

# InGaAs PIN photodiodes

G12180 series

**Photosensitive area from  $\phi 0.3$  mm to  $\phi 5$  mm**

InGaAs PIN photodiodes have large shunt resistance and feature very low noise. Hamamatsu provides various types of InGaAs PIN photodiodes with photosensitive area from  $\phi 0.3$  mm to  $\phi 5$  mm.

## Features

- Low noise, low dark current
- Low terminal capacitance
- Large photosensitive area
- Various photosensitive area sizes available

## Applications

- Laser monitors
- Optical power meters
- Laser diode life test
- NIR (near infrared) photometry
- Optical communications

## Options

- Amplifier for InGaAs PIN photodiode **C4159-03**
- Heatsink for one-stage TE-cooled type **A3179**
- Heatsink for two-stage TE-cooled type **A3179-01**
- Temperature controller for TE-cooler type **C1103-04**

## Structure

| Type no.    | Dimensional outline/<br>Window material*1 | Package | Cooling                | Photosensitive area<br>(mm) |
|-------------|-------------------------------------------|---------|------------------------|-----------------------------|
| G12180-003A | (1)/A                                     | TO-18   | Non-cooled             | φ0.3                        |
| G12180-005A |                                           |         |                        | φ0.5                        |
| G12180-010A |                                           |         |                        | φ1                          |
| G12180-020A | (2)/A                                     | TO-5    |                        | φ2                          |
| G12180-030A |                                           |         |                        | φ3                          |
| G12180-050A | (3)/A                                     | TO-8    |                        | One-stage<br>TE-cooled      |
| G12180-110A | (4)/A                                     |         | φ1                     |                             |
| G12180-120A |                                           |         | φ2                     |                             |
| G12180-130A |                                           |         | φ3                     |                             |
| G12180-150A |                                           |         | φ5                     |                             |
| G12180-210A | (5)/A                                     |         | Two-stage<br>TE-cooled | φ1                          |
| G12180-220A |                                           |         |                        | φ2                          |
| G12180-230A |                                           |         |                        | φ3                          |
| G12180-250A |                                           |         |                        | φ5                          |

\*1: A=Borosilicate glass with anti-reflective coating (optimized for 1.55  $\mu$ m peak)

### Absolute maximum ratings

| Type no.    | Thermistor power dissipation<br>Pd_th<br>(mW) | TE-cooler allowable current<br>ITE max<br>(A) | TE-cooler allowable voltage<br>VTE max<br>(V) | Reverse voltage<br>VR max<br>(V) | Operating temperature*2<br>Topr<br>(°C) | Storage temperature*2<br>Tstg<br>(°C) | Soldering conditions           |
|-------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|----------------------------------|-----------------------------------------|---------------------------------------|--------------------------------|
| G12180-003A | -                                             | -                                             | -                                             | 20                               | -40 to +100                             | -55 to +125                           | 260 °C or less,<br>within 10 s |
| G12180-005A |                                               |                                               |                                               | 10                               |                                         |                                       |                                |
| G12180-010A |                                               |                                               |                                               | 5                                |                                         |                                       |                                |
| G12180-020A |                                               |                                               |                                               | 2                                |                                         |                                       |                                |
| G12180-030A |                                               |                                               |                                               |                                  |                                         |                                       |                                |
| G12180-050A |                                               |                                               |                                               |                                  |                                         |                                       |                                |
| G12180-110A | 0.2                                           | 1.5                                           | 1                                             | 5                                | -40 to +70                              | -55 to +85                            |                                |
| G12180-120A |                                               |                                               |                                               | 2                                |                                         |                                       |                                |
| G12180-130A |                                               |                                               |                                               |                                  |                                         |                                       |                                |
| G12180-150A |                                               | 1                                             | 1.2                                           | 5                                |                                         |                                       |                                |
| G12180-210A |                                               |                                               |                                               | 2                                |                                         |                                       |                                |
| G12180-220A |                                               |                                               |                                               |                                  |                                         |                                       |                                |
| G12180-230A |                                               |                                               |                                               |                                  |                                         |                                       |                                |
| G12180-250A |                                               |                                               |                                               |                                  |                                         |                                       |                                |

\*2: No dew condensation

When there is a temperature difference between a product and the surrounding area in high humidity environment, dew condensation may occur on the product surface. Dew condensation on the product may cause deterioration in characteristics and reliability.

