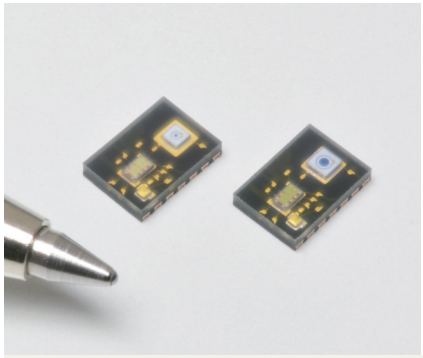
HAMAMATSU
PHOTON IS OUR BUSINESS

Photosensor with front-end IC



S13282-01CR S14847-01CR

Compact APD suitable for various light level detection

The S13282-01CR and S14847-01CR are compact optical devices that integrate a Si APD and a preamp. They have a built-in DC feedback circuit for reducing the effects of background light. They also provide excellent noise and frequency characteristics. We provide an evaluation kit for these products. Contact us for detailed information.

Features

- **High-speed response**
- **Two-level gain switch function (low gain: single output, high gain: differential output)**
- **Reduced background light effects**
- **Small waveform distortion when excessive light is incident**

Applications

- **Distance measurement**

Option

- **Driver circuit** **C13283-03 (for S13282-01CR) C13283-04 (for S14847-01CR)**

Structure

Parameter	Symbol	S13282-01CR	NEW S14847-01CR	Unit
Detector	-	Si APD		-
Photosensitive area size*1	A	ϕ0.2	ϕ0.5	mm
Package	-	Plastic		-

*1: Photosensitive area in which a typical gain can be obtained

Absolute maximum ratings

Parameter	Symbol	Condition	Value	Unit
Supply voltage (for preamp)	Vcc max		4.5	V
Reverse voltage (for APD)	V_APD		0 to V_{BR}	V
Reverse current (DC)	I_R max		0.2	mA
Forward current	I_F max		10	mA
DCFB terminal voltage	-		Vcc + 0.7	V
Gain terminal voltage	-		Vcc + 0.7	V
Operating temperature	Topr	No dew condensation*2	-30 to +85	°C
Storage temperature	Tstg	No dew condensation*2	-30 to +85	°C
Soldering conditions*3	-		Peak temperature: 240 °C, 1 time (see P.8)	-

*2: 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.
*3: JEDEC level 5a
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.

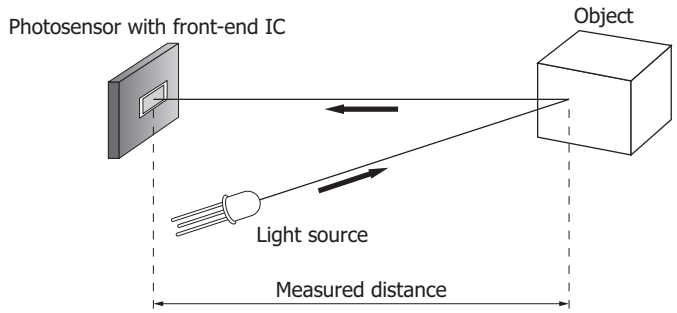
Electrical and optical characteristics (Ta=25 °C)

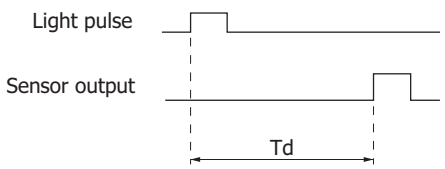
Parameter	Symbol	Condition	S13282-01CR			S14847-01CR			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	
Supply voltage	Vcc1, Vcc2		3.135	3.3	3.465	3.135	3.3	3.465	V
Spectral response range	λ		400 to 1100			400 to 1100			nm
Peak sensitivity wavelength	λp	M=100	-	840	-	-	840	-	nm
Photosensitivity	S	λ=λp, M=100, low gain	0.1	0.2	0.4	0.1	0.2	0.4	MV/W
		λ=λp, M=100, high gain	2	4	8	2	4	8	
Quantum efficiency	QE	λ=900 nm, M=1	-	70	-	-	70	-	%
Breakdown voltage	V_{BR}	I_D=100 µA	120	160	200	120	160	200	V
Temperature coefficient of breakdown voltage	ΔTV_{BR}		-	1.1	-	-	1.1	-	V/°C
Dark current	I_D	M=100	-	100	1000	-	100	1000	pA
Temperature coefficient of dark current	ΔT_{ID}	M=100	-	1.1	-	-	1.1	-	times/°C
Current consumption	Ic	Low gain	17	25	32	17	25	32	mA
		High gain	20	28	35	20	28	35	
Low cutoff frequency	fcl	Low gain	-	0.1	-	-	0.1	-	MHz
		High gain	-	0.5	-	-	0.5	-	
High cutoff frequency	fch	Low gain	120	180	240	110	170	240	MHz
		High gain	100	160	220	90	150	220	
Input conversion noise power	en	f=10 MHz, M=100	-	50	100	-	50	100	$fW/Hz^{1/2}$
		f=100 MHz, M=100	-	65	130	-	100	210	
Output voltage level	-	Low gain	0.6	0.9	1.2	0.6	0.9	1.2	V
		High gain	0.7	1	1.5	0.7	1.1	1.5	
Output offset voltage	Voffset	High gain	-	-	±100	-	-	±100	mV
Maximum output voltage amplitude	Vp-p max	Low gain	-0.3	-0.5	-	-0.3	-0.5	-	V
		High gain	±0.4	±0.7	-	±0.4	±0.7	-	

