

# TLP2066

FA (Factory Automation)

High Speed Interface

3.3V Supply Voltage

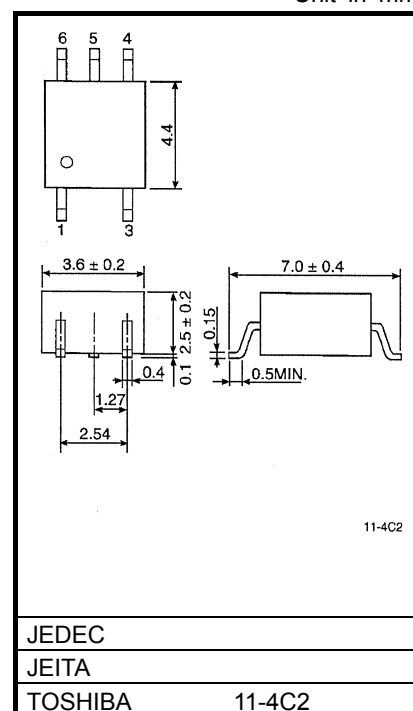
The Toshiba TLP2066 consists of a GaAlAs light-emitting diode and an integrated high-gain, high-speed photodetector. TLP2066 operates with 3.3 V supply voltage. Toshiba offers TLP116 for supply voltage 5V type.

- Inverter logic (totem pole output)
- Package type : MFSOP6
- Guaranteed performance over temperature : -40 to 100°C
- Power supply voltage : 3.0 to 3.6V
- Input threshold current:  $I_{FHL}=5\text{mA}$  (Max.)
- Propagation delay time ( $t_{pHL}/t_{pLH}$ ): 60ns (Max.)
- Switching speed : 20MBd (Typ.) (NRZ)
- Common mode transient immunity : 15 kV/ $\mu\text{s}$
- Isolation voltage : 3750  $V_{rms}$
- UL Recognized : UL1577, File No. E67349
- cUL Recognized : CSA Component Acceptance Service No.5A

- Option (V4)
    - VDE approved : EN60747-5-2
    - Maximum operating insulation voltage : 565 Vpk
    - Highest permissible over voltage : 6000 Vpk
- ( Note ) When a EN60747-5-2 approved type is needed, please designate the "Option(V4)"**

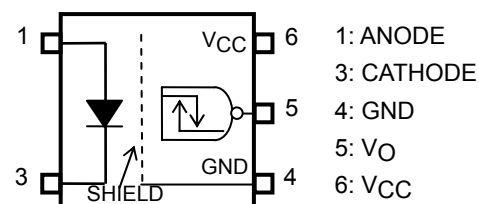
Construction Mechanical Rating

Unit in mm



Weight: 0.09 g(Typ.)

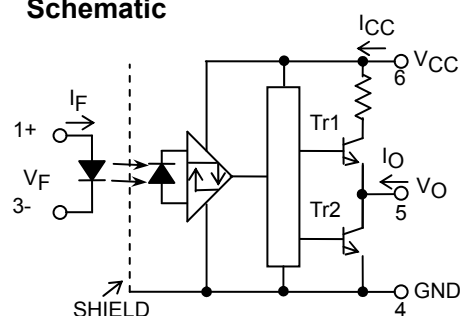
## Pin Configuration (top view)



## Truth Table

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

## Schematic



A 0.1 $\mu\text{F}$  bypass capacitor must be connected between pins 6 and 4.

## Absolute Maximum Ratings (Ta=25°C)

Characteristic		Symbol	Rating	Unit
LED	Forward current	$I_F$	25	mA
	Forward current derating (Ta≥85°C)	$\Delta I_F/\Delta T_a$	-0.63	mA/°C
	Peak transient forward current (Note 1)	$I_{FPT}$	1	A
	Reverse voltage	$V_R$	5	V
DETECTOR	Output current (Note 2)	$I_O$	10	mA
	Output voltage	$V_O$	6	V
	Supply voltage	$V_{CC}$	6	V
	Output power dissipation	$P_O$	40	mW
Operating temperature range		$T_{opr}$	-40 to 100	°C
Storage temperature range		$T_{stg}$	-55 to 125	°C
Lead solder temperature (10s)		$T_{sol}$	260	°C
Isolation voltage (AC, 1min., R.H.≤60%, Ta=25°C) (Note 3)		$BV_S$	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 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  $PW \leq 1\mu s$ , 300pps.

Note 2: Derate 0.25 mA/°C above 85°C.

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

## Recommended Operating Conditions

Characteristic	Symbol	Min	Typ.	Max	Unit
Input current , ON	$I_{F(ON)}$	8	—	18	mA
Input voltage , OFF	$V_{F(OFF)}$	0	—	0.8	V
Supply voltage(*) (Note 4)	$V_{CC}$	3.0	3.3	3.6	V

(\*) This item denotes operating ranges, and does not imply recommended operating conditions.

Note: Recommended operating conditions are given as a design guideline to obtain the expected performance of the device. In addition, each item is an independent guideline.

In developing designs using this product, please confirm the specified characteristics shown in this document.

Note 4: The detector of this product requires a power supply voltage ( $V_{CC}$ ) of 3.0 V or higher for stable operation.

If  $V_{CC}$  is lower than this value,  $I_{CCH}$  may increase, or the output may become unstable.

Be sure to check the supply current, and the on/off operation of the power supply before using the product.

Note 5: A ceramic capacitor(0.1  $\mu F$ ) should be connected from pin 6 to pin 4 to stabilize the operation of the high gain linear amplifier. Failure to do so may impair the switching property.

