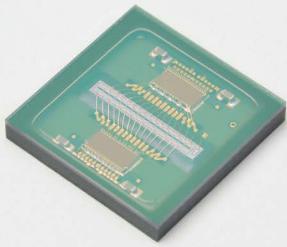


Photosensor with front-end IC



S16430-01CR

Built-in 16-element gain-stabilized APD array suitable for short pulse light detection (parallel output)

This device is for direct TOF (time-of-flight) distance measurement, integrating a 16 ch Si APD array and a transimpedance amplifier. A gain-stabilized APD (GS APD) is used, and there is little gain fluctuation relative to temperature fluctuation, so there is no need for a temperature sensor or microcontroller. It has an increased high-band cutoff frequency (300 MHz) of the transimpedance amplifier compared to previous products, realizing high-speed response.

■ Features

- **16 ch parallel output**
- **Stable gain against temperature fluctuations**
- **No gain adjustment according to individual differences required**
- **Built-in high-speed transimpedance amplifier: 300 MHz**
- **Low noise**
- **No ringing**
- **Low crosstalk**

■ Applications

- **Distance measurement**
- **Presence or absence of objects**

■ Structure

Parameter	Symbol	Specification	Unit
Detector	-	Si APD array	-
Photosensitive area ^{*1} (per element)	A	0.15 × 0.45	mm
Element pitch	-	0.5	mm
Number of elements	-	16	-
Number of output	-	16	-
Package	-	Glass epoxy	-
Window material	-	Glass	-

*1: Area in which a typical gain can be obtained

■ Absolute maximum ratings

Parameter	Symbol	Condition	Value	Unit
Supply voltage (for transimpedance amplifier)	Vcc max		4.0	V
Digital input voltage	Vdig		-0.5 to Vcc+0.5	V
Reverse voltage (for APD)	V_APD		0 to VBR	V
Photocurrent (DC)	IL max		0.2	mA
Incident pulse light level ^{*2}	Ppulse		5	W
Operating temperature	T _{op}	No dew condensation ^{*3}	-40 to +105	°C
Storage temperature	T _{stg}	No dew condensation ^{*3}	-40 to +125	°C
Transimpedance amplifier chip temperature ^{*4}	T _j		150	°C
Soldering temperature ^{*5}	T _{sol}		260 (twice)	°C

*2: FWHM=1 ns (repetition frequency: 1 kHz)

*3: 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.

*4: Do heat dissipation from the PCB to keep the temperature of the transimpedance amplifier chip below 150 °C. The thermal resistance between the transimpedance amplifier chip and the package is 6 °C/W.

*5: Reflow soldering, JEDEC J-STD-020 MSL 3, see P.12

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, Vcc=3.3 V, Power save=high, AC coupling + 50 Ω load, dark state, per element]

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Spectral response range	λ		400 to 1100			nm
Peak sensitivity wavelength	λp		-	840	-	nm
Photosensitivity	S	λ=905 nm, M=1	-	0.5	-	A/W
Breakdown voltage* ⁶	VBR	Vcc=0 V, ID=10 μA Gain_APD terminal: open* ⁷ * ⁹	180	200	220	V
Operating reverse voltage	Vop	Gain-stabilized mode operation* ⁸ * ⁹	185 + 1.1 × (Ta opr - 25)* ¹⁰	-	-	V
Temperature coefficient of operating reverse voltage	ΔTVop	* ⁹	0.95	1.1	1.25	V/°C
Sensitivity uniformity	-	M=50 (averaged over all pixels), including transimpedance amplifier Ianode=100 μA max.	-	±5	±15	%
APD gain* ⁶	M	Gain-stabilized mode operation* ⁸ λ=905 nm	35	50	65	-
Transimpedance amplifier gain	G	Differential	-	30	-	kV/A
Current consumption	Icc	Power save=high Power save=low	-	750 200	900 250	mA
High-band cutoff frequency	fch		200	300	-	MHz
Equivalent input current noise* ⁶	en	f=100 MHz	-	6	9	pA/Hz ^{1/2}
Output impedance* ⁶	Zo	f=100 MHz	-	50	80	Ω
Maximum output voltage amplitude	Vp-p max	Differential	0.4	0.7	-	V
Supply voltage	Vcc		3.135	3.3	3.465	V
Crosstalk* ⁶ * ¹¹	-	FWHM=1 ns, 1 mW	-	-60	-	dB
DC current rejection* ⁶	Idc		1	-	-	mA
Wakeup time* ⁶	Tset	Power save=low→high	-	100	-	μs
Digital voltage* ⁶	VH	High	0.8Vcc	-	-	V
	VL	Low	-	-	0.2Vcc	

*6: Reference values defined by simulation or characteristic evaluation

*7: Opening the Gain_APD terminal enables operation as a typical APD instead of a GS-APD

*8: Apply bias voltage to anode. Ir anode limit=10 μA

*9: Characteristics for APD only

*10: Ta opr=assumed maximum operating temperature

$$*11: \text{Crosstalk [dB]} = 20 \log_{10} \left(\frac{\text{Crosstalk [V]}/\text{Transimpedance amplifier gain [V/W]}}{\text{Incident pulse light level [W]}} \right)$$

■ Standby/operation mode selection

The power save setting selects either standby mode or operation mode.

