

# Infrared Detectors

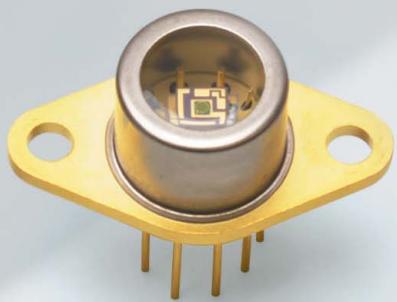
Covering a broad spectral range in the infrared region



■ InAsSb photovoltaic detector (with band-pass filter)  
P13243-016CF



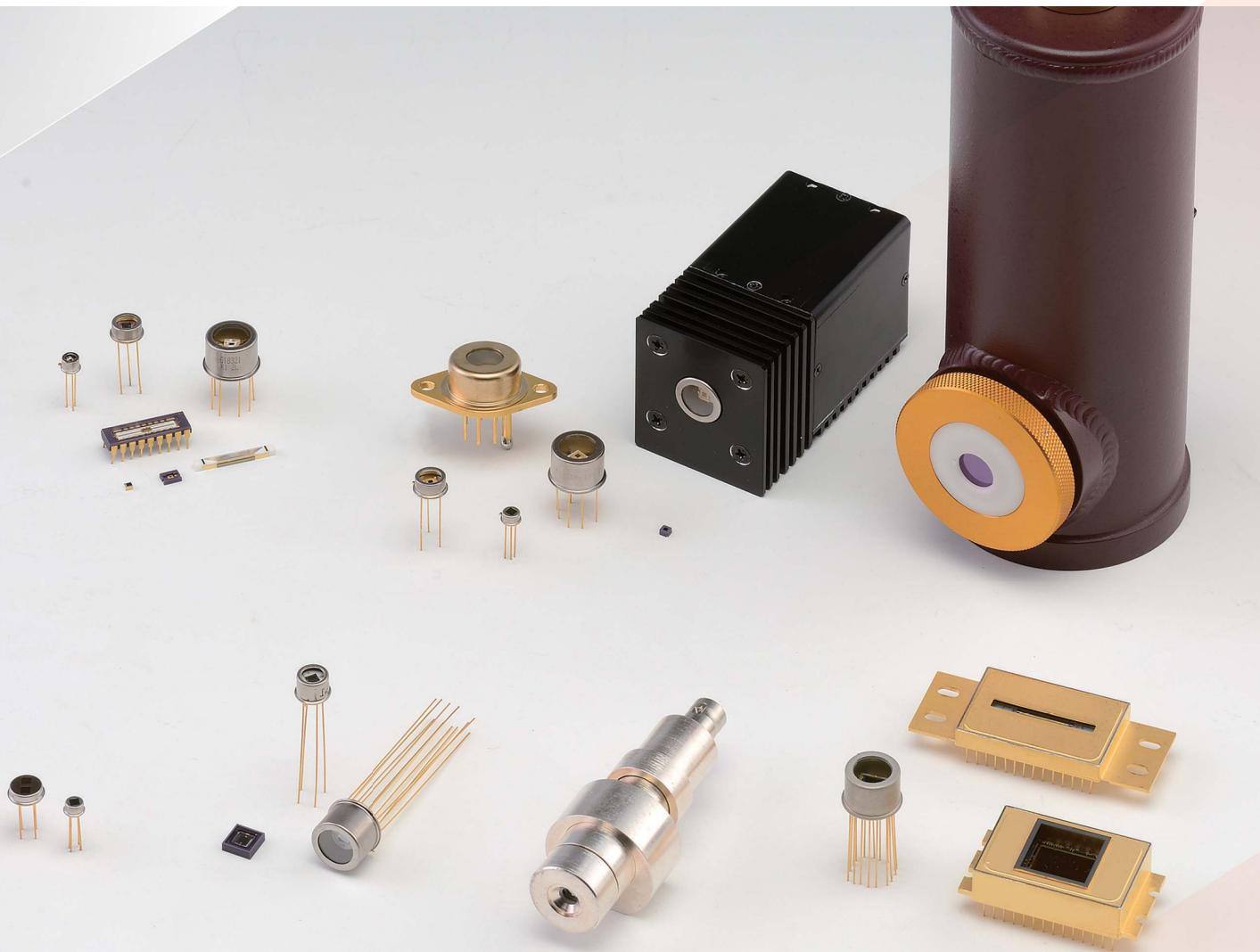
■ Type II superlattice infrared detector  
P15409-901



■ InGaAs PIN photodiode  
G12183-210KA-03

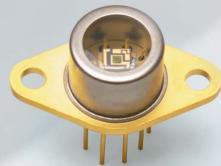
# Infrared detectors

Infrared detectors are widely used in diverse field including measurement, analysis, industry, communication, agriculture, medicine, physical and chemical science, astronomy and space. Based on long experience involving photonic technology, Hamamatsu provides a wide variety of infrared detectors in order to meet a large range of application needs. In addition to the standard devices listed in this catalog, custom devices are also available on request. Please feel free to contact the nearest sales office in your area.



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# Infrared detectors

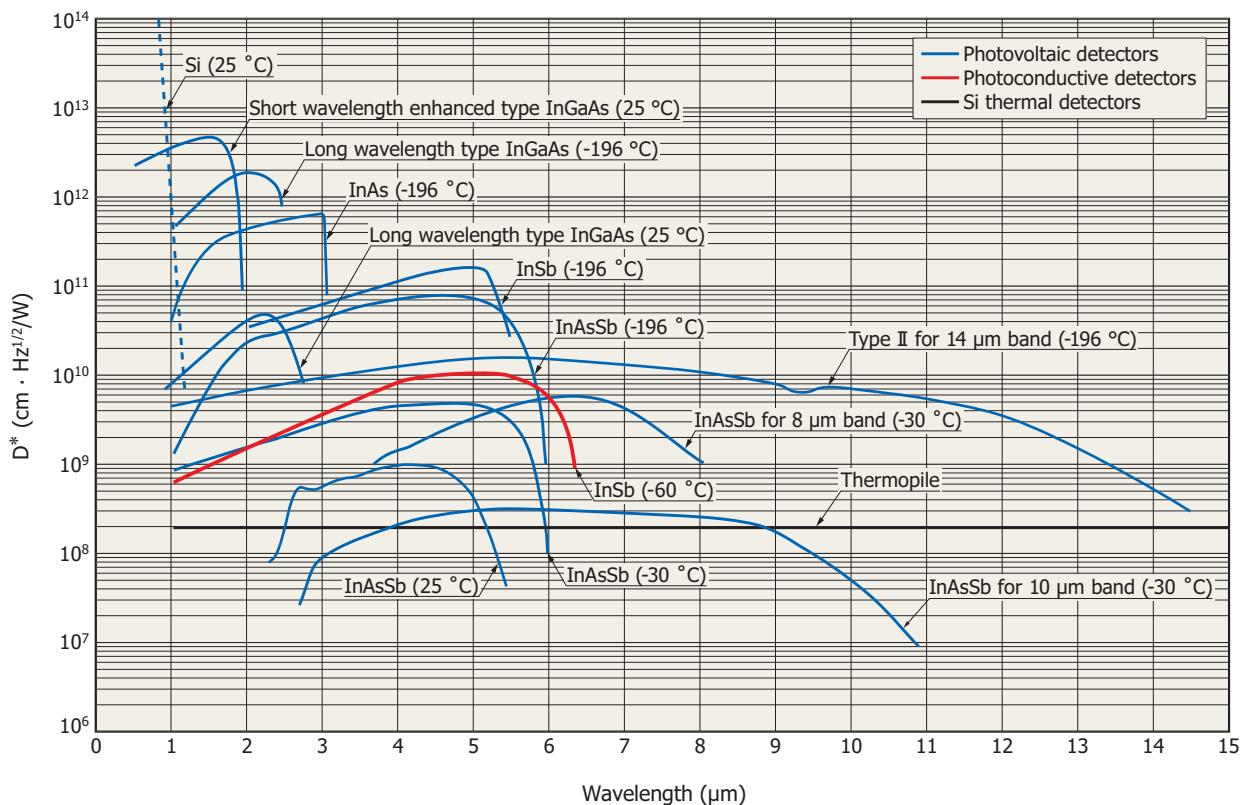
## Hamamatsu infrared detectors

Product name	Spectral response range (μm)	Features	Page
InGaAs PIN photodiodes	0.5 – 1.7	<ul style="list-style-type: none"> <li>Short wavelength enhanced type</li> <li>Can detect light from 0.5 μm</li> </ul>	5
	0.9 – 1.7	<ul style="list-style-type: none"> <li>Standard type</li> <li>High-speed response, high sensitivity, low dark current</li> <li>Available with various photosensitive areas, arrays, and packages</li> </ul>	5, 6, 10
	0.9 – 1.9	<ul style="list-style-type: none"> <li>For optical measurement around 1.7 μm</li> <li>TE-cooled type available</li> </ul>	7
	0.9 – 2.1	<ul style="list-style-type: none"> <li>For optical measurement in the band of water content absorption (1.9 μm)</li> <li>TE-cooled type available</li> </ul>	7
	0.9 – 2.6	<ul style="list-style-type: none"> <li>For NIR spectroscopy</li> <li>TE-cooled type available</li> </ul>	8
InGaAs APD	0.9 – 1.7	<ul style="list-style-type: none"> <li>High sensitivity and low dark current</li> </ul>	9
InGaAs linear image sensors	0.5 – 2.55	<ul style="list-style-type: none"> <li>Timing generator incorporated</li> <li>Gain switching</li> <li>Available with various photosensitive areas, spectral response ranges, numbers of pixels, TE-coolers, and packages</li> <li>TE-cooled type available</li> </ul>	11, 12
InGaAs area image sensors	0.9 – 2.55	<ul style="list-style-type: none"> <li>Timing generator incorporated</li> <li>TE-cooled type</li> <li>Low-density pixel (64x64) to high-density pixel (VGA) formats available</li> </ul>	13

Product name	Spectral response range (μm)	Features	Page
InAs photovoltaic detectors	1 – 3.8	<ul style="list-style-type: none"> <li>Covers a spectral response range close to PbS but offers higher response speed</li> </ul>	14
InSb photovoltaic detectors	1 – 5.5	<ul style="list-style-type: none"> <li>High-speed and high sensitivity in so-called atmospheric window (3 to 5 μm)</li> </ul>	15
InSb photoconductive detectors	1 – 6.7	<ul style="list-style-type: none"> <li>Detects wavelengths up to around 6.5 μm, with high sensitivity over long periods by thermoelectric cooling</li> </ul>	15
InAsSb photovoltaic detectors	1 – 11	<ul style="list-style-type: none"> <li>Infrared detectors in the 5 μm, 8 μm, or 10 μm spectral band</li> <li>High-speed response</li> <li>High reliability</li> </ul>	17
Type II superlattice infrared detector	1 – 14.5	<ul style="list-style-type: none"> <li>InAs and GaSb superlattice structure enables the detection up to around 14.5 μm</li> </ul>	20
Thermopile detectors	1 – 25	<ul style="list-style-type: none"> <li>Sensors that generate thermoelectromotive force in proportion to the energy level of incident infrared light</li> </ul>	21
Two-color detectors	Si + InGaAs 0.32 – 2.6	<ul style="list-style-type: none"> <li>Wide spectral response range</li> <li>Uses two detectors with different spectral response ranges, mounted one over the other along the same optical axis</li> </ul>	22, 23
	Si + InAsSb 0.32 – 5.3		
	InGaAs + InGaAs 0.9 – 2.55		
Photon drag detector	10	<ul style="list-style-type: none"> <li>High-speed detector with high sensitivity in 10 μm band (for CO<sub>2</sub> laser detection)</li> <li>Room temperature operation with high-speed response</li> </ul>	25

For detailed information on the products listed in this catalog, see their datasheets that are available from our website [www.hamamatsu.com](http://www.hamamatsu.com)

## ● Spectral response of Hamamatsu infrared detectors (typical example)



When using infrared detectors, the following points should be taken into consideration for making a device selection.

### • Spectral response

As can be seen from the figure above, Hamamatsu provides a variety of infrared detectors with different spectral response characteristics. It should be noted that cooling a detector element may affect its spectral response. For InGaAs, InAs, InSb and InAsSb detectors, the spectral response shifts to the shorter wavelength side.

### • Response speed

Various detectors are available with different response speeds.

### • Photosensitive area and number of elements

Hamamatsu photosensors are available in a wide range of photosensitive area sizes. Also available are multi-element detector arrays optimized for high-speed multichannel spectrophotometry.

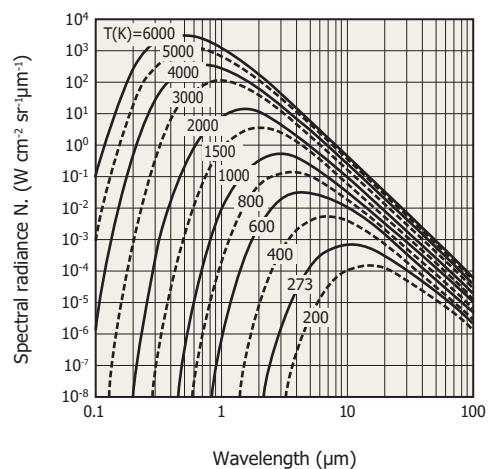
### • Cooling

Besides easy-to-use photosensors designed for room temperature, Hamamatsu provides various types of sensors that are cooled with thermoelectric coolers, cryogenic dewars (for liquid nitrogen cooling).

### • Object temperature

When selecting a detector in accordance with the temperature of an object, it is necessary to consider the distribution of the energy (the wavelength dependency of the energy) radiated from the object. When the temperature of the object is changed, the distribution of the radiating energy is given by the law of black body radiation (Planck's law), as shown in the figure at the right-hand side. The following relationship is established by the peak sensitivity wavelength  $\lambda_p$  (μm) and the absolute temperature T (K).

