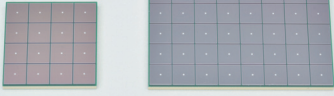


# MPPC® (Multi-Pixel Photon Counter) arrays

S13361-3050 series



## MPPC arrays in a chip size package miniaturized through the adoption of TSV structure

The S13361-3050 series is a MPPC array for precision measurement miniaturized by the use of TSV (through-silicon via) and CSP (chip size package) technologies. The adoption of a TSV structure made it possible to eliminate wiring on the photosensitive area side, resulting in a compact structure with little dead space compared with previous products. The four-side buttable structure allows multiple devices to be arranged side by side to fabricate large-area devices.

They are suitable for applications, such as medical, non-destructive inspection, environmental analysis, and high energy physics experiment, that require photon counting measurement.

### Features

- Low crosstalk
- Low afterpulses
- Outstanding photon counting capability (outstanding photon detection efficiency versus numbers of incident photons)
- Compact chip size package with little dead space
- Low voltage ( $V_{BR}=53\text{ V typ.}$ ) operation
- High gain:  $10^5$  to  $10^6$

### Applications

- Astro physical application
- High energy physics experiment
- Nuclear medicine
- PET
- Environmental analysis

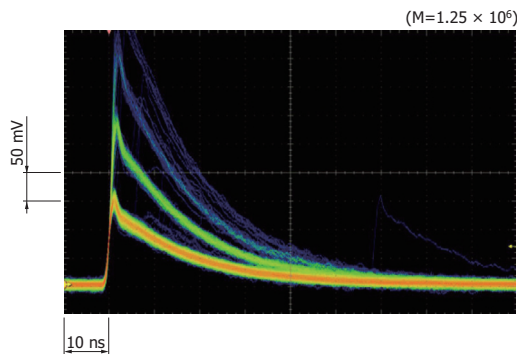
### Lower noise

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.

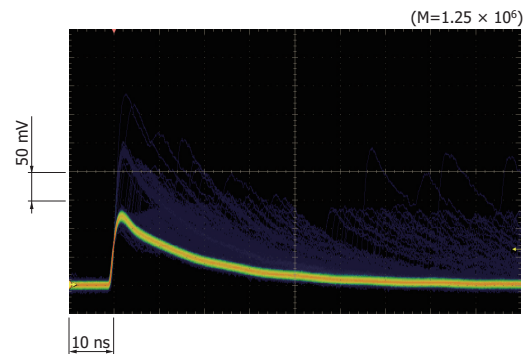
Previous products achieved lower afterpulse through the improvement of material and wafer process technology, but with the S13361-3050 series, low crosstalk has been achieved in addition to low afterpulse.

#### ☒ Pulse waveform comparison (typical example)

Previous product



Improved product (reference data: S13360-3050VE)



## Structure

Parameter	Symbol	S13361-3050NE-04	S13361-3050AE-04	S13361-3050NE-08	S13361-3050AE-08	Unit
Number of channels	-	16 (4 × 4)		64 (8 × 8)		-
Effective photosensitive area/channel	-	3 × 3		3 × 3		mm
Pixel pitch	-	50		50		μm
Number of pixels	-	3584		3584		-
Fill factor	-	74		74		%
Package type	-	Surface mount	With connector*1	Surface mount	With connector*1	-
Window	-	Epoxy resin		Epoxy resin		-
Refractive index of window material	-	1.55		1.55		-

\*1: A connector made by SAMTEC is mounted on the back side of the board.

ST4-20-1.00-L-D-P-TR (S13361-3050NE/AE-04)

ST4-40-1.00-L-D-P-TR (S13361-3050NE/AE-08)

These connectors mate with a SAMTEC receptacle (SS4-20-3.00-L-D-K-TR or SS4-40-3.00-L-D-K-TR).

See the following URL for detailed information.

<http://www.samtec.com/ftppub/pdf/ss4.pdf>

## Absolute maximum ratings

Parameter	Symbol	S13361-3050NE-04	S13361-3050AE-04	S13361-3050NE-08	S13361-3050AE-08	Unit
Operating temperature*2	Topr	-20 to +60		-20 to +60		°C
Storage temperature*2	Tstg	-20 to +80		-20 to +80		°C
Reflow soldering conditions*3	Tsol	Peak temperature: 240 °C, twice (see P.9)	-	Peak temperature: 240 °C, twice (see P.10)	-	-

\*2: 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.

