HAMAMATSU
PHOTON IS OUR BUSINESS

Light modulation photo IC



S4282-51, S6809, S6846, S6986, S7136/-10, S10053/-01DT

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/-01DT) 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/-01DT: 10000 *lx* typ.
  S6809, S6846, S7136/-10 : 3000 *lx* typ.
- **Minimum detection level**
  S4282-51, S6986, S10053/-01DT: 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: stick
  S10053-01DT: reel

Applications

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

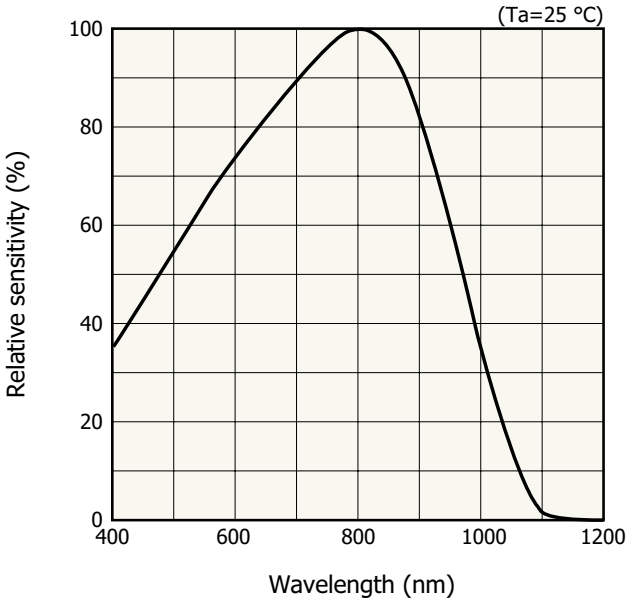
Absolute maximum ratings (Ta=25 °C)

Parameter	Symbol	S10053/-01DT	S4282-51, S6986	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 +85	-25 to +60		°C
Storage temperature	Tstg	-40 to +100			°C
Soldering temperature	Tsol	240 (once)*2	*3	*3	°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
*2: Reflow soldering, IPC/JEDEC-J-STD-020 MSL5a, see P.9
*3: See the recommended soldering conditions (P.9).

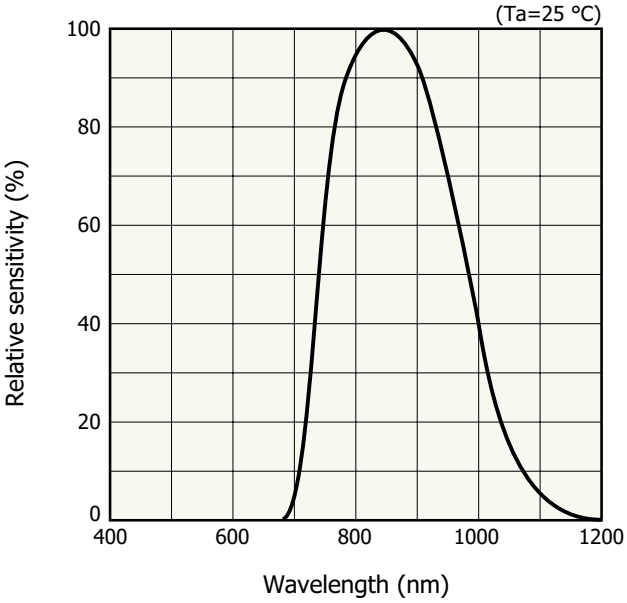
Spectral response (typical example)

