TOSHIBA Photocoupler IRED + Photo IC

TLP700

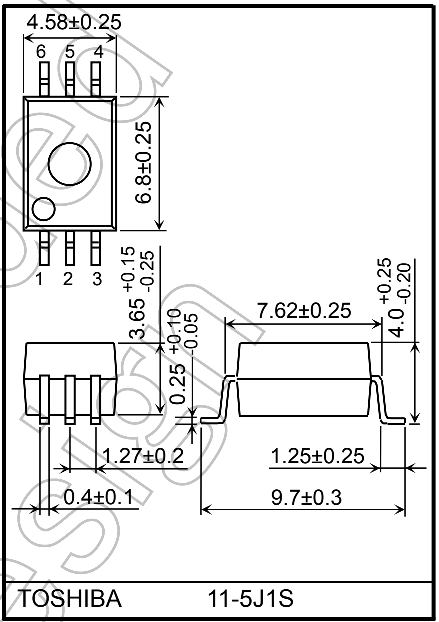
Industrial inverters
Inverter for air conditioners
IGBT/Power MOSFET gate drive

TLP700 consists of an infrared LED and an integrated photodetector. This unit is 6-lead SDIP package. The TLP700 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 TLP700 is suitable for gate driving circuits for IGBTs or power MOSFETs. In particular, the TLP700 is capable of “direct” gate driving of low-power IGBTs.

- Peak output current: ±2.0 A (max)
- Guaranteed performance over temperature: -40 to 100°C
- Supply current: 2.0 mA (max)
- Power supply voltage: 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/μs (min)
- Isolation voltage: 5000 Vrms (min)
- UL-recognized: UL 1577, File No.E67349
- cUL-recognized: CSA Component Acceptance Service No.5A File No.E67349
- VDE-approved: EN 60747-5-5 , EN 62368-1 (Note 1)

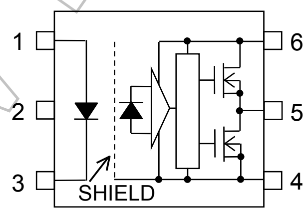
Note 1 : When a VDE approved type is needed, please designate the **Option(D4)**.

Unit: mm



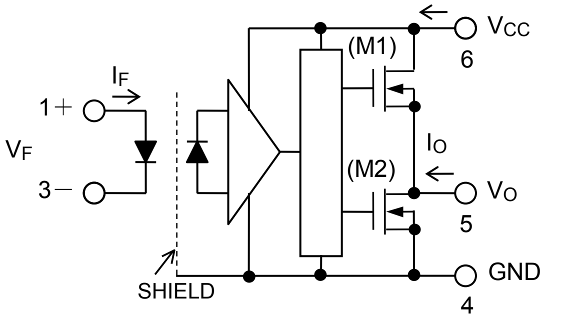
Weight: 0.26 g (typ.)

Pin Configuration (Top View)



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

Schematic



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

Truth Table

Input	LED	M1	M2	Output
H	ON	ON	OFF	H
L	OFF	OFF	ON	L

Start of commercial production
2007-08

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
	Diode power dissipation		P_D	40	mW
	Diode power dissipation derating (Ta ≥ 85 °C)		$\Delta P_D/\Delta Ta$	-1.0	mW/°C
	Junction temperature		T_j	125	°C
Detector	"H" peak output current	Ta=-40 to 100 °C (Note 2)	I_{OPH}	-2.0	A
	"L" peak output current		I_{OPL}	2.0	A
	Output voltage		V_O	35	V
	Supply voltage		V_{CC}	35	V
	Power dissipation		P_C	400	mW
	Junction temperature		T_j	125	°C
Operating frequency		(Note 3)	f	50	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, 60 s, 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: 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.

Note 1: Pulse width P_W ≤ 1 μs, 300 pps

Note 2: Exponential waveform pulse width P_W ≤ 0.3 μs, f ≤ 15 kHz

Note 3: Exponential waveform I_{OPH} ≥ -1.5 A (≤ 0.3 μs), I_{OPL} ≤ +1.5 A (≤ 0.3 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.

Recommended Operating Conditions

Characteristics		Symbol	Min	Typ.	Max	Unit
Input current, ON	(Note 1)	$I_{F (ON)}$	7.5	—	10	mA
Input voltage, OFF		$V_{F (OFF)}$	0	—	0.8	V
Supply voltage	(Note 2)(Note 3)	V_{CC}	15	—	30	V
Peak output current		I_{OPH} / I_{OPL}	—	—	±1.5	A
Operating temperature		Topr	-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 1: Input signal rise time (fall time) ≤ 0.5 μs.

Note 2: This item denotes operating ranges, not meaning of recommended operating conditions.