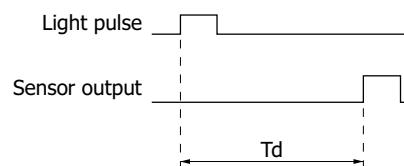
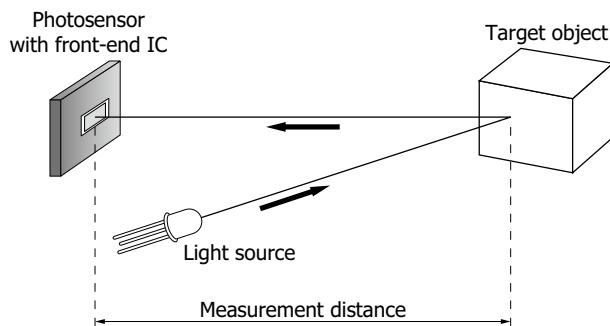
Power save	Mode
Low	Standby mode
High	Operation mode

Pull-up resistor of digital input terminal =100 kΩ

Distance measurement method

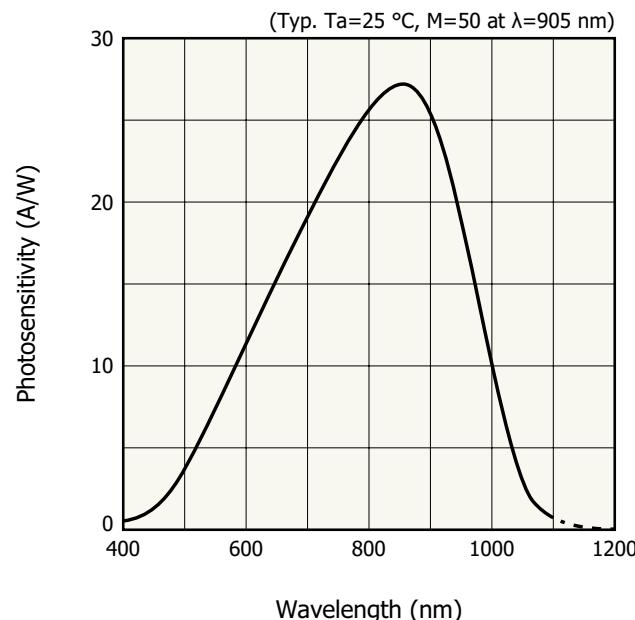
Distance L is calculated from the speed of light c and the time difference Td between the light source's light emission timing and sensor output.

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



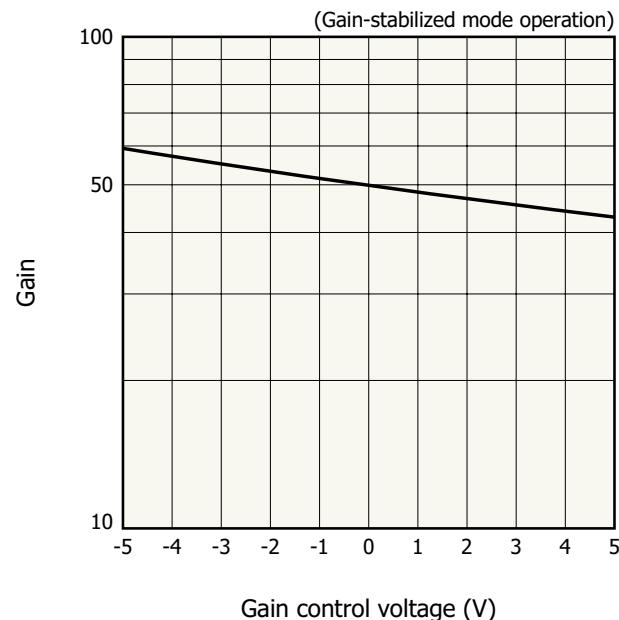
KPICC0306EA

Spectral response



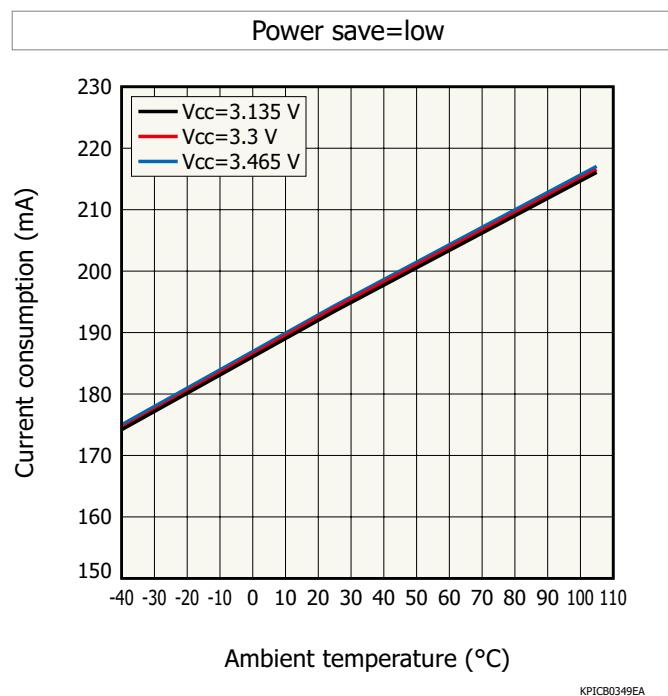
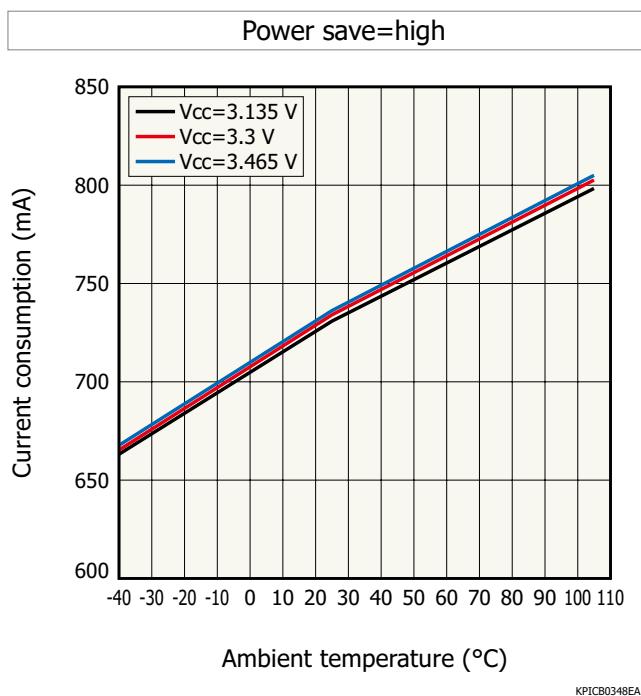
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Gain - gain control voltage (typical example)

