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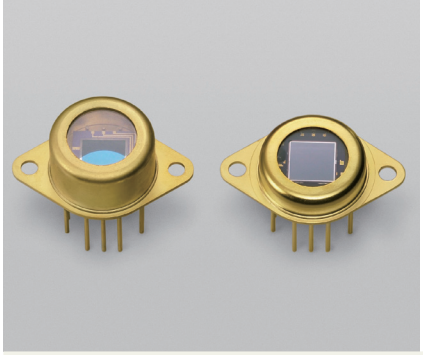
Si photodiodes with preamp



S9295 series

Large area photodiode integrated with op amp and TE-cooler

The 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. The S9295 series also features low noise and low NEP, and is especially suitable for NOx detection. The photosensitive area of the photodiode is internally connected to the GND terminal making it highly resistant to EMC noise.

Features

- **Large photosensitive 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: Rf=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

- **NOx detection**
- **Low-light-level measurement, etc.**

The S9295 series may be damaged by Electro Static Discharge, etc. Please see Precautions in P.6.

Absolute maximum ratings

Parameter	Symbol	Value
Supply voltage (preamp)	Vcc	±20 V
Operating temperature	Topr	-30 to +60 °C
Storage temperature	Tstg	-40 to +80 °C
TE-cooler allowable voltage*1	Vte	5 V*2
TE-cooler allowable current	Ite	1 A
Thermistor power dissipation	Pth	0.2 mW

*1: Ripple max.: 10%
*2: S9295-01: 3.7 V
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.

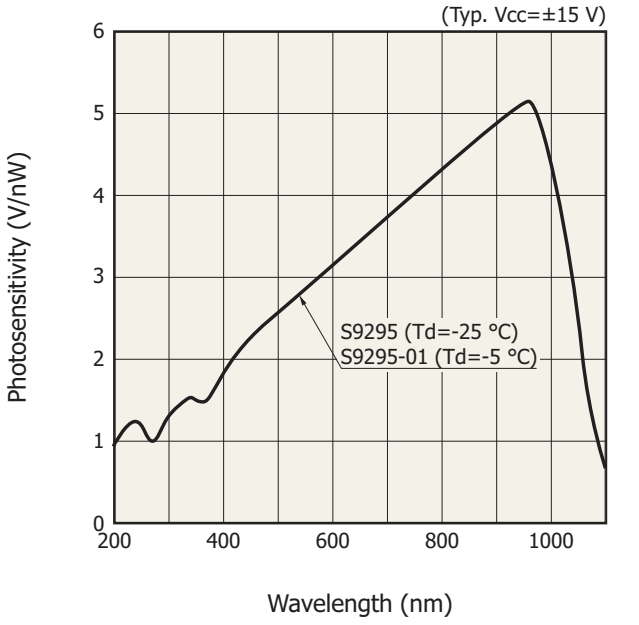
Recommended operating conditions

Parameter	Symbol	Value
Supply voltage (preamp)	Vcc	±5 to ±15 V
TE-cooler current	Ite	0.8 A max.
Thermistor power dissipation	Pth	0.03 mW max.
Load resistance	RL	100 kΩ min.

Electrical and optical characteristics (Typ. Vcc=±15 V, RL=1 MΩ)

Parameter	Symbol	Condition	S9295 Td=-25 °C	S9295-01 Td=-5 °C	Unit
Spectral response range	λ		190 to 1100		nm
Peak sensitivity wavelength	λp		960		nm
Feedback resistance (built-in)	Rf		10		GΩ
Photosensitivity	S	λ=200 nm	0.9		V/nW
		λ=λp	5.1		
Output noise voltage	Vn	Dark state, f=10 Hz	20	25	μV rms/Hz$^{1/2}$
Noise equivalent power	NEP	λ=λp, f=10 Hz	4	5	fW/Hz$^{1/2}$
Output offset voltage	Vos	Dark state	±2		mV
Cutoff frequency	fc	-3 dB	190	180	Hz
Output voltage swing	Vo		13		V
Supply current	Icc	Dark state	0.3		mA
Thermistor resistance	Rth		86	30	kΩ

