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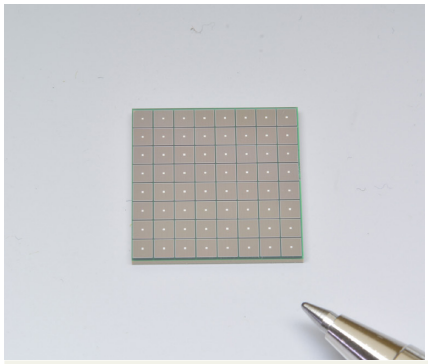
MPPC® (Multi-Pixel Photon Counter) arrays



S13361-2050 series

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

The S13361-2050 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 V typ.) operation**
- **High gain: 10^5 to 10^6**

Applications

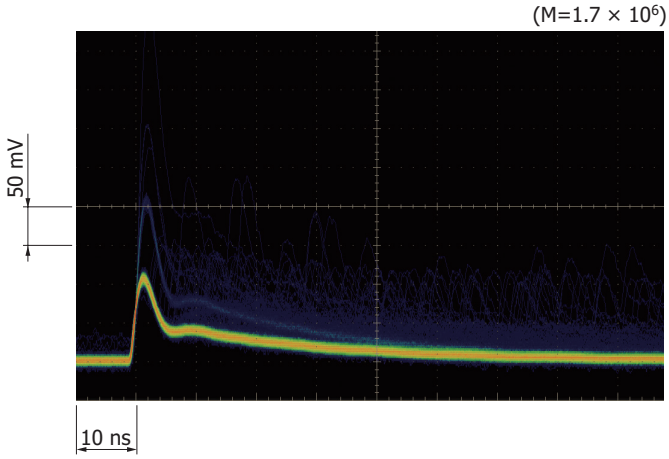
- **Astro physical application**
- **High energy physics experiment**
- **Nuclear medicine**
- **PET**
- **Environmental analysis**

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 S13361-2050 series, low crosstalk has been achieved in addition to low afterpulse.

Pulse waveform (S13360-2050VE, typical example)

(M=1.7 × 10^6)



Structure

Parameter	Symbol	S13361-2050NE-08	S13361-2050AE-08	Unit
Number of channels	-	64 (8 × 8)		-
Effective photosensitive area/channel	-	2 × 2		mm
Pixel pitch	-	50		μm
Number of pixels	-	1584		-
Fill factor	-	74		%
Package type	-	Surface mount	With connector*1	-
Window	-	Epoxy resin		-
Refractive index of window material	-	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 (S13361-2050AE-08)
This connector mates with a SAMTEC receptacle (SS4-20-3.00-L-D-K-TR).
See the following URL for detailed information.
https://www.samtec.com/ftppub/pdf/ss4.pdf

Absolute maximum ratings

Parameter	Symbol	S13361-2050NE-08	S13361-2050AE-08	Unit
Operating temperature*2	Topr	-20 to +60		°C
Storage temperature*2	Tstg	-20 to +80		°C
Soldering temperature*3	Tsol	240 (twice)	-	°C

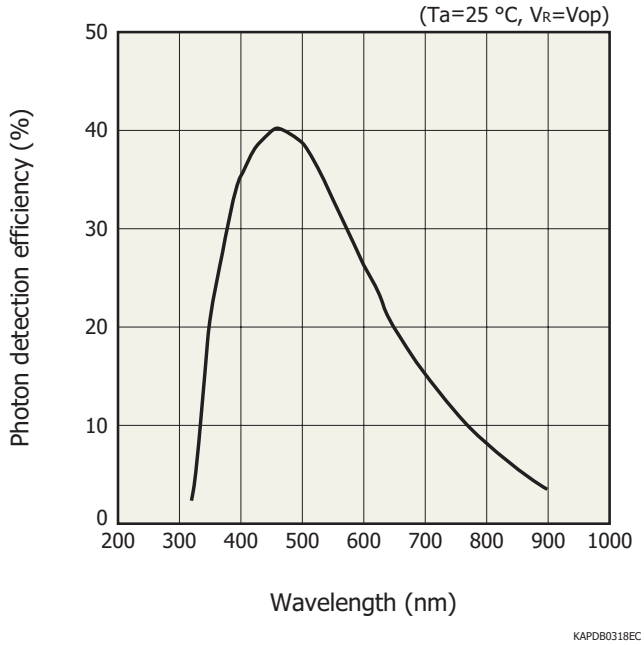
*2: No dew condensation
When there is a temperature difference between a product and the surrounding area in high humidity environments, dew condensation may occur on the product surface. Dew condensation on the product may cause deterioration in characteristics and reliability.
*3: Reflow soldering, JEDEC J-STD-020 MSL 5a, see P.7
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.	C_D	300	kcps
	Max.		900	
Terminal capacitance		Ct	140	pF
Gain		M	1.7×10^6	-
Breakdown voltage		V_{BR}	53 ± 5	V
Recommended operating voltage		Vop	V_{BR} + 3	V
Vop variation between channels in one product	Typ.	-	0.1	V
	Max.		0.3	
Temperature coefficient of recommended operating voltage		ΔTVop	54	mV/°C