The total lead length between the capacitor and the photocoupler should not exceed 1 cm.

## Electrical Characteristics

(Unless otherwise specified, Ta=-40 to 100°C, VCC=3.0 to 3.6 V)

Characteristic	Symbol	Test Circuit	Conditions	Min.	Typ.	Max.	Unit
Input forward voltage	$V_F$	—	$I_F = 10 \text{ mA}$ , $T_a = 25^\circ\text{C}$	1.45	1.6	1.85	V
Temperature coefficient of forward voltage	$\Delta V_F / \Delta T_a$	—	$I_F = 10 \text{ mA}$	—	-1.2	—	mV/°C
Input reverse current	$I_R$	—	$V_R = 6 \text{ V}$ , $T_a = 25^\circ\text{C}$	—	—	10	μA
Input capacitance	$C_T$	—	$V = 0$ , $f = 1 \text{ MHz}$ , $T_a = 25^\circ\text{C}$	—	60	—	pF
Logic low output voltage	$V_{OL}$	1	$I_{OL} = 1.6 \text{ mA}$ , $I_F = 12 \text{ mA}$	—	—	0.6	V
Logic high output voltage	$V_{OH}$	2	$I_{OH} = -0.02 \text{ mA}$ , $V_F = 1.05 \text{ V}$ (Note 6)	2.0	—	—	V
Logic low supply current	$I_{CCL}$	3	$I_F = 12 \text{ mA}$ , $V_{CC} = 3.3 \text{ V}$	—	—	5.0	mA
Logic high supply current	$I_{CCH}$	4	$V_F = 0 \text{ V}$ , $V_{CC} = 3.3 \text{ V}$ (Note 4)	—	—	5.0	mA
Supply voltage	$V_{CC}$	—	—	3.0	—	3.6	V
Input current logic low output	$I_{FHL}$	—	$I_O = 1.6 \text{ mA}$ , $V_O < 0.6 \text{ V}$	—	—	5	mA
Input voltage logic high output	$V_{FLH}$	—	$I_O = -0.02 \text{ mA}$ , $V_O > 2.0 \text{ V}$	0.8	—	—	V

\*All typical values are at Ta=25°C, VCC=3.3V, IF (ON) =12mA unless otherwise specified.

Note 6:  $V_{OH} = V_{CC} - V_O$  [V]

## Isolation Characteristics (Ta = 25°C)

Characteristic	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Capacitance input to output	$C_S$	$V_S = 0$ , $f = 1 \text{ MHz}$ (Note 3)	—	0.8	—	pF
Isolation resistance	$R_S$	R.H. ≤ 60%, $V_S = 500 \text{ V}$ (Note 3)	$1 \times 10^{12}$	$10^{14}$	—	Ω
Isolation voltage	$BV_S$	AC, 1 minute	3750	—	—	$V_{rms}$
		AC, 1 second, in oil	—	10000	—	
		DC, 1 minute, in oil	—	10000	—	$V_{dc}$

## Switching Characteristics

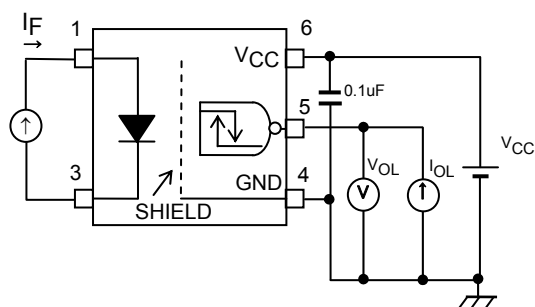
(Unless otherwise specified,  $T_a = -40$  to  $100^\circ\text{C}$ ,  $V_{CC} = 3.3\text{V}$ )

Characteristic	Symbol	Test Circuit	Conditions	Min.	Typ.	Max.	Unit
Propagation delay time to logic high output	$t_{pHL}$	5	$I_F = 0 \rightarrow 12\text{mA}$	—	—	60	ns
Propagation delay time to logic low output	$t_{pLH}$		$I_F = 12 \rightarrow 0\text{mA}$				
Propagation delay time to logic high output	$t_{pHL}$	6	$V_{IN} = 0 \rightarrow 3.3\text{V}$ ( $I_F = 0 \rightarrow 8\text{mA}$ )	—	—	60	ns
Propagation delay time to logic low output	$t_{pLH}$		$V_{IN} = 3.3 \rightarrow 0\text{V}$ ( $I_F = 8 \rightarrow 0\text{mA}$ )				
Switching time dispersion between ON and OFF	$ t_{pHL} - t_{pLH} $	5	$I_F = 12\text{mA}$ , $R_{IN} = 100\Omega$ , $C_L = 15\text{pF}$ (Note 7)	—	—	30	ns
Output fall time (90-10%)	$t_f$		$I_F = 0 \rightarrow 12\text{mA}$	—	4	—	ns
Output rise time (10-90%)	$t_r$		$I_F = 12 \rightarrow 0\text{mA}$	—	5	—	ns
Common mode transient immunity at high Level output	$CM_H$	7	$V_{CM} = 1000\text{Vp-p}$ , $I_F = 0\text{mA}$ , $V_O(\text{Min}) = 2\text{V}$ , $T_a = 25^\circ\text{C}$	15000	—	—	$\text{V}/\mu\text{s}$
Common mode transient immunity at low level output	$CM_L$		$V_{CM} = 1000\text{Vp-p}$ , $I_F = 12\text{mA}$ , $V_O(\text{Max}) = 0.8\text{V}$ , $T_a = 25^\circ\text{C}$	-15000	—	—	$\text{V}/\mu\text{s}$

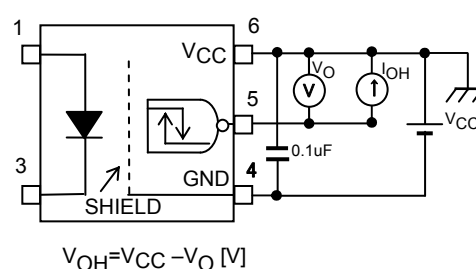
\*All typical values are at  $T_a = 25^\circ\text{C}$

Note 7:  $C_L$  is approximately 15pF which includes probe and jig/stray wiring capacitance.

