

TOSHIBA Photo-IC Silicon Epitaxial Planar

# TPS856

Mobile Phones

Notebook PCs, PDAs

Video cameras, Digital Still Cameras

Other Equipment Requiring Luminosity Adjustment

The TPS856 is an ultra-compact surface-mount photo-IC for illuminance sensors which incorporates a photodiode and current amp circuit in a single chip.

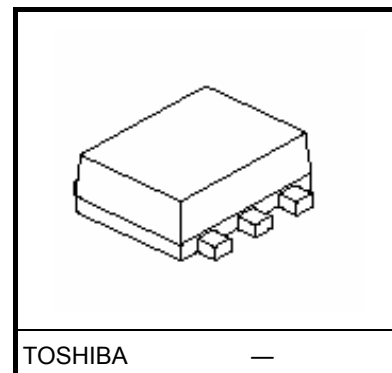
The sensitivity is superior to that of a phototransistor, and exhibits little variation.

It has spectral sensitivity closer to luminous efficiency and excellent output linearity.

With its ultra-compact surface-mount package, this photo-IC can be used as the power-saving control for domestic appliances or for backlighting for displays in cellular phones, this device enables low power consumption to be achieved.

This device includes stand-by function which can reduce the power consumption.

- Ultra-compact and light surface-mount package:  $1.6 \times 1.6 \times 0.55$  mm
- Excellent output linearity of illuminance
- Little fluctuation in light current and high level of sensitivity
  - :  $I_L = 57 \mu\text{A}$  (typ.) @  $E_V = 100$  lx using fluorescent light
  - : Light current variation width:  $\times 1.67$  (When light current classification is specified.)
  - : Little temperature fluctuation
- Built-in luminous-efficiency correction function, reduced sensitivity variations due to various light sources
  - :  $I_L$  (using incandescent light)/ $I_L$  (using fluorescent light) = 1.0 (typ.)
- Low supply voltage, making device suitable for battery-powered equipment:  $V_{CC} = 1.8$  V to 5.5 V
- Lead(Pb)-Free



Weight: 0.003 g (typ.)

## Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	-0.5 to 6	V
Stand-by voltage	$V_{stb}$	$\leq V_{CC}$	V
Output voltage	$V_{OUT}$	$\leq V_{stb}$	V
Light current	$I_L$	5	mA
Permissible power dissipation	P	30	mW
Power dissipation derating (Ta > 25°C)	$\Delta P/^\circ\text{C}$	-0.4	mW/°C
Operating temperature range	$T_{opr}$	-30 to 85	°C
Storage temperature range	$T_{stg}$	-40 to 100	°C
Soldering temperature range (Note 1)	$T_{sol}$	260	°C

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 1: The reflow time and the recommended temperature profile are shown in the section entitled Handling Precautions.

## Operating Ranges

Characteristics	Symbol	Min	Typ.	Max	Unit
Supply voltage	$V_{CC}$	1.8	—	5.5	V
Stand-by on voltage	$V_{stbon}$	1.8	—	$V_{CC}$	V
Stand-by off voltage	$V_{stboff}$	0	—	0.3	V

## Electrical and Optical Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Supply voltage	$V_{CC}$	—	1.8	—	5.5	V
Supply current (1)	$I_{CC(1)}$	$V_{CC} = 3\text{ V}, V_{stb} = 3\text{ V}, E_V = 1000\text{ lx}$ $R_L = 1\text{ k}\Omega$ (Note 2) (Note 5)	—	3.0	—	$\mu\text{A}$
Supply current (2)	$I_{CC(2)}$	$V_{CC} = 3\text{ V}, V_{stb} = 0.3\text{ V}, E_V = 1000\text{ lx}$ $R_L = 1\text{ k}\Omega$ (Note 2) (Note 5)	—	3.0	—	$\mu\text{A}$
Light current (1)	$I_L(1)$	$V_{CC} = 3\text{ V}, V_{stb} = 3\text{ V}, E_V = 100\text{ lx}$ (Note 2), (Note 4)	—	57	—	$\mu\text{A}$
Light current (2)	$I_L(2)$	$V_{CC} = 3\text{ V}, V_{stb} = 3\text{ V}, E_V = 10\text{ lx}$ (Note 3), (Note 4)	4.0	5.7	8.0	$\mu\text{A}$
Light current (3)	$I_L(3)$	$V_{CC} = 3\text{ V}, V_{stb} = 3\text{ V}, E_V = 100\text{ lx}$ (Note 3), (Note 4)	40	57	80	$\mu\text{A}$
Light current (4)	$I_L(4)$	$V_{CC} = 3\text{ V}, V_{stb} = 0.3\text{ V}, E_V = 100\text{ lx}$ (Note 3), (Note 4)	—	0.02	0.1	$\mu\text{A}$
Light current ratio	$\frac{I_L(1)}{I_L(3)}$	—	—	1.0	—	—
Dark current	$I_{LEAK}$	$V_{CC} = 3\text{ V}, V_{stb} = 3\text{ V}, E_V = 0$	—	—	0.1	$\mu\text{A}$
Saturation output voltage	$V_O$	$V_{CC} = 3\text{ V}, V_{stb} = 3\text{ V}, R_L = 150\text{ k}\Omega,$ $E_V = 100\text{ lx}$ (Note 3)	—	0.70	0.85	V
Waiting time	$t_{wait}$	$V_{CC} = 3\text{ V}, V_{stb} = 3\text{ V}, R_L = 150\text{ k}\Omega,$ $E_V = 5\text{ lx}$ (Note 3)	—	—	20	ms
Switching time	Rise time	$t_r$	—	70	—	$\mu\text{s}$
	Fall time	$t_f$	—	40	—	
	Delay time	$t_d$	—	100	—	
	Storage time	$t_s$	—	5	—	

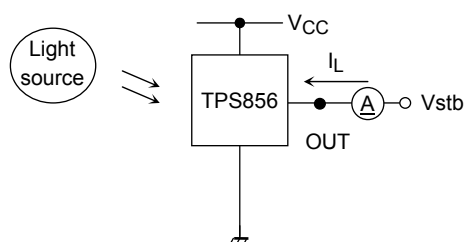
Note 2: CIE standard A light source is used (color temperature = 2856K, approximated incandescence light).

