PSD (position sensitive detector)

- Surface mount type
  - one-dimensional PSD S14241
- Two-dimensional PSD S1880
- PSD module C10443-03

HAMAMATSU PHOTONICS K.K.
PSD (position sensitive detector)
Contents

PSD and application examples .................................. 3

PSD ........................................................................ 4

  · One-dimensional PSD ........................................ 4
  · Two-dimensional PSD ........................................ 5

Applied products of PSD ........................................ 6

  · PSD signal processing circuits ............................... 6
  · PSD modules ..................................................... 6
  · Signal processing unit for PSD module ................. 6
Various methods are available for detecting the position of incident light, including methods using an array of many small detectors and a multi-element detector (e.g., image sensor). In contrast to these, the PSD is a monolithic device designed to detect the position of incident light.

Since the PSD is a non-segmented photosensor that makes use of the surface resistance of the photodiode, it provides continuous electrical signals and offers excellent position resolution, fast response, and high reliability. Hamamatsu PSDs are fabricated using our unique semiconductor process technology and have the following features:

- Excellent position resolution
- Wide spectral response range
- High-speed response
- Simultaneously detection light level and center-of-gravity position of light spot
- High reliability

The PSD is used in a wide range of fields such as measurements of position, angles, distortion, vibration, and lens reflection/refraction. Applications also include precision measurement such as laser displacement meters, as well as optical remote control devices, distance sensors, and optical switches.

**Schematic of PSD cross section**

![Schematic of PSD cross section](image)

**Principle of triangulation**

With the optical system shown in the figure on the right, the distance between the light receiving position of the PSD and the object is related to the following equation from the principle of triangulation. This allows obtaining the distance from the PSD output value.

\[ L = B \times \frac{f}{d} \]

- L: distance to the object
- B: distance between lens optical axes
- f: distance between lens and PSD
- d: PSD light receiving position

**Application examples**

**[ Auto-focus ]**

![Auto-focus example](image)

The PSD measures the distance to the screen to autofocus the image.

**[ Obstacle detection ]**

![Obstacle detection example](image)

The PSD measures distance to avoid obstacles.
These PSDs have a belt-like photosensitive area and detect the position along the longer direction.

<table>
<thead>
<tr>
<th>Type no.</th>
<th>Photosensitive area (mm)</th>
<th>Resistance length (mm)</th>
<th>Interelectrode resistance $V_b=0.1\ \text{V}$ (kΩ)</th>
<th>Spectral response range (nm)</th>
<th>Package</th>
<th>Photo</th>
</tr>
</thead>
<tbody>
<tr>
<td>S4583-04</td>
<td>1 × 3</td>
<td>3</td>
<td>140</td>
<td>760 to 1100</td>
<td>Plastic</td>
<td><img src="image1" alt="Photo" /></td>
</tr>
<tr>
<td>S4584-04</td>
<td></td>
<td></td>
<td>140</td>
<td>760 to 1100</td>
<td></td>
<td><img src="image2" alt="Photo" /></td>
</tr>
<tr>
<td>S4584-06</td>
<td>1 × 3.5</td>
<td>3.5</td>
<td>140</td>
<td>320 to 1100</td>
<td>Plastic</td>
<td><img src="image3" alt="Photo" /></td>
</tr>
<tr>
<td>S3274-05</td>
<td></td>
<td></td>
<td>400</td>
<td>760 to 1100</td>
<td></td>
<td><img src="image4" alt="Photo" /></td>
</tr>
<tr>
<td>S7105-04</td>
<td></td>
<td></td>
<td>760 to 1100</td>
<td>Plastic</td>
<td></td>
<td><img src="image5" alt="Photo" /></td>
</tr>
<tr>
<td>S7105-06</td>
<td>1 × 4.2</td>
<td>4.2</td>
<td>140</td>
<td>320 to 1100</td>
<td>Plastic</td>
<td><img src="image6" alt="Photo" /></td>
</tr>
<tr>
<td>S7105-16</td>
<td></td>
<td></td>
<td>320 to 1100</td>
<td>Glass epoxy</td>
<td></td>
<td><img src="image7" alt="Photo" /></td>
</tr>
<tr>
<td>S7105-05</td>
<td></td>
<td></td>
<td>400</td>
<td>760 to 1100</td>
<td>Plastic</td>
<td><img src="image8" alt="Photo" /></td>
</tr>
<tr>
<td>S15430-01CT</td>
<td>1 × 6</td>
<td>6</td>
<td>50</td>
<td>780 to 1100</td>
<td>Glass epoxy</td>
<td><img src="image9" alt="Photo" /></td>
</tr>
<tr>
<td>S15430-02CT</td>
<td>1 × 6</td>
<td>6</td>
<td>50</td>
<td>320 to 1100</td>
<td>Glass epoxy</td>
<td><img src="image10" alt="Photo" /></td>
</tr>
<tr>
<td>S15430-03CT</td>
<td></td>
<td></td>
<td>300</td>
<td>780 to 1100</td>
<td></td>
<td><img src="image11" alt="Photo" /></td>
</tr>
<tr>
<td>S3931</td>
<td>1 × 6</td>
<td>6</td>
<td>320 to 1100</td>
<td>Ceramic</td>
<td></td>
<td><img src="image12" alt="Photo" /></td>
</tr>
<tr>
<td>S3932</td>
<td>1 × 12</td>
<td>12</td>
<td>50</td>
<td>320 to 1100</td>
<td>Ceramic</td>
<td><img src="image13" alt="Photo" /></td>
</tr>
<tr>
<td>S14241</td>
<td>0.7 × 24</td>
<td>24</td>
<td>380 to 1000</td>
<td>Glass epoxy</td>
<td></td>
<td><img src="image14" alt="Photo" /></td>
</tr>
<tr>
<td>S8543</td>
<td>0.7 × 24</td>
<td>24</td>
<td>140</td>
<td>320 to 1100</td>
<td>Ceramic</td>
<td><img src="image15" alt="Photo" /></td>
</tr>
</tbody>
</table>
These PSDs detect two-dimensional positions.

