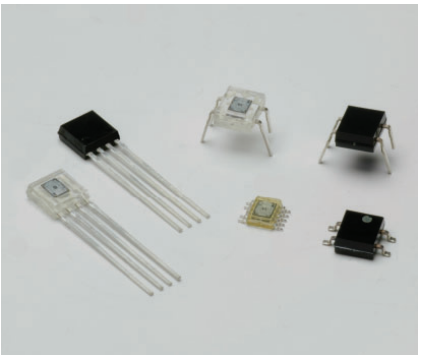
HAMAMATSU
PHOTON IS OUR BUSINESS

Light modulation photo IC



S4282-51, S6809, S6846, S6986, S7136/-10, S10053

Fewer detection errors even under disturbance background light

These light modulation photo ICs were developed for optical synchronous detection under disturbance background light. A photodiode, preamplifier, comparator, oscillator, LED driver and signal processing circuit, etc. are all integrated on a monolithic photo IC chip. Optical synchronous type photoreflectors and photointerrupters, which less susceptible to disturbance background light, can be easily configured by just connecting an external LED to this photo IC. Our unique circuit design achieves an allowable background light level of 10000 *lx* typ. (S4282-51, S6986, S10053) and a minimum detection level of 0.2 μW/mm^2 typ. (S6809, S6846, S7136/-10).

Features

- **Large allowable background light level**
  S4282-51, S6986, S10053: 10000 *lx* typ.
  S6809, S6846, S7136/-10 : 3000 *lx* typ.
- **Minimum detection level**
  S4282-51, S6986, S10053: 0.7 μW/mm^2 typ.
  S6809, S6846, S7136/-10 : 0.2 μW/mm^2 typ.
- **Digital output (Output appears "L" by light input.)**
- **Small hysteresis (S6809)**
- **Small SMD package (S10053)**

Applications

- **Paper detection in office machine (copiers, fax machines, etc.)**
- **Optical switches**

Absolute maximum ratings (Ta=25 °C)

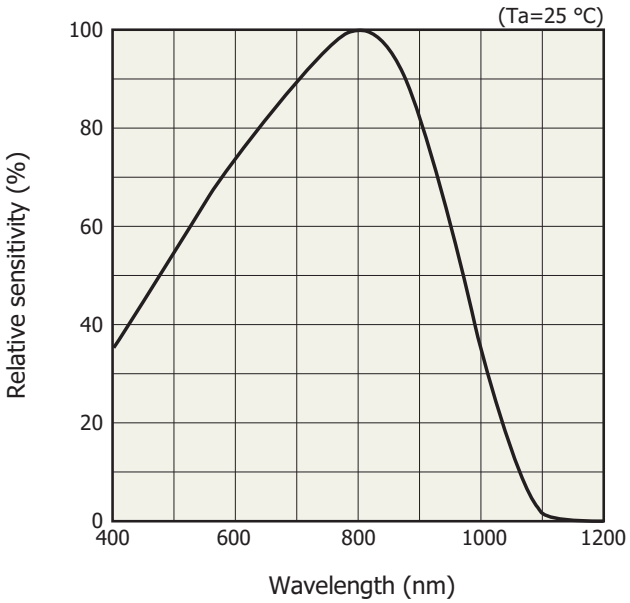
Parameter	Symbol	S4282-51, S6986, S10053	S6809, S6846, S7136/-10	Unit
Supply voltage	Vcc	-0.5 to +16		V
Output voltage	Vo	-0.5 to +16		V
Output current	Io	50		mA
Cathode output voltage	Vcath	-0.5 to +16		V
Cathode output current	Icath		70	mA
Power dissipation*1	P	250		mW
Operating temperature	Topr	-25 to +60		°C
Storage temperature	Tstg	-40 to +100		°C

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.
*1: Power dissipation decreases at a rate of 3.3 mW/°C above Ta=25 °C

Products other than the S10053 do not support lead-free soldering. For details on reflow soldering conditions for surface mount types, please contact our sales office.

