

Infrared Detectors

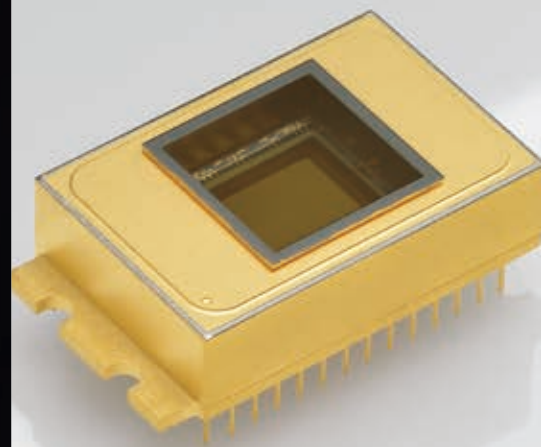
Covering a broad spectral range in the infrared region



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



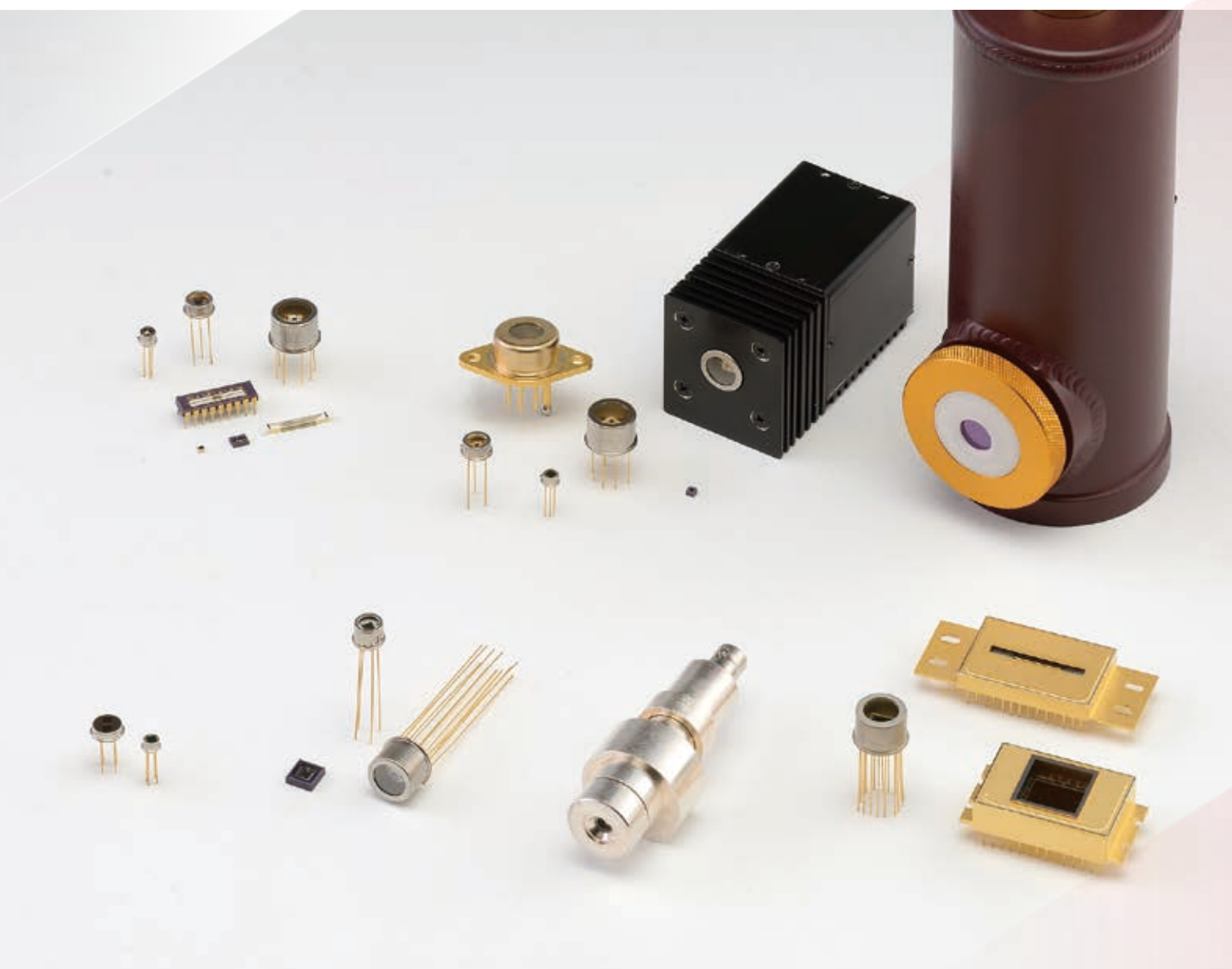
■ Type II superlattice infrared detector
P15409-901



■ InGaAs area image sensor
G13393-0909W

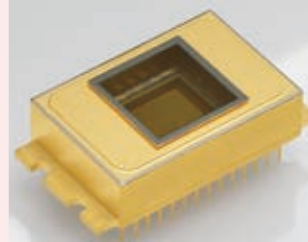
Infrared detectors

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

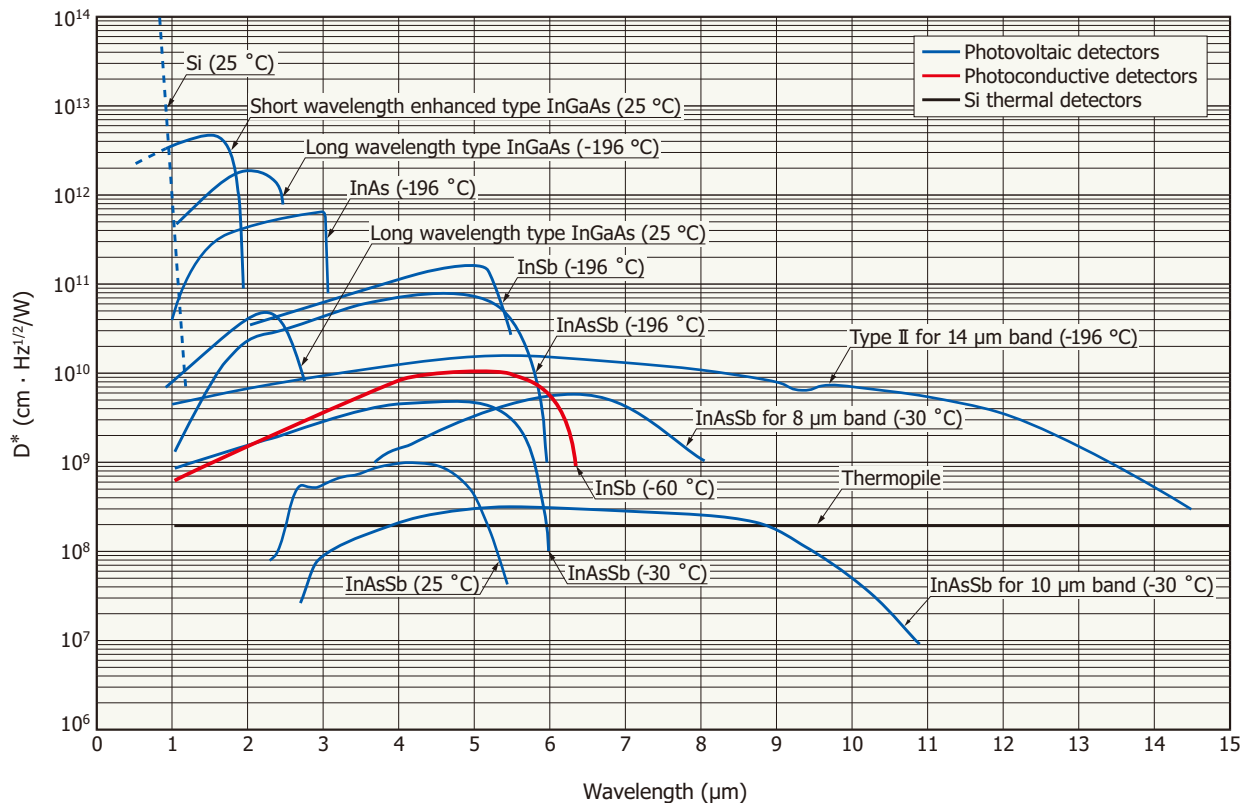
Hamamatsu infrared detectors

Product name	Spectral response range (μm)				Features	Page
	0	1	2	3		
InGaAs PIN photodiodes	0.5 1.7				<ul style="list-style-type: none"> Short wavelength enhanced type Can detect light from 0.5 μm 	5
	0.9 1.7				<ul style="list-style-type: none"> Standard type High-speed response, high sensitivity, low dark current Available with various photosensitive areas, arrays, and packages 	5, 6, 10
	0.9 1.9				<ul style="list-style-type: none"> For optical measurement around 1.7 μm TE-cooled type available 	7
	0.9 2.1				<ul style="list-style-type: none"> For optical measurement in the band of water content absorption (1.9 μm) TE-cooled type available 	7
	0.9 2.6				<ul style="list-style-type: none"> For NIR spectroscopy TE-cooled type available 	8
InGaAs APD	0.9 1.7				<ul style="list-style-type: none"> High sensitivity and low dark current 	9
InGaAs linear image sensors	0.5 2.55				<ul style="list-style-type: none"> Timing generator incorporated Gain switching Available with various photosensitive areas, spectral response ranges, numbers of pixels, TE-coolers, and packages TE-cooled type available 	11, 12
InGaAs area image sensors	0.9 2.55				<ul style="list-style-type: none"> Timing generator incorporated TE-cooled type Low-density pixel (64x64) to high-density pixel (VGA) formats available 	13

Product name		Spectral response range (μm)										Features	Page
		0	5	10	15	20	25						
InAs photovoltaic detectors		<div><div>13.8</div></div>										<ul style="list-style-type: none">Covers a spectral response range close to PbS but offers higher response speed	14
InSb photovoltaic detectors		<div><div>15.5</div></div>										<ul style="list-style-type: none">High-speed and high sensitivity in so-called atmospheric window (3 to 5 μm)	15
InSb photoconductive detectors		<div><div>16.7</div></div>										<ul style="list-style-type: none">Detects wavelengths up to around 6.5 μm, with high sensitivity over long periods by thermoelectric cooling	15
InAsSb photovoltaic detectors		<div><div>111</div></div>										<ul style="list-style-type: none">Infrared detectors in the 5 μm, 8 μm, or 10 μm spectral bandHigh-speed responseHigh reliability	17
Type II superlattice infrared detector		<div><div>114.5</div></div>										<ul style="list-style-type: none">InAs and GaSb superlattice structure enables the detection up to around 14.5 μm	20
Thermopile detectors		<div><div>125</div></div>										<ul style="list-style-type: none">Sensors that generate thermoelectromotive force in proportion to the energy level of incident infrared light	21
Two-color detectors	Si + InGaAs	<div><div>0.322.6</div></div>										<ul style="list-style-type: none">Wide spectral response rangeUses two detectors with different spectral response ranges, mounted one over the other along the same optical axis	22, 23
	Si + InAsSb	<div><div>0.325.3</div></div>											
	InGaAs + InGaAs	<div><div>0.92.55</div></div>											
Photon drag detector		<div><div>10</div></div>										<ul style="list-style-type: none">High-speed detector with high sensitivity in 10 μm band (for CO₂ laser detection)Room temperature operation with high-speed response	24

For detailed information on the products listed in this catalog, see their datasheets that are available from our website www.hamamatsu.com

Spectral response of Hamamatsu infrared detectors (typical example)



KIRD80259EL

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.

