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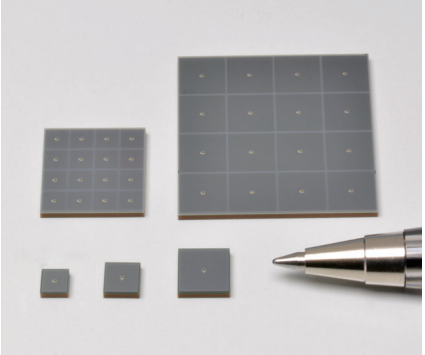
MPPC® (Multi-Pixel Photon Counter)



S14160/S14161 series

Low breakdown voltage type MPPC for scintillation detector

The S14160/S14161 series achieve higher PDE (photon detection efficiency) and lower operation voltage than other MPPC to adapt for PET and radiation monitor application. They achieve small dead space in a photosensitive area with HWB (hole wire bonding) technology (Patent pending). And the gap from the photosensitive area edge to the package edge is only 0.2 mm. This package realizes the four-side buttable arrangement.

Features

- **Higher PDE (50% at λp, Vop=VBR + 2.7 V)**
- **Lower voltage (VBR=38 V typ.) operation**
- **Small dead space in photosensitive area**
- **Low afterpulses and crosstalk**
- **High gain: 10^6 order**
- **Excellent time resolution**
- **Immune to effects of magnetic fields**

Applications

- **PET (positron emission tomography)**
- **Radiation monitor**

Structure

Typ. no.	Number of channels (ch)	Effective photosensitive area/channel (mm^2)	Pixel pitch (μm)	Number of pixels/channel	Package	Window	Window refractive index	Geometrical fill factor (%)
S14160-3050HS	1	3.0 × 3.0	50	3531	Surface mount type	Silicone	1.57	74
S14160-4050HS		4.0 × 4.0		6331				
S14160-6050HS		6.0 × 6.0		14331				
S14161-3050HS-04	16 (4 × 4)	3.0 × 3.0		3531				
S14161-3050HS-08	64 (8 × 8)	3.0 × 3.0		3531				
S14161-4050HS-06	36 (6 × 6)	4.0 × 4.0		6331				
S14161-6050HS-04	16 (4 × 4)	6.0 × 6.0		14331				

Absolute maximum ratings

Parameter	Symbol	Specification	Unit
Operating temperature*1	Topr	-40 to +85	°C
Storage temperature*1	Tstg	-40 to +85	°C
Soldering temperature*2	Tsol	240 (3 times)	°C

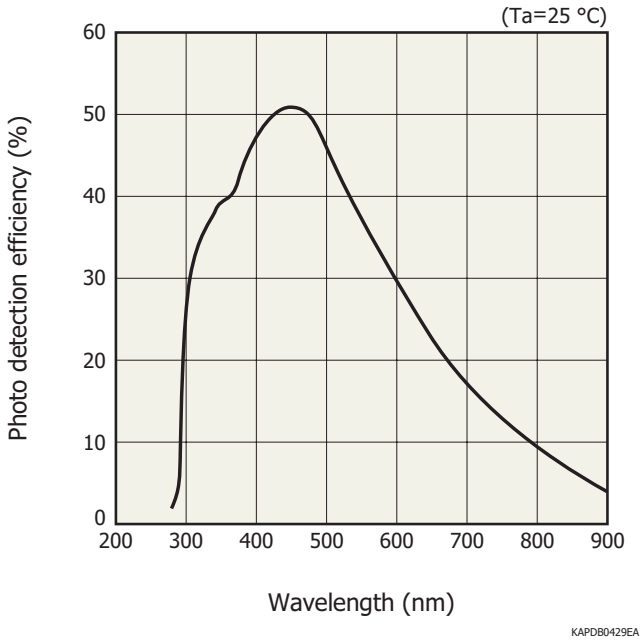
*1: No dew condensation
When there is a temperature difference between a product and the surrounding area in high humidity environment, dew condensation may occur on the product surface. Dew condensation may cause deterioration in characteristics and reliability.
*2: Reflow soldering, JEDEC J-STD-020 MSL 5a, see P.10
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=2.7 V, unless otherwise noted)

Parameter		Symbol	S14160/S14161 -3050HS-04, -08	S14160/S14161 -4050HS-06	S14160/S14161 -6050HS-04	unit
Spectral response range		λ	270 to 900			nm
Peak sensitivity wavelength		λp	450			nm
Photon detection efficiency at λp*3		PDE	50			%
Breakdown voltage		V_{BR}	38			V
Recommended operating voltage*4		Vop	V_{BR} + 2.7			V
Vop variation between channels in one product*5	Typ.	-	0.1			V
	Max.		0.2			
Dark current	Typ.	I_D	0.6	1.1	2.5	μA
	Max.		1.8	3.3	7.5	
Crosstalk probability		-	7			%
Terminal capacitance		Ct	500	900	2000	pF
Gain		M	2.5×10^6			-
Temperature coefficient of recommended reverse voltage		ΔTVop	34			mV/°C

