

TLX9310

1. Applications

- Automotive
- Battery Management System (BMS)

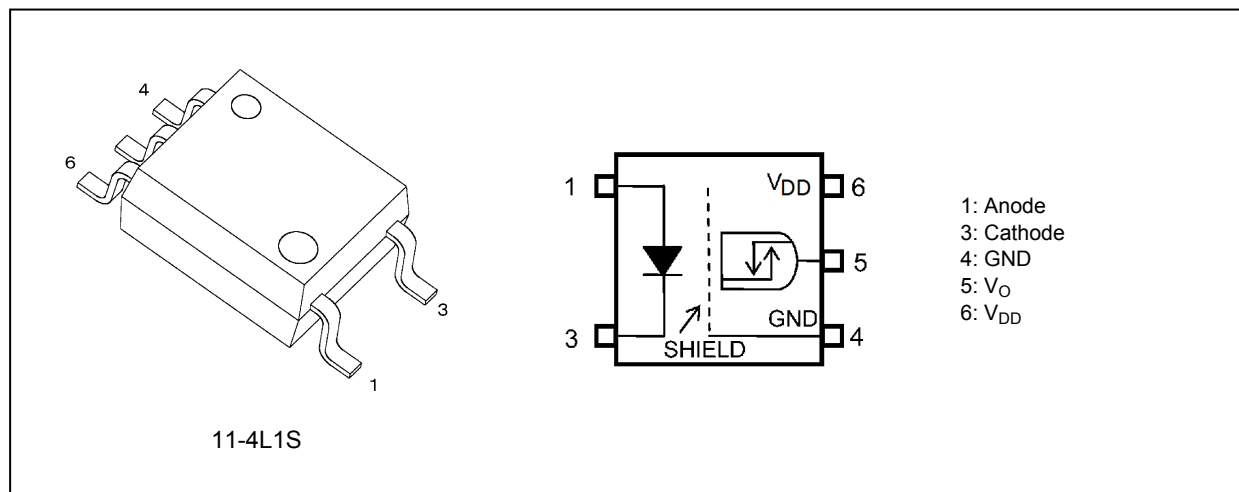
2. General

The Toshiba TLX9310 consists of a high-output 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 ($T_{opr} = 105\text{ °C}$) 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.

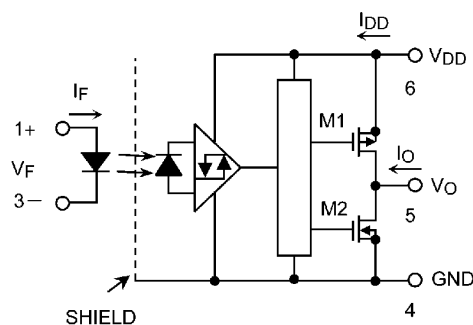
3. Features

- (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: $\pm 25\text{ kV}/\mu\text{s}$ (min)
- (9) Isolation voltage: 3750 Vrms (min)
- (10) AEC-Q101 qualified

4. Packaging and Pin Assignment



5. Internal Circuit (Note)



Note: A 0.1- μ F 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, $T_a = 25\text{ }^\circ\text{C}$)

	Characteristics	Symbol	Note	Rating	Unit
LED	Input forward current	I_F		8	mA
	Input forward current derating ($T_a \geq 85\text{ }^\circ\text{C}$)	$\Delta I_F/\Delta T_a$		-0.05	mA/ $^\circ\text{C}$
	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	$^\circ\text{C}$
	Storage temperature	T_{stg}		-55 to 125	$^\circ\text{C}$
	Lead soldering temperature (10 s)	T_{sol}		260	$^\circ\text{C}$
	Isolation voltage (AC, 60 s, R.H. $\leq 60\%$)	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) $\leq 1\text{ }\mu\text{s}$, 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	°C

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 μ F) 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/ μ s or less for a rising slope of the V_{DD} .

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

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Input forward voltage	V_F		$I_F = 2$ mA, $T_a = 25$ °C	1.4	1.55	1.7	V
			$I_F = 2$ mA	1.2	—	1.9	
Input reverse current	I_R		$V_R = 5$ V, $T_a = 25$ °C	—	—	10	μ A
Input capacitance	C_t		$V = 0$ V, $f = 1$ MHz, $T_a = 25$ °C	—	20	—	pF
Low-level output voltage	V_{OL}	Fig. 12.1	$I_F = 0$ mA, $I_O = 20$ μ A	—	—	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, $I_O = -20$ μ A	$V_{DD}-0.1$	—	—	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, $T_a = 25$ °C, unless otherwise noted.

