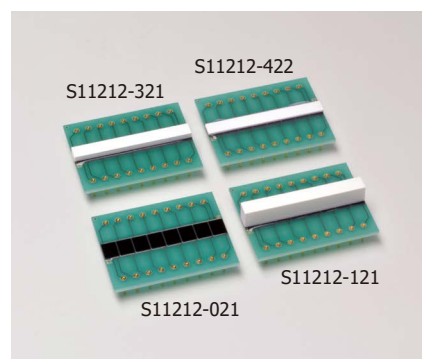


16-element Si photodiode arrays



S11212 series

Back-illuminated photodiode arrays for X-ray non-destructive inspection

The S11212 series is a back-illuminated type 16-element photodiode array specifically designed for non-destructive X-ray inspection. It has improved sensitivity uniformity and smaller photodiode element variations compared to our previous product (S5668 series). The back-illuminated photodiode array is also simple to handle and easily couples to scintillators without having to worry about wire damage because there are no bonding wires and photosensitive areas on the light incident side. The S11212 series can replace the S5668 series since their package size and pin connections are identical.

Features

- Spectral response range: 340 to 1100 nm (S11212-021)
- Element size: 1.175 (W) × 2.0 (H) mm/one element
- Element pitch: 1.575 mm (× 16 pixels)
- Mounted on board size: 25.4 (W) × 20.0 (H) mm
- Long and narrow format by multiple arrays
- Supports dual energy imaging
(When used in an upper and lower two-layer combination. See page 7.)

Applications

- X-ray non-destructive inspection, etc.

Selection guide

Type no.	Number of elements	Element pitch (mm)	Element size W × H (mm)	Board size W × H (mm)	Scintillator			Application example
					Type	Afterglow ^{*1}	Crosstalk ^{*1}	
S11212-021 ^{*2}	16	1.575	1.175 × 2.0	25.4 × 20.0	None	-	-	General photometry
S11212-121					CsI(Tl)	Large	Low	X-ray non-destructive inspection of slow-moving objects (baggage inspection, etc.)
S11212-321					GOS ceramic	Small	Low	X-ray non-destructive inspection of fast-moving objects (baggage inspection, etc.)
S11212-422					Phosphor sheet	Small	May occur.	X-ray non-destructive inspection (at low X-ray energy)

^{*1}: Relative characteristics when three types of scintillators are compared

^{*2}: This photodiode array as it is does not function as an X-ray detector. An appropriate scintillator or phosphor sheet should be added at user's side.

Note: The S11212 series are also compatible with other scintillators than those listed in the above table (custom made devices). Please consult our sales office.

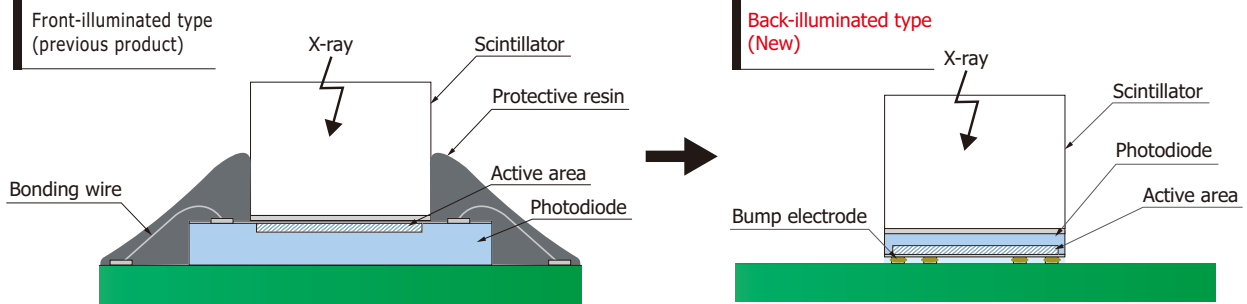
Precautions

CsI(Tl) scintillator of the S11212-121 has deliquescence. Avoid storing or using the S11212-121 at high humidity.

