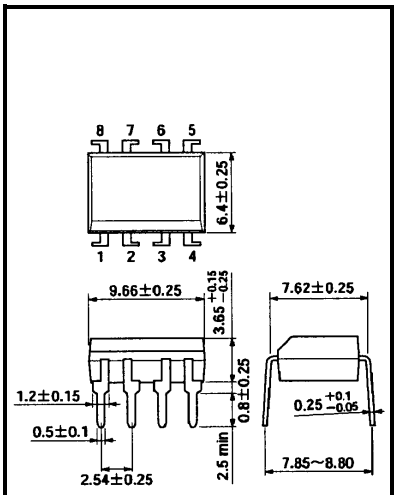
**Preliminary** TOSHIBA Photocoupler GaAℓAs IRED + Photo IC

# TLP350

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

Unit: mm




| | |
|---|---|
| JEDEC | — |
| JEITA | — |
| TOSHIBA | 11-10C4 |

Weight: 0.54 g (typ.)

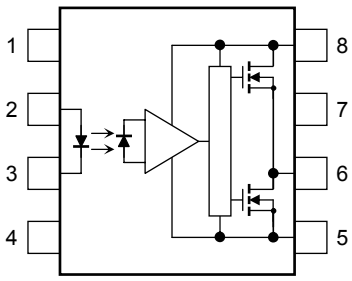
The TOSHIBA TLP350 consists of a GaAℓAs light emitting diode and a integrated photodetector.
This unit is 8-lead DIP package.
TLP350 is suitable for gate driving circuit of IGBT or power MOS FET..

- Peak output current: $I_O$ = ±2.0 A (max)
- Guaranteed performance over temperature: −40 to 100°C
- Supply current:$I_{CC}$ = 2 mA (max)
- Power supply voltage: $V_{CC}$ = 15 to 30 V
- Threshold input current : $I_{FLH}$ = 5 mA (max)
- Switching time ($t_{pLH}$/$t_{pHL}$) : 500 ns (max)
- Common mode transient immunity: 15 kV/μs
- Isolation voltage: 3750 Vrms

## Truth Table

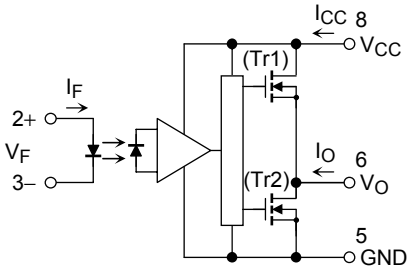
| Input | LED | Tr1 | Tr2 | Output |
|---|---|---|---|---|
| H | ON | ON | OFF | H |
| L | OFF | OFF | ON | L |

## Pin Configuration (top view)




1: NC
2: Anode
3: Cathode
4: NC
5: GND
6: $V_O$ (output)
7: NC
8: $V_{CC}$

## Schematic




A 0.1 μF bypass capacitor must be connected between pin 8 and 5. (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) | | $\Delta I_F/\Delta Ta$ | −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) | $I_{OPH}$ | −2.0 | A |
| | "L" peak output current | (Note 2) | $I_{OPL}$ | 2.0 | A |
| | Output voltage | (Note 3) | $V_O$ | 35 | V |
| | Supply voltage | (Note 3) | $V_{CC}$ | 35 | V |
| | Junction temperature | | $T_j$ | 125 | °C |
| Operating frequency | | (Note 4) | f | | 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 5) | $T_{sol}$ | 260 | °C |
| Isolation voltage (AC, 1 minute, R.H. ≤ 60%) | | (Note 6) | $BV_S$ | 3750 | Vrms |

Note 1: Pulse width $P_W$ ≤ 1 μs, 300 pps

Note 2: Exponential waveform pulse width $P_W$ ≤ μs, f ≤ kHz

Note 3: Ta ≤ 100 °C

Note 4: Exponential waveform $I_{OPH}$ ≤ A (≤ μs), $I_{OPL}$ ≤ + A (≤ μs),Ta = °C

Note 5: It is 2 mm or more from a lead root.

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

Note 7: A ceramic capacitor(0.1 μF) 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 8) | $I_{F\ (ON)}$ | 7.5 | — | 10 | mA |
| Input voltage, OFF | | $V_{F\ (OFF)}$ | 0 | — | 0.8 | V |
| Supply voltage | | $V_{CC}$ | 15 | — | 30 | V |
| Peak output current | | $I_{OPH}/I_{OPL}$ | — | — | ±1.0 | A |
| Operating temperature | | $T_{opr}$ | −40 | — | 100 | °C |

