Technical Information

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

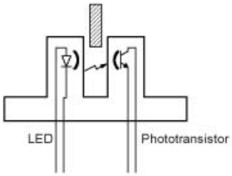
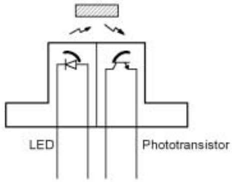


Figure 2. Reflective Photomicrosensor



■ 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 absolutemaximum 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, otherwise 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} (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.
tr	**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.
tf	**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} ($I_{FT\ OFF}$)	**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} ($I_{FT\ ON}$)	**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.
△H	**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.

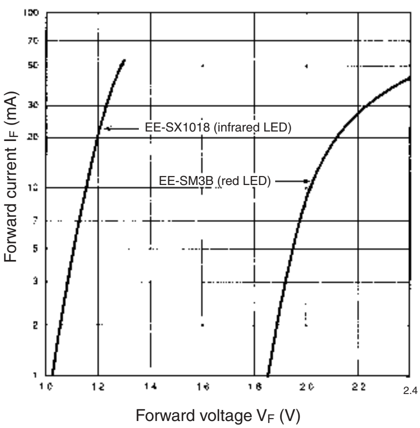
■ Emitter

Characteristics of Emitter

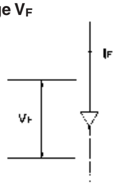
The emitter of each Photomicrosensor has an infrared LED or red LED. Figure 3 shows how the LED forward current characteristics of the EE-SX1018, which has an emitter with an infrared LED, and those of the EE-SM3B, which has an emitter with a red LED, are changed by the voltages imposed on the EE-SX1018 and EE-SM3B. As shown in this figure, the LED forward current characteristics of the EE-SX1018 greatly differ from those of the EE-SM3B. 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

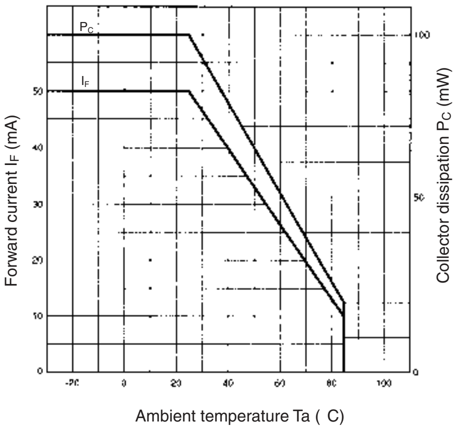
It is especially important to decide the level of the forward current (I_F) of the emitter incorporated by any Photomicrosensor. The forward current must not be too large or too small.

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 Ta (ambient temperature) of 25°C. This means the forward current (I_F) of the emitter is 50 mA maximum at a Ta 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 Ta of 60°C. This means that a current exceeding 27 mA must not flow into the emitter incorporated by the EE-SX1018 at a Ta 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 IF 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 with ease. 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, otherwise 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.

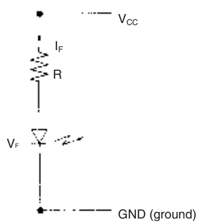
$$R = \frac{V_{CC} - V_F}{I_F}$$

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.

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

The forward current (IF) varies with changes in the supply voltage (VCC), forward voltage (VF), 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.

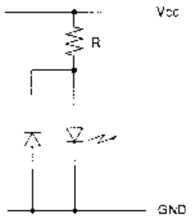
A forward voltage (VF) of approximately 1.2 V is required if the Photomicrosensor has an infrared LED and a forward voltage (VF) of approximately 2 V is required if the Photomicrosensor has a red LED.

The most ideal level of the forward current (IF) 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 (IF).

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).

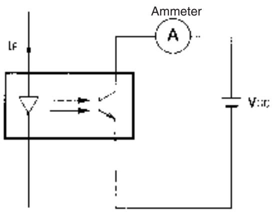
The difference between the dark current and light current is 106 times larger as shown below.

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 106 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.

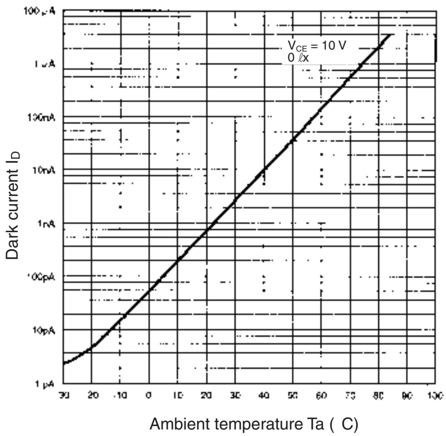
Figure 7. Measuring Circuit



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)

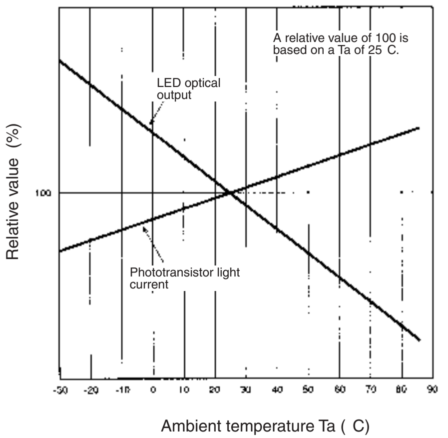
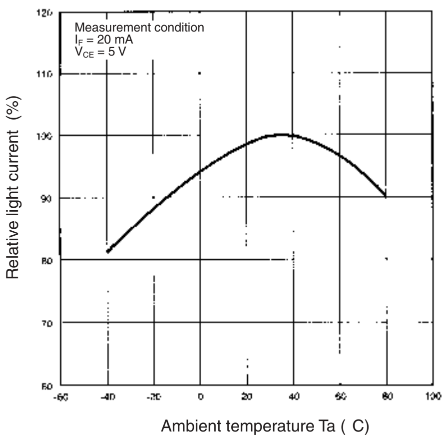


Figure 10. Relative Light Current vs. Ambient Temperature Characteristics (EE-SX1018)



Changes in Characteristics

TThe 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_D) of the phototransistors.

Therefore, if the EE-SX1018 is operated at a Ta of 60°C maximum and a VCC 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 mA and the light current (I_L) of the phototransistor will be approximately 1 mA because the dark current (I_D) of the phototransistor at a Ta of 25°C is 200 nanoamperes maximum and the light current (I_L) of the phototransistor at a Ta of 25°C is 2 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 mA
EE-SX1018, -SX1055 EE-SX1041, -SX1042 EE-SX1070, -SX1071 EE-SX198, -SX199	200 nA	0.5 mA	I_F = 20 mA
EE-SM3 EE-SM3B EE-SJ3W-B EE-SK3W-B	250 nA	1.5 mA	I_F = 3 mA
EE-SB5(-B) EE-SF5(-B) EE-SY110	200 nA	0.2 mA	I_F = 20 mA (see note)
EE-SY201	250 nA	0.3 mA	I_F = 5 mA (see note)
Condition	V_{CE} = 10 V, 0 lx Ta = 25°C	V_{CE} = 10 V Ta = 25°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) **Note:** For an infrared LED.	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.

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

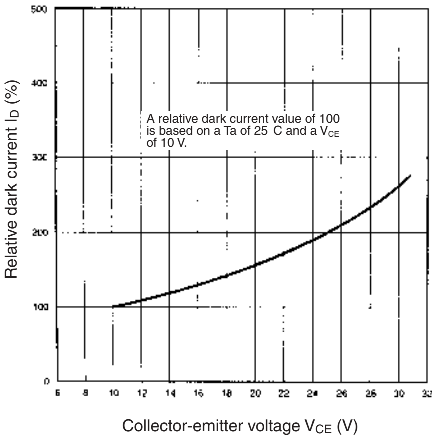


Figure 12. Dark Current Imposed Voltage Dependency (Typical) (EE-SM3B)

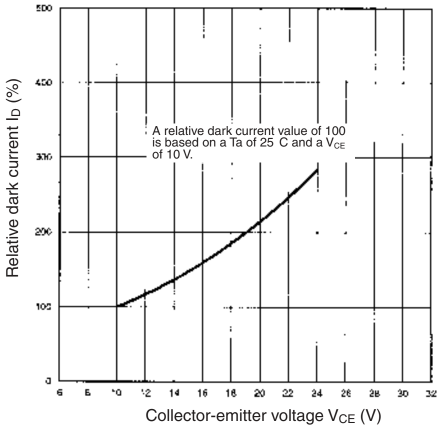


Table 3. Estimated Worst Values of a Variety of Photomicrosensors

Model	Estimated worst value (I_D)	Estimated worst value (I_L)	Condition
EE-SG3(-B)	4 nA	1 mA	I_F = 15 mA
EE-SX1018, -SX1055 EE-SX1041, -SX1042 EE-SX1070, -SX1071 EE-SX198, -SX199	4 nA	0.25 mA	I_F = 20 mA
EE-SM3 EE-SM3B EE-SJ3W-B EE-SK3W-B	25 nA	0.75 mA	I_F = 3 mA
EE-SB5(-B) EE-SF5(-B) EE-SY110	4 nA	0.1 mA	I_F = 20 mA (see note)
EE-SY201	25 nA	0.15 mA	I_F = 5 mA (see note)
Condition	V_{CE} = 10 V, 0 lx Ta = 60°C	V_{CE} = 10 V, Operating hours = 50,000 to 100,000 hrs Ta = Topr	–

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.

IL x RL

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

(I_D + leakage current) x 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 x 4.7 kΩ) will be obtained when the phototransistor is ON and an output of 0.47 V (i.e., 0.1 mA x 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

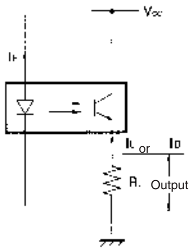
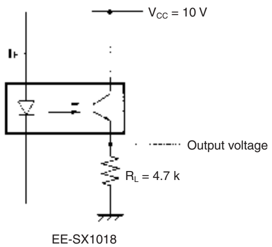


Figure 14. Output Example



EE-SX1018

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 + leakage current) x R_2) is, however, lower than the bias voltage between the base and emitter of Q1. 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 (IL) 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 x 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 Q1.

The voltage output (i.e., (I_D + leakage current) x 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 Q1.

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

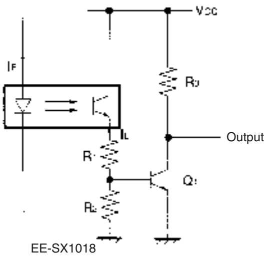


Figure 16. Equivalent Circuit

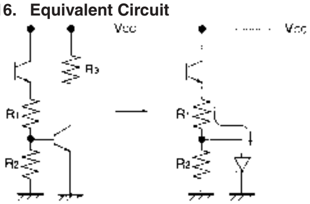
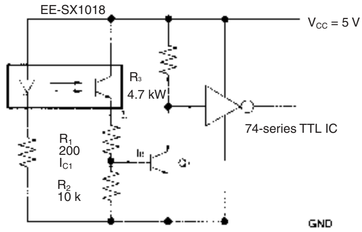


Figure 17. Applied Circuit Example



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.

$I_{C1}\quad R_2 > V_{BE(ON)}$
$I_{C1} = I_L - I_B$
$(I_L - I_B) \text{ x } R_2 > V_{BE(ON)}$

$$R_2 > \frac{V_{BE(ON)}}{I_L - I_B}$$

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 mA if Q_1 is a standard transistor controlling small signals. The estimated worst value of the light current (IL) of the phototransistor is 0.25 mA according to Table 3.

Therefore, the following is obtained.

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

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 turns Q_1 OFF as well. The condition required to turn Q_1 OFF is obtained from the following.

(ID + a) x R_2 < VBE(OFF)

Substitute 10 kΩ for R_2, 4 mA for the dark current (ID) according to Table 3, and 10 μA for the leakage current on the assumption that the leakage current is 10 μA in formula 3. The following is obtained.

$(I_D + a)\quad R_2 > V_{BE(ON)}$
$(4\quad A + 10\quad A)\quad 10 \text{ k} = 0.140 \text{ V}$
$V_{BE(OFF)} = 0.4 \text{ V}$
$0.140 \text{ V} < 0.4 \text{ V}$

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.

R_1

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, and if the light current (I_L) of the phototransistor is large and R_1 is not connected to the phototransistor, the light current will flow into Q_1 and the collector dissipation of the phototransistor will be excessively large. The resistance of R_1 depends on the maximum permissible collector dissipation (PC) of the phototransistor, which can be obtained from the datasheet of the Photomicrosensor. The resistance of R_1 of a phototransistor is several hundred ohms. In the above applied circuit example, the resistance of R_1 is 200 Ω.

If the resistance of R_1 is determined, the design of the circuit is complete.

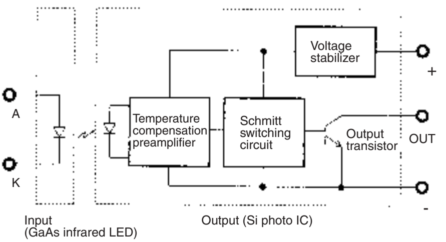
It is important to connect a transistor to the phototransistor incorporated by the Photomicrosensor to amplify the output of the phototransistor, which increases the reliability and stability of the Photomicrosensor. Such reliability and stability of the Photomicrosensor cannot be achieved if the output 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 R_1, 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_{FTOFF}	8 mA max.	V_{CC} = 4.5 to 16 V Ta = 25°C
LED current when output is turned ON (EE-SX401)	I_{FTON}		

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

- A forward current equivalent to or exceeding the IFTOFF value must flow into the LED incorporated by each EE-SX301 Photomicrosensors.
- A forward current equivalent to or exceeding the IFTON value must flow into the LED incorporated by the EE-SX401 Photomicrosensors.

The IFTON value of the EE-SX301 is 8 mA maximum and so is the IFON 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 IOUT value of the output transistor incorporated by the photo IC circuit.

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

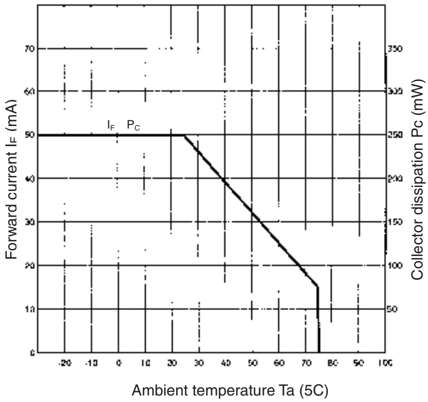


Figure 20. Basic Circuit

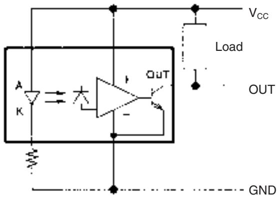
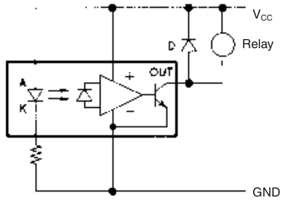


Figure 21. Connected to Inductive Load



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.

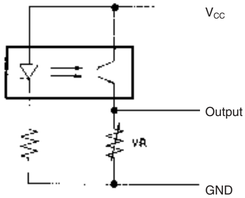
- Highly permeable objects such as paper, film, and plastic
- Objects smaller than the size of the optical beam emitted by the LED or the size of the aperture of the detector.

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.

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

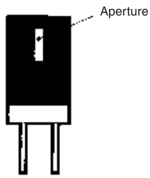
The light current (I_L) of the phototransistor varies with the ambient temperature and secular changes. Therefore, if the signal-noise ratio of the phototransistor is 4 maximum, it is necessary to pay utmost attention to the circuit connected to the transmissive Photomicrosensor so that the transmissive 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 (IL) 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

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

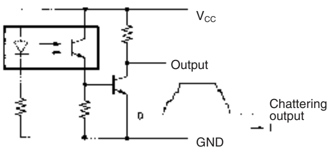


Figure 25. Chattering Prevention (1)

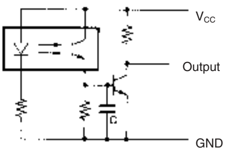
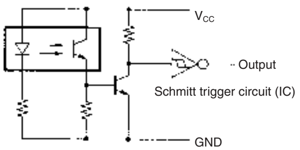


Figure 26. Chattering Prevention (2)



■ 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

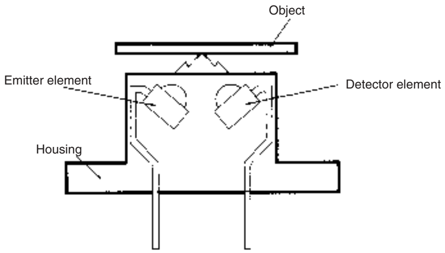


Figure 28. Light Interception Characteristics of Filters

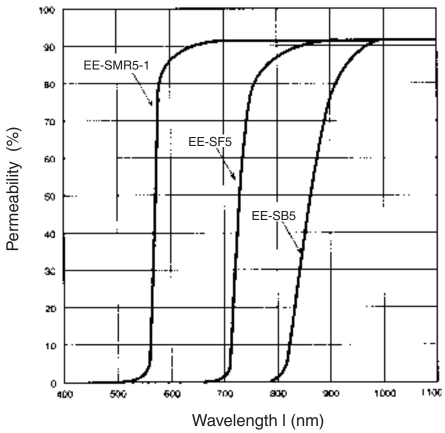
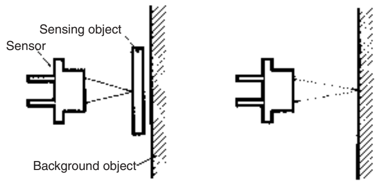


Figure 29. Influence of Background Object



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 (IL(N)) of the phototransistor not sensing the paper may be larger than the light current (IL(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

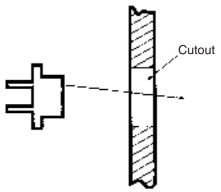
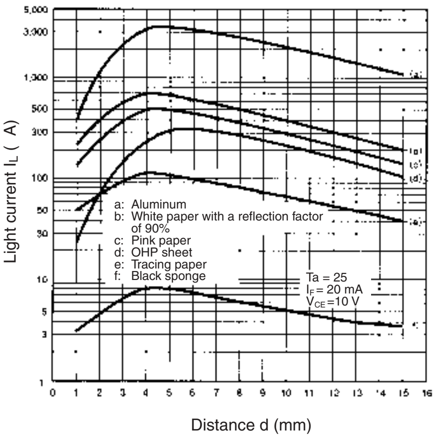


Figure 31. Sensing Distance Characteristics (EE-SF5)



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.

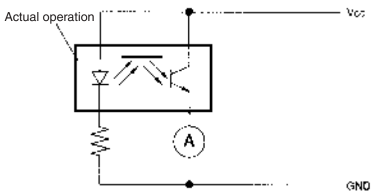
Pay utmost attention when applying the reflective Photomicrosensor to the sensing of the following.

- 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



Precautions

■ Correct 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.

■ 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. On the other hand, the storage temperature of highly resistant Photomicrosensors is 100°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 fibre 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 tightening 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

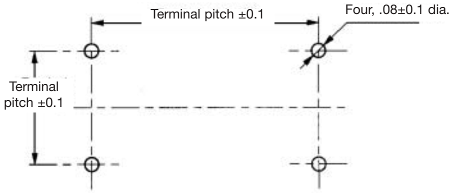
Read the following before tightening the screws.

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.

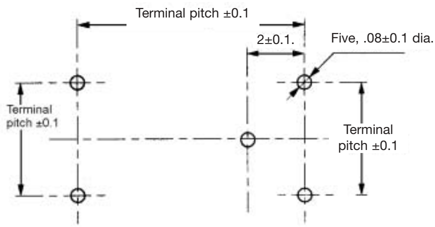
PCB Mounting Holes

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 forces is likely to be imposed on the lead wires, hold the bases of the lead wires.

Soldering Temperature

1. Manual Soldering

Unless otherwise specified, the lead wires of Photomicrosensors can be soldered manually under the following conditions.

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.
Soldering time:	10 s max.
Soldering position:	At least 1.5 mm away from the bases of the lead wires.

Do not use non-washable flux when soldering EE-SA-series Photomicrosensors, otherwise the Photomicrosensors will have operational problems.

3. Reflow Soldering

The reflow soldering of Photomicrosensors is not possible except for the EE-SX1102. The reflow soldering of the EE-SX1102 must be performed carefully under the conditions specified in the datasheet of the EE-SX1102. Before performing the reflow soldering of the EE-SX1102, make sure that the reflow soldering equipment satisfies the conditions.

External Forces

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

■ Cleaning Precautions

Cleaning

Photomicrosensors except the EE-SA105 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.

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
Chlorofluorocarbon:	Depends on the additive agents (see note)
Trichlene:	NG
Acetone:	NG
Methylbenzene:	NG
Water (hot water):	The lead wires corrode depending on the conditions

Note: Chlorofluorocarbon containing ethyl alcohol or methyl alcohol as an additive agent can be used to clean Photomicrosensors except the EE-SA105. Chlorofluorocarbon containing acetone as an additive agent must not be used to clean any Photomicrosensor. For reasons of environmental protection, refrain from using any detergent containing chlorofluorocarbon.

2. Cleaning Method

Unless otherwise specified, Photomicrosensors other than the EE-SA105 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 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

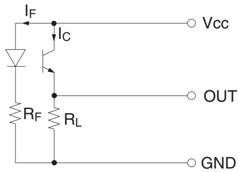
Photomicrosensors consist of LEDs and light detectors. Generally speaking, temperal changes occur to LEDs when power is supplied to them (i.e., the amount of light emitted diminishes). With less light, the photoelectric current is reduced for a sensor with a phototransistor output or the threshold current 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 IL for light reception

I_{L2} is the IL for light interception by the intercepter

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 IF in actual appliction ($= (V_{CC} - V_F)/R_F = (V_{CC} - 1.2)/R_F$)

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

Then,

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

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

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

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 petrolium-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 Stabilisation Time

Photomicrosensors with photo-IC outputs require 100 ms for the internal IC to stablize. 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, stabilisation time is required to achieve thermal balance. Care is required when using a variable resistor or other adjustment.

Sensing Method	Sensing Distance	Model	Output Configuration	Features	Page No.
Transmissive	1 mm	EE-SX1107	Phototransistor	Ultra-compact, surface mounting	799
	2 mm	EE-SX1018	Phototransistor	Compact, general purpose	807
		EE-SX1103	Phototransistor	Ultra-compact, general purpose	799
		EE-SX1105	Phototransistor	Ultra-compact, general purpose	813
		EE-SX1108	Phototransistor	Ultra-compact, surface mounting	799
		EE-SX1131	Phototransistor	Ultra-compact, surface mounting, dual channel output	799
		EE-SX1139	Phototransistor	Ultra-compact, general purpose	816
		EE-SX4134	Photo-IC	Ultra-compact, surface mounting	819
		EE-SX4139	Photo-IC	Ultra-compact with low operating voltage	823
		EE-SX493	Photo-IC	High resolution	826
	2.8 mm	EE-SX1055	Phototransistor	Compact, cost effective	829
	3 mm	EE-SX1046	Phototransistor	With a horizontal aperture	832
		EE-SX1082	Phototransistor	With a horizontal aperture	835
		EE-SX1106	Phototransistor	Ultra-compact, general purpose	838
		EE-SX1109	Phototransistor	Ultra-compact, surface mounting	799
		EE-SX199	Phototransistor	With a positioning boss	841
		EE-SX398/ 498	Photo IC	General purpose	844
	3.4 mm	EE-SV3	Phototransistor	Screw mounting	847
		EE-SX1071	Phototransistor	General purpose	850
		EE-SX1096	Phototransistor	With a horizontal aperture	853
		EE-SX1088	Phototransistor	Screw mounting	856
		EE-SH3	Phototransistor	Screw mounting	859
		EE-SX3088/4088	Photo-IC	Screw mounting	862
	3.6 mm	EE-SG3	Phototransistor	Dust-proof construction	865
		EE-SX1057	Phototransistor	General purpose with dust-proof construction	868
	4.2 mm	EE-SX1128	Phototransistor	With a horizontal aperture	871
	5 mm	EE-SX1041	Phototransistor	General purpose	874
		EE-SX1042	Phototransistor	High profile	877
		EE-SX1081	Phototransistor	General purpose	880
		EE-SX1235A-P2	Phototransistor	Snap-in mounting	883
		EE-SX4009-P1	Photo-IC	Screw mounting	886
		EE-SX4019-P2	Photo-IC	Screw mounting	889
		EE-SX3081/4081	Photo-IC	General purpose	892
		EE-SX4235A-P2	Photo-IC	Snap-in mounting	895
	8 mm	EE-SX1070	Phototransistor	General purpose	898
		EE-SX3070/4070	Photo-IC	General purpose	901
	12 mm	EE-SPX415-P2	Photo-IC	Light modulation built-in amplifier IC	904
	14 mm	EE-SX1140	Phototransistor	Wide, high profile	907
	15 mm	EE-SX461-P11	Photo-IC	Easy to mount	910
	17 mm	EE-SPX414-P1	Photo-IC	Light modulation built-in amplifier IC	914

Sensing Method	Sensing Distance	Model	Output Configuration	Features	Page No.
Actuator	–	EE-SA102	Phototransistor	General purpose	917
		EE-SA103	Phototransistor	Compact	920
		EE-SA104	Phototransistor	Compact	923
		EE-SA107-P2	Phototransistor	Snap-in mounting with connector	926
		EE-SA407-P2	Photo-IC	Snap-in mounting with connector	929
Reflective	1 mm	EE-SY124	Phototransistor	Ultra-compact, general purpose	932
		EE-SY125	Phototransistor	Ultra-compact, surface mounting	932
		EE-SY193	Phototransistor	Ultra-compact, surface mounting	936
	3.5 mm	EE-SY171	Phototransistor	Thin	941
	4 mm	EE-SY169A	Phototransistor	High resolution (infrared LED)	944
		EE-SY169B	Phototransistor	High resolution (red LED)	947
	4.4 mm	EE-SY113	Phototransistor	Dust-proof	950
		EE-SY313/ 413	Photo-IC	Dust-proof	953
	5 mm	EE-SF5-B	Phototransistor	Dust-proof	957
		EE-SY110	Phototransistor	General purpose	960
		EE-SY310/ 410	Photo-IC	General purpose	963
Micro displacement	5.5 - 11.5 mm	Z4D-B01	Analog voltage output	Easy control and built in processor circuit	967
		Z4D-B02	Analog voltage output	Easy control and built in processor circuit	971
Multi-beam	50 - 125mm	EY3A-312	Photo-IC	3 beam high sensitivity and resisitivity to light interference	975
	125 mm	EY3A-112	Photo-IC	1 beam high sensitivity and resisitivity to light interference	978

- Surface mount design, tape and reel packaging facilitate automated PCB.
- Compact size makes these sensors ideal for use in applications with restricted space
- High-resolution sensing with phototransistor output.
- Dual channel model that is ideal for encoder applications (EE-SX1131).

Ordering Information

Appearance	Sensing Method	Slot Width	Slot Depth	Sensing Object	Weight	Part No.
	Transmissive	1 mm	2 mm	Opaque 0.15 x 0.6 mm min.	0.05 g	**EE-SX1107**
		2 mm	2.8 mm	Opaque 0.3 x 1.0 mm min.	0.1 g	**EE-SX1108**
		3 mm	3.5 mm	Opaque 0.5 x 1.0 mm min.	0.1 g	**EE-SX1109**
	Dual channel transmissive	2 mm	2.8 mm	Opaque 0.3 x 1.0 mm min.	0.1 g	**EE-SX1131**

Specifications

■ Absolute Maximum Ratings (Ta = 25°C)

Item		Symbol	Rated value
Emitter	**Forward current**	I_F	25 mA (see note 1)
	Pulse foward 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**	Topr	-30°C to 85°C
	Storage	Tstg	-40°C to 90°C
	Reflow soldering	Tsol	240°C (see note 3)
	Manual soldering	Tsol	300°C (see note 3)

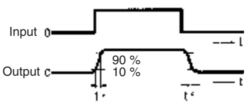
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. Duty: 1/100; Pulse width: 0.1 ms.
3. Complete soldering within 10 seconds for reflow soldering and within 3 seconds for manual soldering.

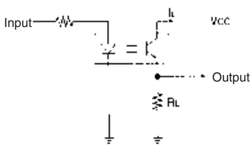
■ Electrical and Optical Characteristics (Ta = 25°C)

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 m 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

Note: The following figures show the rising time (tr) and falling time (tf).1

■ Response Time Measurement Circuit

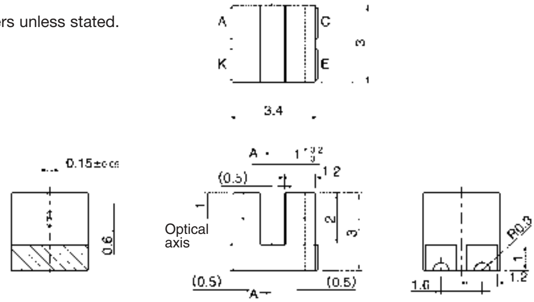




■ Dimensions

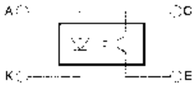
Note: All units are in millimeters unless stated.

EE-SX1107

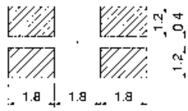


Cross section AA

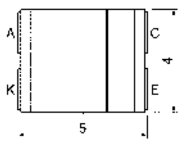
Internal Circuit

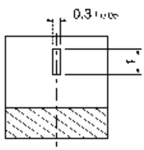


Recommended Soldering Pattern

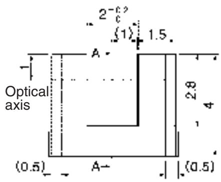


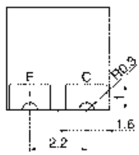
EE-SX1108



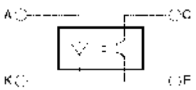


Cross section AA

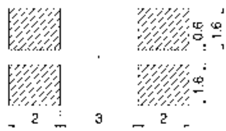




Internal Circuit



Recommended Soldering Pattern

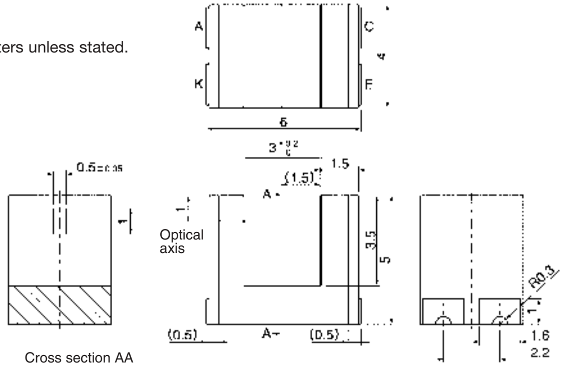


Unless otherwise stated the tolerances are ±0.15mm.

■ Dimensions

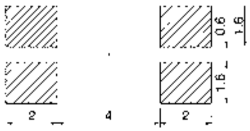
Note: All units are in millimeters unless stated.

EE-SX1109

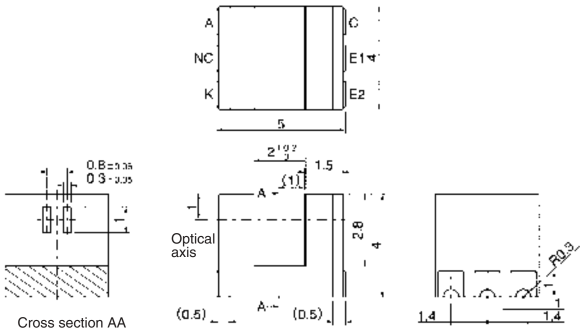


Internal Circuit

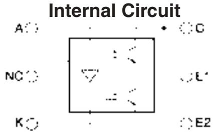
Recommended Soldering Pattern



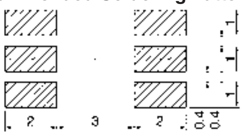
EE-SX1131



Internal Circuit



Recommended Soldering Pattern

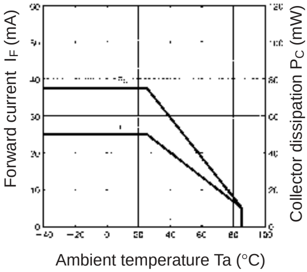


Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter
E1	Emitter 1
E2	Emitter 2

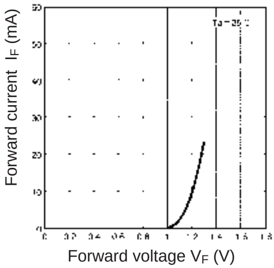
Unless otherwise stated the tolerances are ±0.15mm.

Engineering Data

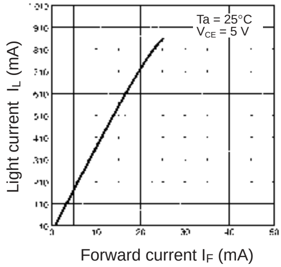
EE-SX1107/1108/1109/1131
Forward Current vs. Collector Dissipation Temperature Rating



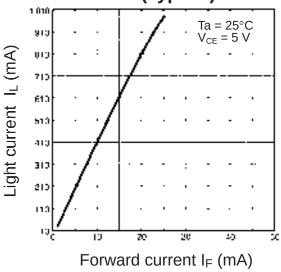
EE-SX1107/1108/1109/1131
Forward Current vs. Forward Voltage Characteristics (Typical)



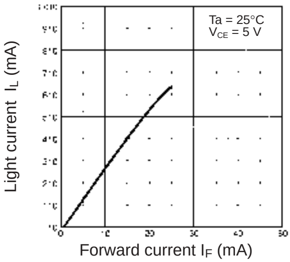
EE-SX1107
Light Current vs. Forward Current Characteristics (Typical)



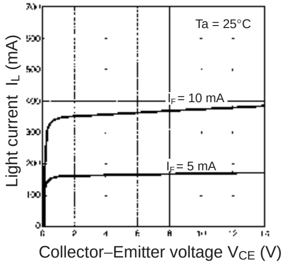
EE-SX1108/1131
Light Current vs. Forward Current Characteristics (Typical)



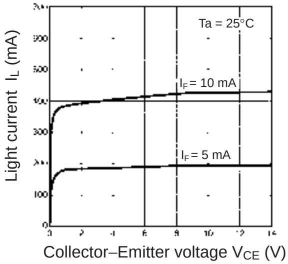
EE-SX1109
Light Current vs. Forward Current Characteristics (Typical)



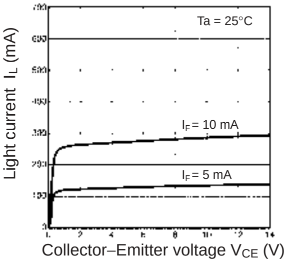
EE-SX1107
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



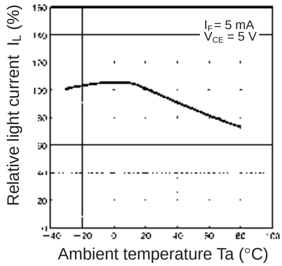
EE-SX1108/1131
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



EE-SX1109
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)

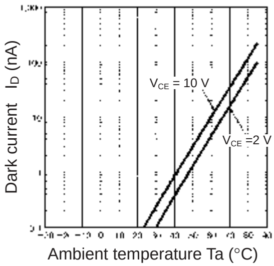


EE-SX1107/1108/1109/1131
Relative Light Current vs. Ambient Temperature Characteristics (Typical)

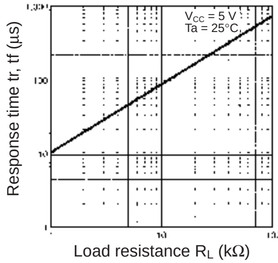


■ Engineering Data

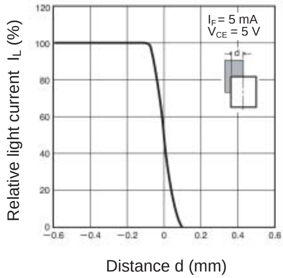
EE-SX1107/1108/1109/1131
Dark Current vs. Ambient Temperature Characteristics (Typical)



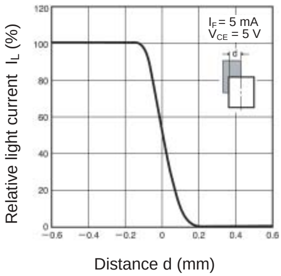
EE-SX1107/1108/1109/1131
Response Time vs. Load Resistance Characteristics (Typical)



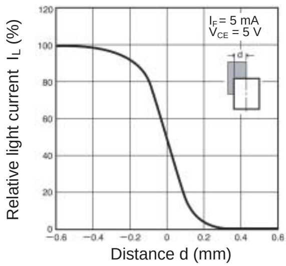
EE-SX1107
Sensing Position Characteristics (Typical)



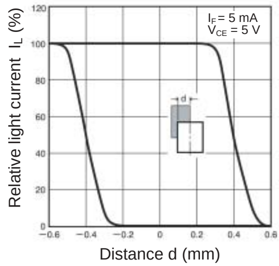
EE-SX1108
Sensing Position Characteristics (Typical)



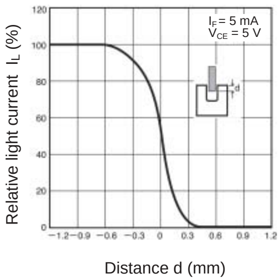
EE-SX1109
Sensing Position Characteristics (Typical)



EE-SX1131
Sensing Position Characteristics (Typical)



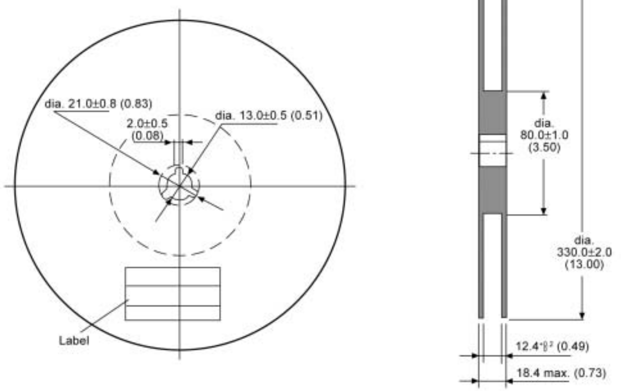
EE-SX1107/1108/1109/1131
Sensing Position Characteristics (Typical)



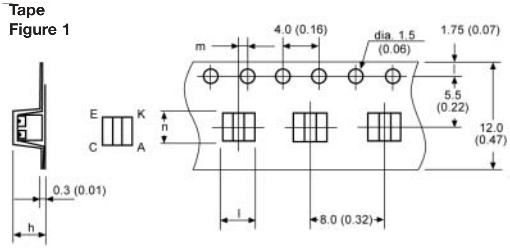
■ Tape and Reel – EE-SX1107, EE-SX1108, EE-SX1109 & EE-SX1131

Unit: mm (inch).

Reel

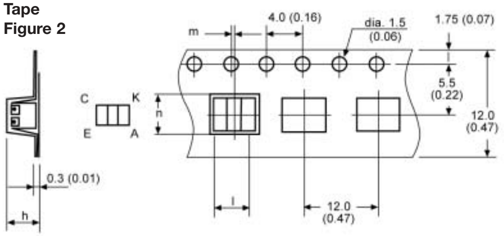


Tape
Figure 1



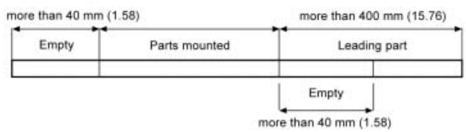
Part No.	*h*	*i*	*m*	*n*
EE-SX1107	3.2 (013)	3.6 (014)	0.9 (0.04)	3.2 (013)
EE-SX1108	4.2 (0.17)	5.2 (0.20)	0.25 (0.01)	4.2 (0.17)
EE-SX1131	4.2 (0.17)	5.2 (0.20)	0.25 (0.01)	4.2 (0.17)

Tape
Figure 2



Part No.	*h*	*i*	*m*	*n*
EE-SX1109	5.2 (0.20)	6.2 (0.24)	0.25 (0.01)	4.2 (0.17)

Tape configuration



Part No.	Pieces per reel
EE-SX1107	2000
EE-SX1108/1131	2000
EE-SX1109	1000

Precautions

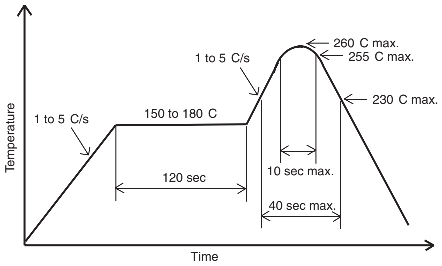
■ Soldering Information

Reflow soldering

- The following soldering paste is recommended:

  Melting temperature: 178 to 192°C

  Composition: Sn 63%, Pb 37%
- 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 25W, 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

ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.
To convert millimeters into inches, multiply by 0.03937. To convert grams into ounces, multiply by 0.03527.

■ Features

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

Specifications

■ Absolute Maximum Ratings (Ta = 25°C)

Item		Symbol	Rated value
Emitter	**Forward current**	I_F	50 mA (see note 1)
	Pulse foward 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**	Topr	-25°C to 85°C
	Storage	Tstg	-30°C to 100°C
Soldering temperature		Tsol	260°C (see note 3)

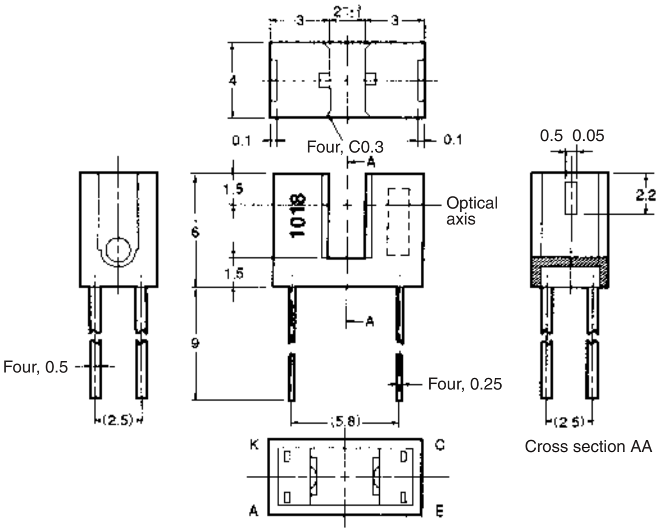
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. The pulse width is10μs maximum with a frequency of 100Hz.
3. Complete soldering within 10 seconds.

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

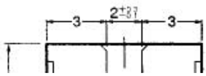
Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.2 V typ., 1.5 V max.	I_F = 30 mA
	Reverse current	I_R	0.01 μA typ., 10 μA max.	V_R = 4 V
	Peak emission wavelength	λ_P	940 nm typ.	I_F = 20 mA
Detector	**Light current**	I_L	0.5 mA min., 14 mA max.	I_F = 20 mA, V_{CE} = 10 V
	Dark current	I_D	2 nA typ., 200 nA max.	V_{CE} = 10 V, 0 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 = 0.1 mA
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.	V_{CF} = 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

■ Dimensions

Note: All units are in millimeters unless stated.



Internal Circuit



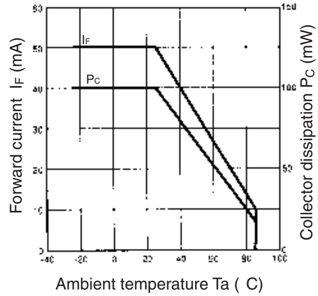
Unless otherwise specified, the tolerances are as shown below.

