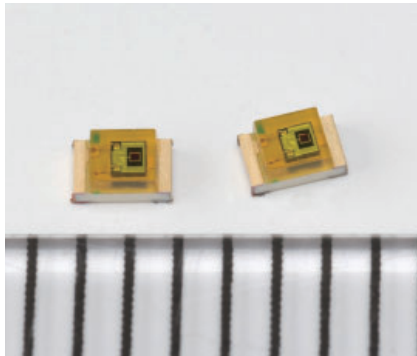


# Photo IC diode



S11154-01CT

## Reduced color temperature errors

The S11154-01CT is a photo IC diode with spectral response characteristics that closely resemble human eye sensitivity. Two active areas are formed on the same chip, and the outputs of the two active areas are subtracted from each other by the current amplifier circuit, in order to have sensitivity almost only in the visible range and reduce the color temperature errors.

### Features

- Spectral response close to human eye sensitivity
- Lower output-current variation compared with phototransistors
- Excellent linearity
- Low output deviation by different color temperature light source
- Suitable for lead-free reflow (RoHS compliance)

### Applications

- Energy-saving sensor for large-screen TVs, etc.
- Various types of light level measurement

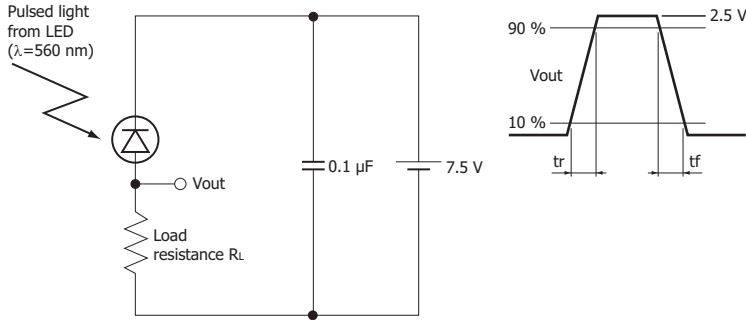
### Absolute maximum ratings (Ta=25 °C)

Parameter	Symbol	Value	Unit
Reverse voltage	V <sub>R</sub>	-0.5 to +12	V
Photocurrent	I <sub>L</sub>	5	mA
Forward current	I <sub>F</sub>	5	mA
Operating temperature	T <sub>opr</sub>	-30 to +80	°C
Storage temperature	T <sub>stg</sub>	-40 to +85	°C

### Electrical and optical characteristics (Ta=25 °C)

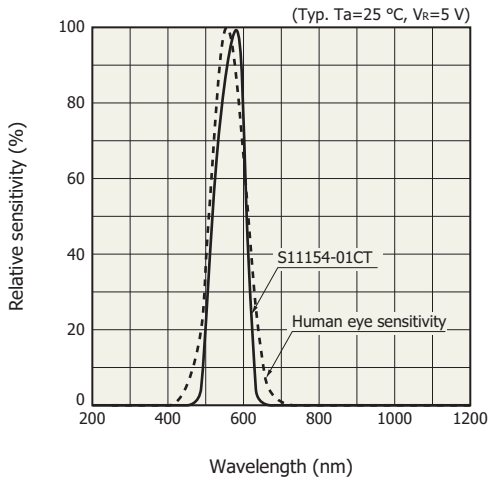
Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Spectral response range	$\lambda$		-	480 to 640	-	nm
Peak sensitivity wavelength	$\lambda_p$		-	580	-	nm
Dark current	I <sub>D</sub>	V <sub>R</sub> =5 V	-	1.0	50	nA
Photocurrent	I <sub>L</sub>	V <sub>R</sub> =5 V, 2856 K 100 lx	70	110	150	μA
Rise time *	t <sub>r</sub>	10 to 90 %, V <sub>R</sub> =7.5 V	-	6.0	-	ms
Fall time *	t <sub>f</sub>	R <sub>L</sub> =10 kΩ, λ=560 nm	-	2.5	-	ms

