TOSHIBA Photocoupler GaAℓAs IRed & Photo IC

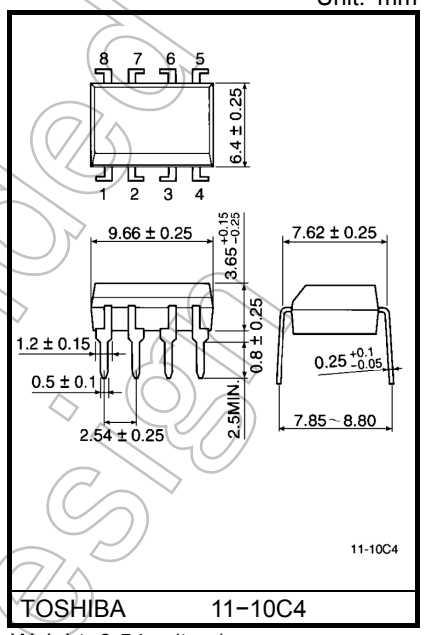
TLP558

Isolated Bus Driver
High Speed Line Receiver
Microprocessor System Interfaces
MOS FET Gate Driver
Transistor Inverter

The TOSHIBA TLP558 consists of a GaAℓAs light emitting diode and integrated high gain, high speed photodetector.
This unit is 8−lead DIP package.
The detector has a three state output stage that provides source drive and sink drive, and built−in schmitt trigger. The detector IC has an internal shield that provides a guaranteed common mode transient immunity of 1000V / μs. TLP558 is inverter logic type. For buffer logic type, TLP555 is in line−up.

- Input current: I_F=1.6 mA (max)
- Power supply voltage: V_{CC}=4.5~20 V
- Switching speed: t_{pHL}, t_{pLH}=400ns (max)
- Common mode transient immunity: ±1000V/μs (min)
- Guaranteed performance over temperature: −25 to 85°C
- Isolation voltage: 2500V_{rms} (min)
- UL recognized: UL1577, file No. E67349

Unit: mm



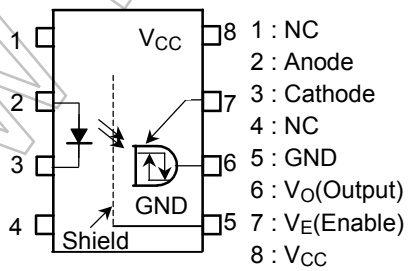
Weight: 0.54 g (typ.)

Truth Table (positive logic)

Input	Enable	Output
H	H	L
L	H	H
H	L	Z
L	L	Z

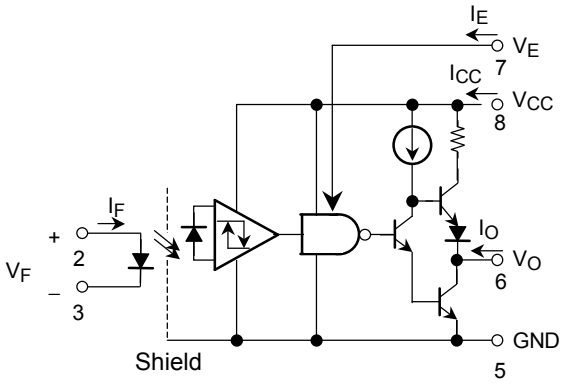
A 0.1μF bypass capacitor must be connected between pins 8 and 5 (see Note 9).

Pin Configuration (top view)



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

Schematic



Start of commercial production
1987/05

Absolute Maximum Ratings

Characersitic			Symbol	Rating	Unit
LED	Forward current		I_F	10	mA
	Peak transient forward current	(Note 1)	I_{FPT}	1	A
	Reverse voltage		V_R	5	V
Detector	Output current		I_O	40 / −25	mA
	Peak output current	(Note 2)	I_{OP}	80 / −50	mA
	Output voltage		V_O	−0.5~20	V
	Supply voltage		V_{CC}	−0.5~20	V
	Three state enabel voltage		V_E	−0.5~20	V
	Output power dissipation	(Note 3)	P_O	100	mW
	Total package power dissipation	(Note 4)	P_T	200	mW
Operating temperature range			T_{opr}	−40~85	°C
Storage temperature range			T_{stg}	−55~125	°C
Lead solder temperature(10s)**			T_{sol}	260	°C
Isolation voltage (AC, 1 minute, R.H. ≤ 60%, Ta=25°C)		(Note 5)	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 ≤ 1μs, 300pps.

