

# TLX9309

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

The TOSHIBA TLX9309 mini-flat photocoupler is suitable for surface-mount assembly.

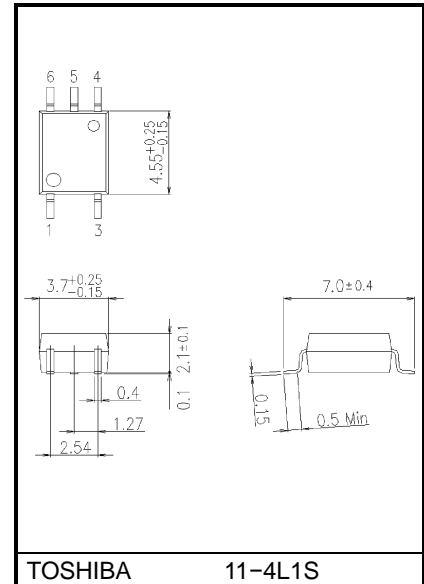
The TLX9309 consists of a high-output light emitting diode optically coupled to a high-speed detector, which consists of a photodiode and a transistor integrated on a single chip.

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.

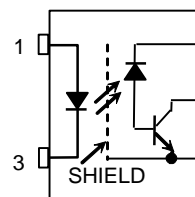
Unit: mm



Weight: 0.08 g (typ.)

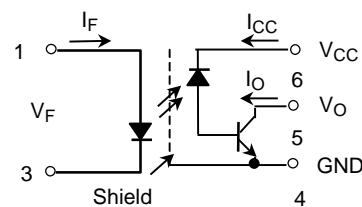
- Isolation voltage: 3750 Vrms (min)
- Common mode transient immunity:  $\pm 10$  kV/ $\mu$ s (min) @VCM=1500V
- Propagation delay time:  $t_{pHL}$ ,  $t_{pLH} = 0.1 \mu$ s (min),  
 $t_{pHL} = 0.8 \mu$ s (max),  $t_{pLH} = 1.0 \mu$ s (max)  
@IF = 7 mA, VCC = 15 V, RL=20 k $\Omega$ , Ta=25°C
- Propagation delay difference: 0.7  $\mu$ s (max) ( $|t_{pLH}-t_{pHL}|$ )  
@IF = 7 mA, VCC = 15 V, RL=20 k $\Omega$ , Ta=25°C
- TTL-compatible