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

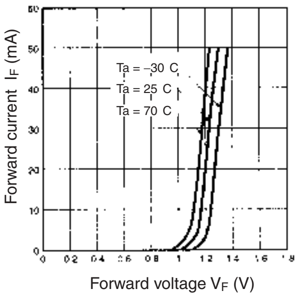
Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

■ Engineering Data

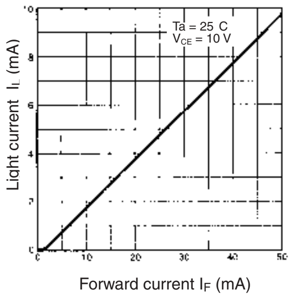
Forward Current vs. Collector Dissipation Temperature Rating



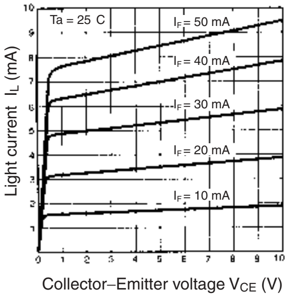
Forward Current vs. Forward Voltage Characteristics (Typical)



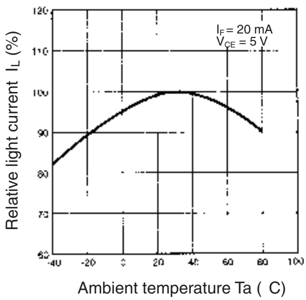
Light Current vs. Forward Current Characteristics (Typical)



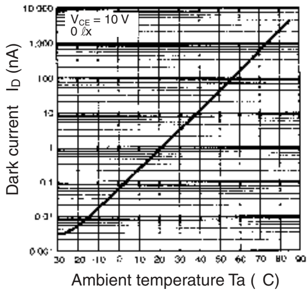
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



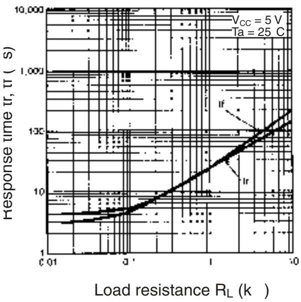
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



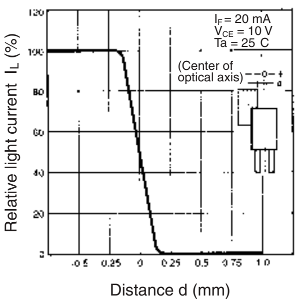
Dark Current vs. Ambient Temperature Characteristics (Typical)



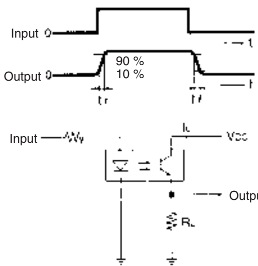
Response Time vs. Load Resistance Characteristics (Typical)



Sensing Position Characteristics (Typical)

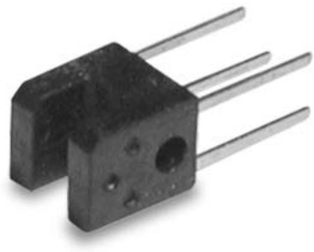


Response Time Measurement Circuit



■ 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.



Specifications

■ Absolute Maximum Ratings (Ta = 25°C)

Item		Symbol	Rated value
Emitter	**Forward current**	I_F	50 mA (see note 1)
	Pulse foward 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**	Topr	-25°C to 85°C
	Storage	Tstg	-30°C to 100°C
Soldering temperature		Tsol	260°C (see note 2)

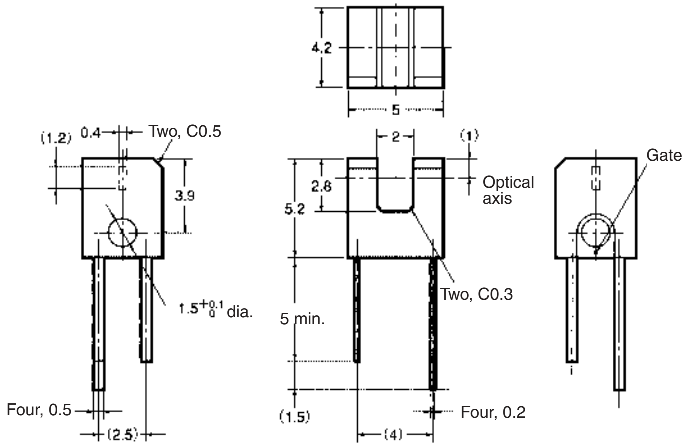
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. Complete soldering within 3 seconds.

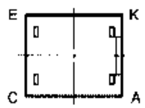
■ Electrical and Optical Characteristics (Ta = 25°C)

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 m typ.	I_F = 50 mA
Detector	**Light current**	I_L	0.5 mA	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 = 0.3 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 Ω, I_L = 20 mA
Falling time		tf	10 μs typ.	V_{CC} = 5 V, R_L = 100 Ω, I_L = 20 mA

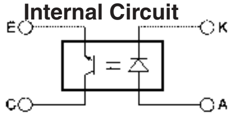
■ Dimensions

Note: All units are in millimeters unless stated.





Internal Circuit

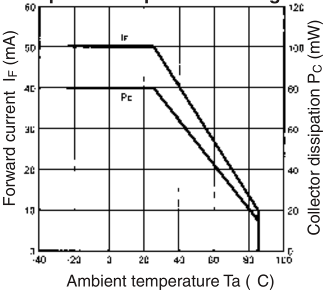


Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

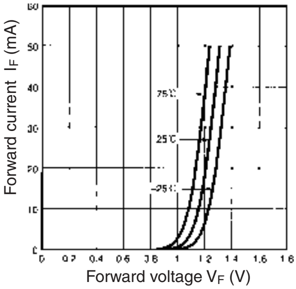
Unless otherwise stated the tolerances are ±0.2mm.

■ Engineering Data

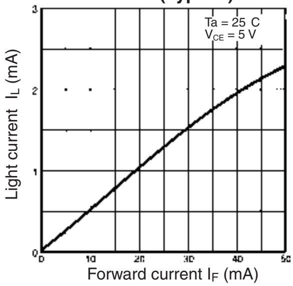
Forward Current vs. Collector Dissipation Temperature Rating



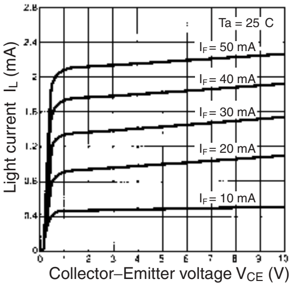
Forward Current vs. Forward Voltage Characteristics (Typical)



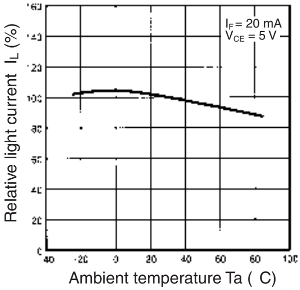
Light Current vs. Forward Current Characteristics (Typical)



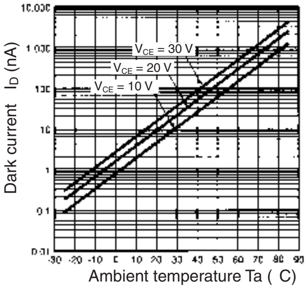
Light Current vs. Collector−Emitter Voltage Characteristics (Typical)



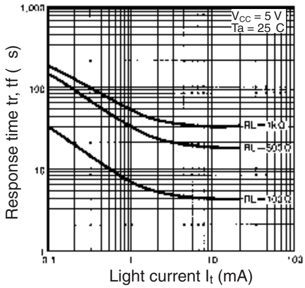
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



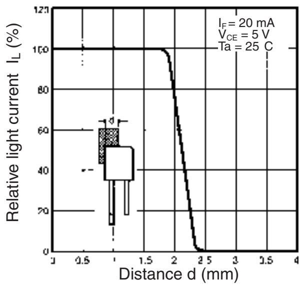
Dark Current vs. Ambient Temperature Characteristics (Typical)



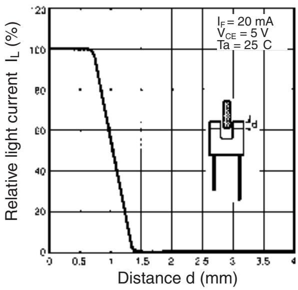
Response Time vs. Light Current Characteristics (Typical)



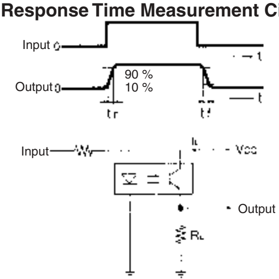
Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)



Response Time Measurement Circuit



■ 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.

Specifications

■ Absolute Maximum Ratings (Ta = 25°C)

Item		Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Pulse foward 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	Topr	-25°C to 85°C
	Storage	Tstg	-30°C to 85°C
Soldering temperature		Tsol	260°C (see note 2)

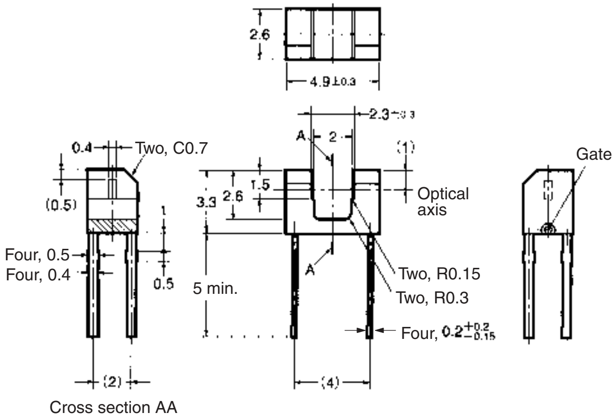
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. Complete soldering within 3 seconds.

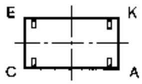
■ Electrical and Optical Characteristics (Ta = 25°C)

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 m 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, $R_L = 100\ \Omega$, $I_L = 20$ mA
Falling time		tf	10 μs typ.	$V_{CC} = 5$ V, $R_L = 100\ \Omega$, $I_L = 20$ mA

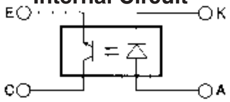
■ Dimensions

Note: All units are in millimeters unless stated.





Internal Circuit

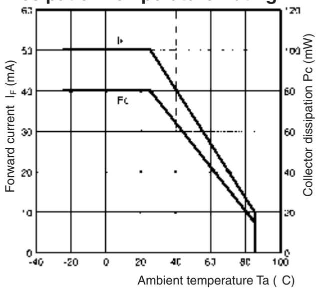


Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

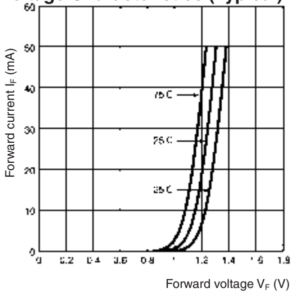
Unless otherwise stated the tolerances are ±0.2mm.

■ Engineering Data

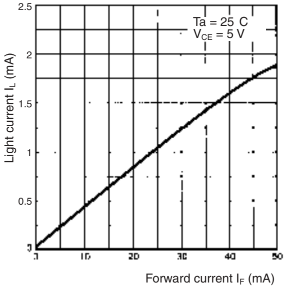
Forward Current vs. Collector Dissipation Temperature Rating



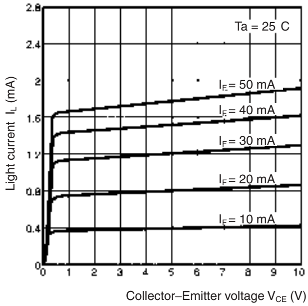
Forward Current vs. Forward Voltage Characteristics (Typical)



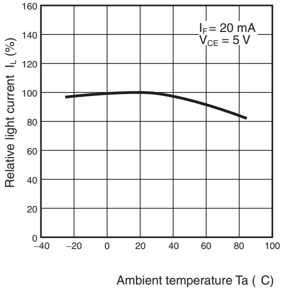
Light Current vs. Forward Current Characteristics (Typical)



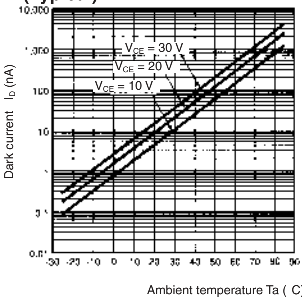
Light Current vs. Collector−Emitter Voltage Characteristics (Typical)



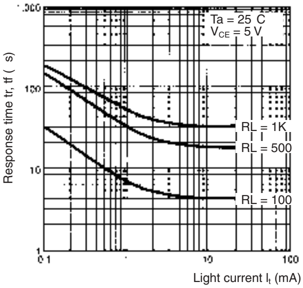
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



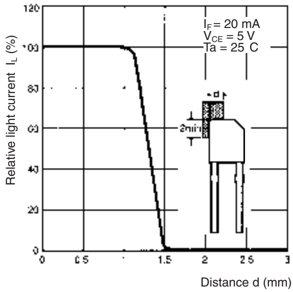
Dark Current vs. Ambient Temperature Characteristics (Typical)



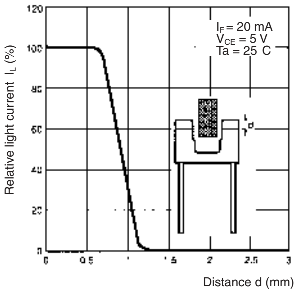
Response Time vs. Light Current Characteristics (Typical)



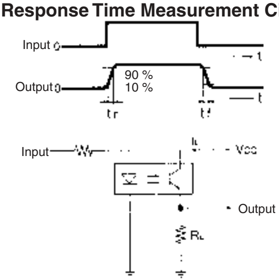
Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)



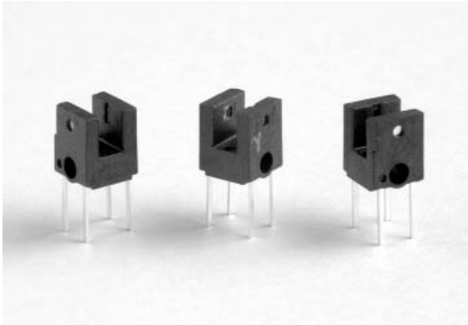
Response Time Measurement Circuit



Photomicrosensors

■ Features

- ■ Ultra-compact with a 4.3-mm-wide sensor and a 2-mm-wide slot.
- ■ PCB surface mounting type.
- ■ High resolution with a 0.5-mm-wide aperture.
- ■ A light current (I_L) of 0.4 mA minimum with a forward current of (I_F) 10 mA.



Specifications

■ Absolute Maximum Ratings (Ta = 25°C)

Item		Symbol	Rated value
Emitter	**Forward current**	I_F	50 mA (see note 1)
	Pulse foward 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	75 mW (see note 1)
Ambient temperature	**Operating**	Topr	-40°C to 85°C
	Storage	Tstg	-40°C to 100°C
	Soldering	Tsol	260°C (see note 3)

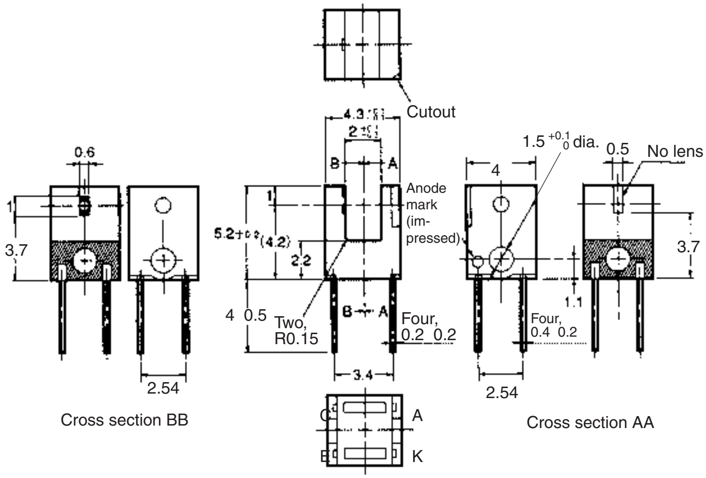
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. The pulse width is10μs maximum with a frequency of 100Hz.
3. Complete soldering within 3 seconds for reflow soldering and within 3 seconds for manual soldering.

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

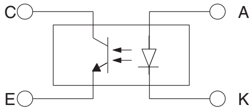
Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.2 V typ., 1.4 V max.	I_F = 20 mA
	Reverse current	I_R	0.01 μA typ., 10 μA max.	V_R = 4 V
	Peak emission wavelength	λ_P	940 nm typ.	I_F = 20 mA
Detector	**Light current**	I_L	0.4 mA min.	I_F = 10 mA, V_{CE} = 5 V
	Dark current	I_D	2 nA typ., 100 nA max.	V_{CE} = 10 V, 0 x
	Leakage current	I_{LEAK}	–	–
	Collector Emitter saturated voltage	V_{CE} (sat)	0.4 V max.	I_F = 20 mA, I_L = 0.1 μA
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.	V_{CF} = 5 V
Rising time		tr	30 μs typ., 150 μs max.	V_{CC} = 5 V, R_L = 1 kΩ, I_L = 100 μA
Falling time		tf	30 μs typ., 150 μs max	V_{CC} = 5 V, R_L = 1 kΩ, I_L = 100 μA

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit

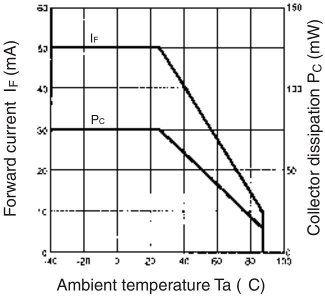


Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

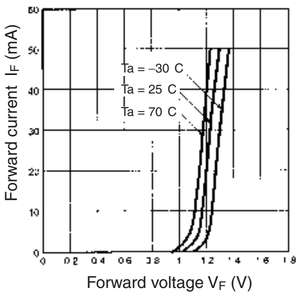
Unless otherwise specified the tolerances are ±0.1 mm.

■ Engineering Data

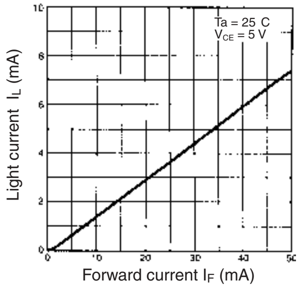
Forward Current vs. Collector Dissipation Temperature Rating



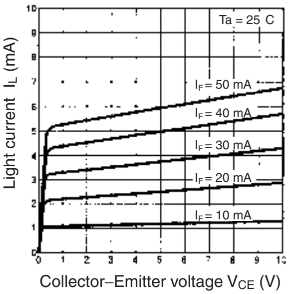
Forward Current vs. Forward Voltage Characteristics (Typical)



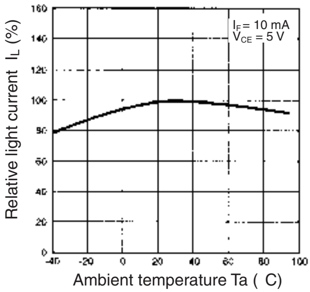
Light Current vs. Forward Current Characteristics (Typical)



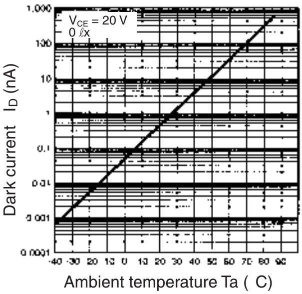
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



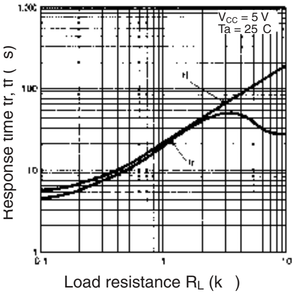
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



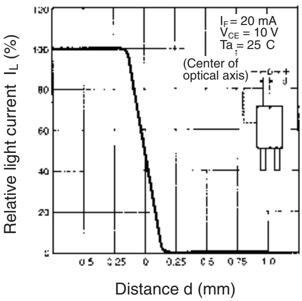
Dark Current vs. Ambient Temperature Characteristics (Typical)



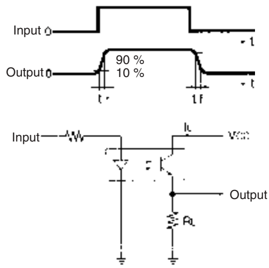
Response Time vs. Load Resistance Characteristics (Typical)



Sensing Position Characteristics (Typical)



Response Time Measurement Circuit



Features

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

Specifications

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
	Possiblr output dissipation	P_{OUT}	80 mW (see note 1)
Ambient temperature	**Operating**	Topr	-25°C to 85°C
	Storage	Tstg	-40°C to 90°C
	Reflow soldering	Tsol	230°C (see note 2)
	Manual soldering	Tsol	300°C (see note 2)

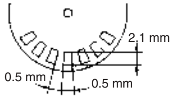
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. Complete soldering within 10 seconds for reflow soldering and within 3 seconds for manual soldering.

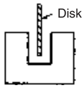
Electrical and Optical Characteristics (Ta = 25°C)

Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.1 V typ., 1.4 V max.	I_F = 5 mA
	Reverse current	I_R	0.01 μA typ., 10 μA max.	VR = 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_{CH}	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, IF = 5 mA, I_{OL} = 8 mA (see note 2)
Response delay time		t_{PHL}	7 ms typ.	V_{CC} = 2.2 to 7 V, IF = 5 mA, I_{OL} = 8 mA (see note 3)
Response delay time		t_{PHL}	18 ms typ.	V_{CC} = 2.2 to 7 V, IF = 5 mA, I_{OL} = 8 mA (see note 3)

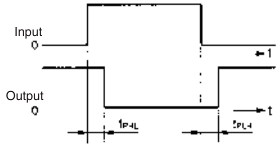
Note: 1. Hysteresis denotes the difference in forward LED current value, expressed in percentage, calculated from the respective forward LED currents when the photo IC in turned from ON to OFF and when the photo IC in turned from OFF to ON.

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

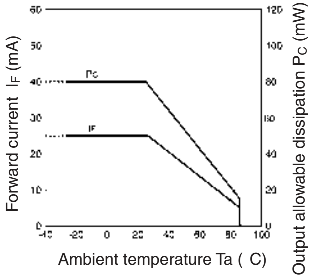




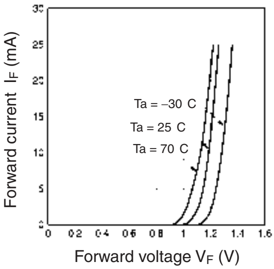
3. The following illustrations show the definition of response delay time.



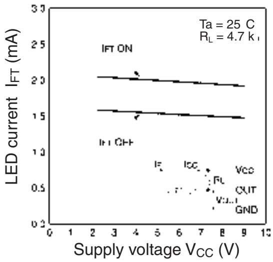
Forward Current vs. Collector Dissipation Temperature Rating



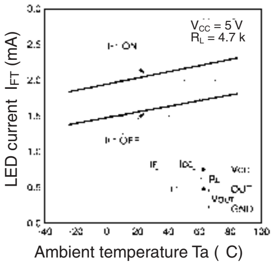
Forward Current vs. Forward Voltage Characteristics (Typical)



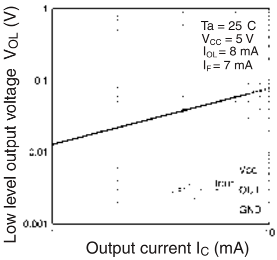
LED Current vs. Supply Voltage (Typical)



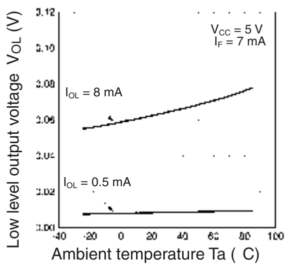
LED Current vs. Ambient Temperature Characteristics (Typical)



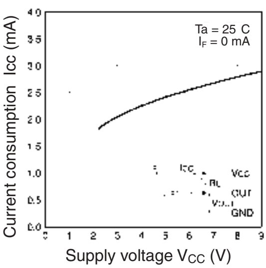
Low-level Output Voltage vs. Output Current (Typical)



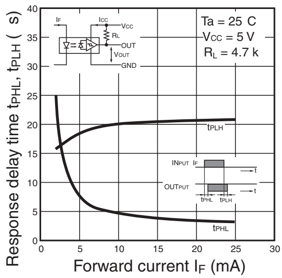
Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



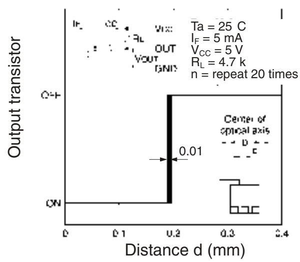
Current Consumption vs. Supply Voltage (Typical)



Response Delay Time vs. Forward Current (Typical)



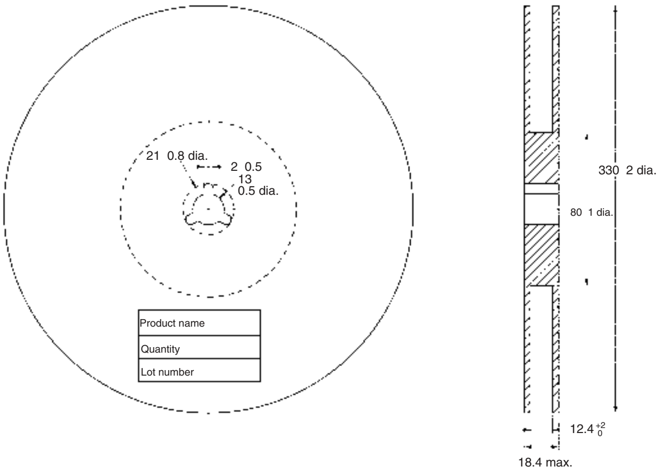
Repeat Sensing Position Characteristics (Typical)



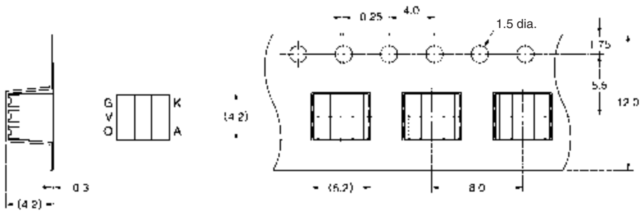
■ Tape and Reel

Unit: mm (inch).

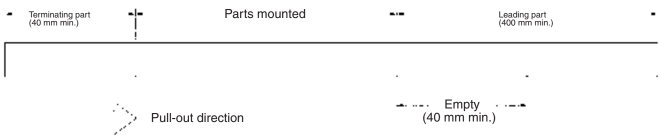
Reel



Tape



Tape configuration



ℓ

Tape quantity

2,000 pcs./reel

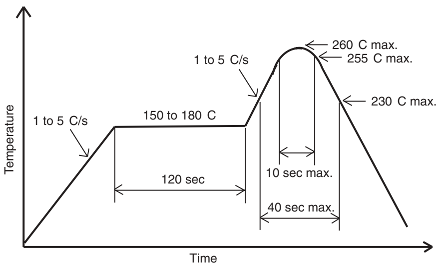
Precautions

■ Soldering Information

- 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

ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.
To convert millimeters into inches, multiply by 0.03937. To convert grams into ounces, multiply by 0.03527.

■ Features

- ■ Ultra-compact model
- ■ Photo IC output model
- ■ Operates at V_{CC} of 2.2 to 7 V
- ■ High speed response

■ 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	**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)
Ambient temperature	**Operating**	Topr	-25°C to 85°C
	Storage	Tstg	-40°C to 100°C
	Soldering	Tsol	260°C (see note 2)

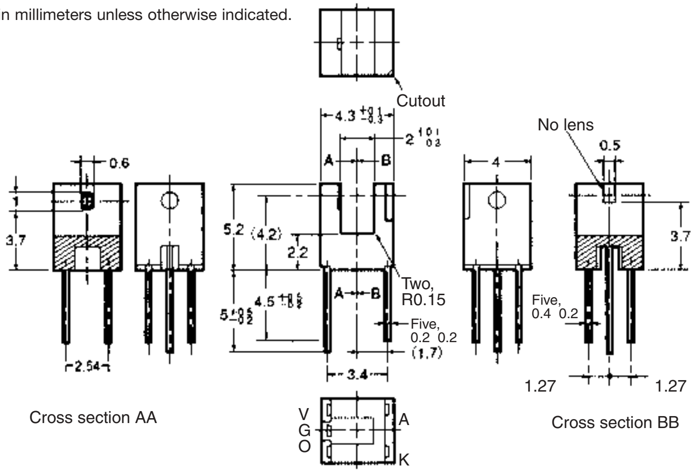
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. Complete soldering within 3 seconds.

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

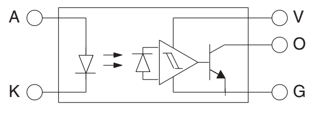
Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.2 V typ., 1.4 V max.	I_F = 20 mA
	Reverse current	I_R	0.01 μA typ., 10 μA max.	V_R = 4 V
	Peak emission wavelength	λ_P	940 nm typ.	I_F = 20 mA
Detector	**Power supply voltage**	V_{CC}	2.2 V min., 7 V max.	–
	Low-level output voltage	V_{OL}	0.12 V typ., 0.4 V max.	V_{CC} = 2.2 to 7 V, I_{OL} = 8 mA, I_F = 5 mA
	High-level output voltage	I_{OH}	10 μA max.	V_{CC} = 2.2 to 7 V, I_F = 0 mA, V_O = 17 V
	Current consumption	I_{CC}	2.3 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}	1.1 mA typ., 2.5 mA max.	V_{CC} = 2.2 to 7 V
Hysteresis		△H	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} = 8mA (see note 2)
Response delay time		t_{PLH}	5 μs min.	V_{CC} = 2.2 to 7 V, I_F = 5 mA, I_{OL} = 8mA (see note 3)
Response delay time		t_{PHL}	18 μs typ.	V_{CC} = 2.2 to 7 V, I_F = 5 mA, I_{OL} = 8mA (see note 3)

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit

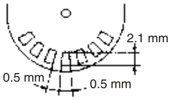


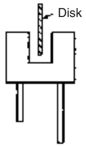
Terminal No.	Name
A	Anode
K	Cathode
V	Supply voltage V_{CC}
O	Output (OUT)
G	Ground (GND)

Unless otherwise specified the tolerances are ±0.15mm.

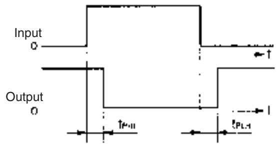
Note: 1. Hysteresis denotes the difference in forward LED current value, expressed in percentage, calculated from the respective forward LED currents when the photo IC is turned from ON to OFF and when the photo IC is turned from OFF to ON.

2. The value of the response frequency is measured by rotating the disk as shown below (P.P.S = pulse/s).



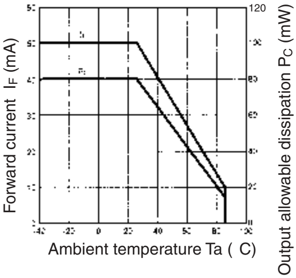


3. The following illustrations show the definition of response delay time.

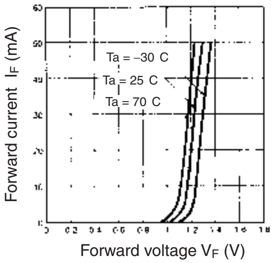


■ Engineering Data

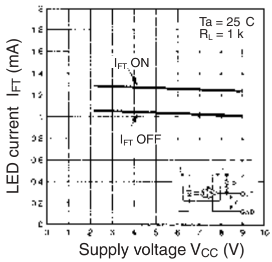
Forward Current vs. Collector Dissipation Temperature Rating



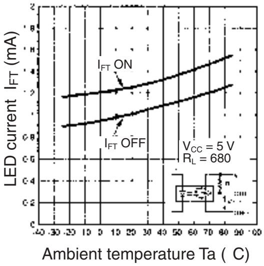
Forward Current vs. Forward Voltage Characteristics (Typical)



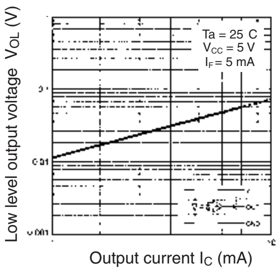
LED Current vs. Supply Voltage (Typical)



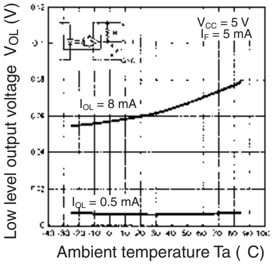
LED Current vs. Ambient Temperature Characteristics (Typical)



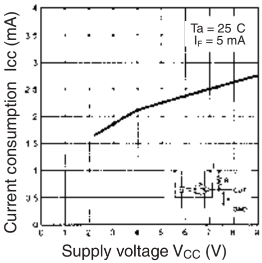
Low-level Output Voltage vs. Output Current (Typical)



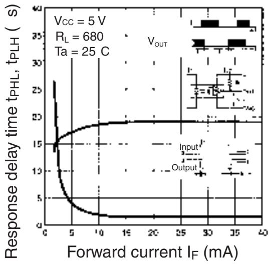
Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



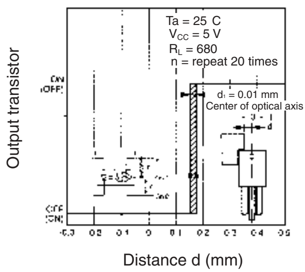
Current Consumption vs. Supply Voltage (Typical)



Response Delay Time vs. Forward Current (Typical)



Repeat Sensing Position Characteristics (Typical)



Photomicrosensors

■ 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.

Specifications

■ 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**	Topr	-40°C to 60°C
	Storage	Tstg	-40°C to 85°C
Soldering temperature		Tsol	260°C (see note 2)

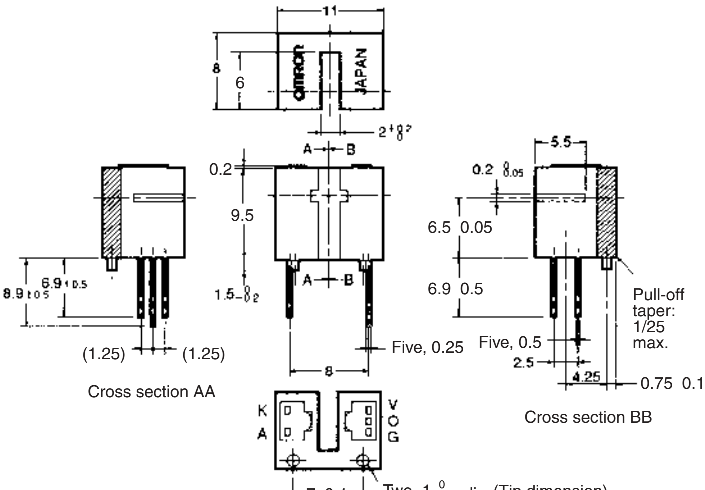
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. Complete soldering within 10 seconds.

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

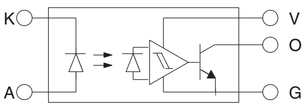
Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.2 V typ., 1.5 V max.	I_F = 20 mA
	Reverse current	I_R	0.01 µA typ., 10 µA max.	V_R = 4 V
	Peak emission wavelength	λ_P	940 nm typ.	I_F = 20 mA
Detector	**Low-level output voltage**	V_{OL}	0.12 V typ., 0.4 V max.	V_{CC} = 4.5 to 16 V, I_{OL} = 16 mA, I_F = 15 mA
	High-level output voltage	V_{OH}	15 V min.	Vcc = 16 V, R_L = 1 kΩ, I_F = 0 mA
	Current consumption	I_{CC}	5 mA typ., 10 mA max.	V_{CC} = 16 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., 15 mA max.	V_{CC} = 4.5 to 16 V
LED current when output is ON				
Hysteresis		△H	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)

■ Dimensions

Note: All units are in millimeters unless stated.



Internal Circuit



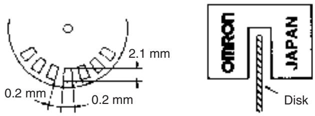
Unless otherwise specified, the tolerances are as shown below.

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

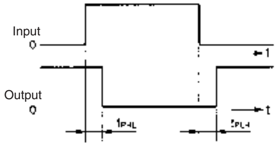
Dimensions	Tolerance
3 mm max.	±0.125
3 < mm ≤ 6	±0.150
6 < mm ≤ 10	±0.180
10 < mm ≤ 18	±0.215
18 < mm ≤ 30	±0.260

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 in turned from ON to OFF and when the photo IC in turned from OFF to ON.

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

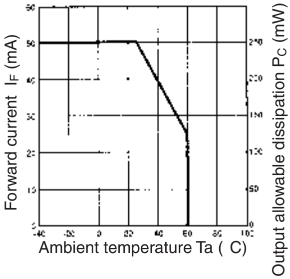


3. The following illustrations show the definition of response delay time.

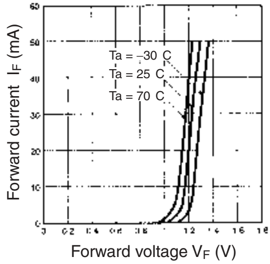


■ Engineering Data

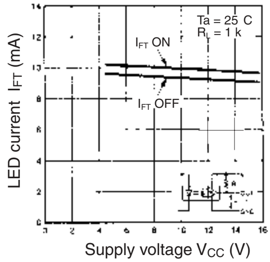
Forward Current vs. Collector Dissipation Temperature Rating



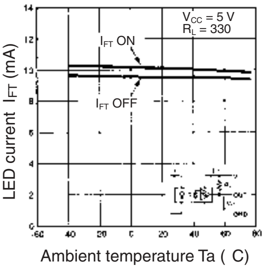
Forward Current vs. Forward Voltage Characteristics (Typical)



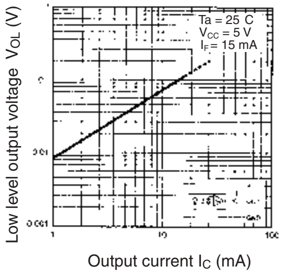
LED Current vs. Supply Voltage (Typical)



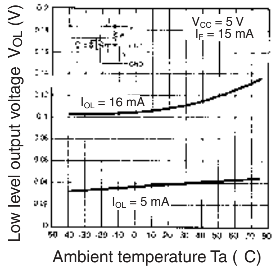
LED Current vs. Ambient Temperature Characteristics (Typical)



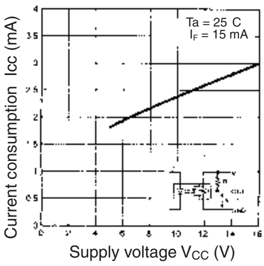
Low-level Output Voltage vs. Output Current (Typical)



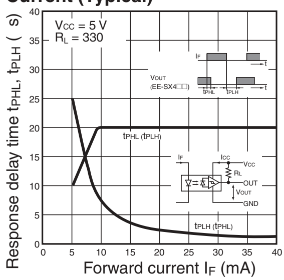
Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



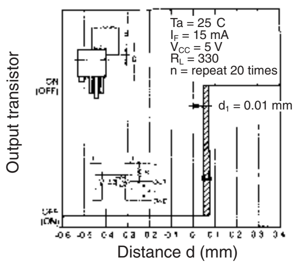
Current Consumption vs. Supply Voltage (Typical)



Response Delay Time vs. Forward Current (Typical)



Repeat Sensing Position Characteristics (Typical)



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.

Specifications

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**	Topr	-25°C to 85°C
	Storage	Tstg	-30°C to 100°C
Soldering temperature		Tsol	260°C (see note 3)

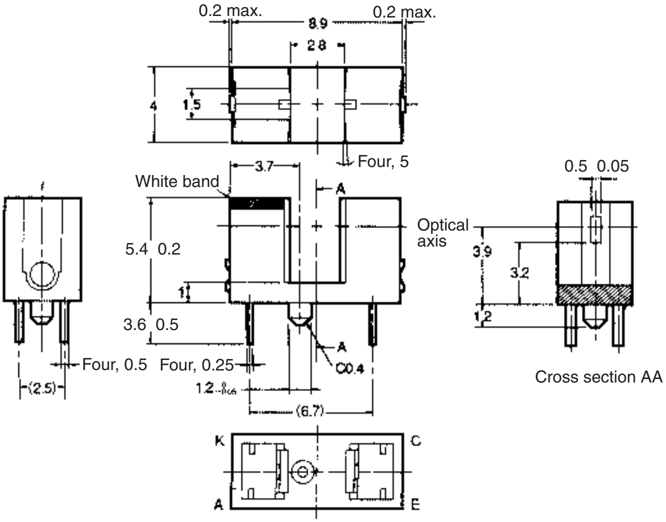
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
3. Complete soldering within 10 seconds.

Electrical and Optical Characteristics (Ta = 25°C)

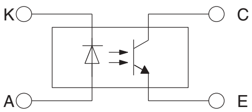
Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.2 V typ., 1.5 V max.	I_F = 30 mA
	Reverse current	I_R	0.01 μA typ., 10 μA max.	V_R = 4 V
	Peak emission wavelength	λ_P	940 nm typ.	I_F = 20 mA
Detector	**Light current**	I_L	0.5 mA min., 14 mA max.	I_F = 20 mA, V_{CE} = 10 V
	Dark current	I_D	2 nA typ., 200 nA max.	V_{CE} = 10 V, 0 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 = 0.1mA
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.	V_{CE} = 10 V
Rising time		tr	4 μs typ.	V_{CC} = 5 V, RL = 100 Ω, IL = 5 mA
Falling time		tf	4 μs typ.	V_{CC} = 5 V, RL = 100 Ω, IL = 5 mA

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



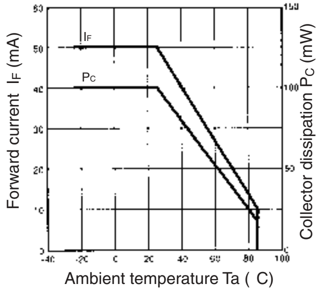
Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Unless otherwise specified, the tolerances are as shown below.

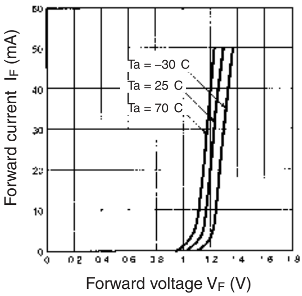
Terminal No.	Name
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

■ Engineering Data

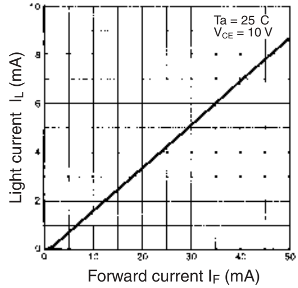
Forward Current vs. Collector Dissipation Temperature Rating



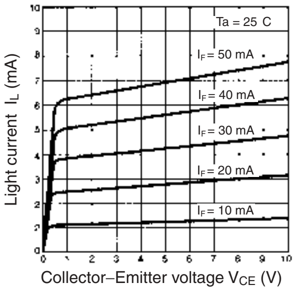
Forward Current vs. Forward Voltage Characteristics (Typical)



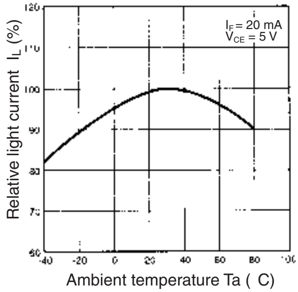
Light Current vs. Forward Current Characteristics (Typical)



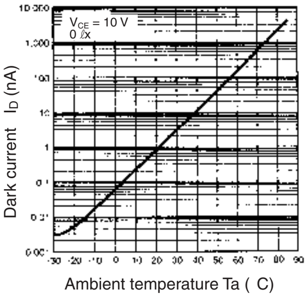
Light Current vs. Collector−Emitter Voltage Characteristics (Typical)



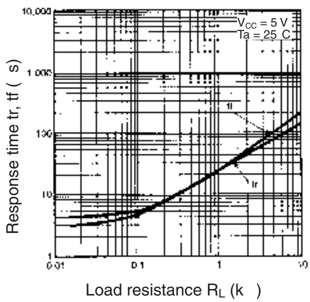
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



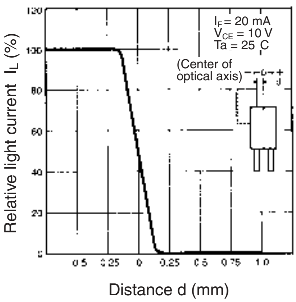
Dark Current vs. Ambient Temperature Characteristics (Typical)



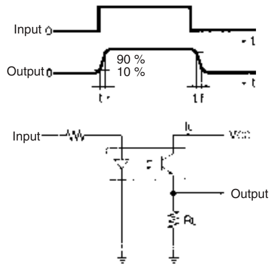
Response Time vs. Load Resistance Characteristics (Typical)



Sensing Position Characteristics (Typical)

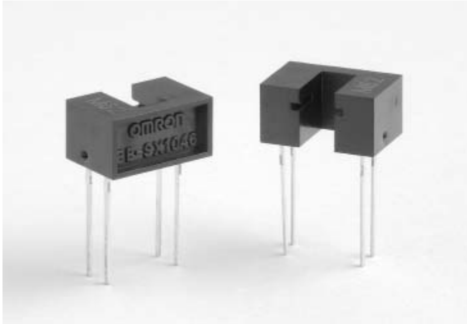


Response Time Measurement Circuit



Features

- With a horizontal sensing aperture.
- 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 foward 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**	Topr	-25°C to 85°C
	Storage	Tstg	-30°C to 100°C
Soldering temperature		Tsol	260°C (see note 3)

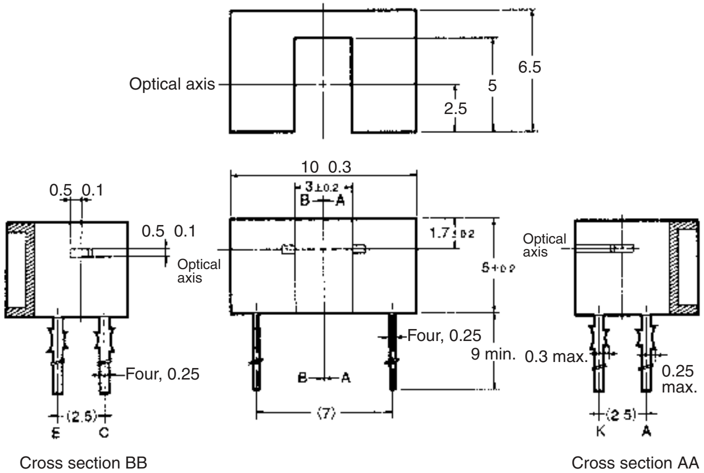
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
3. Complete soldering within 10 seconds.

