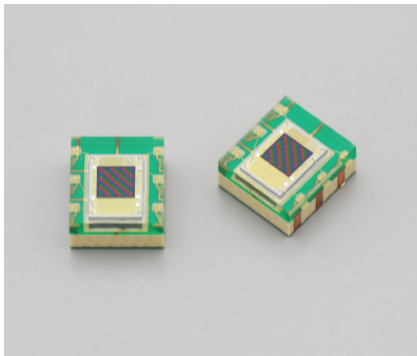


S11012-01CR



12-bit digital output

The S11012-01CR is a digital color sensor sensitive to red ($\lambda=615$ nm), green ($\lambda=540$ nm) and blue ($\lambda=465$ nm) regions of the spectrum. Detected signals are serially output as 12-bit digital data. Built-in three 12-bit registers allow simultaneous measurement of RGB three colors. Sensitivity level is adjustable in two steps to cover a wide photometric range.

Features

- 12-bit digital output
- COB type
- Simultaneous measurement of RGB three colors
- 2-step sensitivity switching (sensitivity ratio of 1 : 9)
- Low voltage (3.3 V) operation
- CMOS monolithic photo IC
- No external components required

Applications

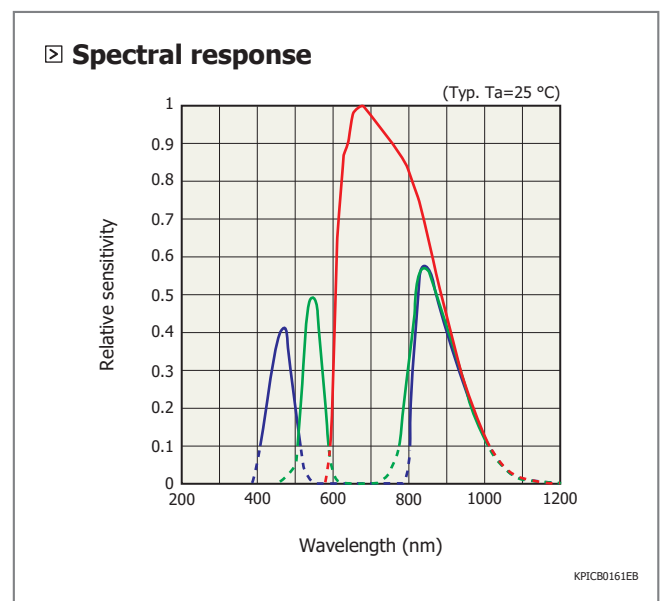
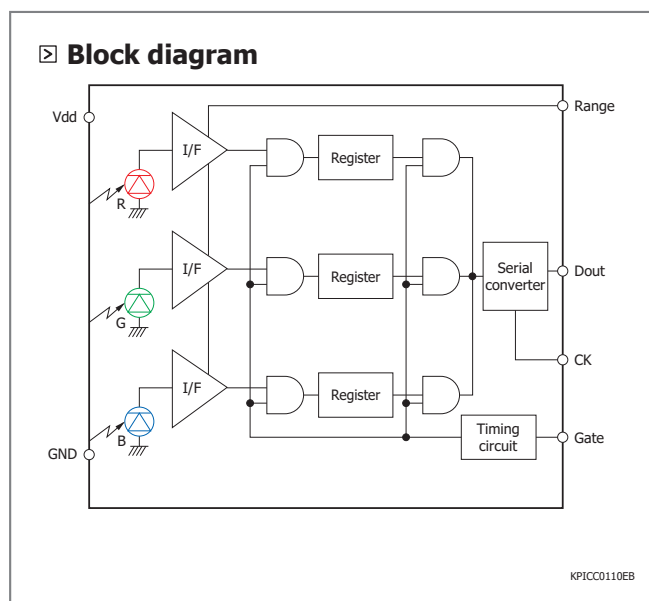
- Display color adjustment
- Various applications involving color detection

Feature 01 12-bit digital output

Light signals detected by the photodiode are amplified and converted into 12-bit digital signals. An amplifier is also formed for each of the RGB photodiode elements arrayed in the mosaic pattern, allowing simultaneous accurate measurement of the RGB components of incident light.

