

TOSHIBA Photocoupler Photorelay

# TLX9176J

## 1. Description

The Toshiba TLX9176J consists of an infrared LED optically coupled to a photo-MOSFET in a SO6 package.

This coupler uses high voltage MOSFET between output terminals.

It adequate for the applications of Battery Control Systems.

Compared to the TLX9175J, the ESD protection function has been improved by revising the device structure.

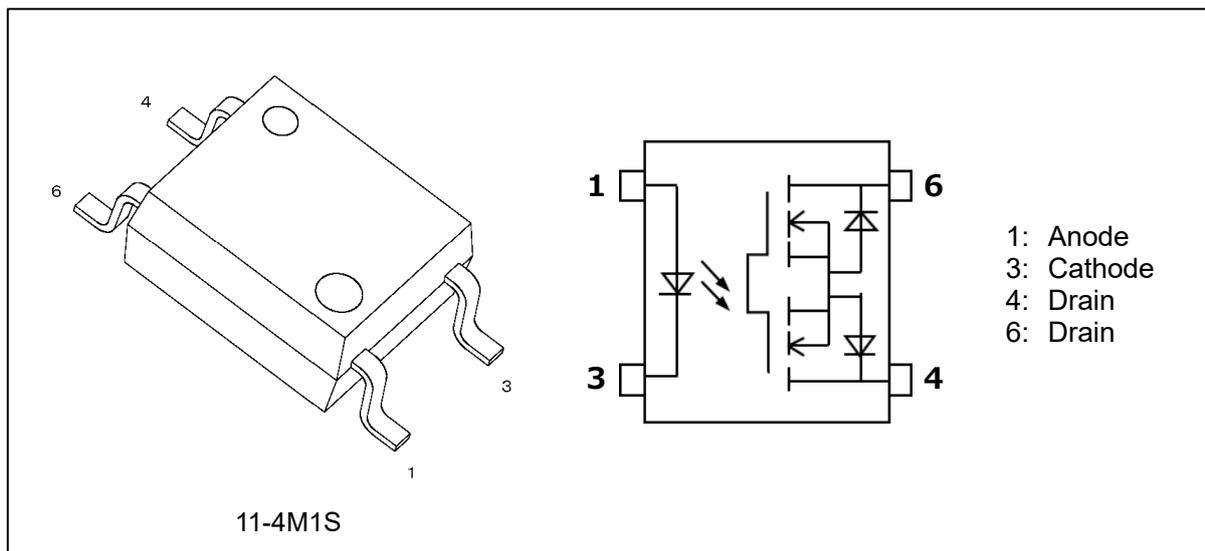
## 2. Applications

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

## 3. Features

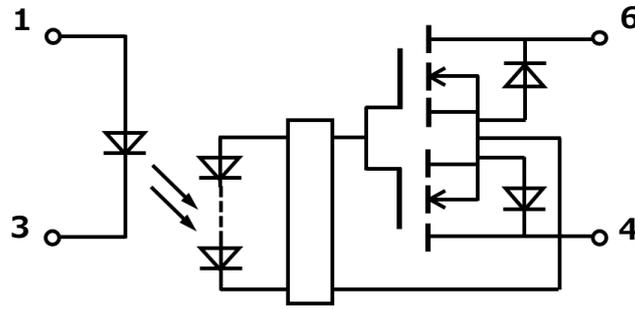
- Normally open (1-Form-A) device
- Peak off-state voltage: 600 V (min)
- Trigger LED current: 3 mA (max)
- On-state current: 15 mA (max)
- On-state resistance: 400  $\Omega$  (max)(@t < 1s)
- Isolation voltage: 3750 Vrms (min)
- AEC-Q101 qualified