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.

The G12180 series may be damaged by electrostatic discharge, etc. Be careful when using the G12180 series.

### Electrical and optical characteristics (Typ. unless otherwise noted)

| Type no.    | Measurement condition    | Thermistor resistance Rth<br>(kΩ) | Thermistor B constant B<br>(K) | Spectral response range λ<br>(μm) | Peak sensitivity wavelength λp<br>(μm) | Photosensitivity S |            |            |            | Dark current Id<br>VR=1 V |             | Temp. coefficient of dark current ΔTID<br>VR=1 V (times/°C) |  |  |      |      |      |      |  |
|-------------|--------------------------|-----------------------------------|--------------------------------|-----------------------------------|----------------------------------------|--------------------|------------|------------|------------|---------------------------|-------------|-------------------------------------------------------------|--|--|------|------|------|------|--|
|             | Element temperature (°C) |                                   |                                |                                   |                                        | 1.3 μm             |            | λ=λp       |            | Typ. (nA)                 | Max. (nA)   |                                                             |  |  |      |      |      |      |  |
|             |                          |                                   |                                |                                   |                                        | Min. (A/W)         | Typ. (A/W) | Min. (A/W) | Typ. (A/W) |                           |             |                                                             |  |  |      |      |      |      |  |
| G12180-003A | 25                       | -                                 | -                              | 0.9 to 1.7                        | 1.55                                   | 0.8                | 0.9        | 0.9        | 1.1        | 0.1*3                     | 0.5*3       | 1.09                                                        |  |  |      |      |      |      |  |
| G12180-005A |                          |                                   |                                |                                   |                                        |                    |            |            |            | 0.15*3                    | 0.75*3      |                                                             |  |  |      |      |      |      |  |
| G12180-010A |                          |                                   |                                |                                   |                                        |                    |            |            |            | 0.8*3                     | 4*3         |                                                             |  |  |      |      |      |      |  |
| G12180-020A |                          |                                   |                                |                                   |                                        |                    |            |            |            | 1.5                       | 7.5         |                                                             |  |  |      |      |      |      |  |
| G12180-030A |                          |                                   |                                |                                   |                                        |                    |            |            |            | 2.5                       | 12.5        |                                                             |  |  |      |      |      |      |  |
| G12180-050A |                          |                                   |                                |                                   |                                        |                    |            |            |            |                           |             |                                                             |  |  |      |      |      |      |  |
| G12180-110A | -10                      | 9.0                               | 3.3                            | 0.9 to 1.67                       |                                        |                    |            |            |            |                           |             |                                                             |  |  | 0.02 | 0.1  |      |      |  |
| G12180-120A |                          |                                   |                                |                                   |                                        |                    |            |            |            |                           |             |                                                             |  |  | 0.1  | 0.5  |      |      |  |
| G12180-130A |                          |                                   |                                |                                   |                                        |                    |            |            |            |                           |             |                                                             |  |  | 0.15 | 0.8  |      |      |  |
| G12180-150A |                          |                                   |                                |                                   |                                        |                    |            |            |            |                           |             |                                                             |  |  | 0.33 | 1.67 |      |      |  |
| G12180-210A | -20                      |                                   |                                |                                   |                                        |                    |            |            |            |                           | 0.9 to 1.65 |                                                             |  |  |      |      | 0.01 | 0.06 |  |
| G12180-220A |                          |                                   |                                |                                   |                                        |                    |            |            |            |                           |             |                                                             |  |  | 0.04 | 0.2  |      |      |  |
| G12180-230A |                          |                                   |                                |                                   |                                        |                    |            |            |            |                           |             |                                                             |  |  | 0.07 | 0.35 |      |      |  |
| G12180-250A |                          |                                   |                                |                                   |                                        |                    |            |            |            |                           |             |                                                             |  |  | 0.15 | 0.75 |      |      |  |

