

SPAD (Single Photon Avalanche Diode)



S16835 series

High sensitivity, low noise 1 ch SPAD for visible and near infrared region

S16835 series is a TE-cooled single photon avalanche diode. It is available in types with photosensitivity area of $\phi 54 \mu\text{m}$ and $\phi 100 \mu\text{m}$, featuring low dark count and high detection efficiency.

Features

- Single photon counting is possible.
- Low dark count
- Low afterpulses
- Low voltage operation: $V_{BR}=40 \text{ V}$ typ.
- High photon detection efficiency: 67% typ.
- High gain: 10^6 to 10^7 typ.

Applications

- Low-light-level measurement
- Particle diameter measurement
- Fluorescence measurement
- Analytical instrument

Structure

Parameter	S16835-050DG	S16835-100DG	Unit
Effective photosensitive area	$\phi 54$	$\phi 100$	μm
Number of pixel	1		-
Package	TO-8		-
Window	Borosilicate glass		-
Refractive index of window material	1.52		-
Cooling	Two-stage TE-cooling		-

Absolute maximum ratings (unless otherwise noted $T_a=25^\circ\text{C}$)

Parameter	Symbol	S16835-050DG	S16835-100DG	Unit
Operating temperature*1	T_{opr}	-20 to +60		$^\circ\text{C}$
Storage temperature*1	T_{stg}	-20 to +85		$^\circ\text{C}$
Chip temperature	T_{chip}	-25 to ambient temperature		$^\circ\text{C}$
Thermistor power dissipation	P_{d_th}	0.2		mW
TE-cooler allowable current	$I_{TE \text{ max}}$	1		A
TE-cooler allowable voltage	$V_{TE \text{ max}}$	0.9		V

*1: 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. $T_a=25\text{ }^{\circ}\text{C}$, $T_{\text{chip}}=-20\text{ }^{\circ}\text{C}$, unless otherwise noted)

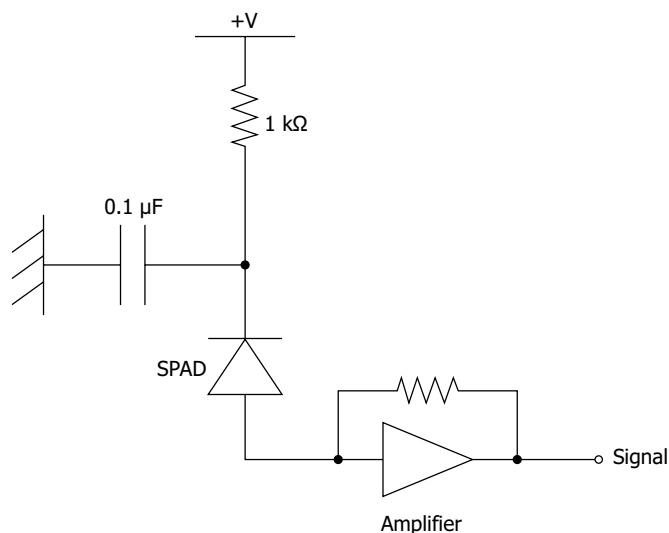
Parameter	Symbol	Condition	S16835-050DG	S16835-100DG	Unit
Spectral response range	λ		400 to 1000		nm
Peak sensitivity wavelength	λ_p		610		nm
Photon detection efficiency*2	PDE	$\lambda=\lambda_p$, $V_R=V_{op}$	67		%
Dark count rate	Typ.	DCR $V_R=V_{op}$	0.015	0.06	kcps
	Max.		0.05	0.2	
Terminal capacitance	C_t	$V_R=V_{op}$, $f=100\text{ kHz}$	2.8	3.2	pF
Gain	M	$V_R=V_{op}$	6.0×10^6	1.5×10^7	-
Breakdown voltage	V_{BR}		40 ± 5		V
Recommended operation voltage*3	V_{op}		$V_{BR} + 7$		V
Temperature coefficient at recommended operation voltage	$\Delta T V_{op}$		45		mV/ $^{\circ}\text{C}$
Recommended TE-cooler temperature	T_{TE_recom}		-20		$^{\circ}\text{C}$

*2: Photon detection efficiency includes afterpulses.

*3: Refer to the data provided with the product.

