Photocouplers GaAlAs Infrared LED & Photo IC

TLP152

1. Applications

- Plasma Display Panels (PDPs)
- Transistor Inverters
- MOSFET Gate Drivers
- IGBT Gate Drivers

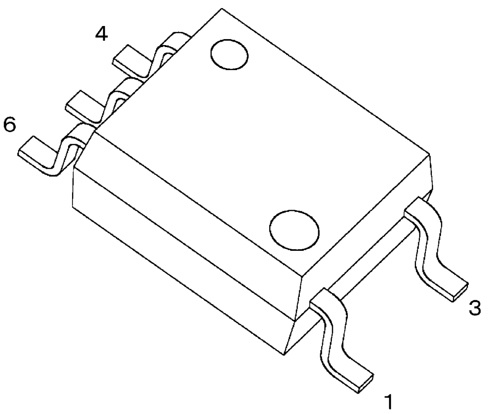
2. General

The TLP152 is a photocoupler in a SO6 package that consists of a GaAlAs infrared light-emitting diode(LED) optically coupled to an integrated high-gain, high-speed photodetector IC chip.

3. Features

(1) Buffer logic type (Totem pole output)
(2) Output peak current: ±2.5 A (max)
(3) Operating temperature: -40 to 100 ℃
(4) Supply current: 3 mA (max)
(5) Supply voltage: 10 to 30 V
(6) Threshold input current: 7.5 mA(max)
(7) Propagation delay time: t_{pHL} = 190 ns (max), t_{pLH} = 170 ns (max)
(8) Common-mode transient immunity: ±20 kV/μs (min)
(9) Isolation voltage: 3750 Vrms (min)

4. Packaging and Pin Assignment



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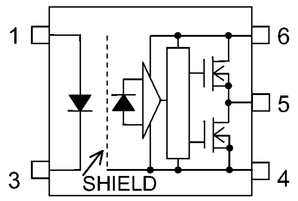


1: Anode
3: Cathode
4: GND
5: V_O(Output)
6: V_{CC}

5. Internal Circuit (Note)

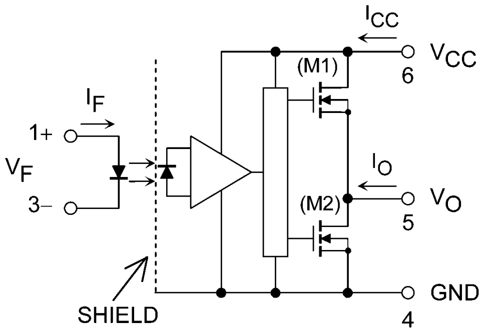


Fig. 5.1 Internal Circuit

Note: A 0.1-μF bypass capacitor must be connected between pin 6 and pin 4.

6. Principle of Operation

6.1. Truth Table

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

6.2. Mechanical Parameters

Characteristics	Min	Unit
Creepage distances	5.0 (min)	mm
Clearance distances	5.0 (min)	
Internal isolation thickness	0.4 (min)	

7. Absolute Maximum Ratings (Note) (Unless otherwise specified, T_a = 25°C)

	Characteristics		Symbol	Note	Rating	Unit
LED	Input forward current		I_F		20	mA
	Peak transient input forward current		I_{FPT}	(Note 1)	1	A
	Input reverse voltage		V_R		5	V
	Input power dissipation		P_D		40	mW
Detector	Peak high-level output current	(T_a = -40 to 100°C)	I_{OPH}	(Note 2)	-2.5	A
	Peak low-level output current	(T_a = -40 to 100°C)	I_{OPL}	(Note 2)	+2.5	
	Output voltage		V_O		35	V
	Supply voltage		V_{CC}		35	
	Output power dissipation		P_O		260	mW
Common	Operating temperature		T_{opr}		-40 to 100	°C
	Storage temperature		T_{stg}		-55 to 125	
	Lead soldering temperature	(10 s)	T_{sol}	(Note 3)	260	
	Isolation voltage	AC, 1 min, R.H. ≤ 60%, T_a = 25°C	BV_S	(Note 4)	3750	Vrms

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) ≤ 1 μs, 300 pps

Note 2: Exponential waveform. Pulse width ≤ 0.2 μs, f ≤ 15 kHz, VCC = 20V, Ta = -40°C to 100 °C
Exponential waveform. Pulse width ≤ 0.08 μs, f ≤ 25 kHz, VCC = 15V, Ta = -40°C to 100 °C

Note 3: ≥ 2 mm below seating plane.