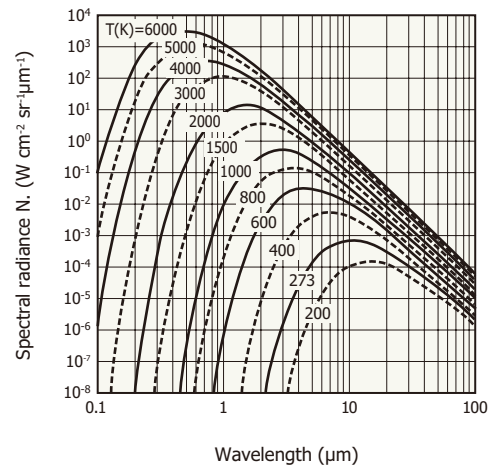
• Cooling

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 λ_p (μm) and the absolute temperature T (K).
 $\lambda_p \cdot T = 2897.9$

• Law of black body radiation (Planck's law)





KIRD80014EB

InGaAs PIN photodiodes

Short wavelength enhanced type

(Typ. Ta=25 °C)









Type no.	Cooling	Photosensitive area (mm)	Spectral response range λ (μm)	Peak sensitivity wavelength λ_p (μm)	Cutoff frequency f_c $V_R=1\text{ V}$ (MHz)	Package	Photo	Option (sold separately)
G10899-003K	Non-cooled	$\phi 0.3$	0.5 to 1.7	1.55	300	TO-18		C4159-03 (P.21)
G10899-005K		$\phi 0.5$			150			
G10899-01K		$\phi 1$			45			
G10899-02K		$\phi 2$			10	TO-5		
G10899-03K		$\phi 3$			5			

Standard type

Metal package

Various photosensitive area sizes are available.

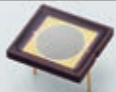
(Typ. Ta=25 °C, unless otherwise noted)

Type no.	Cooling	Photosensitive area (mm)	Spectral response range λ (μm)	Peak sensitivity wavelength λ_p (μm)	Cutoff frequency f_c (MHz)	Package	Photo	Option (sold separately)
G12180-003A	Non-cooled	$\phi 0.3$	0.9 to 1.7	1.55	600 ($V_R=5\text{ V}$)	TO-18		C4159-03 (P.21)
G12180-005A		$\phi 0.5$			200 ($V_R=5\text{ V}$)			
G12180-010A		$\phi 1$			60 ($V_R=5\text{ V}$)			
G12180-020A		$\phi 2$			13 ($V_R=1\text{ V}$)	TO-5		
G12180-030A		$\phi 3$			7 ($V_R=1\text{ V}$)			
G12180-050A		$\phi 5$			3 ($V_R=1\text{ V}$)	TO-8		
G8370-81*		$\phi 1$			35 ($V_R=1\text{ V}$)	TO-18		
G8370-82*		$\phi 2$			4 ($V_R=1\text{ V}$)	TO-5		
G8370-83*		$\phi 3$			2 ($V_R=1\text{ V}$)			
G8370-85*		$\phi 5$			0.6 ($V_R=1\text{ V}$)	TO-8		
G12180-110A	One-stage TE-cooled ($T_{\text{chip}}=-10\text{ }^{\circ}\text{C}$)	$\phi 1$	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		$\phi 2$			13 ($V_R=1\text{ V}$)			
G12180-130A		$\phi 3$			7 ($V_R=1\text{ V}$)			
G12180-150A		$\phi 5$			3 ($V_R=1\text{ V}$)			
G12180-210A	Two-stage TE-cooled ($T_{\text{chip}}=-20\text{ }^{\circ}\text{C}$)	$\phi 1$	0.9 to 1.65		40 ($V_R=1\text{ V}$)	TO-8		C4159-03 (P.21) A3179-01 (P.19) C1103-04 (P.18)
G12180-220A		$\phi 2$			13 ($V_R=1\text{ V}$)			
G12180-230A		$\phi 3$			7 ($V_R=1\text{ V}$)			
G12180-250A		$\phi 5$			3 ($V_R=1\text{ V}$)			
G6854-01	Non-cooled	$\phi 0.08$	0.9 to 1.7			2000 ($V_R=5\text{ V}$)	TO-18 with CD lens	

* Low PDL (polarization dependent loss) type











Ceramic package

(Typ. Ta=25 °C)

Type no.	Photosensitive area (mm)	Spectral response range λ (μm)	Peak sensitivity wavelength λ_p (μm)	Photosensitivity S $\lambda=\lambda_p$ (A/W)	Cutoff frequency fc VR=0 V (MHz)	Photo
G8370-10	$\phi 10$	0.9 to 1.7	1.55	1.0	0.1	

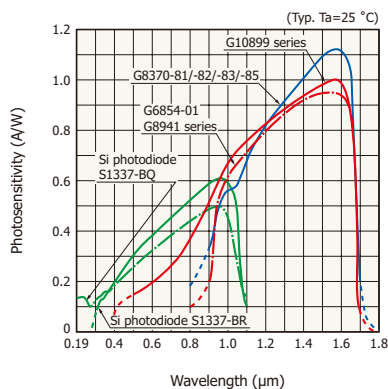
Surface mount type

(Typ. Ta=25 °C)

Type no.	Photosensitive area (mm)	Spectral response range λ (μm)	Peak sensitivity wavelength λ_p (μm)	Cutoff frequency fc VR=5 V (MHz)	Package	Photo
G8941-01	$\phi 1$	0.9 to 1.7	1.55	35	Ceramic (non-sealed)	
G8941-02	$\phi 0.5$			200		
G8941-03	$\phi 0.3$			400		
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	

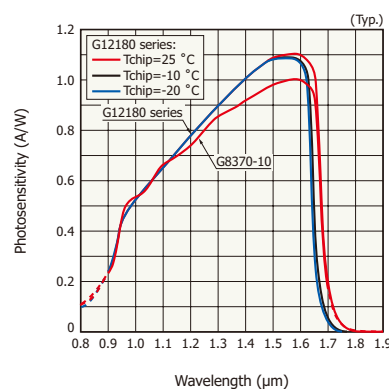
Spectral response

[G10899 series, etc.]



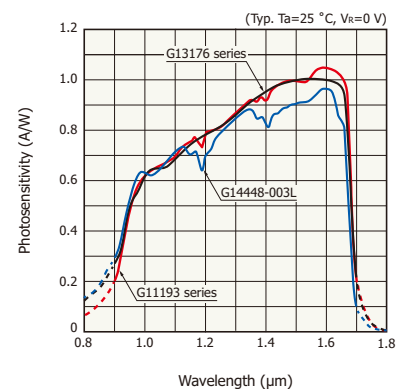
KIRD80444EE

[G12180 series, G8370-10]



KIRD80644EA

[G11193/G13176 series/G14448-003L]






KIRD80646EB

Long wavelength type

Peak sensitivity wavelength: 1.75 μm

These are suitable for optical measurement around 1.7 μm .




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

Type no.	Cooling	Photosensitive area (mm)	Spectral response range λ (μm)	Peak sensitivity wavelength λ_p (μm)	Cutoff frequency f_c $V_R=0\text{ V}$ (MHz)	Package	Photo	Option (sold separately)
G12181-003K	Non-cooled	$\phi 0.3$	0.9 to 1.9	1.75	90	TO-18		C4159-03 (P.21)
G12181-005K		$\phi 0.5$			35			
G12181-010K		$\phi 1$			10			
G12181-020K		$\phi 2$			2.5	TO-5		
G12181-030K		$\phi 3$			1.5			
G12181-103K	One-stage TE-cooled ($T_{\text{chip}}=-10\text{ }^{\circ}\text{C}$)	$\phi 0.3$	0.9 to 1.87		140	TO-8		C4159-03 (P.21) A3179 (P.19) C1103-04 (P.18)
G12181-105K		$\phi 0.5$			50			
G12181-110K		$\phi 1$			16			
G12181-120K		$\phi 2$			3.5			
G12181-130K		$\phi 3$			1.8			
G12181-203K	Two-stage TE-cooled ($T_{\text{chip}}=-20\text{ }^{\circ}\text{C}$)	$\phi 0.3$	0.9 to 1.85		150	TO-8		C4159-03 (P.21) A3179-01 (P.19) C1103-04 (P.18)
G12181-205K		$\phi 0.5$			53			
G12181-210K		$\phi 1$			17			
G12181-220K		$\phi 2$			3.7			
G12181-230K		$\phi 3$			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. $T_a=25\text{ }^{\circ}\text{C}$, unless otherwise noted)

