

# TPS859

- Flat Panel Displays
- Mobile Phones
- Notebook PCs, PDAs
- Video cameras, Digital Still Cameras
- Other Equipment Requiring Luminosity Adjustment

The TPS859 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.

- Ultra-compact and light surface-mount package  
: 1.6 mm × 1.6 mm × 0.55 mm
- Excellent output linearity of illuminance
- Little fluctuation in light current and high level of sensitivity  
:  $I_L = 230 \mu\text{A}$  (typ.) @  $E_V = 100 \text{ lx}$  using fluorescent light  
: Light current variation width: × 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:  $V_{CC} = 1.8 \text{ V}$  to  $5.5 \text{ V}$

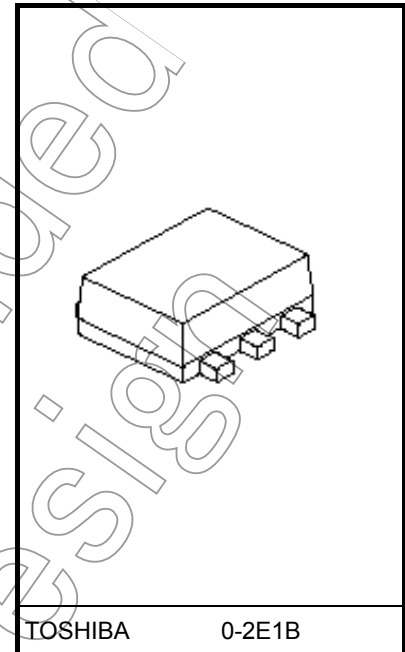
**Maximum Ratings (Ta = 25°C)**

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	-0.5 to 6	V
Output voltage	$V_{OUT}$	$\leq V_{CC}$	V
Light current	$I_L$	4	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.



Weight: 0.003 g (typ.)

## Operation Ranges

Characteristics	Symbol	Min	Typ.	Max	Unit
Supply voltage	$V_{CC}$	1.8	—	5.5	V
Operating temperature	$T_{opr}$	-30	—	85	°C

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

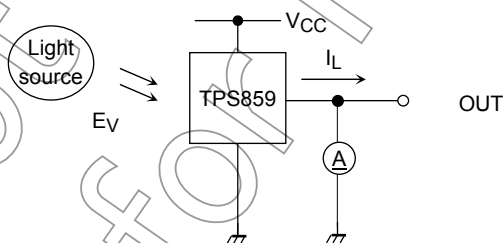
Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Supply voltage		$V_{CC}$	—	1.8	—	5.5	V
Supply current		$I_{CC}(1)$	$V_{CC} = 3\text{ V}$ , $E_V = 1000\text{ lx}$ $R_L = 1\text{ k}\Omega$ (Note 2), (Note 5)	—	2300	—	$\mu\text{A}$
Light current (1)		$I_L(1)$	$V_{CC} = 3\text{ V}$ , $E_V = 100\text{ lx}$ (Note 2), (Note 4)	—	230	—	$\mu\text{A}$
Light current (2)		$I_L(2)$	$V_{CC} = 3\text{ V}$ , $E_V = 10\text{ lx}$ (Note 3), (Note 4)	16	23	32	$\mu\text{A}$
Light current (3)		$I_L(3)$	$V_{CC} = 3\text{ V}$ , $E_V = 100\text{ lx}$ (Note 3), (Note 4)	160	230	320	$\mu\text{A}$
		A rank		180	230	300	
Light current ratio		$\frac{I_L(1)}{I_L(3)}$	—	1.0	—	—	—
Dark current		$I_{LEAK}$	$V_{CC} = 3\text{ V}$ , $E_V = 0$	—	—	0.2	$\mu\text{A}$
Saturation output voltage		$V_O$	$V_{CC} = 3\text{ V}$ , $R_L = 75\text{ k}\Omega$ , $E_V = 100\text{ lx}$ (Note 3)	2.2	2.35	2.6	V
Switching time	Rise time	$t_r$	$V_{CC} = 3\text{ V}$ , $R_L = 5\text{ k}\Omega$ , $V_{OUT} = 1.5\text{ V}$ (Note 6)	—	150	—	$\mu\text{s}$
	Fall time	$t_f$		—	300	—	
	Delay time	$t_d$		—	180	—	
	Storage time	$t_s$		—	8	—	

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

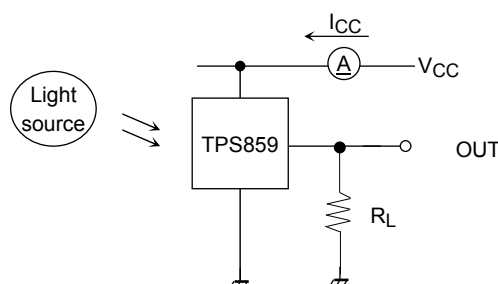
Note 3: F10 of fluorescence light is used as light source. (color temperature = 5000K)