Note 3: F10 of fluorescence light is used as light source. (color temperature = 5000K)

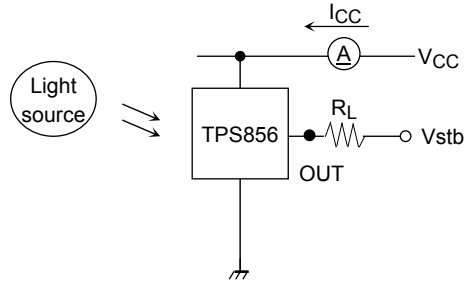
However, white LED is substituted in a mass-production process.

$I_L(3)$  classification A rank: 44.1  $\mu\text{A}$  to 73.7  $\mu\text{A}$

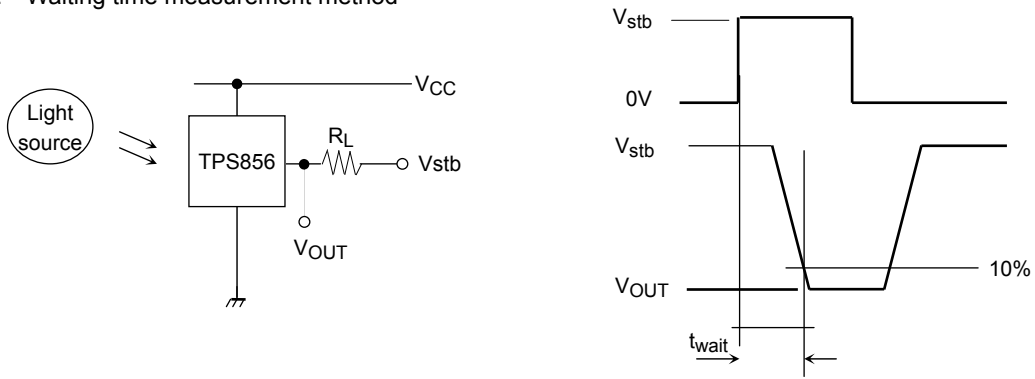
Note 4: Light current measurement circuit



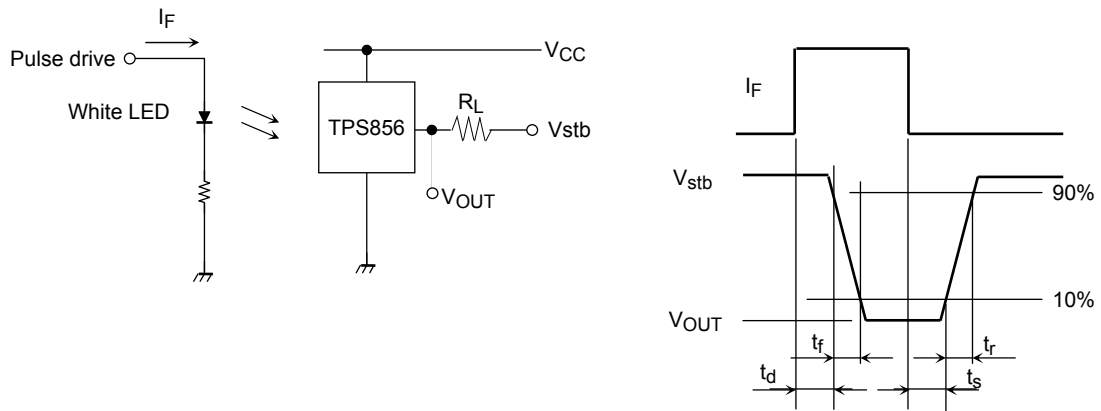
Note 5: Supply current measurement circuit



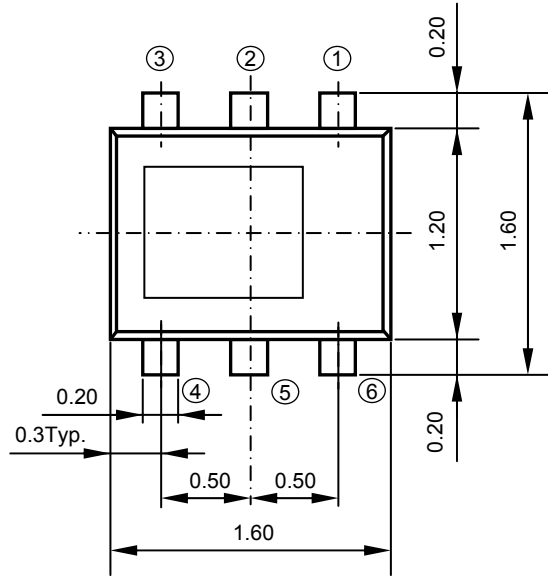
Note 6: Waiting time measurement method



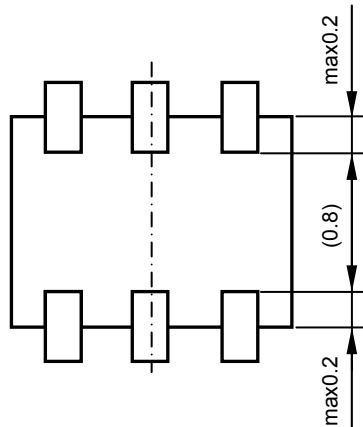
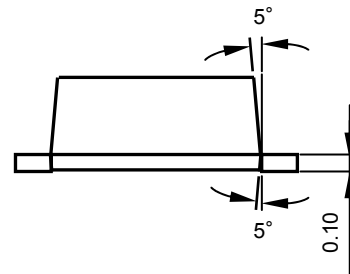
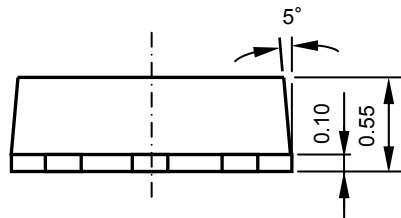
Note 7: Switching time measurement method



