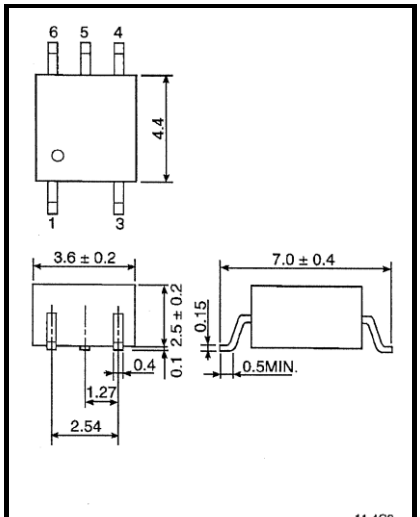
TOSHIBA PHOTOCOUPLER GaAℓAs IRED & PHOTO-IC

TLP2066

FA (Factory Automation)
High Speed Interface
3.3V Supply Voltage

Unit: mm



JEDEC	
JEITA	
TOSHIBA	11-4C2

Weight: 0.09 g (typ.)

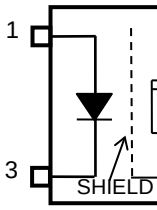
The Toshiba TLP2066 consists of a GaAℓAs light-emitting diode and an integrated high-gain, high-speed photodetector. TLP2066 operates with 3.3 V supply voltage. Toshiba offers TLP116 for supply voltage 5V type.

- 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}=5mA (max)
- Propagation delay time (t_{pHL}/t_{pLH}): 60ns (max)
- Switching speed : 20MBd (typ.) (NRZ)
- Common mode transient immunity : ±15 kV/μs
- Isolation voltage : 3750 V_{rms}
- UL Recognized : UL1577, File No. E67349
- cUL Recognized : CSA Component Acceptance Service No.5A
- Option (V4)
  VDE approved : EN60747-5-5 (Note)
  Maximum operating insulation voltage : 565 V_{pk}
  Highest permissible over voltage : 6000 V_{pk}
- CQC-approved: GB4943.1, GB8898 Japan Factory

仅适用于海拔 2000m 以下地区安全使用

(Note) When a EN60747-5-5 approved type is needed, please designate the "Option(V4)"

Pin Configuration (top view)

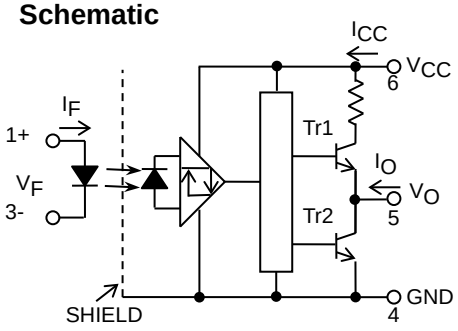


1: ANODE
3: CATHODE
4: GND
5: V_O
6: V_{CC}

Truth Table

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

Schematic



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

Start of commercial production
2007-08

Absolute Maximum Ratings (Ta=25°C)

Characteristic			Symbol	Rating	Unit
LED	Forward current		I_F	25	mA
	Forward current derating (Ta ≥ 85°C)		$\Delta I_F/\Delta Ta$	-0.63	mA/°C
	Peak transient forward current	(Note 1)	I_{FPT}	1	A
	Reverse voltage		V_R	5	V
	Input Power Dissipation		P_D	40	mW
	Input Power Dissipation Derating (Ta ≥ 85°C)		ΔP_D/°C	-1.0	mW/°C
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
	Output Power Dissipation Derating (Ta ≥ 85°C)		ΔP_O/°C	-1.0	mW/°C
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,1minute, R.H. ≤ 60%, Ta=25°C)		(Note 3)	BV_S	3750	V_{rms}

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 P_W ≤ 1μs, 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 μF) 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, V_{CC}=3.0 to 3.6 V)

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

*All typical values are at Ta=25°C, VCC=3.3V, I_F (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 V, f = 1MHz (Note 3)	—	0.8	—	pF
Isolation resistance	R_S	R.H. ≤ 60%,V_S = 500V (Note 3)	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	—	V_{dc}