\*3: JEDEC level 5a

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, Vover=3 V, unless otherwise noted)

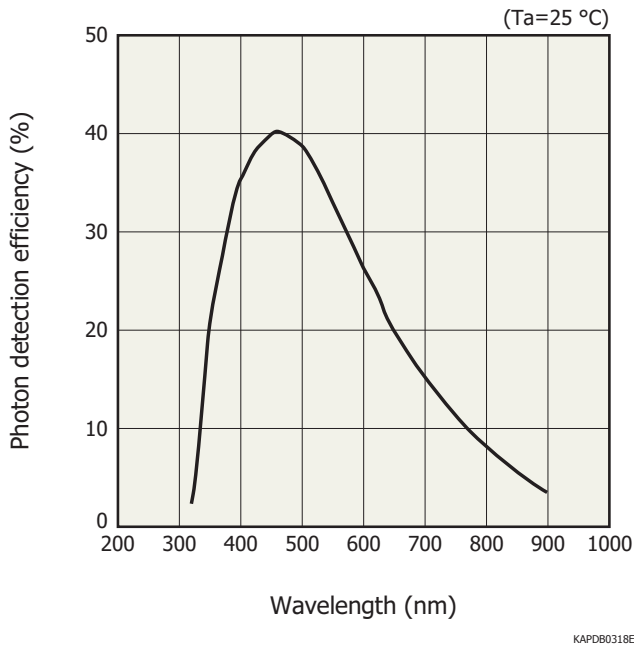
Parameter	Symbol	Value	Unit
Spectral response range	λ	320 to 900	nm
Peak sensitivity wavelength	λp	450	nm
Photon detection efficiency (λ=λp)*4	PDE	40	%
Dark count*5	Typ.	0.5	Mcps
	Max.	1.5	
Terminal capacitance	Ct	320	pF
Gain	M	1.7 × 10 <sup>6</sup>	-
Breakdown voltage	VBR	53 ± 5	V
Recommended operating voltage	Vop	VBR + 3	V
Vop variation between channels	Typ.	±0.05	V
	Max.	±0.15	
Temperature coefficient of recommended operating voltage	ΔTVop	54	mV/°C

\*4: Photon detection efficiency does not include crosstalk or afterpulses.

\*5: Threshold=0.5 p.e.

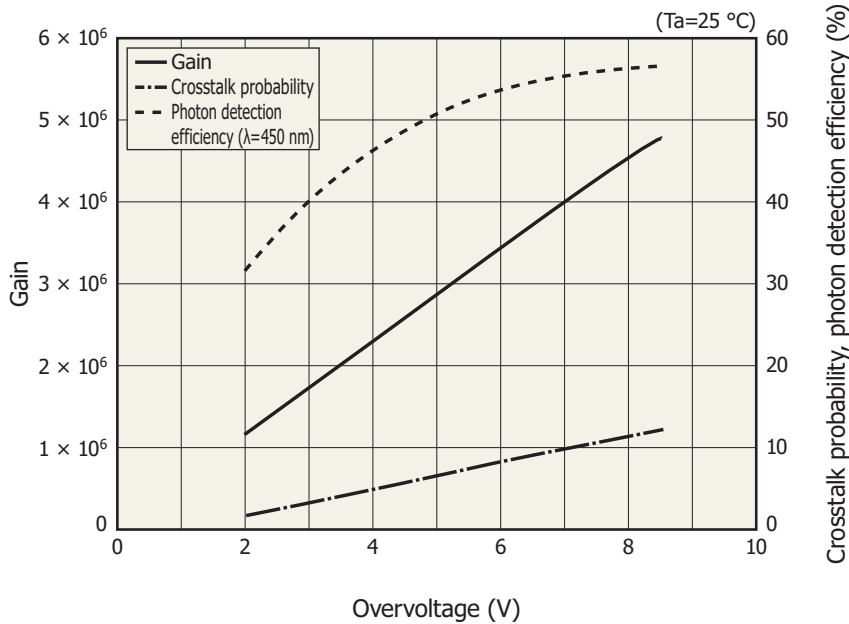
Note: The above characteristics were measured the operating voltage that yields the listed gain in this catalog.  
(See the data attached to each product.)

Photon detection efficiency vs. wavelength (typical example)



Photon detection efficiency does not include crosstalk or afterpulses.

