

TOSHIBA Photocoupler GaAs Ired &amp; Photo-Transistor

# TLP284

Programmable Controllers  
AC/DC-Input Module  
Hybrid ICs

TLP284 consist of photo transistor, optically coupled to two gallium arsenide infrared emitting diode connected inverse parallel, and can operate directly by AC input current.

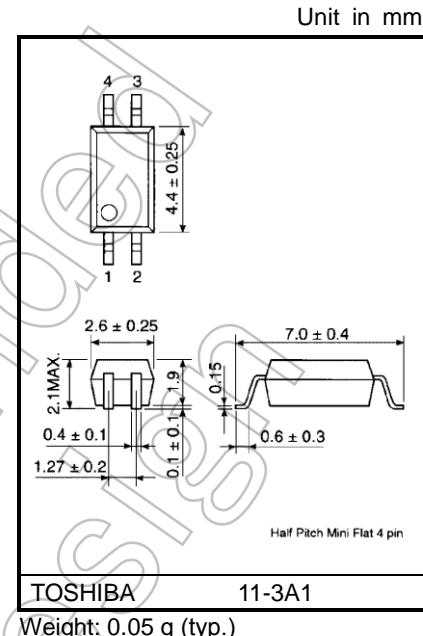
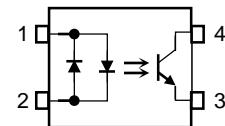
Since TLP284 are guaranteed wide operating temperature ( $T_a = -55$  to  $110$  °C) and high isolation voltage (3750 Vrms), it's suitable for high-density surface mounting applications such as programmable controllers and hybrid ICs.

- Collector-emitter voltage : 80 V (min)
- Current transfer ratio : 50% (min)  
Rank GB : 100% (min)
- Isolation voltage : 3750 Vrms (min)
- Guaranteed performance over -55 to 110 °C
- UL Recognized : UL1577, File No. E67349
- cUL Recognized : CSA Component Acceptance Service No.5A
- Option (V4)  
VDE approved : EN60747-5-5  
Maximum operating insulation voltage : 707 Vpk  
Highest permissible over voltage : 6000 Vpk

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

Construction Mechanical Rating

Creepage Distance	5.0 mm (min)
Clearance	5.0 mm (min)
Insulation Thickness	0.4 mm (min)

**Pin Configuration (top view)**

- 1 : Anode  
Cathode
- 2 : Cathode  
Anode
- 3 : Emitter
- 4 : Collector

Start of commercial production  
2008-12

## Current Transfer Ratio

TYPE	Classi- Fication (Note1)	Current Transfer Ratio (%) (IC / IF)		Marking of Classification	
		IF = 5 mA, VCE = 5 V, Ta = 25°C			
		Min	Max		
TLP284	Blank	50	600	Blank, YE, GR, BL, GB	
	Rank Y	50	150	YE	
	Rank GR	100	300	GR	
	Rank BL	200	600	BL	
	Rank GB	100	600	GB, GR, BL	

Note1: Ex. rank GB: TLP284 (GB)

Note: Application type name for certification test, please use standard product type name, i.e.

TLP284 (GB): TLP284

Note: For the supply status of rank Y and BL products, please contact with our sales representative.

## Absolute Maximum Ratings (Ta = 25°C)

Characteristic		Symbol	Rating	Unit
LED	Forward current	IF(RMS)	±50	mA
	Forward current derating (Ta ≥ 75°C)	ΔIF /°C	-1.0	mA/°C
	Pulse forward current (Note 1)	IFP	±1	A
	Diode power dissipation	PD	100	mW
	Diode power dissipation derating (Ta ≥ 75°C)	ΔPD/°C	-2.0	mW/°C
	Junction temperature	T <sub>j</sub>	125	°C
Detector	Collector-emitter voltage	V <sub>CEO</sub>	80	V
	Emitter-collector voltage	V <sub>ECO</sub>	7	V
	Collector current	I <sub>c</sub>	50	mA
	Collector power dissipation	P <sub>c</sub>	150	mW
	Collector power dissipation derating (Ta ≥ 25°C)	ΔP <sub>c</sub> /°C	-1.5	mW/°C
	Junction temperature	T <sub>j</sub>	125	°C
Storage temperature range		T <sub>stg</sub>	-55 to 125	°C
Operating temperature range		T <sub>opr</sub>	-55 to 110	°C
Lead soldering temperature (10 s)		T <sub>sol</sub>	260	°C
Total package power dissipation		P <sub>T</sub>	200	mW
Total package power dissipation derating (Ta ≥ 25°C)		ΔP <sub>T</sub> /°C	-2.0	mW/°C
Isolation voltage (Note 2)		BVs	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 ≤ 100 μs, frequency 100 Hz

Note 2: AC, 60 s, R.H.≤ 60%,

Device considered a two terminal device: LED side pins shorted together and detector side pins shorted together.