Feature 01 Back-illuminated type

The S11212 series photodiode arrays have a back-illuminated type structure. This structure uses no fragile easily-broken bonding wires since the photodiode array output terminals are directly connected by bump bonding to the electrodes on the board. This structure is robust since the board wiring is laid out within the board. The photodiode surface for coupling the scintillator has no bonding wires or photosensitive areas, so there is less risk of damaging the photodiode array. The S11212 series is also resistant to effects from temperature cycle and so ensures high reliability.

▢ Cross-section diagram (comparison between front-illuminated type and back-illuminated type)

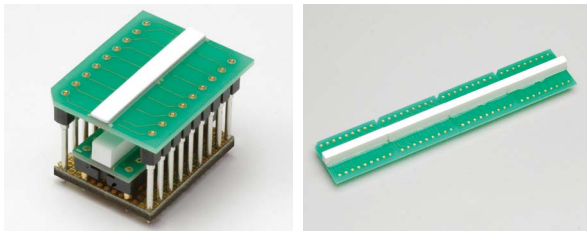


KMPDA0280EA

Feature 02 Multiple applications

The S11212 series supports dual energy imaging. To simultaneously detect high energy X-rays and low energy X-rays, the S11212 series is designed so that two photodiode arrays, each with a different scintillator, are combined in an upper and lower two-layer format. Arranging two or more S11212 series photodiode arrays in a row in close proximity also forms a line sensor that allows measurement of long objects.

▢ Sensor structure example



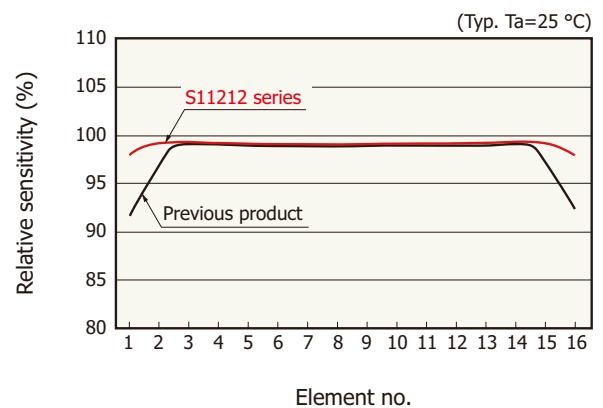
Two-layer combination

Multi-array format

Feature 03 Superb uniformity

Our unique sensor design minimizes variations in sensitivity between photodiode elements as well as at the sensor ends. The S11212 series offers significantly improved sensitivity uniformity compared to our previous product (S5668 series) and so provides optimal X-ray images.

▢ Uniformity



KMPDB0352EA

Absolute maximum ratings

Parameter	Symbol	S11212-021	S11212-121/-321/-422	Unit
Reverse voltage	V_R max	10	10	V
Operating temperature ^{*3}	T_{opr}	-20 to +60	-10 to +60	°C
Storage temperature ^{*3}	T_{stg}	-20 to +80	-20 to +70	°C

^{*3}: 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.

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.