Distance measuring method

Distance L is calculated from the time difference Td between the light source's light emission timing and sensor output and the speed of light c.

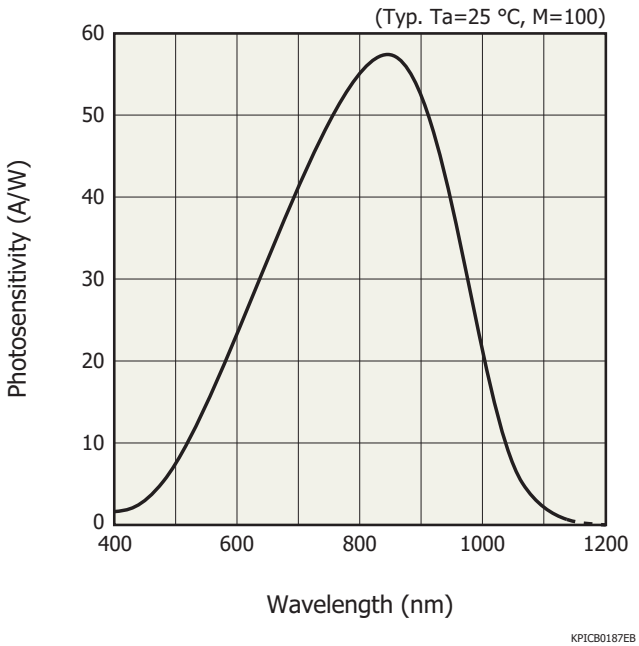
$L = (1/2) \times c \times Td$





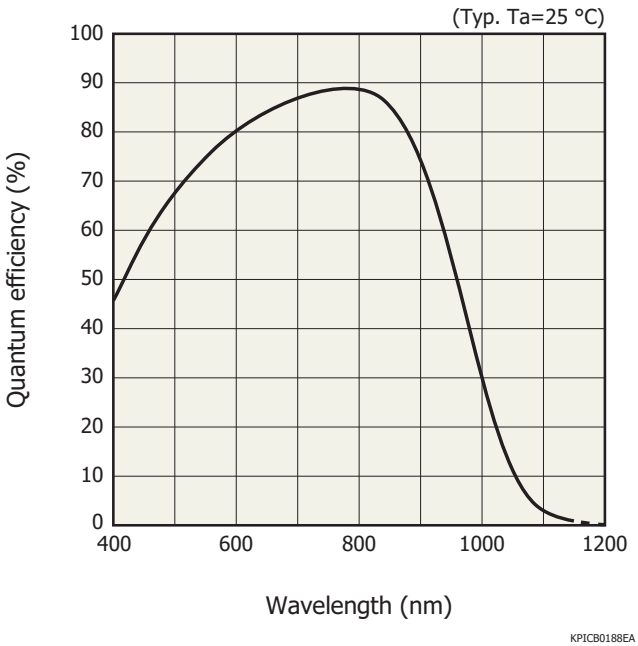
KPICC0306EA

Spectral response