Note 3: If the V_{CC} rise slope is sharp, an internal circuit might not operate with stability. Please design the V_{CC} rise slope under 3.0 V/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 = 10 mA, Ta = 25 °C		—	1.57	1.75	V
Temperature coefficient of forward voltage		$\Delta V_F/\Delta Ta$	—	I_F = 10 mA		—	-1.8	—	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		—	100	—	pF
Output current (Note 1)	"H" Level	I_{OPH1}	1	V_{CC} = 15 V, I_F = 5 mA	$V_{6\text{-}5}$ = 3.5 V	—	-1.4	-1.0	A
		I_{OPH2}			$V_{6\text{-}5}$ = 7 V	—	—	-1.5	
	"L" Level	I_{OPL1}	2	V_{CC} = 15 V, I_F = 0 mA	$V_{5\text{-}4}$ = 2.5 V	1.0	1.4	—	
		I_{OPL2}			$V_{5\text{-}4}$ = 7 V	1.5	—	—	
Output voltage	"H" Level	V_{OH}	3	V_{CC1}=+15V, V_{EE1}=-15V, R_L = 200Ω, I_F = 5 mA		11	13.7	—	V
	"L" Level	V_{OL}	4	V_{CC1}=+15V, V_{EE1}=-15V, R_L = 200Ω, V_F = 0.8 V		—	-14.9	-12.5	
Supply current	"H" Level	I_{CCH}	5	V_{CC} = 30 V, V_O=Open	I_F = 10 mA	—	1.3	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		—	1.8	5	mA
Threshold input voltage	H → L	V_{FHL}	—	V_{CC} = 15 V, V_O < 1 V		0.8	—	—	V
Supply voltage		V_{CC}	—	—		15	—	30	V
UVLO thresh hold		V_{UVLO+}	—	V_O > 2.5V, I_F = 5 mA		11.0	12.5	13.5	V
		V_{UVLO-}	—	V_O < 2.5V, I_F = 5 mA		9.5	11.0	12.0	V
UVLO hysteresis		$UVLO_{HYS}$	—	—		—	1.5	—	V

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

Note: 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.

Note 1: Duration of Io time ≤ 50 μs, 1 pulse

Isolation Characteristics (Ta = 25 °C)

Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit
Capacitance input to output	C_S	Vs = 0 V, f = 1 MHz	—	1.0	—	pF
Isolation resistance	R_S	R.H. ≤ 60 %, V_S = 500 V	10^{12}	10^{14}	—	Ω
Isolation voltage	BV_S	AC, 60 s	5000	—	—	Vrms

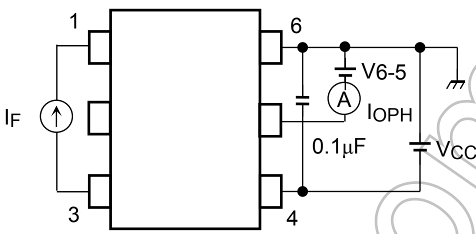
Note: Device considered a two-terminal device: pins 1, 2 and 3 paired with pins 4, 5 and 6 respectively.

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

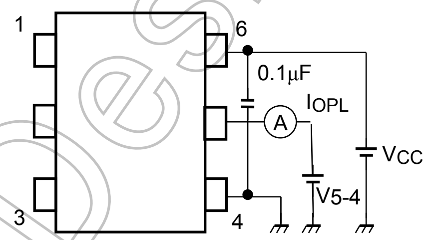
Characteristics		Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit
Propagation delay time	L → H	t_{pLH}	7	V_{CC} = 30 V, R_g = 20 Ω, C_g = 10 nF	I_F = 0 → 5 mA	50	—	500	ns
	H → L	t_{pHL}			I_F = 5 → 0 mA	50	—	500	
Output rise time (10-90 %)		tr			I_F = 0 → 5 mA	—	50	—	
Output fall time (90-10 %)		tf			I_F = 5 → 0 mA	—	50	—	
Switching time dispersion between ON and OFF		$\lvert t_{pHL}-t_{pLH} \rvert$			I_F = 0 ↔ 5 mA	—	—	250	
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	-15	—	—	kV/μs
Common mode transient immunity at LOW level output		CM_L			I_F = 0 mA, $V_{O\ (max)}$ = 1 V	15	—	—	

Note: All typical values are at Ta = 25 °C.