Type no.	Cooling	Photosensitive area (mm)	Spectral response range λ (μm)	Peak sensitivity wavelength λ_p (μm)	Cutoff frequency f_c $V_R=0\text{ V}$ (MHz)	Package	Photo	Option (sold separately)
G12182-003K	Non-cooled	$\phi 0.3$	0.9 to 2.1	1.95	90	TO-18		C4159-03 (P.21)
G12182-005K		$\phi 0.5$			35			
G12182-010K		$\phi 1$			10			
G12182-020K		$\phi 2$			2.5	TO-5		
G12182-030K		$\phi 3$			1.5			
G12182-103K	One-stage TE-cooled ($T_{\text{chip}}=-10\text{ }^{\circ}\text{C}$)	$\phi 0.3$	0.9 to 2.07		140	TO-8		C4159-03 (P.21) A3179 (P.19) C1103-04 (P.18)
G12182-105K		$\phi 0.5$			50			
G12182-110K		$\phi 1$			16			
G12182-120K		$\phi 2$			3.5			
G12182-130K		$\phi 3$			1.8			
G12182-203K	Two-stage TE-cooled ($T_{\text{chip}}=-20\text{ }^{\circ}\text{C}$)	$\phi 0.3$	0.9 to 2.05		150	TO-8		C4159-03 (P.21) A3179-01 (P.19) C1103-04 (P.18)
G12182-205K		$\phi 0.5$			53			
G12182-210K		$\phi 1$			17			
G12182-220K		$\phi 2$			3.7			
G12182-230K		$\phi 3$			1.9			

Peak sensitivity wavelength: 2.3 μm

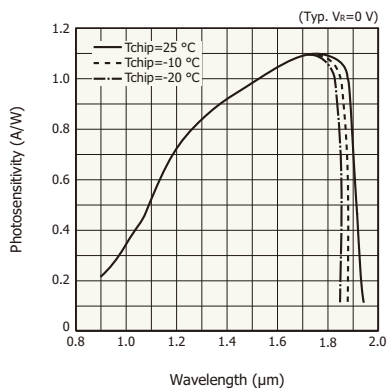
These are suitable for use in NIR (near infrared) spectroscopy.

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

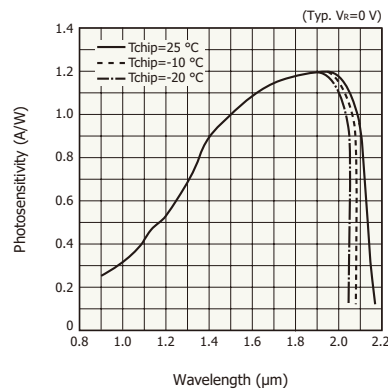
Type no.	Cooling	Photosensitive area (mm)	Spectral response range λ (μm)	Peak sensitivity wavelength λ_p (μm)	Cutoff frequency f_c $V_R=0\text{ V}$ (MHz)	Package	Photo	Option (sold separately)
G12183-003K	Non-cooled	$\phi 0.3$	0.9 to 2.6	2.3	50	TO-18		C4159-03 (P.21)
G12183-005K		$\phi 0.5$			20			
G12183-010K		$\phi 1$			6			
G12183-020K		$\phi 2$			1.5	TO-5		
G12183-030K		$\phi 3$			0.8			
G12183-103K	One-stage TE-cooled ($T_{\text{chip}}=-10\text{ }^{\circ}\text{C}$)	$\phi 0.3$	0.9 to 2.57		70	TO-8		C4159-03 (P.21) A3179 (P.19) C1103-04 (P.18)
G12183-105K		$\phi 0.5$			25			
G12183-110K		$\phi 1$			7			
G12183-120K		$\phi 2$			2			
G12183-130K		$\phi 3$			0.9			
G12183-203K	Two-stage TE-cooled ($T_{\text{chip}}=-20\text{ }^{\circ}\text{C}$)	$\phi 0.3$	0.9 to 2.55	75	TO-8		C4159-03 (P.21) A3179-01 (P.19) C1103-04 (P.18)	
G12183-205K		$\phi 0.5$		28				
G12183-210K		$\phi 1$		8				
G12183-220K		$\phi 2$		2.3				
G12183-230K		$\phi 3$		1				

Spectral response

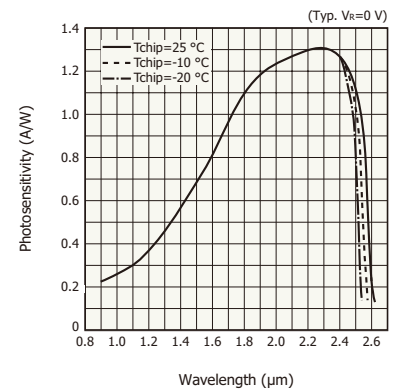
[G12181 series]



[G12182 series]





[G12183 series]



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 (μm)	Breakdown voltage max. $I_D=100\text{ }\mu\text{A}$ (V)	Temperature coefficient of breakdown voltage (V/°C)	Cutoff frequency $R_L=50\text{ }\Omega$ (MHz)	Terminal capacitance (pF)	Gain $\lambda=1.55\text{ }\mu\text{m}$	Photo
 G14858-0020AA	φ0.2	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.

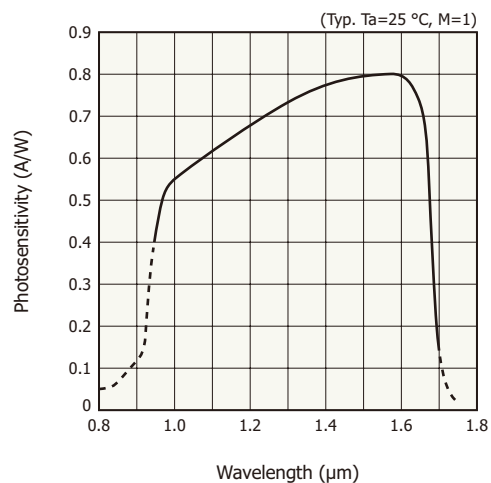
(Typ.)

Type no.	Detector	Cooling (Measurement condition)	Photosensitive area (mm)	Cutoff wavelength λ_c (μm)	Peak sensitivity wavelength λ_p (μm)	Photosensitivity $S_{\lambda=\lambda_p}$ (V/W)	Photo
G6121	G8370-05	Non-cooled ($T_a=25\text{ }^\circ\text{C}$)	φ5	1.7	1.55	1×10^6	
C12483-250	G12180-250A	TE-cooled ($T_{chip}=-15\text{ }^\circ\text{C}$)	φ5	1.66	1.55	5×10^7	
C12485-210	G12182-210K		φ1	2.05	1.95	1.8×10^8	
C12486-210	G12183-210K			2.56	2.3	2×10^8	
G7754-01	G12183-010 (chip)	Liquid nitrogen ($T_{chip}=-196\text{ }^\circ\text{C}$)	φ1	2.4	2.0	2×10^9	
G7754-03	G12183-030 (chip)		φ3			5×10^8	

Note: A power supply cable is included

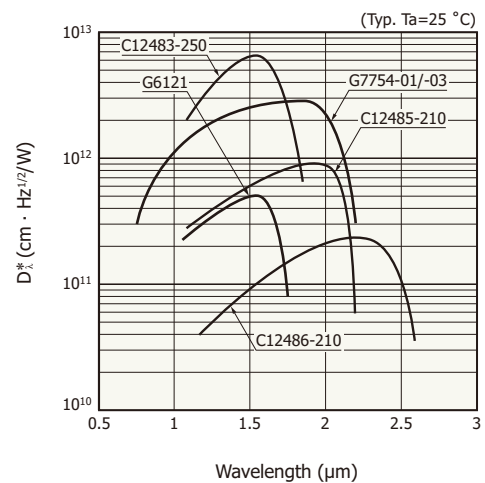
Spectral response

[G14858-0020AA]



KAPD80417EA

[Infrared detector modules with preamp]










KIRDB0369EG

Hamamatsu also provides the C10439-10/-11 photodiode modules that integrate an InGaAs photodiode and an I/V amplifier.

InGaAs PIN photodiode arrays

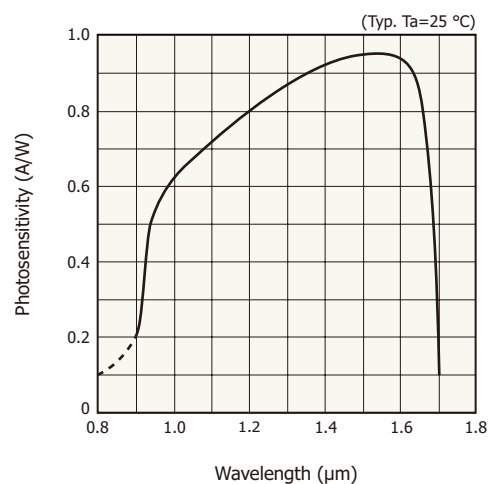
4 segmented type and 16-element, 32-element, 40-element, and 46-element arrays are available.

