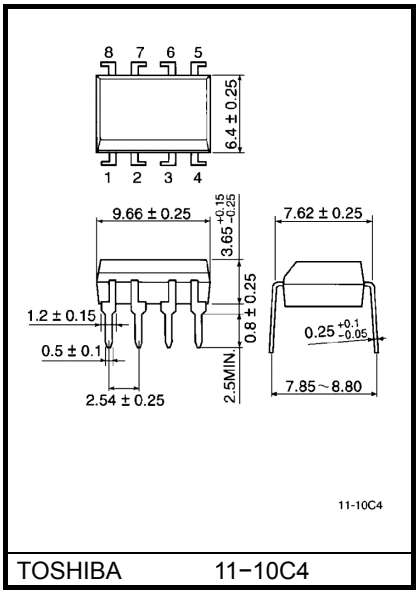
TOSHIBA Photocoupler GaAℓAs Ired & Photo-IC

# TLP251

Inverter For Air Conditioner
Induction Heating
Transistor Inverter
Power MOS FET Gate Drive
IGBT Gate Drive

Unit in mm




TOSHIBA 11−10C4

Weight: 0.54g(typ.)

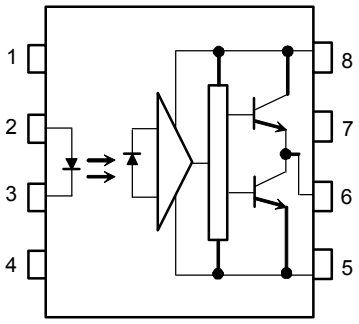
The TOSHIBA TLP251 consists of a GaAℓAs light emitting diode and a integrated photodetector.
This unit is 8-lead DIP package.
TLP251 is suitable for gate driving circuit of IGBT or power MOS FET.
Especially TLP251 is capable of "direct" gate drive of lower power IGBTs. (~15A)

- Input threshold current: $I_F$=5mA(max.)
- Supply current ($I_{CC}$): 11mA(max.)
- Supply voltage ($V_{CC}$): 10−35V
- Output current ($I_O$): ±0.4A(max.)
- Switching time ($t_{pLH}$ / $t_{pHL}$): 1μs(max.)
- Isolation voltage: 2500Vrms(min.)
- UL recognized: UL1577, file no.E67349
- Option(D4)

  VDE Approved : DIN EN60747-5-2
  Maximum Operating Insulation Voltage : 890$V_{PK}$
  Highest Permissible Over Voltage : 4000$V_{PK}$

  **(Note):When a EN60747-5-2 approved type is needed, Please designate "Option(D4)"**

## Pin Configuration (top view)

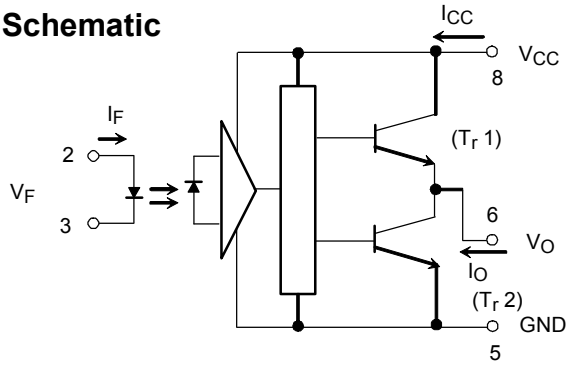



1 : N.C. 5 : GND
2 : Anode 6 : $V_O$ (Output)
3 : Cathode 7 : N.C.
4 : N.C. 8 : $V_{CC}$

## Truth Table

| | | Tr1 | Tr2 |
|---|---|---|---|
| Input LED | On | On | Off |
| | Off | Off | On |

## Schematic




A 0.1μF bypass capcitor must be connected between pin 8 and 5(see Note 5).