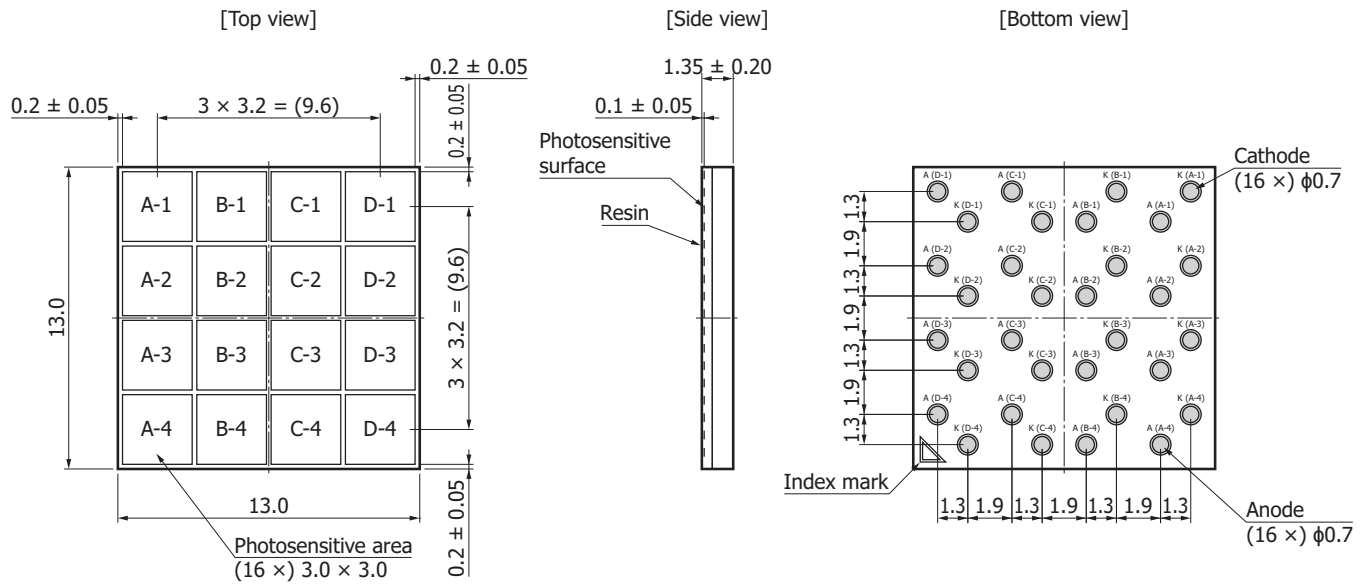
Overvoltage specifications of gain, crosstalk probability, photon detection efficiency (typical example)



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.

Dimensional outlines (unit: mm)

