

S12023 series, etc.

**Low bias operation, for 800 nm band**

These are 800 nm band near-infrared Si APDs that can operate at low voltages, 200 V or less. They are suitable for applications such as FSO (free space optics) and optical rangefinders.

**Features**

- Stable operation at low bias
- High-speed response
- High sensitivity and low noise

**Applications**

- FSO
- Optical rangefinders

**Structure / Absolute maximum ratings**

Type no.	Dimensional outline/Window material*1	Package	Effective photosensitive area size*2 (mm)	Absolute maximum ratings		
				Operating temperature Topr (°C)	Storage temperature Tstg (°C)	Soldering conditions
S12023-02	(1)/K	TO-18	φ0.2	-20 to +85	-55 to +125	260 °C or less, within 10 s
S12023-05	(1)/K		φ0.5			
S12051	(2)/L					
S12086	(3)/L					
S12023-10	(1)/K		φ1.0			
S12023-10A*3	(1)/K					
S3884	(4)/K	TO-5	φ1.5			
S2384	(5)/K		φ3.0			
S2385	(6)/K	TO-8	φ5.0			

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.

\*1: K=borosilicate glass, L=lens type borosilicate glass

\*2: Photosensitive area in which a typical gain can be obtained

\*3: This is a variant of the S12023-10 in which the device chip is light-shielded by aluminum layer except for the photosensitive area.

### Electrical and optical characteristics (Typ. Ta=25 °C, unless otherwise noted)

Type no.	Spectral response range $\lambda$ (nm)	Peak <sup>*4</sup> sensitivity wavelength $\lambda_p$ (nm)	Photo-sensitivity S M=1 $\lambda=800$ nm (A/W)	Quantum efficiency QE M=1 $\lambda=800$ nm (%)	Breakdown voltage V <sub>BR</sub> I <sub>D</sub> =100 $\mu$ A		Temp. co-efficient of V <sub>BR</sub> (V/°C)	Dark <sup>*4</sup> current I <sub>D</sub>		Cutoff <sup>*4</sup> frequency f <sub>c</sub> R <sub>L</sub> =50 $\Omega$ (MHz)	Terminal <sup>*4</sup> capacitance C <sub>t</sub> (pF)	Excess <sup>*4</sup> noise figure x $\lambda=800$ nm	Gain M $\lambda=800$ nm								
					Typ. (V)	Max. (V)		Typ. (nA)	Max. (nA)												
S12023-02	400 to 1000	800	0.5	75	150	200	0.65	0.05	0.5	1000	1	0.3	100								
S12023-05								0.1	1	900	2										
S12051																					
S12086																					
S12023-10														0.2	2	600	6				
S12023-10A <sup>*3</sup>																					
S3884																		0.5	5	400	10
S2384																					
S2385	3	30	40	95	60																
													40								

\*4: Values measured at a gain listed in the characteristics table

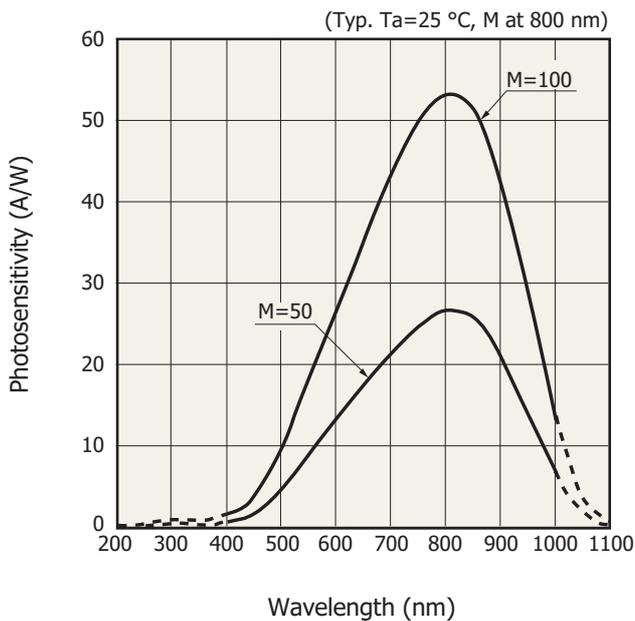
Note: Breakdown voltage can be specified by using the suffix of type number as examples shown below.