## Electrical Characteristics (Ta = 25°C)

Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
LED	Forward voltage	VF	IF = ±10 mA	1.0	1.15	1.3	V
	Capacitance	CT	V = 0 V, f = 1 MHz	—	60	—	pF
Detector	Collector-emitter breakdown voltage	V(BR)CEO	IC = 0.5 mA	80	—	—	V
	Emitter-collector breakdown voltage	V(BR)ECO	IE = 0.1 mA	7	—	—	V
Collector dark current (Note 2)	IC <sub>EO</sub>	V <sub>CE</sub> = 48 V, Ambient light below (100 lx)	(Note 1)	0.01 (2)	0.1 (10)	μA	
		V <sub>CE</sub> = 48 V, Ta = 85°C Ambient light below (100 lx)	(Note 1)	—	2 (4)	50 (50)	μA
Capacitance (collector to emitter)	C <sub>CE</sub>	V = 0 V, f = 1 MHz	—	10	—	—	pF

Note 1: Irradiation to marking side using standard light bulb.

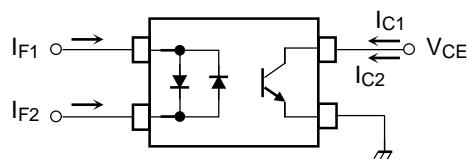
Note 2: Because of the construction, leak current might be increased by ambient light. Please use photocoupler with less ambient light.

## Coupled Electrical Characteristics (Ta = 25°C)

Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit
Current transfer ratio	IC/IF	IF = ±5 mA, V <sub>CE</sub> = 5 V Rank GB	50	—	600	%
			100	—	600	
Saturated CTR	IC/IF(sat)	IF = ±1 mA, V <sub>CE</sub> = 0.4 V Rank GB	—	60	—	%
			30	—	—	
Collector-emitter saturation voltage	V <sub>CE(sat)</sub>	IC = 2.4 mA, IF = ±8 mA	—	—	0.4	V
		IC = 0.2 mA, IF = ±1 mA Rank GB	—	0.2	—	
Off-state collector current	IC(off)	VF = 0.7 V, V <sub>CE</sub> = 48 V	—	—	10	μA
CTR symmetry	IC(ratio)	IC (IF = -5 mA) / IC (IF = 5 mA) (Note 1)	0.33	—	3	—

Note 1:

$$I_{C(ratio)} = \frac{I_{C2}(I_F = I_{F2}, V_{CE} = 5V)}{I_{C1}(I_F = I_{F1}, V_{CE} = 5V)}$$



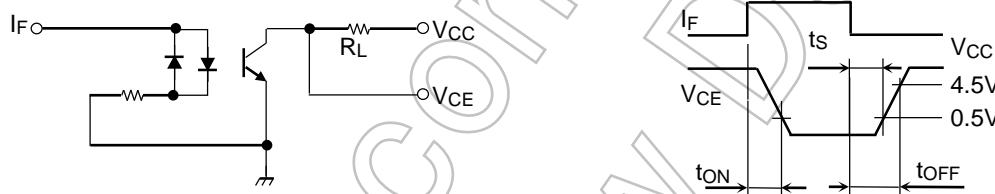
## Isolation Characteristics (Ta = 25°C)