## 4. Packing and Pin Assignments



Start of commercial production  
2025-04

## 5. Internal Circuit



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

	Characteristics	Symbol	Note	Rating	Unit		
LED	Forward current	$I_F$		25	mA		
	Forward current derating ( $T_a \geq 70^\circ\text{C}$ )	$\Delta I_F/^\circ\text{C}$		-0.18	mA/ $^\circ\text{C}$		
	Reverse voltage	$V_R$		5	V		
	Input Power Dissipation	$P_D$		50	mW		
	Input Power Dissipation Derating ( $T_a \geq 70^\circ\text{C}$ )	$\Delta P_D/^\circ\text{C}$		-0.61	mW/ $^\circ\text{C}$		
	Junction temperature	$T_j$		125	$^\circ\text{C}$		
Detector	Off-state output terminal voltage	$V_{OFF}$		600	V		
	On-state current	$T_a = 25^\circ\text{C}$	$I_{ON}$		15	mA	
		$T_a = 85^\circ\text{C}$			11	mA	
		$T_a = 105^\circ\text{C}$			7	mA	
	On-state current derating	$T_a \geq 60^\circ\text{C}$	$\Delta I_{ON}/^\circ\text{C}$		-0.16	mA/ $^\circ\text{C}$	
		$T_a \geq 85^\circ\text{C}$			-0.2	mA/ $^\circ\text{C}$	
	On-state current (Peak)	$T_a = 25^\circ\text{C}$	$I_{ONpk}$	(Note 1)		80	mA
		$T_a = 85^\circ\text{C}$				50	mA
		$T_a = 105^\circ\text{C}$				25	mA
	Output power dissipation	$P_O$		90	mW		
	Output power dissipation derating ( $T_a \geq 70^\circ\text{C}$ )	$\Delta P_O/^\circ\text{C}$		-0.9	mW/ $^\circ\text{C}$		
Junction temperature	$T_j$		125	$^\circ\text{C}$			
Common	Storage temperature	$T_{stg}$		-55 to 125	$^\circ\text{C}$		
	Operating temperature	$T_{opr}$		-55 to 105	$^\circ\text{C}$		
	Lead soldering temperature (10s)	$T_{sol}$		260	$^\circ\text{C}$		
	Isolation voltage (AC, 60 s, R.H. $\leq 60\%$ )	BVs	(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: Exponential curve, pulse width  $< 1\text{ms}$ ,  $f \leq 150\text{Hz}$

Note 2: LED pins are shorted together. Detector pins are also shorted together.

## 7. Recommended Operating Conditions (Note)

Characteristics	Symbol	Min	Typ.	Max	Unit
Supply voltage	$V_{DD}$	—	—	450	V
Forward current	$I_F$	10	12	20	mA
On-state current	$I_{ON}$	—	—	10	mA
Operating temperature	$T_{opr}$	-40	—	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.

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

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
LED	Forward voltage	$V_F$	$I_F = 10 \text{ mA}$	1.5	1.65	1.8	V
			$I_F = 10 \text{ mA}, T_a = -40 \text{ to } 105^\circ\text{C}$	1.4	—	1.95	
	Reverse current	$I_R$	$V_R = 5 \text{ V}$	—	—	10	$\mu\text{A}$
	Capacitance	$C_T$	$V = 0 \text{ V}, f = 1 \text{ MHz}$	—	45	—	pF
Detector	Off-state current	$I_{OFF}$	$V_{OFF} = 600 \text{ V}, T_a = 25^\circ\text{C}$	—	10	50	nA
			$V_{OFF} = 600 \text{ V}, T_a = 85^\circ\text{C}$	—	—	250	
			$V_{OFF} = 600 \text{ V}, T_a = 105^\circ\text{C}$	—	—	400	
	Capacitance	$C_{OFF}$	$V = 0 \text{ V}, f = 1 \text{ MHz}$	—	8.0	—	pF