S12023-02-01: 80 to 120 V

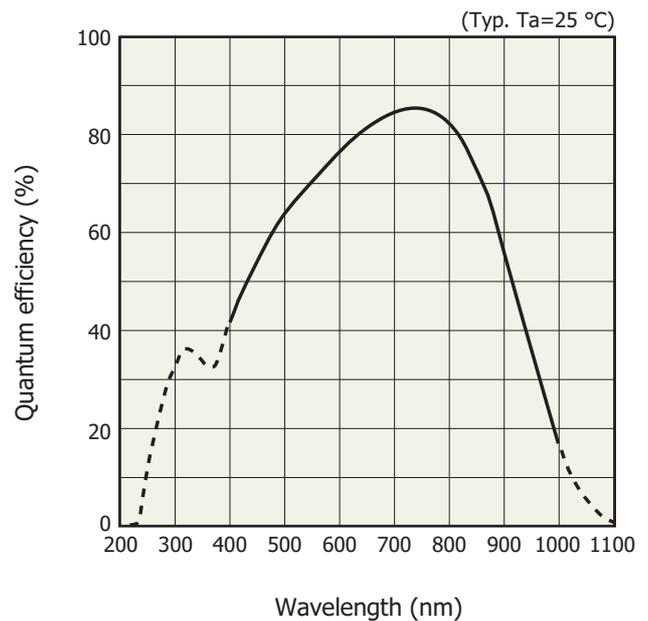
S12023-02-02: 120 to 160 V

S12023-02-03: 160 to 200 V

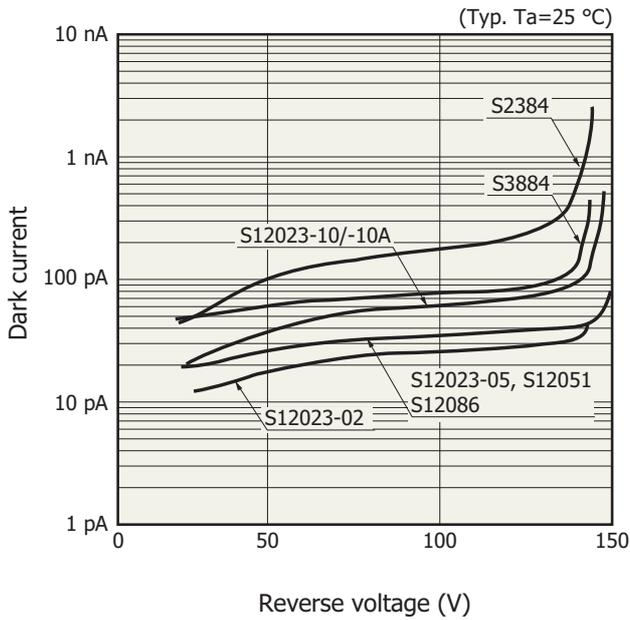
### Spectral response



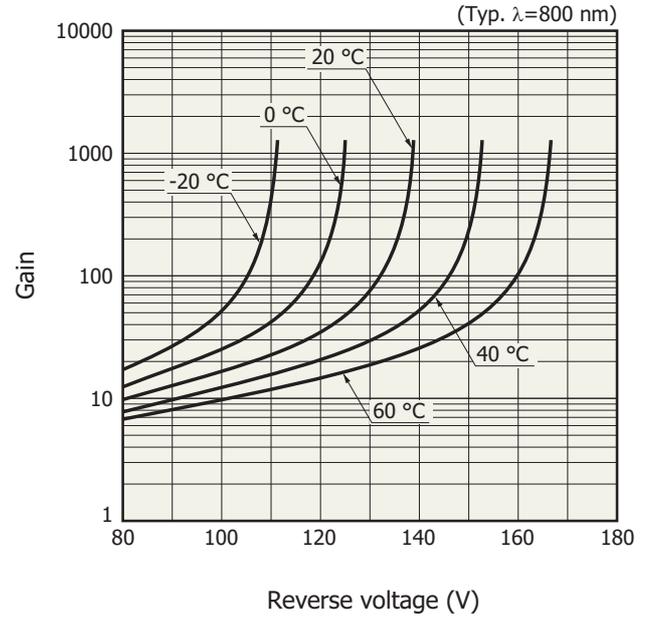
### Quantum efficiency vs. wavelength



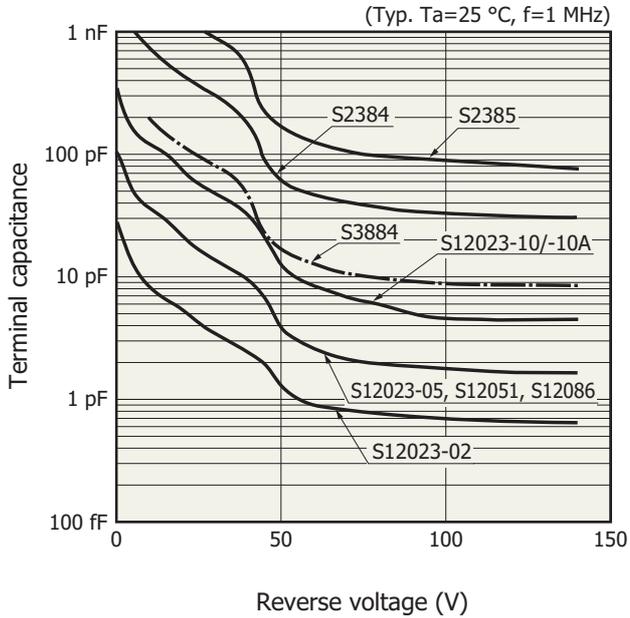
Dark current vs. reverse voltage



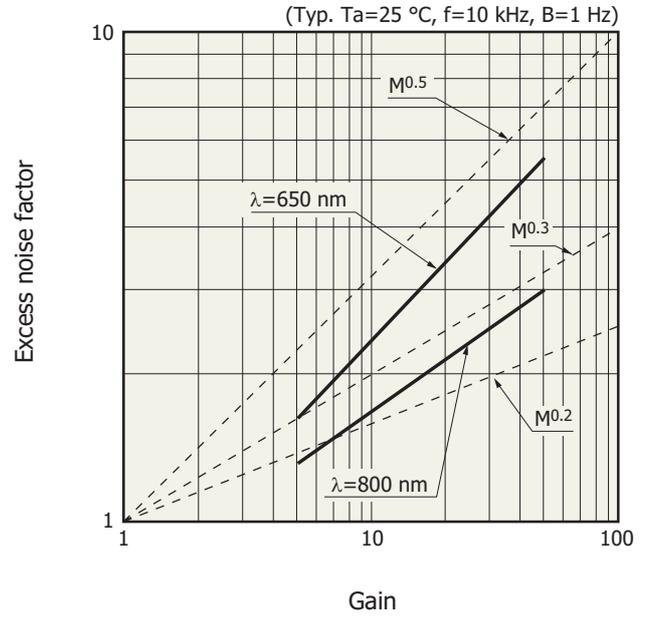
Gain vs. reverse voltage



Terminal capacitance vs. reverse voltage

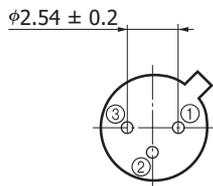