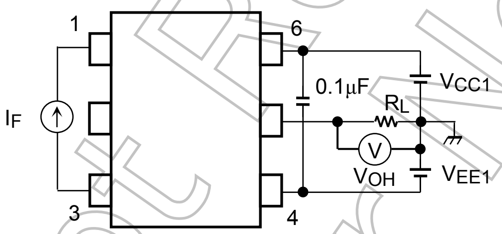
Test Circuit 1: I_{OPH}



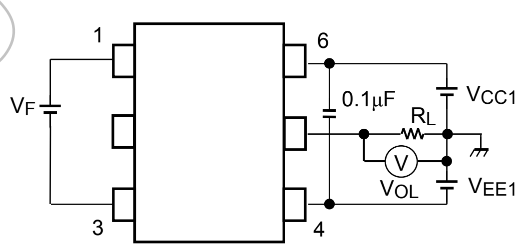
Test Circuit 2: I_{OPL}



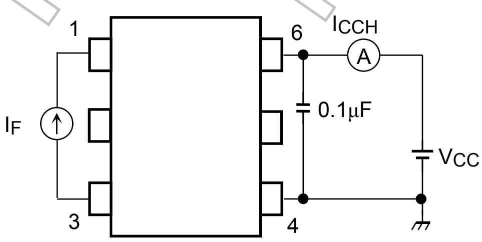
Test Circuit 3: V_{OH}



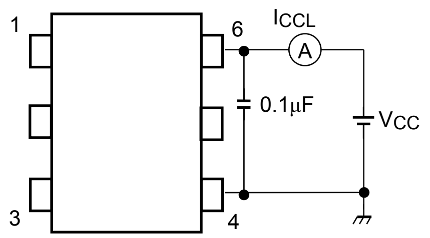
Test Circuit 4: V_{OL}



Test Circuit 5: I_{CCH}

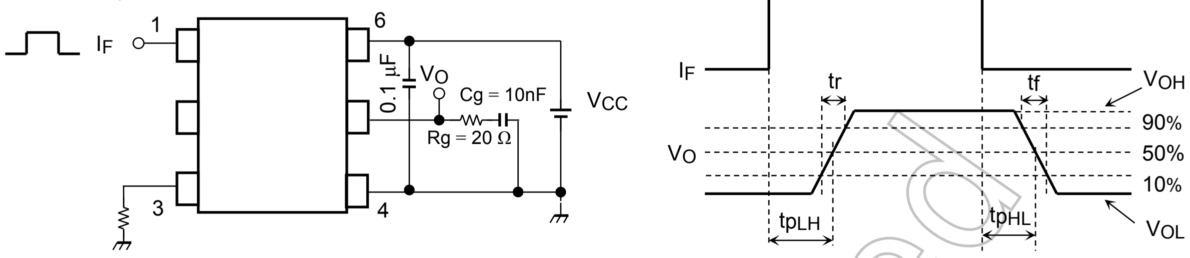


Test Circuit 6: I_{CCL}

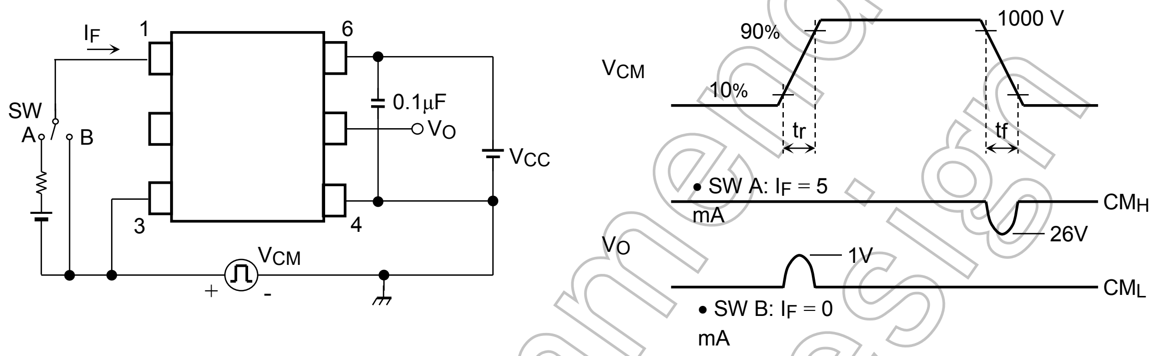


Test Circuit 7: tpLH, tpHL, tr, tf, | tpHL-tpLH |

(f=25kHz, duty=50%, less than tr=tf=5ns)