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

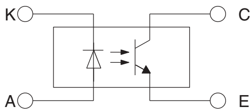
Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.2 V typ., 1.5 V max.	I_F = 30 mA
	Reverse current	I_R	0.01μA typ., 10 μA max.	V_R = 4 V
	Peak emission wavelength	λ_P	920 nm typ.	I_F = 20 mA
Detector	**Light current**	I_L	1.2 mA min., 14 mA Max.	I_F = 20 mA, V_{CE} = 5 V
	Dark current	I_D	2 nA typ., 200 nA max.	V_{CE} = 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 = 0.1 mA
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.	V_{CC} = 10 V
Rising time		tr	4 μs typ.	V_{CC} = 5 V, R_L = 100Ω, I_L = 5 mA
Falling time		tf	4 μs typ.	V_{CC} = 5 V, R_L = 100Ω, I_L = 5 mA

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



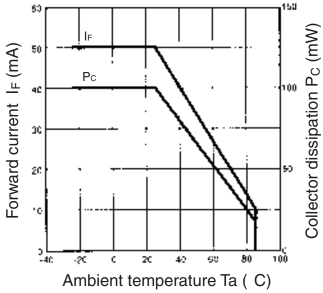
Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Unless otherwise specified, the tolerances are as shown below.

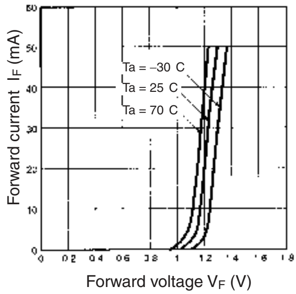
Dimensions	Tolerence
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

■ Engineering Data

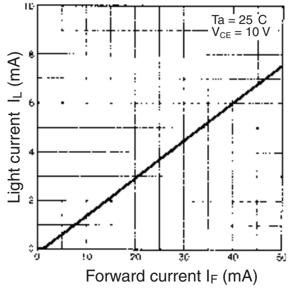
Forward Current vs. Collector Dissipation Temperature Rating



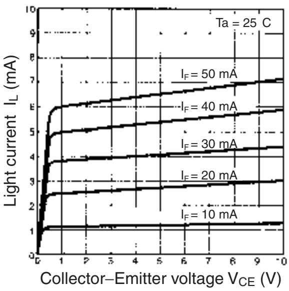
Forward Current vs. Forward Voltage Characteristics (Typical)



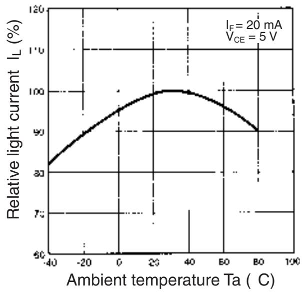
Light Current vs. Forward Current Characteristics (Typical)



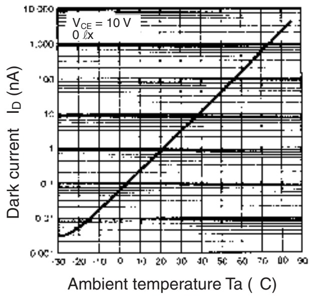
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



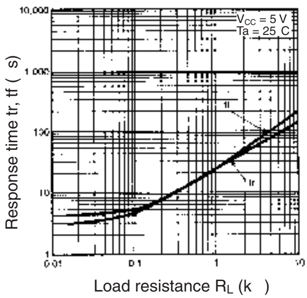
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



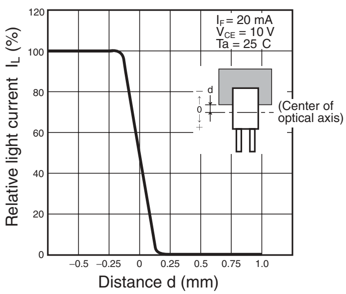
Dark Current vs. Ambient Temperature Characteristics (Typical)



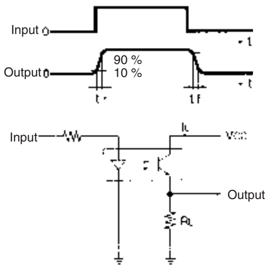
Response Time vs. Load Resistance Characteristics (Typical)



Sensing Position Characteristics (Typical)

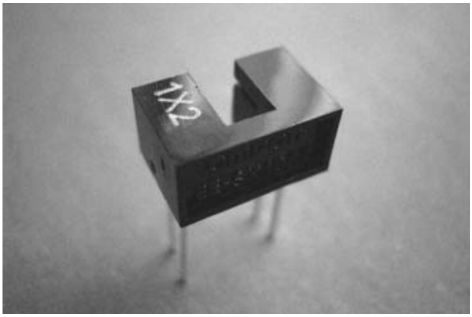


Response Time Measurement Circuit



Features

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



Specifications

Absolute Maximum Ratings (Ta = 25°C)

Item		Symbol	Rated value
Emitter	**Forward current**	I_F	50 mA (see note 1)
	Pulse foward 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**	Topr	-40°C to 85°C
	Storage	Tstg	-40°C to 100°C
Soldering temperature		Tsol	260°C (see note 3)

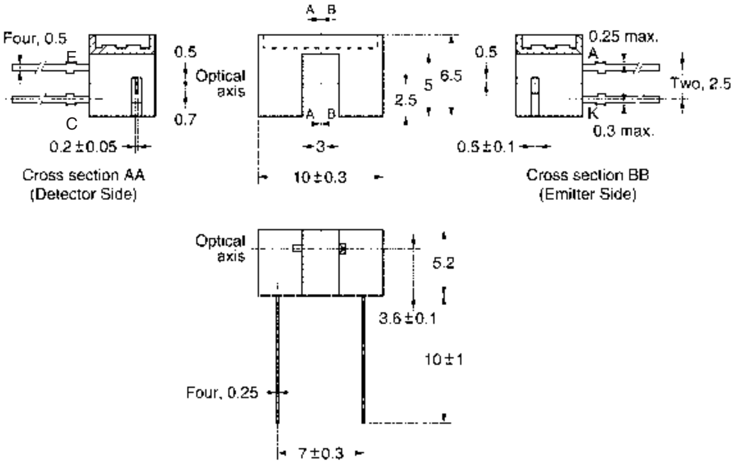
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
3. Complete soldering within 10 seconds.

Electrical and Optical Characteristics (Ta = 25°C)

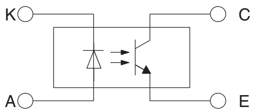
Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.2 V typ., 1.5 V max.	I_F = 30 mA
	Reverse current	I_R	0.01μA typ., 10 μA max.	V_R = 4 V
	Peak emission wavelength	λ_P	920 nm typ.	I_F = 20 mA
Detector	**Light current**	I_L	0.12 mA min.	I_F = 20 mA, V_{CE} = 5 V
	Dark current	I_D	2 nA typ., 200 nA max.	V_{CE} = 10 V, 0 ℓx
	Leakage current	I_{LEAK}	–	–
	Collector-Emitter saturated voltage	V_{CE} (sat)	0.08 V typ., 0.4 V max.	I_F = 20 mA, I_L = 0.05 μA
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.	V_{CC} = 10 V
Rising time		tr	100 μs typ.	V_{CC} = 5 V, R_L = 50 kΩ, I_L = 0.1 mA
Falling time		tf	1,000 μs typ.	V_{CC} = 5 V, R_L = 50 kΩ, I_L = 0.1 mA

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit

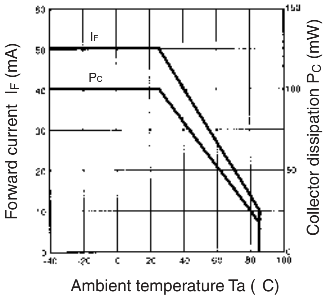


Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

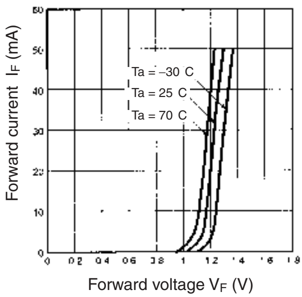
Unless otherwise specified, the tolerances are ±0.02 mm.

■ Engineering Data

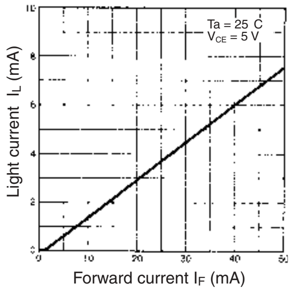
Forward Current vs. Collector Dissipation Temperature Rating



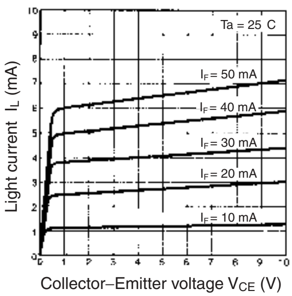
Forward Current vs. Forward Voltage Characteristics (Typical)



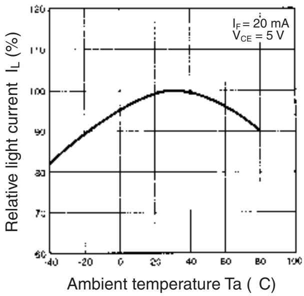
Light Current vs. Forward Current Characteristics (Typical)



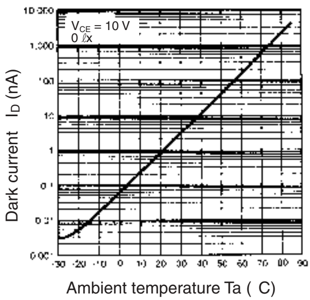
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



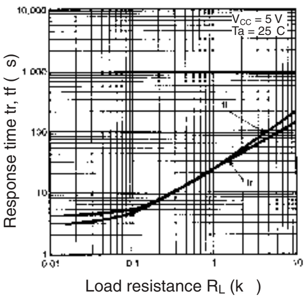
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



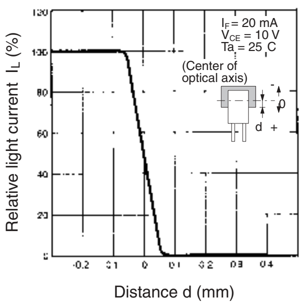
Dark Current vs. Ambient Temperature Characteristics (Typical)



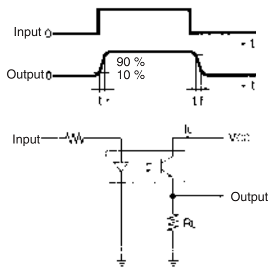
Response Time vs. Load Resistance Characteristics (Typical)



Sensing Position Characteristics (Typical)

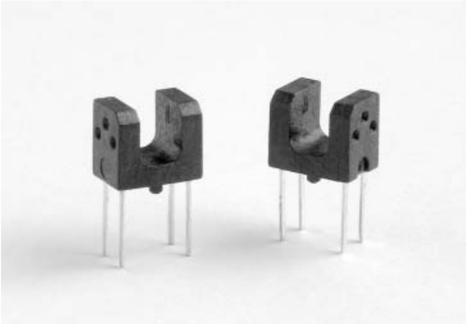


Response Time Measurement Circuit



Features

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



Specifications

Absolute Maximum Ratings (Ta = 25°C)

Item		Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Pulse foward 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	Topr	-25°C to 85°C
	Storage	Tstg	-30°C to 85°C
Soldering temperature		Tsol	260°C (see note 2)

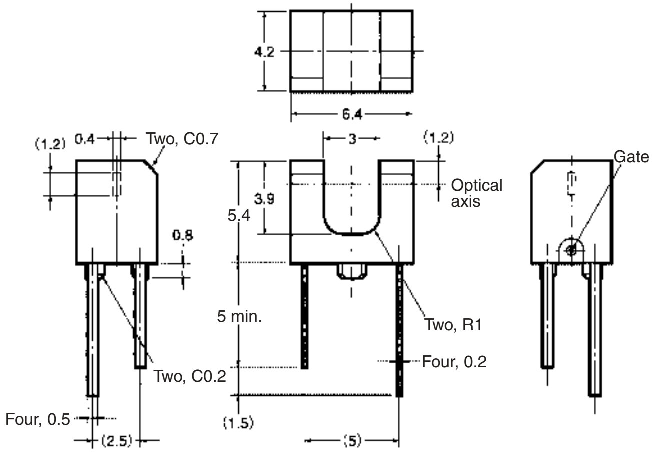
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. Complete soldering within 3 seconds.

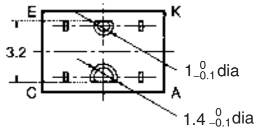
Electrical and Optical Characteristics (Ta = 25°C)

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 μA
	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 = 100Ω, I_L = 20 mA
Falling time		tf	10 μs typ.	V_{CC} = 5 V, R_L = 100Ω, I_L = 20 mA

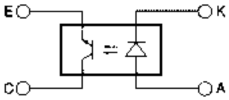
■ Dimensions

Note: All units are in millimeters unless otherwise indicated.





Internal Circuit

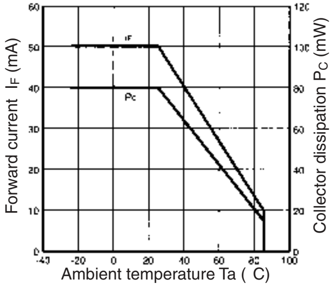


Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

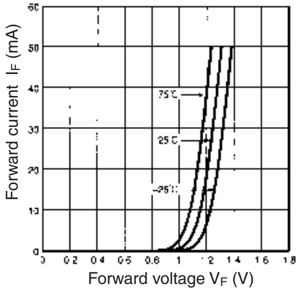
Unless otherwise specified, the tolerances are ± 0.2 mm.

■ Engineering Data

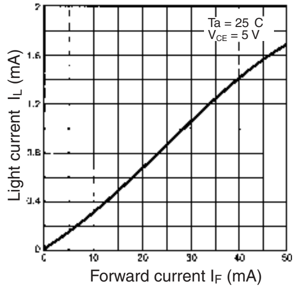
Forward Current vs. Collector Dissipation Temperature Rating



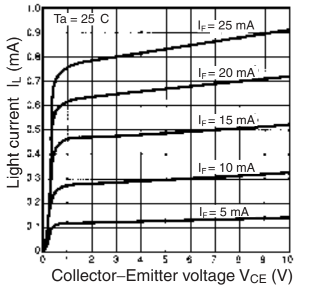
Forward Current vs. Forward Voltage Characteristics (Typical)



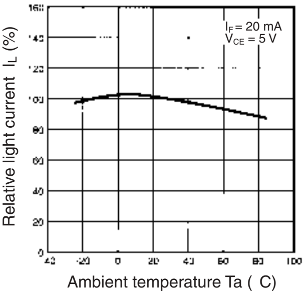
Light Current vs. Forward Current Characteristics (Typical)



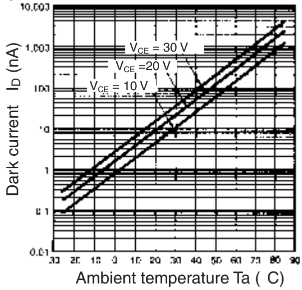
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



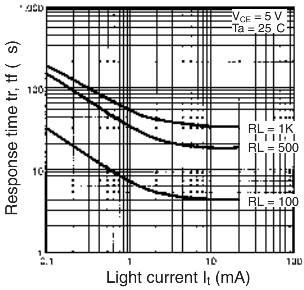
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



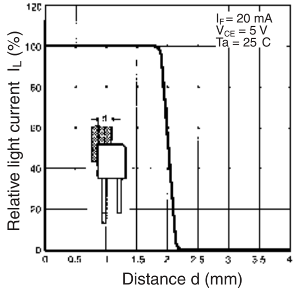
Dark Current vs. Ambient Temperature Characteristics (Typical)



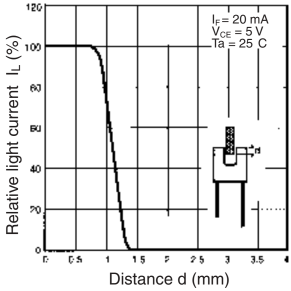
Response Time vs. Light Current Characteristics (Typical)



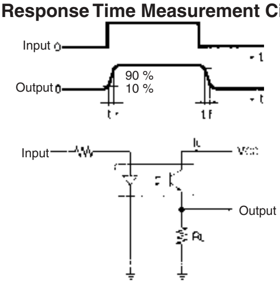
Sensing Position Characteristics (Typical)



Sensing Position Characteristics (Typical)

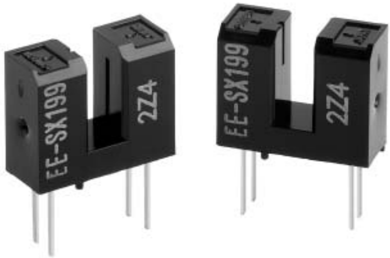


Response Time Measurement Circuit



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.



Specifications

Absolute Maximum Ratings (Ta = 25°C)

Item		Symbol	Rated value
Emitter	**Forward current**	I_F	50 mA (see note 1)
	Pulse foward current	I_{FP}	1A (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**	Topr	-25°C to 85°C
	Storage	Tstg	-40°C to 100°C
Soldering temperature		Tsol	260°C (see note 3)

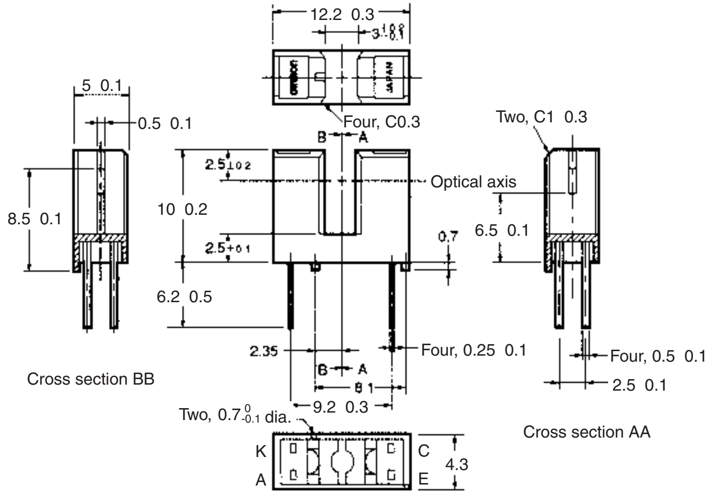
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
3. Complete soldering within 10 seconds.

Electrical and Optical Characteristics (Ta = 25°C)

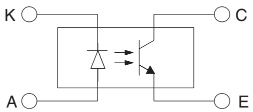
Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.2 V typ., 1.4 V max.	I_F = 30 mA
	Reverse current	I_R	0.01 μA typ., 10 μA max.	V_R = 4 V
	Peak emission wavelength	λ_P	940 nm typ.	I_F = 20 mA
Detector	**Light current**	I_L	0.5 mA min., 14 mA max.	I_F = 20 mA, V_{CE} = 5 V
	Dark current	I_D	2 nA typ., 200 nA max.	V_{CE} = 20 V, 0 ℓx
	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 = 0.5mA
	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

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit

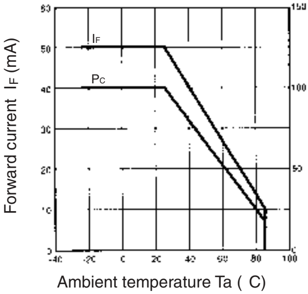


Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

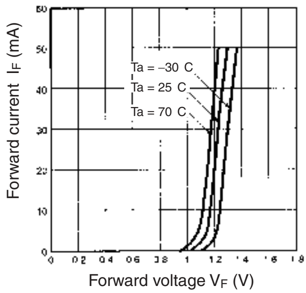
Unless otherwise specified the tolerances are ±0.2mm.

■ Engineering Data

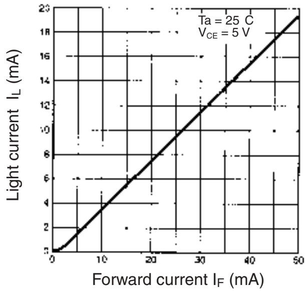
Forward Current vs. Collector Dissipation Temperature Rating



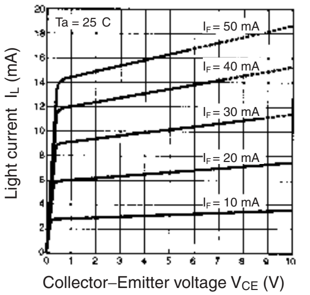
Forward Current vs. Forward Voltage Characteristics (Typical)



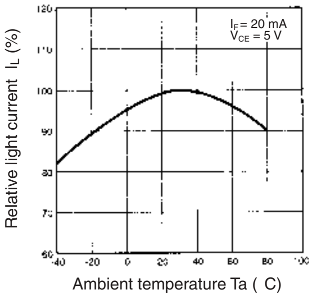
Light Current vs. Forward Current Characteristics (Typical)



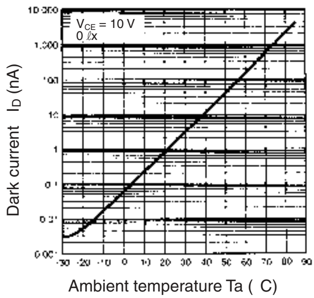
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



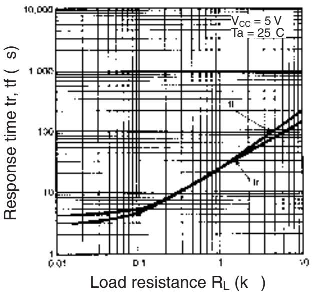
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



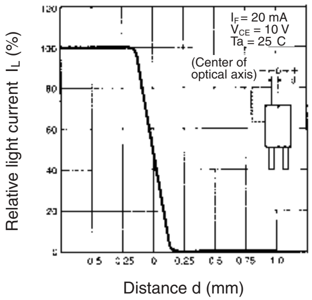
Dark Current vs. Ambient Temperature Characteristics (Typical)



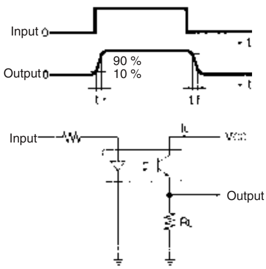
Response Time vs. Load Resistance Characteristics (Typical)



Sensing Position Characteristics (Typical)

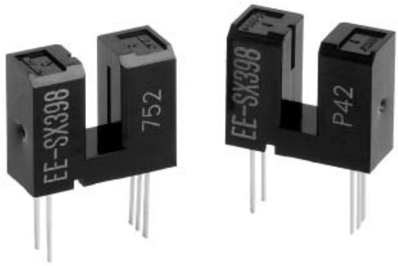


Response Time Measurement Circuit



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)



Specifications

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**	Topr	-40°C to 75°C
	Storage	Tstg	-40°C to 85°C
Soldering temperature		Tsol	260°C (see note 2)

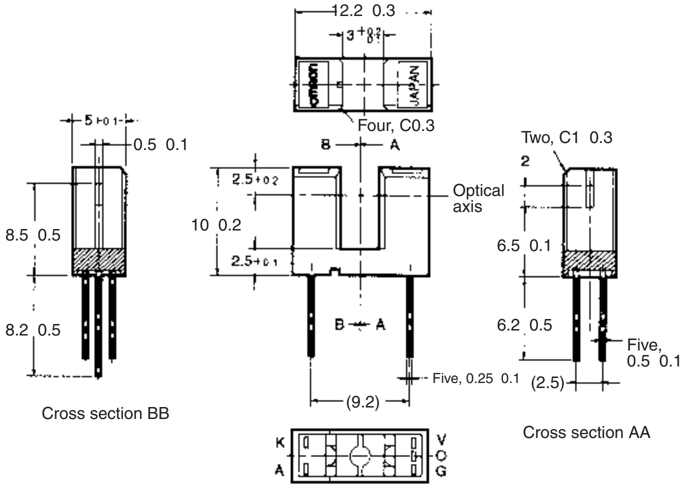
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. Complete soldering within 10 seconds.

Electrical and Optical Characteristics (Ta = 25°C)

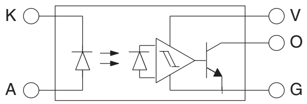
Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.2 V typ., 1.5 V max.	I_F = 20 mA
	Reverse current	I_R	0.01 µA typ., 10 µA max.	V_R = 4 V
	Peak emission wavelength	λ_P	940 nm typ.	I_F = 20 mA
Detector	**Low-level output voltage**	V_{OL}	0.12 V typ., 0.4 V max.	V_{CC} = 4.5 to 16 V, I_{OL} = 16 mA, I_F = 0 mA (EE-SX398), I_F = 5 mA (EE-SX498)
	High-level output voltage	V_{OH}	15 V min.	Vcc = 16 V, R_L = 1 kΩ, I_F = 5 mA (EE-SX398), I_F = 0 mA (EE-SX498)
	Current consumption	I_{CC}	3.2 mA typ., 10 mA max.	V_{CC} = 16 V
	Peak spectral sensitivity wavelength	λ_P	870 nm typ.	V_{CC} = 4.5 to 16 V
LED current when output is OFF **LED current when output is ON**		I_{FT}	2 mA typ., 5 mA max.	V_{CC} = 4.5 to 16
Hysteresis		△H	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 m (see note 3)

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



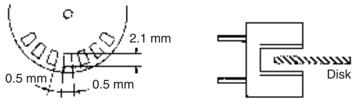
Unless otherwise specified, the tolerances are as shown below.

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

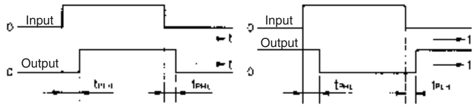
Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

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 in turned from ON to OFF and when the photo IC in 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-SX498.

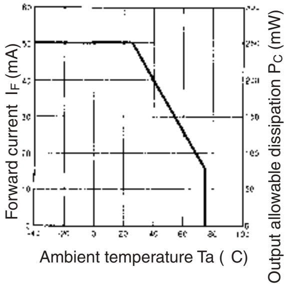


EE-SX398 **EE-SX498**

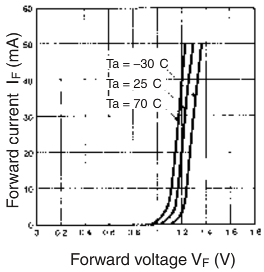
■ Engineering Data

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

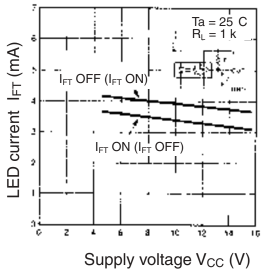
Forward Current vs. Collector Dissipation Temperature Rating



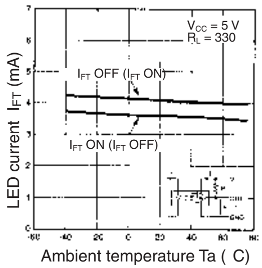
Forward Current vs. Forward Voltage Characteristics (Typical)



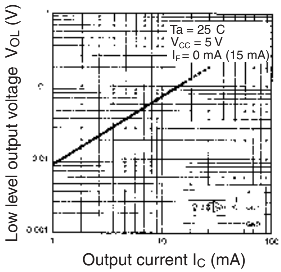
LED Current vs. Supply Voltage (Typical)



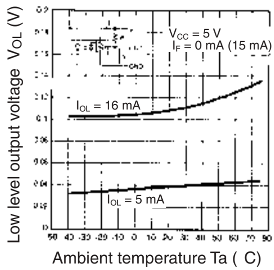
LED Current vs. Ambient Temperature Characteristics (Typical)



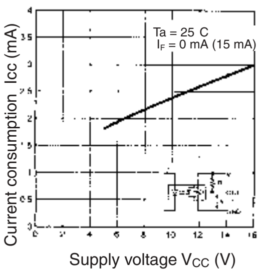
Low-level Output Voltage vs. Output Current (Typical)



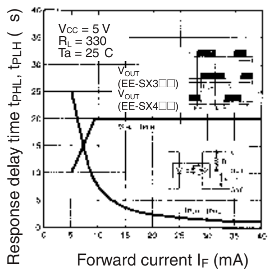
Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



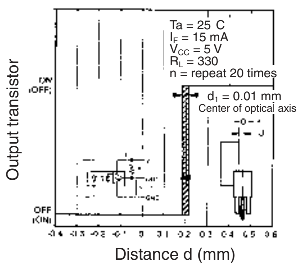
Current Consumption vs. Supply Voltage (Typical)



Response Delay Time vs. Forward Current (Typical)

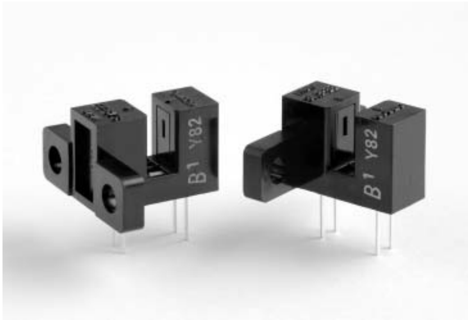


Repeat Sensing Position Characteristics (Typical)



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



Specifications

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**	Topr	-25°C to 85°C
	Storage	Tstg	-30°C to 100°C
Soldering temperature		Tsol	260°C (see note 3)

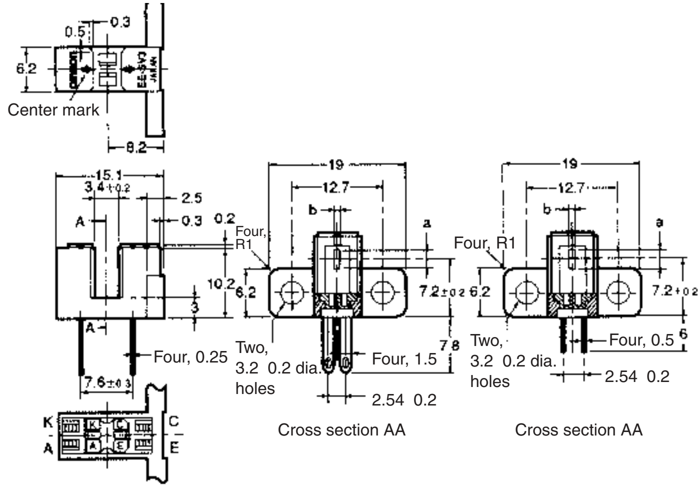
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
3. Complete soldering within 10 seconds.

Electrical and Optical Characteristics (Ta = 25°C)

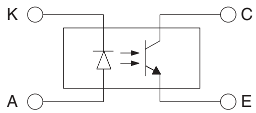
Item		Symbol	Value				Condition
			EE-SV3(-B)	**EE-SV3-C(S)**	**EE-SV3-D(S)**	**EE-SV3-G(S)**	
Emitter	**Forward voltage**	V_F	1.2 V typ., 1.5 V max.				I_F = 30 mA
	Reverse current	I_R	0.01 μA typ., 10 μA max.				V_R = 4 V
	Peak emission wavelength	λ_P	940 nm typ.				I_F = 20 mA
Detector	**Light current**	I_L	0.5 to 14 mA	1 to 28 mA	0.1 mA min.	0.5 to 14 mA	I_F = 20 mA, V_{CE} = 10 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)	0.1 V typ., 0.4 V max.		–	0.1 V typ. 0.4 V max.	I_F = 20 mA, I_L = 0.1 μA
	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.				

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Model	Aperture (a x b)
EE-SV3(-B)	2.1 x 0.5
EE-SV3-C(S)	2.1 x 1.0
EE-SV3-D(S)	2.1 x 0.2
EE-SV3-G(S)	0.5 x 2.1

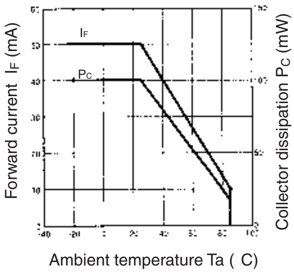
Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Unless otherwise specified, the tolerances are as shown below.

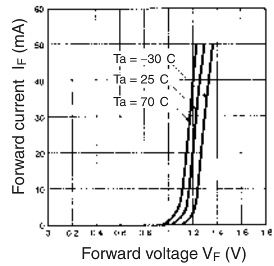
Dimensions	Tolerence
3 mm max.	±0.2
3 < mm ≤ 6	±0.24
6 < mm ≤ 10	±0.29
10 < mm ≤ 18	±0.35
18 < mm ≤ 30	±0.42

■ Engineering Data

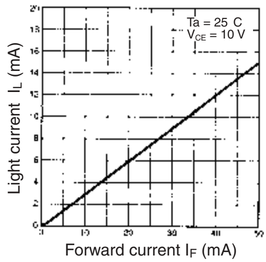
Forward Current vs. Collector Dissipation Temperature Rating



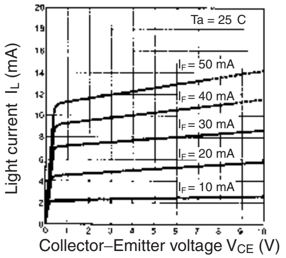
Forward Current vs. Forward Voltage Characteristics (Typical)



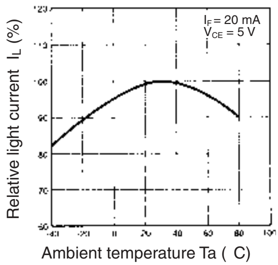
Light Current vs. Forward Current Characteristics (Typical)



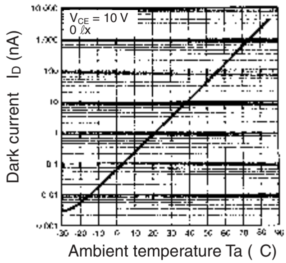
Light Current vs. Collector–Emitter Voltage Characteristics (EE-SV3(-B))



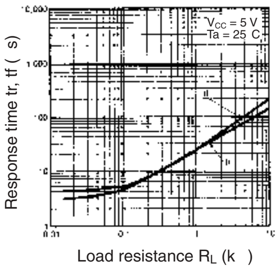
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



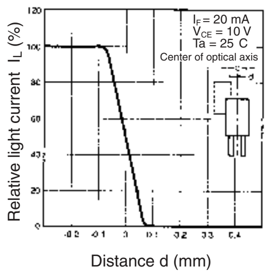
Dark Current vs. Ambient Temperature Characteristics (Typical)



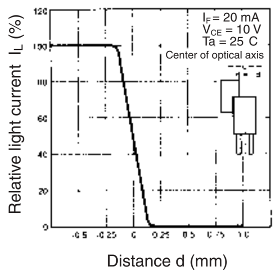
Response Time vs. Load Resistance Characteristics (Typical)



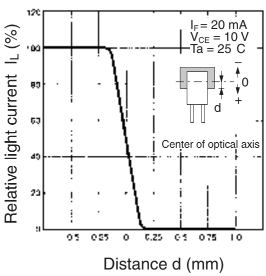
Sensing Position Characteristics (EE-SV3-D(S))



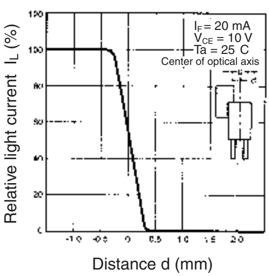
Sensing Position Characteristics (EE-SV3(-B))



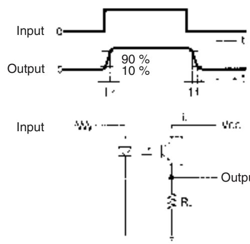
Sensing Position Characteristics (EE-SV3-G(S))



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

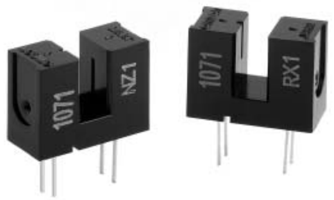


Response Time Measurement Circuit



Features

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



Specifications

■ 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**	Topr	-25°C to 85°C
	Storage	Tstg	-30°C to 100°C
Soldering temperature		Tsol	260°C (see note 3)

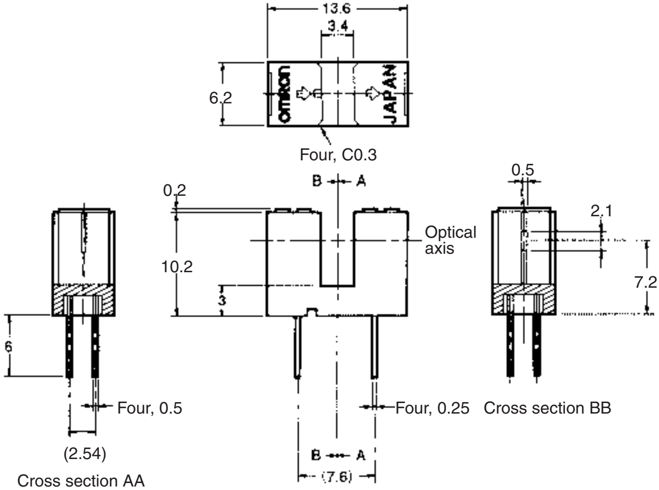
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
3. Complete soldering within 10 seconds.

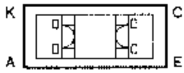
■ Electrical and Optical Characteristics (Ta = 25°C)

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 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 = 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 = 100Ω, I_L = 5 mA
Falling time		tf	4 μs typ.	V_{CC} = 5 V. R_L = 100Ω, I_L = 5 mA

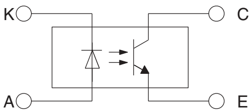
■ Dimensions

Note: All units are in millimeters unless otherwise indicated.





Internal Circuit



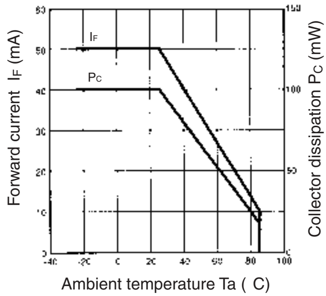
Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Unless otherwise specified, the tolerances are shown below

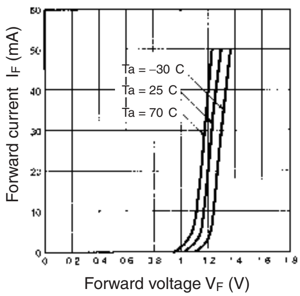
Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

■ Engineering Data

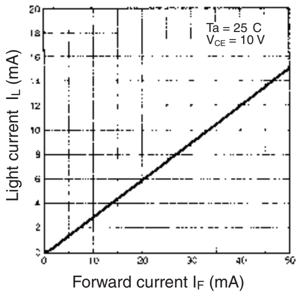
Forward Current vs. Collector Dissipation Temperature Rating



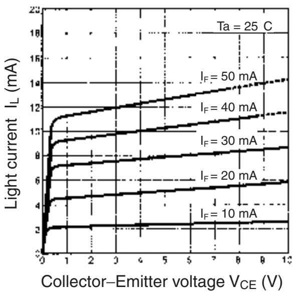
Forward Current vs. Forward Voltage Characteristics (Typical)



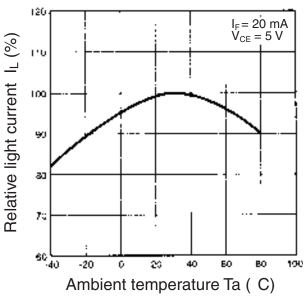
Light Current vs. Forward Current Characteristics (Typical)



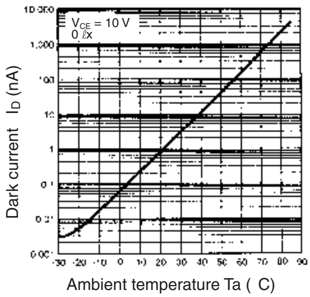
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



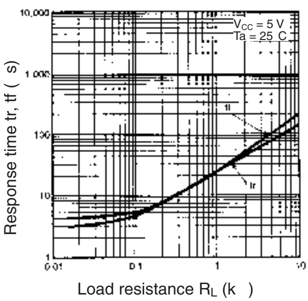
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



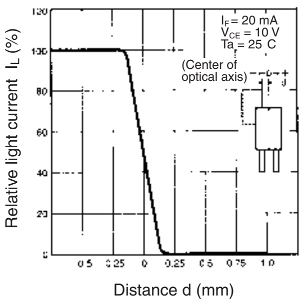
Dark Current vs. Ambient Temperature Characteristics (Typical)



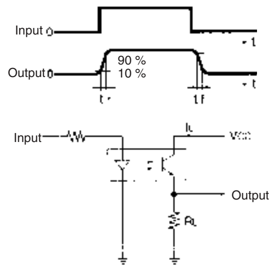
Response Time vs. Load Resistance Characteristics (Typical)



Sensing Position Characteristics (Typical)

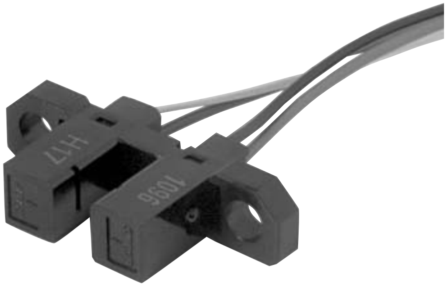


Response Time Measurement Circuit



Features

- General-purpose model with a 3.4-mm-wide slot.
- PCB or connector mounting.
- 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.



Specifications

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**	Topr	-25°C to 85°C
	Storage	Tstg	-30°C to 100°C
Soldering temperature		Tsol	260°C (see note 3)

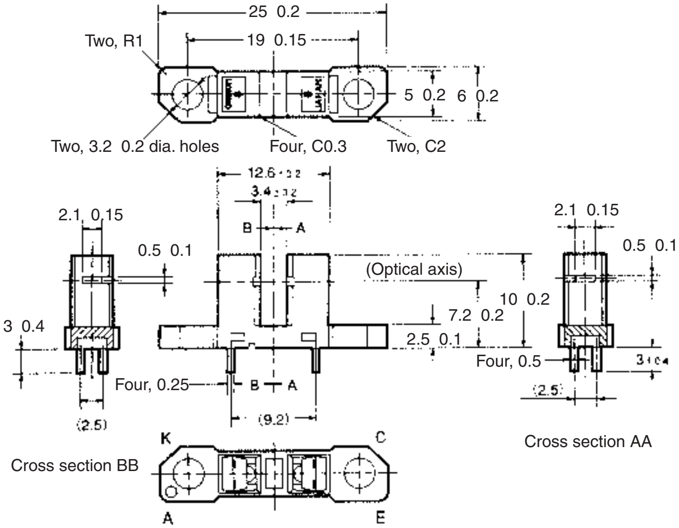
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
3. Complete soldering within 10 seconds.

