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Photosensors with front-end IC

S15597-01CT S15658-01CT

Compact APD suitable for various light level detection

The S15597-01CT and S15658-01CT 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**

Structure

Parameter	Symbol	S15597-01CT	S15658-01CT	Unit
Detector	-	Si APD		-
Photosensitive area size*1	A	ϕ0.2	ϕ0.5	mm
Package	-	Glass epoxy		-
Seal material	-	Silicone resin		-

*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	-40 to +105	°C
Storage temperature	Tstg	No dew condensation*2	-40 to +125	°C
Soldering temperature*3	Tsol		260 °C (twice)	°C

*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: Reflow soldering, IPC/JEDEC J-STD-020 MSL 4, see P.8
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.

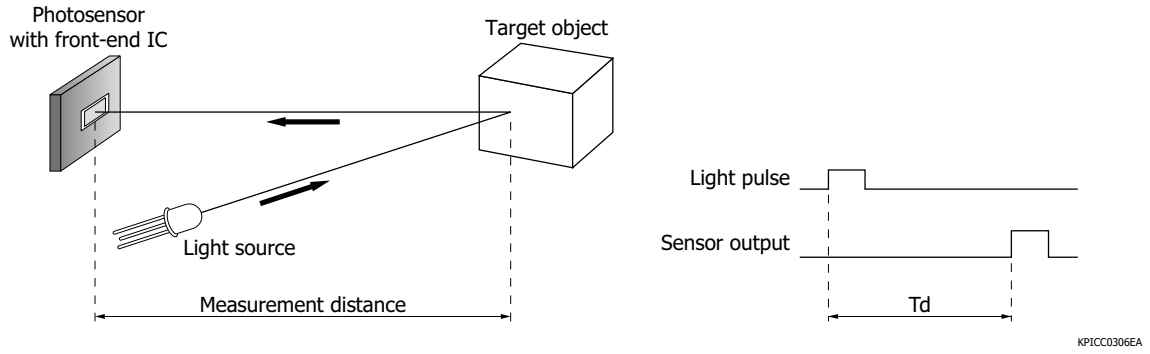
Electrical and optical characteristics (Ta=25 °C)

Parameter	Symbol	Condition	S15597-01CT			S15658-01CT			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=905 nm, M=1	-	0.5	-	-	0.5	-	A/W
Breakdown voltage	V_{BR}	I_D=100 µA	155	175	195	155	175	195	V
Temperature coefficient of breakdown voltage	ΔTV_{BR}		0.8	1.0	1.2	0.8	1.0	1.2	V/°C
Transimpedance amplifier gain	G	Low gain	-	3	-	-	3	-	kV/A
		High gain	-	64	-	-	64	-	
Current consumption	Ic	Low gain	15	25	34	15	25	34	mA
		High gain	17	26	37	17	26	37	
Low cutoff frequency	fcl	Low gain	-	0.01	-	-	0.01	-	MHz
		High gain	-	0.5	-	-	0.5	-	
High cutoff frequency	fch	Low gain	100	180	260	90	160	240	MHz
		High gain	90	160	230	80	150	220	
Output noise voltage	VON	f=20 MHz, M=100 High gain	-	2.0	-	-	2.0	-	mV rms
Output voltage level	-	Low gain	0.5	0.9	1.3	0.5	0.9	1.3	V
		High gain	0.5	1	1.5	0.5	1	1.5	
Output offset voltage	Voffset	High gain	-	-	±100	-	-	±100	mV
Maximum output voltage amplitude	Vp-p max	Low gain	-	-0.5	-	-	-0.5	-	V
		High gain	-	±0.7	-	-	±0.7	-	

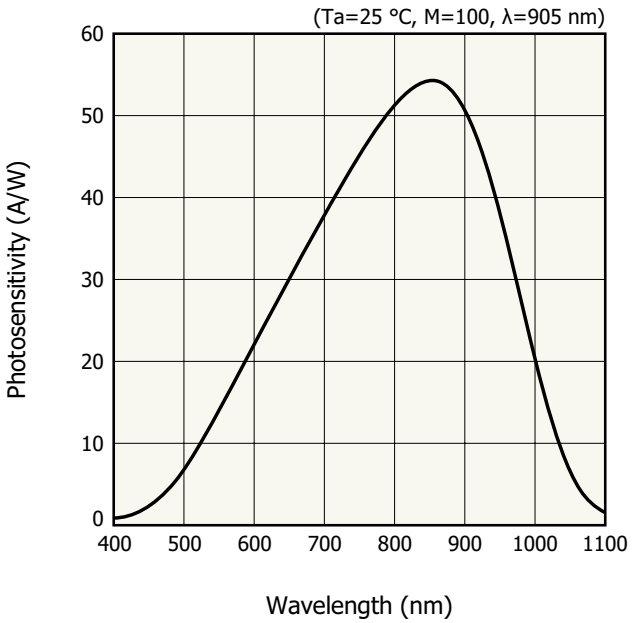
Distance measuring method

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.

