

**Preliminary**

TOSHIBA Photocoupler GaAlAs IRED + Photo IC

# TLP351

Inverter for Air Conditioner  
 IGBT/Power MOS FET Gate Drive  
 Industrial Inverter

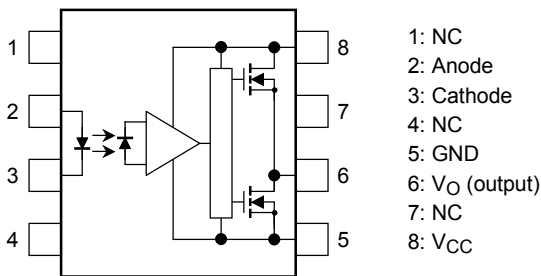
The TOSHIBA TLP351 consists of a GaAlAs light emitting diode and a integrated photodetector.  
 This unit is 8-lead DIP package.  
 TLP351 is suitable for gate driving circuit of IGBT or power MOS FET.  
 Especially TLP351 is capable of "direct" gate drive of lower Power IGBTs.

- Peak output current:  $\pm 0.6$  A (max)
- Guaranteed performance over temperature:  $-40$  to  $100^{\circ}\text{C}$
- Supply current: 2 mA (max)
- Power supply voltage: 10 to 30 V
- Threshold input current :  $I_F = 5$  mA (max)
- Switching time ( $t_{pLH}/t_{pHL}$ ) : 700 ns (max)
- Common mode transient immunity: 10 kV/ $\mu\text{s}$
- Isolation voltage: 3750 Vrms

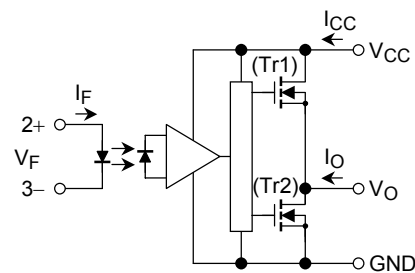
### Truth Table

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

### Pin Configuration (top view)

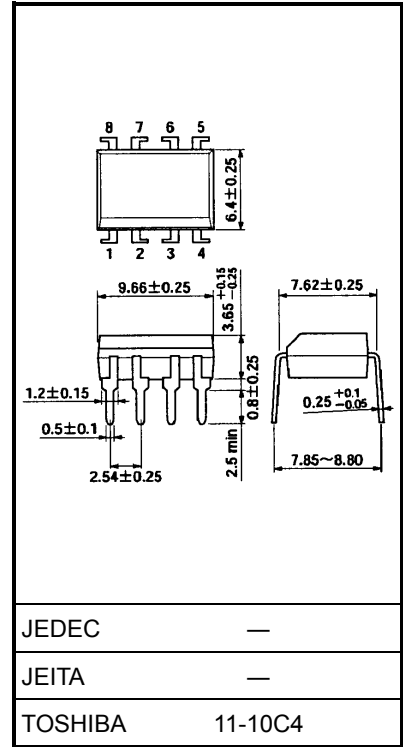


### Schematic



A 0.1  $\mu\text{F}$  bypass capacitor must be connected between pin 8 and 5. (See Note 6)

Unit: mm



Weight: 0.54 g (typ.)

**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	
Storage temperature range	$T_{stg}$	-55 to 125	°C	
Operating temperature range	$T_{opr}$	-40 to 100	°C	
Lead soldering temperature (10 s) (Note 4)	$T_{sol}$	260	°C	
Isolation voltage (AC, 1 minute, R.H. ≤ 60%) (Note 5)	$BV_S$	3750	Vrms	

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

Note 2: Exponential waveform pulse width  $P_W \leq 10 \mu s$ ,  $f \leq 15 \text{ kHz}$

Note 3: Exponential waveform  $I_{OPH} \leq -0.4 \text{ A}$  ( $\leq 2.0 \mu s$ ),  $I_{OPL} \leq +0.4 \text{ A}$  ( $\leq 2.0 \mu s$ ),  $T_a = 100^\circ\text{C}$

Note 4: It is 2 mm or more from a lead root.

Note 5: Device considered a two terminal device: pins 1, 2, 3 and 4 shorted together, and pins 5, 6, 7 and 8 shorted together.