### Pin Configuration (top view)



- 1 : Anode
- 3 : Cathode
- 4 : Emitter (GND)
- 5 : Collector (Output)
- 6 : VCC

### Schematic



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

Characteristic		Symbol	Rating	Unit
LED	Forward current (Note 1)	I <sub>F</sub>	15	mA
	Pulse forward current (Note 2)	I <sub>FP</sub>	30	mA
	Peak transient forward current (Note 3)	I <sub>FPT</sub>	1	A
	Reverse voltage	V <sub>R</sub>	5	V
	Input power dissipation	PD	50	mW
Detector	Output current	I <sub>O</sub>	25	mA
	Peak output current	I <sub>OP</sub>	50	mA
	Output voltage	V <sub>O</sub>	-0.5 to 20	V
	Supply voltage	V <sub>CC</sub>	-0.5 to 30	V
	Output power dissipation (Note 4)	P <sub>O</sub>	100	mW
Storage temperature range		T <sub>stg</sub>	-55 to 150	°C
Operating temperature range		T <sub>opr</sub>	-40 to 125	°C
Lead soldering temperature(10 s)		T <sub>sol</sub>	260	°C
Isolation voltage(AC, 60 s., R.H.≤60%, Ta=25°C) (Note 5)		BV <sub>S</sub>	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: 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 <sub>CC</sub>	—	—	30	V
Output voltage	V <sub>O</sub>	—	—	20	V
Forward current	I <sub>F</sub>	—	7	12	mA
Operating temperature (Note 1)	T <sub>opr</sub>	-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 <sub>F</sub>	I <sub>F</sub> = 7 mA	1.35	1.60	1.75	V
	Forward voltage temperature coefficient	ΔV <sub>F</sub> / ΔT <sub>a</sub>	I <sub>F</sub> = 7 mA Ta = -40 to 125 °C	—	-2.0	—	mV / °C
	Reverse current	I <sub>R</sub>	V <sub>R</sub> = 5 V	—	—	10	μA
	Capacitance between terminal	C <sub>T</sub>	V = 0 V, f = 1MHz, Ta = 25 °C	—	50	—	pF
Detector	High level output current	I <sub>OH</sub> (1)	I <sub>F</sub> = 0 mA, V <sub>CC</sub> = V <sub>O</sub> = 5.5 V	—	—	500	nA
		I <sub>OH</sub> (2)	I <sub>F</sub> = 0 mA, V <sub>CC</sub> = 30 V V <sub>O</sub> = 20 V	—	—	5	μA
		I <sub>OH</sub>	I <sub>F</sub> = 0 mA, V <sub>CC</sub> = 30 V V <sub>O</sub> = 20 V, Ta = 125 °C	—	—	100	
	High level supply current	I <sub>CCH</sub>	I <sub>F</sub> = 0 mA, V <sub>CC</sub> = 30 V	—	0.01	1	μA
	Supply voltage	V <sub>CC</sub>	I <sub>CC</sub> = 0.01 mA	30	—	—	V
	Output voltage	V <sub>O</sub>	I <sub>O</sub> = 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 <sub>O</sub> / I <sub>F</sub>	I <sub>F</sub> = 7 mA, V <sub>CC</sub> = 4.5 V V <sub>O</sub> = 0.4 V	15	—	300	%
		I <sub>F</sub> = 7 mA, V <sub>CC</sub> = 4.5 V V <sub>O</sub> = 0.4 V, Ta = -25 to 100 °C	10	—	—	
		I <sub>F</sub> = 7 mA, V <sub>CC</sub> = 4.5 V V <sub>O</sub> = 0.4 V, Ta = -40 to 100 °C	8	—	—	
Low level output voltage	V <sub>OL</sub>	I <sub>F</sub> = 7 mA, V <sub>CC</sub> = 4.5 V I <sub>O</sub> = 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 <sub>S</sub>	V = 0 V, f = 1 MHz	—	0.6	—	pF
Isolation resistance (Note 1)	R <sub>S</sub>	R.H. ≤ 60%, V <sub>S</sub> = 500 V	5×10 <sup>10</sup>	10 <sup>14</sup>	—	Ω
Isolation voltage (Note 1)	BV <sub>S</sub>	AC, 60 s	3750	—	—	V <sub>rms</sub>

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

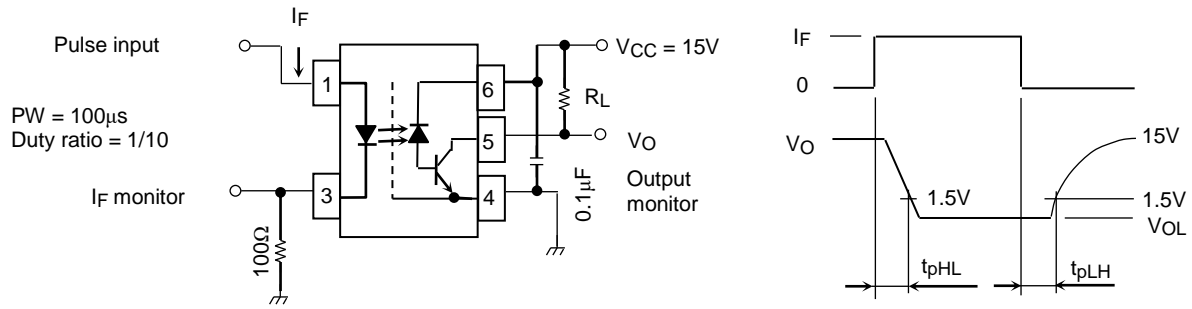
## Switching Characteristics (Unless otherwise specified, Ta = 25°C, Vcc = 15V)

