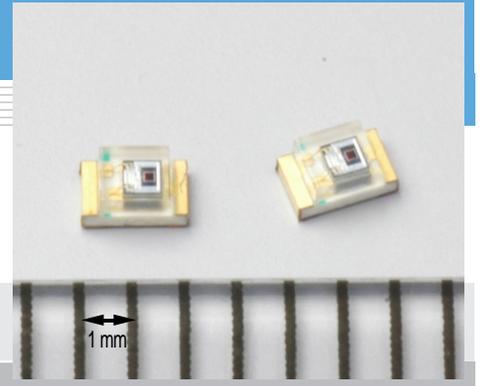


# Photo IC diode

## S10604

### COB (Chip On Board) type, small package



S10604 photo IC has spectral response close to human eye sensitivity. Two active areas are made on a single chip. Almost only the visible range can be measured by finding the difference between the two output signals in the internal current amplifier circuit. Effects of infrared remote control light on sensitivity are reduced when compared to conventional types.

#### Features

- Spectral response close to human eye sensitivity
- Small package:  $2.0 \times 1.25 \times 0.8^t$  mm  
About 1/5 the cubic volume of conventional type (S9067-01)
- Photocurrent produced by infrared remote control light (940 nm) is about 1/4 that of conventional type (S9067-01)
- Lower output-current fluctuations compared with phototransistors
- Excellent linearity
- Low output fluctuations for light sources producing the same illuminance at different color temperatures
- Suitable for lead-free reflow (RoHS compliance)

#### Applications

- Liquid crystal monitor backlight dimmer for cellular phone
- Energy-saving sensor for large-screen TVs, etc.
- Light dimmers for liquid crystal panels
- Various types of light level measurement

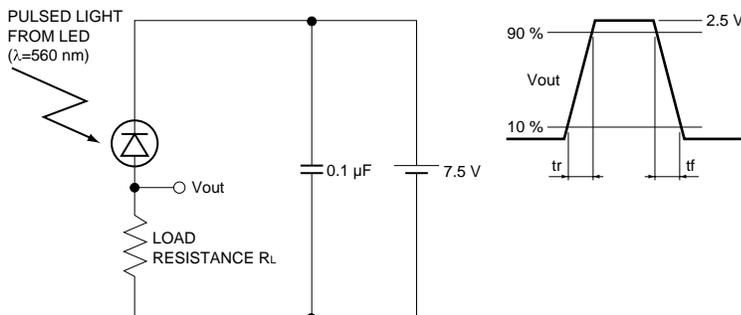
#### Absolute maximum ratings ( $T_a=25^\circ\text{C}$ )

| Parameter             | Symbol    | Value       | Unit             |
|-----------------------|-----------|-------------|------------------|
| Reverse voltage       | $V_R$     | -0.5 to +12 | V                |
| Photocurrent          | $I_L$     | 5           | mA               |
| Forward current       | $I_F$     | 5           | mA               |
| Operating temperature | $T_{opr}$ | -30 to +80  | $^\circ\text{C}$ |
| Storage temperature   | $T_{stg}$ | -40 to +85  | $^\circ\text{C}$ |

#### Electrical and optical characteristics ( $T_a=25^\circ\text{C}$ )

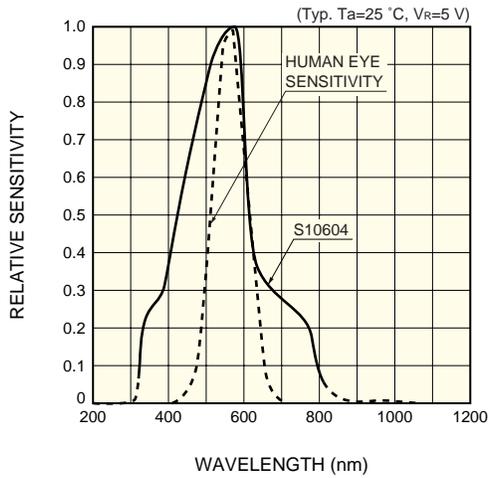
| Parameter                   | Symbol      | Condition   | Min. | Typ.       | Max. | Unit |
|-----------------------------|-------------|---|------|------------|------|------|
| Spectral response range     | $\lambda$   |   | -    | 320 to 820 | -    | nm   |
| Peak sensitivity wavelength | $\lambda_p$ |   | -    | 560        | -    | nm   |
| Dark current                | $I_D$       | $V_R=5\text{ V}$                                  | -    | 1.0        | 50   | nA   |
| Photocurrent                | $I_L$       | $V_R=5\text{ V}$ , 2856 K<br>100 lx               | 0.21 | 0.30       | 0.39 | mA   |
| Rise time *                 | $t_r$       | 10 to 90 %, $V_R=7.5\text{ V}$                    | -    | 6.0        | -    | ms   |
| Fall time *                 | $t_f$       | $R_L=10\text{ k}\Omega$ , $\lambda=560\text{ nm}$ | -    | 2.5        | -    | ms   |

