Photo IC for laser beam synchronous detection

S10317 series  S11257 series

Low voltage operation (3.3 V)

The S10317/S11257 series photo IC use a high-speed PIN photodiode designed for laser beam synchronous detection. They operate at a low voltage (3.3 V) compatible with low-voltage peripheral components mounted on the same PC board. Two types of current amplifiers are available with a gain of 6 times (S10317-01, S11257-01DT) and 20 times (S10317, S11257-02DT) that can be selected according to laser power to be used. HAMAMATSU also provides a 5 V operation type (S9703 series) and dual-element Si PIN photodiode types (S9684 series, S11282-01DS).

Features

- Low voltage operation (3.3 V)
- High sensitivity
  Current amplifier gain: 20 times (S10317, S11257-02DT)
  6 times (S10317-01, S11257-01DT)
- Digital output
- Small package
- Suitable for lead-free solder reflow
- Photosensitive area: 2.84 × 0.5 mm (S10317 series)
  2.84 × 0.25 mm (S11257 series)

Applications

- Print start timing detection for laser printers, digital copiers, fax machines, etc.

Absolute maximum ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>Vcc</td>
<td>Ta=25 °C</td>
<td>-0.5 to +7</td>
<td>V</td>
</tr>
<tr>
<td>Power dissipation(^1)</td>
<td>P</td>
<td>Ta=25 °C</td>
<td>300</td>
<td>mW</td>
</tr>
<tr>
<td>Output voltage(^2)</td>
<td>Vo</td>
<td>Ta=25 °C</td>
<td>-0.5 to +7</td>
<td>V</td>
</tr>
<tr>
<td>Output current</td>
<td>Io</td>
<td>Ta=25 °C</td>
<td>5</td>
<td>mA</td>
</tr>
<tr>
<td>Ro terminal current</td>
<td>Iro</td>
<td>Ta=25 °C</td>
<td>3</td>
<td>mA</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>Topr</td>
<td>Ta=25 °C</td>
<td>-25 to +80</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>Tstg</td>
<td>Ta=25 °C</td>
<td>-40 to +85</td>
<td>°C</td>
</tr>
<tr>
<td>Reflow soldering conditions(^3)</td>
<td>Tsol</td>
<td>Peak temperature 240 °C max., 1 time</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

\(^1\): Power dissipation decreases at a rate of 4 mW/°C above Ta=25 °C.
\(^2\): Vcc=+0.5 V or less
\(^3\): JEDEC level 5a

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.
Electrical and optical characteristics

(Ta=25 °C, λ=780 nm, Vcc=3.3 V, Ro=5.1 kΩ, light incident angle=normal line direction ±0°, unless otherwise noted)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommended operation voltage</td>
<td>S10317 series</td>
<td></td>
<td></td>
<td>3.13</td>
<td>3.3</td>
<td>3.6</td>
</tr>
<tr>
<td></td>
<td>S11257 series</td>
<td></td>
<td></td>
<td>3.135</td>
<td>3.3</td>
<td>3.45</td>
</tr>
<tr>
<td>Current consumption</td>
<td>Icc</td>
<td>No input</td>
<td>-</td>
<td>0.7</td>
<td>1.5</td>
<td>mA</td>
</tr>
<tr>
<td>High level output voltage</td>
<td>VOH</td>
<td>IOH=4 mA</td>
<td>2.9</td>
<td>-</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>Low level output voltage</td>
<td>VOL</td>
<td>IOL=4 mA*</td>
<td>-</td>
<td>-</td>
<td>0.3</td>
<td>V</td>
</tr>
<tr>
<td>Threshold input power</td>
<td>PTH</td>
<td>S10317, S11257-02DT</td>
<td>14</td>
<td>19</td>
<td>24</td>
<td>μW</td>
</tr>
<tr>
<td>H→L propagation delay time</td>
<td>tPHL</td>
<td>S10317, S11257-02DT</td>
<td>-</td>
<td>130</td>
<td>250</td>
<td>ns</td>
</tr>
<tr>
<td>L→H propagation delay time</td>
<td>tPLH</td>
<td>S10317-01, S11257-01DT</td>
<td>-</td>
<td>100</td>
<td>200</td>
<td>ns</td>
</tr>
<tr>
<td>Rise time</td>
<td>tr</td>
<td>Duty ratio 1:1</td>
<td>4</td>
<td>7</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Fall time</td>
<td>tf</td>
<td>CL=15 pF*^5</td>
<td>4</td>
<td>7</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Maximum input power</td>
<td>Pimax</td>
<td></td>
<td>-</td>
<td>-</td>
<td>PTH×8</td>
<td>μW</td>
</tr>
</tbody>
</table>

*4: Input power Pt=57 μW (S10317, S11257-02DT), 186 μW (S10317-01, S11257-01DT)
*5: Measured with a pulse-driven laser diode. Input light-pulse rise time and fall times are 1 ns or less.

Spectral response

(Wavelength (nm))

(Hamamatsu)
These products integrate a photodiode chip and an IC chip into the same package. The photodiode chip is internally connected to the IC chip as shown in the block diagram. The products should be used with terminal Ro connected to an external gain resistance Ro.