Feature 02 Simultaneous measurement of RGB three colors

The photodiode consists of 9×9 elements arrayed in a mosaic pattern. Each element has an on-chip filter that is sensitive to one color of light, either red ($\lambda_p=615$ nm), green ($\lambda_p=540$ nm) or blue ($\lambda_p=465$ nm).



Feature **03** 2-step sensitivity switching

To enable measurement over a wide range of illuminance, the photodiode sensitivity can be selected from two setting modes (high sensitivity mode and low sensitivity mode). The photodiode photosensitive area used to detect light differs depending on which sensitivity mode is selected (high sensitivity mode: 9×9 elements, low sensitivity mode: 3×3 elements in center).

☒ Sensitivity setting

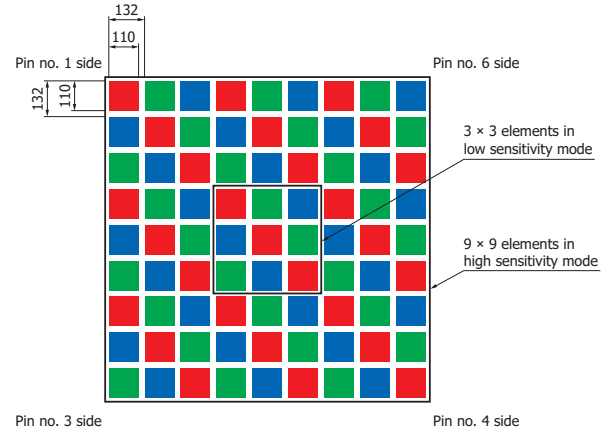
| Range | Mode | Effective photosensitive area* |
|-------|------------------|--------------------------------|
| High | High sensitivity | 9×9 elements |
| Low | Low sensitivity | 3×3 elements |

* The photosensitive area of the S11012-01CR consists of 9×9 elements in a mosaic pattern.

The effective photosensitive area changes depending on which sensitivity mode is used, "high" or "low", as explained below.

- High sensitivity mode: 9×9 elements
- Low sensitivity mode: 3×3 elements in center

☒ Details of photosensitive area (unit: μm)



Note: Spacing between elements is light-shielded.

KPIC0124EB

☒ Absolute maximum ratings

| Parameter | Symbol | Condition | Value | Unit |
|-----------------------------|--------|-----------|--|------|
| Supply voltage | Vdd | Ta=25 °C | -0.3 to 6 | V |
| Load current | Io | Ta=25 °C | ± 10 | mA |
| Power dissipation | P | Ta=25 °C | 100 | mW |
| Operating temperature | Topr | | -20 to +80 | °C |
| Storage temperature | Tstg | | -20 to +85 | °C |
| Reflow soldering conditions | Tsol | | Peak temperature 240 °C max., one time | - |

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

*1: JEDEC level 5a

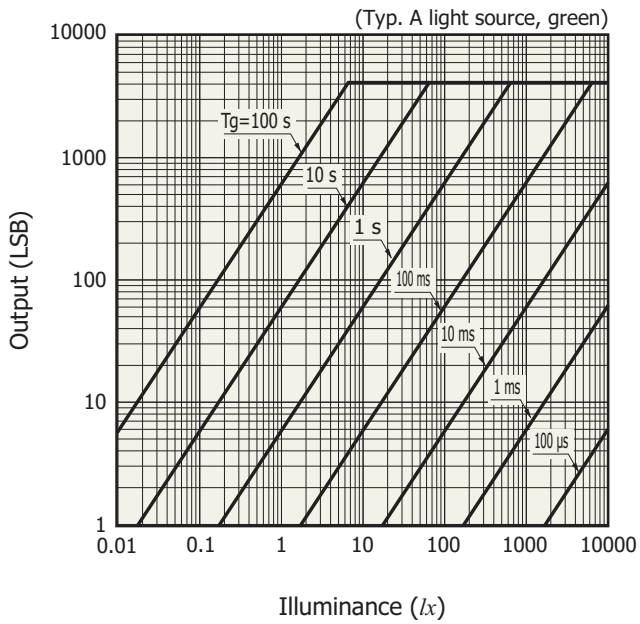
Electrical and optical characteristics (Ta=25 °C, Vdd=5 V, Tg=100 ms, A light source, unless otherwise noted)

| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|--------|--|-----------------------------------|---------------------------|------------|-----------------|
| Photosensitive area size | - | All elements (9 × 9 elements) | - | 1.2 × 1.2 | - | mm |
| Effective photosensitive area | - | All elements (9 × 9 elements) per 1 color, high range | - | 0.32 | - | mm ² |
| | | 3 × 3 elements per 1 color, low range | - | 0.036 | - | |
| Spectral response range*2 | λ | Blue | - | 400 to 540 800 to 1000 | - | nm |
| | | Green | - | 480 to 600 760 to 1000 | - | |
| | | Red | - | 590 to 1000 | - | |
| Supply voltage | Vdd | | 3.0 | - | 5.5 | V |
| Current consumption | Idd | Dark state, no load | - | 5 | 10 | mA |
| Photo sensitivity | Sbl | Blue, low range | 0.21 | 0.3 | 0.39 | LSB/lx |
| | Sgl | Green, low range | 0.42 | 0.6 | 0.78 | |
| | Srl | Red, low range | 0.98 | 1.4 | 1.82 | |
| | Sbh | Blue, high range | 1.8 | 2.6 | 3.4 | |
| | Sgh | Green, high range | 3.7 | 5.3 | 6.9 | |
| | Srh | Red, high range | 9.0 | 12.9 | 16.8 | |
| Incident light power (Conversion value in A light source) | Ibl | Blue, low range | - | - | 172 | k/lx |
| | Igl | Green, low range | - | - | 83 | |
| | Irl | Red, low range | - | - | 35 | |
| | Ibh | Blue, high range | - | - | 19 | |
| | Igh | Green, high range | - | - | 9.2 | |
| | Irh | Red, high range | - | - | 3.9 | |
| Dark output | Dark | Tg=0.5 s, high range | - | - | 1 | LSB |
| Input high level | Vih | | Vdd × 0.82 | - | - | V |
| Input low level | Vil | | - | - | Vdd × 0.18 | V |
| High level output voltage | Voh | Ioh=-0.5 mA | 4.5 | - | - | V |
| Low level output voltage | Vol | Iol=0.5 mA | - | - | 0.5 | V |
| Integration time | Tg | | Refer to "Output vs. illuminance" | | | - |
| Hold time | t1 | | 4 | - | - | μs |
| | t2 | | 3 | - | - | μs |
| | t3 | | 3 | - | - | μs |
| | t4 | | 2000 | - | - | μs |
| | t5 | | 3 | - | - | μs |
| Readout clock period | tck | | 500 | - | - | ns |
| Readout pulse width (positive) | tw | | 200 | - | - | ns |

*2: Since this product has sensitivity in the infrared region, infrared light must be filtered out as needed.