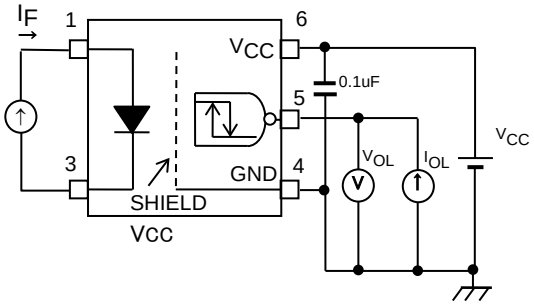
Switching Characteristics
(Unless otherwise specified, Ta=-40 to 100°C, V_{CC}=3.3V)

Characteristic	Symbol	Test Circuit	Conditions		Min.	Typ.	Max.	Unit
Propagation delay time to logic high output	t_{pHL}	5	I_F = 0→12mA	R_{IN}=100Ω, C_L=15pF (Note 7)	—	—	60	ns
Propagation delay time to logic low output	t_{pLH}		I_F = 12→0mA		—	—	60	ns
Propagation delay time to logic high output	t_{pHL}	6	V_{IN} = 0→3.3V (I_F = 0→8mA)	R_{IN}=220Ω, C_{IN}=47pF, C_L=15pF (Note 7)	—	—	60	ns
Propagation delay time to logic low output	t_{pLH}		V_{IN} = 3.3→0V (I_F = 8→0mA)		—	—	60	ns
Switching time dispersion between ON and OFF	$\lvert t_{pHL} - t_{pLH} \rvert$	5	I_F = 12 mA, R_{IN}=100Ω, C_L = 15 pF (Note 7)		—	—	30	ns
Output fall time (90-10%)	t_f	5	I_F = 0→12 mA	R_{IN} = 100Ω, C_L = 15pF (Note 7)	—	4	—	ns
Output rise time (10-90%)	t_r		I_F = 12→0 mA		—	5	—	ns
Common mode transient immunity at high Level output	CM_H	7	V_{CM} = 1000Vp-p, I_F=0mA, V_O(Min) = 2V, Ta = 25°C		15000	—	—	V/μs
Common mode transient immunity at low level output	CM_L		V_{CM} = 1000 Vp-p, I_F = 12 mA, V_O(Max) = 0.8V, Ta=25°C		−15000	—	—	V/μs

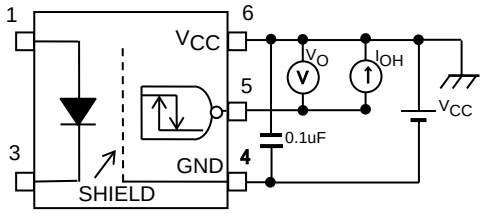
*All typical values are at Ta=25°C

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

TEST CIRCUIT 1: V_{OL}

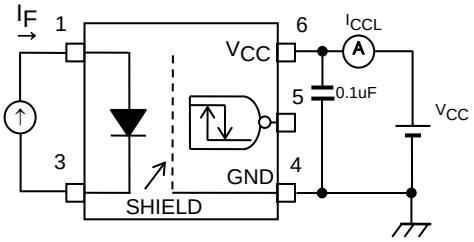


TEST CIRCUIT 2: V_{OH}

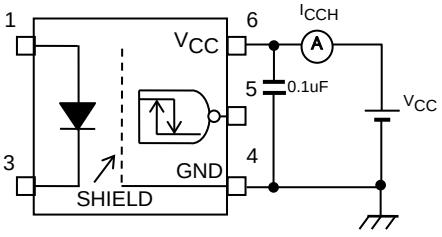


$V_{OH}=V_{CC}-V_O$ [V]

