

# TLP702

## Intelligent power module signal isolation

### Industrial inverters

### Motor drive

The Toshiba TLP702 consists of a GaAlAs light-emitting diode and an integrated high-gain, high-speed photodetector. The TLP702 is suitable for isolating input control signals to intelligent power modules. This unit is a 6-pin SDIP. The TLP702 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 detector has a totem pole output stage to provide both source and sink driving. The detector IC has an internal shield that provides a guaranteed common-mode transient immunity of 10 kV/μs.

The TLP702 is inverter logic type. For buffer logic type, the TLP706 is in line-up.

- Inverter logic type (totem pole output)
- Pb Free
- Guaranteed performance over temperature : -40~100°C
- Power supply voltage : 4.5~20 V
- Input current:  $I_{FHL} = 5 \text{ mA (Max.)}$
- Switching time (  $t_{pHL} / t_{pLH}$  ) : 600 ns (Max.)
- Common-mode transient immunity :  $\pm 10 \text{ kV}/\mu\text{s}$  (Min)
- Isolation voltage : 5000 Vrms (Min)
- UL Recognized : UL1577, File No.E67349
- Option (D4)

TÜV Approved : DIN EN60747-5-2  
No.R50033433

Maximum Operating Insulation Voltage : 890V<sub>PK</sub>

Highest Permissible Over Voltage : 8000V<sub>PK</sub>

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

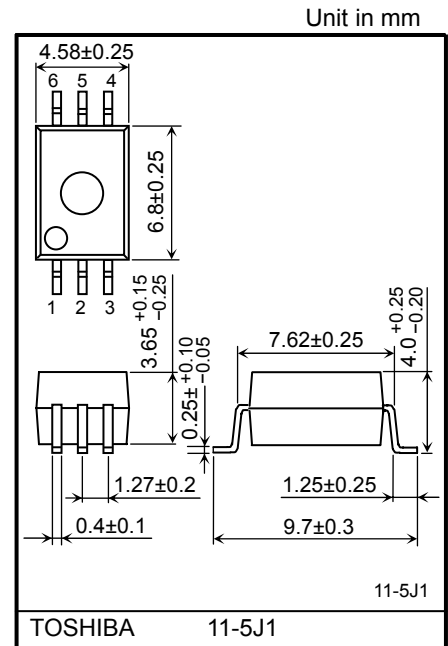
**Please designate "Option(D4)"**

- Construction Mechanical Rating

	7.62 mm pich standard type	10.16 mm pich 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)

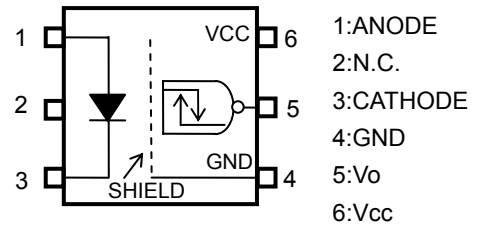
### Truth Table

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

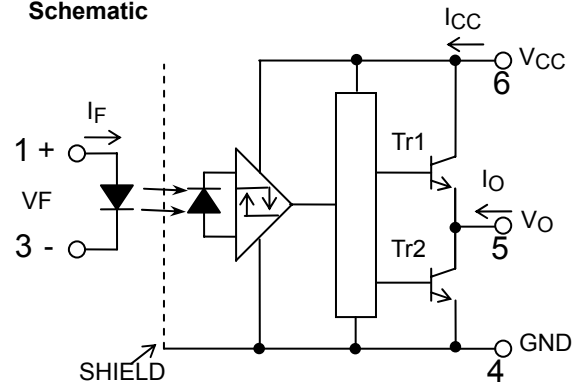


Weight : 0.26 g (typ.)

