

TOSHIBA PHOTOCOUPLER GaAlAs Ired & PHOTO-IC

TLP2116

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

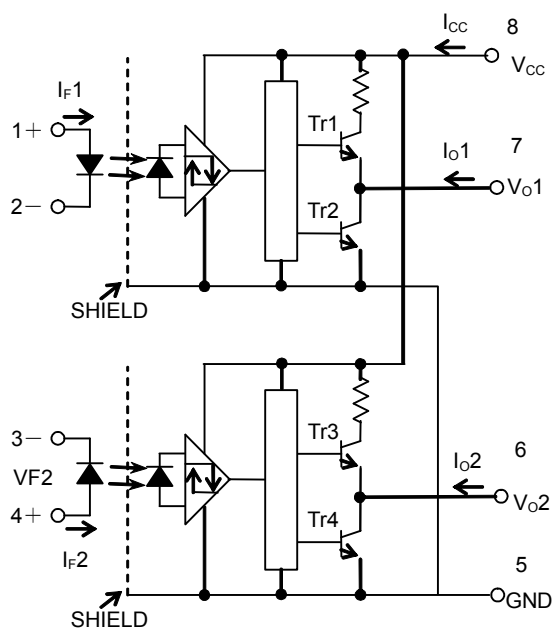
The TOSHIBA TLP2116 dual photocopier consists of a pair of GaAlAs light-emitting diodes optically coupled to integrated high gain and high-speed photodetectors.

- Inverter logic (totem-pole output)
- Package: SO-8
- Guaranteed performance over temperature : -40 to 100°C
- Power supply voltage: 4.5 to 5.5 V
- Input thresholds current: $I_{FHL} = 5 \text{ mA (max)}$
- Propagation delay time (tpHL/tpLH): 75 ns (max)
- Switching speed: 15 MBd (typ.)(NRZ)
- Common mode transient immunity: $\pm 10 \text{ kV}/\mu\text{s}$
- Isolation voltage: 2500 Vrms

Truth Table

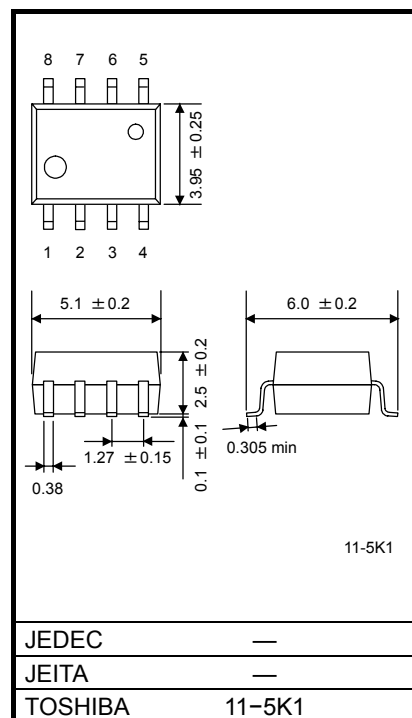
Input	LED1(2)	Tr1(3)	Tr2(4)	Output 1(2)
H	ON	OFF	ON	L
L	OFF	ON	OFF	H

Schematic



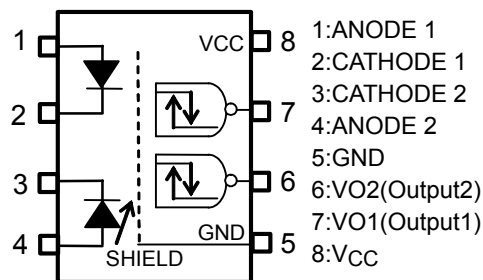
A bypass capacitor of 0.1 μF must be connected between pins 8 and 5.

Unit: mm



Weight: 0.21g (typ.)

Pin Configuration (Top View)



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)	$\Delta I_F / \Delta T_a$	-0.5	mA/°C
	Peak transient forward current (Each Channel) (Note 2)	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, 1min., 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 $PW \leq 1 \mu s$, 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 a power supply voltage (V_{CC}) of 4.5 V or higher for stable operation.

If the V_{CC} is lower than this value, an I_{CCH} may increase, or an 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°C, VCC = 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)	$\Delta V_F / \Delta T_a$	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, VCC=5 V unless otherwise specified

Isolation Characteristics (Ta = 25°C)

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)	1×10 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, $T_a = -40$ to 100°C , $V_{CC} = 4.5$ to 5.5V)(Each Channel)

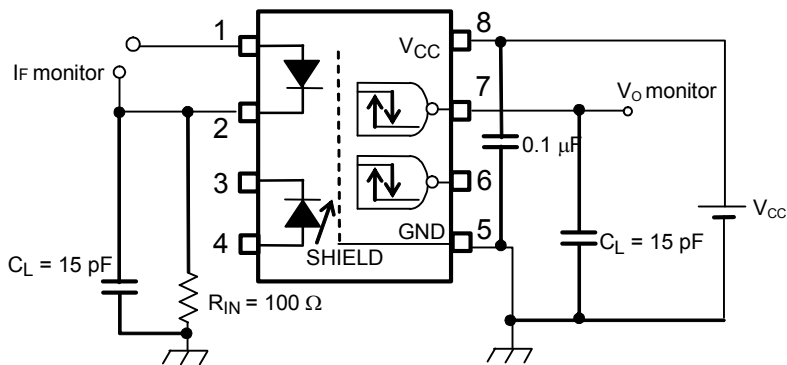
Characteristic	Symbol	Test Circuit	Conditions	Min	Typ.	Max	Unit
Propagation delay time to logic low output	t_{pHL}	1	$I_F = 0 \rightarrow 12 \text{ mA}$	—	—	75	ns
Propagation delay time to logic high output	t_{pLH}		$I_F = 12 \rightarrow 0 \text{ mA}$				
			$R_{IN} = 100 \Omega$ $C_L = 15 \text{ pF}$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

