

TLP188

1. Applications

- Programmable Logic Controllers (PLCs)
- Air Conditioner Inverters

2. General

TLP188 consists of phototransistors optically coupled to an infrared LED. The TLP188 is housed in the very small and thin SO6(4pin) package and that guarantees high temperature operation($T_a = 110\text{ }^{\circ}\text{C}$ max). With the high breakdown voltage between the collector and emitter($V_{CEO} = 350\text{ V}$), TLP188 is suitable for use in programmable logic controllers (PLCs), and home appliances, include air conditioners.

3. Features

- (1) Collector-emitter voltage: 350 V (min)
- (2) Current transfer ratio: 50 % (min)
Rank GB: 100 % (min)
- (3) Isolation voltage: 3750 Vrms (min)
- (4) Operating temperature: -55 to $110\text{ }^{\circ}\text{C}$
- (5) Safety standards

UL-recognized: UL 1577, File No.E67349

cUL-recognized: CSA Component Acceptance Service No.5A File No.E67349

VDE-approved: EN IEC 60747-5-5, EN IEC 62368-1 (**Note 1**)

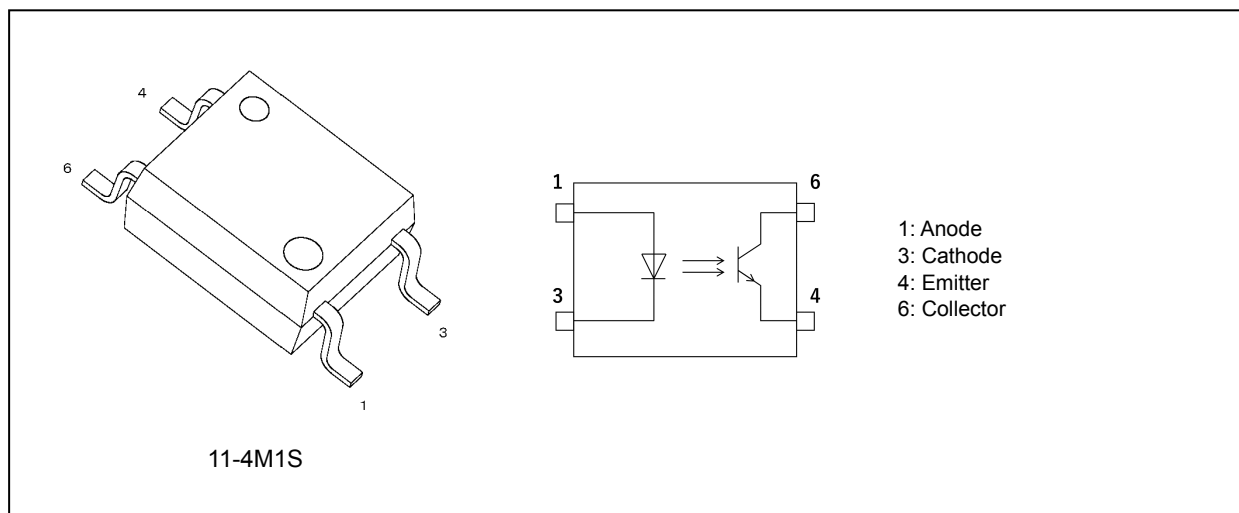
CQC-approved: GB4943.1 Japan and Thailand Factory



Can only be safely used in areas below 2000m above sea level.

Note 1: When a VDE approved type is needed, please designate the **Option (V4)**.

4. Packaging and Pin Configuration



Start of commercial production

2013-03

5. Principle of Operation

5.1. Mechanical Parameters

Characteristics	Min	Unit
Creepage distances	5.0	mm
Clearance	5.0	
Internal isolation thickness	0.4	

6. Absolute Maximum Ratings (Note) (Unless otherwise specified, $T_a = 25\text{ }^{\circ}\text{C}$)

	Characteristics	Symbol	Note	Rating	Unit
LED	Input forward current	I_F		50	mA
	Input forward current derating ($T_a \geq 90\text{ }^{\circ}\text{C}$)	$\Delta I_F / \Delta T_a$		-1.43	mA/ $^{\circ}\text{C}$
	Input forward current (pulsed)	I_{FP}	(Note 1)	1	A
	Input reverse voltage	V_R		5	V
	Input power dissipation	P_D		100	mW
	Input power dissipation derating ($T_a \geq 90\text{ }^{\circ}\text{C}$)	$\Delta P_D / \Delta T_a$		-2.86	mW/ $^{\circ}\text{C}$
	Junction temperature	T_j		135	$^{\circ}\text{C}$
Detector	Collector-emitter voltage	V_{CEO}		350	V
	Emitter-collector voltage	V_{ECO}		7	
	Collector current	I_C		50	mA
	Collector power dissipation	P_C		150	mW
	Collector power dissipation derating ($T_a \geq 25\text{ }^{\circ}\text{C}$)	$\Delta P_C / \Delta T_a$		-1.5	mW/ $^{\circ}\text{C}$
	Junction temperature	T_j		135	$^{\circ}\text{C}$
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	P_T		200	
	Isolation voltage AC, 60 s, R.H. $\leq 60\%$	BV_S	(Note 2)	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 (PW) $\leq 100\text{ }\mu\text{s}$, $f = 100\text{ Hz}$

Note 2: This device is considered as a two-terminal device: Pins 1 and 3 are shorted together, and pins 4 and 6 are shorted together.

