

TOSHIBA PHOTOCOUPLER GaAlAs IRED & PHOTO-IC

# TLP251

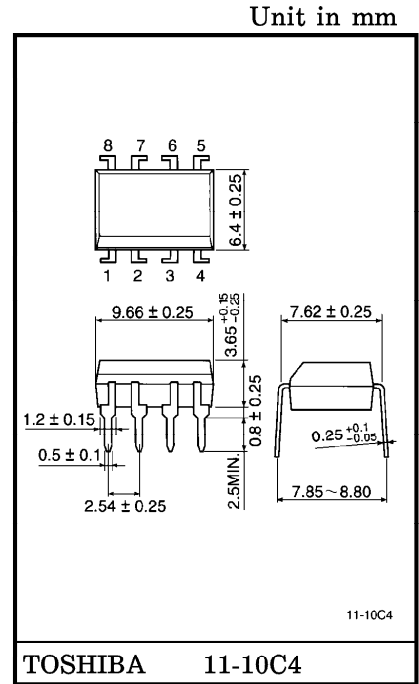
INVERTER FOR AIR CONDITIONOR  
 INDUCTION HEATING  
 TRANSISTOR INVERTER  
 POWER MOS FET GATE DRIVE  
 IGBT GATE DRIVE

The TOSHIBA TLP251 consists of a GaAlAs light emitting diode and a integrated photodetector.

This unit is 8-lead DIP package.

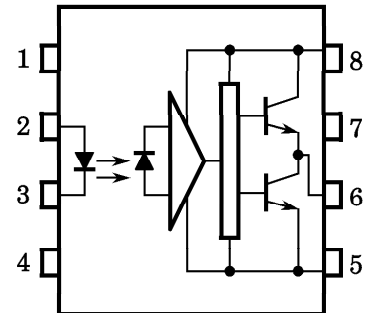
TLP251 is suitable for gate driving circuit of IGBT or power MOS FET. Especially TLP251 is capable of "direct" gate drive of lower power IGBTs. (~15A)

- Input Threshold Current :  $I_F = 5\text{mA (Max.)}$
- Supply Current ( $I_{CC}$ ) :  $11\text{mA (Max.)}$
- Supply Voltage ( $V_{CC}$ ) :  $10\text{--}35\text{V}$
- Output Current ( $I_O$ ) :  $\pm 0.4\text{A (Max.)}$
- Switching Time ( $t_{pLH}/t_{pHL}$ ) :  $1\mu\text{s (Max.)}$
- Isolation Voltage :  $2500\text{Vrms (Min.)}$
- UL Recognized : UL1577, File No. E67349



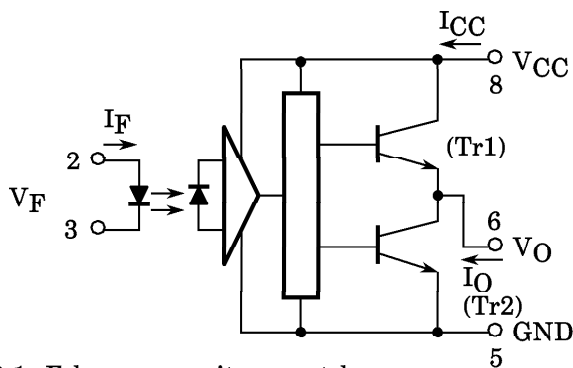
Weight : 0.54g

**PIN CONFIGURATION (TOP VIEW)**



- 1 : N.C.
- 2 : ANODE
- 3 : CATHODE
- 4 : N.C.
- 5 : GND
- 6 :  $V_O$  (OUTPUT)
- 7 : N.C.
- 8 :  $V_{CC}$

**SCHMATIC**



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

**TRUTH TABLE**

|           |     | Tr1 | Tr2 |
|-----------|-----|-----|-----|
| Input LED | ON  | ON  | OFF |
|           | OFF | OFF | ON  |