S4282-51, S6986, S10053/-01DT



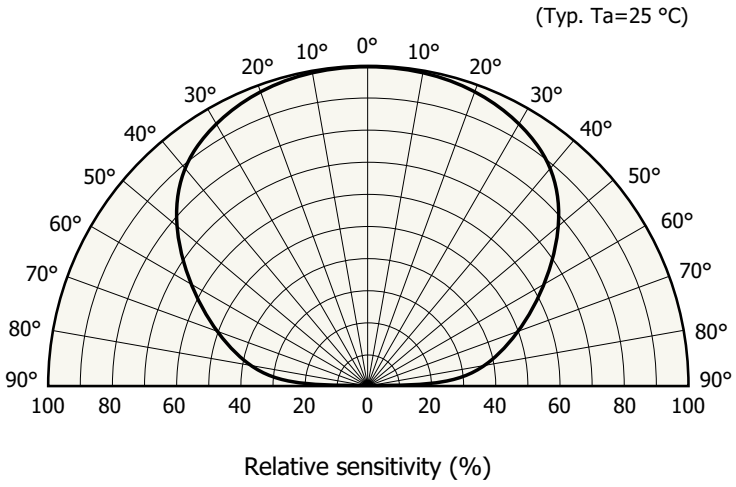
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S6809, S6846, S7136/-10



KPICB0002EA

Directivity

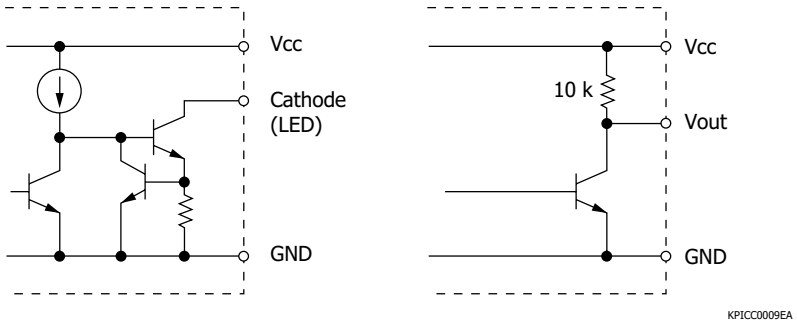


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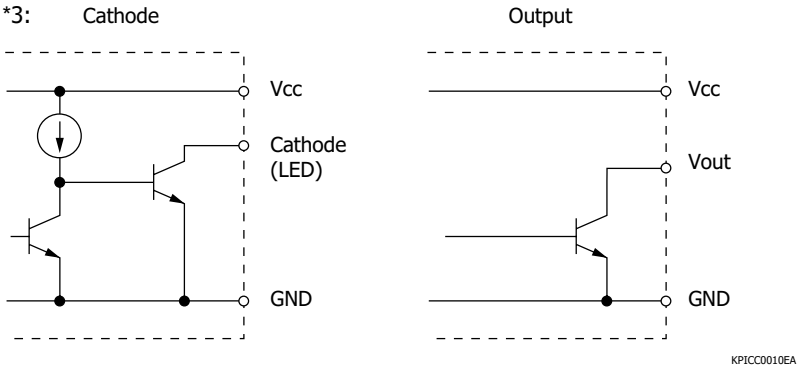
Electrical and optical characteristics (Ta=25 °C, Vcc=5 V)

Parameter		Symbol	Condition	S4282-51, S6986, S10053/-01DT 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				4.5	-	-	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

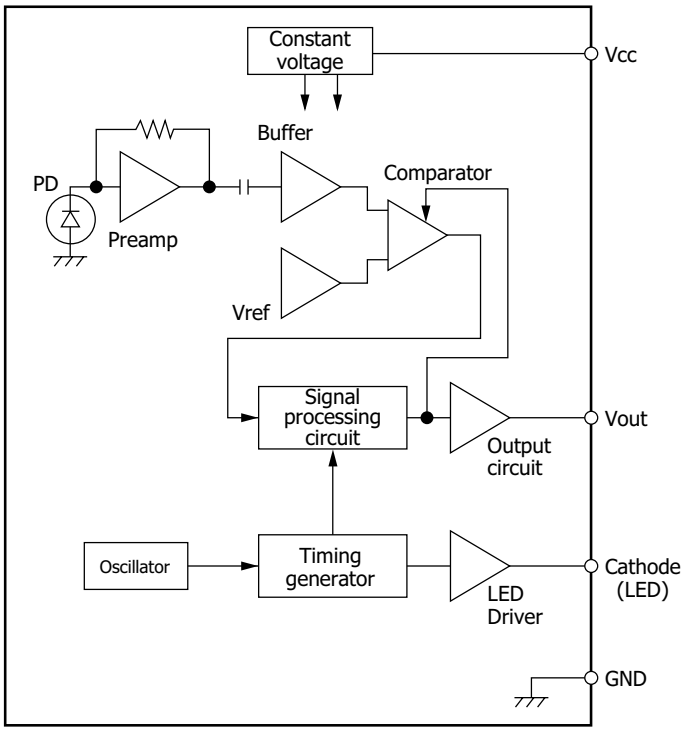
*2:



*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.

