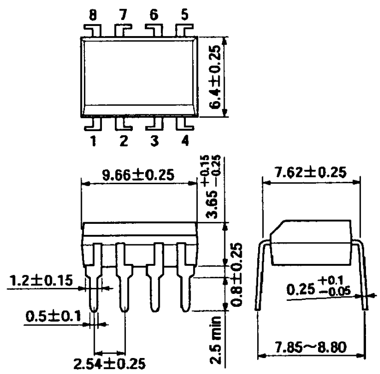
TOSHIBA Photocoupler GaAℓAs IRED + Photo IC

TLP351

Inverter for Air Conditioner
IGBT/Power MOS FET Gate Drive
Industrial Inverter

Unit: mm



TOSHIBA 11-10C4

Weight: 0.54 g (typ.)

The TOSHIBA TLP351 consists of a GaAℓAs light emitting diode and a integrated photodetector.
This unit is 8-lead DIP package.
TLP351 is suitable for gate driving circuit of IGBT or power MOS FET.
Especially TLP351 is capable of "direct" gate drive of lower Power IGBTs.

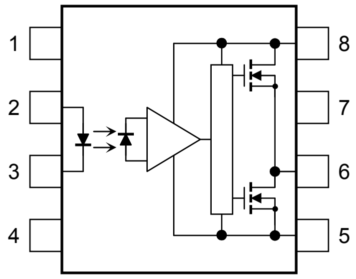
- Peak output current: ±0.6 A (max)
- Guaranteed performance over temperature: −40 to 100°C
- Supply current: 2 mA (max)
- Power supply voltage: 10 to 30 V
- Threshold input current : I_F = 5 mA (max)
- Switching time (t_{pLH}/t_{pHL}) : 700 ns (max)
- Common mode transient immunity: 10 kV/μs
- Isolation voltage: 3750 Vrms
- Option(D4)
  VDE Approved : DIN EN60747-5-2
  Maximum Operating Insulation Voltage : 890V_{PK}
  Highest Permissible Over Voltage : 4000V_{PK}

(Note):When a EN60747-5-2 approved type is needed,
Please designate "Option(D4)"

Truth Table

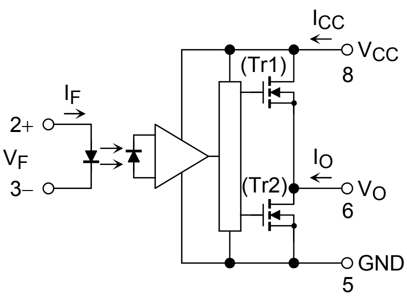
Input	LED	Tr1	Tr2	Output
H	ON	ON	OFF	H
L	OFF	OFF	ON	L

Pin Configuration (top view)



1: NC
2: Anode
3: Cathode
4: NC
5: GND
6: V_O (output)
7: NC
8: V_{CC}

Schematic



A 0.1 μF bypass capacitor must be connected between pin 8 and 5.

Absolute Maximum Ratings (Ta = 25°C)

	Characteristics		Symbol	Rating	Unit
LED	Forward current		I_F	20	mA
	Forward current derating (Ta ≥ 85°C)		$\Delta I_F/\Delta Ta$	−0.54	mA/°C
	Peak transient forward current	(Note 1)	I_{FP}	1	A
	Reverse voltage		V_R	5	V
	Junction temperature		T_j	125	°C
Detector	"H" peak output current	(Note 2)	I_{OPH}	−0.6	A
	"L" peak output current	(Note 2)	I_{OPL}	0.6	A
	Output voltage		V_O	35	V
	Supply voltage		V_{CC}	35	V
	Junction temperature		T_j	125	°C
Operating frequency		(Note 3)	f	25	kHz
Storage temperature range			T_{stg}	−55 to 125	°C
Operating temperature range			T_{opr}	−40 to 100	°C
Lead soldering temperature (10 s)		(Note 4)	T_{sol}	260	°C
Isolation voltage (AC, 1 minute, R.H. ≤ 60%)		(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: Pulse width P_W ≤ 1 μs, 300 pps

Note 2: Exponential waveform pulse width P_W ≤ 10 μs, f ≤ 15 kHz

Note 3: Exponential waveform I_{OPH} ≤ −0.4 A (≤ 2.0 μs), I_{OPL} ≤ +0.4 A (≤ 2.0 μs),Ta = 100°C

Note 4: It is 2 mm or more from a lead root.

