

TLP188

1. Applications

- Programmable Logic Controllers (PLCs)
- Air Conditioner Inverters

2. General

TLP188 consists of phototransistors optically coupled to GaAs infrared emitting diodes. The TLP188 is housed in the very small and thin SO6(4pin) package and that guarantees high temperature operation($T_a = 110^{\circ}\text{C}$ max). With the high brakedown voltage between the collector and emitter($V_{CEO} = 350\text{V}$), TLP188 is suitable for use in programmable logiccontrollers (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°C
- (5) Safety standards

UL-Under application UL1577 File No.E67349

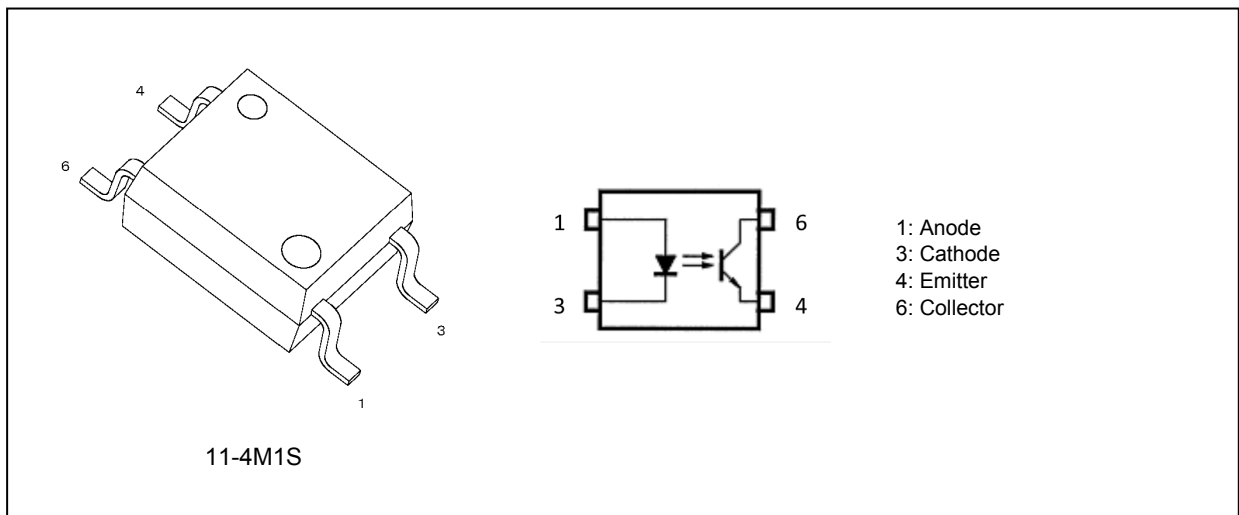
cUL-Under application CSA Component Acceptance Service No.5A File No.E67349

BSI-Under application BS EN60065:2002, BS EN60950-1:2002

VDE-Under application 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



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, $T_a = 25^\circ\text{C}$)

| | Characteristics | Symbol | Note | Rating | Unit |
|----------|--|-------------------------|----------|------------|-------|
| LED | Input forward current | I_F | | 50 | mA |
| | Input forward current derating ($T_a \geq 90^\circ\text{C}$) | $\Delta I_F/\Delta T_a$ | | -1.43 | mA/°C |
| | Input forward current (pulsed) | I_{FP} | (Note 1) | 1 | A |
| | Input reverse voltage | V_R | | 5 | V |
| | Junction temperature | T_j | | 125 | °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 ($T_a \geq 25^\circ\text{C}$) | $\Delta P_C/\Delta T_a$ | | -1.5 | 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 | P_T | | 200 | mW |
| | Input power dissipation derating ($T_a \geq 25^\circ\text{C}$) | $\Delta P_D/\Delta T_a$ | | -2 | mW/°C |
| | Isolation voltage AC, 1min, 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 μs , $f = 100$ 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, $T_a = 25^\circ\text{C}$)