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

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

Spectral response

[InGaAs photodiode arrays]









KIRD80002EB

InGaAs image sensors


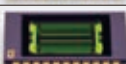




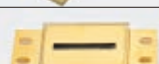
InGaAs linear image sensors for spectrometry

Front-illuminated type

Type no.	Cooling	Pixel height (μm)	Pixel pitch (μm)	Number of pixels	Line rate (lines/s)	Spectral response range λ (μm)	Defective pixels	Photo	Dedicated driver circuit
G9203-256D	Non-cooled	500	50	256	1910	0.9 to 1.7	0		—
G9204-512D			25	512	960* ¹				
G11608-256DA			50	256	17200	0.5 to 1.7	1% max.		—
G11608-512DA			25	512	9150* ¹				
G11508-256SA	One-stage TE-cooled (Tchip=-10 °C)	500	50	256	17200	0.9 to 1.67	0		—
G11508-512SA			25	512	9150* ¹				
G11475-256WB	Two-stage TE-cooled (Tchip=-20 °C)	250	50	256	17200	0.9 to 1.85	5% max.		—
G11476-256WB						0.9 to 2.05			
G11477-256WB						0.9 to 2.15			
G11478-256WB						0.9 to 2.55			
G11475-512WB		25	512	9150* ¹	0.9 to 1.85	4% max.			
G11477-512WB					0.9 to 2.15				
G11478-512WB					0.9 to 2.55				
G14237-512WA					500				

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

Back-illuminated type



Type no.	Cooling	Pixel height (μm)	Pixel pitch (μm)	Number of pixels	Line rate (lines/s)	Spectral response range λ (μm)	Defective pixels	Photo	Dedicated driver circuit*2
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				
G12230-512WB	Two-stage TE-cooled (Tchip=-20 °C)	250	25	512	9150	0.95 to 2.15	2% max.		—
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			—
G11620-512SA			25	512	9150				

*2: Sold separately

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 (μm)	Pixel pitch (μm)	Number of pixels	Line rate (lines/s)	Spectral response range λ (μm)	Defective pixels	Photo	Dedicated driver circuit*3
G9494-256D	Non-cooled	50	50	256	7100	0.9 to 1.7	1% max.		C10820
G9494-512D		25	25	512	3720*4				

*3: Sold separately




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

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 (μm)	Pixel pitch (μm)	Number of pixels	Line rate (lines/s)	Spectral response range λ (μm)	Defective pixels	Photo	Dedicated driver circuit*5
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 (μm)	Pixel pitch (μm)	Number of pixels	Line rate (lines/s)	Spectral response range λ (μm)	Defective pixels	Photo	Dedicated driver circuit*5
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	1.12 to 1.9			

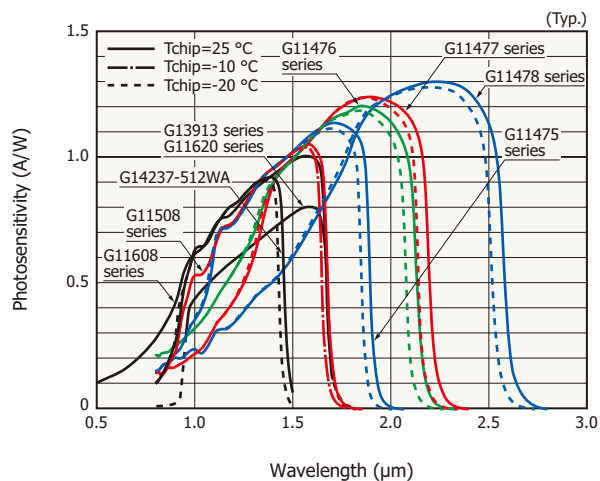
*5: Sold separately

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

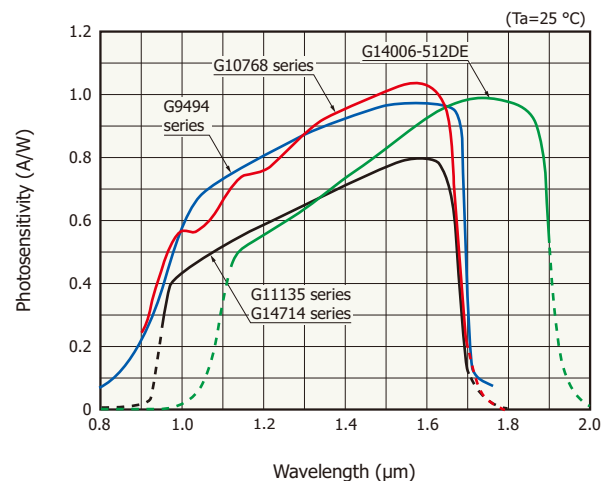
Type no.	Cooling	Pixel height (μm)	Pixel pitch (μm)	Number of pixels	Line rate (lines/s)	Spectral response range λ (μm)	Defective pixels	Photo	Dedicated driver circuit
 G14714-512DE	Non-cooled	25	25	512	40000	0.95 to 1.7	1% max.		—
 G14714-1024DK		12.5	12.5	1024					

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.

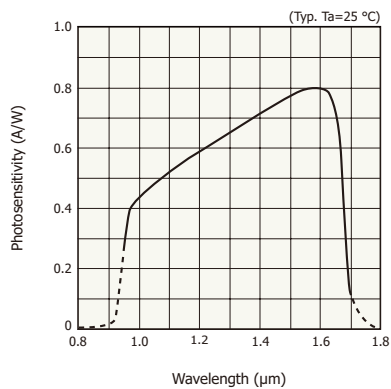
Type no.	Cooling	Pixel size (μm)	Pixel pitch (μm)	Number of pixels	Frame rate*1 (frames/s)	Spectral response range λ (μm)	Defective pixels	Photo	Dedicated driver circuit*2
G11097-0606S	One-stage TE-cooled (Tchip=25 °C)	50 × 50	50	64 × 64	1025	0.95 to 1.7	1% max.		C11512
G12460-0606S	One-stage TE-cooled (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	500	0.95 to 1.7	0.37% max.		—
 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

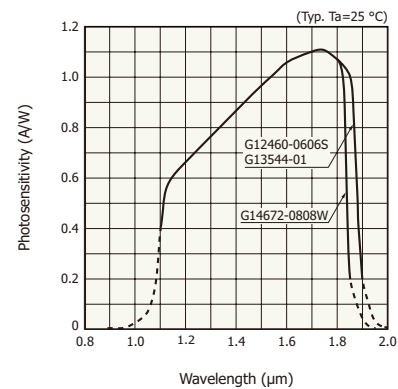
Spectral response

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



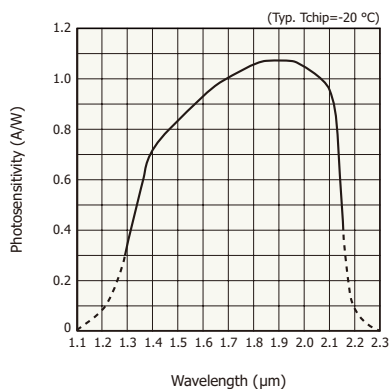
KMIRB0051EB

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



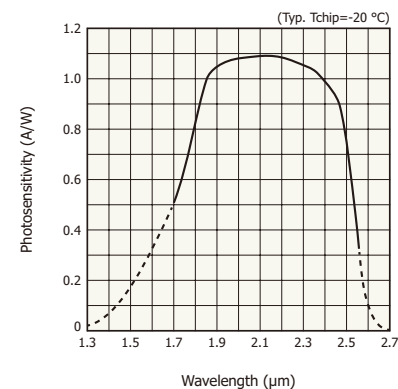
KMIRB0078EC

[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 λ_c (μm)	Peak sensitivity wavelength λ_p (μm)	Package	Photo	Option (sold separately)
P10090-01	Non-cooled	$\phi 1$	3.65	3.35	TO-5		C4159-07 (P21)
P10090-11	One-stage TE-cooled (Tchip=-10 °C)		3.55	3.30	TO-8		A3179-01 (P19) C1103-04 (P18) C4159-06 (P21)
P10090-21	Two-stage TE-cooled (Tchip=-30 °C)		3.45	3.25			A3179-01 (P19) C1103-04 (P18) C4159-06 (P21)
P7163	Liquid nitrogen (Tchip=-196 °C)		3.10	3.00	Metal dewar		C4159-05 (P21)

Infrared detector module with preamp

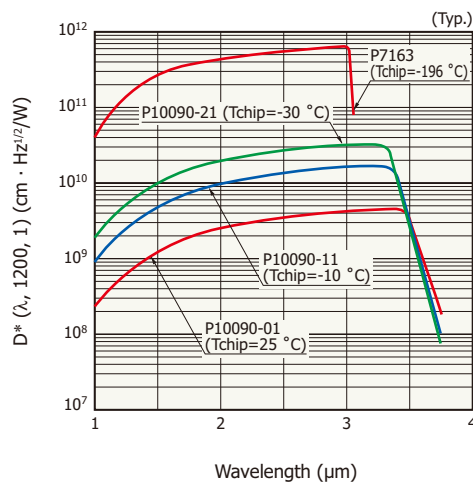
This is an amplifier-integrated module that can detect infrared light simply by giving a DC power supply. (Typ.)

Type no.	Detector	Photosensitive area (mm)	Cooling	Measurement condition Chip temperature (°C)	Cutoff wavelength λ_c (μm)	Peak sensitivity wavelength λ_p (μm)	Photo
C12492-210	InAs (P10090-21)	$\phi 1$	TE-cooled	-28	3.45	3.25	

Note: A power supply cable is included.

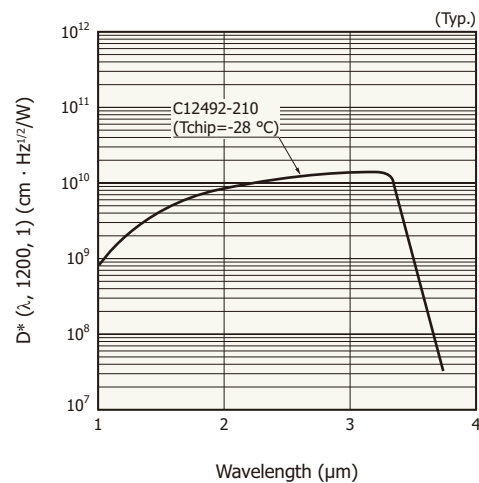
Spectral response

[InAs photovoltaic detectors]



KIRD80356EE

[C12492-210]





KIRD80688EA

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 λ_c (μm)	Peak sensitivity wavelength λ_p (μm)	Package	Photo	Dedicated amplifier (sold separately)
P5968-060	Liquid nitrogen (Tchip=-196 °C)	$\phi 0.6$	5.5	5.3	Metal dewar		C4159-01 (P21)
P5968-100		$\phi 1$					
P5968-200		$\phi 2$					C4159-04 (P21)
P5968-300		$\phi 3$					Custom-made product
P4247-16		0.25×1.4 (1 \times 16-element)					C4159-01 (P21)
P4247-44		0.45×0.45 (4 \times 4-element)					

InSb photoconductive detectors

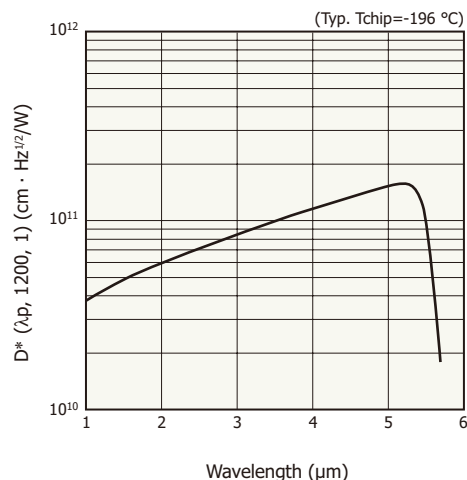
Thermoelectrically cooled InSb photoconductive detectors are capable of detecting infrared light up to around 6 μm with high sensitivity and high speed.

