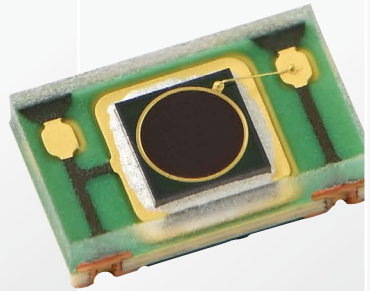
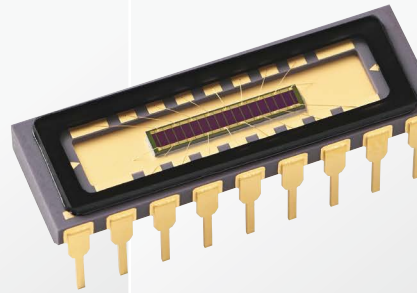
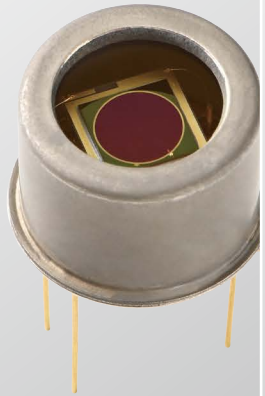
Supports various spectral response ranges in the infrared region

# Infrared detectors








# Infrared detectors



## Supports various spectral response ranges in the infrared region

Infrared detectors are widely used in fields including measurement, analysis, industry, communications, agriculture, medicine, physical-and-chemical science, astronomy, and aerospace. Based on its long experience in optical technology, Hamamatsu provides a wide lineup of products for the infrared region.

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

## Spectral response

We offer detectors with various spectral responses (P.5). By cooling the element, the spectral response of InGaAs, InAs, InSb, and InAsSb shifts to the short-wavelength side.

## Response speed

Various detectors are available with different response speeds.

## Photosensitive area, number of elements

Various types are available, ranging from small to large photosensitive area sizes. We also offer multi-element types suitable for high-speed multi-channel spectrophotometry.

## Cooling

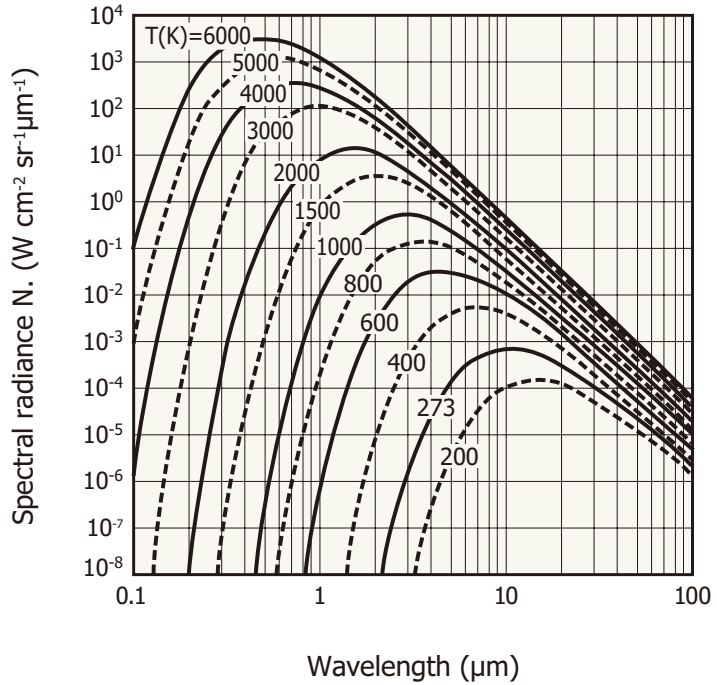
Besides the easy-to-use non-cooled type, we offer a TE-cooled type that does not require coolant, as well as a dewar type (cooled with liquid nitrogen) that realizes low noise.

## Object temperature

When selecting a detector based on the temperature of the object, it is necessary to consider the energy distribution (wavelength dependence of energy) radiated from the object. When the temperature of the object changes, its radiant energy distribution changes according to the law of black body radiation (Planck's law of radiation). (See the figure on the right.) The following relationship exists between the peak sensitivity wavelength λp (μm) and the object temperature T (K).

$\lambda p \cdot T = 2897.9$

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

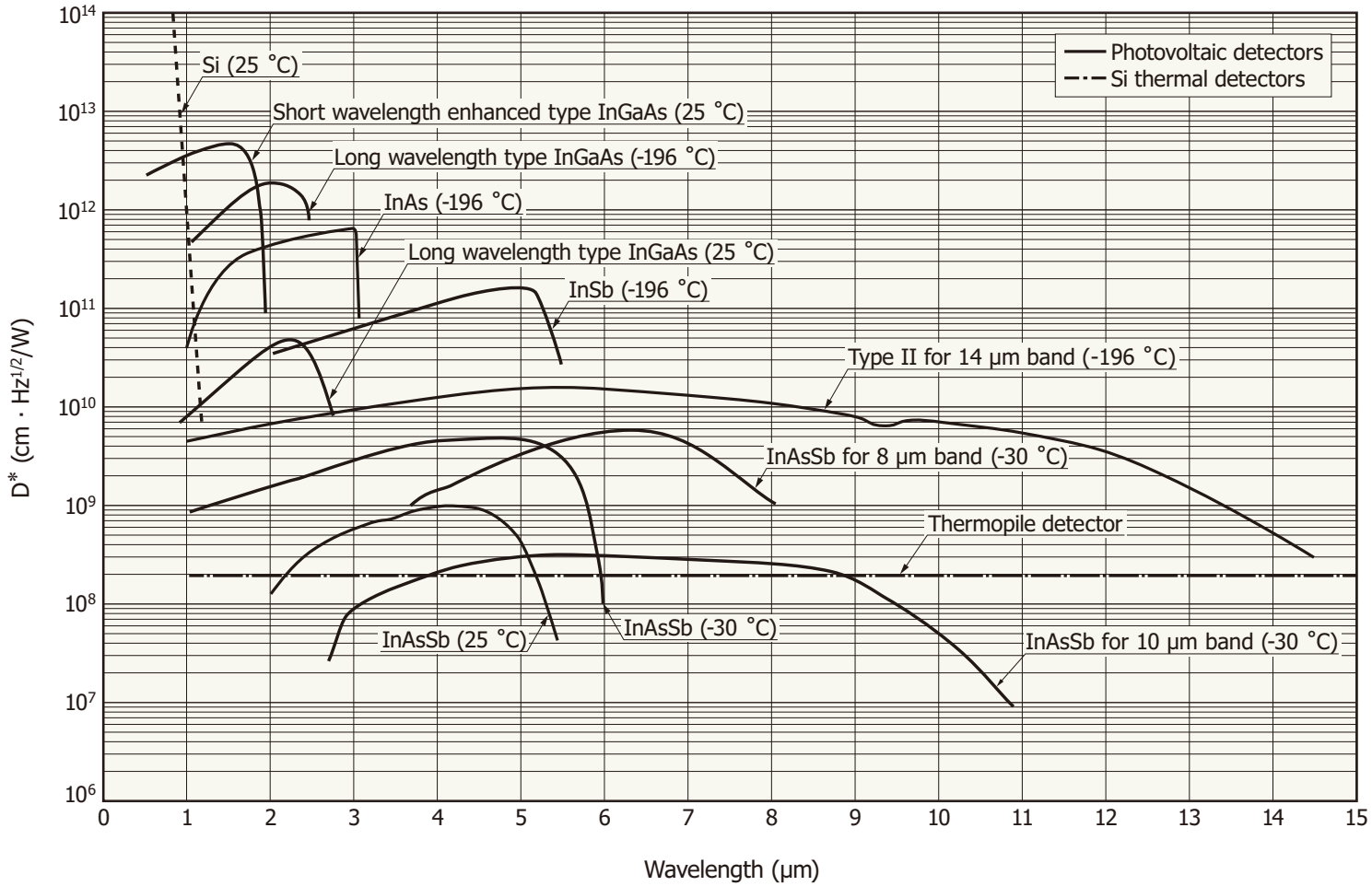



KIRDB0014EB

| Product name | Spectral response range (μm) 0 1 2 3 | Features | Main applications |
|---|---|---|---|
| InGaAs PIN photodiode | 0.5 to 1.7 μm<br>0.9 to 1.7 μm<br>0.9 to 1.9 μm<br>0.9 to 2.1 μm<br>0.9 to 2.6 μm | · High-speed response<br>· Various types of photosensitive areas, arrays, and packages available<br>· TE-cooled type available | · Optical fiber communications<br>· Power meters<br>· Gas analysis<br>· Moisture meters<br>· NIR (near infrared) photometry |
| InGaAs APD | 0.95 to 1.7 μm | · Low dark current<br>· Low capacitance<br>· High sensitivity | · Distance measurement<br>· LiDAR · OTDR |

