

# TLX9165T

## 1. Applications

- Battery Control in Automotive Equipment
- Fuel Battery Control in Automotive Equipment
- Application for Electrical Vehicle

## 2. General

Toshiba TLX9165T consists of an infrared emitting diode optically coupled to a photo-MOSFET in a 10pin SO16L-T package.

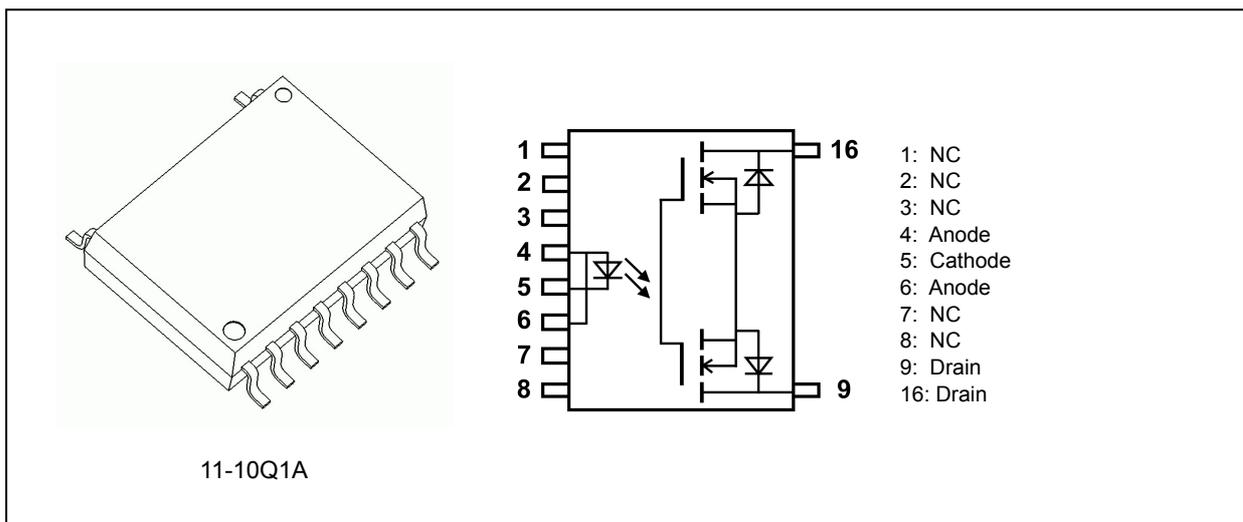
This coupler uses high voltage MOSFET between output terminals.

It adequate for the automotive control applications with a battery voltage of 1500 V or less in an environment with a pollution degree 2 since the creepage distance on the detector side is 7.5 mm or more.

## 3. Features

- (1) Normally opened (1-Form-A)
- (2) Peak off — state voltage: 1800 V (min)
- (3) Trigger LED current: 3 mA (max)
- (4) ON-state current: 30 mA (max)
- (5) ON-state resistance: 340  $\Omega$  (max)(@t < 1 s)
- (6) Isolation voltage: 5000 Vrms (min)
- (7) Clearance distance: 8 mm (min)
- (8) Creepage distance: 8 mm (min)
- (9) Insulation thickness: 0.4 mm (min)
- (10) Outer resin: CTI > 600
- (11) AEC-Q101 qualified