\* Rise/fall time measurement method



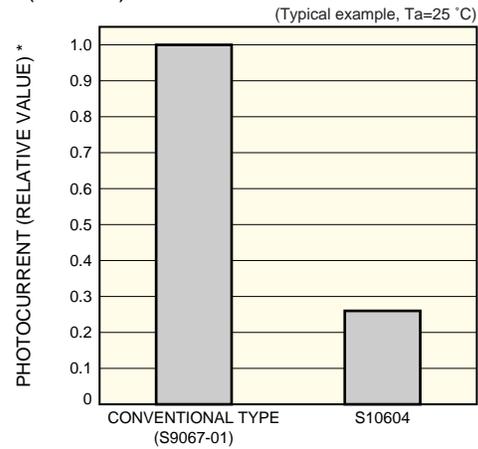
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■ Spectral response



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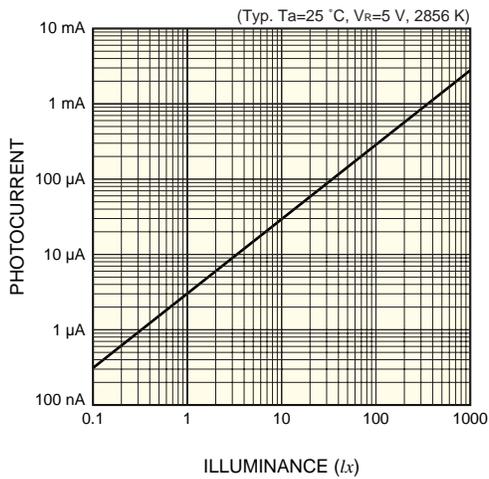
■ Photocurrent produced by infrared remote control light (940 nm)



\* S9067-01 normalized to 1.

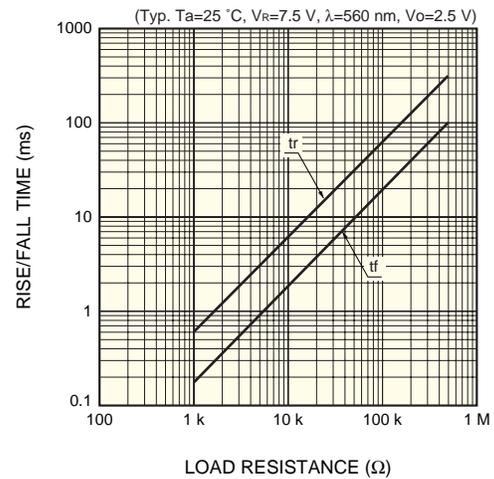
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■ Linearity



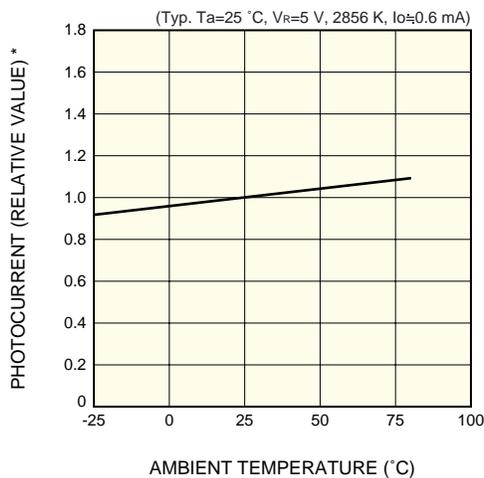
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■ Rise/fall time vs. load resistance



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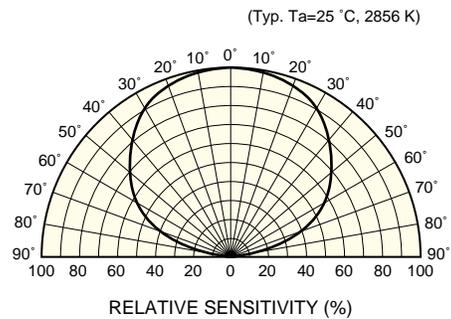
■ Photocurrent vs. ambient temperature



\* At  $T_a=25\text{ }^\circ\text{C}$  normalized to 1.

