

Preliminary

TOSHIBA Photocoupler GaAs IRED + Photo IC

TLP701

INDUSTRIAL INVERTERS
 INVERTER FOR AIR CONDITIONERS
 IGBT/POWER MOS FET GATE DRIVE

The TOSHIBA TLP701 consists of a GaAs light-emitting diode and an integrated photodetector.

This unit is 6-lead SDIP package. The TLP701 is 50% smaller than the 8-PIN DIP and meets the reinforced insulation class requirements of international safety standards. Therefore the mounting area can be reduced in equipment requiring safety standard certification.

The TLP701 is suitable for gate driving circuits for IGBTs or power MOSFETs. In particular, the TLP701 is capable of "direct" gate driving of low-power IGBTs.

- Peak output current : ± 0.6 A (max)
- Guaranteed performance over temperature : -40 to 100°C
- Supply current : 2 mA (max)
- Power supply voltage : 10 to 30 V
- Threshold input current : $I_{FLH} = 5$ mA (max)
- Switching time (t_{PLH} / t_{PHL}) : 700 ns (max)
- Common mode transient immunity : ± 10 kV/ μs (min)
- Isolation voltage : 5000 Vrms (min)
- Construction mechanical rating

	7.62-mm pitch standard type	10.16-mm pitch TLPXXXF type
Creepage Distance	7.0 mm (min)	8.0 mm (min)
Clearance	7.0 mm (min)	8.0 mm (min)
Insulation Thickness	0.4 mm (min)	0.4 mm (min)

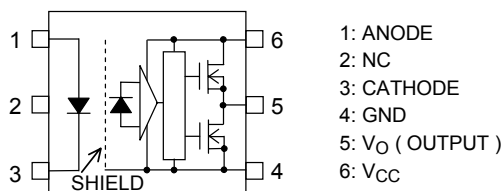
- UL Recognized : UL1577, File No. E67349
- Option (D4)
 TÜV approved : EN60747-5-2
 Certificate No. R50033433
 Maximum operating insulation voltage : 890 Vpk
 Highest permissible over voltage : 8000 Vpk

(Note) When a EN60747-5-2 approved type is needed, please designate the "Option(D4)"

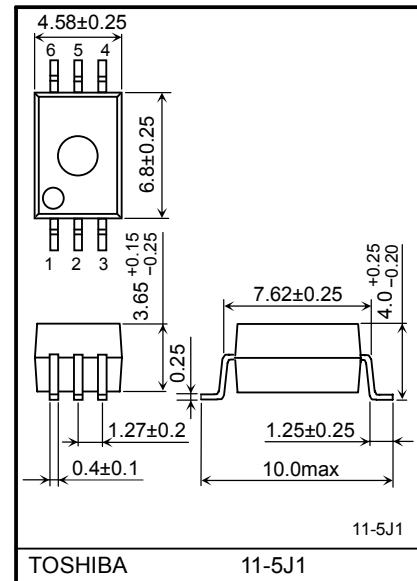
Truth Table

Input	LED	Tr1	Tr2	Output
H	ON	ON	OFF	H
L	OFF	OFF	ON	L

Pin Configuration (Top View)

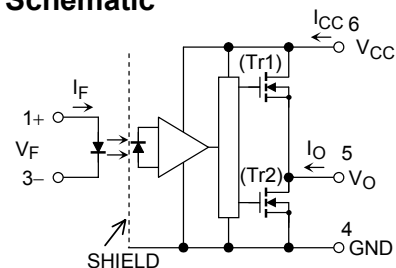


Unit in mm



Weight : 0.26 g (typ.)

Schematic



A 0.1- μF bypass capacitor must be connected between pins 6 and 4. (See Note 6.)

Maximum Ratings (Ta = 25 °C)

Characteristics		Symbol	Rating	Unit
LED	Forward current	I_F	20	mA
	Forward current derating (Ta ≥ 85°C)	$\Delta I_F / \Delta T_a$	-0.54	mA/°C
	Peak transient forward current (Note 1)	I_{FP}	1	A
	Reverse voltage	V_R	5	V
	Junction temperature	T_j	125	°C
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
	Junction temperature	T_j	125	°C
Operating frequency (Note 3)	f	25	kHz	
Operating temperature range	T_{opr}	-40 to 100	°C	
Storage temperature range	T_{stg}	-55 to 125	°C	
Lead soldering temperature (10 s) (Note 4)	T_{sol}	260	°C	
Isolation voltage (AC, 1 minute, R.H. ≤ 60%) (Note 5)	BV_S	5000	Vrms	

Note 1: Pulse width $P_W \leq 1 \mu s$, 300 pps

Note 2: Exponential waveform pulse width $P_W \leq 2 \mu s$, $f \leq 15$ kHz

Note 3: Exponential waveform $I_{OPH} \leq -0.3$ A ($\leq 2 \mu s$), $I_{OPL} \leq +0.3$ A ($\leq 2 \mu s$), $T_a = 100$ °C

Note 4: For the effective lead soldering area

Note 5: Device considered a two-terminal device: pins 1, 2 and 3 paired with pins 4, 5 and 6 respectively.

