Photocouplers Infrared LED & Photo IC

TLX9310

1. Applications

- Automotive
- Battery Management System (BMS)

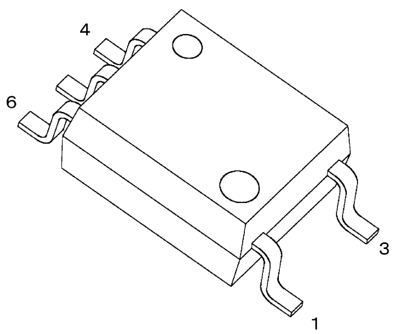
2. General

The Toshiba TLX9310 consists of a high-output an infrared LED coupled with a high-speed photo-diode-transistor chip. It is housed in the SO6 package. This photocoupler guarantees operation at up to 105 °C and on supplies from 2.7 V to 5.5 V. Since TLX9310 has guaranteed 0.3 mA low supply current (I_{DDL}/I_{DDH}), and 1.0 mA (T_{opr} = 105 °C) low threshold input current(I_{FHL}), it contributes to energy saving of devices. It can drive directly from a microcomputer for a low input current.

3. Features

(1) Buffer logic type (totem pole output)
(2) Package: SO6
(3) Operating temperature: -40 to 105 °C
(4) Supply voltage: 2.7 to 5.5 V
(5) Threshold input current: 1.0 mA (max)
(6) Supply current: 0.3 mA (max)
(7) Data transfer rate: 5 Mbps (typ.)
(8) Common-mode transient immunity: ±25 kV/μs (min)
(9) Isolation voltage: 3750 Vrms (min)
(10) AEC-Q101 qualified

4. Packaging and Pin Assignment



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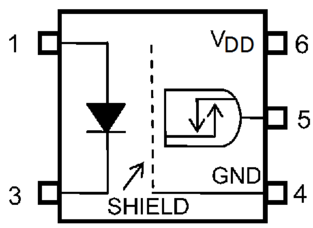
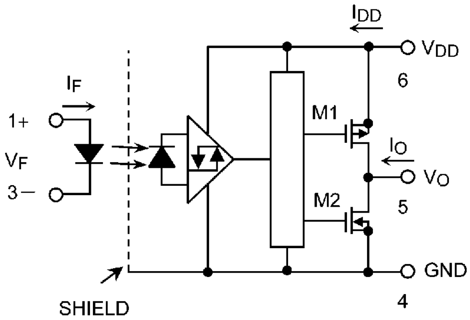


1: Anode
3: Cathode
4: GND
5: V_O
6: V_{DD}

5. Internal Circuit (Note)



Note: A 0.1-μF bypass capacitor must be connected between pin 6 and pin 4.

6. Principle of Operation

6.1. Truth Table

Input	LED	Output
H	ON	H
L	OFF	L

6.2. Mechanical Parameters

Characteristics	Min	Unit
Creepage distances	5.0	mm
Clearance	5.0	
Internal isolation thickness	—	

7. Absolute Maximum Ratings (Note) (Unless otherwise specified, T_a = 25 °C)

	Characteristics	Symbol	Note	Rating	Unit
LED	Input forward current	I_F		8	mA
	Input forward current derating ($T_a \geq$ 85 °C)	$\Delta I_F/\Delta T_a$		-0.05	mA/°C
	Input forward current (pulsed)	I_{FP}	(Note 1)	1	A
	Input power dissipation	P_D		20	mW
	Input reverse voltage	V_R		5	V
Detector	Output current	I_O		10	mA
	Output voltage	V_O		6	V
	Supply voltage	V_{DD}		6	V
	Output power dissipation	P_O		20	mW
Common	Operating temperature	T_{opr}		-40 to 105	°C
	Storage temperature	T_{stg}		-55 to 125	°C
	Lead soldering temperature (10 s)	T_{sol}		260	°C
	Isolation voltage (AC, 60 s, R.H. ≤ 60 %)	BV_S	(Note 2)	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) ≤ 1 μs, 300 pps

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

8. Recommended Operating Conditions (Note)

Characteristics	Symbol	Note	Min	Typ.	Max	Unit
Supply voltage	V_{DD}		2.7	3.0 to 5.0	5.5	V
Operating temperature	T_{opr}		-40	—	105	℃

Note: The recommended operating conditions are given as a design guide necessary to obtain the intended performance of the device. Each parameter is an independent value. When creating a system design using this device, the electrical characteristics specified in this data sheet should also be considered.

