TOSHIBA PHOTOCOUPLER IRLED & PHOTO-IC

TLX9304

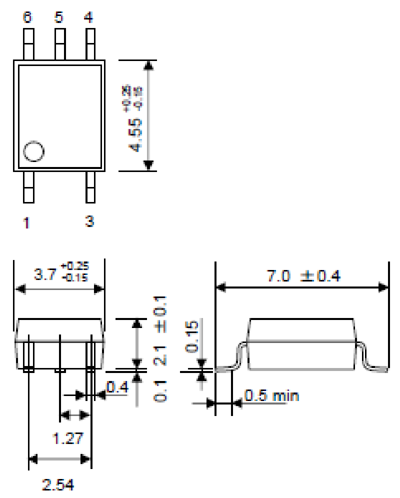
- ○ Inverter control applications in Automotive Equipment
- ○ Interface of IPM (Intelligent Power Module)
- ○ HEV (Hybrid Electric Vehicle) and EV (Electric Vehicle) Applications

The Toshiba TLX9304 consists of an infrared LED and integrated high gain, high-speed photodetector. The TLX9304 is housed in the SO6 package. The output stage is an open collector type.

The photodetector has an internal Faraday shield that provides a common-mode transient immunity of 15 kV/µs. TLX9304 realizes minimum and maximum of propagation delay time, switching speed dispersion, and high common mode transient immunity. Therefore TLX9304 is suitable for isolation interface between IPM (Intelligent Power Module) in motor control application.

- Isolation voltage : 3750 Vrms (min)
- Common mode transient immunity : 15 kV/µs (min) @V_{CM} = 1500 V
- Propagation delay time (t_{pHL}/t_{pLH}): t_{pHL} = 400 ns (max), t_{pLH} = 550 ns (max)
- Switching Time Dispersion($|t_{pLH}-t_{pHL}|$): 400 ns (max)
- It becomes TTL compatible by connecting the resistance.
- AEC-Q101 qualified

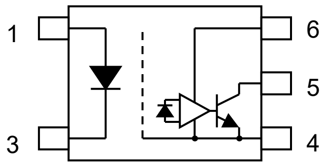
Unit: mm



JEDEC	—
JEITA	—
TOSHIBA	11-4L1

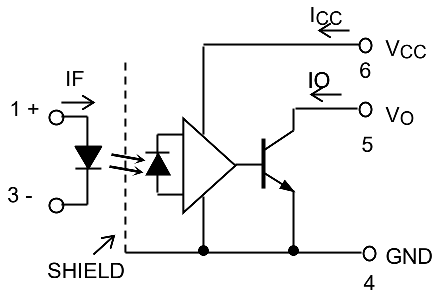
Weight: 0.08 g (typ.)

Pin Configuration



1: ANODE
3: CATHODE
4: GND
5: V_O (Output)
6: V_{CC}

Schematic



A ceramic capacitor (0.1 µF) should be connected from pin 6 (V_{CC}) to pin 4 (GND) to stabilize the operation of the high gain linear amplifier. The total lead length between capacitor and coupler should not exceed 1 cm.

Truth Table

Input	LED	Output
H	ON	L
L	OFF	H

Absolute Maximum Ratings (Note) (T_a = 25 °C, unless otherwise specified)

	Characteristic	Symbol	Rating	Unit
LED	DC Forward Current	I_F	25	mA
	DC Forward Current (Ta=125°C)	I_F	15	mA
	DC Forward Current Derating (Ta ≥ 85°C)	ΔI_F /°C	-0.25	mA/°C
	Peak Transient Forward Current (Note 1)	I_{FPT}	1	A
	Input Power Dissipation	P_D	50	mW
	DC Reverse Voltage	V_R	5	V
DETECTOR	Output Current	I_O	15	mA
	Peak Output Current	IOP	30	mA
	Output Voltage	V_O	-0.5 to 30	V
	Supply Voltage	V_{CC}	-0.5 to 30	V
	Output Power Dissipation	P_O	100	mW
	Output Power Dissipation Derating (Ta ≥ 85°C)	ΔP_O /°C	-1.83	mW/°C
Operating Temperature Range		T_{opr}	-40 to 125	°C
Storage Temperature Range		T_{stg}	-55 to 150	°C
Lead Soldering Temperature (10 s)		T_{sol}	260	°C
Isolation Voltage (R.H.≤ 60%, AC, 60 s.) (Note 2)		BV_S	3750	V_{rms}

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 ≤ 1 μs, 300 pps

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

Recommended Operating Conditions (Note)

Characteristic	Symbol	Min	Typ.	Max	Unit
Supply Voltage	V_{CC}	4.5	-	20	V
Output Voltage	V_O	-	-	V_{CC}	V
Forward Current	I_F	-	10	15	mA
Operating Temperature (Note 1)	T_{opr}	-40	-	125	°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.

