TOSHIBA Photocoupler GaAℓAs IRED + Photo IC

TLP701

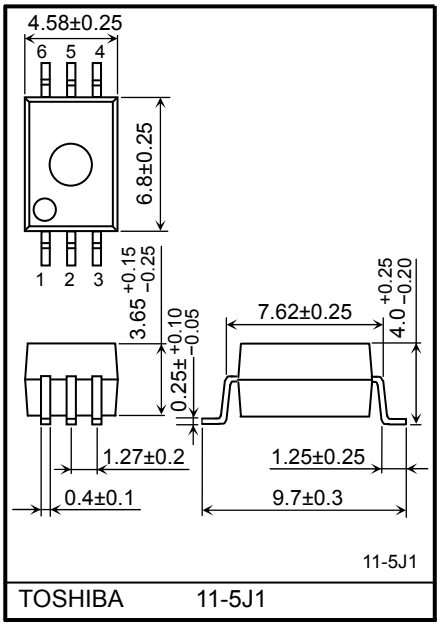
Industrial inverters
Inverter for air conditioners
IGBT/Power MOS FET gate drive

TLP701 consists of a GaAℓAs light-emitting diode and an integrated photodetector.

This unit is 6-lead SDIP package. The TLP701 is 50% smaller than the 8-pin DIP and meets the reinforced insulation class requirements of international safety standards. Therefore the mounting area can be reduced in equipment requiring safety standard certification.

The TLP701 is suitable for gate driving circuits for IGBTs or power MOSFETs. In particular, the TLP701 is capable of “direct” gate driving of low-power IGBTs.

Unit in mm



Weight : 0.26 g (typ.)

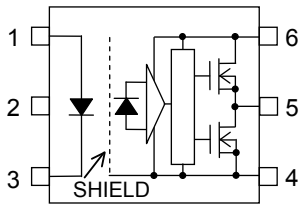
- Peak output current : ±0.6 A (max)
- Guaranteed performance over temperature : −40 to 100°C
- Supply current : 2 mA (max)
- Power supply voltage : 10 to 30 V
- Threshold input current : I_{FLH} = 5 mA (max)
- Switching time (t_{pLH} / t_{pHL}) : 700 ns (max)
- Common mode transient immunity : ±10 kV/μs (min)
- Isolation voltage : 5000 Vrms (min)
- Construction mechanical rating

	7.62-mm pitch standard type	10.16-mm pitch TLPXXXF type
Creepage Distance	7.0 mm (min)	8.0 mm (min)
Clearance	7.0 mm (min)	8.0 mm (min)
Insulation Thickness	0.4 mm (min)	0.4 mm (min)

- UL Recognized : UL1577, File No. E67349
- Option (D4)
  TÜV approved : EN60747-5-2
  Certificate No. R50033433
  Maximum operating insulation voltage : 890 Vpk
  Highest permissible over voltage : 8000 Vpk

(Note) When a EN60747-5-2 approved type is needed, please designate the “Option(D4)”

Pin Configuration (Top View)

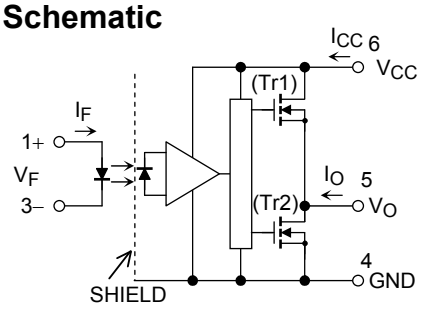


1: ANODE
2: NC
3: CATHODE
4: GND
5: V_O (OUTPUT)
6: V_{CC}

Truth Table

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

Schematic



A 0.1-μF bypass capacitor must be connected between pins 6 and 4. (See Note 6.)

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
Operating temperature range			T_{opr}	−40 to 100	°C
Storage temperature range			T_{stg}	−55 to 125	°C
Lead soldering temperature (10 s)		(Note 4)	T_{sol}	260	°C
Isolation voltage (AC, 1 minute, R.H. ≤ 60%)		(Note 5)	BV_S	5000	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 $P_W \leq 1$ μs, 300 pps

Note 2: Exponential waveform pulse width $P_W \leq 2$ μs, f ≤15 kHz

Note 3: Exponential waveform $I_{OPH} \leq -0.3$ A (≤ 2 μs), $I_{OPL} \leq +0.3$ A (≤ 2 μs),Ta =100 °C

Note 4: For the effective lead soldering area

Note 5: Device considered a two-terminal device: pins 1, 2 and 3 paired with pins 4, 5 and 6 respectively.