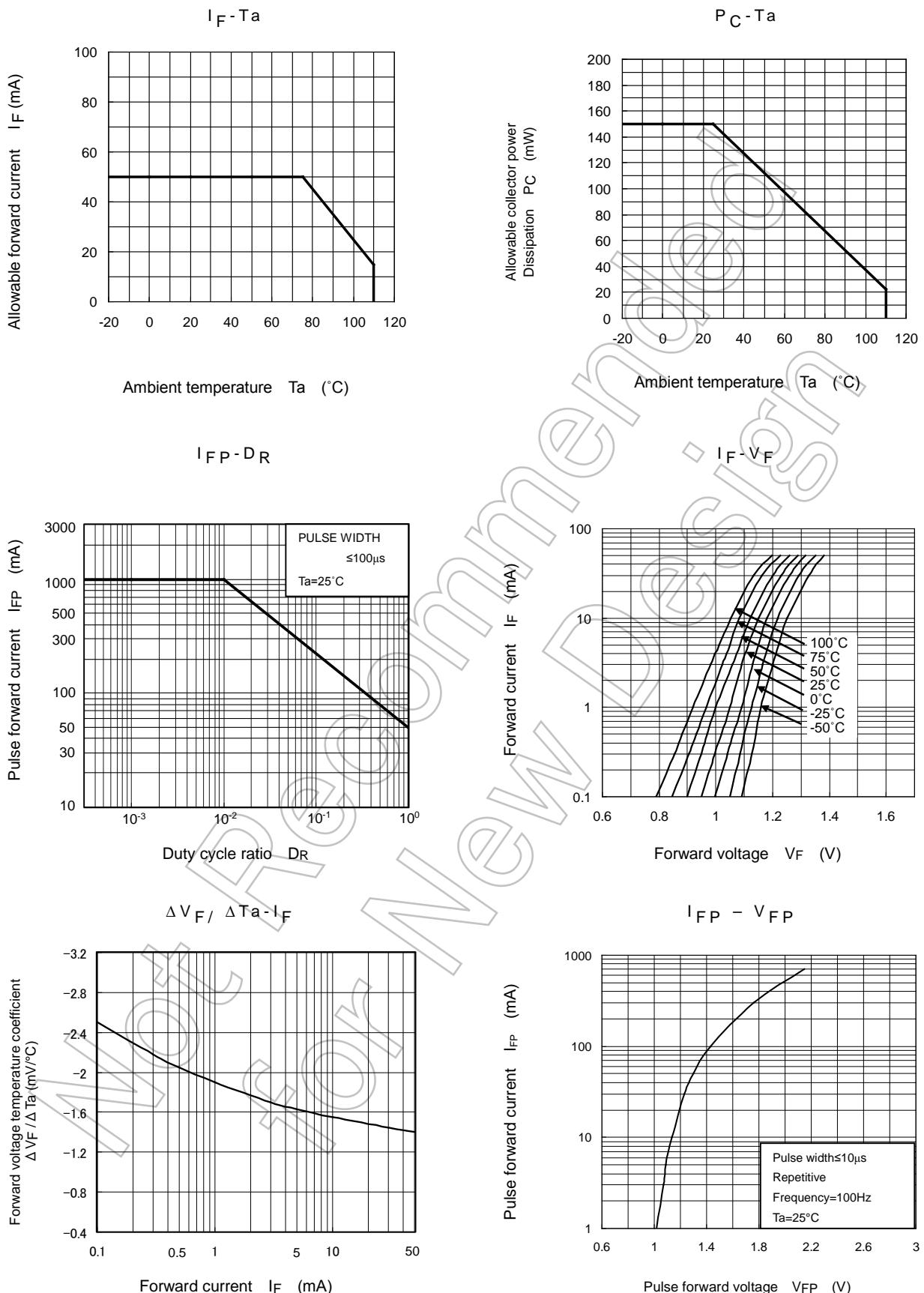
Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit
Capacitance input to output	C <sub>S</sub>	V <sub>S</sub> = 0 V, f = 1 MHz	—	0.8	—	pF
Isolation resistance	R <sub>S</sub>	V <sub>S</sub> = 500 V, R.H.≤ 60%	1x10 <sup>12</sup>	10 <sup>14</sup>	—	Ω
Isolation voltage	BVS	AC, 60 s	3750	—	—	V <sub>rms</sub>
		AC, 1 s, in oil	—	10000	—	
		DC, 60 s, in oil	—	10000	—	V <sub>dc</sub>