Note 1: Denotes the operating range, not the recommended operating condition.

Electrical Characteristics (Note)

(Unless otherwise specified, T_a = -40 to 125 °C, V_{CC} = 4.5 to 20 V)

Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit
Input Forward voltage	V_F	I_F = 10 mA, Ta = 25°C	1.45	1.56	1.75	V
		I_F = 10 mA	1.35	—	1.9	
Input Reverse current	I_R	V_R = 5 V, Ta = 25°C	—	—	10	μA
Input Capacitance between terminals	C_T	V_F = 0 V, f = 1 MHz, Ta = 25°C	—	45	—	pF
High level output current	I_{OH}	I_F = 0 mA, V_O = 20 V	—	—	50	μA
Low level output voltage	V_{OL}	I_F = 10 mA, I_O = 2.4mA	—	0.3	0.6	V
High level supply current	I_{CCH}	I_F = 0 mA	—	—	1.3	mA
Low level supply current	I_{CCL}	I_F = 10 mA	—	—	1.3	mA
Input current logic LOW output	I_{FHL}	I_O = 0.75mA, V_O < 0.8 V	—	1	5	mA
Input voltage logic HIGH output	V_{FLH}	I_O = 0.75mA, V_O > 2.0 V	0.8	—	—	V
Output current	I_O	I_F = 10 mA, V_O = 0.6V	4.0	—	—	mA

Note: All typical values at V_{CC} = 5 V and Ta = 25°C.

Isolation Characteristics (T_a = 25 °C)

Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit
Stray Capacitance (input to output)	C_S	V_S = 0 V, f = 1 MHz	—	0.5	—	pF
Isolation resistance	R_S	V_S = 500 V, R.H. ≤ 60%	10^{12}	10^{14}	—	Ω
Isolation voltage	BV_S	AC, 60 s	3750	—	—	Vrms

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

Switching Characteristics (Note) (Unless otherwise specified, T_a = -40 to 125 °C)

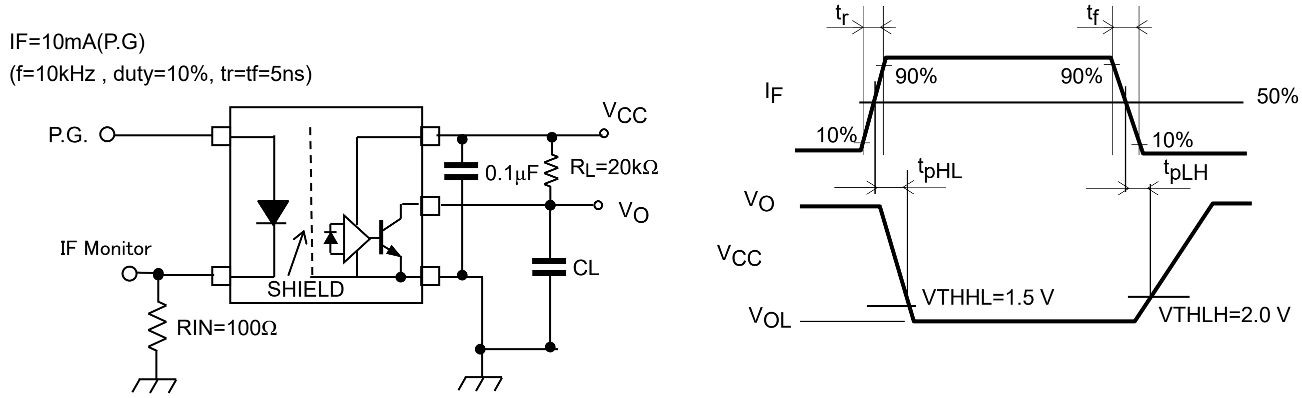
Characteristic	Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit
Propagation delay time (H→L)	$t_{pHL}(1)$	Fig.1	I_F = 10 mA, R_L = 4.7 kΩ V_{CC} = 5 V	C_L = 100 pF	30	100	400	ns
				C_L = 10 pF	—	90	—	
Propagation delay time (L→H)	$t_{pLH}(1)$			C_L = 100 pF	200	300	550	
				C_L = 10 pF	—	140	—	
Switching Time Dispersion between ON and OFF	$\|t_{pLH}-t_{pHL}\|(1)$			C_L = 100 pF	0	200	400	
Propagation Delay Skew (Note 1)	$t_{psk}(1)$				-50	200	450	
Propagation delay time (H→L)	$t_{pHL}(2)$		I_F = 10 mA, R_L = 20 kΩ V_{CC} = 15 V	C_L = 100 pF	30	150	400	ns
				C_L = 10 pF	—	100	—	
Propagation delay time (L→H)	$t_{pLH}(2)$			C_L = 100 pF	200	350	550	
				C_L = 10 pF	—	150	—	
Switching Time Dispersion between ON and OFF	$\|t_{pLH}-t_{pHL}\|(2)$			C_L = 100 pF	0	200	400	
Propagation Delay Skew (Note 1)	$t_{psk}(2)$				-50	200	450	
Common mode transient immunity at high output level (Note 2)	CM_H	Fig.2	V_{CC} = 15 V, CL= 100 pF, V_{CM} = 1500 V_{p-p}, I_F = 0 mA, R_L = 20 kΩ, Ta=25°C		15	—	—	kV/μs
Common mode transient Immunity at low output level (Note 2)	CM_L		V_{CC} = 15 V, CL = 100 pF, V_{CM} = 1500 V_{p-p}, I_F = 10 mA, R_L = 20 kΩ, Ta=25°C		-15	—	—	kV/μs

