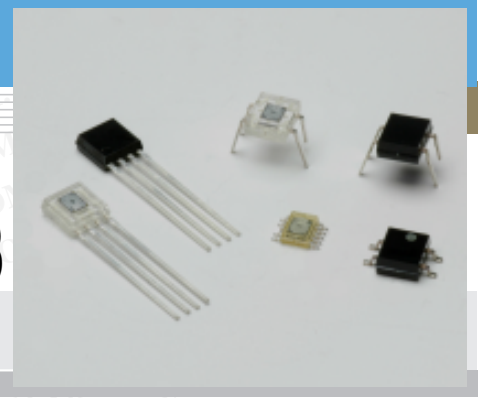


# Light modulation photo IC

## 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  $\mu\text{W}/\text{mm}^2$  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  $\mu\text{W}/\text{mm}^2$  Typ.  
S6809, S6846, S7136/-10 : 0.2  $\mu\text{W}/\text{mm}^2$  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

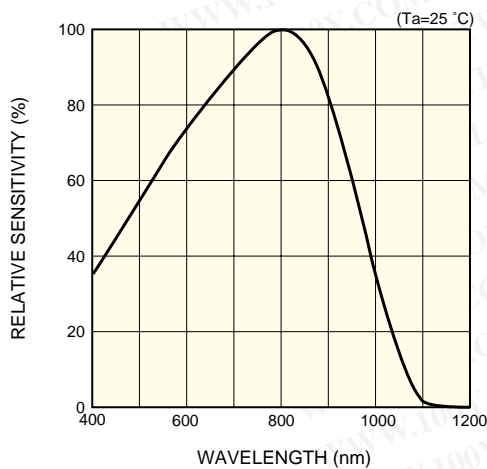
### ■ Absolute maximum ratings (Ta=25 °C)

| 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   |

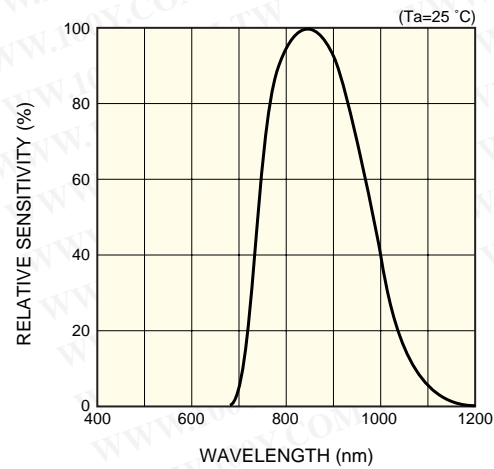
\*1: Derate power dissipation at a rate of 3.3 mW/°C above Ta=25 °C

### ■ Spectral response (typical example)

S4282-51, S6986, S10053



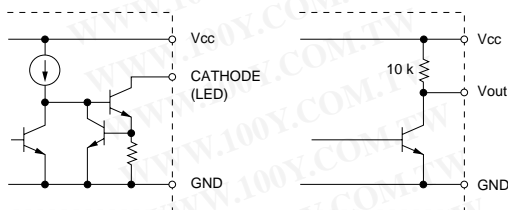
S6809, S6846, S7136/-10



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

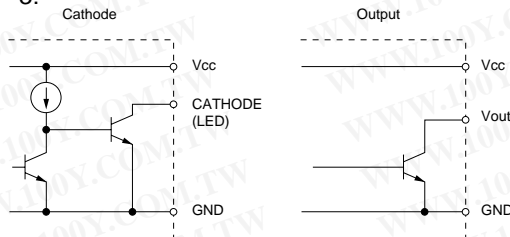
| Parameter                        | Symbol                    | Condition   | S4282-51, S6986, S10053              |       |      | S6809, S6846, S7136 /-10      |                 |                 | Unit               |
|----------------------------------|---------------------------|---|--------------------------------------|-------|------|-------------------------------|-----------------|-----------------|--------------------|
|                                  |                           |   | Output: built-in pull-up resistor *2 |       |      | Output: open collector *3     |                 |                 |                    |
|                                  |                           |   | Cathode: constant current drive      |       |      | Cathode: open collector drive |                 |                 |                    |
|                                  |                           |   | 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             | V                  |
|                                  | High level output voltage | VOH   | 4.9                                  |       |      | -                             |                 |                 | V                  |
| Cathode                          | Low level output voltage  | Vcath   | Icath=40 mA                          |       |      | -                             |                 |                 | V                  |
|                                  | Low level output current  | Icath   | Vcath=1.2 V                          |       |      | 15                            | 35              | 60              | mA                 |
|                                  | Pulse cycle               | Tp  | 65                                   | 130   | 220  | 65                            | 130             | 220             | μs                 |
|                                  | Pulse width               | Tw  | 4                                    | 8     | 13.7 | 4                             | 8               | 13.7            | μs                 |
| H→L Threshold light level        | EHL                       | λ=940 nm<br>No background light   | -                                    | 0.7   | 2    | -                             | 0.2             | 1.0             | μW/mm <sup>2</sup> |
| Hysteresis                       | -                         |   | 0.45                                 | 0.65  | 0.95 | 0.45<br>(S6809)               | 0.65<br>(S6809) | 0.95<br>(S6809) | -                  |
| Frequency response               | f                         |   | 0.5                                  | 1.25  | -    | 0.5                           | 1.25            | -               | kHz                |
| Allowable background light level | Ex                        | Signal light: 5 μW / m <sup>2</sup><br>λp=940 nm<br>Background light:<br>"A" light source | 5000                                 | 10000 | -    | 2000                          | 3000            | -               | lx                 |