## ● Law of black body radiation (Planck's law)



# InGaAs PIN photodiodes

## Short wavelength enhanced type

Type no.	Cooling	Photosensitive area (mm)	Spectral response range $\lambda$ ( $\mu\text{m}$ )	Peak sensitivity wavelength $\lambda_p$ ( $\mu\text{m}$ )	Cutoff frequency $f_c$ $V_R=1 \text{ V}$ (MHz)	Package	Photo	Option (sold separately)	
G10899-003K	Non-cooled	φ0.3	0.5 to 1.7	1.55	300	TO-18		C4159-03 (P.21)	
G10899-005K		φ0.5			150				
G10899-01K		φ1			45				
G10899-02K		φ2			10	TO-5			
G10899-03K		φ3			5				

## Standard type

### Metal package

Various photosensitive area sizes are available.

(Typ.  $T_a=25 \text{ }^\circ\text{C}$ , unless otherwise noted)

Type no.	Cooling	Photosensitive area (mm)	Spectral response range $\lambda$ ( $\mu\text{m}$ )	Peak sensitivity wavelength $\lambda_p$ ( $\mu\text{m}$ )	Cutoff frequency $f_c$ ( $V_R=1 \text{ V}$ ) (MHz)	Package	Photo	Option (sold separately)	
G12180-003A	Non-cooled	φ0.3	0.9 to 1.7	1.55	600 ( $V_R=5 \text{ V}$ )	TO-18		C4159-03 (P.21)	
G12180-005A		φ0.5			200 ( $V_R=5 \text{ V}$ )				
G12180-010A		φ1			60 ( $V_R=5 \text{ V}$ )				
G12180-020A		φ2			13 ( $V_R=1 \text{ V}$ )	TO-5			
G12180-030A		φ3			7 ( $V_R=1 \text{ V}$ )				
G12180-050A		φ5			3 ( $V_R=1 \text{ V}$ )	TO-8			
G8370-81*		φ1			35 ( $V_R=1 \text{ V}$ )	TO-18			
G8370-82*		φ2			4 ( $V_R=1 \text{ V}$ )	TO-5			
G8370-83*		φ3			2 ( $V_R=1 \text{ V}$ )				
G8370-85*		φ5			0.6 ( $V_R=1 \text{ V}$ )	TO-8			
G12180-110A	One-stage TE-cooled ( $T_{chip}=-10 \text{ }^\circ\text{C}$ )	φ1	0.9 to 1.67	1.55	40 ( $V_R=1 \text{ V}$ )	TO-8		C4159-03 (P.21) A3179 (P.19) C1103-04 (P.18)	
G12180-120A		φ2			13 ( $V_R=1 \text{ V}$ )				
G12180-130A		φ3			7 ( $V_R=1 \text{ V}$ )				
G12180-150A		φ5			3 ( $V_R=1 \text{ V}$ )				
G12180-210A	Two-stage TE-cooled ( $T_{chip}=-20 \text{ }^\circ\text{C}$ )	φ1	0.9 to 1.65	1.55	40 ( $V_R=1 \text{ V}$ )			C4159-03 (P.21) A3179-01 (P.19) C1103-04 (P.18)	
G12180-220A		φ2			13 ( $V_R=1 \text{ V}$ )				
G12180-230A		φ3			7 ( $V_R=1 \text{ V}$ )				
G12180-250A		φ5			3 ( $V_R=1 \text{ V}$ )				
G6854-01	Non-cooled	φ0.08	0.9 to 1.7	2000 ( $V_R=5 \text{ V}$ )	TO-18 with CD lens		—	—	

\* Low PDL (polarization dependent loss) type



## Ceramic package

Type no.	Photosensitive area (mm)	Spectral response range $\lambda$ ( $\mu\text{m}$ )	Peak sensitivity wavelength $\lambda_p$ ( $\mu\text{m}$ )	Photosensitivity S $\lambda=\lambda_p$ (A/W)	Cutoff frequency $f_c$ $V_R=0 \text{ V}$ (MHz)	Photo
G8370-10	$\phi 10$	0.9 to 1.7	1.55	1.0	0.1	

(Typ.  $T_a=25 \text{ }^\circ\text{C}$ )

## Surface mount type

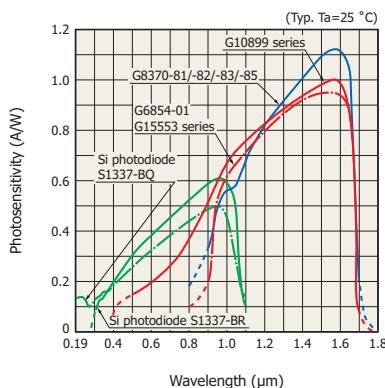
(Typ.  $T_a=25 \text{ }^\circ\text{C}$ )

Type no.	Photosensitive area (mm)	Spectral response range $\lambda$ ( $\mu\text{m}$ )	Peak sensitivity wavelength $\lambda_p$ ( $\mu\text{m}$ )	Cutoff frequency $f_c$ $V_R=5 \text{ V}$ (MHz)	Package	Photo
NEW G15553-003C	$\phi 0.3$	0.9 to 1.7	1.55	600	Ceramic (non-sealed)	
NEW G15553-005C	$\phi 0.5$			200		
NEW G15553-010C	$\phi 1$			60		
G11193-02R	$\phi 0.2$			1000	Ceramic	
G11193-03R	$\phi 0.3$			500		
G11193-10R	$\phi 1$			60		
G13176-003P	$\phi 0.3$			600	Plastic COB	
G13176-010P	$\phi 1$			60		
G14448-003L	$\phi 0.3$			600	Plastic COB with lens	

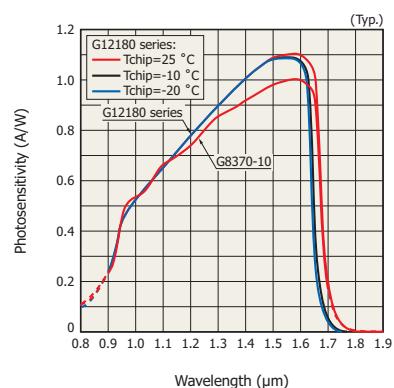
(Typ.  $T_a=25 \text{ }^\circ\text{C}$ )

## Spectral response

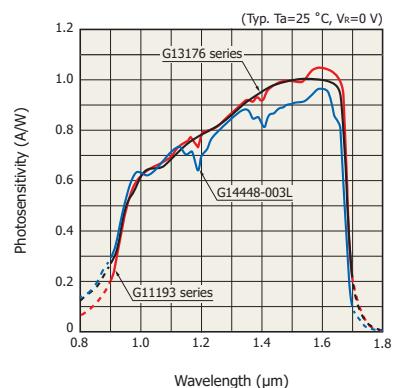
### [ G10899 series, etc. ]



### [ G12180 series, G8370-10 ]



### [ G11193/G13176 series/G14448-003L ]



## Long wavelength type

### Peak sensitivity wavelength: 1.75 μm

These are suitable for optical measurement around 1.7 μm.

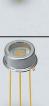
(Typ. Ta=25 °C, unless otherwise noted)

Type no.	Cooling	Photosensitive area (mm)	Spectral response range λ (μm)	Peak sensitivity wavelength λ <sub>p</sub> (μm)	Cutoff frequency f <sub>c</sub> V <sub>R</sub> =0 V (MHz)	Package	Photo	Option (sold separately)	
G12181-003K	Non-cooled	φ0.3	0.9 to 1.9		90	TO-18		C4159-03 (P21)	
G12181-005K		φ0.5			35				
G12181-010K		φ1			10				
G12181-020K		φ2			2.5	TO-5			
G12181-030K		φ3			1.5				
G12181-103K	One-stage TE-cooled (T <sub>chip</sub> =-10 °C)	φ0.3	0.9 to 1.87	1.75	140	TO-8		C4159-03 (P21) A3179 (P19) C1103-04 (P18)	
G12181-105K		φ0.5			50				
G12181-110K		φ1			16				
G12181-120K		φ2			3.5				
G12181-130K		φ3			1.8				
G12181-203K	Two-stage TE-cooled (T <sub>chip</sub> =-20 °C)	φ0.3	0.9 to 1.85		150	TO-8		C4159-03 (P21) A3179-01 (P19) C1103-04 (P18)	
G12181-205K		φ0.5			53				
G12181-210K		φ1			17				
G12181-220K		φ2			3.7				
G12181-230K		φ3			1.9				

### Peak sensitivity wavelength: 1.95 μm

These are suitable for optical measurement in the 1.9 μm band such as water absorption.

(Typ. Ta=25 °C, unless otherwise noted)

Type no.	Cooling	Photosensitive area (mm)	Spectral response range λ (μm)	Peak sensitivity wavelength λ <sub>p</sub> (μm)	Cutoff frequency f <sub>c</sub> V <sub>R</sub> =0 V (MHz)	Package	Photo	Option (sold separately)	
G12182-003K	Non-cooled	φ0.3	0.9 to 2.1		90	TO-18		C4159-03 (P21)	
G12182-005K		φ0.5			35				
G12182-010K		φ1			10				
G12182-020K		φ2			2.5	TO-5			
G12182-030K		φ3			1.5				
G12182-103K	One-stage TE-cooled (T <sub>chip</sub> =-10 °C)	φ0.3	0.9 to 2.07	1.95	140	TO-8		C4159-03 (P21) A3179 (P19) C1103-04 (P18)	
G12182-105K		φ0.5			50				
G12182-110K		φ1			16				
G12182-120K		φ2			3.5				
G12182-130K		φ3			1.8				
G12182-203K	Two-stage TE-cooled (T <sub>chip</sub> =-20 °C)	φ0.3	0.9 to 2.05		150	TO-8		C4159-03 (P21) A3179-01 (P19) C1103-04 (P18)	
G12182-205K		φ0.5			53				
G12182-210K		φ1			17				
G12182-220K		φ2			3.7				
G12182-230K		φ3			1.9				



## Peak sensitivity wavelength: 2.3 μm

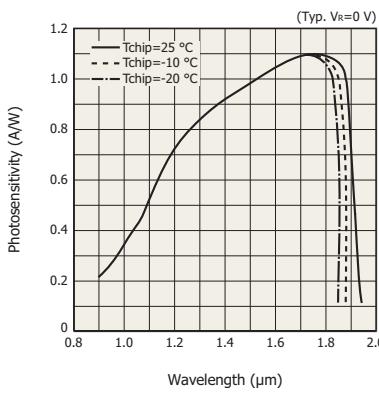
These are suitable for use in NIR (near infrared) spectroscopy.

(Typ. Ta=25 °C, unless otherwise noted)

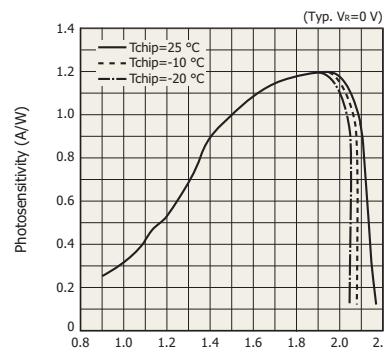
Type no.	Cooling	Photosensitive area (mm)	Spectral response range $\lambda$ (μm)	Peak sensitivity wavelength $\lambda_p$ (μm)	Cutoff frequency $f_c$ $V_R=0$ V (MHz)	Package	Photo	Option (sold separately)	
G12183-003K	Non-cooled	φ0.3	0.9 to 2.6	2.3	50	TO-18		C4159-03 (P.21)	
G12183-005K		φ0.5			20				
G12183-010K		φ1			6				
G12183-020K		φ2			1.5	TO-5			
G12183-030K		φ3			0.8				
G12183-103K	One-stage TE-cooled ( $T_{chip}=-10$ °C)	φ0.3	0.9 to 2.57	2.3	70	TO-8		C4159-03 (P.21) A3179 (P.19) C1103-04 (P.18)	
G12183-105K		φ0.5			25				
G12183-110K		φ1			7				
G12183-120K		φ2			2				
G12183-130K		φ3			0.9				
G12183-203K	Two-stage TE-cooled ( $T_{chip}=-20$ °C)	φ0.3	0.9 to 2.55	2.3	75	TO-8		C4159-03 (P.21) A3179-01 (P.19) C1103-04 (P.18)	
G12183-205K		φ0.5			28				
G12183-210K		φ1			8				
G12183-220K		φ2			2.3				
G12183-230K		φ3			1				
NEW G12183-210KA-03		φ1			4	TO-66			

## Spectral response

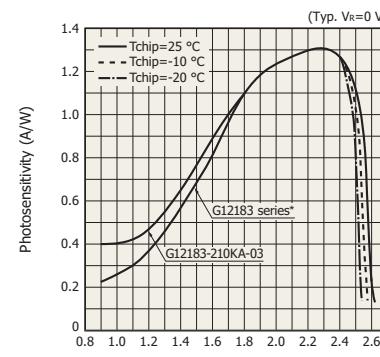
[ G12181 series ]



[ G12182 series ]



[ G12183 series ]



\* Excluding G12183-210KA-03

KIRDB0491EE

## InGaAs APD

The G14858-0020A is used for distance measurement, low-light-level detection, and so on.

(Typ.)

Type no.	Photosensitive area (mm)	Spectral response range ( $\mu\text{m}$ )	Breakdown voltage max. $I_D=100 \mu\text{A}$ (V)	Temperature coefficient of breakdown voltage ( $\text{V}/^\circ\text{C}$ )	Cutoff frequency $R_L=50 \Omega$ (MHz)	Terminal capacitance (pF)	Gain $\lambda=1.55 \mu\text{m}$	Photo
G14858-0020AA	$\phi 0.2$	0.95 to 1.7	80	0.1	900	2.0	30	

## Infrared detector modules with preamp

These modules consist of the InGaAs PIN photodiode assembled with matched preamplifier, and operate by connecting a DC power supply.

