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One-dimensional PSD

S3931 S3932

6 to 12 mm resistance length PSD for precision distance measurement

Hamamatsu provides various types of one-dimensional PSD (position sensitive detector) designed for precision distance measurement such as displacement meters. The S3931 and S3932 have a photosensitive area of 1 × 6 mm and 1 × 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.

Features

- **Superior position detection ability**
- **High reliability**
- **Easy to use 4-pin small ceramic package**

Applications

- **Displacement sensing**
- **Distance measurement**
- **Proximity switching**

Structure / Absolute maximum ratings

Type no.	Package	Window material*1	Photosensitive area size (mm)	Absolute maximum ratings		
				Reverse voltage V_R max (V)	Operating temperature*2 Topr (°C)	Storage temperature*2 Tstg (°C)
S3931	Ceramic	R	1 × 6	20	-10 to +60	-20 to +80
S3932		R	1 × 12			

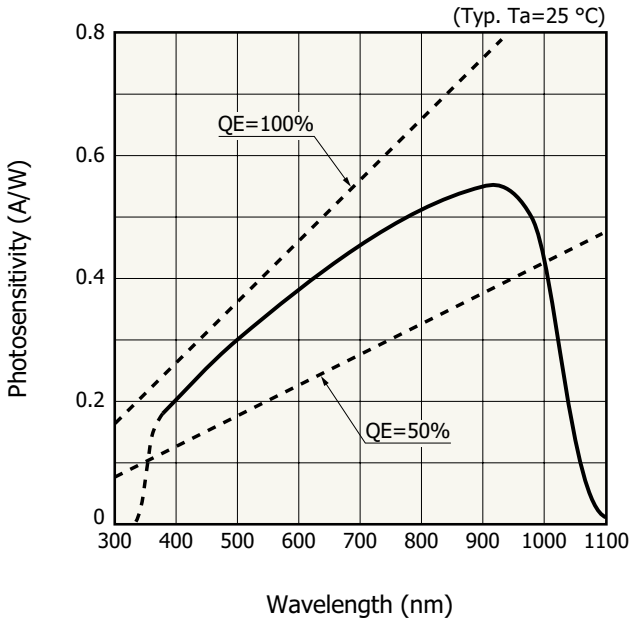
*1: R: resin coating
*2: No dew condensation
When there is a temperature difference between a product and the surrounding area in high humidity environments, dew condensation may occur on the product surface. Dew condensation on the product may cause deterioration in characteristics and reliability.
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 (Typ. Ta=25 °C, unless otherwise noted)

Type no.	Spectral response range λ (nm)	Peak sensitivity wavelength λp (nm)	Photo sensitivity S λ=λp (A/W)	Interelectrode resistance Rie Vb=0.1 V			Position detection error*3 E V_R=5 V light spot ϕ200 μm		Saturation photocurrent*4 V_R=5 V R_L=1 kΩ (μA)	Dark current I_D V_R=5 V		Temp. coefficient of I_D T_{CID} (times/°C)	Rise time tr V_R=5 V R_L=1 kΩ (μs)	Terminal capacitance Ct V_R=5 V f=10 kHz (pF)	Position resolution*5 (μm)
				Min. (kΩ)	Typ. (kΩ)	Max. (kΩ)	Typ. (μm)	Max. (μm)		Typ. (nA)	Max. (nA)				
S3931	320 to 1100	920	0.55	30	50	80	±30	±120	100	0.15	10	1.15	1.5	40	0.2
S3932							±60	±240		0.2	20		3.0	80	0.3

*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)
- Light spot size: ϕ200 μm
- Frequency range: 1 kHz
- Photocurrent: 1 μA
- Circuit system input noise: 1 μV (1 kHz)
- Interelectrode resistance: Typical value (refer to the specification table)

Spectral response



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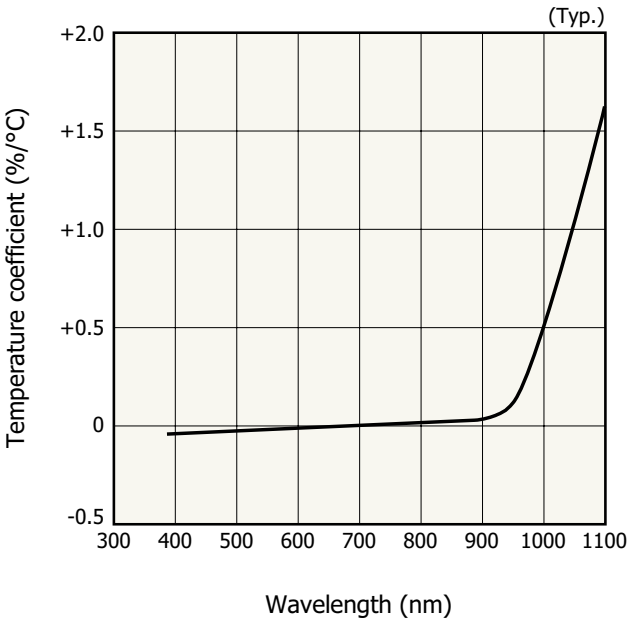
Photosensitivity temperature characteristics



