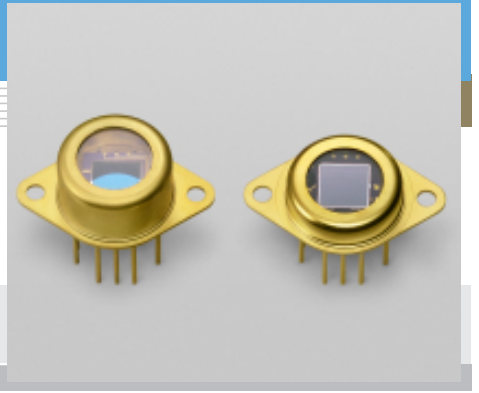


# Si photodiode with preamp S9295 series

Large area photodiode integrated with op amp and TE-cooler



S9295 series is a thermoelectrically cooled Si photodiode with preamp developed for low-light-level detection. A large area photodiode, op amp, TE-cooler and feedback resistor (10 GΩ) are integrated into a single package. A thermistor is also included in the same package for temperature control so that the photodiode and I-V conversion circuit can be cooled for stable operation. S9295 series also features low noise and low NEP, and is especially suitable for NO<sub>x</sub> detection. The active area of the photodiode is internally connected to the GND terminal making it highly resistant to EMC noise.

## Features

- Large active area: 10 × 10 mm
- UV to NIR Si photodiode optimized for precision photometry
- Compact hermetic package with sapphire window
- High precision FET input operational amplifier
- High gain: R<sub>f</sub>=10 GΩ
- Low noise and NEP
- High cooling efficiency  
S9295 : ΔT=50 °C  
S9295-01: ΔT=30 °C
- High stability with thermistor
- Highly resistant to EMC noise

## Applications

- NO<sub>x</sub> detection
- Low-light-level measurement, etc.

S9295 series may be damaged by Electro Static Discharge, etc. Please see Precautions for use in the last page.

### Absolute maximum ratings

Parameter	Symbol	Value
Supply voltage (preamp)	V <sub>cc</sub>	±20 V
Operating temperature	T <sub>opr</sub>	-30 to +60 °C
Storage temperature	T <sub>stg</sub>	-40 to +80 °C
TE-cooler allowable voltage *1	V <sub>te</sub>	5 V *2
TE-cooler allowable current	I <sub>te</sub>	1 A
Thermistor power dissipation	P <sub>th</sub>	0.2 mW

\*1: Ripple Max.: 10 %

\*2: S9295-01: 3.7 V

### Recommended operating conditions

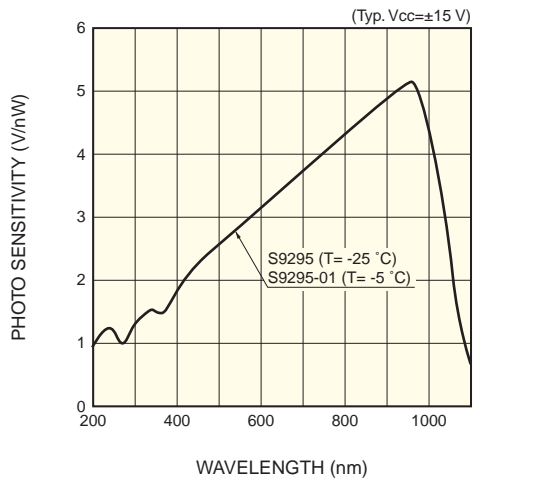
Parameter	Symbol	Value
Supply voltage (preamp)	V <sub>cc</sub>	±5 to ±15 V
TE-cooler current	I <sub>te</sub>	0.8 A Max.
Thermistor power dissipation	P <sub>th</sub>	0.03 mW Max.
Load resistance	R <sub>L</sub>	100 kΩ Min.