Note: All typical values at V_{CC} = 5 V and Ta = 25°C.

Note 1: 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).

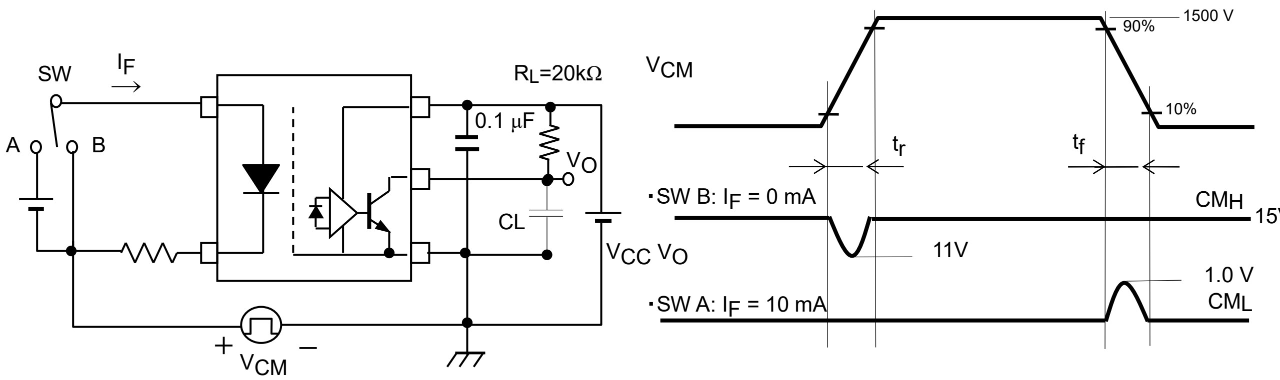
Note 2: CM_H is the maximum rate of rise of the common mode voltage that can be sustained with the output voltage in the logic high state (V_O > 11 V)
CML is the maximum rate of fall of the common mode voltage that can be sustained with the output voltage in the logic low state (V_O < 1.0 V).