## Switching Characteristics (Ta = 25°C)

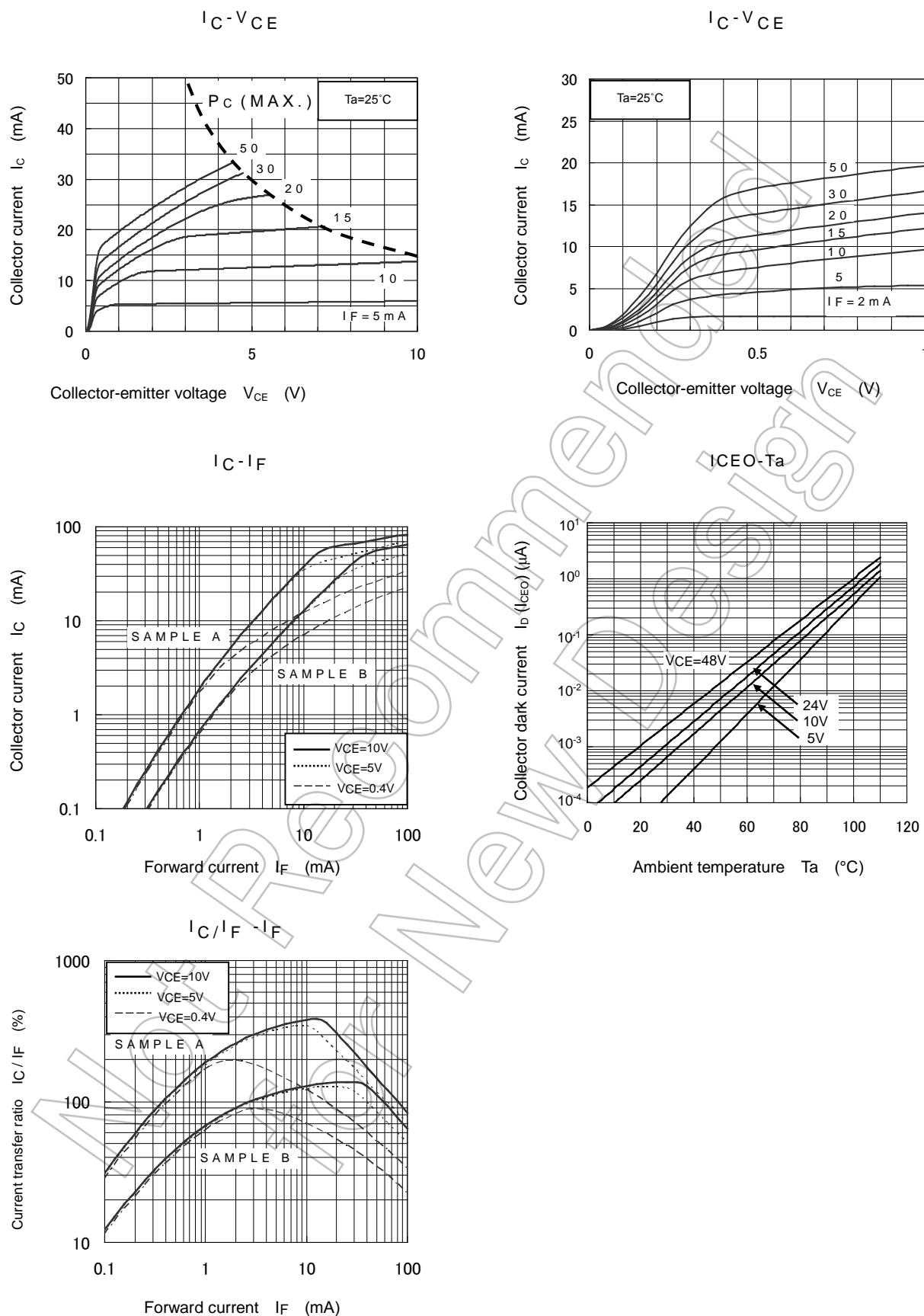
Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit
Rise time	t <sub>r</sub>	V <sub>CC</sub> = 10 V, I <sub>C</sub> = 2 mA R <sub>L</sub> = 100 Ω	—	2	—	μs
Fall time	t <sub>f</sub>		—	3	—	
Turn-on time	t <sub>on</sub>		—	3	—	
Turn-off time	t <sub>off</sub>		—	3	—	
Turn-on time	t <sub>ON</sub>	R <sub>L</sub> = 1.9 kΩ V <sub>CC</sub> = 5 V, I <sub>F</sub> = ±16 mA (Fig. 1)	—	2	—	μs
Storage time	t <sub>s</sub>		—	25	—	
Turn-off time	t <sub>OFF</sub>		—	40	—	

