Photocouplers GaAs Infrared LED & Photo Transistor

TLP290-4

1. Applications

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

2. General

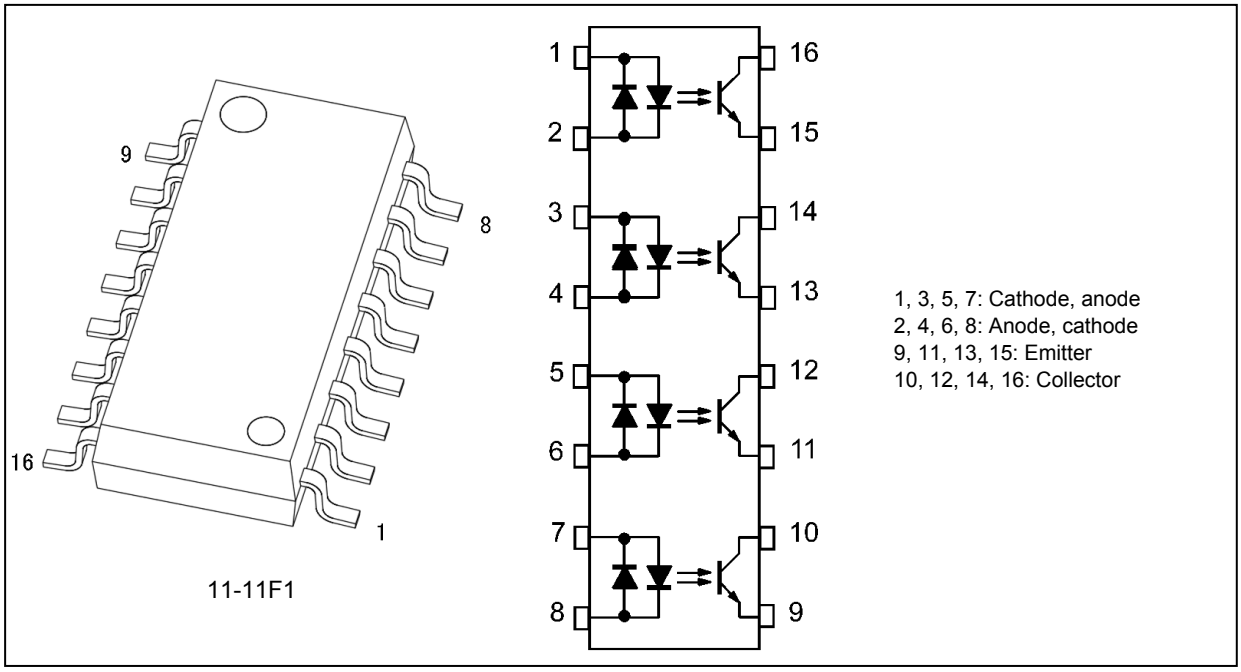
The Toshiba TLP290-4 consists of phototransistors optically coupled to gallium arsenide infrared emitting diodes.
The TLP290-4 Photocoupler is housed in the very small and thin SO16 package.
Since the TLP290-4 is guaranteed over a wide operating temperature range (T_a = -55 to 110℃), it is suitable for 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℃
(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

2014-04-12
Rev.5.0

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_a = 25°C)

	Characteristics		Symbol	Note	Rating	Unit
LED	R.M.S. forward current		$I_{F(RMS)}$		±50	mA
	Input forward current derating	($T_a \geq$ 50°C)	$\Delta I_F/\Delta T_a$		-0.67	mA/°C
	Input forward current (pulsed)		I_{FP}	(Note 1)	±1	A
	Junction temperature		T_j		125	°C
Detector	Collector-emitter voltage		V_{CEO}		80	V
	Emitter-collector voltage		V_{ECO}		7	
	Collector current		I_C		50	mA
	Collector power dissipation		P_C		100	mW
	Collector power dissipation derating (1 circuit)	($T_a \geq$ 25°C)	$\Delta P_C/\Delta T_a$		-1.0	mW/°C
	Junction temperature		T_j		125	°C
Common	Operating temperature		T_{opr}		-55 to 110	
	Storage temperature		T_{stg}		-55 to 125	
	Lead soldering temperature	(10 s)	T_{sol}		260	
	Total power dissipation (1 circuit)		P_T		170	mW
	Input power dissipation derating(1 circuit)	($T_a \geq$ 25°C)	$\Delta P_D/\Delta T_a$		-1.7	mW/°C
	Isolation voltage	AC, 60 s, R.H. ≤ 60%	BV_S	(Note 2)	2500	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 (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_a = 25°C)

	Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
LED	Input forward voltage	V_F		I_F = ±10 mA	1.1	1.20	1.4	V
	Input capacitance	C_t		V = 0 V, f = 1 MHz	—	30	—	pF
Detector	Collector-emitter breakdown voltage	$V_{(BR)CEO}$		I_C = 0.5 mA	80	—	—	V
	Emitter-collector breakdown voltage	$V_{(BR)ECO}$		I_E = 0.1 mA	7	—	—	
	Dark Current	I_{DARK}		V_{CE} = 48 V	—	0.01	0.1	μA
				V_{CE} = 48 V, T_a = 85°C	—	2	50	
	Collector-emitter capacitance	C_{CE}		V = 0 V, f = 1 MHz	—	10	—	pF

8. Coupled Electrical Characteristics (Unless otherwise specified, T_a = 25°C)

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

Rank	Test Condition	Current transfer ratio I_C/I_F Min	Current transfer ratio I_C/I_F Max	Marking of Classification	Unit
Blank	I_F = ±5 mA, V_{CE} = 5 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

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

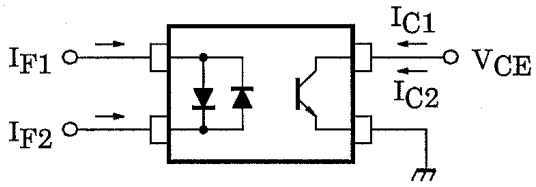


Fig. 8.1 Collector Current Ratio Test Circuit

9. Isolation Characteristics (Unless otherwise specified, T_a = 25°C)

Characteristics	Symbol	Note	Test Conditions	Min	Typ.	Max	Unit
Total capacitance (input to output)	C_S		V_S = 0 V, f = 1 MHz	—	0.8	—	pF
Isolation resistance	R_S		V_S = 500 V, R.H. ≤ 60%	1×10^{12}	10^{14}	—	Ω
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°C)

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Rise time	t_r		V_{CC} = 10 V, I_C = 2 mA, R_L = 100 Ω	—	2	—	μs
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 R_L = 1.9 kΩ, V_{CC} = 5 V, I_F = 16 mA	—	2	—	
Storage time	t_s			—	25	—	
Turn-off time	t_{off}			—	60	—	