Note 4: 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.

8. Recommended Operating Conditions (Note)

Characteristics	Symbol	Note	Min	Typ.	Max	Unit
Input on-state current	$I_{F(ON)}$	(Note 1)	10	—	15	mA
Input off-state voltage	$V_{F(OFF)}$		0	—	0.8	V
Peak high-level output current	I_{OPH}		—	—	-2.0	A
Peak low-level output current	I_{OPL}		—	—	+2.0	
Operating frequency	f	(Note 2)	—	—	250	kHz

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.

Note: A ceramic capacitor (0.1 μF) should be connected between pin 6 and pin 4 to stabilize the operation of a high-gain linear amplifier. Otherwise, this photocoupler may not switch properly. The bypass capacitor should be placed within 1 cm of each pin.

Note 1: The rise and fall times of the input on-current should be less than 0.5 μs.

Note 2: Exponential waveform. I_{OPH} ≥ -0.65 A (≤ 80 ns), I_{OPL} ≤ 0.65 A (≤ 80 ns), T_a = 100°C, V_{CC} = 20V

9. Electrical Characteristics (Note) (Unless otherwise specified, T_a = -40 to 100°C)

Characteristics	Symbol	Note	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Input forward voltage	V_F		—	I_F = 10 mA, T_a = 25°C	1.40	1.57	1.80	V
Input forward voltage temperature coefficient	$\Delta V_F/\Delta T_a$		—	I_F = 10 mA	—	-1.8	—	mV/°C
Input reverse current	I_R		—	V_R = 5 V, T_a = 25°C	—	—	10	μA
Input capacitance	C_t		—	V = 0 V, f = 1 MHz, T_a = 25°C	—	45	—	pF
Peak high-level output current	I_{OPH}	(Note 1)	Fig. 12.1.1	I_F = 10 mA, V_{CC} = 15 V, V_{6-5} = 4 V	—	-2.2	-1.0	A
				I_F = 10 mA, V_{CC} = 15 V, V_{6-5} = 10 V	—	-3.4	-2.0	
Peak low-level output current	I_{OPL}	(Note 1)	Fig. 12.1.2	I_F = 0 mA, V_{CC} = 15 V, V_{5-4} = 2 V	1.0	2.4	—	
				I_F = 0 mA, V_{CC} = 15 V, V_{5-4} = 10 V	2.0	3.5	—	
High-level output voltage	V_{OH}		Fig. 12.1.3	I_F = 10 mA, V_{CC} = 10 V, I_O = -100 mA	6.0	8.5	—	V
Low-level output voltage	V_{OL}		Fig. 12.1.4	V_F = 0.8 V, V_{CC} = 10 V, I_O = 100 mA	—	0.1	1.0	
High-level supply current	I_{CCH}		Fig. 12.1.5	I_F = 10 mA, V_{CC} = 10 to 30 V, V_O = Open	—	1.9	3.0	mA
Low-level supply current	I_{CCL}		Fig. 12.1.6	I_F = 0 mA, V_{CC} = 10 to 30 V, V_O = Open	—	1.8	3.0	
Threshold input current (L/H)	I_{FLH}		—	V_{CC} = 15 V, V_O > 1 V	—	1.5	7.5	
Threshold input voltage (H/L)	V_{FHL}		—	V_{CC} = 15 V, V_O < 1 V	0.8	1.47	—	V
Supply voltage	V_{CC}		—	—	10	—	30	
UVLO threshold voltage	V_{UVLO}+		—	I_F = 5 mA , V_O > 2.5 V	7.5	8.7	9.5	
	V_{UVLO}-			I_F = 5 mA, V_O < 2.5 V	7.5	8.4	9.5	
UVLO hysteresis	$UVLO_{HYS}$			I_F = 5 mA , V_O > 2.5 V	—	0.3	—	

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

Note: This device is designed for low power consumption, making it more sensitive to ESD than its predecessors. Extra care should be taken in the design of circuitry and pc board implementation to avoid ESD problems.