Fig. 1: Switching time test circuit

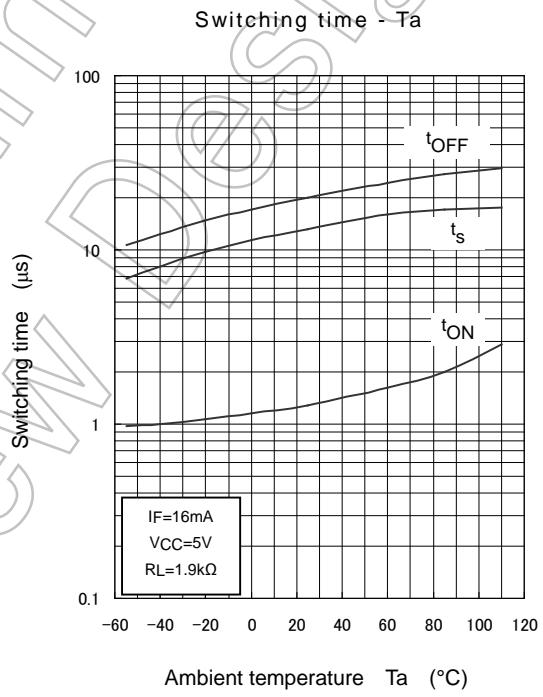
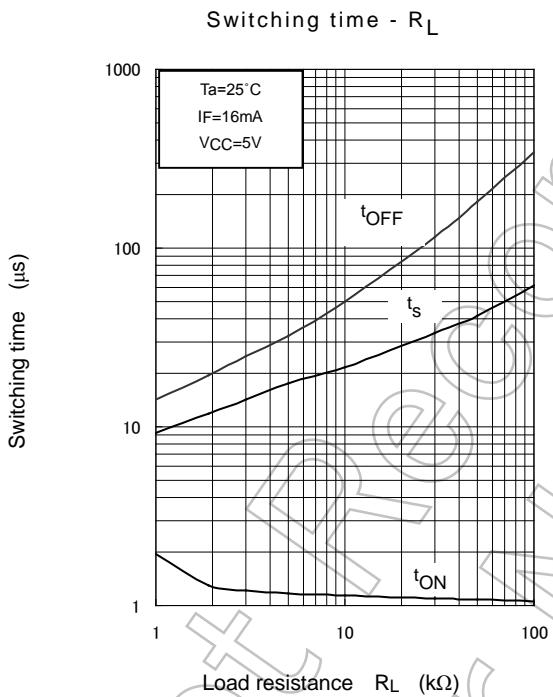
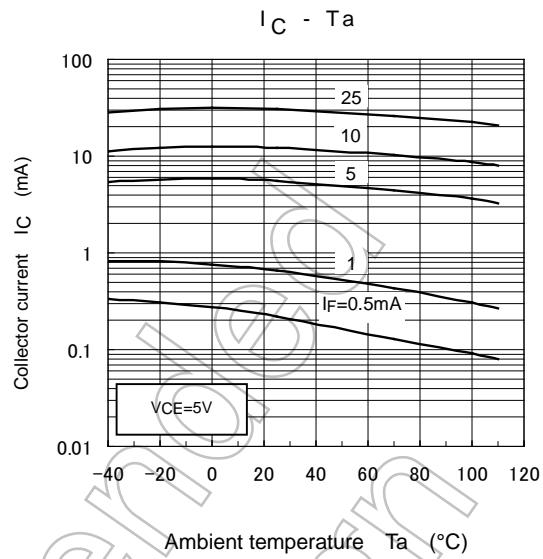
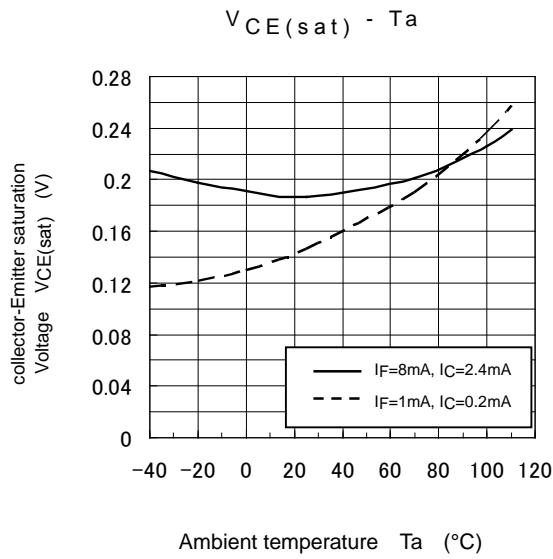




\*The above graphs show typical characteristic.



