

# TLP290-4

## 1. Applications

- Programmable Logic Controllers (PLCs)
- Switching Power Supplies
- Simplex/Multiplex Data Transmission

## 2. General

The Toshiba TLP290-4 consists of phototransistors optically coupled to gallium arsenide infrared emitting diodes. The TLP290-4 Photocoupler is housed in the very small and thin SO16 package.

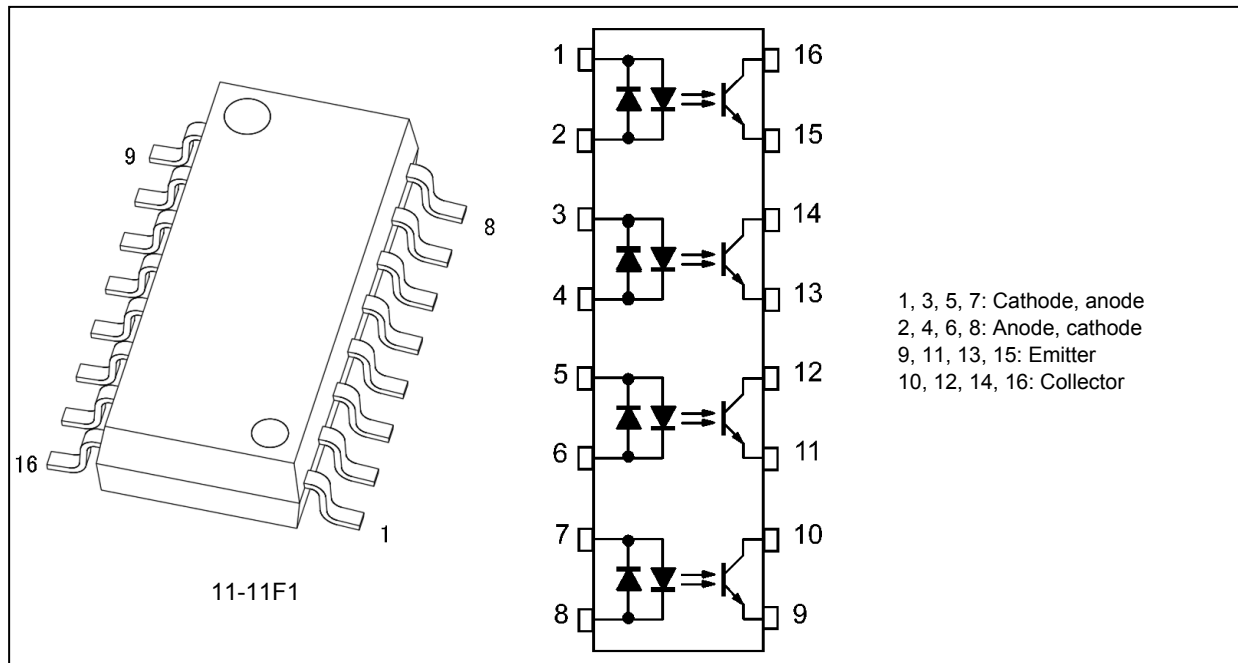
Since the TLP290-4 is guaranteed over a wide operating temperature range ( $T_a = -55$  to  $110^\circ\text{C}$ ), it is suitable for high-density surface mount applications such as programmable controllers.

## 3. Features

- (1) Collector-emitter voltage: 80 V (min)
- (2) Current transfer ratio: 50% (min)  
GB Rank: 100% (min)
- (3) Isolation voltage: 2500 Vrms (min)
- (4) Operating temperature:  $-55$  to  $110^\circ\text{C}$
- (5) Safety standards  
UL-approved UL1577 File No.E67349  
cUL-approved CSA Component Acceptance Service No.5A File No.E67349  
VDE approved EN60747-5-5 Certificate No. 40009347 (Note)

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

## 4. Packaging and Pin Configuration



Start of commercial production

2012-03

**5. Principle of Operation**

**5.1. Mechanical Parameters**

Characteristics	Min	Unit
Creepage distances	5.0	mm
Clearance	5.0	
Internal isolation thickness	0.1	

**6. Absolute Maximum Ratings (Note) (Unless otherwise specified, T<sub>a</sub> = 25°C)**

	Characteristics	Symbol	Note	Rating	Unit	
LED	R.M.S. forward current	I <sub>F(RMS)</sub>		±50	mA	
	Input forward current derating (T <sub>a</sub> ≥ 50°C)	ΔI <sub>F</sub> /ΔT <sub>a</sub>		-0.67	mA/°C	
	Input forward current (pulsed)	I <sub>FP</sub>	(Note 1)	±1	A	
	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		
	Collector current	I <sub>C</sub>		50	mA	
	Collector power dissipation	P <sub>C</sub>		100	mW	
	Collector power dissipation derating (1 circuit) (T <sub>a</sub> ≥ 25°C)	ΔP <sub>C</sub> /ΔT <sub>a</sub>		-1.0	mW/°C	
	Junction temperature	T <sub>j</sub>		125	°C	
Common	Operating temperature	T <sub>opr</sub>		-55 to 110		
	Storage temperature	T <sub>stg</sub>		-55 to 125		
	Lead soldering temperature (10 s)	T <sub>sol</sub>		260		
	Total power dissipation (1 circuit)	P <sub>T</sub>		170		mW
	Input power dissipation derating(1 circuit) (T <sub>a</sub> ≥ 25°C)	ΔP <sub>D</sub> /ΔT <sub>a</sub>		-1.7		mW/°C
	Isolation voltage AC, 60 s, R.H. ≤ 60%	BV <sub>S</sub>	(Note 2)	2500	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 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 (PW) ≤ 100 μs, f = 100 Hz

Note 2: This device is considered as a two-terminal device: Pins 1, 2, 3, 4, 5, 6, 7 and 8 are shorted together, and pins 9, 10, 11, 12, 13, 14, 15 and 16 are shorted together.