Note 6: A ceramic capacitor (0.1 μF) should be connected from pin 6 to pin 4 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 V, 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	$V_{6\text{-}5}$ = 4 V	−0.2	−0.38	—	A
		I_{OPH2}			$V_{6\text{-}5}$ = 10 V	−0.4	−0.60	—	
	"L" Level	I_{OPL1}	2	V_{CC} = 15 V, I_F = 0 mA	$V_{5\text{-}4}$ = 2 V	0.2	0.36	—	
		I_{OPL2}			$V_{5\text{-}4}$ = 10 V	0.4	0.62	—	
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 Io time ≤ 50 μs, 1 pulse

Note 9: This product is more sensitive than conventional products to electrostatic discharge (ESD) owing to its low power consumption design.
It is therefore all the more necessary to observe general precautions regarding ESD when handling this component.

Isolation Characteristics (Ta = 25 °C)

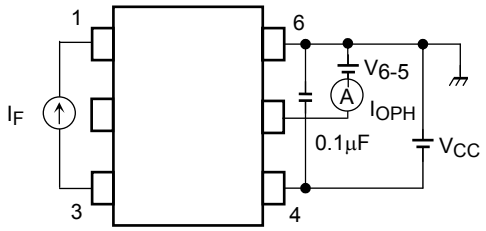
Characteristic	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Capacitance input to output	C_S	V = 0 V , f = 1MHz (Note 5)	—	1.0	—	pF
Isolation resistance	R_S	R.H. ≤ 60 %, V_S = 500 V (Note 5)	1×10^{12}	10^{14}	—	Ω
Isolation voltage	BV_S	AC, 1 minute	5000	—	—	Vrms
		AC, 1 second, in oil	—	10000	—	
		DC, 1 minute, in oil	—	10000	—	Vdc

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

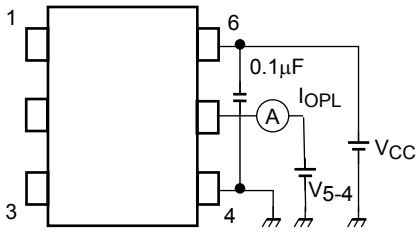
Characteristics		Symbol	Test Circuit	Test Condition		Min	Typ.*	Max	Unit
Propagation delay time	L → H	t_{pLH}	7	V_{CC} = 30 V R_g = 47 Ω C_g = 3 nF	I_F = 0 → 5 mA	100	—	700	ns
	H → L	t_{pHL}			I_F = 5 → 0 mA	100	—	700	
Output rise time (10–90 %)		t_r			I_F = 0 → 5 mA	—	50	—	
Output fall time (90–10 %)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