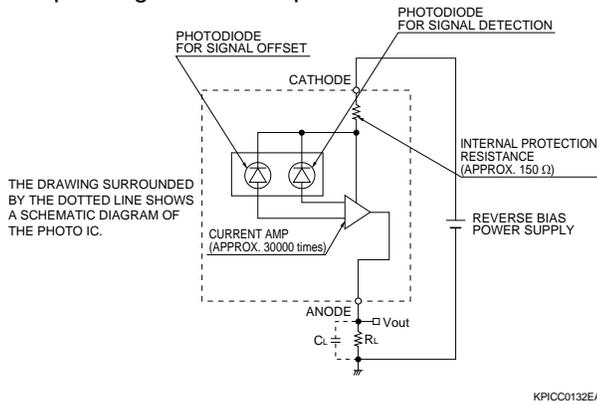
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■ Directivity



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■ Operating circuit example

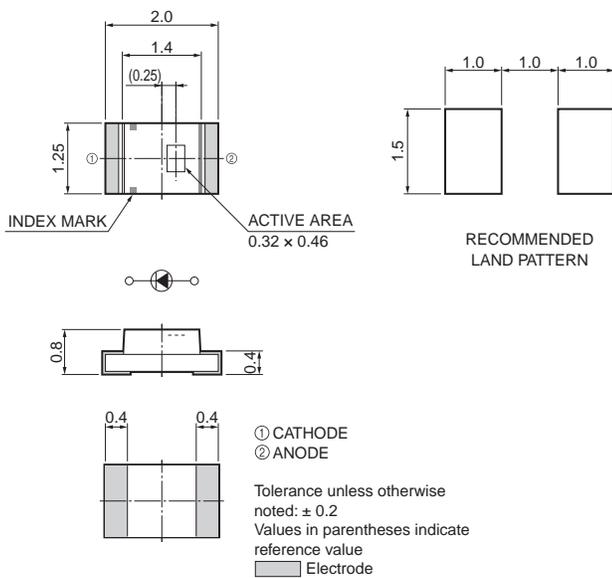


The photo IC diode must be reverse-biased so that a positive potential is applied to the cathode.

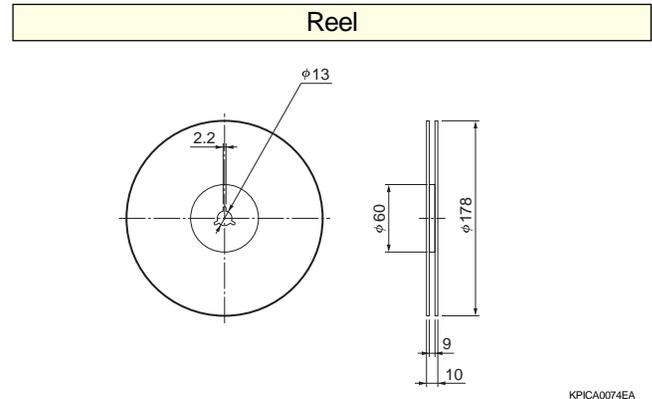
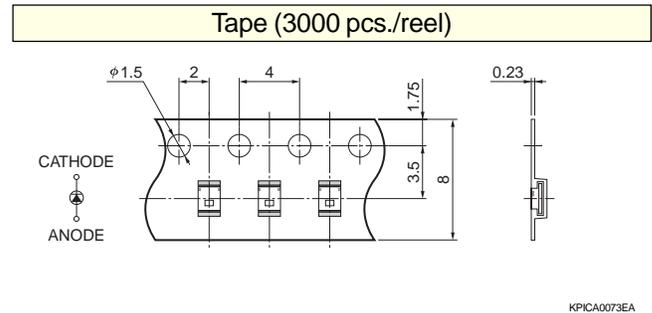
To eliminate high-frequency components, we recommend placing a load capacitance  $C_L$  in parallel with load resistance  $R_L$  as a low-pass filter.