**7. Electrical Characteristics (Unless otherwise specified, T<sub>a</sub> = 25°C)**

	Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
LED	Input forward voltage	V <sub>F</sub>		I <sub>F</sub> = ±10 mA	1.1	1.20	1.4	V
	Input capacitance	C <sub>t</sub>		V = 0 V, f = 1 MHz	—	30	—	pF
Detector	Collector-emitter breakdown voltage	V <sub>(BR)CEO</sub>		I <sub>C</sub> = 0.5 mA	80	—	—	V
	Emitter-collector breakdown voltage	V <sub>(BR)ECO</sub>		I <sub>E</sub> = 0.1 mA	7	—	—	
	Dark Current	I <sub>DARK</sub>		V <sub>CE</sub> = 48 V	—	0.01	0.1	μA
				V <sub>CE</sub> = 48 V, T <sub>a</sub> = 85°C	—	2	50	
	Collector-emitter capacitance	C <sub>CE</sub>		V = 0 V, f = 1 MHz	—	10	—	pF

**8. Coupled Electrical Characteristics (Unless otherwise specified,  $T_a = 25^\circ\text{C}$ )**

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Current transfer ratio	$I_C/I_F$	(Note 1)	$I_F = \pm 5 \text{ mA}, V_{CE} = 5 \text{ V}$	50	—	400	%
			$I_F = \pm 5 \text{ mA}, V_{CE} = 5 \text{ V}, \text{Rank GB}$	100	—	400	
Saturated current transfer ratio	$I_C/I_{F(\text{sat})}$		$I_F = \pm 1 \text{ mA}, V_{CE} = 0.4 \text{ V}$	—	60	—	
			$I_F = \pm 1 \text{ mA}, V_{CE} = 0.4 \text{ V}, \text{Rank GB}$	30	—	—	
Collector-emitter saturation voltage	$V_{CE(\text{sat})}$		$I_C = 2.4 \text{ mA}, I_F = \pm 8 \text{ mA}$	—	—	0.4	V
			$I_C = 0.2 \text{ mA}, I_F = \pm 1 \text{ mA}$	—	0.2	—	
			$I_C = 0.2 \text{ mA}, I_F = \pm 1 \text{ mA}, \text{Rank GB}$	—	—	0.4	
OFF-state collector current	$I_{C(\text{off})}$		$V_F = \pm 0.7 \text{ V}, V_{CE} = 48 \text{ V}$	—	—	10	$\mu\text{A}$
Collector current ratio	$I_C(\text{ratio})$		See Fig. 8.1. $I_C(I_F = -5 \text{ mA}) / I_C(I_F = 5 \text{ mA})$	0.33	—	3	—

Note 1: See Table 8.1 for current transfer ratio.

**Table 8.1 Current transfer ratio (CTR) Rank (Note) (Unless otherwise specified,  $T_a = 25^\circ\text{C}$ )**

Rank	Test Condition	Current transfer ratio $I_C/I_F$	Current transfer ratio $I_C/I_F$	Marking of Classification	Unit
		Min	Max		
Blank	$I_F = \pm 5 \text{ mA}, V_{CE} = 5 \text{ V}$	50	400	Blank	%
GB		100	400	GB	

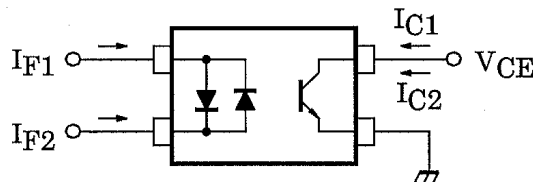
Note: Specify both the part number and a rank in this format when ordering.

Example: TLP290-4 (GB)

For safety standard certification, however, specify the part number alone.

Example: TLP290-4 (GB,E: TLP290-4

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



**Fig. 8.1 Collector Current Ratio Test Circuit**

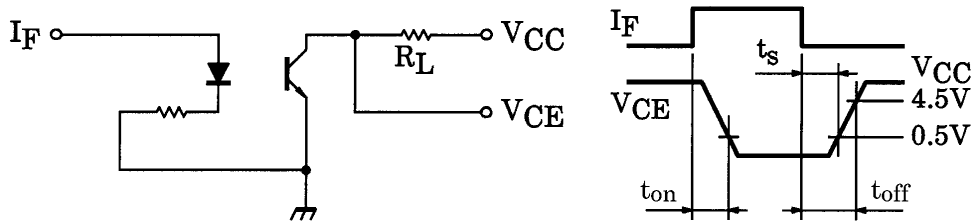
**9. Isolation Characteristics (Unless otherwise specified,  $T_a = 25^\circ\text{C}$ )**