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

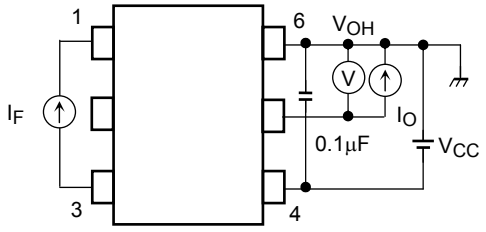
Test Circuit 1: I_{OPH}



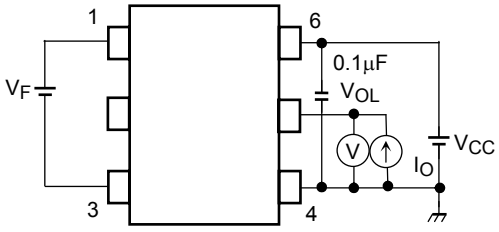
Test Circuit 2: I_{OPL}



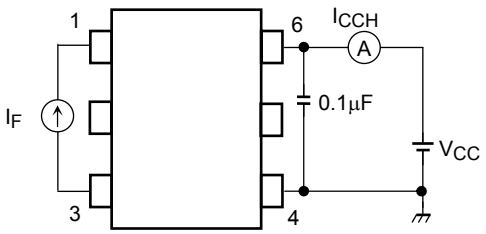
Test Circuit 3: V_{OH}



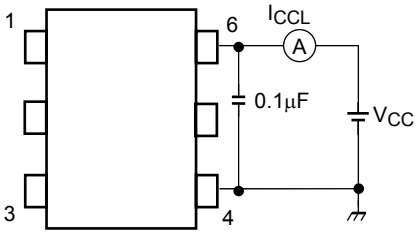
Test Circuit 4: V_{OL}



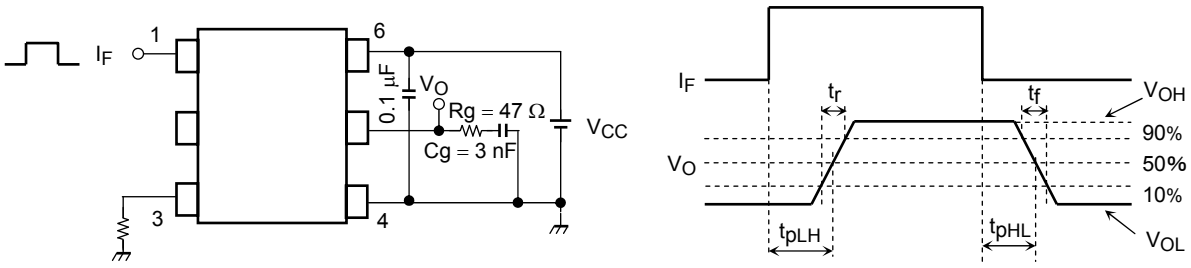
Test Circuit 5: I_{CCH}



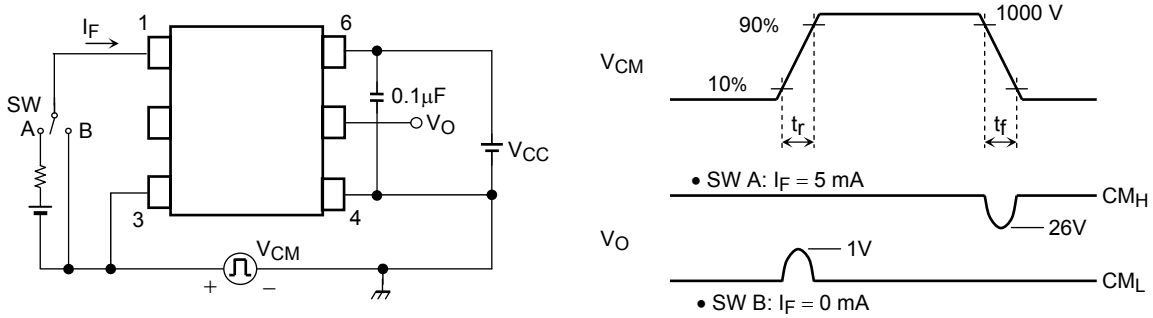
Test Circuit 6: I_{CCL}



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



Test Circuit 8: CM_H, CM_L

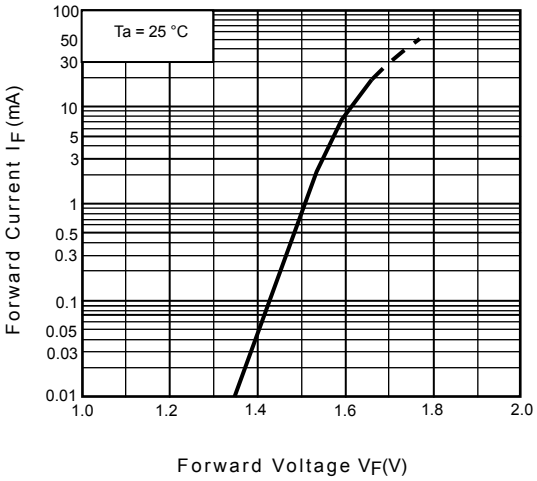


$$CM_L = \frac{800\ V}{t_r\ (\mu s)}$$

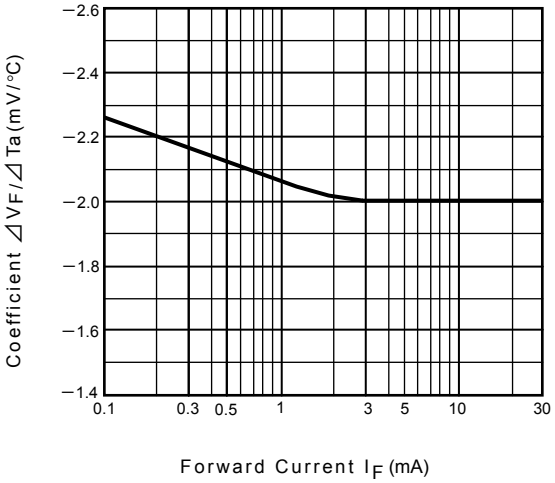
$$CM_H = -\frac{800\ V}{t_f\ (\mu s)}$$

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.

