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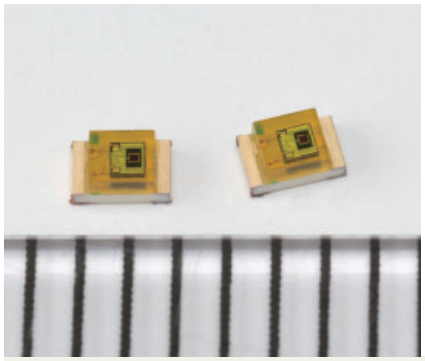
# Photo IC diode



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**

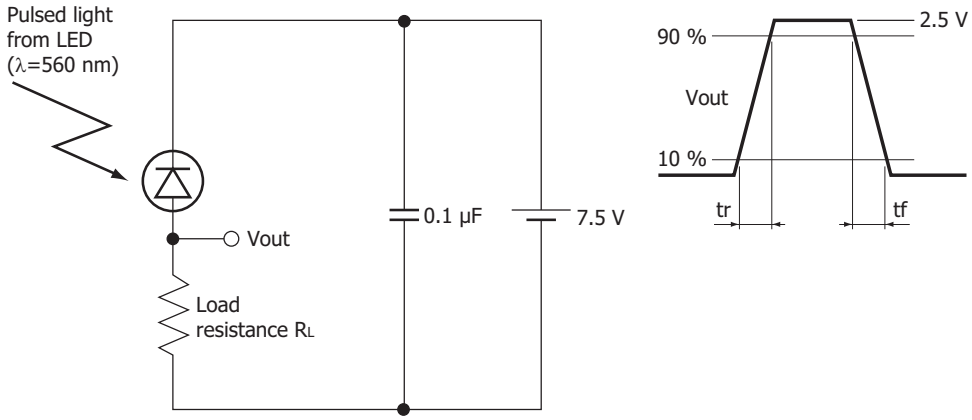
### Absolute maximum ratings (Ta=25 °C)

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Reverse voltage | $V_R$ | -0.5 to +12 | V |
| Photocurrent | $I_L$ | 5 | mA |
| Forward current | $I_F$ | 5 | mA |
| Operating temperature | Topr | -30 to +80 | °C |
| Storage temperature | Tstg | -40 to +85 | °C |

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

| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Spectral response range | λ | | - | 480 to 640 | - | nm |
| Peak sensitivity wavelength | λp | | - | 580 | - | nm |
| Dark current | $I_D$ | $V_R$=5 V | - | 1.0 | 50 | nA |
| Photocurrent | $I_L$ | $V_R$=5 V, 2856 K<br>100 *lx* | 70 | 110 | 150 | μA |
| Rise time * | tr | 10 to 90 %, $V_R$=7.5 V | - | 6.0 | - | ms |
| Fall time * | tf | $R_L$=10 kΩ, λ=560 nm | - | 2.5 | - | ms |

* Rise/fall time measurement method

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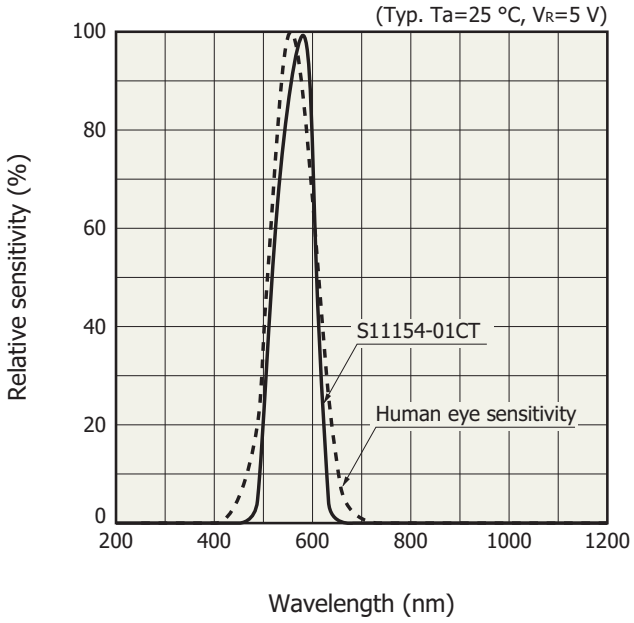
## Spectral response