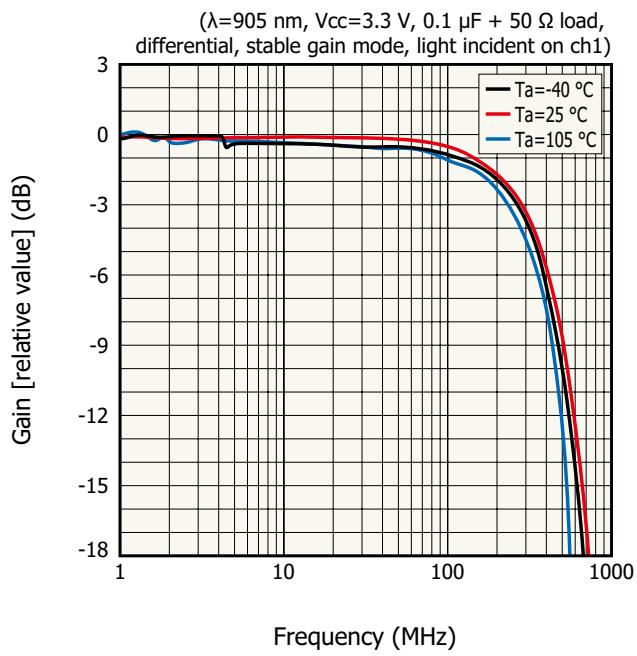


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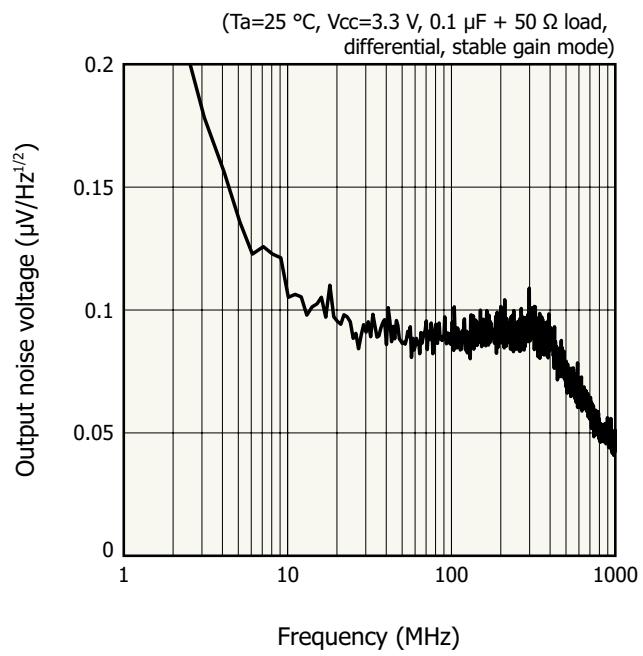
Current consumption vs. ambient temperature (typical example)



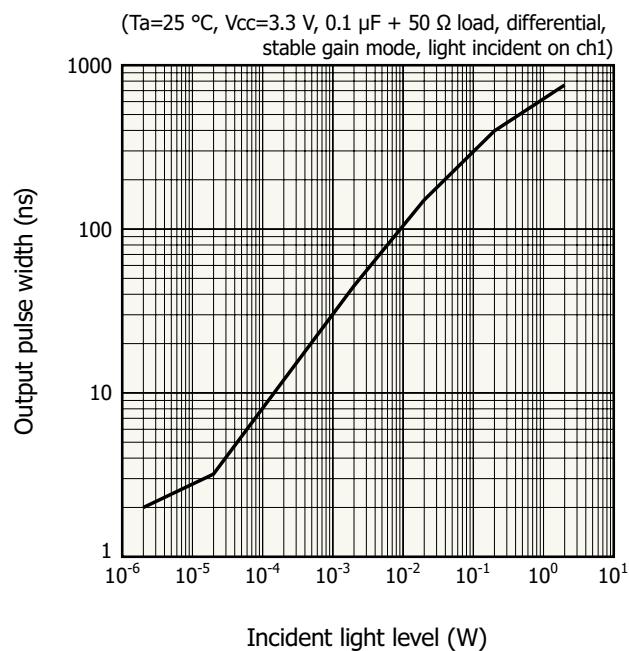
Frequency characteristics (typical example)