| | Characteristics | Symbol | Note | Test Condition | Min | Typ. | Max | Unit |
|-------------------------------|-------------------------------------|---------------|------|--|-----|------|-----|---------------|
| LED | Input forward voltage | V_F | | $I_F = 10$ mA | 1.1 | 1.25 | 1.4 | V |
| | Input reverse current | I_R | | $V_R = 5$ V | — | — | 10 | μA |
| | Input capacitance | C_t | | $V = 0$ V, $f = 1$ MHz | — | 30 | — | pF |
| Detector | Collector-emitter breakdown voltage | $V_{(BR)CEO}$ | | $I_C = 0.1$ mA | 350 | — | — | V |
| | Emitter-collector breakdown voltage | $V_{(BR)ECO}$ | | $I_E = 0.1$ mA | 7 | — | — | |
| | Dark Current | I_{DARK} | | $V_{CE} = 300$ V | — | 0.01 | 0.2 | μA |
| | | | | $V_{CE} = 300$ V, $T_a = 85^\circ\text{C}$ | — | — | 50 | |
| Collector-emitter capacitance | C_{CE} | | | $V = 0$ 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) | $I_F = 5 \text{ mA}, V_{CE} = 5 \text{ V}$ | 50 | — | 600 | % |
| | | | $I_F = 5 \text{ mA}, V_{CE} = 5 \text{ V}, \text{Rank GB}$ | 100 | — | 600 | |
| Saturated current transfer ratio | $I_C/I_{F(\text{sat})}$ | | $I_F = 1 \text{ mA}, V_{CE} = 0.4 \text{ V}$ | — | 60 | — | |
| | | | $I_F = 1 \text{ mA}, V_{CE} = 0.4 \text{ V}, \text{Rank GB}$ | 30 | — | — | |
| Collector-emitter saturation voltage | $V_{CE(\text{sat})}$ | | $I_C = 2.4 \text{ mA}, I_F = 8 \text{ mA}$ | — | — | 0.4 | V |
| | | | $I_C = 0.2 \text{ mA}, I_F = 1 \text{ mA}$ | — | 0.2 | — | |
| | | | $I_C = 0.2 \text{ mA}, I_F = 1 \text{ mA}, \text{Rank GB}$ | — | — | 0.4 | |
| OFF-state collector current | $I_{C(\text{off})}$ | | $V_F = 0.7 \text{ V}, V_{CE} = 350 \text{ V}$ | — | — | 200 | μA |

Note 1: See Table 8.1 for current transfer ratio.

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

| 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 | | 100 | 600 | GB | |

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

Example: TLP188(GB)

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

Example: TLP188(GB,E: TLP188

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 | Note1 | $V_S = 0 \text{ V}, f = 1 \text{ MHz}$ | — | 0.8 | — | pF |
| Isolation resistance | R_S | Note1 | $V_S = 500 \text{ V}, \text{R.H.} \leq 60\%$ | 5×10^{12} | 10^{14} | — | Ω |
| Isolation voltage | BV_S | Note1 | AC, 1 min | 3750 | — | — | Vrms |
| | | | AC, 1s in oil | — | 10000 | — | |
| | | | DC, 1min in oil | — | 10000 | — | Vdc |

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, $T_a = 25^\circ\text{C}$)

| 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 | — | 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 | — | |

