

# TLP109

Programmable Controllers  
Industrial Inverters  
Switching Power Supplies

The Toshiba TLP109 mini-flat coupler is a small-outline coupler suitable for surface-mount assembly. The TLP109 consists of a high-output-power GaAlAs light emitting diode optically coupled to a high-speed photodiode-transistor chip. The TLP109 is housed in the SO6 package and guarantees a creepage distance of  $\geq 5.0$  mm, a clearance of  $\geq 5.0$  mm and an insulation thickness of  $\geq 0.4$  mm. Therefore, the TLP109 meets the reinforced insulation class requirements of international safety standards.

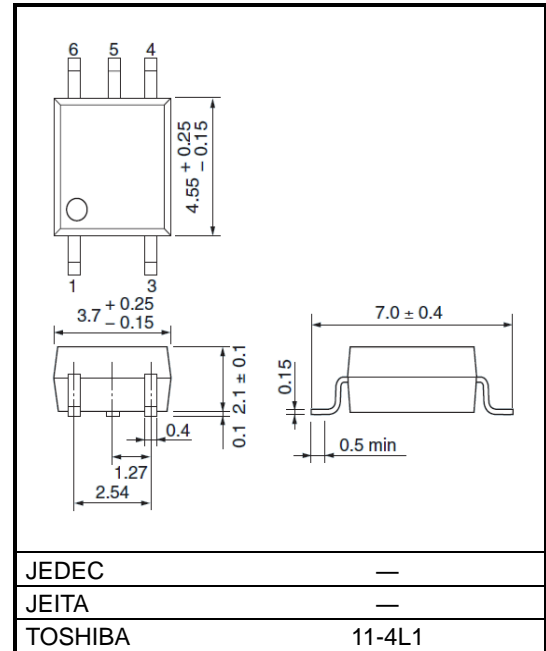
- Isolation voltage: 3750 Vrms (min)
- Switching speed:  $t_{pHL} = 0.8 \mu s$ ,  $t_{pLH} = 0.8 \mu s$  (max)  
@ $R_L = 1.9 k\Omega$
- TTL-compatible
- UL approved : UL1577, File No.E67349
- c-UL approved : CSA Component Acceptance Service No. 5A, File No.E67349
- VDE-approved: EN60747-5-5, EN60065 or EN60950-1 (Note 1)
- CQC-approved: GB4943.1, GB8898 Thailand Factory



仅适用于海拔 2000m 以下地区安全使用

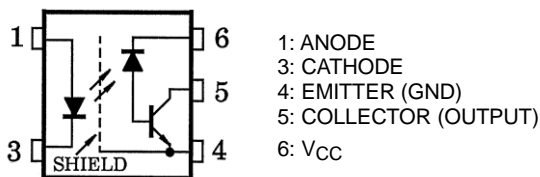
Note 1 : When a EN60747-5-5 approved type is needed, Please designate "Option(V4)"

Unit: mm

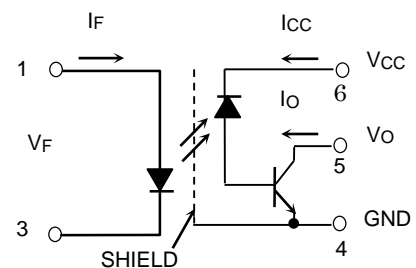


Weight: 0.08 g (typ.)

## Pin Configuration (Top View)



## Schematic



## Construction Mechanical Ratings

- Creepage distance: 5.0 mm (min)
- Clearance: 5.0 mm (min)
- Insulation thickness: 0.4 mm (min)

Start of commercial production  
2008-07

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

Characteristic		Symbol	Rating	Unit
LED	Forward current	I <sub>F</sub>	20	mA
	Forward Current Derating (Ta ≥ 95 °C)	Δ I <sub>F</sub> /°C	-0.36	mA/°C
	Pulse forward current (Note 1)	I <sub>FP</sub>	40	mA
	Peak transient forward current (Note 2)	I <sub>FPT</sub>	1	A
	Reverse voltage	V <sub>R</sub>	5	V
	Power dissipation (Note 3)	P <sub>D</sub>	40	mW
Detector	Output current	I <sub>O</sub>	8	mA
	Output Current Derating (Ta ≥ 95 °C)	Δ I <sub>O</sub> /°C	-0.3	mA/°C
	Peak output current	I <sub>OP</sub>	16	mA
	Supply voltage	V <sub>CC</sub>	-0.5 to 30	V
	Output voltage	V <sub>O</sub>	-0.5 to 20	V
	Output power dissipation (Note 4)	P <sub>O</sub>	100	mW
Operating temperature range		T <sub>opr</sub>	-55 to 125	°C
Storage temperature range		T <sub>stg</sub>	-55 to 125	°C
Lead solder temperature (10 s)		T <sub>sol</sub>	260	°C
Isolation Voltage (AC, 60 s, R.H. ≤ 60%) (Note 5)		BV <sub>S</sub>	3750	V <sub>rms</sub>

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.

