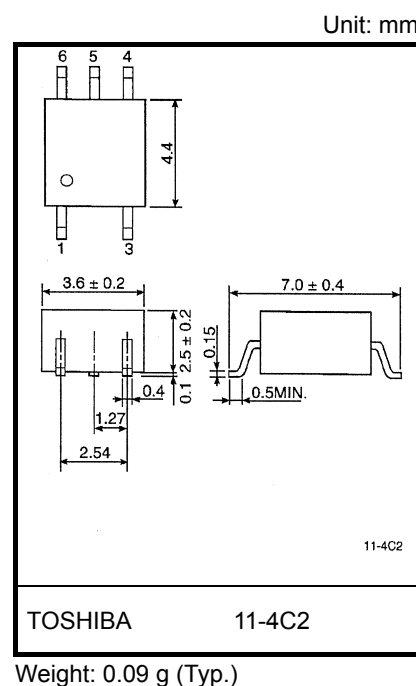


## High-Speed Interface

- Inverter logic (totem pole output)
- Package type : MFSOP6
- Guaranteed performance over temperature : -40 to 105°C
- Power supply voltage : 4.5 to 5.5 V
- Input thresholds current :  $I_{FHL}=5$  mA (Max)
- Propagation delay time (tpHL/tpLH) : 30 ns (Max) at VL=0 V
- 20 ns (Max) at VL=1.1 V
- Switching speed : 50 MBd (Typ.)
- Common mode transient immunity : 10 kV/μs (Min)
- Isolation voltage : 3750 Vrms
- UL Recognized : UL1577, File No.E67349
- c-UL Recognized: CSA Component Acceptance Service No. 5A, File No.E67349



| Input | LED | M1  | M2  | Output |
|-------|-----|-----|-----|--------|
| H     | ON  | OFF | ON  | L      |
| L     | OFF | ON  | OFF | H      |

1:ANODE  
3:CATHODE  
4:GND  
5: V<sub>O</sub>  
6: V<sub>CC</sub>

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

## Absolute Maximum Ratings (Ta=25°C)

| Characteristic                                               |                                         | Symbol                  | Rating     | Unit  |
|--------------------------------------------------------------|-----------------------------------------|-------------------------|------------|-------|
| LED                                                          | Forward current                         | $I_F$                   | 25         | mA    |
|                                                              | Forward current derating (Ta≥85°C)      | $\Delta I_F/\Delta T_a$ | -0.7       | mA/°C |
|                                                              | Peak transient forward current (Note 1) | $I_{FPT}$               | 1          | A     |
|                                                              | Reverse voltage                         | $V_R$                   | 6          | V     |
| DETECTOR                                                     | Output current                          | $I_O$                   | 10         | mA    |
|                                                              | Output voltage                          | $V_O$                   | 6          | V     |
|                                                              | Supply voltage                          | $V_{CC}$                | 6          | V     |
|                                                              | Output power dissipation                | $P_O$                   | 40         | mW    |
| Operating temperature range                                  |                                         | $T_{opr}$               | -40 to 105 | °C    |
| Storage temperature range                                    |                                         | $T_{stg}$               | -55 to 125 | °C    |
| Lead solder temperature(10s)                                 |                                         | $T_{sol}$               | 260        | °C    |
| Isolation voltage<br>(AC, 1min., R.H.≤60%, Ta=25°C) (Note 2) |                                         | BVs                     | 3750       | 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  $PW \leq 1\mu s$ , 300 pps.

Note 2: This device is regarded as a two-terminal device: pins 1 and 3 are shorted together, and pins 4,5 and 6 are shorted together.

## Recommended Operating Conditions

| Characteristic             | Symbol       | Min | Typ. | Max | Unit |
|----------------------------|--------------|-----|------|-----|------|
| Input current , ON         | $I_{F(ON)}$  | 10  | —    | 16  | mA   |
| Input voltage , OFF        | $V_{F(OFF)}$ | 0   | —    | 1.0 | V    |
| Supply voltage(*) (Note 3) | $V_{CC}$     | 4.5 | 5.0  | 5.5 | V    |

\* This item denotes operating ranges, not meaning of recommended operating conditions.