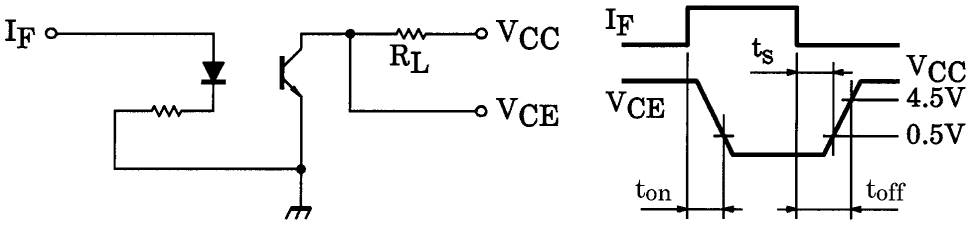


Fig. 10.1 Switching Time Test Circuit

11. Characteristics Curves (Note)

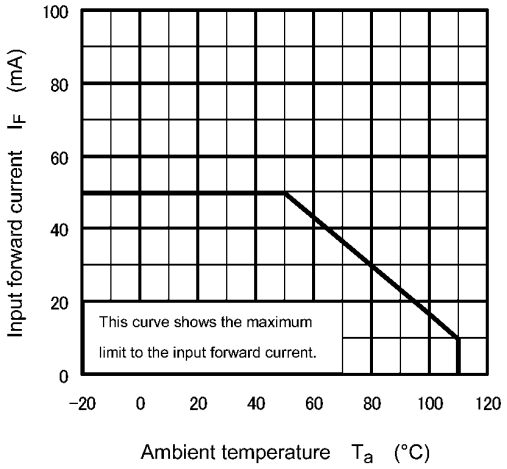


Fig. 11.1 I_F - T_a

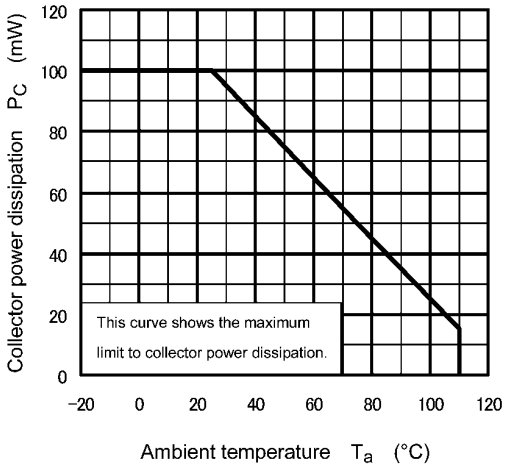


Fig. 11.2 P_C - T_a

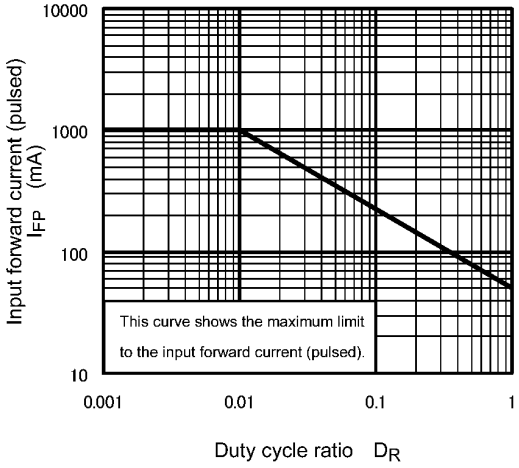


Fig. 11.3 I_{FP} - D_R

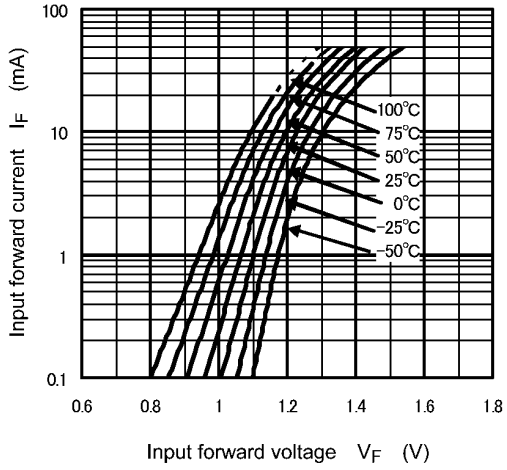


Fig. 11.4 I_F - V_F

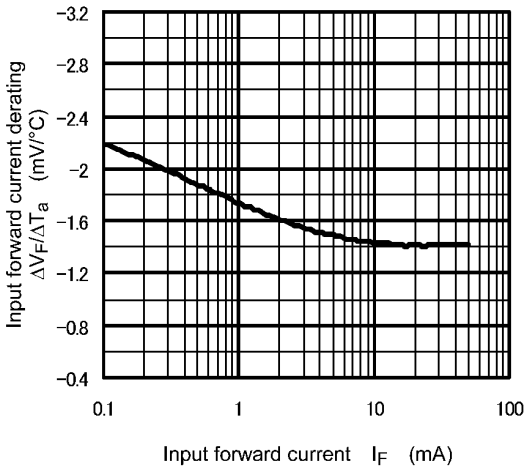