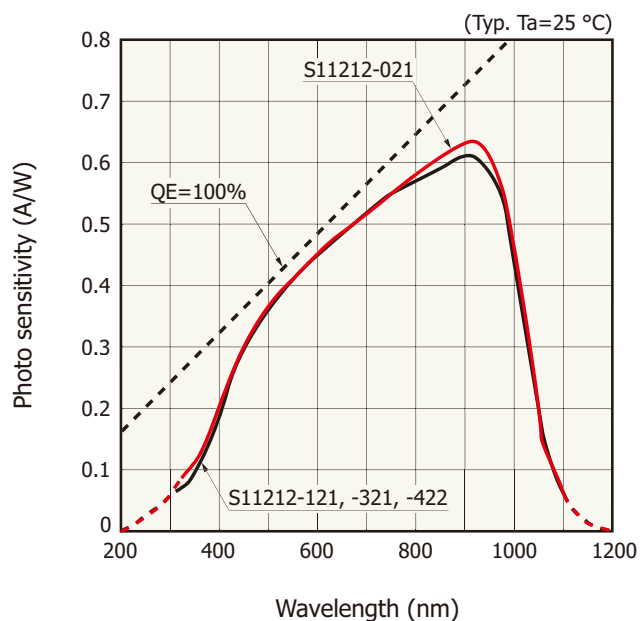
Electrical and optical characteristics ($T_a=25^\circ\text{C}$, per element, S11212-021 characteristics except X-ray sensitivity)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Spectral response range	λ		-	340 to 1100	-	nm
Peak sensitivity wavelength	λ_p		-	920	-	nm
Photosensitivity	S	$\lambda=540\text{ nm}$	380	420	460	mA/W
		$\lambda=\lambda_p$	550	610	670	
Short circuit current	I_{sc}	^{*4}	S11212-021 2.7	3.4	-	μA
X-ray sensitivity	I_{scX}	^{*5}	S11212-121	6.0	-	nA
			S11212-321	3.5	-	
			S11212-422	3.0	-	
Dark current	I_D	$V_R=10\text{ mV}$	-	5	30	pA
Rise time	t_r	$V_R=0\text{ V}$, $R_L=1\text{ k}\Omega$ 10 to 90%, $\lambda=658\text{ nm}$	-	6.5	-	μs
Terminal capacitance	C_t	$V_R=0\text{ V}$, $f=10\text{ kHz}$	30	40	50	pF

^{*4}: 100 lx, 2856 K

^{*5}: These are reference (X-ray tube voltage 120 kV, tube current 1.0 mA, aluminum filter $t=6\text{ mm}$, 830 mm). X-ray sensitivity depends on the X-ray equipment operating and setup conditions.

Spectral response (characteristics without scintillator)

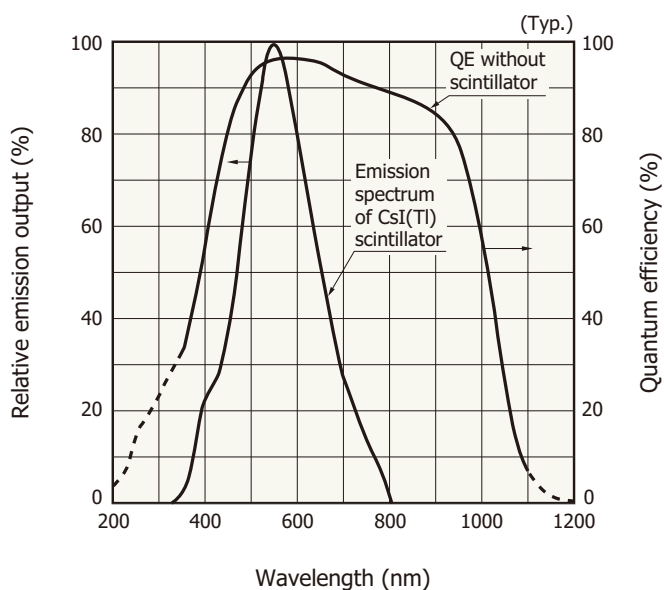


Spectral response characteristics of the S11212-121, -321, -422 include the transmittance and reflectance of the adhesive resin used to bond a scintillator.

KMPD80350EC

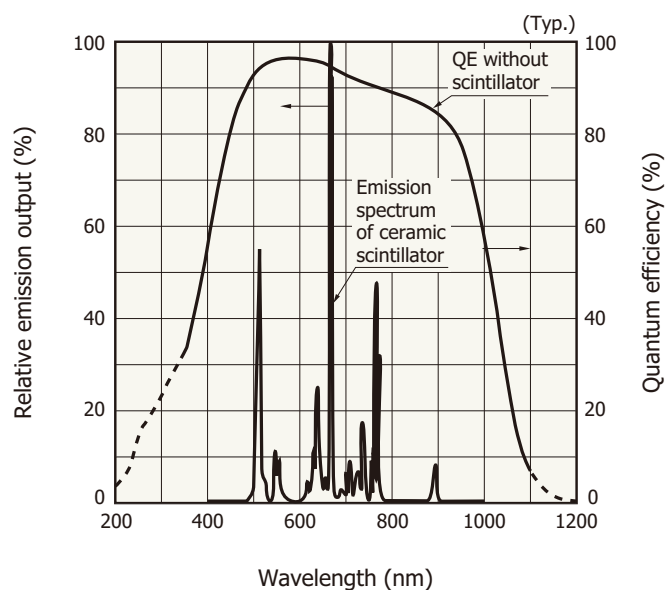
■ Emission spectrum of scintillator and spectral response

