



TOSHIBA Photocoupler GaAlAs IRED + Photo IC

# TLP350

Industrial Inverter  
 Inverter for Air Conditioner  
 IGBT/Power MOSFET Gate Drive  
 IH (Induction Heating)

The TOSHIBA TLP350 consists of a GaAlAs light-emitting diode and an integrated photodetector.

This unit is an 8-lead DIP package.

The TLP350 is suitable for gate driving IGBTs or power MOSFETs.

- Peak output current :  $I_O = \pm 2.5A$  (max)
- Guaranteed performance over temperature :  $-40$  to  $100^\circ C$
- Supply current :  $I_{CC} = 2$  mA (max)
- Power supply voltage:  $V_{CC} = 15$  to  $30$  V
- Threshold input current :  $I_{FLH} = 5$  mA (max)
- Switching time ( $t_{pLH}/t_{pHL}$ ) : 500 ns (max)
- Common mode transient immunity : 15 kV/ $\mu s$
- Isolation voltage : 3750 Vrms
- UL Recognized : UL1577,File No.E67349
- Option(D4)

VDE Approved : DIN EN 60747-5-2

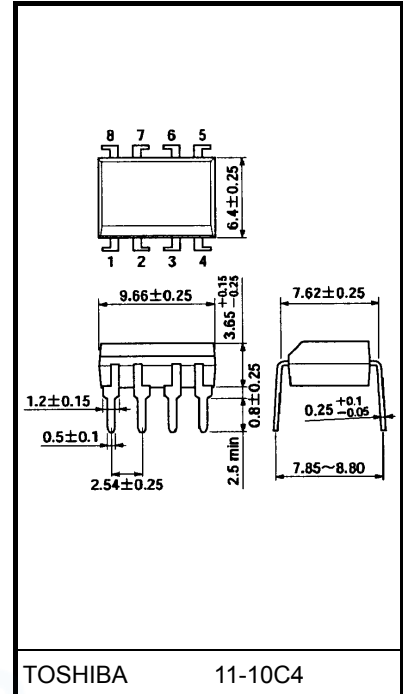
Maximum Operating Insulation Voltage : 890V<sub>PK</sub>

Highest Permissible Over Voltage : 6000V<sub>PK</sub>

(Note):When a EN 60747-5-2 approved type is needed,

Please designate "Option(D4)"

Unit: mm

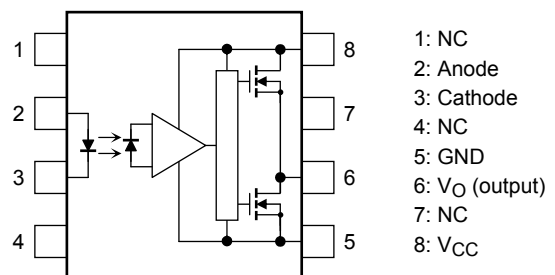


Weight: 0.54 g (typ.)

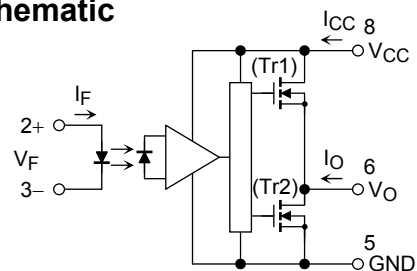
## Truth Table

Input	LED	Tr1	Tr2	Output
H	ON	ON	OFF	H
L	OFF	OFF	ON	L

## Pin Configuration (top view)



## Schematic



A 0.1  $\mu F$  bypass capacitor must be connected between pins 8 and 5. (See Note 6)



**Absolute Maximum Ratings (Ta = 25°C)**

Characteristic		Symbol	Rating	Unit
LED	Forward current	I <sub>F</sub>	20	mA
	Forward current derating (Ta ≥ 85°C)	ΔI <sub>F</sub> /ΔTa	-0.54	mA/°C
	Peak transient forward current (Note 1)	I <sub>FPT</sub>	1	A
	Reverse voltage	V <sub>R</sub>	5	V
	Junction temperature	T <sub>j</sub>	125	°C
Detector	"H" peak output current	I <sub>OPH</sub>	-2.5	A
	"L" peak output current			
	Supply voltage	V <sub>CC</sub>	35	V
	Supply voltage Derating	ΔV <sub>CC</sub> /ΔTa	-1.0	V/°C
	Junction temperature	T <sub>j</sub>	125	°C
Operating frequency (Note 3)		f	50	kHz
Storage temperature range		T <sub>stg</sub>	-55 to 125	°C
Operating temperature range		T <sub>opr</sub>	-40 to 100	°C
Lead soldering temperature (10 s) (Note 4)		T <sub>sol</sub>	260	°C
Isolation voltage (AC, 1 minute, R.H. ≤ 60%) (Note 5)		BV <sub>S</sub>	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: Pulse width P<sub>W</sub> ≤ 1 μs, 300 pps