(Typ.)

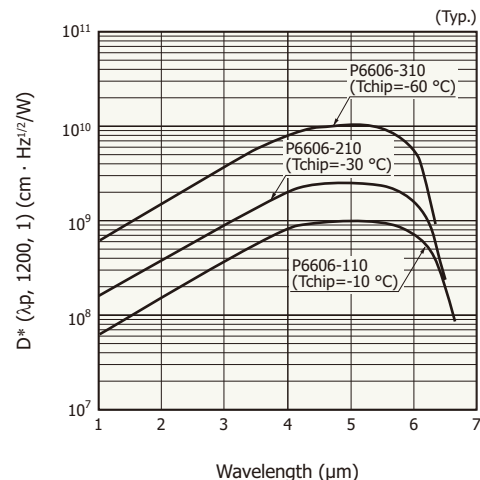
Type no.	Cooling	Photosensitive area (mm)	Cutoff wavelength λ_c (μm)	Peak sensitivity wavelength λ_p (μm)	Package	Photo	Option (sold separately)
P6606-110	One-stage TE-cooled (Tchip=-10 °C)	1 \times 1	6.7	5.5	TO-8		A3179-01 (P19) C1103-07 (P18) C5185-02 (P22)
P6606-210	Two-stage TE-cooled (Tchip=-30 °C)		6.5				A3179-01 (P19) C1103-07 (P18) C5185-02 (P22)
P6606-305	Three-stage TE-cooled (Tchip=-60 °C)	0.5 \times 0.5	6.3		TO-3		A3179-04 (P19) C1103-05 (P18) C5185-02 (P22)
P6606-310		1 \times 1					
P6606-320		2 \times 2					

Spectral response

[InSb photovoltaic detectors]





[InSb photoconductive detectors]





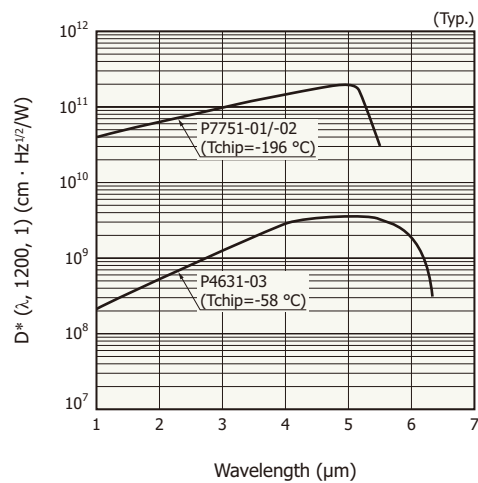
Infrared detector modules with preamp

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 λ_c (μm)	Peak sensitivity wavelength λ_p (μm)	Photo
				Chip temperature ($^{\circ}\text{C}$)			
P4631-03	InSb (P6606-310)	1 × 1	TE-cooled	-58	6.1	5.5	
P7751-01*	InSb (P5968-060)	$\phi 0.6$	Liquid nitrogen	-196	5.5	5.3	
P7751-02*	InSb (P5968-200)	$\phi 2$					

* FOV=60°
Note: A power supply cable is included

Spectral response













KIRDB689EA

InAsSb photovoltaic detectors

Standard type

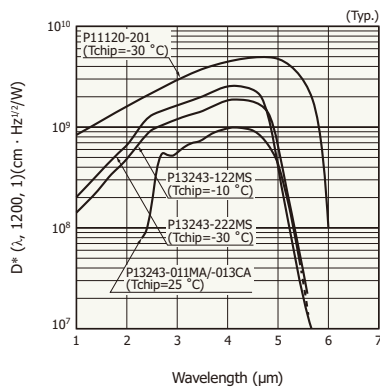
These sensors deliver high-sensitivity in the wavelength 5 μm , 8 μm , and 10 μm bands using our unique crystal technology. A small surface mount package P13243-013CA is also available.

(Typ.)

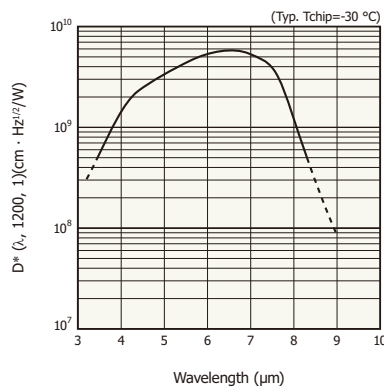
Type no.	Cooling	Photosensitive area (mm)	Cutoff wavelength λ_c (μm)	Peak sensitivity wavelength λ_p (μm)	Package	Photo	Options (sold separately)
P11120-201	Two-stage TE-cooled (Tchip=-30 °C)	$\phi 1$	5.9	4.9	TO-8		A3179-01 (P.27) C1103-04 (P.26) C4159-07 (P.29)
P13243-013CA	Non-cooled	0.7 × 0.7	5.3	3.5	Ceramic		C4159-01 (P.29)
P13243-011MA					TO-46		
P13243-122MS	One-stage TE-cooled (Tchip=-10 °C)	2 × 2	5.2	4.1	TO-8		A3179 (P.27) C1103-04 (P.26) C4159-01 (P.29)
P13243-222MS	Two-stage TE-cooled (Tchip=-30 °C)		5.1				A3179-01 (P.27) C1103-04 (P.26) C4159-01 (P.29)
P12691-201G	Two-stage TE-cooled (Tchip=-30 °C)	$\phi 1$	8.3	6.7	TO-8		A3179-01 (P.27) C1103-04 (P.26) C4159-07 (P.29)
 P13894-011CN	Non-cooled	1 × 1	11.0	5.6	Ceramic		C4159-01 (P.29)
P13894-011MA					TO-5		
P13894-211MA	Two-stage TE-cooled (Tchip=-30 °C)		10.2		TO-8		A3179-01 (P.27) C1103-04 (P.26) C4159-01 (P.29)

Spectral response

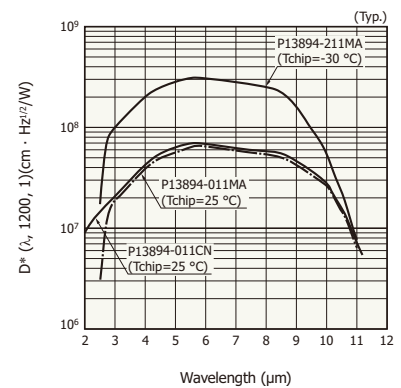
[P11120-201, P13243 series]



[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) for the window material. It is suitable for measurement of gases (CH_4 , CO_2).

(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.29)
 P13243-033MF				TO-46		
 P13243-039CF			BPF (3.9 μm)	Ceramic		
 P13243-039MF				TO-46		
 P13243-043CF			BPF (4.26 μm)	Ceramic		
 P13243-043MF				TO-46		
 P13243-015CF		0.7 × 0.7 (2 elements)	BPF (3.3 μm)	Ceramic		—
			BPF (3.9 μm)			
 P13243-016CF			BPF (3.9 μm)			
			BPF (4.26 μm)			

*1: BPF: Band-pass filter

Array

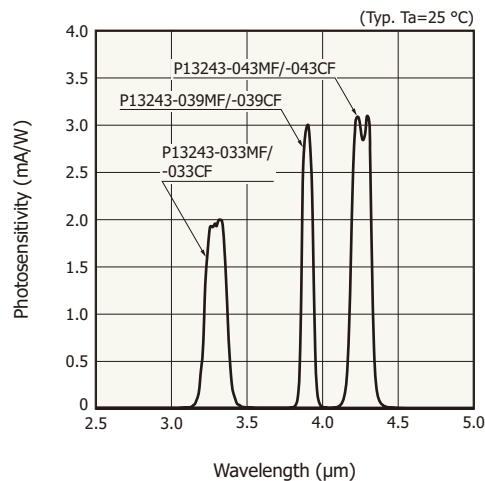
These are InAsSb photodiode arrays in a ceramic DIP. Simultaneous measurement and wide range measurement are possible.

(Typ.)

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

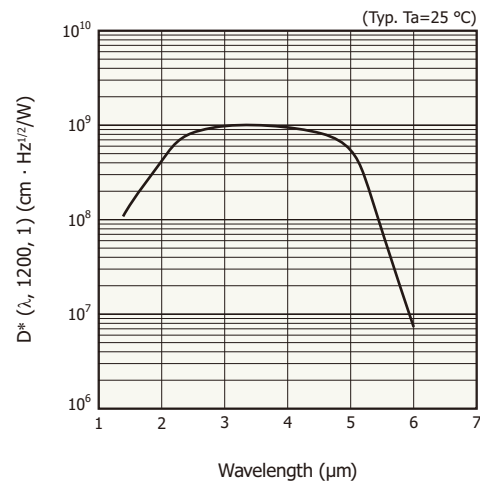
Spectral response

[P13243 series]



KIRD80676EA

[P15742 series]




KIRD80687EA

Infrared detector modules with preamp

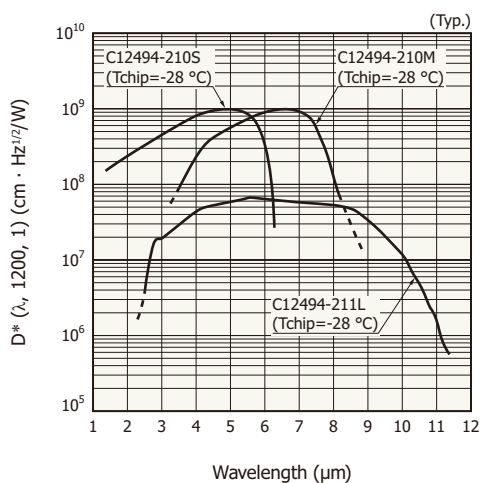
These are amplifier-integrated modules that can detect infrared light simply by connecting a DC power supply.

(Typ.)