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



Spectral response



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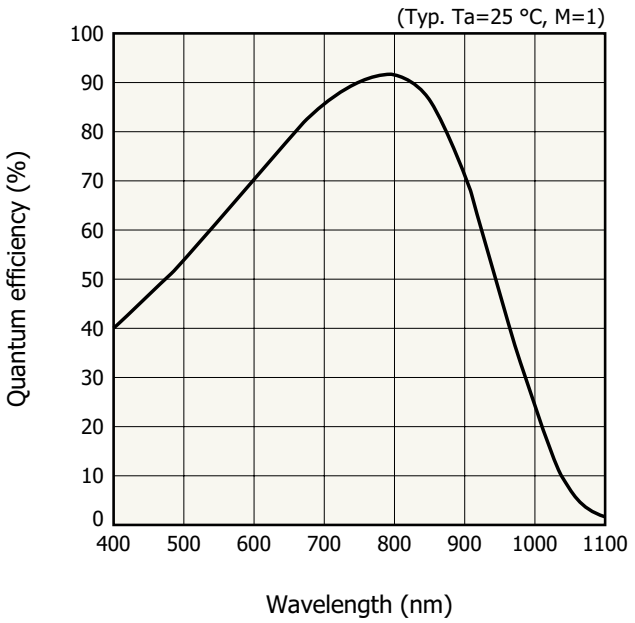
Quantum efficiency vs. wavelength



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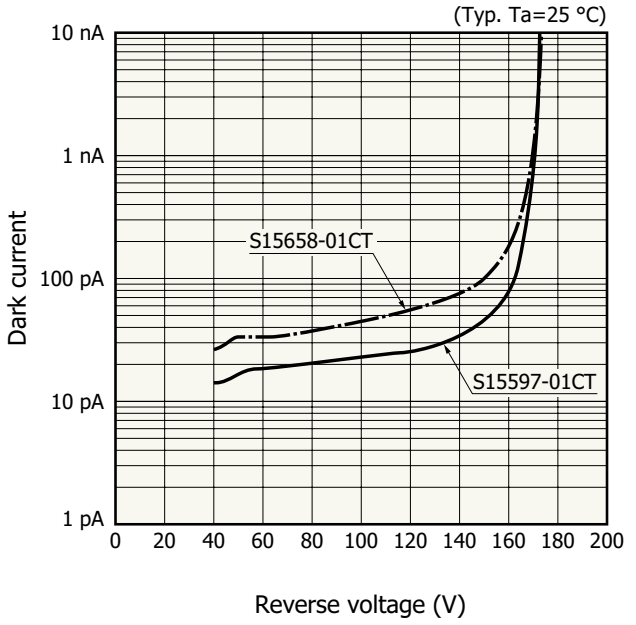
Dark current vs. reverse voltage



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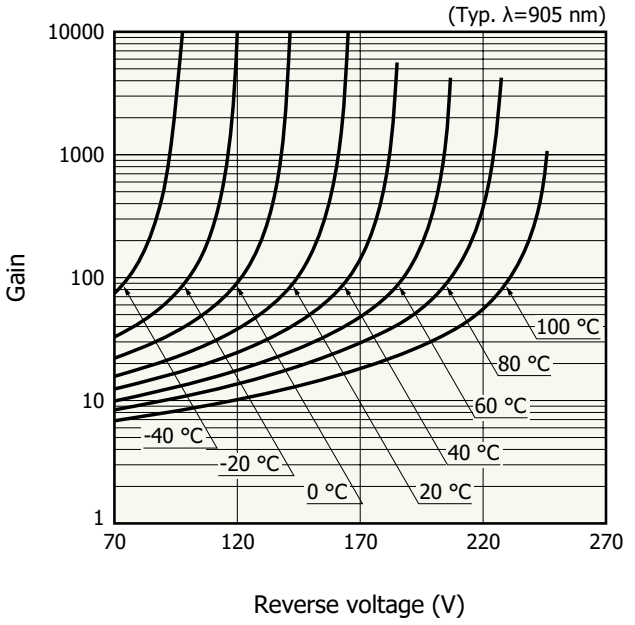
Gain vs. reverse voltage