Characteristics	Symbol	Note	Test Conditions	Min	Typ.	Max	Unit
Total capacitance (input to output)	$C_S$		$V_S = 0\text{ V}$ , $f = 1\text{ MHz}$	—	0.8	—	pF
Isolation resistance	$R_S$		$V_S = 500\text{ V}$ , R.H. $\leq 60\%$	$1 \times 10^{12}$	$10^{14}$	—	$\Omega$
Isolation voltage	$BV_S$	(Note1)	AC, 60 s	2500	—	—	Vrms
			AC, 1 s in oil	—	5000	—	
			DC, 60 s in oil	—	5000	—	Vdc

Note1: This device is considered as a two-terminal device: Pins 1, 2, 3, 4, 5, 6, 7 and 8 are shorted together, and pins 9, 10, 11, 12, 13, 14, 15 and 16 are shorted together.

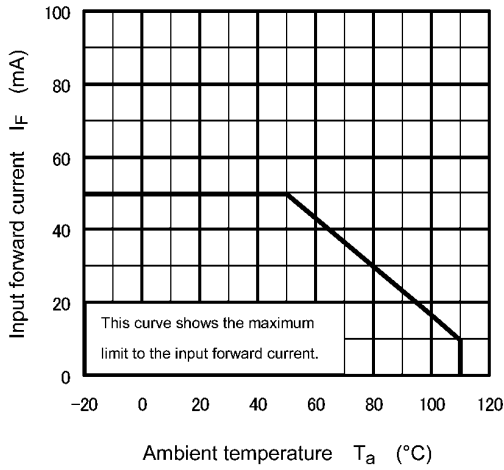
**10. Switching Characteristics (Unless otherwise specified,  $T_a = 25^\circ\text{C}$ )**

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Rise time	$t_r$		$V_{CC} = 10\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\ \Omega$	—	2	—	$\mu\text{s}$
Fall time	$t_f$			—	3	—	
Turn-on time	$t_{on}$			—	3	—	
Turn-off time	$t_{off}$			—	3	—	
Turn-on time	$t_{on}$		See Figure 10.1	—	2	—	
Storage time	$t_s$		$R_L = 1.9\text{ k}\Omega$ , $V_{CC} = 5\text{ V}$ , $I_F = 16\text{ mA}$	—	25	—	
Turn-off time	$t_{off}$			—	60	—	

