OMRON

# Micro Sensing Device Data Book

## Microphotonic Devices
## Photomicrosensors


realizing

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## Microphotonic Devices

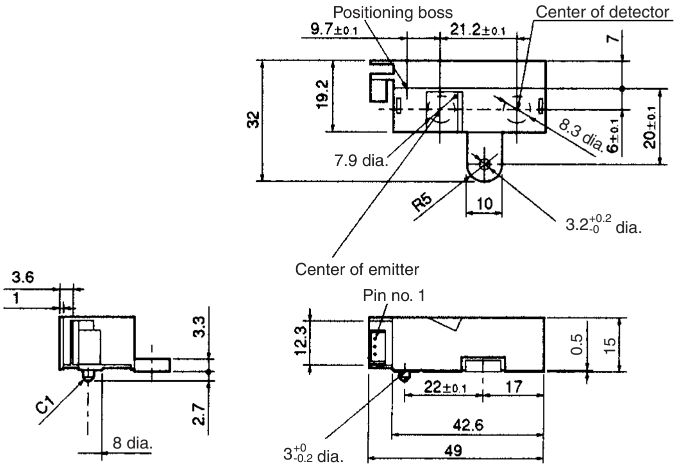
### Manuscript Paper Sensors

# Manuscript Paper Sensor (1 Beam: 50 mm)
# EY3A-1051

⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




| Pin no. | Remarks | Name |
|---|---|---|
| 1 | O | Output (OUT) |
| 2 | V | Power supply (Vcc) |
| 3 | G | Ground (GND) |

Unless otherwise specified, the tolerances are as shown below.

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

Recommended Mating Connectors:
Japan Molex 51090-0300 (crimp connector)
52484-0310 (press-fit connector)

## ■ Features

- Ensures higher sensitivity and external light interference resistivity than any other photomicrosensor.
- Narrow sensing range ensures stable sensing of a variety of sensing objects.

## ■ Absolute Maximum Ratings (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 60°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 60°C)

| Item | Value | Condition |
|---|---|---|
| **Power supply voltage** | 5 V ±5% | --- |
| **Current consumption** | 50 mA max. | $V_{CC}$ = 5 V, $R_L = \infty$ |
| **Peak current consumption** | 200 mA max. | $V_{CC}$ = 5 V, $R_L = \infty$ |
| **Low-level output voltage** | 0.6 V max. | $V_{CC}$ = 5 V, $I_{OL}$ = 4 mA (see note 1) |
| **High-level output voltage** | 3.5 V min. | $V_{CC}$ = 5 V, $R_L$ = 4.7 kΩ (see note 2) |
| **Response delay time (High to Low)** | 1.5 ms max. | The time required for the output to become "Lo" after placing sensing object. |
| **Response delay time (Low to high)** | 1.5 ms max. | The time required for the output to become "Hi" after removing sensing object. |

**Note: 1.** These conditions are for the sensing of lusterless paper with an OD of 0.9 maximum located at the correct sensing position of the Sensor as shown in the optical path arrangement on page 7.

**2.** These conditions are for the sensing of the paper supporting plate with an OD of 0.05 located using the glass plate without paper as shown in the optical path arrangement on page 7.

## ■ Characteristics (Paper Table Glass: t = 6 mm max., Transparency Rate: 90% min.) (Ta =0°C to 60°C)

| Item | Characteristic value |
|---|---|
| **Sensing density** | Lusterless paper with an OD of 0.9 max. (sensing distance: 50 mm) (see note) |
| **Non-sensing distance** | 85 mm (from the top of the sensor), OD: 0.05 |
| **Paper sensing distance** | 50 mm (from the top of the sensor) |
| **Ambient illumination** | Sunlight: 3,000 ℓx max., fluorescent light: 2,000 ℓx max. |

**Note: 1.** The data shown are initial data.

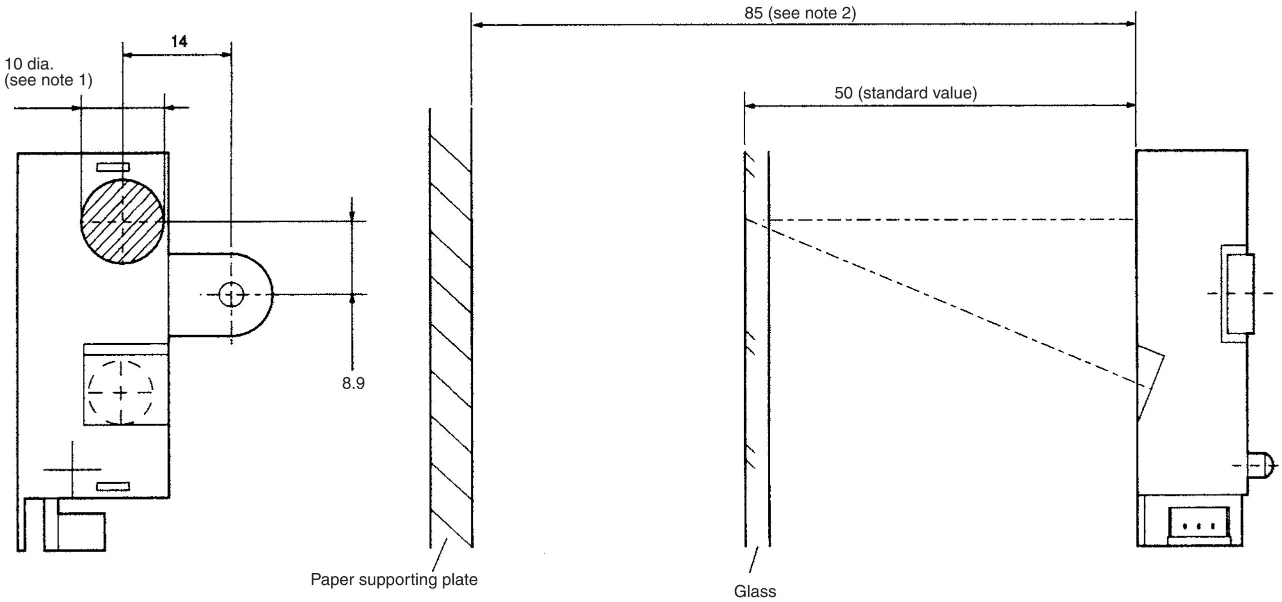
**2.** Optical darkness (OD) is defined by the following formula:

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

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

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

## ■ Optical Path Arrangement

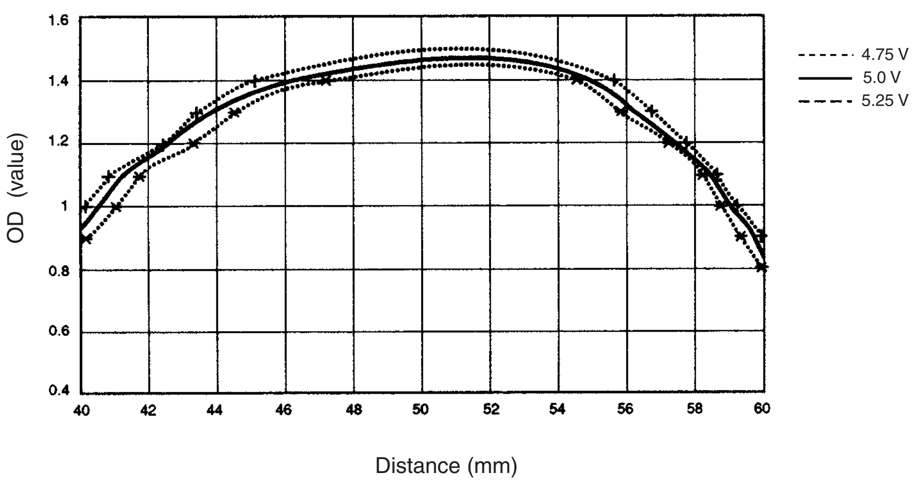



**Note:** 1. The part with oblique lines indicates the paper sensing area of the EY3A-1051, which is practically determined by the diameter of the beam and its tolerance.

2. The non-sensing distance of the EY3A-1051 is determined using a paper with an OD of 0.05.

## ■ Engineering Data

### Distance Characteristics (Typical)

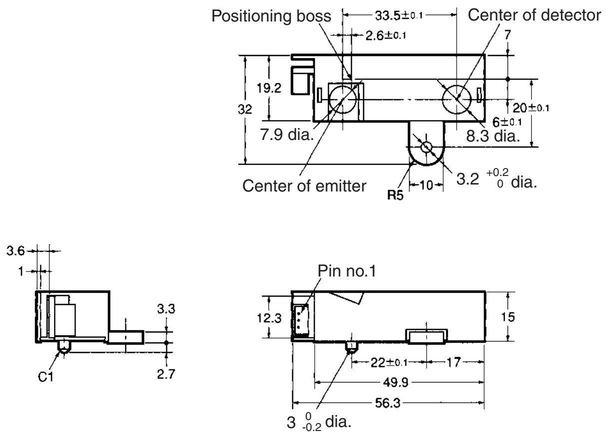


# Manuscript Paper Sensor (1 Beam: 80 mm)
# EY3A-1081

⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




| Pin no. | Remarks | Name |
|---|---|---|
| 1 | O | Output (OUT) |
| 2 | V | Power supply (Vcc) |
| 3 | G | Ground (GND) |

Unless otherwise specified, the tolerances are as shown below.

| Dimensions | Tolerance |
|---|---|
| 3 mm max. | ±0.3 |
| 3 < mm ≤ 6 | ±0.375 |
| 6 < mm ≤ 10 | ±0.45 |
| 10 < mm ≤ 18 | ±0.55 |
| 18 < mm ≤ 30 | ±0.65 |
| 30 < mm ≤ 50 | ±0.8 |
| 50 < mm ≤ 80 | ±0.95 |

Recommended Mating Connectors:
Japan Molex 51090-0300 (crimp connector)
52484-0310 (press-fit connector)

## ■ Features

- Ensures higher sensitivity and external light interference resistivity than any other photomicrosensor.
- Narrow sensing range ensures stable sensing of a variety of sensing objects.

## ■ Absolute Maximum Ratings (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 60°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 60°C)

| Item | Value | Condition |
|---|---|---|
| **Power supply voltage** | 5 V ±5% | --- |
| **Current consumption** | 50 mA max. | $V_{CC}$ = 5 V, $R_L = \infty$ |
| **Peak current consumption** | 200 mA max. | $V_{CC}$ = 5 V, $R_L = \infty$ |
| **Low-level output voltage** | 0.6 V max. | $V_{CC}$ = 5 V, $I_{OL}$ = 4 mA (see note 1) |
| **High-level output voltage** | 3.5 V min. | $V_{CC}$ = 5 V, $R_L$ = 4.7 kΩ (see note 2) |
| **Response delay time (High to Low)** | 1.5 ms max. | The time required for the output to become “Lo” after placing sensing object. |
| **Response delay time (Low to high)** | 1.5 ms max. | The time required for the output to become “Hi” after removing sensing object. |

**Note: 1.** These conditions are for the sensing of lusterless paper with an OD of 0.7 maximum located at the correct sensing position of the Sensor as shown in the optical path arrangement on page 9.

**2.** These conditions are for the sensing of the paper supporting plate with an OD of 0.05 located using the glass plate without paper as shown in the optical path arrangement on page 9.

## ■ Characteristics (Paper Table Glass: t = 6 mm max., Transparency Rate: 90% min.) (Ta =0°C to 60°C)

| Item | Characteristic value |
|---|---|
| **Sensing density** | Lusterless paper with an OD of 0.7 max. (sensing distance: 80 mm) (see note) |
| **Non-sensing distance** | 120 mm (from the top of the sensor), OD: 0.05 |
| **Paper sensing distance** | 80 mm (from the top of the sensor) |
| **Ambient illumination** | Sunlight: 3,000 ℓx max., fluorescent light: 2,000 ℓx max. |

**Note: 1.** The data shown are initial data.

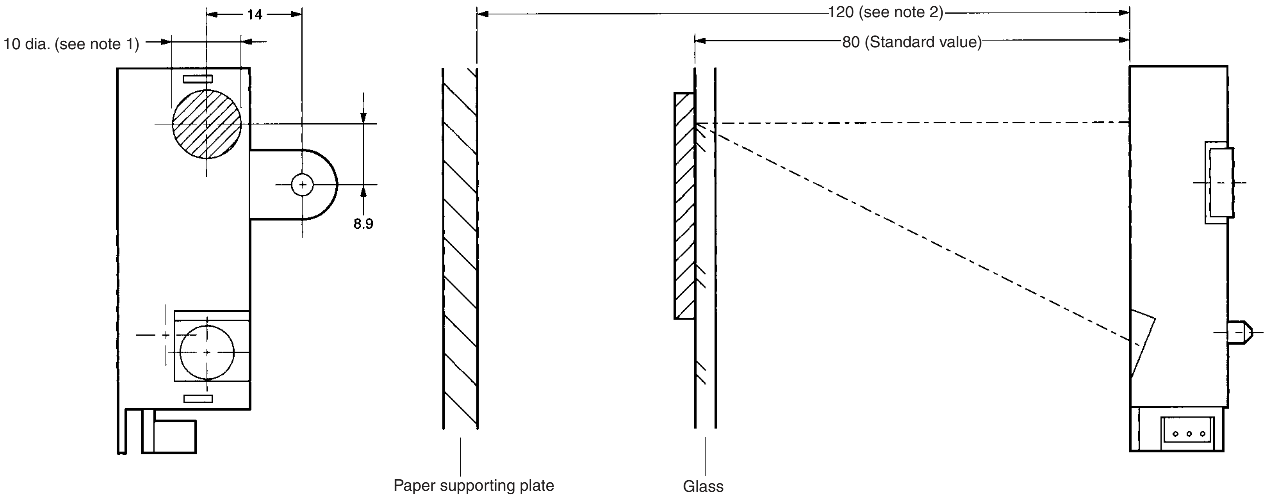
**2.** Optical darkness (OD) is defined by the following formula:

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

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

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

## ■ Optical Path Arrangement

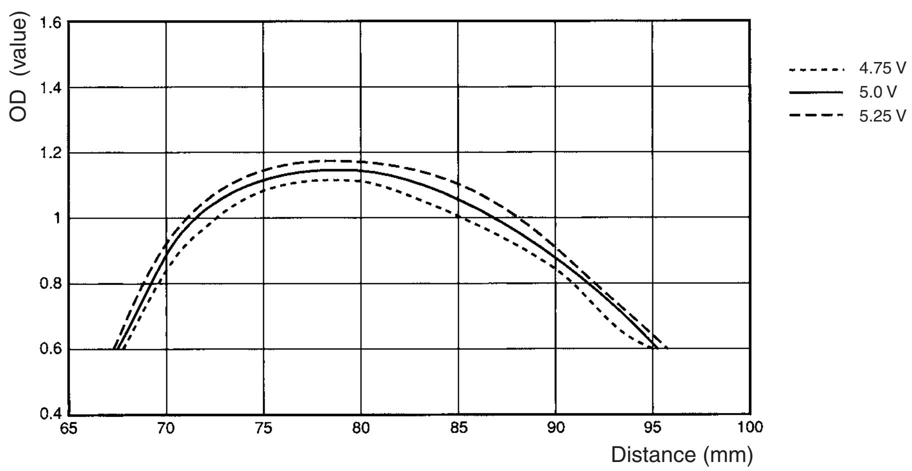



**Note: 1.** The part with oblique lines indicates the paper sensing area of the EY3A-1081, which is practically determined by the diameter of the beam and its tolerance.

**2.** The non-sensing distance of the EY3A-1081 is determined using a paper with an OD of 0.05.

## ■ Engineering Data

### Distance Characteristics (Typical)



# Photomicrosensors

## Transmissive Sensors



## Reflective Sensors

# Technical Information

## Features of Photomicrosensors

The Photomicrosensor is a compact optical sensor that senses objects or object positions with an optical beam. The transmissive Photomicrosensor and reflective Photomicrosensor are typical Photomicrosensors.
The transmissive Photomicrosensor incorporates an emitter and a transmissive that face each other as shown in Figure 1. When an object is located in the sensing position between the emitter and the detector, the object intercepts the optical beam of the emitter, thus reducing the amount of optical energy reaching the detector.
The reflective Photomicrosensor incorporates an emitter and a detector as shown in Figure 2. When an object is located in the sensing area of the reflective Photomicrosensor, the object reflects the optical beam of the emitter, thus changing the amount of optical energy reaching the detector.
"Photomicrosensor" is an OMRON product name. Generally, the Photomicrosensor is called a photointerrupter.

**Figure 1. Transmissive Photomicrosensor**

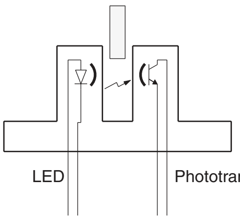
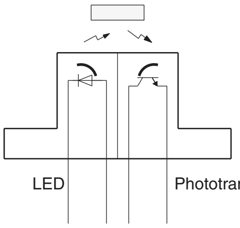



**Figure 2. Reflective Photomicrosensor**




## Datasheet

### ■ Absolute Maximum Ratings and Electrical and Optical Characteristics

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

### ■ Absolute Maximum Ratings

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

### ■ Electrical and Optical Characteristics

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

# Terminology

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

## ■ Phototransistor Output Photomicrosensor

| Symbol | Item | Definition |
|---|---|---|
| $I_{FP}$ | **Pulse forward current** | The maximum pulse current that is allowed to flow continuously from the anode to cathode of an LED under a specified temperature, a repetition period, and a pulse width condition. |
| $I_C$ | **Collector current** | The current that flows to the collector junction of a phototransistor. |
| $P_C$ | **Collector dissipation** | The maximum power that is consumed by the collector junction of a phototransistor. |
| $I_D$ | **Dark current** | The current leakage of the phototransistor when a specified bias voltage is imposed on the phototransistor so that the polarity of the collector is positive and that of the emitter is negative on condition that the illumination of the Photomicrosensor is 0 ℓx. |
| $I_L$ | **Light current** | The collector current of a phototransistor under a specified input current condition and at a specified bias voltage. |
| $V_{CE}$ (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. |
| $\Delta H$ | **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

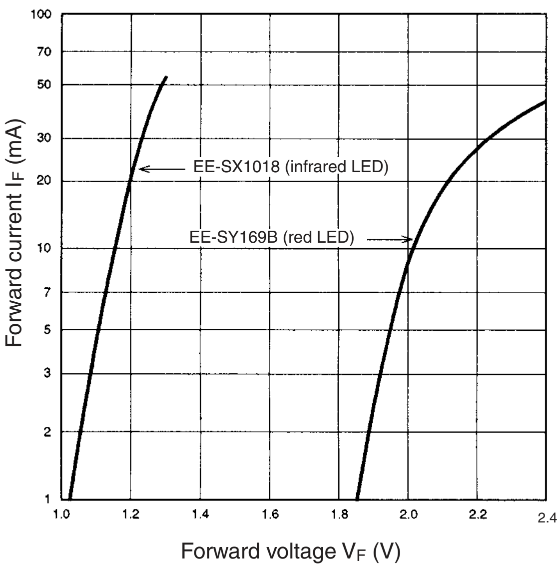
The following explains how systems using Photomicrosensors must be designed.

## ■ Emitter

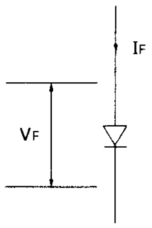
### Characteristics of Emitter

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-SY169B, which has an emitter with a red LED, are changed by the voltages imposed on the EE-SX1018 and EE-SY169B. As shown in this figure, the LED forward current characteristics of the EE-SX1018 greatly differ from those of the EE-SY169B. The LED forward current characteristics of any Photomicrosensor indicate how the voltage drop of the LED incorporated by the emitter of the Photomicrosensor is changed by the LED's forward current ($I_F$) flowing from the anode to cathode. Figure 3 shows that the forward voltage ($V_F$) of the red LED is higher than that of the infrared LED.
The forward voltage ($V_F$) of the infrared LED is approximately 1.2 V and that of the red LED is approximately 2 V provided that the practical current required by the infrared LED and that required by the red LED flow into these LEDs respectively.

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




**Forward Voltage $V_F$**

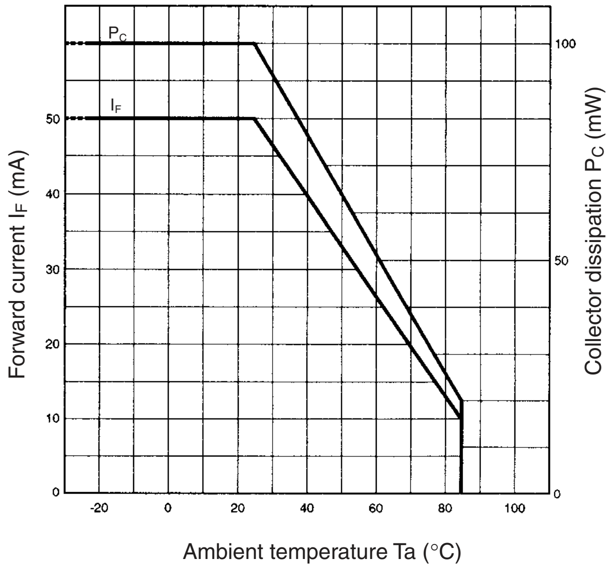



### Driving Current Level

It is especially important to decide the level of the forward current ($I_F$) of the emitter incorporated by any Photomicrosensor. The forward current must not be too large or too small.
Before using any Photomicrosensor, refer to the absolute maximum ratings in the datasheet of the Photomicrosensor to find the emitter's forward current upper limit. For example, the first item in the absolute maximum ratings in the datasheet of the EE-SX1018 shows that the forward current ($I_F$) of its emitter is 50 mA at a 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 $I_F$ is zero.

**Figure 4. Temperature Characteristics (EE-SX1018)**




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

## Design Method

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

The basic circuit absolutely requires a limiting resistor (R). If the LED is imposed with a forward bias voltage without the limiting resistor, the current of the LED is theoretically limitless because the forward impedance of the LED is low. As a result the LED will burn out. Users often ask OMRON about the appropriate forward voltage to be imposed on the LED incorporated by each Photomicrosensor model that they use. There is no upper limit of the forward voltage imposed on the LED provided that an appropriate limiting resistor is connected to the LED. There is, however, the lower limit of the forward voltage imposed on the LED. As shown in Figure 3, the lower limit of the forward voltage imposed on the LED must be at least 1.2 to 2 V, or no forward current will flow into the LED. The supply voltage of a standard electronic circuit is 5 V minimum. Therefore, a minimum of 5 V should be imposed on the LED. A system incorporating any Photomicrosensor must be designed by considering the following.

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

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

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

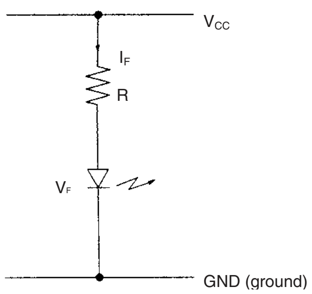
In this case 5 V must be substituted for the supply voltage ($V_{CC}$). The forward voltage ($V_F$) obtained from Figure 3 is approximately 1.2 V when the forward current ($I_F$) of the LED is 20 mA. Therefore, the following resistance is obtained.

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

= approx. 180 to 220 Ω

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

**Figure 5. Basic Circuit**




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

In short, the following are important points required to operate any Photomicrosensor.

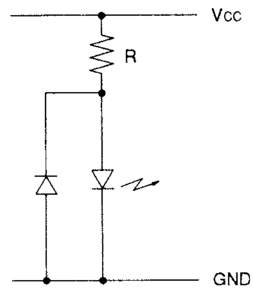
A forward voltage ($V_F$) of approximately 1.2 V is required if the Photomicrosensor has an infrared LED and a forward voltage ($V_F$) of approximately 2 V is required if the Photomicrosensor has a red LED.

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

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

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

**Figure 6. Reverse Voltage Protection Circuit**



## ■ Design of Systems Incorporating Photomicrosensors (1)

# Phototransistor Output

### Characteristics of Detector Element

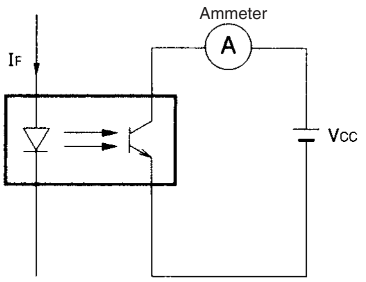
The changes in the current flow of the detector element with and without an optical input are important characteristics of a detector element. Figure 7 shows a circuit used to check how the current flow of the phototransistor incorporated by a Photomicrosensor is changed by the LED with or without an appropriate forward current ($I_F$) flow, provided that the ambient illumination of the Photomicrosensor is ideal (i.e., 0 ℓx). When there is no forward current ($I_F$) flowing into the LED or the optical beam emitted from the LED is intercepted by an opaque object, the ammeter indicates several nanoamperes due to a current leaking from the phototransistor. This current is called the dark current ($I_D$). When the forward current ($I_F$) flows into the LED with no object intercepting the optical beam emitted from the LED, the ammeter indicates several milliamperes. This current is called the light current ($I_L$).

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

- When optical beam to the phototransistor is interrupted
  Dark current $I_D$: $10^{-9}$ A
- When optical beam to the phototransistor is not interrupted
  Light current $I_L$: $10^{-3}$ A

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

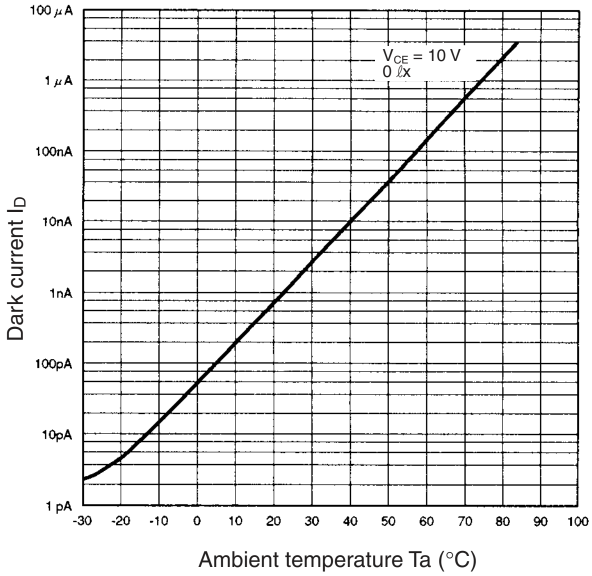
**Figure 7. Measuring Circuit**




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

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

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




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

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

**Figure 9. LED and Phototransistor Temperature Characteristics (Typical)**

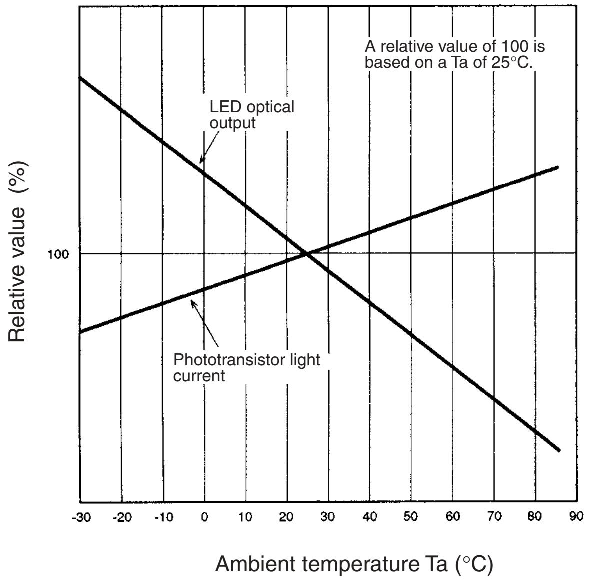
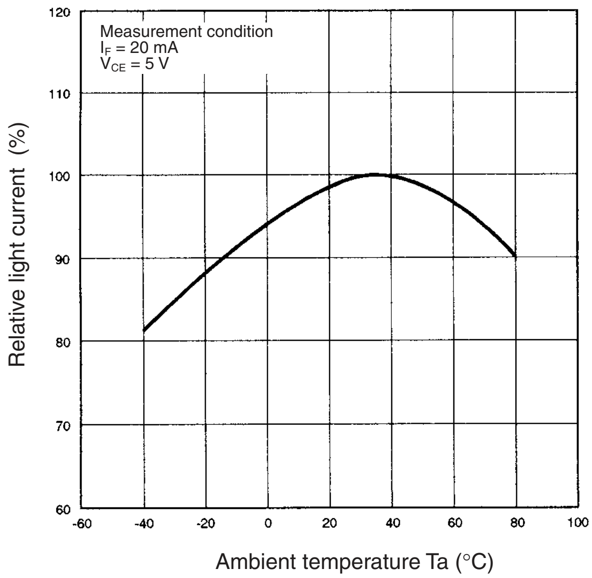



**Figure 10. Relative Light Current vs. Ambient Temperature Characteristics (EE-SX1018)**




## Changes in Characteristics

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

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

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

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

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

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

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

- Temperature change
- Secular change

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

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

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

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

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

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

| Model | Upper limit ($I_D$) | Lower limit ($I_L$) | Condition |
|---|---|---|---|
| EE-SG3(-B) | 200 nA | 2 mA | $I_F$ = 15 mA |
| EE-SX1018, -SX1055<br>EE-SX1041, -SX1042<br>EE-SX1070, -SX1071<br>EE-SX198, -SX199 | 200 nA | 0.5 mA | $I_F$ = 20 mA |
| EE-SB5(-B)<br>EE-SF5(-B)<br>EE-SY110 | 200 nA | 0.2 mA | $I_F$ = 20 mA (see note) |
| Condition | $V_{CE}$ = 10 V, 0 ℓx<br>Ta = 25°C | $V_{CE}$ = 10 V<br>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)**<br>**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)**

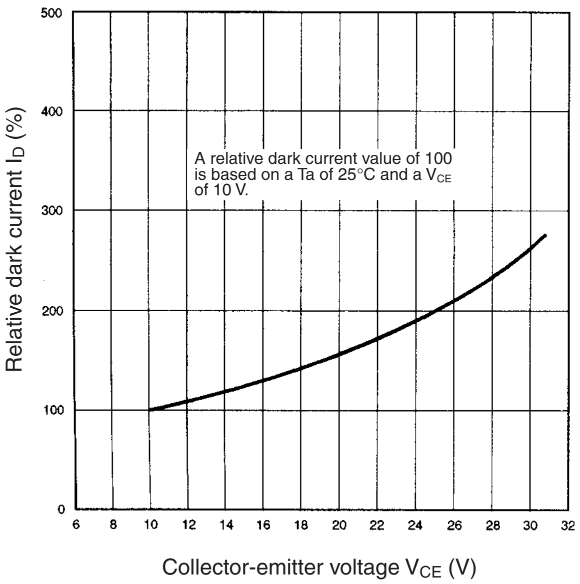


**Table 3. Estimated Worst Values of a Variety of Photomicrosensors**

| 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<br>EE-SX1041, -SX1042<br>EE-SX1070, -SX1071<br>EE-SX198, -SX199 | 4 nA | 0.25 mA | $I_F$ = 20 mA |
| EE-SB5(-B)<br>EE-SF5(-B)<br>EE-SY110 | 4 nA | 0.1 mA | $I_F$ = 20 mA (see note) |
| Condition | $V_{CE}$ = 10 V, 0 ℓx<br>Ta = 60°C | $V_{CE}$ = 10 V,<br>Operating hours = 50,000 to 100,000 hrs<br>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 ($R_L$) 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**

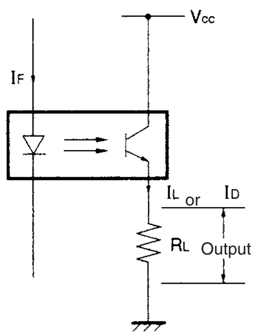
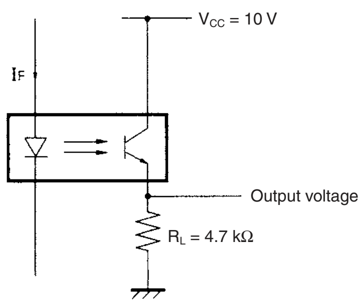



**Figure 14. Output Example**




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 $Q_1$. Therefore, no current will flow into the base of $Q_1$ and $Q_1$ will be OFF. The output of $Q_1$ will be at a high level. As shown in Figure 16, when the phototransistor is ON, the phototransistor will be seemingly short-circuited through the base and emitter of the $Q_1$, which is equivalent to a diode, and if the light current ($I_L$) of the phototransistor is large and $R_1$ is not connected to the phototransistor, the light current ($I_L$) will flow into $Q_1$ and the collector dissipation of the phototransistor will be excessively large.

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

- The voltage output (i.e., $I_L$ 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 $Q_1$.
- 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 $Q_1$.

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

**Figure 15. Applied Circuit**

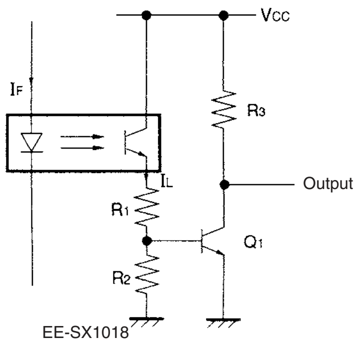



**Figure 16. Equivalent Circuit**

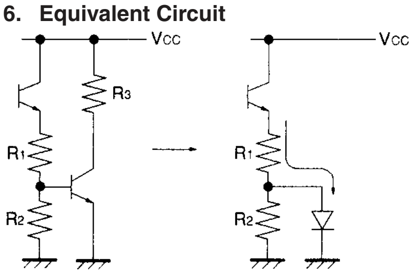
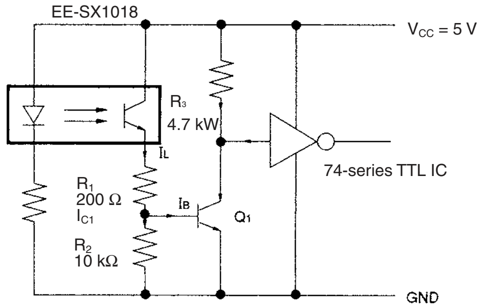



**Figure 17. Applied Circuit Example**




## Calculation of $R_2$

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

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

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

Therefore, the following is obtained.

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

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

### Verification of $R_2$ Value

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

$$(I_D + \alpha) \times R_2 < V_{BE(OFF)}$$

Substitute 10 kΩ for $R_2$, 4 µA for the dark current ($I_D$) 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.

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

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.

**$R_1$**

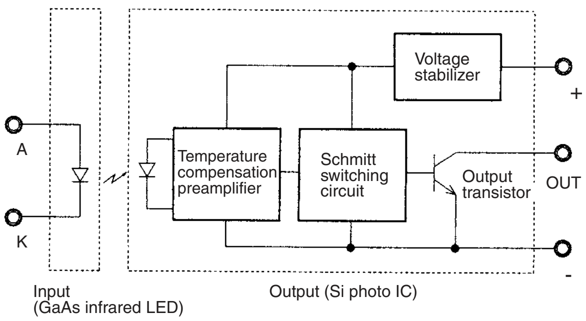
As shown in Figure 16, when the phototransistor is ON, the phototransistor will be seemingly short-circuited through the base and emitter of the $Q_1$, and if the light current ($I_L$) of the phototransistor is large and $R_1$ is not connected to the phototransistor, the light current will flow into $Q_1$ and the collector dissipation of the phototransistor will be excessively large. The resistance of $R_1$ depends on the maximum permissible collector dissipation ($P_C$) 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<br>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 $I_{FTOFF}$ value must flow into the LED incorporated by each EE-SX301 Photomicrosensors.
- A forward current equivalent to or exceeding the $I_{FTON}$ value must flow into the LED incorporated by the EE-SX401 Photomicrosensors.

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

## Detector Circuit

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

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

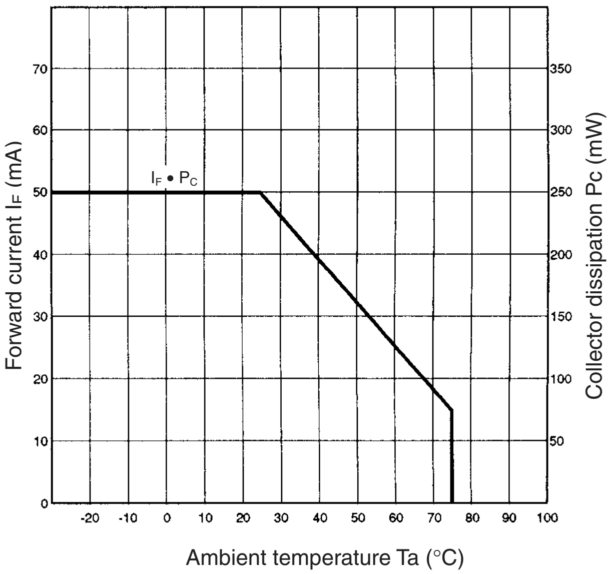



**Figure 20. Basic Circuit**

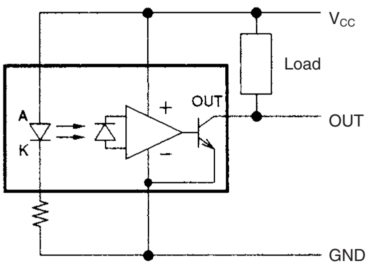
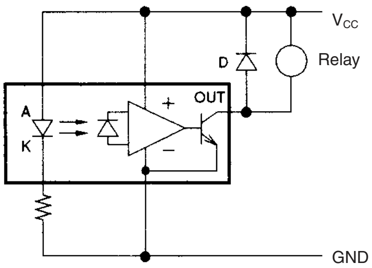



**Figure 21. Connected to Inductive Load**




# 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.

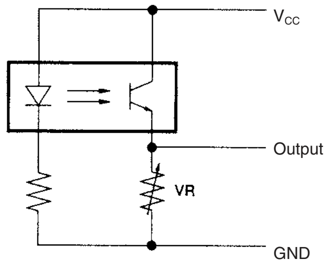
- Highly permeable objects such as paper, film, and plastic
- Objects smaller than the size of the optical beam emitted by the LED or the size of the aperture of the detector.

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.

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

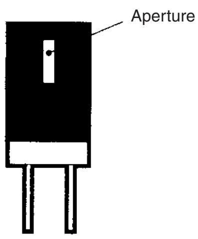
The light current ($I_L$) of the phototransistor varies with the ambient temperature and secular changes. Therefore, if the signal-noise ratio of the phototransistor is 4 maximum, it is necessary to pay utmost attention to the circuit connected to the transmissive Photomicrosensor so that the transmissive 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 ($I_L$) of the phototransistor incorporated by the detector will decrease. It is desirable to attach apertures to both the emitter and detector. If an aperture is attached to the detector only, the transmissive Photomicrosensor will have trouble sensing the above objects when they pass near the emitter.

**Figure 23. Aperture Example**



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

**Figure 24. Chattering Output Signal**

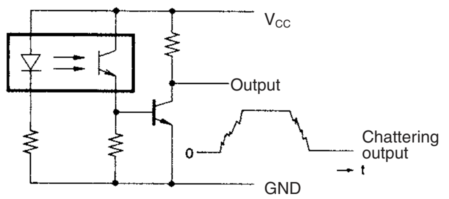



**Figure 25. Chattering Prevention (1)**

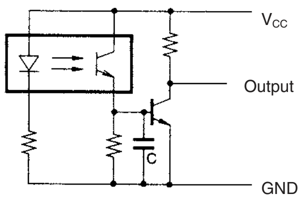
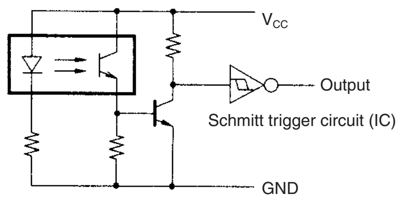



**Figure 26. Chattering Prevention (2)**




## ■ Reflective Photomicrosensor Incorporating Phototransistor Output Circuit

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

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

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

**Figure 27. Configuration of Reflective Photomicrosensor**

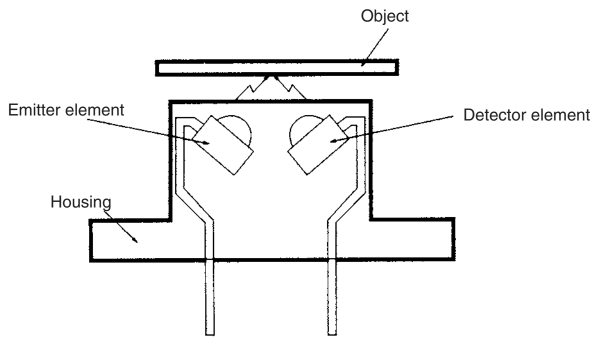



**Figure 28. Light Interception Characteristics of Filters**

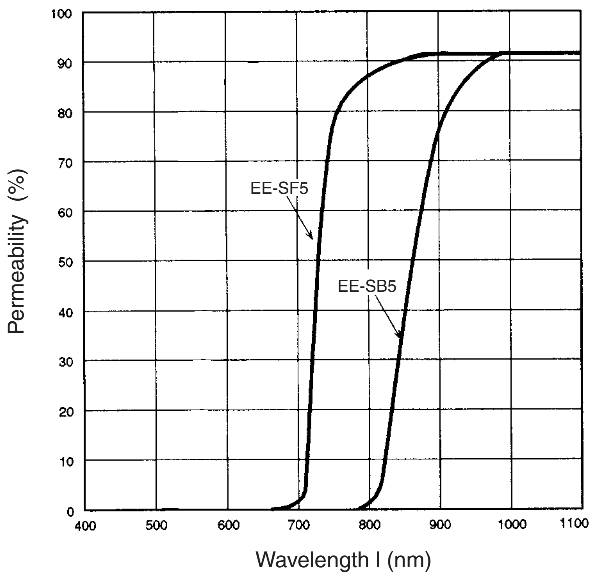
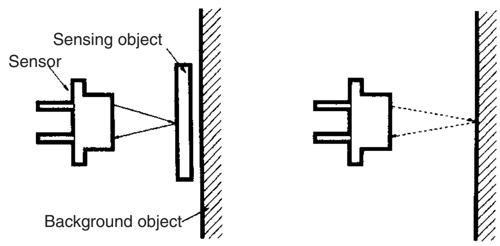



**Figure 29. Influence of Background Object**




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

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

Unlike the output (i.e., $I_L$) of any transmissive Photomicrosensor, the light current ($I_L$) of a reflective Photomicrosensor greatly varies according to sensing object type, sensing distance, and sensing object size.

**Figure 30. Example of Countermeasure**

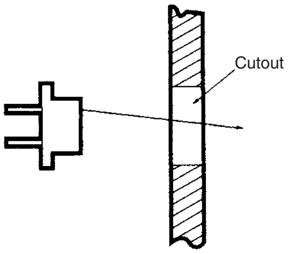
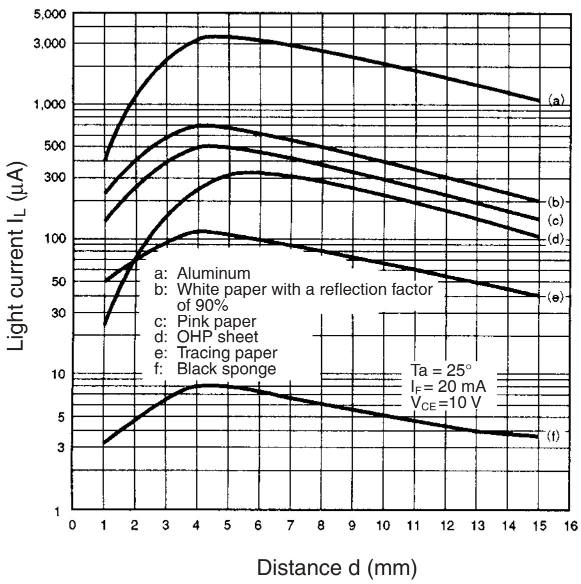



**Figure 31. Sensing Distance Characteristics (EE-SF5)**




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

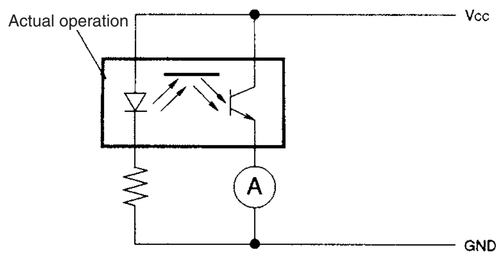
Pay utmost attention when applying the reflective Photomicrosensor to the sensing of the following.

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

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

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

**Figure 32. Output Current Measurement**



# Precautions

## ■ Correct Use

**⚠ WARNING**

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

### Precautions for Safe Use

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

### Precautions for Correct Use

### ● Structure and Materials

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

1. **Low Heat Resistivity**
   The storage temperature of standard ICs and transistors is approximately 150°C. The storage temperature of highly resistant Photomicrosensors is 100°C maximum. The heat resistance of the EE-SY169 Series which use ABS resin in the case, is particularly low (80°C maximum).
2. **Low Mechanical Strength**
   Black epoxy resin, which is used for the main bodies of ICs and transistors, contains additive agents including glass fiber to increase the heat resistivity and mechanical strength of the main bodies. Materials with additive agents cannot be used for the bodies of Photomicrosensors because Photomicrosensors must maintain good optical permeability. Unlike ICs and transistors, Photomicrosensors must be handled with utmost care because Photomicrosensors are not as heat or mechanically resistant as ICs and transistors. No excessive force must be imposed on the lead wires of Photomicrosensors.

### ● Mounting

#### Screw Mounting

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

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

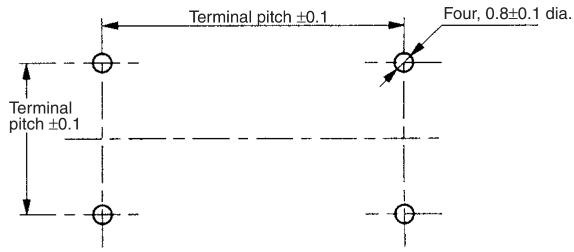
Read the following before tightening the screws.

1. The use of a torque screwdriver is recommended to tighten each of the screws so that the screws can be tightened to the tightening torque required.
2. The use of a screw with a spring washer and flat washer for the mounting holes of a Photomicrosensor is recommended. If a screw with a spring washer but without a flat washer is used for any mounting hole, the part around the mounting hole may crack.
3. Do not mount Photomicrosensors to plates stained with machining oil, otherwise the machining oil may cause cracks on the Photomicrosensors.
4. Do not impose excessive forces on Photomicrosensors mounted to PCBs. Make sure that no continuous or instantaneous external force exceeding 500 g (4.9 N) is imposed on any lead wire of the Photomicrosensors.

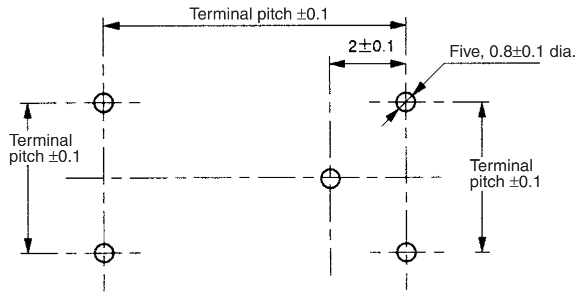
#### PCB Mounting Holes

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

**Four Terminals**




**Five Terminals**




### ● Soldering

#### Lead Wires

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

#### Soldering Temperature

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

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

| | |
|---|---|
| Soldering temperature: | 350°C max. (The temperature of the tip of a 30-W soldering iron is approximately 320°C when the soldering iron is heated up.) |
| Soldering time: | 3 s max. |
| Soldering position: | At least 1.5 mm away from the bases of the lead wires. |

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

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

| | |
|---|---|
| Preheating temperature: | Must not exceed the storage temperature of the Photomicrosensors. |
| Soldering temperature: | 260°C max. (the lead wires) |
| Soldering time: | 10 s max. |
| Soldering position: | At least 0.3 mm away from the bases of the housing. |

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

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

3. **Reflow Soldering**
   The reflow soldering of Photomicrosensors is not possible except for the EE-SX1107, -SX1108, -SX1109, -SX1131, -SX4134 and EE-SY193. The reflow soldering of these products must be performed carefully under the conditions specified in the datasheets of these products, respectively. Before performing the reflow soldering of these products, make sure that the reflow soldering equipment satisfies the conditions.

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

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

### External Forces

The heat resistivity and mechanical strength of Photomicrosensors are lower than those of ICs or transistors. Do not 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 dip-soldered.

## ● Cleaning Precautions

### Cleaning

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

1. **Types of Detergent**
   Polycarbonate is used for the bodies of most Photomicrosensors. Some types of detergent dissolve or crack polycarbonate. Before cleaning Photomicrosensors, refer to the following results of experiments, which indicate what types of detergent are suitable for cleaning Photomicrosensors other than the EE-SA105 and EE-SA113.
   Observe the law and prevent against any environmental damage when using any detergent.

   **Results of Experiments**

| | |
|---|---|
| Ethyl alcohol: | OK |
| Methyl alcohol: | OK |
| Isopropyl alcohol: | OK |
| Trichlene: | NG |
| Acetone: | NG |
| Methylbenzene: | NG |
| Water (hot water): | The lead wires corrode depending on the conditions |

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

| | |
|---|---|
| DIP cleaning: | OK |
| Ultrasonic cleaning: | Depends on the equipment and the PCB size. Before cleaning Photomicrosensors, conduct a cleaning test with a single Photomicrosensor and make sure that the Photomicrosensor has no broken lead wires after the Photomicrosensor is cleaned. |
| Brushing: | The marks on Photomicrosensors may be brushed off. The emitters and detectors of reflective Photomicrosensors may have scratches and deteriorate when they are brushed. Before brushing Photomicrosensors, conduct a brushing test with a single Photomicrosensor and make sure that the Photomicrosensor is not damaged after it is brushed. |

## ● Operating and Storage Temperatures

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

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

## ● LED Drive Currents

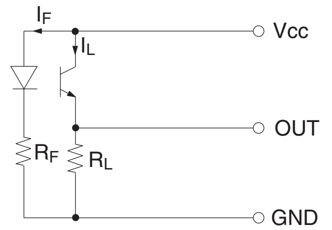
Photomicrosensors consist of LEDs and light detectors. Generally speaking, temporal changes occur to LEDs when power is supplied to them (i.e., the amount of light emitted diminishes). With less light, the photoelectric current is reduced for a sensor with a phototransistor output or the threshold current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

## ● Light Interceptors

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

### Guideline for Light Interceptors

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




**Criteria**

Where,

$I_{L1}$ is the $I_L$ for light reception
$I_{L2}$ is the $I_L$ for light interception by the 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 $I_F$ in actual application ( $= (V_{CC} - V_F)/R_F = (V_{CC} - 1.2)/R_F$)
$I_{LMAX}$ is the standard upper limit of the optical current $I_L$

Then,

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

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

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

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

## ● Reflectors

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

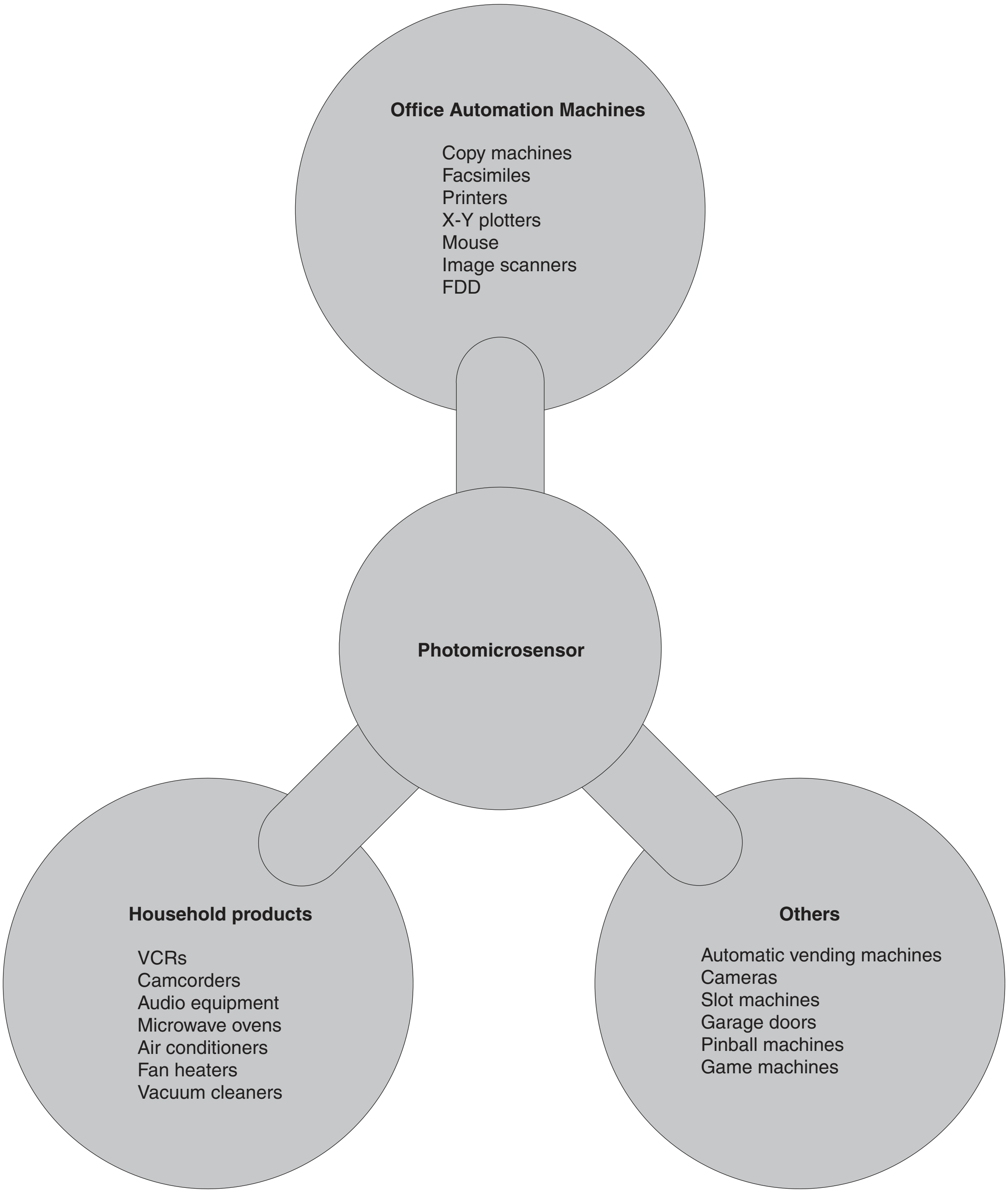
## ● Output Stabilization Time

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

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

# Application Examples

**Most People May Not Realize the Fact that Photomicrosensors are Built Into Machines and Equipment that are Used Everyday**



## ■ Application Examples

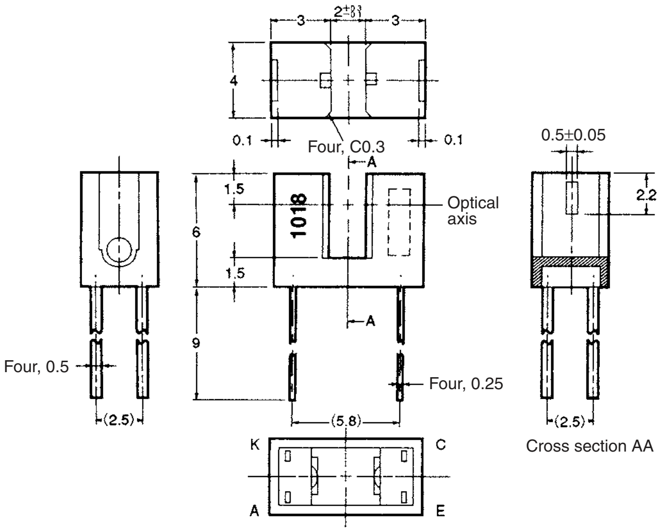
| Classification | Products | Sensing example |
|---|---|---|
| **Household products** | VCRs | Rotating reel sensing and tape sensing |
| | Camcorders | Lens origin sensing and lens control |
| | Laserdisc players | Rotation sensing and disk size sensing |
| | Air conditioners/Fan heaters | Louver direction sensing and fan motor rotation sensing |
| | Microwave ovens | Turntable sensing |
| | Vacuum cleaners | Carpet and floor discrimination |
| **Office automation machines** | Printers | Origin sensing, paper sensing, paper size sensing, and ink ribbon end sensing |
| | Copy machines | Paper sensing, cassette sensing, and toner sensing |
| | Facsimiles | Paper sensing, black end mark sensing, paper size sensing |
| | Floppy disk drives | Disk sensing, origin sensing, and write protect sensing |
| | Optical disk drives | Disk sensing, disk type sensing, and write protection sensing |
| | Image scanners | Origin sensing and movement value sensing |
| | Mouse | Movement direction sensing and movement value sensing |
| | X-Y plotters | Paper sensing, origin sensing, pen sensing, and movement value sensing |
| **Others** | Automatic vending machines/Ticket machines | Coin sensing, coin discrimination, and ticket sensing |
| | Cameras | Film forwarding, lens control, and motor control |
| | Cash dispensers | Card sensing, bill sensing, mechanical control |
| | Robot/Machine tools | Mechanical control |
| | Sewing machines | Motor rotation sensing and needle position sensing |
| | Pinball machines | Ball sensing, mechanical control, and sensing of remaining balls |
| | Slot machines | Coil sensing and lever sensing |
| | Game machines | Prize sensing, coil sensing, and mechanical control |
| | Garage doors | Door opening and closing sensing |

# Photomicrosensor (Transmissive)
# EE-SX1018

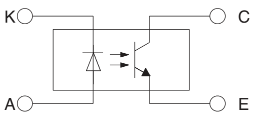
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

| Item | | Symbol | Rated value |
|---|---|---|---|
| **Emitter** | **Forward current** | $I_F$ | 50 mA (see note 1) |
| | **Pulse forward current** | $I_{FP}$ | 1 A (see note 2) |
| | **Reverse voltage** | $V_R$ | 4 V |
| **Detector** | **Collector–Emitter voltage** | $V_{CEO}$ | 30 V |
| | **Emitter–Collector voltage** | $V_{ECO}$ | --- |
| | **Collector current** | $I_C$ | 20 mA |
| | **Collector dissipation** | $P_C$ | 100 mW (see note 1) |
| **Ambient temperature** | **Operating** | 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.

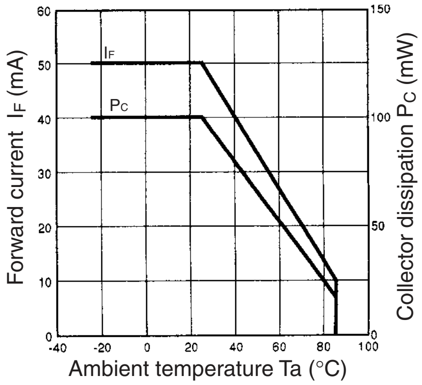
**3.** Complete soldering within 10 seconds.

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

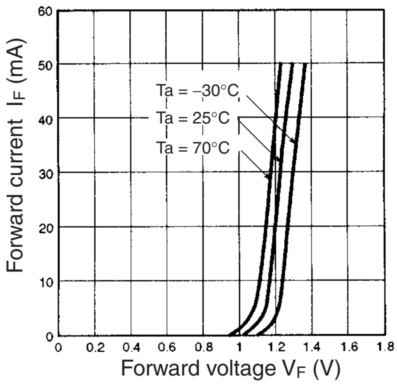
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 30 mA |
| | **Reverse current** | $I_R$ | 0.01 μA typ., 10 μA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **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** | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| **Rising time** | | tr | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |
| **Falling time** | | tf | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |

## ■ Engineering Data

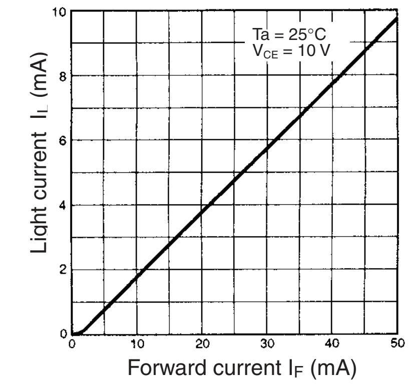
### Forward Current vs. Collector Dissipation Temperature Rating



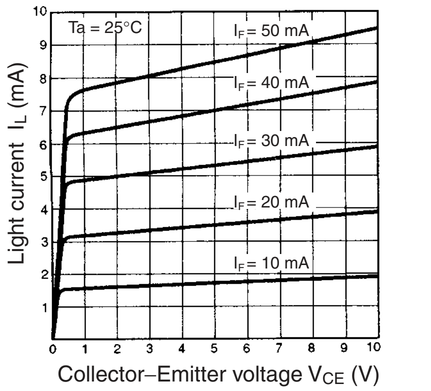

### Forward Current vs. Forward Voltage Characteristics (Typical)



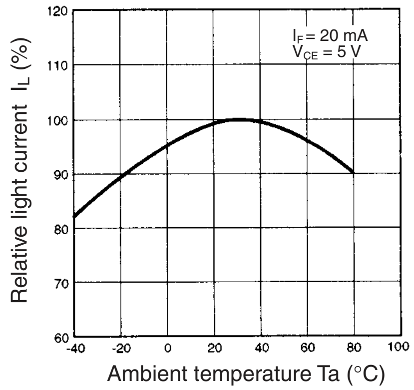

### Light Current vs. Forward Current Characteristics (Typical)



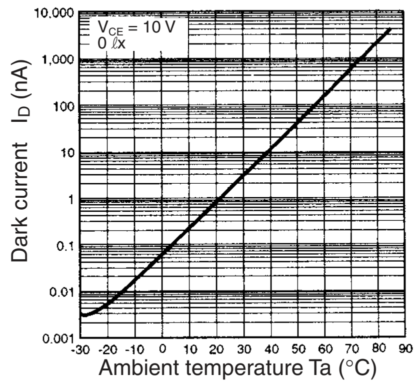

### Light Current vs. Collector−Emitter Voltage Characteristics (Typical)



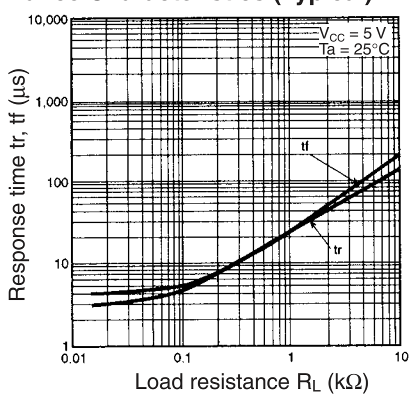

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



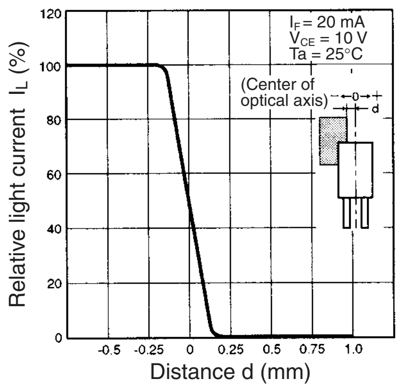

### Dark Current vs. Ambient Temperature Characteristics (Typical)



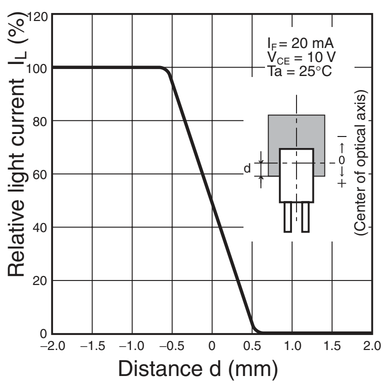

### Response Time vs. Load Resistance Characteristics (Typical)



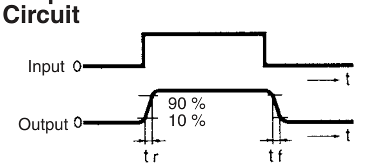

### Sensing Position Characteristics (Typical)

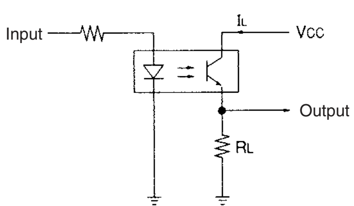



### Sensing Position Characteristics (Typical)




### Response Time Measurement Circuit



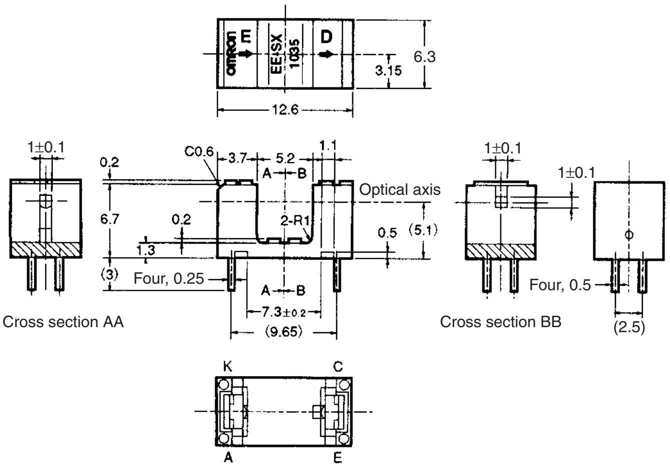



# Photomicrosensor (Transmissive)
# EE-SX1035

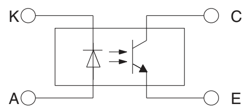
⚠ Be sure to read *Precautions* on page 25.

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

| Item | | Symbol | Rated value |
|---|---|---|---|
| Emitter | Forward current | $I_F$ | 50 mA (see note 1) |
| | Pulse forward current | $I_{FP}$ | 1 A (see note 2) |
| | Reverse voltage | $V_R$ | 4 V |
| Detector | Collector–Emitter voltage | $V_{CEO}$ | 30 V |
| | Emitter–Collector voltage | $V_{ECO}$ | 5 V |
| | Collector current | $I_C$ | 20 mA |
| | Collector dissipation | $P_C$ | 100 mW (see note 1) |
| Ambient temperature | Operating | 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.

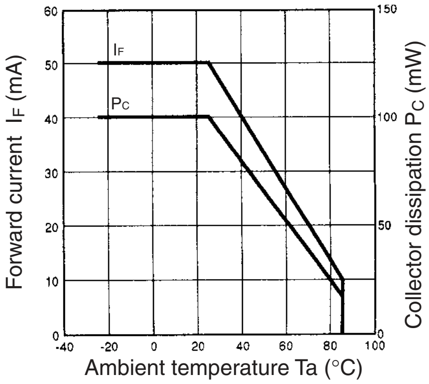
**3.** Complete soldering within 10 seconds.

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

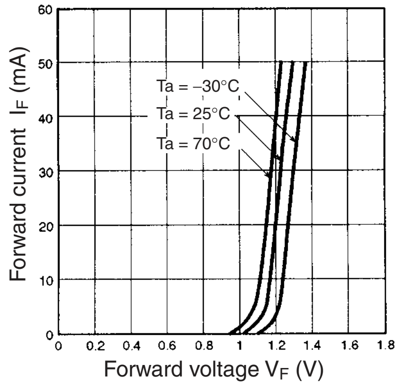
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| Emitter | Forward voltage | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 30 mA |
| | Reverse current | $I_R$ | 0.01 μA typ., 10 μA max. | $V_R$ = 4 V |
| | Peak emission wavelength | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| Detector | Light current | $I_L$ | 0.5 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) | 0.15 V typ., 0.4 V max. | $I_F$ = 20 mA, $I_L$ = 0.1 mA |
| | Peak spectral sensitivity wavelength | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| Rising time | | tr | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |
| Falling time | | tf | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |

## ■ Engineering Data

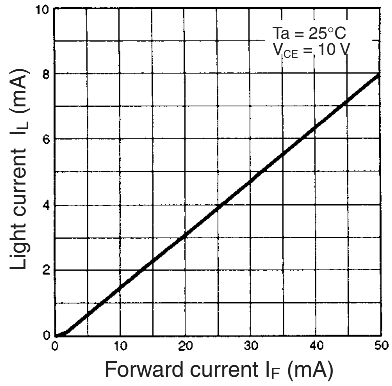
### Forward Current vs. Collector Dissipation Temperature Rating



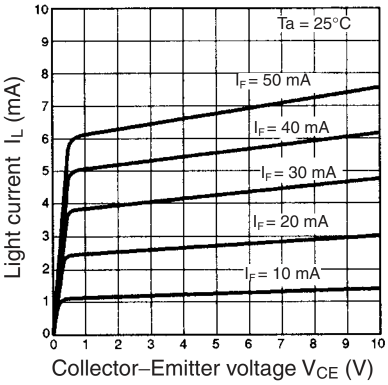

### Forward Current vs. Forward Voltage Characteristics (Typical)



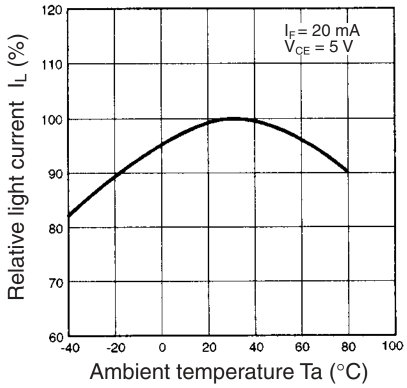

### Light Current vs. Forward Current Characteristics (Typical)



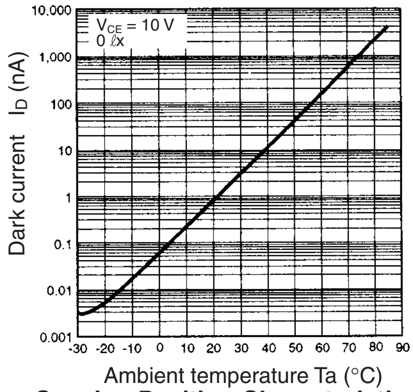

### Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



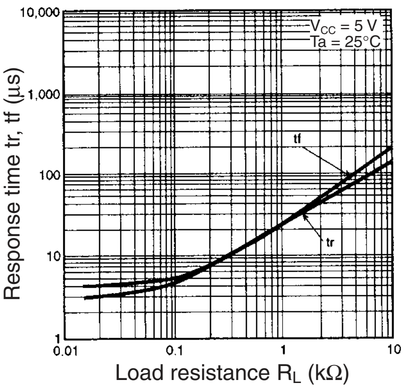

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



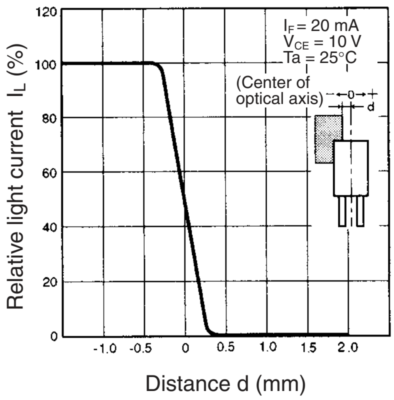

### Dark Current vs. Ambient Temperature Characteristics (Typical)



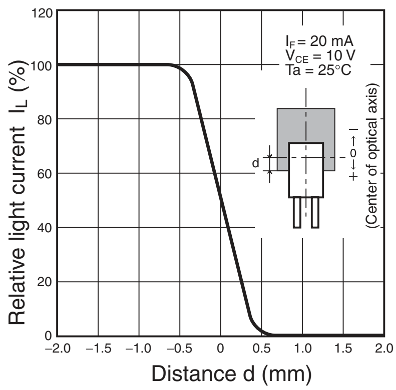

### Response Time vs. Load Resistance Characteristics (Typical)



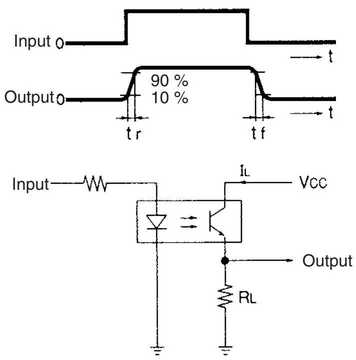

### Sensing Position Characteristics (Typical)




### Sensing Position Characteristics (Typical)




### Response Time Measurement Circuit

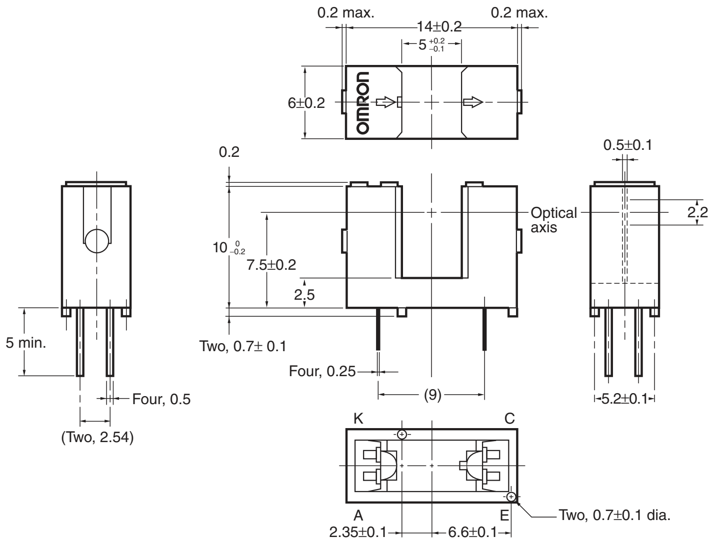


# Photomicrosensor (Transmissive)
# EE-SX1041

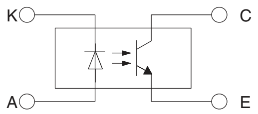
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

| Item | | Symbol | Rated value |
|---|---|---|---|
| **Emitter** | **Forward current** | $I_F$ | 50 mA (see note 1) |
| | **Pulse forward current** | $I_{FP}$ | 1 A (see note 2) |
| | **Reverse voltage** | $V_R$ | 4 V |
| **Detector** | **Collector–Emitter voltage** | $V_{CEO}$ | 30 V |
| | **Emitter–Collector voltage** | $V_{ECO}$ | --- |
| | **Collector current** | $I_C$ | 20 mA |
| | **Collector dissipation** | $P_C$ | 100 mW (see note 1) |
| **Ambient temperature** | **Operating** | 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.

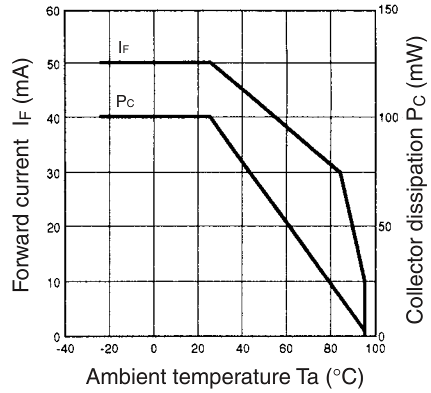
**3.** Complete soldering within 10 seconds.