Electrical and Optical Characteristics (Ta = 25°C)

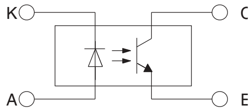
Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.2 V typ., 1.5 V max.	I_F = 30 mA
	Reverse current	I_R	0.01 μA typ., 10 μA max.	V_R = 4 V
	Peak emission wavelength	λ_P	940 nm typ.	I_F = 20 mA
Detector	**Light current**	I_L	0.5 mA min., 14 mA max.	I_F = 20 mA, V_{CE} = 10 V
	Dark current	I_D	2 nA typ., 200 nA max.	V_{CE} = 10 V, 0 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 = 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 = 100Ω, I_L = 5 mA
Falling time		tf	4 μs typ.	V_{CC} = 5 V, R_L = 100Ω, I_L = 5 mA

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



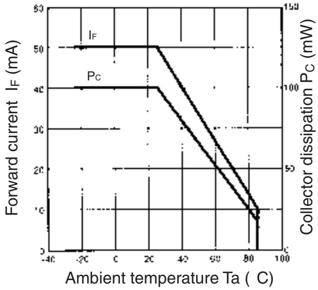
Unless otherwise specified, the tolerances are shown below

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

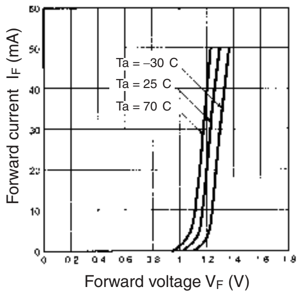
Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

■ Engineering Data

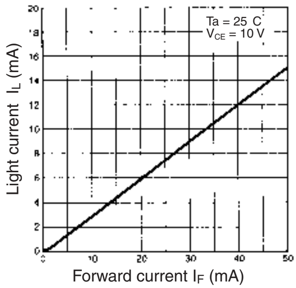
Forward Current vs. Collector Dissipation Temperature Rating



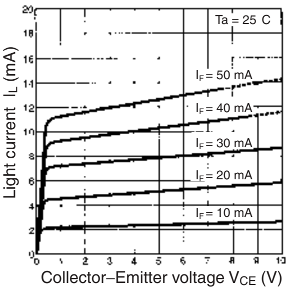
Forward Current vs. Forward Voltage Characteristics (Typical)



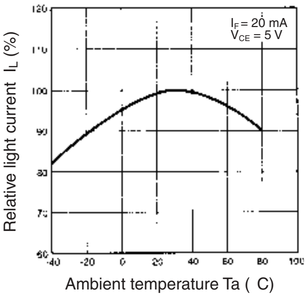
Light Current vs. Forward Current Characteristics (Typical)



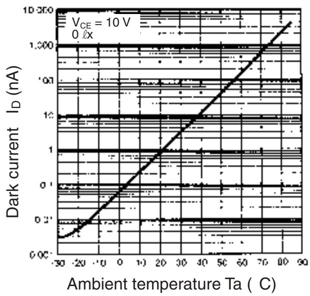
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



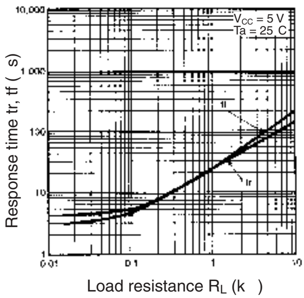
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



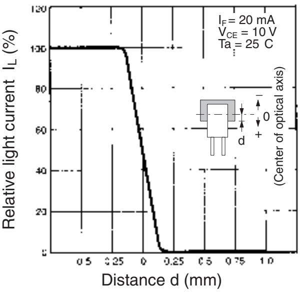
Dark Current vs. Ambient Temperature Characteristics (Typical)



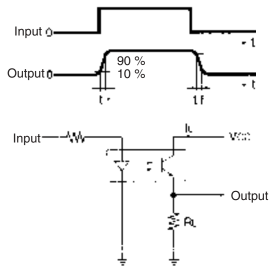
Response Time vs. Load Resistance Characteristics (Typical)



Sensing Position Characteristics (Typical)



Response Time Measurement Circuit



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.

Specifications

■ 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**	Topr	-25°C to 85°C
	Storage	Tstg	-30°C to 100°C
Soldering temperature		Tsol	260°C (see note 3)

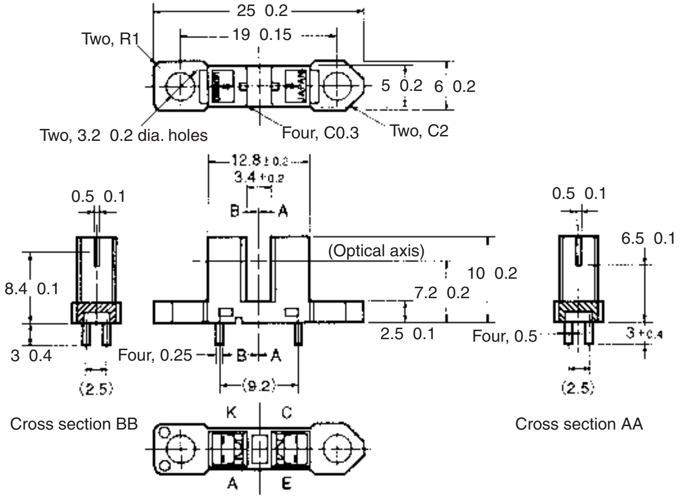
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
3. Complete soldering within 10 seconds.

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

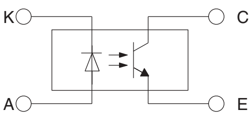
Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.2 V typ., 1.5 V max.	I_F = 30 mA
	Reverse current	I_R	0.01 μA typ., 10 μA max.	V_R = 4 V
	Peak emission wavelength	λ_P	940 nm typ.	I_F = 20 mA
Detector	**Light current**	I_L	0.5 mA min., 14 mA max.	I_F = 20 mA, V_{CE} = 10 V
	Dark current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

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



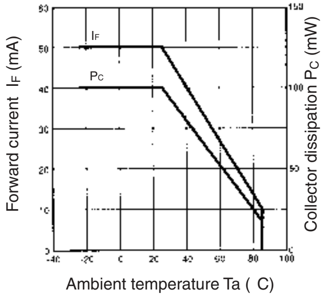
Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Unless otherwise specified, the tolerances are shown below

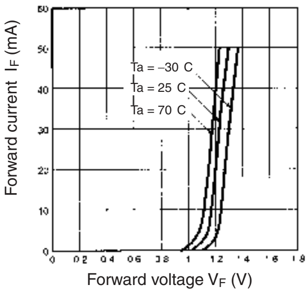
Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

■ Engineering Data

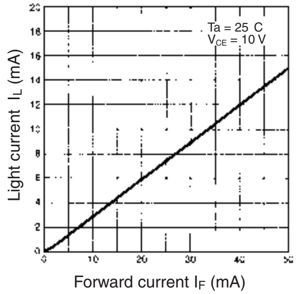
Forward Current vs. Collector Dissipation Temperature Rating



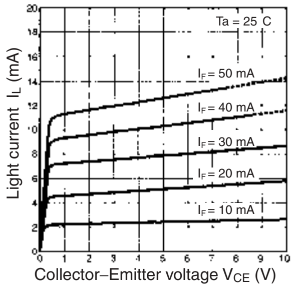
Forward Current vs. Forward Voltage Characteristics (Typical)



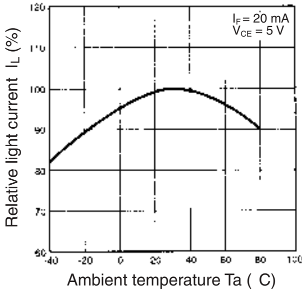
Light Current vs. Forward Current Characteristics (Typical)



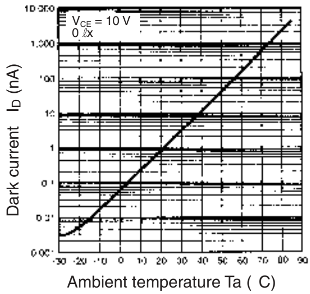
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



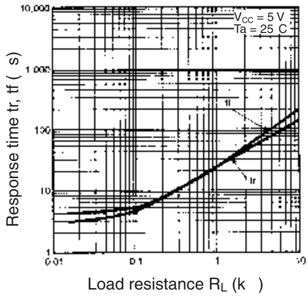
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



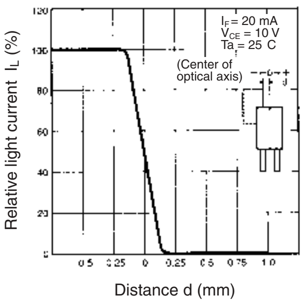
Dark Current vs. Ambient Temperature Characteristics (Typical)



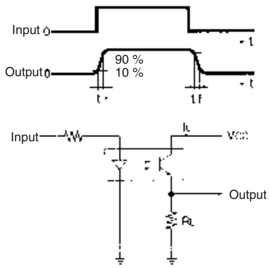
Response Time vs. Load Resistance Characteristics (Typical)



Sensing Position Characteristics (Typical)

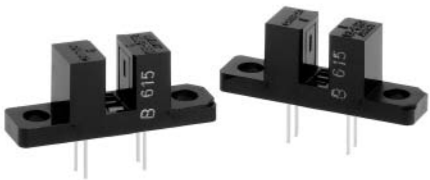


Response Time Measurement Circuit



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



Specifications

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**	Topr	-25°C to 85°C
	Storage	Tstg	-30°C to 100°C
Soldering temperature		Tsol	260°C (see note 3)

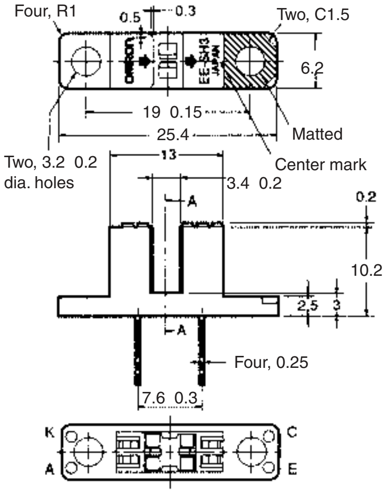
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
3. Complete soldering within 10 seconds.

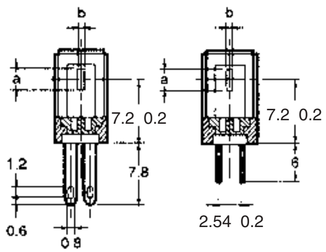
Electrical and Optical Characteristics (Ta = 25°C)

Item		Symbol	Value				Condition
			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 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 to 14 mA typ.	1 to 28 mA typ.	0.1 mA min.	0.5 to 14 mA	I_F = 20 mA, V_{CE} = 10 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)	0.1 V typ., 0.4 max.		–	0.1 V typ. 0.4 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 = 100Ω, I_L = 5 mA
Falling time		tf	4 μs typ.				

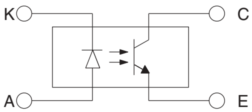
■ Dimensions

Note: All units are in millimeters unless otherwise indicated.





Internal Circuit



Model	Aperture (a x b)
EE-SH3(-B)	2.1 x 0.5
EE-SH3-C(S)	2.1 x 1.0
EE-SH3-D(S)	2.1 x 0.2
EE-SH3-G(S)	0.5 x 2.1

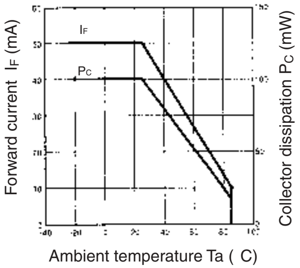
Unless otherwise specified, the tolerances are shown below

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

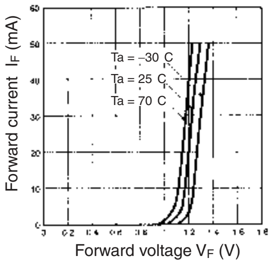
Dimensions	Tolerance
3 mm max.	±0.2
3 < mm ≤ 6	±0.24
6 < mm ≤ 10	±0.29
10 < mm ≤ 18	±0.35
18 < mm ≤ 30	±0.42

■ Engineering Data

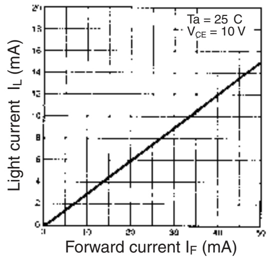
Forward Current vs. Collector Dissipation Temperature Rating



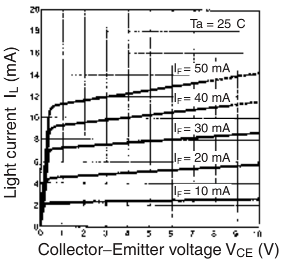
Forward Current vs. Forward Voltage Characteristics (Typical)



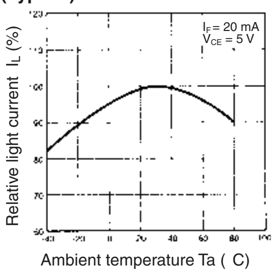
Light Current vs. Forward Current Characteristics (Typical)



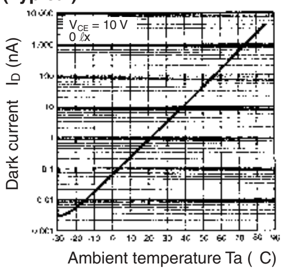
Light Current vs. Collector–Emitter Voltage Characteristics (EE-SH3(-B))



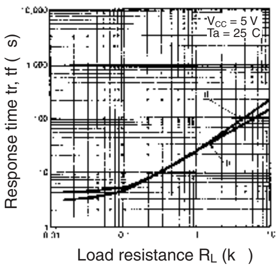
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



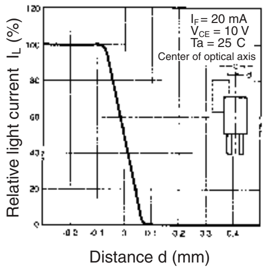
Dark Current vs. Ambient Temperature Characteristics (Typical)



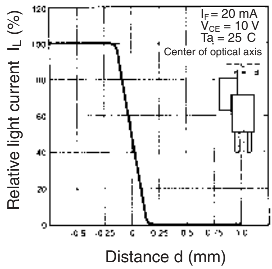
Response Time vs. Load Resistance Characteristics (Typical)



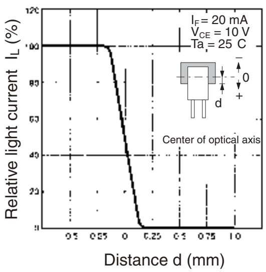
Sensing Position Characteristics (EE-SH3-D(S))



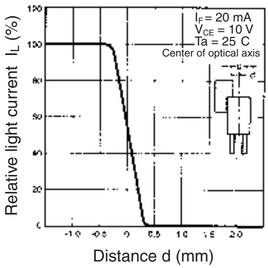
Sensing Position Characteristics (EE-SH3(-B))



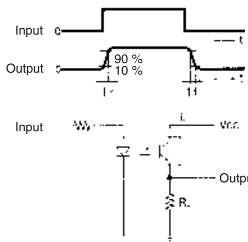
Sensing Position Characteristics (EE-SH3-G(S))



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



Response Time Measurement Circuit



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.

Specifications

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**	Topr	-40°C to 75°C
	Storage	Tstg	-40°C to 85°C
Soldering temperature		Tsol	260°C (see note 2)

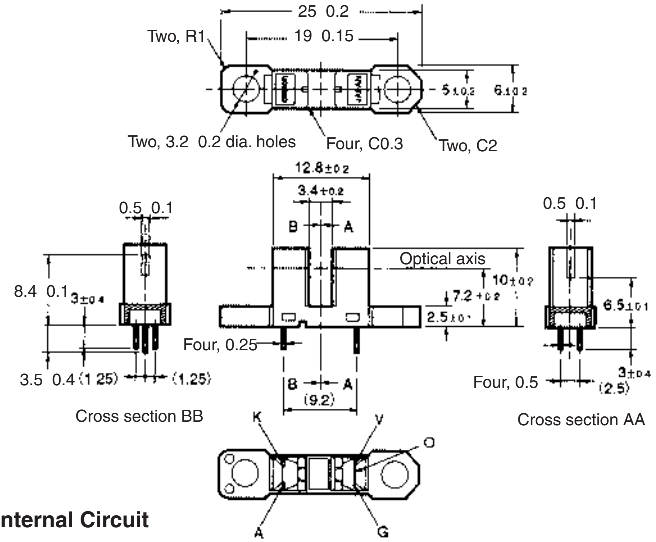
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. Complete soldering within 10 seconds.

Electrical and Optical Characteristics (Ta = 25°C)

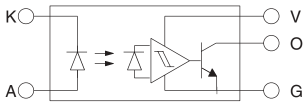
Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.2 V typ., 1.5 V max.	I_F = 20 mA
	Reverse current	I_R	0.01 μA typ., 10 μA max.	V_R = 4 V
	Peak emission wavelength	λ_P	940 nm	I_F = 20 mA
Detector	**Low-level output voltage**	V_{OL}	0.12 V typ., 0.4 V max.	V_{CC} = 4.5 to 16 V, I_{OL} = 16 mA, I_F = 0 mA (EE-SX3088), I_F = 5 mA (EE-SX4088)
	High-level output voltage	V_{OH}	15 V min.	V_{CC} = 16 V, R_L = 1 kΩ, I_F = 5 mA (EE-SX3088), I_F = 0 mA (EE-SX4088)
	Current consumption	I_{CC}	3.2 mA typ., 10 mA max.	V_{CC} = 16 V
	Peak spectral sensitivity wavelength	λ_P	870 nm	V_{CC} = 4.5 to 16 V
LED current when output is OFF		I_{FT}	2 mA typ., 5 mA max.	V_{CC} = 4.5 to 16 V
LED current when output is ON				
Hysteresis		△H	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} = 16mA (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)

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



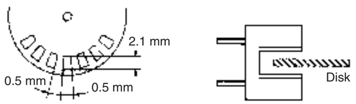
Unless otherwise specified, the tolerances are shown below

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

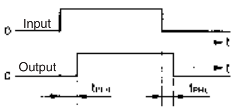
Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

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 in turned from ON to OFF and when the photo IC in turned from OFF to ON.

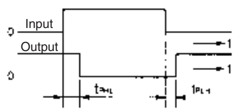
2. The value of the response frequency is measured by rotating the disk as shown below.



3. The following illustrations show the definition of response delay time. The value in the parentheses applies to the EESX4088.



EE-SX3088

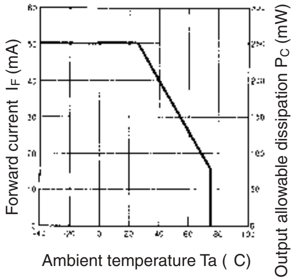


EE-SX4088

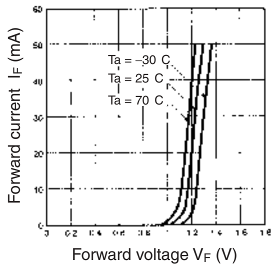
■ Engineering Data

Note: The values in the parentheses apply to EE-SX4080.

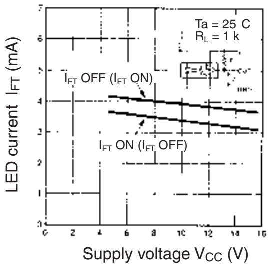
Forward Current vs. Collector Dissipation Temperature Rating



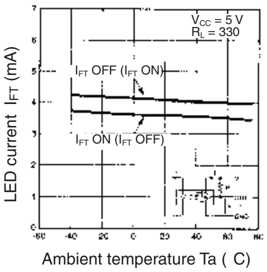
Forward Current vs. Forward Voltage Characteristics (Typical)



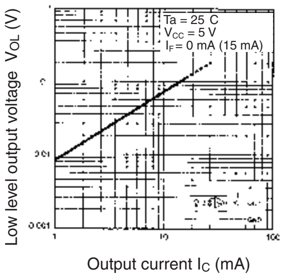
LED Current vs. Supply Voltage (Typical)



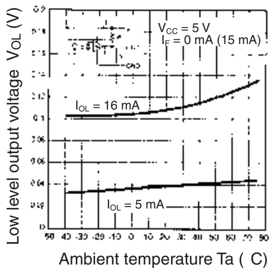
LED Current vs. Ambient Temperature Characteristics (Typical)



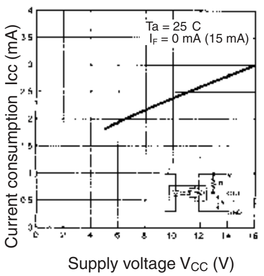
Low-level Output Voltage vs. Output Current (Typical)



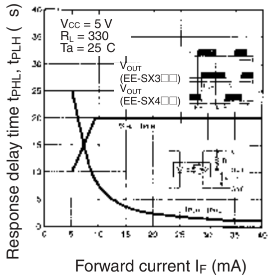
Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



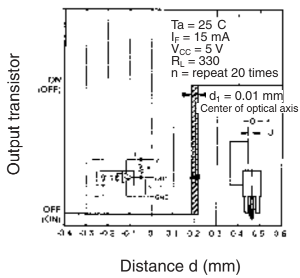
Current Consumption vs. Supply Voltage (Typical)



Response Delay Time vs. Forward Current (Typical)



Repeat Sensing Position Characteristics (Typical)



Features

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

Specifications

■ 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**	Topr	-25°C to 85°C
	Storage	Tstg	-30°C to 100°C
Soldering temperature		Tsol	260°C (see note 3)

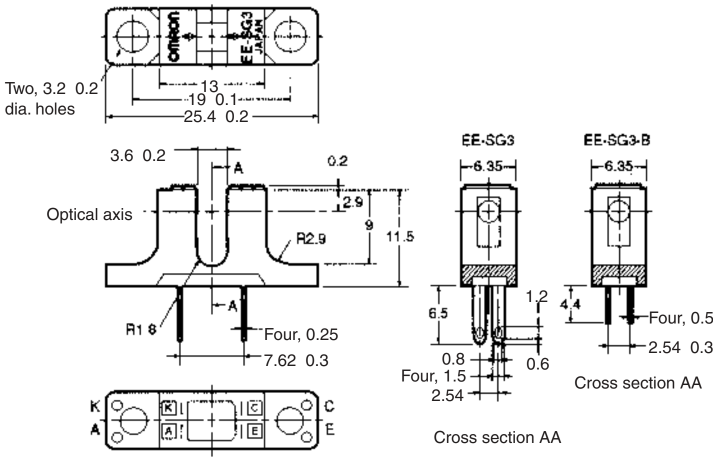
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
3. Complete soldering within 10 seconds.

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

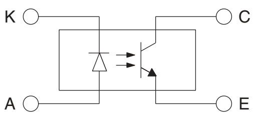
Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.2 V typ., 1.5 V max.	I_F = 30 mA
	Reverse current	I_R	0.01 μA typ., 10 μA max.	V_R = 4 V
	Peak emission wavelength	λ_P	940 nm typ.	I_F = 20 mA
Detector	**Light current**	I_L	2 mA min., 40 mA max.	I_F = 15 mA, V_{CE} = 10 V
	Dark current	I_D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

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



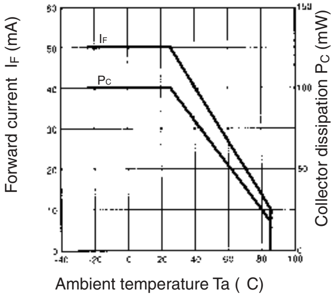
Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Unless otherwise specified, the tolerances are shown below

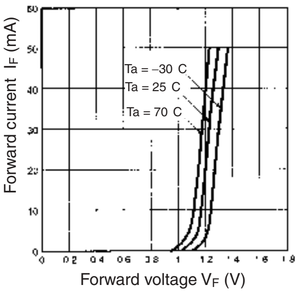
Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

■ Engineering Data

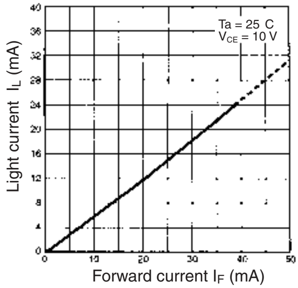
Forward Current vs. Collector Dissipation Temperature Rating



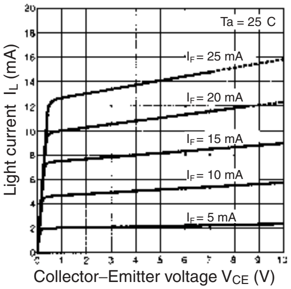
Forward Current vs. Forward Voltage Characteristics (Typical)



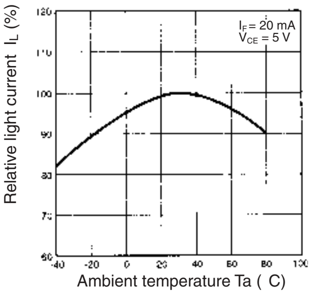
Light Current vs. Forward Current Characteristics (Typical)



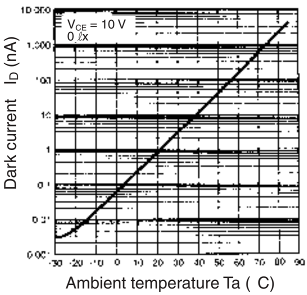
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



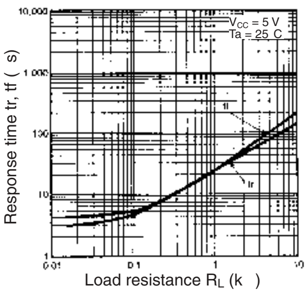
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



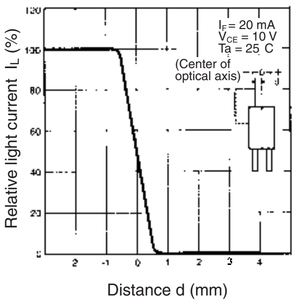
Dark Current vs. Ambient Temperature Characteristics (Typical)



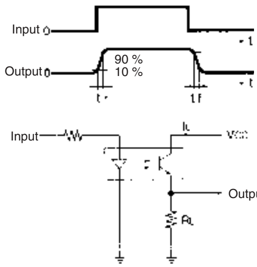
Response Time vs. Load Resistance Characteristics (Typical)



Sensing Position Characteristics (Typical)



Response Time Measurement Circuit



Features

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

Specifications

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 85°C
	Storage	Tstg	-30°C to 100°C
Soldering temperature		Tsol	260°C (see note 3)

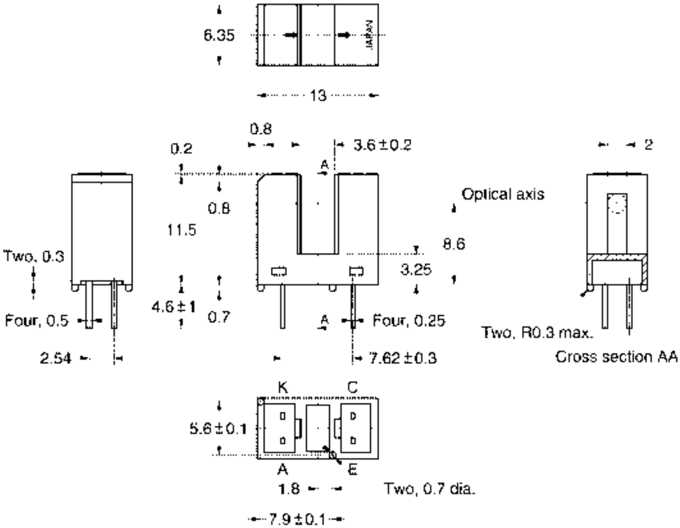
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
3. Complete soldering within 10 seconds.

Electrical and Optical Characteristics (Ta = 25°C)

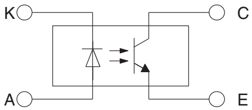
Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.5 V typ., 1.5 V max.	I_F = 30 mA
	Reverse current	I_R	0.01 μA typ., 10 μA max.	V_R = 4 V
	Peak emission wavelength	λ_P	940 nm typ.	I_F = 20 mA
Detector	**Light current**	I_L	1.5 mA min., 8 mA typ., 30 mA max.	I_F = 15 mA, V_{CE} = 2 V
	Dark 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 ms typ., 20 mA max.	V_{CC} = 10 V. R_L = 100Ω, I_L = 5 mA
Falling time		tf	4 ms typ., 20 mA max.	V_{CC} = 10 V. R_L = 100Ω, I_L = 5 mA

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



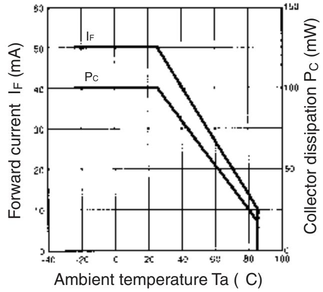
Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Unless otherwise specified, the tolerances are shown below

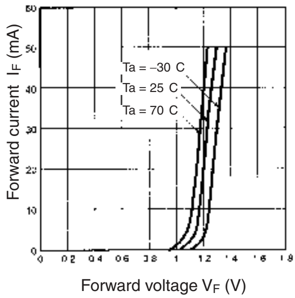
Dimensions	Tolerance
3 mm max.	±0.
3 < mm ≤ 6	±0.24
6 < mm ≤ 10	±0.29
10 < mm ≤ 18	±0.35
18 < mm ≤ 30	±0.42

■ Engineering Data

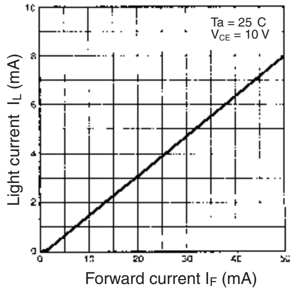
Forward Current vs. Collector Dissipation Temperature Rating



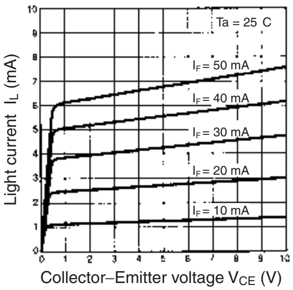
Forward Current vs. Forward Voltage Characteristics (Typical)



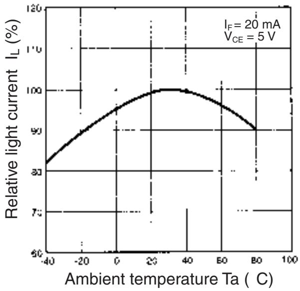
Light Current vs. Forward Current Characteristics (Typical)



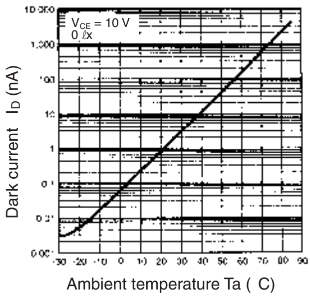
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



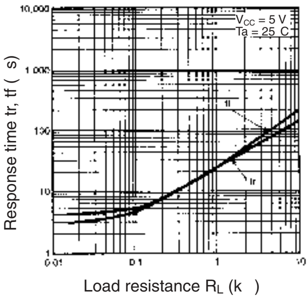
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



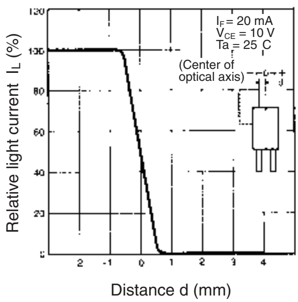
Dark Current vs. Ambient Temperature Characteristics (Typical)



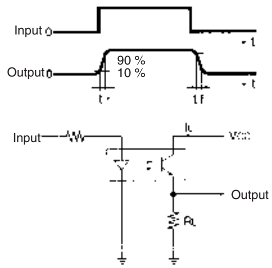
Response Time vs. Load Resistance Characteristics (Typical)



Sensing Position Characteristics (Typical)

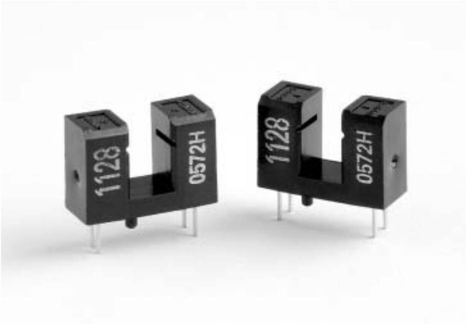


Response Time Measurement Circuit



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.



Specifications

■ 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**	Topr	-25°C to 85°C
	Storage	Tstg	-30°C to 100°C
Soldering temperature		Tsol	260°C (see note 3)

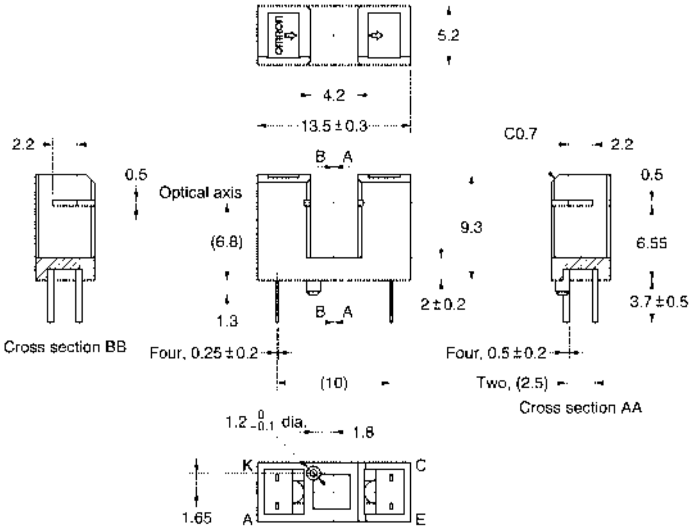
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
3. Complete soldering within 10 seconds.

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

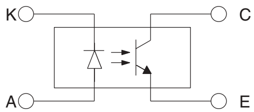
Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.2 V typ., 1.5 V max.	I_F = 30 mA
	Reverse current	I_R	0.01 μA typ., 10 μA max.	V_R = 4 V
	Peak emission wavelength	λ_P	940 nm typ.	I_F = 20 mA
Detector	**Light current**	I_L	0.5 mA min., 10 mA max.	I_F = 20 mA, V_{CE} = 10 V
	Dark current	I_D	2 nA typ., 200 nA max.	V_{CE} = 10 V, 0 ℓx
	Leakage current	I_{LEAK}	–	–
	Collector-Emitter saturated voltage	V_{CE} (sat)	0.1 V typ., 0.4 max.	I_F = 20 mA, I_L = 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

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



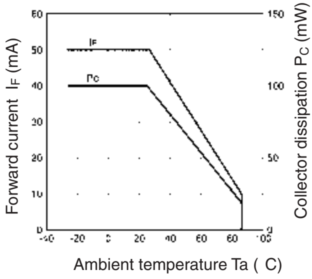
Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Unless otherwise specified, the tolerances are shown below

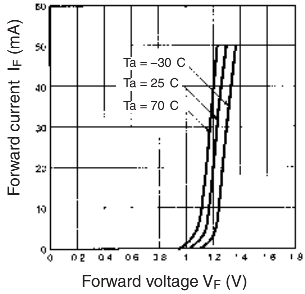
Dimensions	Tolerance
0 < mm ≤ 4	±0.100
4 < mm ≤ 18	±0.200

■ Engineering Data

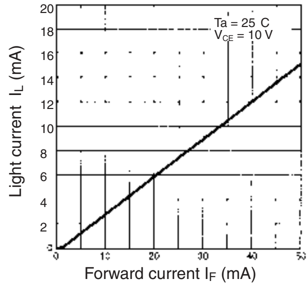
Forward Current vs. Collector Dissipation Temperature Rating



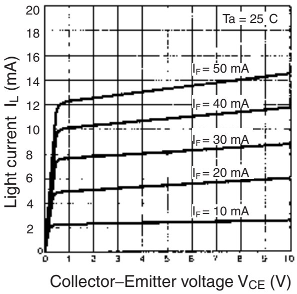
Forward Current vs. Forward Voltage Characteristics (Typical)



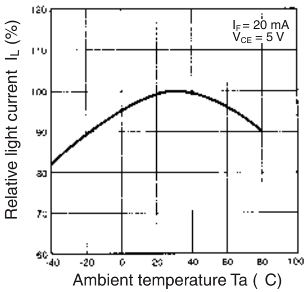
Light Current vs. Forward Current Characteristics (Typical)



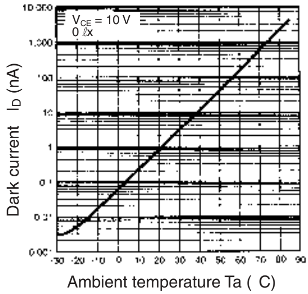
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



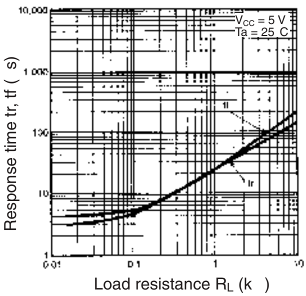
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



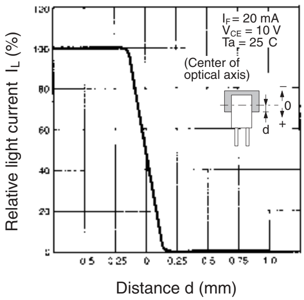
Dark Current vs. Ambient Temperature Characteristics (Typical)



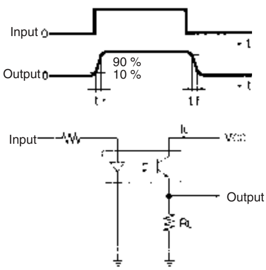
Response Time vs. Load Resistance Characteristics (Typical)



Sensing Position Characteristics (Typical)

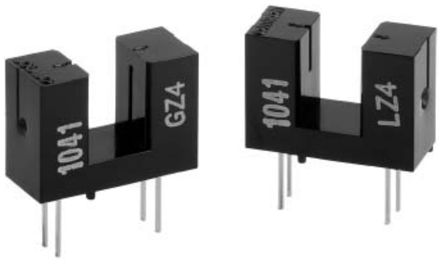


Response Time Measurement Circuit



Features

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



Specifications

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**	Topr	-25°C to 85°C
	Storage	Tstg	-30°C to 100°C
Soldering temperature		Tsol	260°C (see note 3)

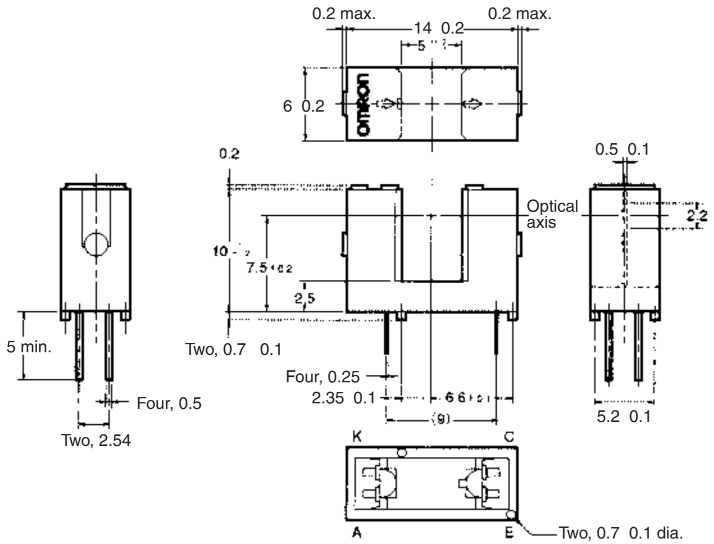
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
3. Complete soldering within 10 seconds.

Electrical and Optical Characteristics (Ta = 25°C)

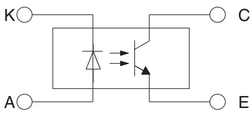
Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.2 V typ., 1.5 V max.	I_F = 30 mA
	Reverse current	I_R	0.01 μA typ., 10 μA max.	V_R = 4 V
	Peak emission wavelength	λ_P	940 nm typ.	I_F = 20 mA
Detector	**Light current**	I_L	0.5 mA min., 14 mA max.	I_F = 20 mA, V_{CE} = 10 V
	Dark current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

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



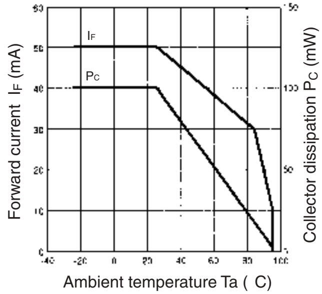
Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Unless otherwise specified, the tolerances are shown below

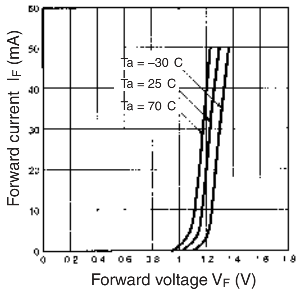
Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

■ Engineering Data

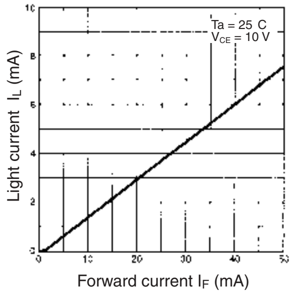
Forward Current vs. Collector Dissipation Temperature Rating



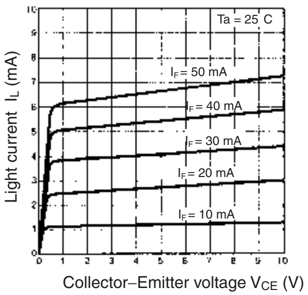
Forward Current vs. Forward Voltage Characteristics (Typical)



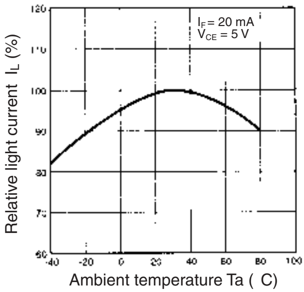
Light Current vs. Forward Current Characteristics (Typical)



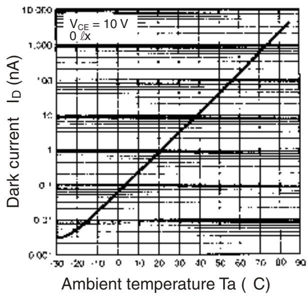
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



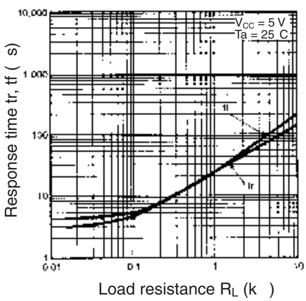
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



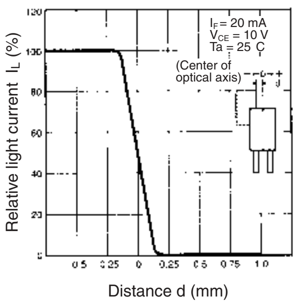
Dark Current vs. Ambient Temperature Characteristics (Typical)



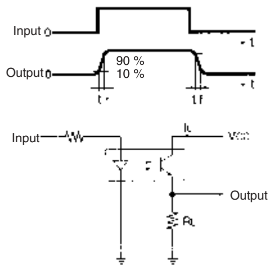
Response Time vs. Load Resistance Characteristics (Typical)



Sensing Position Characteristics (Typical)

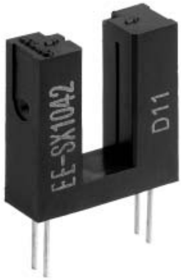


Response Time Measurement Circuit



Features

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



Specifications

■ 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**	Topr	-25°C to 85°C
	Storage	Tstg	-30°C to 100°C
Soldering temperature		Tsol	260°C (see note 3)

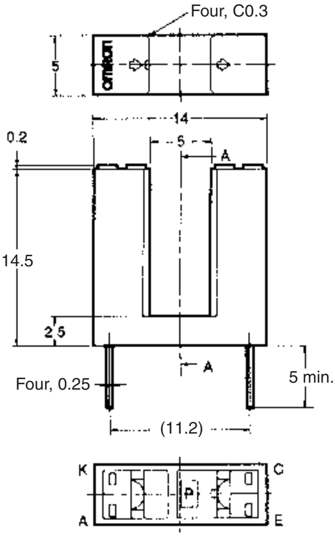
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
3. Complete soldering within 10 seconds.

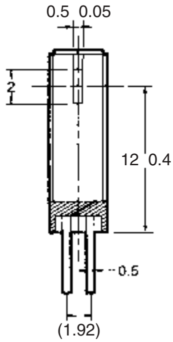
■ Electrical and Optical Characteristics (Ta = 25°C)

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 ℓx
	Leakage current	I_{LEAK}	–	–
	Collector-Emitter saturated voltage	V_{CE} (sat)	0.1 V typ., 0.4 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 = 100Ω, I_L = 5 mA
Falling time		tf	4 μs typ.	V_{CC} = 5 V. R_L = 100Ω, I_L = 5 mA

■ Dimensions

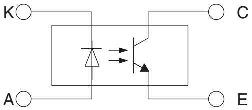
Note: All units are in millimeters unless otherwise indicated.