S11212-121



KSPD80282EE

S11212-321



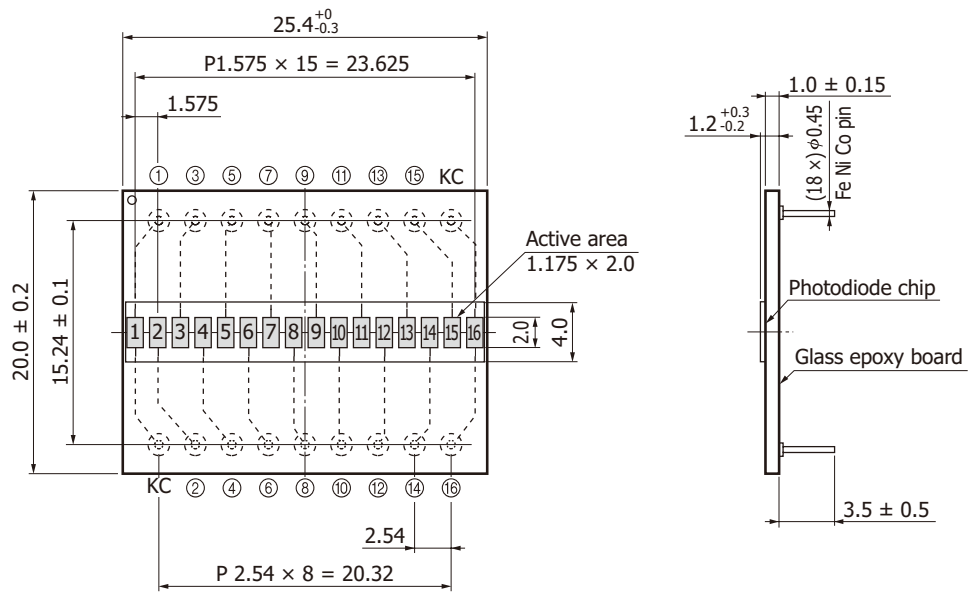
KSPD80281EE

■ Scintillator specifications

Parameter	Condition	CsI(Tl)	Ceramic	Unit
Peak emission wavelength		560	512	nm
X-ray absorption coefficient	100 keV	10	7	cm ⁻¹
Refractive index	at peak emission wavelength	1.7	2.2	-
Decay constant		1	3	μs
Afterglow	100 ms after X-ray turn off	0.3	0.01	%
Density		4.51	7.34	g/cm ³
Color		Transparent	Light yellow-green	-
Sensitivity non-uniformity		±10	±5	%

