

# Photo IC diode

S13948-01SB



## Plastic package shaped the same as metal package

The S13948-01SB photo IC has spectral response close to human eye sensitivity. Two photosensitive 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. Compared to the previous type, the S13948-01SB offers lower output fluctuations for light sources producing the same illuminance at different color temperatures. The S13948-01SB is encapsulated in a plastic package having the same shape as a metal package.

### Features

- Spectral response close to human eye sensitivity is attained without using visual-compensated filter.
- Operation just as easy to use as a photodiode
- Lower output-current fluctuations compared with phototransistors and CdS photoconductive cells.
- Excellent linearity
- Low output fluctuations for light sources producing the same illuminance at different color temperatures

### Applications

- Energy-saving sensor for TVs, etc.
- Light dimmers for liquid crystal panels
- Various types of light level measurement

### Absolute maximum ratings (Ta=25 °C)

Parameter	Symbol	Condition	Value	Unit
Maximum reverse voltage	V <sub>R</sub> max		-0.5 to 12	V
Photocurrent	I <sub>L</sub>		5	mA
Forward current	I <sub>F</sub>		5	mA
Power dissipation*1	P		250	mW
Operating temperature	T <sub>opr</sub>	No dew condensation*2	-30 to +80	°C
Storage temperature	T <sub>stg</sub>	No dew condensation*2	-40 to +85	°C
Soldering conditions	-		260 °C, within 5 s, at least 5.3 mm away from lead roots	-

\*1: Power dissipation decreases at a rate of 3.3 mW/°C above Ta=25 °C.

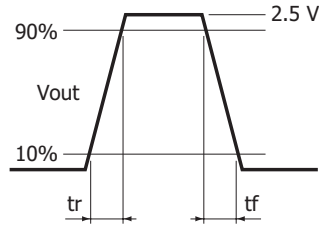
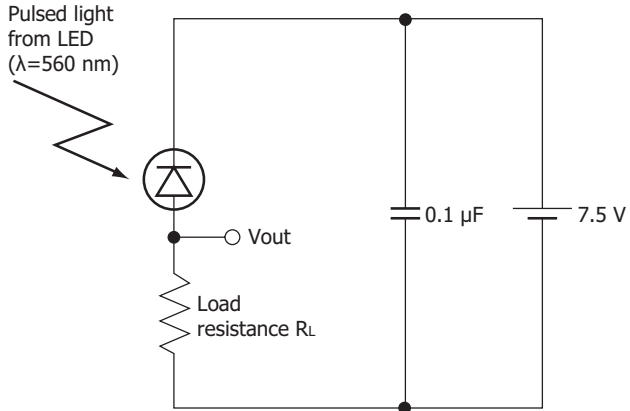
\*2: When there is a temperature difference between a product and the surrounding area in high humidity environment, dew condensation may occur on the product surface. Dew condensation on the product may cause deterioration in characteristics and reliability.

Note: Exceeding the absolute maximum ratings even momentarily may cause a drop in product quality. Always be sure to use the product within absolute maximum ratings.

### Electrical and optical characteristics (Ta=25 °C, unless otherwise noted.)

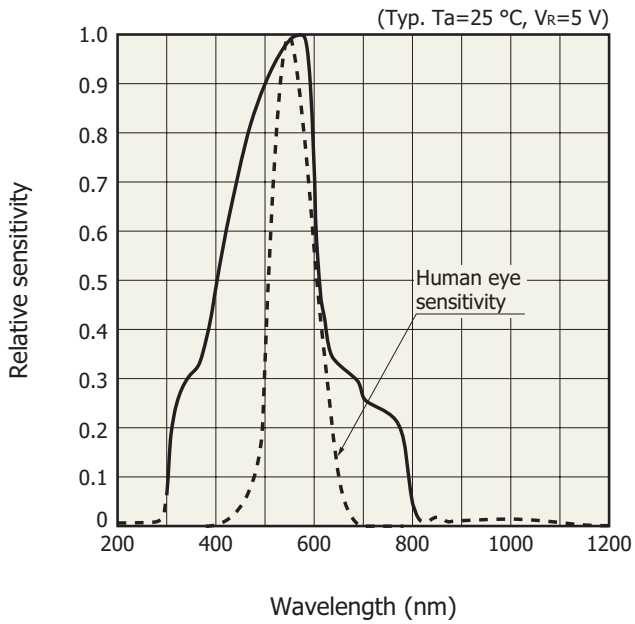
Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Spectral response range	$\lambda$		-	300 to 820	-	nm
Peak sensitivity wavelength	$\lambda_p$		-	560	-	nm
Dark current	I <sub>D</sub>	V <sub>R</sub> =5 V	-	1.0	50	nA
Photocurrent	I <sub>L</sub>	V <sub>R</sub> =5 V, 2856 K, 100 lx	0.18	-	0.34	mA
Rise time*3	t <sub>r</sub>	10 to 90%, V <sub>R</sub> =7.5 V R <sub>L</sub> =10 k $\Omega$ , $\lambda$ =560 nm	-	6.0	-	ms
Fall time*3	t <sub>f</sub>	90 to 10%, V <sub>R</sub> =7.5 V R <sub>L</sub> =10 k $\Omega$ , $\lambda$ =560 nm	-	2.5	-	ms