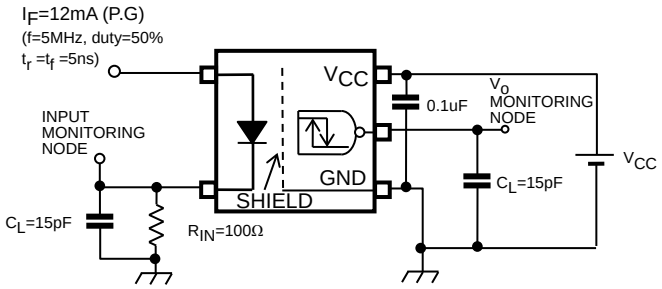
TEST CIRCUIT 3: I_{CCL}

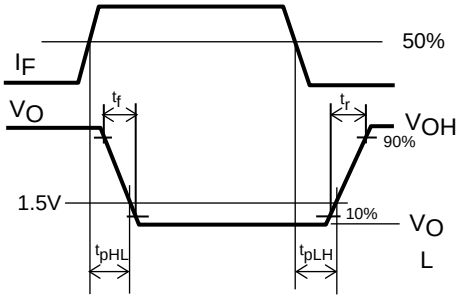


TEST CIRCUIT 4: I_{CCH}



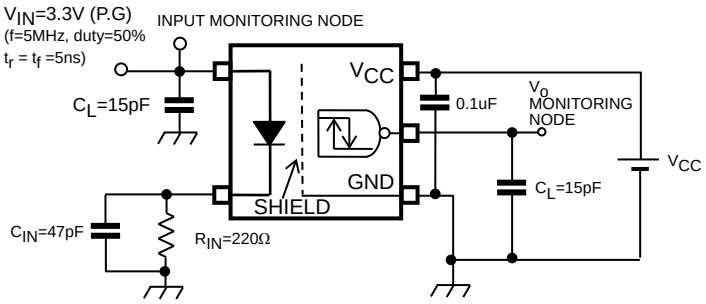
TEST CIRCUIT 5: t_{pHL} , t_{pLH}

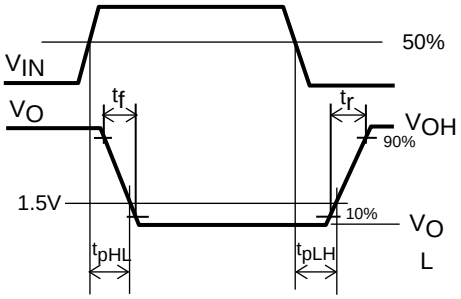




C_L is capacitance of the probe and jig.
(P.G): Pulse Generator

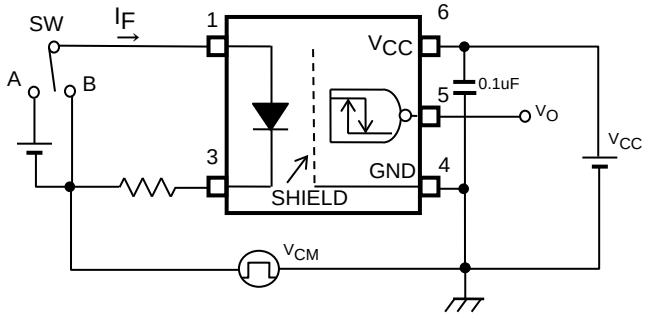
TEST CIRCUIT 6: t_{pHL}, t_{pLH}

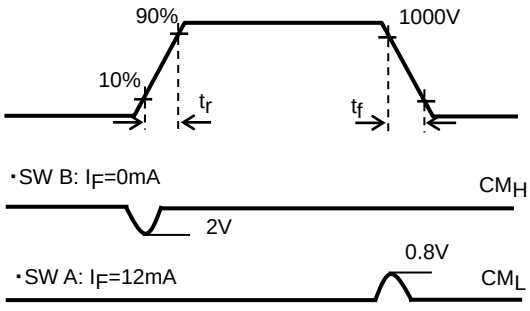




C_L is capacitance of the probe and jig.
(P.G): Pulse Generator

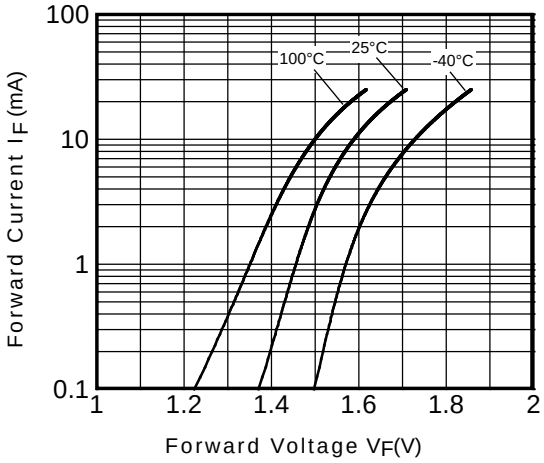
TEST CIRCUIT 7: Common-Mode Transient Immunity Test Circuit