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

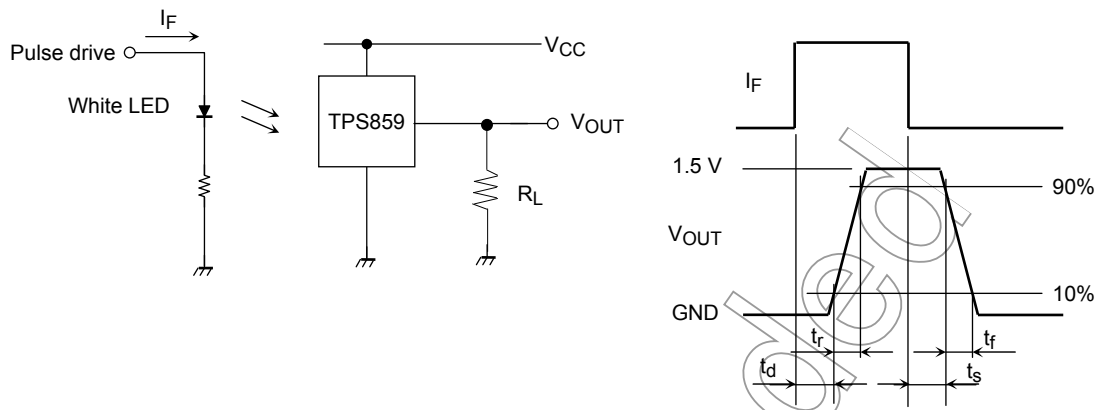
Note 4: Light current measurement circuit



Note 5: Supply current measurement circuit



Note 6: Switching time measurement method



Not Recommended for New Design

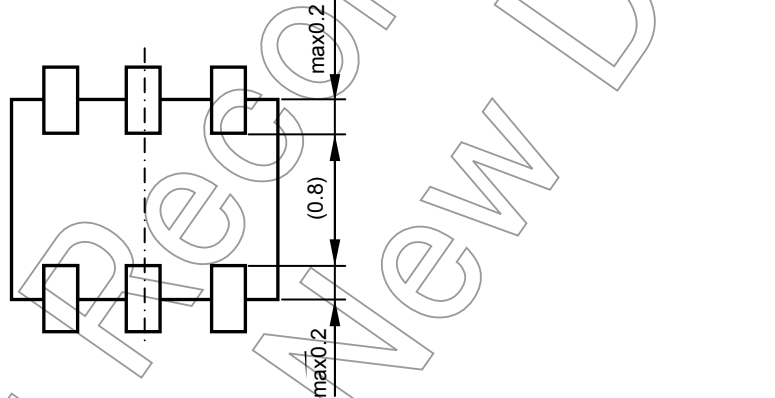
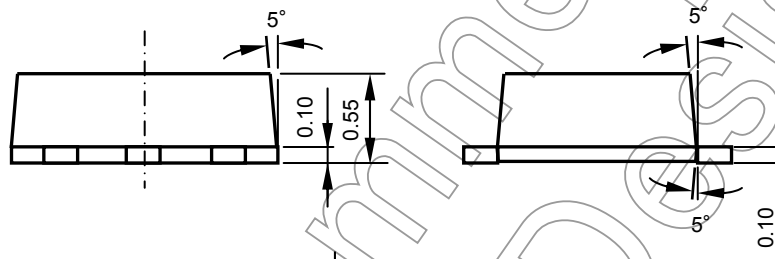
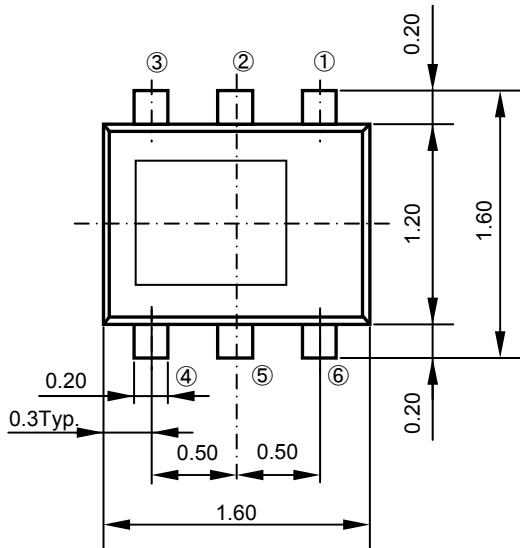
## Package Dimensions