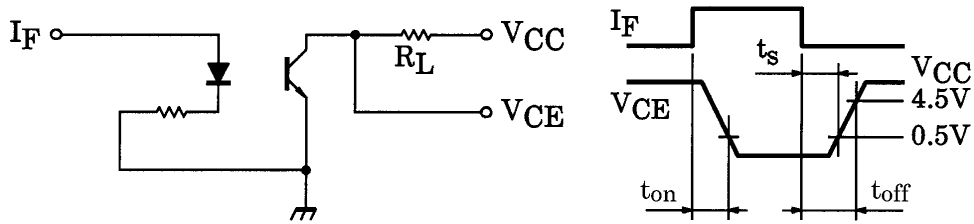


Fig. 10.1 Switching Time Test Circuit

11. Characteristics Curves (Note)

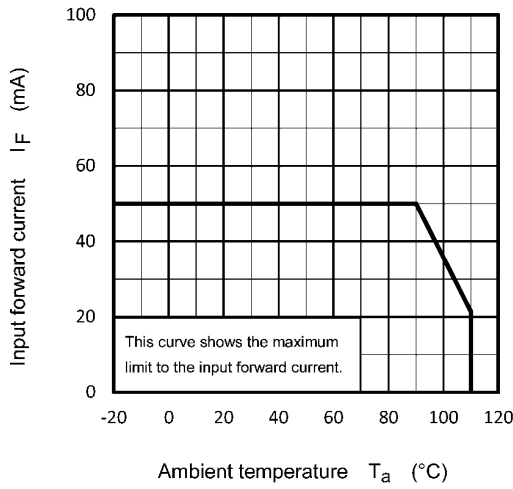


Fig. 11.1 $I_F - T_a$

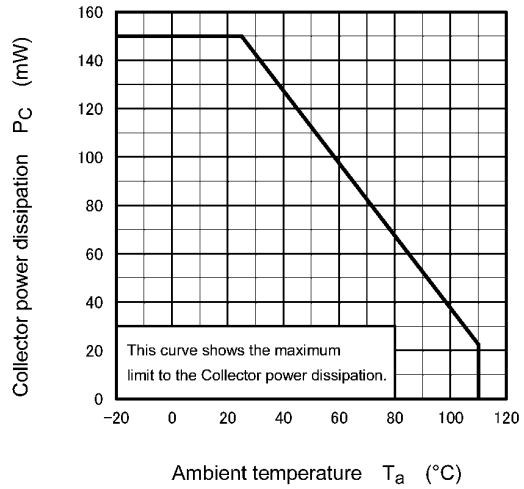


Fig. 11.2 $P_C - T_a$

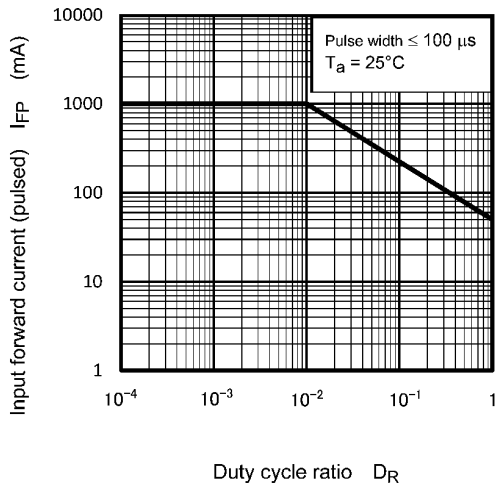


Fig. 11.3 $I_{FP} - D_R$

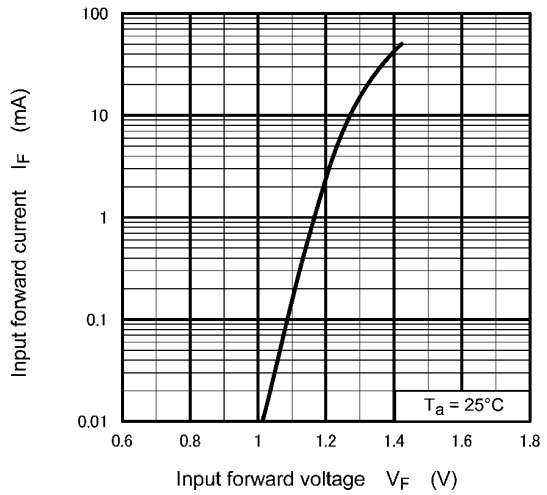


Fig. 11.4 $I_F - V_F$

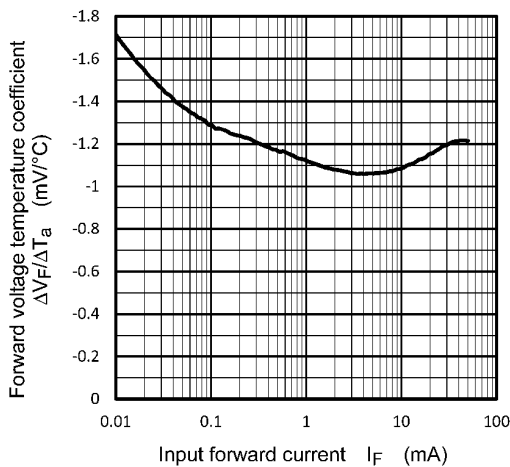


Fig. 11.5 $\Delta V_F/\Delta T_a - I_F$