Fig. 1: t_{pHL}, t_{pLH}



C_L includes probe and stray capacitance.
P.G.: Pulse generator

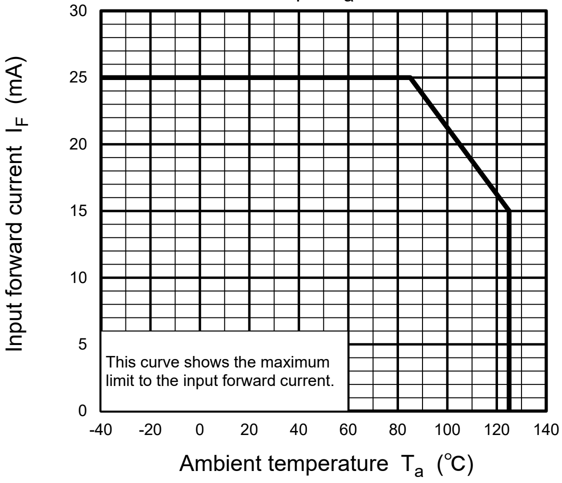
Fig. 2: CM_H, CM_L



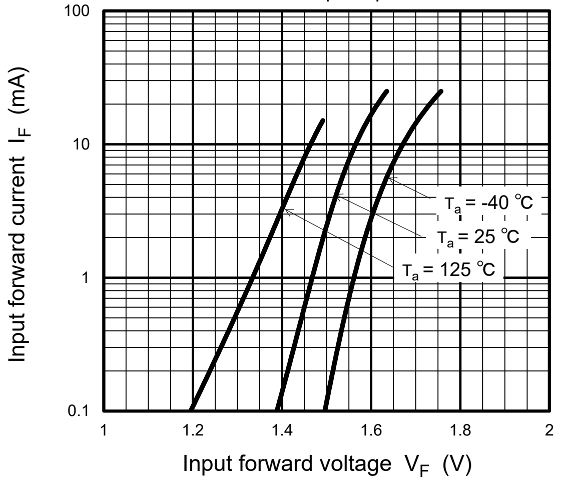
$$CM_H = \frac{1200(V)}{tr(\mu s)} \quad CM_L = -\frac{1200(V)}{tf(\mu s)}$$

Characteristics Curves (Note)