### Electrical and optical characteristics (Typ. V<sub>cc</sub>=±15 V, R<sub>L</sub>=1 MΩ)

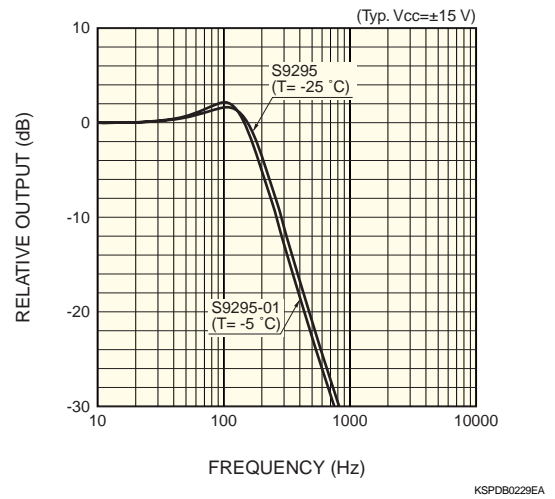
Parameter	Symbol	Condition	S9295	S9295-01	Unit
			T= -25 °C	T= -5 °C	
Spectral response range	λ		190 to 1100		nm
Peak sensitivity wavelength	λ <sub>p</sub>		960		nm
Feedback resistance (built-in) *3	R <sub>f</sub>		10		GΩ
Photo sensitivity	S	λ=200 nm	0.9	0.9	V/nW
		λ=λ <sub>p</sub>	5.1	5.1	
Output noise voltage	V <sub>n</sub>	Dark state, f=10 Hz	20	25	μV <sub>rms</sub> /Hz <sup>1/2</sup>
Noise equivalent power	NEP	λ=λ <sub>p</sub> , f=10 Hz	4	5	fW/Hz <sup>1/2</sup>
Output offset voltage	V <sub>os</sub>	Dark state	±2	±2	mV
Cut-off frequency	f <sub>c</sub>	-3 dB	190	180	Hz
Output voltage swing	V <sub>o</sub>		13		V
Supply current	I <sub>cc</sub>	Dark state	0.3		mA
Thermistor resistance	R <sub>th</sub>		86	30	kΩ

\*3: Custom devices are available with different R<sub>f</sub> values and/or internal C<sub>f</sub>, etc.