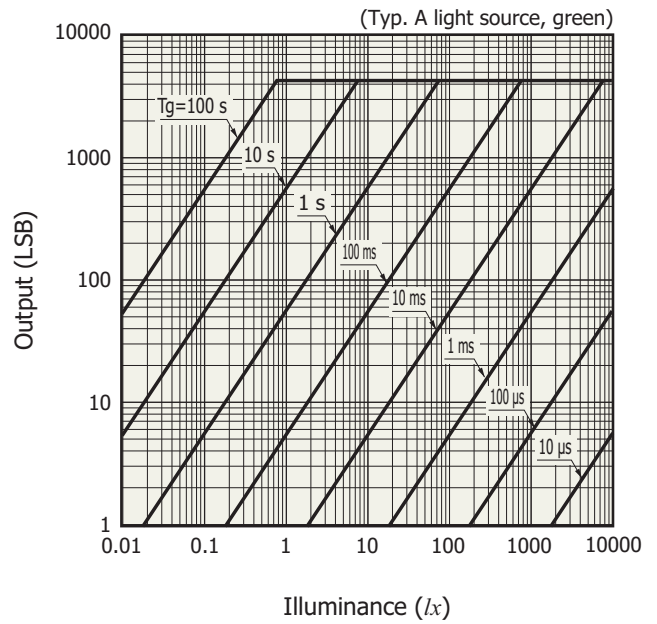
Output vs. illuminance

Low range



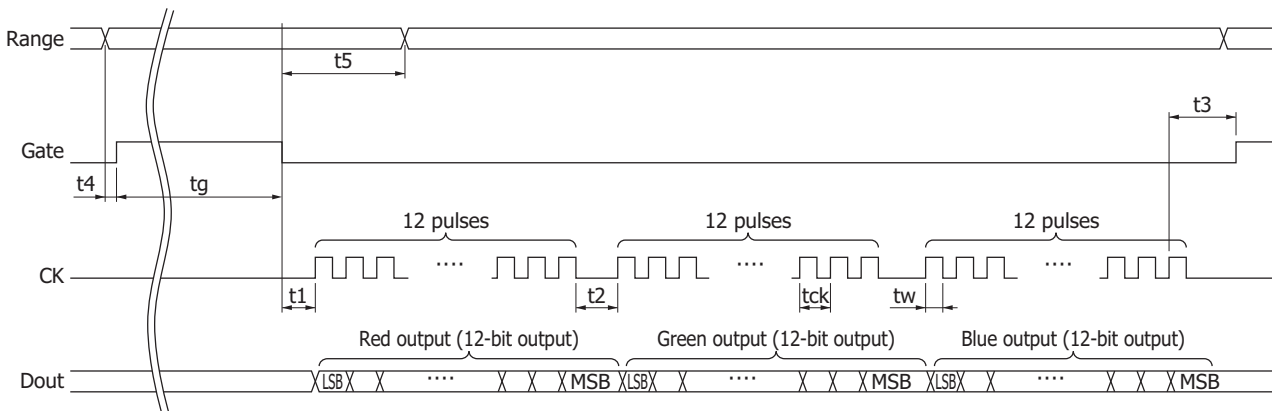
KPICB0162EA

High range



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Timing chart



Operating sequence

- (1) Set the Gate terminal and CK terminal to "Low".
- (2) Select the desired sensitivity with the Range terminal.
- (3) Set the Gate terminal from "Low" to "High", to start integrating the light intensity.
- (4) After the desired integration time (t_g) has passed, set the Gate terminal from "High" to "Low" to end the light intensity integration.
- (5) Measurement data is output from the Dout terminal by inputting 36 CK pulses to the CK terminal.

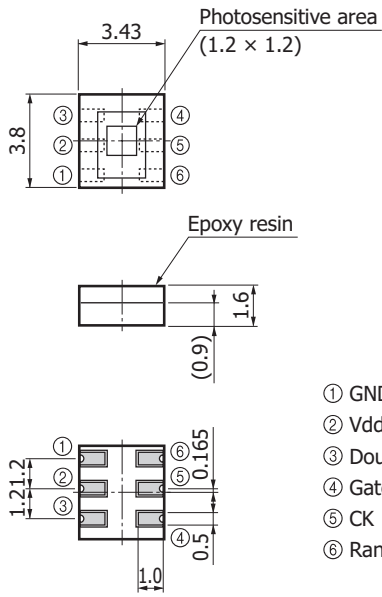
Note 1: A total of 36 CK pulses are required to read out 3-color measurement data. Red data is output by the first 12 pulses, green data by the next 12 pulses, and blue data by the last 12 pulses. Measurement data is output from the LSB side.

Note 2: Measurement data changes at the CK pulse rising edge.

Note 3: Do not switch the Range terminal during integration time (t_g).