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

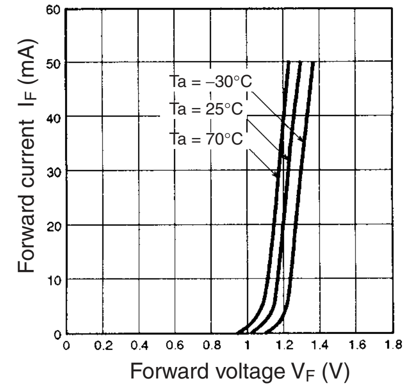
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 30 mA |
| | **Reverse current** | $I_R$ | 0.01 µA typ., 10 µA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **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** | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| **Rising time** | | tr | 4 µs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |
| **Falling time** | | tf | 4 µs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |

## ■ Engineering Data

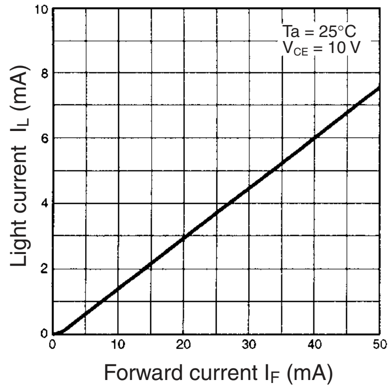
### Forward Current vs. Collector Dissipation Temperature Rating



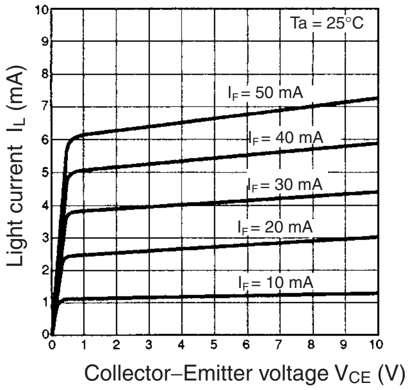

### Forward Current vs. Forward Voltage Characteristics (Typical)



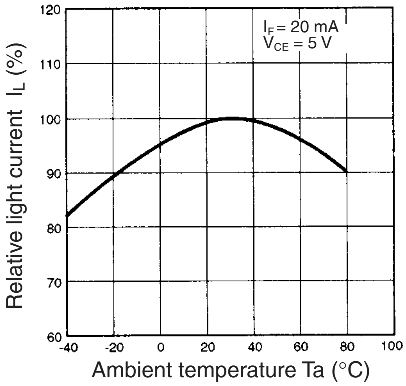

### Light Current vs. Forward Current Characteristics (Typical)



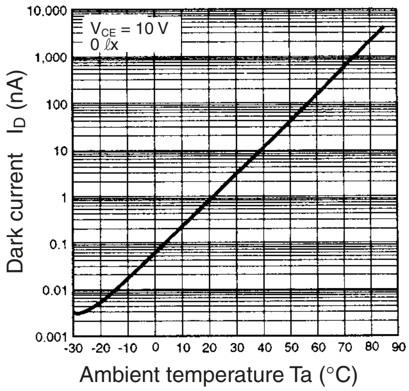

### Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



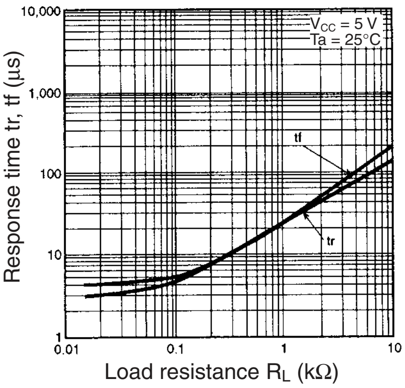

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



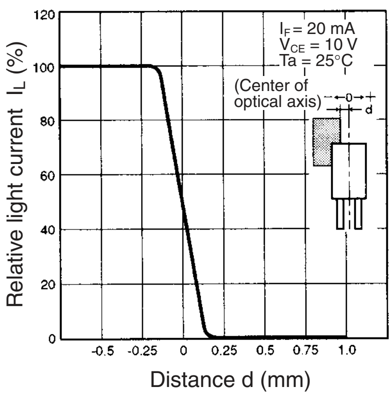

### Dark Current vs. Ambient Temperature Characteristics (Typical)



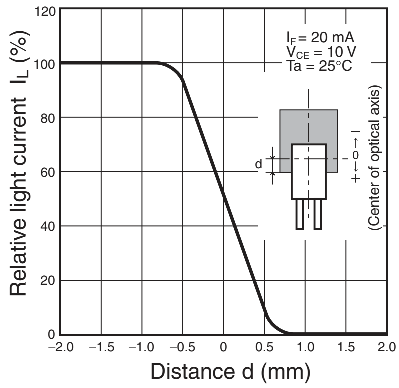

### Response Time vs. Load Resistance Characteristics (Typical)



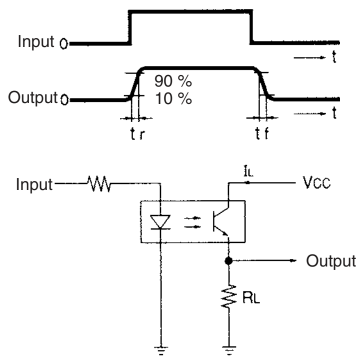

### Sensing Position Characteristics (Typical)




### Sensing Position Characteristics (Typical)




### Response Time Measurement Circuit

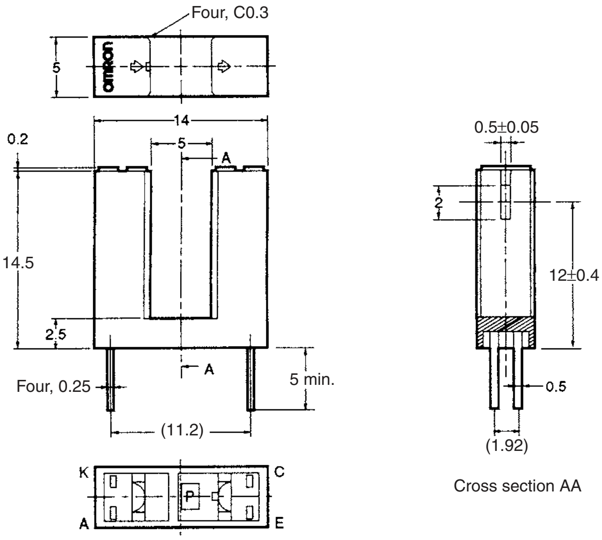


# Photomicrosensor (Transmissive)
# EE-SX1042

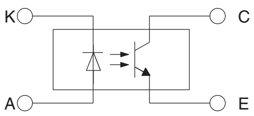
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

| Item | | Symbol | Rated value |
|---|---|---|---|
| Emitter | Forward current | $I_F$ | 50 mA (see note 1) |
| | Pulse forward current | $I_{FP}$ | 1 A (see note 2) |
| | Reverse voltage | $V_R$ | 4 V |
| Detector | Collector–Emitter voltage | $V_{CEO}$ | 30 V |
| | Emitter–Collector voltage | $V_{ECO}$ | --- |
| | Collector current | $I_C$ | 20 mA |
| | Collector dissipation | $P_C$ | 100 mW (see note 1) |
| Ambient temperature | Operating | 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.

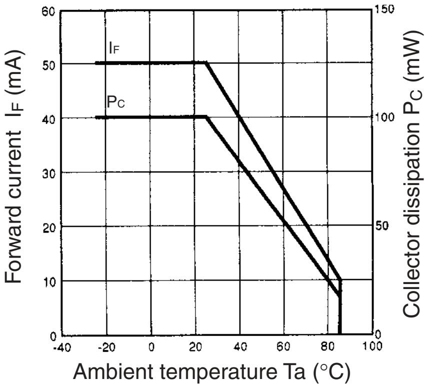
**3.** Complete soldering within 10 seconds.

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

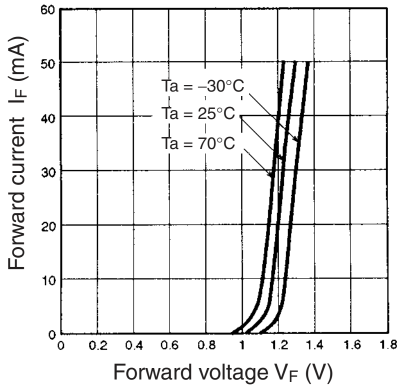
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| Emitter | Forward voltage | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 30 mA |
| | Reverse current | $I_R$ | 0.01 µA typ., 10 µA max. | $V_R$ = 4 V |
| | Peak emission wavelength | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| Detector | Light 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 V max. | $I_F$ = 20 mA, $I_L$ = 0.1 mA |
| | Peak spectral sensitivity wavelength | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| Rising time | | tr | 4 µs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |
| Falling time | | tf | 4 µs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |

## ■ Engineering Data

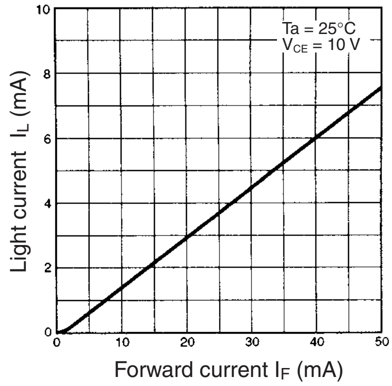
### Forward Current vs. Collector Dissipation Temperature Rating



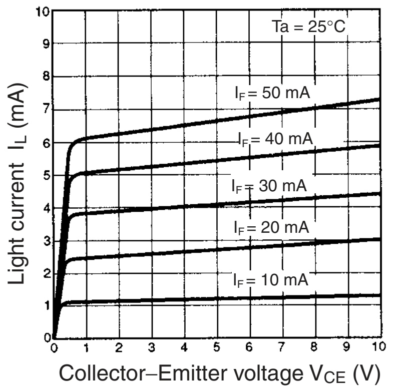

### Forward Current vs. Forward Voltage Characteristics (Typical)



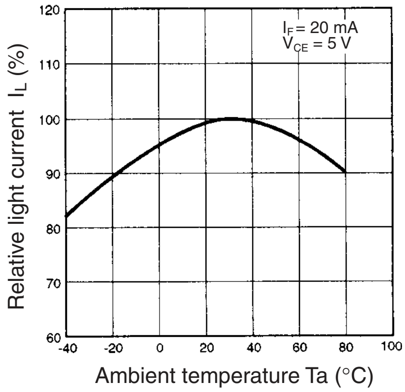

### Light Current vs. Forward Current Characteristics (Typical)



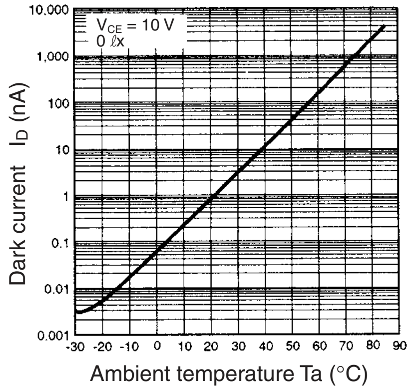

### Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



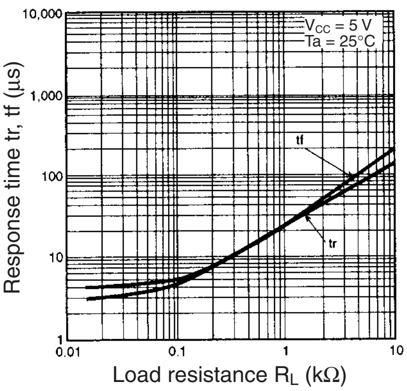

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



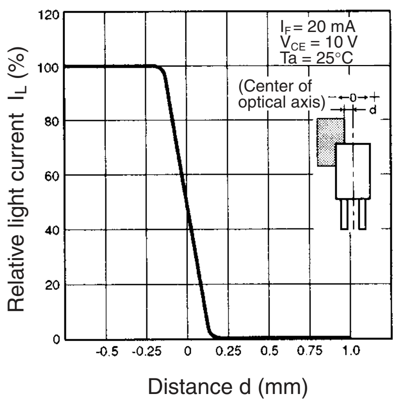

### Dark Current vs. Ambient Temperature Characteristics (Typical)



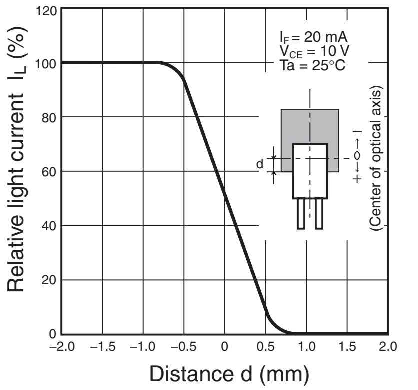

### Response Time vs. Load Resistance Characteristics (Typical)



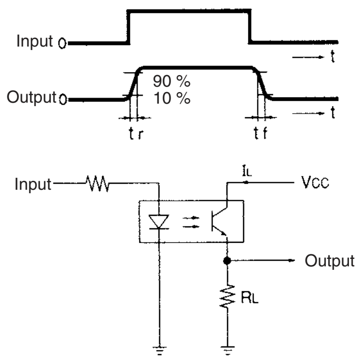

### Sensing Position Characteristics (Typical)




### Sensing Position Characteristics (Typical)




### Response Time Measurement Circuit



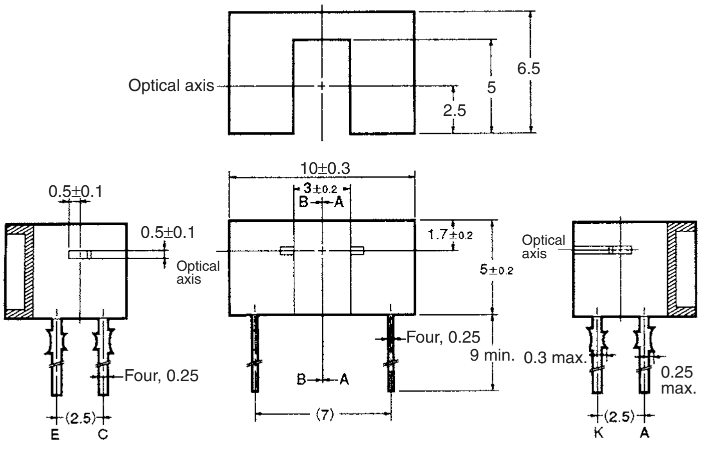
# Photomicrosensor (Transmissive)

# EE-SX1046

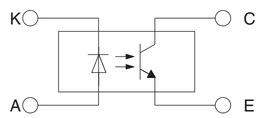
**Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




### Internal Circuit




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

- 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 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.

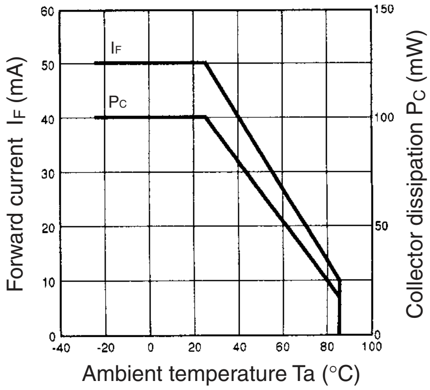
**3.** Complete soldering within 10 seconds.

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

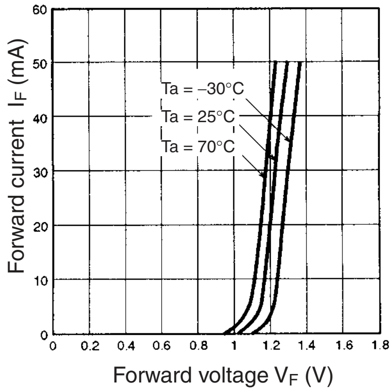
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 30 mA |
| | **Reverse current** | $I_R$ | 0.01 µA typ., 10 µA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 920 nm typ. | $I_F$ = 20 mA |
| **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** | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| **Rising time** | | tr | 4 µs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |
| **Falling time** | | tf | 4 µs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |

## Engineering Data

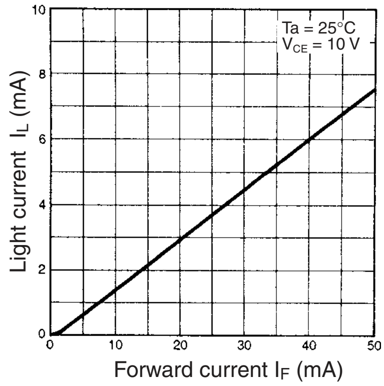
### Forward Current vs. Collector Dissipation Temperature Rating



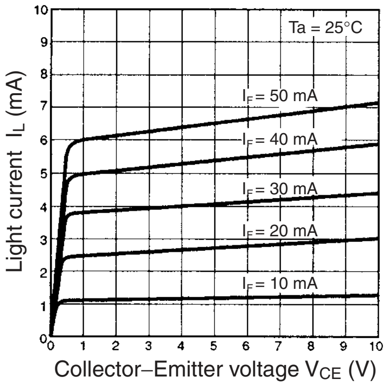

### Forward Current vs. Forward Voltage Characteristics (Typical)



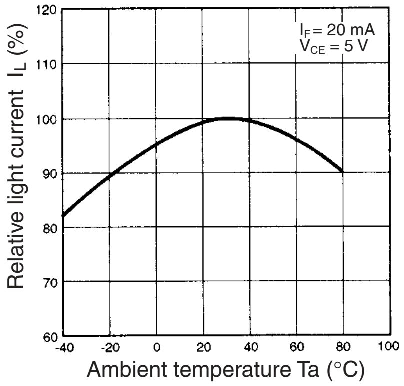

### Light Current vs. Forward Current Characteristics (Typical)



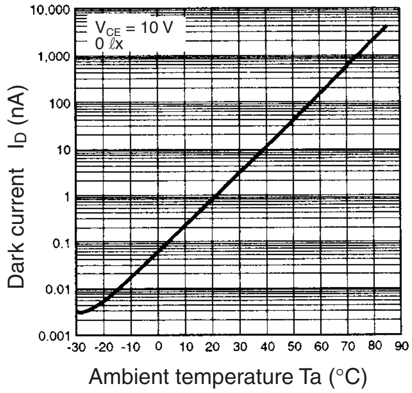

### Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



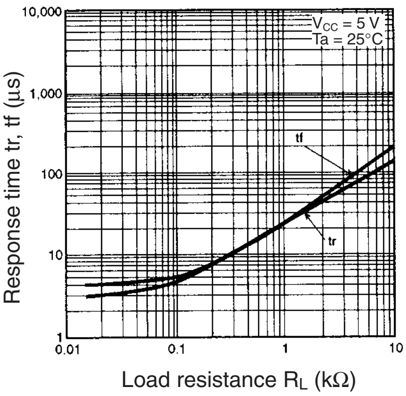

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



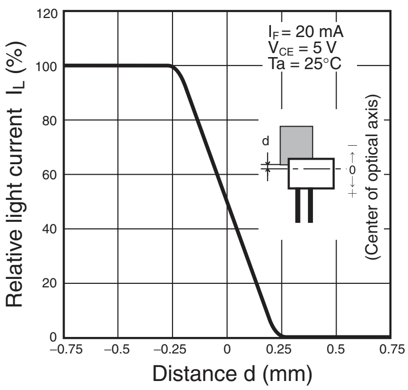

### Dark Current vs. Ambient Temperature Characteristics (Typical)



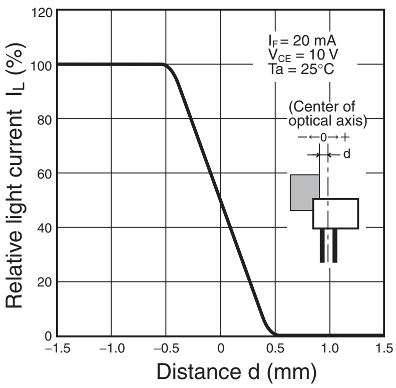

### Response Time vs. Load Resistance Characteristics (Typical)



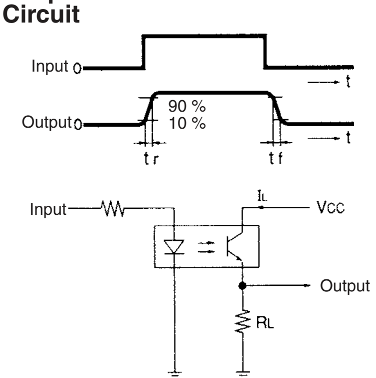

### Sensing Position Characteristics (Typical)




### Sensing Position Characteristics (Typical)




### Response Time Measurement Circuit

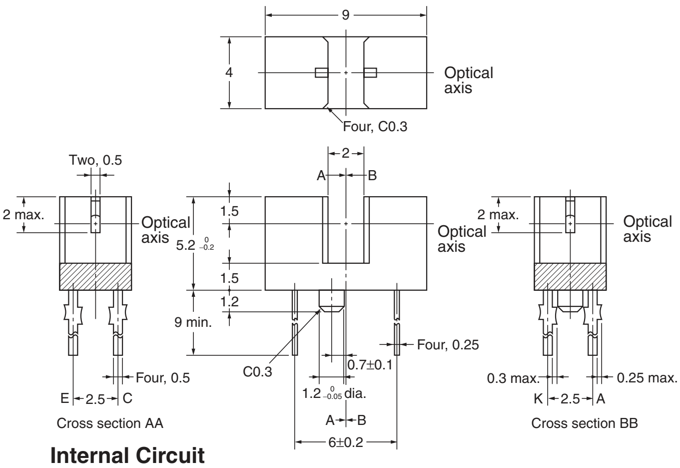


# Photomicrosensor (Transmissive)
# EE-SX1049

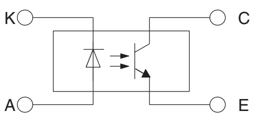
⚠ Be sure to read *Precautions* on page 25.

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

| Item | | Symbol | Rated value |
|---|---|---|---|
| **Emitter** | **Forward current** | $I_F$ | 50 mA (see note 1) |
| | **Pulse forward current** | $I_{FP}$ | 1 A (see note 2) |
| | **Reverse voltage** | $V_R$ | 4 V |
| **Detector** | **Collector–Emitter voltage** | $V_{CEO}$ | 30 V |
| | **Emitter–Collector voltage** | $V_{ECO}$ | --- |
| | **Collector current** | $I_C$ | 20 mA |
| | **Collector dissipation** | $P_C$ | 100 mW (see note 1) |
| **Ambient temperature** | **Operating** | 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.

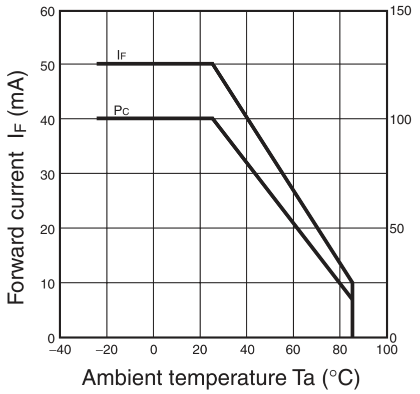
**3.** Complete soldering within 10 seconds.

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

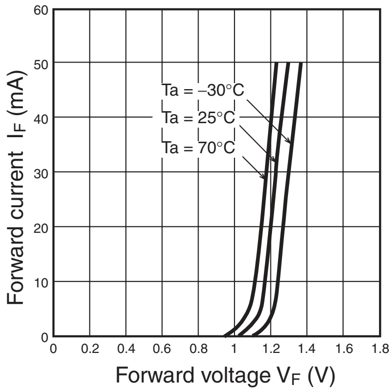
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 30 mA |
| | **Reverse current** | $I_R$ | 0.01 µA typ., 10 µA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **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** | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| **Rising time** | | tr | 4 µs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |
| **Falling time** | | tf | 4 µs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |

## Engineering Data

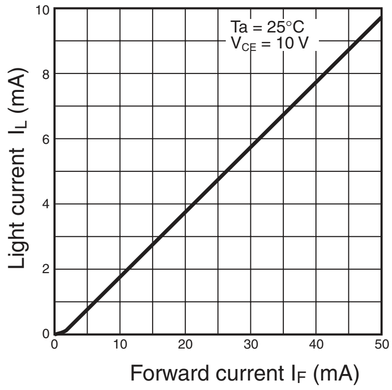
**Forward Current vs. Collector Dissipation Temperature Rating**



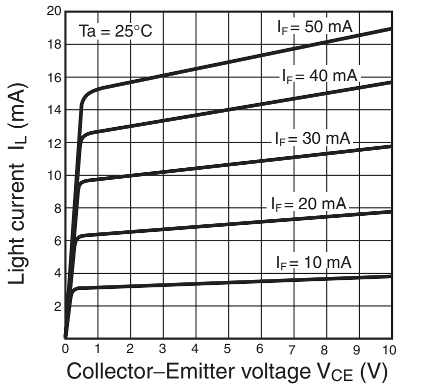

**Forward Current vs. Forward Voltage Characteristics (Typical)**



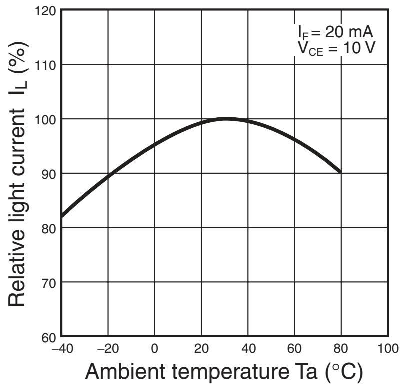

**Light Current vs. Forward Current Characteristics (Typical)**



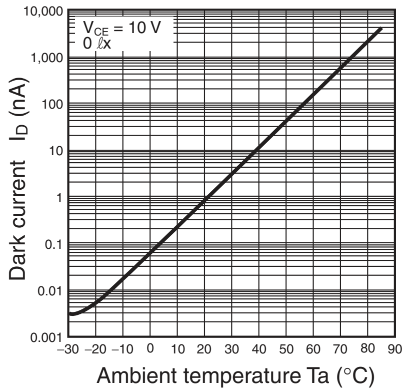

**Light Current vs. Collector–Emitter Voltage Characteristics (Typical)**



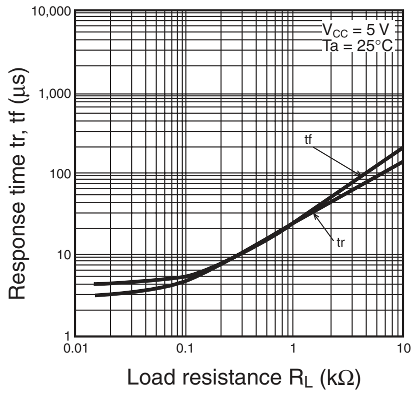

**Relative Light Current vs. Ambient Temperature Characteristics (Typical)**



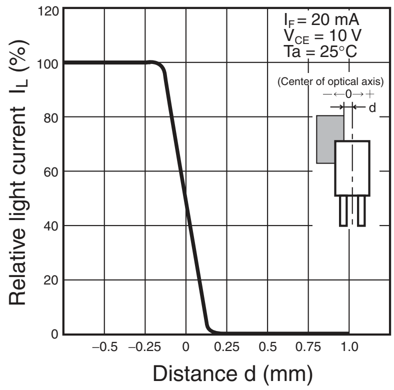

**Dark Current vs. Ambient Temperature Characteristics (Typical)**



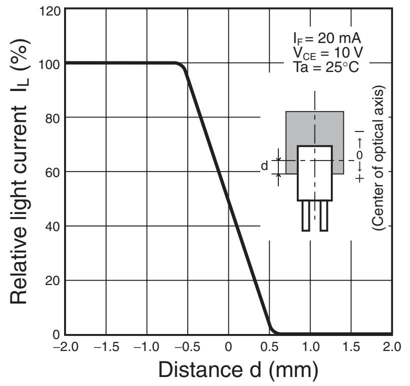

**Response Time vs. Load Resistance Characteristics (Typical)**



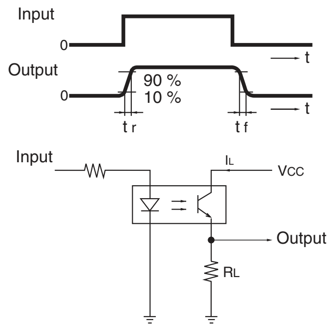

**Sensing Position Characteristics (Typical)**




**Sensing Position Characteristics (Typical)**




**Response Time Measurement Circuit**

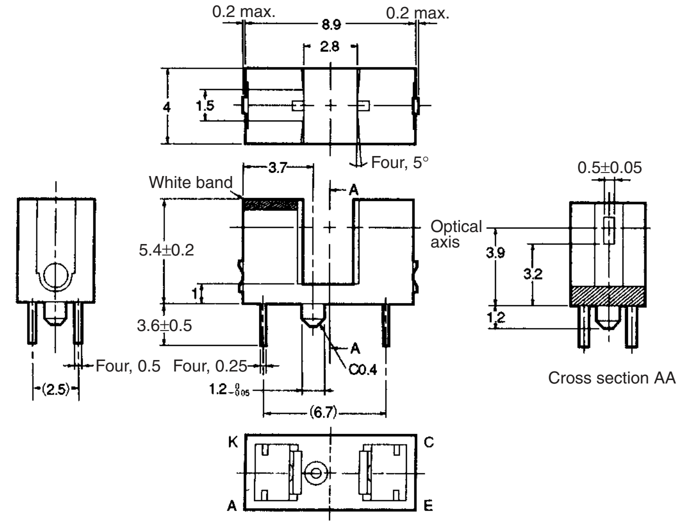


# Photomicrosensor (Transmissive)
# EE-SX1055

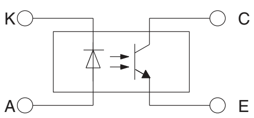
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ Absolute Maximum Ratings (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.

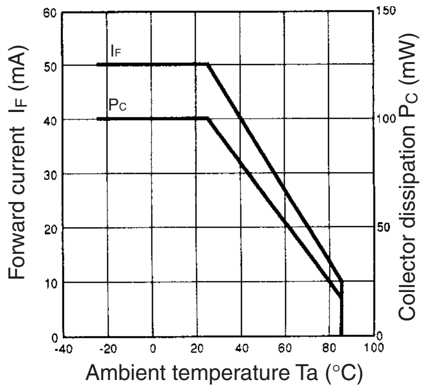
**3.** Complete soldering within 10 seconds.

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

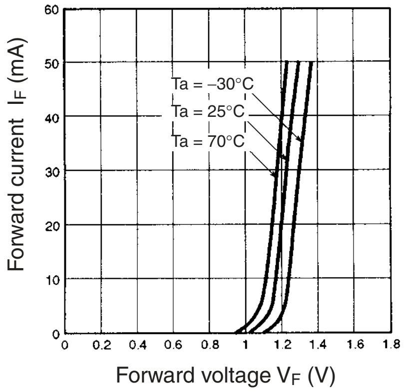
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 30 mA |
| | **Reverse current** | $I_R$ | 0.01 μA typ., 10 μA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **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** | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| **Rising time** | | tr | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |
| **Falling time** | | tf | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |

## ■ Engineering Data

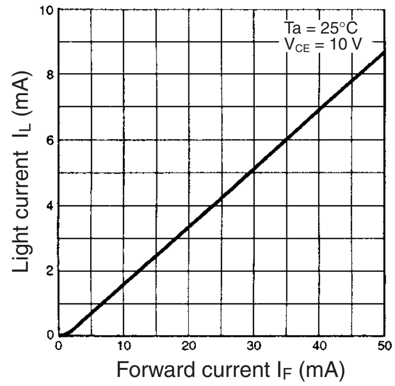
### Forward Current vs. Collector Dissipation Temperature Rating



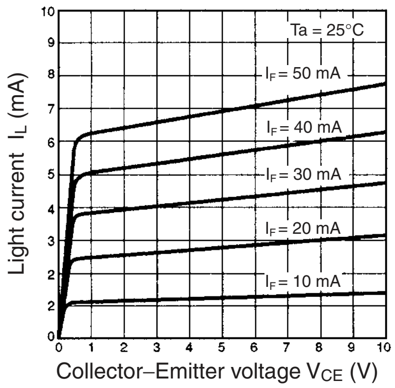

### Forward Current vs. Forward Voltage Characteristics (Typical)



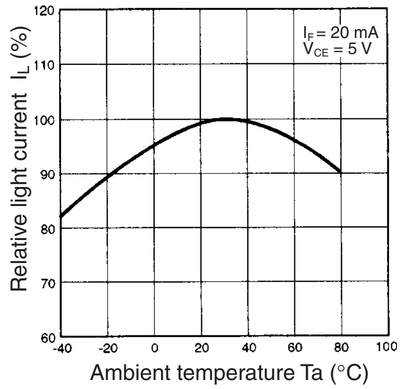

### Light Current vs. Forward Current Characteristics (Typical)



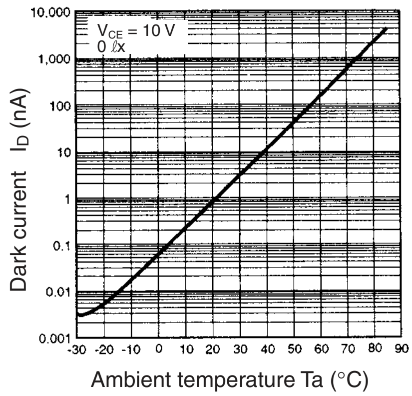

### Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



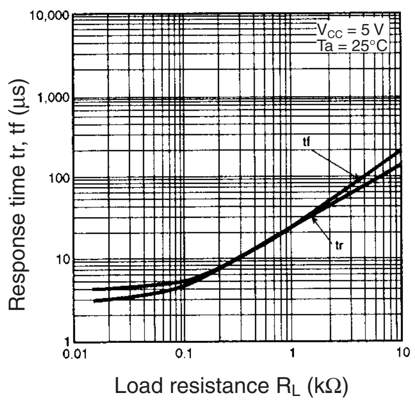

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



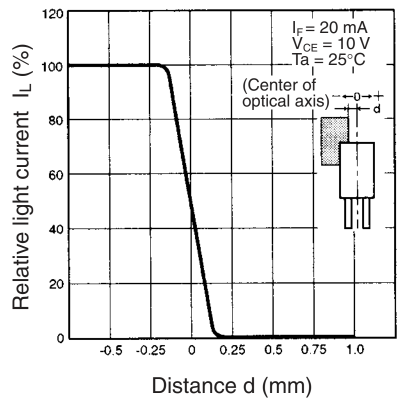

### Dark Current vs. Ambient Temperature Characteristics (Typical)



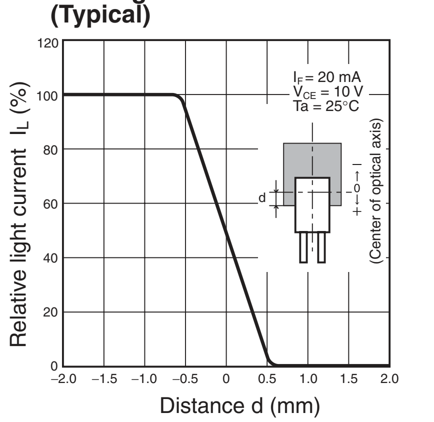

### Response Time vs. Load Resistance Characteristics (Typical)



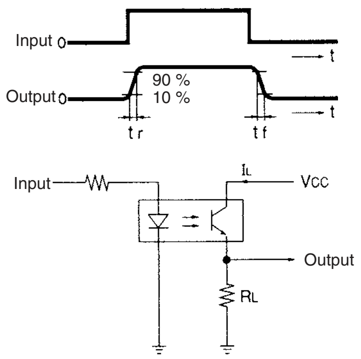

### Sensing Position Characteristics (Typical)




### Sensing Position Characteristics (Typical)




### Response Time Measurement Circuit

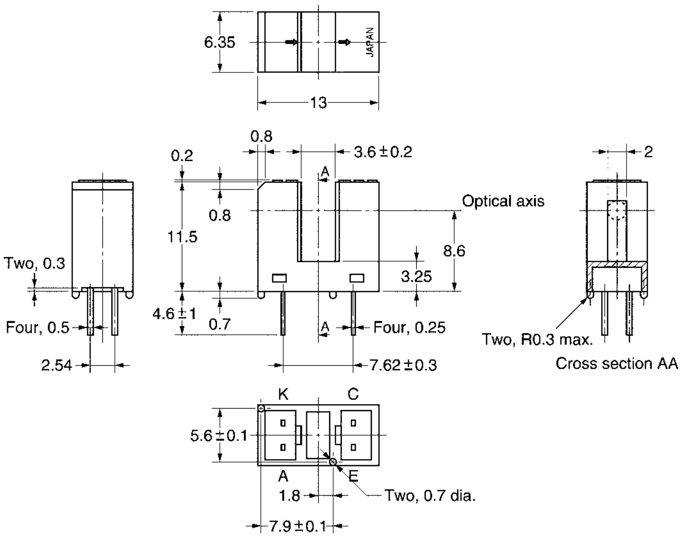


# Photomicrosensor (Transmissive)
# EE-SX1057

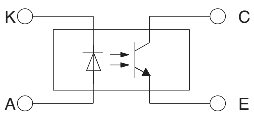
⚠ Be sure to read *Precautions* on page 25.

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

| Item | | Symbol | Rated value |
|---|---|---|---|
| **Emitter** | **Forward current** | $I_F$ | 50 mA (see note 1) |
| | **Pulse forward current** | $I_{FP}$ | 1 A (see note 2) |
| | **Reverse voltage** | $V_R$ | 4 V |
| **Detector** | **Collector–Emitter voltage** | $V_{CEO}$ | 30 V |
| | **Emitter–Collector voltage** | $V_{ECO}$ | 5 V |
| | **Collector current** | $I_C$ | 20 mA |
| | **Collector dissipation** | $P_C$ | 100 mW (see note 1) |
| **Ambient temperature** | **Operating** | 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.

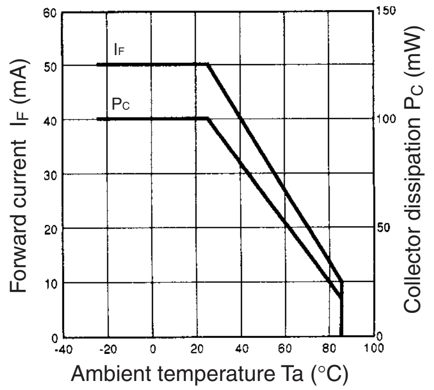
**3.** Complete soldering within 10 seconds.

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

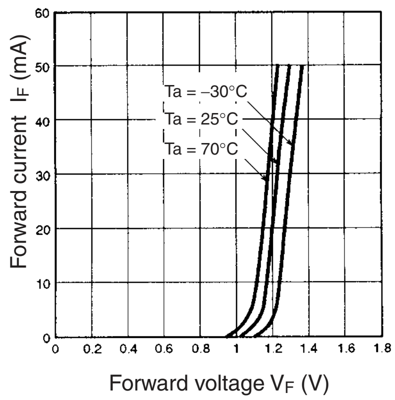
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.15 V typ., 1.5 V max. | $I_F$ = 30 mA |
| | **Reverse current** | $I_R$ | 0.01 μA typ., 10 μA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **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** | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| **Rising time** | | tr | 4 μs typ., 20 μA max. | $V_{CC}$ = 10 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |
| **Falling time** | | tf | 4 μs typ., 20 μA max. | $V_{CC}$ = 10 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |

## ■ Engineering Data

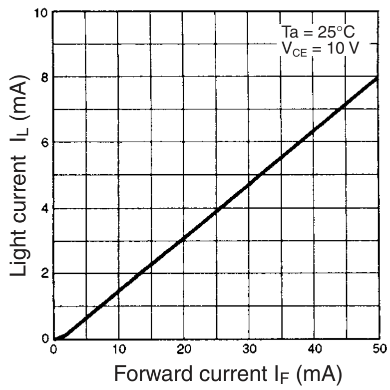
**Forward Current vs. Collector Dissipation Temperature Rating**



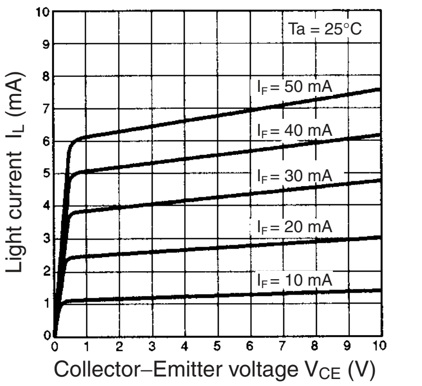

**Forward Current vs. Forward Voltage Characteristics (Typical)**



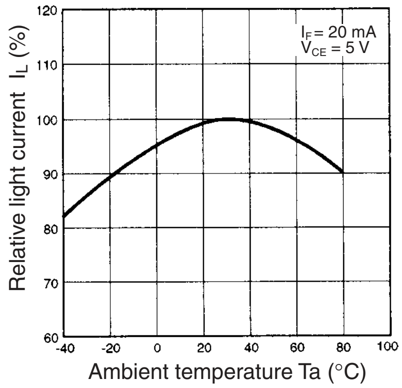

**Light Current vs. Forward Current Characteristics (Typical)**



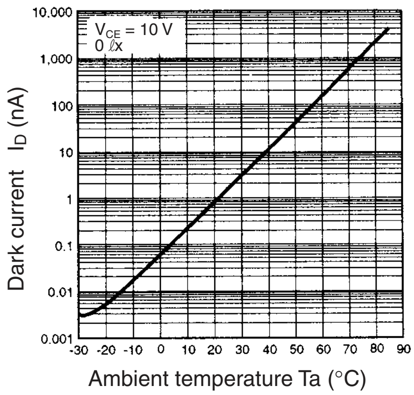

**Light Current vs. Collector–Emitter Voltage Characteristics (Typical)**



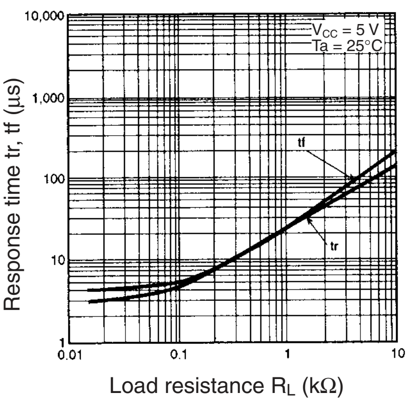

**Relative Light Current vs. Ambient Temperature Characteristics (Typical)**



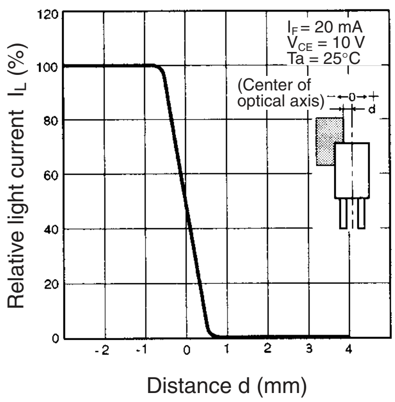

**Dark Current vs. Ambient Temperature Characteristics (Typical)**



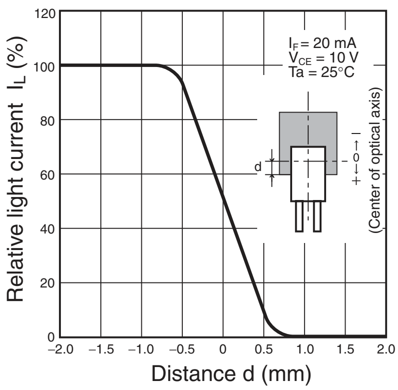

**Response Time vs. Load Resistance Characteristics (Typical)**



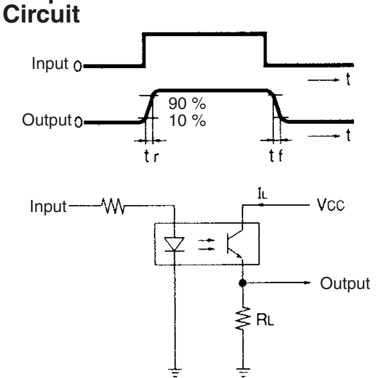

**Sensing Position Characteristics (Typical)**




**Sensing Position Characteristics (Typical)**




**Response Time Measurement Circuit**



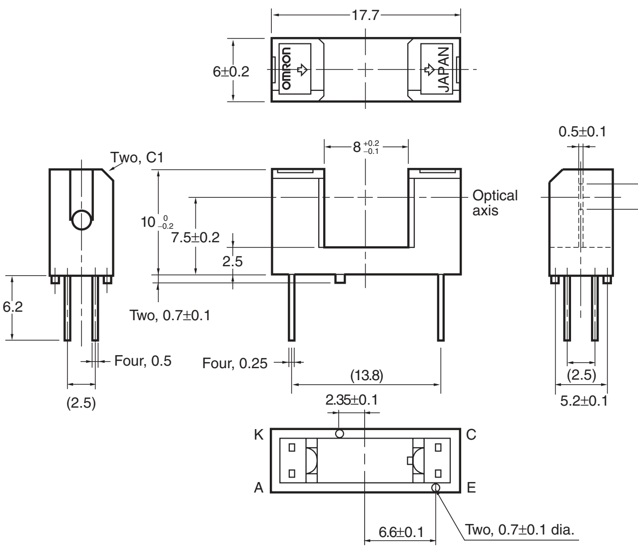
OMRON

# Photomicrosensor (Transmissive)
# EE-SX1070

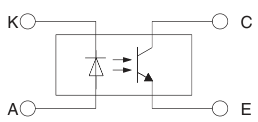
Be sure to read *Precautions* on page 25.

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

| Item | | Symbol | Rated value |
|---|---|---|---|
| Emitter | Forward current | $I_F$ | 50 mA (see note 1) |
| | Pulse forward current | $I_{FP}$ | 1 A (see note 2) |
| | Reverse voltage | $V_R$ | 4 V |
| Detector | Collector–Emitter voltage | $V_{CEO}$ | 30 V |
| | Emitter–Collector voltage | $V_{ECO}$ | --- |
| | Collector current | $I_C$ | 20 mA |
| | Collector dissipation | $P_C$ | 100 mW (see note 1) |
| Ambient temperature | Operating | 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.

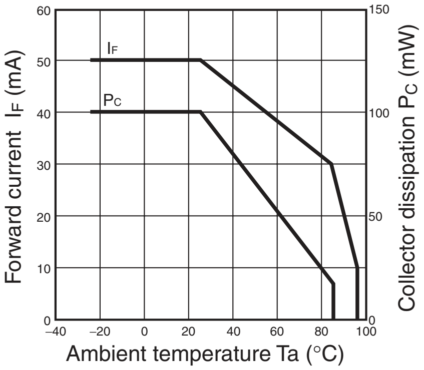
**3.** Complete soldering within 10 seconds.

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

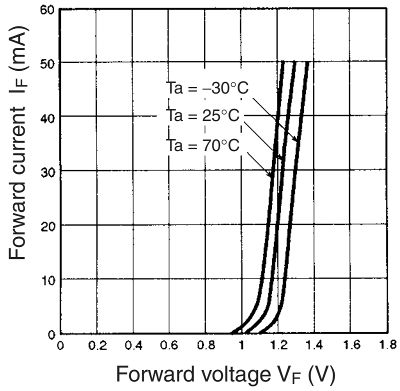
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| Emitter | Forward voltage | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 30 mA |
| | Reverse current | $I_R$ | 0.01 μA typ., 10 μA max. | $V_R$ = 4 V |
| | Peak emission wavelength | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| Detector | Light 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 | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| Rising time | | tr | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |
| Falling time | | tf | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |

## ■ Engineering Data

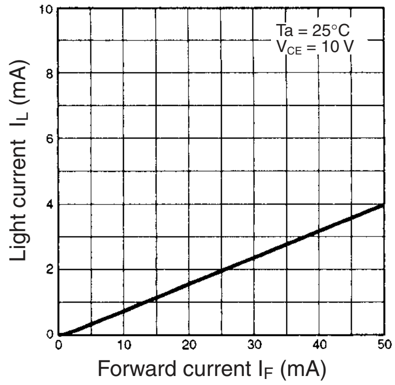
### Forward Current vs. Collector Dissipation Temperature Rating



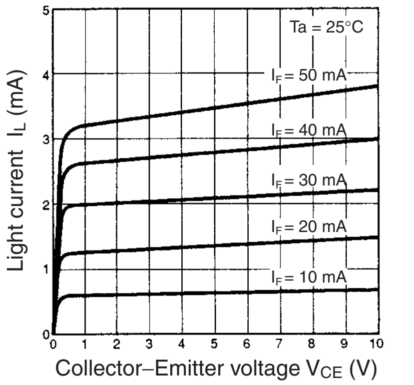

### Forward Current vs. Forward Voltage Characteristics (Typical)



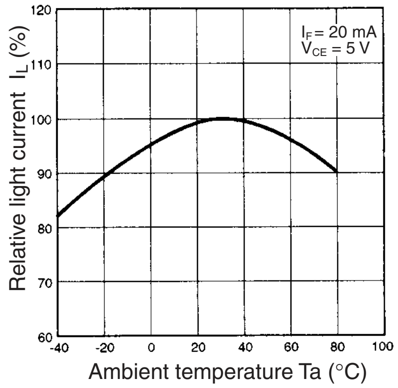

### Light Current vs. Forward Current Characteristics (Typical)



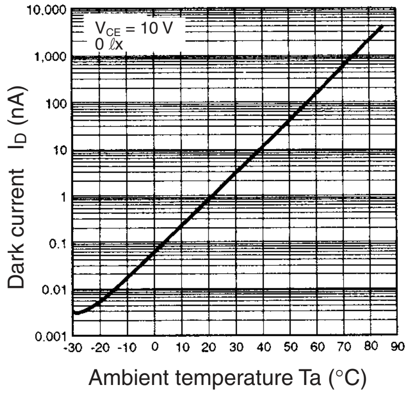

### Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



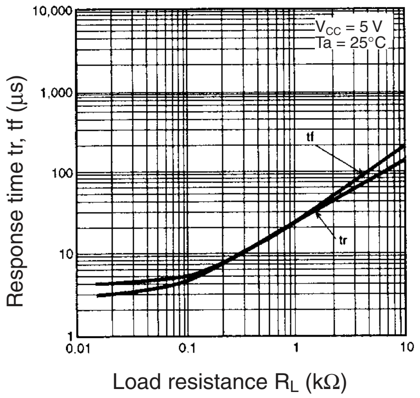

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



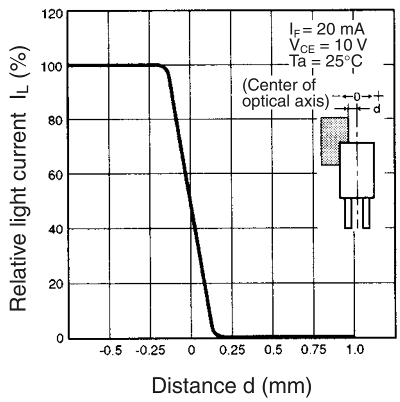

### Dark Current vs. Ambient Temperature Characteristics (Typical)



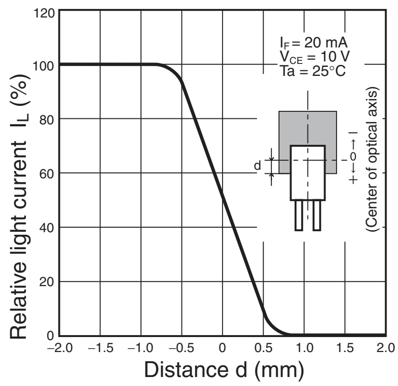

### Response Time vs. Load Resistance Characteristics (Typical)



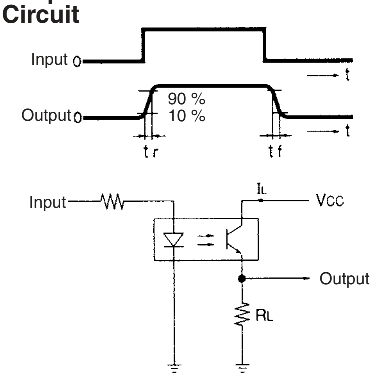

### Sensing Position Characteristics (Typical)




### Sensing Position Characteristics (Typical)




### Response Time Measurement Circuit



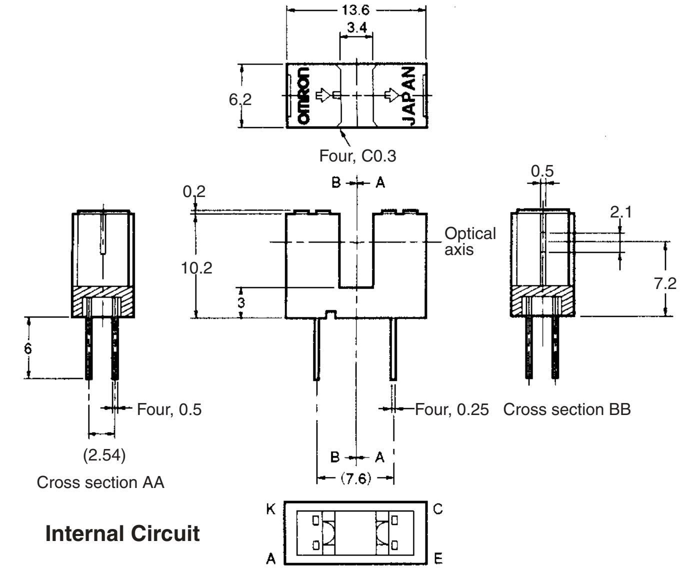
Photomicrosensor (Transmissive)

# EE-SX1071

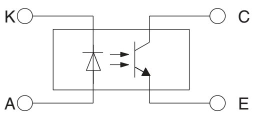
⚠ Be sure to read *Precautions* on page 25.

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

| Item | | Symbol | Rated value |
|---|---|---|---|
| **Emitter** | **Forward current** | $I_F$ | 50 mA (see note 1) |
| | **Pulse forward current** | $I_{FP}$ | 1 A (see note 2) |
| | **Reverse voltage** | $V_R$ | 4 V |
| **Detector** | **Collector–Emitter voltage** | $V_{CEO}$ | 30 V |
| | **Emitter–Collector voltage** | $V_{ECO}$ | --- |
| | **Collector current** | $I_C$ | 20 mA |
| | **Collector dissipation** | $P_C$ | 100 mW (see note 1) |
| **Ambient temperature** | **Operating** | 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.

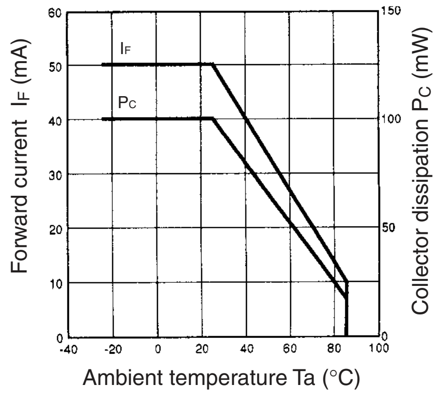
**3.** Complete soldering within 10 seconds.

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

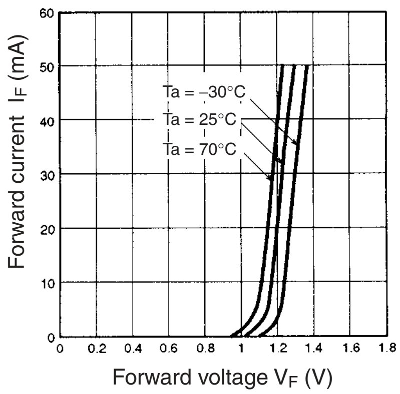
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 30 mA |
| | **Reverse current** | $I_R$ | 0.01 μA typ., 10 μA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **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** | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| **Rising time** | | tr | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |
| **Falling time** | | tf | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |

## ■ Engineering Data

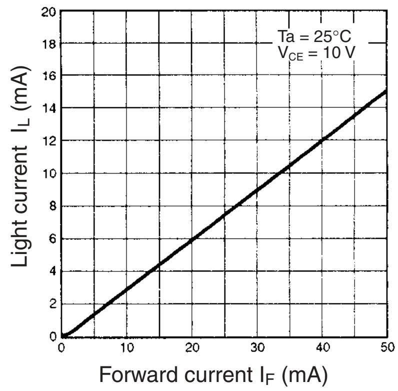
### Forward Current vs. Collector Dissipation Temperature Rating



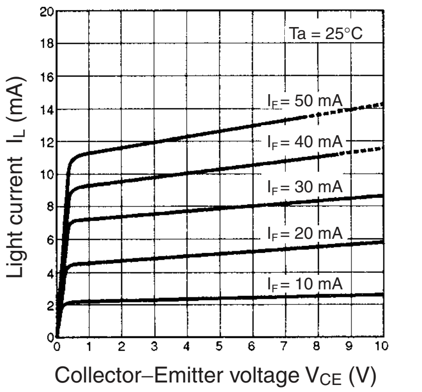

### Forward Current vs. Forward Voltage Characteristics (Typical)



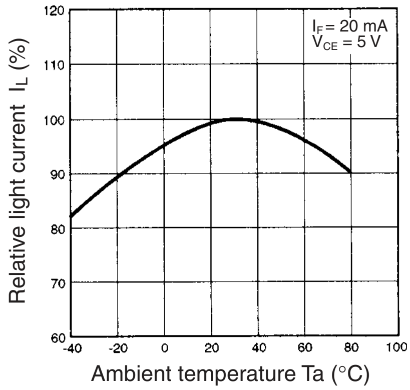

### Light Current vs. Forward Current Characteristics (Typical)



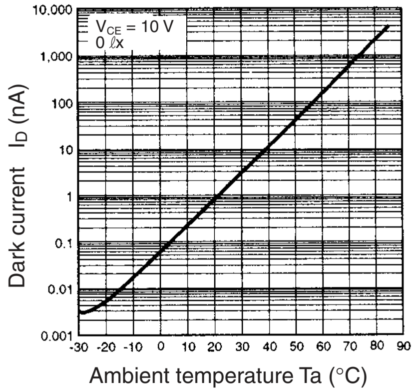

### Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



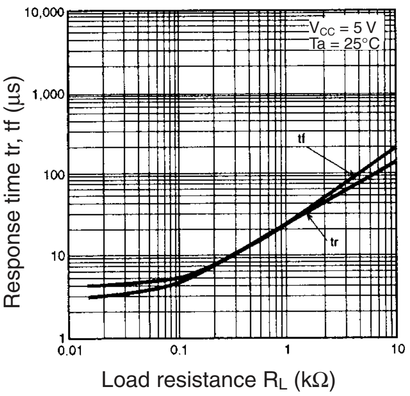

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



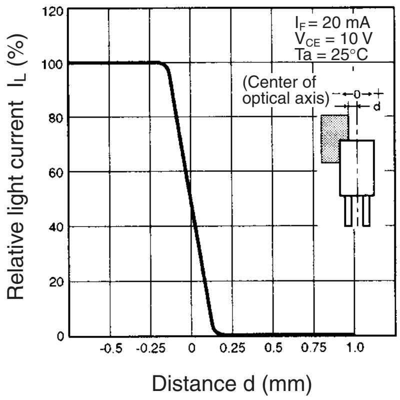

### Dark Current vs. Ambient Temperature Characteristics (Typical)



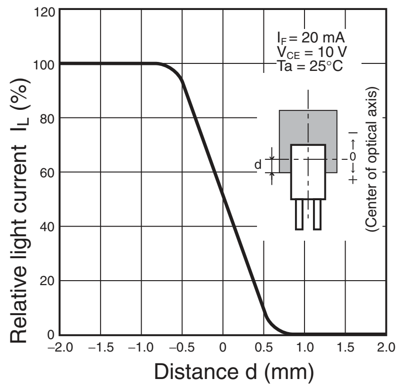

### Response Time vs. Load Resistance Characteristics (Typical)



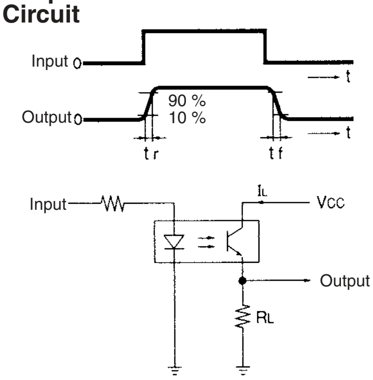

### Sensing Position Characteristics (Typical)




### Sensing Position Characteristics (Typical)




### Response Time Measurement Circuit

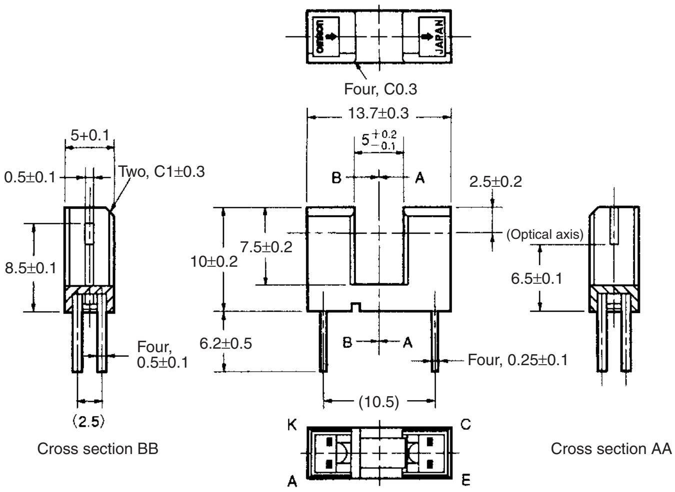


# Photomicrosensor (Transmissive)
# EE-SX1081

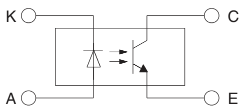
⚠ Be sure to read *Precautions* on page 25.

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

| Item | | Symbol | Rated value |
|---|---|---|---|
| **Emitter** | **Forward current** | $I_F$ | 50 mA (see note 1) |
| | **Pulse forward current** | $I_{FP}$ | 1 A (see note 2) |
| | **Reverse voltage** | $V_R$ | 4 V |
| **Detector** | **Collector–Emitter voltage** | $V_{CEO}$ | 30 V |
| | **Emitter–Collector voltage** | $V_{ECO}$ | --- |
| | **Collector current** | $I_C$ | 20 mA |
| | **Collector dissipation** | $P_C$ | 100 mW (see note 1) |
| **Ambient temperature** | **Operating** | 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.

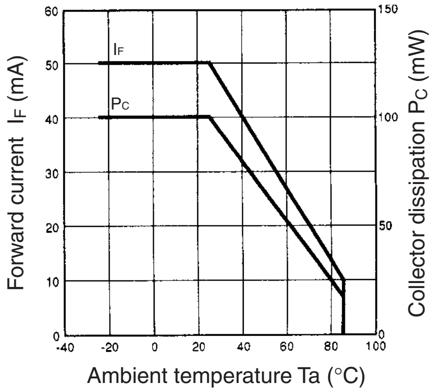
**3.** Complete soldering within 10 seconds.

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

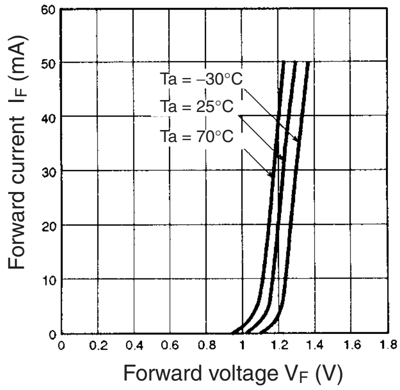
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 30 mA |
| | **Reverse current** | $I_R$ | 0.01 μA typ., 10 μA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **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** | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| **Rising time** | | tr | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |
| **Falling time** | | tf | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |

## ■ Engineering Data

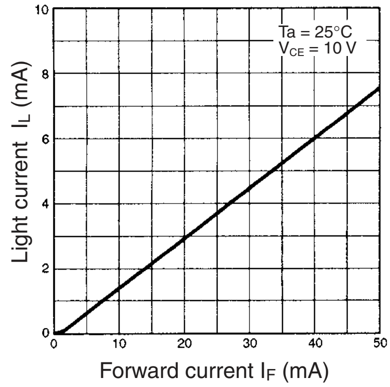
### Forward Current vs. Collector Dissipation Temperature Rating



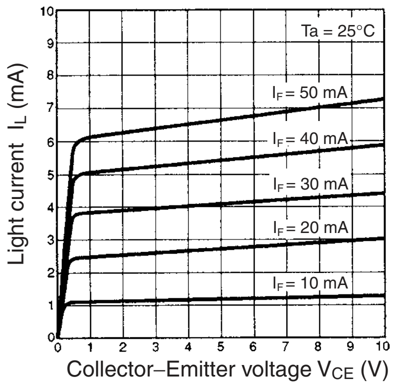

### Forward Current vs. Forward Voltage Characteristics (Typical)



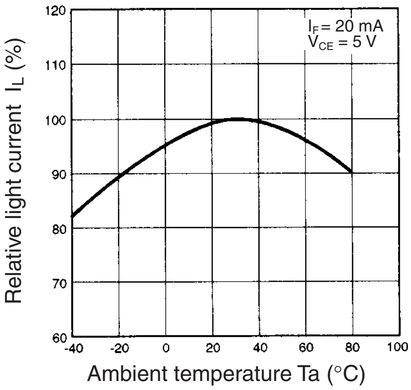

### Light Current vs. Forward Current Characteristics (Typical)



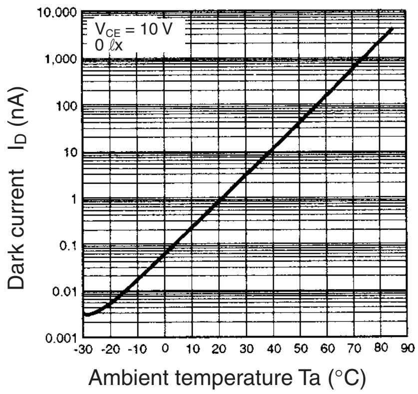

### Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



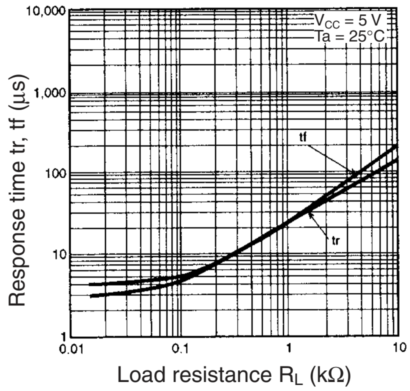

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



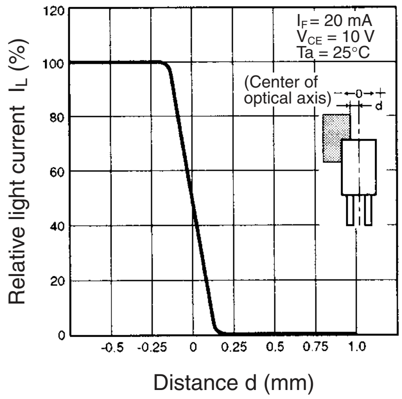

### Dark Current vs. Ambient Temperature Characteristics (Typical)



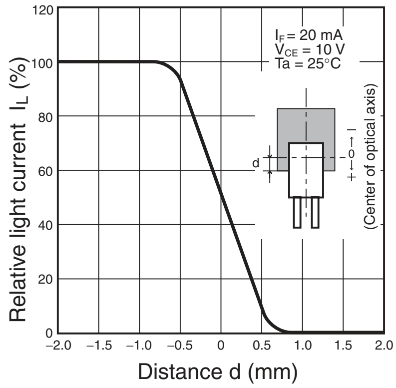

### Response Time vs. Load Resistance Characteristics (Typical)



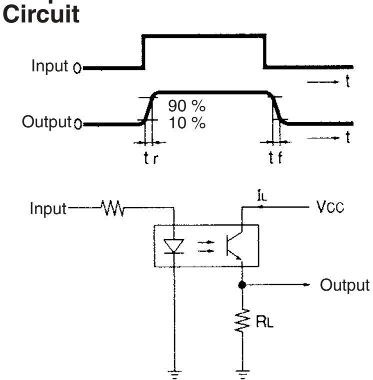

### Sensing Position Characteristics (Typical)




### Sensing Position Characteristics (Typical)




### Response Time Measurement Circuit

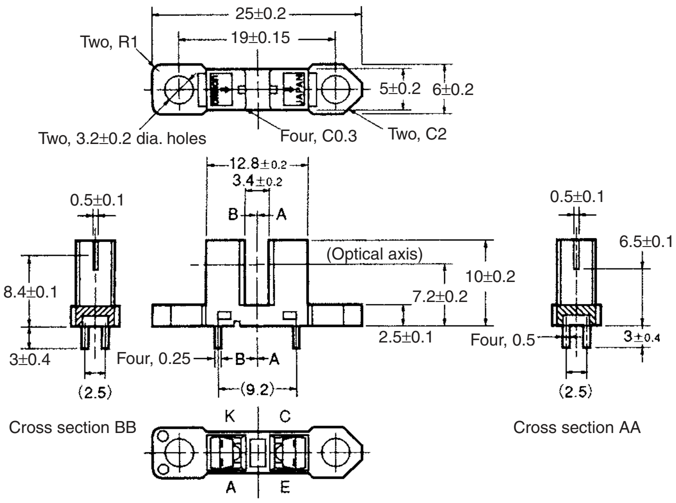


# Photomicrosensor (Transmissive)
# EE-SX1088

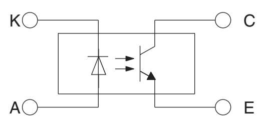
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




### Internal Circuit




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ Absolute Maximum Ratings (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.

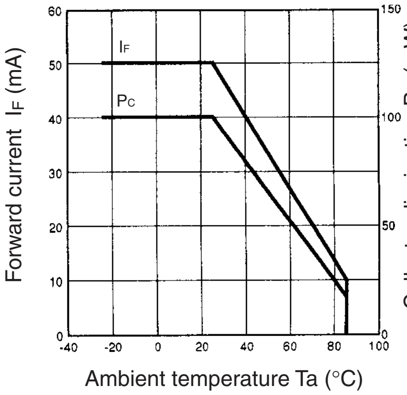
**3.** Complete soldering within 10 seconds.

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

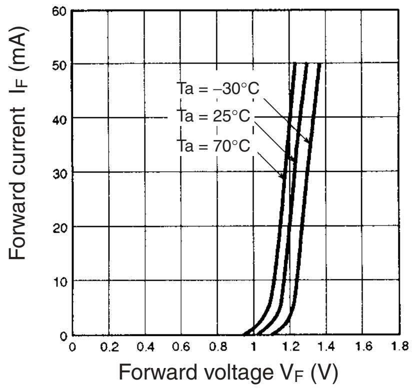
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 30 mA |
| | **Reverse current** | $I_R$ | 0.01 μA typ., 10 μA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **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 V max. | $I_F$ = 20 mA, $I_L$ = 0.1 mA |
| | **Peak spectral sensitivity wavelength** | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| **Rising time** | | tr | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |
| **Falling time** | | tf | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |

## ■ Engineering Data

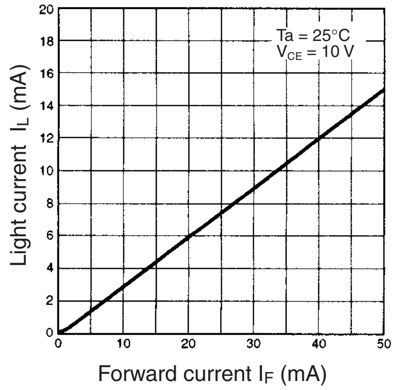
**Forward Current vs. Collector Dissipation Temperature Rating**



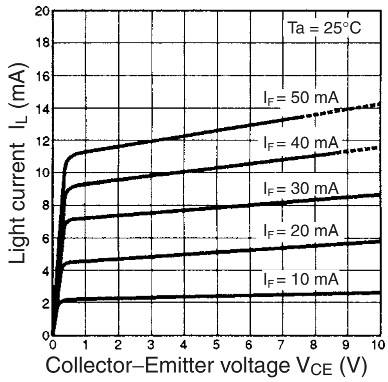

**Forward Current vs. Forward Voltage Characteristics (Typical)**



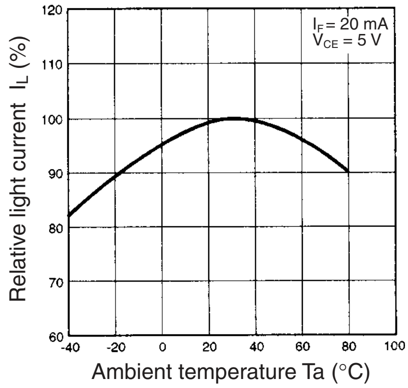

**Light Current vs. Forward Current Characteristics (Typical)**



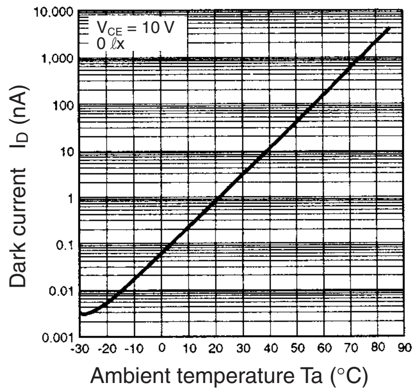

**Light Current vs. Collector–Emitter Voltage Characteristics (Typical)**



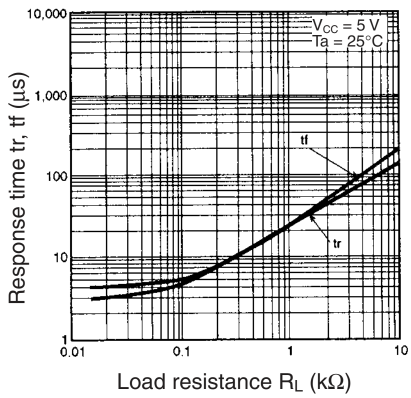

**Relative Light Current vs. Ambient Temperature Characteristics (Typical)**



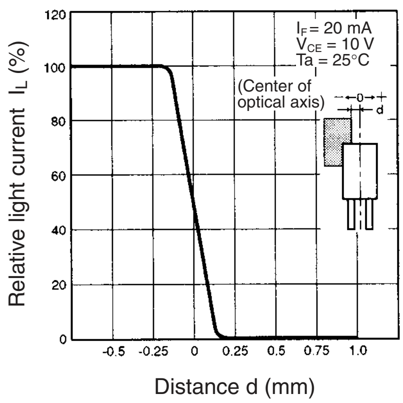

**Dark Current vs. Ambient Temperature Characteristics (Typical)**



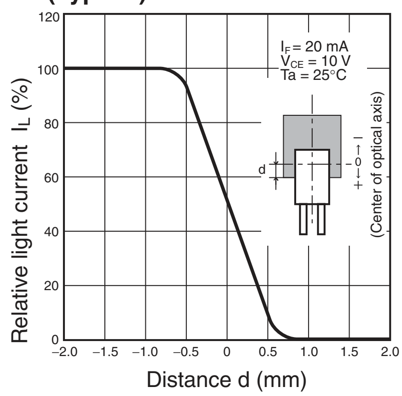

**Response Time vs. Load Resistance Characteristics (Typical)**



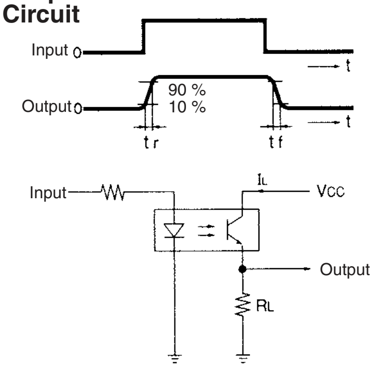

**Sensing Position Characteristics (Typical)**




**Sensing Position Characteristics (Typical)**




**Response Time Measurement Circuit**

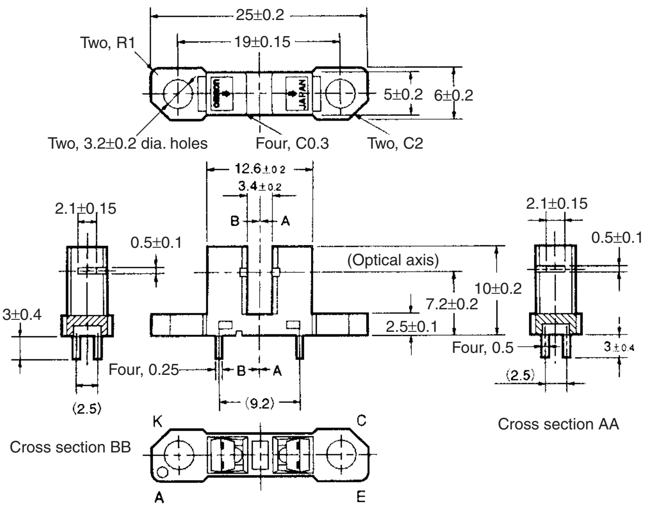


# Photomicrosensor (Transmissive)
# EE-SX1096

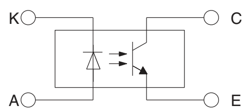
⚠ Be sure to read *Precautions* on page 25.

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ Absolute Maximum Ratings (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) |

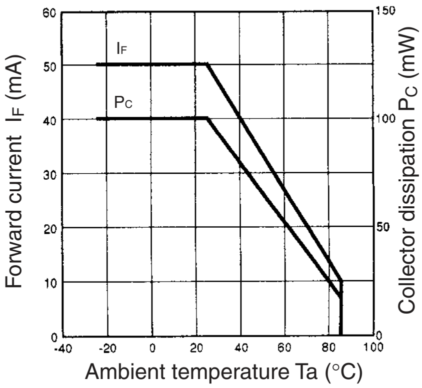
**Note: 1.** Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
**2.** The pulse width is 10 μs maximum with a frequency of 100 Hz.
**3.** Complete soldering within 10 seconds.