| Product name | | Spectral response range (μm) 0 5 10 15 20 25 | Features | Main applications |
|---|---|---|---|---|
| InAs photovoltaic detector | | 1 to 3.8 μm | · Covers a spectral response range close to PbS but offers higher response speed | · Gas measurement<br>· Infrared measurement · FTIR |
| InSb photovoltaic detector | | 1 to 5.5 μm | · High sensitivity in the 3 to 5 μm band makes it suitable for analysis of gases such as $CO_2$, SOx. | · FTIR · Gas measurement<br>· Radiation thermometers · Flame detection |
| InAsSb photovoltaic detector | | 1 to 11 μm | · High-speed response, high sensitivity, and high reliability infrared detectors in the 5 μm, 8 μm, or 10 μm band<br>· Covers a spectral response range (5 μm band) close to PbSe but offers higher response speed | · Gas measurement · FTIR<br>· Radiation thermometers · Laser monitors |
| Type Ⅱ superlattice infrared detector | | 1 to 14.5 μm | · This sensor has expanded sensitivity up to the 14 μm band without using mercury or cadmium restricted by RoHS directive. | · FTIR · Gas measurement<br>· Radiation thermometers |
| Thermopile detector | | 1 to 25 μm | · Sensors that generate thermoelectromotive force in proportion to the incident infrared light energy | · Gas measurement<br>· $CO_2$density measurement |
| Two-color detector | Si + InGaAs | 0.32 to 2.55 μm | · Wide spectral response range from UV to infrared<br>· Sensor with transmitting Si photodiode and InGaAs placed on top and bottom | · Spectrophotometers<br>· Laser monitors<br>· Flame monitors<br>· Radiation thermometers |
| | Si + InAsSb | 0.32 to 5.3 μm | · Wide spectral response range from UV to infrared<br>· Sensor with transmitting Si photodiode and InAsSb placed on top and bottom | |
| | InGaAs + InGaAs | 0.9 to 2.55 μm | · Sensor with two InGaAs PIN photodiodes with different spectral ranges placed on top and bottom | |

## Spectral response (typical example)



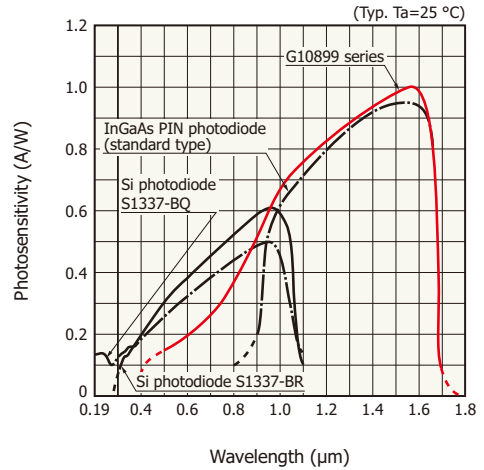

KIRDB0259ET

# Short wavelength enhanced type

(Typ. Ta=25 °C)

| Type no. | Cooling | Photosensitive area (mm) | Spectral response range λ (μm) | Peak sensitivity wavelength λp (μm) | Cutoff frequency fc $V_R$=1 V (MHz) | Package | Photo | Dedicated amplifier (sold separately) |
|---|---|---|---|---|---|---|---|---|
| G10899-003K | Non-cooled | ϕ0.3 | 0.5 to 1.7 | 1.55 | 300 | TO-18 |  | C4159-03 |
| G10899-005K | | ϕ0.5 | | | 150 | | | |
| G10899-01K | | ϕ1 | | | 45 | | | |
| G10899-02K | | ϕ2 | | | 10 | TO-5 |  | |
| G10899-03K | | ϕ3 | | | 5 | | | |

## Spectral response




KIRDB0408EC

# Standard type

## Metal package

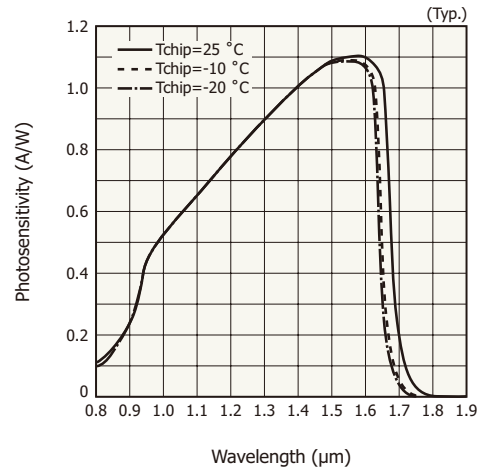
Various sizes of photosensitive areas are available.

(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 | Options (sold separately) |
|---|---|---|---|---|---|---|---|---|
| G12180-003A | Non-cooled | ϕ0.3 | 0.9 to 1.7 | 1.55 | 600 (VR=5 V) | TO-18 |  | C4159-03 |
| G12180-005A | | ϕ0.5 | | | 200 (VR=5 V) | | | |
| G12180-010A | | ϕ1 | | | 60 (VR=5 V) | | | |
| G12180-020A | | ϕ2 | | | 13 (VR=1 V) | TO-5 |  | |
| G12180-030A | | ϕ3 | | | 7 (VR=1 V) | | | |
| G12180-050A | | ϕ5 | | | 3 (VR=1 V) | TO-8 |  | |
| G8370-81* | | ϕ1 | | | 35 (VR=1 V) | TO-18 |  | |
| G8370-82* | | ϕ2 | | | 4 (VR=1 V) | TO-5 |  | |
| G8370-83* | | ϕ3 | | | 2 (VR=1 V) | | | |
| G8370-85* | | ϕ5 | | | 0.6 (VR=1 V) | TO-8 |  | |
| G12180-110A | One-stage TE-cooled (Tchip=-10 °C) | ϕ1 | 0.9 to 1.67 | | 40 (VR=1 V) | TO-8 |  | C4159-03<br>A3179<br>C1103-04 |
| G12180-120A | | ϕ2 | | | 13 (VR=1 V) | | | |
| G12180-130A | | ϕ3 | | | 7 (VR=1 V) | | | |
| G12180-150A | | ϕ5 | | | 3 (VR=1 V) | | | |
| G12180-210A | Two-stage TE-cooled (Tchip=-20 °C) | ϕ1 | 0.9 to 1.65 | | 40 (VR=1 V) | |  | C4159-03<br>A3179-01<br>C1103-04 |
| G12180-220A | | ϕ2 | | | 13 (VR=1 V) | | | |
| G12180-230A | | ϕ3 | | | 7 (VR=1 V) | | | |
| G12180-250A | | ϕ5 | | | 3 (VR=1 V) | | | |
| G6854-01 | Non-cooled | ϕ0.08 | 0.9 to 1.7 | | 2000 (VR=5 V) | With CD lens TO-18 |  | – |

* Low PDL type

### ● Spectral response

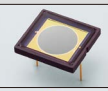
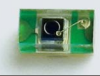



