characteristics (Typical)



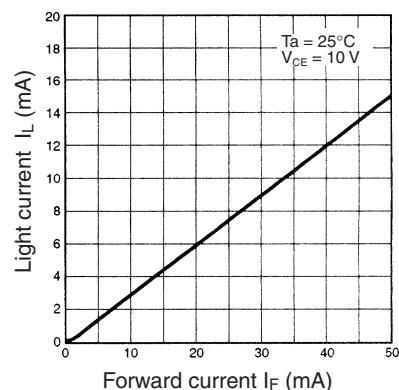
Response Time Measurement Circuit



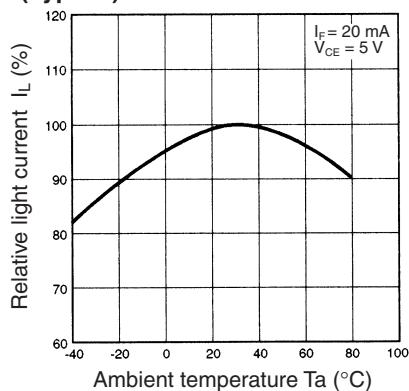
Forward Current vs. Forward Voltage Characteristics (Typical)



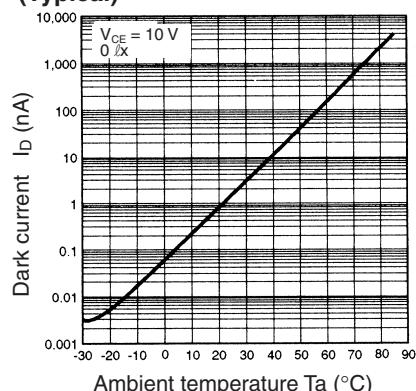
Light Current vs. Forward Current Characteristics (Typical)



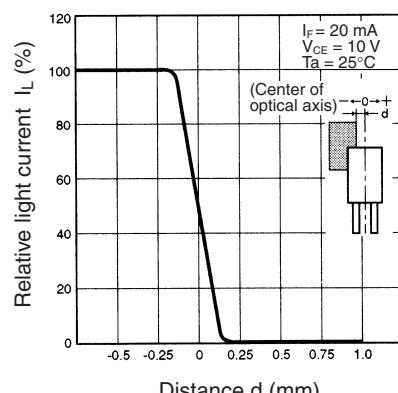
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



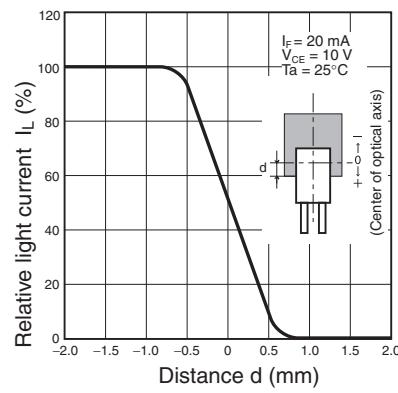
Dark Current vs. Ambient Temperature Characteristics (Typical)



Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)

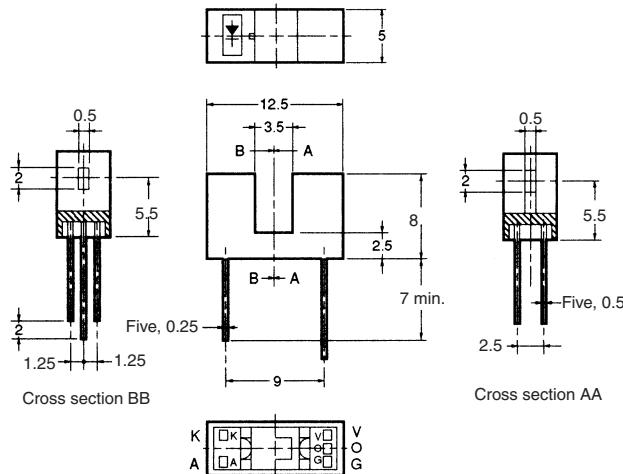


Photomicrosensor (Transmissive) EE-SX384/-SX484

⚠ Be sure to read *Precautions* on page 24.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



■ Features

- Incorporates an IC chip with a built-in detector element and amplifier.
- Incorporates a detector element with a built-in temperature compensation circuit.
- A wide supply voltage range: 4.5 to 16 VDC
- Directly connects with C-MOS and TTL.
- High resolution with a 0.5-mm-wide sensing aperture.
- Dark ON model (EE-SX384)
- Light ON model (EE-SX484)

■ Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item		Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Reverse voltage	V_R	4 V
Detector	Power supply voltage	V_{CC}	16 V
	Output voltage	V_{OUT}	28 V
	Output current	I_{OUT}	16 mA
	Permissible output dissipation	P_{OUT}	250 mW (see note 1)
Ambient temperature	Operating	T_{OPR}	-40°C to 75°C
	Storage	T_{STG}	-40°C to 85°C
Soldering temperature		T_{SOL}	260°C (see note 2)

Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

2. Complete soldering within 10 seconds.

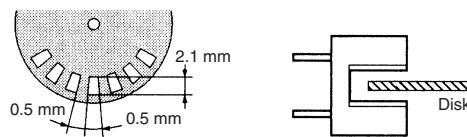
Unless otherwise specified,
the tolerances are ± 0.2 mm.

■ Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

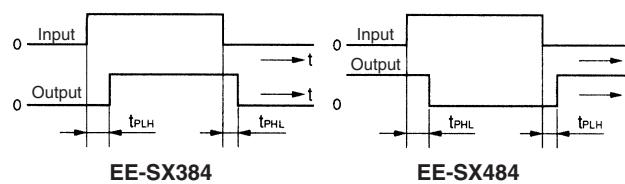
Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.
	Reverse current	I_R	0.01 μA typ., 10 μA max.
	Peak emission wavelength	λ_P	940 nm typ.
Detector	Low-level output voltage	V_{OL}	$V_{CC} = 4.5$ to 16 V, $I_{OL} = 16$ mA, $I_F = 0$ mA (EE-SX384), $I_F = 8$ mA (EE-SX484)
	High-level output voltage	V_{OH}	$V_{CC} = 16$ V, $R_L = 1$ k Ω , $I_F = 8$ mA (EE-SX384), $I_F = 0$ mA (EE-SX484)
	Current consumption	I_{CC}	$V_{CC} = 16$ V
	Peak spectral sensitivity wavelength	λ_P	$V_{CC} = 4.5$ to 16 V
LED current when output is OFF	I_{FT}	3 mA typ., 8 mA max.	$V_{CC} = 4.5$ to 16 V
LED current when output is ON			
Hysteresis	ΔH	15% typ.	$V_{CC} = 4.5$ to 16 V (see note 1)
Response frequency	f	3 kHz min.	$V_{CC} = 4.5$ to 16 V, $I_F = 15$ mA, $I_{OL} = 16$ mA (see note 2)
Response delay time	t_{PLH} (t_{PHL})	3 μs typ.	$V_{CC} = 4.5$ to 16 V, $I_F = 15$ mA, $I_{OL} = 16$ mA (see note 3)
Response delay time	t_{PHL} (t_{PLH})	20 μs typ.	$V_{CC} = 4.5$ to 16 V, $I_F = 15$ mA, $I_{OL} = 16$ mA (see note 3)

Note: 1. Hysteresis denotes the difference in forward LED current value, expressed in percentage, calculated from the respective forward LED currents when the photo IC is turned from ON to OFF and when the photo IC is turned from OFF to ON.

2. The value of the response frequency is measured by rotating the disk as shown below.



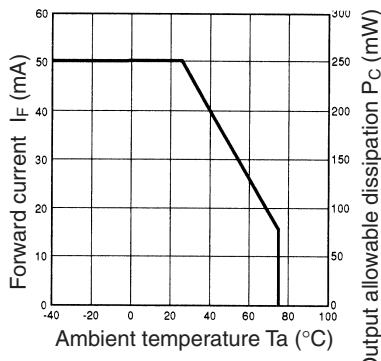
3. The following illustrations show the definition of response delay time. The value in the parentheses applies to the EE-SX484.



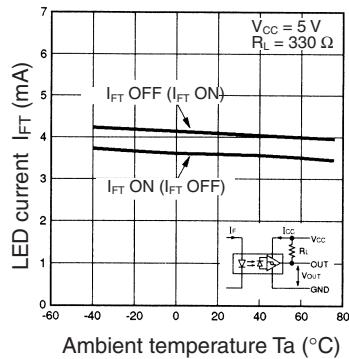
■ Engineering Data

Note: The values in the parentheses apply to the EE-SX484.

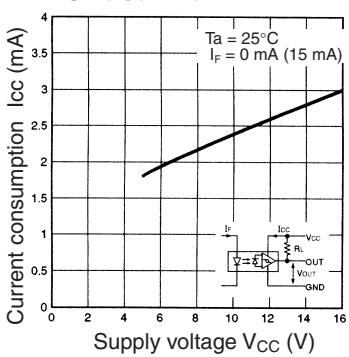
Forward Current vs. Collector Dissipation Temperature Rating



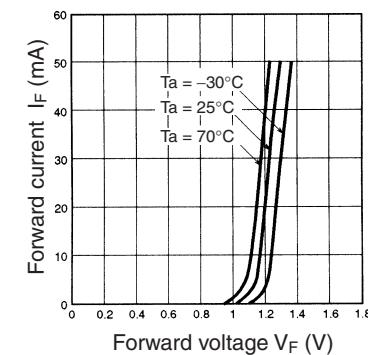
LED Current vs. Ambient Temperature Characteristics (Typical)



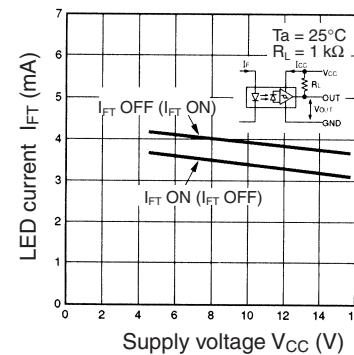
Current Consumption vs. Supply Voltage (Typical)



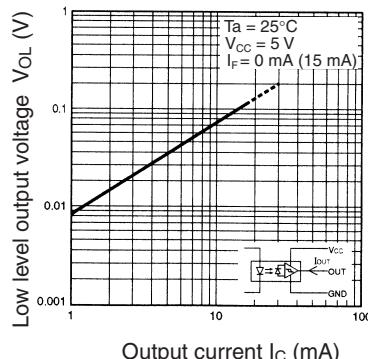
Forward Current vs. Forward Voltage Characteristics (Typical)



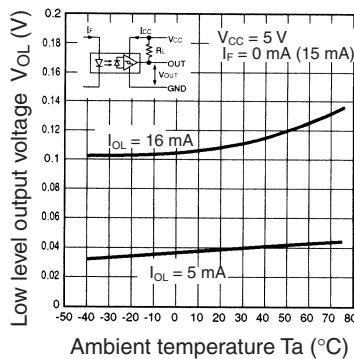
LED Current vs. Supply Voltage (Typical)



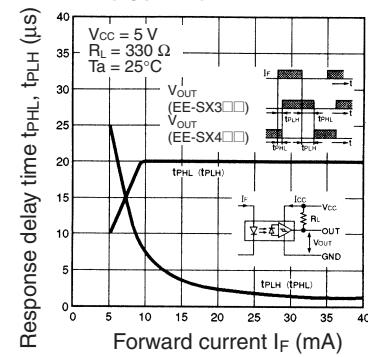
Low-level Output Voltage vs. Output Current (Typical)



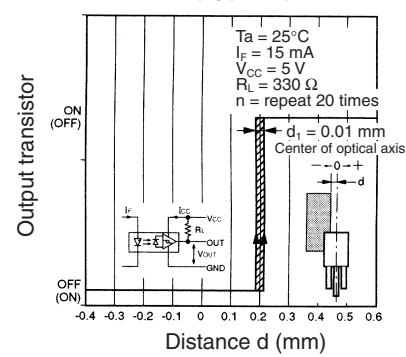
Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



Response Delay Time vs. Forward Current (Typical)



Repeat Sensing Position Characteristics (Typical)

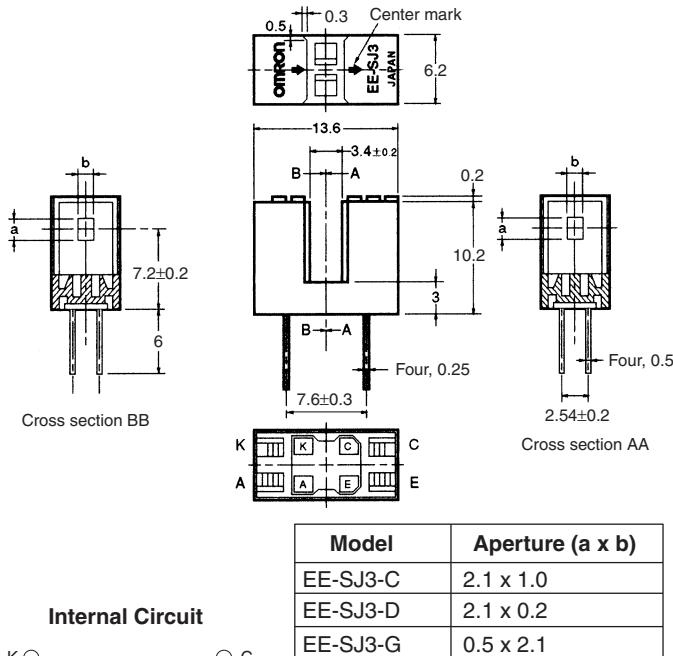


Photomicrosensor (Transmissive) EE-SJ3 Series

⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Features

- High-resolution model with a 0.2-mm-wide sensing aperture, high-sensitivity model with a 1-mm-wide sensing aperture, and model with a horizontal sensing aperture are available.

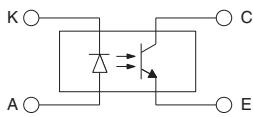
Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rated value
Emitter	Forward current	I_F 50 mA (see note 1)
	Pulse forward current	I_{FP} 1 A (see note 2)
	Reverse voltage	V_R 4 V
Detector	Collector-Emitter voltage	V_{CEO} 30 V
	Emitter-Collector voltage	V_{ECO} ---
	Collector current	I_C 20 mA
	Collector dissipation	P_C 100 mW (see note 1)
Ambient temperature	Operating	T_{opr} -25°C to 85°C
	Storage	T_{stg} -30°C to 100°C
Soldering temperature	T_{sol}	260°C (see note 3)

Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

- The pulse width is 10 μs maximum with a frequency of 100 Hz.
- Complete soldering within 10 seconds.

Internal Circuit



Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Unless otherwise specified, the tolerances are as shown below.

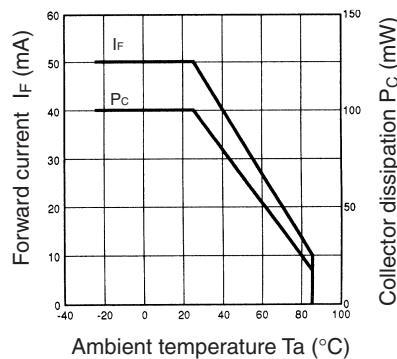
Dimensions	Tolerance
3 mm max.	± 0.3
$3 < \text{mm} \leq 6$	± 0.375
$6 < \text{mm} \leq 10$	± 0.45
$10 < \text{mm} \leq 18$	± 0.55
$18 < \text{mm} \leq 30$	± 0.65

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

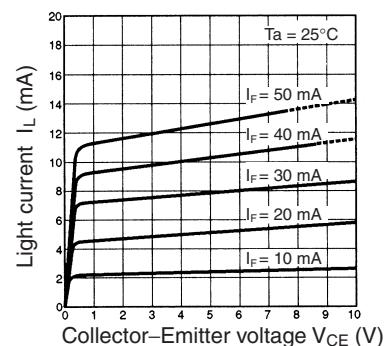
Item		Symbol	Value			Condition
			EE-SJ3-C	EE-SJ3-D	EE-SJ3-G	
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.			$I_F = 30 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.			$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_p	940 nm typ.			$I_F = 20 \text{ mA}$
Detector	Light current	I_L	1 to 28 mA typ.	0.1 mA min.	0.5 to 14 mA	$I_F = 20 \text{ mA}, V_{CE} = 10 \text{ V}$
	Dark current	I_D	2 nA typ., 200 nA max.			$V_{CE} = 10 \text{ V}, 0 \text{ }lx$
	Leakage current	I_{LEAK}	---			---
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$	0.1 V typ., 0.4 V max.	---	0.1 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 0.1 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_p	850 nm typ.			$V_{CE} = 10 \text{ V}$
Rising time		tr	4 μs typ.			$V_{CC} = 5 \text{ V}$
Falling time		tf	4 μs typ.			$R_L = 100 \Omega, I_L = 5 \text{ mA}$

■ Engineering Data

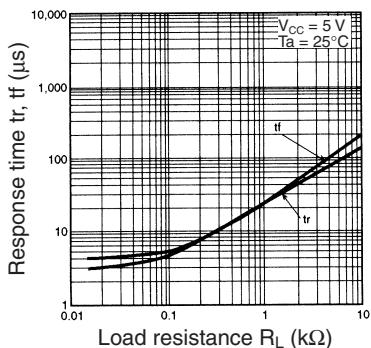
Forward Current vs. Collector Dissipation Temperature Rating



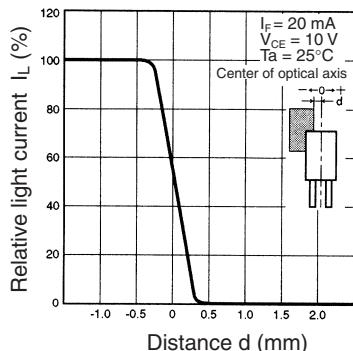
Light Current vs. Collector-Emitter Voltage Characteristics (EE-SJ3-G)



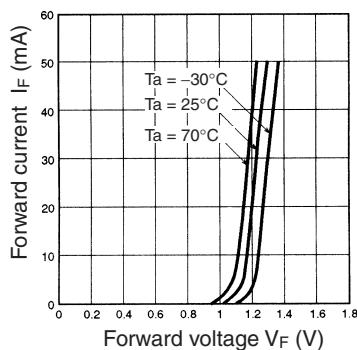
Response Time vs. Load Resistance Characteristics (Typical)



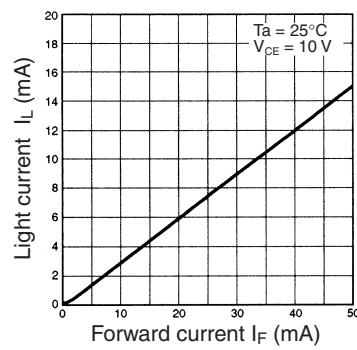
Sensing Position Characteristics (EE-SJ3-C)



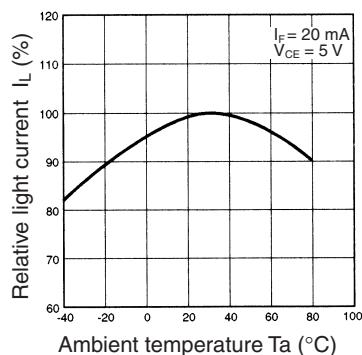
Forward Current vs. Forward Voltage Characteristics (Typical)



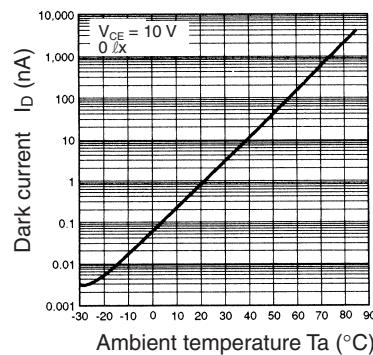
Light Current vs. Forward Current Characteristics (Typical)



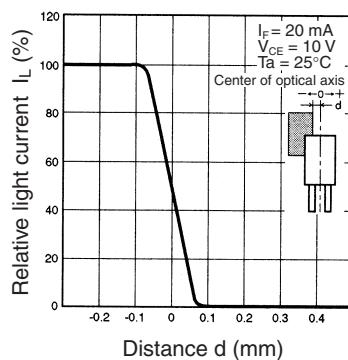
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



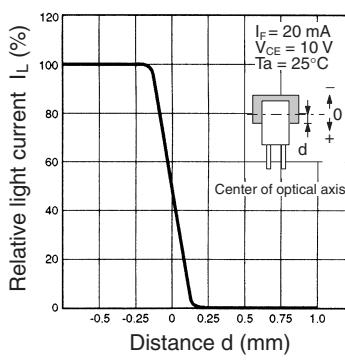
Dark Current vs. Ambient Temperature Characteristics (Typical)



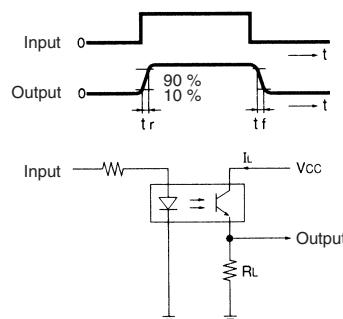
Sensing Position Characteristics (EE-SJ3-D)



Sensing Position Characteristics (EE-SJ3-G)



Response Time Measurement Circuit

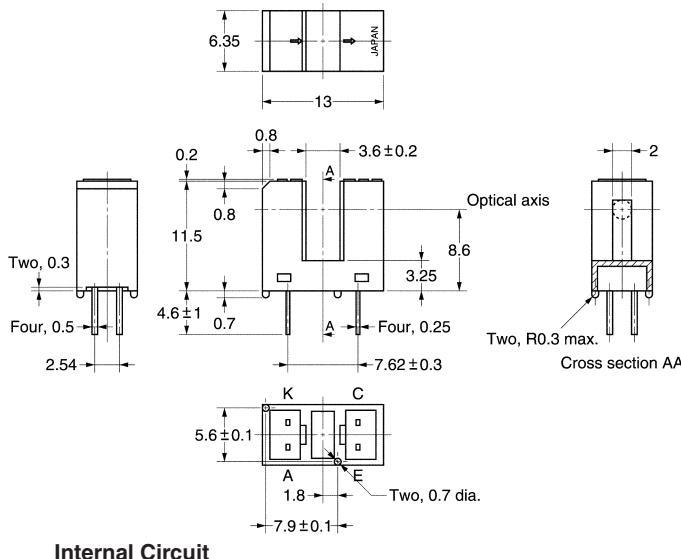


Photomicrosensor (Transmissive) EE-SX1057

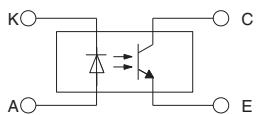
⚠ Be sure to read *Precautions* on page 24.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.2
3 < mm ≤ 6	±0.24
6 < mm ≤ 10	±0.29
10 < mm ≤ 18	±0.35
18 < mm ≤ 30	±0.42

■ Features

- Compact model with a 3.6-mm-wide slot.
- PCB mounting type.

■ Absolute Maximum Ratings (Ta = 25°C)

Item	Symbol	Rated value
Emitter	Forward current	I _F 50 mA (see note 1)
	Pulse forward current	I _{FP} 1 A (see note 2)
	Reverse voltage	V _R 4 V
Detector	Collector-Emitter voltage	V _{CEO} 30 V
	Emitter-Collector voltage	V _{ECO} 5 V
	Collector current	I _C 20 mA
	Collector dissipation	P _C 100 mW (see note 1)
Ambient temperature	Operating	T _{opr} -25°C to 85°C
	Storage	T _{stg} -30°C to 100°C
Soldering temperature	T _{sol}	260°C (see note 3)

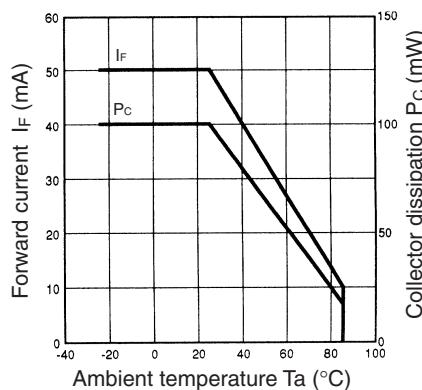
- Note:**
1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 2. The pulse width is 10 µs maximum with a frequency of 100 Hz.
 3. Complete soldering within 10 seconds.

■ Electrical and Optical Characteristics (Ta = 25°C)

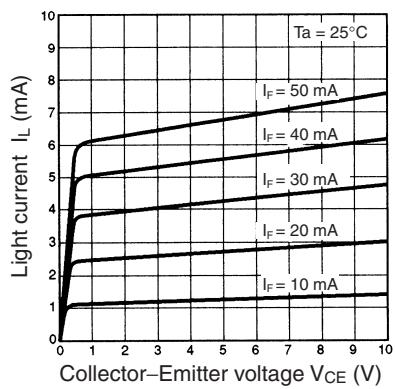
Item	Symbol	Value	Condition
Emitter	Forward voltage	V _F 1.15 V typ., 1.5 V max.	I _F = 30 mA
	Reverse current	I _R 0.01 µA typ., 10 µA max.	V _R = 4 V
	Peak emission wavelength	λ _P 940 nm typ.	I _F = 20 mA
Detector	Light current	I _L 1.5 mA min., 8 mA typ., 30 mA max.	I _F = 15 mA, V _{CE} = 2 V
	Dark current	I _D 2 nA typ., 200 nA max.	V _{CE} = 10 V, 0 lx
	Leakage current	I _{LEAK} ---	---
	Collector-Emitter saturated voltage	V _{CE} (sat) 0.4 V max.	I _F = 30 mA, I _L = 1 mA
	Peak spectral sensitivity wavelength	λ _P 850 nm typ.	V _{CE} = 10 V
Rising time	tr	4 µs typ., 20 µA max.	V _{CC} = 10 V, R _L = 100 Ω, I _L = 5 mA
Falling time	tf	4 µs typ., 20 µA max.	V _{CC} = 10 V, R _L = 100 Ω, I _L = 5 mA

■ Engineering Data

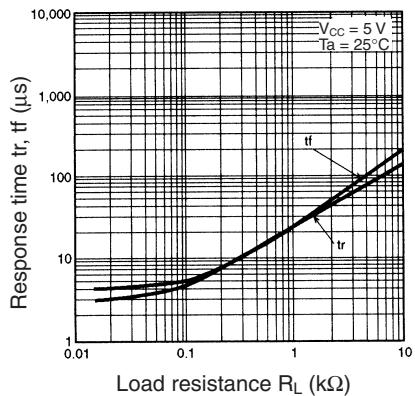
Forward Current vs. Collector Dissipation Temperature Rating



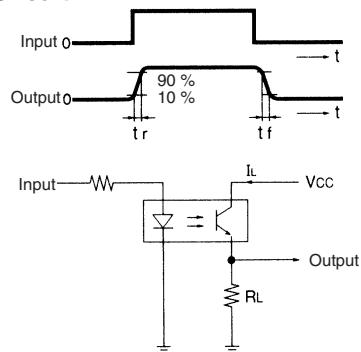
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



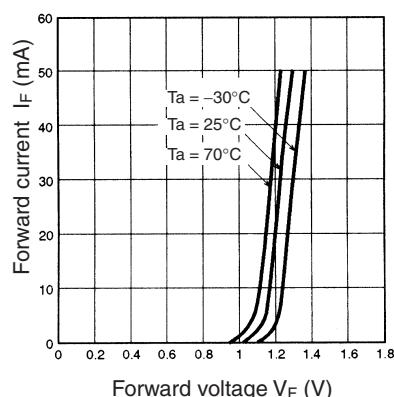
Response Time vs. Load Resistance Characteristics (Typical)



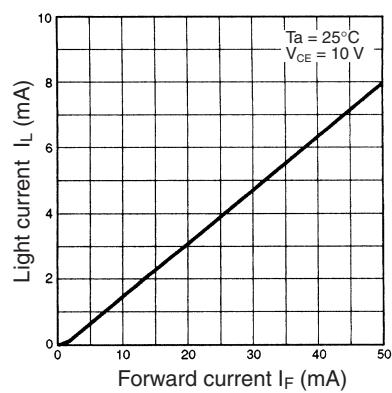
Response Time Measurement Circuit



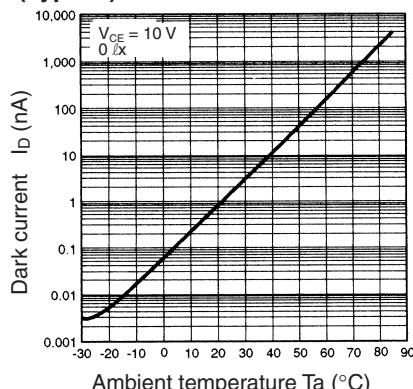
Forward Current vs. Forward Voltage Characteristics (Typical)



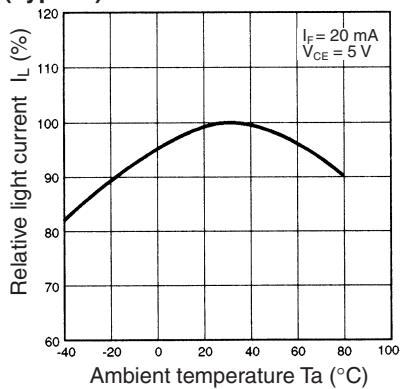
Light Current vs. Forward Current Characteristics (Typical)



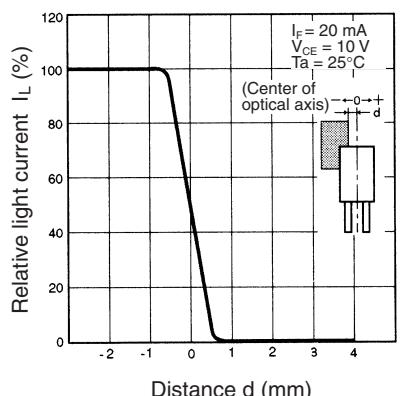
Dark Current vs. Ambient Temperature Characteristics (Typical)



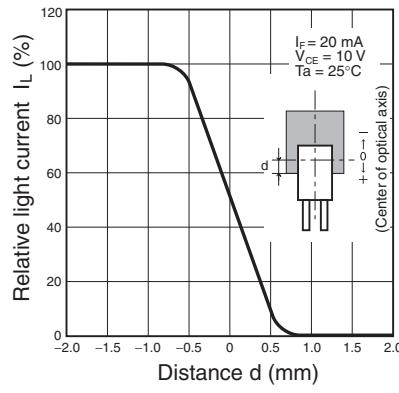
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)

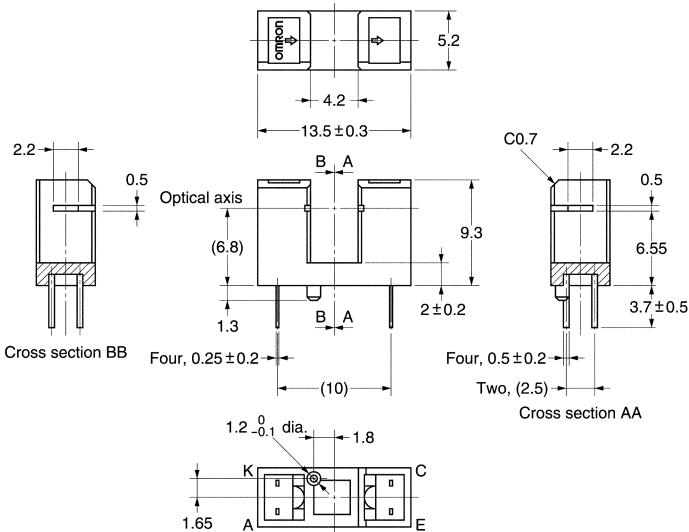


Photomicrosensor (Transmissive) EE-SX1128

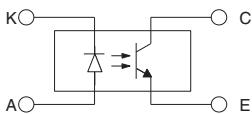
⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
$0 < x \leq 4$	± 0.100
$4 < x \leq 18$	± 0.200

Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Features

- General-purpose model with a 4.2-mm-wide slot.
- PCB mounting type.
- High resolution with a 0.5-mm-wide aperture.
- Horizontal sensing aperture.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Pulse forward current	I_{FP}	1 A (see note 2)
	Reverse voltage	V_R	4 V
Detector	Collector-Emitter voltage	V_{CEO}	30 V
	Emitter-Collector voltage	V_{ECO}	---
	Collector current	I_C	20 mA
	Collector dissipation	P_C	100 mW (see note 1)
Ambient temperature	Operating	T_{opr}	-25°C to 85°C
	Storage	T_{stg}	-30°C to 100°C
Soldering temperature		T_{sol}	260°C (see note 3)

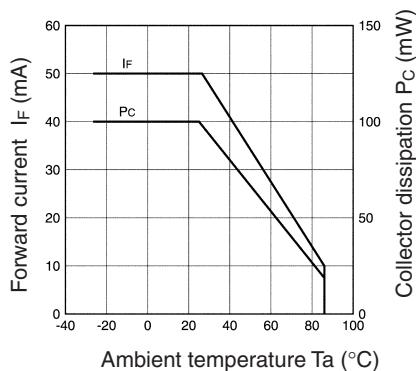
- Note:
- Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 - The pulse width is 10 μs maximum with a frequency of 100 Hz.
 - Complete soldering within 10 seconds.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

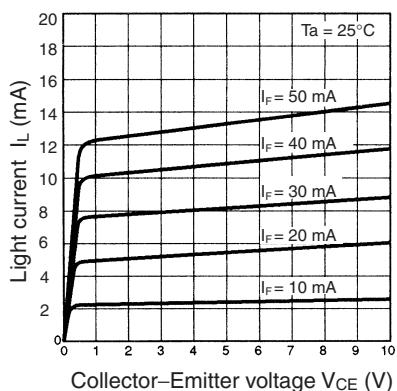
	Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_p	940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L	0.5 mA min., 10 mA max.	$I_F = 20 \text{ mA}, V_{CE} = 10 \text{ V}$
	Dark current	I_D	2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lux}$
	Leakage current	I_{LEAK}	---	---
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$	0.1 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 0.1 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_p	850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time		t_r	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$
Falling time		t_f	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$

■ Engineering Data

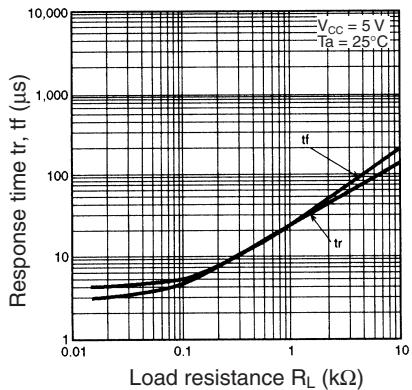
Forward Current vs. Collector Dissipation Temperature Rating



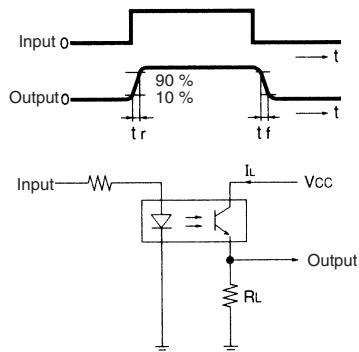
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



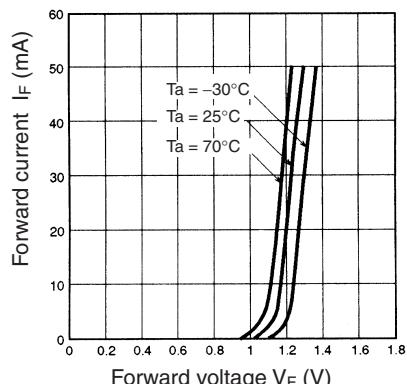
Response Time vs. Load Resistance Characteristics (Typical)



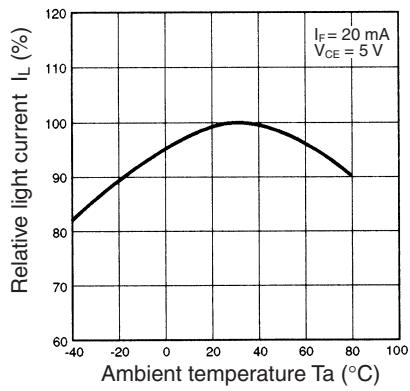
Response Time Measurement Circuit



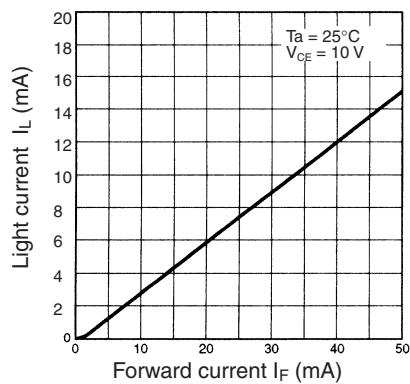
Forward Current vs. Forward Voltage Characteristics (Typical)



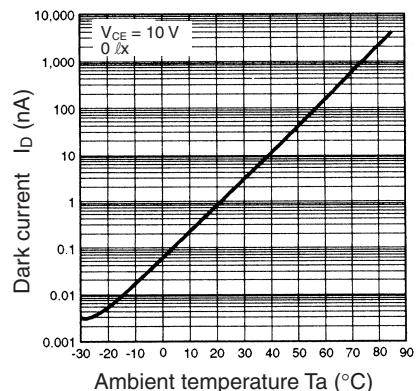
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



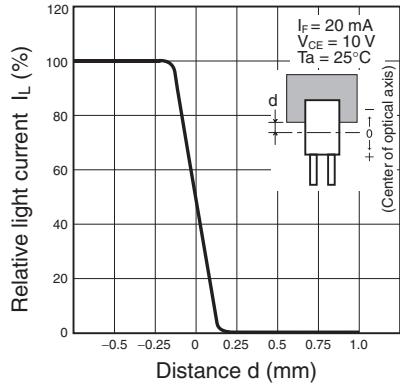
Light Current vs. Forward Current Characteristics (Typical)



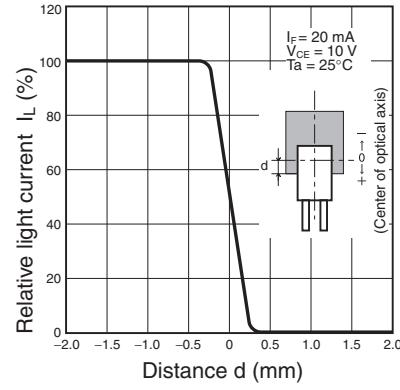
Dark Current vs. Ambient Temperature Characteristics (Typical)



Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)

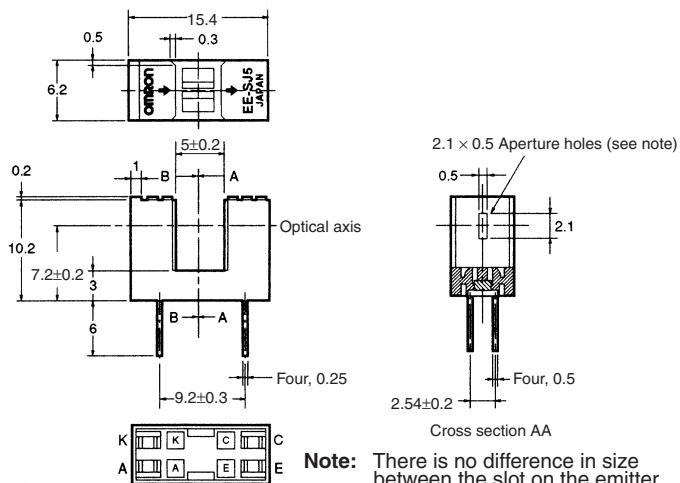


Photomicrosensor (Transmissive) EE-SJ5-B

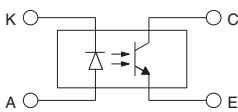
⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	± 0.3
$3 < \text{mm} \leq 6$	± 0.375
$6 < \text{mm} \leq 10$	± 0.45
$10 < \text{mm} \leq 18$	± 0.55
$18 < \text{mm} \leq 30$	± 0.65

Features

- General-purpose model with a 5-mm-wide slot.
- PCB mounting type.
- High resolution with a 0.5-mm-wide aperture.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rated value
Emitter	Forward current	I_F 50 mA (see note 1)
	Pulse forward current	I_{FP} 1 A (see note 2)
	Reverse voltage	V_R 4 V
Detector	Collector-Emitter voltage	V_{CEO} 30 V
	Emitter-Collector voltage	V_{ECO} ---
	Collector current	I_C 20 mA
	Collector dissipation	P_C 100 mW (see note 1)
Ambient temperature	Operating	T_{opr} -25°C to 85°C
	Storage	T_{stg} -30°C to 100°C
Soldering temperature	T_{sol}	260°C (see note 3)

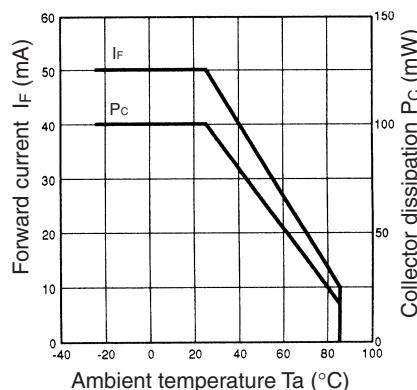
- Note:**
- Refer to the temperature rating chart if the ambient temperature exceeds 25°C .
 - The pulse width is 10 μs maximum with a frequency of 100 Hz.
 - Complete soldering within 10 seconds.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

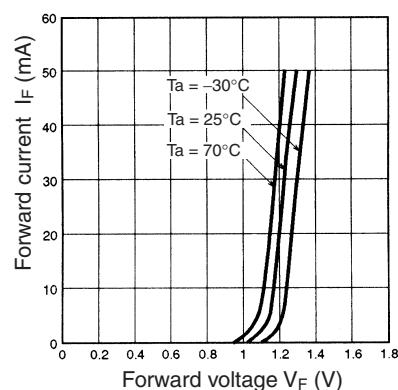
Item		Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P	940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L	0.5 mA min., 14 mA max.	$I_F = 20 \text{ mA}, V_{CE} = 10 \text{ V}$
	Dark current	I_D	2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lux}$
	Leakage current	I_{LEAK}	---	---
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$	0.1 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 0.1 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time		tr	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$
Falling time		tf	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$

■ Engineering Data

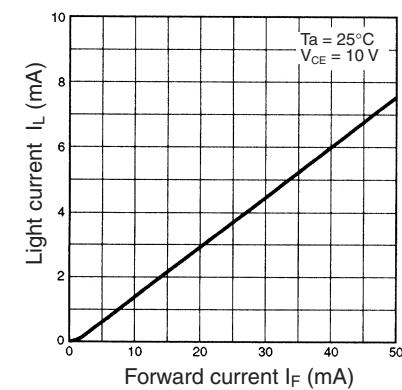
Forward Current vs. Collector Dissipation Temperature Rating



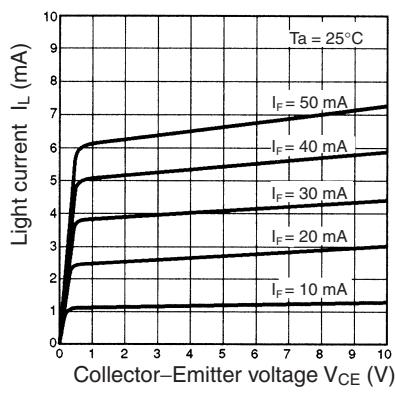
Forward Current vs. Forward Voltage Characteristics (Typical)



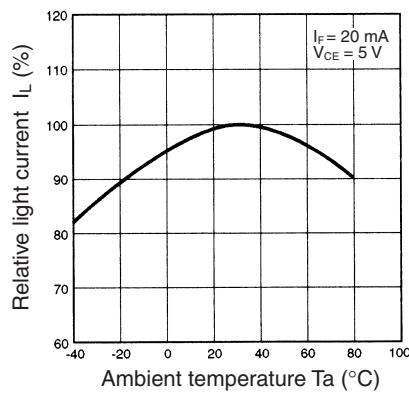
Light Current vs. Forward Current Characteristics (Typical)



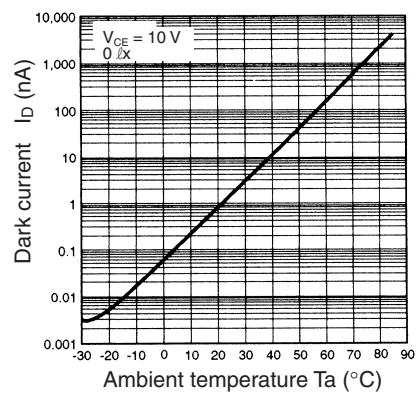
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



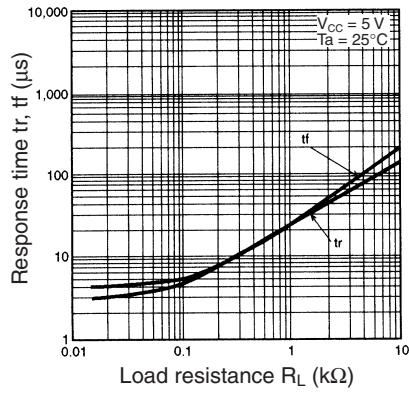
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



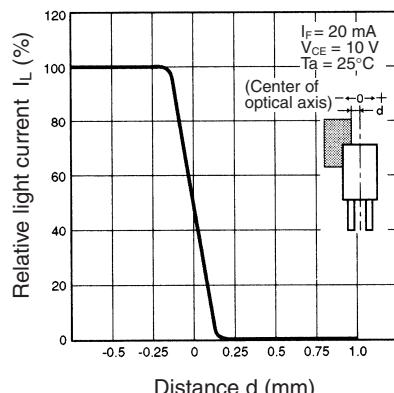
Dark Current vs. Ambient Temperature Characteristics (Typical)



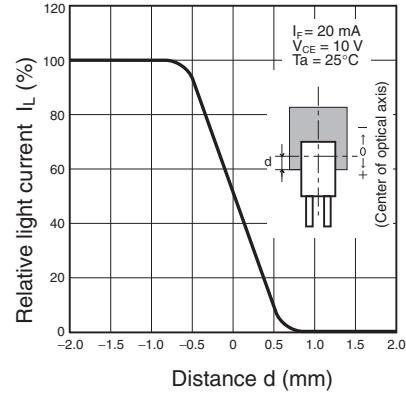
Response Time vs. Load Resistance Characteristics (Typical)



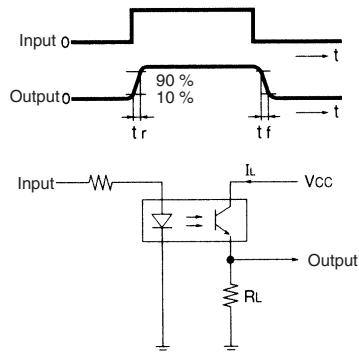
Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)



Response Time Measurement Circuit

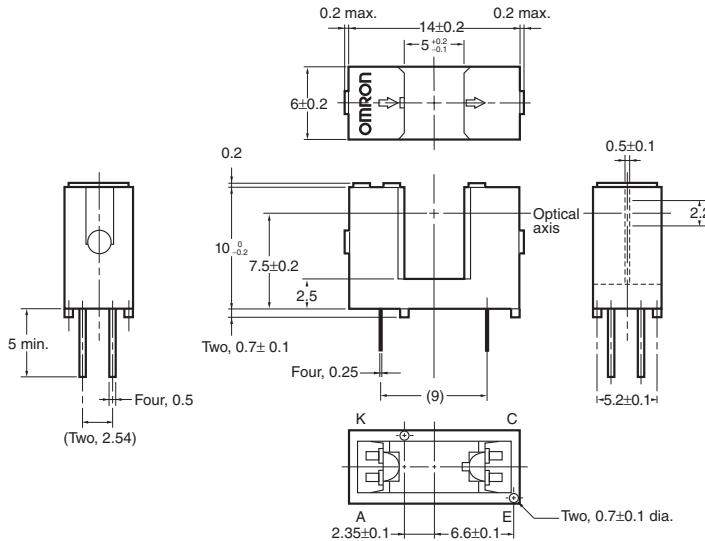


Photomicrosensor (Transmissive) EE-SX1041

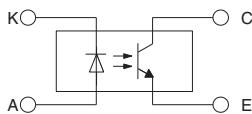
⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

Features

- General-purpose model with a 5-mm-wide slot.
- PCB mounting type.
- High resolution with a 0.5-mm-wide aperture.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Pulse forward current	I_{FP}	1 A (see note 2)
	Reverse voltage	V_R	4 V
Detector	Collector-Emitter voltage	V_{CEO}	30 V
	Emitter-Collector voltage	V_{ECO}	---
	Collector current	I_C	20 mA
	Collector dissipation	P_C	100 mW (see note 1)
Ambient temperature	Operating	T_{opr}	-25°C to 95°C
	Storage	T_{stg}	-30°C to 100°C
Soldering temperature		T_{sol}	260°C (see note 3)

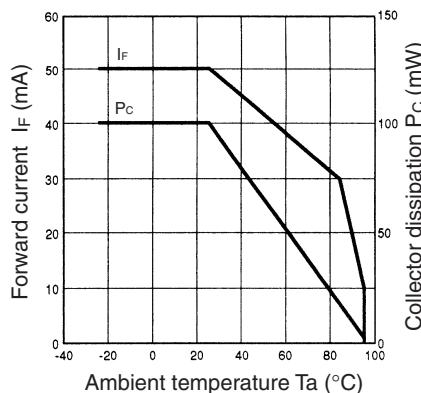
- Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
 3. Complete soldering within 10 seconds.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

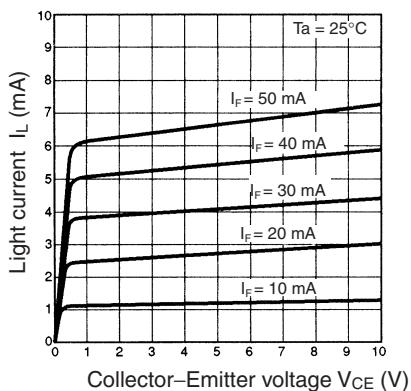
Item		Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P	940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L	0.5 mA min., 14 mA max.	$I_F = 20 \text{ mA}, V_{CE} = 10 \text{ V}$
	Dark current	I_D	2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lux}$
	Leakage current	I_{LEAK}	---	---
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$	0.1 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 0.1 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time		t_r	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$
Falling time		t_f	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$

■ Engineering Data

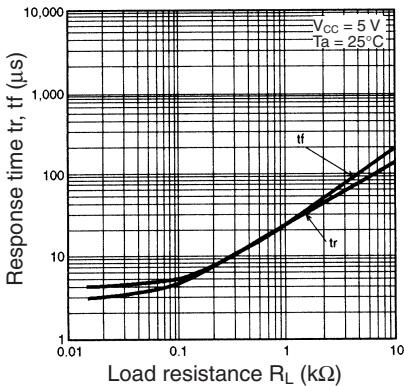
Forward Current vs. Collector Dissipation Temperature Rating



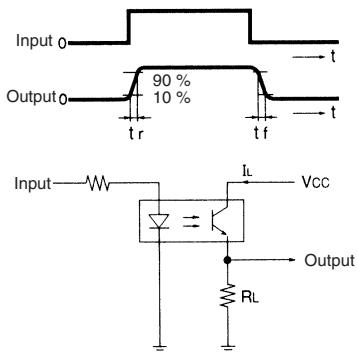
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



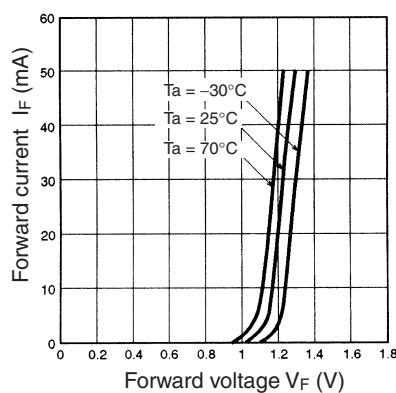
Response Time vs. Load Resistance Characteristics (Typical)



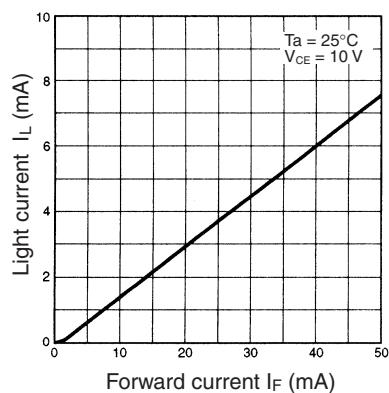
Response Time Measurement Circuit



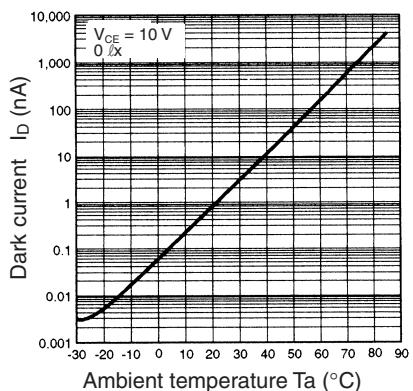
Forward Current vs. Forward Voltage Characteristics (Typical)



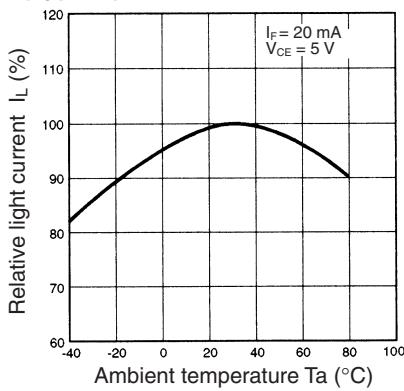
Light Current vs. Forward Current Characteristics (Typical)



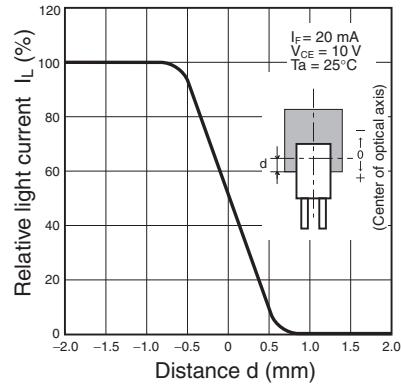
Dark Current vs. Ambient Temperature Characteristics (Typical)



Relative Light Current vs. Ambient Temperature Characteristics (Typical)



Sensing Position Characteristics (Typical)

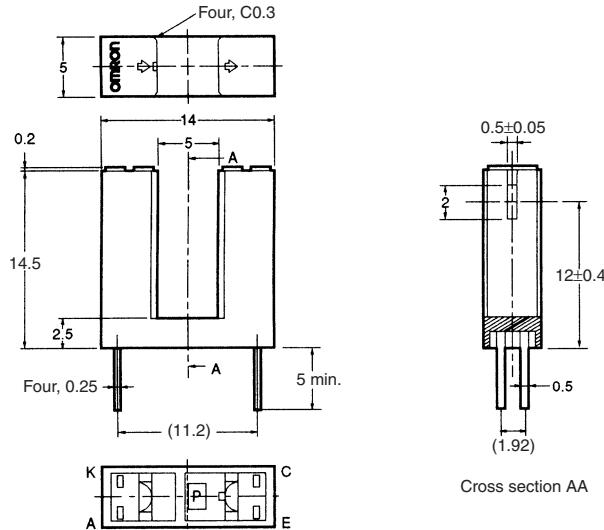


Photomicrosensor (Transmissive) EE-SX1042

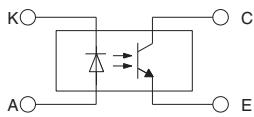
⚠ Be sure to read *Precautions* on page 24.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

■ Features

- 14.5-mm-tall model with a deep slot.
- PCB mounting type.
- High resolution with a 0.5-mm-wide aperture.

■ Absolute Maximum Ratings (Ta = 25°C)

Item		Symbol	Rated value
Emitter	Forward current	I _F	50 mA (see note 1)
	Pulse forward current	I _{FP}	1 A (see note 2)
	Reverse voltage	V _R	4 V
Detector	Collector-Emitter voltage	V _{CEO}	30 V
	Emitter-Collector voltage	V _{ECO}	---
	Collector current	I _C	20 mA
	Collector dissipation	P _C	100 mW (see note 1)
Ambient temperature	Operating	T _{opr}	-25°C to 85°C
	Storage	T _{stg}	-30°C to 100°C
Soldering temperature		T _{sol}	260°C (see note 3)

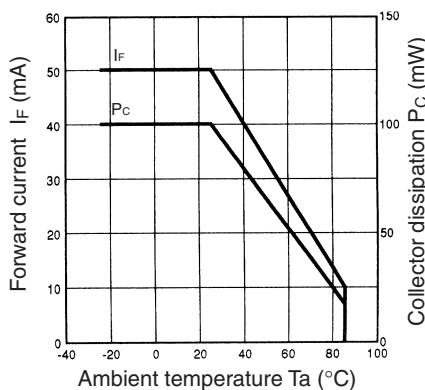
- Note:**
1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 2. The pulse width is 10 µs maximum with a frequency of 100 Hz.
 3. Complete soldering within 10 seconds.