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MAXIMUM RATINGS (Ta = 25°C)

| CHARACTERISTIC  |   | SYMBOL                    | RATING                       | UNIT    |        |
|---|---|---------------------------|------------------------------|---------|--------|
| LED   | Forward Current   | $I_F$                     | 20                           | mA      |        |
|   | Forward Current Derating<br>(Ta ≥ 70°C)   | $\Delta I_F / \Delta T_a$ | -0.36                        | mA / °C |        |
|   | Peak Transient Forward<br>Current (Note 1)  | $I_{FPT}$                 | 1                            | A       |        |
|   | Reverse Voltage   | $V_R$                     | 5                            | V       |        |
|   | Junction Temperature  | $T_j$                     | 125                          | °C      |        |
| DETECTOR  | “H” Peak Output Current<br>( $P_W \leq 2.0 \mu s$ , $f \leq 15 kHz$ )<br>(Note 2) |                           | $I_{OPH}$                    | -0.4    | A      |
|   | “L” Peak Output Current<br>( $P_W \leq 2.0 \mu s$ , $f \leq 15 kHz$ )<br>(Note 2) |                           | $I_{OPL}$                    | 0.4     | A      |
|   | Output Voltage  | (Ta ≤ 70°C)               | $V_O$                        | 35      | V      |
|   |   | (Ta = 85°C)               |                              | 24      |        |
|   | Supply Voltage  | (Ta ≤ 70°C)               | $V_{CC}$                     | 35      | V      |
|   |   | (Ta = 85°C)               |                              | 24      |        |
|   | Output Voltage Derating<br>(Ta ≥ 70°C)  |                           | $\Delta V_O / \Delta T_a$    | -0.73   | V / °C |
|   | Supply Voltage Derating<br>(Ta ≥ 70°C)  |                           | $\Delta V_{CC} / \Delta T_a$ | -0.73   | V / °C |
|   | Junction Temperature  |                           | $T_j$                        | 125     | °C     |
| Operating Frequency (Note 3)                          |   | $f$                       | 25                           | kHz     |        |
| Operating Temperature Range                           |   | $T_{opr}$                 | -20~85                       | °C      |        |
| Storage Temperature Range                             |   | $T_{stg}$                 | -55~125                      | °C      |        |
| Lead Soldering Temperature (10s)                      |   | $T_{sol}$                 | 260                          | °C      |        |
| Isolation Voltage (AC, 1min.,<br>R.H. ≤ 60%) (Note 4) |   | $BV_S$                    | 2500                         | Vrms    |        |

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

(Note 2) Exponential Waveform

(Note 3) Exponential Waveform,  $I_{OPH} \leq -0.25A (\leq 2.0 \mu s)$ ,  $I_{OPL} \leq +0.25A (\leq 2.0 \mu s)$

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

(Note 5) A ceramic capacitor (0.1μF) 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 1cm.

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- Gallium arsenide (GaAs) is a substance used in the products described in this document. GaAs dust and fumes are toxic. Do not break, cut or pulverize the product, or use chemicals to dissolve them. When disposing of the products, follow the appropriate regulations. Do not dispose of the products with other industrial waste or with domestic garbage.
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**RECOMMENDED OPERATING CONDITIONS**

| CHARACTERISTIC        | SYMBOL                             | MIN. | TYP. | MAX.    | UNIT |
|-----------------------|------------------------------------|------|------|---------|------|
| Input Current, ON     | I <sub>F</sub> (ON)                | 7    | 8    | 10      | mA   |
| Input Voltage, OFF    | V <sub>F</sub> (OFF)               | 0    | —    | 0.8     | V    |
| Supply Voltage        | V <sub>CC</sub>                    | 10   | —    | 30   20 | V    |
| Peak Output Current   | I <sub>OPH</sub> /I <sub>OPL</sub> | —    | —    | ±0.1    | A    |
| Operating Temperature | T <sub>opr</sub>                   | -20  | 25   | 70   85 | °C   |

