TOSHIBA Photocoupler IRED + Photo IC

TLP151

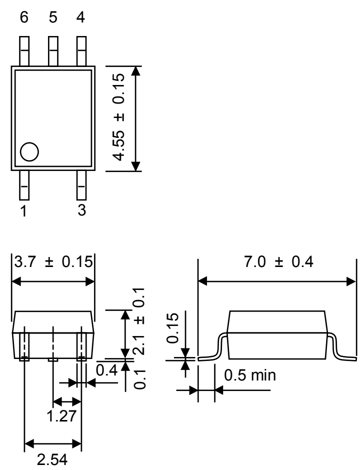
Industrial Inverter
MOS FET / IGBT Gate Driver
IH(Induction Heating)
Operate at high ambient temperatures up to 110°C

The Toshiba TLP151 consists of an infrared LED and integrated high gain, high-speed photodetectors. The TLP151 is housed in the SO6 package.
The photodetector has an internal Faraday shield that provides a guaranteed common-mode transient immunity of ±15 kV/μs. TLP151 is suitable for direct gate driving circuit for IGBTs or power MOSFETs.

- Buffer logic type (Totem pole output)
- Package type: SO6
- Peak Output Current : I_{OP} = ±0.6 A (max)
- Guaranteed performance over temperature: -40 to 110°C
- Power supply voltage: 10 to 30 V
- Threshold Input Current: I_{FLH} = 5.0 mA (max)
- Propagation delay time : t_{pLH} / t_{pHL} = 700 ns (max)
- Common mode transient immunity : ±15 kV/μs (min)
- Isolation voltage : 3750 V_{rms} (min)
- UL-recognized : UL 1577, File No.E67349
- cUL-recognized : CSA Component Acceptance Service No.5A File No.E67349
- VDE-approved : EN 60747-5-5 ,EN 62368-1 (Note 1)

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

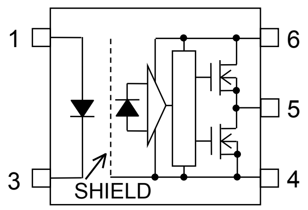
Unit: mm



JEDEC	—
JEITA	—
TOSHIBA	11-4L1

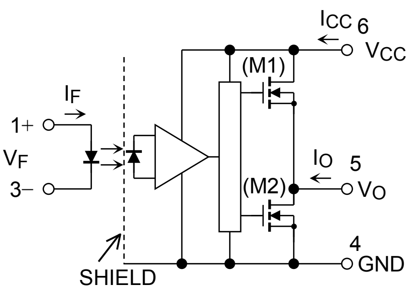
Weight: 0.08 g (typ.)

Pin Configuration (Top View)



1: ANODE
3: CATHODE
4: GND
5: V_O (Output)
6: V_{CC}

Schematic



Truth Table

Input	LED	M1	M2	Output
H	ON	ON	OFF	H
L	OFF	OFF	ON	L

Construction Mechanical Ratings

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

Start of commercial production
2009-10

Absolute Maximum Ratings (Ta = 25 °C)

	Characteristic	Symbol	Rating	Unit
LED	Forward Current	I_F	25	mA
	Forward Current Derating (Ta ≥ 95°C)	ΔI_F /°C	-0.67	mA/°C
	Peak Transient Forward Current (Note 1)	I_{FPT}	50	mA
	Peak Transient Forward Current Derating (Ta ≥ 95°C)	ΔI_{FPT} /°C	-1.34	mA/°C
	Diode Power Dissipation	P_D	40	mW
	Diode Power Dissipation Derating (Ta ≥ 95°C)	$\Delta P_D/\Delta Ta$	-1.3	mW/°C
	Reverse Voltage	V_R	5	V
Detector	"H" Peak Output Current (Note 2)	I_{OPH}	-0.6	A
	"L" Peak Output Current (Note 2)	I_{OPL}	0.6	A
	Output Voltage	V_O	35	V
	Supply Voltage	V_{CC}	35	V
	Output Power Dissipation	P_O	80	mW
	Output Power Dissipation Derating (Ta ≥ 95°C)	$\Delta P_O/\Delta Ta$	-2.0	mW/°C
Operating Temperature Range		T_{opr}	-40 to 110	°C
Storage Temperature Range		T_{stg}	-55 to 125	°C
Lead Soldering Temperature (10 s)		T_{sol}	260	°C
Isolation Voltage (AC,60 s, R.H.≤ 60 %) (Note 3)		BV_S	3750	V_{rms}

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 ≤ 1 ms, duty = 50 %.

Note 2: Exponential waveform pulse width P_W ≤ 2 μs, f ≤ 10 kHz

Note 3: This device is regarded as a two terminal device: pins 1 and 3 are shorted together, as are pins 4, 5 and 6.

