



S9648-200SB

## Plastic package shaped the same as metal package

The S9648-200SB 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 S9648-200SB offers lower output fluctuations for light sources producing the same illuminance at different color temperatures. The S9648-200SB is encapsulated in a plastic package having the same shape as a metal package. The shape of the S9648-100 also resembles our 5R type visible sensors (CdS photoconductive cells), so the S9648-200SB can be used as a replacement for those visible sensors.

### 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

Parameter	Symbol	Condition	Value	Unit
Maximum reverse voltage	$V_R$ max	$T_a=25\text{ }^\circ\text{C}$	-0.5 to 12	V
Photocurrent	$I_L$	$T_a=25\text{ }^\circ\text{C}$	5	mA
Forward current	$I_F$	$T_a=25\text{ }^\circ\text{C}$	5	mA
Power dissipation*1	P	$T_a=25\text{ }^\circ\text{C}$	250	mW
Operating temperature	$T_{opr}$	No dew condensation*2	-30 to +80	$^\circ\text{C}$
Storage temperature	$T_{stg}$	No dew condensation*2	-40 to +85	$^\circ\text{C}$

\*1: Power dissipation decreases at a rate of 3.3 mW/ $^\circ\text{C}$  above  $T_a=25\text{ }^\circ\text{C}$ .

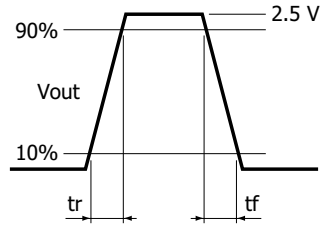
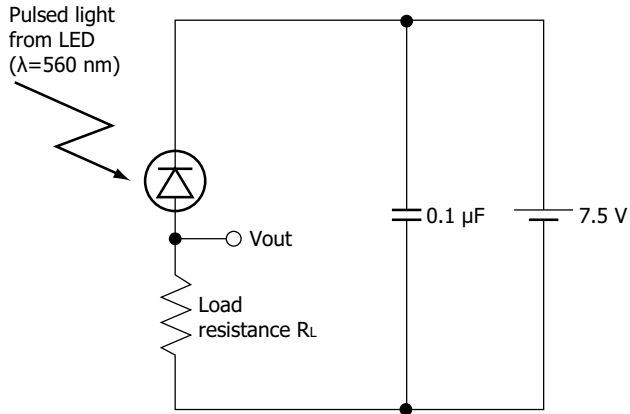
\*2: When there is a temperature difference between a product and the surrounding area in high humidity environment, dew condensation may occur on the product surface. Dew condensation on the product may cause deterioration in characteristics and reliability.

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 ( $T_a=25\text{ }^\circ\text{C}$ , unless otherwise noted.)

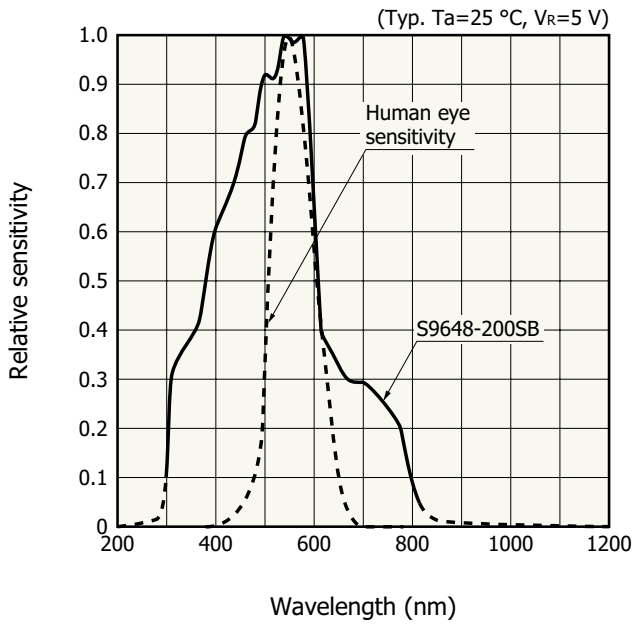
Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Spectral response range	$\lambda$		-	300 to 820	-	nm
Peak sensitivity wavelength	$\lambda_p$		-	560	-	nm
Dark current	$I_D$	$V_R=5\text{ V}$	-	1.0	50	nA
Photocurrent	$I_L$	$V_R=5\text{ V}$ , 2856 K, 100 lx	0.18	-	0.34	mA
Rise time*3	$t_r$	10 to 90%, $V_R=7.5\text{ V}$ $R_L=10\text{ k}\Omega$ , $\lambda=560\text{ nm}$	-	6.0	-	ms
Fall time*3	$t_f$	90 to 10%, $V_R=7.5\text{ V}$ $R_L=10\text{ k}\Omega$ , $\lambda=560\text{ nm}$	-	2.5	-	ms

