

# TLP106

Intelligent Power Module Signal Isolation  
 Industrial Inverters  
 Motor Drive

The Toshiba TLP106 consists of a GaAlAs light-emitting diode and an integrated high-gain, high-speed photo-detector. The TLP106 is suitable for isolating input control signals isolation to intelligent power modules. This unit is a 6-pin MFSOP.

The detector has a totem pole output stage to provide source drive and sink drive and features a built-in Schmitt trigger.

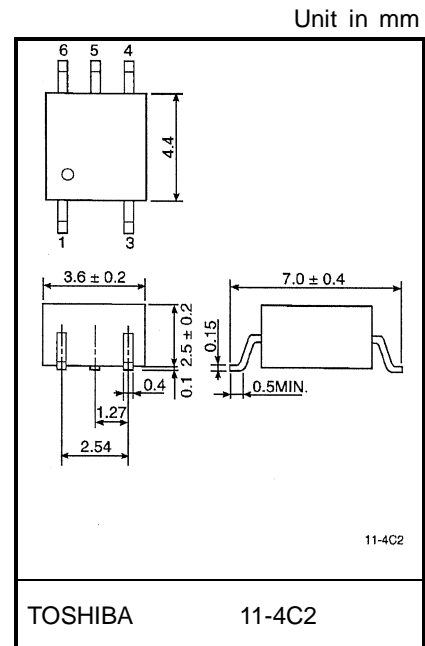
The detector IC has an internal shield that provides a guaranteed common-mode transient immunity of 10 kV/ $\mu$ s.

The TLP106 is of a buffer logic type. An inverter logic version, the TLP102, is also available.

- Buffer logic type (totem pole output)
- Guaranteed performance over temperature : -40~85°C
- Power supply voltage: -0.5~20 V
- Input current: IFLH = 3 mA (Max.)
- Switching Time (tpLH/tpHL): 400 ns (Max.)
- Common-mode transient immunity : 10 kV/ $\mu$ s
- Isolation voltage: 3750 Vrms

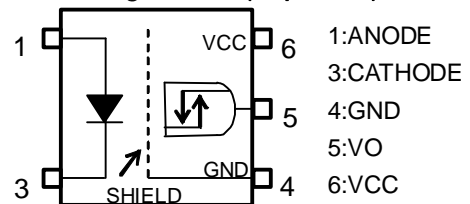
**Truth Table**

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

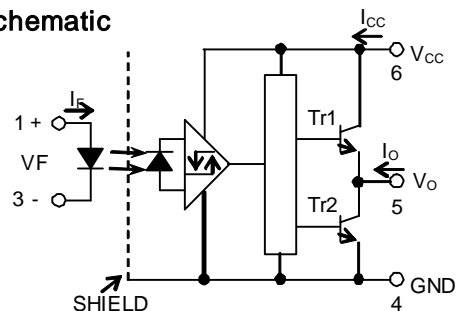


Weight: 0.09 g(typ.)

**Pin Configuration (Top View)**



**Schematic**



0.1  $\mu$ F bypass capacitor must be connected between pins 6 and 4

## Recommended Operating Conditions

| CHARACTERISTIC        | SYMBOL   | MIN. | TYP. | MAX. | UNIT |
|-----------------------|----------|------|------|------|------|
| Input Current, ON     | IF (ON)  | 5    | —    | 10   | mA   |
| Input Voltage, OFF    | VF (OFF) | 0    | —    | 0.8  | V    |
| Supply Voltage        | VCC      | 4.5  | —    | 20   | V    |
| Operating Temperature | Topr     | -40  | —    | 85   | °C   |

## Maximum Ratings (Ta = 25°C)

| CHARACTERISTIC  |   | SYMBOL | RATING   | UNIT |
|---|---|--------|----------|------|
| LED   | Forward Current                         | IF     | 20       | mA   |
|   | Peak Transient Forward Current (Note 1) | IFPT   | 1        | A    |
|   | Reverse Voltage                         | VR     | 5        | V    |
| DETECTOR  | Output Current 1 (Ta ≤ 25°C)            | IO1    | 15/-15   | mA   |
|   | Output Current 2 (Ta = 85°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    |
| Operating Temperature Range                                     |   | Topr   | -40-85   | °C   |
| Storage Temperature Range                                       |   | Tstg   | -55-125  | °C   |
| Lead Solder Temperature (10 s)                                  |   | Tsol   | 260      | °C   |
| Isolation Voltage<br>(AC, 1 min., R.H. ≤60%, Ta = 25°C) (Note2) |   | BVs    | 3750     | Vrms |

Note 1: Pulse width PW ≤ 10 us, 500 pps.