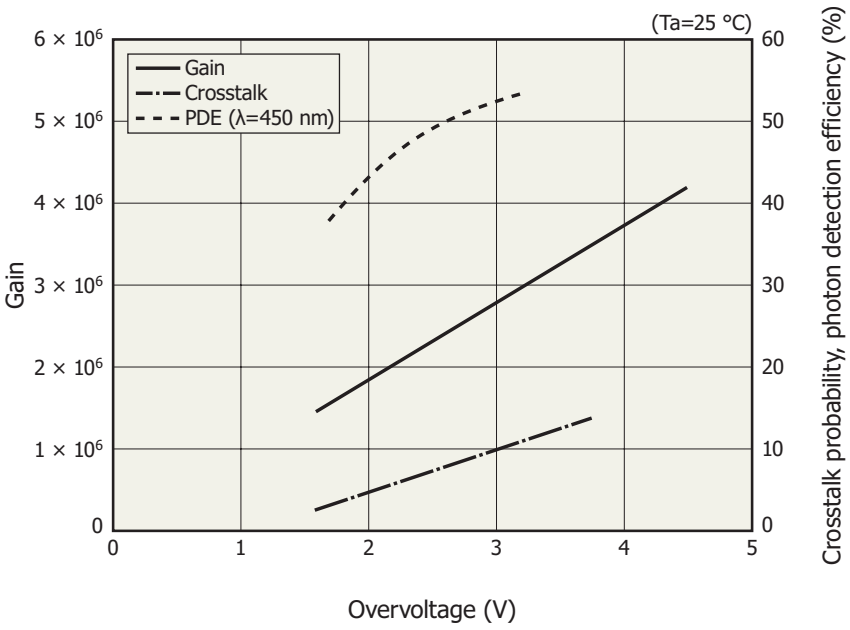
*3: Photon detection efficiency does not include crosstalk and afterpulses.
*4: Refer to the data attached for each product.
*5: The parameter is for the S14161 series (multichannel type)

Photon detection efficiency vs. wavelength (typical example)



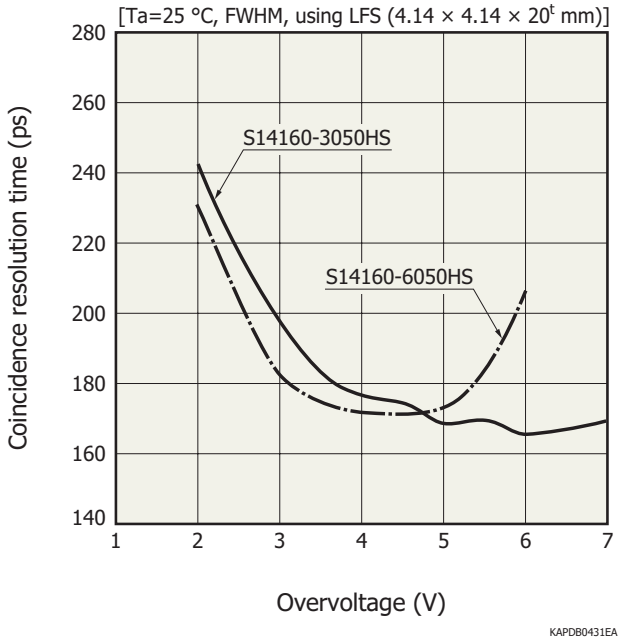
Photon detection efficiency does not include crosstalk and afterpulses.

Overvoltage vs. gain, crosstalk probability, photon detection efficiency (typical example)



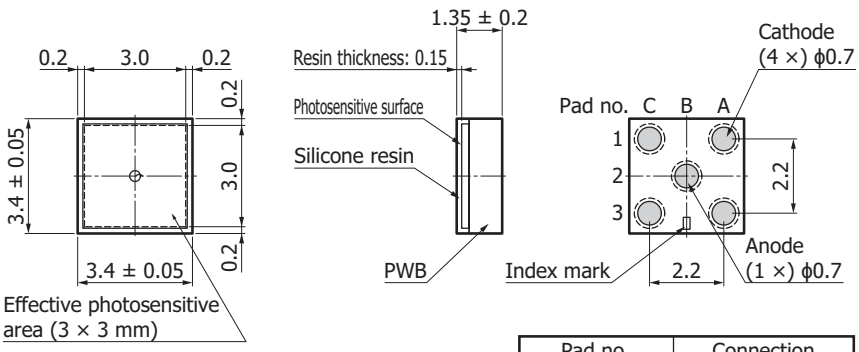
MPPC characteristics vary with the operating voltage. Although increasing the operating voltage improves the photon detection efficiency and time resolution, it also increases the dark count and crosstalk at the same time, so an optimum operating voltage must be selected to match the application.