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

Recommended Operating Conditions

Characteristics	Symbol	Min	Typ.	Max	Unit
Input current, ON (Note 7)	$I_F (ON)$	7.5	—	10	mA
Input voltage, OFF	$V_F (OFF)$	0	—	0.8	V
Supply voltage	V_{CC}	10	—	30	V
Peak output current	I_{OPH} / I_{OPL}	—	—	± 0.2	A
Operating temperature	T_{opr}	-40	—	100	°C

Note 7: Input signal rise time (fall time) < 0.5 μs .

Electrical Characteristics (Ta = -40 to 100 °C, unless otherwise specified)

Characteristics		Symbol	Test Circuit	Test Condition		Min	Typ.*	Max	Unit
Forward voltage		V _F	—	I _F = 5 mA, Ta = 25 °C		—	1.55	1.70	V
Temperature coefficient of forward voltage		ΔV _F /ΔTa	—	I _F = 5 mA		—	-2.0	—	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, Ta = 25 °C		—	45	—	pF
Output current (Note 8)	"H" Level	I _{OPH1}	1	V _{CC} = 15 V I _F = 5 mA	V ₆₋₅ = 4 V	-0.2	-0.38	—	A
		I _{OPH2}			V ₆₋₅ = 10 V	-0.4	-0.60	—	
	"L" Level	I _{OPL1}	2	V _{CC} = 15 V I _F = 0 mA	V ₅₋₄ = 2 V	0.2	0.36	—	
		I _{OPL2}			V ₅₋₄ = 10 V	0.4	0.62	—	
Output voltage	"H" Level	V _{OH}	3	V _{CC} = 10 V	I _O = -100 mA, I _F = 5 mA	6.0	8.5	—	V
	"L" Level	V _{OL}			4	I _O = 100 mA, V _F = 0.8 V	—	0.4	
Supply current	"H" Level	I _{CCH}	5	V _{CC} = 10 to 30 V V _O = Open	I _F = 10 mA	—	1.4	2.0	mA
	"L" Level	I _{CCL}			6	I _F = 0 mA	—	1.3	
Threshold input current	L → H	I _{FLH}	—	V _{CC} = 15 V, V _O > 1 V		—	2.5	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

(*): All typical values are at Ta = 25°C

Note 8: Duration of I_O time ≤ 50 μs, 1 pulse

Note 9: This product is more sensitive than conventional products to electrostatic discharge (ESD) owing to its low power consumption design.
It is therefore all the more necessary to observe general precautions regarding ESD when handling this component.

Isolation Characteristics (Ta = 25 °C)

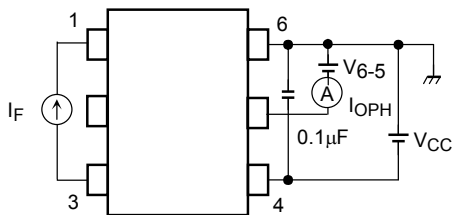
Characteristic	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Capacitance input to output	C _S	V = 0 V, f = 1MHz (Note 5)	—	1.0	—	pF
Isolation resistance	R _S	R.H. ≤ 60 %, V _S = 500 V (Note 5)	1×10 ¹²	10 ¹⁴	—	Ω
Isolation voltage	BV _S	AC, 1 minute	5000	—	—	Vrms
		AC, 1 second, in oil	—	10000	—	
		DC, 1 minute, in oil	—	10000	—	Vdc

Switching Characteristics (Ta = -40 to 100 °C, unless otherwise specified)

