



S2044

Non-discrete position sensors utilizing photodiode surface resistance

PSD (position sensitive detector) is an optoelectronic position sensor utilizing photodiode surface resistance. There is no element gap due to non-discrete type. Therefore, continuous output signals (X/Y coordinate signals) can be obtained for the movement of the light spot, and the position resolution and response are excellent.

Features

- Continuous output signal for light spot movement
- High position resolution
- High-speed response
- Simultaneous measurements of position and intensity
- Position is measured independent of light spot size
- Wide spectral response range
- 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

Parameter	Symbol	Specification	Unit
Photosensitive area size	-	4.7 × 4.7	mm
Package	-	Metal	-
Window material	-	Borosilicate glass	-
Resistance length	RI	5.7	mm

Absolute maximum ratings

Parameter	Symbol	Value	Unit
Reverse voltage	VR max	20	V
Operating temperature*1	Topr	-10 to +60	°C
Storage temperature*1	Tstg	-20 to +80	°C

*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)

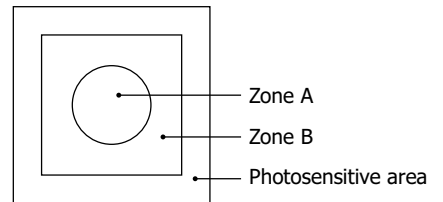
Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Spectral response range	λ		-	340 to 1060	-	nm
Peak sensitivity wavelength	λ_p		-	920	-	nm
Photosensitivity	S	$\lambda=\lambda_p$	-	0.6	-	A/W
Interelectrode resistance*2	Rie	Vb=0.1 V	5	10	15	k Ω
Position detection error*3	Zone A	E	-	± 40	± 100	μm
	Zone B		-	± 70	± 150	
Saturation current	Ist	VR=5 V RL=1 k Ω	-	0.5	-	mA
Dark current	ID	VR=5 V	-	0.5	5	nA
Temperature coefficient of ID	TcID		-	1.15	-	times/°C
Rise time	tr	VR=5 V RL=1 k Ω	-	0.3	-	μs
Terminal capacitance	Ct	VR=5 V f=10 kHz	-	45	-	pF
Position resolution*4	-		-	0.6	-	μm

*2: Measured between two output terminals opposite to each other, and the other terminals are open-circuited on measurement.

*3: Zone A= $\phi 1.8$ mm, Zone B= 4×4 mm (See the figure on the right)

*4: Position resolution

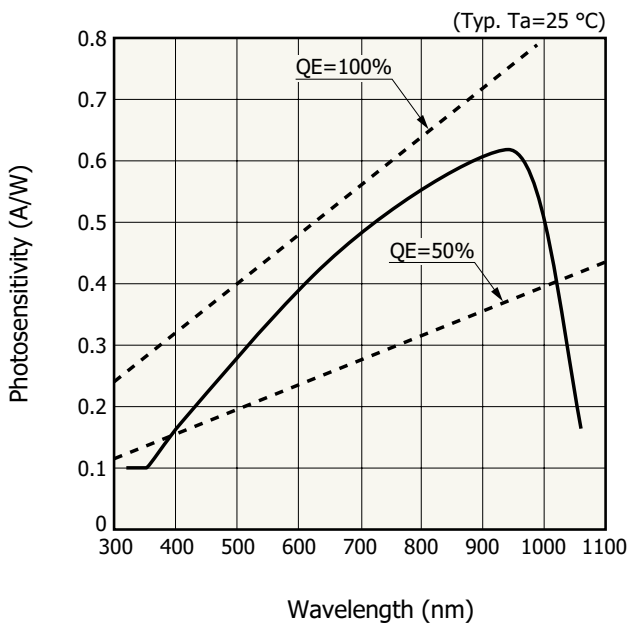
This is the minimum detectable light spot displacement. The detection limit is indicated by distance on the photosensitive surface. The numerical value of the resolution of a position sensor using a PSD is proportional to both the length of the PSD and the noise of the measuring system (resolution deteriorates)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



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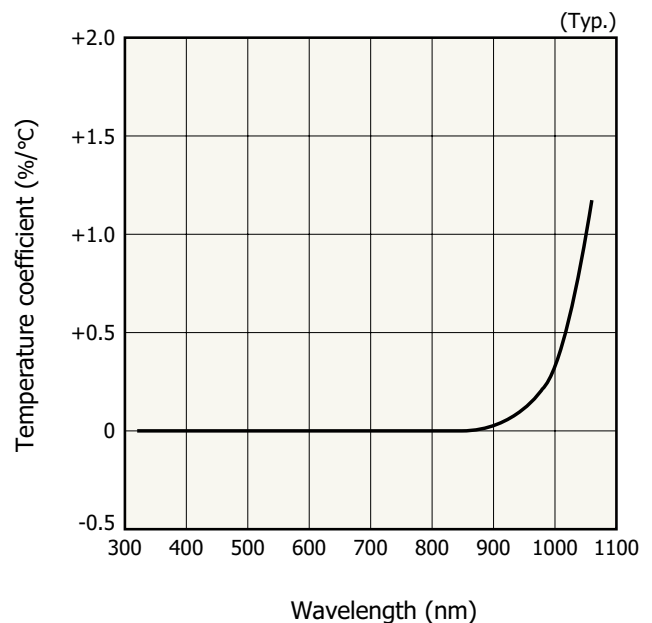
- Light source: LED (900 nm)
- Light spot size: $\phi 200 \mu\text{m}$
- Frequency range: 1 kHz
- Photocurrent: 1 μA
- Circuit system input noise: 1 μV (1 kHz)
- Interelectrode resistance: Typical value (Refer to specification table.)