Recommended Operating Conditions

Characteristic	Symbol	Min	Typ.	Max	Unit
Input Current, High Level (Note 1)	I_{FLH}	7.5	-	15	mA
Input Voltage, Low Level	V_{FHL}	0	-	0.8	V
Supply Voltage (Note 2)	V_{CC}	10	-	30	V
Peak output current	I_{OPH}/ I_{OPL}	-	-	±0.2	A
Operating Temperature	T_{opr}	-40	-	110	°C

Note: Recommended operating conditions are given as a design guideline to obtain expected performance of the device. Additionally, each item is an independent guideline respectively. In developing designs using this product, please confirm specified characteristics shown in this document.

Note 1: Input signal rise time (fall time) < 0.5 μs.

Note 2: This item denotes operating range, not meaning of recommended operating conditions. A steep rising slope of the V_{CC} may cause an unstable operation of the device. Therefore please design the V_{CC} rise slope under 3.0 V/μs.

Electrical Characteristics (Ta = −40 to 110 °C, unless otherwise specified)

Characteristics		Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit
Forward voltage		V_F	—	I_F = 10 mA, Ta = 25 °C		1.45	1.61	1.85	V
Temperature coefficient of forward voltage		$\Delta V_F/\Delta Ta$	—	I_F = 10 mA		—	−1.8	—	mV/°C
Input reverse current		I_R	—	V_R = 5 V, Ta = 25 °C		—	—	10	μA
Input capacitance		C_T	—	V = 0 V, f = 1 MHz		—	60	—	pF
Output current (Note 1)	"H" Level	I_{OPH1}	Figure 1	V_{CC} = 15 V, I_F = 5 mA	V_{6-5} = 4 V	−0.2	−0.4	—	A
		I_{OPH2}			V_{6-5} = 10 V	−0.4	—	—	
	"L" Level	I_{OPL1}	Figure 2	V_{CC} = 15 V, I_F = 0 mA	V_{5-4} = 2 V	0.2	0.5	—	
		I_{OPL2}			V_{5-4} = 10 V	0.4	—	—	
Output voltage	"H" Level	V_{OH}	Figure 3	V_{CC} = 10 V	I_O = −100 mA, I_F = 5 mA	6.0	8.5	—	V
	"L" Level	V_{OL}	Figure 4		I_O = 100 mA, V_F = 0.8 V	—	0.35	1.0	
Supply current	"H" Level	I_{CCH}	Figure 5	V_{CC} = 10 to 30 V, V_O = Open	I_F = 10 mA	—	1.1	2.0	mA
	"L" Level	I_{CCL}	Figure 6		I_F = 0 mA	—	1.1	2.0	
Threshold input current	L → H	I_{FLH}	—	V_{CC} = 15 V, V_O > 1 V		—	1.2	5	mA
Threshold input voltage	H → L	V_{FHL}	—	V_{CC} = 15 V, V_O < 1 V		0.8	—	—	V
Supply voltage		V_{CC}	—	—		10	—	30	V

Note: All typical values are at Ta = 25 °C, V_{CC} = 10 V unless otherwise specified

Note 1: Duration of I_O time ≤ 50 μs, 1 pulse

Isolation Characteristics (Ta = 25 °C)

Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit
Capacitance input to output	C_S (Note 1)	V_S = 0 V , f = 1MHz	—	0.8	—	pF
Isolation resistance	R_S (Note 1)	R.H. ≤ 60 %, V_S = 500 V	10^{12}	10^{14}	—	Ω
Isolation voltage	BV_S (Note 1)	AC, 60 s	3750	—	—	V_{rms}

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

Switching Characteristics (Ta = −40 to 110 °C, unless otherwise specified)

Characteristics		Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit
Propagation delay time	L → H	t_{pLH}	Figure 7	V_{CC} = 30 V, R_g = 47 Ω, C_g = 3 nF	I_F = 0 → 5 mA	100	—	700	ns
	H → L	t_{pHL}			I_F = 5 → 0 mA	100	—	700	
Output rise time (10−90 %)		tr			I_F = 0 → 5 mA	—	50	—	
Output fall time (90−10 %)		tf			I_F = 5 → 0 mA	—	50	—	
Switching time dispersion between ON and OFF		$\lvert t_{pHL}-t_{pLH} \rvert$			I_F = 0 ↔ 5 mA	—	—	500	
Common mode transient immunity at HIGH level output		CM_H	Figure 8	V_{CM} =1000 Vp-p, V_{CC} = 30 V, Ta = 25 °C	I_F = 5 mA, $V_{O\,(min)}$ = 26 V	−15	—	—	kV/μs
Common mode transient immunity at LOW level output		CM_L			I_F = 0 mA, $V_{O\,(max)}$ = 1 V	15	—	—	

Note: All typical values are at Ta = 25 °C.

