

# TLP2409

## 1. Applications

- High-Speed Digital Interfacing for Instrumentation and Control Devices
- Industrial Inverters
- Switching Power Supplies

## 2. General

The Toshiba TLP2409 consists of a high output power infrared LED coupled with a high-speed photodiode-transistor chip. It is housed in the SO8 package. The TLP2409 features an operating temperature range of up to 125°C, making it ideal for applications like DC-DC converters and industrial equipment which require operations at high temperatures.

## 3. Features

- (1) Package: SO8
- (2) Propagation delay time:  $t_{pHL} = 0.8 \mu s$ ,  $t_{pLH} = 0.8 \mu s$  (max) @  $R_L = 1.9 k\Omega$
- (3) Operating temperature: -55 to 125 °C
- (4) Isolation voltage: 3750 Vrms (min)
- (5) TTL-compatible
- (6) Safety standards

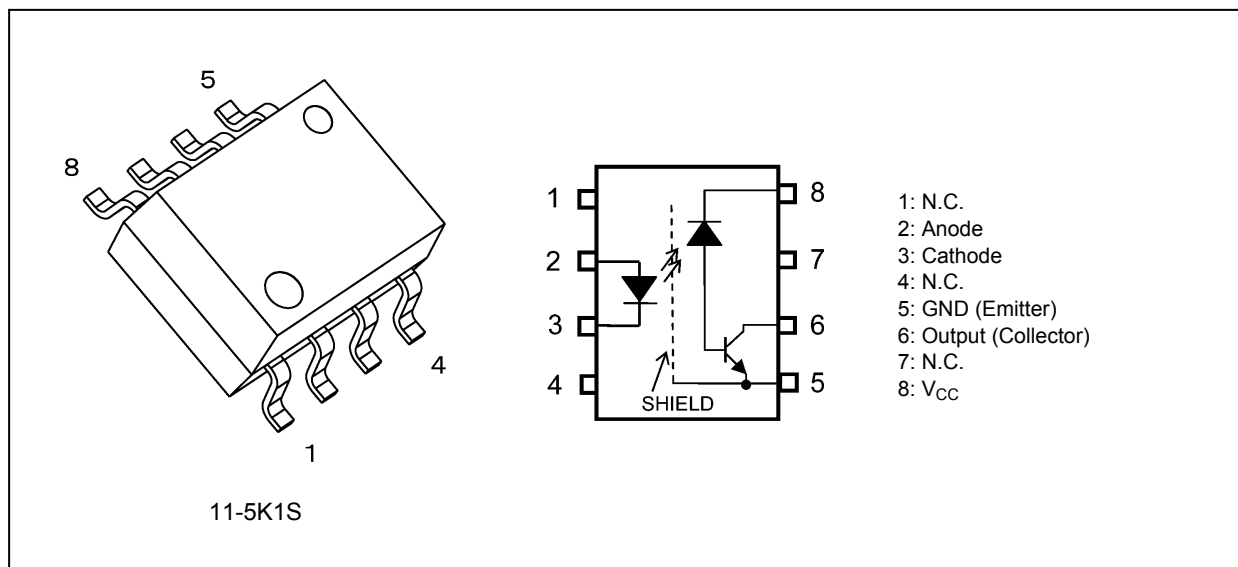
UL-recognized: UL 1577, File No.E67349

cUL-recognized: CSA Component Acceptance Service No.5A File No.E67349

VDE-approved: EN 60747-5-5 (**Note 1**)

Note 1: When a VDE approved type is needed, please designate the **Option (V4)**.

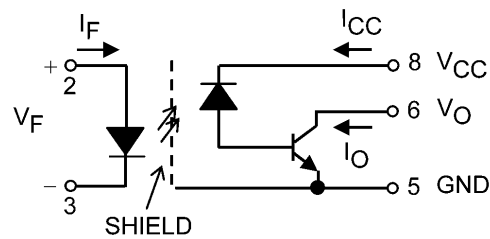
## 4. Packaging and Pin Assignment



Start of commercial production

2010-03

### 5. Internal Circuit (Note)



Note: A 0.1 $\mu$ F bypass capacitor must be connected between pin 8 and pin 5.