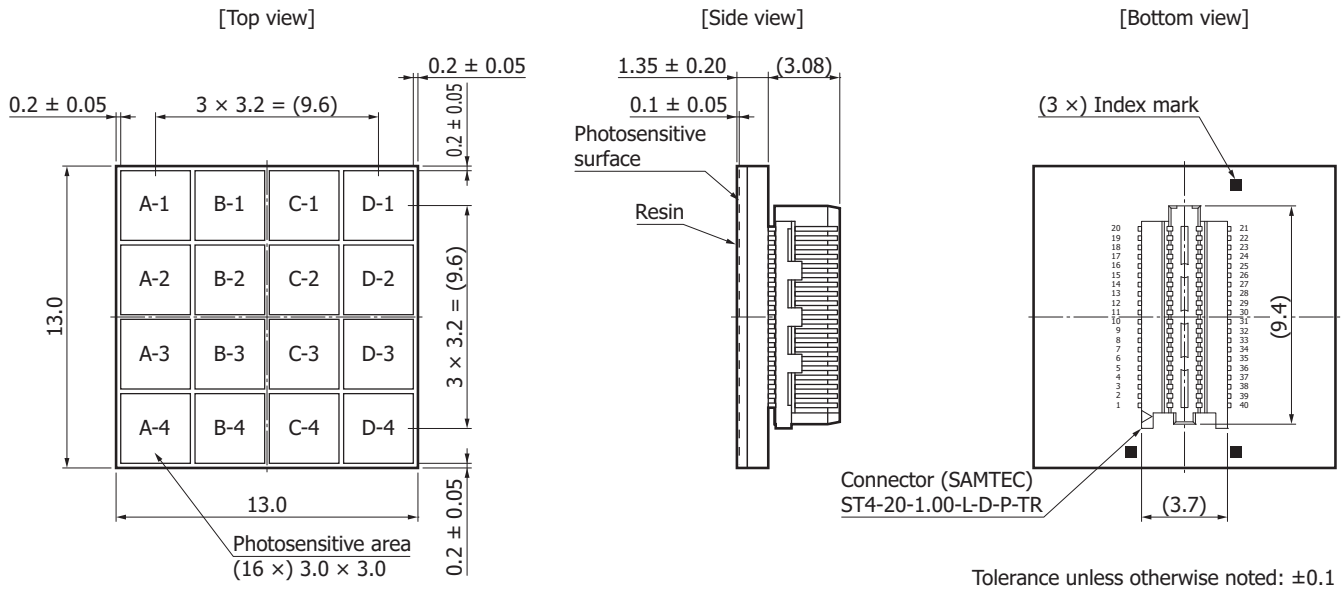
S13361-3050NE-04



Tolerance unless otherwise noted: ±0.1  
 A (X-Y): Anode pad of (X-Y) channel  
 K (X-Y): Cathode pad of (X-Y) channel

KAPDA0168EB

S13361-3050AE-04

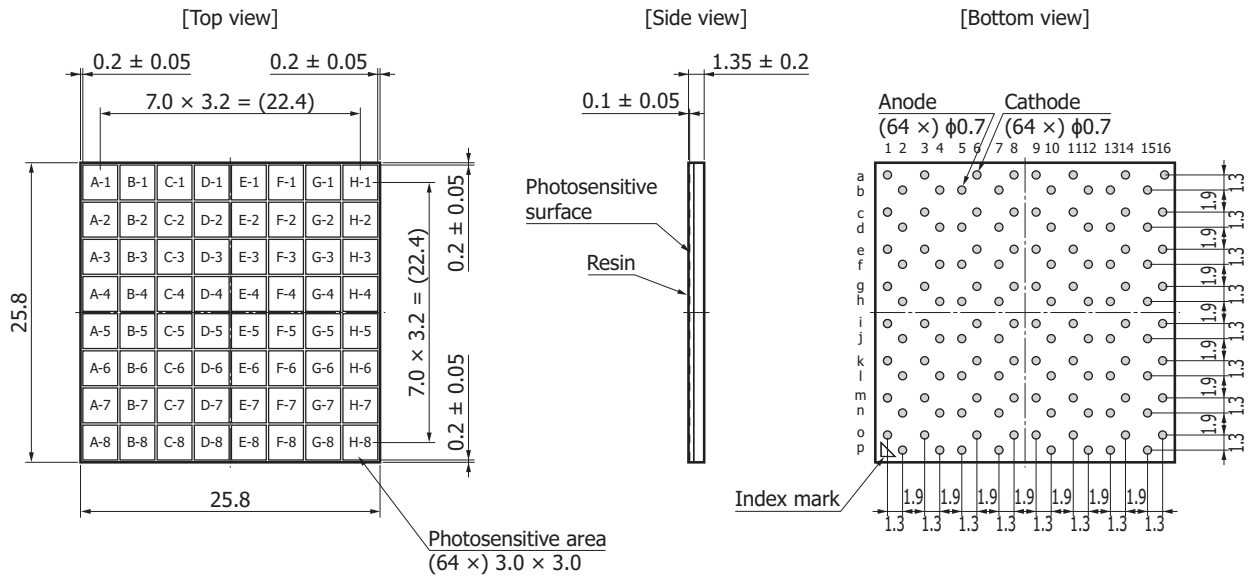


KAPDA0169EB

Pin no.	Connection	Pin no.	Connection
20	K (C-1)	21	K (B-1)
19	K (D-1)	22	K (A-1)
18	NC	23	NC
17	A (C-1)	24	A (B-1)
16	A (D-1)	25	A (A-1)
15	A (D-2)	26	A (A-2)
14	A (C-2)	27	A (B-2)
13	NC	28	NC
12	K (D-2)	29	K (A-2)
11	K (C-2)	30	K (B-2)
10	K (C-3)	31	K (B-3)
9	K (D-3)	32	K (A-3)
8	NC	33	NC
7	A (C-3)	34	A (B-3)
6	A (D-3)	35	A (A-3)
5	A (D-4)	36	A (A-4)
4	A (C-4)	37	A (B-4)
3	NC	38	NC
2	K (D-4)	39	K (A-4)
1	K (C-4)	40	K (B-4)