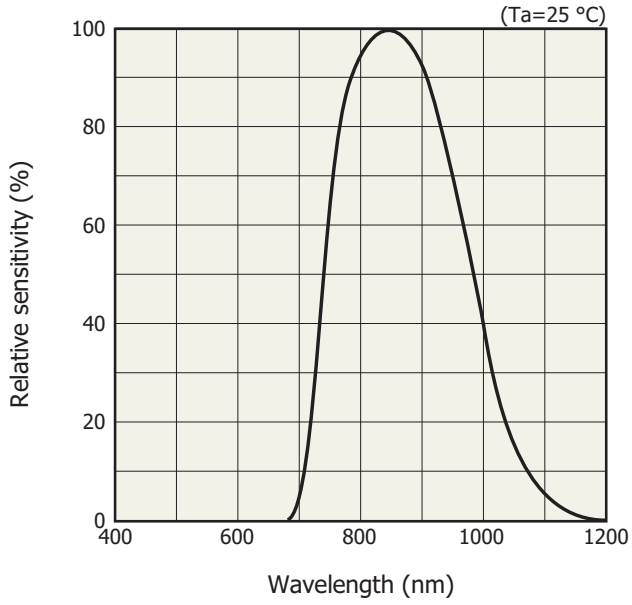
Spectral response (typical example)

S4282-51, S6986, S10053



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S6809, S6846, S7136/-10

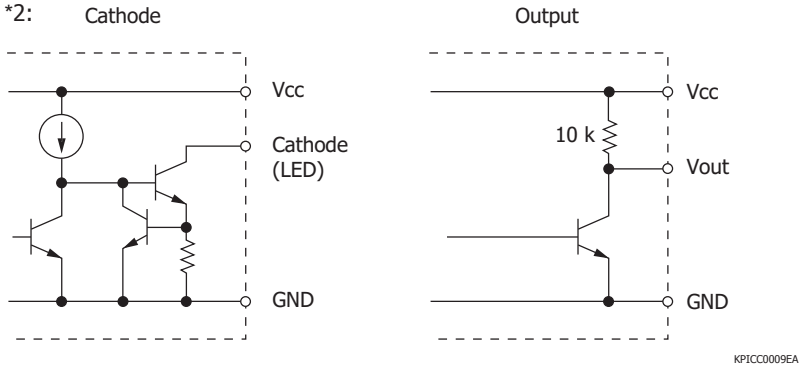


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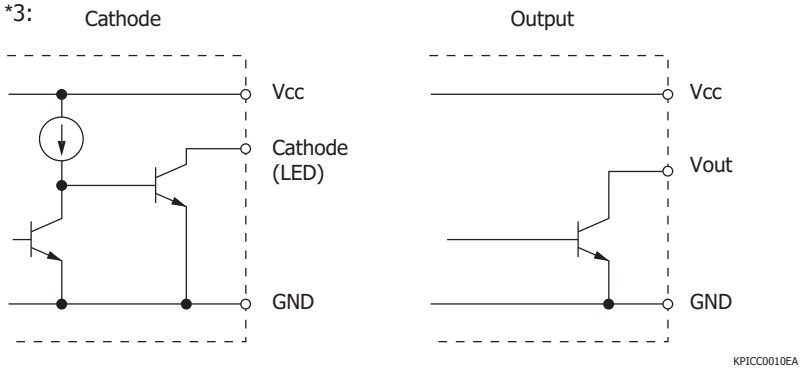
Electrical and optical characteristics (Ta=25 °C, Vcc=5 V)