**Package Dimensions**



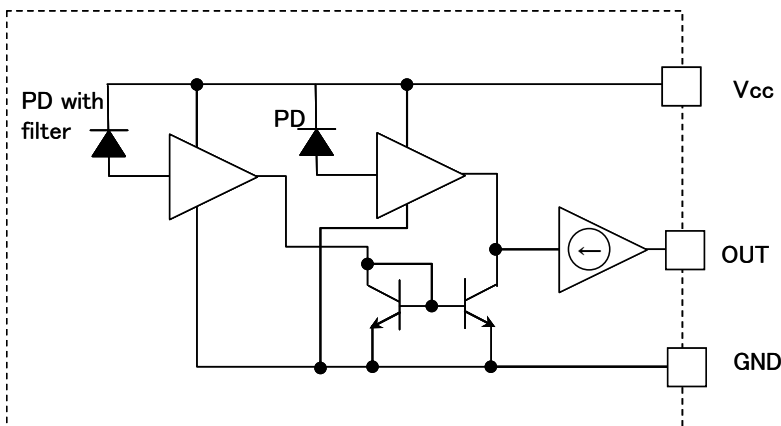
Unit: mm  
 Tolerance:  $\pm 0.1$   
 ( ): Reference value



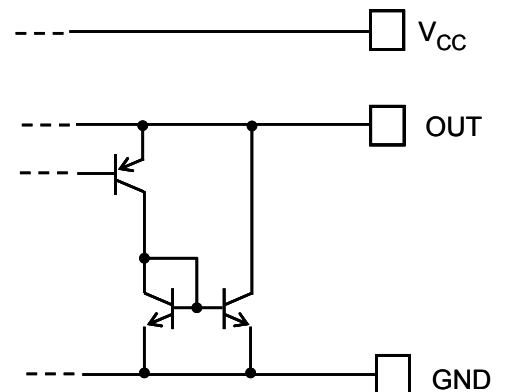
- Pin connection
1. V<sub>CC</sub>
  2. GND
  3. GND
  4. GND
  5. GND
  6. OUT (V<sub>stb</sub>)

Weight: 0.003 g (typ.)

**Block Diagram**



**Equivalent circuit in output part**



**Handling Precautions**

Insert a bypass condenser of up to 0.1μF between VCC and GND near the device to stabilize the power supply line. Please put the bypass capacitor of 0.1μF between OUT and GND near the device if you use it as a current output (There is no load resistance).

When VCC is turned on it takes at least 20 ms for the internal circuit to stabilize. During this time the output signal is unstable. Please do not use the unstable signal as the output signal.

**Moisture-Proof Packing**

- (1) To avoid moisture absorption by the resin, the product is packed in an aluminum envelope with silica gel.
- (2) Since the optical characteristics of the device can be affected during soldering by vaporization resulting from prior absorption of moisture and they should therefore be stored under the following conditions:  
 Temperature: 5°C to 30°C, Relative humidity: 70% (max), Time: 168 h (max)
- (3) Baking in taping with reel is required if the devices have been store unopened for more than six months or if the aluminum envelope has been opened for more than 168 h.  
 These devices are packed on tapes; hence, please avoid baking at high temperature.  
 Recommended baking conditions: 60°C for 12 h or longer, Perform baking only once

**Mounting Precautions**

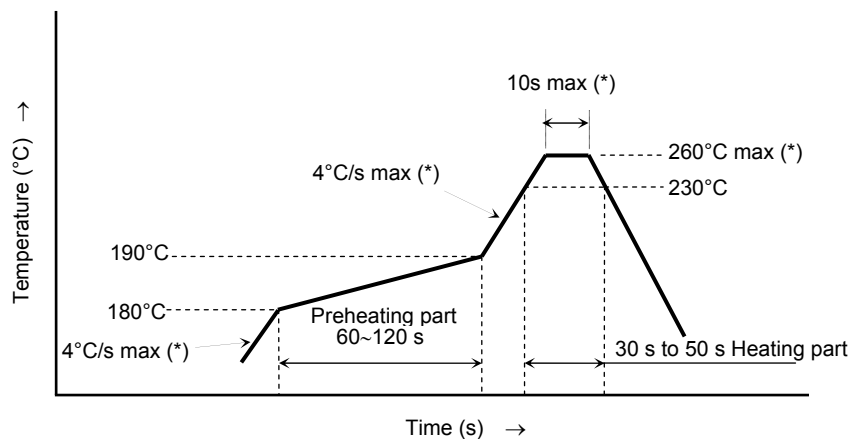
TPS856 uses a clear resin, and delicate handling is necessary for it.

The characteristic change or the product might be damaged by the handling method of mounting. Please note the following and handle the product.