Type no.	Detector	Photosensitive area (mm)	Cooling	Measurement conditions	Cutoff wavelength λ_c (μm)	Peak sensitivity wavelength λ_p (μm)	Photo
				Chip temperature ($^{\circ}\text{C}$)			
C12494-210S	InAsSb (P11120-201)	$\phi 1$	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





KIRDB0690EA

Hamamatsu also provides the C10439-14 photodiode module that integrates an InAsSb photovoltaic detector and an I/V amplifier.

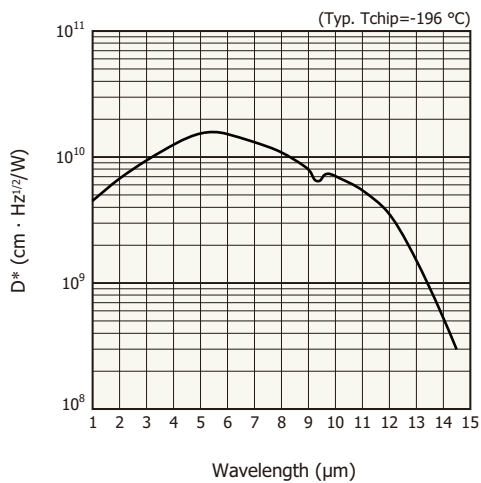
Type II superlattice infrared detector

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.

Type no.	Cooling	Photosensitive area (mm)	Cutoff wavelength*1 λ_c (μm)	Peak sensitivity wavelength λ_p (μm)	Package	Photo	Dedicated amplifier (Sold separately)
 P15409-901	Liquid nitrogen (Tchip=-196 °C)	$\phi 0.1$	14.5	5.4	Metal dewar		C4159-01 (P.29)

*1: Wavelength at which signal/noise=1

Spectral response




KIRD0673EB

Thermopile detectors (Si thermal detectors)

Single-element type

Hamamatsu provides high-sensitivity 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 T11262-06 is suitable for flame detection and the T11361-05 for CO₂ concentration measurement.

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*				Band-pass filter	4.45	
T11262-06					4.3	
T11361-05*						

* Built-in thermistor

Dual-element type

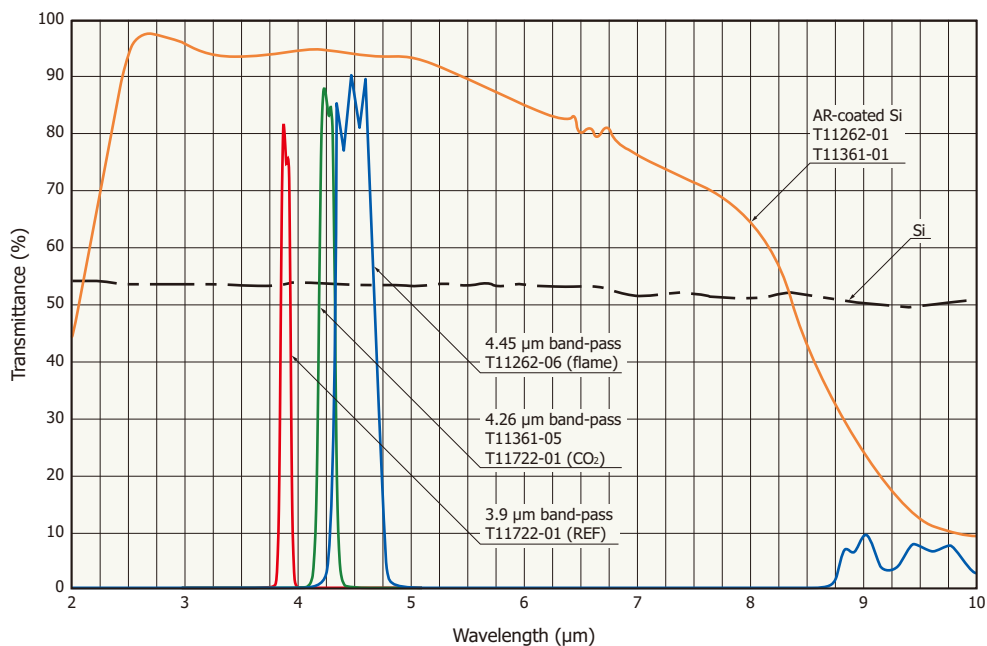
The T11722-01 is a dual-element type thermopile detector designed to detect CO₂ concentrations with a high accuracy. It consists of a high sensitivity dual-element thermopile detector and two band-pass filters for sensing two wavelengths (reference: 3.9 μm, CO₂: 4.3 μm) simultaneously.

Type no.	Package	Number of elements	Photosensitive area (mm)	Window	Spectral response (μm)	Photo
T11722-01	TO-5	2	1.2 × 1.2 (per 1 element)	Band-pass filter	Reference: 3.9 CO ₂ : 4.3	

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.

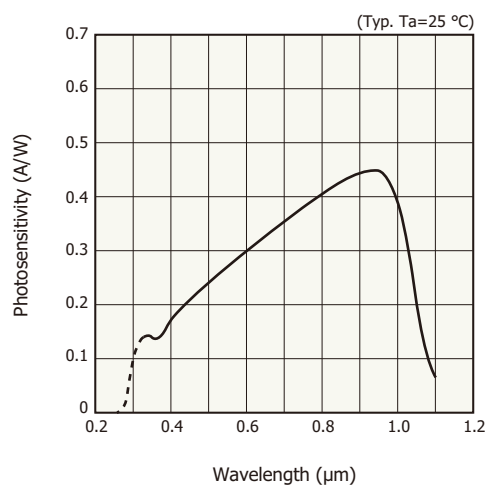
(Typ.)

Type no.	Cooling	Detector	Photosensitive area (mm)	Spectral response range λ (μm)	Peak sensitivity wavelength λ_p (μm)	Photo-sensitivity S (A/W)	Package	Photo	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			
K1713-05		Si	2.4×2.4	0.32 to 1.7	0.94	0.45			C9329 C4159-03 (P.21)
		InGaAs	$\phi 0.5$		1.55	0.55			
K1713-08		Si	2.4×2.4	0.32 to 2.6	0.94	0.45			C9329 C4159-03 (P.21)
		InGaAs	$\phi 1$		2.3	0.60			
K1713-09		Si	2.4×2.4	0.32 to 1.7	0.94	0.45			C4159-03 (P.21)
		InGaAs	$\phi 1$		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) A3179-03 (P.19) C1103-04 (P.18)
		InGaAs	$\phi 1$		2.1	1.0			
K3413-05		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	$\phi 0.5$		1.55	0.55			
K3413-08		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	$\phi 1$		2.3	0.60			
K3413-09		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	$\phi 1$		1.55	0.55			
K12728-010K	Non-cooled	Si	2.4×2.4	0.32 to 1.7	0.96	0.45	Ceramic		—
		InGaAs	$\phi 1$		1.55	0.55			
K12729-010K		InGaAs	2.4×2.4	0.9 to 2.55	1.55	0.95			
		InGaAs	$\phi 1$		2.1	1.0			

Spectral response

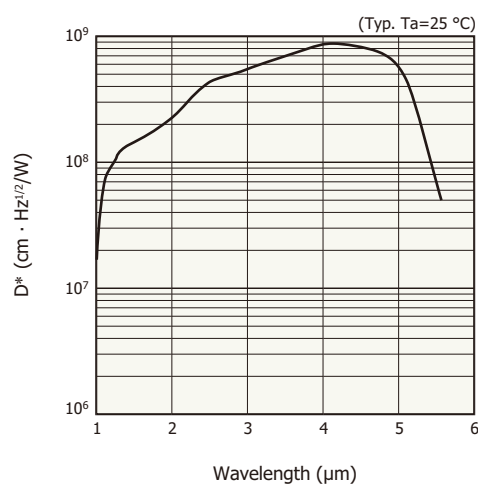
[K1713-003]

Si photodiode



KIRD80199EA

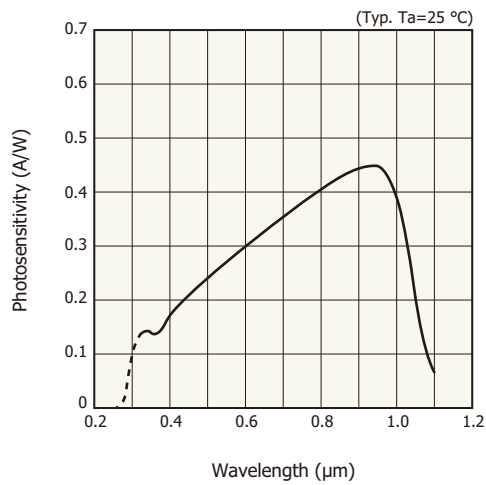
InAsSb photovoltaic detector



KIRD80623EA

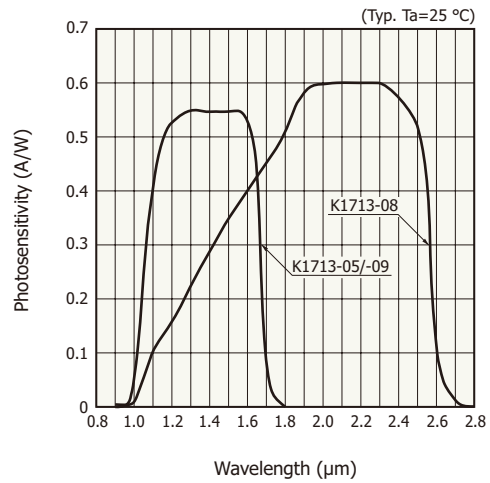
[K1713-05/-08/-09]