Parameter		Symbol	Condition	S4282-51, S6986, S10053 Output: built-in pull-up resistor*2 Cathode: constant current drive			S6809, S6846, S7136/-10 Output: open collector*3 Cathode: open collector drive			Unit
				Min.	Typ.	Max.	Min.	Typ.	Max.	
Supply voltage		Vcc		4.5	-	16	4.5	-	16	V
Current consumption		Icc	Vo, LED terminals open	-	4	11	-	4	11	mA
Output	Low level output voltage	VOL	IOL=16 mA	-	0.2	0.4	-	0.2	0.4	V
Output	High level output voltage	VOH		4.9	-	-				V
Output	High level output voltage	VOH	4.7 kΩ between Vcc and Vo				4.9	-	-	V
Cathode	Low level output voltage	Vcath	Icath=40 mA				-	-	0.8	V
Cathode	Low level output current	Icath	Vcath=1.2 V	15	35	60				mA
Cathode	Pulse cycle	Tp		65	130	220	65	130	220	µs
Cathode	Pulse width	Tw		4	8	13.7	4	8	13.7	µs
H→L threshold light level		EHL	λ=940 nm No background light	-	0.7	2	-	0.2	1.0	µW/mm²
Hysteresis		-		0.45	0.65	0.95	0.45 0.65 (S6809)	0.65 0.8 (S6809)	0.95 0.95 (S6809)	-
Frequency response		f		0.5	1.25	-	0.5	1.25	-	kHz
Allowable background light level		Ex	Signal light: 5 µW/mm², λp=940 nm Background light: "A" light source	5000	10000	-	2000	3000	-	lx

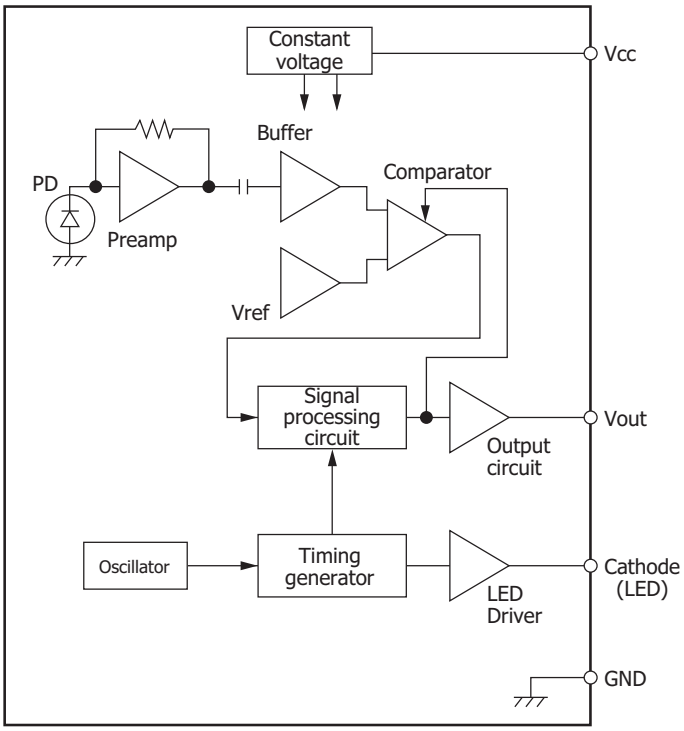
*2:



*3:



Block diagram and internal functions



Truth table

Input	Output level
Light on	low
Light off	high

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(a) Oscillator and timing signal generator
The oscillator produces a reference oscillation output by charging and discharging the built-in capacitor with constant current. The oscillation output is fed to the timing signal generator, which then creates LED drive pulses and various timing pulses for digital signal processing.

(b) LED driver circuit
This circuit drives an external LED using the LED drive pulses created by the timing signal generator. The duty cycle is 1/16.

(c) Photodiode and preamplifier circuit
The photodiode is formed on the same monolithic chip. A photocurrent generated in the photodiode is converted to a voltage by a preamplifier circuit. The preamplifier circuit uses an AC amplifier to expand the dynamic range versus DC or low-frequency background light, without impairing signal detection sensitivity.

(d) Capacitive coupling, buffer amplifier and reference voltage generator
Capacitive coupling removes low-frequency noise and also cancels the DC offset in the preamplifier. The buffer amplifier boosts the signal up to the comparator level, and the reference voltage generator produces a comparator level voltage.