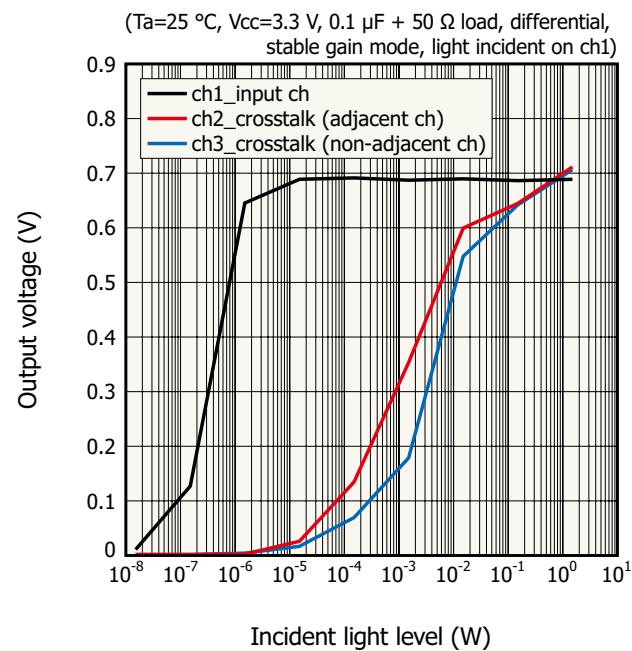
Output noise voltage vs. frequency (typical example)



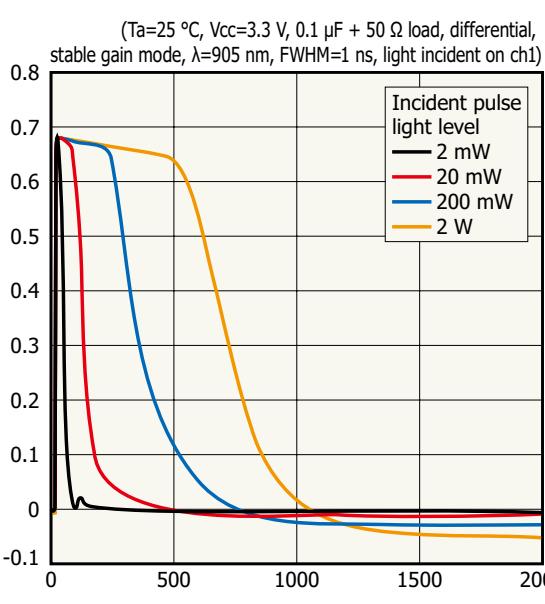
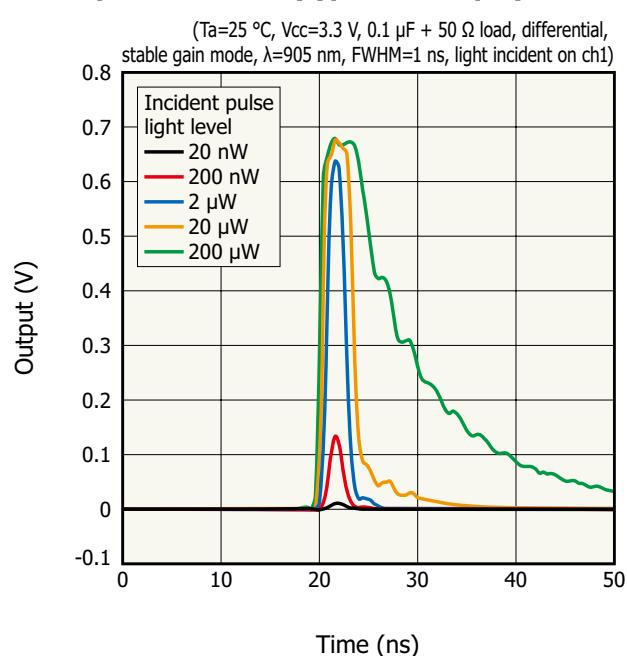
Output pulse width vs. incident light level (typical example)



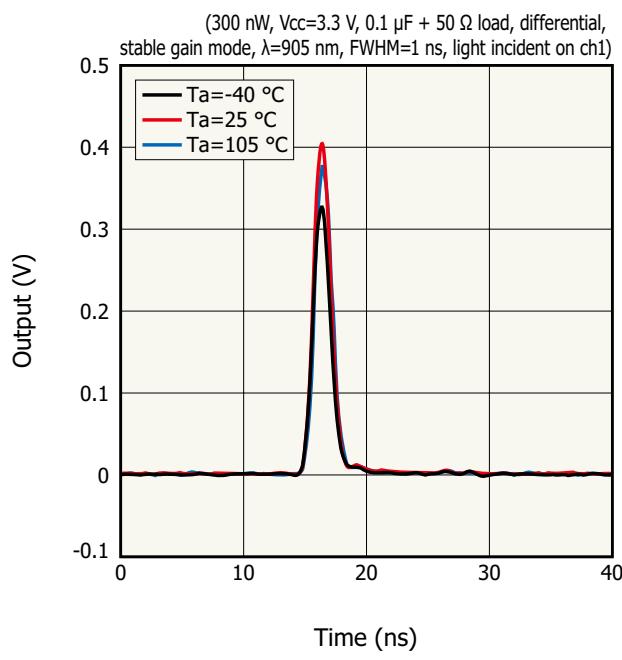
Output voltage vs. incident light level (typical example)