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

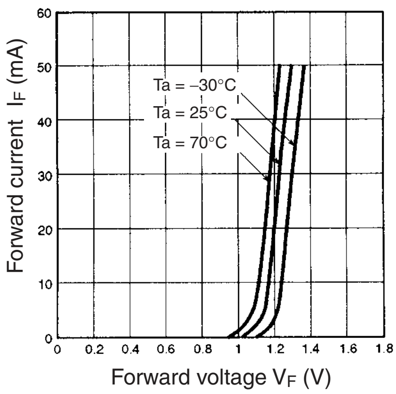
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 30 mA |
| | **Reverse current** | $I_R$ | 0.01 μA typ., 10 μA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **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** | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| **Rising time** | | tr | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |
| **Falling time** | | tf | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |

## ■ Engineering Data

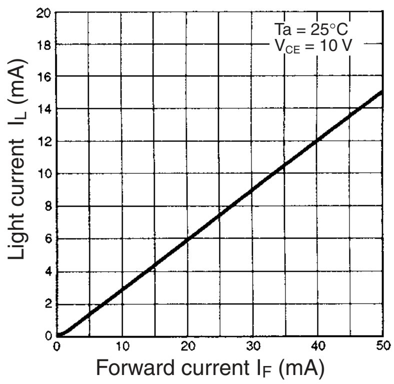
**Forward Current vs. Collector Dissipation Temperature Rating**



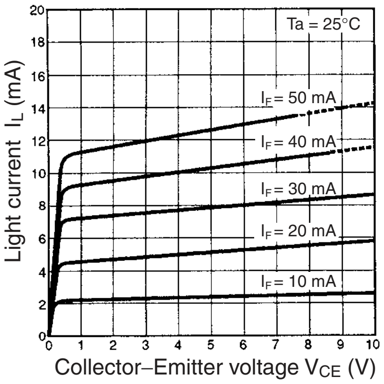

**Forward Current vs. Forward Voltage Characteristics (Typical)**



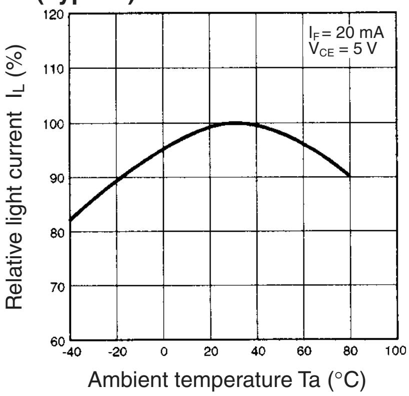

**Light Current vs. Forward Current Characteristics (Typical)**



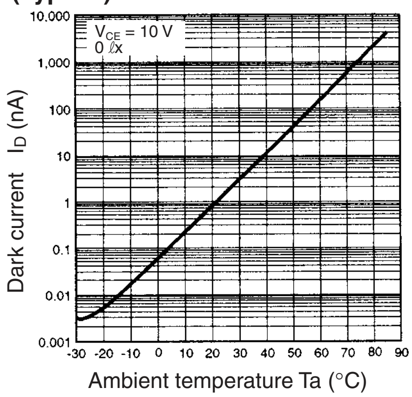

**Light Current vs. Collector–Emitter Voltage Characteristics (Typical)**



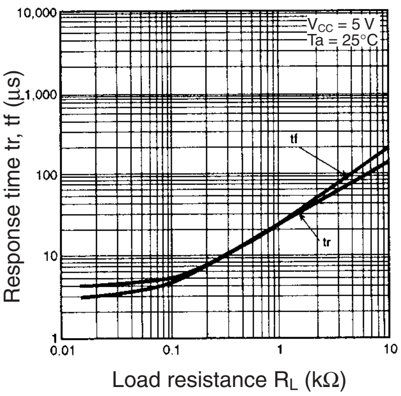

**Relative Light Current vs. Ambient Temperature Characteristics (Typical)**



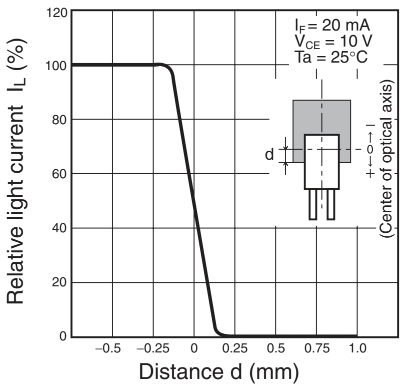

**Dark Current vs. Ambient Temperature Characteristics (Typical)**



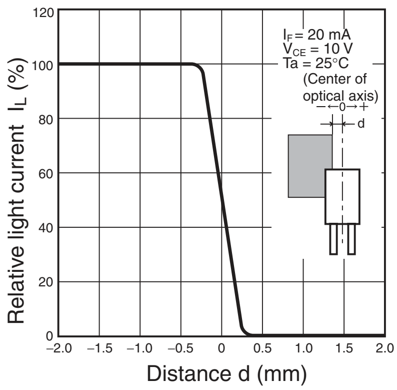

**Response Time vs. Load Resistance Characteristics (Typical)**



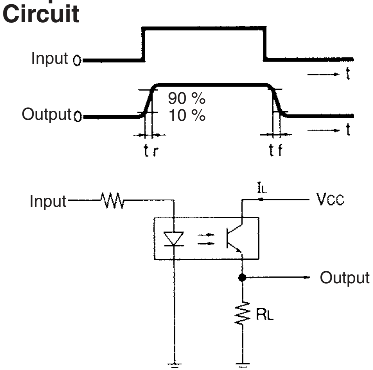

**Sensing Position Characteristics (Typical)**




**Sensing Position Characteristics (Typical)**




**Response Time Measurement Circuit**

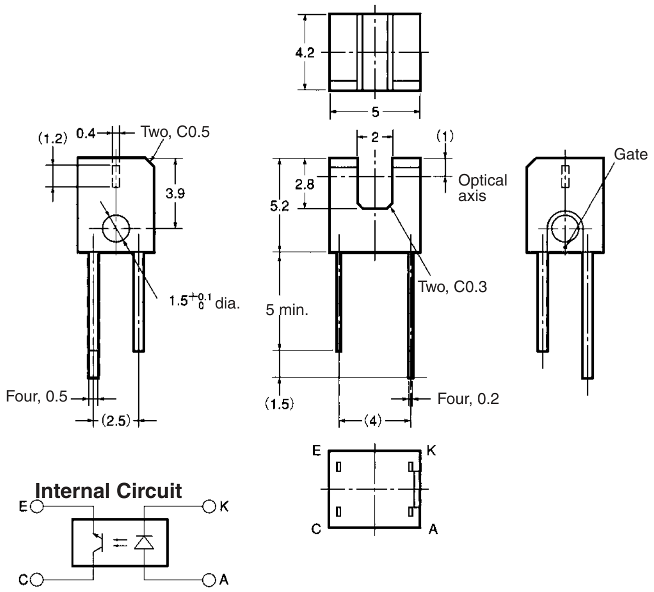


# Photomicrosensor (Transmissive)
# EE-SX1103

⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




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

Unless otherwise specified, the tolerances are ±0.2 mm.

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

| Item | | Symbol | Rated value |
|---|---|---|---|
| **Emitter** | **Forward current** | $I_F$ | 50 mA (see note 1) |
| | **Pulse forward current** | $I_{FP}$ | --- |
| | **Reverse voltage** | $V_R$ | 5 V |
| **Detector** | **Collector–Emitter voltage** | $V_{CEO}$ | 30 V |
| | **Emitter–Collector voltage** | $V_{ECO}$ | 4.5 V |
| | **Collector current** | $I_C$ | 30 mA |
| | **Collector dissipation** | $P_C$ | 80 mW (see note 1) |
| **Ambient temperature** | **Operating** | 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.

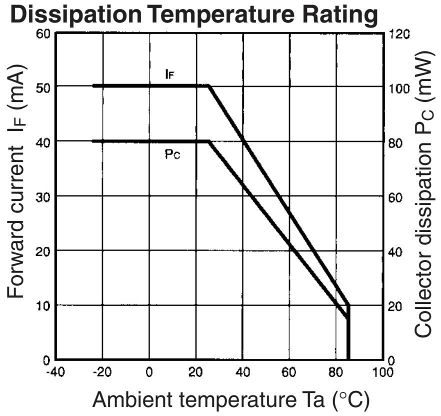
**2.** Complete soldering within 3 seconds.

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

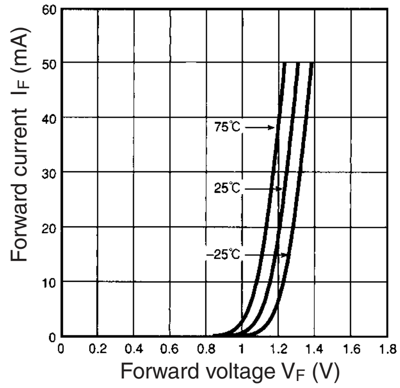
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.3 V typ., 1.6 V max. | $I_F$ = 50 mA |
| | **Reverse current** | $I_R$ | 10 μA max. | $V_R$ = 5 V |
| | **Peak emission wavelength** | $\lambda_P$ | 950 nm typ. | $I_F$ = 50 mA |
| **Detector** | **Light current** | $I_L$ | 0.5 mA min. | $I_F$ = 20 mA, $V_{CE}$ = 5 V |
| | **Dark current** | $I_D$ | 500 nA max. | $V_{CE}$ = 10 V, 0 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** | $\lambda_P$ | 800 nm typ. | $V_{CE}$ = 5 V |
| **Rising time** | | tr | 10 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_F$ = 20 mA |
| **Falling time** | | tf | 10 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_F$ = 20 mA |

## ■ Engineering Data

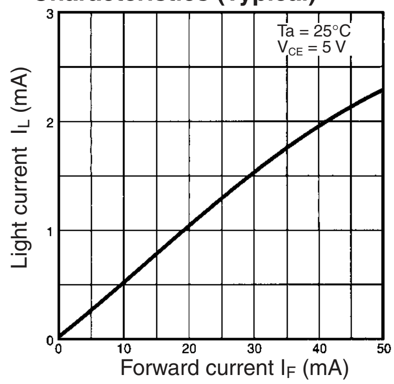
**Forward Current vs. Collector Dissipation Temperature Rating**



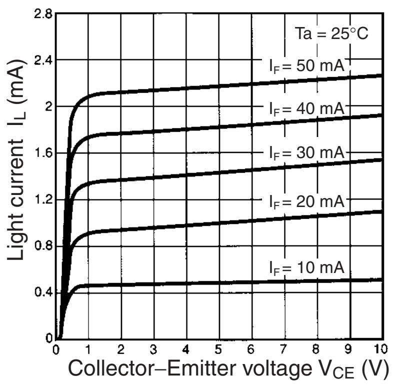

**Forward Current vs. Forward Voltage Characteristics (Typical)**



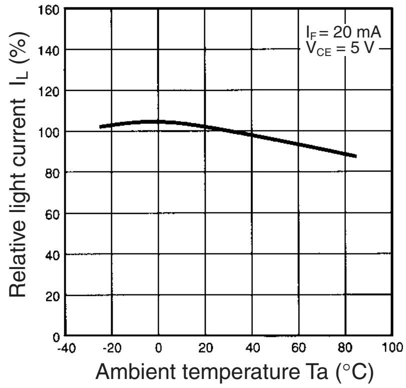

**Light Current vs. Forward Current Characteristics (Typical)**



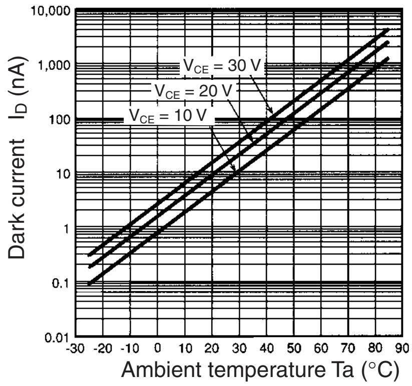

**Light Current vs. Collector−Emitter Voltage Characteristics (Typical)**



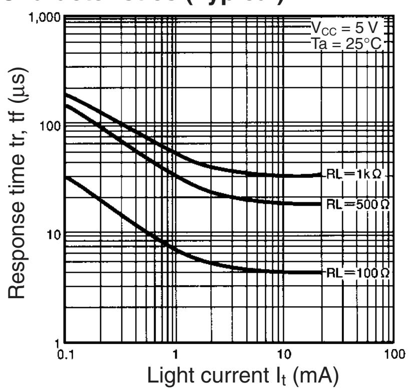

**Relative Light Current vs. Ambient Temperature Characteristics (Typical)**



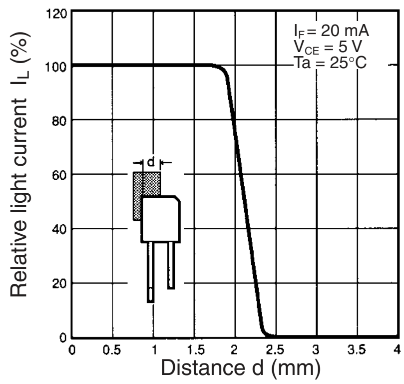

**Dark Current vs. Ambient Temperature Characteristics (Typical)**



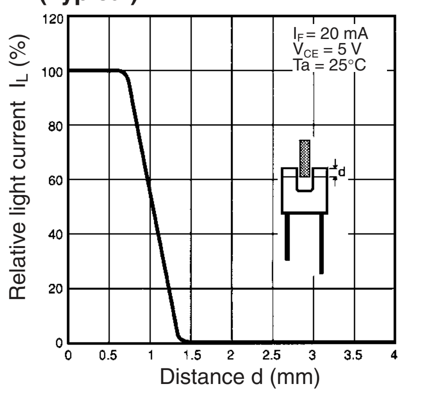

**Response Time vs. Light Current Characteristics (Typical)**



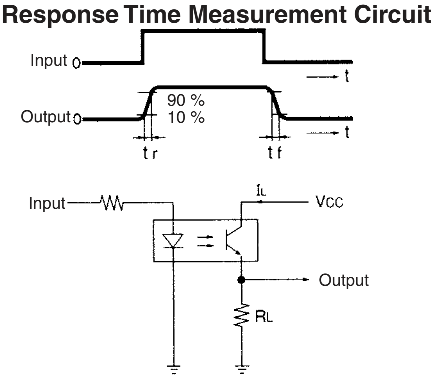

**Sensing Position Characteristics (Typical)**




**Sensing Position Characteristics (Typical)**




**Response Time Measurement Circuit**

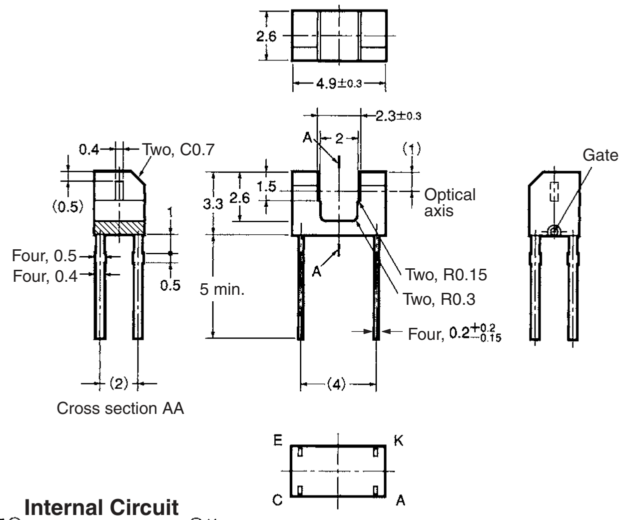


# Photomicrosensor (Transmissive)
# EE-SX1105

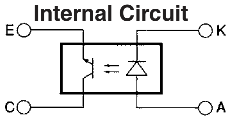
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




Internal Circuit




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

Unless otherwise specified, the tolerances are ±0.2 mm.

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

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

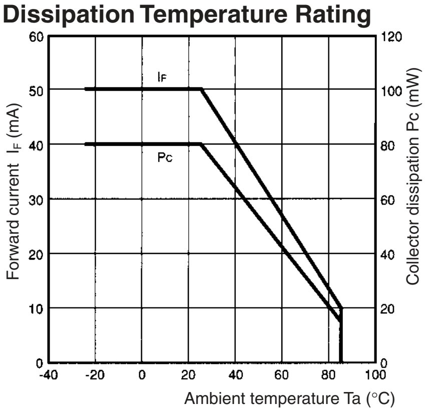
**Note:** **1.** Refer to the temperature rating chart if the ambient temperature exceeds 25°C.
**2.** Complete soldering within 3 seconds.

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

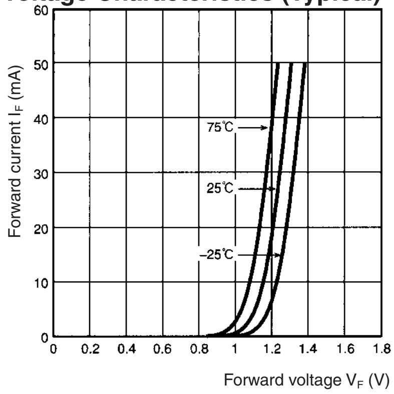
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.3 V typ., 1.6 V max. | $I_F$ = 50 mA |
| | **Reverse current** | $I_R$ | 10 µA max. | $V_R$ = 5 V |
| | **Peak emission wavelength** | $\lambda_P$ | 950 nm typ. | $I_F$ = 50 mA |
| **Detector**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

## ■ Engineering Data

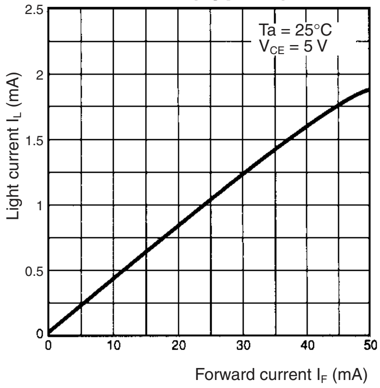
### Forward Current vs. Collector Dissipation Temperature Rating



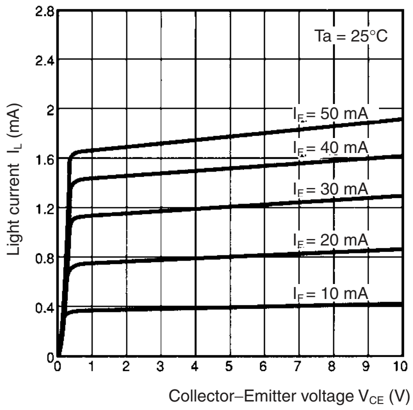

### Forward Current vs. Forward Voltage Characteristics (Typical)



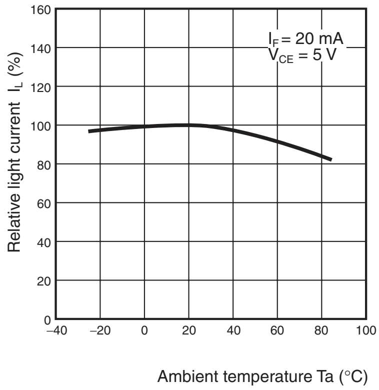

### Light Current vs. Forward Current Characteristics (Typical)



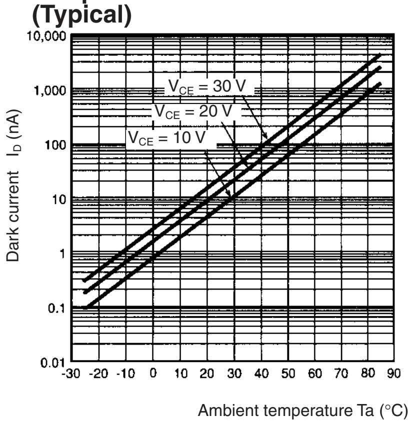

### Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



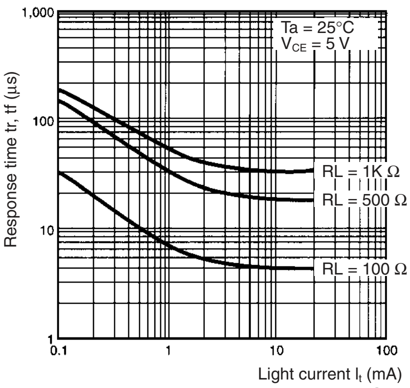

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



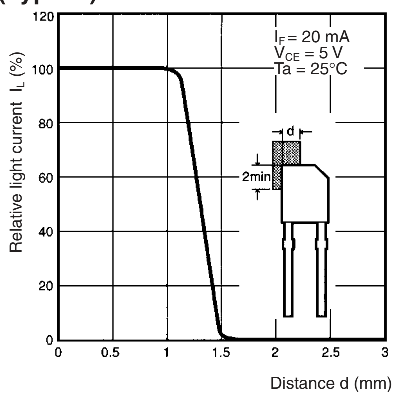

### Dark Current vs. Ambient Temperature Characteristics (Typical)



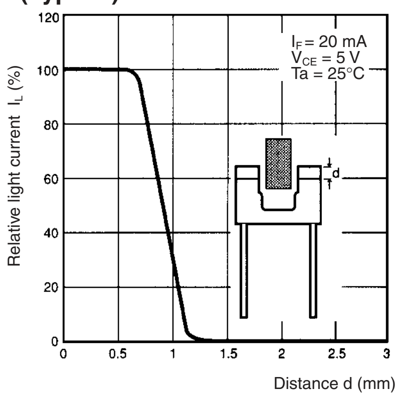

### Response Time vs. Light Current Characteristics (Typical)



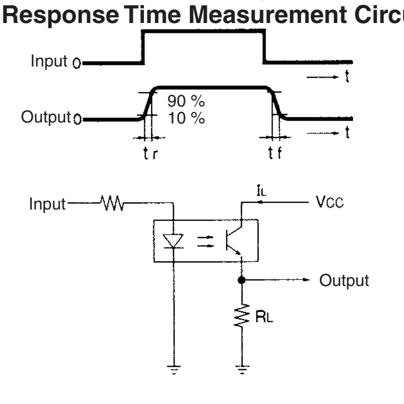

### Sensing Position Characteristics (Typical)




### Sensing Position Characteristics (Typical)




### Response Time Measurement Circuit

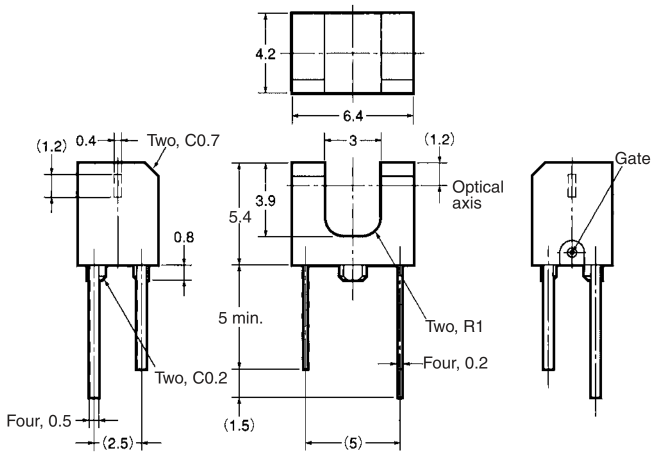


# Photomicrosensor (Transmissive)
# EE-SX1106

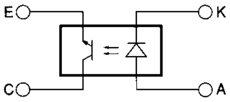
⚠ Be sure to read *Precautions* on page 25.

## ■ Dimensions

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




Internal Circuit




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

Unless otherwise specified, the tolerances are ±0.2 mm.

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

| Item | | Symbol | Rated value |
|---|---|---|---|
| **Emitter** | **Forward current** | $I_F$ | 50 mA (see note 1) |
| | **Pulse forward current** | $I_{FP}$ | --- |
| | **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.

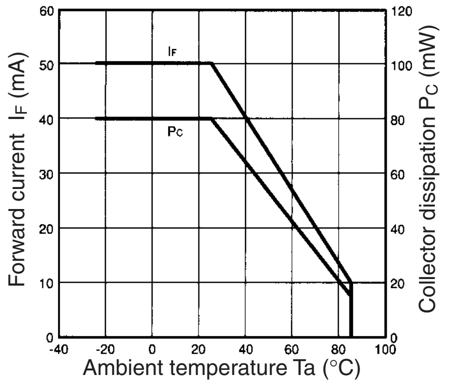
**2.** Complete soldering within 3 seconds.

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

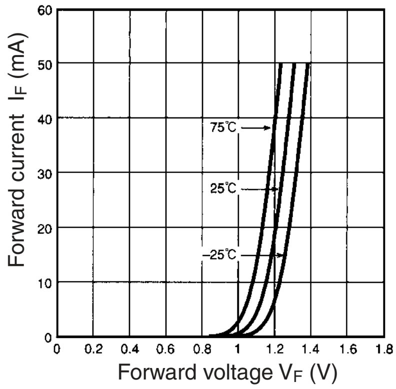
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.3 V typ., 1.6 V max. | $I_F$ = 50 mA |
| | **Reverse current** | $I_R$ | 10 µA max. | $V_R$ = 5 V |
| | **Peak emission wavelength** | $\lambda_P$ | 950 nm typ. | $I_F$ = 50 mA |
| **Detector**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

## ■ Engineering Data

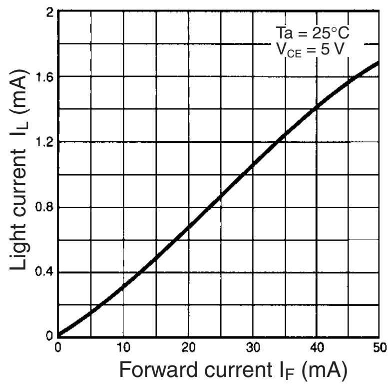
### Forward Current vs. Collector Dissipation Temperature Rating



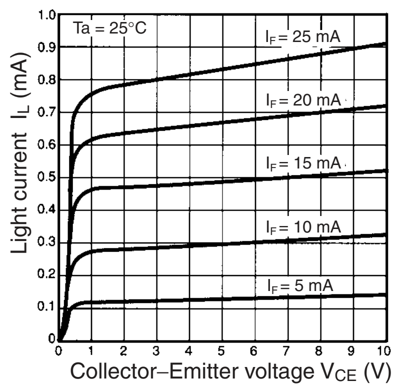

### Forward Current vs. Forward Voltage Characteristics (Typical)



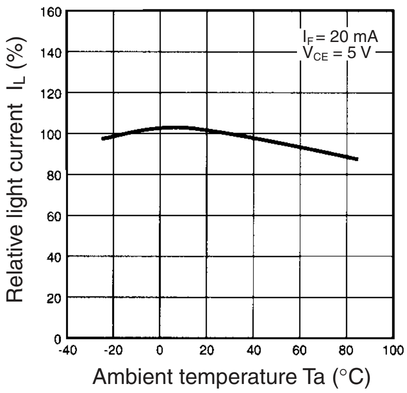

### Light Current vs. Forward Current Characteristics (Typical)



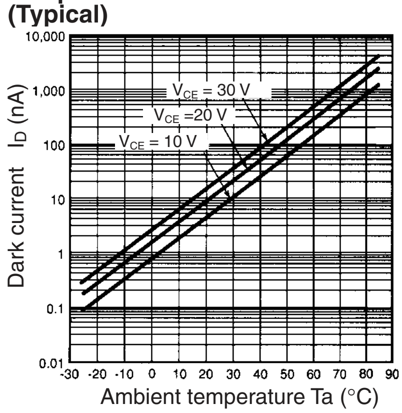

### Light Current vs. Collector−Emitter Voltage Characteristics (Typical)



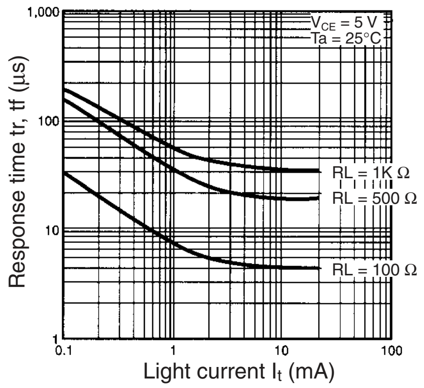

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



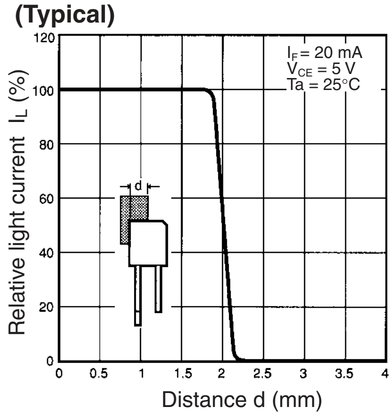

### Dark Current vs. Ambient Temperature Characteristics (Typical)



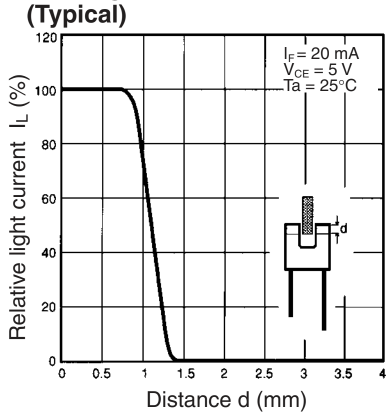

### Response Time vs. Light Current Characteristics (Typical)



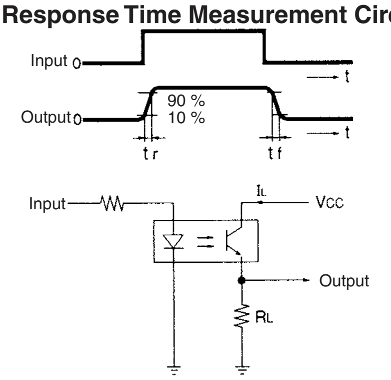

### Sensing Position Characteristics (Typical)




### Sensing Position Characteristics (Typical)




### Response Time Measurement Circuit



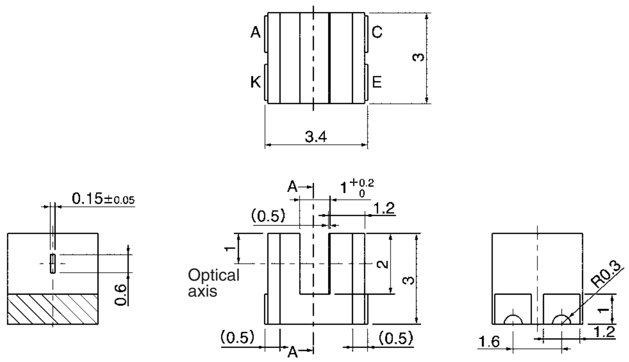
# Photomicrosensor (Transmissive)

# EE-SX1107

Be sure to read *Precautions* on page 25.

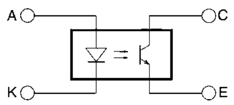
## ■ Dimensions

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



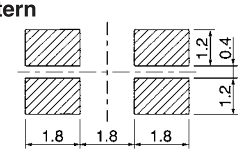

Cross section AA

### Internal Circuit




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

### Recommended Soldering Pattern




Unless otherwise specified, the tolerances are ±0.15 mm.

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

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

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

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

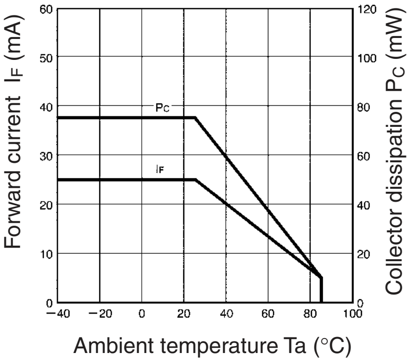
**3.** Complete soldering within 10 seconds for reflow soldering and within 3 seconds for manual soldering.

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

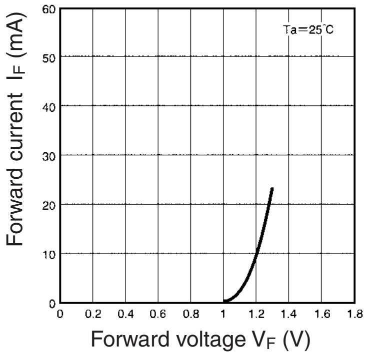
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.1 V typ., 1.3 V max. | $I_F$ = 5 mA |
| | **Reverse current** | $I_R$ | 10 µA max. | $V_R$ = 5 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **Detector**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

## ■ Engineering Data

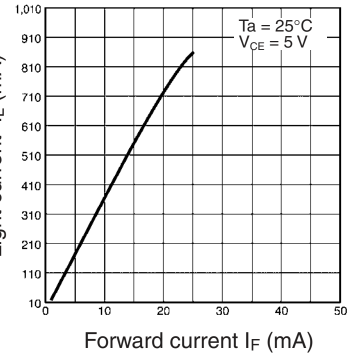
### Forward Current vs. Collector Dissipation Temperature Rating



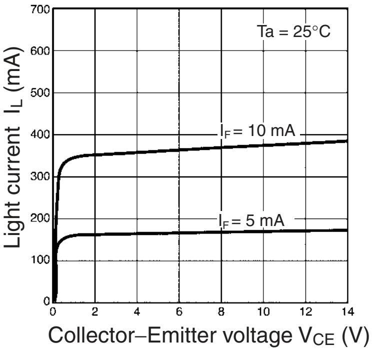

### Forward Current vs. Forward Voltage Characteristics (Typical)



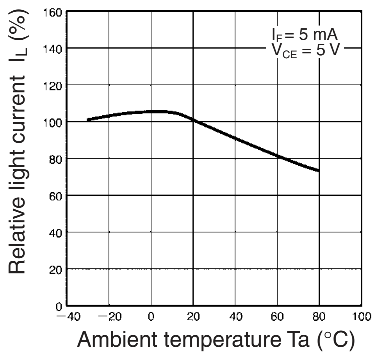

### Light Current vs. Forward Current Characteristics (Typical)



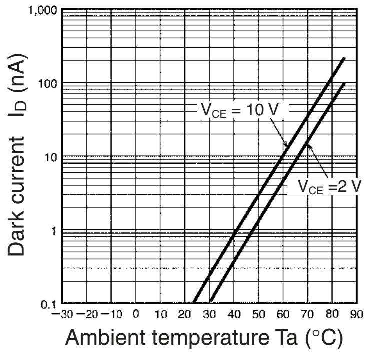

### Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



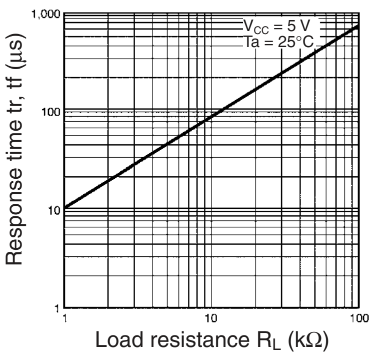

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



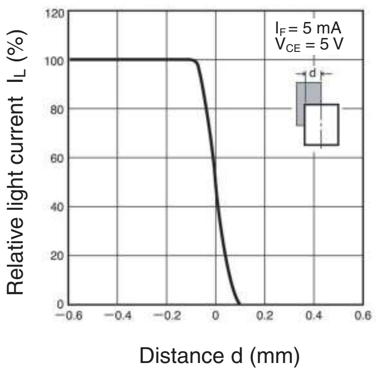

### Dark Current vs. Ambient Temperature Characteristics (Typical)



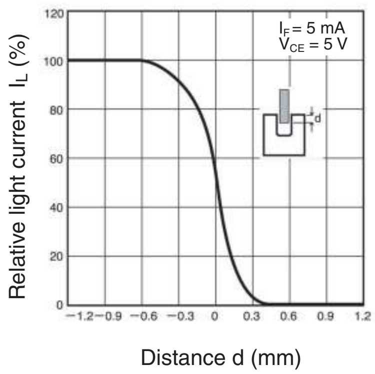

### Response Time vs. Load Resistance Characteristics (Typical)



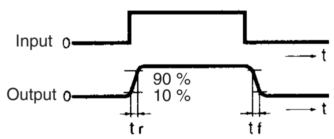

### Sensing Position Characteristics (Typical)

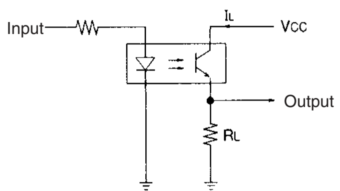



### Sensing Position Characteristics (Typical)




### Response Time Measurement Circuit

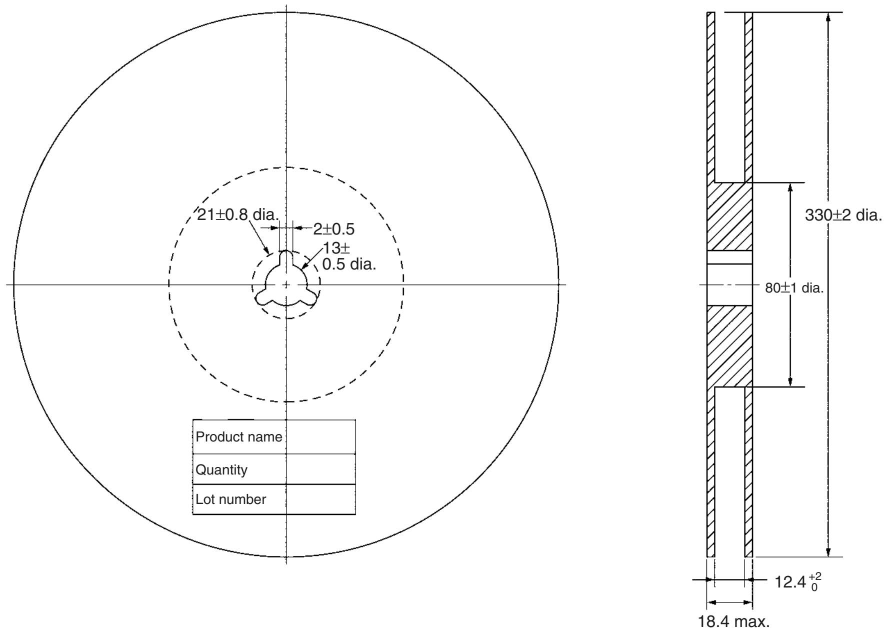


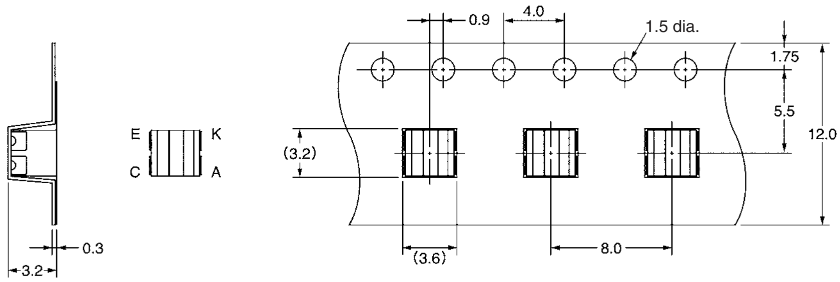
Unit: mm (inch)

## ■ Tape and Reel

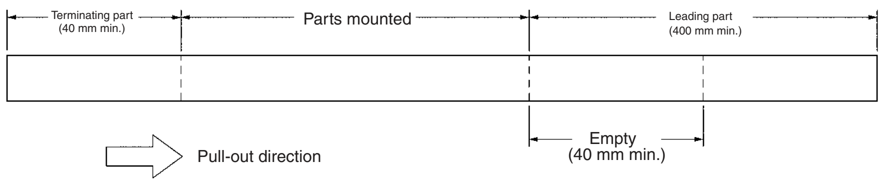
### Reel




### Tape




### Tape configuration




### Tape quantity

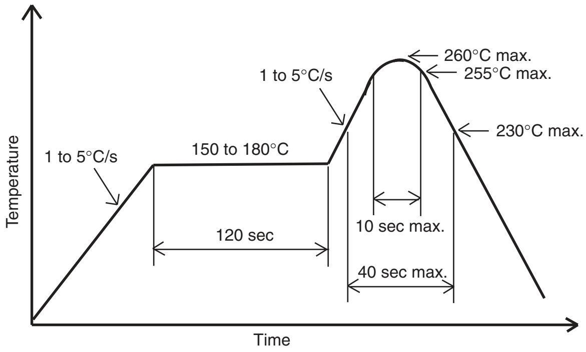
2,500 pcs./reel

# Precautions

## ■ Soldering Information

### Reflow soldering

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




### Manual soldering

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

### Storage

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

Temperature: 10 to 30°C
Humidity: 60% max.

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

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

### Baking

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

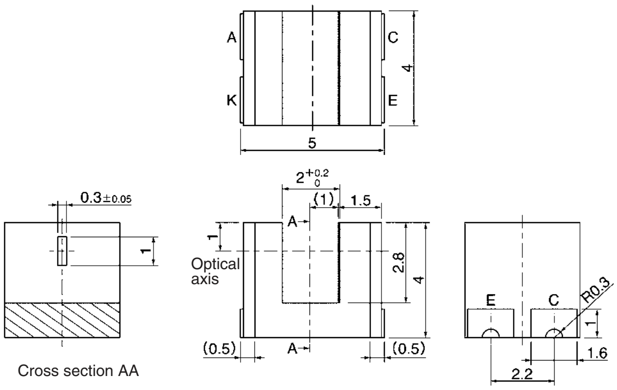
Reel: 60°C for 24 hours or more
Bulk: 80°C for 4 hours or more

# Photomicrosensor (Transmissive)
# EE-SX1108

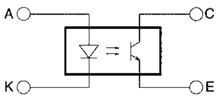
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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

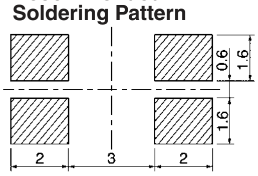



**Internal Circuit**




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

**Recommended Soldering Pattern**




Unless otherwise specified, the tolerances are ±0.15 mm.

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

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

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

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

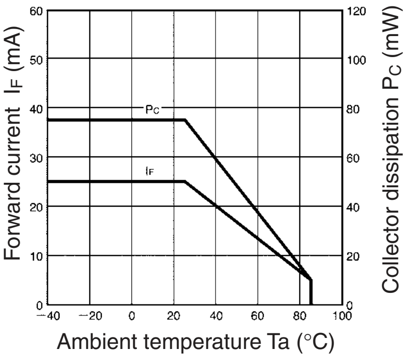
**3.** Complete soldering within 10 seconds for reflow soldering and within 3 seconds for manual soldering.

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

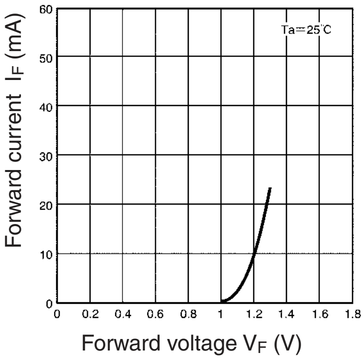
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| Emitter | Forward voltage | $V_F$ | 1.1 V typ., 1.3 V max. | $I_F$ = 5 mA |
| | Reverse current | $I_R$ | 10 μA max. | $V_R$ = 5 V |
| | Peak emission wavelength | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| Detector | Light current |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

## ■ Engineering Data

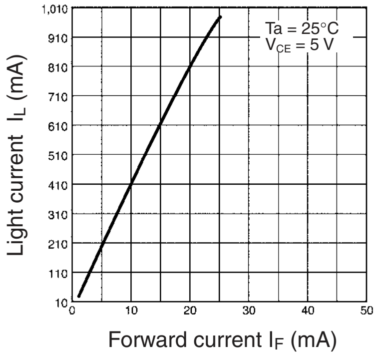
**Forward Current vs. Collector Dissipation Temperature Rating**



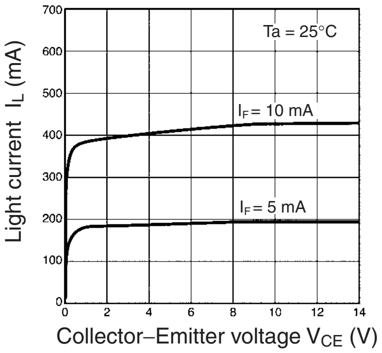

**Forward Current vs. Forward Voltage Characteristics (Typical)**



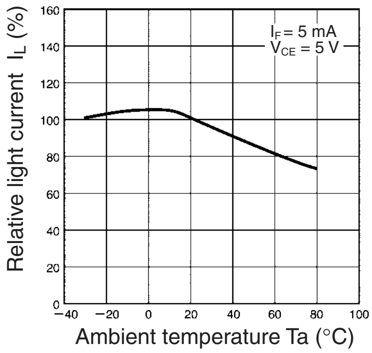

**Light Current vs. Forward Current Characteristics (Typical)**



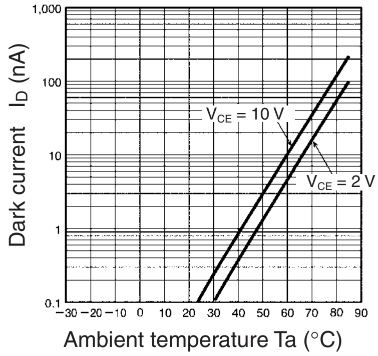

**Light Current vs. Collector–Emitter Voltage Characteristics (Typical)**



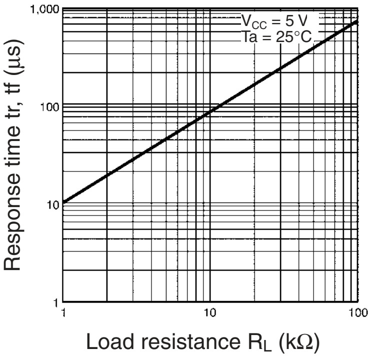

**Relative Light Current vs. Ambient Temperature Characteristics (Typical)**



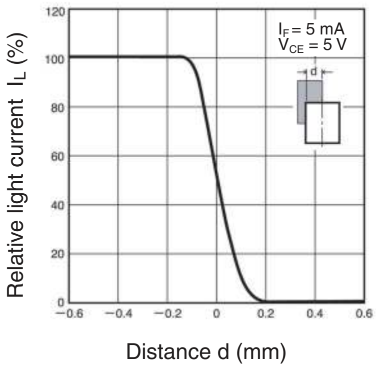

**Dark Current vs. Ambient Temperature Characteristics (Typical)**



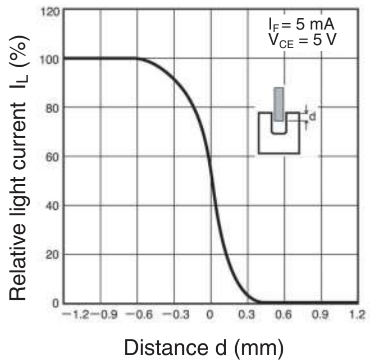

**Response Time vs. Load Resistance Characteristics (Typical)**



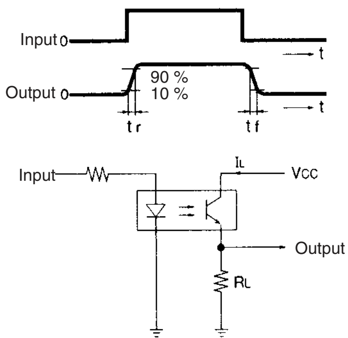

**Sensing Position Characteristics (Typical)**




**Sensing Position Characteristics (Typical)**



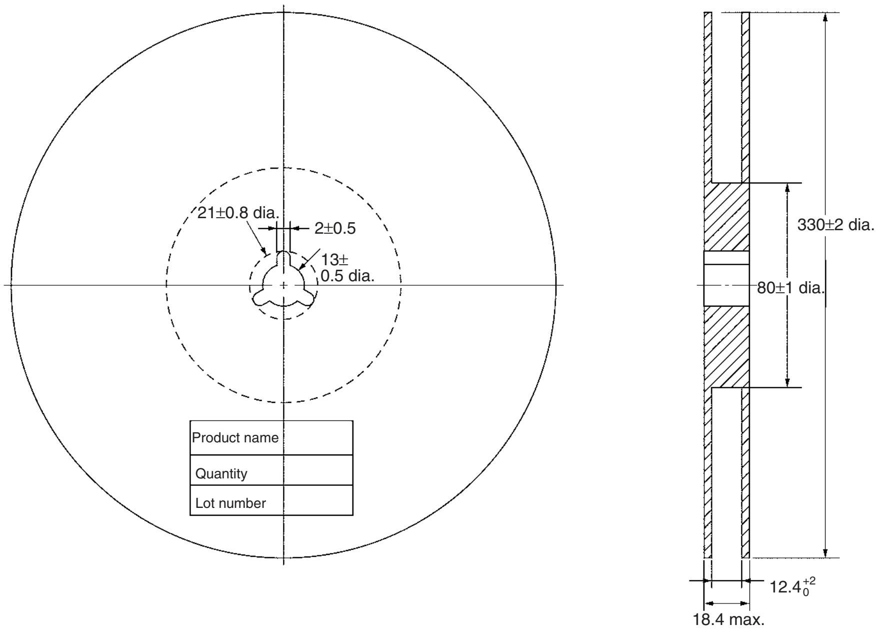

**Response Time Measurement Circuit**



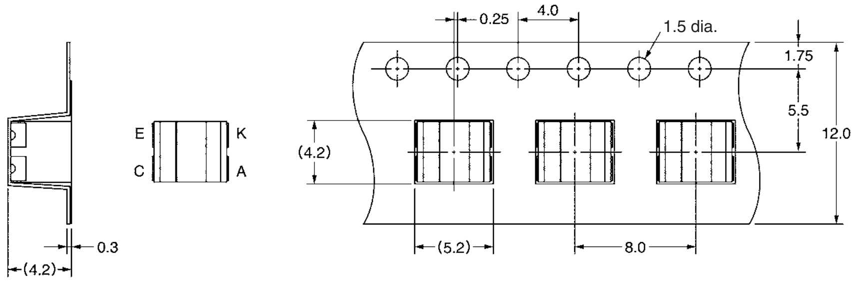
Unit: mm (inch)

## ■ Tape and Reel

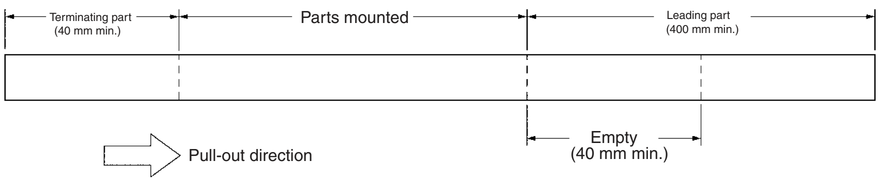
### Reel




### Tape




### Tape configuration




### Tape quantity

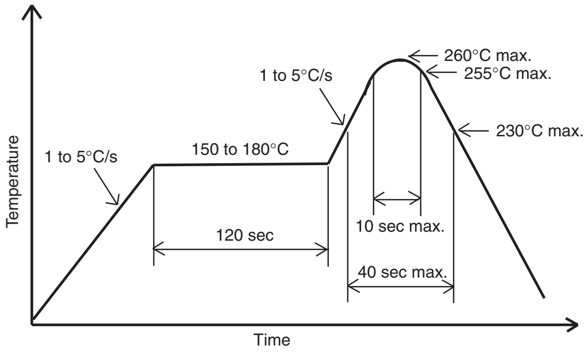
2,000 pcs./reel

# Precautions

## ■ Soldering Information

### Reflow soldering

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




### Manual soldering

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

### Storage

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

Temperature: 10 to 30°C
Humidity: 60% max.

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

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

### Baking

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

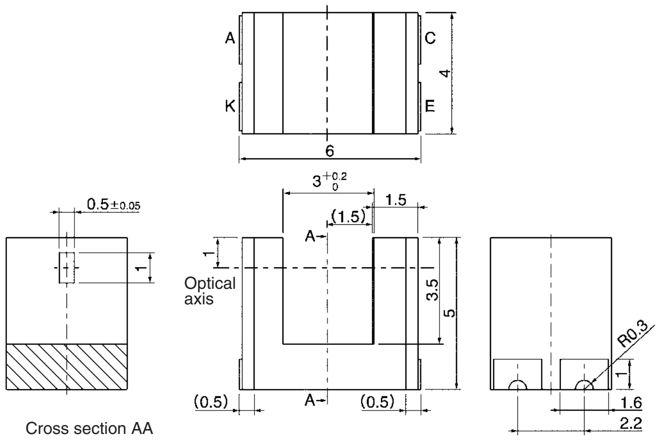
Reel: 60°C for 24 hours or more
Bulk: 80°C for 4 hours or more

# Photomicrosensor (Transmissive)
# EE-SX1109

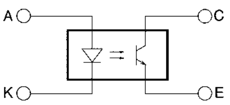
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

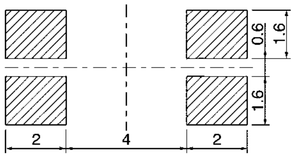
**Note:** All units are in millimeters unless otherwise indicated.




### Internal Circuit




### Recommended Soldering Pattern




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

Unless otherwise specified, the tolerances are ±0.15 mm.

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

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

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

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

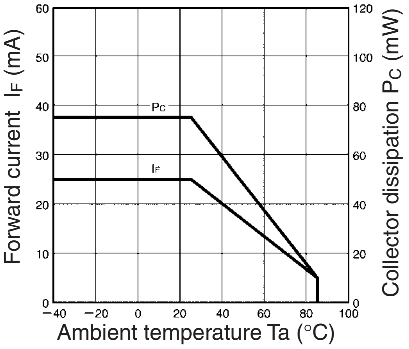
**3.** Complete soldering within 10 seconds for reflow soldering and within 3 seconds for manual soldering.

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

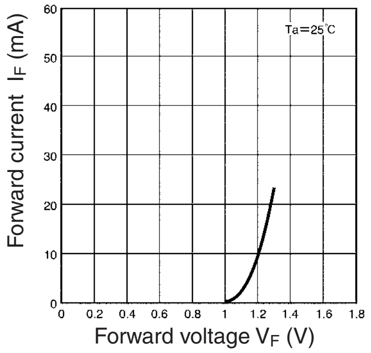
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.1 V typ., 1.3 V max. | $I_F$ = 5 mA |
| | **Reverse current** | $I_R$ | 10 µA max. | $V_R$ = 5 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **Detector**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

## ■ Engineering Data

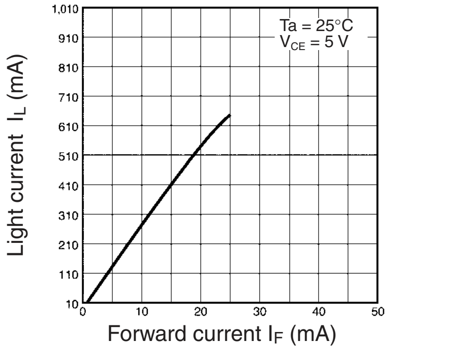
### Forward Current vs. Collector Dissipation Temperature Rating



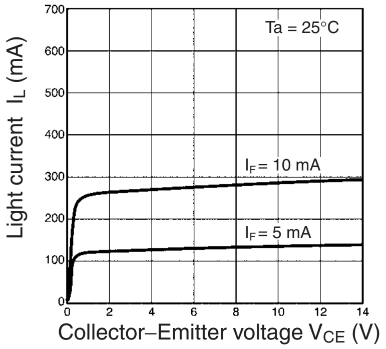

### Forward Current vs. Forward Voltage Characteristics (Typical)



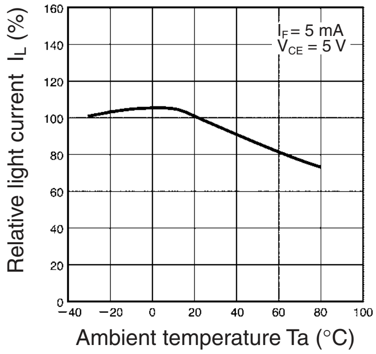

### Light Current vs. Forward Current Characteristics (Typical)



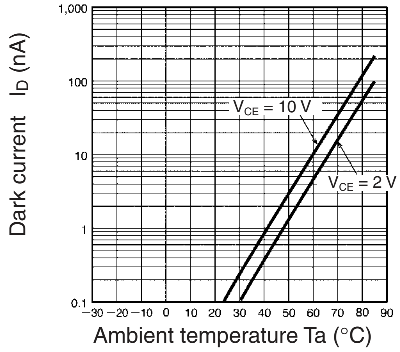

### Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



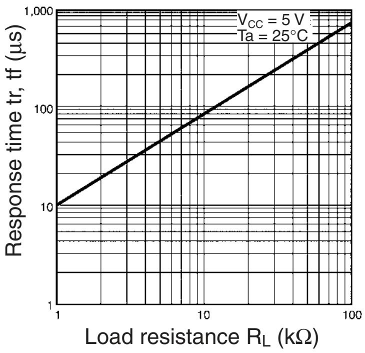

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



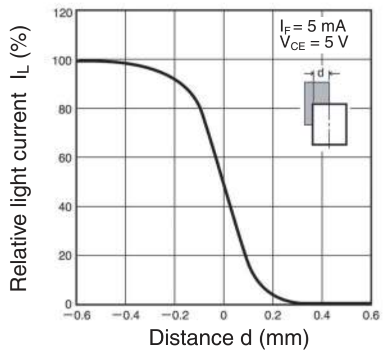

### Dark Current vs. Ambient Temperature Characteristics (Typical)



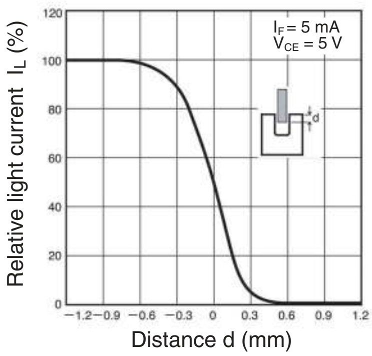

### Response Time vs. Load Resistance Characteristics (Typical)



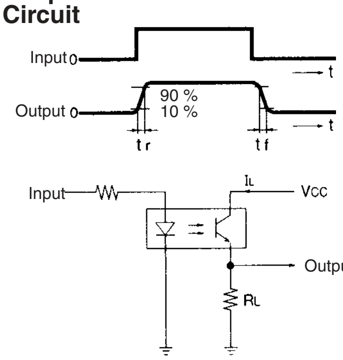

### Sensing Position Characteristics (Typical)




### Sensing Position Characteristics (Typical)



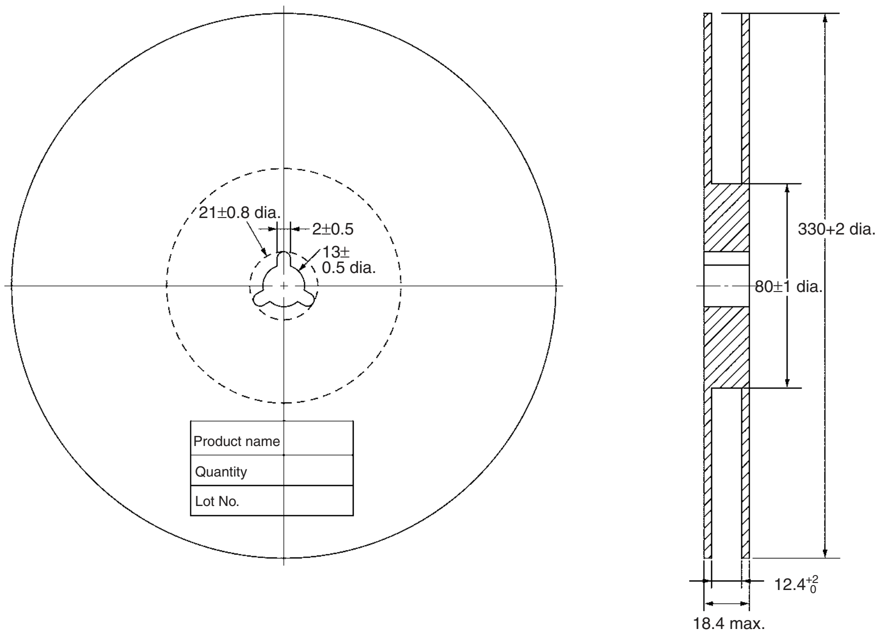

### Response Time Measurement Circuit



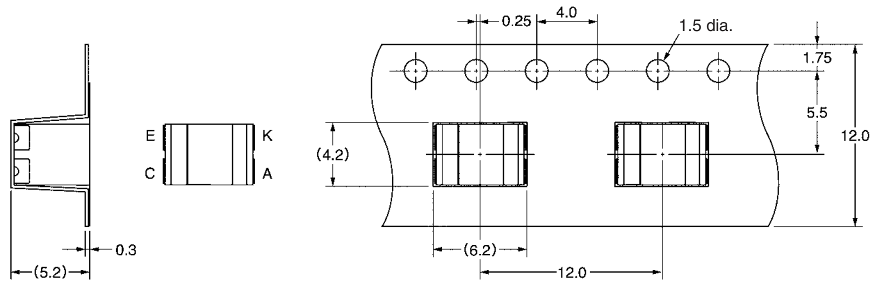
Unit: mm (inch)

# ■ Tape and Reel

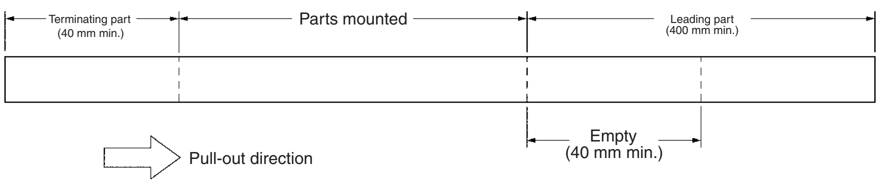
## Reel




## Tape




## Tape configuration




## Tape quantity

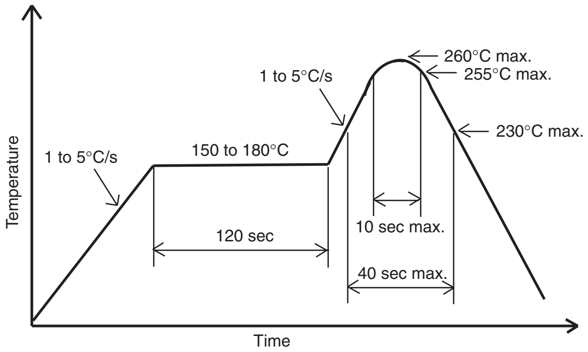
1,000 pcs./reel

# Precautions

## ■ Soldering Information

### Reflow soldering

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




### Manual soldering

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

### Storage

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

Temperature: 10 to 30°C
Humidity: 60% max.

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

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

### Baking

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

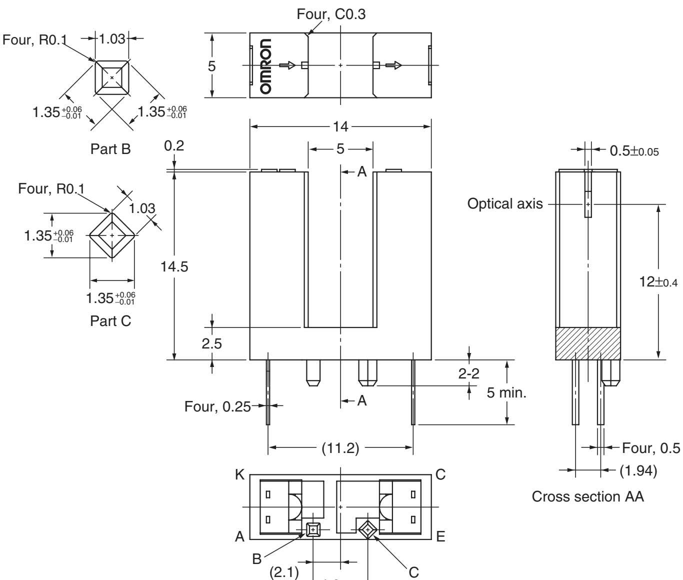
Reel: 60°C for 24 hours or more
Bulk: 80°C for 4 hours or more

# Photomicrosensor (Transmissive)
# EE-SX1115

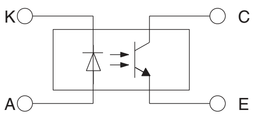
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

| Item | | Symbol | Rated value |
|---|---|---|---|
| **Emitter** | **Forward current** | $I_F$ | 50 mA (see note 1) |
| | **Pulse forward current** | $I_{FP}$ | 1 A (see note 2) |
| | **Reverse voltage** | $V_R$ | 4 V |
| **Detector** | **Collector–Emitter voltage** | $V_{CEO}$ | 30 V |
| | **Emitter–Collector voltage** | $V_{ECO}$ | --- |
| | **Collector current** | $I_C$ | 20 mA |
| | **Collector dissipation** | $P_C$ | 100 mW (see note 1) |
| **Ambient temperature** | **Operating** | 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.

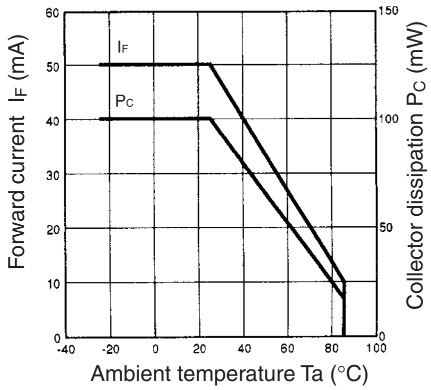
**3.** Complete soldering within 10 seconds.

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

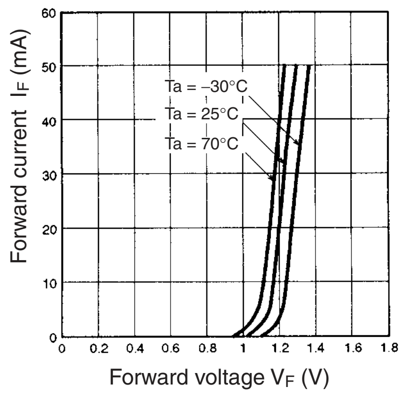
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 30 mA |
| | **Reverse current** | $I_R$ | 0.01 μA typ., 10 μA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **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** | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| **Rising time** | | tr | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |
| **Falling time** | | tf | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |

## ■ Engineering Data

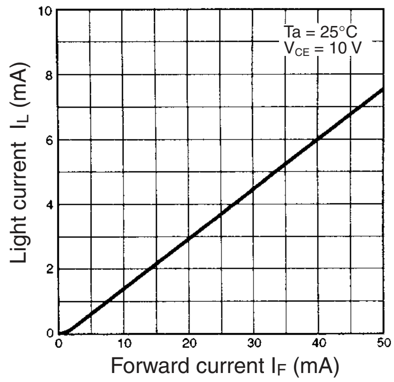
### Forward Current vs. Collector Dissipation Temperature Rating



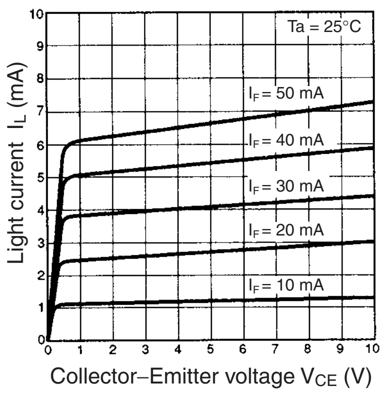

### Forward Current vs. Forward Voltage Characteristics (Typical)



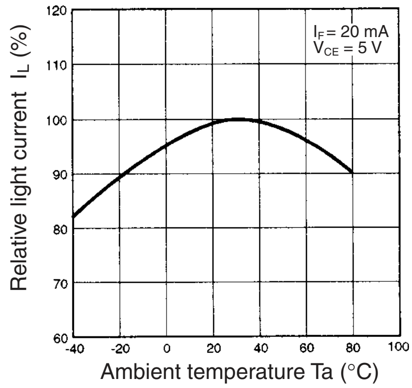

### Light Current vs. Forward Current Characteristics (Typical)



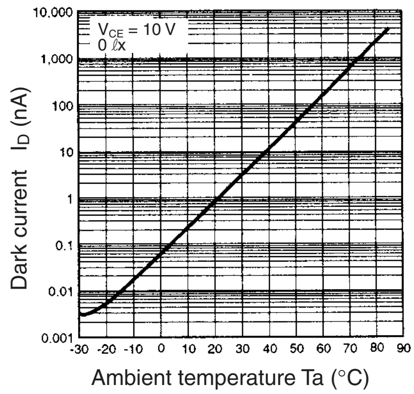

### Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



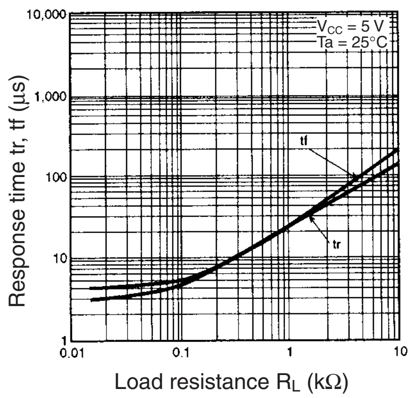

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



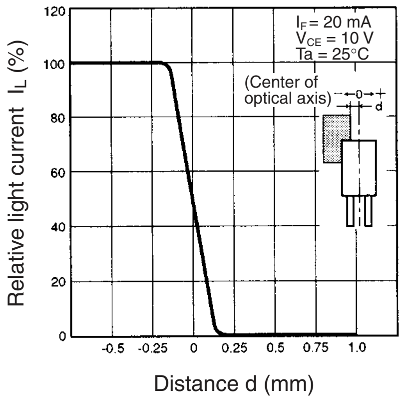

### Dark Current vs. Ambient Temperature Characteristics (Typical)



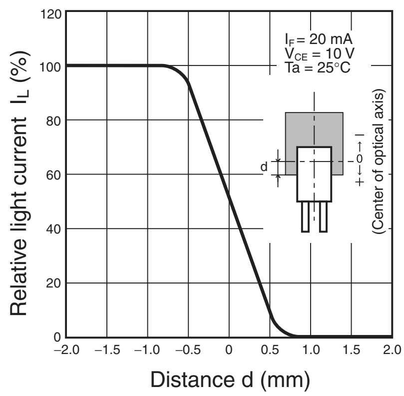

### Response Time vs. Load Resistance Characteristics (Typical)



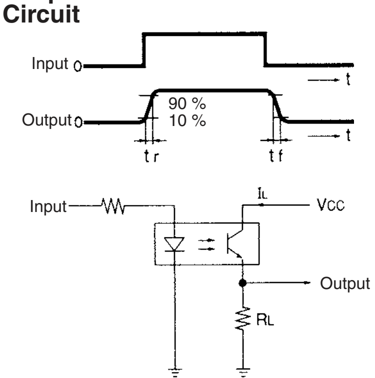

### Sensing Position Characteristics (Typical)




### Sensing Position Characteristics (Typical)




### Response Time Measurement Circuit

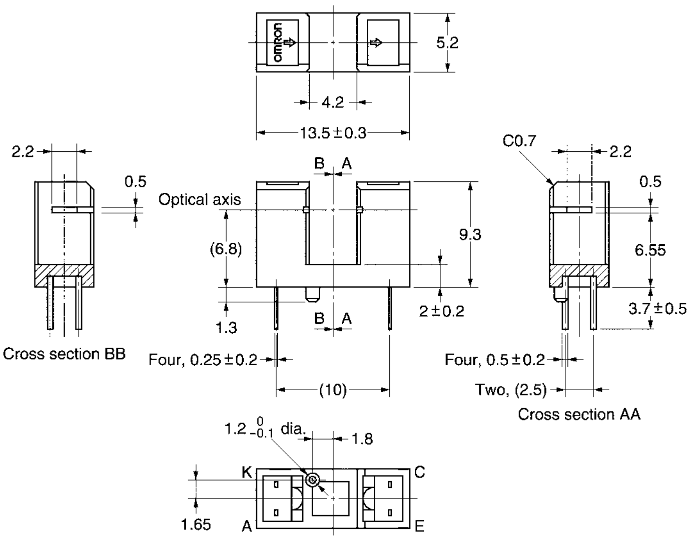


# Photomicrosensor (Transmissive)
# EE-SX1128

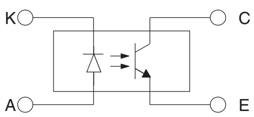
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ Absolute Maximum Ratings (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.

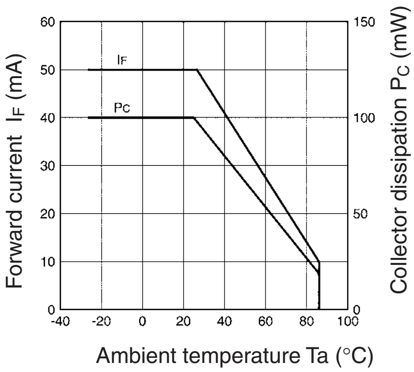
**3.** Complete soldering within 10 seconds.

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

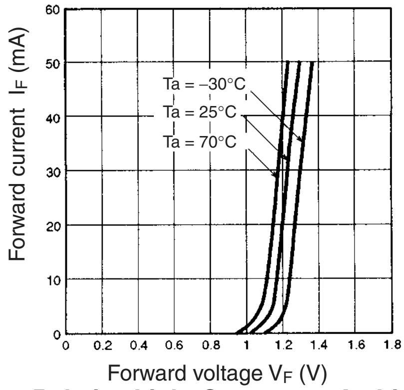
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 30 mA |
| | **Reverse current** | $I_R$ | 0.01 μA typ., 10 μA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **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 V max. | $I_F$ = 20 mA, $I_L$ = 0.1 mA |
| | **Peak spectral sensitivity wavelength** | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| **Rising time** | | tr | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |
| **Falling time** | | tf | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |

## ■ Engineering Data

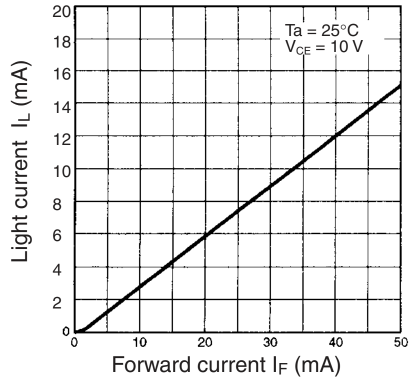
### Forward Current vs. Collector Dissipation Temperature Rating



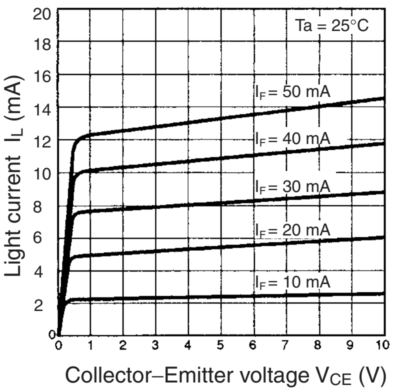

### Forward Current vs. Forward Voltage Characteristics (Typical)



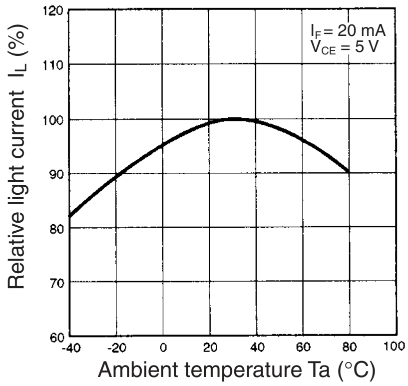

### Light Current vs. Forward Current Characteristics (Typical)



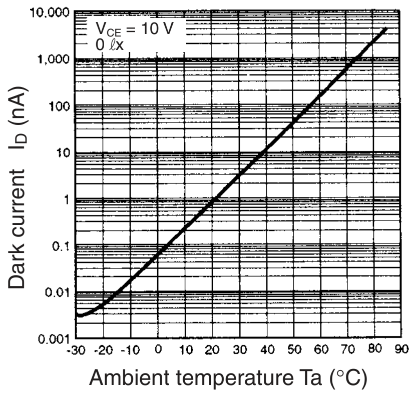

### Light Current vs. Collector−Emitter Voltage Characteristics (Typical)



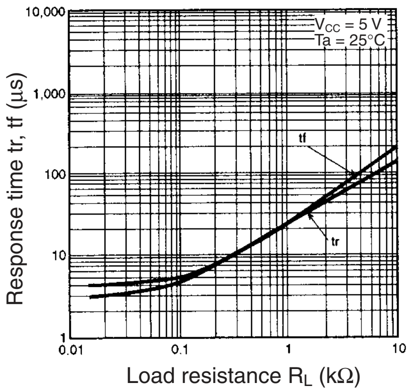

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



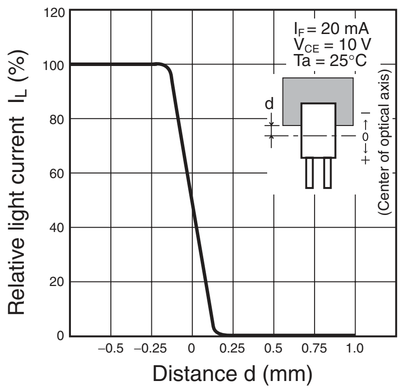

### Dark Current vs. Ambient Temperature Characteristics (Typical)



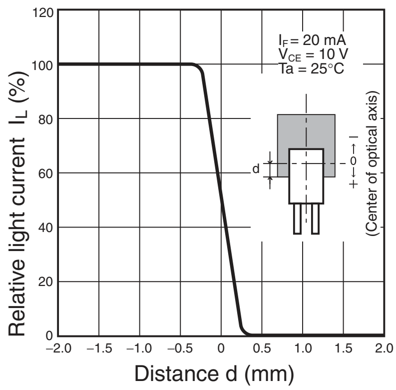

### Response Time vs. Load Resistance Characteristics (Typical)



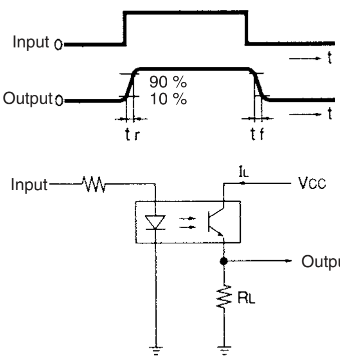

### Sensing Position Characteristics (Typical)




### Sensing Position Characteristics (Typical)




### Response Time Measurement Circuit

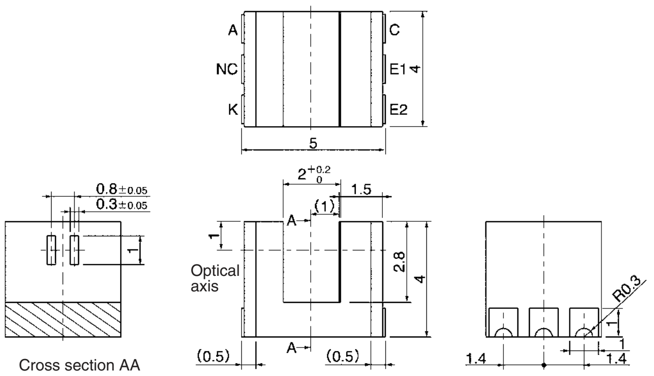


# Photomicrosensor (Transmissive)
# EE-SX1131

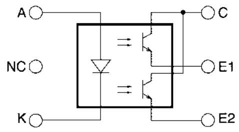
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

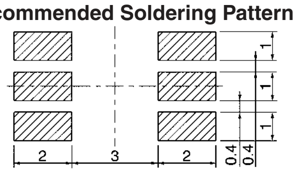
**Note:** All units are in millimeters unless otherwise indicated.




**Internal Circuit**




**Recommended Soldering Pattern**




| Terminal No. | Name |
|---|---|
| A | Anode |
| NC | Not connected. |
| K | Cathode |
| C | Collector |
| E1 | Emitter 1 |
| E2 | Emitter 2 |

Unless otherwise specified, the tolerances are ±0.15 mm.

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

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

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

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

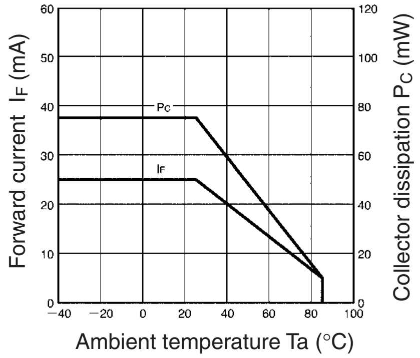
**3.** Complete soldering within 10 seconds for reflow soldering and within 3 seconds for manual soldering.