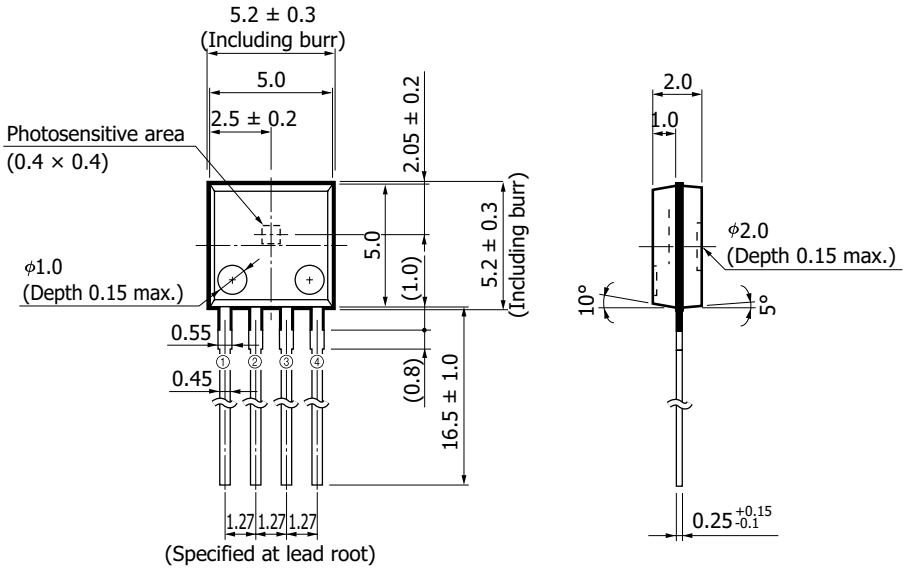
(e) Comparator circuit
The comparator circuit has a hysteresis function to prevent chattering caused by small fluctuations in the input light.

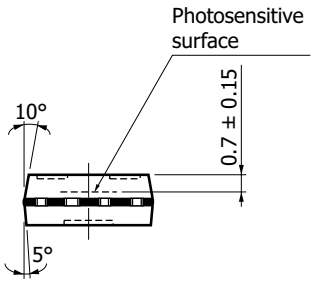
(f) Signal processing circuit
The signal processing circuit consists of a gate circuit and digital integrator circuit. The gate circuit discriminates input pulses during synchronous detection, to prevent operational errors caused by asynchronous background light. Background light which is synchronized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