### Pin Configuration (Top View)



### Schematic



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

## Absolute maximum ratings (Ta = 25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current (Ta ≤ 85°C)	IF	20	mA
	Forward Current Derating (Ta > 85°C)	ΔIF/ΔTa	-0.5	mA/°C
	Peak Transient Forward Current (Note 1)	IFPT	1	A
	Reverse Voltage	VR	5	V
	Junction Temperature	TJ	125	°C
DETECTOR	Output Current 1 (Ta ≤ 25°C)	IO1	15/-15	mA
	Output Current 2 (Ta ≤ 100°C)	IO2	4.5/-4.5	mA
	Peak Output Current	IOP	20/-20	mA
	Output Voltage	VO	-0.5~20	V
	Supply Voltage	VCC	-0.5~20	V
	Junction Temperature	TJ	125	°C
Operating Temperature Range		Topr	-40~100	°C
Storage Temperature Range		Tstg	-55~125	°C
Lead Solder Temperature (10 s)		Tsol	260	°C
Isolation Voltage (AC, 1 min., R.H. ≤ 60%, Ta = 25°C) (Note 2)		BVs	5000	Vrms

## Recommended Operating Conditions

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Input Current, ON	IF (ON)	7	-	12	mA
Input Voltage, OFF	VF (OFF)	0	-	0.8	V
Supply Voltage (*) (Note 3, Note 4)	VCC	4.5	-	20	V

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.

(\*) This item denotes operating ranges, not meaning of recommended operating conditions.

Note1 : Pulse width PW≤1us,300pps.

Note2 : Device Considered a two terminal device : pins 1,2 and 3 shorted together and pins 4,5 and 6 shorted together.

Note3 :The detector of this product requires a power supply voltage (VCC) of 4.5 V or higher for stable operation.

If the VCC is lower than this value, an output may be unstable. Be sure to use the product after checking the supply current, and the operation of a power-on/-off.

Note4 : 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.

**Electrical Characteristics**

(Unless otherwise specified, Ta = -40~100°C, Vcc = 4.5~20 V.)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	CONDITION	MIN.	TYP. *	MAX.	UNIT	
Input forward voltage	V <sub>F</sub>	—	I <sub>F</sub> = 5 mA, Ta = 25°C	—	1.6	1.7	V	
Temperature coefficient of forward voltage	ΔV <sub>F</sub> /ΔTa	—	I <sub>F</sub> = 5 mA	—	-2.0	—	mV/°C	
Input reverse current	I <sub>R</sub>	—	V <sub>R</sub> = 5 V, Ta = 25°C	—	—	10	μA	
Input capacitance	C <sub>T</sub>	—	V = 0 V, f = 1 MHz, Ta = 25°C	—	30	—	pF	
Logic LOW output voltage	V <sub>OL</sub>	1	I <sub>OL</sub> = 3.5 mA, I <sub>F</sub> = 5 mA	—	0.1	0.35	V	
Logic HIGH output voltage	V <sub>OH</sub>	2	I <sub>OH</sub> = -3.5 mA, V <sub>F</sub> = 0.8 V	V <sub>CC</sub> = 5 V	2.4	3.1	—	V
				V <sub>CC</sub> = 20 V	17.4	18.1	—	
Logic LOW supply current	I <sub>CCL</sub>	3	I <sub>F</sub> = 5 mA	V <sub>CC</sub> = 20 V Ta = -40~100°C	—	4.0	6.0	mA
				V <sub>CC</sub> = 5 V Ta = 25°C	—	3.6	4.5	
Logic HIGH supply current	I <sub>CCH</sub>	4	V <sub>F</sub> = 0V	V <sub>CC</sub> = 20 V Ta = -40~100°C	—	3.1	6.0	mA
				V <sub>CC</sub> = 5 V Ta = 25°C	—	2.8	4.5	
Logic LOW short circuit output current	I <sub>OSL</sub>	5	I <sub>F</sub> = 5 mA V <sub>CC</sub> = V <sub>O</sub> = 20 V	7	37	—	mA	
Logic HIGH short circuit output current	I <sub>OSH</sub>	6	V <sub>F</sub> = 0 V, V <sub>O</sub> = GND V <sub>CC</sub> = 20 V	-7	-40	—	mA	
Input current logic LOW output	I <sub>FHL</sub>	—	I <sub>O</sub> = 3.5 mA, V <sub>O</sub> < 0.4 V	—	0.5	5	mA	
Input voltage logic HIGH output	V <sub>FLH</sub>	—	I <sub>O</sub> = -3.5 mA, V <sub>O</sub> > 2.4V V <sub>CC</sub> = 5 V	0.8	—	—	V	
Input current hysteresis	I <sub>HYS</sub>	—	V <sub>CC</sub> = 5 V	—	0.05	—	mA	

