HAMAMATSU
PHOTON IS OUR BUSINESS

Selection guide - March 2013

INFRARED DETECTORS

Covering a broad spectral range in the infrared region

INFRARED DETECTORS

HAMAMATSU PHOTONICS K.K.

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 detector

Infrared detectors

HAMAMATSU infrared detectors

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InGaAs PIN photodiodes	0.5 – 1.7	• Short wavelength enhanced type • Can detect light from 0.5 μm	1
	0.9 – 1.7	• Standard type • High-speed response, high sensitivity, low dark current • Available various types of photosensitive areas, arrays and packages	1, 2
	0.9 – 1.9	• For optical measurement around 1.7 μm • Available TE-cooled type	3
	0.9 – 2.1	• For optical measurement in the band of water content absorption (1.9 μm) • Available TE-cooled type	3
	0.9 – 2.6	• For NIR spectroscopy • Available TE-cooled type	4
InGaAs image sensors	0.5 – 2.55	• Types for spectrophotometry and WDM monitor, and high-speed type available	6, 7

Product name		Spectral response range (μm)	Features	Page
PbS photoconductive detectors		1 – 3.2	• Photoconductive detectors whose resistance decreases with the input of infrared light • Can be used at room temperatures in a wide range of applications such as radiation thermometers and flame monitors	9, 10
PbSe photoconductive detectors		1 – 5.2	• Detects wavelengths up to 5.2 μm • Offers higher response speed at room temperatures compared to other detectors used in the same wavelength range. Suitable for a wide range of applications such as gas analyzers.	9, 10
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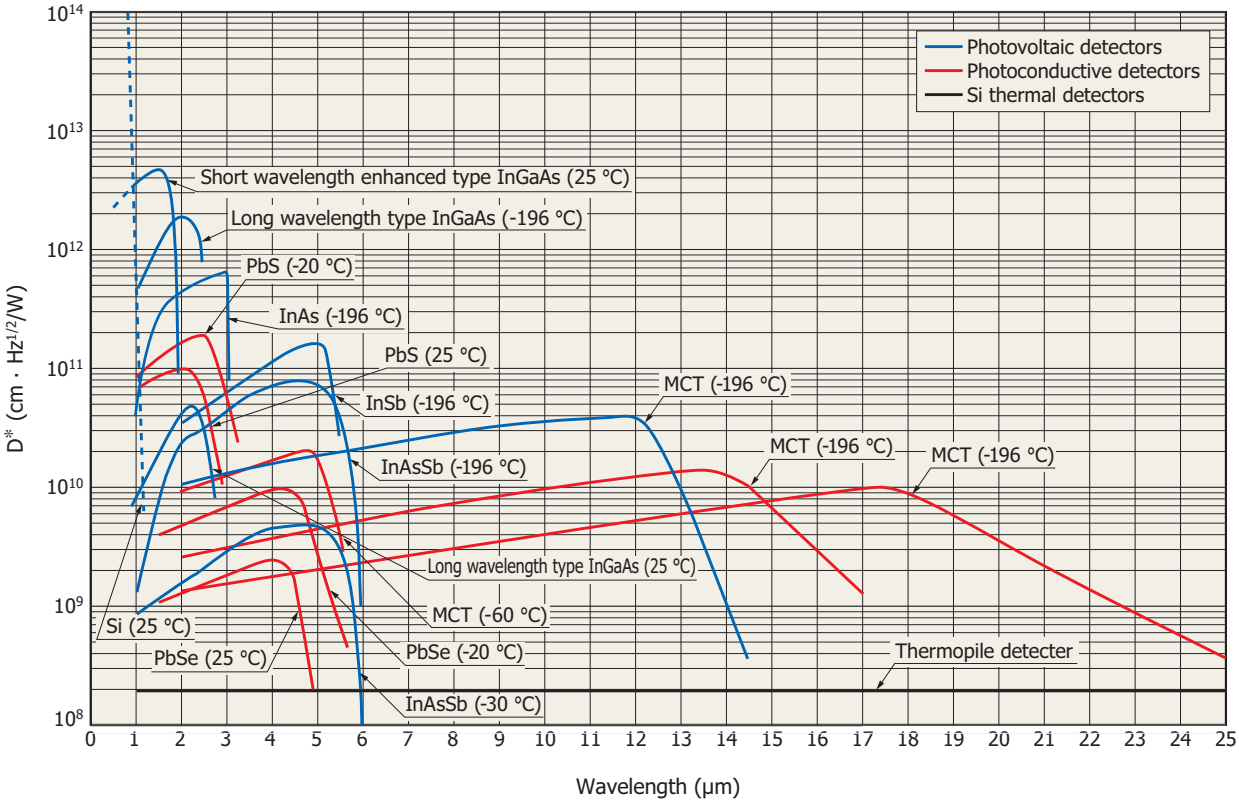
MCT (HgCdTe) photoconductive detectors		1 – 25	• Various types with different spectral response range are provided by changing the HgTe and CdTe composition ratio. • High sensitivity photoconductive detectors whose resistance decreases with the input of infrared light • Available with TE-cooled type and cryogenic dewar	14, 15
MCT (HgCdTe) photovoltaic detectors		1 – 13.5	• High-speed response and low noise	15
Thermopile detectors		1 – 25	• Sensors that generate thermoelectromotive force in proportion to the energy level of incident infrared light	17
Two-color detectors	Si + PbS	0.2 – 3	• Wide spectral response range from UV to IR • Uses two detectors with different spectral response ranges, mounted one over the other along the same optical axis	18, 19
	Si + PbSe	0.2 – 4.85		
	Si + InGaAs	0.32 – 2.55		
	InGaAs + InGaAs	0.9 – 2.55		
Photon drag detector		10	• High-speed detector with high sensitivity in 10 μm band (for CO_2 laser detection) • Room temperature operation with high-speed response	20

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)



KIRDB0259EF

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; in contrast, for PbS, PbSe and MCT detectors it shifts to the longer wavelength side.

Response speed

Various detectors are available with different response speeds. It should be noted that the response speeds of the PbS and PbSe detectors become worse with cooling.

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

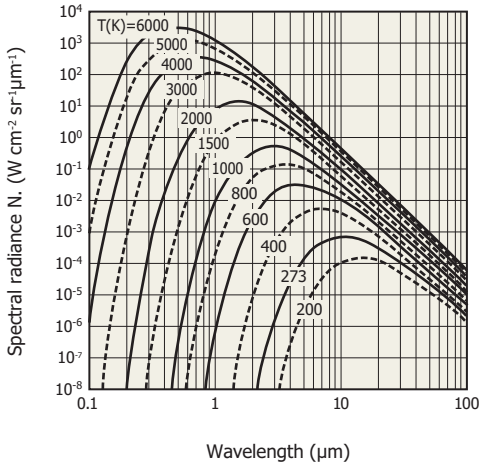
Besides easy-to-use photosensors designed for room temperature, HAMAMATSU provides various types of sensors that are cooled with thermoelectric coolers, cryogenic dewars (for liquid nitrogen cooling).

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 λp (µm) and the absolute temperature T (K).

$\lambda p \cdot T = 2897.9$

Law of black body radiation (Planck's law)



KIRDB0014EB

InGaAs PIN photodiodes

Short wavelength enhanced type

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

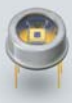
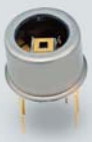
Type no.	Cooling	Photosensitive area (mm)	Spectral response range λ (μm)	Peak sensitivity wavelength λp (μm)	Cutoff frequency fc (MHz)	Package	Photo	Option (sold separately)
G10899-003K	Non-cooled	φ0.3	0.5 to 1.7	1.55	300	TO-18		C4159-03 (P.25)
G10899-005K		φ0.5			150			
G10899-01K		φ1			45			
G10899-02K		φ2			10	TO-5		
G10899-03K		φ3			5			

Standard type

Metal package

Various photosensitive area sizes are available.

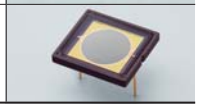
(Typ. Ta=25 °C, unless otherwise noted)

Type no.	Cooling	Photosensitive area (mm)	Spectral response range λ (μm)	Peak sensitivity wavelength λp (μm)	Cutoff frequency fc (MHz)	Package	Photo	Option (sold separately)
NEW G12180-003A	Non-cooled	φ0.3	0.9 to 1.7	1.55	600 (V_R=5 V)	TO-18		C4159-03 (P.25)
NEW G12180-005A		φ0.5			200 (V_R=5 V)			
NEW G12180-010A		φ1			60 (V_R=5 V)			
NEW G12180-020A		φ2			13 (V_R=1 V)	TO-5		
NEW G12180-030A		φ3			7 (V_R=1 V)			
NEW G12180-050A		φ5			1 (V_R=1 V)	TO-8		
G8370-81*		φ1			35 (V_R=1 V)	TO-18		
G8370-82*		φ2			4 (V_R=1 V)	TO-5		
G8370-83*		φ3			2 (V_R=1 V)			
G8370-85*		φ5			0.6 (V_R=1 V)	TO-8		
G8605-11	One-stage TE-cooled (Td=-10 °C)	φ1	0.9 to 1.67		18 (V_R=1 V)	TO-8		C4159-03 (P.25) A3179 (P.23) C1103-04 (P.22)
G8605-12		φ2			4 (V_R=1 V)			
G8605-13		φ3			2 (V_R=1 V)			
G8605-15		φ5			0.6 (V_R=1 V)			
G8605-21	Two-stage TE-cooled (Td=-20 °C)	φ1	0.9 to 1.65		18 (V_R=1 V)			C4159-03 (P.25) A3179-01 (P.23) C1103-04 (P.22)
G8605-22		φ2			4 (V_R=1 V)			
G8605-23		φ3			2 (V_R=1 V)			
G8605-25		φ5			0.6 (V_R=1 V)			

* 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 λp (μm)	Cutoff frequency fc V_R=5 V (MHz)	Package	Photo
G11193-02R	φ0.2	0.9 to 1.7	1.55	1000	Surface mount type ceramic	
G11193-03R	φ0.3			500		
G8370-10	φ10			0.1*1	Ceramic	

*1: V_R=0 V

Surface mount type

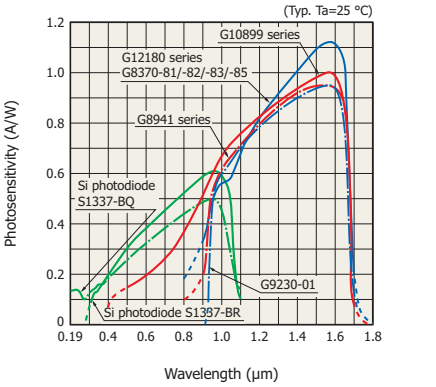
These InGaAs PIN photodiodes are assembled on a small ceramic base originally developed for laser diode monitoring. The G8941 series InGaAs photodiodes use a front-illuminated sensor chip, while the G9230-01 uses a back-illuminated sensor chip mounted on a base without wire bonding to allow an optical fiber to be set in close proximity.