## 9. Coupled Electrical Characteristics

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Trigger LED current	$I_{FT}$	$I_{ON} = 15 \text{ mA}, T_a = 25^\circ\text{C}, t = 10 \text{ ms}$	—	—	3	mA
		$I_{ON} = 11 \text{ mA}, T_a = -40 \text{ to } 85^\circ\text{C}, t = 10 \text{ ms}$	—	—	5	
		$I_{ON} = 7 \text{ mA}, T_a = -40 \text{ to } 105^\circ\text{C}, t = 10 \text{ ms}$	—	—	8	
Return LED current	$I_{FC}$	$I_{OFF} = 100 \mu\text{A}, T_a = 25^\circ\text{C}, t = 40 \text{ ms}$	0.1	—	—	mA
		$I_{OFF} = 100 \mu\text{A}, T_a = -40 \text{ to } 85^\circ\text{C}, t = 40 \text{ ms}$	0.05	—	—	
		$I_{OFF} = 100 \mu\text{A}, T_a = -40 \text{ to } 105^\circ\text{C}, t = 40 \text{ ms}$	0.05	—	—	
On-state resistance	$R_{ON}$	$I_{ON} = 15 \text{ mA}, I_F = 10 \text{ mA}, T_a = 25^\circ\text{C}, t < 1 \text{ s}$	200	—	400	$\Omega$
		$I_{ON} = 11 \text{ mA}, I_F = 10 \text{ mA}, T_a = 85^\circ\text{C}, t < 1 \text{ s}$	380	—	610	
		$I_{ON} = 7 \text{ mA}, I_F = 10 \text{ mA}, T_a = 105^\circ\text{C}, t < 1 \text{ s}$	440	—	710	
		$I_{ON} = 15 \text{ mA}, I_F = 10 \text{ mA}, T_a = 25^\circ\text{C}, t > 60 \text{ s}$	—	360	—	

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

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Capacitance input to output	$C_s$	(Note1)	$V_s = 0\text{ V}$ , $f = 1\text{ MHz}$	—	0.5	—	pF
Isolation resistance	$R_s$	(Note1)	$V_s = 500\text{V}$ , R.H. $\leq 60\%$	$5 \times 10^{10}$	$10^{14}$	—	$\Omega$
Isolation voltage	BVs	(Note1)	AC, 60 s	3750	—	—	Vrms

Note1: Device considered a two-terminal device: Pins 1 and 3 shorted together, and pins 4 and 6 shorted together.

## 11. Switching Characteristics

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Turn on time	$t_{ON}$		$I_F = 10\text{ mA}$ $R_L = 4\text{ k}\Omega$ $V_{DD} = 20\text{ V}$	—	—	0.2	ms
Turn off time	$t_{OFF}$						
Turn on time	$t_{ON}$		$T_a = -40\text{ to }105^\circ\text{C}$	—	—	0.35	ms
Turn off time	$t_{OFF}$						

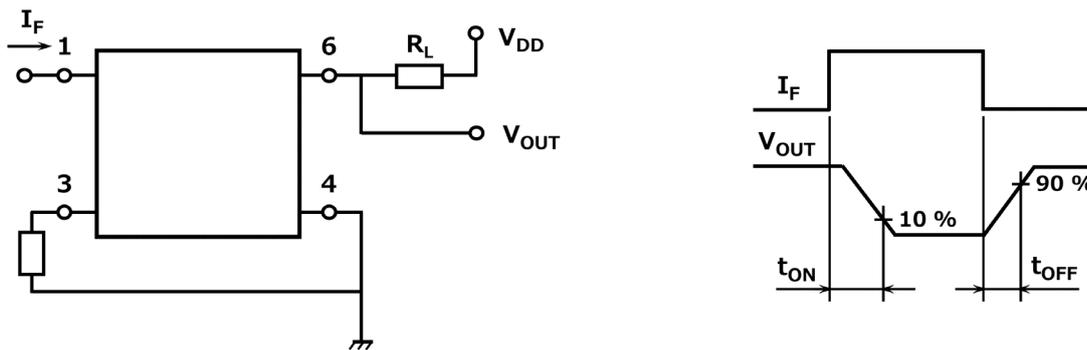
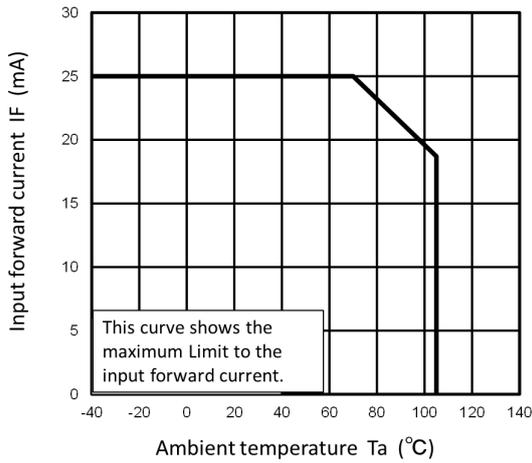
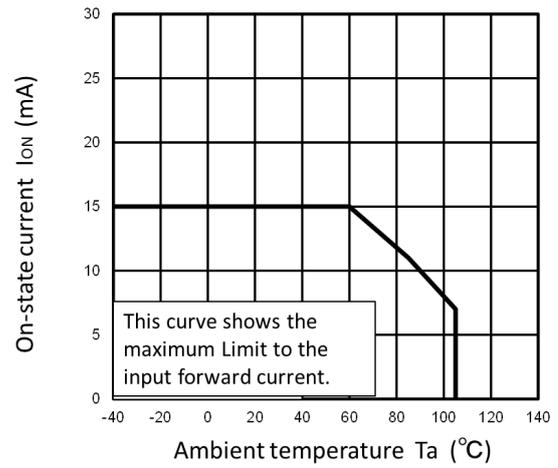