KIRDB0672EB

# Standard type

Ceramic package, plastic package

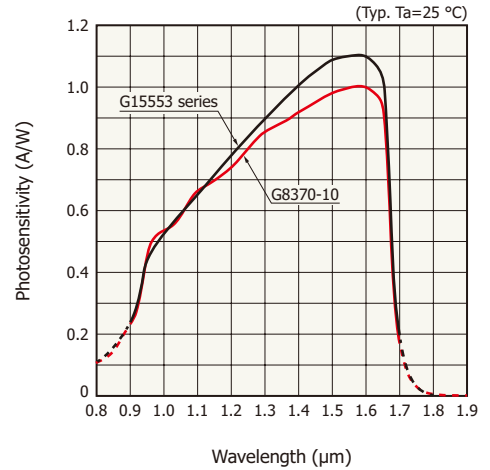
(Typ. Ta=25 °C)

| Type no. | Photosensitive area (mm) | Spectral response range λ (μm) | Peak sensitivity wavelength λp (μm) | Cutoff frequency fc VR=5 V (MHz) | Package | Photo |
|---|---|---|---|---|---|---|
| G8370-10 | φ10 | 0.9 to 1.7 | 1.55 | 0.1* | Ceramic |  |
| G15553-003C | φ0.3 | | | 600 | Ceramic (unsealed, surface mount type) |  |
| G15553-005C | φ0.5 | | | 200 | |  |
| G15553-010C | φ1 | | | 60 | |  |
| G11193-02R | φ0.2 | | | 1000 | Ceramic (surface mount type) |  |
| G11193-03R | φ0.3 | | | 500 | |  |
| G11193-10R | φ1 | | | 60 | |  |
| G13176-003P | φ0.3 | | | 600 | Plastic COB (surface mount type) |  |
| G13176-010P | φ1 | | | 60 | |  |
| G14448-003L | φ0.3 | | | 600 | Plastic COB with lens (surface mount type) |  |

* VR=0 V

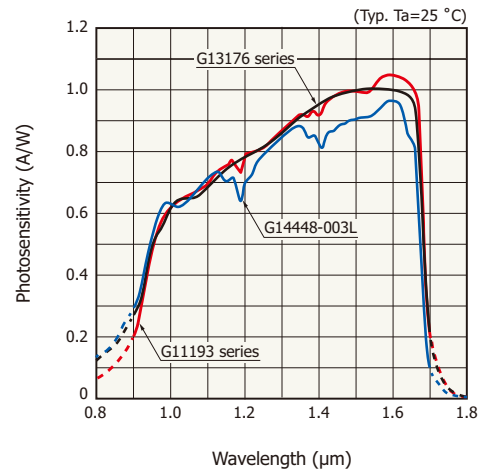
## Spectral response

[ G8370-10, G15553 series ]




KIRDB0719EA

[ G11193, G13176 series, G14448-003L ]



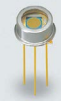
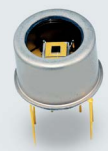

KIRDB0646EC

# Long wavelength type

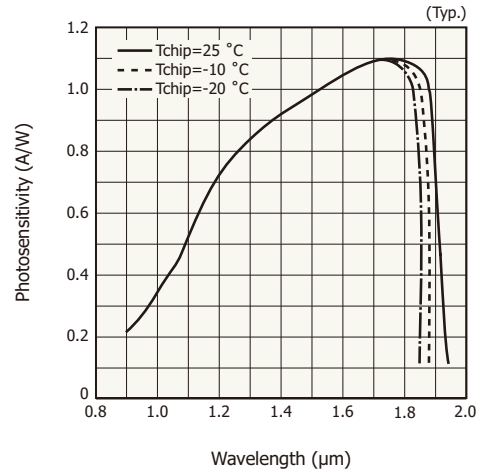
Peak sensitivity wavelength: 1.75 µm

These are suitable for light 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 $V_R$=0 V (MHz) | Package | Photo | Options (sold separately) |
|---|---|---|---|---|---|---|---|---|
| G12181-003K | Non-cooled | φ0.3 | 0.9 to 1.9 | 1.75 | 90 | TO-18 |  | C4159-03 |
| G12181-005K | | φ0.5 | | | 35 | | | |
| G12181-010K | | φ1 | | | 10 | | | |
| G12181-020K | | φ2 | | | 2.5 | TO-5 |  | |
| G12181-030K | | φ3 | | | 1.5 | | | |
| G12181-103K | One-stage TE-cooled (Tchip=-10 °C) | φ0.3 | 0.9 to 1.87 | | 140 | TO-8 |  | C4159-03 A3179 C1103-04 |
| G12181-105K | | φ0.5 | | | 50 | | | |
| G12181-110K | | φ1 | | | 16 | | | |
| G12181-120K | | φ2 | | | 3.5 | | | |
| G12181-130K | | φ3 | | | 1.8 | | | |
| G12181-203K | Two-stage TE-cooled (Tchip=-20 °C) | φ0.3 | 0.9 to 1.85 | | 150 | TO-8 |  | C4159-03 A3179-01 C1103-04 |
| G12181-205K | | φ0.5 | | | 53 | | | |
| G12181-210K | | φ1 | | | 17 | | | |
| G12181-220K | | φ2 | | | 3.7 | | | |
| G12181-230K | | φ3 | | | 1.9 | | | |

## Spectral response



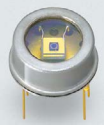

KIRDB0483ED

# Long wavelength type

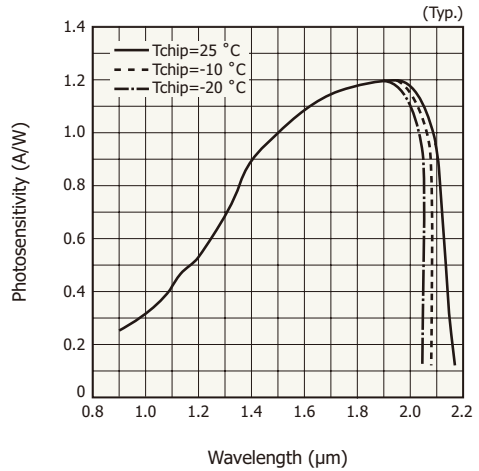
Peak sensitivity wavelength: 1.95 µm

These are suitable for optical measurement in the moisture absorption wavelength band in the 1.9 µm band.

(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 $V_R$=0 V (MHz) | Package | Photo | Options (sold separately) |
|---|---|---|---|---|---|---|---|---|
| G12182-003K | Non-cooled | φ0.3 | 0.9 to 2.1 | 1.95 | 90 | TO-18 |  | C4159-03 |
| G12182-005K | | φ0.5 | | | 35 | | | |
| G12182-010K | | φ1 | | | 10 | | | |
| G12182-020K | | φ2 | | | 2.5 | TO-5 |  | |
| G12182-030K | | φ3 | | | 1.5 | | | |
| G12182-103K | One-stage TE-cooled (Tchip=-10 °C) | φ0.3 | 0.9 to 2.07 | | 140 | TO-8 |  | C4159-03 A3179 C1103-04 |
| G12182-105K | | φ0.5 | | | 50 | | | |
| G12182-110K | | φ1 | | | 16 | | | |
| G12182-120K | | φ2 | | | 3.5 | | | |
| G12182-130K | | φ3 | | | 1.8 | | | |
| G12182-203K | Two-stage TE-cooled (Tchip=-20 °C) | φ0.3 | 0.9 to 2.05 | | 150 | TO-8 |  | C4159-03 A3179-01 C1103-04 |
| G12182-205K | | φ0.5 | | | 53 | | | |
| G12182-210K | | φ1 | | | 17 | | | |
| G12182-220K | | φ2 | | | 3.7 | | | |
| G12182-230K | | φ3 | | | 1.9 | | | |

## Spectral response



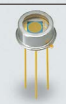
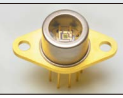

KIRDB0487ED

# Long wavelength type

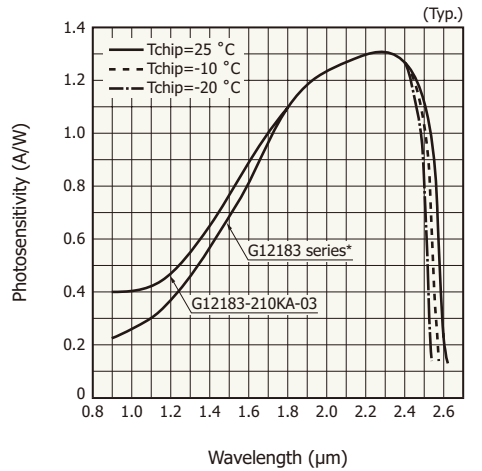
Peak sensitivity wavelength: 2.3 µm

These are suitable for NIR (near infrared) spectrometers.