Note 5: Device considered a two terminal device: pins 1, 2, 3 and 4 shorted together, and pins 5, 6, 7 and 8 shorted together.

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 bypassing may impair the switching property.
The total lead length between capacitor and coupler should not exceed 1 cm.

Recommended Operating Conditions

Characteristics		Symbol	Min	Typ.	Max	Unit
Input current, ON	(Note 7)	$I_{F\ (ON)}$	7.5	—	10	mA
Input voltage, OFF		$V_{F\ (OFF)}$	0	—	0.8	V
Supply voltage		V_{CC}	10	—	30	V
Peak output current		I_{OPH}/I_{OPL}	—	—	±0.2	A
Operating temperature		T_{opr}	−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.

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

Characteristics		Symbol	Test Circuit	Test Condition		Min	Typ.*	Max	Unit
Forward voltage		V_F	—	I_F = 5 mA, Ta = 25°C		—	1.55	1.70	V
Temperature coefficient of forward voltage		$\Delta V_F/\Delta Ta$	—	I_F = 5 mA		—	−2.0	—	mV/°C
Input reverse current		I_R	—	V_R = 5 V, Ta = 25°C		—	—	10	μA
Input capacitance		C_T	—	V = 0 , f = 1 MHz,Ta = 25°C		—	45	—	pF
Output current (Note 8)	"H" Level	I_{OPH1}	1	V_{CC} = 15 V, I_F = 5 mA	$V_{8\text{-}6}$ = 4 V	—	−0.4	−0.2	A
		I_{OPH2}			$V_{8\text{-}6}$ = 10 V	—	−0.67	−0.4	
	"L" Level	I_{OPL1}	2	V_{CC} = 15 V, I_F = 0 mA	$V_{6\text{-}5}$ = 2 V	0.2	0.35	—	
		I_{OPL2}			$V_{6\text{-}5}$ = 10 V	0.4	0.63	—	
Output voltage	"H" Level	V_{OH}	3	V_{CC} = 10 V	I_O = −100 mA, I_F = 5 mA	6.0	8.5	—	V
	"L" Level	V_{OL}	4		I_O = 100 mA, V_F = 0.8 V	—	0.4	1.0	
Supply current	"H" Level	I_{CCH}	5	V_{CC} = 10 to 30 V, V_O open	I_F = 10 mA	—	1.4	2.0	mA
	"L" Level	I_{CCL}	6		I_F = 0 mA	—	1.3	2.0	
Threshold input current	L → H	I_{FLH}	—	V_{CC} = 15 V, V_O > 1 V		—	2.5	5	mA
Threshold input voltage	H → L	V_{FHL}	—	V_{CC} = 15 V, V_O < 1 V		0.8	—	—	V
Supply voltage		V_{CC}	—	—		10	—	30	V

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

Note 8: Duration of I_O time ≤ 50 μs

Note 9: This product is more sensitive than the conventional product to static electricity (ESD) because of a lowest power consumption design.
General precaution to static electricity (ESD) is necessary for handling this component.

Isolation Characteristics (Ta = 25°C)

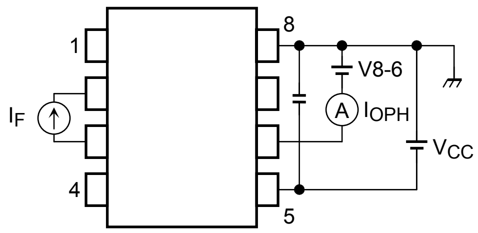
Characteristic	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Capacitance input to output	C_S	V = 0,f = 1MHz (Note5)	—	1.0	—	pF
Isolation resistance	R_S	V_S = 500 V, Ta = 25°C, R.H. ≤ 60% (Note5)	1×10^{12}	10^{14}	—	Ω
Isolation voltage	BV_S	AC,1 minute	3750	—	—	V_{rms}
		AC,1 second,in oil	—	10000	—	
		DC,1 minute,in oil	—	10000	—	Vdc