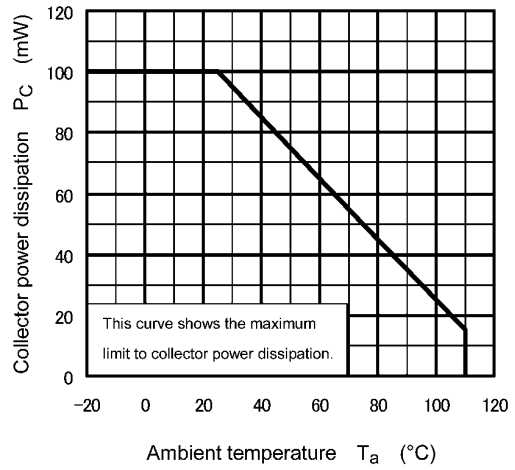


**Fig. 10.1 Switching Time Test Circuit**

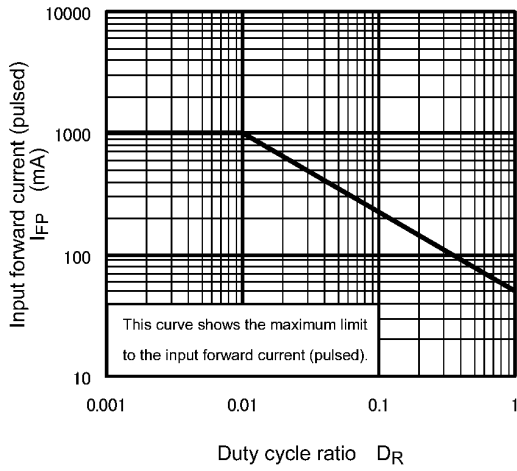
**11. Characteristics Curves (Note)**



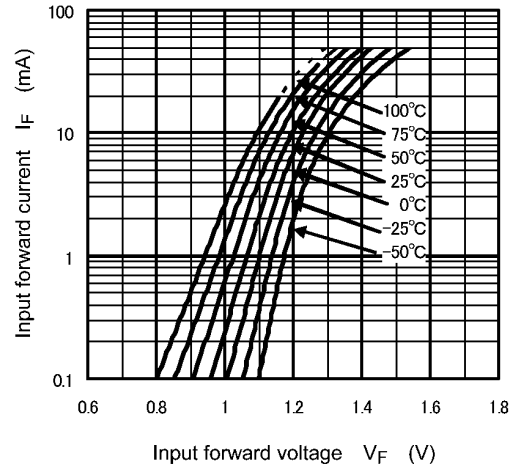
**Fig. 11.1  $I_F - T_a$**



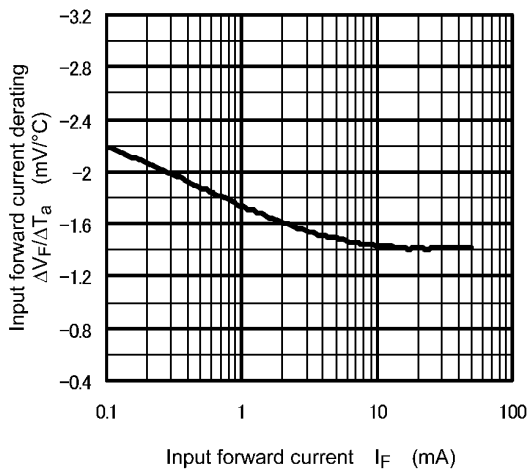
**Fig. 11.2  $P_C - T_a$**



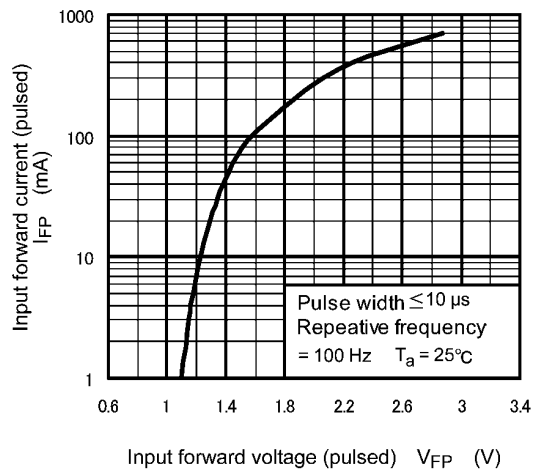
**Fig. 11.3  $I_{FP} - D_R$**



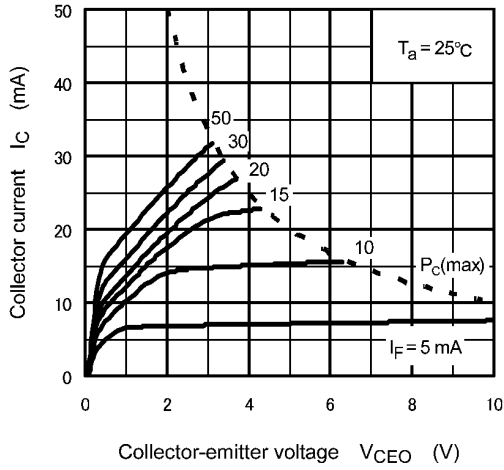
**Fig. 11.4  $I_F - V_F$**



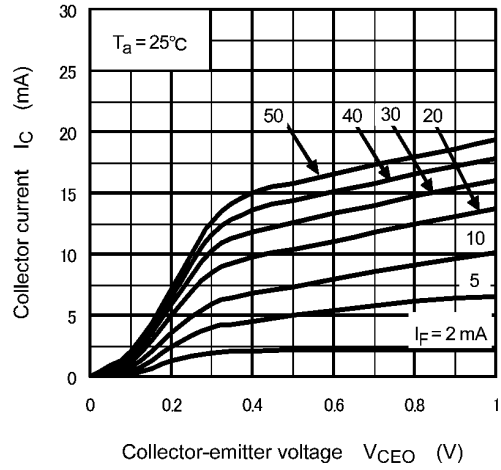
**Fig. 11.5  $\Delta V_F/\Delta T_a - I_F$**