**ELECTRICAL CHARACTERISTICS (Ta = -20~70°C, Unless otherwise specified)**

| CHARACTERISTIC                             | SYMBOL               | TEST CIR-CUIT    | TEST CONDITION                                 | MIN.   | TYP.*  | MAX.  | UNIT  |    |
|--|----------------------|------------------|--|--|--|-------|-------|----|
| Input Forward Voltage                      | V <sub>F</sub>       | —                | I <sub>F</sub> = 10mA, Ta = 25°C               | —  | 1.6  | 1.8   | V     |    |
| Temperature Coefficient of Forward Voltage | ΔV <sub>F</sub> /ΔTa | —                | I <sub>F</sub> = 10mA                          | —  | -2.0   | —     | mV/°C |    |
| Input Reverse Current                      | I <sub>R</sub>       | —                | V <sub>R</sub> = 5V, Ta = 25°C                 | —  | —  | 10    | μA    |    |
| Input Capacitance                          | C <sub>T</sub>       | —                | V = 0, f = 1MHz, Ta = 25°C                     | —  | 45   | 250   | pF    |    |
| Output Current                             | “H” Level            | I <sub>OPH</sub> | 3  | V <sub>CC</sub> = 30V<br>(*1)  | I <sub>F</sub> = 10mA<br>V <sub>8-6</sub> = 4V | -0.1  | -0.25 | A  |
|  | “L” Level            | I <sub>OPL</sub> | 2  |  | I <sub>F</sub> = 0<br>V <sub>6-5</sub> = 2.5V  | 0.1   | 0.2   |    |
| Output Voltage                             | “H” Level            | V <sub>OH</sub>  | 4  | V <sub>CC1</sub> = +15V, V <sub>EE1</sub> = -15V<br>R <sub>L</sub> = 200Ω, I <sub>F</sub> = 5mA  | 11   | 13.2  | —     | V  |
|  | “L” Level            | V <sub>OL</sub>  | 5  | V <sub>CC1</sub> = +15V, V <sub>EE1</sub> = -15V<br>R <sub>L</sub> = 200Ω, V <sub>F</sub> = 0.8V | —  | -14.5 | -12.5 |    |
| Supply Current                             | “H” Level            | I <sub>CCH</sub> | —  | V <sub>CC</sub> = 30V, I <sub>F</sub> = 10mA<br>Ta = 25°C  | —  | 7.5   | —     | mA |
|  |                      |                  |  | V <sub>CC</sub> = 30V, I <sub>F</sub> = 10mA   | —  | —     | 11    |    |
|  | “L” Level            | I <sub>CCL</sub> | —  | V <sub>CC</sub> = 30V, I <sub>F</sub> = 0mA<br>Ta = 25°C   | —  | 8     | —     |    |
|  |                      |                  |  | V <sub>CC</sub> = 30V, I <sub>F</sub> = 0mA  | —  | —     | 11    |    |
| Threshold Input Current                    | “Output L→H”         | I <sub>FLH</sub> | —  | V <sub>CC1</sub> = +15V, V <sub>EE1</sub> = -15V<br>R <sub>L</sub> = 200Ω, V <sub>O</sub> > 0V   | —  | 1.2   | 5     | mA |
| Threshold Input Voltage                    | “Output H→L”         | V <sub>FHL</sub> | —  | V <sub>CC1</sub> = +15V, V <sub>EE1</sub> = -15V<br>R <sub>L</sub> = 200Ω, V <sub>O</sub> < 0V   | 0.8  | —     | —     | V  |
| Supply Voltage                             | V <sub>CC</sub>      | —                |  |  | 10   | —     | 35    | V  |
| Capacitance (Input-Output)                 | C <sub>S</sub>       | —                | V <sub>s</sub> = 0, f = 1MHz<br>Ta = 25°C      | —  | 1.0  | 2.0   | pF    |    |
| Resistance (Input-Output)                  | R <sub>S</sub>       | —                | V <sub>s</sub> = 500V, Ta = 25°C<br>R.H. ≤ 60% | 1 × 10 <sup>12</sup>   | 10 <sup>14</sup>                               | —     | Ω     |    |

