Two-dimensional PSD

S1880, S2044

Non-discrete position sensors utilizing photodiode surface resistance

PSD (position sensitive detector) is an optoelectronic position sensor utilizing photodiode surface resistance. Unlike discrete element detectors such as CCD, PSD provides continuous position data and features high position resolution and high-speed response.

Features

- High position resolution
- Wide spectral response range
- High-speed response
- Simultaneous measurements of position and intensity
- Position is measured independent of light spot size.
- High reliability

Applications

- Optical position and angle sensing
- Remote optical control systems
- Automatic range finder systems
- Displacement and vibration monitors
- Laser beam alignment
- Medical equipment

Structure / Absolute maximum ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>S1880</th>
<th>S2044</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>-</td>
<td>Ceramic</td>
<td>Metal</td>
<td>-</td>
</tr>
<tr>
<td>Photosensitive area size</td>
<td>-</td>
<td>12 × 12</td>
<td>4.7 × 4.7</td>
<td>mm</td>
</tr>
<tr>
<td>Reverse voltage</td>
<td>Vr max</td>
<td>20 V</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>Operating temperature*1</td>
<td>Topr</td>
<td>-10 to +60</td>
<td>-</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature*1</td>
<td>Tstg</td>
<td>-20 to +80</td>
<td>-</td>
<td>°C</td>
</tr>
</tbody>
</table>

*1: No dew condensation

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 the absolute maximum ratings.
Electrical and optical characteristics (Ta=25 °C unless otherwise noted)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>S1880</th>
<th>S2044</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectral response range</td>
<td>λ</td>
<td></td>
<td>320 to 1060</td>
<td>320 to 1060</td>
<td>nm</td>
</tr>
<tr>
<td>Peak sensitivity wavelength</td>
<td>λp</td>
<td></td>
<td>920</td>
<td>920</td>
<td>nm</td>
</tr>
<tr>
<td>Photosensitivity</td>
<td>S</td>
<td>λ=λp</td>
<td>0.6</td>
<td>0.6</td>
<td>A/W</td>
</tr>
<tr>
<td>Interelectrode resistance</td>
<td>Rie</td>
<td>Vb=0.1 V</td>
<td>5</td>
<td>5</td>
<td>15 kΩ</td>
</tr>
<tr>
<td>Position detection error</td>
<td>E</td>
<td>Zone A</td>
<td>±80</td>
<td>±80</td>
<td>±150 µm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Zone B</td>
<td>±150</td>
<td>±150</td>
<td>±250 µm</td>
</tr>
<tr>
<td>Saturation current</td>
<td>Ist</td>
<td>VR=5 V</td>
<td>0.5</td>
<td>0.5</td>
<td>mA</td>
</tr>
<tr>
<td>Dark current</td>
<td>Id</td>
<td>VR=5 V</td>
<td>1.0</td>
<td>0.5</td>
<td>5 nA</td>
</tr>
<tr>
<td>Temperature coefficient of Id</td>
<td>Tcid</td>
<td></td>
<td>1.15</td>
<td>1.15</td>
<td>times/°C</td>
</tr>
<tr>
<td>Rise time</td>
<td>tr</td>
<td>VR=5 V</td>
<td>1.5</td>
<td>0.3</td>
<td>µs</td>
</tr>
<tr>
<td>Terminal capacitance</td>
<td>Ct</td>
<td>VR=5 V</td>
<td>300</td>
<td>45</td>
<td>pF</td>
</tr>
<tr>
<td>Position resolution</td>
<td></td>
<td></td>
<td>1.5</td>
<td>0.6</td>
<td>µm</td>
</tr>
</tbody>
</table>

*2: Measured between two output terminals opposite to each other, and the other terminals are open-circuited on measurement.
*3: The radius of Zones A and B depend on the product type. They are determined as follows:

<table>
<thead>
<tr>
<th>Type no.</th>
<th>Zone A (mm)</th>
<th>Zone B (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1880</td>
<td>2.5</td>
<td>5</td>
</tr>
<tr>
<td>S2044</td>
<td>0.9</td>
<td>4 × 4 (quadrant)</td>
</tr>
</tbody>
</table>

*4: Position resolution
This is the minimum detectable light spot displacement. The detection limit is indicated by distance on the photosensitive surface. The numerical value of the resolution of a position sensor using a PSD is proportional to both the length of the PSD and the noise of the measuring system (resolution deteriorates) and inversely proportional to the photocurrent (incident energy) of the PSD (resolution improves).

- Light source: LED (900 nm)
- Light spot size: ø200 µm
- Frequency range: 1 kHz
- Photocurrent: 1 μA
- Circuit system input noise: 1 µV (1 kHz)
- Interelectrode resistance: Typical value (Refer to specification table.)

Spectral response

Photosensitivity temperature characteristics
**Terminal capacitance vs. reverse voltage**

(Typ. Ta=25 °C, f=10 kHz)

- **Examples of position detectability** (Ta=25 °C, λ=900 nm, light spot size: φ200 μm)

<table>
<thead>
<tr>
<th>S1880</th>
<th>S2044</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line interval: 1 mm</td>
<td>Line interval: 0.5 mm</td>
</tr>
</tbody>
</table>
Example of DC-operating circuit

R1 - R24: same value
Rf: depends on input level
U1 - U4: low drift head amplifier, TL071, etc.
U12, U13: analog divider, AD538 (Analog Devices), etc.

Example of AC-operating circuit

R1 - R24: same value
Rf: depends on input level
U1 - U4: low drift head amplifier, TL071, etc.
U12, U13: analog divider, AD538 (Analog Devices), etc.
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Dimensional outlines (unit: mm)

S1880

Photosensitive area 12 × 12

Photosensitive surface

0.7 t glass

φ 0.75 lead

Anode (Y2)
Anode (X1)
Anode (Y1)
Anode (X2)
Cathode (common)

S2044

Photosensitive area 4.7 × 4.7

Photosensitive surface

φ 0.75 lead

Anode (X2)
Anode (Y2)
Cathode (case)
Anode (X1)
Anode (Y1)

Photosensitive area chart

Position conversion formula

\[
\begin{align*}
\frac{(D_2 + I_2) - (D_1 + I_1)}{D_1 + D_2 + I_1 + I_2} &= \frac{2x}{L_x} \\
\frac{(D_2 + I_2) - (D_1 + I_1)}{D_1 + D_2 + I_1 + I_2} &= \frac{2y}{L_y}
\end{align*}
\]

S1880: Lx=14 mm
Ly=14 mm
S2044: Lx=5.7 mm
Ly=5.7 mm

* Photosensitive area is specified at the inscribed square.
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Related information

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

Precautions

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

Technical information

- PSD

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

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