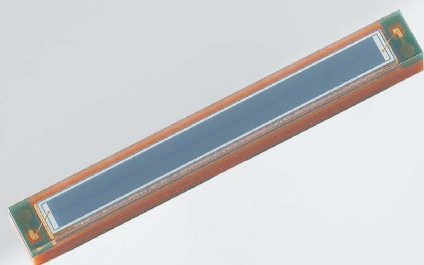
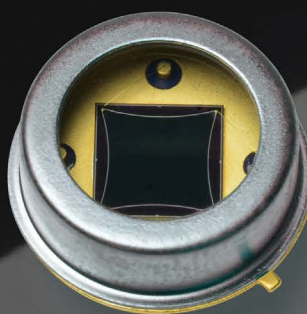


PSD (position sensitive detector)



■ Surface mount type
one-dimensional PSD
S14241



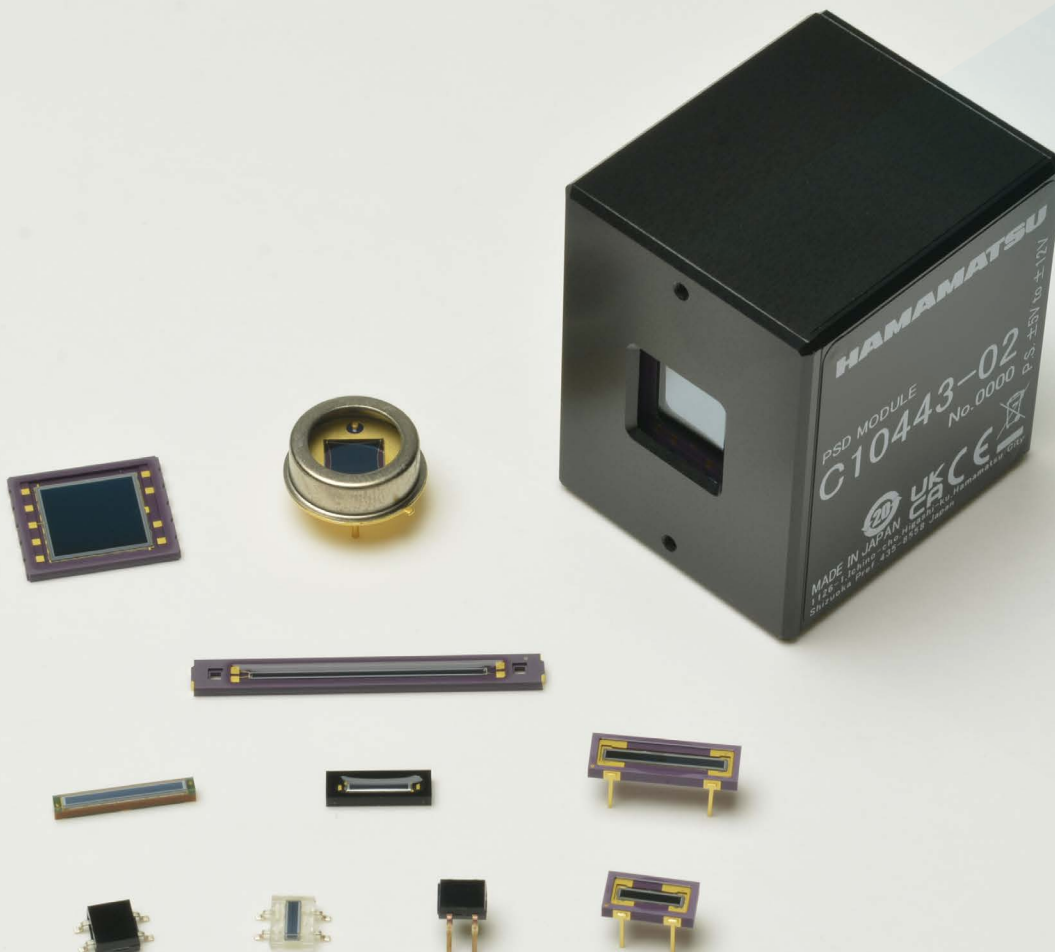
■ Two-dimensional PSD
S2044



■ PSD module
C10443-02

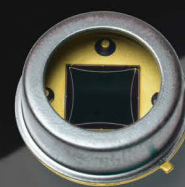
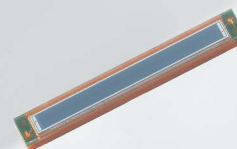
P S D

PSD (position sensitive detector)