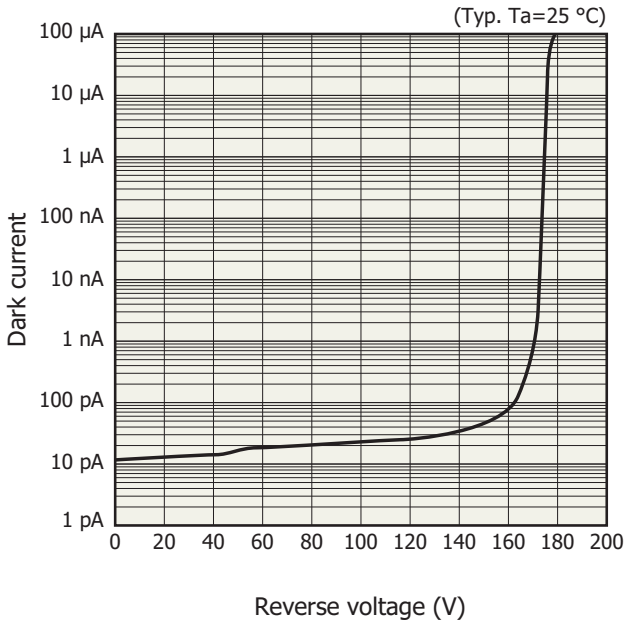
KPICB0187EB

Quantum efficiency vs. wavelength



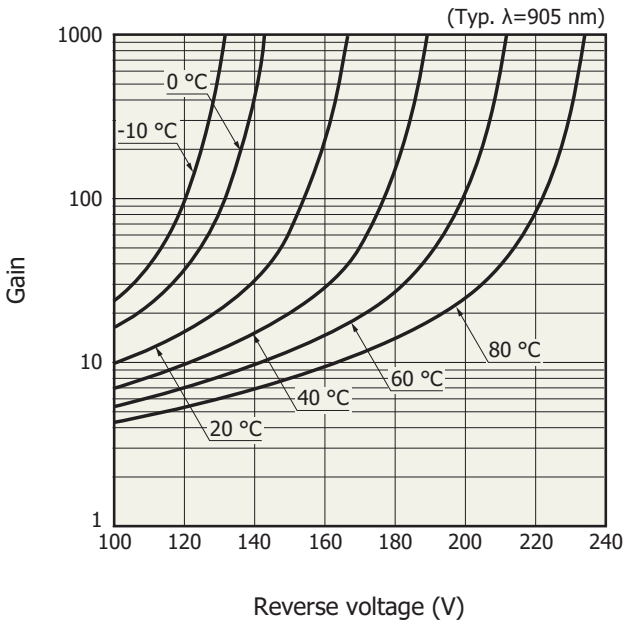
KPICB0188EA

Dark current vs. reverse voltage



KPICB0189EB

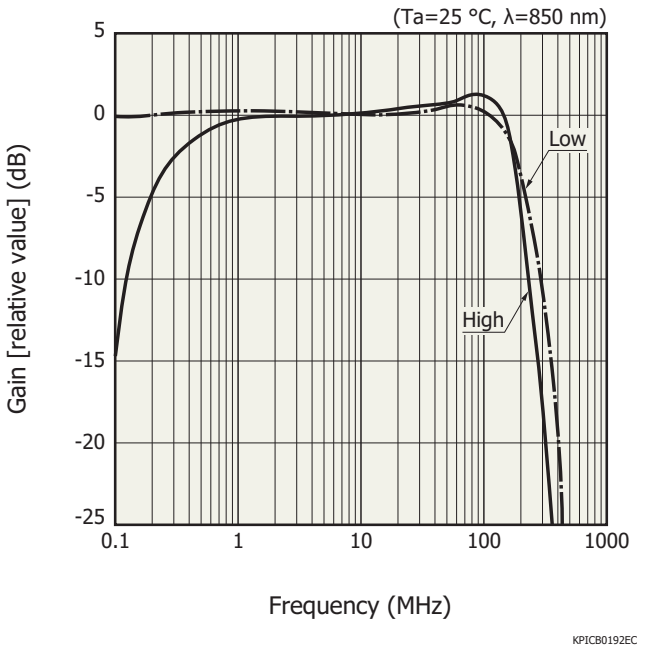
Gain vs. reverse voltage



KPICB0191EB

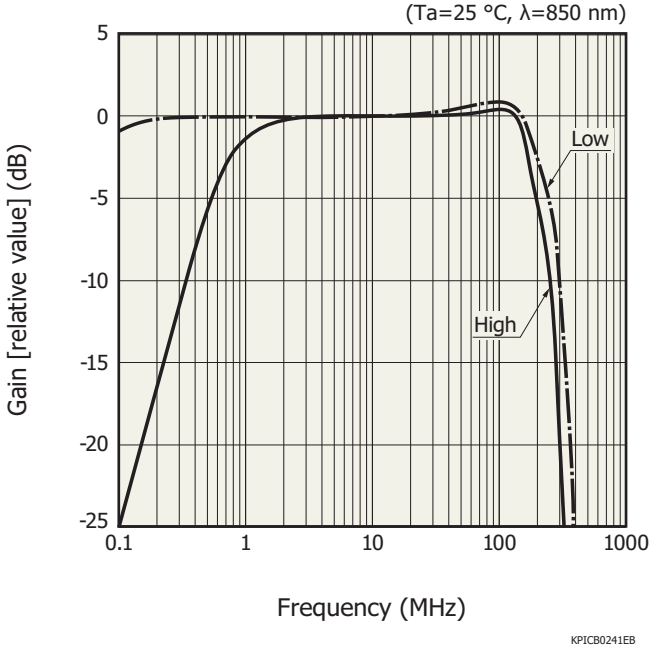