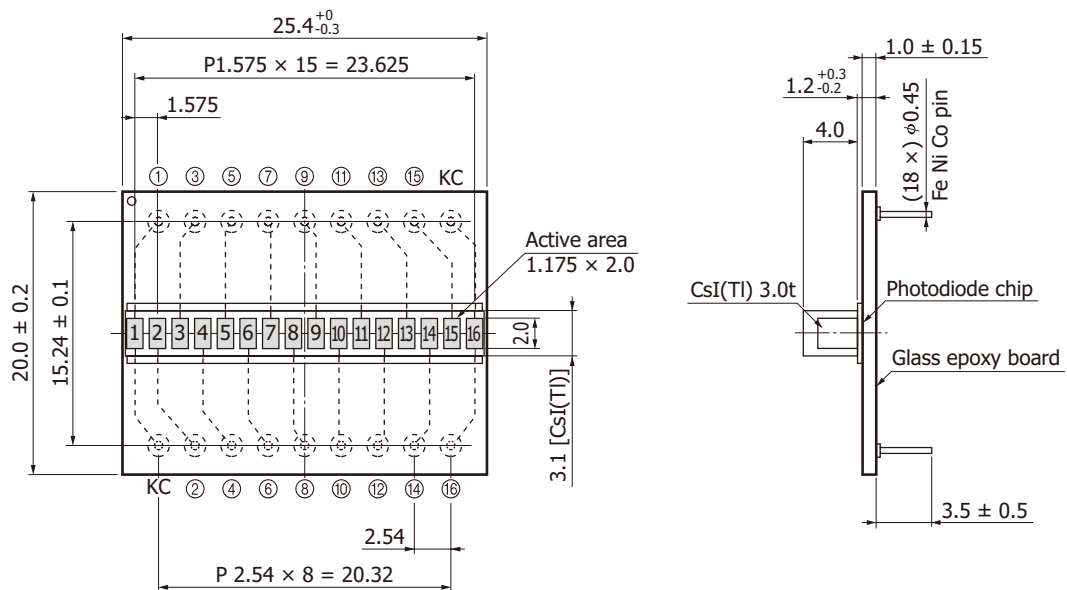
❖ Dimensional outlines (unit: mm, tolerance: ± 0.1 mm unless otherwise noted)