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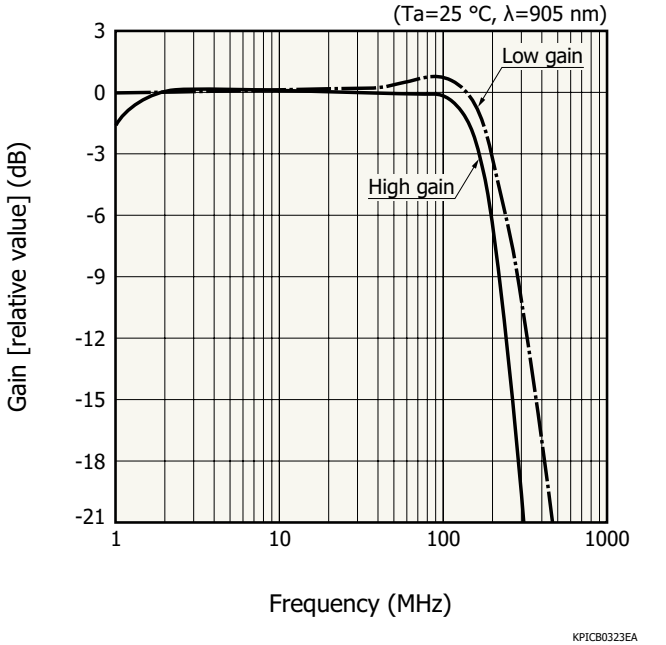
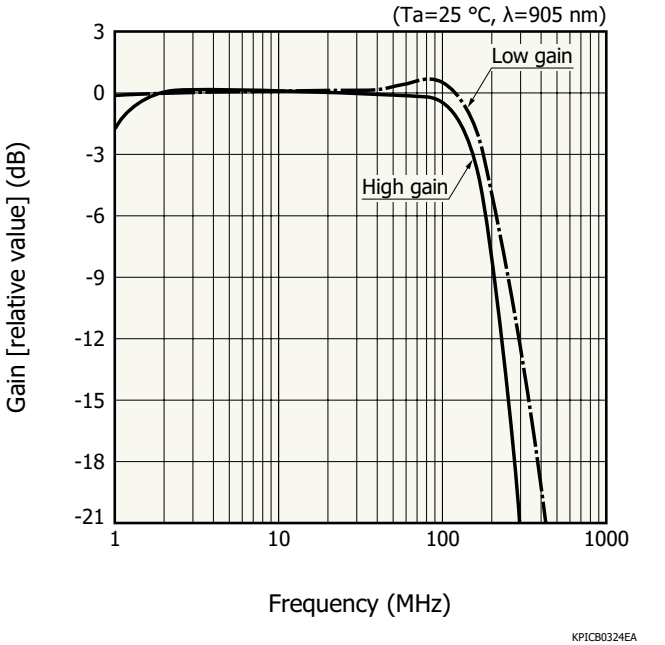
Frequency characteristics (typical example)

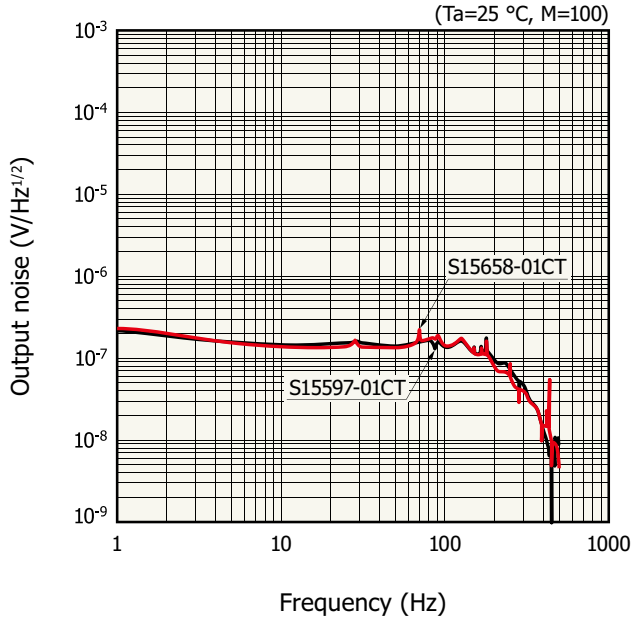
S15597-01CT



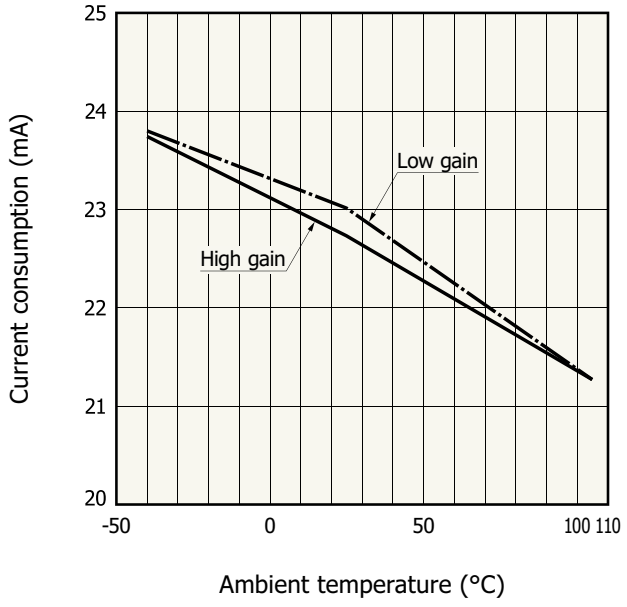
S15658-01CT



Output noise vs. frequency (high gain, typical example)