(Typ. Ta=25 °C)

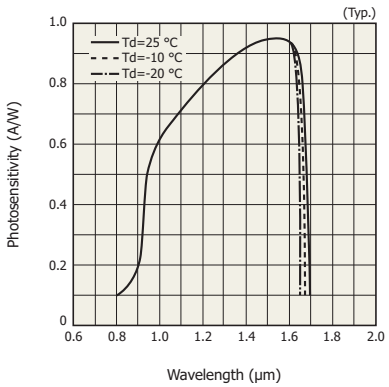
Type no.	Photosensitive area (mm)	Spectral response range λ (μm)	Peak sensitivity wavelength λp (μm)	Cutoff frequency fc V_R=5 V (MHz)	Package	Photo	Type
G8941-01	φ1	0.9 to 1.7	1.55	35	Ceramic		Front-illuminated type
G8941-02	φ0.5			200			
G8941-03	φ0.3	0.9 to 1.7		400			
G9230-01		0.95 to 1.7					Back-illuminated type
NEW G11777-003P		0.9 to 1.7		500	Plastic		COB

Spectral response

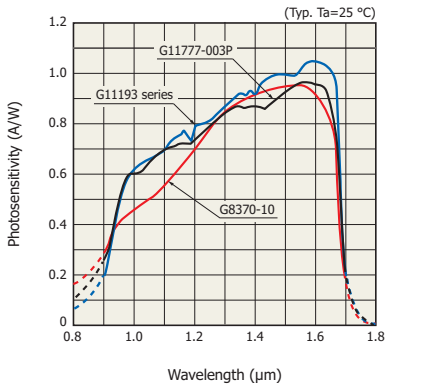
G10899/G12180 series, etc.



G8605 series



G11193 series, G8370-10, etc.



Long wavelength type

Peak sensitivity wavelength: 1.75 µm

These are suitable for optical measurement around 1.7 µm.

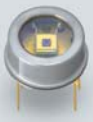
(Typ. Ta=25 °C, unless otherwise noted)

Type no.	Cooling	Photosensitive area (mm)	Spectral response range λ (µm)	Peak sensitivity wavelength λp (µm)	Cutoff frequency fc VR=0 V (MHz)	Package	Photo	Option (sold separately)
NEW G12181-003K	Non-cooled	φ0.3	0.9 to 1.9	1.75	90	TO-18		C4159-03 (P.25)
NEW G12181-005K		φ0.5			35			
NEW G12181-010K		φ1			10			
NEW G12181-020K		φ2			2.5	TO-5		
NEW G12181-030K		φ3			1.5			
NEW G12181-103K	One-stage TE-cooled (Td=-10 °C)	φ0.3	0.9 to 1.87		140	TO-8		C4159-03 (P.25) A3179 (P.23) C1103-04 (P.22)
NEW G12181-105K		φ0.5			50			
NEW G12181-110K		φ1			16			
NEW G12181-120K		φ2			3.5			
NEW G12181-130K		φ3			1.8			
NEW G12181-203K	Two-stage TE-cooled (Td=-20 °C)	φ0.3	0.9 to 1.85		150	TO-8		C4159-03 (P.25) A3179-01 (P.23) C1103-04 (P.22)
NEW G12181-205K		φ0.5			53			
NEW G12181-210K		φ1			17			
NEW G12181-220K		φ2			3.7			
NEW 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.

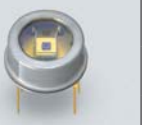
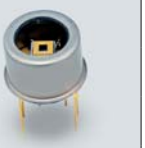
(Typ. Ta=25 °C, unless otherwise noted)

Type no.	Cooling	Photosensitive area (mm)	Spectral response range λ (µm)	Peak sensitivity wavelength λp (µm)	Cutoff frequency fc VR=0 V (MHz)	Package	Photo	Option (sold separately)
NEW G12182-003K	Non-cooled	φ0.3	0.9 to 2.1	1.95	90	TO-18		C4159-03 (P.25)
NEW G12182-005K		φ0.5			35			
NEW G12182-010K		φ1			10			
NEW G12182-020K		φ2			2.5	TO-5		
NEW G12182-030K		φ3			1.5			
NEW G12182-103K	One-stage TE-cooled (Td=-10 °C)	φ0.3	0.9 to 2.07		140	TO-8		C4159-03 (P.25) A3179 (P.23) C1103-04 (P.22)
NEW G12182-105K		φ0.5			50			
NEW G12182-110K		φ1			16			
NEW G12182-120K		φ2			3.5			
NEW G12182-130K		φ3			1.8			
NEW G12182-203K	Two-stage TE-cooled (Td=-20 °C)	φ0.3	0.9 to 2.05		150	TO-8		C4159-03 (P.25) A3179-01 (P.23) C1103-04 (P.22)
NEW G12182-205K		φ0.5			53			
NEW G12182-210K		φ1			17			
NEW G12182-220K		φ2			3.7			
NEW G12182-230K		φ3			1.9			

Peak sensitivity wavelength: 2.3 µm

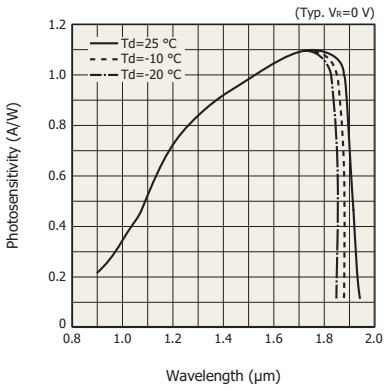
These are suitable for use in NIR (near infrared) spectroscopy.

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

Type no.	Cooling	Photosensitive area (mm)	Spectral response range λ (µm)	Peak sensitivity wavelength λp (µm)	Cutoff frequency fc VR=0 V (MHz)	Package	Photo	Option (sold separately)
NEW G12183-003K	Non-cooled	φ0.3	0.9 to 2.6	2.3	50	TO-18		C4159-03 (P.25)
NEW G12183-005K		φ0.5			20			
NEW G12183-010K		φ1			6			
NEW G12183-020K		φ2			1.5	TO-5		
NEW G12183-030K		φ3			0.8			
NEW G12183-103K	One-stage TE-cooled (Td=-10 °C)	φ0.3	0.9 to 2.57		70	TO-8		C4159-03 (P.25) A3179 (P.23) C1103-04 (P.22)
NEW G12183-105K		φ0.5			25			
NEW G12183-110K		φ1			7			
NEW G12183-120K		φ2			2			
NEW G12183-130K		φ3			0.9			
NEW G12183-203K	Two-stage TE-cooled (Td=-20 °C)	φ0.3	0.9 to 2.55		75	TO-8		C4159-03 (P.25) A3179-01 (P.23) C1103-04 (P.22)
NEW G12183-205K		φ0.5			28			
NEW G12183-210K		φ1			8			
NEW G12183-220K		φ2			2.3			
NEW G12183-230K		φ3			1			

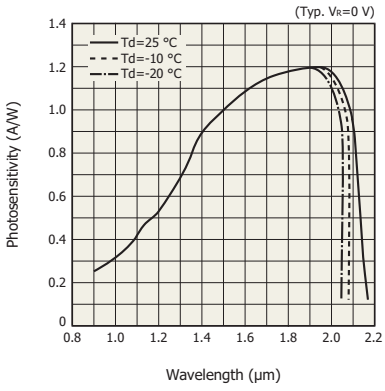
Spectral response

G12181 series



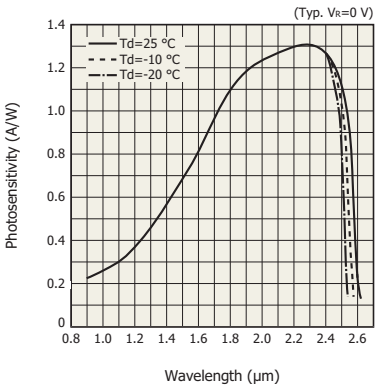
KIRDB0483EC

G12182 series



KIRDB0487EC

G12183 series



KIRDB0491EC

Infrared detector modules with preamp

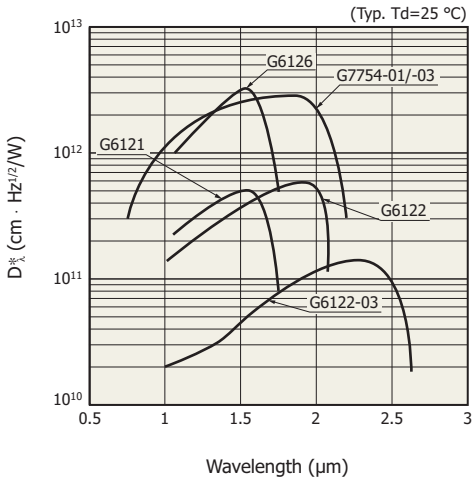
These modules consist of an InGaAs PIN photodiode assembled with matched preamplifier, and operate by connecting a DC power supply.

(Typ.)

Type no.	Detector	Cooling	Photosensitive area (mm)	Measurement condition: Element temperature (°C)	Cutoff wavelength λc (μm)	Peak sensitivity wavelength λp (μm)	Photo
G6121	G12180-050A	Non-cooled	φ5	25	1.70	1.55	
G6122*1	G12182-210K	TE-cooled	φ1	-15	2.05	1.95	
G6122-03*1	G12183-210K				2.56	2.30	
G6126*1	G8605-25		φ5		1.66	1.55	
G7754-01	G12183-010 (chip)	Liquid nitrogen	φ1	-196	2.4	2.0	
G7754-03	G12183-030 (chip)		φ3				

*1: CE EN 61326-1 Class B
Note: Supplied with a power supply cable

Spectral response



KIRDB0369ED

Image sensors, photodiode arrays

InGaAs linear image sensors for spectrophotometry

One-stage TE-cooled types can be cooled down to -10 °C and cover a spectral range from 0.9 to 1.67 µm.

Type no.	Cooling	Pixel pitch (µm)	Number of pixels	Photosensitive area (mm × mm)	Spectral response range λ (µm)	Defective pixels	Photo	Applicable driver circuit (sold separately)
G9211-256S	One-stage TE-cooled (Td=-10 °C)	50	256	12.8 × 0.25	0.9 to 1.67	1% max.		C8061-01
G9212-512S		25	512					
G9213-256S		50	256	12.8 × 0.5				
G9214-512S		25	512					

Output can be obtained from all pixels since there are no defective pixels. Suitable for precision measurement.