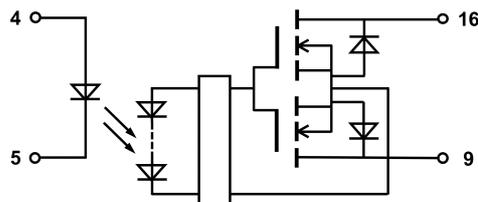
## 4. Packaging and Pin Assignment



Start of commercial production

2025-05

## 5. Internal Circuit



## 6. Absolute Maximum Ratings (Note) (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ )

	Characteristics		Symbol	Note	Rating	Unit
LED	Input forward current		$I_F$		30	mA
	Input forward current derating ( $T_a \geq 100\text{ }^\circ\text{C}$ )		$\Delta I_F/\Delta T_a$		-0.8	mA/ $^\circ\text{C}$
	Input reverse voltage		$V_R$		5	V
	Input power dissipation		$P_D$		50	mW
	Input power dissipation derating ( $T_a \geq 100\text{ }^\circ\text{C}$ )		$\Delta P_D/\Delta T_a$		-1.3	mW/ $^\circ\text{C}$
	Junction temperature		$T_j$		135	$^\circ\text{C}$
Detector	ON-state current	$T_a = 25\text{ }^\circ\text{C}$	$I_{ON}$		30	mA
		$T_a = 105\text{ }^\circ\text{C}$			12	mA
		$T_a = 125\text{ }^\circ\text{C}$			6	mA
	ON-state current derating	$T_a \geq 45\text{ }^\circ\text{C}$	$\Delta I_{ON}/\Delta T_a$		-0.3	mA/ $^\circ\text{C}$
	ON-state current (Peak)	$T_a = 25\text{ }^\circ\text{C}$	$I_{ONpk}$	(Note 1)	90	mA
		$T_a = 105\text{ }^\circ\text{C}$			36	mA
		$T_a = 125\text{ }^\circ\text{C}$			18	mA
	Avalanche current		$I_{AV}$	(Note 2)	0.6	mA
	Output power dissipation		$P_O$		600	mW
	Output power dissipation derating ( $T_a \geq 47\text{ }^\circ\text{C}$ )		$\Delta P_O/\Delta T_a$		-7	mW/ $^\circ\text{C}$
Junction temperature		$T_j$		135	$^\circ\text{C}$	
Common	Storage temperature		$T_{stg}$		-55 to 150	$^\circ\text{C}$
	Operating temperature		$T_{opr}$		-40 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 3)	5000	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: This device is sensitive to electrostatic discharge (ESD). Extreme ESD conditions should be guarded against by using proper antistatic precautions for the worktable, operator, solder iron, soldering equipment and so on.

Note 1: Exponential curve, pulse width < 1 ms,  $f \leq 150\text{ Hz}$

Note 2: 1min (max continuous), Duty cycle=0.1 %, 5 time over lifetime.

Note 3: LED pins are shorted together. Detector pins are also shorted together.

## 7. Recommended Operating Conditions (Note)

Characteristics	Symbol	Note	Min	Typ.	Max	Unit
Supply voltage	$V_{DD}$		—	—	1500	V
Input forward current	$I_F$		5	10	20	mA
ON-state current	$I_{ON}$		—	—	30	mA
Operating temperature	$T_{opr}$		-40	—	125	°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.

## 8. Electrical Characteristics (Unless otherwise specified, $T_a = 25\text{ °C}$ )

	Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
LED	Input forward voltage	$V_F$		$I_F = 10\text{ mA}$	1.5	1.65	1.8	V
				$I_F = 10\text{ mA}, T_a = -40\text{ to }125\text{ °C}$	1.4	—	1.95	V
	Input reverse current	$I_R$		$V_R = 5\text{ V}$	—	—	10	$\mu\text{A}$
	Input capacitance	$C_t$		$V = 0\text{ V}, f = 1\text{ MHz}$	—	45	—	pF
Detector	Output withstand voltage	$V_{OFF}$	(Note 1)	$I_{OFF} = 10\text{ }\mu\text{A}, T_a = 25\text{ °C}$	1800	—	—	V
Detector	OFF-state current	$I_{OFF}$		$V_{OFF} = 1500\text{ V}, T_a = 25\text{ °C}$	—	—	0.1	$\mu\text{A}$
				$V_{OFF} = 1500\text{ V}, T_a = -40\text{ to }105\text{ °C}$	—	—	3	$\mu\text{A}$
				$V_{OFF} = 1500\text{ V}, T_a = -40\text{ to }125\text{ °C}$	—	—	10	$\mu\text{A}$
	Output capacitance	$C_{OFF}$		$V = 0\text{ V}, f = 1\text{ MHz}$	—	140	—	pF

Note 1: Reliability test of applying high voltage is demonstrated at 1500V.

## 9. Coupled Electrical Characteristics

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Trigger LED current	$I_{FT}$	$I_{ON} = 30\text{ mA}, T_a = 25\text{ °C}, t = 10\text{ ms}$	—	—	3	mA
		$I_{ON} = 12\text{ mA}, T_a = -40\text{ to }105\text{ °C}, t = 10\text{ ms}$	—	—	3	
		$I_{ON} = 6\text{ mA}, T_a = -40\text{ to }125\text{ °C}, t = 10\text{ ms}$	—	—	3	
Return LED current	$I_{FC}$	$I_{OFF} = 100\text{ }\mu\text{A}, T_a = -40\text{ to }125\text{ °C}, t = 40\text{ ms}$	0.05	—	—	mA
ON-state resistance	$R_{ON}$	$I_{ON} = 30\text{ mA}, I_F = 10\text{ mA}, T_a = 25\text{ °C}, t < 1\text{ s}$	—	—	340	$\Omega$
		$I_{ON} = 12\text{ mA}, I_F = 10\text{ mA}, T_a = -40\text{ to }105\text{ °C}, t < 1\text{ s}$	—	—	600	
		$I_{ON} = 6\text{ mA}, I_F = 10\text{ mA}, T_a = -40\text{ to }125\text{ °C}, t < 1\text{ s}$	—	—	680	