Characteristic	Symbol	Test Cir-Cuit	Test Condition	Min.	Typ.	Max.	Unit
Propagation delay time (H→L)	t <sub>pHL</sub>	1	I <sub>F</sub> = 0→7 mA, R <sub>L</sub> = 20 kΩ	0.1	0.35	0.8	μs
			I <sub>F</sub> = 0→7 mA, R <sub>L</sub> = 20 kΩ Ta = 0 to 85 °C	0.1	—	0.9	
			I <sub>F</sub> = 0→7 mA, R <sub>L</sub> = 20 kΩ Ta = - 40 to 100 °C	0.05	—	1.0	
Propagation delay time (L→H)	t <sub>pLH</sub>		I <sub>F</sub> = 7→0 mA, R <sub>L</sub> = 20 kΩ	0.1	0.45	1.0	μs
			I <sub>F</sub> = 7→0 mA, R <sub>L</sub> = 20 kΩ Ta = 0 to 85 °C	0.1	—	1.1	
			I <sub>F</sub> = 7→0 mA, R <sub>L</sub> = 20 kΩ Ta = - 40 to 100 °C	0.05	—	1.2	
Propagation delay difference	t <sub>pLH</sub> -t <sub>pHL</sub>		I <sub>F</sub> = 7 mA, R <sub>L</sub> = 20 kΩ	—	0.1	0.7	μs
			I <sub>F</sub> = 7 mA, R <sub>L</sub> = 20 kΩ Ta = 0 to 85 °C	—	—	1.0	
			I <sub>F</sub> = 7 mA, R <sub>L</sub> = 20 kΩ Ta = - 40 to 100 °C	—	—	1.1	
Common mode transient immunity at logic high output (Note 1)	CMH	2	I <sub>F</sub> = 0 mA V <sub>CM</sub> = 1500 V <sub>p-p</sub> R <sub>L</sub> = 20 kΩ	10000	15000	—	V / μs
Common mode transient immunity at logic low output (Note 1)	CML		I <sub>F</sub> = 7 mA V <sub>CM</sub> = 1500 V <sub>p-p</sub> R <sub>L</sub> = 20 kΩ	-10000	-15000	—	V / μs

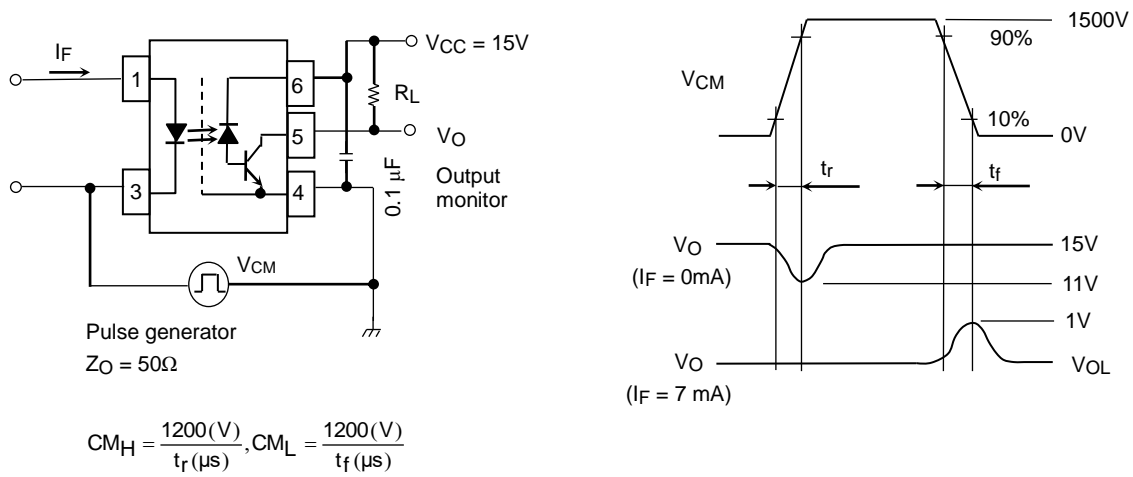
Note 1: CML is the maximum rate of fall of the common mode voltage that can be sustained with the output voltage in the logic low state (V<sub>O</sub><1.0V).