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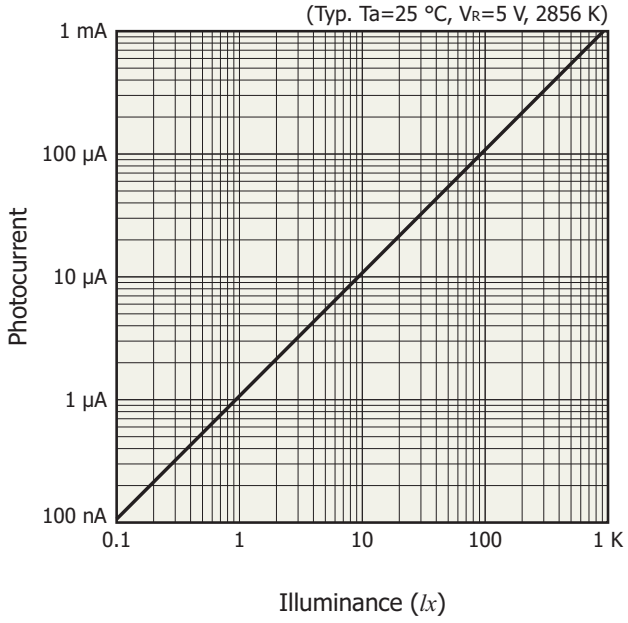
## Linearity

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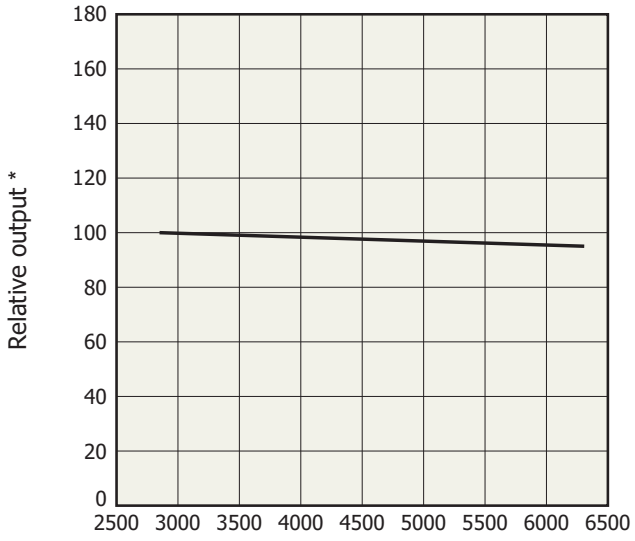
## Color temperature error

Black body radiation flux (simulation)




* At 2856 K normalized to 100.

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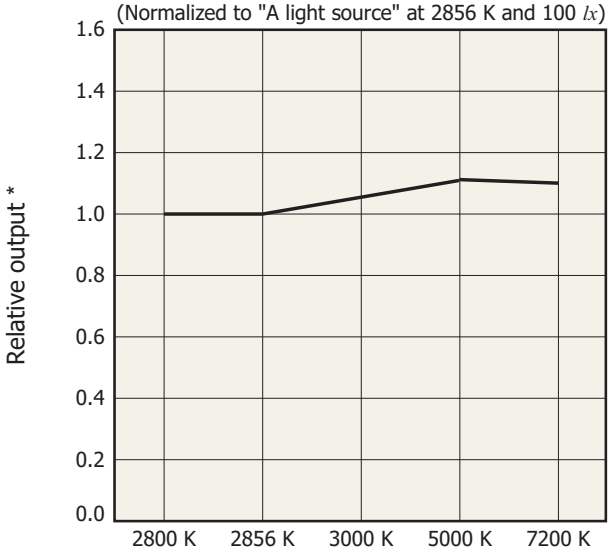
Difference between various light sources