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: 50% duty cycle, 1 ms pulse width. Derate 0.72 mA / °C above 95°C.

Note 2: Pulse width ≤ 1 μs, 300 pps.

Note 3: Derate 0.72 mW / °C above 95°C.

Note 4: Derate 1.8 mW / °C above 95°C.

Note 5: Device considered a two-terminal device: Pins 1 and 3 shorted together, and pins 4, 5 and 6 shorted together.

## Electrical Characteristics (Ta = 25°C)

Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
LED	Forward voltage	V <sub>F</sub>	I <sub>F</sub> = 16 mA	1.50	1.64	1.85	V
	Forward voltage temperature coefficient	ΔV <sub>F</sub> / ΔT <sub>a</sub>	I <sub>F</sub> = 16 mA	—	-1.6	—	mV / °C
	Reverse current	I <sub>R</sub>	V <sub>R</sub> = 3 V	—	—	10	μA
	Capacitance between terminals	C <sub>T</sub>	V <sub>F</sub> = 0 V, f = 1 MHz	—	60	—	pF
Detector	High level output current	I <sub>OH</sub> (1)	I <sub>F</sub> = 0 mA, V <sub>CC</sub> = V <sub>O</sub> = 5.5 V	—	3	500	nA
		I <sub>OH</sub> (2)	I <sub>F</sub> = 0 mA, V <sub>CC</sub> = 30 V, V <sub>O</sub> = 20 V	—	—	5	μA
		I <sub>OH</sub>	I <sub>F</sub> = 0 mA, V <sub>CC</sub> = 30 V, V <sub>O</sub> = 20 V, T <sub>a</sub> = 100°C	—	—	50	
	High level supply current	I <sub>CC</sub> H	I <sub>F</sub> = 0 mA, V <sub>CC</sub> = 30 V	—	0.01	1	μA
Current transfer ratio		I <sub>O</sub> / I <sub>F</sub>	I <sub>F</sub> = 16 mA, V <sub>CC</sub> = 4.5 V, V <sub>O</sub> = 0.4 V	20	—	—	%
Low level output voltage		V <sub>OL</sub>	I <sub>F</sub> = 16 mA, V <sub>CC</sub> = 4.5 V, I <sub>O</sub> = 2.4 mA	—	—	0.4	V

## Isolation Characteristics (Ta = 25°C)

Characteristic	Symbol	Test Conditions	Min	Typ.	Max	Unit
Capacitance input to output	C <sub>S</sub>	V = 0 V, f = 1 MHz (Note 6)	—	0.8	—	pF
Isolation resistance	R <sub>S</sub>	R.H. ≤ 60%, V <sub>S</sub> = 500 V (Note 6)	1×10 <sup>12</sup>	10 <sup>14</sup>	—	Ω
Isolation voltage	B <sub>V</sub> S	AC, 60 s	3750	—	—	V <sub>rms</sub>
		AC, 1 s, in oil	—	10000	—	
		DC, 60 s, in oil	—	10000	—	V <sub>dc</sub>

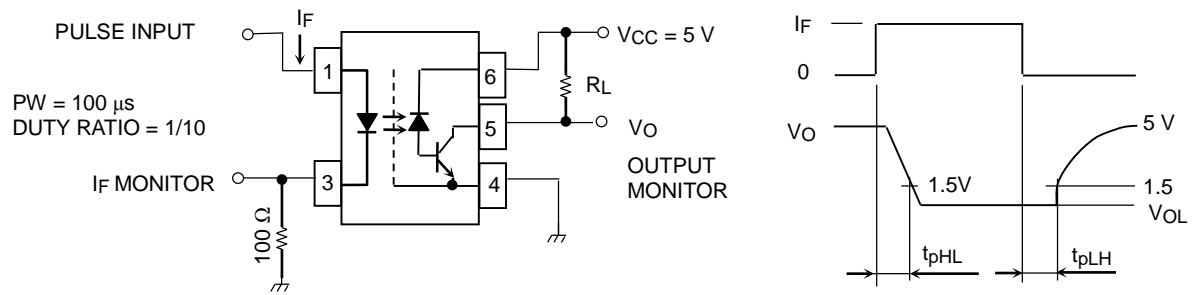
Note 6: Maximum electrostatic discharge voltage for any pins: 100 V (C = 200 pF, R=0 Ω)