Test Circuit 8: CMH, CML

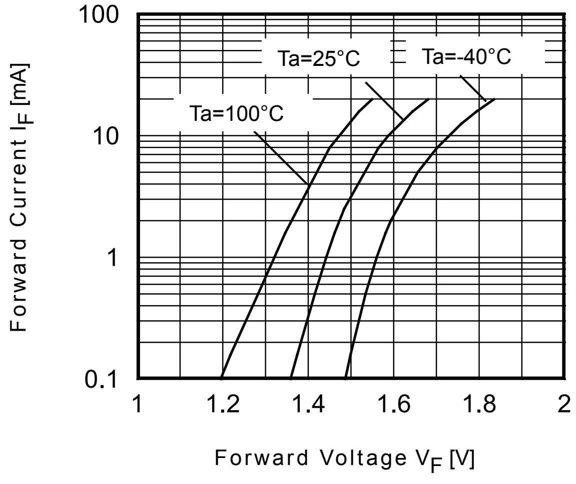


$$CM_H = -\frac{800\ V}{tf\ (\mu s)}$$

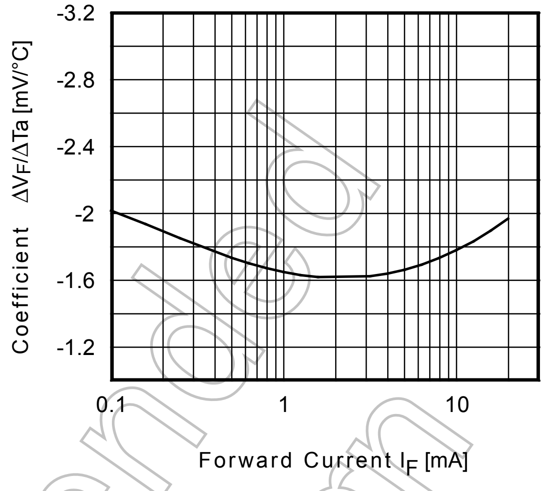
$$CM_L = \frac{800\ V}{tr\ (\mu s)}$$

Note: CML (CMH) 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.