(Note 2) Pulse width ≤ 5μs, duty ratio ≤ 0.025.

(Note 3) Derate 1.8mW / °C above 70°C ambient temperature.

(Note 4) Derate 3.6mW / °C above 70°C ambient temperature.

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

**1.6mm below seating plane.

Recommended Operating Conditions

Characteristic	Symbol	Min	Typ.	Max	Unit
Input current, on	$I_{F(ON)}$	2*	—	5	mA
Input voltage, off	$V_{F(OFF)}$	0	—	0.8	V
Supply voltage	V_{CC}	4.5	—	20	V
Enable voltage high	V_{EH}	2.0	—	20	V
Enable voltage low	V_{EL}	0	—	0.8	V
Fan out(TTL load)	N	—	—	4	—
Operating temperature	T_{opr}	−25	—	85	°C

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.

* 2mA condition permits at least 20% CTR degradation guardband.
Initial switching threshold is 1.6mA or less.

Electrical Characteristics (unless otherwise specified, Ta = −25~85°C, V_{CC} = 4.5~20V)

Characteristic	Symbol	Test Condition		Min	Typ.*	Max	Unit
Input forward voltage	V_F	I_F=5mA, Ta=25°C		—	1.55	1.7	V
Temperature coefficient of forward voltage	$\Delta V_F / \Delta Ta$	I_F=5mA		—	−2.0	—	mV / °C
Input reverse current	I_R	V_R=5V, Ta=25°C		—	—	10	μA
Input capacitance	C_T	V_F=0, f=1MHz, Ta=25°C		—	45	—	pF
Output leakage current (V_O > V_{CC})	I_{OHH}	V_F=0, V_{CC}=4.5V	V_O=V_E=5.5V	—	—	100	μA
			V_O=V_E=20V	—	0.01	500	
Logic low output voltage	V_{OL}	I_{OL}=6.4mA, I_F=1.6mA V_E=2V		—	0.4	0.5	V
Logic high output voltage	V_{OH}	I_{OH}=−2.6mA, V_F=0.8V V_E=2V		2.4	3.3	—	V
Logic low enable current	I_{EL}	V_E=0.4V		—	−0.13	−0.32	mA
Logic high enable current	I_{EH}	V_E=2.7V		—	—	20	μA
		V_E=5.5V		—	—	100	
		V_E=20V		—	0.01	250	
Logic low enable voltage	V_{EL}	—		—	—	0.8	V
Logic high enable voltage	V_{EH}	—		2.0	—	—	V
Logic low supply current	I_{CCL}	I_F=5mA	V_{CC}=V_E=5.5V	—	4.0	6.0	mA
			V_{CC}=V_E=20V	—	4.6	7.5	
Logic high supply current	I_{CCH}	V_F=0V	V_{CC}=V_E=5.5V	—	4.2	6.0	mA
			V_{CC}=V_E=20V	—	4.7	7.5	
High impedance state output current	I_{OZL}	V_F=0V V_E=0.8V	V_O=0.4V	—	—	−20	μA
	I_{OZH}	I_F=5mA V_E=0.8V	V_O=2.4V	—	—	20	
			V_O=5.5V	—	—	100	
			V_O=20V	—	1	500	
Logic low short circuit output current (Note 6)	I_{OSL}	I_F=5mA V_E=2V	V_O=V_{CC}=5.5V	25	55	—	mA
			V_O=V_{CC}=20V	40	80	—	
Logic high short circuit output current (Note 6)	I_{OSH}	V_F=0V, V_O=GND V_E=2V	V_{CC}=5.5V	−10	−25	—	mA
			V_{CC}=20V	−25	−60	—	
Input current logic low output	I_{FL}	V_E=2V, I_O=6.4mA V_O < 0.4V		—	0.4	1.6	mA
Input voltage logic high output	V_{FH}	V_E=2V, I_O=−2.6mA V_O > 2.4V		0.8	—	—	V
Input current hysteresis	I_{HYS}	V_{CC}=V_E=5V		—	0.05	—	mA
Resistance (input−output)	R_S	V_S=500V, R.H. ≤60% Ta=25°C (Note 5)		5×10^{10}	10^{14}	—	Ω
Capacitance(input−output)	C_S	V_S=0, f=1MHz, Ta=25°C (Note 5)		—	1.0	—	pF

*All typical values are at Ta=25°C, V_{CC}=5V, $I_{F(ON)}$=3mA unless otherwise specified.