Spectral response



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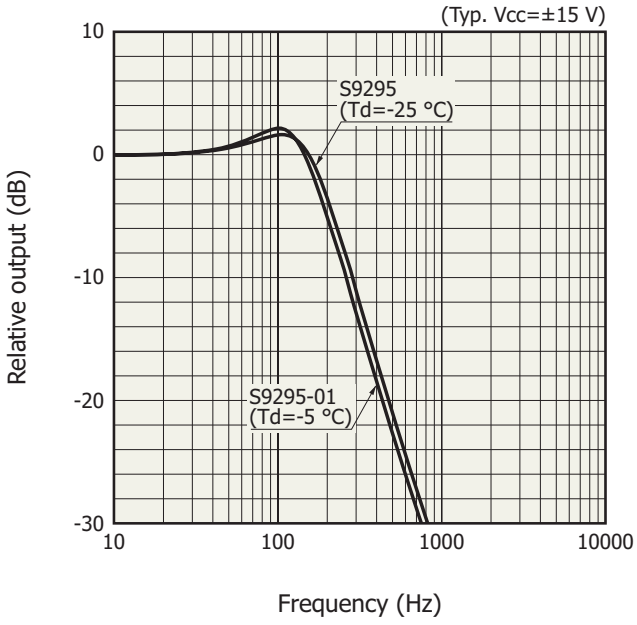
Frequency response



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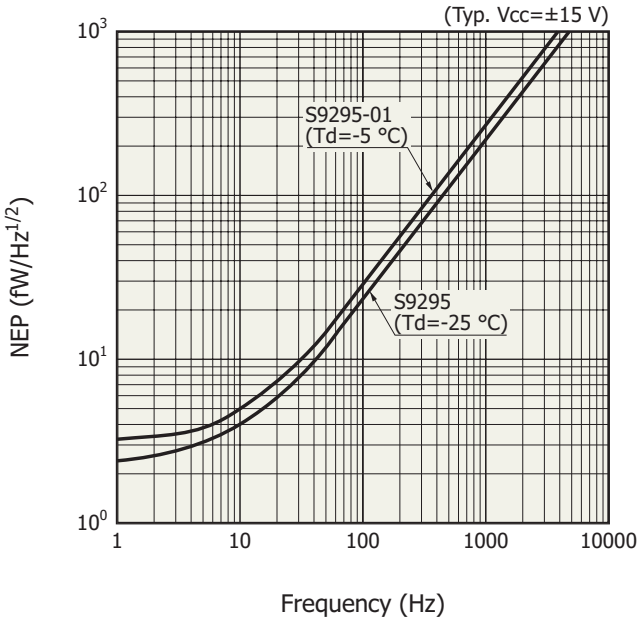
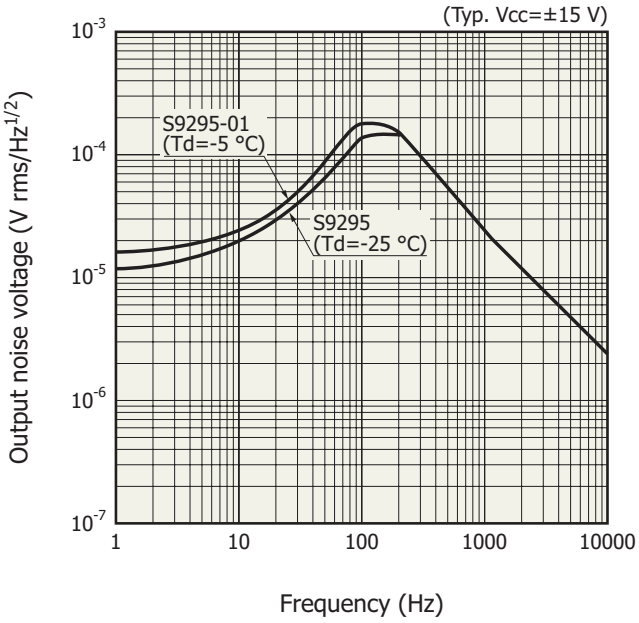
NEP vs. frequency