Current consumption vs. ambient temperature (typical example)



Truth table

■ Gain

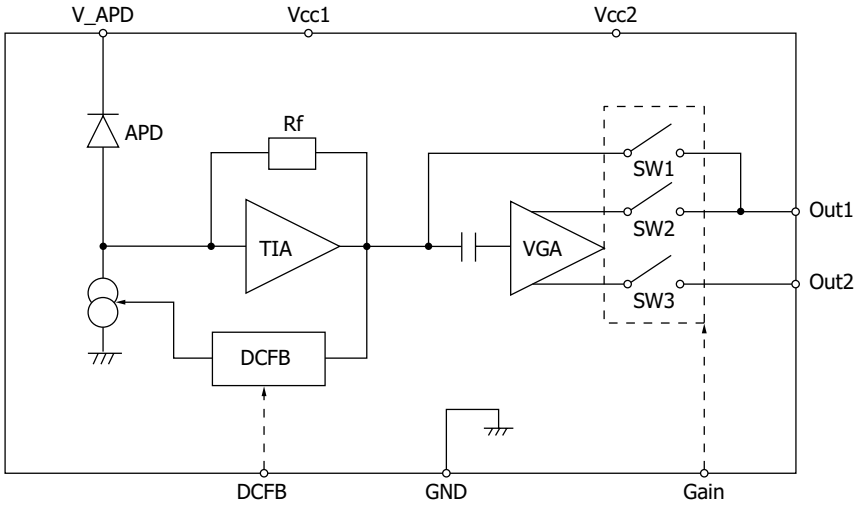
Setting	Gain
0	Low gain (× 1)
1	High gain (× 20)

■ 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.

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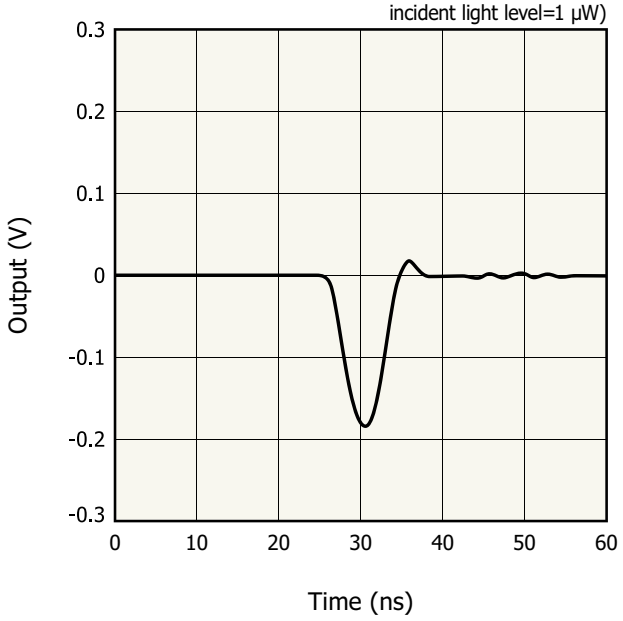
Output waveform examples

S15597-01CT

(Low gain, Ta=25 °C, λ=905 nm, input pulse width=5 ns, incident light level=1 μW)



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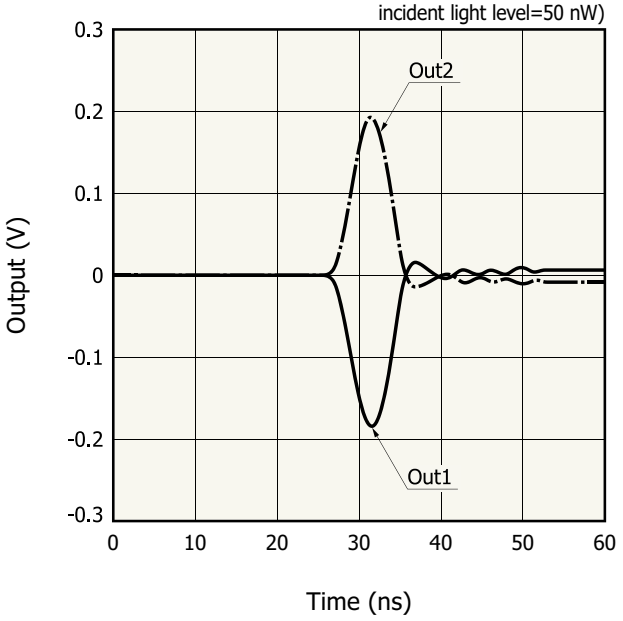
(High gain, Ta=25 °C, λ=905 nm, input pulse width=5 ns, incident light level=50 nW)