Coincidence resolution time vs. overvoltage (typical example)



Dimensional outlines (unit: mm)

S14160-3050HS



Pad no.	Connection
A1, A3, C1, C3	Cathode common
B2	Anode

Tolerance unless otherwise noted: ±0.1

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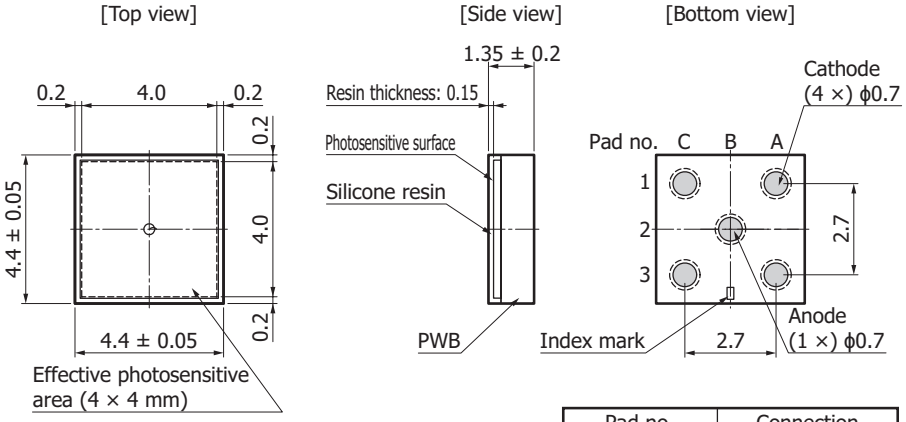
S14160-4050HS



Pad no.	Connection
A1, A3, C1, C3	Cathode common
B2	Anode

Tolerance unless otherwise noted: ±0.1

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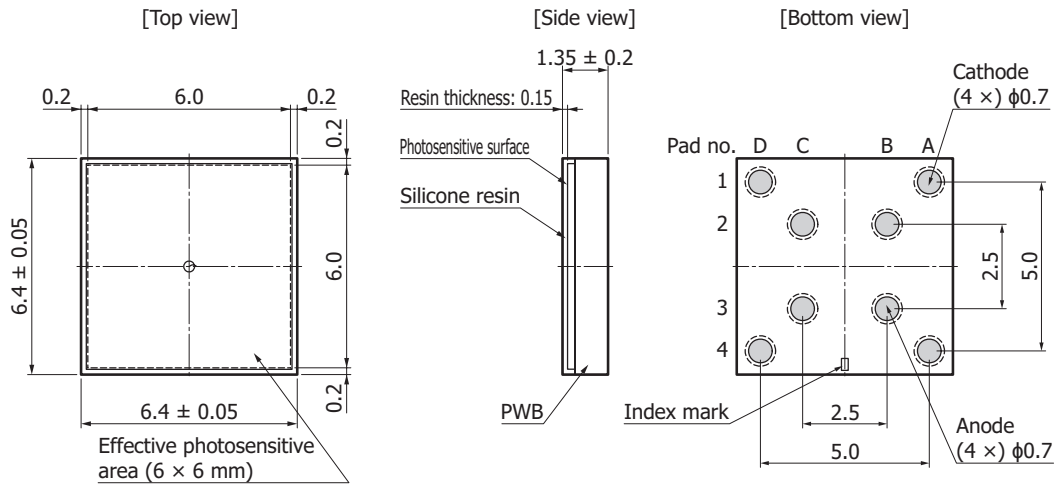
S14160-6050HS



Tolerance unless otherwise noted: ±0.1

Pad no.	Connection
A1, A4, D1, D4	Cathode common
B2, B3, C2, C3	Anode common

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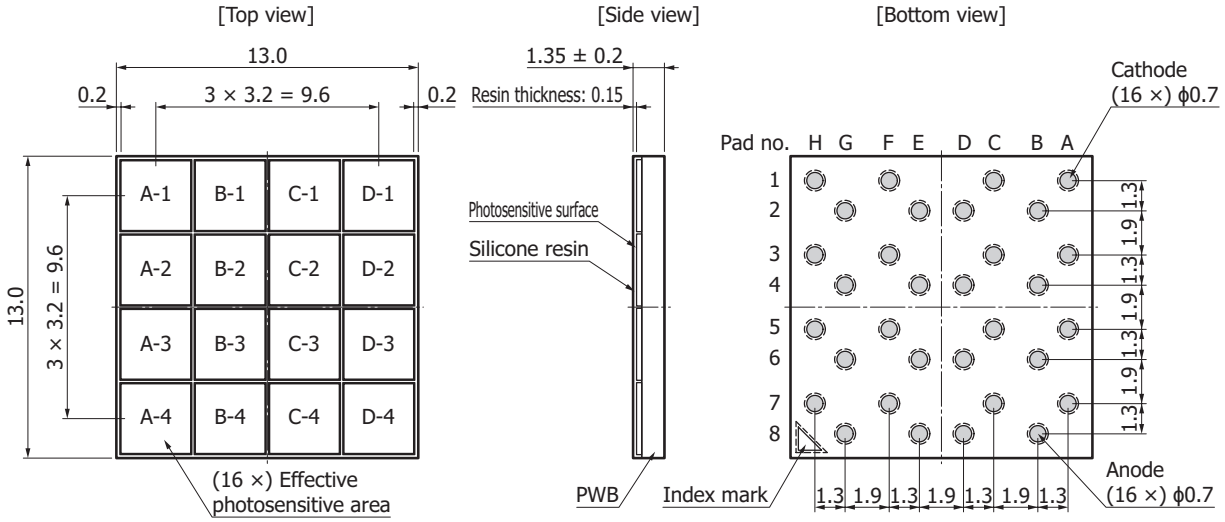
S14161-3050HS-04