Note: A=Anode, K=Cathode

S13361-3050NE-08



Tolerance unless otherwise noted: ±0.1

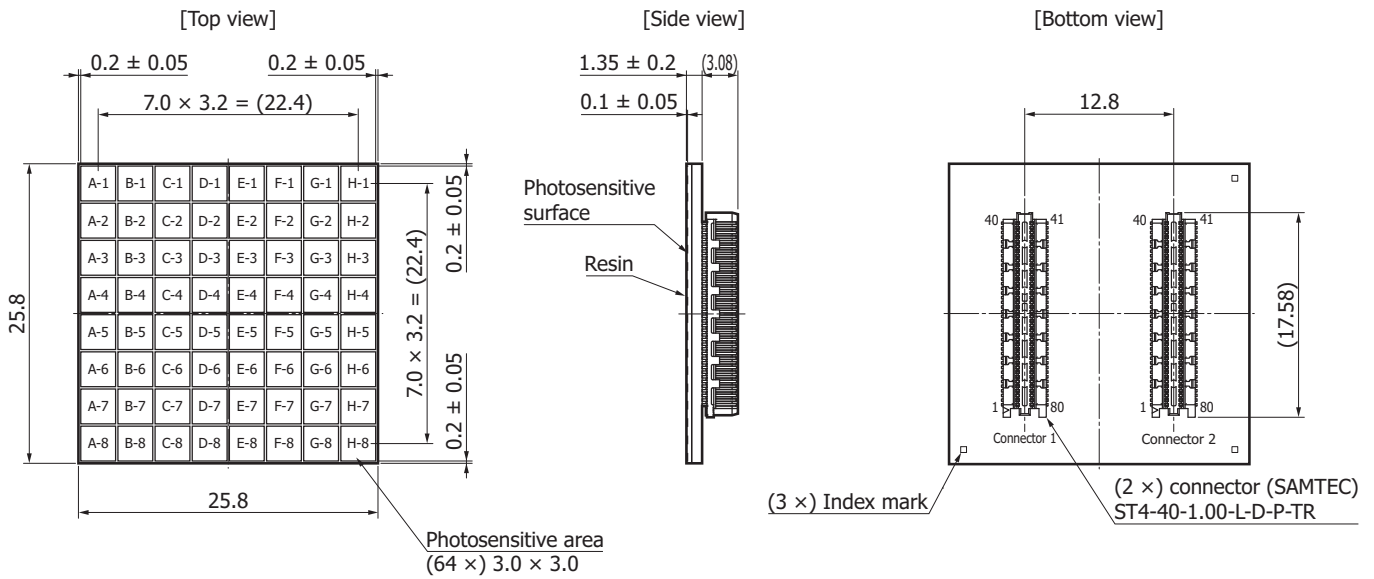
KAPDA0170EB

Pad no.	Connection	Pad no.	Connection	Pad no.	Connection	Pad no.	Connection
a-1	A (H-1)	a-3	A (G-1)	b-5	A (F-1)	b-7	A (E-1)
b-2	K (H-1)	b-4	K (G-1)	a-6	K (F-1)	a-8	K (E-1)
c-1	A (H-2)	c-3	A (G-2)	d-5	A (F-2)	d-7	A (E-2)
d-2	K (H-2)	d-4	K (G-2)	c-6	K (F-2)	c-8	K (E-2)
e-1	A (H-3)	e-3	A (G-3)	f-5	A (F-3)	f-7	A (E-3)
f-2	K (H-3)	f-4	K (G-3)	e-6	K (F-3)	e-8	K (E-3)
g-1	A (H-4)	g-3	A (G-4)	h-5	A (F-4)	h-7	A (E-4)
h-2	K (H-4)	h-4	K (G-4)	g-6	K (F-4)	g-8	K (E-4)
i-1	A (H-5)	i-3	A (G-5)	j-5	A (F-5)	j-7	A (E-5)
j-2	K (H-5)	j-4	K (G-5)	i-6	K (F-5)	i-8	K (E-5)
k-1	A (H-6)	k-3	A (G-6)	l-5	A (F-6)	l-7	A (E-6)
l-2	K (H-6)	l-4	K (G-6)	k-6	K (F-6)	k-8	K (E-6)
m-1	A (H-7)	m-3	A (G-7)	n-5	A (F-7)	n-7	A (E-7)
n-2	K (H-7)	n-4	K (G-7)	m-6	K (F-7)	m-8	K (E-7)
o-1	A (H-8)	o-3	A (G-8)	p-5	A (F-8)	p-7	A (E-8)
p-2	K (H-8)	p-4	K (G-8)	o-6	K (F-8)	o-8	K (E-8)