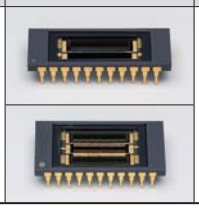
Type no.	Cooling	Pixel pitch (µm)	Number of pixels	Photosensitive area (mm × mm)	Spectral response range λ (µm)	Defective pixels	Photo	Applicable driver circuit (sold separately)
G9201-256S	One-stage TE-cooled (Td=-10 °C)	50	256	12.8 × 0.25	0.9 to 1.67	0		C8061-01
G9202-512S		25	512					
G9203-256D	Non-cooled	50	256	12.8 × 0.5	0.9 to 1.7			—
G9203-256S	One-stage TE-cooled (Td=-10 °C)				0.9 to 1.67			C8061-01
G9204-512D	Non-cooled	25	512		0.9 to 1.7			—
G9204-512S	One-stage TE-cooled (Td=-10 °C)				0.9 to 1.67			C8061-01

Two-stage TE-cooled types can be cooled down to -20 °C, which make them suitable for measuring longer wavelengths from 0.9 to 2.55 µm.

Type no.	Cooling	Pixel pitch (µm)	Number of pixels	Photosensitive area (mm × mm)	Spectral response range λ (µm)	Defective pixels	Photo	Applicable driver circuit (sold separately)
G9205-256W	Two-stage TE-cooled (Td=-20 °C)	50	256	12.8 × 0.25	0.9 to 1.85	5% max.		C8062-01
G9206-256W					0.9 to 2.05			
G9207-256W					0.9 to 2.25			
G9208-256W					0.9 to 2.55			

High-speed type InGaAs linear image sensors

These are high-speed linear image sensors suitable for industrial and measurement equipment.

Type no.	Cooling	Pixel pitch (μm)	Number of pixels	Photosensitive area (mm × mm)	Spectral response range λ (μm)	Defective pixels	Photo	Applicable driver circuit (sold separately)
G9494-256D	Non-cooled	50	256	12.8 × 0.05	0.9 to 1.7	1% max.		C10820
G9494-512D		25	512	12.8 × 0.025				

These are 1024 pixels, high-speed NIR linear image sensors designed for applications such as foreigh object screening and medical diagnostic equipment where a multichannel high-speed line rate is required.

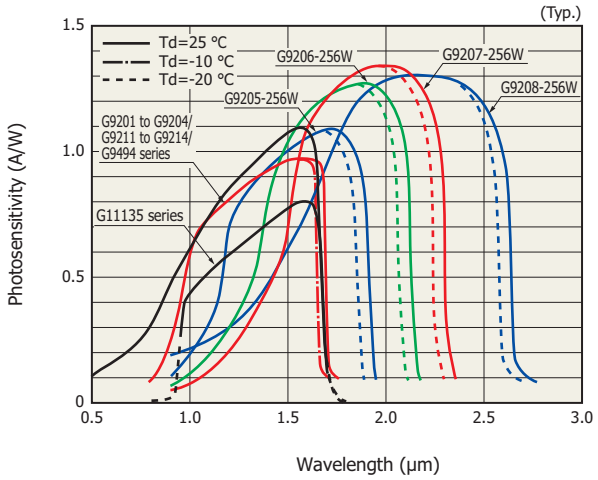
Type no.	Cooling	Pixel pitch (μm)	Number of pixels	Photosensitive area (mm × mm)	Spectral response range λ (μm)	Defective pixels	Photo	Applicable driver circuit (sold separately)
G10768-1024D	Non-cooled	25	1024	25.6 × 0.1	0.9 to 1.7	1% max.		C10854
G10768-1024DB				25.6 × 0.025				

These linear image sensors use a back-illuminated type InGaAs photodiode array that is bump-connected to a CMOS-ROIC with a single output terminal.

Type no.	Cooling	Pixel pitch (μm)	Number of pixels	Photosensitive area (mm × mm)	Spectral response range λ (μm)	Defective pixels	Photo	Applicable driver circuit (sold separately)
NEW G11135-256DD	Non-cooled	50	256	12.8 × 0.05	0.95 to 1.7	1% max.		C11514
NEW G11135-512DE		25	512	12.8 × 0.025				

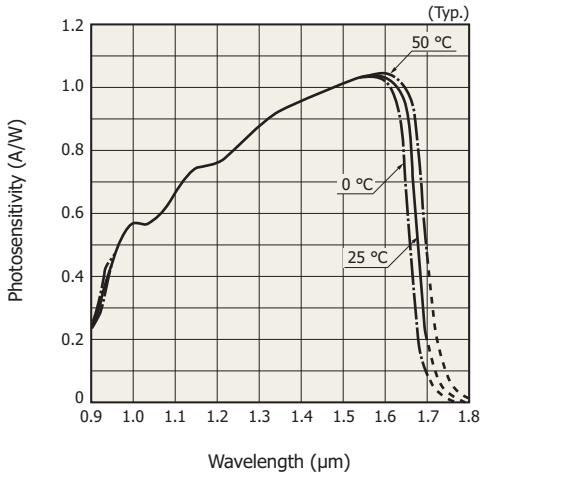
Spectral response

G9201 to G9208 series, etc.



KMIRB0068EB

G10768 series



KMIRB0042EB

InGaAs area image sensors

The G11097 series has a hybrid structure consisting of a CMOS readout circuit (ROIC: readout integrated circuit) and back-illuminated InGaAs photodiode array.

Type no.	Cooling	Pixel pitch (μm)	Number of pixels	Photosensitive area (mm × mm)	Spectral response range λ (μm)	Defective pixels	Photo	Applicable driver circuit (sold separately)
G11097-0606S	One-stage TE-cooled (Td=25 °C)	50	64 × 64	3.2 × 3.2	0.95 to 1.7	1% max.		C11512
G11097-0707S			128 × 128	6.4 × 6.4				C11512-01

InGaAs photodiode arrays

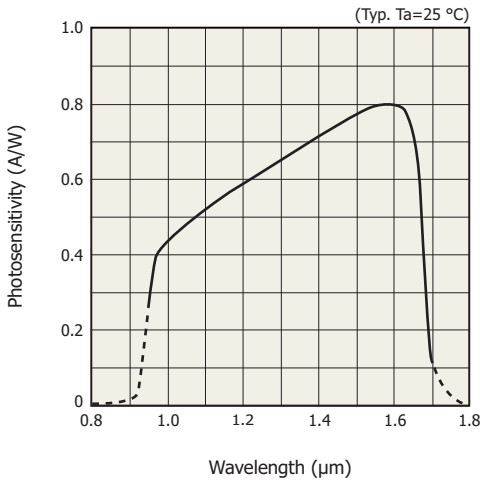
Quadrant InGaAs photodiodes and 16-element/40-element linear arrays are available.

(Typ. Ta=25 °C)

Type no.	Photosensitive area (mm)	Spectral response range λ (μm)	Peak sensitivity wavelength λp (μm)	Package	Photo
G6849-01	φ1 (Quadrant element)	0.9 to 1.7	1.55	TO-5	
G6849	φ2 (Quadrant element)				
G7150-16	0.45 × 1.0 (16-element)			DIP	
G7151-16	0.08 × 0.2 (16-element)				
G8909-01	φ0.08 (40-element)			Ceramic	

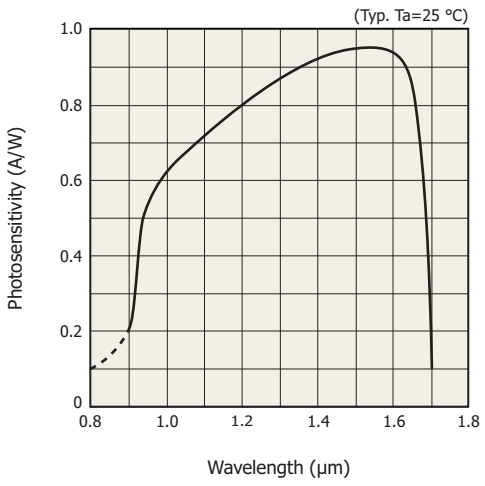
Spectral response

InGaAs area image sensors



KMIRB0051EB

InGaAs photodiode arrays



KIRDB0002EB

PbS/PbSe photoconductive detectors

PbS and PbSe detectors are photoconductive sensors whose resistance decreases with the input of infrared light.
PbS has a spectral response range from 1 to 3.2 µm, while the PbSe has a wider spectral range from 1.5 to 5.2 µm.

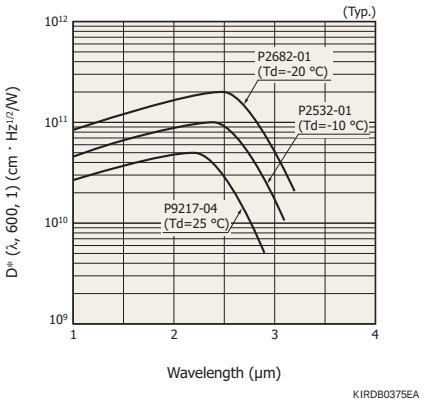
PbS photoconductive detectors

PbS photoconductive detectors are infrared sensors having a spectral response range from 1 to 3.2 µm. These sensors can be used at room temperature in a wide range of applications such as radiation thermometers and flame monitors.

(Typ.)

Type no.	Cooling	Photosensitive area (mm)	Cutoff wavelength λc (µm)	Peak sensitivity wavelength λp (µm)	Package	Photo	Option (sold separately)
P9217	Non-cooled	1 × 5	2.9	2.2	TO-5		C3757-02 (P.26)
P9217-02		2 × 2					
P9217-03		3 × 3					
P9217-04		4 × 5			TO-8		
P2532-01	One-stage TE-cooled (Td=-10 °C)	4 × 5	3.1	2.4	TO-8		C3757-02 (P.26) A3179 (P.23) C1103-04 (P.22)
P2682-01	Two-stage TE-cooled (Td=-20 °C)		3.2	2.5			C3757-02 (P.26) A3179-01 (P.23) C1103-04 (P.22)

Spectral response



PbSe photoconductive detectors

PbSe photoconductive detectors are infrared sensors having a spectral response range from 1.5 to 5.2 µm. These sensors deliver high sensitivity and high-speed response at room temperatures. Cooled types are also available with a higher S/N making them widely used in precision photometry such as analytical and measuring instrument.

