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MPPC (Multi-Pixel Photon Counter)

S13362 series

S13362-3050DG

Significantly reduced crosstalk, low afterpulses

The S13362 series can reduce dark count by cooling in addition to low afterpulses and low crosstalk of the S13360 series. The S13362 series integrates the S13360 series with thermoelectric cooler. The photosensitive area is available in two sizes of 1.3 × 1.3 mm and 3.0 × 3.0 mm.

Features

- **Significantly reduced crosstalk**
- **Low afterpulses**
- **Superior photon counting capability**
- **Low voltage (V_{BR}=51.1 V typ.) operation**
- **High gain: 10^5 to 10^6**
- **Low dark count (no more than 1/20 the count at room temperature by cooling)**
- **Operates with simple readout circuit**

Applications

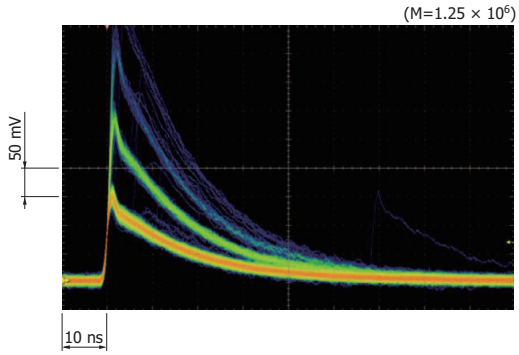
- **Low light level detection**
- **Scattered light measurement**
- **Fluorescence measurement**
- **Laser microscopes**
- **Flow cytometry**
- **DNA sequencers**
- **Environmental analysis**
- **Various academic research**

Lower noise

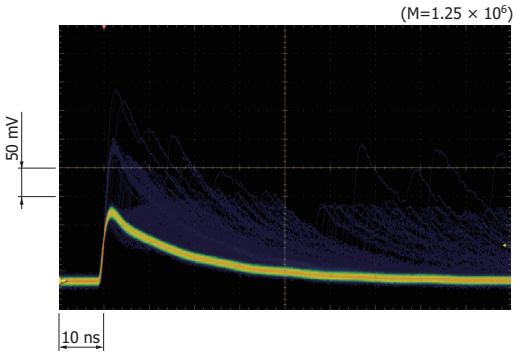
When an MPPC detects photons, the output may contain spurious pulses, namely afterpulse and crosstalk, that are separate from the output pulses of the incident photons. Afterpulses are output later than the timing at which the incident light is received. Crosstalk is output from other pixels at the same time as the detection of light.
Previous products achieved lower afterpulse through the improvement of material and wafer process technology, but with the S13362 series, low crosstalk has been achieved in addition to low afterpulse.

Pulse waveform comparison (typical example)

Previous product



Improved product (reference data: S13362-3050DG)



Structure

Parameter	S13362		Unit
	-1350DG	-3050DG	
Effective photosensitive area	1.3 × 1.3	3.0 × 3.0	mm
Pixel pitch	50		μm
Number of pixels/ch	667	3600	-
Fill factor	74		%
Package	Metal (TO-8)		-
Window	Borosilicate glass		-
Refractive index of window material	1.52		-
Cooling	Two-stage TE-cooling		-

Absolute maximum ratings

Parameter	Symbol	Value	Unit
Operating temperature*1	Topr	-20 to +60	°C
Storage temperature*1	Tstg	-20 to +85	°C
Chip temperature	Tchip	-25 to ambient temperature	°C
Thermistor power dissipation	Pd_th	0.2	mW
TE-cooler allowable current	I_{TE} max	1	A
TE-cooler allowable voltage	V_{TE} max	0.9	V
Soldering conditions*2	-	350 °C max.*3, once, 3 s max.	-

