

# 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
- Option (V4)  
 VDE approved : DIN EN60747-5-2

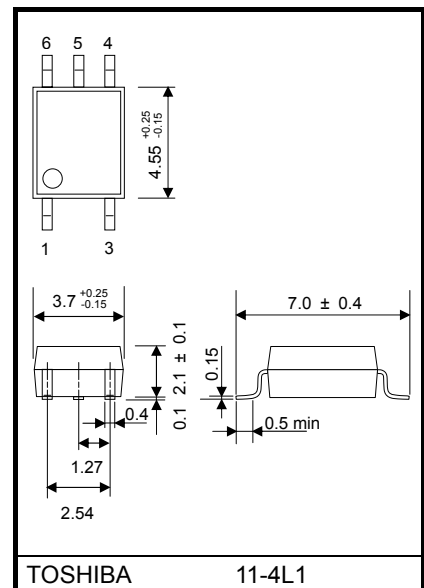
Maximum Operating Insulation Voltage : 707 V<sub>PK</sub>

Highest Permissible Over Voltage : 6000 V<sub>PK</sub>

(Note) : When a EN60747-5-2 approved type is needed,

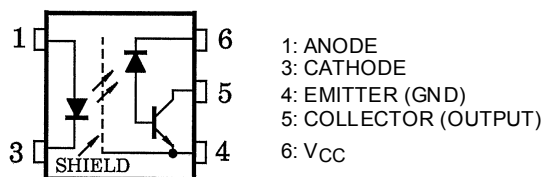
Please designate "Option(V4)"

Unit: mm

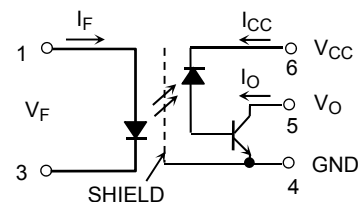


Weight: 0.08 g (typ.)

## 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 (Note 1)	I <sub>F</sub>	20	mA
	Pulse forward current (Note 2)	I <sub>FP</sub>	40	mA
	Peak transient forward current (Note 3)	I <sub>FPT</sub>	1	A
	Reverse voltage	V <sub>R</sub>	5	V
	Power dissipation (Note 4)	P <sub>D</sub>	40	mW
Detector	Output current	I <sub>O</sub>	8	mA
	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 5)	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, 1 minute, R.H. ≤ 60%) (Note 6)		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) Derate 0.36 mA / °C above 95°C.

(Note 2) 50% duty cycle, 1 ms pulse width. Derate 0.72 mA / °C above 95°C.

(Note 3) Pulse width ≤ 1 μs, 300 pps.

(Note 4) Derate 0.72 mA / °C above 95°C.

(Note 5) Derate 1.8 mW / °C above 95°C.

(Note 6) 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	$V_F$	$I_F = 16 \text{ mA}$	1.50	1.64	1.85	V
	Forward voltage temperature coefficient	$\Delta V_F / \Delta T_a$	$I_F = 16 \text{ mA}$	—	-1.6	—	mV/°C
	Reverse current	$I_R$	$V_R = 3 \text{ V}$	—	—	10	$\mu\text{A}$
	Capacitance between terminals	$C_T$	$V_F = 0 \text{ V}, f = 1 \text{ MHz}$	—	60	—	pF
Detector	High level output current	$I_{OH(1)}$	$I_F = 0 \text{ mA}, V_{CC} = V_O = 5.5 \text{ V}$	—	3	500	nA
		$I_{OH(2)}$	$I_F = 0 \text{ mA}, V_{CC} = 30 \text{ V}, V_O = 20 \text{ V}$	—	—	5	$\mu\text{A}$
		$I_{OH}$	$I_F = 0 \text{ mA}, V_{CC} = 30 \text{ V}, V_O = 20 \text{ V}, T_a = 100^\circ\text{C}$	—	—	50	
	High level supply current	$I_{CCH}$	$I_F = 0 \text{ mA}, V_{CC} = 30 \text{ V}$	—	0.01	1	$\mu\text{A}$
Current transfer ratio	$I_O / I_F$	$I_F = 16 \text{ mA}, V_{CC} = 4.5 \text{ V}, V_O = 0.4 \text{ V}$	20	—	—	%	
Low level output voltage	$V_{OL}$	$I_F = 16 \text{ mA}, V_{CC} = 4.5 \text{ V}, I_O = 2.4 \text{ mA}$	—	—	0.4	V	