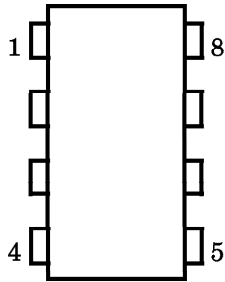
\* All typical values are at Ta = 25°C (\*1) : Duration of I<sub>O</sub> time ≤ 50μs

## SWITCHING CHARACTERISTICS (Ta = -20~70°C, Unless otherwise specified)

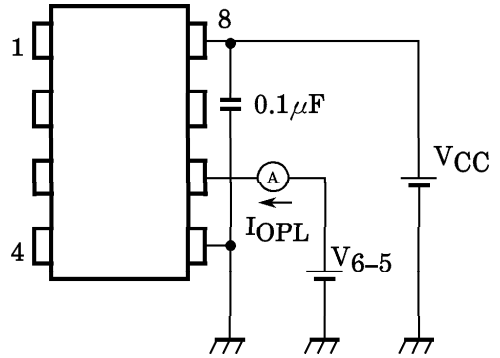
| CHARACTERISTIC                                      |     | SYMBOL           | TEST CIR-CUIT | TEST CONDITION  | MIN.  | TYP.* | MAX. | UNIT   |
|---|-----|------------------|---------------|---|-------|-------|------|--------|
| Propagation Delay Time                              | L→H | t <sub>pLH</sub> | 6             | I <sub>F</sub> = 8mA<br>V <sub>CC1</sub> = +15V, V <sub>EE1</sub> = -15V<br>R <sub>L</sub> = 200Ω | —     | 0.25  | 1.0  | μs     |
|   | H→L | t <sub>pHL</sub> |               |   | —     | 0.25  | 1.0  |        |
| Output Rise Time                                    |     | t <sub>r</sub>   |               |   | —     | —     | —    |        |
| Output Fall Time                                    |     | t <sub>f</sub>   |               |   | —     | —     | —    |        |
| Common Mode Transient Immunity at High Level Output |     | C <sub>MH</sub>  | 7             | V <sub>CM</sub> = 600V, I <sub>F</sub> = 8mA<br>V <sub>CC</sub> = 30V, Ta = 25°C                  | -5000 | —     | —    | V / μs |
| Common Mode Transient Immunity at Low Level Output  |     | C <sub>ML</sub>  | 7             | V <sub>CM</sub> = 600V, I <sub>F</sub> = 0mA<br>V <sub>CC</sub> = 30V, Ta = 25°C                  | 5000  | —     | —    | V / μs |

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

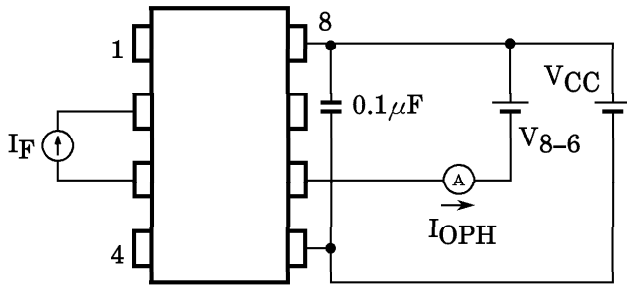
TEST CIRCUIT 1 :



