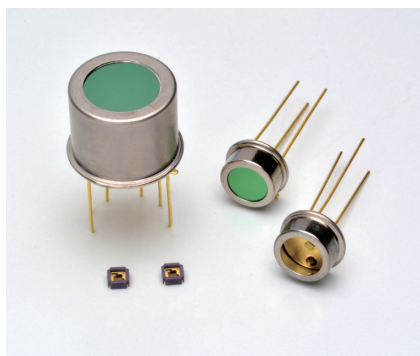


# InAsSb photovoltaic detectors



P13894 series

## High-speed response and high sensitivity in the spectral band up to 11 $\mu\text{m}$ , infrared detectors

The P13894 series are photovoltaic type detectors that have achieved high sensitivity in the spectral range up to 11  $\mu\text{m}$  using Hamamatsu unique crystal growth technology and process technology. These products are environmentally friendly infrared detectors and do not use mercury or cadmium, which are substances restricted by the RoHS Directive. They are replacements for previous products that contain these substances. A compact surface mount type has been added to the easily handled non-cooling type.

### Features

- High sensitivity
- High-speed response
- High shunt resistance
- Non-cooled (P13894-011CN/-011NA/-011MA)
- Compact, surface mount ceramic package (P13894-011CN)
- Compatible with lead-free reflow soldering (P13894-011CN)
- RoHS compliant (lead, mercury, cadmium free)

### Applications

- Gas detection (CH<sub>4</sub>, CO<sub>2</sub>, CO, NH<sub>3</sub>, O<sub>3</sub>, etc.)
- Radiation thermometers

### Options (sold separately)

- Heatsink for two-stage TE-cooled type **A3179-01**
- Temperature controller for TE-cooled type **C1103-04**
- Amplifier for infrared detector **C4159-01**

### Structure

Parameter	P13894-011CN	P13894-011NA	P13894-011MA	P13894-211MA	Unit
Window material	None	None	Ge with AR coating	Ge with AR coating	-
Package	Ceramic	TO-5		TO-8	-
Cooling	Non-cooled			Two-stage TE-cooled	-
Photosensitive area	1 × 1				mm
Field of view (FOV)	90	102		113	degrees

### Absolute maximum ratings

Parameter	Symbol	Condition	P13894-011CN	P13894-011NA	P13894-011MA	P13894-211MA	Unit
Reverse voltage	V <sub>R</sub>		1				V
Operating temperature	T <sub>opr</sub>	No dew condensation*1	-40 to +85		-40 to +60		°C
Storage temperature	T <sub>stg</sub>	No dew condensation*1	-40 to +85		-40 to +60		°C
Soldering temperature	T <sub>sol</sub>		240 (once)*2	*3			-

\*1: 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.

\*2: Reflow soldering, JEDEC J-STD-020 MSL 2, See P.6

\*3: See P.7 "Recommended soldering conditions"

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.

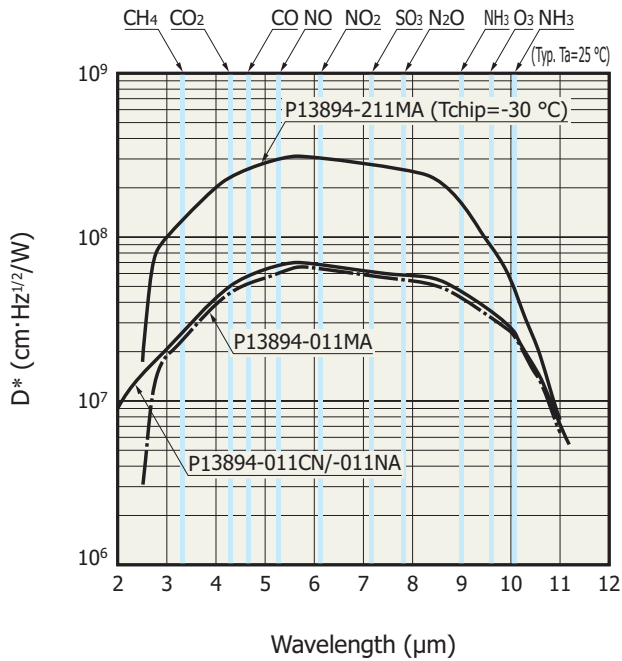
**Electrical and optical characteristics (Ta=25 °C)**