<table>
<thead>
<tr>
<th>Type no.</th>
<th>Photosensitive area (mm)</th>
<th>Resistance length (mm)</th>
<th>Inter-electrode resistance Vb=0.1 V (kΩ)</th>
<th>Spectral response range (nm)</th>
<th>Package</th>
<th>Photo</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1880*1</td>
<td>12 × 12</td>
<td>14</td>
<td>10</td>
<td>320 to 1060</td>
<td>Ceramic</td>
<td></td>
</tr>
<tr>
<td>S2044*1</td>
<td>4.7 × 4.7</td>
<td>5.7</td>
<td>10</td>
<td>320 to 1060</td>
<td>Metal</td>
<td></td>
</tr>
<tr>
<td>S5990-01</td>
<td>4 × 4</td>
<td>4.5</td>
<td>7</td>
<td>320 to 1100</td>
<td>Ceramic chip carrier</td>
<td></td>
</tr>
<tr>
<td>S5991-01</td>
<td>9 × 9</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*1: Corresponds to small spot light

Examples of position detectability

[ Ta=25 °C, λ=900 nm (S1880, S2044), λ=830 nm (S5990-01, S5991-01), light spot size: φ0.2 mm]
# Applied products of PSD

## PSD signal processing circuits

### DC type

These are signal processing circuits for DC light detection.

<table>
<thead>
<tr>
<th>Type no.</th>
<th>Compatible PSD</th>
<th>Output</th>
<th>Dimensions (mm)</th>
<th>Photo</th>
</tr>
</thead>
<tbody>
<tr>
<td>C3683-02</td>
<td>One-dimensional PSD</td>
<td>Analog</td>
<td>66 × 56 × 15</td>
<td><img src="image1.png" alt="Photo" /></td>
</tr>
<tr>
<td>C9068</td>
<td></td>
<td>Digital (RS-232C)</td>
<td>110 × 75 × 15</td>
<td><img src="image2.png" alt="Photo" /></td>
</tr>
<tr>
<td>C4674-01</td>
<td>Two-dimensional PSD</td>
<td>Analog</td>
<td>90 × 65 × 15</td>
<td><img src="image3.png" alt="Photo" /></td>
</tr>
<tr>
<td>C9069</td>
<td></td>
<td>Digital (RS-232C)</td>
<td>110 × 75 × 15</td>
<td><img src="image4.png" alt="Photo" /></td>
</tr>
</tbody>
</table>

## PSD modules

The high-precision analog output position detectors combine a PSD for precision photometry with a low-noise amplifier.