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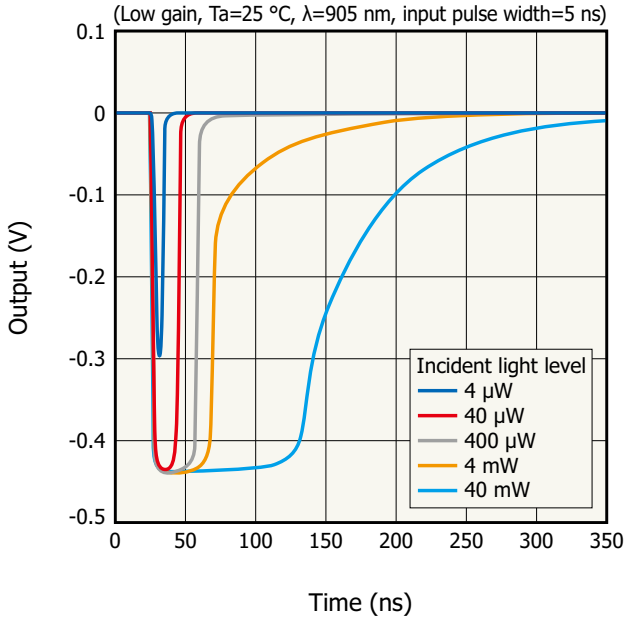
(Low gain, Ta=25 °C, λ=905 nm, input pulse width=5 ns)



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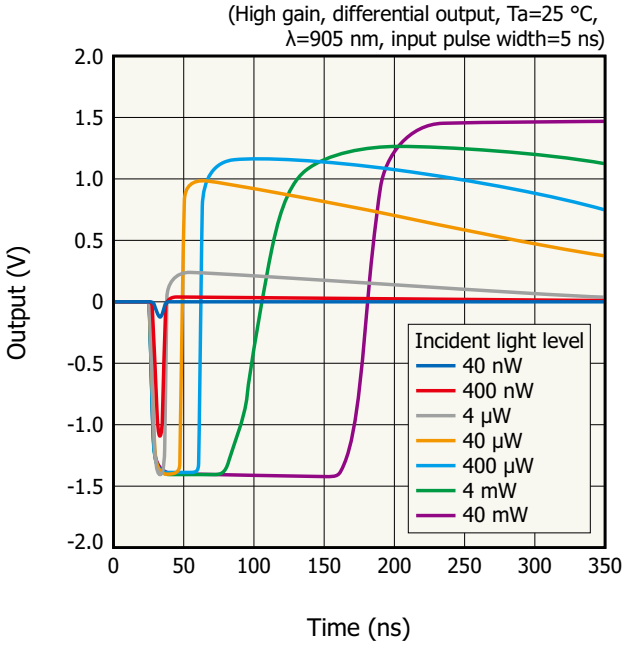
(High gain, differential output, Ta=25 °C, λ=905 nm, input pulse width=5 ns)



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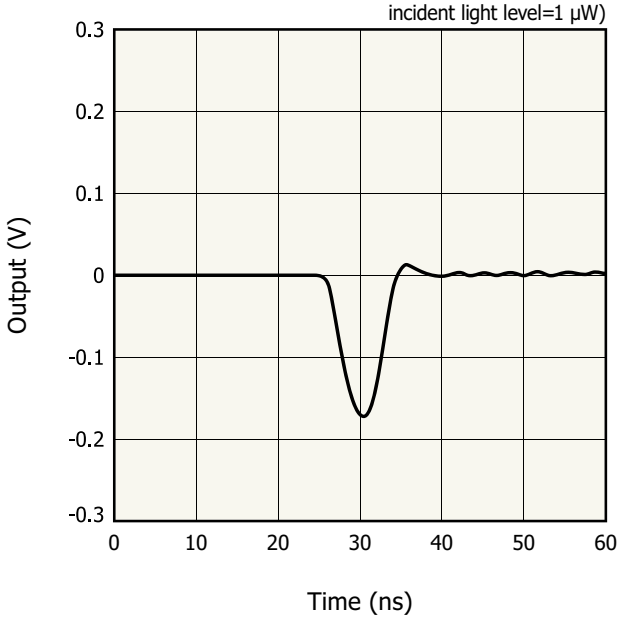
S15658-01CT