Note 8: 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 | | $\Delta V_F/\Delta Ta$ | — | $I_F$ = 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 , f = 1 MHz,Ta = 25°C | | — | 45 | — | pF |
| Output current (Note 9) | "H" Level | $I_{OPH1}$ | 1 | $V_{CC}$ = 30 V<br>$I_F$ = 5 mA | $V_{8-6}$ = 4.0 V | –1.0 | –1.5 | — | A |
| | | $I_{OPH2}$ | | | $V_{8-6}$ = | | | — | |
| | "L" Level | $I_{OPL1}$ | 2 | $V_{CC}$ = 30 V<br>$I_F$ = 0 mA | $V_{6-5}$ = 2.0 V | 1.0 | 2.0 | — | |
| | | $I_{OPL2}$ | | | $V_{6-5}$ = | | | — | |
| Output voltage | "H" Level | $V_{OH}$ | 3 | $V_{CC\ 1}$= +15 V<br>$V_{EE\ 1}$= -15 V | $I_O$ = –100 mA,<br>$I_F$ = 5 mA | 11 | | — | V |
| | "L" Level | $V_{OL}$ | 4 | | $I_O$ = 100 mA,<br>$V_F$ = 0.8 V | — | | 1.0 | |
| Supply current | "H" Level | $I_{CCH}$ | 5 | $V_{CC}$ = 30 V<br>$V_O$ open | $I_F$ = 10 mA | — | | 2.0 | mA |
| | "L" Level | $I_{CCL}$ | 6 | | $I_F$ = 0 mA | — | | 2.0 | |
| Threshold input current | L → H | $I_{FLH}$ | — | $V_{CC\ 1}$= +15 V<br>$V_{EE\ 1}$= -15 V, $V_O$ > 0 V | | — | | 5 | mA |
| Threshold input voltage | H → L | $V_{FHL}$ | — | $V_{CC\ 1}$= +15 V<br>$V_{EE\ 1}$= -15 V, $V_O$ < 0 V | | 0.8 | — | — | V |
| Supply voltage | | $V_{CC}$ | — | — | | 15 | — | 30 | V |
| UVLO thresh hold | | $V_{UVLO+}$ | — | $V_O$ > 2.5 V , $I_F$ = 5 mA ,<br>$I_O$=100 mA | | 11.0 | — | 13.5 | V |
| | | $V_{UVLO-}$ | — | | | 9.5 | — | 12.0 | V |

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

Note 9: Duration of $I_O$ time ≤ 50 μs

Note 10: 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.

## Isolation Characteristics (Ta = 25°C)

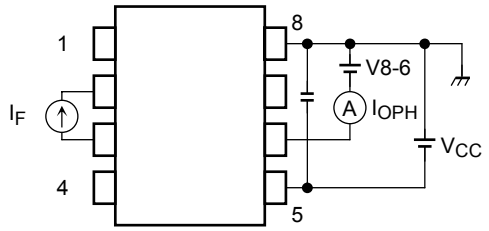
| Characteristic | Symbol | Test Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Capacitance input to output | $C_S$ | V = 0,f = 1MHz (Note6) | — | 0.8 | — | pF |
| Isolation resistance | $R_S$ | $V_S$ = 500 V, Ta = 25°C,<br>R.H. ≤ 60% (Note6) | $1\times10^{12}$ | $10^{14}$ | — | Ω |
| Isolation voltage | $BV_S$ | AC,1 minute | 3750 | — | — | $V_{rms}$ |
| | | AC,1 second,in oil | — | 10000 | — | |
| | | DC,1 minute,in oil | — | 10000 | — | Vdc |

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

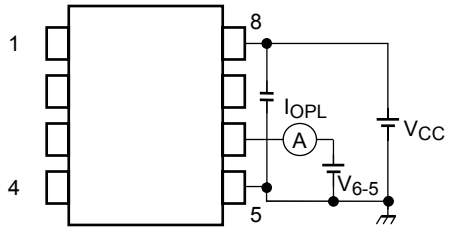
| Characteristics | | Symbol | Test Circuit | Test Condition | | Min | Typ.* | Max | Unit |
|---|---|---|---|---|---|---|---|---|---|
| Propagation delay time | L → H | $t_{pLH}$ | 7 | $V_{CC\ 1}$= +15 V<br>$V_{EE\ 1}$= -15 V<br>$R_g$ = 20 Ω<br>$C_g$ = 10 nF | $I_F$ = 0 → 5 mA | 50 | 250 | 500 | ns |
| | H → L | $t_{pHL}$ | | | $I_F$ = 5 → 0 mA | 50 | 250 | 500 | |
| Propagation delay difference between any two parts or channels | | PDD<br>$\lvert t_{pHL}-t_{pLH}\rvert$ | | $V_{CC\ 1}$= +15 V , $V_{EE\ 1}$= -15 V,<br>$R_g$ = 20 Ω,<br>$C_g$ = 10 nF | | — | — | 450 | ns |
| Output rise time (10-90%) | | $t_r$ | | $V_{CC\ 1}$= +15 V<br>$V_{EE\ 1}$= -15 V<br>$R_g$ = 20 Ω<br>$C_g$ = 10 nF | $I_F$ = 0 → 5 mA | — | | — | ns |
| Output fall time (90-10%) | | $t_f$ | | | $I_F$ = 5 → 0 mA | — | | — | |
| Common mode transient immunity at hight level output | | $CM_H$ | 8 | $V_{CM}$ = 1000 Vp-p<br>Ta = 25°C<br>$V_{CC}$ = 30 V | $I_F$ = 5 mA<br>$V_{O\ (min)}$ =26V | −15000 | — | — | V/μs |
| Common mode transient immunity at low level output | | $CM_L$ | | | $I_F$ = 0 mA<br>$V_{O\ (max)}$ =1V | 15000 | — | — | |