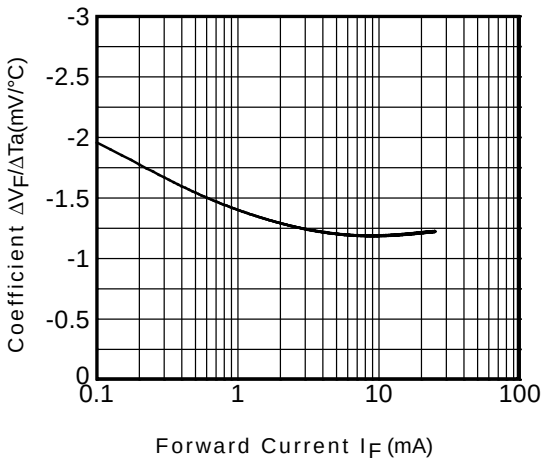


$$CM_H = \frac{800(V)}{t_r(\mu s)} \qquad CM_L = \frac{800(V)}{t_f(\mu s)}$$

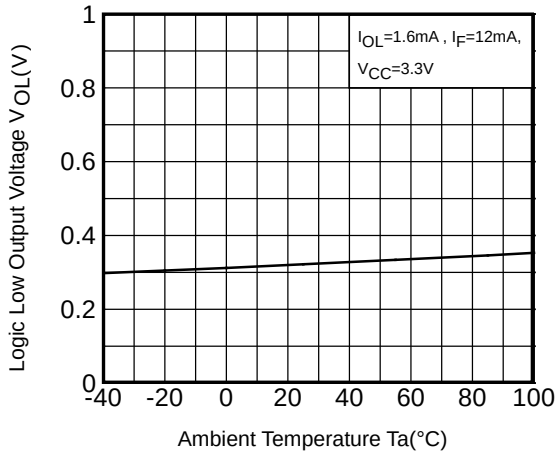
I_F-V_F



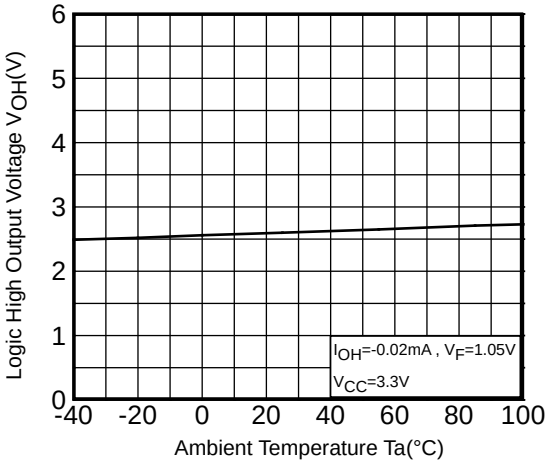
$\Delta V_F/\Delta Ta$-I_F



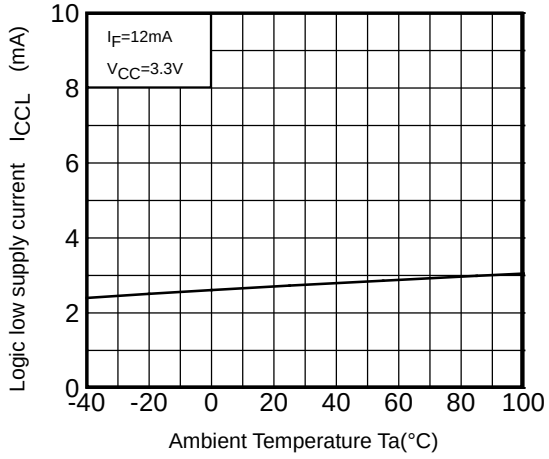
V_{OL}-Ta



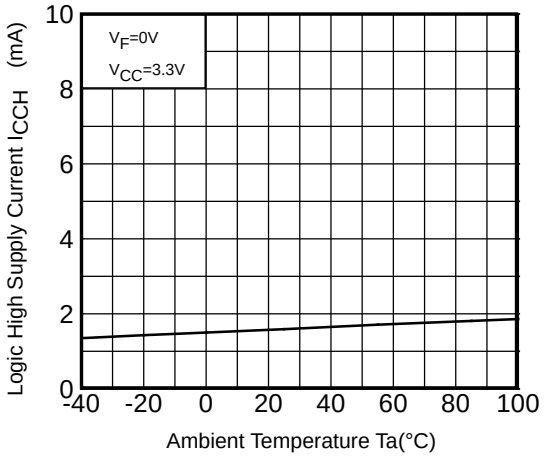
V_{OH}-Ta



I_{CCL}-Ta

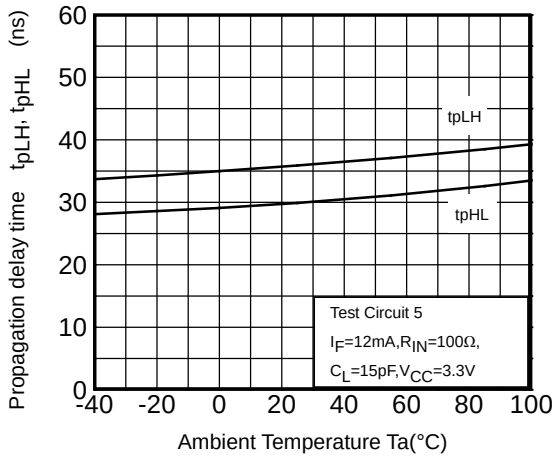


I_{CCH}-Ta

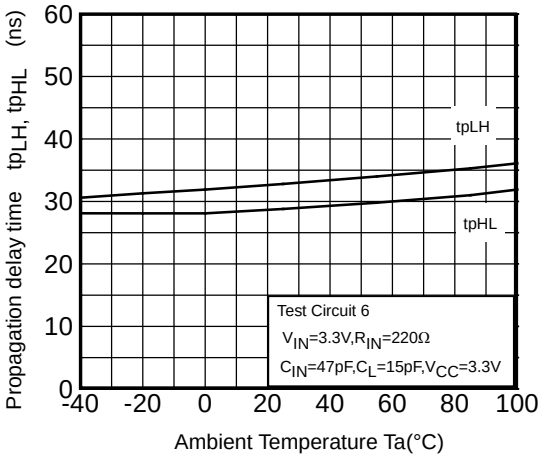


*: The above graphs show typical characteristics.