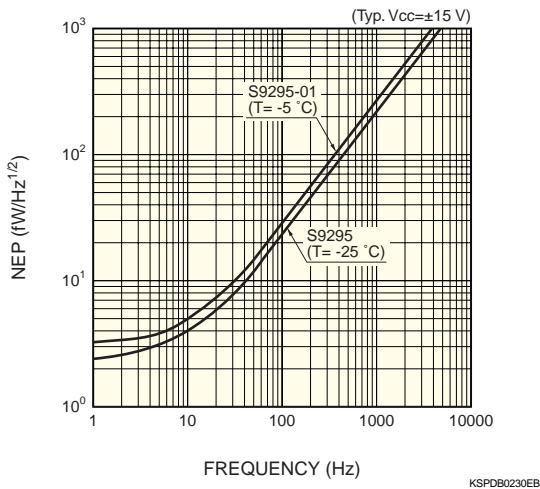
■ Spectral response



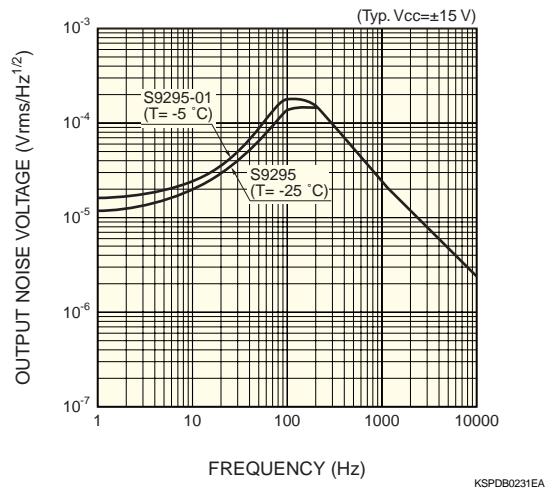
■ Frequency response



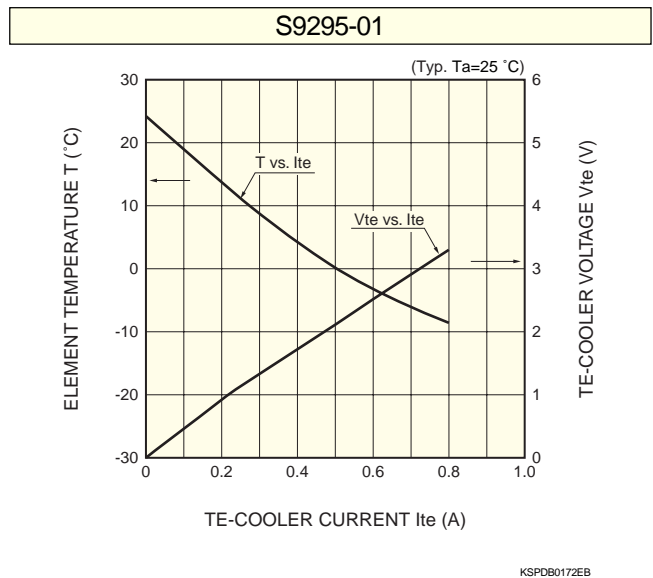
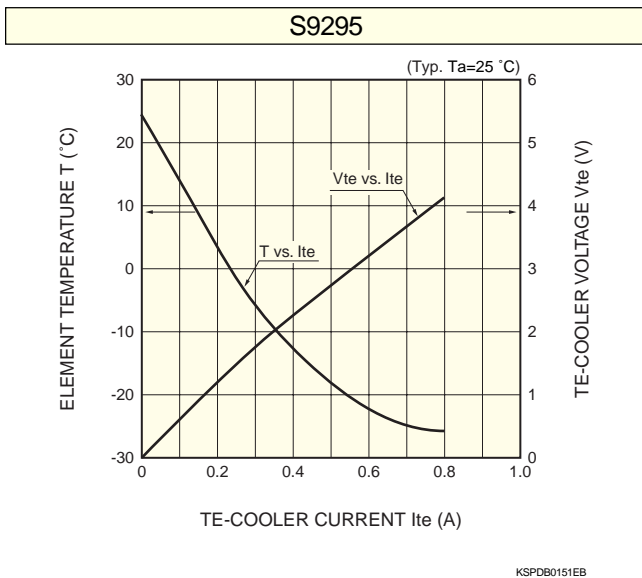
■ NEP vs. frequency



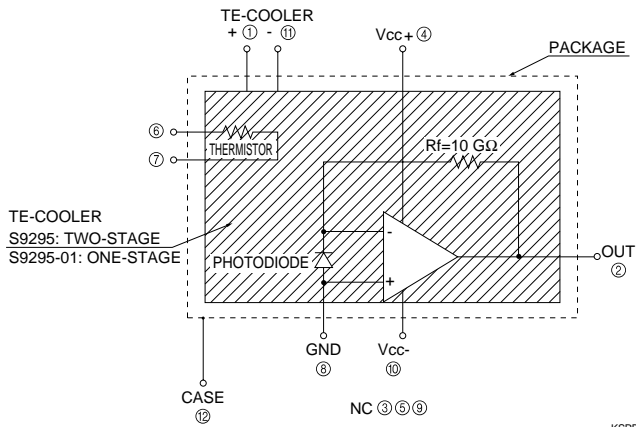
■ Output noise voltage vs. frequency



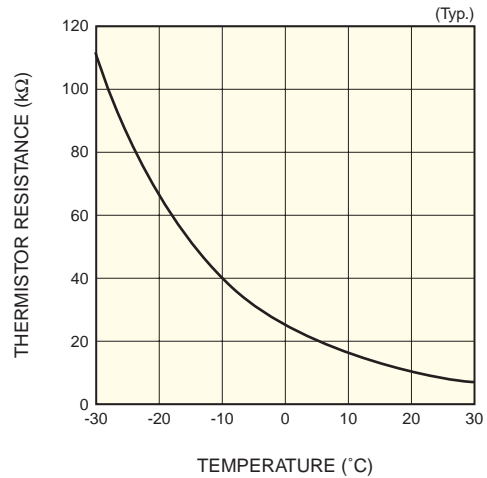
■ Element temperature vs. TE-cooler current



## External connection

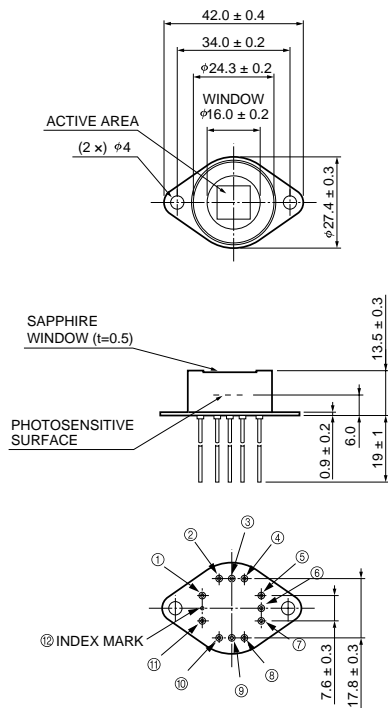


## Thermistor resistance vs. temperature

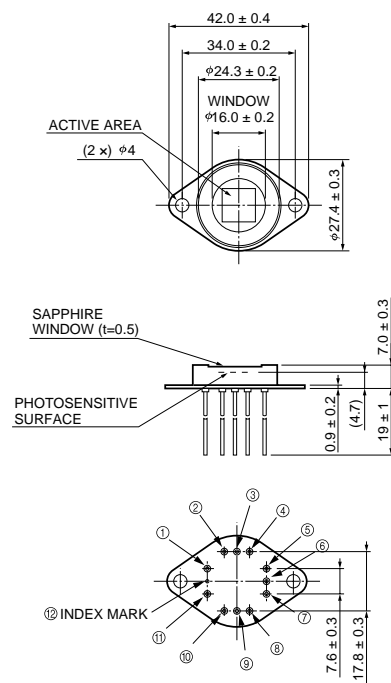


## Dimensional outlines (unit: mm)

S9295



S9295-01



A tantalum or ceramic capacitor of 0.1 to 10  $\mu\text{F}$  must be connected to the supply voltage leads (pins ④ and ⑩) as a bypass capacitor used to prevent the device from oscillation.