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## Soldering and Storage

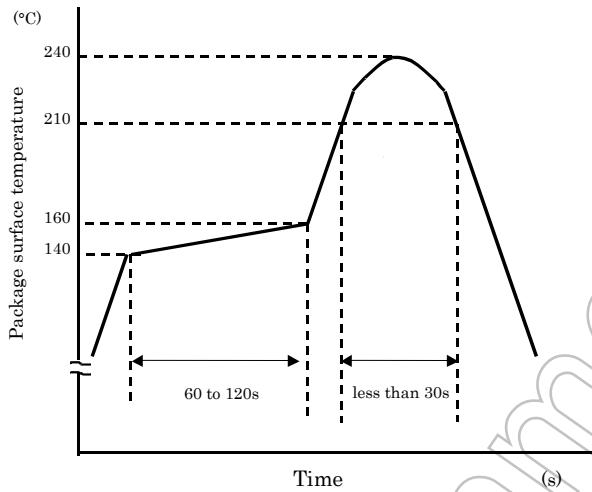
### 1. Soldering

#### 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.

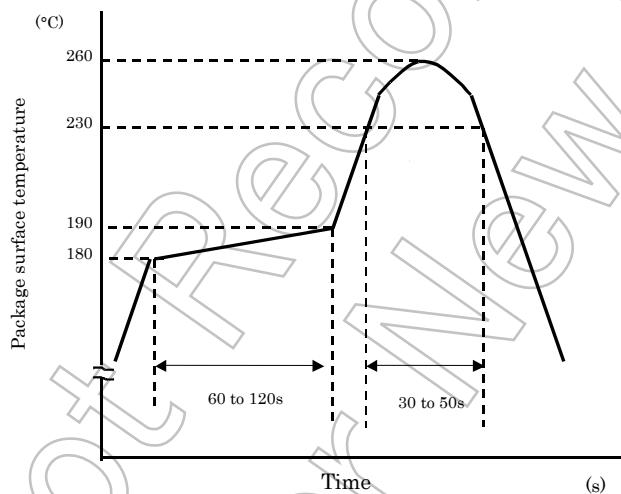
##### 1) Using solder reflow

###### ·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.

Not Recommended for New Design

# Embossed-Tape Packing (TP) Specification for Mini-Flat Couplers

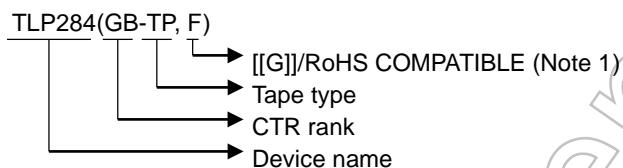
## 1. Applicable Package

Package	Product Type
SOP4	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.

(Example)



Note 1: Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product.

The 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.

## 3. Tape Dimensions

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

Device orientation in the recesses is as shown in Figure 2.

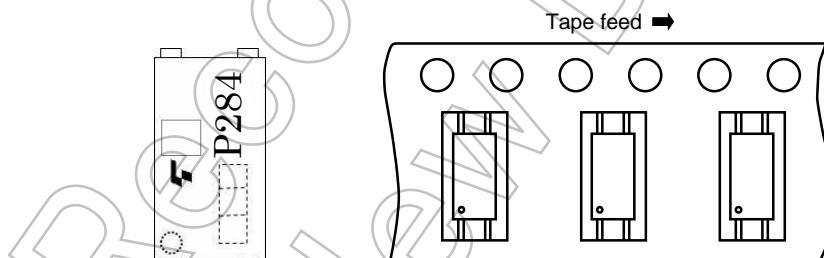


Figure 2 Device Orientation

### 3.2 Tape Packing Quantity: 2500 devices per reel

### 3.3 Empty Device Recesses Are as Shown in Table 1.

Table 1 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 device (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 3 and table 2.