\*2: Cathode



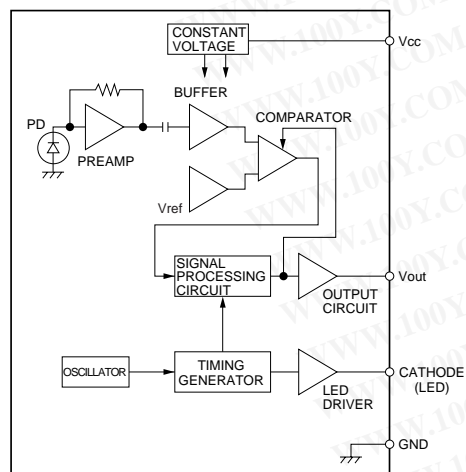
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\*3:



KPIC0010EA

■ Block diagram and internal functions



TRUTH TABLE

| INPUT     | OUTPUT LEVEL |
|-----------|--------------|
| LIGHT ON  | LOW          |
| LIGHT OFF | HIGH         |

KPIC0002EA

(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.

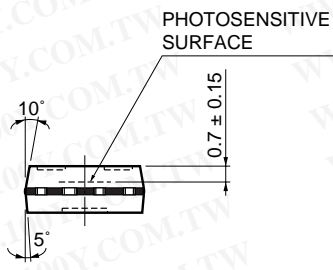
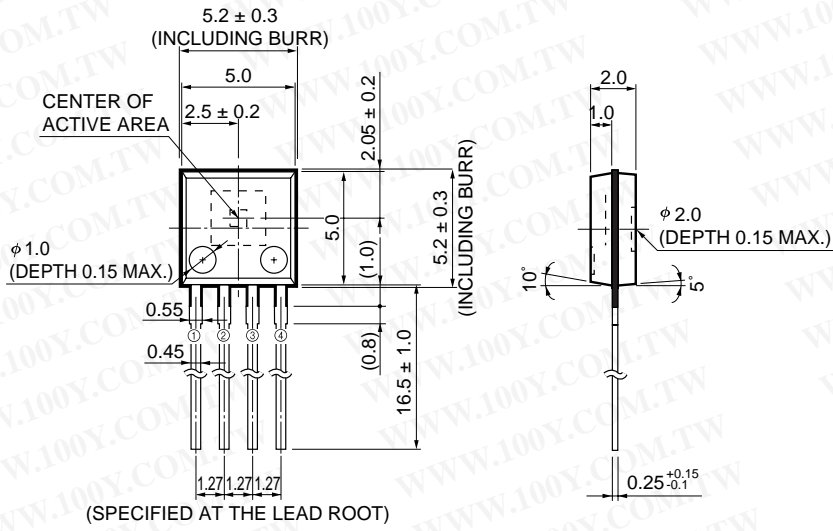
(g) Output circuit

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

■ Dimensional outlines (unit: mm)

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S6809, S6846, S6986

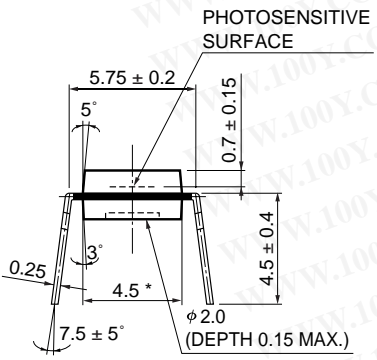
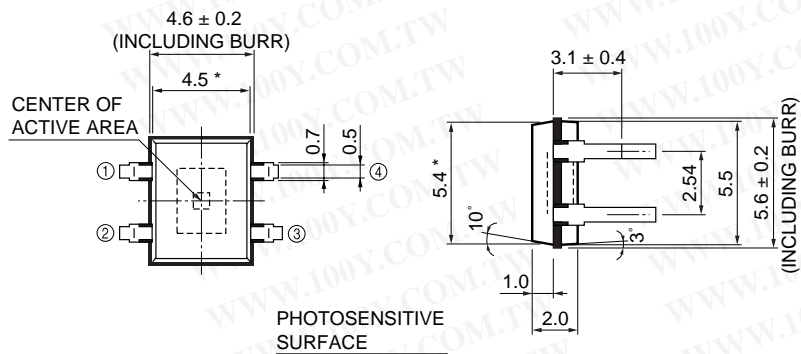