## Isolation Characteristics (Ta = 25°C)

Characteristic	Symbol	Test Conditions	Min	Typ.	Max	Unit
Capacitance input to output	$C_S$	$V = 0 \text{ V}, f = 1 \text{ MHz}$ (Note 6)	—	0.8	—	pF
Isolation resistance	$R_S$	R.H. $\leq 60\%$ , $V_S = 500 \text{ V}$ (Note 6)	$1 \times 10^{12}$	$10^{14}$	—	$\Omega$
Isolation voltage	$BV_S$	AC, 1 minute	3750	—	—	$V_{rms}$
		AC, 1 second, in oil	—	10000	—	
		DC, 1 minute, in oil	—	10000	—	Vdc

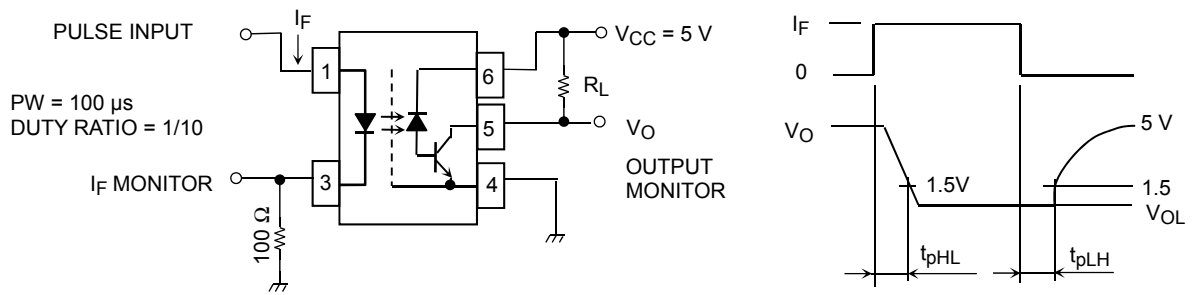
## Switching Characteristics (Ta = 25°C, VCC = 5 V)

Characteristic	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Propagation delay time (H→L)	$t_{pHL}$	1	$I_F = 0 \rightarrow 16 \text{ mA}$ $R_L = 1.9 \text{ k}\Omega$	—	—	0.8	$\mu\text{s}$
Propagation delay time (L→H)	$t_{pLH}$	1	$I_F = 16 \rightarrow 0 \text{ mA}$ $R_L = 1.9 \text{ k}\Omega$	—	—	0.8	$\mu\text{s}$
Common mode transient immunity at high output level (Note 7)	$CM_H$	2	$I_F = 0 \text{ mA}, V_{CM} = 400 \text{ V}_{p-p}$ $R_L = 4.1 \text{ k}\Omega$	5000	10000	—	V / $\mu\text{s}$
Common mode transient immunity at low output level (Note 7)	$CM_L$	2	$I_F = 16 \text{ mA}, V_{CM} = 400 \text{ V}_{p-p}$ $R_L = 4.1 \text{ k}\Omega$	-5000	-10000	—	V / $\mu\text{s}$