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

	Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
LED	Input forward voltage	V_F		$I_F = 10\text{ mA}$	1.1	1.25	1.4	V
	Input reverse current	I_R		$V_R = 5\text{ V}$	—	—	10	μA
	Input capacitance	C_t		$V = 0\text{ V}, f = 1\text{ MHz}$	—	30	—	pF
Detector	Collector-emitter breakdown voltage	$V_{(BR)CEO}$		$I_C = 0.1\text{ mA}$	350	—	—	V
	Emitter-collector breakdown voltage	$V_{(BR)ECO}$		$I_E = 0.1\text{ mA}$	7	—	—	
	Dark Current	I_{DARK}		$V_{CE} = 300\text{ V}$	—	0.01	0.2	μA
				$V_{CE} = 300\text{ V}, T_a = 85\text{ }^{\circ}\text{C}$	—	—	50	
	Collector-emitter capacitance	C_{CE}		$V = 0\text{ V}, f = 1\text{ MHz}$	—	10	—	pF

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

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Current transfer ratio	I_C/I_F	(Note 1)	$I_F = 5\text{ mA}, V_{CE} = 5\text{ V}, \text{Blank Rank}$	50	—	600	%
			$I_F = 5\text{ mA}, V_{CE} = 5\text{ V}, \text{GB Rank}$	100	—	600	
Saturated current transfer ratio	$I_C/I_{F(sat)}$		$I_F = 1\text{ mA}, V_{CE} = 0.4\text{ V}$	—	60	—	
			$I_F = 1\text{ mA}, V_{CE} = 0.4\text{ V}, \text{GB Rank}$	30	—	—	
Collector-emitter saturation voltage	$V_{CE(sat)}$		$I_C = 2.4\text{ mA}, I_F = 8\text{ mA}$	—	—	0.4	V
			$I_C = 0.2\text{ mA}, I_F = 1\text{ mA}$	—	0.2	—	
			$I_C = 0.2\text{ mA}, I_F = 1\text{ mA}, \text{GB Rank}$	—	—	0.4	
OFF-state collector current	$I_{C(off)}$		$V_F = 0.7\text{ V}, V_{CE} = 350\text{ V}$	—	—	200	μA

Note 1: See Table 8.1 for current transfer ratio.

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

Rank	Test Condition	Current transfer ratio I_C/I_F Min	Current transfer ratio I_C/I_F Max	Marking of Classification	Unit
Blank	$I_F = 5\text{ mA}, V_{CE} = 5\text{ V}$	50	600	Blank, GB	%
GB		100	600	GB	

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

Example: TLP188(GB,E)

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

Example: TLP188(GB,E: TLP188

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

Characteristics	Symbol	Note	Test Conditions	Min	Typ.	Max	Unit
Total capacitance (input to output)	C_S	Note1	$V_S = 0\text{ V}, f = 1\text{ MHz}$	—	0.8	—	pF
Isolation resistance	R_S	Note1	$V_S = 500\text{ V}, \text{R.H.} \leq 60\%$	10^{12}	10^{14}	—	Ω
Isolation voltage	BV_S	Note1	AC, 60 s	3750	—	—	Vrms

Note1: This device is considered as a two-terminal device: Pins 1 and 3 are shorted together, and pins 4 and 6 are shorted together.

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

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Rise time	t_r		$V_{CC} = 10\text{ V}$, $I_C = 2\text{ mA}$, $R_L = 100\text{ }\Omega$	—	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 $R_L = 1.9\text{ k}\Omega$, $V_{CC} = 5\text{ V}$, $I_F = 16\text{ mA}$	—	3	—	
Storage time	t_s			—	60	—	
Turn-off time	t_{off}			—	80	—	