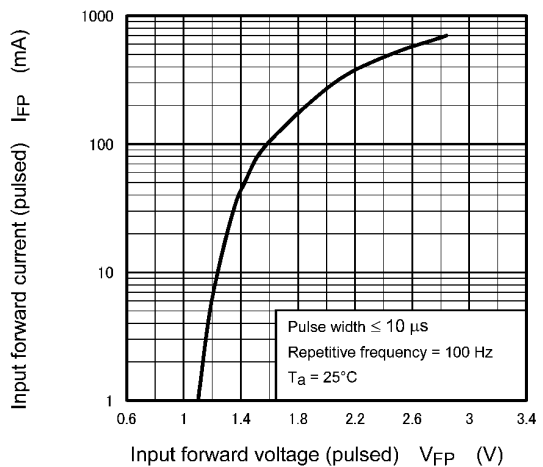


Fig. 11.6 $I_{FP} - V_{FFP}$

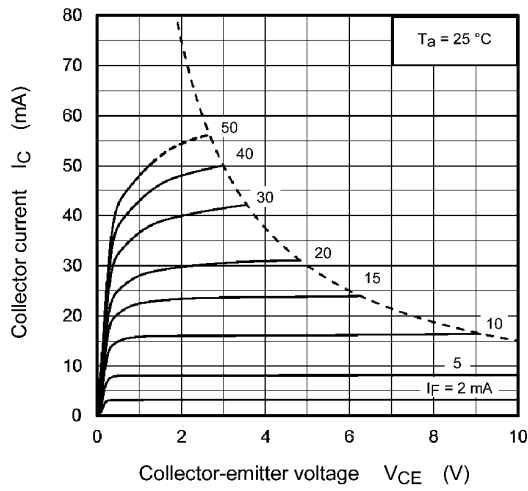


Fig. 11.7 $I_C - V_{CE}$

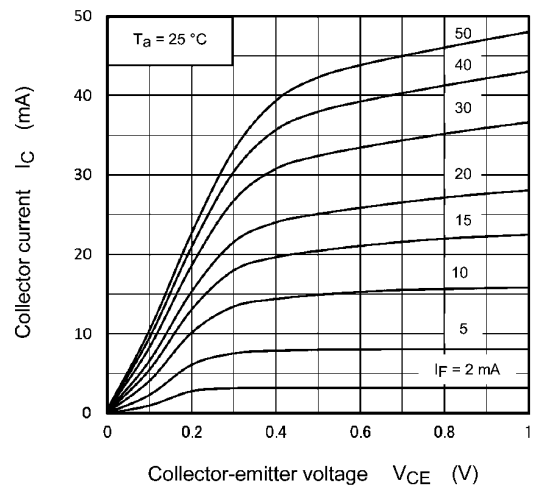


Fig. 11.8 $I_C - V_{CE}$

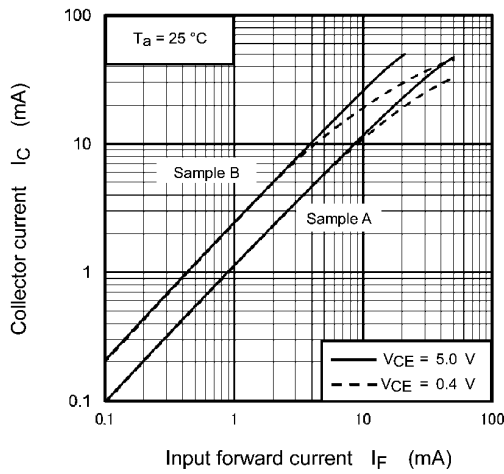


Fig. 11.9 $I_C - I_F$

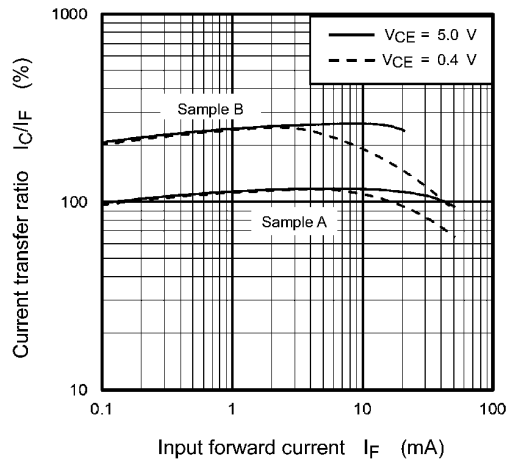


Fig. 11.10 $I_C/I_F - I_F$

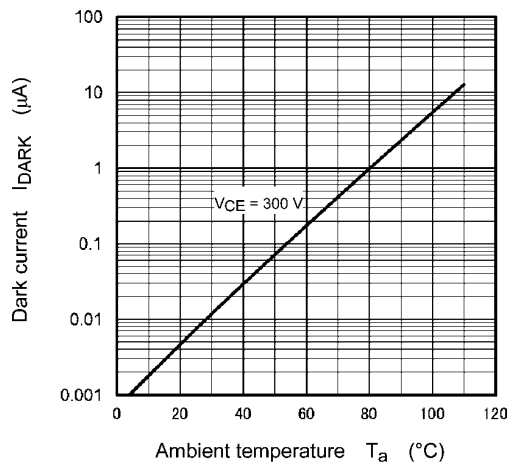


Fig. 11.11 $I_{DARK} - T_a$