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 3 : The detector of this product requires a power supply voltage ( $V_{CC}$ ) of 4.5 V or higher for stable operation. If  $V_{CC}$  is lower than this value,  $I_{CC}$  may increase or the output may be unstable.

Be sure to use the product after checking the supply current, and the operation of a power-on/-off.

## Electrical Characteristics

(Unless otherwise specified, Ta=-40 to 105°C, VCC =4.5 to 5.5V)

| Characteristic                             |           | Symbol               | Test Circuit | Conditions                                                                                   | Min        | Typ.   | Max    | Unit  |
|--------------------------------------------|-----------|----------------------|--------------|----------------------------------------------------------------------------------------------|------------|--------|--------|-------|
| Input forward voltage                      |           | V <sub>F</sub>       | —            | I <sub>F</sub> =10 mA, Ta=25°C                                                               | 1.45       | 1.6    | 1.85   | V     |
| Temperature coefficient of forward voltage |           | ΔV <sub>F</sub> /ΔTa | —            | I <sub>F</sub> =10 mA                                                                        | —          | -2.0   | —      | mV/°C |
| Input reverse current                      |           | I <sub>R</sub>       | —            | V <sub>R</sub> =5 V, Ta=25°C                                                                 | —          | —      | 10     | μA    |
| Input capacitance                          |           | C <sub>T</sub>       | —            | V=0, f=1 MHz, Ta=25°C                                                                        | —          | 60     | —      | pF    |
| Output voltage                             | "L" Level | V <sub>OL</sub>      | 1            | I <sub>OL</sub> =4 mA, I <sub>F</sub> =10 mA                                                 | —          | —      | 0.6    | V     |
|                                            | "H" Level | V <sub>OH</sub>      | 2            | I <sub>OH</sub> =-4mA, V <sub>CC</sub> =4.5V<br>V <sub>F</sub> =1.05V, V <sub>CC</sub> =5.5V | 3.9<br>4.9 | —<br>— | —<br>— | V     |
| Supply current                             | "L" Level | I <sub>CCL</sub>     | 3            | I <sub>F</sub> =10 mA                                                                        | —          | —      | 5.0    | mA    |
|                                            | "H" Level | I <sub>CCH</sub>     | 4            | V <sub>F</sub> =0 V                                                                          | —          | —      | 5.0    | mA    |
| Input current                              | H → L     | I <sub>FHL</sub>     | —            | I <sub>O</sub> =20 μA, V <sub>O</sub> <0.3 V                                                 | —          | —      | 5      | mA    |
| Input voltage                              | L → H     | V <sub>FLH</sub>     | —            | I <sub>O</sub> =-20 μA, V <sub>O</sub> >4.0 V                                                | 0.8        | —      | —      | V     |

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

## Isolation Characteristics (Ta = 25°C)

| Characteristic              | Symbol          | Test Conditions                             | Min                | Typ.             | Max | Unit             |
|-----------------------------|-----------------|---------------------------------------------|--------------------|------------------|-----|------------------|
| Capacitance input to output | C <sub>S</sub>  | V = 0, f = 1 MHz (Note 2)                   | —                  | 0.8              | —   | pF               |
| Isolation resistance        | R <sub>S</sub>  | R.H. ≤ 60%, V <sub>S</sub> = 500 V (Note 2) | 1×10 <sup>12</sup> | 10 <sup>14</sup> | —   | Ω                |
| Isolation voltage           | BV <sub>S</sub> | AC, 1 minute                                | 3750               | —                | —   | V <sub>rms</sub> |
|                             |                 | AC, 1 second, in oil                        | —                  | 10000            | —   |                  |
|                             |                 | DC, 1 minute, in oil                        | —                  | 10000            | —   | V <sub>dc</sub>  |

Note 4: A ceramic capacitor (0.1 μF) should be connected from pin 6 to pin 4 to stabilize the operation of the high gain linear amplifier. Failure to provide the bypass may impair the switching property.