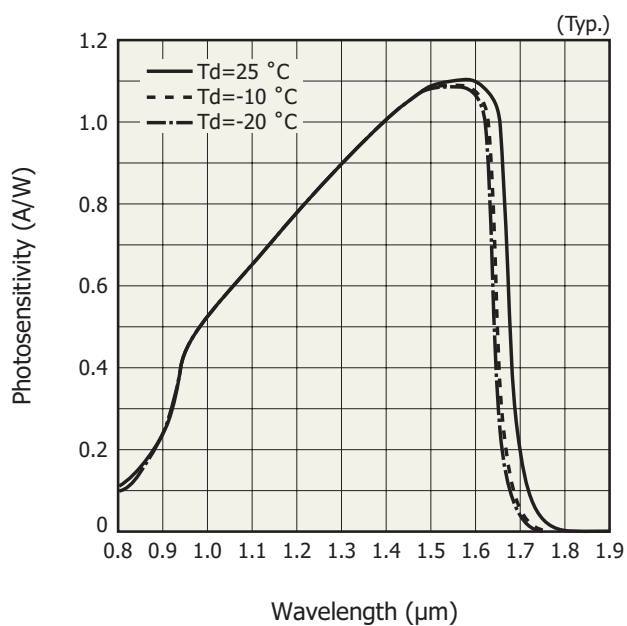
\*3: VR=5 V

| Type no.    | Measurement condition       | Cutoff frequency<br>fc |               | Terminal capacitance<br>Ct |              | Shunt resistance<br>Rsh |              | Detectivity<br>D*                 |                                   | Noise equivalent power<br>NEP  |                                |
|-------------|-----------------------------|------------------------|---------------|----------------------------|--------------|-------------------------|--------------|-----------------------------------|-----------------------------------|--------------------------------|--------------------------------|
|             | Element temperature<br>(°C) | VR=1 V<br>RL=50 Ω      |               | VR=1 V<br>f=1 MHz          |              | VR=10 mV                |              | $\lambda=\lambda_p$               |                                   | $\lambda=\lambda_p$            |                                |
|             |                             | Min.<br>(MHz)          | Typ.<br>(MHz) | Typ.<br>(pF)               | Max.<br>(pF) | Min.<br>(MΩ)            | Typ.<br>(MΩ) | Min.<br>(cm·Hz <sup>1/2</sup> /W) | Typ.<br>(cm·Hz <sup>1/2</sup> /W) | Typ.<br>(W/Hz <sup>1/2</sup> ) | Max.<br>(W/Hz <sup>1/2</sup> ) |
| G12180-003A | 25                          | 450*4                  | 600*4         | 5*5                        | 7.5*5        | 200                     | 1000         | $2.4 \times 10^{12}$              | $6.3 \times 10^{12}$              | $4.2 \times 10^{-15}$          | $1.2 \times 10^{-14}$          |
| G12180-005A |                             | 160*4                  | 200*4         | 15*5                       | 20*5         | 80                      | 400          |                                   |                                   | $7.0 \times 10^{-15}$          | $1.9 \times 10^{-14}$          |
| G12180-010A |                             | 25*4                   | 60*4          | 55*5                       | 120*5        | 25                      | 125          |                                   |                                   | $1.4 \times 10^{-14}$          | $3.8 \times 10^{-14}$          |
| G12180-020A |                             | 4                      | 13            | 250                        | 800          | 6.5                     | 30           |                                   |                                   | $2.8 \times 10^{-14}$          | $7.5 \times 10^{-14}$          |
| G12180-030A |                             | 2.5                    | 7             | 450                        | 1500         | 4                       | 20           |                                   |                                   | $4.4 \times 10^{-14}$          | $1.1 \times 10^{-13}$          |
| G12180-050A |                             | 0.5                    | 3             | 1000                       | 7000         | 1.3                     | 6.5          |                                   |                                   | $7.0 \times 10^{-14}$          | $1.9 \times 10^{-13}$          |
| G12180-110A | -10                         | 20                     | 40            | 75                         | 140          | 750                     | 3750         | $1.6 \times 10^{13}$              | $4.4 \times 10^{13}$              | $2.0 \times 10^{-15}$          | $5.4 \times 10^{-15}$          |
| G12180-120A |                             | 4                      | 13            | 250                        | 800          | 200                     | 900          |                                   |                                   | $4.0 \times 10^{-15}$          | $1.1 \times 10^{-14}$          |
| G12180-130A |                             | 2.5                    | 7             | 450                        | 1500         | 120                     | 600          |                                   |                                   | $4.9 \times 10^{-15}$          | $1.4 \times 10^{-14}$          |
| G12180-150A |                             | 0.5                    | 3             | 1000                       | 7000         | 40                      | 200          |                                   |                                   | $8.6 \times 10^{-15}$          | $2.3 \times 10^{-14}$          |
| G12180-210A | -20                         | 20                     | 40            | 75                         | 140          | 1750                    | 8750         | $2.6 \times 10^{13}$              | $6.7 \times 10^{13}$              | $1.3 \times 10^{-15}$          | $3.5 \times 10^{-15}$          |
| G12180-220A |                             | 4                      | 13            | 250                        | 800          | 500                     | 2000         |                                   |                                   | $2.7 \times 10^{-15}$          | $6.5 \times 10^{-15}$          |
| G12180-230A |                             | 2.5                    | 7             | 450                        | 1500         | 280                     | 1400         |                                   |                                   | $3.2 \times 10^{-15}$          | $8.7 \times 10^{-15}$          |
| G12180-250A |                             | 0.5                    | 3             | 1000                       | 7000         | 90                      | 500          |                                   |                                   | $5.3 \times 10^{-15}$          | $1.5 \times 10^{-14}$          |