Note 2: Exponential waveform pulse width P<sub>W</sub> ≤ 0.3μs, f ≤ 15 kHz

Note 3: Exponential waveform I<sub>OPH</sub> ≥ -2.0A (≤ 0.3μs), I<sub>OPL</sub> ≤ 2.0A (≤ 0.3μs)

Note 4: At 2 mm or more from the lead root.

Note 5: This device is regarded as a two terminal device: pins 1, 2, 3 and 4 are shorted together, as are pins 5, 6, 7 and 8.

Note 6: A ceramic capacitor (0.1 μF) should be connected from pin 8 to pin 5 to stabilize the operation of the high gain linear amplifier. Failure to provide the bypass may impair the switching property.  
The total lead length between capacitor and coupler should not exceed 1 cm.

**Recommended Operating Conditions**

Characteristic	Symbol	Min	Typ.	Max	Unit
Input current, ON (Note 7)	I <sub>F</sub> (ON)	7.5	—	10	mA
Input voltage, OFF	V <sub>F</sub> (OFF)	0	—	0.8	V
Supply voltage	V <sub>CC</sub>	15	—	30	V
Peak output current	I <sub>OPH</sub> /I <sub>OPL</sub>	—	—	±2.0	A
Operating temperature	T <sub>opr</sub>	-40	—	100	°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 7: Input signal rise time (fall time) < 0.5 μs.

Note 8: If the rising slope of the supply voltage (V<sub>CC</sub>) for the detector is steep, stable operation of the internal circuits cannot be guaranteed.  
Be sure to set 3.0V/μs or less for a rising slope of the V<sub>CC</sub>.



**Electrical Characteristics (Ta = -40 to 100°C, unless otherwise specified)**

Characteristic	Symbol	Test Circuit	Test Conditions	Min	Typ.*	Max	Unit		
Forward voltage	V <sub>F</sub>	—	I <sub>F</sub> = 10 mA, Ta = 25°C	—	1.6	1.8	V		
Temperature coefficient of forward voltage	ΔV <sub>F</sub> /ΔTa	—	I <sub>F</sub> = 10 mA	—	-2.0	—	mV/°C		
Input reverse current	I <sub>R</sub>	—	V <sub>R</sub> = 5 V, Ta = 25°C	—	—	10	μA		
Input capacitance	C <sub>T</sub>	—	V = 0, f = 1 MHz, Ta = 25°C	—	45	250	pF		
Output current (Note 9)	“H” Level	I <sub>OPH</sub>	1	V <sub>CC</sub> = 30 V, I <sub>F</sub> = 5 mA V <sub>8-6</sub> = 3.5 V	—	-1.6	-1.0	A	
				V <sub>CC</sub> = 15 V, I <sub>F</sub> = 5 mA V <sub>8-6</sub> = 7.0 V	—	—	-2.0		
	“L” Level	I <sub>OPL</sub>	2	V <sub>CC</sub> = 30 V, I <sub>F</sub> = 0 mA V <sub>6-5</sub> = 2.5V	1.0	1.6	—		
				V <sub>CC</sub> = 15 V, I <sub>F</sub> = 0 mA V <sub>6-5</sub> = 7.0V	2.0	—	—		
Output voltage	“H” Level	V <sub>OH</sub>	3	V <sub>CC</sub> 1= +15 V V <sub>EE</sub> 1= +15 V	I <sub>F</sub> = 5 mA V <sub>F</sub> = 0.8 V	11	13.7	—	V
	“L” Level	V <sub>OL</sub>	4	R <sub>L</sub> = 200 Ω		—	-14.9	-12.5	
Supply current	“H” Level	I <sub>CCH</sub>	5	V <sub>CC</sub> = 30 V V <sub>O</sub> open	I <sub>F</sub> = 10 mA	—	1.3	2.0	mA
	“L” Level	I <sub>CCL</sub>	6		I <sub>F</sub> = 0 mA	—	1.3	2.0	
Threshold input current	L → H	I <sub>FLH</sub>	—	V <sub>CC</sub> = 15V, V <sub>O</sub> > 1V, I <sub>O</sub> = 0mA	—	1.8	5	mA	
Threshold input voltage	H → L	V <sub>FHL</sub>	—	V <sub>CC</sub> = 15V, V <sub>O</sub> < 1V, I <sub>O</sub> = 0mA	0.8	—	—	V	
Supply voltage	V <sub>CC</sub>	—	—	—	15	—	30	V	
UVLO threshold	V <sub>UVLO+</sub>	—	V <sub>O</sub> > 2.5 V, I <sub>F</sub> = 5 mA	—	11.0	12.5	13.5	V	
	V <sub>UVLO-</sub>	—		—	9.5	11.0	12.0	V	
UVLO hysteresis	UVLO <sub>HYS</sub>	—	—	—	—	1.5	—	V	