Fig. 11.5 $\Delta V_F/\Delta T_a$ - I_F

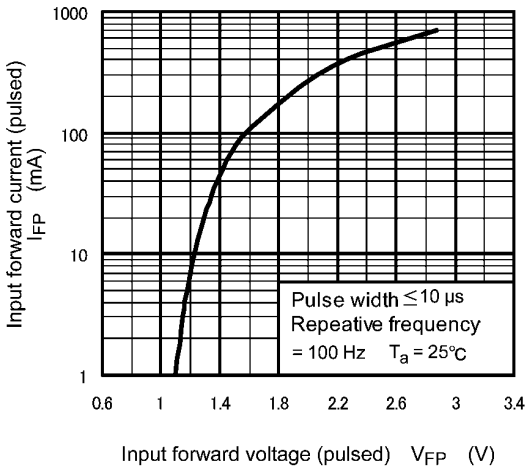


Fig. 11.6 I_{FP} - V_{FP}

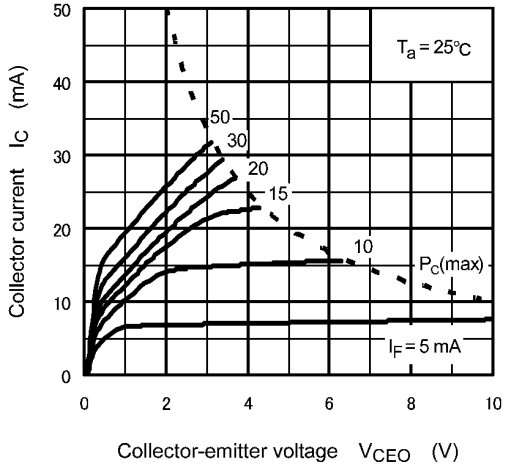


Fig. 11.7 I_C - V_{CEO}

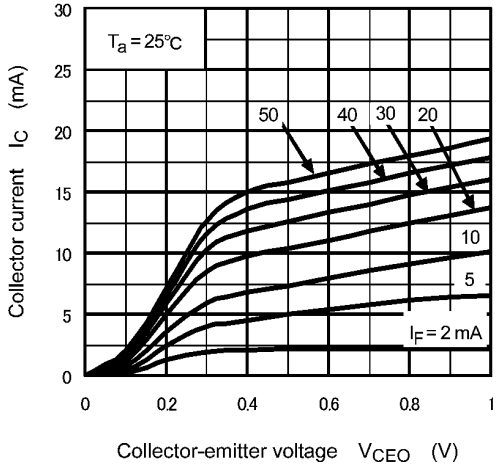


Fig. 11.8 I_C - V_{CEO}

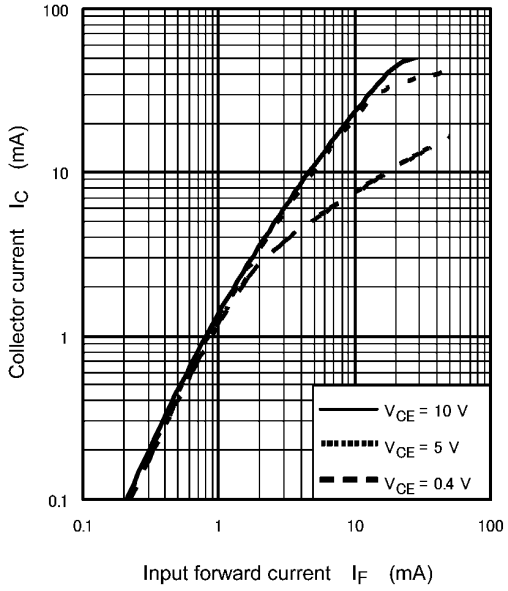


Fig. 11.9 I_C - I_F

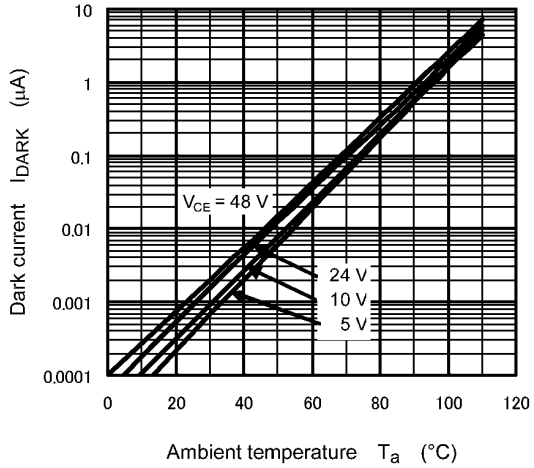


Fig. 11.10 I_{DARK} - T_a