\*4: VR=5 V, RL=50 Ω, -3 dB

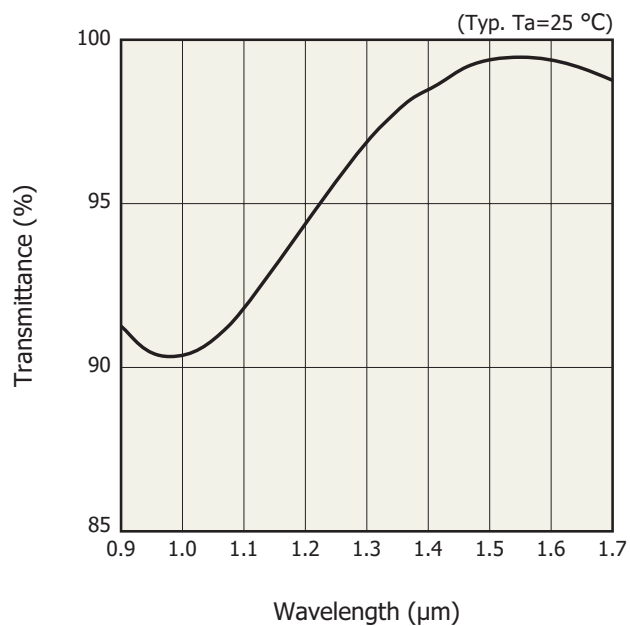
\*5: VR=5 V, f=1 MHz

### Spectral response



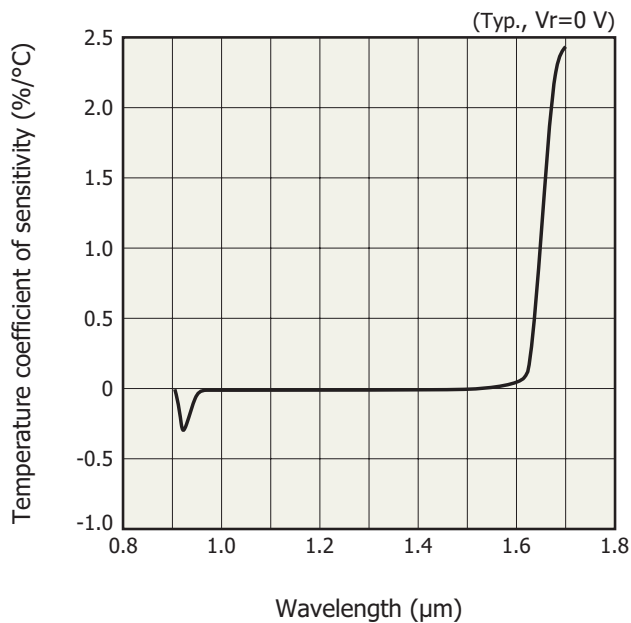
KIRD80672EA

### Spectral transmittance characteristics of window material

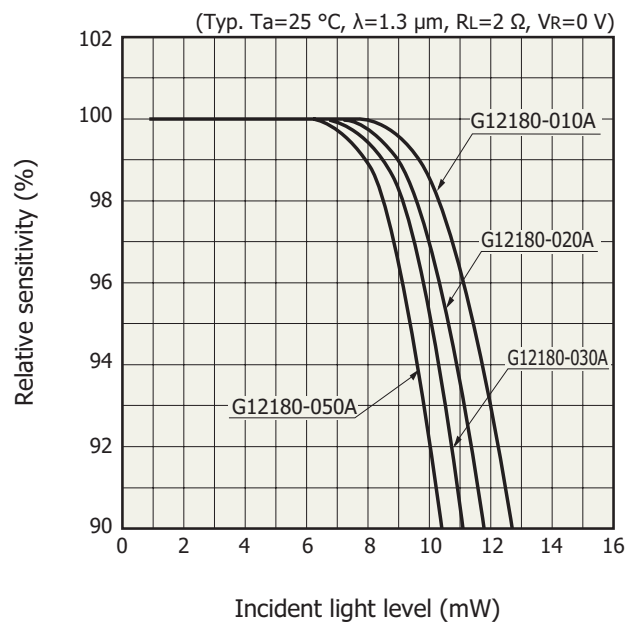


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### Photosensitivity temperature characteristics