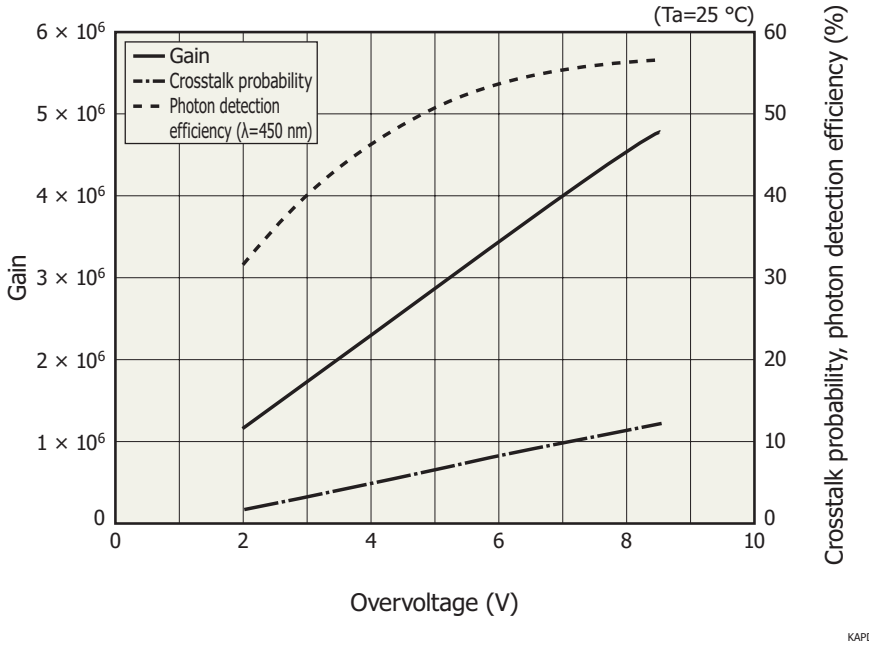
*4: Photon detection efficiency does not include crosstalk or afterpulses.
*5: Threshold=0.5 p.e.
Note: The above characteristics were measured the operating voltage that yields the listed gain in this catalog.
(See the data attached to each product.)

Photon detection efficiency vs. wavelength (typical example)



Photon detection efficiency does not include crosstalk or afterpulses.