$$\text{Cut-off frequency } f_c \approx \frac{1}{2\pi C_L R_L}$$

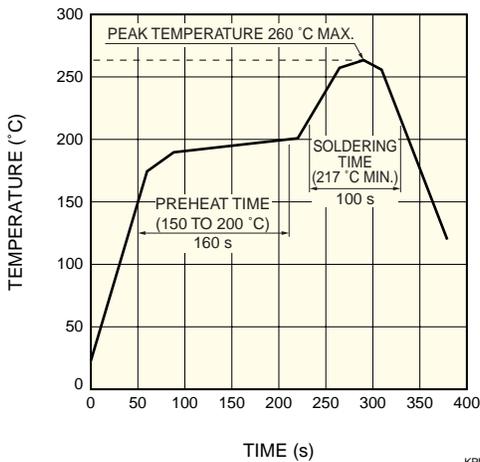
■ Dimensional outline (unit: mm)



■ Packing specifications



■ Recommended solder reflow condition



- After unpacking, store this device in an environment at a temperature of 5 to 25 °C and a humidity below 60 %, and perform reflow soldering on this device within 168 hours (7 days).
- Thermal stress applied to the device during reflow soldering differs depending on the PC boards and reflow oven being used. When setting the reflow conditions, make sure that the reflow soldering process does not degrade device reliability.

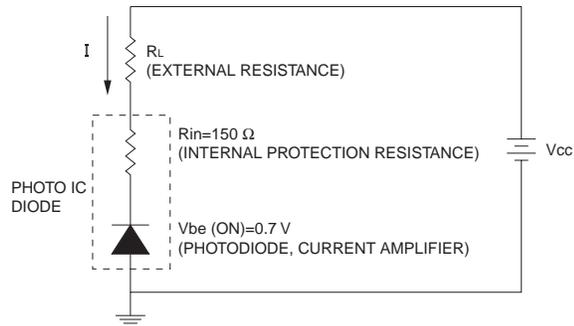
■ Operating voltage, output characteristics

Figure 2 shows photocurrent vs. reverse voltage characteristics (light source: LED) measured using the circuit shown in Figure 1. Output curves are plotted at different illuminance levels equivalent to a standard source A. The output curves start rising at a reverse voltage of approx. 0.7 V (rising voltage).

Photo IC diode contains an internal resistance of approx. 150 Ω to protect against excessive current. The reverse voltage  $V_R$  of a photo IC diode is the sum of  $V_{be}$  (ON) and the voltage drop across the protective resistance  $R_{in}$ .

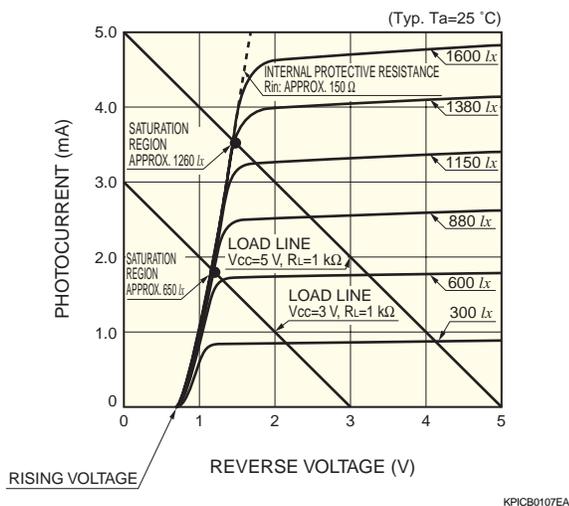
$$V_R = V_{be} (ON) + I \times R_{in} \dots\dots\dots (1)$$

Figure 1 Measurement circuit



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Figure 2 Photocurrent vs. reverse voltage



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The voltage drop ( $V_L$ ) caused by the external resistance is expressed by the following equation and is shown as load lines in Figure 2.

$$V_L = V_{cc} - I \times R_L \dots\dots\dots (2)$$

In Figure 2, the intersections between the output curves and load lines indicate the saturation region. Maximum detectable light levels can be estimated from this saturation point. Since the maximum detectable light level is determined by the power supply voltage ( $V_{cc}$ ) and load resistance ( $R_L$ ), change them to meet the required operating conditions.

Note:  $V_{be}$  (ON) and internal protection resistance have a respective temperature dependence of approximately -2 mV/°C and 0.1 %/°C.