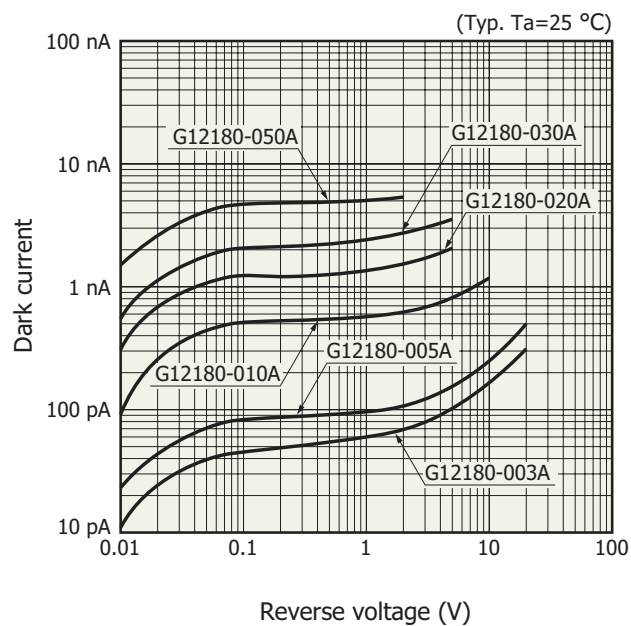


### Linearity

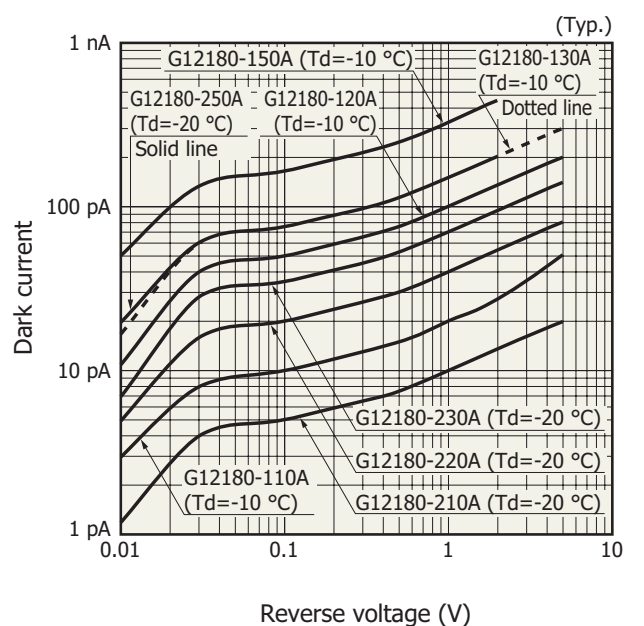


### Dark current vs. reverse voltage

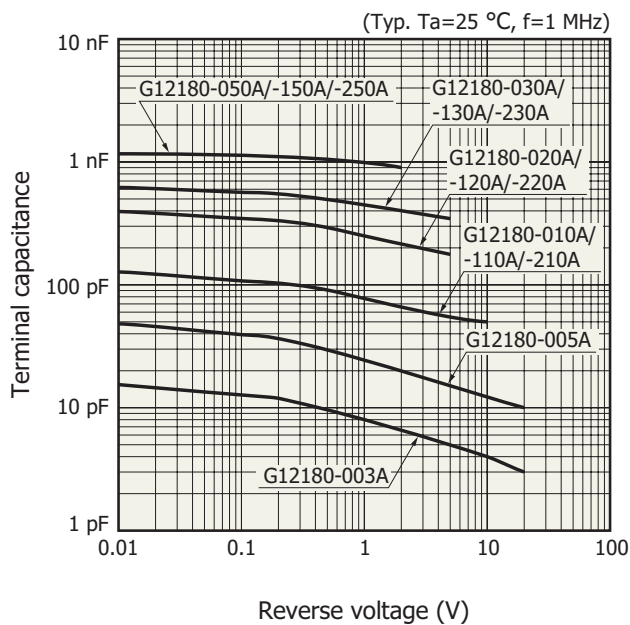
Non-cooled type