<table>
<thead>
<tr>
<th>Type no.</th>
<th>Compatible PSD</th>
<th>Photosensitive area (mm)</th>
<th>Peak sensitivity wavelength (nm)</th>
<th>Photosensitivity*2 (mV/µW)</th>
<th>Output noise voltage Vn Dark state (mVp-p)</th>
<th>Cutoff frequency fc -3 dB (kHz)</th>
<th>Photo</th>
</tr>
</thead>
<tbody>
<tr>
<td>C10443-01</td>
<td>Two-dimensional PSD</td>
<td>4 × 4</td>
<td>960</td>
<td>-60</td>
<td>1</td>
<td>DC 16</td>
<td><img src="image5.png" alt="Photo" /></td>
</tr>
<tr>
<td>C10443-02</td>
<td>9 × 9</td>
<td>960</td>
<td>-60</td>
<td>1</td>
<td>DC 16</td>
<td><img src="image6.png" alt="Photo" /></td>
<td></td>
</tr>
<tr>
<td>C10443-03</td>
<td>12 × 12</td>
<td>920</td>
<td>-60</td>
<td>3</td>
<td>DC 160</td>
<td><img src="image7.png" alt="Photo" /></td>
<td></td>
</tr>
<tr>
<td>C10443-04</td>
<td>16 × 16</td>
<td>920</td>
<td>-60</td>
<td>3</td>
<td>DC 160</td>
<td><img src="image8.png" alt="Photo" /></td>
<td></td>
</tr>
</tbody>
</table>

*2: λ=λp

## Signal processing unit for PSD module

The product converts the output of the PSD module into position signals and outputs in analog and digital form.

<table>
<thead>
<tr>
<th>Type no.</th>
<th>Compatible PSD module</th>
<th>Analog output (V)</th>
<th>Digital output</th>
<th>Minimum measurement time interval (ms)</th>
<th>Dimensions (mm)</th>
<th>Photo</th>
</tr>
</thead>
<tbody>
<tr>
<td>C10460</td>
<td>C10443-01/-02/-03/-04</td>
<td>-10 to +10</td>
<td>Conforms to RS-232C (16-bit)</td>
<td>2</td>
<td>150 × 30 × 100</td>
<td><img src="image9.png" alt="Photo" /></td>
</tr>
</tbody>
</table>
**Main Products**

- **Opto-semiconductors**
  - Si photodiodes
  - APD
  - MPPC®
  - Photo IC
  - Image sensors
  - PSD
  - Infrared detectors
  - LED
  - Optical communication devices
  - Automotive devices
  - X-ray flat panel sensors
  - Mini-spectrometers
  - Opto-semiconductor modules

- **Electron Tubes**
  - Photomultiplier tubes
  - Photomultiplier tube modules
  - Microchannel plates
  - Image intensifiers
  - Xenon lamps / Mercury-xenon lamps
  - Deuterium lamps
  - Light source applied products
  - Laser applied products
  - Microfocus X-ray sources
  - X-ray imaging devices

- **Imaging and Processing Systems**
  - Cameras / Image processing measuring systems
  - X-ray products
  - Life science systems
  - Medical systems
  - Semiconductor failure analysis systems
  - FPD / LED characteristic evaluation systems
  - Spectroscopic and optical measurement systems

- **Laser Products**
  - Semiconductor lasers
  - Applied products of semiconductor lasers
  - Solid state lasers

---

**Sales Offices**

**Japan:**

HAMAMATSU PHOTONICS K.K.
325-6, Sunayama-cho, Naka-ku, Hamamatsu City, Shizuoka Pref. 430-8587, Japan
Telephone: (81)53-456-2141, Fax: (81)53-456-7000
E-mail: info@hamamatsu.co.jp

China:

HAMAMATSU PHOTONICS (CHINA) Co., Ltd.
Main Office
1201 Tower B, Jamiering Center, 27 Donganhuai Beilu, Chaoyang District, 100020 Beijing, P.R. China
Telephone: (86)10-6586-6006, Fax: (86)10-6586-2866
E-mail: hpc@hamamatsu.com.cn

Shanghai Branch
409 Wheelock Square, 1717 Nanjing Road West, Jingan District, 200040 Shanghai, P.R. China
Telephone: (86)21-6089-7018, Fax: (86)21-6089-7017

Shenzhen Branch
74F CHINA MERCHANTS TOWER 18, NO. 1166 Wanghai Road, Shekou, Nanshan district, Shenzhen, P.R. China
Telephone: (86)755-2165-9058, Fax: (86)755-2165-9056
E-mail: hpcsz@hamamatsu.com.cn

Taiwan:

HAMAMATSU PHOTONICS TAIWAN Co., Ltd.
Main Office
8F-3, No.168, Section 2, Gongdiao 5th Road, East District, Hsinchu, 300, Taiwan R.O.C.
Telephone: (886)3-659-0030, Fax: (886)3-659-0081
E-mail: info@hamamatsu.com.tw

**U.S.A.:**

HAMAMATSU CORPORATION
Main Office
360 Foothill Road, Bridgewater, NJ 08807, U.S.A.
Telephone: (1)908-231-1218
E-mail: usa@hamamatsu.com