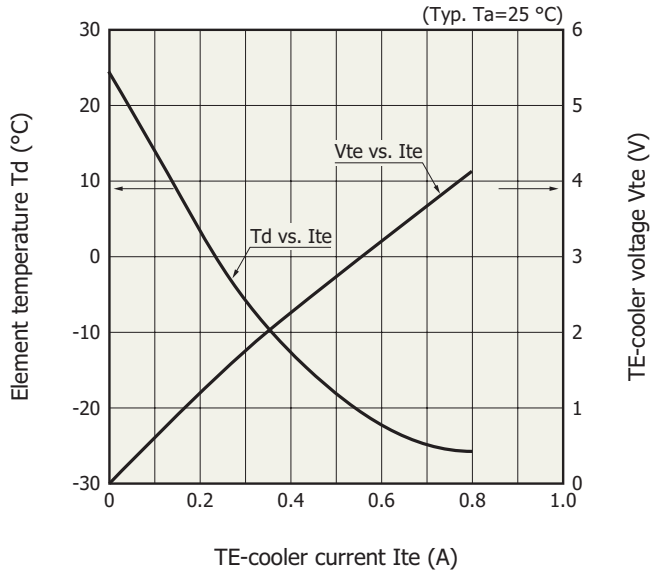


Output noise voltage vs. frequency

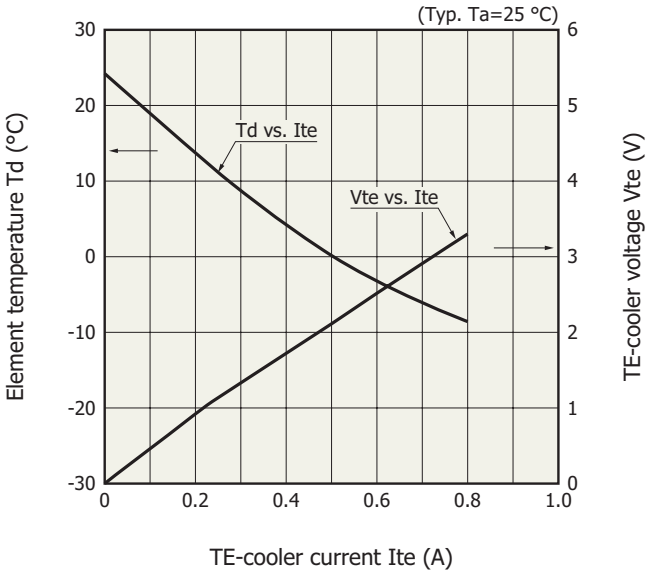


Element temperature vs. TE-cooler current

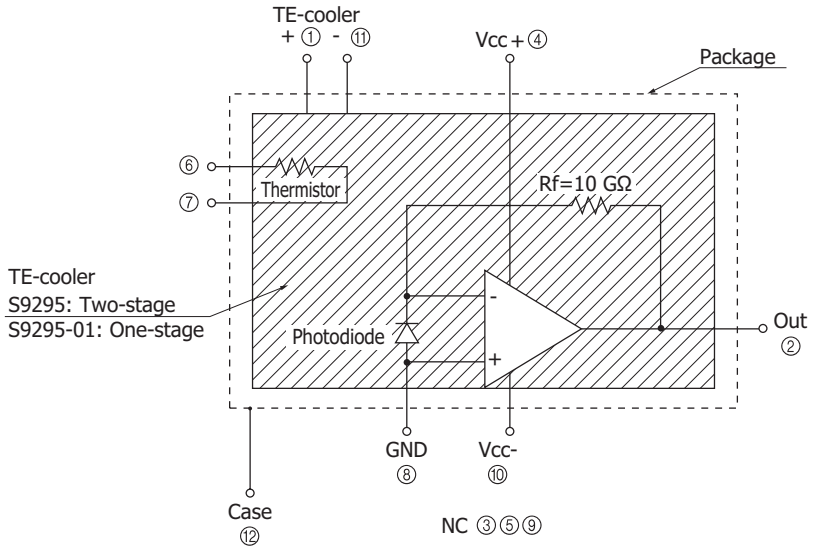
S9295



S9295-01



External connection



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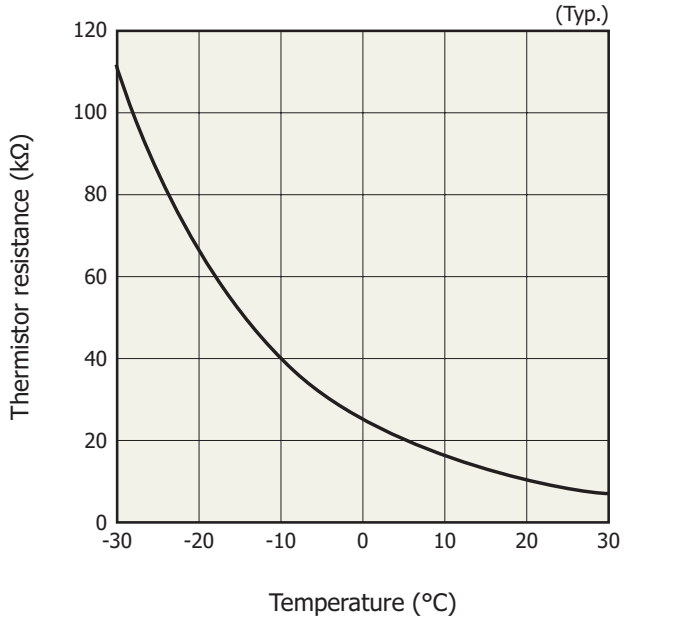
Thermistor resistance vs. temperature