## Switching Characteristics (Ta = 25°C, Vcc = 5 V)

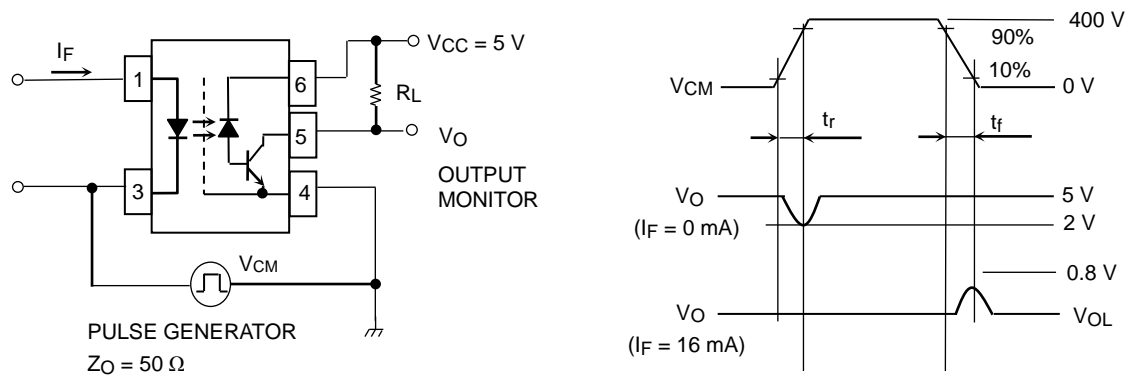
Characteristic	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Propagation delay time (H→L)	t <sub>pHL</sub>	Figure 1	I <sub>F</sub> = 0→16 mA, R <sub>L</sub> = 1.9 kΩ	—	—	0.8	μs
Propagation delay time (L→H)	t <sub>pLH</sub>	Figure 1	I <sub>F</sub> = 16→0 mA, R <sub>L</sub> = 1.9 kΩ	—	—	0.8	μs
Common mode transient immunity at high output level (Note 7)	CM <sub>H</sub>	Figure 2	I <sub>F</sub> = 0 mA, V <sub>CM</sub> = 400 V <sub>p-p</sub> , R <sub>L</sub> = 4.1 kΩ	5000	10000	—	V / μs
Common mode transient immunity at low output level (Note 7)	CM <sub>L</sub>	Figure 2	I <sub>F</sub> = 16 mA, V <sub>CM</sub> = 400 V <sub>p-p</sub> , R <sub>L</sub> = 4.1 kΩ	-5000	-10000	—	V / μs

Note 7: CM<sub>L</sub> is the maximum rate of fall of the common mode voltage that can be sustained with the output voltage in the logic low state (V<sub>O</sub> < 0.8 V).  
 CM<sub>H</sub> is the maximum rate of rise of the common mode voltage that can be sustained with the output voltage in the logic high state (V<sub>O</sub> > 2.0 V)