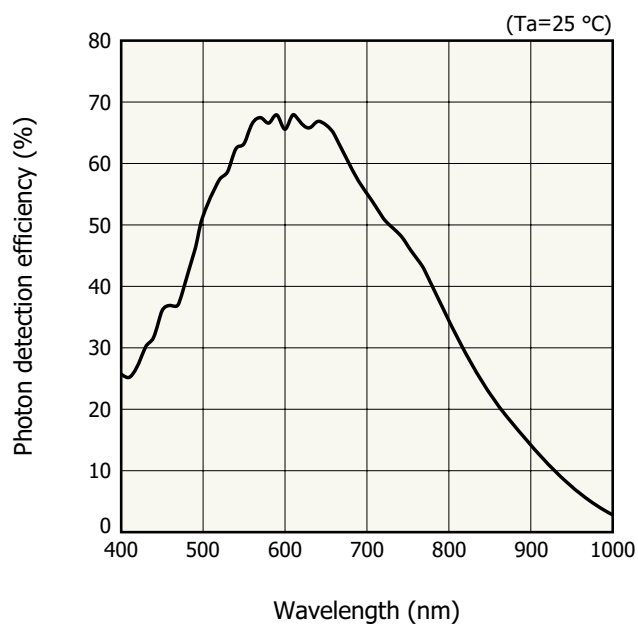
Note: The above characteristics were measured at the operating voltage that yields the tested gain (See the data attached to each product).

Connection example



KAPDC0136EA

Photon detection efficiency vs. wavelength (typical example)

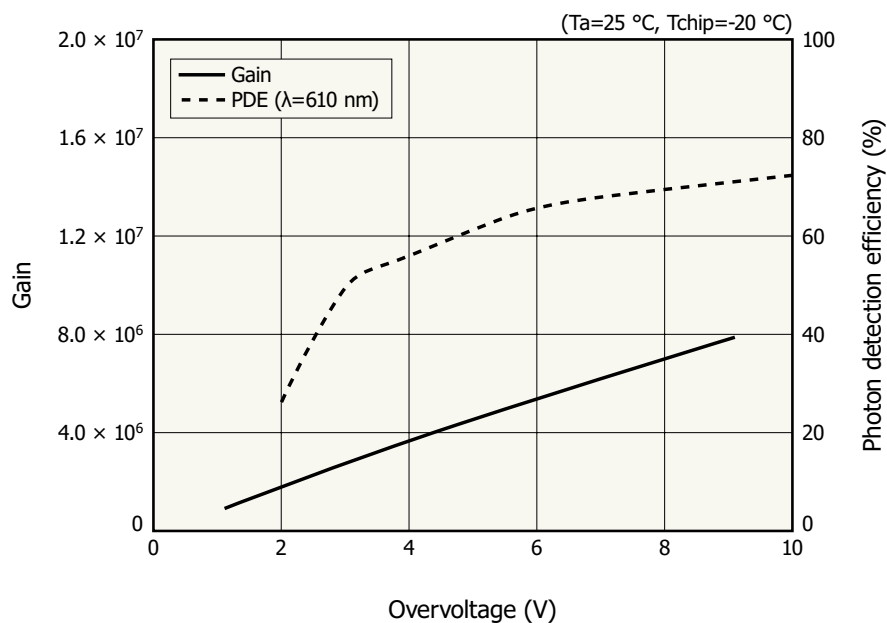


KAPD80641EA

Photon detection efficiency include afterpulses.

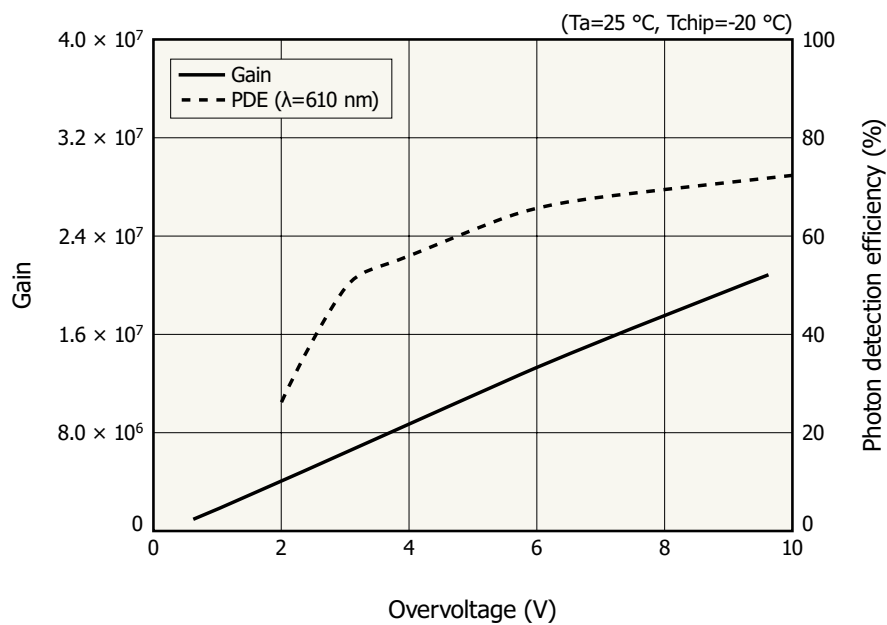
Gain, photon detection efficiency vs. overvoltage characteristics (typical example)