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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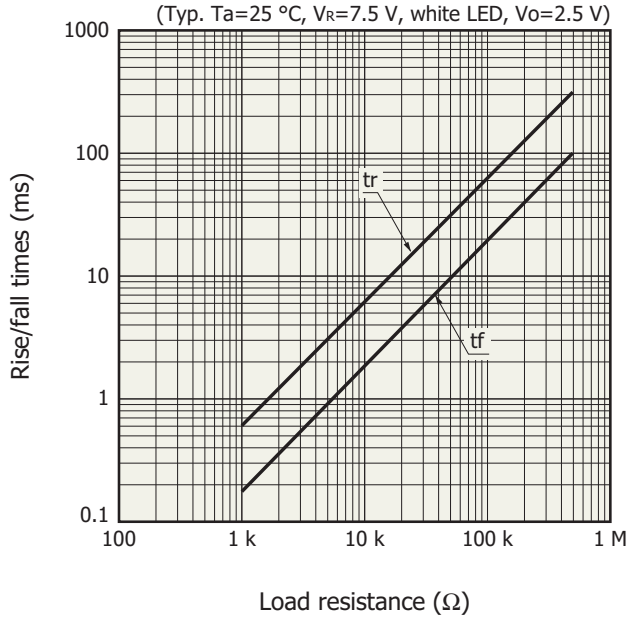
## Rise/fall times vs. load resistance

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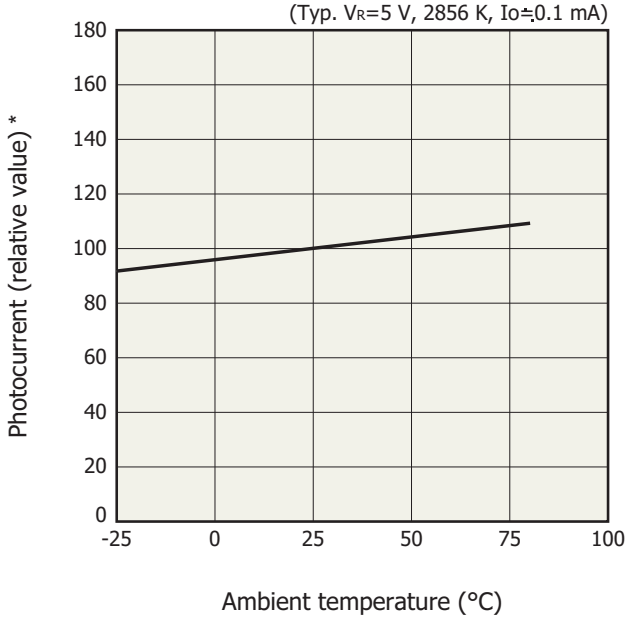
## Photocurrent vs. ambient temperature




* At Ta=25 °C normaolized to 100.

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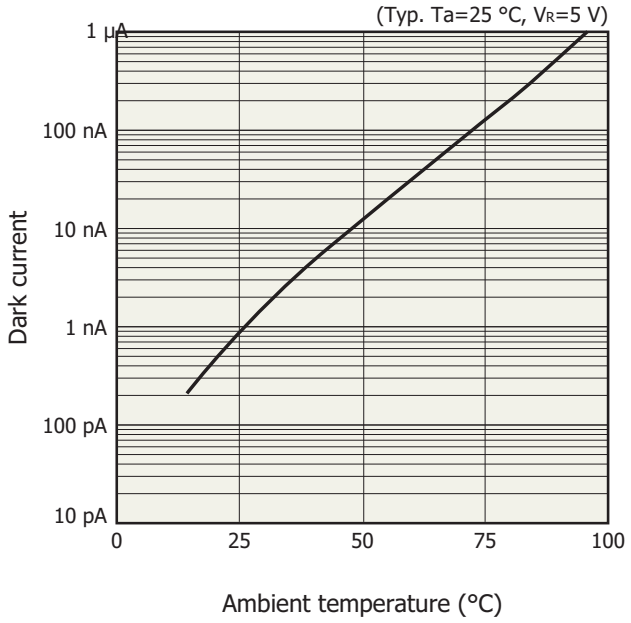
## Dark current vs. ambient temperature