Tolerance unless otherwise noted: ±0.1

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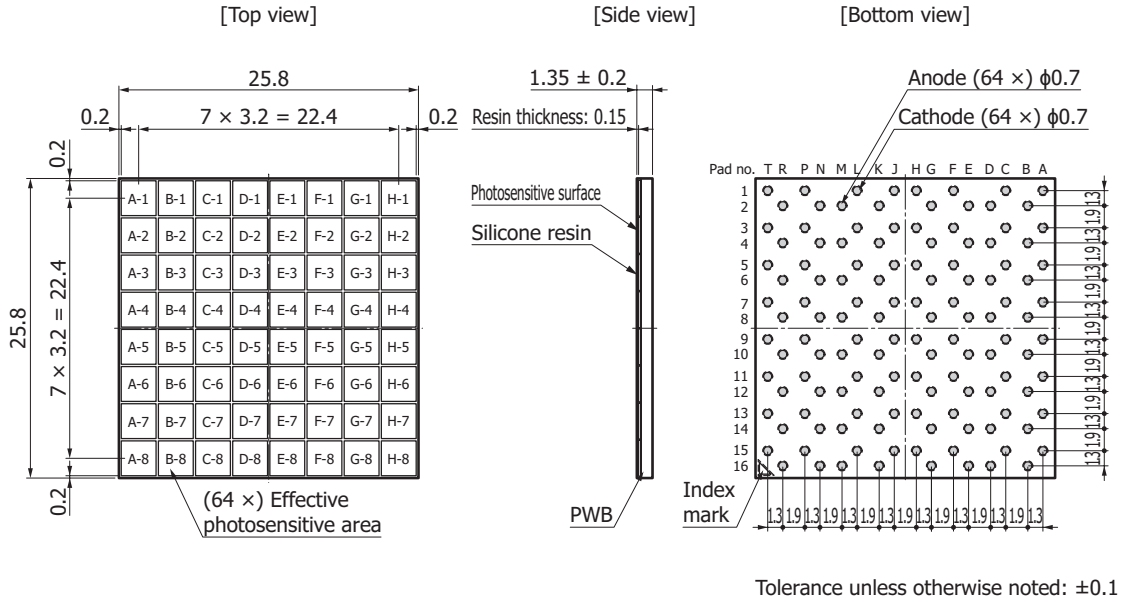
Pad no.	Connection	Pad no.	Connection	Pad no.	Connection	Pad no.	Connection	Pad no.	Connection	Pad no.	Connection	Pad no.	Connection	Pad no.	Connection
H1	A(D-1)	-	-	F1	A(C-1)	-	-	-	-	C1	K(B-1)	-	-	A1	K(A-1)
-	-	G2	K(D-1)	-	-	E2	K(C-1)	D2	A(B-1)	-	-	B2	A(A-1)	-	-
H3	A(D-2)	-	-	F3	A(C-2)	-	-	-	-	C3	K(B-2)	-	-	A3	K(A-2)
-	-	G4	K(D-2)	-	-	E4	K(C-2)	D4	A(B-2)	-	-	B4	A(A-2)	-	-
H5	A(D-3)	-	-	F5	A(C-3)	-	-	-	-	C5	K(B-3)	-	-	A5	K(A-3)
-	-	G6	K(D-3)	-	-	E6	K(C-3)	D6	A(B-3)	-	-	B6	A(A-3)	-	-
H7	A(D-4)	-	-	F7	A(C-4)	-	-	-	-	C7	K(B-4)	-	-	A7	K(A-4)
-	-	G8	K(D-4)	-	-	E8	K(C-4)	D8	A(B-4)	-	-	B8	A(A-4)	-	-