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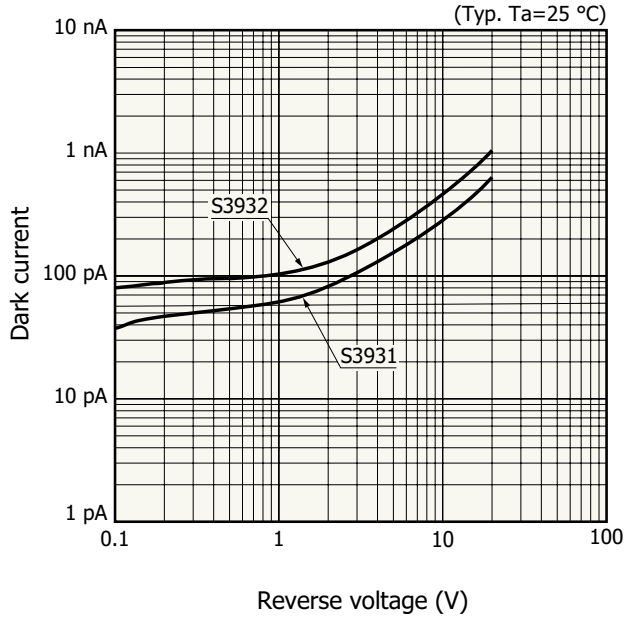
Dark current vs. reverse voltage



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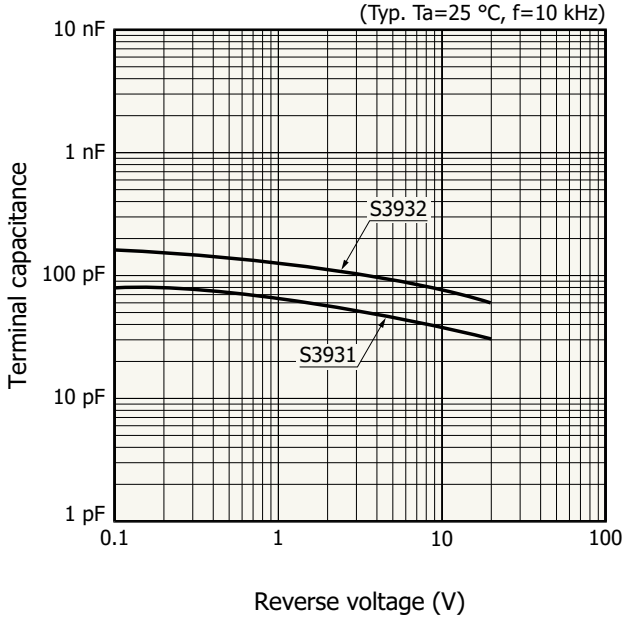
Terminal capacitance vs. reverse voltage



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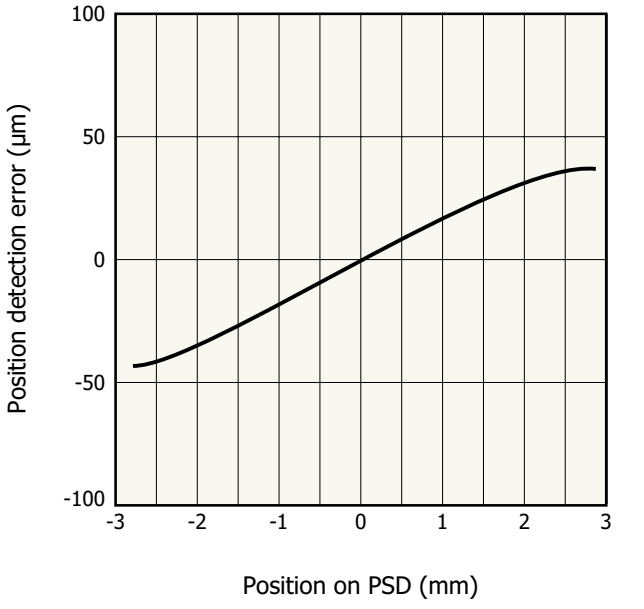
Examples of position detectability (Ta=25 °C, λ=900 nm, light spot size: ϕ0.2 mm)