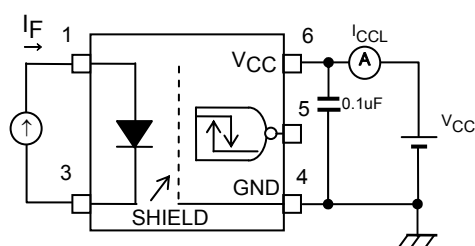
TEST CIRCUIT 1:  $V_{OL}$



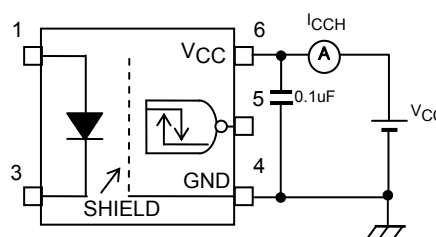
TEST CIRCUIT 2:  $V_{OH}$



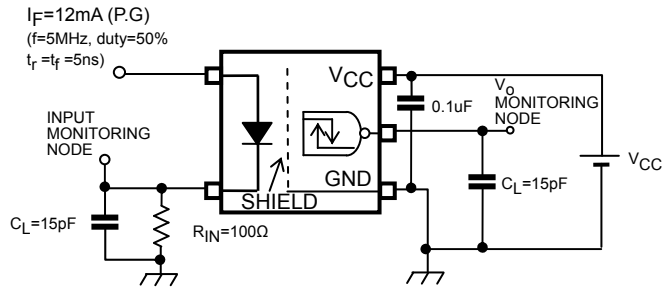
TEST CIRCUIT 3:  $I_{CCL}$



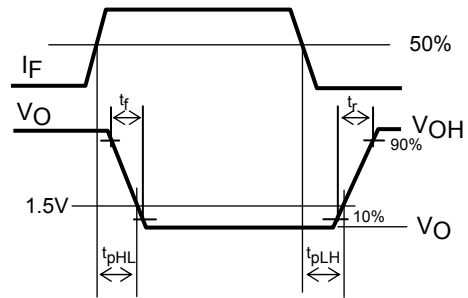
TEST CIRCUIT 4:  $I_{CCH}$



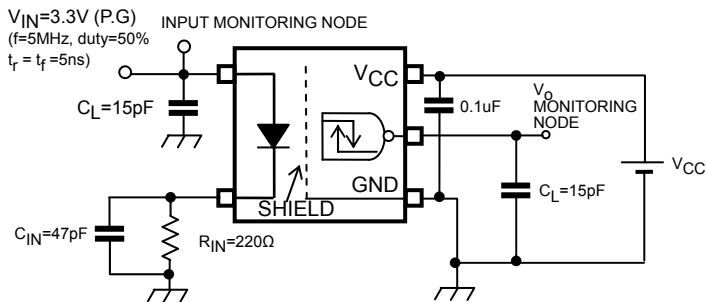
## TEST CIRCUIT 5: $t_{pHL}$ , $t_{pLH}$



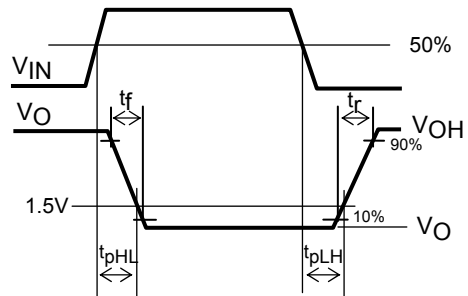
$C_L$  is capacitance of the probe and jig.  
(P.G): Pulse Generator



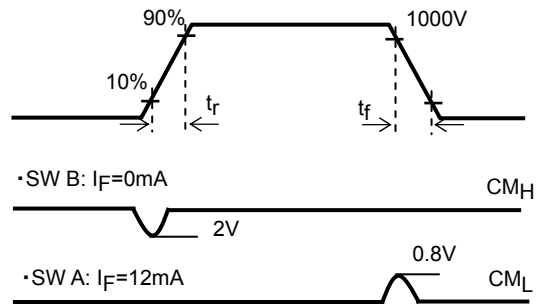
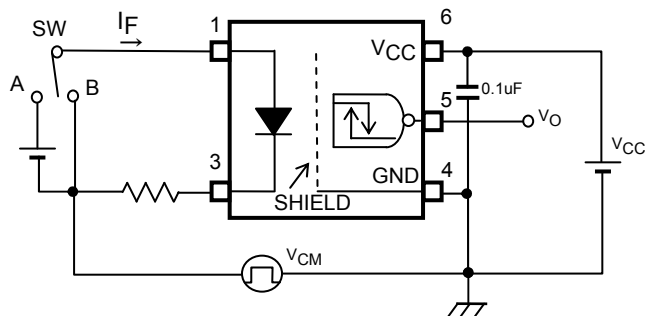
## TEST CIRCUIT 6: $t_{pHL}$ , $t_{pLH}$