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

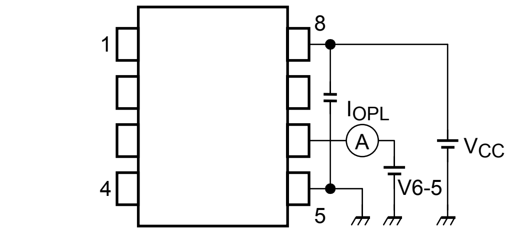
Characteristics		Symbol	Test Circuit	Test Condition		Min	Typ.*	Max	Unit
Propagation delay time	L → H	t_{pLH}	7	V_{CC} = 30 V, R_g = 47 Ω, C_g = 3 nF	I_F = 0 → 5 mA	100	—	700	ns
	H → L	t_{pHL}	7		I_F = 5 → 0 mA	100	—	700	ns
Propagation delay difference between any two parts or channels		PDD $\lvert t_{pHL}-t_{pLH}\rvert$	7	V_{CC} = 30 V, R_g = 47 Ω, C_g = 3 nF		−500	—	500	ns
Output rise time (10-90%)		t_r	7	V_{CC} = 30 V, R_g = 47 Ω, C_g = 3 nF	I_F = 0 → 5 mA	—	50	—	ns
Output fall time (90-10%)		t_f	7		I_F = 5 → 0 mA	—	50	—	ns
Common mode transient immunity at high level output		CM_H	8	V_{CM} = 1000 Vp-p, Ta = 25°C, V_{CC} = 30 V	I_F = 5 mA, $V_{O\,(min)}$ = 26 V	−10000	—	—	V/μs
Common mode transient immunity at low level output		CM_L	8		I_F = 0 mA, $V_{O\,(max)}$ = 1 V	10000	—	—	V/μs

