Hamamatsu provides various types of one-dimensional PSD (Position Sensitive Detector) designed for precision distance measurement such as displacement meters.

S3931 and S3932 have an active area of $1 \times 6$ mm and $1 \times 12$ mm respectively, and are mounted on a compact ceramic package with a transparent resin window. Variant types (S3931-01, S3932-01) with a visible-cut resin window are also available.

S3270 offers an active area longer than 30 mm, allowing position detection at a long distance. S3270 has a visible-cut resin window, and S3270-01 with a transparent resin window is also available.

### General ratings / Absolute maximum ratings

<table>
<thead>
<tr>
<th>Type No.</th>
<th>Package</th>
<th>Window material</th>
<th>Active area size (mm)</th>
<th>Reverse voltage $V_R$ Max. (V)</th>
<th>Operating temperature $Topr$ (°C)</th>
<th>Storage temperature $Tstg$ (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S3931</td>
<td>Ceramic</td>
<td>R</td>
<td>$1 \times 6$</td>
<td>20</td>
<td>-10 to +60</td>
<td>-20 to +80</td>
</tr>
<tr>
<td>S3932</td>
<td>Ceramic</td>
<td>R</td>
<td>$1 \times 12$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S3270</td>
<td>Ceramic</td>
<td>R (B)</td>
<td>$1 \times 37$</td>
<td></td>
<td>-10 to +75</td>
<td></td>
</tr>
</tbody>
</table>

### Electrical and optical characteristics (Typ. $Ta=25$ °C, unless otherwise noted)

<table>
<thead>
<tr>
<th>Type No.</th>
<th>Spectral response range $\lambda$ (nm)</th>
<th>Peak sensitivity wavelength $\lambda_p$ (nm)</th>
<th>Photo sensitivity $S_{\lambda_p}$ (A/W)</th>
<th>Interelectrode resistance $R_{ie}$ Vb=0.1 V</th>
<th>Position detection error $E_{VR=5 , V}$</th>
<th>Saturation photocurrent $S_{VR=5 , V}$ (A)</th>
<th>Dark current $I_D$ $VR=5 , V$ (nA)</th>
<th>Temp. coefficient of $I_D$ $T_{CID}$ (times/°C)</th>
<th>Rise time $t_{rise}$ $VR=5 , V$ $RL=1 , k\Omega$ (µs)</th>
<th>Terminal capacitance CT $VR=5 , V$ $f=10 , kHz$ (pF)</th>
<th>Position resolution *5 (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S3931</td>
<td>320 to 1100</td>
<td>920</td>
<td>0.55</td>
<td>$\pm 30$</td>
<td>$\pm 120$</td>
<td>$\pm 60$</td>
<td>100</td>
<td>0.15</td>
<td>1.5</td>
<td>40</td>
<td>0.2</td>
</tr>
<tr>
<td>S3932</td>
<td>320 to 1100</td>
<td>920</td>
<td>0.55</td>
<td>$\pm 120$</td>
<td>$\pm 60$</td>
<td>$\pm 240$</td>
<td>100</td>
<td>0.2</td>
<td>3.0</td>
<td>80</td>
<td>0.3</td>
</tr>
<tr>
<td>S3270</td>
<td>700 to 1100</td>
<td>960</td>
<td>0.55</td>
<td>$\pm 100$</td>
<td>$\pm 400$</td>
<td>$\pm 240$</td>
<td>300</td>
<td>0.5</td>
<td>1.0</td>
<td>100</td>
<td>2.8</td>
</tr>
</tbody>
</table>

*1: R: clear resin coating, R (B): visible-cut resin coating.

*2: Works with microscopic spot light detection.

*3: A range of 75% of that from the center of the photosensitive surface to the edge.

*4: The upper limit of linearity of photocurrent in response to the quantity of light is defined as the point where the linearity deviates by 10%.

*5: Position resolution

This is the minimum detectable light spot displacement. The detection limit is indicated by the 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)
- Photocurrent: 1 µA
- Spot light size: φ 200 µm
- Circuit system input noise: 1 µV (1 kHz)
- Frequency range: 1 kHz
- Interelectrode resistance: Typical value (refer to the specification table)
Example of position detectability (Ta=25 °C, λ=900 nm, spot light size: φ0.2 mm)

Conversion formula of spot light position on the PSD

If output signals (photocurrent) I₁ and I₂ are obtained from electrodes X₁ and X₂, then the light spot position (x) on the PSD can be found by the following formula.

\[
\frac{I_2 - I_1}{I_1 + I_2} = \frac{2x}{L}
\]

Correction for position detection error

Position detection characteristics obtained by the above formula can be corrected to reduce position detection errors. For example, the maximum position detection error (±120 µm) of S3931 can be significantly reduced to ±9 µm by using the least square method.
Dimensional outlines (unit: mm)

**S3931**

- ACTIVE AREA: 9.2 ± 0.2
- PHOTOSENSITIVE SURFACE: 4.4 ± 0.2
- CATHODE (COMMON): 1.5 ± 0.2
- ANODE (X1): 0.7
- ANODE (X2): 5.08 ± 0.3
- (4 × 0.4)

**S3932**

- ACTIVE AREA: 15.2 ± 0.2
- PHOTOSENSITIVE SURFACE: 4.8 ± 0.2
- CATHODE (COMMON): 1.5 ± 0.2
- ANODE (X2): 0.7
- ANODE (X1): 5.08 ± 0.3
- (4 × 0.25)

**S3270**

- ACTIVE AREA: 5.5 ± 0.25
- PHOTOSENSITIVE SURFACE: 42.3 ± 0.4
- CATHODE (COMMON): 1.0
- ANODE (X2): (2 × R1.1)
- R2.0
- (4 × 0.4)
- LEAD: 3.75 ± 0.25
- (4 × 0.25)
- 10.16 ± 0.4
- 5.08 ± 0.3
- 15.2 ± 0.2

Information described in this material is current as of April, 2011. Product specifications are subject to change without prior notice due to improvements or other reasons. Before assembly into final products, please contact us for the delivery specification sheet to check the latest information.

Type numbers of products listed in the delivery specification sheets or supplied as samples may have a suffix "(X)" which means preliminary specifications or a suffix "(Z)" which means developmental 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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