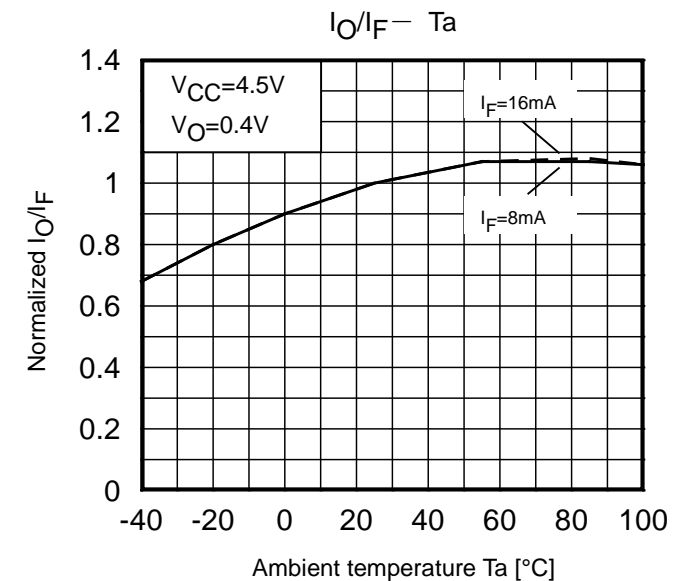
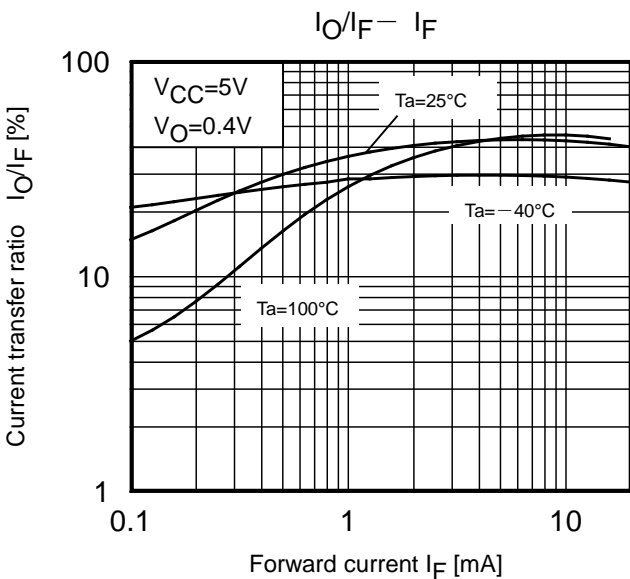
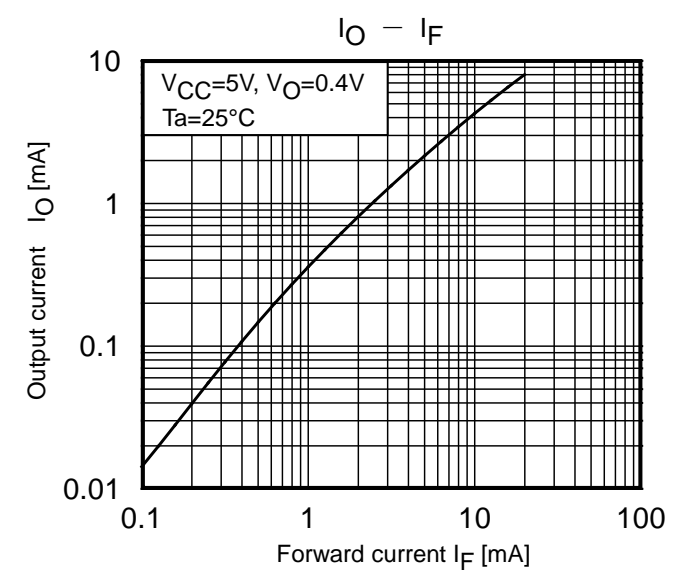
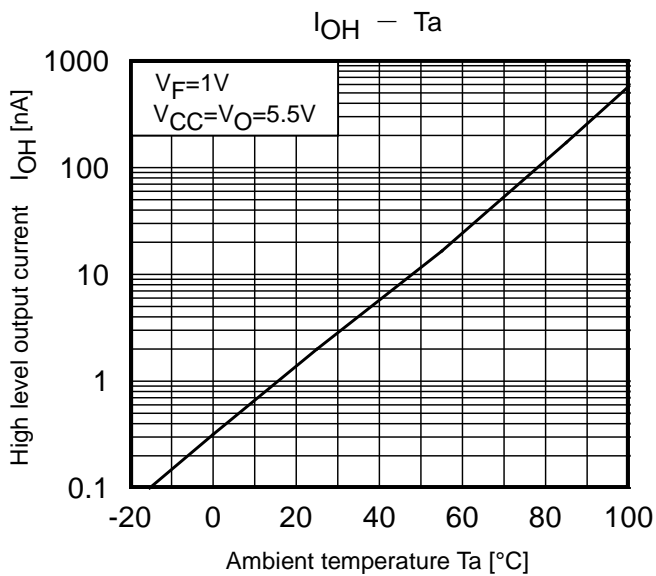
