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TOSHIBA PHOTOCOUPLER GaAℓAs Ired & PHOTO-IC

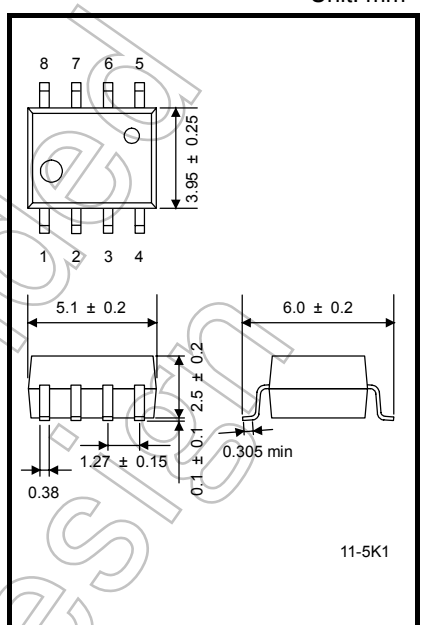
# TLP2116

○ Plasma Display Panels (PDP)
○ High-Speed Interfaces
○ Factory Automation (FA)

The TOSHIBA TLP2116 dual photocoupler consists of a pair of GaAℓAs light-emitting diodes optically coupled to integrated high gain and high-speed photodetectors.

- Inverter logic (totem-pole output)
- Package: SO8
- Guaranteed performance over temperature : -40 to 100°C
- Power supply voltage: 4.5 to 5.5 V
- Input thresholds current: $I_{FHL}$ = 5 mA (max)
- Propagation delay time (tpHL/tpLH): 75 ns (max)
- Switching speed: 15 MBd (typ.) (NRZ)
- Common mode transient immunity: ±10 kV/μs
- Isolation voltage: 2500 Vrms

Unit: mm



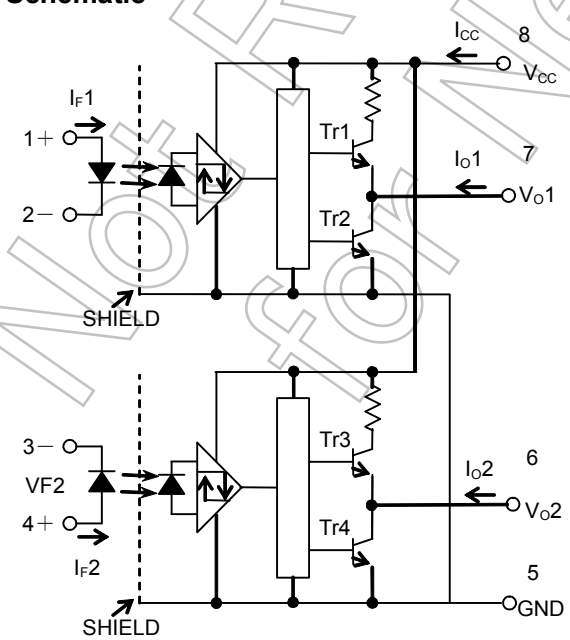

| | |
|---|---|
| JEDEC | — |
| JEITA | — |
| TOSHIBA | 11−5K1 |

Weight: 0.21 g (typ.)

**Truth Table**

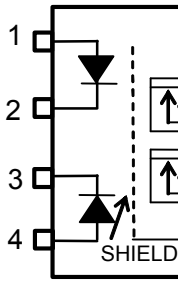
| Input | LED1(2) | Tr1(3) | Tr2(4) | Output 1(2) |
|---|---|---|---|---|
| H | ON | OFF | ON | L |
| L | OFF | ON | OFF | H |

**Schematic**




A bypass capacitor of 0.1 μF must be connected between pins 8 and 5.