(Note 6) Duration of output short circuit time should not exceed 10ms.

Switching Characteristics (unless otherwise specified, V_{CC} = 4.5~20V, Ta = 25°C)

Characteristic	Symbol	Test Circuit	Test Condition	Min	Typ.*	Max	Unit
Propagation delay time to logic high output (Note 7)	t_{pLH}	1	I_F=3→ 0mA	—	250	400	ns
Propagation delay time to logic low output (Note 7)	t_{pHL}		I_F=0→ 3mA	—	270	400	ns
Output rise time (10−90%)	t_r		I_F=3→ 0mA, V_{CC}=5V	—	35	75	ns
Output fall time (90−10%)	t_f		I_F=0→ 3mA, V_{CC}=5V	—	20	75	ns
Output enable time to logic high	t_{pZH}	2	V_E=0→ 3V	—	—	—	ns
Output enable time to logic low	t_{pZL}		V_E=0→ 3V	—	—	—	ns
Output disable time from logic high	t_{pHZ}		V_E=3→ 0V	—	—	—	ns
Output disable time from logic low	t_{pLZ}		V_E=3→ 0V	—	—	—	ns
Common mode transient immunity at logic high output (Note 8)	C_{MH}	3	I_F=0mA, V_{CM}=50V $V_{O\ (Min)}$ =2V	1000	—	—	V / μs
Common mode transient immunity at logic low output (Note 8)	C_{ML}		I_F=1.6mA, V_{CM}=50V $V_{O\ (Max)}$ =0.8V	−1000	—	—	V / μs

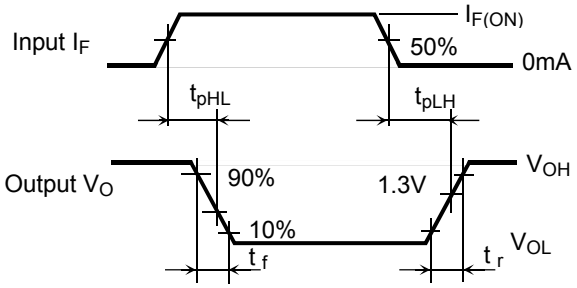
* All typical values are at Ta=25°C, V_{CC}=5V

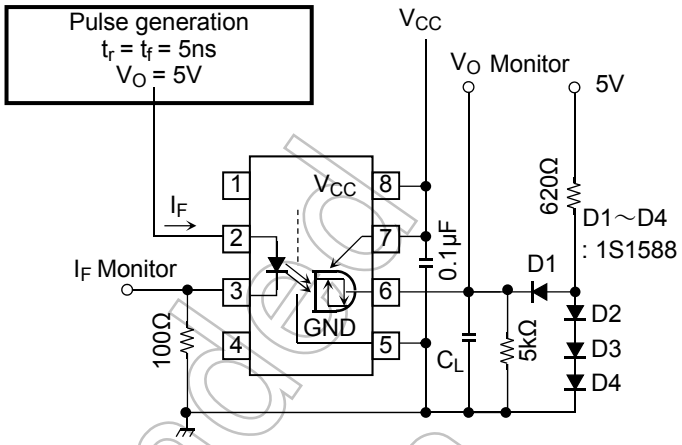
(Note 7) The t_{pLH} propagation delay is measured from the 50% point on the trailing edge of the input pulse to the 1.3V point on the leading edge of the output pulse. The t_{pHL} propagation delay is measured from the 50% point on the leading edge of the input pulse to the 1.3V point on the trailing edge of the output pulse.

(Note 8) C_{ML} is the maximum rate of fall of the common mode voltage that can be sustained with the output voltage in the logic low state (V_O < 0.8V).
C_{MH} is the maximum rate of rise of the common mode voltage that can be sustained with the output voltage in the logic state (V_O > 2.0V).

(Note 9) A ceramic capacitor (0.1μF) 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 1cm.