A photocurrent is generated when a laser beam enters the photodiode. This photocurrent is fed to the input terminal of the IC and, after being amplified by the current amplifier, flows to the external gain resistance. At this time, voltages VRO at terminal Ro is given by the following expression.

\[ V_{RO} = A \times S \times P_i \times R_o \ [V] \]  \hspace{0.5cm} (1)

- \( A \): Current amplifier gain (S10317, S11257-02DT: 20 times, S10317-01, S11257-01DT: 6 times)
- \( S \): Photodiode sensitivity [A/W] (approx. 0.44 A/W at 780 nm)
- \( P_i \): Input power [W]
- \( R_o \): External gain resistance [\( \Omega \)]; usable range 2 k\( \Omega \) to 10 k\( \Omega \)

VRO is input to the internal comparator and compared with the internal reference voltage Vref (approx. 0.8 V) so the output Vo is “High” when \( V_{RO} < V_{ref} \) or “Low” when \( V_{RO} > V_{ref} \).

We recommend that VRO be set higher than 1.5 V but lower than 8 times of VRO calculated from equation (1) where \( P_i \) is the threshold input power. Also set the Ro resistance so that the Ro terminal current does not exceed the absolute maximum rating of 3 mA.

(Monitoring Vro shows that it is limited to about 2 V (with respect to GND) by the voltage limiting circuit. Keep this in mind when monitoring.)
Photo IC for laser beam synchronous detection

S10317/ S11257 series

**Dimensional outline (unit: mm)**

### S10317 series

- Center of photosensitive area:
  - 3.2 ± 0.2
  - (Including burr)
  - 0.66
- Photosensitive surface:
  - 4.2 ± 0.2
  - 3.8
  - 3.4
  - Mirror area range:
    - 0.15
    - 2.8
    - 2.9
    - 3.0
- Tolerance unless otherwise noted: ±0.1, ±2°
- Shaded area indicates burr.
- Chip position accuracy with respect to package dimensions marked *
- X, Y ≤±0.2, θ ≤±2°

### S11257 series

- Center of photosensitive area:
  - 3.2 ± 0.2
  - (Including burr)
  - 0.54 ± 0.2
- Photosensitive surface:
  - 4.2 ± 0.2
  - 3.8
  - Mirror area range:
    - 0.15
    - 2.8
    - 2.9
    - 3.0
- Tolerance unless otherwise noted: ±0.1, ±2°
- Shaded area indicates burr.
- Chip position accuracy with respect to package dimensions marked *
- X, Y ≤±0.2, θ ≤±2°

Values in parentheses indicate reference value. Chip position accuracy with respect to package dimensions marked *
**Recommended land pattern (unit: mm)**

![Recommended land pattern diagram]

**Standard packing specifications**

- Reel (conforms to JEITA ET-7200)

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Hub diameter</th>
<th>Tape width</th>
<th>Material</th>
<th>Electrostatic characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>254 mm</td>
<td>100 mm</td>
<td>12 mm</td>
<td>PS</td>
<td>Antistatic treatment</td>
</tr>
</tbody>
</table>

- Embossed tape (unit: mm, material: PS, conductive)

![Embossed tape diagram]

- Packing quantity
  2000 pcs/reel

- Packing type
  Reel and desiccant in moisture-proof packaging (vacuum-sealed)
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**Measured example of temperature profile with our hot-air reflow oven for product testing**

<table>
<thead>
<tr>
<th>Time</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>70 s</td>
<td>300 °C</td>
</tr>
<tr>
<td>90 s</td>
<td>220 °C</td>
</tr>
<tr>
<td>90 s</td>
<td>190 °C</td>
</tr>
<tr>
<td>90 s</td>
<td>170 °C</td>
</tr>
<tr>
<td></td>
<td>240 °C max.</td>
</tr>
<tr>
<td></td>
<td>220 °C</td>
</tr>
<tr>
<td></td>
<td>190 °C</td>
</tr>
<tr>
<td></td>
<td>170 °C</td>
</tr>
</tbody>
</table>

- 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/ssp/doc_en.html

**Precautions**

- Notice

**Surface mount type products / Precautions**

Information described in this material is current as of December, 2013. 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.

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.

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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, P.O.Box 6910, Bridgewater, N.J. 08807-0910, 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) 8152-365-6
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 Town Road, Welwyn Garden City, Hertfordshire AL7 1BW, United Kingdom, Telephone: (44) 1707-294888, Fax: (44) 1707-325777
North Europe: Hamamatsu Photonics Norden AB: Thorshammargatan 25 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 Arse, (Milano), Italy, Telephone: (39) 02-935-81-733, Fax: (39) 02-935-81-741
China: Hamamatsu Photonics (China) Co., Ltd.: 1201 Tower B, Jinning Center, No.27 Dongnanhuai Bei, Chaoyang District, Beijing 100020, China, Telephone: (86) 10-6586-6006, Fax: (86) 10-6586-2866

www.hamamatsu.com