Frequency characteristics (typical example)

S13282-01CR



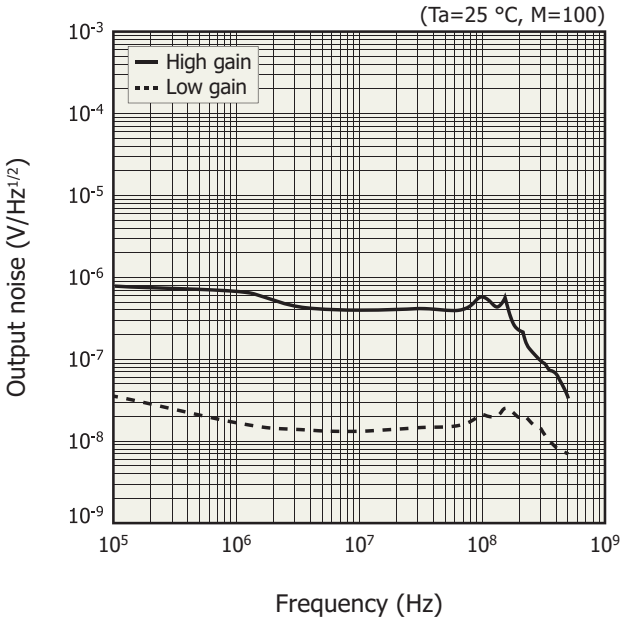
KPICB0192EC

S14847-01CR



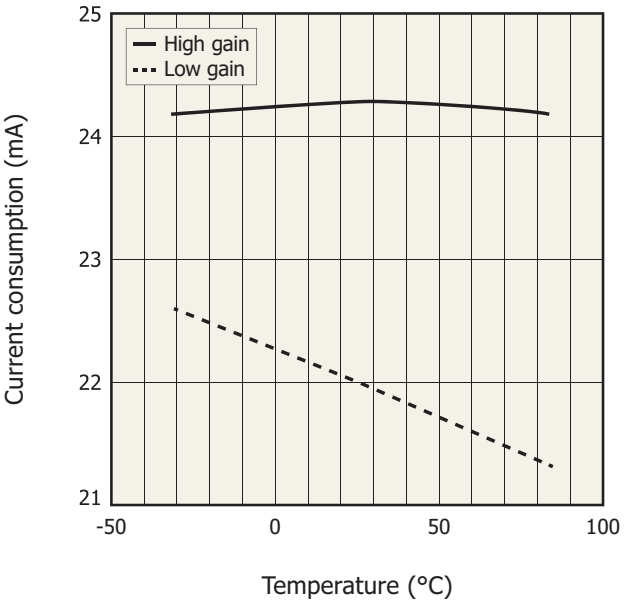
KPICB0241EB

Output noise vs. frequency (typical example)



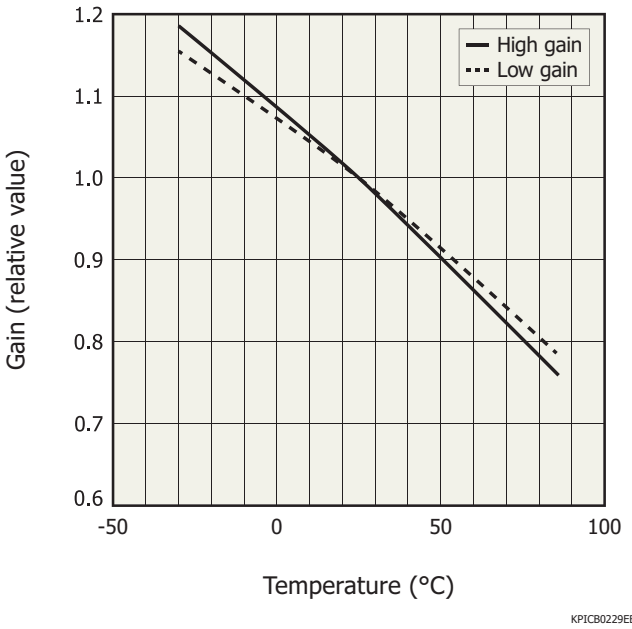
KPICB0226EC

Current consumption vs. temperature (typical example)