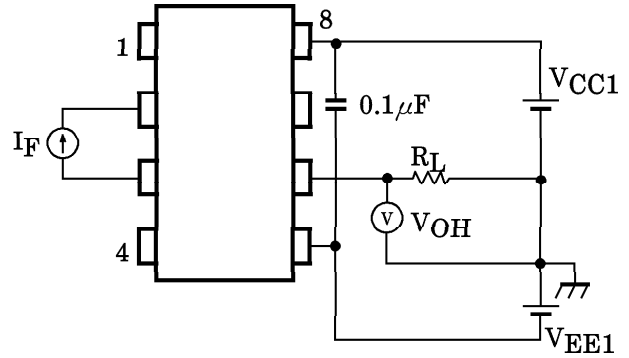
TEST CIRCUIT 2 :  $I_{OPL}$



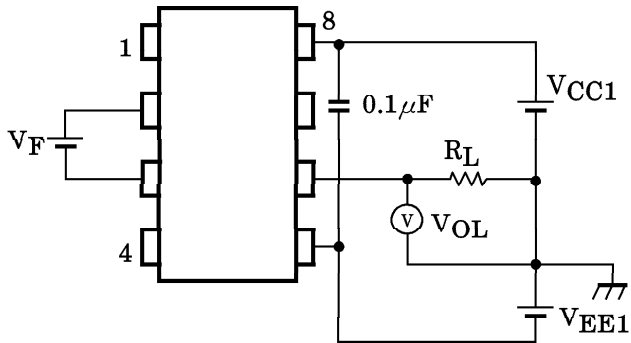
TEST CIRCUIT 3 :  $I_{OPH}$



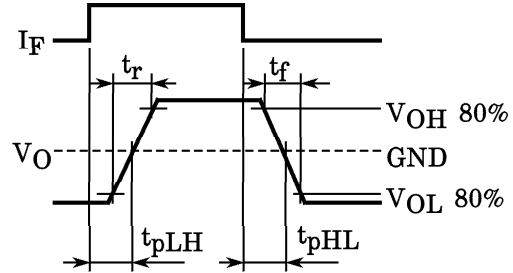
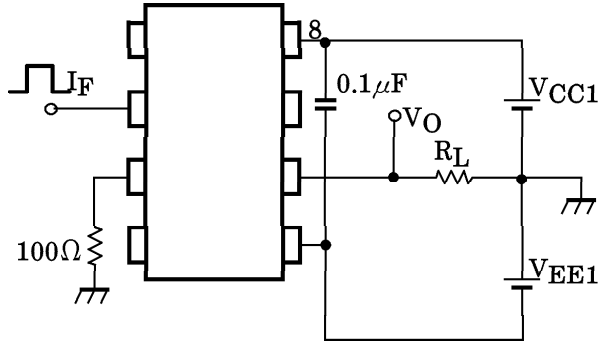
TEST CIRCUIT 4 :  $V_{OH}$



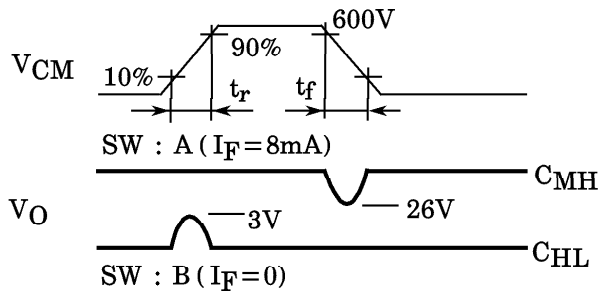
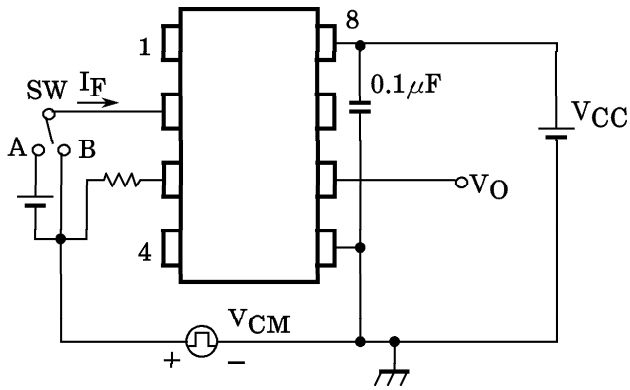
TEST CIRCUIT 5 :  $V_{OL}$



TEST CIRCUIT 6 :  $t_{pLH}$ ,  $t_{pHL}$ ,  $t_r$ ,  $t_f$



TEST CIRCUIT 7 :  $C_{MH}$ ,  $C_{ML}$



$$C_{ML} = \frac{480(V)}{t_r(\mu s)}$$

$$C_{MH} = \frac{480(V)}{t_f(\mu s)}$$

$C_{ML}$  ( $C_{MH}$ ) 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.