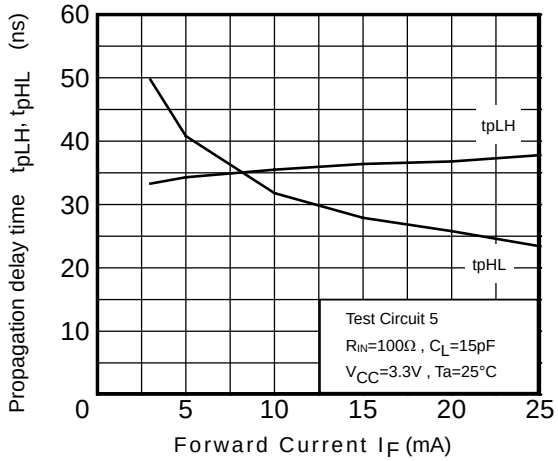
t_{pHL},t_{pLH}-Ta



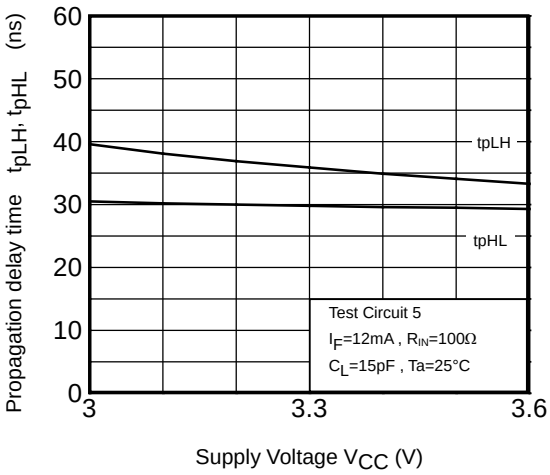
t_{pHL},t_{pLH}-Ta



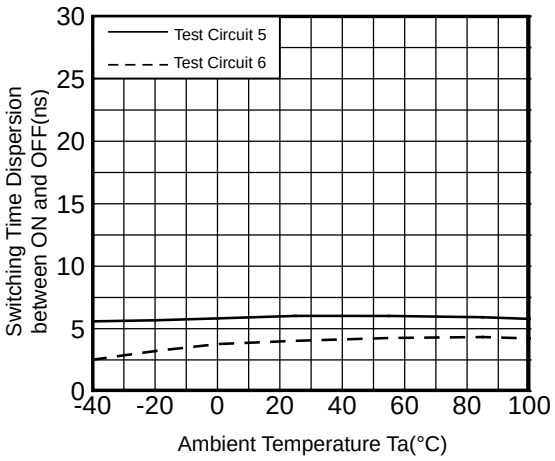
t_{pHL},t_{pLH}-I_F



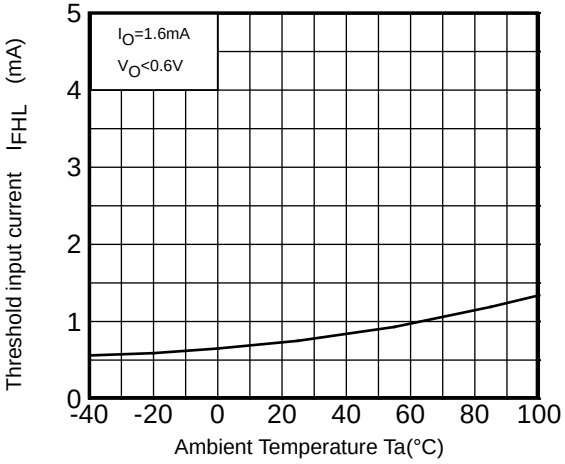
t_{pHL},t_{pLH}-V_{CC}



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



I_{FHL}-Ta



*: The above graphs show typical characteristics.

Soldering and Storage