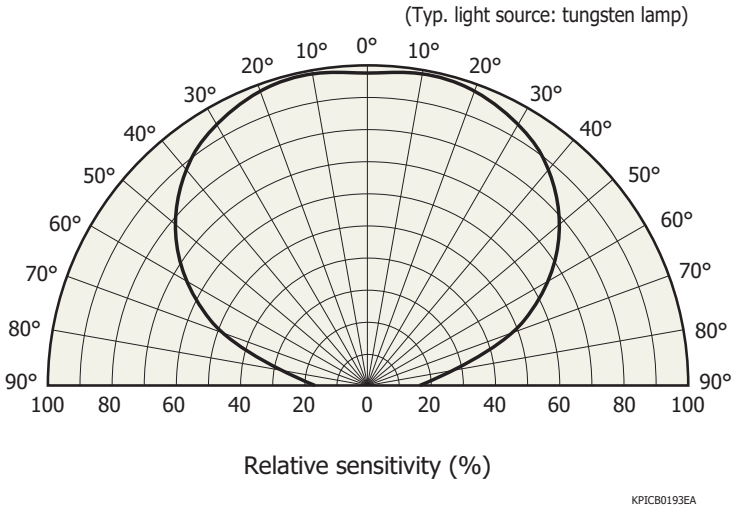


KPICB0227EB

Gain vs. temperature (typical example)



Directivity



Truth table

Gain

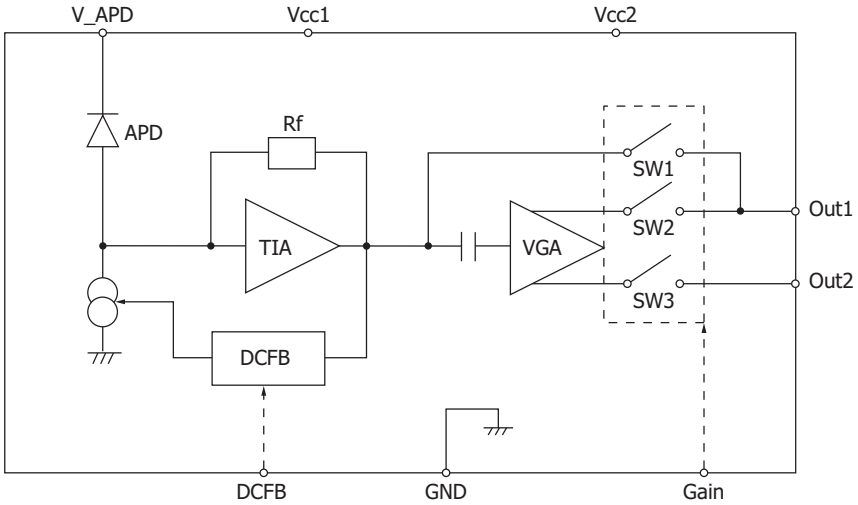
Setting	Gain
0	Low gain (× 1)
1	High gain (× 20)

DC feedback circuit

Setting	Background light elimination function
0	OFF
1	ON

Note: The pull-up resistor of the digital input terminal is 10 kΩ.