Parameter	Symbol	Condition	P13894-011CN/-011NA			P13894-011MA			P13894-211MA			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Chip temperature	Tchip		25			25			-30			°C
Peak sensitivity wavelength	$\lambda_p$		-	5.6	-	-	5.6	-	-	5.6	-	$\mu\text{m}$
Cutoff wavelength	$\lambda_c$		9.7	11.0	-	9.7	11.0	-	8.9	10.2	-	$\mu\text{m}$
Photosensitivity	S	$\lambda = \lambda_p^{*4}$	1.4	2.0	-	1.3	1.9	-	2.8	3.8	-	mA/W
Shunt resistance	Rsh	$V_R = 10 \text{ mV}$	1.5	2.0	-	1.5	2.0	-	7.5	10.0	-	k $\Omega$
Detectivity	D*	( $\lambda_p, 1200, 1$ )	$4.0 \times 10^7$	$7.0 \times 10^7$	-	$3.8 \times 10^7$	$6.5 \times 10^7$	-	$1.8 \times 10^8$	$3.2 \times 10^8$	-	cm·Hz <sup>1/2</sup> /W
Noise equivalent power	NEP	$\lambda = \lambda_p$	-	$1.4 \times 10^{-9}$	$2.5 \times 10^{-9}$	-	$1.5 \times 10^{-9}$	$2.6 \times 10^{-9}$	-	$3.1 \times 10^{-10}$	$5.6 \times 10^{-10}$	W/Hz <sup>1/2</sup>
Terminal capacitance	Ct	$V_R = 0 \text{ V}, f = 1 \text{ MHz}$	-	0.6	-	-	0.6	-	-	0.6	-	pF
Rise time	tr	10 to 90%, no window, $\lambda = 1.55 \mu\text{m}$	-	3	10	-	3	10	-	3	10	ns

\*4: Uniform irradiation on the entire photosensitive area

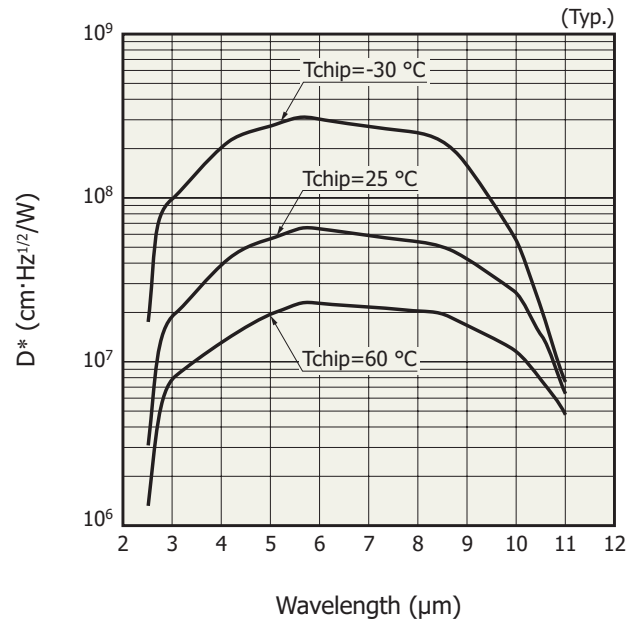
Note: Uniform irradiation must be applied to the entire photosensitive area during use.

