PHOTO IC

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 switch

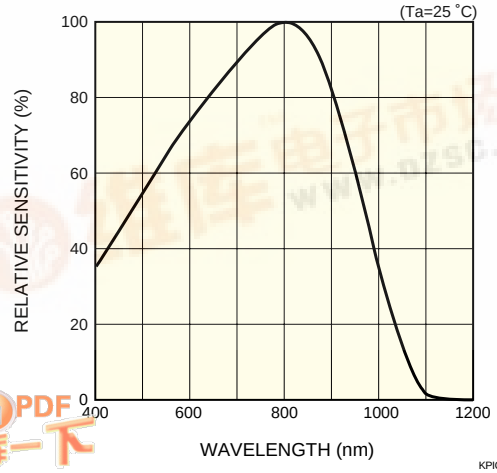
■ Absolute maximum ratings (Ta=25 °C)

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

*1: Derate power dissipation at a rate of 3.3 mW/°C above Ta=25 °C

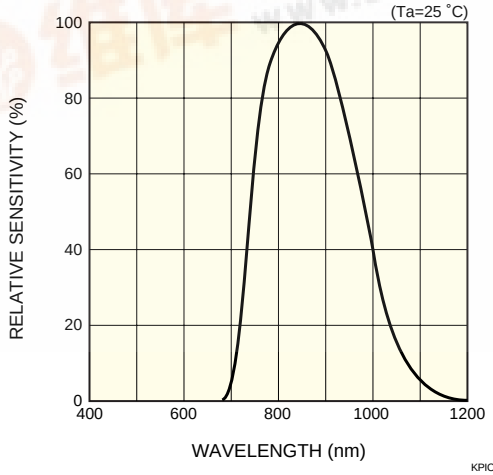
■ Spectral response (typical example)

S4282-51, S6986, S10053



KPICB0001EB

S6809, S6846, S7136/-10

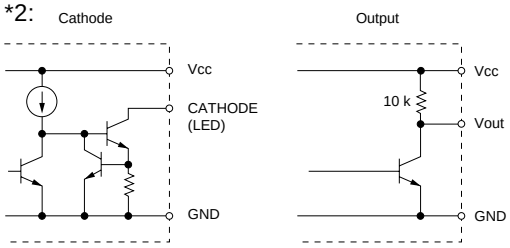


KPICB0002EA

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

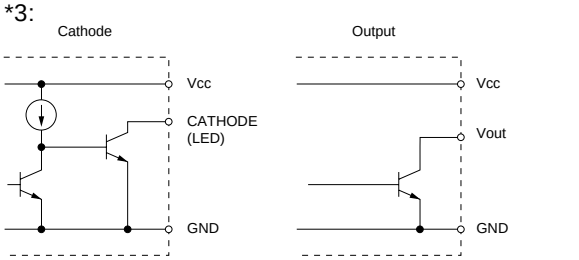
Parameter		Symbol	Condition	S4282-51, S6986, S10053 Output: built-in pull-up resistor *2 Cathode: constant current drive			S6809, S6846, S7136 /-10 Output: open collector *3 Cathode: open collector drive			Unit
				Min.	Typ.	Max.	Min.	Typ.	Max.	
Supply voltage		Vcc		4.5	-	16	4.5	-	16	V
Current consumption		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/mm^2
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/mm^2 λp=940 nm Background light: "A" light source	5000	10000	-	2000	3000	-	*lx*

*2:



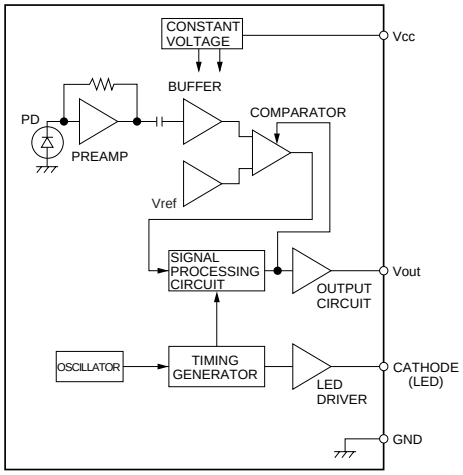
KPICC0009EA

*3:



KPICC0010EA

■ Block diagram and internal functions



TRUTH TABLE

INPUT	OUTPUT LEVEL
LIGHT ON	LOW
LIGHT OFF	HIGH

KPICC0002EA

(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.