Note: A=Anode, K=Cathode

S14161-3050HS-08



Tolerance unless otherwise noted: ±0.1

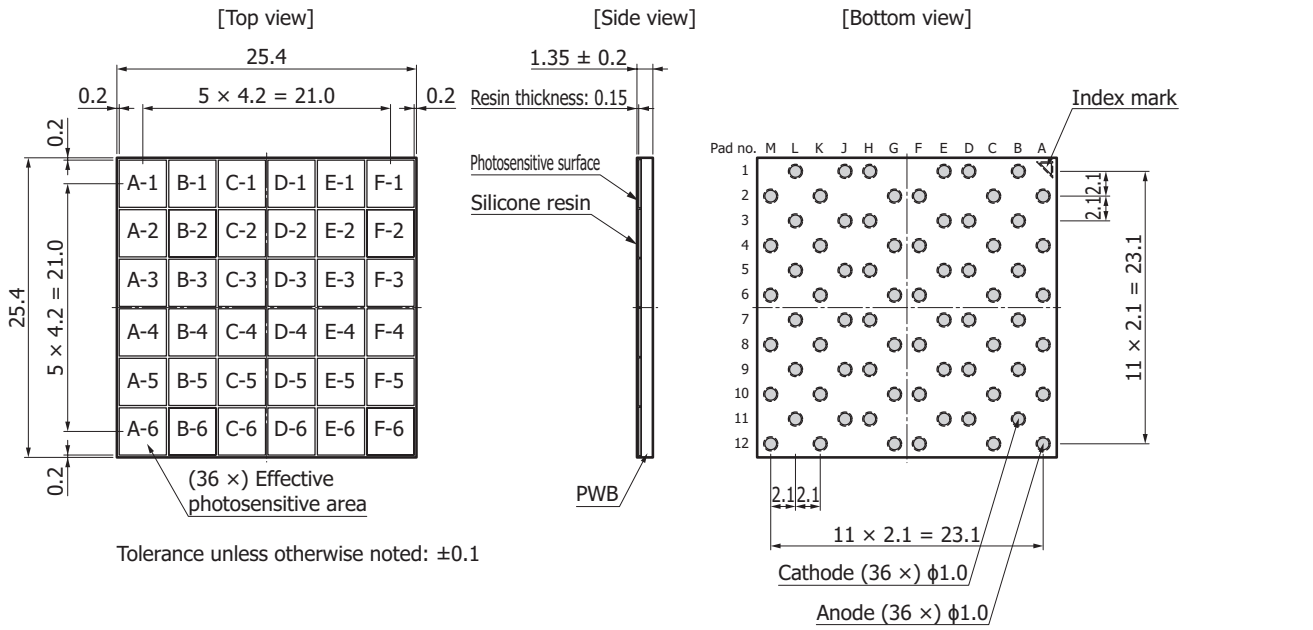
KAPDA0199EA

Pad no.	Connection	Pad no.	Connection	Pad no.	Connection	Pad no.	Connection	Pad no.	Connection	Pad no.	Connection	Pad no.	Connection	Pad no.	Connection
T1	A(H-1)	-	-	P1	A(G-1)	-	-	-	-	L1	K(F-1)	-	-	J1	K(E-1)
-	-	R2	K(H-1)	-	-	N2	K(G-1)	M2	A(F-1)	-	-	K2	A(E-1)	-	-
T3	A(H-2)	-	-	P3	A(G-2)	-	-	-	-	L3	K(F-2)	-	-	J3	K(E-2)
-	-	R4	K(H-2)	-	-	N4	K(G-2)	M4	A(F-2)	-	-	K4	A(E-2)	-	-
T5	A(H-3)	-	-	P5	A(G-3)	-	-	-	-	L5	K(F-3)	-	-	J5	K(E-3)
-	-	R6	K(H-3)	-	-	N6	K(G-3)	M6	A(F-3)	-	-	K6	A(E-3)	-	-
T7	A(H-4)	-	-	P7	A(G-4)	-	-	-	-	L7	K(F-4)	-	-	J7	K(E-4)
-	-	R8	K(H-4)	-	-	N8	K(G-4)	M8	A(F-4)	-	-	K8	A(E-4)	-	-
T9	A(H-5)	-	-	P9	A(G-5)	-	-	-	-	L9	K(F-5)	-	-	J9	K(E-5)
-	-	R10	K(H-5)	-	-	N10	K(G-5)	M10	A(F-5)	-	-	K10	A(E-5)	-	-
T11	A(H-6)	-	-	P11	A(G-6)	-	-	-	-	L11	K(F-6)	-	-	J11	K(E-6)
-	-	R12	K(H-6)	-	-	N12	K(G-6)	M12	A(F-6)	-	-	K12	A(E-6)	-	-
T13	A(H-7)	-	-	P13	A(G-7)	-	-	-	-	L13	K(F-7)	-	-	J13	K(E-7)
-	-	R14	K(H-7)	-	-	N14	K(G-7)	M14	A(F-7)	-	-	K14	A(E-7)	-	-
T15	A(H-8)	-	-	P15	A(G-8)	-	-	-	-	L15	K(F-8)	-	-	J15	K(E-8)
-	-	R16	K(H-8)	-	-	N16	K(G-8)	M16	A(F-8)	-	-	K16	A(E-8)	-	-