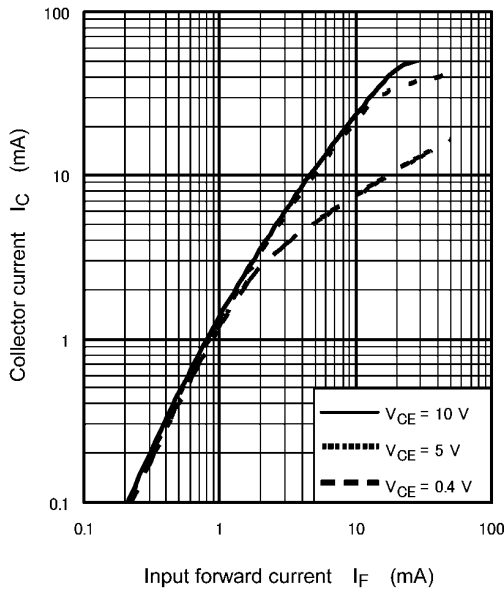
**Fig. 11.6  $I_{FP} - V_{FP}$**



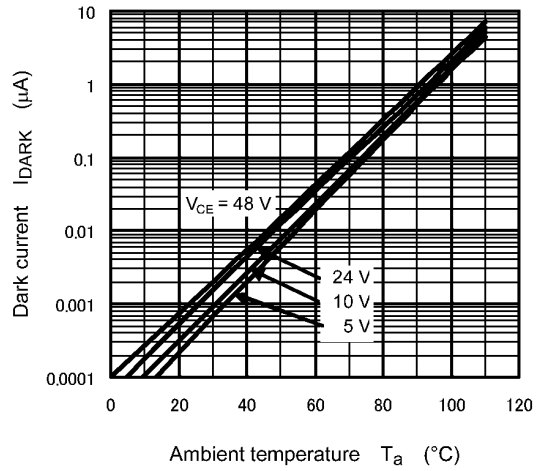
**Fig. 11.7  $I_C - V_{CE0}$**



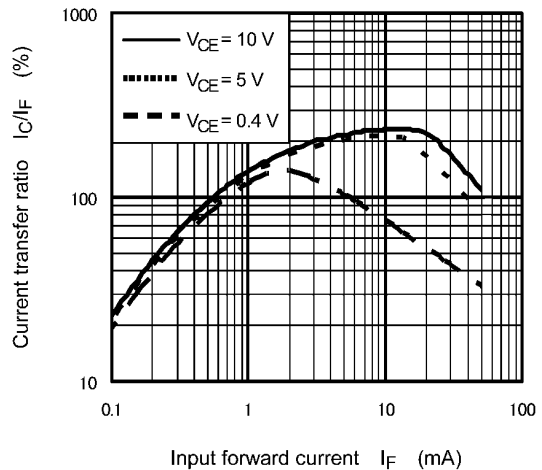
**Fig. 11.8  $I_C - V_{CE0}$**



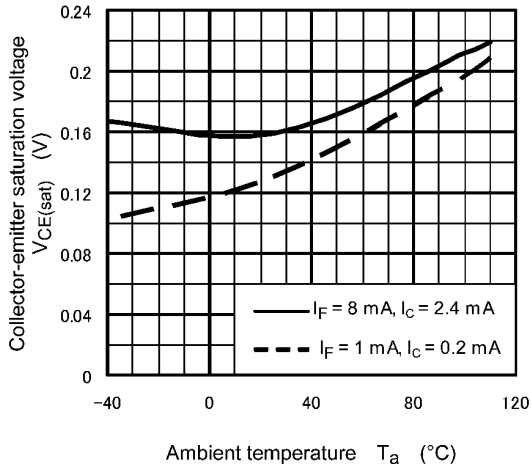
**Fig. 11.9  $I_C - I_F$**



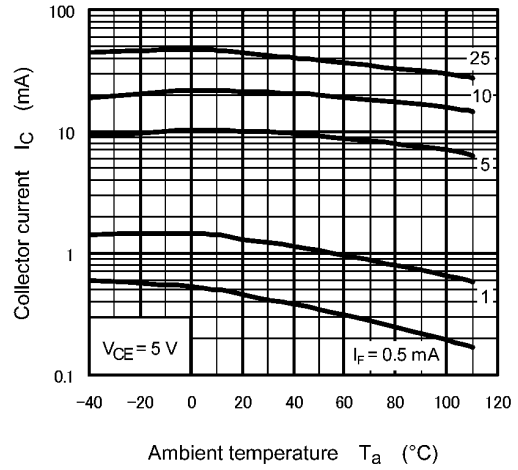
**Fig. 11.10  $I_{DARK} - T_a$**



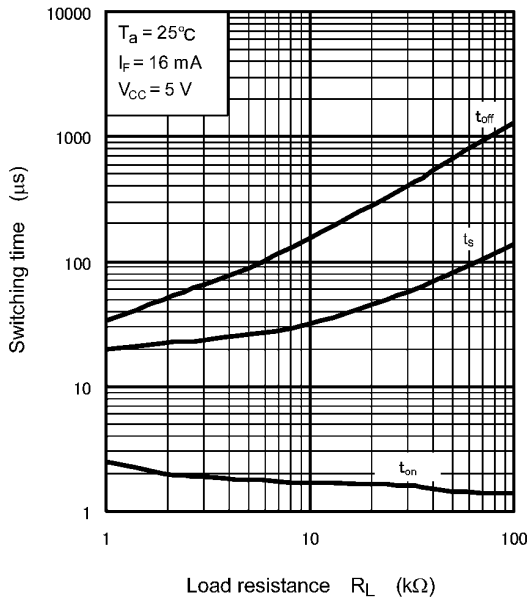
**Fig. 11.11  $I_C/I_F - I_F$**



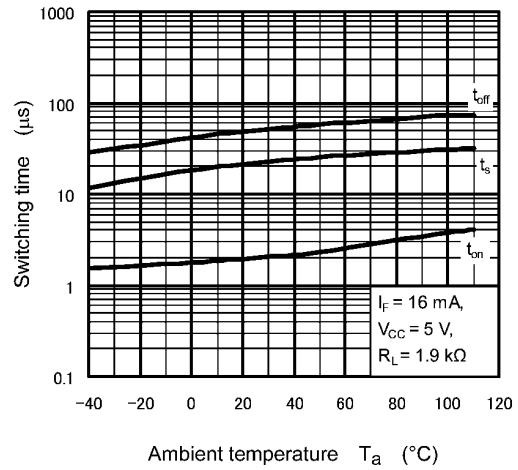
**Fig. 11.12**  $V_{CE(sat)} - T_a$



**Fig. 11.13**  $I_C - T_a$



**Fig. 11.14** Switching Time -  $R_L$



**Fig. 11.15** Switching Time -  $T_a$

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

## 12. Soldering and Storage

### 12.1. 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.

- When using soldering reflow (See Fig. 12.1.1 and 12.1.2)

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.