**Spectral response (D\*)**



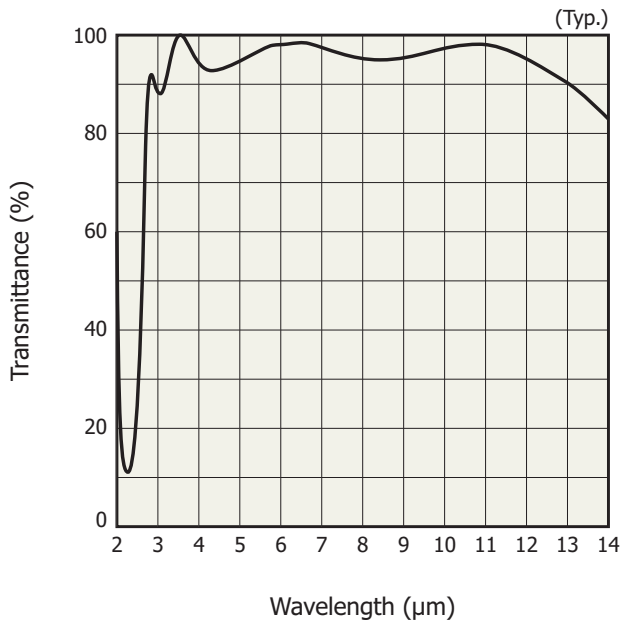
KIRDB0632EB

**Sensitivity temperature characteristics (P13894-011MA/ -211MA)**

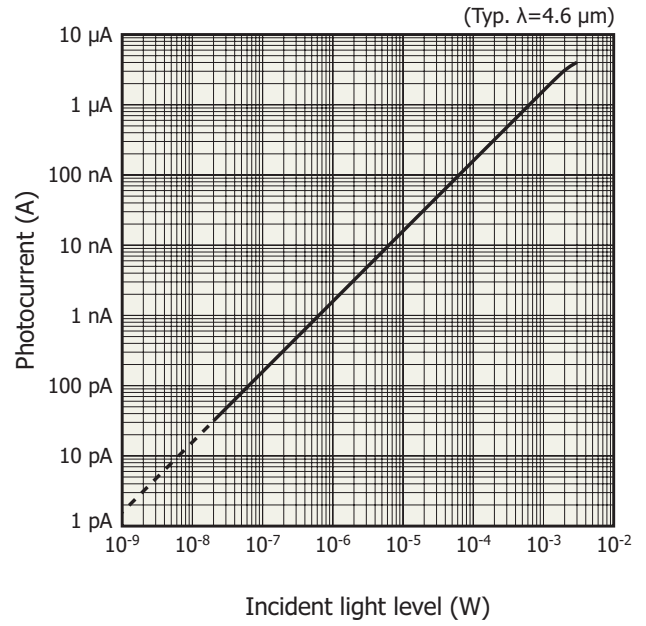


KIRDB0633EA

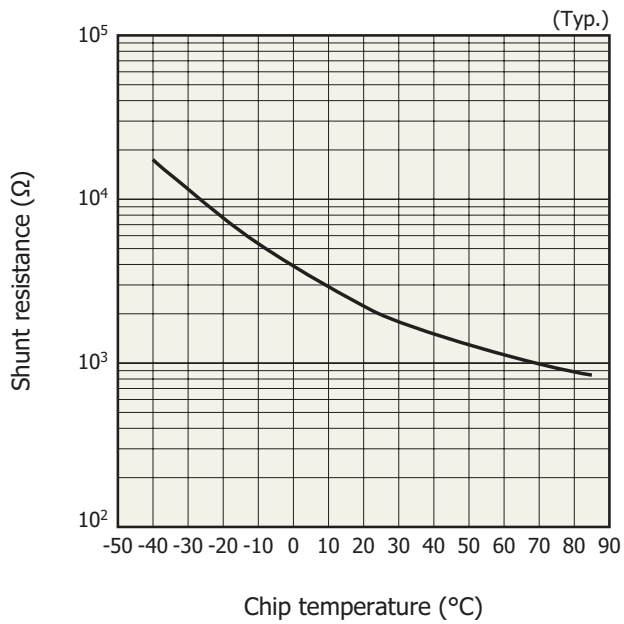
**Spectral transmittance of window material**