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

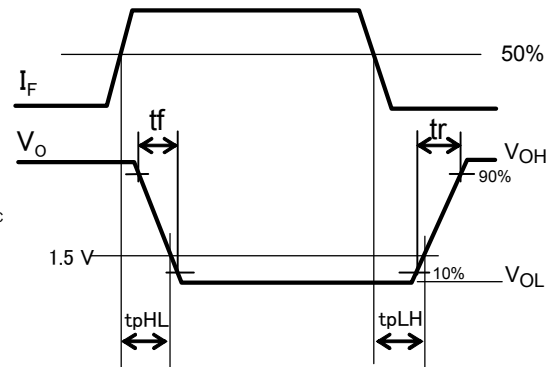
Note 5: C_L is approximately 15 pF which includes probe and Jig/stray wiring capacitance.

Test Circuit 1: Switching Time Test Circuit

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

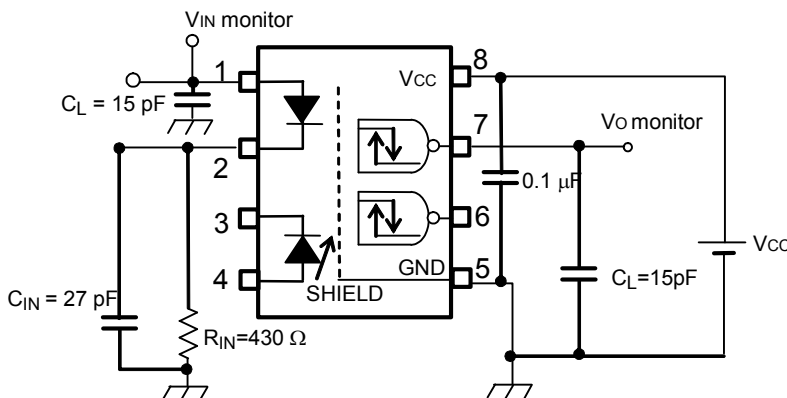


C_L is capacitance of the probe and JIG.
(P.G) : Pulse Generator

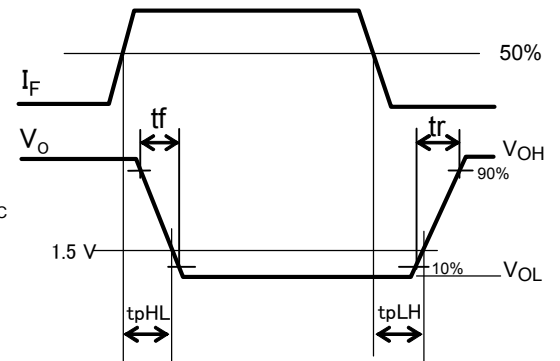


Test Circuit 2: Switching Time Test Circuit

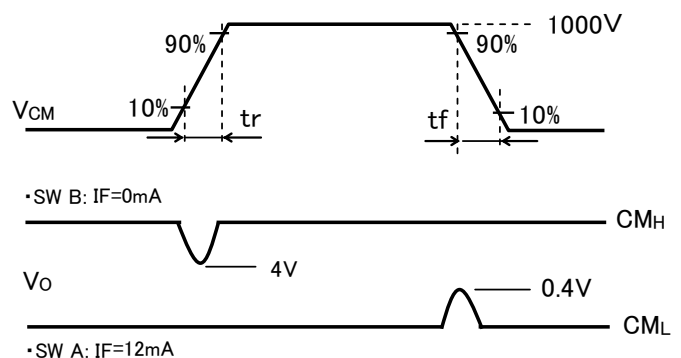
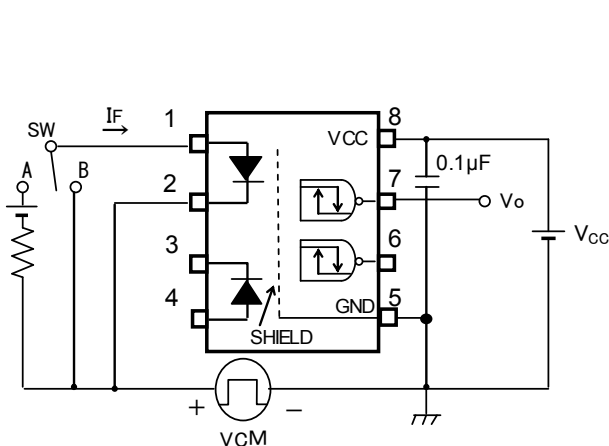
$V_{IN} = 5 \text{ V}$ (P.G)
 $(f = 5 \text{ MHz, duty} = 50\%,$
less than $t_r = t_f = 5 \text{ ns})$



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



Test Circuit 3: Common-Mode Transient Immunity Test Circuit



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

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