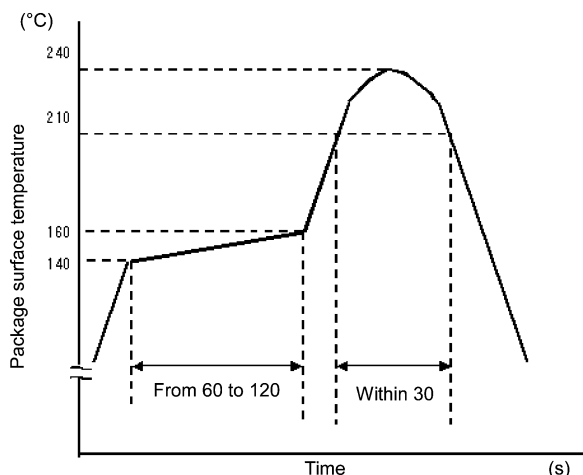


Fig. 12.1.1 An example of a temperature profile when Sn-Pb eutectic solder is used

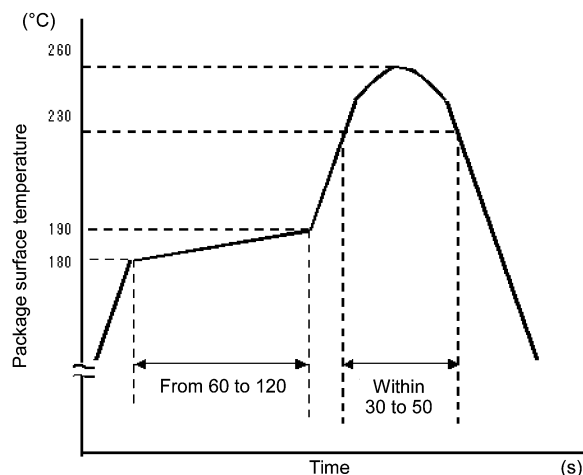


Fig. 12.1.2 An example of a temperature profile when lead(Pb)-free solder is used

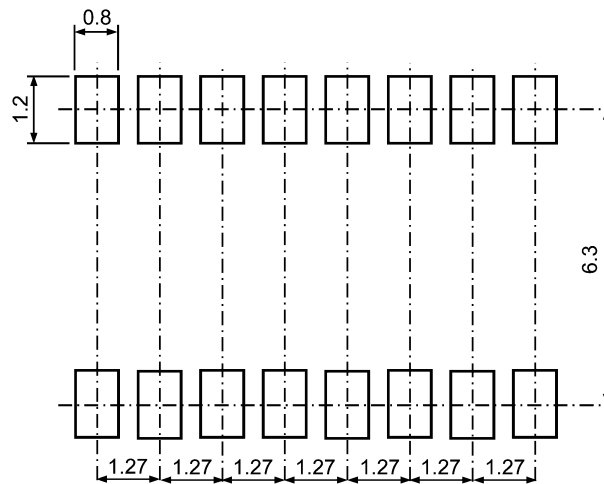
- When using soldering flow (Applicable to both eutectic solder and Lead(Pb)-Free solder)  
Apply preheating of 150°C for 60 to 120 seconds.  
Mounting condition of 260°C within 10 seconds is recommended.  
Flow soldering must be performed once.
- When using soldering Iron  
Complete soldering within 10 seconds for lead temperature not exceeding 260°C or within 3 seconds not exceeding 350°C  
Heating by soldering iron must be done only once per lead.

### 12.2. Precautions for General Storage

- Avoid storage locations where devices may be exposed to moisture or direct sunlight.
- Follow the precautions printed on the packing label of the device for transportation and storage.
- Keep the storage location temperature and humidity within a range of 5°C to 35°C and 45% to 75%, respectively.
- Do not store the products in locations with poisonous gases (especially corrosive gases) or in dusty conditions.
- 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.
- When restoring devices after removal from their packing, use anti-static containers.
- Do not allow loads to be applied directly to devices while they are in storage.
- 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.

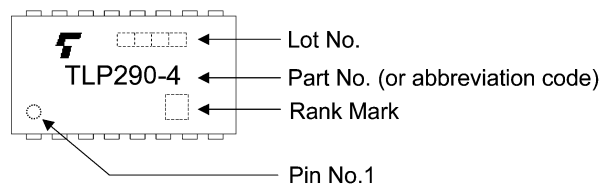


**13. Land Pattern Dimensions for Reference Only**



**Fig. 13.1 Land Pattern Dimensions for Reference Only (unit: mm)**

**14. Marking**



**Fig. 14.1 Marking**

**15. Embossed-Tape Packing (TP) Specification for Mini-Flat Photocouplers**

**15.1. Applicable Package**

Package Name	Product Type
SO16	Mini-Flat Coupler

**15.2. Product Naming Conventions**

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

Example) TLP290-4 (GB-TP, E

Part number: TLP290-4

CTR rank: (GB

Tape type: TP

[[G]]/RoHS COMPATIBLE: E (Note)

Note: Please contact your Toshiba sales representative for details on environmental information such as the product's RoHS compatibility.

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 electronics equipment.

**15.3. Tape Dimensions Specification**

**15.3.1. Orientation of Device in Relation to Direction of Feed**

Device orientation in the carrier cavities as shown in Figure 15.3.1.1.