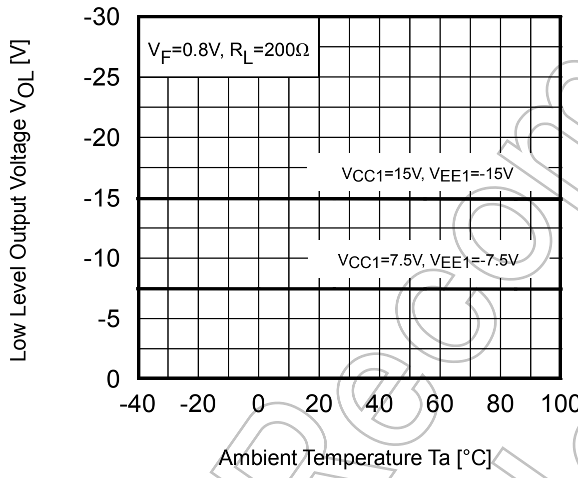
I_F – V_F



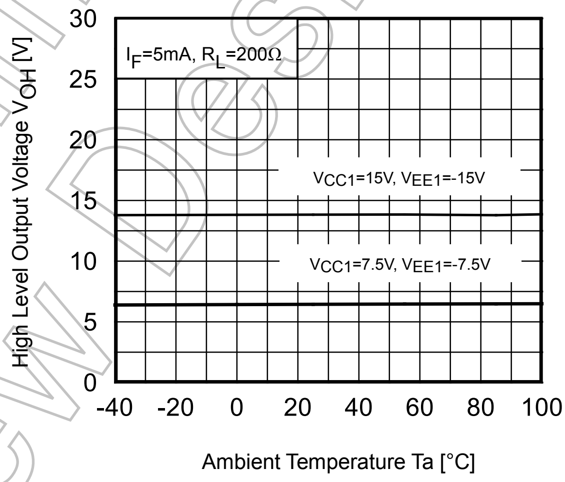
$\Delta V_F/\Delta Ta$ – I_F



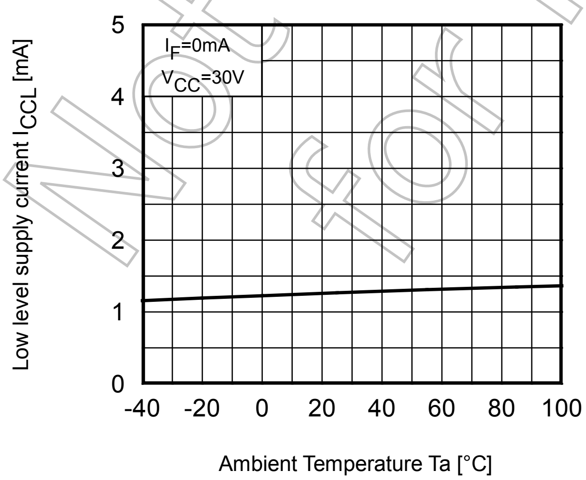
V_{OL} – Ta



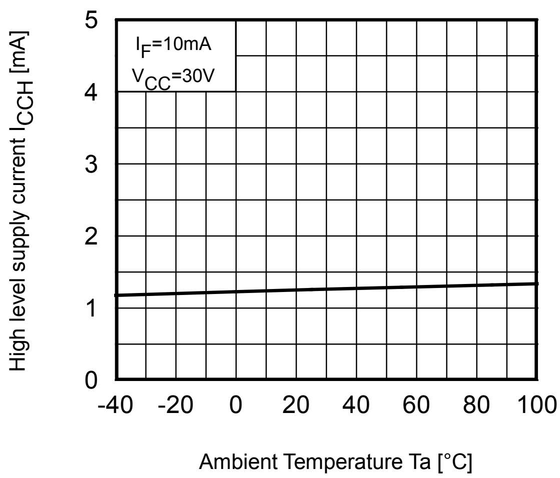
V_{OH} – Ta



I_{CCL} – Ta

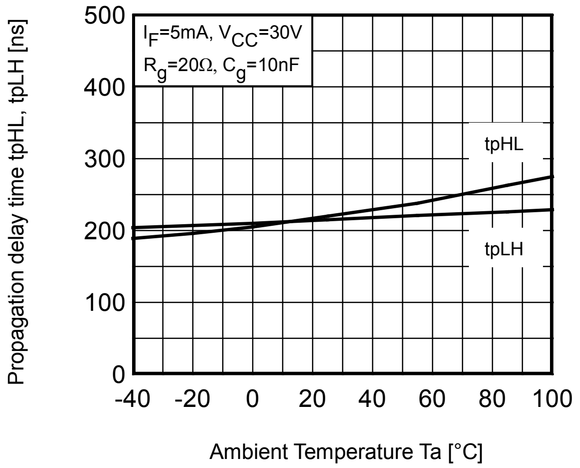


I_{CCH} – Ta

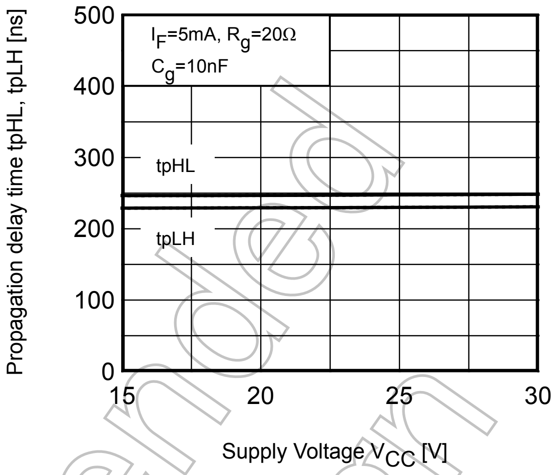


NOTE: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

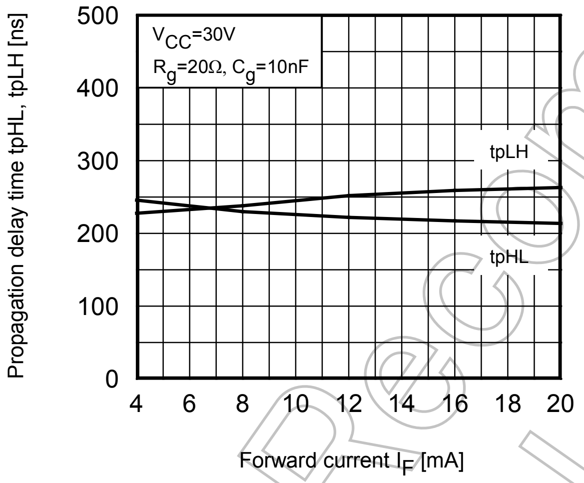
tpHL, tpLH — Ta



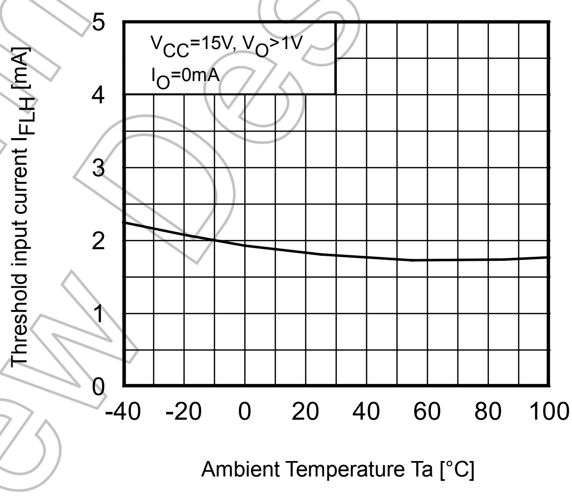