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

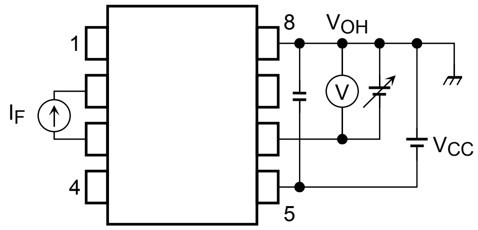
Test Circuit 1: I_{OPH}



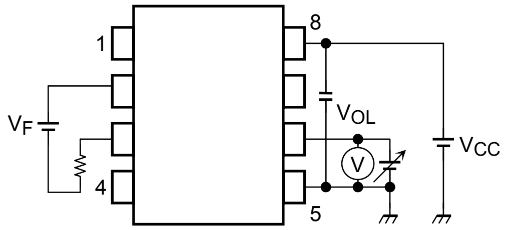
Test Circuit 2: I_{OPL}



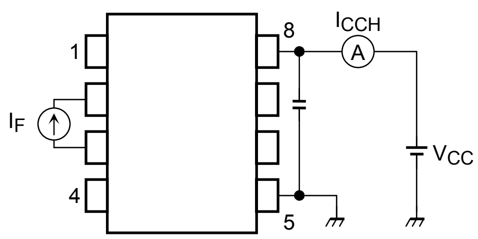
Test Circuit 3: V_{OH}



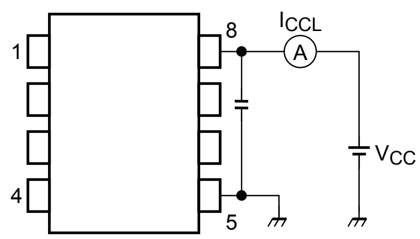
Test Circuit 4: V_{OL}



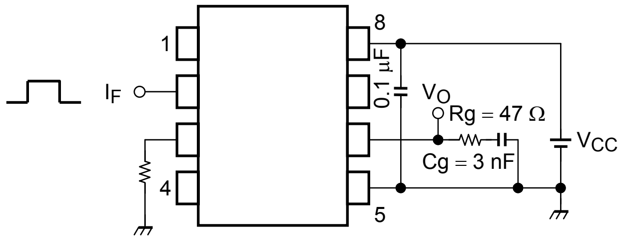
Test Circuit 5: I_{CCH}

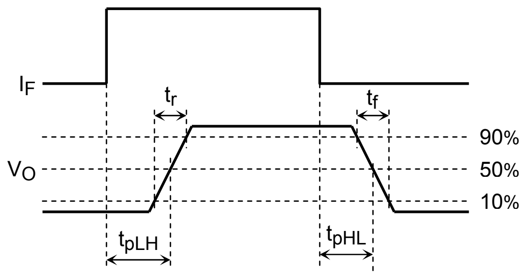


Test Circuit 6: I_{CCL}

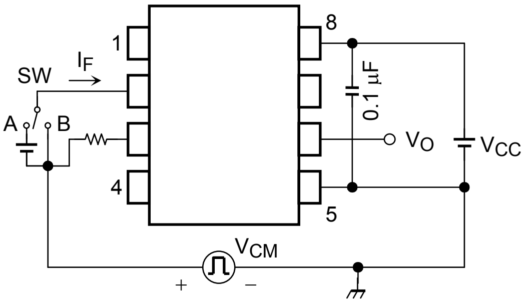


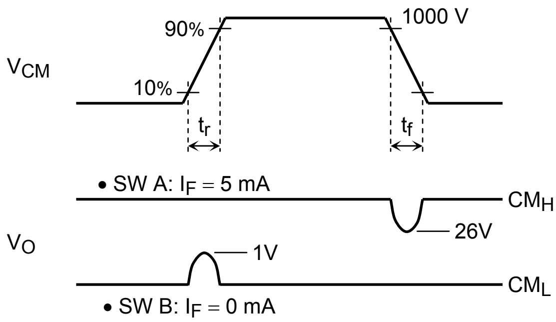
Test Circuit 7: t_{pLH}, t_{pHL}, t_r, t_f, PDD





Test Circuit 8: CM_H, CM_L



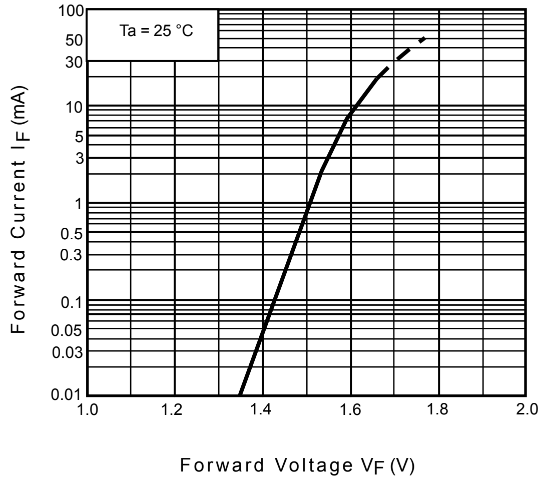


$$CM_L = \frac{800\ V}{t_r\ (\mu s)}$$

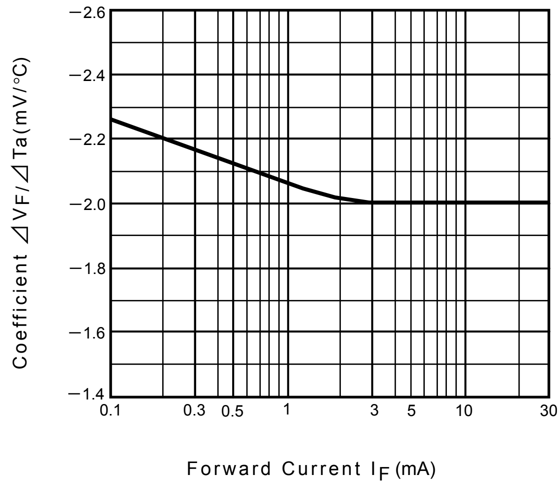
$$CM_H = \frac{800\ V}{t_f\ (\mu s)}$$

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.