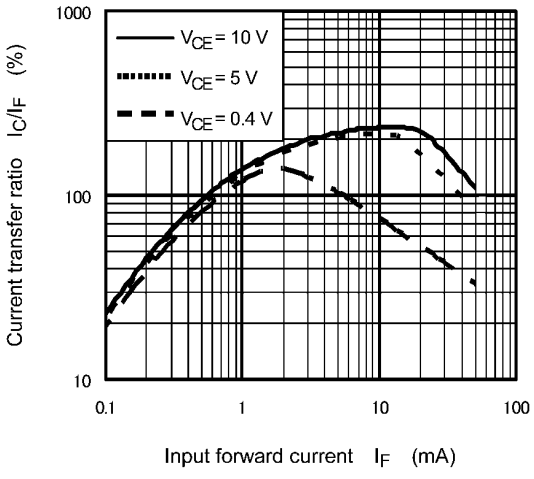


Fig. 11.11 I_C/I_F - I_F

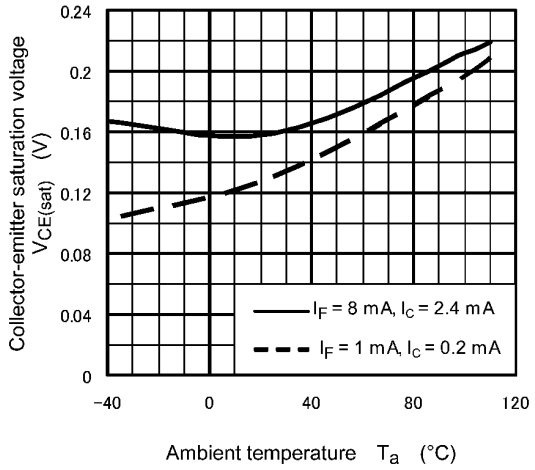


Fig. 11.12 $V_{CE(sat)}$ - T_a

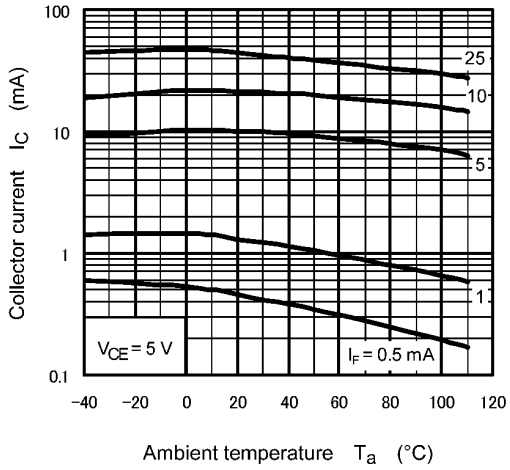


Fig. 11.13 I_C - T_a

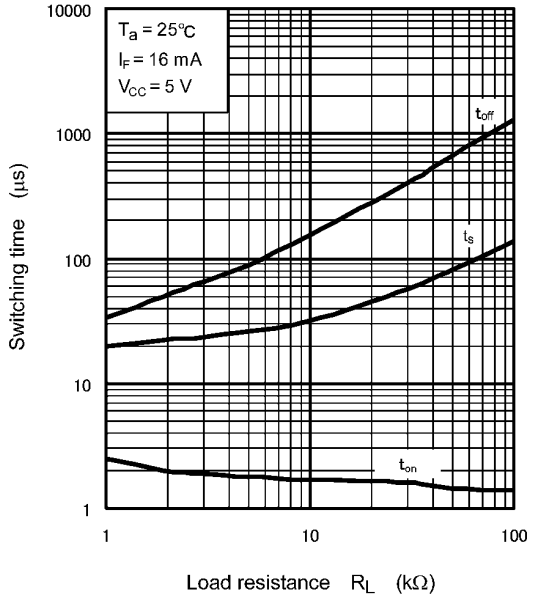


Fig. 11.14 Switching Time - R_L

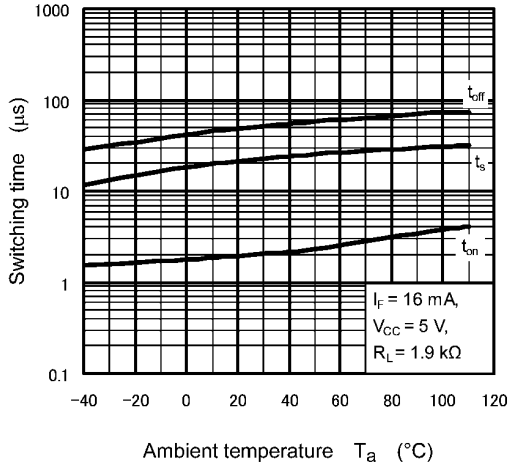


Fig. 11.15 Switching Time - T_a

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.