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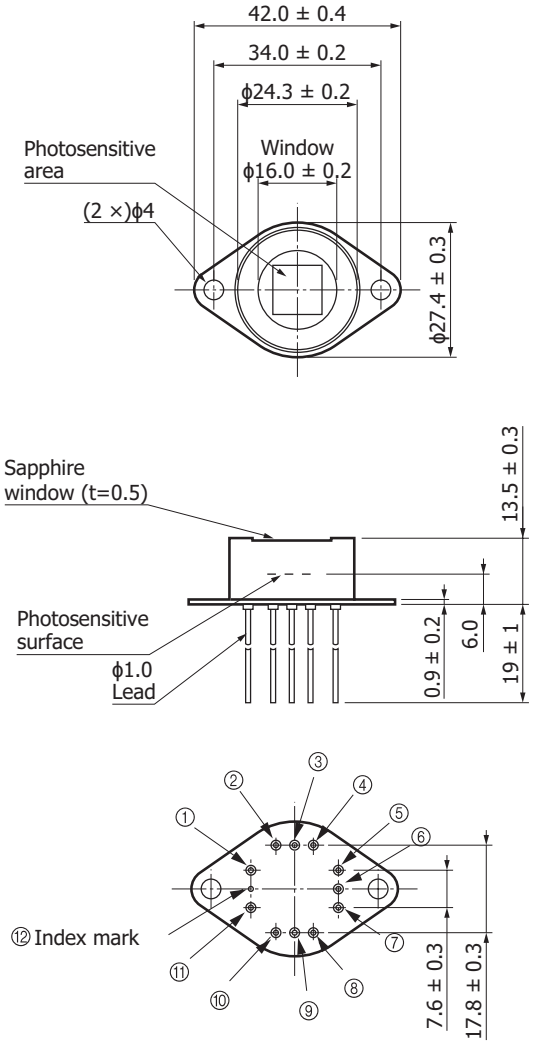
Dimensional outlines (unit: mm)

S9295



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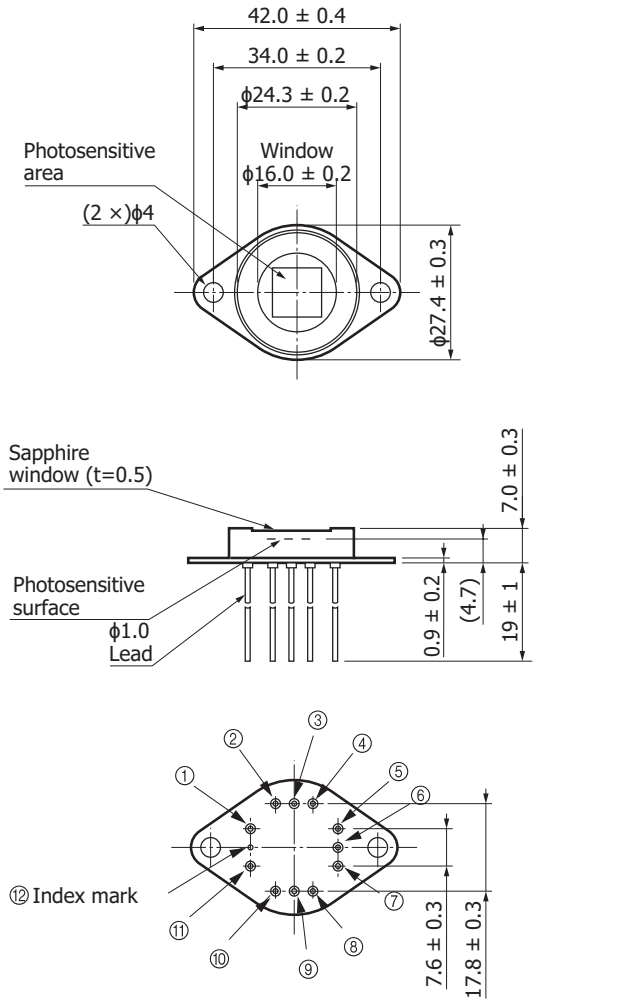
S9295-01



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A tantalum or ceramic capacitor of 0.1 to 10 µF must be connected to the supply voltage leads (pins ④ and ⑩) as a bypass capacitor used to prevent the device from oscillation.

Precautions

ESD

The 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 MΩ).
- A semiconductive sheet (1 MΩ to 10 MΩ) 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 MΩ.
- 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 MΩ/cm^2 to 1 GΩ/cm^2.

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.

Against UV light exposure

- When UV light irradiation is applied, the product characteristics may degrade. Such examples include degradation of the product's UV sensitivity and increase in dark current. This phenomenon varies depending on the irradiation level, irradiation intensity, usage time, and ambient environment and also varies depending on the product model. Before employing the product, we recommend that you check the tolerance under the ultraviolet light environment that the product will be used in.
- Exposure to UV light may cause the characteristics to degrade due to gas released from the resin bonding the product's component materials. As such, we recommend that you avoid applying UV light directly on the resin and apply it on only the inside of the photosensitive area by using an aperture or the like.

Related information

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

■ Precautions

· Disclaimer
· Metal, ceramic, plastic package products

■ Technical information

· Si photodiode/Application circuit examples

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