Si photodiode



KIRDB0199EA

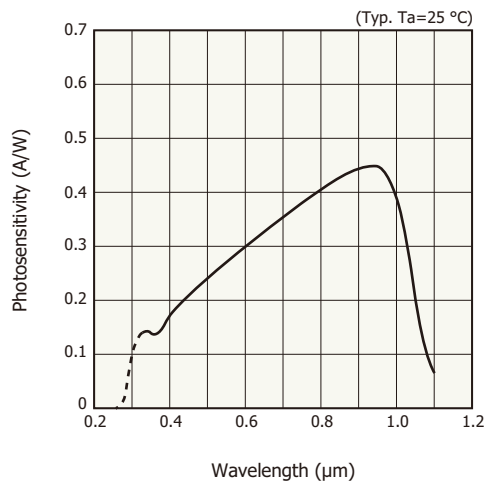
InGaAs PIN photodiode



KIRDB0211EA

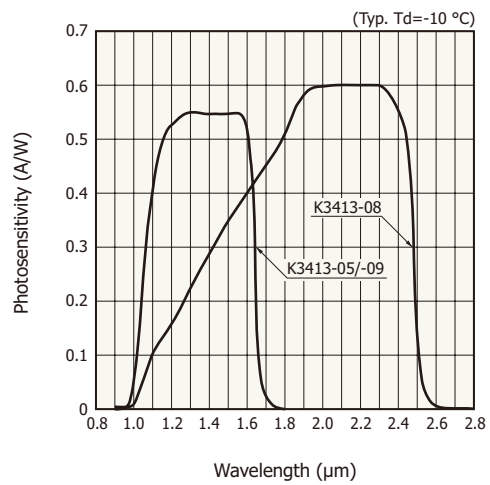
[K3413-05/-08/-09]

Si photodiode



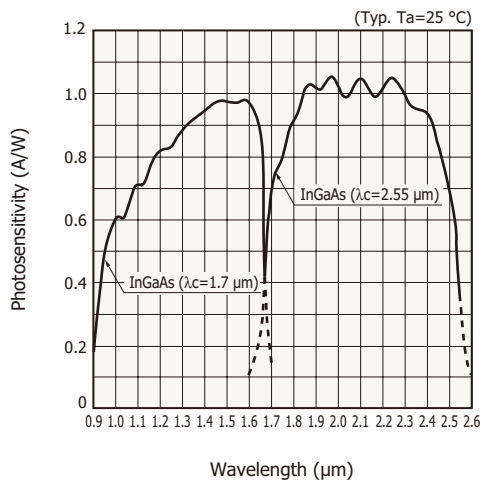
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InGaAs PIN photodiode



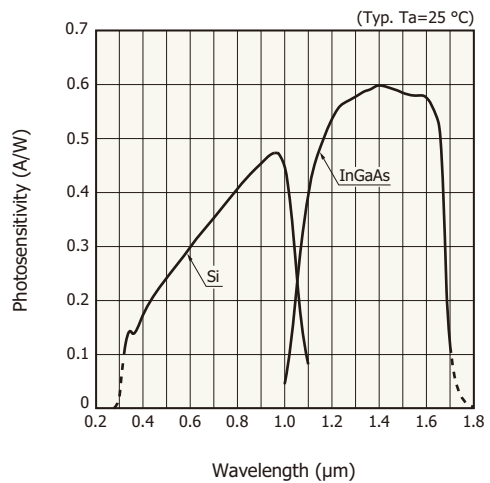
KIRDB0212EA

[K11908-010K, K12729-010K]



KIRDB0479EB

[K12728-010K]





KIRDB0598EC

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 CO₂ 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.

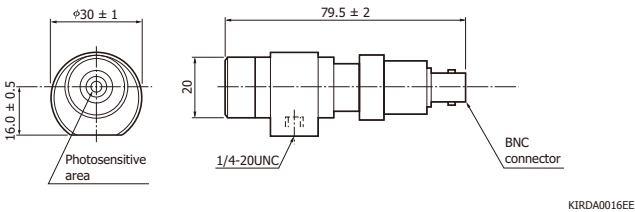
Non-cooled type

(Typ.)

Type no.	Cooling	Photosensitive area (mm)	Peak sensitivity wavelength λ_p (μm)	Photosensitivity $S_{\lambda=10.6\mu\text{m}}$ (V/W)	Photo	Magnet stand (sold separately)
B749	Non-cooled	$\phi 5.0$	10.6	1.2×10^{-6}		A1447
C12496-046		$\phi 4.6$		1.3×10^{-2}		-

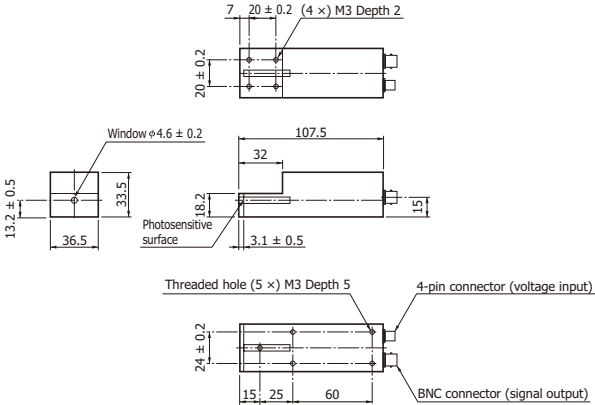
Dimensional outlines (unit: mm, tolerance unless otherwise noted: ± 1)

[B749]

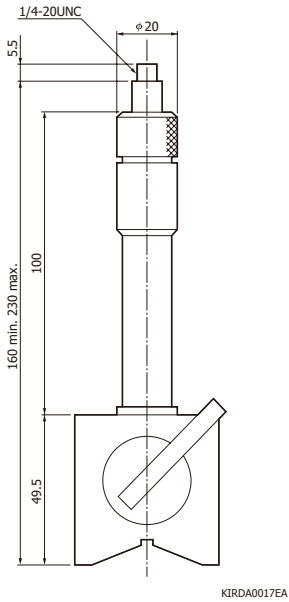


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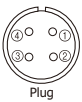
[C12496-046]



[Magnet stand A1447]



KIRDA0017EA



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

Tolerance unless otherwise noted: ± 1

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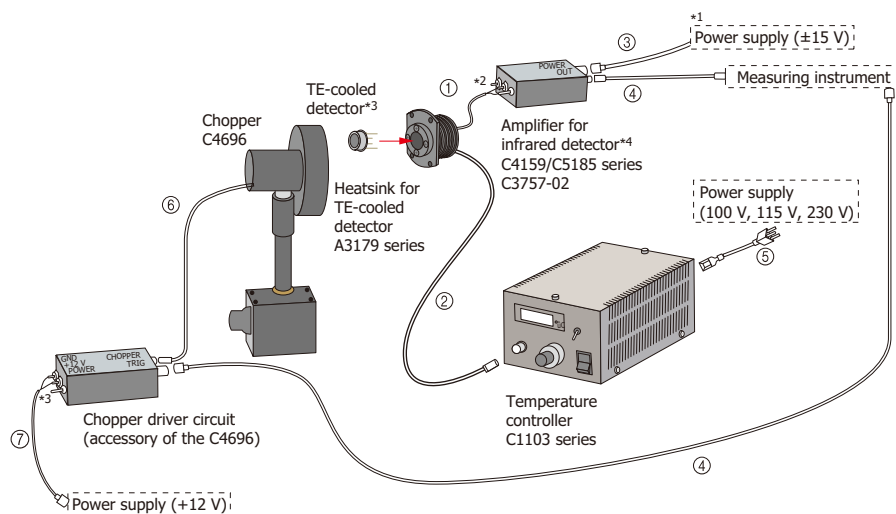
Accessories for infrared detectors

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



KACCC0321ED

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 \pm 10% · 50/60 Hz*5		
Power consumption	30 W		
Dimensions	107 (W) \times 87 (H) \times 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.

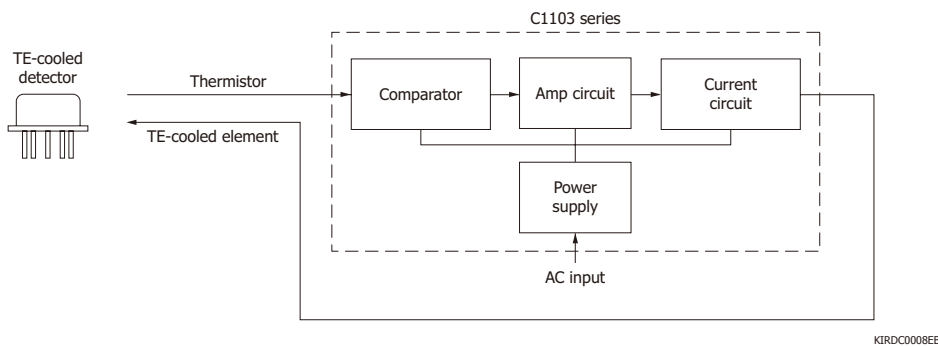
*5: Please specify power supply requirement (AC line voltage) from among 100 V, 115 V and 230 V when ordering.

*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

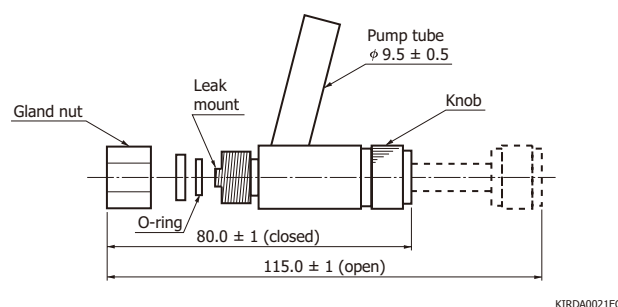


Valve operator for metal dewar A3515

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

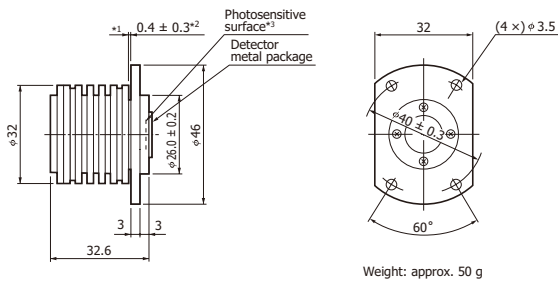
- Instruction manual
- 4-conductor cable (2 m): for TE-cooler and thermistor*1 *2
- Coaxial cable (2 m): for signal*2

*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: ± 0.3)

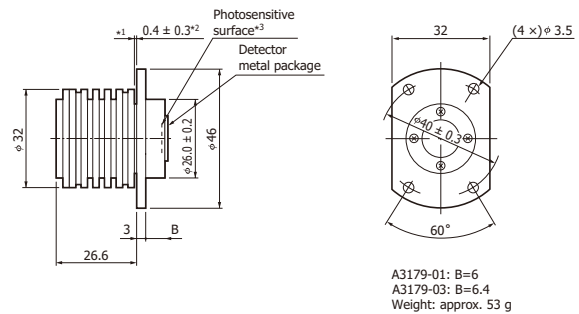
[A3179]



- *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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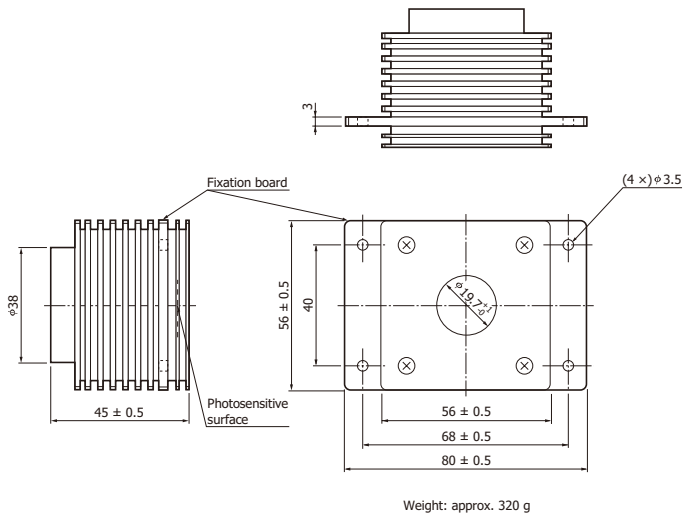
[A3179-01, A3179-03]



- *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.