S11212-021



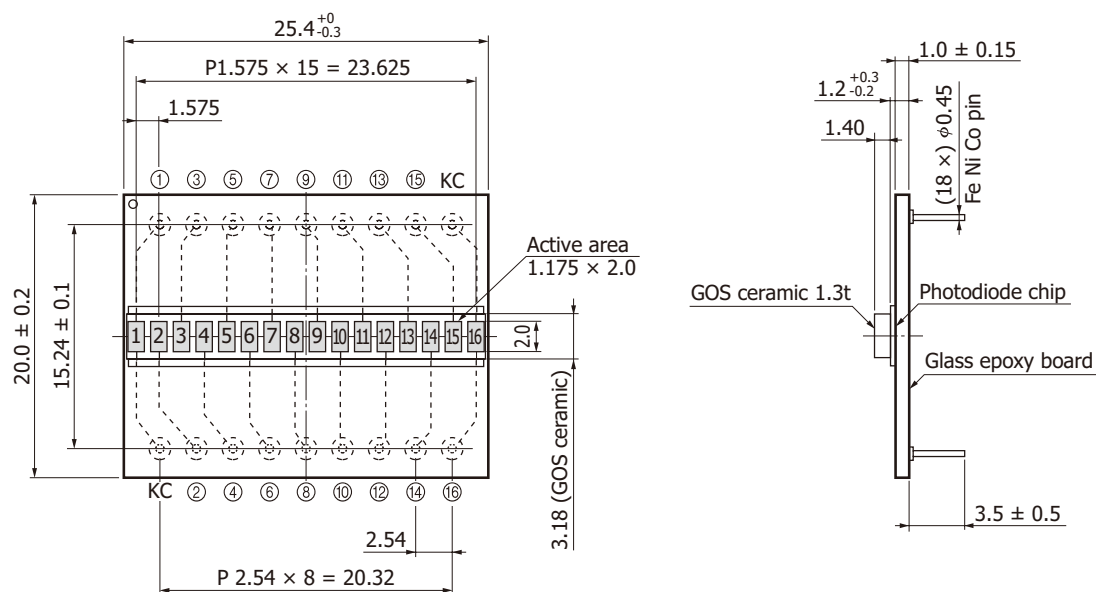
KMPDA0269EC

S11212-121



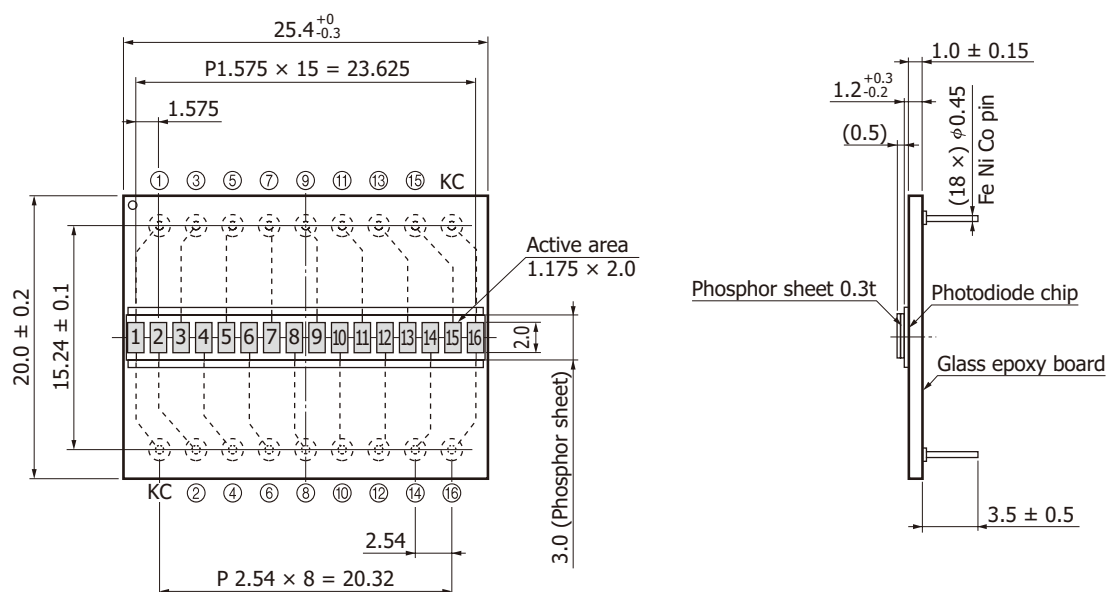
KMPDA0273EB

S11212-321



KMPDA0274EC

S11212-422



KMPDA0275ED

☐ Combination examples (for dual energy imaging)

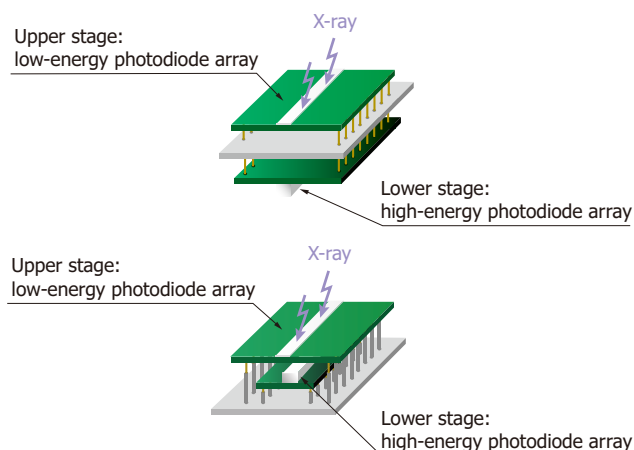
Dual energy imaging is a technique that acquires and superimposes two types of data in a single scan by using X-rays at two different energy levels (high energy and low energy). Two photodiode arrays with scintillators are used: one at the upper stage and the other at the lower stage. The upper stage is used for low energy detection, and the lower stage for high energy detection. Arranging two or more of these devices in a row also forms a line sensor for dual energy imaging.

① This combination uses the S11212 series in both upper and lower stages.

- [Upper stage] S11212-422 + [Lower stage] S11212-121
- [Upper stage] S11212-422 + [Lower stage] S11212-321

② This combination uses the S11212 series in the upper stage and the S11299 series in the lower stage

- [Upper stage] S11212-422 + [Lower stage] S11299-121
- [Upper stage] S11212-422 + [Lower stage] S11299-321



Note: For details on the S11299 series, refer to the S11299 series datasheet.

■ Related information

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

■ Precautions

- Disclaimer
- Precautions / Metal, ceramic, plastic package products

■ Catalog

- Technical note / Si photodiodes

Information described in this material is current as of November 2025.

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.