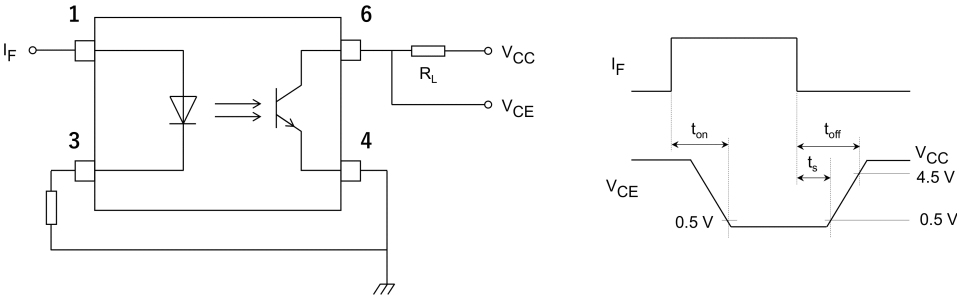


Fig. 10.1 Switching Time Test Circuit and Waveform

11. Characteristics Curves (Note)

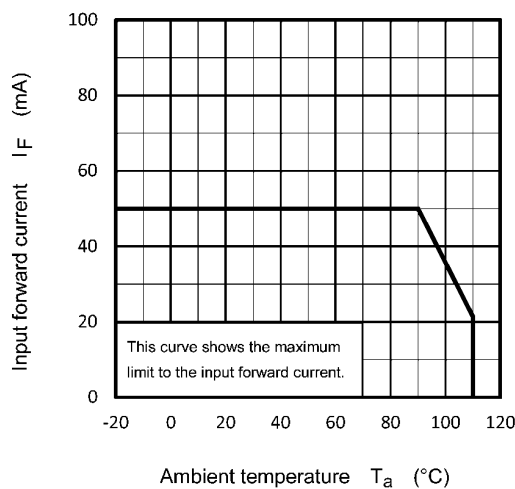


Fig. 11.1 $I_F - T_a$

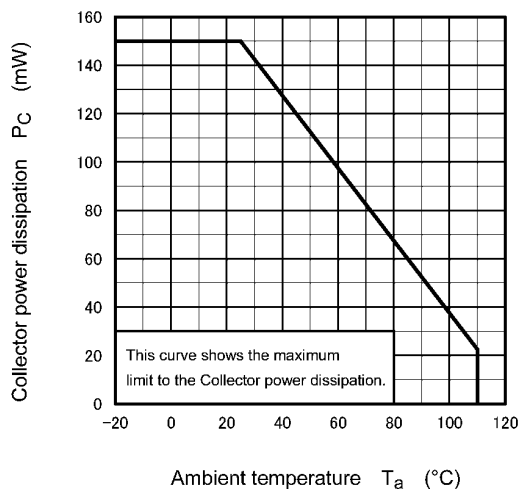


Fig. 11.2 $P_C - T_a$

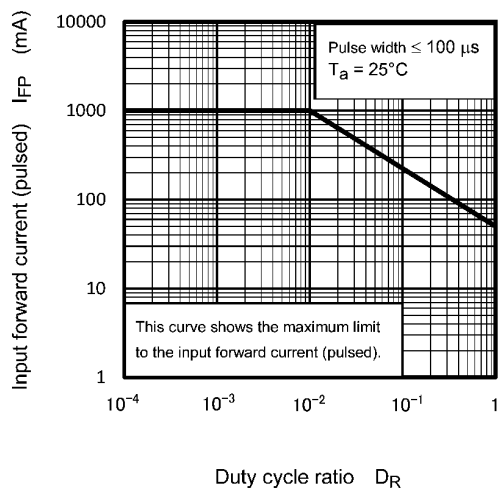


Fig. 11.3 $I_{FP} - D_R$

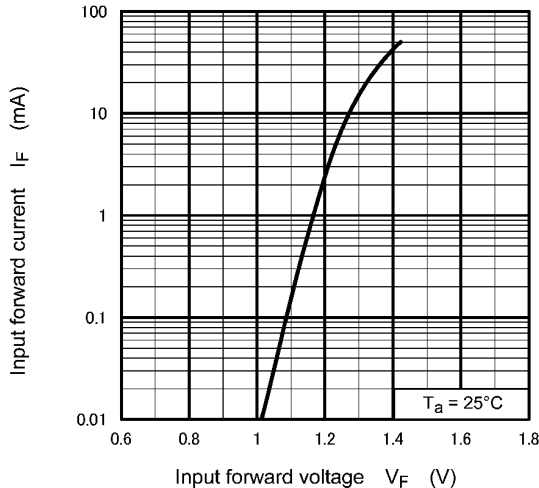


Fig. 11.4 $I_F - V_F$

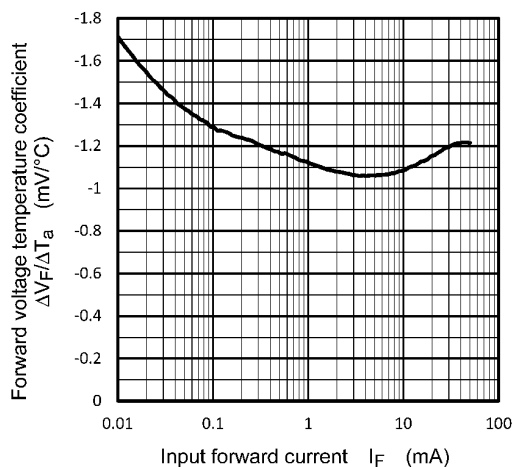


Fig. 11.5 $\Delta V_F / \Delta T_a - I_F$

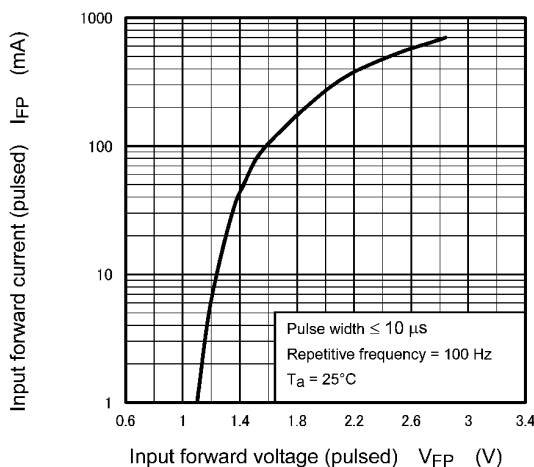


Fig. 11.6 $I_{FP} - V_{FP}$

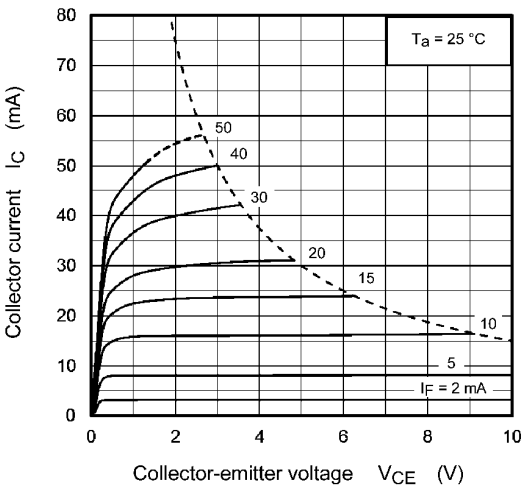


Fig. 11.7 $I_C - V_{CE}$