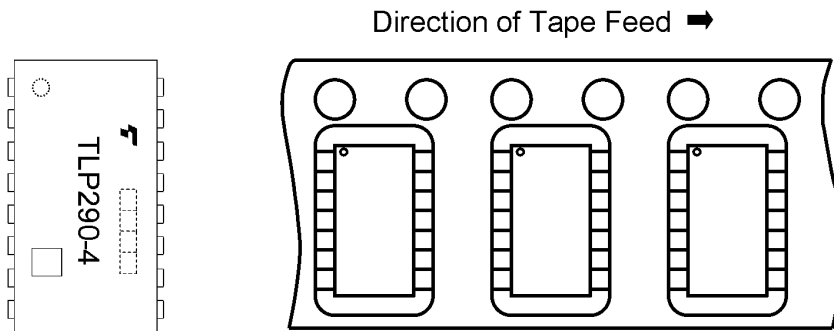


Fig. 15.3.1.1 Device Orientation

**15.3.2. Packing Quantity**

2000 pcs per reel

**15.3.3. Empty Cavities**

Table 15.3.3.1 Empty Cavities

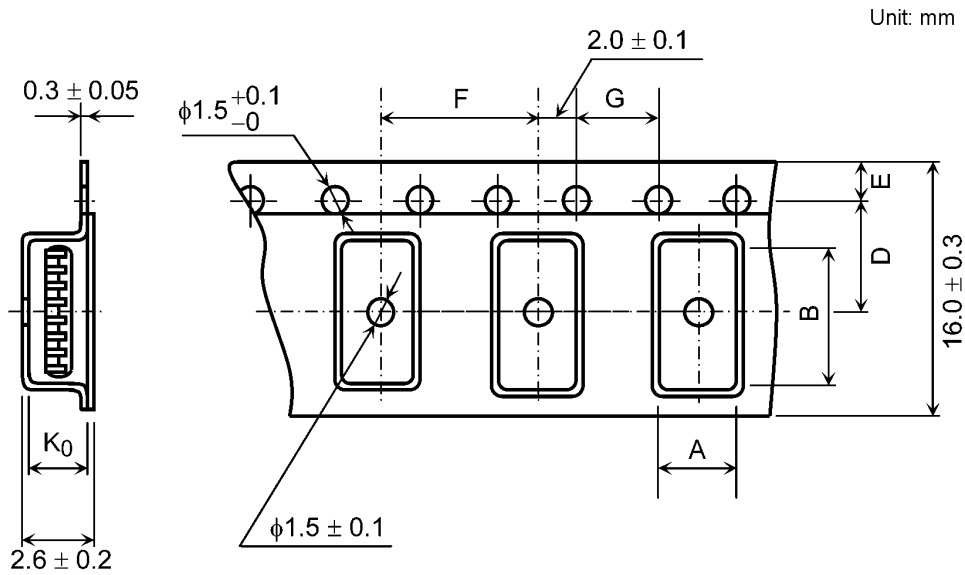
Characteristics	Criterion	Remarks
Occurrences of 2 or more successive empty cavities	0	Within any given 40-mm section of tape, not including leader and trailer
Single empty cavity	6 devices (max) per reel	Not including leader and trailer

**15.3.4. Tape Leader and Trailer**

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

**15.3.5. Tape Dimensions**

Tape material: Plastic (for protection against static electricity)



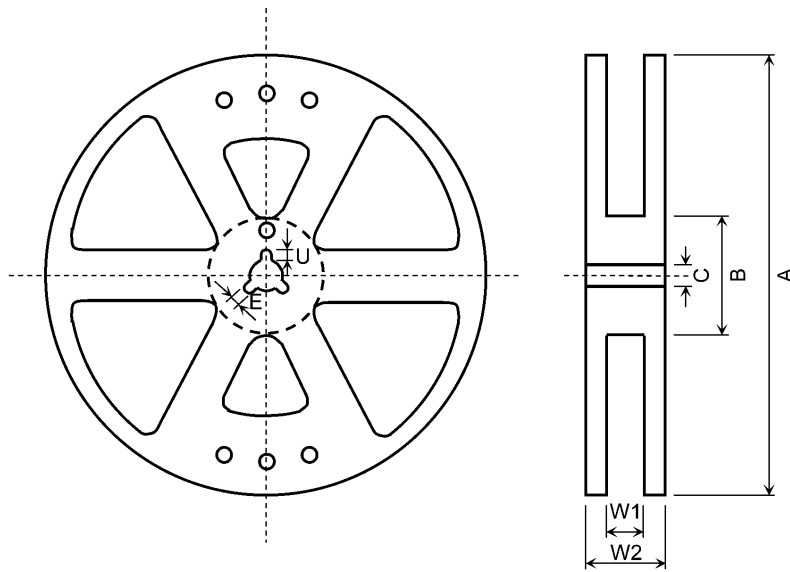
**Fig. 15.3.5.1 Tape Dimensions**

**Table 15.3.5.1 Tape Dimensions (unit: mm, unless otherwise specified: ±0.1)**

Symbol	Dimension	Remark
A	7.5	—
B	10.5	—
D	7.5	Center line of embossed cavity and sprocket hole
E	1.75	Distance between tape edge and sprocket hole center
F	12.0	Cumulative error +0.1/-0.3 (max) per 10 empty cavities holes
G	4.0	Cumulative error +0.1/-0.3 (max) per 10 sprocket holes
K <sub>0</sub>	2.2	Internal space

**15.3.6. Reel specification**

Material: Plastic



**Fig. 15.3.6.1 Reel Dimensions**

**Table 15.3.6.1  
Reel Dimensions (unit: mm)**

Symbol	Dimension
A	$\phi 330 \pm 2$
B	$\phi 80 \pm 1$ or $\phi 100 \pm 1$
C	$\phi 13 \pm 0.5$
E	$2.0 \pm 0.5$
U	$4.0 \pm 0.5$
W1	$17.5 \pm 0.5$
W2	$21.5 \pm 1.0$

**15.4. Packing**

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

**15.5. Label Format**

The label on each carton provides the part number, quantity, lot number, the Toshiba logo, CTR rank, etc.