Cross section AA

Internal Circuit



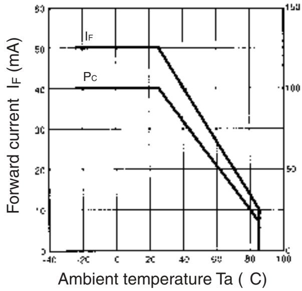
Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Unless otherwise specified, the tolerances are shown below

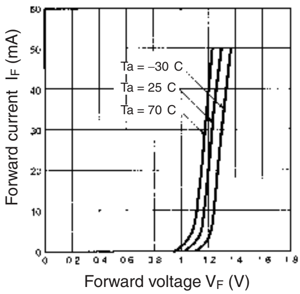
Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

■ Engineering Data

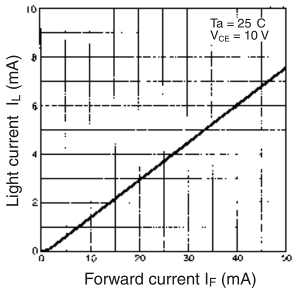
Forward Current vs. Collector Dissipation Temperature Rating



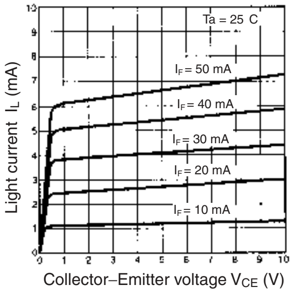
Forward Current vs. Forward Voltage Characteristics (Typical)



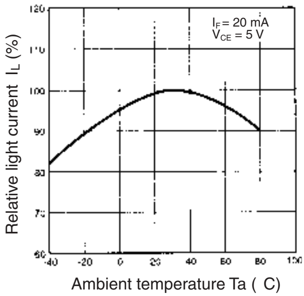
Light Current vs. Forward Current Characteristics (Typical)



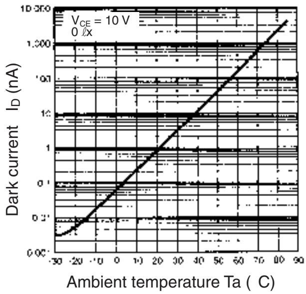
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



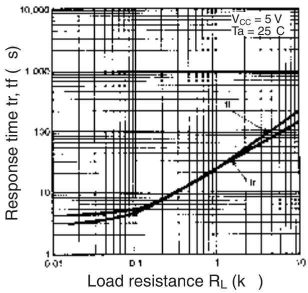
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



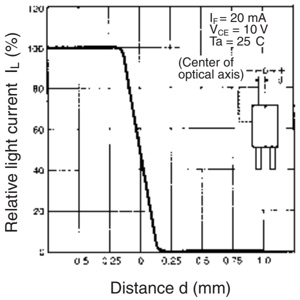
Dark Current vs. Ambient Temperature Characteristics (Typical)



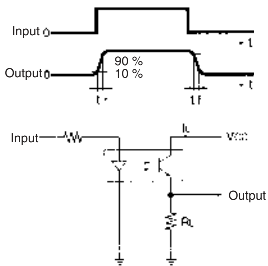
Response Time vs. Load Resistance Characteristics (Typical)



Sensing Position Characteristics (Typical)



Response Time Measurement Circuit



Features

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

Specifications

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**	Topr	-25°C to 85°C
	Storage	Tstg	-30°C to 100°C
Soldering temperature		Tsol	260°C (see note 3)

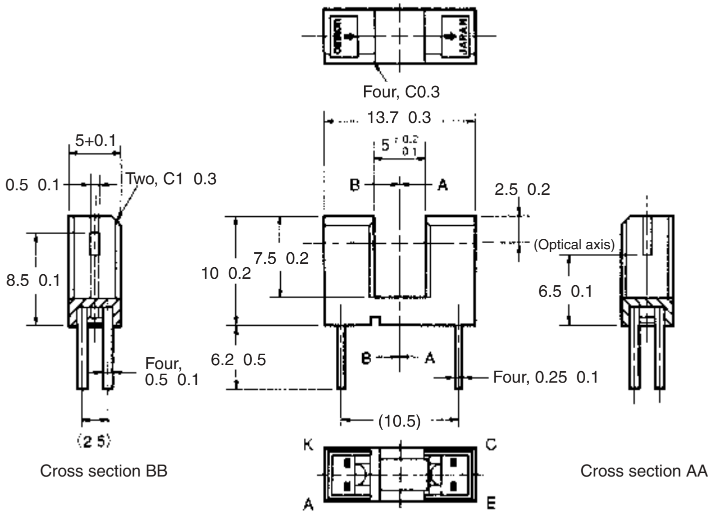
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. The pulse width is 10 μs maximum with a frequency of 100Hz.
3. Complete soldering within 10 seconds.

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 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 = 0.1 mA
	Peak spectral sensitivity	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

■ Dimensions

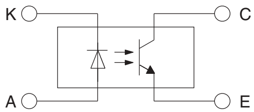
Note: All units are in millimeters unless otherwise indicated.



Cross section BB

Cross section AA

Internal Circuit



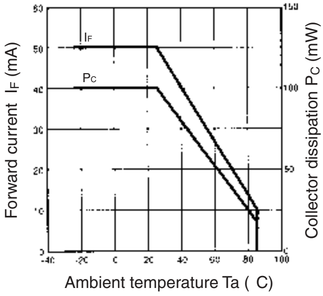
Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Unless otherwise specified, the tolerances are as shown below.

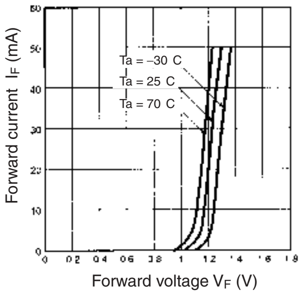
Terminal No.	Name
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

■ Engineering Data

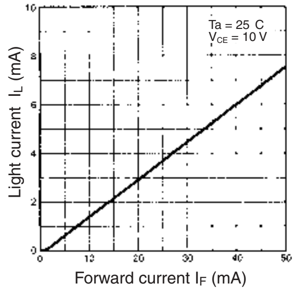
Forward Current vs. Collector Dissipation Temperature Rating



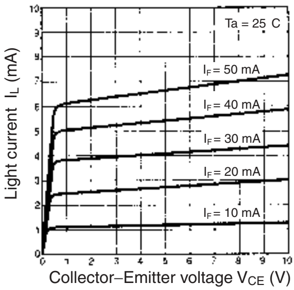
Forward Current vs. Forward Voltage Characteristics (Typical)



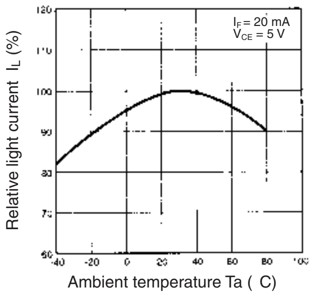
Light Current vs. Forward Current Characteristics (Typical)



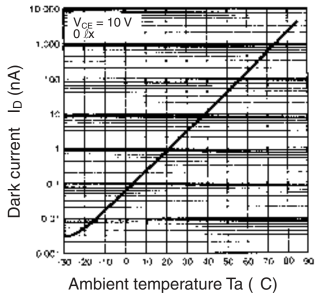
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



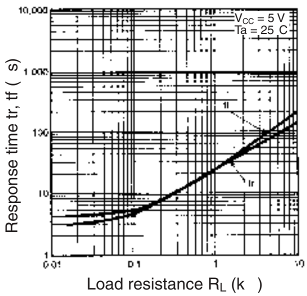
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



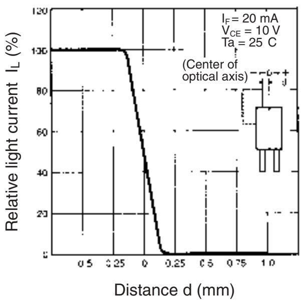
Dark Current vs. Ambient Temperature Characteristics (Typical)



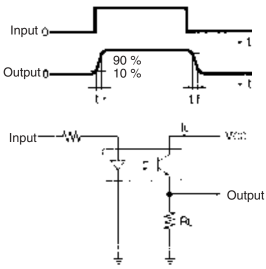
Response Time vs. Load Resistance Characteristics (Typical)



Sensing Position Characteristics (Typical)



Response Time Measurement Circuit



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.

Specifications

Absolute Maximum Ratings (Ta = 25°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**	Topr	-25°C to 95°C
	Storage	Tstg	-40°C to 100°C
Soldering temperature		Tsol	–

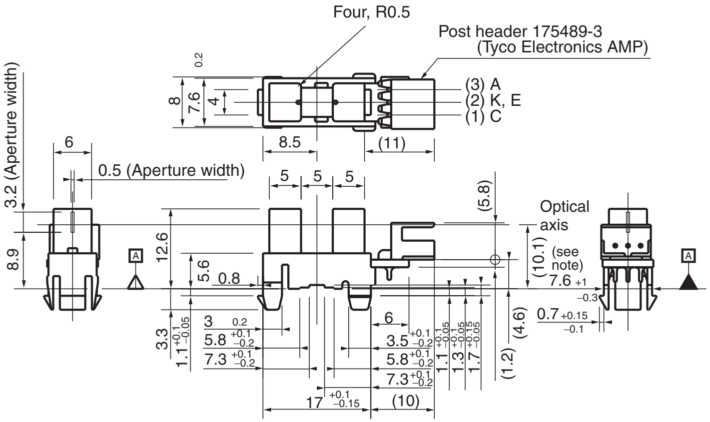
Note: Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

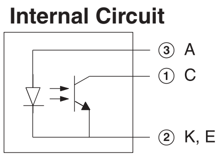
Electrical and Optical Characteristics (Ta = 25°C)

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 = 30 mA
Detector	**Light current**	I_L	0.6 mA min., 14 mA max.	I_F = 20 mA, V_{CE} = 5 V
	Dark current	I_D	200 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 max.	I_F = 20 mA, I_L = 0.3 mA
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.	V_{CE} = 5 V
Rising time		tr	8 μs typ.	V_{CC} = 5 V. R_L = 100Ω, I_L = 1 mA
Falling time		tf	8 μs typ.	V_{CC} = 5 V. R_L = 100Ω, I_L = 1 mA

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.





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

Unless otherwise specified, the tolerances are shown below

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

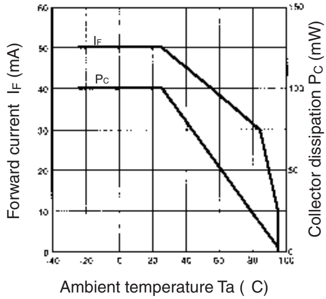
Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

Recommended Mating Connectors:

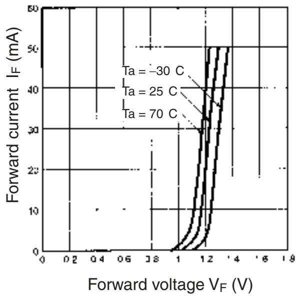
Tyco Electronics AMP 173977-3 (insulation displacement-type connector)
175778-3 (crimp-type connector)
179228-3 (crimp-type connector)

■ Engineering Data

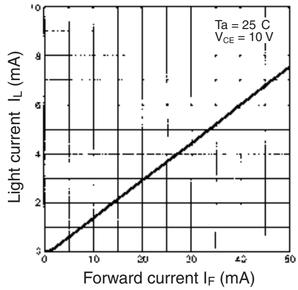
Forward Current vs. Collector Dissipation Temperature Rating



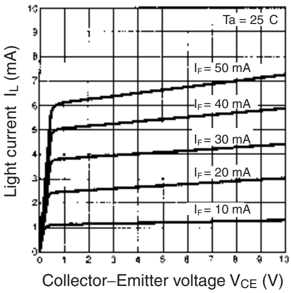
Forward Current vs. Forward Voltage Characteristics (Typical)



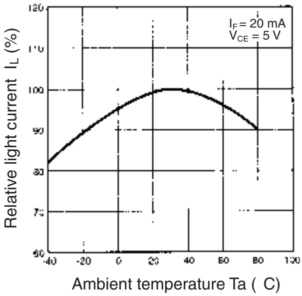
Light Current vs. Forward Current Characteristics (Typical)



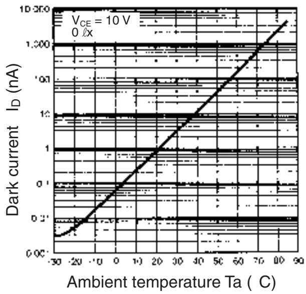
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



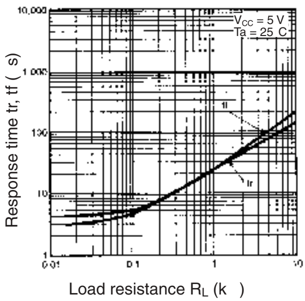
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



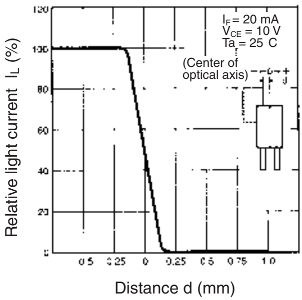
Dark Current vs. Ambient Temperature Characteristics (Typical)



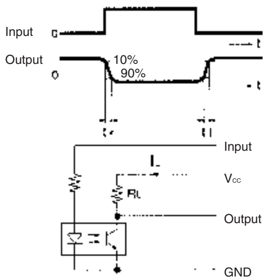
Response Time vs. Load Resistance Characteristics (Typical)



Sensing Position Characteristics (Typical)

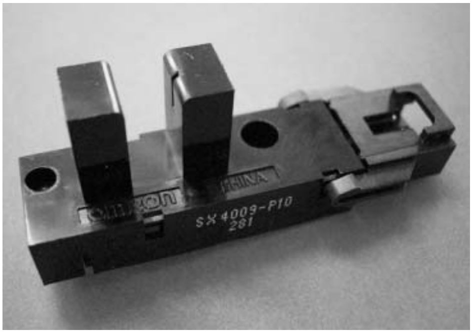


Response Time Measurement Circuit



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.



Specifications

Absolute Maximum Ratings (Ta = 25°C)

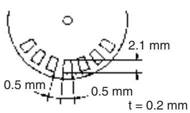
Item		Symbol	Rated value
Power supply voltage		V_{CC}	10 V
Output voltage		V_{OUT}	28 V
Output current		I_{OUT}	16 mA
Permissible output dissipation		P_{OUT}	250 mW (see note)
Ambient temperature	**Operating**	Topr	-25°C to 75°C
	Storage	Tstg	-40°C to 85°C
Soldering temperature		Tsol	–

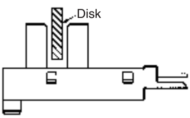
Note: Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

Electrical and Optical Characteristics (Ta = 25°C, Vcc = 5 V ± 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 mA Without incident (EE-SX3009-P1) With incident (EE-SX4009-P1)
High-level output voltage	V_{OH}	(V_{CC} x 0.9) V min.	$V_{OUT} = V_{CC}$ With incident (EE-SX3009-P1) Without incident (EE-SX4009-P1), R_L = 47 kΩ
Response frequency	f	3 kHz min.	$V_{OUT} = V_{CC}$, R_L = 47 kΩ (see note)

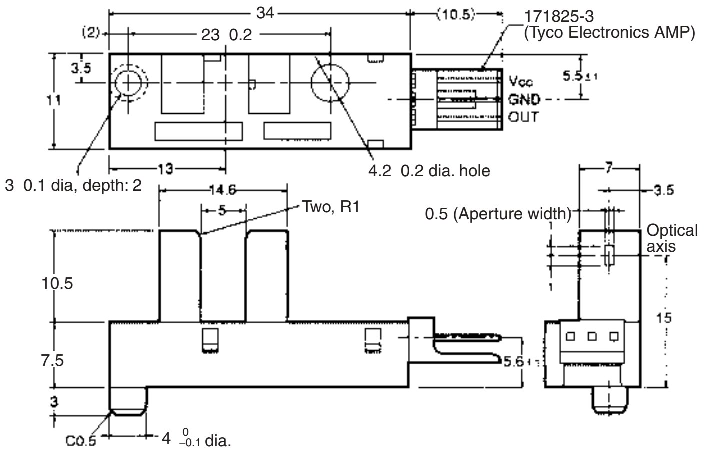
Note: The value of the response frequency is measured by rotating the disk as shown below.



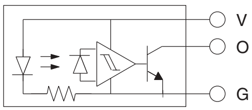


■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are shown below

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

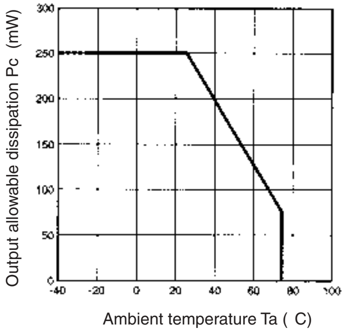
Dimensions	Tolerance
4 mm max.	±0.2
1 < mm ≤ 16	±0.3
16 < mm ≤ 63	±0.5

Recommended Mating Connectors:

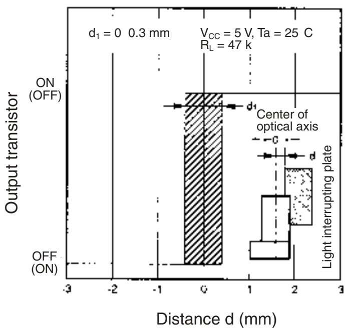
Tyco Electronics AMP 171822-3 (crimp-type connector)
172142-3 (crimp-type connector)
OMRON EE-1005 (with harness)

■ Engineering Data

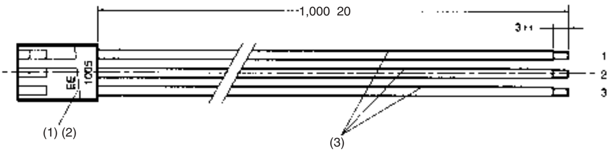
Output Allowable Dissipation vs. Ambient Temperature Characteristics



Sensing Position Characteristics (Typical)



EE-1005 Connector



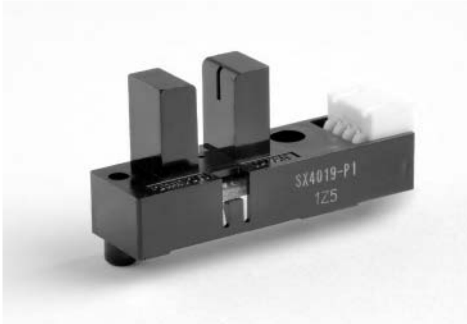
Number	Name	Model	Quantity	Maker
1	Receptacle housing	171822-3	1	Tyco Electronics AMP
2	Receptacle contact	170262-1	3	Tyco Electronics AMP
3	Lead wire	UL1007 AWG24	3	–

■ Wiring

Connector circuit no.	Lead wire colour	Output when connected to EE-SX4009-P1
1	Red	V_{CC}
2	Orange	GND
3	Yellow	OUT

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 CT-series connectors.



Specifications

■ Absolute Maximum Ratings (Ta = 25°C)

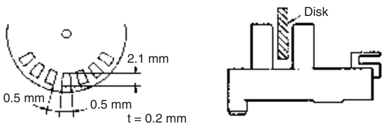
Item		Symbol	Rated value
Power supply voltage		V_{CC}	7 V
Output voltage		V_{OUT}	28 V
Output current		I_{OUT}	16 mA
Permissible output dissipation		P_{OUT}	250 mW (see note)
Ambient temperature	**Operating**	Topr	-20°C to 75°C
	Storage	Tstg	-40°C to 85°C
Soldering temperature		Tsol	–

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

■ Electrical and Optical Characteristics (Ta = 25°C, Vcc = 5 V ± 10%)

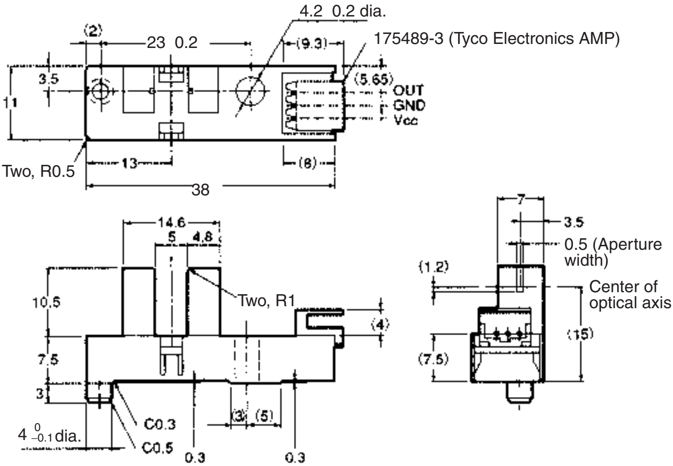
Item	Symbol	Value	Condition
Current consumption	I_{CC}	20 mA max.	With and without incident
Low-level output voltage	V_{OL}	0.3 V max.	I_{OUT} = 16 mA Without incident (EE-SX3019-P2) With incident (EE-SX4019-P2)
High-level output voltage	V_{OH}	(V_{CC} x 0.9) V min.	V_{OUT} = V_{CC} without incident, Without incident (EE-SX3019-P2) With incident (EE-SX4019-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.

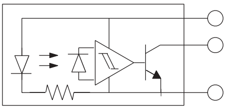


Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are shown below

Terminal No.	Name
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

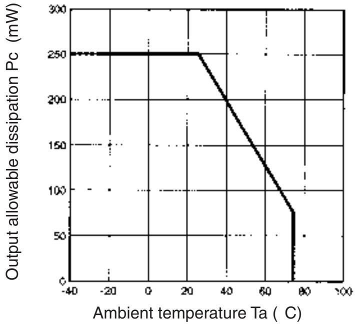
Recommended Mating Connectors:

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

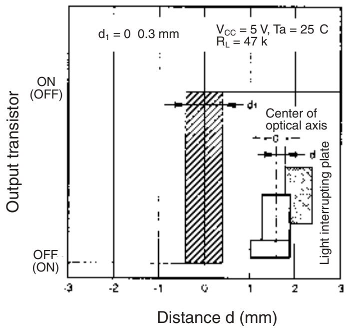
■ Engineering Data

Note: the values in the parenthesis apply to the EE-SX4019-P2.

Output Allowable Dissipation vs. Ambient Temperature Characteristics

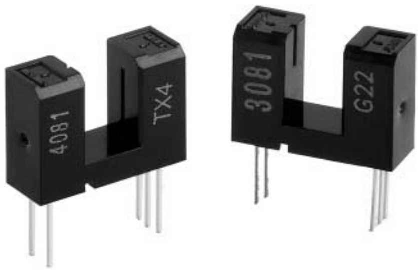


Sensing Position Characteristics (Typical)



Features

- Incorporates an IC chip with a built-in detector element and amplifier.
- Incorporates a detector element with 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.



Specifications

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**	Topr	-40°C to 75°C
	Storage	Tstg	-40°C to 85°C
Soldering temperature		Tsol	260°C (see note 2)

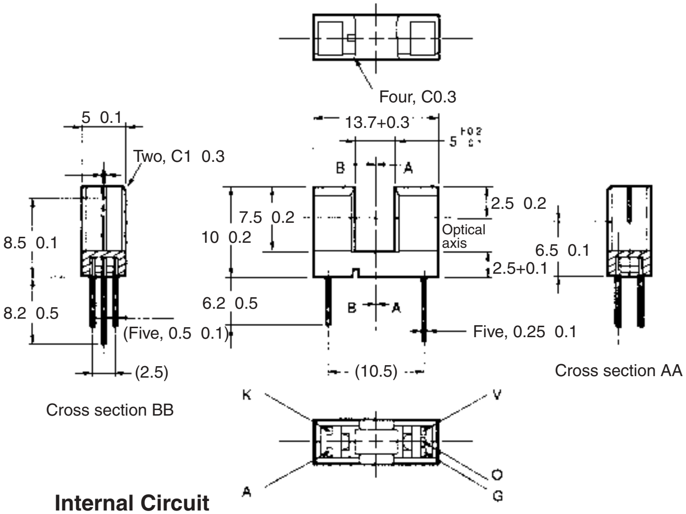
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. Complete soldering within 10 seconds.

Electrical and Optical Characteristics (Ta = 25°C)

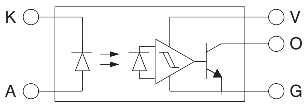
Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.2 V typ., 1.5 V max.	I_F = 20 mA
	Reverse current	I_R	0.01 μA typ., 10 μA max.	V_R = 4 V
	Peak emission wavelength	λ_P	940 nm typ.	I_F = 20 mA
Detector	**Low-level output voltage**	I_L	0.12 V typ., 0.4 V max.	V_{CC} = 4.5 to 16 V, I_{OL} = 16 mA, I_F = 0 mA (EE-SX3081), I_F = 8 mA (EE-SX4081)
	High-level output voltage	I_D	15 V min.	V_{CC} = 16 V, R_L = 1 kΩ, I_F = 8 mA (EE-SX3081), I_F = 0 mA (EE-SX4081)
	Current consumption	I_{CC}	3.2 mA., 10 mA max.	V_{CC} = 4.5 to 16 V
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.	V_{CE} = 5 V
LED current when output is OFF		I_{FT}	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 = 20 mA, I_{OL} = 16 mA (see note 2)
Response delay time		t_{PHL} (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_{PHL})	20 μs typ.	V_{CC} = 4.5 to 16 V, I_F = 20 mA, I_{OL} = 16 mA (see note 3)

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



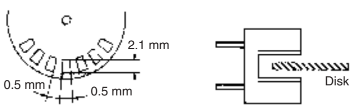
Unless otherwise specified, the tolerances are as shown below

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

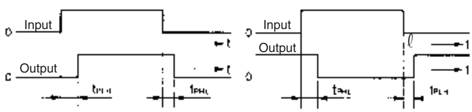
Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

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 in turned from ON to OFF and when the photo IC in 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 EESX4081.

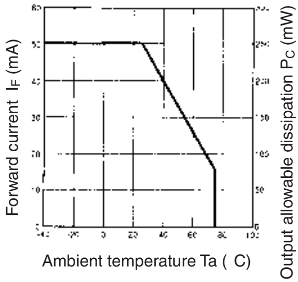


EE-SX3081 EE-SX4081

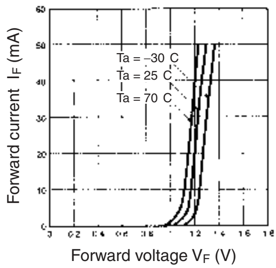
■ Engineering Data

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

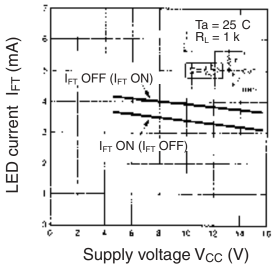
Forward Current vs. Collector Dissipation Temperature Rating



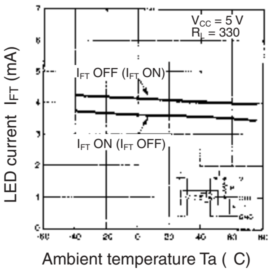
Forward Current vs. Forward Voltage Characteristics (Typical)



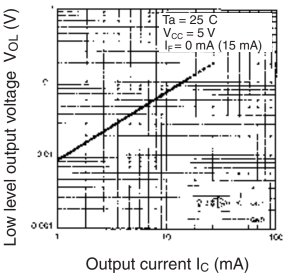
LED Current vs. Supply Voltage (Typical)



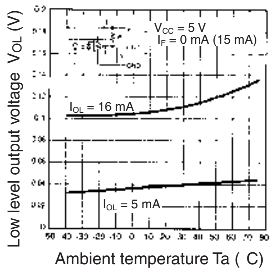
LED Current vs. Ambient Temperature Characteristics (Typical)



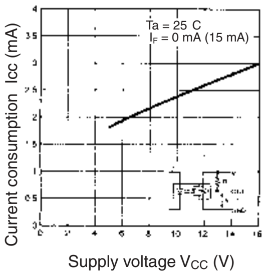
Low-level Output Voltage vs. Output Current (Typical)



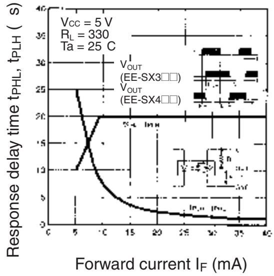
Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



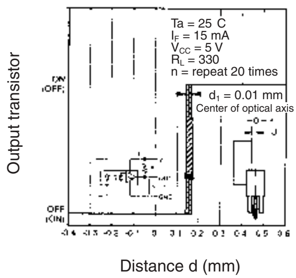
Current Consumption vs. Supply Voltage (Typical)



Response Delay Time vs. Forward Current (Typical)

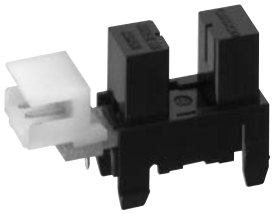


Repeat Sensing Position Characteristics (Typical)



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.



Specifications

■ Absolute Maximum Ratings (Ta = 25°C)

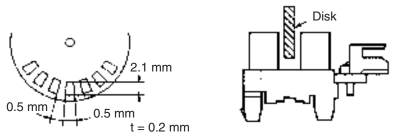
Item		Symbol	Rated value
Power supply voltage		V_{CC}	7 V
Output voltage		V_{OUT}	28 V
Output current		I_{OUT}	16 mA
Permissible output dissipation		P_{OUT}	250 mW (see note)
Ambient temperature	**Operating**	Topr	-25°C to 75°C
	Storage	Tstg	-40°C to 85°C
Soldering temperature		Tsol	–

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

■ Electrical and Optical Characteristics (Ta = 25°C, Vcc = 5 V ± 10%)

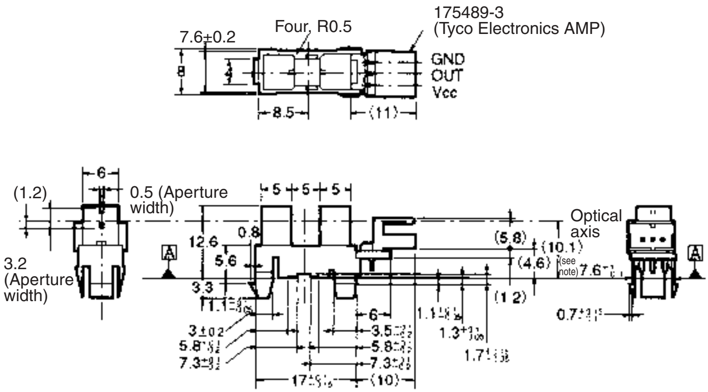
Item	Symbol	Value	Condition
Current consumption	I_{CC}	16.5 mA max.	With and without incident
Low-level output voltage	V_{OL}	0.35 V max.	I_{OUT} = 16 mA with incident
High-level output voltage	V_{OH}	(V_{CC} x 0.9) V min.	$V_{OUT} = V_{CC}$ without incident, R_L = 47 kΩ
Response frequency	f	3 kHz min.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

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

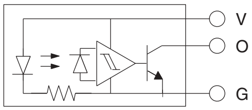


■ Dimensions

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 shown below

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

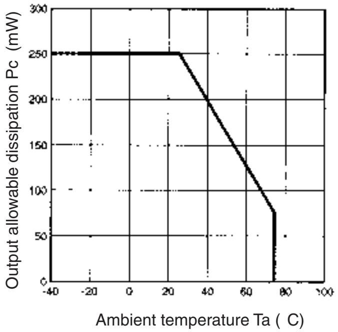
Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

Recommended Mating Connectors:

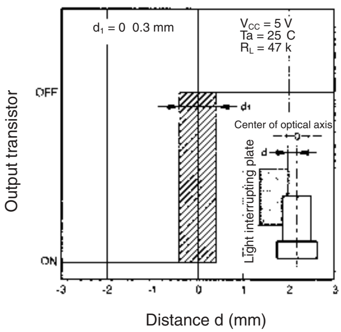
Tyco Electronics AMP 179228-3 (crimp-type connector)
175778-3 (crimp-type connector)
173977-3 (press-fit connector)

■ Engineering Data

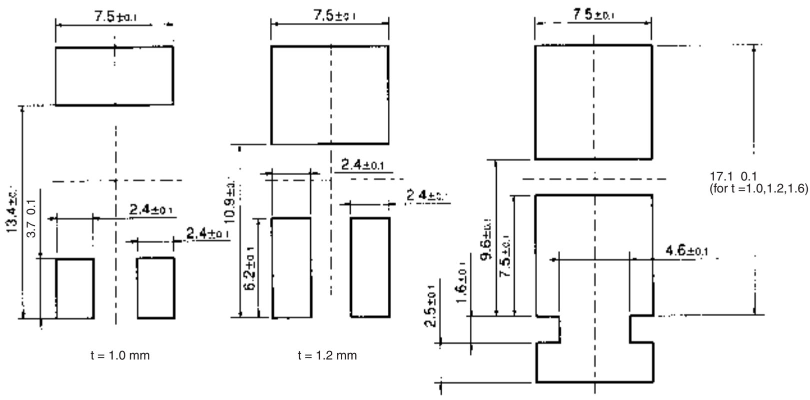
Output Allowable Dissipation vs. Ambient Temperature Characteristics



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.

Features

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

Specifications

■ 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**	Topr	-25°C to 95°C
	Storage	Tstg	-30°C to 100°C
Soldering temperature		Tsol	260°C (see note 3)

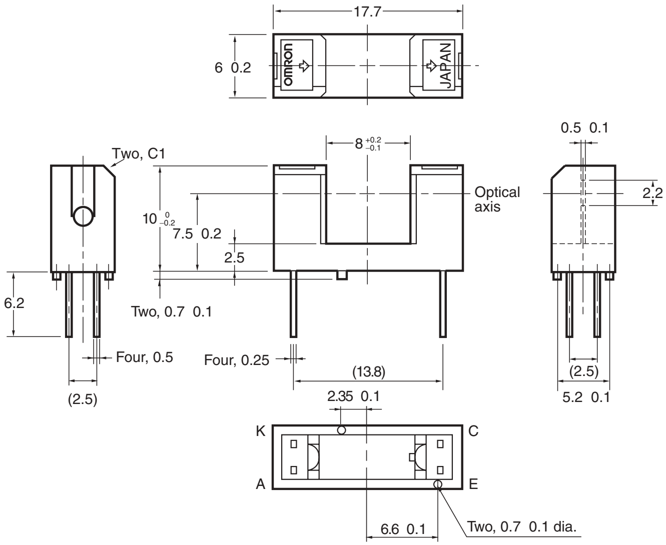
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
3. Complete soldering within 10 seconds.

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

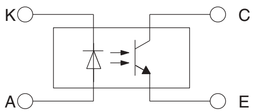
Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.2 V typ., 1.5 V max.	I_F = 30 mA
	Reverse current	I_R	0.01 μA typ., 10 μA max.	V_R = 4 V
	Peak emission wavelength	λ_P	940 nm typ.	I_F = 20 mA
Detector	**Light current**	I_L	0.5 mA min., 14 mA max.	I_F = 20 mA, V_{CE} = 10 V
	Dark current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

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



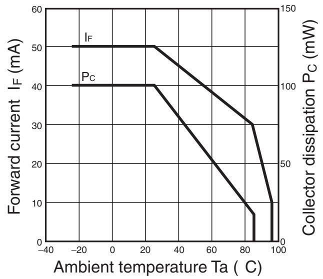
Unless otherwise specified, the tolerances are shown below

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

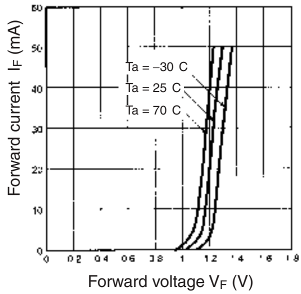
Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

■ Engineering Data

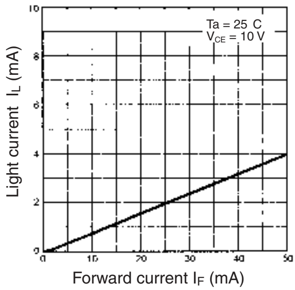
Forward Current vs. Collector Dissipation Temperature Rating



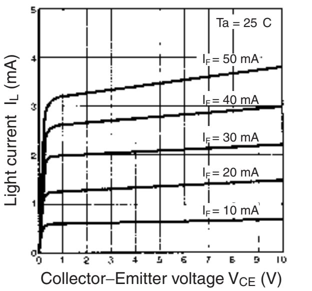
Forward Current vs. Forward Voltage Characteristics (Typical)



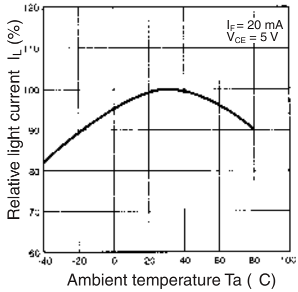
Light Current vs. Forward Current Characteristics (Typical)



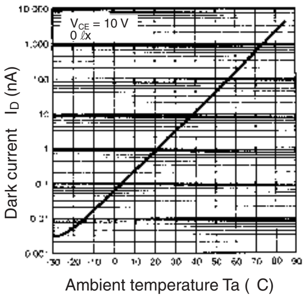
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



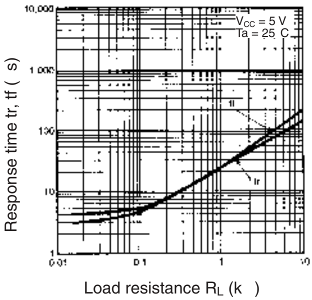
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



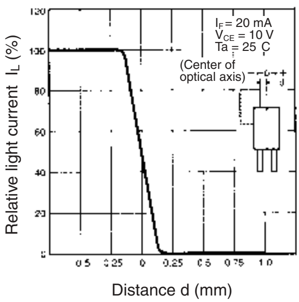
Dark Current vs. Ambient Temperature Characteristics (Typical)



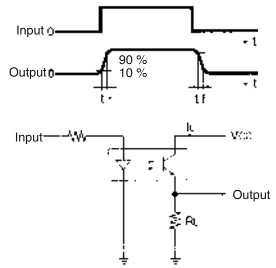
Response Time vs. Load Resistance Characteristics (Typical)



Sensing Position Characteristics (Typical)

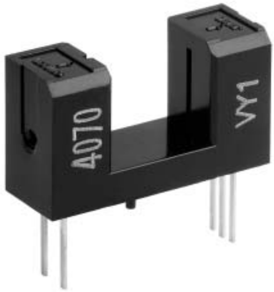


Response Time Measurement Circuit



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)



Specifications

■ 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**	Topr	-40°C to 75°C
	Storage	Tstg	-40°C to 85°C
Soldering temperature		Tsol	260°C (see note 2)

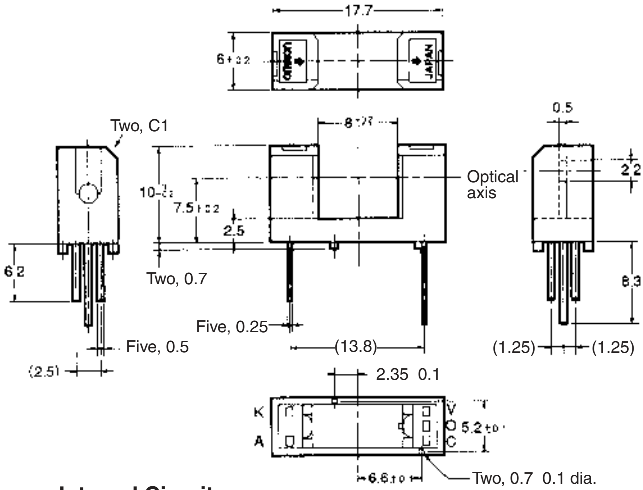
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. Complete soldering within 10 seconds.

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

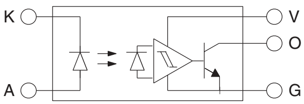
Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.2 V typ., 1.5 V max.	I_F = 20 mA
	Reverse current	I_R	0.01 μA typ., 10 μA max.	V_R = 4 V
	Peak emission wavelength	λ_P	940 nm typ.	I_F = 20 mA
Detector	**Low-level output voltage**	I_L	0.12 V typ., 0.4 V max.	V_{CC} = 4.5 to 16 V, I_{OL} = 16 mA, I_F = 0 mA (EE-SX3070), I_F = 10 mA (EE-SX4070)
	High-level output voltage	I_D	15 V min.	V_{CC} = 16 V, R_L = 1 kΩ, I_F = 10 mA (EE-SX3070), I_F = 0 mA (EE-SX4070)
	Current consumption	I_{CC}	3.2 mA., 10 mA max.	V_{CC} = 4.5 to 16 V
	Peak spectral sensitivity wavelength	λ_P	870 nm typ.	V_{CE} = 5 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_{PHL} (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_{PHL})	20 μs typ.	V_{CC} = 4.5 to 16 V, I_F = 20 mA, I_{OL} = 16 mA (see note 3)

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



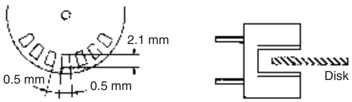
Unless otherwise specified, the tolerances are shown below

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

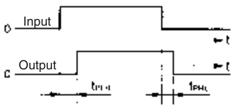
Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

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 in turned from ON to OFF and when the photo IC in turned from OFF to ON.

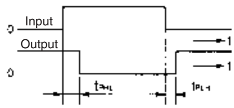
2. The value of the response frequency is measured by rotating the disk as shown below.



3. The following illustrations show the definition of response delay time. The value in the parentheses applies to the EESX4070.



EE-SX3070

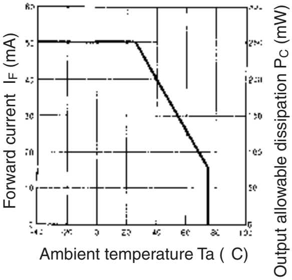


EE-SX4070

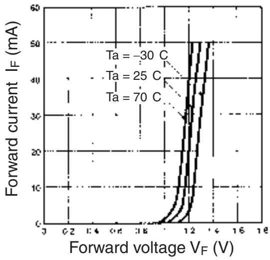
■ Engineering Data

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

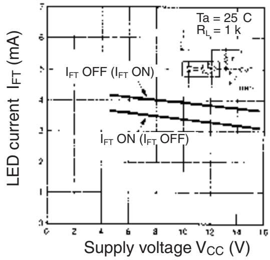
Forward Current vs. Collector Dissipation Temperature Rating



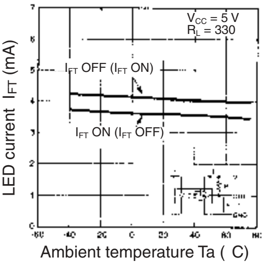
Forward Current vs. Forward Voltage Characteristics (Typical)



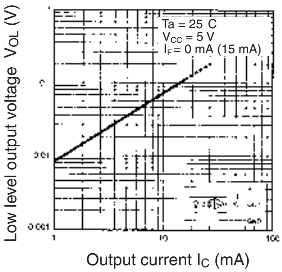
LED Current vs. Supply Voltage (Typical)



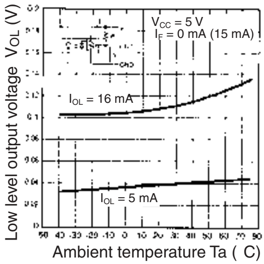
LED Current vs. Ambient Temperature Characteristics (Typical)



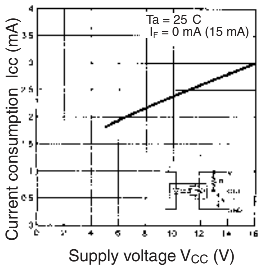
Low-level Output Voltage vs. Output Current (Typical)



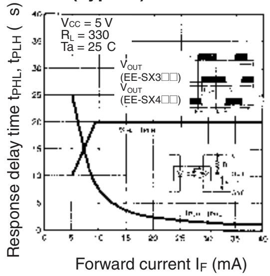
Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



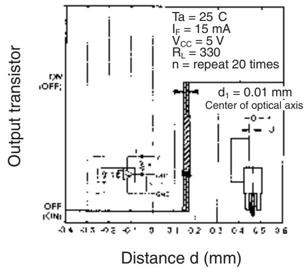
Current Consumption vs. Supply Voltage (Typical)



Response Delay Time vs. Forward Current (Typical)



Repeat Sensing Position Characteristics (Typical)



Features

- Separate LED/Photo IC combinations with 12-mm slot.
- Uses light modulation via built-in amplifier IC.
- Applicable to the PA connector series from JST (Japan Solderless Terminal).