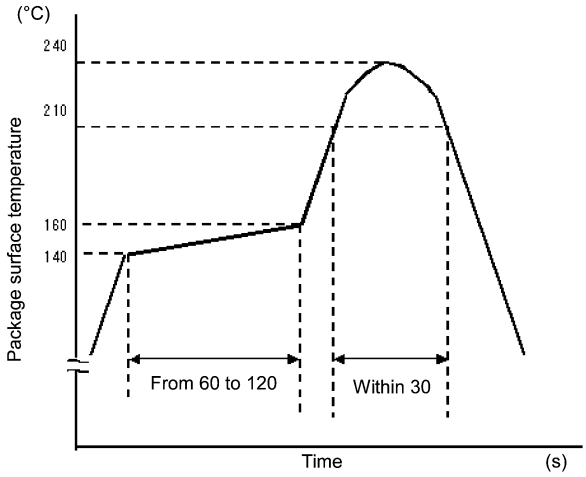


Fig. 12.1.1 An example of a temperature profile when Sn-Pb eutectic solder is used

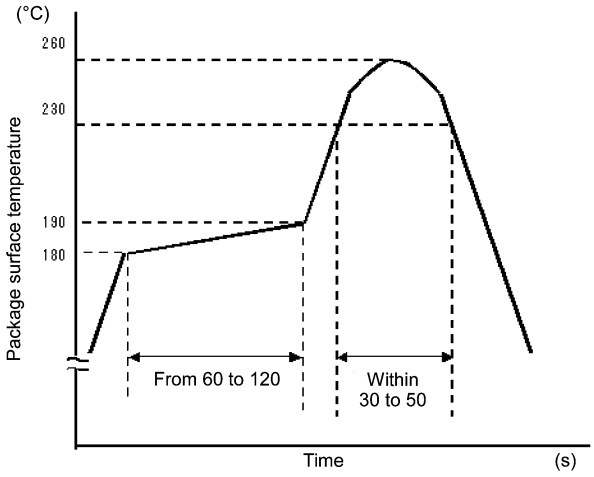


Fig. 12.1.2 An example of a temperature profile when lead(Pb)-free solder is used

- When using soldering flow (Applicable to both eutectic solder and Lead(Pb)-Free solder)
  Apply preheating of 150℃ for 60 to 120 seconds.
  Mounting condition of 260℃ 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℃ or within 3 seconds not exceeding 350℃
  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℃ to 35℃ 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

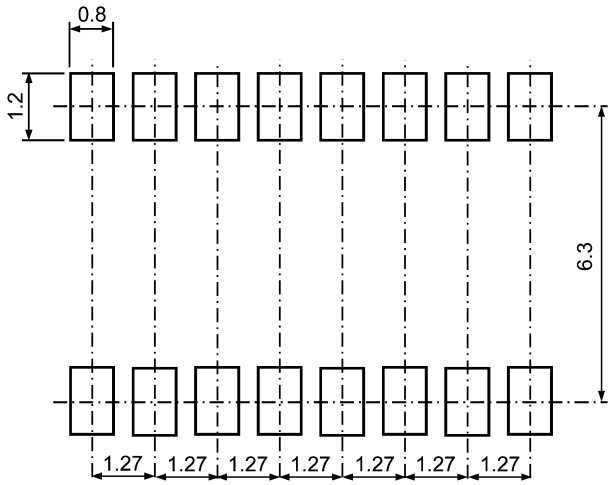


Fig. 13.1 Land Pattern Dimensions for Reference Only (unit: mm)

14. Marking

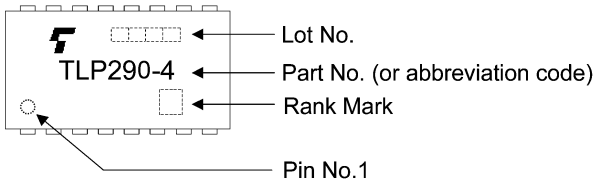


Fig. 14.1 Marking

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.