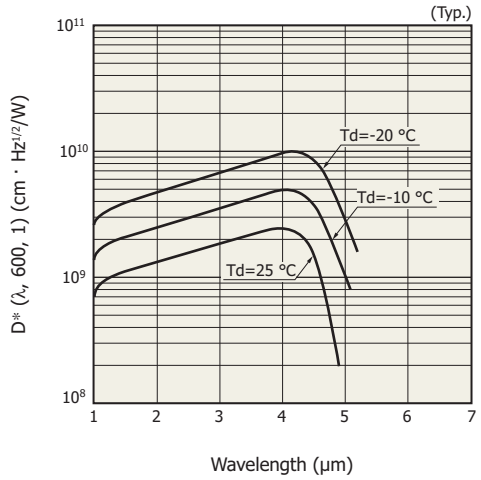
(Typ.)

Type no.	Cooling	Photosensitive area (mm)	Cutoff wavelength λc (µm)	Peak sensitivity wavelength λp (µm)	Rise time max. (µs)	Package	Photo	Option (sold separately)
P9696-02	Non-cooled	2 × 2	4.8	4.0	10	TO-5		C3757-02 (P.26)
P9696-03		3 × 3						
NEW P3207-08*		2 × 2	4.35	4.25				
P9696-102	One-stage TE-cooled (Td=-10 °C)	2 × 2	5.1	4.1	20	TO-8		C3757-02 (P.26) A3179 (P.23) C1103-04 (P.22)
P9696-103		3 × 3						
P9696-202	Two-stage TE-cooled (Td=-20 °C)	2 × 2	5.2	4.2				C3757-02 (P.26) A3179-01 (P.23) C1103-04 (P.22)
P9696-203		3 × 3						

* Incorporates a band-pass filter, spectral response range: 4.15 to 4.35 µm

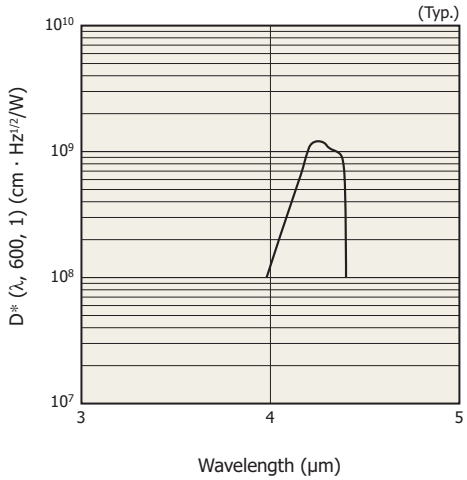
Spectral response

P9696 series



KIRDB0342EF

P3207-08



KIRDB0540EA

Infrared detector modules with preamp

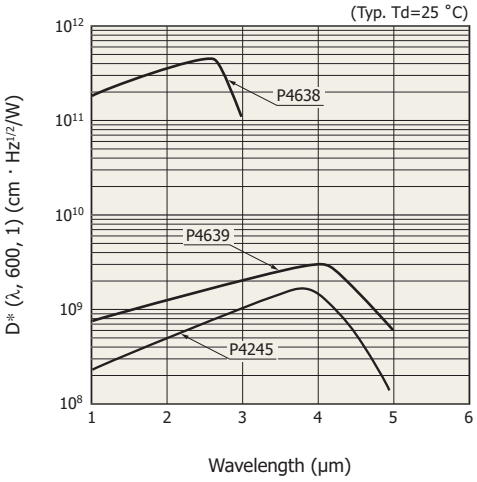
These modules consist of an infrared detector assembled with matched preamplifier, and operate by connecting a DC power supply.

(Typ.)

Type no.	Detector	Photosensitive area (mm)	Cooling	Measurement condition: Element temperature (°C)	Cutoff wavelength λc (µm)	Peak sensitivity wavelength λp (µm)	Photo
P4245	PbSe (P9696-03)	3 × 3	Non-cooled	25	4.8	4.0	
P4638*1	PbS (P2682-01)	4 × 5	TE-cooled	-15	3.1	2.4	
P4639	PbSe (P9696-203)	3 × 3			5.0	4.1	

*1: CE EN 61326-1 Class B
Note: Supplied with a power supply cable

Spectral response



KIRDB0370ED

InAs/InAsSb/InSb photovoltaic detectors, InSb photoconductive detectors

InAs photovoltaic detectors are capable of detecting infrared light up to approx. 3.5 µm. InSb photovoltaic detector can sense infrared light up to approx. 5.5 µm, and InSb photoconductive detectors infrared light up to approx. 6 µm. InAsSb photovoltaic detectors also delivers high sensitivity in the 5 µm band. InSb photoconductive detectors are available in multi-element arrays (custom-made product). InAs and InSb photovoltaic detectors cover a spectral response range equivalent to PbS and PbSe photoconductive detectors, respectively, and feature higher response speed and better S/N.

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 λc (µm)	Peak sensitivity wavelength (µm)	Package	Photo	Option (sold separately)
P10090-01	Non-cooled	φ1	3.65	3.35	TO-5		C4159-06 (P.25)
P10090-11	One-stage TE-cooled (Td=-10 °C)		3.55	3.30	TO-8		A3179-01 (P.23) C1103-04 (P.22) C4159-06 (P.25)
P10090-21	Two-stage TE-cooled (Td=-30 °C)		3.45	3.25			A3179-01 (P.23) C1103-04 (P.22) C4159-06 (P.25)
P7163	Liquid nitrogen (Td=-196 °C)		3.10	3.00	Metal dewar		C4159-05 (P.25)

InAsSb photovoltaic detectors

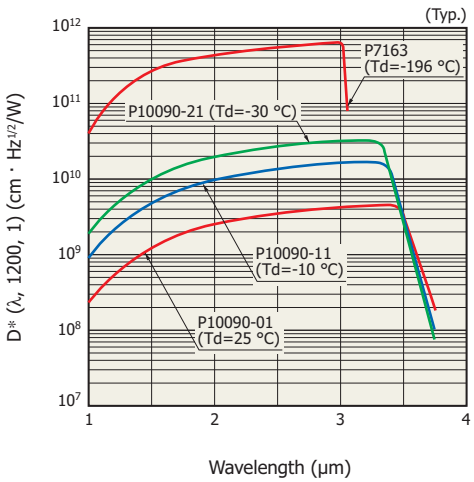
This InAsSb photovoltaic detectors deliver high sensitivity in the 5 µm band due to our unique crystal growth technology. (Typ.)

Type no.	Cooling	Photosensitive area (mm)	Cutoff wavelength λc (µm)	Peak sensitivity wavelength (µm)	Package	Photo	Option (sold separately)
P11120-901	Liquid nitrogen (Td=-196 °C)	φ1	5.8	4.8	Metal dewar		C4159-01 (P.25)
NEW P11120-201	Two-stage TE-cooled (Td=-30 °C)		5.9	4.9	TO-8		A3179-01 (P.23) C1103-04 (P.22) *1

*1: The amplifier for the P11120-201 is available upon request (custom-made product).

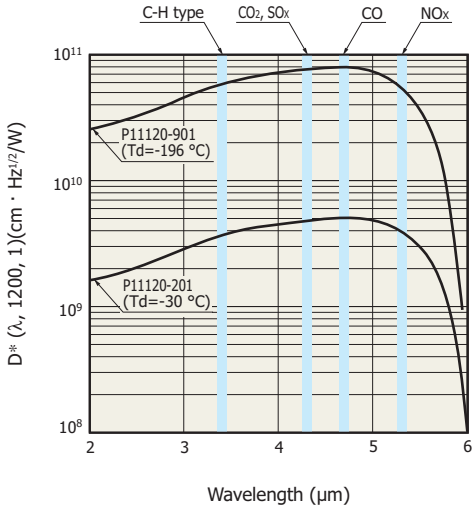
Spectral response

InAs photovoltaic detectors



KIRDB0356ED

InAsSb photovoltaic detectors



KIRDB0430ED

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. 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 λc (µm)	Peak sensitivity wavelength λp (µm)	Package	Photo	Option (sold separately)
P5968-060	Liquid nitrogen (Td=-196 °C)	φ0.6	5.5	5.3	Metal dewar		C4159-01 (P.25)
P5968-100		φ1					
P5968-200		φ2					C4159-04 (P.25)
P5968-300		φ3					Custom-made product
P4247-16		0.25 × 1.4 (16-element)					Custom-made product
P4247-44		0.45 × 0.45 (4 × 4-element)					

InSb photoconductive detectors

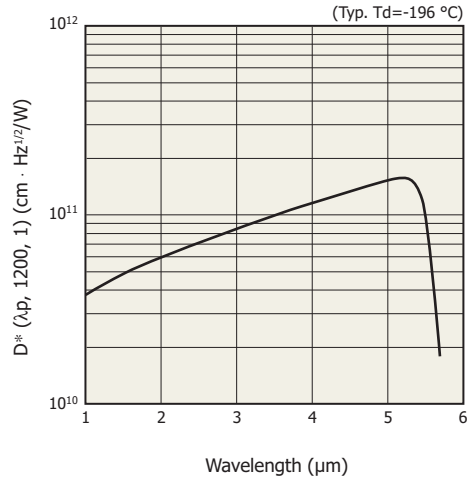
Thermoelectrically cooled InSb photoconductive detectors are capable of detecting infrared light up to around 6 µm with high sensitivity and high speed.

(Typ.)

Type no.	Cooling	Photosensitive area (mm)	Cutoff wavelength λc (µm)	Peak sensitivity wavelength λp (µm)	Package	Photo	Option (sold separately)
P6606-110	One-stage TE-cooled (Td=-10 °C)	1 × 1	6.7	5.5	TO-8		A3179-01 (P.23) C1103-07 (P.22) C5185-02 (P.26)
P6606-210	Two-stage TE-cooled (Td=-30 °C)		6.5				A3179-01 (P.23) C1103-07 (P.22) C5185-02 (P.26)
P6606-310	Three-stage TE-cooled (Td=-60 °C)	1 × 1	6.3		TO-3		A3179-04 (P.23) C1103-05 (P.22) C5185-02 (P.26)
P6606-305		0.5 × 0.5					
P6606-320		2 × 2					

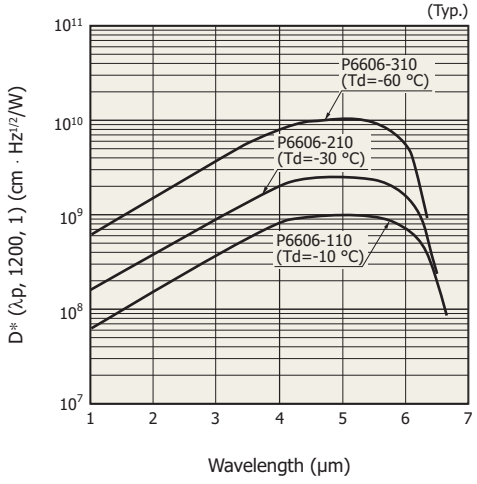
Spectral response

InSb photovoltaic detectors



KIRDB0063EE

InSb photoconductive detectors



KIRDB0166EC

Infrared detector modules with preamp

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

(Typ.)