### 6. Principle of Operation

#### 6.1. Mechanical Parameters

Characteristics	Min	Unit
Creepage distances	4.0	mm
Clearance	4.0	
Internal isolation thickness	—	

### 7. Absolute Maximum Ratings (Note) (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ )

	Characteristics	Symbol	Note	Rating	Unit
LED	Input forward current ( $T_a \leq 110\text{ }^\circ\text{C}$ )	$I_F$		25	mA
	Input forward current derating ( $T_a \geq 110\text{ }^\circ\text{C}$ )	$\Delta I_F / \Delta T_a$		-0.67	mA/ $^\circ\text{C}$
	Input forward current (pulsed) ( $T_a \leq 110\text{ }^\circ\text{C}$ )	$I_{FP}$	(Note 1)	50	mA
	Input forward current derating (pulsed) ( $T_a \geq 110\text{ }^\circ\text{C}$ )	$\Delta I_{FP} / \Delta T_a$		-1.34	mA/ $^\circ\text{C}$
	Input reverse voltage	$V_R$		5	V
	Input power dissipation ( $T_a \leq 110\text{ }^\circ\text{C}$ )	$P_D$		40	mW
	Input power dissipation derating ( $T_a \geq 110\text{ }^\circ\text{C}$ )	$\Delta P_D / \Delta T_a$		-1.0	mW/ $^\circ\text{C}$
Detector	Output current ( $T_a \leq 95\text{ }^\circ\text{C}$ )	$I_O$		16	mA
	Output current derating ( $T_a \geq 95\text{ }^\circ\text{C}$ )	$\Delta I_O / \Delta T_a$		-0.3	mA/ $^\circ\text{C}$
	Output voltage	$V_O$		-0.5 to 20	V
	Supply voltage	$V_{CC}$		-0.5 to 30	
	Output power dissipation ( $T_a \leq 95\text{ }^\circ\text{C}$ )	$P_O$		100	mW
	Output power dissipation derating ( $T_a \geq 95\text{ }^\circ\text{C}$ )	$\Delta P_O / \Delta T_a$		-1.8	mW/ $^\circ\text{C}$
Common	Operating temperature	$T_{opr}$		-55 to 125	$^\circ\text{C}$
	Storage temperature	$T_{stg}$		-55 to 150	
	Lead soldering temperature (10 s)	$T_{sol}$		260	
	Isolation voltage AC, 60 s, R.H. $\leq 60\%$	$BV_S$	(Note 2)	3750	

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: Pulse width (PW)  $\leq 1\text{ ms}$ , duty = 50 %

Note 2: This device is considered as a two-terminal device: Pins 1, 2, 3 and 4 are shorted together, and pins 5, 6, 7 and 8 are shorted together.

## 8. Recommended Operating Conditions (Note)

Characteristics	Symbol	Note	Min	Typ.	Max	Unit
Input forward current	$I_F$		—	—	15	mA
Output current	$I_O$		—	—	7	
Operating temperature	$T_{opr}$		-55	—	125	°C

Note: The recommended operating conditions are given as a design guide necessary to obtain the intended performance of the device. Each parameter is an independent value. When creating a system design using this device, the electrical characteristics specified in this datasheet should also be considered.

## 9. Electrical Characteristics (Note) (Unless otherwise specified, $T_a = 25\text{ °C}$ )

Characteristics	Symbol	Note	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Input forward voltage	$V_F$		—	$I_F = 16\text{ mA}$	1.40	1.57	1.80	V
Input forward voltage temperature coefficient	$\Delta V_F/\Delta T_a$		—	$I_F = 16\text{ mA}$	—	-2	—	mV/°C
Input reverse current	$I_R$		—	$V_R = 3\text{ V}$	—	—	10	μA
Input capacitance	$C_t$		—	$V_F = 0\text{ V}, f = 1\text{ MHz}$	—	60	—	pF
High-level output current	$I_{OH}$		—	$I_F = 0\text{ mA}, V_{CC} = V_O = 5.5\text{ V}$	—	3	500	nA
				$I_F = 0\text{ mA}, V_{CC} = 30\text{ V}, V_O = 20\text{ V}$	—	—	5	μA
				$I_F = 0\text{ mA}, V_{CC} = 30\text{ V}, V_O = 20\text{ V}, T_a = 100\text{ °C}$	—	—	50	
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
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	—	—	%
High-level supply current	$I_{CCH}$		—	$I_F = 0\text{ mA}, V_{CC} = 30\text{ V}$	—	0.01	1	μA