0-2E1B

Unit: mm

Tolerance:  $\square 0.1$

( ) : Reference value

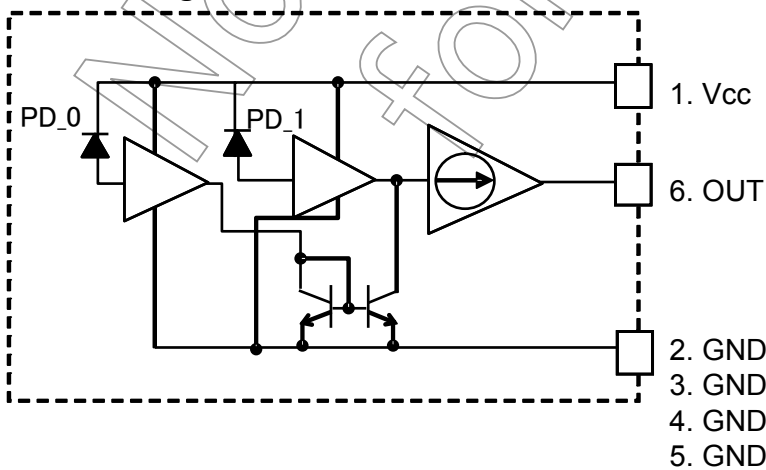


Pin connection

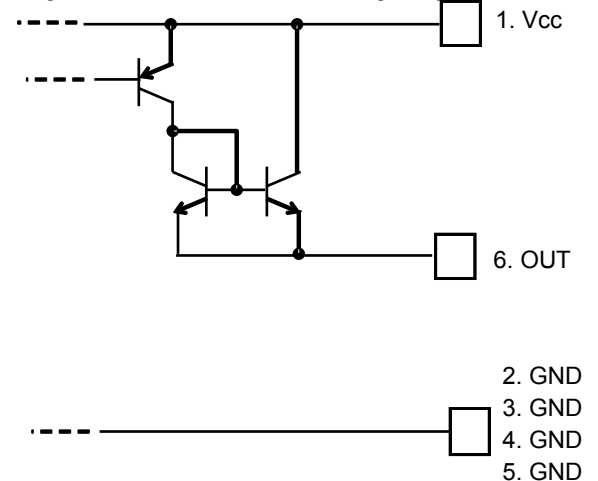
- 1. V<sub>CC</sub>
- 2. GND
- 3. GND
- 4. GND
- 5. GND
- 6. OUT

Weight: 0.003 g (typ.)

### Block Diagram



### Equivalent circuit in output part



## Handling Precautions

Insert a bypass condenser of up to 0.1 $\mu$ F between VCC and GND near the device to stabilize the power supply line.

Select a load resistor ( $R_L$ ) that the load current ( $I_L$ ) doesn't exceed the absolute maximum rating.

Calculation example of minimum load resistor:  $R_L = (V_{CC} - V_{sat}) / I_L$  (Absolute maximum rating) =  $(V_{CC} - 0.4V) / 4mA$

$V_{sat}$ : (Supply voltage ( $V_{CC}$ )) - (Maximum value of saturation output voltage) = 0.4V

$V_{sat}$  is constant regardless of the supply voltage.

When Vcc is turned on it takes at least 200 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

To avoid moisture absorption by the resin, the product is packed in an aluminum envelope with silica gel. 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:

1. If the aluminum bag has been stored unopened
  - Temperature: 5 to 30°C
  - Relative humidity: 90% RH (max)
  - Time: 6 months
2. If the aluminum bag has been opened
  - Temperature: 5 to 30°C
  - Relative humidity: 70% RH (max)
  - Time: 168 h
3. Baking should be conducted within 72 h after the humidity indicator shows > 30% or the bag seal date is over 6 months. The number of baking should be once. If the baking is conducted repeatedly, it may affect the peel-back force and cause a problem for mounting.
  - Baking condition: 60  $\pm$  5°C, 12 to 24 h
  - Storage period: 6 months from the seal date on the label
4. When the photointerrupter is baked, protect it from electrostatic discharge.
5. Do not toss or drop to avoid damaging the moisture-proof bag.

## Mounting Precautions

TPS859 uses a clear resin, and delicate handling is necessary for it.

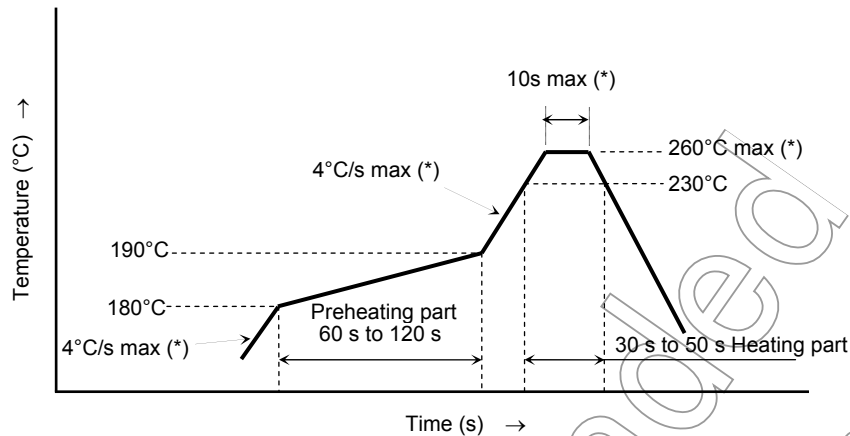
The characteristic change or the product might be damaged by the handling method of mounting.