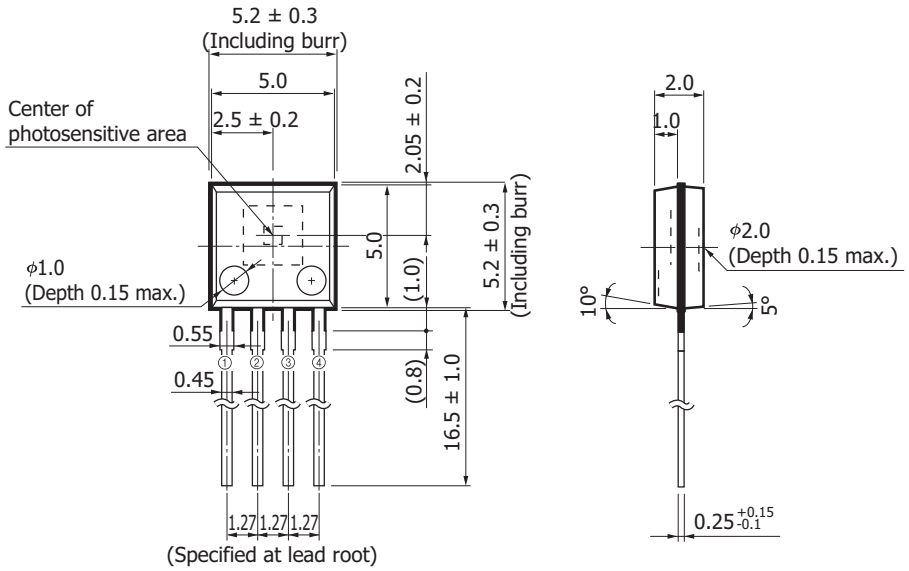
(e) Comparator circuit
The comparator circuit has a hysteresis function to prevent chattering caused by small fluctuations in the input light.

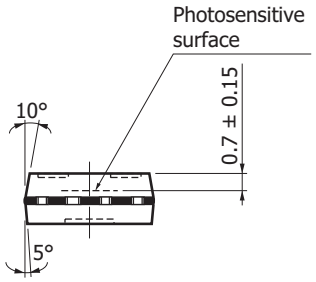
(f) Signal processing circuit
The signal processing circuit consists of a gate circuit and digital integrator circuit. The gate circuit discriminates input pulses during synchronous detection, to prevent operational errors caused by asynchronous background light. Background light which is synchronized with the signal detection timing cannot be eliminated by the gate circuit, but is canceled out by the digital integrator circuit at the latter stage.

(g) Output circuit
This circuit serves as an output buffer for the signal processing circuit and outputs the signal to an external circuit.

Dimensional outlines (unit: mm)