Note: All typical values are at  $T_a = 25\text{ °C}$ .

## 10. Isolation Characteristics (Unless otherwise specified, $T_a = 25\text{ °C}$ )

Characteristics	Symbol	Note	Test Conditions	Min	Typ.	Max	Unit
Total capacitance (input to output)	$C_S$	(Note 1)	$V_S = 0\text{ V}, f = 1\text{ MHz}$	—	1.0	—	pF
Isolation resistance	$R_S$	(Note 1)	$V_S = 500\text{ V}, R.H. \leq 60\%$	$10^{12}$	$10^{14}$	—	Ω
Isolation voltage	$BV_S$		AC, 60 s	3750	—	—	Vrms

Note 1: This device is considered as a two-terminal device: Pins 1, 2, 3 and 4 are shorted together, and pins 5, 6, 7 and 8 are shorted together.

## 11. Switching Characteristics (Unless otherwise specified, $T_a = 25\text{ °C}, V_{CC} = 5\text{ V}$ )

Characteristics	Symbol	Note	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Propagation delay time (H/L)	$t_{pHL}$		Fig 12.1.1	$I_F = 0 \rightarrow 16\text{ mA}, R_L = 1.9\text{ k}\Omega$	—	—	0.8	μs
Propagation delay time (L/H)	$t_{pLH}$			$I_F = 16 \rightarrow 0\text{ mA}, R_L = 1.9\text{ k}\Omega$	—	—	0.8	
High-level common-mode transient immunity	$CM_H$	(Note 1)	Fig 12.1.2	$I_F = 0\text{ mA}, R_L = 4.1\text{ k}\Omega, V_{CM} = 400\text{ V}_{p-p}$	5000	10000	—	V/μs
Low-level common-mode transient immunity	$CM_L$	(Note 2)		$I_F = 16\text{ mA}, R_L = 4.1\text{ k}\Omega, V_{CM} = 400\text{ V}_{p-p}$	-5000	-10000	—	

Note 1:  $CM_H$  is the maximum rate of rise of the common mode voltage that can be sustained with the output voltage in the logic high state ( $V_O > 2.0\text{ V}$ ).

Note 2:  $CM_L$  is the maximum rate of fall of the common mode voltage that can be sustained with the output voltage in the logic low state ( $V_O < 0.8\text{ V}$ ).