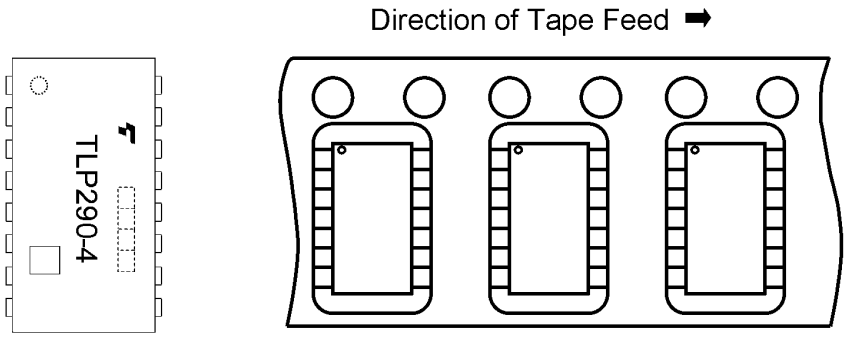


Fig. 15.3.1.1 Device Orientation

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)

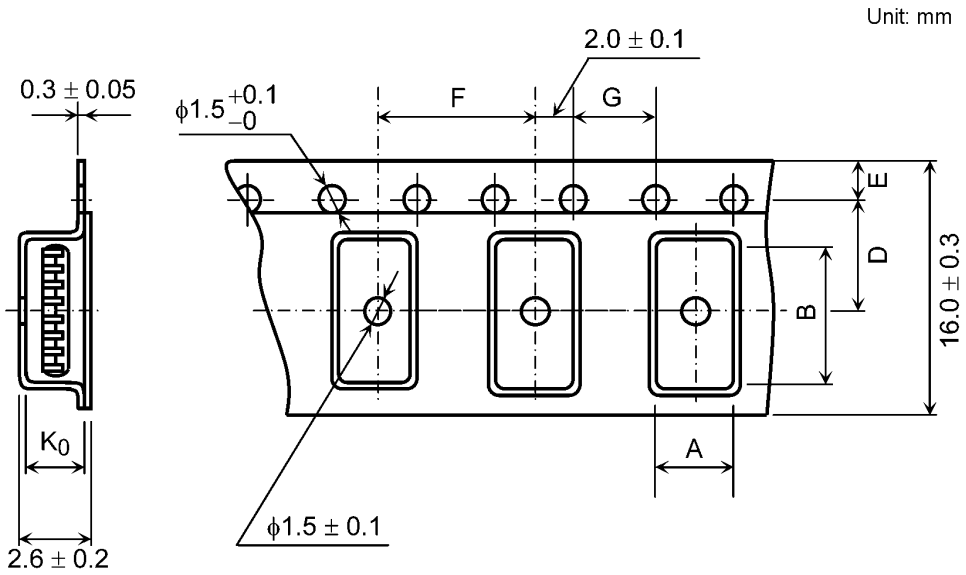


Fig. 15.3.5.1 Tape Dimensions

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_0	2.2	Internal space

15.3.6. Reel specification

Material: Plastic

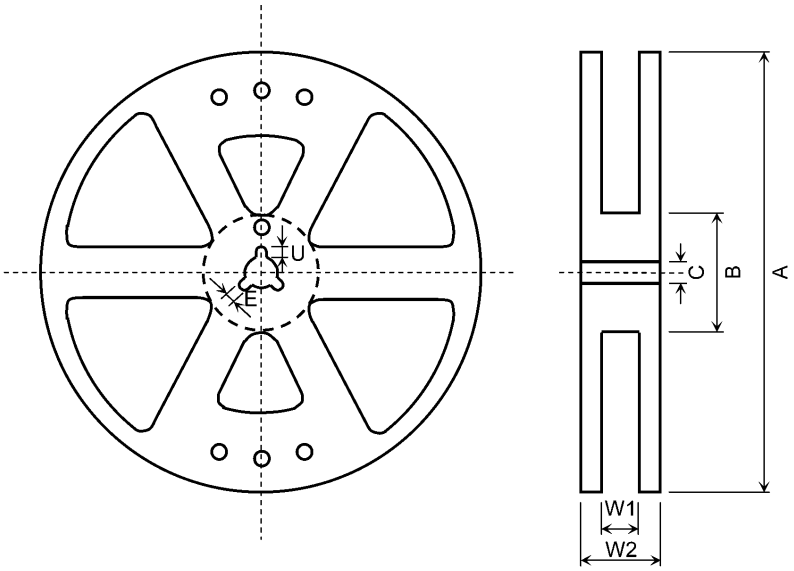


Fig. 15.3.6.1 Reel Dimensions

Table 15.3.6.1
Reel Dimensions (unit: mm)

Symbol	Dimension
A	ϕ330 ± 2
B	ϕ80 ± 1 or ϕ100 ± 1
C	ϕ13 ± 0.5
E	2.0 ± 0.5
U	4.0 ± 0.5
W1	17.5 ± 0.5
W2	21.5 ± 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.