Block diagram

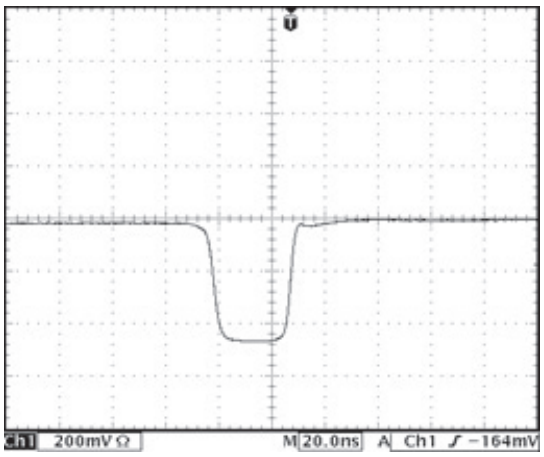


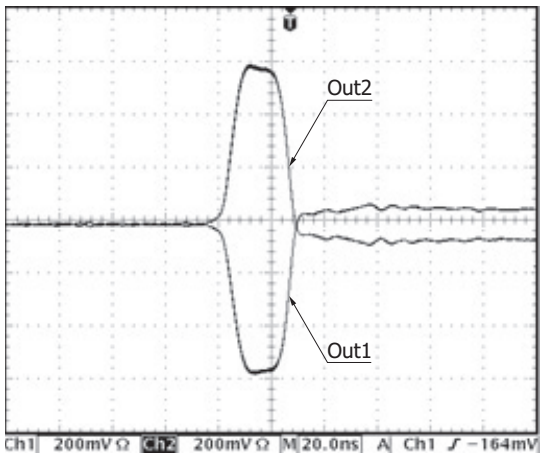
The DCFB (DC feedback) circuit detects the DC component of photocurrent, and reduces the effects of background light through the differential processor.

KPICC0285ED

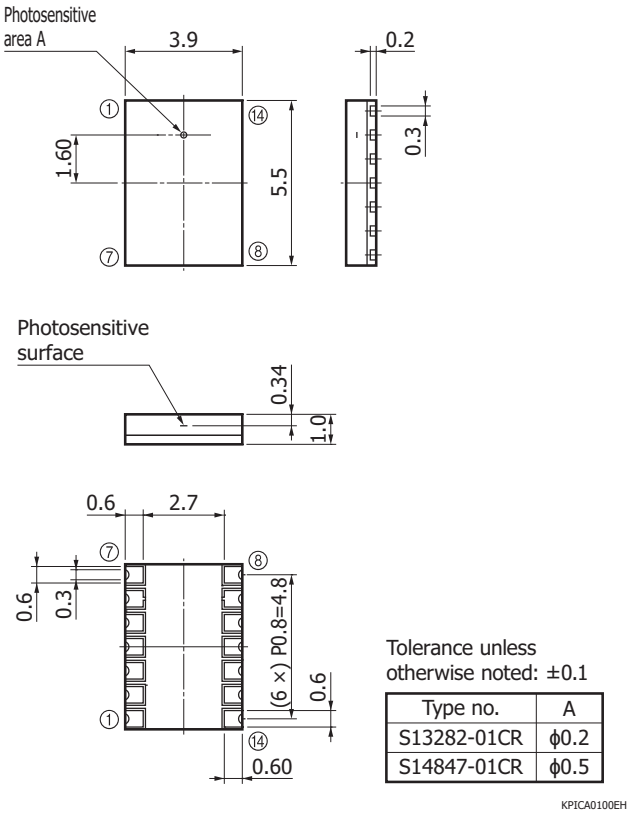
Output waveform examples (Ta=25 °C, M=100, linear region, input pulse width=20 ns)

Low gain	High gain





Dimensional outline (unit: mm)



Tolerance unless otherwise noted: ±0.1

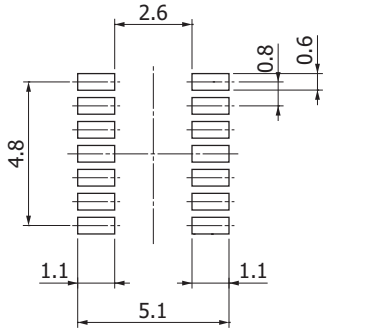
Type no.	A
S13282-01CR	ϕ0.2
S14847-01CR	ϕ0.5