Note 6: A ceramic capacitor(0.1  $\mu\text{F}$ ) should be connected from pin 8 to pin 5 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	$I_{OPH}/I_{OPL}$	—	—	$\pm 0.2$	A
Operating temperature	$T_{opr}$	-40	—	100	°C

Note 7: Input signal rise time (fall time) < 0.5  $\mu s$ .

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

Characteristics		Symbol	Test Circuit	Test Condition	Min	Typ.*	Max	Unit	
Forward voltage		$V_F$	—	$I_F = 5 \text{ mA}$ , $T_a = 25^\circ\text{C}$	—	1.55	1.70	V	
Temperature coefficient of forward voltage		$\Delta V_F / \Delta T_a$	—	$I_F = 5 \text{ mA}$	—	-2.0	—	mV/°C	
Input reverse current		$I_R$	—	$V_R = 5 \text{ V}$ , $T_a = 25^\circ\text{C}$	—	—	10	$\mu\text{A}$	
Input capacitance		$C_T$	—	$V = 0$ , $f = 1 \text{ MHz}$ , $T_a = 25^\circ\text{C}$	—	45	—	pF	
Output current (Note 8)	"H" Level	$I_{OPH1}$	1	$V_{CC} = 15 \text{ V}$ $I_F = 5 \text{ mA}$	$V_{8-6} = 4 \text{ V}$	-0.2	-0.4	—	A
		$I_{OPH2}$			$V_{8-6} = 10 \text{ V}$	-0.4	-0.67		
	"L" Level	$I_{OPL1}$	2	$V_{CC} = 15 \text{ V}$ $I_F = 0 \text{ mA}$	$V_{6-5} = 2 \text{ V}$	0.2	0.35	—	
		$I_{OPL2}$			$V_{6-5} = 10 \text{ V}$	0.4	0.63	—	
Output voltage	"H" Level	$V_{OH}$	3	$V_{CC} = 10 \text{ V}$	$I_O = -100 \text{ mA}$ , $I_F = 5 \text{ mA}$	6.0	8.5	—	V
	"L" Level	$V_{OL}$				4	$I_O = 100 \text{ mA}$ , $V_F = 0.8 \text{ V}$	—	
Supply current	"H" Level	$I_{CCH}$	5	$V_{CC} = 10 \text{ to } 30 \text{ V}$ $V_O$ open	$I_F = 10 \text{ mA}$	—	1.4	2.0	mA
	"L" Level	$I_{CCL}$				6	$I_F = 0 \text{ mA}$	—	
Threshold input current	L → H	$I_{FLH}$	—	$V_{CC} = 15 \text{ V}$ , $V_O > 1 \text{ V}$	—	2.5	5	mA	
Threshold input voltage	H → L	$V_{FHL}$	—	$V_{CC} = 15 \text{ V}$ , $V_O < 1 \text{ V}$	0.8	—	—	V	
Supply voltage		$V_{CC}$	—	—	10	—	30	V	
Capacitance (Input-Output)		$C_S$	—	$V = 0$ , $f = 1 \text{ MHz}$ , $T_a = 25^\circ\text{C}$	—	1.0	—	pF	
Resistance (Input-Output)		$R_S$	—	$V_S = 500 \text{ V}$ , $T_a = 25^\circ\text{C}$ , R.H. ≤ 60%	$1 \times 10^{12}$	$10^{14}$	—	$\Omega$	

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

Note 8: Duration of  $I_O$  time ≤ 50  $\mu\text{s}$

Note 9: This product is more sensitive than the conventional product to static electricity (ESD) because of a lowest power consumption design.

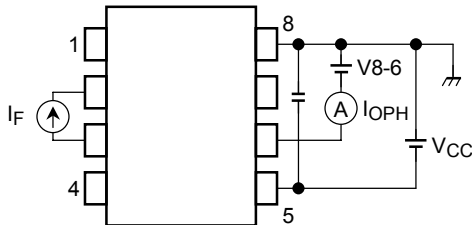
General precaution to static electricity (ESD) is necessary for handling this component.