S6809, S6846, S6986



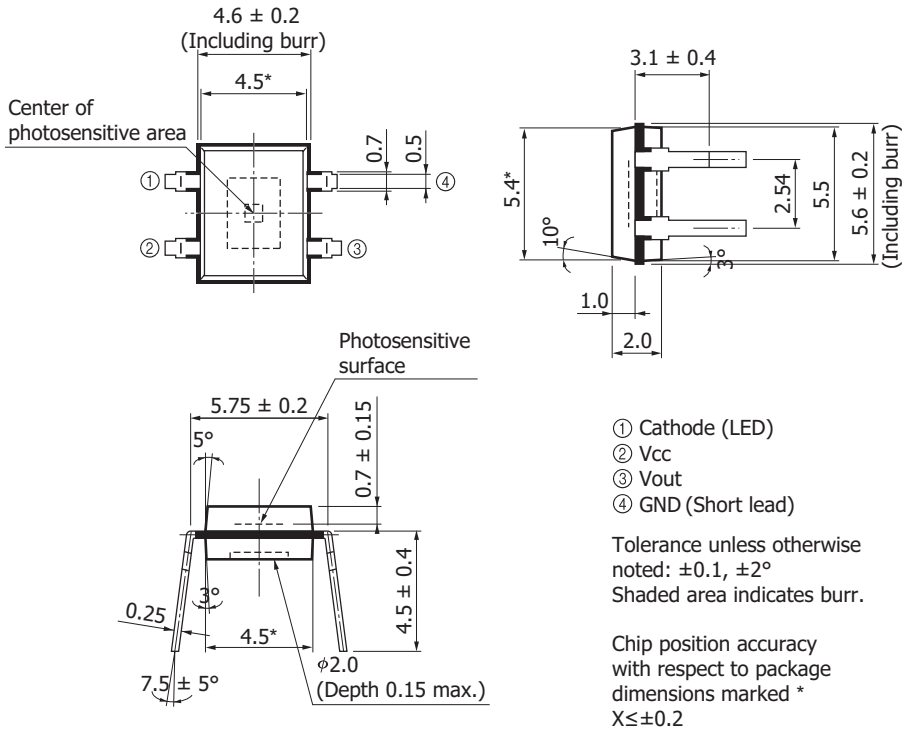


① Vout
② GND
③ Cathode (LED)
④ Vcc

Tolerance unless otherwise noted: ±0.1, ±2°
Shaded area indicates burr.
Values in parentheses are not guaranteed, but for reference.

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S4282-51, S7136



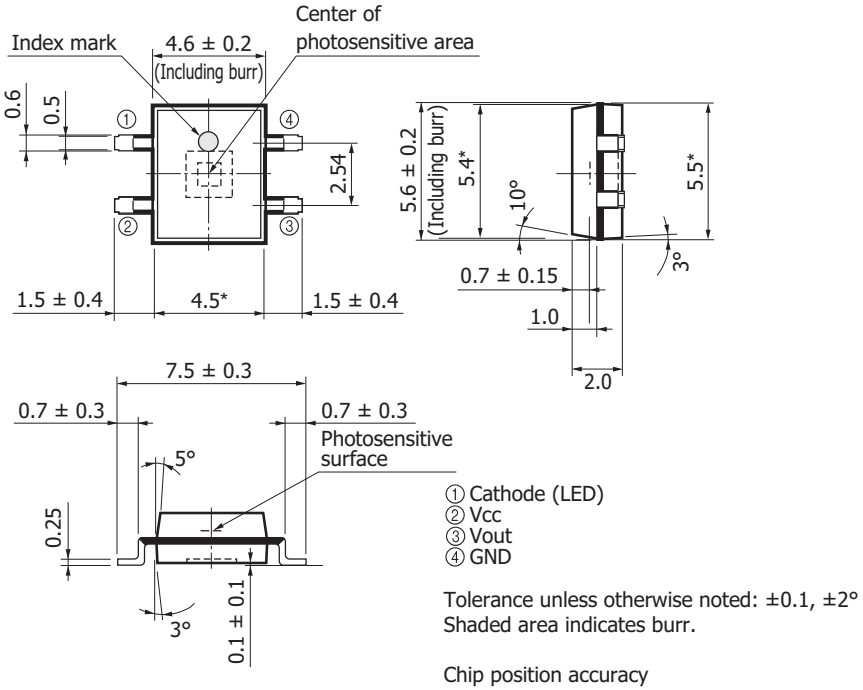
① Cathode (LED)
② Vcc
③ Vout
④ GND (Short lead)

Tolerance unless otherwise noted: ±0.1, ±2°
Shaded area indicates burr.