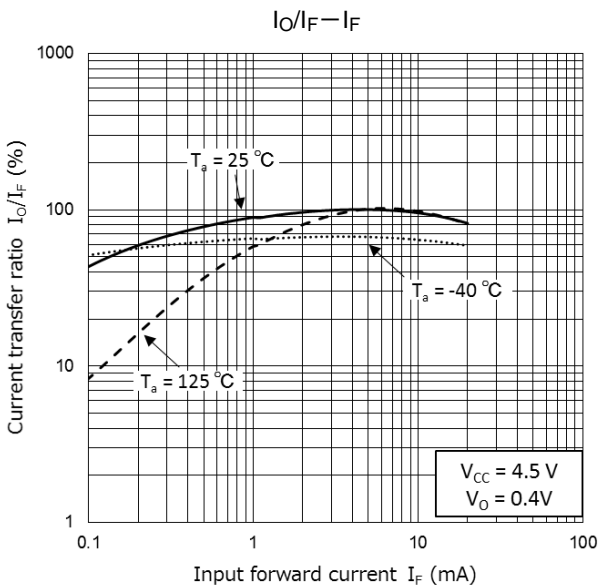
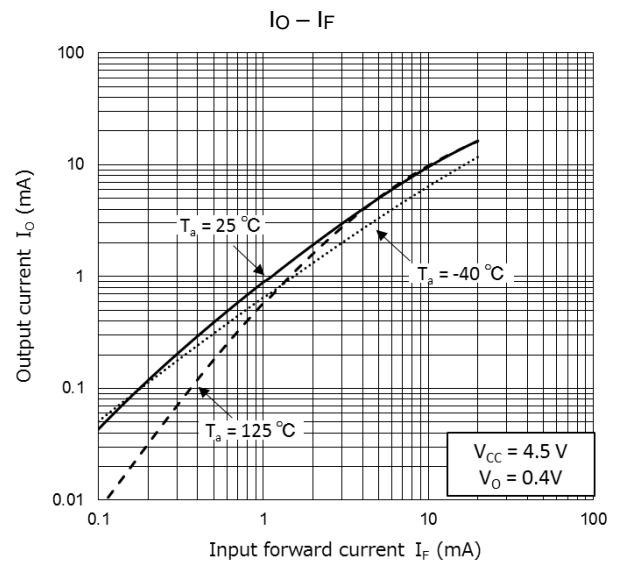
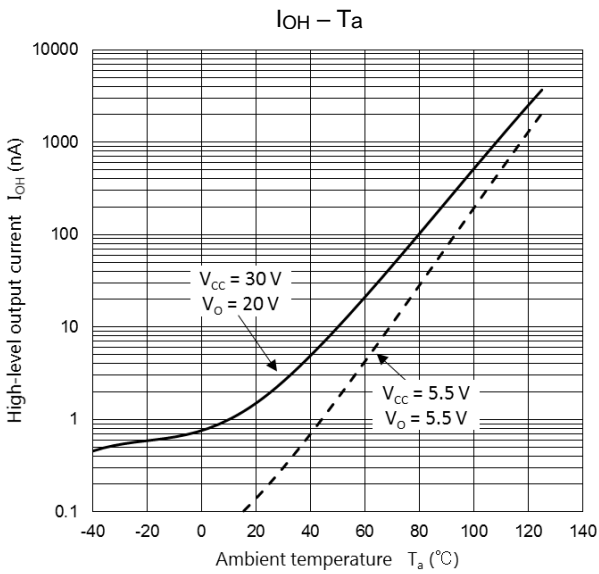
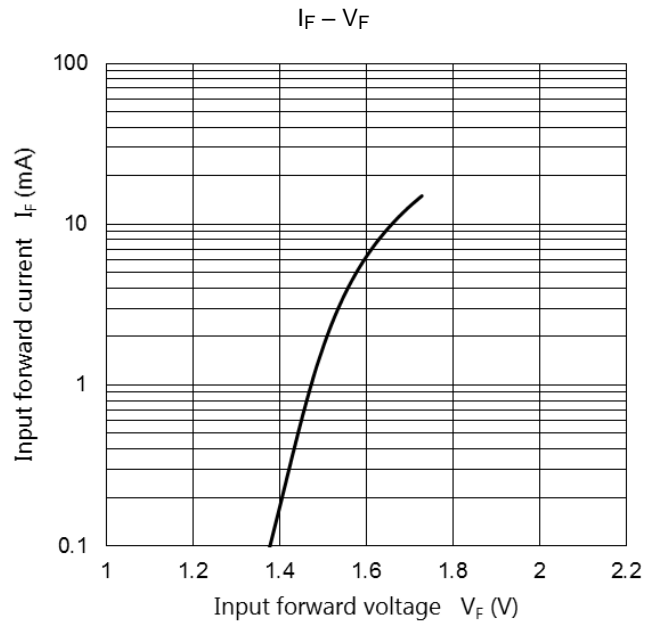
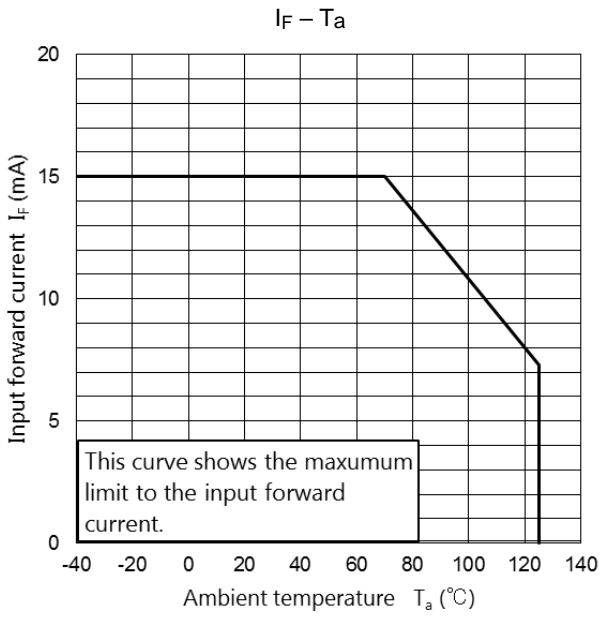
CMH is the maximum rate of rise of the common mode voltage that can be sustained with the output voltage in the logic high state (V<sub>O</sub>>11.0V).