■ Electrical and Optical Characteristics (Ta = 25°C)

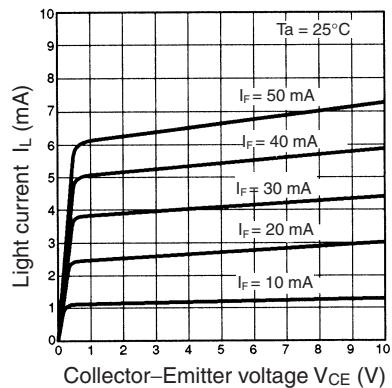
Item		Symbol	Value	Condition
Emitter	Forward voltage	V _F	1.2 V typ., 1.5 V max.	I _F = 30 mA
	Reverse current	I _R	0.01 µA typ., 10 µA max.	V _R = 4 V
	Peak emission wavelength	λ _P	940 nm typ.	I _F = 20 mA
Detector	Light current	I _L	0.5 mA min., 10 mA max.	I _F = 20 mA, V _{CE} = 10 V
	Dark current	I _D	2 nA typ., 200 nA max.	V _{CE} = 10 V, 0 lux
	Leakage current	I _{LEAK}	---	---
	Collector-Emitter saturated voltage	V _{CE} (sat)	0.1 V typ., 0.4 V max.	I _F = 20 mA, I _L = 0.1 mA
	Peak spectral sensitivity wavelength	λ _P	850 nm typ.	V _{CE} = 10 V
Rising time		tr	4 µs typ.	V _{CC} = 5 V, R _L = 100 Ω, I _L = 5 mA
Falling time		tf	4 µs typ.	V _{CC} = 5 V, R _L = 100 Ω, I _L = 5 mA

■ Engineering Data

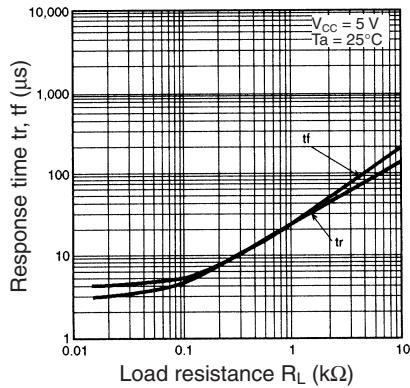
Forward Current vs. Collector Dissipation Temperature Rating



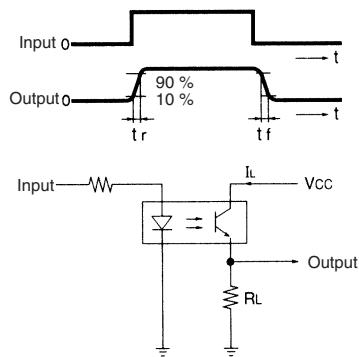
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



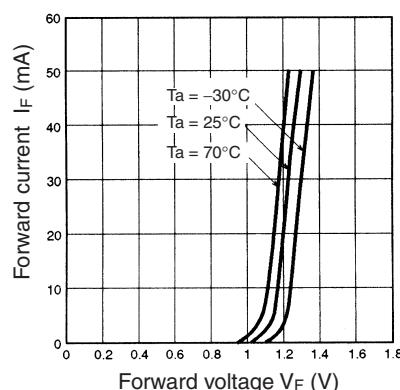
Response Time vs. Load Resistance Characteristics (Typical)



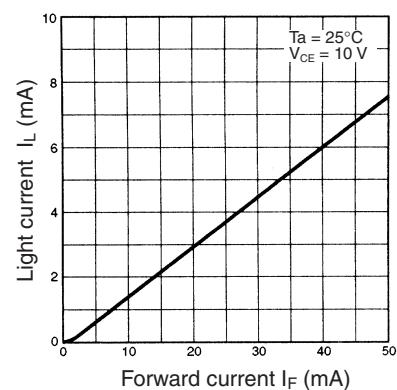
Response Time Measurement Circuit



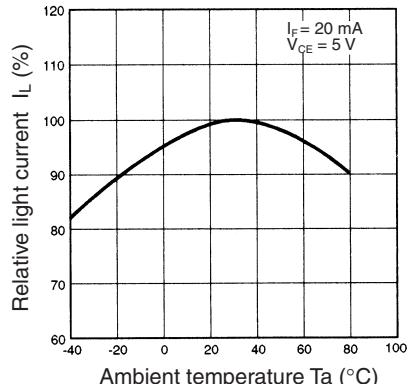
Forward Current vs. Forward Voltage Characteristics (Typical)



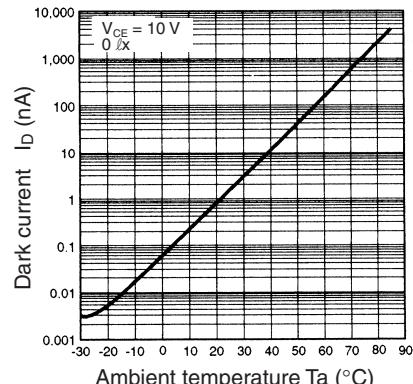
Light Current vs. Forward Current Characteristics (Typical)



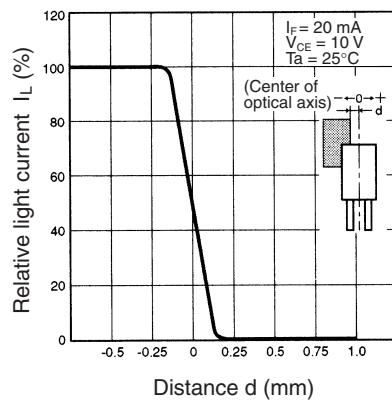
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



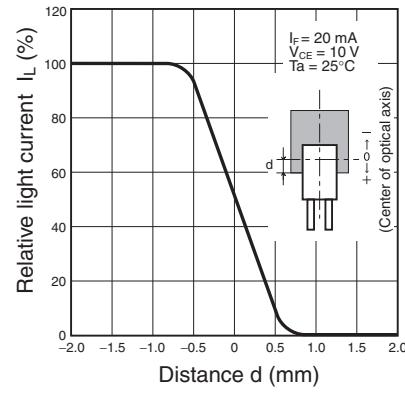
Dark Current vs. Ambient Temperature Characteristics (Typical)



Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)

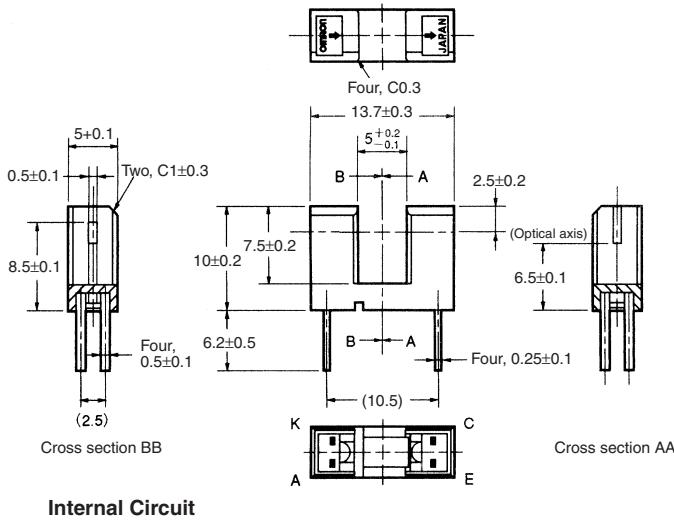


Photomicrosensor (Transmissive) EE-SX1081

⚠ Be sure to read *Precautions* on page 24.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	± 0.3
$3 < \text{mm} \leq 6$	± 0.375
$6 < \text{mm} \leq 10$	± 0.45
$10 < \text{mm} \leq 18$	± 0.55
$18 < \text{mm} \leq 30$	± 0.65

■ Features

- General-purpose model with a 5-mm-wide slot.
- PCB mounting type.
- High resolution with a 0.5-mm-wide aperture.

■ Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rated value
Emitter	Forward current	I_F 50 mA (see note 1)
	Pulse forward current	I_{FP} 1 A (see note 2)
	Reverse voltage	V_R 4 V
Detector	Collector-Emitter voltage	V_{CEO} 30 V
	Emitter-Collector voltage	V_{ECO} ---
	Collector current	I_C 20 mA
	Collector dissipation	P_C 100 mW (see note 1)
Ambient temperature	Operating	T_{opr} -25°C to 85°C
	Storage	T_{stg} -30°C to 100°C
Soldering temperature	T_{sol}	260°C (see note 3)

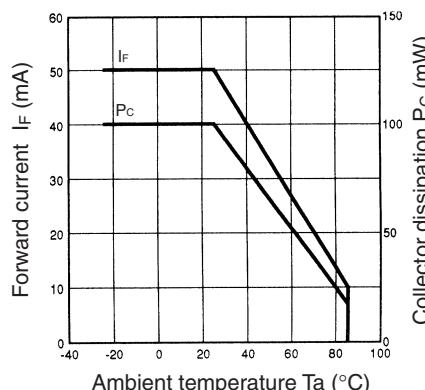
- Note:
- Refer to the temperature rating chart if the ambient temperature exceeds 25°C .
 - The pulse width is 10 μs maximum with a frequency of 100 Hz.
 - Complete soldering within 10 seconds.

■ Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

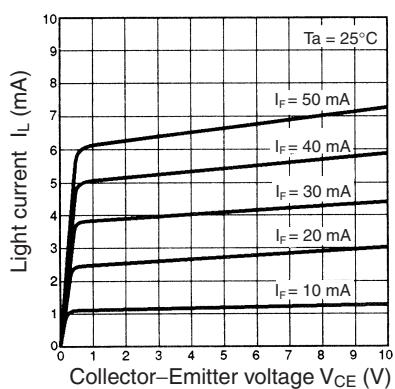
Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F 1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R 0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P 940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L 0.5 mA min., 14 mA max.	$I_F = 20 \text{ mA}, V_{CE} = 10 \text{ V}$
	Dark current	I_D 2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lux}$
	Leakage current	I_{LEAK} ---	---
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$ 0.1 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 0.1 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_P 850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time	t_r	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$
Falling time	t_f	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$

■ Engineering Data

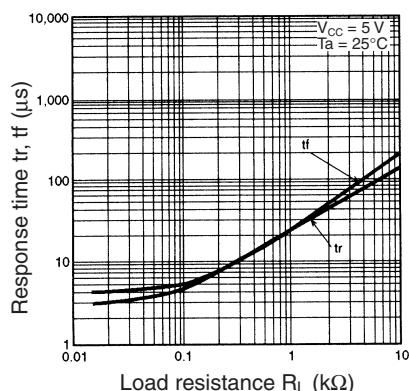
Forward Current vs. Collector Dissipation Temperature Rating



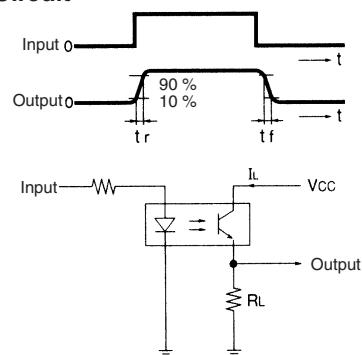
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



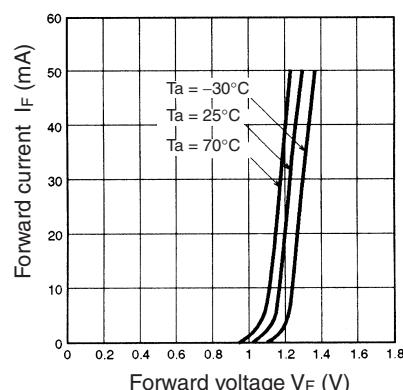
Response Time vs. Load Resistance Characteristics (Typical)



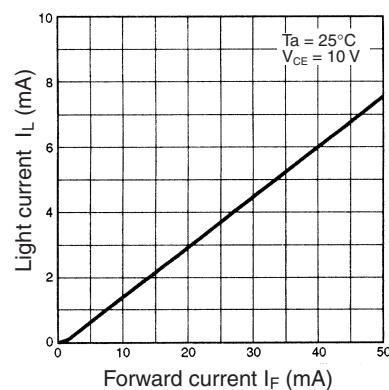
Response Time Measurement Circuit



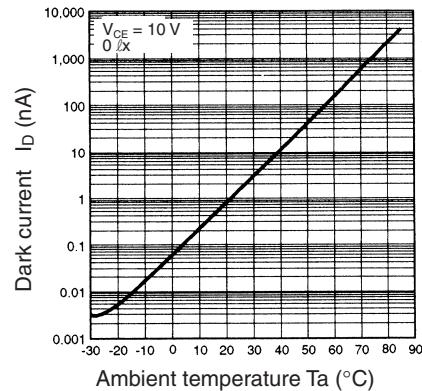
Forward Current vs. Forward Voltage Characteristics (Typical)



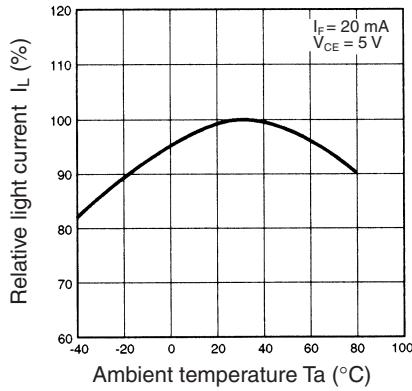
Light Current vs. Forward Current Characteristics (Typical)



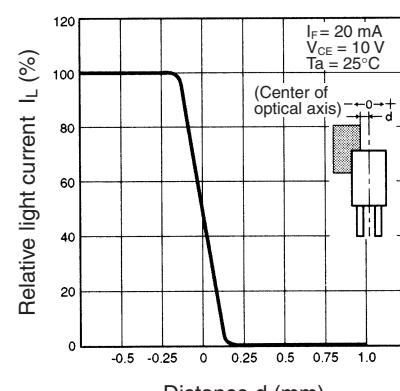
Dark Current vs. Ambient Temperature Characteristics (Typical)



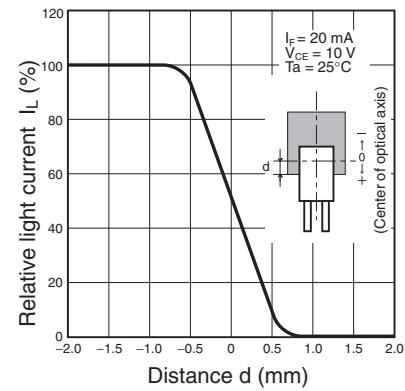
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)

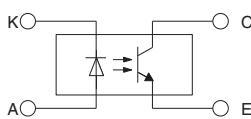
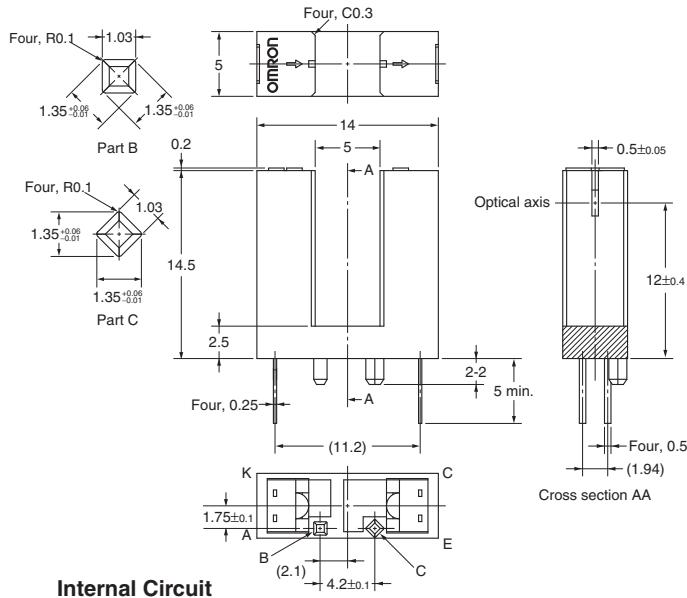


Photomicrosensor (Transmissive) EE-SX1115

⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	± 0.3
$3 < \text{mm} \leq 6$	± 0.375
$6 < \text{mm} \leq 10$	± 0.45
$10 < \text{mm} \leq 18$	± 0.55
$18 < \text{mm} \leq 30$	± 0.65

Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Features

- 14.5-mm-tall model with a deep slot.
- PCB mounting type.
- High resolution with a 0.5-mm-wide aperture.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Pulse forward current	I_{FP}	1 A (see note 2)
	Reverse voltage	V_R	4 V
Detector	Collector-Emitter voltage	V_{CEO}	30 V
	Emitter-Collector voltage	V_{ECO}	---
	Collector current	I_C	20 mA
	Collector dissipation	P_C	100 mW (see note 1)
Ambient temperature	Operating	T_{opr}	-25°C to 85°C
	Storage	T_{stg}	-30°C to 100°C
Soldering temperature		T_{sol}	260°C (see note 3)

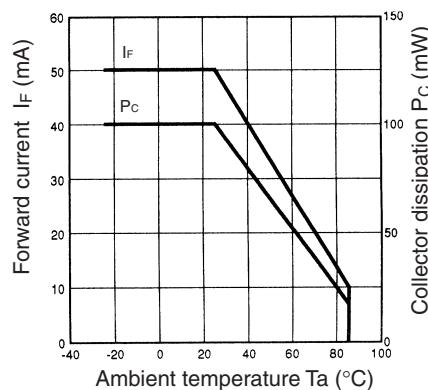
- Note:**
1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
 3. Complete soldering within 10 seconds.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

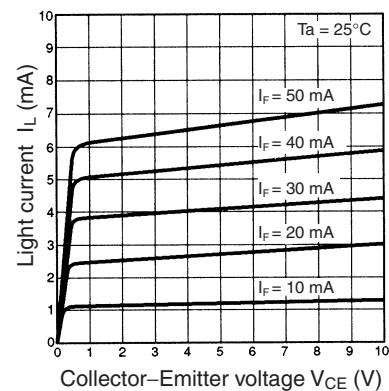
	Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P	940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L	0.5 mA min., 14 mA max.	$I_F = 20 \text{ mA}, V_{CE} = 10 \text{ V}$
	Dark current	I_D	2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lux}$
	Leakage current	I_{LEAK}	---	---
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$	0.1 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 0.1 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time		t_r	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$
Falling time		t_f	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$

■ Engineering Data

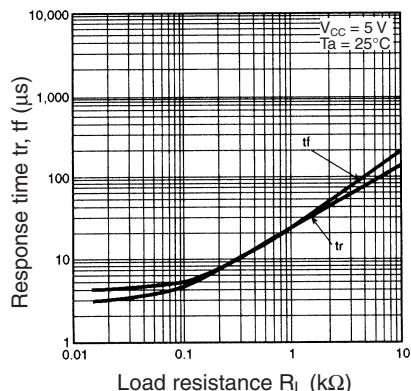
Forward Current vs. Collector Dissipation Temperature Rating



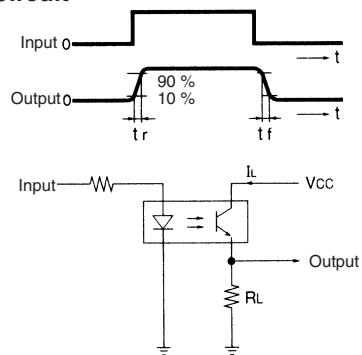
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



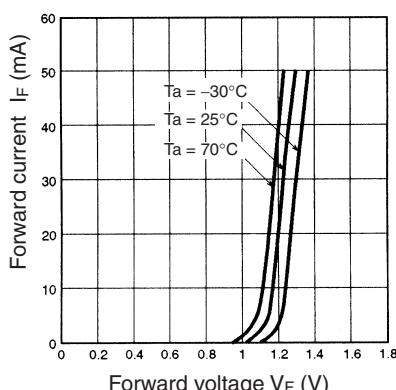
Response Time vs. Load Resistance Characteristics (Typical)



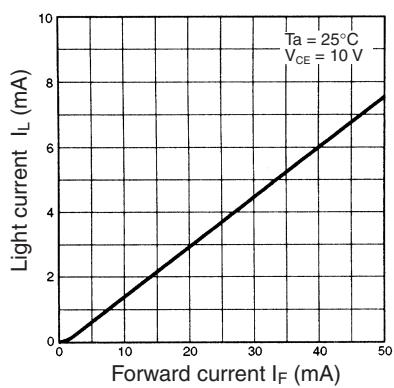
Response Time Measurement Circuit



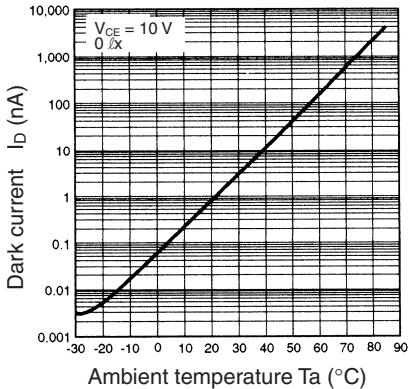
Forward Current vs. Forward Voltage Characteristics (Typical)



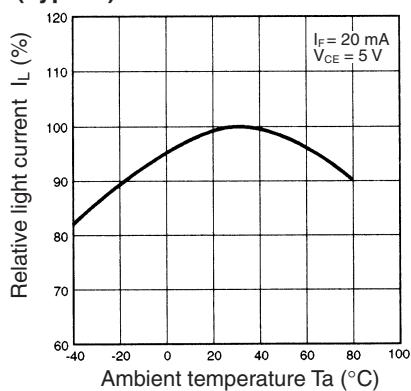
Light Current vs. Forward Current Characteristics (Typical)



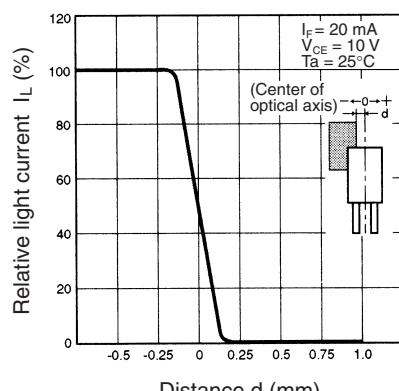
Dark Current vs. Ambient Temperature Characteristics (Typical)



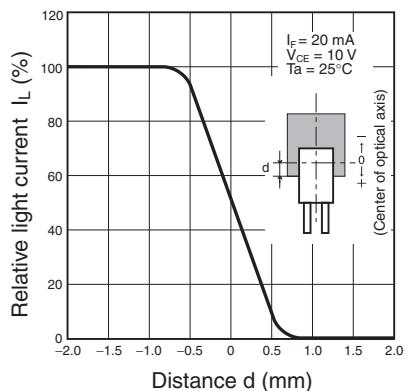
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)

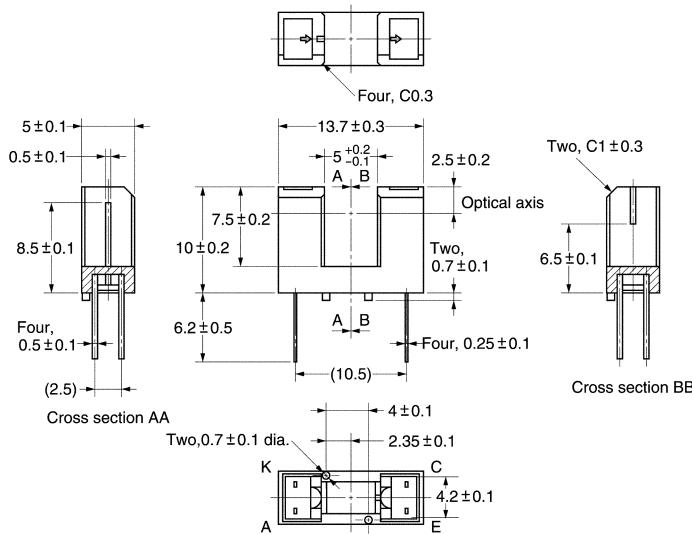


Photomicrosensor (Transmissive) EE-SX1137

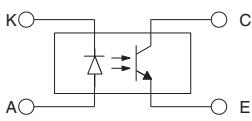
⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are as shown below.

Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

Features

- General-purpose model with a 5-mm-wide slot.
- PCB mounting type.
- High resolution with a 0.5-mm-wide aperture.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Pulse forward current	I_{FP}	1 A (see note 2)
	Reverse voltage	V_R	4 V
Detector	Collector-Emitter voltage	V_{CEO}	30 V
	Emitter-Collector voltage	V_{ECO}	---
	Collector current	I_C	20 mA
	Collector dissipation	P_C	100 mW (see note 1)
Ambient temperature	Operating	T_{opr}	-25°C to 85°C
	Storage	T_{stg}	-30°C to 100°C
Soldering temperature		T_{sol}	260°C (see note 3)

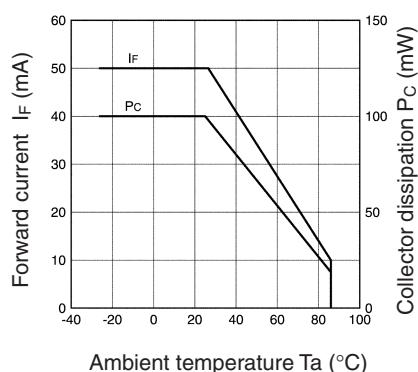
- Note:
- Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 - The pulse width is 10 μs maximum with a frequency of 100 Hz.
 - Complete soldering within 10 seconds.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

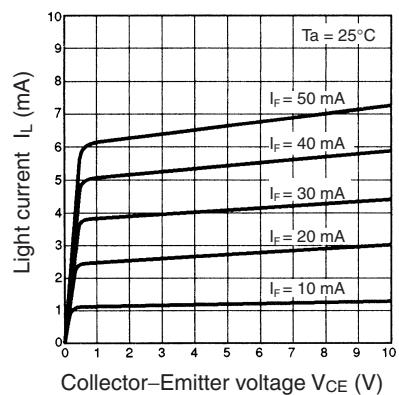
	Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_p	940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L	0.5 mA min., 14 mA max.	$I_F = 20 \text{ mA}, V_{CE} = 10 \text{ V}$
	Dark current	I_D	2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lux}$
	Leakage current	I_{LEAK}	---	---
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$	0.1 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 0.1 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_p	850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time	t_r		4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$
Falling time	t_f		4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$

■ Engineering Data

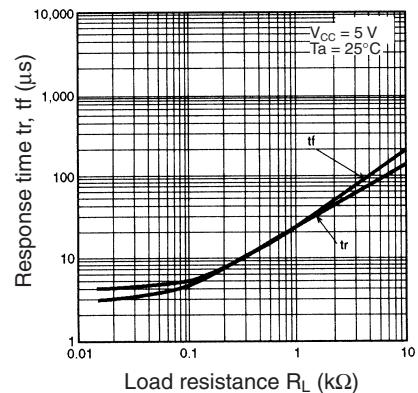
Forward Current vs. Collector Dissipation Temperature Rating



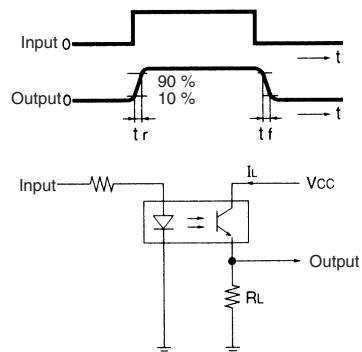
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



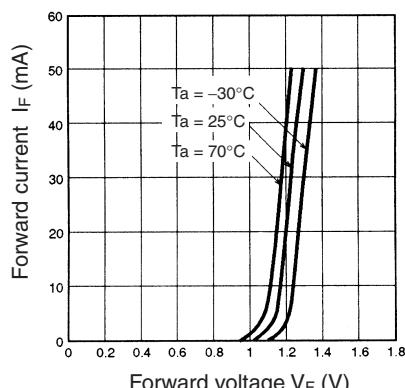
Response Time vs. Load Resistance Characteristics (Typical)



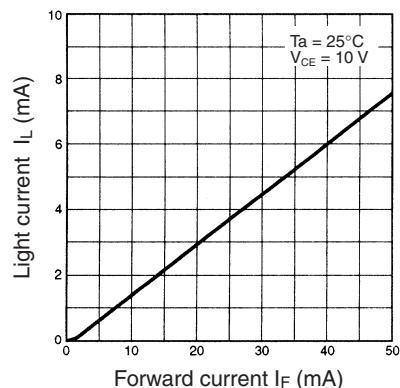
Response Time Measurement Circuit



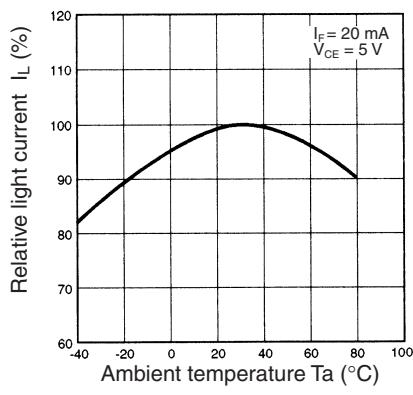
Forward Current vs. Forward Voltage Characteristics (Typical)



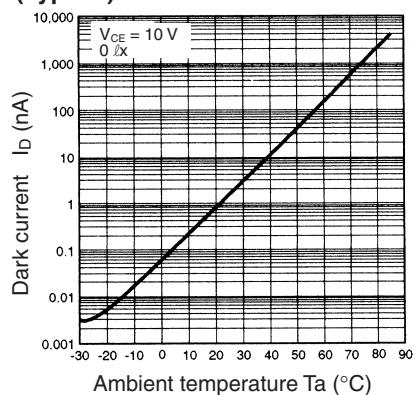
Light Current vs. Forward Current Characteristics (Typical)



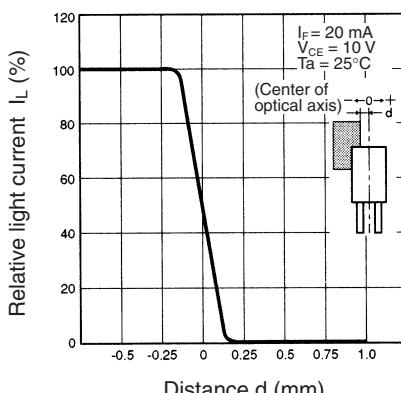
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



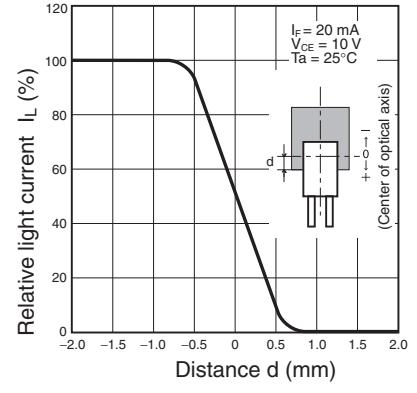
Dark Current vs. Ambient Temperature Characteristics (Typical)



Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)

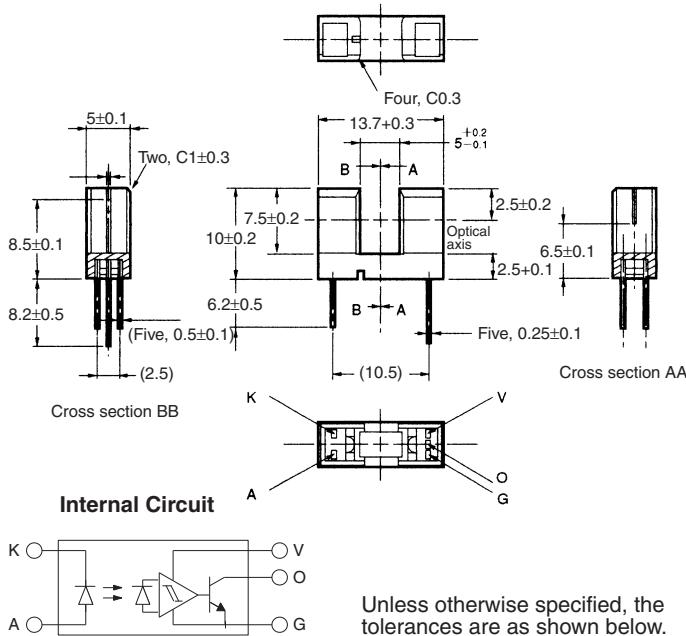


Photomicrosensor (Transmissive) EE-SX3081/-SX4081

⚠ Be sure to read *Precautions* on page 24.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Unless otherwise specified, the tolerances are as shown below.

Terminal No.	Name
A	Anode
K	Cathode
V	Power supply (Vcc)
O	Output (OUT)
G	Ground (GND)

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

■ Features

- Incorporates an IC chip with a built-in detector element and amplifier.
- Incorporates a detector element with a built-in temperature compensation circuit.
- A wide supply voltage range: 4.5 to 16 VDC
- Directly connects with C-MOS and TTL.
- High resolution with a 0.5-mm-wide sensing aperture.
- Dark ON model (EE-SX3081)
- Light ON model (EE-SX4081)

■ Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rated value
Emitter	Forward current	I_F 50 mA (see note 1)
	Reverse voltage	V_R 4 V
Detector	Power supply voltage	V_{CC} 16 V
	Output voltage	V_{OUT} 28 V
	Output current	I_{OUT} 16 mA
	Permissible output dissipation	P_{OUT} 250 mW (see note 1)
Ambient temperature	Operating	T_{OPR} -40°C to 75°C
	Storage	T_{STG} -40°C to 85°C
Soldering temperature	T_{SOL}	260°C (see note 2)

Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

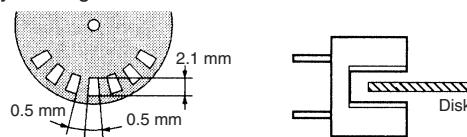
2. Complete soldering within 10 seconds.

■ Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F 1.2 V typ., 1.5 V max.	$I_F = 20 \text{ mA}$
	Reverse current	I_R 0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P 940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Low-level output voltage	V_{OL} 0.12 V typ., 0.4 V max.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_{OL} = 16 \text{ mA}$, $I_F = 0 \text{ mA}$ (EE-SX3081), $I_F = 8 \text{ mA}$ (EE-SX4081)
	High-level output voltage	V_{OH} 15 V min.	$V_{CC} = 16 \text{ V}$, $R_L = 1 \text{ k}\Omega$, $I_F = 8 \text{ mA}$ (EE-SX3081), $I_F = 0 \text{ mA}$ (EE-SX4081)
	Current consumption	I_{CC} 3.2 mA typ., 10 mA max.	$V_{CC} = 16 \text{ V}$
	Peak spectral sensitivity wavelength	λ_P 870 nm typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$
LED current when output is OFF	I_{FT}	8 mA max.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$
LED current when output is ON			
Hysteresis	ΔH	15% typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$ (see note 1)
Response frequency	f	3 kHz min.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_F = 20 \text{ mA}$, $I_{OL} = 16 \text{ mA}$ (see note 2)
Response delay time	t_{PLH} (t_{PHL})	3 μs typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_F = 20 \text{ mA}$, $I_{OL} = 16 \text{ mA}$ (see note 3)
Response delay time	t_{PHL} (t_{PLH})	20 μs typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_F = 20 \text{ mA}$, $I_{OL} = 16 \text{ mA}$ (see note 3)

Note: 1. Hysteresis denotes the difference in forward LED current value, expressed in percentage, calculated from the respective forward LED currents when the photo IC is turned from ON to OFF and when the photo IC is turned from OFF to ON.

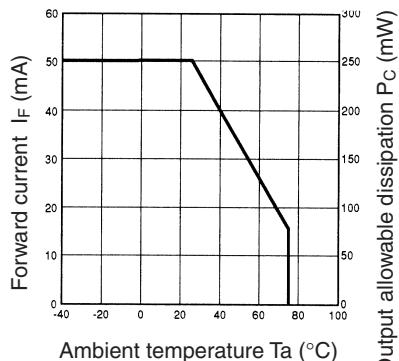
2. The value of the response frequency is measured by rotating the disk as shown below.



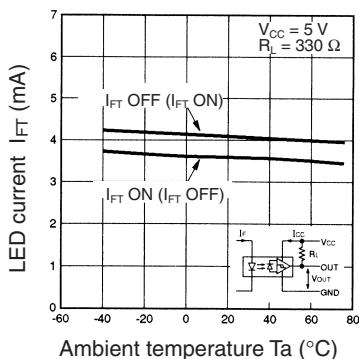
■ Engineering Data

Note: The values in the parentheses apply to the EE-SX4081.

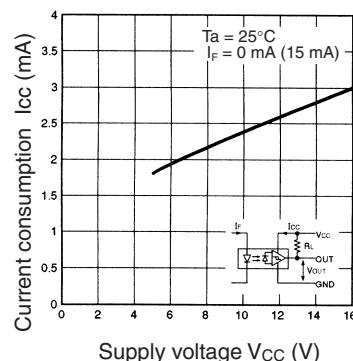
Forward Current vs. Collector Dissipation Temperature Rating



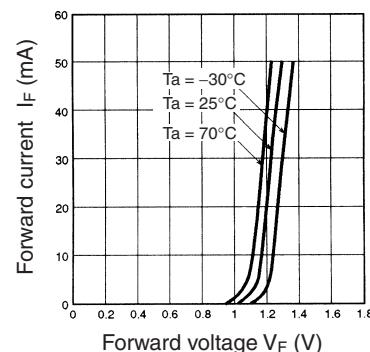
LED Current vs. Ambient Temperature Characteristics (Typical)



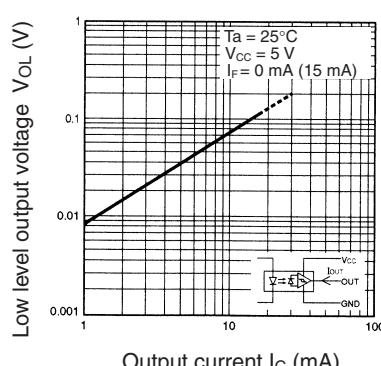
Current Consumption vs. Supply Voltage (Typical)



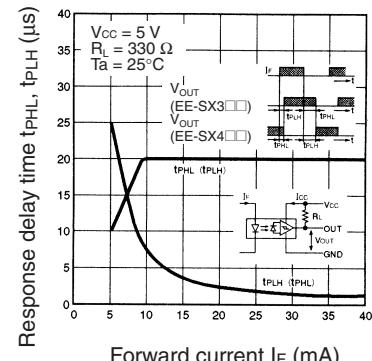
Forward Current vs. Forward Voltage Characteristics (Typical)



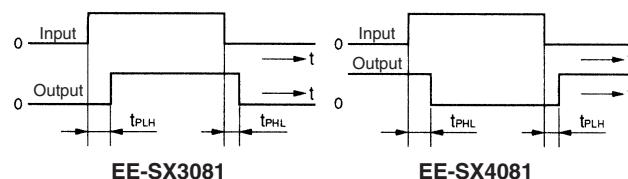
Low-level Output Voltage vs. Output Current (Typical)



Response Delay Time vs. Forward Current (Typical)



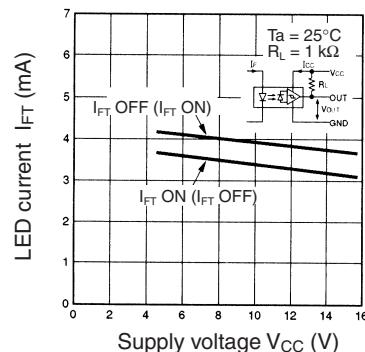
3. The following illustrations show the definition of response delay time. The value in the parentheses applies to the EE-SX4081.



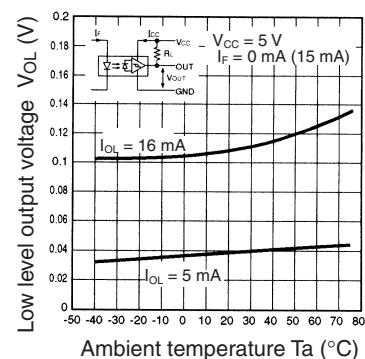
EE-SX3081

EE-SX4081

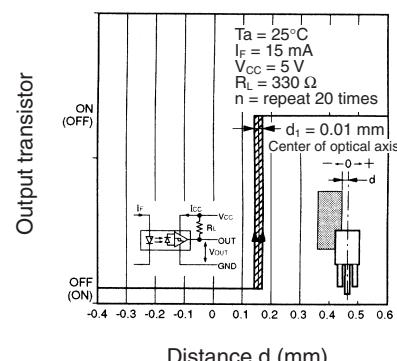
LED Current vs. Supply Voltage (Typical)



Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



Repeat Sensing Position Characteristics (Typical)

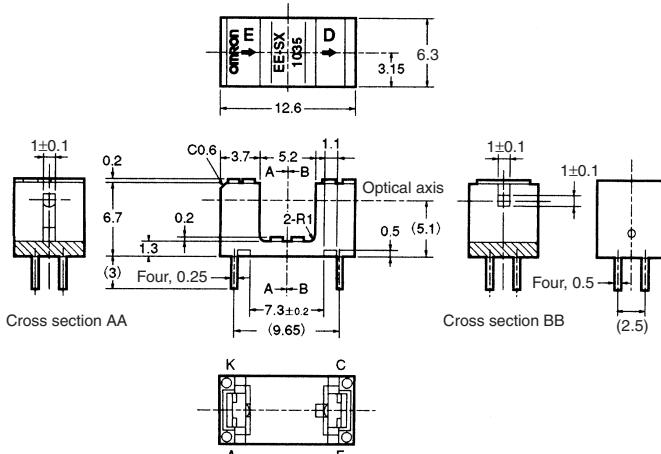


Photomicrosensor (Transmissive) EE-SX1035

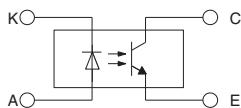
⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	± 0.2
$3 < \text{mm} \leq 6$	± 0.24
$6 < \text{mm} \leq 10$	± 0.29
$10 < \text{mm} \leq 18$	± 0.35
$18 < \text{mm} \leq 30$	± 0.42

Features

- Compact model with a 5.2-mm-wide slot.
- PCB mounting type.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rated value
Emitter	Forward current	I_F 50 mA (see note 1)
	Pulse forward current	I_{FP} 1 A (see note 2)
	Reverse voltage	V_R 4 V
Detector	Collector-Emitter voltage	V_{CEO} 30 V
	Emitter-Collector voltage	V_{ECO} 5 V
	Collector current	I_C 20 mA
	Collector dissipation	P_C 100 mW (see note 1)
Ambient temperature	Operating	T_{opr} -25°C to 85°C
	Storage	T_{stg} -30°C to 100°C
Soldering temperature		T_{sol} 260°C (see note 3)

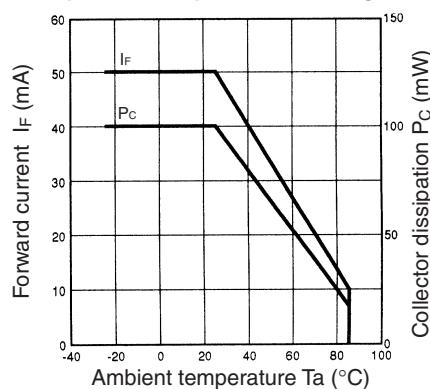
- Note:
- Refer to the temperature rating chart if the ambient temperature exceeds 25°C .
 - The pulse width is 10 μs maximum with a frequency of 100 Hz.
 - Complete soldering within 10 seconds.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

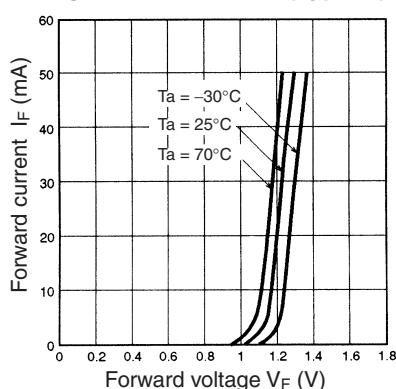
Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F 1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R 0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P 940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L 0.5 mA min.	$I_F = 20 \text{ mA}, V_{CE} = 10 \text{ V}$
	Dark current	I_D 2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lx}$
	Leakage current	I_{LEAK} ---	---
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$ 0.15 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 0.1 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_P 850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time	tr	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$
Falling time	tf	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$

■ Engineering Data

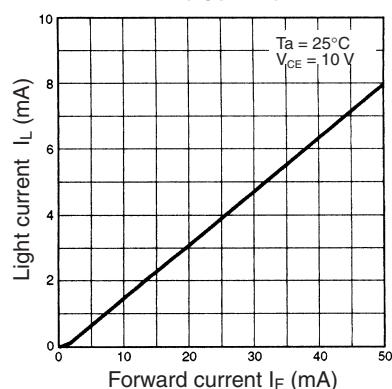
Forward Current vs. Collector Dissipation Temperature Rating



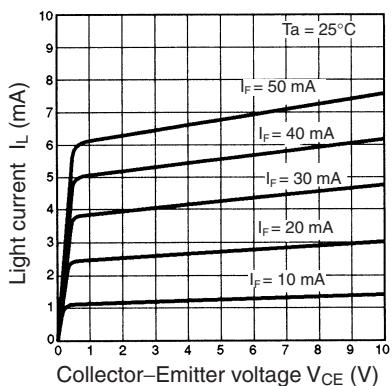
Forward Current vs. Forward Voltage Characteristics (Typical)



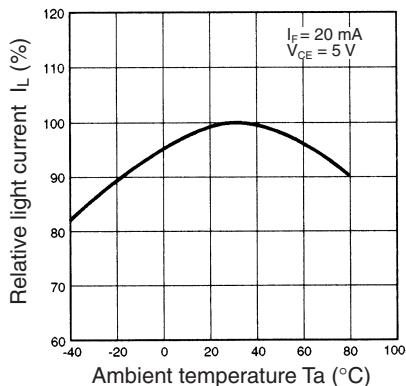
Light Current vs. Forward Current Characteristics (Typical)



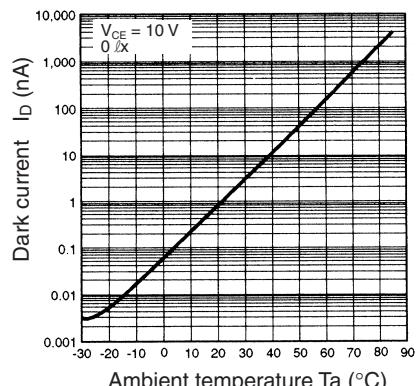
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



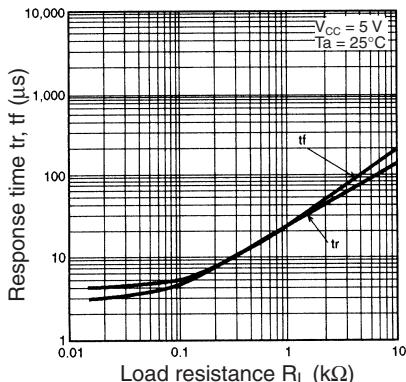
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



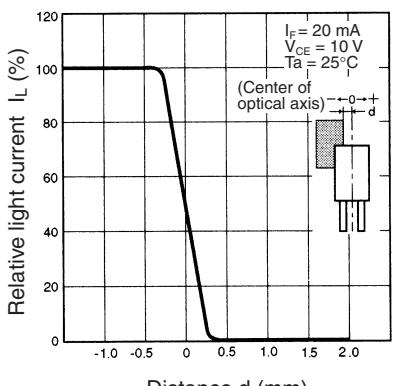
Dark Current vs. Ambient Temperature Characteristics (Typical)



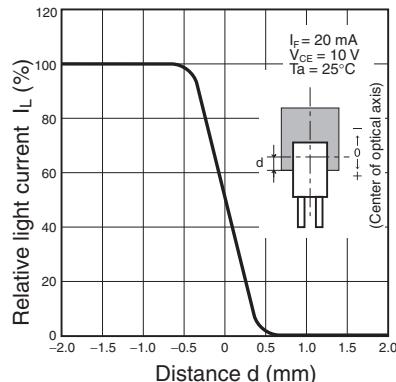
Response Time vs. Load Resistance Characteristics (Typical)



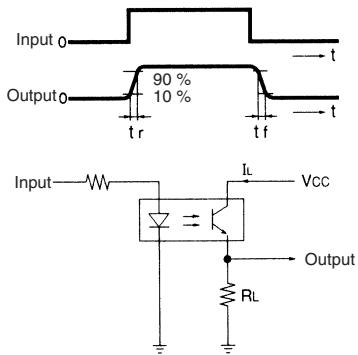
Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)



Response Time Measurement Circuit

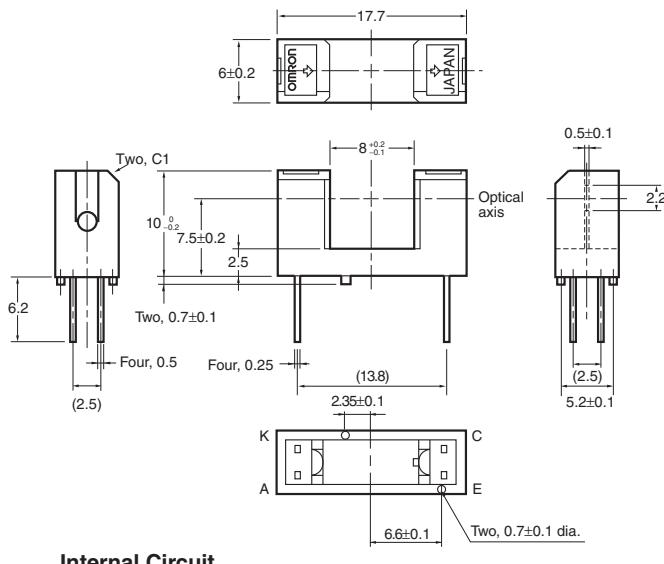


Photomicrosensor (Transmissive) EE-SX1070

⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	± 0.3
$3 < \text{mm} \leq 6$	± 0.375
$6 < \text{mm} \leq 10$	± 0.45
$10 < \text{mm} \leq 18$	± 0.55
$18 < \text{mm} \leq 30$	± 0.65

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

Item	Symbol	Value	Condition
Emitter	V_F	1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	I_R	0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	λ_P	940 nm typ.	$I_F = 20 \text{ mA}$
Detector	I_L	0.5 mA min., 14 mA max.	$I_F = 20 \text{ mA}, V_{CE} = 10 \text{ V}$
	I_D	2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lx}$
	I_{LEAK}	---	---
	$V_{CE} (\text{sat})$	0.1 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 0.1 \text{ mA}$
	λ_P	850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time	t_r	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$
Falling time	t_f	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$

Features

- Wide model with a 8-mm-wide slot.
- PCB mounting type.
- High resolution with a 0.5-mm-wide aperture.

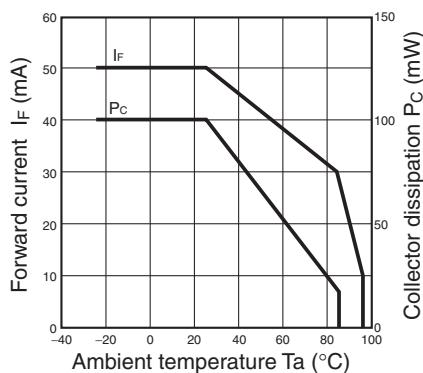
Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Pulse forward current	I_{FP}	1 A (see note 2)
	Reverse voltage	V_R	4 V
Detector	Collector-Emitter voltage	V_{CEO}	30 V
	Emitter-Collector voltage	V_{ECO}	---
	Collector current	I_C	20 mA
	Collector dissipation	P_C	100 mW (see note 1)
Ambient temperature	Operating	T_{opr}	-25°C to 95°C
	Storage	T_{stg}	-30°C to 100°C
Soldering temperature		T_{sol}	260°C (see note 3)

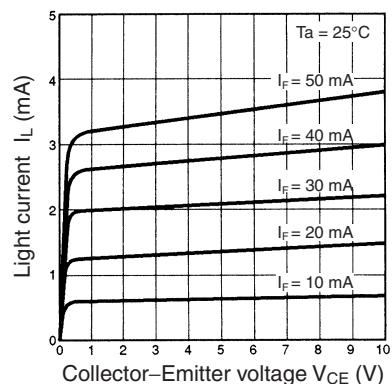
- Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
 3. Complete soldering within 10 seconds.

■ Engineering Data

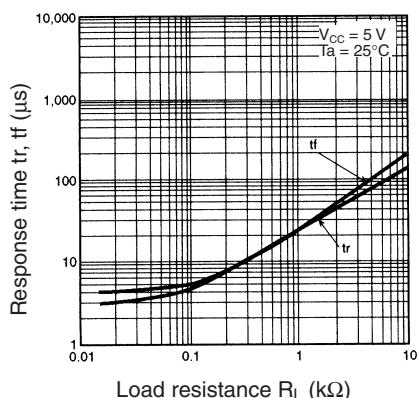
Forward Current vs. Collector Dissipation Temperature Rating



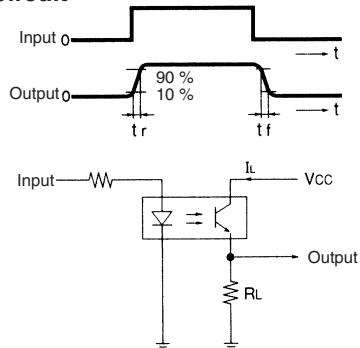
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



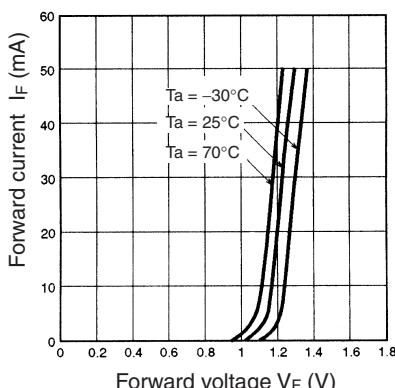
Response Time vs. Load Resistance Characteristics (Typical)



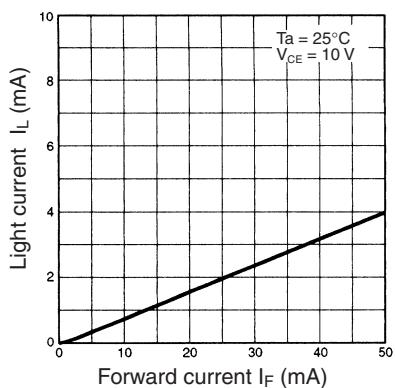
Response Time Measurement Circuit



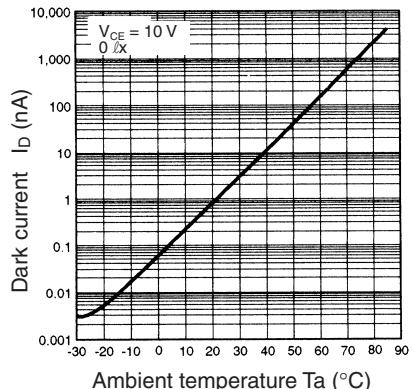
Forward Current vs. Forward Voltage Characteristics (Typical)



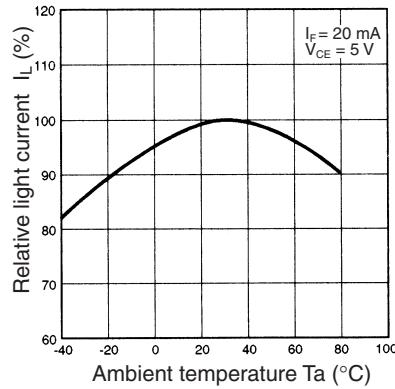
Light Current vs. Forward Current Characteristics (Typical)



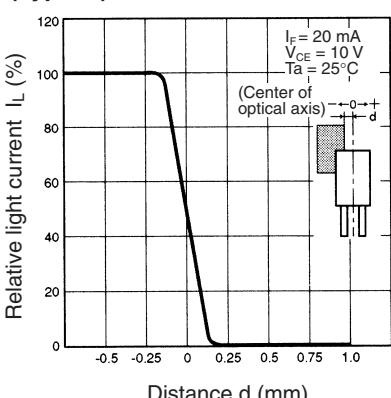
Dark Current vs. Ambient Temperature Characteristics (Typical)



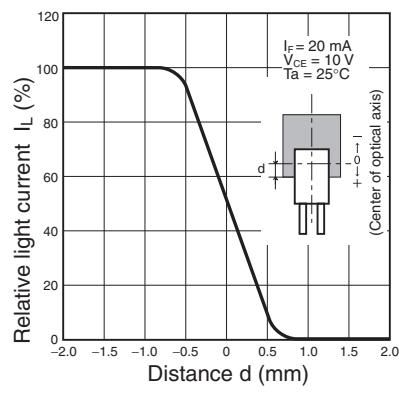
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)

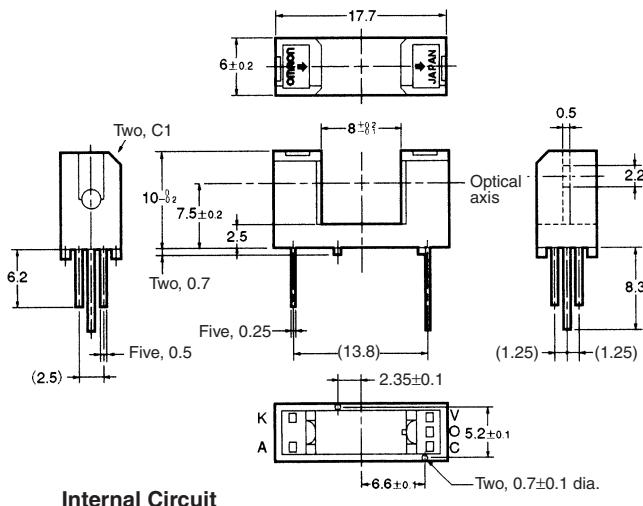


Photomicrosensor (Transmissive) EE-SX3070/-SX4070

⚠ Be sure to read *Precautions* on page 24.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Unless otherwise specified, the tolerances are as shown below.

Terminal No.	Name
A	Anode
K	Cathode
V	Power supply (Vcc)
O	Output (OUT)
G	Ground (GND)

Dimensions	Tolerance
3 mm max.	± 0.3
$3 < \text{mm} \leq 6$	± 0.375
$6 < \text{mm} \leq 10$	± 0.45
$10 < \text{mm} \leq 18$	± 0.55
$18 < \text{mm} \leq 30$	± 0.65

■ Features

- Incorporates an IC chip with a built-in detector element and amplifier.
- Incorporates a detector element with a built-in temperature compensation circuit.
- A wide supply voltage range: 4.5 to 16 VDC
- Directly connects with C-MOS and TTL.
- High resolution with a 0.5-mm-wide sensing aperture.
- Dark ON model (EE-SX3070)
- Light ON model (EE-SX4070)

■ Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Reverse voltage	V_R	4 V
Detector	Power supply voltage	V_{CC}	16 V
	Output voltage	V_{OUT}	28 V
	Output current	I_{OUT}	16 mA
Ambient temperature	Permissible output dissipation	P_{OUT}	250 mW (see note 1)
	Operating	T_{OPR}	-40°C to 75°C
	Storage	T_{STG}	-40°C to 85°C
Soldering temperature		T_{SOL}	260°C (see note 2)

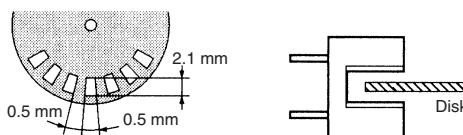
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. Complete soldering within 10 seconds.

■ Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

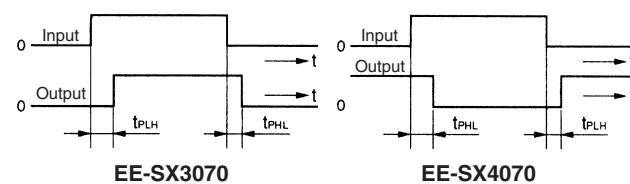
Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.
	Reverse current	I_R	0.01 μA typ., 10 μA max.
	Peak emission wavelength	λ_P	940 nm typ.
Detector	Low-level output voltage	V_{OL}	$V_{CC} = 4.5$ to 16 V, $I_{OL} = 16$ mA, $I_F = 0$ mA (EE-SX3070), $I_F = 10$ mA (EE-SX4070)
	High-level output voltage	V_{OH}	$V_{CC} = 16$ V, $R_L = 1$ k Ω , $I_F = 10$ mA (EE-SX3070), $I_F = 0$ mA (EE-SX4070)
	Current consumption	I_{CC}	$V_{CC} = 16$ V
	Peak spectral sensitivity wavelength	λ_P	$V_{CC} = 4.5$ to 16 V
LED current when output is OFF	I_{FT}	10 mA max.	$V_{CC} = 4.5$ to 16 V
LED current when output is ON			
Hysteresis	ΔH	15% typ.	$V_{CC} = 4.5$ to 16 V (see note 1)
Response frequency	f	3 kHz min.	$V_{CC} = 4.5$ to 16 V, $I_F = 20$ mA, $I_{OL} = 16$ mA (see note 2)
Response delay time	t_{PLH} (t_{PHL})	3 μs typ.	$V_{CC} = 4.5$ to 16 V, $I_F = 20$ mA, $I_{OL} = 16$ mA (see note 3)
Response delay time	t_{PHL} (t_{PLH})	20 μs typ.	$V_{CC} = 4.5$ to 16 V, $I_F = 20$ mA, $I_{OL} = 16$ mA (see note 3)

Note: 1. Hysteresis denotes the difference in forward LED current value, expressed in percentage, calculated from the respective forward LED currents when the photo IC is turned from ON to OFF and when the photo IC is turned from OFF to ON.

2. The value of the response frequency is measured by rotating the disk as shown below.



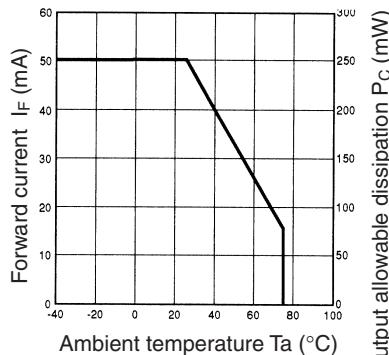
3. The following illustrations show the definition of response delay time. The value in the parentheses applies to the EE-SX4070.



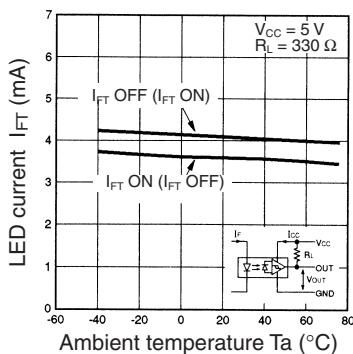
■ Engineering Data

Note: The values in the parentheses apply to the EE-SX4070.