## Absolute Maximum Ratings (Ta = 25°C)

| Characteristic | | | Symbol | Rating | Unit |
|---|---|---|---|---|---|
| LED | Forward current | | $I_F$ | 20 | mA |
| | Forward current derating | (Ta ≥ 70°C) | $\Delta I_F / \Delta Ta$ | − 0.36 | mA / °C |
| | Peak transient forward current | (Note 1) | $I_{FPT}$ | 1 | A |
| | Reverse voltage | | $V_R$ | 5 | V |
| | Junction temperature | | $T_j$ | 125 | °C |
| Detector | "H" peak output current ($P_W$ ≤ 2.0μs, f ≤ 15kHz) | (Note 2) | $I_{OPH}$ | − 0.4 | A |
| | "L" peak output current ($P_W$ ≤ 2.0μs, f ≤ 15kHz) | (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 (Ta ≥ 70°C) | | $\Delta V_O / \Delta Ta$ | − 0.73 | V / °C |
| | Supply voltage derating (Ta ≥ 70°C) | | $\Delta V_{CC} / \Delta Ta$ | − 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., R.H.≤ 60%) | | (Note 4) | $BV_S$ | 2500 | 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 $P_W$ ≤ 1μs, 300pps

Note 2: Expornential waveform

Note 3: Expornential waveform, $I_{OPH}$ ≤ −0.25A(≤ 2.0μs), $I_{OPL}$ ≤ +0.25A(≤2.0μs)

Note 4: Device considerd 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 ampifier. Failure to provide the bypassing may impair the swiching property.The total lead length between capacitor and coupler should not exceed 1cm.

## Recommended Operating Conditions

| Characteristic | Symbol | Min. | Typ. | Max. | | Unit |
|---|---|---|---|---|---|---|
| Input current, on (Note6) | $I_{F(ON)}$ | 7 | 8 | 10 | | mA |
| Input voltage, off | $V_{F(OFF)}$ | 0 | — | 0.8 | | V |
| Supply voltage | $V_{CC}$ | 10 | — | 30 | 20 | V |
| Peak output current | $I_{OPH}$ / $I_{OPL}$ | — | — | ±0.1 | | A |
| Operating temperature | $T_{opr}$ | −20 | 25 | 70 | 85 | °C |

Note: 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.

Note 6: Input signal rise time(fall time)<0.5μs.

## Electrical Characteristics (Ta = −20~70°C, unless otherwise specified)

| Characteristic | | Symbol | Test Cir−cuit | Test Condition | | Min. | Typ.* | Max. | Unit |
|---|---|---|---|---|---|---|---|---|---|
| Input forward voltage | | $V_F$ | — | $I_F$ = 10 mA , Ta = 25°C | | — | 1.6 | 1.8 | V |
| Temperature coefficient of forward voltage | | $\Delta V_F$ / $\Delta$Ta | — | $I_F$ = 10 mA | | — | −2.0 | — | mV / °C |
| Input reverse current | | $I_R$ | — | $V_R$ = 5V, Ta = 25°C | | — | — | 10 | μA |
| Input capacitance | | $C_T$ | — | V = 0 , f = 1MHz , Ta = 25°C | | — | 45 | 250 | pF |
| Output current | "H" level | $I_{OPH}$ | 1 | $V_{CC}$=30V (*1) | $I_F$ = 10mA $V_{8-6}$ = 4V | −0.1 | −0.25 | — | A |
| | "L" level | $I_{OPL}$ | 2 | | $I_F$ =0 $V_{6-5}$ = 2.5V | 0.1 | 0.2 | — | |
| Output voltage | "H" level | $V_{OH}$ | 3 | $V_{CC1}$ = +15V, $V_{EE1}$ = −15V $R_L$ = 200Ω, $I_F$ = 5mA | | 11 | 13.2 | — | V |
| | "L" level | $V_{OL}$ | 4 | $V_{CC1}$ = +15V, $V_{EE1}$ = −15V $R_L$ = 200Ω, $V_F$ = 0.8V | | — | −14.5 | −12.5 | |
| Supply current | "H" level | $I_{CCH}$ | — | $V_{CC}$ = 30V, $I_F$ = 10mA Ta = 25°C | | — | 7.5 | — | mA |
| | | | | $V_{CC}$ = 30V, $I_F$ = 10mA | | — | — | 11 | |
| | "L" level | $I_{CCL}$ | — | $V_{CC}$ = 30V, $I_F$ = 0mA Ta = 25°C | | — | 8 | — | |
| | | | | $V_{CC}$ = 30V, $I_F$ = 0mA | | — | — | 11 | |
| Threshould input current | "Output L → H" | $I_{FLH}$ | — | $V_{CC1}$ = +15V, $V_{EE1}$ = −15V $R_L$ = 200Ω, $V_O$ > 0V | | — | 1.2 | 5 | mA |
| Threshold input voltage | "Output H → L" | $V_{FHL}$ | — | $V_{CC1}$ = +15V, $V_{EE1}$ = −15V $R_L$ = 200Ω, $V_O$ < 0V | | 0.8 | — | — | V |
| Supply voltage | | $V_{CC}$ | — | | | 10 | — | 35 | V |
| Capacitance (input−output) | | $C_s$ | — | Vs = 0 , f = 1MHz Ta = 25°C | | — | 1.0 | 2.0 | pF |
| Resistance (input−output) | | $R_s$ | — | Vs = 500V, Ta = 25°C R.H. ≤ 60% | | $1\times10^{12}$ | $10^{14}$ | — | Ω |