The total lead length between capacitor and coupler should not exceed 1 cm.

## Switching Characteristics

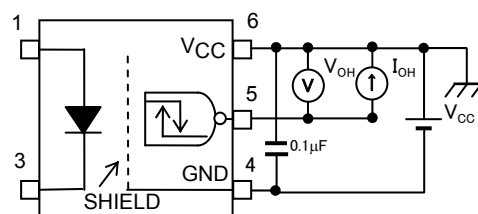
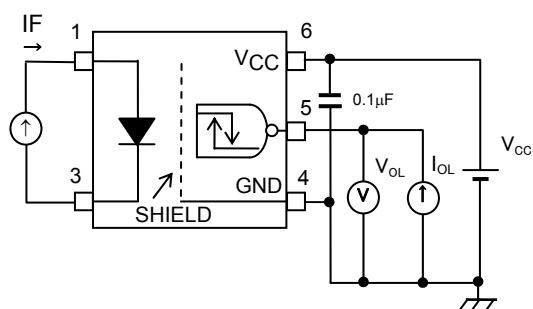
(Unless otherwise specified, Ta=-40 to 105°C, V<sub>CC</sub>=4.5 to 5.5V)

| Characteristic                                      | Symbol          | Test Circuit | Conditions                                                                                                 | Min    | Typ. | Max | Unit |
|-----------------------------------------------------|-----------------|--------------|------------------------------------------------------------------------------------------------------------|--------|------|-----|------|
| Propagation delay time to logic high output         | tpHL            | 5            | V <sub>IN</sub> =0 to 5V                                                                                   | —      | —    | 30  | ns   |
| Propagation delay time to logic low output          | tpLH            |              | V <sub>IN</sub> =5 to 0V                                                                                   | —      | —    | 30  | ns   |
| Switching time dispersion between ON and OFF        | tpHL-tpLH       |              | —                                                                                                          | —      | —    | 10  | ns   |
| Output fall time(90-10%)                            | tf              |              | V <sub>IN</sub> =0 to 5V                                                                                   | —      | 3    | —   | ns   |
| Output rise time(10-90%)                            | tr              |              | V <sub>IN</sub> =5 to 0V                                                                                   | —      | 2    | —   | ns   |
| Propagation delay time to logic high output         | tpHL            | 6            | V <sub>IN</sub> =1.1 to 5V                                                                                 | —      | —    | 20  | ns   |
| Propagation delay time to logic low output          | tpLH            |              | V <sub>IN</sub> =5 to 1.1V                                                                                 | —      | —    | 20  | ns   |
| Propagation delay skew                              | tpsk            |              | —                                                                                                          | —      | —    | 16  | ns   |
| Switching time dispersion between ON and OFF        | tpHL-tpLH       |              | —                                                                                                          | —      | 2    | 8   | ns   |
| Output fall time(90-10%)                            | tf              |              | V <sub>IN</sub> =1.1 to 5V                                                                                 | —      | 3    | —   | ns   |
| Output rise time(10-90%)                            | tr              |              | V <sub>IN</sub> =5 to 1.1V                                                                                 | —      | 3    | —   | ns   |
| Data rate                                           | T               |              | —                                                                                                          | —      | 50   | —   | MBd  |
| Common mode transient immunity at high Level output | CM <sub>H</sub> | 7            | V <sub>CM</sub> =1000Vp-p, Ta=25°C<br>I <sub>F</sub> =0mA, V <sub>CC</sub> =5V, V <sub>O</sub> (Min)=4V,   | 10000  | —    | —   | V/μs |
| Common mode transient immunity at low level output  | CM <sub>L</sub> |              | V <sub>CM</sub> =1000Vp-p, Ta=25°C<br>I <sub>F</sub> =10mA, V <sub>CC</sub> =5V, V <sub>O</sub> (Max)=0.4V | -10000 | —    | —   | V/μs |