- (1) Do not apply stress to the resin at high temperature.  
 Time until the product returns at the normal temperature after mounting of the reflow is different according to the mounting substrate and the environment.  
 Please do not give the stress with heat remained in the product.
- (2) The resin part is easily scratched, so avoid friction with hard materials.
- (3) When installing the assembly board in equipment, ensure that this product does not come into contact with other components.
- (4) Please confirm the heat contraction of the substrate of the reflow mounting doesn't influence the product. The load is given to the product by mounting that the heat contraction is large on the substrate and the installation position of the substrate. Please note that the characteristic changes or the product might be damaged.

**Mounting Methods**

- (1) Example of reflow soldering



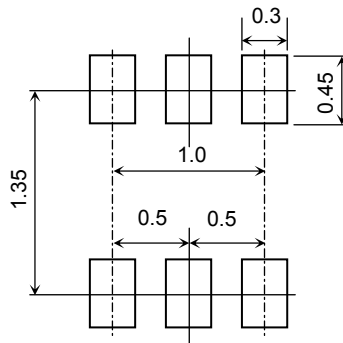
(\*)The product is evaluated using above reflow soldering conditions. No additional test is performed exceed the condition (i.e. the condition more than MAX values) as an evaluation. Please perform reflow soldering under the above conditions. Perform reflow soldering no more than twice.

- Please perform the first reflow soldering within 168 h after opening the package with reference to the above temperature profile.

- Second reflow soldering  
 In case of second reflow soldering, it should be performed within 168 h after first reflow under the above conditions.  
 Storage conditions before second reflow soldering: 30°C, 70% RH or lower
- Do not perform flow soldering.
- Make any necessary soldering correction manually.  
 (Do not do this more than once for any given pin.)  
 Temperature: no more than 350°C (25 W for soldering iron)  
 Time: within 5 s

(2) Recommended soldering pattern

Unit: mm



- (3) Cleaning conditions
- When cleaning is required after soldering
- Chemicals: AK225 alcohol
  - Temperature and time: 50°C × 30 s or 30°C × 3 min
  - Ultrasonic cleaning: 300 W or less

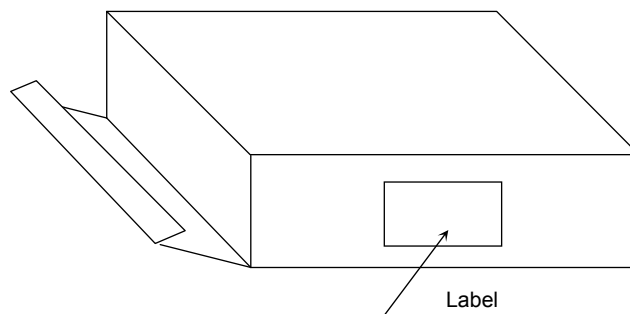
**Packing Specification**

(1) Packing quantity

Reel (minimum packing quantity)	3,000 devices
Carton	5 reels (15,000 devices)

- (2) Packing format
- Silica gel and reel are packed into sealed aluminum envelope.  
 Pack shock-absorbent materials around the aluminum envelopes in the cartons to cushion them.