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· Two-dimensional PSD	5
■ Applied products of PSD	6
· PSD signal processing circuits	6
· PSD modules	6
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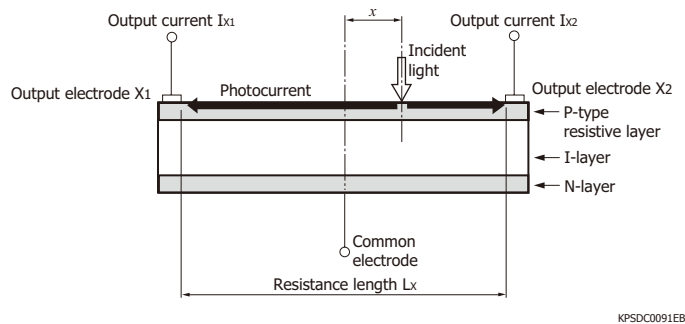
PSD and application examples

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
- Simultaneous detection of light intensity and light intensity center of gravity of spot light
- 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



- Conversion formula for light spot incident position

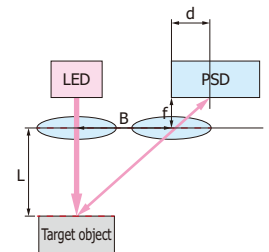
$$\frac{Ix2 - Ix1}{Ix1 + Ix2} = \frac{2x}{Lx}$$

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.

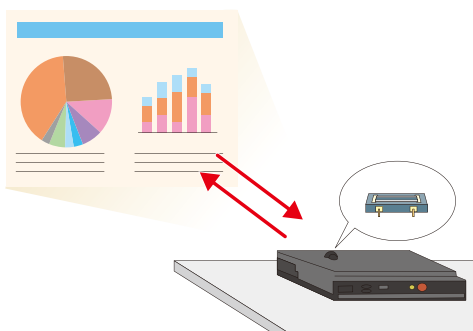
$$L = B \times f/d$$

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



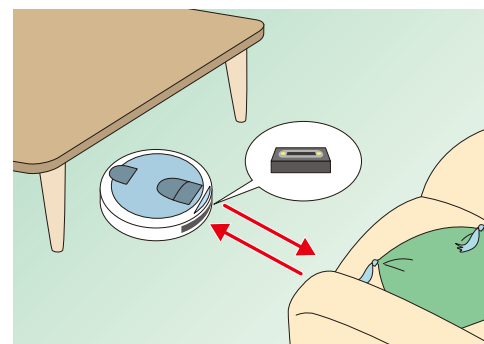
Application examples

[Auto-focus]



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

[Obstacle detection]



The PSD measures distance to avoid obstacles.

PSD



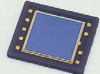

One-dimensional PSD

These PSDs have a belt-like photosensitive area and detect the position along the longer direction.

Type no.	Photosensitive area (mm)	Resistance length (mm)	Interelectrode resistance Vb=0.1 V (kΩ)	Spectral response range (nm)	Package	Photo
S4583-04	1 × 3	3	140	760 to 1100	Plastic	
S4584-04	1 × 3.5	3.5	140	760 to 1100	Plastic	
S4584-06				320 to 1100		
S3274-05			400	760 to 1100		
S7105-04	1 × 4.2	4.2	140	760 to 1100	Plastic	
S7105-06				320 to 1100		
S7105-16				320 to 1100	Glass epoxy	
S7105-05			400	760 to 1100	Plastic	
S15430-01CT	1 × 6	6	50	780 to 1100	Glass epoxy	
S15430-02CT				320 to 1100		
S15430-03CT			300	780 to 1100		
S3931	1 × 6	6	50	320 to 1100	Ceramic	
S3932	1 × 12	12		320 to 1100	Ceramic	
S14241				380 to 1000	Glass epoxy	
S8543	0.7 × 24	24	140	320 to 1100	Ceramic	

Two-dimensional PSD

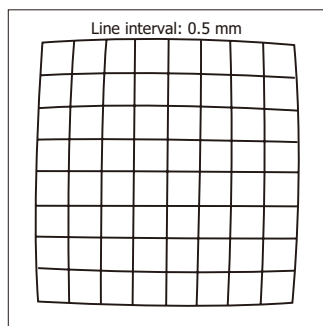
These PSDs detect two-dimensional positions.