tpHL, tpLH — V_{CC}



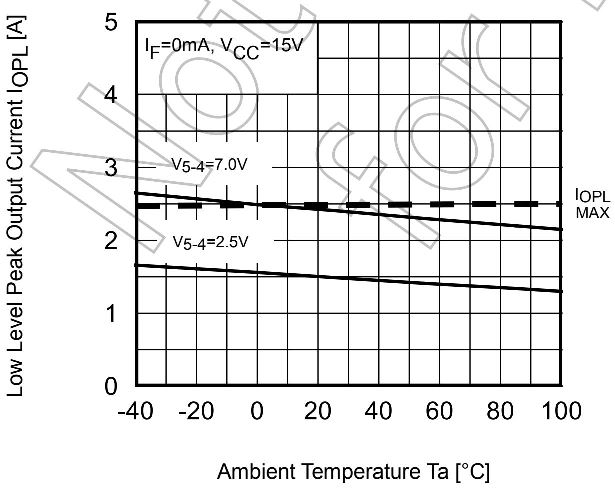
tpHL, tpLH — I_F



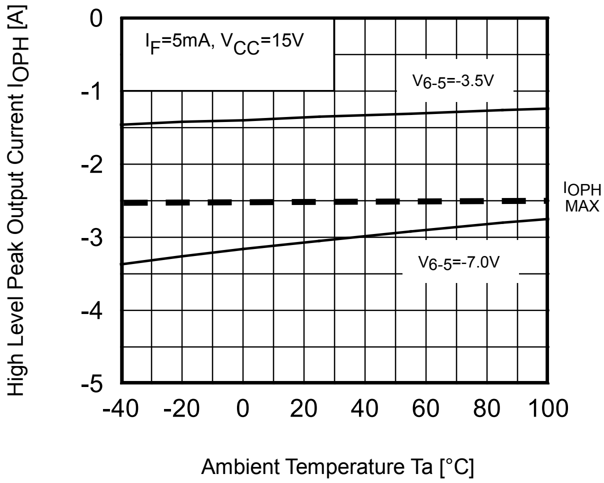
I_{FLH} — Ta



I_{OPL} — Ta



I_{OPH} — Ta



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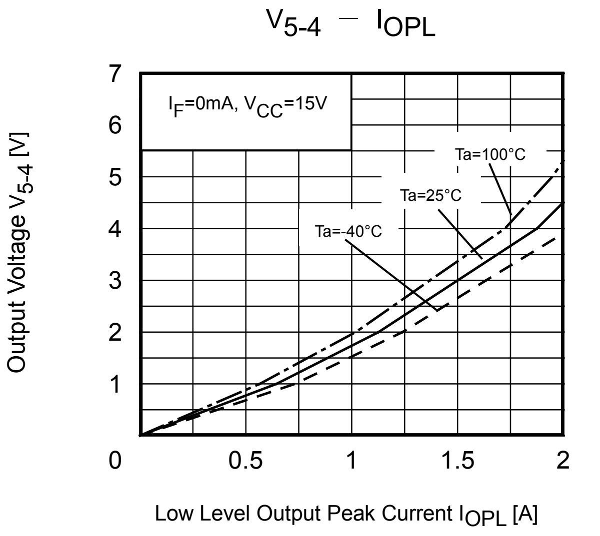
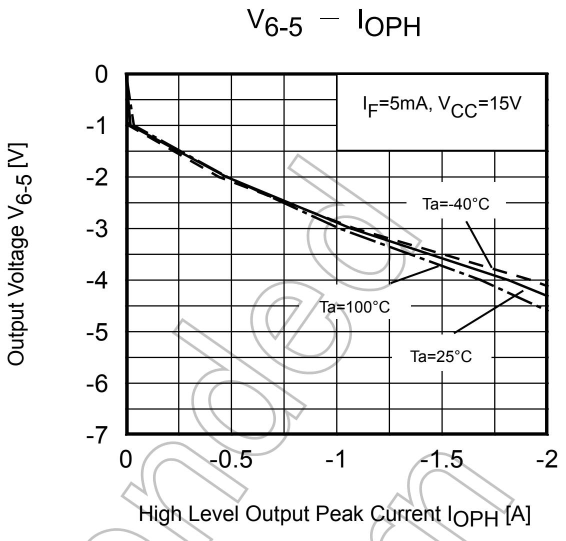
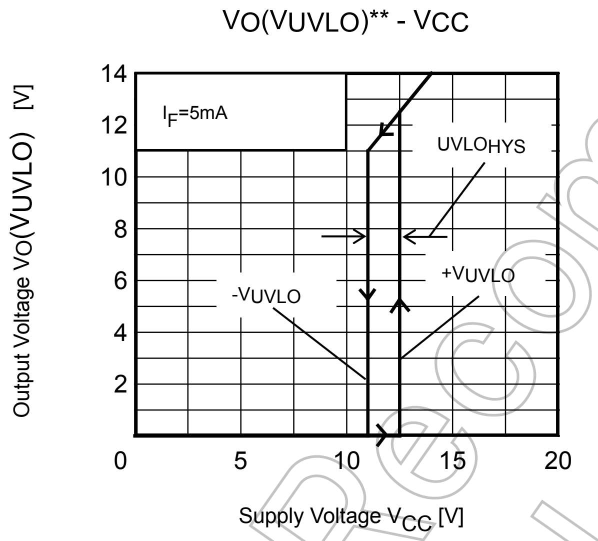
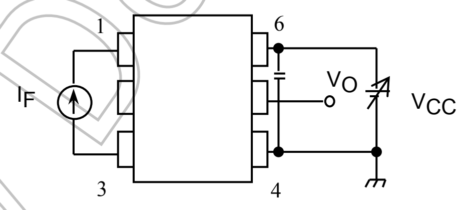






**Test Circuit : VO(VUVLO) - VCC



*: The above graphs show typical characteristics.