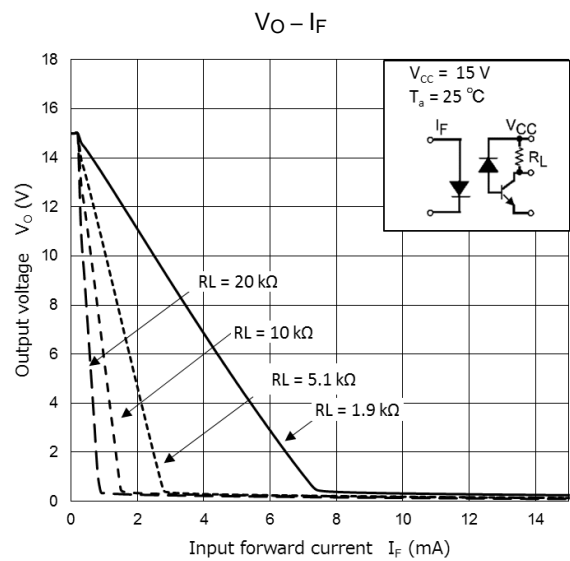
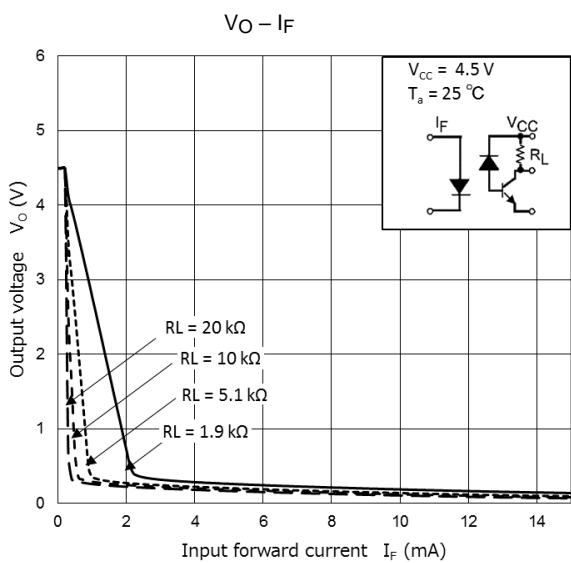
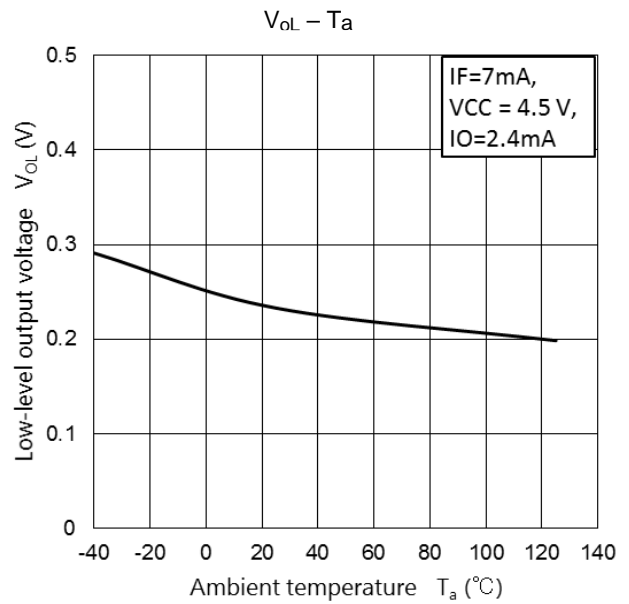
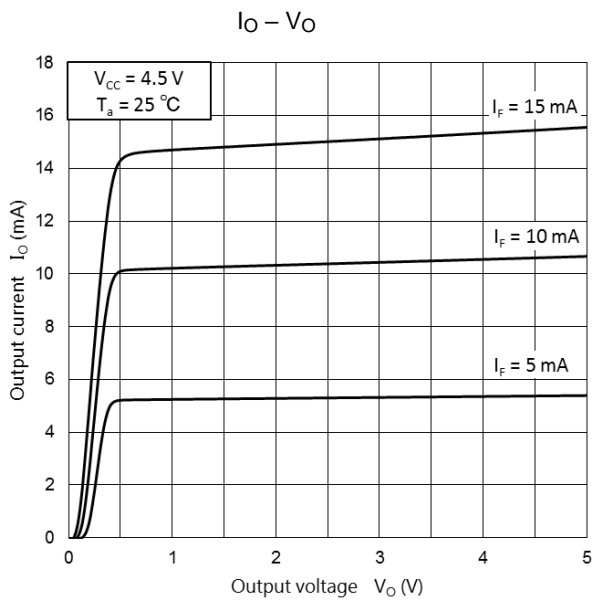