10. Isolation Characteristics (Unless otherwise specified, $T_a = 25$ °C)

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	—	—	V _{rms}

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, $R_T = 1.6$ k 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	
Rise time	t_r	(Note 1)	Fig.12.5	$V_{IN} = 0 \rightarrow 3.3$ V, $R_T = 820$ Ω , $V_{DD} = 5$ V	—	11	—	ns
Fall time	t_f			$V_{IN} = 3.3 \rightarrow 0$ 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/ μ s
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

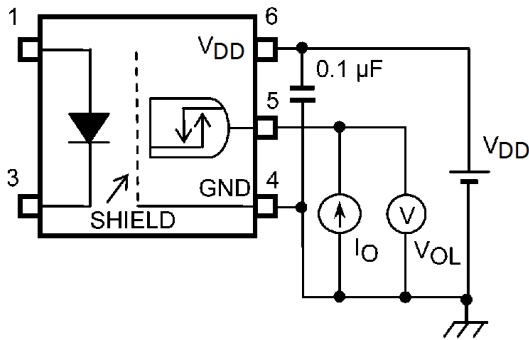


Fig. 12.1 VOL Test Circuit

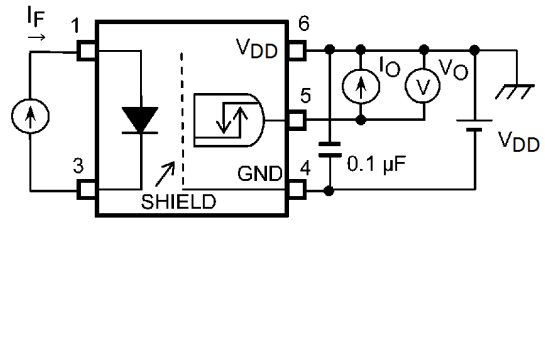


Fig. 12.2 VOH Test Circuit

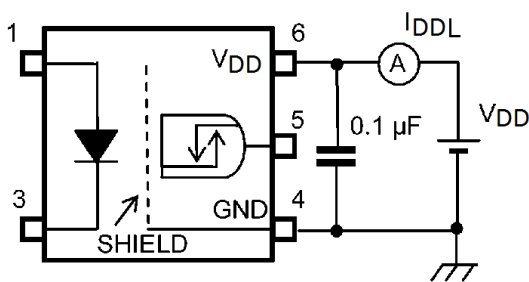


Fig. 12.3 IDD_L Test Circuit

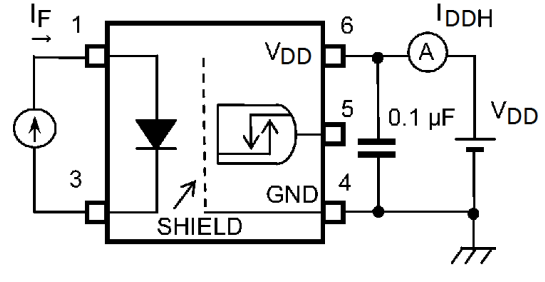
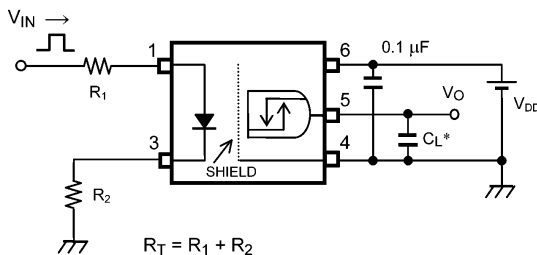