Note: A ceramic capacitor (0.1 μF) should be connected between pin 6 (V_{DD}) and pin 4 (GND) to stabilize the operation of a high-gain linear amplifier. Otherwise, this photocoupler may not switch properly. The bypass capacitor should be placed within 1 cm of each pin.

Note: If the rising slope of the supply voltage (V_{DD}) for the detector is steep, stable operation of the internal circuits cannot be guaranteed.
Be sure to set 3.0 V/μs or less for a rising slope of the V_{DD}.

9. Electrical Characteristics (Note) (Unless otherwise specified, T_a = -40 to 105 ℃, V_{DD} = 2.7 to 5.5 V)

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Input forward voltage	V_F		I_F = 2 mA, T_a = 25 ℃	1.4	1.55	1.7	V
			I_F = 2 mA	1.2	—	1.9	
Input reverse current	I_R		V_R = 5 V, T_a = 25 ℃	—	—	10	μA
Input capacitance	C_t		V = 0 V, f = 1 MHz , T_a = 25 ℃	—	20	—	pF
Low-level output voltage	V_{OL}	Fig. 12.1	I_F = 0 mA, I_O = 20 μA	—	—	0.1	V
			I_F = 0 mA, I_O = 3.2 mA	—	—	0.4	
High-level output voltage	V_{OH}	Fig. 12.2	I_F = 2 mA, I_O = -20 μA	V_{DD}-0.1	—	—	V
			I_F = 2 mA, I_O = -3.2 mA	V_{DD}-1.0	—	—	
Low-level supply current	I_{DDL}	Fig. 12.3	I_F = 0 mA	—	—	0.3	mA
High-level supply current	I_{DDH}	Fig. 12.4	I_F = 2 mA	—	—	0.3	mA
Threshold input current (L/H)	I_{FLH}		I_O = -3.2 mA, V_O > 2.4 V	—	—	1.0	mA

Note: All typical values are at V_{DD} = 5 V, T_a = 25 ℃, unless otherwise noted.

10. Isolation Characteristics (Unless otherwise specified, T_a = 25 ℃)

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Total capacitance (input to output)	C_S	(Note 1)	V_S = 0 V, f = 1 MHz	—	0.8	—	pF
Isolation resistance	R_S	(Note 1)	V_S = 500 V, R.H. ≤ 60 %	10^{12}	10^{14}	—	Ω
Isolation voltage	BV_S	(Note 1)	AC, 60 s	3750	—	—	Vrms

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

11. Switching Characteristics (Note)
(Unless otherwise specified, T_a = -40 to 105 °C, V_{DD} = 2.7 to 5.5 V)

Characteristics	Symbol	Note	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Propagation delay time (L/H)	t_{pLH}	(Note 1)	Fig.12.5	V_{IN} = 3.3 V, R_T = 820 Ω	—	—	250	ns
Propagation delay time (H/L)	t_{pHL}				—	—	250	
Pulse width distortion	$\|t_{pHL}-t_{pLH}\|$				—	—	50	
Propagation delay skew (device to device)	t_{psk}	(Note 1), (Note 2)			—	—	65	
Propagation delay time (L/H)	t_{pLH}	(Note 1)	Fig.12.5	V_{IN} = 5 V, R_T = 1.6 kΩ	—	—	250	ns
Propagation delay time (H/L)	t_{pHL}				—	—	250	
Pulse width distortion	$\|t_{pHL}-t_{pLH}\|$				—	—	50	
Propagation delay skew (device to device)	t_{psk}	(Note 1), (Note 2)			—	—	65	
Rise time	t_r	(Note 1)	Fig.12.5	V_{IN} = 0 → 3.3 V, R_T = 820 Ω, V_{DD} = 5 V	—	11	—	ns
Fall time	t_f			V_{IN} = 3.3 → 0 V, R_T = 820 Ω, V_{DD} = 5 V	—	13	—	
High-level common-mode transient immunity	CM_H		Fig.12.6	V_{IN} = 3.3 V/5 V, V_{DD} = 2.7 V/5 V, V_{CM} = 1000 V_{p-p}, T_a = 25 °C	±25	±40	—	kV/µs
Low-level common-mode transient immunity	CM_L							

Note: All typical values are at V_{DD} = 5 V, T_a = 25 °C, unless otherwise noted.

Note: Recommendation input resistance conditions
- V_{IN} = 3.3 V: R_1 = R_2 = 430 Ω
- V_{IN} = 5 V: R_1 = R_2 = 820 Ω

Note 1: f = 250 kHz, duty = 50 %, input current t_r = t_f = 5 ns, C_L is less than 15 pF which includes probe and stray wiring capacitance.

