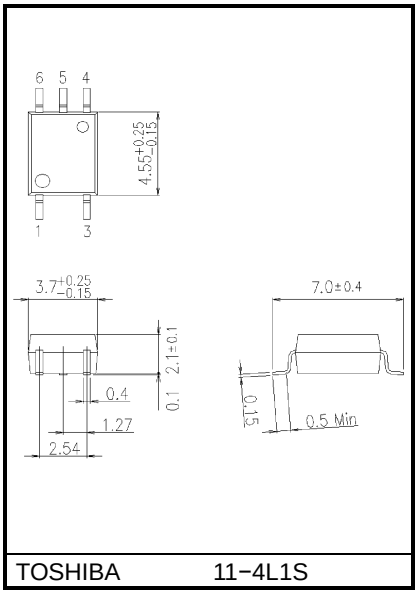
TOSHIBA Photocoupler LED + Photo−IC

TLX9309

- ○ Inverter Control Applications
- ○ Interface for Intelligent Power Modules
- ○ HEV (Hybrid Electric Vehicle) and EV (Electric Vehicle) Applications

Unit: mm



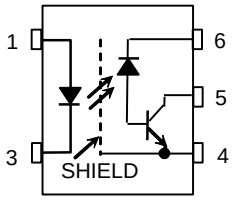
TOSHIBA 11−4L1S

Weight: 0.08 g (typ.)

The TOSHIBA TLX9309 mini-flat photocoupler is suitable for surface-mount assembly.
The TLX9309 consists of a high-output light emitting diode optically coupled to a high-speed detector, which consists of a photodiode and a transistor integrated on a single chip.
Faraday shield integrated on the photodetector chip provides an enhanced common-mode transient immunity.
The TLX9309 guarantees minimum and maximum propagation delay time, propagation delay difference between t_{pHL} and t_{pLH}, and high common-mode transient immunity.
Therefore, the TLX9309 is suitable for isolation interface between an IPM (intelligent power module) and a control IC circuit in motor control applications.

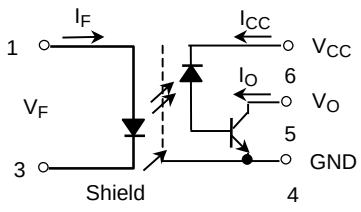
- Isolation voltage: 3750 V_{rms} (min)
- Common mode transient immunity: ±10 kV/μs (min) @V_{CM}=1500V
- Propagation delay time: t_{pHL}, t_{pLH} = 0.1 μs (min), t_{pHL} = 0.8 μs (max), t_{pLH} = 1.0 μs (max) @I_F = 7 mA, V_{CC} = 15 V, R_L=20 kΩ, Ta=25°C
- Propagation delay difference: 0.7 μs (max) ($|t_{pLH}-t_{pHL}|$) @I_F = 7 mA, V_{CC} = 15 V, R_L=20 kΩ, Ta=25°C
- TTL-compatible

Pin Configuration (top view)



1 : Anode
3 : Cathode
4 : Emitter (GND)
5 : Collector (Output)
6 : V_{CC}

Schematic



Absolute Maximum Ratings (Note) (Unless otherwise specified, Ta = 25°C)

	Characteristic		Symbol	Rating	Unit
LED	Forward current	(Note 1)	I_F	15	mA
	Pulse forward current	(Note 2)	I_{FP}	30	mA
	Peak transient forward current	(Note 3)	I_{FPT}	1	A
	Reverse voltage		V_R	5	V
	Input power dissipation		PD	50	mW
Detector	Output current		I_O	25	mA
	Peak output current		I_{OP}	50	mA
	Output voltage		V_O	−0.5 to 20	V
	Supply voltage		V_{CC}	−0.5 to 30	V
	Output power dissipation	(Note 4)	P_O	100	mW
Storage temperature range			T_{stg}	−55 to 150	°C
Operating temperature range			T_{opr}	−40 to 125	°C
Lead soldering temperature(10 s)			T_{sol}	260	°C
Isolation voltage(AC, 60 s., R.H.≤60%, Ta=25°C)		(Note 5)	BV_S	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: Derate 0.14 mA / °C above 70 °C.

Note 2: 50% duty cycle, 1ms pulse width.
Derate 0.29 mA / °C above 70 °C.

Note 3: Pulse width PW ≤ 1μs, 300pps.

Note 4: Derate 1.8 mW / °C above 70 °C.