\*All typical values are at Ta = 25°C.

**Isolation Characteristics (Ta = 25°C)**

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance input to output	C <sub>S</sub>	V = 0V, f = 1 MHz (Note 2)	—	1.0	—	pF
Isolation resistance	R <sub>S</sub>	R.H. ≤ 60%, V <sub>S</sub> = 500 V (Note 2)	1×10 <sup>12</sup>	10 <sup>14</sup>	—	Ω
Isolation voltage	BV <sub>S</sub>	AC, 1 minute	5000	—	—	V <sub>rms</sub>
		AC, 1 second, in oil	—	10000	—	V <sub>dc</sub>
		DC, 1 minute, in oil	—	10000	—	

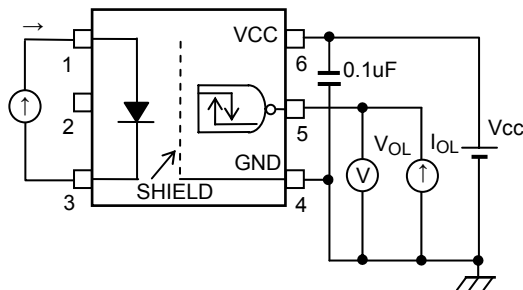
## Switching Characteristics

(Unless otherwise specified,  $T_a = -40 \sim 100^\circ\text{C}$ ,  $V_{CC} = 4.5 \sim 20 \text{ V}$ .)

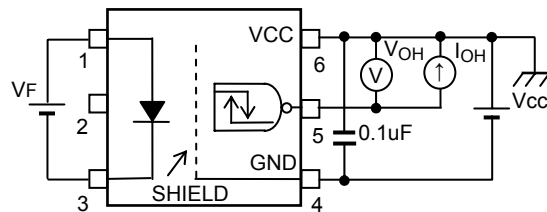
CHARACTERISTIC	SYMBOL	TEST CIRCUIT	CONDITION	MIN.	TYP. *	MAX.	UNIT
Propagation delay time to logic LOW output	$t_{pHL}$	7	$I_F = 0 \rightarrow 5 \text{ mA}$ , $C_L = 100 \text{ pF}$ $V_{CC} = 20 \text{ V}$	50	250	600	ns
Propagation delay time to logic HIGH output	$t_{pLH}$		$I_F = 5 \rightarrow 0 \text{ mA}$ , $C_L = 100 \text{ pF}$ $V_{CC} = 20 \text{ V}$	50	260	600	ns
Switching time dispersion Between ON and OFF	$ t_{pLH} - t_{pHL} $		$I_F = 0 \sim 5 \text{ mA}$ , $C_L = 100 \text{ pF}$ $V_{CC} = 20 \text{ V}$	—	—	550	ns
Output fall time	$t_f$		$I_F = 0 \rightarrow 5 \text{ mA}$ , $V_{CC} = 20 \text{ V}$	—	95	—	ns
Output rise time	$t_r$		$I_F = 5 \rightarrow 0 \text{ mA}$ , $V_{CC} = 20 \text{ V}$	—	175	—	ns
Propagation delay time to logic LOW output	$t_{pHL}$	8	$I_F = 0 \rightarrow 5 \text{ mA}$	50	—	600	ns
Propagation delay time to logic HIGH output	$t_{pLH}$		$I_F = 5 \rightarrow 0 \text{ mA}$	50	—	600	ns
Common-mode transient Immunity at HIGH level output	$CM_H$	9	$V_{CM} = 1000 \text{ Vp-p}$ , $I_F = 0 \text{ mA}$ , $V_{CC} = 20 \text{ V}$ , $T_a = 25^\circ\text{C}$	10000	—	—	V/us
Common-mode transient Immunity at LOW level output	$CM_L$		$V_{CM} = 1000 \text{ Vp-p}$ , $I_F = 5 \text{ mA}$ , $V_{CC} = 20 \text{ V}$ , $T_a = 25^\circ\text{C}$	-10000	—	—	V/us