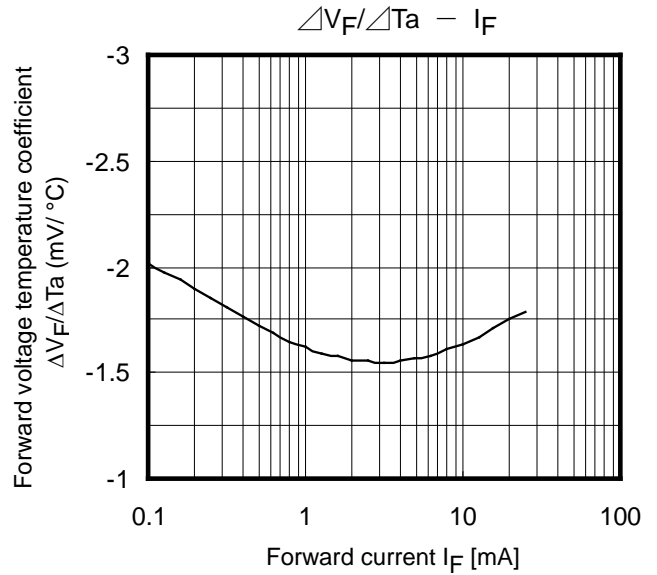
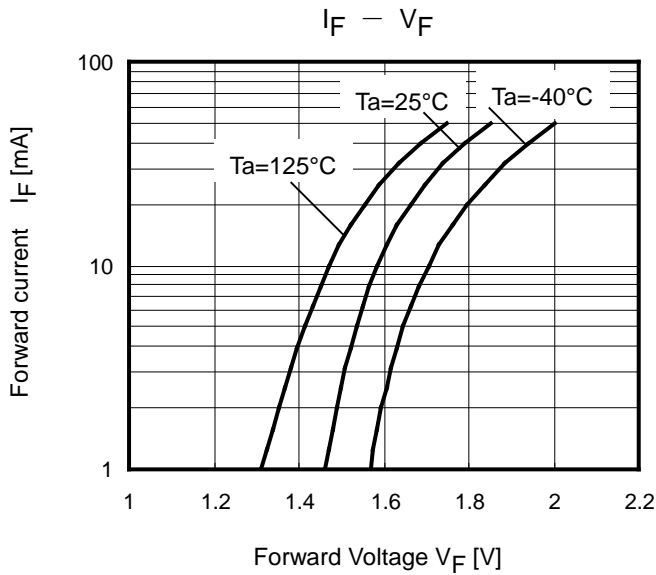
**Figure 1: Switching Time Test Circuit and Waveform**



