

# TLX9310

## 1. Applications

- Automotive
- Battery Management System (BMS)

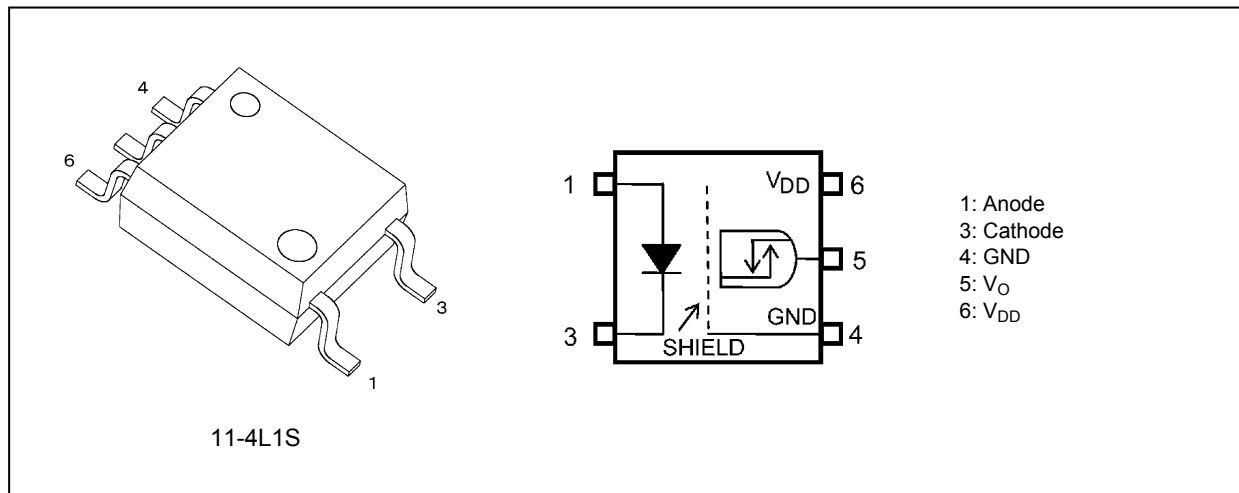
## 2. General

The Toshiba TLX9310 consists of a high-output a light-emitting diode 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.

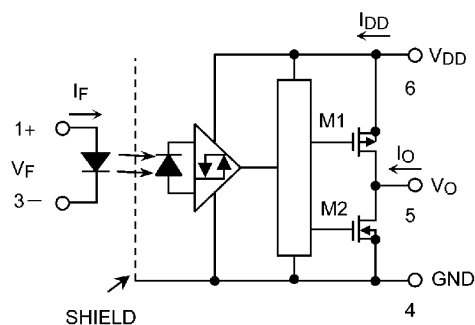
## 3. Features

- (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- $\mu$ 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	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 (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  $\mu$ 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/ $\mu$ 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	$\mu$ 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, $I_O = 20$ $\mu$ 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, $I_O = -20$ $\mu$ 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. $\leq 60$ %	$1 \times 10^{12}$	$10^{14}$	—	$\Omega$
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, $R_T = 820$ $\Omega$	—	—	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 $\Omega$	—	—	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, $R_T = 820$ $\Omega$ , $V_{DD} = 5$ V	—	11	—	ns
Fall time	$t_f$			$V_{IN} = 3.3 \rightarrow 0$ V, $R_T = 820$ $\Omega$ , $V_{DD} = 5$ 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 <sub>p-p</sub> , $T_a = 25$ °C	$\pm 25$	$\pm 40$	—	kV/ $\mu$ 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:  $R_1 = R_2 = 430$   $\Omega$