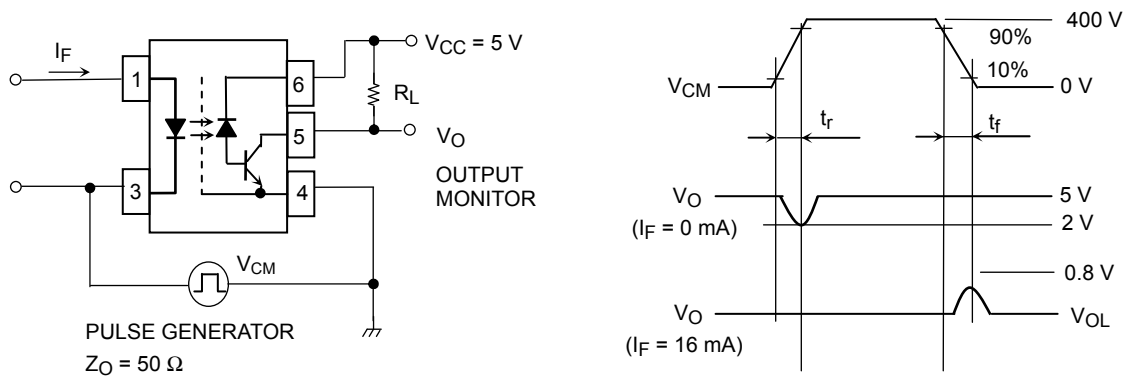
(Note) Maximum electrostatic discharge voltage for any pins: 100 V (C = 200 pF, R=0)

(Note 7)  $CM_L$  is the maximum rate of fall of the common mode voltage that can be sustained with the output voltage in the logic low state ( $V_O < 0.8 \text{ V}$ ).  
 $CM_H$  is the maximum rate of rise of the common mode voltage that can be sustained with the output voltage in the logic high state ( $V_O > 2.0 \text{ V}$ )