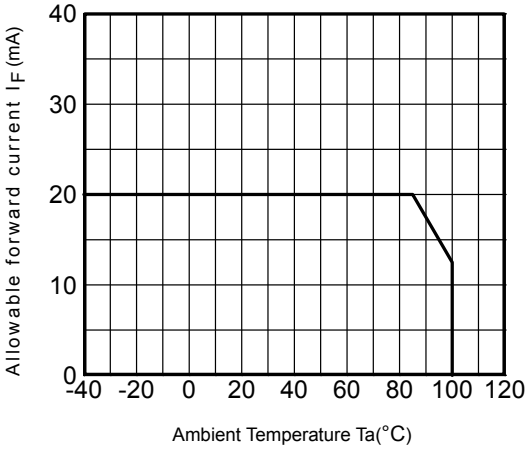
$I_F - V_F$



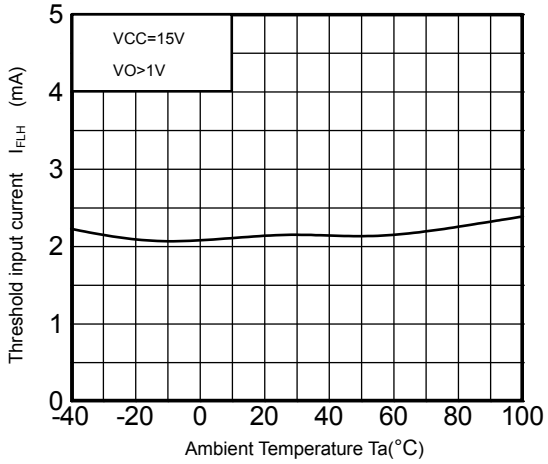
$\Delta V_F / \Delta Ta - I_F$



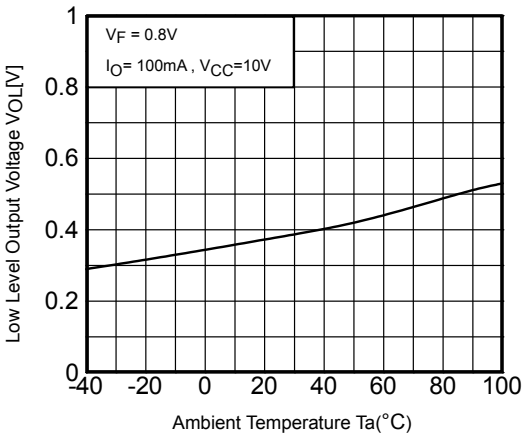
I_F -Ta



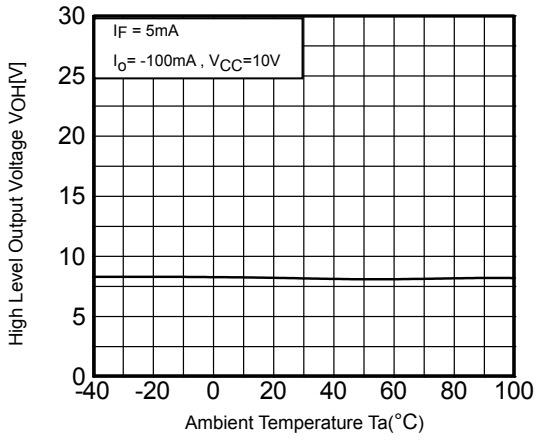
I_{FLH} – Ta



V_{OL} -Ta

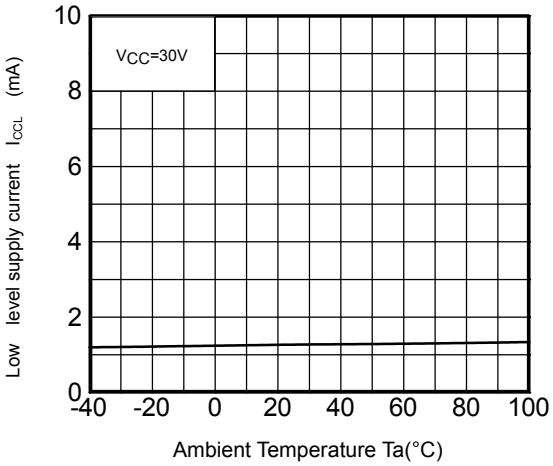


V_{OH} -Ta

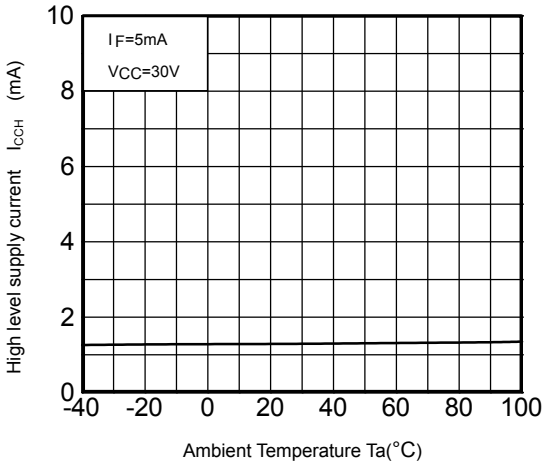


*: The above graphs show typical characteristics.

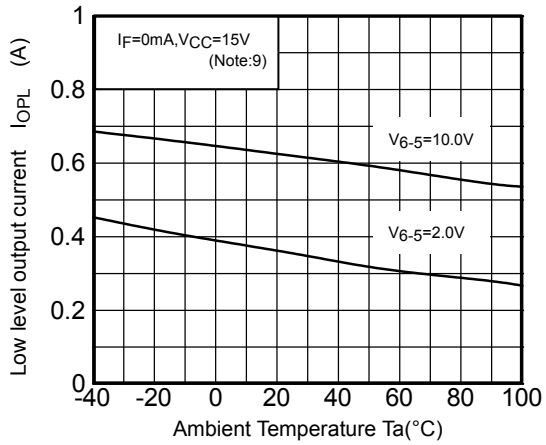
ICCL-Ta



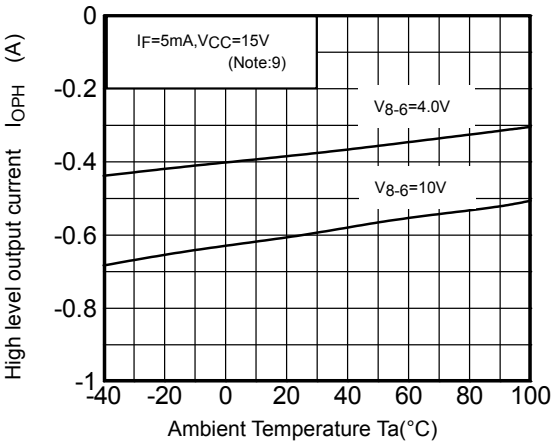
ICCH-Ta



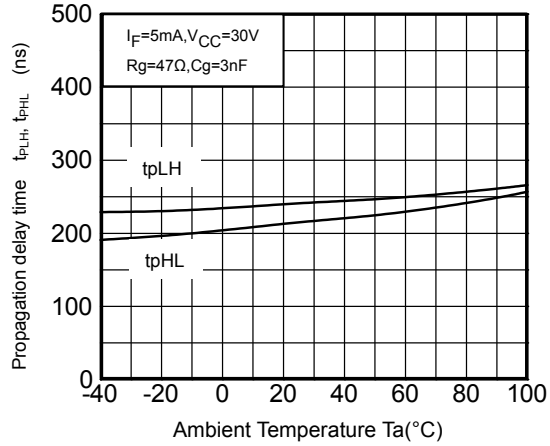
I_{OPL} – Ta



I_{OPH} – Ta



tpHL,tpLH-Ta



*: The above graphs show typical characteristics.

RESTRICTIONS ON PRODUCT USE

20070701-EN

- The information contained herein is subject to change without notice.
- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.
  In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the “Handling Guide for Semiconductor Devices,” or “TOSHIBA Semiconductor Reliability Handbook” etc.
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.).These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury (“Unintended Usage”). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in his document shall be made at the customer’s own risk.
- The products described in this document shall not be used or embedded to any downstream products of which manufacture, use and/or sale are prohibited under any applicable laws and regulations.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA for any infringements of patents or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any patents or other rights of TOSHIBA or the third parties.
- GaAs(Gallium Arsenide) is used in this product. The dust or vapor is harmful to the human body. Do not break, cut, crush or dissolve chemically.
- Please contact your sales representative for product-by-product details in this document regarding RoHS compatibility. Please use these products in this document in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances. Toshiba assumes no liability for damage or losses occurring as a result of noncompliance with applicable laws and regulations.