## 10. Isolation Characteristics ( $T_a = 25\text{ °C}$ )

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Total capacitance (input to output)	$C_S$	(Note 1)	$V_S = 0\text{ V}, f = 1\text{ MHz}$	—	0.9	—	pF
Isolation resistance	$R_S$	(Note 1)	$V_S = 1000\text{ V}, R.H. \leq 60\%$	$5 \times 10^{10}$	$10^{14}$	—	$\Omega$
Isolation voltage	$BV_S$	(Note 1)	AC, 60 s	5000	—	—	Vrms

Note 1: This device is considered as a two-terminal device: Pins 1 to 8 are shorted together, and pins 9 and 16 are shorted together.

## 11. Switching Characteristics

Characteristics	Symbol	Test Condition	Test Condition	Min	Typ.	Max	Unit
Turn-on time	$t_{ON}$	$I_F = 10\text{ mA}$ , $R_L = 20\text{ k}\Omega$ , $V_{DD} = 40\text{ V}$	$T_a = 25\text{ }^\circ\text{C}$	—	—	1	ms
Turn-off time	$t_{OFF}$			—	—	1	ms
Turn-on time	$t_{ON}$		$T_a = -40\text{ to }125\text{ }^\circ\text{C}$	—	—	1	ms
Turn-off time	$t_{OFF}$			—	—	1	ms