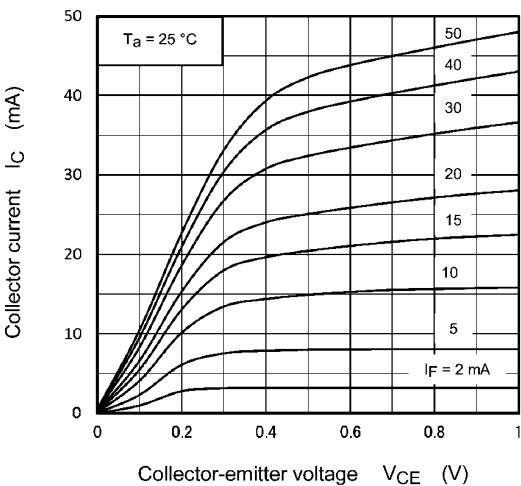


Fig. 11.8 $I_C - V_{CE}$

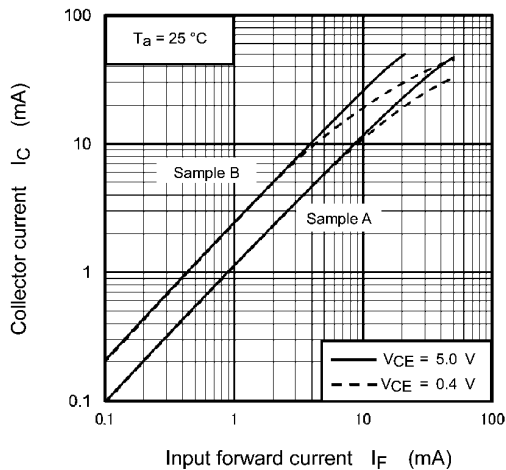


Fig. 11.9 $I_C - I_F$

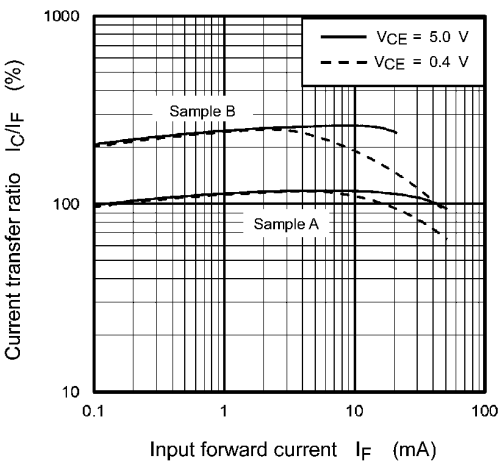


Fig. 11.10 $I_C/I_F - I_F$

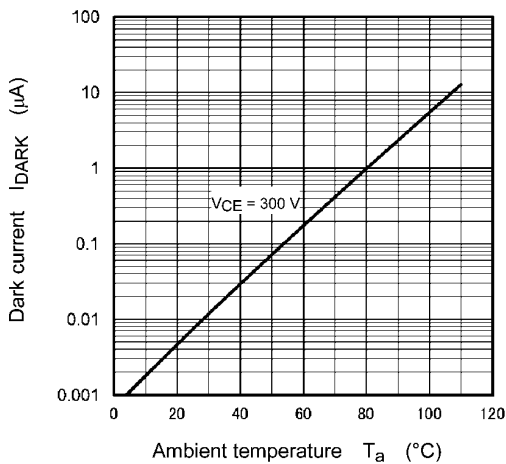


Fig. 11.11 $I_{DARK} - T_a$

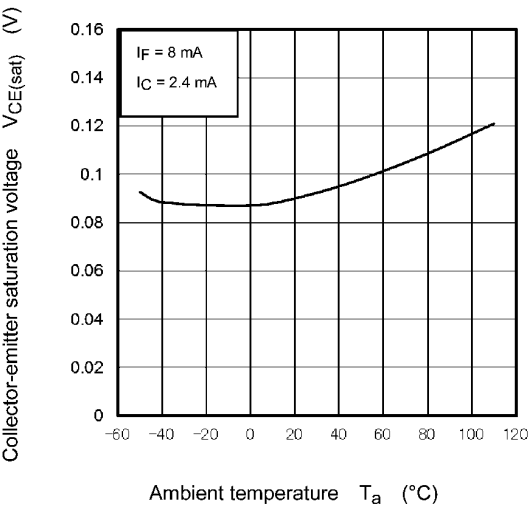


Fig. 11.12 $V_{CE(sat)} - T_a$

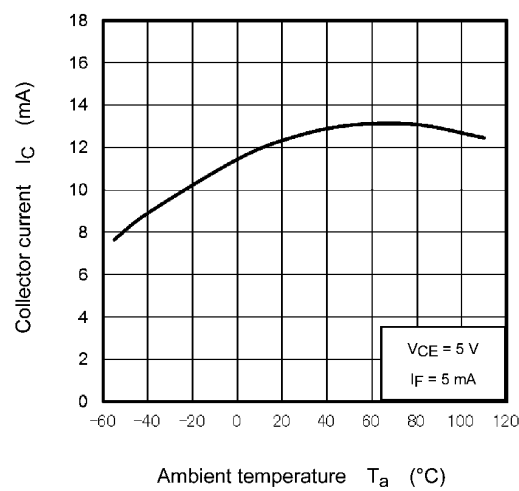


Fig. 11.13 $I_C - T_a$

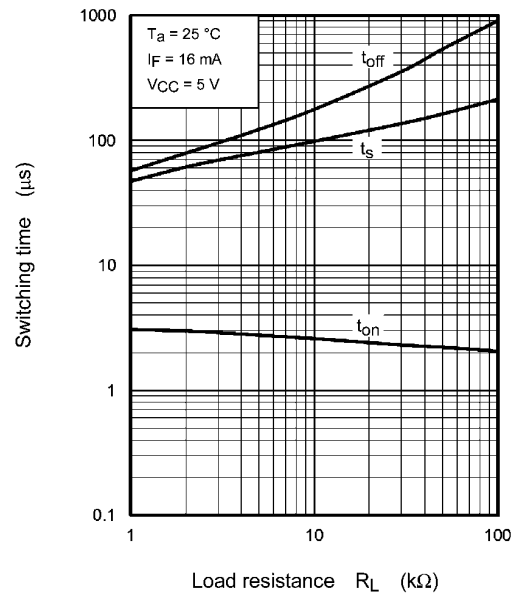


Fig. 11.14 Switching Time - R_L

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.

The soldering temperature profile is based on the package surface temperature.