\*: All typical values are at Ta = 25°C

Note 9: Duration of I<sub>O</sub> : ≤ 50 μs (1 PULSE)

Note 10: This product is more sensitive to static electricity (ESD) than the conventional product because of its minimal power consumption design.

General static electricity precautions are necessary for handling this component.

**Isolation Characteristics (Ta = 25°C)**

Characteristic	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Capacitance input to output	C <sub>S</sub>	V = 0, f = 1MHz (Note5)	—	1.0	—	pF
Isolation resistance	R <sub>S</sub>	V <sub>S</sub> = 500 V, R.H. ≤ 60% (Note5)	1×10 <sup>12</sup>	10 <sup>14</sup>	—	Ω
Isolation voltage	BV <sub>S</sub>	AC, 1 minute	3750	—	—	V <sub>rms</sub>
		AC, 1 second, in oil	—	10000	—	
		DC, 1 minute, in oil	—	10000	—	V <sub>dc</sub>

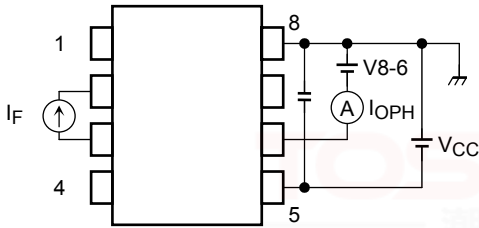


**Switching Characteristics (Ta = -40 to 100°C, unless otherwise specified)**

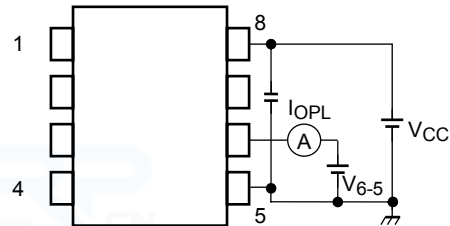
Characteristic	Symbol	Test Circuit	Test Conditions	Min	Typ.*	Max	Unit	
Propagation delay time	L → H	7	V <sub>CC</sub> = 30 V R <sub>g</sub> = 20 Ω C <sub>g</sub> = 10 nF	I <sub>F</sub> = 0 → 5 mA	50	260	500	ns
	H → L			I <sub>F</sub> = 5 → 0 mA	50	260	500	
Switching Time Dispersion between ON and OFF	t <sub>pHL</sub> - t <sub>pLH</sub>	7	V <sub>CC</sub> = 30 V R <sub>g</sub> = 20 Ω, C <sub>g</sub> = 10 nF	—	—	350		
Output rise time (10-90%)	t <sub>r</sub>	7	V <sub>CC</sub> = 30 V R <sub>g</sub> = 20 Ω C <sub>g</sub> = 10 nF	I <sub>F</sub> = 0 → 5 mA	—	15	—	
Output fall time (90-10%)	t <sub>f</sub>			I <sub>F</sub> = 5 → 0 mA	—	8	—	
Common mode transient immunity at high level output	CM <sub>H</sub>	8	V <sub>CM</sub> = 1000 V <sub>p-p</sub> Ta = 25°C V <sub>CC</sub> = 30 V	I <sub>F</sub> = 5 mA V <sub>O</sub> (min) = 26V	-15000	—	—	
Common mode transient immunity at low level output	CM <sub>L</sub>			I <sub>F</sub> = 0 mA V <sub>O</sub> (max) = 1V	15000	—	—	