Fig. 12.4 IDD_H Test Circuit

$V_{IN} = 3.3\text{ V} / 5\text{ V (P.G.)}$

$(f = 250\text{ kHz, duty} = 50\%, \text{less than } t_r = t_f = 5\text{ ns})$



$$R_T = R_1 + R_2$$

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

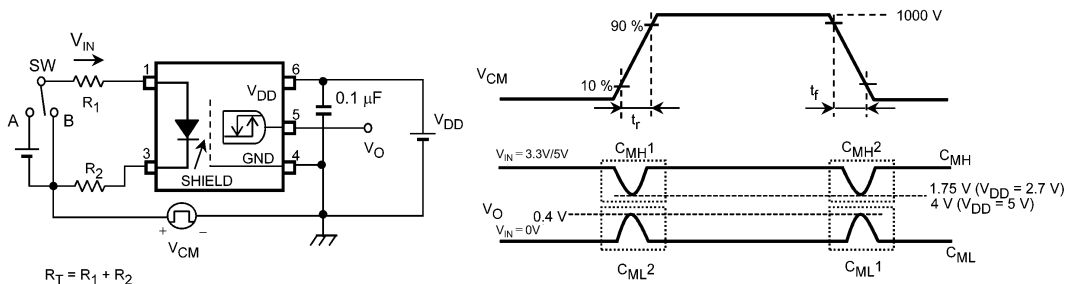
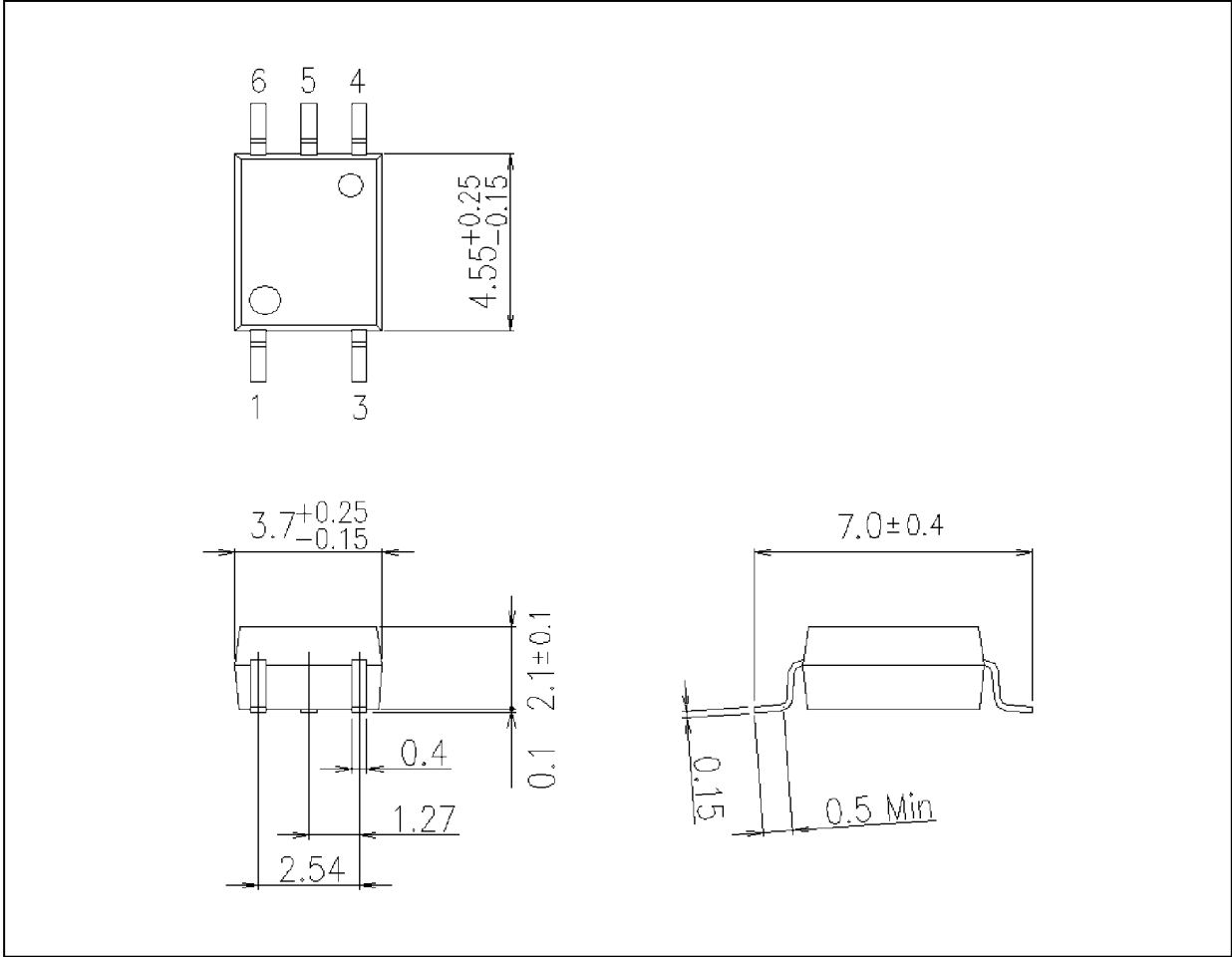


Fig. 12.6 Common-Mode Transient Immunity Test Circuit and Waveform

Package Dimensions

Unit: mm



Weight: 0.08 g (typ.)

Package Name(s)
TOSHIBA: 11-4L1S

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