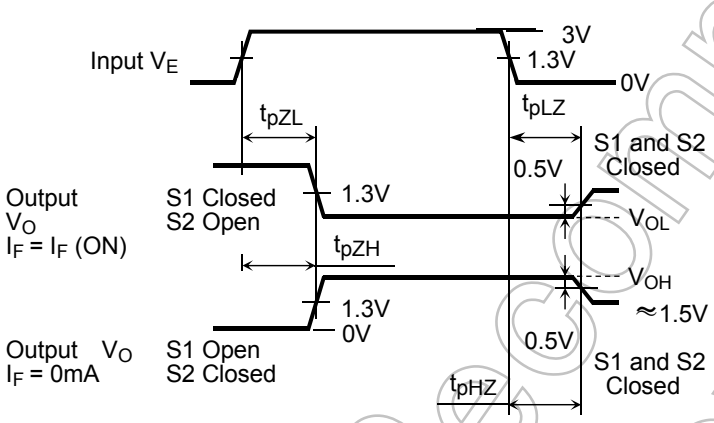
Test Circuit 1: t_{pLH}, t_{pHL}, t_r and t_f

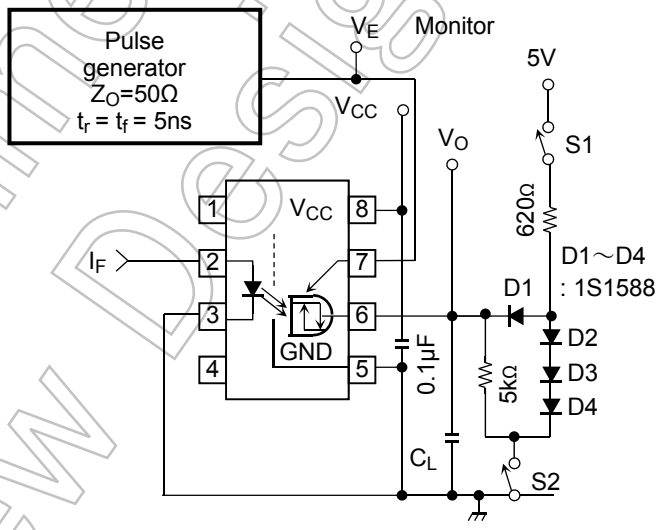




C_L is approximately 15pF which includes probe and stray wiring capacitance.

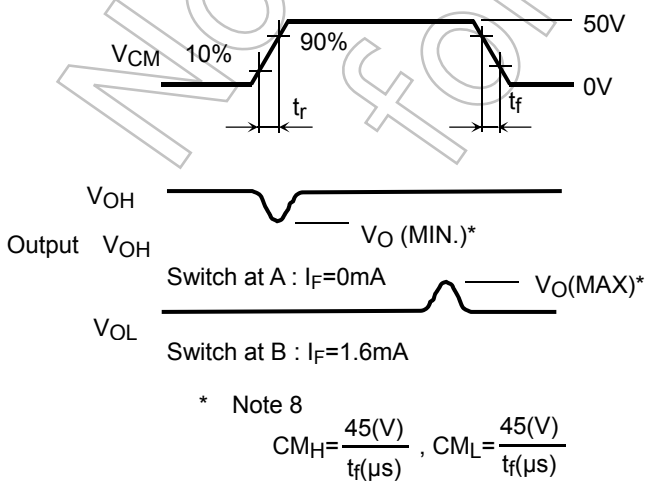
Test Circuit 2: t_{pHZ}, t_{pZH}, t_{pLZ} and t_{pZL}





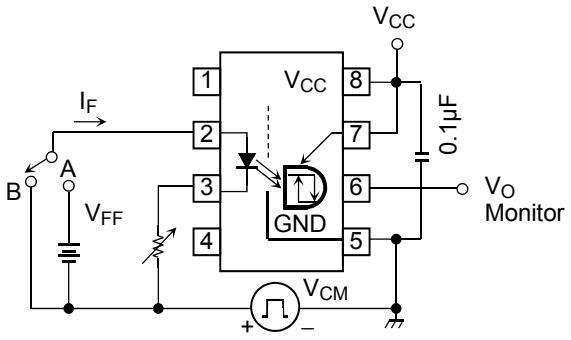
C_L is approximately 15$_p$F which includes probe and stray wiring capacitance.

Test Circuit 3: Common Mode Transient Immunity



* Note 8

$$CM_H = \frac{45(V)}{t_f(\mu s)}\ ,\ CM_L = \frac{45(V)}{t_f(\mu s)}$$



Pulse generator
Z_O =50Ω

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