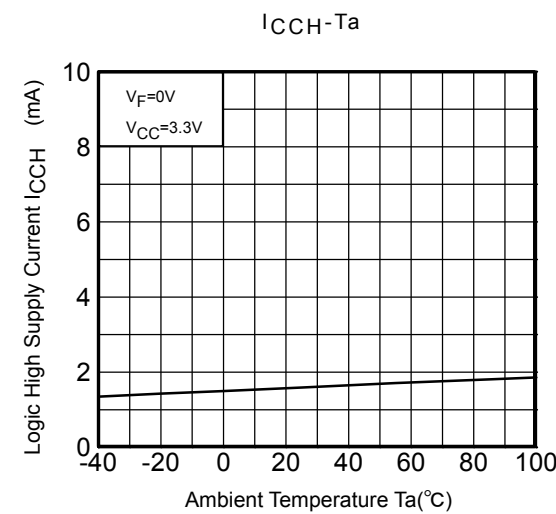
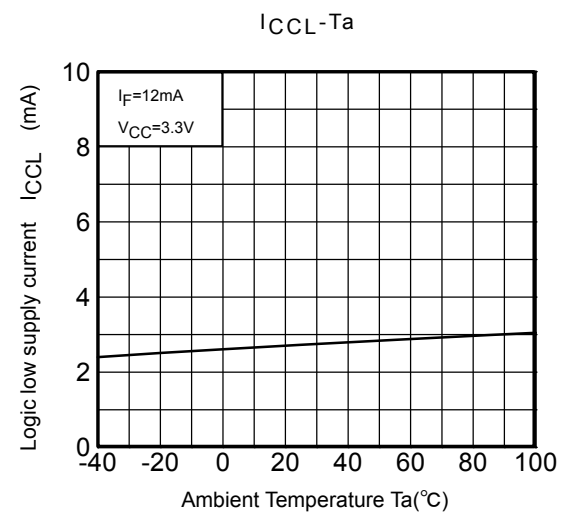
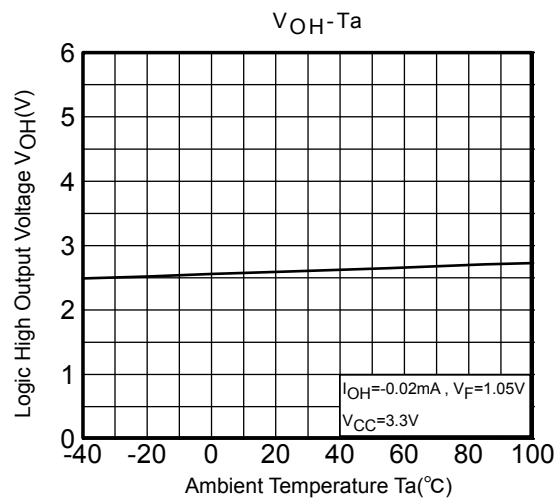
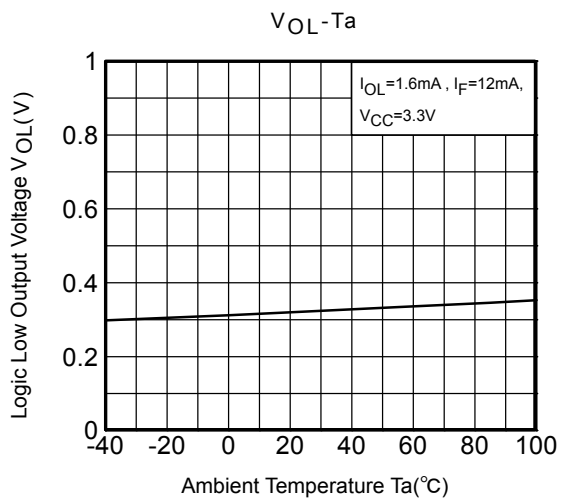
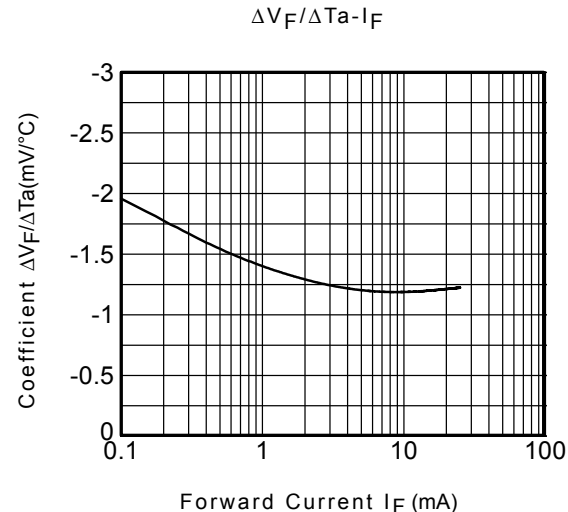
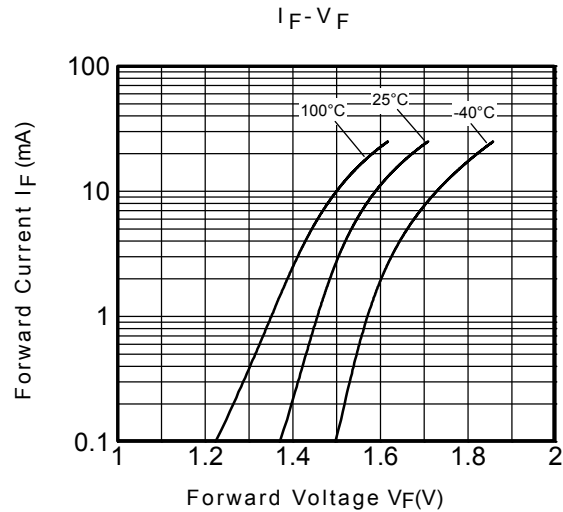
$C_L$  is capacitance of the probe and jig.  
(P.G): Pulse Generator