\*: All typical values are at Ta = 25°C

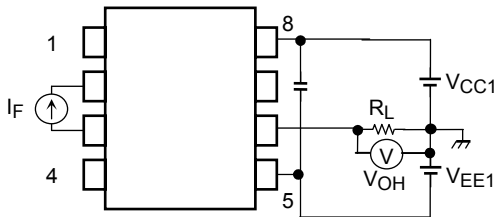
**Test Circuit 1: I<sub>OPH</sub>**



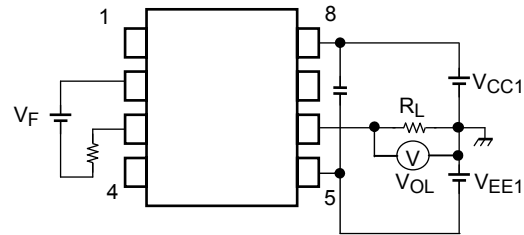
**Test Circuit 2: I<sub>OPL</sub>**



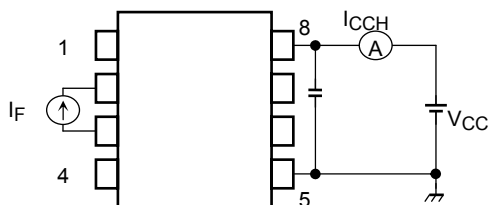
**Test Circuit 3: V<sub>OH</sub>**



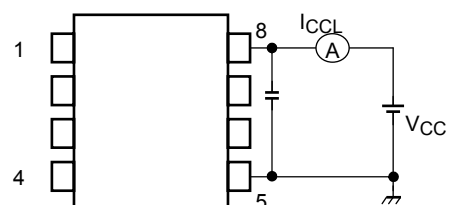
**Test Circuit 4: V<sub>OL</sub>**



**Test Circuit 5: I<sub>CCH</sub>**

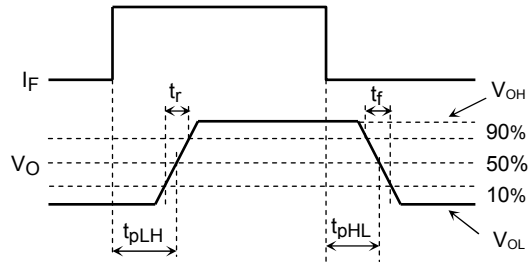
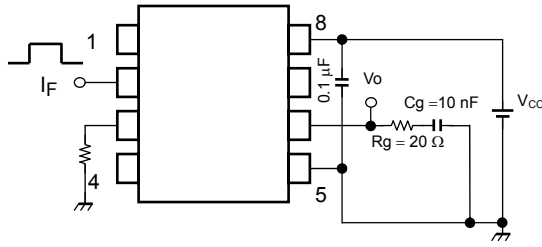


**Test Circuit 6: I<sub>CCL</sub>**

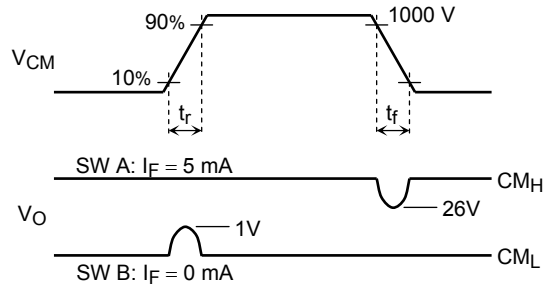
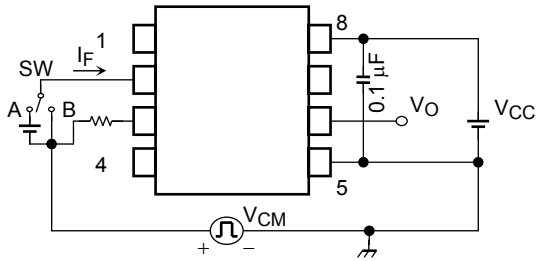