KPICA0100EH

Pin connections

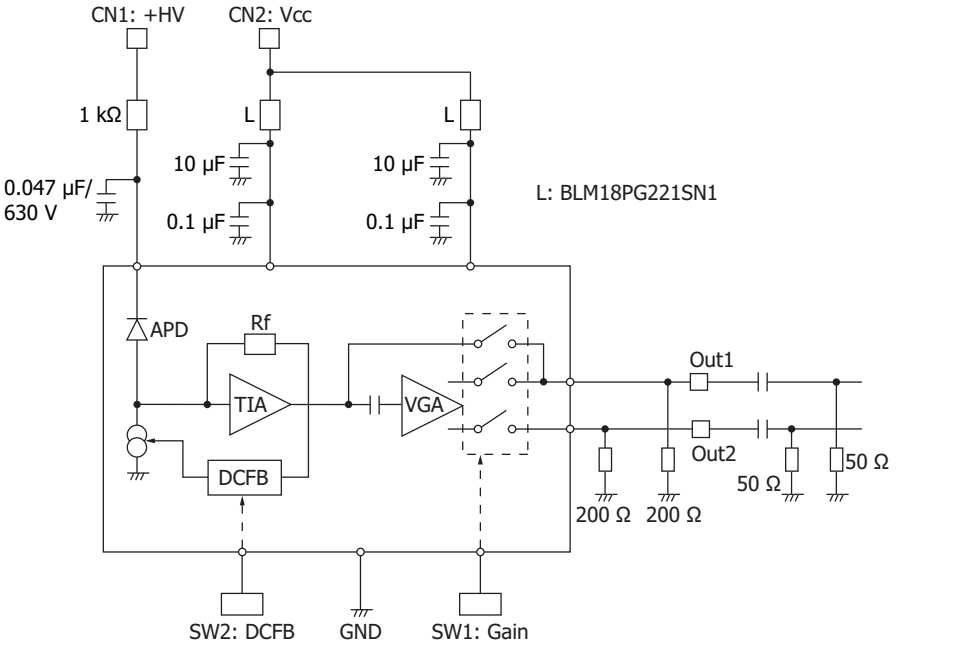
Pin no.	Function	Pin no.	Pin no.
1	NC	8	Out2
2	NC	9	GND
3	GND	10	Gain
4	GND	11	Vcc2
5	DCFB	12	Vcc1
6	GND	13	NC
7	Out1	14	V_APD

Recommended land pattern (unit: mm)



KPICC0286EC

Connection example (50 Ω system)



KPICC0309EA

When using the photosensor with front-end IC in a 50 Ω system, connect resistors with the same resistance (200 Ω in the above figure) to output loads Out1 and Out2. If resistors with the same resistance are not connected to the output loads, the waveform may be distorted or the output may oscillate.

Handling of temperature characteristics of APD gain

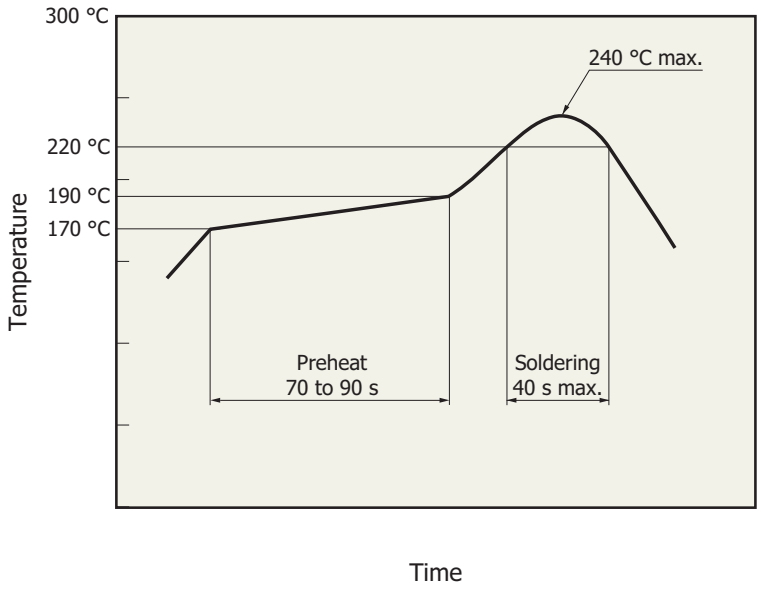
The gain of the APD built into the photosensor with front-end IC varies depending on the temperature. The following two methods are available for handling this issue in using the sensor over a wide temperature range.

① Temperature correction method, which controls the reverse voltage according to the temperature change
A thermistor or other temperature sensor is installed near the APD to measure the APD's temperature. The reverse voltage after APD temperature correction is expressed by the following equation using temperature T of the APD.

V_R (after temperature correction) = V_R (at 25 °C) + (T - 25) × ΔTV_{BR}

② Temperature control method, which keeps the APD temperature constant
A TE-cooler or an equivalent device is used to maintain a constant APD temperature.

Recommended reflow soldering conditions



· This product supports lead-free soldering. After unpacking, store it in an environment at a temperature of 30 °C or less and a humidity of 60% or less, and perform soldering within 24 hours.
· The effect that the product receives during reflow soldering varies depending on the circuit board and reflow oven that are used. Before actual reflow soldering, check for any problems by testing out the reflow soldering methods in advance.