Note 5: Device considered a two-terminal device: Pins1 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}	—	—	30	V
Output voltage	V_O	—	—	20	V
Forward current	I_F	—	7	12	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 (Unless otherwise specified, Ta = 25°C)

Characteristic		Symbol	Test Condition	Min.	Typ.	Max.	Unit
LED	Forward voltage	V_F	I_F= 7 mA	1.35	1.60	1.75	V
	Forward voltage temperature coefficient	$\Delta V_F / \Delta Ta$	I_F= 7 mA Ta = -40 to 125 °C	—	-2.0	—	mV / °C
	Reverse current	I_R	V_R = 5 V	—	—	10	μA
	Capacitance between terminal	C_T	V = 0 V, f = 1MHz, Ta = 25 °C	—	50	—	pF
Detector	High level output current	$I_{OH(1)}$	I_F = 0 mA, V_{CC} = V_O = 5.5 V	—	—	500	nA
		$I_{OH(2)}$	I_F = 0 mA, V_{CC} = 30 V V_O = 20 V	—	—	5	μA
		I_{OH}	I_F= 0 mA, V_{CC} = 30 V V_O = 20 V, Ta = 125 °C	—	—	100	
	High level supply current	I_{CCH}	I_F = 0 mA, V_{CC} = 30 V	—	0.01	1	μA
	Supply voltage	V_{CC}	I_{CC} = 0.01 mA	30	—	—	V
	Output voltage	V_O	I_O = 0.5 mA	20	—	—	V

Coupled Electrical Characteristics (Unless otherwise specified, Ta = 25°C)

Characteristic	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Current transfer ratio	I_O / I_F	I_F= 7 mA, V_{CC} = 4.5 V V_O = 0.4 V	15	—	300	%
		I_F= 7 mA, V_{CC} = 4.5 V V_O= 0.4 V, Ta = − 25 to 100 °C	10	—	—	
		I_F= 7 mA, V_{CC} = 4.5 V V_O = 0.4 V, Ta = − 40 to100 °C	8	—	—	
Low level output voltage	V_{OL}	I_F = 7 mA, V_{CC} = 4.5 V I_O = 2.4 mA	—	—	0.4	V

Isolation Characteristics (Ta = 25°C)

Characteristic	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Capacitance input to output (Note 1)	C_S	V = 0 V, f = 1 MHz	—	0.6	—	pF
Isolation resistance (Note 1)	R_S	R.H. ≤ 60%, V_S = 500 V	5×10^{10}	10^{14}	—	Ω
Isolation voltage (Note 1)	BV_S	AC, 60 s	3750	—	—	Vrms

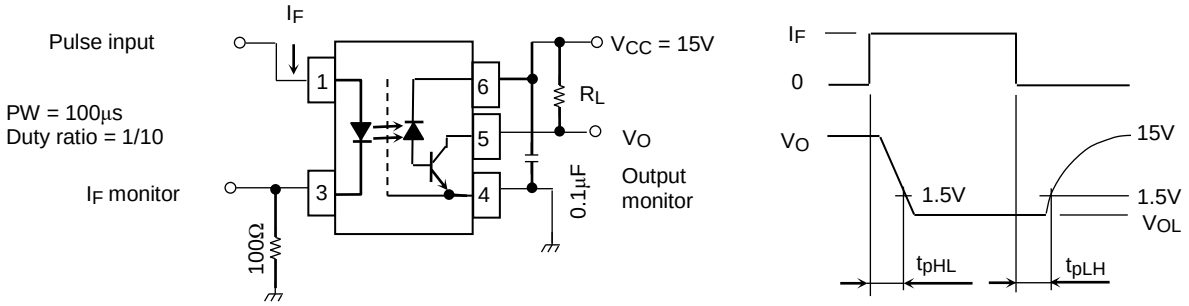
Note 1: Device considered a two-terminal device: Pins1 and 3 are shorted together, and pins 4, 5 and 6 are shorted together.