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

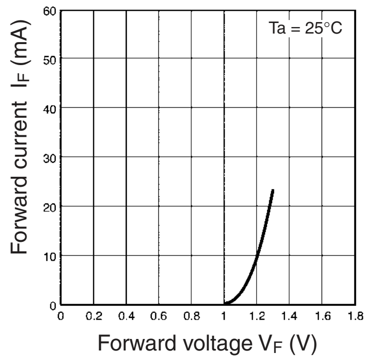
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.1 V typ., 1.3 V max. | $I_F$ = 5 mA |
| | **Reverse current** | $I_R$ | 10 µA max. | $V_R$ = 5 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **Detector** | **Light current** | $I_{L1}/I_{L2}$ | 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** | $\lambda_P$ | 900 nm typ. | --- |
| **Rising time** | | tr | 10 µs typ. | $V_{CC}$ = 5 V, $R_L$ = 1 kΩ, $I_L$ = 100 µA |
| **Falling time** | | tf | 10 µs typ. | $V_{CC}$ = 5 V, $R_L$ = 1 kΩ, $I_L$ = 100 µA |

## ■ Engineering Data

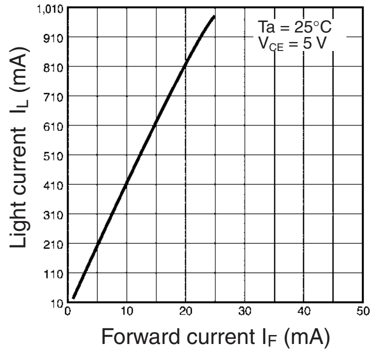
**Forward Current vs. Collector Dissipation Temperature Rating**



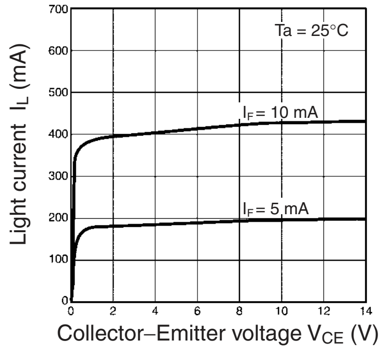

**Forward Current vs. Forward Voltage Characteristics (Typical)**



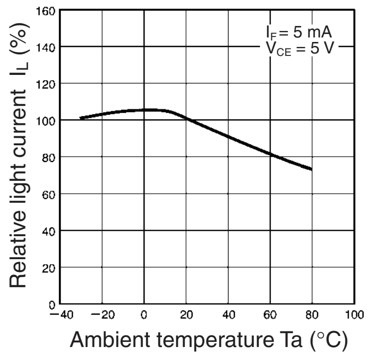

**Light Current vs. Forward Current Characteristics (Typical)**



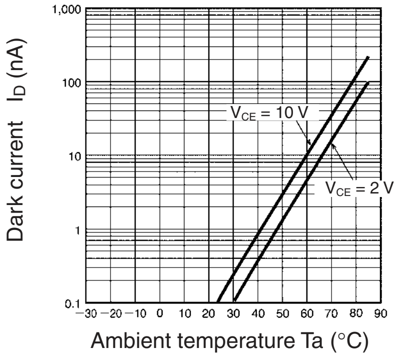

**Light Current vs. Collector−Emitter Voltage Characteristics (Typical)**



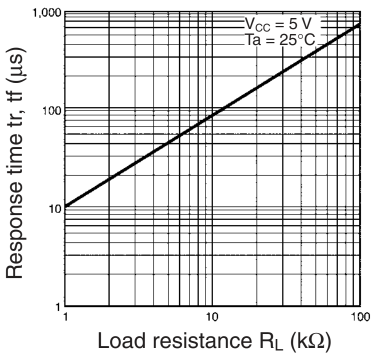

**Relative Light Current vs. Ambient Temperature Characteristics (Typical)**



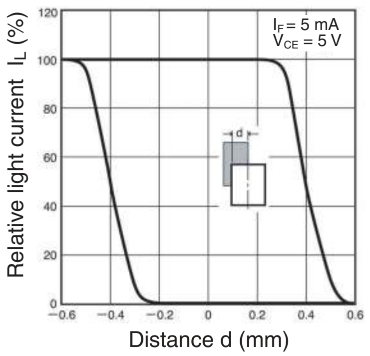

**Dark Current vs. Ambient Temperature Characteristics (Typical)**



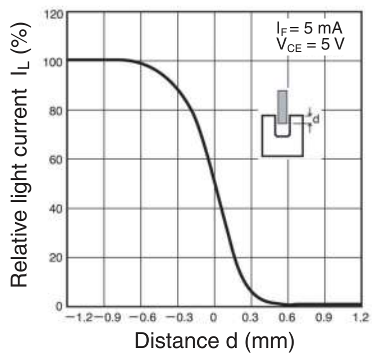

**Response Time vs. Load Resistance Characteristics (Typical)**



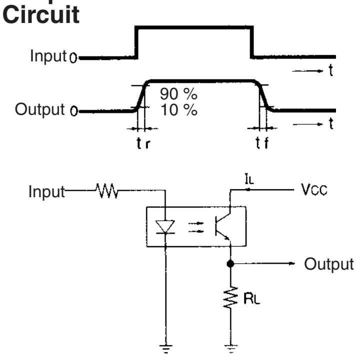

**Sensing Position Characteristics (Typical)**




**Sensing Position Characteristics (Typical)**



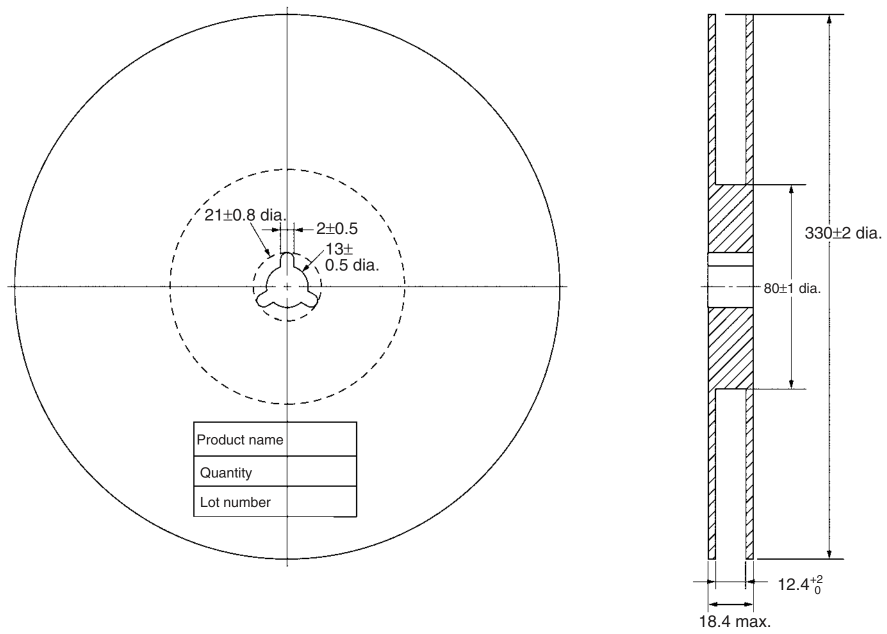

**Response Time Measurement Circuit**



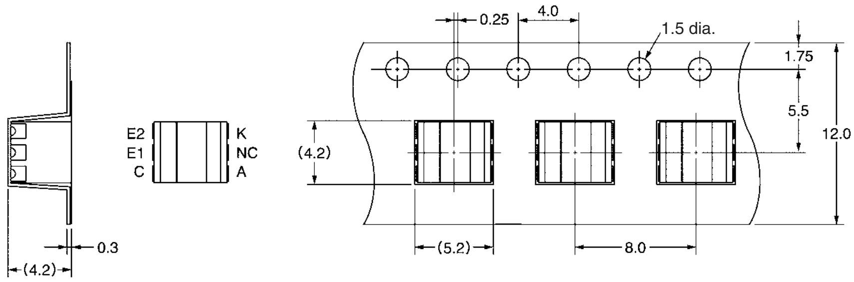
Unit: mm (inch)

## ■ Tape and Reel

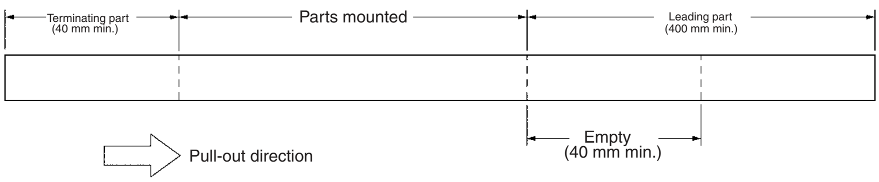
### Reel




### Tape




### Tape configuration




### Tape quantity

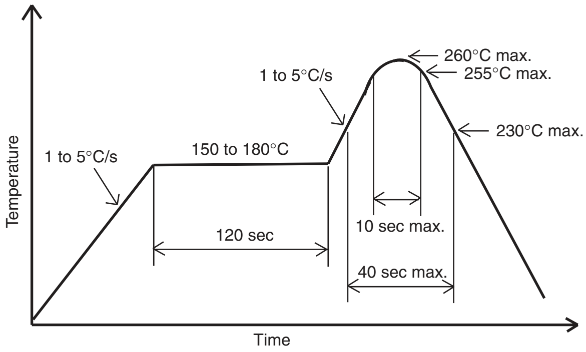
2,000 pcs./reel

# Precautions

## ■ Soldering Information

### Reflow soldering

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




### Manual soldering

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

### Storage

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

Temperature: 10 to 30°C
Humidity: 60% max.

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

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

### Baking

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

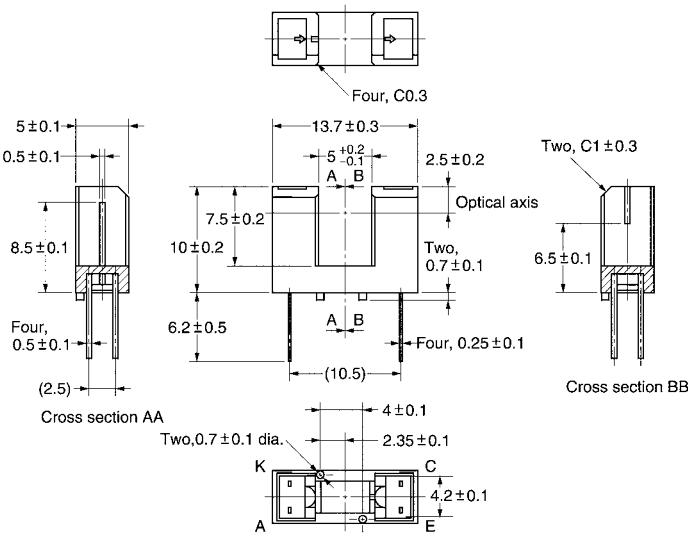
Reel: 60°C for 24 hours or more
Bulk: 80°C for 4 hours or more

# Photomicrosensor (Transmissive)
# EE-SX1137

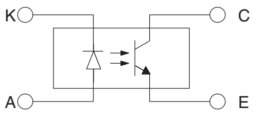
Be sure to read *Precautions* on page 25.

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

| Item | | Symbol | Rated value |
|---|---|---|---|
| **Emitter** | **Forward current** | $I_F$ | 50 mA (see note 1) |
| | **Pulse forward current** | $I_{FP}$ | 1 A (see note 2) |
| | **Reverse voltage** | $V_R$ | 4 V |
| **Detector** | **Collector–Emitter voltage** | $V_{CEO}$ | 30 V |
| | **Emitter–Collector voltage** | $V_{ECO}$ | --- |
| | **Collector current** | $I_C$ | 20 mA |
| | **Collector dissipation** | $P_C$ | 100 mW (see note 1) |
| **Ambient temperature** | **Operating** | 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.

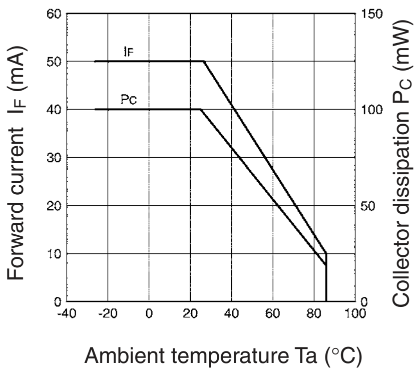
**3.** Complete soldering within 10 seconds.

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

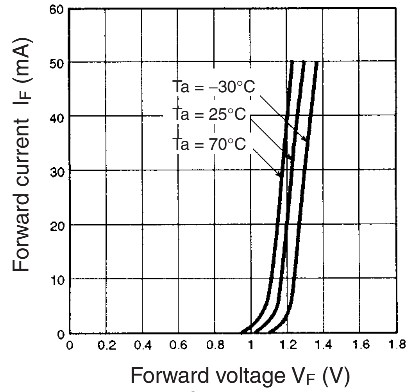
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 30 mA |
| | **Reverse current** | $I_R$ | 0.01 μA typ., 10 μA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **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** | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| **Rising time** | | tr | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |
| **Falling time** | | tf | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |

## ■ Engineering Data

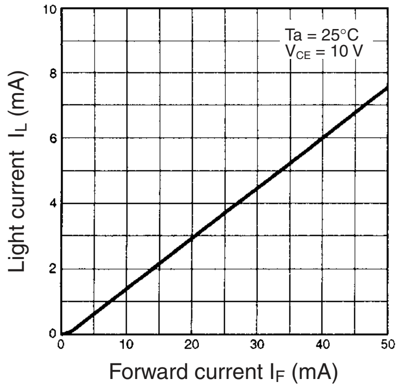
### Forward Current vs. Collector Dissipation Temperature Rating



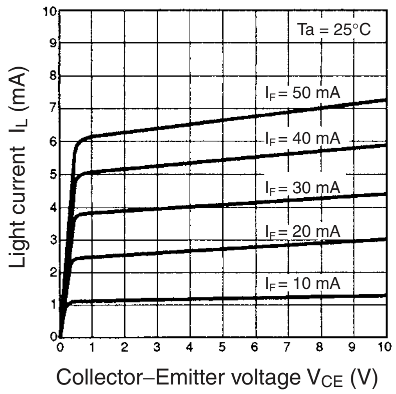

### Forward Current vs. Forward Voltage Characteristics (Typical)



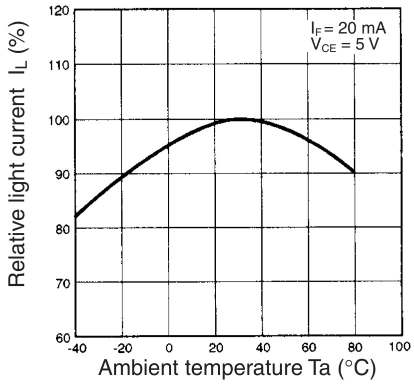

### Light Current vs. Forward Current Characteristics (Typical)



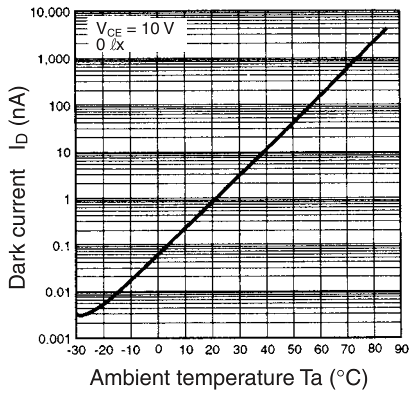

### Light Current vs. Collector−Emitter Voltage Characteristics (Typical)



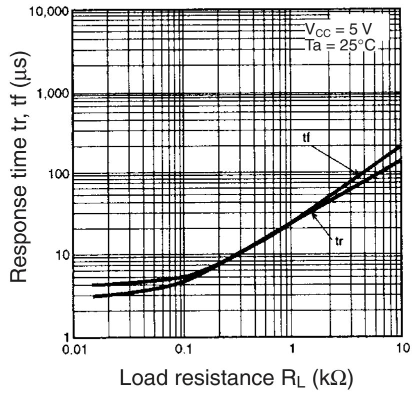

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



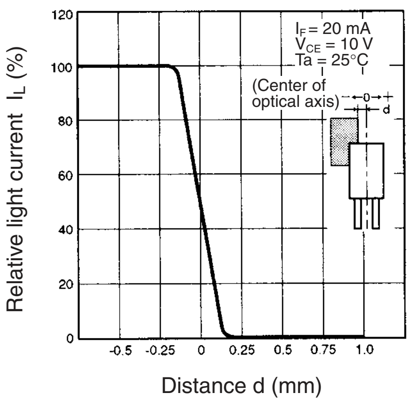

### Dark Current vs. Ambient Temperature Characteristics (Typical)



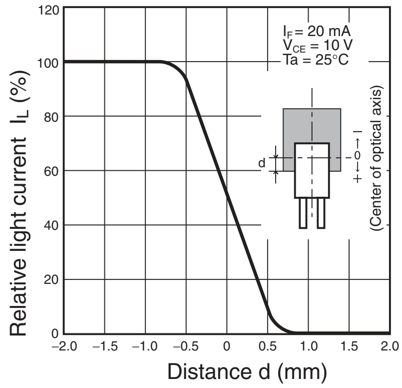

### Response Time vs. Load Resistance Characteristics (Typical)



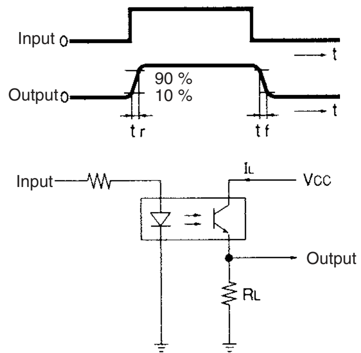

### Sensing Position Characteristics (Typical)




### Sensing Position Characteristics (Typical)




### Response Time Measurement Circuit

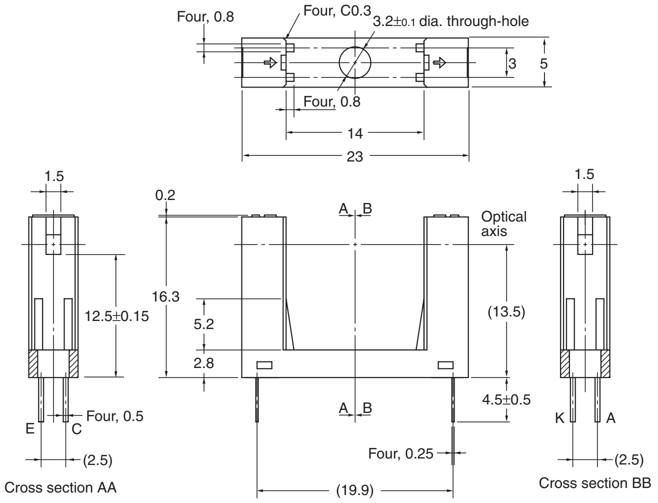


# Photomicrosensor (Transmissive)
# EEE-SX1140

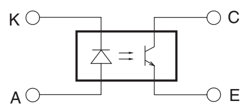
Be sure to read *Precautions* on page 25.

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

| Item | | Symbol | Rated value |
|---|---|---|---|
| **Emitter** | **Forward current** | $I_F$ | 50 mA (see note 1) |
| | **Pulse forward current** | $I_{FP}$ | 1 A (see note 2) |
| | **Reverse voltage** | $V_R$ | 4 V |
| **Detector** | **Collector–Emitter voltage** | $V_{CEO}$ | 30 V |
| | **Emitter–Collector voltage** | $V_{ECO}$ | --- |
| | **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.

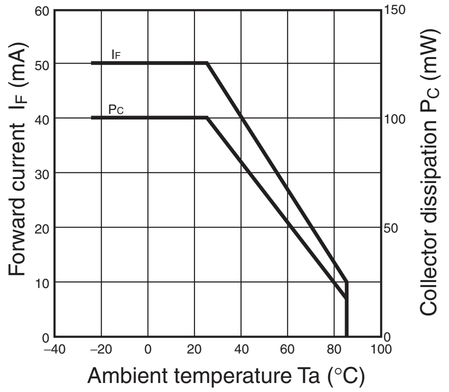
**3.** Complete soldering within 10 seconds.

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

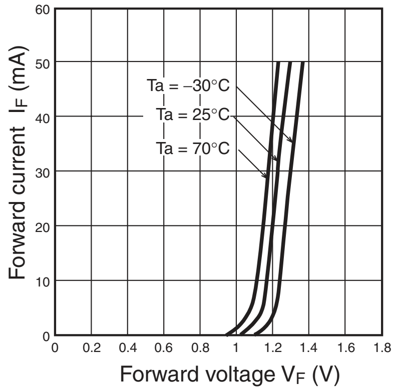
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 30 mA |
| | **Reverse current** | $I_R$ | 0.01 μA typ., 10 μA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **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, $I_L$ = 0.1 mA |
| | **Peak spectral sensitivity wavelength** | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| **Rising time** | | tr | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |
| **Falling time** | | tf | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |

## ■ Engineering Data

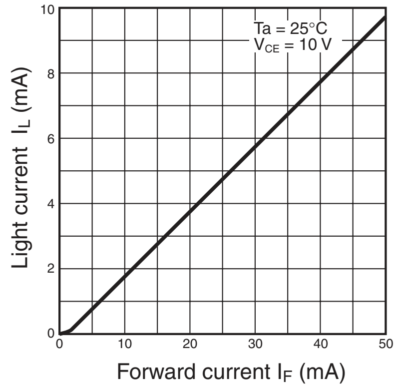
### Forward Current vs. Collector Dissipation Temperature Rating



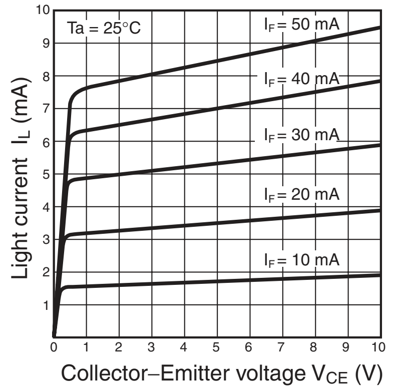

### Forward Current vs. Forward Voltage Characteristics (Typical)



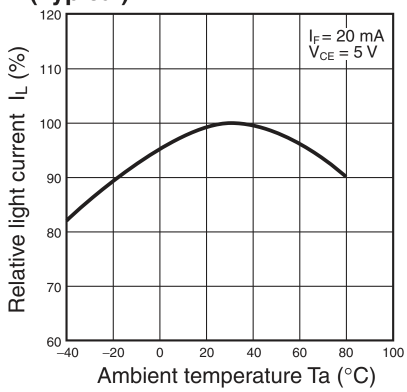

### Light Current vs. Forward Current Characteristics (Typical)



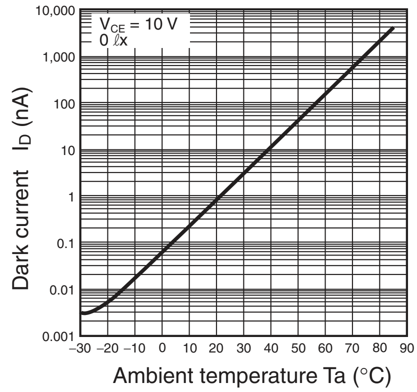

### Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



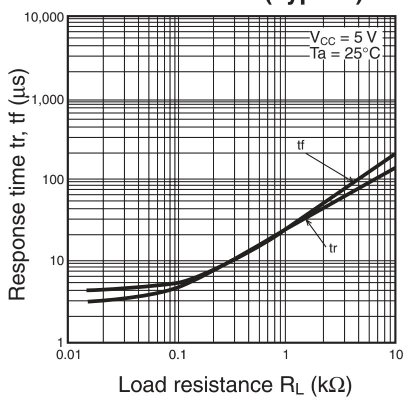

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



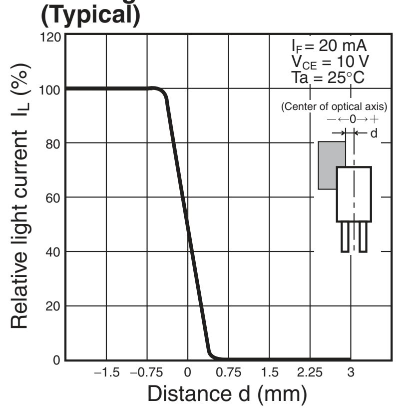

### Dark Current vs. Ambient Temperature Characteristics (Typical)



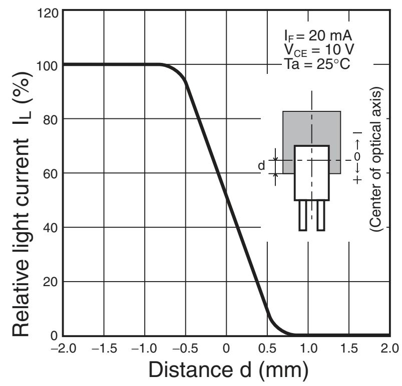

### Response Time vs. Load Resistance Characteristics (Typical)



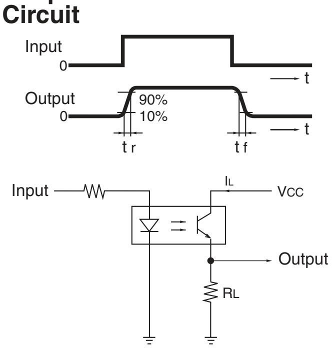

### Sensing Position Characteristics (Typical)




### Sensing Position Characteristics (Typical)




### Response Time Measurement Circuit

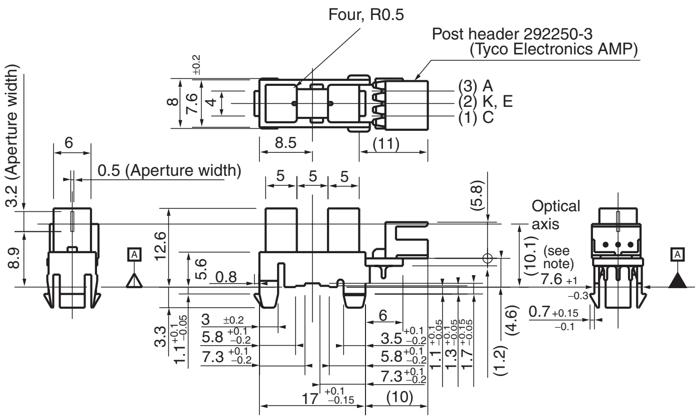


# Photomicrosensor (Transmissive)
# EE-SX1235A-P2

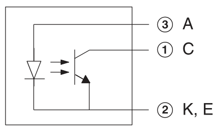
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




### Internal Circuit




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

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

Unless otherwise specified, the tolerances are as shown below.

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

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

## ■ Features

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

## ■ Absolute Maximum Ratings (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 | --- |

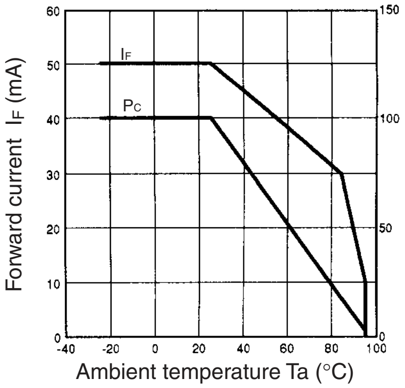
**Note:** Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

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

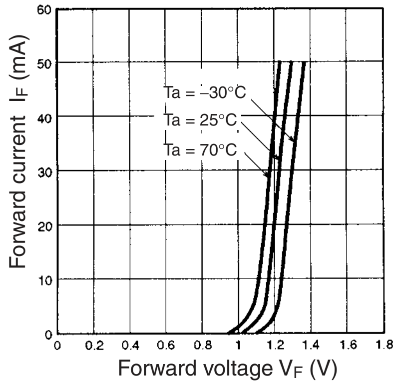
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| Emitter | Forward voltage | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 30 mA |
| | Reverse current | $I_R$ | 0.01 µA typ., 10 µA max. | $V_R$ = 4 V |
| | Peak emission wavelength | $\lambda_P$ | 940 nm typ. | $I_F$ = 30 mA |
| Detector | Light 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 V max. | $I_F$ = 20 mA, $I_L$ = 0.3 mA |
| | Peak spectral sensitivity wavelength | $\lambda_P$ | 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 |

## ■ Engineering Data

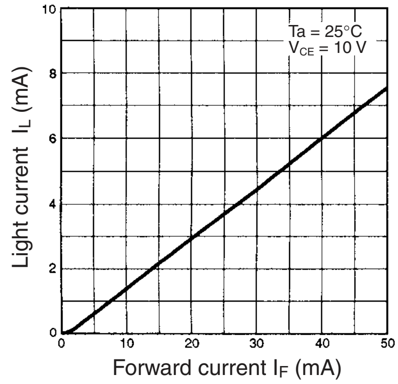
### Forward Current vs. Collector Dissipation Temperature Rating



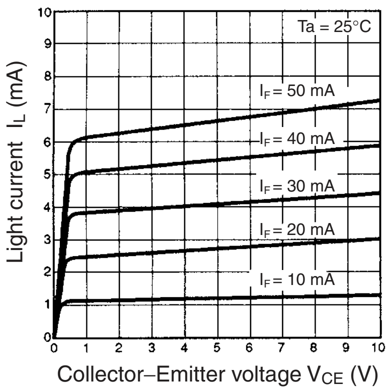

### Forward Current vs. Forward Voltage Characteristics (Typical)



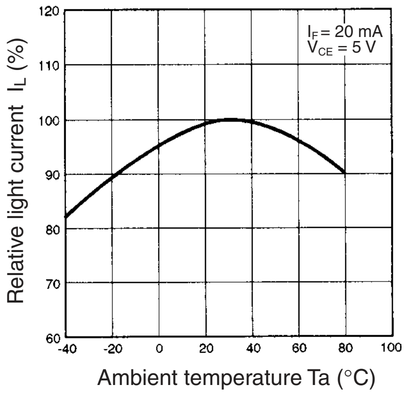

### Light Current vs. Forward Current Characteristics (Typical)



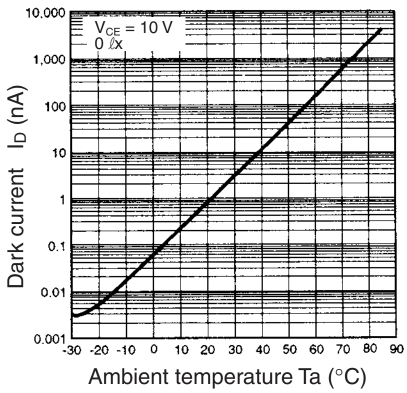

### Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



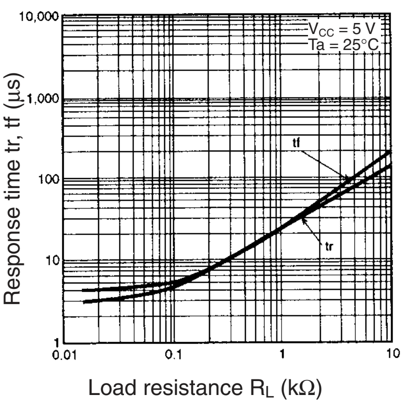

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



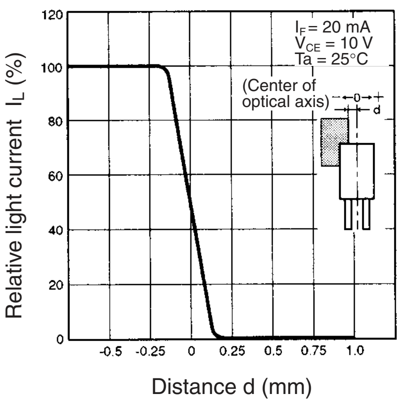

### Dark Current vs. Ambient Temperature Characteristics (Typical)



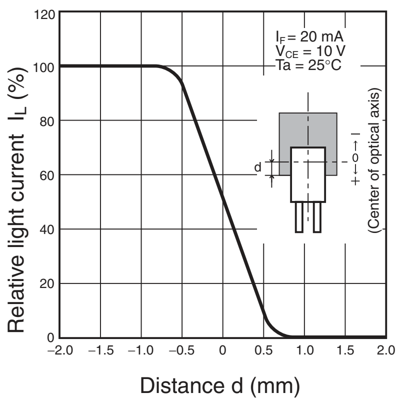

### Response Time vs. Load Resistance Characteristics (Typical)



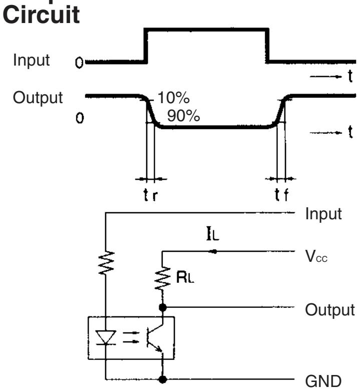

### Sensing Position Characteristics (Typical)




### Sensing Position Characteristics (Typical)




### Response Time Measurement Circuit



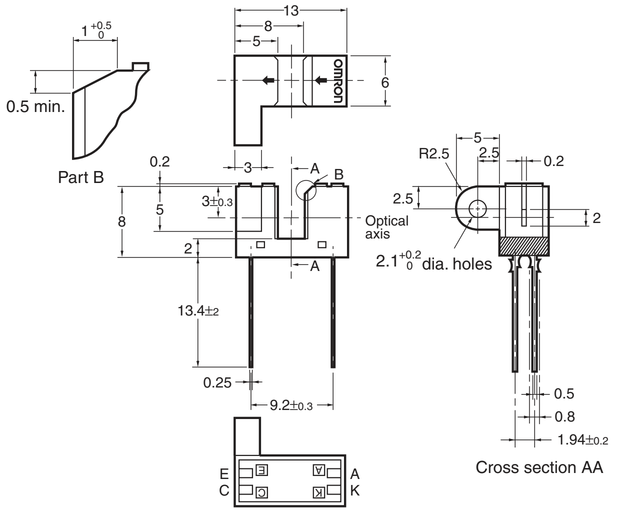

Refer to *EE-SX4235A-P2* on page 140.

# Photomicrosensor (Transmissive)
# EE-SX129

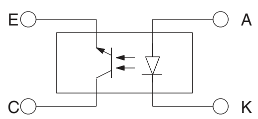
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

| Item | | Symbol | Rated value |
|---|---|---|---|
| **Emitter** | **Forward current** | $I_F$ | 50 mA (see note 1) |
| | **Pulse forward current** | $I_{FP}$ | 1 A (see note 2) |
| | **Reverse voltage** | $V_R$ | 4 V |
| **Detector** | **Collector–Emitter voltage** | $V_{CEO}$ | 30 V |
| | **Emitter–Collector voltage** | $V_{ECO}$ | --- |
| | **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.

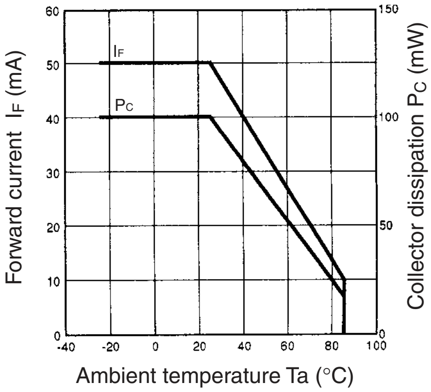
2. The pulse width is 10 μs maximum with a frequency of 100 Hz.
3. Complete soldering within 10 seconds.

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

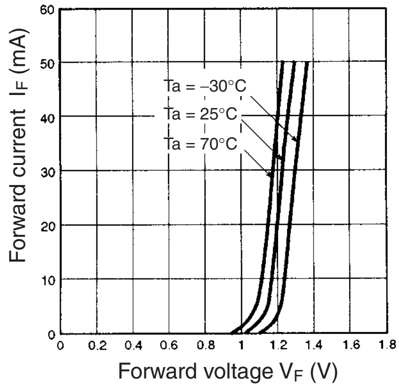
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 30 mA |
| | **Reverse current** | $I_R$ | 0.01 μA typ., 10 μA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 920 nm typ. | $I_F$ = 20 mA |
| **Detector** | **Light current** | $I_L$ | 0.2 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) | --- | --- |
| | **Peak spectral sensitivity wavelength** | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| **Rising time** | | tr | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |
| **Falling time** | | tf | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |

## ■ Engineering Data

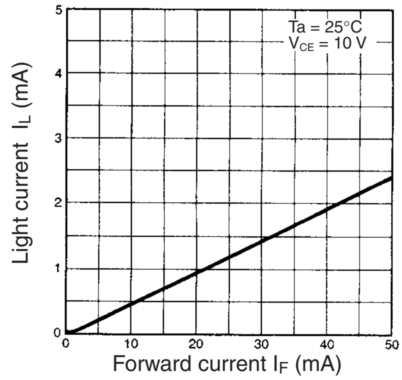
### Forward Current vs. Collector Dissipation Temperature Rating



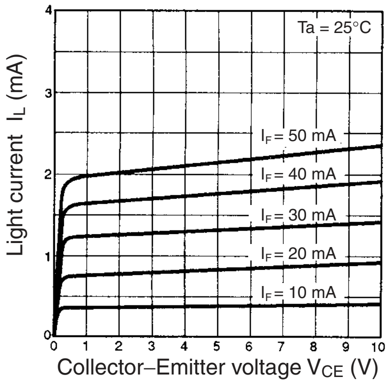

### Forward Current vs. Forward Voltage Characteristics (Typical)



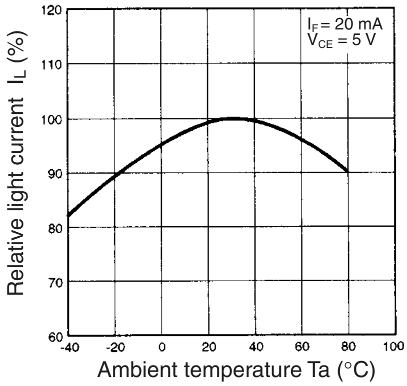

### Light Current vs. Forward Current Characteristics (Typical)



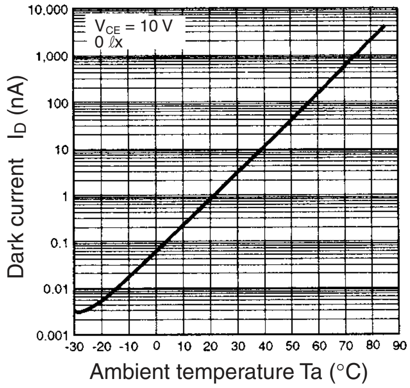

### Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



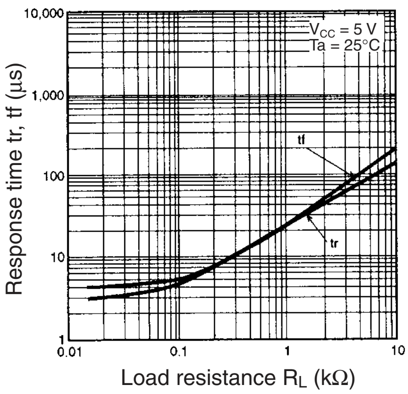

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



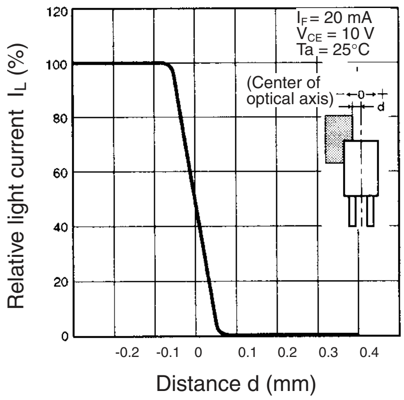

### Dark Current vs. Ambient Temperature Characteristics (Typical)



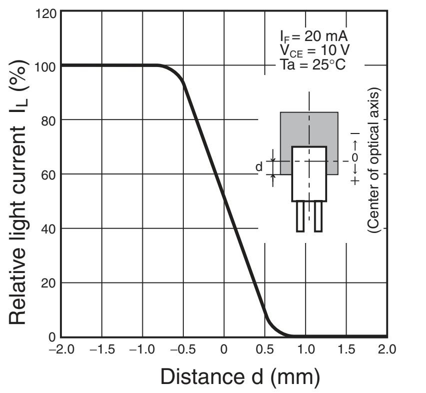

### Response Time vs. Load Resistance Characteristics (Typical)



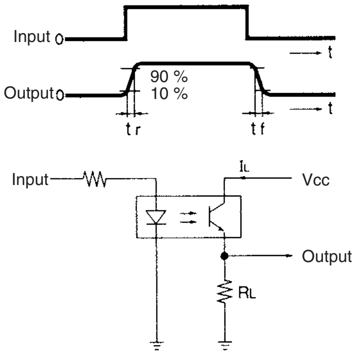

### Sensing Position Characteristics (Typical)




### Sensing Position Characteristics (Typical)




### Response Time Measurement Circuit

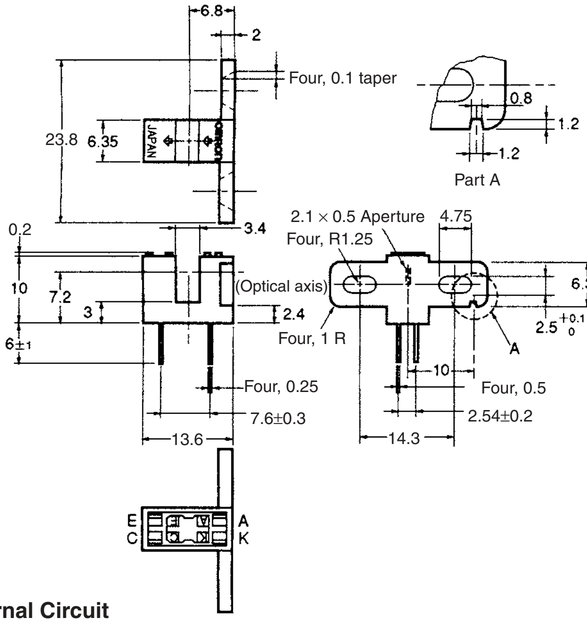


# Photomicrosensor (Transmissive)
# EE-SX138

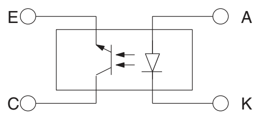
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ Absolute Maximum Ratings (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 | –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.

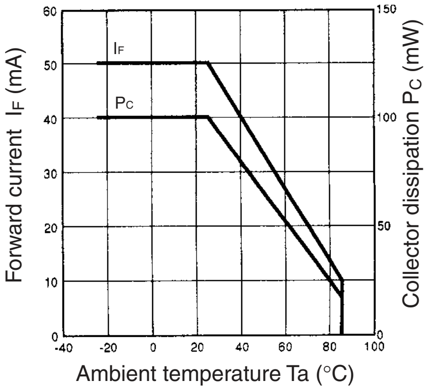
**3.** Complete soldering within 10 seconds.

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

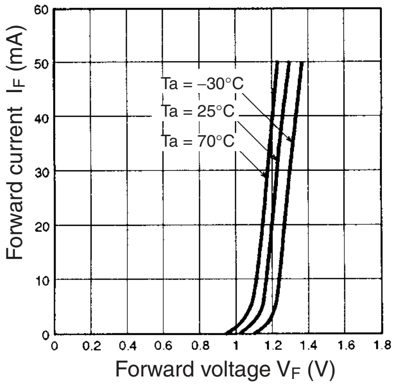
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 30 mA |
| | **Reverse current** | $I_R$ | 0.01 μA typ., 10 μA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **Detector** | **Light current** | $I_L$ | 1.9 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** | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| **Rising time** | | tr | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |
| **Falling time** | | tf | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |

## ■ Engineering Data

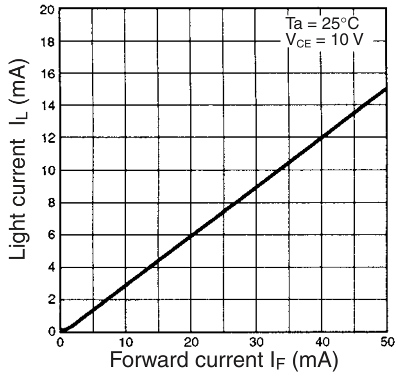
### Forward Current vs. Collector Dissipation Temperature Rating



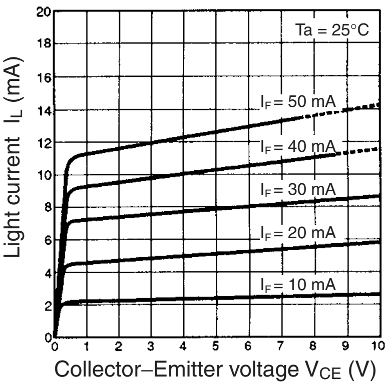

### Forward Current vs. Forward Voltage Characteristics (Typical)



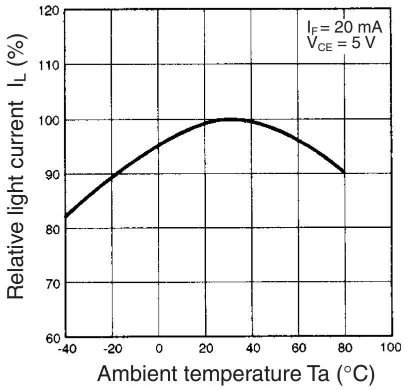

### Light Current vs. Forward Current Characteristics (Typical)



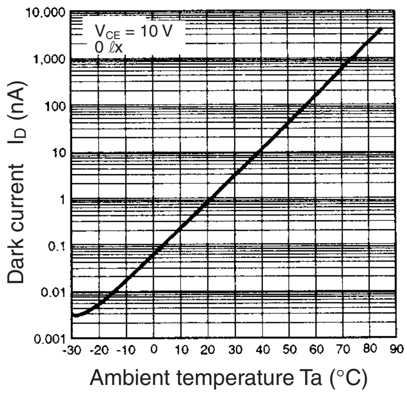

### Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



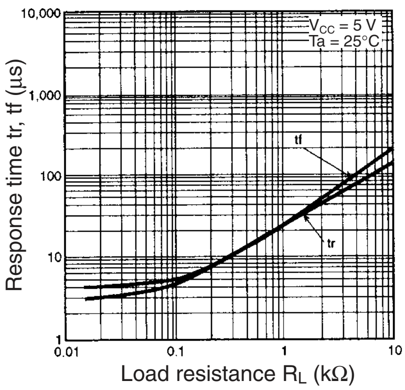

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



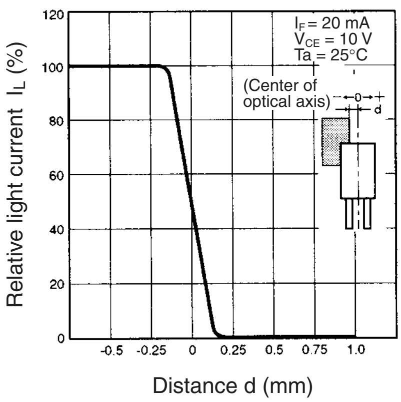

### Dark Current vs. Ambient Temperature Characteristics (Typical)



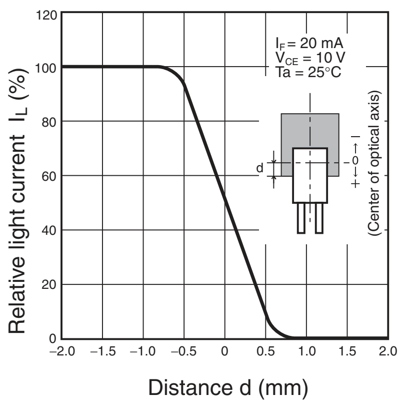

### Response Time vs. Load Resistance Characteristics (Typical)



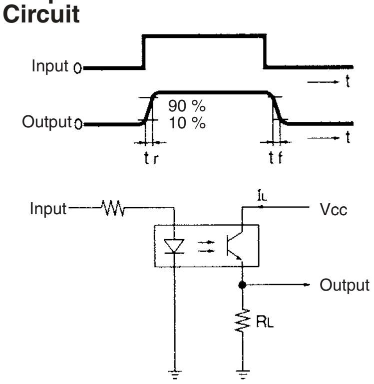

### Sensing Position Characteristics (Typical)




### Sensing Position Characteristics (Typical)




### Response Time Measurement Circuit



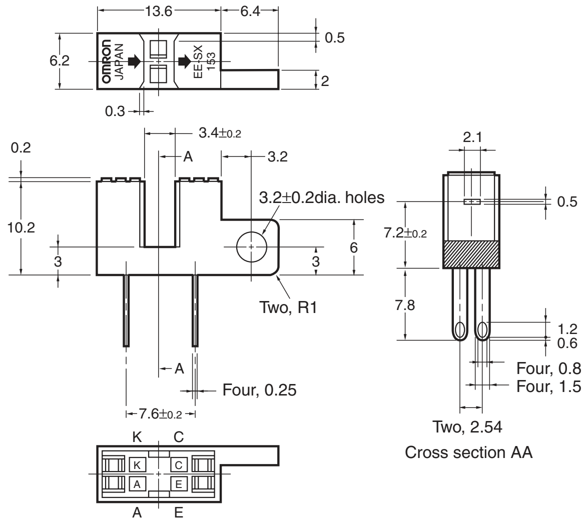
OMRON

# Photomicrosensor (Transmissive)
# EE-SX153

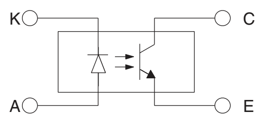
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ 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 | –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.

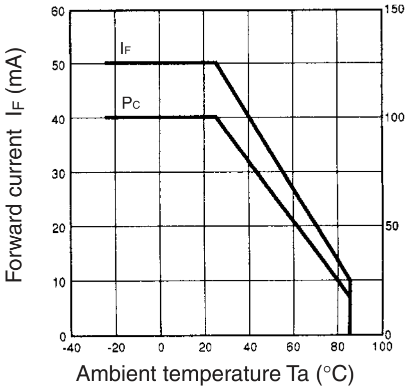
**3.** Complete soldering within 10 seconds.

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

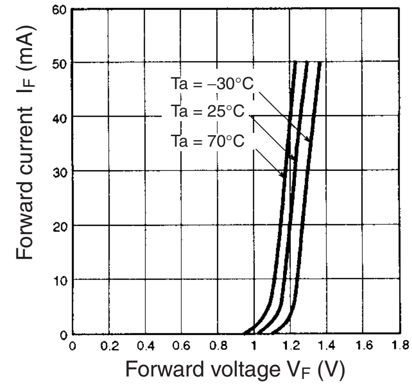
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 30 mA |
| | **Reverse current** | $I_R$ | 0.01 μA typ., 10 μA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **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** | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| **Rising time** | | tr | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |
| **Falling time** | | tf | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |

## ■ Engineering Data

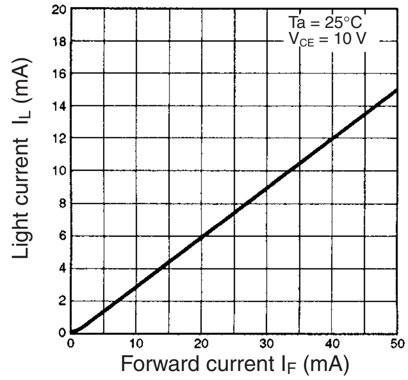
### Forward Current vs. Collector Dissipation Temperature Rating



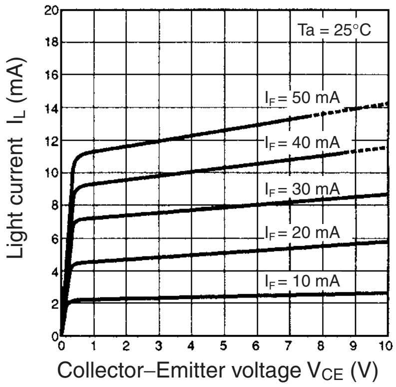

### Forward Current vs. Forward Voltage Characteristics (Typical)



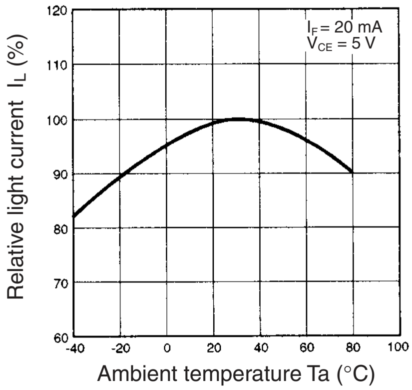

### Light Current vs. Forward Current Characteristics (Typical)



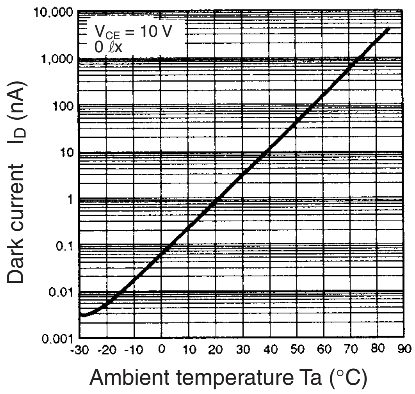

### Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



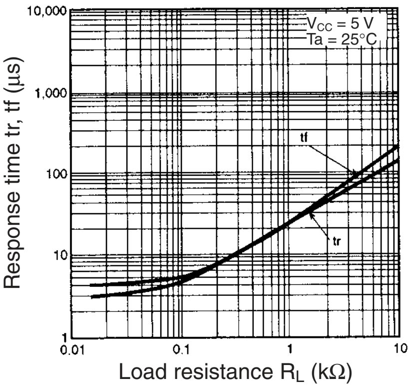

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



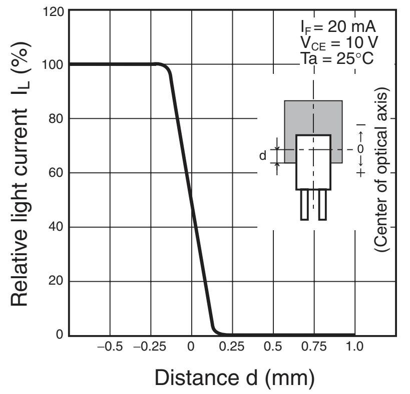

### Dark Current vs. Ambient Temperature Characteristics (Typical)



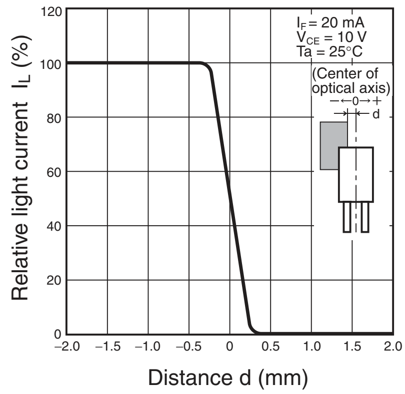

### Response Time vs. Load Resistance Characteristics (Typical)



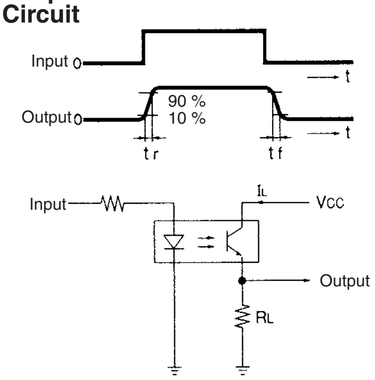

### Sensing Position Characteristics (Typical)




### Sensing Position Characteristics (Typical)




### Response Time Measurement Circuit

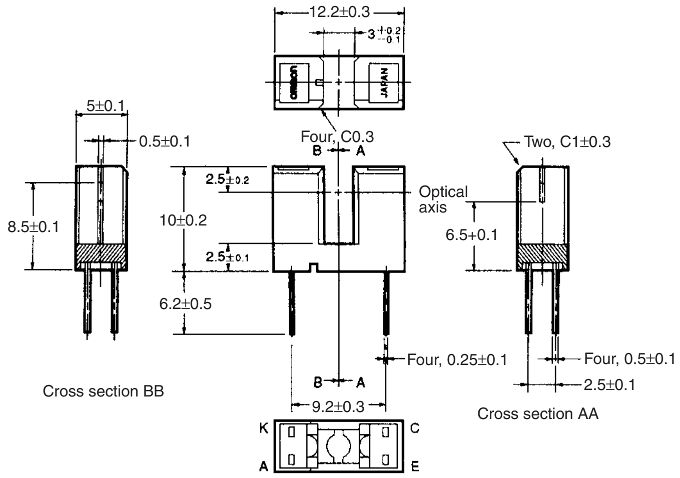


# Photomicrosensor (Transmissive)
# EE-SX198

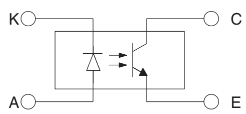
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are ±0.2 mm.

## ■ Features

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

## ■ Absolute Maximum Ratings (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.

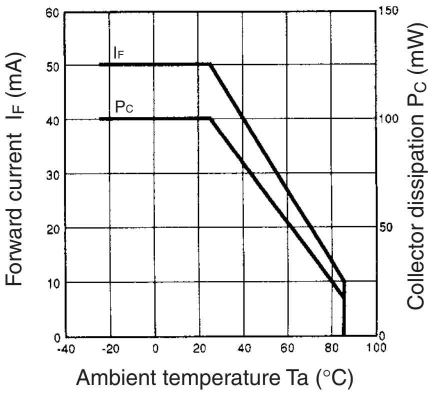
**3.** Complete soldering within 10 seconds.

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

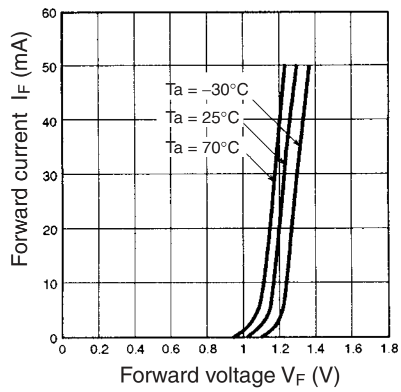
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.4 V max. | $I_F$ = 30 mA |
| | **Reverse current** | $I_R$ | 0.01 µA typ., 10 µA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **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, $I_L$ = 0.5 mA |
| | **Peak spectral sensitivity wavelength** | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| **Rising time** | | tr | 4 µs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |
| **Falling time** | | tf | 4 µs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |

## ■ Engineering Data

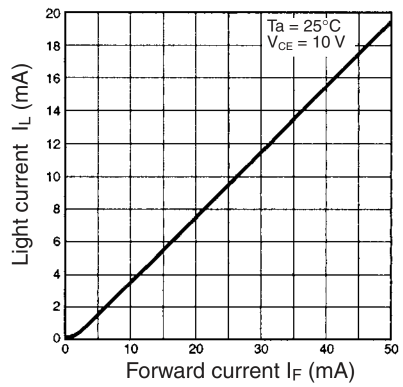
### Forward Current vs. Collector Dissipation Temperature Rating



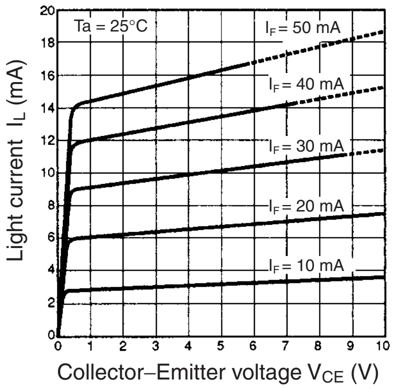

### Forward Current vs. Forward Voltage Characteristics (Typical)



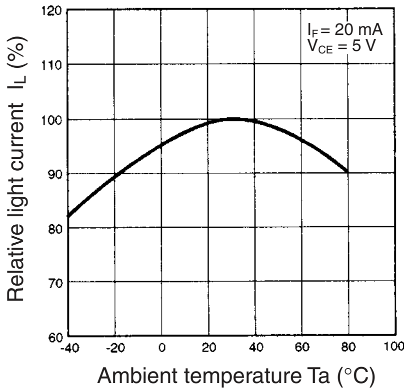

### Light Current vs. Forward Current Characteristics (Typical)



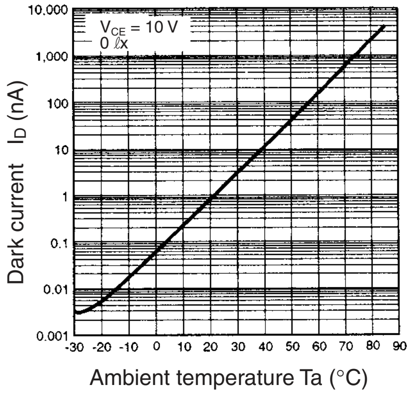

### Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



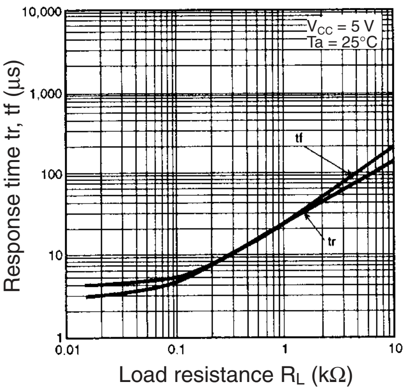

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



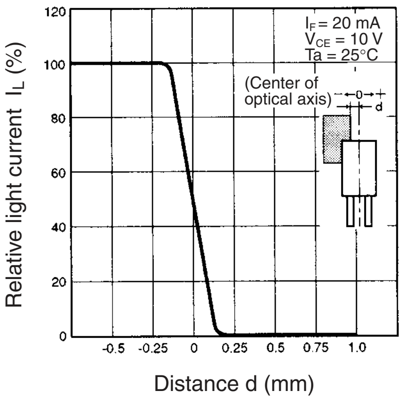

### Dark Current vs. Ambient Temperature Characteristics (Typical)



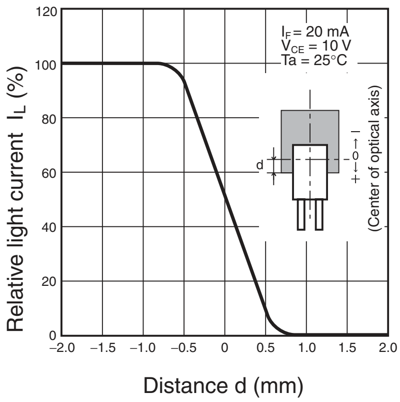

### Response Time vs. Load Resistance Characteristics (Typical)



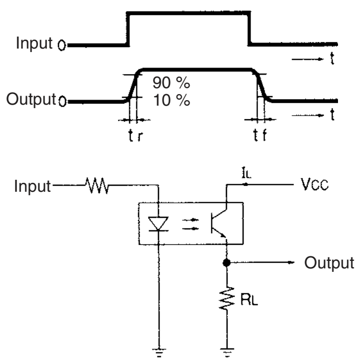

### Sensing Position Characteristics (Typical)




### Sensing Position Characteristics (Typical)




### Response Time Measurement Circuit

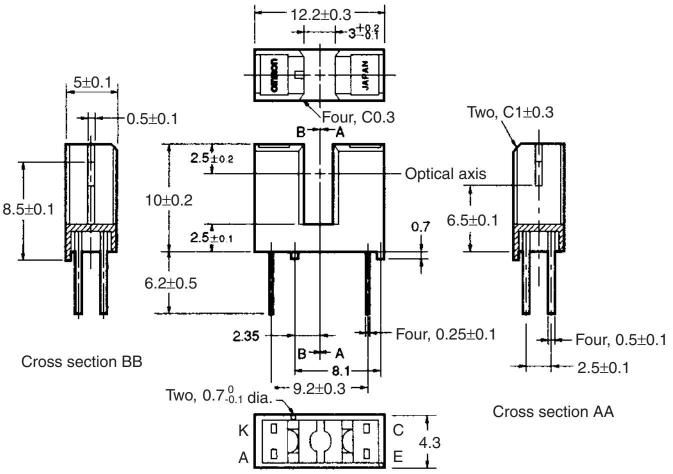


# 7Photomicrosensor (Transmissive)
# EE-SX199

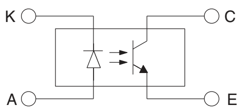
⚠ Be sure to read *Precautions* on page 25.

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are ±0.2 mm.

## ■ Features

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

## ■ Absolute Maximum Ratings (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 | –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.

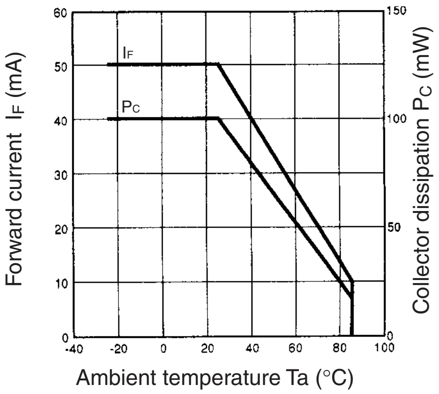
**3.** Complete soldering within 10 seconds.

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

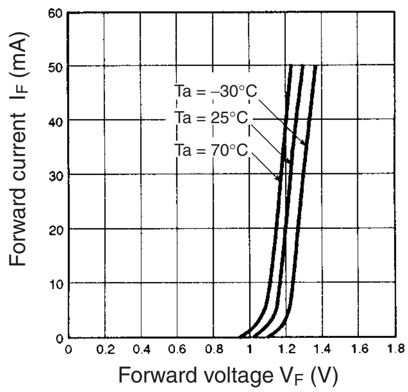
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.4 V max. | $I_F$ = 30 mA |
| | **Reverse current** | $I_R$ | 0.01 μA typ., 10 μA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **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, $I_L$ = 0.5 mA |
| | **Peak spectral sensitivity wavelength** | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| **Rising time** | | tr | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |
| **Falling time** | | tf | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |

## ■ Engineering Data

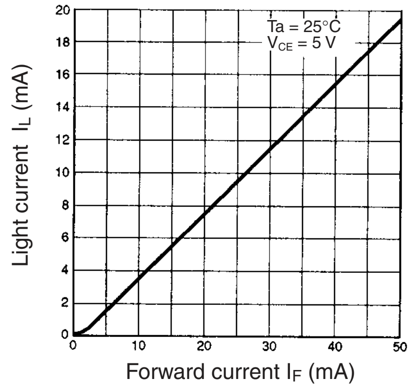
### Forward Current vs. Collector Dissipation Temperature Rating



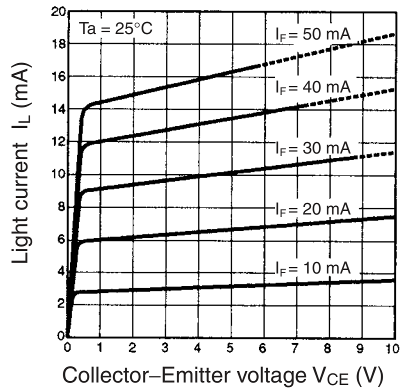

### Forward Current vs. Forward Voltage Characteristics (Typical)



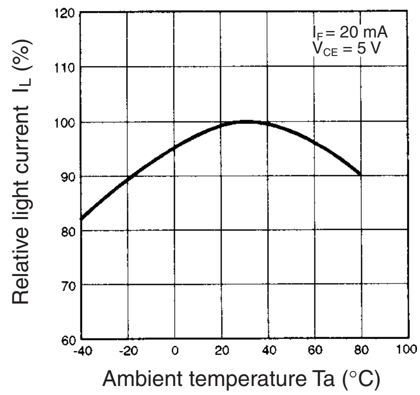

### Light Current vs. Forward Current Characteristics (Typical)



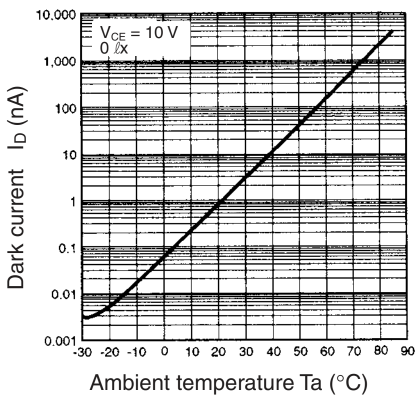

### Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



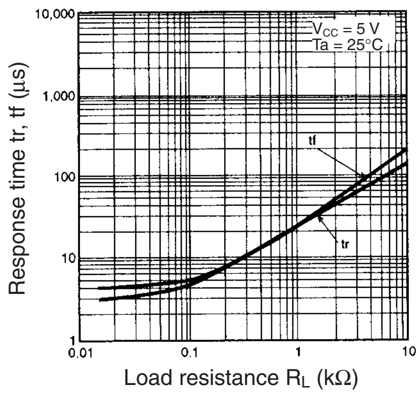

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



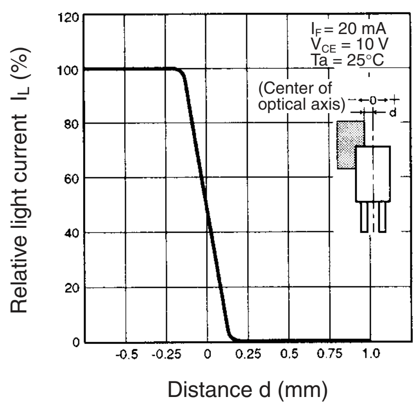

### Dark Current vs. Ambient Temperature Characteristics (Typical)



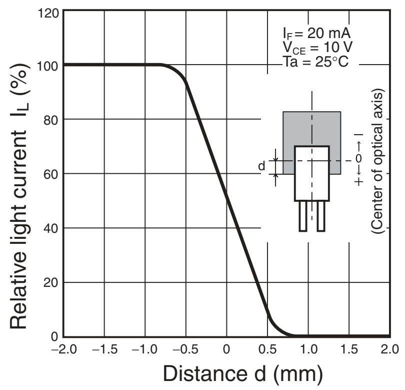

### Response Time vs. Load Resistance Characteristics (Typical)



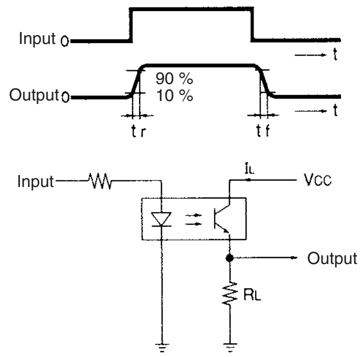

### Sensing Position Characteristics (Typical)




### Sensing Position Characteristics (Typical)




### Response Time Measurement Circuit

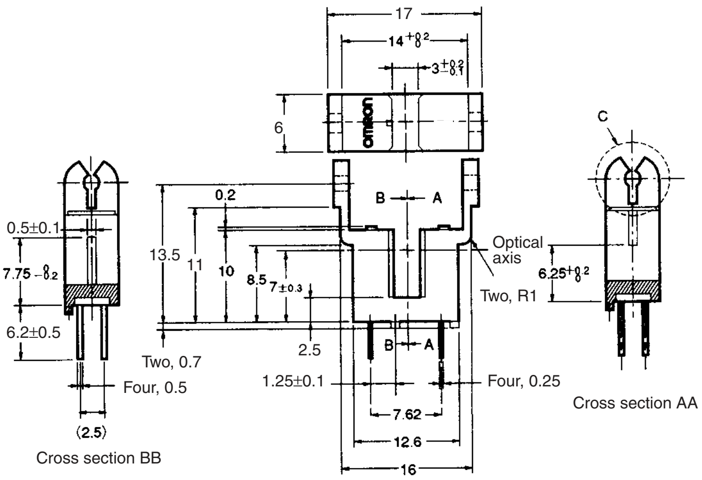


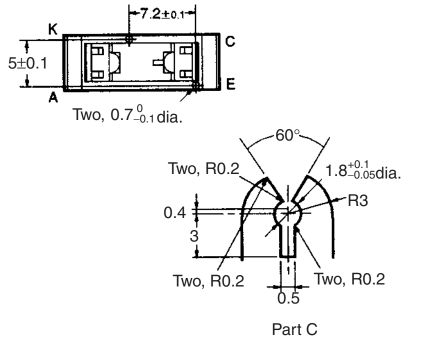
# Photomicrosensor (Actuator Mounted)
# EE-SA102

⚠ **Be sure to read *Precautions* on page 25.**

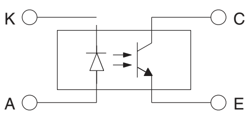
## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are ±0.2 mm.

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

| Item | | Symbol | Rated value |
|---|---|---|---|
| **Emitter** | **Forward current** | $I_F$ | 50 mA (see note 1) |
| | **Pulse forward current** | $I_{FP}$ | 1 A (see note 2) |
| | **Reverse voltage** | $V_R$ | 4 V |
| **Detector** | **Collector–Emitter voltage** | $V_{CEO}$ | 30 V |
| | **Emitter–Collector voltage** | $V_{ECO}$ | --- |
| | **Collector current** | $I_C$ | 20 mA |
| | **Collector dissipation** | $P_C$ | 100 mW (see note 1) |
| **Ambient temperature** | **Operating** | 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.

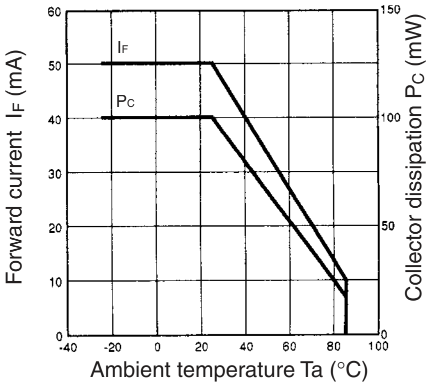
**3.** Complete soldering within 10 seconds.

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

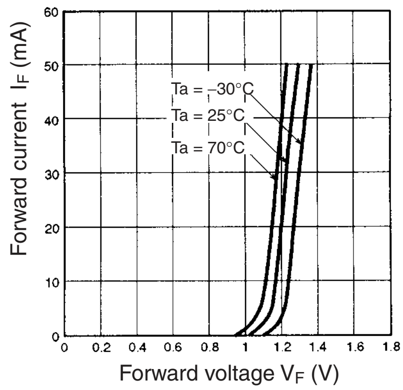
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 30 mA |
| | **Reverse current** | $I_R$ | 0.01 µA typ., 10 µA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **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** | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| **Rising time** | | tr | 4 µs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |
| **Falling time** | | tf | 4 µs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |

## ■ Engineering Data

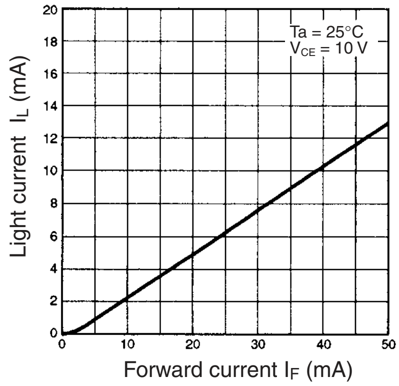
### Forward Current vs. Collector Dissipation Temperature Rating



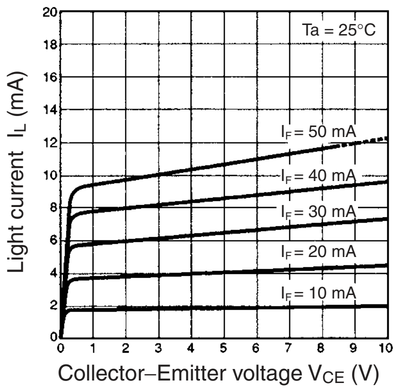

### Forward Current vs. Forward Voltage Characteristics (Typical)



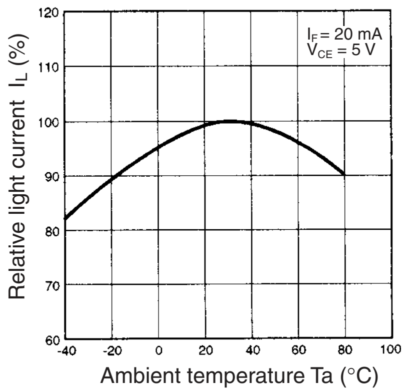

### Light Current vs. Forward Current Characteristics (Typical)



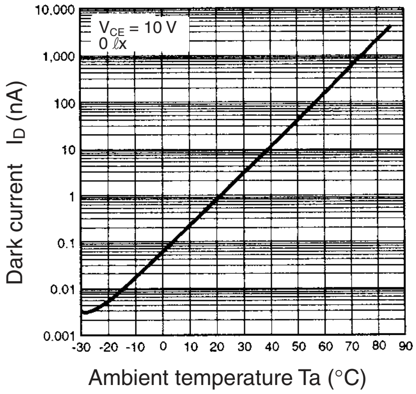

### Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



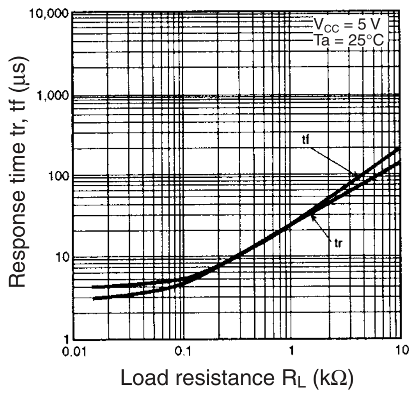

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



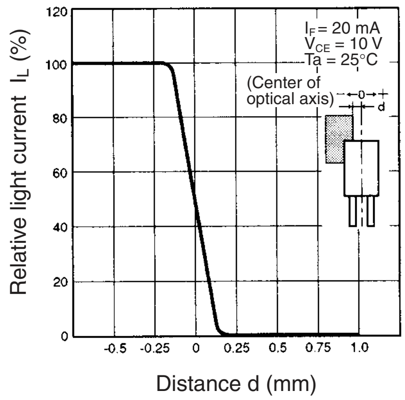

### Dark Current vs. Ambient Temperature Characteristics (Typical)



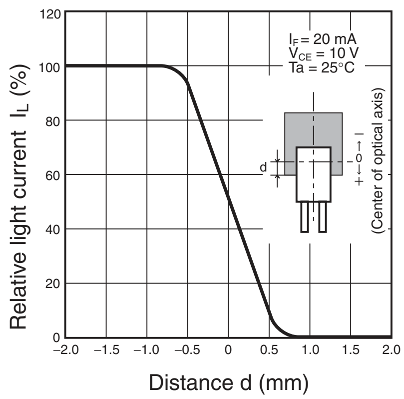

### Response Time vs. Load Resistance Characteristics (Typical)



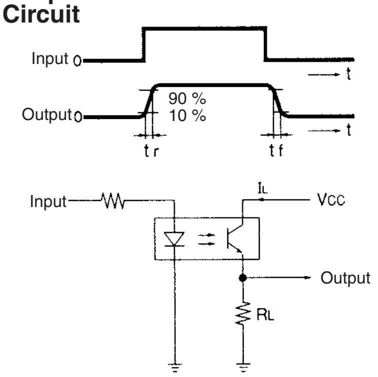

### Sensing Position Characteristics (Typical)



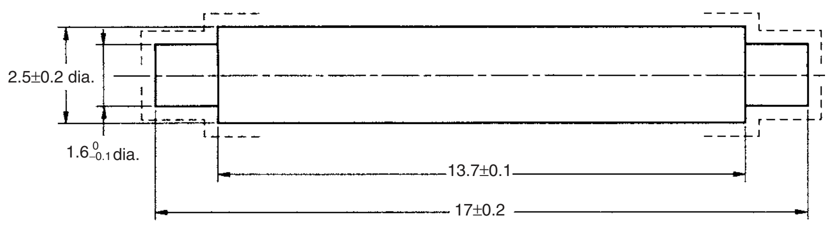

### Sensing Position Characteristics (Typical)




### Response Time Measurement Circuit




### Actuator Dimensions



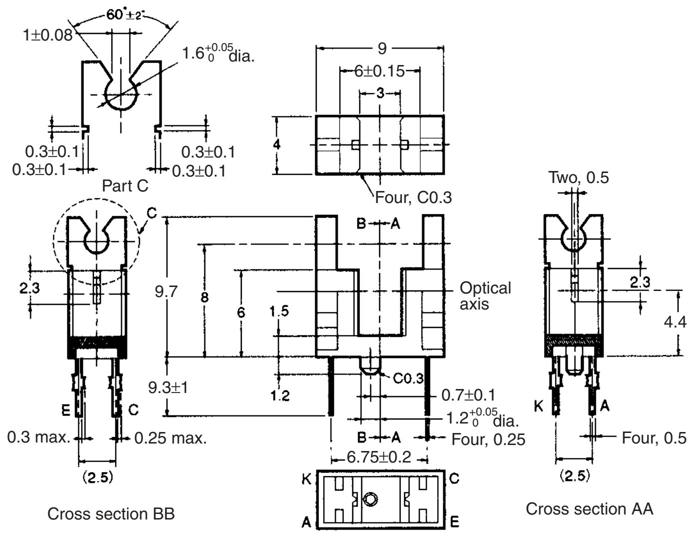

**Note:**
1. Make sure that the portions marked with dotted lines have no burrs.
2. The material of the actuator must be selected by considering the infrared permeability of the actuator.