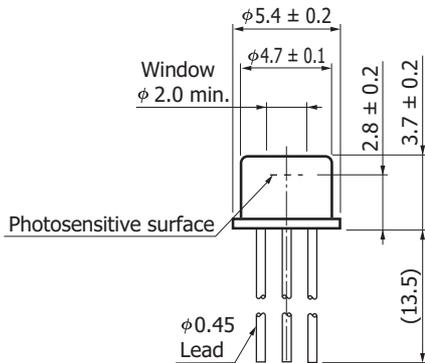


Excess noise factor vs. gain

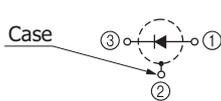


### Dimensional outlines (unit: mm)

(1) S12023-02/-05/-10/-10A



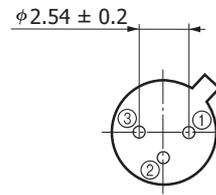
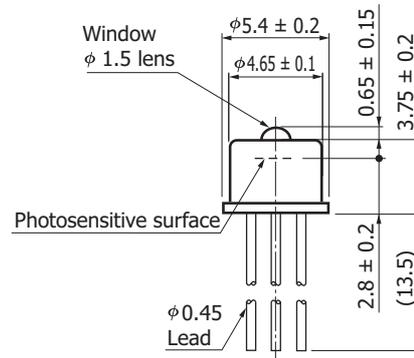
Distance from photosensitive area center to cap center  
 $-0.2 \leq X \leq +0.2$   
 $-0.2 \leq Y \leq +0.2$



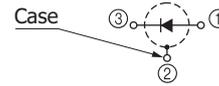
The glass window may extend a maximum of 0.2 mm above the upper surface of the cap.