Switching Characteristics (Unless otherwise specified, Ta = 25°C, V_{CC} = 15V)

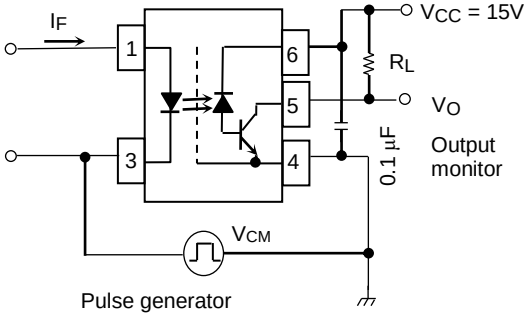
Characteristic	Symbol	Test Cir− Cuit	Test Condition	Min.	Typ.	Max.	Unit
Propagation delay time (H→ L)	t_{pHL}	1	I_F= 0→7 mA, R_L = 20 kΩ	0.1	0.35	0.8	μs
			I_F= 0→7 mA, R_L = 20 kΩ Ta = 0 to 85 °C	0.1	—	0.9	
			I_F= 0→7 mA, R_L = 20 kΩ Ta = − 40 to 100 °C	0.05	—	1.0	
Propagation delay time (L→ H)	tpLH		I_F= 7→0 mA, R_L = 20 kΩ	0.1	0.45	1.0	μs
			I_F= 7→0 mA, R_L = 20 kΩ Ta = 0 to 85 °C	0.1	—	1.1	
			I_F= 7→0 mA, R_L = 20 kΩ Ta = − 40 to 100 °C	0.05	—	1.2	
Propagation delay difference	$\lvert t_{pLH}-t_{pHL}\rvert$		I_F= 7 mA, R_L = 20 kΩ	—	0.1	0.7	μs
			I_F= 7 mA, R_L = 20 kΩ Ta = 0 to 85 °C	—	—	1.0	
			I_F= 7 mA, R_L = 20 kΩ Ta = − 40 to 100 °C	—	—	1.1	
Common mode transient immunity at logic high output (Note 1)	CM_H	2	I_F= 0 mA V_{CM} = 1500 V_{p-p} R_L = 20 kΩ	10000	15000	—	V / μs
Common mode transient immunity at logic low output (Note 1)	CM_L		I_F= 7 mA V_{CM} = 1500 V_{p-p} R_L = 20 kΩ	−10000	−15000	—	V / μs

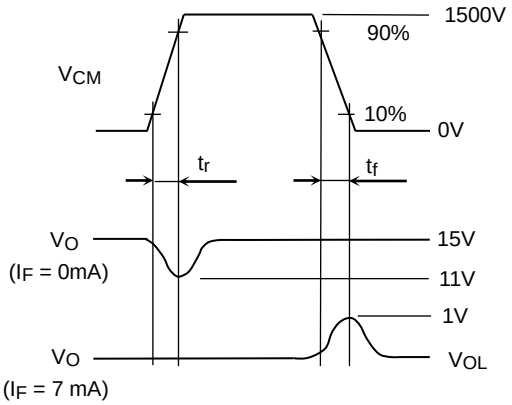
Note 1: CM_L is the maximum rate of fall of the common mode voltage that can be sustained with the output voltage in the logic low state (V_O<1.0V).
CM_H is the maximum rate of rise of the common mode voltage that can be sustained with the output voltage in the logic high state (V_O>11.0V).

Test Circuit 1: Switching Time Test Circuit



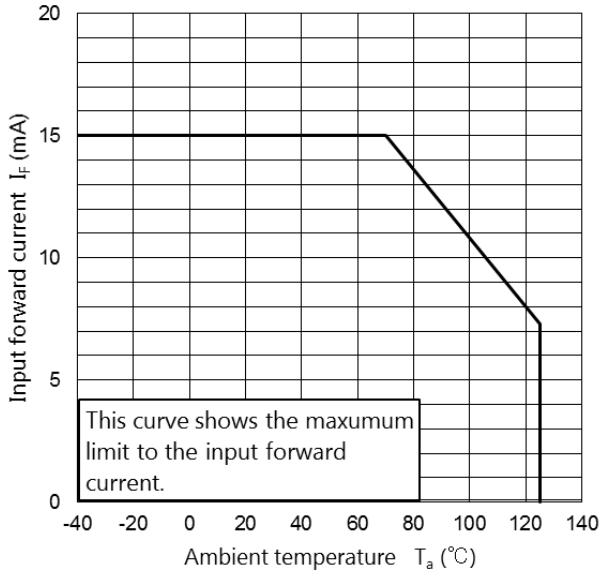
Test Circuit 2: Common Mode Noise Immunity Test Circuit