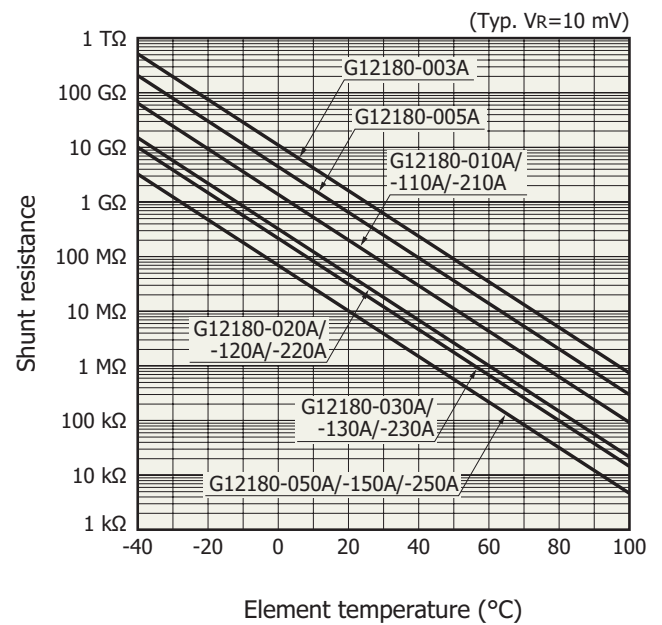
TE-cooled type



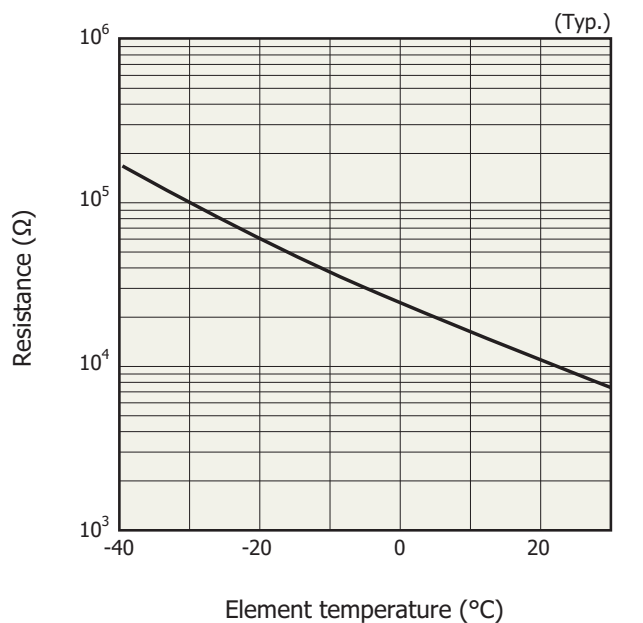
### Terminal capacitance vs. reverse voltage



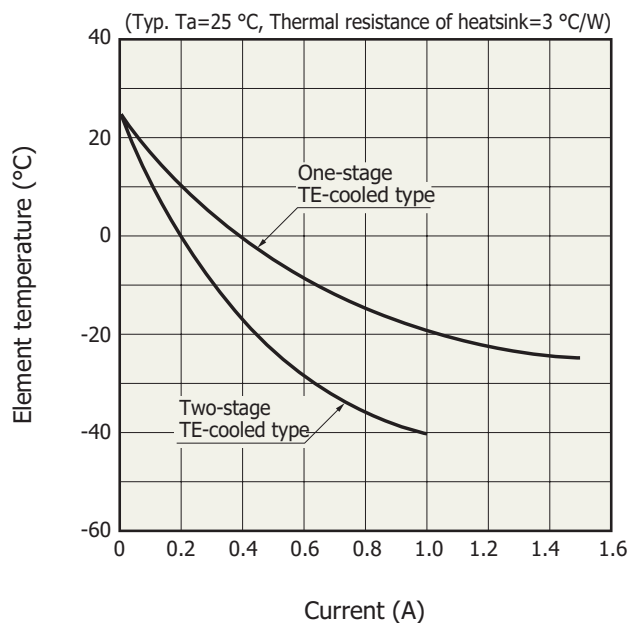
### Shunt resistance vs. element temperature