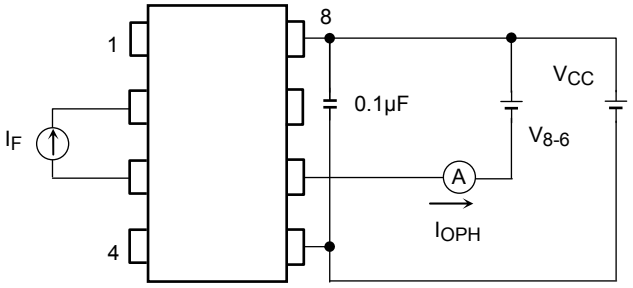
* All typical values are at Ta=25°C (*1): Duration of $I_O$ time ≤ 50μs

## Switching Characteristics (Ta = −20~70°C, unless otherwise specified)

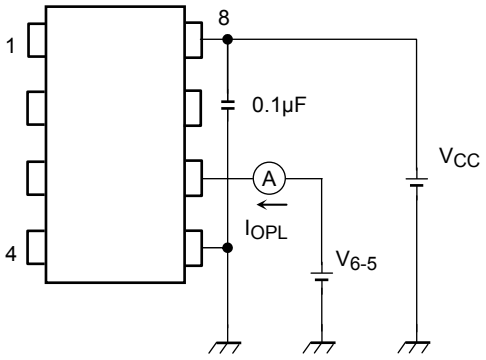
| Characteristic | | Symbol | Test Cir- cuit | Test Condition | Min. | Typ.* | Max. | Unit |
|---|---|---|---|---|---|---|---|---|
| Propagation delay time | L→H | $t_{pLH}$ | 5 | $I_F$ = 8mA<br>$V_{CC1}$ = +15V, $V_{EE1}$ = −15V<br>$R_L$ = 200 Ω | — | 0.25 | 1.0 | μs |
| | H→L | $t_{pHL}$ | | | — | 0.25 | 1.0 | |
| Output rise time | | $t_r$ | | | — | — | — | |
| Output fall time | | $t_f$ | | | — | — | — | |
| Common mode transient immunity at high level output | | $C_{MH}$ | 6 | $V_{CM}$ = 600V, $I_F$ = 8mA,<br>$V_{CC}$ = 30V, Ta = 25°C | −5000 | — | — | V / μs |
| Common mode transient immunity at low level output | | $C_{ML}$ | | $V_{CM}$ = 600V, $I_F$ = 0mA,<br>$V_{CC}$ = 30V, Ta = 25°C | 5000 | — | — | V / μs |