- ① Vout
- ② GND
- ③ CATHODE (LED)
- ④ Vcc

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



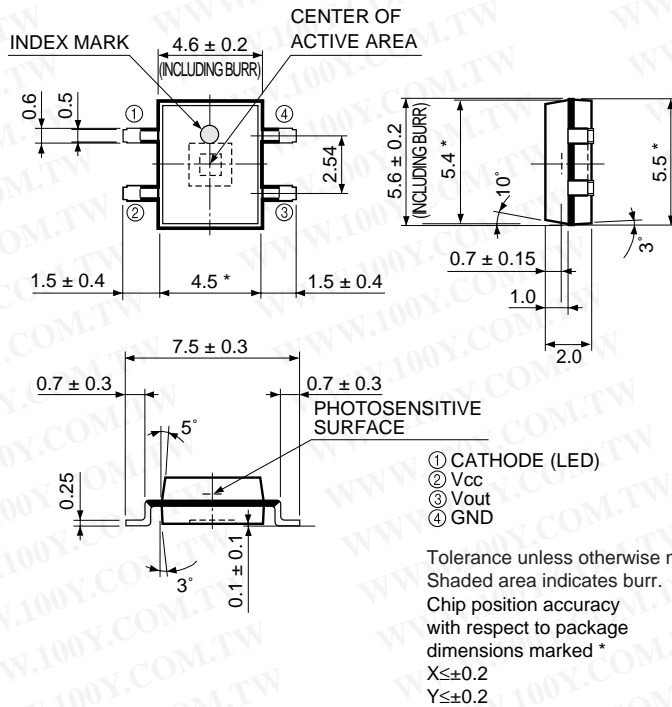
- ① CATHODE (LED)
- ② Vcc
- ③ Vout
- ④ GND (SHORT LEAD)

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

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

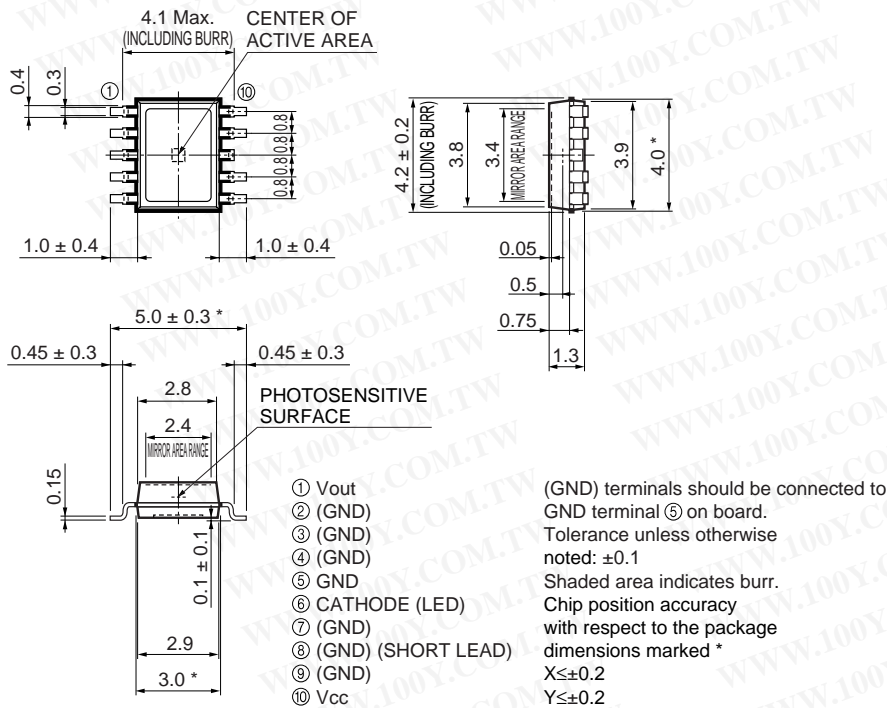
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S7136-10



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S10053



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