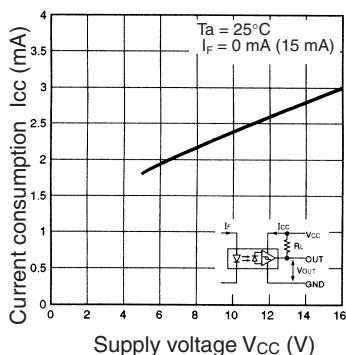
Forward Current vs. Collector Dissipation Temperature Rating



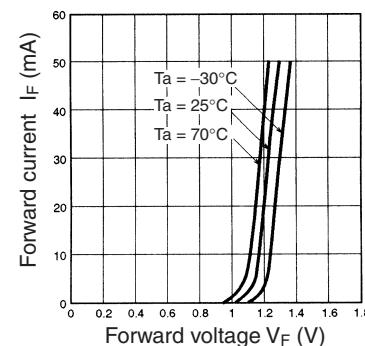
LED Current vs. Ambient Temperature Characteristics (Typical)



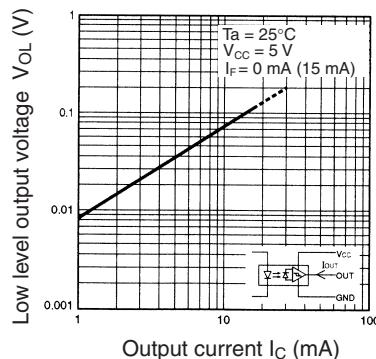
Current Consumption vs. Supply Voltage (Typical)



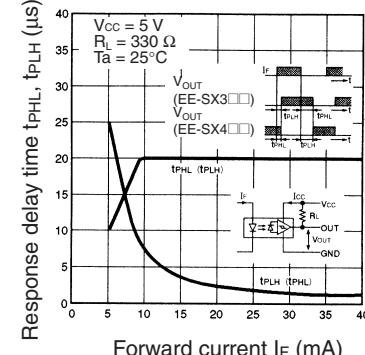
Forward Current vs. Forward Voltage Characteristics (Typical)



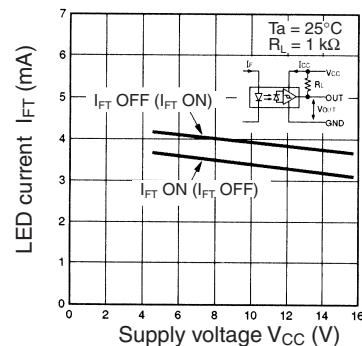
Low-level Output Voltage vs. Output Current (Typical)



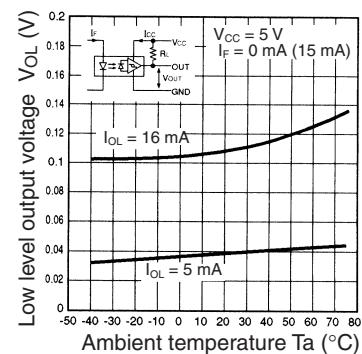
Response Delay Time vs. Forward Current (Typical)



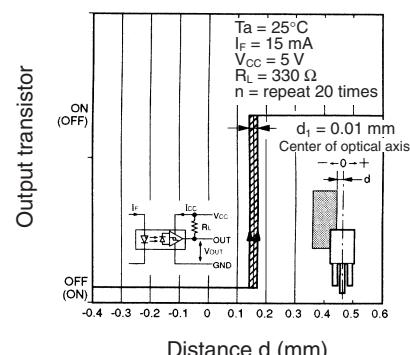
LED Current vs. Supply Voltage (Typical)



Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



Repeat Sensing Position Characteristics (Typical)

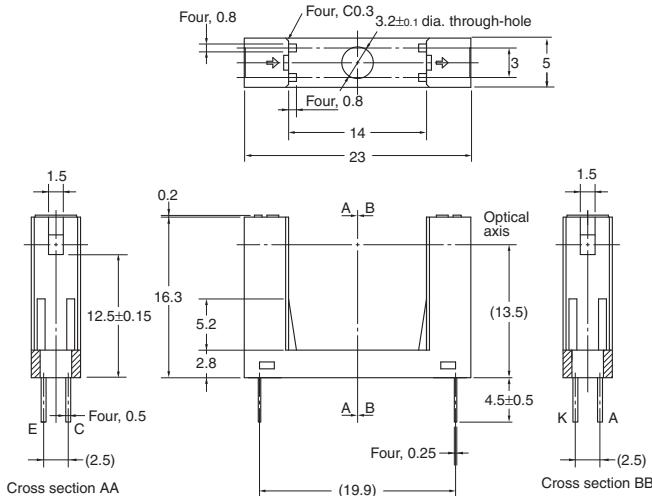


Photomicrosensor (Transmissive) EE-SX1140

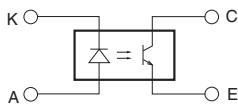
⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Features

- General-purpose model with a 14-mm-wide slot.
- 16.3-mm-tall model with a deep slot.
- PCB mounting type.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Pulse forward current	I_{FP}	1 A (see note 2)
	Reverse voltage	V_R	4 V
Detector	Collector-Emitter voltage	V_{CEO}	30 V
	Emitter-Collector voltage	V_{ECO}	---
	Collector current	I_C	20 mA
	Collector dissipation	P_C	100 mW (see note 1)
Ambient temperature	Operating	T_{opr}	-25°C to 85°C
	Storage	T_{stg}	-30°C to 100°C
Soldering temperature		T_{sol}	260°C (see note 3)

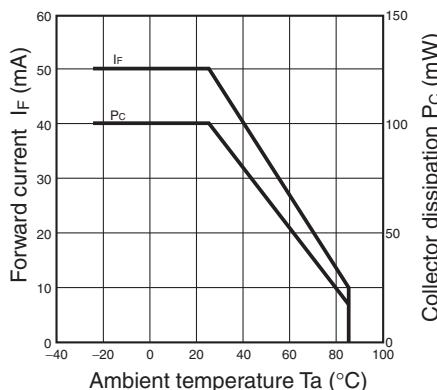
- Note:
- Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 - The pulse width is 10 μs maximum with a frequency of 100 Hz.
 - Complete soldering within 10 seconds.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

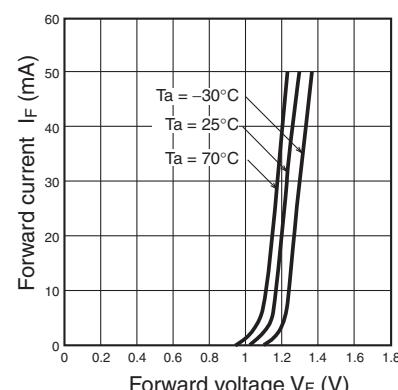
	Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P	940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L	0.4 mA min.	$I_F = 20 \text{ mA}, V_{CE} = 10 \text{ V}$
	Dark current	I_D	2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lux}$
	Leakage current	I_{LEAK}	---	---
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$	0.1 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 0.1 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time		t_r	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$
Falling time		t_f	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$

■ Engineering Data

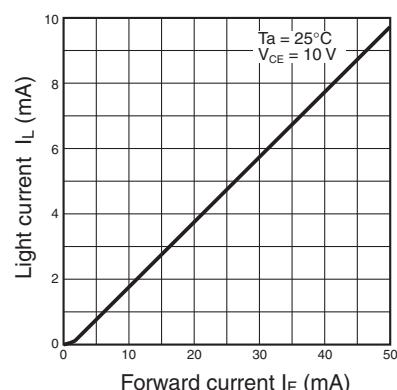
Forward Current vs. Collector Dissipation Temperature Rating



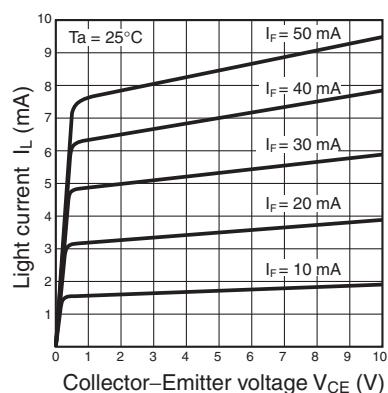
Forward Current vs. Forward Voltage Characteristics (Typical)



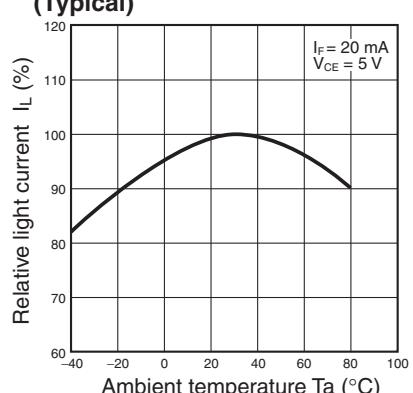
Light Current vs. Forward Current Characteristics (Typical)



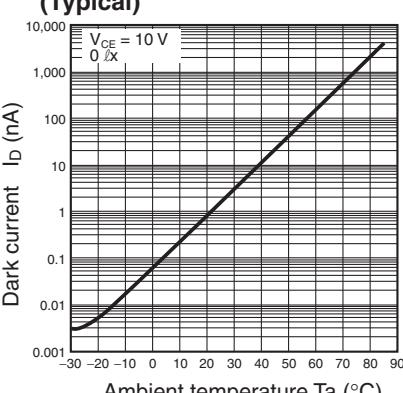
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



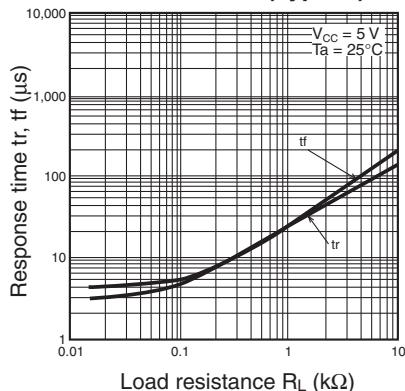
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



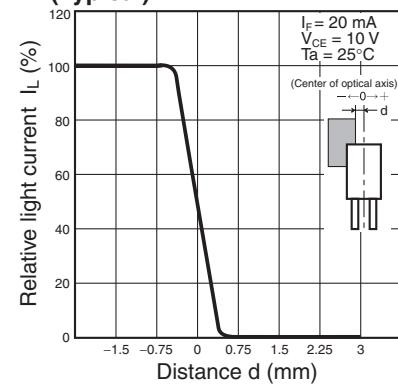
Dark Current vs. Ambient Temperature Characteristics (Typical)



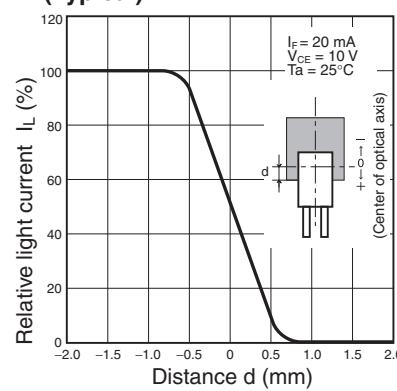
Response Time vs. Load Resistance Characteristics (Typical)



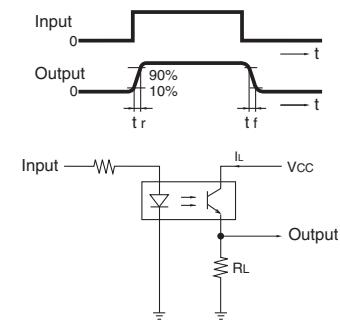
Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)



Response Time Measurement Circuit

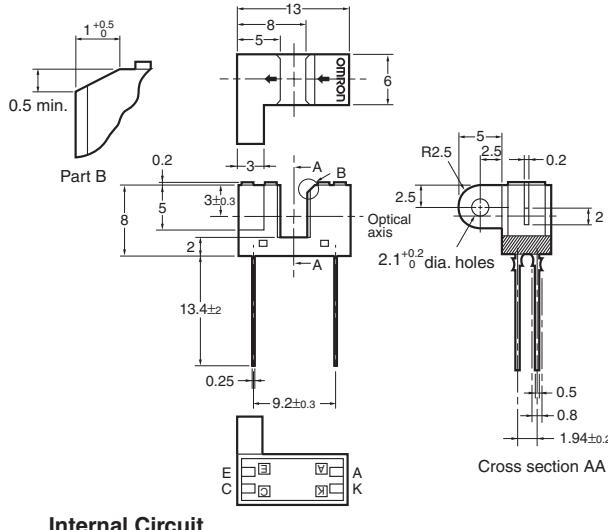


Photomicrosensor (Transmissive) EE-SX129

⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

Features

- High-resolution model with a 0.2-mm-wide sensing aperture.
- PCB mounting type.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rated value
Emitter	Forward current	I_F 50 mA (see note 1)
	Pulse forward current	I_{FP} 1 A (see note 2)
	Reverse voltage	V_R 4 V
Detector	Collector-Emitter voltage	V_{CEO} 30 V
	Emitter-Collector voltage	V_{ECO} ---
	Collector current	I_C 20 mA
	Collector dissipation	P_c 100 mW (see note 1)
Ambient temperature	Operating	T_{opr} -25°C to 85°C
	Storage	T_{stg} -40°C to 100°C
Soldering temperature		T_{sol} 260°C (see note 3)

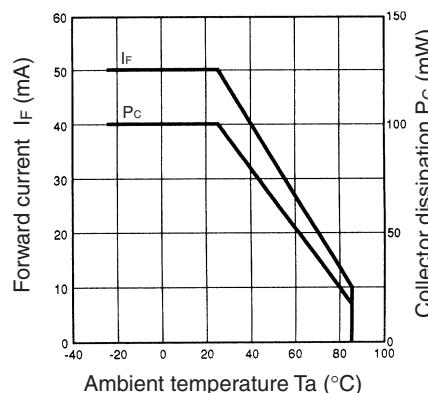
- Note:
- Refer to the temperature rating chart if the ambient temperature exceeds 25°C .
 - The pulse width is 10 μs maximum with a frequency of 100 Hz.
 - Complete soldering within 10 seconds.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

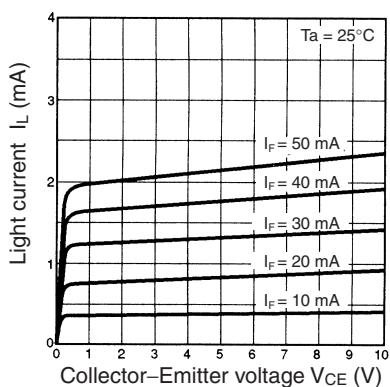
Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F 1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R 0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_p 920 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L 0.2 mA min.	$I_F = 20 \text{ mA}, V_{CE} = 10 \text{ V}$
	Dark current	I_D 2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lx}$
	Leakage current	I_{LEAK} ---	---
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$ ---	---
	Peak spectral sensitivity wavelength	λ_p 850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time	tr	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$
Falling time	tf	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$

■ Engineering Data

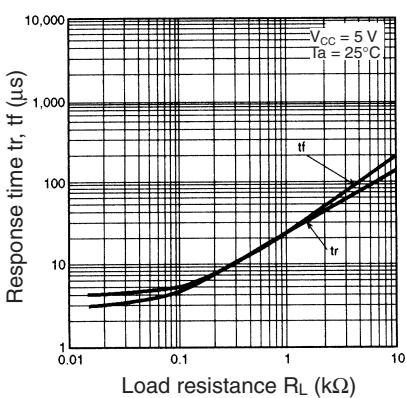
Forward Current vs. Collector Dissipation Temperature Rating



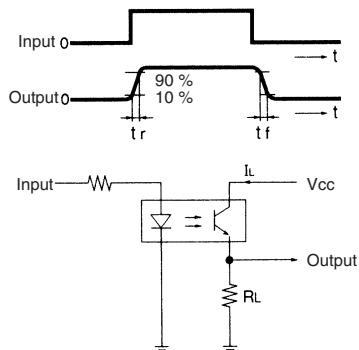
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



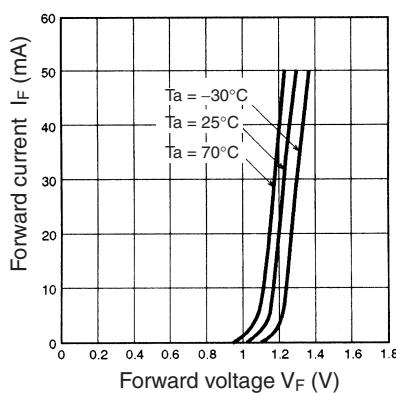
Response Time vs. Load Resistance Characteristics (Typical)



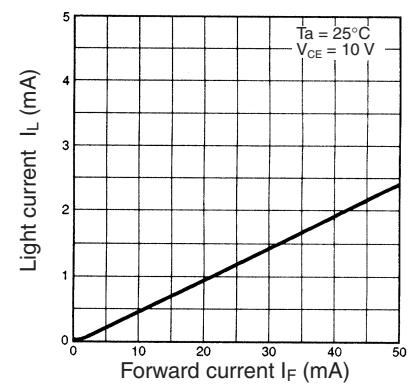
Response Time Measurement Circuit



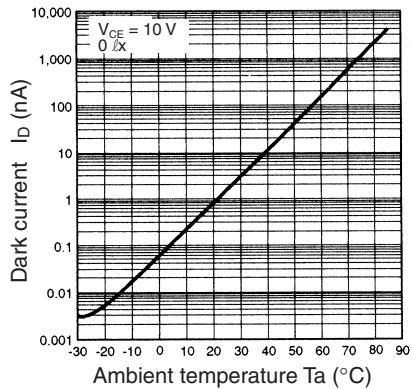
Forward Current vs. Forward Voltage Characteristics (Typical)



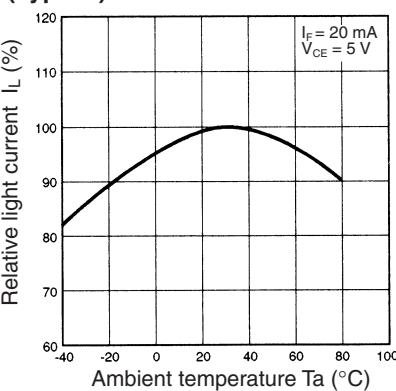
Light Current vs. Forward Current Characteristics (Typical)



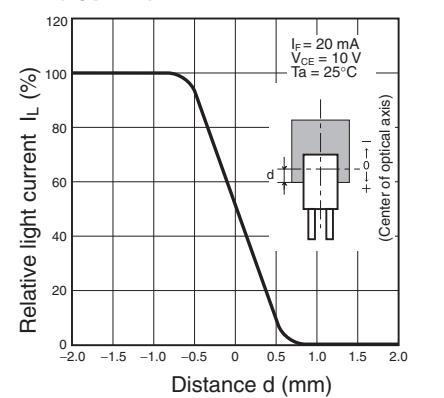
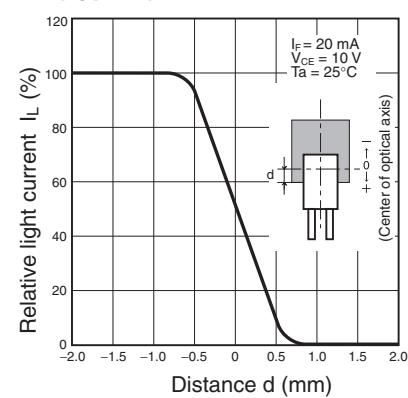
Dark Current vs. Ambient Temperature Characteristics (Typical)



Relative Light Current vs. Ambient Temperature Characteristics (Typical)



Sensing Position Characteristics (Typical)

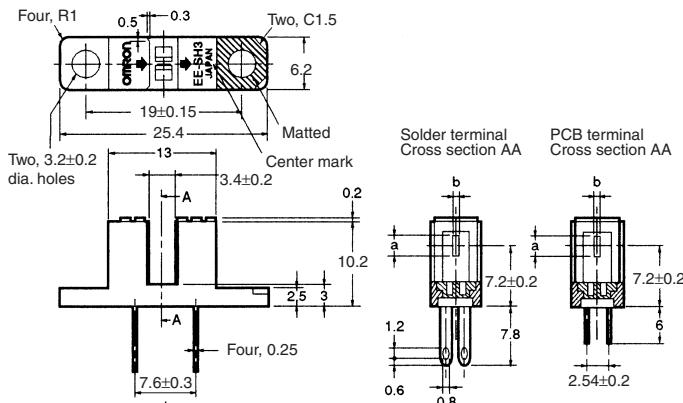


Photomicrosensor (Transmissive) EE-SH3 Series

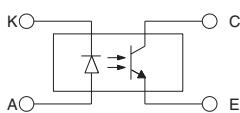
⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	± 0.2
$3 < \text{mm} \leq 6$	± 0.24
$6 < \text{mm} \leq 10$	± 0.29
$10 < \text{mm} \leq 18$	± 0.35
$18 < \text{mm} \leq 30$	± 0.42

Features

- High-resolution model with a 0.2-mm-wide or 0.5-mm-wide sensing aperture, high-sensitivity model with a 1-mm-wide sensing aperture, and model with a horizontal sensing aperture are available.
- Solder terminal models:
EE-SH3/-SH3-CS/-SH3-DS/-SH3-GS
- PCB terminal models:
EE-SH3-B/-SH3-C/-SH3-D/-SH3-G

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rated value
Emitter	Forward current	I_F 50 mA (see note 1)
	Pulse forward current	I_{FP} 1 A (see note 2)
	Reverse voltage	V_R 4 V
Detector	Collector-Emitter voltage	V_{CEO} 30 V
	Emitter-Collector voltage	V_{ECO} ---
	Collector current	I_C 20 mA
	Collector dissipation	P_C 100 mW (see note 1)
Ambient temperature	Operating	T_{opr} -25°C to 85°C
	Storage	T_{stg} -30°C to 100°C
Soldering temperature	T_{sol}	260°C (see note 3)

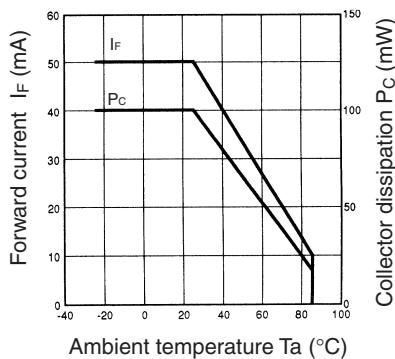
- Note:**
- Refer to the temperature rating chart if the ambient temperature exceeds 25°C .
 - The pulse width is 10 μs maximum with a frequency of 100 Hz.
 - Complete soldering within 10 seconds.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

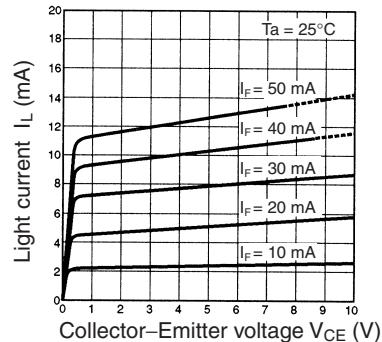
Item	Symbol	Value				Condition
		EE-SH3(-B)	EE-SH3-C(S)	EE-SH3-D(S)	EE-SH3-G(S)	
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.			$I_F = 30 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.			$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P	940 nm typ.			$I_F = 20 \text{ mA}$
Detector	Light current	I_L	0.5 to 14 mA typ.	1 to 28 mA typ.	0.1 mA min.	0.5 to 14 mA
	Dark current	I_D	2 nA typ., 200 nA max.			$V_{CE} = 10 \text{ V}$, 0 lux
	Leakage current	I_{LEAK}	---			---
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$	0.1 V typ., 0.4 V max.	---	0.1 V typ., 0.4 V max.	$I_F = 20 \text{ mA}$, $I_L = 0.1 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.			$V_{CE} = 10 \text{ V}$
Rising time	t_r	4 μs typ.				$V_{CC} = 5 \text{ V}$, $R_L = 100 \Omega$, $I_L = 5 \text{ mA}$
Falling time	t_f	4 μs typ.				

■ Engineering Data

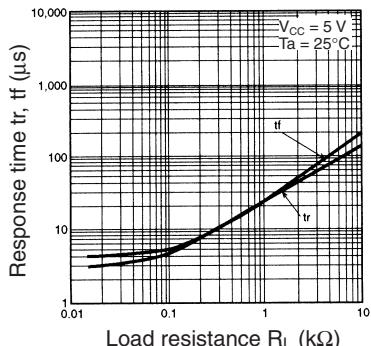
Forward Current vs. Collector Dissipation Temperature Rating



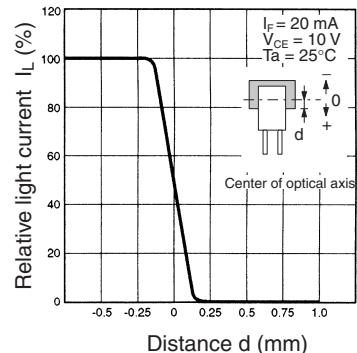
Light Current vs. Collector-Emitter Voltage Characteristics (EE-SH3-(B))



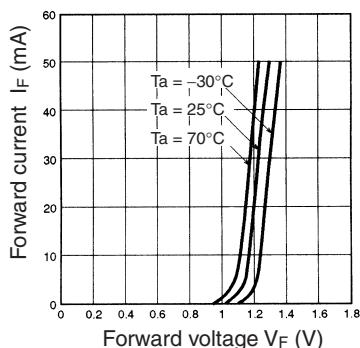
Response Time vs. Load Resistance Characteristics (Typical)



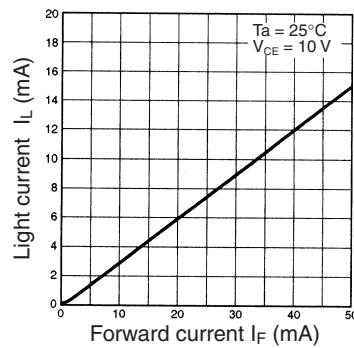
Sensing Position Characteristics (EE-SH3-G(S))



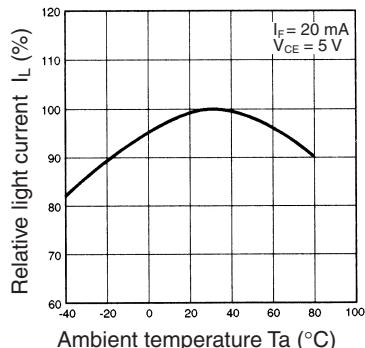
Forward Current vs. Forward Voltage Characteristics (Typical)



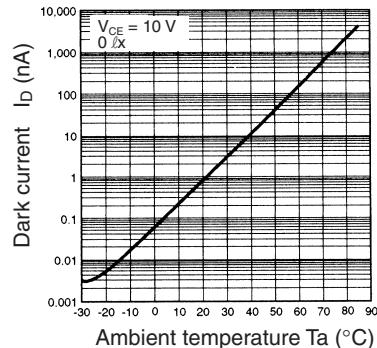
Light Current vs. Forward Current Characteristics (Typical)



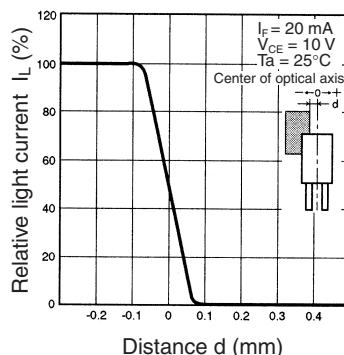
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



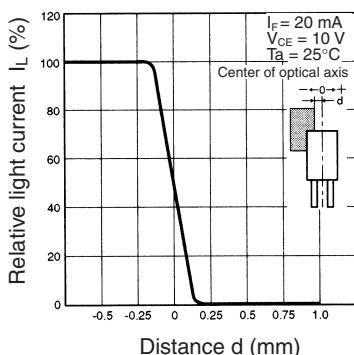
Dark Current vs. Ambient Temperature Characteristics (Typical)



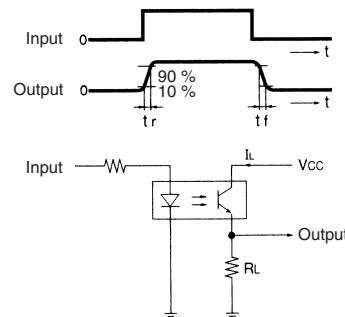
Sensing Position Characteristics (EE-SH3-D(S))



Sensing Position Characteristics (EE-SH3-B)



Response Time Measurement Circuit

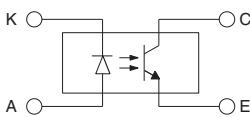
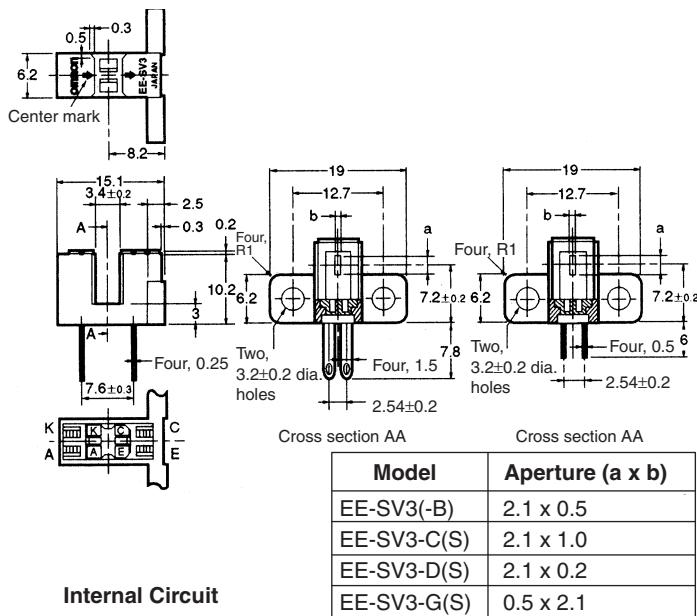


Photomicrosensor (Transmissive) EE-SV3 Series

⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.2
3 < mm ≤ 6	±0.24
6 < mm ≤ 10	±0.29
10 < mm ≤ 18	±0.35
18 < mm ≤ 30	±0.42

Features

- High-resolution model with a 0.2-mm-wide or 0.5-mm-wide sensing aperture, high-sensitivity model with a 1-mm-wide sensing aperture, and model with a horizontal sensing aperture are available.
- Solder terminal models:
EE-SV3/-SV3-CS/-SV3-DS/-SV3-GS
- PCB terminal models
EE-SV3-B/-SV3-C/-SV3-D/-SV3-G

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rated value
Emitter	Forward current	I_F 50 mA (see note 1)
	Pulse forward current	I_{FP} 1 A (see note 2)
	Reverse voltage	V_R 4 V
Detector	Collector-Emitter voltage	V_{CEO} 30 V
	Emitter-Collector voltage	V_{ECO} ---
	Collector current	I_C 20 mA
	Collector dissipation	P_c 100 mW (see note 1)
Ambient temperature	Operating	T_{opr} -25°C to 85°C
	Storage	T_{stg} -30°C to 100°C
Soldering temperature	T_{sol}	260°C (see note 3)

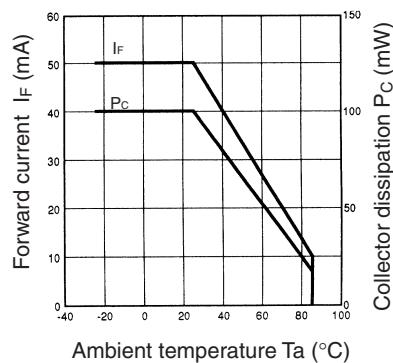
- Note:
- Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 - The pulse width is 10 μs maximum with a frequency of 100 Hz.
 - Complete soldering within 10 seconds.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

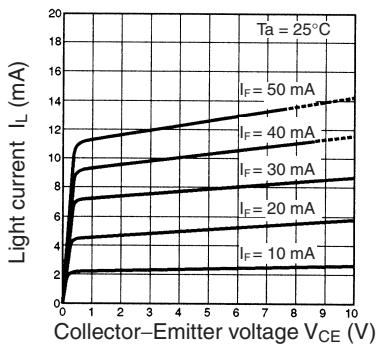
Item	Symbol	Value				Condition
		EE-SV3(-B)	EE-SV3-C(S)	EE-SV3-D(S)	EE-SV3-G(S)	
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.			$I_F = 30 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.			$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_p	940 nm typ.			$I_F = 20 \text{ mA}$
Detector	Light current	I_L	0.5 to 14 mA	1 to 28 mA	0.1 mA min.	0.5 to 14 mA
	Dark current	I_D	2 nA typ., 200 nA max.			$V_{CE} = 10 \text{ V}$, $0 \text{ } \Omega$
	Leakage current	I_{LEAK}	---			---
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$	0.1 V typ., 0.4 V max.	---	0.1 V typ., 0.4 V max.	$I_F = 20 \text{ mA}$, $I_L = 0.1 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_p	850 nm typ.			$V_{CE} = 10 \text{ V}$
Rising time	t_r	4 μs typ.				$V_{CC} = 5 \text{ V}$, $R_L = 100 \text{ } \Omega$
Falling time	t_f	4 μs typ.				$I_L = 5 \text{ mA}$

■ Engineering Data

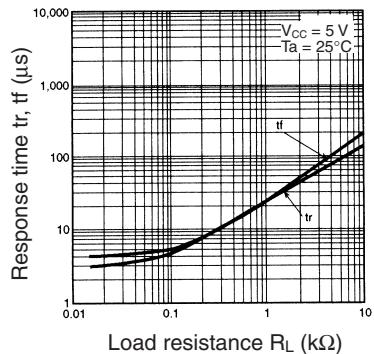
Forward Current vs. Collector Dissipation Temperature Rating



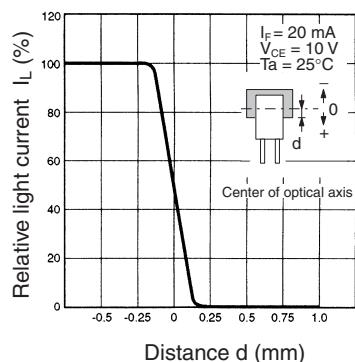
Light Current vs. Collector-Emitter Voltage Characteristics (EE-SV3-(B))



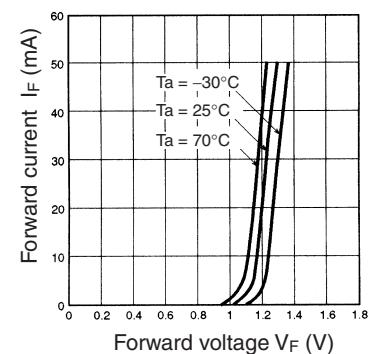
Response Time vs. Load Resistance Characteristics (Typical)



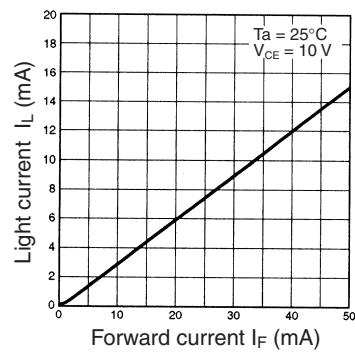
Sensing Position Characteristics (EE-SV3-G(S))



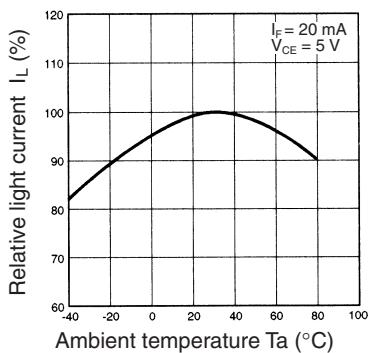
Forward Current vs. Forward Voltage Characteristics (Typical)



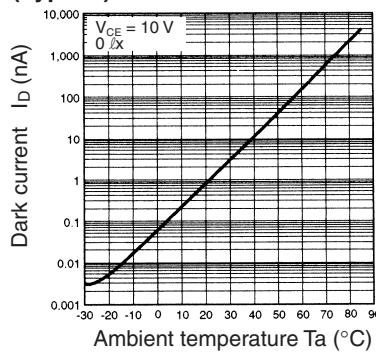
Light Current vs. Forward Current Characteristics (Typical)



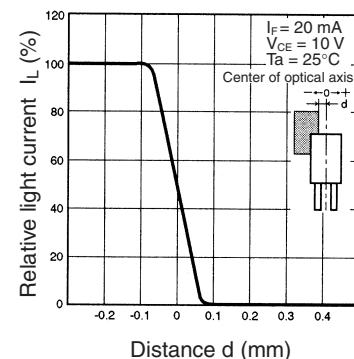
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



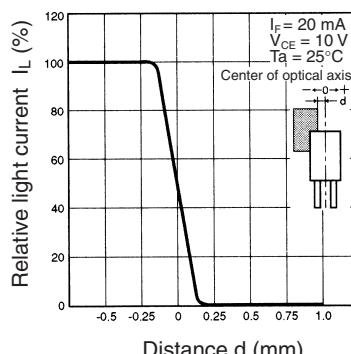
Dark Current vs. Ambient Temperature Characteristics (Typical)



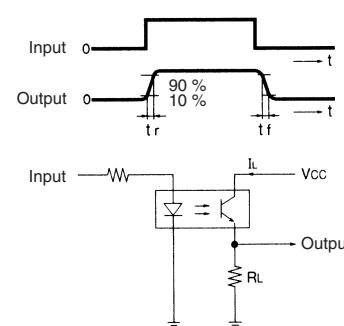
Sensing Position Characteristics (EE-SV3-D(S))



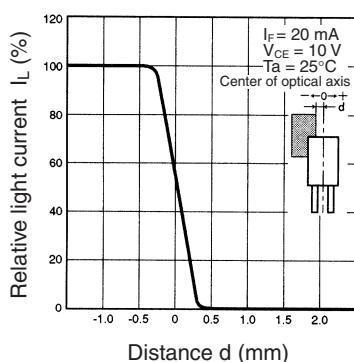
Sensing Position Characteristics (EE-SV3-(B))



Response Time Measurement Circuit



Sensing Position Characteristics (EE-SV3-C(S))

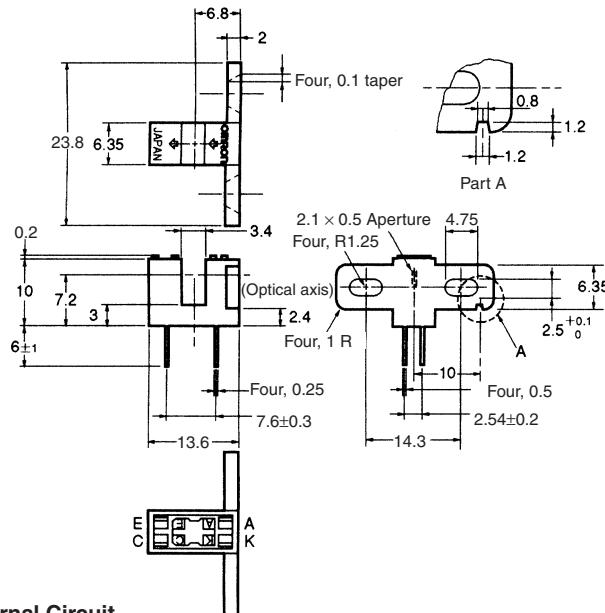


Photomicrosensor (Transmissive) EE-SX138

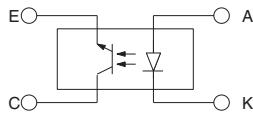
⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.2
3 < mm ≤ 6	±0.24
6 < mm ≤ 10	±0.29
10 < mm ≤ 18	±0.35
18 < mm ≤ 30	±0.42

Features

- General-purpose model with a 3.4-mm-wide slot.
- PCB mounting type.
- High resolution with a 0.5-mm-wide aperture.
- Screw-mounting possible.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Pulse forward current	I_{FP}	1 A (see note 2)
	Reverse voltage	V_R	4 V
Detector	Collector-Emitter voltage	V_{CEO}	30 V
	Emitter-Collector voltage	V_{ECO}	---
	Collector current	I_C	20 mA
	Collector dissipation	P_C	100 mW (see note 1)
Ambient temperature	Operating	T_{opr}	-25°C to 85°C
	Storage	T_{stg}	-40°C to 100°C
Soldering temperature		T_{sol}	260°C (see note 3)

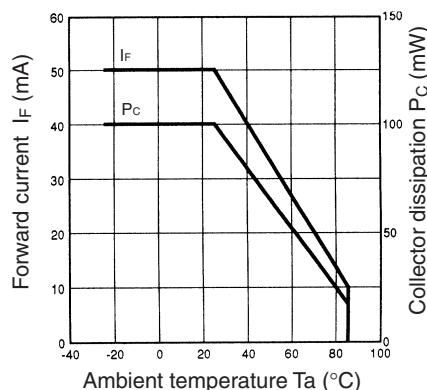
- Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
 3. Complete soldering within 10 seconds.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

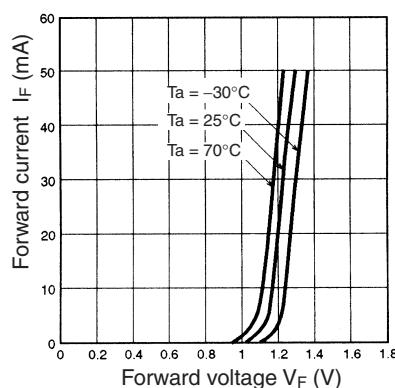
	Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P	940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L	1.9 mA min., 14 mA max.	$I_F = 20 \text{ mA}, V_{CE} = 10 \text{ V}$
	Dark current	I_D	2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lux}$
	Leakage current	I_{LEAK}	---	---
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$	0.1 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 0.1 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time	t_r		4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$
Falling time	t_f		4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$

■ Engineering Data

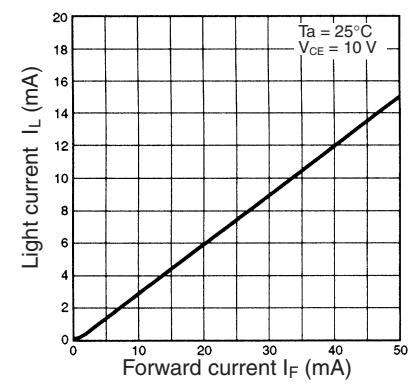
Forward Current vs. Collector Dissipation Temperature Rating



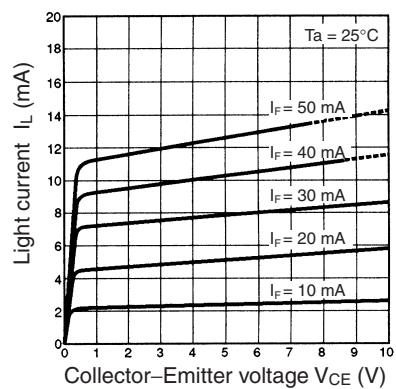
Forward Current vs. Forward Voltage Characteristics (Typical)



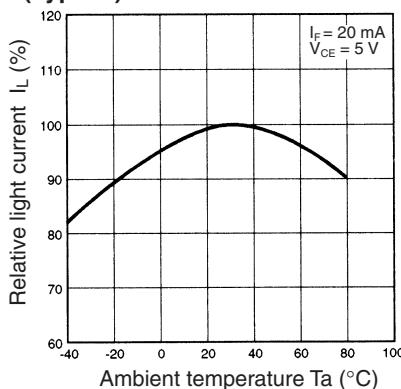
Light Current vs. Forward Current Characteristics (Typical)



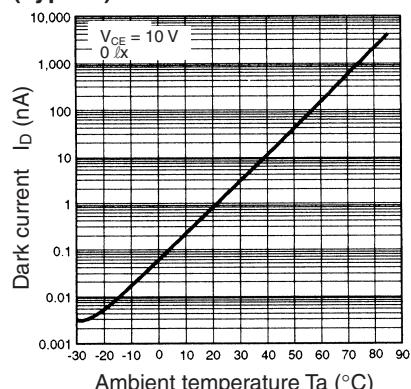
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



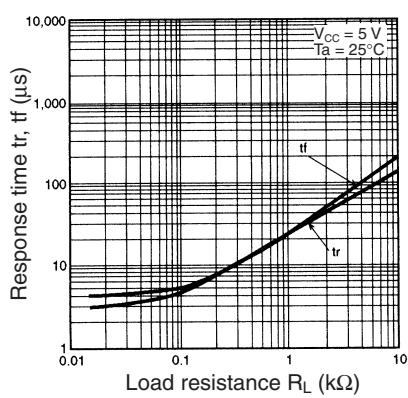
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



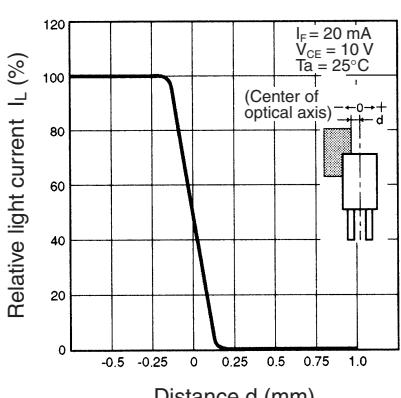
Dark Current vs. Ambient Temperature Characteristics (Typical)



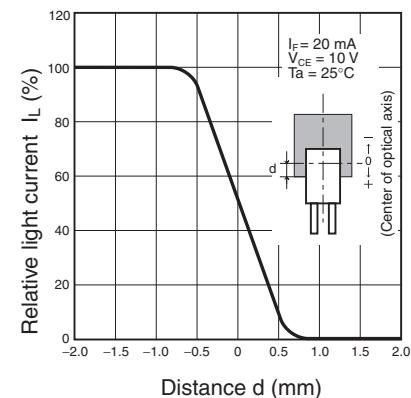
Response Time vs. Load Resistance Characteristics (Typical)



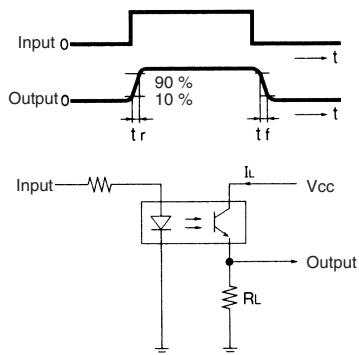
Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)



Response Time Measurement Circuit

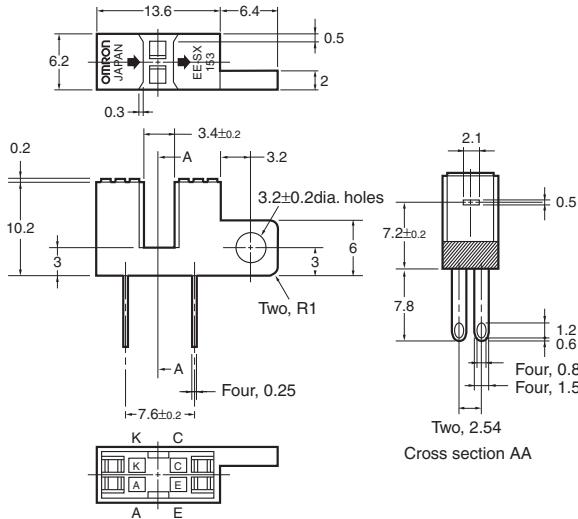


Photomicrosensor (Transmissive) EE-SX153

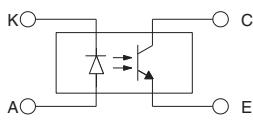
⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	± 0.3
$3 < \text{mm} \leq 6$	± 0.375
$6 < \text{mm} \leq 10$	± 0.45
$10 < \text{mm} \leq 18$	± 0.55
$18 < \text{mm} \leq 30$	± 0.65

Features

- General-purpose model with a 3.4-mm-wide slot.
- PCB mounting type.
- High resolution with a 0.5-mm-wide aperture.
- With a horizontal sensing aperture.
- Screw-mounting possible.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Pulse forward current	I_{FP}	1 A (see note 2)
	Reverse voltage	V_R	4 V
Detector	Collector-Emitter voltage	V_{CEO}	30 V
	Emitter-Collector voltage	V_{ECO}	---
	Collector current	I_C	20 mA
	Collector dissipation	P_C	100 mW (see note 1)
Ambient temperature	Operating	T_{opr}	-25°C to 85°C
	Storage	T_{stg}	-40°C to 100°C
Soldering temperature		T_{sol}	260°C (see note 3)

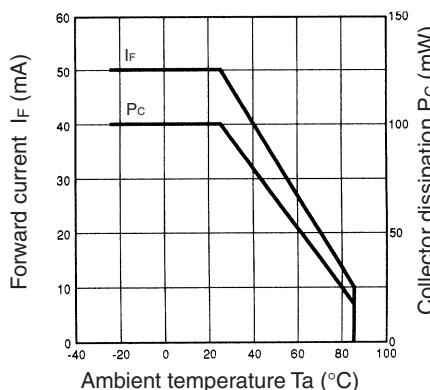
- Note:**
- Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 - The pulse width is 10 μs maximum with a frequency of 100 Hz.
 - Complete soldering within 10 seconds.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

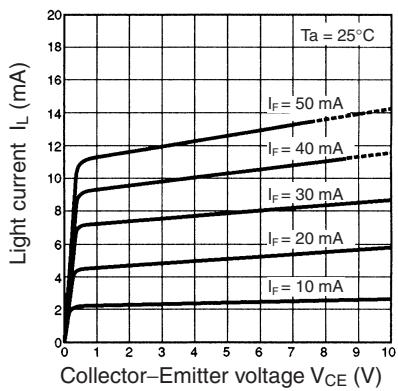
	Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P	940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L	0.5 mA min., 14 mA max.	$I_F = 20 \text{ mA}, V_{CE} = 10 \text{ V}$
	Dark current	I_D	2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lux}$
	Leakage current	I_{LEAK}	---	---
	Collector-Emitter saturated voltage	$V_{CE}(\text{sat})$	0.1 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 0.1 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time		t_r	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$
Falling time		t_f	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$

■ Engineering Data

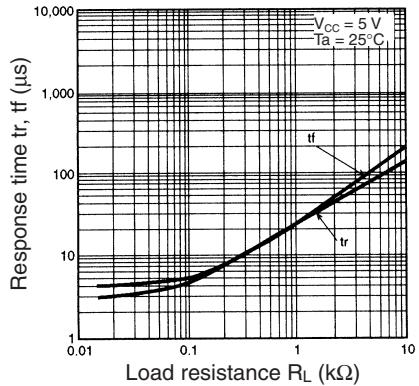
Forward Current vs. Collector Dissipation Temperature Rating



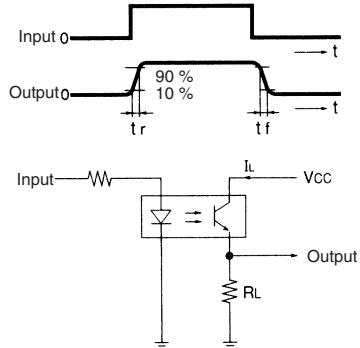
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



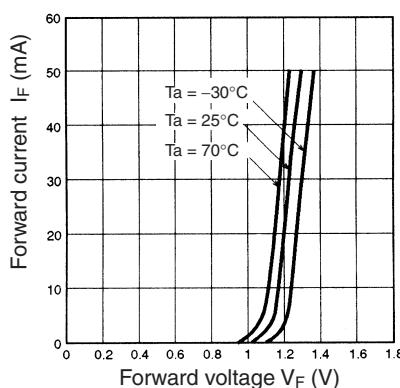
Response Time vs. Load Resistance Characteristics (Typical)



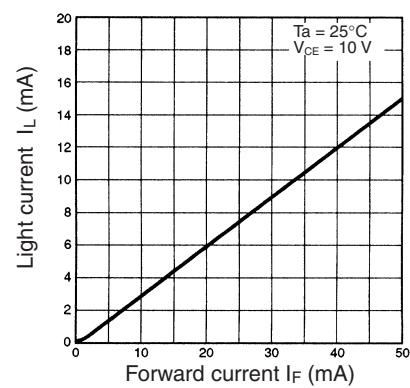
Response Time Measurement Circuit



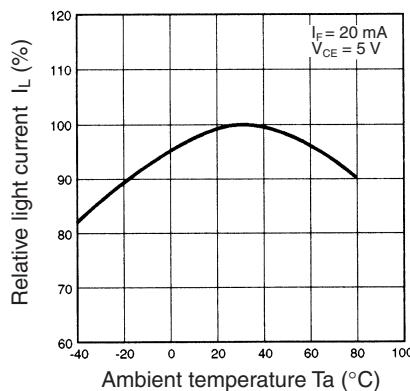
Forward Current vs. Forward Voltage Characteristics (Typical)



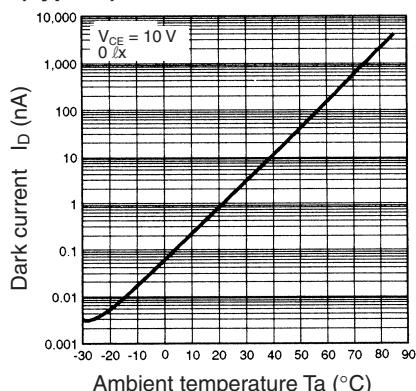
Light Current vs. Forward Current Characteristics (Typical)



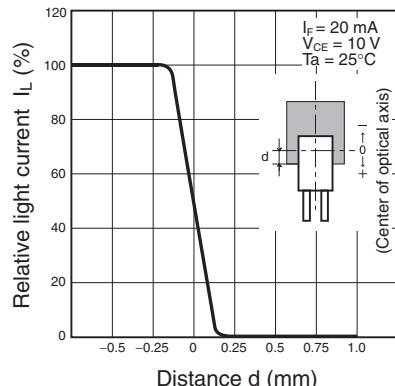
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



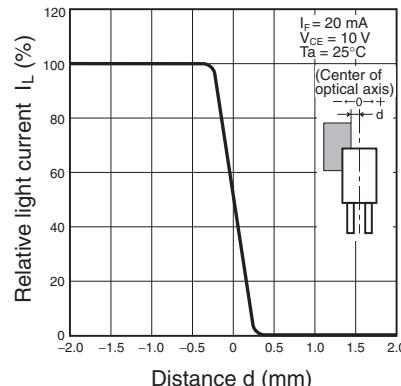
Dark Current vs. Ambient Temperature Characteristics (Typical)



Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)

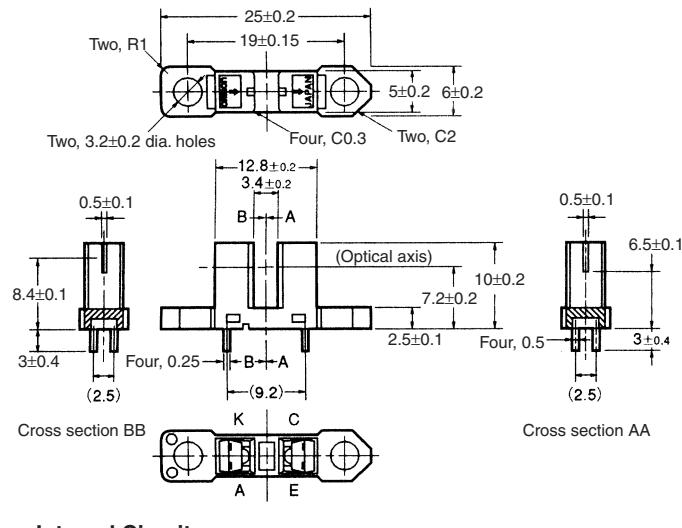


Photomicrosensor (Transmissive) EE-SX1088

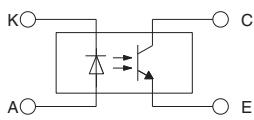
⚠ Be sure to read *Precautions* on page 24.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

■ Features

- General-purpose model with a 3.4-mm-wide slot.
- Mounts to PCBs or connects to connectors.
- High resolution with a 0.5-mm-wide aperture.
- OMRON's XK8-series Connectors can be connected without soldering. Contact your OMRON representative for information on obtaining XK8-series Connectors.

■ Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Pulse forward current	I_{FP}	1 A (see note 2)
	Reverse voltage	V_R	4 V
Detector	Collector-Emitter voltage	V_{CEO}	30 V
	Emitter-Collector voltage	V_{ECO}	---
	Collector current	I_C	20 mA
	Collector dissipation	P_C	100 mW (see note 1)
Ambient temperature	Operating	T_{opr}	-25°C to 85°C
	Storage	T_{stg}	-30°C to 100°C
Soldering temperature		T_{sol}	260°C (see note 3)

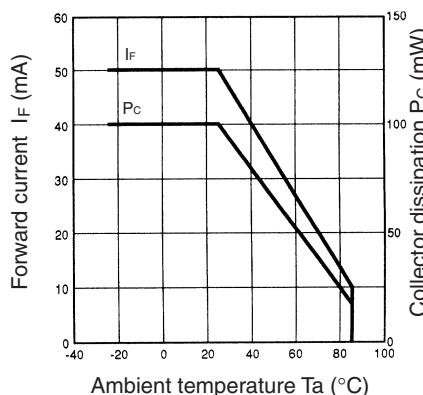
- Note:
- Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 - The pulse width is 10 μs maximum with a frequency of 100 Hz.
 - Complete soldering within 10 seconds.

■ Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

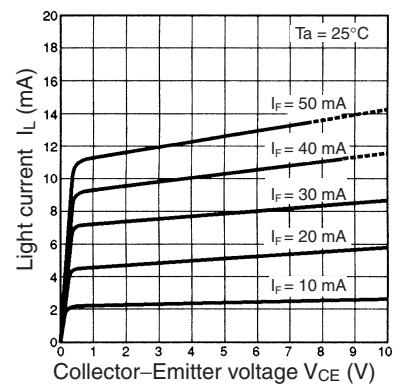
	Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P	940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L	0.5 mA min., 14 mA max.	$I_F = 20 \text{ mA}, V_{CE} = 10 \text{ V}$
	Dark current	I_D	2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lux}$
	Leakage current	I_{LEAK}	---	---
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$	0.15 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 0.1 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time		t_r	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$
Falling time		t_f	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$

■ Engineering Data

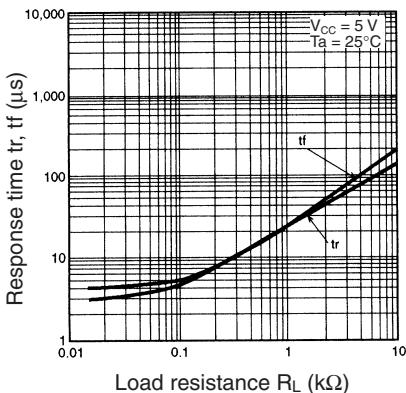
Forward Current vs. Collector Dissipation Temperature Rating



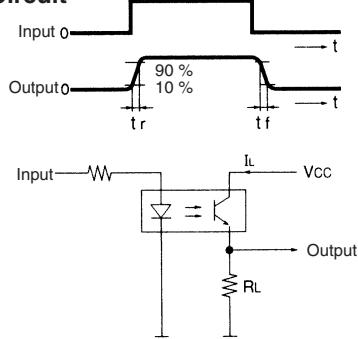
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



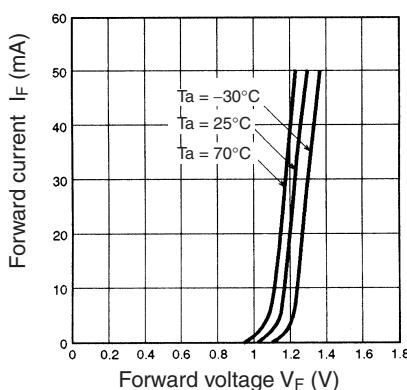
Response Time vs. Load Resistance Characteristics (Typical)



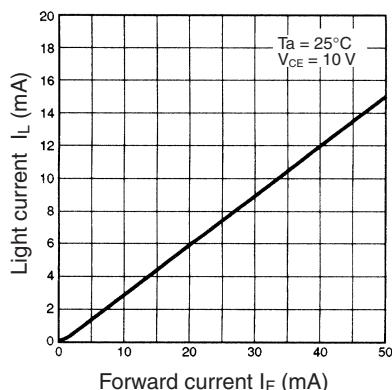
Response Time Measurement Circuit



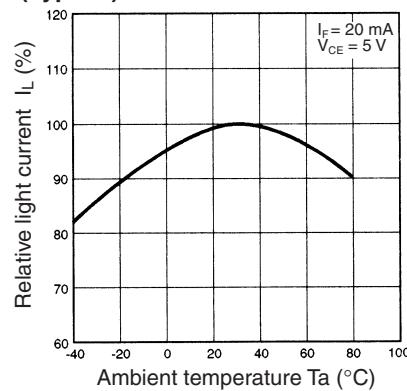
Forward Current vs. Forward Voltage Characteristics (Typical)



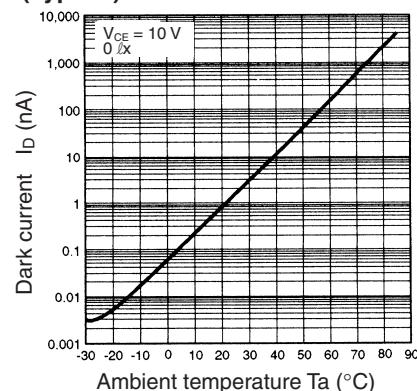
Light Current vs. Forward Current Characteristics (Typical)



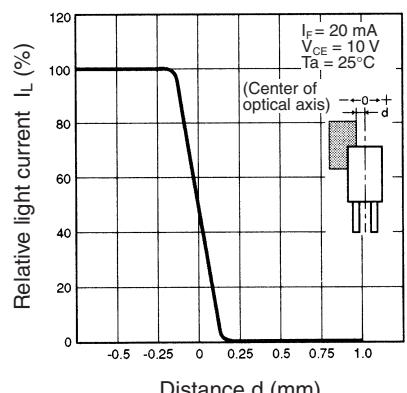
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



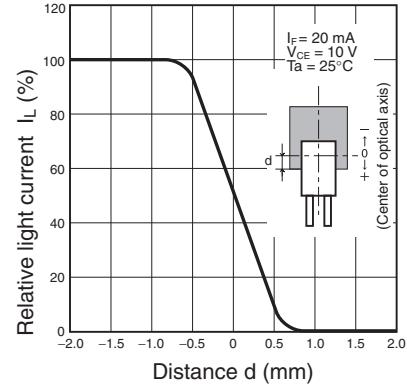
Dark Current vs. Ambient Temperature Characteristics (Typical)



Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)

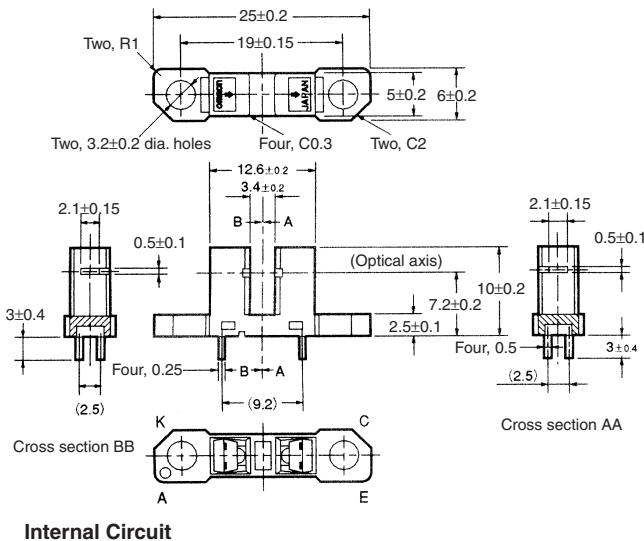


Photomicrosensor (Transmissive) EE-SX1096

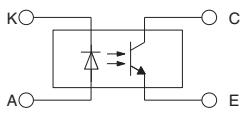
⚠ Be sure to read *Precautions* on page 24.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

■ Features

- General-purpose model with a 3.4-mm-wide slot.
- Mounts to PCBs or connects to connectors.
- High resolution with a 0.5-mm-wide aperture.
- With a horizontal sensing slot.
- OMRON's XK8-series Connectors can be connected without soldering. Contact your OMRON representative for information on obtaining XK8-series Connectors.

■ Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rated value
Emitter	Forward current	I_F 50 mA (see note 1)
	Pulse forward current	I_{FP} 1 A (see note 2)
	Reverse voltage	V_R 4 V
Detector	Collector-Emitter voltage	V_{CEO} 30 V
	Emitter-Collector voltage	V_{ECO} ---
	Collector current	I_C 20 mA
	Collector dissipation	P_C 100 mW (see note 1)
Ambient temperature	Operating	T_{opr} -25°C to 85°C
	Storage	T_{stg} -30°C to 100°C
Soldering temperature	T_{sol}	260°C (see note 3)

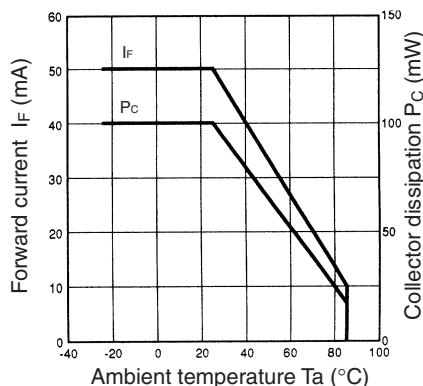
- Note:
- Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 - The pulse width is 10 μs maximum with a frequency of 100 Hz.
 - Complete soldering within 10 seconds.

■ Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

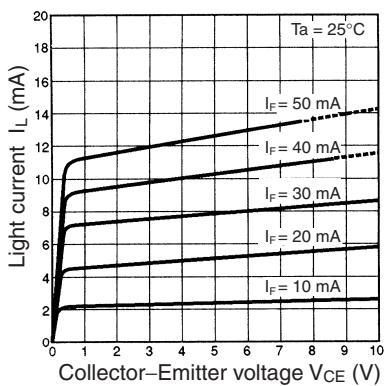
Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F 1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R 0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P 940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L 0.5 mA min., 14 mA max.	$I_F = 20 \text{ mA}, V_{CE} = 10 \text{ V}$
	Dark current	I_D 2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lx}$
	Leakage current	I_{LEAK} ---	---
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$ 0.1 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 0.1 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_P 850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time	tr	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$
Falling time	tf	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$

■ Engineering Data

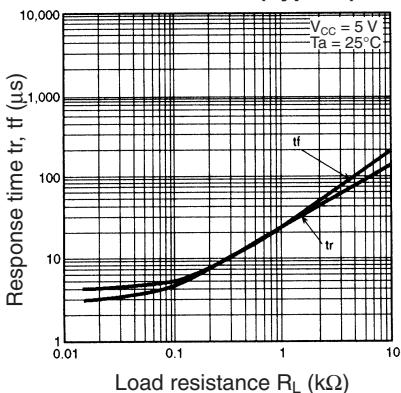
Forward Current vs. Collector Dissipation Temperature Rating



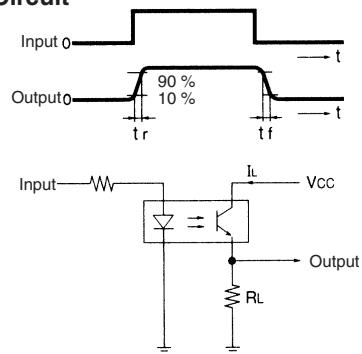
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



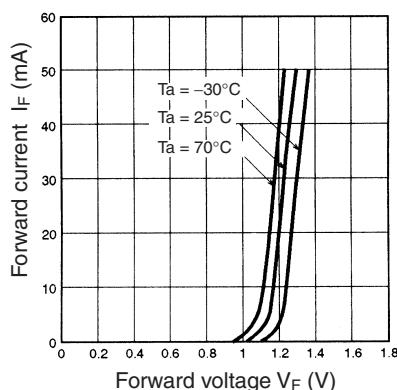
Response Time vs. Load Resistance Characteristics (Typical)



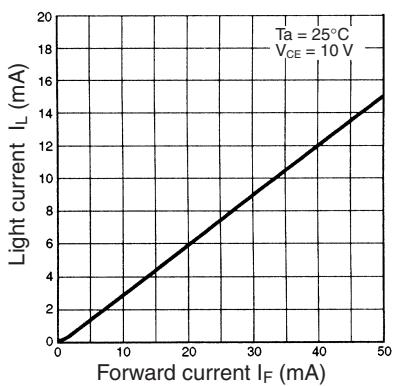
Response Time Measurement Circuit



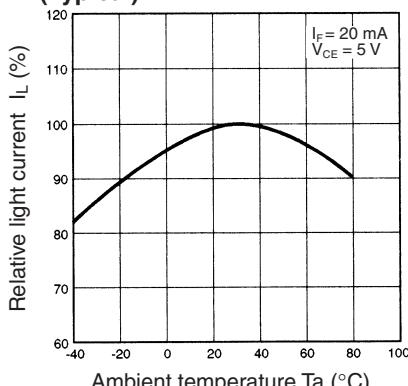
Forward Current vs. Forward Voltage Characteristics (Typical)



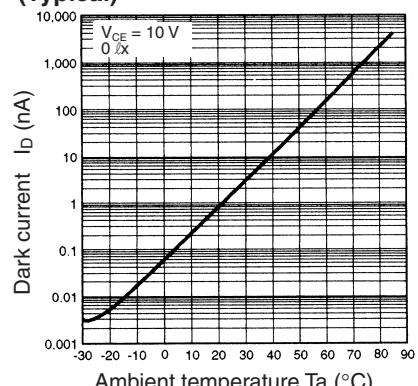
Light Current vs. Forward Current Characteristics (Typical)



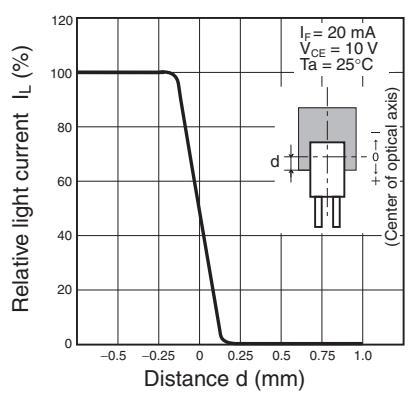
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



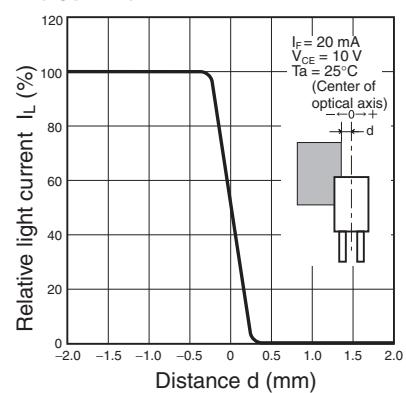
Dark Current vs. Ambient Temperature Characteristics (Typical)



Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)

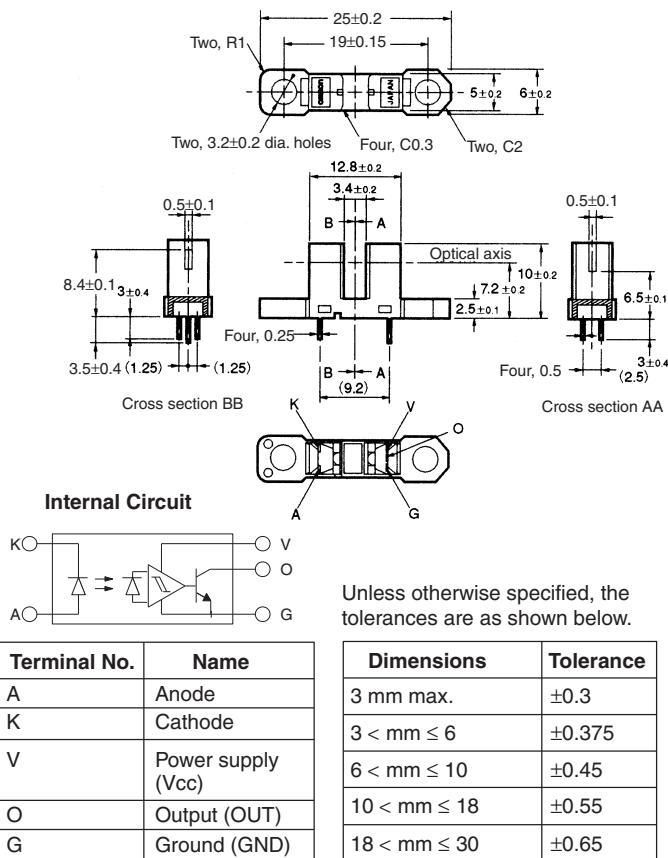


Photomicrosensor (Transmissive) **EE-SX3088/-SX4088**

 Be sure to read *Precautions* on page 24.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



■ Features

- Incorporates an IC chip with a built-in detector element and amplifier.
 - A wide supply voltage range: 4.5 to 16 VDC
 - Directly connects with C-MOS and TTL.
 - High resolution with a 0.5-mm-wide sensing aperture.
 - Dark ON model (EE-SX3088)
 - Light ON model (EE-SX4088)
 - OMRON's XK8-series Connectors can be connected to the lead wires without a PCB. Contact your OMRON representative for information on obtaining XK8-series Connectors.

■ Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Reverse voltage	V_R	4 V
Detector	Power supply voltage	V_{CC}	16 V
	Output voltage	V_{OUT}	28 V
	Output current	I_{OUT}	16 mA
	Permissible output dissipation	P_{OUT}	250 mW (see note 1)
Ambient temperature	Operating	T_{opr}	-40°C to 75°C
	Storage	T_{stg}	-40°C to 85°C
Soldering temperature		T_{sol}	260°C (see note 2)

Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

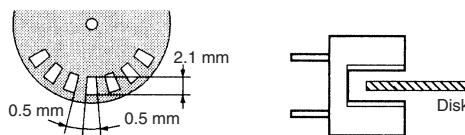
2. Complete soldering within 10 seconds.

■ Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

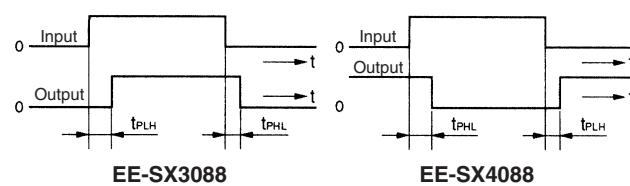
Item		Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.	$I_F = 20 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wave-length	λ_P	940 nm	$I_F = 20 \text{ mA}$
Detector	Low-level output voltage	V_{OL}	0.12 V typ., 0.4 V max.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_{OL} = 16 \text{ mA}$, $I_F = 0 \text{ mA}$ (EE-SX3088), $I_F = 5 \text{ mA}$ (EE-SX4088)
	High-level output voltage	V_{OH}	15 V min.	$V_{CC} = 16 \text{ V}$, $R_L = 1 \text{ k}\Omega$, $I_F = 5 \text{ mA}$ (EE-SX3088), $I_F = 0 \text{ mA}$ (EE-SX4088)
	Current consumption	I_{CC}	3.2 mA typ., 10 mA max.	$V_{CC} = 16 \text{ V}$
	Peak spectral sensitivity wavelength	λ_P	870 nm	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$
LED current when output is OFF	I_{FT}	2 mA typ., 5 mA max.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$	
LED current when output is ON				
Hysteresis	ΔH	15% typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$ (see note 1)	
Response frequency	f	3kHz min.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_F = 15 \text{ mA}$, $I_{OL} = 16 \text{ mA}$ (see note 2)	
Response delay time	t_{PLH} (t_{PHL})	3 μs typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_F = 15 \text{ mA}$, $I_{OL} = 16 \text{ mA}$ (see note 3)	
Response delay time	t_{PHL} (t_{PLH})	20 μs typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_F = 15 \text{ mA}$, $I_{OL} = 16 \text{ mA}$ (see note 3)	

Note: 1. Hysteresis denotes the difference in forward LED current value, expressed in percentage, calculated from the respective forward LED currents when the photo IC is turned from ON to OFF and when the photo IC is turned from OFF to ON.

2. The value of the response frequency is measured by rotating the disk as shown below.



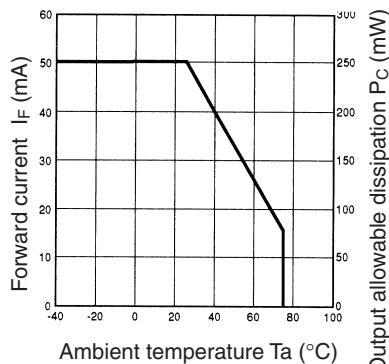
3. The following illustrations show the definition of response delay time. The value in the parentheses applies to the EE-SX4088.



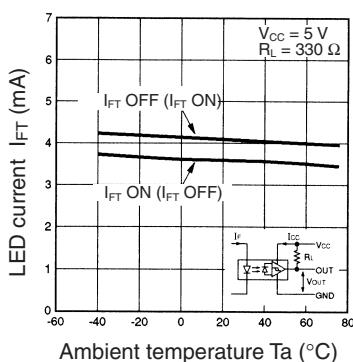
■ Engineering Data

Note: The values in the parentheses apply to the EE-SX4088.

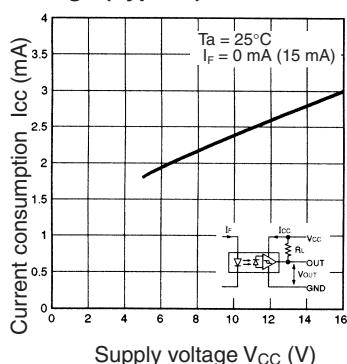
Forward Current vs. Collector Dissipation Temperature Rating



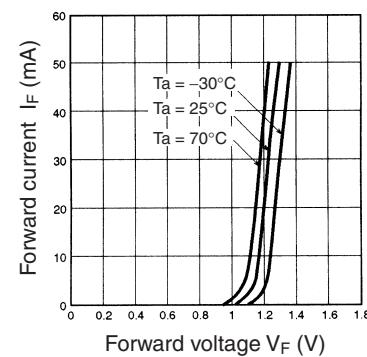
LED Current vs. Ambient Temperature Characteristics (Typical)



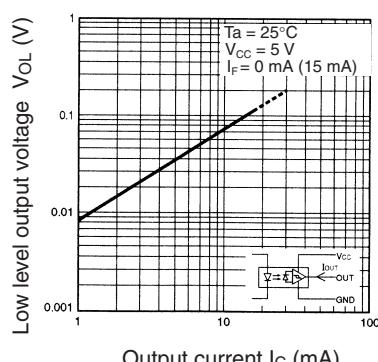
Current Consumption vs. Supply Voltage (Typical)



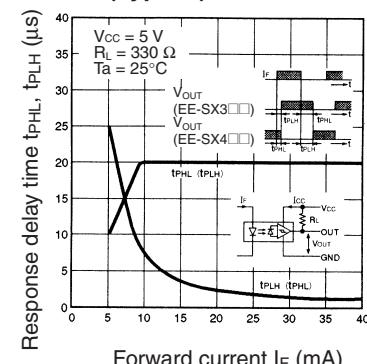
Forward Current vs. Forward Voltage Characteristics (Typical)



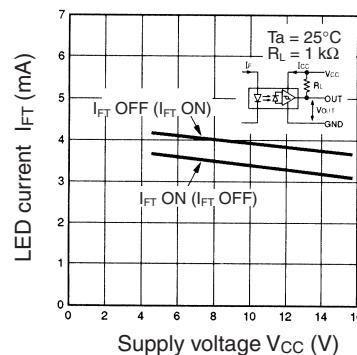
Low-level Output Voltage vs. Output Current (Typical)



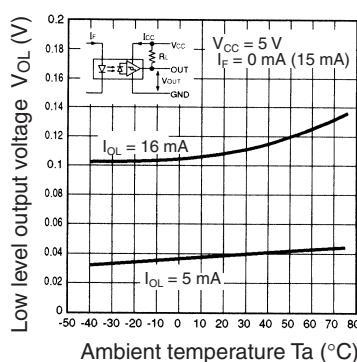
Response Delay Time vs. Forward Current (Typical)



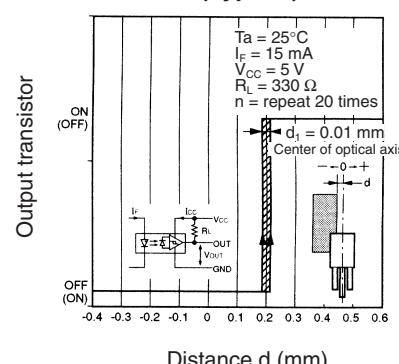
LED Current vs. Supply Voltage (Typical)



Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



Repeat Sensing Position Characteristics (Typical)

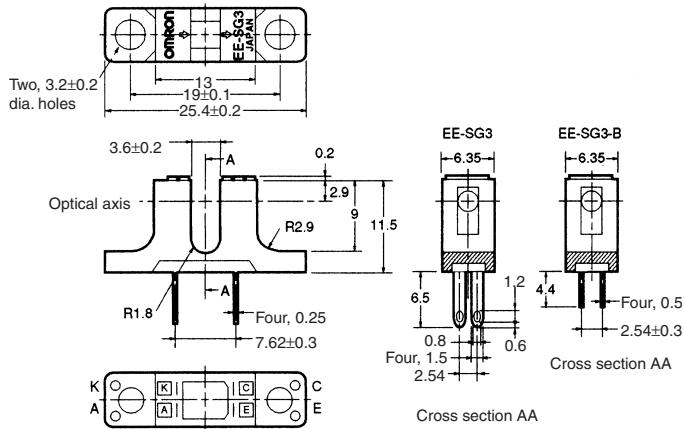


Photomicrosensor (Transmissive) EE-SG3/EE-SG3-B

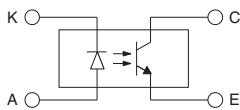
⚠ Be sure to read *Precautions* on page 24.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

■ Features

- Dust-proof model.
- Solder terminal model (EE-SG3).
- PCB terminal model (EE-SG3-B).

■ Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rated value
Emitter	Forward current	I_F 50 mA (see note 1)
	Pulse forward current	I_{FP} 1 A (see note 2)
	Reverse voltage	V_R 4 V
Detector	Collector-Emitter voltage	V_{CEO} 30 V
	Emitter-Collector voltage	V_{ECO} ---
	Collector current	I_C 20 mA
	Collector dissipation	P_C 100 mW (see note 1)
Ambient temperature	Operating	T_{opr} -25°C to 85°C
	Storage	T_{stg} -30°C to 100°C
Soldering temperature	T_{sol}	260°C (see note 3)

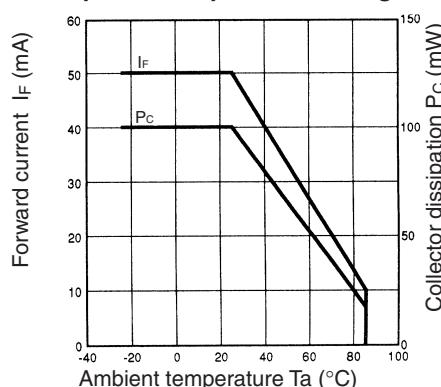
- Note:
- Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 - The pulse width is 10 μs maximum with a frequency of 100 Hz.
 - Complete soldering within 10 seconds.

■ Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

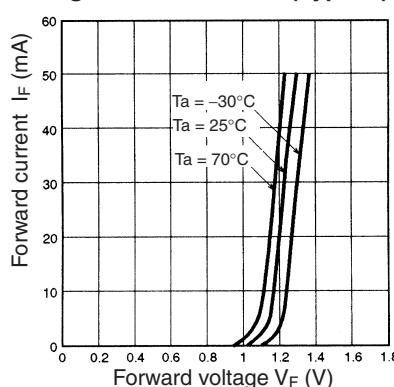
Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F 1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R 0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P 940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L 2 mA min., 40 mA max.	$I_F = 15 \text{ mA}, V_{CE} = 10 \text{ V}$
	Dark current	I_D 2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lx}$
	Leakage current	I_{LEAK} ---	---
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$ 0.1 V typ., 0.4 V max.	$I_F = 30 \text{ mA}, I_L = 1 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_P 850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time	t_r	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$
Falling time	t_f	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$

■ Engineering Data

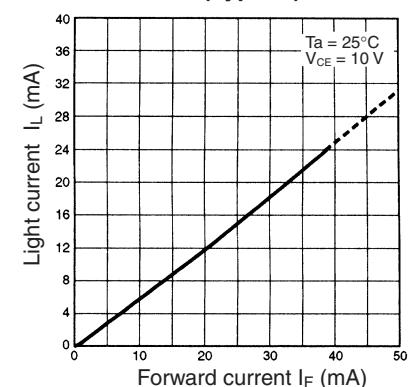
Forward Current vs. Collector Dissipation Temperature Rating



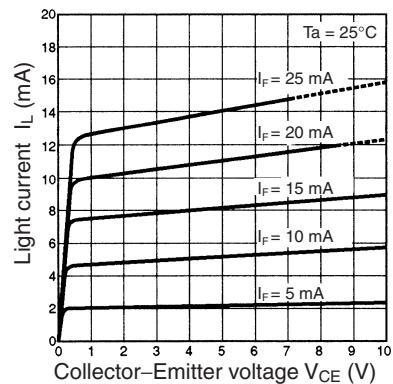
Forward Current vs. Forward Voltage Characteristics (Typical)



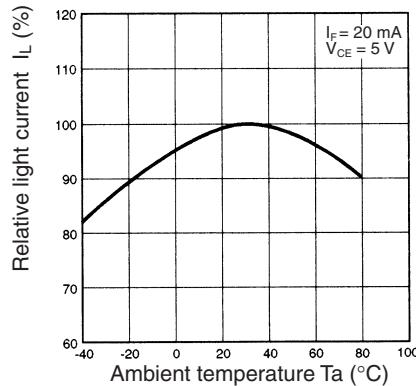
Light Current vs. Forward Current Characteristics (Typical)



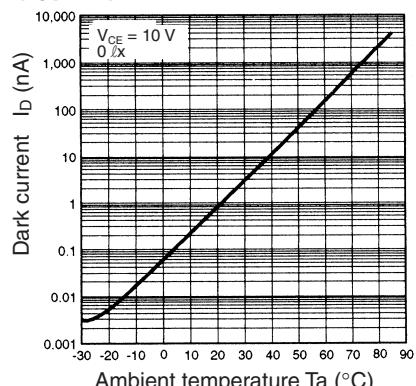
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



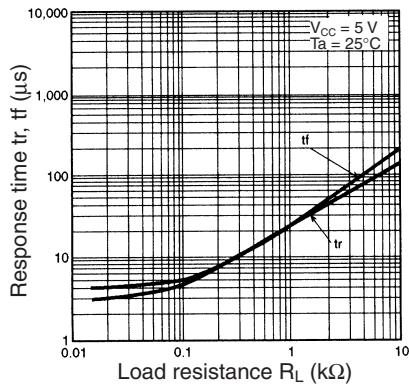
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



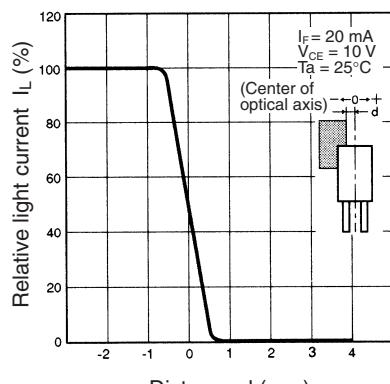
Dark Current vs. Ambient Temperature Characteristics (Typical)



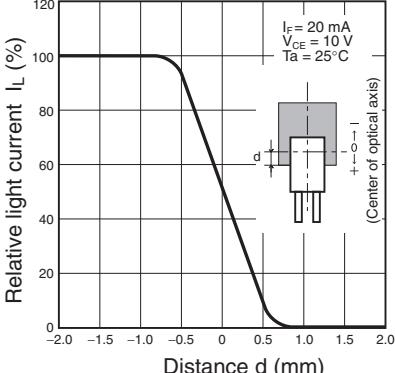
Response Time vs. Load Resistance Characteristics (Typical)



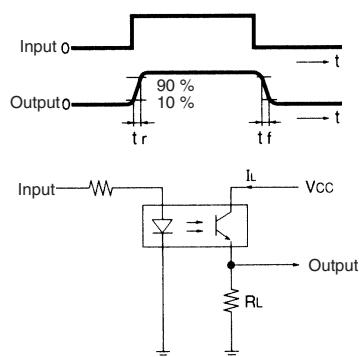
Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)



Response Time Measurement Circuit

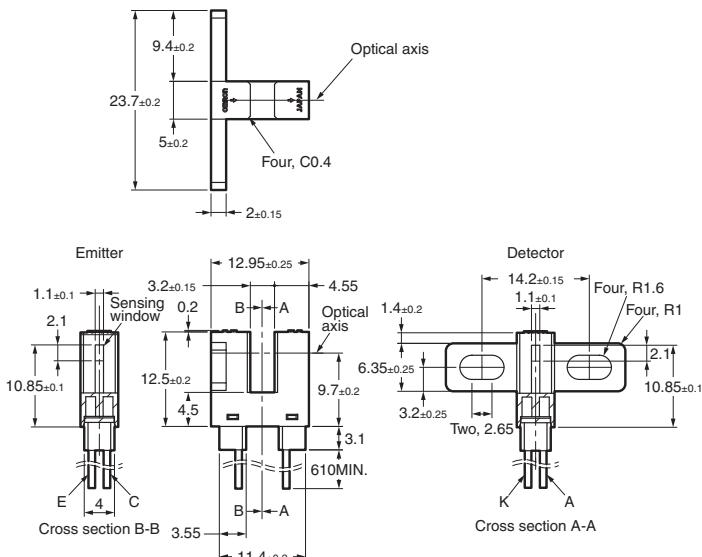


Photomicrosensor (Transmissive) EE-SX1161-W11

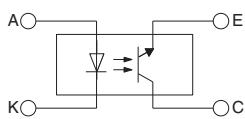
⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

Electrical and Optical Characteristics (Ta = 25°C)

Item	Symbol	Value	Condition
Emitter	V _F	1.2 V typ., 1.5 V max.	I _F = 30 mA
	I _R	0.01 μA typ., 10 μA max.	V _R = 4 V
	Peak emission wavelength	λ _P	I _F = 20 mA
Detector	I _L	0.625 mA min.	I _F = 20 mA, V _{CE} = 10 V
	I _D	2 nA typ., 200 nA max.	V _{CE} = 10 V, 0 lx
	I _{LEAK}	---	---
	V _{CE} (sat)	0.15 V typ., 0.4 V max.	I _F = 20 mA, I _L = 0.1 mA
	λ _P	850 nm typ.	V _{CE} = 10 V
Rising time	tr	4 μs typ.	V _{CC} = 5 V, R _L = 100 Ω, I _L = 5 mA
Falling time	tf	4 μs typ.	V _{CC} = 5 V, R _L = 100 Ω, I _L = 5 mA

Features

- Dust-proof model.
- Pre-wired Sensors (AWG28).
- Solder-less lead wire connection to increase reliability.

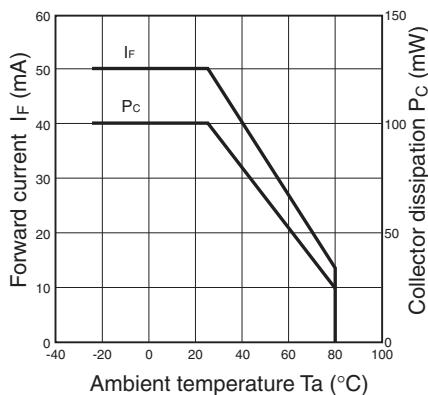
Absolute Maximum Ratings (Ta = 25°C)

	Item	Symbol	Rated value
Emitter	Forward current	I _F	50 mA (see note 1)
	Pulse forward current	I _{FP}	1 A (see note 2)
	Reverse voltage	V _R	4 V
Detector	Collector-Emitter voltage	V _{CEO}	30 V
	Emitter-Collector voltage	V _{ECO}	5 V
	Collector current	I _C	20 mA
	Collector dissipation	P _C	100 mW (see note 1)
Ambient temperature	Operating	Topr	-25°C to 80°C
	Storage	Tstg	-25°C to 85°C

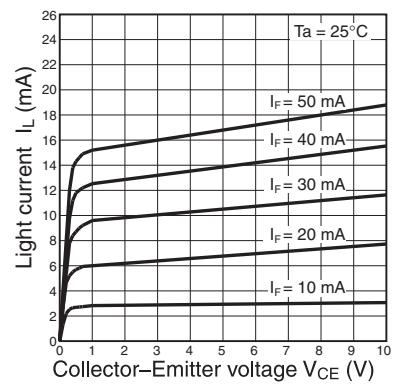
- Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
 3. If you mount the Sensor with screws, use M3 screws, and flat washers and use a tightening torque of 0.5 N·m max.

■ Engineering Data

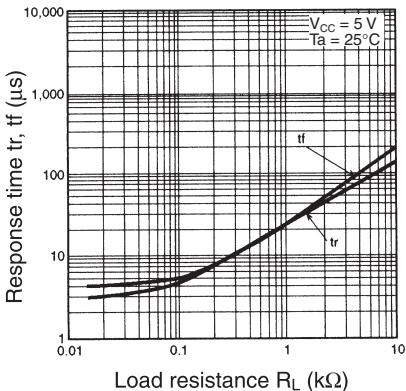
Forward Current vs. Collector Dissipation Temperature Rating



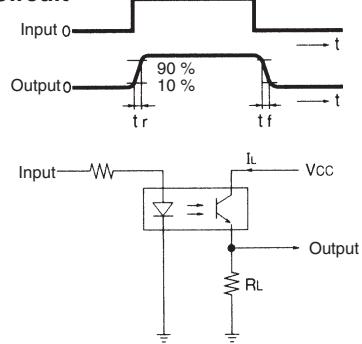
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



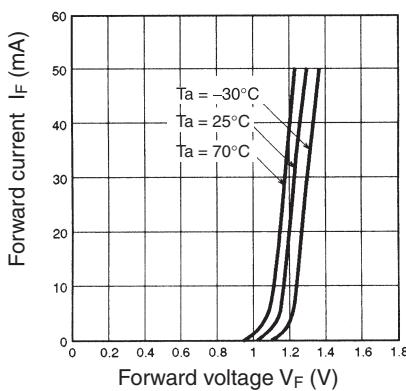
Response Time vs. Load Resistance Characteristics (Typical)



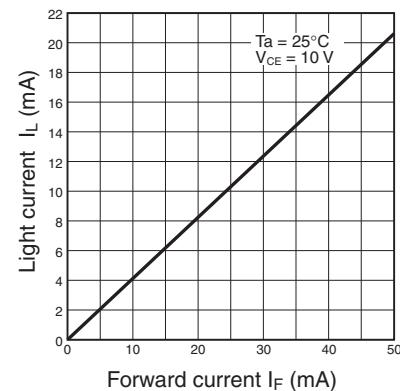
Response Time Measurement Circuit



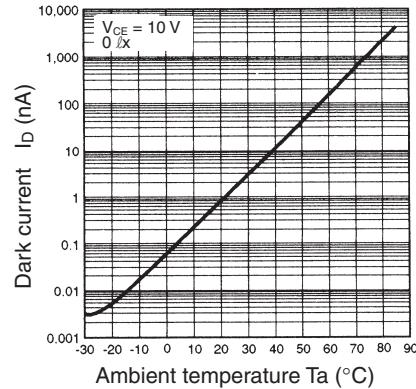
Forward Current vs. Forward Voltage Characteristics (Typical)



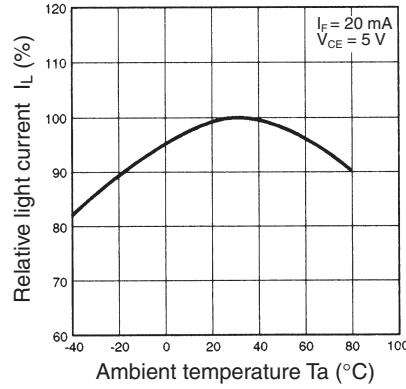
Light Current vs. Forward Current Characteristics (Typical)



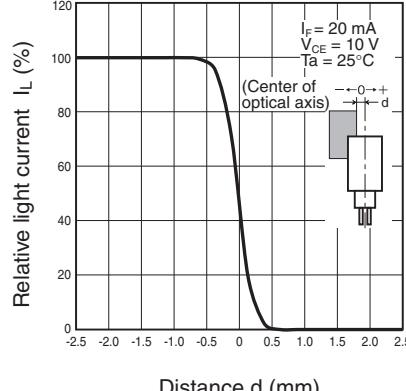
Dark Current vs. Ambient Temperature Characteristics (Typical)



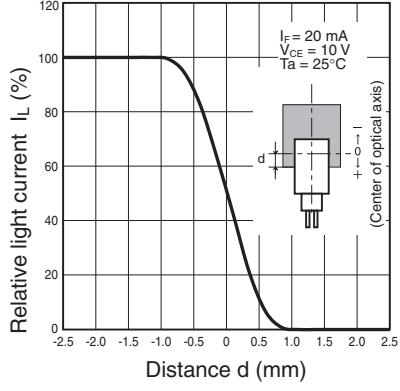
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)

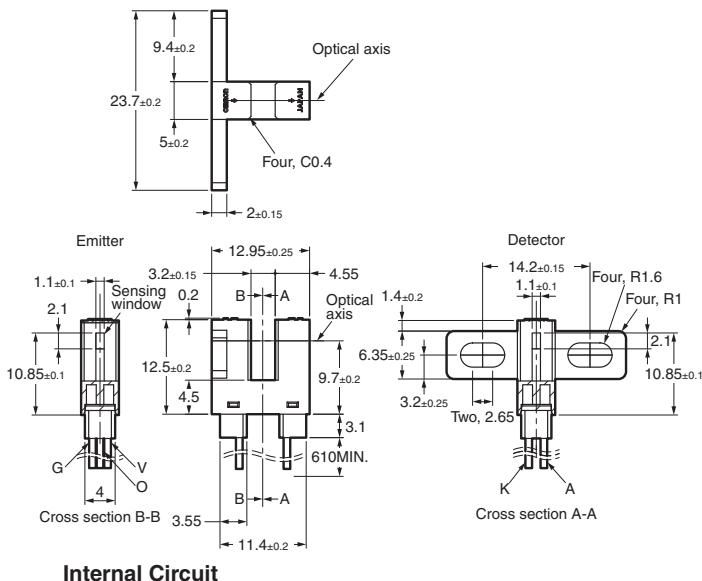


Photomicrosensor (Transmissive) EE-SX3161-W11/4161-W11

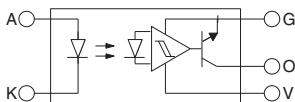
⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are as shown below.

Terminal No.	Name
A	Anode
K	Cathode
V	Power supply (Vcc)
O	Output (OUT)
G	Ground (GND)

Features

- Dust-proof model.
- Light-receiving element and amplification circuits contained in one chip.
- Can use a power supply voltage of 4.5 to 16 V.
- Connects directly to C-MOS or TTL.
- Dark-ON Sensor: EE-SX3161-W11
- Light-ON Sensor: EE-SX4161-W11
- Pre-wired Sensors (AWG28).
- Solder-less lead wire connection to increase reliability.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item		Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Reverse voltage	V_R	4 V
Detector	Power supply voltage	V_{CC}	16 V
	Output voltage	V_{OUT}	28 V
	Output current	I_{OUT}	16 mA
	Permissible output dissipation	P_{OUT}	250 mW (see note 1)
Ambient temperature	Operating	T_{opr}	-25°C to 75°C
	Storage	T_{stg}	-25°C to 85°C

Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

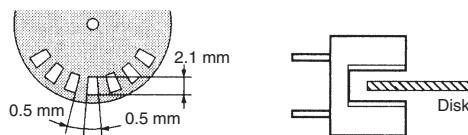
2. If you mount the Sensor with screws, use M3 screws, and flat washers and use a tightening torque of 0.5 N·m max.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

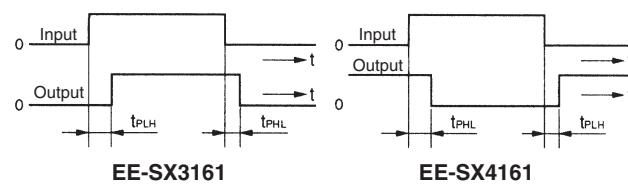
Item		Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.	$I_F = 20 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P	940 nm	$I_F = 20 \text{ mA}$
Detector	Low-level output voltage	V_{OL}	0.12 V typ., 0.4 V max.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_{OL} = 16 \text{ mA}$, $I_F = 0 \text{ mA}$ (EE-SX3161), $I_F = 10 \text{ mA}$ (EE-SX4161)
	High-level output voltage	V_{OH}	15 V min.	$V_{CC} = 16 \text{ V}$, $R_L = 1 \text{ k}\Omega$, $I_F = 10 \text{ mA}$ (EE-SX3161), $I_F = 0 \text{ mA}$ (EE-SX4161)
	Current consumption	I_{CC}	3.2 mA typ., 10 mA max.	$V_{CC} = 16 \text{ V}$
	Peak spectral sensitivity wavelength	λ_P	870 nm	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$
LED current when output is OFF	I_{FT}	2 mA typ., 10 mA max.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$	
LED current when output is ON				
Hysteresis	ΔH	15% typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$ (see note 1)	
Response frequency	f	3kHz min.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_F = 15 \text{ mA}$, $I_{OL} = 16 \text{ mA}$ (see note 2)	
Response delay time	t_{PLH} (t_{PHL})	3 μs typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_F = 15 \text{ mA}$, $I_{OL} = 16 \text{ mA}$ (see note 3)	
Response delay time	t_{PHL} (t_{PLH})	20 μs typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_F = 15 \text{ mA}$, $I_{OL} = 16 \text{ mA}$ (see note 3)	

Note: 1. Hysteresis denotes the difference in forward LED current value, expressed in percentage, calculated from the respective forward LED currents when the photo IC is turned from ON to OFF and when the photo IC is turned from OFF to ON.

2. The value of the response frequency is measured by rotating the disk as shown below.



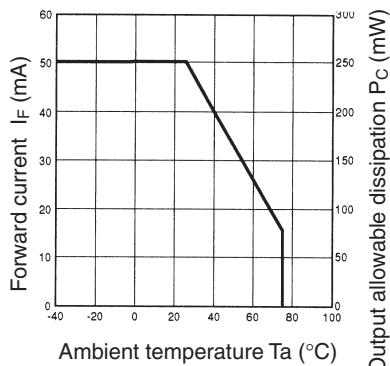
3. The following illustrations show the definition of response delay time. The value in the parentheses applies to the EE-SX4161.



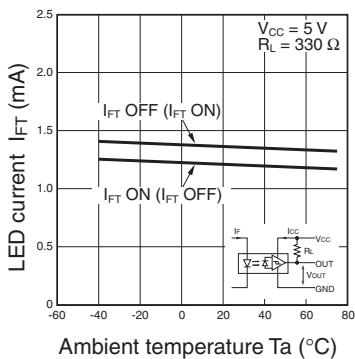
■ Engineering Data

Note: The values in the parentheses apply to the EE-SX4161.

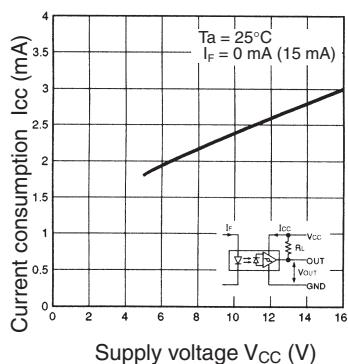
Forward Current vs. Collector Dissipation Temperature Rating



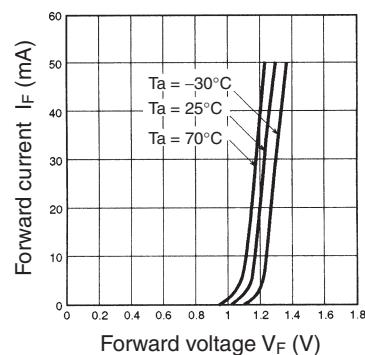
LED Current vs. Ambient Temperature Characteristics (Typical)



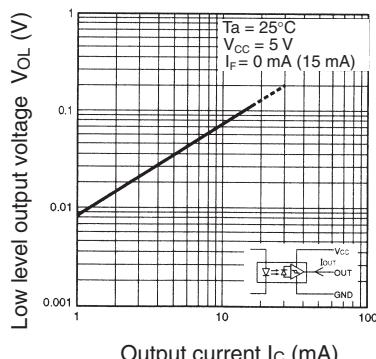
Current Consumption vs. Supply Voltage (Typical)



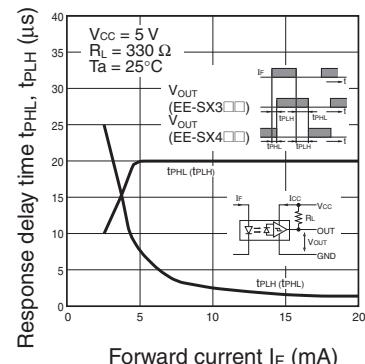
Forward Current vs. Forward Voltage Characteristics (Typical)



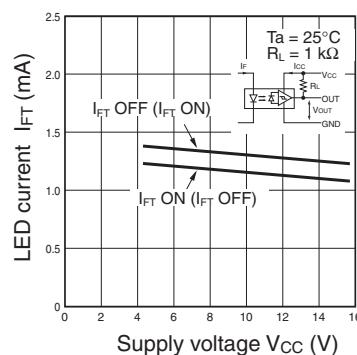
Low-level Output Voltage vs. Output Current (Typical)



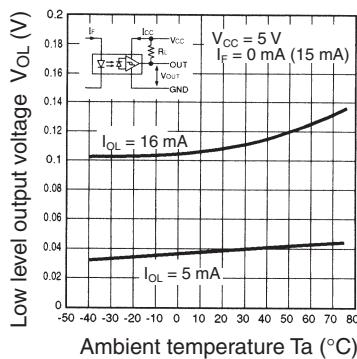
Response Delay Time vs. Forward Current (Typical)



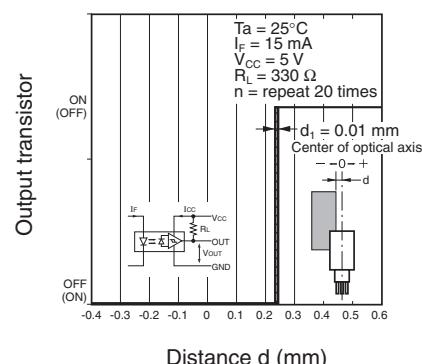
LED Current vs. Supply Voltage (Typical)



Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



Repeat Sensing Position Characteristics (Typical)

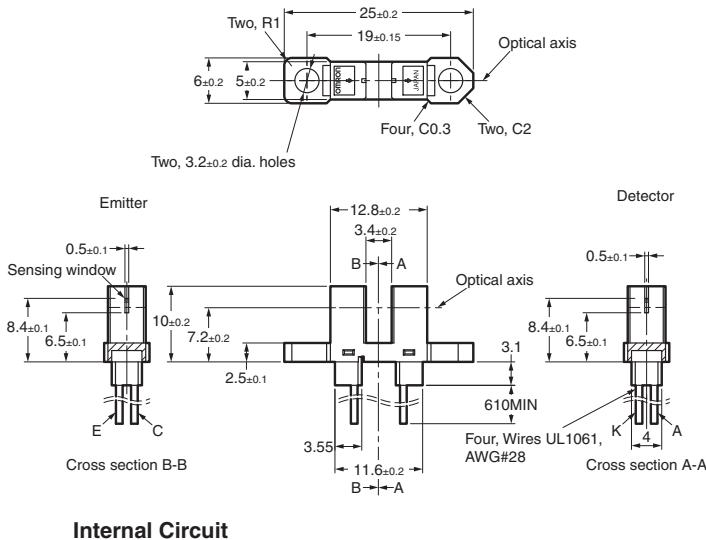


Photomicrosensor (Transmissive) EE-SX1088-W11

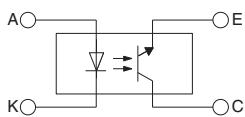
⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

Features

- General-purpose model with a 3.4-mm-wide slot.
- Pre-wired Sensors (AWG28).
- Solder-less lead wire connection to increase reliability.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Pulse forward current	I_{FP}	1 A (see note 2)
	Reverse voltage	V_R	4 V
Detector	Collector-Emitter voltage	V_{CEO}	30 V
	Emitter-Collector voltage	V_{ECO}	---
	Collector current	I_C	20 mA
	Collector dissipation	P_C	100 mW (see note 1)
Ambient temperature	Operating	T_{opr}	-25°C to 80°C
	Storage	T_{stg}	-25°C to 85°C

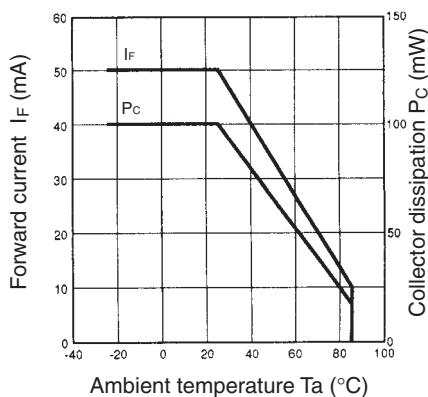
- Note:
- Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 - The pulse width is 10 μs maximum with a frequency of 100 Hz.
 - If you mount the Sensor with screws, use M3 screws, spring washers, and flat washers and use a tightening torque of 0.5 N·m max.
 - You should use the product in the condition without any stress on the cable.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

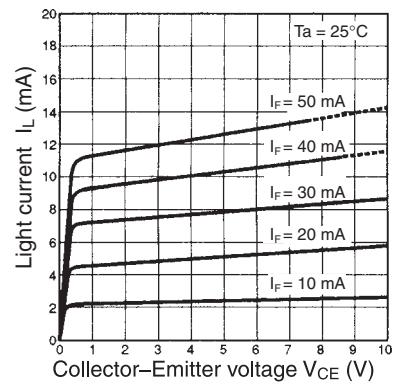
	Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P	940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L	0.5 mA min., 14 mA max.	$I_F = 20 \text{ mA}, V_{CE} = 10 \text{ V}$
	Dark current	I_D	2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lux}$
	Leakage current	I_{LEAK}	---	---
	Collector-Emitter saturated voltage	$V_{CE}(\text{sat})$	0.15 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 0.1 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time		t_r	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$
Falling time		t_f	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$

■ Engineering Data

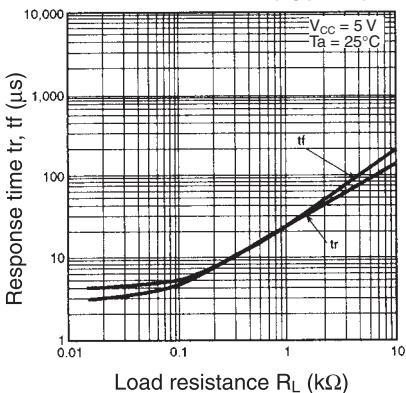
Forward Current vs. Collector Dissipation Temperature Rating



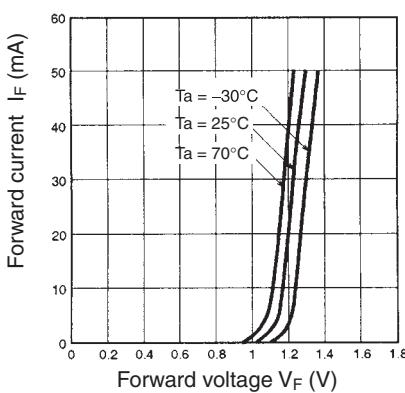
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



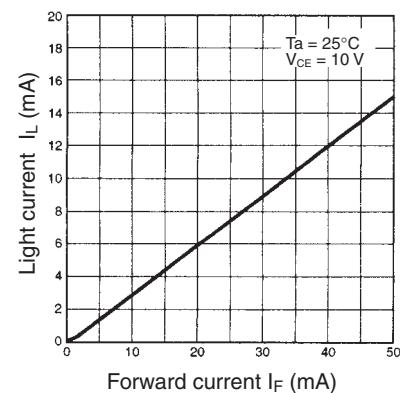
Response Time vs. Load Resistance Characteristics (Typical)



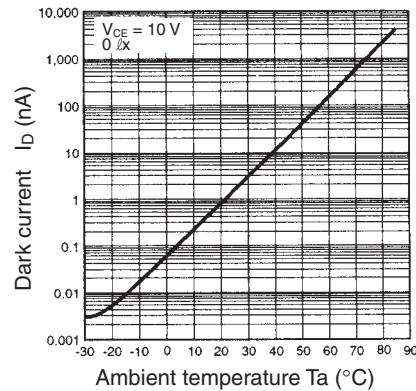
Forward Current vs. Forward Voltage Characteristics (Typical)



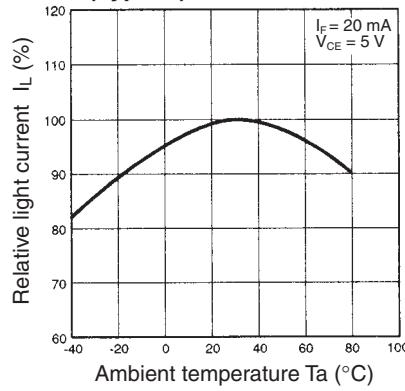
Light Current vs. Forward Current Characteristics (Typical)



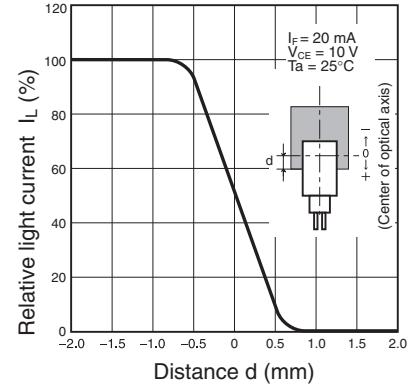
Dark Current vs. Ambient Temperature Characteristics (Typical)



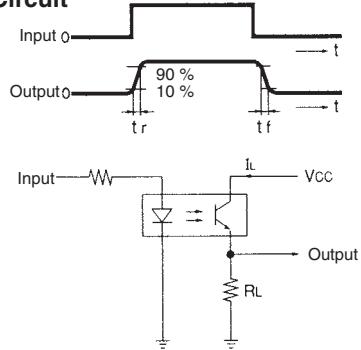
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



Sensing Position Characteristics (Typical)



Response Time Measurement Circuit

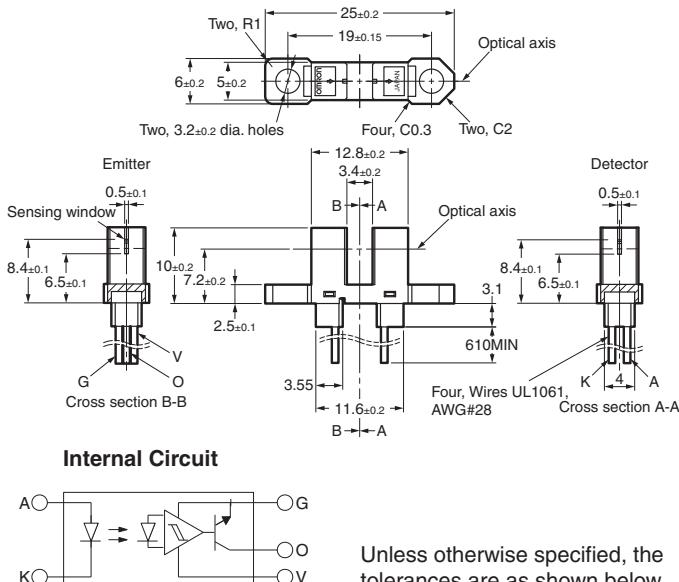


Photomicrosensor (Transmissive) EE-SX3088-W11/4088-W11

⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Unless otherwise specified, the tolerances are as shown below.

Terminal No.	Name
A	Anode
K	Cathode
V	Power supply (Vcc)
O	Output (OUT)
G	Ground (GND)

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

Features

- General-purpose model with a 3.4-mm-wide slot.
- Light-receiving element and amplification circuits contained in one chip.
- Can use a power supply voltage of 4.5 to 16 V.
- Connects directly to C-MOS or TTL.
- Dark-ON Sensor: EE-SX3088-W11
- Light-ON Sensor: EE-SX4088-W11
- Pre-wired Sensors (AWG28).
- Solder-less lead wire connection to increase reliability.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rated value
Emitter	Forward current	I_F 50 mA (see note 1)
	Reverse voltage	V_R 4 V
Detector	Power supply voltage	V_{CC} 16 V
	Output voltage	V_{OUT} 28 V
	Output current	I_{OUT} 16 mA
	Permissible output dissipation	P_{OUT} 250 mW (see note 1)
Ambient temperature	Operating	T_{opr} -25°C to 75°C
	Storage	T_{stg} -25°C to 85°C

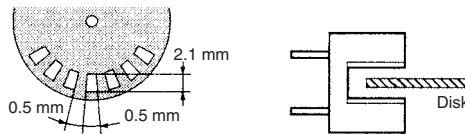
- Note:**
- Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 - If you mount the Sensor with screws, use M3 screws, spring washers, and flat washers and use a tightening torque of 0.5 N·m max.
 - You should use the product in the condition without any stress on the cable.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

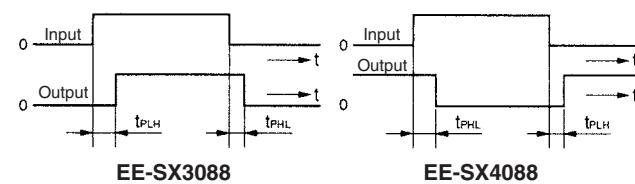
Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F 1.2 V typ., 1.5 V max.	$I_F = 20 \text{ mA}$
	Reverse current	I_R 0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P 940 nm	$I_F = 20 \text{ mA}$
Detector	Low-level output voltage	V_{OL} 0.12 V typ., 0.4 V max.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_{OL} = 16 \text{ mA}$, $I_F = 0 \text{ mA}$ (EE-SX3088), $I_F = 5 \text{ mA}$ (EE-SX4088)
	High-level output voltage	V_{OH} 15 V min.	$V_{CC} = 16 \text{ V}$, $R_L = 1 \text{ k}\Omega$, $I_F = 5 \text{ mA}$ (EE-SX3088), $I_F = 0 \text{ mA}$ (EE-SX4088)
	Current consumption	I_{CC} 3.2 mA typ., 10 mA max.	$V_{CC} = 16 \text{ V}$
	Peak spectral sensitivity wavelength	λ_P 870 nm	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$
LED current when output is OFF	I_{FT}	2 mA typ., 5 mA max.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$
LED current when output is ON			
Hysteresis	ΔH	15% typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$ (see note 1)
Response frequency	f	3kHz min.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_F = 15 \text{ mA}$, $I_{OL} = 16 \text{ mA}$ (see note 2)
Response delay time	t_{PLH} (t_{PHL})	3 μs typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_F = 15 \text{ mA}$, $I_{OL} = 16 \text{ mA}$ (see note 3)
Response delay time	t_{PHL} (t_{PLH})	20 μs typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_F = 15 \text{ mA}$, $I_{OL} = 16 \text{ mA}$ (see note 3)

Note: 1. Hysteresis denotes the difference in forward LED current value, expressed in percentage, calculated from the respective forward LED currents when the photo IC is turned from ON to OFF and when the photo IC is turned from OFF to ON.

2. The value of the response frequency is measured by rotating the disk as shown below.



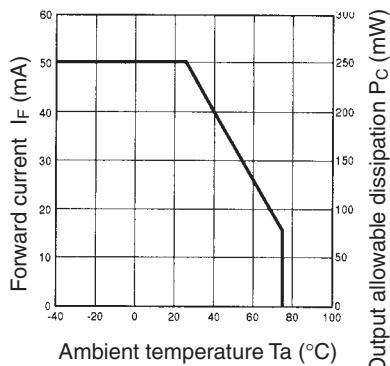
3. The following illustrations show the definition of response delay time. The value in the parentheses applies to the EE-SX4088.



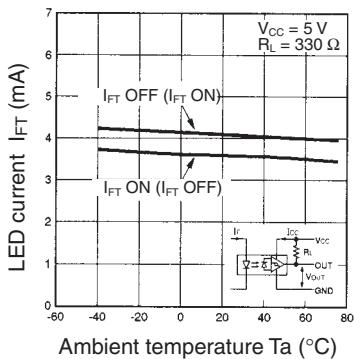
■ Engineering Data

Note: The values in the parentheses apply to the EE-SX4088.

