

# TLP558

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

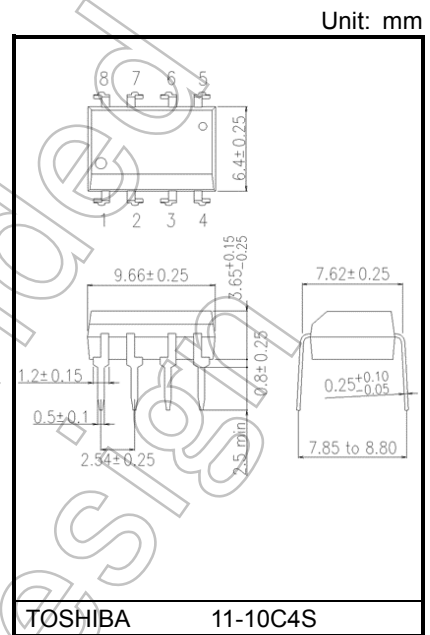
The TOSHIBA TLP558 consists of an infrared emitting diode and integrated high gain, high speed photodetector.  
 This unit is 8-lead DIP package.  
 The detector has a three state output stage that provides source drive and sink drive, and built-in schmitt trigger. The detector IC has an internal shield 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:  $V_{CC}=4.5$  to 20 V
- Switching speed:  $t_{pHL}$ ,  $t_{pLH}=400$ ns (max)
- Common mode transient immunity:  $\pm 1000V/\mu s$  (min)
- Guaranteed performance over temperature: -25 to 85°C
- Isolation voltage: 2500Vrms (min)
- UL-recognized: UL 1577, File No.E67349
- cUL-recognized: CSA Component Acceptance Service No.5A File No.E67349

### Truth Table

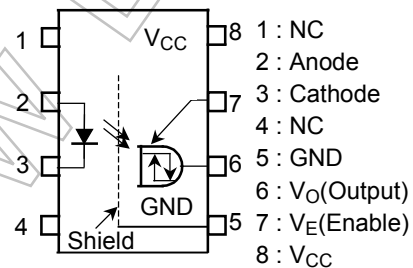
Input	Enable	Output
H	H	L
L	H	H
H	L	Z
L	L	Z

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

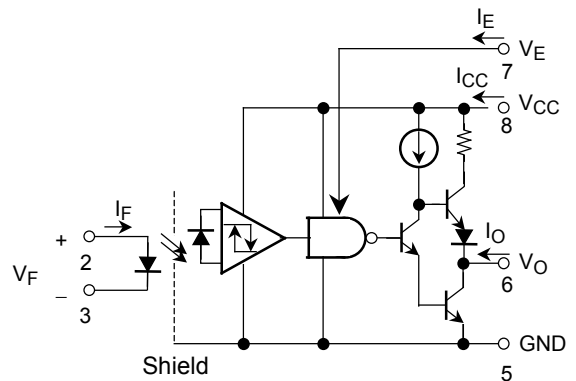


Weight: 0.54 g (typ.)

### Pin Configuration (top view)



### Schematic



Start of commercial production  
 1987-05

## Absolute Maximum Ratings

Characteristic		Symbol	Rating	Unit
LED	Forward current	I <sub>F</sub>	10	mA
	Peak transient forward current (Note 1)	I <sub>FPT</sub>	1	A
	Reverse voltage	V <sub>R</sub>	5	V
	Diode power dissipation	P <sub>D</sub>	45	mW
Detector	Output current	I <sub>O</sub>	40 / -25	mA
	Peak output current (Note 2)	I <sub>OP</sub>	80 / -50	mA
	Output voltage	V <sub>O</sub>	-0.5 to 20	V
	Supply voltage	V <sub>CC</sub>	-0.5 to 20	V
	Three state enable voltage	V <sub>E</sub>	-0.5 to 20	V
	Output power dissipation	P <sub>O</sub>	100	mW
	Output power dissipation derating (Ta > 70 °C)	ΔP <sub>O</sub> /ΔTa	-1.8	mW/°C
	Total package power dissipation	P <sub>T</sub>	200	mW
	Total package power dissipation derating (Ta > 70 °C)	ΔP <sub>T</sub> /ΔTa	-3.6	mW/°C
Operating temperature range		T <sub>opr</sub>	-40 to 85	°C
Storage temperature range		T <sub>stg</sub>	-55 to 125	°C
Lead solder temperature(10 s) (Note 3)		T <sub>sol</sub>	260	°C
Isolation voltage (AC, 60 s, R.H. ≤ 60 %, Ta=25°C) (Note 4)		BV <sub>S</sub>	2500	V <sub>rms</sub>

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 ≤ 1 μs, 300 pps.