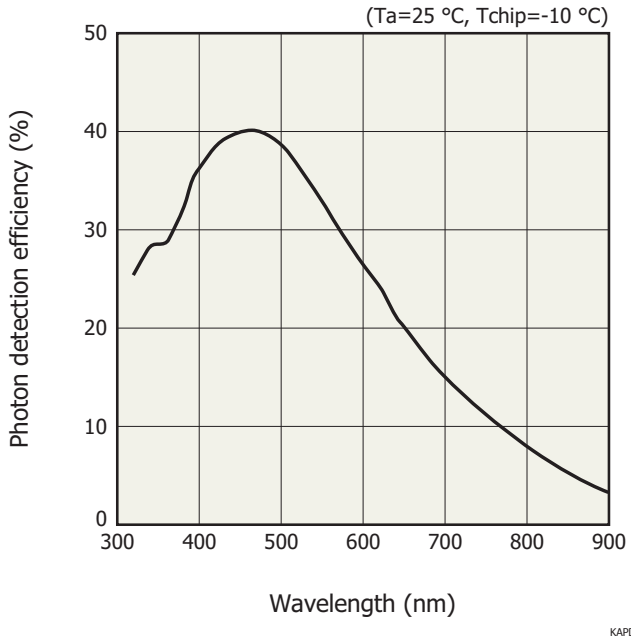
*1: No dew condensation
When there is a temperature difference between a product and the surrounding area in high humidity environment, dew condensation may occur on the product surface. Dew condensation on the product may cause deterioration in characteristics and reliability.
*2: At least 1 mm away from lead root
*3: Soldering iron tip
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. Ta=25 °C, Tchip=-10 °C, unless otherwise noted)

Parameter		Symbol	S13362		Unit
			-1350DG	-3050DG	
Spectral response range		λ	320 to 900		nm
Peak sensitivity wavelength		λp	450		nm
Breakdown voltage		V_{BR}	51.1 ± 5		V
Photon detection efficiency at λp*4		PDE	40		%
Recommended operating voltage		Vop	V_{BR} + 3		V
Dark count	Typ.	-	5	25	kcps
	Max.		13	72	
Crosstalk probability		-	3		%
Terminal capacitance		Ct	60	320	pF
Gain		M	1.7×10^6		-
Temperature coefficient of recommended reverse voltage		ΔTVop	54		mV/°C
Recommended temperature of TE-cooler		TTE_recom	-10		°C
Thermistor resistance*5		Rth	9		kΩ
Thermistor B constant*6		B	3410		K

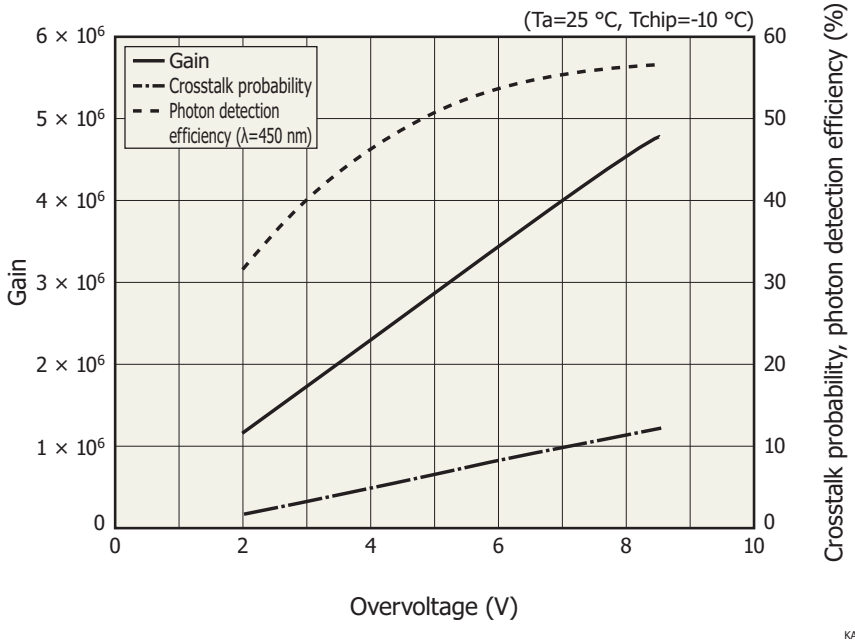
*4: Photon detection efficiency does not include crosstalk and afterpulses.
*5: Thermistor temperature=25 °C
*6: T1=25 °C, T2=50 °C
Note: The above characteristics were measured at the operating voltage that yields the listed gain. (See the data attached to each product.)