- Carton specification

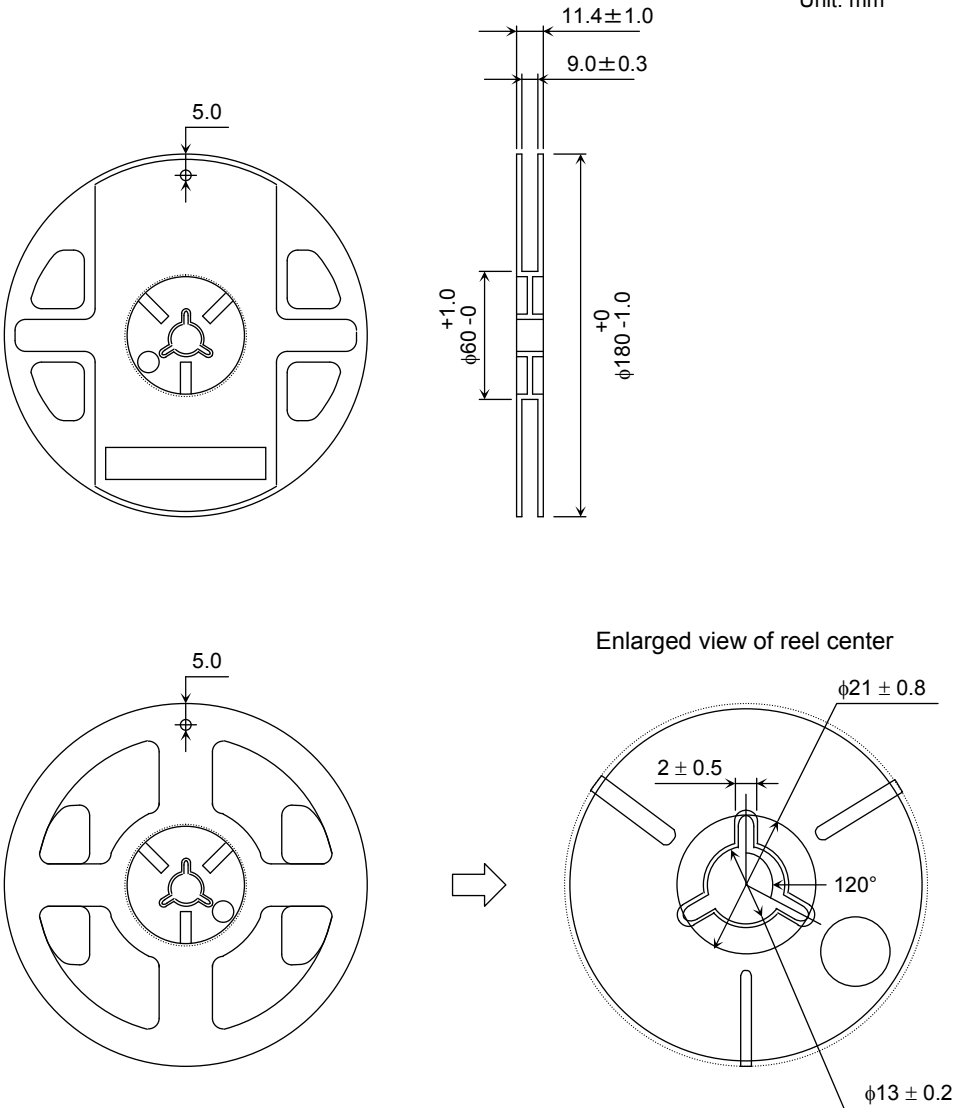


Carton dimensions  
 (W) 81 mm × (L) 280 mm × (H) 280 mm

Tape Packing Specifications

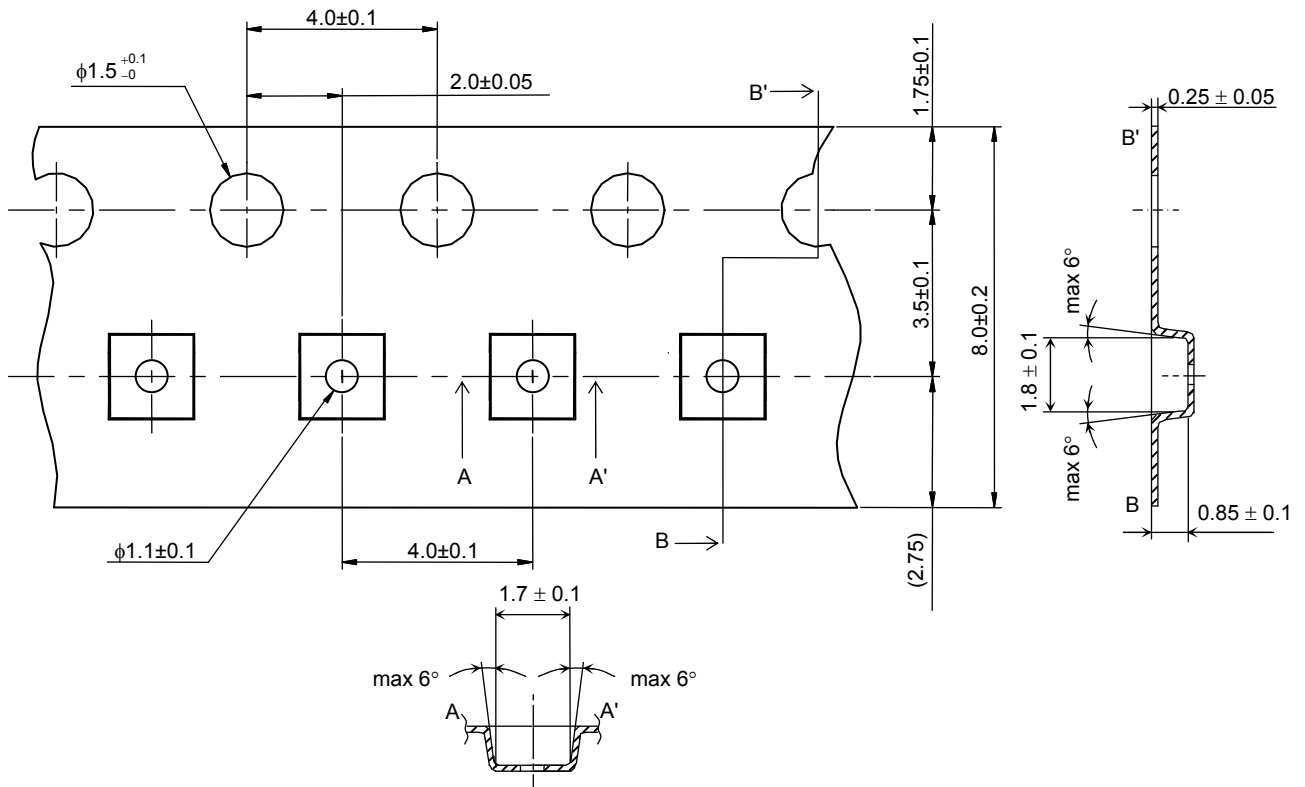
- (1) Reel dimensions  
Reel material: Plastic

Unit: mm

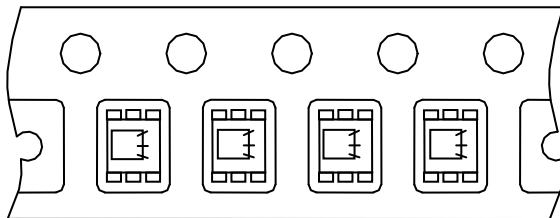


(2) Tape dimensions  
Tape material: Plastic (anti-electrostatic)