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

Note 3: 1.6 mm below seating plane.

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

## Recommended Operating Conditions

Characteristic	Symbol	Min	Typ.	Max	Unit
Input current, on	I <sub>F(ON)</sub>	2 (Note 1)	—	5	mA
Input voltage, off	V <sub>F(OFF)</sub>	0	—	0.8	V
Supply voltage	V <sub>CC</sub>	4.5	—	20	V
Enable voltage high	V <sub>EH</sub>	2.0	—	20	V
Enable voltage low	V <sub>EL</sub>	0	—	0.8	V
Fan out(TTL load)	N	—	—	4	—
Operating temperature	T <sub>opr</sub>	-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.

Note 1: 2 mA condition permits at least 20 % CTR degradation guardband.  
Initial switching threshold is 1.6 mA or less.

## Electrical Characteristics (unless otherwise specified, Ta = -25 to 85°C, Vcc = 4.5 to 20V)

Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit	
Input forward voltage	V <sub>F</sub>	I <sub>F</sub> = 5 mA, Ta = 25 °C	—	1.55	1.7	V	
Temperature coefficient of forward voltage	ΔV <sub>F</sub> / ΔTa	I <sub>F</sub> = 5 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 <sub>F</sub> = 0 V, f = 1 MHz, Ta = 25 °C	—	45	—	pF	
Output leakage current (V <sub>O</sub> > V <sub>CC</sub> )	I <sub>OHH</sub>	V <sub>F</sub> = 0 V, V <sub>CC</sub> = 4.5 V	V <sub>O</sub> = V <sub>E</sub> = 5.5 V	—	—	100	μA
			V <sub>O</sub> = V <sub>E</sub> = 20 V	—	0.01	500	
Logic low output voltage	V <sub>OL</sub>	I <sub>OL</sub> = 6.4 mA, I <sub>F</sub> = 1.6 mA V <sub>E</sub> = 2 V	—	0.4	0.5	V	
Logic high output voltage	V <sub>OH</sub>	I <sub>OH</sub> = -2.6 mA, V <sub>F</sub> = 0.8 V V <sub>E</sub> = 2 V	2.4	3.3	—	V	
Logic low enable current	I <sub>EL</sub>	V <sub>E</sub> = 0.4 V	—	-0.13	-0.32	mA	
Logic high enable current	I <sub>EH</sub>	V <sub>E</sub> = 2.7 V	—	—	20	μA	
		V <sub>E</sub> = 5.5 V	—	—	100		
		V <sub>E</sub> = 20 V	—	0.01	250		
Logic low enable voltage	V <sub>EL</sub>	—	—	—	0.8	V	
Logic high enable voltage	V <sub>EH</sub>	—	2.0	—	—	V	
Logic low supply current	I <sub>CCL</sub>	I <sub>F</sub> = 5 mA	V <sub>CC</sub> = V <sub>E</sub> = 5.5 V	—	4.0	6.0	mA
			V <sub>CC</sub> = V <sub>E</sub> = 20 V	—	4.6	7.5	
Logic high supply current	I <sub>CCH</sub>	V <sub>F</sub> = 0 V	V <sub>CC</sub> = V <sub>E</sub> = 5.5 V	—	4.2	6.0	mA
			V <sub>CC</sub> = V <sub>E</sub> = 20 V	—	4.7	7.5	
High impedance state output current	I <sub>OZL</sub>	V <sub>F</sub> = 0 V V <sub>E</sub> = 0.8 V	V <sub>O</sub> = 0.4 V	—	—	-20	μA
			V <sub>O</sub> = 2.4 V	—	—	20	
	I <sub>OZH</sub>	I <sub>F</sub> = 5 mA V <sub>E</sub> = 0.8 V	V <sub>O</sub> = 5.5 V	—	—	100	
			V <sub>O</sub> = 20 V	—	1	500	
Logic low short circuit output current (Note 1)	I <sub>OSL</sub>	I <sub>F</sub> = 5 mA V <sub>E</sub> = 2 V	V <sub>O</sub> = V <sub>CC</sub> = 5.5 V	25	55	—	mA
			V <sub>O</sub> = V <sub>CC</sub> = 20 V	40	80	—	
Logic high short circuit output current (Note 1)	I <sub>OSH</sub>	V <sub>F</sub> = 0 V, V <sub>O</sub> = GND V <sub>E</sub> = 2 V	V <sub>CC</sub> = 5.5 V	-10	-25	—	mA
			V <sub>CC</sub> = 20 V	-25	-60	—	
Input current logic low output	I <sub>FL</sub>	V <sub>E</sub> = 2 V, I <sub>O</sub> = 6.4 mA V <sub>O</sub> < 0.4 V	—	0.4	1.6	mA	
Input voltage logic high output	V <sub>FH</sub>	V <sub>E</sub> = 2 V, I <sub>O</sub> = -2.6 mA V <sub>O</sub> > 2.4 V	0.8	—	—	V	
Input current hysteresis	I <sub>HYS</sub>	V <sub>CC</sub> = V <sub>E</sub> = 5 V	—	0.05	—	mA	
Resistance (input-output)	R <sub>S</sub>	V <sub>S</sub> = 500 V, R.H. ≤60 % Ta = 25 °C (Note 2)	5×10 <sup>10</sup>	10 <sup>14</sup>	—	Ω	
Capacitance(input-output)	C <sub>S</sub>	V <sub>S</sub> = 0 V, f = 1 MHz, Ta = 25 °C (Note 2)	—	1.0	—	pF	