Type no.	Photosensitive area (mm)	Resistance length (mm)	Interelectrode resistance $V_b=0.1\text{ V}$ (k Ω)	Spectral response range (nm)	Package	Photo
S2044 *1	4.7 × 4.7	5.7	10	320 to 1060	Metal	
S5990-01	4 × 4	4.5	7	320 to 1100	Ceramic chip carrier	
S5991-01	9 × 9	10				
S15534	4 × 4	4.5		380 to 1100	Glass epoxy	

*1: Corresponds to small spot light

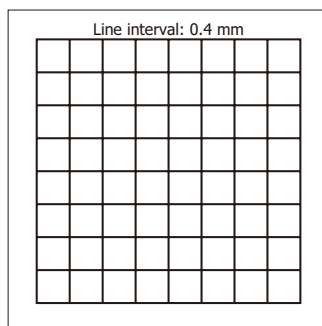
Examples of position detectability [$T_a=25\text{ }^{\circ}\text{C}$, $\lambda=900\text{ nm}$ (S2044), $\lambda=830\text{ nm}$ (S5990-01, S5991-01, S15534), light spot size: $\phi 0.2\text{ mm}$]

[S2044]



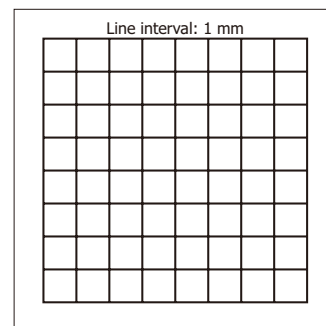
KPSDC0019EA

[S5990-01]



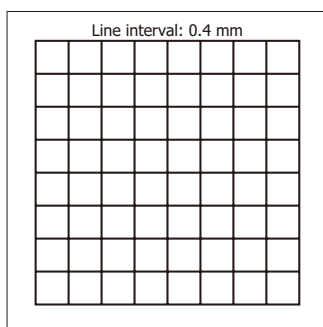
KPSDC0064EB

[S5991-01]



KPSDC0065EA

[S15534]







KPSDC0064EC

Applied products of PSD

PSD signal processing circuits



DC type

These are signal processing circuits for DC light detection.

Type no.	Compatible PSD	Output	Dimensions (mm)	Photo
C3683-02	One-dimensional PSD	Analog	66 × 56 × 15	
C9068-01		Digital (RS-232C)	110 × 75 × 15	
C4674-01	Two-dimensional PSD	Analog	90 × 65 × 15	
C9069-01		Digital (RS-232C)	110 × 75 × 15	

PSD modules

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




Type no.	Built-in PSD	Photosensitive area (mm)	Peak sensitivity wavelength (nm)	Photosensitivity*2 (mV/μW)	Output noise voltage Vn Dark state (mVp-p)	Cutoff frequency fc -3 dB (kHz)		Photo
						Lower	Upper	
C10443-01	Two-dimensional PSD	4 × 4	960	-60	1	DC	16	
C10443-02		9 × 9						

*2: $\lambda = \lambda_p$

Related products

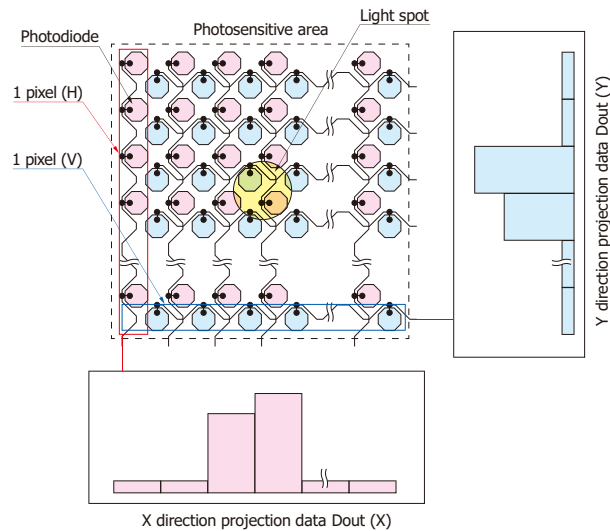
Profile sensors

These high-speed frame rate CMOS image sensors are specialized for acquiring 2-D projection data. A built-in A/D converter makes them available for digital output. The S15366 series also integrates a center-of-gravity calculation circuit, so the center-of-gravity calculation result of light is output.

Type no.	Photosensitive area [mm (H) × mm (V)]	Number of lines X/Y directions	Pixel pitch (μm)	Frame rate 8-bit max. (frames/s)	Package	Photo
S9132	1.9968 × 1.9968	256	7.8	3200	Ceramic	
S15366-256				3156	Glass epoxy	
S15366-512	3.9936 × 3.9936	512		1602		

Operating principle

In the photosensitive area arranged two-dimensionally, the photosensitive area for the X-direction projection data is connected in one vertical column, and the photosensitive area for the Y-direction projection data is connected in one horizontal row using metal wiring. Output of the photosensitive area of the same line is read out as added data, making it possible to acquire projection data in the X/Y directions. The amount of data per frame is small, achieving a high frame rate.