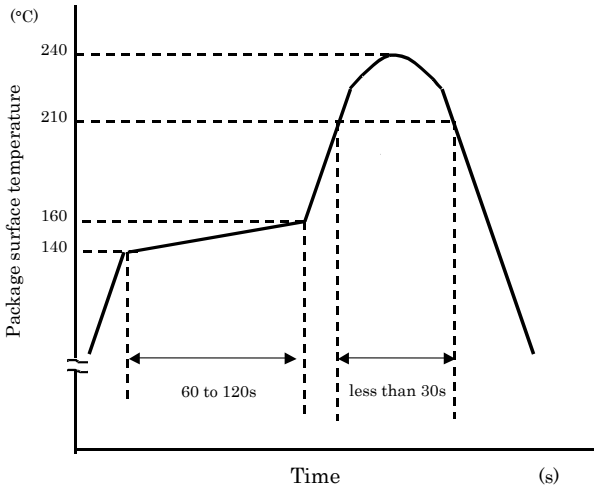
1. Soldering

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

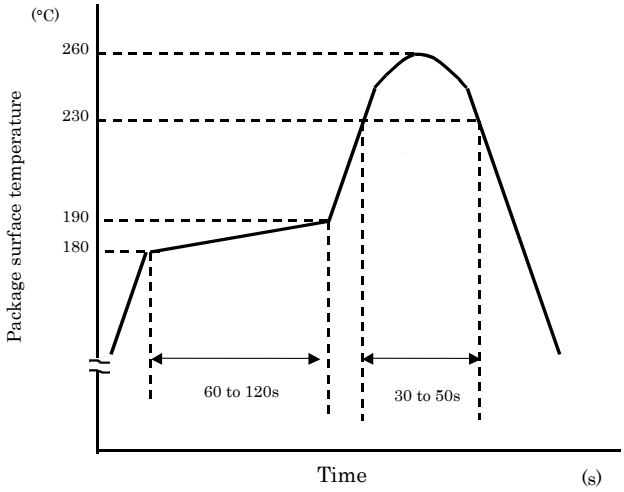
·Temperature profile example of lead (Pb) solder



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.

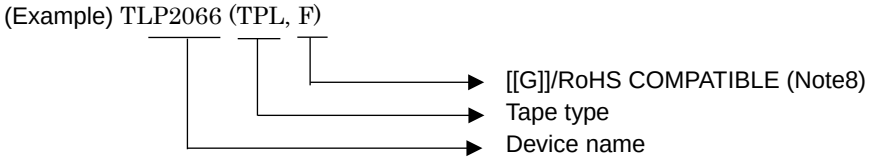
Specification for Embossed–Tape Packing (TPL)(TPR) for Mini-flat Coupler

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.