\*3: Rise/fall time measurement method (page 2)

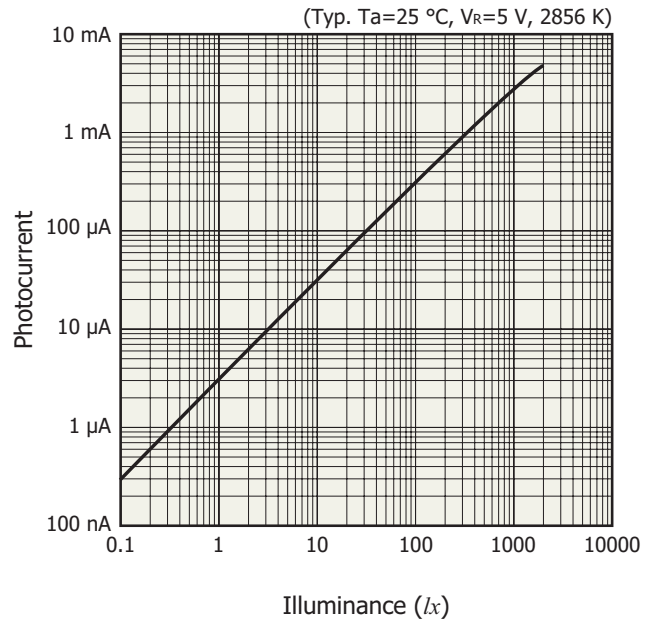


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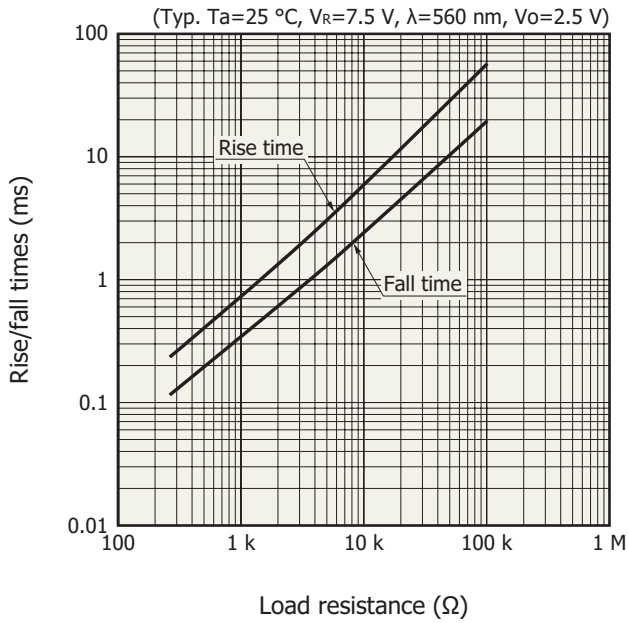
**Spectral response**