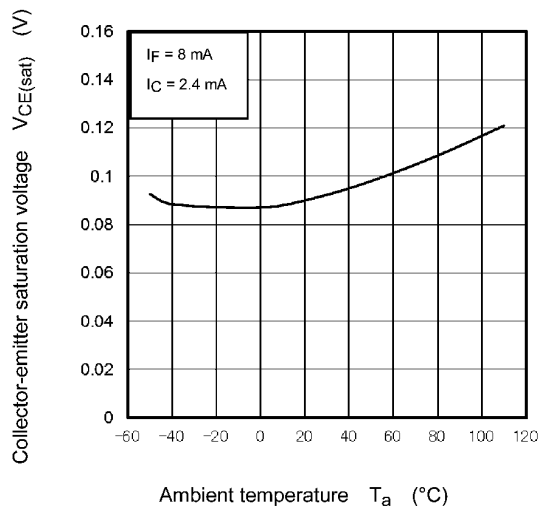


Fig. 11.12 $V_{CE(sat)} - T_a$

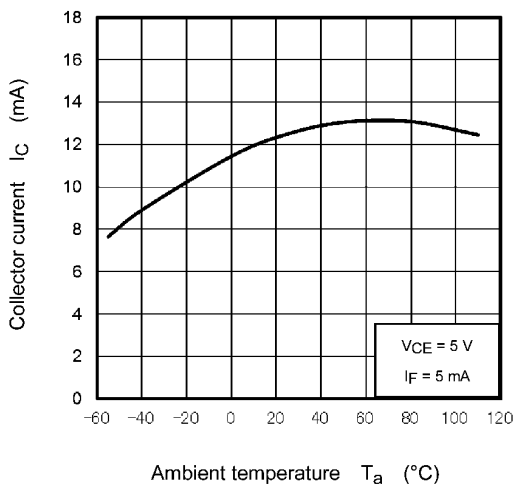


Fig. 11.13 $I_C - T_a$

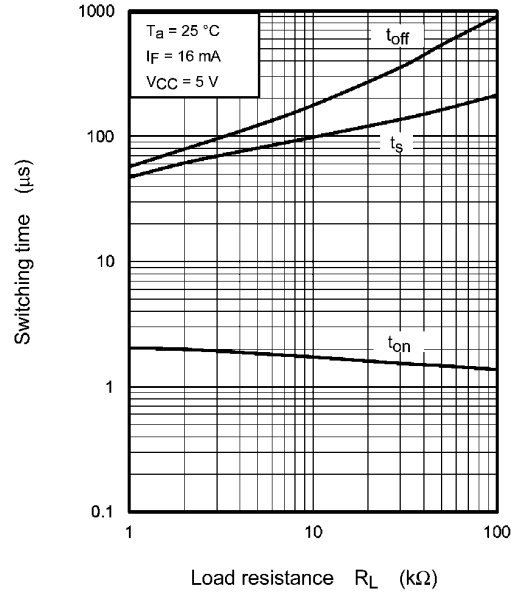


Fig. 11.14 Switching Time - R_L

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 (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.

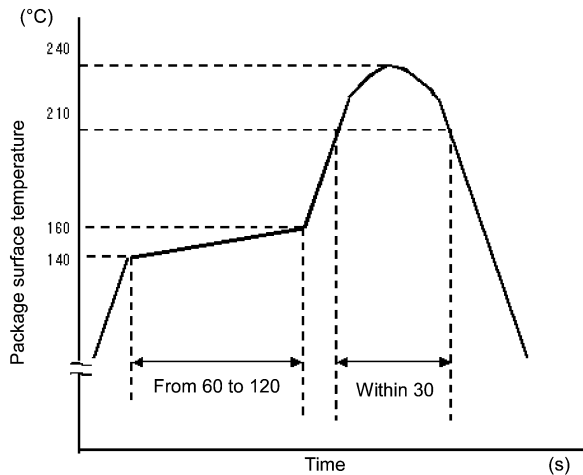


Fig. 12.1.1 An Example of a Temperature Profile When Sn-Pb Eutectic Solder is Used