- $V_{IN} = 5$  V:  $R_1 = R_2 = 820$   $\Omega$

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

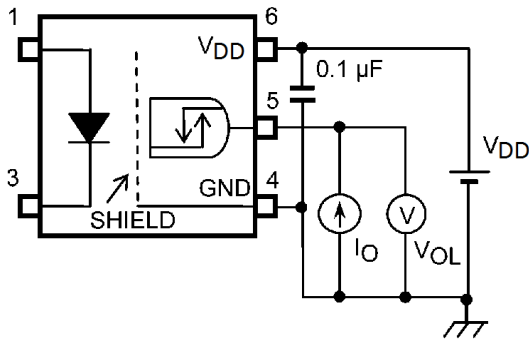


Fig. 12.1 VOL Test Circuit

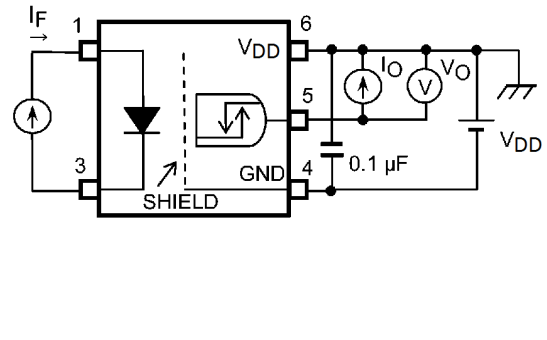


Fig. 12.2 VOH Test Circuit

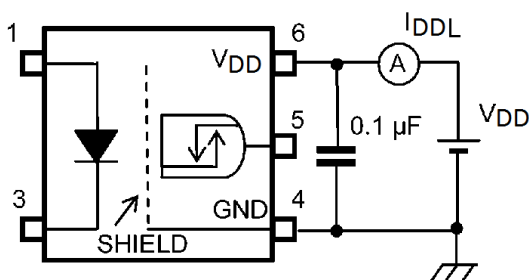


Fig. 12.3 IDD\_L Test Circuit

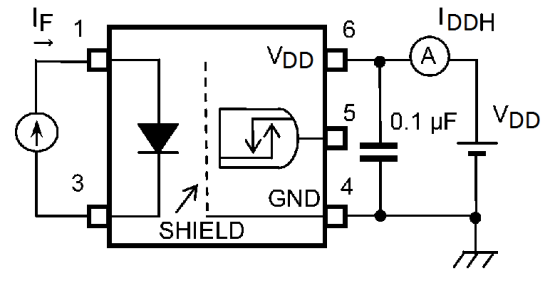
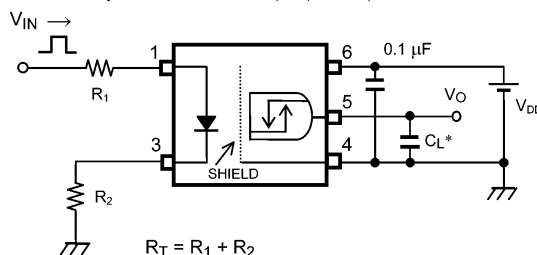