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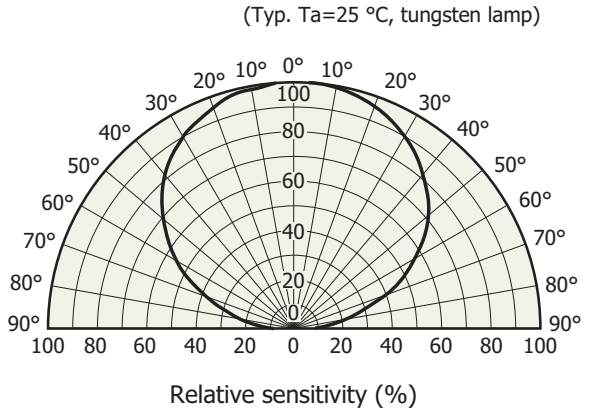
## Directivity

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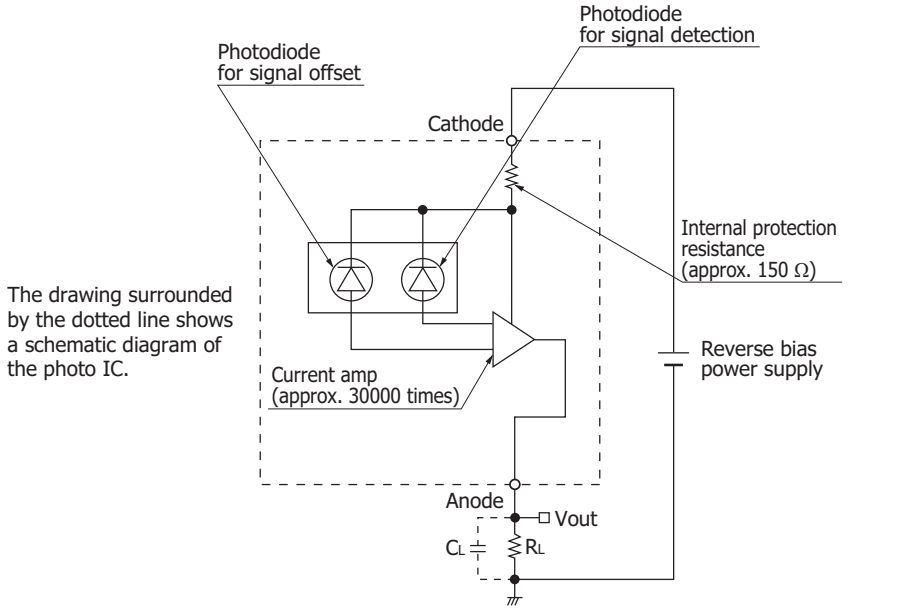
## Block diagram

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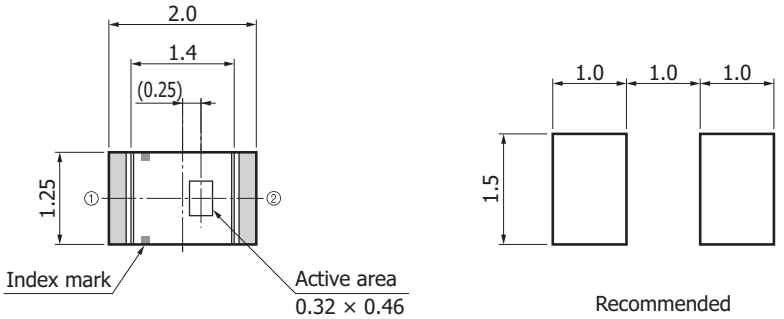
The photo IC diode must be reverse-biased so that a positive potential is applied to the cathode.
To eliminate high-frequency components, we recommend placing a load capacitance $C_L$ in parallel with load resistance $R_L$ as a low-pass filter.