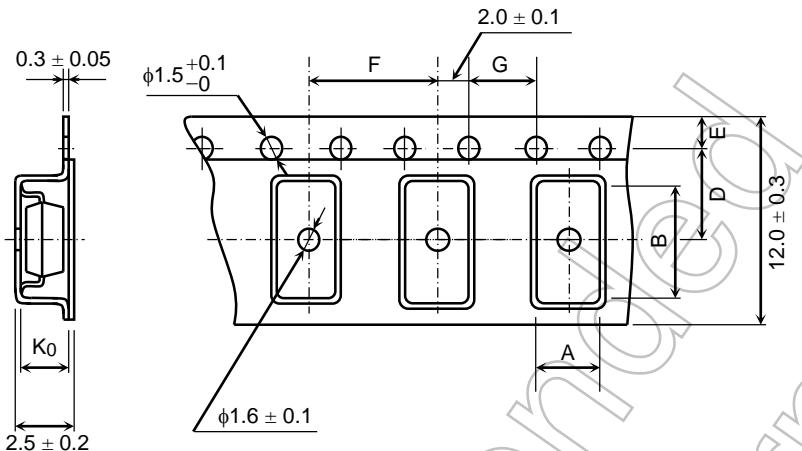


Figure 3 Tape Forms

Table 2 Tape Dimensions

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

Symbol	Dimension	Remark
A	3.1	—
B	7.5	—
D	5.5	Center 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
$K_0$	2.3	Internal space

### 3.6 Reel

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

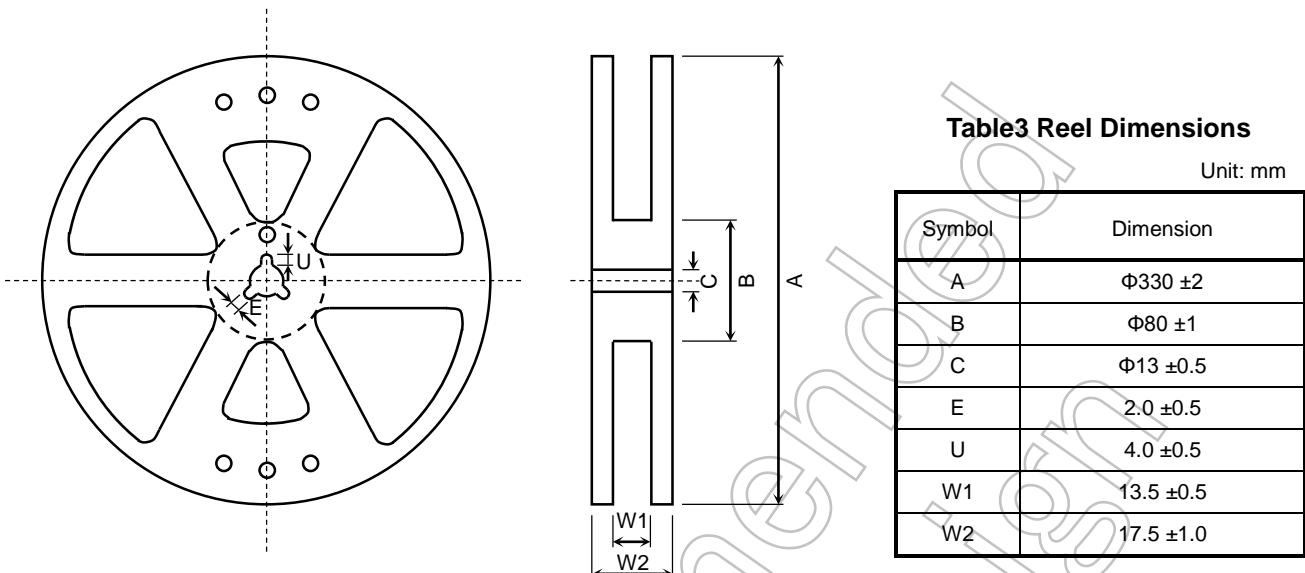


Figure 4 Reel Form

### 4. Packing

Either one reel or ten reels of photocoupler 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 CTR rank, the tape type and the quantity as shown in the following example.

Example)

TLP284(GB-TP, F) 2500 pcs.

Quantity (must be a multiple of 2500)  
 [[G]]/RoHS COMPATIBLE (Note 1)  
 Tape type  
 CTR rank  
 Device name

Note 1: Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product.

The 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.

## EN60747-5-5 Option (V4) Specification

Types : TLP284 (Note 1)

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

Ex.: TLP284 (V4-GB-TP,F)      V4 : EN60747 option  
     GB: CTR rank type  
     TP : Standard tape & reel type  
     F : [[G]]/RoHS COMPATIBLE (Note 2)

Note 1: Use TOSHIBA standard type number for safety standard application.

Ex.: TLP284 (V4-GB-TP,F) → TLP284

Note 2: Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product.

The 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.