Fig. 11.1 Switching Time Test Circuit and Waveform

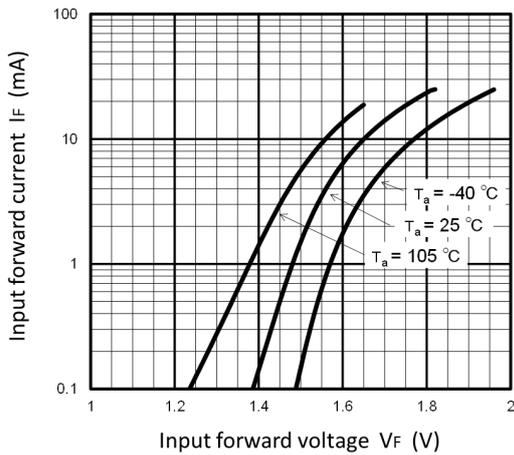
**12. Characteristics Curves (Note)**



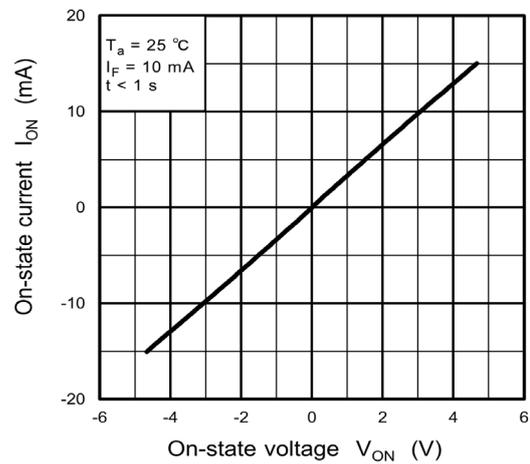
**Fig. 12.1  $I_F - T_a$**



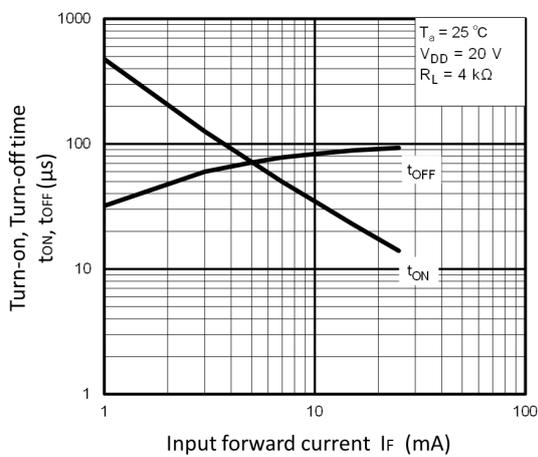
**Fig. 12.2  $I_{ON} - T_a$**



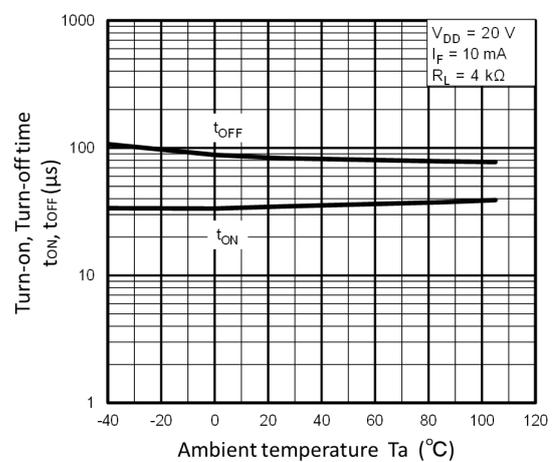
**Fig. 12.3  $I_F - V_F$**



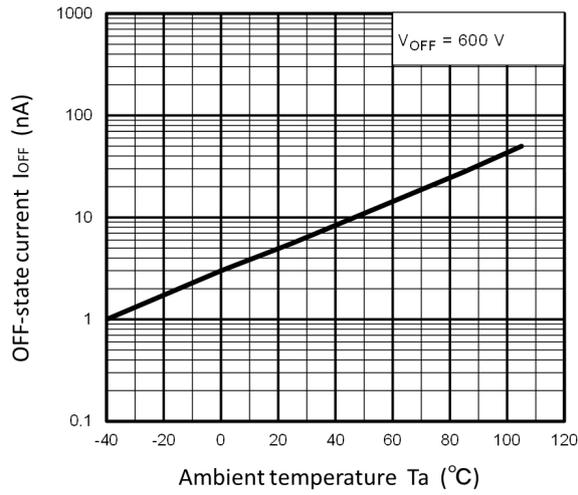