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



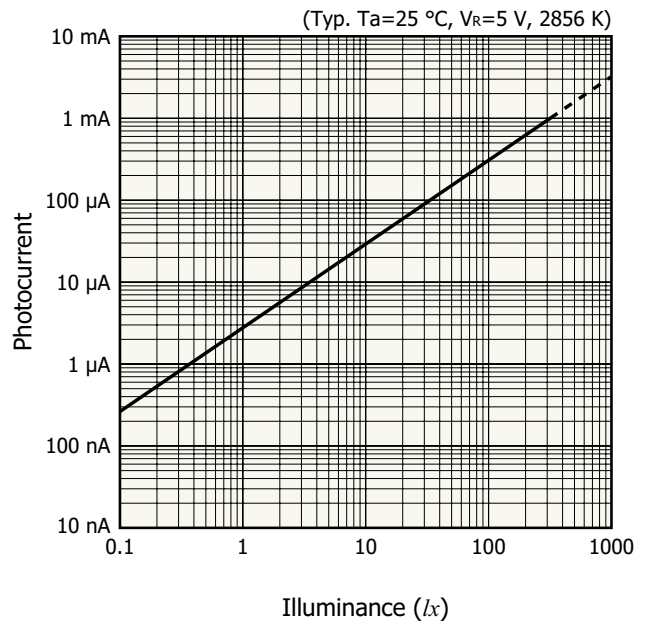
KPIC00229EB

**Spectral response**



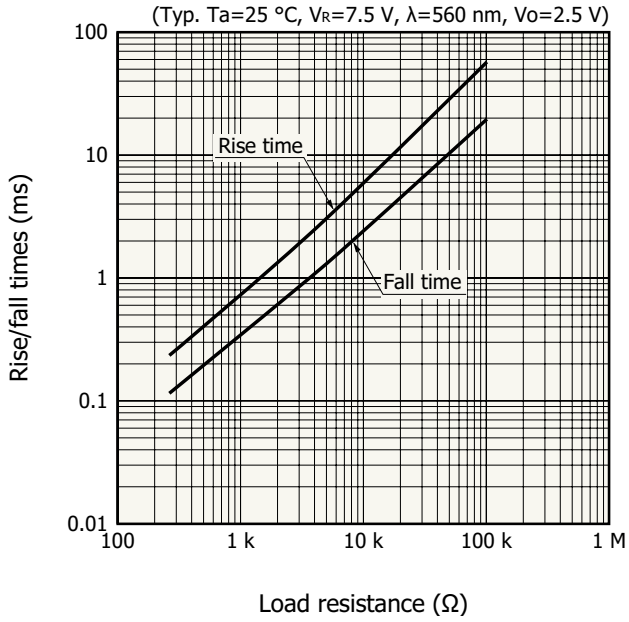
KPIC0085EC

**Linearity**



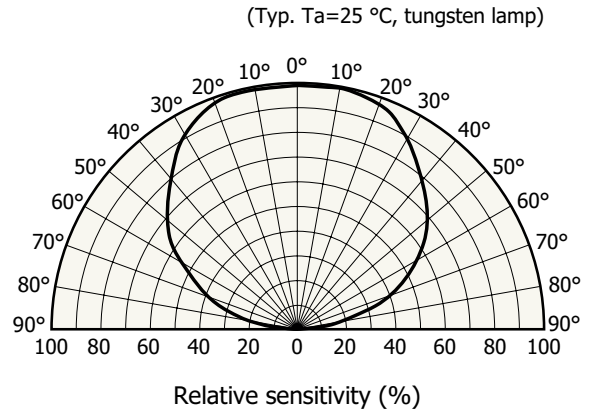
KPIC0086EB

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



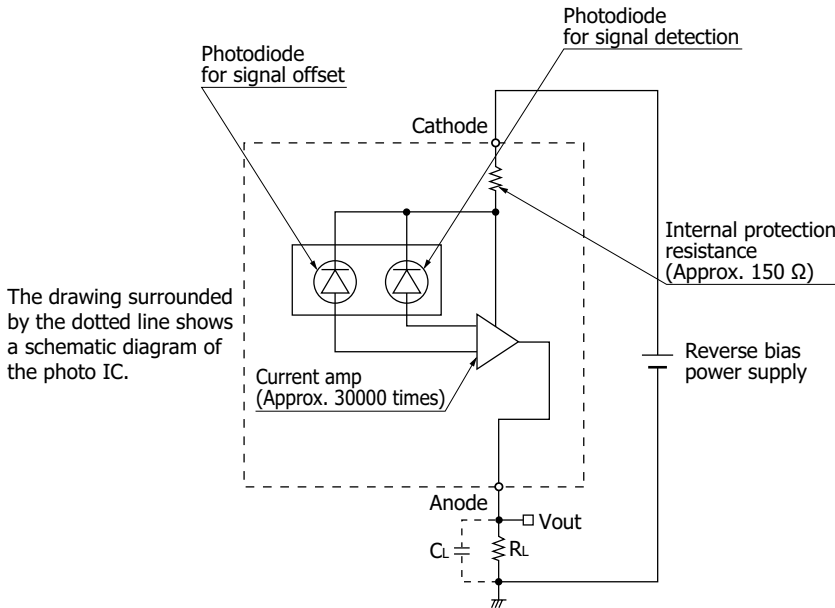
KPICB0077EB

**Directivity**



KPICB0174EA

**Operating circuit example**



KPICC0091EC

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.

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