Pad no.	Connection	Pad no.	Connection	Pad no.	Connection	Pad no.	Connection	Pad no.	Connection	Pad no.	Connection	Pad no.	Connection	Pad no.	Connection
H1	A(D-1)	-	-	F1	A(C-1)	-	-	-	-	C1	K(B-1)	-	-	A1	K(A-1)
-	-	G2	K(D-1)	-	-	E2	K(C-1)	D2	A(B-1)	-	-	B2	A(A-1)	-	-
H3	A(D-2)	-	-	F3	A(C-2)	-	-	-	-	C3	K(B-2)	-	-	A3	K(A-2)
-	-	G4	K(D-2)	-	-	E4	K(C-2)	D4	A(B-2)	-	-	B4	A(A-2)	-	-
H5	A(D-3)	-	-	F5	A(C-3)	-	-	-	-	C5	K(B-3)	-	-	A5	K(A-3)
-	-	G6	K(D-3)	-	-	E6	K(C-3)	D6	A(B-3)	-	-	B6	A(A-3)	-	-
H7	A(D-4)	-	-	F7	A(C-4)	-	-	-	-	C7	K(B-4)	-	-	A7	K(A-4)
-	-	G8	K(D-4)	-	-	E8	K(C-4)	D8	A(B-4)	-	-	B8	A(A-4)	-	-
H9	A(D-5)	-	-	F9	A(C-5)	-	-	-	-	C9	K(B-5)	-	-	A9	K(A-5)
-	-	G10	K(D-5)	-	-	E10	K(C-5)	D10	A(B-5)	-	-	B10	A(A-5)	-	-
H11	A(D-6)	-	-	F11	A(C-6)	-	-	-	-	C11	K(B-6)	-	-	A11	K(A-6)
-	-	G12	K(D-6)	-	-	E12	K(C-6)	D12	A(B-6)	-	-	B12	A(A-6)	-	-
H13	A(D-7)	-	-	F13	A(C-7)	-	-	-	-	C13	K(B-7)	-	-	A13	K(A-7)
-	-	G14	K(D-7)	-	-	E14	K(C-7)	D14	A(B-7)	-	-	B14	A(A-7)	-	-
H15	A(D-8)	-	-	F15	A(C-8)	-	-	-	-	C15	K(B-8)	-	-	A15	K(A-8)
-	-	G16	K(D-8)	-	-	E16	K(C-8)	D16	A(B-8)	-	-	B16	A(A-8)	-	-

Note: A=Anode, K=Cathode

S14161-4050HS-06



Tolerance unless otherwise noted: ±0.1

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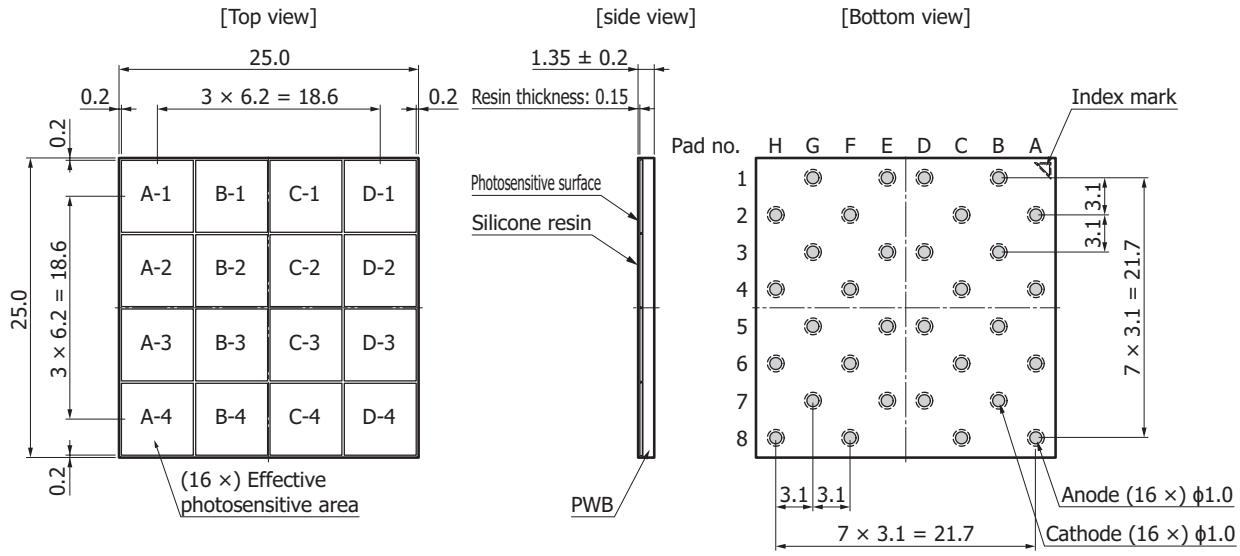
Pad no.	Connection	Pad no.	Connection	Pad no.	Connection	Pad no.	Connection	Pad no.	Connection	Pad no.	Connection
-	-	L1	A(F-1)	-	-	J1	A(E-1)	H1	K(D-1)	-	-
M2	K(F-1)	-	-	K2	K(E-1)	-	-	-	-	G2	A(D-1)
-	-	L3	A(F-2)	-	-	J3	A(E-2)	H3	K(D-2)	-	-
M4	K(F-2)	-	-	K4	K(E-2)	-	-	-	-	G4	A(D-2)
-	-	L5	A(F-3)	-	-	J5	A(E-3)	H5	K(D-3)	-	-
M6	K(F-3)	-	-	K6	K(E-3)	-	-	-	-	G6	A(D-3)
-	-	L7	A(F-4)	-	-	J7	A(E-4)	H7	K(D-4)	-	-
M8	K(F-4)	-	-	K8	K(E-4)	-	-	-	-	G8	A(D-4)
-	-	L9	A(F-5)	-	-	J9	A(E-5)	H9	K(D-5)	-	-
M10	K(F-5)	-	-	K10	K(E-5)	-	-	-	-	G10	A(D-5)
-	-	L11	A(F-6)	-	-	J11	A(E-6)	H11	K(D-6)	-	-
M12	K(F-6)	-	-	K12	K(E-6)	-	-	-	-	G12	A(D-6)