**Fig. 12.4  $I_{ON} - V_{ON}$**



**Fig. 12.5  $t_{ON}/t_{OFF} - I_F$**



**Fig. 12.6  $t_{ON}/t_{OFF} - T_a$**

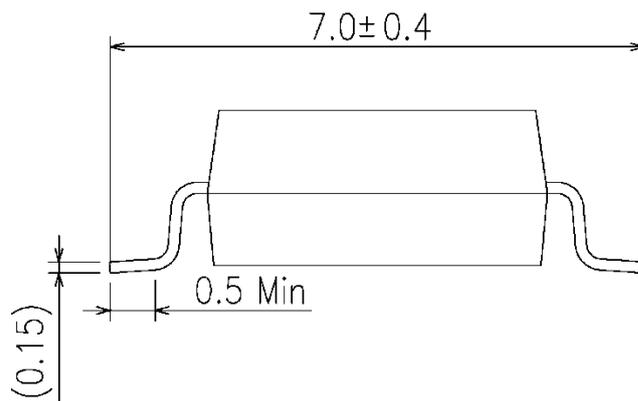
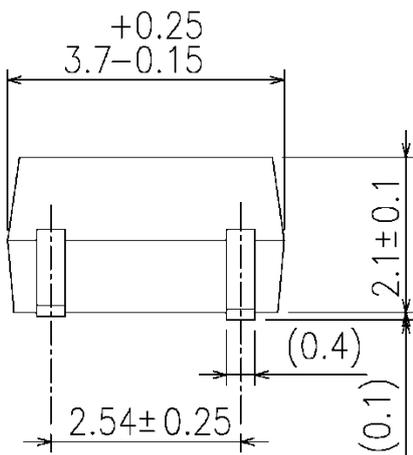
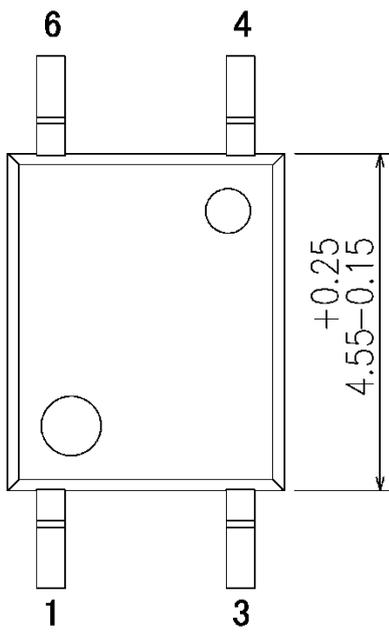


**Fig. 12.7  $I_{OFF} - T_a$**

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

## 13. Package Dimensions

Unit: mm



Weight: 0.08 g (typ.)

Package Name(s)
TOSHIBA: 11-4M1S

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