Photon detection efficiency vs. wavelength (typical example)



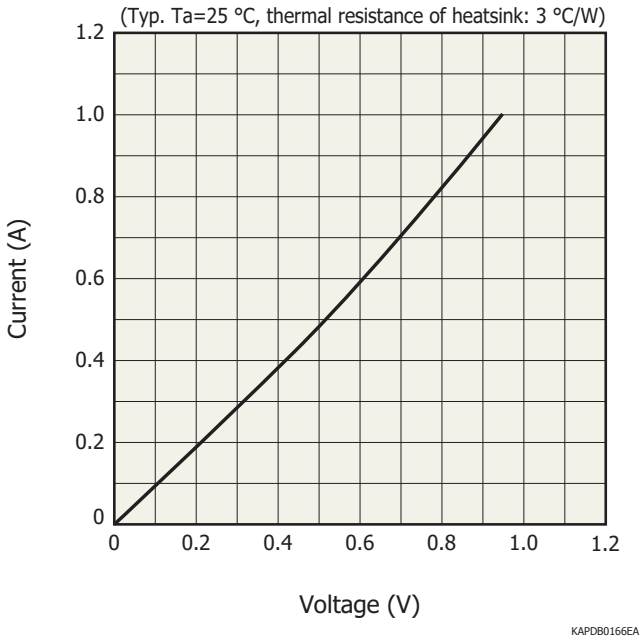
The components of the afterpulse and cross talk are excluded from the plots.

Overvoltage specifications of gain, crosstalk probability, photon detection efficiency (typical example)



MPPC 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 and crosstalk at the same time, so an optimum operating voltage must be selected to match the application.

Current vs. voltage characteristics of TE-cooler



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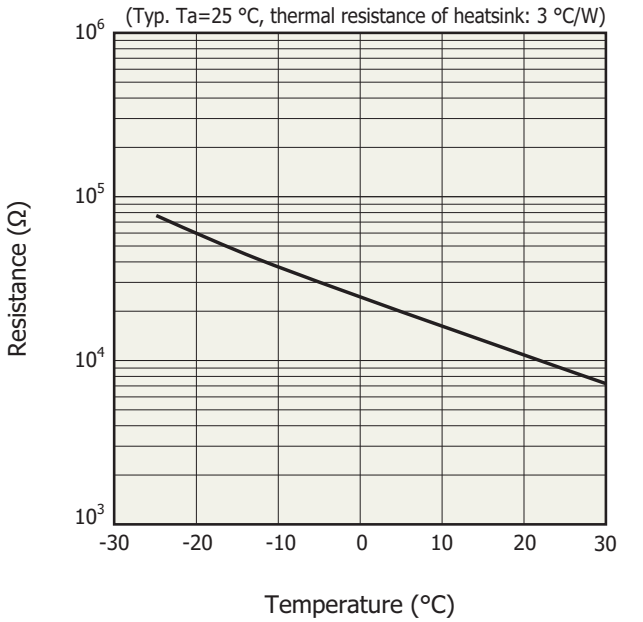
Thermistor temperature characteristics



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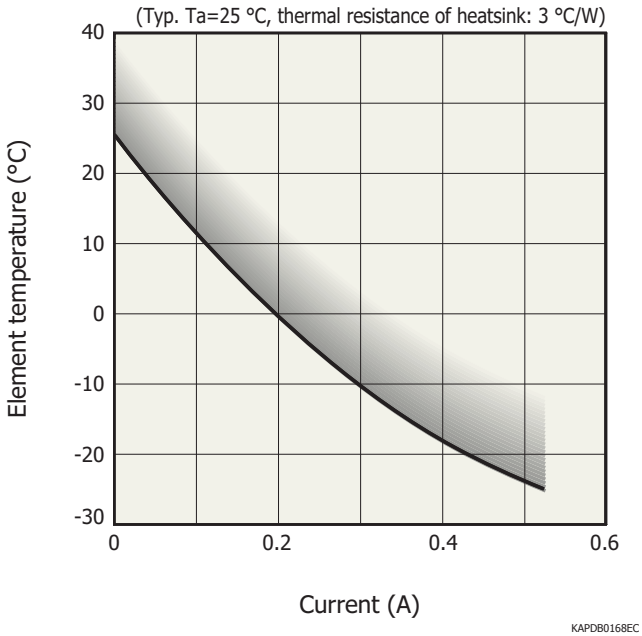
Cooling characteristics of TE-cooler