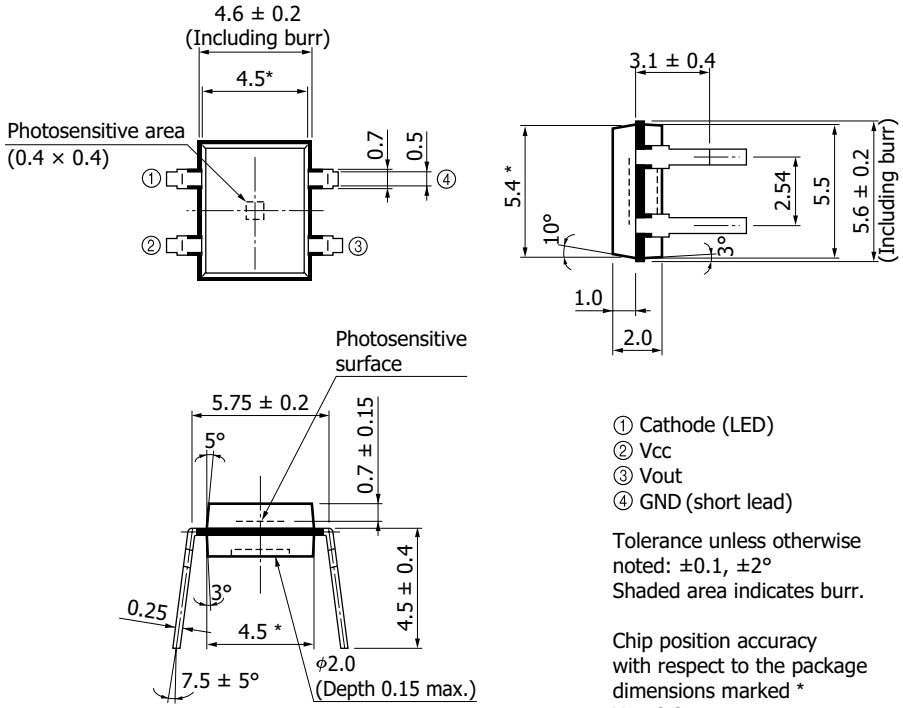
① Vout
② GND
③ Cathode (LED)
④ Vcc

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

Packing type: Polyethylene bag (antistatic type)

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S4282-51, S7136



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

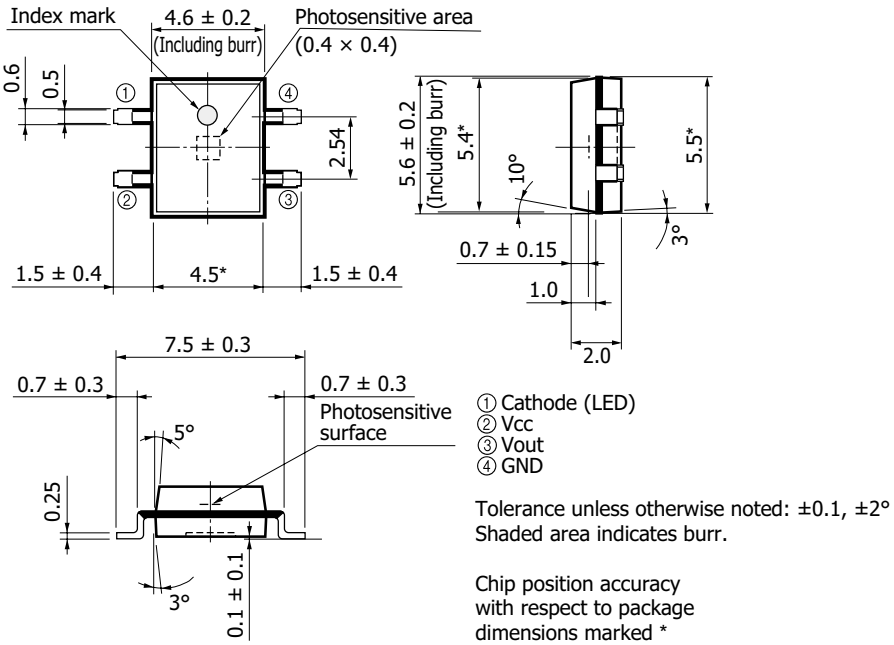
Tolerance unless otherwise noted: ±0.1, ±2°
Shaded area indicates burr.