\* Rise/fall time measurement method



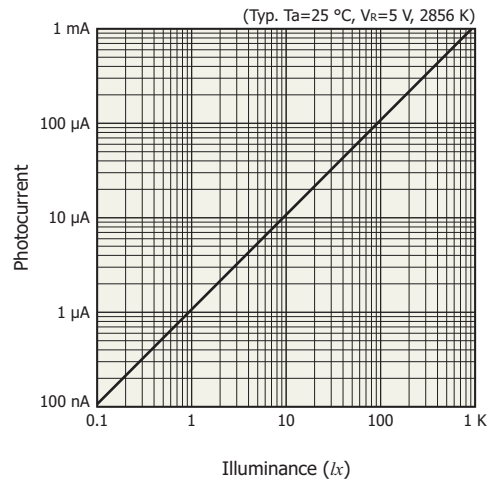
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▣ Spectral response



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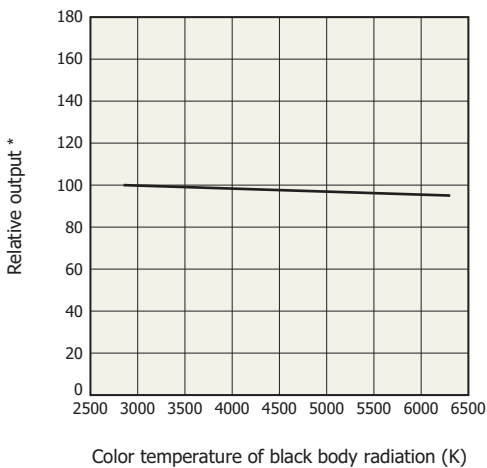
▣ Linearity



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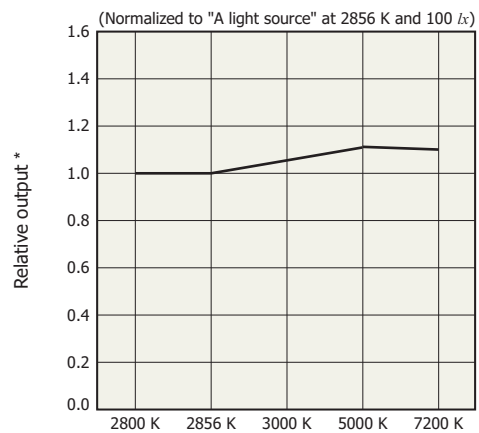
▣ Color temperature error

Black body radiation flux (simulation)



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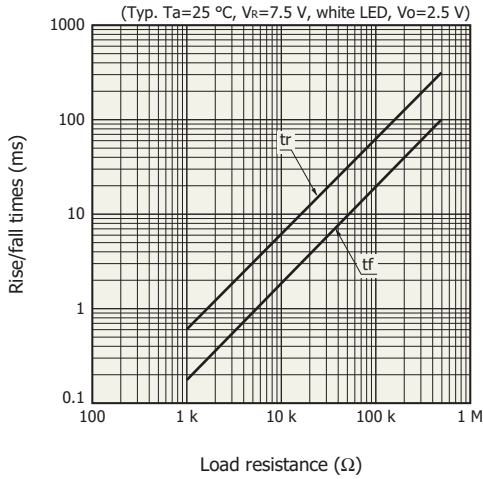
Difference between various light sources



2800 K: Silica bulb  
 2856 K: A light source  
 3000 K: Fluorescent light bulb  
 3000 K: Fluorescent light bulb  
 7200 K: Fluorescent light bulb  
 \* At 2856 K normalized to 100.