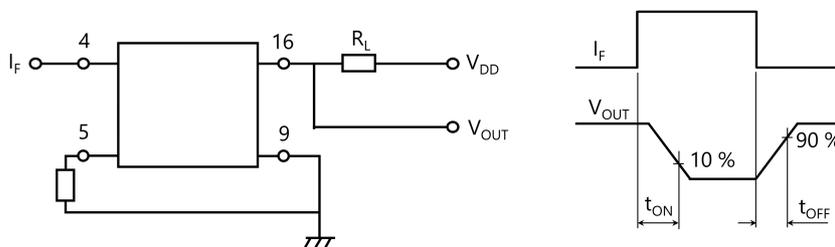


Fig. 11.1 Switching Time Test Circuit and Waveform

## 12. Characteristics Curves (Note)

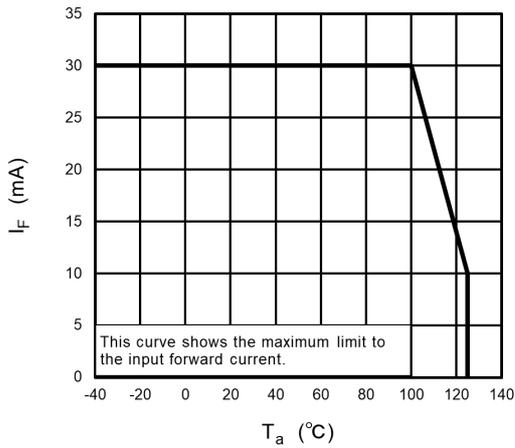


Fig. 12.1  $I_F - T_a$

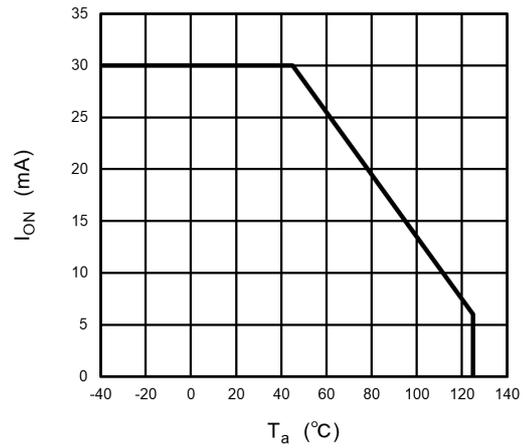


Fig. 12.2  $I_{ON} - T_a$

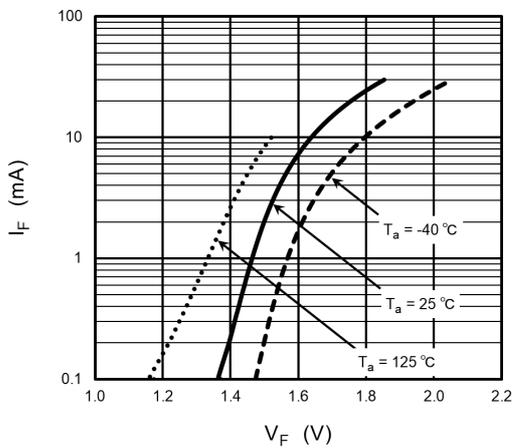


Fig. 12.3  $I_F - V_F$

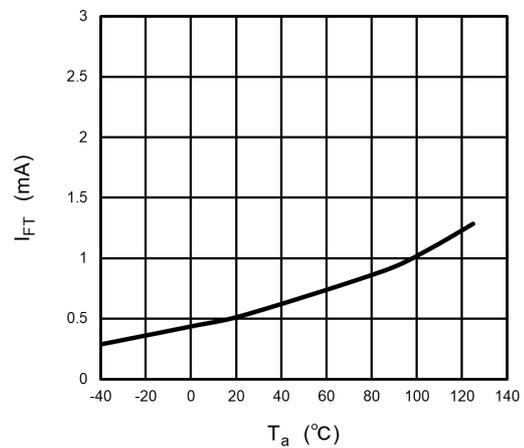


Fig. 12.4  $I_{FT} - T_a$

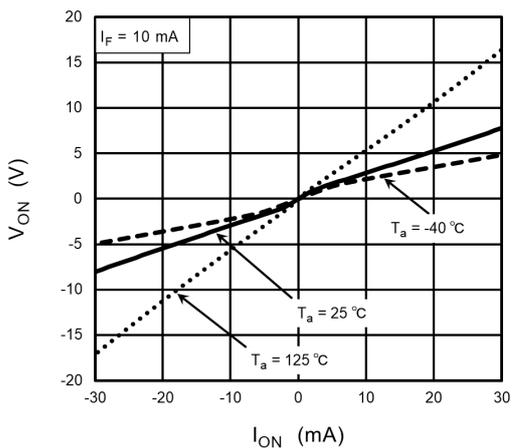


Fig. 12.5  $V_{ON} - I_{ON}$

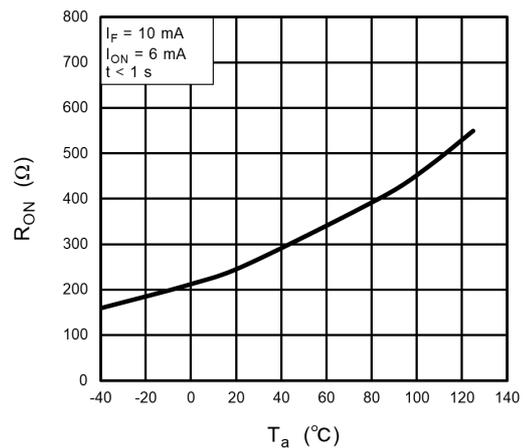