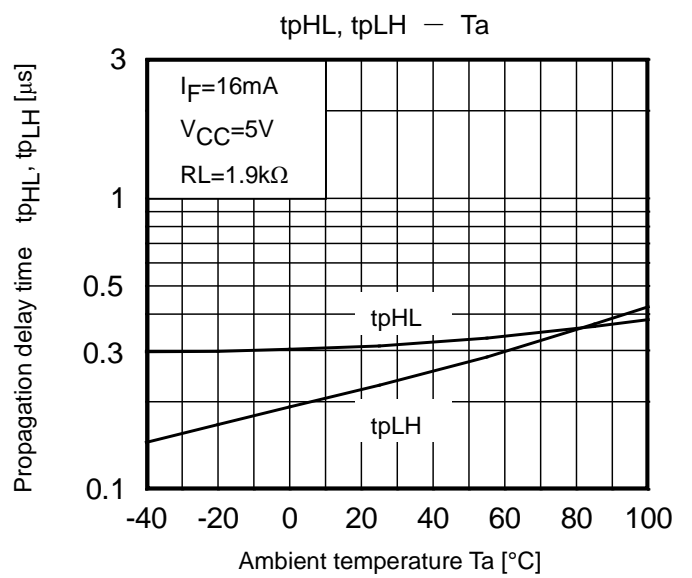
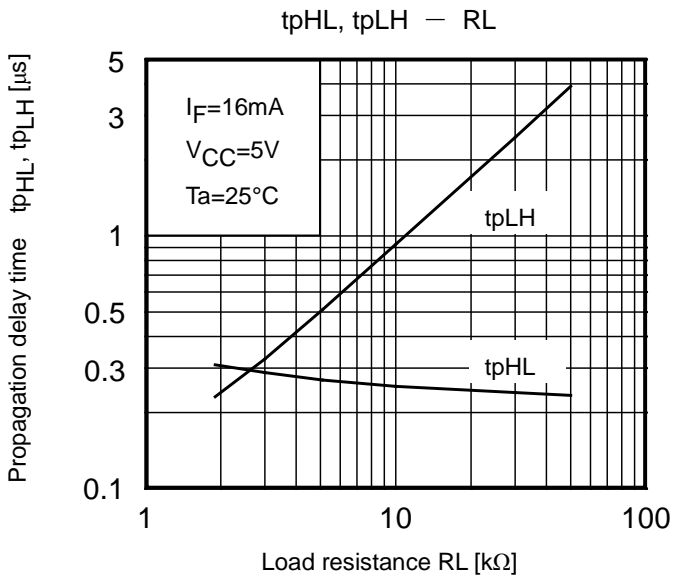
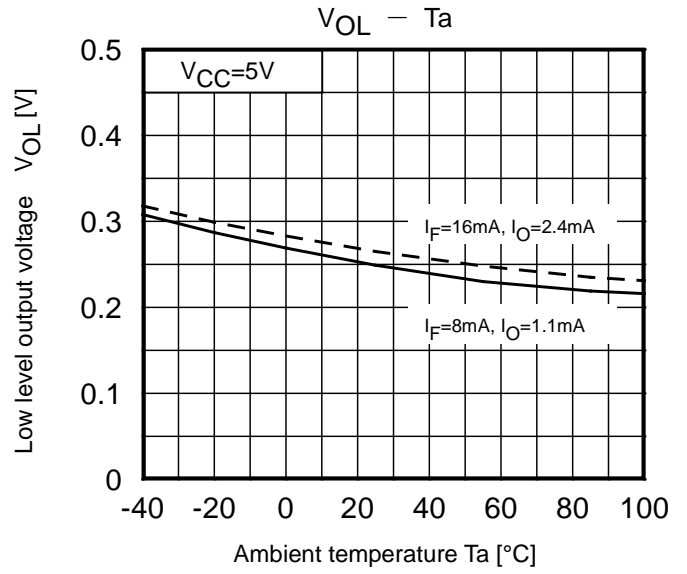
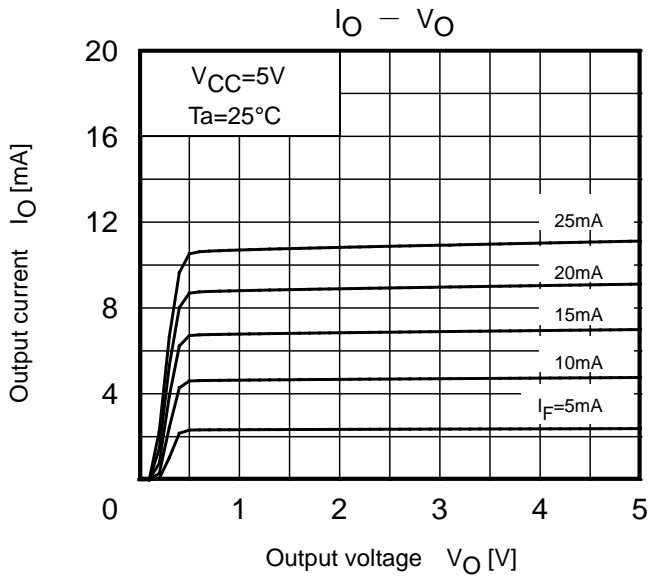
**Figure 2: Common Mode Transient Immunity Test Circuit and Waveform**