Specifications

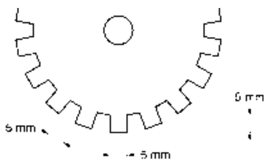
Absolute Maximum Ratings (Ta = 25°C)

Item	Symbol	Rated value
Supply voltage	V_{CC}	16 VDC
Output voltage	V_{OUT}	16 V
Output current	I_{OUT}	50 mA
Operating temperature	T_{OPR}	-10°C to 60°C
Storage temperature	T_{SBG}	-40°C to 80°C

Electrical and Optical Characteristics (Ta = 25°C, Vcc = 12 V±10%)

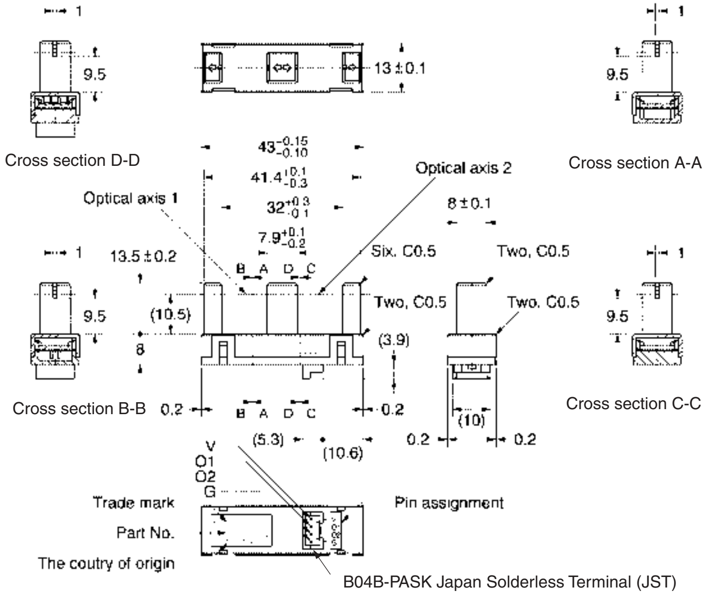
Item	Symbol	Value			Unit	Testing Conditions
		Min.	Typ.	Max.		
Current consumption	I_{CC}	–	–	35	mA	With/without object
Low level output voltage	V_{OL}	0.01	0.2	0.4	V	I_{OUT} = 20 mA without object
High level output current	I_{OH}	0	–	40	mA	V_{OUT} = 12 V with object
Ambient illumination	–	0	–	3,000	ℓx	Sunlight and fluorescent light
Response frequency	f	500	–	–	Hz	$V_{CC}0 = V_{CC}1 = V_{CC}2$ = 12 VDC RL = 1.2 kΩ (See note.)

Note: The value indicated is that measured by rotating the disk as shown below.

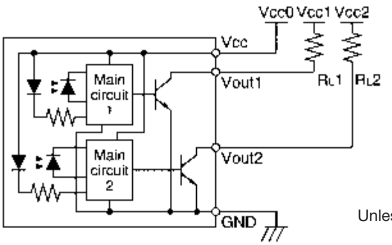


■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are shown below

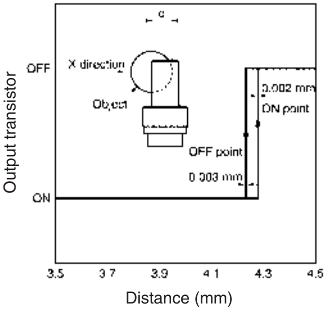
Terminal No.	Name
V	Power supply (Vcc)
O1	V_{OUT}1 (Optical axis1)
O2	V_{OUT}2 (Optical axis2)
G	Ground (GND)

Recommended Mating Connectors:
JST (Japan Solderless Terminal) PAP-04V-S

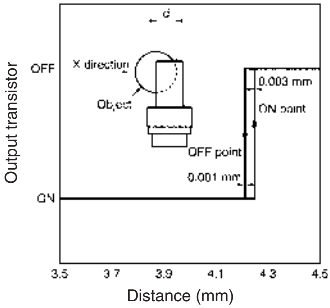
Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65
30 < mm ≤ 50	±0.8

■ Engineering Data

Repetitive Sensing Position Characteristics for OUT1 (in horizontal direction, typical)



Repetitive Sensing Position Characteristics for OUT2 (in horizontal direction, typical)



Features

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

Specifications

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**	Topr	-25°C to 85°C
	Storage	Tstg	-30°C to 100°C
Soldering temperature		Tsol	260°C (see note 3)

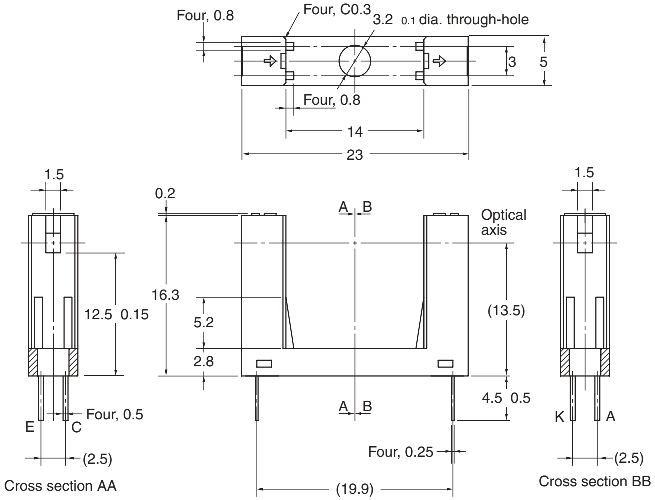
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
3. Complete soldering within 10 seconds.

Electrical and Optical Characteristics (Ta = 25°C)

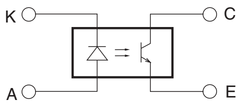
Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.2 V typ., 1.5 V max.	I_F = 30 mA
	Reverse current	I_R	0.01 μA typ., 10 μA max.	V_R = 4 V
	Peak emission wavelength	λ_P	940 nm typ.	I_F = 20 mA
Detector	**Light current**	I_L	0.4 mA min.	I_F = 20 mA, V_{CE} = 10 V
	Dark current	I_D	2 nA typ., 200 nA max.	V_{CE} = 10 V, 0 ℓx
	Leakage current	I_{LEAK}	–	–
	Collector-Emitter saturated voltage	V_{CE} (sat)	0.1 V typ., 0.4 V max.	I_F = 20 mA, I_L = 0.1mA
	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

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



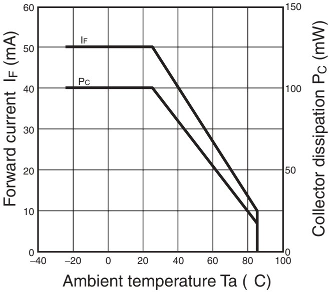
Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Unless otherwise specified, the tolerances are as shown below.

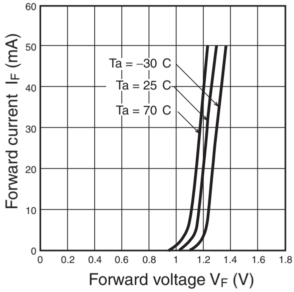
Terminal No.	Name
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

■ Engineering Data

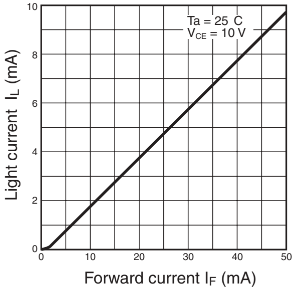
Forward Current vs. Collector Dissipation Temperature Rating



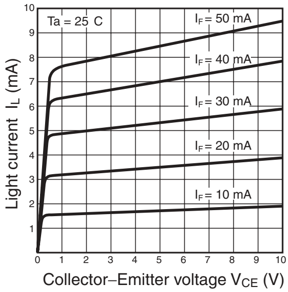
Forward Current vs. Forward Voltage Characteristics (Typical)



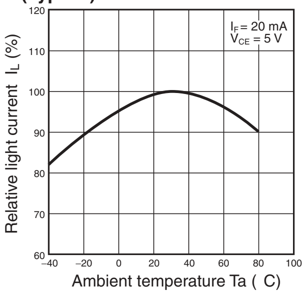
Light Current vs. Forward Current Characteristics (Typical)



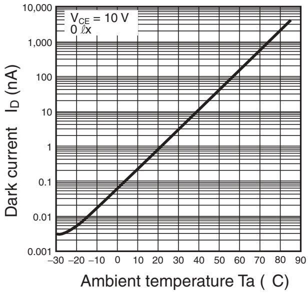
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



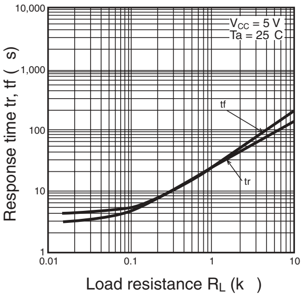
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



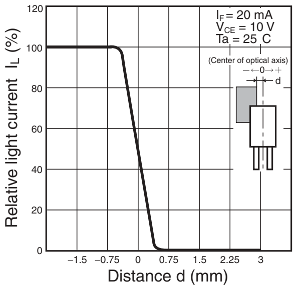
Dark Current vs. Ambient Temperature Characteristics (Typical)



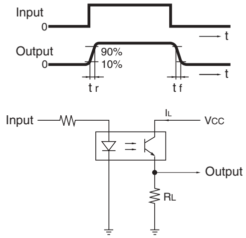
Response Time vs. Load Resistance Characteristics (Typical)



Sensing Position Characteristics (Typical)



Response Time Measurement Circuit



Photomicrosensors

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

Specifications

Absolute Maximum Ratings (Ta = 25°C)

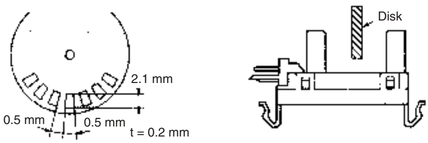
Item		Symbol	Rated value
Power supply voltage		V_{CC}	7 V
Output voltage		V_{OUT}	28 V
Output current		I_{OUT}	16 mA
Permissible output dissipation		P_{OUT}	250 mW (see note)
Ambient temperature	**Operating**	Topr	-25°C to 75°C
	Storage	Tstg	-40°C to 85°C
Soldering temperature		Tsol	–

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

Electrical and Optical Characteristics (Ta = 25°C, Vcc = 5 V ± 10%)

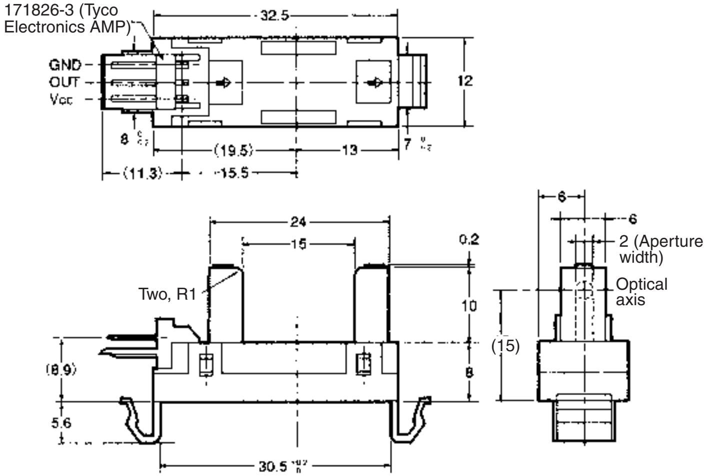
Item	Symbol	Value	Condition
Current consumption	I_{CC}	35 mA max.	With and without incident
Low-level output voltage	V_{OL}	0.3 V max.	I_{OUT} = 16 mA with incident
High-level output voltage	V_{OH}	(V_{CC} x 0.9) V min.	V_{OUT} = V_{CC} without incident, R_L = 47 kΩ
Response frequency	f	3 kHz min.	V_{OUT}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

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

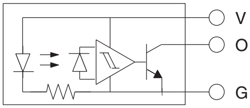


■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are shown below

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

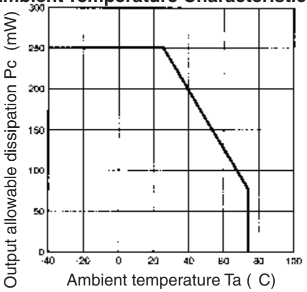
Recommended Mating Connectors:

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

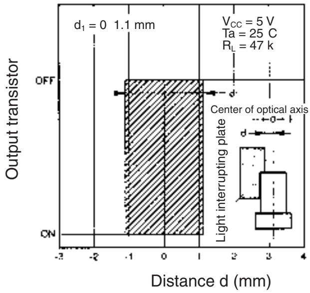
Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

■ Engineering Data

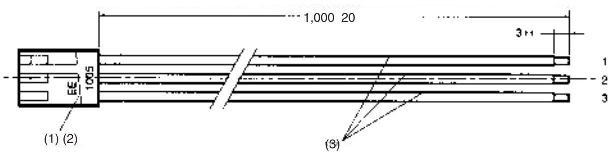
Output Allowable Dissipation vs. Ambient Temperature Characteristics



Sensing Position Characteristics (Typical)



EE-1005 Connector

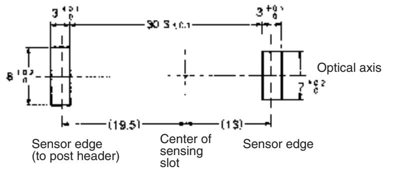


Number	Name	Model	Quantity	Maker
1	Receptacle housing	171822-3	1	Tyco Electronics AMP
2	Receptacle contact	170262-1	3	Tyco Electronics AMP
3	Lead wire	UL1007 AWG24	3	–

■ Wiring

Connector circuit no.	Lead wire colour	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



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

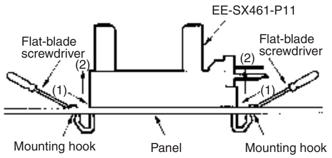
Refer to the above mounting hole dimensions and open the mounting holes in the panel to which the Photomicrosensor will be mounted.

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.

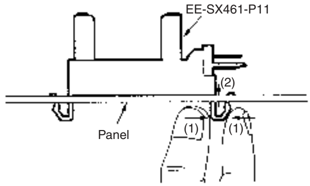
Dismounting with Screwdriver

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



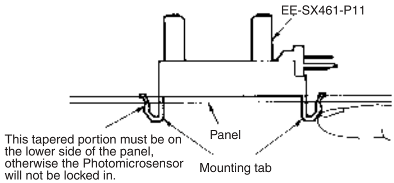
Dismounting by Hand

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.



Features

- Wide-width transmissive sensor with 17-mm slot.
- Uses light modulation via built-in amplifier IC.
- Applicable to the PH connector series from JST (Japan Solderless Terminal).

Specifications

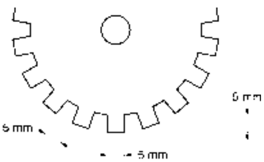
Absolute Maximum Ratings (Ta = 25°C)

Item	Symbol	Rated value
Supply voltage	V_{CC}	16 VDC
Output voltage	V_{OUT}	16 V
Output current	I_{OUT}	50 mA
Operating temperature	Topr	-10°C to 60°C
Storage temperature	Tstg	-40°C to 80°C

Electrical Characteristics (Ta = 25°C, Vcc = 12)

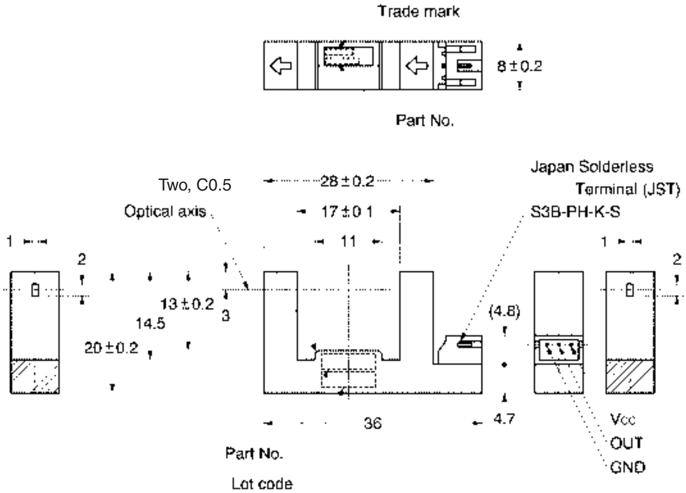
Item	Symbol	Limits			Unit	Testing Conditions
		MIN.	TYP.	MAX.		
Current consumption	I_{CC}	–	–	20	mA	With/without object
Low level output voltage	V_{OL}	0.01	0.2	0.4	V	I_{OUT} = 20 mA without object
High level output current	I_{OH}	0	–	40	mA	V_{OUT} = 12 V with object
Response frequency	f	500	–	–	Hz	$V_{CC}0 = V_{CC}$ = 12 VDC RL = 1.2 kΩ (See note.)

Note: The value indicated is that measured by rotating the disk as shown below.

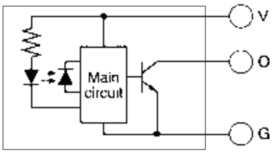


■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Unless otherwise specified, the tolerances are shown below

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

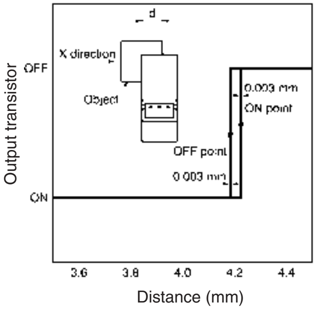
Dimensions	Tolerance
4 mm max.	±0.2
34 < mm ≤ 16	±0.3
16 < mm ≤ 63	±0.5

Recommended Mating Connectors:

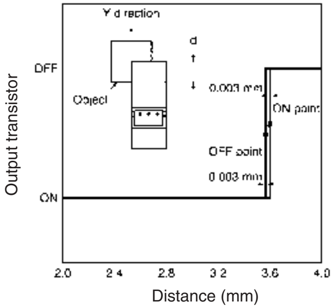
JST (Japan Solderless Terminal) PHR-3
03CR-6H
03KR-8M
03KR-6S

■ Engineering Data

Repetitive Sensing Position Characteristics (in horizontal direction, typical)



Repetitive Sensing Position Characteristics (in vertical direction, typical)



■ Features

- ■ An actuator can be attached.
- ■ PCB mounting type.
- ■ High resolution with a 0.5-mm-wide aperture.

Specifications

■ Absolute Maximum Ratings (Ta = 25°C)

Item		Symbol	Rated value
Emitter	Forward current	I_F	50 mA (see note 1)
	Pulse foward 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	Topr	-25°C to 85°C
	Storage	Tstg	-30°C to 100°C
Soldering temperature		Tsol	260°C (see note 3)

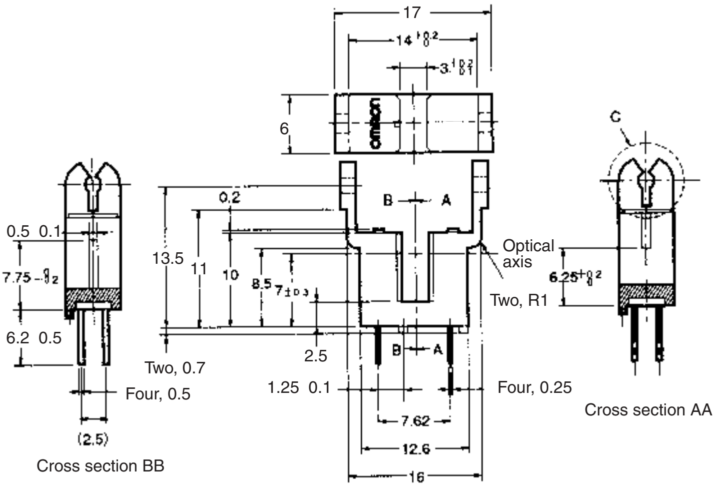
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. The pulse width is 10 μs maximum with frequency of 100 Hz.
3. Complete soldering within 10 seconds.

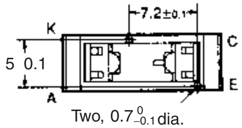
■ Electrical and Optical Characteristics (Ta = 25°C)

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 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 = 0.1 μA
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.	V_{CF} = 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

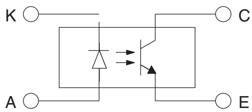
■ Dimensions

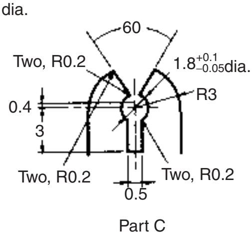
Note: All units are in millimeters unless otherwise indicated.





Internal Circuit



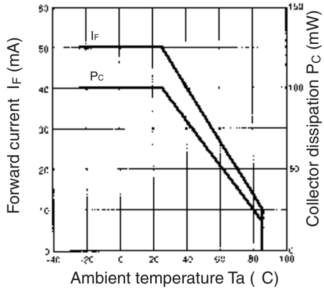


Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

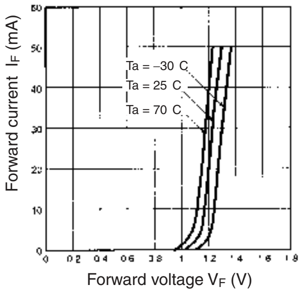
Unless otherwise specified, the tolerances are ±0.2 mm.

■ Engineering Data

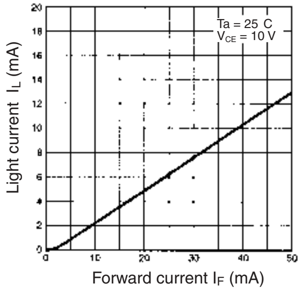
Forward Current vs. Collector Dissipation Temperature Rating



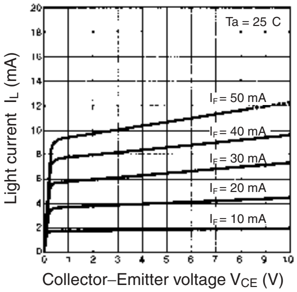
Forward Current vs. Forward Voltage Characteristics (Typical)



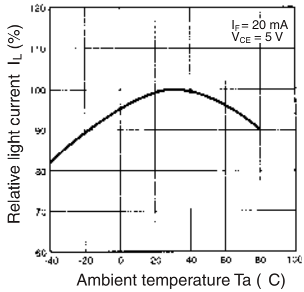
Light Current vs. Forward Current Characteristics (Typical)



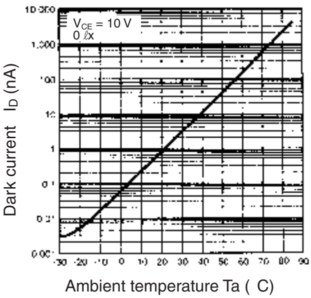
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



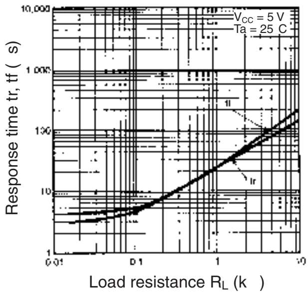
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



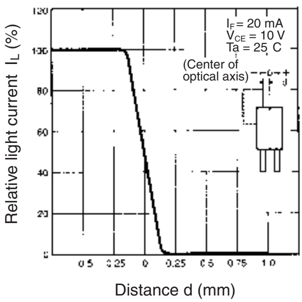
Dark Current vs. Ambient Temperature Characteristics (Typical)



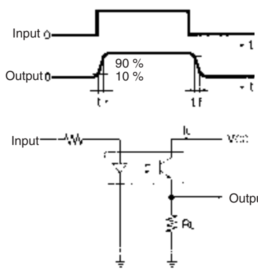
Response Time vs. Load Resistance Characteristics (Typical)



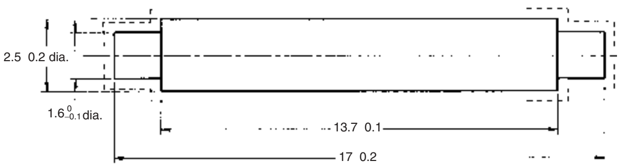
Sensing Position Characteristics (Typical)



Response Time Measurement Circuit



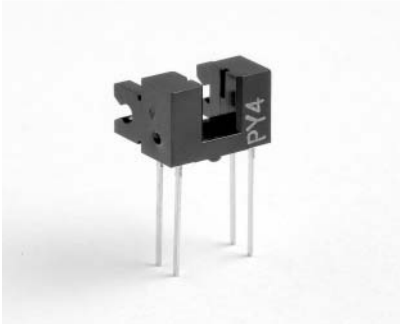
Actuator Dimensions



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.

■ Features

- An actuator can be attached.
- PCB mounting type.
- High resolution with a 0.5-mm-wide aperture.



Specifications

■ Absolute Maximum Ratings (Ta = 25°C)

Item		Symbol	Rated value
Emitter	**Forward current**	I_F	50 mA (see note 1)
	Pulse foward 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**	Topr	-25°C to 85°C
	Storage	Tstg	-30°C to 100°C
Soldering temperature		Tsol	260°C (see note 3)

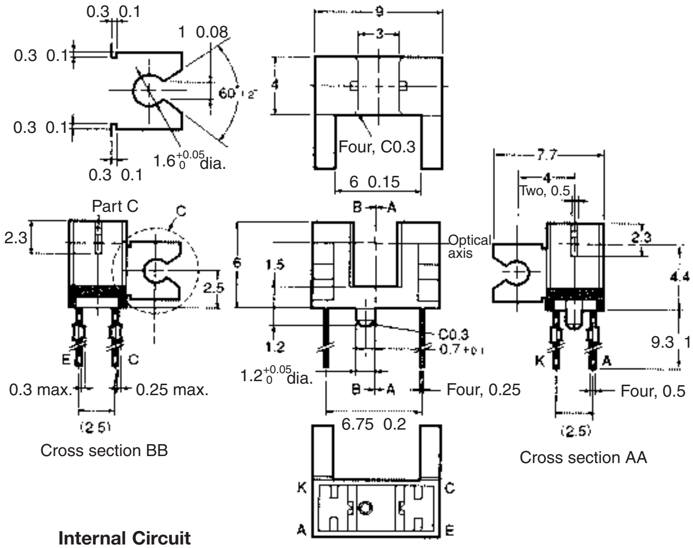
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. The pulse width is 10 μs maximum with frequency of 100 Hz.
3. Complete soldering within 10 seconds.

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

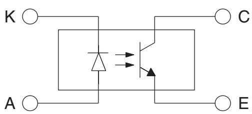
Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.2 V typ., 1.5 V max.	I_F = 30 mA
	Reverse current	I_R	0.01 μA typ., 10 μA max.	V_R = 4 V
	Peak emission wavelength	λ_P	940 m typ.	I_F = 20 mA
Detector	**Light current**	I_L	0.5 μA min., 14 μA max.	I_F = 20 mA, V_{CE} = 10 V
	Dark current	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)	0.1 V typ., 0.4 V max.	I_F = 20 mA, I_L = 0.1 μA
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.	V_{CF} = 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

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



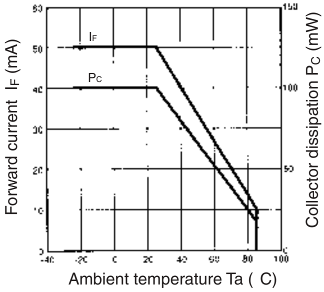
Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Unless otherwise specified, the tolerances are as shown below.

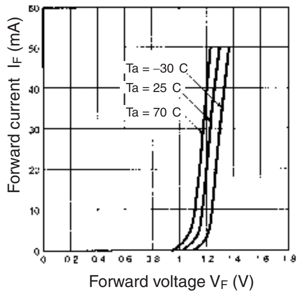
Terminal No.	Name
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

■ Engineering Data

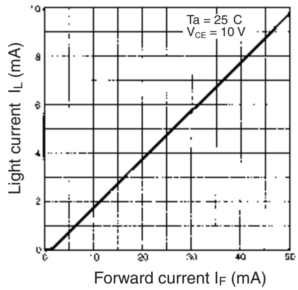
Forward Current vs. Collector Dissipation Temperature Rating



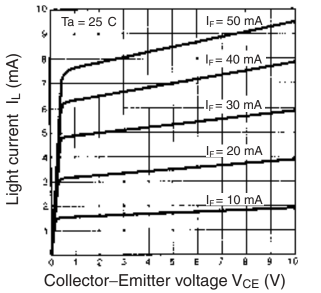
Forward Current vs. Forward Voltage Characteristics (Typical)



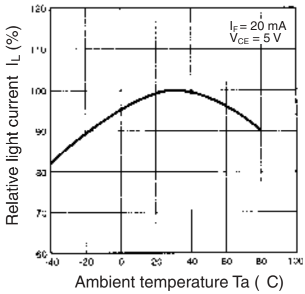
Light Current vs. Forward Current Characteristics (Typical)



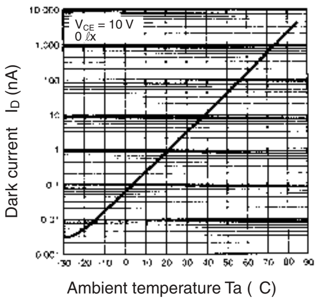
Light Current vs. Collector−Emitter Voltage Characteristics (Typical)



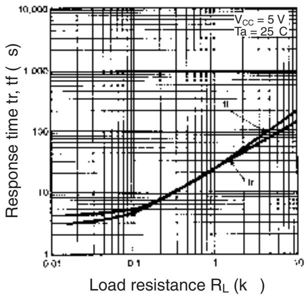
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



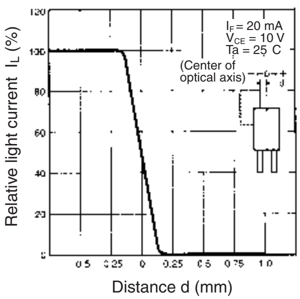
Dark Current vs. Ambient Temperature Characteristics (Typical)



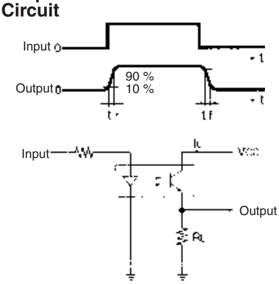
Response Time vs. Load Resistance Characteristics (Typical)



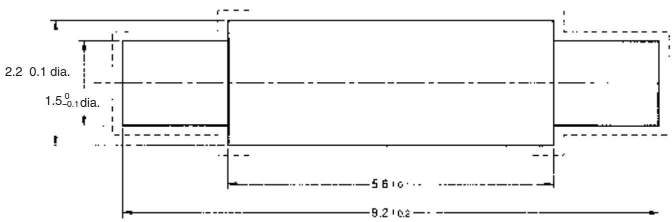
Sensing Position Characteristics (Typical)



Response Time Measurement Circuit



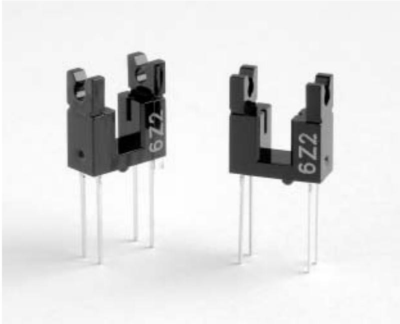
Actuator Dimensions



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.

■ Features

- ■ An actuator can be attached.
- ■ PCB mounting type.
- ■ High resolution with a 0.5-mm-wide aperture.



Specifications

■ Absolute Maximum Ratings (Ta = 25°C)

Item		Symbol	Rated value
Emitter	**Forward current**	I_F	50 mA (see note 1)
	Pulse foward 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**	Topr	-25°C to 85°C
	Storage	Tstg	-30°C to 100°C
Soldering temperature		Tsol	260°C (see note 3)

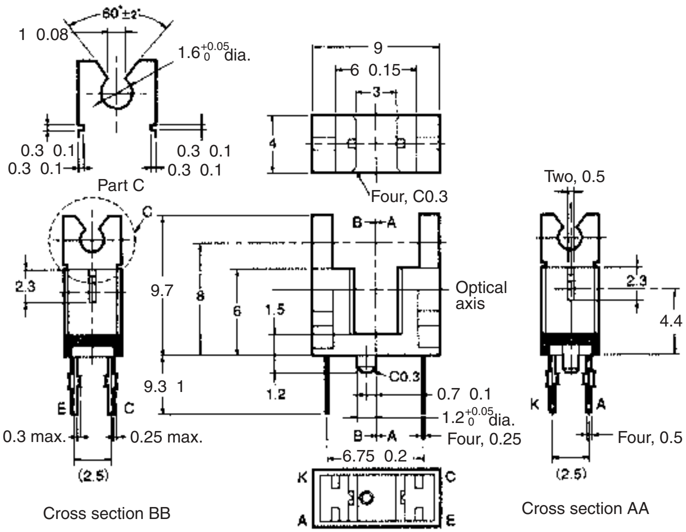
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
2. The pulse width is 10 μs maximum with frequency of 100 Hz.
3. Complete soldering within 10 seconds.

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

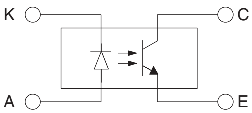
Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.2 V typ., 1.5 V max.	I_F = 30 mA
	Reverse current	I_R	0.01 μA typ., 10 μA max.	V_R = 4 V
	Peak emission wavelength	λ_P	940 m typ.	I_F = 20 mA
Detector	**Light current**	I_L	0.5 mA min., 14 mA max.	I_F = 20 mA, V_{CE} = 10 V
	Dark current	I_D	2 nA typ., 200 nA max.	V_{CE} = 10 V, 0 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 = 0.1 mA
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.	V_{CF} = 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

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



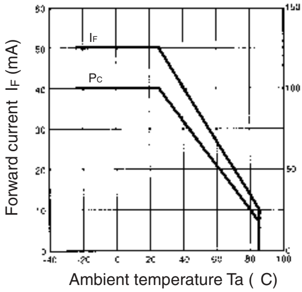
Unless otherwise specified, the tolerances are as shown below.

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

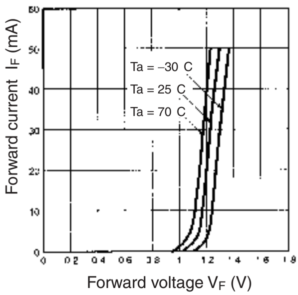
Terminal No.	Name
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

■ Engineering Data

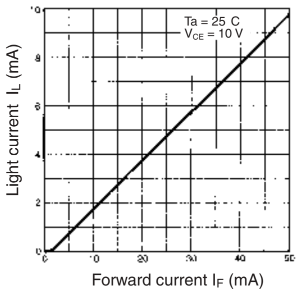
Forward Current vs. Collector Dissipation Temperature Rating



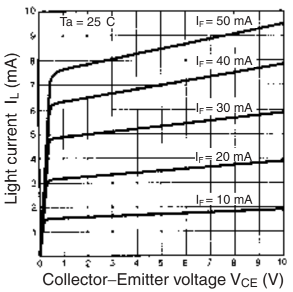
Forward Current vs. Forward Voltage Characteristics (Typical)



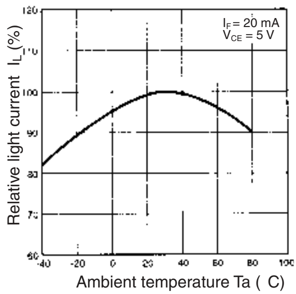
Light Current vs. Forward Current Characteristics (Typical)



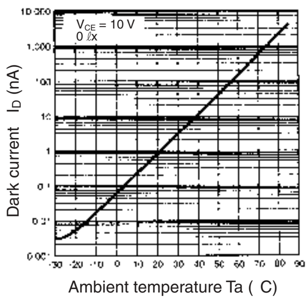
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



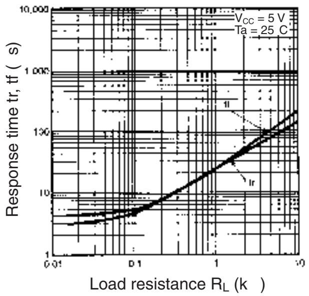
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



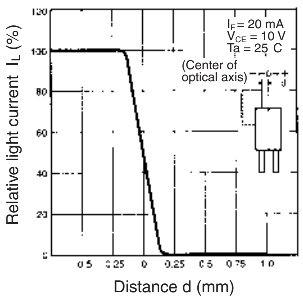
Dark Current vs. Ambient Temperature Characteristics (Typical)



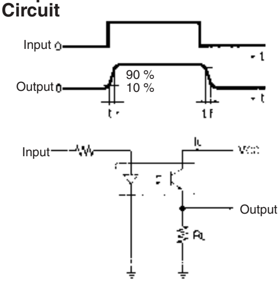
Response Time vs. Load Resistance Characteristics (Typical)



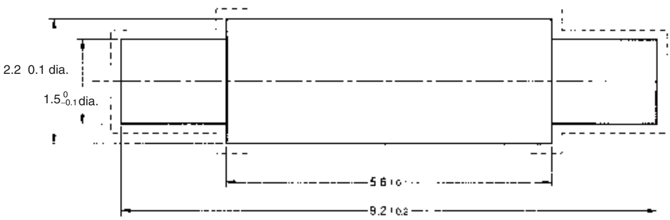
Sensing Position Characteristics (Typical)



Response Time Measurement Circuit



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.

Features

- An actuator can be attached.
- Snap-in mounting model.
- Mountable to 1.0, 1.2 and 1.6 mm thick boards.
- Connects to Tyco Electronics AMP's CT series connectors.

Specifications

■ Absolute Maximum Ratings (Ta = 25°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_{ECO}	30 V
	Emitter-Collector voltage	V_{CEO}	5 V
	Collector current	I_C	20 mA
	Collector dissipation	P_C	100 mW (see note 1)
Ambient temperature	**Operating**	Topr	-25°C to 85°C
	Storage	Tstg	-40°C to 85°C
Soldering temperature		Tsol	–

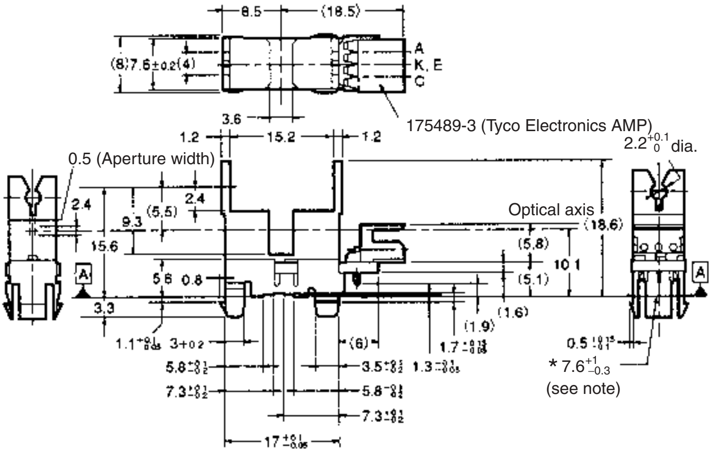
Note: 1. Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

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

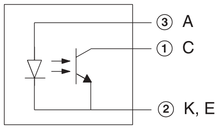
Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.2 V typ., 1.5 V max.	I_F = 30 mA
	Reverse current	I_R	0.01 μA typ., 10 μA max.	V_R = 4 V
	Peak emission wavelength	λ_P	940 m typ.	I_F = 30 mA
Detector	**Light current**	I_L	0.5 mA min., 14 mA max.	I_F = 20 mA, V_{CE} = 5 V
	Dark current	I_D	200 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 = 0.3 mA
	Peak spectral sensitivity wavelength	λ_P	850 nm typ.	V_{CE} = 5 V
Rising time		tr	8 μs typ.	V_{CC} = 5 V, R_L = 100 Ω, I_L = 1 mA
Falling time		tf	8 μs typ.	V_{CC} = 5 V, R_L = 100 Ω, I_L = 1 mA

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



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

Recommended Mating Connectors:
Tyco Electronics AMP 173977-3 (press-fit connector)
175778-3 (crimp connector)
179228-3 (crimp connector)

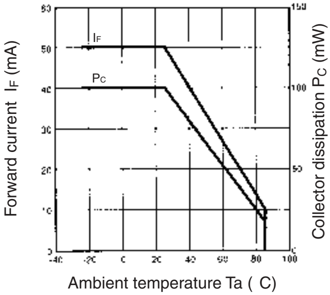
Terminal No.	Name
A	Anode
C	Collector
K, E	Cathode, Emitter

Unless otherwise specified, the tolerances are as shown below.

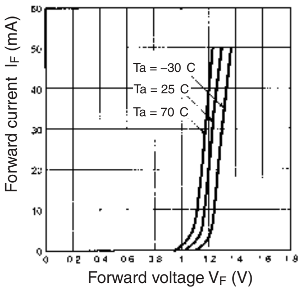
Terminal No.	Name
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

■ Engineering Data

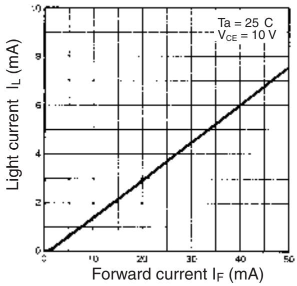
Forward Current vs. Collector Dissipation Temperature Rating



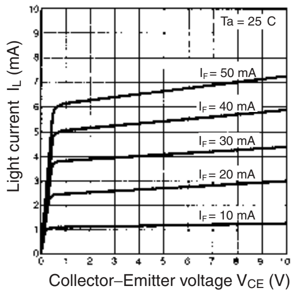
Forward Current vs. Forward Voltage Characteristics (Typical)



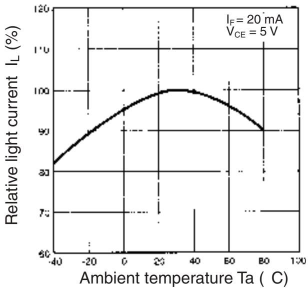
Light Current vs. Forward Current Characteristics (Typical)



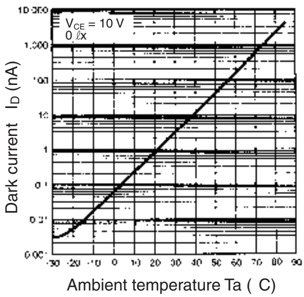
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



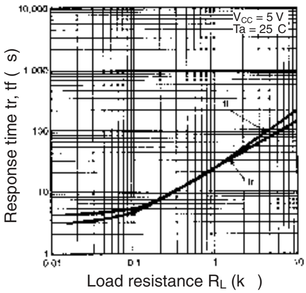
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



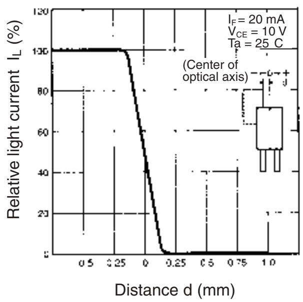
Dark Current vs. Ambient Temperature Characteristics (Typical)



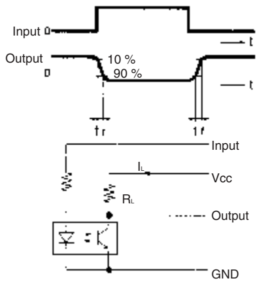
Response Time vs. Load Resistance Characteristics (Typical)



Sensing Position Characteristics (Typical)



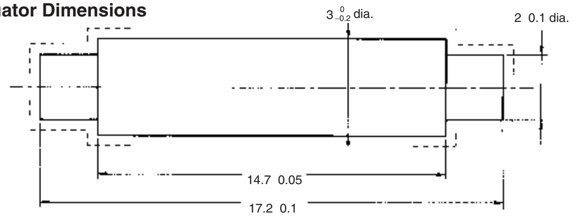
Response Time Measurement Circuit



Recommended Mounting Holes

Refer to EE-SA407-

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.

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.

Specifications

Absolute Maximum Ratings (Ta = 25°C)

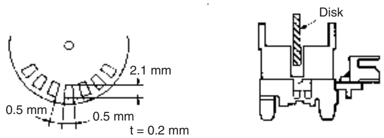
Item		Symbol	Rated value
Power supply voltage		V_{CC}	7 V
Output voltage		V_{OUT}	28 V
Output current		I_{OUT}	16 mA
Permissable output dissipation		P_{OUT}	250 mW (see note)
Ambient temperature	**Operating**	Topr	-20°C to 75°C
	Storage	Tstg	-40°C to 85°C
Soldering temperature		Tsol	–

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%)

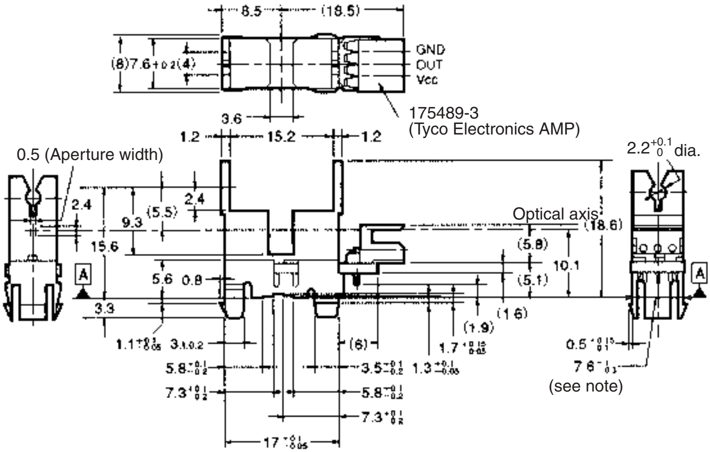
Item	Symbol	Value	Condition
Current consumption	I_{CC}	30 mA max.	With and without incident
Low-level output voltage	V_{OL}	0.35 V max.	I_{OUT} = 16 mA with incident
High-level output voltage	V_{OH}	(V_{CC} x 0.9) V min.	V_{OUT} = V_{CC} without incident, R_L = 47 kΩ
Response frequency	f	3 kHz min.	V_{OUT} = V_{CC}, R_L = 47 kΩ (see note)

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

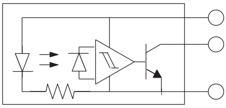


■ Dimensions

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)

Note: The dimension is specified by datum A only.