Fig. 12.6  $R_{ON} - T_a$

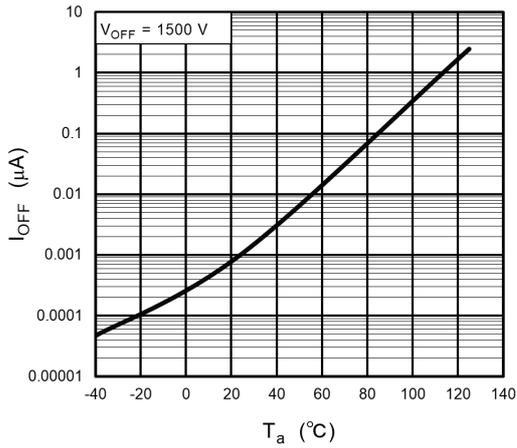


Fig. 12.7  $I_{OFF} - T_a$

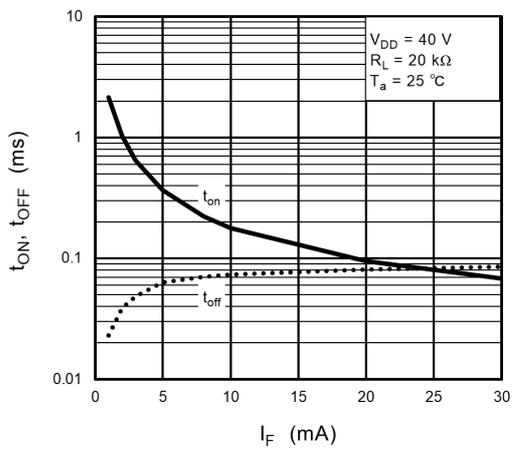


Fig. 12.8  $t_{ON}, t_{OFF} - I_F$

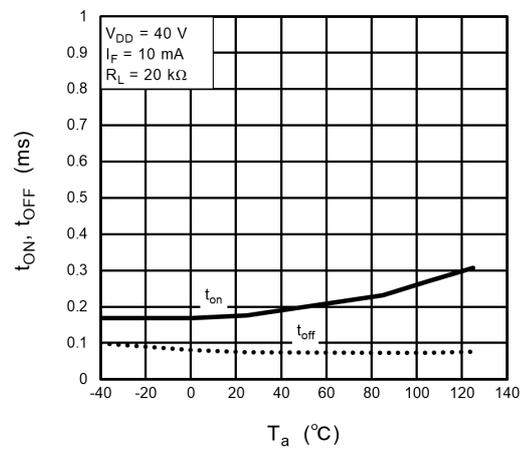
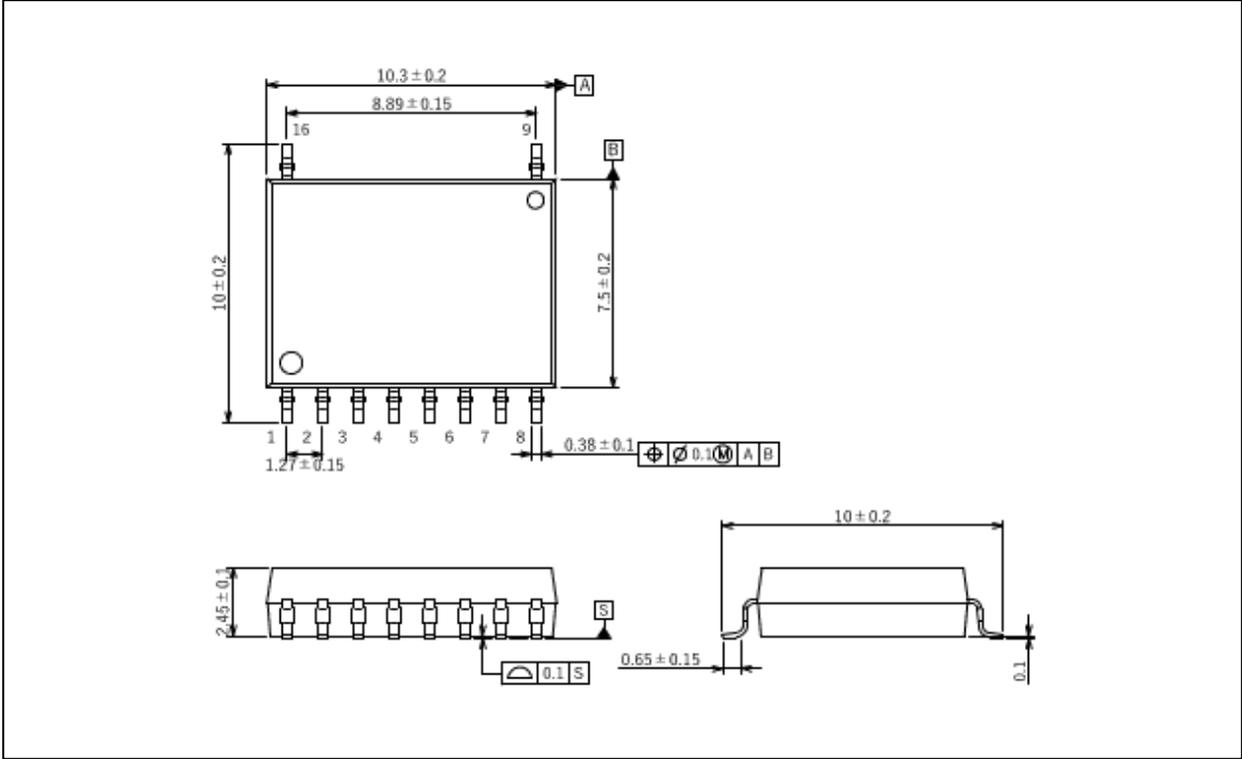


Fig. 12.9  $t_{ON}, t_{OFF} - T_a$

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

Package Dimensions

Unit: mm



Weight: 0.41 g (typ.)

Package Name(s)
TOSHIBA: 11-10Q1A

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