**Linearity (P13894-011CN/-011NA)**



**Shunt resistance vs. chip temperature**

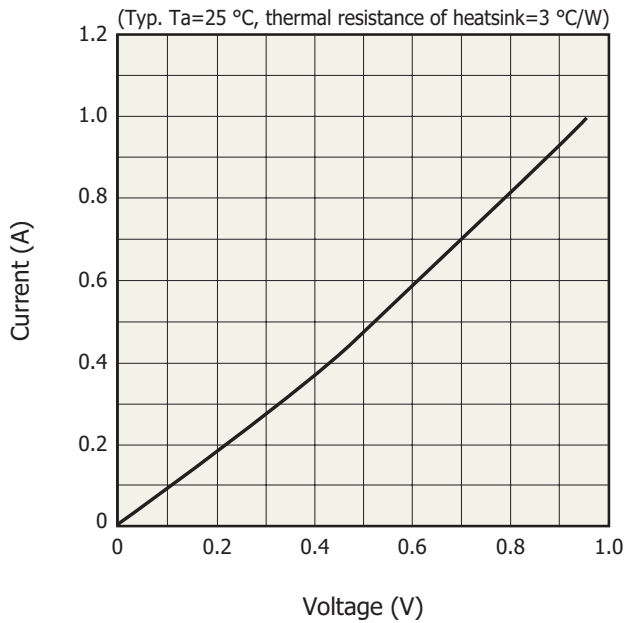


▣ Specifications of two-stage TE-cooler (Ta=25 °C)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Allowable current	Ic	-	-	1.0	A
Allowable voltage	Vc	-	-	0.95	V
Thermistor resistance	Rth	8.1	9.0	9.9	kΩ
Thermistor B constant*5	B	3232	3298	3364	K
Thermistor power dissipation	Pth	-	-	0.2	mW