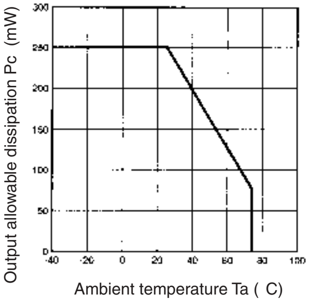
Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerence
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

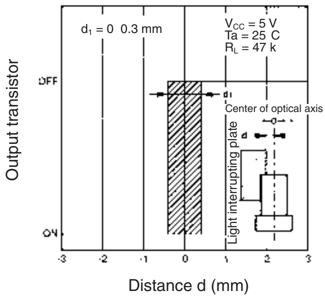
Recommended Mating Connectors:
Tyco Elctronics AMP 179228-3 (insulation displacement - type connector)
175778-3 (crimp-type connector)
173977-3 (crimp-type connector)

■ Engineering Data

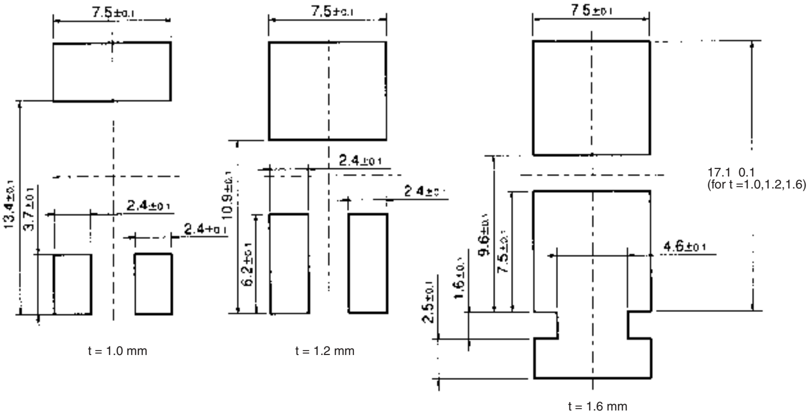
Output Allowable Dissipation vs. Ambient Temperature Characteristics



Sensing Position Characteristics (Typical)

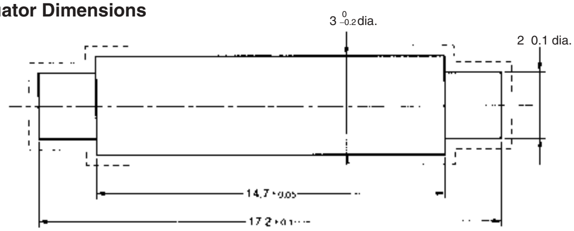


■ Recommended Mounting Holes



- 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.

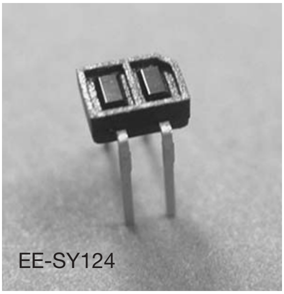
Actuator Dimensions



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.

■ Features

- ■ Ultra-compact model.
- ■ PCB Surface mounting (SY125).
- ■ Through hole mount (SY124).


EE-SY124


EE-SY125

Specifications

■ Absolute Maximum Ratings (Ta = 25°C)

Item		Symbol	Rated value
Emitter	**Forward current**	I_F	50 mA (see note 1)
	Pulse foward 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	75 mW (see note 1)
Ambient temperature	**Operating**	Topr	-25°C to 85°C
	Storage	Tstg	-40°C to 100°C
Soldering temperature		Tsol	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 frequency of 100 Hz.
3. Complete soldering within 10 seconds.

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

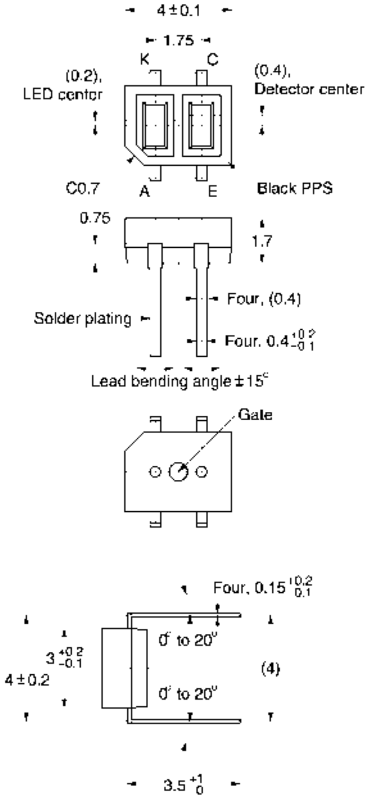
Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.2 V typ., 1.5 V max.	I_F = 20 mA
	Reverse current	I_R	0.01 μA typ., 10 μA max.	V_R = 4 V
	Peak emission wavelength	λ_P	940 nm typ.	I_F = 4 mA
Detector	**Light current**	I_L	50 μA min., 300 μA max.	I_F = 4 mA, V_{CE} = 2 V Aluminum-deposited surface, d = 1 mm (see note 1)
	Dark current	I_D	2 nA typ., 200 nA max.	V_{CE} = 10 V, 0 ℓx
	Leakage current	I_{LEAK}	200 nA max.	I_F = 4 mA, V_{CE} = 2 V with no reflection
	Collector-Emitter saturated voltage	V_{CE} (sat)	–	–
	Peak spectral sensitivity wavelength	λ_P	930 nm typ.	V_{CF} = 10 V
Rising time		tr	35 μs typ.	V_{CC} = 2 V, R_L = 1 kΩ, I_L = 100 μA
Falling time		tf	25 μs typ.	V_{CC} = 2 V, R_L = 1 kΩ, I_L = 100 μA

Note: The letter 'd' indicates the distance between the top surface of the sensor and the sensing object.

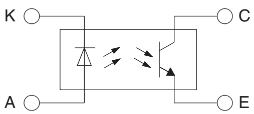
■ Dimensions

Note: All units are in millimeters unless otherwise indicated.

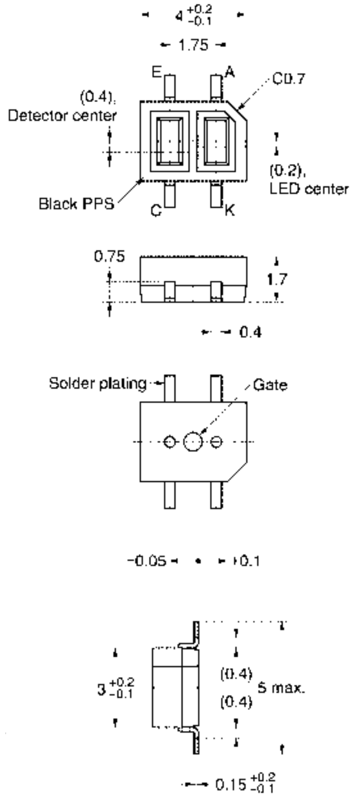
EE-SY124



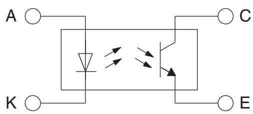
Internal Circuit



EE-SY125



Internal Circuit

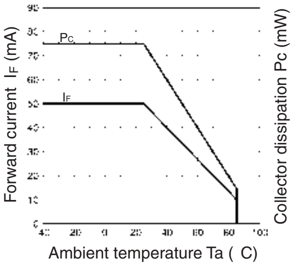


Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

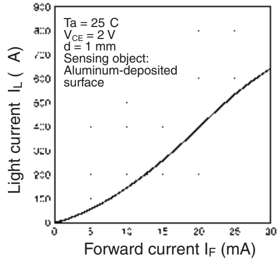
Unless otherwise specified, the tolerances are ±0.15 mm.

■ Engineering Data

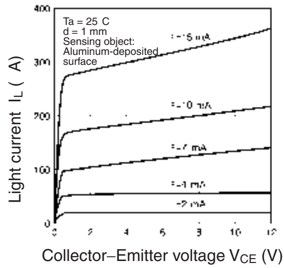
Forward Current vs. Collector Dissipation Temperature Rating



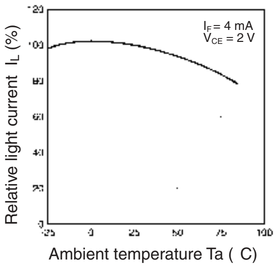
Light Current vs. Forward Current Characteristics (Typical)



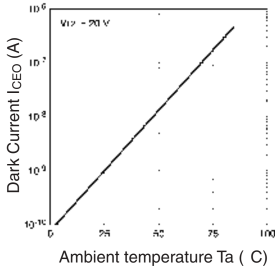
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



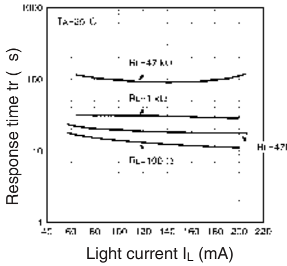
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



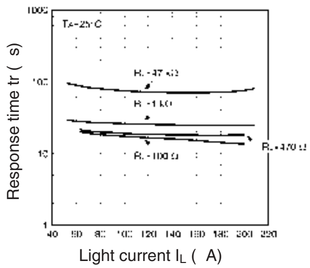
Dark Current vs. Ambient Temperature Characteristics (Typical)



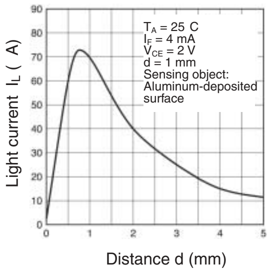
Response Time vs. Load Resistance Characteristics (Typical)



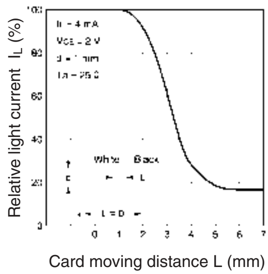
Response Time vs. Load Resistance Characteristics (Typical)



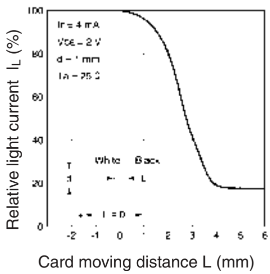
Sensing Distance Characteristics (Typical)



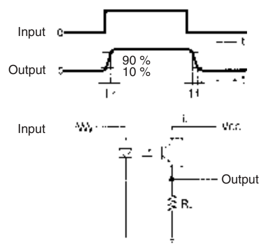
Relative Light Current vs. Card Moving Distance (1)



Relative Collector Current vs. Card Moving Distance (2)



Response Time Measurement Circuit

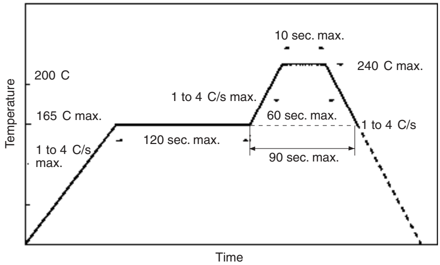


Precautions

■ Soldering Information

Reflow soldering

- 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 a soldering iron of less than 25 W, and keep the temperature of the iron tip at 260°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: 5 to 30°C

Humidity: 70% 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 at 5 to 25°C at 60% maximum humidity.

If it is necessary to store the product after opening the envelope, use dry-box storage or reseal the envelope at 5 to 30°C at 70% maximum humidity within two weeks.

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 only one time:

Bulk:125°C for 16 to 24 hours

■ Features

- Ultra-compact model.
- PCB surface mounting type.

Specifications

■ Absolute Maximum Ratings (Ta = 25°C)

Item		Symbol	Rated value
Emitter	Forward current	I_F	25 mA (see note 1)
	Pulse foward current	I_{FP}	100 mA (see note 2)
	Reverse Voltage	V_R	6 V
Detector	Collector-Emitter voltage	V_{CEO}	18 V
	Emitter-Collector voltage	V_{ECO}	4 V
	Collector current	I_C	20 mA
	Collector dissipation	P_C	75 mW (see note 1)
Ambient temperature	Operating	Topr	-30°C to 80°C
	Storage	Tstg	-40°C to 85°C
	Reflow soldering	Tsol	220°C (see note 3)
	Manual soldering	Tsol	300°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.

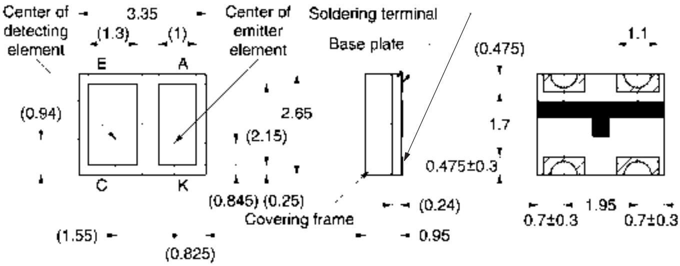
■ Electrical and Optical Characteristics (Ta = 25°C)

Item		Symbol	Value	Condition
Emitter	Forward voltage	V_F	1.1 V typ., 1.3 V max.	I_F = 4 mA
	Reverse current	I_R	10 μA max.	V_R = 6 V
	Peak emission wavelength	λ_P	940 nm typ.	I_F = 20 mA
Detector	Light current	I_L	100 μA min., 150 μA typ., 360 μA max.	Aluminum-deposited surface, I_F = 4 mA, V_{CE} = 2 V, d = 1 mm (see note 1)
	Dark current	I_D	100 nA max.	V_{CE} = 10 V, 0 ℓx
	Leakage current	I_{LEAK}	1 μA max.	I_F = 4 mA, V_{CE} = 2 V
	Collector-Emitter saturated voltage	V_{CE} (sat)	–	–
	Peak spectral sensitivity wavelength	λ_P	900 nm typ.	–
Rising time		tr	25 μs typ.	V_{CC} = 2 V, R_L = 1 kΩ
Falling time		tf	30 μs typ.	V_{CC} = 2 V, R_L = 1 kΩ

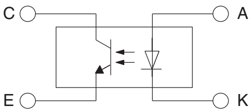
Note: The letter ‘d’ indicates the distance between the top surface of the sensor and the sensing object.

■ Dimensions

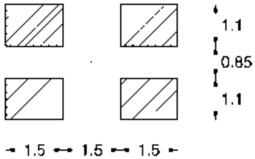
Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



Recommended soldering patterns

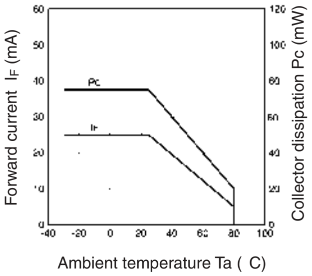


Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

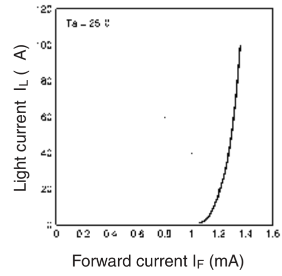
Unless otherwise specified, the tolerances are ±0.2 mm.

■ Engineering Data

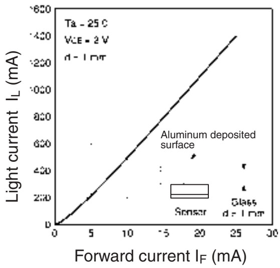
Forward Current vs. Collector Dissipation Temperature Rating



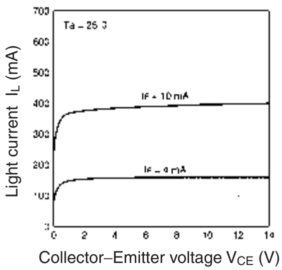
Forward Current vs. Forward Voltage Characteristics (Typical)



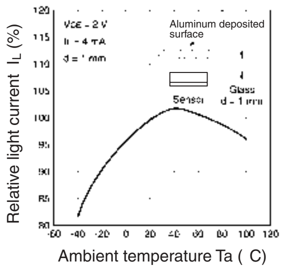
Light Current vs. Forward Current Characteristics (Typical)



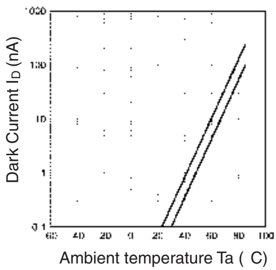
Light Current vs. Collector−Emitter Voltage Characteristics (Typical)



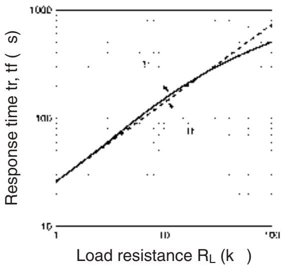
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



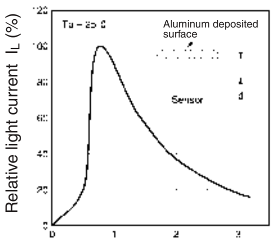
Dark Current vs. Ambient Temperature Characteristics (Typical)



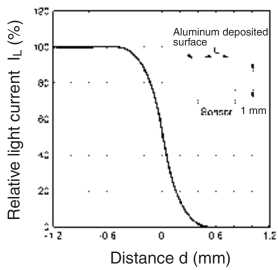
Response Time vs. Load Resistance Characteristics (Typical)



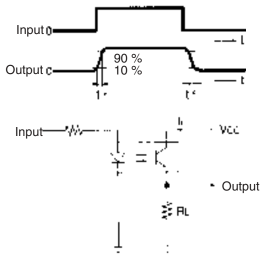
Sensing Distance Characteristics (Typical)



Sensing Position Characteristics (Typical)



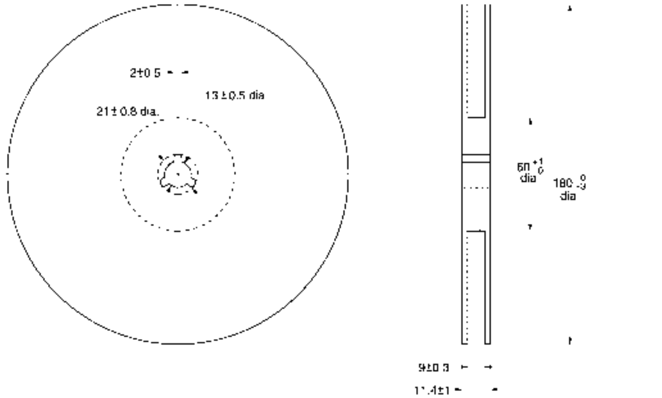
Response Time Measurement Circuit



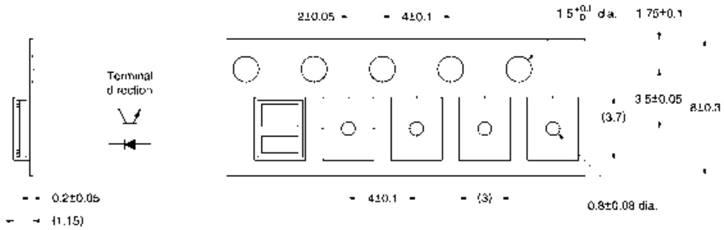
■ Tape and Reel

Unit: mm (inch).

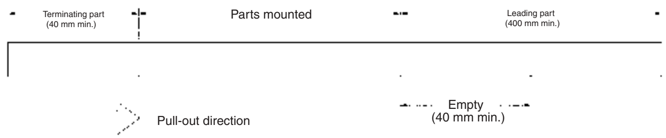
Reel



Tape



Tape configuration



Tape quantity

3,000 pcs./reel

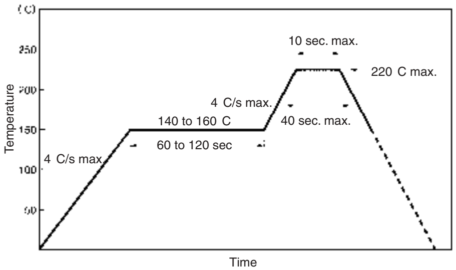
Precautions

■ Soldering Information

Reflow soldering

- The following soldering paste is recommended:

  Melting temperature: 178 to 192°C
- 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 25W, 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

■ Features

■ 3 mm tall, thin model.

Specifications

■ Absolute Maximum Ratings (Ta = 25°C)

Item		Symbol	Rated value
Emitter	**Forward current**	I_F	50 mA (see note 1)
	Pulse foward 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**	Topr	-40°C to 85°C
	Storage	Tstg	-40°C to 85°C
Soldering temperature		Tsol	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 frequency of 100 Hz.
3. Complete soldering within 10 seconds.

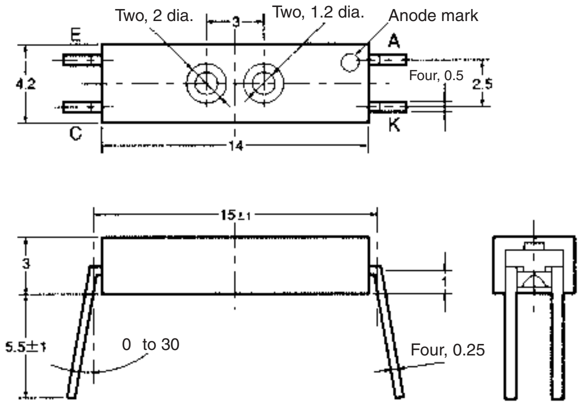
■ Electrical and Optical Characteristics (Ta = 25°C)

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 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_{CC} = 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

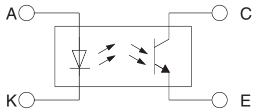
Note: The letter ‘d’ indicates the distance between the top surface of the sensor and the sensing object.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



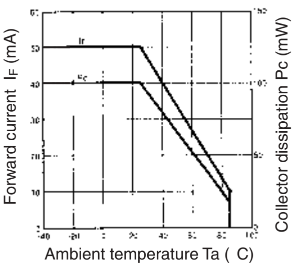
Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Unless otherwise specified, the tolerances are as shown below.

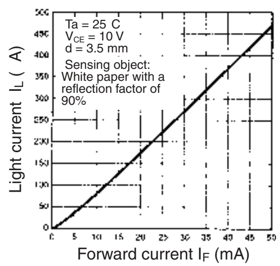
Dimensions	Tolerence
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

■ Engineering Data

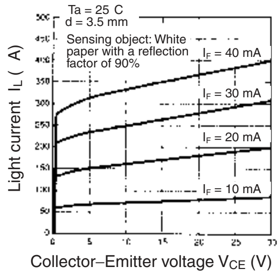
Forward Current vs. Collector Dissipation Temperature Rating



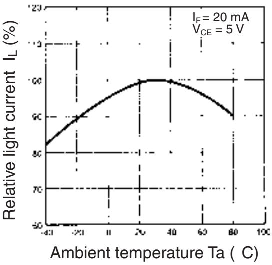
Light Current vs. Forward Current Characteristics (Typical)



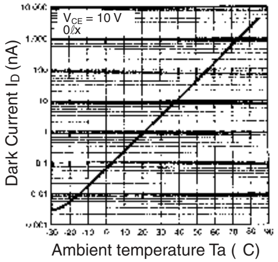
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



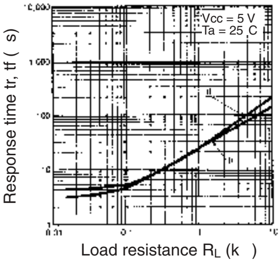
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



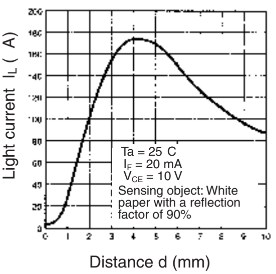
Dark Current vs. Ambient Temperature Characteristics (Typical)



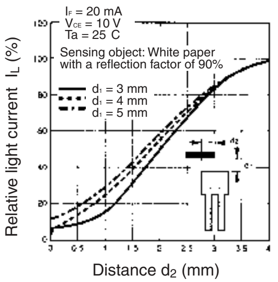
Response Time vs. Load Resistance Characteristics (Typical)



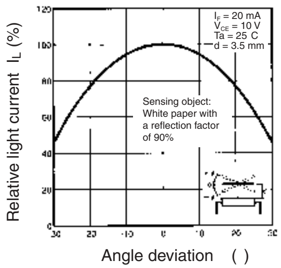
Sensing Distance Characteristics (Typical)



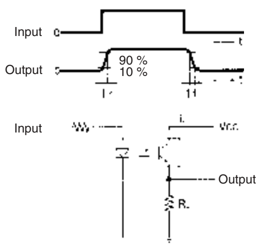
Sensing Position Characteristics (Typical)



Sensing Angle Characteristics (Typical)



Response Time Measurement Circuit



■ 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.

Specifications

■ Absolute Maximum Ratings (Ta = 25°C)

Item		Symbol	Rated value
Emitter	**Forward current**	I_F	50 mA (see note 1)
	Pulse foward 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**	Topr	0°C to 70°C
	Storage	Tstg	-20°C to 80°C
Soldering temperature		Tsol	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 frequency of 100 Hz.
3. Complete soldering within 10 seconds.

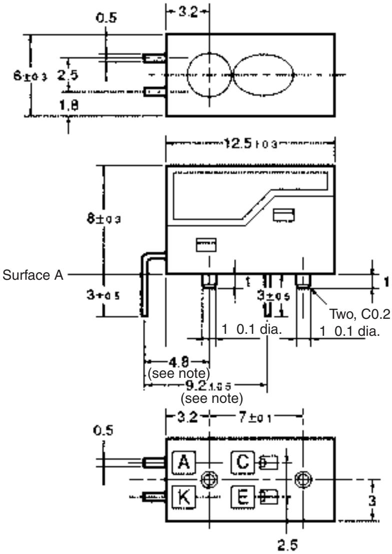
■ Electrical and Optical Characteristics (Ta = 25°C)

Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.5 V max.	I_F = 30 mA
	Reverse current	I_R	10 μA max.	V_R = 4 V
	Peak emission wavelength	λ_P	920 nm typ.	I_F = 20 mA
Detector	**Light current**	I_L	16 μA min., 2,000 μA max.	I_F = 20 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 ℓx
	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_{CC} = 5 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

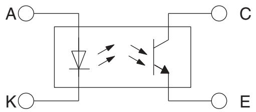
Note: The letter ‘d’ indicates the distance between the top surface of the sensor and the sensing object.

■ 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.

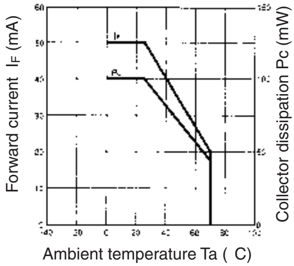
Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Unless otherwise specified, the tolerances are as shown below.

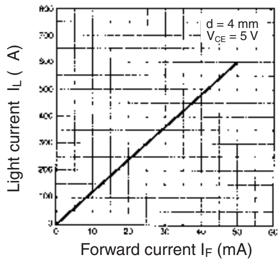
Dimensions	Tolerence
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

■ Engineering Data

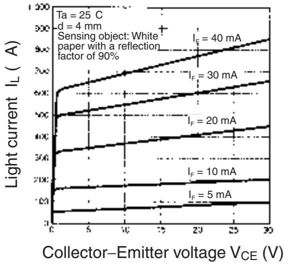
Forward Current vs. Collector Dissipation Temperature Rating



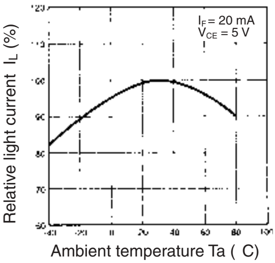
Light Current vs. Forward Current Characteristics (Typical)



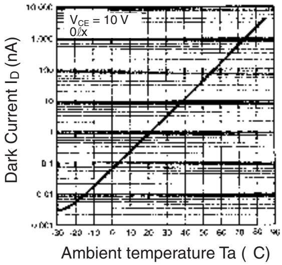
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



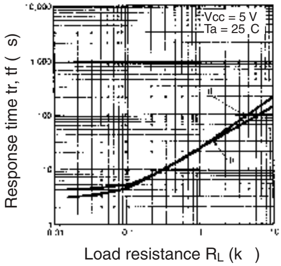
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



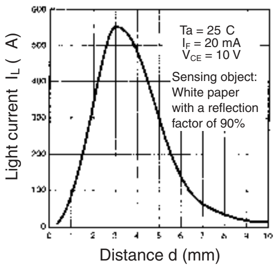
Dark Current vs. Ambient Temperature Characteristics (Typical)



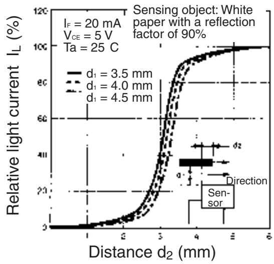
Response Time vs. Load Resistance Characteristics (Typical)



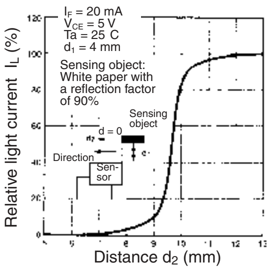
Sensing Distance Characteristics (Typical)



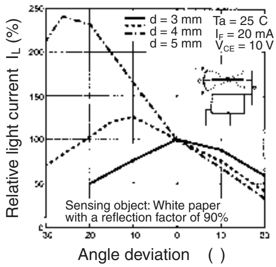
Sensing Position Characteristics (Typical)



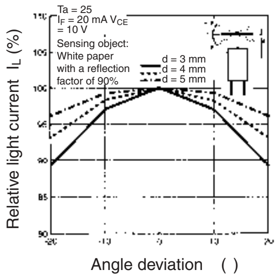
Sensing Position Characteristics (Typical)



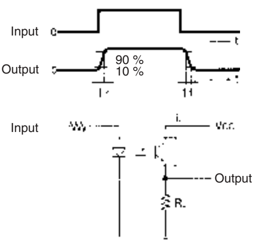
Sensing Angle Characteristics (Typical)



Sensing Angle Characteristics (Typical)



Response Time Measurement Circuit



■ 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).

Specifications

■ Absolute Maximum Ratings (Ta = 25°C)

Item		Symbol	Rated value
Emitter	**Forward current**	I_F	40 mA (see note 1)
	Pulse foward 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**	Topr	0°C to 70°C
	Storage	Tstg	-20°C to 80°C
Soldering temperature		Tsol	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 frequency of 100 Hz.
3. Complete soldering within 10 seconds.

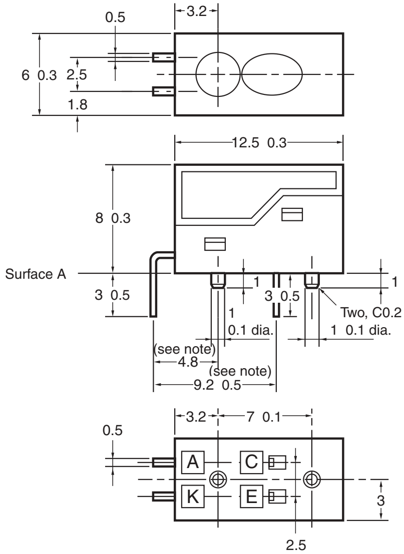
■ Electrical and Optical Characteristics (Ta = 25°C)

Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.85 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	16 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 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} = 5 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

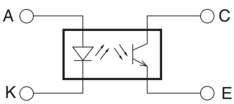
Note: The letter ‘d’ indicates the distance between the top surface of the sensor and the sensing object.

■ 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.

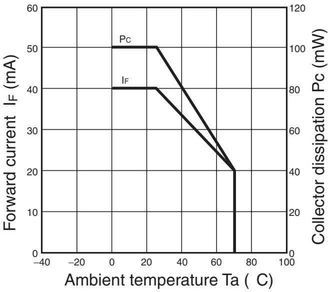
Terminal No.	Name
A	Anode
K	Cathode
C	Collector
E	Emitter

Unless otherwise specified, the tolerances are as shown below.

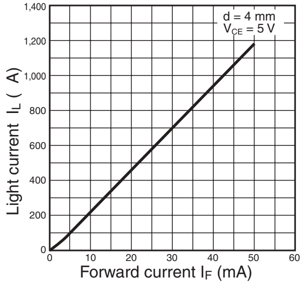
Dimensions	Tolerence
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

■ Engineering Data

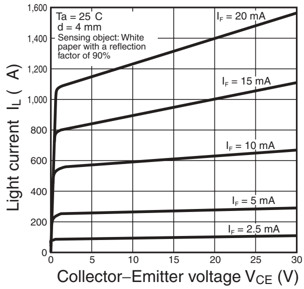
Forward Current vs. Collector Dissipation Temperature Rating



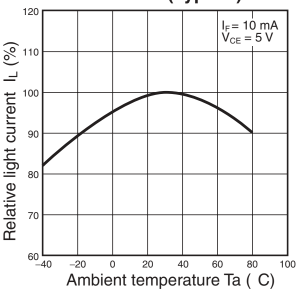
Light Current vs. Forward Current Characteristics (Typical)



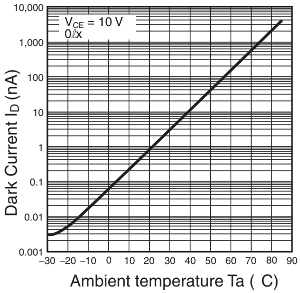
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



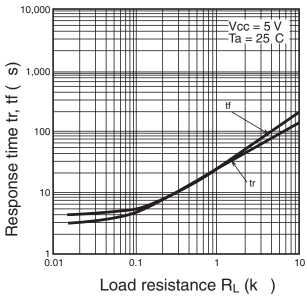
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



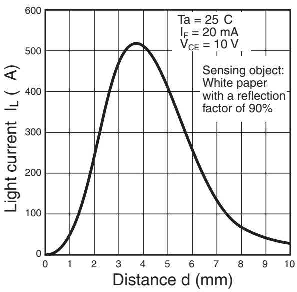
Dark Current vs. Ambient Temperature Characteristics (Typical)



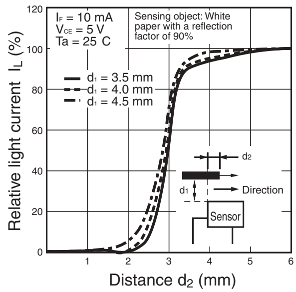
Response Time vs. Load Resistance Characteristics (Typical)



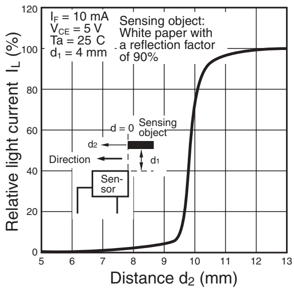
Sensing Distance Characteristics (Typical)



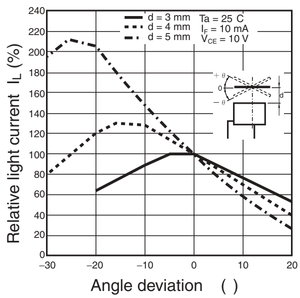
Sensing Position Characteristics (Typical)



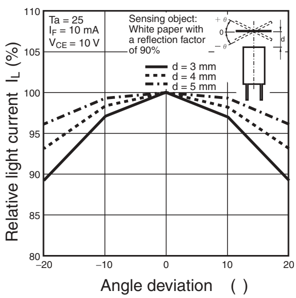
Sensing Position Characteristics (Typical)



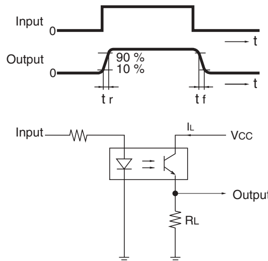
Sensing Angle Characteristics (Typical)



Sensing Angle Characteristics (Typical)



Response Time Measurement Circuit



Photomicrosensors

Features

- Compact reflective Photomicrosensor (EE-SY110) with a moulded housing and dust-tight cover.

Specifications

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**	Topr	-40°C to 80°C
	Storage	Tstg	-40°C to 85°C
Soldering temperature		Tsol	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 100Hz.
3. Complete soldering within 10 seconds.

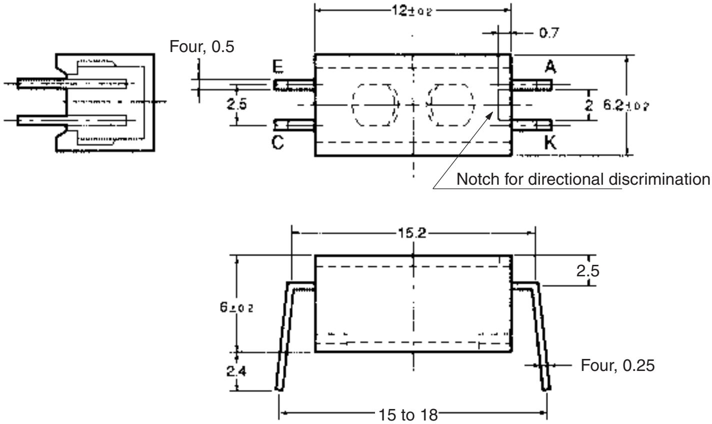
Electrical and Optical Characteristics (Ta = 25°C)

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	160 μA min., 1,600 μA max.	I_F = 20 mA, V_{CE} = 10 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 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_{CC} = 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

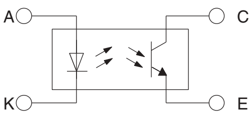
Note: The letter ‘d’ indicates the distance between the top surface of the sensor and the sensing object.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



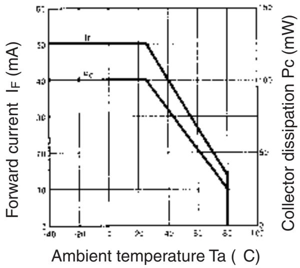
Unless otherwise specified, the tolerances are as shown below.

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

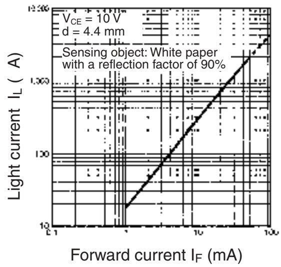
Dimensions	Tolerence
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

■ Engineering Data

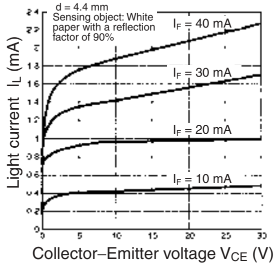
Forward Current vs. Collector Dissipation Temperature Rating



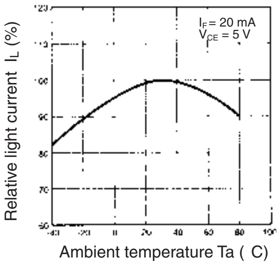
Light Current vs. Forward Current Characteristics (Typical)



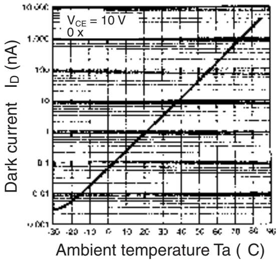
Light Current vs. Collector−Emitter Voltage Characteristics (Typical)



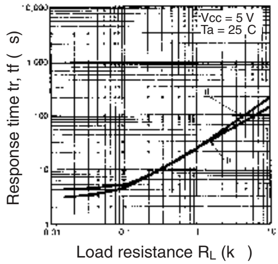
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



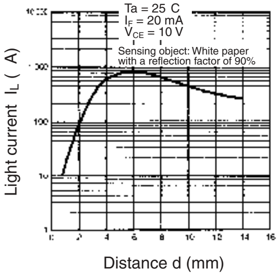
Dark Current vs. Ambient Temperature Characteristics (Typical)



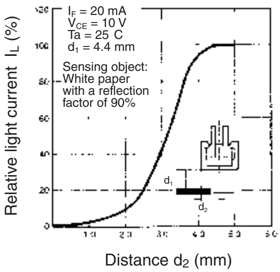
Response Time vs. Load Resistance Characteristics (Typical)



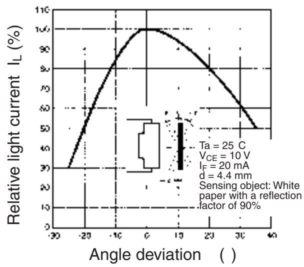
Sensing Distance Characteristics (Typical)



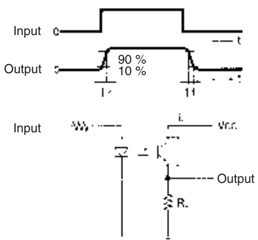
Sensing Position Characteristics (Typical)



Sensing Angle Characteristics (Typical)



Response Time Measurement Circuit



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)

Specifications

Absolute Maximum Ratings (Ta = 25°C)

Item		Symbol	Rated value
Emitter	**Forward current**	I_F	50 mA (see note 1)
	Pulse foward current	I_{FP}	1 A (see note 2)
	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**	Topr	-40°C to 65°C
	Storage	Tstg	-40°C to 85°C
Soldering temperature		Tsol	260°C (see note 2)

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

2. The pulse width is 10 μs maximum with frequency of 100 Hz.

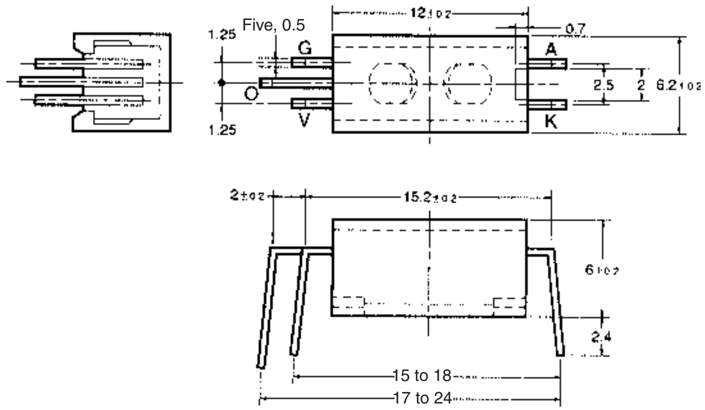
3. Complete soldering within 10 seconds.

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

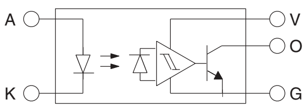
Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.2 V typ., 1.5 V max.	I_F = 20 mA
	Reverse current	I_R	0.01 µA typ., 10 µA max.	V_R = 4 V
	Peak emission wavelength	λ_P	920 nm typ.	I_F = 20 mA
Detector	**Low-level output voltage**	V_{OL}	0.12 V typ., 0.4 V max.	V_{CC} = 4.5 to 16 V, I_{OL} = 16 mA, without incident light (EE-SY313), with incident light (EE-SY413) (see notes 1 & 2)
	High-level output voltage	V_{OH}	15 V min.	V_{CC} = 16 V, R_L = 1 kΩ, with incident light (EE-SY313), without incident light (EE-SY413) (see notes 1 & 2)
	Current consumption	I_{CC}	3.2 mA typ., 10 mA max.	V_{CC} = 16 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		$\triangle H$	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 mA, I_{OL} = 16mA
Response delay time		t_{PLH} (t_{PHL})	3 µs typ.	V_{CC} = 4.5 to 16 V, I_F = 20 mA, I_{OL} = 16mA
Response delay time		t_{PHL} (t_{PLH})	20 µs typ.	V_{CC} = 4.5 to 16 V, I_F = 20 mA, I_{OL} = 16mA

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



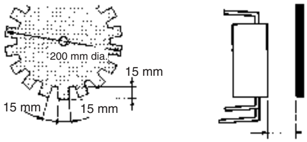
Unless otherwise specified, the tolerances are as shown right.

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

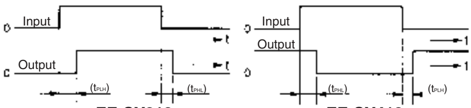
Dimensions	Tolerence
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

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.



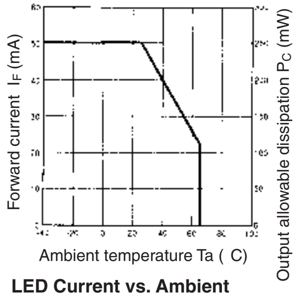
5. The following illustrations show the definition of response delay time. The value in the parentheses applies to the EESY413.