# Photomicrosensor (Actuator Mounted)
# EE-SA104

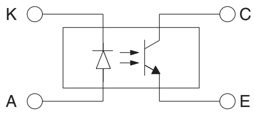
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ Absolute Maximum Ratings (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.

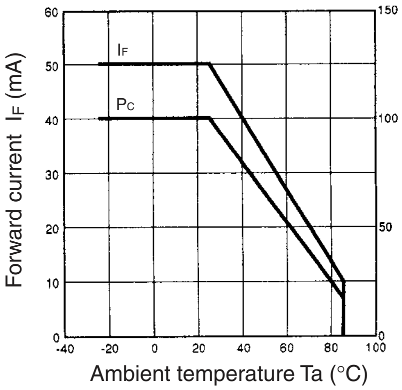
**3.** Complete soldering within 10 seconds.

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

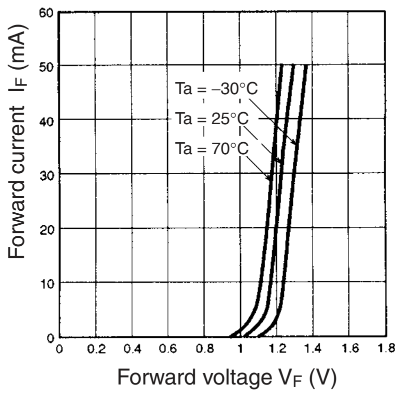
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 30 mA |
| | **Reverse current** | $I_R$ | 0.01 μA typ., 10 μA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **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** | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| **Rising time** | | tr | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |
| **Falling time** | | tf | 4 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |

## ■ Engineering Data

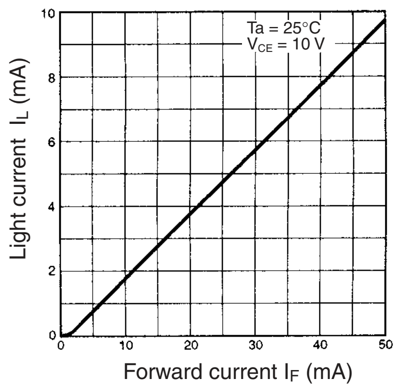
### Forward Current vs. Collector Dissipation Temperature Rating



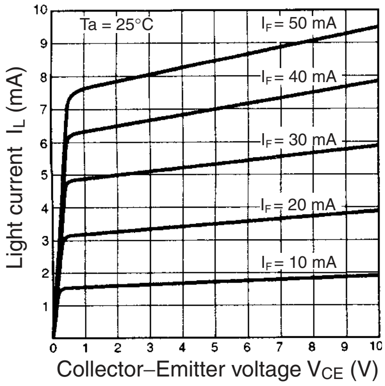

### Forward Current vs. Forward Voltage Characteristics (Typical)



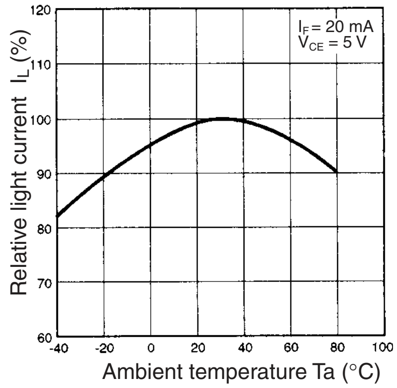

### Light Current vs. Forward Current Characteristics (Typical)



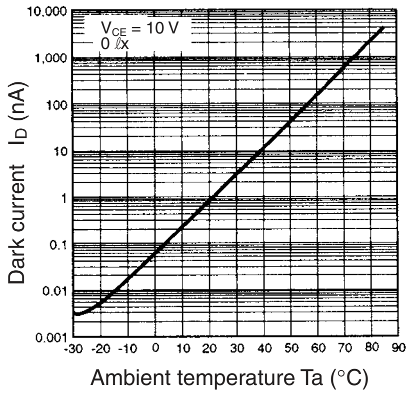

### Light Current vs. Collector−Emitter Voltage Characteristics (Typical)



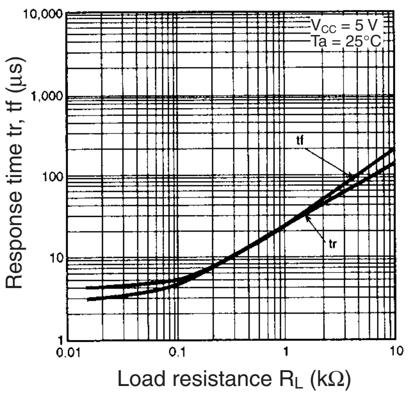

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



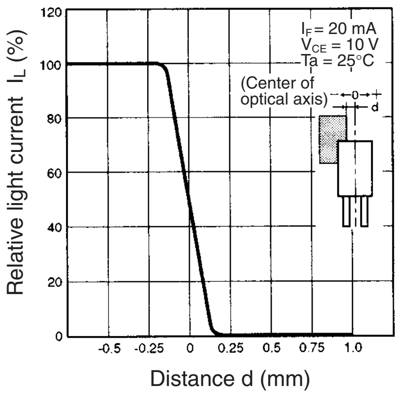

### Dark Current vs. Ambient Temperature Characteristics (Typical)



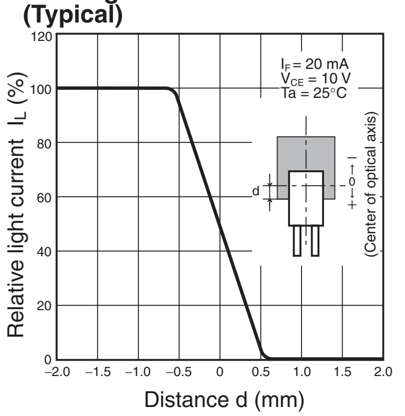

### Response Time vs. Load Resistance Characteristics (Typical)



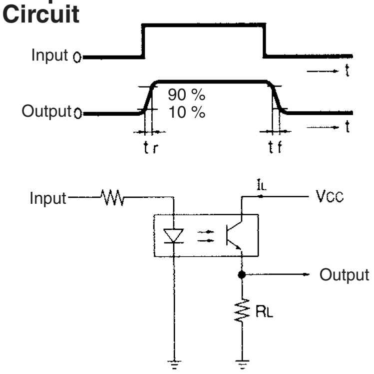

### Sensing Position Characteristics (Typical)



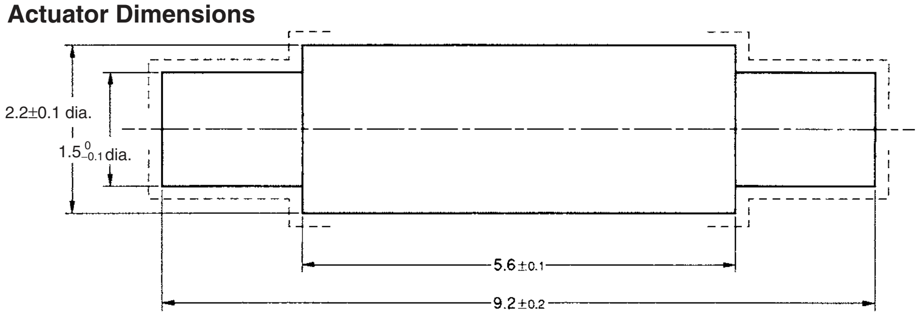

### Sensing Position Characteristics (Typical)




### Response Time Measurement Circuit




### Actuator Dimensions



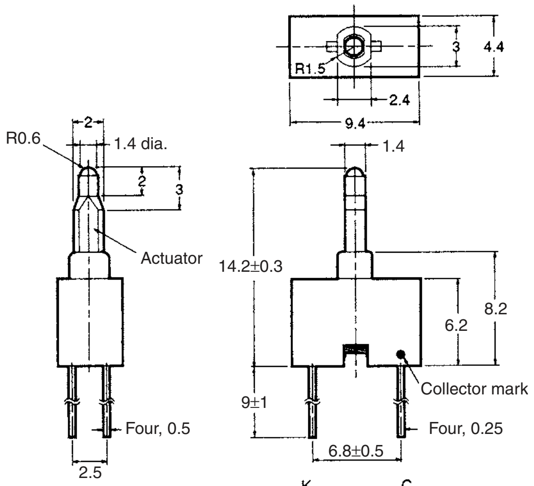

**Note:** 1. Make sure that the portions marked with dotted lines have no burrs.
2. The material of the actuator must be selected by considering the infrared permeability of the actuator.

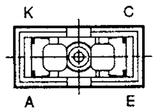
# Photomicrosensor (Actuator)
# EE-SA105

⚠ Be sure to read *Precautions* on page 25.

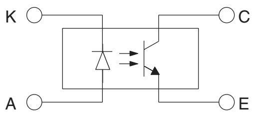
## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

- Model has an actuator.
- Low operating force (0.15 N (15 gf)).
- Connects to circuits with ease.

## ■ 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 |
| | Collector–Emitter voltage | $V_{CEO}$ | 30 V |
| Detector | Emitter–Collector voltage | $V_{ECO}$ | 5 V |
| | Collector current | $I_C$ | 20 mA |
| | Collector dissipation | $P_C$ | 100 mW (see note 1) |
| Ambient temperature | Operating | Topr | –25°C to 70°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 | $I_R$ | 0.01 μA typ., 10 μA max. | $V_R$ = 4 V |
| | Peak emission wavelength | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| Detector | Light current | $I_L$ | 0.5 mA min. | $I_F$ = 20 mA, $V_{CE}$ = 5 V at free position (FP) |
| | Dark current | $I_D$ | 2 nA typ., 200 nA max. | $V_{CE}$ = 10 V, 0 ℓx |
| | Leakage current | $I_{LEAK}$ | 10 μA max. | $I_F$ = 20 mA, $V_{CE}$ = 5 V at operating position (OP) |
| | Collector–Emitter saturated voltage | $V_{CE}$ (sat) | 0.15 V typ., 0.4 V max. | $I_F$ = 20 mA, $I_L$ = 0.1 mA |
| | Peak spectral sensitivity wavelength | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| Rising time | | tr | --- | --- |
| Falling time | | tf | --- | --- |

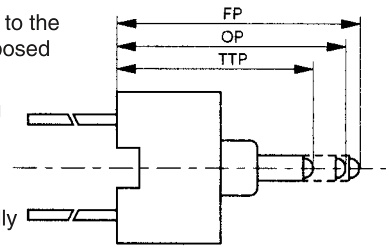
## ■ Mechanical Characteristics

| | |
|---|---|
| **Actuator operation ($I_F$ = 20 mA, $V_{CE}$ = 5 V) (see note 1)** | Free position (FP): 14.2±0.3 mm<br>Operating position (OP): 13.0 mm min.<br>Total travel position (TTP): 12.1 mm max. |
| **Operating force (see note 2)** | 0.15 N (15 gf) max. |
| **Mechanical life expectancy** | 500,000 operations min. (The actuator traveling from its FP to FP via TTP is regarded as one operation.) |

**Note:** 1. Free position (FP): The distance between the bottom of the housing to the top of the actuator without any external force imposed on the actuator.

Operating position (OP): The distance between the bottom of the housing to the top of the actuator when the actuator is pressed and the $I_L$ becomes $I_{LEAK}$ or less.

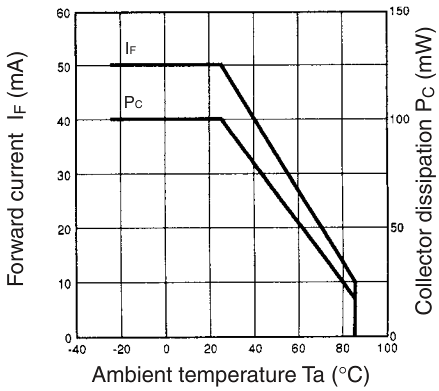
Total travel position (TTP): The distance between the bottom of the housing to the top of the actuator when the actuator is fully pressed.



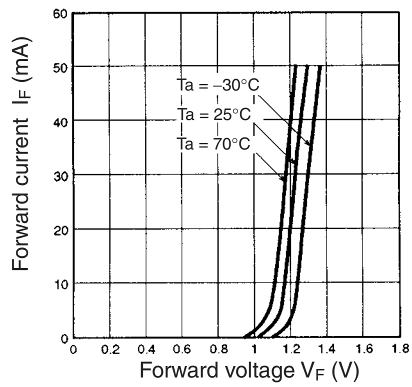

2. Operating force: The force required to press the actuator from its FP to OP.

## ■ Engineering Data

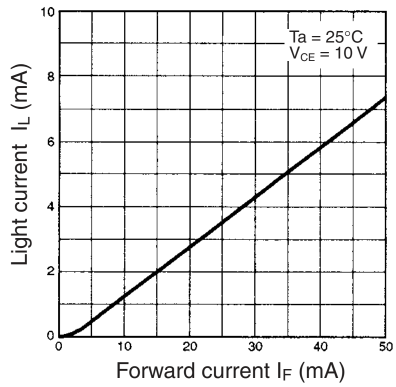
### Forward Current vs. Collector Dissipation Temperature Rating



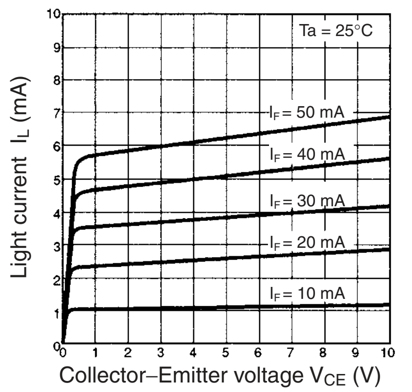

### Forward Current vs. Forward Voltage Characteristics (Typical)



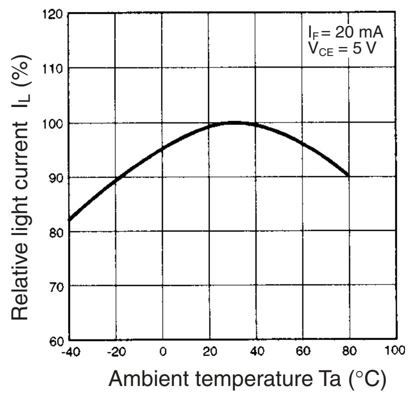

### Light Current vs. Forward Current Characteristics (Typical)



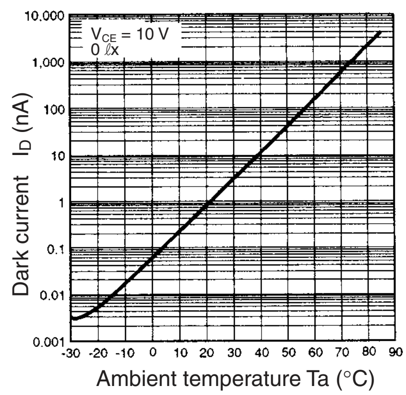

### Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



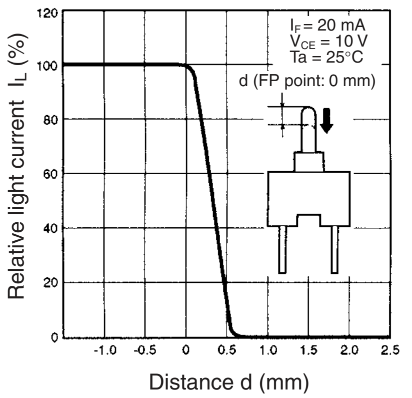

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)




### Dark Current vs. Ambient Temperature Characteristics (Typical)




### Sensing Position Characteristics (Typical)

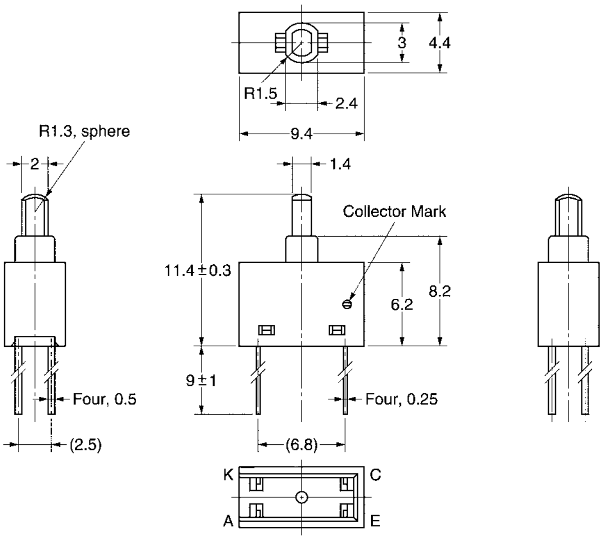


# Photomicrosensor (Actuator)
# EE-SA113

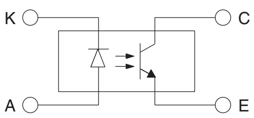
**Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

- Model has an actuator.
- Low operating force (0.15 N (15 gf)).
- Connects to circuits with ease.

## ■ 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 |
| | Collector–Emitter voltage | $V_{CEO}$ | 30 V |
| Detector | Emitter–Collector voltage | $V_{ECO}$ | 5 V |
| | Collector current | $I_C$ | 20 mA |
| | Collector dissipation | $P_C$ | 100 mW (see note 1) |
| Ambient temperature | Operating | Topr | –25°C to 70°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 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 | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| Detector | Light current | $I_L$ | 0.5 mA min. | $I_F$ = 20 mA, $V_{CE}$ = 5 V at free position (FP) |
| | Dark current | $I_D$ | 2 nA typ., 200 nA max. | $V_{CE}$ = 10 V, 0 ℓx |
| | Leakage current | $I_{LEAK}$ | 10 μA max. | $I_F$ = 20 mA, $V_{CE}$ = 5 V at operating position (OP) |
| | Collector–Emitter saturated voltage | $V_{CE}$ (sat) | 0.15 V typ., 0.4 V max. | $I_F$ = 20 mA, $I_L$ = 0.1 mA |
| | Peak spectral sensitivity wavelength | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| Rising time | | tr | --- | --- |
| Falling time | | tf | --- | --- |

## ■ Mechanical Characteristics

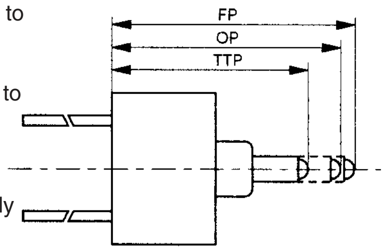
| | |
|---|---|
| **Actuator operation ($I_F$ = 20 mA, $V_{CE}$ = 5 V) (see note 1)** | Free position (FP): 11.4±0.3 mm<br>Operating position (OP): 10.2 mm min.<br>Total travel position (TTP): 9.3 mm max. |
| **Operating force (see note 2)** | 0.15 N (15 gf) max. |
| **Mechanical life expectancy** | 500,000 operations min. (The actuator traveling from its FP to FP via TTP is regarded as one operation.) |

**Note:** 1. Free position (FP): The distance between the bottom of the housing to the top of the actuator without any external force imposed on the actuator.

Operating position (OP): The distance between the bottom of the housing to the top of the actuator when the actuator is pressed and the $I_L$ becomes $I_{LEAK}$ or less.

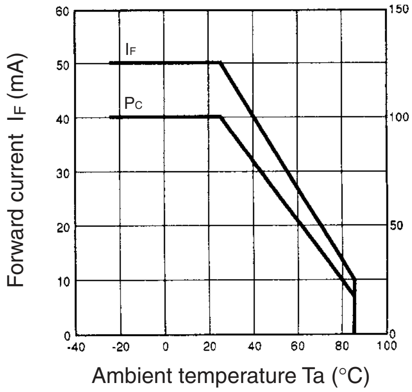
Total travel position (TTP): The distance between the bottom of the housing to the top of the actuator when the actuator is fully pressed.

2. Operating force: The force required to press the actuator from its FP to OP.

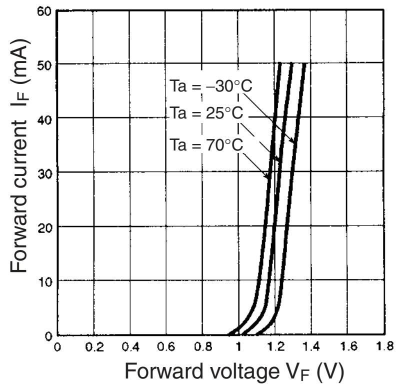



## ■ Engineering Data

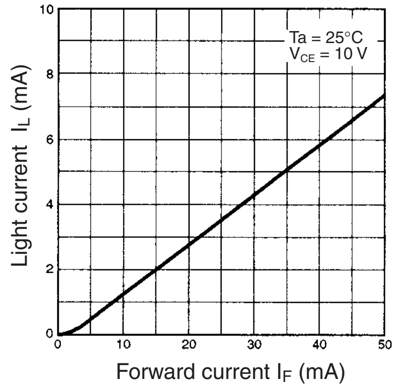
**Forward Current vs. Collector Dissipation Temperature Rating**



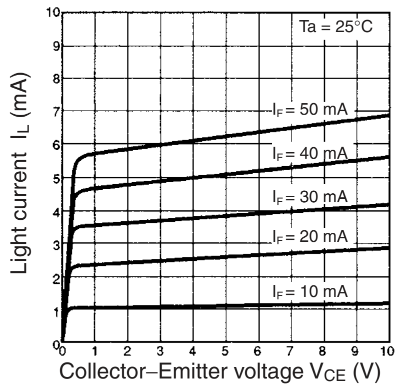

**Forward Current vs. Forward Voltage Characteristics (Typical)**



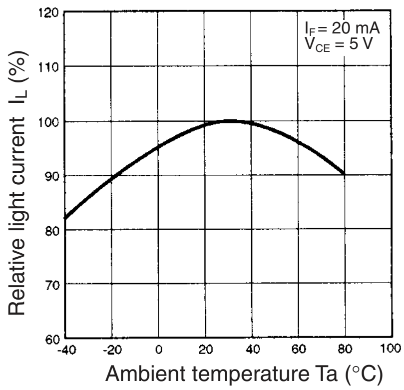

**Light Current vs. Forward Current Characteristics (Typical)**



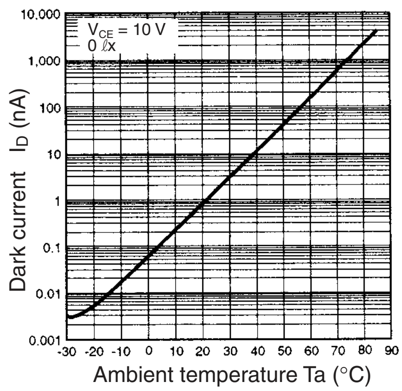

**Light Current vs. Collector–Emitter Voltage Characteristics (Typical)**



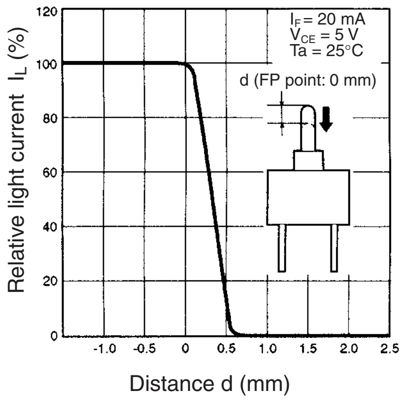

**Relative Light Current vs. Ambient Temperature Characteristics (Typical)**




**Dark Current vs. Ambient Temperature Characteristics (Typical)**




**Sensing Position Characteristics (Typical)**

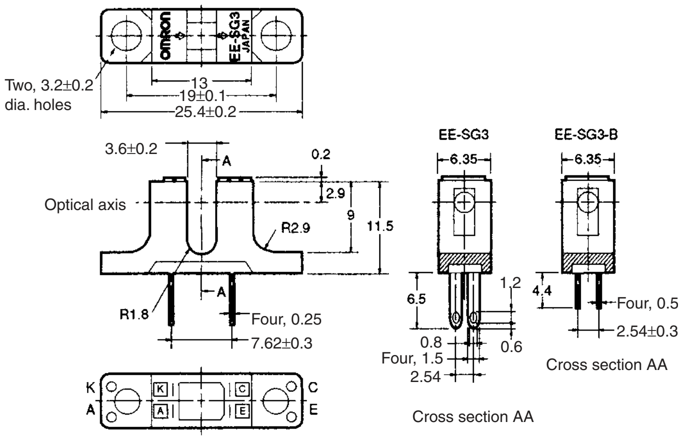


# Photomicrosensor (Transmissive)
# EE-SG3/EE-SG3-B

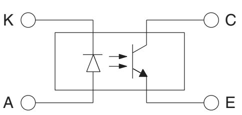
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ 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.

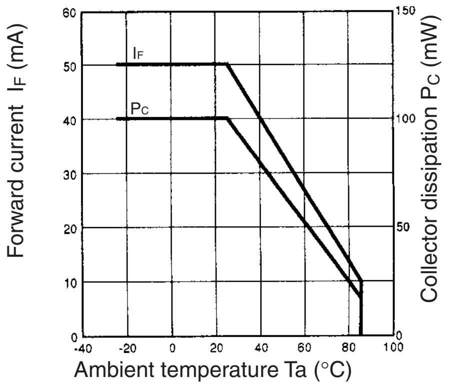
**3.** Complete soldering within 10 seconds.

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

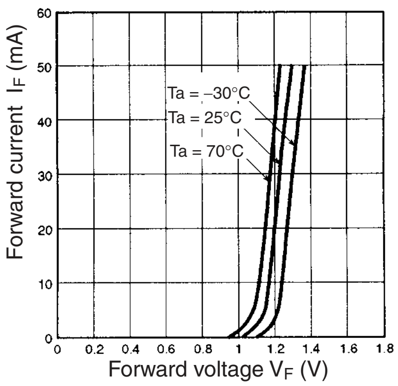
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 30 mA |
| | **Reverse current** | $I_R$ | 0.01 µA typ., 10 µA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **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 V max. | $I_F$ = 30 mA, $I_L$ = 1 mA |
| | **Peak spectral sensitivity wavelength** | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| **Rising time** | | tr | 4 µs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |
| **Falling time** | | tf | 4 µs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |

## ■ Engineering Data

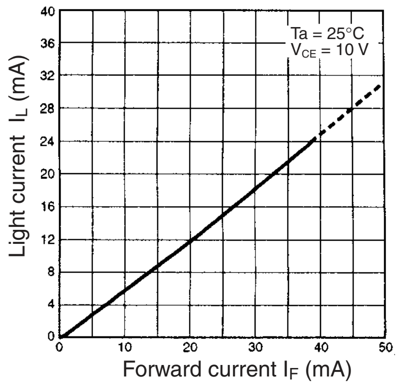
**Forward Current vs. Collector Dissipation Temperature Rating**



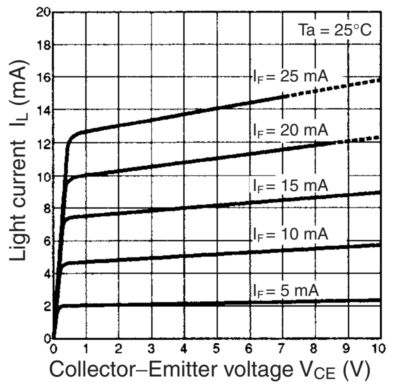

**Forward Current vs. Forward Voltage Characteristics (Typical)**



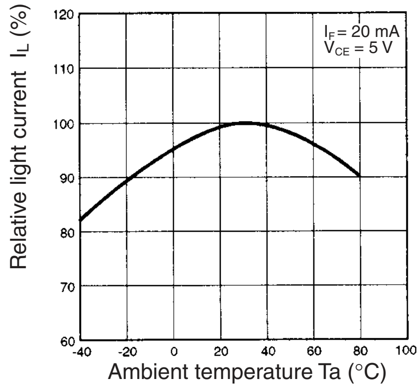

**Light Current vs. Forward Current Characteristics (Typical)**



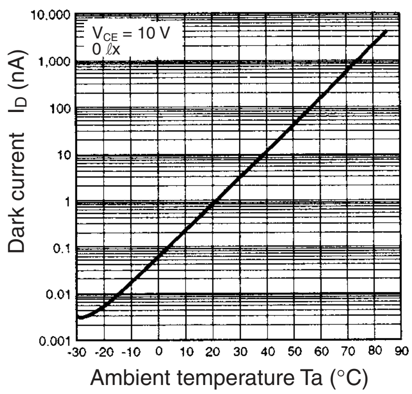

**Light Current vs. Collector–Emitter Voltage Characteristics (Typical)**



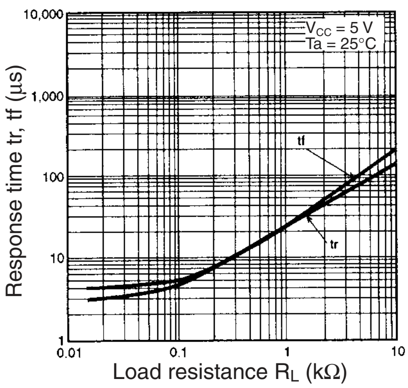

**Relative Light Current vs. Ambient Temperature Characteristics (Typical)**



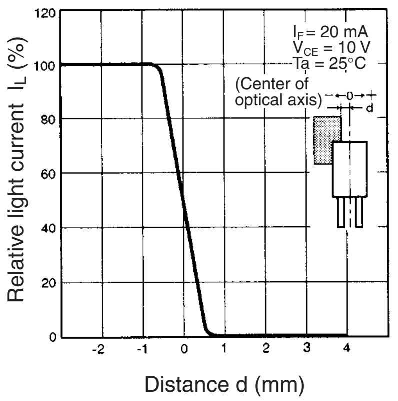

**Dark Current vs. Ambient Temperature Characteristics (Typical)**



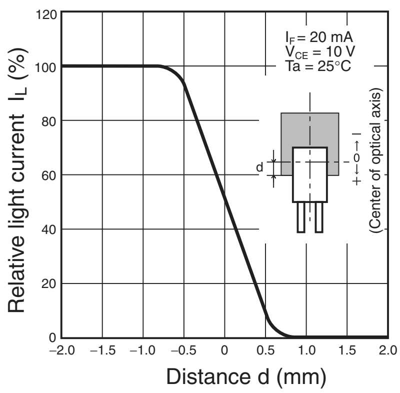

**Response Time vs. Load Resistance Characteristics (Typical)**



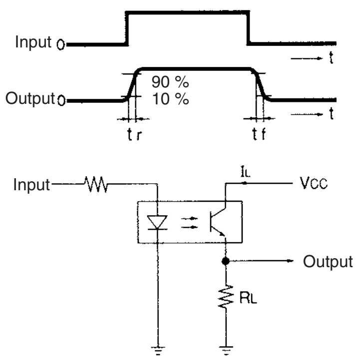

**Sensing Position Characteristics (Typical)**




**Sensing Position Characteristics (Typical)**




**Response Time Measurement Circuit**

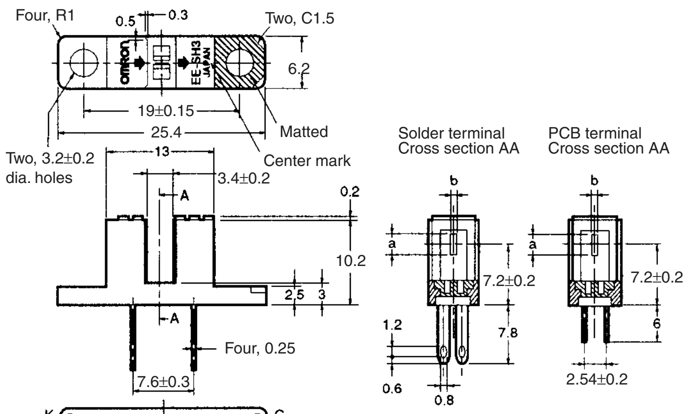


## Photomicrosensor (Transmissive)
# EE-SH3 Series

⚠ Be sure to read *Precautions* on page 25.

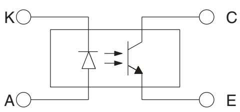
## ■ Dimensions

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




| 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 |

**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ Absolute Maximum Ratings (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.

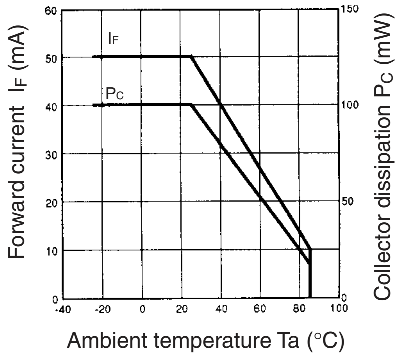
**3.** Complete soldering within 10 seconds.

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

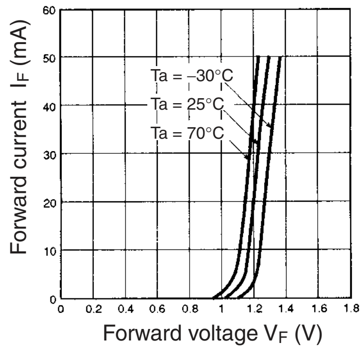
| Item | | Symbol | Value | | | | Condition |
|---|---|---|---|---|---|---|---|
| | | | EE-SH3(-B) | EE-SH3-C(S) | EE-SH3-D(S) | EE-SH3-G(S) | |
| Emitter | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | | | | $I_F$ = 30 mA |
| | **Reverse current** | $I_R$ | 0.01 μA typ., 10 μA max. | | | | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 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 V max. | | --- | 0.1 V typ., 0.4 V max. | $I_F$ = 20 mA, $I_L$ = 0.1 mA |
| | **Peak spectral sensitivity wavelength** | $\lambda_P$ | 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. | | | | |

## ■ Engineering Data

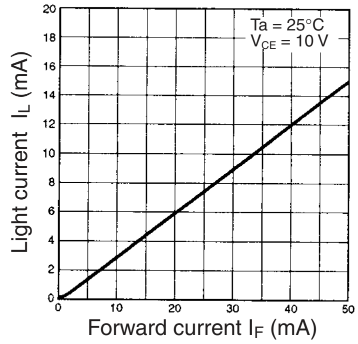
### Forward Current vs. Collector Dissipation Temperature Rating



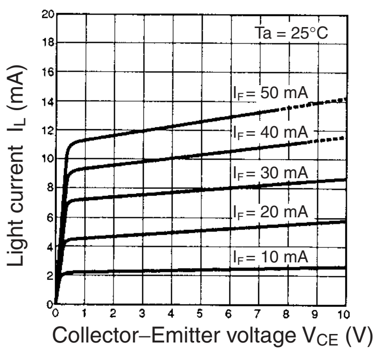

### Forward Current vs. Forward Voltage Characteristics (Typical)



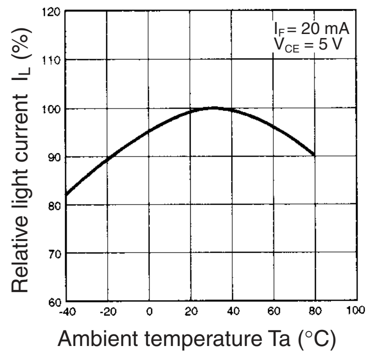

### Light Current vs. Forward Current Characteristics (Typical)



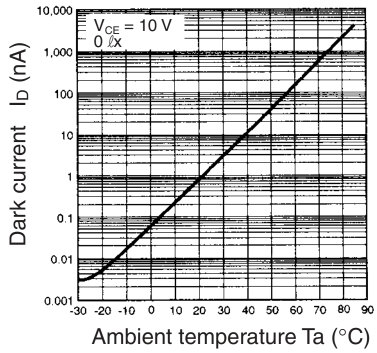

### Light Current vs. Collector–Emitter Voltage Characteristics (EE-SH3(-B))



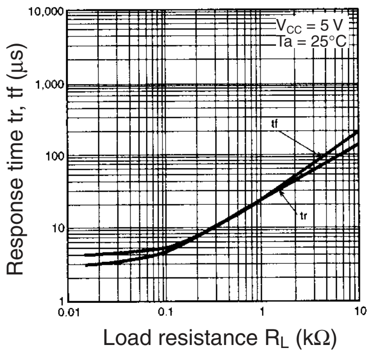

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



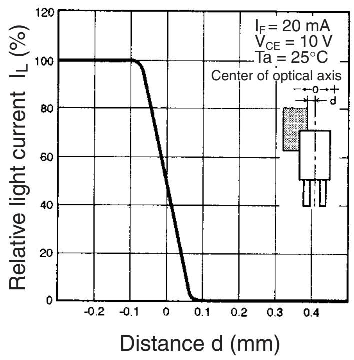

### Dark Current vs. Ambient Temperature Characteristics (Typical)



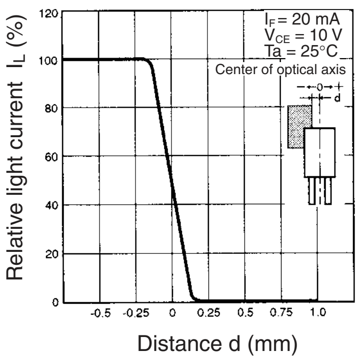

### Response Time vs. Load Resistance Characteristics (Typical)



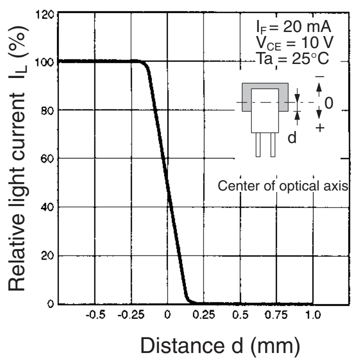

### Sensing Position Characteristics (EE-SH3-D(S))



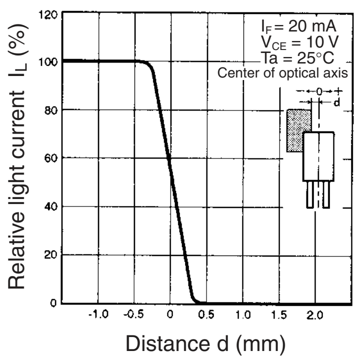

### Sensing Position Characteristics (EE-SH3(-B))



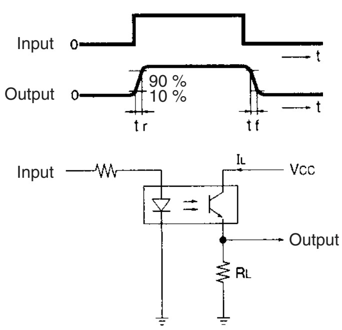

### Sensing Position Characteristics (EE-SH3-G(S))




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




### Response Time Measurement Circuit

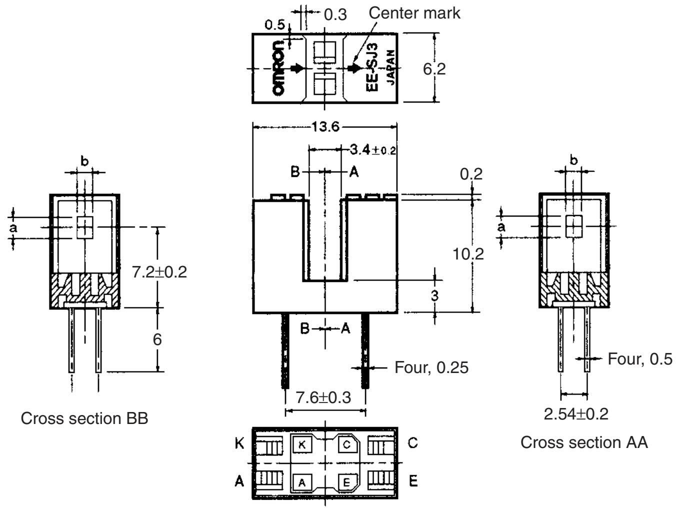


# Photomicrosensor (Transmissive)
# EE-SJ3 Series

**Be sure to read *Precautions* on page 25.**

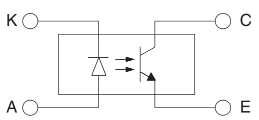
## ■ Dimensions

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




| Model | Aperture (a x b) |
|---|---|
| EE-SJ3-C | 2.1 x 1.0 |
| EE-SJ3-D | 2.1 x 0.2 |
| EE-SJ3-G | 0.5 x 2.1 |

**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ Absolute Maximum Ratings (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.

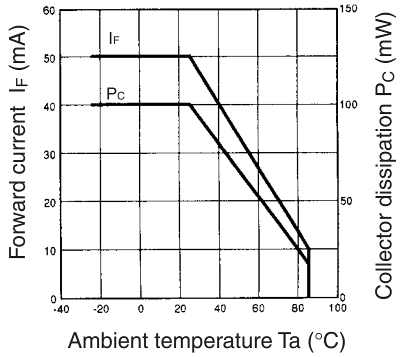
**3.** Complete soldering within 10 seconds.

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

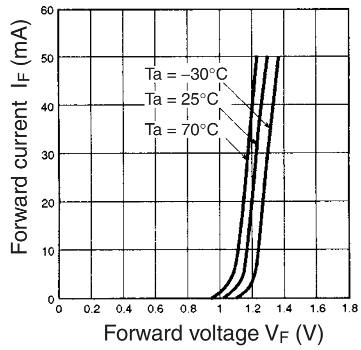
| Item | | Symbol | Value | | | Condition |
|---|---|---|---|---|---|---|
| | | | EE-SJ3-C | EE-SJ3-D | EE-SJ3-G | |
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | | | $I_F$ = 30 mA |
| | **Reverse current** | $I_R$ | 0.01 μA typ., 10 μA max. | | | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | | | $I_F$ = 20 mA |
| **Detector** | **Light current** | $I_L$ | 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 V max. | --- | 0.1 V typ., 0.4 V max. | $I_F$ = 20 mA, $I_L$ = 0.1 mA |
| | **Peak spectral sensitivity wavelength** | $\lambda_P$ | 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. | | | |

## ■ Engineering Data

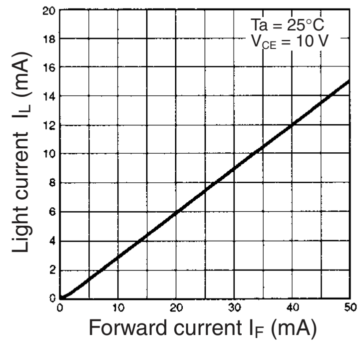
**Forward Current vs. Collector Dissipation Temperature Rating**



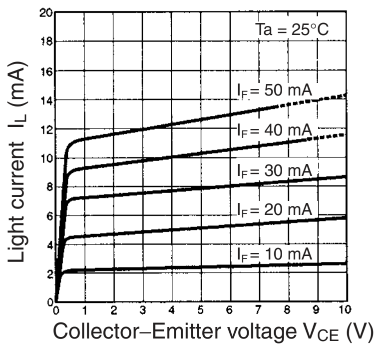

**Forward Current vs. Forward Voltage Characteristics (Typical)**



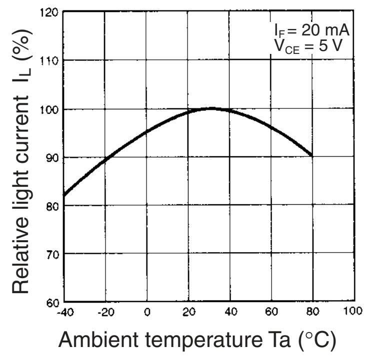

**Light Current vs. Forward Current Characteristics (Typical)**



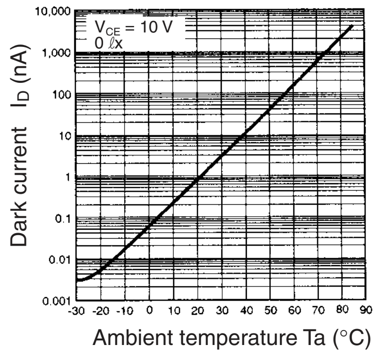

**Light Current vs. Collector–Emitter Voltage Characteristics (EE-SJ3-G)**



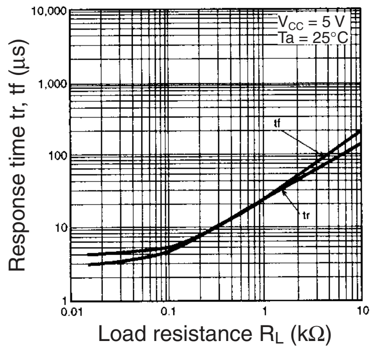

**Relative Light Current vs. Ambient Temperature Characteristics (Typical)**



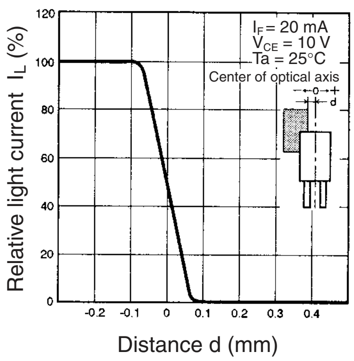

**Dark Current vs. Ambient Temperature Characteristics (Typical)**



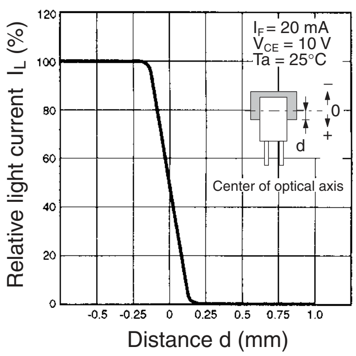

**Response Time vs. Load Resistance Characteristics (Typical)**



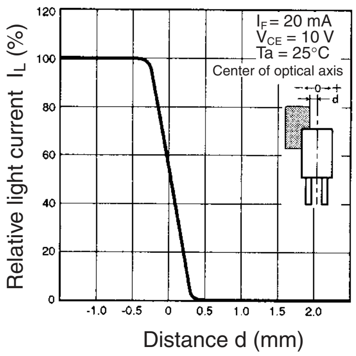

**Sensing Position Characteristics (EE-SJ3-D)**



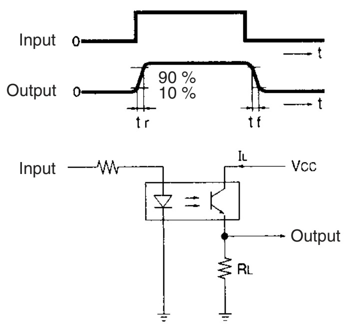

**Sensing Position Characteristics (EE-SJ3-G)**




**Sensing Position Characteristics (EE-SJ3-C)**




**Response Time Measurement Circuit**

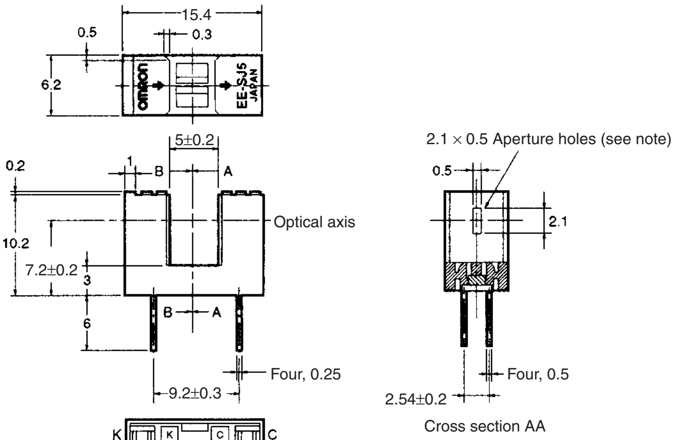


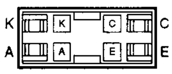
# Photomicrosensor (Transmissive)
# EE-SJ5-B

⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

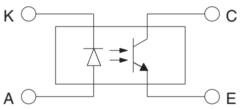
**Note:** All units are in millimeters unless otherwise indicated.




**Note:** There is no difference in size between the slot on the emitter and that on the detector.

**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

| Item | | Symbol | Rated value |
|---|---|---|---|
| **Emitter** | **Forward current** | $I_F$ | 50 mA (see note 1) |
| | **Pulse forward current** | $I_{FP}$ | 1 A (see note 2) |
| | **Reverse voltage** | $V_R$ | 4 V |
| **Detector** | **Collector–Emitter voltage** | $V_{CEO}$ | 30 V |
| | **Emitter–Collector voltage** | $V_{ECO}$ | --- |
| | **Collector current** | $I_C$ | 20 mA |
| | **Collector dissipation** | $P_C$ | 100 mW (see note 1) |
| **Ambient temperature** | **Operating** | 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.

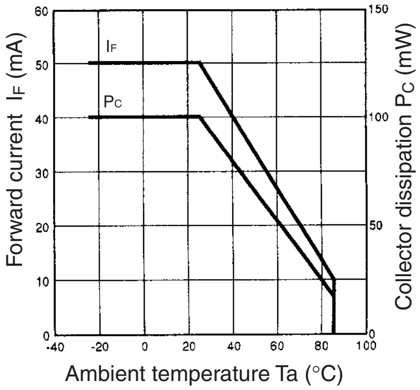
**3.** Complete soldering within 10 seconds.

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

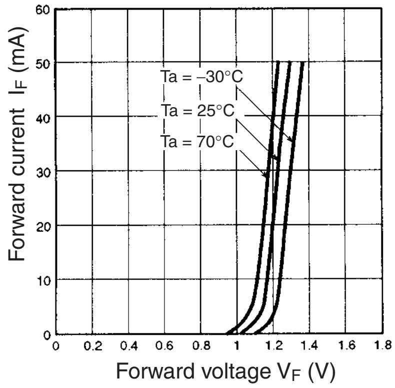
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 30 mA |
| | **Reverse current** | $I_R$ | 0.01 µA typ., 10 µA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **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** | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| **Rising time** | | tr | 4 µs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |
| **Falling time** | | tf | 4 µs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 5 mA |

## ■ Engineering Data

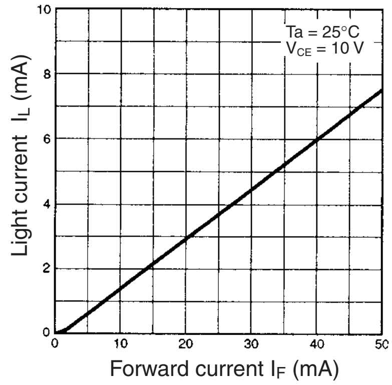
### Forward Current vs. Collector Dissipation Temperature Rating



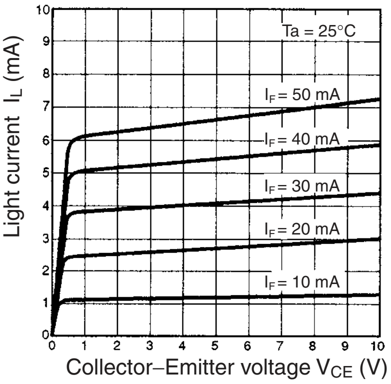

### Forward Current vs. Forward Voltage Characteristics (Typical)



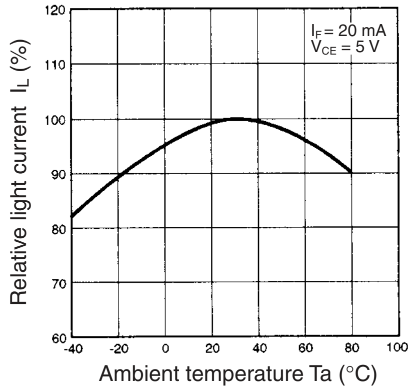

### Light Current vs. Forward Current Characteristics (Typical)



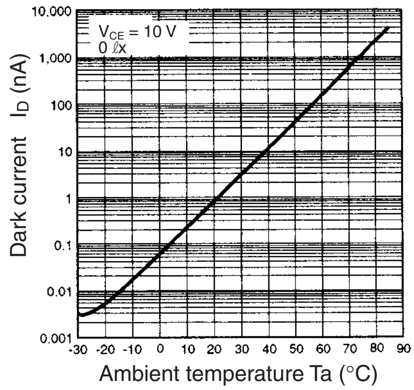

### Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



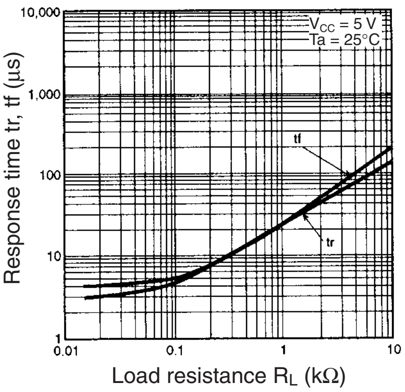

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



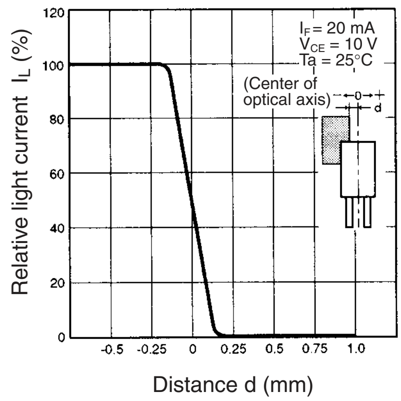

### Dark Current vs. Ambient Temperature Characteristics (Typical)



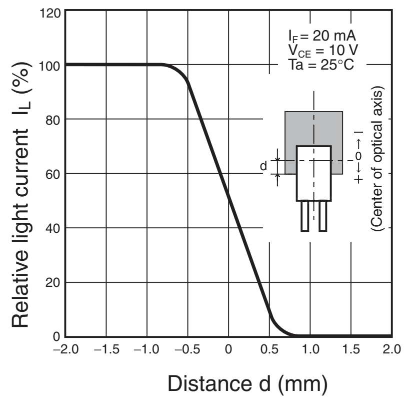

### Response Time vs. Load Resistance Characteristics (Typical)



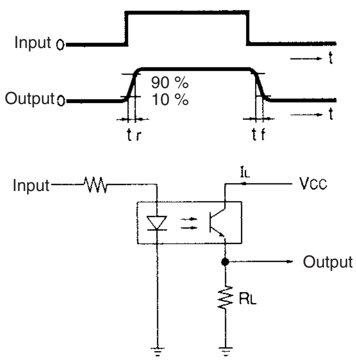

### Sensing Position Characteristics (Typical)




### Sensing Position Characteristics (Typical)




### Response Time Measurement Circuit

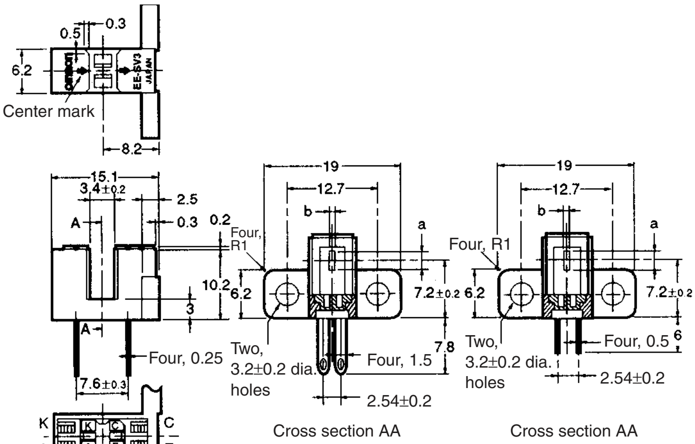


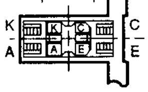
# Photomicrosensor (Transmissive)
# EE-SV3 Series

⚠ Be sure to read *Precautions* on page 25.

## ■ Dimensions

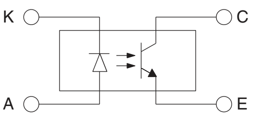
**Note:** All units are in millimeters unless otherwise indicated.




| 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 |

**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ Absolute Maximum Ratings (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.

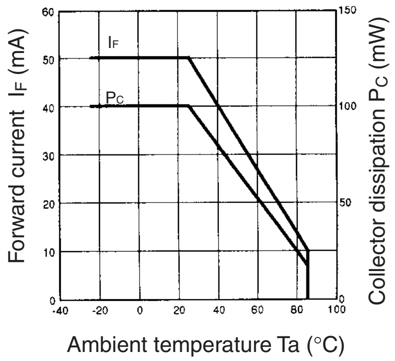
**3.** Complete soldering within 10 seconds.

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

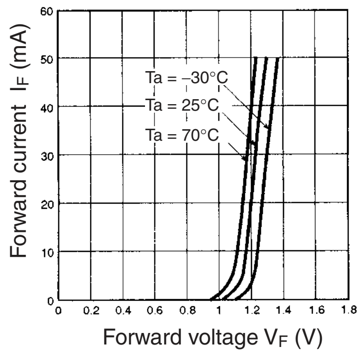
| Item | | Symbol | Value | | | | Condition |
|---|---|---|---|---|---|---|---|
| | | | **EE-SV3(-B)** | **EE-SV3-C(S)** | **EE-SV3-D(S)** | **EE-SV3-G(S)** | |
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | | | | $I_F$ = 30 mA |
| | **Reverse current** | $I_R$ | 0.01 μA typ., 10 μA max. | | | | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 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 mA |
| | **Peak spectral sensitivity wavelength** | $\lambda_P$ | 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. | | | | |

## ■ Engineering Data

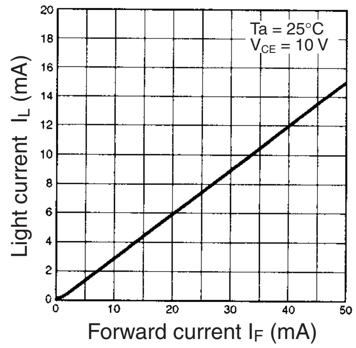
**Forward Current vs. Collector Dissipation Temperature Rating**



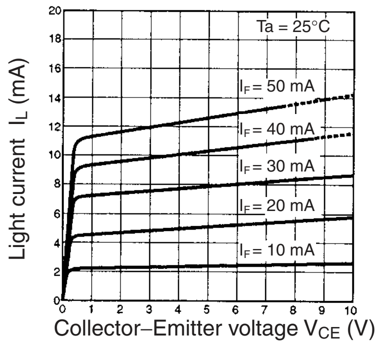

**Forward Current vs. Forward Voltage Characteristics (Typical)**



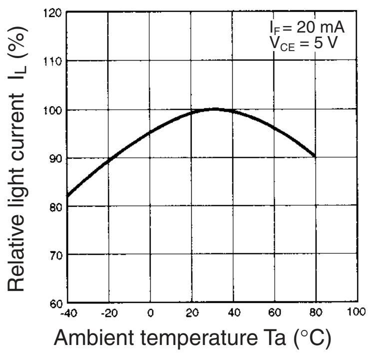

**Light Current vs. Forward Current Characteristics (Typical)**



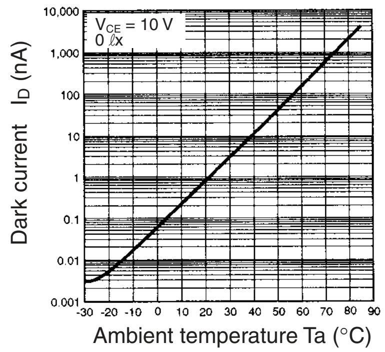

**Light Current vs. Collector−Emitter Voltage Characteristics (EE-SV3(-B))**



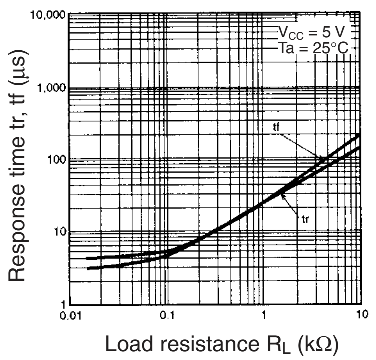

**Relative Light Current vs. Ambient Temperature Characteristics (Typical)**



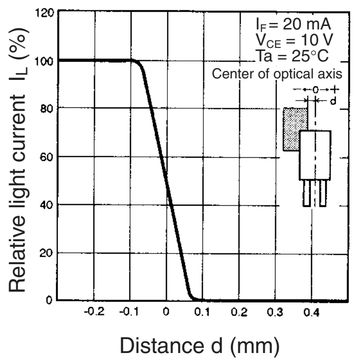

**Dark Current vs. Ambient Temperature Characteristics (Typical)**



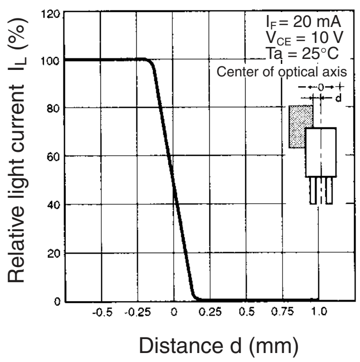

**Response Time vs. Load Resistance Characteristics (Typical)**



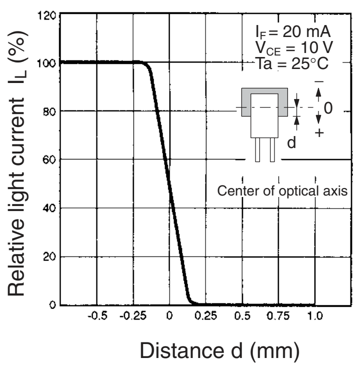

**Sensing Position Characteristics (EE-SV3-D(S))**



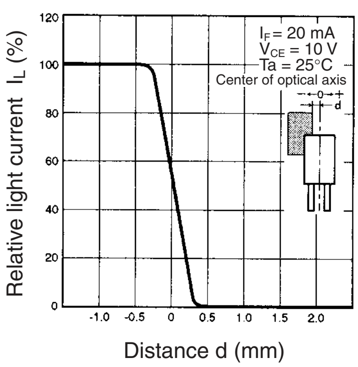

**Sensing Position Characteristics (EE-SV3(-B))**



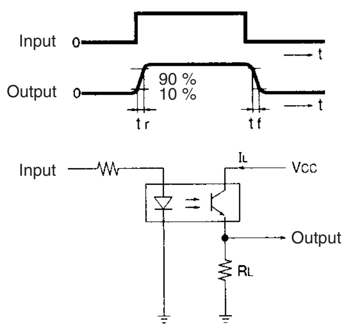

**Sensing Position Characteristics (EE-SV3-G(S))**




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




**Response Time Measurement Circuit**

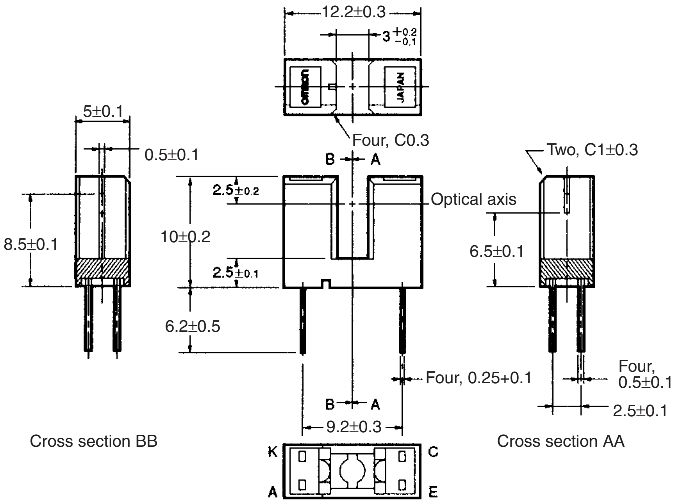


# Photomicrosensor (Transmissive)
# EE-SX298

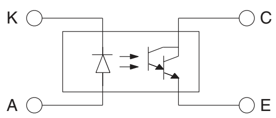
⚠ Be sure to read *Precautions* on page 25.

## ■ Dimensions

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




### Internal Circuit




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

Unless otherwise specified, the tolerances are ±0.2 mm.

## ■ Features

- General-purpose model with a 3-mm-wide slot.
- PCB mounting type.
- High resolution with a 0.5-mm-wide aperture.
- With a Photo-Darlington transistor as a detector element.

## ■ 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 | $V_{CEO}$ | 35 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.

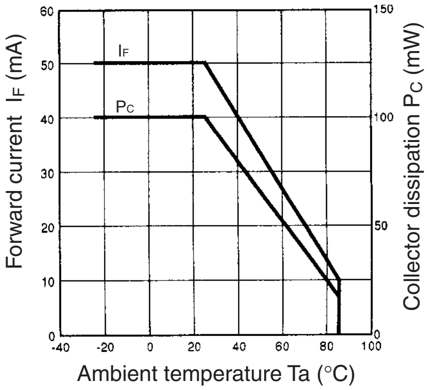
**3.** Complete soldering within 10 seconds.

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

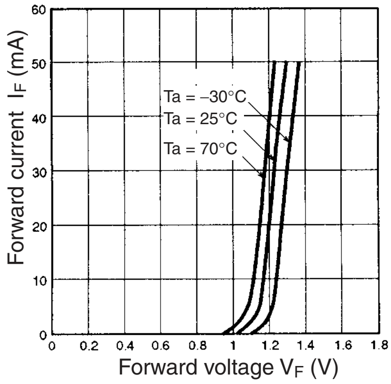
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| Emitter | Forward voltage | $V_F$ | 1.2 V typ., 1.4 V max. | $I_F$ = 20 mA |
| | Reverse current | $I_R$ | 0.01 µA typ., 10 µA max. | $V_R$ = 4 V |
| | Peak emission wavelength | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| Detector | Light current | $I_L$ | 0.5 mA min., 20 mA max. | $I_F$ = 1 mA, $V_{CE}$ = 2 V |
| | Dark current | $I_D$ | 2 nA typ., 1,000 nA max. | $V_{CE}$ = 10 V, 0 ℓx |
| | Leakage current | $I_{LEAK}$ | --- | --- |
| | Collector–Emitter saturated voltage | $V_{CE}$ (sat) | 0.75 V typ., 1.0 V max. | $I_F$ = 2 mA, $I_L$ = 0.5 mA |
| | Peak spectral sensitivity wavelength | $\lambda_P$ | 780 nm typ. | $V_{CE}$ = 5 V |
| Rising time | | tr | 70 µs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 10 mA |
| Falling time | | tf | 70 µs typ. | $V_{CC}$ = 5 V, $R_L$ = 100 Ω, $I_L$ = 10 mA |

## ■ Engineering Data

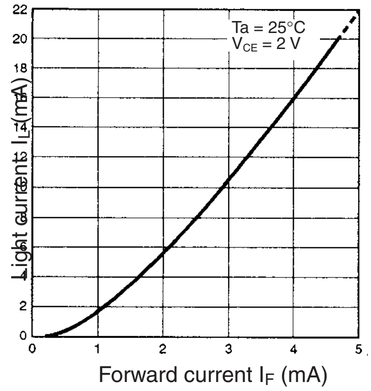
### Forward Current vs. Collector Dissipation Temperature Rating



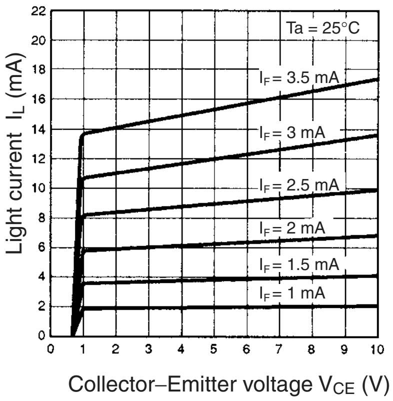

### Forward Current vs. Forward Voltage Characteristics (Typical)



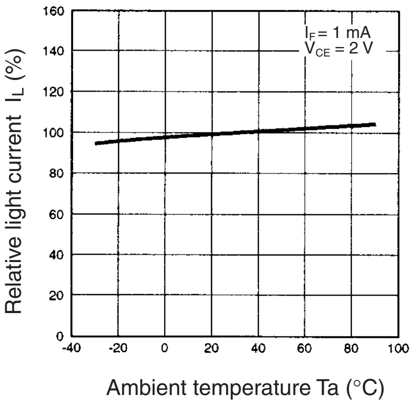

### Light Current vs. Forward Current Characteristics (Typical)



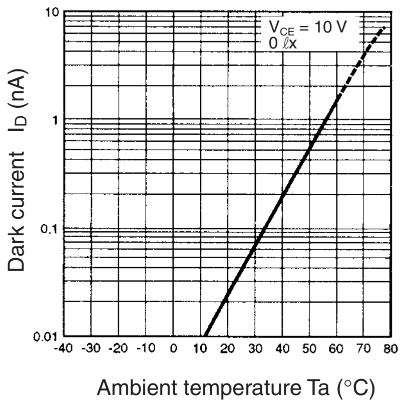

### Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



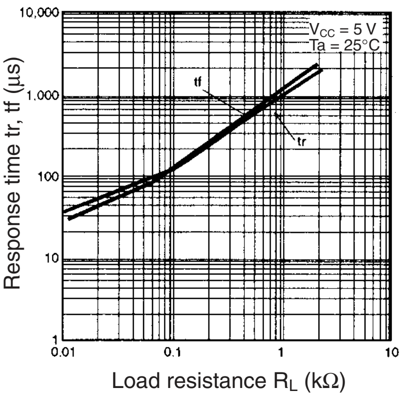

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



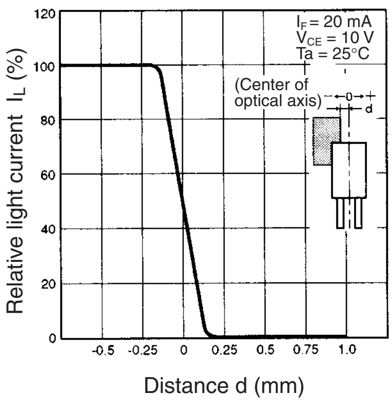

### Dark Current vs. Ambient Temperature Characteristics (Typical)



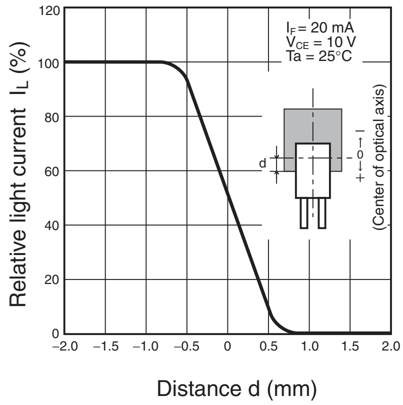

### Response Time vs. Load Resistance Characteristics (Typical)



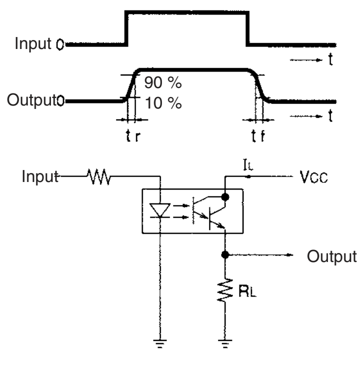

### Sensing Position Characteristics (Typical)




### Sensing Position Characteristics (Typical)




### Response Time Measurement Circuit

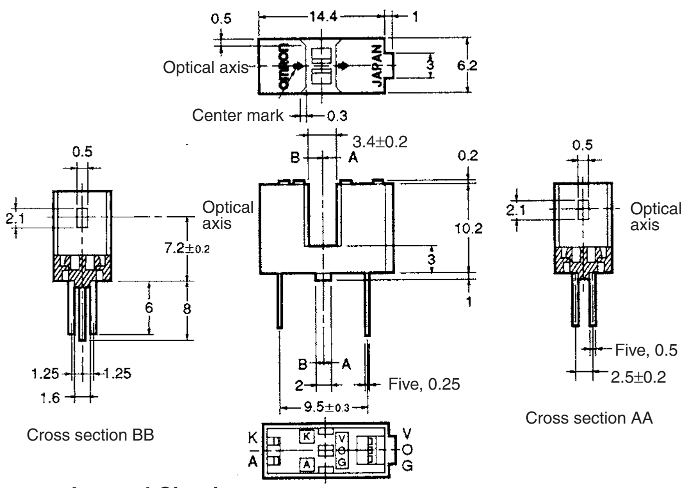


# Photomicrosensor (Transmissive)
# EE-SX301/-SX401

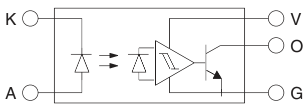
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ 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.

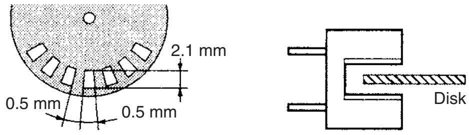
**2.** Complete soldering within 10 seconds.

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

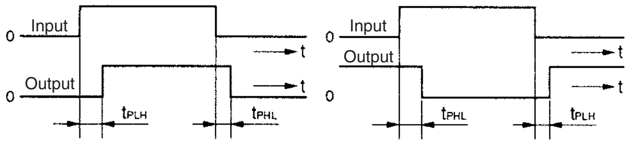
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 20 mA |
| | **Reverse current** | $I_R$ | 0.01 µA typ., 10 µA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA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

**Note:** 1. Hysteresis denotes the difference in forward LED current value, expressed in percentage, calculated from the respective forward LED currents when the photo IC 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-SX401.