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

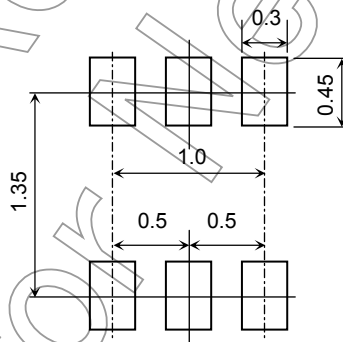


(\*)The product is evaluated using above reflow soldering conditions. No additional test is performed exceed the condition (i.e. the condition more than MAX values) as an evaluation. Please perform reflow soldering under the above conditions. Perform reflow soldering no more than twice.

- 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

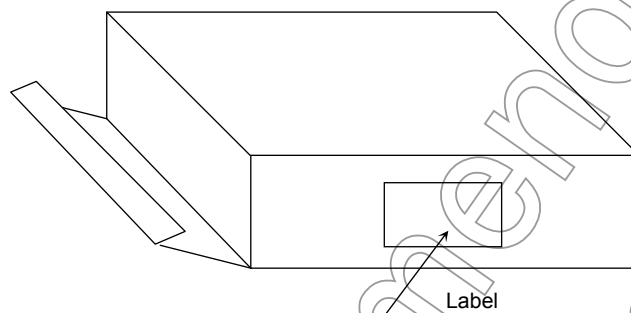
(1) Packing quantity

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

(2) Packing format

An aluminum envelope containing silica gel and reels is deaerated and sealed.  
Pack shock-absorbent materials around the aluminum envelopes in the cartons to cushion them.