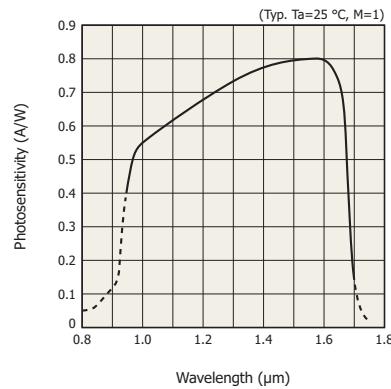
(Typ.)

Type no.	Detector	Cooling (Measurement condition)	Photosensitive area (mm)	Cutoff wavelength $\lambda_c$ ( $\mu\text{m}$ )	Peak sensitivity wavelength $\lambda_p$ ( $\mu\text{m}$ )	Photosensitivity S $\lambda=\lambda_p$ (V/W)	Photo
C10439-10	G10899-01K	Non-cooled ( $T_a=25^\circ\text{C}$ )	$\phi 1$	1.70	1.55	$1 \times 10^6$	
C10439-11	G10899-03K		$\phi 3$				
C12483-250	G12180-250A	TE-cooled ( $T_{\text{chip}}=-15^\circ\text{C}$ )	$\phi 5$	1.66	1.55	$5 \times 10^7$	
C12485-210	G12182-210K		$\phi 1$	2.05	1.95	$1.8 \times 10^8$	
C12486-210	G12183-210K			2.56	2.3	$2 \times 10^8$	
G7754-01	G12183-010 (chip)	Liquid nitrogen ( $T_{\text{chip}}=-196^\circ\text{C}$ )	$\phi 1$	2.4	2.0	$2 \times 10^9$	
G7754-03	G12183-030 (chip)		$\phi 3$			$5 \times 10^8$	

Note: A power supply cable is included

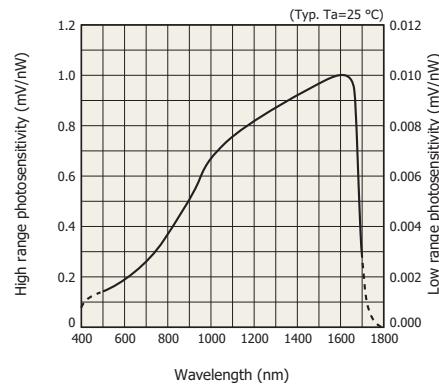
## Spectral response

[ G14858-0020AA ]



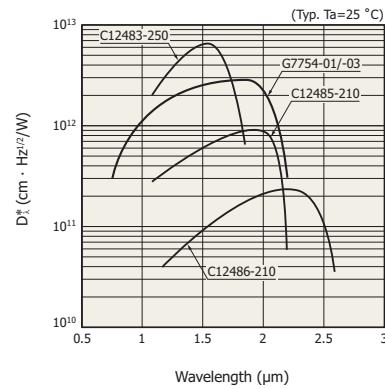
KAPDB0417EA

[ C10439-10/-11 ]



KACCB0348EB

[ C12483-250, C12485-210, C12486-210, G7754-01/-03 ]



KIRDB0369EH



## InGaAs PIN photodiode arrays

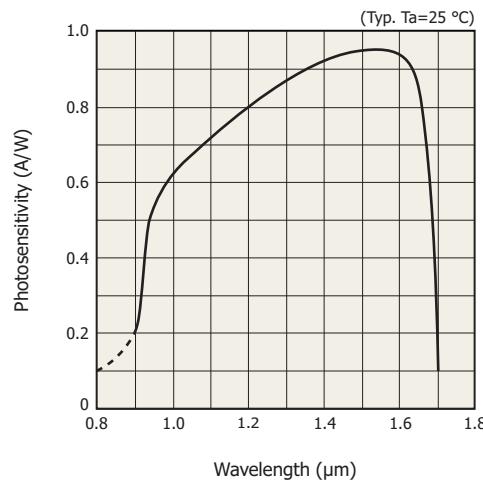
4 segmented type and 16-element, 32-element, 40-element, and 46-element arrays are available.

(Typ. Ta=25 °C)

Type no.	Photosensitive area (mm)	Spectral response range $\lambda$ ( $\mu\text{m}$ )	Peak sensitivity wavelength $\lambda_p$ ( $\mu\text{m}$ )	Package	Photo
G6849-01	$\phi 1$ (Quadrant element)	0.9 to 1.7	1.55	TO-5	
G6849	$\phi 2$ (Quadrant element)				
G7151-16	$0.08 \times 0.2$ (16-element)	0.9 to 1.7	1.55	Ceramic	
G12430-016D	$0.45 \times 1.0$ (16-element)				
G12430-032D	$0.2 \times 1.0$ (32-element)				
G12430-046D	$0.2 \times 1.0$ (46-element)				
G8909-01	$\phi 0.08$ (40-element)			Ceramic (Non-sealed)	

## Spectral response

### [ InGaAs photodiode arrays ]

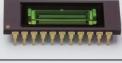


KIRDB0002EB

# InGaAs image sensors

## InGaAs linear image sensors for spectrometry

### Front-illuminated type

Type no.	Cooling	Pixel height (μm)	Pixel pitch (μm)	Number of pixels	Line rate (lines/s)	Spectral response range $\lambda$ (μm)	Defective pixels	Photo	Dedicated driver circuit <sup>*1</sup>	
G9203-256D	Non-cooled	500	50	256	1910	0.9 to 1.7	0		—	
G9204-512D			25	512	960 <sup>*2</sup>					
G11608-256DA			50	256	17200	0.5 to 1.7	1% max.			
G11608-512DA			25	512	9150 <sup>*2</sup>					
G11508-256SA	One-stage TE-cooled (Tchip=-10 °C)	500	50	256	17200	0.9 to 1.67	0		C16091-08 <sup>*3</sup>	
G11508-512SA			25	512	9150 <sup>*2</sup>				C16091-09 <sup>*3</sup>	
G11475-256WB	Two-stage TE-cooled (Tchip=-20 °C)	250	50	256	17200	0.9 to 1.85	5% max.		C16091-01 <sup>*3</sup>	
G11476-256WB						0.9 to 2.05			C16091-03 <sup>*3</sup>	
G11477-256WB						0.9 to 2.15			C16091-04 <sup>*3</sup>	
G11478-256WB						0.9 to 2.55			C16091-06 <sup>*3</sup>	
G11475-512WB		25	25	512	9150 <sup>*2</sup>	0.9 to 1.85	4% max.		C16091-02 <sup>*3</sup>	
G11477-512WB						0.9 to 2.15			C16091-05 <sup>*3</sup>	
G11478-512WB						0.9 to 2.55			C16091-07 <sup>*3</sup>	
G14237-512WA			500			0.85 to 1.4	1% max.		C16091-10 <sup>*3</sup>	

### Back-illuminated type

Type no.	Cooling	Pixel height (μm)	Pixel pitch (μm)	Number of pixels	Line rate (lines/s)	Spectral response range $\lambda$ (μm)	Defective pixels	Photo	Dedicated driver circuit <sup>*1</sup>
G11620-128DA	Non-cooled	500	50	128	30800	0.95 to 1.7	1% max.		C11513
G11620-256DA				256	17200				
G11620-256DF			25	256	17200				
G11620-512DA				512	9150				
G13913-128FB	Non-cooled	250	50	128	13600	0.95 to 1.7	1% max.		—
G13913-256FG			25	256	7290				
G11620-256SA	One-stage TE-cooled (Tchip=-10 °C)	500	50	256	17200	0.95 to 1.67	1% max.		C16091-11 <sup>*3</sup>
G11620-512SA			25	512	9150				C16091-12 <sup>*3</sup>
G12230-512WB	Two-stage TE-cooled (Tchip=-20 °C)	250	25	512	9150	0.95 to 2.15	2% max.		C16091-13 <sup>*3</sup>

\*1: Sold separately

\*2: When two video lines are used for readout, the line rate is equal to that for 256 channels.

\*3: With sensor



## High-speed type InGaAs linear image sensors

### Front-illuminated type

These are linear image sensors with high-speed data rate designed for industrial measuring instruments.

Type no.	Cooling	Pixel height ( $\mu\text{m}$ )	Pixel pitch ( $\mu\text{m}$ )	Number of pixels	Line rate (lines/s)	Spectral response range $\lambda$ ( $\mu\text{m}$ )	Defective pixels	Photo	Dedicated driver circuit <sup>*4</sup>
G9494-256D	Non-cooled	50	50	256	7100	0.9 to 1.7	1% max.		C10820
G9494-512D		25	25	512	3720 <sup>*5</sup>				

This is a 1024-pixel, high-speed linear image sensor designed for foreign object screening and medical diagnosis equipment where a multichannel high-speed line rate is required.

Type no.	Cooling	Pixel height ( $\mu\text{m}$ )	Pixel pitch ( $\mu\text{m}$ )	Number of pixels	Line rate (lines/s)	Spectral response range $\lambda$ ( $\mu\text{m}$ )	Defective pixels	Photo	Dedicated driver circuit <sup>*4</sup>
G10768-1024D	Non-cooled	100	25	1024	39000	0.9 to 1.7	1% max.		C10854
G10768-1024DB		25							

### Back-illuminated type

The back-illuminated InGaAs photodiode and CMOS-ROIC are bump bonded to provide a single output terminal.

Type no.	Cooling	Pixel height ( $\mu\text{m}$ )	Pixel pitch ( $\mu\text{m}$ )	Number of pixels	Line rate (lines/s)	Spectral response range $\lambda$ ( $\mu\text{m}$ )	Defective pixels	Photo	Dedicated driver circuit <sup>*4</sup>
G11135-256DD	Non-cooled	50	50	256	14000	0.95 to 1.7	1% max.		C11514
G11135-512DE		25	25	512	8150				
G14006-512DE		25	25	512	8150				

\*4: Sold separately

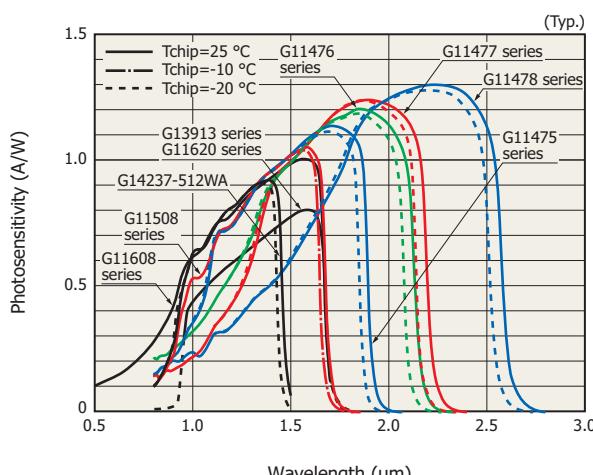
\*5: When two video lines are used for readout, the line rate is equal to that for 256 channels.

These are high-speed line rate, back-illuminated type InGaAs linear imaging sensors with multiple output terminals.

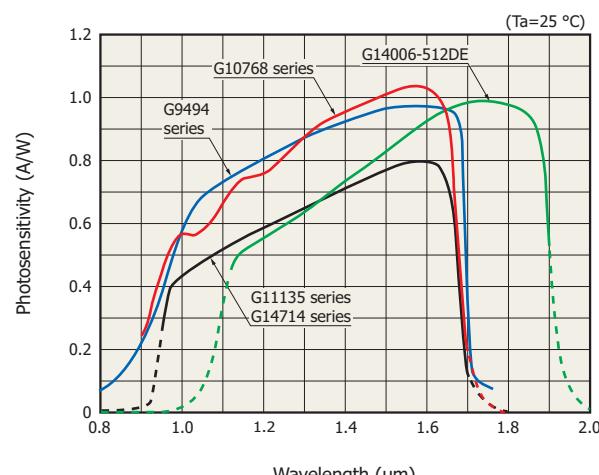
Type no.	Cooling	Pixel height ( $\mu\text{m}$ )	Pixel pitch ( $\mu\text{m}$ )	Number of pixels	Line rate (lines/s)	Spectral response range $\lambda$ ( $\mu\text{m}$ )	Defective pixels	Photo	Dedicated driver circuit
G14714-512DE	Non-cooled	25	25	512	40000	0.95 to 1.7	1% max.		—
G14714-1024DK		12.5	12.5	1024					

### Spectral response

#### [ InGaAs linear image sensors for spectrometry ]



#### [ High-speed type InGaAs linear image sensors ]



## InGaAs area image sensors

The InGaAs area image sensors have a hybrid structure consisting of a CMOS readout circuit (ROIC: readout integrated circuit) and back-illuminated InGaAs photodiodes.

Type no.	Cooling	Pixel size (μm)	Pixel pitch (μm)	Number of pixels	Frame rate*1 (frames/s)	Spectral response range λ (μm)	Defective pixels	Photo	Dedicated driver circuit*2						
G11097-0606S	One-stage TE-cooled (Tchip=25 °C)	50 × 50	50	64 × 64	1025	0.95 to 1.7	1% max.		C11512						
G12460-0606S	One-stage TE-cooled (Tchip=0 °C)					1.12 to 1.9									
G12242-0707W	Two-stage TE-cooled (Tchip=15 °C)	20 × 20	20	128 × 128	258	0.95 to 1.7	1% max.		C11512-02						
G13393-0808W				320 × 256	228		0.37% max.								
G13393-0909W				640 × 512	62										
G13544-01	Two-stage TE-cooled (Tchip=-10 °C)	50 × 50	50	192 × 96	867	1.12 to 1.9	1% max.								
G13441-01	Two-stage TE-cooled (Tchip=-20 °C)					1.3 to 2.15									
G14671-0808W	Two-stage TE-cooled (Tchip=15 °C)	20 × 20	20	320 × 256	509	0.95 to 1.7	0.37% max.		C16090-01*3						
G14672-0808W	Two-stage TE-cooled (Tchip=-20 °C)					1.12 to 1.85	1% max.								
G14673-0808W						1.3 to 2.15									
G14674-0808W						1.7 to 2.55									

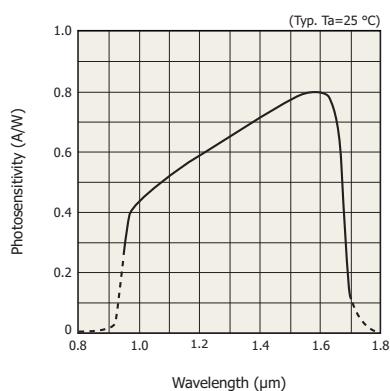
\*1: Integration time 1 μs (min.)