Fig. 12.4 IDD\_H Test Circuit

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

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

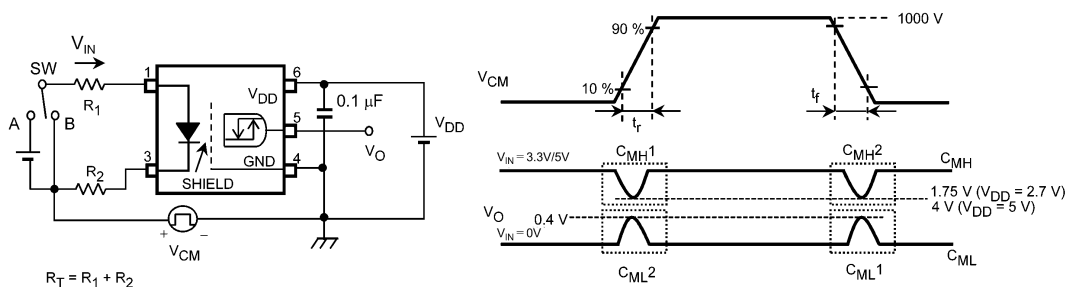


$$R_T = R_1 + R_2$$

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

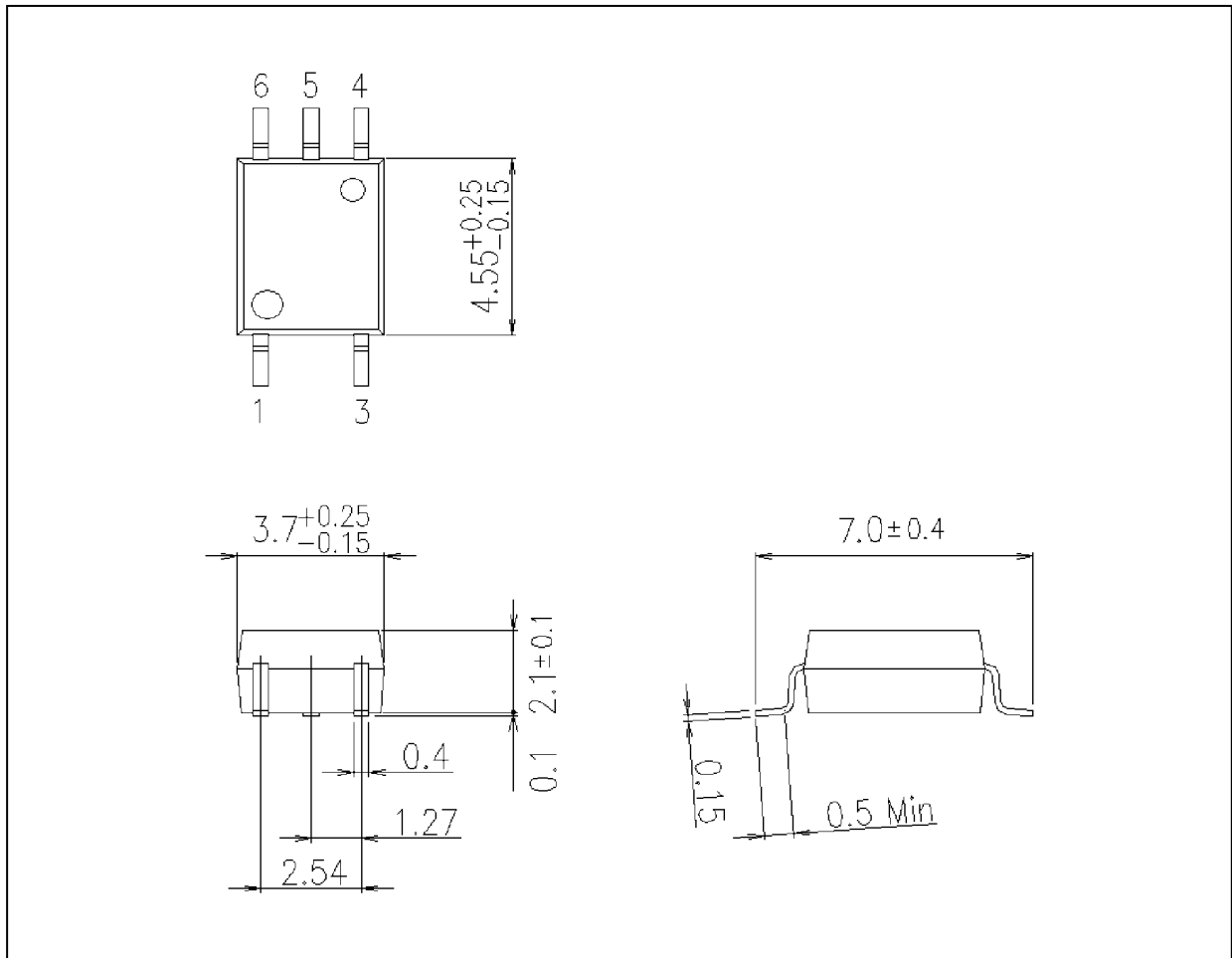


$$R_T = R_1 + R_2$$

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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