**Pin Configuration (Top View)**




1:ANODE 1
2:CATHODE 1
3:CATHODE 2
4:ANODE 2
5:GND
6:VO2(Output2)
7:VO1(Output1)
8:$V_{CC}$

Start of commercial production
2008/02

## Absolute Maximum Ratings (Ta=25°C)

| Characteristic | | | Symbol | Rating | Unit |
|---|---|---|---|---|---|
| LED | Forward current | (Each Channel) | $I_F$ | 20 | mA |
| | Forward current derating | (Ta ≥ 85°C) (Each Channel) | $\Delta I_F/\Delta Ta$ | -0.5 | mA/°C |
| | Peak transient forward current | (Each Channel) (Note 1) | $I_{FPT}$ | 1 | A |
| | Reverse voltage | (Each Channel) | $V_R$ | 5 | V |
| DETECTOR | Output current | (Each Channel) | $I_O$ | 10 | mA |
| | Output voltage | (Each Channel) | $V_O$ | 6 | V |
| | Supply voltage | | $V_{CC}$ | 6 | V |
| | Output power dissipation | | $P_O$ | 40 | mW |
| Operating temperature range | | | $T_{opr}$ | -40 to 100 | °C |
| Storage temperature range | | | $T_{stg}$ | -55 to 125 | °C |
| Lead solder temperature | | (10 s) | $T_{sol}$ | 260 | °C |
| Isolation voltage (AC,1 minute, R.H. ≤ 60%, Ta=25°C) | | (Note 2) | $BV_S$ | 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 PW ≤ 1 μs, 300pps.

Note 2: This device is regarded as a two terminal device: pins 1, 2, 3 and 4 are shorted together, as are pins 5, 6, 7 and 8.

## Recommended Operating Conditions

| Characteristic | | Symbol | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Input current, ON | (Each Channel) | $I_{F(ON)}$ | 8 | — | 18 | mA |
| Input voltage, OFF | (Each Channel) | $V_{F(OFF)}$ | 0 | — | 0.8 | V |
| Supply voltage(*) | (Note 3) | $V_{CC}$ | 4.5 | 5.0 | 5.5 | V |
| Operating temperature | | $T_{opr}$ | -40 | — | 100 | °C |

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

Note 3: The detector of this product requires power supply voltage ($V_{CC}$) of 4.5 V or higher for stable operation.
If the $V_{CC}$ is lower than this value, $I_{CCH}$ may increase, or output may be unstable.
Be sure to use the product after checking the supply current, and the operation of a power-on/-off.

Note 4: A ceramic capacitor (0.1 μF) should be connected from pin 8 ($V_{CC}$) to pin 5 (GND) 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.

## Electrical Characteristics
## (Unless otherwise specified, Ta = -40 to 100℃, $V_{CC}$ = 4.5 to 5.5V)

| Characteristic | | Symbol | Conditions | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|
| Input forward voltage | (Each Channel) | $V_F$ | $I_F$ = 10 mA, Ta = 25°C | 1.3 | 1.65 | 1.75 | V |
| Temperature coefficient of forward voltage | (Each Channel) | $\Delta V_F/\Delta Ta$ | $I_F$ = 10 mA | — | -2.0 | — | mV/°C |
| Input reverse current | (Each Channel) | $I_R$ | $V_R$ = 5 V, Ta = 25°C | — | — | 10 | μA |
| Input capacitance | (Each Channel) | $C_T$ | V = 0, f = 1 MHz, Ta = 25°C | — | 45 | — | pF |
| Logic low output voltage | (Each Channel) | $V_{OL}$ | $I_{OL}$ = 1.6 mA, $I_F$ = 12 mA, $V_{CC}$ = 5 V | — | — | 0.4 | V |
| Logic high output voltage | (Each Channel) | $V_{OH}$ | $I_{OH}$ = -0.02 mA, $V_F$ = 1.05 V $V_{CC}$ = 5 V | 4.0 | — | — | V |
| Logic low supply current | | $I_{CCL}$ | $I_F$ = 12 mA | — | — | 10.0 | mA |
| Logic high supply current | | $I_{CCH}$ | $V_F$ = 0 V (Note 3) | — | — | 10.0 | mA |
| Input current logic low output | (Each Channel) | $I_{FHL}$ | $I_O$ =1.6 mA, $V_O$ < 0.4 V | — | — | 5 | mA |
| Input voltage logic high output | (Each Channel) | $V_{FLH}$ | $I_O$ = -0.02 mA, $V_O$ > 4.0 V | 0.8 | — | — | V |