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

Packing type: Stick

KPICA0009ED

S7136-10



① Cathode (LED)
② Vcc
③ Vout
④ GND

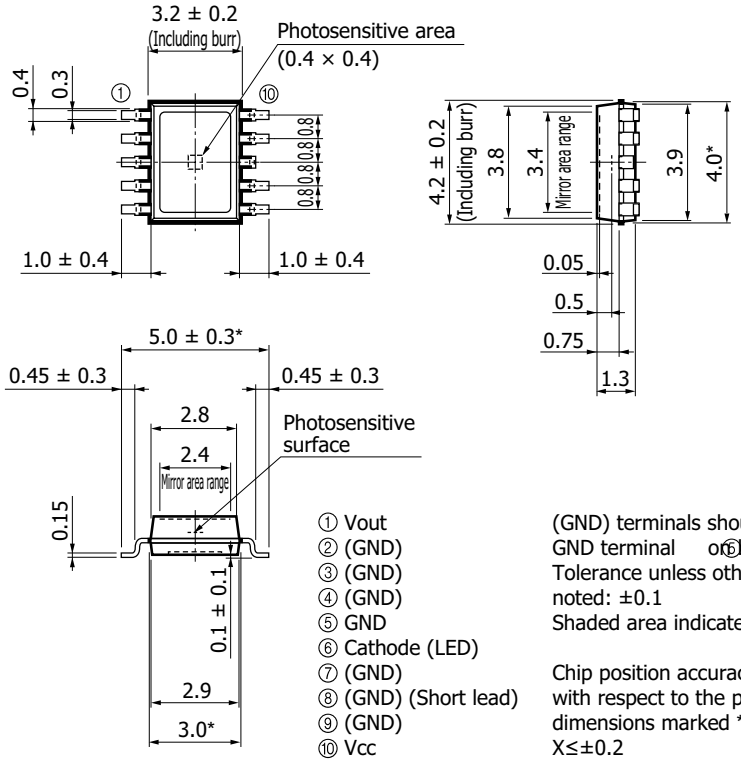
Tolerance unless otherwise noted: ±0.1, ±2°
Shaded area indicates burr.

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

Packing type: Stick

KPICA0034EC

S10053/-01DT



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.

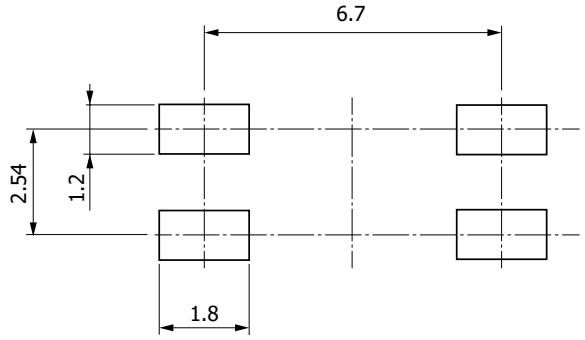
Chip position accuracy with respect to the package dimensions marked *
X≤±0.2
Y≤±0.2

Packing type: Stick (S10053)
Reel (S10053-01DT)

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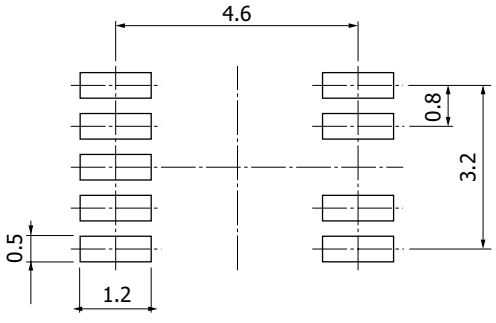
Recommended land patterns (unit: mm)