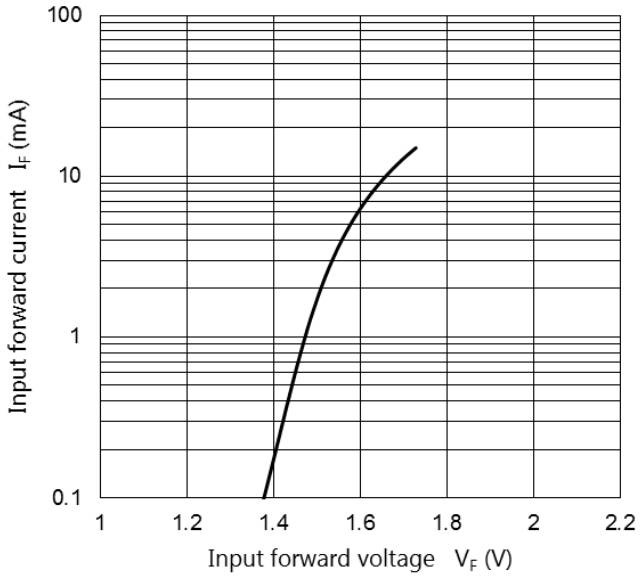


$$CM_H = \frac{1200(V)}{t_r(\mu s)}, CM_L = \frac{1200(V)}{t_f(\mu s)}$$

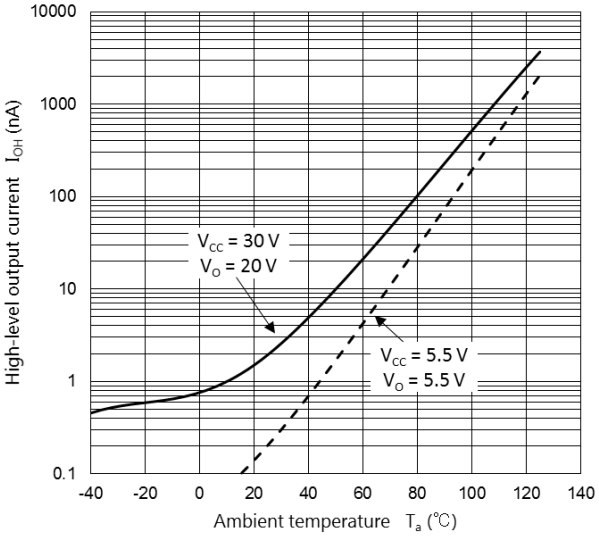
$I_F - Ta$



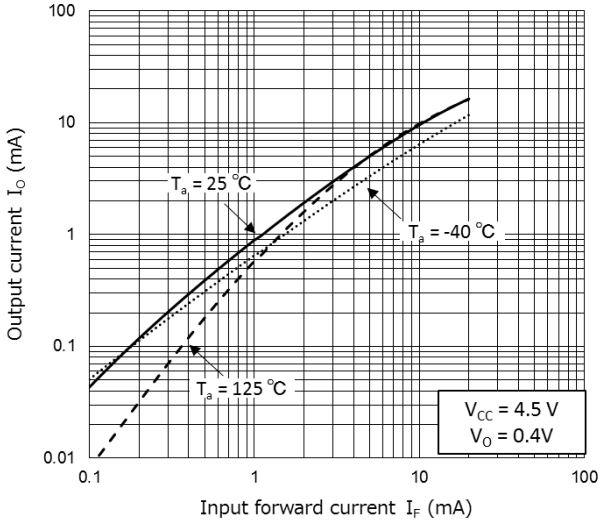
$I_F - V_F$



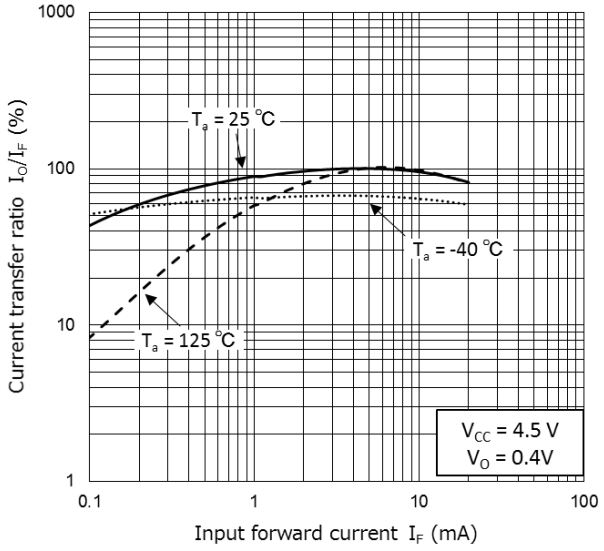
$I_{OH} - Ta$