- Carton specification

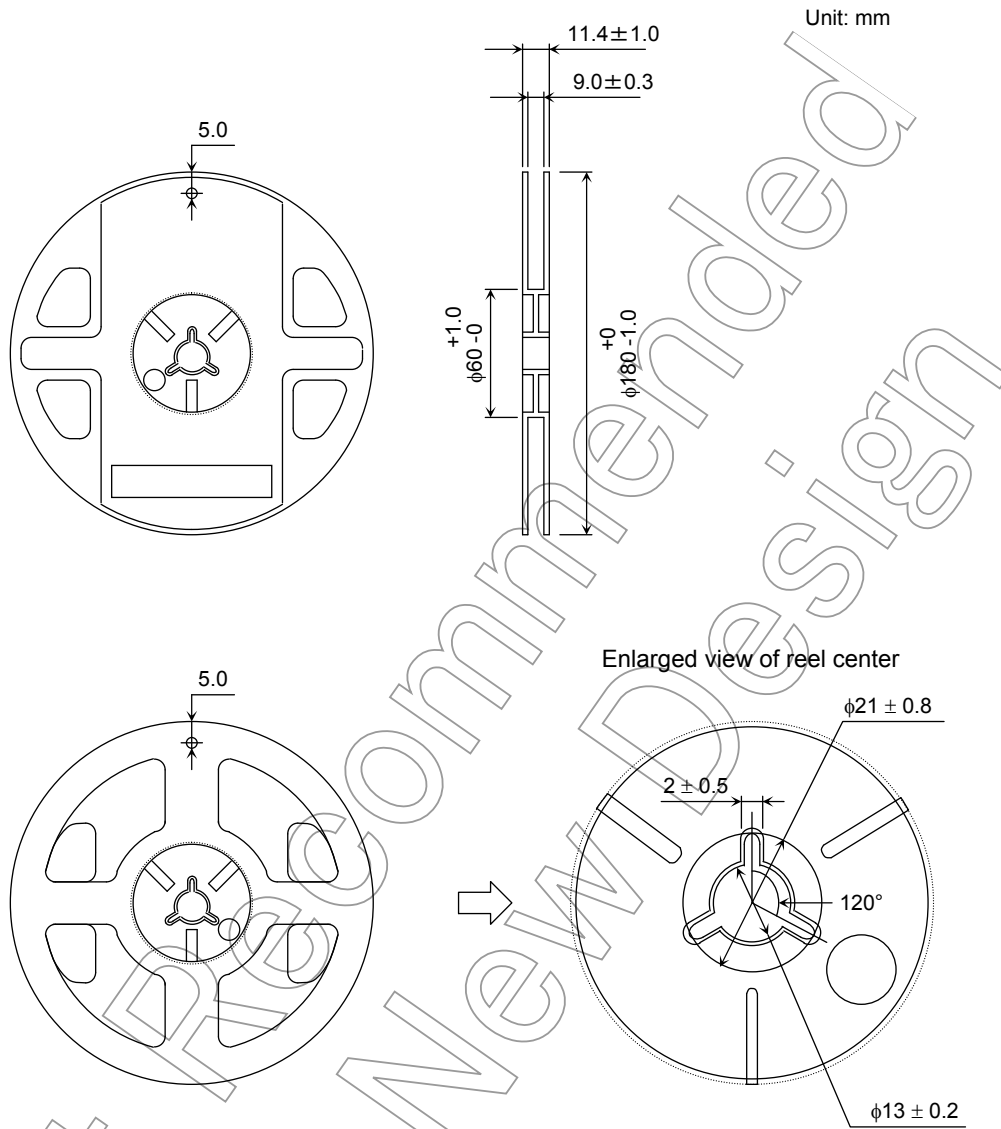


Carton dimensions  
(W) 81 mm × (L) 280 mm × (H) 280 mm

Not Recommended for New Design

Tape Packing Specifications

- (3) Reel dimensions  
Reel material: Plastic

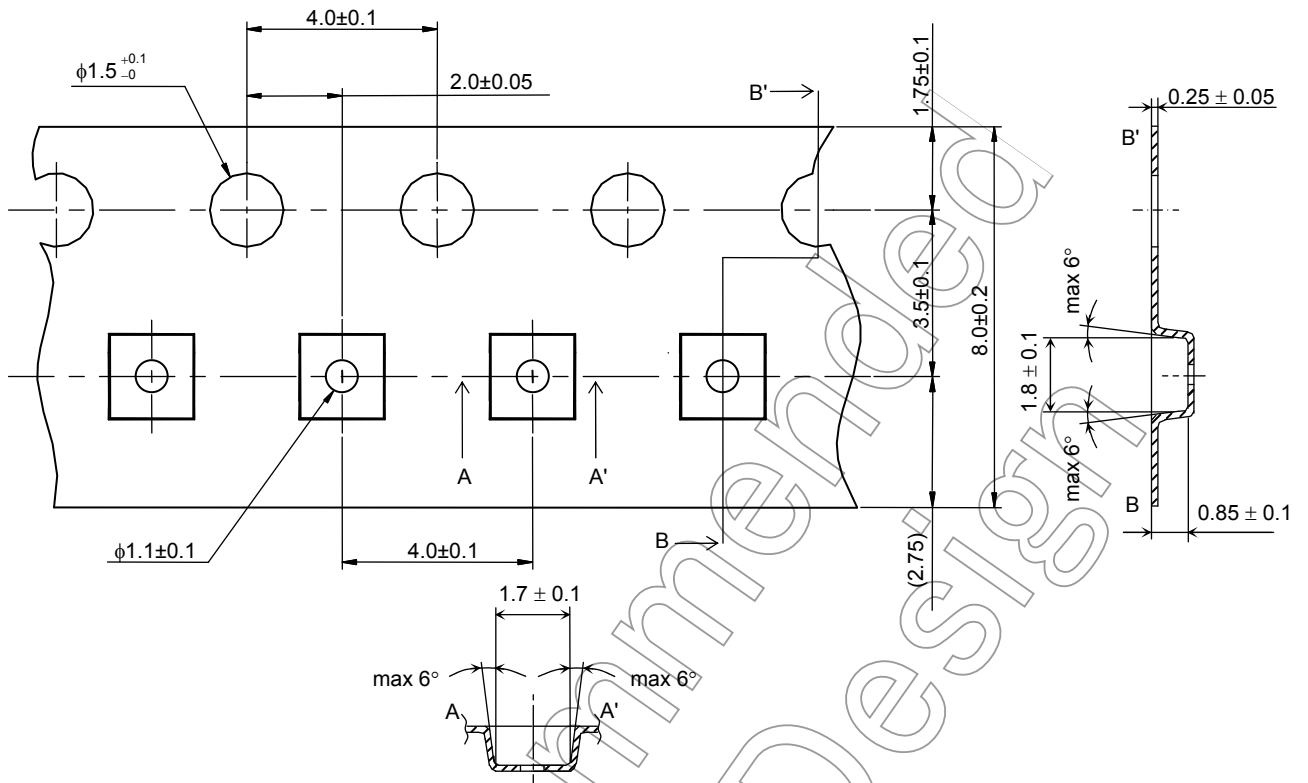


Not for New Design

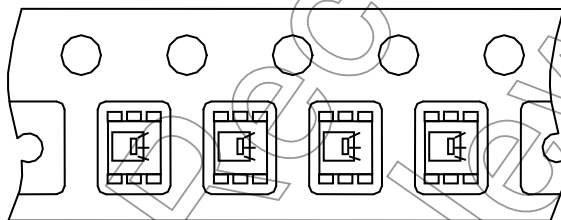


(4) Tape dimensions  
Tape material: Plastic (anti-electrostatic)