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

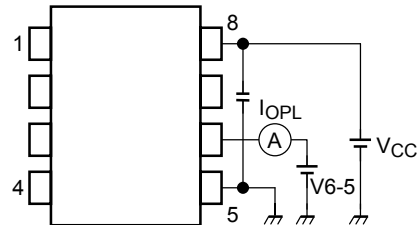
Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.*	Max	Unit	
Propagation delay time	L → H	7	V <sub>CC</sub> = 30 V R <sub>g</sub> = 47 Ω C <sub>g</sub> = 3 nF	I <sub>F</sub> = 0 → 5 mA	100	—	700	ns
	H → L			I <sub>F</sub> = 5 → 0 mA	100	—	700	
Propagation delay difference between any two parts or channels	PDD  t <sub>pHL</sub> - t <sub>pLH</sub>	7	V <sub>CC</sub> = 30 V, R <sub>g</sub> = 47 Ω, C <sub>g</sub> = 3 nF	-500	—	500	ns	
Output rise time (10-90%)	t <sub>r</sub>	7	V <sub>CC</sub> = 30 V R <sub>g</sub> = 47 Ω C <sub>g</sub> = 3 nF	I <sub>F</sub> = 0 → 5 mA	—	50	—	ns
Output fall time (90-10%)	t <sub>f</sub>			I <sub>F</sub> = 5 → 0 mA	—	50	—	
Common mode transient immunity at high level output	CM <sub>H</sub>	8	V <sub>CM</sub> = 1000 V <sub>p-p</sub> Ta = 25°C V <sub>CC</sub> = 30 V	I <sub>F</sub> = 5 mA V <sub>O</sub> (min) = 26 V	-10000	—	—	V/μs
Common mode transient immunity at low level output	CM <sub>L</sub>			I <sub>F</sub> = 0 mA V <sub>O</sub> (max) = 1 V	10000	—	—	

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

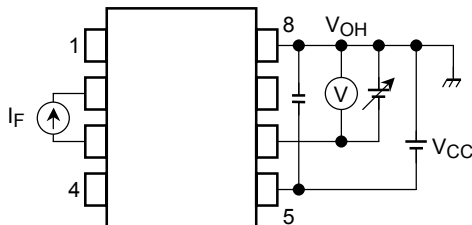
**Test Circuit 1: I<sub>OPH</sub>**



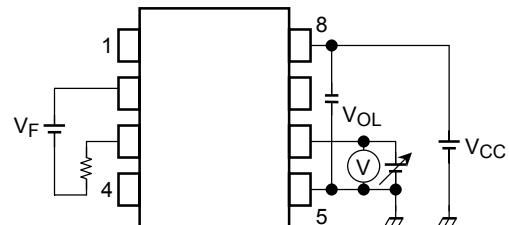
**Test Circuit 2: I<sub>OPL</sub>**



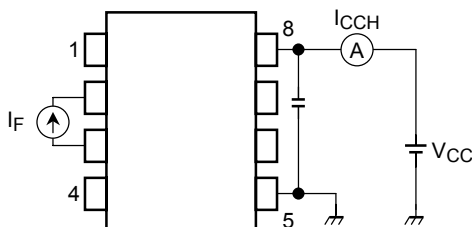
**Test Circuit 3: V<sub>OH</sub>**



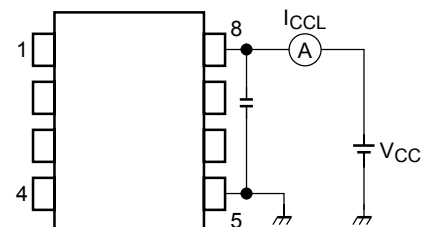
**Test Circuit 4: V<sub>OL</sub>**



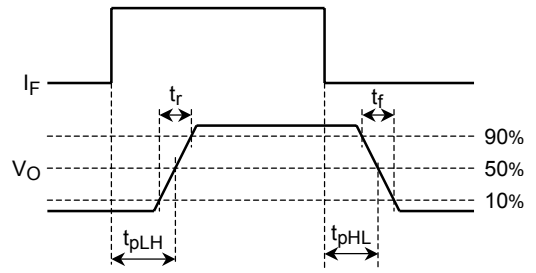
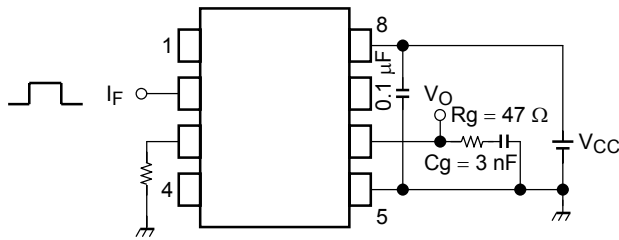
**Test Circuit 5: I<sub>CCH</sub>**