S16835-050DG



KAPD80639EA

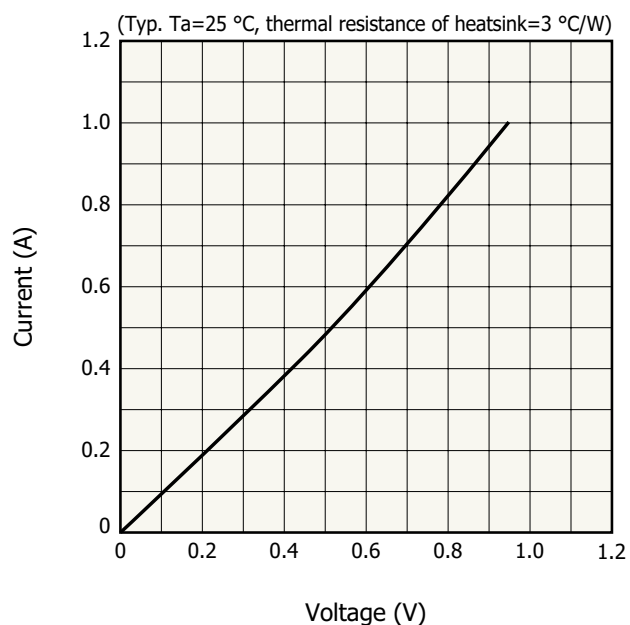
S16835-100DG



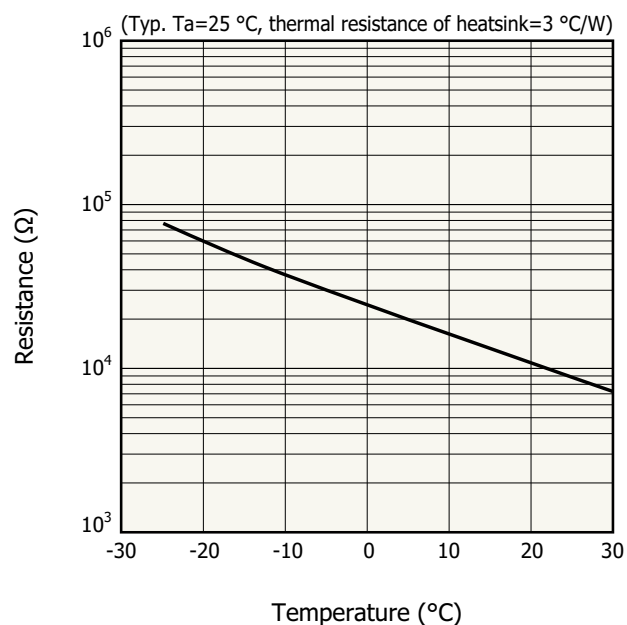
KAPD80640EA

SPAD characteristics vary with the operating voltage. Although increasing the operating voltage improves the photon detection efficiency and time resolution, it also increases the dark count at the same time, so an optimum operating voltage must be selected to match the application.

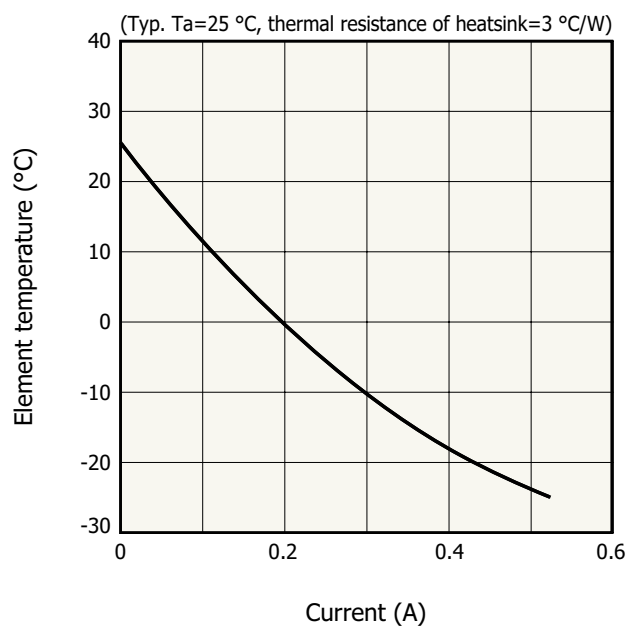
❖ Current vs. voltage characteristics of TE-cooler