*All typical values are at Ta=25°C, $V_{CC}$=5 V unless otherwise specified

## Isolation Characteristics (Ta = 25℃)

| Characteristic | Symbol | Test Conditions | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Capacitance input to output | $C_S$ | $V_S$ = 0, f = 1 MHz (Note 2) | — | 0.8 | — | pF |
| Isolation resistance | $R_S$ | R.H. ≤ 60%, $V_S$ = 500 V (Note 2) | $1\times10^{12}$ | $10^{14}$ | — | Ω |
| Isolation voltage | $BV_S$ | AC, 1 minute | 2500 | — | — | Vrms |
| | | AC, 1 second, in oil | — | 5000 | — | |
| | | DC, 1 minute, in oil | — | 5000 | — | Vdc |

## Switching Characteristics
## (Unless otherwise specified, Ta = -40 to 100°C, $V_{CC}$ = 4.5 to 5.5V)(Each Channel)

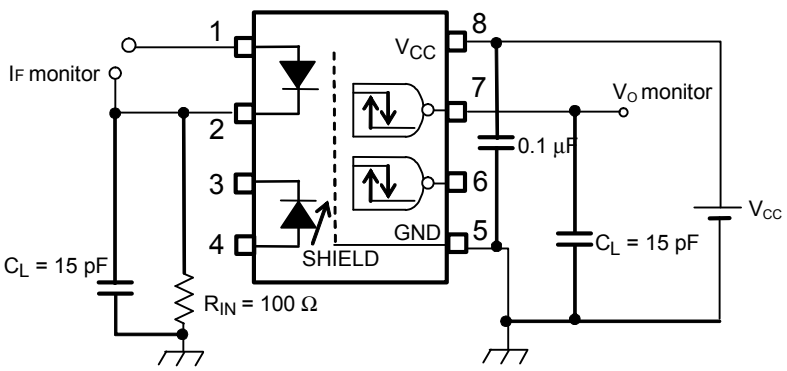
| Characteristic | Symbol | Test Circuit | Conditions | | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|---|
| Propagation delay time to logic low output | $t_{pHL}$ | 1 | $I_F$ = 0→12 mA | $R_{IN}$ = 100 Ω, $C_L$ = 15 pF (Note 5) | — | — | 75 | ns |
| Propagation delay time to logic high output | $t_{pLH}$ | | $I_F$ = 12→0 mA | | — | — | 75 | ns |
| Propagation delay time to logic low output | $t_{pHL}$ | 2 | $V_{IN}$ = 0→5 V ($I_F$ = 0→8 mA) | $R_{IN}$ = 430 Ω, $C_{IN}$ = 27 pF, $C_L$ = 15 pF (Note 5) | — | — | 75 | ns |
| Propagation delay time to logic high output | $t_{pLH}$ | | $V_{IN}$ = 5→0 V ($I_F$ = 8→0 mA) | | — | — | 75 | ns |
| Switching time dispersion between ON and OFF | $\lvert t_{pHL} - t_{pLH} \rvert$ | 1 | $I_F$ = 12 mA, $R_{IN}$ = 100 Ω, $C_L$ = 15 pF (Note 5) | | — | — | 30 | ns |
| Output fall time (90 - 10%) | $t_f$ | | $I_F$ = 0→12 mA | $R_{IN}$ = 100 Ω, $C_L$ = 15 pF (Note 5) | — | 15 | — | ns |
| Output rise time (10 - 90%) | $t_r$ | | $I_F$ = 12→0 mA | | — | 15 | — | ns |
| Common mode transient immunity at high level output | $CM_H$ | 3 | $VC_M$ = 1000 Vp-p , $I_F$ = 0 mA, $V_O$ (min) = 4 V , Ta = 25°C | | 10000 | — | — | V/μs |
| Common mode transient immunity at low level output | $CM_L$ | | $VC_M$ = 1000 Vp-p , $I_F$ = 12 mA, $V_O$ (max) = 0.4 V , Ta = 25°C | | -10000 | — | — | V/μs |

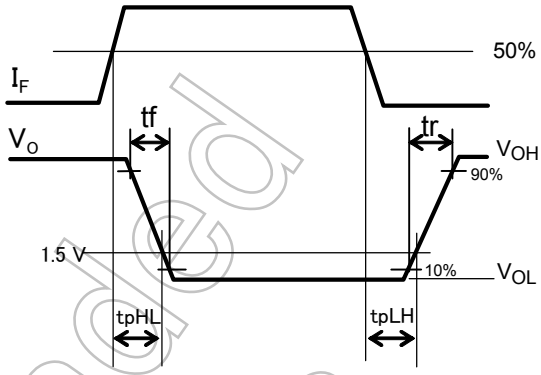
*All typical values are at Ta=25°C

Note 5: $C_L$ is approximately 15 pF which includes probe and Jig/stray wiring capacitance.