*All typical values are at Ta=25°C

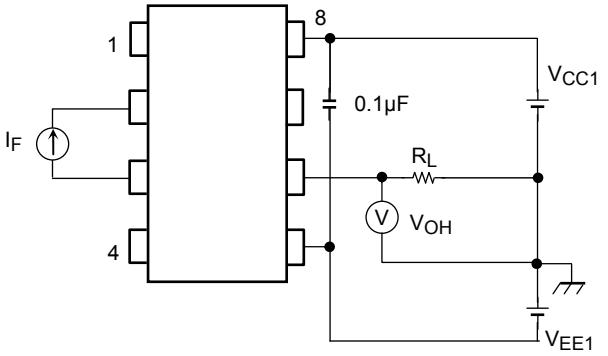
Test Circuit 1 : $I_{OPH}$



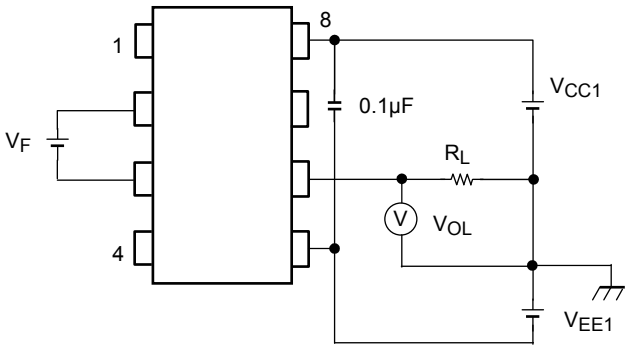

Test Circuit 2 : $I_{OPL}$



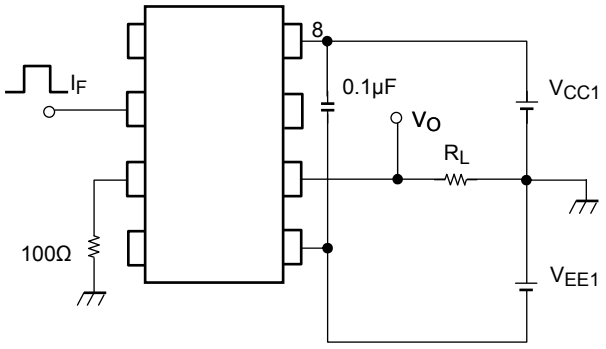

Test Circuit 3 : $V_{OH}$

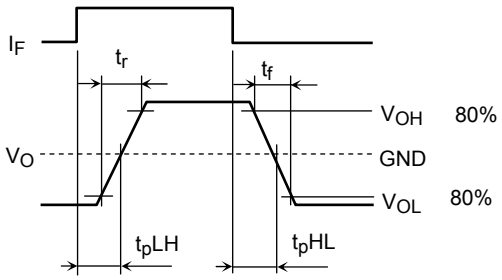



Test Circuit 4 : $V_{OL}$

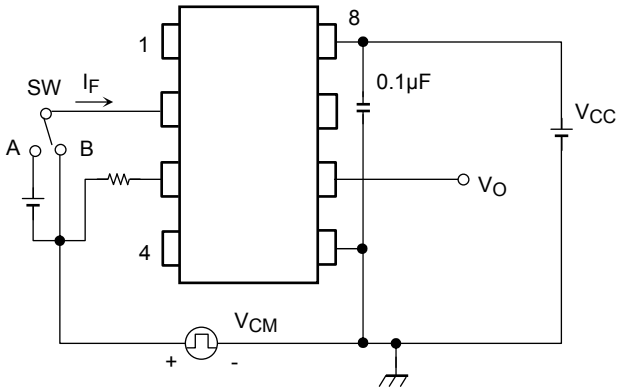


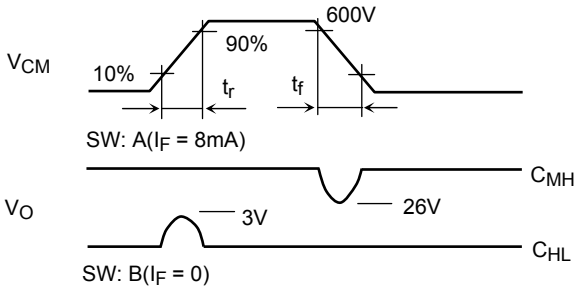
### Test Circuit 5: $t_{pLH}$, $t_{pHL}$, $t_r$, $t_f$