Note 1: I_O application time ≤ 50 μs, single pulse.

10. Isolation Characteristics (Unless otherwise specified, T_a = 25°C)

Characteristics	Symbol	Note	Test Conditions	Min	Typ.	Max	Unit
Total capacitance (input to output)	C_S	(Note 1)	V_S = 0 V, f = 1 MHz	—	0.35	—	pF
Isolation resistance	R_S	(Note 1)	V_S = 500 V, R.H. ≤ 60%	1×10^{12}	10^{14}	—	Ω
Isolation voltage	BV_S	(Note 1)	AC, 1 min	3750	—	—	Vrms
			AC, 1 s, in oil	—	10000	—	
			DC, 1 min, in oil	—	10000	—	Vdc

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.

11. Switching Characteristics (Note)
(Unless otherwise specified, T_a = -40 to 100°C)

Characteristics	Symbol	Note	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Propagation delay time (L/H)	t_{pLH}	(Note 1)	Fig. 12.1.7	I_F = 0 → 10 mA, V_{CC} = 30 V, R_g = 20 Ω, C_g = 10 nF, T_a = 25°C	—	95	145	ns
Propagation delay time (H/L)	t_{pHL}	(Note 1)		I_F = 10 → 0 mA, V_{CC} = 30 V, R_g = 20 Ω, C_g = 10 nF, T_a = 25°C	—	110	165	
Propagation delay time (L/H)	t_{pLH}	(Note 1)		I_F = 0 → 10 mA, V_{CC} = 30 V, R_g = 20 Ω, C_g = 10 nF	50	95	170	
Propagation delay time (H/L)	t_{pHL}	(Note 1)		I_F = 10 → 0 mA, V_{CC} = 30 V, R_g = 20 Ω, C_g = 10 nF	50	110	190	
Propagation delay skew (device to device)	t_{psk}	(Note 1) (Note 4)		I_F = 0 ←→ 10 mA, V_{CC} = 30 V, R_g = 20 Ω, C_g = 10 nF	-85	—	85	
Pulse width distortion	$\|t_{pHL}-t_{pLH}\|$	(Note 1)		I_F = 0 ←→ 10 mA, V_{CC} = 30 V, R_g = 20 Ω, C_g = 10 nF	—	15	50	
Rise time	t_r	(Note 1)		I_F = 0 → 10 mA, V_{CC} = 30 V, R_g = 20 Ω, C_g = 10 nF	—	18	—	
Fall time	t_f	(Note 1)		I_F = 10 → 0 mA, V_{CC} = 30 V, R_g = 20 Ω, C_g = 10 nF	—	22	—	
Common-mode transient immunity at output high	CM_H	(Note 2)	Fig. 12.1.8	V_{CM} = 1000 V_{p-p}, I_F = 10 mA, V_{CC} = 30 V, T_a = 25°C, $V_{O(min)}$ = 26 V	±20	—	—	kV/μs
Common-mode transient immunity at output low	CM_L	(Note 3)		V_{CM} = 1000 V_{p-p}, I_F = 0 mA, V_{CC} = 30 V, T_a = 25°C, $V_{O(max)}$ = 1 V	±20	—	—	

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

Note 1: Input signal (f = 125 kHz, duty = 50%, t_r = t_f = 5 ns or less).
CL is approximately 15 pF which includes probe and stray wiring capacitance.

Note 2: 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 > 26 V).

Note 3: 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 < 1 V).

Note 4: The propagation delay skew, t_{psk}, is equal to the magnitude of the worst-case difference in t_{pHL} and/or t_{pLH} that will be seen between units at the same given conditions (supply voltage, input current, temperature, etc).