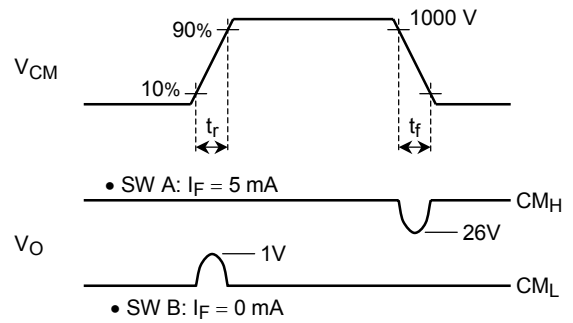
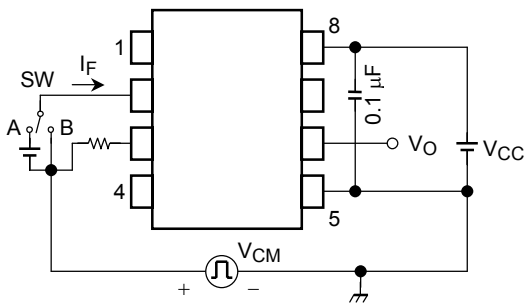
**Test Circuit 6: I<sub>CCL</sub>**



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



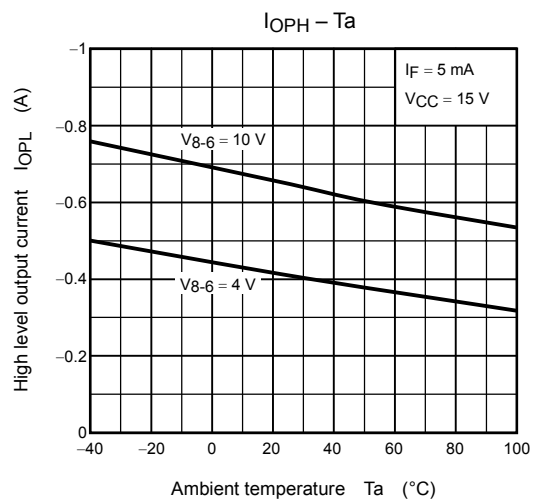
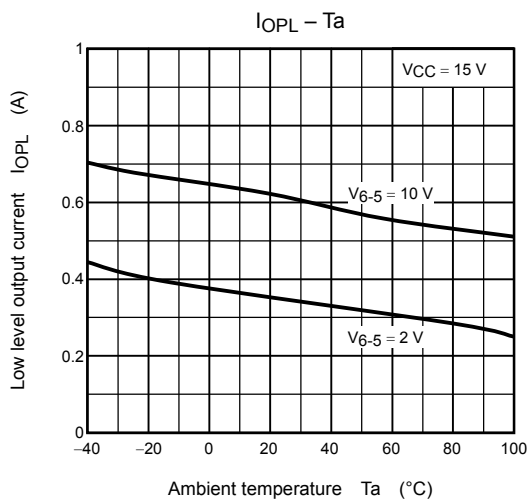
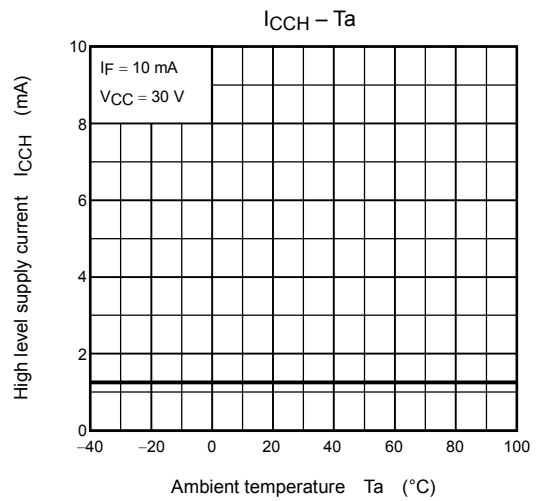
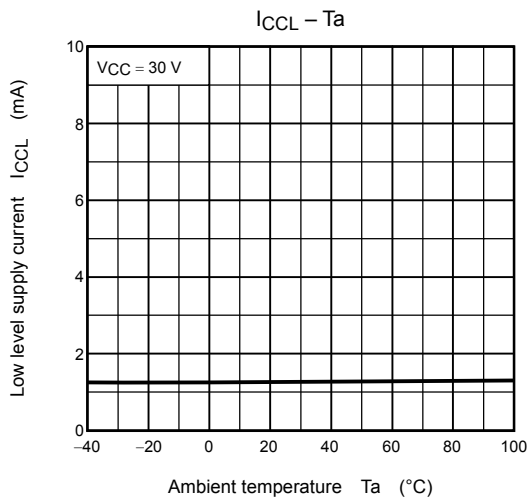
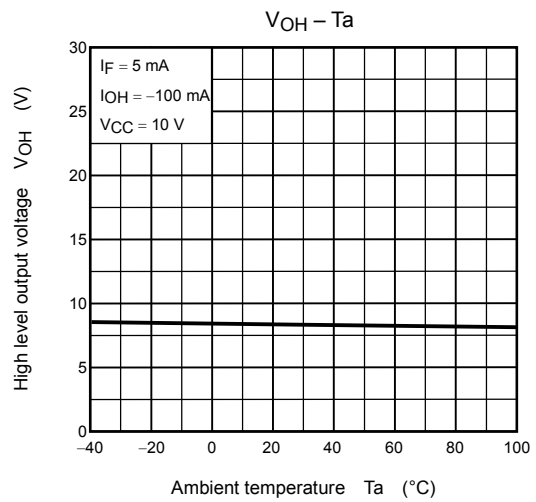
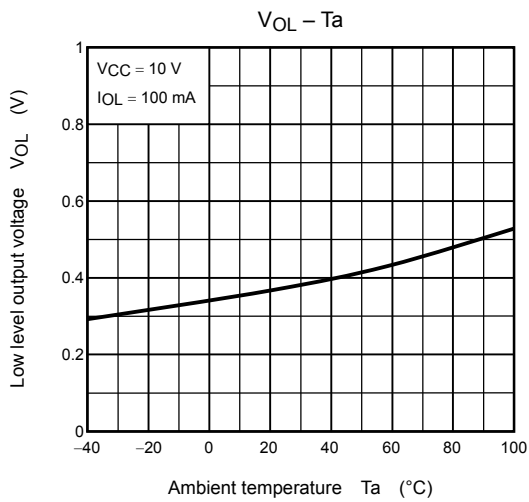
**Test Circuit 8:  $CM_H$ ,  $CM_L$**