Spectral response



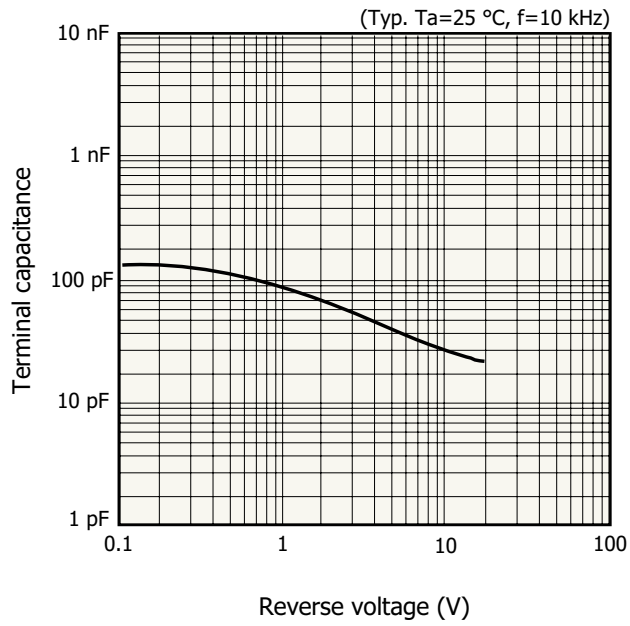
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Photosensitivity temperature characteristics



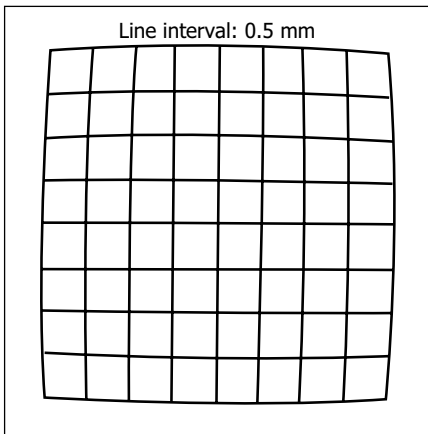
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Terminal capacitance vs. reverse voltage



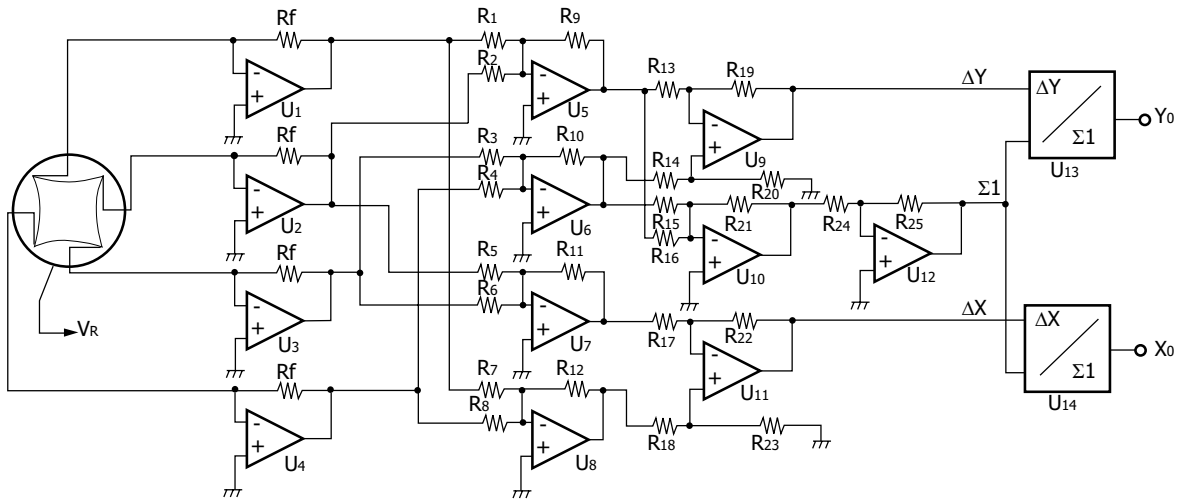
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Examples of position detectability ($T_a=25\text{ }^\circ\text{C}$, $\lambda=900\text{ nm}$, light spot size: $\phi 200\text{ }\mu\text{m}$)