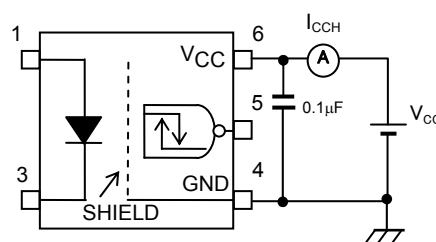
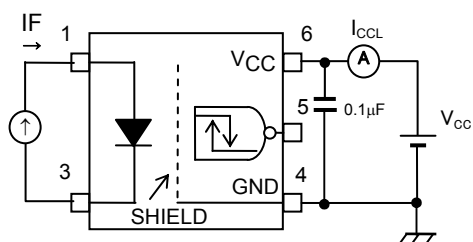
\*All typical values are at Ta=25°C, V<sub>CC</sub>=5V.Note 5 : C<sub>L</sub> is approximately 15pF which includes probe and Jig/stray wiring capacitance.

Note 6 : This product has an automatic threshold control (ATC) circuit in order to reduce input current dependence of its switching time. The ATC circuit may not be able to respond accordingly when an input signal is driven after a prolonged absence of signals to the product. As a result, switching operation, pertaining to the first pulse of an input signal, could be unstable. Theoretically however, stable switching operation should be achievable from the second pulse onwards. As such, please check the switching operation and take the appropriate measures when designing applications in which this product shall be used.

### TEST CIRCUIT 2 : $V_{OH}$



### TEST CIRCUIT 4: $I_{CCH}$

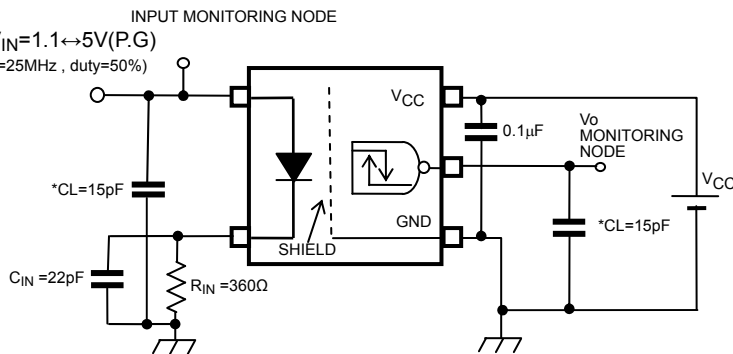


The diagram illustrates the timing characteristics of a CMOS inverter. The input signal  $V_{IN}$  is a square wave with a rise time  $t_r = 4.5\text{ns}$  and a fall time  $t_f = 4.5\text{ns}$ . The output signal  $V_O$  is also a square wave, but its rise and fall times are labeled  $t_r$  and  $t_f$  respectively. The input signal transitions from 10% to 90% of its full swing, and the output signal transitions from 90% to 10% of its full swing. The output signal levels are labeled  $V_{OH}$  (high) and  $V_{OL}$  (low), with a threshold voltage  $V_L = 0\text{V}$  (GND). The propagation delay times are labeled  $t_{pHL}$  (from input 50% to output 50% during a high-to-low transition) and  $t_{pLH}$  (from input 50% to output 50% during a low-to-high transition).

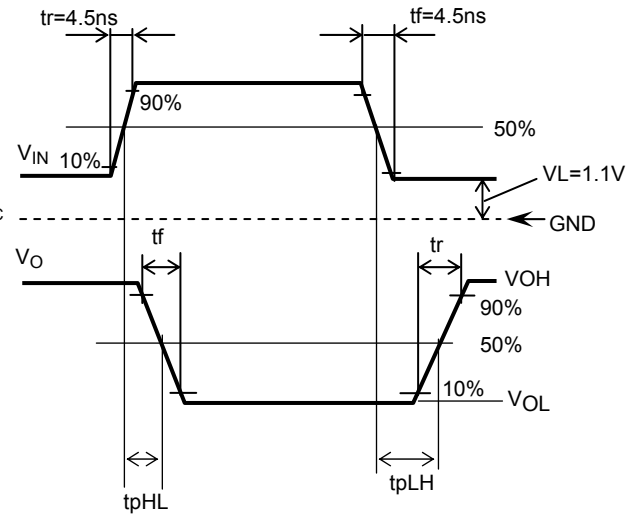
CL is capacitance of the probe and JIG.  
(P.G) : Pulse Generator

