# Triac (Bidirectional Triode Thyristor)

## Features and Benefits

- Exceptional reliability
- Small fully-molded SIP package with heatsink mounting for high thermal dissipation and long life
- $V_{DRM}$ of 400 or 600 V
- 25 $A_{RMS}$ on-state current
- Uniform switching
- UL Recognized Component (File No.: E118037) (suffix I)

## Package: 3-pin SIP (TO-3PF)

*Not to scale*

## Description

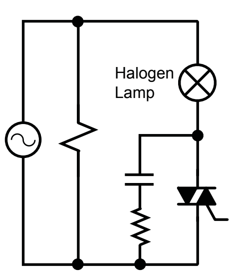
This Sanken triac (bidirectional triode thyristor) is designed for AC power control, providing reliable, uniform switching for full-cycle AC applications.

In comparison with other products on the market, the TMA25x series provides increased isolation voltage (2000 $VAC_{RMS}$), guaranteed for up to 1 minute, and greater peak nonrepetitive off-state voltage, $V_{DSM}$ (700 V). In addition, commutation dv/dt and (dv/dt)c are improved.

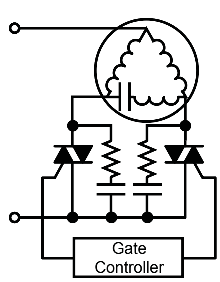
## Applications

- Residential and commercial appliances: vacuum cleaners, rice cookers, TVs, home entertainment
- White goods: washing machines
- Office automation power control, photocopiers
- Motor control for small tools
- Temperature control, light dimmers, electric blankets
- General use switching mode power supplies (SMPS)

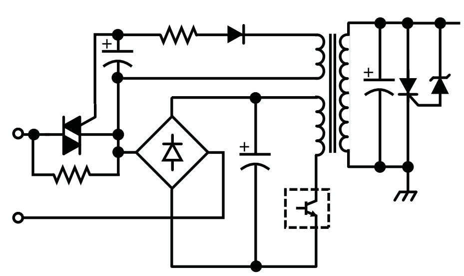
## Typical Applications




Heater control
(for example, LBP. PPC, MFP)




Two-phase motor control
(for example, washing machine)



In-rush current control
(for example, SMPS)



SANKEN ELECTRIC CO., LTD.
http://www.sanken-ele.co.jp/en/

## Selection Guide

| Part Number | $V_{DRM}$ (V) | UL-Recognized Component | Package | Packing |
|---|---|---|---|---|
| TMA254B(I) | 400 | Yes | 3-pin fully molded SIP with heatsink mount | 30 pieces per tube |
| TMA254B-L | 400 | – | | |
| TMA256B(I) | 600 | Yes | | |
| TMA256B-L | 600 | – | | |

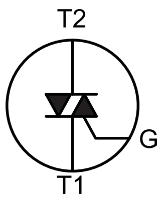
## Absolute Maximum Ratings

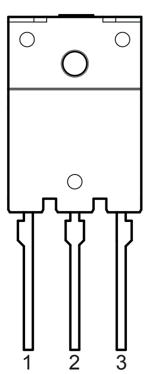
| Characteristic | Symbol | Notes | | Rating | Units |
|---|---|---|---|---|---|
| Peak Repetitive Off-State Voltage | $V_{DRM}$ | TMA254Bx | $R_{GREF} = \infty$ | 400 | V |
| | | TMA256Bx | | 600 | V |
| Peak Non-Repetitive Off-State Voltage | $V_{DSM}$ | TMA254Bx | $R_{GREF} = \infty$ | 500 | V |
| | | TMA256Bx | | 700 | V |
| Isolation Voltage | $V_{ISO}$ | AC RMS applied for 1 minute between lead and case | | 2000 | V |
| RMS On-State Current | $I_{T(RMS)}$ | 50/60 Hz full cycle sine wave, total Conduction angle $(\alpha+) + (\alpha-) = 360°$, $T_C = 83°C$ | | 25 | A |
| Surge On-State Current | $I_{TSM}$ | f = 60 Hz | Full cycle sine wave, peak value, non-repetitive, initial $T_J = 125°C$ | 263 | A |
| | | f = 50 Hz | | 250 | A |
| $I^2t$ Value for Fusing | $I^2t$ | Value for 50 Hz half cycle sine wave, 1 cycle, $I_{TSM} = 250$ A | | 312 | $A^2 \cdot s$ |
| Critical Rising Rate of On-State Current | di/dt | $I_T = I_{T(RMS)} \times \sqrt{2}$, $V_D = V_{DRM} \times 0.5$, $f \leq 60$ Hz, $t_{gw} \geq 100$ µs, $t_{gr} \leq 250$ ns, $I_{gp} \geq 60$ mA | | 25 | A/µs |
| Peak Gate Current | $I_{GM}$ | $f \geq 50$ Hz, duty cycle ≤ 10% | | 2 | A |
| Peak Gate Power Dissipation | $P_{GM}$ | $f \geq 50$ Hz, duty cycle ≤ 10% | | 5 | W |
| Average Gate Power Dissipation | $P_{GM(AV)}$ | $T_J < T_J(max)$ | | 0.5 | W |
| Junction Temperature | $T_J$ | | | –40 to 125 | ºC |
| Storage Temperature | $T_{stg}$ | | | –40 to 125 | ºC |