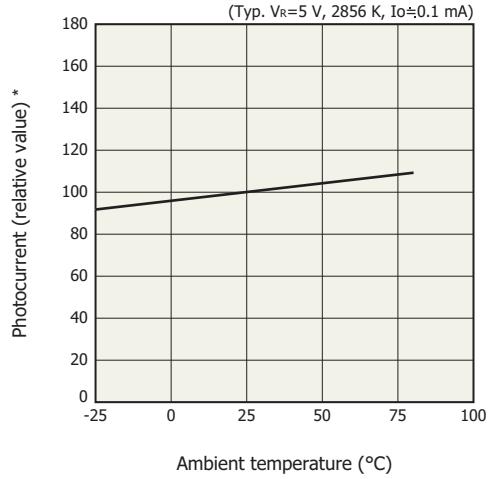
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**Rise/fall times vs. load resistance**



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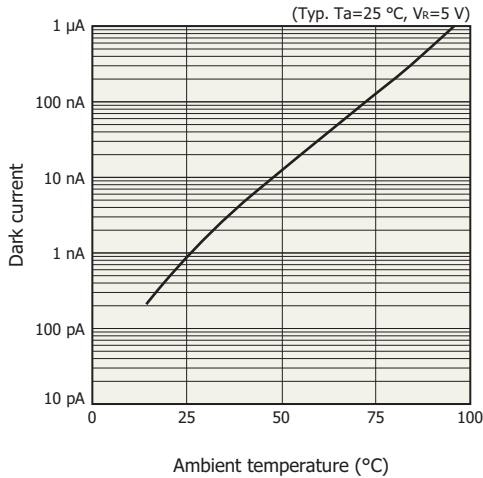
**Photocurrent vs. ambient temperature**



\* At Ta=25 °C normalized to 100.

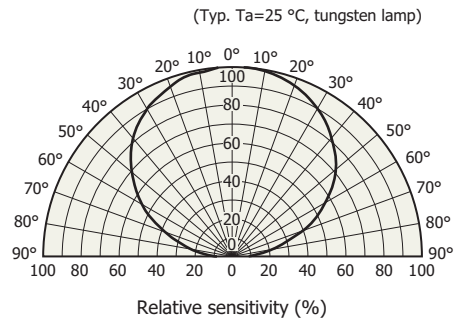
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**Dark current vs. ambient temperature**



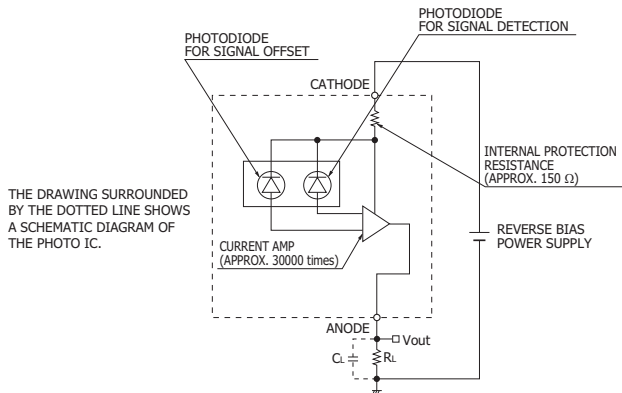
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**Directivity**



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**Block diagram**



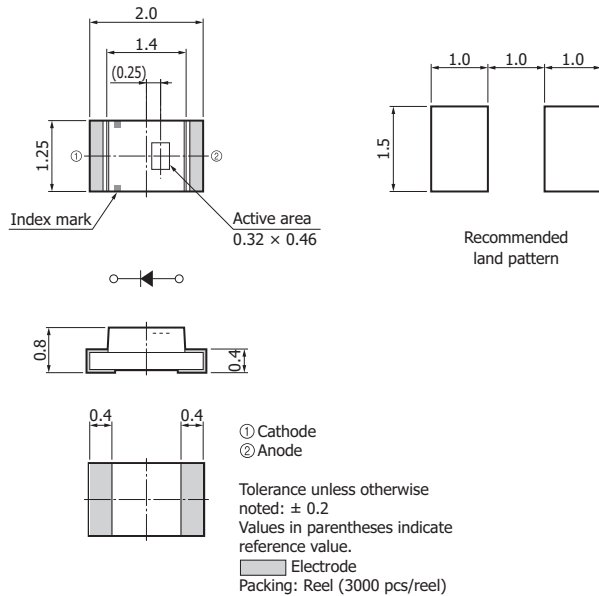
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The photo IC diode must be reverse-biased so that a positive potential is applied to the cathode.