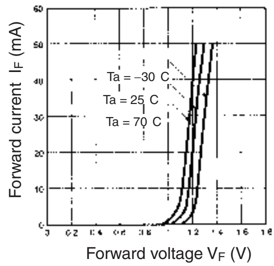
■ Engineering Data

Note: The values in parentheses apply to EE-SY413.

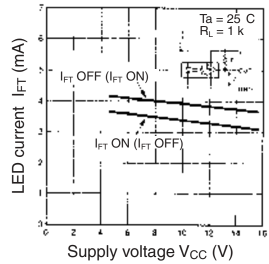
Forward Current vs. Collector Dissipation Temperature Rating



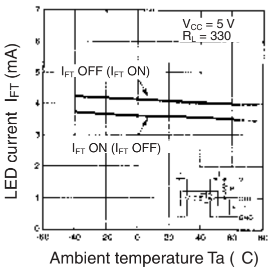
Forward Current vs. Forward Voltage Characteristics (Typical)



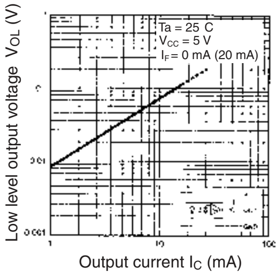
LED Current vs. Supply Voltage (Typical)



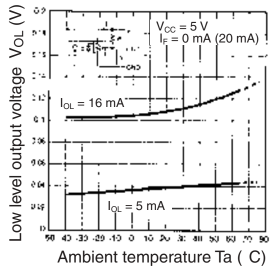
LED Current vs. Ambient Temperature Characteristics (Typical)



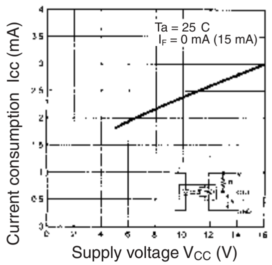
Low-level Output Voltage vs. Output Current (Typical)



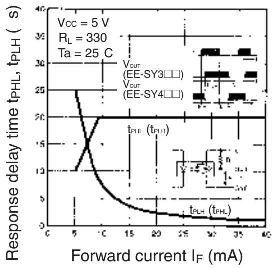
Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



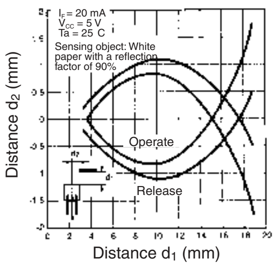
Current Consumption vs. Supply Voltage (Typical)



Response Delay Time vs. Forward Current (Typical)



Sensing Position Characteristics (Typical)



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).

Specifications

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**	Topr	-25°C to 80°C
	Storage	Tstg	-30°C to 80°C
Soldering temperature		Tsol	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 100Hz.
3. Complete soldering within 10 seconds.

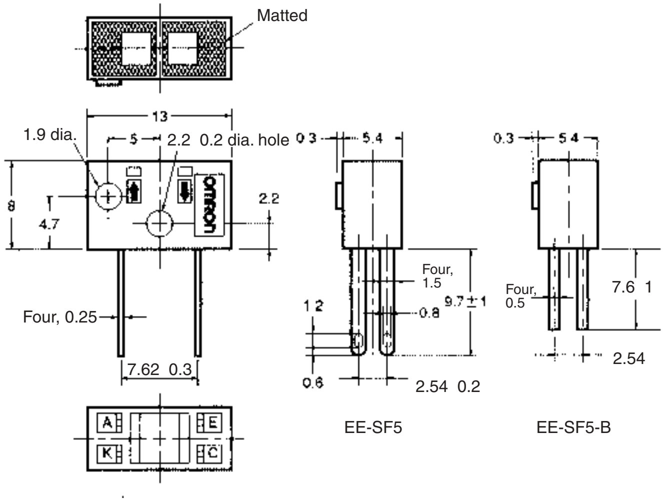
Electrical and Optical Characteristics (Ta = 25°C)

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	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_{CC} = 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

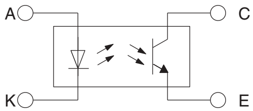
Note: The letter 'd' indicates the distance between the top surface of the sensor and the sensing object.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



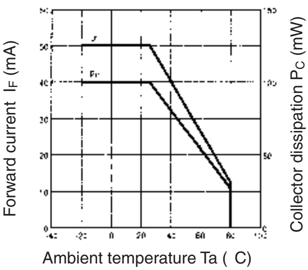
Unless otherwise specified, the tolerances are as shown below.

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

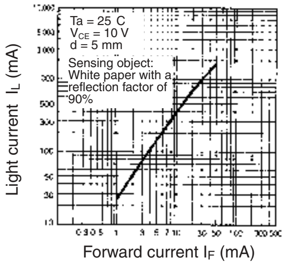
Dimensions	Tolerance
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
6 < mm ≤ 10	±0.45
10 < mm ≤ 18	±0.55
18 < mm ≤ 30	±0.65

■ Engineering Data

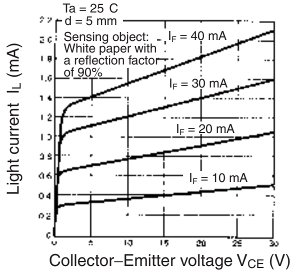
Forward Current vs. Collector Dissipation Temperature Rating



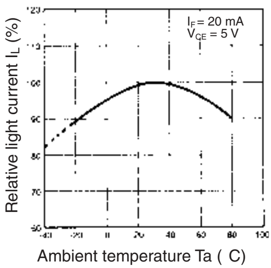
Light Current vs. Forward Current Characteristics (Typical)



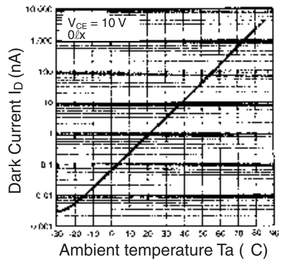
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



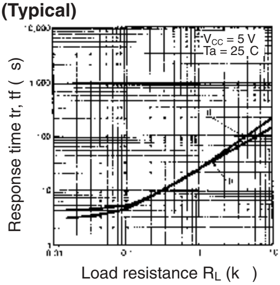
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



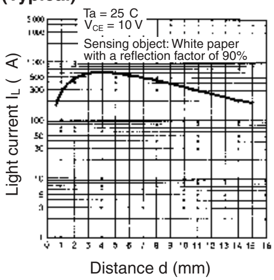
Dark Current vs. Ambient Temperature Characteristics (Typical)



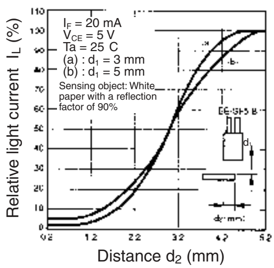
Response Time vs. Load Resistance Characteristics (Typical)



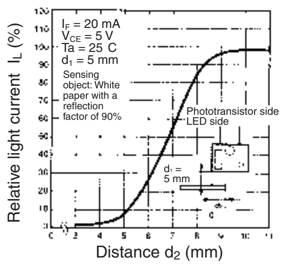
Sensing Distance Characteristics (Typical)



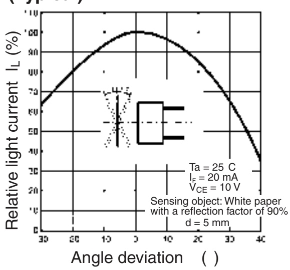
Sensing Position Characteristics (Typical)



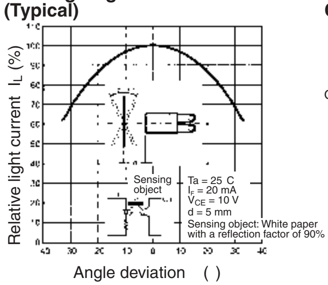
Sensing Position Characteristics (Typical)



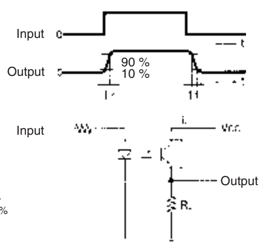
Sensing Angle Characteristics (Typical)



Sensing Angle Characteristics (Typical)



Response Time Measurement Circuit



Features

■ Compact reflective model with a moulded housing.

Specifications

■ 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**	Topr	-40°C to 85°C
	Storage	Tstg	-40°C to 85°C
Soldering temperature		Tsol	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 100Hz.
3. Complete soldering within 10 seconds.

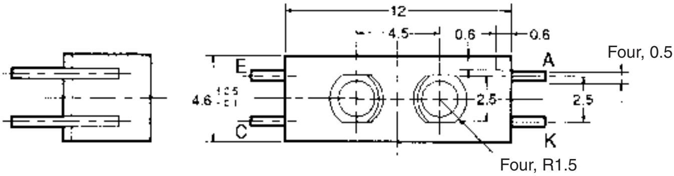
■ Electrical and Optical Characteristics (Ta = 25°C)

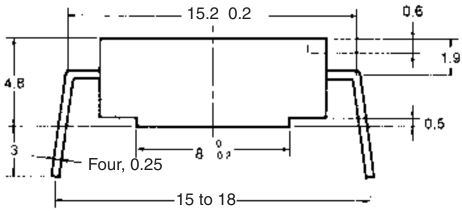
Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.2 V typ., 1.5 V max.	I_F = 30 mA
	Reverse current	I_R	0.01 μA typ., 10 μA max.	V_R = 4 V
	Peak emission wavelength	λ_P	940 nm typ.	I_F = 20 mA
Detector	**Light current**	I_L	200 μA min., 2,000 μA max.	I_F = 20 mA, V_{CE} = 10 V White paper 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_{CC} = 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.

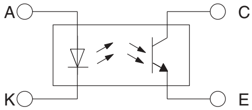
■ Dimensions

Note: All units are in millimeters unless otherwise indicated.





Internal Circuit



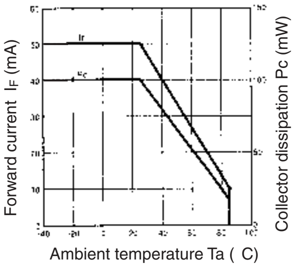
Unless otherwise specified, the tolerances are as shown below.

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

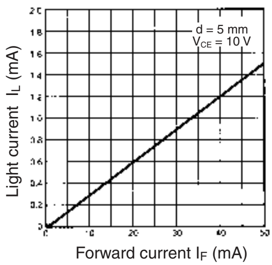
Dimensions	Tolerence
3 mm max.	±0.2
3 < mm ≤ 6	±0.24
6 < mm ≤ 10	±0.29
10 < mm ≤ 18	±0.35
18 < mm ≤ 30	±0.42

■ Engineering Data

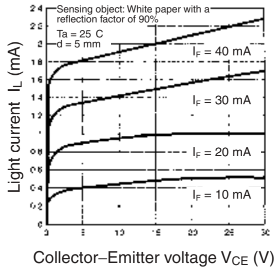
Forward Current vs. Collector Dissipation Temperature Rating



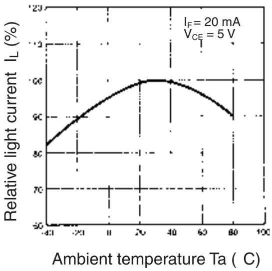
Light Current vs. Forward Current Characteristics (Typical)



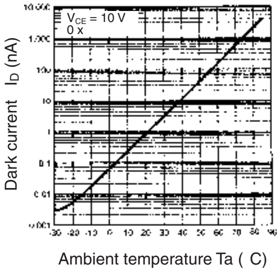
Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



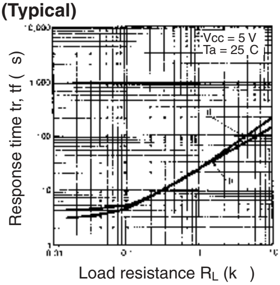
Relative Light Current vs. Ambient Temperature Characteristics (Typical)



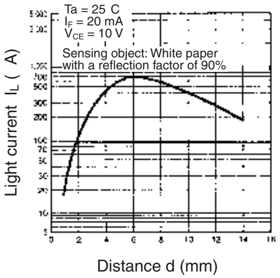
Dark Current vs. Ambient Temperature Characteristics (Typical)



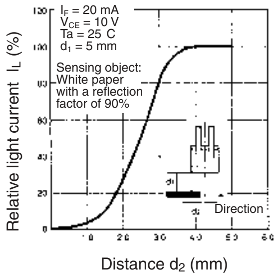
Response Time vs. Load Resistance Characteristics (Typical)



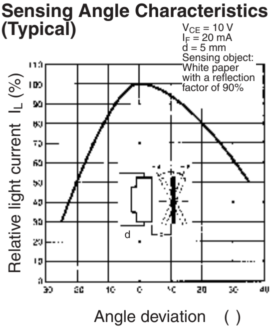
Sensing Distance Characteristics (Typical)



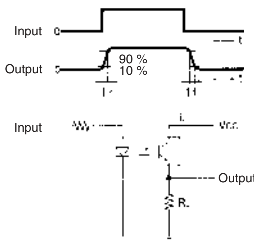
Sensing Position Characteristics (Typical)



Sensing Angle Characteristics (Typical)

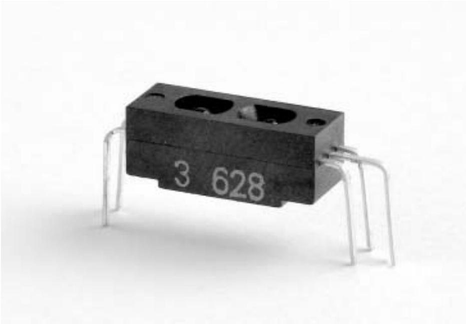


Response Time Measurement Circuit



■ 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)



Specifications

■ Absolute Maximum Ratings (Ta = 25°C)

Item		Symbol	Rated value
Emitter	**Forward current**	I_F	50 mA (see note 1)
	Pulse foward current	I_{FP}	1 A (see note 2)
	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**	Topr	-40°C to 75°C
	Storage	Tstg	-40°C to 85°C
Soldering temperature		Tsol	260°C (see note 2)

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

2. The pulse width is 10 μs maximum with frequency of 100 Hz.

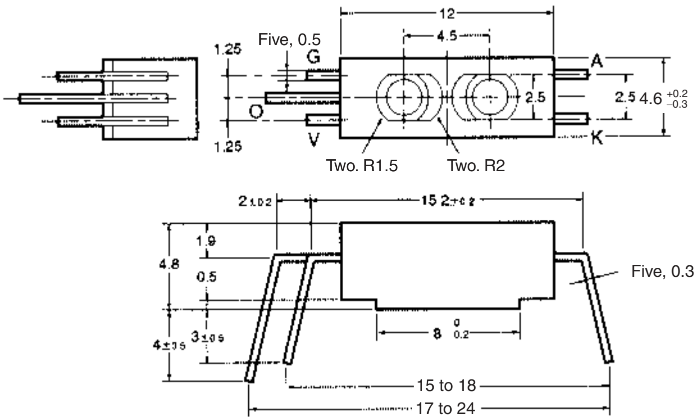
3. Complete soldering within 10 seconds.

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

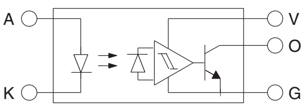
Item		Symbol	Value	Condition
Emitter	**Forward voltage**	V_F	1.2 V typ., 1.5 V max.	I_F = 20 mA
	Reverse current	I_R	0.01 µA typ., 10 µA max.	V_R = 4 V
	Peak emission wavelength	λ_P	920 nm typ.	I_F = 20 mA
Detector	**Low-level output voltage**	V_{OL}	0.12 V typ., 0.4 V max.	V_{CC} = 4.5 to 16 V, I_{OL} = 16 mA, without incident light (EE-SY310), with incident light (EE-SY410) (see notes 1 & 2)
	High-level output voltage	V_{OH}	15 V min.	V_{CC} = 16 V, R_L = 1 kΩ, with incident light (EE-SY310), without incident light (EE-SY410) (see notes 1 & 2)
	Current consumption	I_{CC}	3.2 mA typ., 10 mA max.	V_{CC} = 16 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}	6 mA typ., 15 mA max.	V_{CC} = 4.5 to 16 V
LED current when output is ON				
Hysteresis		△H	17% typ.	V_{CC} = 4.5 to 16 V
Response frequency		f	50 Hz min.	V_{CC} = 4.5 to 16 V, I_F = 15 mA, I_{OL} = 16mA
Response delay time		t_{PLH} (t_{PHL})	3 µs min.	V_{CC} = 4.5 to 16 V, I_F = 15 mA, I_{OL} = 16mA
Response delay time		t_{PHL} (t_{PLH})	20 µs typ.	V_{CC} = 4.5 to 16 V, I_F = 15 mA, I_{OL} = 16mA

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Internal Circuit



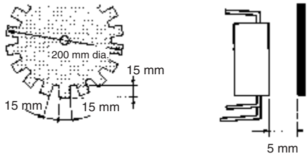
Unless otherwise specified, the tolerances are as shown right.

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

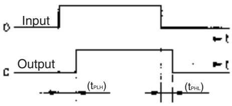
Dimensions	Tolerence
3 mm max.	±0.2
3 < mm ≤ 6	±0.24
6 < mm ≤ 10	±0.29
10 < mm ≤ 18	±0.35
18 < mm ≤ 30	±0.42

Note: 1. “With incident light” denotes the condition whereby thelight 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.

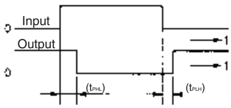
2. Sensing object: White paper with a reflection factor of 90% at a sensing distance of 5 mm.
3. Hysteresis denotes the difference in forward LED current value, expressed in percentage, calculated from the respective forward LED currents when the photo IC is turned from ON to OFF and when the photo IC 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 EESY410.



EE-SY310

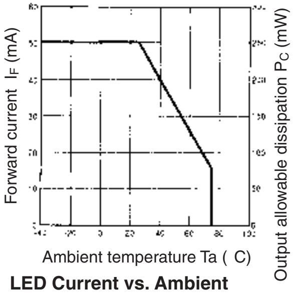


EE-SY410

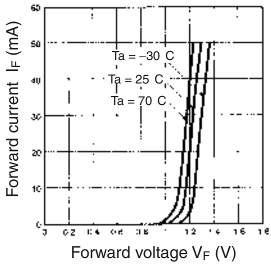
■ Engineering Data

Note: The values in parentheses apply to EE-SY413.

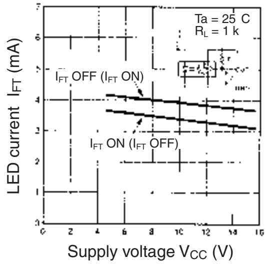
Forward Current vs. Collector Dissipation Temperature Rating



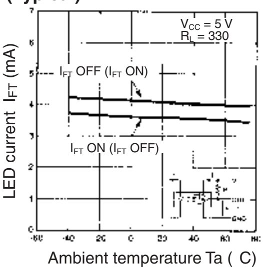
Forward Current vs. Forward Voltage Characteristics (Typical)



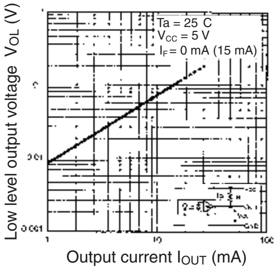
LED Current vs. Supply Voltage (Typical)



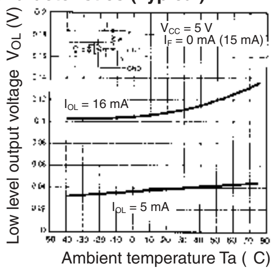
LED Current vs. Ambient Temperature Characteristics (Typical)



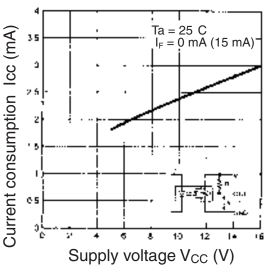
Low-level Output Voltage vs. Output Current (Typical)



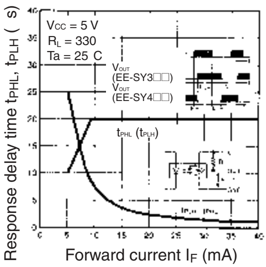
Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



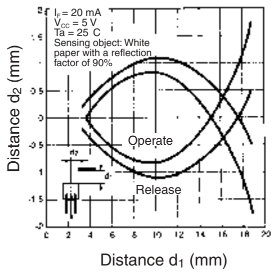
Current Consumption vs. Supply Voltage (Typical)



Response Delay Time vs. Forward Current (Typical)

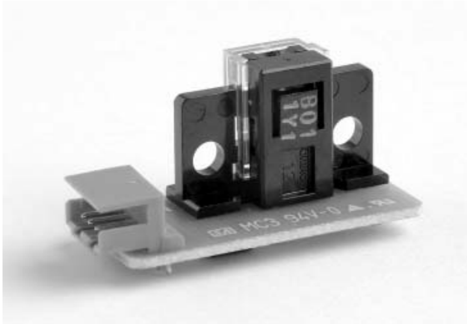


Sensing Position Characteristics (Typical)



■ Features

- ■ Easier control enabled by built-in processor circuit.
- ■ Resolution: ±10 µm.
- ■ Operating area: 6.5±1 mm.
- ■ Adapts well to changes in reflection factor using division processing.



Specifications

■ Absolute Maximum Ratings (Ta = 25°C)

Item	Symbol	Value	Unit	Features
Supply voltage	V_{CC}	7	VDC	–
LED pulse light emission control signal	PLS	7	VDC	LED
LED light emission pulse	t_{FP}	100	ms	–
Operating temperature	T_{opr}	-10 to 65	°C	No icing or condensation
Storage temperature	T_{stg}	-25 to 80	°C	–

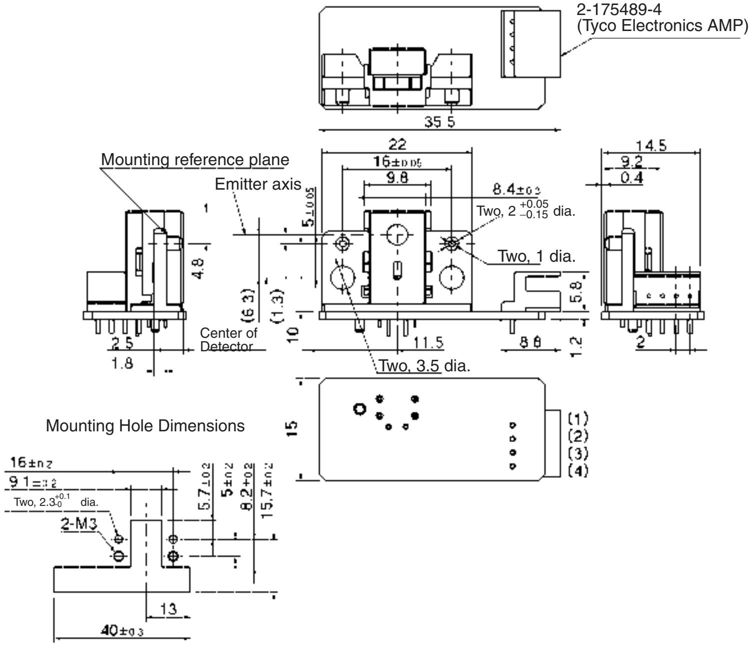
■ Electrical and Optical Characteristics (Ta = -10°C to 65°C)

Item	Symbol	Rated value	Remarks
Supply voltage	V_{CC}	5 VDC±10%	Ripple (p-p): 10 mV p-p max.
Output voltage	OUT	0.2 VDC to (V_{CC}–0.3) V	(see note 1)
Response time	tr	100 µs max.	(see note 2)
LED pulse light emission control signal	PLS	3.5 VDC to V_{CC}	(see note 3)

Note: 1. Load impedance (between OUT-GND) is set at more than 10 kΩ.
2. The time for output voltage to rise from 10% to 90% of the full output range.
3. Apply the voltage ranging from 3.5 V to V_{CC} on the LED pulse light emission control signal terminal. In this case, a maximum of 2 mA (typ.1 mA) current is sunk.

■ 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)

Pin No.	Remarks
1	PLS
2	V_{CC}
3	OUT
4	GND

Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerence
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

■ Characteristics (Ta = -10°C to 65°C)

Object: N8.5 Munsell paper with a reflection factor of 70%.

Pin No.	Remarks
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 the mounting reference plane.

2. "Sensitivity" is defined as "inclination of divided output line" and the variation value between individual products of fluctuating divided output voltage per unit length.

$$\text{Sensitivity} = \frac{V_2 - V_0}{2000} \text{ (mV/µm)}$$

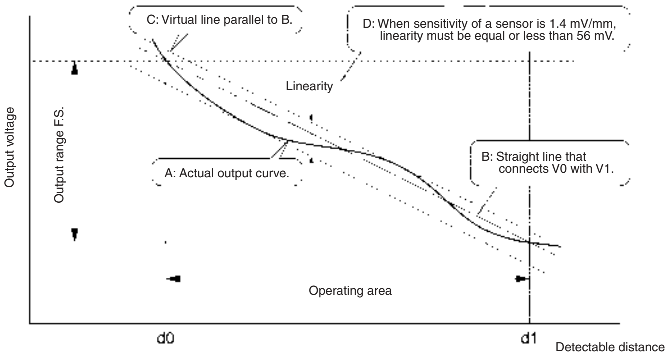
Where V_0: Output voltage when d = 5.5 mm
V_2: Output voltage when d = 7.5 mm
d: Distance from reference mounting plane to an object.

3. Value of electrical noise range of divided output signal converted to distance under the following conditions.

Sensor — Sample and hold circuit — Oscilloscope

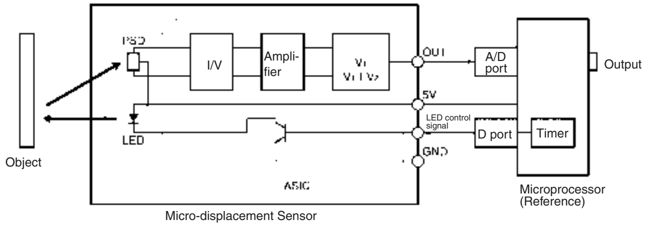
(1) Ripple noise of power supply: 10 mV p-p max.
(2) Sampling time of the sample and hold circuit: 50 µsec
(3) Distance to object: Distance from the reference mounting plane is 6.5 mm±1 mm
** When the testing conditions are deviated from the above conditions, resolution changes.
For details, please consult OMRON sales representative.

4. The peak-to-peak value of the output error from the ideal line.
Calculation, based on a linearity of 2% F.S., is as follows:
(1) The conversion value based on the full scale distance: 2 mm 0.02 = 0.04 mm (40 µm)
(2) The conversion value based on the output voltage: 1.4 mV/µm 40 µm = 56 mV
(When the product sensitivity variation is 1.4 mV/µm)



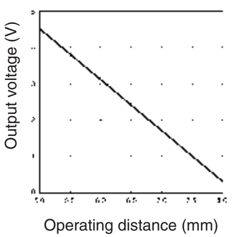
Photomicrosensors

■ Circuit Diagram

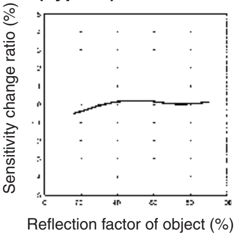


■ Engineering Data

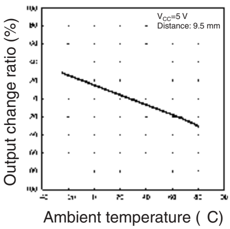
Operating Distance Characteristics (Typical)



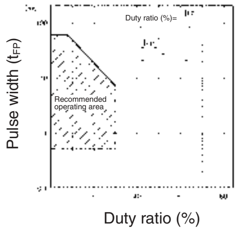
Dependency of Object on Reflection Factor (Typical)



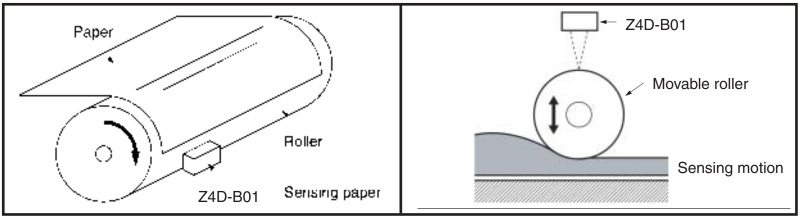
Temperature Characteristics (Typical)



Pulsed Forward Current Rated Curve



■ Paper thickness detection for printers



■ Features

■ Easier control enabled by built-in processor circuit.

■ Resolution: ±50 µm.

■ Operating area: 9.5±3 mm.

■ Adapts well to changes in reflection factor using division processing.

Specifications

■ Absolute Maximum Ratings (Ta = 25°C)

Item	Symbol	Value	Unit	Features
Supply voltage	V_{CC}	7	VDC	–
LED pulse light emission control signal	PLS	7	VDC	LED
LED light emission pulse	t_{FP}	100	ms	–
Operating temperature	T_{opr}	-10 to 65	°C	No icing or condensation
Storage temperature	T_{stg}	-25 to 80	°C	–

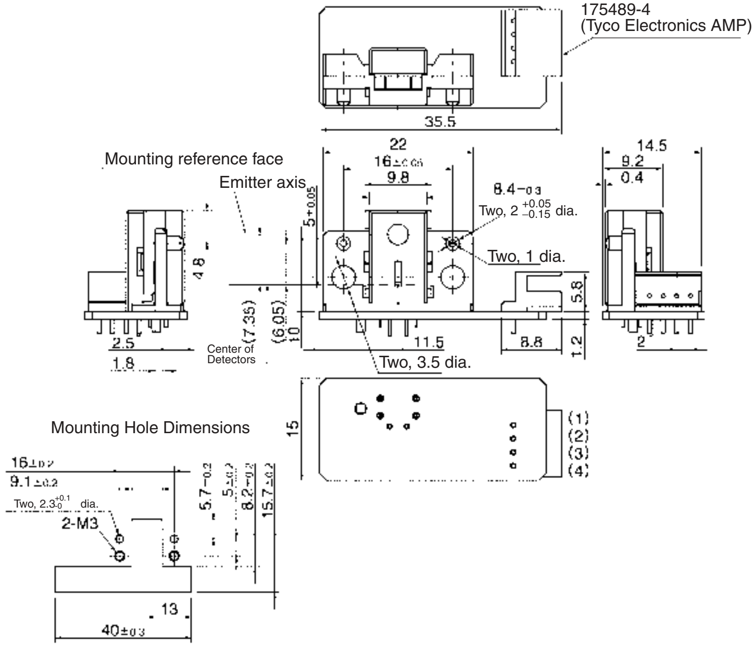
■ Electrical and Optical Characteristics (Ta = -10°C to 65°C)

Item	Symbol	Rated value	Remarks
Supply voltage	V_{CC}	5 VDC±10%	Ripple (p-p): 10 mV p-p max.
Output voltage	OUT	0.2 VDC to (V_{cc}–0.3) V	(see note 1)
Response time	tr	100 µs max.	(see note 2)
LED pulse light emission control signal	PLS	3.5 VDC to V_{cc}	(see note 3)

Note: 1. Load impedance (between OUT-GND) is set at more than 10 kΩ.
2. The time for output voltage to rise from 10% to 90% of the full output range.
3. Apply the voltage ranging from 3.5 V to V_{cc} on the LED pulse light emission control signal terminal. In this case, a maximum of 2 mA (typ.1 mA) current is sunk.

■ 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)

Pin No.	Remarks
1	PLS
2	V_{CC}
3	OUT
4	GND

Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerence
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

■ Characteristics (Ta = -10°C to 65°C)

Object: N8.5 Munsell paper with a reflection factor of 70%.

Pin No.	Remarks
Operating area (see note 1)	9.5 ±3 mm
Sensitivity variation (see note 2)	-0.45 mV/μm±10% max.
Resolution (see note 3)	±50 μm max. (Ta = 25°C)
Linearity (see note 4)	2% F.S. (full scale) max.

Note: 1. Distance from the mounting reference plane.

2. "Sensitivity" is defined as "inclination of divided output line" and the variation value between individual products of fluctuating divided output voltage per unit length.

$$\text{Sensitivity} = \frac{V_2 - V_0}{2000} \text{ (mV/μm)}$$

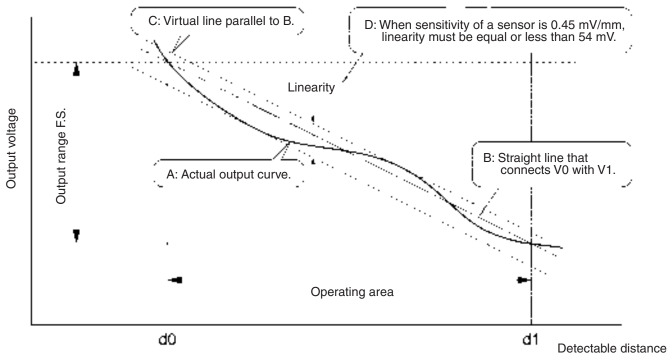
Where V_0: Output voltage when d = 6.5 mm
V_2: Output voltage when d = 12.5 mm
d: Distance from reference mounting plane to an object.

3. Value of electrical noise range of divided output signal converted to distance under the following conditions.

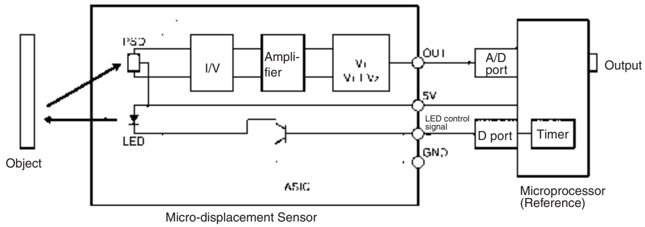
Sensor — Sample and hold circuit — Oscilloscope

(1) Ripple noise of power supply: 10 mV p-p max.
(2) Sampling time of the sample and hold circuit: 50 μsec
(3) Distance to object: Distance from the reference mounting plane is 6.5 mm±1 mm
** When the testing conditions are deviated from the above conditions, resolution changes.
For details, please consult OMRON sales representative.

4. The peak-to-peak value of the output error from the ideal line.
Calculation, based on a linearity of 2% F.S., is as follows:
(1) The conversion value based on the full scale distance: 6 mm 0.02 = 0.12 mm (120 μm)
(2) The conversion value based on the output voltage: 0.45 mV/μm 120 μm = 54 mV
(When the product sensitivity variation is 45 mV/μm)

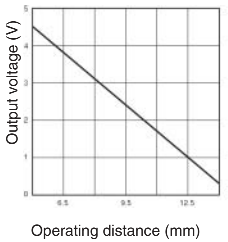


■ Circuit Diagram

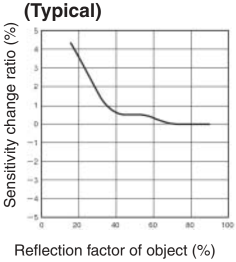


■ Engineering Data

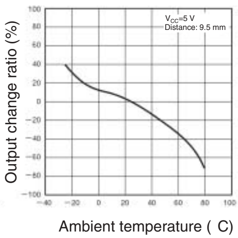
Operating Distance Characteristics (Typical)



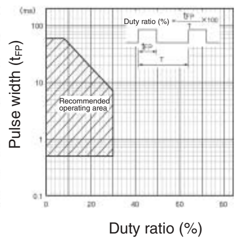
Dependency of Object on Reflection Factor (Typical)



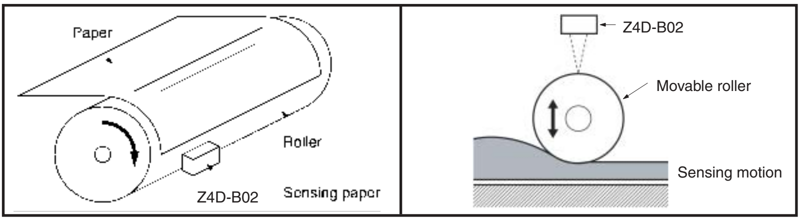
Temperature Characteristics (Typical)



Pulsed Forward Current Rated Curve



■ ■ Paper thickness detection for printers



■ Features

- ■ Simultaneously senses three objects positioned differently, thus saving space.
- ■ Ensures higher sensitivity and external light interference resistivity than any other photomicrosensor.
- ■ Narrow sensing range ensures stable sensing of a variety of sensing objects.

■ Application Examples

Sensing of paper sizes.

Specifications

■ Absolute Maximum Ratings (Ta = 0°C to 65°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**	Topr	0°C to 65°C
	Storage	Tstg	-15°C to 70°C

Note: 1. Make sure there is no icing or condensation when operating the sensor.

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

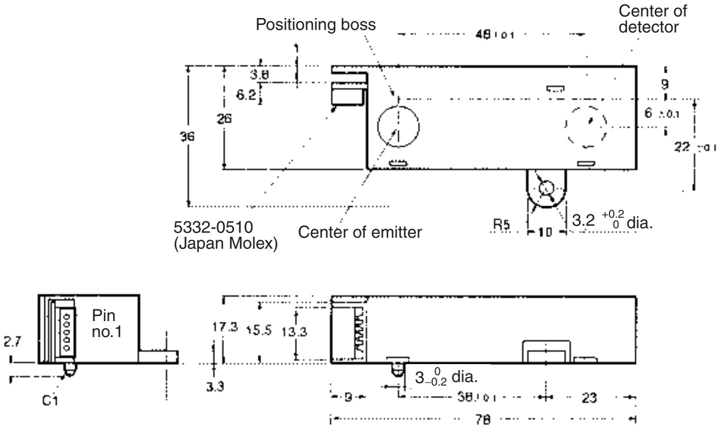
Item	Value	Condition
Power supply voltage	5 V ±5%	–
Current consumption	50 mA max.	V_{CC} = 5 V, $R_L = \infty$
Peak current consumption	300 mA max.	V_{CC} = 5 V, $R_L = \infty$
Low-level output voltage	0.6 V max.	V_{CC} = 5 V, I_{OL} = 4 mA (see note 1)
High-level output voltage	3.5 V min.	V_{CC} = 5 V, R_L = 4.7 kΩ (see note 2)
Response delay time (High to low)	35 ms max.	The time required for the output to become “Lo” after placing sensing object.
Response delay time (Low to high)	20 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 0.6 maximum located at the correct sensing position.

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.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.



Recommended Mating Connectors:

Japan Molex 51090-0500 (crimp-type connector)
52484-0510 (press-fit connector)

Pin No.	Remarks	Name
1	O1	Output 1 (OUT1)
2	O2	Output 2 (OUT2)
3	O3	Output 3 (OUT3)
4	V	Power supply (V_{CC})
5	G	Ground (GND)

Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerence
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

■ Characteristics (Paper Table Glass: t = 6 mm max., Transparency Rate: 90% min.) (Ta = 0°C to 65°C)

Item	Characteristic value
Sensing density	Lusterless paper with an OD of 0.6 max. (sensing distance: 125 mm) (see note)
Non-sensing distance	185 mm (from the top of the sensor), OD: 0.05
Paper sensing distance	125 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.

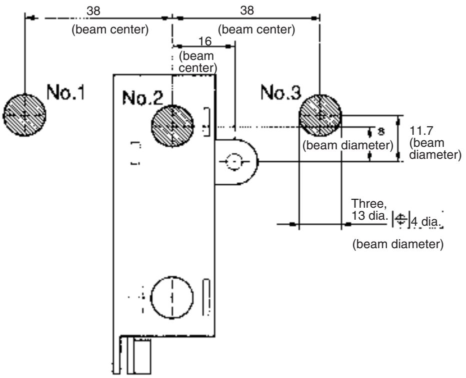
2. Optical darkness (OD) is defined by the following formula:

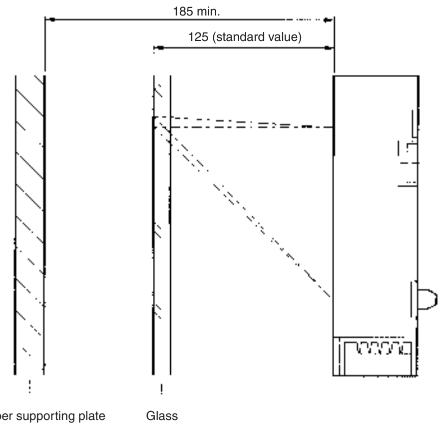
$$CD = -\log_{10}\left(\frac{P_{OUT}}{P_{IN}}\right)$$

P_{IN} (mW): Light power incident upon the document

P_{OUT} (mW): Reflected light power from the document

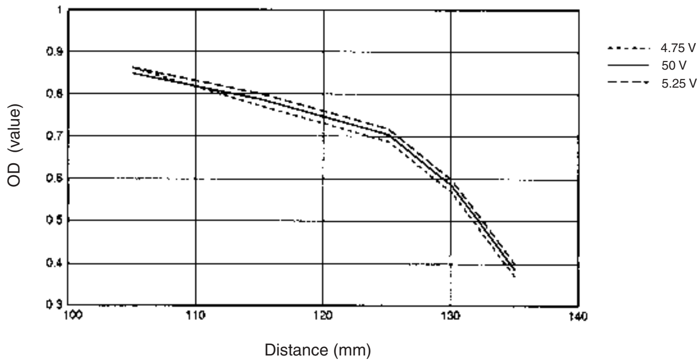
■ Optical Path Arrangement





■ Engineering Data

Distance Characteristics (Estimated Lower-limit Value).



■ 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.

Specifications

■ Absolute Maximum Ratings (Ta = 25°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**	Topr	0°C to 65°C
	Storage	Tstg	-15°C to 70°C

Note: Make sure there is no icing or condensation when operating the sensor.

■ Electrical and Optical Characteristics (Ta = 0°C to 65°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)	35 ms max.	The time required for the output to become “Lo” after placing sensing object.
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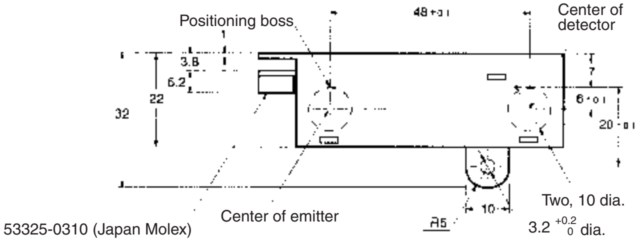
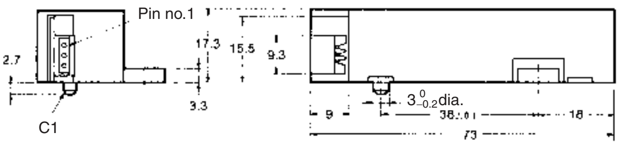
Note: 1. These conditions are for the sensing of lusterless paper with an OD of 0.6 maximum located at the correct sensing position of the Sensor.

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.

■ Dimensions

Note: All units are in millimeters unless otherwise indicated.





Recommended Mating Connectors:

Japan Molex 51090-0300 (crimp-type connector)
52484-0310 (insulation displacement-type connector)

Pin No.	Remarks	Name
1	O	Output (OUT)
2	V	Power supply (V_{CC})
3	G	Ground (GND)

Unless otherwise specified, the tolerances are as shown below.

Dimensions	Tolerence
3 mm max.	±0.3
3 < mm ≤ 6	±0.375
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Photomicrosensors

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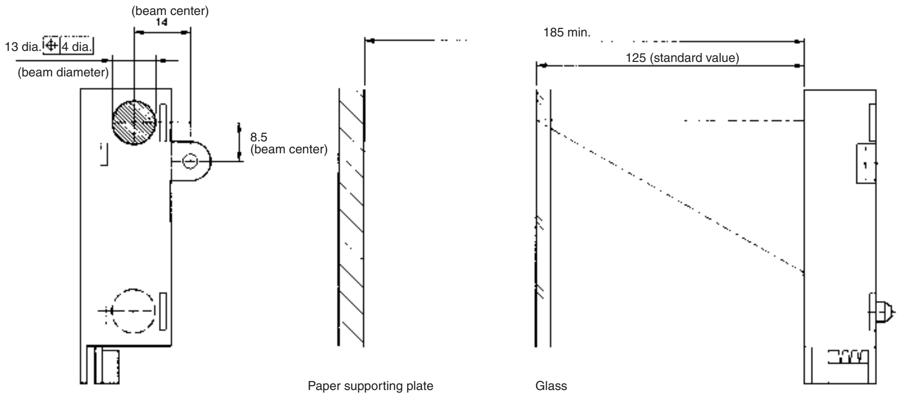
■ Optical Path Arrangement



■ Engineering Data

Distance Characteristics (Estimated Lower-limit Value).