Pad no.	Connection	Pad no.	Connection	Pad no.	Connection	Pad no.	Connection	Pad no.	Connection	Pad no.	Connection
-	-	E1	A(C-1)	D1	K(B-1)	-	-	B1	K(A-1)	-	-
F2	K(C-1)	-	-	-	-	C2	A(B-1)	-	-	A2	A(A-1)
-	-	E3	A(C-2)	D3	K(B-2)	-	-	B3	K(A-2)	-	-
F4	K(C-2)	-	-	-	-	C4	A(B-2)	-	-	A4	A(A-2)
-	-	E5	A(C-3)	D5	K(B-3)	-	-	B5	K(A-3)	-	-
F6	K(C-3)	-	-	-	-	C6	A(B-3)	-	-	A6	A(A-3)
-	-	E7	A(C-4)	D7	K(B-4)	-	-	B7	K(A-4)	-	-
F8	K(C-4)	-	-	-	-	C8	A(B-4)	-	-	A8	A(A-4)
-	-	E9	A(C-5)	D9	K(B-5)	-	-	B9	K(A-5)	-	-
F10	K(C-5)	-	-	-	-	C10	A(B-5)	-	-	A10	A(A-5)
-	-	E11	A(C-6)	D11	K(B-6)	-	-	B11	K(A-6)	-	-
F12	K(C-6)	-	-	-	-	C12	A(B-6)	-	-	A12	A(A-6)

Note: A=Anode, K=Cathode

S14161-6050HS-04



Tolerance unless otherwise noted: ±0.1

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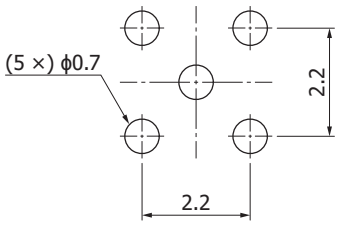
Pad no.	Connection	Pad no.	Connection	Pad no.	Connection	Pad no.	Connection	Pad no.	Connection	Pad no.	Connection	Pad no.	Connection	Pad no.	Connection
-	-	G1	A(D-1)	-	-	E1	A(C-1)	D1	K(B-1)	-	-	B1	K(A-1)	-	-
H2	K(D-1)	-	-	F2	K(C-1)	-	-	-	-	C2	A(B-1)	-	-	A2	A(A-1)
-	-	G3	A(D-2)	-	-	E3	A(C-2)	D3	K(B-2)	-	-	B3	K(A-2)	-	-
H4	K(D-2)	-	-	F4	K(C-2)	-	-	-	-	C4	A(B-2)	-	-	A4	A(A-2)
-	-	G5	A(D-3)	-	-	E5	A(C-3)	D5	K(B-3)	-	-	B5	K(A-3)	-	-
H6	K(D-3)	-	-	F6	K(C-3)	-	-	-	-	C6	A(B-3)	-	-	A6	A(A-3)
-	-	G7	A(D-4)	-	-	E7	A(C-4)	D7	K(B-4)	-	-	B7	K(A-4)	-	-
H8	K(D-4)	-	-	F8	K(C-4)	-	-	-	-	C8	A(B-4)	-	-	A8	A(A-4)

Note: A=Anode, K=Cathode

Recommended land pattern (unit: mm)

S14160-3050HS



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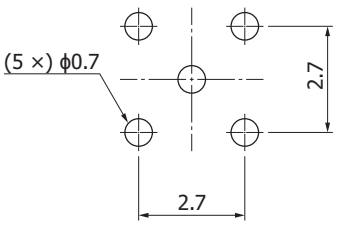
S14160-4050HS



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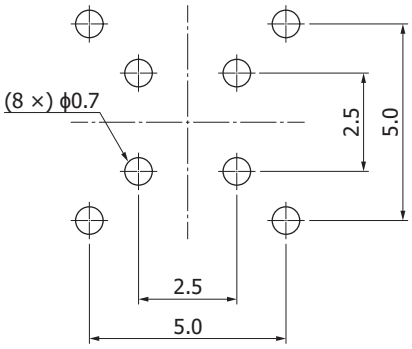
S14160-6050HS