(Low gain, Ta=25 °C, λ=905 nm, input pulse width=5 ns, incident light level=1 μW)



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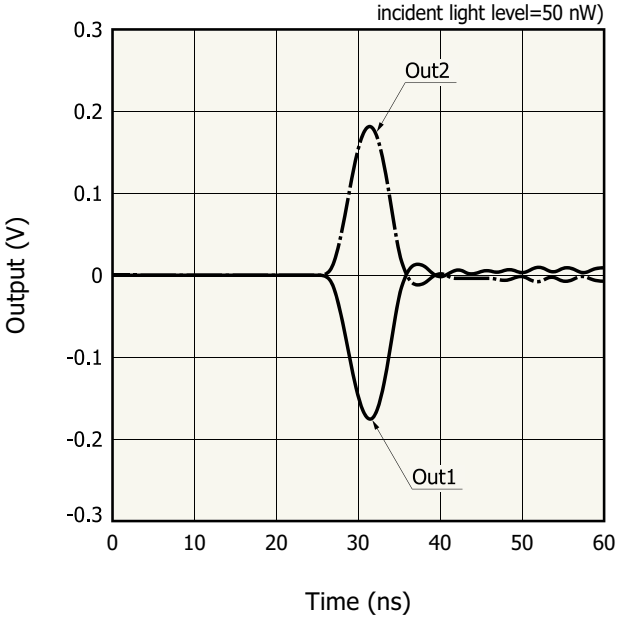
(High gain, Ta=25 °C, λ=905 nm, input pulse width=5 ns, incident light level=50 nW)



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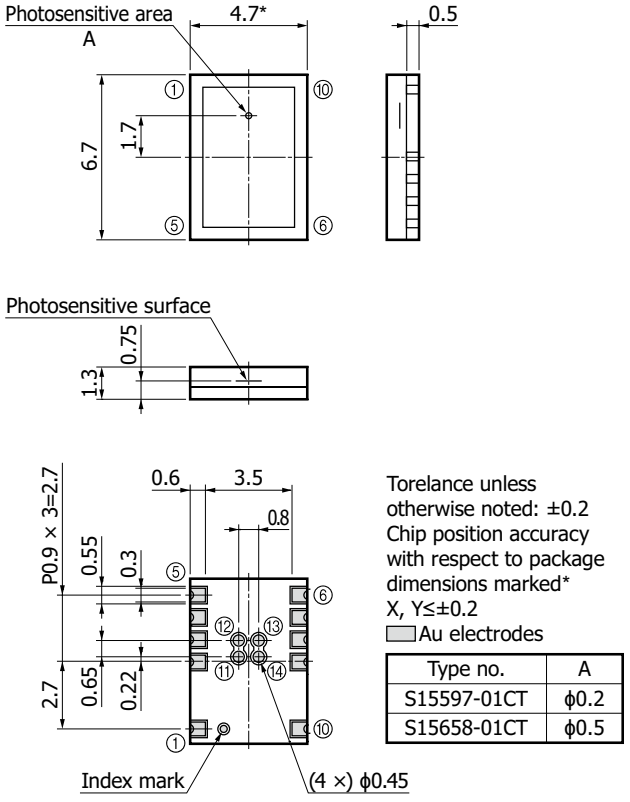
Dimensional outline (unit: mm)



Torelance unless otherwise noted: ±0.2
Chip position accuracy with respect to package dimensions marked*
X, Y≤±0.2
Au electrodes

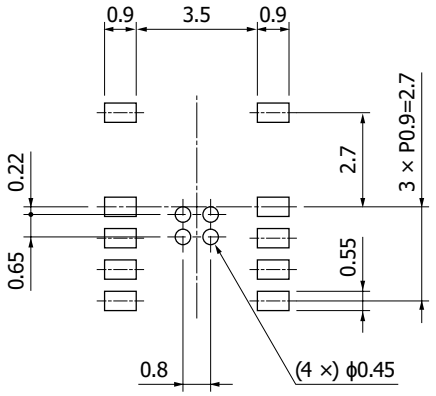
Type no.	A
S15597-01CT	ϕ0.2
S15658-01CT	ϕ0.5

KPICA0114EA

Pin connections

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

Recommended land pattern (unit: mm)