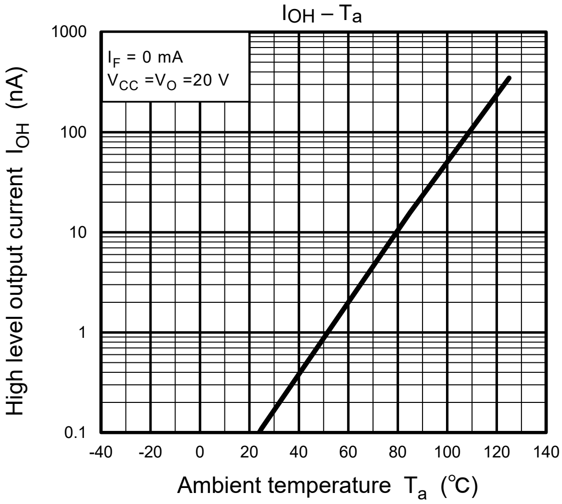
I_F – T_a



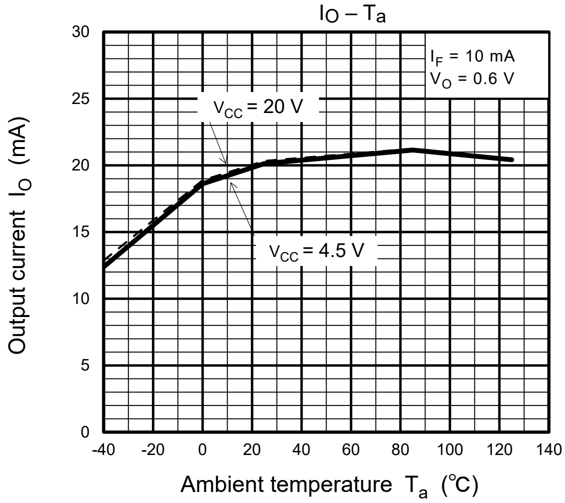
I_F – V_F



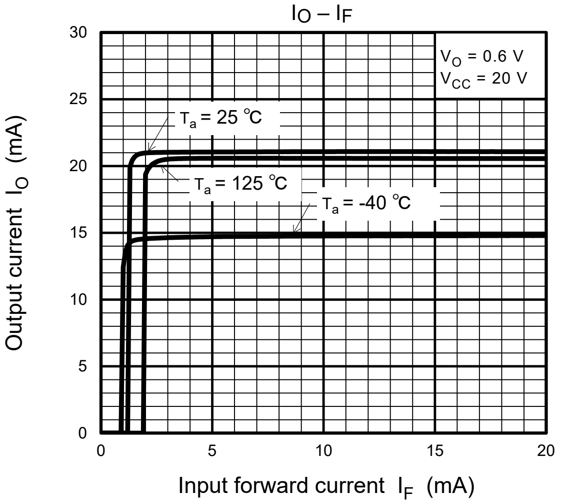
I_{OH} – T_a



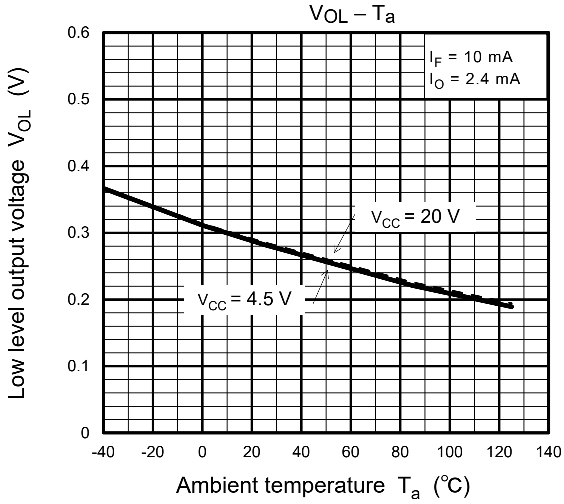
I_O – T_a

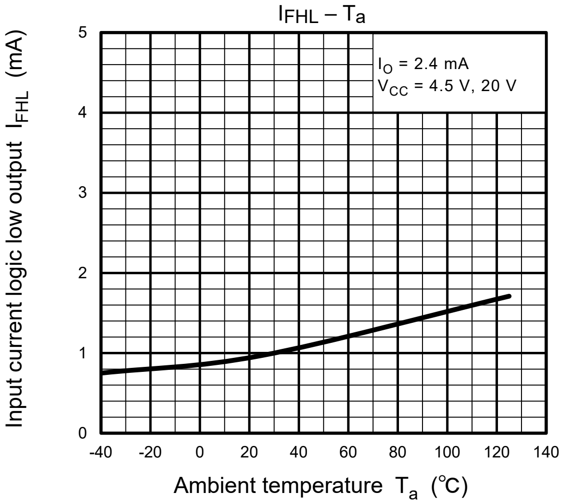


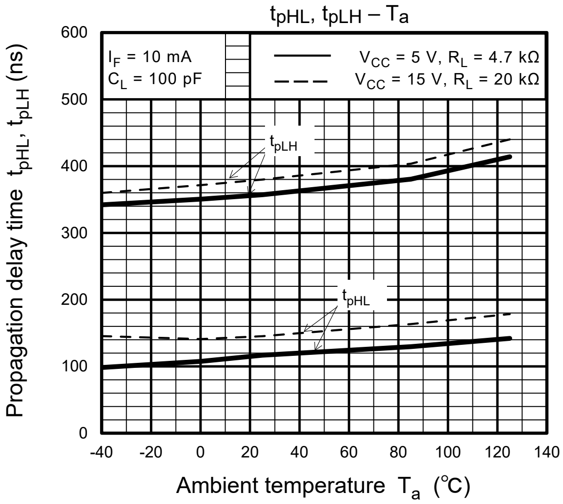
I_O – I_F

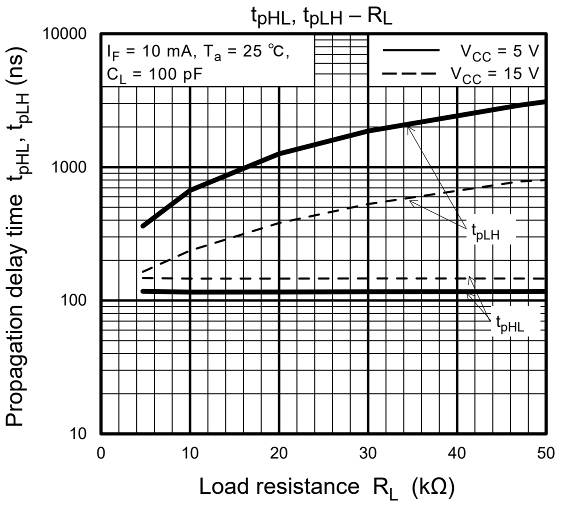


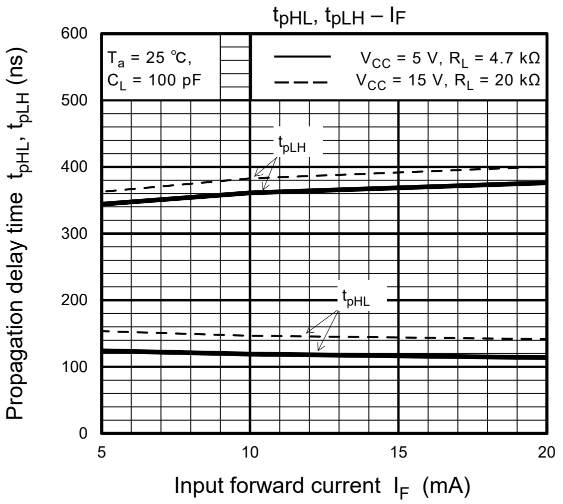
V_{OL} – T_a











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

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