**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)].

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

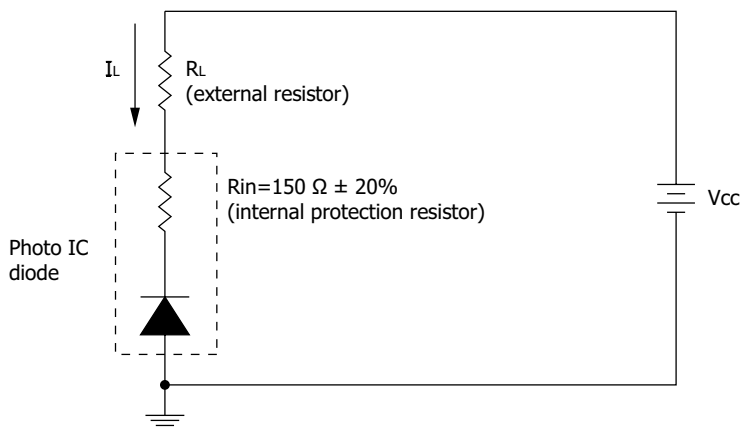
The photodiode's reverse voltage ( $V_R$ ) is expressed by Equation (2) according to the voltage drop across the external resistor. This is indicated as load lines in Figure 2.

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

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.

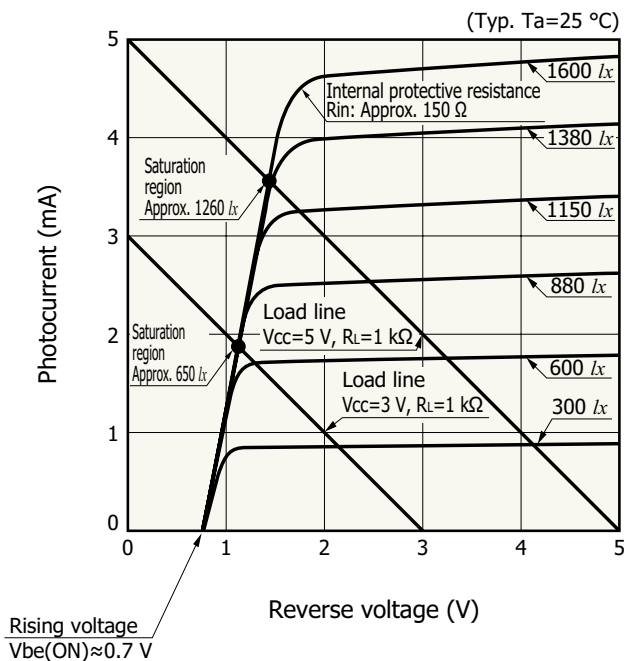
Note: The temperature characteristics of  $V_{be(ON)}$  is approximately  $-2 \text{ mV}/^\circ\text{C}$ , and that of the protection resistor is approximately  $0.1\%/^\circ\text{C}$ .