## TEST CIRCUIT 7: Common-Mode Transient Immunity Test Circuit

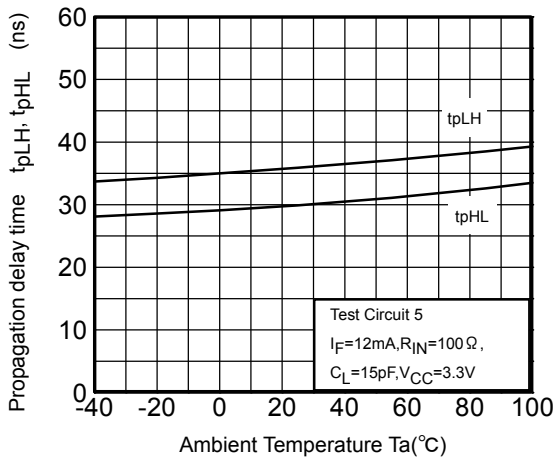


$$CM_H = \frac{800(V)}{t_r(\mu s)} \quad CM_L = \frac{800(V)}{t_f(\mu s)}$$

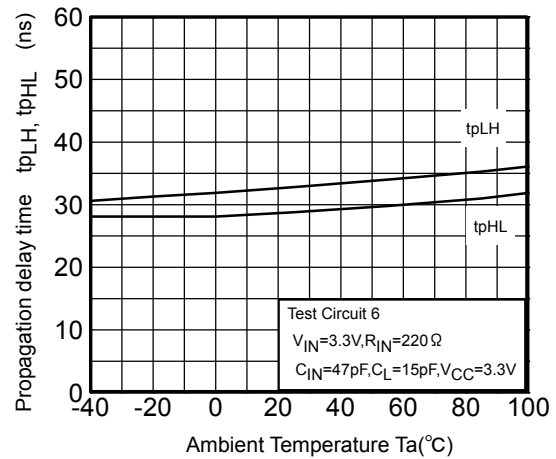


\*: The above graphs show typical characteristics.

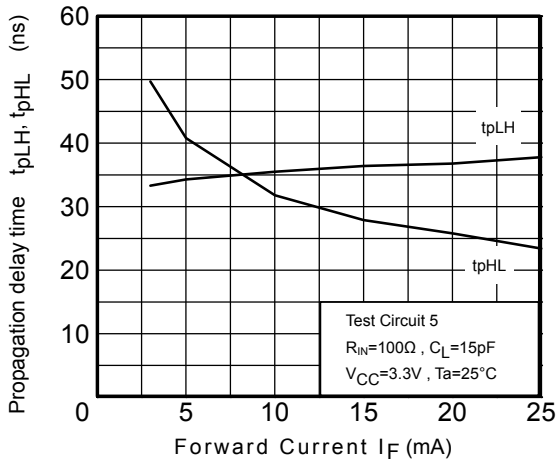
$t_{pHL}, t_{pLH} - T_a$



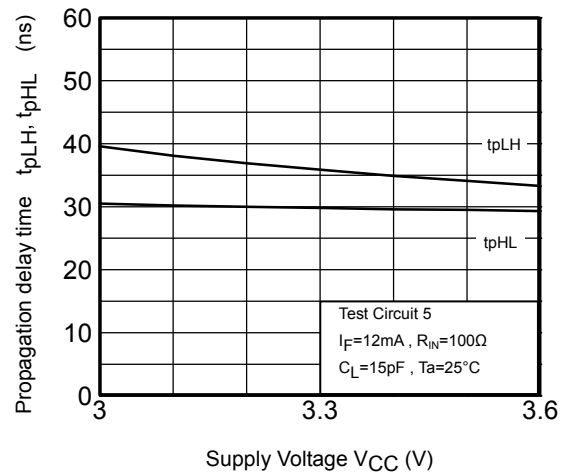
$t_{pHL}, t_{pLH} - T_a$



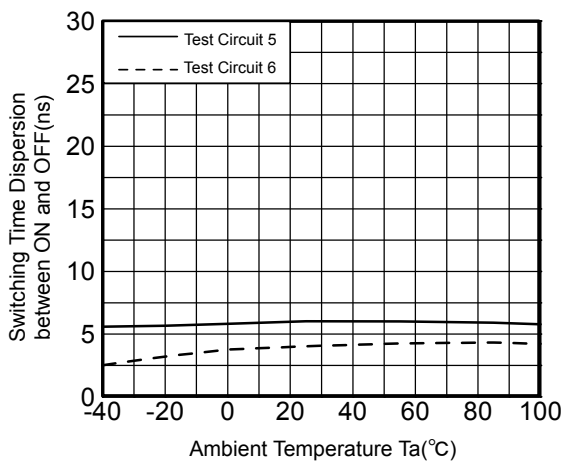
$t_{pHL}, t_{pLH} - I_F$



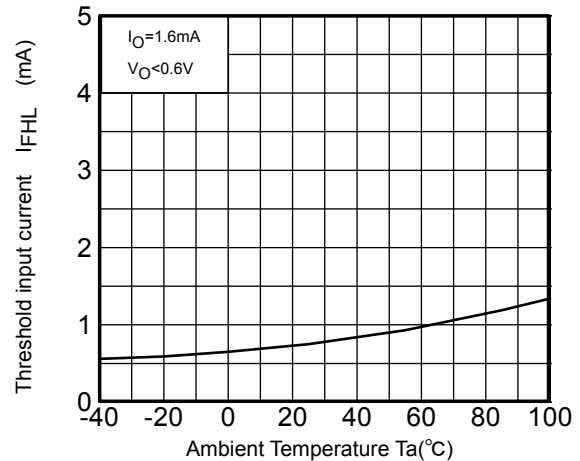
$t_{pHL}, t_{pLH} - V_{CC}$



$|t_{pHL} - t_{pLH}| - T_a$



$I_{FHL} - T_a$



\*: The above graphs show typical characteristics.