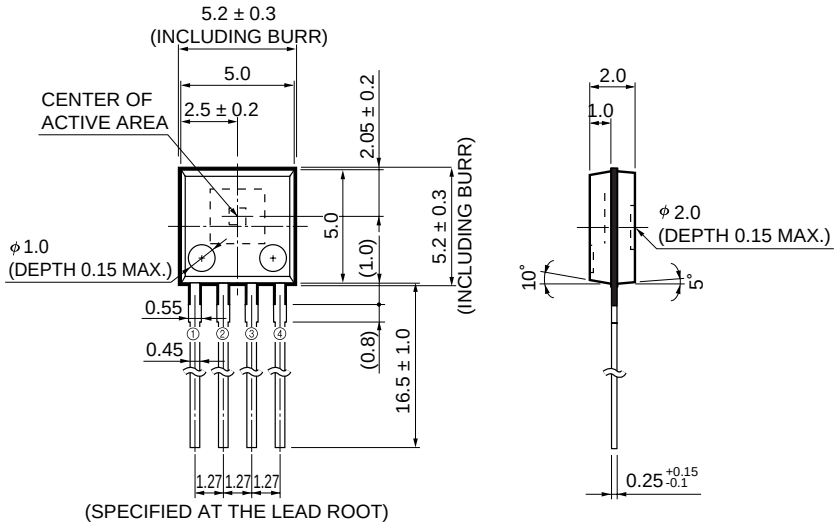
(e) Comparator circuit
The comparator circuit has a hysteresis function to prevent chattering caused by small fluctuations in the input light.

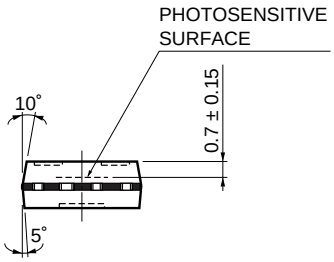
(f) Signal processing circuit
The signal processing circuit consists of a gate circuit and digital integrator circuit. The gate circuit discriminates input pulses during synchronous detection, to prevent operational errors caused by asynchronous background light. Background light which is synchronized 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