Chip position accuracy with respect to package dimensions marked *
X≤±0.2
Y≤±0.2

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S7136-10



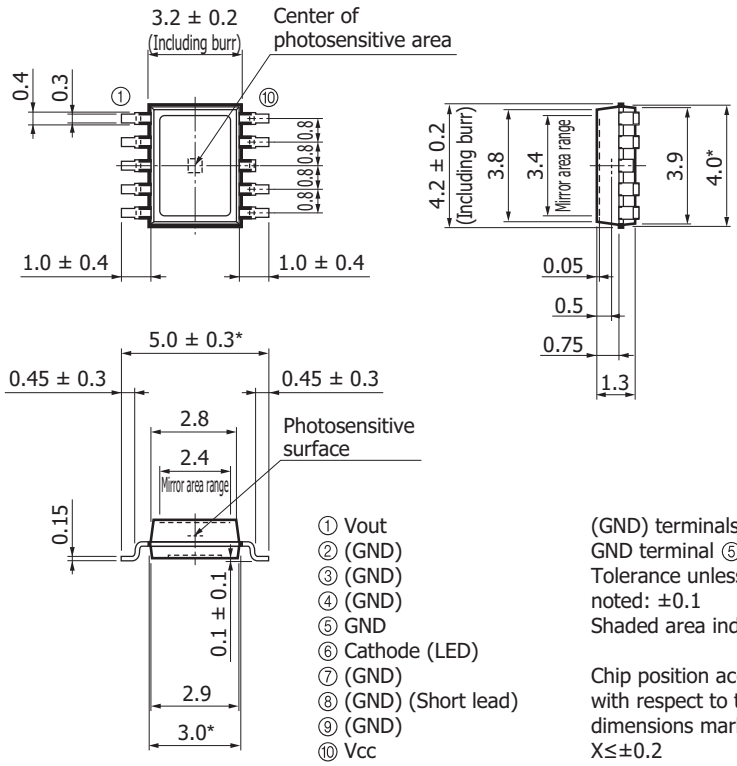
① Cathode (LED)
② Vcc
③ Vout
④ GND

Tolerance unless otherwise noted: ±0.1, ±2°
Shaded area indicates burr.

Chip position accuracy with respect to package dimensions marked *
X≤±0.2
Y≤±0.2

KPICA0034JB

S10053



① Vout
② (GND)
③ (GND)
④ (GND)
⑤ GND
⑥ Cathode (LED)
⑦ (GND)
⑧ (GND) (Short lead)
⑨ (GND)
⑩ Vcc

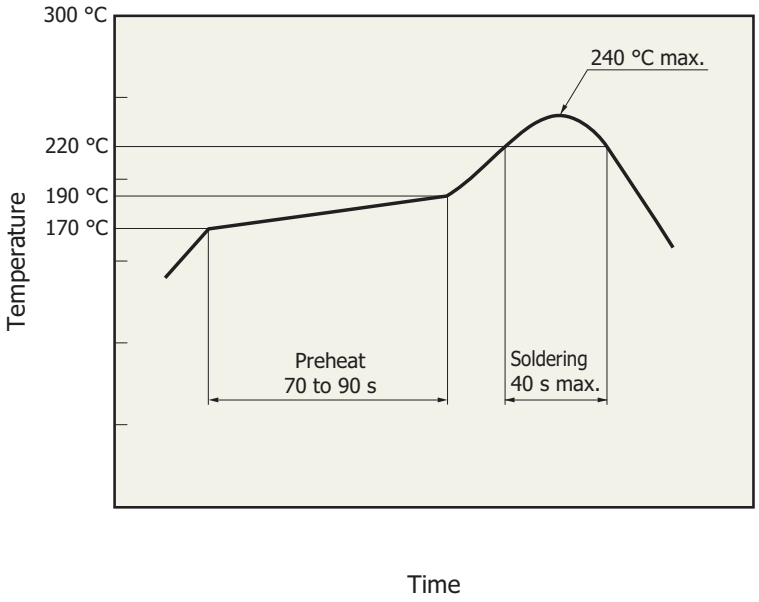
(GND) terminals should be connected to GND terminal ⑤ on board.
Tolerance unless otherwise noted: ±0.1
Shaded area indicates burr.

Chip position accuracy with respect to the package dimensions marked *
X≤±0.2
Y≤±0.2

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Measured example of temperature profile with our hot-air reflow oven for product testing (S10053)

The S10053 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.



Information described in this material is current as of March, 2013.
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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