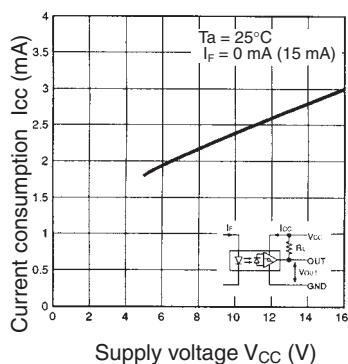
Forward Current vs. Collector Dissipation Temperature Rating



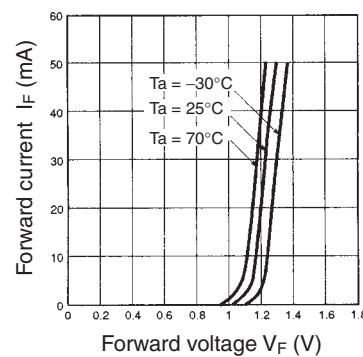
LED Current vs. Ambient Temperature Characteristics (Typical)



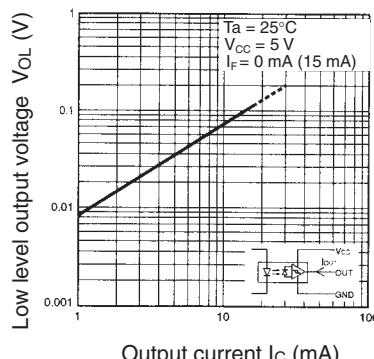
Current Consumption vs. Supply Voltage (Typical)



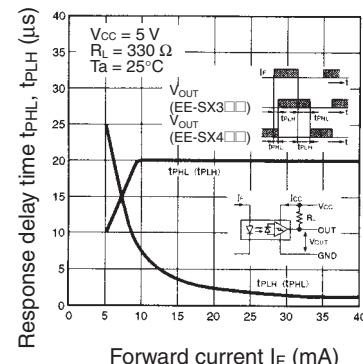
Forward Current vs. Forward Voltage Characteristics (Typical)



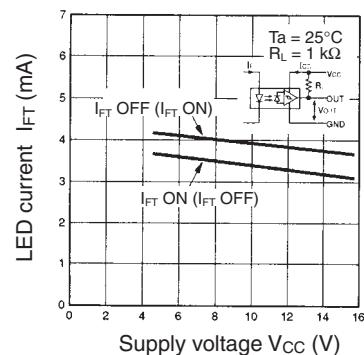
Low-level Output Voltage vs. Output Current (Typical)



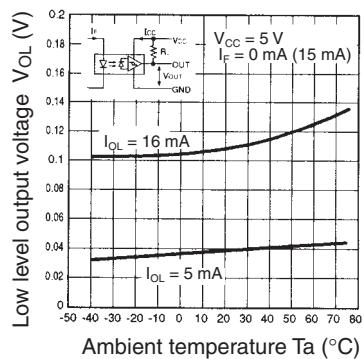
Response Delay Time vs. Forward Current (Typical)



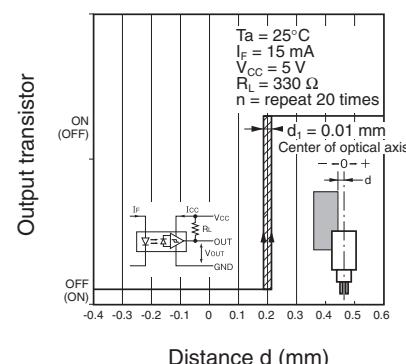
LED Current vs. Supply Voltage (Typical)



Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



Repeat Sensing Position Characteristics (Typical)

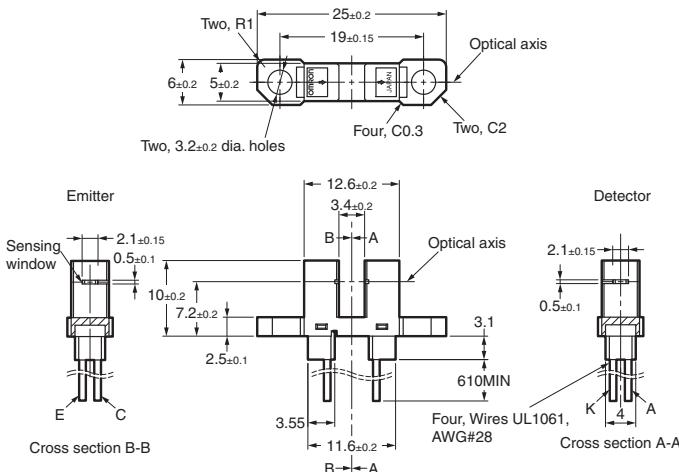


Photomicrosensor (Transmissive) EE-SX1096-W11

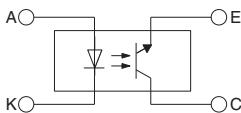
⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

Features

- Pre-wired Sensors (AWG28).
- Solder-less lead wire connection to increase reliability.
- With a horizontal aperture.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rated value
Emitter	Forward current	I_F 50 mA (see note 1)
	Pulse forward current	I_{FP} 1 A (see note 2)
	Reverse voltage	V_R 4 V
Detector	Collector-Emitter voltage	V_{CEO} 30 V
	Emitter-Collector voltage	V_{ECO} ---
	Collector current	I_C 20 mA
	Collector dissipation	P_C 100 mW (see note 1)
	Operating	T_{opr} -25°C to 80°C
Ambient temperature	Storage	T_{stg} -25°C to 85°C

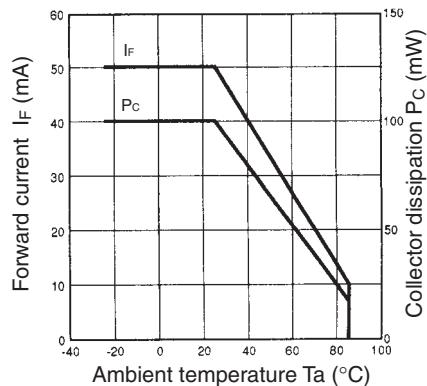
- Note:
1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
 3. If you mount the Sensor with screws, use M3 screws, spring washers, and flat washers and use a tightening torque of 0.5 N·m max.
 4. You should use the product in the condition without any stress on the cable.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

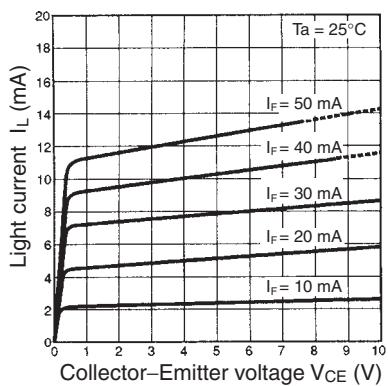
Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F 1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R 0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P 940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L 0.5 mA min., 14 mA max.	$I_F = 20 \text{ mA}, V_{CE} = 10 \text{ V}$
	Dark current	I_D 2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lux}$
	Leakage current	I_{LEAK} ---	---
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$ 0.1 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 0.1 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_P 850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time	tr	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$
Falling time	tf	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$

■ Engineering Data

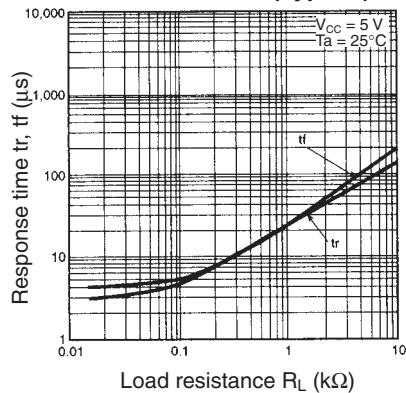
Forward Current vs. Collector Dissipation Temperature Rating



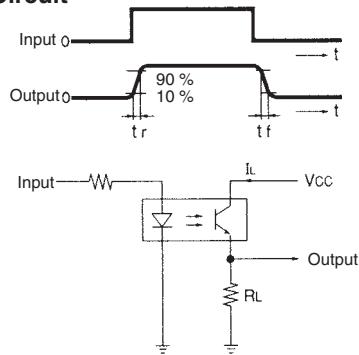
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



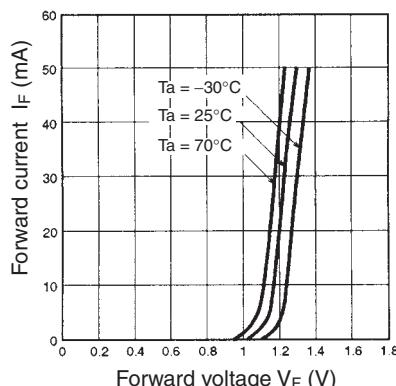
Response Time vs. Load Resistance Characteristics (Typical)



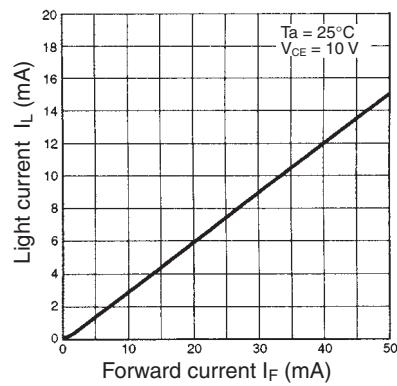
Response Time Measurement Circuit



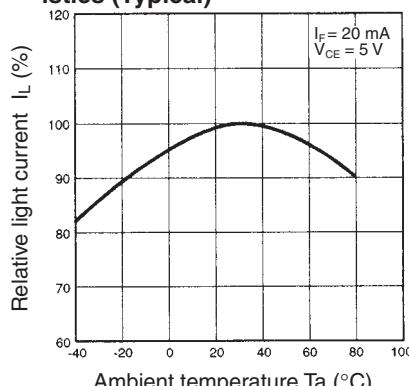
Forward Current vs. Forward Voltage Characteristics (Typical)



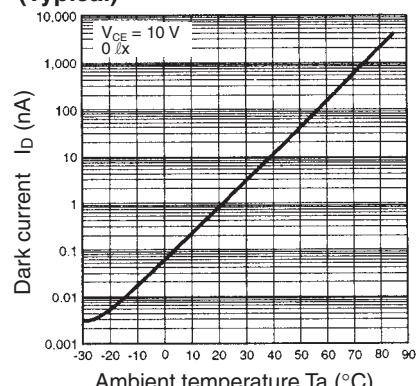
Light Current vs. Forward Current Characteristics (Typical)



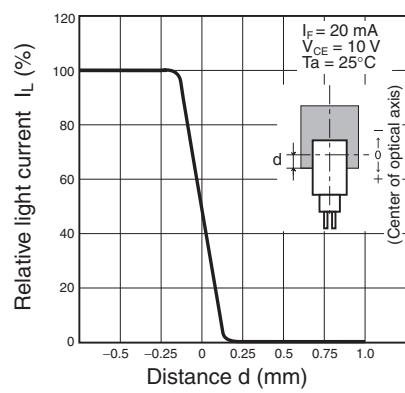
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



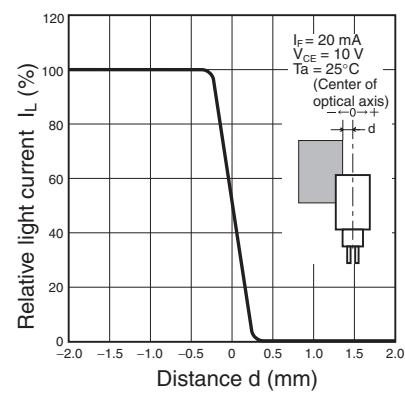
Dark Current vs. Ambient Temperature Characteristics (Typical)



Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)

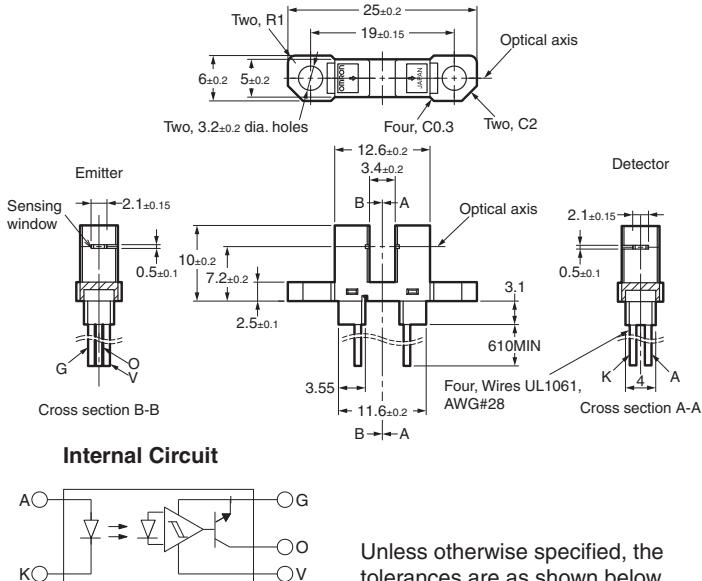


Photomicrosensor (Transmissive) EE-SX3096-W11/4096-W11

⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Unless otherwise specified, the tolerances are as shown below.

Terminal No.	Name
A	Anode
K	Cathode
V	Power supply (Vcc)
O	Output (OUT)
G	Ground (GND)

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

Features

- Light-receiving element and amplification circuits contained in one chip.
- Can use a power supply voltage of 4.5 to 16 V.
- Connects directly to C-MOS or TTL.
- Dark-ON Sensor: EE-SX3096-W11
- Light-ON Sensor: EE-SX4096-W11
- Pre-wired Sensors (AWG28).
- Solder-less lead wire connection to increase reliability.
- With a horizontal aperture.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item		Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Reverse voltage	V_R	4 V
Detector	Power supply voltage	V_{CC}	16 V
	Output voltage	V_{OUT}	28 V
	Output current	I_{OUT}	16 mA
	Permissible output dissipation	P_{OUT}	250 mW (see note 1)
Ambient temperature	Operating	T_{opr}	-25°C to 75°C
	Storage	T_{stg}	-25°C to 85°C

Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

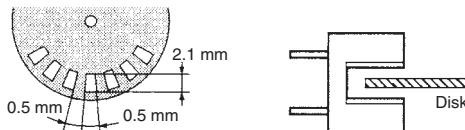
2. If you mount the Sensor with screws, use M3 screws, spring washers, and flat washers and use a tightening torque of 0.5 N·m max.
3. You should use the product in the condition without any stress on the cable.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

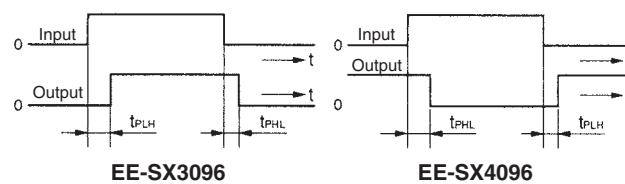
Item		Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.	$I_F = 20 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P	940 nm	$I_F = 20 \text{ mA}$
Detector	Low-level output voltage	V_{OL}	0.12 V typ., 0.4 V max.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}, I_{OL} = 16 \text{ mA}, I_F = 0 \text{ mA}$ (EE-SX3096), $I_F = 5 \text{ mA}$ (EE-SX4096)
	High-level output voltage	V_{OH}	15 V min.	$V_{CC} = 16 \text{ V}, R_L = 1 \text{ k}\Omega, I_F = 5 \text{ mA}$ (EE-SX3096), $I_F = 0 \text{ mA}$ (EE-SX4096)
	Current consumption	I_{CC}	3.2 mA typ., 10 mA max.	$V_{CC} = 16 \text{ V}$
	Peak spectral sensitivity wavelength	λ_P	870 nm	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$
LED current when output is OFF	I_{FT}	2 mA typ., 5 mA max.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$	
LED current when output is ON				
Hysteresis	ΔH	15% typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$ (see note 1)	
Response frequency	f	3kHz min.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}, I_F = 15 \text{ mA}, I_{OL} = 16 \text{ mA}$ (see note 2)	
Response delay time	t_{PLH} (t_{PHL})	3 μs typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}, I_F = 15 \text{ mA}, I_{OL} = 16 \text{ mA}$ (see note 3)	
Response delay time	t_{PHL} (t_{PLH})	20 μs typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}, I_F = 15 \text{ mA}, I_{OL} = 16 \text{ mA}$ (see note 3)	

Note: 1. Hysteresis denotes the difference in forward LED current value, expressed in percentage, calculated from the respective forward LED currents when the photo IC is turned from ON to OFF and when the photo IC is turned from OFF to ON.

2. The value of the response frequency is measured by rotating the disk as shown below.



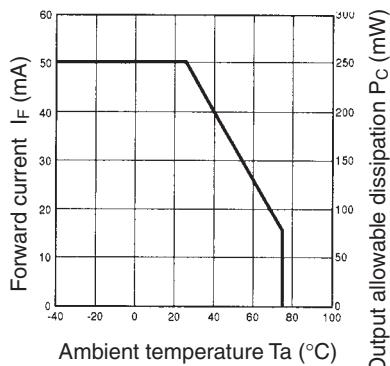
3. The following illustrations show the definition of response delay time. The value in the parentheses applies to the EE-SX4096.



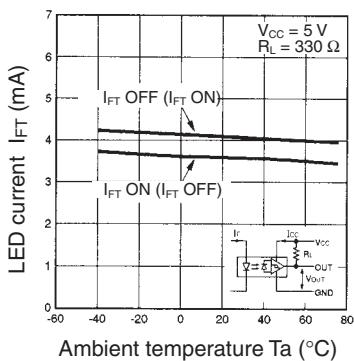
■ Engineering Data

Note: The values in the parentheses apply to the EE-SX4096.

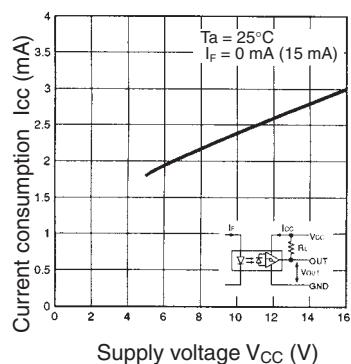
Forward Current vs. Collector Dissipation Temperature Rating



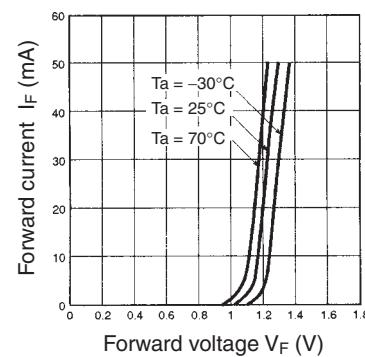
LED Current vs. Ambient Temperature Characteristics (Typical)



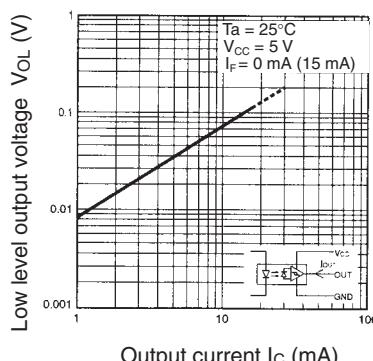
Current Consumption vs. Supply Voltage (Typical)



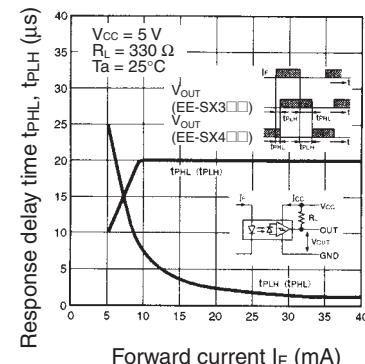
Forward Current vs. Forward Voltage Characteristics (Typical)



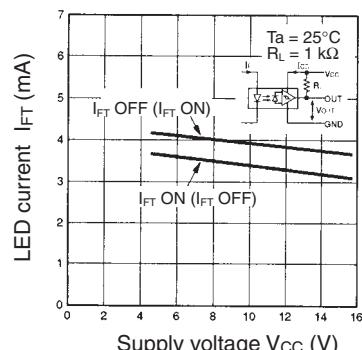
Low-level Output Voltage vs. Output Current (Typical)



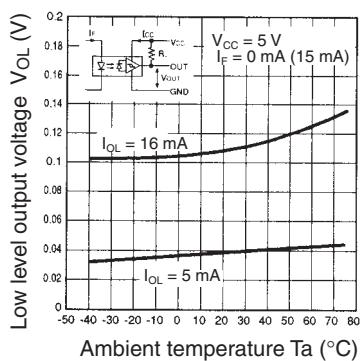
Response Delay Time vs. Forward Current (Typical)



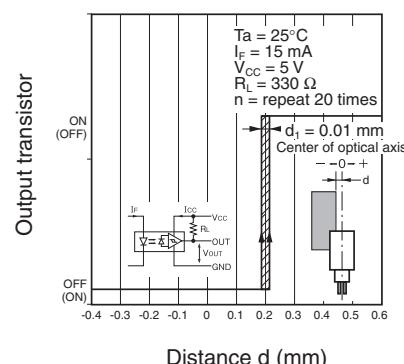
LED Current vs. Supply Voltage (Typical)



Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



Repeat Sensing Position Characteristics (Typical)

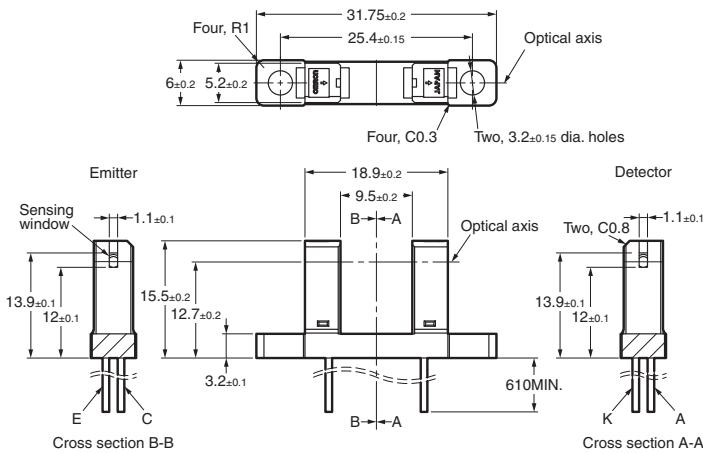


Photomicrosensor (Transmissive) EE-SX1160-W11

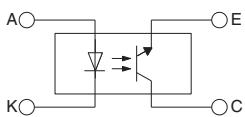
⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

Features

- Wide model with a 9.5-mm-wide slot.
- Pre-wired Sensors (AWG28).
- Solder-less lead wire connection to increase reliability.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Pulse forward current	I_{FP}	1 A (see note 2)
	Reverse voltage	V_R	4 V
Detector	Collector-Emitter voltage	V_{CEO}	30 V
	Emitter-Collector voltage	V_{ECO}	5 V
	Collector current	I_C	20 mA
	Collector dissipation	P_C	100 mW (see note 1)
Ambient temperature	Operating	T_{opr}	-25°C to 80°C
	Storage	T_{stg}	-25°C to 85°C

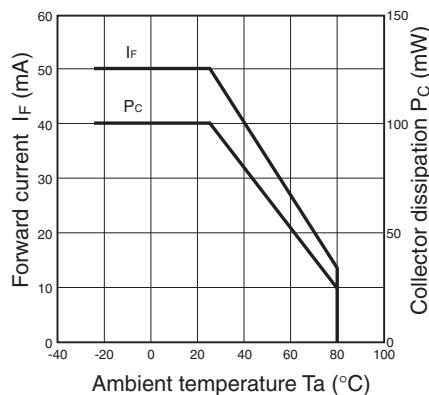
- Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
 3. If you mount the Sensor with screws, use M3 screws, and flat washers and use a tightening torque of 0.5 N·m max.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

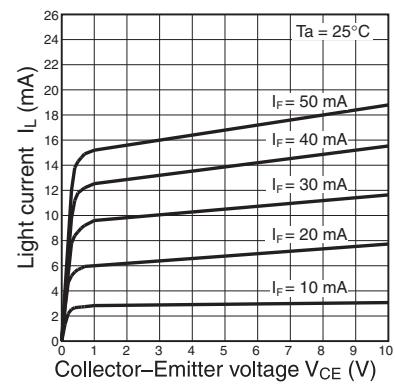
	Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P	920 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L	3.5 mA min., 16 mA max.	$I_F = 20 \text{ mA}, V_{CE} = 10 \text{ V}$
	Dark current	I_D	2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lux}$
	Leakage current	I_{LEAK}	---	---
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$	0.15 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 0.1 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time		t_r	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$
Falling time		t_f	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$

■ Engineering Data

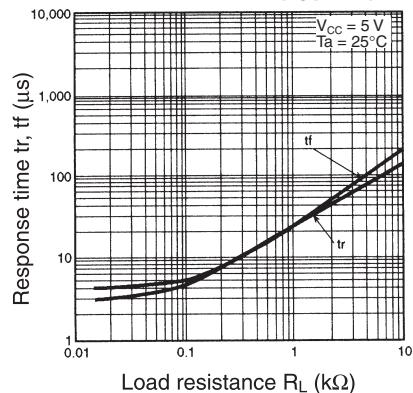
Forward Current vs. Collector Dissipation Temperature Rating



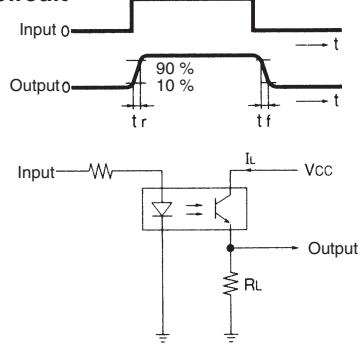
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



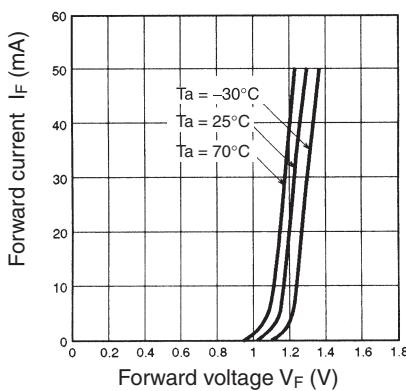
Response Time vs. Load Resistance Characteristics (Typical)



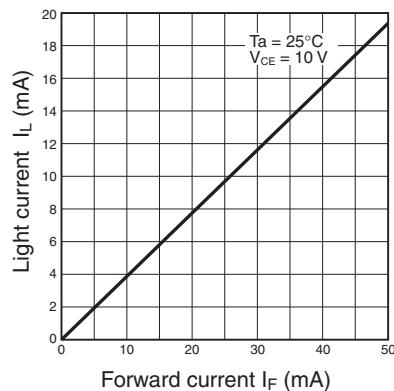
Response Time Measurement Circuit



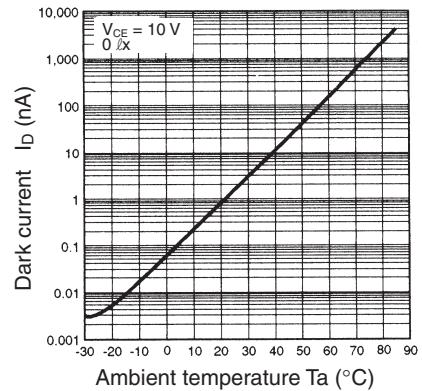
Forward Current vs. Forward Voltage Characteristics (Typical)



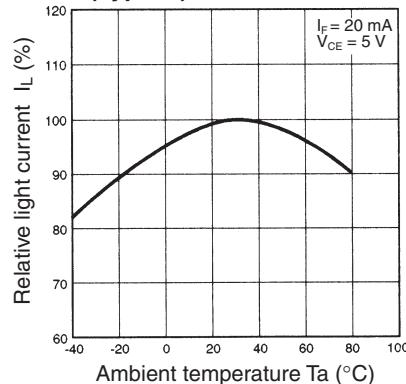
Light Current vs. Forward Current Characteristics (Typical)



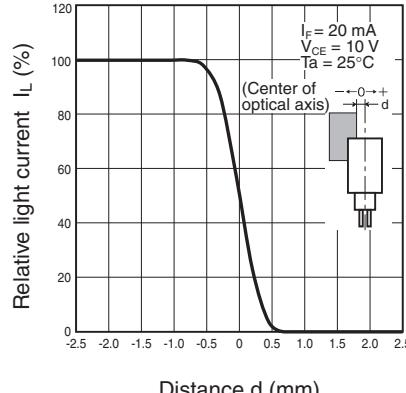
Dark Current vs. Ambient Temperature Characteristics (Typical)



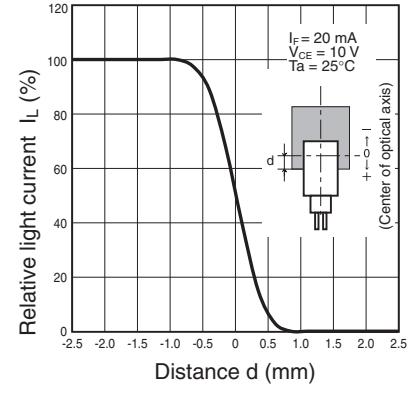
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)

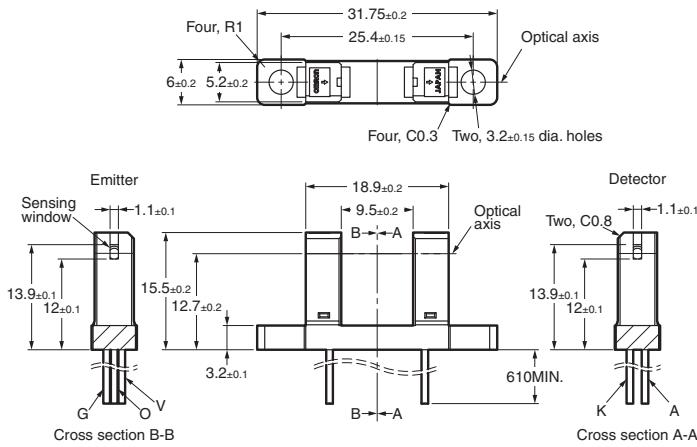


Photomicrosensor (Transmissive) EE-SX3160-W11/4160-W11

⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit

Unless otherwise specified, the tolerances are as shown below.

Terminal No.	Name
A	Anode
K	Cathode
V	Power supply (V _{CC})
O	Output (OUT)
G	Ground (GND)

Features

- Wide model with a 9.5-mm-wide slot.
- Light-receiving element and amplification circuits contained in one chip.
- Can use a power supply voltage of 4.5 to 16 V.
- Connects directly to C-MOS or TTL.
- Dark-ON Sensor: EE-SX3160-W11
- Light-ON Sensor: EE-SX4160-W11
- Pre-wired Sensors (AWG28).
- Solder-less lead wire connection to increase reliability.

Absolute Maximum Ratings (Ta = 25°C)

Item		Symbol	Rated value
Emitter	Forward current	I _F	50 mA (see note 1)
	Reverse voltage	V _R	4 V
Detector	Power supply voltage	V _{CC}	16 V
	Output voltage	V _{OUT}	28 V
	Output current	I _{OUT}	16 mA
	Permissible output dissipation	P _{OUT}	250 mW (see note 1)
Ambient temperature	Operating	T _{opr}	-25°C to 75°C
	Storage	T _{stg}	-25°C to 85°C

Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

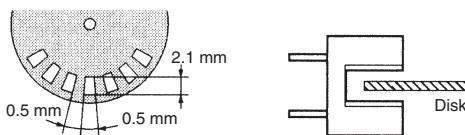
2. If you mount the Sensor with screws, use M3 screws, and flat washers and use a tightening torque of 0.5 N·m max.

Electrical and Optical Characteristics (Ta = 25°C)

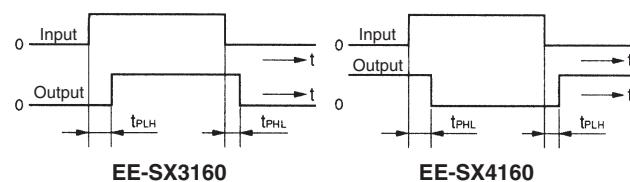
Item	Symbol	Value	Condition
Emitter	Forward voltage	V _F	1.2 V typ., 1.5 V max.
	Reverse current	I _R	0.01 μA typ., 10 μA max.
	Peak emission wavelength	λ _P	920 nm
Detector	Low-level output voltage	V _{OL}	0.12 V typ., 0.4 V max.
	High-level output voltage	V _{OH}	15 V min.
	Current consumption	I _{CC}	3.2 mA typ., 10 mA max.
	Peak spectral sensitivity wavelength	λ _P	870 nm
LED current when output is OFF	I _{FT}	2 mA typ., 10 mA max.	V _{CC} = 4.5 to 16 V
LED current when output is ON			
Hysteresis	ΔH	15% typ.	V _{CC} = 4.5 to 16 V (see note 1)
Response frequency	f	3kHz min.	V _{CC} = 4.5 to 16 V, I _F = 15 mA, I _{OL} = 16 mA (see note 2)
Response delay time	t _{PLH} (t _{PHL})	3 μs typ.	V _{CC} = 4.5 to 16 V, I _F = 15 mA, I _{OL} = 16 mA (see note 3)
Response delay time	t _{PHL} (t _{PLH})	20 μs typ.	V _{CC} = 4.5 to 16 V, I _F = 15 mA, I _{OL} = 16 mA (see note 3)

Note: 1. Hysteresis denotes the difference in forward LED current value, expressed in percentage, calculated from the respective forward LED currents when the photo IC is turned from ON to OFF and when the photo IC is turned from OFF to ON.

2. The value of the response frequency is measured by rotating the disk as shown below.



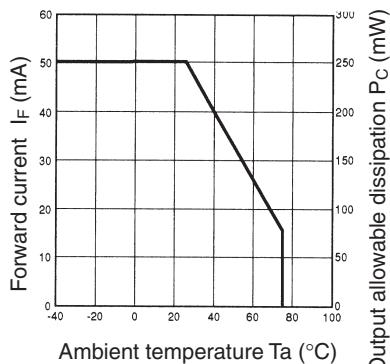
3. The following illustrations show the definition of response delay time. The value in the parentheses applies to the EE-SX4160.



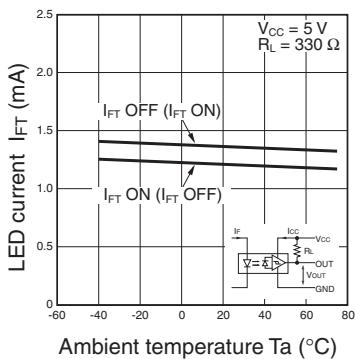
■ Engineering Data

Note: The values in the parentheses apply to the EE-SX4160.

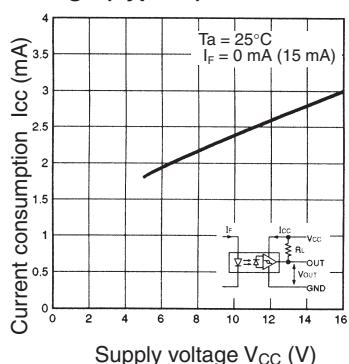
Forward Current vs. Collector Dissipation Temperature Rating



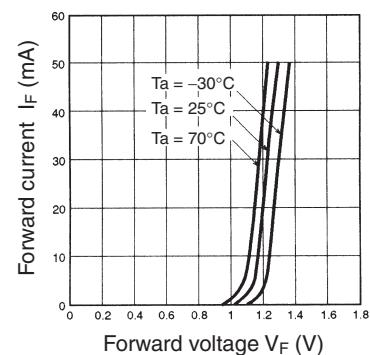
LED Current vs. Ambient Temperature Characteristics (Typical)



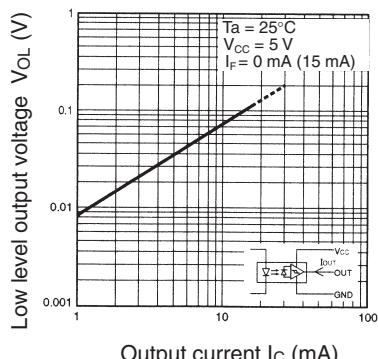
Current Consumption vs. Supply Voltage (Typical)



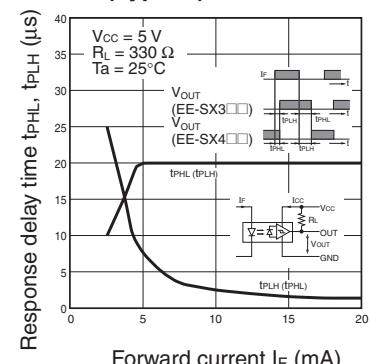
Forward Current vs. Forward Voltage Characteristics (Typical)



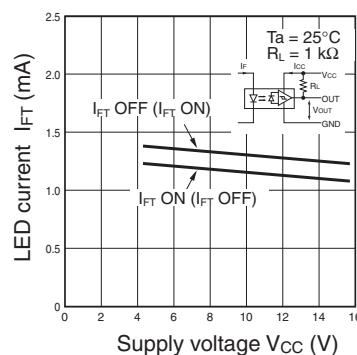
Low-level Output Voltage vs. Output Current (Typical)



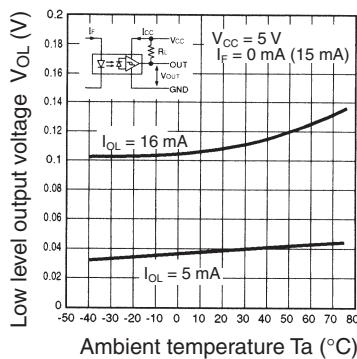
Response Delay Time vs. Forward Current (Typical)



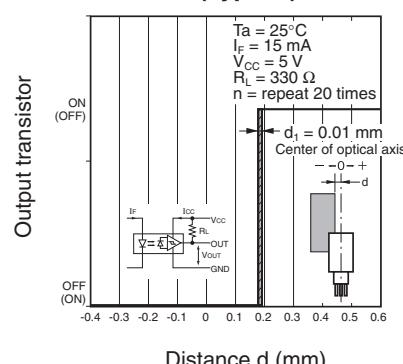
LED Current vs. Supply Voltage (Typical)



Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



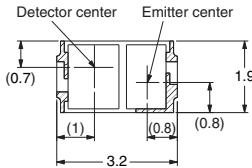
Repeat Sensing Position Characteristics (Typical)



Photomicrosensor (Reflective) EE-SY1200

⚠ Be sure to read *Precautions* on page 24.

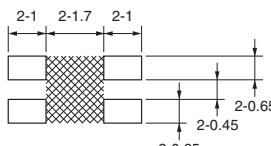
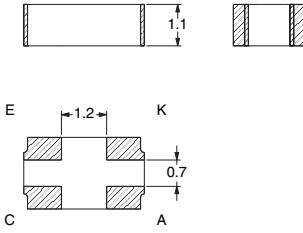
Dimensions



Note:

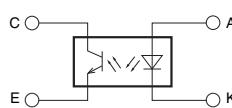
Unless otherwise specified tolerances are ± 0.15 .
No burrs dimensions are included in outline dimensions.
The burrs dimensions are 0.15 MAX.
Diagonal line indicate the region is part Au plating area.

Recommended Soldering Pattern



- Note:**
- The shaded portion in the above figure may cause shorting. Do not wire in this portion.
 - The dimensional tolerance for the recommended soldering pattern is ± 0.1 mm.

Internal Circuit



Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Features

- Ultra-compact model.
- PCB surface mounting type.
- High S/N ratio
(High light current / Low leakage current)
- Recommended sensing distance = 1.0 to 4.0 mm

Absolute Maximum Ratings (Ta=25°C)

	Item	Symbol	Rated value	Unit
Emitter	Forward current	I _F	50 ¹	mA
	Pulse forward current	I _{FP}	500 ²	mA
	Reverse voltage	V _R	4	V
Detector	Collector-Emitter voltage	V _{CEO}	30	V
	Emitter-Collector voltage	V _{ECO}	5	V
	Collector current	I _C	20	mA
	Collector dissipation	P _C	50 ¹	mW
Operating temperature		T _{opr}	-25 to +85	°C
Storage temperature		T _{stg}	-40 to +100	°C
Reflow soldering temperature		T _{sol}	240 ³	°C

¹ Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

² The pulse width is 10 µs maximum with a frequency of 100 Hz.

³ Complete soldering within 10 seconds for reflow soldering.

Electrical and Optical Characteristics (Ta=25°C)

Item		Symbol	Value			Unit	Condition
			MIN.	TYP.	MAX.		
Emitter	Forward voltage	V _F	---	1.2	1.4	V	I _F = 20 mA
	Reverse current	I _R	---	---	10	µA	V _R = 4 V
	Peak emission wavelength	λ _P	---	940	---	nm	---
Detector	Light current 1	I _{L1}	200	---	1000	µA	I _F = 10 mA, V _{CE} = 2 V, Aluminum-deposited surface, d = 4 mm ^{*1}
	Light current 2	I _{L2}	150	---	---	µA	I _F = 4 mA, V _{CE} = 2 V, Aluminum-deposited surface, d = 1 mm ^{*1}
	Dark current	I _D	---	2	200	nA	V _{CE} = 10 V, 0 lx
	Leakage current 1	I _{LEAK1}	---	---	500	nA	I _F = 10 mA, V _{CE} = 2 V, with no reflection ^{*2}
	Leakage current 2	I _{LEAK2}	---	---	200	nA	I _F = 4 mA, V _{CE} = 2 V, with no reflection ^{*2}
	Collector-Emitter saturated voltage	V _{CE} (sat)	---	---	---	V	---
	Peak spectral sensitivity wavelength	λ _P	---	850	---	nm	---
Rising time		tr	---	30	---	µs	V _{CC} = 2 V, R _L = 1 kΩ, I _L = 100 µA, d = 1 mm ^{*1}
Falling time		t _f	---	30	---	µs	V _{CC} = 2 V, R _L = 1 kΩ, I _L = 100 µA, d = 1 mm ^{*1}

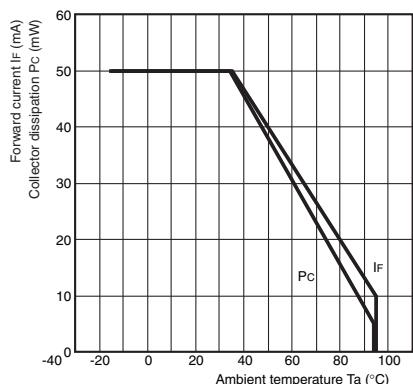
*1. The letter "d" indicates the distance between the top surface of the sensor and the sensing object.

*2. Depends on the installed condition of the Photomicrosensor, the detector may receive the sensor's LED light and/or the external light which is reflected from surroundings of the Photomicrosensor and/or the background object.

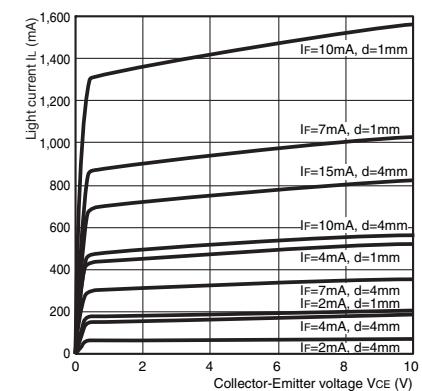
Please confirm the condition of the Photomicrosensor by actual intended application prior to the mass production use.

■ Engineering Data

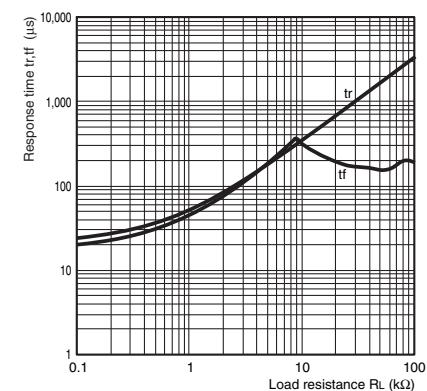
Forward Current vs. Collector Dissipation Temperature Rating



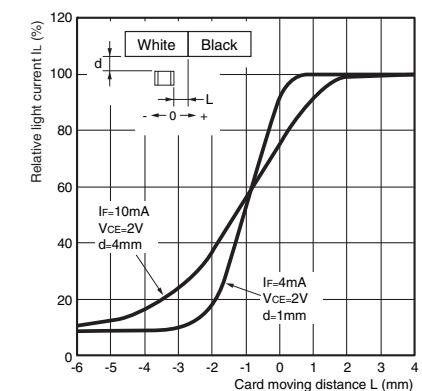
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



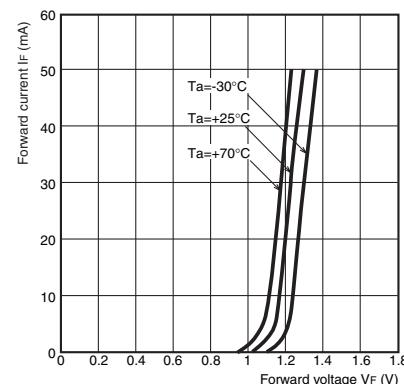
Response Time vs. Load Resistance Characteristics (Typical)



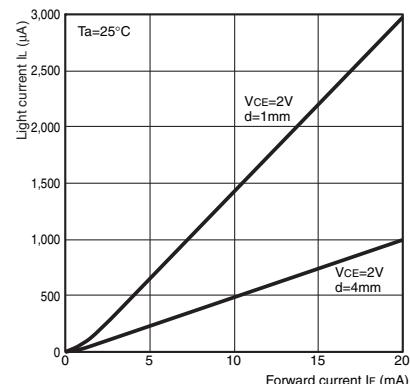
Sensing Position Characteristics (Typical)



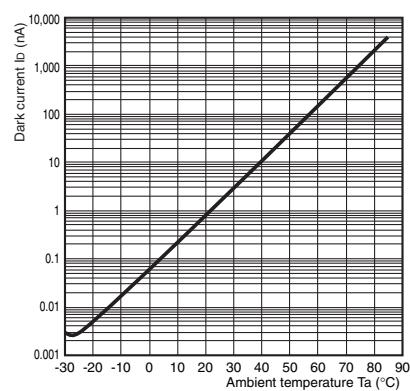
Forward Current vs. Forward Voltage Characteristics (Typical)



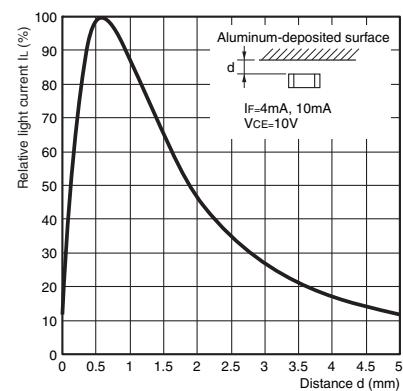
Light Current vs. Forward Current Characteristics (Typical)



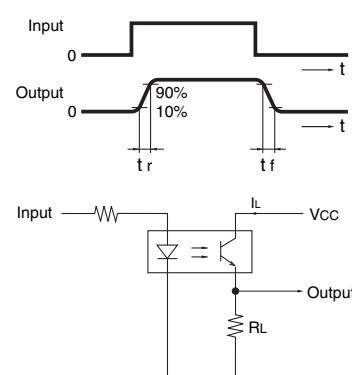
Dark Current vs. Ambient Temperature Characteristics (Typical)



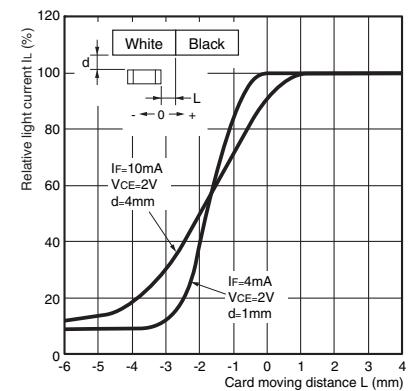
Sensing Distance Characteristics (Typical)



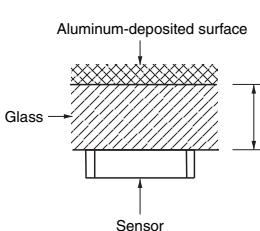
Response Time Measurement Circuit



Sensing Position Characteristics (Typical)

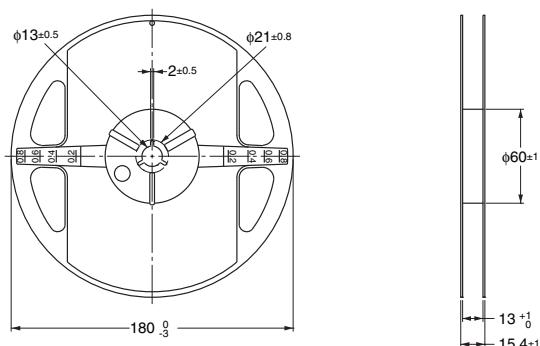


Light Current Measurement Setup Diagram

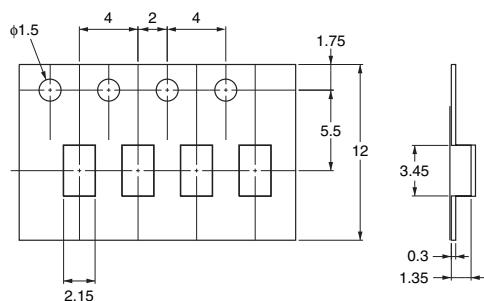


■ Tape and Reel

Reel Dimension (Unit: mm)

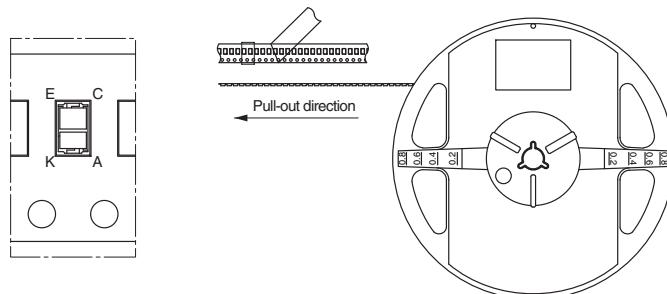


Tape Dimension (Unit: mm)



Part Mounting Direction

- The devices are oriented in the rectangular holes in the carrier tape so that the edge with the LED faces the round feeding holes.



Tape Quantity

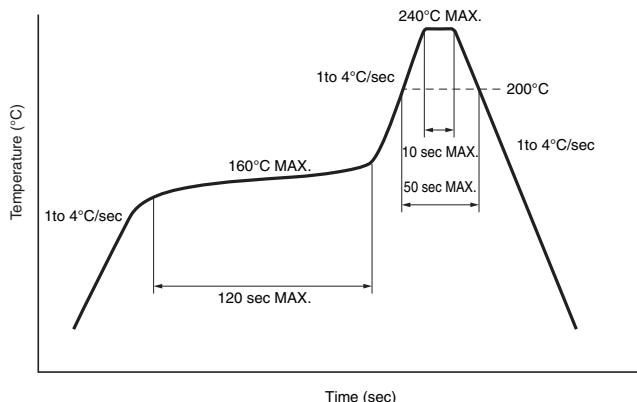
2,000 pcs./reel

■ Precautions to be taken on mounting

Temperature Profile

The reflow soldering can be implemented in two times complying with the following diagram.

All the temperatures in the product must be within the diagram.



Manual soldering

The manual soldering cannot be applied to the products.

There is a possibility that the housing is deformed and/or Au plating is peeled off by heat.

Other Notes

The use of infrared lamp causes the temperature at the resin to rise particularly too high.

All the temperatures in the product must be within the above diagram.

Do not immerse the resin part into the solder.

Even if within the above temperature diagram, there is a possibility that the gold wire in the products is broken in case that the deformation of PCB gives the stress to the product terminals.

Please confirm the conditions of the reflow soldering fully by actual solder reflow machine prior to the mass production use.

■ Storage and Handling after Opening

Storage Conditions

In order to avoid the absorption of moisture, the products shall be stored in a dry box with desiccant or in the following conditions.

Storage temp. : 5 to 30°C

Storage humidity : 70%RH or less

Treatment after Opening

1. Reflow soldering must be done within 48 hours stored at the conditions of humidity 60%RH or less and temperature 5 to 25°C.
2. In case of long time storage after open, please mount at the conditions of humidity 70%RH or less and temperature 5 to 30°C within 1 week by using dry box or resealing with desiccant in moisture-proof bag by sealer.

Baking before Mounting

In case that it could not carry out the above treatment, it is able to mount by baking treatment.

However baking treatment shall be limited only 1 time.

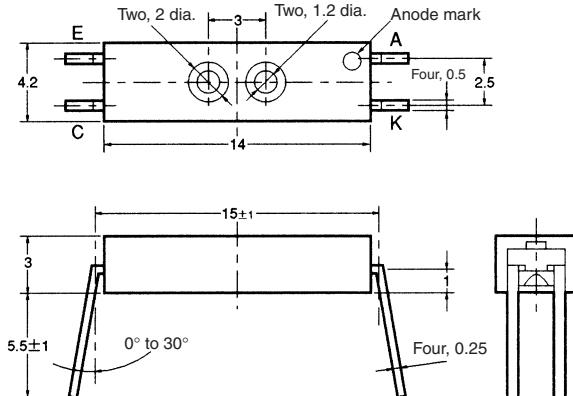
Recommended conditions : 60°C, 12 to 24 hours (reeled one)
100°C, 8 to 24 hours (loose one)

Photomicrosensor (Reflective) EE-SY171

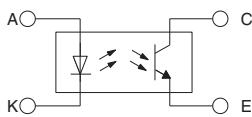
⚠ Be sure to read *Precautions* on page 24.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are as shown below.

Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

■ Features

- 3-mm-tall, thin model
- Recommended sensing distance = 3.5 mm

■ Absolute Maximum Ratings (Ta = 25°C)

	Item	Symbol	Rated value
Emitter	Forward current	I _F	50 mA (see note 1)
	Pulse forward current	I _{FP}	1 A (see note 2)
	Reverse voltage	V _R	4 V
Detector	Collector-Emitter voltage	V _{CEO}	30 V
	Emitter-Collector voltage	V _{ECO}	---
	Collector current	I _C	20 mA
	Collector dissipation	P _C	100 mW (see note 1)
	Ambient temperature	Operating	-40°C to 85°C
	Storage		-40°C to 85°C
	Soldering temperature	T _{SOL}	260°C (see note 3)

- Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 2. The pulse width is 10 µs maximum with a frequency of 100 Hz.
 3. Complete soldering within 10 seconds.

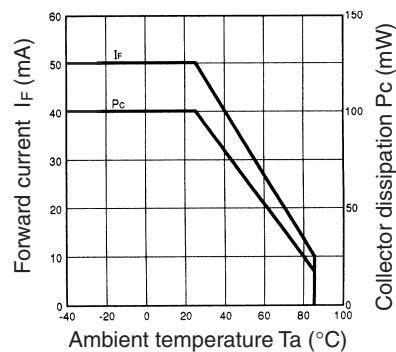
■ Electrical and Optical Characteristics (Ta = 25°C)

	Item	Symbol	Value	Condition
Emitter	Forward voltage	V _F	1.2 V typ., 1.5 V max.	I _F = 30 mA
	Reverse current	I _R	0.01 µA typ., 10 µA max.	V _R = 4 V
	Peak emission wavelength	λ _P	940 nm typ.	I _F = 20 mA
Detector	Light current	I _L	50 µA min., 500 µA max.	I _F = 20 mA, V _{CE} = 10 V White paper with a reflection ratio of 90%, d = 3.5 mm (see note)
	Dark current	I _D	2 nA typ., 200 nA max.	V _{CE} = 10 V, 0 lux
	Leakage current	I _{LEAK}	2 µA max.	I _F = 20 mA, V _{CE} = 10 V with no reflection
	Collector-Emitter saturated voltage	V _{CE} (sat)	---	---
	Peak spectral sensitivity wavelength	λ _P	850 nm typ.	V _{CE} = 10 V
	Rising time	tr	30 µs typ.	V _{CC} = 5 V, R _L = 1 kΩ, I _L = 1 mA
Falling time		tf	30 µs typ.	V _{CC} = 5 V, R _L = 1 kΩ, I _L = 1 mA

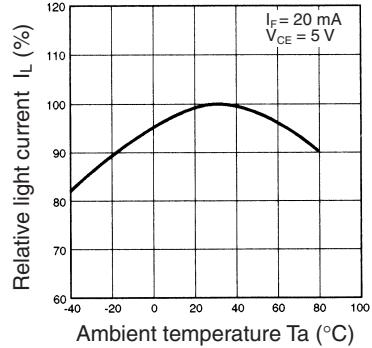
Note: The letter "d" indicates the distance between the top surface of the sensor and the sensing object.

■ Engineering Data

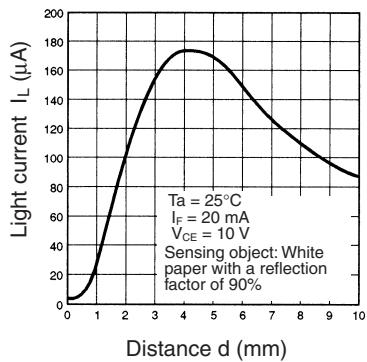
Forward Current vs. Collector Dissipation Temperature Rating



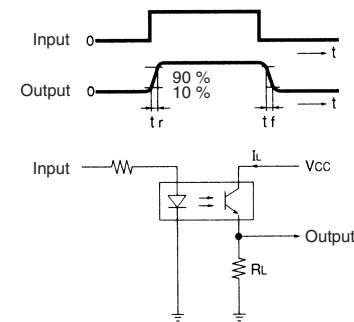
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



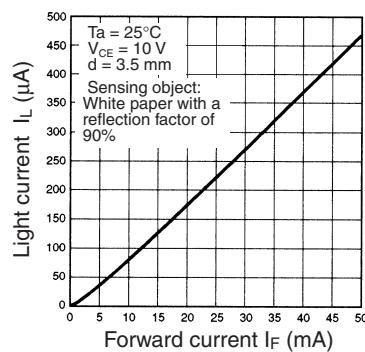
Sensing Distance Characteristics (Typical)



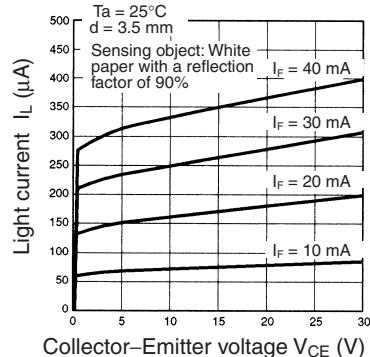
Response Time Measurement Circuit



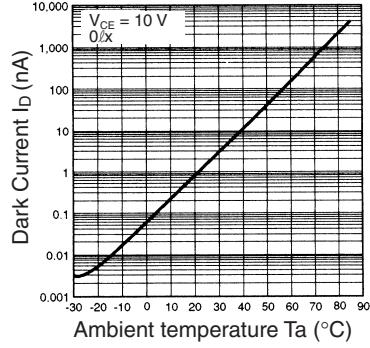
Light Current vs. Forward Current Characteristics (Typical)



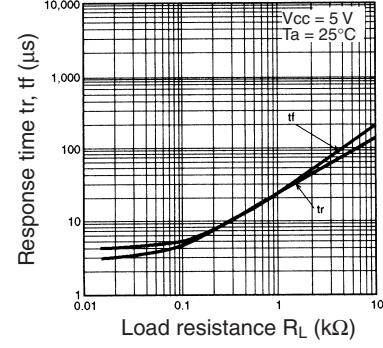
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



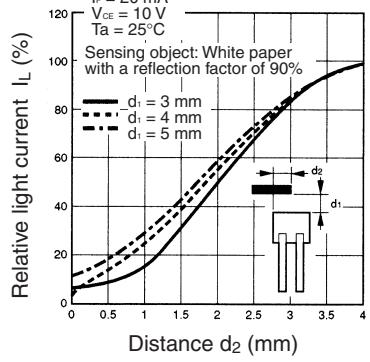
Dark Current vs. Ambient Temperature Characteristics (Typical)



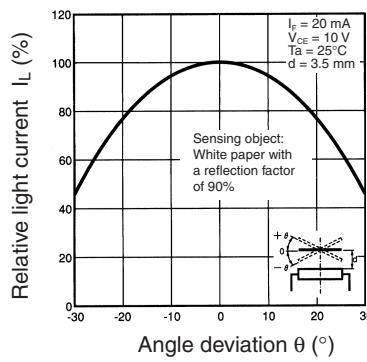
Response Time vs. Load Resistance Characteristics (Typical)



Sensing Position Characteristics (Typical)



Sensing Angle Characteristics (Typical)

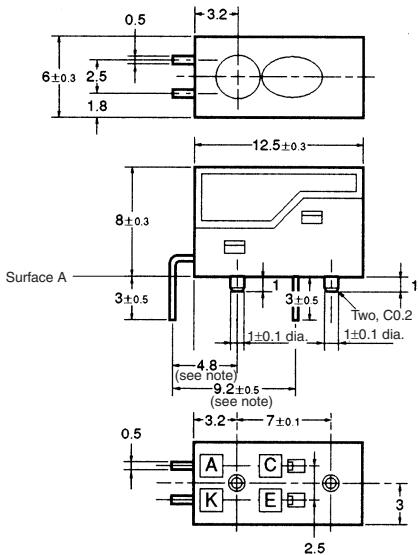


Photomicrosensor (Reflective) EE-SY169

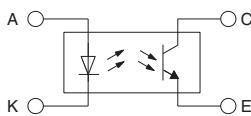
⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Note: These dimensions are for the surface A. Other lead wire pitch dimensions are for the housing surface.

Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

Features

- High-quality model with plastic lenses.
- Highly precise sensing range with a tolerance of ±0.6 mm horizontally and vertically.
- With a red LED sensing dyestuff-type inks.
- Limited reflective model.
- Recommended sensing distance = 4.0 mm
- For lesser LED forward current the EE-SY169B would be a better choice.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	40 mA (see note 1)
	Pulse forward current	I_{FP}	300 mA (see note 2)
	Reverse voltage	V_R	3 V
Detector	Collector-Emitter voltage	V_{CEO}	30 V
	Emitter-Collector voltage	V_{ECO}	---
	Collector current	I_C	20 mA
	Collector dissipation	P_C	100 mW (see note 1)
Ambient temperature	Operating	T_{opr}	0°C to 70°C
	Storage	T_{stg}	-20°C to 80°C
Soldering temperature		T_{sol}	260°C (see note 3)

Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

2. The pulse width is 10 μs maximum with a frequency of 100 Hz.

3. Complete soldering within 10 seconds.

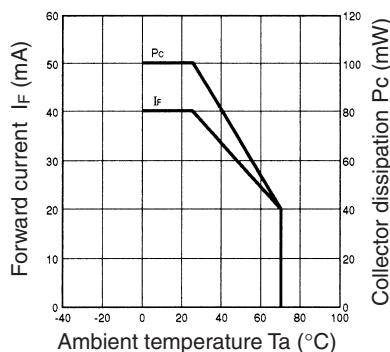
Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

Item		Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.85 V typ., 2.3 V max.	$I_F = 20 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 3 \text{ V}$
	Peak emission wavelength	λ_p	660 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L	160 μA min., 2,000 μA max.	$I_F = 20 \text{ mA}, V_{CE} = 5 \text{ V}$ White paper with a reflection ratio of 90%, $d = 4 \text{ mm}$ (see note)
	Dark current	I_D	2 nA typ., 200 nA max.	$V_{CE} = 5 \text{ V}, 0 \text{ lux}$
	Leakage current	I_{LEAK}	2 μA max.	$I_F = 20 \text{ mA}, V_{CE} = 5 \text{ V}$ with no reflection
	Collector-Emitter saturated voltage	$V_{CE}(\text{sat})$	---	---
	Peak spectral sensitivity wavelength	λ_p	850 nm typ.	$V_{CE} = 5 \text{ V}$
	Rising time	t_r	30 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 1 \text{ k}\Omega, I_L = 1 \text{ mA}$
Falling time		t_f	30 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 1 \text{ k}\Omega, I_L = 1 \text{ mA}$

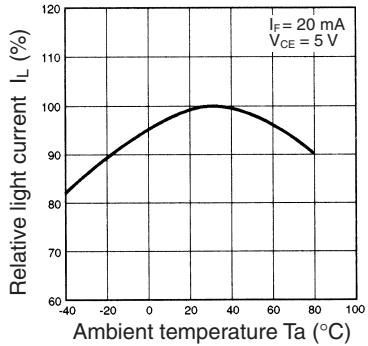
Note: The letter "d" indicates the distance between the top surface of the sensor and the sensing object.