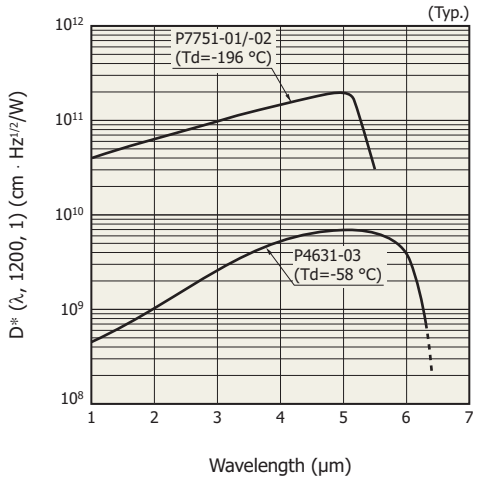
Type no.	Detector	Photosensitive area (mm)	Cooling	Measurement condition: Element temperature (°C)	Cutoff wavelength λc (μm)	Peak sensitivity wavelength λp (μm)	Photo
P4631-03	InSb (P6606-310)	1 × 1	TE-cooled	-58	6.1	5.5	
P7751-01*1 *2	InSb (P5968-060)	ϕ0.6	Liquid nitrogen	-196	5.5	5.3	
P7751-02*2	InSb (P5968-200)	ϕ2					

*1: CE EN 61326-1 Class B

*2: FOV=60°

Note: Supplied with a power supply cable

Spectral response



KIRDB0371EE

MCT (HgCdTe) photoconductive/photovoltaic detectors

MCT photoconductive detectors decrease their resistance when illuminated by infrared light and are available with various ranges of spectral response up to 22 µm. MCT photovoltaic detectors generate a photocurrent when illuminated by infrared light.

MCT photoconductive detectors

Metal package

Non-cooled type and one-stage TE-cooled type have sensitivity up to 10 µm, making them suitable for CO_2 laser detection. Two or three-stage TE-cooled types deliver high sensitivity in detecting short wavelengths.

(Typ.)

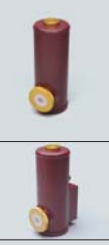
Type no.	Cooling	Photosensitive area (mm)	Cutoff wavelength λc (µm)	Peak sensitivity wavelength λp (µm)	Package	Photo	Option (sold separately)
P3257-30	Non-cooled	1 × 1	10.0	6.5	With BNC connector		Custom-made product
P3257-31	One-stage TE-cooled (Td=0 °C)		10.6	7.0	TO-8		A3179-01 (P.23) C1103-07 (P.22)
P3981	Two-stage TE-cooled (Td=-30 °C)		4.3	3.6	TO-8		A3179-01*1 (P.23) C1103-07 (P.22) C5185-03 (P.26)
P3981-01			4.3	3.6	TO-66		
P2750-08			5.4	4.8	TO-8		
P2750	Three-stage TE-cooled (Td=-60 °C)	1 × 1	5.5	4.8	TO-3		A3179-04 (P.23) C1103-05 (P.22) C5185-03 (P.26)
P2750-06		0.25 × 0.25					

*1: For P3981 and P2750-08. The heatsink for the P3981-01 is a custom product.

Metal dewar type

These include MCT detectors whose peak sensitivity at 10 µm wavelength is suitable for non-contact temperature measurements at room temperature and MCT detectors whose high sensitivity at longer wavelengths (narrow, medium, and wide wavelength bands) makes them suitable for FTIR.

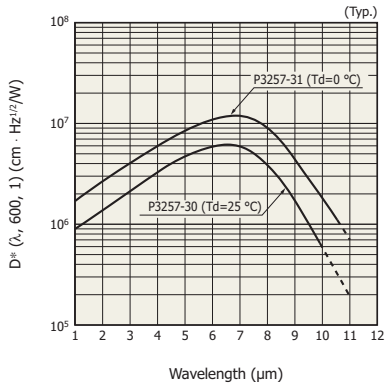
(Typ.)

Type no.	Cooling	Photosensitive area (mm)	Cutoff wavelength λc (µm)	Peak sensitivity wavelength λp (µm)	Package	Photo	Option (sold separately)
P3257-25	Liquid nitrogen (Td=-196 °C)	0.025 × 0.025	12	10	Side-on type metal dewar		A3515*2 (P.22)
P3257-01		0.1 × 0.1					A3515 (P.22) C5185-02 (P.26)
P3257-10		1 × 1					
P4249-08		0.5 × 0.5/ 8-element					
P2748-40		1 × 1	14	12			
P2748-42		0.25 × 0.25					
P5274		1 × 1	17	14			
P5274-01		1 × 1	22	17			
P2748-41		1 × 1	14	12	Head-on type metal dewar		

*2: The amplifier for the P3257-25 is available upon request (custom-made product).

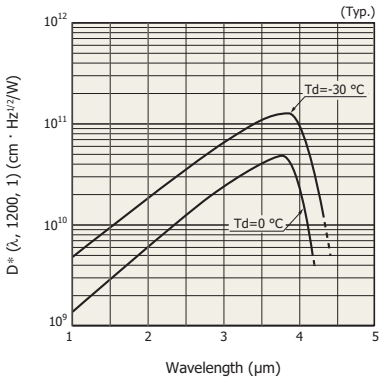
Spectral response

P3257-30/-31



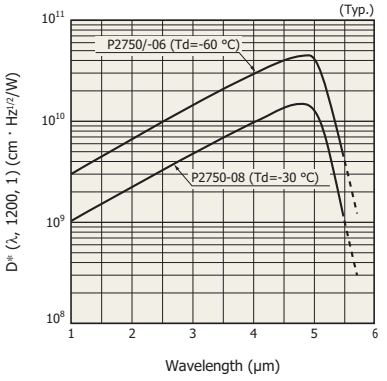
KIRDB0164EF

P3981 series



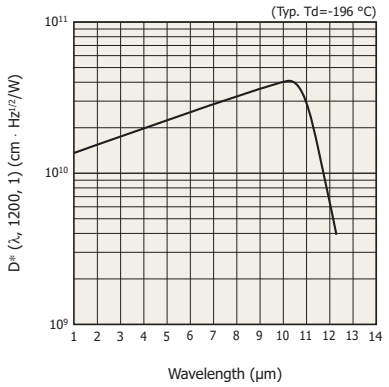
KIRDB0066EE

P2750 series



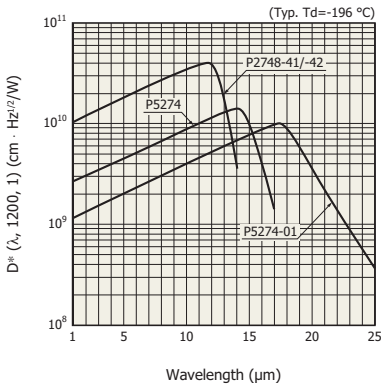
KIRDB0068EE

P3257-01/-10/-25, P4249-08



KIRDB0169EB

P2748/P5274 series



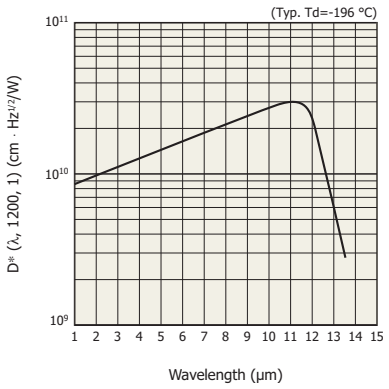
KIRDB0072EG

MCT photovoltaic detectors

(Typ.)

Type no.	Cooling	Photosensitive area (mm)	Cutoff wavelength λc (µm)	Peak sensitivity wavelength λp (µm)	Package	Photo	Option (sold separately)
P9697-01	Liquid nitrogen (Td=-196 °C)	ϕ0.5	13	11	Metal dewar		Custom-made product
P9697-02		ϕ1					

Spectral response



KIRDB0334EC

Infrared detector modules with preamp

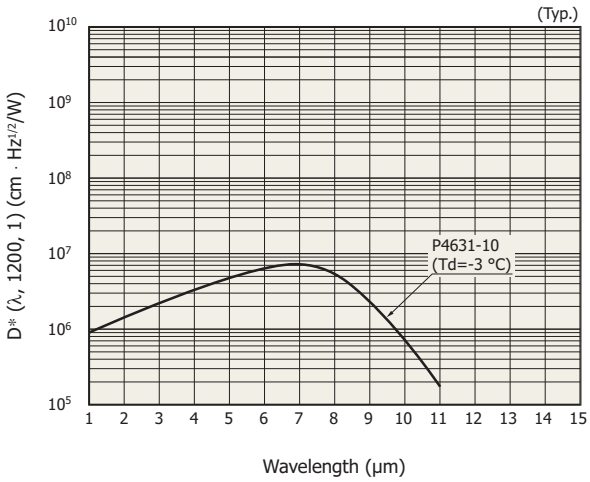
The P4631 consists of an MCT detector assembled with a matched preamplifier, and operates by connecting a DC power supply.

(Typ.)

Type no.	Detector	Photosensitive area (mm)	Cooling	Measurement condition: Element temperature (°C)	Cutoff wavelength λc (μm)	Peak sensitivity wavelength λp (μm)	Photo
P4631-10*1	MCT (P3257-31)	1 × 1	TE-cooled	-3	11.5	6.5	

*1: CE EN 61326-1 Class B
Note: Supplied with a power supply cable

Spectral response



KIRDB0372EF

Thermopile detectors (Si thermal detectors)

Single-element type

The T11262-01 is a high-sensitivity thermopile detector suitable for gas analysis applications, It uses a TO-18 package with window having high transmittance in the 3 to 5 µm spectral band, the T11262-01 can be used for various types of gas analysis by externally attaching a band-pass filter on a user's end.