## 12. Test Circuits and Characteristics Curves

### 12.1. Test Circuits

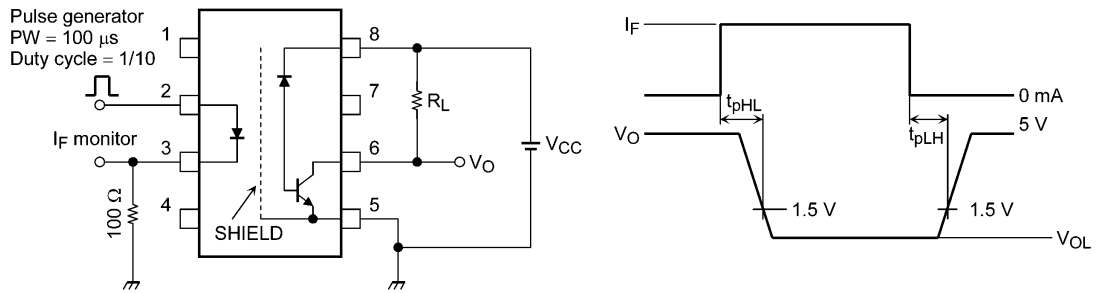


Fig. 12.1.1 Switching Time Test Circuit and Waveform

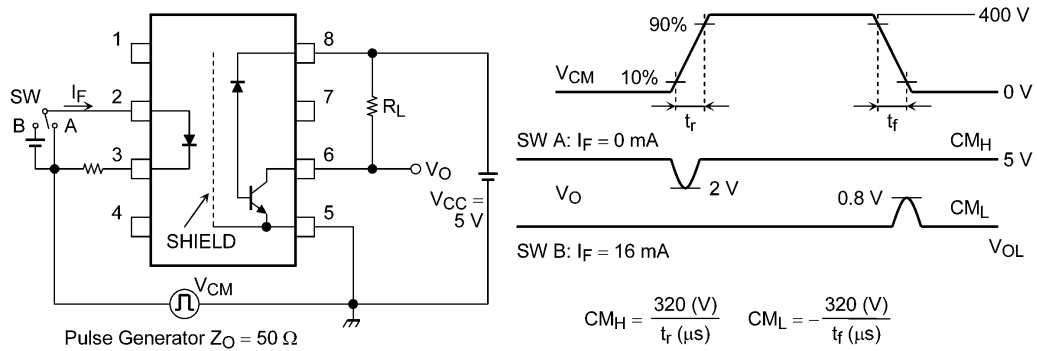


Fig. 12.1.2 Common-Mode Transient Immunity Test Circuit and Waveform

## 13. Soldering and Storage

### 13.1. 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.

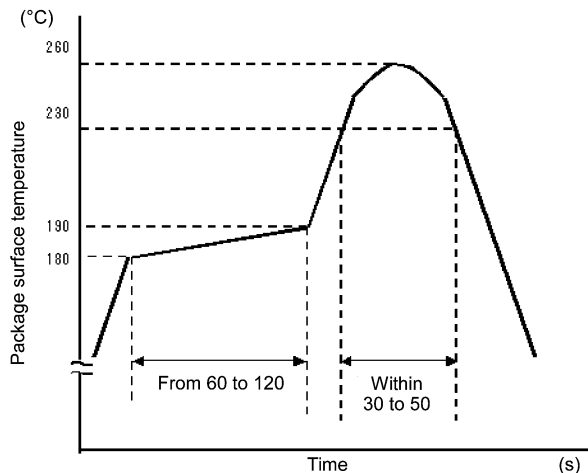
- When using soldering reflow.

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.



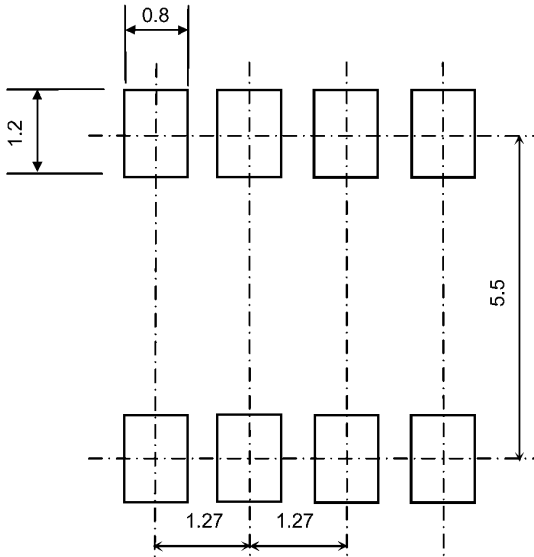
**Fig. 13.1.1 An example of a temperature profile when lead(Pb)-free solder is used**

- 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.
- 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 done only once per lead.