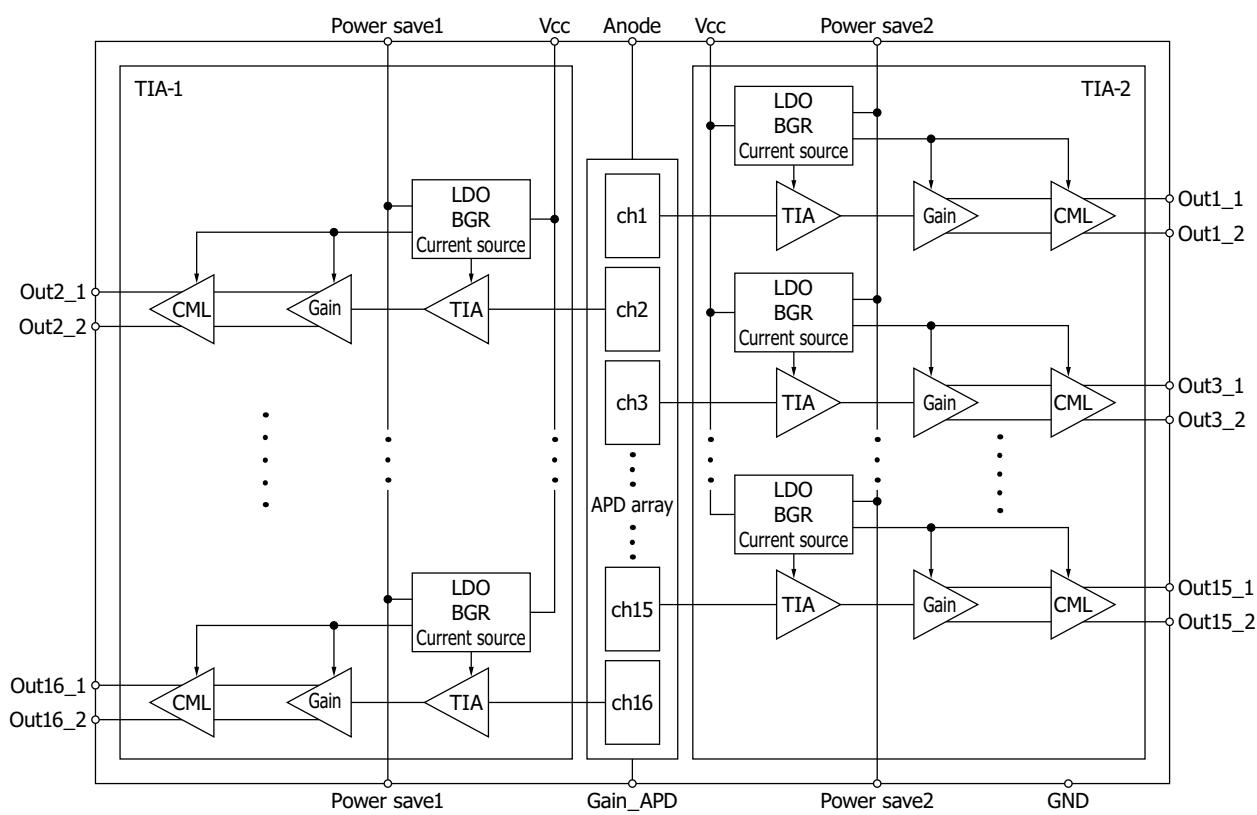
Output waveform (typical example)



**Temperature characteristics of output waveform
(typical example)**

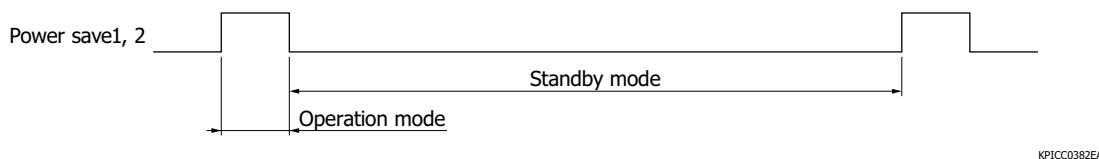


Block diagram



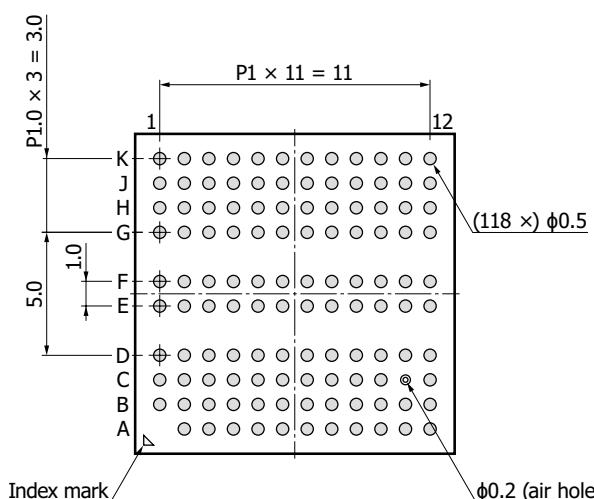
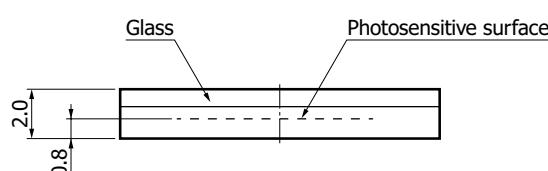
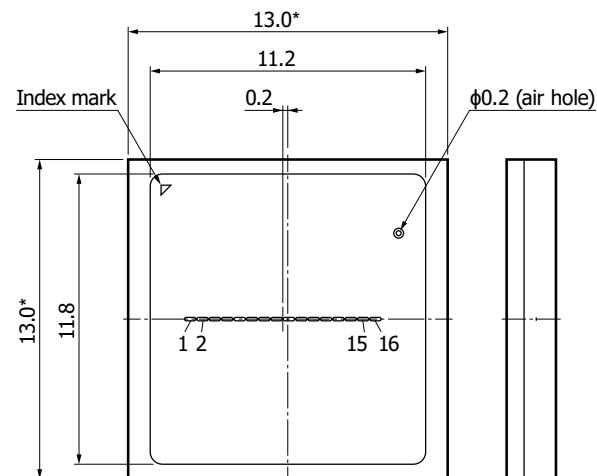
Timing chart (typical example)

Set the duty ratio of operation mode and standby mode so that the temperature of the transimpedance amplifier chip is below 150 °C.