Note 2: Product considered a two-terminal device: pins 1 and 3 shorted together and pins 4, 5 and 6 shorted together.

## Electrical Characteristics

(Unless otherwise specified, Ta = -40 to 85°C, VCC = 4.5~20 V.)

| CHARACTERISTIC                             | SYMBOL                | TEST CIRCUIT | CONDITION                         | MIN.                      | TYP. | MAX. | UNIT  |    |
|--|-----------------------|--------------|-----------------------------------|---------------------------|------|------|-------|----|
| Input Forward Voltage                      | VF                    | —            | IF = 5 mA, Ta = 25°C              | —                         | 1.5  | 1.7  | V     |    |
| Temperature Coefficient of Forward Voltage | $\Delta VF/\Delta Ta$ | —            | IF = 5 mA                         | —                         | -2.0 | —    | mV/°C |    |
| Input Reverse Current                      | IR                    | —            | VR = 5 V, Ta = 25°C               | —                         | —    | 10   | μA    |    |
| Input Capacitance                          | CT                    | —            | V = 0, f = 1 MHz, Ta = 25°C       | —                         | 30   | —    | pF    |    |
| Logic LOW Output Voltage                   | VOL                   | 1            | IOL = 3.5 mA, VF = 0.8 V          | —                         | 0.1  | 0.35 | V     |    |
| Logic HIGH Output Voltage                  | VOH                   | 2            | IOH = -3.5 mA, VCC = 5 V          | 2.4                       | 3.1  | —    | V     |    |
|  |                       |              | IF = 5 mA, VCC = 20 V             | 17.4                      | 18.1 | —    |       |    |
| Logic LOW Supply Current                   | ICCL                  | 3            | VF = 0 V                          | VCC = 20 V, Ta = -40~85°C | —    | 4.0  | 6.0   | mA |
|  |                       |              |                                   | VCC = 5 V, Ta = 25°C      | —    | 3.6  | 4.5   |    |
| Logic HIGH Supply Current                  | ICCH                  | 4            | IF = 5 mA                         | VCC = 20 V, Ta = -40~85°C | —    | 3.1  | 6.0   | mA |
|  |                       |              |                                   | VCC = 5 V, Ta = 25°C      | —    | 2.8  | 4.5   |    |
| Logic LOW Short Circuit Output Current     | IOSL                  | 5            | VF = 0 V<br>VCC = VO = 20 V       | 7                         | 37   | —    | mA    |    |
| Logic HIGH Short Circuit Output Current    | IOSH                  | 6            | IF = 5 mA, VO = GND<br>VCC = 20 V | -7                        | -40  | —    | mA    |    |
| Input Current Logic HIGH Output            | IFLH                  | —            | IO = -3.5 mA, VO > 2.4 V          | —                         | 0.3  | 3    | mA    |    |
| Input Voltage Logic LOW Output             | VFHL                  | —            | IO = 3.5 mA, VO < 0.4 V           | 0.8                       | —    | —    | V     |    |
| Input Current Hysteresis                   | IHYS                  | —            | VCC = 5 V                         | —                         | 0.05 | —    | mA    |    |

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

## Isolation Characteristics (Ta = 25°C)

| CHARACTERISTIC              | SYMBOL | TEST CIRCUIT                    | MIN.               | TYP.      | MAX. | UNIT |
|-----------------------------|--------|---------------------------------|--------------------|-----------|------|------|
| Capacitance Input to Output | CS     | V = 0, f = 1 MHz (Note 2)       | —                  | 0.8       | —    | pF   |
| Isolation Resistance        | RS     | R.H. ≤ 60%, VS = 500 V (Note 2) | $1 \times 10^{12}$ | $10^{14}$ | —    | Ω    |
| Isolation Voltage           | BVS    | AC, 1 minute                    | 3750               | —         | —    | Vrms |
|                             |        | AC, 1 second, in oil            | —                  | 10000     | —    | Vdc  |
|                             |        | DC, 1 minute, in oil            | —                  | 10000     | —    |      |

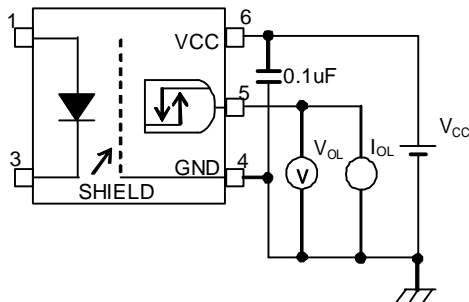
## Switching Characteristics

(Unless otherwise specified,  $T_a = -40$  to  $85^\circ\text{C}$ ,  $V_{CC} = 4.5\sim 20\text{ V}$ .)