## Soldering and Storage

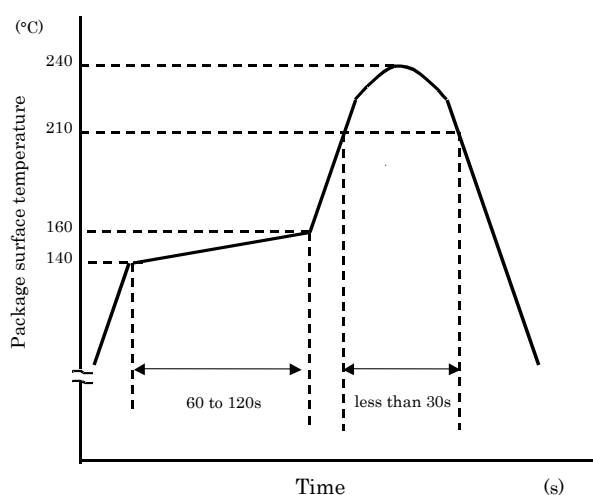
### 1. Soldering

#### 1.1 Soldering

When using a soldering iron or medium infrared ray/hot air reflow, avoid a rise in device temperature as much as possible by observing the following conditions.

#### 1) Using solder reflow

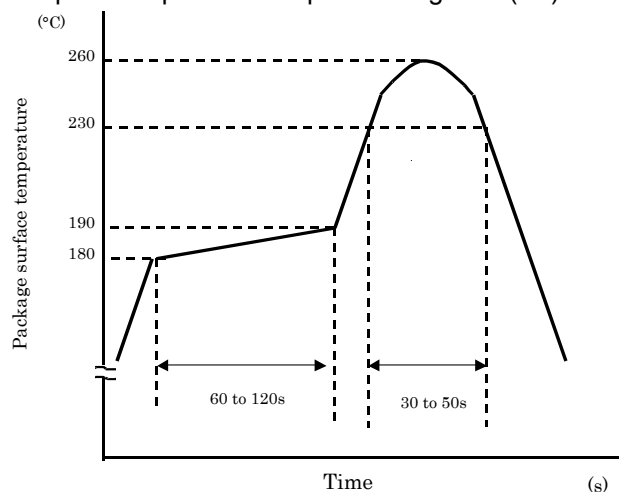
· Temperature profile example of lead (Pb) solder



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.

· Temperature profile example of using lead (Pb)-free solder



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.

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.

#### 2) Using solder flow (for lead (Pb) solder, or lead (Pb)-free solder)

- Please preheat it at 150°C between 60 and 120 seconds.
- Complete soldering within 10 seconds below 260°C. Each pin may be heated at most once.

#### 3) Using a soldering iron

Complete soldering within 10 seconds below 260°C, or within 3 seconds at 350°C. Each pin may be heated at most once.



**2. Storage**

- 1) Avoid storage locations where devices may be exposed to moisture or direct sunlight.
- 2) Follow the precautions printed on the packing label of the device for transportation and storage.
- 3) Keep the storage location temperature and humidity within a range of 5°C to 35°C and 45% to 75% respectively.
- 4) Do not store the products in locations with poisonous gases (especially corrosive gases) or in dusty conditions.
- 5) Store the products in locations with minimal temperature fluctuations. Rapid temperature changes during storage can cause condensation, resulting in lead oxidation or corrosion, which will deteriorate the solderability of the leads.
- 6) When restoring devices after removal from their packing, use anti-static containers.
- 7) Do not allow loads to be applied directly to devices while they are in storage.
- 8) If devices have been stored for more than two years under normal storage conditions, it is recommended that you check the leads for ease of soldering prior to use.

## Specification for Embossed-Tape Packing (TPL)(TPR) for Mini-flat Coupler

### 1. Applicable Package

Package	Product Type
MFSOP	Mini-flat coupler

### 2. Product Naming System

Type of package used for shipment is denoted by a symbol suffix after a product number. The method of classification is as below.



### 3. Tape Dimensions

#### 3.1 Specification Classification are as shown in Table 1

Table 1 Tape Type Classification

Tape type	Classification	Quantity (pcs / reel)
TPL	L direction	3000
TPR	R direction	3000

#### 3.2 Orientation of Device in Relation to Direction of Tape Movement

Device orientation in the recesses is as shown in Figure 1.