Torelance unless otherwise noted: ±0.1

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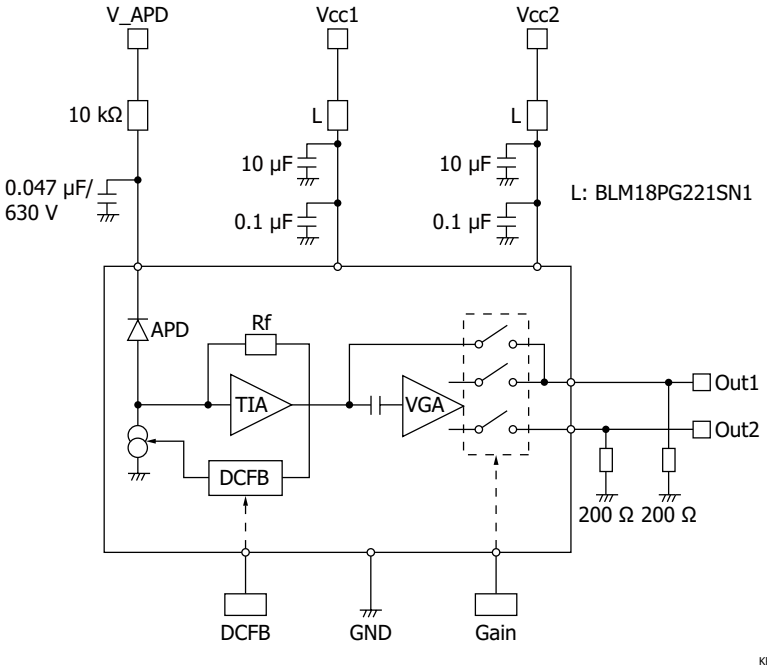
Connection example (50 Ω system)



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

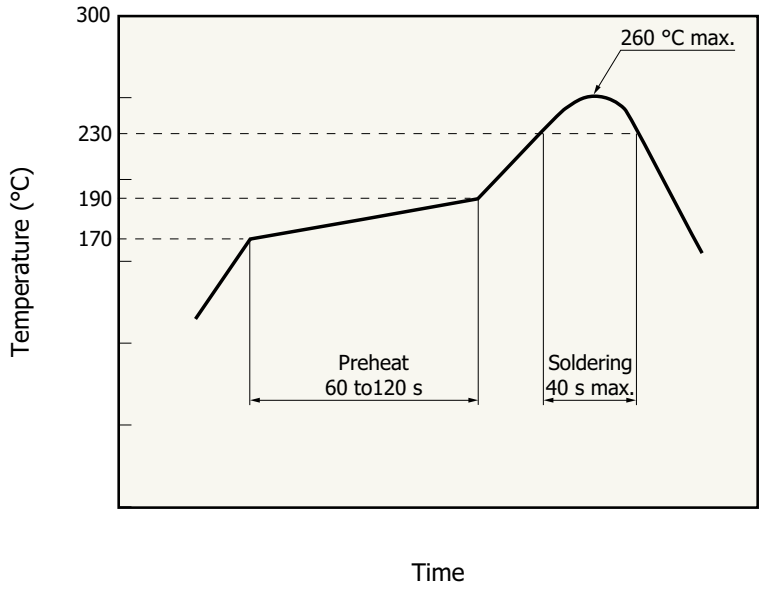
The gain of the APD built into the photosensor with front-end IC varies depending on the temperature. The following two methods are available for handling this issue in using the sensor over a wide temperature range.

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 soldering conditions



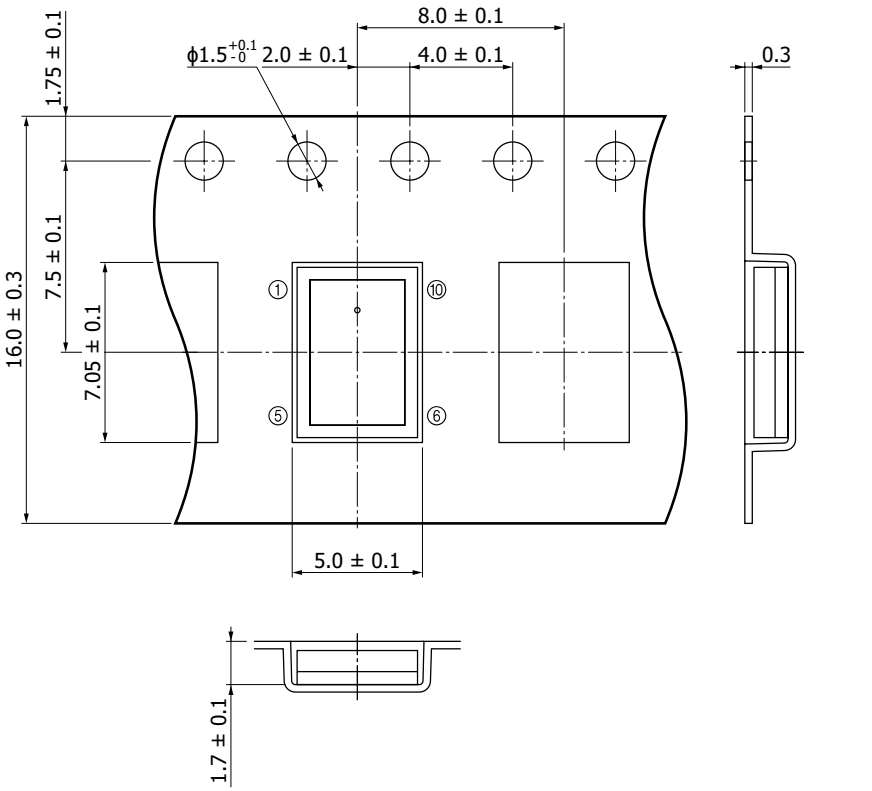
· This product supports lead-free soldering. After unpacking, store it in an environment at a temperature of 30 °C or less and a humidity of 60% or less, and perform soldering within 72 hours.
· The effect that the product receives during reflow soldering varies depending on the circuit board and reflow oven that are used. Before actual reflow soldering, check for any problems by testing out the reflow soldering methods in advance.