Test Circuit 7:  $t_{pLH}$ ,  $t_{pHL}$ ,  $t_r$ ,  $t_f$ , PDD

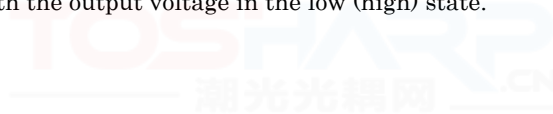


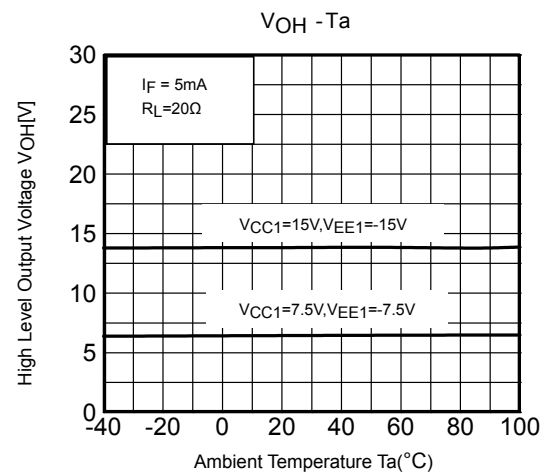
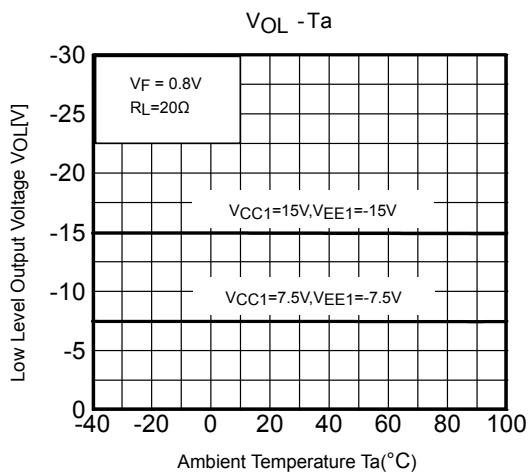