\*2: Sold separately

\*3: With sensor

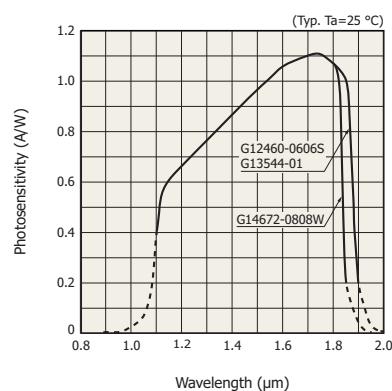
### Spectral response

[ G11097-0606S, G12242-0707W, G13393 series, G14671-0808W ]



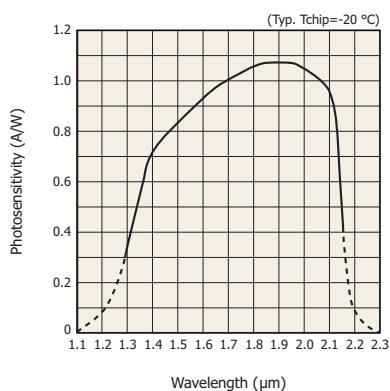
KMIRB0051EB

[ G12460-0606S, G13544-01, G14672-0808W ]



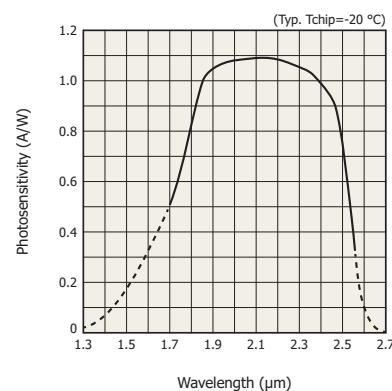
KMIRB0078EC

[ G13441-01, G14673-0808W ]



KMIRB0099EB

[ G14674-0808W ]



KMIRB0114EA

# InAs photovoltaic detectors

## InAs photovoltaic detectors

InAs photovoltaic detectors are high-speed, low-noise infrared detectors capable of detecting infrared light up to approx. 3.5 µm. (Typ.)

Type no.	Cooling	Photosensitive area (mm)	Cutoff wavelength $\lambda_c$ (µm)	Peak sensitivity wavelength $\lambda_p$ (µm)	Package	Photo	Option (sold separately)
P10090-01	Non-cooled	φ1	3.65	3.35	TO-5		C4159-07 (P.21)
P10090-11	One-stage TE-cooled (Tchip=-10 °C)		3.55	3.30	TO-8		A3179-01 (P.19) C1103-04 (P.18) C4159-06 (P.21)
P10090-21	Two-stage TE-cooled (Tchip=-30 °C)		3.45	3.25			A3179-01 (P.19) C1103-04 (P.18) C4159-06 (P.21)
P7163	Liquid nitrogen (Tchip=-196 °C)		3.10	3.00	Metal dewar		C4159-05 (P.21)

## Infrared detector module with preamp

This is an amplifier-integrated module that can detect infrared light simply by a DC power supply.

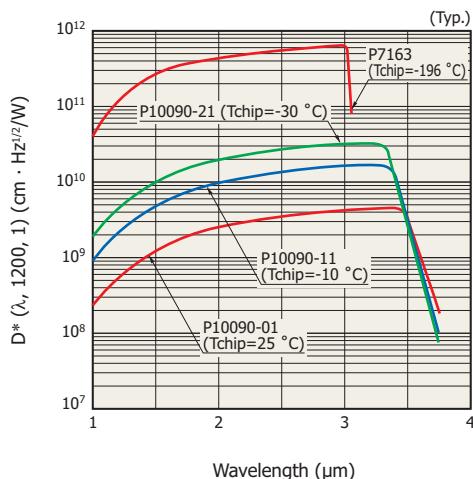
(Typ.)

Type no.	Detector	Photosensitive area (mm)	Cooling	Measurement condition		Cutoff wavelength $\lambda_c$ (µm)	Peak sensitivity wavelength $\lambda_p$ (µm)	Photo
				Chip temperature (°C)				
C12492-210	InAs (P10090-21)	φ1	TE-cooled	-28		3.45	3.25	

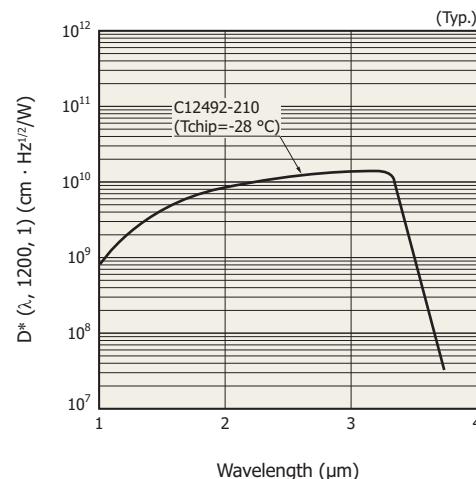
Note: A power supply cable is included.

## Spectral response

### [ InAs photovoltaic detectors ]



### [ C12492-210 ]



KIRDB0356EE

KIRDB0688EA

# InSb photovoltaic detectors, InSb photoconductive detectors

## InSb photovoltaic detectors

InSb photovoltaic detectors are high-speed, low-noise infrared detectors that deliver high sensitivity in the so-called atmospheric window between 3 and 5 μm. The infrared light in the 5 μm band can be detected with peak sensitivity and high response speed. A metal dewar type cooled with liquid nitrogen is also available.

(Typ.)

Type no.	Cooling	Photosensitive area (mm)	Cutoff wavelength $\lambda_c$ (μm)	Peak sensitivity wavelength $\lambda_p$ (μm)	Package	Photo	Dedicated amplifier (sold separately)
P5968-060	Liquid nitrogen (Tchip=-196 °C)	φ0.6	5.5	5.3	Metal dewar		C4159-01 (P.21)
P5968-100		φ1					C4159-04 (P.21)
P5968-200		φ2					Custom-made product
P5968-300		φ3					
P4247-16		0.25 × 1.4 (1 × 16-element)					
P4247-44		0.45 × 0.45 (4 × 4-element)					

## InSb photoconductive detectors

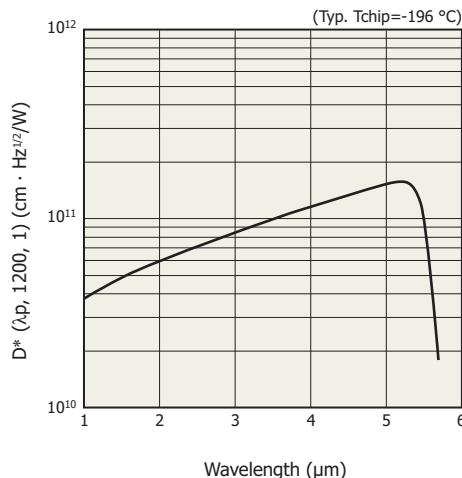
Thermoelectrically cooled InSb photoconductive detectors are capable of detecting infrared light up to around 6 μm with high sensitivity and high speed.

(Typ.)

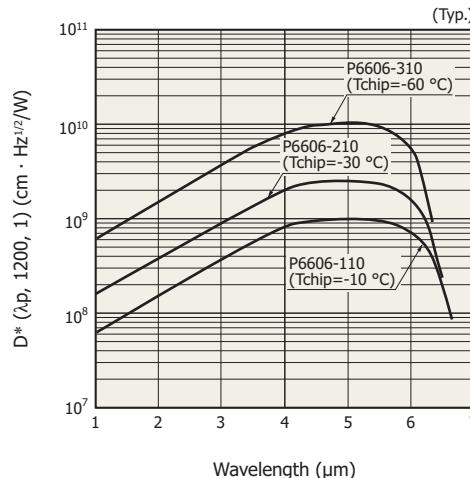
Type no.	Cooling	Photosensitive area (mm)	Cutoff wavelength $\lambda_c$ (μm)	Peak sensitivity wavelength $\lambda_p$ (μm)	Package	Photo	Option (sold separately)
P6606-110	One-stage TE-cooled (Tchip=-10 °C)	1 × 1	6.7	5.5	TO-8		A3179-01 (P.19) C1103-07 (P.18) C5185-02 (P.22)
P6606-210							A3179-01 (P.19) C1103-07 (P.18) C5185-02 (P.22)
P6606-305	Three-stage TE-cooled (Tchip=-60 °C)	0.5 × 0.5	6.3	5.5	TO-3		A3179-04 (P.19) C1103-05 (P.18) C5185-02 (P.22)
P6606-310		1 × 1					
P6606-320		2 × 2					

## Spectral response

### [ InSb photovoltaic detectors ]



### [ InSb photoconductive detectors ]





## Infrared detector modules with preamp

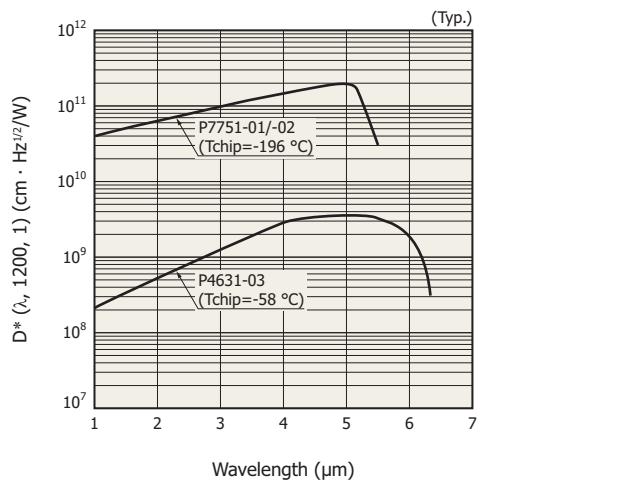
These modules consist of the detector assembled with the matched preamplifier, and operate by connecting a DC power supply. (Typ.)

Type no.	Detector	Photosensitive area (mm)	Cooling	Measurement condition	Cutoff wavelength $\lambda_c$ (μm)	Peak sensitivity wavelength $\lambda_p$ (μm)	Photo
				Chip temperature (°C)			
P4631-03	InSb (P6606-310)	1 × 1	TE-cooled	-58	6.1	5.5	
P7751-01*	InSb (P5968-060)	φ0.6					
P7751-02*	InSb (P5968-200)	φ2	Liquid nitrogen	-196	5.5	5.3	

\* FOV=60°

Note: A power supply cable is included

## Spectral response



# InAsSb photovoltaic detectors

## Standard type

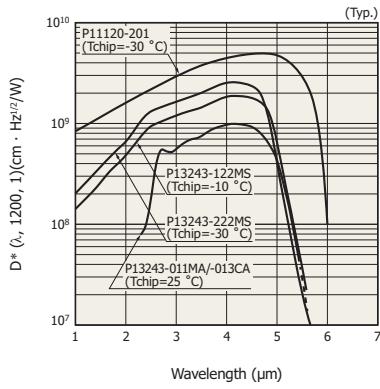
These sensors deliver high-sensitivity in the wavelength 5 µm, 8 µm, and 10 µm bands using our unique crystal technology. A small surface mount package P13243-013CA is also available.

(Typ.)

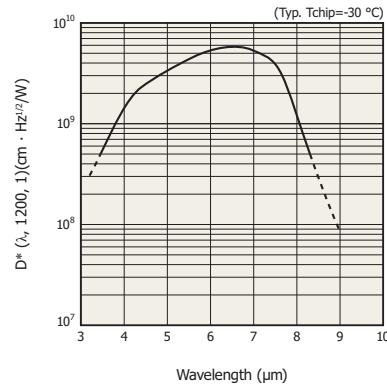
Type no.	Cooling	Photosensitive area (mm)	Cutoff wavelength $\lambda_c$ (µm)	Peak sensitivity wavelength $\lambda_p$ (µm)	Package	Photo	Options (sold separately)
P11120-201	Two-stage TE-cooled ( $T_{chip}=-30$ °C)	ø1	5.9	4.9	TO-8		A3179-01 (P.28) C1103-04 (P.27) C4159-07 (P.30)
P13243-013CA	Non-cooled	0.7 × 0.7	5.3	3.5	Ceramic		C4159-01 (P.30)
P13243-011MA					TO-46		
P13243-122MS	One-stage TE-cooled ( $T_{chip}=-10$ °C)	2 × 2	5.2	4.1	TO-8		A3179 (P.28) C1103-04 (P.27) C4159-01 (P.30)
P13243-222MS	Two-stage TE-cooled ( $T_{chip}=-30$ °C)		5.1				A3179-01 (P.28) C1103-04 (P.27) C4159-01 (P.30)
P12691-201G	Two-stage TE-cooled ( $T_{chip}=-30$ °C)	ø1	8.3	6.7	TO-8		A3179-01 (P.28) C1103-04 (P.27) C4159-07 (P.30)
P13894-011CN	Non-cooled	1 × 1	11.0	5.6	Ceramic		C4159-01 (P.30)
P13894-011NA					TO-5		
P13894-011MA							
P13894-211MA	Two-stage TE-cooled ( $T_{chip}=-30$ °C)		10.2		TO-8		A3179-01 (P.28) C1103-04 (P.27) C4159-01 (P.30)

## Spectral response

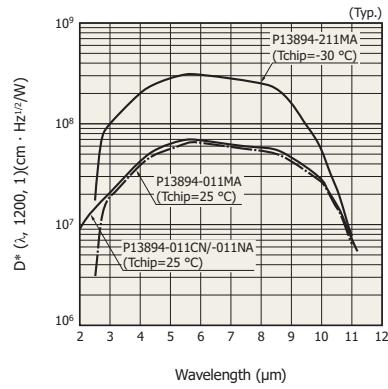
[ P11120-201, P13243 series ]



[ P12691-201G ]



[ P13894 series ]





## With band-pass filter

These are InAsSb photovoltaic detectors that use a band-pass filter (center wavelength: 3.3 μm, 3.9 μm, 4.26 μm, 4.45 μm) for the window material. It is suitable for measurement of gases (CH<sub>4</sub>, CO<sub>2</sub>).