(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 $V_R$=0 V (MHz) | Package | Photo | Options (sold separately) |
|---|---|---|---|---|---|---|---|---|
| G12183-003K | Non-cooled | φ0.3 | 0.9 to 2.6 | 2.3 | 50 | TO-18 |  | C4159-03 |
| G12183-005K | | φ0.5 | | | 20 | | | |
| G12183-010K | | φ1 | | | 6 | | | |
| G12183-020K | | φ2 | | | 1.5 | TO-5 |  | |
| G12183-030K | | φ3 | | | 0.8 | | | |
| G12183-103K | One-stage TE-cooled (Tchip=-10 °C) | φ0.3 | 0.9 to 2.57 | | 70 | TO-8 |  | C4159-03 A3179 C1103-04 |
| G12183-105K | | φ0.5 | | | 25 | | | |
| G12183-110K | | φ1 | | | 7 | | | |
| G12183-120K | | φ2 | | | 2 | | | |
| G12183-130K | | φ3 | | | 0.9 | | | |
| G12183-203K | Two-stage TE-cooled (Tchip=-20 °C) | φ0.3 | 0.9 to 2.55 | | 75 | TO-8 |  | C4159-03 A3179-01 C1103-04 |
| G12183-205K | | φ0.5 | | | 28 | | | |
| G12183-210K | | φ1 | | | 8 | | | |
| G12183-220K | | φ2 | | | 2.3 | | | |
| G12183-230K | | φ3 | | | 1 | | | |
| G12183-210KA-03 | | φ1 | | | 4 | TO-66 |  | |

## Spectral response



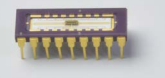
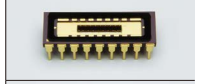

* Excluding G12183-210KA-03

KIRDB0491EF

# InGaAs PIN photodiode arrays

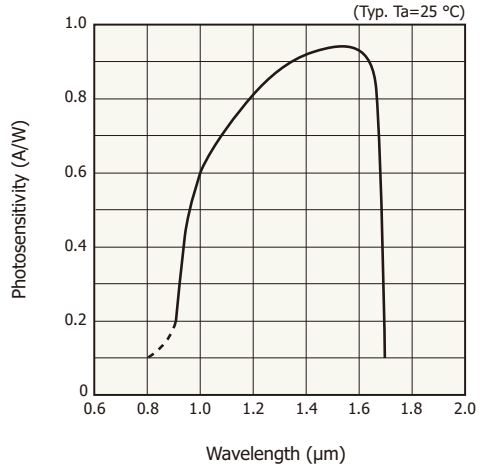
4-segmented type and 16, 32, 40, 46-element arrays are available.

(Typ. Ta=25 °C)

| Type no. | Photosensitive area (mm) | Number of elements | Spectral response range λ (μm) | Peak sensitivity wavelength λp (μm) | Package | Photo |
|---|---|---|---|---|---|---|
| G6849-01 | ϕ1 | 4-segment | 0.9 to 1.7 | 1.55 | TO-5 |  |
| G6849 | ϕ2 | 4-segment | | | |  |
| G7151-16 | 0.08 × 0.2 | 16 elements | | | Ceramic |  |
| G12430-016D | 0.45 × 1.0 | 16 elements | | | |  |
| G12430-032D | 0.2 × 1.0 | 32 elements | | | |  |
| G12430-046D | 0.2 × 1.0 | 46 elements | | | |  |
| G8909-01 | ϕ0.08 | 40 elements | | | Ceramic (unsealed) |  |

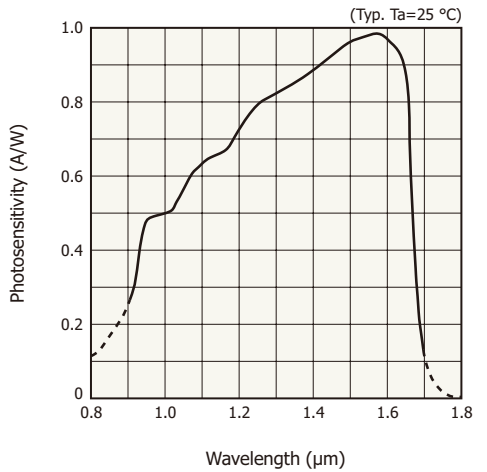
● Spectral response

[ G6849 series, G7151-16, G8909-01 ]




KIRDB0002EB

[ G12430 series ]




KIRDB0565EA

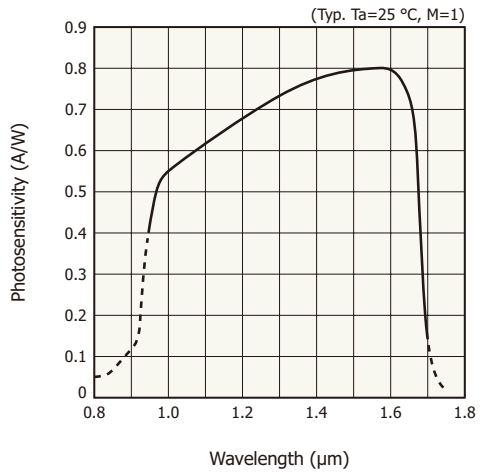
# InGaAs APD

The G14858-0020AA 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. ID=100 μA (V) | Cutoff frequency RL=50 Ω (MHz) | Terminal capacitance (pF) | Gain λ=1.55 μm | Package | Photo |
|---|---|---|---|---|---|---|---|---|
| G14858-0020AA | ϕ0.2 | 0.95 to 1.7 | 80 | 900 | 2.0 | 30 | TO-18 |  |

## Spectral response




KAPDB0417EA

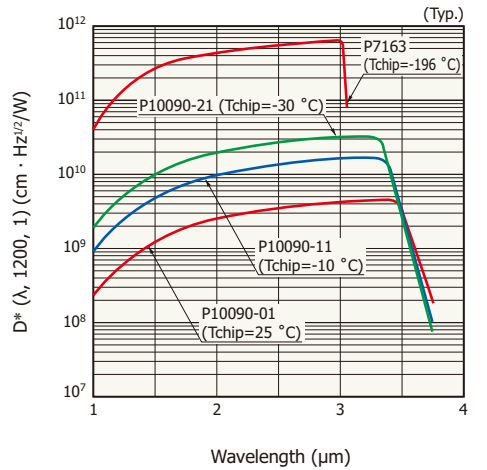
# InAs photovoltaic detectors

The InAs photovoltaic detectors are low-noise, high-speed response infrared detectors that can detect up to around 3.5 µm.

(Typ.)

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

● Spectral response




KIRDB0356EE

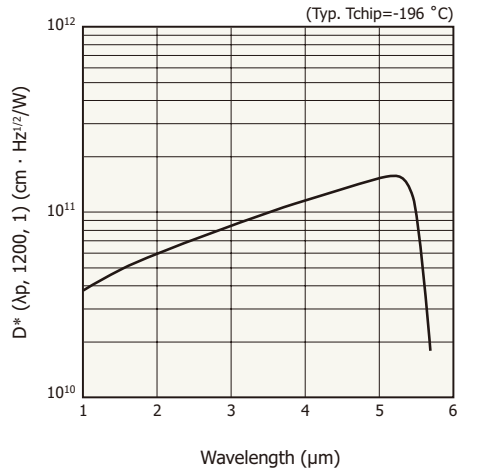
# InSb photovoltaic detectors

These are the most sensitive and fastest response detectors among our products in 5 µm band.