KPICCO382EA

Dimensional outline (unit: mm)



Tolerance unless otherwise noted: ± 0.25 , $\pm 2.5^\circ$

Chip position accuracy with respect to package dimensions marked*:

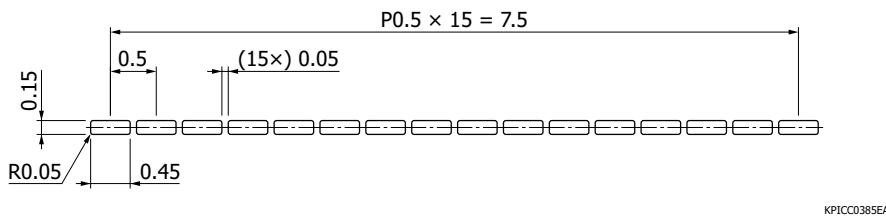
$X, Y \leq \pm 0.3$, $\theta \leq \pm 2.5^\circ$

Au plating

Packing: tray (60 pcs/tray)

KPICA0117EA

Enlarged view of photosensitive area (unit: mm)

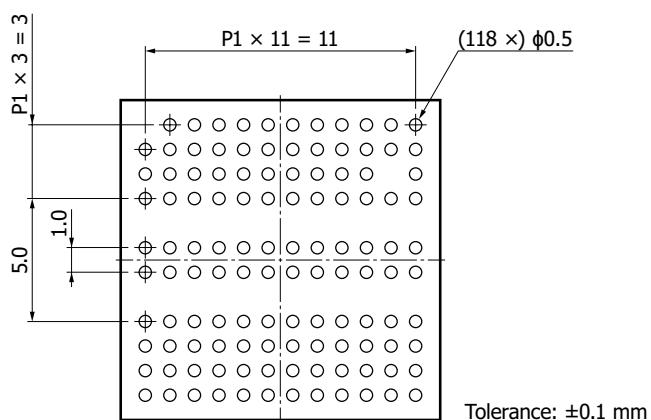


Pin connections

Pin no.	Function	Pin no.	Function	Pin no.	Function	Pin no.	Function	Pin no.	Function
A1	-	C1	GND	E1	Anode	G1	GND	J1	Power save2
A2	Vcc	C2	GND	E2	Anode	G2	GND	J2	Vcc
A3	Out2_1 ^{*12}	C3	GND	E3	Anode	G3	GND	J3	Out1_2 ^{*13}
A4	Out4_2 ^{*13}	C4	GND	E4	Anode	G4	GND	J4	Out3_1 ^{*12}
A5	Out6_1 ^{*12}	C5	GND	E5	Anode	G5	GND	J5	Out5_2 ^{*13}
A6	Out8_2 ^{*13}	C6	GND	E6	Anode	G6	GND	J6	Out7_1 ^{*12}
A7	Out10_2 ^{*13}	C7	GND	E7	Anode	G7	GND	J7	Out9_1 ^{*12}
A8	Out12_1 ^{*12}	C8	GND	E8	Anode	G8	GND	J8	Out11_2 ^{*13}
A9	Out14_2 ^{*13}	C9	GND	E9	Anode	G9	GND	J9	Out13_1 ^{*12}
A10	Out16_1 ^{*12}	C10	GND	E10	Anode	G10	GND	J10	Out15_2 ^{*13}
A11	Vcc	C11	-	E11	Anode	G11	GND	J11	Vcc
A12	NC	C12	GND	E12	Anode	G12	GND	J12	Power save2
B1	Power save1	D1	GND	F1	Anode	H1	GND	K1	NC
B2	Vcc	D2	GND	F2	Anode	H2	GND	K2	Vcc
B3	Out2_2 ^{*13}	D3	GND	F3	Anode	H3	GND	K3	Out1_1 ^{*12}
B4	Out4_1 ^{*12}	D4	GND	F4	Anode	H4	GND	K4	Out3_2 ^{*13}
B5	Out6_2 ^{*13}	D5	GND	F5	Anode	H5	GND	K5	Out5_1 ^{*12}
B6	Out8_1 ^{*12}	D6	GND	F6	Anode	H6	GND	K6	Out7_2 ^{*13}
B7	Out10_1 ^{*12}	D7	GND	F7	Anode	H7	GND	K7	Out9_2 ^{*13}
B8	Out12_2 ^{*13}	D8	GND	F8	Anode	H8	GND	K8	Out11_1 ^{*12}
B9	Out14_1 ^{*12}	D9	GND	F9	Anode	H9	GND	K9	Out13_2 ^{*13}
B10	Out16_2 ^{*13}	D10	GND	F10	Anode	H10	GND	K10	Out15_1 ^{*12}
B11	Vcc	D11	GND	F11	Anode	H11	GND	K11	Vcc
B12	Power save1	D12	Gain_APD	F12	Anode	H12	GND	K12	NC