Pad no.	Connection	Pad no.	Connection	Pad no.	Connection	Pad no.	Connection
a-9	A (D-1)	a-11	A (C-1)	b-13	A (B-1)	b-15	A (A-1)
b-10	K (D-1)	b-12	K (C-1)	a-14	K (B-1)	a-16	K (A-1)
c-9	A (D-2)	c-11	A (C-2)	d-13	A (B-2)	d-15	A (A-2)
d-10	K (D-2)	d-12	K (C-2)	c-14	K (B-2)	c-16	K (A-2)
e-9	A (D-3)	e-11	A (C-3)	f-13	A (B-3)	f-15	A (A-3)
f-10	K (D-3)	f-12	K (C-3)	e-14	K (B-3)	e-16	K (A-3)
g-9	A (D-4)	g-11	A (C-4)	h-13	A (B-4)	h-15	A (A-4)
h-10	K (D-4)	h-12	K (C-4)	g-14	K (B-4)	g-16	K (A-4)
i-9	A (D-5)	i-11	A (C-5)	j-13	A (B-5)	j-15	A (A-5)
j-10	K (D-5)	j-12	K (C-5)	i-14	K (B-5)	i-16	K (A-5)
k-9	A (D-6)	k-11	A (C-6)	l-13	A (B-6)	l-15	A (A-6)
l-10	K (D-6)	l-12	K (C-6)	k-14	K (B-6)	k-16	K (A-6)
m-9	A (D-7)	m-11	A (C-7)	n-13	A (B-7)	n-15	A (A-7)
n-10	K (D-7)	n-12	K (C-7)	m-14	K (B-7)	m-16	K (A-7)
o-9	A (D-8)	o-11	A (C-8)	p-13	A (B-8)	p-15	A (A-8)
p-10	K (D-8)	p-12	K (C-8)	o-14	K (B-8)	o-16	K (A-8)