California Office
2875 Moorpark Ave., San Jose, CA 95128, U.S.A.
Telephone: (1)408-261-2022, (1)408-261-2522
E-mail: usa@hamamatsu.com

Chicago Office
4711 W. Golf Road, Suite 805, Skokie, IL 60076, U.S.A.
Telephone: (1)847-825-6046, (1)847-825-2189
E-mail: usa@hamamatsu.com

Boston Office
20 Park Plaza, Suite 312, Boston, MA 02116, U.S.A.
Telephone: (1)617-536-9900, (1)617-536-9901
E-mail: usa@hamamatsu.com

**Germany, The Netherlands, Poland, Denmark, Israel:**

HAMAMATSU PHOTONICS DEUTSCHLAND GmbH
Main Office
Arzbergerstr. 10, D-82211 Herrsching am Ammersee, Germany
Telephone: (49)8185-375-0, Fax: (49)8185-265-8
E-mail: info@hamamatsu.de

Netherlands Office
Transistorstraat 7, NL-1322 CJ Almere, The Netherlands
Telephone: (31)36-5405384, Fax: (31)36-5244948
E-mail: info@hamamatsu.nl

Poland Office
10 Ciołka Street, RN 126-127 01-402 Warsaw, Poland
Telephone: (48)22-646-0016, Fax: (48)22-646-0018
E-mail: poland@hamamatsu.de

---

**Other Sales Offices:**

**Danish Office**
Lautruphøj 1-3, DK-2750 Ballerup, Denmark
Telephone: (45)70 20 93 69, Fax: (45)44 20 99 10
E-mail: info@hamamatsu.dk

**Israel Office**
Hamahamatsu Photonics (Israel Ltd.)
5/1060 Limnia, Herzliya, Israel
E-mail: info@hamamatsu.co.il

**France, Switzerland, Belgium, Spain:**

HAMAMATSU PHOTONICS FRANCE S.A.R.L.
Main Office
19, Rue du Saule Trau, Parc du Moulin de Massy, 91882 Massy Cedex, France
Telephone: (33)1 69 53 71 00, Fax: (33)1 69 53 71 10
E-mail: infosfr@hamamatsu.fr

**Swiss Office**
Dornacherplatz 7, 4500 Solothurn, Switzerland
Telephone: (41)32-625-60-60, Fax: (41)32-625-60-61
E-mail: swiss@hamamatsu.ch

**Belgian Office**
Axiaparc Technology, rue Andre Dumont 7
1435 Mont-Saint-Guibert, Belgium
Telephone: (32)10 45 63 34, Fax: (32)110 45 63 67
E-mail: info@hamamatsu.be

**Spain Office**
A. Cortes, 4 2º Parque Tecnológico del Vallés 08290 Cerdenyola (Barcelona), Spain
Telephone: (34)93 582 44 30, (34)93 582 44 31
E-mail: infoespain@hamamatsu.es

**North Europe and CIS:**

HAMAMATSU PHOTONICS NORDEN AB
Main Office
Torshammsgatan 35 16440 Kista, Sweden
Telephone: (46)8-509 031 00, Fax: (46)8-509 031 01
E-mail: info@hamamatsu.se

**Russian Office**
11, Christoprudny Boulevard, Building 1, Office 114, 101000, Moscow, Russia
Telephone: (7)495 258 85 18, Fax: (7)495 258 85 19
E-mail: info@hamamatsu.ru

**Italy:**

HAMAMATSU PHOTONICS ITALIA S.r.l.
Main Office
Strada della Moja, 1 int. 6, 20020 Arese (Milano), Italy
Telephone: (39)02-93 58 17 33, Fax: (39)02-93 58 17 41
E-mail: info@hamamatsu.it

**United Kingdom:**

HAMAMATSU PHOTONICS UK Limited
Main Office
2 Howard Court, 10 Texin Road, Welwyn Garden City, Hertfordshire AL7 1BW, UK
Telephone: (44)1707-294888, Fax: (44)1707-325777
E-mail: info@hamamatsu.co.uk

**South Africa Contact:**

9 Beukes Avenue, Highway Gardens, Edenvale
1609 South Africa
Telephone/Fax: (27)11-609-0387

---

Information in this catalog is believed to be reliable. However, no responsibility is assumed for possible inaccuracies or omission. Specifications are subject to change without notice. No patent rights are granted to any of the circuits described herein.

© 2020 Hamamatsu Photonics K.K.

Quality, technology and service are part of every product.