**Precautions for use****■ ESD**

S9295 series may be damaged or their performance may deteriorate by such factors as electro static discharge from the human body, surge voltage from measurement equipment, leakage voltages from soldering irons and packing materials. As a countermeasure against electro static discharge, the device, operator, work place and measuring jigs must all be set at the same potential. The following precautions must be observed during use:

- To protect the device from electro static discharge which accumulate on the operator or the operator's clothes, use a wrist strap or similar tools to ground the operator's body via a high impedance resistor (1 M $\Omega$ ).
- A semiconductive sheet (1 M $\Omega$  to 10 M $\Omega$ ) should be laid on both the work table and the floor in the work area.
- When soldering, use an electrically grounded soldering iron with an isolation resistance of more than 10 M $\Omega$ .
- For containers and packing, use of a conductive material or aluminum foil is effective. When using an antistatic material, use one with a resistance of 0.1 M $\Omega$ /cm<sup>2</sup> to 1 G $\Omega$ /cm<sup>2</sup>.

**■ Strength**

Thermoelectrically-cooler devices may be damaged if subjected to shock, for example drop impact. Take sufficient care when handling these devices.

**■ Lead forming**

When forming the leads, take care not to apply excessive force to the lead sealing glass. Excessive force may impair the hermetic sealing, possibly degrading the cooling capacity.

To form the leads, hold the roots of the leads securely with a pair of pliers and bend them.

**■ Heatsink**

Use a heatsink with thermal resistance less than 1.3 °C/W. Apply thermal grease between the heatsink and detector package, and then fasten them with the screws. Be careful not to give any excessive force or mechanical stress to the detector package at this point.

**■ Wiring**

- Be careful not to misconnect the plus and minus leads of the thermoelectric cooler or preamplifier. Supplying a voltage or current while these connections are reversed may damage the device.
- The feedback resistor integrated into S9295 series is high so it is susceptible to external noise. Always ground the case terminal when using S9295.

**HAMAMATSU**

Information furnished by HAMAMATSU is believed to be reliable. However, no responsibility is assumed for possible inaccuracies or omissions. Specifications are subject to change without notice. No patent rights are granted to any of the circuits described herein. ©2004 Hamamatsu Photonics K.K.

HAMAMATSU PHOTONICS K.K., Solid State Division

1126-1 Ichino-cho, Higashi-ku, Hamamatsu City, 435-8558 Japan, Telephone: (81) 53-434-3311, Fax: (81) 53-434-5184, <http://www.hamamatsu.com>

U.S.A.: Hamamatsu Corporation: 360 Foothill Road, P.O.Box 6910, Bridgewater, N.J. 08807-0910, U.S.A., Telephone: (1) 908-231-0960, Fax: (1) 908-231-1218

Germany: Hamamatsu Photonics Deutschland GmbH: Arzbergerstr. 10, D-82211 Herrsching am Ammersee, Germany, Telephone: (49) 08152-3750, Fax: (49) 08152-2658

France: Hamamatsu Photonics France S.A.R.L.: 19, Rue du Saule Trape, Parc du Moulin de Massy, 91882 Massy Cedex, France, Telephone: 33-(1) 69 53 71 00, Fax: 33-(1) 69 53 71 10

United Kingdom: Hamamatsu Photonics UK Limited: 2 Howard Court, 10 Tewin Road, Welwyn Garden City, Hertfordshire AL7 1BW, United Kingdom, Telephone: (44) 1707-294888, Fax: (44) 1707-325777

North Europe: Hamamatsu Photonics Norden AB: Smidesvägen 12, SE-171 41 Solna, Sweden, Telephone: (46) 8-509-031-00, Fax: (46) 8-509-031-01

Italy: Hamamatsu Photonics Italia S.R.L.: Strada della Moia, 1/E, 20020 Arese, (Milano), Italy, Telephone: (39) 02-935-81-733, Fax: (39) 02-935-81-741