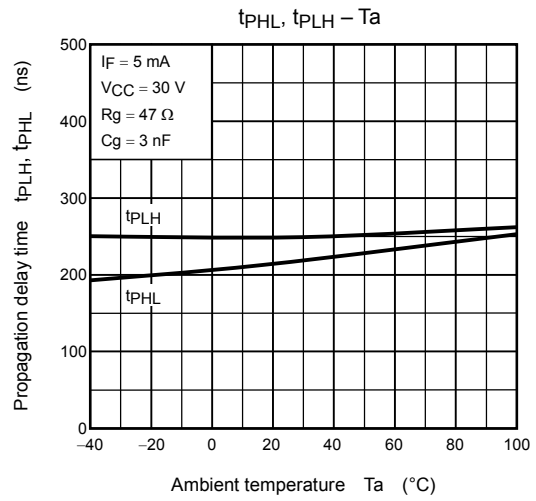
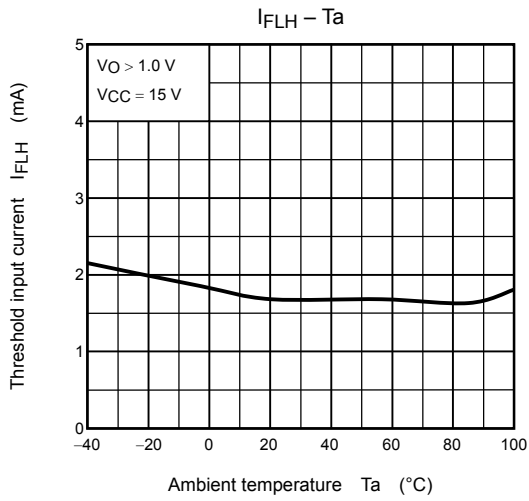
$$CM_L = \frac{800 \text{ V}}{t_f (\mu\text{s})}$$

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

$CM_L$  ( $CM_H$ ) 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.



\*: The above graphs show typical characteristics.



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