**Thermal Characteristics** May require derating at maximum conditions

| Characteristic | Symbol | Test Conditions | Value | Units |
|---|---|---|---|---|
| Package Thermal Resistance (Junction to Case) | $R_{\theta JC}$ | For AC | 1.5 | ºC/W |

## Pin-out Diagram




**Terminal List Table**

| Number | Name | Function |
|---|---|---|
| 1 | T1 | Main terminal, gate referenced |
| 2 | T2 | Main terminal connect to signal side |
| 3 | G | Gate control |

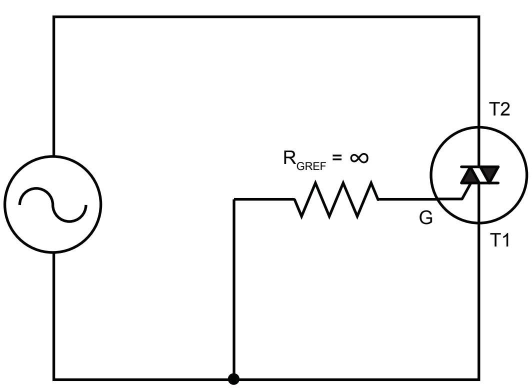
All performance characteristics given are typical values for circuit or system baseline design only and are at the nominal operating voltage and an ambient temperature, $T_A$, of 25°C, unless otherwise stated.

## ELECTRICAL CHARACTERISTICS

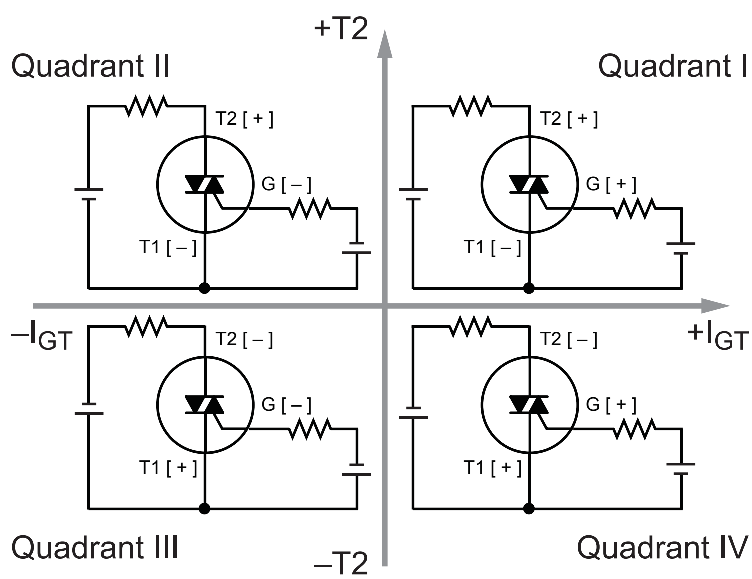
| Characteristics | Symbol | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Off-State Leakage Current | $I_{DRM}$ | $V_D = V_{DRM}$, $T_J$ = 125°C, $R_{GREF} = \infty$ using test circuit 1 | – | – | 2.0 | mA |
| | | $V_D = V_{DRM}$, $T_J$ = 25°C, $R_{GREF} = \infty$ using test circuit 1 | – | – | 100 | μA |
| On-State Voltage | $V_{TM}$ | $I_T$ = 20 A, $T_J$ = 25°C | – | – | 1.4 | V |
| Gate Trigger Voltage | $V_{GT}$ | Quadrant I: T2+, G+; $V_D$ = 12 V, $R_L$ = 20 Ω, $T_J$ = 25°C | – | – | 1.5 | V |
| | | Quadrant II: T2+, G–; $V_D$ = 12 V, $R_L$ = 20 Ω, $T_J$ = 25°C | – | – | 1.5 | V |
| | | Quadrant III: T2–, G–; $V_D$ = 12 V, $R_L$ = 20 Ω, $T_J$ = 25°C | – | – | 1.5 | V |
| Gate Trigger Current | $I_{GT}$ | Quadrant I: T2+, G+; $V_D$ = 12 V, $R_L$ = 20 Ω, $T_J$ = 25°C | – | – | 30 | mA |
| | | Quadrant II: T2+, G–; $V_D$ = 12 V, $R_L$ = 20 Ω, $T_J$ = 25°C | – | – | 30 | mA |
| | | Quadrant III: T2–, G–; $V_D$ = 12 V, $R_L$ = 20 Ω, $T_J$ = 25°C | – | – | 30 | mA |
| Gate Non-trigger Voltage | $V_{GD}$ | $V_D = V_{DRM} \times 0.5$, $R_L$ = 4 kΩ, $T_J$ = 125°C | 0.2 | – | – | V |
| Critical Rising Rate of Off-State Voltage during Commutation* | (dv/dt)c | $T_J$ = 125°C, $V_D$ = 400 V, (di/dt)c = –12 A/ms, $I_{TP}$ = 2 A | 15 | – | – | V/μs |
| Critical Rising Rate of Off-StateVoltage | dv/dt | $V_D = V_{DRM} \times 0.66$, $T_J$ = 125°C, $R_{GREF} = \infty$ using test circuit 1 | 100 | – | – | V/μs |