■ Engineering Data

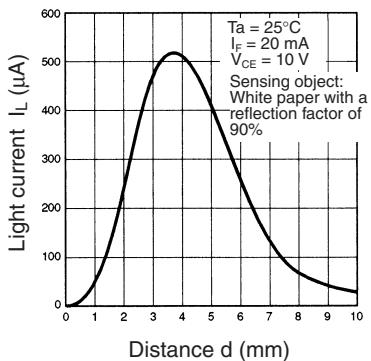
Forward Current vs. Collector Dissipation Temperature Rating



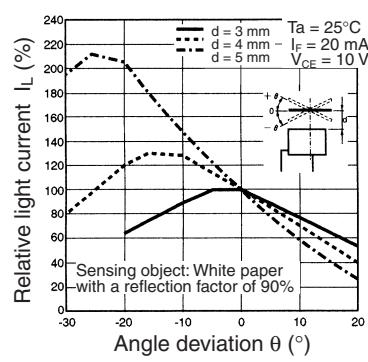
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



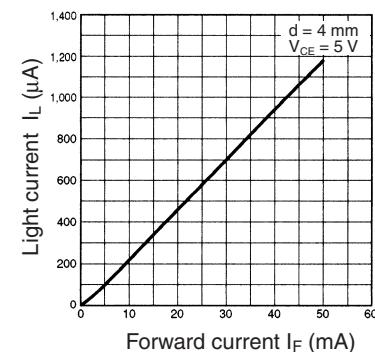
Sensing Distance Characteristics (Typical)



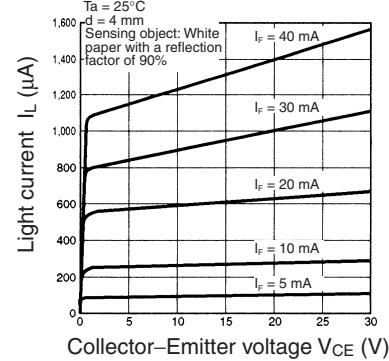
Sensing Angle Characteristics (Typical)



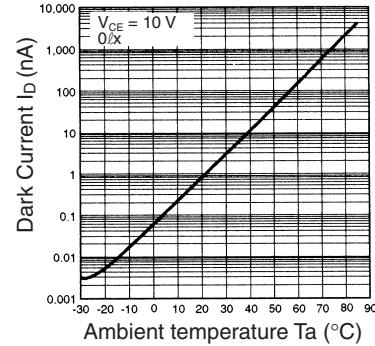
Light Current vs. Forward Current Characteristics (Typical)



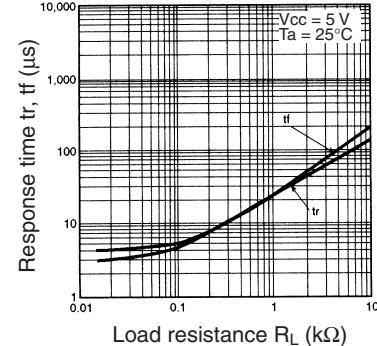
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



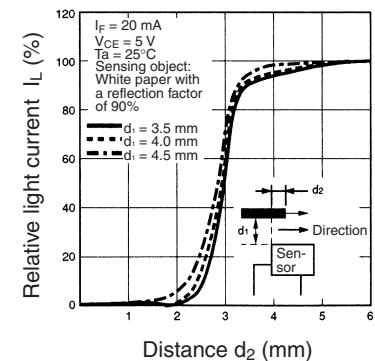
Dark Current vs. Ambient Temperature Characteristics (Typical)



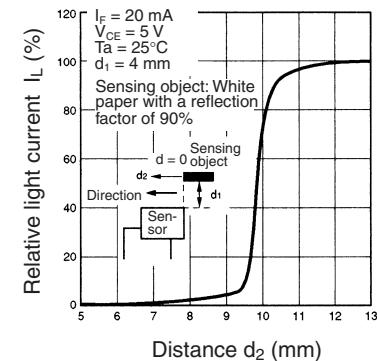
Response Time vs. Load Resistance Characteristics (Typical)



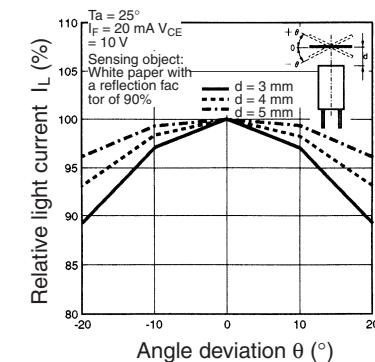
Sensing Position Characteristics (Typical)



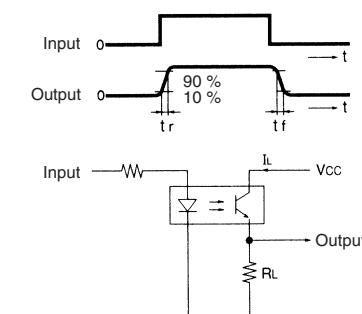
Sensing Position Characteristics (Typical)



Sensing Angle Characteristics (Typical)



Response Time Measurement Circuit

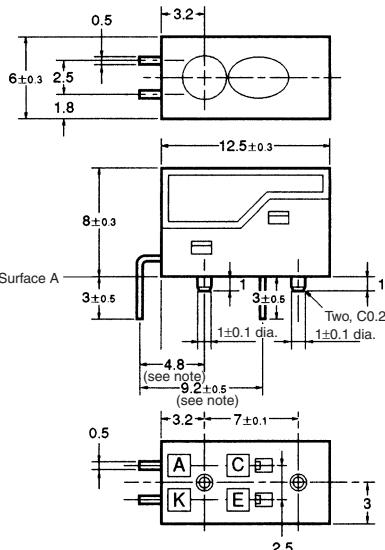


Photomicrosensor (Reflective) EE-SY169A

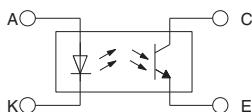
⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Note: These dimensions are for the surface A. Other lead wire pitch dimensions are for the housing surface.

Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

Features

- High-quality model with plastic lenses.
- Highly precise sensing range with a tolerance of ±0.6 mm horizontally and vertically.
- Convergent reflective model with infrared LED.
- Recommended sensing distance = 4.0 mm

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rated value
Emitter	Forward current	I_F 50 mA (see note 1)
	Pulse forward current	I_{FP} 1 A (see note 2)
	Reverse voltage	V_R 3 V
Detector	Collector-Emitter voltage	V_{CEO} 30 V
	Emitter-Collector voltage	V_{ECO} ---
	Collector current	I_C 20 mA
	Collector dissipation	P_C 100 mW (see note 1)
Ambient temperature	Operating	T_{opr} 0°C to 70°C
	Storage	T_{stg} -20°C to 80°C
Soldering temperature	T_{sol}	260°C (see note 3)

Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

- The pulse width is 10 μs maximum with a frequency of 100 Hz.
- Complete soldering within 10 seconds.

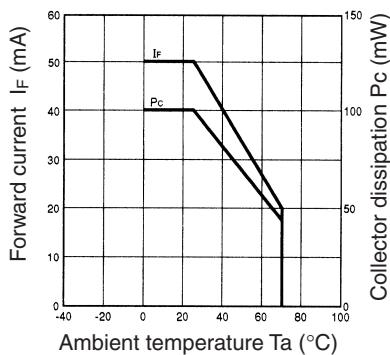
Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P 920 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L 160 μA min., 2,000 μA max.	$I_F = 20 \text{ mA}$, $V_{CE} = 5 \text{ V}$ White paper with a reflection ratio of 90%, $d = 4 \text{ mm}$ (see note)
	Dark current	I_D 2 nA typ., 200 nA max.	$V_{CE} = 5 \text{ V}$, 0 lux
	Leakage current	I_{LEAK} 2 μA max.	$I_F = 20 \text{ mA}$, $V_{CE} = 5 \text{ V}$ with no reflection
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$ ---	---
	Peak spectral sensitivity wavelength	λ_P 850 nm typ.	$V_{CE} = 5 \text{ V}$
Rising time	t_r	30 μs typ.	$V_{CC} = 5 \text{ V}$, $R_L = 1 \text{ k}\Omega$, $I_L = 1 \text{ mA}$
Falling time	t_f	30 μs typ.	$V_{CC} = 5 \text{ V}$, $R_L = 1 \text{ k}\Omega$, $I_L = 1 \text{ mA}$

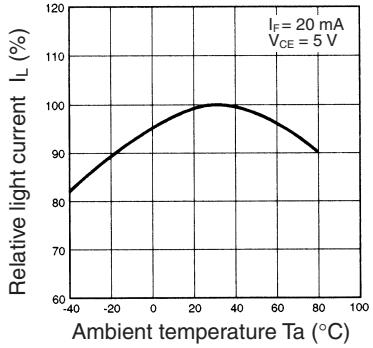
Note: The letter "d" indicates the distance between the top surface of the sensor and the sensing object.

■ Engineering Data

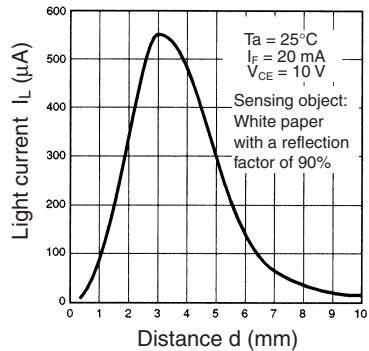
Forward Current vs. Collector Dissipation Temperature Rating



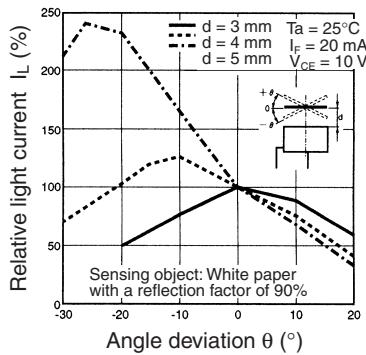
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



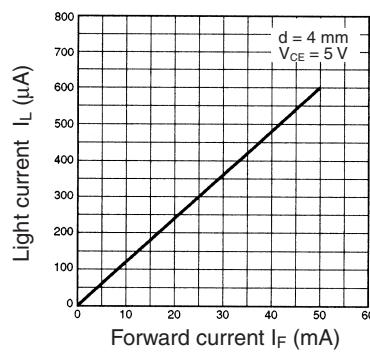
Sensing Distance Characteristics (Typical)



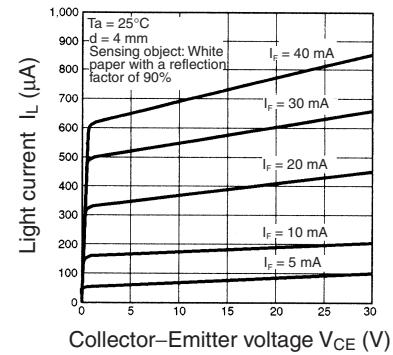
Sensing Angle Characteristics (Typical)



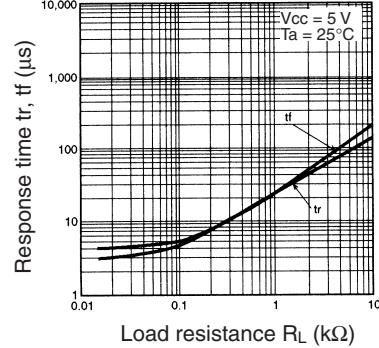
Light Current vs. Forward Current Characteristics (Typical)



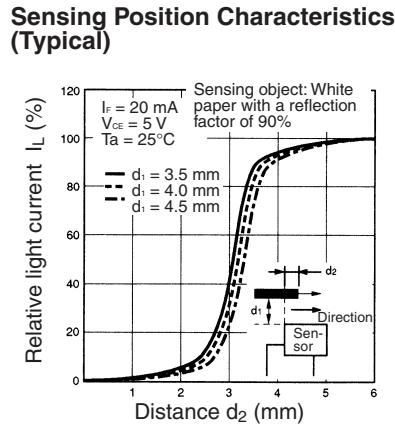
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



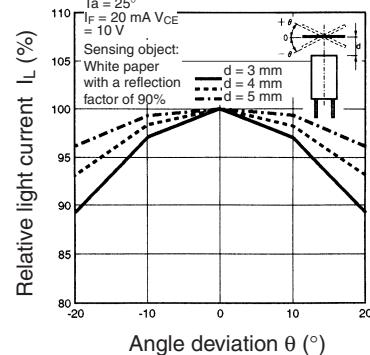
Response Time vs. Load Resistance Characteristics (Typical)



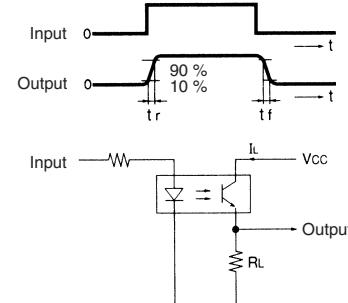
Sensing Position Characteristics (Typical)



Sensing Angle Characteristics (Typical)



Response Time Measurement Circuit

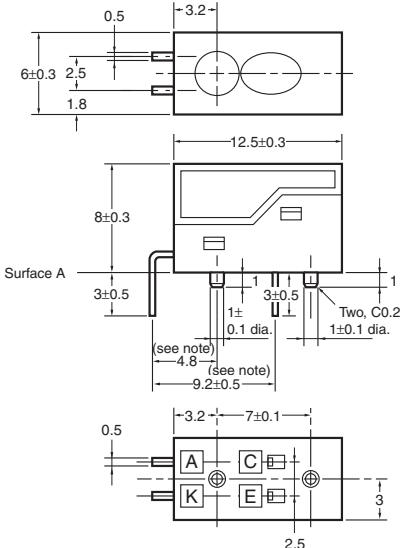


Photomicrosensor (Reflective) EE-SY169B

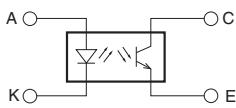
⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Note: These dimensions are for the surface A. Other lead wire pitch dimensions are for the housing surface.

Unless otherwise specified, the tolerances are as shown below.

Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

Features

- High-quality model with plastic lenses.
- Highly precise sensing range with a tolerance of ±0.6 mm horizontally and vertically.
- With a red LED sensing dyestuff-type links.
- Limited reflective model
- Higher gain than EE-SY169.
- Possible to get the same I_L as EE-SY169 with $I_F=10$ mA. (half of EE-SY169 condition)
- Recommended sensing distance = 4.0 mm

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	40 mA (see note 1)
	Pulse forward current	I_{FP}	300 mA (see note 2)
	Reverse voltage	V_R	3 V
Detector	Collector-Emitter voltage	V_{CEO}	30 V
	Emitter-Collector voltage	V_{ECO}	---
	Collector current	I_C	20 mA
	Collector dissipation	P_C	100 mW (see note 1)
Ambient temperature	Operating	T_{opr}	0°C to 70°C
	Storage	T_{stg}	-20°C to 80°C
Soldering temperature		T_{sol}	260°C (see note 3)

Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

2. The pulse width is 10 μs maximum with a frequency of 100 Hz.

3. Complete soldering within 10 seconds.

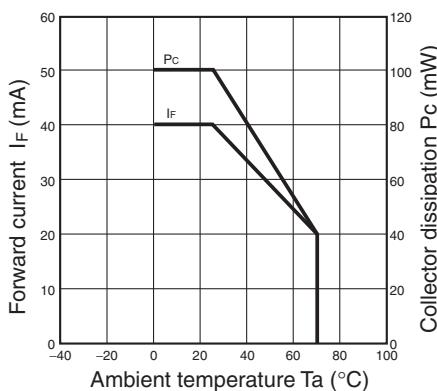
Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.85 V typ., 2.3 V max.	$I_F = 20$ mA
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 3$ V
	Peak emission wavelength	λ_p	660 nm typ.	$I_F = 20$ mA
Detector	Light current	I_L	160 μA min., 2,000 μA max.	$I_F = 10$ mA, $V_{CE} = 5$ V White paper with a reflection ratio of 90%, d = 4 mm (see note)
	Dark current	I_D	2 nA typ., 200 nA max.	$V_{CE} = 5$ V, 0 μA
	Leakage current	I_{LEAK}	2 μA max.	$I_F = 20$ mA, $V_{CE} = 5$ V with no reflection
	Collector-Emitter saturated voltage	V_{CE} (sat)	---	---
	Peak spectral sensitivity wavelength	λ_p	850 nm typ.	$V_{CE} = 5$ V
Rising time		tr	30 μs typ.	$V_{CC} = 5$ V, $R_L = 1 \text{ k}\Omega$, $I_L = 1$ mA
Falling time		tf	30 μs typ.	$V_{CC} = 5$ V, $R_L = 1 \text{ k}\Omega$, $I_L = 1$ mA

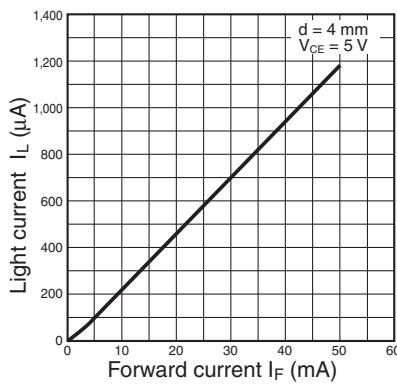
Note: The letter "d" indicates the distance between the top surface of the sensor and the sensing object.

■ Engineering Data

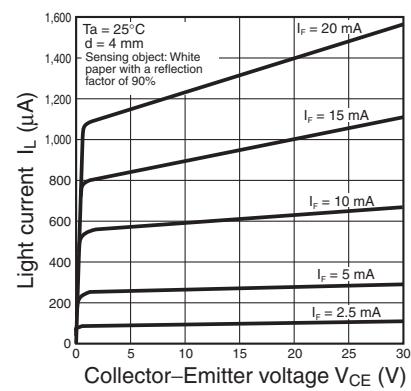
Forward Current vs. Collector Dissipation Temperature Rating



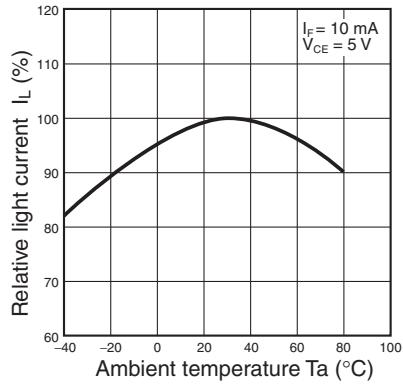
Light Current vs. Forward Current Characteristics (Typical)



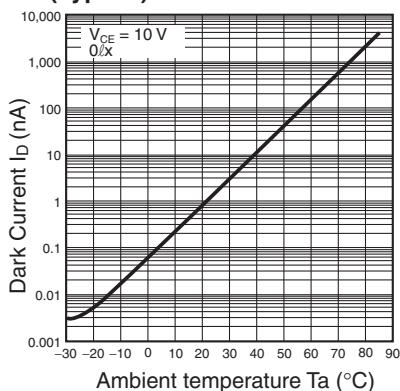
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



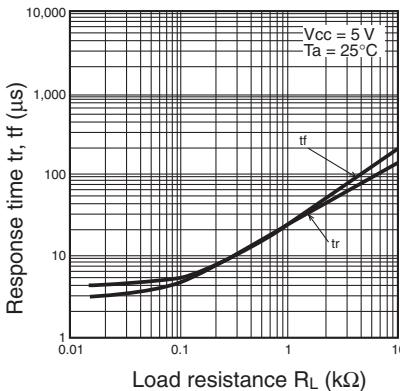
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



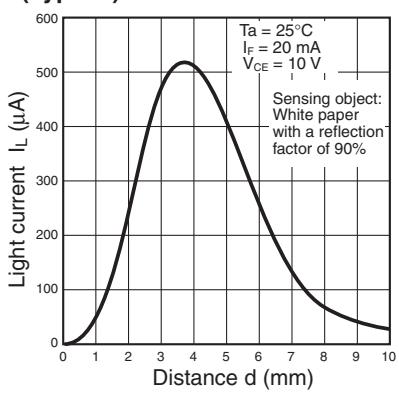
Dark Current vs. Ambient Temperature Characteristics (Typical)



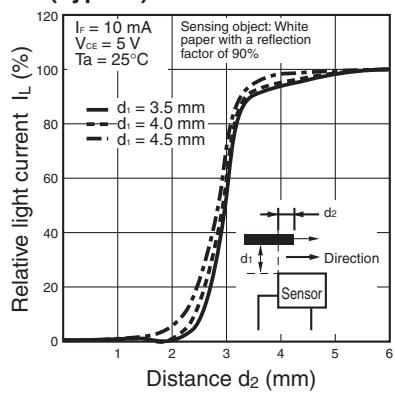
Response Time vs. Load Resistance Characteristics (Typical)



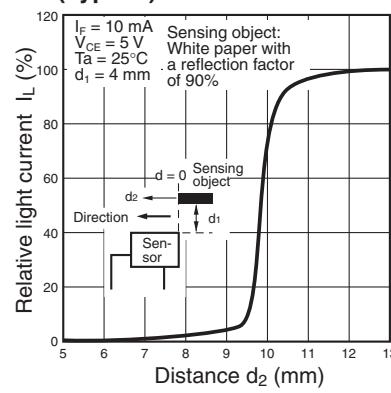
Sensing Distance Characteristics (Typical)



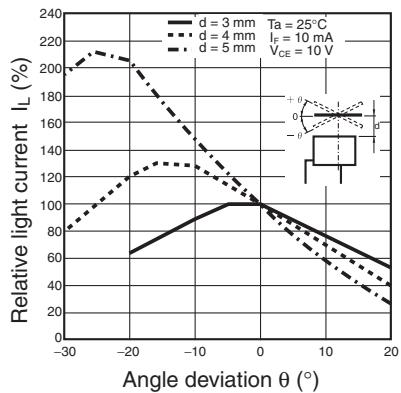
Sensing Position Characteristics (Typical)



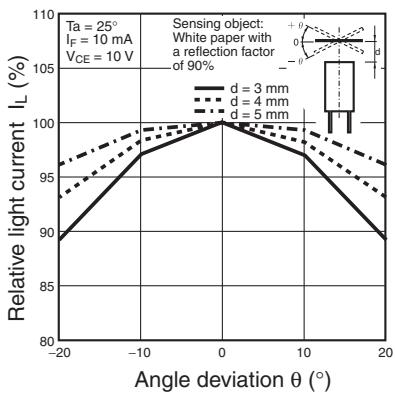
Sensing Position Characteristics (Typical)



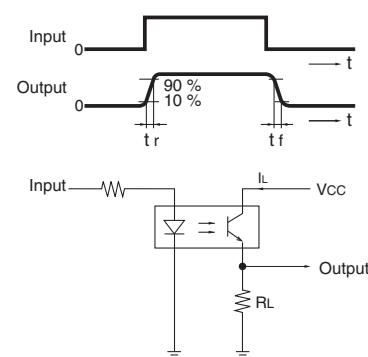
Sensing Angle Characteristics (Typical)



Sensing Angle Characteristics (Typical)



Response Time Measurement Circuit

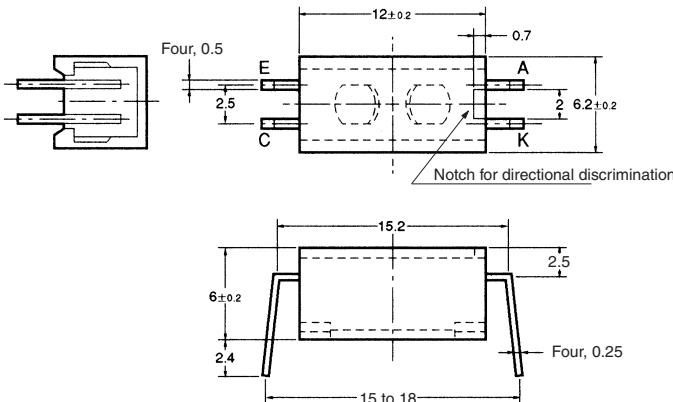


Photomicrosensor (Reflective) EE-SY113

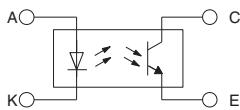
⚠ Be sure to read *Precautions* on page 24.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

■ Features

- Compact reflective Photomicrosensor (EE-SY110) with a molded housing and a dust-tight cover.
- Recommended sensing distance = 4.4 mm

■ Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Pulse forward current	I_{FP}	1 A (see note 2)
	Reverse voltage	V_R	4 V
Detector	Collector-Emitter voltage	V_{CEO}	30 V
	Emitter-Collector voltage	V_{ECO}	---
	Collector current	I_C	20 mA
	Collector dissipation	P_C	100 mW (see note 1)
Ambient temperature	Operating	T_{opr}	-40°C to 80°C
	Storage	T_{stg}	-40°C to 85°C
Soldering temperature		T_{sol}	260°C (see note 3)

- Note:**
- Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 - The pulse width is 10 μs maximum with a frequency of 100 Hz.
 - Complete soldering within 10 seconds.

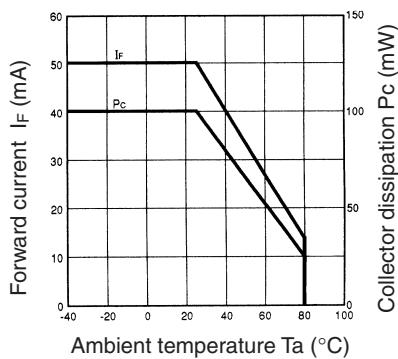
■ Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_p	940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L	160 μA min., 1,600 μA max.	$I_F = 20 \text{ mA}, V_{CE} = 10 \text{ V}$ White paper with a reflection ratio of 90%, d = 4.4 mm (see note)
	Dark current	I_D	2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lx}$
	Leakage current	I_{LEAK}	2 μA max.	$I_F = 20 \text{ mA}, V_{CE} = 10 \text{ V}$ with no reflection
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$	---	---
	Peak spectral sensitivity wavelength	λ_p	850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time	t_r		30 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 1 \text{ k}\Omega, I_L = 1 \text{ mA}$
Falling time	t_f		30 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 1 \text{ k}\Omega, I_L = 1 \text{ mA}$

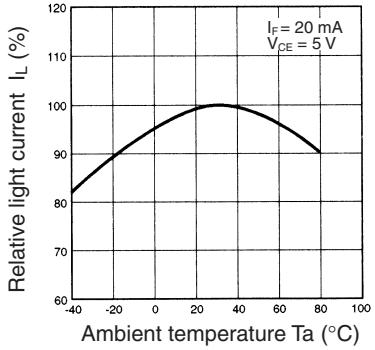
Note: The letter "d" indicates the distance between the top surface of the sensor and the sensing object.

■ Engineering Data

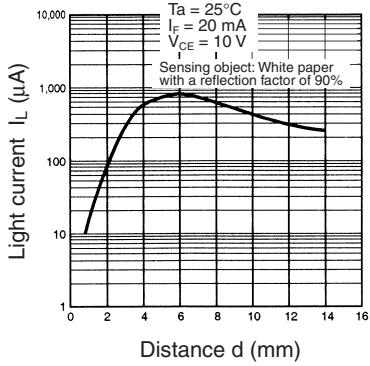
Forward Current vs. Collector Dissipation Temperature Rating



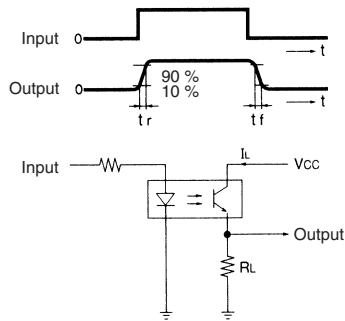
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



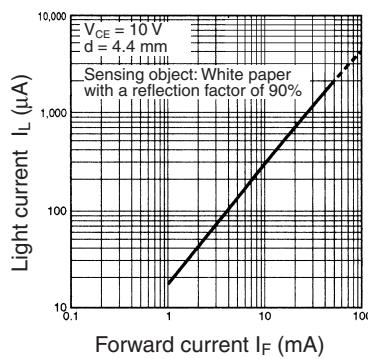
Sensing Distance Characteristics (Typical)



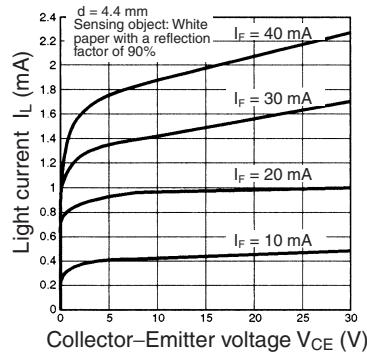
Response Time Measurement Circuit



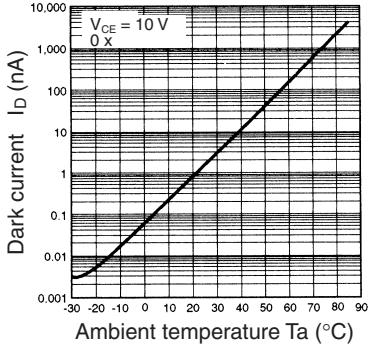
Light Current vs. Forward Current Characteristics (Typical)



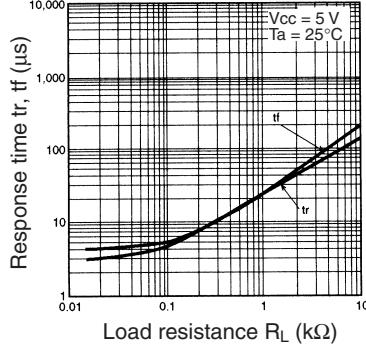
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



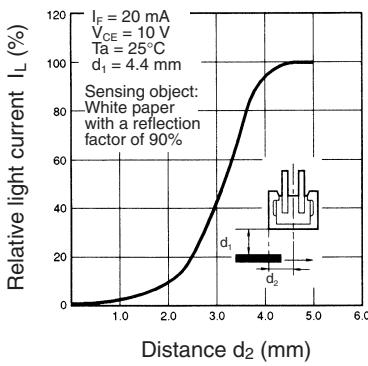
Dark Current vs. Ambient Temperature Characteristics (Typical)



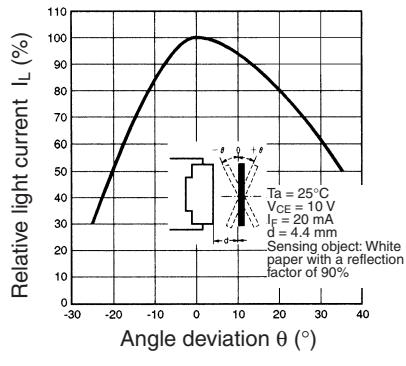
Response Time vs. Load Resistance Characteristics (Typical)



Sensing Position Characteristics (Typical)



Sensing Angle Characteristics (Typical)

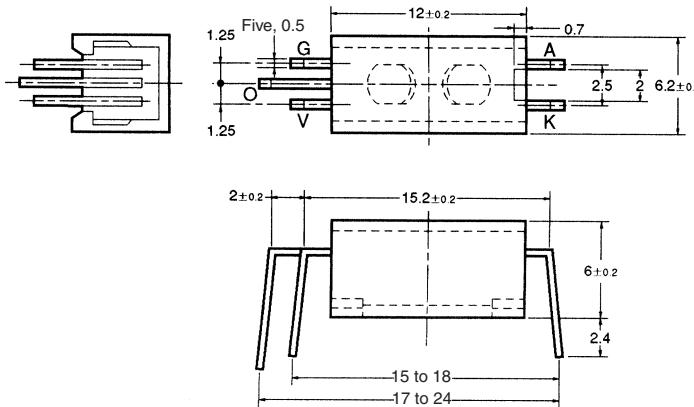


Photomicrosensor (Reflective) EE-SY313/-SY413

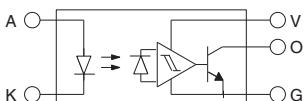
⚠ Be sure to read *Precautions* on page 24.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are as shown below.

Terminal No.	Name
A	Anode
K	Cathode
V	Power supply (Vcc)
O	Output (OUT)
G	Ground (GND)

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

■ Features

- Incorporates an IC chip with a built-in detector element and amplifier.
- Incorporates a detector element with a built-in temperature compensation circuit.
- Compact reflective Photomicrosensor (EE-SY310/-SY410) with a molded housing and a dust-tight cover.
- A wide supply voltage range: 4.5 to 16 VDC
- Directly connects with C-MOS and TTL.
- Dark ON model (EE-SY313)
- Light ON model (EE-SY413)
- Recommended sensing distance = 4.4 mm

■ Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rated value
Emitter	Forward current	I_F 50 mA (see note 1)
	Reverse voltage	V_R 4 V
	Pulse forward current	I_{FP} 1 A (see note 2)
Detector	Power supply voltage	V_{CC} 16 V
	Output voltage	V_{OUT} 28 V
	Output current	I_{OUT} 16 mA
	Permissible output dissipation	P_{OUT} 250 mW (see note 1)
Ambient temperature	Operating	T_{opr} -40°C to 65°C
	Storage	T_{stg} -40°C to 85°C
Soldering temperature	T_{sol}	260°C (see note 3)

- Note:**
- Refer to the temperature rating chart if the ambient temperature exceeds 25°C .
 - The pulse width is 10 μs maximum with a frequency of 100 Hz.
 - Complete soldering within 10 seconds.

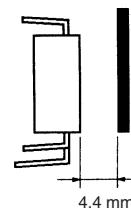
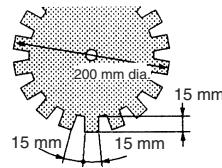
■ Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F 1.2 V typ., 1.5 V max.	$I_F = 20 \text{ mA}$
	Reverse current	I_R 0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P 920 nm typ.	$I_F = 20 \text{ mA}$
Detector	Low-level output voltage	V_{OL} 0.12 V typ., 0.4 V max.	$V_{CC} = 4.5$ to 16 V , $I_{OL} = 16 \text{ mA}$, without incident light (EE-SY313), with incident light (EE-SY413) (see notes 1 and 2)
	High-level output voltage	V_{OH} 15 V min.	$V_{CC} = 16 \text{ V}$, $R_L = 1 \text{ k}\Omega$, with incident light (EE-SY313), without incident light (EE-SY413) (see notes 1 and 2)
	Current consumption	I_{CC} 3.2 mA typ., 10 mA max.	$V_{CC} = 16 \text{ V}$
	Peak spectral sensitivity wavelength	λ_P 870 nm typ.	$V_{CC} = 4.5$ to 16 V
LED current when output is OFF	I_{FT}	10 mA typ., 20 mA max.	$V_{CC} = 4.5$ to 16 V
LED current when output is ON			
Hysteresis	ΔH	17% typ.	$V_{CC} = 4.5$ to 16 V
Response frequency	f	50 pps min.	$V_{CC} = 4.5$ to 16 V , $I_F = 20 \text{ mA}$, $I_{OL} = 16 \text{ mA}$
Response delay time	t_{PLH} (t_{PHL})	3 μs typ.	$V_{CC} = 4.5$ to 16 V , $I_F = 20 \text{ mA}$, $I_{OL} = 16 \text{ mA}$
Response delay time	t_{PHL} (t_{PLH})	20 μs typ.	$V_{CC} = 4.5$ to 16 V , $I_F = 20 \text{ mA}$, $I_{OL} = 16 \text{ mA}$

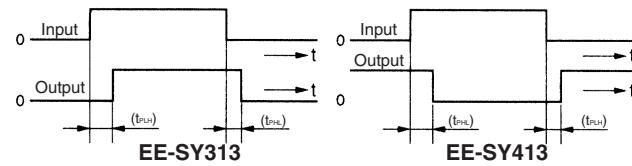
Note: 1. With "incident light" denotes the condition whereby the light reflected by white paper with a reflection factor of 90% at a sensing distance of 4.4 mm is received by the photo IC when the forward current (I_F) of the LED is 20 mA.

2. Sensing object: White paper with a reflection factor of 90% at a sensing distance of 4.4 mm.
3. Hysteresis denotes the difference in forward LED current value, expressed in percentage, calculated from the respective forward LED currents when the photo IC is turned from ON to OFF and when the photo IC is turned from OFF to ON.

4. The value of the response frequency is measured by rotating the disk as shown below.



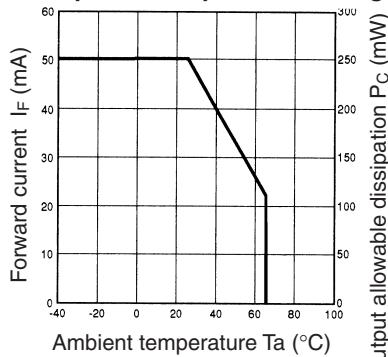
5. The following illustrations show the definition of response delay time. The value in the parentheses applies to the EE-SY413.



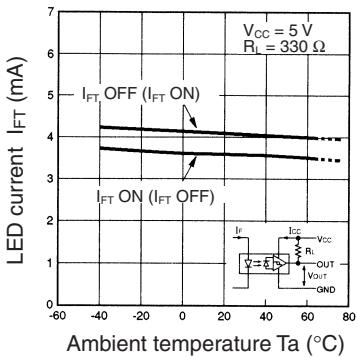
■ Engineering Data

Note: The values in the parentheses apply to the EE-SY413.

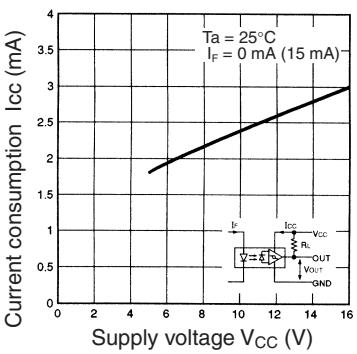
Forward Current vs. Collector Dissipation Temperature Rating



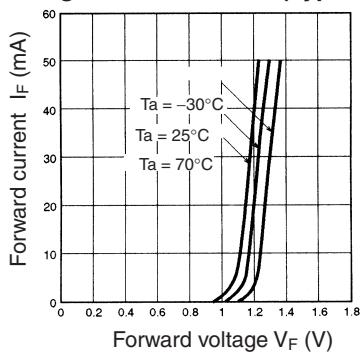
LED Current vs. Ambient Temperature Characteristics (Typical)



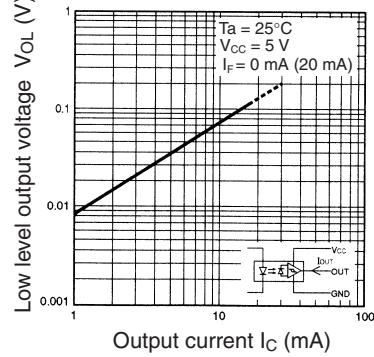
Current Consumption vs. Supply Voltage (Typical)



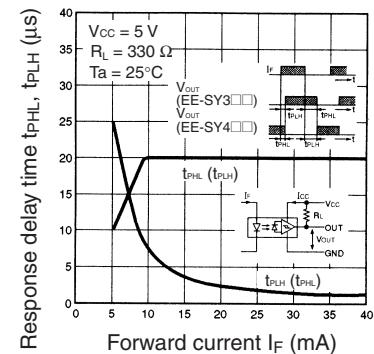
Forward Current vs. Forward Voltage Characteristics (Typical)



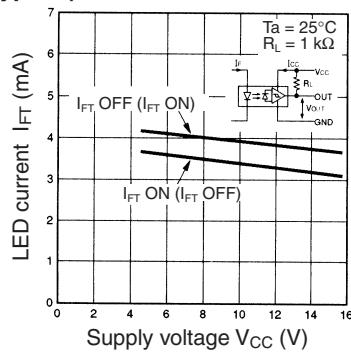
Low-level Output Voltage vs. Output Current (Typical)



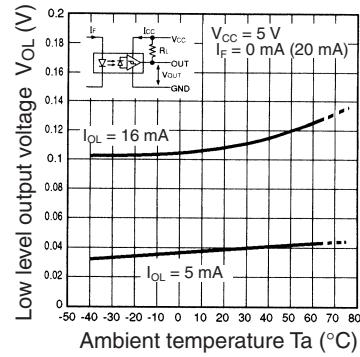
Response Delay Time vs. Forward Current (Typical)



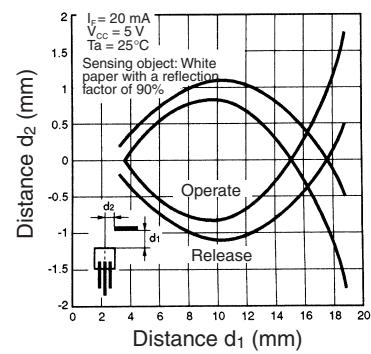
LED Current vs. Supply Voltage (Typical)



Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



Sensing Position Characteristics (Typical)

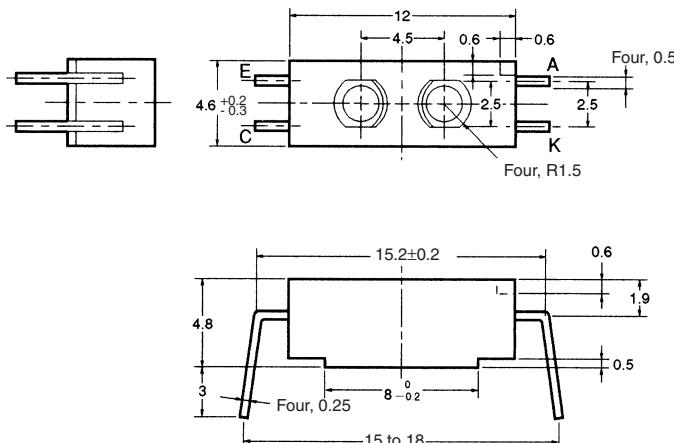


Photomicrosensor (Reflective) EE-SY110

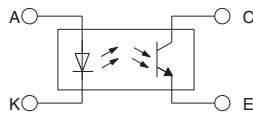
⚠ Be sure to read *Precautions* on page 24.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are as shown below.

Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Dimensions	Tolerance
3 mm max.	±0.2
3 < mm ≤ 6	±0.24
6 < mm ≤ 10	±0.29
10 < mm ≤ 18	±0.35
18 < mm ≤ 30	±0.42

■ Features

- Compact reflective model with a molded housing.
- Recommended sensing distance = 5.0 mm

■ Absolute Maximum Ratings (Ta = 25°C)

Item	Symbol	Rated value
Emitter	Forward current	I _F 50 mA (see note 1)
	Pulse forward current	I _{FP} 1 A (see note 2)
	Reverse voltage	V _R 4 V
Detector	Collector-Emitter voltage	V _{CEO} 30 V
	Emitter-Collector voltage	V _{ECO} ---
	Collector current	I _C 20 mA
	Collector dissipation	P _C 100 mW (see note 1)
Ambient temperature	Operating	T _{opr} -40°C to 85°C
	Storage	T _{stg} -40°C to 85°C
Soldering temperature	T _{sol}	260°C (see note 3)

- Note:**
- Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 - The pulse width is 10 µs maximum with a frequency of 100 Hz.
 - Complete soldering within 10 seconds.

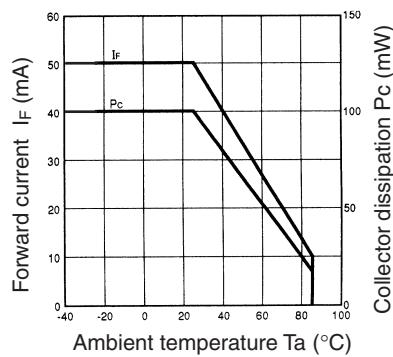
■ Electrical and Optical Characteristics (Ta = 25°C)

Item	Symbol	Value	Condition
Emitter	Forward voltage	V _F 1.2 V typ., 1.5 V max.	I _F = 30 mA
	Reverse current	I _R 0.01 µA typ., 10 µA max.	V _R = 4 V
	Peak emission wavelength	λ _P 940 nm typ.	I _F = 20 mA
Detector	Light current	I _L 200 µA min., 2,000 µA max.	I _F = 20 mA, V _{CE} = 10 V White paper with a reflection ratio of 90%, d = 5 mm (see note)
	Dark current	I _D 2 nA typ., 200 nA max.	V _{CE} = 10 V, 0 lx
	Leakage current	I _{LEAK} 2 µA max.	I _F = 20 mA, V _{CE} = 10 V with no reflection
	Collector-Emitter saturated voltage	V _{CE} (sat)	---
	Peak spectral sensitivity wavelength	λ _P 850 nm typ.	V _{CE} = 10 V
Rising time	tr	30 µs typ.	V _{CC} = 5 V, R _L = 1 kΩ, I _L = 1 mA
Falling time	tf	30 µs typ.	V _{CC} = 5 V, R _L = 1 kΩ, I _L = 1 mA

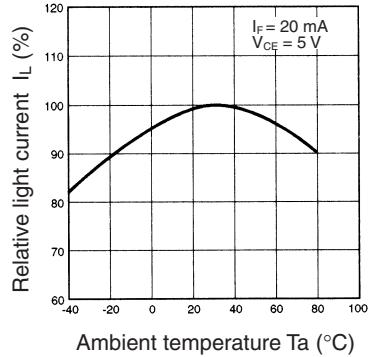
Note: The letter "d" indicates the distance between the top surface of the sensor and the sensing object.

■ Engineering Data

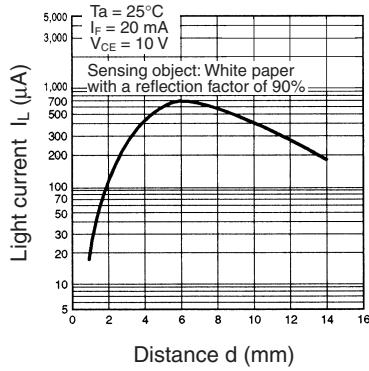
Forward Current vs. Collector Dissipation Temperature Rating



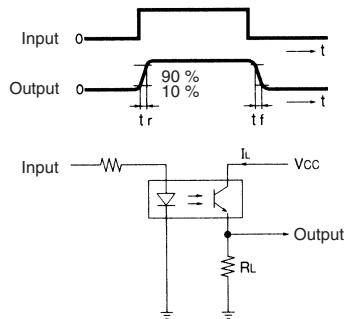
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



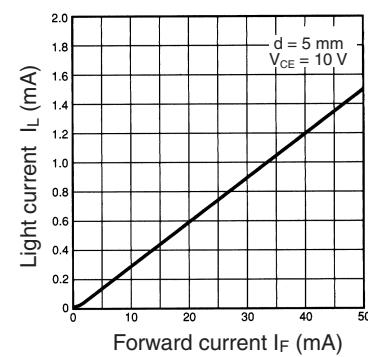
Sensing Distance Characteristics (Typical)



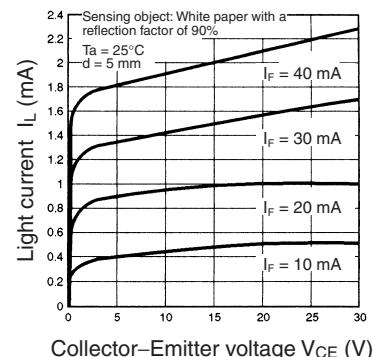
Response Time Measurement Circuit



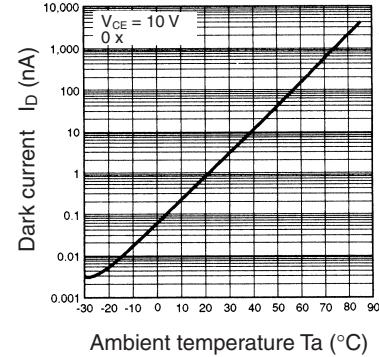
Light Current vs. Forward Current Characteristics (Typical)



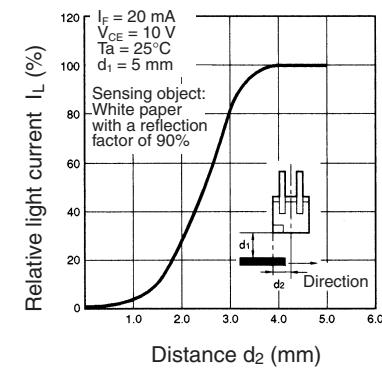
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



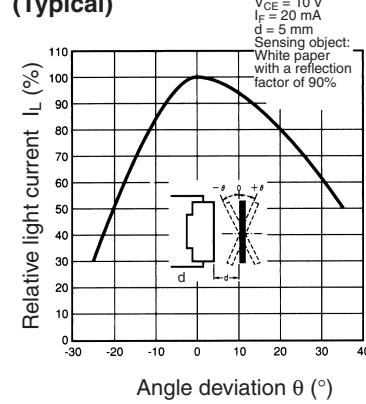
Dark Current vs. Ambient Temperature Characteristics (Typical)



Sensing Position Characteristics (Typical)



Sensing Angle Characteristics (Typical)

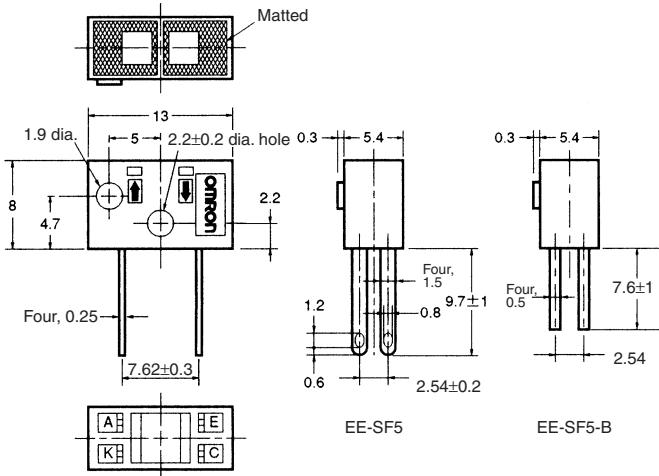


Photomicrosensor (Reflective) EE-SF5(-B)

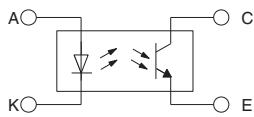
⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

Features

- Dust-tight construction.
- With a visible-light intercepting filter which allows objects to be sensed without being greatly influenced by the light radiated from fluorescent lamps.
- Mounted with M2 screws.
- Model with soldering terminals (EE-SF5).
- Model with PCB terminals (EE-SF5-B).
- Recommended sensing distance = 5.0 mm

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rated value
Emitter	Forward current	I_F 50 mA (see note 1)
	Pulse forward current	I_{FP} 1 A (see note 2)
	Reverse voltage	V_R 4 V
Detector	Collector-Emitter voltage	V_{CEO} 30 V
	Emitter-Collector voltage	V_{ECO} ---
	Collector current	I_C 20 mA
	Collector dissipation	P_C 100 mW (see note 1)
Ambient temperature	Operating	T_{opr} -25°C to 80°C
	Storage	T_{stg} -30°C to 80°C
Soldering temperature	T_{sol}	260°C (see note 3)

- Note:
- Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 - The pulse width is 10 μs maximum with a frequency of 100 Hz.
 - Complete soldering within 10 seconds.

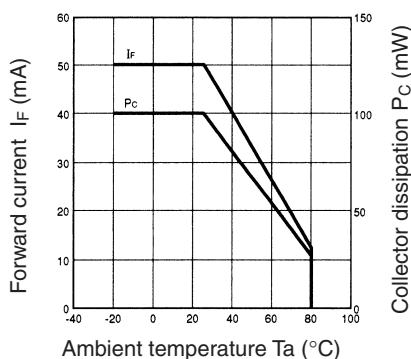
Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F 1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R 0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P 940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L 200 μA min., 2,000 μA max.	$I_F = 20 \text{ mA}$, $V_{CE} = 10 \text{ V}$ White paper with a reflection ratio of 90%, $d = 5 \text{ mm}$ (see note)
	Dark current	I_D 2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}$, 0 lx
	Leakage current	I_{LEAK} 2 μA max.	$I_F = 20 \text{ mA}$, $V_{CE} = 10 \text{ V}$ with no reflection
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$ ---	---
	Peak spectral sensitivity wavelength	λ_P 850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time	t_r	30 μs typ.	$V_{CC} = 5 \text{ V}$, $R_L = 1 \text{ k}\Omega$, $I_L = 1 \text{ mA}$
Falling time	t_f	30 μs typ.	$V_{CC} = 5 \text{ V}$, $R_L = 1 \text{ k}\Omega$, $I_L = 1 \text{ mA}$

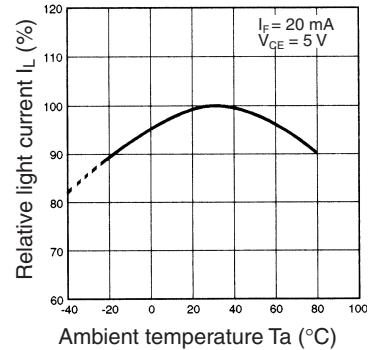
Note: The letter "d" indicates the distance between the top surface of the sensor and the sensing object.

■ Engineering Data

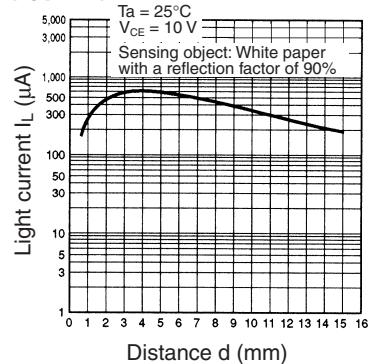
Forward Current vs. Collector Dissipation Temperature Rating



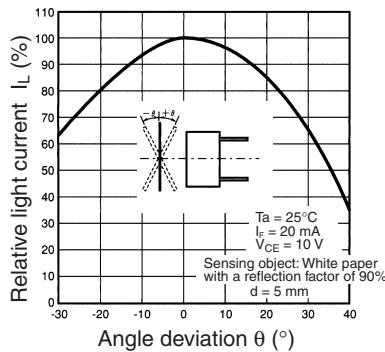
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



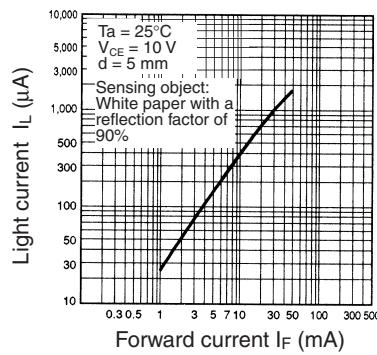
Sensing Distance Characteristics (Typical)



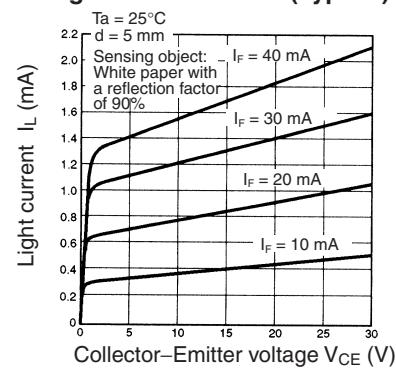
Sensing Angle Characteristics (Typical)



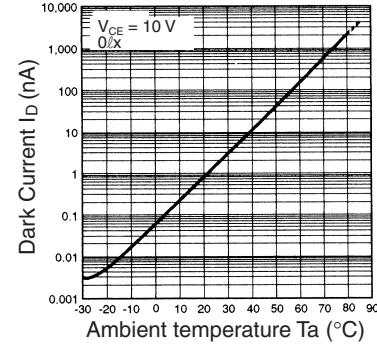
Light Current vs. Forward Current Characteristics (Typical)



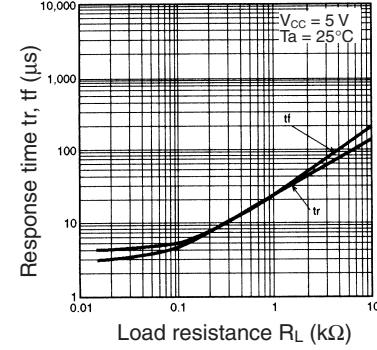
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



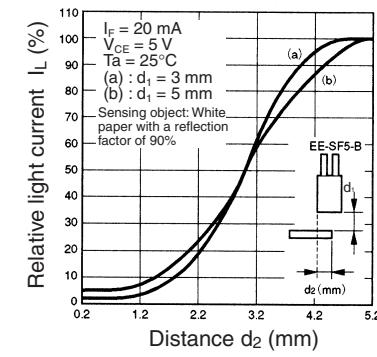
Dark Current vs. Ambient Temperature Characteristics (Typical)



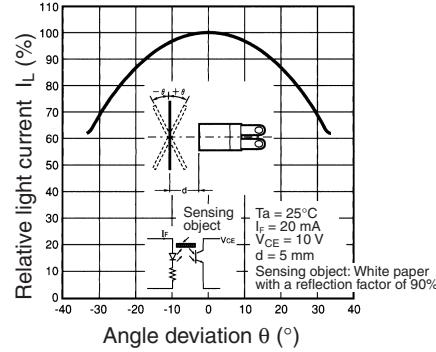
Response Time vs. Load Resistance Characteristics (Typical)



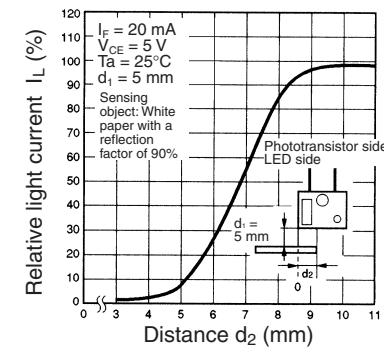
Sensing Position Characteristics (Typical)



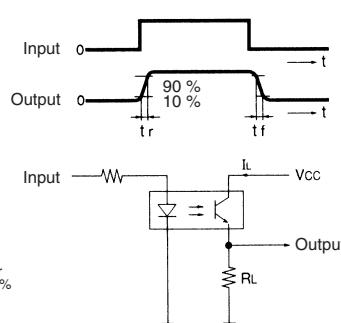
Sensing Angle Characteristics (Typical)



Sensing Position Characteristics (Typical)



Response Time Measurement Circuit

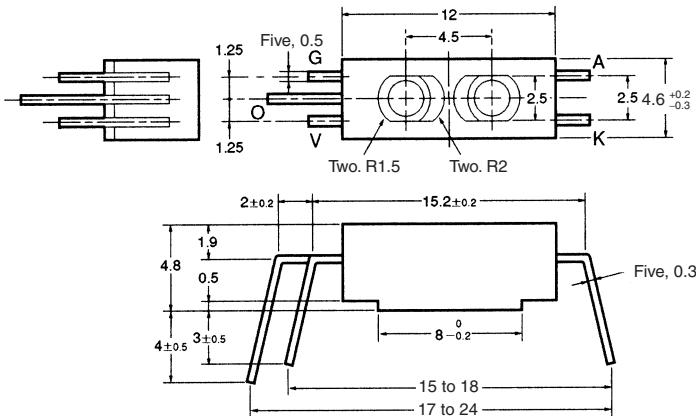


Photomicrosensor (Reflective) EE-SY310/-SY410

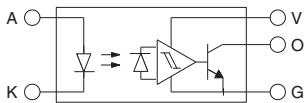
! Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are as shown below.