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

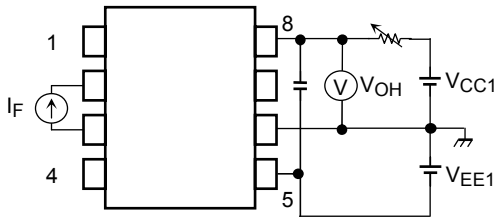
### Test Circuit 1: $I_{OPH}$



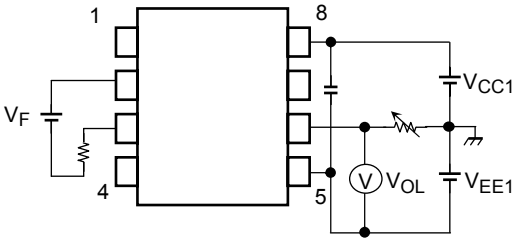

### Test Circuit 2: $I_{OPL}$



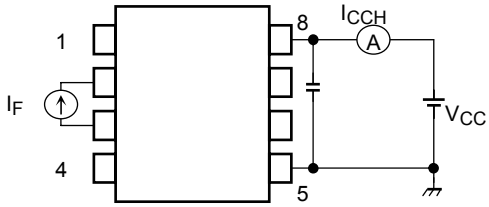

### Test Circuit 3: $V_{OH}$



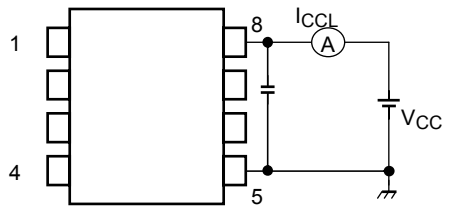

### Test Circuit 4: $V_{OL}$



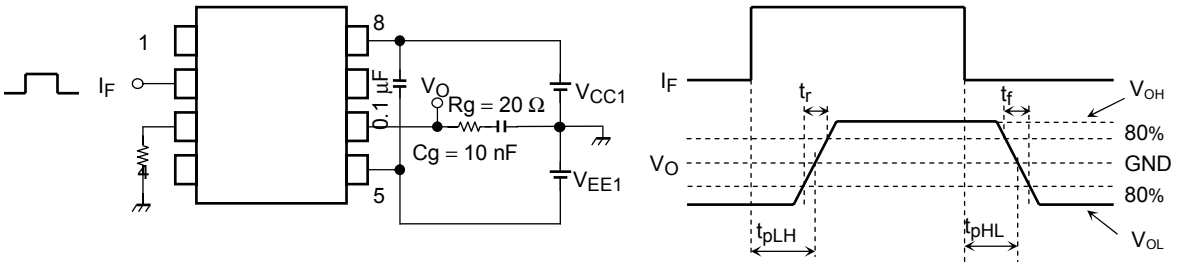

### Test Circuit 5: $I_{CCH}$



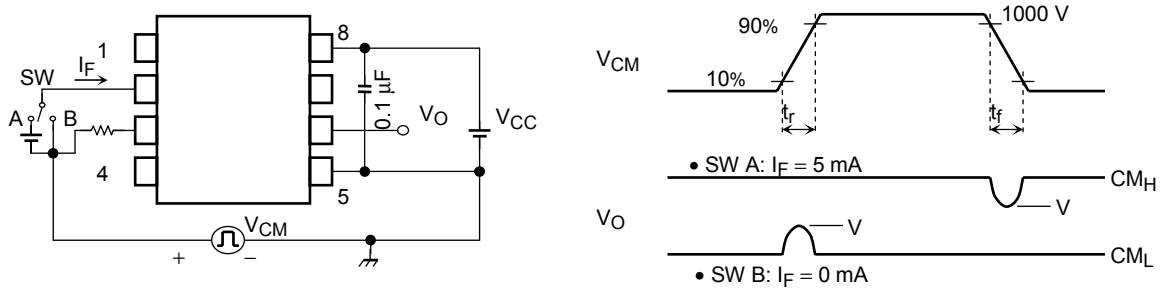

### Test Circuit 6: $I_{CCL}$



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




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




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

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

$CM_L$ ($CM_H$) 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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