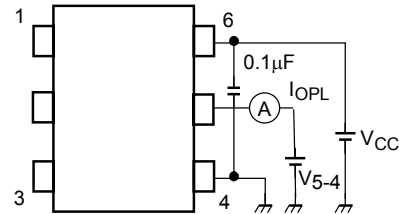
Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.*	Max	Unit	
Propagation delay time	L → H	7	$V_{CC} = 30\text{ V}$ $R_g = 47\ \Omega$ $C_g = 3\text{ nF}$	$I_F = 0 \rightarrow 5\text{ mA}$	100	—	700	ns
	H → L			$I_F = 5 \rightarrow 0\text{ mA}$	100	—	700	
Output rise time (10–90 %)	t_r			$I_F = 0 \rightarrow 5\text{ mA}$	—	50	—	
Output fall time (90–10 %)	t_f			$I_F = 5 \rightarrow 0\text{ mA}$	—	50	—	
Propagation delay difference between any two parts or channels	PDD $ t_{pHL} - t_{pLH} $			$I_F = 0, 5\text{ mA}$	-500	—	500	
Common mode transient immunity at HIGH level output	CM _H	8		$V_{CM} = 1000\text{ V}_{p-p}$ $V_{CC} = 30\text{ V}$ $T_a = 25\text{ °C}$	$I_F = 5\text{ mA}$ $V_O(\text{min}) = 26\text{ V}$	-10000	—	—
Common mode transient immunity at LOW level output	CM _L		$I_F = 0\text{ mA}$ $V_O(\text{max}) = 1\text{ V}$		10000	—	—	

(*): All typical values are at Ta = 25 °C.

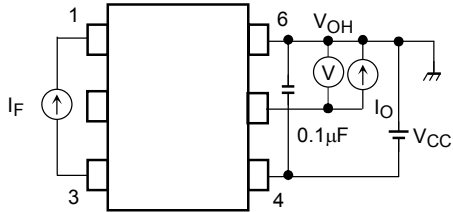
Test Circuit 1: I_{OPH}



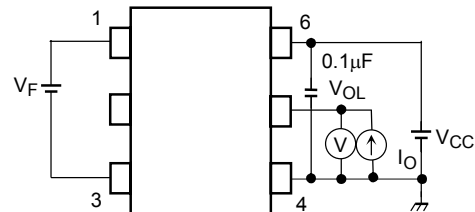
Test Circuit 2: I_{OPL}



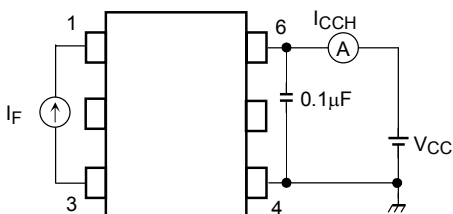
Test Circuit 3: V_{OH}



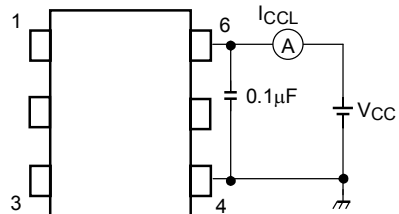
Test Circuit 4: V_{OL}



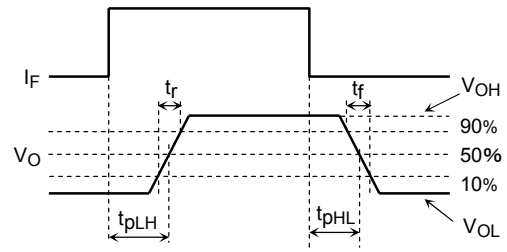
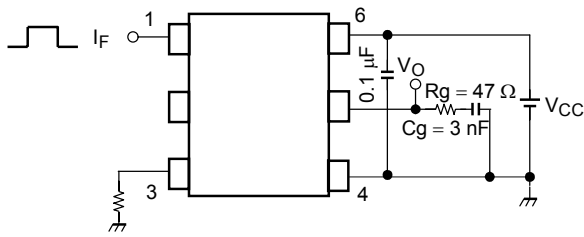
Test Circuit 5: I_{CCH}



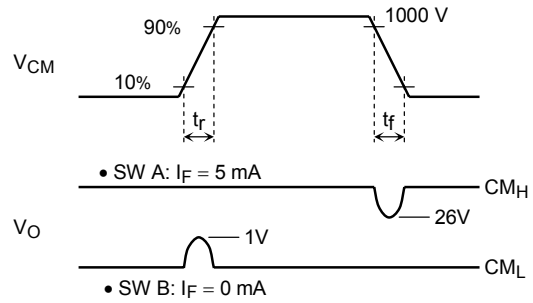
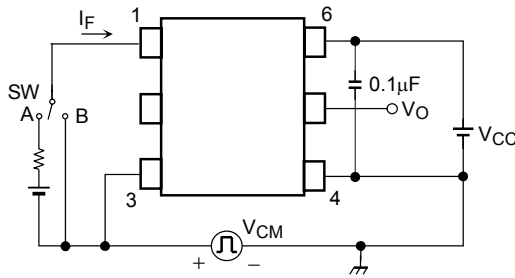
Test Circuit 6: I_{CCL}



Test Circuit 7: t_{pLH} , t_{pHL} , t_r , t_f , PDD



Test Circuit 8: CM_H , CM_L



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

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

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.

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