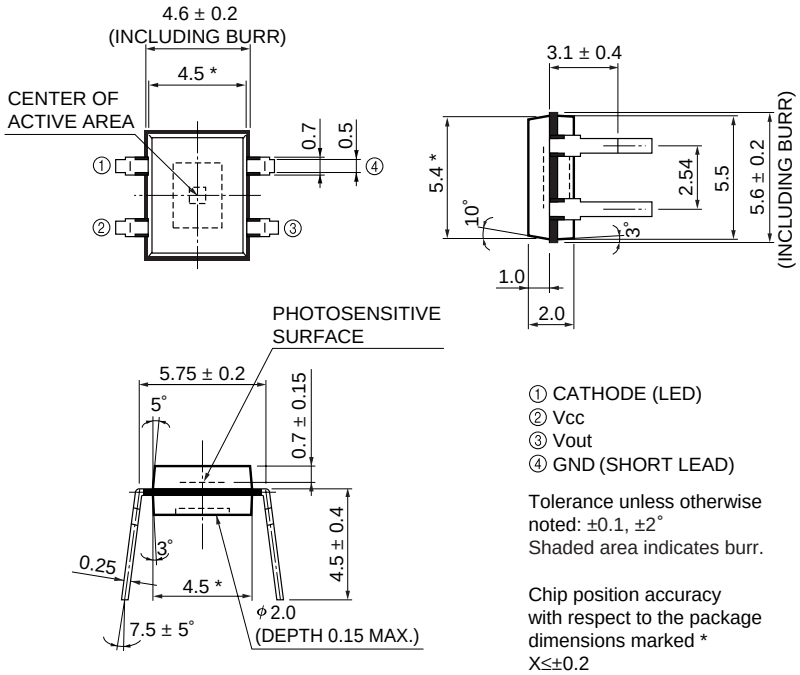


① Vout
② GND
③ CATHODE (LED)
④ Vcc

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

KPICA0008EC

S4282-51, S7136



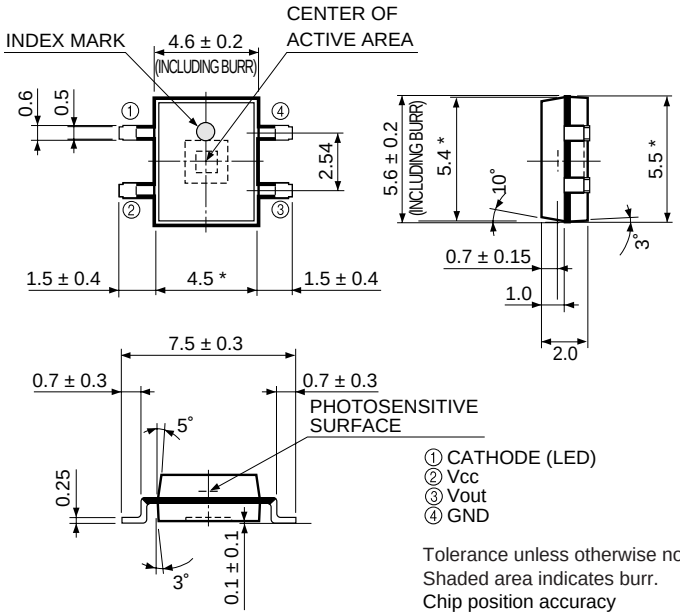
① CATHODE (LED)
② Vcc
③ Vout
④ GND (SHORT LEAD)

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

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

KPICA0009EB

S7136-10

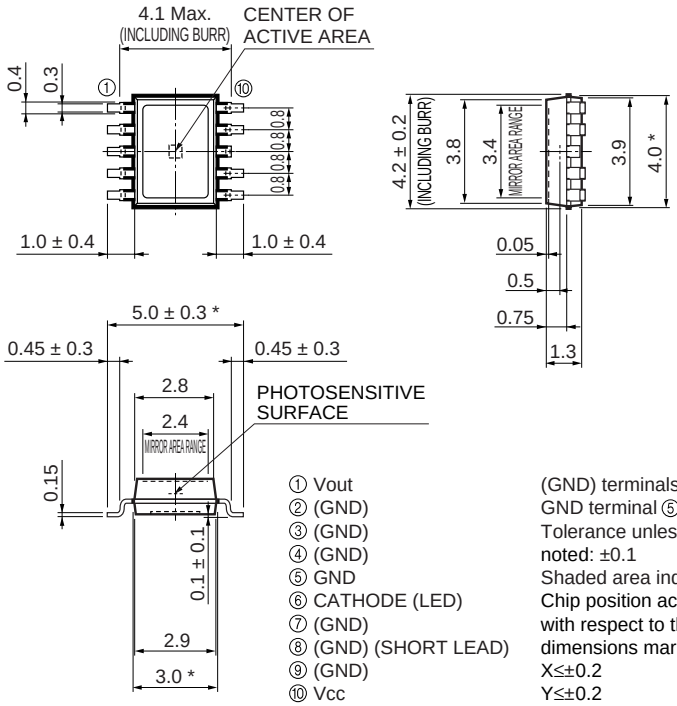


① CATHODE (LED)
② Vcc
③ Vout
④ GND

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

KPICA0034EB

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

KPICA0076EB

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, www.hamamatsu.com
U.S.A.: Hamamatsu Corporation: 360 Foothill Road, P.O.Box 6910, Bridgewater, N.J. 08807-0910, U.S.A., Telephone: (1) 908-231-0960, Fax: (1) 908-231-1218
Germany: Hamamatsu Photonics Deutschland GmbH: Arzbergerstr. 10, D-82211 Herrsching am Ammersee, Germany, Telephone: (49) 08152-3750, Fax: (49) 08152-2658
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
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
North Europe: Hamamatsu Photonics Norden AB: Smidesvägen 12, SE-171 41 Solna, Sweden, Telephone: (46) 8-509-031-00, Fax: (46) 8-509-031-01