\*All typical values are at  $T_a = 25^\circ\text{C}$ .

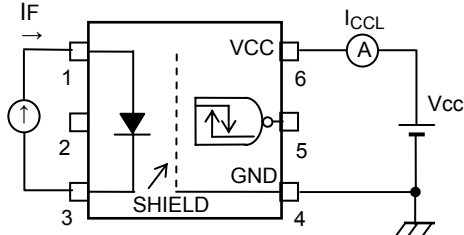
TEST CIRCUIT 1 :  $V_{OL}$



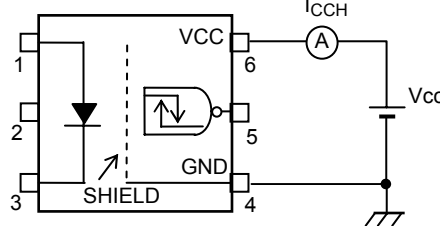
TEST CIRCUIT 2 :  $V_{OH}$



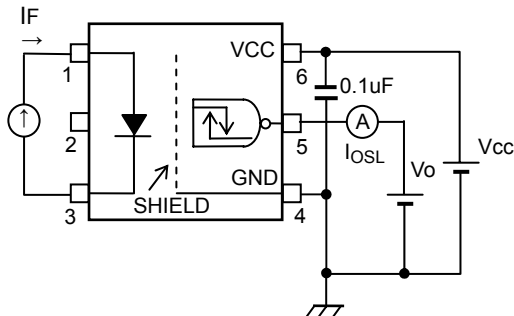
TEST CIRCUIT 3 :  $I_{CCL}$



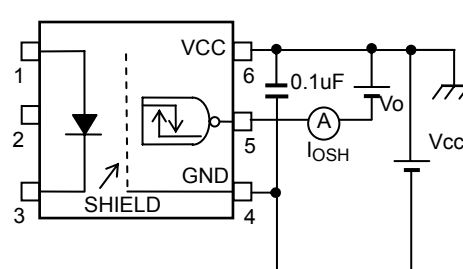
TEST CIRCUIT 4 :  $I_{CCH}$



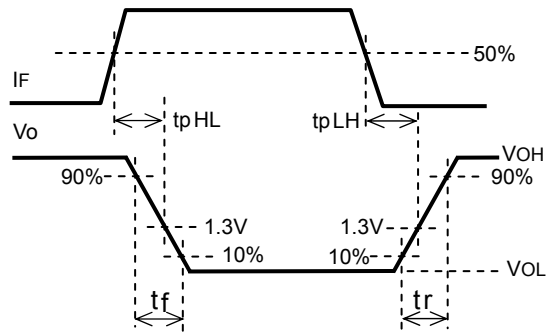
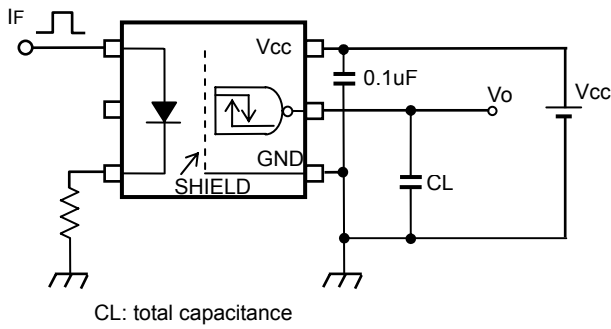
TEST CIRCUIT 5 :  $I_{OSL}$