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(2) S12051

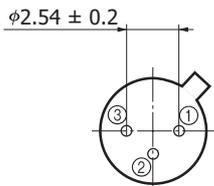
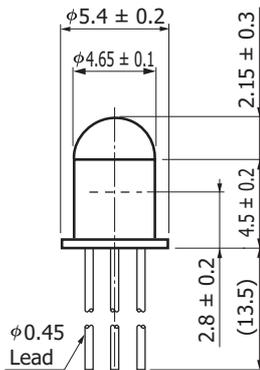


Distance from photosensitive area center to cap center  
 $-0.2 \leq X \leq +0.2$   
 $-0.2 \leq Y \leq +0.2$

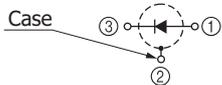


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(3) S12086

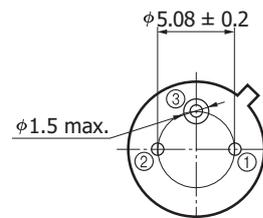
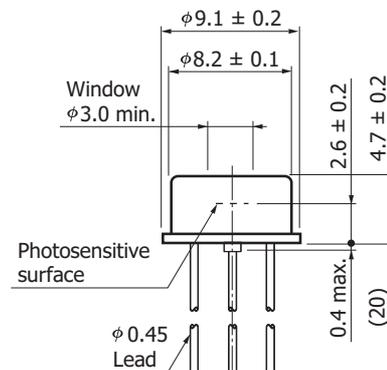


Distance from photosensitive area center to cap center  
 $-0.2 \leq X \leq +0.2$   
 $-0.2 \leq Y \leq +0.2$

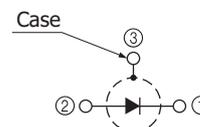


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(4) S3884

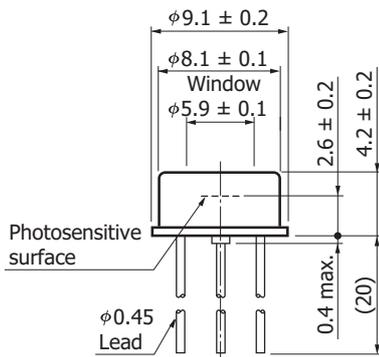


Distance from photosensitive area center to cap center  
 $-0.3 \leq X \leq +0.3$   
 $-0.3 \leq Y \leq +0.3$

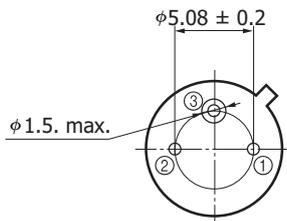
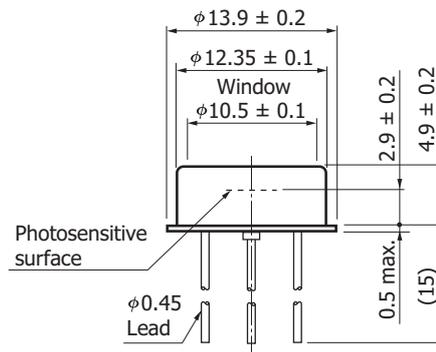


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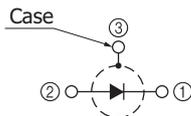
(5) S2384



(6) S2385

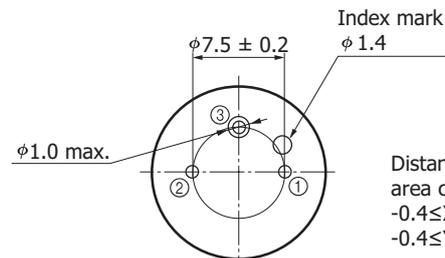


Distance from photosensitive area center to cap center  
 $-0.3 \leq X \leq +0.3$   
 $-0.3 \leq Y \leq +0.3$

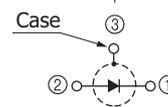


The glass window may extend a maximum of 0.2 mm above the upper surface of the cap.

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Distance from photosensitive area center to cap center  
 $-0.4 \leq X \leq +0.4$   
 $-0.4 \leq Y \leq +0.4$



The glass window may extend a maximum of 0.2 mm above the upper surface of the cap.

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## Replacements for previous products

Previous product (listed on the previous datasheet)*	Replacement (listed on this datasheet)
S2381	S12023-02
S2382	S12023-05
S5139	S12051
S8611	S12086
S2383	S12023-10
S2383-10	S12023-10A

\* Products that have been removed from this datasheet

## 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

### ■ Technical information

- Si APD

Information described in this material is current as of April 2018.

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.

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