KMPDC1038EA

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
- MEMS devices
- 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
- Microfocus X-ray sources
- X-ray imaging devices

Imaging and Processing Systems

- Scientific cameras
- Spectroscopic and optical measurement systems
- Ultrafast photometry systems
- Life science systems
- Medical systems
- Non-destructive inspection products
- Semiconductor manufacturing support systems
- Material research systems

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- Single chip laser diodes
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- Applied products of semiconductor lasers
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Sales Offices

Japan:

HAMAMATSU PHOTONICS K.K.

325-6, Sunayama-cho, Chuo-ku,
Hamamatsu City, Shizuoka Pref. 430-8587, Japan
Telephone: (81)53-452-2141, Fax: (81)53-456-7889
E-mail: intl-div@hq.hpkk.co.jp

China:

HAMAMATSU PHOTONICS (CHINA) CO., LTD.

Main Office
1201, Tower B, Jiaming Center, 27 Dongsanhuan 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

4905 Wheelock Square, 1717 Nanjing Road West,
Jingan District, 200040 Shanghai, P.R. China
Telephone: (86)21-6089-7018, Fax: (86)21-6089-7017
E-mail: hpcsh@hamamatsu.com.cn

Shenzhen Branch

14F China Merchants Tower 1#, 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

Wuhan Branch

Room 1005 Fanyue City T2 Building, No. 19 Guanshan
Avenue, East Lake High-tech District, Wuhan 430075,
Hubei, P.R. China
Telephone: (86)27-5953-8219
E-mail: hpcwh@hamamatsu.com.cn

Taiwan:

HAMAMATSU PHOTONICS TAIWAN CO., LTD.

Main Office
13F-1, No.101, Section 2, Gongdao 5th Road,
East Dist., Hsinchu City 300046, Taiwan (R.O.C.)
Telephone: (886)3-659-0080, Fax: (886)3-659-0081
E-mail: info@hamamatsu.com.tw

Korea:

HAMAMATSU PHOTONICS KOREA CO., LTD.

A-912, 167, Songpa-daero, Seoul, 05855, Republic of Korea
Telephone: (82)2-2054-8202, Fax: (82)2-2054-8207
E-mail: sales@hpkr.co.kr

U.S.A.:

HAMAMATSU CORPORATION

Main Office
360 Foothill Road, Bridgewater, NJ 08807, U.S.A.
Telephone: (1)908-231-0960, Fax: (1)908-231-1218

California Office

2875 Moorpark Ave., San Jose, CA 95128, U.S.A.
Telephone: (1)408-261-2022, Fax: (1)408-261-2522

Germany, The Netherlands, Poland, Israel:

HAMAMATSU PHOTONICS DEUTSCHLAND GMBH

Main Office
Arzbergerstr. 10, 82211 Herrsching am Ammersee,
Germany
Telephone: (49)8152-375-0, Fax: (49)8152-265-8
E-mail: info@hamamatsu.de

Netherlands Office

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

Poland Office

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

Israel Office (HAMAMATSU PHOTONICS ISRAEL LTD.)

Ha-Menofim 10 st., third floor, 4672561 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 Trapu, 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: infos@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

Axisparc Technology, Rue André Dumont 7,
1435 Mont-Saint-Guibert, Belgium
Telephone: (32)10 45 63 34, Fax: (32)10 45 63 67
E-mail: info@hamamatsu.be

Spanish Office

C. Argenters 4, edif 2, Parque Tecnológico del Vallés,
08290 Cerdanyola, (Barcelona), Spain
Telephone: (34)93 582 44 30
E-mail: infospain@hamamatsu.es

North Europe and CIS:

HAMAMATSU PHOTONICS NORDEN AB

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

Danish Office

Lautrupvej 1-3, 2750 Ballerup, Denmark
Telephone: (45)88-74-53-10
Email: info@hamamatsu.dk

Italy:

HAMAMATSU PHOTONICS ITALIA S.R.L.

Main Office
Strada della Moia, 1 int. 6 20044 Arese (Milano), Italy
Telephone: (39)02-93 58 17 33, Fax: (39)02-93 58 17 41
E-mail: info@hamamatsu.it

Rome Office

Viale Cesare Pavese, 435, 00144 Roma, Italy
Telephone: (39)06-50 51 34 54
E-mail: inforoma@hamamatsu.it

United Kingdom:

HAMAMATSU PHOTONICS UK LIMITED

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

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9 Beukes Avenue, Highway Gardens, Edenvale,
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Solid State Division, HAMAMATSU PHOTONICS K.K.

1126-1, Ichino-cho, Chuo-ku, Hamamatsu City, 435-8558, Japan
Telephone: (81)53-434-3311, Fax: (81)53-434-5184

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