Note: A=Anode, K=Cathode

S13361-3050AE-08



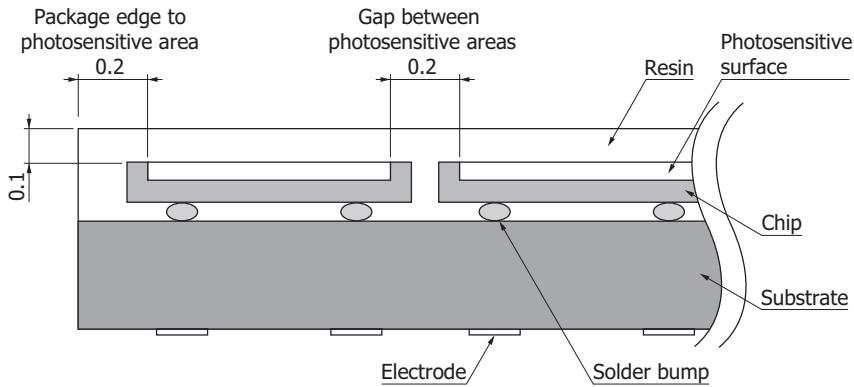
Tolerance unless otherwise noted: ±0.1

KAPDA0171EB

Connector 1				Connector 2			
Pin no.	Connection	Pin no.	Connection	Pin no.	Connection	Pin no.	Connection
40	K (G-1)	41	K (F-1)	40	K (C-1)	41	K (B-1)
39	K (H-1)	42	K (E-1)	39	K (D-1)	42	K (A-1)
38	NC	43	NC	38	NC	43	NC
37	A (G-1)	44	A (F-1)	37	A (C-1)	44	A (B-1)
36	A (H-1)	45	A (E-1)	36	A (D-1)	45	A (A-1)
35	A (H-2)	46	A (E-2)	35	A (D-2)	46	A (A-2)
34	A (G-2)	47	A (F-2)	34	A (C-2)	47	A (B-2)
33	NC	48	NC	33	NC	48	NC
32	K (H-2)	49	K (E-2)	32	K (D-2)	49	K (A-2)
31	K (G-2)	50	K (F-2)	31	K (C-2)	50	K (B-2)
30	K (G-3)	51	K (F-3)	30	K (C-3)	51	K (B-3)
29	K (H-3)	52	K (E-3)	29	K (D-3)	52	K (A-3)
28	NC	53	NC	28	NC	53	NC
27	A (G-3)	54	A (F-3)	27	A (C-3)	54	A (B-3)
26	A (H-3)	55	A (E-3)	26	A (D-3)	55	A (A-3)
25	A (H-4)	56	A (E-4)	25	A (D-4)	56	A (A-4)
24	A (G-4)	57	A (F-4)	24	A (C-4)	57	A (B-4)
23	NC	58	NC	23	NC	58	NC
22	K (H-4)	59	K (E-4)	22	K (D-4)	59	K (A-4)
21	K (G-4)	60	K (F-4)	21	K (C-4)	60	K (B-4)
20	K (G-5)	61	K (F-5)	20	K (C-5)	61	K (B-5)
19	K (H-5)	62	K (E-5)	19	K (D-5)	62	K (A-5)
18	NC	63	NC	18	NC	63	NC
17	A (G-5)	64	A (F-5)	17	A (C-5)	64	A (B-5)
16	A (H-5)	65	A (E-5)	16	A (D-5)	65	A (A-5)
15	A (H-6)	66	A (E-6)	15	A (D-6)	66	A (A-6)
14	A (G-6)	67	A (F-6)	14	A (C-6)	67	A (B-6)
13	NC	68	NC	13	NC	68	NC
12	K (H-6)	69	K (E-6)	12	K (D-6)	69	K (A-6)
11	K (G-6)	70	K (F-6)	11	K (C-6)	70	K (B-6)
10	K (G-7)	71	K (F-7)	10	K (C-7)	71	K (B-7)
9	K (H-7)	72	K (E-7)	9	K (D-7)	72	K (A-7)
8	NC	73	NC	8	NC	73	NC
7	A (G-7)	74	A (F-7)	7	A (C-7)	74	A (B-7)
6	A (H-7)	75	A (E-7)	6	A (D-7)	75	A (A-7)
5	A (H-8)	76	A (E-8)	5	A (D-8)	76	A (A-8)
4	A (G-8)	77	A (F-8)	4	A (C-8)	77	A (B-8)
3	NC	78	NC	3	NC	78	NC
2	K (H-8)	79	K (E-8)	2	K (D-8)	79	K (A-8)
1	K (G-8)	80	K (F-8)	1	K (C-8)	80	K (B-8)

Note: A=Anode, K=Cathode

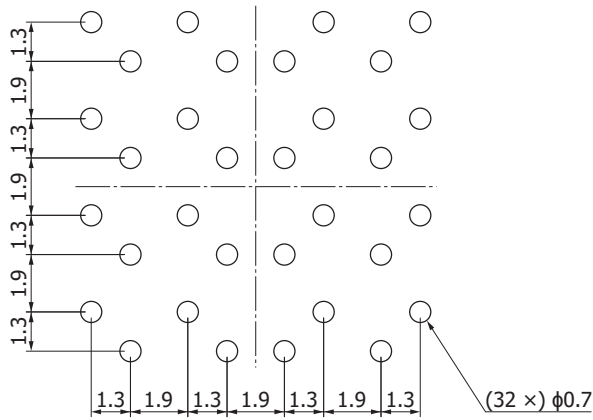
**❑ Cross section detail (unit: mm)**



KAPDC0060EA

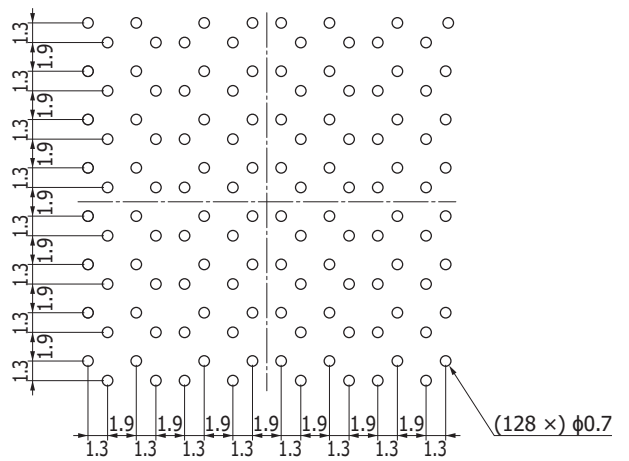
**❑ Recommended land pattern (Unit: mm)**