Note 2: The propagation delay skew, t_{psk}, is equal to the magnitude of the worst-case difference in t_{pHL} and/or t_{pLH} that will be seen between units at the same given conditions (supply voltage, input current, temperature, etc.).

12. Test Circuits

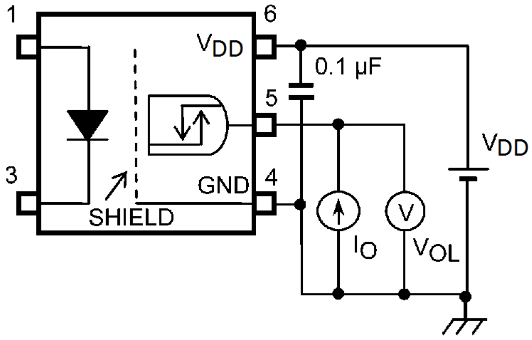


Fig. 12.1 V_{OL} Test Circuit

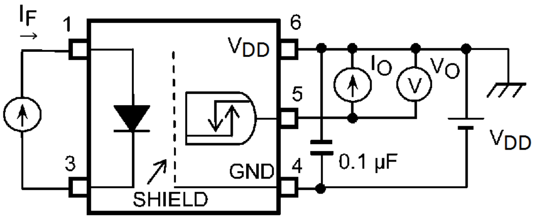


Fig. 12.2 V_{OH} Test Circuit

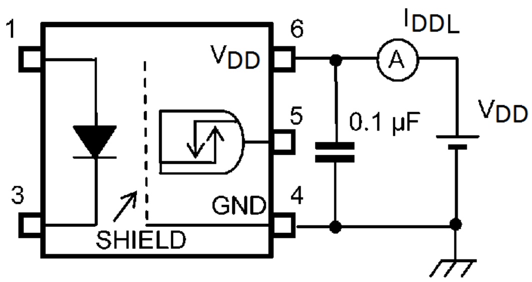


Fig. 12.3 I_{DDL} Test Circuit

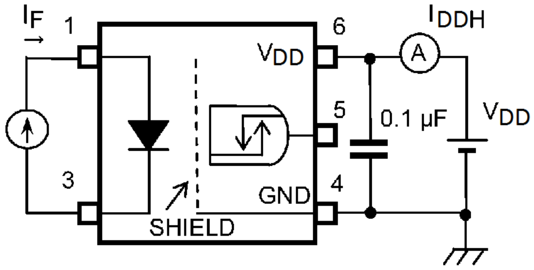
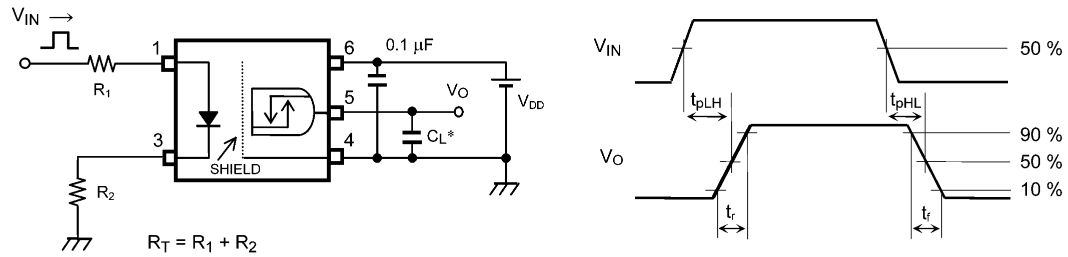


Fig. 12.4 I_{DDH} Test Circuit

V_{IN} = 3.3 V / 5 V (P.G.)
(f = 250 kHz, duty = 50 %, less than $t_r = t_f$ = 5 ns)



$R_T = R_1 + R_2$
P.G. : Pulse generator
*C_L is less than 15 pF which includes probe and stray wiring capacitance.