Unit: mm



Product direction



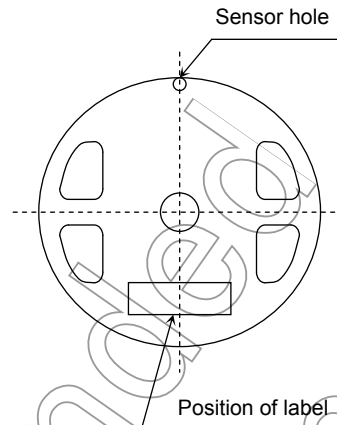
Not for New Design

**Reel Label**

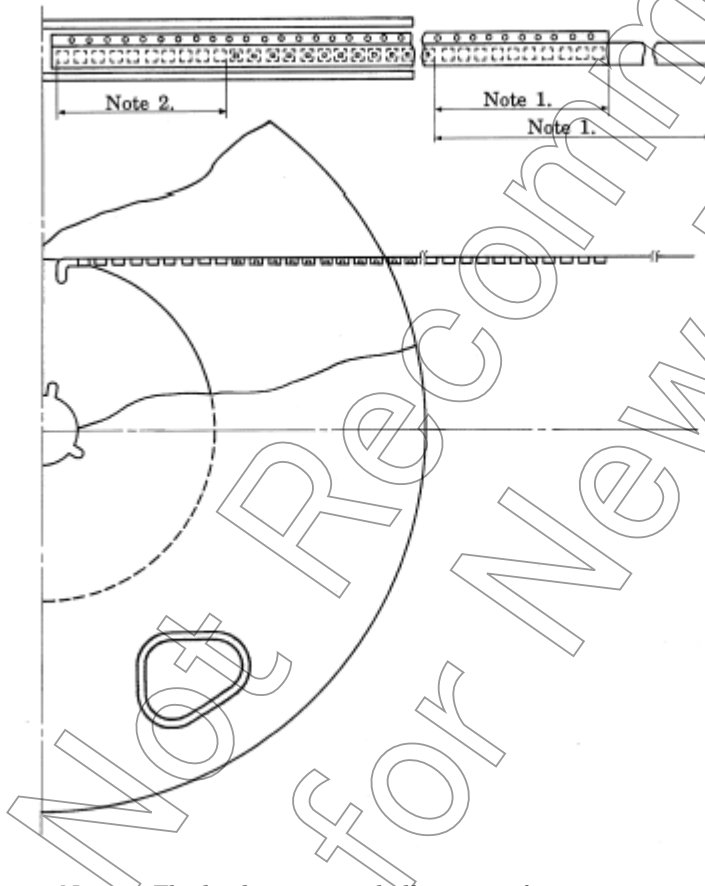
The label markings may include product number, quantity and seal date.