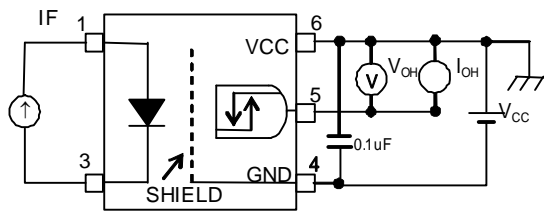
| CHARACTERISTIC                                      | SYMBOL    | TEST CIRCUIT | CONDITION  | MIN.   | TYP. | MAX. | UNIT |
|---|-----------|--------------|--|--------|------|------|------|
| Propagation Delay Time to Logic HIGH Output         | tpLH      | 7            | IF = 0→5mA, CL = 100 pF<br>VCC = 20 V                | 50     | 250  | 400  | ns   |
| Propagation Delay Time to Logic LOW Output          | tpHL      |              | IF = 5→0 mA, CL = 100 pF<br>VCC = 20 V               | 50     | 260  | 400  | ns   |
| Switching Time Dispersion between ON and OFF        | tpHL-tpLH |              | CL = 100 PF  | —      | —    | 350  | ns   |
| Output Rise Time                                    | tr        |              | IF = 0→5 mA, VCC = 20 V                              | —      | 175  | —    | ns   |
| Output Fall Time                                    | tf        |              | IF = 5→0 mA, VCC = 20 V                              | —      | 95   | —    | ns   |
| Propagation Delay Time to Logic HIGH Output         | tpLH      | 8            | IF = 0→5 mA  | 50     | —    | 400  | ns   |
| Propagation Delay Time to Logic LOW Output          | tpHL      |              | IF = 5→0 mA  | 50     | —    | 400  | ns   |
| Common-Mode Transient Immunity at HIGH Level Output | CMH       | 9            | VCM = 1000 Vp-p, IF = 5 mA,<br>VCC = 20 V, Ta = 25°C | -10000 | —    | —    | V/us |
| Common-Mode Transient Immunity at LOW Level Output  | CML       |              | VCM = 1000 Vp-p, IF = 0 mA,<br>VCC = 20 V, Ta = 25°C | 10000  | —    | —    | V/us |