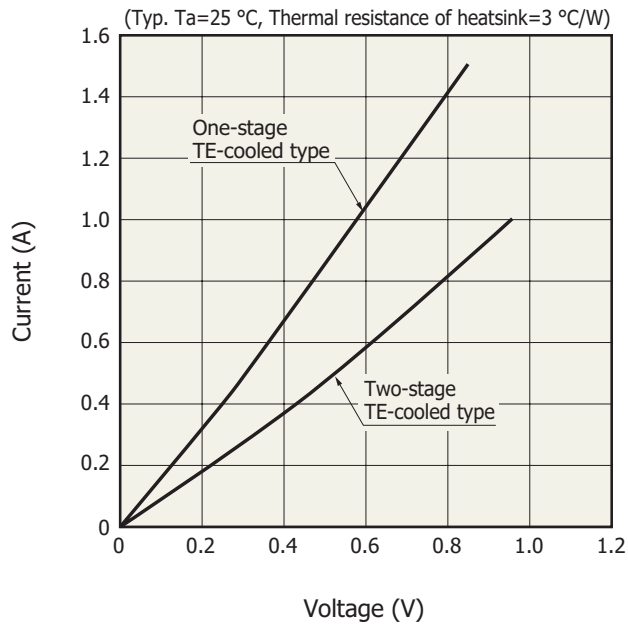
### Thermistor temperature characteristics



### Cooling characteristics of TE-cooler



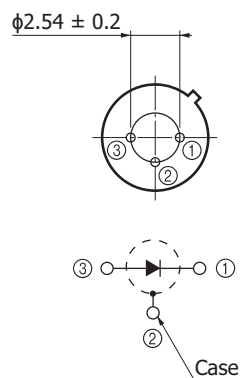
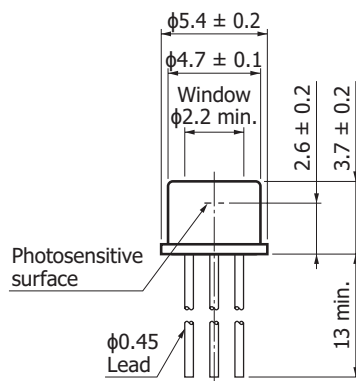
### Current vs. voltage (TE-cooler)



KIRD80115EB

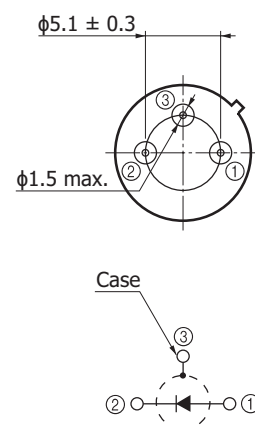
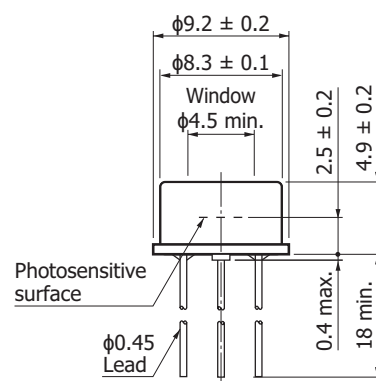
### Dimensional outlines (unit: mm)