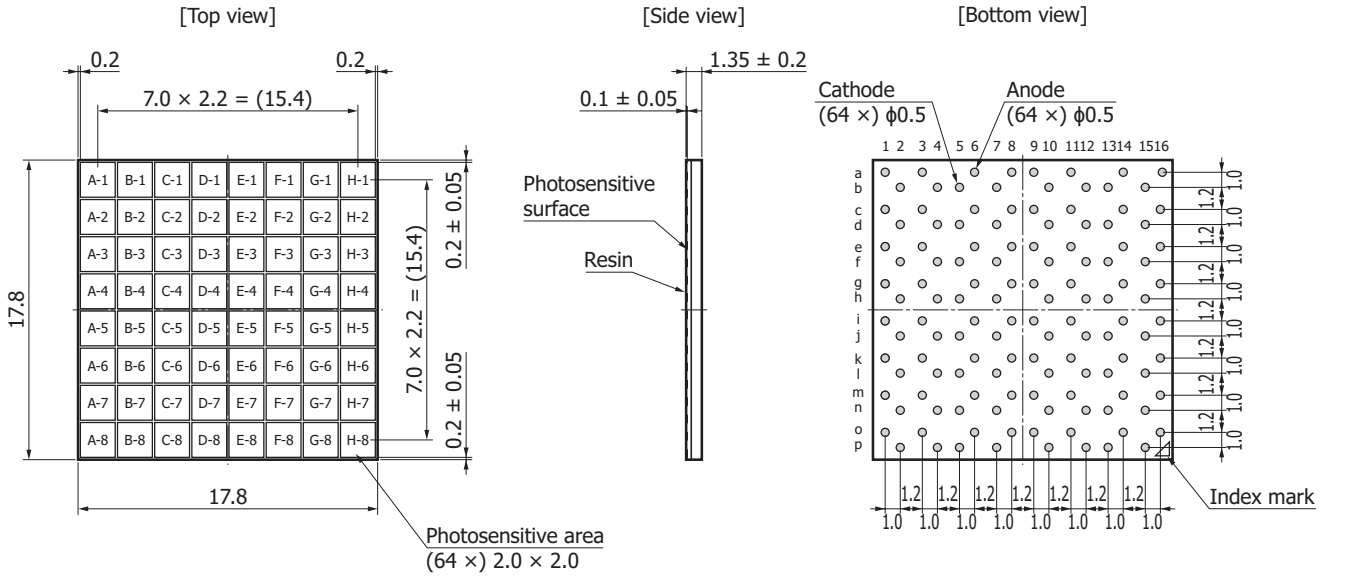
Overvoltage specifications of gain, crosstalk probability, photon detection efficiency (typical example)



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)