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Dimensional outline (unit: mm)

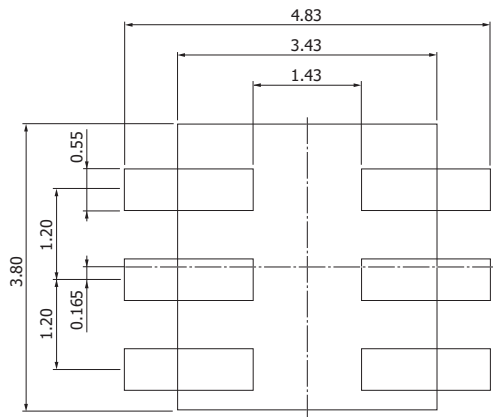


- ① GND
- ② Vdd
- ③ Dout
- ④ Gate
- ⑤ CK
- ⑥ Range

Tolerance unless otherwise noted: ± 0.2
 Chip position accuracy with respect to package center
 $X, Y \leq \pm 0.3$
 Values in parentheses indicate reference value.
 ■ Electrode

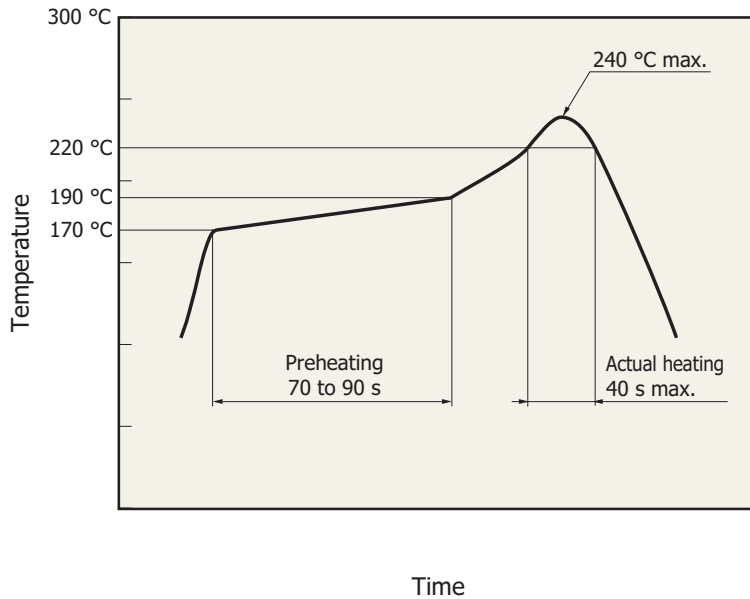
KPICA0088EA

Recommended land pattern (unit: mm)



KPIC0199EA

Measured example of temperature profile with hot-air reflow oven for product testing



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- This product supports lead-free soldering. After unpacking, store it in an environment at a temperature of 30 °C or less and a humidity of 60% or less, and perform soldering within 24 hours.
- The effect that the product receives during reflow soldering varies depending on the circuit board and reflow oven that are used. Before actual reflow soldering, check for any problems by testing out the reflow soldering methods in advance.

Related information

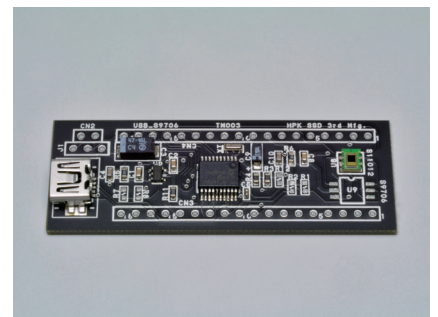
www.hamamatsu.com/sp/ssd/doc_en.html

Precautions

- Disclaimer
- Metal, ceramic, plastic package products
- Surface mount type products

Evaluation kit for color sensor (S11012-01CR)

An evaluation kit [60 mm (H) × 22 mm (V)] for understanding the operating principle of Hamamatsu's S11012-01CR color sensor is available. Contact us for detailed information.



Information described in this material is current as of October 2019.

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.

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