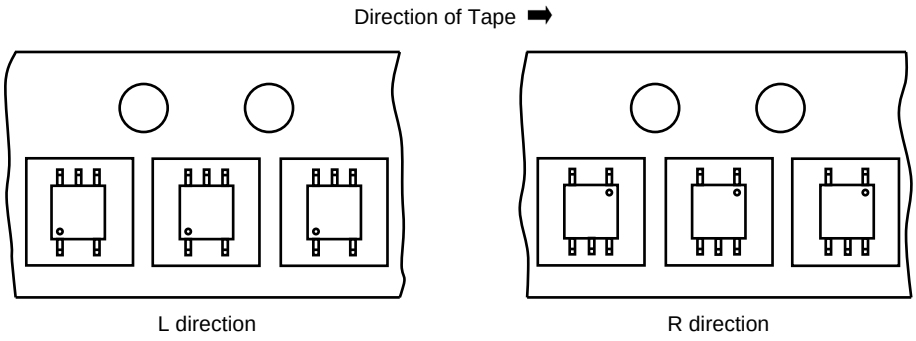


Figure 1 Device Orientation

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 device	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.

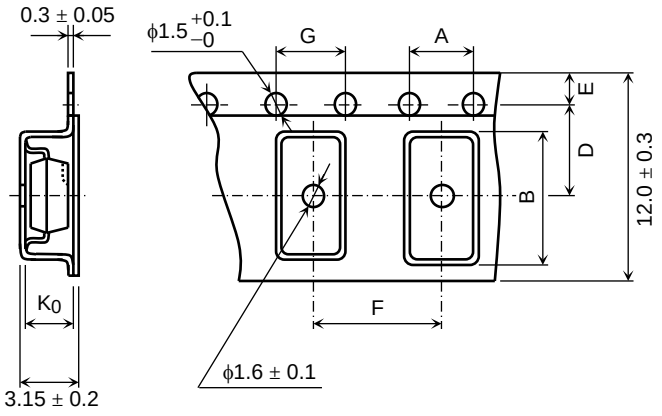


Figure 2 Tape Forms

Table 3 Tape Dimensions

Unit: mm
Unless otherwise specified: ±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 $^{+0.1}_{-0.3}$ (max) per 10 feed holes
G	4.0	Cumulative error $^{+0.1}_{-0.3}$ (max) per 10 feed holes
K_0	2.8	Internal space

3.6 Reel

(1) Material: Plastic

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

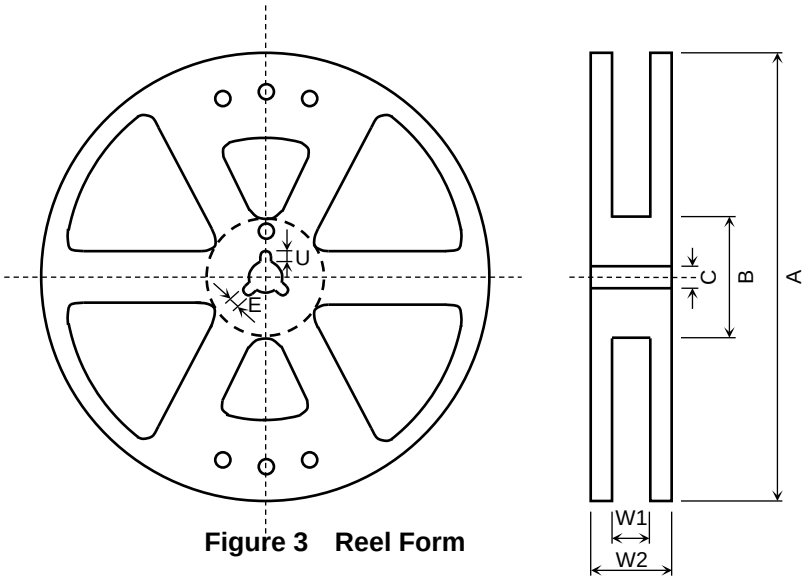


Figure 3 Reel Form

Table 4 Reel Dimensions

Unit: mm

Symbol	Dimension
A	Φ380±2
B	Φ80±1
C	Φ13±0.5
E	2.0±0.5
U	4.0±0.5
W1	13.5±0.5
W2	17.5±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

- Quantity (must be a multiple of 3000)
- [[G]]/RoHS COMPATIBLE (Note 8)
- Tape type
- Device name

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 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.