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

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

**Dimensional outline (unit: mm)**



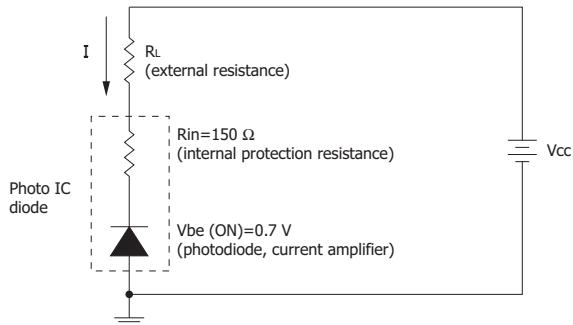
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**Operating voltage, output characteristics**

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 light source. The output curves start rising at a reverse voltage of approx. 0.7 V. 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  $R_{in}$ .

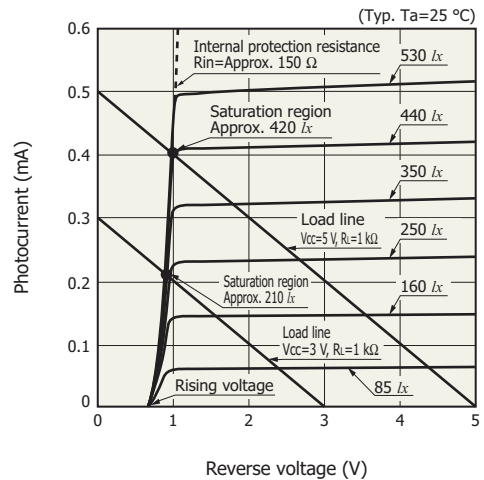
$$V_R = V_{be} (ON) + I \times R_{in}$$

Figure 1 Measurement circuit



KP1CC0128EB

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.

$$V_L = I \times R_L$$






Thus, the reverse voltage ( $V_R$ ) for the photo IC diode is given by the following equation:

$$V_R = V_{CC} - V_L = V_{CC} - I_L \times R_L$$

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.

### Lineup of illuminance sensors

Type No.	Type	Output	Package (mm)	Reverse voltage [Supply voltage]	Spectral response range (nm)	Photocurrent * 2856 K, 100 lx	Rise time (ms)	Photo
S9648-100	Photo IC diode	Analog current output	$\phi 5 \times 3.5^t$ (Top view)	-0.5 to +12 V	300 to 820	0.26 mA	6	
S9067-101			$3.2 \times 2.7 \times 1.1^t$ COB			0.26 mA		
S10925			$2.0 \times 1.25 \times 0.8^t$ COB			0.0036 mA	0.06	
S11154-01CT						480 to 640	0.11 mA	6
S9705	Light-to-frequency converter photo IC	Frequency output (for direct connection to microcontroller)	$3.0 \times 4.0 \times 1.3^t$ 4-pin plastic	[2.7 to 5.5 V]	380 to 640	50 kHz	-	
S11252-01WT	I <sup>2</sup> C compatible illuminance sensor	Digital output (for direct connection to microcontroller)	$1.18 \times 1.18 \times 0.58^t$ WL-CSP	[2.25 to 3.63 V]	490 to 650	3.1 counts/lx (low gain) 28.8 counts/lx (high gain)	-	

\* S9705: frequency output, S11252-01WT: digital output

Information furnished by HAMAMATSU is believed to be reliable. However, no responsibility is assumed for possible inaccuracies or omissions.

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Type numbers of products listed in the specification sheets or supplied as samples may have a suffix "(X)" which means tentative specifications or a suffix "(Z)" which means developmental specifications. ©2009 Hamamatsu Photonics K.K.

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