12. Test Circuits and Characteristics Curves

12.1. Test Circuits

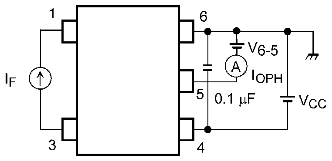


Fig. 12.1.1 I_{OPH} Test Circuit

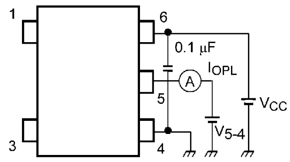


Fig. 12.1.2 I_{OPL} Test Circuit

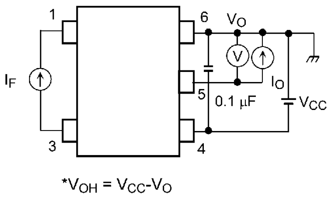


Fig. 12.1.3 V_{OH} Test Circuit

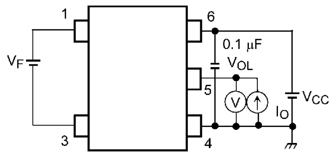


Fig. 12.1.4 V_{OL} Test Circuit

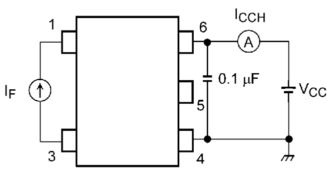


Fig. 12.1.5 I_{CCH} Test Circuit

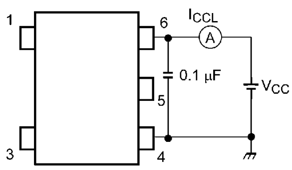


Fig. 12.1.6 I_{CCL} Test Circuit

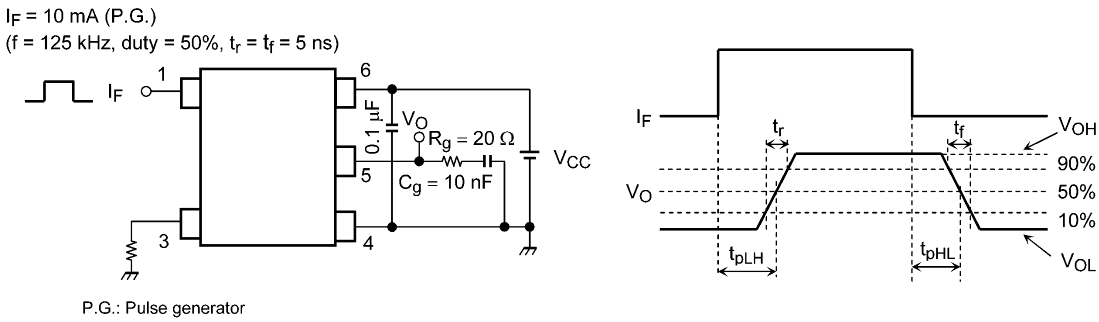
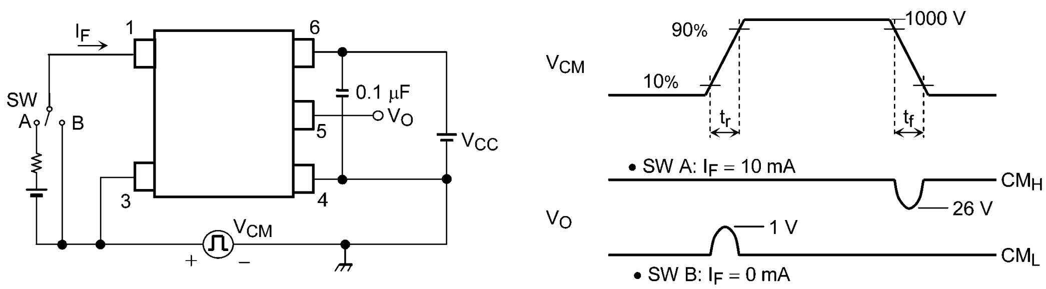


Fig. 12.1.7 Switching Time Test Circuit and Waveform



$$CM_L = \frac{800\ V}{t_r\ (\mu s)} \qquad CM_H = -\frac{800\ V}{t_f\ (\mu s)}$$

Fig. 12.1.8 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 (See Fig. 13.1.1 and 13.1.2)
  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.