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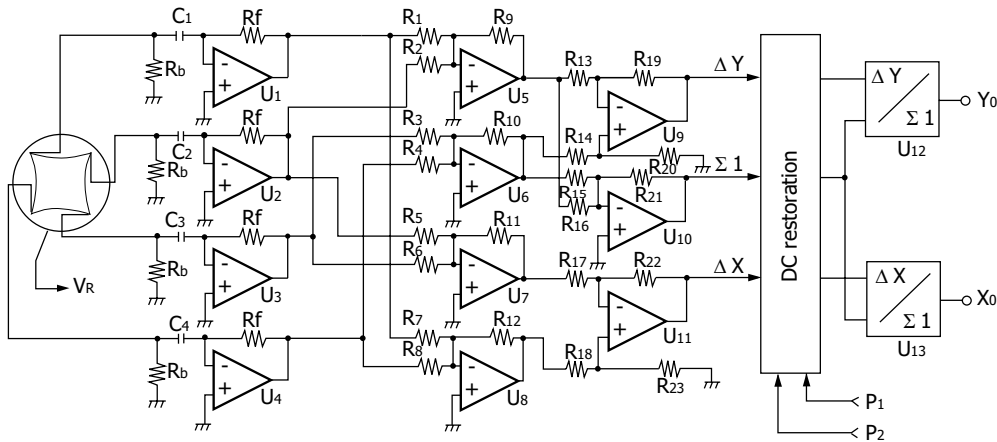
Example of DC-operating circuit



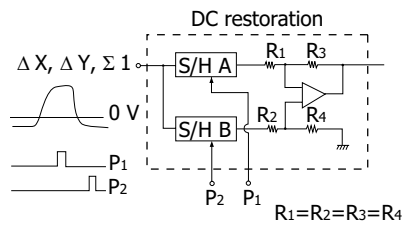
R₁ - R₂₅: same value
 R_f: depends on input level
 U₁ - U₄: low drift head amplifier, TL071, etc.
 U₁₃, U₁₄: analog divider, AD538 (Analog Devices), etc.

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Example of AC-operating circuit

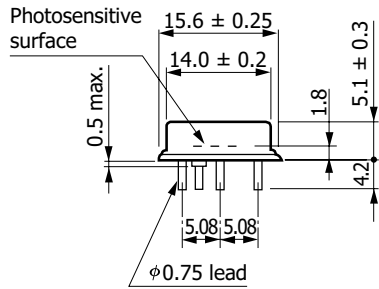
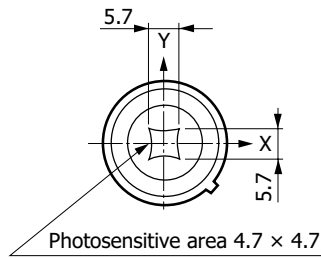


R₁ - R₂₄: same value
 R_f: depends on input level
 U₁ - U₄: low drift head amplifier, TL071, etc.
 U₁₂, U₁₃: analog divider, AD538 (Analog Devices), etc.

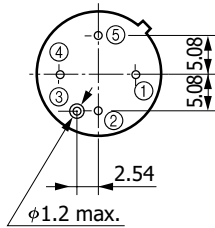


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Dimensional outlines (unit: mm)



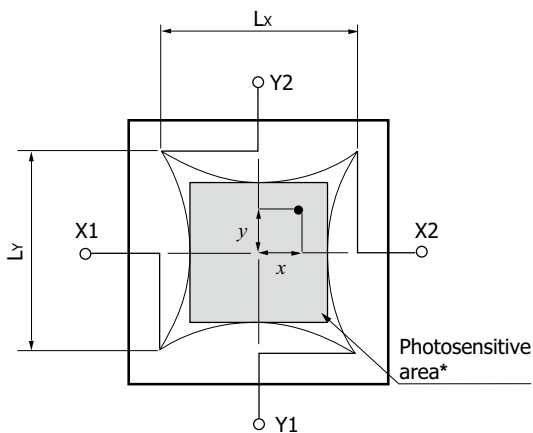
- ① Anode (X2)
- ② Anode (Y2)
- ③ Cathode (case)
- ④ Anode (X1)
- ⑤ Anode (Y1)



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Conversion formula of spot light position on the PSD

Output signals (photocurrent) I_{X1} , I_{X2} , I_{Y1} , I_{Y2} obtained from electrodes and the light spot position x , y can be found by the following formula.



$$\frac{(I_{X2} + I_{Y1}) - (I_{X1} + I_{Y2})}{I_{X1} + I_{X2} + I_{Y1} + I_{Y2}} = \frac{2x}{Lx}$$

$$\frac{(I_{X2} + I_{Y2}) - (I_{X1} + I_{Y1})}{I_{X1} + I_{X2} + I_{Y1} + I_{Y2}} = \frac{2y}{Ly}$$

- I_{X1} : Output signal from electrode X1
- I_{X2} : Output signal from electrode X2
- I_{Y1} : Output signal from electrode Y1
- I_{Y2} : Output signal from electrode Y2
- x, y : Position coordinate of light spot
- Lx, Ly : Resistance length (5.7 mm)

* Photosensitive area is specified at the inscribed square.

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Related information

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

- Precautions
 - Disclaimer
 - Precautions / Metal, ceramic, plastic package products
- Catalogs
 - Technical note / PSD

Information described in this material is current as of January 2025.

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