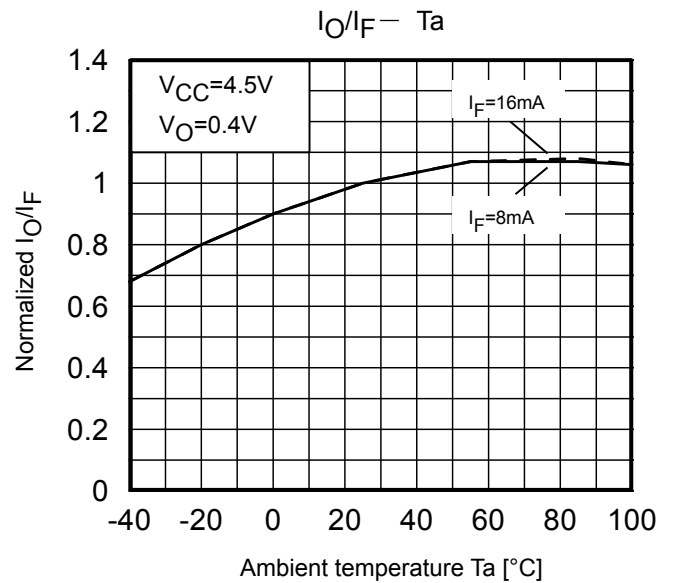
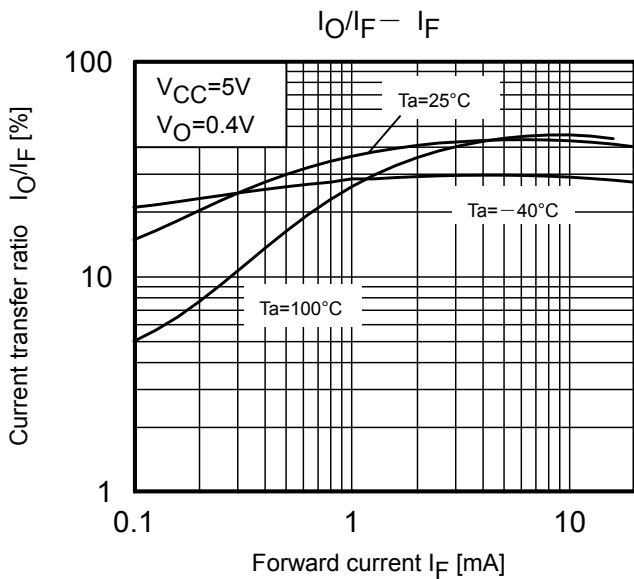
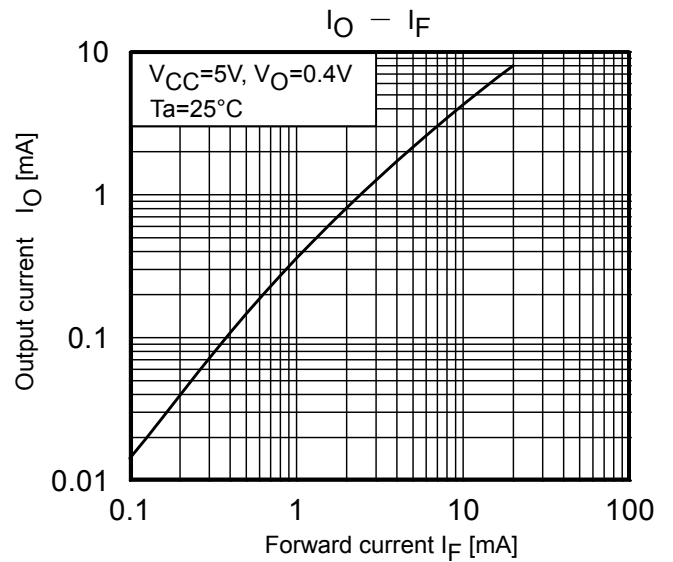
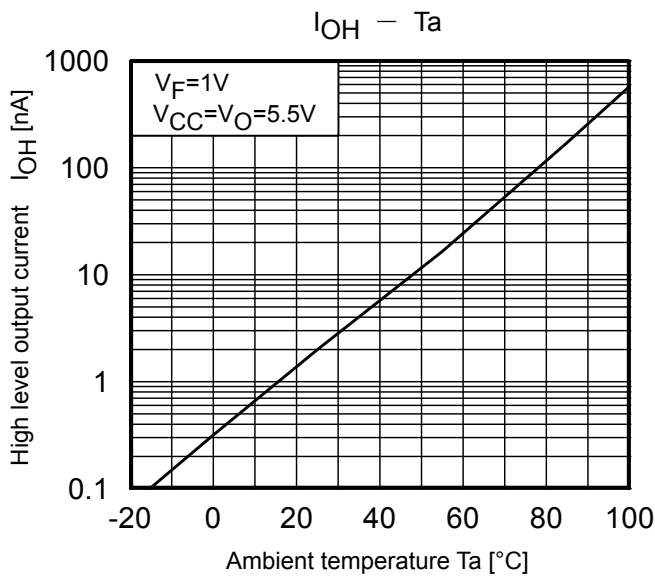