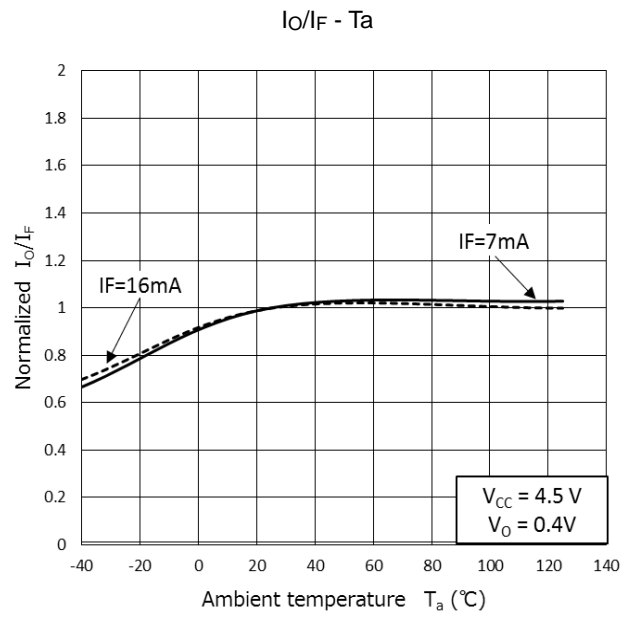
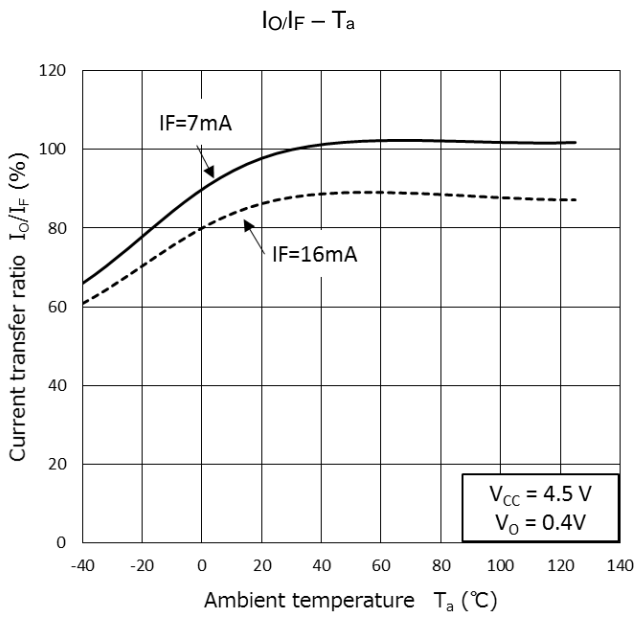
**Test Circuit 1: Switching Time Test Circuit**