(Typ.)

Type no.	Cooling	Photosensitive area (mm)	Window material*1	Package	Photo	Dedicated amplifier (Sold separately)
P13243-033CF	Non-cooled	0.7 × 0.7	BPF (3.3 μm)	Ceramic		C4159-01 (P.30)
P13243-033MF				TO-46		
P13243-039CF			BPF (3.9 μm)	Ceramic		
P13243-039MF				TO-46		
P13243-043CF		0.7 × 0.7 (2 elements)	BPF (4.26 μm)	Ceramic		
P13243-043MF				TO-46		
NEW P13243-045CF			BPF (4.45 μm)	Ceramic		
NEW P13243-045MF				TO-46		
P13243-015CF		0.7 × 0.7 (2 elements)	BPF (3.3 μm)	Ceramic		
P13243-016CF			BPF (3.9 μm)			
			BPF (3.9 μm)			
			BPF (4.26 μm)			

\*1: BPF: Band-pass filter

## Array

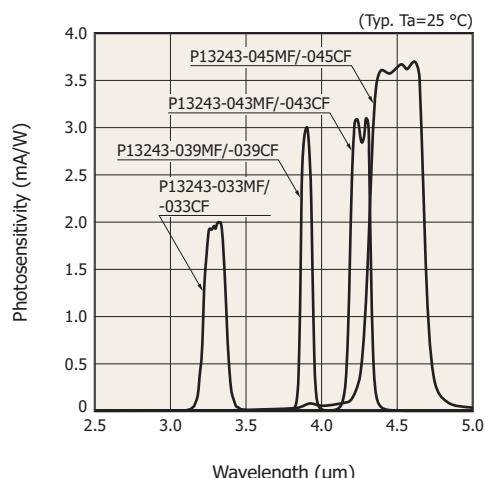
These are InAsSb photodiode arrays in a ceramic DIP. Simultaneous measurement and wide range measurement are possible.

(Typ.)

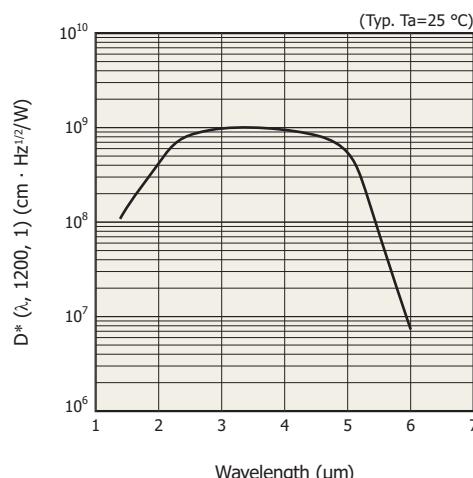
Type no.	Cooling	Photosensitive area (mm)	Cutoff wavelength $\lambda_c$ (μm)	Peak sensitivity wavelength $\lambda_p$ (μm)	Package	Photo	Dedicated amplifier (sold separately)
NEW P15742-016DS	Non-cooled	0.45 × 0.7 (16 elements)	5.3	3.5	Ceramic		—
NEW P15742-046DS		0.2 × 0.7 (46 elements)					

## Spectral response

[ P13243 series ]



[ P15742 series ]



## Infrared detector modules with preamp

These are amplifier-integrated modules that can detect infrared light simply by connecting a DC power supply.

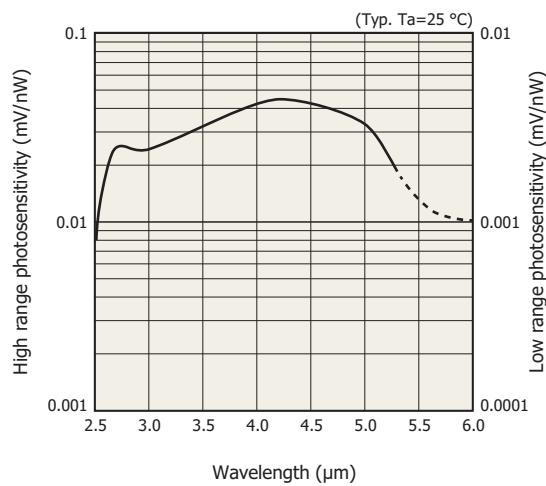
(Typ.)

Type no.	Detector	Photosensitive area (mm)	Cooling	Measurement conditions	Cutoff wavelength $\lambda_c$ (μm)	Peak sensitivity wavelength $\lambda_p$ (μm)	Photo
				Chip temperature (°C)			
C10439-14	InAsSb (P13243-011MA)	0.7 × 0.7	Non-cooled	+25	5.3	4.1	
NEW C12494-011LH	InAsSb (P13894-011NA)	1 × 1			11	5.6	
C12494-210S	InAsSb (P11120-201)	φ1	TE-cooled	-28	5.9	4.9	
C12494-210M	InAsSb (P12691-201G)				8.3	6.7	
NEW C12494-211L	InAsSb (P13894-211MA)	1 × 1		-28	10.6	5.6	

Note: A power supply cable is included.

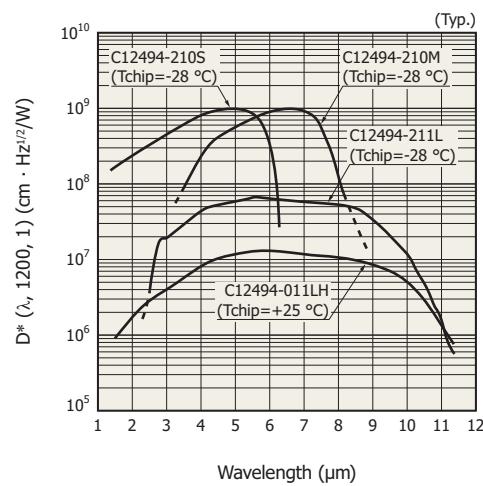
## Spectral response

[ C10439-14 ]



KACCB0419EB

[ C12494-011LH/-210S/-210M/-211L ]



KIRDB0690EB

# Type II superlattice infrared detector

## Type II superlattice infrared detector

The P15409-901 is a Type II superlattice infrared detector with sensitivity expanded to the 14 μm band using Hamamatsu unique crystal growth technology and process technology. This product is an environmentally friendly infrared detector and does not use mercury or cadmium, which are substances restricted by the RoHS Directive. This is a replacement for conventional products that contain these substances.

(Typ.)

Type no.	Cooling	Photosensitive area (mm)	Cutoff wavelength <sup>*1</sup> λc (μm)	Peak sensitivity wavelength λp (μm)	Package	Photo	Dedicated amplifier (Sold separately)
P15409-901	Liquid nitrogen (Tchip=-196 °C)	φ0.1	14.5	5.4	Metal dewar		C4159-01 (P.30)

\*1: Wavelength at which signal/noise=1

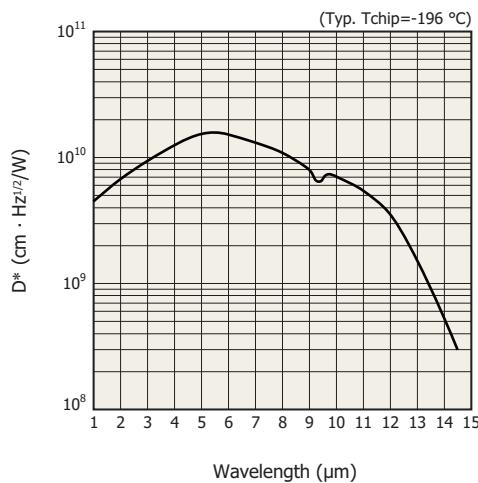
## Infrared detector modules with preamp

This is an amplifier-integrated module that can detect infrared light simply by connecting a DC power supply.

(Typ.)

Type no.	Detector	Photosensitive area (mm)	Cooling	Measurement conditions		Cutoff wavelength λc (μm)	Peak sensitivity wavelength λp (μm)	Photo
				Chip temperature (°C)				
NEW C15780-401	Type II superlattice (P15409-901)	φ0.1	Liquid nitrogen	-196		14.5	5.4	

## Spectral response



KIRD80673EB

# Thermopile detectors (thermal detectors)

## Single-element type

Hamamatsu provides high-sensitivity Si thermopile detectors suitable for gas concentration measurement, etc. Concentration of various types of gases can be measured by attaching a band-pass filter to thermopile detectors.

The T15770 is suitable for flame detection and the T11361-05 for CO<sub>2</sub> concentration measurement.

(Typ.)

Type no.	Package	Number of elements	Photosensitive area (mm)	Window	Spectral response (μm)	Photo
T11262-01	TO-18	1	1.2 × 1.2	AR-coated Si	3 to 5	
T11361-01*						
NEW T15770				Band-pass filter	4.45	
T11361-05*					4.3	

\* Built-in thermistor

## Dual-element type

These are dual type thermopile detectors developed to measure the concentration of carbon dioxide and methane with high accuracy. They consist of two high sensitivity Si thermopile chips and two band-pass filters so that two wavelengths can be detected simultaneously.

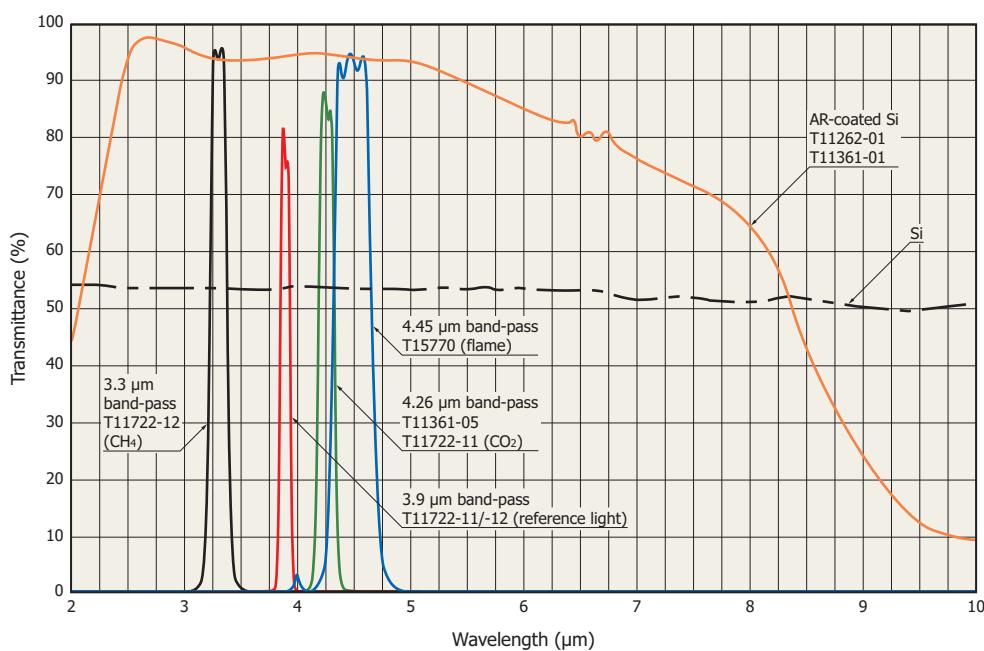
(Typ.)

Type no.	Package	Number of elements	Photosensitive area (mm)	Window	Spectral response (μm)	Photo
NEW T11722-11	TO-5	2	1.2 × 1.2 (per element)	Band-pass filter	Reference light: 3.9 CO <sub>2</sub> : 4.3	
NEW T11722-12					Reference light: 3.9 CH <sub>4</sub> : 3.3	

## Spectral response (typical example)

Since thermopile detectors have no wavelength dependence, their spectral response characteristics are determined only by the transmittance of the window material.

The graph below shows transmittance characteristics of typical window materials. Please contact our sales office about changing the window of a thermopile detector to the following materials.



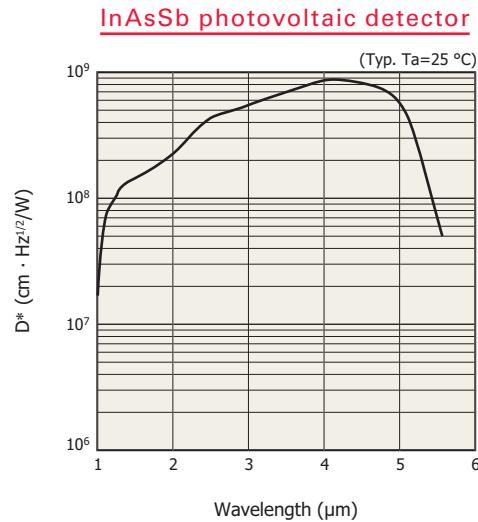
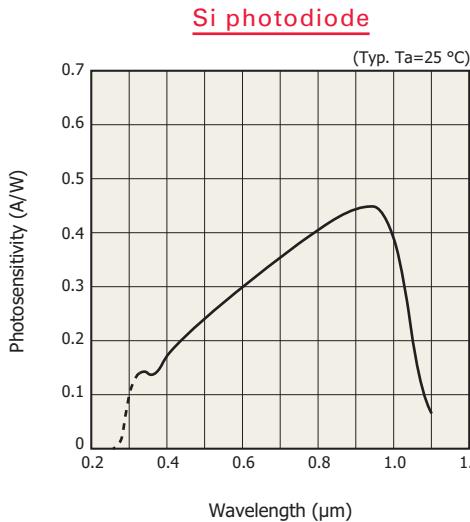
# Two-color detectors

Two-color detectors use a combination of two light sensors with different spectral response, in which one sensor is mounted over the other sensor along the same optical axis to provide a broad spectral response range. Thermoelectrically cooled two-color detectors are also provided that cool the sensors to maintain their temperatures constant, allowing high precision measurement with an improved S/N.