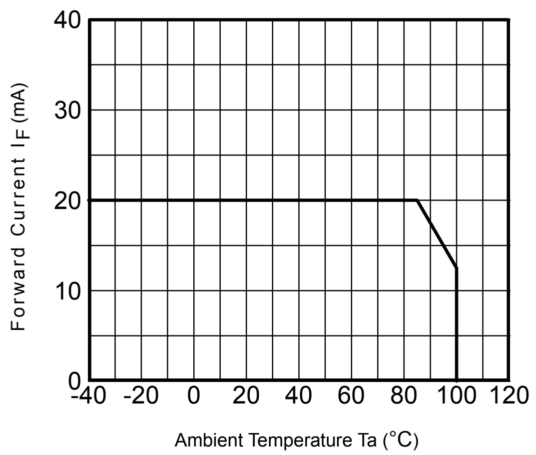
$I_F - V_F$



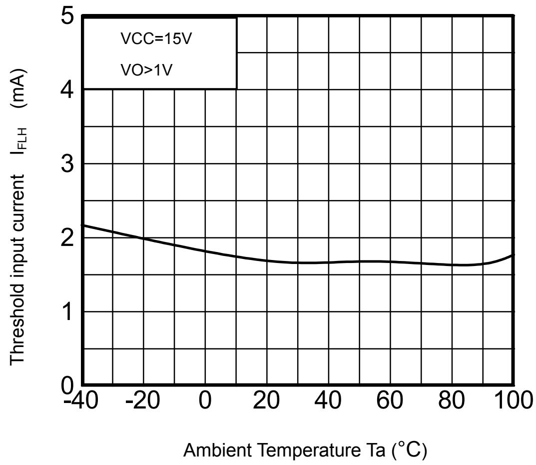
$\Delta V_F / \Delta Ta - I_F$



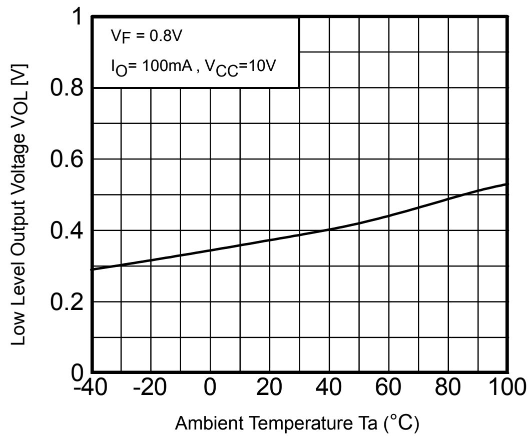
I_F - Ta



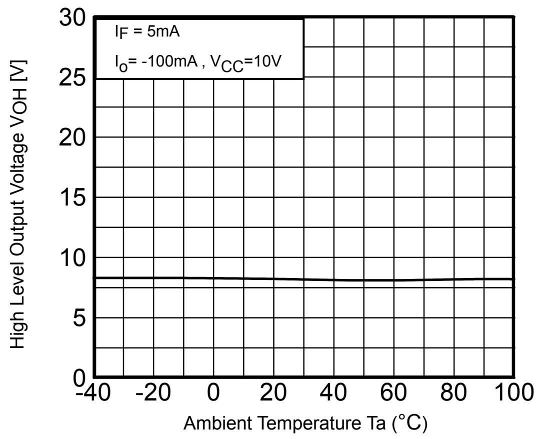
I_{FLH} – Ta



V_{OL} - Ta

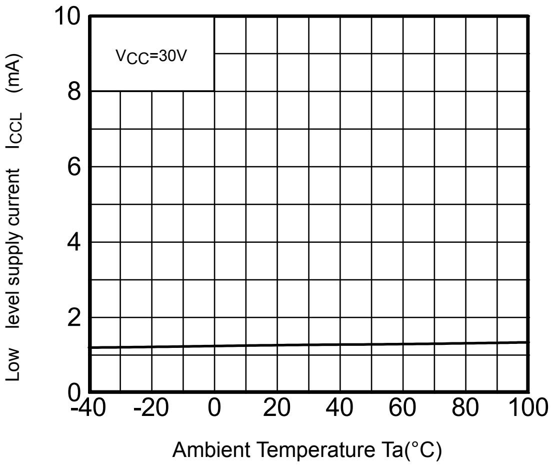


V_{OH} - Ta

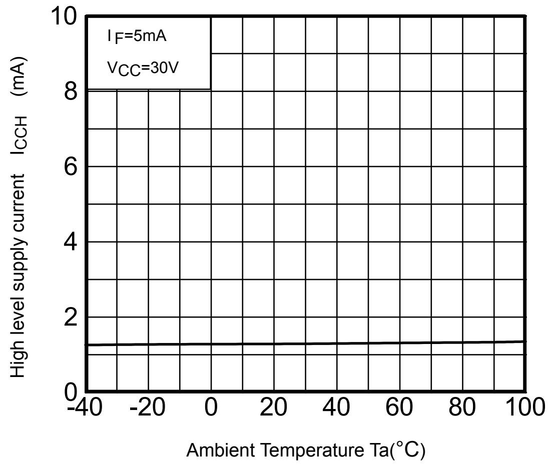


*: The above graphs show typical characteristics.