(Typ.)

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

● Spectral response




KIRDB0063EF

# Front-illuminated type

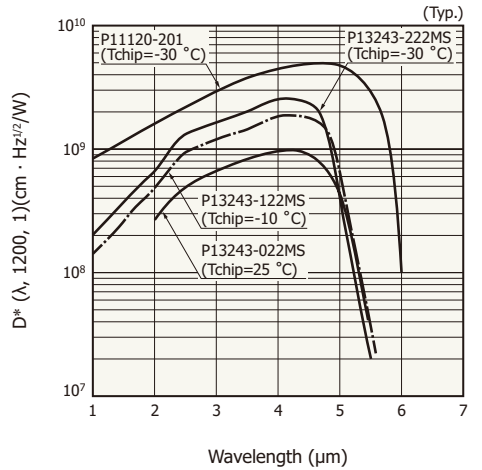
These are InAsSb photovoltaic detectors with cutoff wavelengths of 5 µm band or 10 µm band. The TE-cooled type capable of stable S/N measurement are available.

(Typ.)

| Type no. | Cooling | Photosensitive area (mm) | Cutoff wavelength λc (µm) | Peak sensitivity wavelength λp (µm) | Package | Photo | Options (sold separately) |
|---|---|---|---|---|---|---|---|
| P11120-201 | Two-stage TE-cooled (Tchip=-30 °C) | ϕ1 | 5.9 | 4.9 | TO-8 |  | A3179-01 C1103-04 C4159-07 |
| P13243-022MS | Non-cooled | 2 × 2 | 5.3 | 4.1 | TO-5 |  | C4159-01 |
| P13243-122MS | One-stage TE-cooled (Tchip=-10 °C) | | 5.2 | | TO-8 |  | A3179 C1103-04 C4159-01 |
| P13243-222MS | Two-stage TE-cooled (Tchip=-30 °C) | | 5.1 | | |  | A3179-01 C1103-04 C4159-01 |
| P13894-011MA | Non-cooled | 1 × 1 | 11.0 | 5.6 | TO-5 |  | C4159-01 |
| P13894-211MA | Two-stage TE-cooled (Tchip=-30 °C) | | 10.2 | | TO-8 |  | A3179-01 C1103-04 C4159-01 |

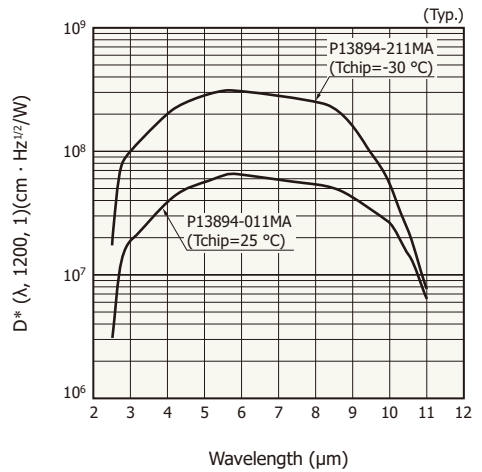
## Spectral response

[ P11120-201, P13243 series ]




KIRDB0430EM

[ P13894 series ]

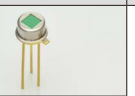
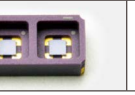



KIRDB0626ED

# Back-illuminated type

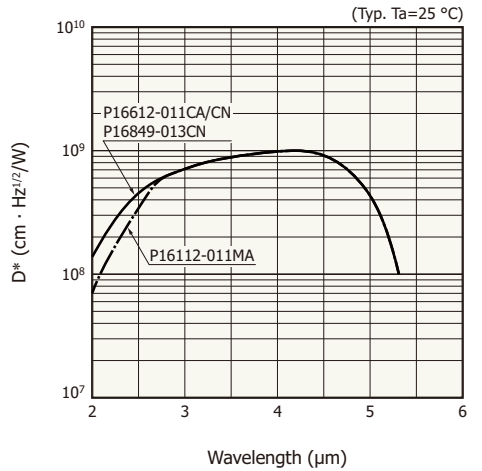
The back-illuminated type InAsSb photovoltaic detectors achieve cutoff wavelength of 5 µm, 8 µm, or 10 µm using Hamamatsu's unique crystal growth technology. Compared to the front-illuminated type, they achieve high sensitivity and improve the temperature characteristics of sensitivity.

(Typ.)

| Type no. | Cooling | Photosensitive area (mm) | Cutoff wavelength λc (µm) | Peak sensitivity wavelength λp (µm) | Package | Photo | Dedicated amplifier (sold separately) |
|---|---|---|---|---|---|---|---|
| P16112-011MA | Non-cooled | 0.7 × 0.7 | 5.3 | 4.1 | TO-46 |  | C4159-01 |
| P16612-011CA | | | | | Ceramic (Surface mount type) |  | |
| P16612-011CN NEW | | | | | |  | |
| P16613-011CN NEW | | | 8.3 | 6.5 | | | |
| P16614-011CN NEW | | | 11 | 7.4 | | | |
| P16849-013CN NEW | | 0.7 × 0.7 (two-element) | 5.3 | 4.1 | |  | – |

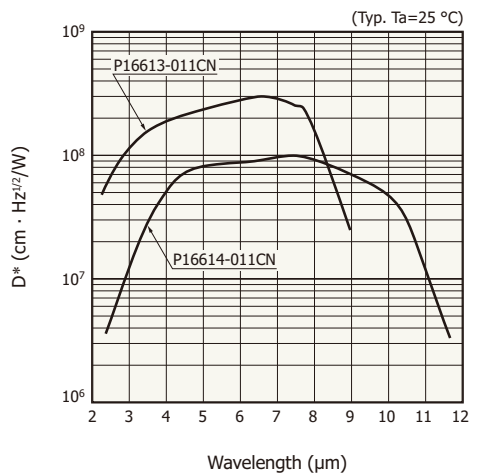
● Spectral response

[ P16112-011MA, P16612 series, P16849-013CN ]




KIRDB0715ED

[ P16613-011CN, P16614-011CN ]




KIRDB0733EA

# With band-pass filter

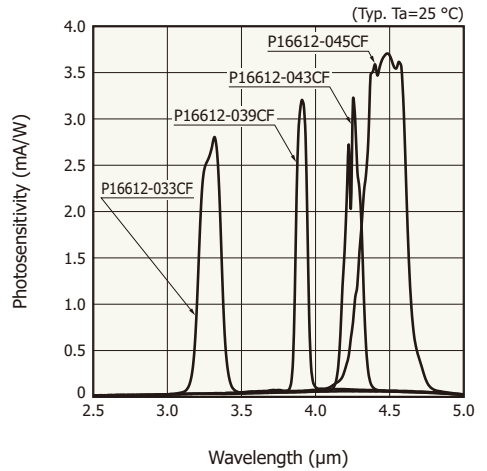
These are back-illuminated type InAsSb photovoltaic detectors that use a band-pass filter (center wavelength: 3.3 µm, 3.9 µm, 4.26 µm, 4.45 µm) for the window material. They are suitable for gas measurement ($CH_4$, $CO_2$) and flame detection.

(Typ.)

| Type no. | Cooling | Photosensitive area (mm) | Window material* | Package | Photo | Dedicated amplifier (sold separately) |
|---|---|---|---|---|---|---|
| P16612-033CF NEW | Non-cooled | 0.7 × 0.7 | BPF (3.3 µm) | Ceramic (Surface mount type) |  | C4159-01 |
| P16612-039CF NEW | | | BPF (3.9 µm) | | | |
| P16612-043CF NEW | | | BPF (4.26 µm) | | | |
| P16612-045CF NEW | | | BPF (4.45 µm) | | | |
| P16849-011CF NEW | | 0.7 × 0.7 (two-element) | BPF (3.3 µm) | |  | – |
| P16849-012CF NEW | | | BPF (3.9 µm) | | | |
| | | | BPF (3.9 µm) | | | |
| | | | BPF (4.26 µm) | | | |

* BPF: band-pass filter

● Spectral response

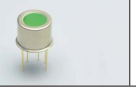



KIRDB0732EA

# With lens

This is an InAsSb photovoltaic detector that achieves high sensitivity by mounting a lens on a chip with a back-illuminated structure. It is an electronically cooled type that provides a stable S/N.