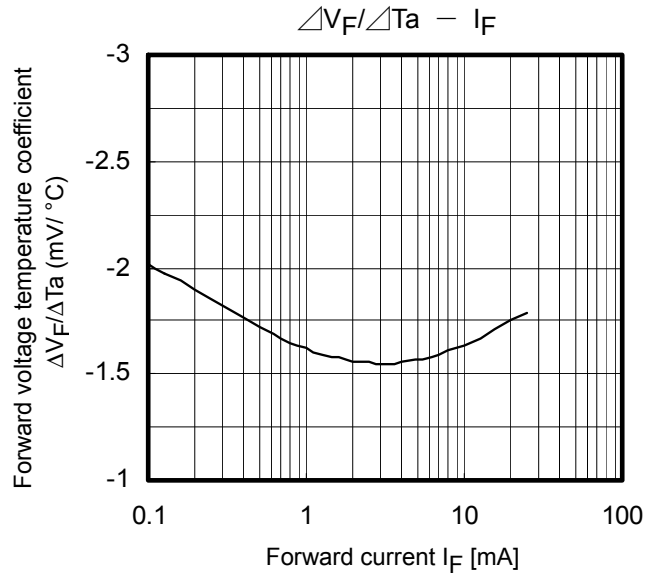
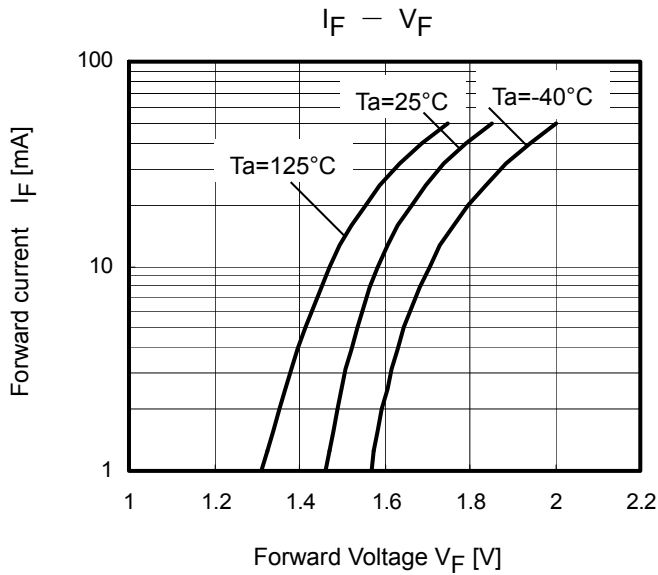
**Test Circuit 1: Switching Time Test Circuit**