Type no.	Package	Number of elements	Photosensitive area (mm)	Window	Spectral response range (µm)	Photo
T11262-01	TO-18	1	1.2 × 1.2	AR-coated Si	3 to 5	

Dual-element type

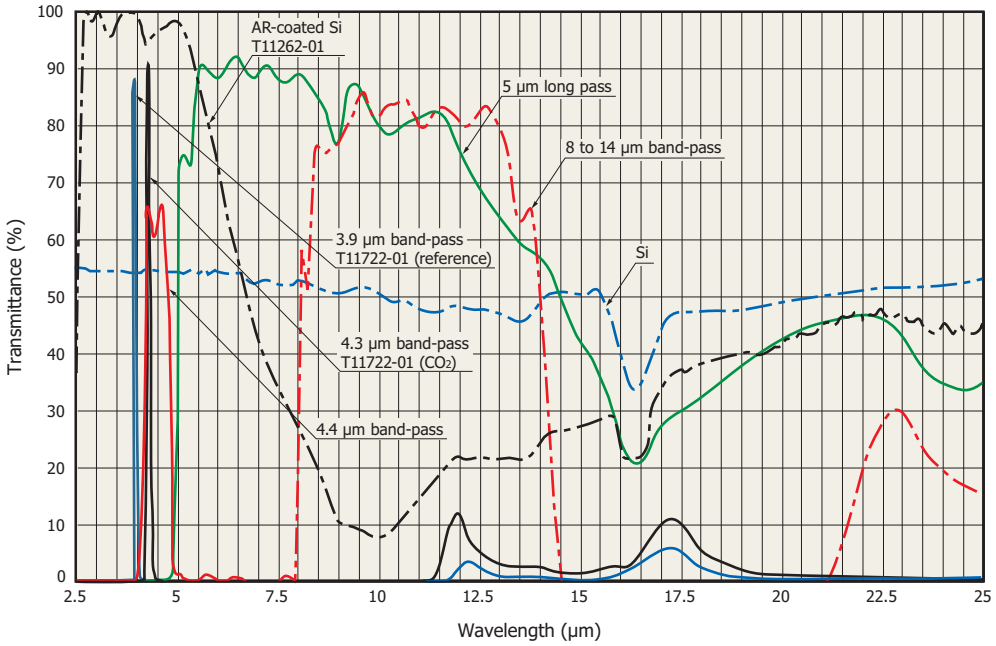
The T11722-01 is a dual-element type thermopile detector designed to detect CO_2 concentrations with high accuracy. It consists of a high sensitivity dual-element thermopile detector and two band-pass filters for sensing two wavelengths (reference: 3.9 µm, CO_2: 4.3 µm) simultaneously.

Type no.	Package	Number of elements	Photosensitive area (mm)	Window	Spectral response range (µm)	Photo
NEW T11722-01	TO-5	2	1.2 × 1.2 (per 1 element)	Bandpass filter	Reference: 3.9 CO_2: 4.3	

Window options (typical examples of spectral response)

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.



KIRDB0512EA

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.

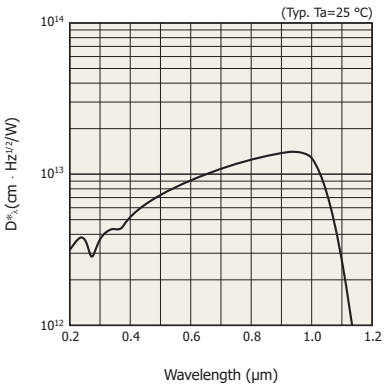
(Typ.)

Type no.	Cooling	Detector	Photosensitive area (mm)	Spectral response range λ (μm)	Peak sensitivity wavelength λp (μm)	Photo sensitivity S (A/W)	Package	Photo	Option (sold separately)
K1713-01	Non-cooled	Si	2.4 × 2.4	0.2 to 2.9	0.94	0.45	TO-5		C9329 C3757-02 (P.26)
		PbS	1.8 × 1.8		2.2	6 × 10^4 (V/W)			
NEW K1713-002		Si	2.4 × 2.4	0.2 to 4.8	0.94	0.45			
		PbSe	1.8 × 1.8		4.0	1.5 × 10^3 (V/W)			
K1713-05		Si	2.4 × 2.4	0.32 to 1.7	0.94	0.45			C9329 C4159-03 (P.25)
		InGaAs	ϕ0.5		1.55	0.55			
K1713-08		Si	2.4 × 2.4	0.32 to 2.6	0.94	0.45			
		InGaAs	ϕ1		2.3	0.60			
K1713-09		Si	2.4 × 2.4	0.32 to 1.7	0.94	0.45			
		InGaAs	ϕ1		1.55	0.55			
NEW K11908-010K		InGaAs	2.4 × 2.4	0.9 to 2.55	1.55	0.95			C4159-03 (P.25)
		InGaAs	ϕ1		2.1	1.0			
K3413-01	One-stage TE-cooled (Td=-10 °C)	Si	2.4 × 2.4	0.2 to 3.1	0.94	0.45	TO-8		C9329 C3757-02 (P.26) A3179-03 (P.23) C1103-04 (P.22)
		PbS	1.8 × 1.8		2.4	3 × 10^5 (V/W)			
NEW K3413-002		Si	2.4 × 2.4	0.2 to 5.1	0.94	0.45			
		PbSe	1.8 × 1.8		4.1	4.5 × 10^3 (V/W)			
K3413-05		Si	2.4 × 2.4	0.32 to 1.67	0.94	0.45			C9329 C4159-03 (P.25) A3179-03 (P.23) C1103-04 (P.22)
		InGaAs	ϕ0.5		1.55	0.55			
K3413-08		Si	2.4 × 2.4	0.32 to 2.57	0.94	0.45			
		InGaAs	ϕ1		2.3	0.60			
K3413-09		Si	2.4 × 2.4	0.32 to 1.67	0.94	0.45			
		InGaAs	ϕ1		1.55	0.55			

Spectral response

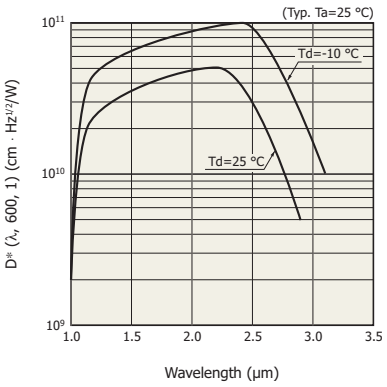
K1713-01/-002, K3413-01/-002

[Si photodiode]



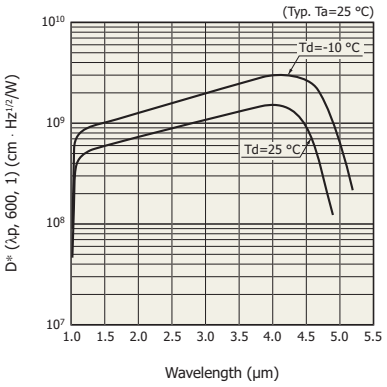
KIRDB0058EE

[PbS photoconductive detector]



KIRDB0282EB

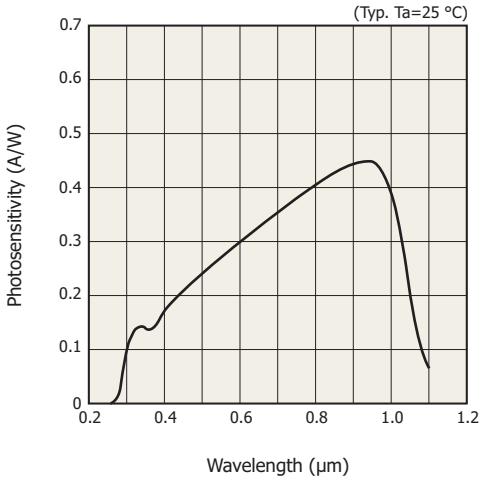
[PbSe photoconductive detector]



KIRDB0283EC

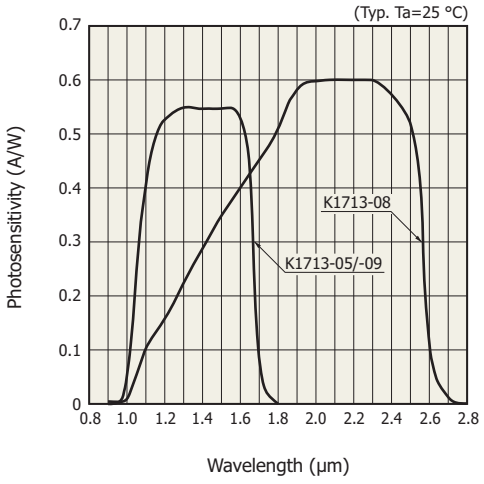
K1713-05/-08/-09

[Si photodiode]



KIRDB0199EA

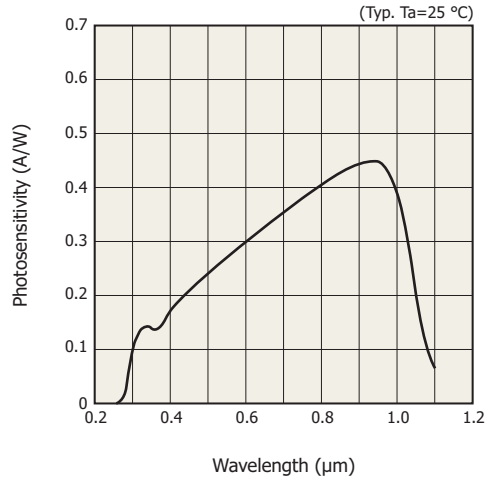
[InGaAs PIN photodiode]



KIRDB0211EA

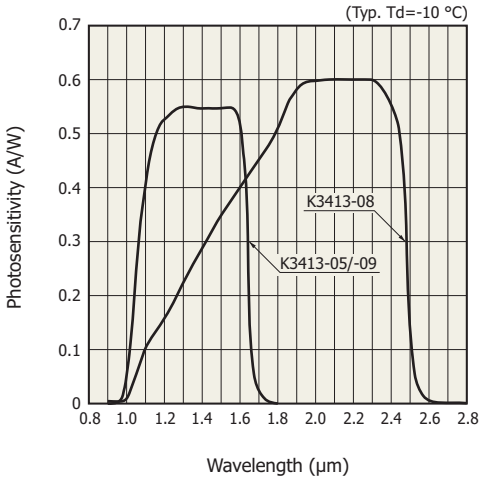
K3413-05/-08/-09

[Si photodiode]



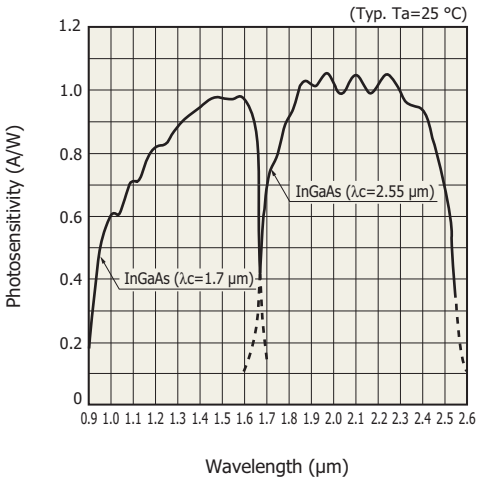
KIRDB0199EA

[InGaAs PIN photodiode]



KIRDB0212EA

K11908-010K



KIRDB0479EB

Photon drag detector

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_2 lasers. The surface of the detector element is coated with a non-reflective material.