TOSHIBA Photocoupler

Option:(V4)

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

Types : TLP2066(F)

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

Ex.: TLP2066 (V4-TPL,F) V4 : EN60747 option
TPL : 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 ≤ 150Vrms for rated mains voltage ≤ 300Vrms		 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}=1.6 × V_{IORM}, type and sample test tp=10s, partial discharge<5pC	V_{pr}	904	Vpk
Input to output test voltage, Method B V_{pr}=1.875 × V_{IORM}, 100% production test tp=1s, partial discharge<5pC	V_{pr}	1060	Vpk
Highest permissible overvoltage (transient overvoltage, tpr=60s)	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, Psi=0) power (output or total power dissipation) temperature	 I_{si} P_{si} T_{si}	 250 400 150	 mA mW °C
Insulation resistance V_{IO}=500V, Ta=T_{si}	R_{si}	≧ 10^9	Ω

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. 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

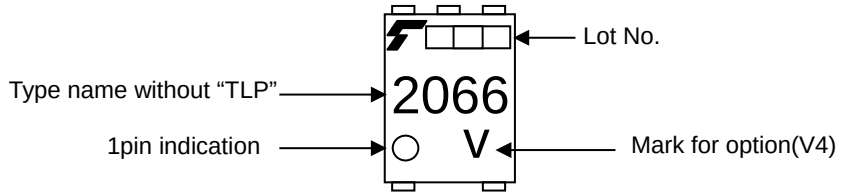


Figure 1 Partial discharge measurement procedure according to EN60747
Destructive test for qualification and sampling tests.

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

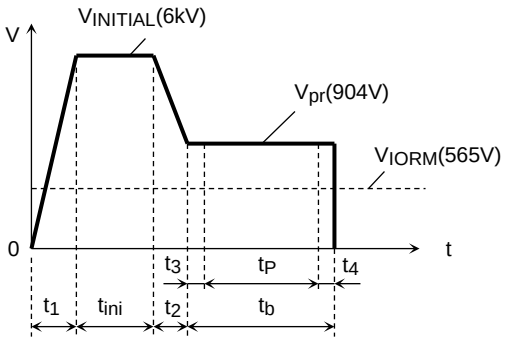


Figure 2 Partial discharge measurement procedure according to EN60747
Non-destructive test for100% inspection.

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

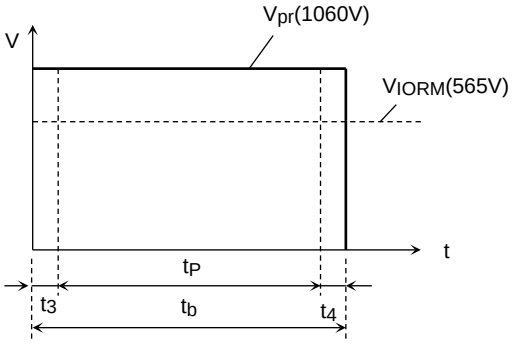
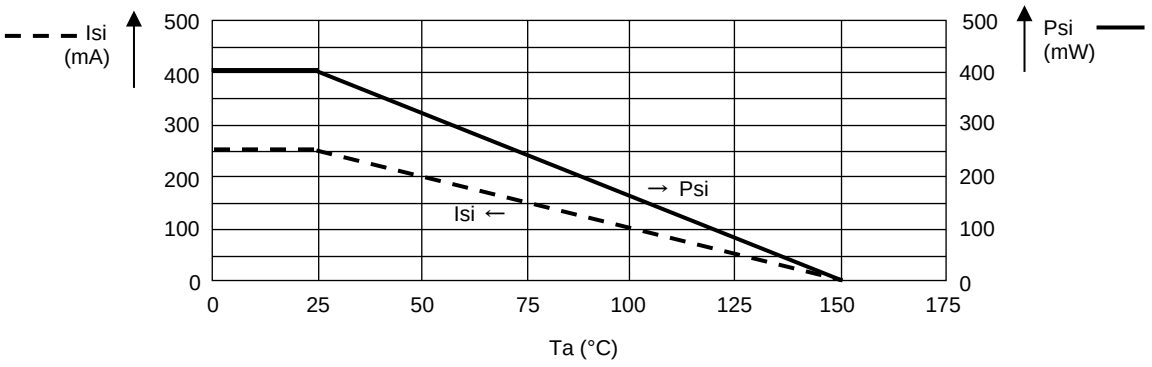


Figure 3 Dependency of maximum safety ratings on ambient temperature



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