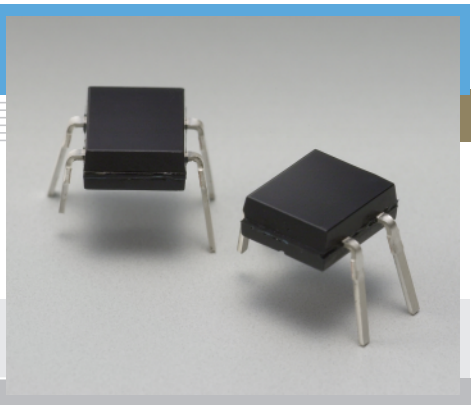
Light modulation photo IC
S4289-61

Asynchronous type light modulation photo IC



S4289-61 is an asynchronous type light modulation photo IC designed for reliable detection even under disturbance background light. A photodiode, preamplifier, comparator, oscillator and signal processing circuit, etc. are all integrated on a monolithic photo IC chip. Using asynchronous optical detection means that no wiring to a signal light source (such as LED) is required and allows greater versatility in equipment

Features

- Asynchronous detection
- Large allowable background illuminance: 4000 *lx* Typ.
- Minimum detection level: 0.2 µW/mm^2 Typ.
- Digital output (Output appears “L” by light input.)
- Small plastic package

Applications

- Paper detection in office machines (copier, fax machines, etc.)
- Photosensor switches

■ Absolute maximum ratings (Ta=25 °C)

Parameter	Symbol	Value	Unit
Supply voltage	Vcc	-0.5 to +16	V
Output voltage	Vo	-0.5 to +16	V
Output current	Io	50	mA
Power dissipation *1	P	250	mW
Operating temperature	Topr	-25 to +60	°C
Storage temperature	Tstg	-40 to +100	°C
Soldering	-	230 °C, 5 s, at least 1.8 mm away from package surface	-

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

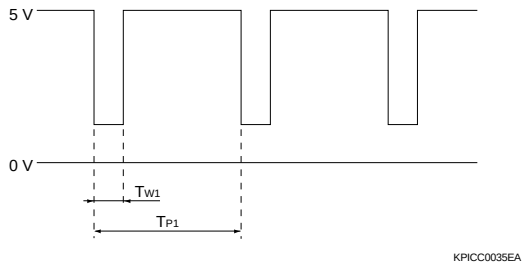
■ Electrical and optical characteristics (Ta=25 °C, Vcc=5 V)

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage		Vcc		4.5	-	16	V
Current consumption		Icc	Vo and cathode terminals are open	-	4.0	11	mA
Output	Low level output voltage	VOL	IOL=16 mA	-	0.2	0.4	V
	High level output voltage	VOH	4.7 kΩ between Vcc and Vo	4.9	-	-	V
Cathode output *3	Pulse cycle 1	TP1	*2	65	130	220	µs
	Pulse width 1	TW1	*2	4	8	13.7	µs
Input signal light	Pulse cycle 2	TP2	*4	-	-	50	µs
	Pulse width 2	TW2	*4	5	-	-	µs
H→L threshold light level		EHL	λ=940 nm, No background light	-	0.2	1.0	µW/mm^2
Hysteresis		Hys	*5	0.45	0.65	0.85	-
Frequency response		f		0.5	1.25	-	kHz
Allowable background light level		Ex	Signal light: 5 µW/mm^2 λp=940 nm Background light: “A” light source	2000	4000	-	*lx*

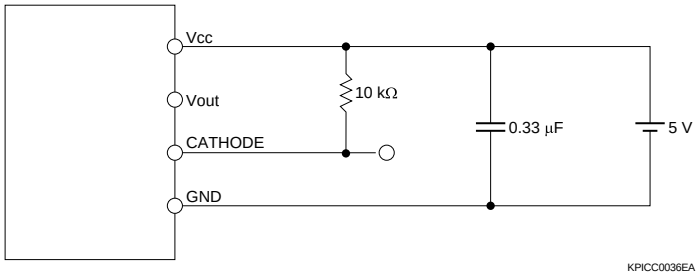
*2: Pulse cycle and pulse width of built-in LED driver circuit.
*3: Cathode terminal provides output for monitoring internal logic operation. When using it should be grounded.
*4: LED drive pulse cycle and pulse width of LED in an external circuit.
*5: Hysteresis Hys = (L → H threshold illuminance) / (H → L threshold illuminance)

SOLID STATE DIVISION

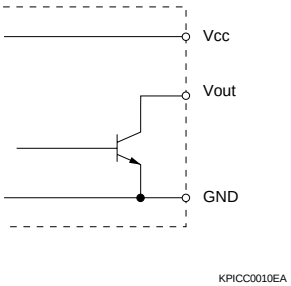
■ Cathode terminal output voltage waveform