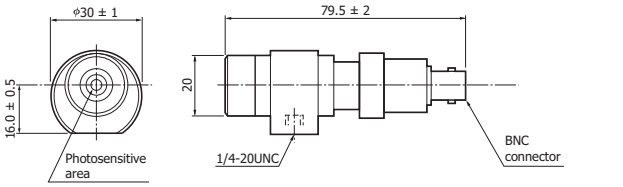
Non-cooled type

(Typ.)

Type no.	Cooling	Photosensitive area (mm)	Peak sensitivity wavelength λp (µm)	Photosensitivity S λ=10.6 µm (V/W)	Photo	Magnet stand (sold separately)
B749	Non-cooled	ϕ5.0	10.6	1.2×10^{-6}		A1447

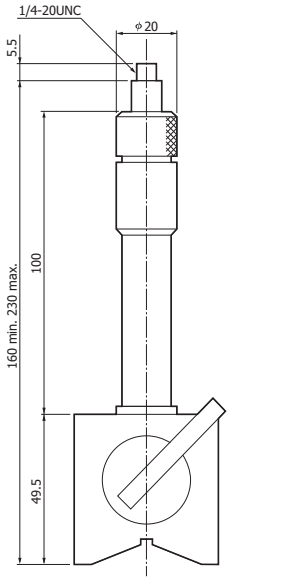
Dimensional outlines (unit: mm, tolerance unless otherwise noted: ±1)

B749



KIRDA0016EE

Magnet stand A1447



KIRDA0017EA

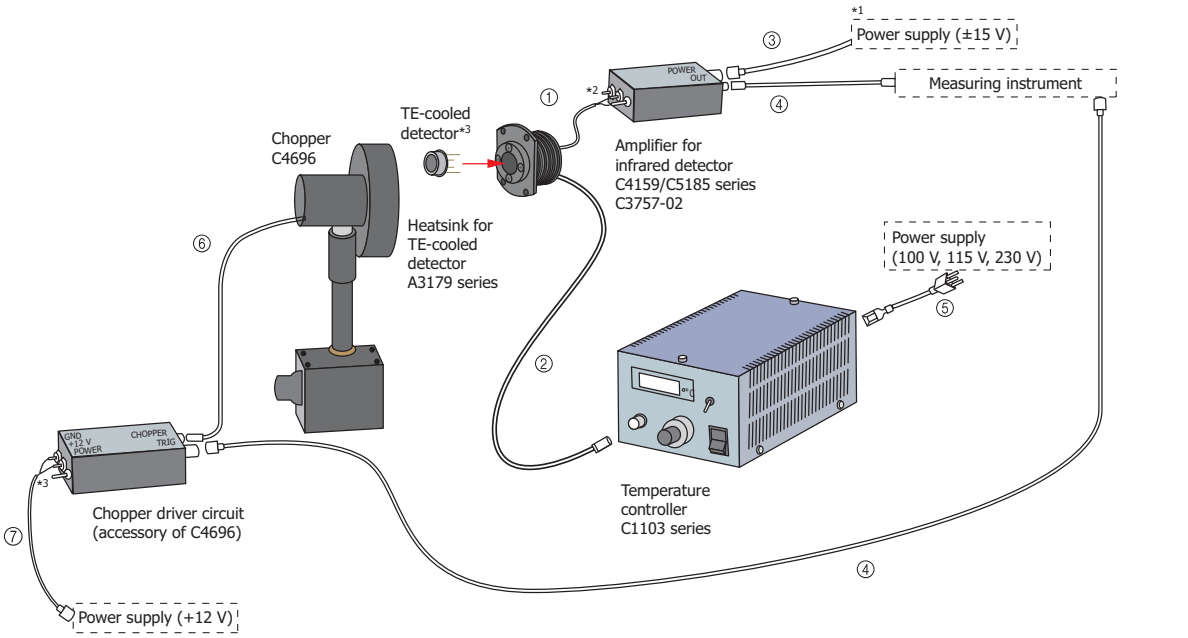
Accessories for infrared detectors

HAMAMATSU provides following accessories for infrared detectors.

- Temperature controllers (P.22)
- Heatsinks for TE-cooled detector (P.23)
- Chopper (P.24)
- Amplifiers for infrared detectors (P.25)

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	Power supply cable (with a 4-conductor connector) A4372-02	2 m	This cable is supplied with the C4159/C5185 series amplifiers for infrared detectors, the C3757-02, and infrared detector modules with preamps (room temperature type). This cable is also sold separately. Besides this cable, the A4372-03, which is a power supply cable (with a 6-conductor connector) supplied with “infrared detector modules with preamps (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: Connect loose wires to terminals of a power supply.
*2: Soldering is needed. When using the C5185 series 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

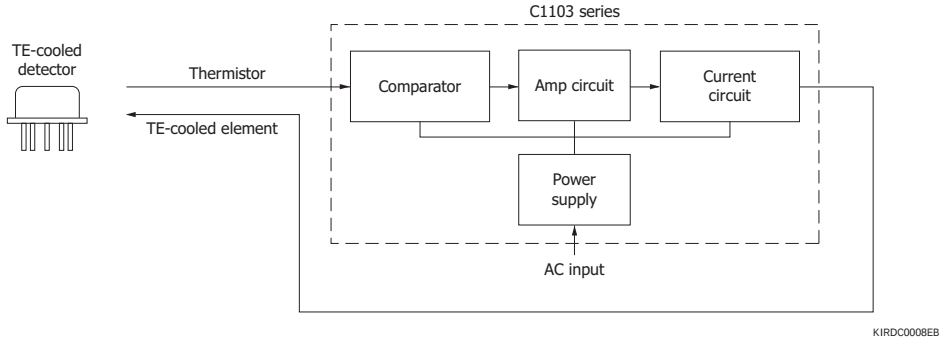
The C1103 series is a temperature controller designed for TE-cooled infrared detectors. The C1103 series allows temperature setting for the TE-cooler mounted in an infrared detector.

Specifications

Parameter	C1103-04	C1103-05	C1103-07
Applicable detector*1	One-stage/two-stage TE-cooled type PbS, PbSe photoconductive detectors, InAs photovoltaic detectors, InGaAs, Si photodiodes	Two-stage/three-stage TE-cooled type MCT, InSb photoconductive detectors	One-stage TE-cooled type MCT, InSb photoconductive detectors
Setting element temperature	-30 to +20 °C	-75 to -25 °C	-30 to +20 °C
Temperature stability	Within ±0.1 °C		
Temperature control output current	1.3 A max.		
Power supply	100 V ± 10% · 50/60 Hz*2		
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	+10 to +40 °C		
Accessories	Instruction manual 4-conductor cable (with a connector, 3 m) A4372-05*3, power supply cable		

*1: It does not correspond to TE-cooled type infrared detector module with preamp.
*2: Please specify power supply requirement (AC line voltage) from among 100 V, 115 V and 230 V when ordering.
*3: 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



KIRDC0008EB

CE

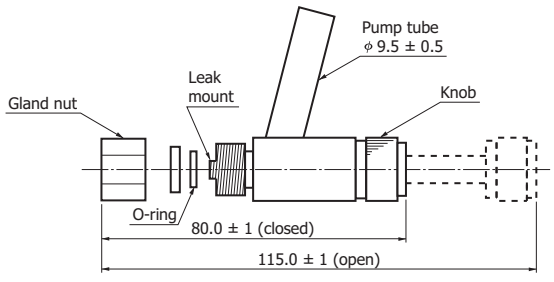
The C1103-04 and C1103-05 conform to European EMC directives: EN 61326-1 Class B

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.

Vaccum pump — Valve operator — Metal dewar type detector

Dimensional outline (unit: mm)



KIRDA0021EC

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 (heatsink for TO-66 is available as a custom product.).

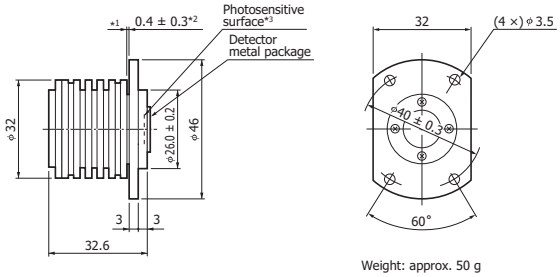
Accessories

■ 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) that comes with the C1103 series.
*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

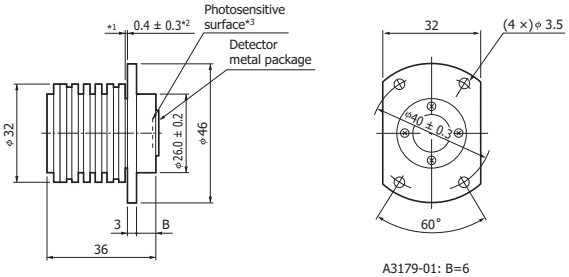


Weight: approx. 50 g

*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.

KIRDA0018EE

A3179-01, A3179-03

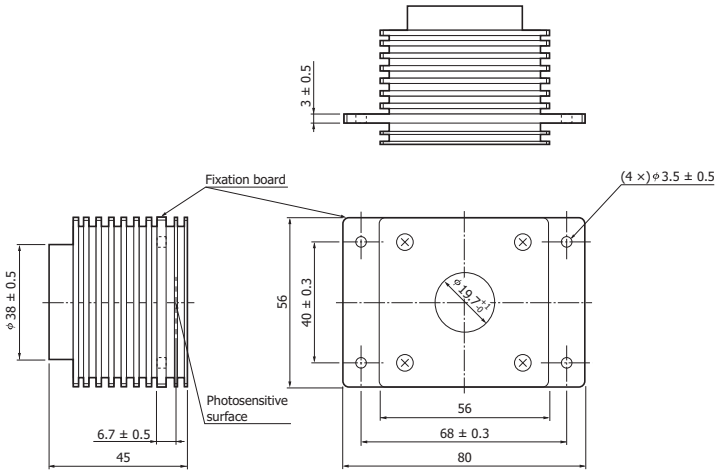


A3179-01: B=6
A3179-03: B=6.4
Weight: approx. 53 g

*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.