(See the figure shown below, which is based on the package surface temperature.)

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.

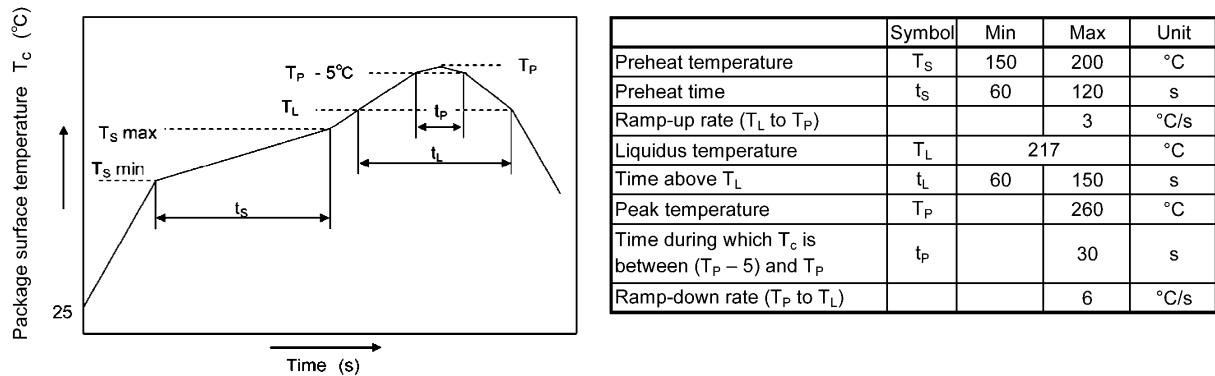


Fig. 12.1.1 An Example of a Temperature Profile When Lead(Pb)-Free Solder is Used

- When using soldering flow

Preheat the device at a temperature of 150 °C (package surface temperature) 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 devices in locations with poisonous gases (especially corrosive gases) or in dusty conditions.
- Store the devices 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.