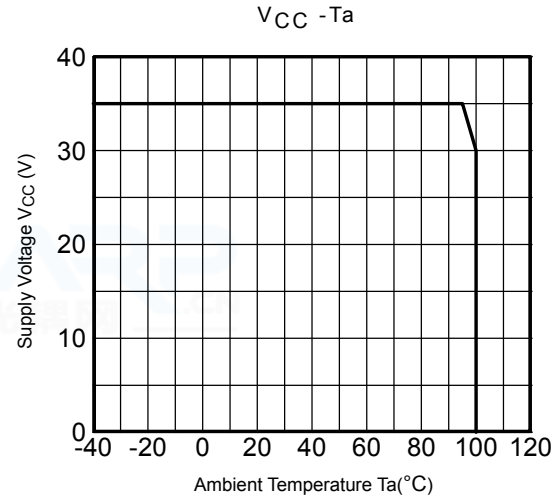
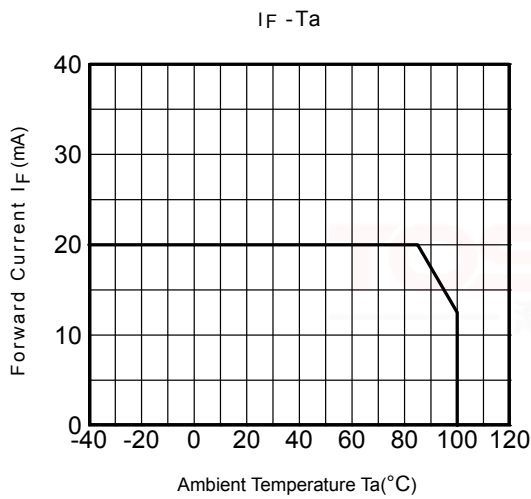
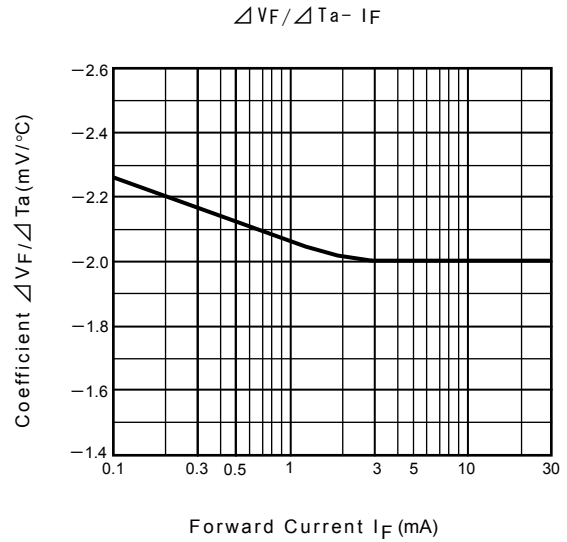
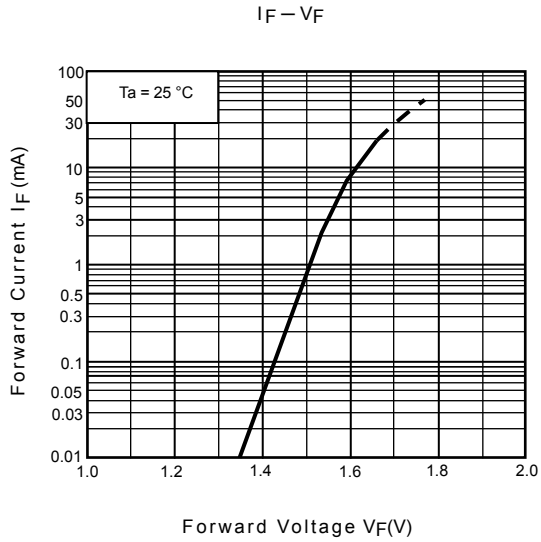
Test Circuit 8:  $CM_H$ ,  $CM_L$