Cut-off frequency $fc \fallingdotseq \frac{1}{2\pi C_L R_L}$

## Dimensional outline (unit: mm)




① Cathode
② Anode

Tolerance unless otherwise noted: ± 0.2
Values in parentheses indicate reference value.
Electrode
Packing: Reel (3000 pcs/reel)

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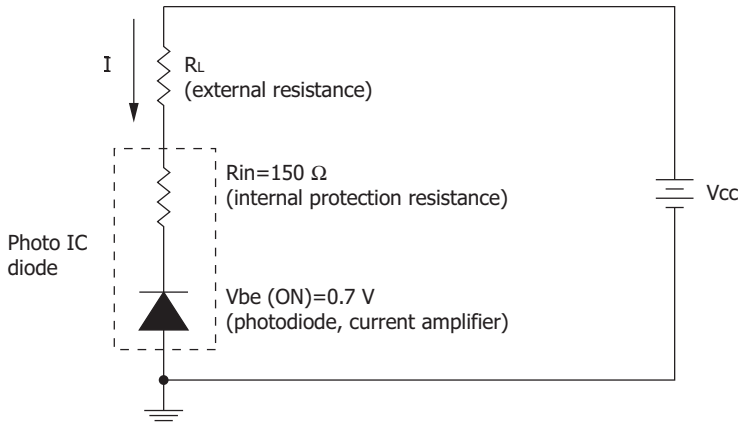
## Operating voltage, output characteristics

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 Vbe (ON) and the voltage drop across the protective resistance Rin.

$$V_R = Vbe\ (ON) + I \times Rin$$

■ Figure 1 Measurement circuit

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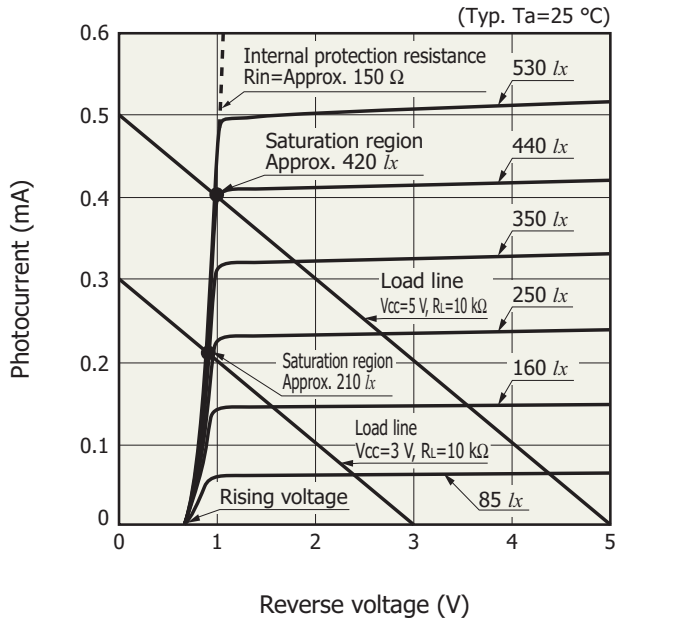
■ Figure 2 Photocurrent vs. reverse voltage




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:

$$V_R = Vcc - V_L = Vcc - I_L \times R_L$$

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 (Vcc) and load resistance ($R_L$), change them to meet the required operating conditions.

Note: Vbe (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 | φ5 × 3.5$^t$ (Top view) | -0.5 to +12 V | 300 to 820 | 0.26 mA | 6 |  |
| S9067-101 | | | 3.2 × 2.7 × 1.1$^t$ COB | | | 0.26 mA | |  |
| S11154-01CT | | | 2.0 × 1.25 × 0.8$^t$ COB | | 480 to 640 | 0.11 mA | 6 |  |
| S9705 | Light-to-frequency converter photo IC | Frequency output (for direct connection to microcontroller) | 3.0 × 4.0 × 1.3$^t$ 4-pin plastic | [2.7 to 5.5 V] | 380 to 640 | 50 kHz | - |  |

* S9705: frequency output

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