S13361-3050NE-04



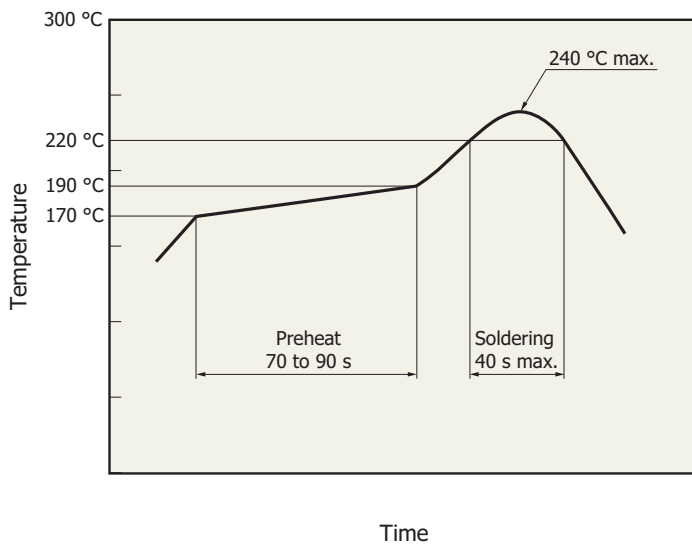
KAPDC0061EA

S13361-3050NE-08



KAPDC0062EA



**Temperature profile measurement example using our experimental hot-air reflow oven (surface mount type)**

KPICB0171EA

- This surface mount type package product supports lead-free soldering. After unpacking, store it in an environment at a temperature of 25 °C or less and a humidity of 60% or less, and perform soldering within 24 hours.
- The effect that the product is subject to during reflow soldering varies depending on the circuit board and reflow furnace that are used. Before actual reflow soldering, check for any problems by testing out the reflow soldering methods in advance.
- When three or more months have passed or if the packing bag has not been stored in an environment described above, perform baking. For the baking method, see the related information "Surface mount type products" precautions.

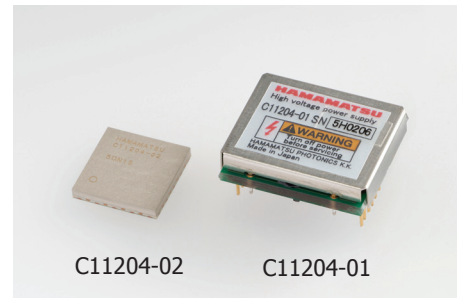
**Precautions**

- If necessary, incorporate appropriate protective circuits in power supplies, devices, and measuring instruments to prevent overvoltage and overcurrent.

**Related products**

Power supply for MPPC C11204 series

The C11204 series is a high voltage power supply that is optimized for driving MPPCs. Since it has a temperature compensation function, MPPCs can be driven stably even in environments subject to temperature changes.

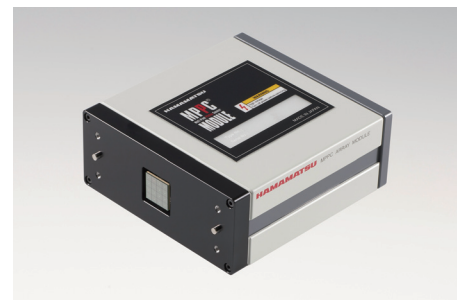


■ Power supplies for MPPC lineup

Type no.	Package type	Temperature stability (ppm/°C)	Voltage boost circuit	MR (magnetic resonance) compatibility	Features
C11204-01	With leads	±10	Yes	-	High precision Low ripple noise
C11204-02	Surface mount	±10	Yes	-	High precision Low ripple noise Compact: 11.5 x 11.5 mm
C11204-03	With leads	±10	-	Yes	MR compatible Low price
C11204-04	Surface mount	±30	-	Yes	MR compatible Low price Compact: 11.5 x 11.5 mm

MPPC modules C13369 series

The C13369 series is a photon counting module capable of detecting low light level. This module consists of a MPPC array, current-to-voltage converter circuit, high-voltage power supply circuit, and temperature-compensation circuit, etc.



**Related information**

[www.hamamatsu.com/sp/ssd/doc\\_en.html](http://www.hamamatsu.com/sp/ssd/doc_en.html)

## ■ Precautions

- Disclaimer
- Metal, ceramic, plastic package products
- Surface mount type products

## ■ Technical information

- MPPC

MPPC is a registered trademark of Hamamatsu Photonics K.K.

Information described in this material is current as of April, 2016.

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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