## TEST CIRCUIT 6 : tpHL , tpLH

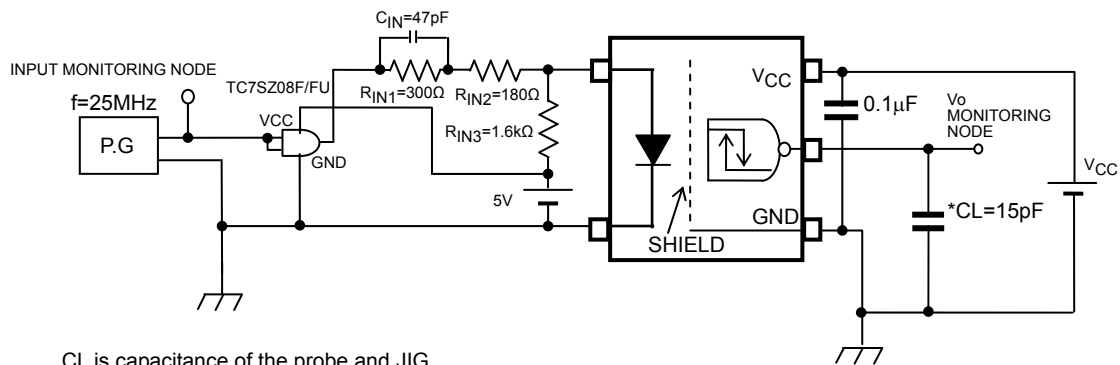
INPUT MONITORING NODE  
 $V_{IN}=1.1 \leftrightarrow 5V(P.G)$   
 $(f=25MHz, duty=50\%)$



CL is capacitance of the probe and JIG.  
(P.G) : Pulse Generator

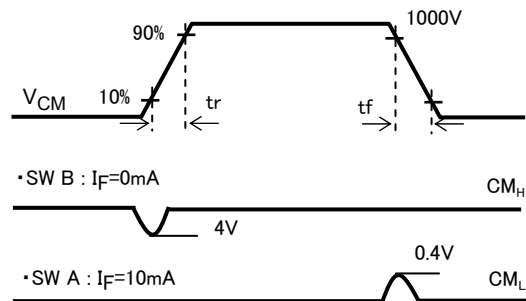
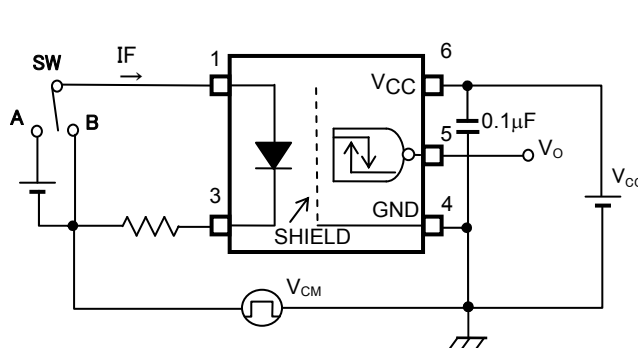


(example for LED drive circuit)



CL is capacitance of the probe and JIG.  
(P.G) : Pulse Generator

## TEST CIRCUIT 7 : Common-Mode Transient Immunity Test Circuit



$$CM_H = \frac{800(V)}{t_r(\mu s)} \quad CM_L = -\frac{800(V)}{t_f(\mu s)}$$

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