Unit: mm



Product direction



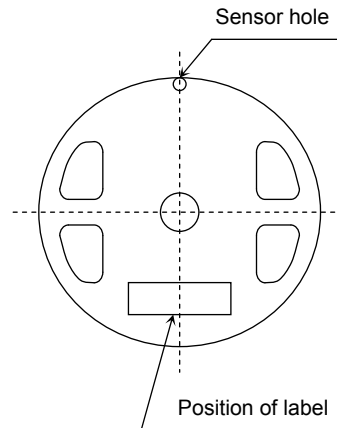


**Reel Label**

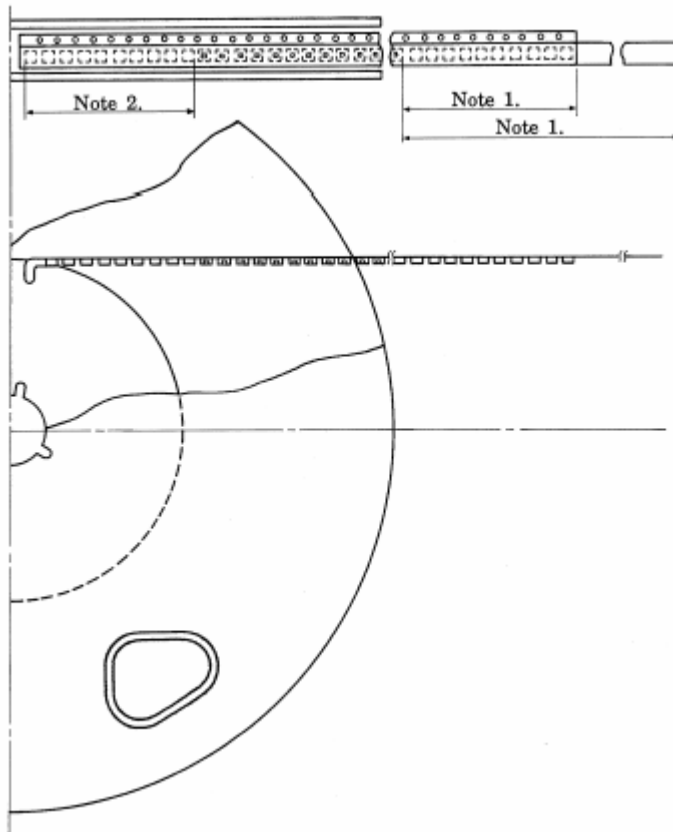
The label markings may include product number, quantity and seal date.

P/N

TYPE	TPS856		
ADDC		Q'TY	3,000 pcs.
NOTE			

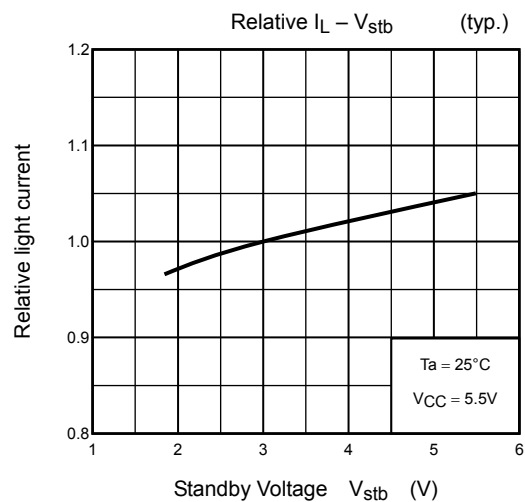
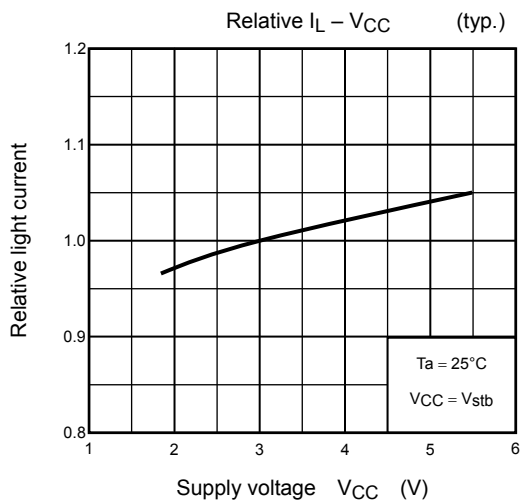
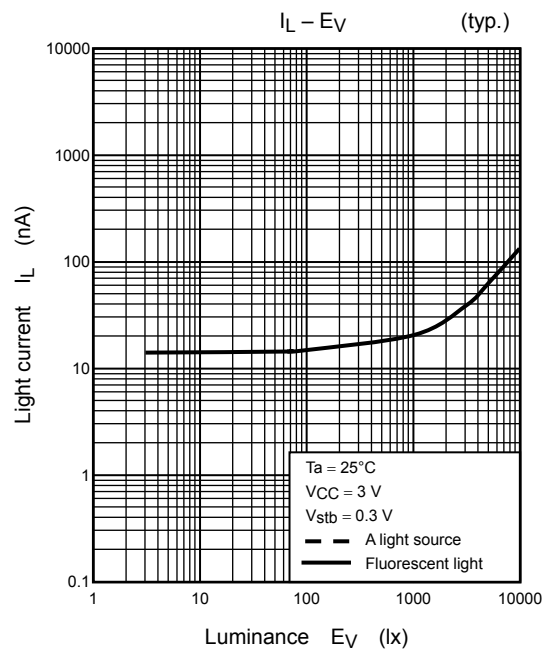
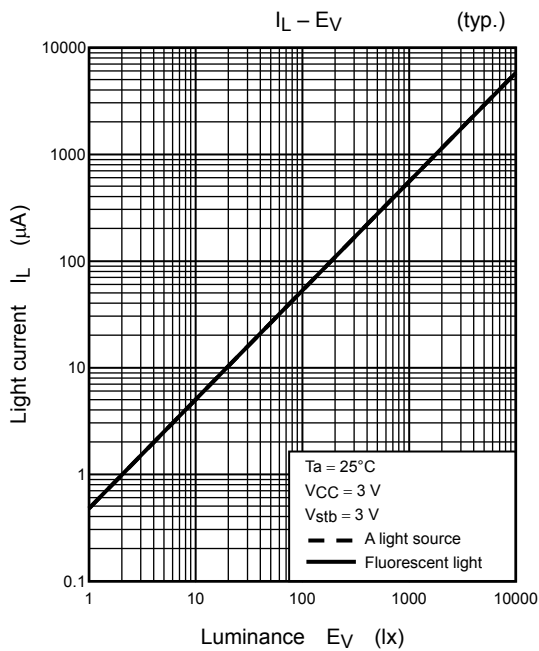
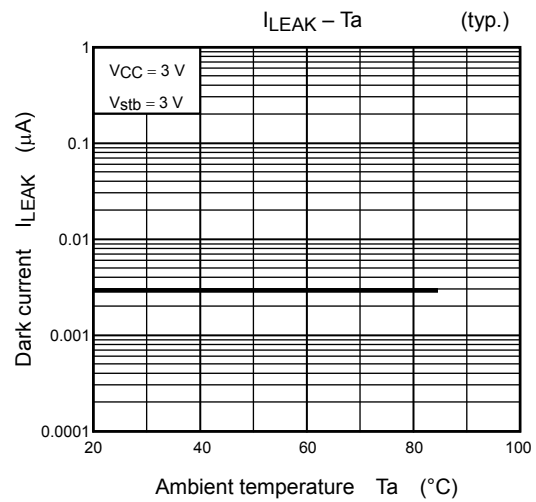
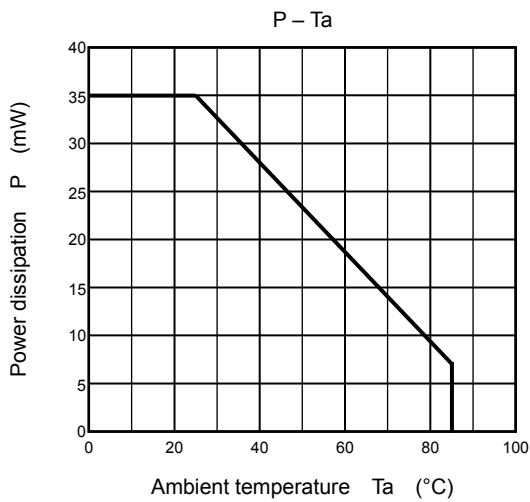