P/N

TYPE	TPS859		
ADDC		Q'TY	3,000 pcs.
NOTE			

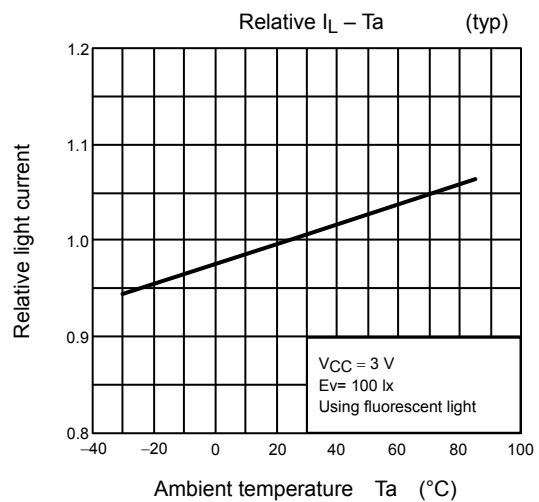
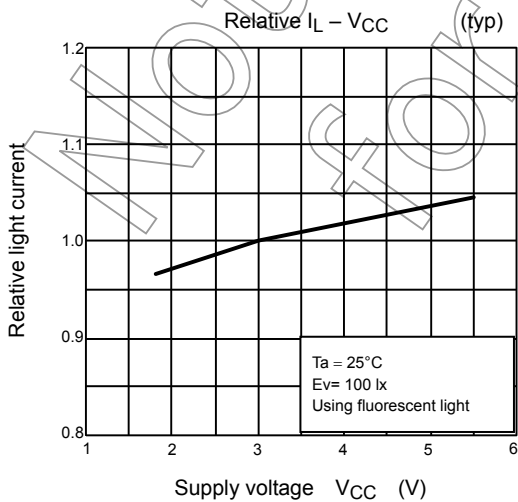
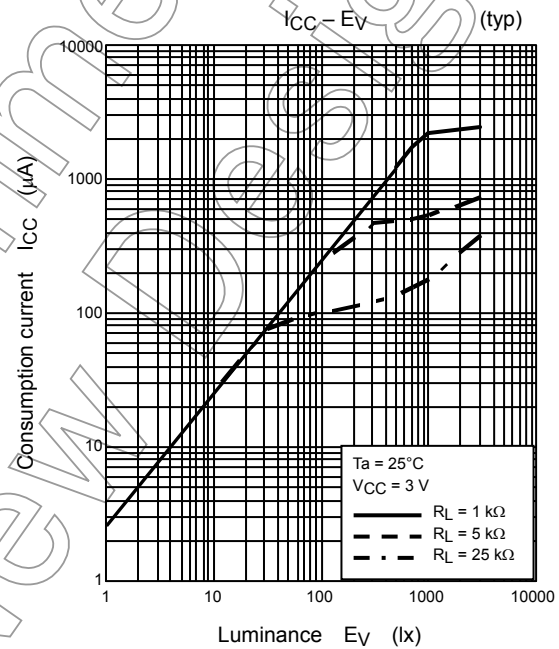
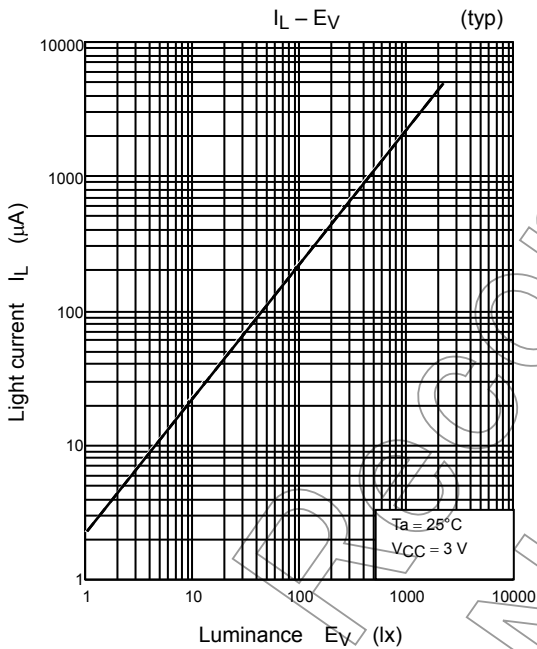
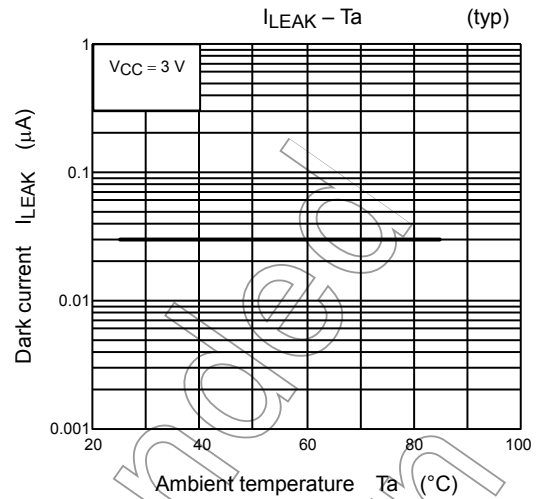
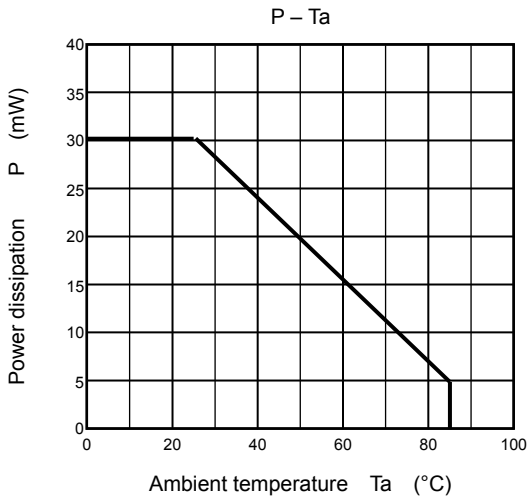