13. Marking

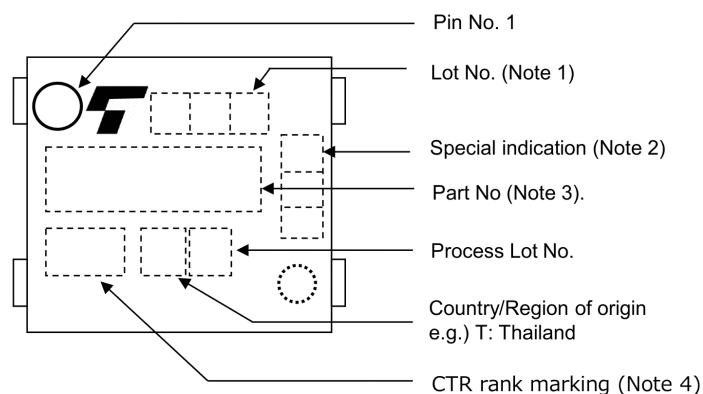


Fig. 13.1 Marking Example

Note 1: If the lot number is expressed with three characters, it indicates "manufacturing year (1 character) + manufacturing week (2 characters)".

For example, if the lot number shown on the product is "841", it means the product was manufactured in the 41st week of a year ending in 8.

Note 2: Special indication is put for the traceability enhancement.

Information of special indication

e.g. A01

A: Factory administration number

01: A counting of the number is started on every week from 01.

and reset when Lot No or weekly code is changed.

Note 3: P188 (Abbreviation code)

Note 4: For the CTR rank mark, please refer to the marking of classification in table 8.1 CTR rank table.

14. EN IEC 60747-5-5 Option (V4) Specification

- Part number: TLP188 (Note 1)
- The following part naming conventions are used for the devices that have been qualified according to option (V4) of EN IEC 60747.

Example: TLP188(V4GB-TL,E

V4: EN IEC 60747 option

GB: CTR rank

TL: Tape type

E: [[G]]/RoHS COMPATIBLE (Note 2)

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

e.g., TLP188(V4GB-TL,E → TLP188

Note 2: 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 electronic equipment.

Description	Symbol	Rating	Unit
Application classification			
for rated mains voltage ≤ 150 Vrms		I-IV	—
for rated mains voltage ≤ 300 Vrms		I-III	
Climatic classification		55 / 110 / 21	—
Pollution degree		2	—
Maximum operating insulation voltage	V_{IORM}	707	Vpeak
Input to output test voltage, Method A $V_{pr} = 1.6 \times V_{IORM}$, type and sample test $t_p = 10$ s, partial discharge < 5 pC	V_{pr}	1131	Vpeak
Input to output test voltage, Method B $V_{pr} = 1.875 \times V_{IORM}$, 100 % production test $t_p = 1$ s, partial discharge < 5 pC	V_{pr}	1330	Vpeak
Highest permissible overvoltage (transient overvoltage, $t_{pr} = 60$ s)	V_{TR}	6000	Vpeak
Safety limiting values (max. permissible ratings in case of fault, also refer to thermal derating curve)			
current (input current IF, $P_{so} = 0$)	I_{si}	250	mA
power (output or total power dissipation)	P_{so}	400	mW
temperature	T_s	150	°C
Insulation resistance $V_{IO} = 500$ V, $T_a = 25$ °C $V_{IO} = 500$ V, $T_a = 100$ °C $V_{IO} = 500$ V, $T_a = T_s$	R_{si}	$\geq 10^{12}$ $\geq 10^{11}$ $\geq 10^9$	Ω

Fig. 14.1 EN IEC 60747 Insulation Characteristics

Minimum creepage distance	Cr	5.0 mm
Minimum clearance	Cl	5.0 mm
Minimum insulation thickness	ti	0.4 mm
Comparative tracking index	CTI	500

Fig. 14.2 Insulation Related Specifications (Note)

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 circuits.



Fig. 14.3 Marking on Packing

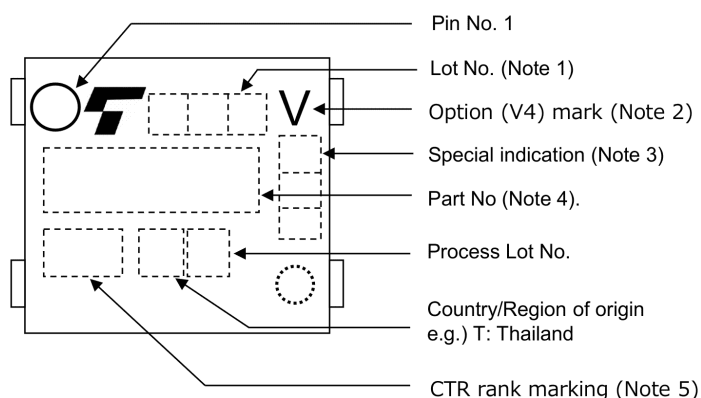


Fig. 14.4 Marking Example

Note 1: If the lot number is expressed with three characters, it indicates "manufacturing year (1 character) + manufacturing week (2 characters)".

For example, if the lot number shown on the product is "841", it means the product was manufactured in the 41st week of a year ending in 8.