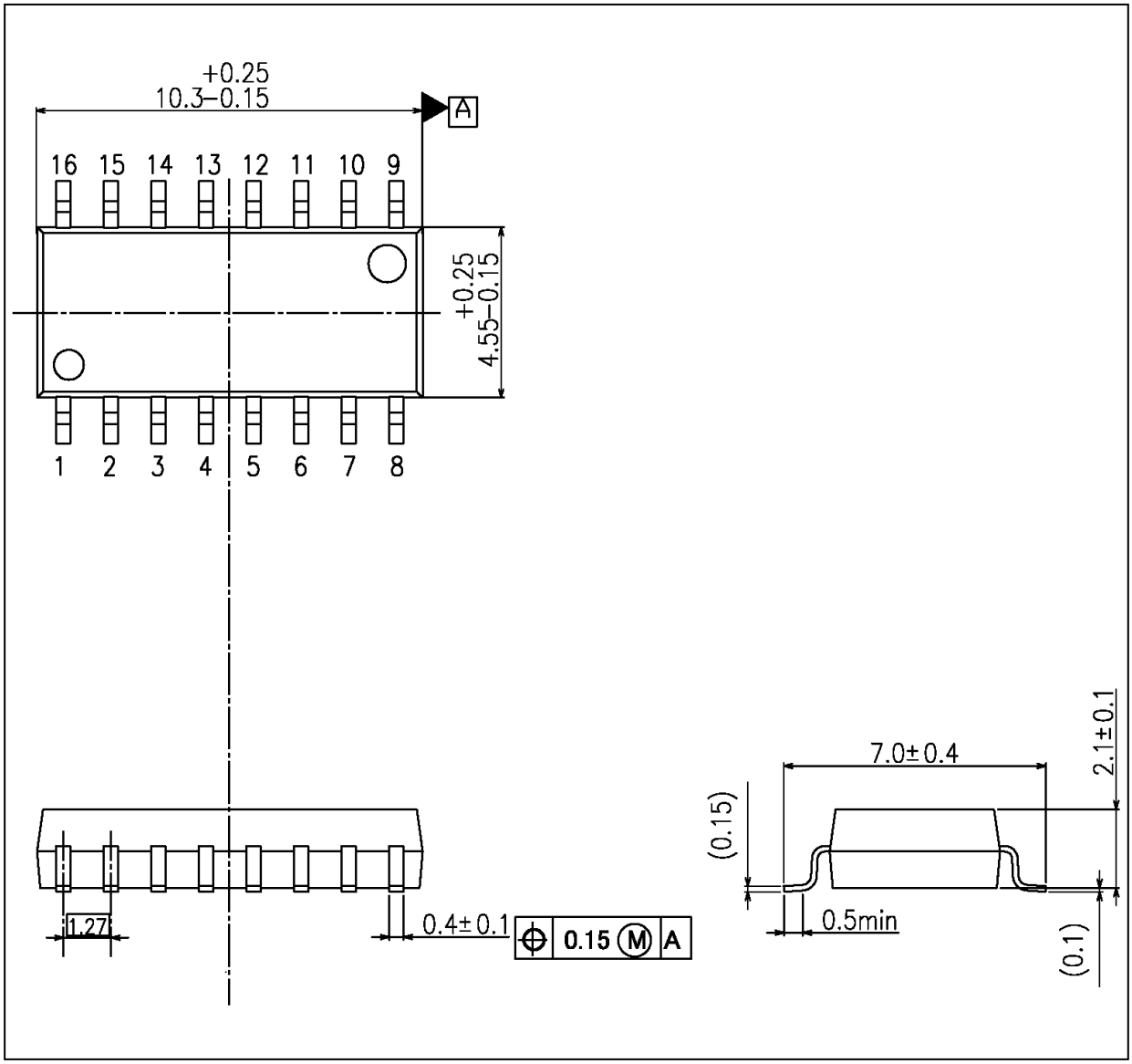
Example) TLP290-4 (GB-TP, E 2000

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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