[Figure 1] Measurement circuit example



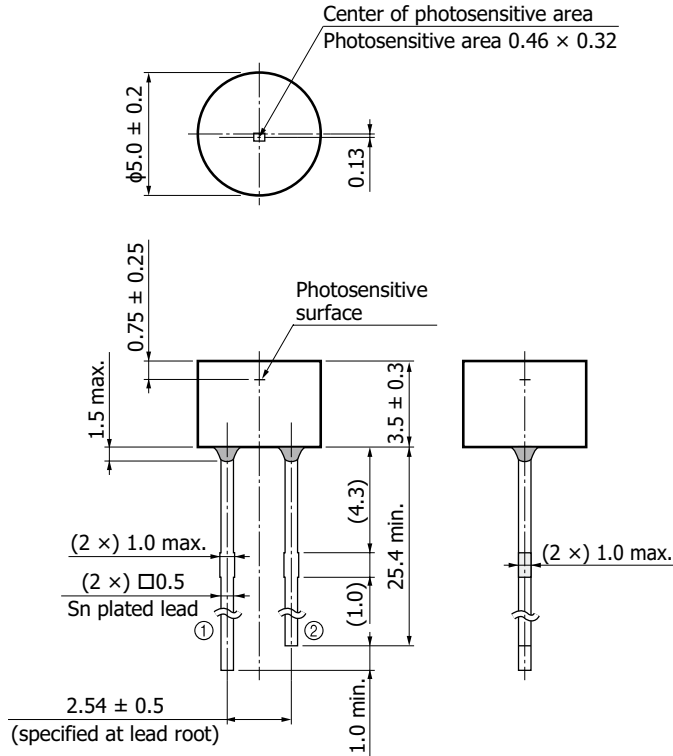
KPIC0128EC

[Figure 2] Photocurrent vs. reverse voltage



KPIC0107EB

### Dimensional outline (unit: mm)



- Fillet
- Tie-bar cut point (including burr, no plating)
- ① Anode
- ② Cathode
- Lead surface finish: Sn plating
- Packing: Polyethylene pack [anti-static type]  
(500 pcs/pack)

KPICA0057ED

### Related information

[www.hamamatsu.com/sp/ssd/doc\\_en.html](http://www.hamamatsu.com/sp/ssd/doc_en.html)

#### Precautions

- Disclaimer

Information described in this material is current as of March, 2015.

Product specifications are subject to change without prior notice due to improvements or other reasons. This document has been carefully prepared and the information contained is believed to be accurate. In rare cases, however, there may be inaccuracies such as text errors. Before using these products, always contact us for the delivery specification sheet to check the latest specifications.

Type numbers of products listed in the delivery specification sheets or supplied as samples may have a suffix "(X)" which means preliminary specifications or a suffix "(Z)" which means developmental specifications.

The product warranty is valid for one year after delivery and is limited to product repair or replacement for defects discovered and reported to us within that one year period. However, even if within the warranty period we accept absolutely no liability for any loss caused by natural disasters or improper product use.

Copying or reprinting the contents described in this material in whole or in part is prohibited without our prior permission.

# HAMAMATSU

[www.hamamatsu.com](http://www.hamamatsu.com)

HAMAMATSU PHOTONICS K.K., Solid State Division

1126-1 Ichino-cho, Higashi-ku, Hamamatsu City, 435-8558 Japan, Telephone: (81) 53-434-3311, Fax: (81) 53-434-5184

U.S.A.: Hamamatsu Corporation: 360 Foothill Road, Bridgewater, N.J. 08807, U.S.A., Telephone: (1) 908-231-0960, Fax: (1) 908-231-1218

Germany: Hamamatsu Photonics Deutschland GmbH: Arzbergerstr. 10, D-82211 Herrsching am Ammersee, Germany, Telephone: (49) 8152-375-0, Fax: (49) 8152-265-8

France: Hamamatsu Photonics France S.A.R.L.: 19, Rue du Saule Trapu, Parc du Moulin de Massy, 91882 Massy Cedex, France, Telephone: 33-(1) 69 53 71 00, Fax: 33-(1) 69 53 71 10

United Kingdom: Hamamatsu Photonics UK Limited: 2 Howard Court, 10 Tewin Road, Welwyn Garden City, Hertfordshire AL7 1BW, United Kingdom, Telephone: (44) 1707-294888, Fax: (44) 1707-325777

North Europe: Hamamatsu Photonics Norden AB: Torshamnsgatan 35 16440 Kista, Sweden, Telephone: (46) 8-509-031-00, Fax: (46) 8-509-031-01

Italy: Hamamatsu Photonics Italia S.r.l.: Strada della Moia, 1 int. 6, 20020 Arese (Milano), Italy, Telephone: (39) 02-93581733, Fax: (39) 02-93581741

China: Hamamatsu Photonics (China) Co., Ltd.: B1201, Jiaming Center, No.27 Dongsanhuan Beilu, Chaoyang District, Beijing 100020, China, Telephone: (86) 10-6586-6006, Fax: (86) 10-6586-2866