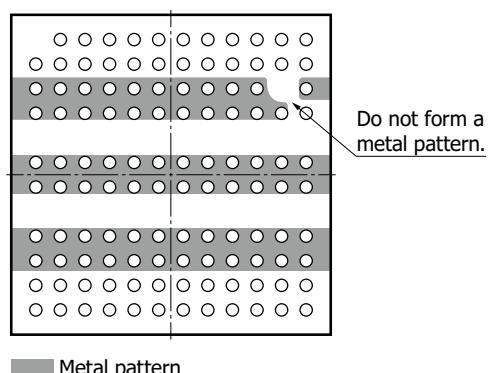
*12: positive

*13: negative

■ Recommended land pattern (unit: mm)**■ Precautions during reflow soldering**

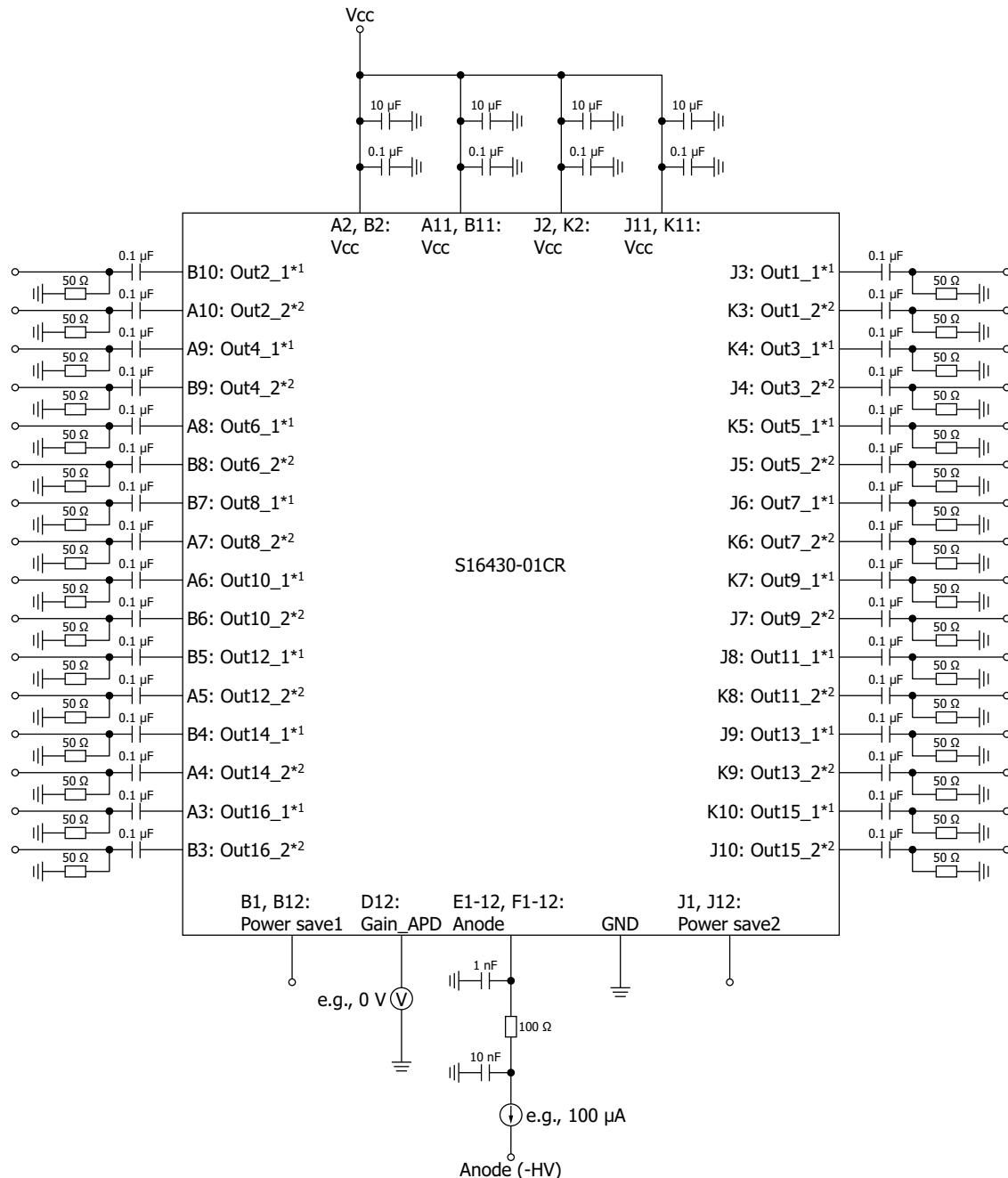
Take care to prevent excess flux. If there is excess flux, then flux may enter the product through the air hole.

We recommend forming metal patterns as shown in the figure on the right. Form the GND and anode metal patterns long horizontally for heat dissipation. To prevent flux from entering through the air hole, do not form a metal pattern on part of the 3rd and 4th rows of the land patterns.