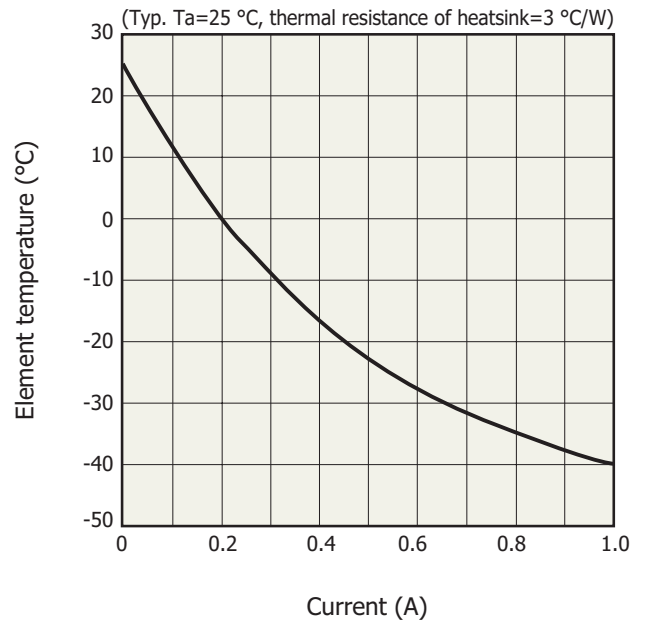
\*5: T1=25 °C, T2=-30 °C

▣ Current vs. voltage characteristics of TE-cooler



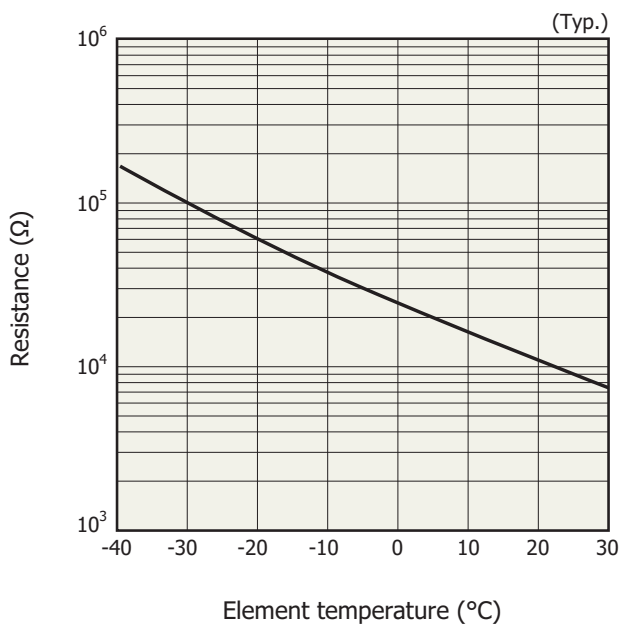
KIRDB0459EA

▣ Cooling characteristics of TE-cooler



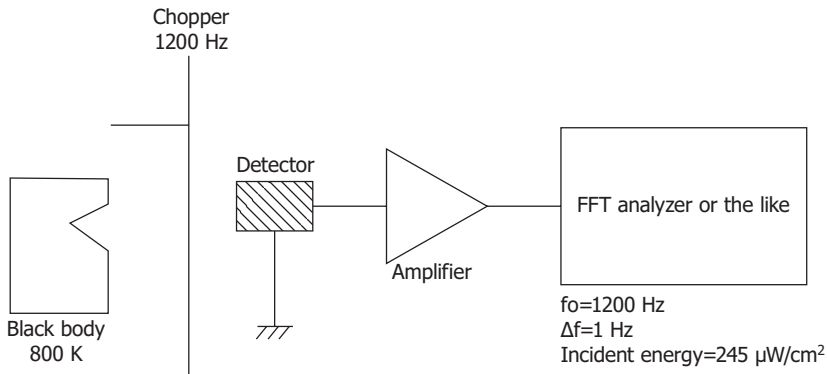
KIRDB0464EA

▣ Thermistor temperature characteristics



KIRDB0116EC

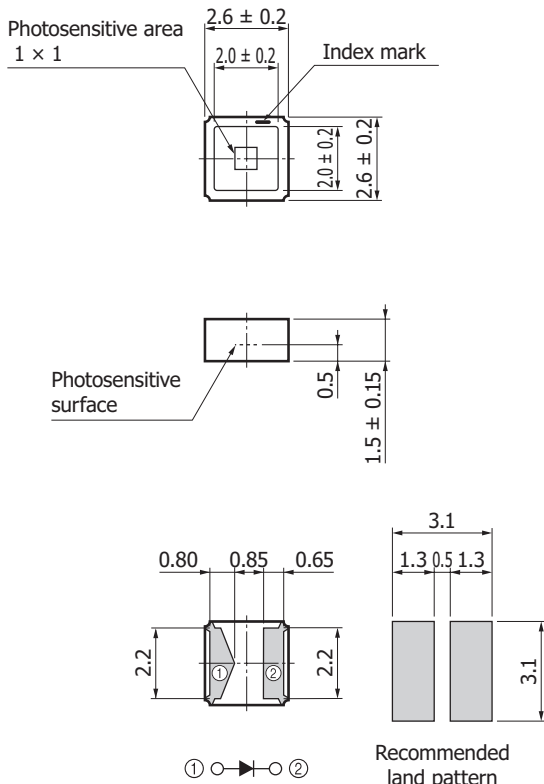
Block diagram for characteristic measurement



KIRDC0127EA

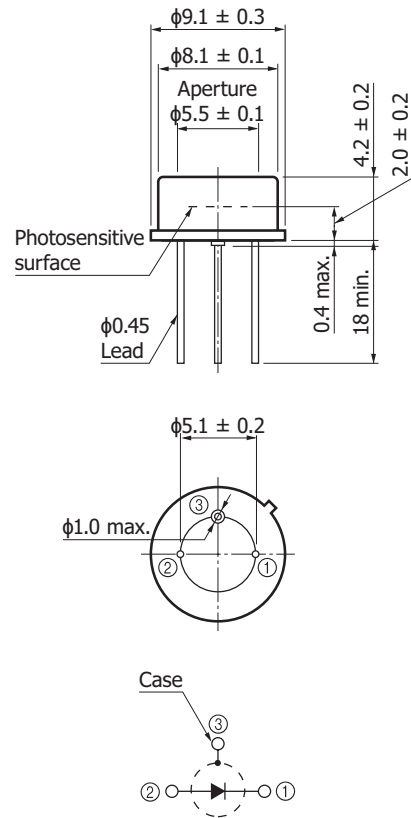
Dimensional outline (unit: mm)