Reel packing specifications

■ Reel (conforms to JEITA ET-7200)

Outer diameter	Hub diameter	Tape width	Material	Electrostatic characteristics
ϕ254 mm	ϕ100 mm	16 mm	PS	Conductive

■ Embossed tape (unit: mm, material: PS, conductive)



■ Packing quantity
1000 pcs/reel

■ Packing state
Reel and desiccant in moisture-proof packing (vacuum-sealed)

Related information

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

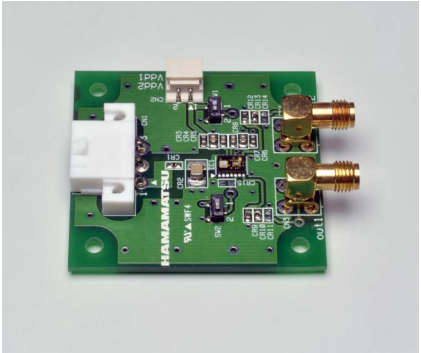
■ Precautions
· Disclaimer
· Precautions / Surface mount type products

■ Catalogs
· Selection guide / Photo IC

Evaluation kits for photosensor with front-end IC C16188-03, C16189-03

Evaluation kits equipped with S15597-01CT / S15658-01CT are available. Contact us for detailed information.

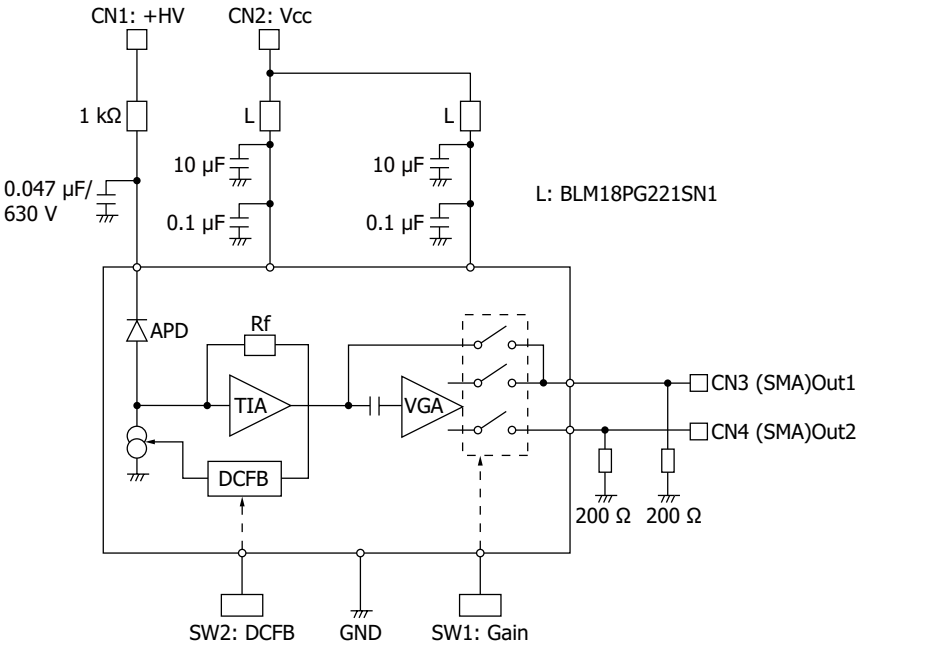
· C16188-03 (Equipped with S15597-01CT)
· C16189-03 (Equipped with S15658-01CT)



Accessories

· IC power cable
· APD power cable

Equivalent circuit



Information described in this material is current as of September 2024.
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.

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