## 15.6. Ordering Information

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

Example) TLP290-4 (GB-TP, E 2000)

Part number: TLP290-4

CTR rank: (GB

Tape type: TP

[[G]]/RoHS COMPATIBLE: E (**Note**)

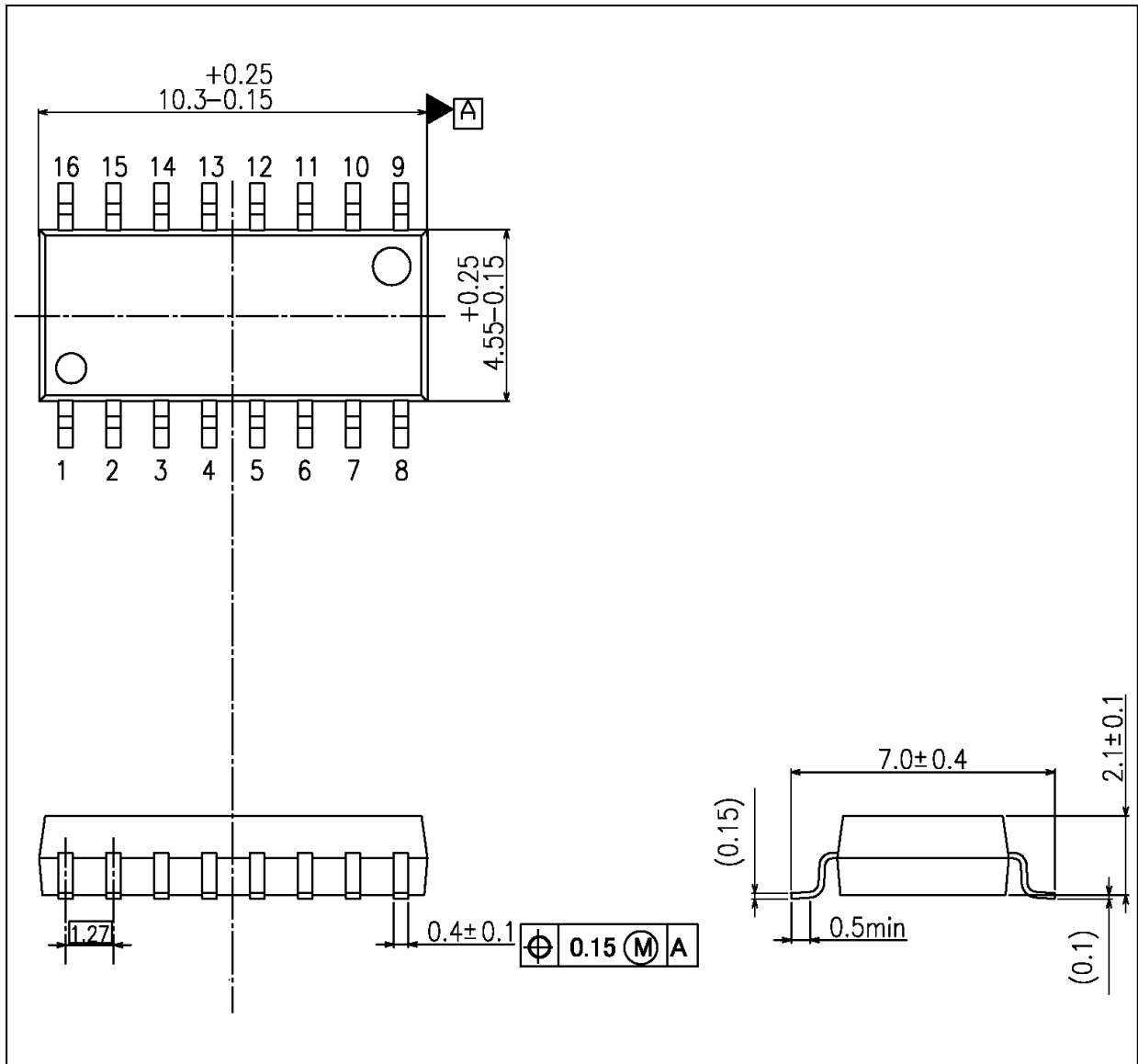
Quantity (must be a multiple of 2000)

Note: Please contact your Toshiba sales representative for details on environmental information such as the product's RoHS compatibility.

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 electronics equipment.

**Package Dimensions**

Unit: mm



Weight: 0.19 g (typ.)

Package Name(s)
TOSHIBA: 11-11F1

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