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

Soldering and Storage

(1) Precautions for Soldering

The soldering temperature should be controlled as closely as possible to the conditions shown below, irrespective of whether a soldering iron or a reflow soldering method is used.

1) When Using Soldering Reflow

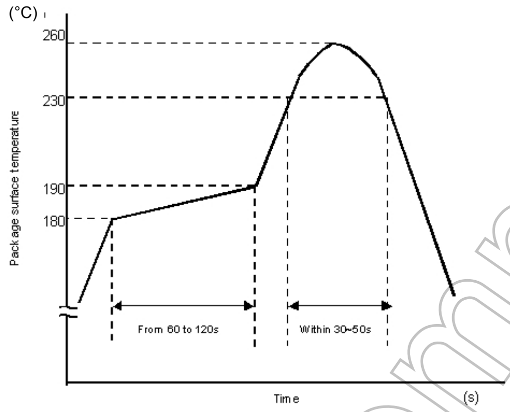
The soldering temperature profile is based on the package surface temperature.

(See the figure shown below, which is based on the package surface temperature.)

Reflow soldering must be performed once or twice.

The mounting should be completed with the interval from the first to the last mountings being 2 weeks.

- An example of a temperature profile when lead(Pb)-free solder is used:



This profile is based on the device's maximum heat resistance guaranteed value.
Set the preheat temperature/heating temperature to the optimum temperature corresponding to the solder paste type used by the customer within the described profile.

2) When using soldering flow

- Preheat the device at a temperature of 150 °C (package surface temperature) for 60 to 120 seconds.
- Mounting condition of 260 °C within 10 seconds is recommended.
- Flow soldering must be performed once

3) When using soldering Iron

- Complete soldering within 10 seconds for lead temperature not exceeding 260 °C or within 3 seconds not exceeding 350 °C.
- Heating by soldering iron must be only once per 1 lead

(2) Precautions for General Storage

1) Do not store devices at any place where they will be exposed to moisture or direct sunlight.

2) When transportation or storage of devices, follow the cautions indicated on the carton box.

3) The storage area temperature should be kept within a temperature range of 5 °C to 35 °C, and relative humidity should be maintained at between 45% and 75%.

4) Do not store devices in the presence of harmful (especially corrosive) gases, or in dusty conditions.

5) Use storage areas where there is minimal temperature fluctuation. Because rapid temperature changes can cause condensation to occur on stored devices, resulting in lead oxidation or corrosion, as a result, the solderability of the leads will be degraded.

6) When repacking devices, use anti-static containers.

7) Do not apply any external force or load directly to devices while they are in storage.

8) If devices have been stored for more than two years, even though the above conditions have been followed, it is recommended that solderability of them should be tested before they are used.

EN 60747-5-5 Option (D4) Specification

Types : TLP700

Type designations for "option: (D4)", which are tested under EN 60747 requirements.

Ex.: TLP700 (D4-TP,F)

D4 : EN 60747 option
TP : Standard tape & reel type
F : [[G]]/RoHS COMPATIBLE (Note 1)

Note: Use TOSHIBA standard type number for safety standard application.
Ex.: TLP700 (D4-TP,F) → TLP700

Note 1: Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product.
RoHS is the Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

EN 60747 Isolation Characteristics

Description		Symbol	Rating	Unit
Application classification for rated mains voltage ≤ $300V_{rms}$ for rated mains voltage ≤ $600V_{rms}$			I-IV I-III	—
Climatic classification			40/ 100 / 21	—
Pollution degree			2	—
Maximum operating insulation voltage	TLPxxx type	V_{IORM}	890	Vpk
	TLPxxxFtype		1140	
Input to output test voltage, method A $Vpr=1.6 \times V_{IORM}$, type and sample test tp=10 s, partial discharge<5 pC	TLPxxx type	Vpr	1424	Vpk
	TLPxxxFtype		1824	
Input to output test voltage, method B $Vpr=1.875 \times V_{IORM}$, 100 % production test t_p=1 s, partial discharge < 5 pC	TLPxxx type	Vpr	1670	Vpk
	TLPxxxFtype		2140	
Highest permissible overvoltage (transient overvoltage, t_{pr} = 60 s)		V_{TR}	8000	Vpk
Safety limiting values (max. permissible ratings in case of fault, also refer to thermal derating curve) current (input current I_F, P_{si} = 0) power (output or total power dissipation) temperature		Isi Psi Ts	300 700 150	mA mW °C
Insulation resistance,	V_{IO}=500 V, Ta = 25 °C V_{IO}=500 V, Ta = 100 °C V_{IO}=500 V, Ta = Ts	Rsi	$\geq 10^{12}$ $\geq 10^{11}$ $\geq 10^{9}$	Ω

Insulation Related Specifications

		7.62mm pitch TLPxxx type	10.16mm pitch TLPxxxF type
Minimum creepage distance	Cr	7.0mm	8.0mm
Minimum clearance	Cl	7.0mm	8.0mm
Minimum insulation thickness	ti	0.4mm	
Comperative tracking index	CTI	175	

1. If a printed circuit is incorporated, the creepage distance and clearance may be reduced below this value. If this is not permissible, the user shall take suitable measures.
2. This photocoupler is suitable for ‘safe electrical isolation’ only within the safety limit data. Maintenance of the safety data shall be ensured by means of protective circuits.