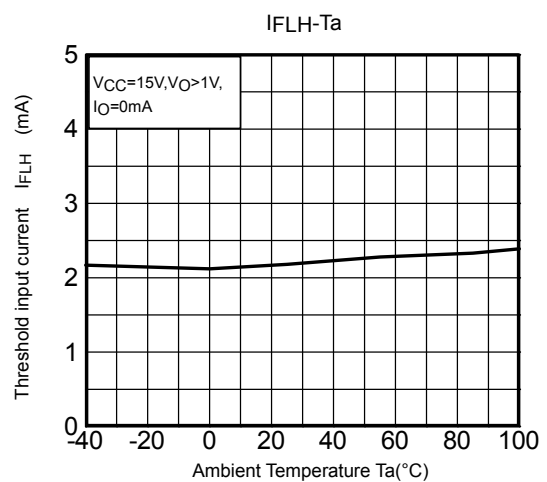
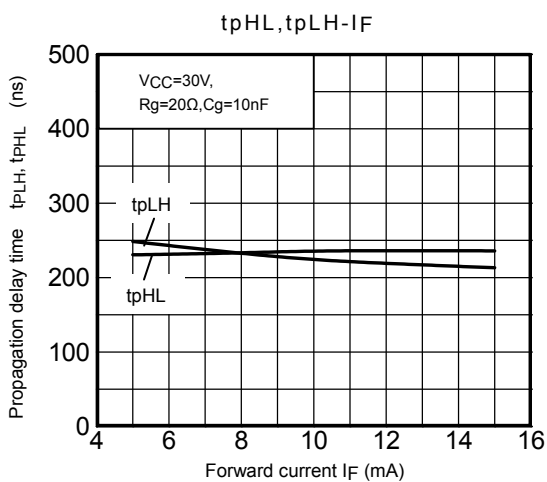
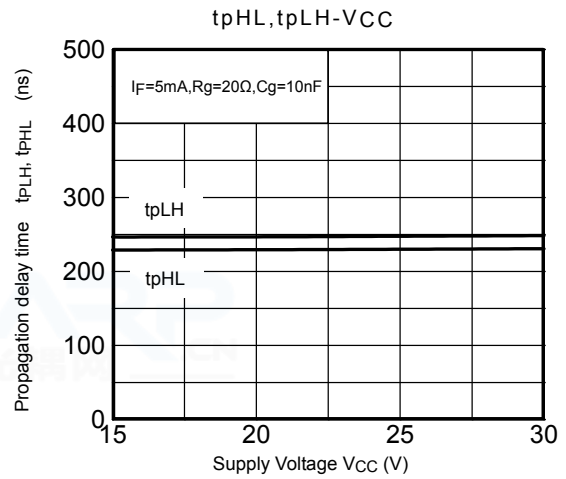
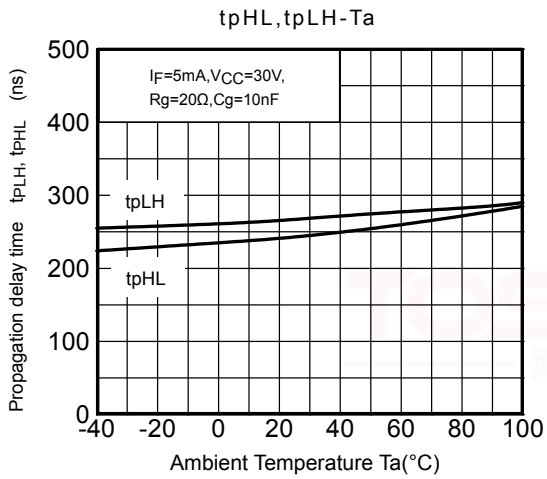
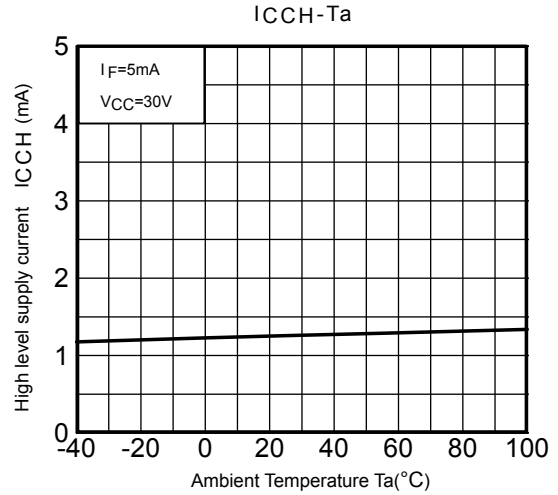
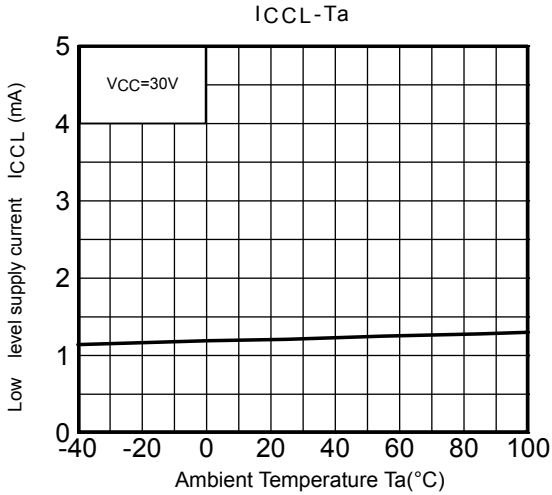
$$CM_L = \frac{800(V)}{t_r(\mu s)} \quad CM_H = \frac{800(V)}{t_f(\mu s)}$$