Terminal No.	Name
A	Anode
K	Cathode
V	Power supply (Vcc)
O	Output (OUT)
G	Ground (GND)

Dimensions	Tolerance
3 mm max.	±0.2
3 < mm ≤ 6	±0.24
6 < mm ≤ 10	±0.29
10 < mm ≤ 18	±0.35
18 < mm ≤ 30	±0.42

Features

- Incorporates an IC chip with a built-in detector element and amplifier.
- Incorporates a detector element with a built-in temperature compensation circuit.
- Compact reflective model with a molded housing.
- A wide supply voltage range: 4.5 to 16 VDC
- Directly connects with C-MOS and TTL.
- Dark ON model (EE-SY310)
- Light ON model (EE-SY410)
- Recommended sensing distance = 5.0 mm

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rated value
Emitter	Forward current	I_F 50 mA (see note 1)
	Reverse voltage	V_R 4 V
	Pulse forward current	I_{FP} 1 A (see note 2)
Detector	Power supply voltage	V_{CC} 16 V
	Output voltage	V_{OUT} 28 V
	Output current	I_{OUT} 16 mA
	Permissible output dissipation	P_{OUT} 250 mW (see note 1)
Ambient temperature	Operating	T_{OPR} -40°C to 75°C
	Storage	T_{STG} -40°C to 85°C
Soldering temperature		T_{SOL} 260°C (see note 3)

Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

2. The pulse width is 10 μs maximum with a frequency of 100 Hz.

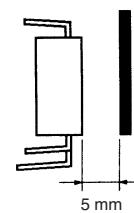
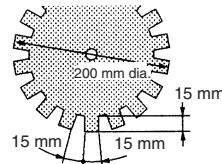
3. Complete soldering within 10 seconds.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

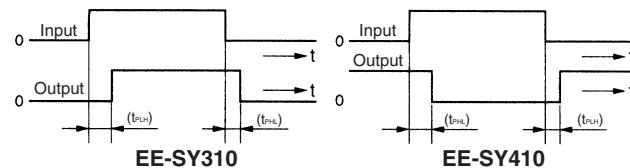
Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F 1.2 V typ., 1.5 V max.	$I_F = 20 \text{ mA}$
	Reverse current	I_R 0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P 920 nm typ.	$I_F = 20 \text{ mA}$
Detector	Low-level output voltage	V_{OL} 0.12 V typ., 0.4 V max.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_{OL} = 16 \text{ mA}$, without incident light (EE-SY310), with incident light (EE-SY410) (see notes 1 and 2)
	High-level output voltage	V_{OH} 15 V min.	$V_{CC} = 16 \text{ V}$, $R_L = 1 \text{ k}\Omega$, with incident light (EE-SY310), without incident light (EE-SY410) (see notes 1 and 2)
	Current consumption	I_{CC} 3.2 mA typ., 10 mA max.	$V_{CC} = 16 \text{ V}$
	Peak spectral sensitivity wavelength	λ_P 870 nm typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$
	LED current when output is OFF	I_{FT} 6 mA typ., 15 mA max.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$
LED current when output is ON			
Hysteresis	ΔH	17% typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$
Response frequency	f	50 Hz min.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_F = 15 \text{ mA}$, $I_{OL} = 16 \text{ mA}$
Response delay time	t_{PLH} (t_{PHL})	3 μs typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_F = 15 \text{ mA}$, $I_{OL} = 16 \text{ mA}$
Response delay time	t_{PHL} (t_{PLH})	20 μs typ.	$V_{CC} = 4.5 \text{ to } 16 \text{ V}$, $I_F = 15 \text{ mA}$, $I_{OL} = 16 \text{ mA}$

- Note:**
- With "incident light" denotes the condition whereby the light reflected by white paper with a reflection factor of 90% at a sensing distance of 5 mm is received by the photo IC when the forward current (I_F) of the LED is 20 mA.
 - Sensing object: White paper with a reflection factor of 90% at a sensing distance of 5 mm.
 - Hysteresis denotes the difference in forward LED current value, expressed in percentage, calculated from the respective forward LED currents when the photo IC is turned from ON to OFF and when the photo IC is turned from OFF to ON.

- The value of the response frequency is measured by rotating the disk as shown below.



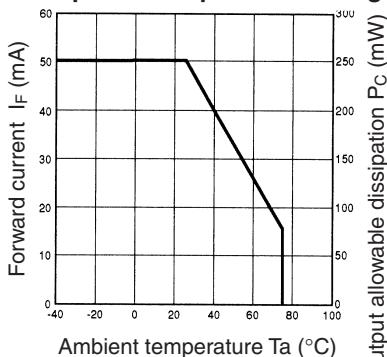
- The following illustrations show the definition of response delay time. The value in the parentheses applies to the EE-SY410.



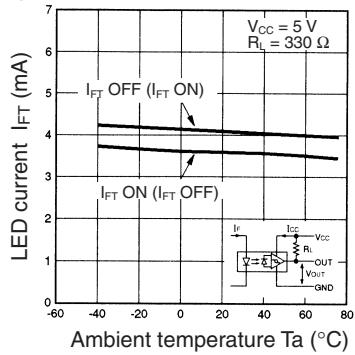
■ Engineering Data

Note: The values in the parentheses apply to the EE-SY410.

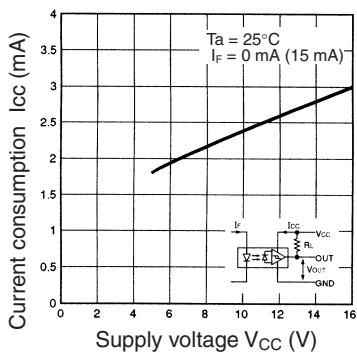
Forward Current vs. Collector Dissipation Temperature Rating



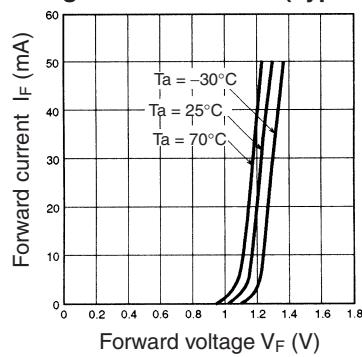
LED Current vs. Ambient Temperature Characteristics (Typical)



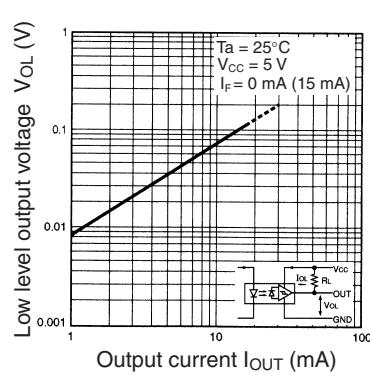
Current Consumption vs. Supply Voltage (Typical)



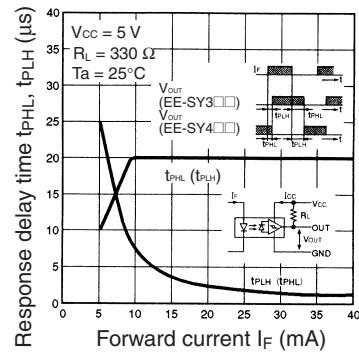
Forward Current vs. Forward Voltage Characteristics (Typical)



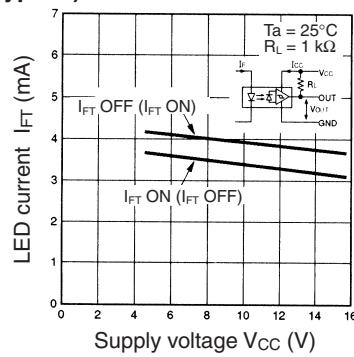
Low-level Output Voltage vs. Output Current (Typical)



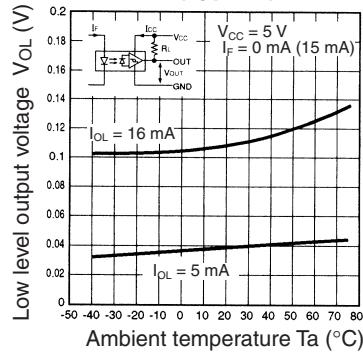
Response Delay Time vs. Forward Current (Typical)



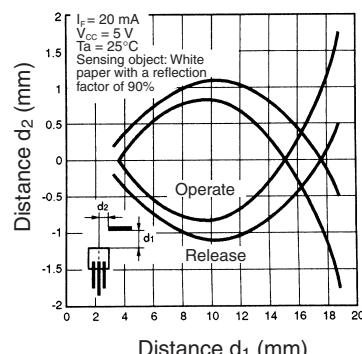
LED Current vs. Supply Voltage (Typical)



Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



Sensing Position Characteristics (Typical)

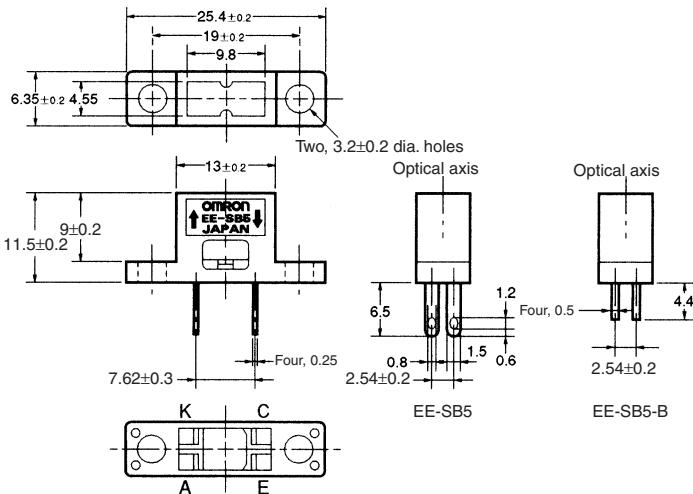


Photomicrosensor (Reflective) EE-SB5(-B)

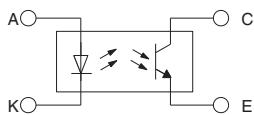
⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

Features

- Dust-tight construction.
- With a visible-light intercepting filter which allows objects to be sensed without being greatly influenced by the light radiated from fluorescent lamps.
- Mounted with M3 screws.
- Model with soldering terminals (EE-SB5).
- Model with PCB terminals (EE-SB5-B).
- Recommended sensing distance = 5.0 mm

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rated value
Emitter	Forward current	I_F 50 mA (see note 1)
	Pulse forward current	I_{FP} 1 A (see note 2)
	Reverse voltage	V_R 4 V
Detector	Collector-Emitter voltage	V_{CEO} 30 V
	Emitter-Collector voltage	V_{ECO} ---
	Collector current	I_C 20 mA
	Collector dissipation	P_C 100 mW (see note 1)
Ambient temperature	Operating	T_{opr} -25°C to 80°C
	Storage	T_{stg} -30°C to 80°C
Soldering temperature	T_{sol}	260°C (see note 3)

Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

- The pulse width is 10 μs maximum with a frequency of 100 Hz.
- Complete soldering within 10 seconds.

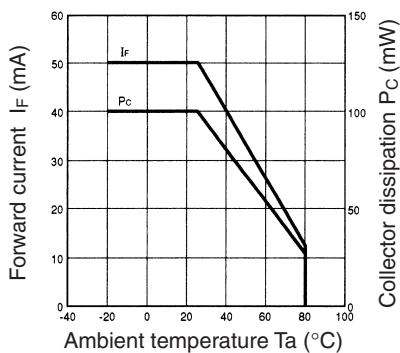
Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F 1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R 0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_p 940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L 200 μA min., 2,000 μA max.	$I_F = 20 \text{ mA}$, $V_{CE} = 10 \text{ V}$ White paper with a reflection ratio of 90%, $d = 5 \text{ mm}$ (see note)
	Dark current	I_D 2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}$, 0 lx
	Leakage current	I_{LEAK} 2 μA max.	$I_F = 20 \text{ mA}$, $V_{CE} = 10 \text{ V}$ with no reflection
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$ ---	---
	Peak spectral sensitivity wavelength	λ_p 850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time	t_r	30 μs typ.	$V_{CC} = 5 \text{ V}$, $R_L = 1 \text{ k}\Omega$, $I_L = 1 \text{ mA}$
Falling time	t_f	30 μs typ.	$V_{CC} = 5 \text{ V}$, $R_L = 1 \text{ k}\Omega$, $I_L = 1 \text{ mA}$

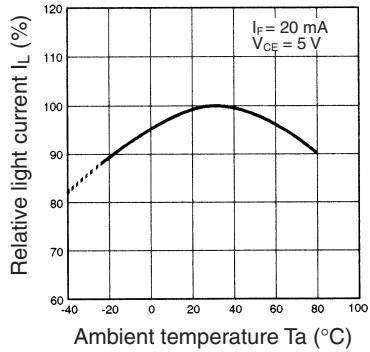
Note: The letter "d" indicates the distance between the top surface of the sensor and the sensing object.

■ Engineering Data

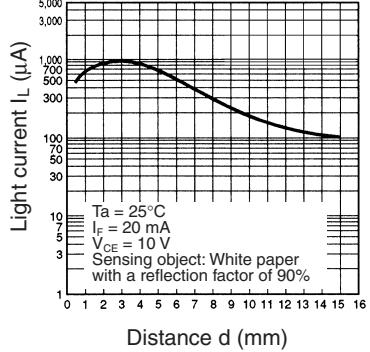
Forward Current vs. Collector Dissipation Temperature Rating



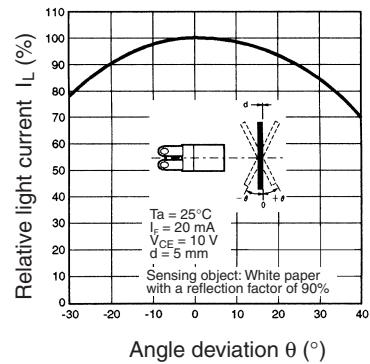
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



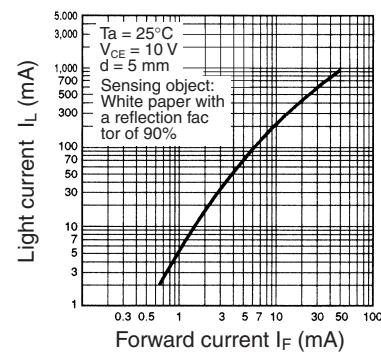
Sensing Distance Characteristics (Typical)



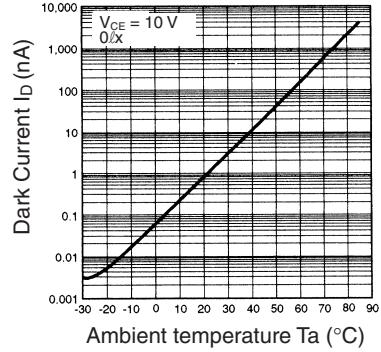
Sensing Angle Characteristics (Typical)



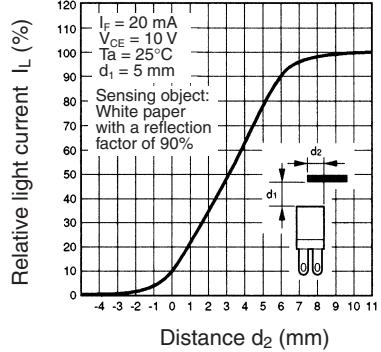
Light Current vs. Forward Current Characteristics (Typical)



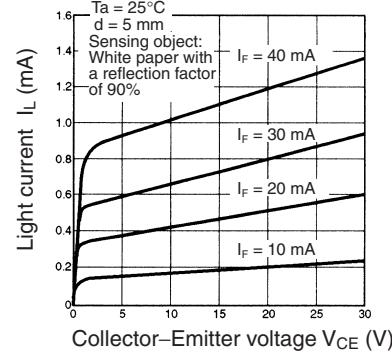
Dark Current vs. Ambient Temperature Characteristics (Typical)



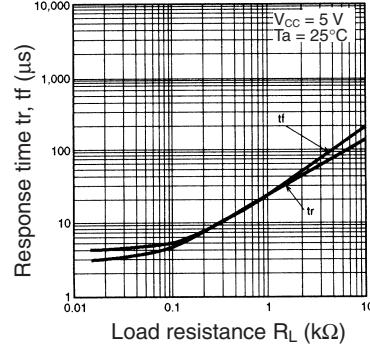
Sensing Position Characteristics (Typical)



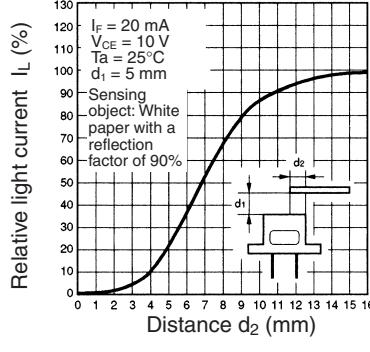
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



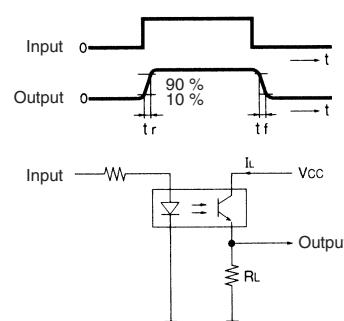
Response Time vs. Load Resistance Characteristics (Typical)



Sensing Position Characteristics (Typical)



Response Time Measurement Circuit

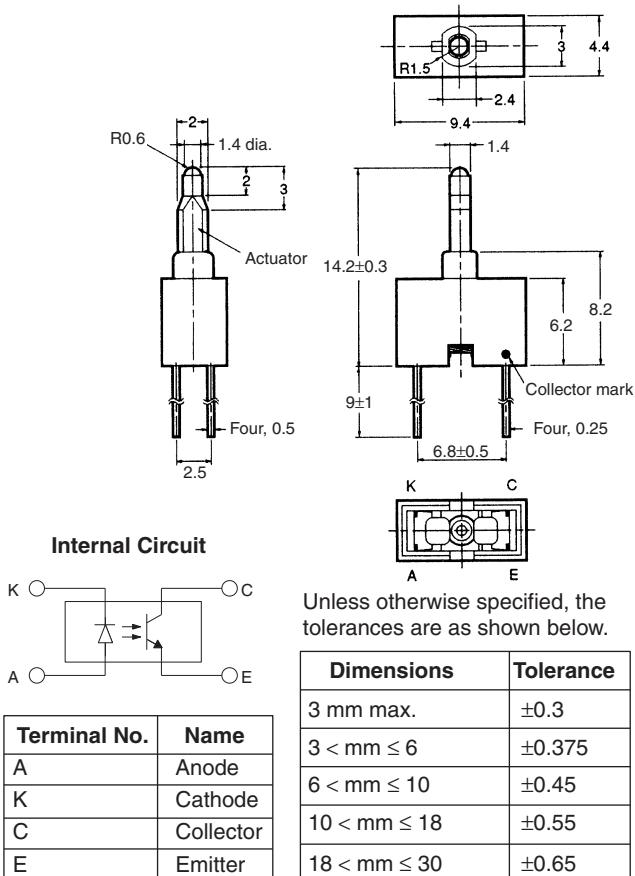


Photomicrosensor (Actuator) EE-SA105

⚠ Be sure to read *Precautions* on page 24.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



■ Features

- Model has an actuator.
- Low operating force (0.15 N (15 gf)).
- Connects to circuits with ease.

■ Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rated value
Emitter	Forward current	I_F 50 mA (see note 1)
	Pulse forward current	I_{FP} 1 A (see note 2)
	Reverse voltage	V_R 4 V
	Collector-Emitter voltage	V_{CEO} 30 V
Detector	Emitter-Collector voltage	V_{ECO} 5 V
	Collector current	I_C 20 mA
	Collector dissipation	P_C 100 mW (see note 1)
	Operating	T_{opr} -25°C to 70°C
Ambient temperature	Storage	T_{stg} -40°C to 100°C
	Soldering temperature	T_{sol} 260°C (see note 3)

- Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C .
 2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
 3. Complete soldering within 10 seconds.

■ Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

Item		Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P	940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L	0.5 mA min.	$I_F = 20 \text{ mA}$, $V_{CE} = 5 \text{ V}$ at free position (FP)
	Dark current	I_D	2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}$, 0 lux
	Leakage current	I_{LEAK}	10 μA max.	$I_F = 20 \text{ mA}$, $V_{CE} = 5 \text{ V}$ at operating position (OP)
	Collector-Emitter saturated voltage	$V_{CE}(\text{sat})$	0.15 V typ., 0.4 V max.	$I_F = 20 \text{ mA}$, $I_L = 0.1 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time		t_r	---	---
Falling time		t_f	---	---

■ Mechanical Characteristics

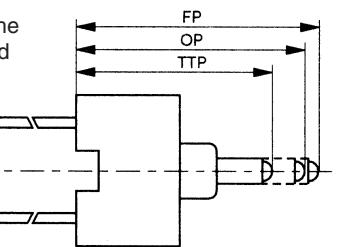
Actuator operation ($I_F = 20 \text{ mA}$, $V_{CE} = 5 \text{ V}$) (see note 1)	Free position (FP): 14.2 ± 0.3 mm Operating position (OP): 13.0 mm min. Total travel position (TTP): 12.1 mm max.
Operating force (see note 2)	0.15 N (15 gf) max.
Mechanical life expectancy	500,000 operations min. (The actuator traveling from its FP to FP via TTP is regarded as one operation.)

Note: 1. Free position (FP): The distance between the bottom of the housing to the top of the actuator without any external force imposed on the actuator.

Operating position (OP): The distance between the bottom of the housing to the top of the actuator when the actuator is pressed and the I_L becomes I_{LEAK} or less.

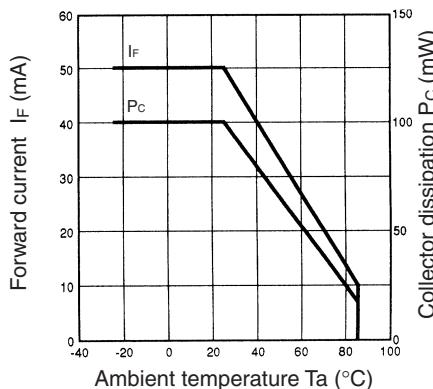
Total travel position (TPP): The distance between the bottom of the housing to the top of the actuator when the actuator is fully pressed.

2. Operating force: The force required to press the actuator from its FP to OP.

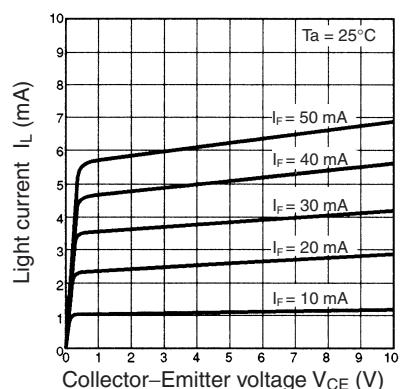


■ Engineering Data

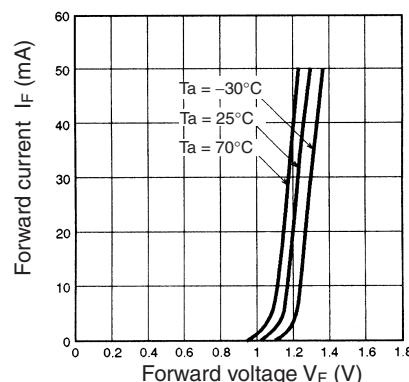
Forward Current vs. Collector Dissipation Temperature Rating



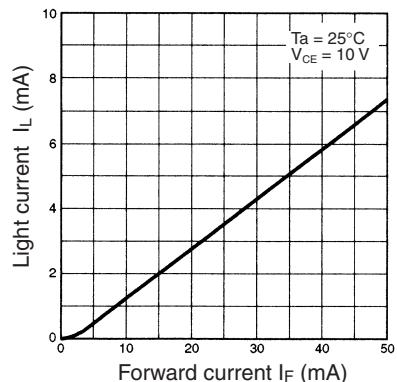
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



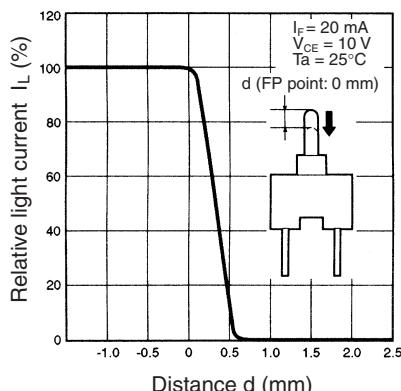
Forward Current vs. Forward Voltage Characteristics (Typical)



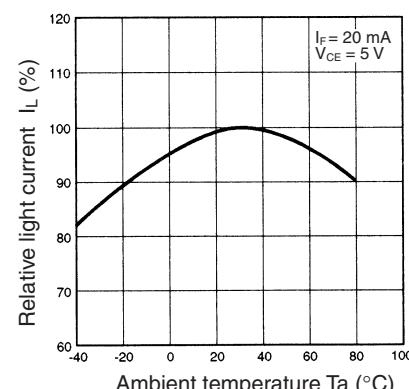
Light Current vs. Forward Current Characteristics (Typical)



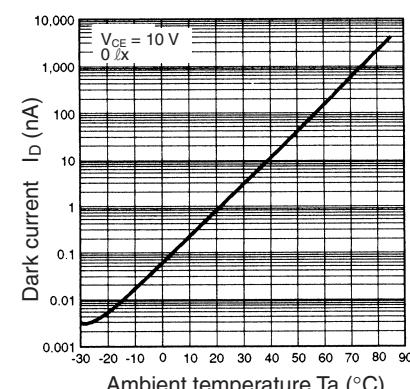
Sensing Position Characteristics (Typical)



Relative Light Current vs. Ambient Temperature Characteristics (Typical)



Dark Current vs. Ambient Temperature Characteristics (Typical)

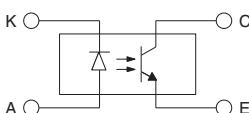
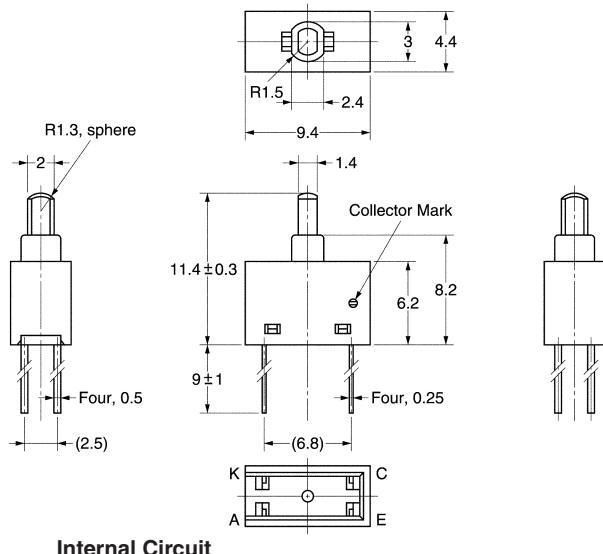


Photomicrosensor (Actuator) EE-SA113

⚠ Be sure to read *Precautions* on page 24.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

■ Features

- Model has an actuator.
- Low operating force (0.15 N (15 gf)).
- Connects to circuits with ease.
- Recommended sensing distance = 4.4 mm

■ Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rated value
Emitter	Forward current	I_F 50 mA (see note 1)
	Pulse forward current	I_{FP} 1 A (see note 2)
	Reverse voltage	V_R 4 V
	Collector-Emitter voltage	V_{CEO} 30 V
Detector	Emitter-Collector voltage	V_{ECO} 5 V
	Collector current	I_C 20 mA
	Collector dissipation	P_C 100 mW (see note 1)
Ambient temperature	Operating	T_{opr} -25°C to 70°C
	Storage	T_{stg} -40°C to 85°C
Soldering temperature	T_{sol}	260°C (see note 3)

- Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
 3. Complete soldering within 10 seconds.

■ Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F 1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R 0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P 940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L 0.5 mA min.	$I_F = 20 \text{ mA}, V_{CE} = 5 \text{ V}$ at free position (FP)
	Dark current	I_D 2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lx}$
	Leakage current	I_{LEAK} 10 μA max.	$I_F = 20 \text{ mA}, V_{CE} = 5 \text{ V}$ at operating position (OP)
	Collector-Emitter saturated voltage	$V_{CE}(\text{sat})$ 0.15 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 0.1 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_P 850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time	t_r	---	---
Falling time	t_f	---	---

■ Mechanical Characteristics

Actuator operation ($I_F = 20 \text{ mA}, V_{CE} = 5 \text{ V}$) (see note 1)	Free position (FP): 11.4 ± 0.3 mm Operating position (OP): 10.2 mm min. Total travel position (TTP): 9.3 mm max.
Operating force (see note 2)	0.15 N (15 gf) max.
Mechanical life expectancy	500,000 operations min. (The actuator traveling from its FP to FP via TTP is regarded as one operation.)

Note: 1. Free position (FP):

The distance between the bottom of the housing to the top of the actuator without any external force imposed on the actuator.

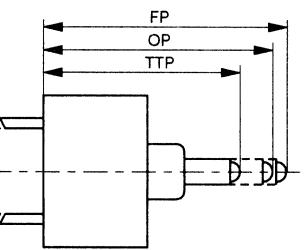
Operating position (OP):

The distance between the bottom of the housing to the top of the actuator when the actuator is pressed and the I_L becomes I_{LEAK} or less.

Total travel position (TPP):

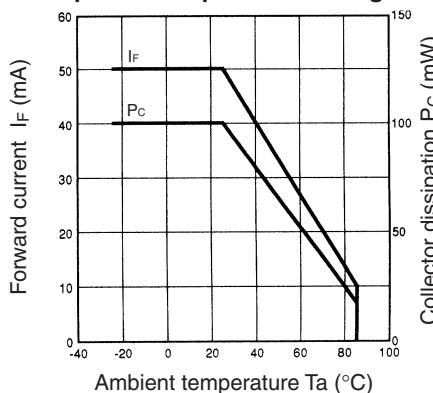
The distance between the bottom of the housing to the top of the actuator when the actuator is fully pressed.

2. Operating force: The force required to press the actuator from its FP to OP.

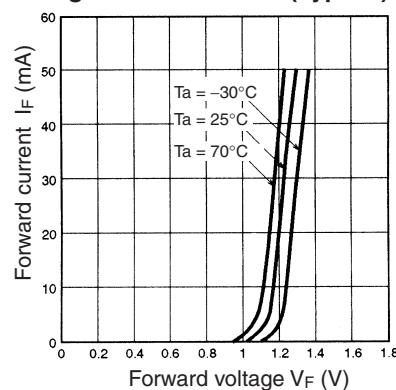


■ Engineering Data

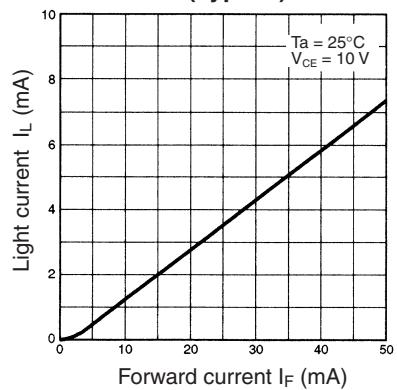
Forward Current vs. Collector Dissipation Temperature Rating



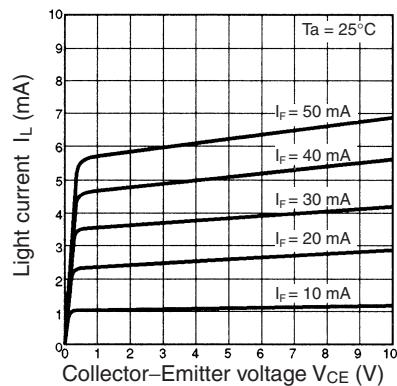
Forward Current vs. Forward Voltage Characteristics (Typical)



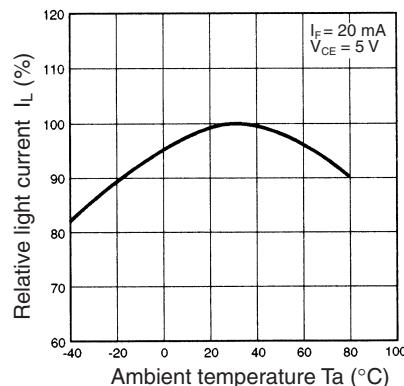
Light Current vs. Forward Current Characteristics (Typical)



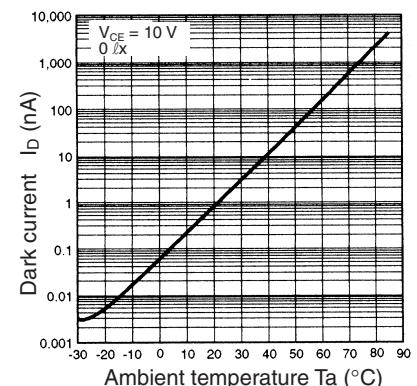
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



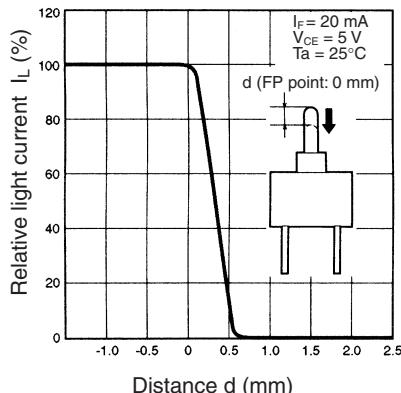
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



Dark Current vs. Ambient Temperature Characteristics (Typical)



Sensing Position Characteristics (Typical)

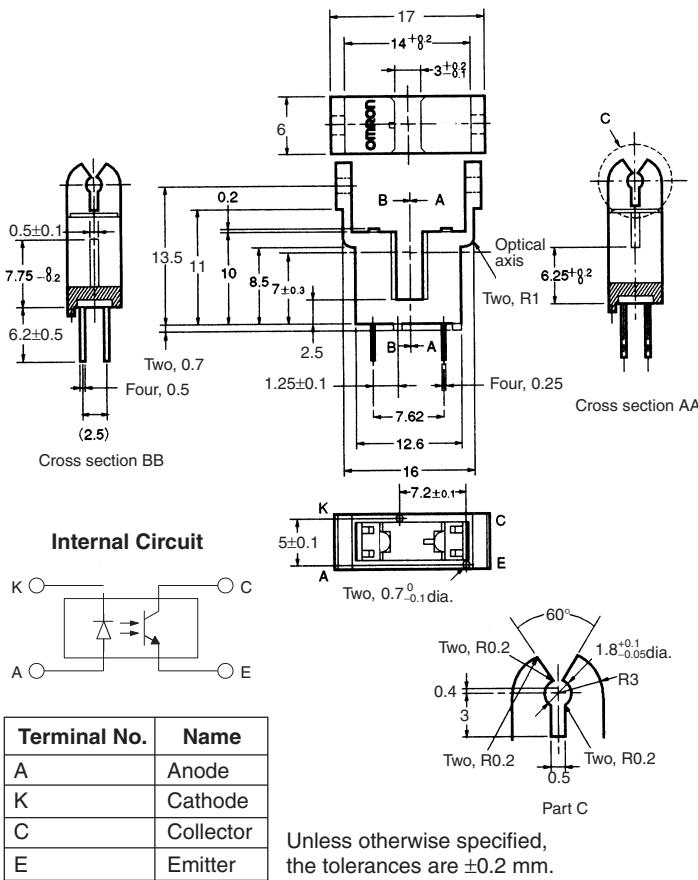


Photomicrosensor (Actuator Mounted) EE-SA102

⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Unless otherwise specified,
the tolerances are ± 0.2 mm.

Features

- An actuator can be attached.
- PCB mounting type.
- High resolution with a 0.5-mm-wide aperture.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Pulse forward current	I_{FP}	1 A (see note 2)
	Reverse voltage	V_R	4 V
Detector	Collector-Emitter voltage	V_{CEO}	30 V
	Emitter-Collector voltage	V_{ECO}	---
	Collector current	I_C	20 mA
	Collector dissipation	P_C	100 mW (see note 1)
Ambient temperature	Operating	T_{opr}	-25°C to 85°C
	Storage	T_{stg}	-30°C to 100°C
Soldering temperature		T_{sol}	260°C (see note 3)

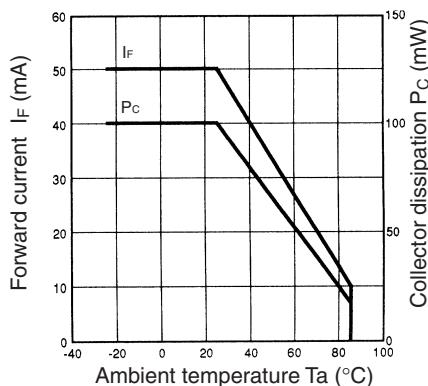
- Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
3. Complete soldering within 10 seconds.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

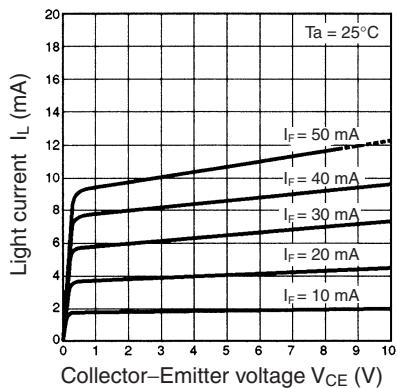
	Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_p	940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L	0.5 mA min., 14 mA max.	$I_F = 20 \text{ mA}, V_{CE} = 10 \text{ V}$
	Dark current	I_D	2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lux}$
	Leakage current	I_{LEAK}	---	---
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$	0.1 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 0.1 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_p	850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time		t_r	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$
Falling time		t_f	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$

■ Engineering Data

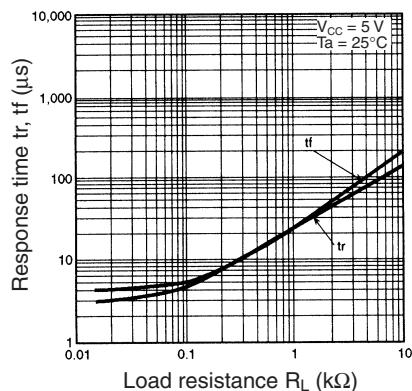
Forward Current vs. Collector Dissipation Temperature Rating



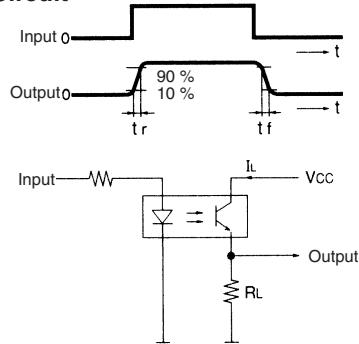
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



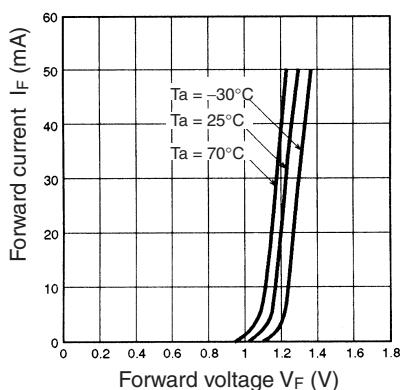
Response Time vs. Load Resistance Characteristics (Typical)



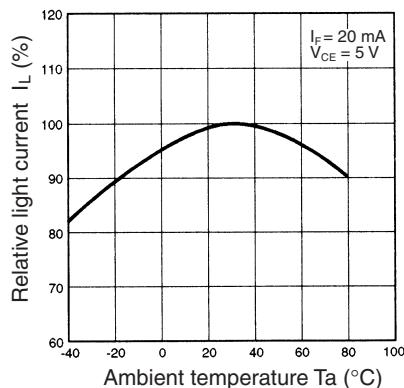
Response Time Measurement Circuit



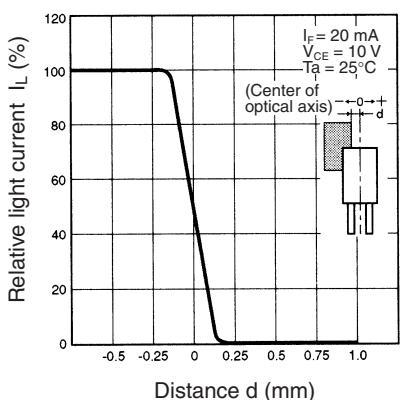
Forward Current vs. Forward Voltage Characteristics (Typical)



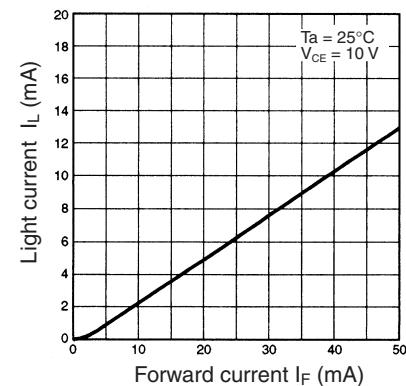
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



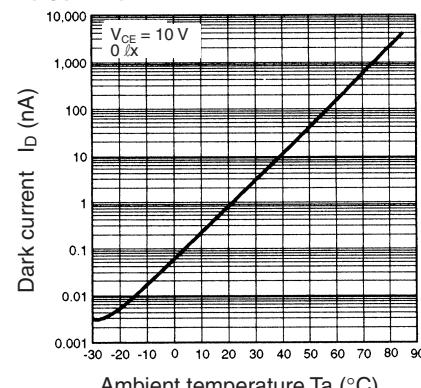
Sensing Position Characteristics (Typical)



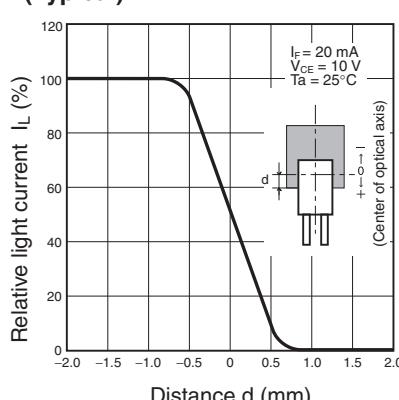
Light Current vs. Forward Current Characteristics (Typical)



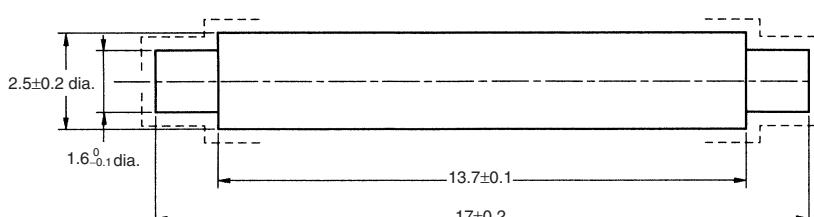
Dark Current vs. Ambient Temperature Characteristics (Typical)



Sensing Position Characteristics (Typical)



Actuator Dimensions



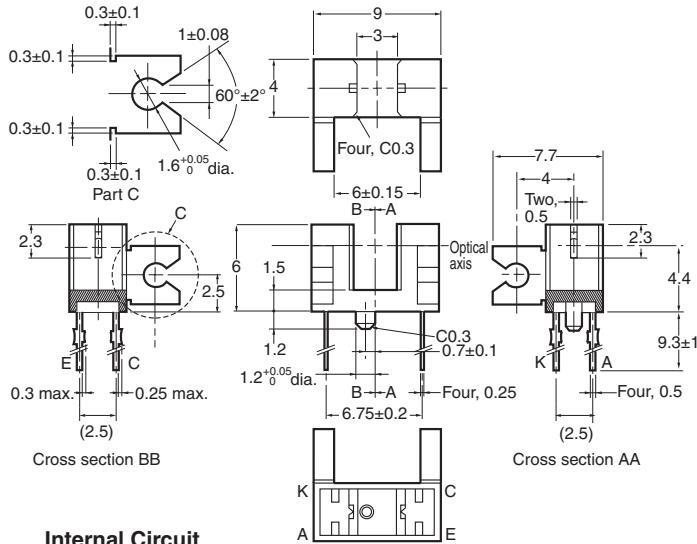
Note: 1. Make sure that the portions marked with dotted lines have no burrs.
2. The material of the actuator must be selected by considering the infrared permeability of the actuator.

Photomicrosensor (Actuator Mounted) EE-SA103

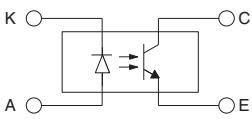
⚠ Be sure to read *Precautions* on page 24.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm £ 6	±0.375
6 < mm £ 10	±0.45
10 < mm £ 18	±0.55
18 < mm £ 30	±0.65

■ Features

- An actuator can be attached.
- PCB mounting type.
- High resolution with a 0.5-mm-wide aperture.

■ Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Pulse forward current	I_{FP}	1 A (see note 2)
	Reverse voltage	V_R	4 V
Detector	Collector-Emitter voltage	V_{CEO}	30 V
	Emitter-Collector voltage	V_{ECO}	---
	Collector current	I_C	20 mA
	Collector dissipation	P_C	100 mW (see note 1)
	Ambient temperature	Operating	-25°C to 85°C
Ambient temperature	Storage	T_{STG}	-30°C to 100°C
	Soldering temperature	T_{SOL}	260°C (see note 3)

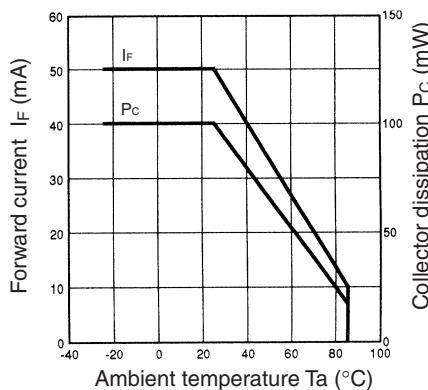
- Note:
- Refer to the temperature rating chart if the ambient temperature exceeds 25°C .
 - The pulse width is 10 μs maximum with a frequency of 100 Hz.
 - Complete soldering within 10 seconds.

■ Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

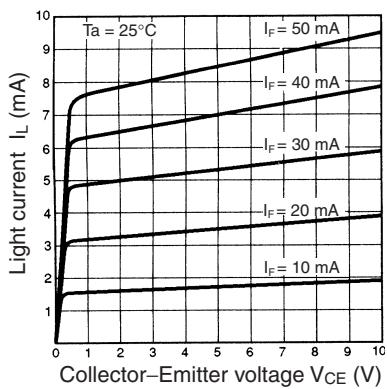
	Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P	940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L	0.5 mA min., 14 mA max.	$I_F = 20 \text{ mA}, V_{CE} = 10 \text{ V}$
	Dark current	I_D	2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lux}$
	Leakage current	I_{LEAK}	---	---
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$	0.1 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 0.1 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time		t_r	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$
Falling time		t_f	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$

■ Engineering Data

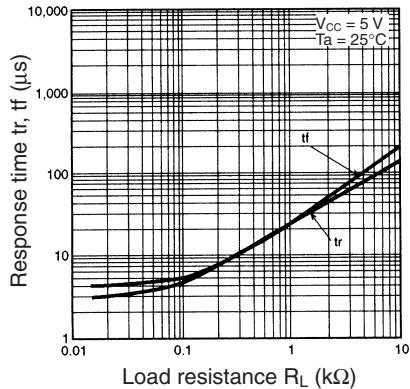
Forward Current vs. Collector Dissipation Temperature Rating



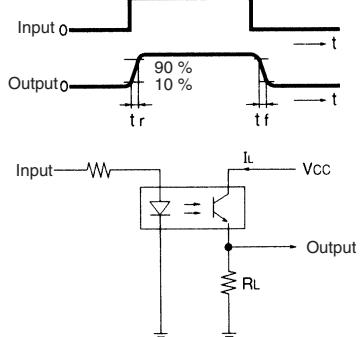
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



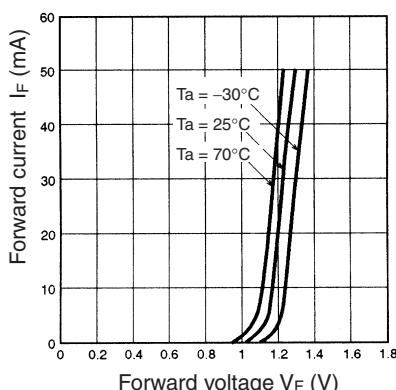
Response Time vs. Load Resistance Characteristics (Typical)



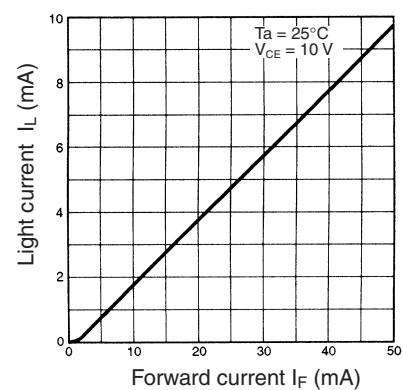
Response Time Measurement Circuit



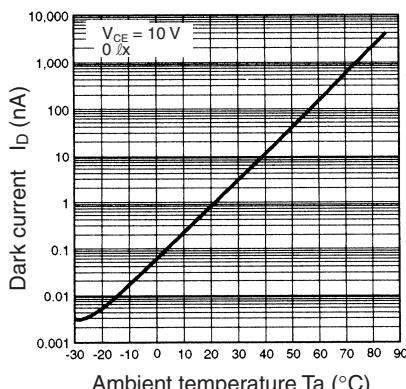
Forward Current vs. Forward Voltage Characteristics (Typical)



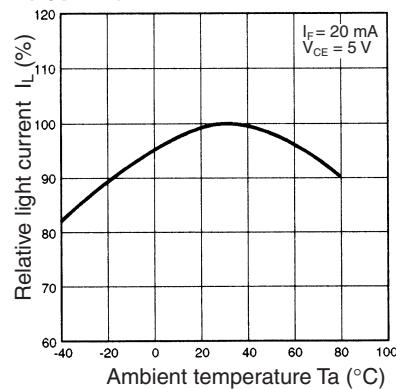
Light Current vs. Forward Current Characteristics (Typical)



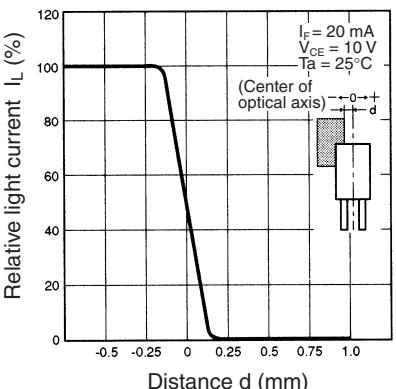
Dark Current vs. Ambient Temperature Characteristics (Typical)



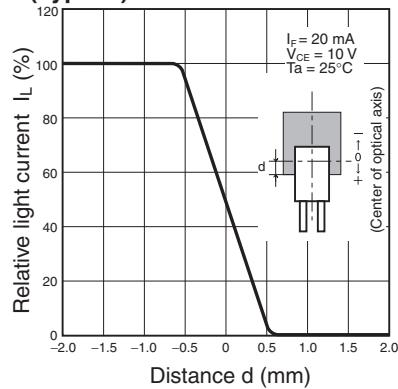
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



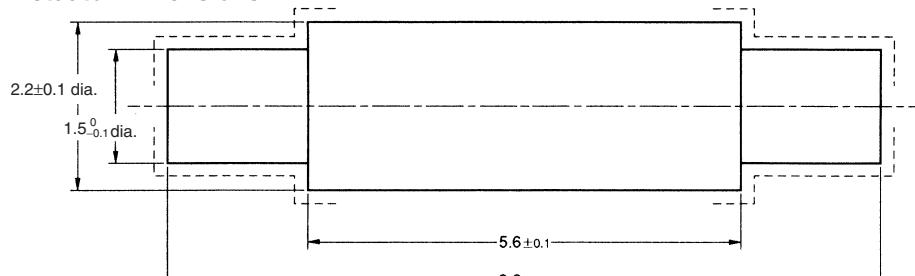
Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)



Actuator Dimensions



Note:

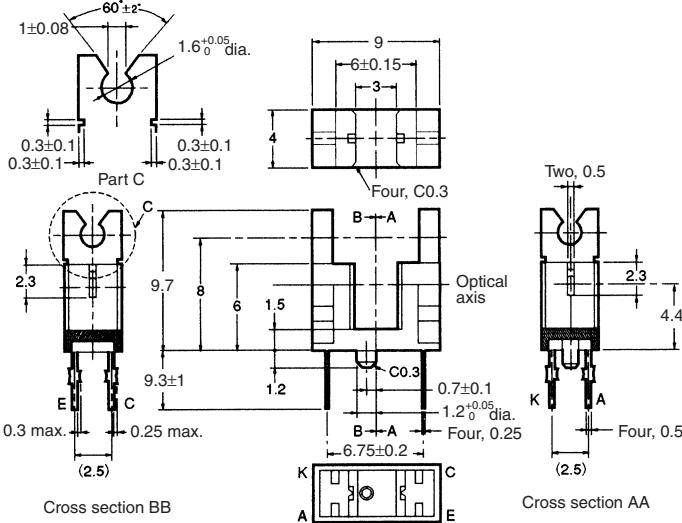
1. Make sure that the portions marked with dotted lines have no burrs.
2. The material of the actuator must be selected by considering the infrared permeability of the actuator.

Photomicrosensor (Actuator Mounted) EE-SA104

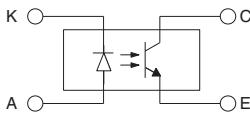
⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

Features

- An actuator can be attached.
- PCB mounting type.
- High resolution with a 0.5-mm-wide aperture.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Pulse forward current	I_{FP}	1 A (see note 2)
	Reverse voltage	V_R	4 V
Detector	Collector-Emitter voltage	V_{CEO}	30 V
	Emitter-Collector voltage	V_{ECO}	---
	Collector current	I_C	20 mA
	Collector dissipation	P_C	100 mW (see note 1)
Ambient temperature	Operating	T_{opr}	-25°C to 85°C
	Storage	T_{stg}	-30°C to 100°C
Soldering temperature		T_{sol}	260°C (see note 3)

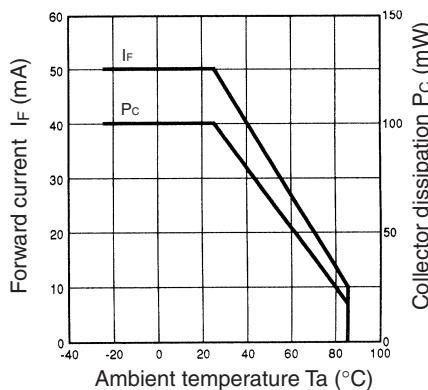
- Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
 2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
 3. Complete soldering within 10 seconds.

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

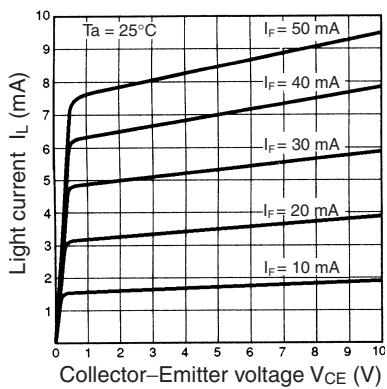
	Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P	940 nm typ.	$I_F = 20 \text{ mA}$
Detector	Light current	I_L	0.5 mA min., 14 mA max.	$I_F = 20 \text{ mA}, V_{CE} = 10 \text{ V}$
	Dark current	I_D	2 nA typ., 200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lux}$
	Leakage current	I_{LEAK}	---	---
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$	0.1 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 0.1 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.	$V_{CE} = 10 \text{ V}$
Rising time		t_r	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$
Falling time		t_f	4 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 5 \text{ mA}$

■ Engineering Data

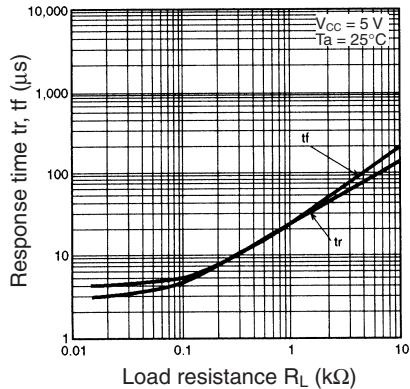
Forward Current vs. Collector Dissipation Temperature Rating



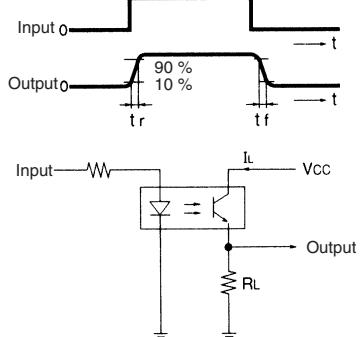
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



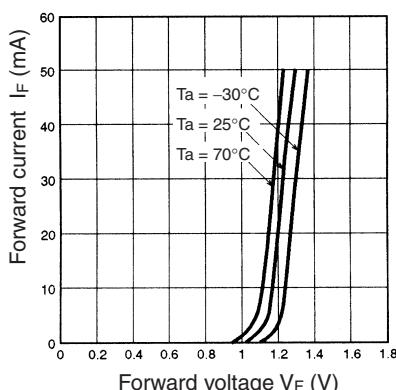
Response Time vs. Load Resistance Characteristics (Typical)



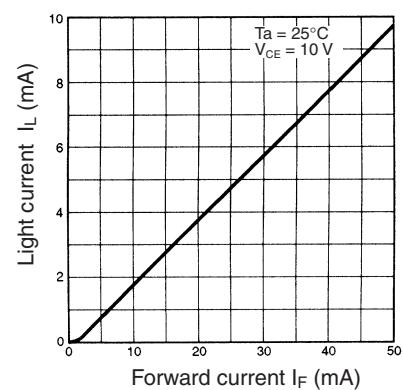
Response Time Measurement Circuit



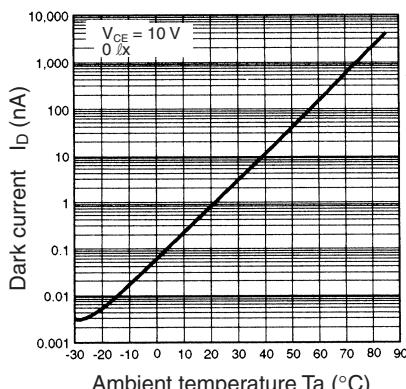
Forward Current vs. Forward Voltage Characteristics (Typical)



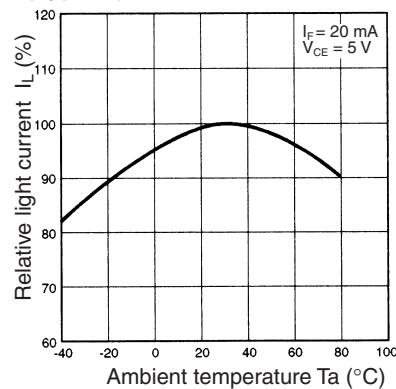
Light Current vs. Forward Current Characteristics (Typical)



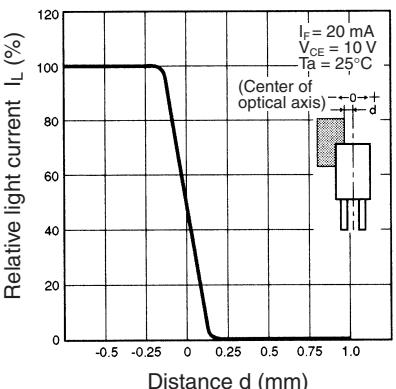
Dark Current vs. Ambient Temperature Characteristics (Typical)



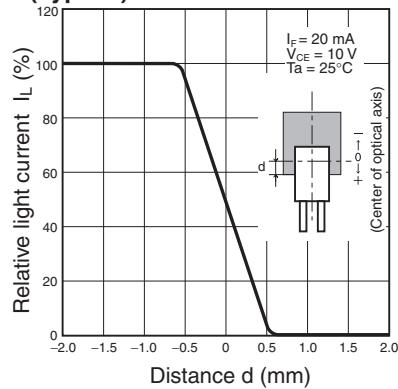
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



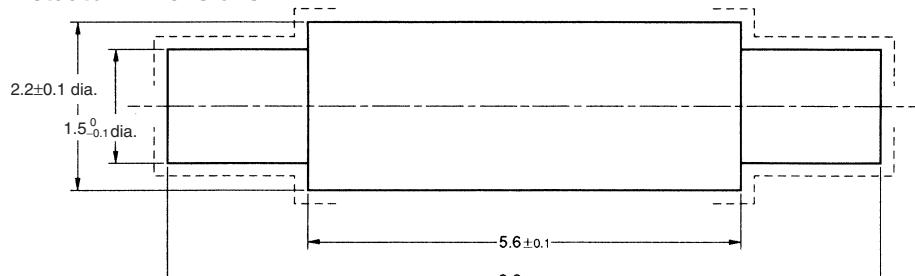
Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)



Actuator Dimensions



Note:

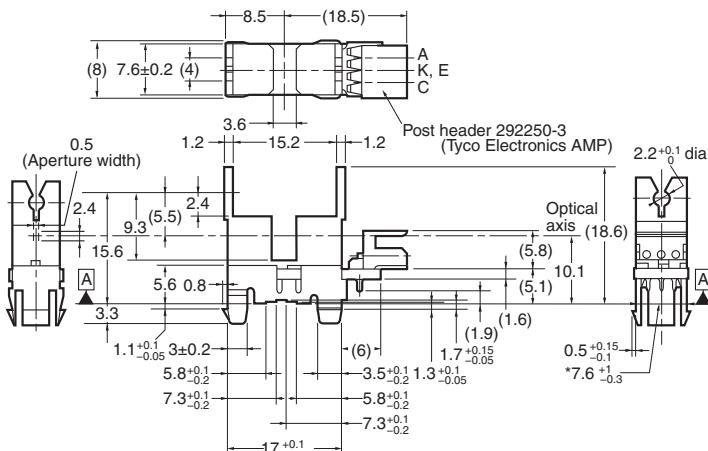
1. Make sure that the portions marked with dotted lines have no burrs.
2. The material of the actuator must be selected by considering the infrared permeability of the actuator.