Marking on product for EN 60747 : 4

Marking Example:

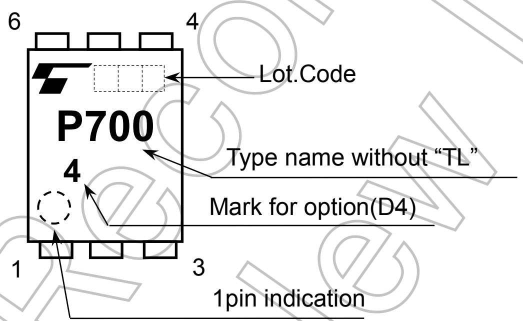


Figure 1 Partial discharge measurement procedure according to EN 60747
Destructive test for qualification and sampling tests.

Method A

(for type and sampling tests, destructive tests)

t_1, t_2	= 1 to 10 s
t_3, t_4	= 1 s
t_p(Measuring time for partial discharge)	= 10 s
t_b	= 12 s
t_{ini}	= 60 s

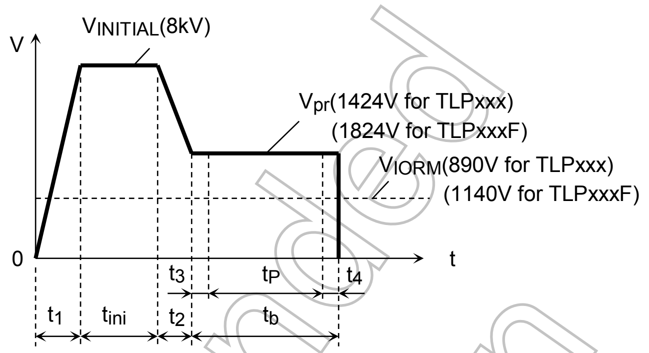


Figure 2 Partial discharge measurement procedure according to EN 60747
Non-destructive test for100% inspection.

Method B

(for sample test,non-destructive test)

t_3, t_4	= 0.1 s
t_p(Measuring time for partial discharge)	= 1 s
t_b	= 1.2 s

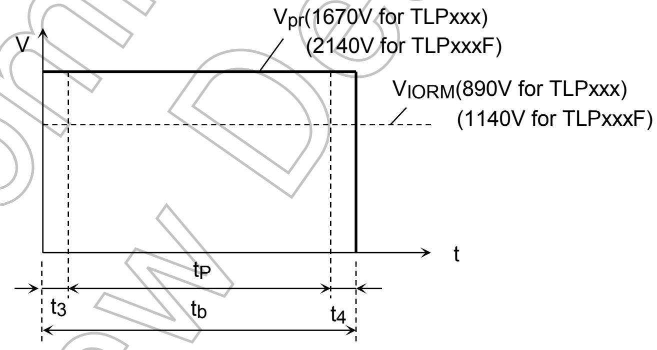
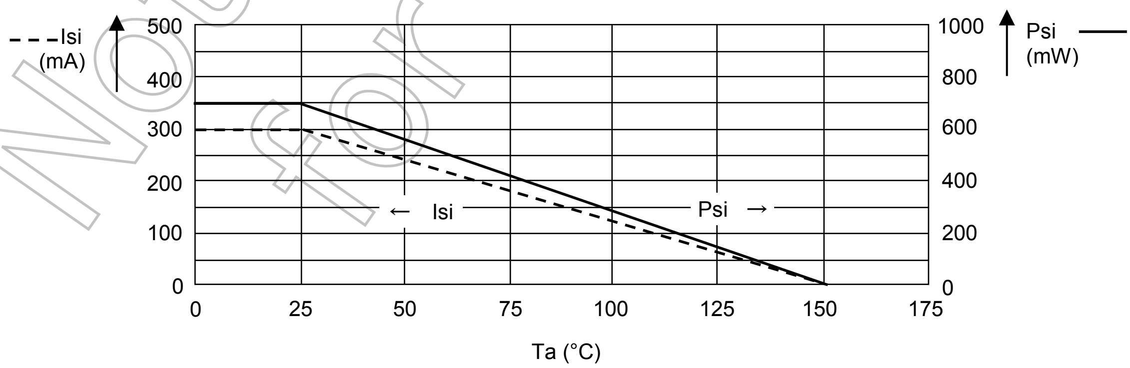


Figure 3 Dependency of maximum safety ratings on ambient temperature



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