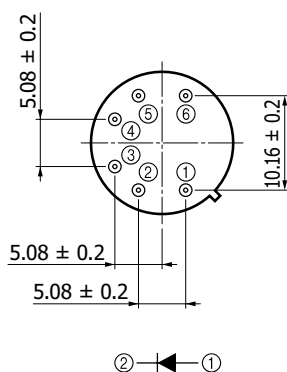
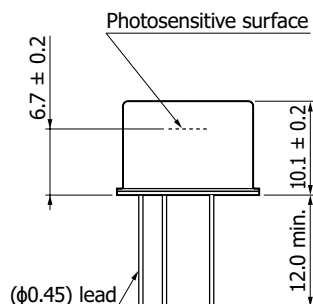
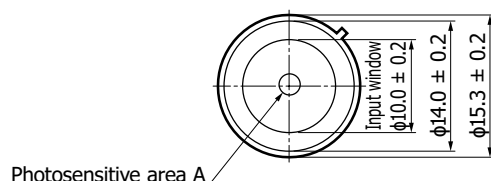
❖ Thermistor temperature characteristics



❖ Cooling characteristics of TE-cooler



Dimensional outlines (unit: mm)



Type no.	A
S16835-050DG	$\phi 54 \mu\text{m}$
S16835-100DG	$\phi 100 \mu\text{m}$

Tolerance unless
otherwise noted: ± 0.2
Distance from photosensitive
area center to cap center
 $-0.3 \leq X \leq +0.3$
 $-0.3 \leq Y \leq +0.3$

- ① Detector (anode)
- ② Detector (cathode)
- ③ TE-cooler (-)
- ④ TE-cooler (+)
- ⑤ ⑥ Thermistor

KAPDA0228EA

Recommended soldering conditions

- Solder temperature: 260°C (10 s or less, once)

Note: When you set soldering conditions, check that problems do not occur in the product by testing out the conditions in advance.

Precautions

■ Electrostatic breakdown

The S16835 series may be destroyed or deteriorated by static electricity. See precautions of "metal, ceramic, plastic package products" for use.

■ Wiring

If necessary, incorporate an appropriate protective circuit in a power supply, device, and measuring instrument, etc. to prevent overvoltage and overcurrent.

Related product

SPAD module C16531 series, C16533-050GD, C16534-050GD

These are photon counting modules capable of detecting low-level-light. They consist of a TE-cooled SPAD, amplifier, comparator, SPAD bias circuit, and temperature control circuit. These modules are operated by simply supplying external power (± 5 V). Fiber coupling types and compact and lightweight modules suitable for integration into devices are also available.

Type no.	Output format	Built-in element	Photosensitive area (μm)	Note
C16531-050GD	Digital	S16835-050DG	$\phi 54$	
C16531-100GD		S16835-100DG	$\phi 100$	
C16533-050GD		S16835-050DG	$\phi 54$	Fiber coupling type
C16534-050GD		S16835-050DG	$\phi 54$	Fiber coupling type (for embedded use)



C16531-050GD/100GD



C16533-050GD



C16534-050GD

Related information

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

Precautions

- Disclaimer
- Metal, ceramic, plastic package products

Information described in this material is current as of December 2024.

Product specifications are subject to change without prior notice due to improvements or other reasons. This document has been carefully prepared and the information contained is believed to be accurate. In rare cases, however, there may be inaccuracies such as text errors. Before using these products, always contact us for the delivery specification sheet to check the latest specifications.

The product warranty is valid for one year after delivery and is limited to product repair or replacement for defects discovered and reported to us within that one year period. However, even if within the warranty period we accept absolutely no liability for any loss caused by natural disasters or improper product use. Copying or reprinting the contents described in this material in whole or in part is prohibited without our prior permission.

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