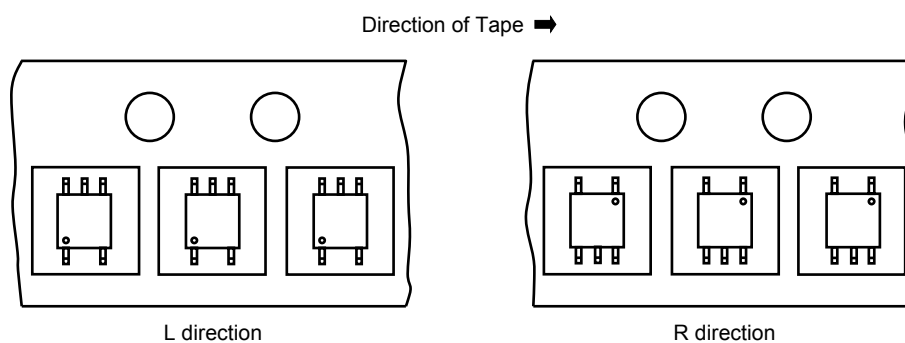


Figure 1 Device Orientation

## 3.3 Empty Device Recesses are as shown in Table 2.

**Table 2 Empty Device Recesses**

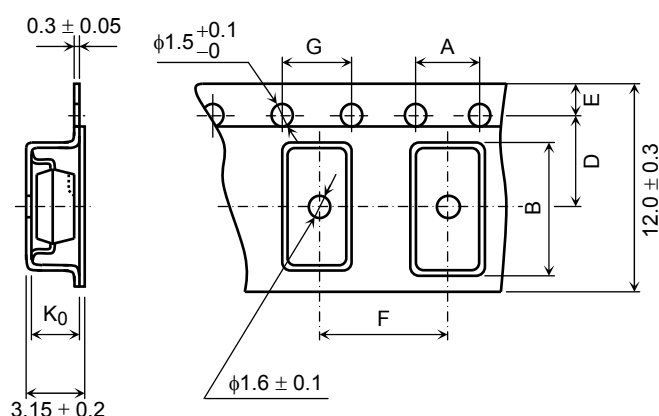
	Standard	Remarks
Occurrences of 2 or more successive empty device recesses	0	Within any given 40-mm section of tape, not including leader and trailer
Single empty device recesses	6 devices (max) per reel	Not including leader and trailer

## 3.4 Start and End of Tape

The start of the tape has 50 or more empty holes. The end of tape has 50 or more empty holes and two empty turns only for a cover tape.

## 3.5 Tape Specification

- (1) Tape material: Plastic (protection against electrostatics)
- (2) Dimensions: The tape dimensions are as shown in Figure 2 and Table 3.



**Figure 2 Tape Forms**

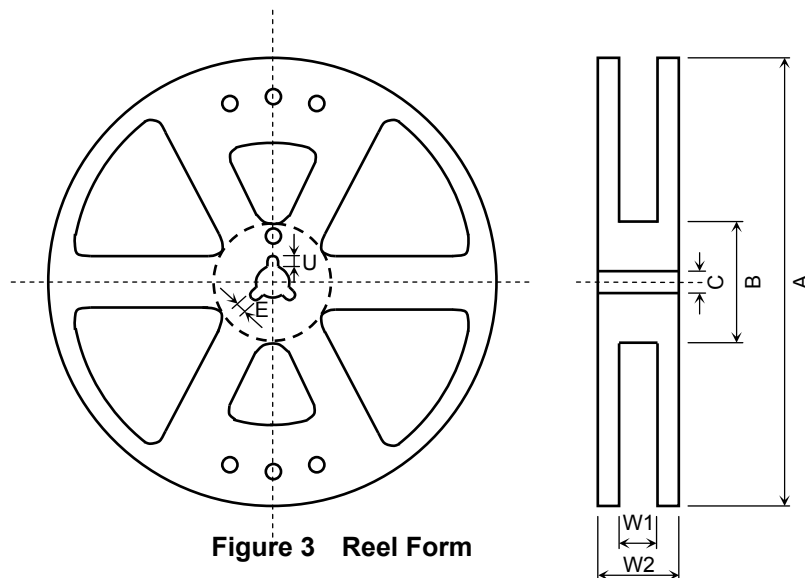
**Table 3 Tape Dimensions**

Unit: mm  
Unless otherwise specified:  $\pm 0.1$

Symbol	Dimension	Remark
A	4.2	—
B	7.6	—
D	5.5	Centre line of indented square hole and sprocket hole
E	1.75	Distance between tape edge and hole center
F	8.0	Cumulative error $\begin{smallmatrix} +0.1 \\ -0.3 \end{smallmatrix}$ (max) per 10 feed holes
G	4.0	Cumulative error $\begin{smallmatrix} +0.1 \\ -0.3 \end{smallmatrix}$ (max) per 10 feed holes
K <sub>0</sub>	2.8	Internal space

### 3.6 Reel

- (1) Material: Plastic
- (2) Dimensions: The reel dimensions are as shown in Figure 3 and Table 4.



### Table 4 Reel Dimensions

Unit: mm

Symbol	Dimension
A	$\Phi 380 \pm 2$
B	$\Phi 80 \pm 1$
C	$\Phi 13 \pm 0.5$
E	$2.0 \pm 0.5$
U	$4.0 \pm 0.5$
W1	$13.5 \pm 0.5$
W2	$17.5 \pm 1.0$

## 4. Packing

Either one reel or five reels of photocouplers are packed in a shipping carton.

## 5. Label Indication

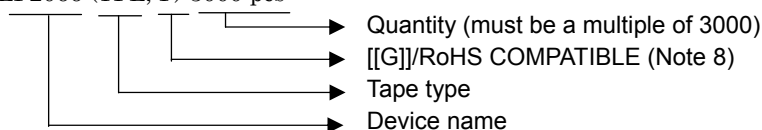
The carton bears a label indicating the product number, the symbol representing classification of standard, the quantity, the lot number and the Toshiba company name.

## 6. Ordering Method

When placing an order, please specify the product number, the tape type and the quantity as shown in the following example.

(Example)

(Example) TLP2066 (TPL, F) 3000 pcs



Note 8 : Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product.

RoHS is the Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronics equipment.