■ Recommended metal pattern

Operating circuit example

Stable gain mode

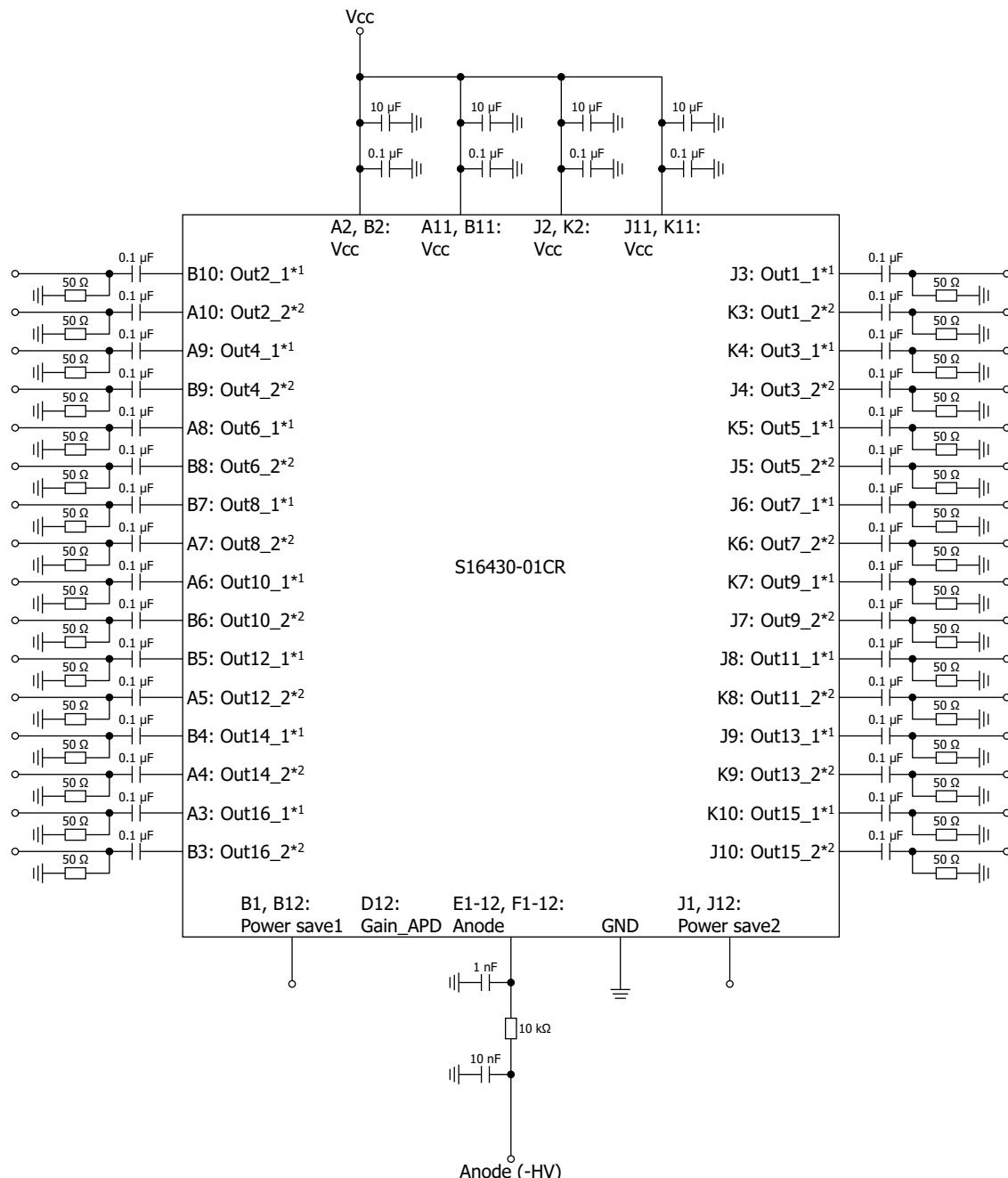


*1: positive

*2: negative

KPICC0383EB

Normal APD mode



*1: positive

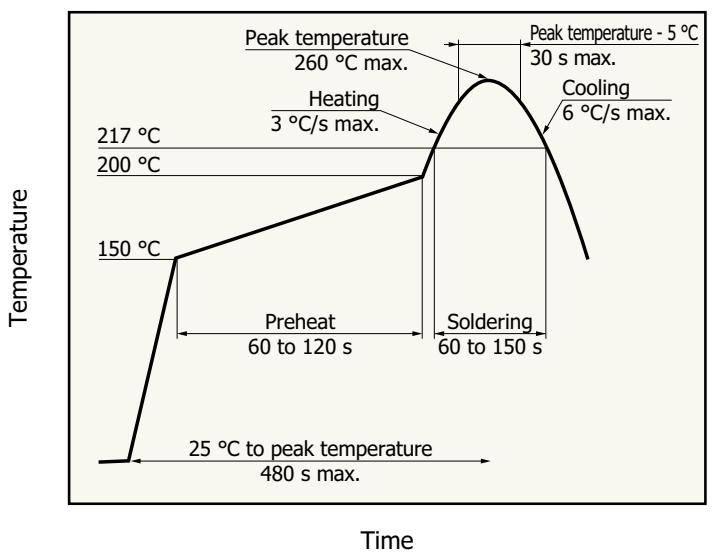
*2: negative

KPICC0384EB

Precautions

- Do not do cleaning or vapor phase soldering, as cleaning liquid or water may get inside the package through the air hole on the bottom of the package.
- High voltage is applied to the anode terminal. Beware of electric shock.
- Apply negative voltage (-165 V, etc.) with respect to GND to the anode terminal.
- The top of the package is glass. Be careful not to pinch it too hard with metal tweezers, as this can cause cracks or flakes.

■ Recommended reflow soldering conditions



KSPDB0419EA

- 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 168 hours.
- 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.

■ Related information

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

- Precautions
- Disclaimer
- Precautions / Surface mount type products

The content of this document is current as of January 2025.

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