(Typ.)

| Type no. | Cooling | Photosensitive area (mm) | Cutoff wavelength λc (μm) | Peak sensitivity wavelength λp (μm) | Package | Photo | Options (sold separately) |
|---|---|---|---|---|---|---|---|
| P12691-201G | Two-stage TE-cooled (Tchip=-30 °C) | ϕ1 | 8.3 | 6.7 | TO-8 |  | A3179-01<br>C1103-04<br>C4159-07 |

# Arrays

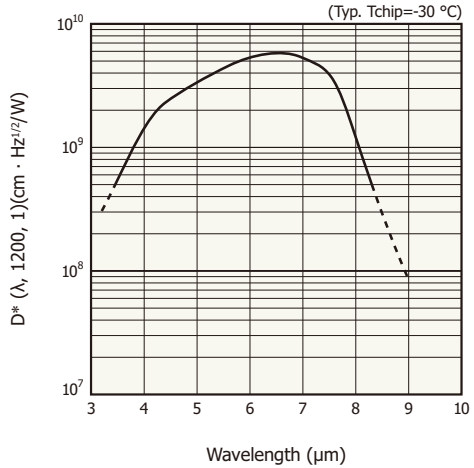
These are InAsSb arrays in DIP ceramic packages. Simultaneous measurement and wide range measurement are possible.

(Typ.)

| Type no. | Cooling | Photosensitive area (mm) | Cutoff wavelength λc (μm) | Peak sensitivity wavelength λp (μm) | Package | Photo | Dedicated amplifier (sold separately) |
|---|---|---|---|---|---|---|---|
| P15742-016DS | Non-cooled | 0.45 × 0.7 (16 elements) | 5.3 | 4.1 | Ceramic |  | — |
| P15742-046DS | | 0.2 × 0.7 (46 elements) | | | |  | |

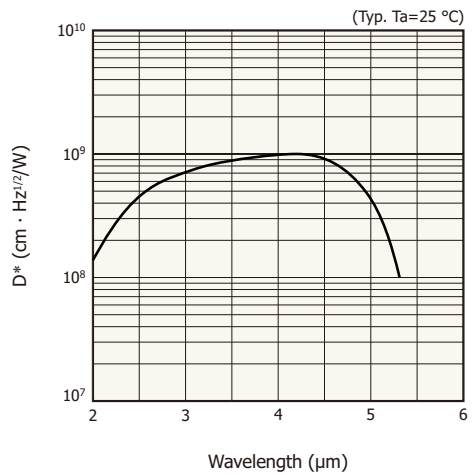
● Spectral response

[ P12691-201G ]




KIRDB0592EA

[ P15742 series ]




KIRDB0687EB

# Type Ⅱ superlattice infrared detectors

## 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's 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. It is a replacement for conventional products that contain these substances.

(Typ.)

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

* Wavelength at which signal/noise = 1

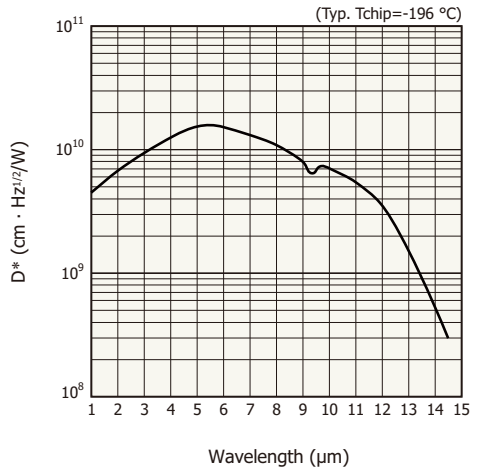
## Infrared detector module with preamp

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

(Typ.)

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

● Spectral response




KIRDB0673EB

# Thermopile detectors (thermal detectors)

## Single element

These are high-sensitivity Si thermopile detectors suitable for gas density measurement or the like. By attaching a band-pass filter to the thermopile detector, it is possible to measure the concentration of various gases. The T15570 is suitable for flame detection.

(Typ.)

| Type no. | Number of elements | Photosensitive area (mm) | Window material | Spectral response range (μm) | Package | Photo |
|---|---|---|---|---|---|---|
| T11361-01* | 1 | 1.2 × 1.2 | Si with AR coating | 3 to 5 | TO-18 |  |
| T15770 | | | With band-pass filter | 4.45 | | |
| T15962-01* | | | Si | 1.1 or longer | | |

* Built-in thermistor

## Dual element

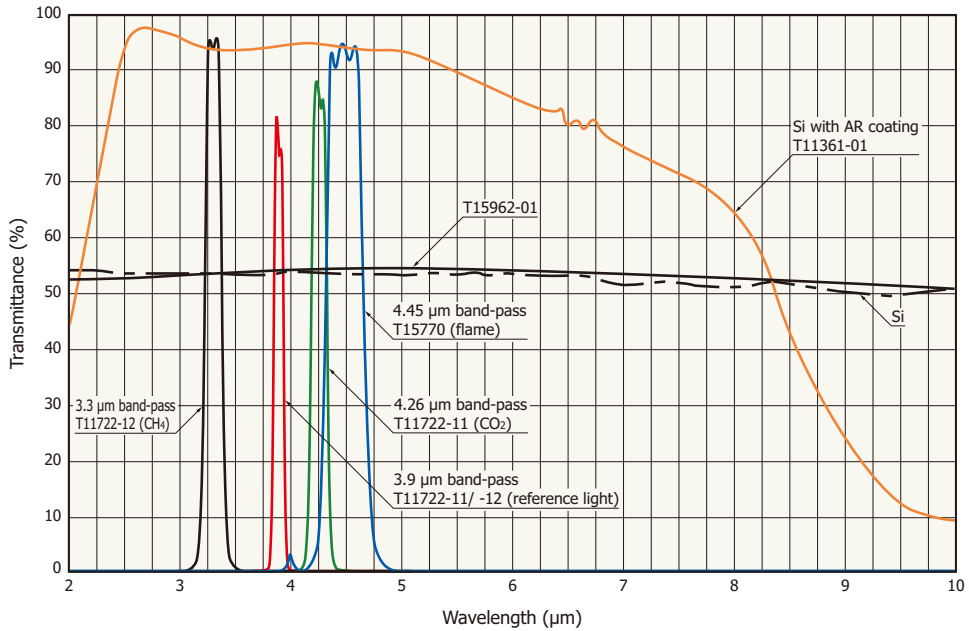
These dual type thermopile detectors were developed to measure concentration of carbon dioxide ($CO_2$) and methane ($CH_4$) with high accuracy. They consist of two high-sensitivity Si thermopile chips and two band-pass filters so that two wavelengths can be detected simultaneously.

(Typ.)

| Type no. | Number of elements | Photosensitive area (mm) | Window material | Spectral response range (μm) | Package | Photo |
|---|---|---|---|---|---|---|
| T11722-11 | 2 | 1.2 × 1.2 (per element) | With band-pass filter | Reference light: 3.9<br>$CO_2$: 4.26 | TO-5 |  |
| T11722-12 | | | | Reference light: 3.9<br>$CH_4$: 3.3 | | |

### ● Spectral response (typical example)

Since thermopile detectors have no wavelength dependence, their spectral response is determined by the transmittance characteristics of window materials. Spectral transmittance characteristics of typical window materials are shown below. Please contact our sales office if you wish to replace a window material with the one shown below for thermopile detectors.




KIRDB0671ED

# Two-color detectors

These sensors have two photosensors with different spectral response ranges arranged on the top and bottom of the same optical axis. They realize a wide spectral response range. The TE-cooled types improve the S/N and enable high accuracy measurement by cooling the element and keeping the temperature constant.