Note: A ceramic capacitor (0.1 μF) should be connected from pin 6 (V_{CC}) to pin 4 (GND) to stabilize the operation of the high gain linear amplifier. Failure to provide the bypass may impair the switching property. The total lead length between capacitor and coupler should not exceed 1 cm.

Figure 1: I_{OPH} Test Circuit

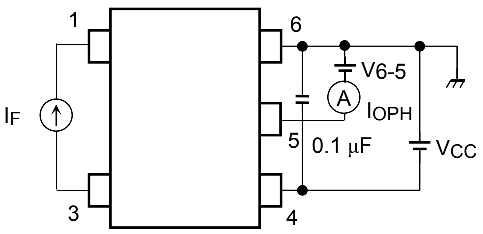


Figure 2: I_{OPL} Test Circuit

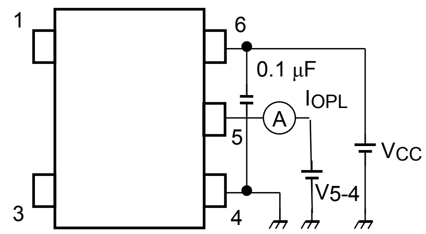
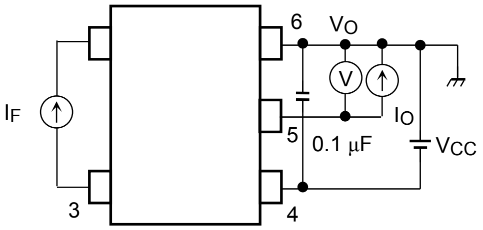


Figure 3: V_{OH} Test Circuit



*V_{OH} = V_{CC}-V_O

Figure 4: V_{OL} Test Circuit

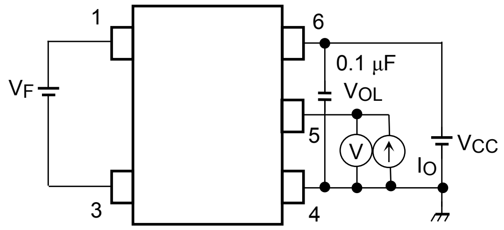


Figure 5: I_{CCH} Test Circuit

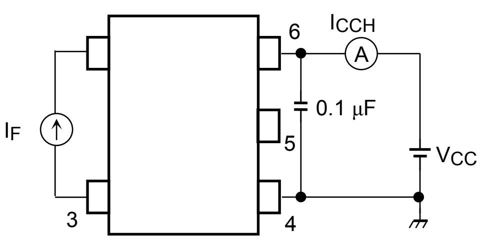


Figure 6: I_{CCL} Test Circuit

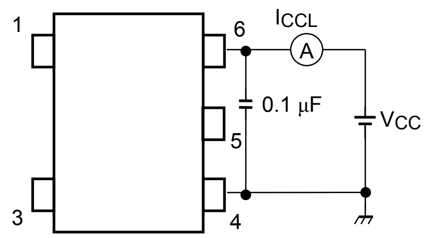


Figure 7: t_{pLH}, t_{pHL}, t_r, t_f, $|t_{pHL}-t_{pLH}|$ Test Circuit

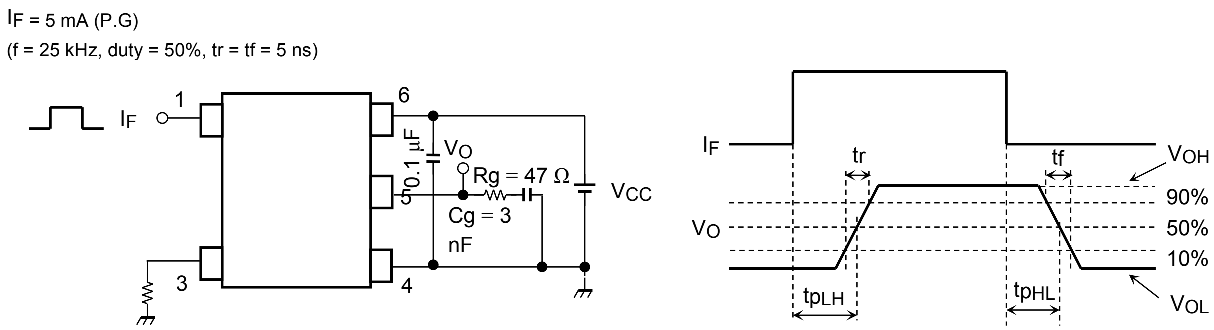
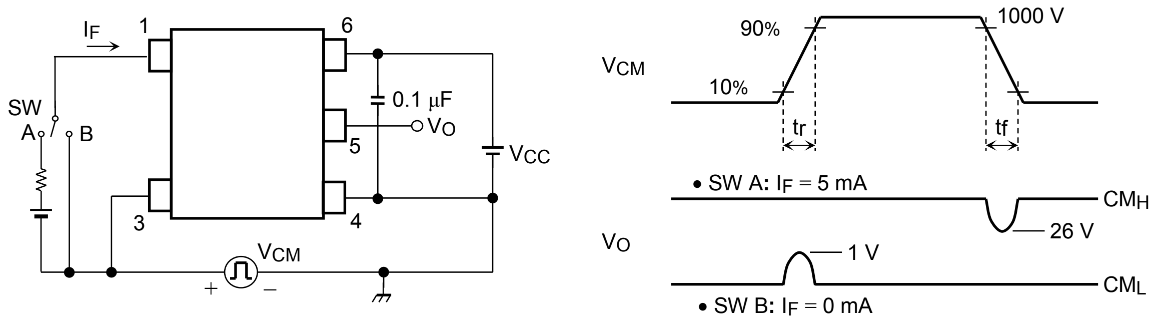