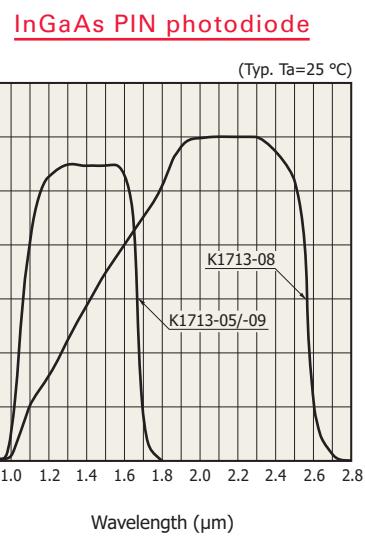
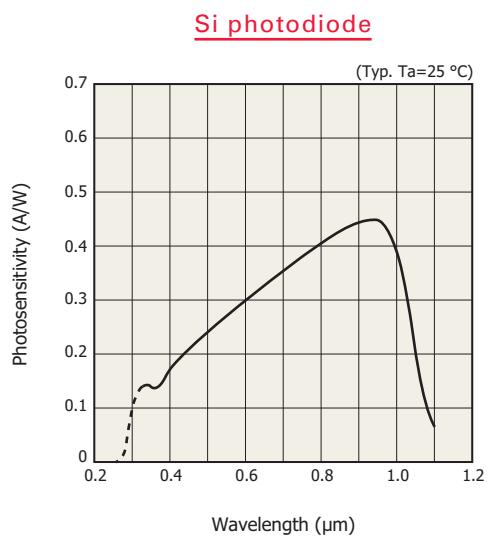
Type no.	Cooling	Detector	Photosensitive area (mm)	Spectral response range $\lambda$ ( $\mu\text{m}$ )	Peak sensitivity wavelength $\lambda_p$ ( $\mu\text{m}$ )	Photo-sensitivity S (A/W)	Package	Photo	(Typ.) Option (sold separately)
K1713-003	Non-cooled	Si	2.4 × 2.4	0.32 to 5.3	0.94	0.45	TO-5		C9329 C4159-01 (P.21)
		InAsSb	0.7 × 0.7		4.0	0.0039			
		Si	2.4 × 2.4	0.32 to 1.7	0.94	0.45			C9329 C4159-03 (P.21)
		InGaAs	ϕ0.5		1.55	0.55			
		Si	2.4 × 2.4	0.32 to 2.6	0.94	0.45			C4159-03 (P.21)
		InGaAs	ϕ1		2.3	0.60			
		Si	2.4 × 2.4	0.32 to 1.7	0.94	0.45			C9329 C4159-03 (P.21)
		InGaAs	ϕ1		1.55	0.55			
K11908-010K	One-stage TE-cooled (Tchip=-10 °C)	InGaAs	2.4 × 2.4	0.9 to 2.55	1.55	0.95	TO-8		C9329 C4159-03 (P.21)
		InGaAs	ϕ1		2.1	1.0			
		Si	2.4 × 2.4	0.32 to 1.67	0.94	0.45			C9329 C4159-03 (P.21) A3179-03 (P.19) C1103-04 (P.18)
		InGaAs	ϕ0.5		1.55	0.55			
		Si	2.4 × 2.4	0.32 to 2.57	0.94	0.45			C9329 C4159-03 (P.21) A3179-03 (P.19) C1103-04 (P.18)
		InGaAs	ϕ1		2.3	0.60			
		Si	2.4 × 2.4	0.32 to 1.67	0.94	0.45			—
		InGaAs	ϕ1		1.55	0.55			
K12728-010K	Non-cooled	Si	2.4 × 2.4	0.32 to 1.7	0.96	0.45	Ceramic		—
		InGaAs	ϕ1		1.55	0.55			
		InGaAs	2.4 × 2.4	0.9 to 2.55	1.55	0.95			
		InGaAs	ϕ1		2.1	1.0			

## Spectral response

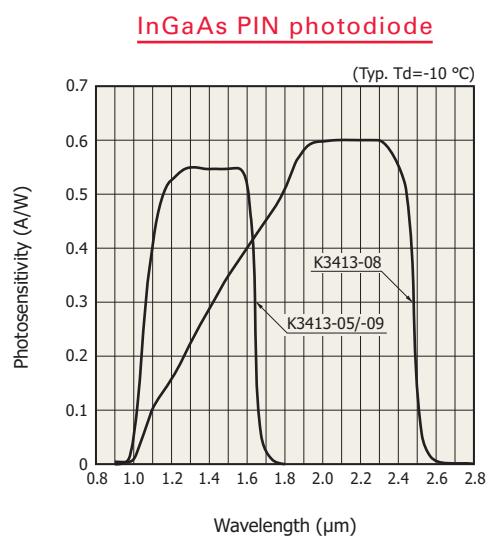
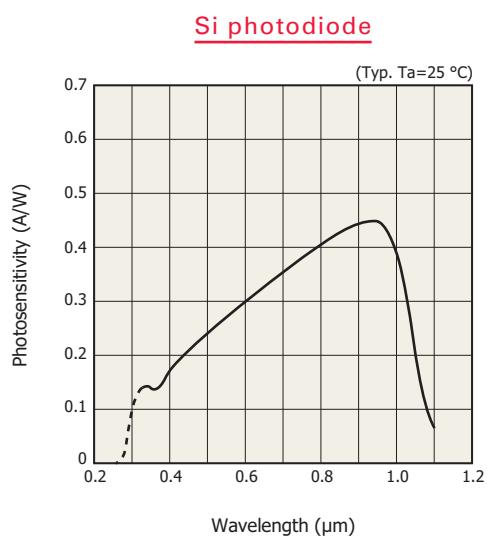
[ K1713-003 ]



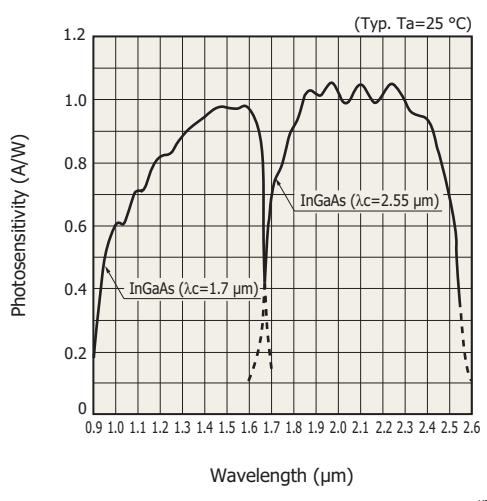
[ K1713-05/-08/-09 ]



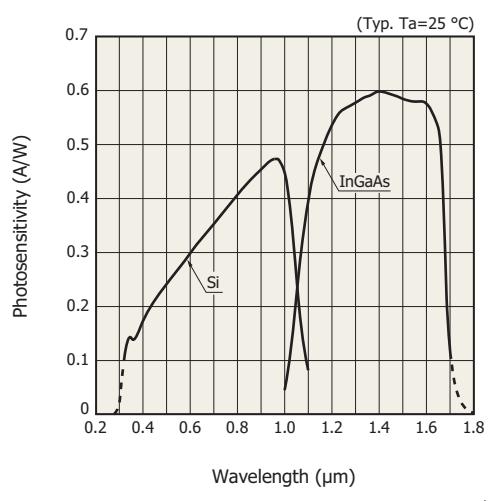
[ K3413-05/-08/-09 ]



[ K11908-010K, K12729-010K ]



[ K12728-010K ]





## Infrared detector modules with preamp

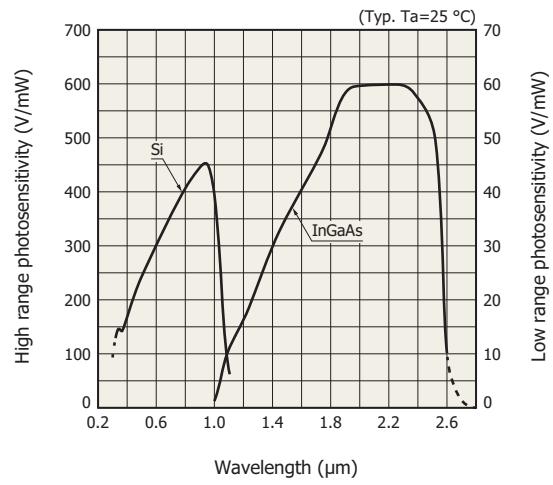
This is an amplifier-integrated module using a two-color detector. This can detect wide spectral range simply by connecting a DC power supply.

(Typ.)

Type no.	Detector	Cooling	Photosensitive area (mm)	Spectral response range $\lambda$ ( $\mu\text{m}$ )	Peak sensitivity wavelength $\lambda_p$ ( $\mu\text{m}$ )	Photosensitivity $S^{*1}$ $\lambda=\lambda_p$ (V/W)	Photo
C10439-15	K1713-08 (Si + InGaAs)	Non-cooled (Ta=25 °C)	Si: 2.4 × 2.4 InGaAs: $\phi 1$	0.32 to 2.6	Si: 0.94 InGaAs: 2.3	Si: $4.5 \times 10^5$ InGaAs: $6.5 \times 10^5$	

\*1: High range

### Spectral response



# Photon drag detectors

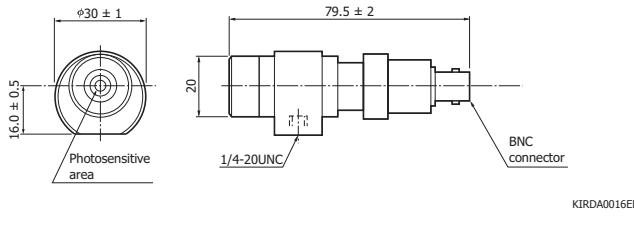
The photon drag detector makes use of the “photon drag effect” in which holes created in a semiconductor by incident photons are dragged along in the direction of the photons, generating an electromotive force. Because of its sensitivity at 10.6 µm, this detector is suitable for detection of CO<sub>2</sub> lasers. The surface of the detector element is coated with a non-reflective material. The C12496-046 is a infrared detector module with preamp designed to detect infrared light by connecting to a DC power supply.

## Non-cooled type

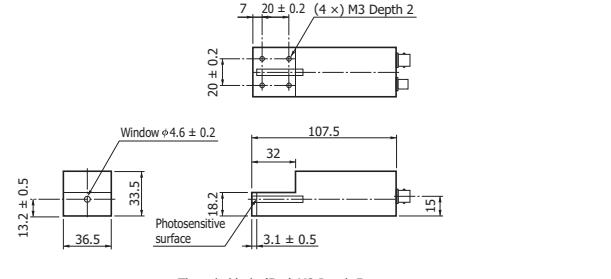
Type no.	Cooling	Photosensitive area (mm)	Peak sensitivity wavelength $\lambda_p$ (µm)	Photosensitivity S $\lambda=10.6 \mu\text{m}$ (V/W)	Photo	Magnet stand (sold separately)	(Typ.)
B749	Non-cooled	φ5.0	10.6	1.2 × 10 <sup>-6</sup>		A1447	
C12496-046		φ4.6		1.3 × 10 <sup>-2</sup>		-	

## Dimensional outlines (unit: mm, tolerance unless otherwise noted: ±1)

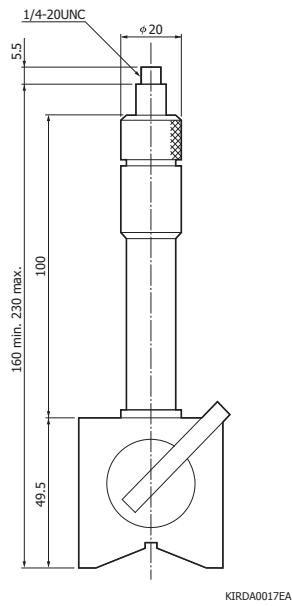
[ B749 ]



[ C12496-046 ]



[ Magnet stand A1447 ]



Pin no.	Pin connection	Lead color
①	Vcc=+15 V	White
②	GND	Blue/white stranded wire
③	GND	
④	Vcc=-15 V	Blue

Tolerance unless otherwise noted: ±1

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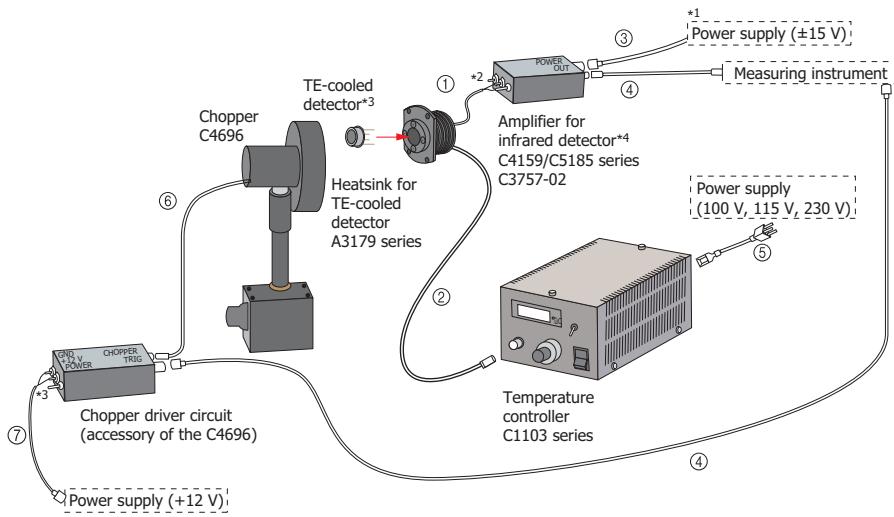
# Accessories for infrared detectors

Hamamatsu provides following accessories for infrared detectors.