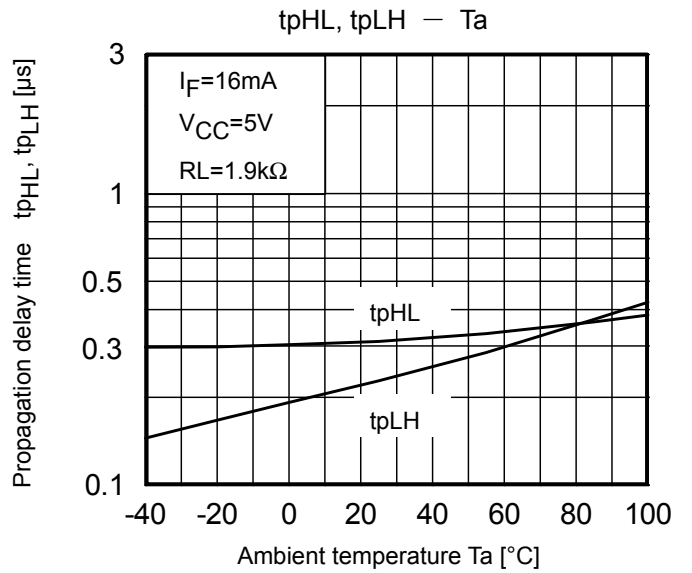
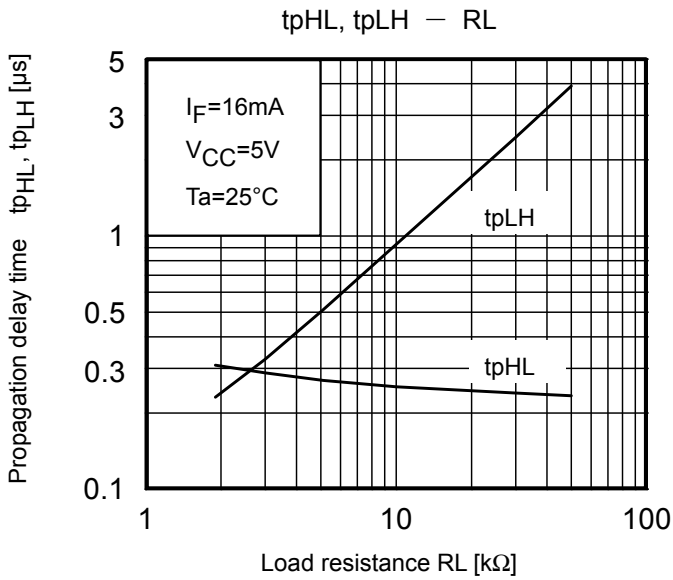
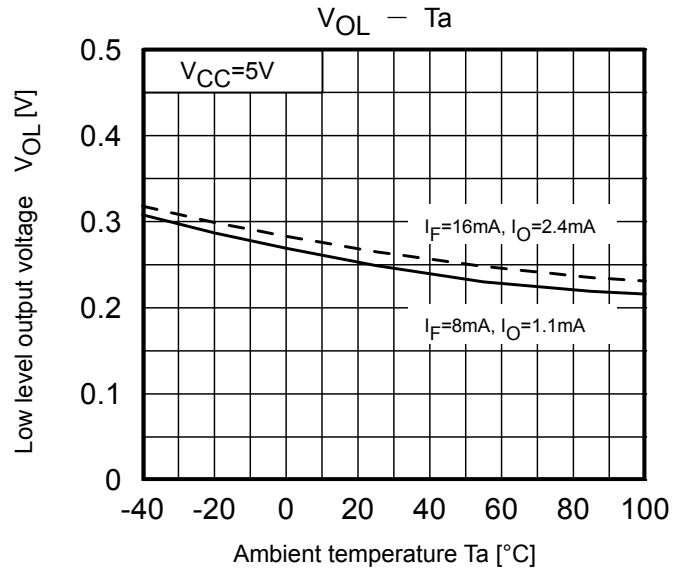
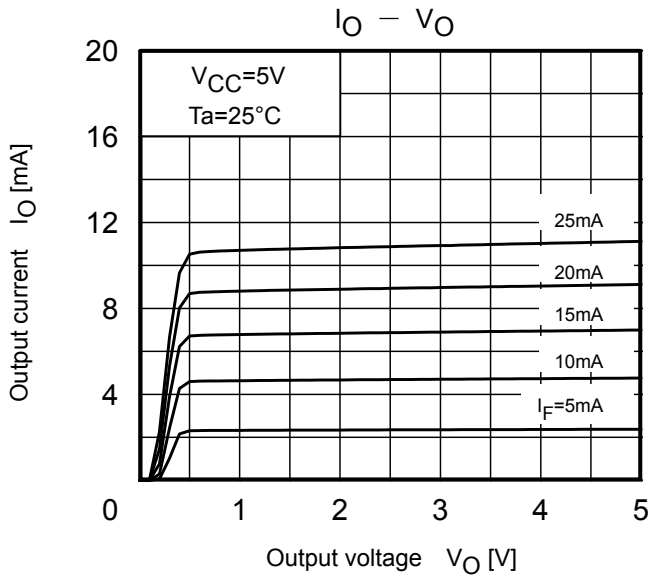
**Test Circuit 2: Common Mode Transient Immunity Test Circuit**