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

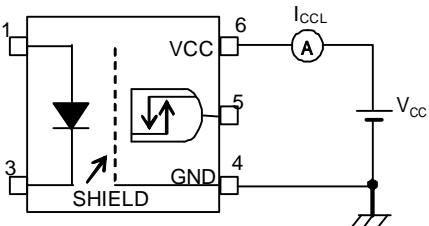
TEST CIRCUIT 1 : VOL



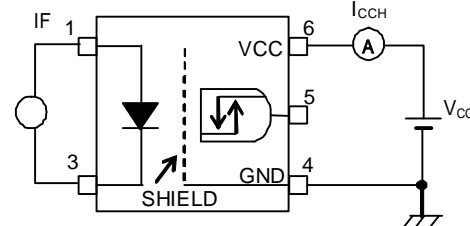
TEST CIRCUIT 2 : VOH



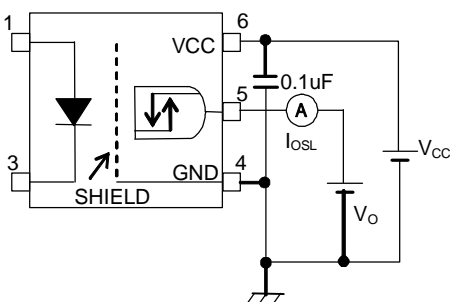
TEST CIRCUIT 3 : ICCL



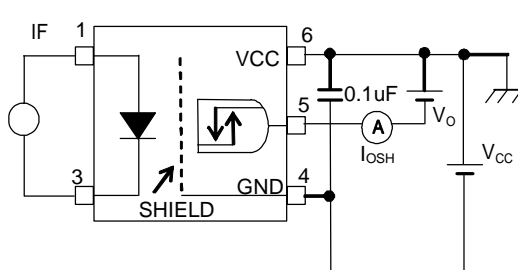
TEST CIRCUIT 4 : ICCH



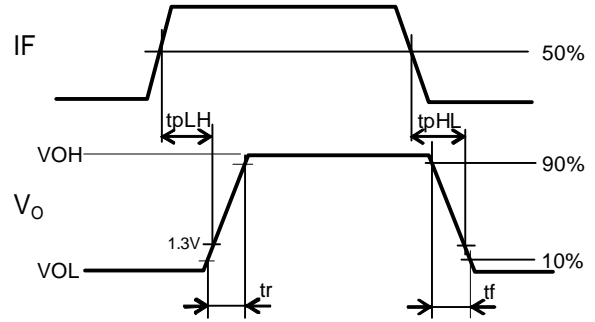
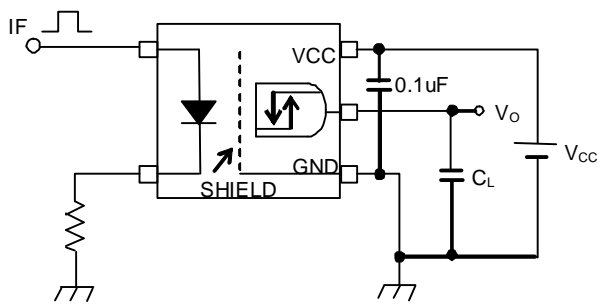
TEST CIRCUIT 5 : IOSL



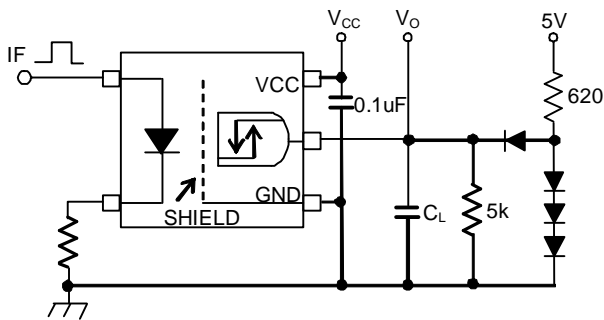
TEST CIRCUIT 6 : IOSH



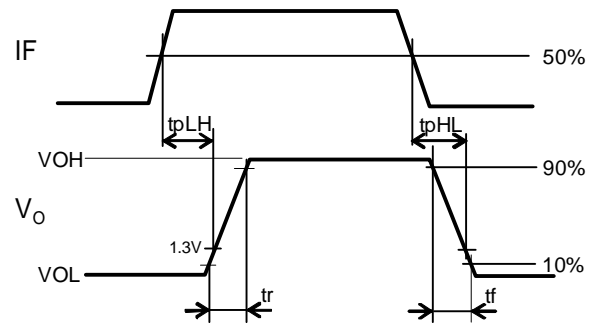
## TEST CIRCUIT 7: Switching Time Test Circuit



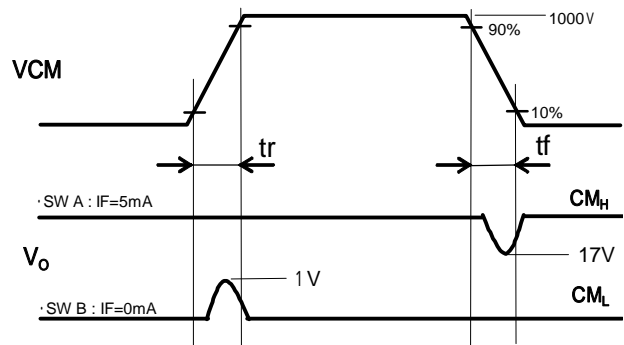
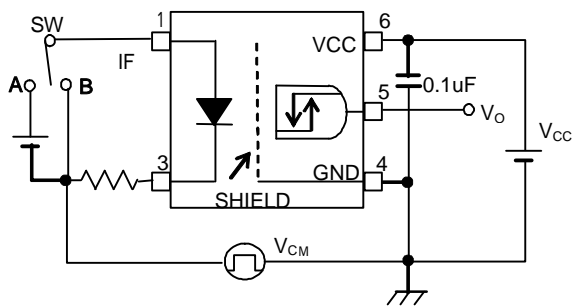
## TEST CIRCUIT 8: Switching Time Test Circuit



CL: stray capacitance of probe and wiring (to 15 pF)



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



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

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

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