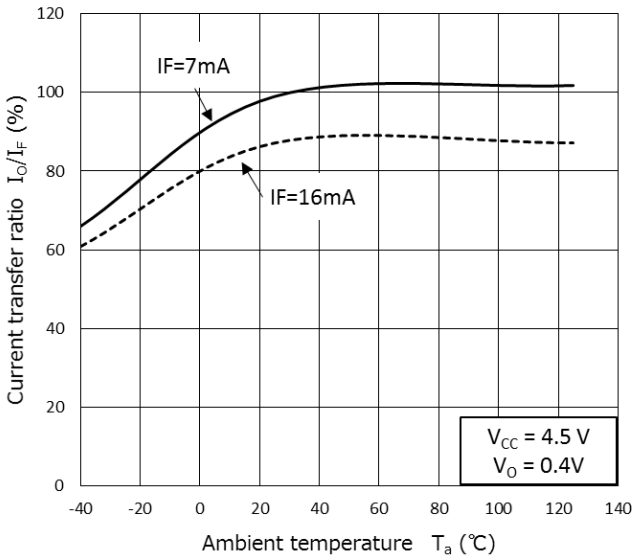
$I_O - I_F$



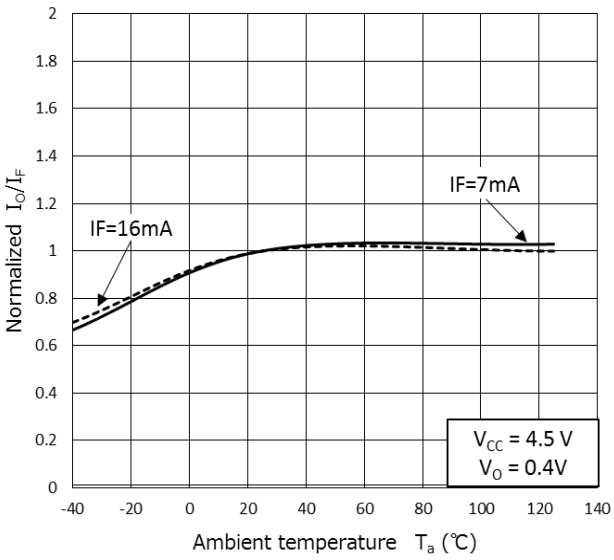
$I_O/I_F - I_F$



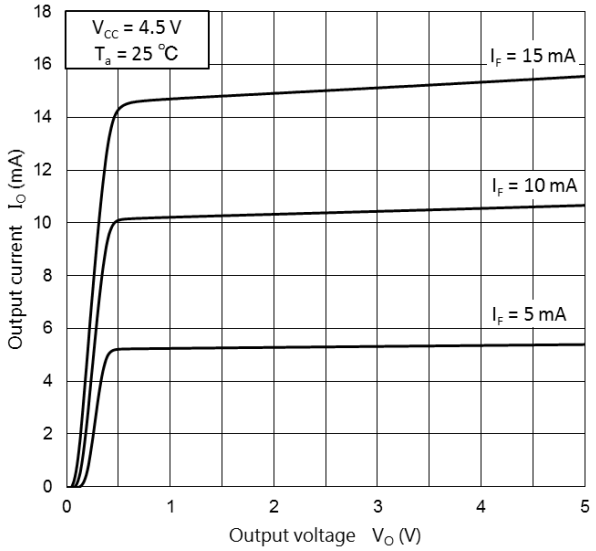
I_O/I_F – Ta



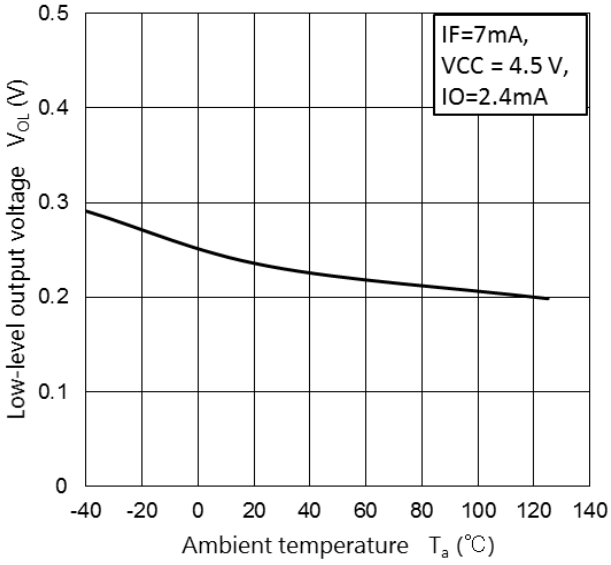
I_O/I_F - Ta



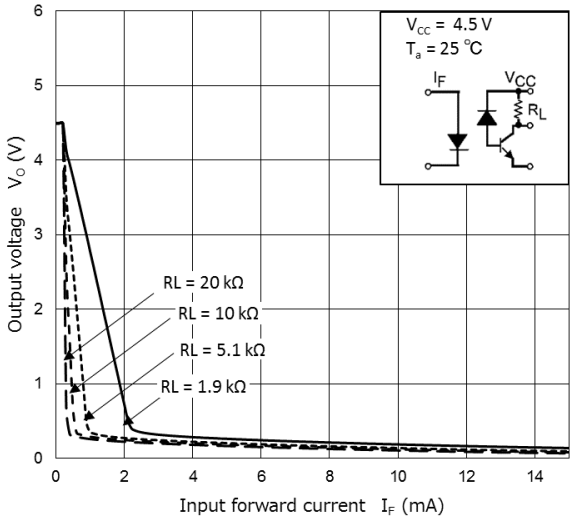
I_O – V_O



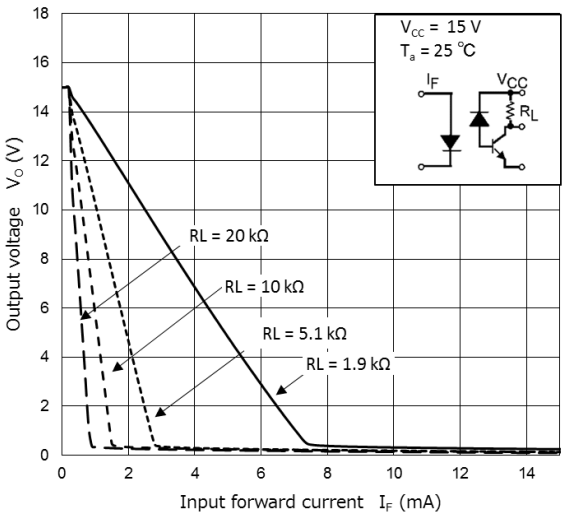