(1) G12180-003A/-005A/-010A



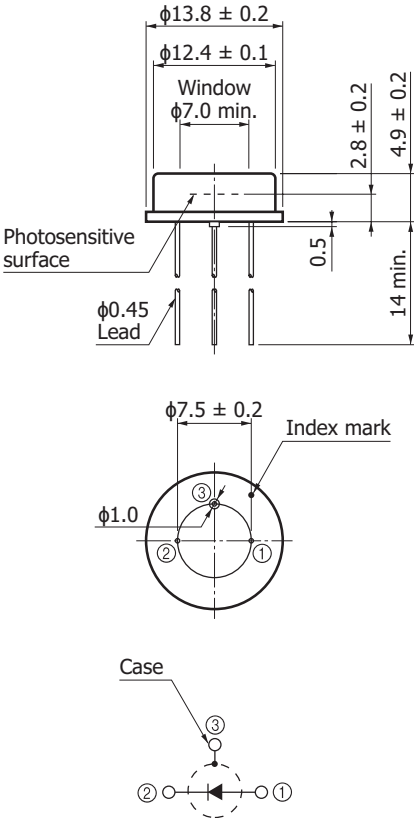
KIRDA0150ED

(2) G12180-020A/-030A



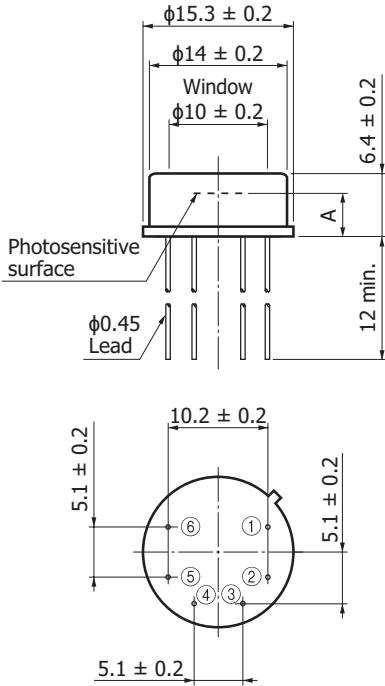
KIRDA0155EB

(3) G12180-050A



KTRDA0052EC

(4) G12180-110A/-120A/-130A/-150A



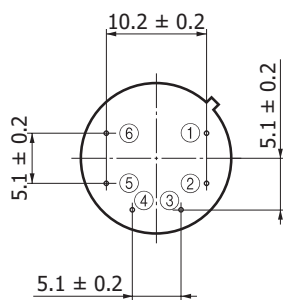
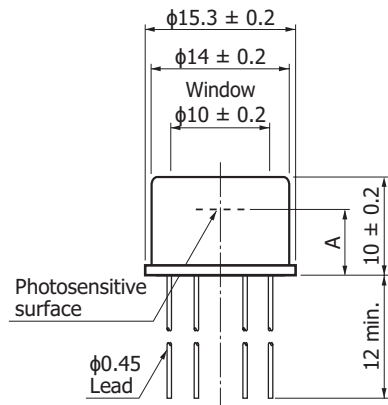
- ① Detector (anode)
- ② Detector (cathode)
- ③ TE-cooler (-)
- ④ TE-cooler (+)
- ⑤ ⑥ Thermistor

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

|   | G12180-110A   | G12180-120A/-130A/-150A |
|---|---------------|-------------------------|
| A | $4.3 \pm 0.2$ | $4.4 \pm 0.2$           |

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(5) G12180-210A/-220A/-230A/-250A



- ① Detector (anode)
- ② Detector (cathode)
- ③ TE-cooler (-)
- ④ TE-cooler (+)
- ⑤⑥ Thermistor

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

|   | G12180-210A   | G12180-220A<br>/-230A/-250A |
|---|---------------|-----------------------------|
| A | $6.6 \pm 0.2$ | $6.7 \pm 0.2$               |

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## Related information

[www.hamamatsu.com/sp/ssd/doc\\_en.html](http://www.hamamatsu.com/sp/ssd/doc_en.html)

### ■ Precautions

- Disclaimer
- Safety consideration
- Metal, ceramic, plastic package products

Information described in this material is current as of March 2019.

Product specifications are subject to change without prior notice due to improvements or other reasons. This document has been carefully prepared and the information contained is believed to be accurate. In rare cases, however, there may be inaccuracies such as text errors. Before using these products, always contact us for the delivery specification sheet to check the latest specifications.

The product warranty is valid for one year after delivery and is limited to product repair or replacement for defects discovered and reported to us within that one year period. However, even if within the warranty period we accept absolutely no liability for any loss caused by natural disasters or improper product use. Copying or reprinting the contents described in this material in whole or in part is prohibited without our prior permission.

# HAMAMATSU

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