$$CM_H = \frac{320(V)}{t_r(\mu s)}, \quad CM_L = \frac{320(V)}{t_f(\mu s)}$$



\* The above graphs show typical characteristics.



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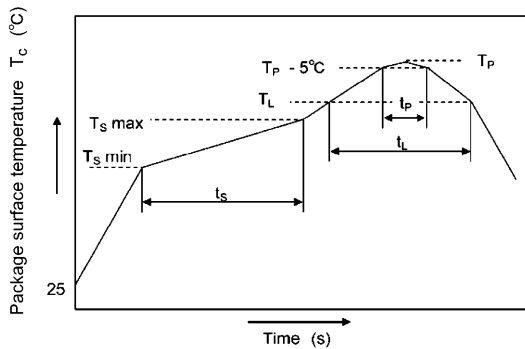
## PRECAUTIONS OF SURFACE MOUNTING TYPE PHOTOCOUPLER SOLDERING & GENERAL STORAGE

### (1) Precautions for Soldering

The soldering temperature should be controlled as closely as possible to the conditions shown below, irrespective of whether a soldering iron or a reflow soldering method is used.

#### 1) When Using Soldering Reflow

An example of a temperature profile when lead(Pb)-free solder is used



	Symbol	Min	Max	Unit
Preheat temperature	$T_S$	150	200	°C
Preheat time	$t_s$	60	120	s
Ramp-up rate ( $T_L$ to $T_P$ )			3	°C/s
Liquidus temperature	$T_L$	217		°C
Time above $T_L$	$t_L$	60	150	s
Peak temperature	$T_P$		260	°C
Time during which $T_c$ is between ( $T_P - 5$ ) and $T_P$	$t_p$		30	s
Ramp-down rate ( $T_P$ to $T_L$ )			6	°C/s

- The soldering temperature profile is based on the package surface temperature (See the figure shown below, which is based on the package surface temperature.)
- Reflow soldering must be performed once or twice.
- The mounting should be completed with the interval from the first to the last mountings being 2 weeks..

#### 2) When using soldering Flow

- Preheat the device at a temperature of 150 °C (package surface temperature) for 60 to 120 seconds.
- Mounting condition of 260 °C within 10 seconds is recommended.
- Flow soldering must be performed once.

#### 3) When using soldering Iron

- Complete soldering within 10 seconds for lead temperature not exceeding 260 °C or within 3 seconds not exceeding 350 °C.
- Heating by soldering iron must be only once per 1 lead

**Specification for Embossed–Tape Packing (TPL)(TPR) for SO6 Coupler**

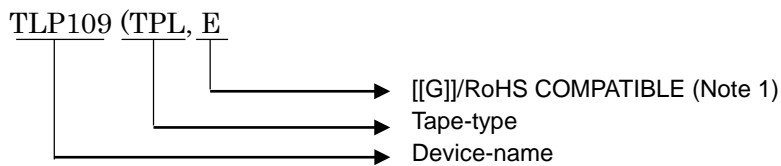
**1. Applicable Package**

Package	Product Type
SO6	Mini-flat coupler

**2. Product Naming System**

Type of package used for shipment is denoted by a symbol suffix after a product number. The method of classification is as below.

(Example)



Note 1: Please contact your Toshiba sales representative for details on environmental information such as the product's RoHS compatibility. RoHS is the Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronics equipment.

**3. Tape Dimensions**

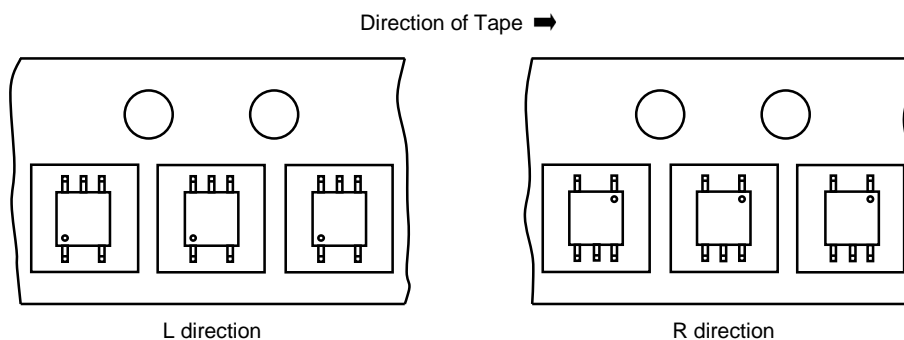
**3.1 Specification Classification Are as Shown in Table 1**

**Table 1 Tape Type Classification**

Tape type	Classification	Quantity (pcs / reel)
TPL	L direction	3000
TPR	R direction	3000

**3.2 Orientation of Device in Relation to Direction of Tape Movement**

Device orientation in the recesses is as shown in Figure 1.



**Figure 1 Device Orientation**



**3.3 Empty Device Recesses Are as Shown in Table 2.**

**Table 2 Empty Device Recesses**

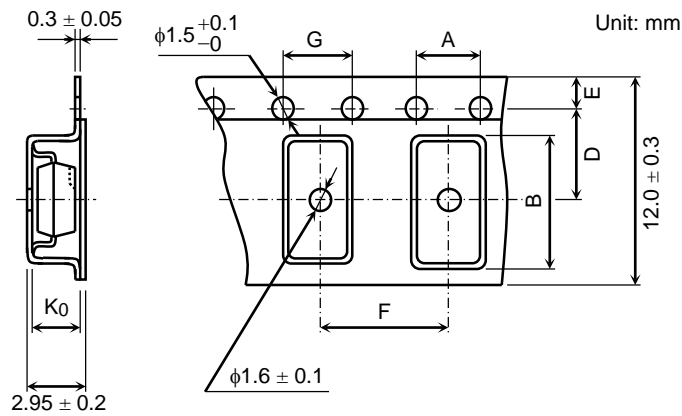
	Standard	Remarks
Occurrences of 2 or more successive empty device recesses	0	Within any given 40-mm section of tape, not including leader and trailer
Single empty device recesses	6 devices (max) per reel	Not including leader and trailer