S3931



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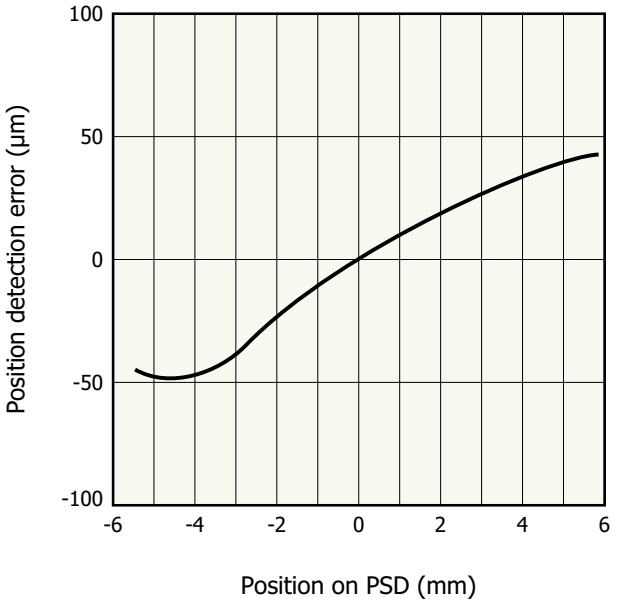
S3932



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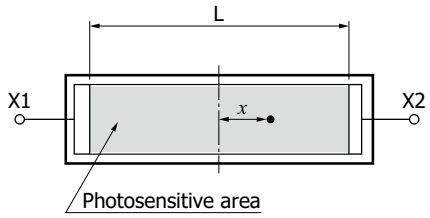
Conversion formula of spot light position on the PSD

Output signals (photocurrent) I_1 and I_2 obtained from electrodes X1 and X2, and the light spot position x on the PSD can be found by the following formula.



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

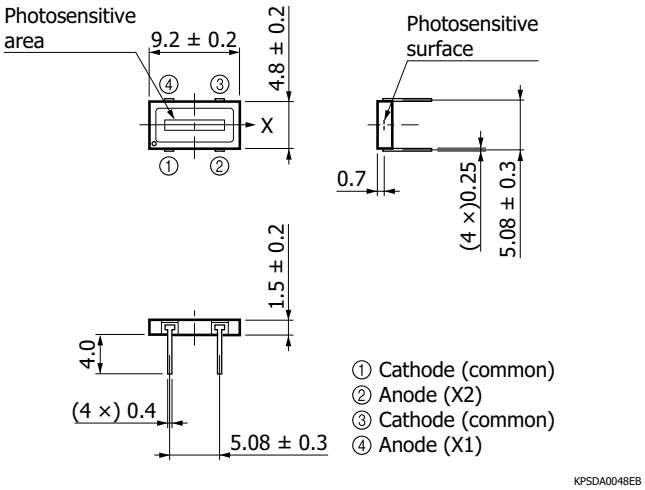
I_1: Output signal from electrode X1
I_2: Output signal from electrode X2
x : Light spot position
L : Photosensitive area size (Resistance length)
S3931=6 mm, S3932=12 mm

Correction for position detection error

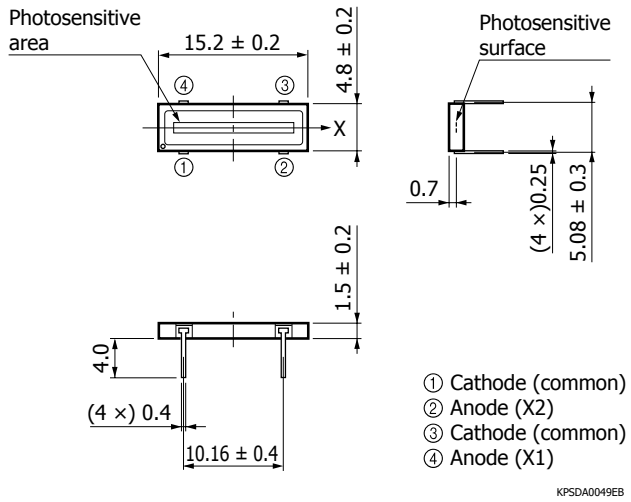
Position detection characteristics obtained by the above formula can be corrected to reduce position detection errors. For example, the maximum position detection error (±120 µm) of the S3931 can be significantly reduced to ±9 µm by using the least square method.

Dimensional outlines (unit: mm)

S3931



S3932



Recommended soldering conditions

· Solder temperature: 260 °C (5s or less, once)
Solder the leads at a point at least 2 mm away from the package body.
Note: When you set soldering conditions, check that problems do not occur in the product by testing out the conditions in advance.

Related information

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

■ Precautions
· Disclaimer
· Precautions / Metal, ceramic, plastic package products

■ Catalog
· Technical note / PSD

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