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 ($10~G\Omega$) 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 NOx 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 x 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 thermistorHighly resistant to EMC noise

Applications

- NOx 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) | 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 |
| *4 D: 1 M 40 0/ | | |

*1: Ripple Max.: 10 % *2: S9295-01: 3.7 V ■ 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)

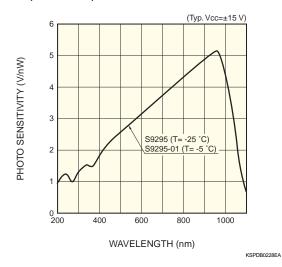
| Parameter | Symbol | Condition | S9295 | S9295-01 | Unit |
|-----------------------------------|--------|---------------------|-------------|----------|-------------------------|
| | | | T= -25 °C | T= -5 °C | |
| Spectral response range | λ | | 190 to 1100 | | nm |
| Peak sensitivity wavelength | λр | | 960 | | nm |
| Feedback resistance (built-in) *3 | Rf | | 10 | | GΩ |
| Photo sensitivity | S | λ=200 nm | 0.9 | 0.9 | V/nW |
| | | λ=λρ | 5.1 | 5.1 | |
| Output noise voltage | Vn | Dark state, f=10 Hz | 20 | 25 | μVrms/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 | ±2 | mV |
| Cut-off 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 |

^{*3:} Custom devices are available with different Rf values and/or internal Cf, etc.

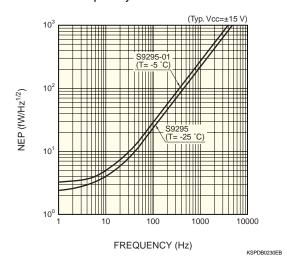


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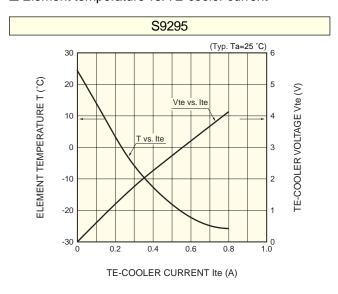
■ Spectral response



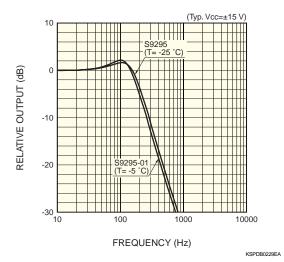
■ NEP vs. frequency



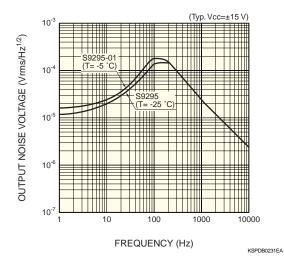
■ Element temperature vs. TE-cooler current

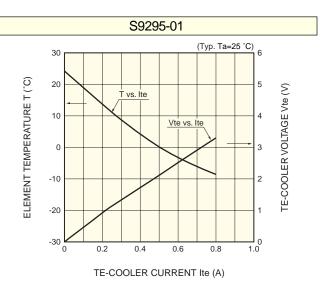


■ Frequency response



■ Output noise voltage vs. frequency



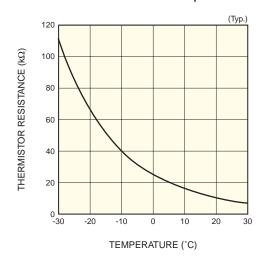


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■ External connection

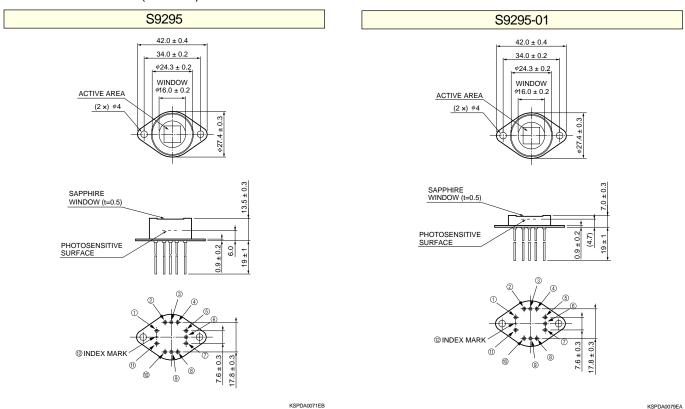
TE-COOLER + ① - ① VCC+ ② PACKAGE B O THERMISTOR THERMISTOR RI=10 GΩ OUT S9295: TWO-STAGE S9295-01: ONE-STAGE PHOTODIODE CASE ® NC ③⑤⑨ KSPDCO047EA

■ Thermistor resistance vs. temperature



KSPDB0152EA

■ Dimensional outlines (unit: mm)



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

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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 Ω to 10 M Ω) 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 M Ω /cm² to 1 G Ω /cm².
- 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.

Information furnished by HAMAMATSU is believed to be reliable. However, no responsibility is assumed for possible inaccuracies or omissions.

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