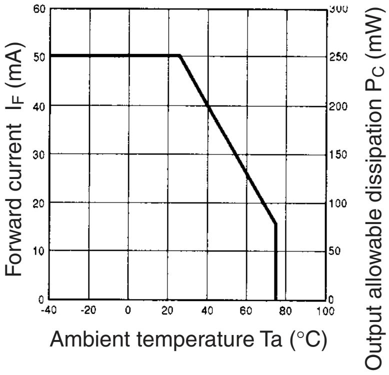



**EE-SX301** **EE-SX401**

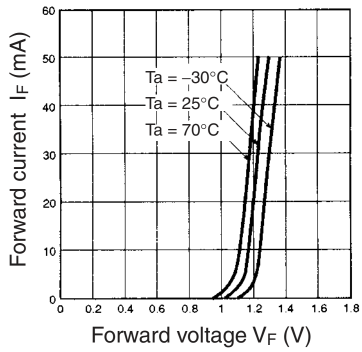
## ■ Engineering Data

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

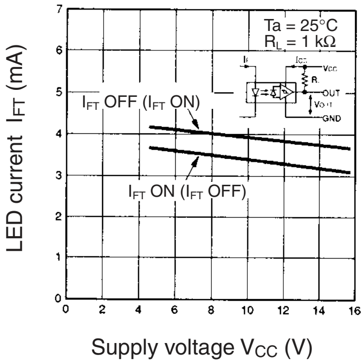
### Forward Current vs. Collector Dissipation Temperature Rating



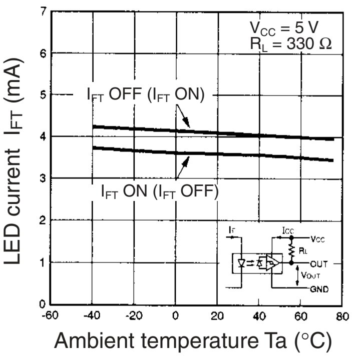

### Forward Current vs. Forward Voltage Characteristics (Typical)



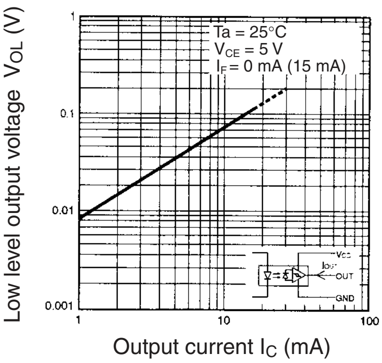

### LED Current vs. Supply Voltage (Typical)



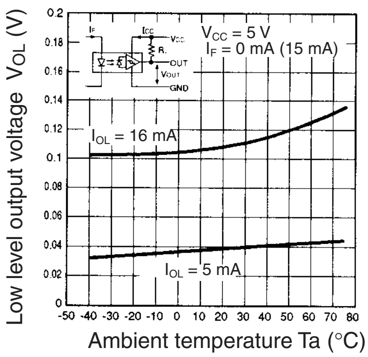

### LED Current vs. Ambient Temperature Characteristics (Typical)



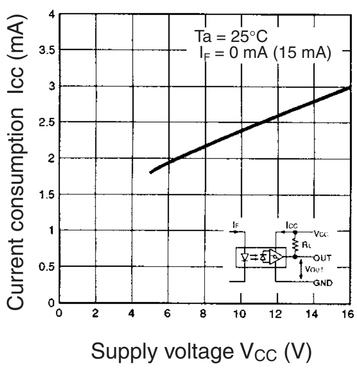

### Low-level Output Voltage vs. Output Current (Typical)



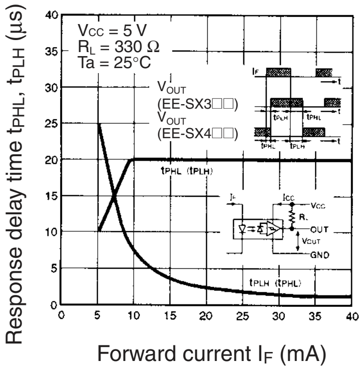

### Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



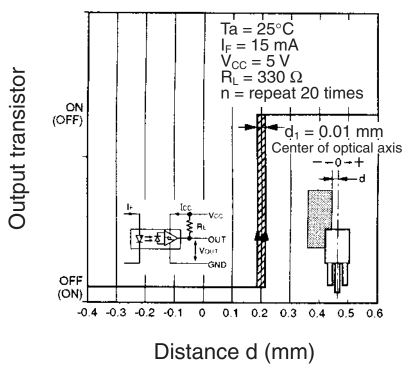

### Current Consumption vs. Supply Voltage (Typical)




### Response Delay Time vs. Forward Current (Typical)




### Repeat Sensing Position Characteristics (Typical)

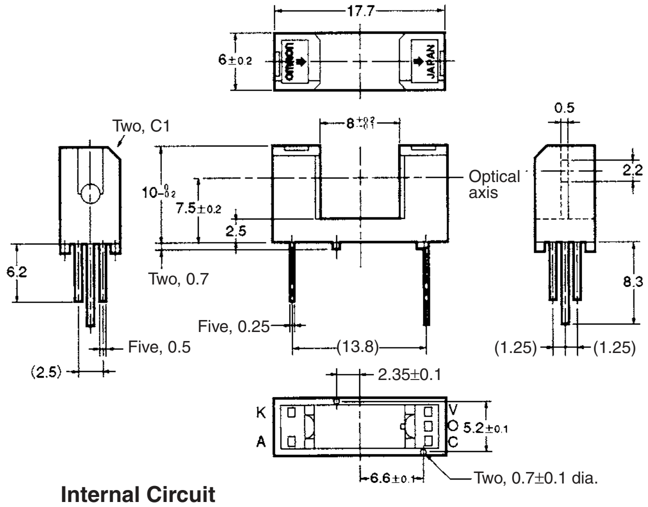


# Photomicrosensor (Transmissive)
# EE-SX3070/-SX4070

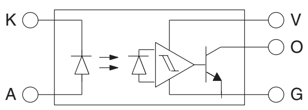
Be sure to read *Precautions* on page 25.

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ 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.

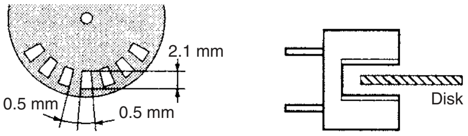
**2.** Complete soldering within 10 seconds.

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

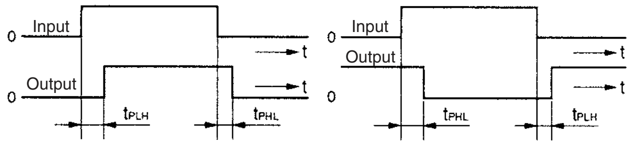
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 20 mA |
| | **Reverse current** | $I_R$ | 0.01 µA typ., 10 µA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **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-SX3070), $I_F$ = 10 mA (EE-SX4070) |
| | **High-level output voltage** | $V_{OH}$ | 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 typ., 10 mA max. | $V_{CC}$ = 16 V |
| | **Peak spectral sensitivity wavelength** | $\lambda_P$ | 870 nm typ. | $V_{CC}$ = 4.5 to 16 V |
| **LED current when output is OFF** | | $I_{FT}$ | 10 mA max. | $V_{CC}$ = 4.5 to 16 V |
| **LED current when output is ON** | | | | |
| **Hysteresis** | | ΔH | 15% typ. | $V_{CC}$ = 4.5 to 16 V (see note 1) |
| **Response frequency** | | f | 3 kHz min. | $V_{CC}$ = 4.5 to 16 V, $I_F$ = 20 mA, $I_{OL}$ = 16 mA (see note 2) |
| **Response delay time** | | $t_{PLH}$ ($t_{PHL}$) | 3 µs typ. | $V_{CC}$ = 4.5 to 16 V, $I_F$ = 20 mA, $I_{OL}$ = 16 mA (see note 3) |
| **Response delay time** | | $t_{PHL}$ ($t_{PLH}$) | 20 µs typ. | $V_{CC}$ = 4.5 to 16 V, $I_F$ = 20 mA, $I_{OL}$ = 16 mA (see note 3) |

**Note:** 1. Hysteresis denotes the difference in forward LED current value, expressed in percentage, calculated from the respective forward LED currents when the photo IC 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-SX4070.

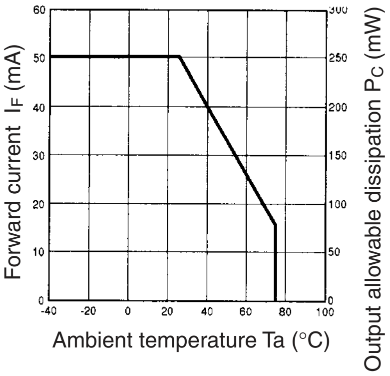



**EE-SX3070** **EE-SX4070**

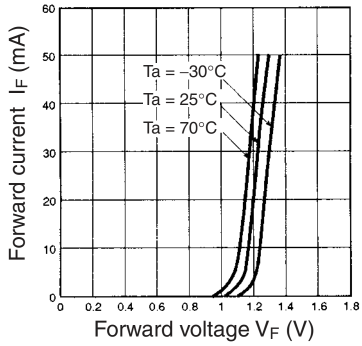
## ■ Engineering Data

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

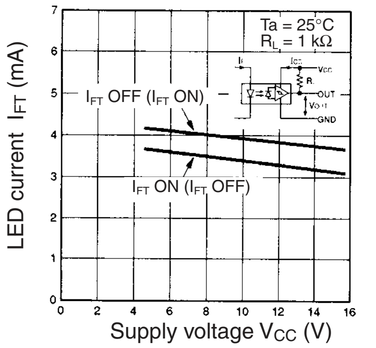
### Forward Current vs. Collector Dissipation Temperature Rating



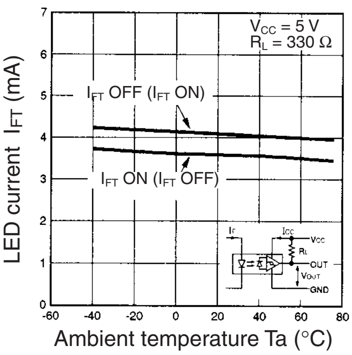

### Forward Current vs. Forward Voltage Characteristics (Typical)



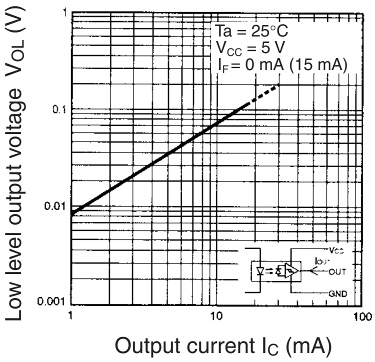

### LED Current vs. Supply Voltage (Typical)



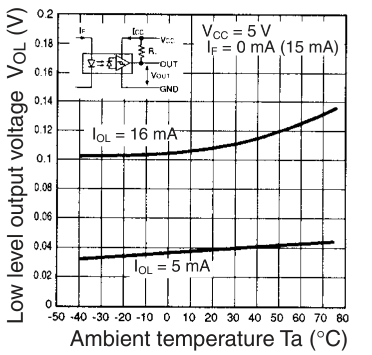

### LED Current vs. Ambient Temperature Characteristics (Typical)



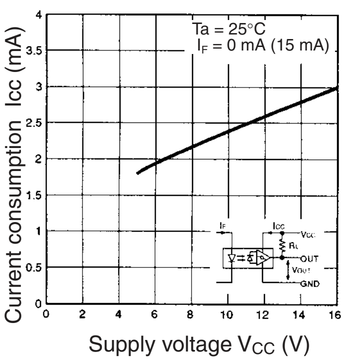

### Low-level Output Voltage vs. Output Current (Typical)



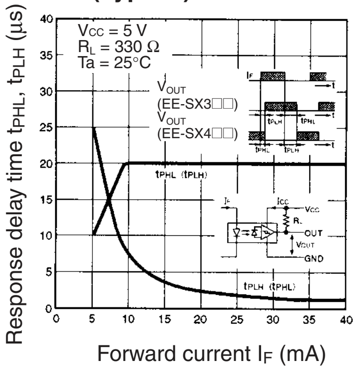

### Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



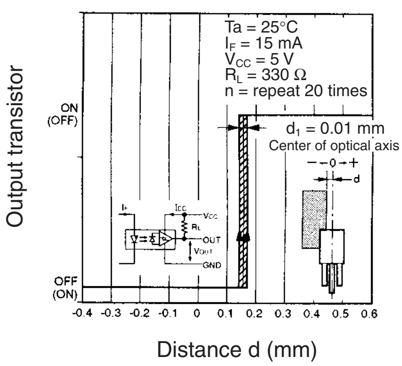

### Current Consumption vs. Supply Voltage (Typical)




### Response Delay Time vs. Forward Current (Typical)




### Repeat Sensing Position Characteristics (Typical)



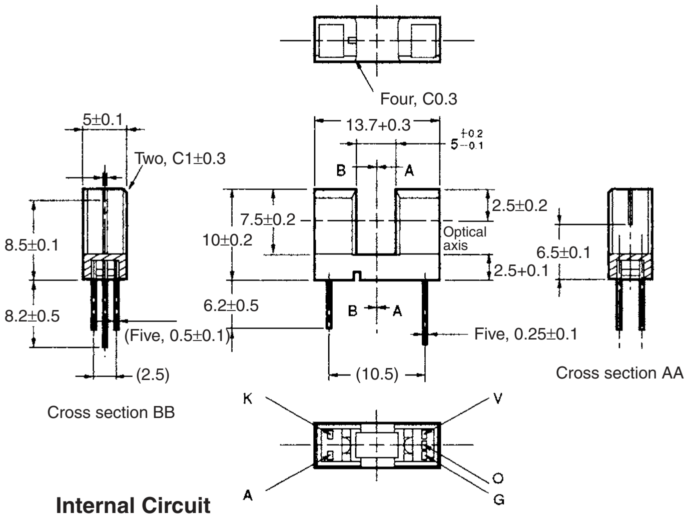
# Photomicrosensor (Transmissive)

# EE-SX3081/-SX4081

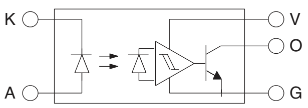
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ Absolute Maximum Ratings (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.

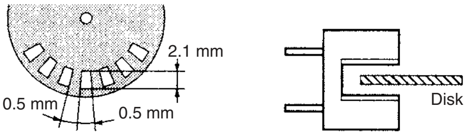
**2.** Complete soldering within 10 seconds.

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

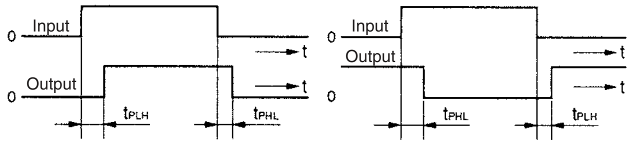
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 20 mA |
| | **Reverse current** | $I_R$ | 0.01 µA typ., 10 µA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **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-SX3081), $I_F$ = 8 mA (EE-SX4081) |
| | **High-level output voltage** | $V_{OH}$ | 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 typ., 10 mA max. | $V_{CC}$ = 16 V |
| | **Peak spectral sensitivity wavelength** | $\lambda_P$ | 870 nm typ. | $V_{CC}$ = 4.5 to 16 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** | | $t_{PLH}$ ($t_{PHL}$) | 3 µs typ. | $V_{CC}$ = 4.5 to 16 V, $I_F$ = 20 mA, $I_{OL}$ = 16 mA (see note 3) |
| **Response delay time** | | $t_{PHL}$ ($t_{PLH}$) | 20 µs typ. | $V_{CC}$ = 4.5 to 16 V, $I_F$ = 20 mA, $I_{OL}$ = 16 mA (see note 3) |

**Note:** 1. Hysteresis denotes the difference in forward LED current value, expressed in percentage, calculated from the respective forward LED currents when the photo IC 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.



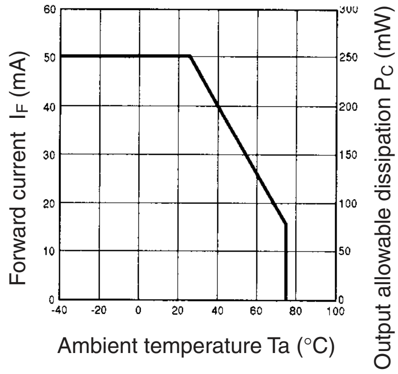

3. The following illustrations show the definition of response delay time. The value in the parentheses applies to the EE-SX4081.



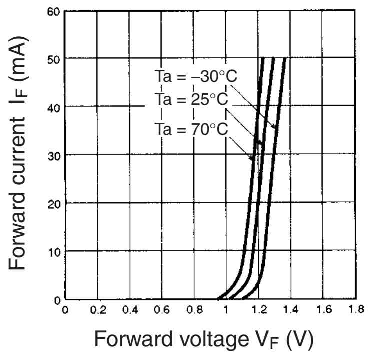

## ■ Engineering Data

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

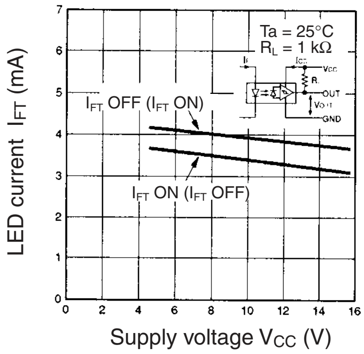
### Forward Current vs. Collector Dissipation Temperature Rating



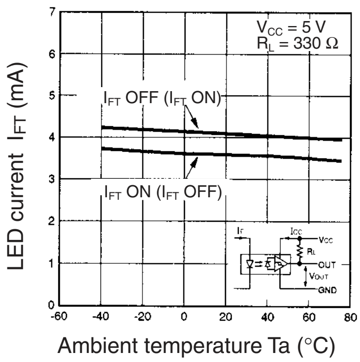

### Forward Current vs. Forward Voltage Characteristics (Typical)



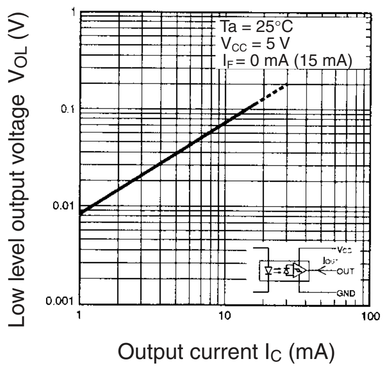

### LED Current vs. Supply Voltage (Typical)



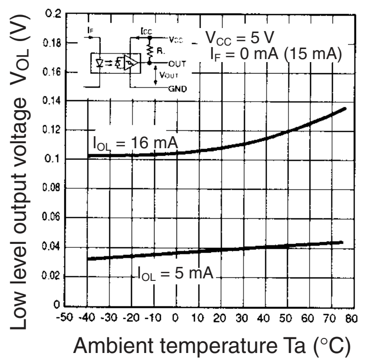

### LED Current vs. Ambient Temperature Characteristics (Typical)



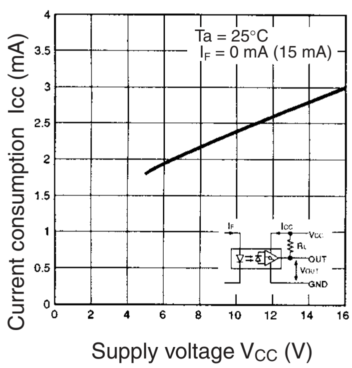

### Low-level Output Voltage vs. Output Current (Typical)



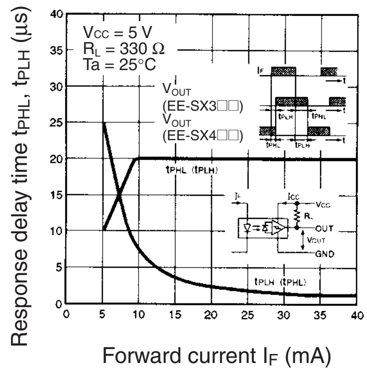

### Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



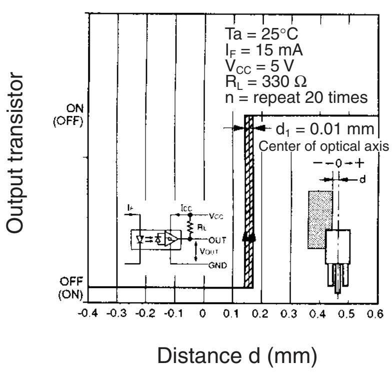

### Current Consumption vs. Supply Voltage (Typical)




### Response Delay Time vs. Forward Current (Typical)




### Repeat Sensing Position Characteristics (Typical)

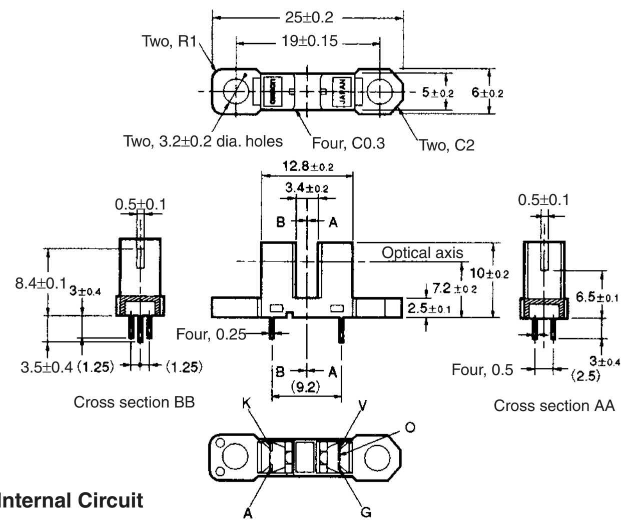


# Photomicrosensor (Transmissive)
# EE-SX3088/-SX4088

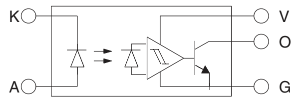
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ Absolute Maximum Ratings (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.

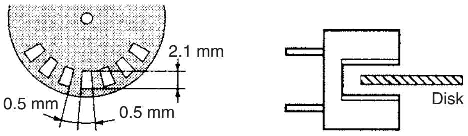
**2.** Complete soldering within 10 seconds.

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

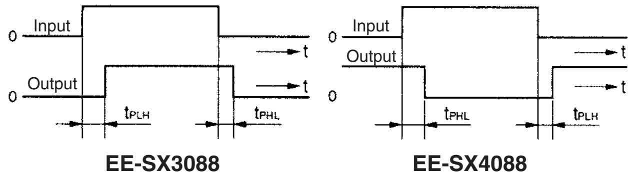
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 20 mA |
| | **Reverse current** | $I_R$ | 0.01 µA typ., 10 µA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm | $I_F$ = 20 mA |
| **Detector** | **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** | $\lambda_P$ | 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** | | ΔH | 15% typ. | $V_{CC}$ = 4.5 to 16 V (see note 1) |
| **Response frequency** | | f | 3kHz min. | $V_{CC}$ = 4.5 to 16 V, $I_F$ = 15 mA, $I_{OL}$ = 16 mA (see note 2) |
| **Response delay time** | | $t_{PLH}$ ($t_{PHL}$) | 3 µs typ. | $V_{CC}$ = 4.5 to 16 V, $I_F$ = 15 mA, $I_{OL}$ = 16 mA (see note 3) |
| **Response delay time** | | $t_{PHL}$ ($t_{PLH}$) | 20 µs typ. | $V_{CC}$ = 4.5 to 16 V, $I_F$ = 15 mA, $I_{OL}$ = 16 mA (see note 3) |

**Note:** 1. Hysteresis denotes the difference in forward LED current value, expressed in percentage, calculated from the respective forward LED currents when the photo IC 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.



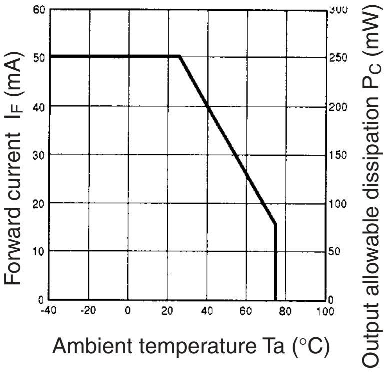

3. The following illustrations show the definition of response delay time. The value in the parentheses applies to the EE-SX4088.



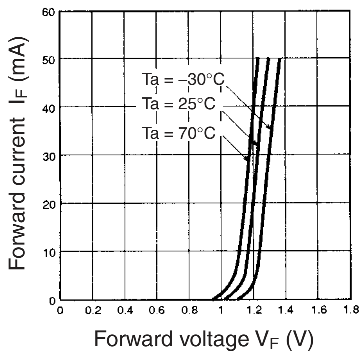

## ■ Engineering Data

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

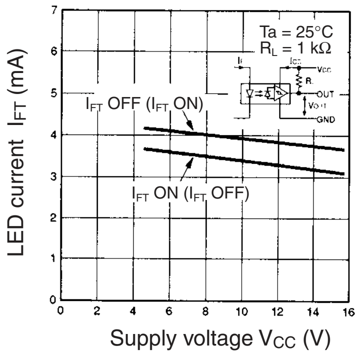
### Forward Current vs. Collector Dissipation Temperature Rating



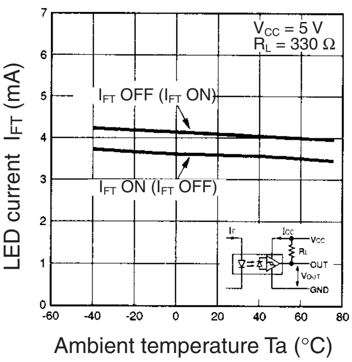

### Forward Current vs. Forward Voltage Characteristics (Typical)



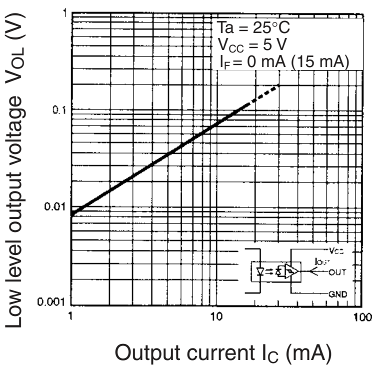

### LED Current vs. Supply Voltage (Typical)



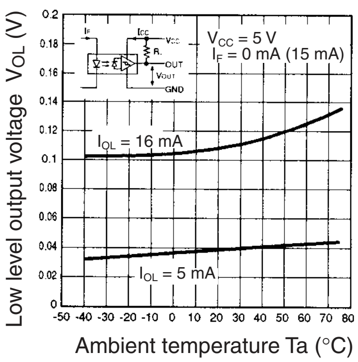

### LED Current vs. Ambient Temperature Characteristics (Typical)



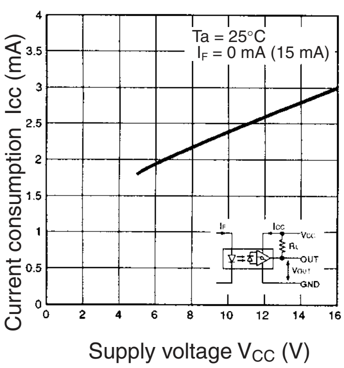

### Low-level Output Voltage vs. Output Current (Typical)



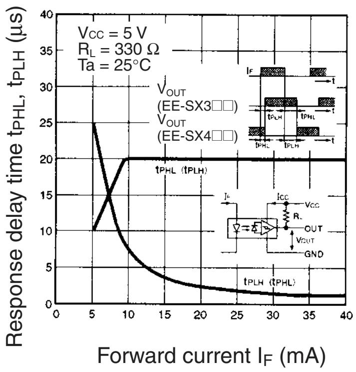

### Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)




### Current Consumption vs. Supply Voltage (Typical)




### Response Delay Time vs. Forward Current (Typical)




### Repeat Sensing Position Characteristics (Typical)

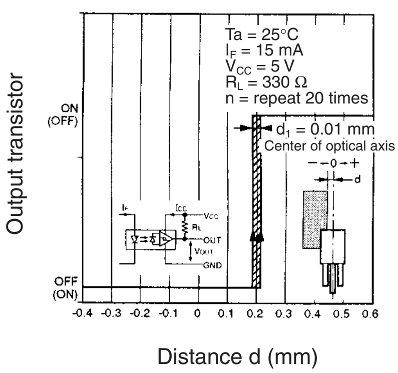


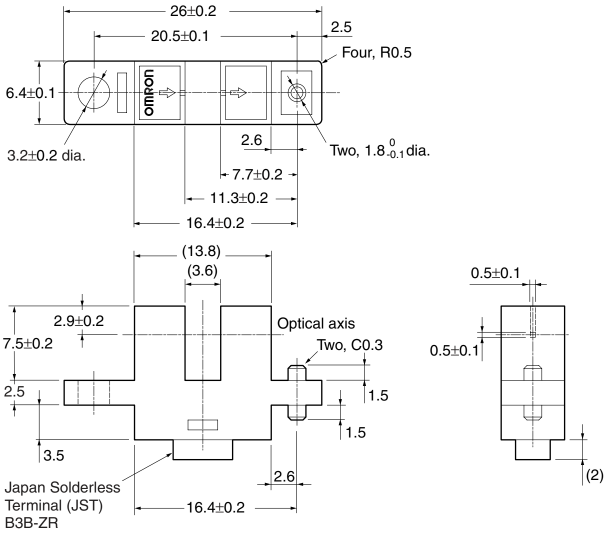
Photo IC Output Photomicrosensor (Transmissive)

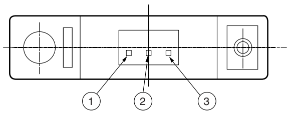
# EE-SX3148-P1

⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




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

Unless otherwise specified, the tolerances are as shown below.

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

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

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

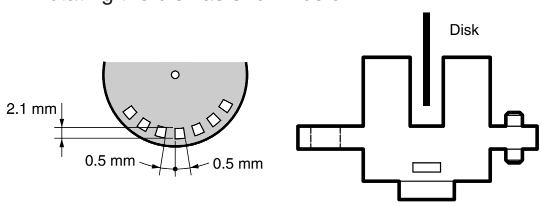
| Item | | Symbol | Rated value |
|---|---|---|---|
| **Power supply voltage** | | $V_{CC}$ | 6 VDC |
| **Output voltage** | | $V_{OUT}$ | 28 V |
| **Output current** | | $I_{OUT}$ | 16 mA |
| **Permissible output dissipation** | | $P_{OUT}$ | 250 mW (see note) |
| **Ambient temperature** | **Operating** | 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%)

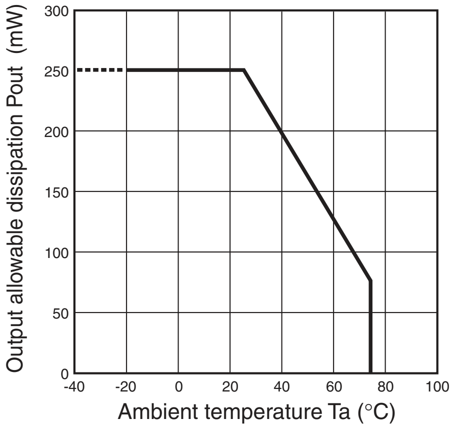
| Item | Symbol | Value | Condition |
|---|---|---|---|
| **Current consumption** | $I_{CC}$ | 30 mA max. | With and without incident |
| **Low-level output voltage** | $V_{OL}$ | 0.3 V max. | $I_{OUT}$ = 16 mA<br>without incident |
| **High-level output voltage** | $V_{OH}$ | ($V_{CC}$ x 0.9) V min.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

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

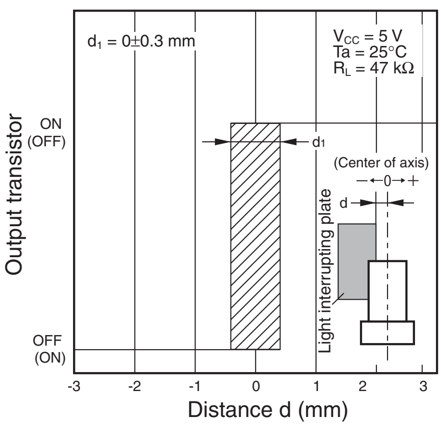


## ■ Engineering Data

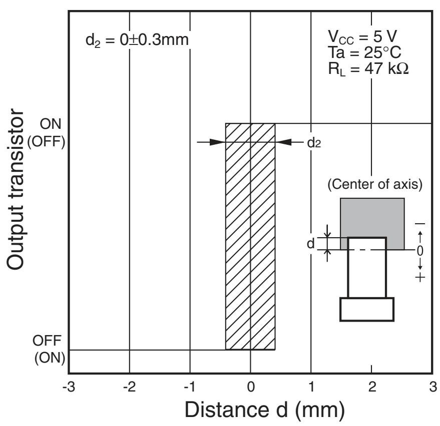
### Output Allowable Dissipation vs. Ambient Temperature Characteristics




### Sensing Position Characteristics (Typical)




### Sensing Position Characteristics (Typical)



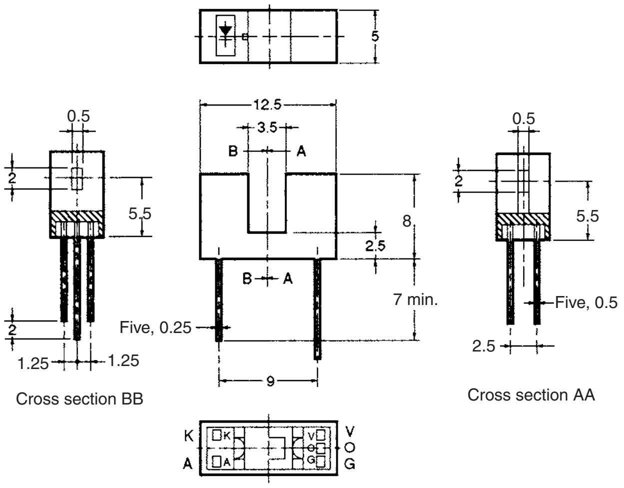
## Photomicrosensor (Transmissive)

# EE-SX384/-SX484

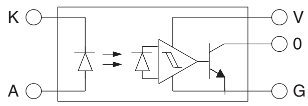
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are ±0.2 mm.

## ■ Features

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

## ■ Absolute Maximum Ratings (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.

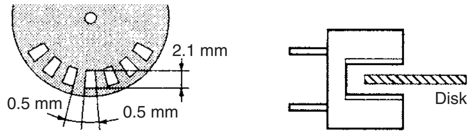
**2.** Complete soldering within 10 seconds.

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

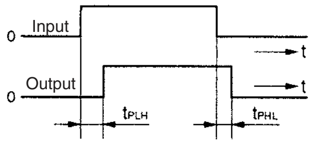
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 20 mA |
| | **Reverse current** | $I_R$ | 0.01 μA typ., 10 μA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **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-SX384), $I_F$ = 8 mA (EE-SX484) |
| | **High-level output voltage** | $V_{OH}$ | 15 V min. | $V_{CC}$ = 16 V, $R_L$ = 1 kΩ, $I_F$ = 8 mA (EE-SX384), $I_F$ = 0 mA (EE-SX484) |
| | **Current consumption** | $I_{CC}$ | 3.2 mA typ., 10 mA max. | $V_{CC}$ = 16 V |
| | **Peak spectral sensitivity wavelength** | $\lambda_P$ | 870 nm typ. | $V_{CC}$ = 4.5 to 16 V |
| **LED current when output is OFF** | | $I_{FT}$ | 3 mA typ., 8 mA max. | $V_{CC}$ = 4.5 to 16 V |
| **LED current when output is ON** | | | | |
| **Hysteresis** | | ΔH | 15% typ. | $V_{CC}$ = 4.5 to 16 V (see note 1) |
| **Response frequency** | | f | 3 kHz min. | $V_{CC}$ = 4.5 to 16 V, $I_F$ = 15 mA, $I_{OL}$ = 16 mA (see note 2) |
| **Response delay time** | | $t_{PLH}$ ($t_{PHL}$) | 3 μs typ. | $V_{CC}$ = 4.5 to 16 V, $I_F$ = 15 mA, $I_{OL}$ = 16 mA (see note 3) |
| **Response delay time** | | $t_{PHL}$ ($t_{PLH}$) | 20 μs typ. | $V_{CC}$ = 4.5 to 16 V, $I_F$ = 15 mA, $I_{OL}$ = 16 mA (see note 3) |

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

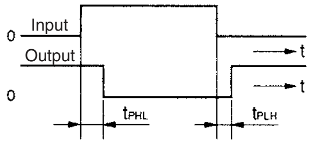
2. The value of the response frequency is measured by rotating the disk as shown below.




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




**EE-SX384**

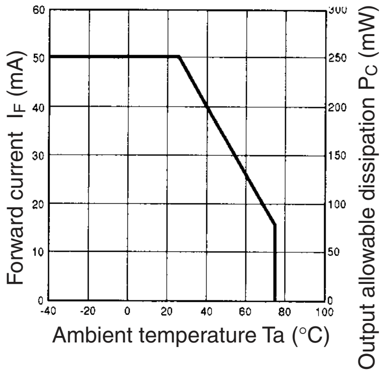



**EE-SX484**

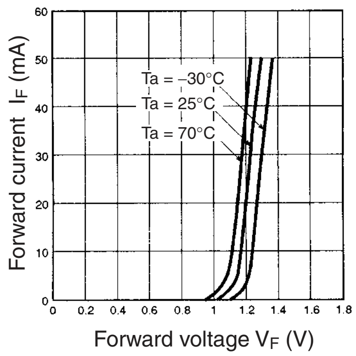
## ■ Engineering Data

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

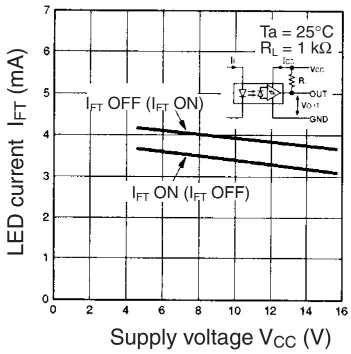
### Forward Current vs. Collector Dissipation Temperature Rating



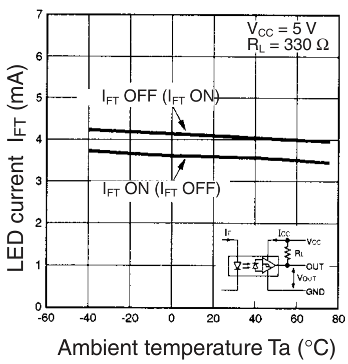

### Forward Current vs. Forward Voltage Characteristics (Typical)



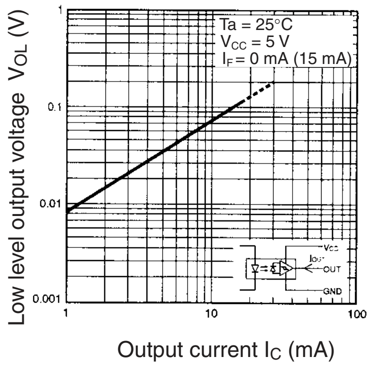

### LED Current vs. Supply Voltage (Typical)



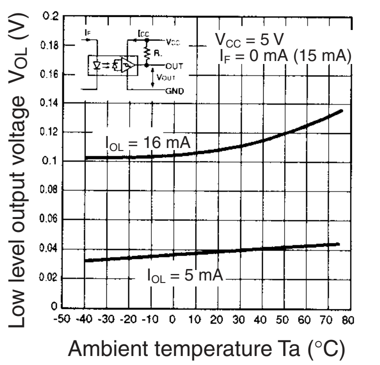

### LED Current vs. Ambient Temperature Characteristics (Typical)



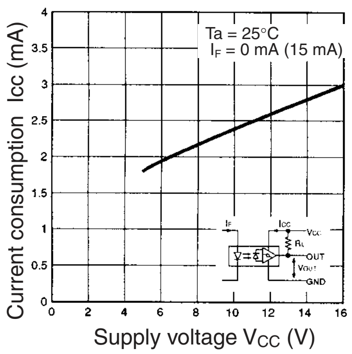

### Low-level Output Voltage vs. Output Current (Typical)



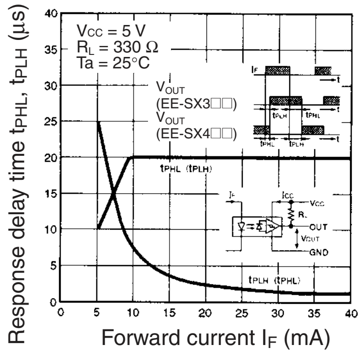

### Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



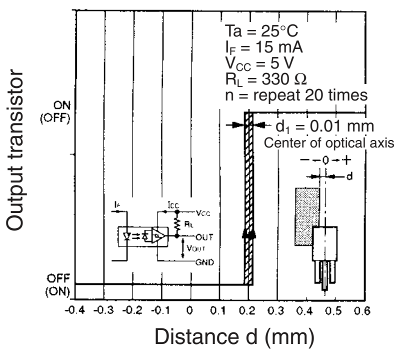

### Current Consumption vs. Supply Voltage (Typical)




### Response Delay Time vs. Forward Current (Typical)




### Repeat Sensing Position Characteristics (Typical)

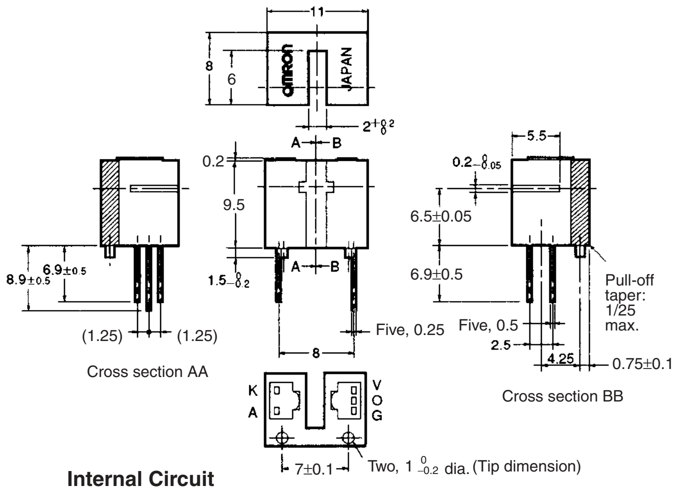


# Photomicrosensor (Transmissive)
# EE-SX493

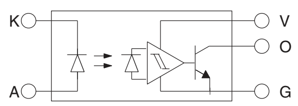
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




Internal Circuit




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

| Item | | Symbol | Rated value |
|---|---|---|---|
| **Emitter** | **Forward current** | $I_F$ | 50 mA (see note 1) |
| | **Reverse voltage** | $V_R$ | 4 V |
| **Detector** | **Power supply voltage** | $V_{CC}$ | 16 V |
| | **Output voltage** | $V_{OUT}$ | 28 V |
| | **Output current** | $I_{OUT}$ | 16 mA |
| | **Permissible output dissipation** | $P_{OUT}$ | 250 mW (see note 1) |
| **Ambient temperature** | **Operating** | 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.

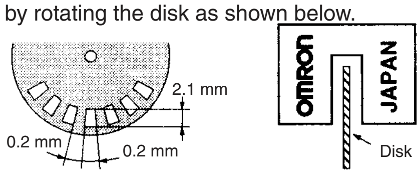
**2.** Complete soldering within 10 seconds.

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

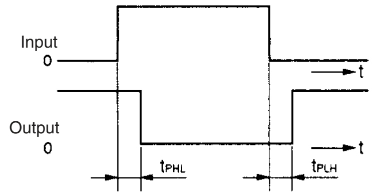
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 20 mA |
| | **Reverse current** | $I_R$ | 0.01 µA typ., 10 µA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **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. | $V_{CC}$ = 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** | $\lambda_P$ | 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** | | ΔH | 15% typ. | $V_{CC}$ = 4.5 to 16 V (see note 1) |
| **Response frequency** | | f | 3 kHz min. | $V_{CC}$ = 4.5 to 16 V, $I_F$ = 15 mA, $I_{OL}$ = 16 mA (see note 2) |
| **Response delay time** | | $t_{PLH}$ ($t_{PHL}$) | 3 µs typ. | $V_{CC}$ = 4.5 to 16 V, $I_F$ = 15 mA, $I_{OL}$ = 16 mA (see note 3) |
| **Response delay time** | | $t_{PHL}$ ($t_{PLH}$) | 20 µs typ. | $V_{CC}$ = 4.5 to 16 V, $I_F$ = 15 mA, $I_{OL}$ = 16 mA (see note 3) |

**Note:** 1. Hysteresis denotes the difference in forward LED current value, expressed in percentage, calculated from the respective forward LED currents when the photo IC 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.

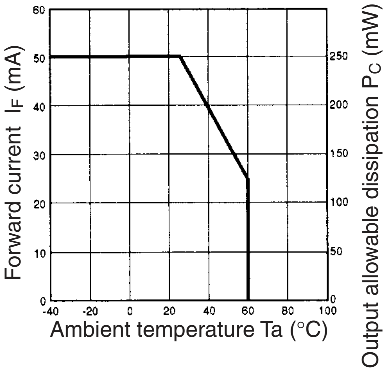



3. The following illustrations show the definition of response delay time.

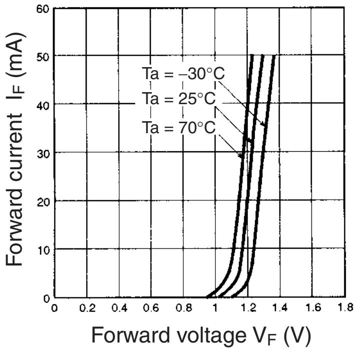



## ■ Engineering Data

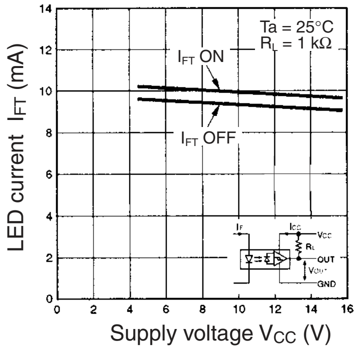
### Forward Current vs. Collector Dissipation Temperature Rating



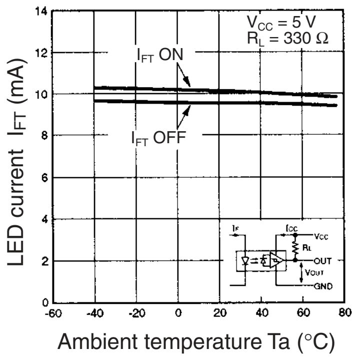

### Forward Current vs. Forward Voltage Characteristics (Typical)



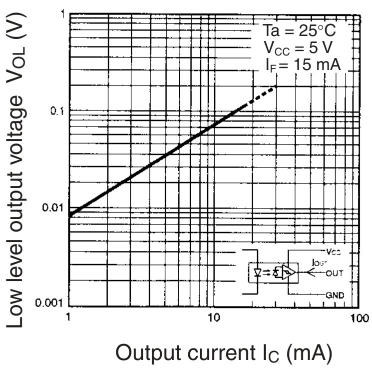

### LED Current vs. Supply Voltage (Typical)



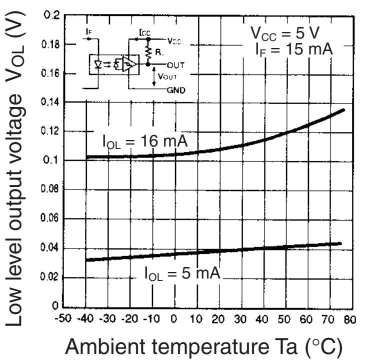

### LED Current vs. Ambient Temperature Characteristics (Typical)



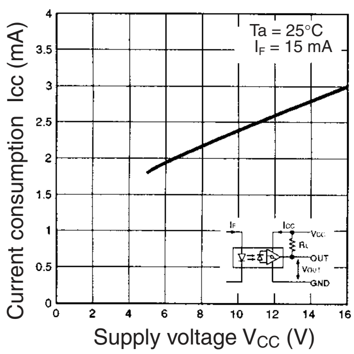

### Low-level Output Voltage vs. Output Current (Typical)



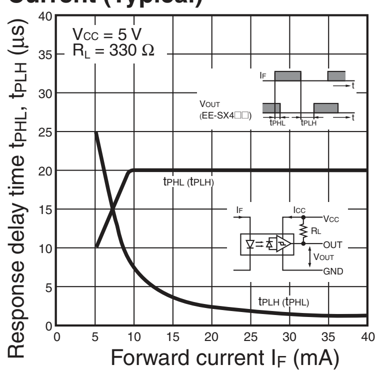

### Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



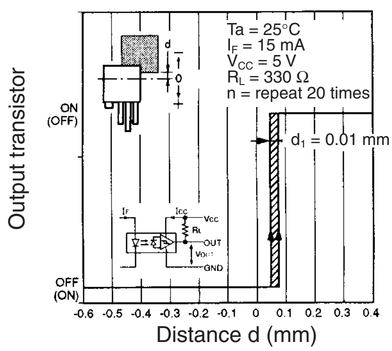

### Current Consumption vs. Supply Voltage (Typical)




### Response Delay Time vs. Forward Current (Typical)




### Repeat Sensing Position Characteristics (Typical)

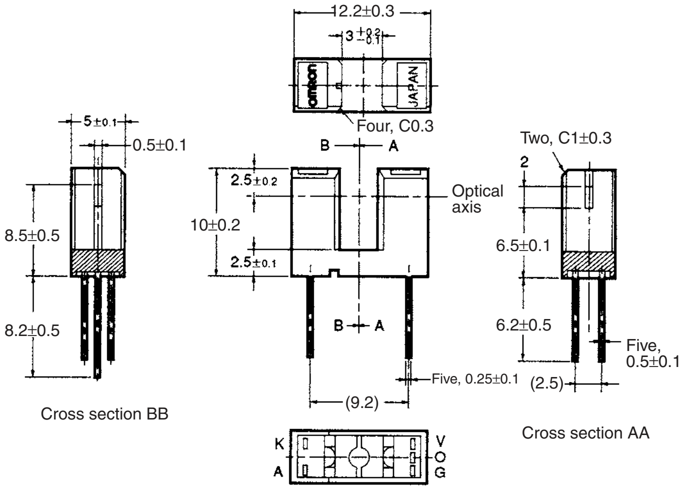


# Photomicrosensor (Transmissive)
# EE-SX398/498

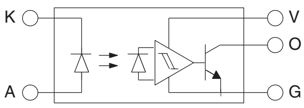
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ Absolute Maximum Ratings (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.

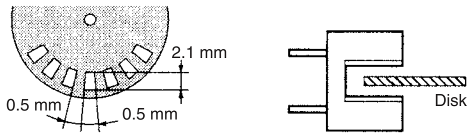
**2.** Complete soldering within 10 seconds.

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

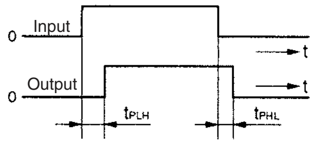
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| Emitter | Forward voltage | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 20 mA |
| | Reverse current | $I_R$ | 0.01 µA typ., 10 µA max. | $V_R$ = 4 V |
| | Peak emission wavelength | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| Detector | Low-level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

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

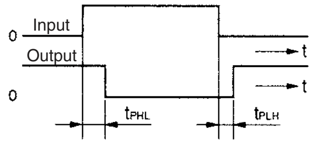
2. The value of the response frequency is measured by rotating the disk as shown below.




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




**EE-SX398**

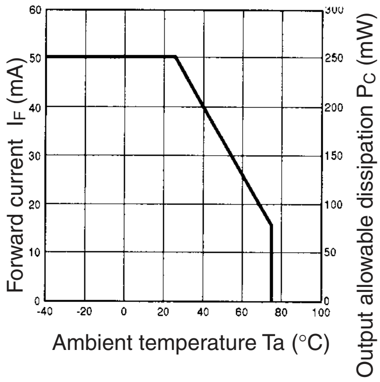



**EE-SX498**

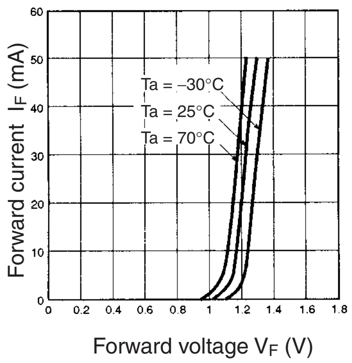
## ■ Engineering Data

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

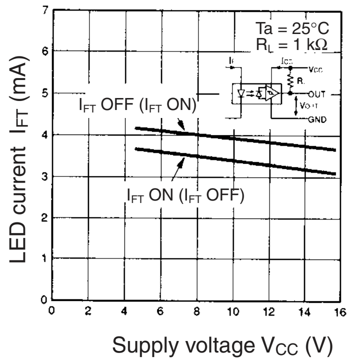
### Forward Current vs. Collector Dissipation Temperature Rating



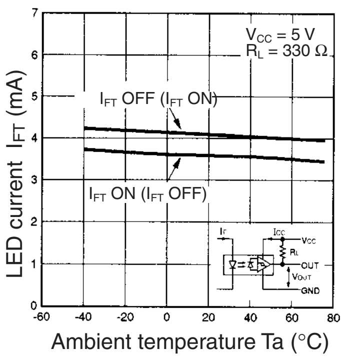

### Forward Current vs. Forward Voltage Characteristics (Typical)



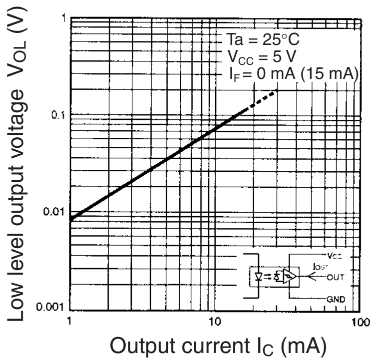

### LED Current vs. Supply Voltage (Typical)



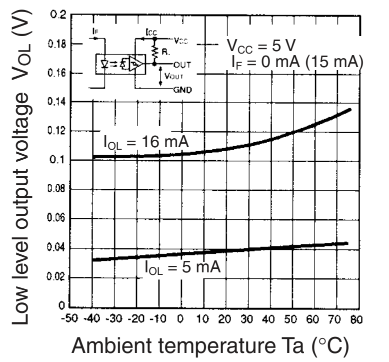

### LED Current vs. Ambient Temperature Characteristics (Typical)



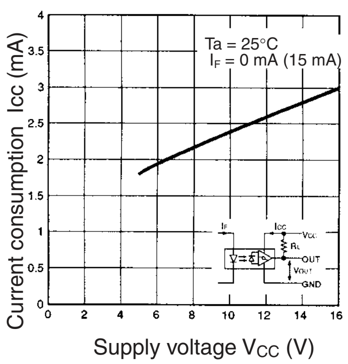

### Low-level Output Voltage vs. Output Current (Typical)



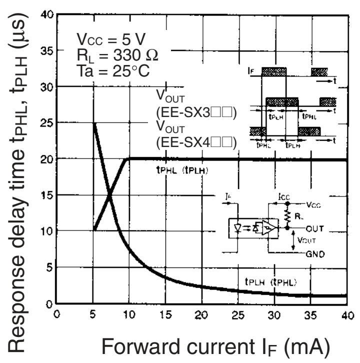

### Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



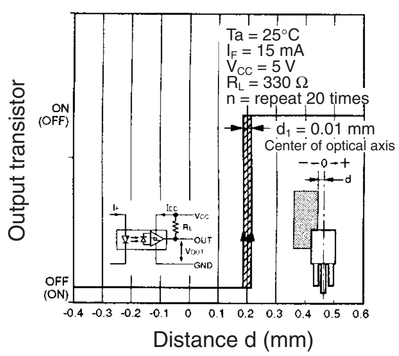

### Current Consumption vs. Supply Voltage (Typical)




### Response Delay Time vs. Forward Current (Typical)




### Repeat Sensing Position Characteristics (Typical)

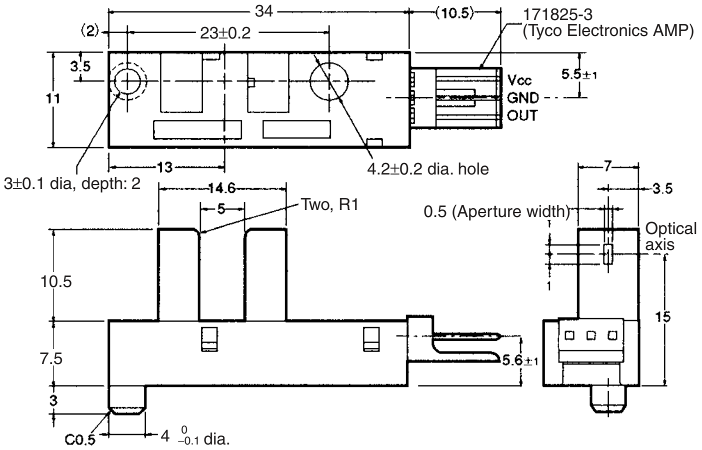


# Photomicrosensor (Transmissive)
# EE-SX3009-P1/-SX4009-P1

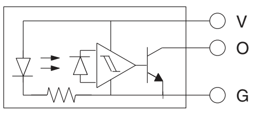
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

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

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

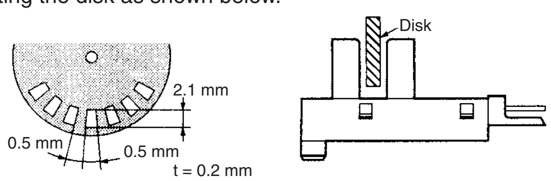
| Item | | Symbol | Rated value |
|---|---|---|---|
| **Power supply voltage** | | $V_{CC}$ | 10 V |
| **Output voltage** | | $V_{OUT}$ | 28 V |
| **Output current** | | $I_{OUT}$ | 16 mA |
| **Permissible output dissipation** | | $P_{OUT}$ | 250 mW (see note) |
| **Ambient temperature** | **Operating** | 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<br>Without incident (EE-SX3009-P1)<br>With incident (EE-SX4009-P1) |
| **High-level output voltage** | $V_{OH}$ | ($V_{CC}$ x 0.9) V min. | $V_{OUT} = V_{CC}$<br>With incident (EE-SX3009-P1)<br>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) |

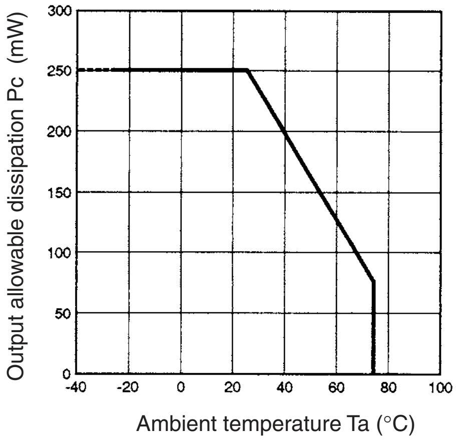
**Note:** The value of the response frequency is measured by rotating the disk as shown below.



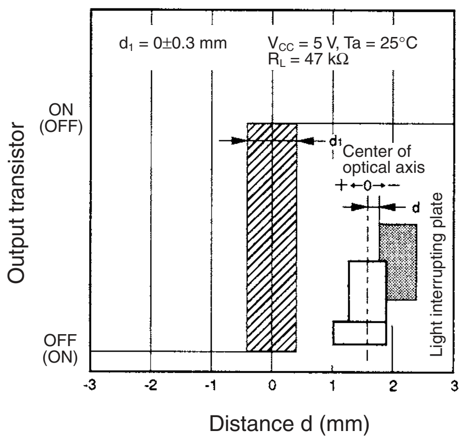
## ■ Engineering Data

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

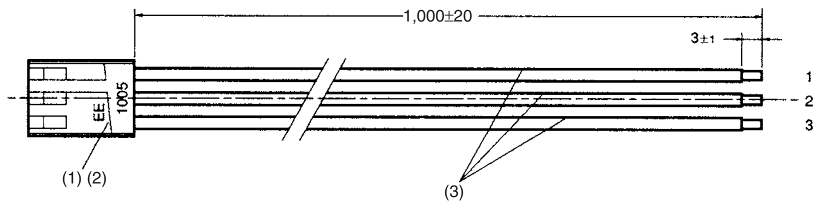
### Output Allowable Dissipation vs. Ambient Temperature Characteristics




### Sensing Position Characteristics (Typical)




### EE-1005 Connector




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

## Wiring

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

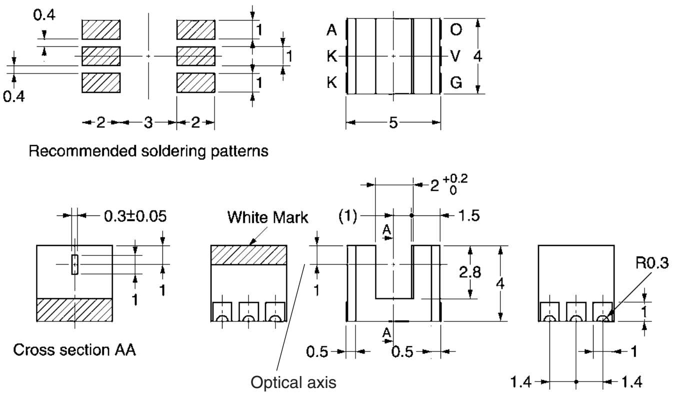
OMRON

# Photomicrosensor (Transmissive)
# EE-SX4134

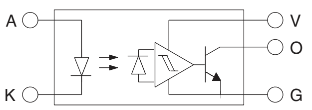
⚠ Be sure to read *Precautions* on page 25.

## ■ Dimensions

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




### Internal Circuit




Unless otherwise specified, the tolerances are ±0.15 mm.

| Terminal No. | Name |
|---|---|
| A | Anode |
| K | Cathode |
| V | Supply voltage (Vcc) |
| O | Output (OUT) |
| G | Ground (GND) |

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

| Item | | Symbol | Rated value |
|---|---|---|---|
| **Emitter** | **Forward current** | $I_F$ | 25 mA (see note 1) |
| | **Reverse voltage** | $V_R$ | 5 V |
| **Detector** | **Supply voltage** | $V_{CC}$ | 9 V |
| | **Output voltage** | $V_{OUT}$ | 17 V |
| | **Output current** | $I_{OUT}$ | 8 mA |
| | **Permissible output dissipation** | $P_{OUT}$ | 80 mW (see note 1) |
| **Ambient temperature** | **Operating** | Topr | –25°C to 85°C |
| | **Storage** | Tstg | –40°C to 90°C |
| | **Reflow soldering** | Tsol | 255°C (see note 2) |
| | **Manual soldering** | Tsol | 350°C (see note 2) |

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

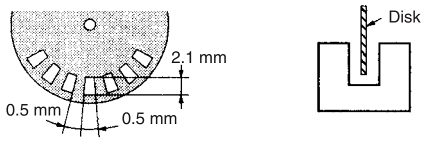
**2.** Complete soldering within 10 seconds for reflow soldering and within 3 seconds for manual soldering.

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

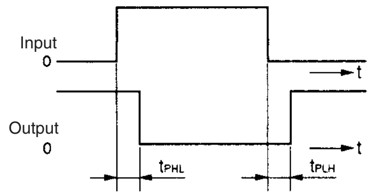
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.4 V max. | $I_F$ = 20 mA |
| | **Reverse current** | $I_R$ | 0.01 µA typ., 10 µA max. | $V_R$ = 5 V |
| | **Peak emission wave-length** | $\lambda_P$ | 940 nm typ. | $I_F$ = 20 mA |
| **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. | Vcc = 2.2 to 7 V, $I_{OL}$ = 8 mA, $I_F$ = 7 mA |
| | **High-level output current** | $I_{OH}$ | 10 µA max. | Vcc = 2.2 to 7 V, $I_F$ = 0 mA, $V_{OUT}$ = 17 V |
| | **Current consumption** | $I_{CC}$ | 2.8 mA typ., 4 mA max. | Vcc = 7 V |
| | **Peak spectral sensitivity wavelength** | $\lambda_P$ | 870 mm typ. | Vcc = 2.2 to 7 V |
| **LED current when output is ON** | | $I_{FT}$ | 2.0 mA typ., 3.5 mA max. | $V_{CC}$ = 2.2 to 7 V |
| **Hysteresis** | | ΔH | 21% typ. | $V_{CC}$ = 2.2 to 7 V (see note 1) |
| **Response frequency** | | f | 3 kHz min. | $V_{CC}$ = 2.2 to 7 V, $I_F$ = 5 mA, $I_{OL}$ = 8 mA (see note 2) |
| **Response delay time** | | $t_{PHL}$ | 7 µs typ. | $V_{CC}$ = 2.2 to 7 V, $I_F$ = 5 mA, $I_{OL}$ = 8 mA (see note 3) |
| **Response delay time** | | $t_{PLH}$ | 18 µs typ. | $V_{CC}$ = 2.2 to 7 V, $I_F$ = 5 mA, $I_{OL}$ = 8 mA (see note 3) |

**Note:** 1. Hysteresis denotes the difference in forward LED current value, expressed in percentage, calculated from the respective forward LED currents when the photo IC 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.

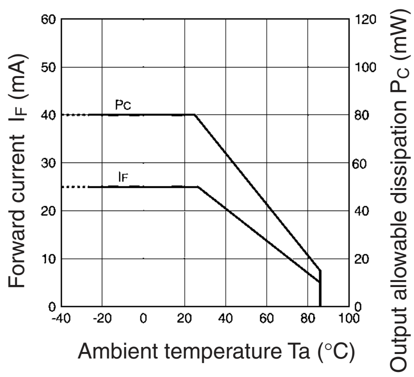



3. The following illustrations show the definition of response delay time.

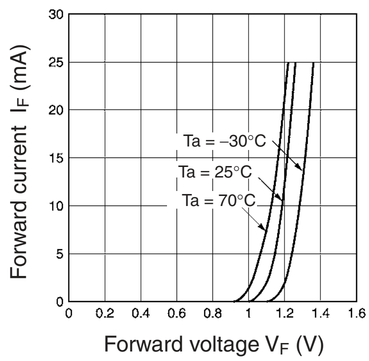



## ■ Engineering Data

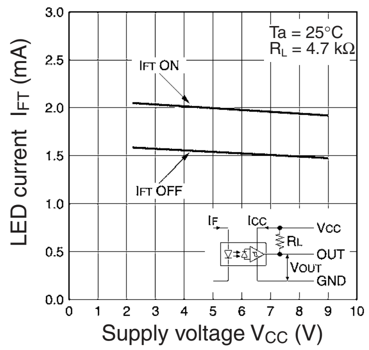
### Forward Current vs. Collector Dissipation Temperature Rating



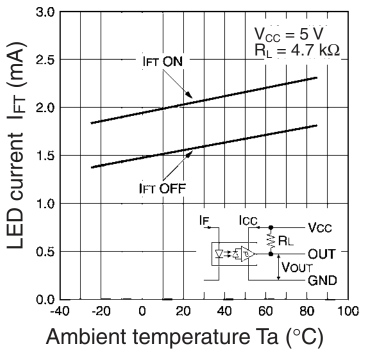

### Forward Current vs. Forward Voltage Characteristics (Typical)



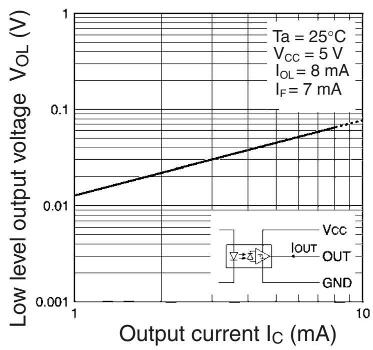

### LED Current vs. Supply Voltage (Typical)



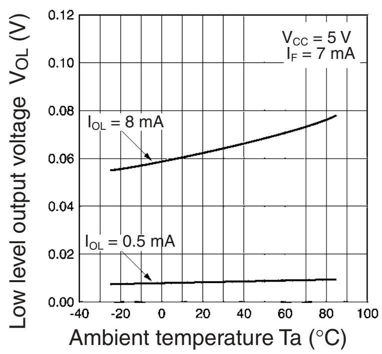

### LED Current vs. Ambient Temperature Characteristics (Typical)



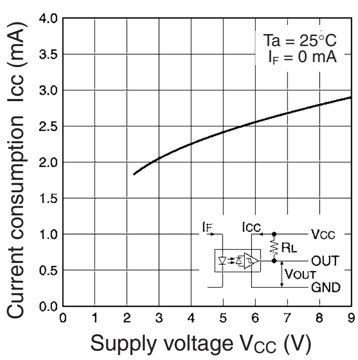

### Low-level Output Voltage vs. Output Current (Typical)



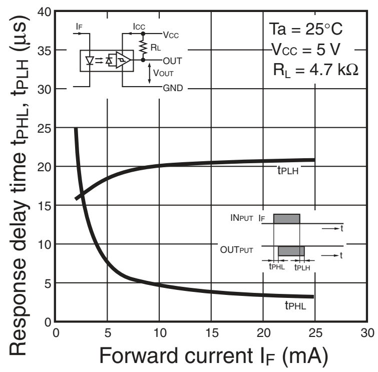

### Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



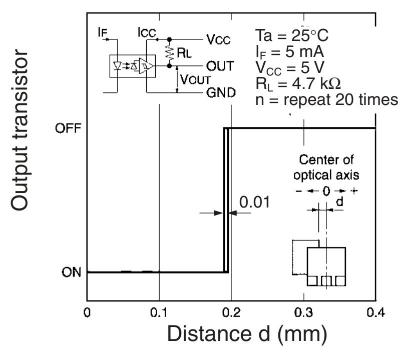

### Current Consumption vs. Supply Voltage (Typical)




### Response Delay Time vs. Forward Current (Typical)



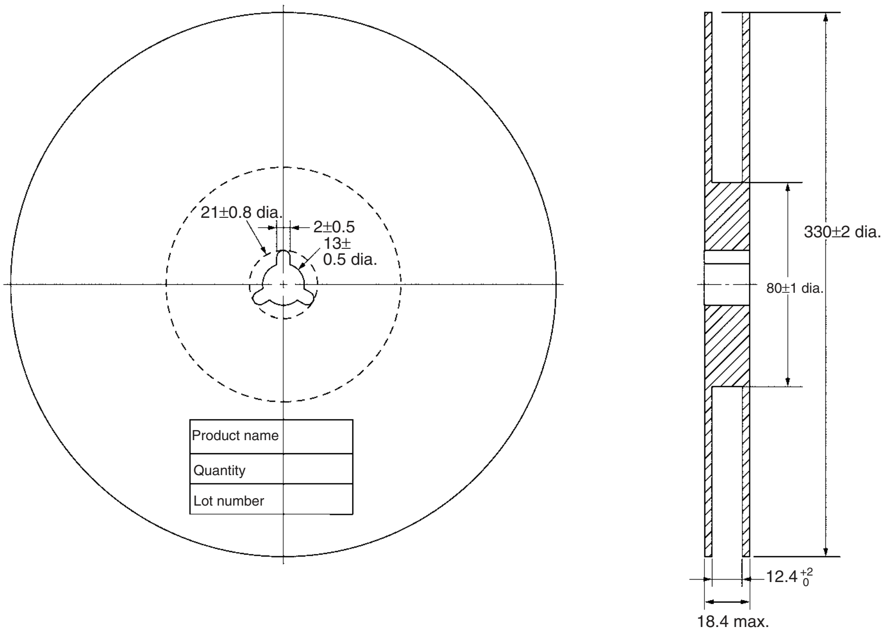

### Repeat Sensing Position Characteristics (Typical)



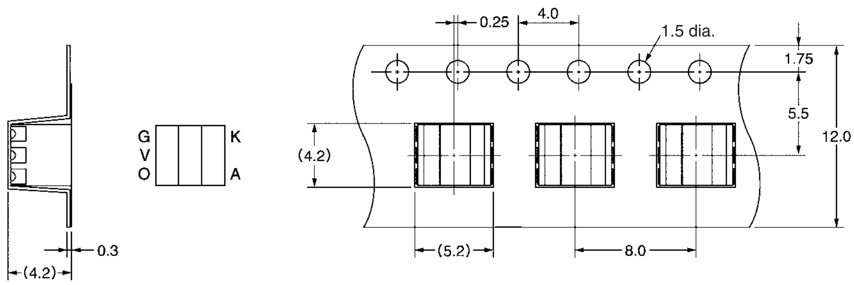
Unit: mm (inch)

## ■ Tape and Reel

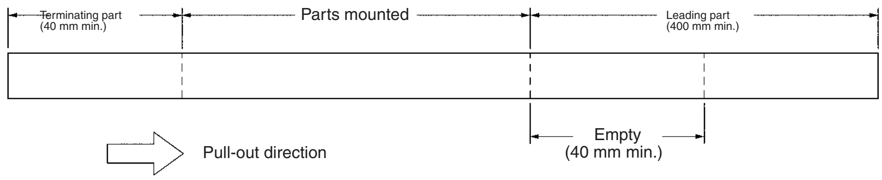
### Reel




### Tape




### Tape configuration




### Tape quantity

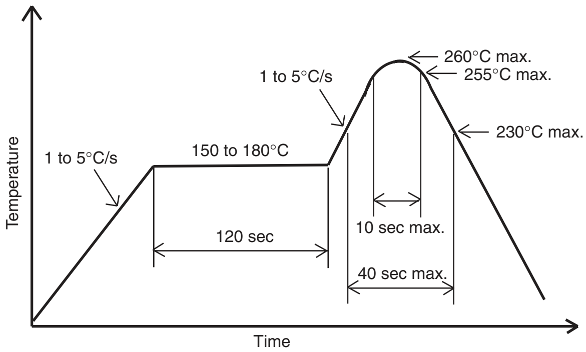
2,000 pcs./reel

# Precautions

## ■ Soldering Information

### Reflow soldering

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




### Manual soldering

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

### Storage

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

Temperature: 10 to 30°C

Humidity: 60% max.

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

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

### Baking

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

Reel: 60°C for 24 hours or more

Bulk: 80°C for 4 hours or more

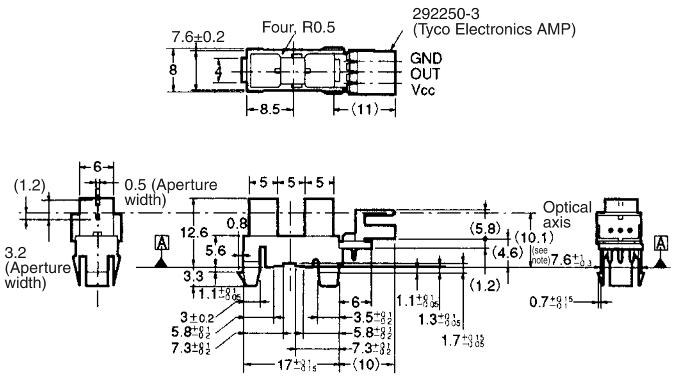
## Photomicrosensor (Transmissive)

# EE-SX4235A-P2

⚠ **Be sure to read *Precautions* on page 25.**

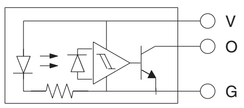
## ■ Dimensions

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




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

**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

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

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

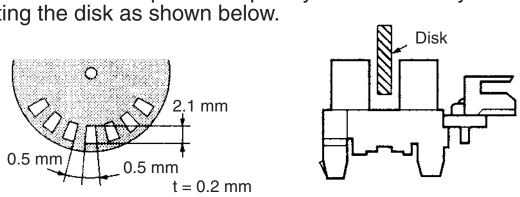
| Item | | Symbol | Rated value |
|---|---|---|---|
| Power supply voltage | | $V_{CC}$ | 7 V |
| Output voltage | | $V_{OUT}$ | 28 V |
| Output current | | $I_{OUT}$ | 16 mA |
| Permissible output dissipation | | $P_{OUT}$ | 250 mW (see note) |
| Ambient temperature | Operating | Topr | –25°C to 75°C |
| | 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, $V_{CC}$ = 5 V ±10%)

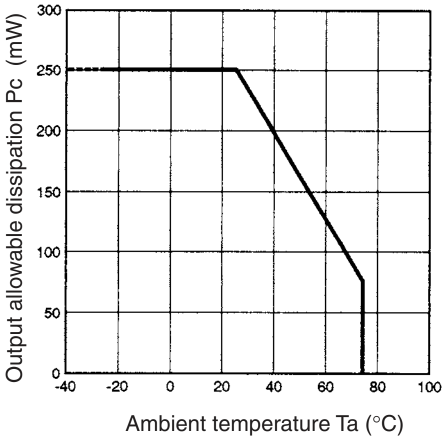
| Item | Symbol | Value | Condition |
|---|---|---|---|
| **Current consumption** | $I_{CC}$ | 16.5 mA max. | With and without incident |
| **Low-level output voltage** | $V_{OL}$ | 0.35 V max. | $I_{OUT}$ = 16 mA with incident |
| **High-level output voltage** | $V_{OH}$ | ($V_{CC}$ x 0.9) V min. | $V_{OUT}$ = $V_{CC}$ 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.