Note: All typical values are at Ta = 25 °C, V<sub>CC</sub> = 5 V, I<sub>F(ON)</sub> = 3 mA unless otherwise specified.

Note 1: Duration of output short circuit time should not exceed 10 ms.

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

## Switching Characteristics (unless otherwise specified, $V_{CC} = 4.5$ to $20V$ , $T_a = 25^\circ C$ )

Characteristic	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Propagation delay time to logic high output (Note 1)	$t_{pLH}$	1	$I_F = 3 \rightarrow 0$ mA	—	250	400	ns
Propagation delay time to logic low output (Note 1)	$t_{pHL}$		$I_F = 0 \rightarrow 3$ mA	—	270	400	ns
Output rise time (10-90%)	$t_r$		$I_F = 3 \rightarrow 0$ mA, $V_{CC} = 5$ V	—	35	75	ns
Output fall time (90-10%)	$t_f$		$I_F = 0 \rightarrow 3$ mA, $V_{CC} = 5$ V	—	20	75	ns
Common mode transient immunity at logic high output (Note 2)	$C_{MH}$	3	$I_F = 0$ mA, $V_{CM} = 50$ V $V_O$ (Min) = 2 V	1000	—	—	V / $\mu$ s
Common mode transient immunity at logic low output (Note 2)	$C_{ML}$		$I_F = 1.6$ mA, $V_{CM} = 50$ V $V_O$ (Max) = 0.8 V	-1000	—	—	V / $\mu$ s

Note: All typical values are at  $T_a = 25^\circ C$ ,  $V_{CC} = 5$  V

Note: A ceramic capacitor (0.1  $\mu$ F) 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.

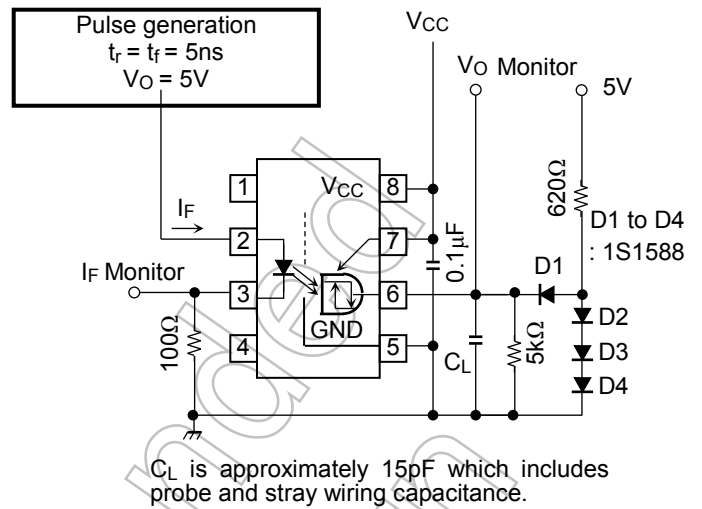
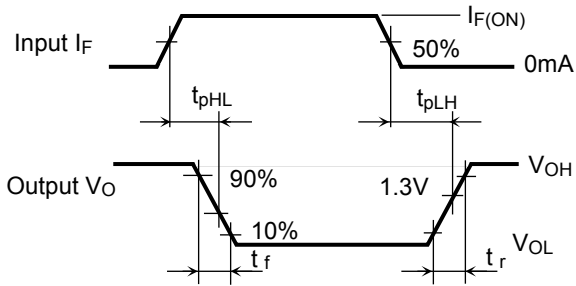
Note 1: The  $t_{pLH}$  propagation delay is measured from the 50 % point on the trailing edge of the input pulse to the 1.3 V point on the leading edge of the output pulse. The  $t_{pHL}$  propagation delay is measured from the 50 % point on the leading edge of the input pulse to the 1.3 V point on the trailing edge of the output pulse.