## TOSHIBA Photocoupler

**Option:(V4)**

Attachment : Specifications for EN60747-5-2 option: (V4)

Types : TLP2066(F)

Type designations for “option: (V4)”, which are tested under EN60747 requirements.

Ex.: TLP2066 (V4-TPL,F)      V4 : EN60747 option  
TLP : Standard tape & reel type  
F : [[G]]/RoHS COMPATIBLE (Note 8)

Note: Use TOSHIBA standard type number for safety standard application.

Ex.: TLP2066 (V4-TPL,F) → TLP2066

## EN60747 Isolation Characteristics

Description	Symbol	Rating	Unit
Application classification for rated mains voltage $\leq 150\text{Vrms}$ for rated mains voltage $\leq 300\text{Vrms}$		I-IV I-III	—
Climatic classification		40 / 100 / 21	—
Pollution degree		2	—
Maximum operating insulation voltage	$V_{IORM}$	565	Vpk
Input to output test voltage, Method A $V_{pr}=1.5 \times V_{IORM}$ , type and sample test $t_p=10\text{s}$ , partial discharge $<5\text{pC}$	$V_{pr}$	850	Vpk
Input to output test voltage, Method B $V_{pr}=1.875 \times V_{IORM}$ , 100% production test $t_p=1\text{s}$ , partial discharge $<5\text{pC}$	$V_{pr}$	1060	Vpk
Highest permissible overvoltage (transient overvoltage, $t_{pr}=60\text{s}$ )	$V_{TR}$	6000	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	$I_{si}$ $P_{si}$ $T_{si}$	250 400 150	mA mW °C
Insulation resistance $V_{IO}=500\text{V}$ , $T_a=T_{si}$	$R_{si}$	$\geq 10^9$	$\Omega$

## Insulation Related Specifications

Minimum creepage distance	Cr	4.4mm
Minimum clearance	Cl	4.4mm
Minimum insulation thickness	ti	0.4mm
Comparative tracking index	CTI	175

1. If a printed circuit is incorporated, the creepage distance and clearance may be reduced below this value.  
(e.g. at a standard distance between soldering eye centers of 3.5mm).  
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 circuit.

TÜV test sign : Marking on product  
for EN60747

V

Marking Example : TLP2066

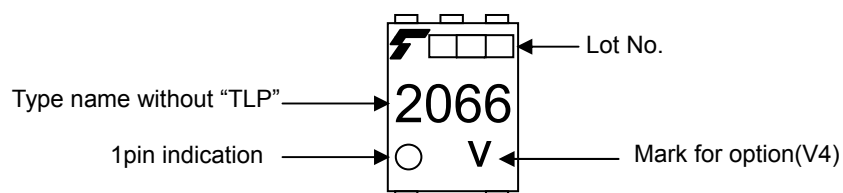


Figure 1 Partial discharge measurement procedure according to EN60747  
Destructive test for qualification and sampling tests.

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

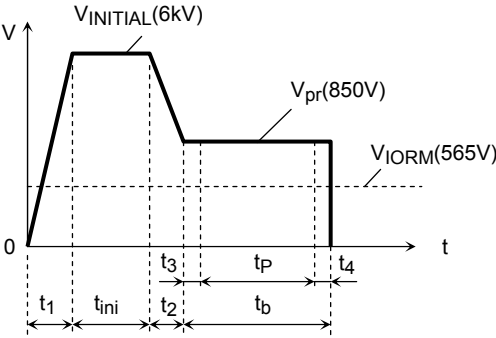


Figure 2 Partial discharge measurement procedure according to EN60747  
Non-destructive test for 100% inspection.

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

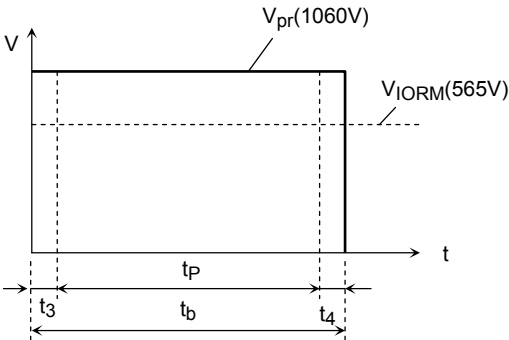
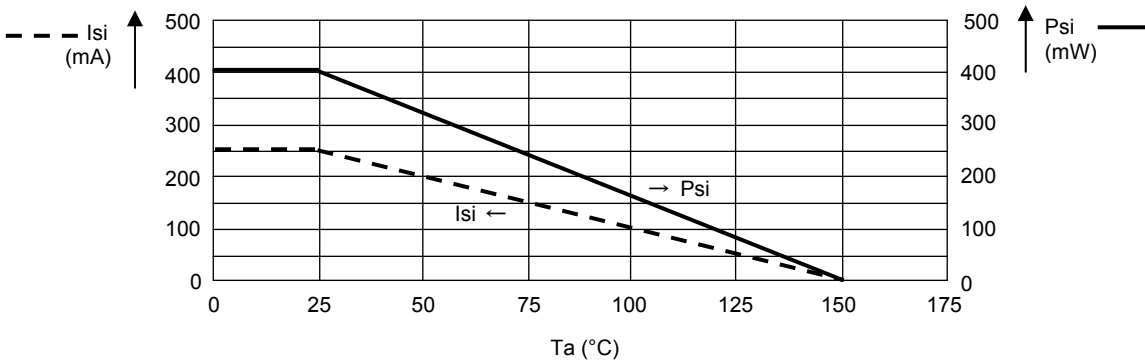


Figure 3 Dependency of maximum safety ratings on ambient temperature



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