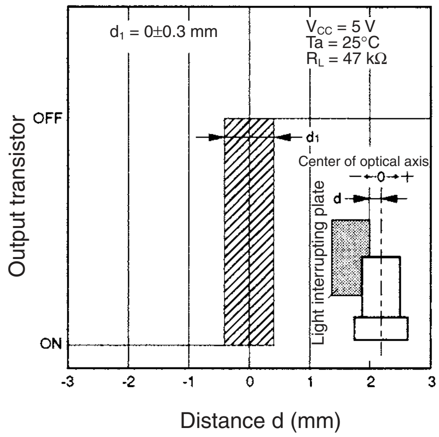


## ■ Engineering Data

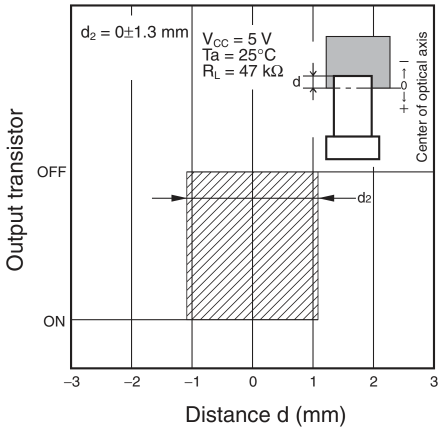
### Output Allowable Dissipation vs. Ambient Temperature Characteristics



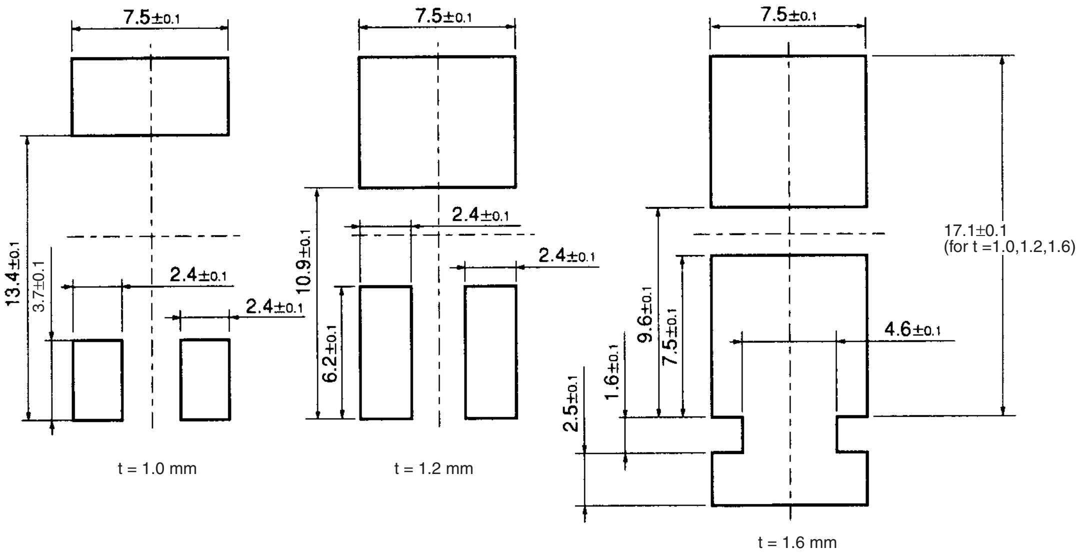

### Sensing Position Characteristics (Typical)




### Sensing Position Characteristics (Typical)




## ■ Recommended Mounting Holes



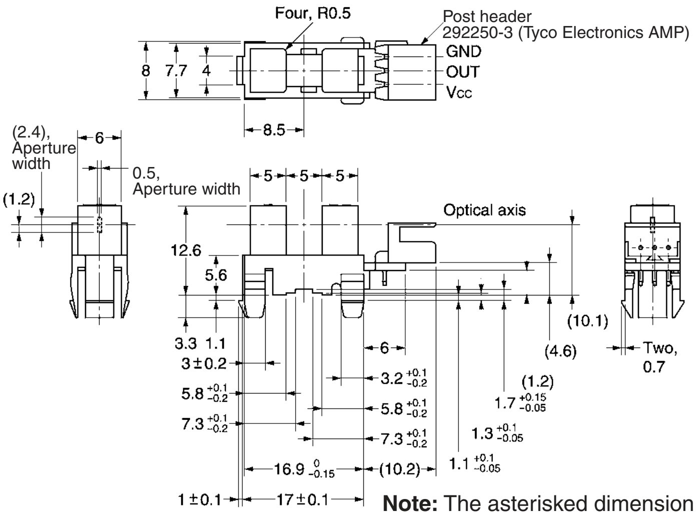

- When mounting the Photomicrosensor to a panel with a hole opened by pressing, make sure that the hole has no burrs. The mounting strength of the Photomicrosensor will decrease if the hole has burrs.
- When mounting the Photomicrosensor to a panel with a hole opened by pressing, be sure to mount the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

# Photomicrosensor (Transmissive)
# EEE-SX3239-P2

⚠ Be sure to read *Precautions* on page 25.

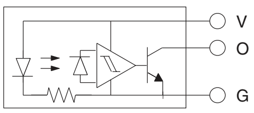
## ■ Dimensions

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




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

**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

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

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

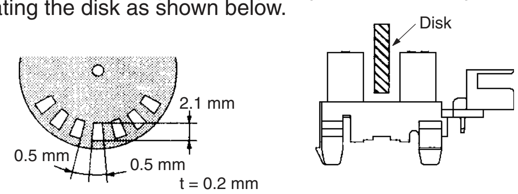
| Item | | Symbol | Rated value |
|---|---|---|---|
| **Power supply voltage** | | $V_{CC}$ | 7 V |
| **Output voltage** | | $V_{OUT}$ | 28 V |
| **Output current** | | $I_{OUT}$ | 16 mA |
| **Permissible output dissipation** | | $P_{OUT}$ | 250 mW (see note) |
| **Ambient temperature** | **Operating** | 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%)

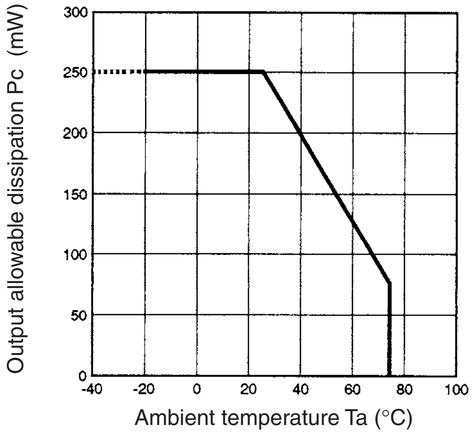
| Item | Symbol | Value | Condition |
|---|---|---|---|
| **Current consumption** | $I_{CC}$ | 16.5 mA max. | With and without incident |
| **Low-level output voltage** | $V_{OL}$ | 0.35 V max. | $I_{OUT}$ = 16 mA<br>without incident (EE-SX3239-P2) |
| **High-level output voltage** | $V_{OH}$ | ($V_{CC}$ x 0.9) V min. | $V_{OUT}$ = $V_{CC}$ with incident (EE-SX3239-P2),<br>$R_L$ = 47 kΩ |
| **Response frequency** | f | 3 kHz min. | $V_{OUT}$ = $V_{CC}$, $R_L$ = 47 kΩ (see note) |

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

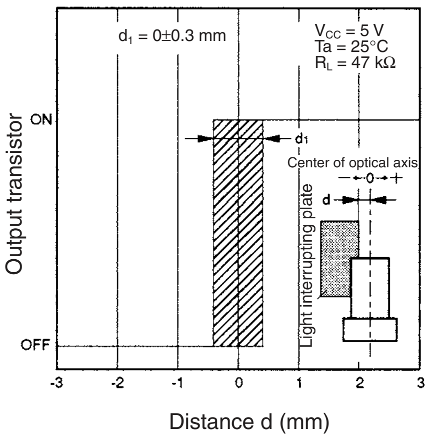


## ■ Engineering Data

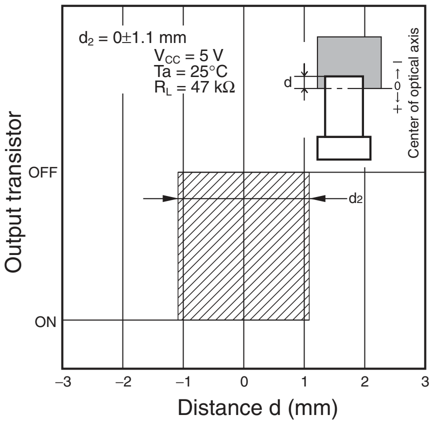
### Output Allowable Dissipation vs. Ambient Temperature Characteristics



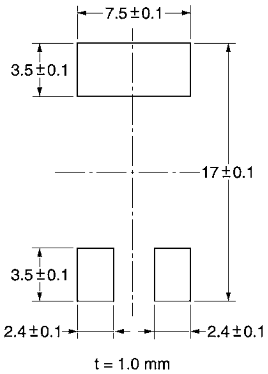

### Sensing Position Characteristics (Typical)

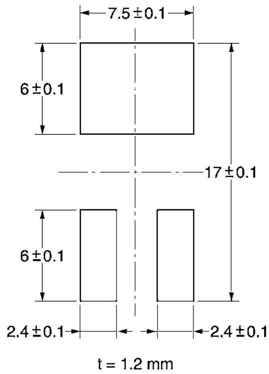


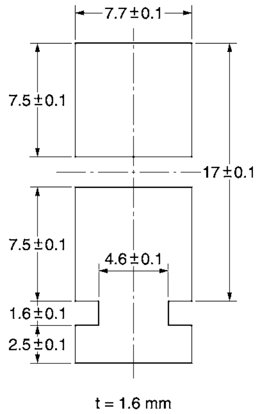

### Sensing Position Characteristics (Typical)




## ■ Recommended Mounting Holes



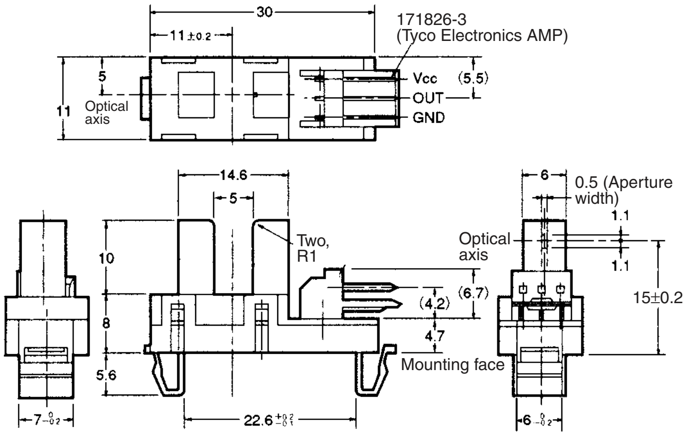

- When mounting the Photomicrosensor to a panel with a hole opened by pressing, make sure that the hole has no burrs. The mounting strength of the Photomicrosensor will decrease if the hole has burrs.
- When mounting the Photomicrosensor to a panel with a hole opened by pressing, be sure to mount the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

# Photomicrosensor (Transmissive)
# EE-SX460-P1

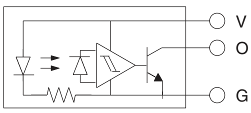
⚠ Be sure to read *Precautions* on page 25.

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

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

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

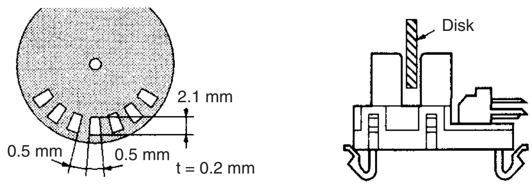
| Item | | Symbol | Rated value |
|---|---|---|---|
| **Power supply voltage** | | $V_{CC}$ | 10 V |
| **Output voltage** | | $V_{OUT}$ | 28 V |
| **Output current** | | $I_{OUT}$ | 16 mA |
| **Permissible output dissipation** | | $P_{OUT}$ | 250 mW (see note) |
| **Ambient temperature** | **Operating** | Topr | –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%)

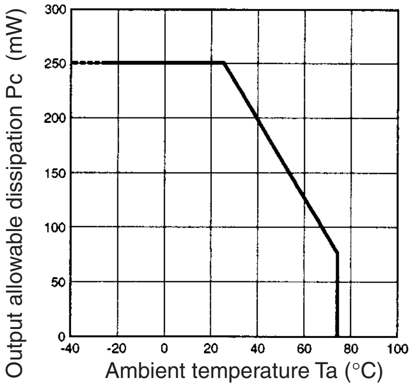
| Item | Symbol | Value | Condition |
|---|---|---|---|
| **Current consumption** | $I_{CC}$ | 30 mA max. | With and without incident |
| **Low-level output voltage** | $V_{OL}$ | 0.3 V max. | $I_{OUT}$ = 16 mA with incident |
| **High-level output voltage** | $V_{OH}$ | ($V_{CC}$ x 0.9) V min. | $V_{OUT}$ = $V_{CC}$ 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.

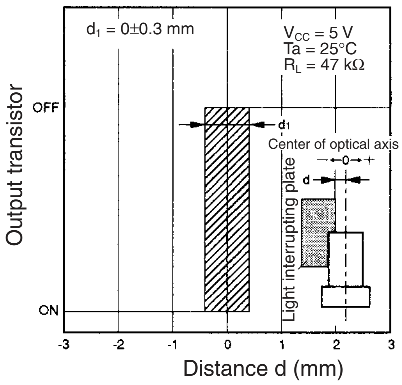


## ■ Engineering Data

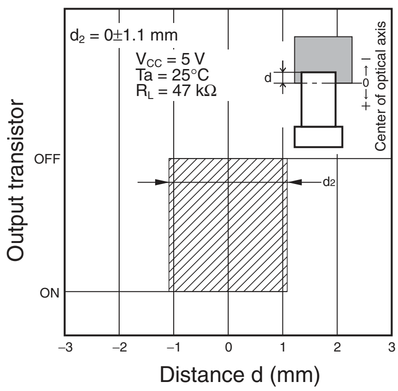
### Output Allowable Dissipation vs. Ambient Temperature Characteristics



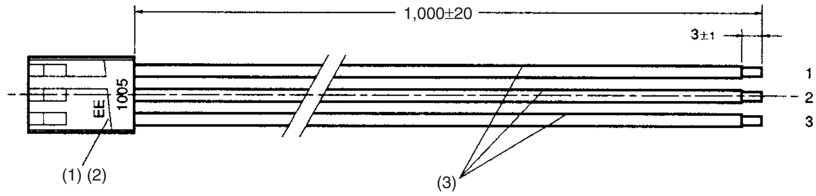

### Sensing Position Characteristics (Typical)




### Sensing Position Characteristics (Typical)




### EE-1005 Connector

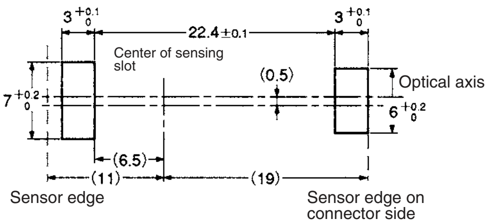



| No. | Name | Model | Quantity | Maker |
|---|---|---|---|---|
| 1 | Receptacle housing | 171822-3 | 1 | Tyco Electronics AMP |
| 2 | Receptacle contact | 170262-1 | 3 | Tyco Electronics AMP |
| 3 | Lead wire | UL1007 AWG24 | 3 | --- |

## Wiring

| Connector circuit no. | Lead wire color | Output when connected to EE-SX460-P1 |
|---|---|---|
| 1 | Red | $V_{CC}$ |
| 2 | Orange | OUT |
| 3 | Yellow | GND |

## ■ Recommended Mounting Hole Dimensions and Mounting and Dismounting Method




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

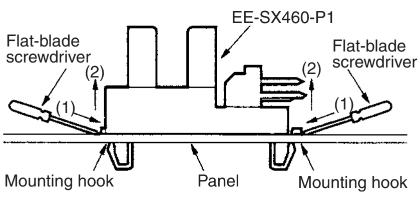
Refer to the above mounting hole dimensions and open the mounting holes in the panel to which the Photomicrosensor will be mounted.

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.

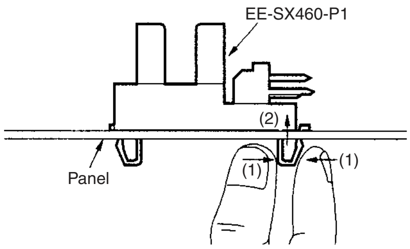
### Dismounting with Screwdriver

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



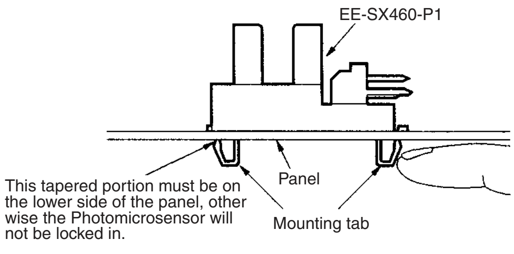

### Dismounting by Hand

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.

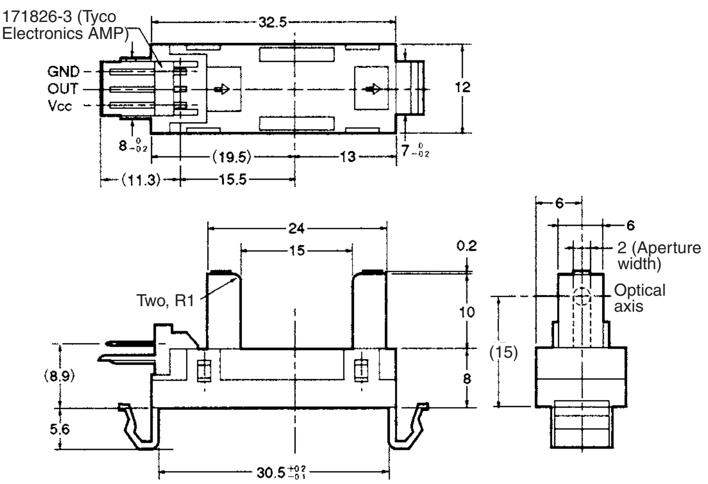


# Photomicrosensor (Transmissive)
# EE-SX461-P11

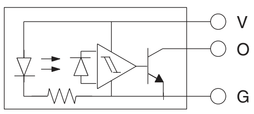
⚠ Be sure to read *Precautions* on page 25.

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

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

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

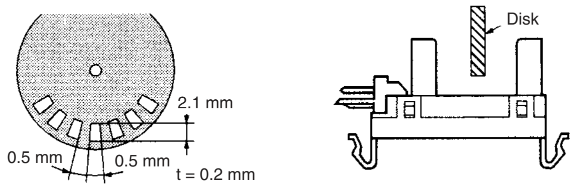
| Item | | Symbol | Rated value |
|---|---|---|---|
| **Power supply voltage** | | $V_{CC}$ | 7 V |
| **Output voltage** | | $V_{OUT}$ | 28 V |
| **Output current** | | $I_{OUT}$ | 16 mA |
| **Permissible output dissipation** | | $P_{OUT}$ | 250 mW (see note) |
| **Ambient temperature** | **Operating** | 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%)

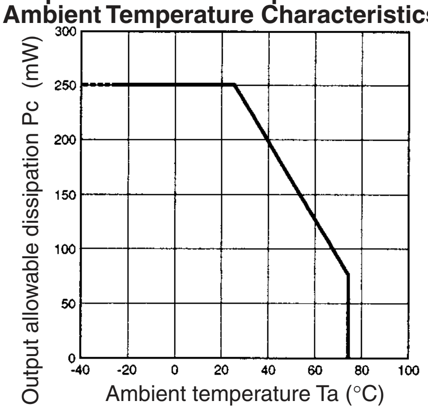
| Item | Symbol | Value | Condition |
|---|---|---|---|
| **Current consumption** | $I_{CC}$ | 35 mA max. | With and without incident |
| **Low-level output voltage** | $V_{OL}$ | 0.3 V max. | $I_{OUT}$ = 16 mA with incident |
| **High-level output voltage** | $V_{OH}$ | ($V_{CC}$ x 0.9) V min. | $V_{OUT} = V_{CC}$ 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.

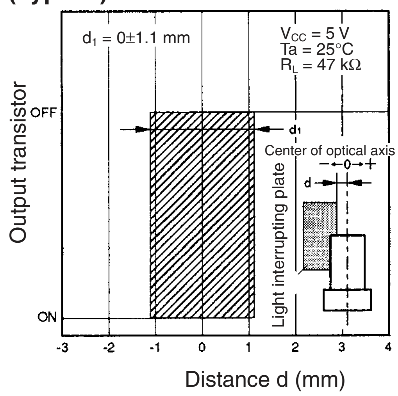


## ■ Engineering Data

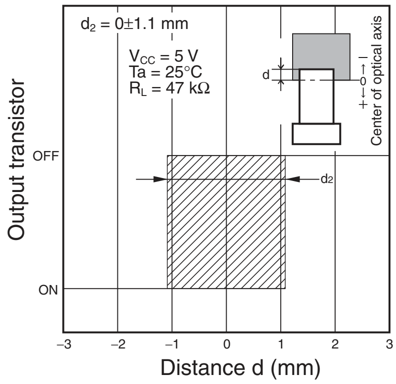
### Output Allowable Dissipation vs. Ambient Temperature Characteristics



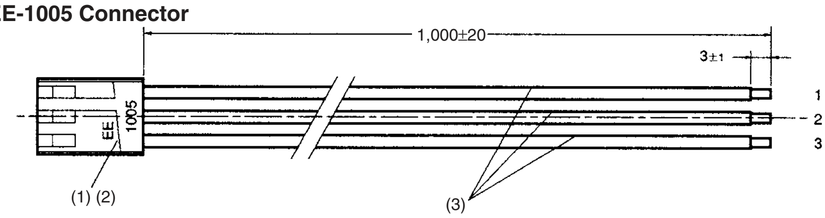

### Sensing Position Characteristics (Typical)




### Sensing Position Characteristics (Typical)




### EE-1005 Connector

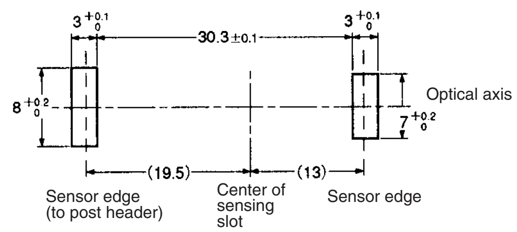



| No. | Name | Model | Quantity | Maker |
|---|---|---|---|---|
| 1 | Receptacle housing | 171822-3 | 1 | Tyco Electronics AMP |
| 2 | Receptacle contact | 170262-1 | 3 | Tyco Electronics AMP |
| 3 | Lead wire | UL1007 AWG24 | 3 | --- |

## Wiring

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

## ■ Recommended Mounting Hole Dimensions and Mounting and Dismounting Method




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

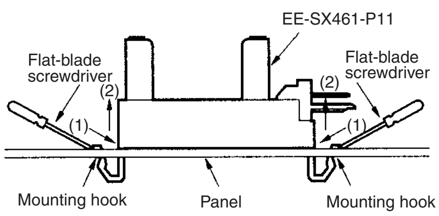
Refer to the above mounting hole dimensions and open the mounting holes in the panel to which the Photomicrosensor will be mounted.

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.

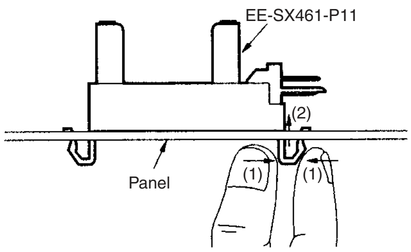
### Dismounting with Screwdriver

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



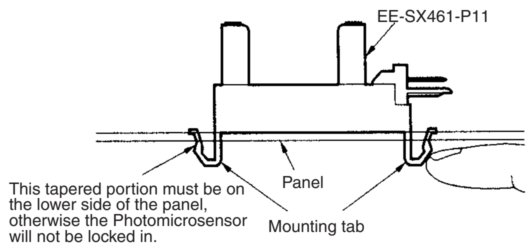

### Dismounting by Hand

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.



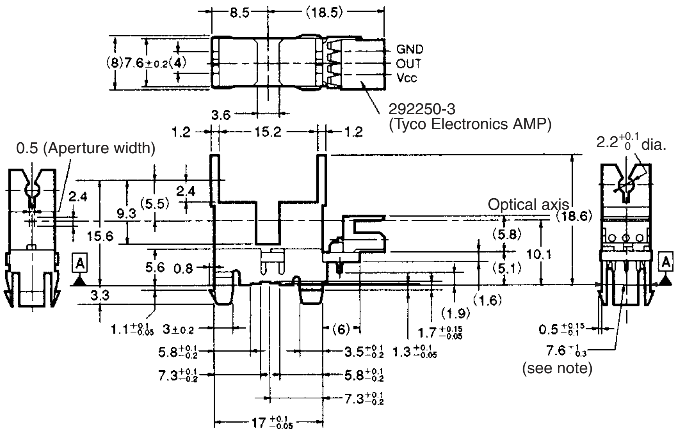
OMRON

# Photomicrosensor (Actuator Mounted)
# EE-SA407-P2

Be sure to read *Precautions* on page 25.

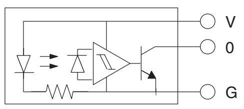
## ■ Dimensions

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




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

**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

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

## ■ Features

- An actuator can be attached.
- Snap-in mounting model.
- Mounts to 1.0-, 1.2- and 1.6-mm-thick panels.
- High resolution with a 0.5-mm-wide sensing aperture.
- With a 3.6-mm-wide slot.
- Photo IC output signals directly connect with logic circuit and TTL.
- Connects to Tyco Electronics AMP's CT-series connectors.

## ■ Absolute Maximum Ratings (Ta = 25°C)

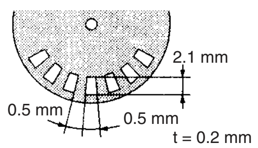
| Item | | Symbol | Rated value |
|---|---|---|---|
| **Power supply voltage** | | $V_{CC}$ | 7 V |
| **Output voltage** | | $V_{OUT}$ | 28 V |
| **Output current** | | $I_{OUT}$ | 16 mA |
| **Permissible output dissipation** | | $P_{OUT}$ | 250 mW (see note) |
| **Ambient temperature** | **Operating**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

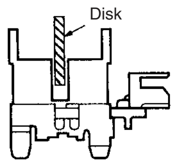
**Note:** Refer to the temperature rating chart if the ambient temperature exceeds 25°C.

## ■ Electrical and Optical Characteristics (Ta = 25°C, $V_{CC}$ = 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) |

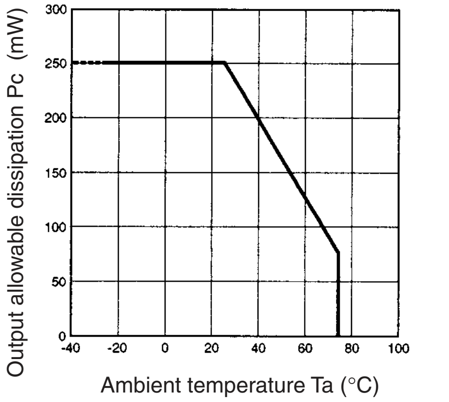
**Note:** The value of the response frequency is measured by rotating the disk as shown below.



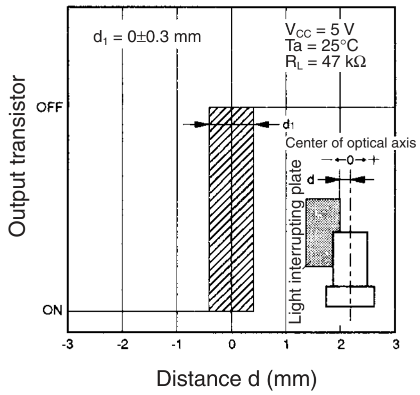



## ■ Engineering Data

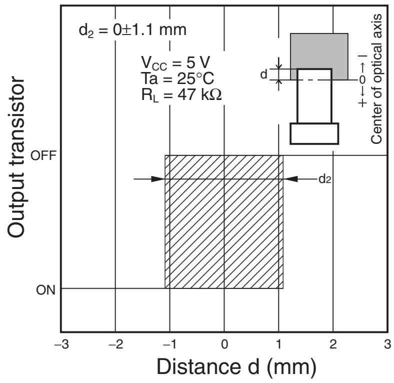
**Output Allowable Dissipation vs. Ambient Temperature Characteristics**



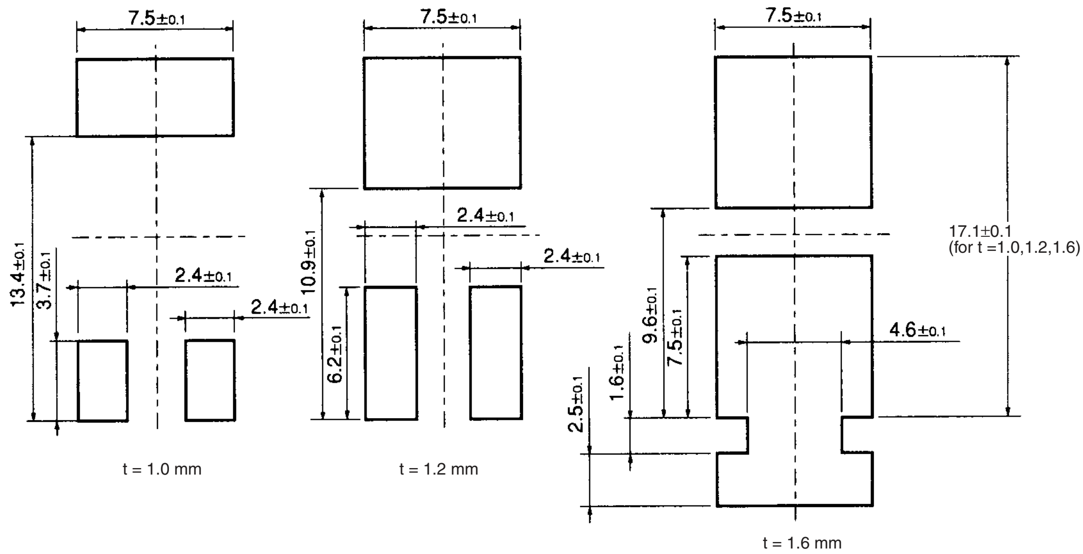

**Sensing Position Characteristics (Typical)**




**Sensing Position Characteristics (Typical)**

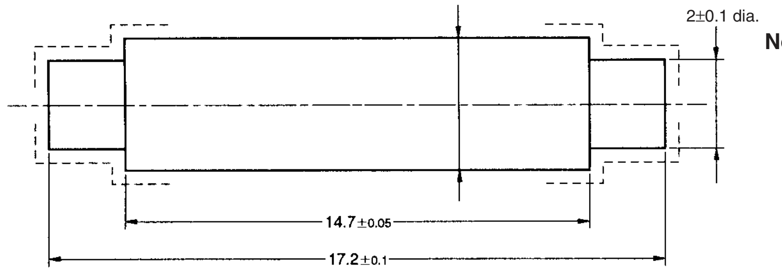



## ■ Recommended Mounting Holes




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

### Actuator Dimensions




**Note:**
1. Make sure that the portions marked with dotted lines have no burrs.
2. The material of the actuator must be selected by considering the infrared permeability of the actuator.

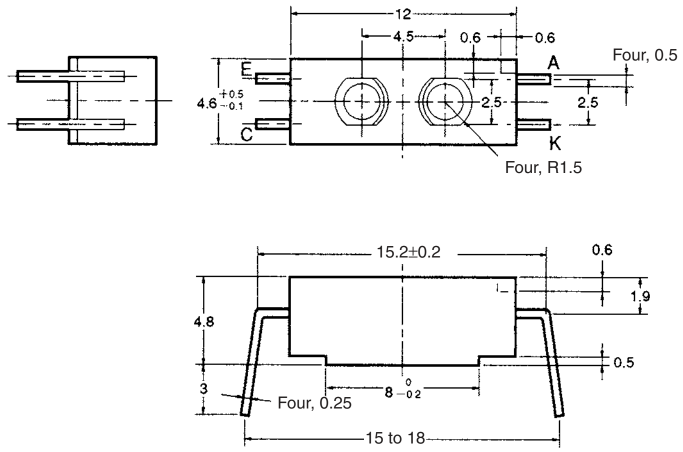
OMRON

# Photomicrosensor (Reflective)
# EE-SY110

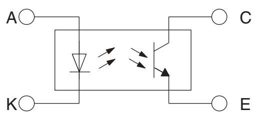
⚠ Be sure to read *Precautions* on page 25.

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

- Compact reflective model with a molded housing.

## ■ 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 100 Hz.

**3.** Complete soldering within 10 seconds.

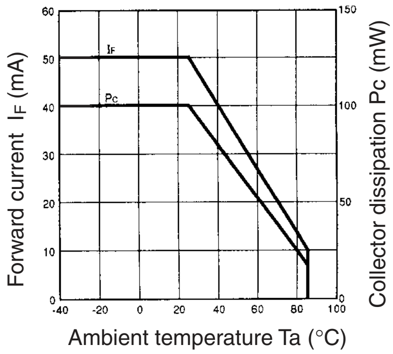
## ■ Electrical and Optical Characteristics (Ta = 25°C)

| 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** | $\lambda_P$ | 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** | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| **Rising time** | | tr | 30 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 1 kΩ, $I_L$ = 1 mA |
| **Falling time** | | tf | 30 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 1 kΩ, $I_L$ = 1 mA |

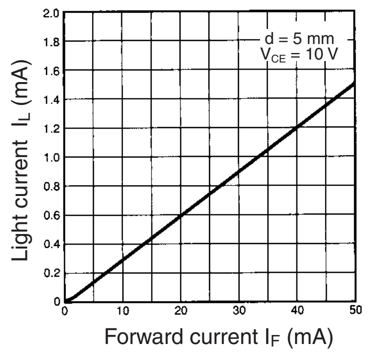
**Note:** The letter “d” indicates the distance between the top surface of the sensor and the sensing object.

## ■ Engineering Data

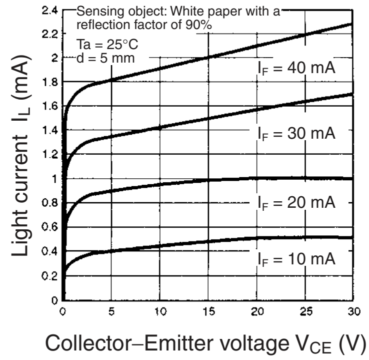
**Forward Current vs. Collector Dissipation Temperature Rating**



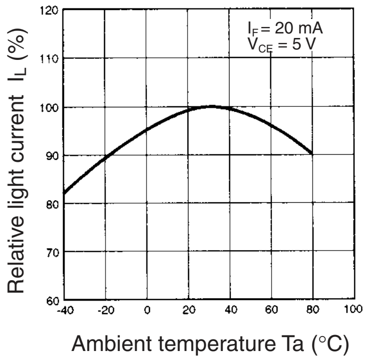

**Light Current vs. Forward Current Characteristics (Typical)**



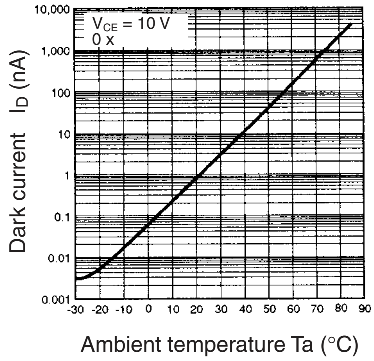

**Light Current vs. Collector−Emitter Voltage Characteristics (Typical)**



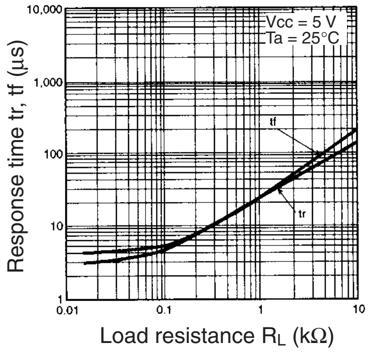

**Relative Light Current vs. Ambient Temperature Characteristics (Typical)**



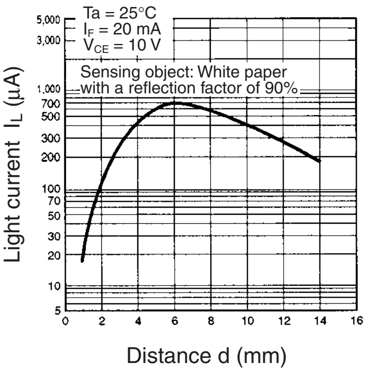

**Dark Current vs. Ambient Temperature Characteristics (Typical)**



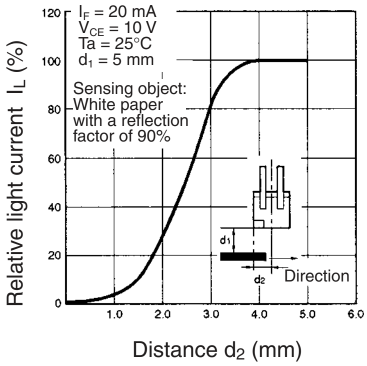

**Response Time vs. Load Resistance Characteristics (Typical)**



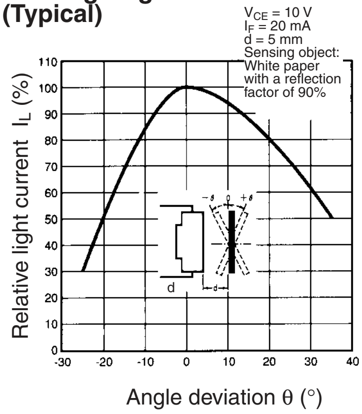

**Sensing Distance Characteristics (Typical)**



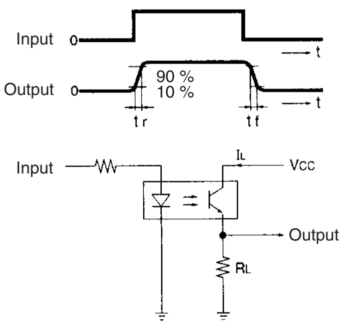

**Sensing Position Characteristics (Typical)**




**Sensing Angle Characteristics (Typical)**




**Response Time Measurement Circuit**

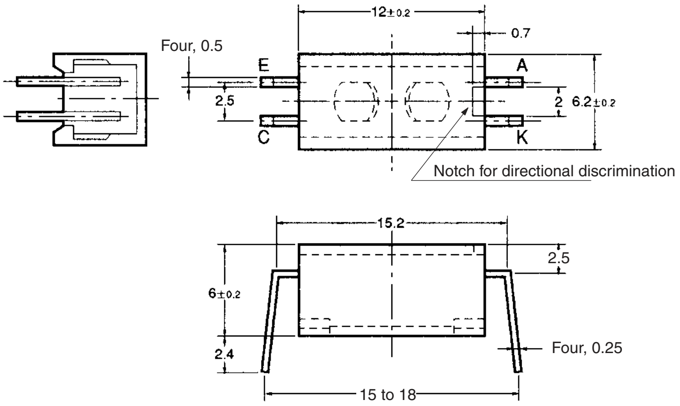


# Photomicrosensor (Reflective)
# EE-SY113

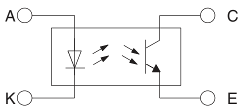
⚠ Be sure to read *Precautions* on page 25.

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

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

## ■ 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 100 Hz.

**3.** Complete soldering within 10 seconds.

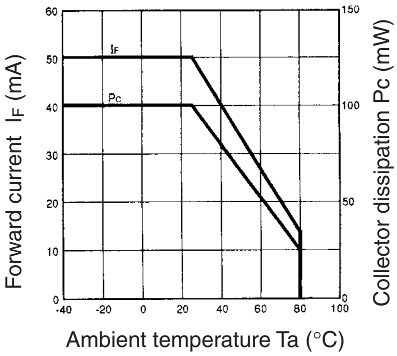
## ■ Electrical and Optical Characteristics (Ta = 25°C)

| 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** | $\lambda_P$ | 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** | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| **Rising time** | | tr | 30 µs typ. | $V_{CC}$ = 5 V, $R_L$ = 1 kΩ, $I_L$ = 1 mA |
| **Falling time** | | tf | 30 µs typ. | $V_{CC}$ = 5 V, $R_L$ = 1 kΩ, $I_L$ = 1 mA |

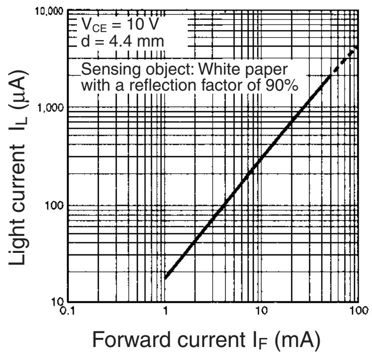
**Note:** The letter “d” indicates the distance between the top surface of the sensor and the sensing object.

## ■ Engineering Data

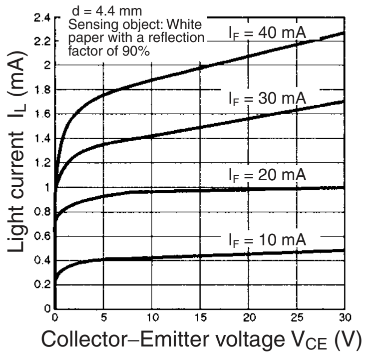
### Forward Current vs. Collector Dissipation Temperature Rating



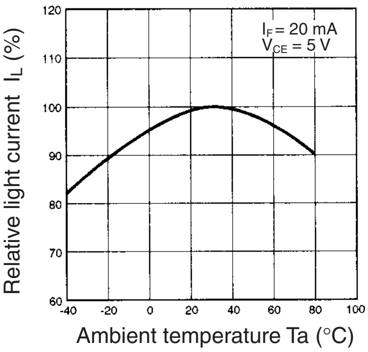

### Light Current vs. Forward Current Characteristics (Typical)



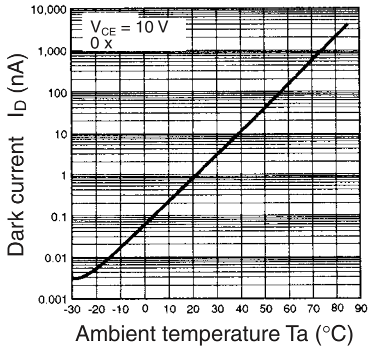

### Light Current vs. Collector−Emitter Voltage Characteristics (Typical)



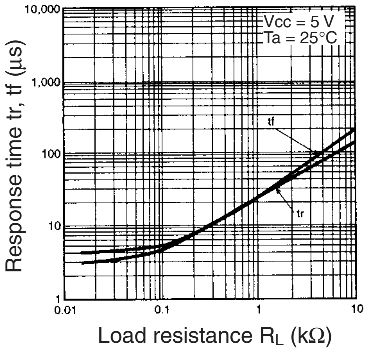

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



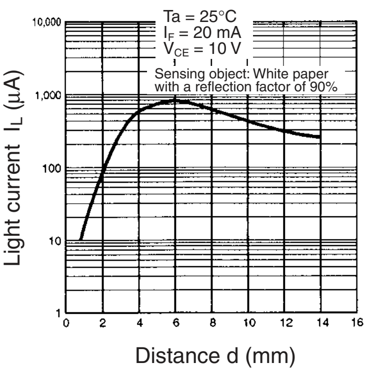

### Dark Current vs. Ambient Temperature Characteristics (Typical)



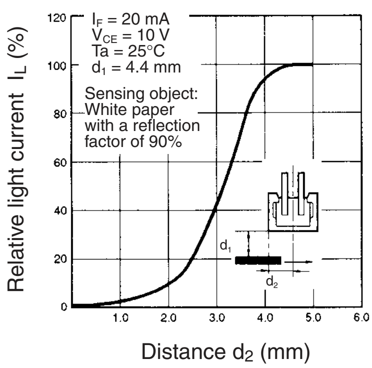

### Response Time vs. Load Resistance Characteristics (Typical)



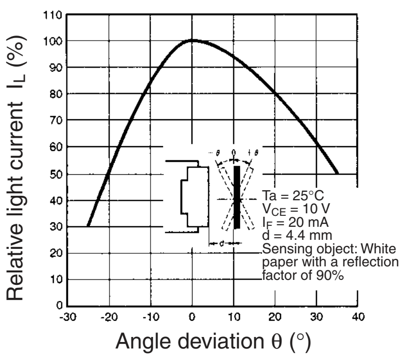

### Sensing Distance Characteristics (Typical)



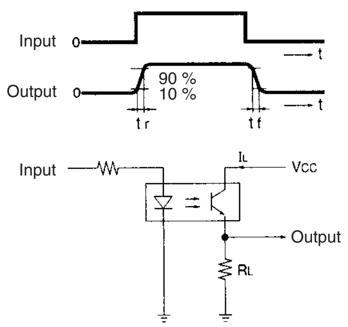

### Sensing Position Characteristics (Typical)




### Sensing Angle Characteristics (Typical)




### Response Time Measurement Circuit

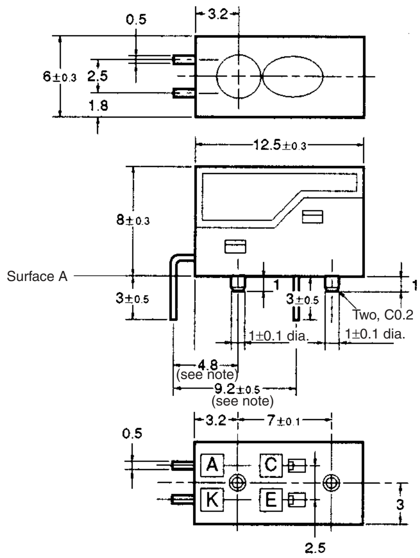


# Photomicrosensor (Reflective)
# EE-SY169

⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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

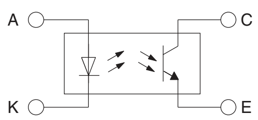



**Note:** These dimensions are for the surface A. Other lead wire pitch dimensions are for the housing surface.

Unless otherwise specified, the tolerances are as shown below.

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

**Internal Circuit**




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

## ■ Features

- High-quality model with plastic lenses.
- Highly precise sensing range with a tolerance of ±0.6 mm horizontally and vertically.
- With a red LED sensing dyestuff-type inks.
- Limited reflective model.
- For lesser LED forward current the EE-SY169B would be a better choice.

## ■ Absolute Maximum Ratings (Ta = 25°C)

| Item | | Symbol | Rated value |
|---|---|---|---|
| **Emitter** | **Forward current** | $I_F$ | 40 mA (see note 1) |
| | **Pulse forward current** | $I_{FP}$ | 300 mA (see note 2) |
| | **Reverse voltage** | $V_R$ | 3 V |
| **Detector** | **Collector–Emitter voltage** | $V_{CEO}$ | 30 V |
| | **Emitter–Collector voltage** | $V_{ECO}$ | --- |
| | **Collector current** | $I_C$ | 20 mA |
| | **Collector dissipation** | $P_C$ | 100 mW (see note 1) |
| **Ambient temperature** | **Operating** | 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 a frequency of 100 Hz.

**3.** Complete soldering within 10 seconds.

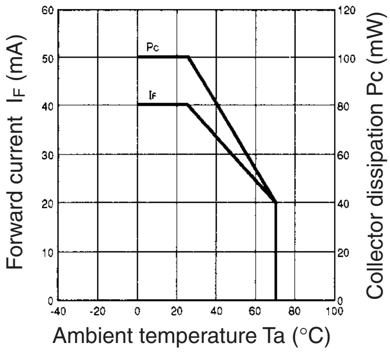
## ■ Electrical and Optical Characteristics (Ta = 25°C)

| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.85 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** | $\lambda_P$ | 660 nm typ. | $I_F$ = 20 mA |
| **Detector** | **Light current** | $I_L$ | 160 μA min., 2,000 μA max. | $I_F$ = 20 mA, $V_{CE}$ = 5 V<br>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** | $\lambda_P$ | 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 |

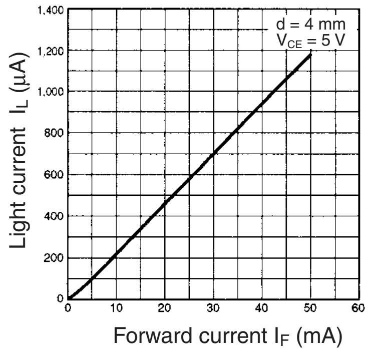
**Note:** The letter “d” indicates the distance between the top surface of the sensor and the sensing object.

## ■ Engineering Data

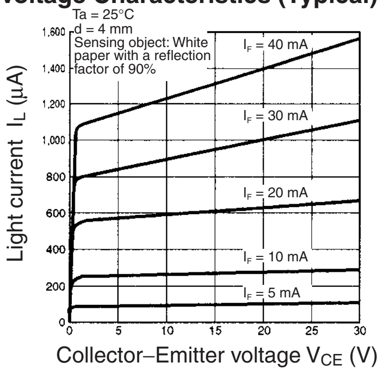
### Forward Current vs. Collector Dissipation Temperature Rating



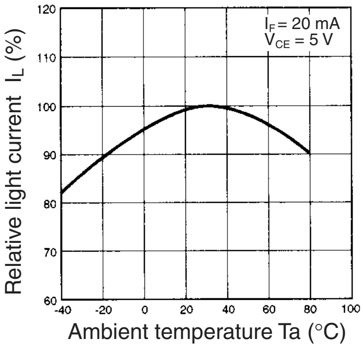

### Light Current vs. Forward Current Characteristics (Typical)



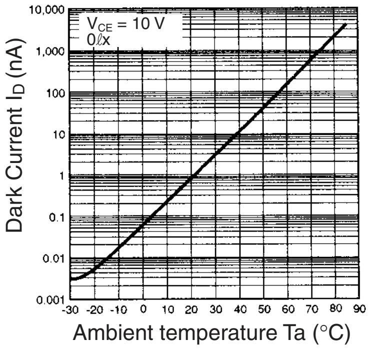

### Light Current vs. Collector−Emitter Voltage Characteristics (Typical)



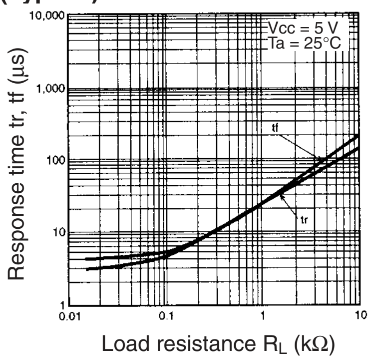

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



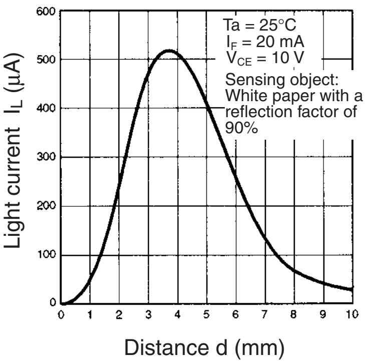

### Dark Current vs. Ambient Temperature Characteristics (Typical)



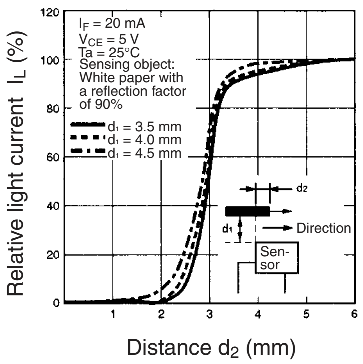

### Response Time vs. Load Resistance Characteristics (Typical)



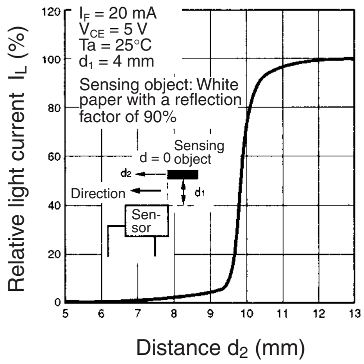

### Sensing Distance Characteristics (Typical)



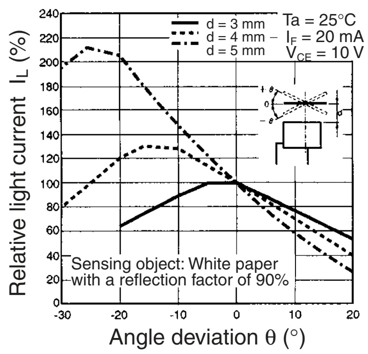

### Sensing Position Characteristics (Typical)



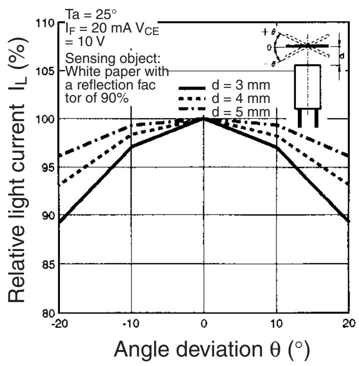

### Sensing Position Characteristics (Typical)



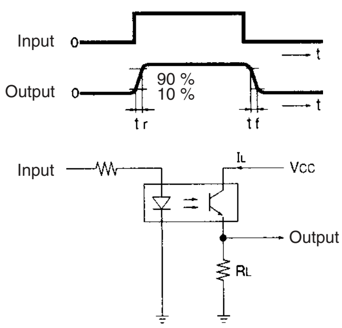

### Sensing Angle Characteristics (Typical)




### Sensing Angle Characteristics (Typical)




### Response Time Measurement Circuit



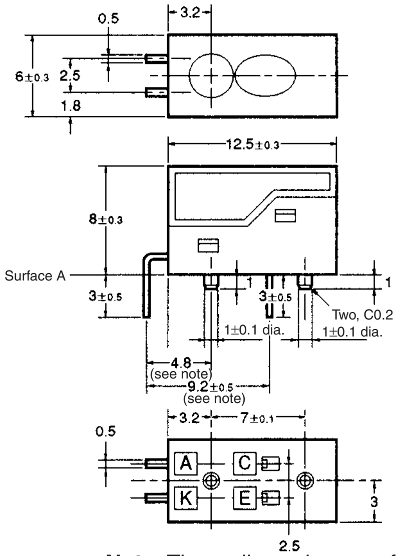
OMRON

# Photomicrosensor (Reflective)
# EE-SY169A

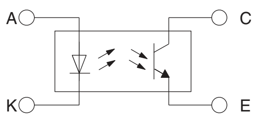
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




**Internal Circuit**




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

**Note:** These dimensions are for the surface A. Other lead wire pitch dimensions are for the housing surface.

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

- High-quality model with plastic lenses.
- Highly precise sensing range with a tolerance of ±0.6 mm horizontally and vertically.
- Convergent reflective model with infrared LED.

## ■ 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** | $V_R$ | 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 a frequency of 100 Hz.

**3.** Complete soldering within 10 seconds.

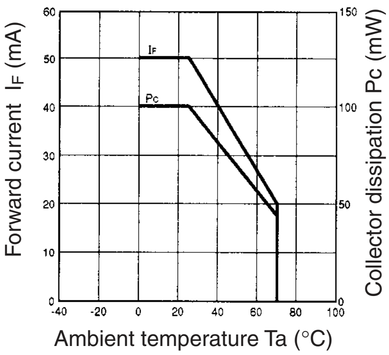
## ■ Electrical and Optical Characteristics (Ta = 25°C)

| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.5 V max. | $I_F$ = 30 mA |
| | **Reverse current** | $I_R$ | 10 µA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 920 nm typ. | $I_F$ = 20 mA |
| **Detector** | **Light current** | $I_L$ | 160 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** | $\lambda_P$ | 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 |

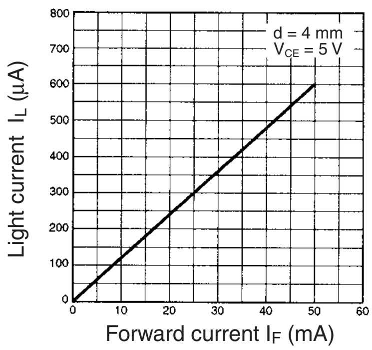
**Note:** The letter "d" indicates the distance between the top surface of the sensor and the sensing object.

## ■ Engineering Data

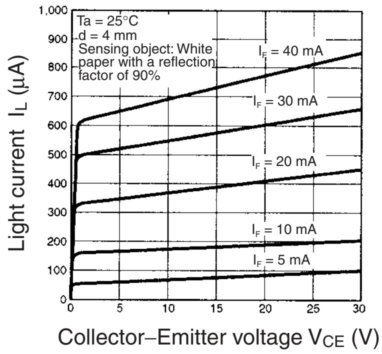
### Forward Current vs. Collector Dissipation Temperature Rating



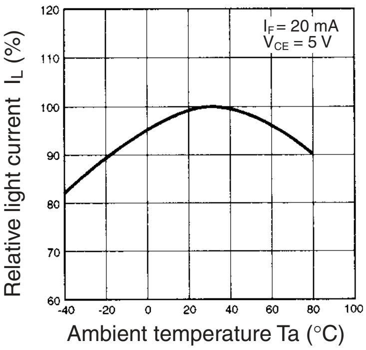

### Light Current vs. Forward Current Characteristics (Typical)



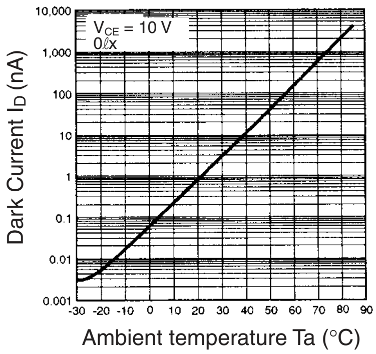

### Light Current vs. Collector–Emitter Voltage Characteristics (Typical)



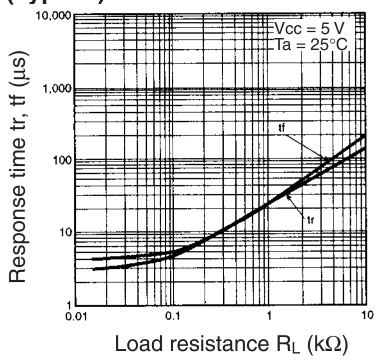

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



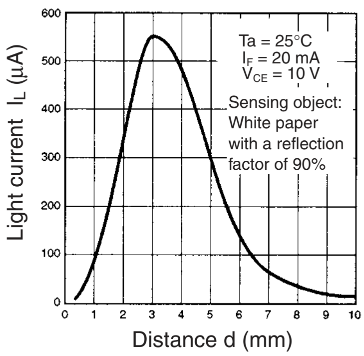

### Dark Current vs. Ambient Temperature Characteristics (Typical)



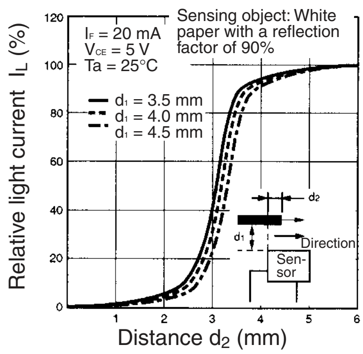

### Response Time vs. Load Resistance Characteristics (Typical)



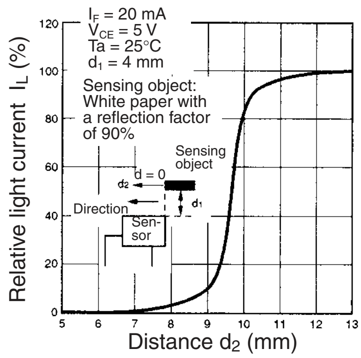

### Sensing Distance Characteristics (Typical)



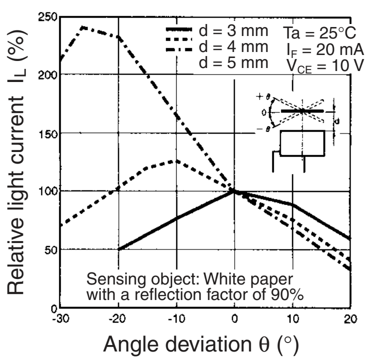

### Sensing Position Characteristics (Typical)



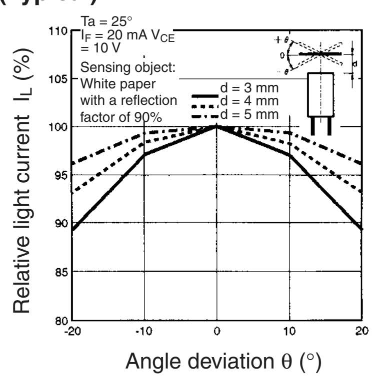

### Sensing Position Characteristics (Typical)



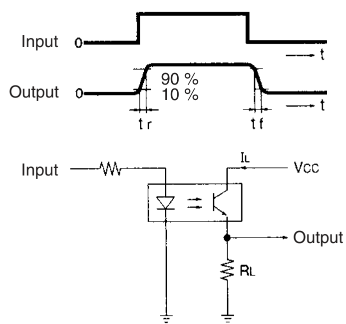

### Sensing Angle Characteristics (Typical)




### Sensing Angle Characteristics (Typical)




### Response Time Measurement Circuit

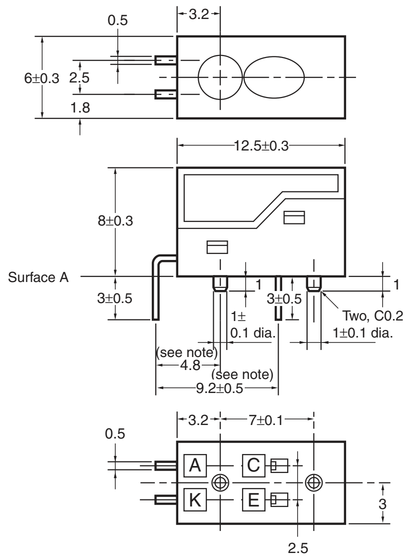


# Photomicrosensor (Reflective)
# EE-SY169B

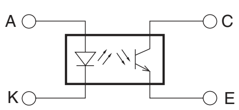
**Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




**Internal Circuit**




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

**Note:** These dimensions are for the surface A. Other lead wire pitch dimensions are for the housing surface.

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

- High-quality model with plastic lenses.
- Highly precise sensing range with a tolerance of ±0.6 mm horizontally and vertically.
- With a red LED sensing dyestuff-type 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)

## ■ Absolute Maximum Ratings (Ta = 25°C)

| Item | | Symbol | Rated value |
|---|---|---|---|
| **Emitter** | **Forward current** | $I_F$ | 40 mA (see note 1) |
| | **Pulse forward current** | $I_{FP}$ | 300 mA (see note 2) |
| | **Reverse voltage** | $V_R$ | 3 V |
| **Detector** | **Collector–Emitter voltage** | $V_{CEO}$ | 30 V |
| | **Emitter–Collector voltage** | $V_{ECO}$ | --- |
| | **Collector current** | $I_C$ | 20 mA |
| | **Collector dissipation** | $P_C$ | 100 mW (see note 1) |
| **Ambient temperature** | **Operating** | 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 a frequency of 100 Hz.

**3.** Complete soldering within 10 seconds.

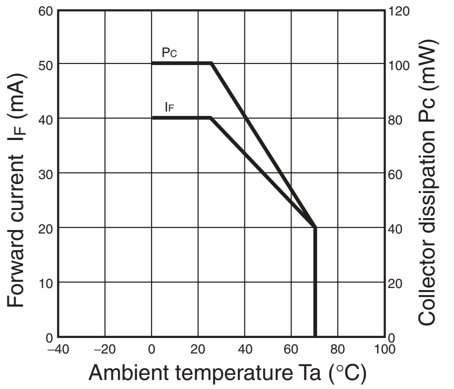
## ■ Electrical and Optical Characteristics (Ta = 25°C)

| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.85 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** | $\lambda_P$ | 660 nm typ. | $I_F$ = 20 mA |
| **Detector** | **Light current** | $I_L$ | 160 μA min., 2,000 μA max. | $I_F$ = 10 mA, $V_{CE}$ = 5 V White paper with a reflection ratio of 90%, d = 4 mm (see note) |
| | **Dark current** | $I_D$ | 2 nA typ., 200 nA max. | $V_{CE}$ = 5 V, 0 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** | $\lambda_P$ | 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 |

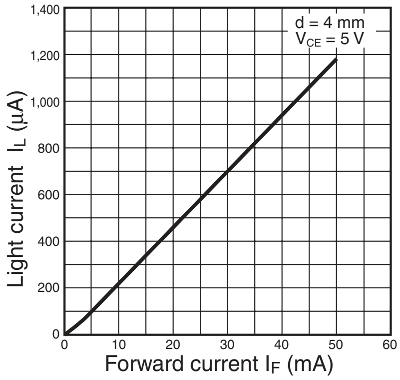
**Note:** The letter “d” indicates the distance between the top surface of the sensor and the sensing object.

## ■ Engineering Data

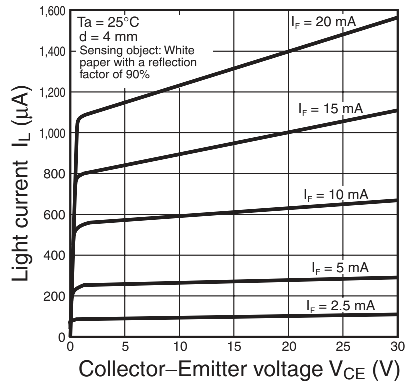
### Forward Current vs. Collector Dissipation Temperature Rating



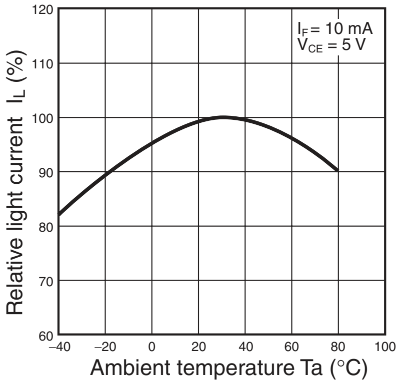

### Light Current vs. Forward Current Characteristics (Typical)



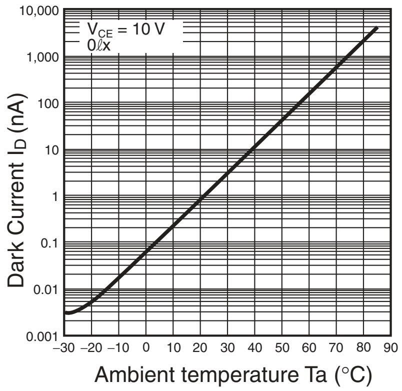

### Light Current vs. Collector−Emitter Voltage Characteristics (Typical)



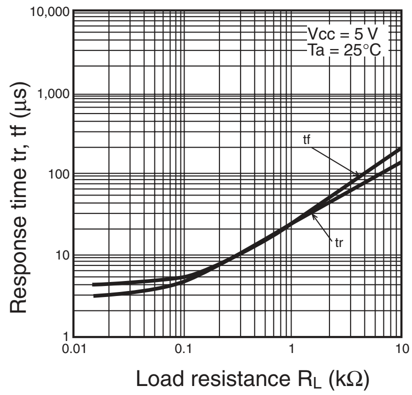

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



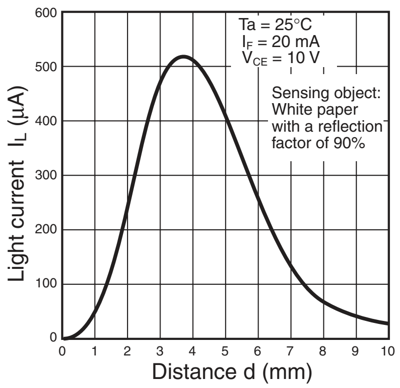

### Dark Current vs. Ambient Temperature Characteristics (Typical)



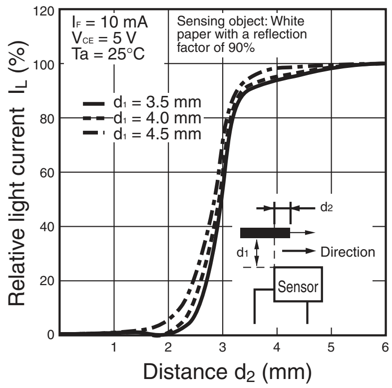

### Response Time vs. Load Resistance Characteristics (Typical)



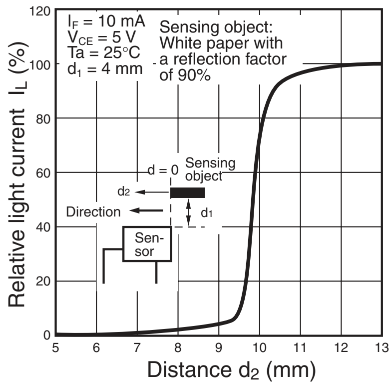

### Sensing Distance Characteristics (Typical)



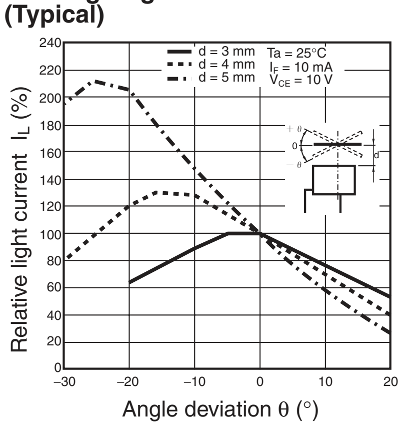

### Sensing Position Characteristics (Typical)



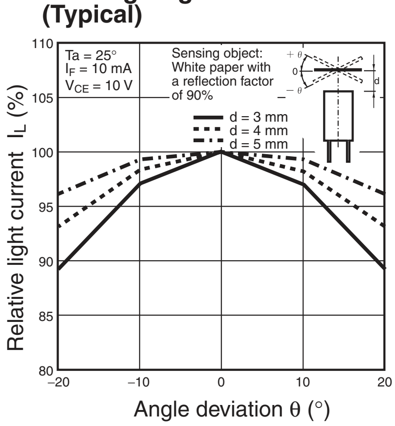

### Sensing Position Characteristics (Typical)



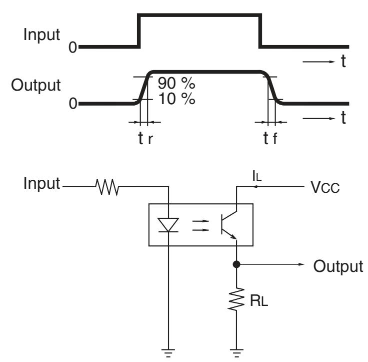

### Sensing Angle Characteristics (Typical)




### Sensing Angle Characteristics (Typical)




### Response Time Measurement Circuit



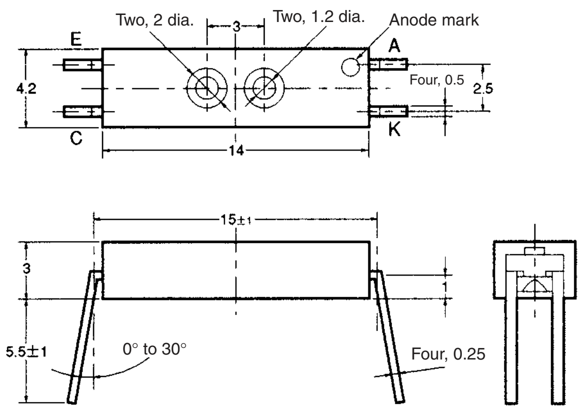
Photomicrosensor (Reflective)

# EE-SY171

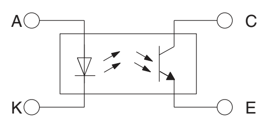
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

- 3-mm-tall, thin model

## ■ 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 100 Hz.

**3.** Complete soldering within 10 seconds.

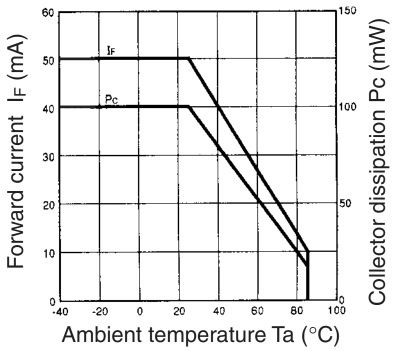
## ■ Electrical and Optical Characteristics (Ta = 25°C)

| 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** | $\lambda_P$ | 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<br>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** | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| **Rising time** | | tr | 30 µs typ. | $V_{CC}$ = 5 V, $R_L$ = 1 kΩ, $I_L$ = 1 mA |
| **Falling time** | | tf | 30 µs typ. | $V_{CC}$ = 5 V, $R_L$ = 1 kΩ, $I_L$ = 1 mA |

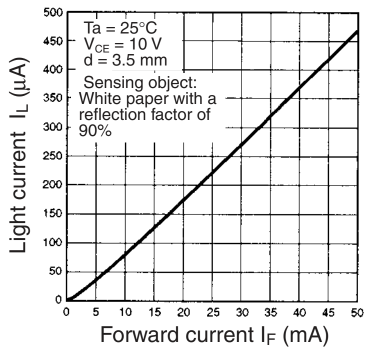
**Note:** The letter "d" indicates the distance between the top surface of the sensor and the sensing object.

## ■ Engineering Data

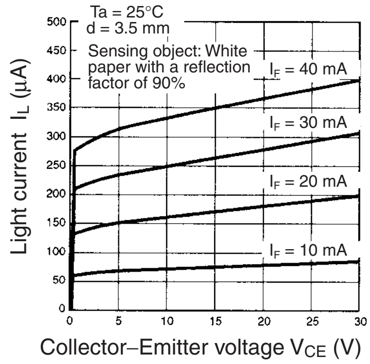
### Forward Current vs. Collector Dissipation Temperature Rating



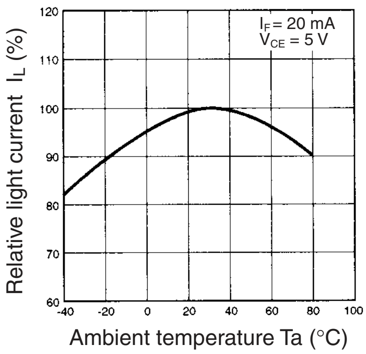

### Light Current vs. Forward Current Characteristics (Typical)



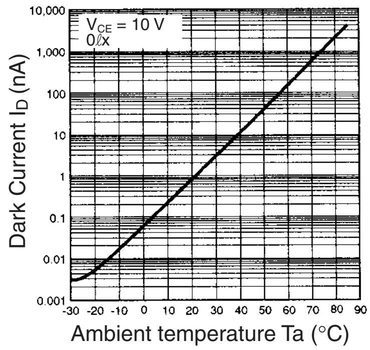

### Light Current vs. Collector−Emitter Voltage Characteristics (Typical)



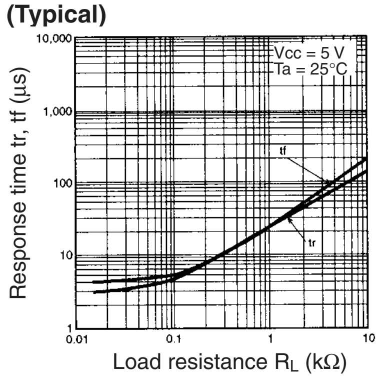

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



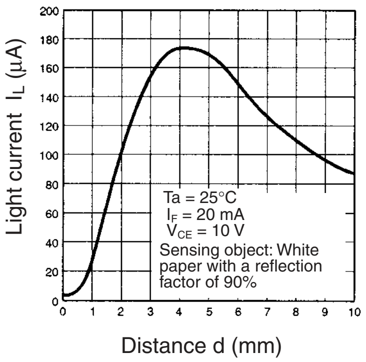

### Dark Current vs. Ambient Temperature Characteristics (Typical)



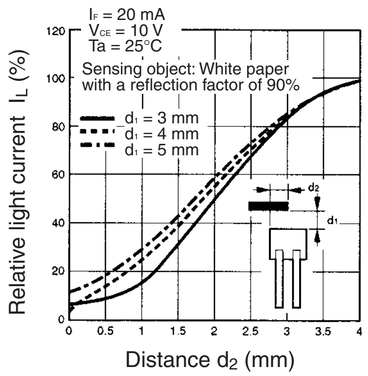

### Response Time vs. Load Resistance Characteristics (Typical)



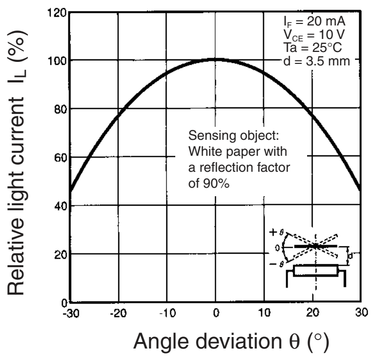

### Sensing Distance Characteristics (Typical)



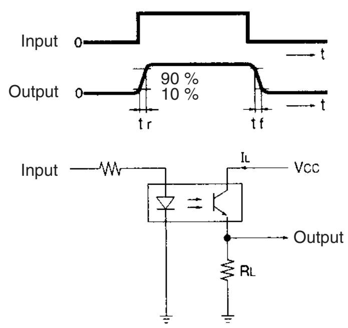

### Sensing Position Characteristics (Typical)




### Sensing Angle Characteristics (Typical)




### Response Time Measurement Circuit

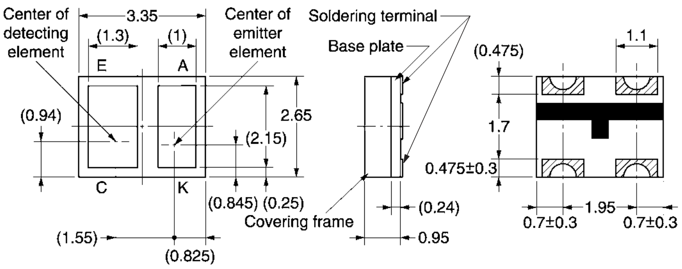


# Photomicrosensor (Reflective)
# EE-SY193

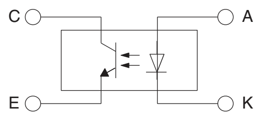
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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

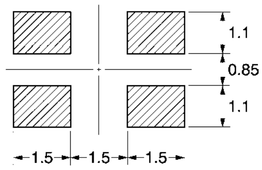



**Internal Circuit**




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

**Recommended soldering patterns**




Unless otherwise specified, the tolerances are ±0.2 mm.

## ■ Features

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

## ■ Absolute Maximum Ratings (Ta = 25°C)

| Item | | Symbol | Rated value |
|---|---|---|---|
| **Emitter** | **Forward current** | $I_F$ | 25 mA (see note 1) |
| | **Pulse forward current** | $I_{FP}$ | 100 mA (see note 2) |
| | **Reverse voltage** | $V_R$ | 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.

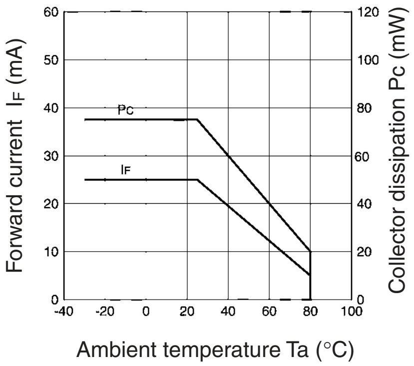
## ■ Electrical and Optical Characteristics (Ta = 25°C)

| 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** | $\lambda_P$ | 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) |
| | **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** | $\lambda_P$ | 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, |

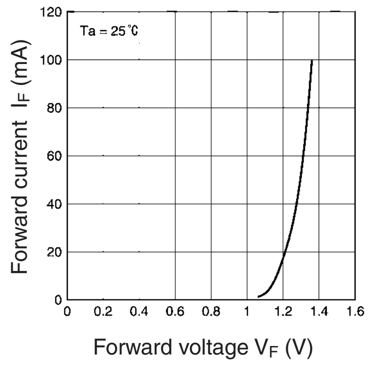
**Note:** The letter “d” indicates the distance between the top surface of the sensor and the sensing object.