**Leader and Trailer Sections of Tape**

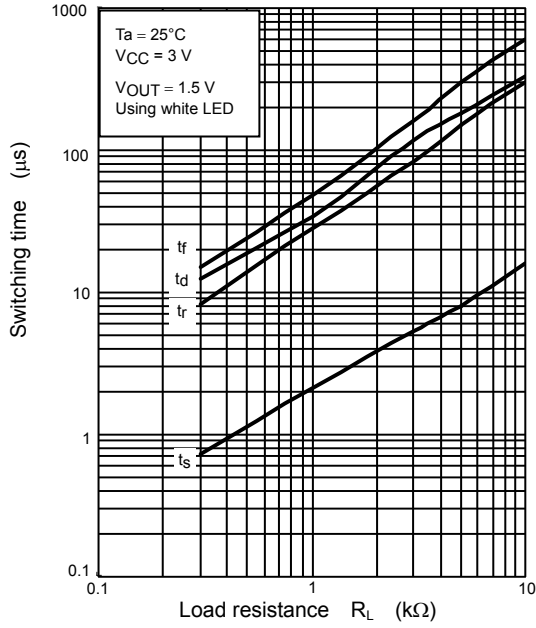


Note 1: The leader portion shall consist of cover tape minimum length of 300 mm and a piece of carrier tape with empty portion of 100 mm minimum.

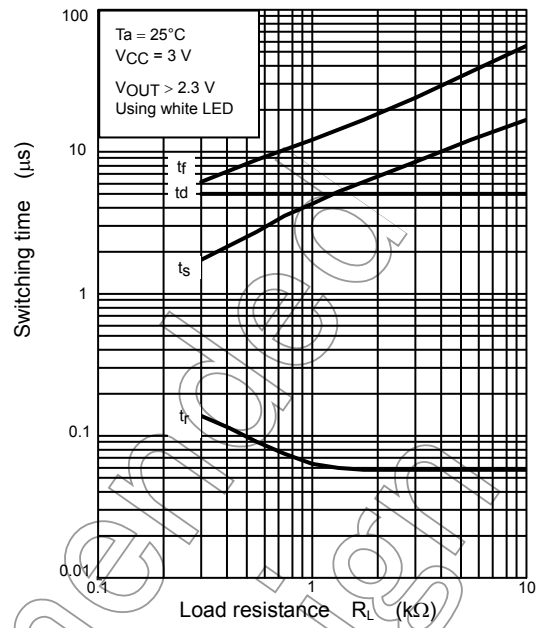
Note 2: The trailer portion shall consist of empty carrier of more than 10 cavities.



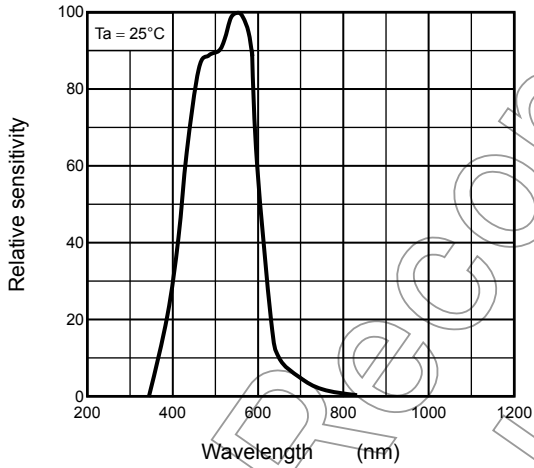
Switching Characteristics  
(Non-saturating operation) (typ.)



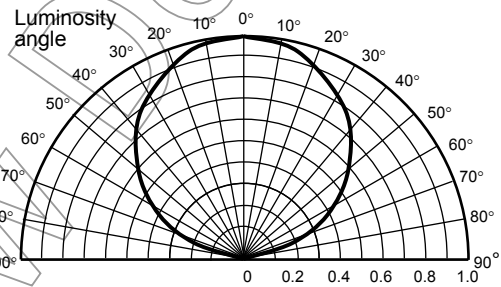
Switching Characteristics  
(Saturating operation) (typ.)



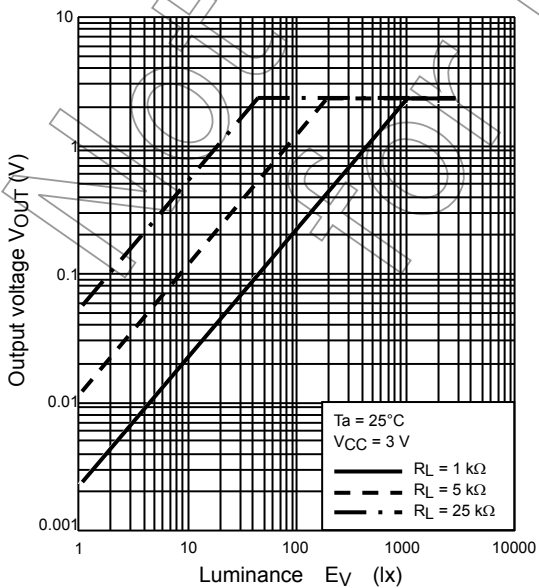
Spectral Response (typ.)



Radiation pattern (typ)  
 $T_a = 25^\circ\text{C}$



$V_{OUT} - E_V$  (typ.)



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