- Temperature controllers (P.18)
- Heatsinks for TE-cooled detector (P.19)
- Chopper (P.20)
- Amplifiers for infrared detectors (P.21)

A connection example is shown below.

## Connection example



Cable no.	Cable	Length approx.	Note
①	Coaxial cable (for signal)	2 m	Supplied with heatsink A3179 series. When using this cable, make it as short as possible (preferably approx. 10 cm).
②	4-conductor cable (with a connector) A4372-05	3 m	Supplied with temperature controller C1103 series. This cable is also sold separately.
③	4-conductor cable (with a connector) A4372-02	2 m	This cable is supplied with the C4159 series, C5185-02 amplifiers for infrared detectors, and infrared detector modules with preamps (room temperature type). This cable is also sold separately. A power supply cable (with a 6-conductor connector) A4372-03 supplied with "infrared detector modules with preamps (TE-cooled type)", is also sold separately.
④	BNC connector cable E2573	1 m	Option
⑤	Power supply cable (for temperature controller)	1.9 m	Supplied with temperature controller C1103 series
⑥	Chopper driver cable (connected to chopper)	2 m	Connected to chopper driver circuit
⑦	2-conductor cable or coaxial cable (for chopper power supply)	2 m or less	Prepared by user

\*1: Attach the bare wire ends to a 3-pin or 4-pin connector or to a banana jack, and then connect them to the power supply.

\*2: Soldering is needed. When using the C5185-02 amplifier, a BNC connector (prepared by the user, example: one end of the E2573) is required.

\*3: No socket is available. Soldering is needed.

Note: Refer to the datasheet "Accessories for infrared detectors" for detailed information about cables.

## Temperature controllers C1103 series

The C1103 series is a temperature controller designed for TE-cooled infrared detectors. The C1103 series allows temperature setting for the TE-cooler mounted in an infrared detector.

Parameter	C1103-04	C1103-05	C1103-07
Applicable detector*4	One-stage/two-stage TE-cooled type InAsSb, InAs photovoltaic detectors, InGaAs, Si photodiodes	Two-stage/three-stage TE-cooled type InSb photoconductive detectors	One-stage TE-cooled type InSb photoconductive detectors
Setting element temperature	-30 to +20 °C	-75 to -25 °C	-30 to +20 °C
Temperature stability		Within ±0.1 °C	
Output current for temperature control		1.1 A min., 1.2 A typ., 1.3 A max.	
Power supply		100 V ± 10% · 50/60 Hz*5	
Power consumption		30 W	
Dimensions		107 (W) × 87 (H) × 190 (D) mm	
Weight		Approx. 1.9 kg	
Operating temperature		+10 to +40 °C	
Operating humidity		90% max.	
Storage temperature*6		-20 to +40 °C	
Accessories	Instruction manual 4-conductor cable (with a connector, 3 m) A4372-05*7, power supply cable		

\*4: It does not correspond to TE-cooled type infrared detector module with preamp.

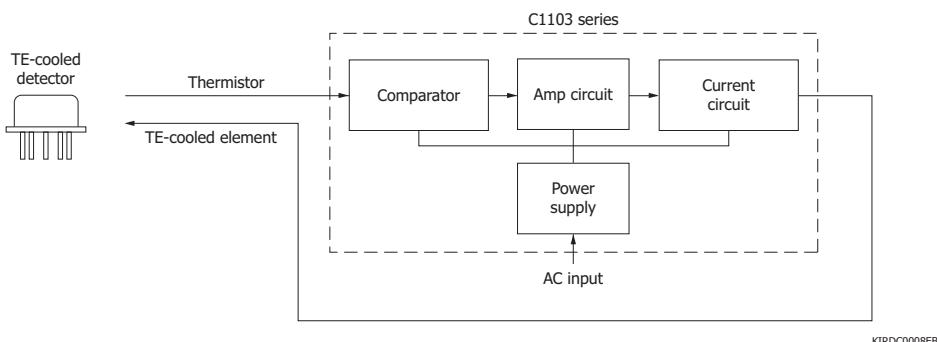
\*5: Please specify power supply requirement (AC line voltage) from among 100 V, 115 V and 230 V when ordering.

\*6: 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.

\*7: When used in combination with the A3179 series heatsink, do not use the 4-conductor cable supplied with the A3179 series, but use the A4372-05 instead.

## Block diagram

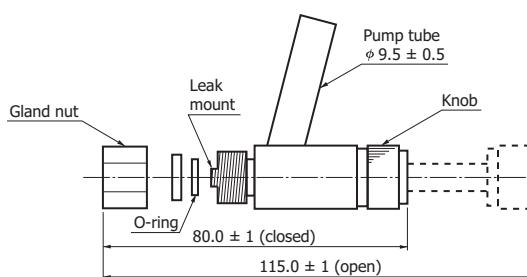


## Valve operator for metal dewar A3515

With this valve operator, metal dewars can be re-evacuated to maintain the desired vacuum level. Refer to the instruction manual for details. Please be aware that the detector performance is not guaranteed after re-evacuation is performed with the valve operator.



## Dimensional outline (unit: mm)





## Heatsinks for TE-cooled detectors (TO-8, TO-3 package) A3179 series

These heatsinks are designed for use with thermoelectrically cooled detector sealed in a 6-pin TO-8, TO-3 package. The cooling (heat dissipation) capacity of the A3179 and A3179-03 is approx. 35 °C relative to the ambient temperature 25 °C, the A3179-01 is approx. 40 °C, and that of the A3179-04 is approx. 85 °C. The A3179-03 is designed only for two-color detector K3413 series, the A3179 for one-stage TE-cooled TO-8, the A3179-01 for two-stage TE-cooled TO-8, the A3179-04 for TO-3.

### ▲ Accessories

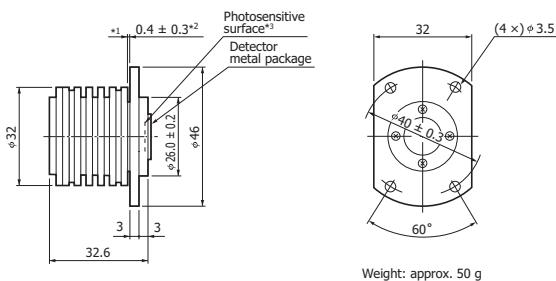
- Instruction manual
- 4-conductor cable (2 m): for TE-cooler and thermistor<sup>\*1</sup> <sup>\*2</sup>
- Coaxial cable (2 m): for signal<sup>\*</sup>

\*1: When used in combination with the C1103 series temperature controller, do not use the 4-conductor cable supplied with the A3179 series, but use the 4-conductor cable A4372-05 (sold separately, with a connector).

\*2: No socket is supplied for connection to infrared detectors. Connect infrared detectors by soldering. Cover the soldered joints and detector pins with vinyl insulating tubes.

### ● Dimensional outlines (unit: mm, tolerance unless otherwise noted: $\pm 0.3$ )

[ A3179 ]

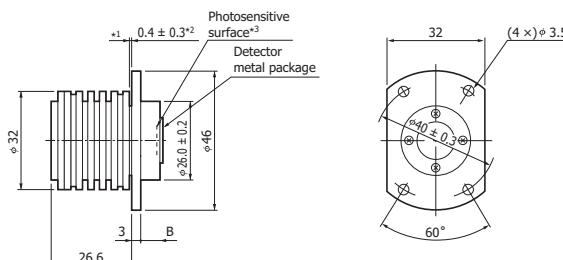


Weight: approx. 50 g

- \*1: Bottom surface (reference surface) of detector metal package
- \*2: When the detector is installed
- \*3: The position of the photosensitive surface differs according to the detector used.  
Refer to the dimensional outline for the detector.

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[ A3179-01, A3179-03 ]

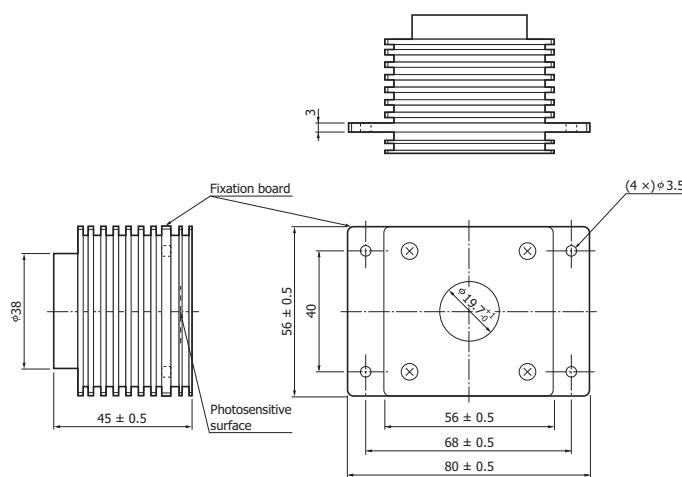


A3179-01: B=6  
A3179-03: B=6.4  
Weight: approx. 53 g

- \*1: Bottom surface (reference surface) of detector metal package
- \*2: When detector is installed
- \*3: The position of the photosensitive surface differs according to the detector used.  
Refer to the dimensional outline for the detector.

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[ A3179-04 ]



Weight: approx. 320 g

KIRDA0149ED

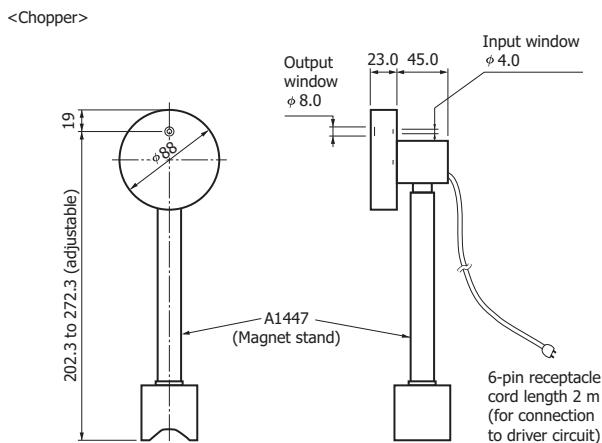
## Chopper C4696

Parameter	Specification				
Chopping frequency	115 to 380 Hz, 345 Hz typ.*3				
Operating voltage $V_D$	DC 5 to 13 V, 12 V typ.				
Duty ratio	1:1				
Rotational stability	0.06%/ $^{\circ}$ C				
Sync signal $V_H$	<table border="1"> <tr> <td>Min.</td> <td><math>V_D - 0.5</math> V</td> </tr> <tr> <td>Max.</td> <td><math>V_D - 0.2</math> V</td> </tr> </table>	Min.	$V_D - 0.5$ V	Max.	$V_D - 0.2$ V
Min.	$V_D - 0.5$ V				
Max.	$V_D - 0.2$ V				
Operating temperature	0 to 50 $^{\circ}$ C				
Maximum current consumption*4	90 mA				
Accessories	Magnet stand A1447 (see P.16), driver circuit				

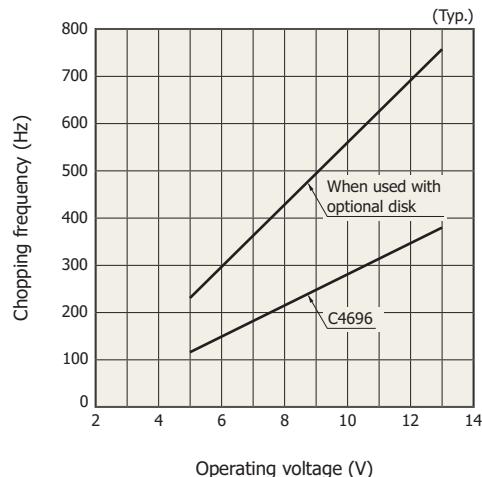
\*3: Chopping frequency will be 230 to 760 Hz when an optional disk is used.

\*4:  $V_D = 12$  V

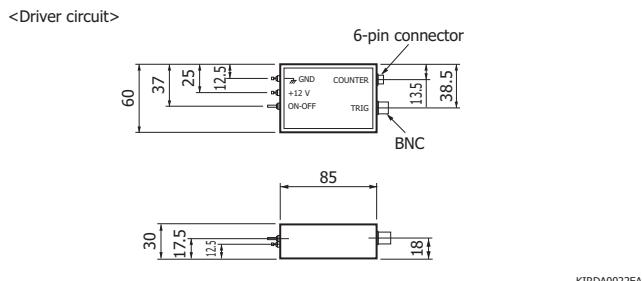
### Dimensional outline (unit: mm, tolerance unless otherwise noted: $\pm 1$ )



### Chopping frequency vs. operating voltage



KIRDB0376EA



KIRDA0022EA



## Amplifiers for infrared detector C4159 series, C5158-02

These are low noise amplifiers for InSb, InAs, InAsSb, and InGaAs detectors

### ▲ Accessories

- Instruction manual
- Power cable A4372-02 (one end with 4-pin connector for connection to amplifier and the other end unterminated, 2 m)



### Required power supply specifications

- C4159 series, C5185-02:  $\pm 15 \text{ V} \pm 0.5$
  - Current capacity: 1.5 times or more of amplifier's maximum current consumption
  - Ripple noise: 5 mVp-p or less
  - Analog power supply only
- Recommended DC power supply (example): PW18-3AD (TEXIO)  
E3620A, E3630A (Keysight Technologies)

## Applicable detectors

Group	Type no.	Applicable detectors*1 *2 *3
Amplifier for photovoltaic detector	C4159-01	Dewar type InSb (P5968-060/-100), non-cooled type InAsSb (P13243-015CF/-016CF/-011MA/-033CF/-033MF/-039CF/-039MF/-043CF/-043MF/-045CF/-045MF, P13894-011CN/-011MA/-011NA), TE-cooled type InAsSb (P13243-122MS/-222MS, P13894-211MA), dewar type Type II (P15409-901)
	C4159-04	Dewar type InSb (P5968-200)
	C4159-05	Dewar type InAs (P7163)
	C4159-06	TE-cooled type InAs (P10090-11/-21)
	C4159-07	Non-cooled type InAs (P10090-01), TE-cooled type InAsSb (P11120-201, P12691-201G)
Amplifier for InGaAs PIN photodiode	C4159-03	Non-cooled/TE-cooled type InGaAs (G12180/G12181/G12182/G12183 series)
Amplifier for photoconductive detector	C5185-02	TE-cooled type InSb (P6606-110/-210/-305/-310/-320)

\*1: These products cannot operate multiple detectors.