**3.4 Start and End of Tape**

The start of the tape has 50 or more empty holes. The end of tape has 50 or more empty holes and two empty turns only for a cover tape.

**3.5 Tape Specification**

- (1) Tape material: Plastic (protection against electrostatics)
- (2) Dimensions: The tape dimensions are as shown in Figure 2 and Table 3.



**Figure 2 Tape Forms**

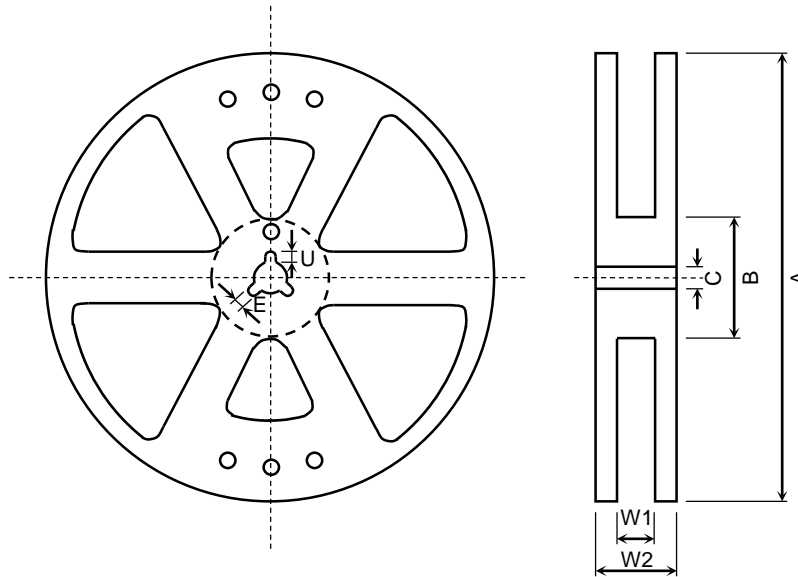
**Table 3 Tape Dimensions**

Unit: mm  
Unless otherwise specified: ±0.1

Symbol	Dimension	Remark
A	4.0	—
B	7.6	—
D	5.5	Center line of indented square hole and sprocket hole
E	1.75	Distance between tape edge and hole center
F	8.0	Cumulative error $\begin{matrix} +0.1 \\ -0.3 \end{matrix}$ (max) per 10 feed holes
G	4.0	Cumulative error $\begin{matrix} +0.1 \\ -0.3 \end{matrix}$ (max) per 10 feed holes
K0	2.6	Internal space

**3.6 Reel**

- (1) Material: Plastic
- (2) Dimensions: The reel dimensions are as shown in Figure 3 and Table 4.



**Figure 3 Reel Form**

**Table 4 Reel Dimensions**

Unit: mm

Symbol	Dimension
A	$\Phi 380 \pm 2$
B	$\Phi 80 \pm 1$
C	$\Phi 13 \pm 0.5$
E	$2.0 \pm 0.5$
U	$4.0 \pm 0.5$
W1	$13.5 \pm 0.5$
W2	$17.5 \pm 1.0$

**4. Packing**

Either one reel or five reels of photocoupler are packed in a shipping carton.

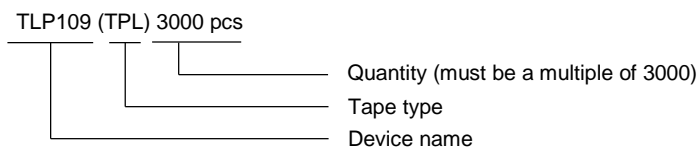
**5. Label Indication**

The carton bears a label indicating the product number, the symbol representing classification of standard, the quantity, the lot number and the Toshiba company name.

**6. Ordering Method**

When placing an order, please specify the product number, the tape type and the quantity as shown in the following example.

(Example)



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