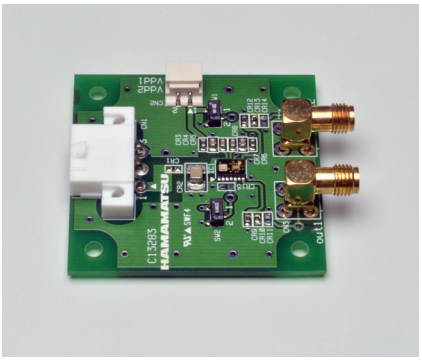
Related information

www.hamamatsu.com/sp/ssd/doc_en.html

■ Precautions
· Disclaimer
· Metal, ceramic, plastic packages
· Surface mount type products

Evaluation kit for photosensor with front-end IC C13283-03/-04

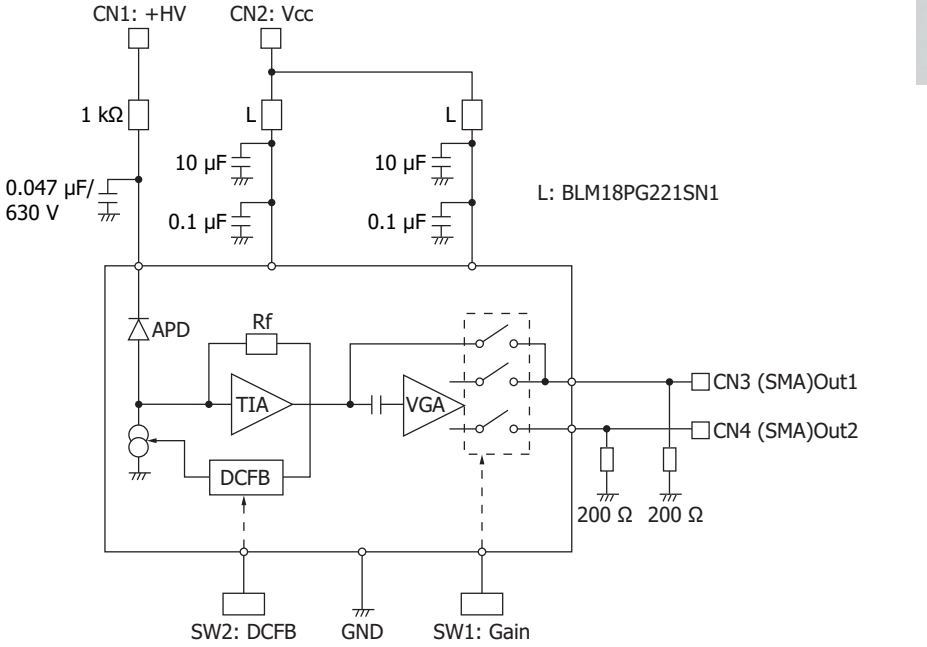
Evaluation kits [48 × 50 (H × V) mm] for photosensors with front-end IC are available [C13283-03 (for S13282-01CR), C13283-04 (for S14847-01CR)]. Contact us for detailed information.



Accessories

· IC power cable
· APD power cable

Equivalent circuit



Information described in this material is current as of December 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.

HAMAMATSU 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, N.J. 08807, U.S.A., Telephone: (1)908-231-0960, Fax: (1)908-231-1218, E-mail: usa@hamamatsu.com
Germany: Hamamatsu Photonics Deutschland GmbH: Arzbergerstr. 10, D-82211 Herrsching am Ammersee, Germany, Telephone: (49)8152-375-0, Fax: (49)8152-265-8, E-mail: 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
United Kingdom: Hamamatsu Photonics UK Limited: 2 Howard Court, 10 Tewin Road, Welwyn Garden City, Hertfordshire AL7 1BW, United Kingdom, Telephone: (44)1707-294888, Fax: (44)1707-325777, E-mail: 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
Italy: Hamamatsu Photonics Italia S.r.l.: Strada della Moia, 1 int. 6, 20020 Arese (Milano), Italy, Telephone: (39)02-93 58 17 33, Fax: (39)02-93 58 17 41, E-mail: info@hamamatsu.it
China: Hamamatsu Photonics (China) Co., Ltd.: B1201, Jiaming Center, No.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
Taiwan: Hamamatsu Photonics Taiwan Co., Ltd.: 8F-3, No. 158, Section2, 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

Cat. No. KPIC1096E12 Dec. 2019 DN