$CM_L$  ( $CM_H$ ) is the maximum rate of rise (fall) of the common mode voltage that can be sustained with the output voltage in the low (high) state.

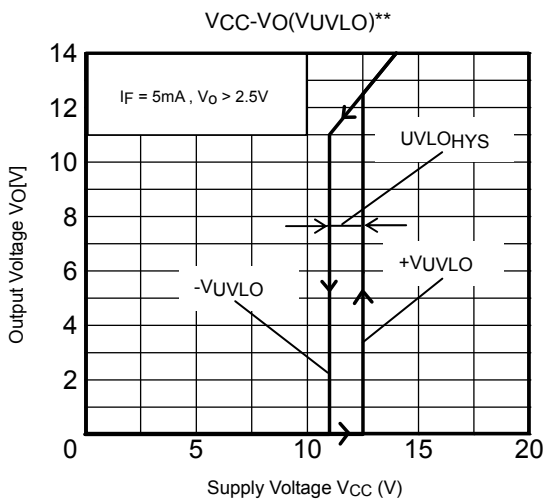
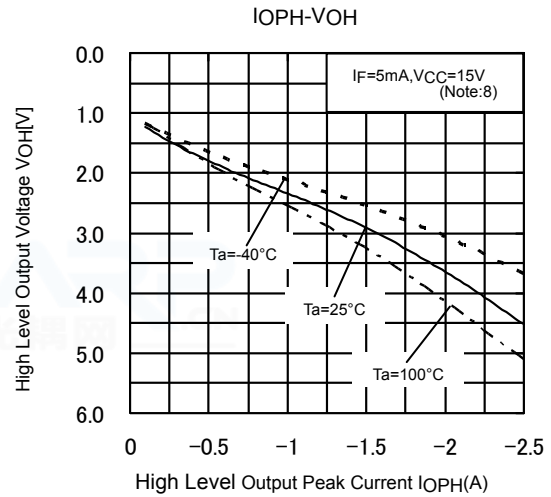
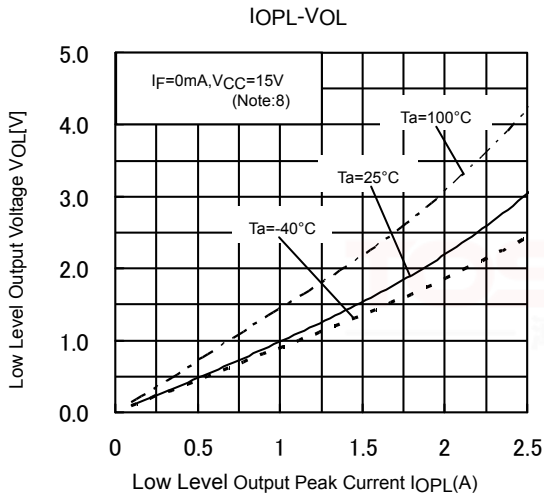
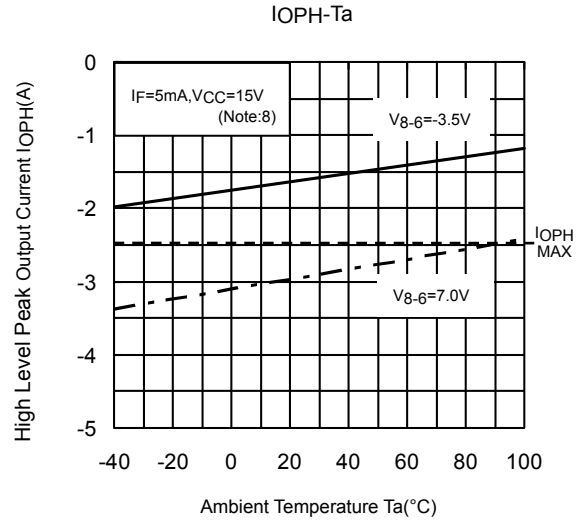
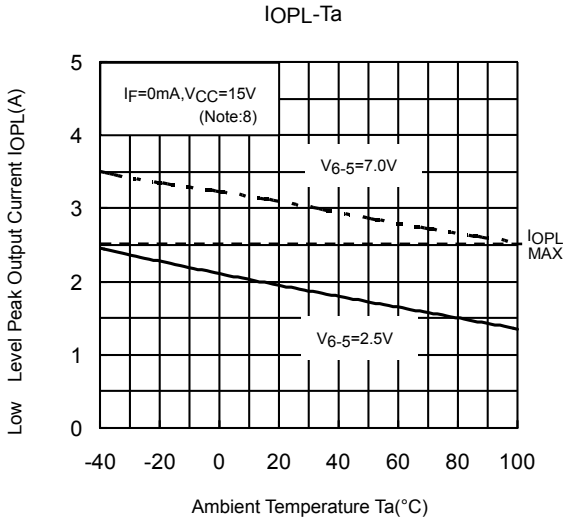




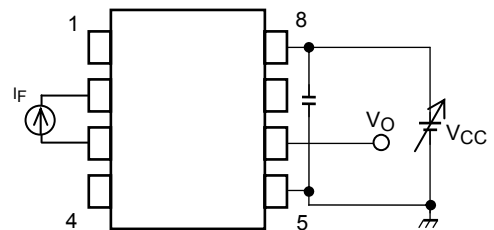
\*: The above graphs show typical characteristics.



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\*\*Test Circuit : VCC-VO(VUVLO)



\*: The above graphs show typical characteristics.





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