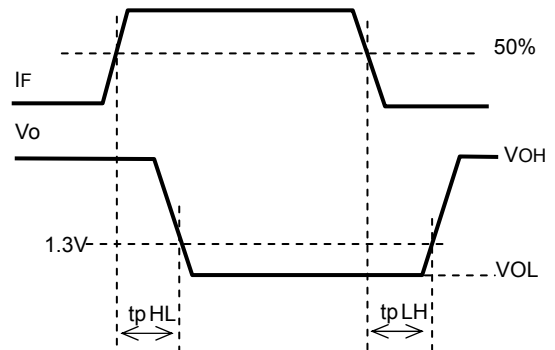
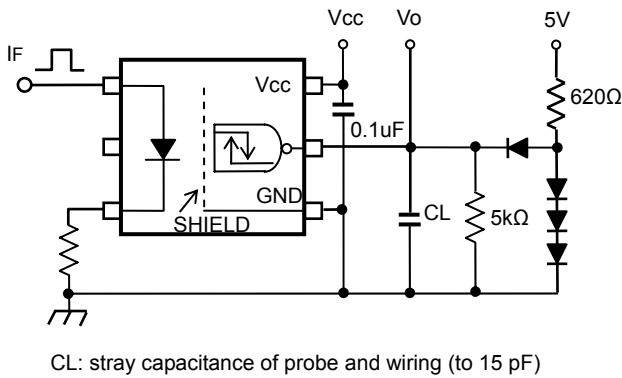
TEST CIRCUIT 6 :  $I_{OSH}$



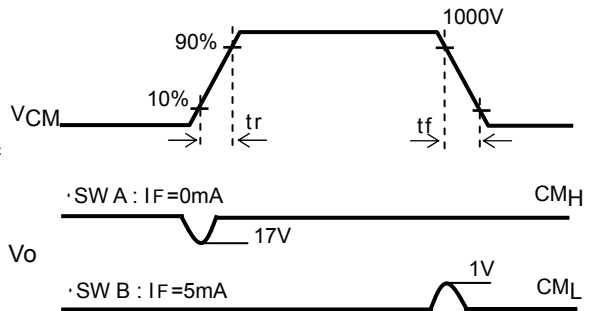
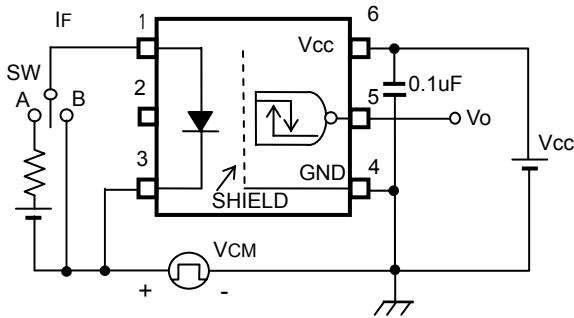
**TEST CIRCUIT 7: Switching Time Test Circuit**



**TEST CIRCUIT 8: Switching Time Test Circuit**



**TEST CIRCUIT 9: Common-Mode Transient Immunity Test Circuit**



$$CM_H = \frac{800(V)}{tr(\mu s)} \quad CM_L = -\frac{800(V)}{tf(\mu s)}$$

CM<sub>H</sub> (CM<sub>L</sub>) is the maximum rate of rise (fall) of the common mode voltage that can be sustained with the output voltage in the high (low) state.

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