$$CM_{Hi} = \frac{320(V)}{t_r(\mu s)}, \quad CM_{Li} = \frac{320(V)}{t_f(\mu s)}$$



\* The above graphs show typical characteristics.



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

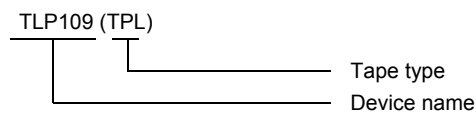
**1. Applicable Package**

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)



**3. Tape Dimensions**

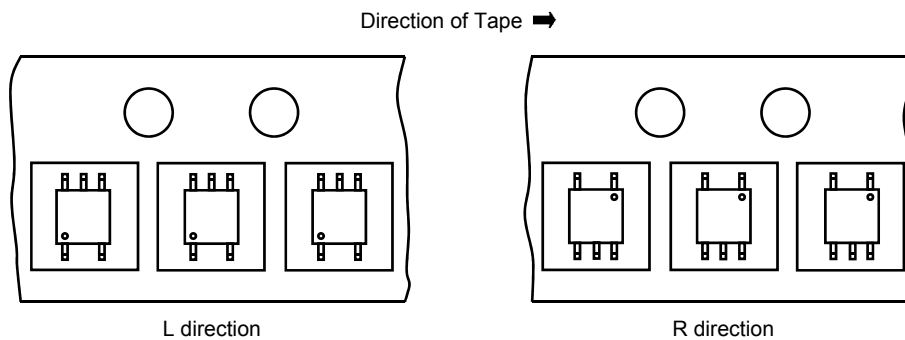
**3.1 Specification Classification Are as Shown in Table 1**

**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**

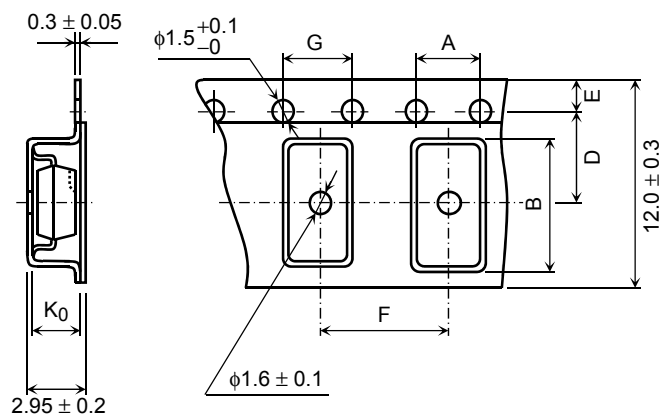
	Standard	Remarks
Occurrences of 2 or more successive empty device recesses	0	Within any given 40-mm section of tape, not including leader and trailer
Single empty device recesses	6 devices (max) per reel	Not including leader and trailer

**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**

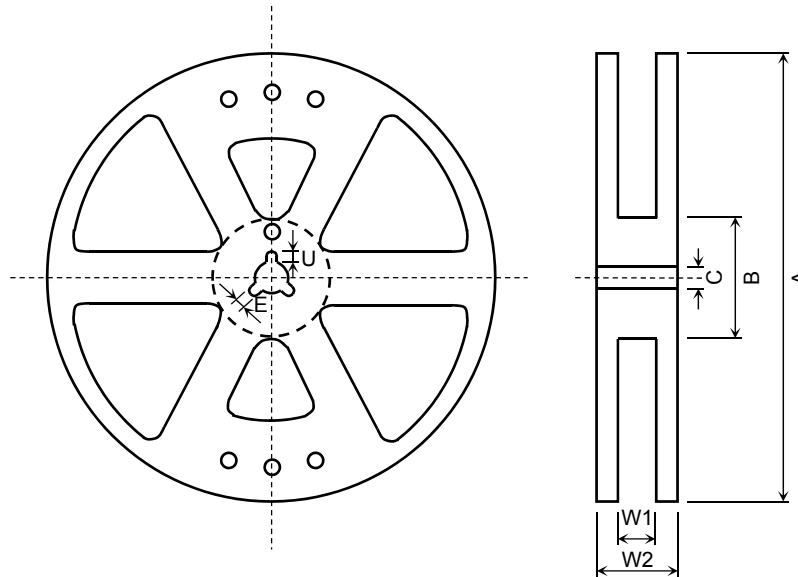
Unit: mm  
Unless otherwise specified: ±0.1

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
K <sub>0</sub>	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.

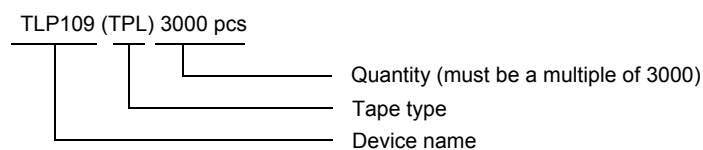
**5. Label Indication**

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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