KIRDA0019EF

[A3179-04]



KIRDA0149ED

Chopper C4696

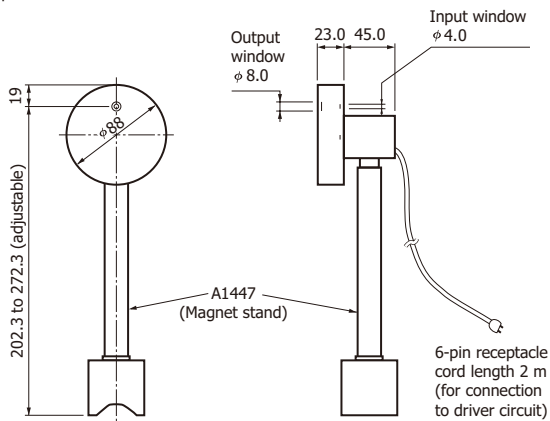
Parameter	Specification
Chopping frequency	115 to 380 Hz, 345 Hz typ.* ³
Operating voltage V_D	DC 5 to 13 V, 12 V typ.
Duty ratio	1:1
Rotational stability	0.06%/°C
Sync signal V_H (high level)	Min. $V_D - 0.5$ V Max. $V_D - 0.2$ V
Operating temperature	0 to 50 °C
Maximum current consumption* ⁴	90 mA
Accessories	Magnet stand A1447 (see P.16), driver circuit

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

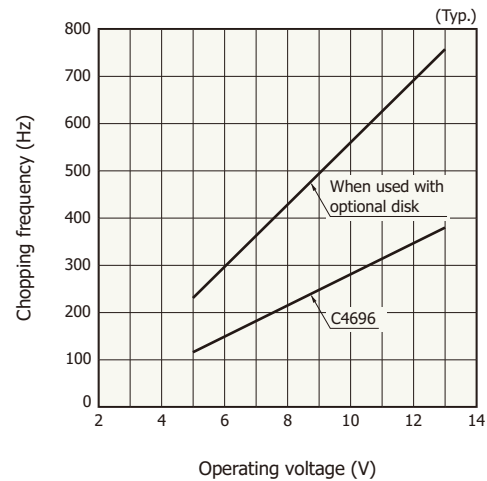
*⁴: $V_D = 12$ V

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

<Chopper>

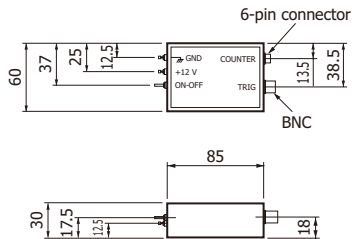


Chopping frequency vs. operating voltage



KIRD80376EA

<Driver circuit>



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, C5158-02: $\pm 15\text{ V} \pm 0.5$
- 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, P13894-011CN/-011MA), 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	C5158-02	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 (Ta=25 °C)

Parameter	Value	Unit
Supply voltage	± 18.0 max.	V
Operating temperature	0 to +40	°C
Storage temperature	-20 to +70	°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	Ω
Maximum output voltage (1 k Ω load)	+10	+10	+10	+10	+10	V
Output offset voltage	± 5	± 5	± 10	± 5	± 5	mV
Equivalent input noise current*5 (f=1 kHz)	0.15 ($10^8, 10^7$ range) 0.65 (10^6 range)	0.55	0.15 ($10^8, 10^7$ range) 0.65 (10^6 range)	6	10	pA/Hz ^{1/2}
Reverse voltage	Limited to 0 V operation, cannot be applied from external unit					-
External power supply*6	± 15					V
Current consumption	+30, -10 max.			+30, -22 max.		mA

*4: When connected to a detector, the frequency becomes 60 kHz or less ($\phi 0.6$ mm: 60 kHz or less, $\phi 1$ 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 μ 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 Ω (C4159-01/-04/-05), 500 Ω (C4159-06/-07)

*6: Recommended DC power supply (analog power supply): ± 15 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	Ω
Maximum output voltage (1 kΩ load)	+10	V
Output offset voltage	±5	mV
Equivalent input noise current (f=1 kHz)	2.5	pA/Hz ^{1/2}
Reverse voltage	Cannot be applied from external unit	-
External power supply*7	±15	V
Current consumption	±15 max.	mA

Amplifier for photoconductive detector (Typ.)*8

Parameter	C5185-02	Unit
Input impedance	5	kΩ
Voltage gain	66 (× 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	Ω
Maximum output voltage (1 kΩ load)	±10	V
Equivalent input noise voltage (f=1 kHz)	2.6*9	nV/Hz ^{1/2}
External power supply*7	±15	V
Current consumption	+100, -30 max.	mA

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

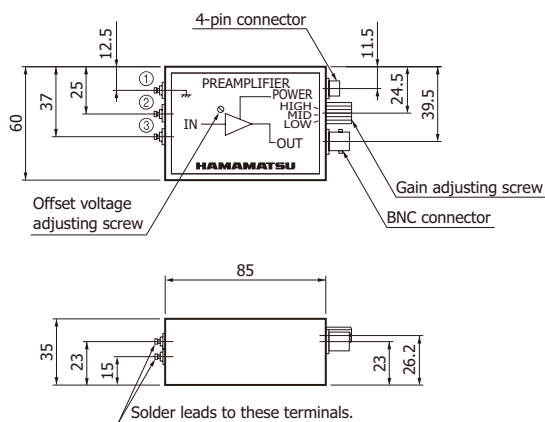
*8: Before purchasing, make sure the bias current to the detector matches the detector bias current specified in the table.

*9: At the maximum detector bias current

Note: Output noise voltage = Equivalent input noise voltage × Voltage gain

Dimensional outlines (unit: mm)

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



Pin connections

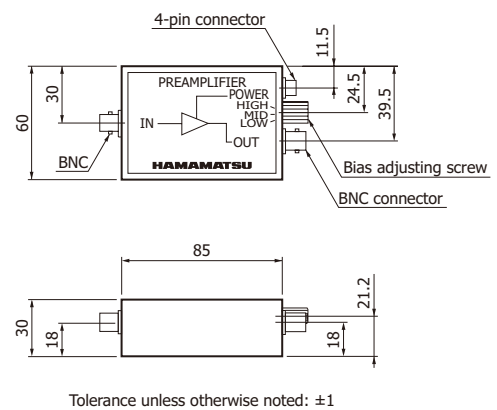
- ① GND
- ② Cathode
- ③ Anode

Tolerance unless otherwise noted: ±1

Note: Socket for lead attachment is not provided.

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[C5185-02]



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

KIRDA0048EB

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: λ_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 (λ_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.

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

► 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 μm), laser diode (1.3 μm), 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 lx illuminance.

► Cutoff wavelength: λ_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 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 [μm], 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 Δf 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]:

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



No.



No.

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- Hamamatsu products should not be used in excess of their absolute maximum ratings. Attention must be paid to all documented precautions.
- Hamamatsu continually makes efforts to improve the quality and reliability of its products; however these efforts cannot ensure 100% compliance with the manufacturing specifications. Sufficient safety design (such as redundant safety, fire preventative, and malfunction preventative features) are to be implemented in the development of equipment manufactured with the Hamamatsu product so that personal injury, fire, or damage to public property or welfare does not occur in the unlikely event of a malfunction of the Hamamatsu product. A dangerous condition could be created if sufficient consideration is not given to safety design that addresses potential problems, especially in the design of equipment where the failure or malfunction of the Hamamatsu product within the equipment could result in bodily harm, life-threatening injury, or serious property damage during the use of the equipment. With such types of equipment, Hamamatsu shall not be responsible for the use of its products within the equipment in any way for not obtaining our written consent such as specification sheets beforehand.
- Appropriate descriptions of the functions, performance, and methods of operation of the Hamamatsu product and the equipment within which the Hamamatsu product is incorporated are to be provided to end-users of the equipment. All accompanying warnings and cautionary labeling are also to be provided to the end-user.
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Image intensifiers
Xenon lamps / mercury-xenon lamps
Deuterium lamps
Light source applied products
Laser applied products
Microfocus X-ray sources
X-ray imaging devices

Opto-semiconductors

Si photodiodes
APD
MPPC®
Photo IC
Image sensors
PSD
Infrared detectors
LED
Optical communication devices
Automotive devices
X-ray flat panel sensors
Mini-spectrometers
Opto-semiconductor modules

Imaging and Processing Systems

Cameras / image processing measuring systems
X-ray products
Life science systems
Medical systems
Semiconductor failure analysis systems
FPD / LED characteristic evaluation systems
Spectroscopic and optical measurement systems

Laser Products

Semiconductor lasers
Applied products of semiconductor lasers
Solid state lasers

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Quality, technology and service are part of every product.

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