(Typ.)

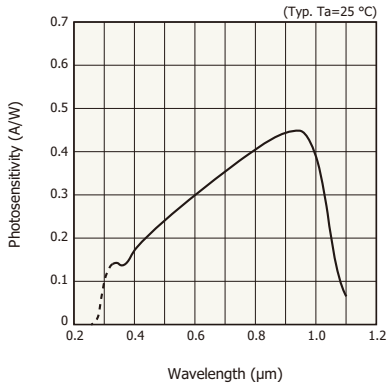
| Type no. | Cooling | Detector | Photosensitive area (mm) | Spectral response range λ (μm) | Peak sensitivity wavelength λp (μm) | Photosensitivity S λ=λp (A/W) | Package | Photo | Options (sold separately) |
|---|---|---|---|---|---|---|---|---|---|
| K1713-003 | Non-cooled | Si | 2.4 × 2.4 | 0.32 to 5.3 | 0.94 | 0.45 | TO-5 |  | C9329<br>C4159-01 |
| | | 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<br>C4159-03 |
| | | 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 | | | |
| K11908-010K | | InGaAs | 2.4 × 2.4 | 0.9 to 2.55 | 1.55 | 0.95 | | | C4159-03 |
| | | InGaAs | ϕ1 | | 2.1 | 1.0 | | | |
| K13085-010K | | InGaAs | 2.4 × 2.4 | 0.9 to 1.85 | 1.55 | 0.95 | | | |
| | | InGaAs | ϕ1 | | 1.75 | 0.8 | | | |
| K3413-05 | One-stage TE-cooled (Tchip=-10 °C) | Si | 2.4 × 2.4 | 0.32 to 1.67 | 0.94 | 0.45 | TO-8 |  | C9329<br>C4159-03<br>A3179-03<br>C1103-04 |
| | | 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 | | | |
| K12728-010K | Non-cooled | Si | 2.4 × 2.4 | 0.32 to 1.7 | 0.96 | 0.45 | Ceramic (surface mount type) |  | – |
| | | InGaAs | ϕ1 | | 1.55 | 0.55 | | | |
| K12729-010K | | InGaAs | 2.4 × 2.4 | 0.9 to 2.55 | 1.55 | 0.95 | |  | |
| | | InGaAs | ϕ1 | | 2.1 | 1.0 | | | |

# Two-color detectors

## Spectral response

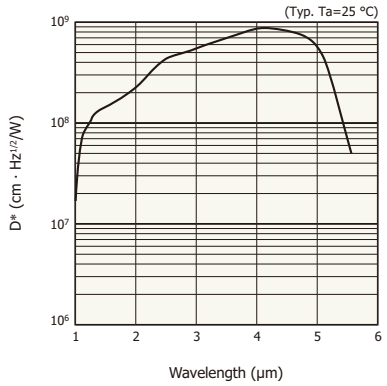
[ K1713-003 ]

Si photodiode




KIRDB0199EB

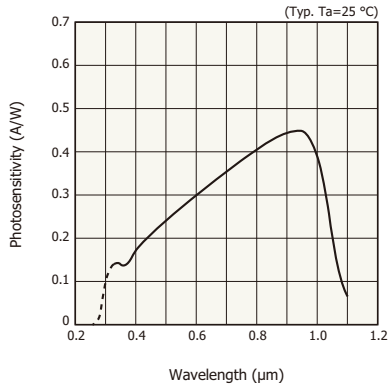
InAsSb photovoltaic detector




KIRDB0623EB

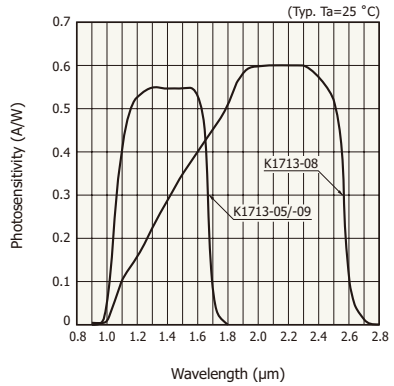
[ K1713-05/-08/-09 ]

Si photodiode




KIRDB0199EB

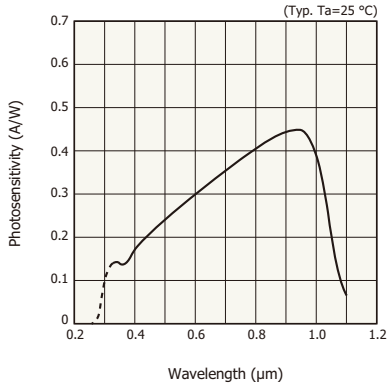
InGaAs PIN photodiode




KIRDB0211EB

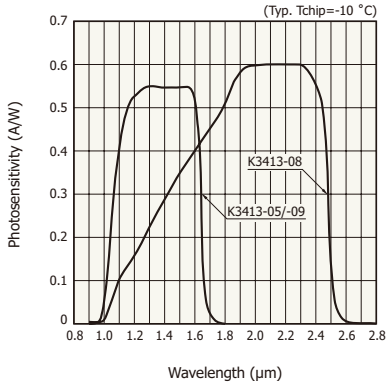
[ K3413-05/-08/-09 ]

Si photodiode



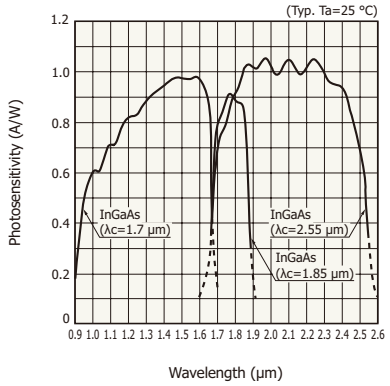

KIRDB0199EB

InGaAs PIN photodiode



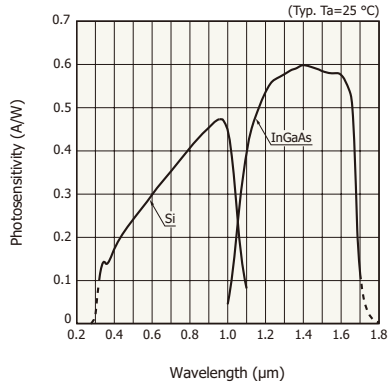

KIRDB0212EB

[ K11908-010K, K13085-010K, K12729-010K ]




KIRDB0661EA

[ K12728-010K ]



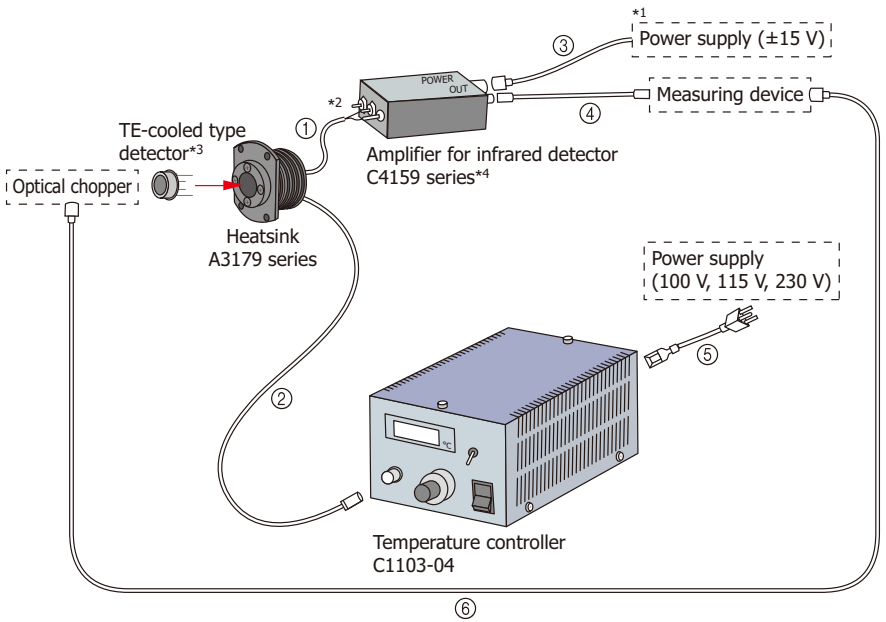

KIRDB0598EC

# Accessories for infrared detectors

Hamamatsu provides the following accessories for infrared detectors.