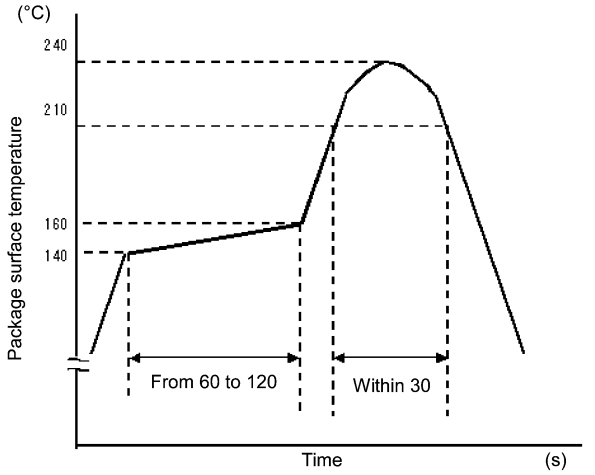


Fig. 13.1.1 An Example of a Temperature Profile When Sn-Pb Eutectic Solder Is Used

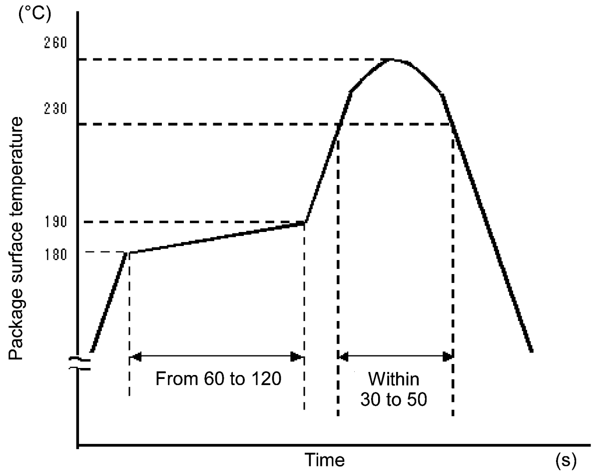


Fig. 13.1.2 An Example of a Temperature Profile When Lead(Pb)-Free Solder Is Used

- When using soldering flow (Applicable to both eutectic solder and Lead(Pb)-Free solder)
  Apply preheating of 150°C 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 (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.

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

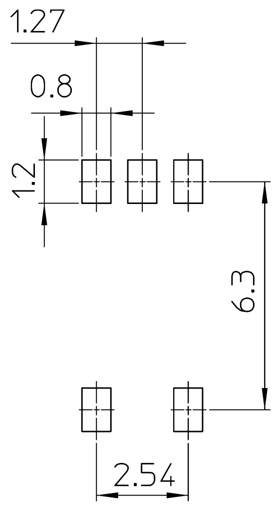


Fig. 14.1 Land Pattern Dimensions for Reference Only (unit: mm)

15. Marking

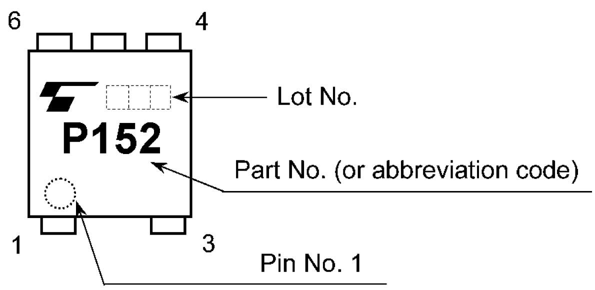
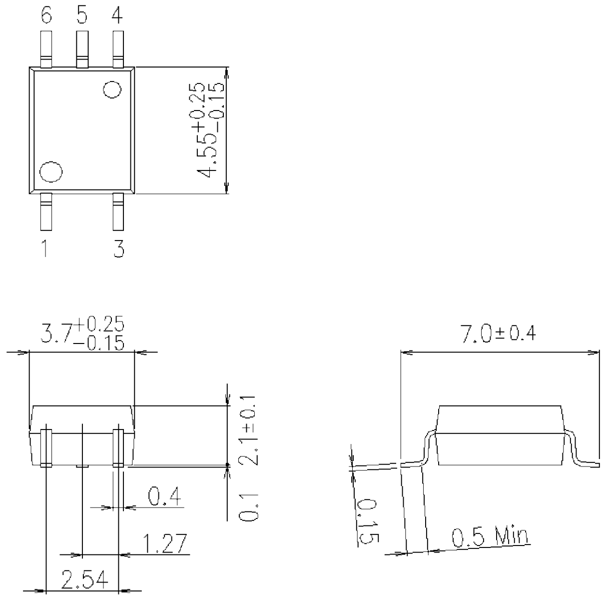


Fig. 15.1 Marking

Package Dimensions

Unit: mm



Weight: 0.08 g (typ.)

Package Name(s)
TOSHIBA: 11-4L1S

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