Figure 8: CM_H, CM_L Test Circuit



$$CM_L = \frac{800\ \text{V}}{t_r\ (\mu s)}$$

$$CM_H = -\frac{800\ \text{V}}{t_f\ (\mu s)}$$

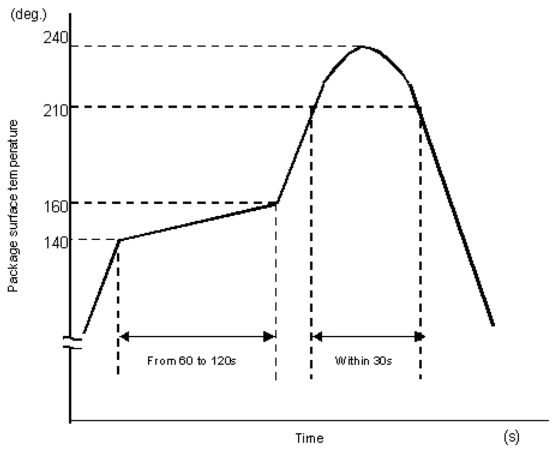
CM_L (CM_H) is the maximum rate of rise (fall) of the common mode voltage that can be sustained with the output voltage in the LOW (HIGH) state.

PRECAUTIONS OF SURFACE MOUNTING TYPE PHOTOCOUPLER SOLDERING & GENERAL STORAGE

(1) Precautions for Soldering

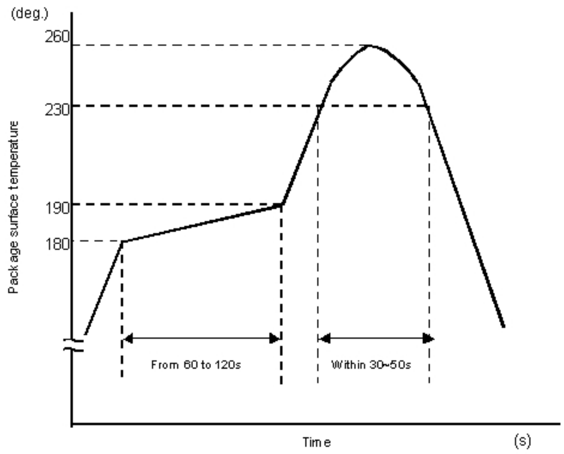
1) When Using Soldering Reflow

- An example of a temperature profile when Sn-Pb eutectic solder is used:



This profile is based on the device's maximum heat resistance guaranteed value.
Set the preheat temperature/heating temperature to the optimum temperature corresponding to the solder paste type used by the customer within the described profile.

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



This profile is based on the device's maximum heat resistance guaranteed value.
Set the preheat temperature/heating temperature to the optimum temperature corresponding to the solder paste type used by the customer within the described profile.

- 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 (Applicable to both eutectic solder and Lead(Pb)-Free solder)

- 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 (Applicable to both eutectic solder and Lead(Pb)-Free solder)

- 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.

(2) Precautions for General Storage

1) Do not store devices at any place where they will be exposed to moisture or direct sunlight.

2) When transportation or storage of devices, follow the cautions indicated on the carton box.

3) The storage area temperature should be kept within a temperature range of 5 °C to 35 °C, and relative humidity should be maintained at between 45% and 75%.

4) Do not store devices in the presence of harmful (especially corrosive) gases, or in dusty conditions.

5) Use storage areas where there is minimal temperature fluctuation. Because rapid temperature changes can cause condensation to occur on stored devices, resulting in lead oxidation or corrosion, as a result, the solderability of the leads will be degraded.

6) When repacking devices, use anti-static containers.

7) Do not apply any external force or load directly to devices while they are in storage.

8) If devices have been stored for more than two years, even though the above conditions have been followed, it is recommended that solderability of them should be tested before they are used.

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