Fig. 12.5 Switching Time Test Circuit and Waveform

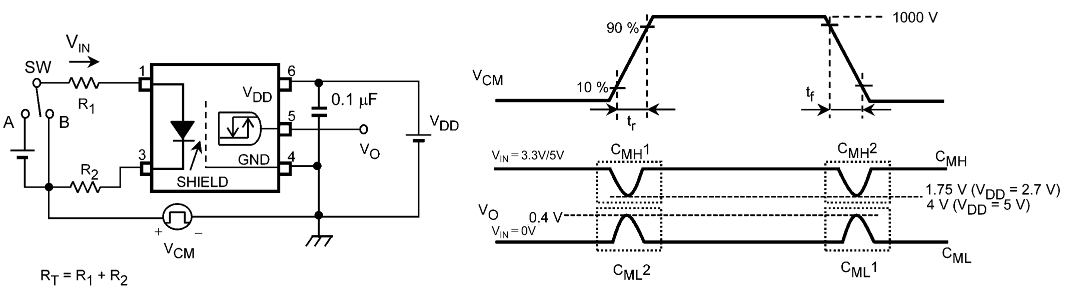
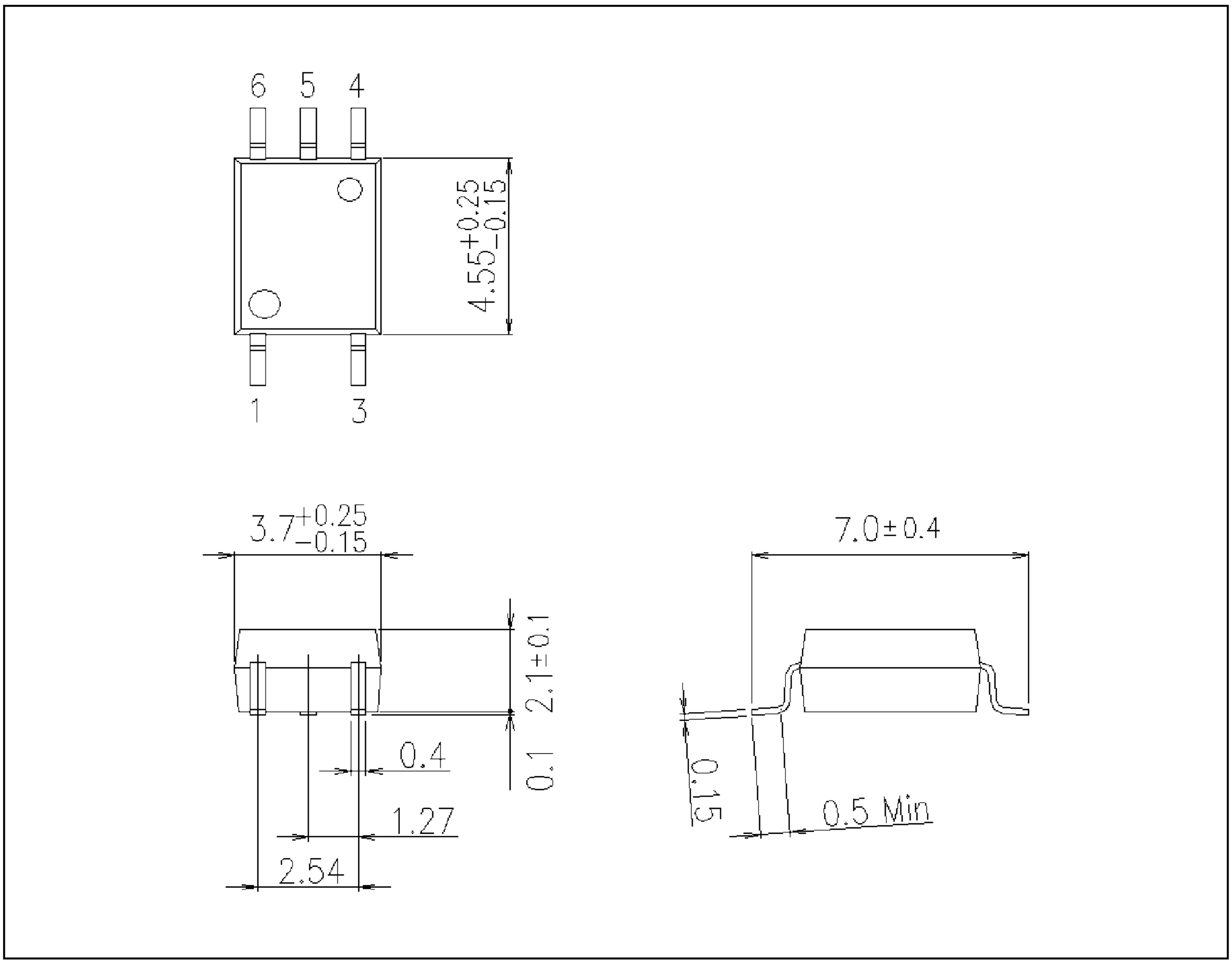


Fig. 12.6 Common-Mode Transient Immunity Test Circuit and Waveform

Package Dimensions

Unit: mm



Weight: 0.08 g (typ.)

Package Name(s)
TOSHIBA: 11-4L1S

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