Note 2: The above marking is applied to the photocouplers that have been qualified according to option (V4) of EN IEC 60747.

Note 3: Special indication is put for the traceability enhancement.

Information of special indication

e.g. A01

A: Factory administration number

01: A counting of the number is started on every week from 01.

and reset when Lot No or weekly code is changed.

Note 4: P188 (Abbreviation code)

Note 5: For the CTR rank mark, please refer to the marking of classification in table 8.1 CTR rank table.

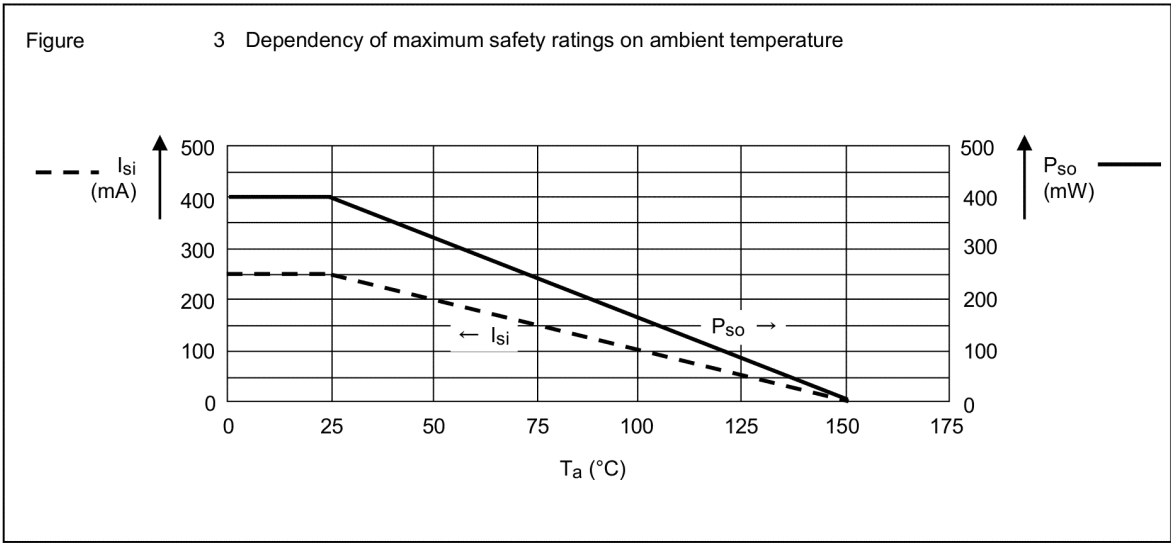
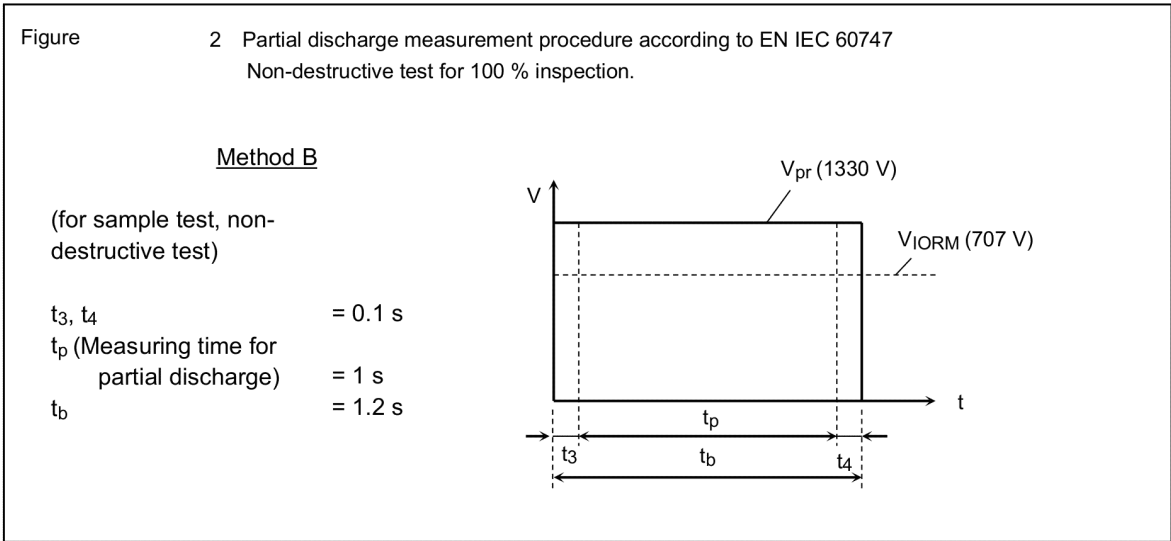
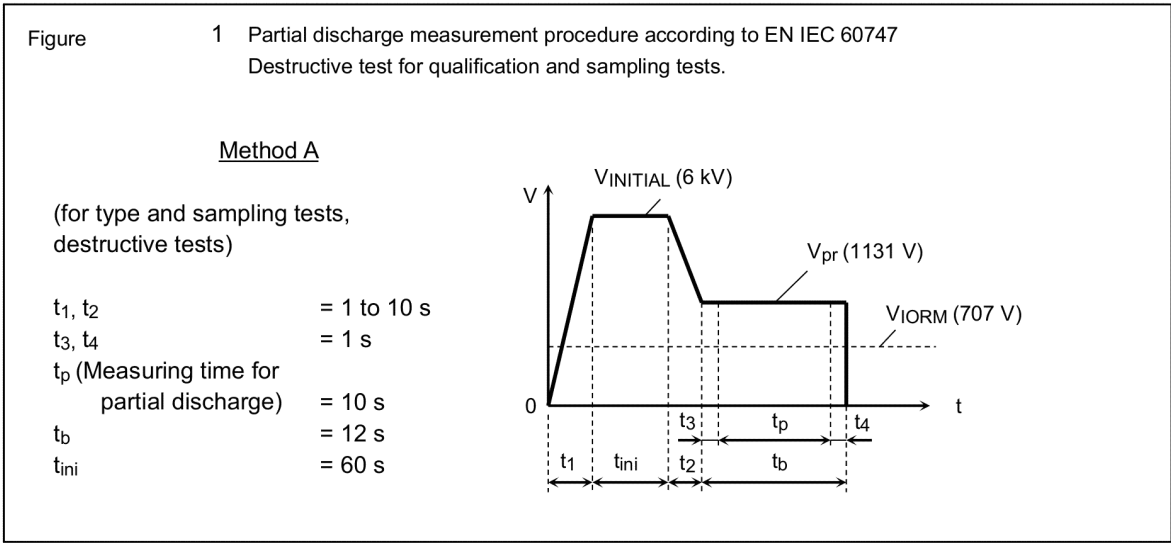
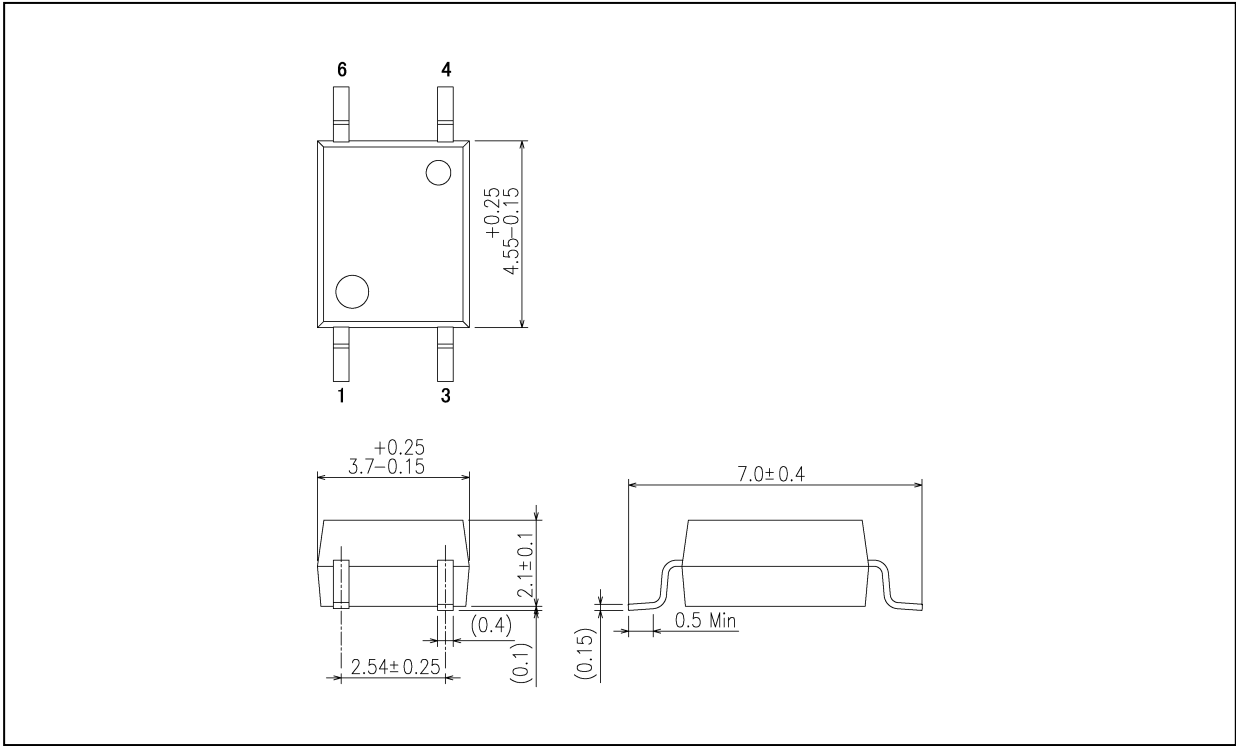


Fig. 14.5 Measurement Procedure

Package Dimensions

Unit: mm



Weight: 0.08 g (typ.)

Package Name(s)
TOSHIBA: 11-4M1S

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