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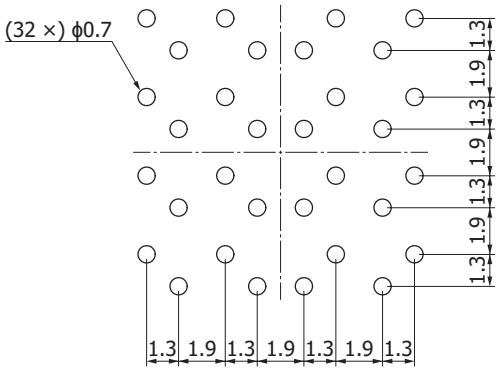
S14161-3050HS-04



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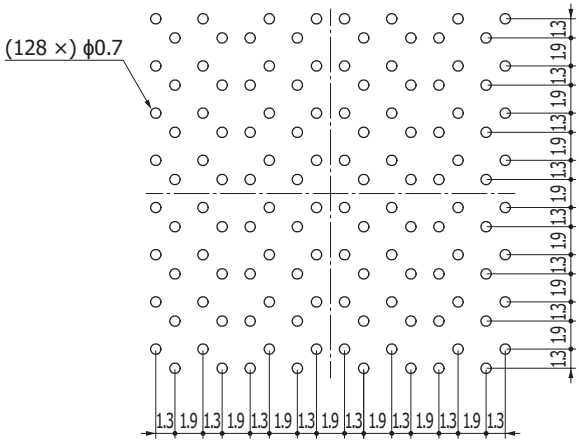
S14161-3050HS-08



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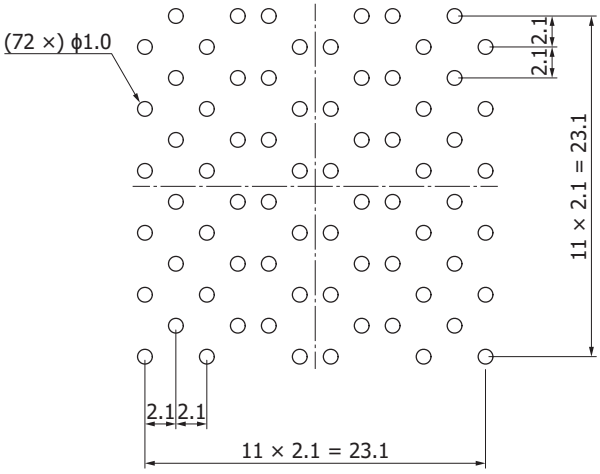
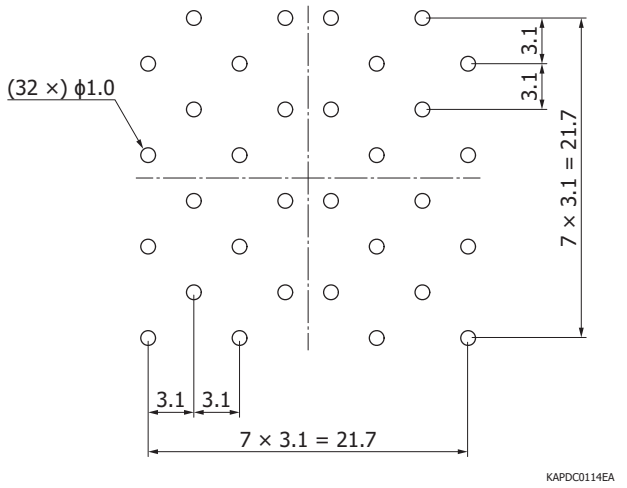
S14161-4050HS-06



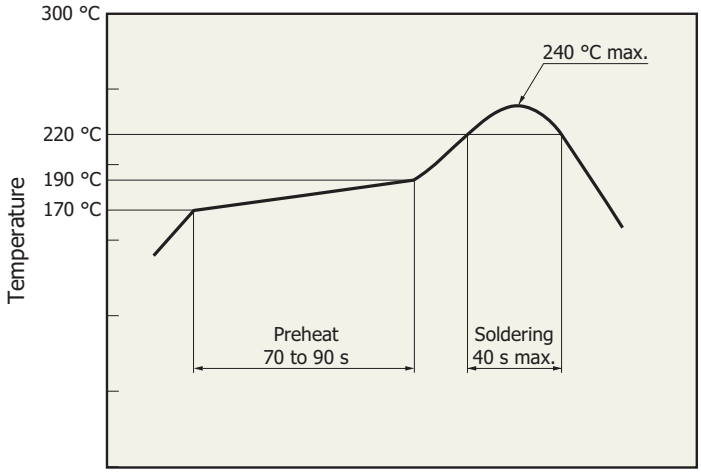
KAPDC0113EA

S14161-6050HS-04



KAPDC0114EA

Recommended reflow soldering conditions



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 mounths 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 information

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

■ Precautions
· Disclaimer
· Surface mount type products

■ Technical information
· MPPC

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