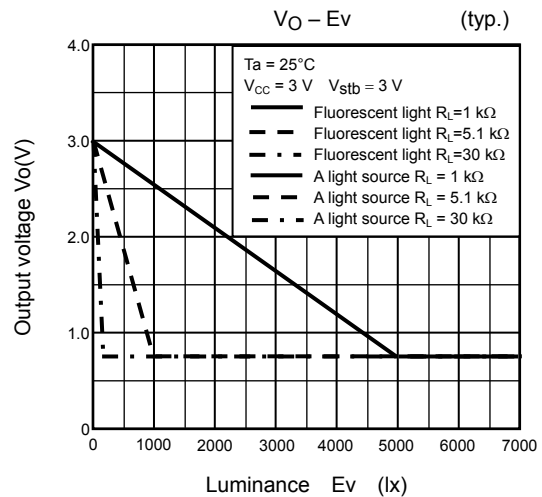
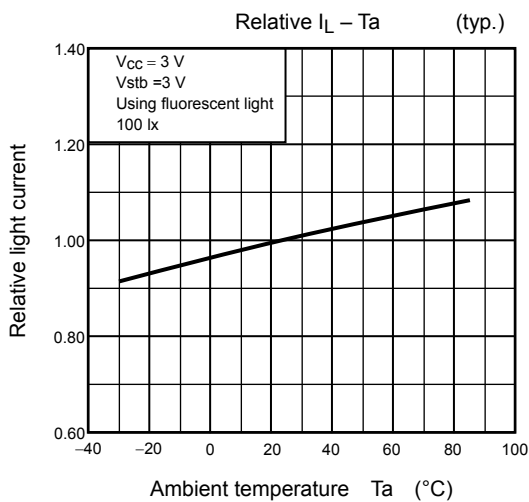
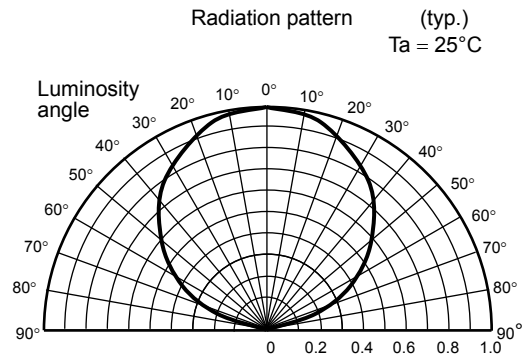
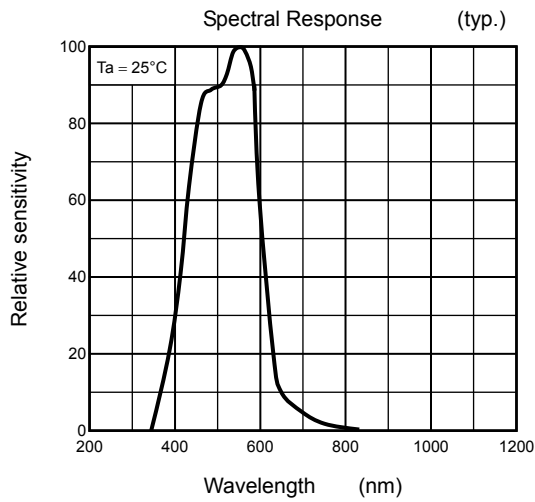
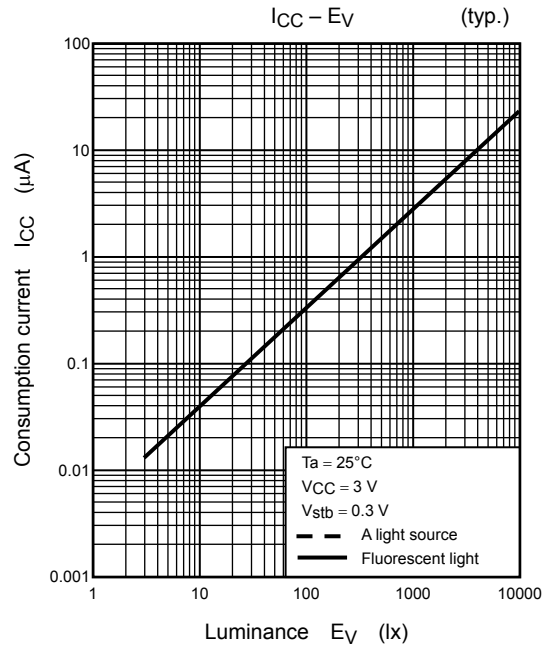
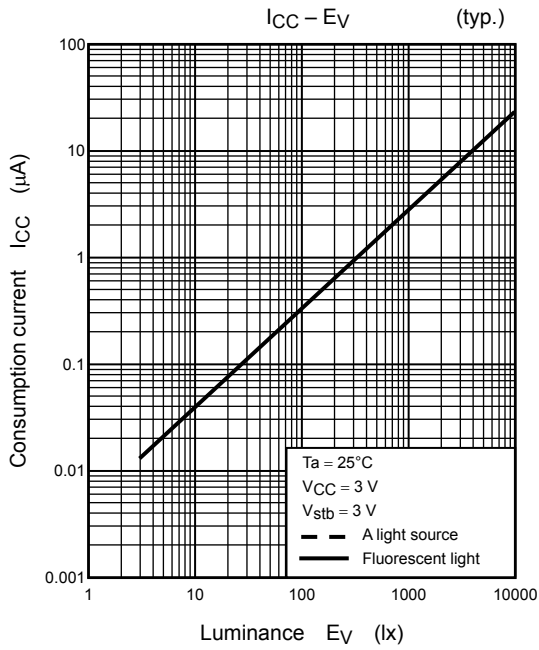
**Leader and Trailer Sections of Tape**