Note 2:  $C_{ML}$  is the maximum rate of fall of the common mode voltage that can be sustained with the output voltage in the logic low state ( $V_O < 0.8$  V).

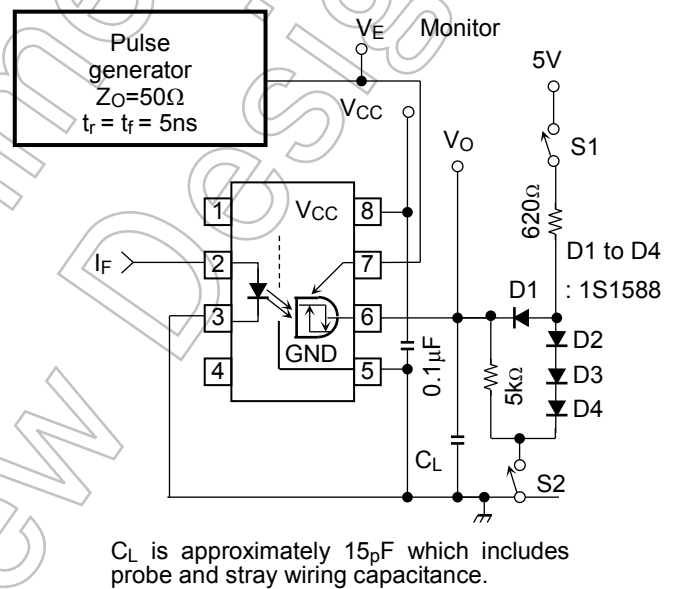
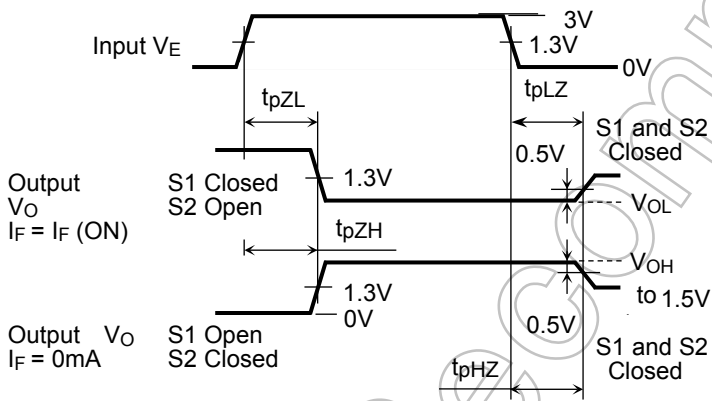
$C_{MH}$  is the maximum rate of rise of the common mode voltage that can be sustained with the output voltage in the logic state ( $V_O > 2.0$  V).

Not Recommended for New Design

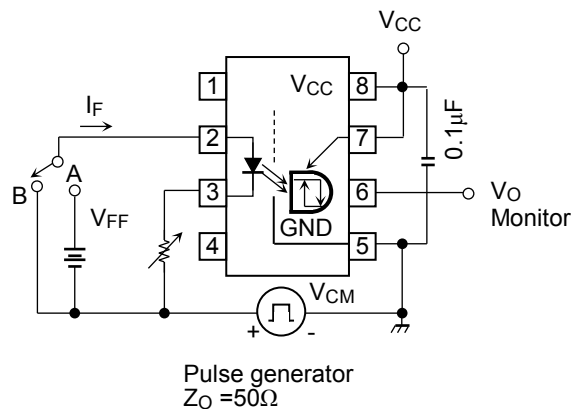
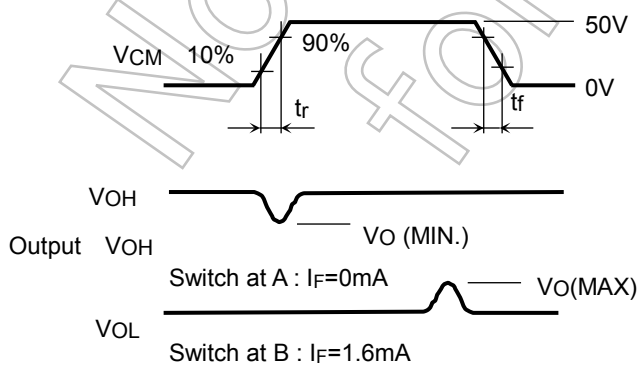
### Test Circuit 1: $t_{pLH}$ , $t_{pHL}$ , $t_r$ and $t_f$



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



### Test Circuit 3: Common Mode Transient Immunity



$$CMH = \frac{45(\text{V})}{t_f(\mu\text{s})}, \quad CML = \frac{45(\text{V})}{t_r(\mu\text{s})}$$

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