S7136-10



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S10053/-01DT



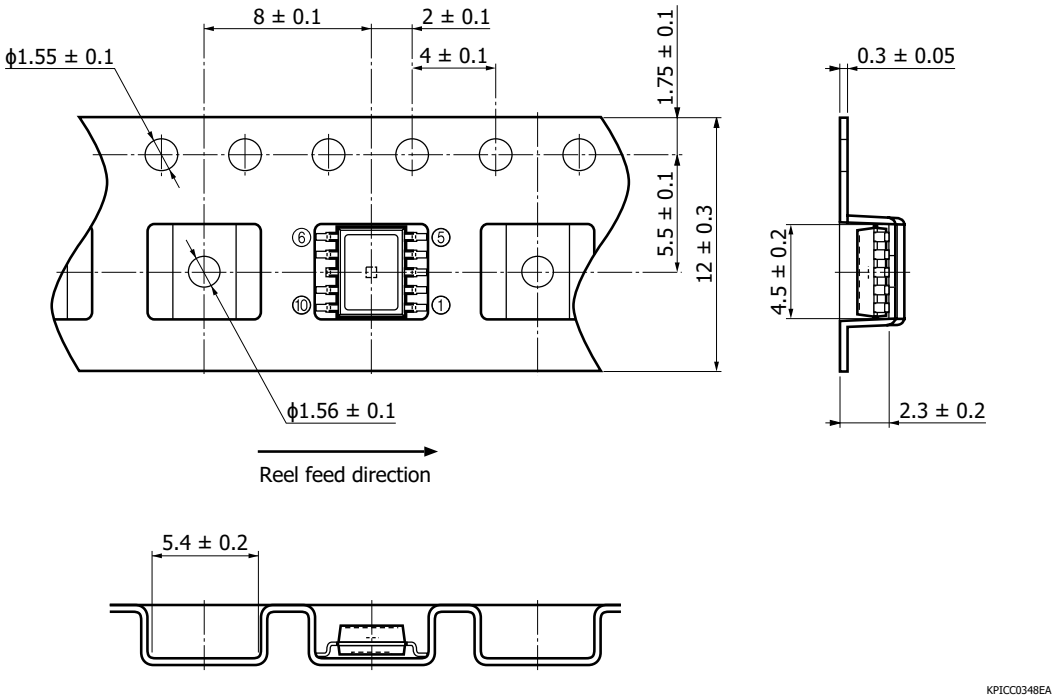
KPICC0370EA

Reel packing specifications (S10053-01DT)

■ Reel (conforms to JEITA ET-7200)

Outer diameter	Hub diameter	Tape width	Material	Electrostatic characteristics
ϕ254 mm	ϕ80 mm	12 mm	PS	Antistatic treatment

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



■ Packing quantity
2000 pcs/reel

■ Packing type
Reel and desiccant in moisture-proof packaging (vacuum-sealed)

Recommended soldering conditions

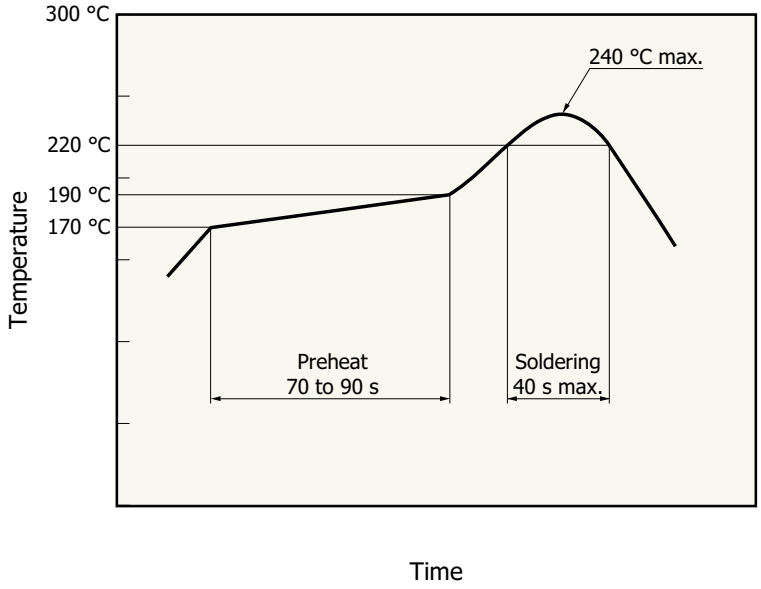
S4282-51, S6809, S6846, S6986, S7136/-10

Type No.	Solder temperature	Remarks
S4282-51	230 °C (less than 5 s) max.	at least 1 mm away from lead roots*6
S6809, S6846, S6986		at least 1.8 mm away from lead roots*6
S7136		at least 1 mm away from lead roots*6
S7136-10	*7	-

*6: Lead length: in case of 2 mm or more
*7: Contact us for detailed information.
Note: When setting the soldering conditions, check for any problems by testing out the soldering methods in advance.

S10053/-01DT

The S10053/-01DT 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.



Note: The effect that the product receives during reflow soldering varies depending on the circuit board and reflow oven that are used. When setting the reflow soldering conditions, check for any problems by testing out the reflow soldering methods in advance.

Related information

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

■ Precautions
· Disclaimer
· Metal, ceramic, plastic package products
· Surface mount type products

Information described in this material is current as of August 2021.
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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