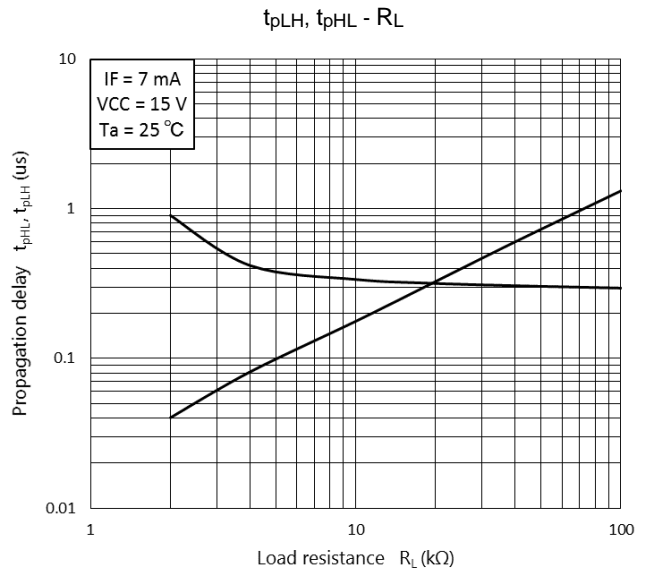
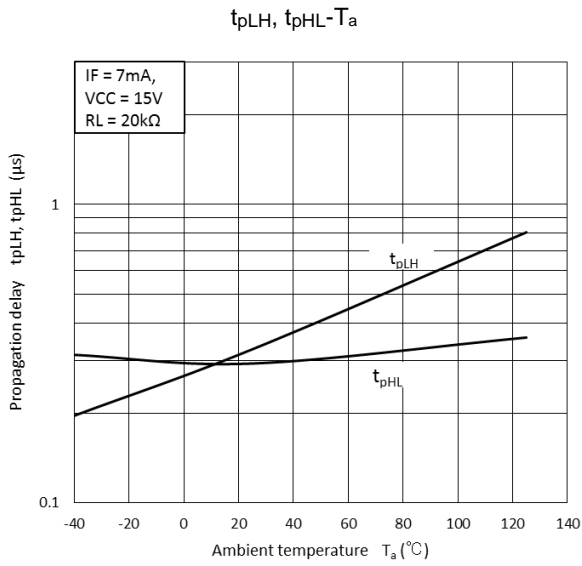


**Test Circuit 2: Common Mode Noise Immunity Test Circuit**









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



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