KIRDA0019EE

A3179-04



Weight: approx. 320 g

KIRDA0149EC

Chopper C4696

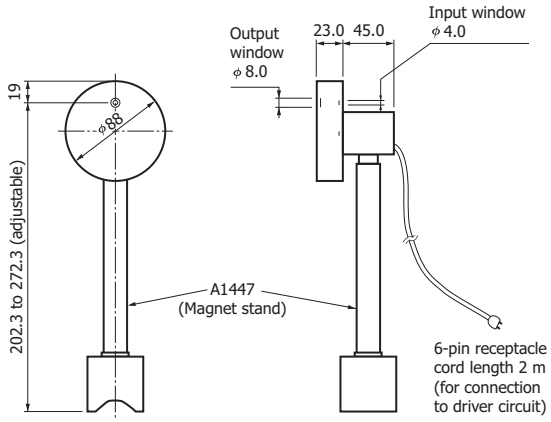
Specifications

Parameter		Specification
Chopping frequency*1		115 to 380 Hz, 345 Hz typ.*1
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*2		90 mA
Accessories		Magnet stand A1447 (see P.20), driver circuit

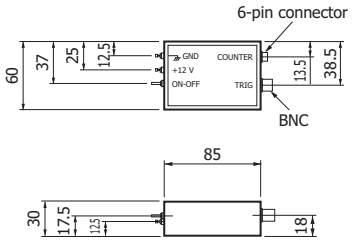
*1: Chopping frequency will be 230 to 760 Hz when an optional disk is used.
*2: V_D=12 V

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

<Chopper>

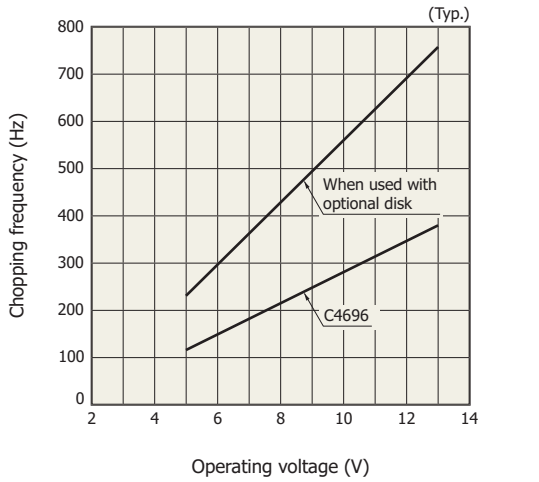


<Driver circuit>



KIRDA0022EA

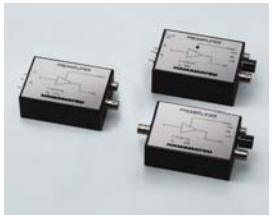
Chopping frequency vs. operating voltage



KIRDB0376EA

Amplifiers for infrared detectors C4159/C5185 series, C3757-02

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



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

Required power supply specifications

- C4159 series: ±15 V ± 0.5
- C5185 series: ±15 V ± 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): E3620A, E3630A (Agilent Technologies)

Absolute maximum ratings (Ta=25 ˚C)

Parameter	Value	Unit
Operating temperature	0 to +40	°C
Storage temperature	-20 to +70	°C

Amplifiers for photovoltaic detectors (Typ.)

Parameter	C4159-01	C4159-04	C4159-05	C4159-06	Unit
Applicable detector*1 *2 *3	Dewar type InSb (P5968-060, P5968-100) Dewar type InAsSb (P11120-201)	Dewar type InSb (P5968-200)	Dewar type InAs (P7163)	InAs (P10090 series)	-
Conversion impedance	10^8, 10^7, 10^6 (3 ranges switchable)	2×10^7, 2×10^6, 2×10^5 (3 ranges switchable)	10^8, 10^7, 10^6 (3 ranges switchable)	10^6, 10^5, 10^4 (3 ranges switchable)	V/A
Frequency response (amp only, -3 dB)	DC to 100 kHz*4	DC to 45 kHz	DC to 15 kHz	DC to 100 kHz	-
Output impedance	50				Ω
Maximum output voltage (1 kΩ load)	+10				V
Output offset voltage	±5	±5	±10	±5	mV
Equivalent input noise current (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	pA/Hz$^{1/2}$
Reverse voltage	Impossible				-
External power supply*5	±15				V
Current consumption	+30, -10 max.			+30, -22 max.	mA

Amplifiers for InGaAs PIN photodiodes (Typ.)

Parameter	C4159-03*6	Unit
Applicable detector*1 *2	InGaAs	-
Conversion impedance	10^7, 10^6, 10^5 (3 ranges switchable)	V/A
Frequency response (amp 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	Can be applied from external unit	-
External power supply*5	±15	V
Current consumption	±15 max.	mA

Note: Output noise voltage = Equivalent input noise current × Conversion impedance

*1: These amplifiers 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.
*4: When connected to a detector, frequency response becomes 60 kHz or less depending on the detector photosensitive area. (ϕ0.6 mm: 60 kHz or less, ϕ1 mm: 25 kHz or less) Ringing occurs in the output if the rise time tr (0 to 90%) of incident light is approximately 100 µs or less. The ringing becomes larger as the rise time becomes shorter. No ringing occurs when detecting sine-wave light. (For information on the ringing specifications, refer to the datasheet "Amplifier for infrared detector".)
*5: Recommended DC power supply (analog power supply): ±15 V
Current capacity: More than 1.5 times the maximum current consumption
Ripple noise: 5 mVp-p or less
*6: CE EN 61326-1 Class B

Amplifiers for photoconductive detectors (Typ.)*1

Parameter	C5185-02*2	C5185-03*2	C3757-02*2	Unit
Applicable detector*3 *4 *5	Dewar type MCT, InSb (P6606 series)	MCT (P3981/P2750 series)*6	PbS, PbSe	-
Input impedance	5	5	10000	kΩ
Voltage gain	66 (× 2000)	66 (× 2000)	40 (× 100)	dB
Frequency response (amp only, -3 dB)	5 Hz to 250 kHz	5 Hz to 250 kHz	0.2 Hz to 10 kHz	-
Detector bias current	5 mA, 10 mA, 15 mA (3 ranges switchable)	0.1 mA, 0.5 mA, 1 mA (3 ranges switchable)	Internal bias	-
Output impedance	50			Ω
Maximum output voltage (1 kΩ load)	±10			V
Equivalent input noise voltage (f=1 kHz)	2.6	1.8	40	$nV/Hz^{1/2}$
External power supply*7	±15			V
Current consumption	+60, -10 max.	+60, -10 max.	+15, -15 max.	mA

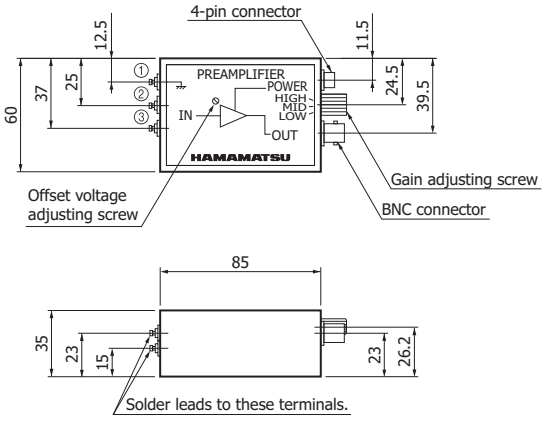
Note: Output noise voltage = Equivalent input noise voltage × Voltage gain

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

*2: CE EN 61326-1 Class B
*3: These amplifiers cannot operate multiple detectors.
*4: Consult us before purchasing if you want to use with a detector other than listed here.
*5: Consult us before purchasing if you want to use with a multi-element detector.
*6: The amplifier for the P3257-30/-31 is a custom product.
*7: Recommended DC power supply (analog power supply): ±15 V
Current capacity: More than 1.5 times the maximum current consumption
Ripple noise: 5 mVp-p or less

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

C4159-01/-03/-04/-05/-06

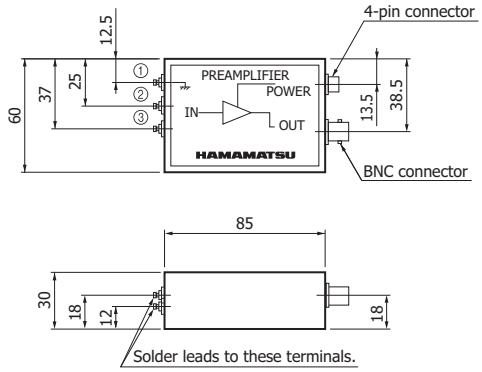


Pin connections
① GND
② Cathode
③ Anode

Note: Socket for lead attachment is not provided.

KIRDA0046EC

C3757-02

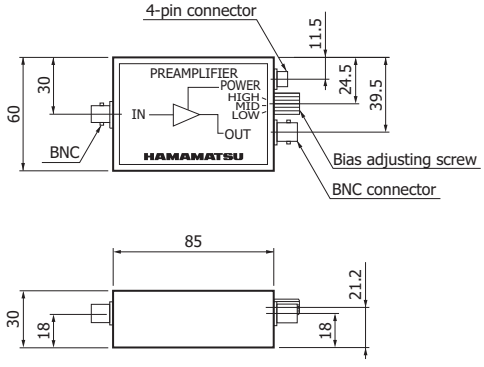


Pin connections
① GND
② Detector
③ Detector

Note: Socket for lead attachment is not provided.

KIRDA0049EC

C5185-02/-03



KIRDA0048EA

Description of terms

Dark resistance: Rd

This is the resistance of a photoconductive detector (PbS, PbSe, MCT, etc.) 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. For photon drag detectors, this is represented as the output voltage with respect to incident pulsed energy of 1 kW radiated from a CO_2 laser.

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, InSb, and MCT (HgCdTe).

Photoconductive detector

This is a semiconductor detector whose conductivity increases with increasing incident light. Detector materials include PbS, PbSe, InSb and MCT (HgCdTe).

Peak sensitivity wavelength: λp

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

Reverse voltage (max.): V_R max, supply voltage

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 (λp). Since the noise level is proportional to the square root of the frequency bandwidth, the NEP is normalized to a bandwidth of 1 Hz.

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

Cutoff frequency: fc

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

$$\text{tr [s]} = \frac{0.35}{\text{fc [Hz]}}$$

Rise time: tr

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: Ct

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: Isc

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: λc

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 cm · $Hz^{1/2}$/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 [W/cm^2], A is the photosensitive area in [cm^2] and Δf is the noise bandwidth in [Hz]. The following relation is established by D* and NEP.

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

Noise: N

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

Shunt resistance: Rsh

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.

$$\text{Rsh [}\Omega\text{]} = \frac{10\ \text{[mV]}}{I_D\ \text{[A]}}$$

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 and photosensitivity S have the following relationship at a given wavelength [nm]:

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

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