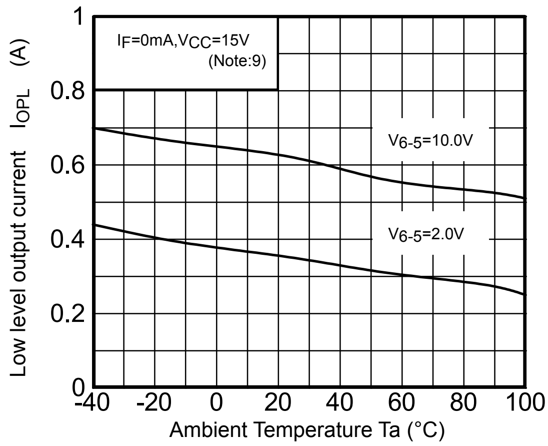
I_{CCL} - Ta



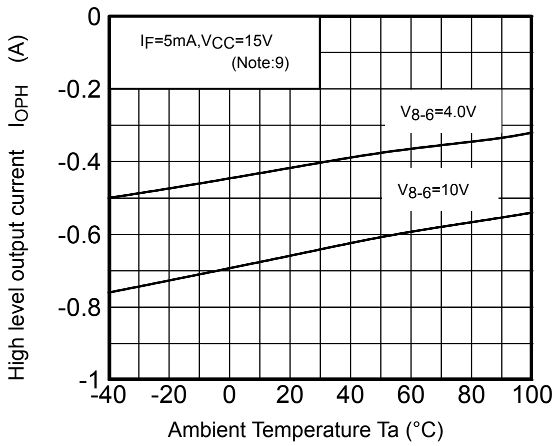
I_{CCH} - Ta



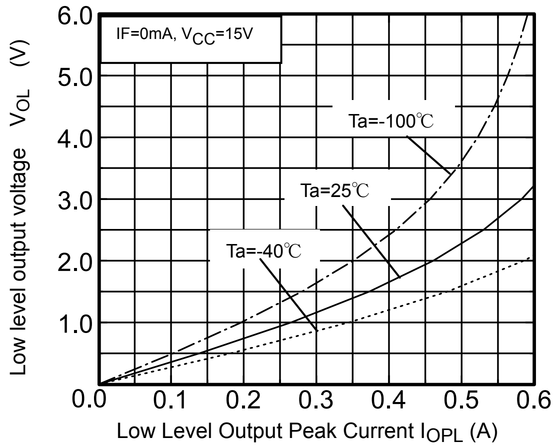
I_{OPL} – Ta



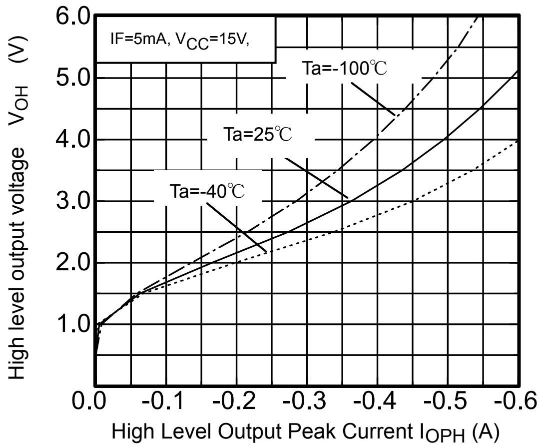
I_{OPH} – Ta



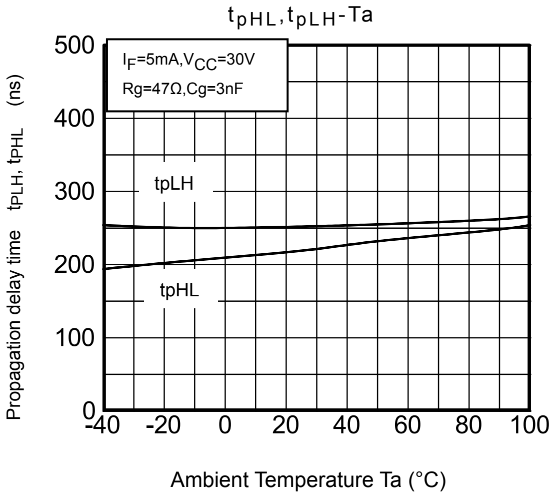
I_{OPL} – V_{OL}



I_{OPH} – V_{OH}



*: The above graphs show typical characteristics.


tpHL,tpLH-Ta
IF=5mA,VCC=30V
Rg=47Ω,Cg=3nF
tpLH
tpHL
Propagation delay time tPLH, tPHL (ns)
500
400
300
200
100
0
-40
-20
0
20
40
60
80
100
Ambient Temperature Ta (°C)

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