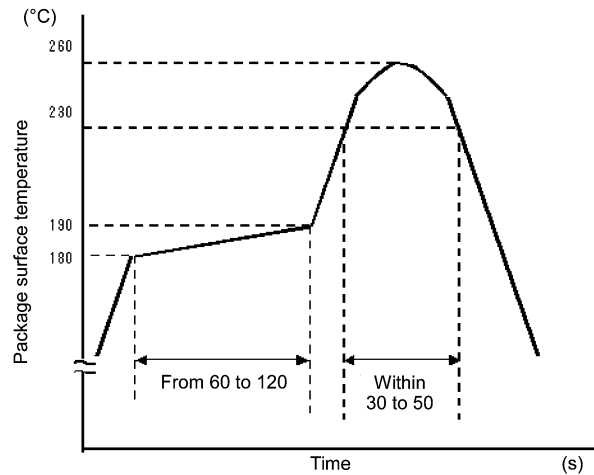


Fig. 12.1.2 An Example of a Temperature Profile When Lead(Pb)-Free Solder is Used

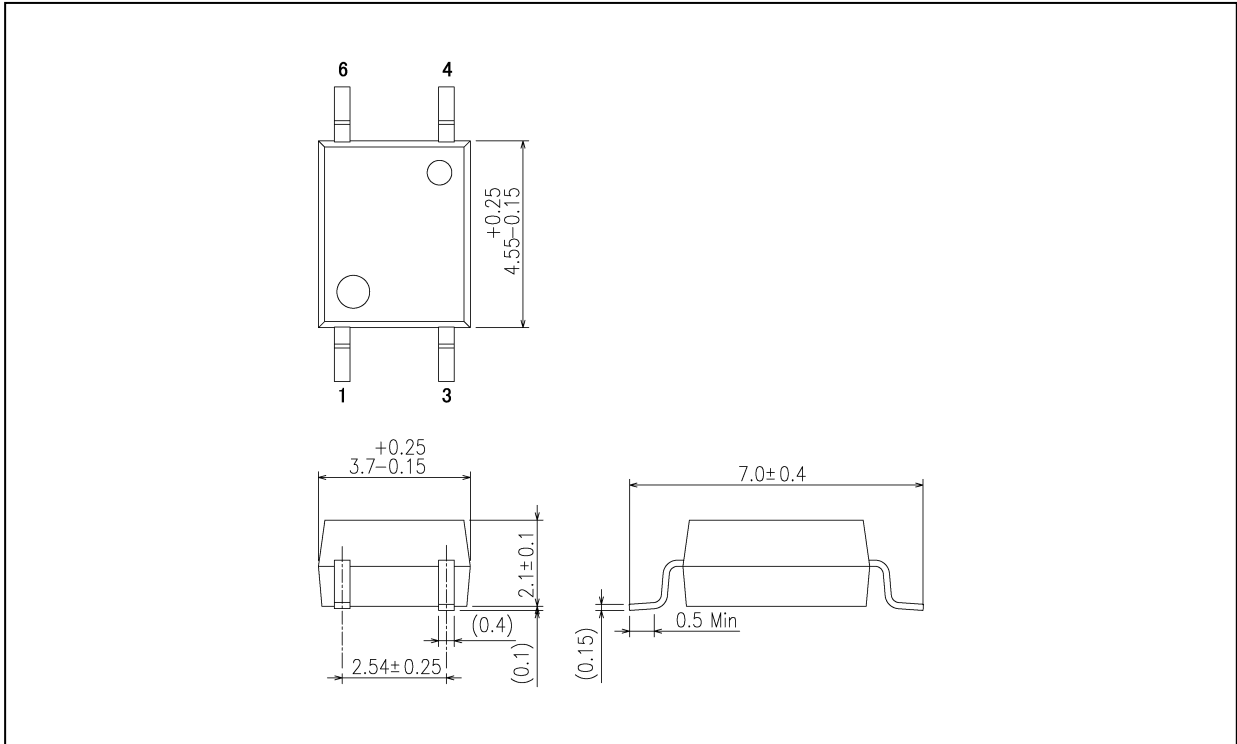
- When using soldering flow (Applicable to both eutectic solder and Lead(Pb)-Free solder)
Apply preheating of 150°C for 60 to 120 seconds.
Mounting condition of 260°C within 10 seconds is recommended.
Flow soldering must be performed once.
- When using soldering Iron
Complete soldering within 10 seconds 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.

Package Dimensions

Unit: mm



Weight: 0.08 g (typ.)

| Package Name(s) |
|------------------|
| TOSHIBA: 11-4M1S |

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