### 13.2. Precautions for General Storage

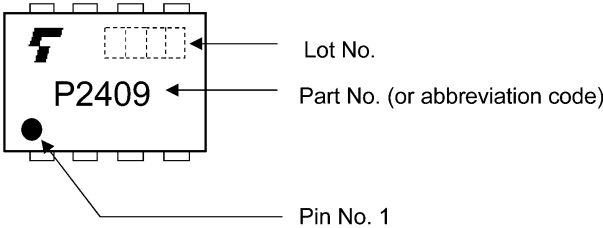
- Avoid storage locations where devices may be exposed to moisture or direct sunlight.
- Follow the precautions printed on the packing label of the device for transportation and storage.
- Keep the storage location temperature and humidity within a range of 5°C to 35°C and 45% to 75%, respectively.
- Do not store the products in locations with poisonous gases (especially corrosive gases) or in dusty conditions.
- Store the products in locations with minimal temperature fluctuations. Rapid temperature changes during storage can cause condensation, resulting in lead oxidation or corrosion, which will deteriorate the solderability of the leads.
- When restoring devices after removal from their packing, use anti-static containers.
- Do not allow loads to be applied directly to devices while they are in storage.
- If devices have been stored for more than two years under normal storage conditions, it is recommended that you check the leads for ease of soldering prior to use.

14. Land Pattern Dimensions for Reference Only



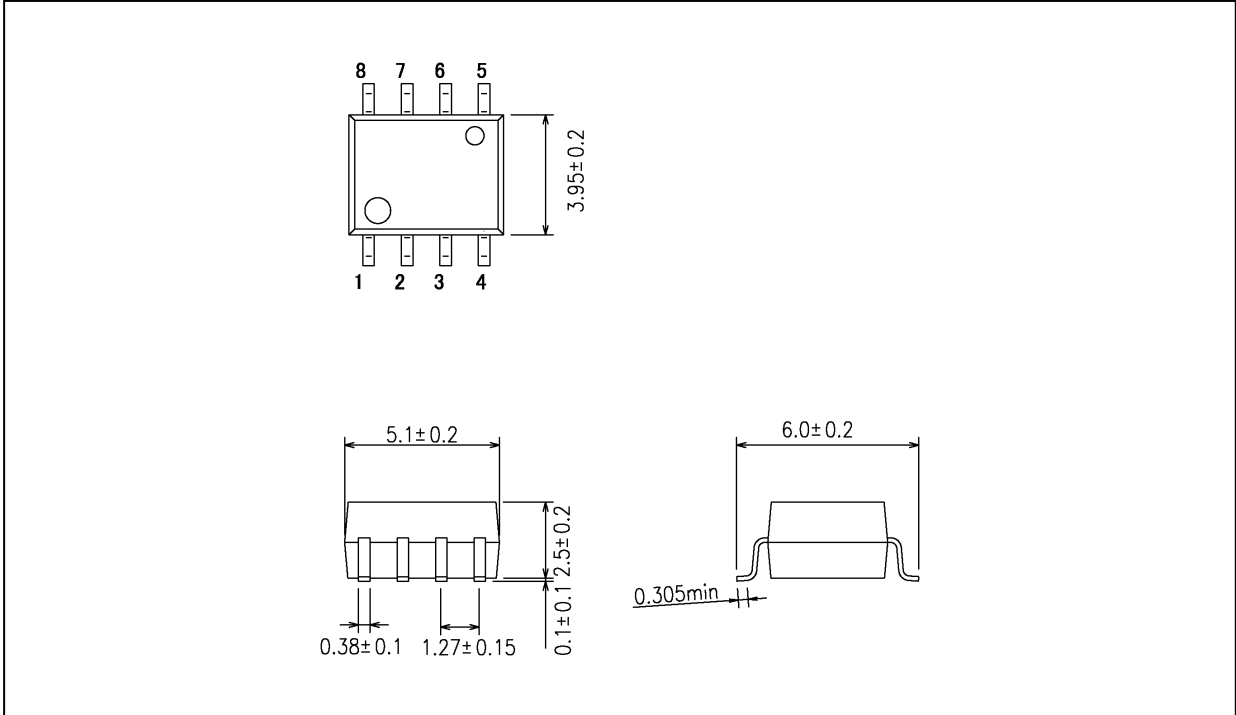
Unit: mm

15. Marking



Package Dimensions

Unit: mm



Weight: 0.11 g (typ.)

Package Name(s)
TOSHIBA: 11-5K1S

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