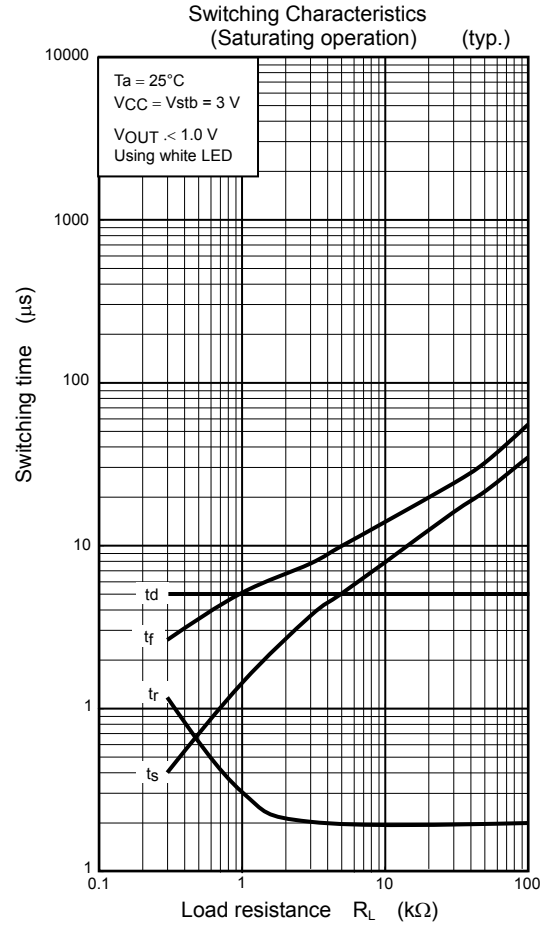
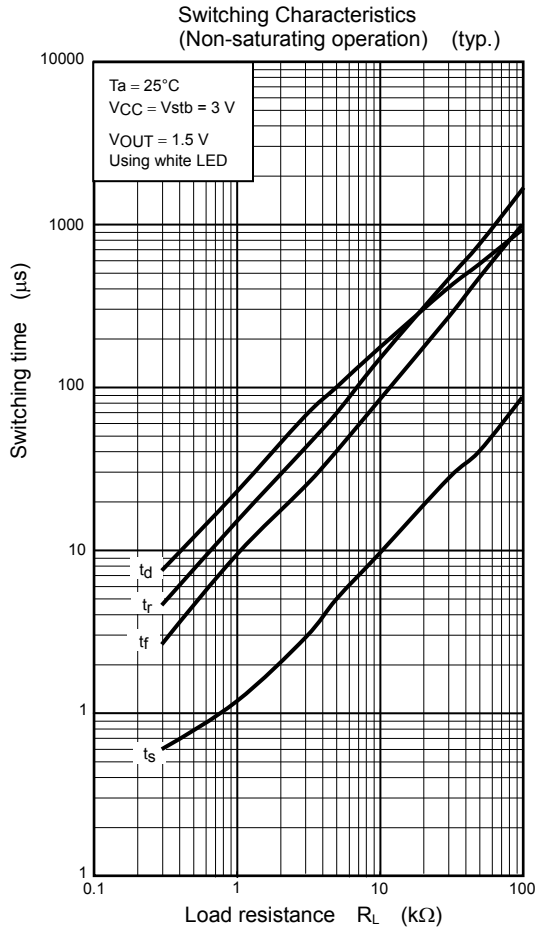


Note 1 : The leader portion shall consist of cover tape minimum length of 300 mm and a piece of carrier tape with empty portion of 100 mm minimum.

Note 2 : The trailer portion shall consist of empty carrier of more than 10 cavities.







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20070701-EN GENERAL

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