### Test Circuit 1: Switching Time Test Circuit

$I_F$=12 mA (P.G)
(f=5 MHz, duty=50%,
less than $t_r = t_f$= 5 ns)

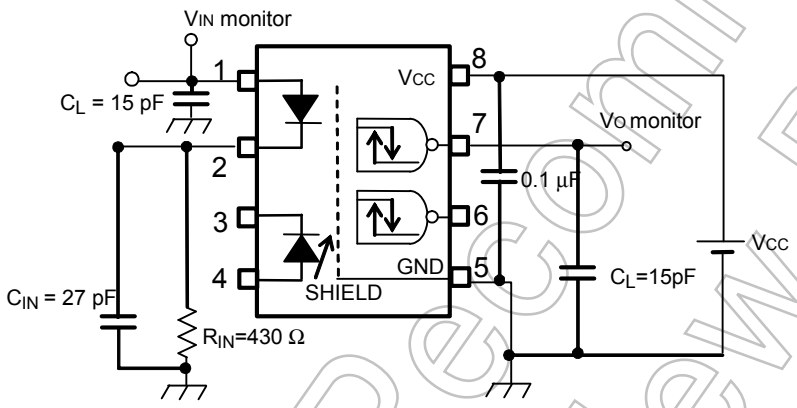


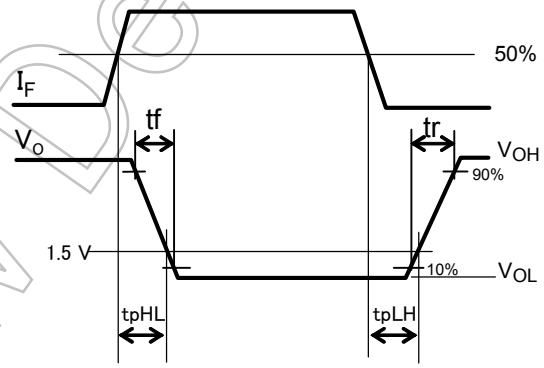




$C_L$ is capacitance of the probe and JIG.
(P.G): Pulse Generator

### Test Circuit 2: Switching Time Test Circuit

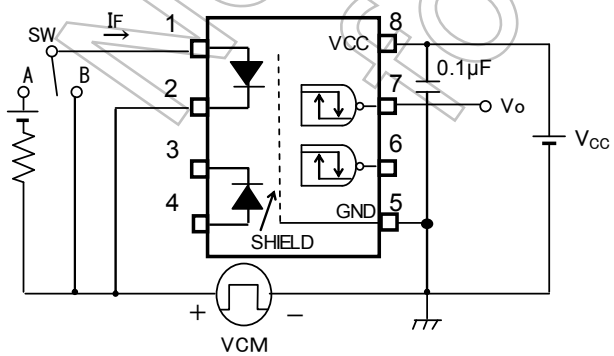
VIN=5V (P.G)
(f=5 MHz, duty=50%,
less than $t_r = t_f$= 5 ns)

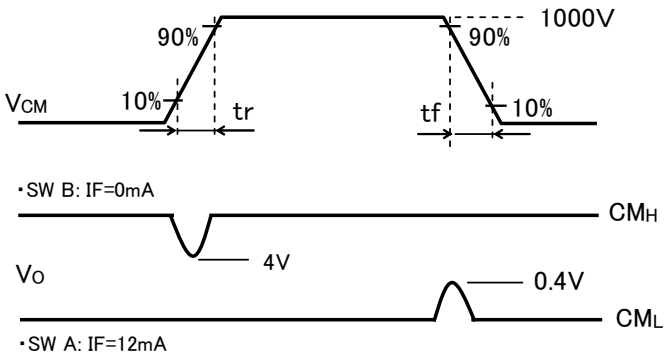



$C_L$ is capacitance of the probe and JIG.
(P.G): Pulse Generator

### Test Circuit 3: Common-Mode Transient Immunity Test Circuit




$$CM_H = \frac{800(V)}{tr(\mu s)} \qquad CM_L = -\frac{800(V)}{tf(\mu s)}$$

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