\*2: Consult us before purchasing if you want to use with a detector other than listed here.

\*3: Consult us before purchasing if you want to use with a multi-element detector.

## Absolute maximum ratings ( $T_a=25 \text{ }^{\circ}\text{C}$ )

Parameter	Value	Unit
Supply voltage	$\pm 18.0 \text{ max.}$	V
Operating temperature	0 to $+40$	$^{\circ}\text{C}$
Storage temperature	-20 to $+70$	$^{\circ}\text{C}$

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.

## Amplifiers for photovoltaic detector (Typ.)

Parameter	C4159-01	C4159-04	C4159-05	C4159-06	C4159-07	Unit
Conversion impedance	$10^8, 10^7, 10^6$ (3 range switchable)	$2 \times 10^7, 2 \times 10^6, 2 \times 10^5$ (3 range switchable)	$10^8, 10^7, 10^6$ (3 range switchable)	$10^6, 10^5, 10^4$ (3 range switchable)	$10^6, 10^5, 10^4$ (3 range switchable)	V/A
Frequency characteristics (amplifier only, -3 dB)	DC to 100 kHz*4	DC to 45 kHz	DC to 15 kHz	DC to 100 kHz	DC to 100 kHz	-
Output impedance	50	50	50	50	50	$\Omega$
Maximum output voltage (1 k $\Omega$ load)	+10	+10	+10	+10	+10	V
Output offset voltage	$\pm 5$	$\pm 5$	$\pm 10$	$\pm 5$	$\pm 5$	mV
Equivalent input noise current*5 (f=1 kHz)	0.15 (10 <sup>8</sup> , 10 <sup>7</sup> range) 0.65 (10 <sup>6</sup> range)	0.55	0.15 (10 <sup>8</sup> , 10 <sup>7</sup> range) 0.65 (10 <sup>6</sup> range)	6	10	pA/Hz <sup>1/2</sup>
Reverse voltage	Limited to 0 V operation, cannot be applied from external unit					-
External power supply*6	$\pm 15$					V
Current consumption	+30, -10 max.		+30, -22 max.		mA	

\*4: When connected to a detector, the frequency becomes 60 kHz or less ( $\phi 0.6 \text{ mm}$ : 60 kHz or less,  $\phi 1 \text{ mm}$ : 25 kHz or less). Ringing occurs in the output if the rise time  $t_r$  (10 to 90%) of incident light is approximately 100  $\mu\text{s}$  or less. The ringing becomes larger as the rise time becomes shorter. However, ringing does not occur for sine wave light.

\*5: Input resistance: 1 M $\Omega$  (C4159-01/-04/-05), 500  $\Omega$  (C4159-06/-07)

\*6: Recommended DC power supply (analog power supply):  $\pm 15 \text{ V}$ , current capacity: 1.5 times the maximum current consumption or more, ripple noise: 5 mVp-p or less

Note:

· Output noise voltage = Equivalent input noise current  $\times$  Conversion impedance

· For information about accessories except for the amplifiers for infrared detectors, refer to the "Accessories for infrared detectors" datasheet.

## ■ Amplifier for InGaAs PIN photodiode (Typ.)

Parameter	C4159-03	Unit
Conversion impedance	$10^7, 10^6, 10^5$ (3 range switchable)	V/A
Frequency characteristics (amplifier only, -3 dB)	DC to 15 kHz	-
Output impedance	50	$\Omega$
Maximum output voltage (1 k $\Omega$ load)	+10	V
Output offset voltage	$\pm 5$	mV
Equivalent input noise current (f=1 kHz)	2.5	pA/Hz <sup>1/2</sup>
Reverse voltage	Cannot be applied from external unit	-
External power supply*7	$\pm 15$	V
Current consumption	$\pm 15$ max.	mA

## ■ Amplifier for photoconductive detector (Typ.)\*8

Parameter	C5185-02	Unit
Input impedance	5	k $\Omega$
Voltage gain	66 ( $\times 2000$ )	dB
Frequency characteristics (amplifier only, -3 dB)	5 Hz to 250 kHz	-
Detector bias current	5 mA, 10 mA, 15 mA (3 range switchable)	-
Output impedance	50	$\Omega$
Maximum output voltage (1 k $\Omega$ load)	$\pm 10$	V
Equivalent input noise voltage (f=1 kHz)	2.6*9	nV/Hz <sup>1/2</sup>
External power supply*7	$\pm 15$	V
Current consumption	+100, -30 max.	mA

\*7: Recommended DC power supply (analog power supply):  $\pm 15$  V, current capacity: 1.5 times the maximum current consumption or more, ripple noise: 5 mVp-p or less

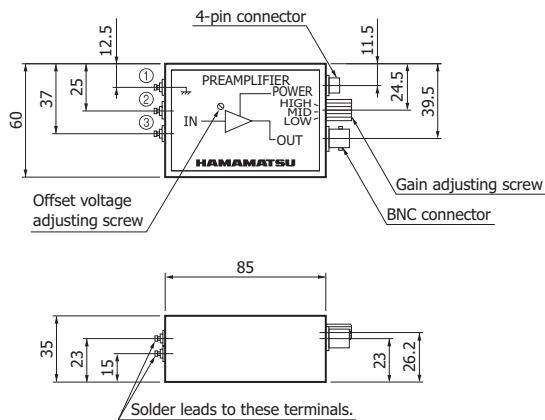
\*8: Before purchasing, make sure the bias current to the detector matches the detector bias current specified in the table.

\*9: At the maximum detector bias current

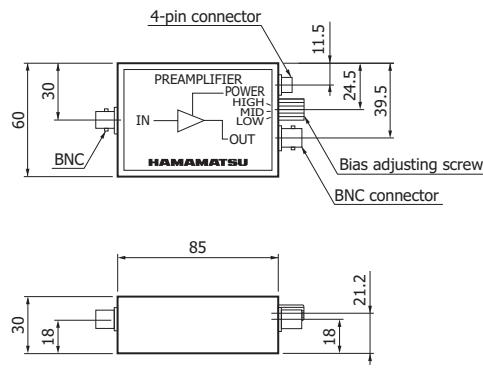
Note: Output noise voltage = Equivalent input noise voltage  $\times$  Voltage gain

## ● Dimensional outlines (unit: mm)

[ C4159-01/-03/-04/-05/-06/-07 ]



[ C5185-02 ]



### Pin connections

- ① GND
- ② Cathode
- ③ Anode

Tolerance unless otherwise noted: ±1

Note: Socket for lead attachment is not provided.

Type no.	Weight
C4159-01/-03/-04/-05	320 g
C4159-06/-07	330 g
C5185-02	290 g

# Description of terms

## ► Dark resistance: $R_d$

This is the resistance of a photoconductive detector in the dark state.

## ► Dark current: $I_d$

The dark current is the small current which flows when a reverse voltage is applied to a photovoltaic detector (InGaAs, InAs, InSb, etc.) under dark conditions. This is a factor for determining the lower limit of light detection.

## ► FOV (field of view)

The field of view is related to the background radiation noise and greatly influences the value of  $D^*$ .

## ► Offset voltage

This is DC output voltage of an amplifier when the input signal is zero.

## ► Photosensitivity: $S$

This is the detector output per watt of incident light at a given wavelength. The unit is usually expressed in V/W for photoconductive and in A/W for photovoltaic detectors.

## ► Photovoltaic detector (photodiode)

This is a semiconductor detector that generates electrical current or voltage when light enters its PN junction. Detector materials include InGaAs, InAs, InAsSb, and InSb.

## ► Photoconductive detector

This is a semiconductor detector whose conductivity increases with increasing incident light.

## ► Peak sensitivity wavelength: $\lambda_p$

This is the wavelength at which the sensitivity of the detector is at maximum.

## ► Reverse voltage (max.): $V_R$ max, supply voltage (max.)

Applying a reverse voltage to a photovoltaic detector (or applying a voltage to a photoconductive detector) triggers a breakdown at a certain voltage and causes severe deterioration of the detector performance. Therefore the absolute maximum rating for the voltage is specified at the voltage somewhat lower than this breakdown voltage. Do not apply a voltage higher than the maximum rating.

## ► Allowable current (max.)

This is a maximum value of current which can be used when photoconductive detectors are operated. When the supply current is higher than the maximum allowable current, the detector performance may deteriorate, therefore, excessive current must be avoided.

## ► NEP (noise equivalent power)

This is the radiant power that produces S/N of 1 at the detector output. At Hamamatsu we list the NEP measured at the peak sensitivity wavelength ( $\lambda_p$ ) and the like. Since the noise level is proportional to the square root of the frequency bandwidth, the NEP is normalized to a bandwidth of 1 Hz.

$$\text{NEP at } \lambda_p [\text{W}/\text{Hz}^{1/2}] = \frac{\text{Noise current } [\text{A}/\text{Hz}^{1/2}]}{\text{Photosensitivity } [\text{A}/\text{W}] \text{ at } \lambda_p}$$

## ► Cutoff frequency: $f_c$

This is the frequency at which the output decreases 3 dB from the steady output level. The cutoff frequency ( $f_c$ ) is related to rise time ( $t_r$ : time required for the output to rise from 10% to 90% of the maximum output value) as follows:

$$t_r [\text{s}] = \frac{0.35}{f_c [\text{Hz}]}$$

## ► Rise time: $t_r$

This is the value of a detector time response to a stepped light input, and defined as the time required for transition from 10% to 90% (or 0 to 63%) of the maximum (constant) output value. The light sources used are GaAs LED (0.92  $\mu\text{m}$ ), laser diode (1.3  $\mu\text{m}$ ), etc.

## ► Terminal capacitance: $C_t$

An effective capacitor is formed at the PN junction of a photovoltaic detector. Its capacitance is termed the junction capacitance and is one of the parameters that determine the response speed of the photovoltaic detector. And it can cause the phenomenon of gain peaking in I-V conversion circuit using op amp. In Hamamatsu, the terminal capacitance including this junction capacitance plus package stray capacitance is listed.

## ► Short circuit current: $I_{sc}$

The short circuit current is the output current which flows when the load resistance is 0 and is nearly proportional to the device photosensitive area. This is often called "white light sensitivity" with regards to the spectral response. This value is measured with light from a tungsten lamp of 2856 K distribution temperature (color temperature), providing 100  $\text{lx}$  illuminance.

## ► Cutoff wavelength: $\lambda_c$

This represents the long wavelength limit of spectral response and in datasheets is listed as the wavelength at which the sensitivity becomes 10% of the value at the peak sensitivity wavelength.

## ► Chopping frequency

In the measurement of infrared detector sensitivity, an optical chopper is often used to perform on-off operation of incident light. This is the frequency of the chopper.

## ► $D^*$ (D-star: Detectivity)

$D^*$  is the detectivity indicating the S/N in an AC signal obtained by a detector when radiant energy of 1 W is input to the detector.  $D^*$  is normalized to a detector area of 1  $\text{cm}^2$  and a noise bandwidth of 1 Hz, to allow comparing of characteristics of detector materials independent of the detector area.  $D^*$  is usually represented as  $D^*$  (A, B, C), in which A is the light source temperature [K] or wavelength [ $\mu\text{m}$ ], B is the chopping frequency [Hz], and C is the noise bandwidth [Hz].  $D^*$  is expressed in units of  $\text{cm} \cdot \text{Hz}^{1/2}/\text{W}$ , and the higher the  $D^*$ , the better the detector.  $D^*$  is given by the following equation.

$$D^* = \frac{S/N \cdot \Delta f^{1/2}}{P \cdot A^{1/2}}$$

where S is the signal, N is the noise, P is the incident energy in [ $\text{W}/\text{cm}^2$ ], A is the photosensitive area in [ $\text{cm}^2$ ] and  $\Delta f$  is the noise bandwidth in [Hz]. The following relation is established by  $D^*$  and NEP.

$$D^* = \frac{A^{1/2}}{\text{NEP}}$$

## ► Noise: $N$

The noise is the output voltage (current) from a detector operated under specified conditions and 300 K background radiations.

## ► Shunt resistance: $R_{sh}$

This shunt resistance is the voltage-to-current ratio in the vicinity of 0 V in photovoltaic detectors and defined as follows:

Where  $I_d$  is the dark current at reverse voltage=10 mV.

$$R_{sh} [\Omega] = \frac{10 \text{ [mV]}}{I_d [\text{A}]}$$

For applications where no reverse voltage is applied, noise resulting from the shunt resistance becomes predominant.

## ► Quantum efficiency: $QE$

The quantum efficiency is the number of electrons or holes that can be detected as a photocurrent, divided by the number of incident photons. This is commonly expressed in percent [%]. The quantum efficiency QE and photosensitivity S [A/W] have the following relationship at a given wavelength [nm]:

$$QE = \frac{S \times 1240}{\lambda} \times 100 [\%]$$

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