P13894-011CN



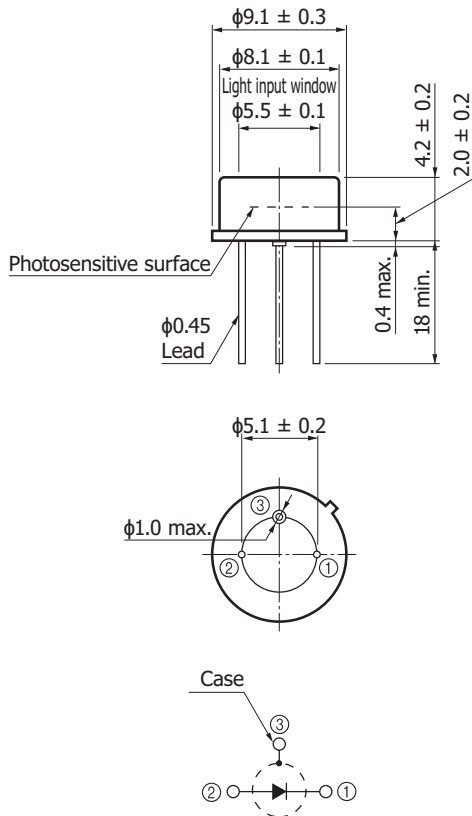
KIRDA0268EB

P13894-011NA



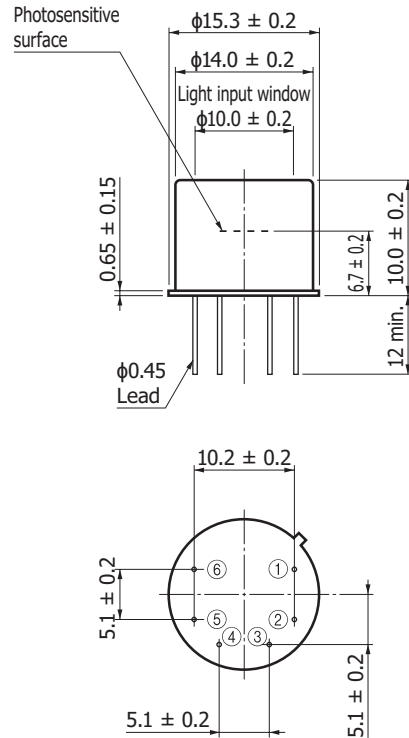
KIRDA0256EB

P13894-011MA



K1RDA0257EA

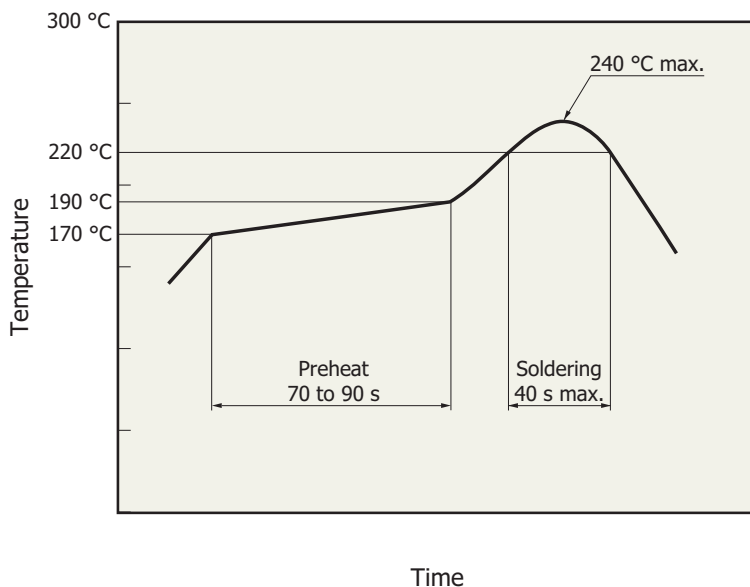
P13894-211MA



K1RDA0258EB

Recommended soldering conditions

P13894-011CN



- After unpacking, store the device in an environment at a temperature range of 5 to 30 °C and a humidity of 60% or less, and perform reflow soldering within 1 year.
- The effect that the product receives during reflow soldering varies depending on the circuit board and reflow oven that are used. When you set reflow soldering conditions, check that problems do not occur in the product by testing out the conditions in advance.