| Product name | Type no. | Overview |
|---|---|---|
| Temperature controller | C1103-04 | The temperature of the TE-cooler inside the detector can be set. Compatible with one-stage and two-stage TE-cooled InAsSb/InAs photovoltaic detectors and InGaAs/Si photodiodes |
| Valve operator for metal dewar | A3515 | The valve operator can be used to re-evacuate the metal dewar. Please be aware of that the detector performance is not guaranteed after re-evacuation at the customer side. |
| Heatsink (for TE-cooled detector TO-8/TO-3 package) | A3179 series | This heatsink is designed for TE-cooled detectors in 6-pin TO-8 packages and TO-3 packages. |

## Connection example




KACCC0321EE

## Cable

| Cable no. | Cable | Approx. length | Note |
|---|---|---|---|
| ① | Coaxial cable (for signals) | 2 m | Supplied with heatsink A3179 series. Make the cable as short as possible. (approx. 10 cm is desirable) |
| ② | 4-conductor cable (with a connector) A4372-05 | 3 m | Supplied with temperature controller C1103 series. It is also sold separately. |
| ③ | 4-conductor cable (with a connector) A4372-02 | 2 m | Supplied with C4159 series amplifiers for infrared detectors and infrared detector modules with preamp (room temperature type). It is also sold separately. |
| ④ | BNC connector cable E2573 | 1 m | Sold separately |
| ⑤ | Power cable (for temperature controller) | 1.9 m | Supplied with temperature controller C1103 series |
| ⑥ | Cable | - | It needs to be prepared by user side. |

*1: Attach the unterminated wire to a 3-4 pin connector or banana plug, then connect it to the power supply.
*2: Soldering is required.
*3: No dedicated socket is available. Soldering is required.
*4: Refer to amplifiers for infrared detectors (P.24) for details.

# Amplifiers for infrared detectors

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


| Product name | Type no. | Conversion impedance 3 range switchable (V/A) | Frequency characteristics Amplifier only, -3 dB | Equivalent input noise current f=1 kHz (pA/Hz$^{1/2}$) | External power supply (V) | Applicable detectors |
|---|---|---|---|---|---|---|
| Amplifier for photovoltaic detector | C4159-01 | $10^8$, $10^7$, $10^6$ | DC to 100 kHz | 0.15 ($10^8$, $10^7$ range)<br>0.65 ($10^6$ range) | ±15 | Dewar type InSb (P5968-060/-100), non-cooled type InAsSb (P13243-022MS, P13894-011MA, P16112-011MA, P16612-011CA/-011CN/-033CF/-039CF/-043CF/-045CF, P16613-011CN, P16614-011CN), TE-cooled type InAsSb (P13243-122MS/-222MS, P13894-211MA), dewar Type Ⅱ (P15409-901) |
| | C4159-04 | $2 \times 10^7$, $2 \times 10^6$, $2 \times 10^5$ | DC to 45 kHz | 0.55 | ±15 | Dewar type InSb (P5968-200) |
| | C4159-05 | $10^8$, $10^7$, $10^6$ | DC to 15 kHz | 0.15 ($10^8$, $10^7$ range)<br>0.65 ($10^6$ range) | ±15 | Dewar type InAs (P7163) |
| | C4159-06 | $10^6$, $10^5$, $10^4$ | DC to 100 kHz | 6 | ±15 | TE-cooled type InAs (P10090-11/-21) |
| | C4159-07 | $10^6$, $10^5$, $10^4$ | DC to 100 kHz | 10 | ±15 | Non-cooled type InAs (P10090-01), TE-cooled type InAsSb (P11120-201, P12691-201G) |
| Amplifier for InGaAs PIN photodiode | C4159-03 | $10^7$, $10^6$, $10^5$ | DC to 15 kHz | 2.5 | ±15 | Non-cooled/TE-cooled type InGaAs (G12180/G12181/G12182/G12183 series) |

## Accessories

· Instruction manual
· Power cable A4372-02
(with 4-pin connector for amplifier connection, the othe side: unterminated wire, 2 m)

## Required power supply specifications

· C4159 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): PW18-3AD [TEXIO], E3630A [Keysight Technologies]

## 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 |

* No dew condensation. When there is a temperature difference between a product and the surrounding area in high humidity environments, dew condensation may occur on the product surface. Dew condensation on the product may cause deterioration in characteristics and reliability.

Note: Exceeding the absolute maximum ratings even momentarily may cause a drop in product quality. Always be sure to use the product within the absolute maximum ratings.

# Infrared detector modules with preamp

These modules integrate a preamp with an infrared detector of various types. They can detect infrared light simply by connecting a DC power supply.

(Typ.)

| Type | Type no. | Photo | Detector (type no.) | Photosensitive area (mm) | Cooling | Measurement condition Chip temperature (°C) | Cutoff wavelength (μm) | Peak sensitivity wavelength (μm) |
|---|---|---|---|---|---|---|---|---|
| TE-cooled type | C12483-250 |  | InGaAs (G12180-250A) | ϕ5 | TE-cooled | -15 | 1.66 | 1.55 |
| | C12485-210 | | InGaAs (G12182-210K) | ϕ1 | | | 2.05 | 1.95 |
| | C12486-210 | | InGaAs (G12183-210K) | | | | 2.56 | 2.3 |
| | C12492-210 | | InAs (P10090-21) | ϕ1 | | -28 | 3.45 | 3.25 |
| | C12494-222S NEW | | InAsSb (P13243-222MS) | 2 × 2 | | -28 | 4.1 | 5.1 |
| | C12494-210S | | InAsSb (P11120-201) | ϕ1 | | | 5.9 | 4.9 |
| | C12494-210M | | InAsSb (P12691-201G) | | | | 8.3 | 6.7 |
| | C12494-211L | | InAsSb (P13894-211MA) | 1 × 1 | | | 10.2 | 5.6 |
| Metal dewar type | G7754-01 |  | InGaAs (G12183-010)*1 | ϕ1 | Liquid nitrogen | -196 | 2.4 | 2.0 |
| | G7754-03 | | InGaAs (G12183-030)*1 | ϕ3 | | | | |
| | P7751-01*2 | | InSb (P5968-060) | ϕ0.6 | | | 5.5 | 5.3 |
| | P7751-02*2 | | InSb (P5968-200) | ϕ2 | | | | |

*1: Chip
*2: FOV=60°

# Photodiode modules

These high accuracy photodetectors have a high/low 2-range switching function.

| Type no. | Spectral response range (μm) | Peak sensitivity wavelength (μm) | Detector | Photosensitive area (mm) | Cooling | Photo |
|---|---|---|---|---|---|---|
| C10439-10 | 0.5 to 1.7 | 1.55 | InGaAs | ϕ1 | Non-cooled |  |
| C10439-11 | 0.5 to 1.7 | 1.55 | InGaAs | ϕ3 | |  |
| C10439-15 | 0.32 to 2.6 | 0.94 | Si | 2.4 × 2.4 | |  |
| | | 2.3 | InGaAs | ϕ1 | | |

## Signal processing unit for photodiode module C10475-01

The C10475-01 is a signal processing unit specifically designed to convert the output of a photodiode module (C10439 series) into digital signals. Digital output (16-bit) can be obtained through serial connection (RS-232C) to a PC.

## Technical notes

Compound semiconductor photosensors
Thermopile detectors

## Precautions

Disclaimer
Safety consideration
Metal, ceramic, plastic package products
Unsealed products
Surface mount type products
Compound opto-semiconductors (photosensors, light emitters)

## Inquiries from online

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