### Test Circuit 6: $C_{MH}$, $C_{ML}$



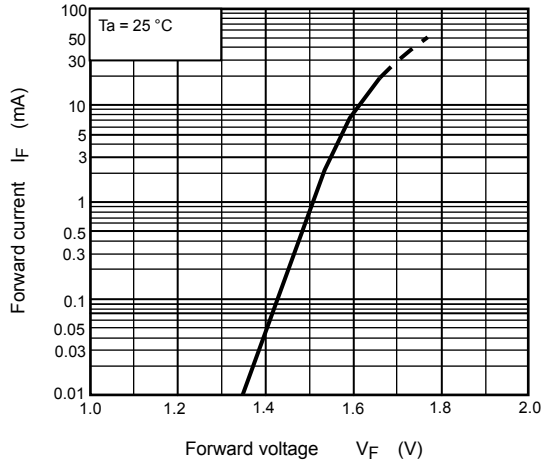




$$C_{ML} = \frac{480(V)}{t_r(\mu s)}$$

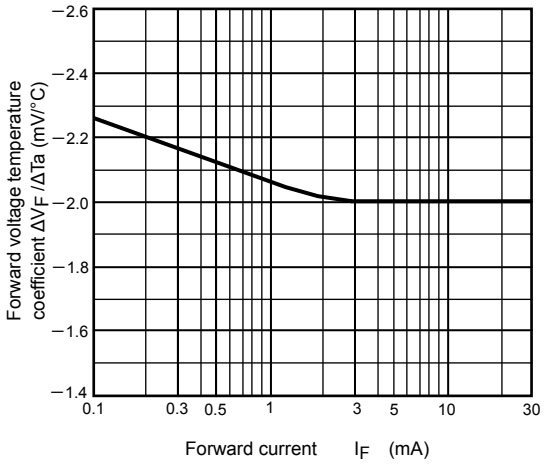
$$C_{MH} = \frac{480(V)}{t_f(\mu s)}$$

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

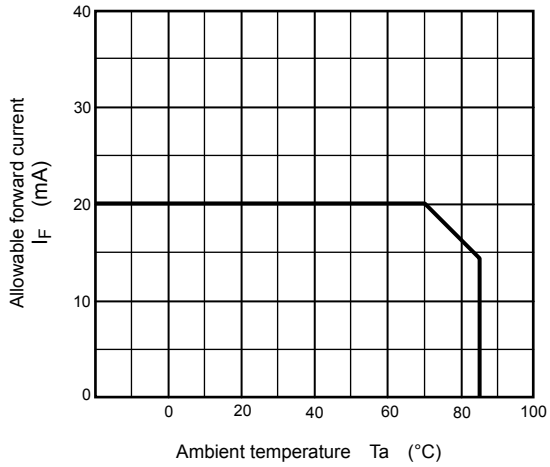
$I_F - V_F$



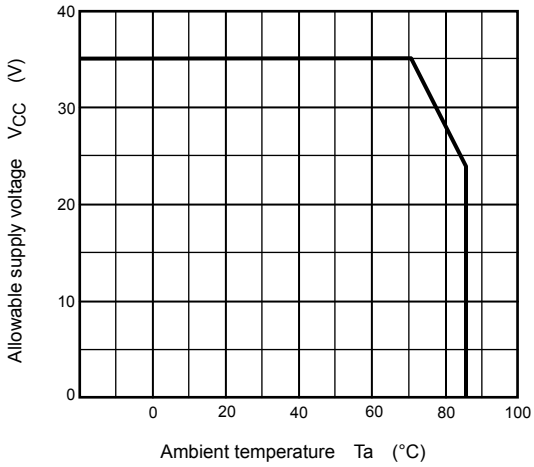

$\Delta V_F / \Delta V_F - I_F$



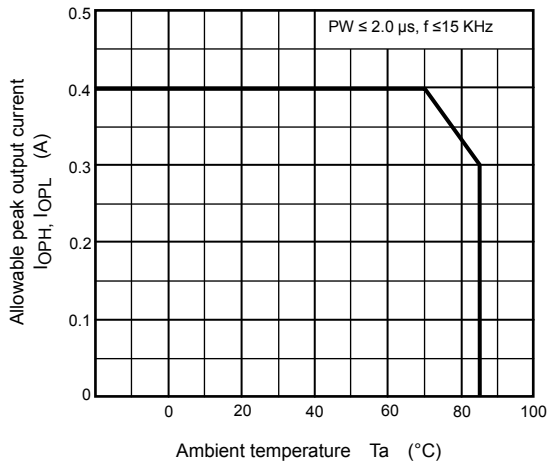

$I_F - Ta$




$V_{CC} - Ta$




$I_{OPH}, I_{OPL} - Ta$



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