K1RDB0648EB

P13894-011NA/-011MA/-211MA

Soldering temperature: 260°C (once, within 10 s)

Solder the lead more than 1mm away from the root.

Note: When you set soldering conditions, check that problems do not occur in the product by testing out the conditions in advance.

## Related information

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

### ■ Precautions

- Disclaimer
- Safety consideration
- Unsealed products
- Compound opto-semiconductors (photosensors, light emitters)

### ■ Technical information

- Compound semiconductor photosensors / Technical note

Information described in this material is current as of April 2022.

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

[www.hamamatsu.com](http://www.hamamatsu.com)

HAMAMATSU PHOTONICS K.K., Solid State Division

1126-1 Ichino-cho, Higashi-ku, Hamamatsu City, 435-8558 Japan, Telephone: (81)53-434-3311, Fax: (81)53-434-5184

U.S.A.: HAMAMATSU CORPORATION: 360 Foothill Road, Bridgewater, NJ 08807, U.S.A., Telephone: (1)908-231-0960, Fax: (1)908-231-1218 E-mail: [usa@hamamatsu.com](mailto:usa@hamamatsu.com)

Germany: HAMAMATSU PHOTONICS DEUTSCHLAND GMBH.: Arzbergerstr. 10, 82211 Herrsching am Ammersee, Germany, Telephone: (49)8152-375-0, Fax: (49)8152-265-8 E-mail: [info@hamamatsu.de](mailto:info@hamamatsu.de)

France: HAMAMATSU PHOTONICS FRANCE S.A.R.L.: 19, Rue du Saule Trapu, Parc du Moulin de Massy, 91882 Massy Cedex, France, Telephone: (33)1 69 53 71 00, Fax: (33)1 69 53 71 10 E-mail: [infos@hamamatsu.fr](mailto:infos@hamamatsu.fr)

United Kingdom: HAMAMATSU PHOTONICS UK LIMITED: 2 Howard Court, 10 Tewin Road, Welwyn Garden City, Hertfordshire AL7 1BW, UK, Telephone: (44)1707-294888, Fax: (44)1707-325777 E-mail: [info@hamamatsu.co.uk](mailto:info@hamamatsu.co.uk)

North Europe: HAMAMATSU PHOTONICS NORDEN AB: Torshamnsgatan 35 16440 Kista, Sweden, Telephone: (46)8-509 031 00, Fax: (46)8-509 031 01 E-mail: [info@hamamatsu.se](mailto:info@hamamatsu.se)

Italy: HAMAMATSU PHOTONICS ITALIA S.R.L.: Strada della Moia, 1 int. 6, 20044 Arese (Milano), Italy, Telephone: (39)02-93 58 17 33, Fax: (39)02-93 58 17 41 E-mail: [info@hamamatsu.it](mailto:info@hamamatsu.it)

China: HAMAMATSU PHOTONICS (CHINA) CO., LTD.: 1201 Tower B, Jiaming Center, 27 Dongsanhuan Beilu, Chaoyang District, 100020 Beijing, P.R. China, Telephone: (86)10-6586-6006, Fax: (86)10-6586-2866 E-mail: [hpc@hamamatsu.com.cn](mailto:hpc@hamamatsu.com.cn)

Taiwan: HAMAMATSU PHOTONICS TAIWAN CO., LTD.: 8F-3, No.158, Section 2, Gongdao 5th Road, East District, Hsinchu, 300, Taiwan R.O.C. Telephone: (886)3-659-0080, Fax: (886)3-659-0081 E-mail: [info@hamamatsu.com.tw](mailto:info@hamamatsu.com.tw)