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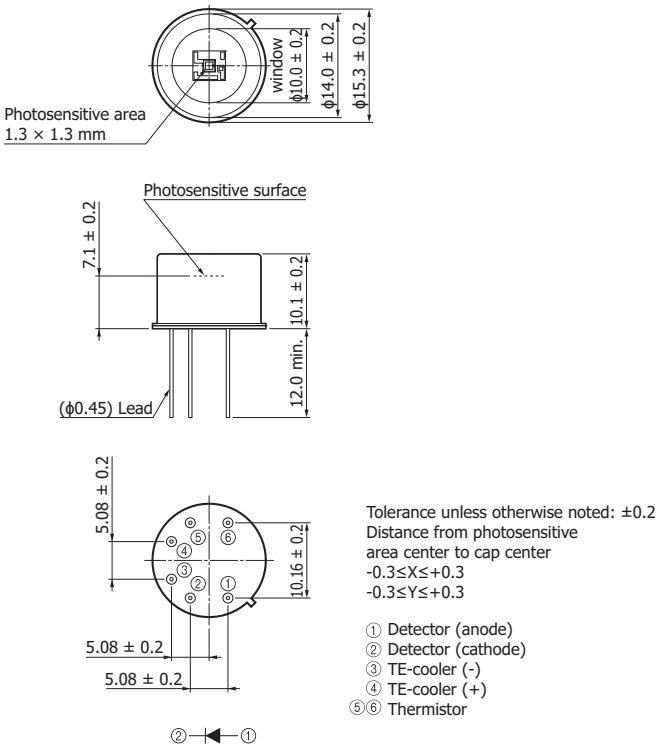
Dimensional outlines (unit: mm)

S13362-1350DG



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

① Detector (anode)
② Detector (cathode)
③ TE-cooler (-)
④ TE-cooler (+)
⑤⑥ Thermistor

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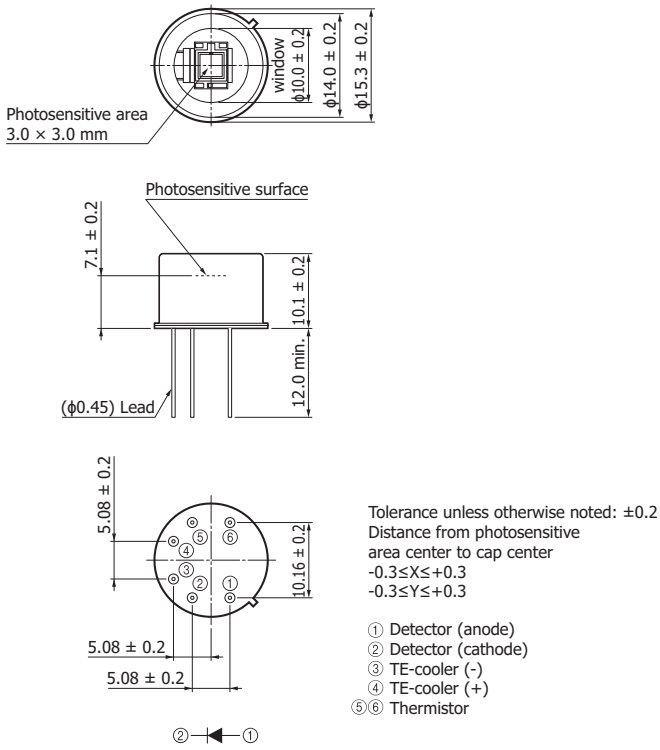
S13362-3050DG



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

① Detector (anode)
② Detector (cathode)
③ TE-cooler (-)
④ TE-cooler (+)
⑤⑥ Thermistor

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MPPC module C13366 series

The C13366 series (GA type and GD type) are optical measurement modules capable of detecting low level light. These modules consist of a thermoelectrically cooled MPPC, an amplifier, a high-voltage power supply circuit, and a temperature control circuit. The photosensitive area is available in two sizes of 1.3 × 1.3 mm and 3 × 3 mm.Modules operate just by connecting them to an external power supply (±5 V).

Type no.	Built-in MPPC	Photosensitive area (mm)	Pixel pitch (μm)	Cooling	Supply voltage	Feature
C13366-1350GA	S13362-1350DG	1.3 × 1.3	50	TE-cooled	±5 V	Analog output
C13366-3050GA	S13362-3050DG	3 × 3				
C13366-1350GD	S13362-1350DG	1.3 × 1.3			±5 V	Digital output
C13366-3050GD	S13362-3050DG	3 × 3				

Related information

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

■ Precautions

· Disclaimer
· Metal, ceramic, plastic package products

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Cat. No. KAPD1059E02 Jan. 2018 DN