## ■ Engineering Data

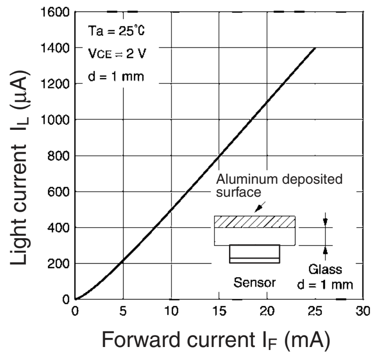
### Forward Current vs. Collector Dissipation Temperature Rating



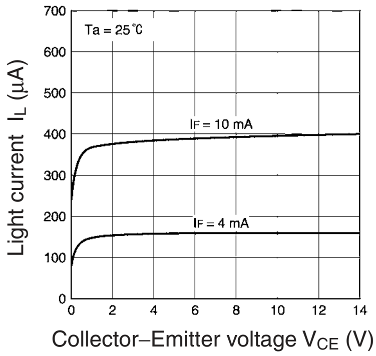

### Forward Current vs. Forward Voltage Characteristics (Typical)



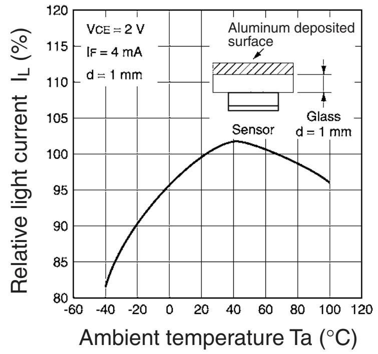

### Light Current vs. Forward Current Characteristics (Typical)



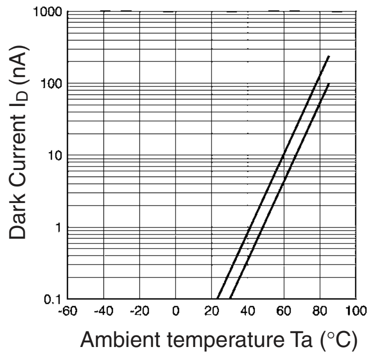

### Light Current vs. Collector−Emitter Voltage Characteristics (Typical)



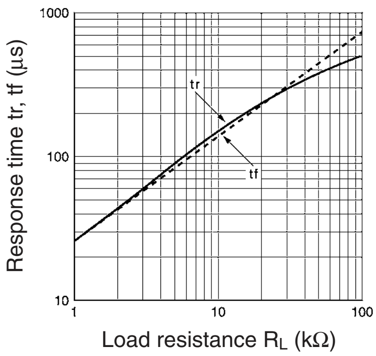

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



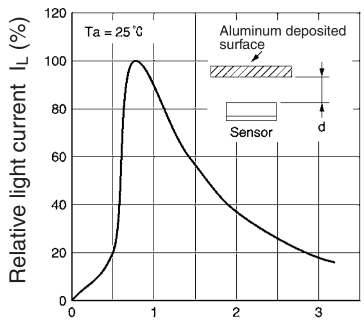

### Dark Current vs. Ambient Temperature Characteristics (Typical)



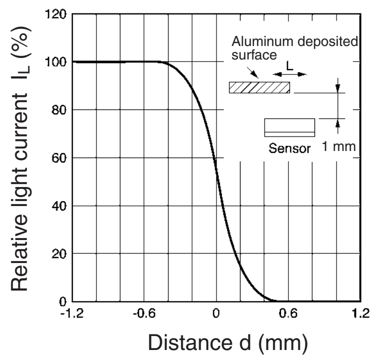

### Response Time vs. Load Resistance Characteristics (Typical)



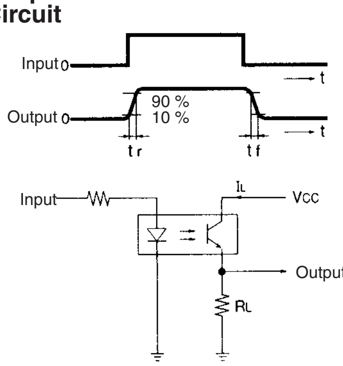

### Sensing Distance Characteristics (Typical)




### Sensing Position Characteristics (Typical)



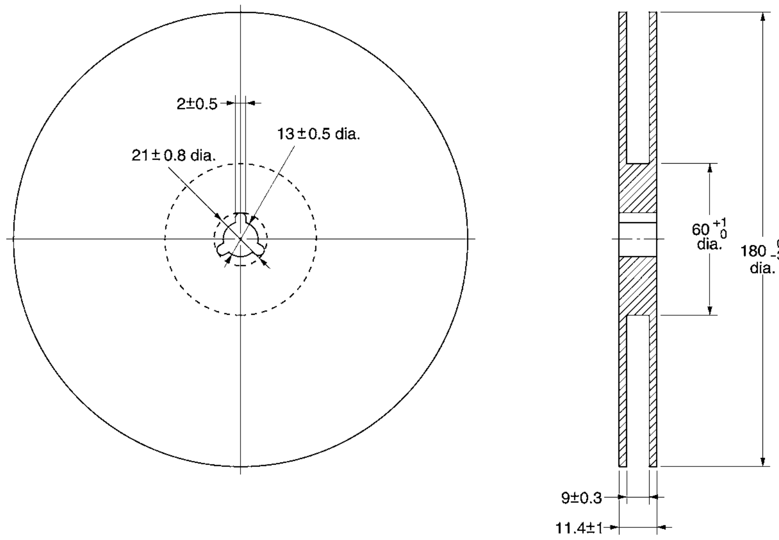

### Response Time Measurement Circuit



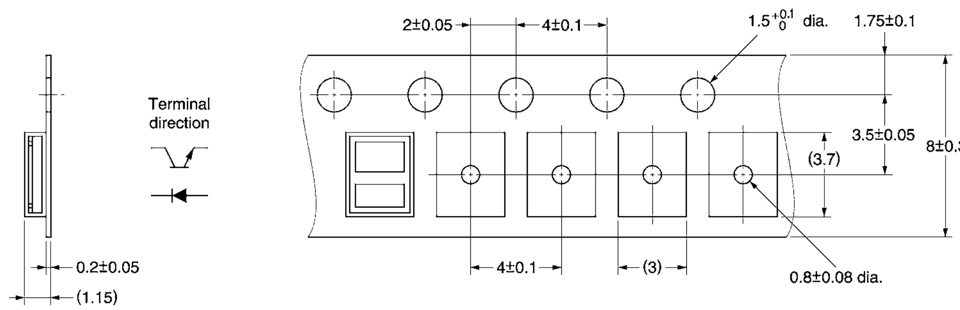
Unit: mm (inch)

## ■ Tape and Reel

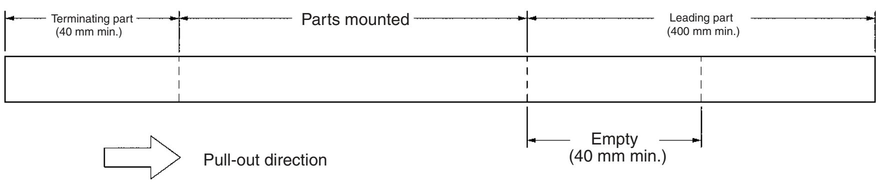
### Reel




### Tape




### Tape configuration




### Tape quantity

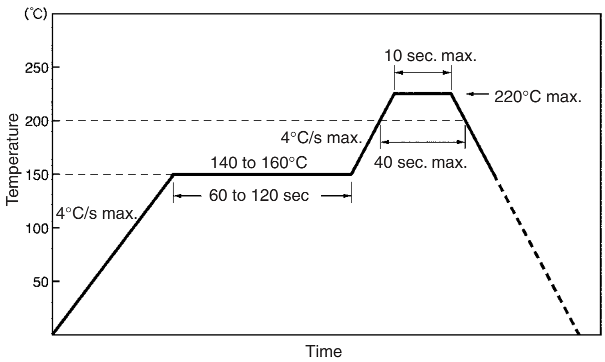
3,000 pcs./reel

# 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 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 24 hours or more

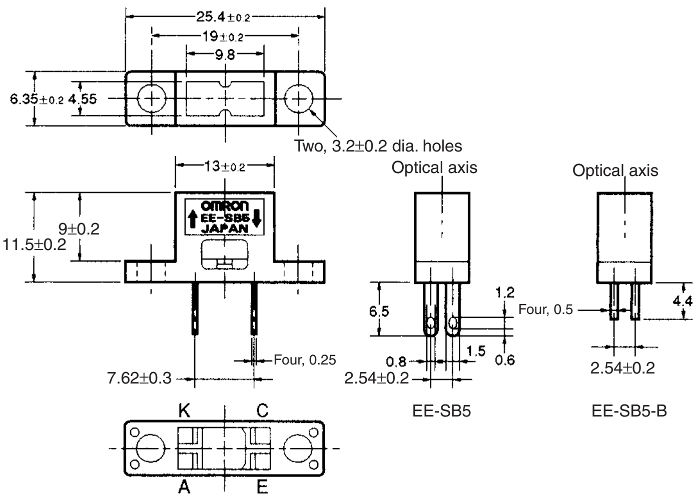
# Photomicrosensor (Reflective)

# EE-SB5(-B)

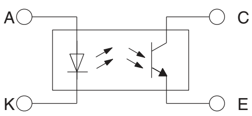
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

- Dust-tight construction.
- With a visible-light intercepting filter which allows objects to be sensed without being greatly influenced by the light radiated from fluorescent lamps.
- Mounted with M3 screws.
- Model with soldering terminals (EE-SB5).
- Model with PCB terminals (EE-SB5-B).

## ■ 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 100 Hz.

**3.** Complete soldering within 10 seconds.

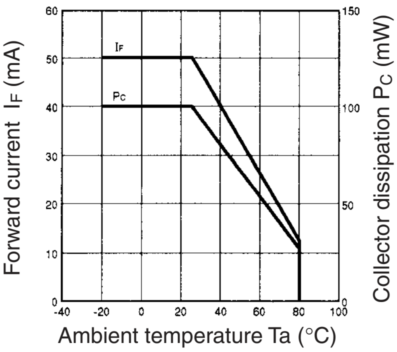
## ■ Electrical and Optical Characteristics (Ta = 25°C)

| 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** | $\lambda_P$ | 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** | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| **Rising time** | | tr | 30 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 1 kΩ, $I_L$ = 1 mA |
| **Falling time** | | tf | 30 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 1 kΩ, $I_L$ = 1 mA |

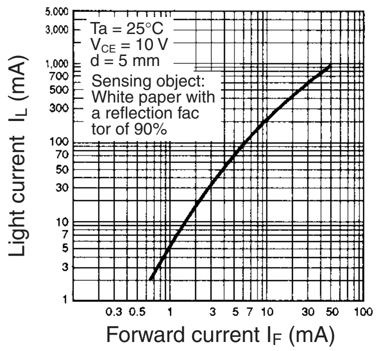
**Note:** The letter “d” indicates the distance between the top surface of the sensor and the sensing object.

## ■ Engineering Data

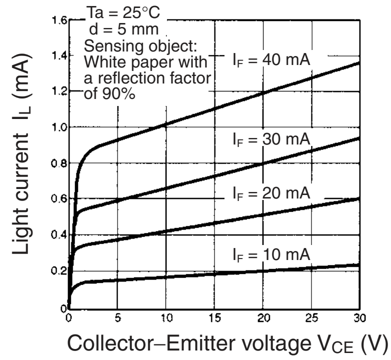
### Forward Current vs. Collector Dissipation Temperature Rating



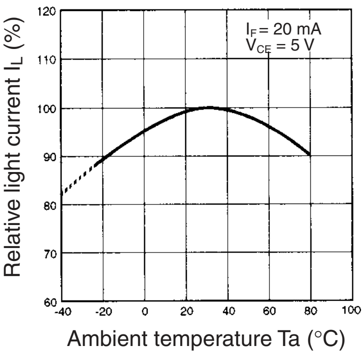

### Light Current vs. Forward Current Characteristics (Typical)



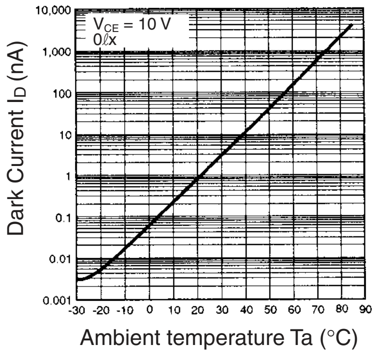

### Light Current vs. Collector−Emitter Voltage Characteristics (Typical)



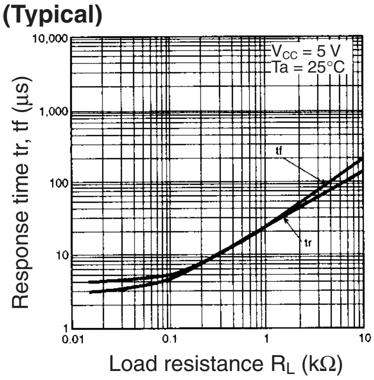

### Relative Light Current vs. Ambient Temperature Characteristics (Typical)



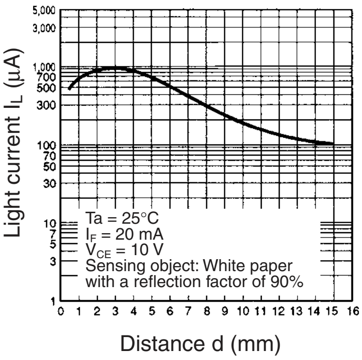

### Dark Current vs. Ambient Temperature Characteristics (Typical)



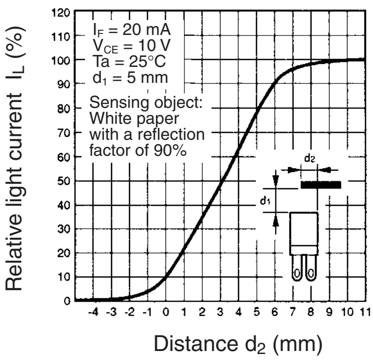

### Response Time vs. Load Resistance Characteristics (Typical)



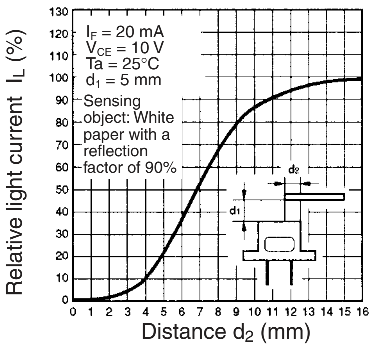

### Sensing Distance Characteristics (Typical)



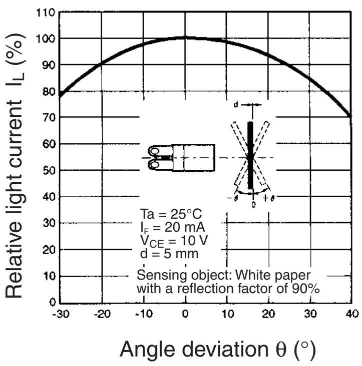

### Sensing Position Characteristics (Typical)



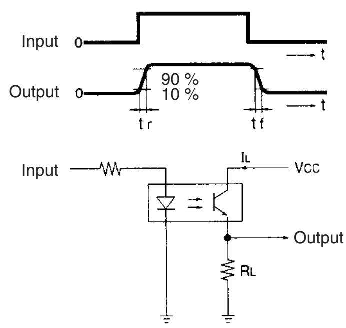

### Sensing Position Characteristics (Typical)




### Sensing Angle Characteristics (Typical)




### Response Time Measurement Circuit

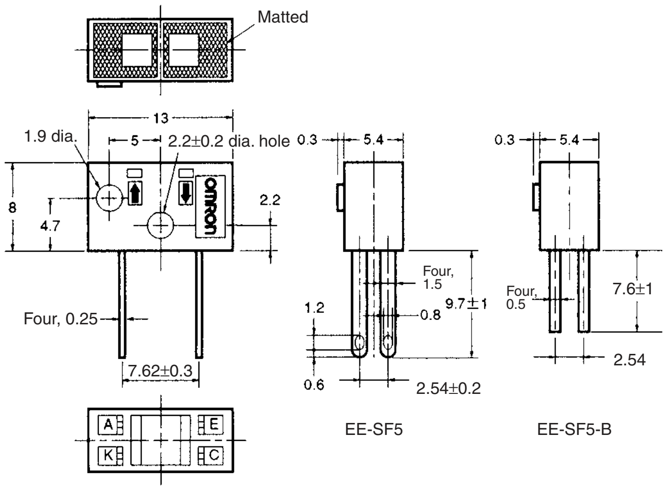


# Photomicrosensor (Reflective)
# EE-SF5(-B)

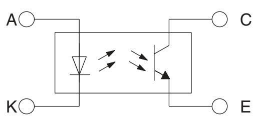
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

- 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).

## ■ 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 100 Hz.

**3.** Complete soldering within 10 seconds.

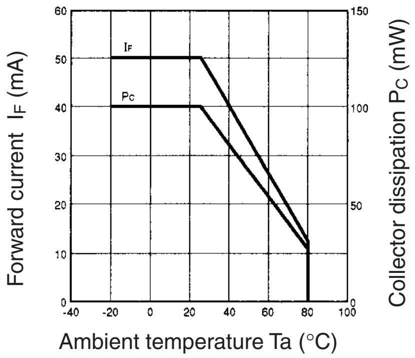
## ■ Electrical and Optical Characteristics (Ta = 25°C)

| 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** | $\lambda_P$ | 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** | $\lambda_P$ | 850 nm typ. | $V_{CE}$ = 10 V |
| **Rising time** | | tr | 30 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 1 kΩ, $I_L$ = 1 mA |
| **Falling time** | | tf | 30 μs typ. | $V_{CC}$ = 5 V, $R_L$ = 1 kΩ, $I_L$ = 1 mA |

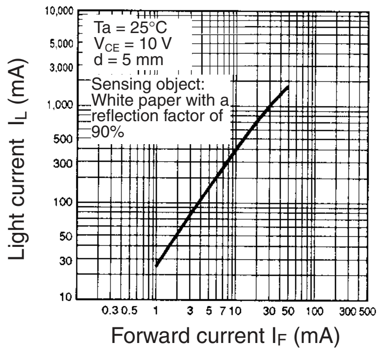
**Note:** The letter "d" indicates the distance between the top surface of the sensor and the sensing object.

## ■ Engineering Data

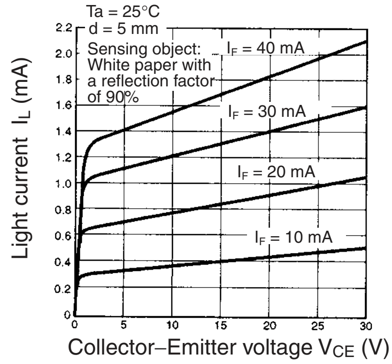
**Forward Current vs. Collector Dissipation Temperature Rating**



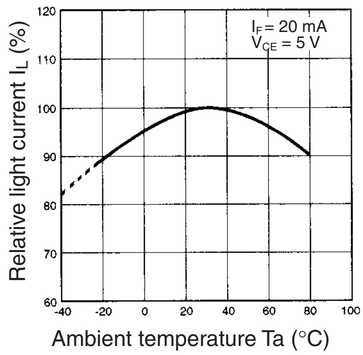

**Light Current vs. Forward Current Characteristics (Typical)**



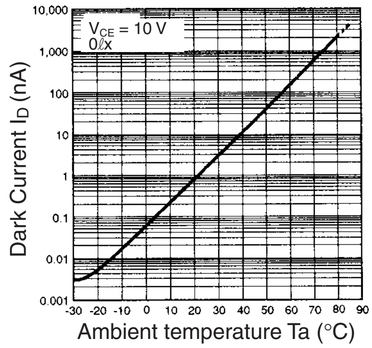

**Light Current vs. Collector−Emitter Voltage Characteristics (Typical)**



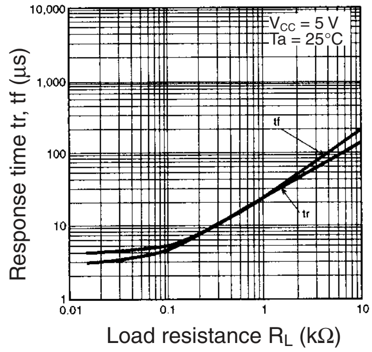

**Relative Light Current vs. Ambient Temperature Characteristics (Typical)**



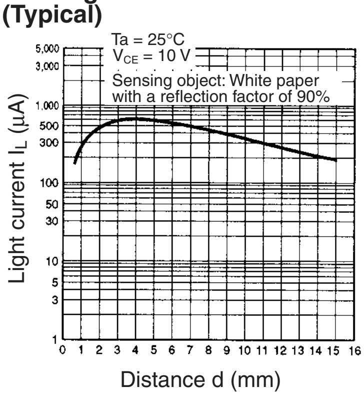

**Dark Current vs. Ambient Temperature Characteristics (Typical)**



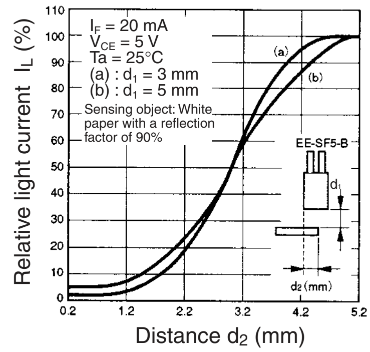

**Response Time vs. Load Resistance Characteristics (Typical)**



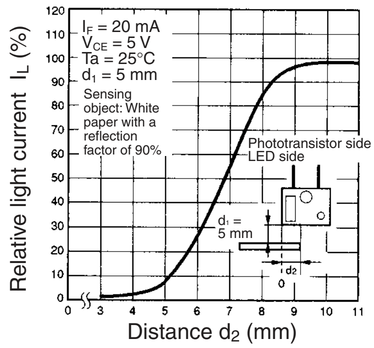

**Sensing Distance Characteristics (Typical)**



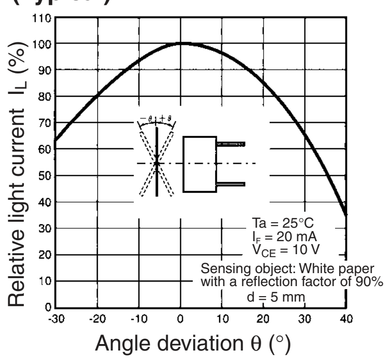

**Sensing Position Characteristics (Typical)**



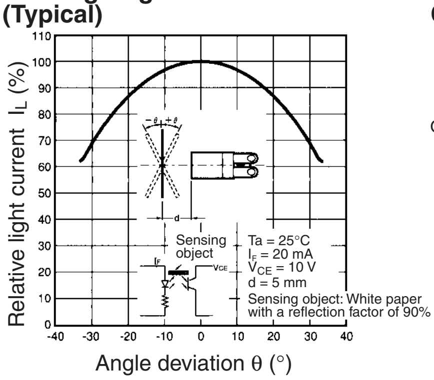

**Sensing Position Characteristics (Typical)**



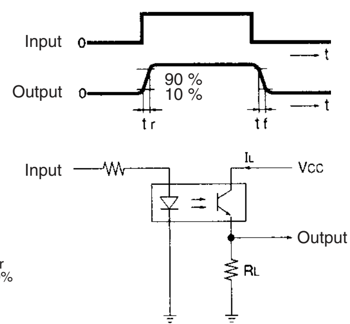

**Sensing Angle Characteristics (Typical)**




**Sensing Angle Characteristics (Typical)**




**Response Time Measurement Circuit**

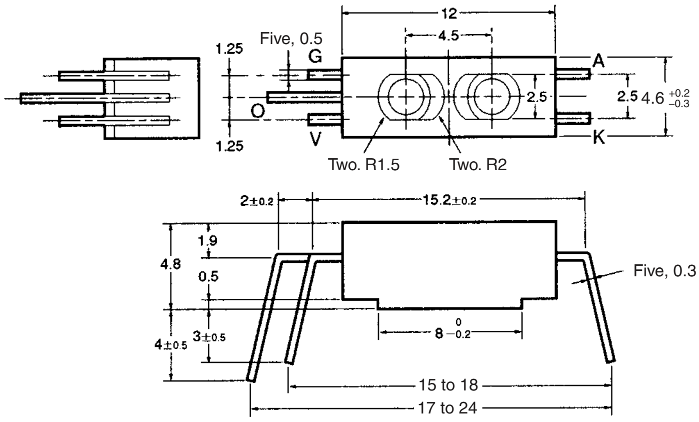


# Photomicrosensor (Reflective)
# EE-SY310/-SY410

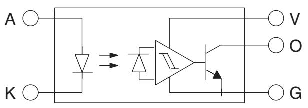
⚠ Be sure to read *Precautions* on page 25.

## ■ Dimensions

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




**Internal Circuit**




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

- Incorporates an IC chip with a built-in detector element and amplifier.
- Incorporates a detector element with a built-in temperature compensation circuit.
- Compact reflective model with a molded housing.
- A wide supply voltage range: 4.5 to 16 VDC
- Directly connects with C-MOS and TTL.
- Dark ON model (EE-SY310)
- Light ON model (EE-SY410)

## ■ 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 |
| | Pulse forward current | $I_{FP}$ | 1 A (see note 2) |
| Detector | Power supply voltage | $V_{CC}$ | 16 V |
| | Output voltage | $V_{OUT}$ | 28 V |
| | Output current | $I_{OUT}$ | 16 mA |
| | Permissible output dissipation | $P_{OUT}$ | 250 mW (see note 1) |
| Ambient temperature | Operating | Topr | –40°C to 75°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 100 Hz.

**3.** Complete soldering within 10 seconds.

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

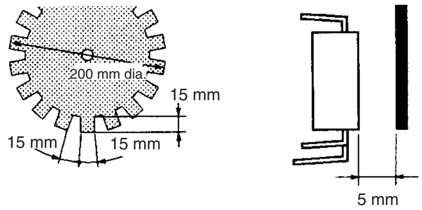
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| Emitter | Forward voltage | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 20 mA |
| | Reverse current | $I_R$ | 0.01 μA typ., 10 μA max. | $V_R$ = 4 V |
| | Peak emission wavelength | $\lambda_P$ | 920 nm typ. | $I_F$ = 20 mA |
| Detector | Low-level output voltage | $V_{OL}$ | 0.12 V typ., 0.4 V max. | Vcc = 4.5 to 16 V, $I_{OL}$ = 16 mA, without incident light (EE-SY310), with incident light (EE-SY410) (see notes 1 and 2) |
| | High-level output voltage | $V_{OH}$ | 15 V min. | Vcc = 16 V, $R_L$ = 1 kΩ, with incident light (EE-SY310), without incident light (EE-SY410) (see notes 1 and 2) |
| | Current consumption | $I_{CC}$ | 3.2 mA typ., 10 mA max. | Vcc = 16 V |
| | Peak spectral sensitivity wavelength | $\lambda_P$ | 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 | | ΔH | 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, $I_{OL}$ = 16 mA |
| 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 |
| 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 |

**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 5 mm is received by the photo IC when the forward current ($I_F$) of the LED is 20 mA.

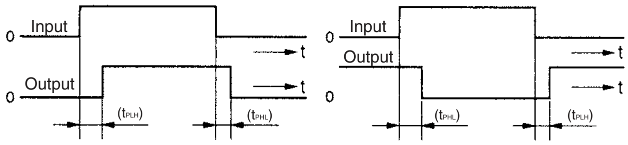
2. Sensing object: White paper with a reflection factor of 90% at a sensing distance of 5 mm.

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 EE-SY410.

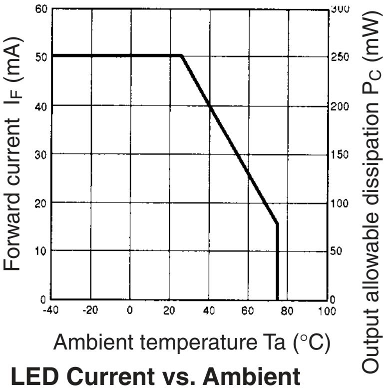



**EE-SY310** **EE-SY410**

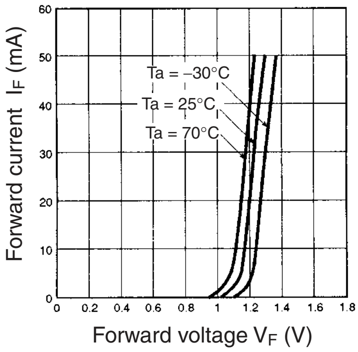
## ■ Engineering Data

**Note:** The values in the parentheses apply to the EE-SY410.

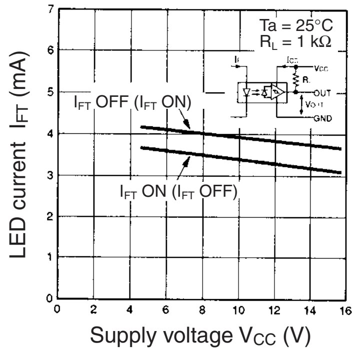
**Forward Current vs. Collector Dissipation Temperature Rating**



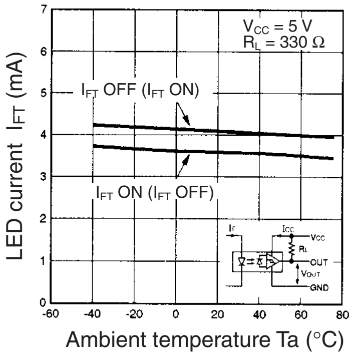

**Forward Current vs. Forward Voltage Characteristics (Typical)**



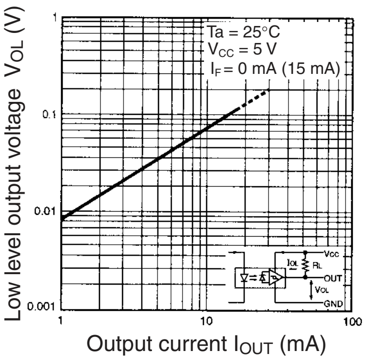

**LED Current vs. Supply Voltage (Typical)**



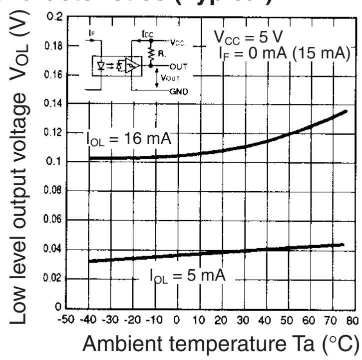

**LED Current vs. Ambient Temperature Characteristics (Typical)**



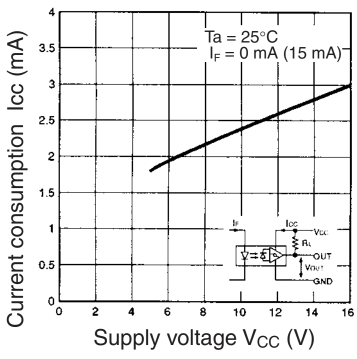

**Low-level Output Voltage vs. Output Current (Typical)**



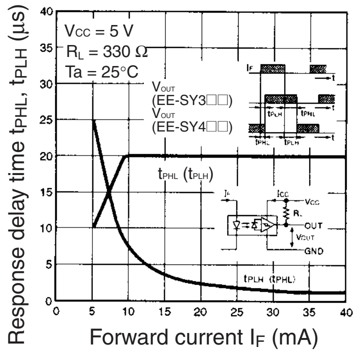

**Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)**



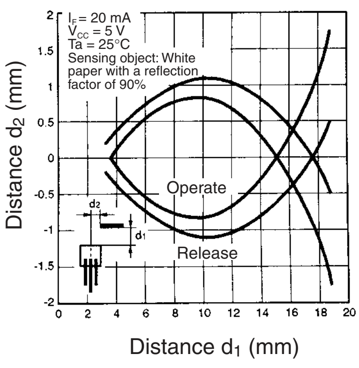

**Current Consumption vs. Supply Voltage (Typical)**




**Response Delay Time vs. Forward Current (Typical)**




**Sensing Position Characteristics (Typical)**

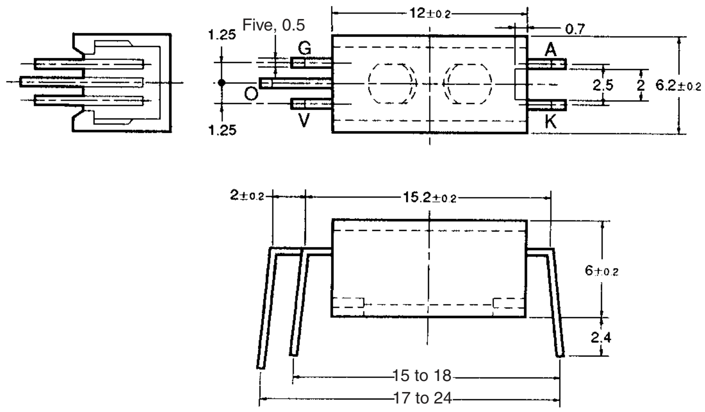


# Photomicrosensor (Reflective)
# EE-SY313/-SY413

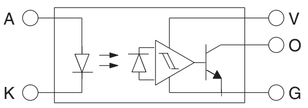
⚠ **Be sure to read *Precautions* on page 25.**

## ■ Dimensions

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




### Internal Circuit




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

Unless otherwise specified, the tolerances are as shown below.

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

## ■ Features

- Incorporates an IC chip with a built-in detector element and amplifier.
- Incorporates a detector element with a built-in temperature compensation circuit.
- Compact reflective Photomicrosensor (EE-SY310/-SY410) with a molded housing and a dust-tight cover.
- A wide supply voltage range: 4.5 to 16 VDC
- Directly connects with C-MOS and TTL.
- Dark ON model (EE-SY313)
- Light ON model (EE-SY413)

## ■ 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 |
| | **Pulse forward current** | $I_{FP}$ | 1 A (see note 2) |
| **Detector** | **Power supply voltage** | $V_{CC}$ | 16 V |
| | **Output voltage** | $V_{OUT}$ | 28 V |
| | **Output current** | $I_{OUT}$ | 16 mA |
| | **Permissible output dissipation** | $P_{OUT}$ | 250 mW (see note 1) |
| **Ambient temperature** | **Operating** | Topr | –40°C to 65°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 100 Hz.

**3.** Complete soldering within 10 seconds.

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

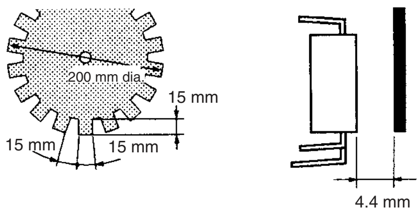
| Item | | Symbol | Value | Condition |
|---|---|---|---|---|
| **Emitter** | **Forward voltage** | $V_F$ | 1.2 V typ., 1.5 V max. | $I_F$ = 20 mA |
| | **Reverse current** | $I_R$ | 0.01 µA typ., 10 µA max. | $V_R$ = 4 V |
| | **Peak emission wavelength** | $\lambda_P$ | 920 nm typ. | $I_F$ = 20 mA |
| **Detector** | **Low-level output voltage** | $V_{OL}$ | 0.12 V typ., 0.4 V max. | Vcc = 4.5 to 16 V, $I_{OL}$ = 16 mA, without incident light (EE-SY313), with incident light (EE-SY413) (see notes 1 and 2) |
| | **High-level output voltage** | $V_{OH}$ | 15 V min. | Vcc = 16 V, $R_L$ = 1 kΩ, with incident light (EE-SY313), without incident light (EE-SY413) (see notes 1 and 2) |
| | **Current consumption** | $I_{CC}$ | 3.2 mA typ., 10 mA max. | Vcc = 16 V |
| | **Peak spectral sensitivity wavelength** | $\lambda_P$ | 870 nm typ. | $V_{CC}$ = 4.5 to 16 V |
| **LED current when output is OFF** | | $I_{FT}$ | 10 mA typ., 20 mA max. | $V_{CC}$ = 4.5 to 16 V |
| **LED current when output is ON** | | | | |
| **Hysteresis** | | ΔH | 17% typ. | $V_{CC}$ = 4.5 to 16 V |
| **Response frequency** | | f | 50 pps min. | $V_{CC}$ = 4.5 to 16 V, $I_F$ = 20 mA, $I_{OL}$ = 16 mA |
| **Response delay time** | | $t_{PLH}$ ($t_{PHL}$) | 3 µs typ. | $V_{CC}$ = 4.5 to 16 V, $I_F$ = 20 mA, $I_{OL}$ = 16 mA |
| **Response delay time** | | $t_{PHL}$ ($t_{PLH}$) | 20 µs typ. | $V_{CC}$ = 4.5 to 16 V, $I_F$ = 20 mA, $I_{OL}$ = 16 mA |

**Note:** 1. With incident light" denotes the condition whereby the light reflected by white paper with a reflection factor of 90% at a sensing distance of 4.4 mm is received by the photo IC when the forward current ($I_F$) of the LED is 20 mA.

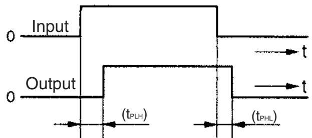
2. Sensing object: White paper with a reflection factor of 90% at a sensing distance of 4.4 mm.

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

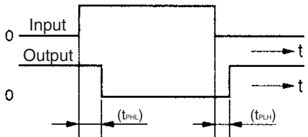
4. The value of the response frequency is measured by rotating the disk as shown below.




5. The following illustrations show the definition of response delay time. The value in the parentheses applies to the EE-SY413.




**EE-SY313**

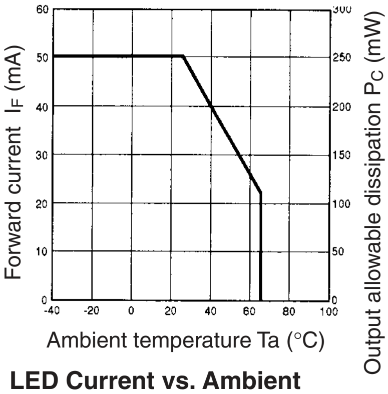



**EE-SY413**

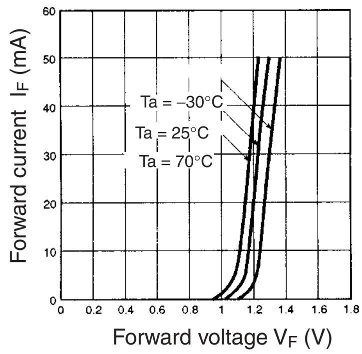
## ■ Engineering Data

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

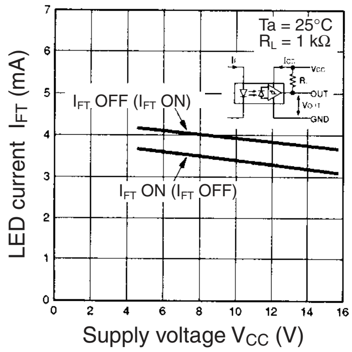
### Forward Current vs. Collector Dissipation Temperature Rating



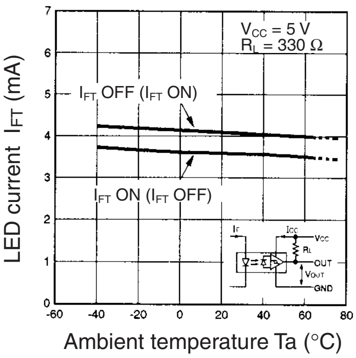

### Forward Current vs. Forward Voltage Characteristics (Typical)



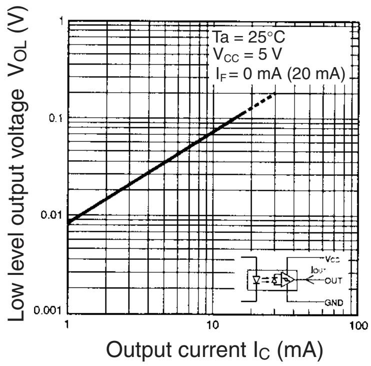

### LED Current vs. Supply Voltage (Typical)



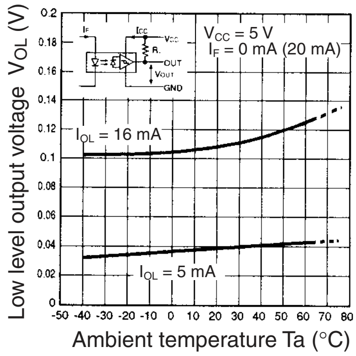

### LED Current vs. Ambient Temperature Characteristics (Typical)



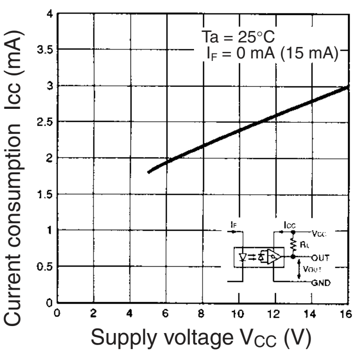

### Low-level Output Voltage vs. Output Current (Typical)



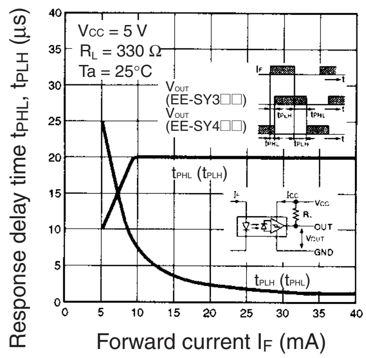

### Low-level Output Voltage vs. Ambient Temperature Characteristics (Typical)



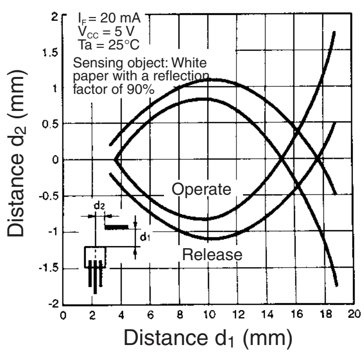

### Current Consumption vs. Supply Voltage (Typical)




### Response Delay Time vs. Forward Current (Typical)




### Sensing Position Characteristics (Typical)



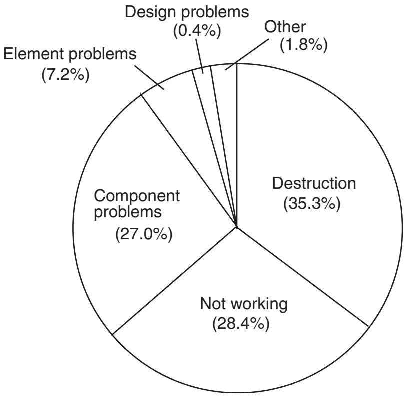
## Information

# Reliability

## ■ Market Product Quality

OMRON is making efforts so that OMRON's Photomicrosensors can achieve a failure rate of only $10^{-7}$/h.
OMRON will continue improving the quality of its products to comply with OMRON Photomicrosensors users' demand for product quality while actively providing good after-sales service.
OMRON's Photomicrosensors achieved a failure rate of 10 ppm. Figure 5 shows the reasons for the return of OMRON Photomicrosensors.
The reasons for approximately two-thirds of the products sent back were that they were not working or they were destroyed. It is possible that they were not working or they were destructed because excessive voltages were imposed on them or they were not operated properly according to their specifications. To solve such problems, OMRON is actively holding preliminary meetings with customers who will use OMRON products and advise them of the operating conditions required by the products while actively providing them with after-sales service.

**Figure 5. Reasons for Products Sent Back**




## ■ Reliability

The life of any Photomicrosensor depends on the secular changes of the optical output of the LED built into the Photomicrosensor. The following are the output characteristics of the Photomicrosensor, all of which depend on the optical output of the LED.

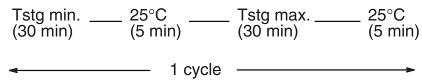
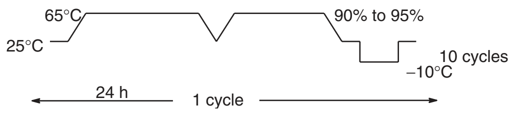
| | |
|---|---|
| **Phototransistor output** | Light current ($I_L$) |
| **Photo IC output** | LED current $I_{FT}$ with the photo IC output ON and OFF |
| **Amplifier output (reflective sensor)** | Sensing distance d |

OMRON has been conducting reliability tests of each type of Photomicrosensor to check the secular changes of the optical output of the LED built into the Photomicrosensor.

## ■ Reliability Tests

In principle, Photomicrosensors conform to JEITA standards. The following table shows the details of the reliability tests of Photomicrosensors conducted by OMRON.

**Figure 6. Details of Reliability Tests**

| Classification | Test | Detail | Conforming standard | |
|---|---|---|---|---|
| **Thermal condition test** | Soldering heat resistivity | Evaluates the soldering heat resistivity of products. Usually, this test is conducted under the following conditions.<br>Soldering temperature: 260±5°C<br>Soldering time:10±1 s | JEITA ED-4701/300<br>ED-8121<br>JIS C7021: A1<br>IEC Pub68-2-20 | |
| | Thermal shock | Evaluates the resistivity of products to radical temperature changes. Usually, this test is conducted under the following conditions.<br>Ta: 0°C to 100°C (liquid bath) or TstgMIN to TstgMAX (liquid bath) | JEITA ED-4701/300<br>JIS C7021: A3<br>IEC Pub68-2-14 | |
| | Temperature cycle | Evaluates the low- and high-temperature resistivity of products.<br> | JEITA ED-4701/100<br>JIS C7021: A4<br>IEC Pub68-2-14 | The five-minute storage periods at a temperature of 25°C in the test may be omitted. |
| | Temperature and humidity cycle | Evaluates the high-temperature and high-humidity resistivity of products.<br> | JEITA ED-4701/200<br>JIS C7021: A5<br>IEC Pub68-2-4 | |
| **Mechanical test** | Soldering ease | Evaluates the terminal soldering ease of the products. Usually, this test is conducted under the following conditions.<br>Soldering temperature: 230±5°C<br>Soldering time: 5±0.5 s | JEITA ED-4701/300<br>ED-8121<br>JIS C7021: A2<br>IEC Pub68-2-20 | |
| | Terminal strength | Evaluates the resistivity of the terminals of products to the force imposed on the terminals while the products are mounted, wired, or operated.<br>**1.** Tension test<br>On each terminal of products, a specified load is imposed for 10±1 s in the direction of the terminal.<br>**2.** Bending test<br>On the tip of each terminal of products, a specified load is imposed to bend the terminal by 90° and to change it back. | JEITA ED-4701/400<br>ED-8121<br>JIS C7021: A11<br>IEC Pub68-2-21 | |
| | Shock resistance | Judges the structural resistivity and mechanical resistivity of products. The conditions of this test vary with the product structure. Usually, this test is conducted under the following conditions.<br>Impact acceleration:14,700 m/s$^2$<br>Pulse width: 0.5 ms | JEITA ED-4701/400<br>ED-8121<br>JIS C7021: A7<br>IEC Pub68-2-27 | A product may be subjected to this test after it is packed up. |
| | Vibration resistance | Evaluates the vibration resistivity of products while they are transported or operated. Usually, this test is conducted under the following conditions.<br>Frequency: 100 to 2000 Hz/4 min<br>200 m/s$^2$ | JEITA ED-4701/400<br>ED-8121<br>JIS C7021: A10<br>IEC Pub68-2-21 | A product may be subjected to this test after it is packed up. |
| | Natural drop | Evaluates the irregular shock resistivity of products while they are handled, transported, or operated. Usually, this test is conducted under the following conditions.<br>Height: 75 cm<br>No. of times: 3 | JEITA EIAJ-8121<br>JIS C7021: A8<br>IEC Pub68-2-32 | A product may be subjected to this test after it is packed up. |

| Classification | Test | Detail | Conforming standard | |
|---|---|---|---|---|
| **Life expectancy test** | Continuous operation | Evaluates the resistivity of products to a continuous, long-time electrical stress and temperature stress. Usually, this test is conducted under the following conditions.<br>Ta: 25±5°C<br>Bias: $I_{FMAX}$ or $P_{CMAX}$ | EIAJ-EDX-8121<br>EIAJ-SD-121: 201<br>JIS C7021: B4 | A product may be subjected to this test at a high temperature, low temperature, or high temperature and humidity. |
| | High-temperature storage | Evaluates the resistivity of products to a high-storage temperature for a long time. Usually, this test is conducted under the following conditions.<br>Ta: TstgMAX<br>Time: 1,000 hrs | EIAJ-EDX-8121<br>EIAJ-SD-121: 115<br>JIS C7021: B10<br>IEC Pub68-2-2 | |
| | Low-temperature storage | Evaluates the resistivity of products to a low-storage temperature for a long time. Usually, this test is conducted under the following conditions.<br>Ta: TstgMIN<br>Time: 1,000 hrs | EIAJ-EDX-8121<br>EIAJ-SD-121: 116<br>JIS C7021: B12<br>IEC Pub68-2-1 | |
| | High-temperature and high-humidity storage | Evaluates the resistivity of products to a high-storage temperature and high storage humidity for a long time. Usually, this test is conducted under the following conditions.<br>Ta: 60°C<br>Humidity: 90%<br>Time: 1,000 hrs | EIAJ-EDX-8121<br>EIAJ-SD-121: 117<br>JIS C7021: B11<br>IEC Pub68-2-3 | |
| | High-temperature reverse bias | Evaluates the resistivity of products to a continuous electrical stress and temperature stress. | EIAJ-SD-121: 203<br>JIS C7021: B8 | A product may be subjected to this test at a low temperature, high temperature, or high humidity. |

**Note:** The above testing conditions and testing times depend on the features of each product.

## ■ Data from Reliability Tests

The following tables show the results of the reliability tests of typical Transmissive Photomicrosensors with an Infrared LED conducted by OMRON. Providing this data does not imply that OMRON guarantees the specified reliability level.

## Typical Failure Rates (MTTF Data)

### EE-SX1041 (Transmissive Phototransistor Output)

#### Failure Criteria

| Item | Symbol | Measuring conditions | Failure criteria | |
|---|---|---|---|---|
| | | | General test (see note) | Life test |
| Forward voltage | $V_F$ | $I_F$ = 30 mA | 1.5 V max. | 1.8 V max. |
| Reverse current | $I_R$ | $V_R$ = 4 V | 10 μA max. | 20 μA max. |
| Dark current | $I_D$ | $V_{CE}$ = 10 V 0lx | 200 nA max. | 400 nA max. |
| Light current | $I_L$ | $I_F$ = 20 mA<br>$V_{CE}$ = 10 V | 0.5 mA min.<br>14 mA max. | Initial value × 0.7 min. |

**Note:** Except life test.

#### Test Results

| Test item | Test conditions (see note 1) | Number of samples | Component hours (h) | Number of failures | Failure rate (1/h) (see note 2) |
|---|---|---|---|---|---|
| Continuous operation | Ta = 25°C, $I_F$ = 50 mA<br>2000 h | 22 pcs | $4.4 \times 10^4$ | 0 | $5.22 \times 10^{-5}$ |
| High-temperature storage | Ta = 100°C<br>2000 h | 22 pcs | $4.4 \times 10^4$ | 0 | $5.22 \times 10^{-5}$ |
| Low-temperature storage | Ta = –30°C<br>2000 h | 22 pcs | $4.4 \times 10^4$ | 0 | $5.22 \times 10^{-5}$ |
| High-temperature and high-humidity storage | Ta = 60°C, 90%<br>2000 h | 22 pcs | $4.4 \times 10^4$ | 0 | $5.22 \times 10^{-5}$ |
| High-temperature reverse bias | Ta = 85°C, $V_{CE}$ = 30 V<br>2000 h | 22 pcs | $4.4 \times 10^4$ | 0 | $5.22 \times 10^{-5}$ |
| Temperature cycle | –30°C (30 min) to 100°C (30 min)<br>10 times | 22 pcs | --- | 0 | --- |
| Shock resistance | 14,700 m/s$^2$, 0.5 ms, 3 times each in ±X, ±Y, and ±Z directions | 11 pcs | --- | 0 | --- |
| Vibration resistance | 20 to 2,000 Hz, 1.5 mm or 98 m/s$^2$ each in X, Y, and Z directions | 11 pcs | --- | 0 | --- |

**Note:** **1.** The tests after 1001 hours are for reference only.
**2.** Confidence level of 90%.

### EE-SX1235A-P2 (Transmissive Phototransistor Output)

#### Failure Criteria

| Item | Symbol | Measuring conditions | Failure criteria | |
|---|---|---|---|---|
| | | | General test (see note) | Life test |
| Forward voltage | $V_F$ | $I_F$ = 30 mA | 1.5 V max. | 1.8 V max. |
| Reverse current | $I_R$ | $V_R$ = 4 V | 10 µA max. | 20 µA max. |
| Dark current | $I_D$ | $V_{CE}$ = 10 V 0lx | 200 nA max. | 400 nA max. |
| Light current | $I_L$ | $I_F$ = 20 mA<br>$V_{CE}$ = 5 V | 0.5 mA min.<br>14 mA max. | Initial value × 0.7 min. |

**Note:** Except life test.

#### Test Results

| Test item | Test conditions (see note 1) | Number of samples | Component hours (h) | Number of failures | Failure rate (1/h) (see note 2) |
|---|---|---|---|---|---|
| Continuous operation | Ta = 25°C, $I_F$ = 50 mA<br>2000 h | 22 pcs | $4.4 \times 10^4$ | 0 | $5.22 \times 10^{-5}$ |
| High-temperature storage | Ta = 100°C<br>2000 h | 22 pcs | $4.4 \times 10^4$ | 0 | $5.22 \times 10^{-5}$ |
| Low-temperature storage | Ta = –40°C<br>2000 h | 22 pcs | $4.4 \times 10^4$ | 0 | $5.22 \times 10^{-5}$ |
| High-temperature and high-humidity storage | Ta = 60°C, 90%<br>2000 h | 22 pcs | $4.4 \times 10^4$ | 0 | $5.22 \times 10^{-5}$ |
| High-temperature reverse bias | Ta = 85°C, $V_{CE}$ = 30 V<br>2000 h | 22 pcs | $4.4 \times 10^4$ | 0 | $5.22 \times 10^{-5}$ |
| Temperature cycle | –40°C (30 min) to 100°C (30 min)<br>10 times | 22 pcs | --- | 0 | --- |
| Shock resistance | 294 m/s$^2$, 0.5 ms, 3 times each in ±X, ±Y, and ±Z directions | 11 pcs | --- | 0 | --- |
| Vibration resistance | 5 to 50 Hz, 1.5 mm or 9.8 m/s$^2$ each in X, Y, and Z directions | 11 pcs | --- | 0 | --- |

**Note: 1.** The tests after 1001 hours are for reference only.
**2.** Confidence level of 90%.

### EE-SX398 (Transmissive Photo-IC Output)

#### Failure Criteria

| Item | Symbol | Measuring conditions | Failure criteria | |
|---|---|---|---|---|
| | | | General test (see note) | Life test |
| Forward voltage | $V_F$ | $I_F$ = 20 mA | 1.5 V max. | 1.8 V max. |
| Reverse current | $I_R$ | $V_R$ = 4 V | 10 µA max. | 20 µA max. |
| Low-level output voltage | $V_{OL}$ | $V_{CC}$ = 16 V<br>$I_{OL}$ = 16 mA<br>$I_F$ = 0 mA | 0.4 V max. | 0.48 V max. |
| High-level output current | $I_{OH}$ | $V_{CC}$ = 16 V<br>$V_{OUT}$ = 28 V<br>$I_F$ = 5 mA | 100 µA max. | 200 µA max. |
| Current consumption | $I_{CC}$ | $V_{CC}$ = 16 V | 10 mA max. | 12 mA max. |
| LED current when output is OFF | $I_{FT}$ | $V_{CC}$ = 16 V<br>$I_{OL}$ = 16 mA | 5 mA max. | Initial value × 1.3 max. |

**Note:** Except life test.

#### Test Results

| Test item | Test conditions (see note 1) | Number of samples | Component hours (h) | Number of failures | Failure rate (1/h) (see note 2) |
|---|---|---|---|---|---|
| Continuous operation | Ta = 25°C, $I_F$ = 20 mA, $V_{CC}$ = 5 V<br>1500 h | 22 pcs | $3.3 \times 10^4$ | 0 | $6.96 \times 10^{-5}$ |
| High-temperature storage | Ta = 100°C<br>2000 h | 22 pcs | $3.3 \times 10^4$ | 0 | $6.96 \times 10^{-5}$ |
| Low-temperature storage | Ta = –40°C<br>2000 h | 22 pcs | $3.3 \times 10^4$ | 0 | $6.96 \times 10^{-5}$ |
| High-temperature and high-humidity storage | Ta = 60°C, 90%<br>2000 h | 22 pcs | $3.3 \times 10^4$ | 0 | $6.96 \times 10^{-5}$ |
| High-temperature reverse bias | Ta = 85°C, $V_{CE}$ = 30 V<br>2000 h | 22 pcs | $3.3 \times 10^4$ | 0 | $6.96 \times 10^{-5}$ |
| Temperature cycle | –40°C (30 min) to 100°C (30 min)<br>10 times | 22 pcs | --- | 0 | --- |
| Shock resistance | 14,700 m/s², 0.5 ms, 3 times each in ±X, ±Y, and ±Z directions | 11 pcs | --- | 0 | --- |
| Vibration resistance | 20 to 2,000 Hz, 1.5 mm or<br>98 m/s² each in X, Y, and Z directions | 11 pcs | --- | 0 | --- |

**Note: 1.** The tests after 1001 hours are for reference only.
**2.** Confidence level of 90%.

### EE-SX4235A-P2 (Transmissive Photo-IC Output)

#### Failure Criteria

| Item | Symbol | Measuring conditions | Failure criteria | |
|---|---|---|---|---|
| | | | General test (see note) | Life test |
| Current consumption | $I_{CC}$ | $V_{CC}$ = 5.5 V | 16.5 mA max. | 19.8 mA max. |
| Low-level output voltage | $V_{OL}$ | $V_{CC}$ = 4.5 V<br>$I_{OUT}$ = 16 mA<br>with incident | 0.35 V max. | 0.42 V max. |
| High-level output voltage | $I_{OH}$ | $V_{CC}$ = 5.5 V<br>$V_{OUT}$ = $V_{CC}$<br>with incident<br>$R_L$ = 47 kΩ | 4.95 V max. | 3.96 V max. |

**Note:** Except life test.

#### Test Results

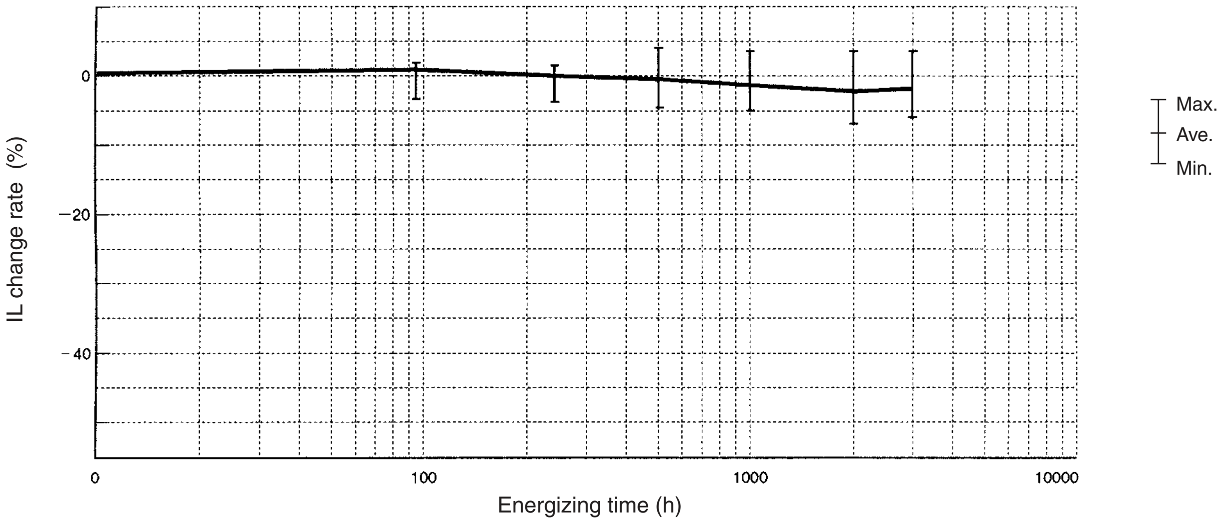
| Test item | Test conditions (see note 1) | Number of samples | Component hours (h) | Number of failures | Failure rate (1/h) (see note 2) |
|---|---|---|---|---|---|
| Continuous operation | Ta = 25°C, $V_{CC}$ = 5 V<br>1000 h | 22 pcs | $2.2 \times 10^4$ | 0 | $1.05 \times 10^{-4}$ |
| High-temperature storage | Ta = 85°C<br>1000 h | 22 pcs | $2.2 \times 10^4$ | 0 | $1.05 \times 10^{-4}$ |
| Low-temperature storage | Ta = –40°C<br>1000 h | 22 pcs | $2.2 \times 10^4$ | 0 | $1.05 \times 10^{-4}$ |
| High-temperature and high-humidity storage | Ta = 60°C, 90%<br>1000 h | 22 pcs | $2.2 \times 10^4$ | 0 | $1.05 \times 10^{-4}$ |
| Temperature cycle | –40°C (30 min) to 85°C (30 min)<br>10 times | 22 pcs | --- | 0 | --- |
| Shock resistance | 294 $m/s^2$, 0.5 ms, 3 times each in ±X, ±Y, and ±Z directions | 11 pcs | --- | 0 | --- |
| Vibration resistance | 5 to 50 Hz, 1.5 mm or 9.8 $m/s^2$ each in X, Y, and Z directions | 11 pcs | --- | 0 | --- |

**Note: 1.** The tests after 1001 hours are for reference only.
**2.** Confidence level of 90%.

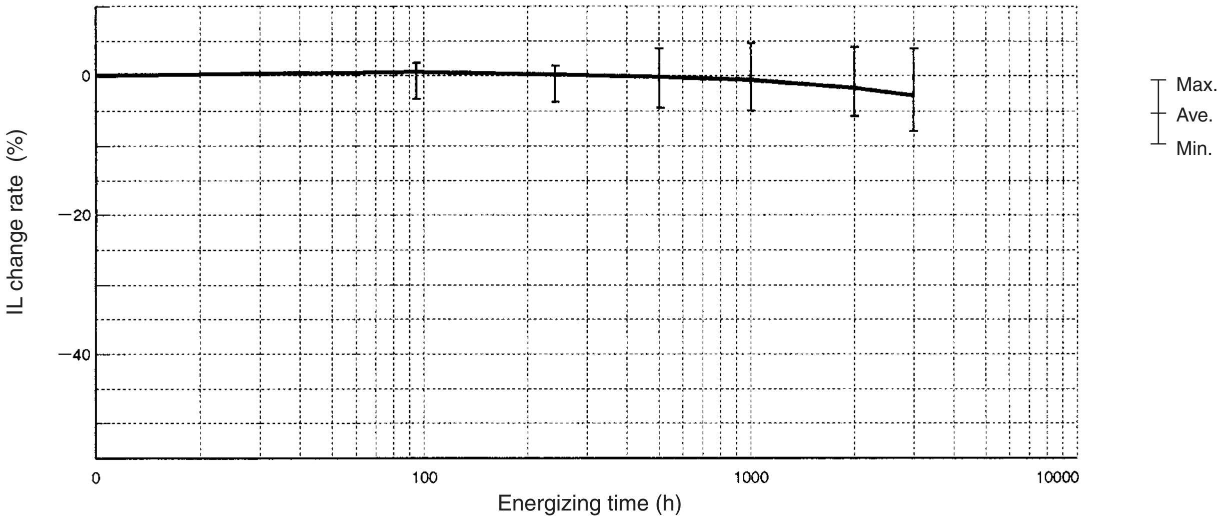
## Light Current ($I_L$) Secular Changes of Phototransistor Output Photomicrosensor

**Note:** Secular changes in Photomicrosensor light current (with a phototransistor output circuit) and LED current (with a photo IC output circuit) during output ON/OFF are generally due to reductions in the LED emission intensity.
The emission intensity of a GaAs infrared LED is shown in the graphs below. The information in these graphs applies to most of the GaAs infrared LEDs manufactured by OMRON. Because reductions in the emission intensity of an ordinary red LED tend to be larger than those of an infrared LED, the information in these graphs cannot be applied to ordinary red LEDs. For detailed information, consult your OMRON representative.

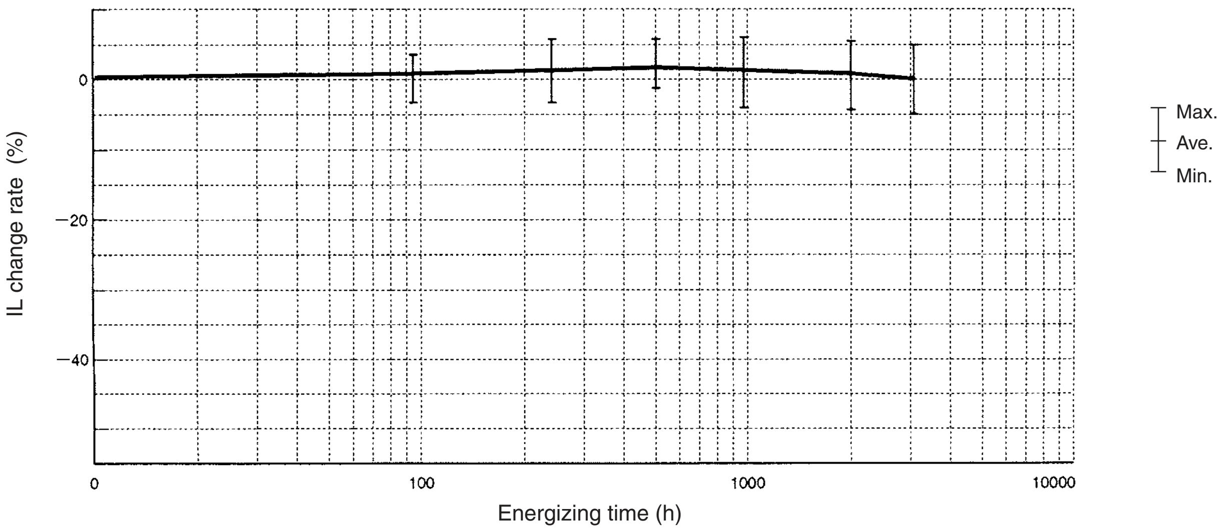
**Ta = 25°C, $I_F$ = 20 mA, n = 22**



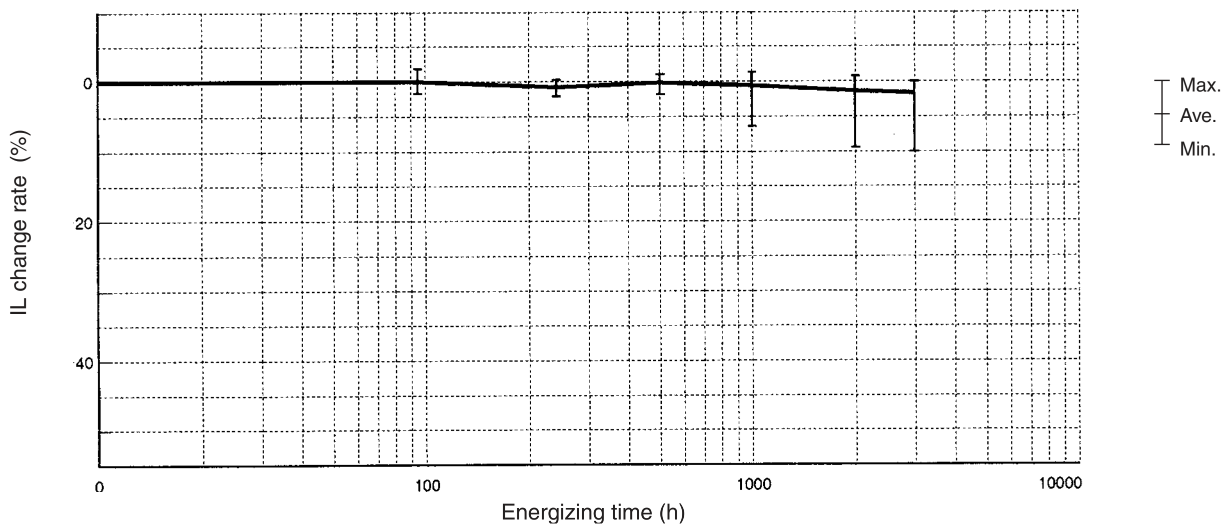

**Ta = 25°C, $I_F$ = 50 mA, n = 22**




**Ta = 85°C, $I_F$ = 10 mA, n = 22**



**Ta = –25°C, $I_F$ = 50 mA, n = 22**



# Security Trade Control

**(As of March 2003)**

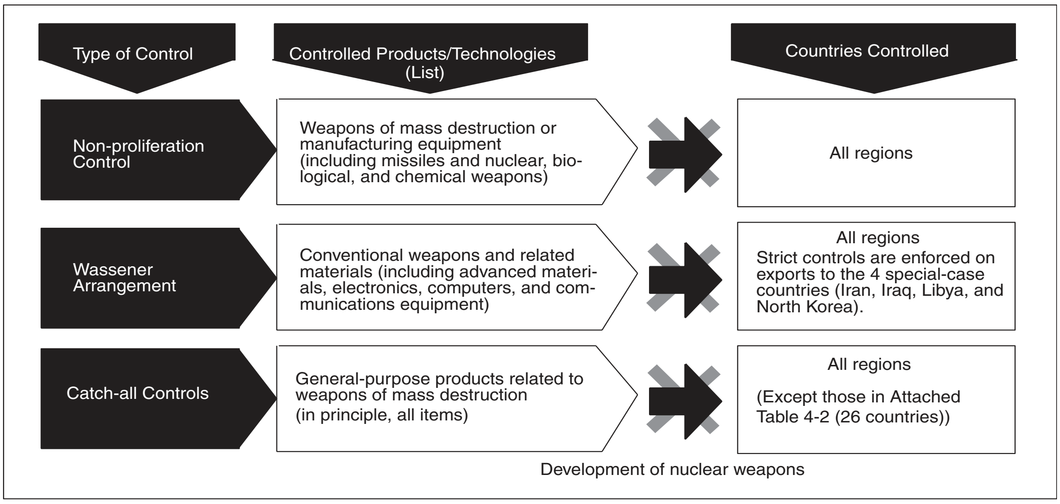
## ■ Purpose of the Export Controls

To preserve free trade and global security, it is necessary to prevent the proliferation, development, and production of weapons of mass destructions such as nuclear weapons, biological/chemical weapons, and missile systems. It is also necessary to prevent the accumulation of large amounts of conventional weapons or weapons–related materials to prevent regional disputes.

## ■ Contents of the Export Controls

The following chart provides a simple summary of export controls.

### The 3 Export Controls

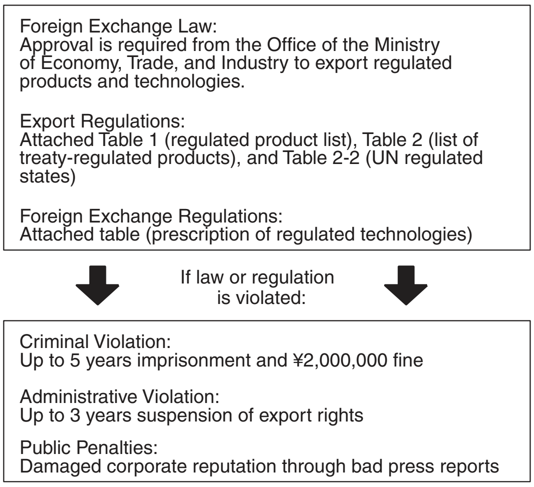



## ■ Laws, Ordinances, and Regulations Related to Export Controls

With respect to the Foreign Exchange Laws (Foreign Exchange and Foreign Trade Laws), etc., it is necessary to obtain approval from the Ministry of Economy, Trade, and Industry when exporting (or providing to a non–resident) any products or technologies* that require approval. If the product or technology is exported without approval or inappropriately, an individual will be charged with a criminal offense and a business will be subject to public penalties as outlined below.

**Note:** The Export Regulations (Export Exchange Regulations), Foreign Exchange Regulations, and related laws and ordinances specify which products and technologies require approval for export.

### Laws, Ordinances, and Regulations




## ■ Catch-all Controls

Catch-all controls is the general terms used for export controls that apply to the export of all products and technologies when 1) it is know that they will be used for the development or manufacture of weapons of mass destruction or 2) the government has informed an individual or business of such use. Catch-all controls are replacing the previous list controls.

Catch-all controls were implemented in Japan on April 1, 2002. Refer to the following websites for further information.

- Ministry of Economy, Trade, and Industry: http://www.meti.go.jp/policy/anpo/index.html
- CISTEC (Center for Information on Security Trade Control): http://www.cistec.or.jp

## ■ Compliance with the Regulations

As a corporate citizen of Japan and the global community, OMRON has established a Compliance Program to assure compliance with the regulations outlined above in order to help maintain free trade and global security. We have also planned a training course on export controls.

OMRON determines whether each of its products is subject to export controls and carefully controls transactions so that OMRON products are not exported inappropriately.

## ■ Request to Customers

When exporting goods that require export approval, always obtain approval from an Official of the Ministry of Economy, Trade, and Industry. When dealing with products that are subject to export controls, take precautions to prevent incorrect exportation even when the products are resold.

When exporting a controlled product, check the final application and end user to verify that the product will not be used in a weapon–related application such as a weapon itself or weapons research.

Furthermore, always verify that the OMRON product will not be used in any case in a nuclear weapon, missile, chemical weapon, other weapon, or equipment used to manufacture these weapons.

The limitations described above will be submitted to OMRON or an OMRON sales representative as an approval form or contract, so please fully understand and comply with these procedures.

If you have any questions, please contact your OMRON representative for further details. These security procedures are based on domestic Japanese laws and apply to exports from Japan.

## READ AND UNDERSTAND THIS DOCUMENT

Please read and understand this document before using the products. Please consult your OMRON representative if you have any questions or comments.

## WARRANTY

OMRON's exclusive warranty is that the products are free from defects in materials and workmanship for a period of one year (or other period if specified) from date of sale by OMRON.

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OMRON SHALL NOT BE RESPONSIBLE FOR SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS OR COMMERCIAL LOSS IN ANY WAY CONNECTED WITH THE PRODUCTS, WHETHER SUCH CLAIM IS BASED ON CONTRACT, WARRANTY, NEGLIGENCE, OR STRICT LIABILITY.

In no event shall responsibility of OMRON for any act exceed the individual price of the product on which liability is asserted.

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THE PRODUCTS CONTAINED IN THIS DOCUMENT ARE NOT SAFETY RATED. THEY ARE NOT DESIGNED OR RATED FOR ENSURING SAFETY OF PERSONS, AND SHOULD NOT BE RELIED UPON AS A SAFETY COMPONENT OR PROTECTIVE DEVICE FOR SUCH PURPOSES. Please refer to separate catalogs for OMRON's safety rated products.

OMRON shall not be responsible for conformity with any standards, codes, or regulations that apply to the combination of products in the customer's application or use of the product.

At the customer's request, OMRON will provide applicable third party certification documents identifying ratings and limitations of use that apply to the products. This information by itself is not sufficient for a complete determination of the suitability of the products in combination with the end product, machine, system, or other application or use.

The following are some examples of applications for which particular attention must be given. This is not intended to be an exhaustive list of all possible uses of the products, nor is it intended to imply that the uses listed may be suitable for the products:

- Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this document.
- Nuclear energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations.
- Systems, machines, and equipment that could present a risk to life or property.

Please know and observe all prohibitions of use applicable to the products.
NEVER USE THE PRODUCTS FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCT IS PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

## PERFORMANCE DATA

Performance data given in this document is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of OMRON's test conditions, and the users must correlate it to actual application requirements. Actual performance is subject to the OMRON Warranty and Limitations of Liability.

## CHANGE IN SPECIFICATIONS

Product specifications and accessories may be changed at any time based on improvements and other reasons.

It is our practice to change model numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the product may be changed without any notice. When in doubt, special model numbers may be assigned to fix or establish key specifications for your application on your request. Please consult with your OMRON representative at any time to confirm actual specifications of purchased products.

## DIMENSIONS AND WEIGHTS

Dimensions and weights are nominal and are not to be used for manufacturing purposes, even when tolerances are shown.

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**OMRON Corporation**
**Industrial Automation Company**
**Sensing Devices Division H.Q.**
**Industrial Sensors Division**
Shiokoji Horikawa, Shimogyo-ku,
Kyoto, 600-8530 Japan
Tel: (81)75-344-7022/Fax: (81)75-344-7107

***Regional Headquarters***
**OMRON EUROPE B.V.**
**Sensor Business Unit**
Carl-Benz-Str. 4, D-71154 Nufringen,
Germany
Tel: (49) 7032-811-0/Fax: (49) 7032-811-199

**OMRON ELECTRONICS LLC**
One Commerce Drive Schaumburg,
IL 60173-5302 U.S.A.
Tel: (1) 847-843-7900/Fax: (1) 847-843-7787

**OMRON ASIA PACIFIC PTE. LTD.**
No. 438A Alexandra Road # 05-05/08 (Lobby 2),
Alexandra Technopark, Singapore 119967
Tel: (65) 6835-3011/Fax: (65) 6835-2711

**OMRON (CHINA) CO., LTD.**
Room 2211, Bank of China Tower,
200 Yin Cheng Zhong Road,
PuDong New Area, Shanghai, 200120, China
Tel: (86) 21-5037-2222/Fax: (86) 21-5037-2200

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