### 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		55 / 110 / 21	—
Pollution degree		2	—
Maximum operating insulation voltage	VIORM	707	Vpk
Input to output test voltage, Method A  Vpr=1.6 × VIORM, type and sample test tp=10s, partial discharge<5pC	Vpr	1131	Vpk
Input to output test voltage, Method B  Vpr=1.875 × VIORM, 100% production test tp=1s, partial discharge<5pC	Vpr	1325	Vpk
Highest permissible overvoltage (transient overvoltage, tpr=60s)	VTR	6000	Vpk
Safety limiting values (max. permissible ratings in case of fault, also refer to thermal derating curve)  current (input current IF, Psi=0) power (output or total power dissipation) temperature	Isi Psi Tsi	250 400 150	mA mW °C
Insulation resistance      VI0=500 V, Ta=Tsi	Rsi	≥10 <sup>9</sup>	Ω

**Insulation Related Specifications**

Minimum creepage distance	Cr	5.0 mm
Minimum clearance	Cl	5.0 mm
Minimum insulation thickness	ti	0.4 mm
Comparative tracking index	CTI	175

Note: 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.

Note: 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.

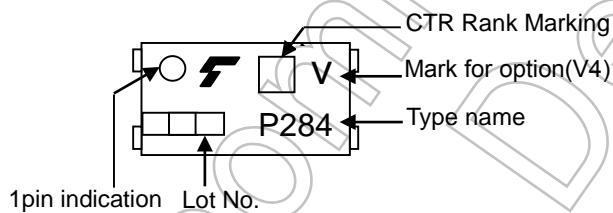
VDE test sign:

V

Marking on packing:



Marking Example:



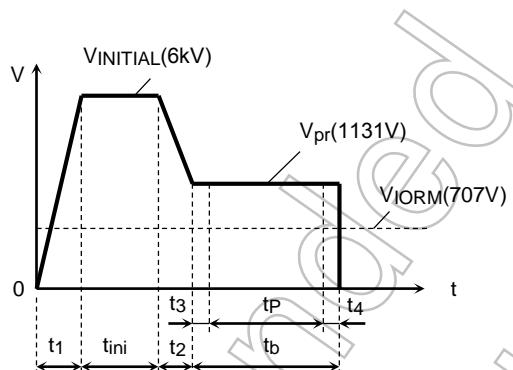
Figure

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



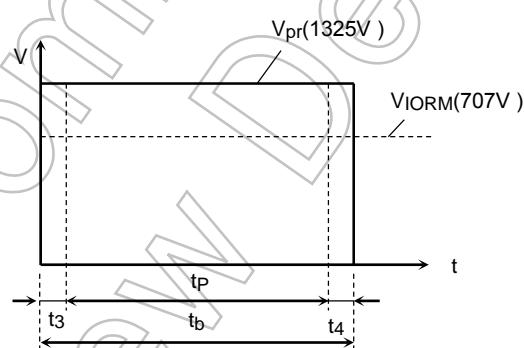
Figure

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

Method B

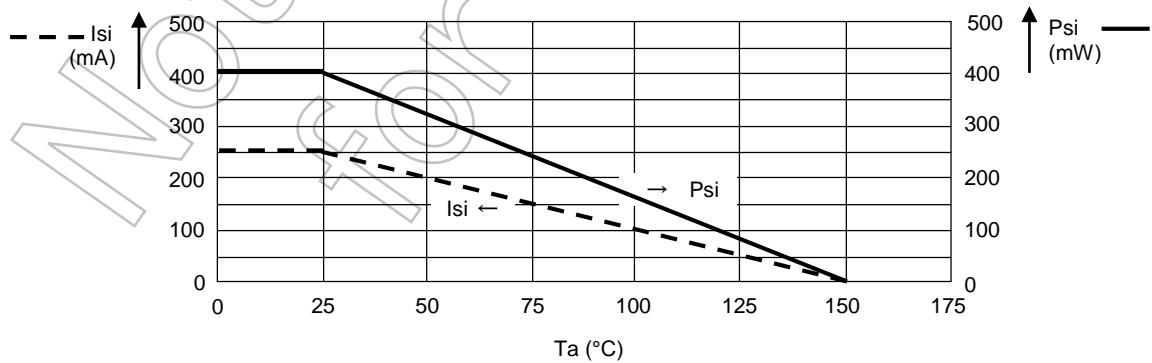
(for sample test,non-  
destructive test)

$t_3, t_4$	= 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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