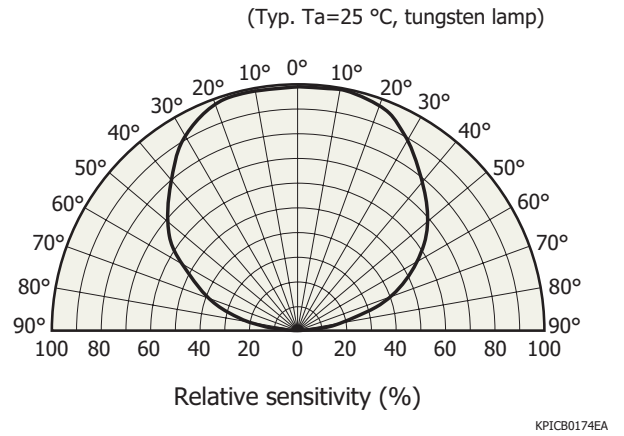
**Photocurrent vs. illuminance**



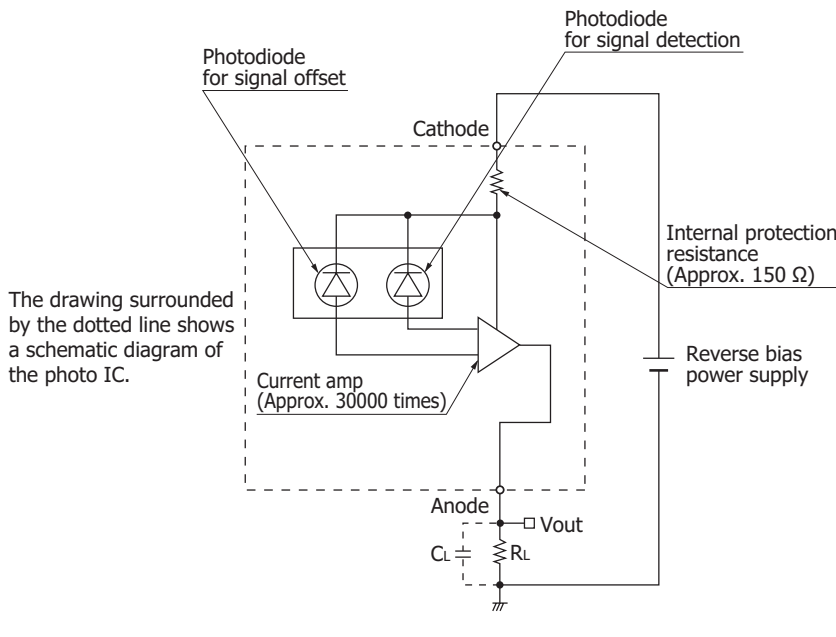
**Rise/fall times vs. load resistance**



**Directivity**



**Block diagram**



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 CL in parallel with load resistance RL as a low-pass filter.

$$\text{Cutoff frequency (fc)} \approx \frac{1}{2\pi C_L R_L}$$

**Operating voltage, output characteristics**

Figure 2 shows the photocurrent vs. reverse voltage characteristics (light source: LED) for the measurement circuit example in Figure 1. The output curves are shown for illuminance levels. The output curves rise from a reverse voltage (rising voltage) of approximately 0.7 V ( $\pm 10\%$ ).

To protect the photo IC diode from excessive current, a 150  $\Omega$  ( $\pm 20\%$ ) protection resistor is inserted in the circuit. Reverse voltage  $V_R$  when the photo IC diode is saturated is the sum of  $V_{be(ON)}$  and the voltage drop across the protection resistor  $R_{in}$  [Equation (1)].

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

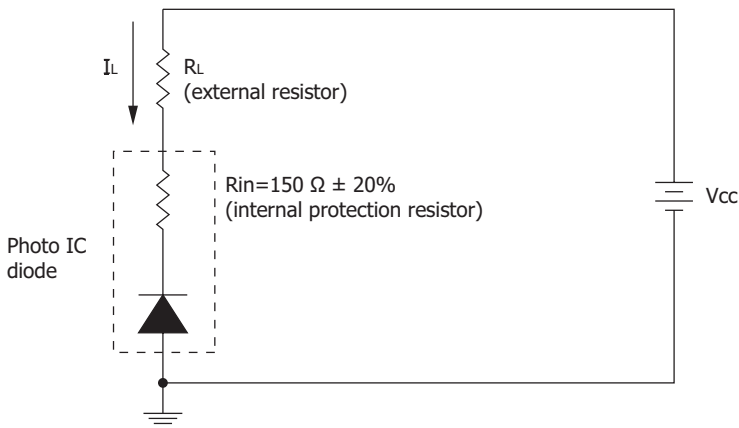
The photodiode's reverse voltage ( $V_R$ ) is expressed by Equation (2) according to the voltage drop across the external resistor. This is indicated as load lines in Figure 2.

$$V_R = V_{cc} - I_L \times R_L \dots\dots\dots (2)$$

In Figure 2, the intersections between the output curves and the load lines are the saturation points. From these points, the maximum detectable light level can be specified. Since the maximum light level is determined by the supply voltage ( $V_{cc}$ ) and load resistance ( $R_L$ ), adjust them according to the operating conditions.

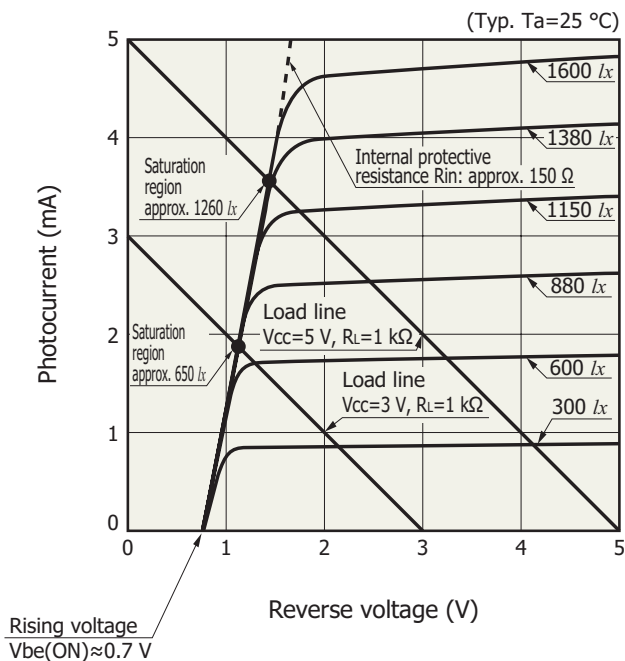
Note: The temperature characteristics of  $V_{be(ON)}$  is approximately  $-2 \text{ mV}/^\circ\text{C}$ , and that of the protection resistor is approximately  $0.1\%/^\circ\text{C}$ .

[Figure 1] Measurement circuit example



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[Figure 2] Photocurrent vs. reverse voltage



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