S13361-2050NE-08



Tolerance unless otherwise noted: ±0.1

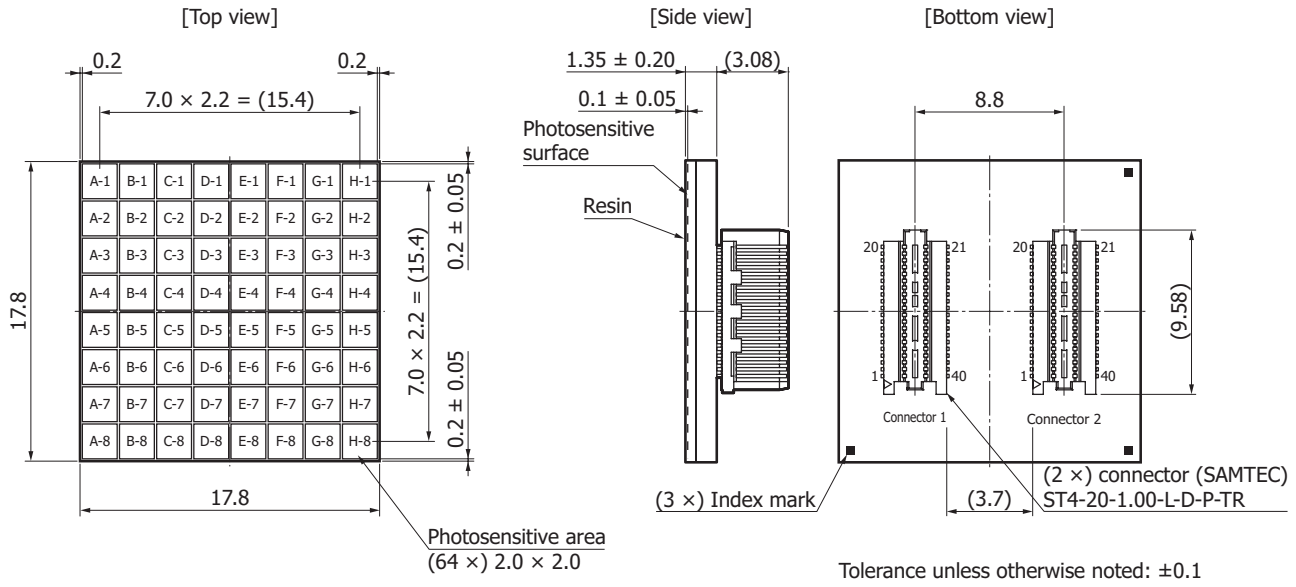
KAPDA0193EA

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

Note: A=Anode, K=Cathode

S13361-2050AE-08



■ Connector 1

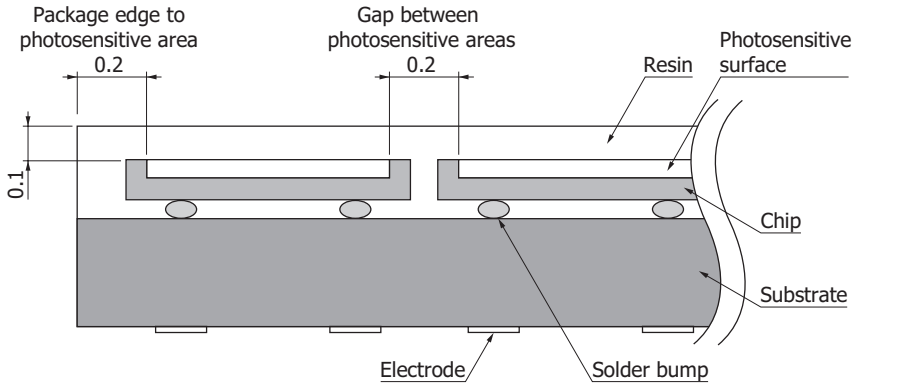
Pin no.	Connection	Pin no.	Connection
20	A (G-2)	21	A (F-2)
19	A (G-1)	22	A (F-1)
18	A (H-1)	23	A (E-1)
17	A (H-2)	24	A (E-2)
16	A (G-3)	25	A (F-3)
15	A (H-3)	26	A (E-3)
14	A (H-4)	27	A (E-4)
13	A (G-4)	28	A (F-4)
12	NC	29	NC
11	K (common)	30	K (common)
10	K (common)	31	K (common)
9	NC	32	NC
8	A (G-5)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

■ Connector 2

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

Note: A=Anode, K=Cathode

Cross section detail (unit: mm)



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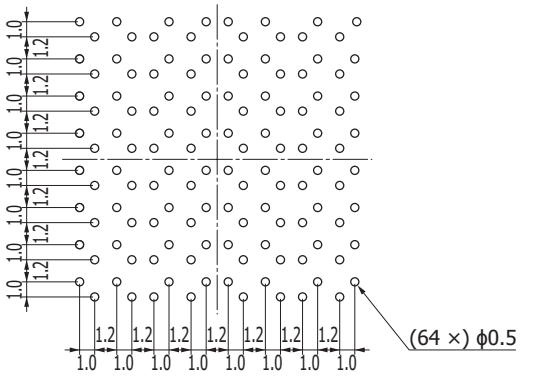
Recommended land pattern (unit: mm)

S13361-2050NE-08



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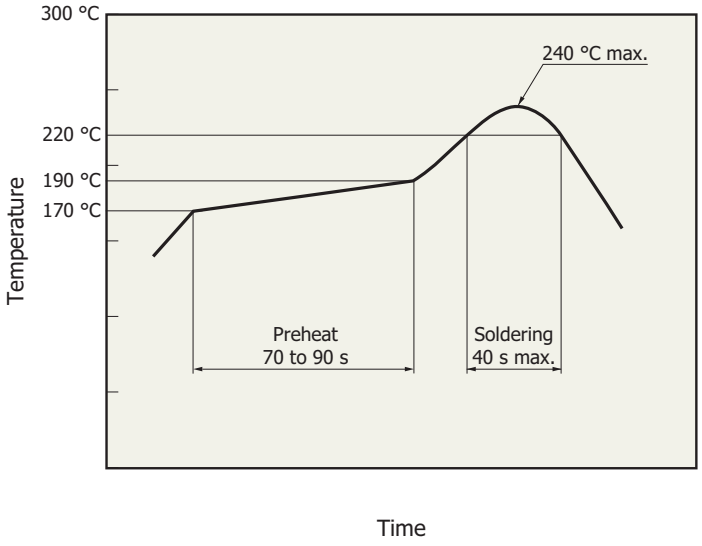
Recommended reflow soldering conditions (S13361-2050NE-08)



· 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
· Metal, ceramic, plastic package products
· Surface mount type products

■ Technical information
· MPPC / Technical note
· MPPC / Literature

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.

■ Lineup of power supplies for MPPC

Photo	Type no.	Package type	Temperature stability (ppm/°C)	Features
	C11204-01	With leads	±10	High precision Low ripple noise
	C11204-02	Surface mount	±10	High precision Low ripple noise Compact: 11.5 × 11.5 mm
	C14156	Surface mount	±200	Low price Compact: 7 × 7 mm

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Information described in this material is current as of May 2022.
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.
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