Photomicrosensor (Actuator Mounted) EE-SA107-P2

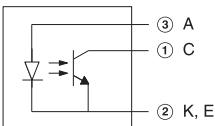
⚠ Be sure to read *Precautions* on page 24.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Note: The asterisked dimension is specified by datum A only.

Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Recommended Mating Connectors:

Tyco Electronics AMP 179228-3 (crimp connector)
173977-3 (press-fit connector)
175778-3 (crimp connector)

■ Features

- An actuator can be attached.
- Snap-in mounting model.
- Mounts to 1.0-, 1.2- and 1.6-mm-thick PCBs.
- Connects to Tyco Electronics AMP's CT-series connectors.

■ Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

	Item	Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note)
	Pulse forward current	I_{FP}	---
	Reverse voltage	V_R	4 V
Detector	Collector-Emitter voltage	V_{CEO}	30 V
	Emitter-Collector voltage	V_{ECO}	5 V
	Collector current	I_C	20 mA
	Collector dissipation	P_C	100 mW (see note)
Ambient temperature	Operating	T_{opr}	-25°C to 85°C
	Storage	T_{stg}	-40°C to 85°C
Soldering temperature		T_{sol}	---

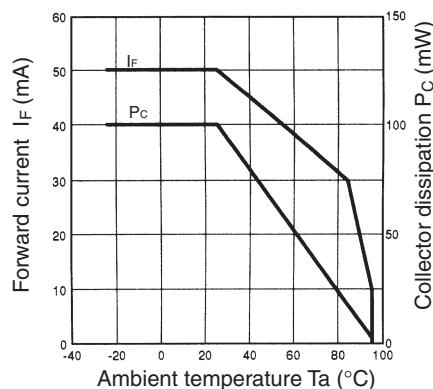
Note: Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

■ Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$)

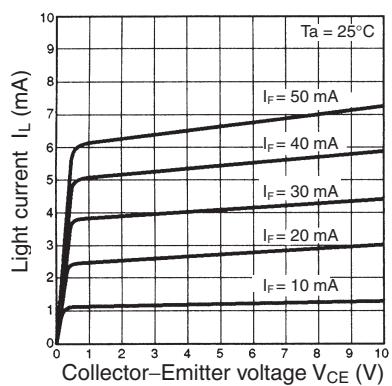
	Item	Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.2 V typ., 1.5 V max.	$I_F = 30 \text{ mA}$
	Reverse current	I_R	0.01 μA typ., 10 μA max.	$V_R = 4 \text{ V}$
	Peak emission wavelength	λ_P	940 nm typ.	$I_F = 30 \text{ mA}$
Detector	Light current	I_L	0.5 mA min., 14 mA max.	$I_F = 20 \text{ mA}, V_{CE} = 5 \text{ V}$
	Dark current	I_D	200 nA max.	$V_{CE} = 10 \text{ V}, 0 \text{ lux}$
	Leakage current	I_{LEAK}	---	---
	Collector-Emitter saturated voltage	$V_{CE} (\text{sat})$	0.1 V typ., 0.4 V max.	$I_F = 20 \text{ mA}, I_L = 0.3 \text{ mA}$
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.	$V_{CE} = 5 \text{ V}$
Rising time	t_r		8 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 1 \text{ mA}$
Falling time	t_f		8 μs typ.	$V_{CC} = 5 \text{ V}, R_L = 100 \Omega, I_L = 1 \text{ mA}$

■ Engineering Data

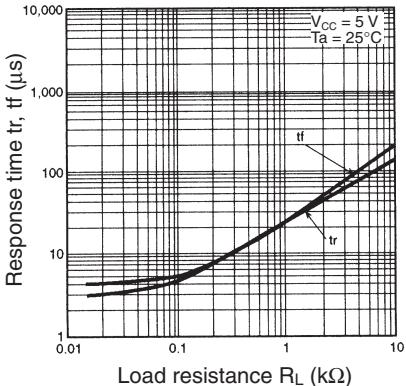
Forward Current vs. Collector Dissipation Temperature Rating



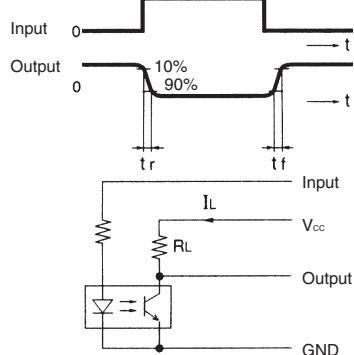
Light Current vs. Collector-Emitter Voltage Characteristics (Typical)



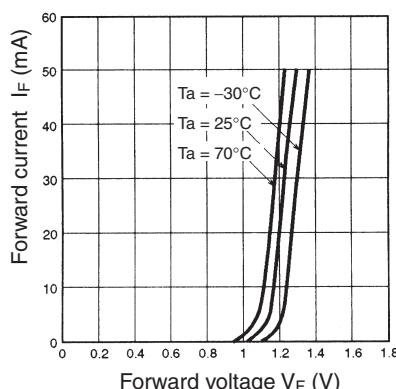
Response Time vs. Load Resistance Characteristics (Typical)



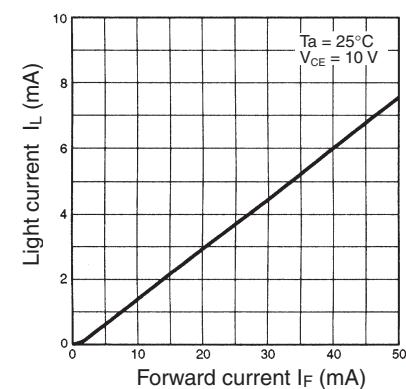
Response Time Measurement Circuit



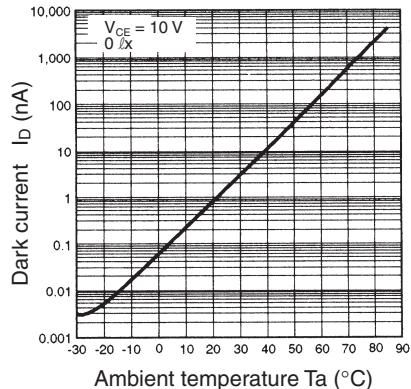
Forward Current vs. Forward Voltage Characteristics (Typical)



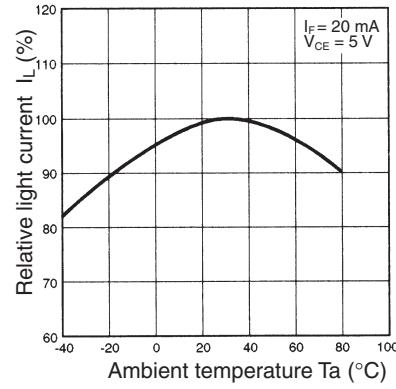
Light Current vs. Forward Current Characteristics (Typical)



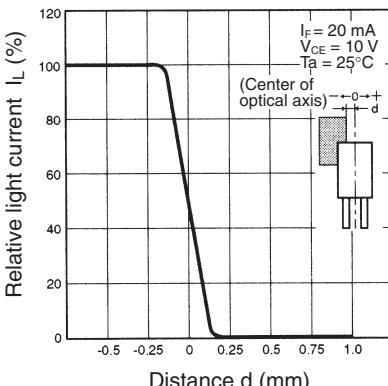
Dark Current vs. Ambient Temperature Characteristics (Typical)



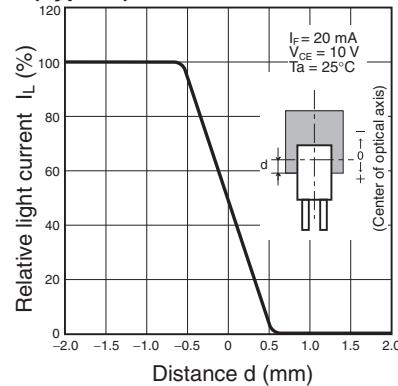
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



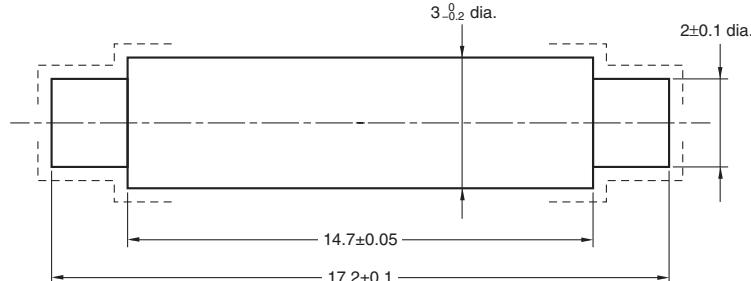
Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)



Actuator Dimensions



Note:

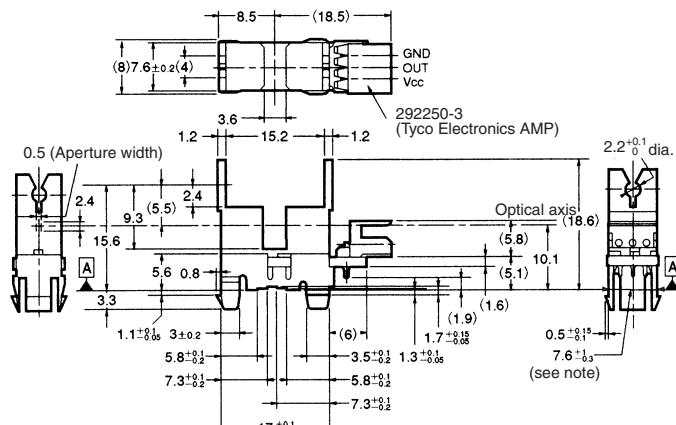
1. Make sure that the portions marked with dotted lines have no burrs.
2. The material of the actuator must be selected by considering the infrared permeability of the actuator.

Photomicrosensor (Actuator Mounted) EE-SA407-P2

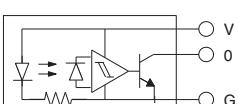
⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Terminal No.	Name
V	Power supply (Vcc)
O	Output (OUT)
G	Ground (GND)

Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	± 0.3
$3 < \text{mm} \leq 6$	± 0.375
$6 < \text{mm} \leq 10$	± 0.45
$10 < \text{mm} \leq 18$	± 0.55
$18 < \text{mm} \leq 30$	± 0.65

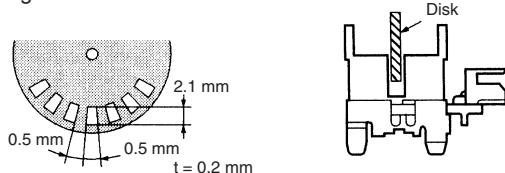
Recommended Mating Connectors:

Tyco Electronics AMP 179228-3 (crimp connector)
175778-3 (crimp connector)
173977-3 (press-fit connector)

Electrical and Optical Characteristics ($T_a = 25^\circ\text{C}$, $V_{CC} = 5 \text{ V} \pm 10\%$)

Item	Symbol	Value	Condition
Current consumption	I_{CC}	30 mA max.	With and without incident
Low-level output voltage	V_{OL}	0.35 V max.	$I_{OUT} = 16 \text{ mA}$ with incident
High-level output voltage	V_{OH}	$(V_{CC} \times 0.9) \text{ V}$ min.	$V_{OUT} = V_{CC}$ without incident, $R_L = 47 \text{ k}\Omega$
Response frequency	f	3 kHz min.	$V_{OUT} = V_{CC}$, $R_L = 47 \text{ k}\Omega$ (see note)

Note: The value of the response frequency is measured by rotating the disk as shown below.



Features

- An actuator can be attached.
- Snap-in mounting model.
- Mounts to 1.0-, 1.2- and 1.6-mm-thick panels.
- High resolution with a 0.5-mm-wide sensing aperture.
- With a 3.6-mm-wide slot.
- Photo IC output signals directly connect with logic circuit and TTL.
- Connects to Tyco Electronics AMP's CT-series connectors.

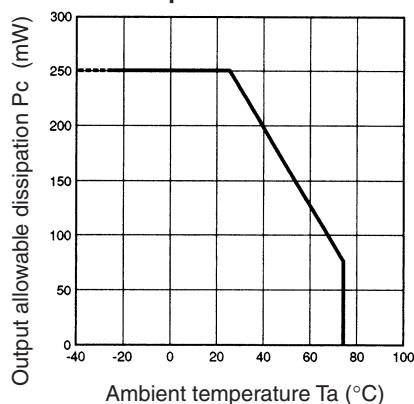
Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rated value
Power supply voltage	V_{CC}	7 V
Output voltage	V_{OUT}	28 V
Output current	I_{OUT}	16 mA
Permissible output dissipation	P_{OUT}	250 mW (see note)
Ambient temper- ature	Operating	$T_{opr} = -20^\circ\text{C}$ to 75°C
	Storage	$T_{stg} = -40^\circ\text{C}$ to 85°C
Soldering temperature	T_{sol}	---

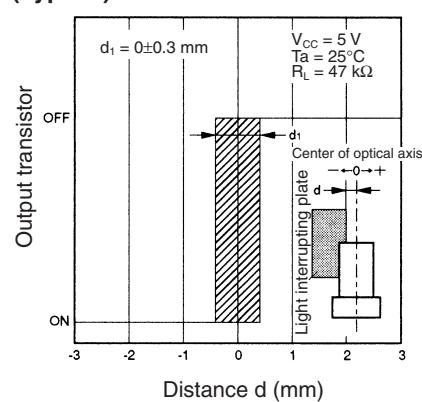
Note: Refer to the temperature rating chart if the ambient temperature exceeds 25°C .

■ Engineering Data

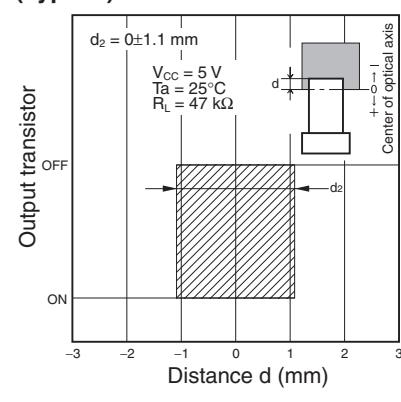
Output Allowable Dissipation vs. Ambient Temperature Characteristics



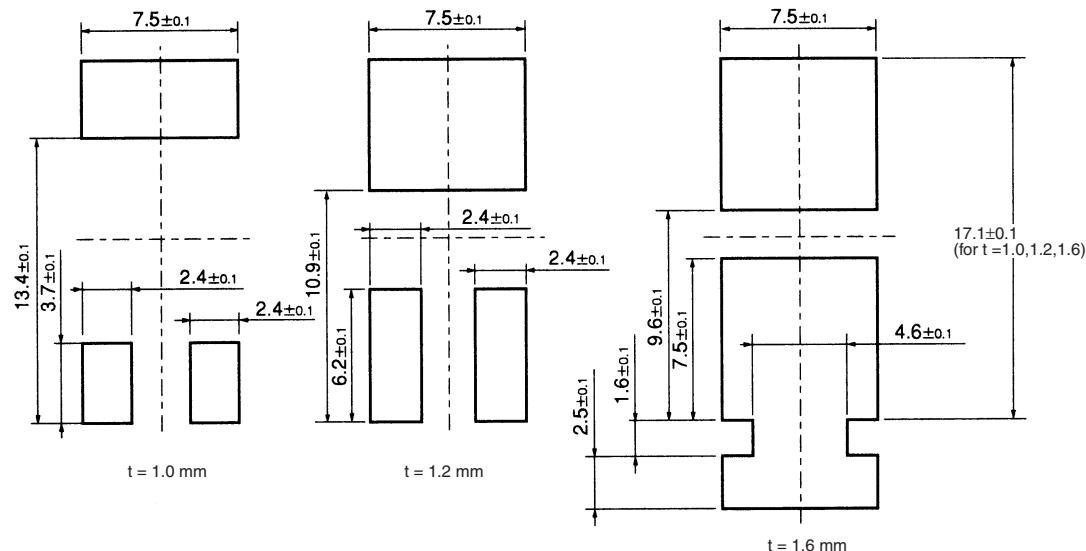
Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)

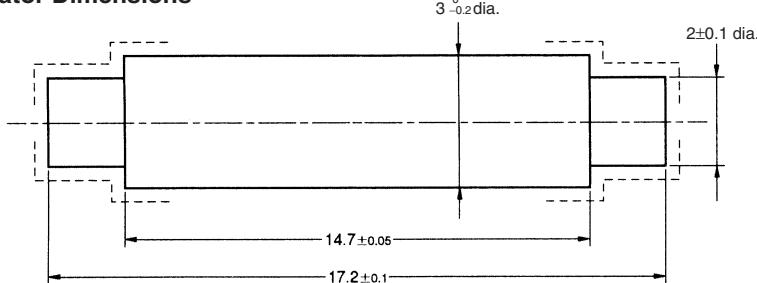


■ Recommended Mounting Holes



- When mounting the Photomicrosensor to a panel with a hole opened by pressing, make sure that the hole has no burrs. The mounting strength of the Photomicrosensor will decrease if the hole has burrs.
- When mounting the Photomicrosensor to a panel with a hole opened by pressing, be sure to mount the Photomicrosensor on the pressing side of the panel.
- The mounting strength of the Photomicrosensor will increase if the Photomicrosensor is mounted to a panel with a hole that is only a little larger than the size of the Photomicrosensor, in which case, however, it will be difficult to mount the Photomicrosensor to the panel. The mounting strength of the Photomicrosensor will decrease if the Photomicrosensor is mounted to a panel with a hole that is comparatively larger than the size of the Photomicrosensor, in which case, however, it will be easy to mount the Photomicrosensor to the panel. When mounting the Photomicrosensor to a panel, open an appropriate hole for the Photomicrosensor according to the application.
- After mounting the Photomicrosensor to any panel, make sure that the Photomicrosensor does not wobble.
- When mounting the Photomicrosensor to a molding with a hole, make sure that the edges of the hole are sharp enough, otherwise the Photomicrosensor may come fall out.

Actuator Dimensions



- Note:**
1. Make sure that the portions marked with dotted lines have no burrs.
 2. The material of the actuator must be selected by considering the infrared permeability of the actuator.

MEMO

Microphotonic Devices

Selection Guide	194
Manuscript Paper Sensors	
EY3A-1051	196
EY3A-1081	198
Micro-displacement Sensor	
Z4D-B01	200

Selection Guide

■ Manuscript Paper Sensors

Sensing distance	Model	Page
50 mm	EY3A-1051	196
80 mm	EY3A-1081	198

■ Micro-displacement Sensor

Sensing distance	Resolution	Model	Page
4±1 mm	±10 µm	Z4D-B01	200

MEMO

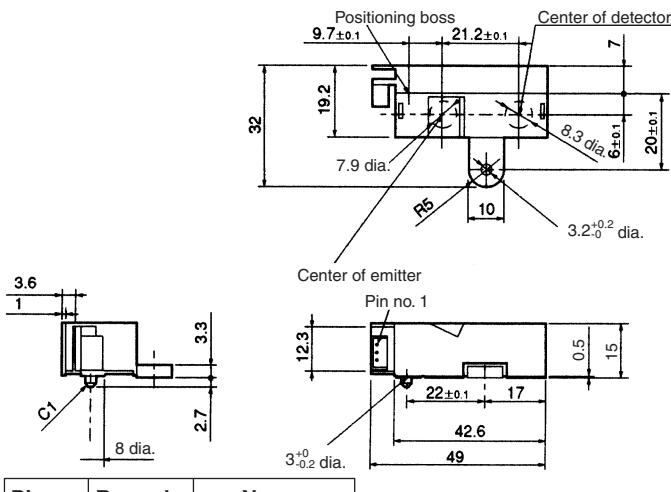
Manuscript Paper Sensor (1 Beam: 50 mm)

EY3A-1051

⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Pin no.	Remarks	Name
1	O	Output (OUT)
2	V	Power supply (Vcc)
3	G	Ground (GND)

Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65
30 < mm ≤ 50	±0.8

Recommended Mating Connectors:
Japan Molex 51090-0300 (crimp connector)
52484-0310 (press-fit connector)

Features

- Ensures higher sensitivity and external light interference resistivity than any other photomicrosensor.
- Narrow sensing range ensures stable sensing of a variety of sensing objects.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rated value
Power supply voltage	V_{CC}	7 V
Load voltage	V_{OUT}	7 V
Load current	I_{OUT}	10 mA
Ambient temperature	Operating	T_{opr} 0°C to 60°C
	Storage	T_{stg} -15°C to 70°C

Note: Make sure there is no icing or condensation when operating the Sensor.

Electrical and Optical Characteristics ($T_a = 0^\circ\text{C}$ to 60°C)

Item	Value	Condition
Power supply voltage	5 V ±5%	---
Current consumption	50 mA max.	$V_{CC} = 5 \text{ V}$, $R_L = \infty$
Peak current consumption	200 mA max.	$V_{CC} = 5 \text{ V}$, $R_L = \infty$
Low-level output voltage	0.6 V max.	$V_{CC} = 5 \text{ V}$, $I_{OL} = 4 \text{ mA}$ (see note 1)
High-level output voltage	3.5 V min.	$V_{CC} = 5 \text{ V}$, $R_L = 4.7 \text{ k}\Omega$ (see note 2)
Response delay time (High to Low)	1.5 ms max.	The time required for the output to become "Lo" after placing sensing object.
Response delay time (Low to high)	1.5 ms max.	The time required for the output to become "Hi" after removing sensing object.

Note: 1. These conditions are for the sensing of lusterless paper with an OD of 0.9 maximum located at the correct sensing position of the Sensor as shown in the optical path arrangement on page 197.

2. These conditions are for the sensing of the paper supporting plate with an OD of 0.05 located using the glass plate without paper as shown in the optical path arrangement on page 197.

■ Characteristics (Paper Table Glass: $t = 6 \text{ mm max.}$, Transparency Rate: 90% min.) (Ta = 0°C to 60°C)

Item	Characteristic value
Sensing density	Lusterless paper with an OD of 0.9 max. (sensing distance: 50 mm) (see note)
Non-sensing distance	85 mm (from the top of the sensor), OD: 0.05
Paper sensing distance	50 mm (from the top of the sensor)
Ambient illumination	Sunlight: 3,000 lx max., fluorescent light: 2,000 lx max.

Note: 1. The data shown are initial data.

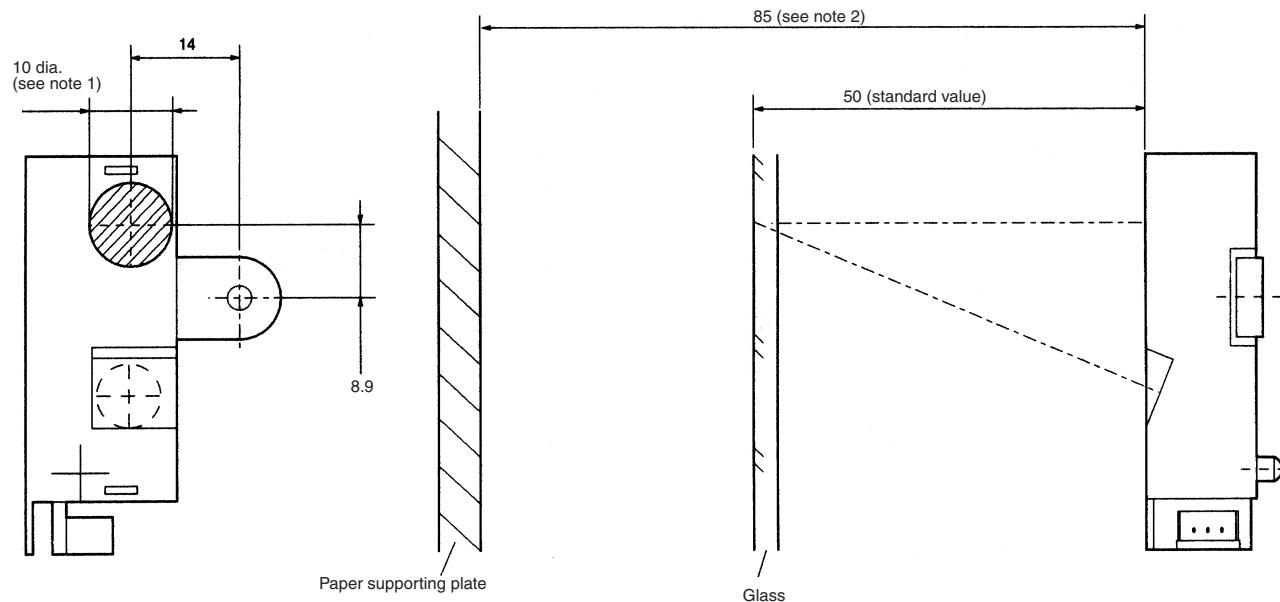
2. Optical darkness (OD) is defined by the following formula:

$$\text{OD} = -\log_{10} \left(\frac{P_{\text{OUT}}}{P_{\text{IN}}} \right)$$

P_{IN} (mW): Light power incident upon the document

P_{OUT} (mW): Reflected light power from the document

■ Optical Path Arrangement

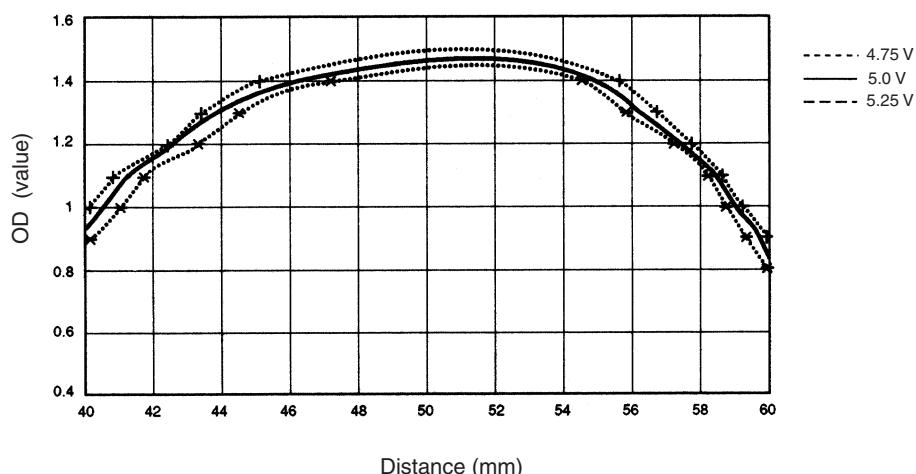


Note: 1. The part with oblique lines indicates the paper sensing area of the EY3A-1051, which is practically determined by the diameter of the beam and its tolerance.

2. The non-sensing distance of the EY3A-1051 is determined using a paper with an OD of 0.05.

■ Engineering Data

Distance Characteristics (Typical)



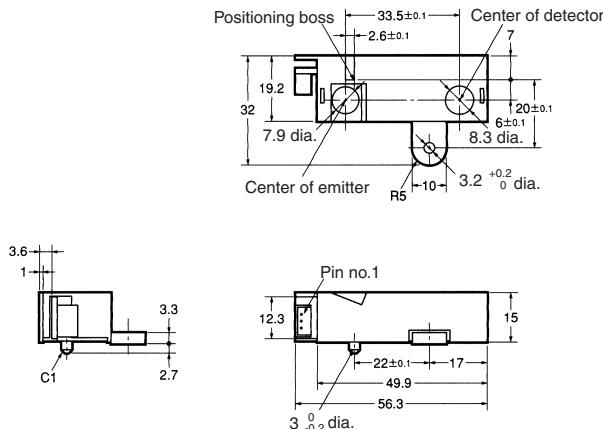
Manuscript Paper Sensor (1 Beam: 80 mm)

EY3A-1081

! Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Pin no.	Remarks	Name
1	O	Output (OUT)
2	V	Power supply (Vcc)
3	G	Ground (GND)

Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65
30 < mm ≤ 50	±0.8
50 < mm ≤ 80	±0.95

Recommended Mating Connectors:
Japan Molex 51090-0300 (crimp connector)
52484-0310 (press-fit connector)

Features

- Ensures higher sensitivity and external light interference resistivity than any other photomicrosensor.
- Narrow sensing range ensures stable sensing of a variety of sensing objects.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rated value
Power supply voltage	V_{CC}	7 V
Load voltage	V_{OUT}	7 V
Load current	I_{OUT}	10 mA
Ambient temperature	Operating	T_{opr}
	Storage	T_{stg}

Note: Make sure there is no icing or condensation when operating the Sensor.

Electrical and Optical Characteristics ($T_a = 0^\circ\text{C}$ to 60°C)

Item	Value	Condition
Power supply voltage	5 V ±5%	---
Current consumption	50 mA max.	$V_{CC} = 5$ V, $R_L = \infty$
Peak current consumption	200 mA max.	$V_{CC} = 5$ V, $R_L = \infty$
Low-level output voltage	0.6 V max.	$V_{CC} = 5$ V, $I_{OL} = 4$ mA (see note 1)
High-level output voltage	3.5 V min.	$V_{CC} = 5$ V, $R_L = 4.7$ kΩ (see note 2)
Response delay time (High to Low)	1.5 ms max.	The time required for the output to become "Lo" after placing sensing object.
Response delay time (Low to high)	1.5 ms max.	The time required for the output to become "Hi" after removing sensing object.

- Note:**
- These conditions are for the sensing of lusterless paper with an OD of 0.7 maximum located at the correct sensing position of the Sensor as shown in the optical path arrangement on page 199.
 - These conditions are for the sensing of the paper supporting plate with an OD of 0.05 located using the glass plate without paper as shown in the optical path arrangement on page 199.

■ Characteristics (Paper Table Glass: $t = 6 \text{ mm}$ max., Transparency Rate: 90% min.) ($T_a = 0^\circ\text{C}$ to 60°C)

Item	Characteristic value
Sensing density	Lusterless paper with an OD of 0.7 max. (sensing distance: 80 mm) (see note)
Non-sensing distance	120 mm (from the top of the sensor), OD: 0.05
Paper sensing distance	80 mm (from the top of the sensor)
Ambient illumination	Sunlight: 3,000 lx max., fluorescent light: 2,000 lx max.

Note: 1. The data shown are initial data.

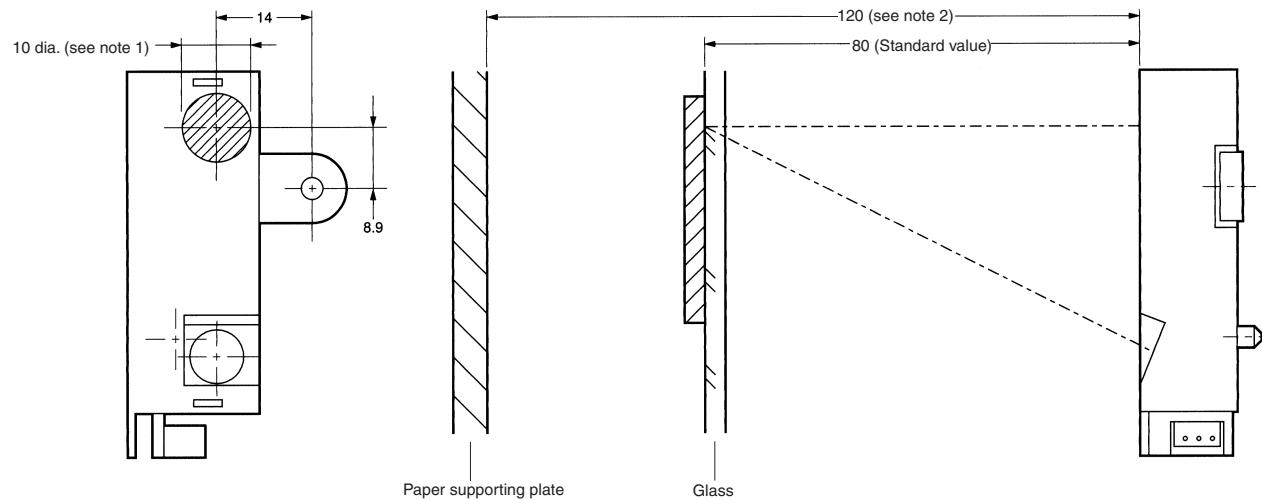
2. Optical darkness (OD) is defined by the following formula:

$$\text{OD} = -\log_{10} \left(\frac{P_{\text{OUT}}}{P_{\text{IN}}} \right)$$

P_{IN} (mW):Light power incident upon the document

P_{OUT} (mW):Reflected light power from the document

■ Optical Path Arrangement

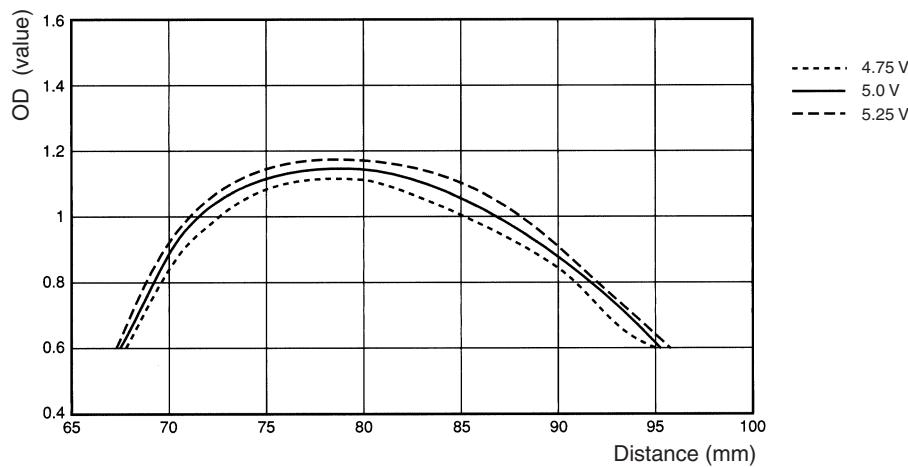


Note: 1. The part with oblique lines indicates the paper sensing area of the EY3A-1081, which is practically determined by the diameter of the beam and its tolerance.

2. The non-sensing distance of the EY3A-1081 is determined using a paper with an OD of 0.05.

■ Engineering Data

Distance Characteristics (Typical)



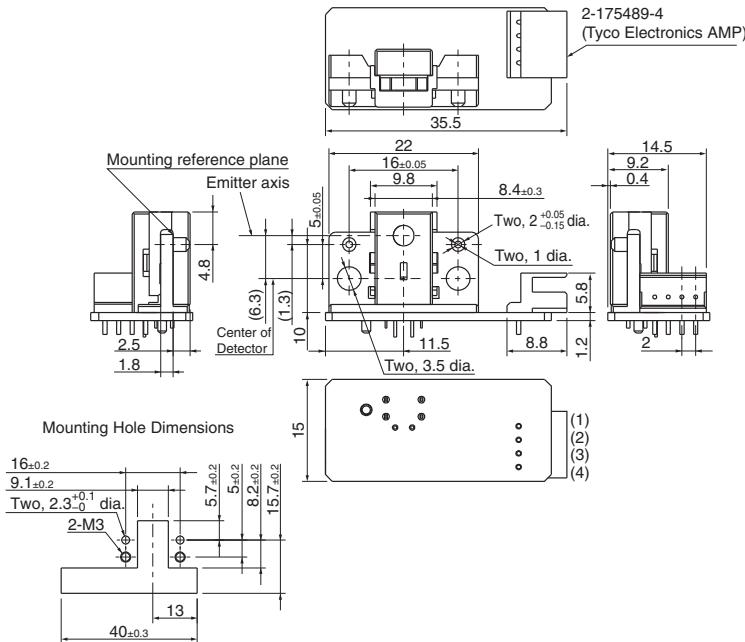
Micro-displacement Sensor

Z4D-B01

⚠ Be sure to read *Precautions* on page 24.

Dimensions

Note: All units are in millimeters unless otherwise indicated.



Recommended Mating Connectors:
Tyco Electronics AMP

- 175778-4 (crimp-type connector)
- 173977-4 (press-fit connector)

Features

- Easier control enabled by built-in processor circuit.
- Resolution: $\pm 10 \mu\text{m}$.
- Operating area: $6.5 \pm 1 \text{ mm}$.
- Adapts well to changes in reflection factor using division processing.

Applications

- Paper thickness detection
- Multi-feed detection
- Travel distance detection

Pin no.	Remarks	Name
1	PLS	LED pulse light emission control signal
2	V _{cc}	Power supply
3	OUT	Output
4	GND	Ground

Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerance
3 mm max.	± 0.3
$3 < \text{mm} \leq 6$	± 0.375
$6 < \text{mm} \leq 10$	± 0.45
$10 < \text{mm} \leq 18$	± 0.55
$18 < \text{mm} \leq 30$	± 0.65
$30 < \text{mm} \leq 50$	± 0.8

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Value	Unit	Condition
Supply voltage	V _{cc}	7	VDC	---
LED pulse light emission control signal	PLS	7	VDC	LED
LED light emission pulse	T _{FP}	100 (see note)	ms	---
Operating temperature	T _{opr}	-10 to 65	°C	No freezing or condensation
Storage temperature	T _{stg}	-25 to 80	°C	---

Note: Refer to Pulsed Forward Current Rated Curve.

Electrical and Optical Characteristics ($T_a = -10^\circ\text{C}$ to 65°C)

Item	Symbol	Rated value	Condition
Power supply voltage	V _{cc}	5 VDC $\pm 10\%$	Ripple (p-p): 10 mV p-p max.
Current consumption	OUT	0.2 VDC to $(V_{cc}-0.3)$ V	(see note 1)
Response delay time (High to Low)	tr	100 μs max.	(see note 2)
Response delay time (Low to high)	PLS	3.5 VDC to V _{cc}	---

Note: 1. Load impedance (between OUT-GND) is set at more than $10 \text{ k}\Omega$.

2. The time for output voltage to rise from 10% to 90% of the full output range.

■ Characteristics (Ta = -10°C to 65°C)

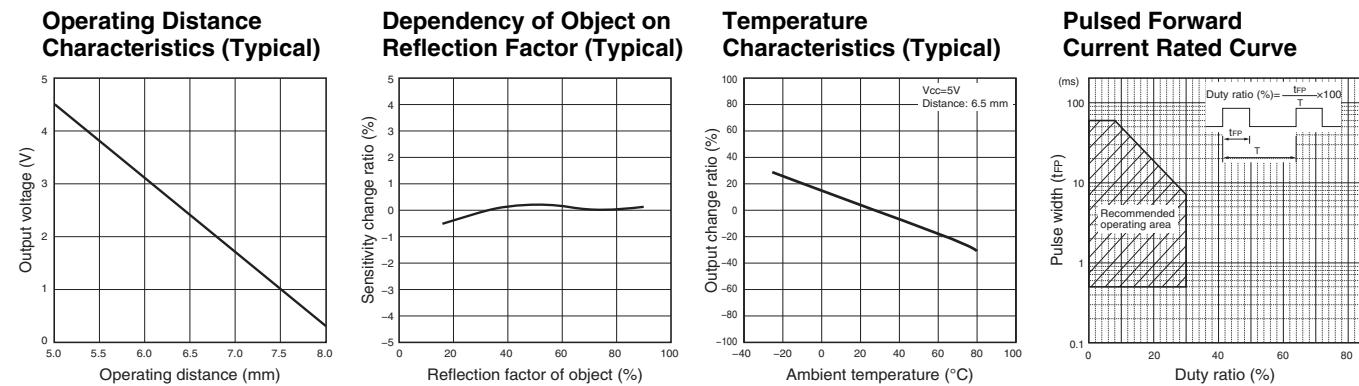
Object: N8.5 Munsell paper with a reflection factor of 70%.

Item	Value
Operating area (see note 1)	6.5 ± 1 mm
Sensitivity variation (see note 2)	-1.4 mV/μm ±10% max.
Resolution (see note 3)	±10 μm max. (Ta = 25°C)
Linearity (see note 4)	2% F.S. (full scale) max.

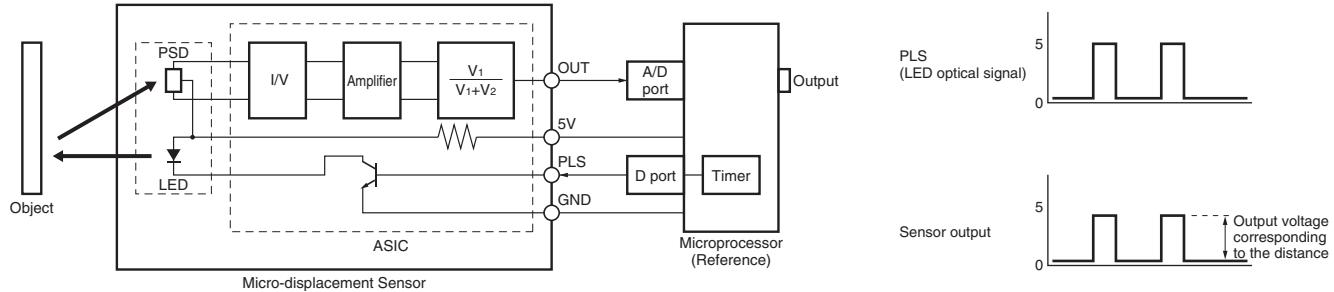
Note: 1. Distance from Mounting Reference Plane to Target.

2. The sensitivity is defined as slope of the line and it represents the variation in the output voltage per unit length between different products.
3. This is the value of the electrical noise width in the output signal converted to a distance under the following conditions.
 - (1) A/D conversion time: 50 μs max.
 - (2) Ripple noise in the power supply voltage (Vcc): 10 mVp-p max.
 - (3) Low-pass filter time constant of the downstream signal processing circuit: 0.4 ms
 - (4) Distance from mounting reference plane to target: 6.5 mm
4. This is the peak-to-peak value of the deviation of the signal output from a straight line. A linearity of 2% F.S. indicates the following value:
 - (1) Distance full-scale converted value: 2 mm × 0.02 = 0.04 mm (40 μm)
 - (2) Output voltage converted value: 1.4 mV/μm × 40 μm = 56 mV (for a sensor with a sensitivity of 1.4 mV/μm)

■ Engineering Data

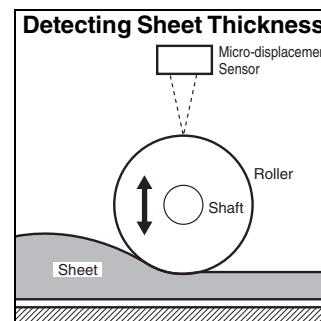
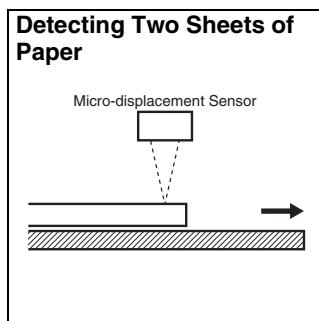
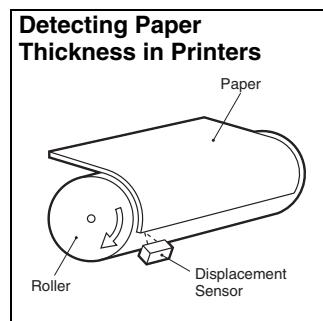


■ Circuit Diagram



The sensor output is obtained by adding a pulse signal to the PLS terminal. An output cannot be obtained merely by adding a DC voltage to the PLS terminal. The output will be a pulse output synchronized with the PLS signal. The output must be held with a latching or sample-and-hold circuit in the microprocessor.

■ Typical Application



MEMO

Information

Reliability 204

Reliability

■ Market Product Quality

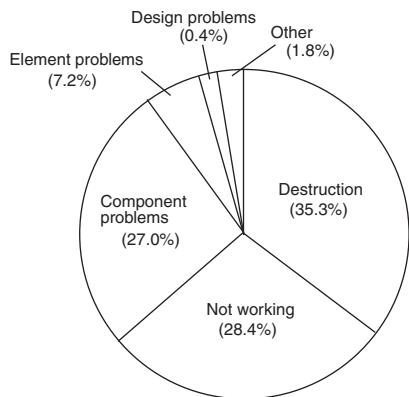
OMRON is making efforts so that OMRON's Photomicrosensors can achieve a failure rate of only $10^{-7}/\text{h}$.

OMRON will continue improving the quality of its products to comply with OMRON Photomicrosensors users' demand for product quality while actively providing good after-sales service.

OMRON's Photomicrosensors achieved a failure rate of 10 ppm. Figure 5 shows the reasons for the return of OMRON Photomicrosensors.

The reasons for approximately two-thirds of the products sent back were that they were not working or they were destroyed. It is possible that they were not working or they were destructed because excessive voltages were imposed on them or they were not operated properly according to their specifications. To solve such problems, OMRON is actively holding preliminary meetings with customers who will use OMRON products and advise them of the operating conditions required by the products while actively providing them with after-sales service.

Figure 5. Reasons for Products Sent Back



■ Reliability

The life of any Photomicrosensor depends on the secular changes of the optical output of the LED built into the Photomicrosensor. The following are the output characteristics of the Photomicrosensor, all of which depend on the optical output of the LED.

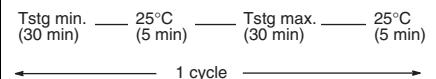
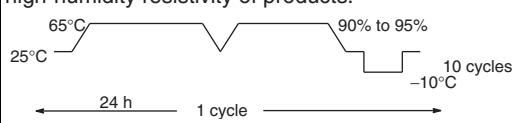
Phototransistor output	Light current (I_L)
Photo IC output	LED current I_{FT} with the photo IC output ON and OFF
Amplifier output (reflective sensor)	Sensing distance d

OMRON has been conducting reliability tests of each type of Photomicrosensor to check the secular changes of the optical output of the LED built into the Photomicrosensor.

■ Reliability Tests

In principle, Photomicrosensors conform to JEITA standards. The following table shows the details of the reliability tests of Photomicrosensors conducted by OMRON.

Figure 6. Details of Reliability Tests

Classification	Test	Detail	Conforming standard	
Thermal condition test	Soldering heat resistivity	Evaluates the soldering heat resistivity of products. Usually, this test is conducted under the following conditions. Soldering temperature: $260 \pm 5^\circ\text{C}$ Soldering time: 10 ± 1 s	JEITA ED-4701/300 ED-8121 JIS C7021: A1 IEC Pub68-2-20	
	Thermal shock	Evaluates the resistivity of products to radical temperature changes. Usually, this test is conducted under the following conditions. Ta: 0°C to 100°C (liquid bath) or TstgMIN to TstgMAX (liquid bath)	JEITA ED-4701/300 JIS C7021: A3 IEC Pub68-2-14	
	Temperature cycle	Evaluates the low- and high-temperature resistivity of products.  Tstg min. ————— 25°C ————— Tstg max. ————— 25°C (30 min) (5 min) (30 min) (5 min) ←————— 1 cycle —————→	JEITA ED-4701/100 JIS C7021: A4 IEC Pub68-2-14	The five-minute storage periods at a temperature of 25°C in the test may be omitted.
	Temperature and humidity cycle	Evaluates the high-temperature and high-humidity resistivity of products.  65°C 25°C 90% to 95% -10°C 24 h 1 cycle	JEITA ED-4701/200 JIS C7021: A5 IEC Pub68-2-4	
Mechanical test	Soldering ease	Evaluates the terminal soldering ease of the products. Usually, this test is conducted under the following conditions. Soldering temperature: $230 \pm 5^\circ\text{C}$ Soldering time: 5 ± 0.5 s	JEITA ED-4701/300 ED-8121 JIS C7021: A2 IEC Pub68-2-20	
	Terminal strength	Evaluates the resistivity of the terminals of products to the force imposed on the terminals while the products are mounted, wired, or operated. 1. Tension test On each terminal of products, a specified load is imposed for 10 ± 1 s in the direction of the terminal. 2. Bending test On the tip of each terminal of products, a specified load is imposed to bend the terminal by 90° and to change it back.	JEITA ED-4701/400 ED-8121 JIS C7021: A11 IEC Pub68-2-21	
	Shock resistance	Judges the structural resistivity and mechanical resistivity of products. The conditions of this test vary with the product structure. Usually, this test is conducted under the following conditions. Impact acceleration: $14,700 \text{ m/s}^2$ Pulse width: 0.5 ms	JEITA ED-4701/400 ED-8121 JIS C7021: A7 IEC Pub68-2-27	A product may be subjected to this test after it is packed up.
	Vibration resistance	Evaluates the vibration resistivity of products while they are transported or operated. Usually, this test is conducted under the following conditions. Frequency: 100 to 2000 Hz/4 min 200 m/s^2	JEITA ED-4701/400 ED-8121 JIS C7021: A10 IEC Pub68-2-21	A product may be subjected to this test after it is packed up.
	Natural drop	Evaluates the irregular shock resistivity of products while they are handled, transported, or operated. Usually, this test is conducted under the following conditions. Height: 75 cm No. of times: 3	JEITA EIAJ-8121 JIS C7021: A8 IEC Pub68-2-32	A product may be subjected to this test after it is packed up.

Classification	Test	Detail	Conforming standard	
Life expectancy test	Continuous operation	Evaluates the resistivity of products to a continuous, long-time electrical stress and temperature stress. Usually, this test is conducted under the following conditions. Ta: $25 \pm 5^{\circ}\text{C}$ Bias: I_{FMAX} or P_{CMAX}	EIAJ-EDX-8121 EIAJ-SD-121: 201 JIS C7021: B4	A product may be subjected to this test at a high temperature, low temperature, or high temperature and humidity.
	High-temperature storage	Evaluates the resistivity of products to a high-storage temperature for a long time. Usually, this test is conducted under the following conditions. Ta: T _{STGMAX} Time: 1,000 hrs	EIAJ-EDX-8121 EIAJ-SD-121: 115 JIS C7021: B10 IEC Pub68-2-2	
	Low-temperature storage	Evaluates the resistivity of products to a low-storage temperature for a long time. Usually, this test is conducted under the following conditions. Ta: T _{STGMIN} Time: 1,000 hrs	EIAJ-EDX-8121 EIAJ-SD-121: 116 JIS C7021: B12 IEC Pub68-2-1	
	High-temperature and high-humidity storage	Evaluates the resistivity of products to a high-storage temperature and high storage humidity for a long time. Usually, this test is conducted under the following conditions. Ta: 60°C Humidity: 90% Time: 1,000 hrs	EIAJ-EDX-8121 EIAJ-SD-121: 117 JIS C7021: B11 IEC Pub68-2-3	
	High-temperature reverse bias	Evaluates the resistivity of products to a continuous electrical stress and temperature stress.	EIAJ-SD-121: 203 JIS C7021: B8	A product may be subjected to this test at a low temperature, high temperature, or high humidity.

Note: The above testing conditions and testing times depend on the features of each product.

■ Data from Reliability Tests

The following tables show the results of the reliability tests of typical Transmissive Photomicrosensors with an Infrared LED conducted by OMRON.
Providing this data does not imply that OMRON guarantees the specified reliability level.

Typical Failure Rates (MTTF Data)

EE-SX1041 (Transmissive Phototransistor Output)

Failure Criteria

Item	Symbol	Measuring conditions	Failure criteria	
			General test (see note)	Life test
Forward voltage	V_F	$I_F = 30 \text{ mA}$	1.5 V max.	1.8 V max.
Reverse current	I_R	$V_R = 4 \text{ V}$	10 μA max.	20 μA max.
Dark current	I_D	$V_{CE} = 10 \text{ V } 0lx$	200 nA max.	400 nA max.
Light current	I_L	$I_F = 20 \text{ mA}$ $V_{CE} = 10 \text{ V}$	0.5 mA min. 14 mA max.	Initial value $\times 0.7$ min.

Note: Except life test.

Test Results

Test item	Test conditions (see note 1)	Number of samples	Component hours (h)	Number of failures	Failure rate (1/h) (see note 2)
Continuous operation	$T_a = 25^\circ\text{C}$, $I_F = 50 \text{ mA}$ 2000 h	22 pcs	4.4×10^4	0	5.22×10^{-5}
High-temperature storage	$T_a = 100^\circ\text{C}$ 2000 h	22 pcs	4.4×10^4	0	5.22×10^{-5}
Low-temperature storage	$T_a = -30^\circ\text{C}$ 2000 h	22 pcs	4.4×10^4	0	5.22×10^{-5}
High-temperature and high-humidity storage	$T_a = 60^\circ\text{C}$, 90% 2000 h	22 pcs	4.4×10^4	0	5.22×10^{-5}
High-temperature reverse bias	$T_a = 85^\circ\text{C}$, $V_{CE} = 30 \text{ V}$ 2000 h	22 pcs	4.4×10^4	0	5.22×10^{-5}
Temperature cycle	-30°C (30 min) to 100°C (30 min) 10 times	22 pcs	---	0	---
Shock resistance	14,700 m/s ² , 0.5 ms, 3 times each in $\pm X$, $\pm Y$, and $\pm Z$ directions	11 pcs	---	0	---
Vibration resistance	20 to 2,000 Hz, 1.5 mm or 98 m/s ² each in X, Y, and Z directions	11 pcs	---	0	---

Note: 1. The tests after 1001 hours are for reference only.

2. Confidence level of 90%.

EE-SX1235A-P2 (Transmissive Phototransistor Output)

Failure Criteria

Item	Symbol	Measuring conditions	Failure criteria	
			General test (see note)	Life test
Forward voltage	V_F	$I_F = 30 \text{ mA}$	1.5 V max.	1.8 V max.
Reverse current	I_R	$V_R = 4 \text{ V}$	10 μA max.	20 μA max.
Dark current	I_D	$V_{CE} = 10 \text{ V } 0lx$	200 nA max.	400 nA max.
Light current	I_L	$I_F = 20 \text{ mA}$ $V_{CE} = 5 \text{ V}$	0.5 mA min. 14 mA max.	Initial value $\times 0.7$ min.

Note: Except life test.

Test Results

Test item	Test conditions (see note 1)	Number of samples	Component hours (h)	Number of failures	Failure rate (1/h) (see note 2)
Continuous operation	$T_a = 25^\circ\text{C}$, $I_F = 50 \text{ mA}$ 2000 h	22 pcs	4.4×10^4	0	5.22×10^{-5}
High-temperature storage	$T_a = 100^\circ\text{C}$ 2000 h	22 pcs	4.4×10^4	0	5.22×10^{-5}
Low-temperature storage	$T_a = -40^\circ\text{C}$ 2000 h	22 pcs	4.4×10^4	0	5.22×10^{-5}
High-temperature and high-humidity storage	$T_a = 60^\circ\text{C}$, 90% 2000 h	22 pcs	4.4×10^4	0	5.22×10^{-5}
High-temperature reverse bias	$T_a = 85^\circ\text{C}$, $V_{CE} = 30 \text{ V}$ 2000 h	22 pcs	4.4×10^4	0	5.22×10^{-5}
Temperature cycle	-40°C (30 min) to 100°C (30 min) 10 times	22 pcs	---	0	---
Shock resistance	294 m/s ² , 0.5 ms, 3 times each in $\pm X$, $\pm Y$, and $\pm Z$ directions	11 pcs	---	0	---
Vibration resistance	5 to 50 Hz, 1.5 mm or 9.8 m/s ² each in X, Y, and Z directions	11 pcs	---	0	---

Note: 1. The tests after 1001 hours are for reference only.

2. Confidence level of 90%.

EE-SX398 (Transmissive Photo-IC Output)

Failure Criteria

Item	Symbol	Measuring conditions	Failure criteria	
			General test (see note)	Life test
Forward voltage	V_F	$I_F = 20 \text{ mA}$	1.5 V max.	1.8 V max.
Reverse current	I_R	$V_R = 4 \text{ V}$	10 μA max.	20 μA max.
Low-level output voltage	V_{OL}	$V_{CC} = 16 \text{ V}$ $I_{OL} = 16 \text{ mA}$ $I_F = 0 \text{ mA}$	0.4 V max.	0.48 V max.
High-level output current	I_{OH}	$V_{CC} = 16 \text{ V}$ $V_{OUT} = 28 \text{ V}$ $I_F = 5 \text{ mA}$	100 μA max.	200 μA max.
Current consumption	I_{CC}	$V_{CC} = 16 \text{ V}$	10 mA max.	12 mA max.
LED current when output is OFF	I_{FT}	$V_{CC} = 16 \text{ V}$ $I_{OL} = 16 \text{ mA}$	5 mA max.	Initial value $\times 1.3$ max.

Note: Except life test.

Test Results

Test item	Test conditions (see note 1)	Number of samples	Component hours (h)	Number of failures	Failure rate (1/h) (see note 2)
Continuous operation	$T_a = 25^\circ\text{C}$, $I_F = 20 \text{ mA}$, $V_{CC} = 5 \text{ V}$ 1500 h	22 pcs	3.3×10^4	0	6.96×10^{-5}
High-temperature storage	$T_a = 100^\circ\text{C}$ 2000 h	22 pcs	3.3×10^4	0	6.96×10^{-5}
Low-temperature storage	$T_a = -40^\circ\text{C}$ 2000 h	22 pcs	3.3×10^4	0	6.96×10^{-5}
High-temperature and high-humidity storage	$T_a = 60^\circ\text{C}$, 90% 2000 h	22 pcs	3.3×10^4	0	6.96×10^{-5}
High-temperature reverse bias	$T_a = 85^\circ\text{C}$, $V_{CE} = 30 \text{ V}$ 2000 h	22 pcs	3.3×10^4	0	6.96×10^{-5}
Temperature cycle	-40°C (30 min) to 100°C (30 min) 10 times	22 pcs	---	0	---
Shock resistance	14,700 m/s ² , 0.5 ms, 3 times each in $\pm X$, $\pm Y$, and $\pm Z$ directions	11 pcs	---	0	---
Vibration resistance	20 to 2,000 Hz, 1.5 mm or 98 m/s ² each in X, Y, and Z directions	11 pcs	---	0	---

Note: 1. The tests after 1001 hours are for reference only.

2. Confidence level of 90%.

EE-SX4235A-P2 (Transmissive Photo-IC Output)

Failure Criteria

Item	Symbol	Measuring conditions	Failure criteria	
			General test (see note)	Life test
Current consumption	I _{CC}	V _{CC} = 5.5 V	16.5 mA max.	19.8 mA max.
Low-level output voltage	V _{OL}	V _{CC} = 4.5 V I _{OUT} = 16 mA with incident	0.35 V max.	0.42 V max.
High-level output voltage	I _{OH}	V _{CC} = 5.5 V V _{OUT} = V _{CC} with incident R _L = 47 kΩ	4.95 V max.	3.96 V max.

Note: Except life test.

Test Results

Test item	Test conditions (see note 1)	Number of samples	Component hours (h)	Number of failures	Failure rate (1/h) (see note 2)
Continuous operation	T _a = 25°C, V _{CC} = 5 V 1000 h	22 pcs	2.2 × 10 ⁴	0	1.05 × 10 ⁻⁴
High-temperature storage	T _a = 85°C 1000 h	22 pcs	2.2 × 10 ⁴	0	1.05 × 10 ⁻⁴
Low-temperature storage	T _a = -40°C 1000 h	22 pcs	2.2 × 10 ⁴	0	1.05 × 10 ⁻⁴
High-temperature and high-humidity storage	T _a = 60°C, 90% 1000 h	22 pcs	2.2 × 10 ⁴	0	1.05 × 10 ⁻⁴
Temperature cycle	-40°C (30 min) to 85°C (30 min) 10 times	22 pcs	---	0	---
Shock resistance	294 m/s ² , 0.5 ms, 3 times each in ±X, ±Y, and ±Z directions	11 pcs	---	0	---
Vibration resistance	5 to 50 Hz, 1.5 mm or 9.8 m/s ² each in X, Y, and Z directions	11 pcs	---	0	---

Note: 1. The tests after 1001 hours are for reference only.

2. Confidence level of 90%.

- Application examples provided in this document are for reference only. In actual applications, confirm equipment functions and safety before using the product.
- Consult your OMRON representative before using the product under conditions which are not described in the manual or applying the product to nuclear control systems, railroad systems, aviation systems, vehicles, combustion systems, medical equipment, amusement machines, safety equipment, and other systems or equipment that may have a serious influence on lives and property if used improperly. Make sure that the ratings and performance characteristics of the product provide a margin of safety for the system or equipment, and be sure to provide the system or equipment with double safety mechanisms.

Note: Do not use this document to operate the Unit.