V_{OL} – Ta



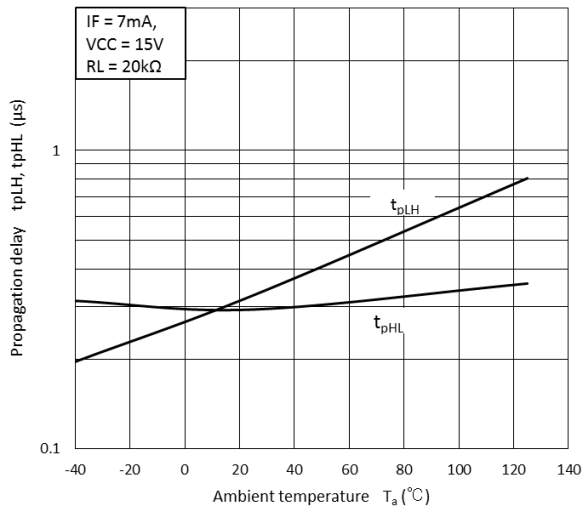
V_O – I_F



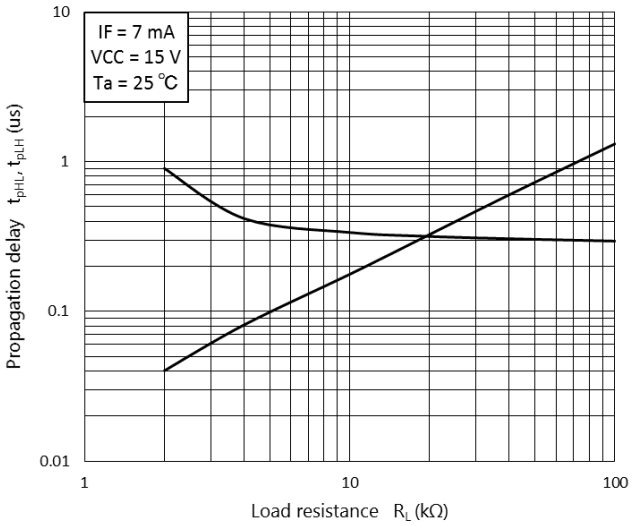
V_O – I_F



t_{pLH}, t_{pHL}-T_a



t_{pLH}, t_{pHL} - R_L



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

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