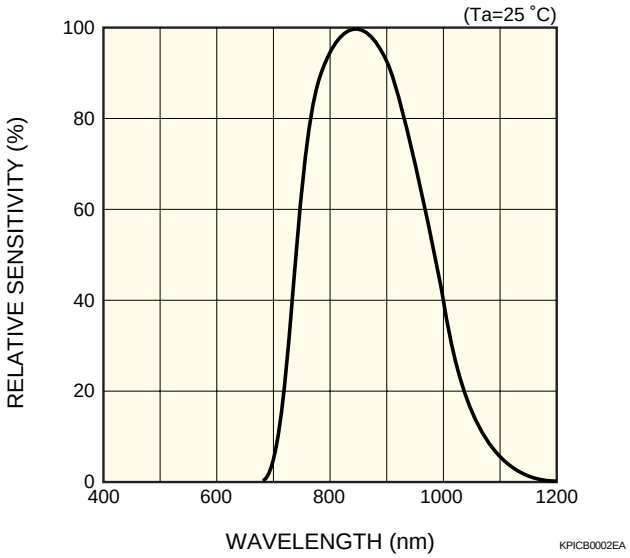
■ Measurement circuit



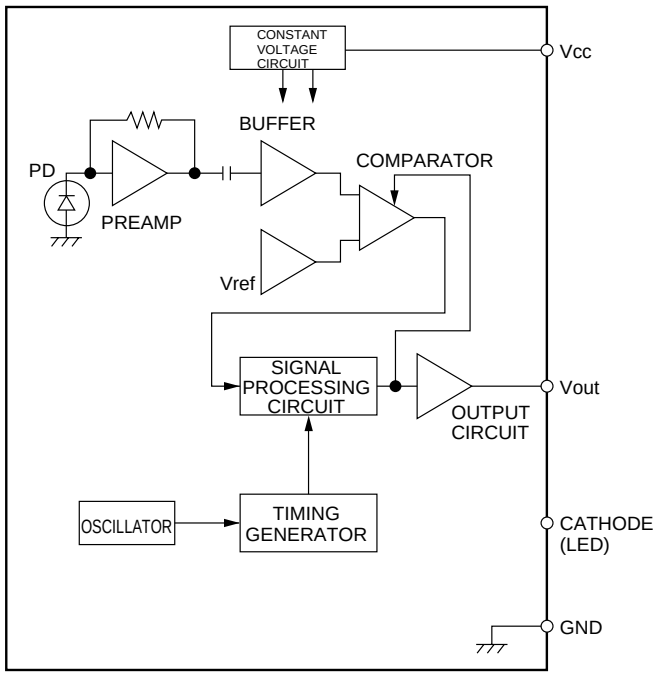
■ Output terminal circuit



■ Spectral response (typical example)



■ 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) 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.

(c) 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.

(d) Comparator circuit

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

(e) Signal processing circuit

The signal processing circuit consists of a digital integrator circuit that eliminates non-continuous, synchronous background light.

(f) Output circuit

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

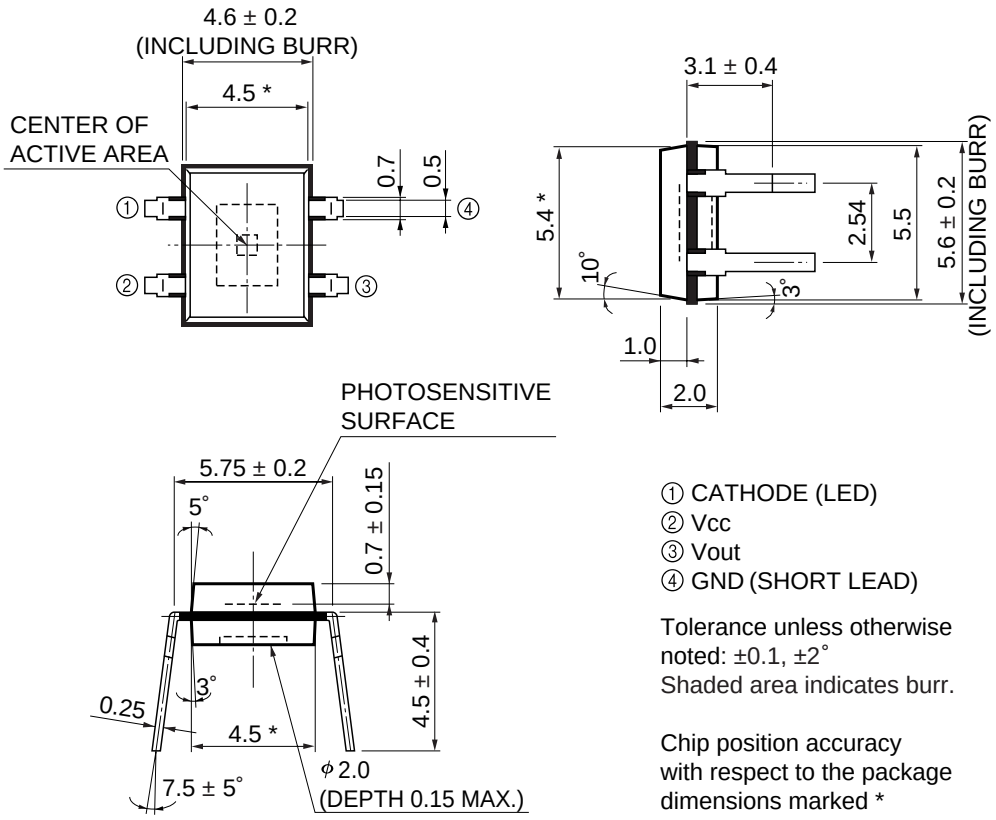
Note: The cathode (LED) terminal should be grounded.

■ Handling precautions

Synchronous mode acquires signals in synchronization with the LED emission timing. In asynchronous mode, a time window is provided which opens at a certain cycle to acquire signals, and the LED frequency is set so that at least one signal enters the time window while open. Since this time window for signal acquisition is wider when compared with synchronous mode operation, the asynchronous mode is less capable of eliminating disturbance background light at high frequencies or in pulsed form (noise light). However, asynchronous mode has the advantage of not requiring any wiring in order to synchronize the LED with the photo IC.

S4289-61 exhibits the same characteristics as S7136 series light modulation photo IC except for synchronous detection. To use S4289-61, the cathode (LED) terminal should be grounded and the LED operated by an external driver circuit.

■ Dimensional outline (unit: mm)



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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