*Where $I_{TP}$ is the peak current through T2 to T1.

### Test Circuit 1

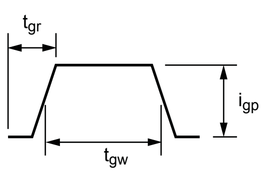



### Gate Trigger Characteristics

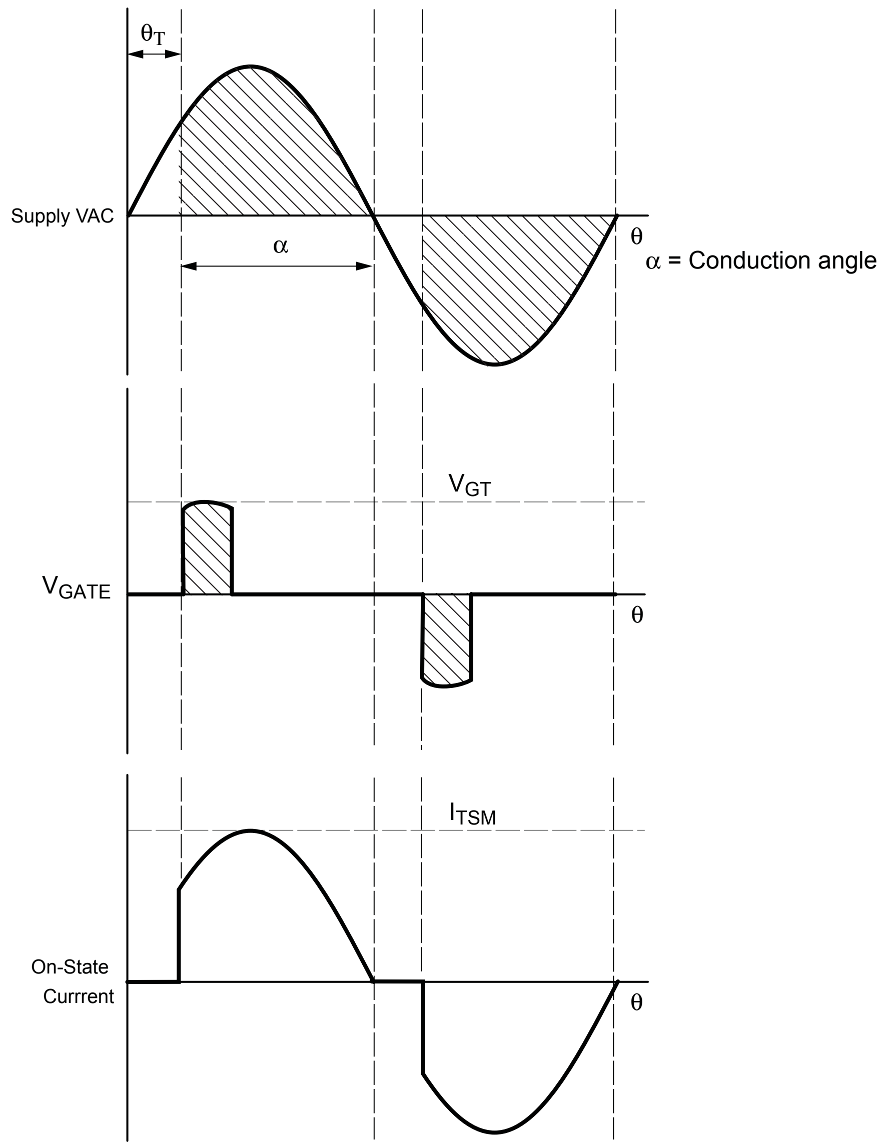



Polarities referenced to T1

### Gate Trigger Current

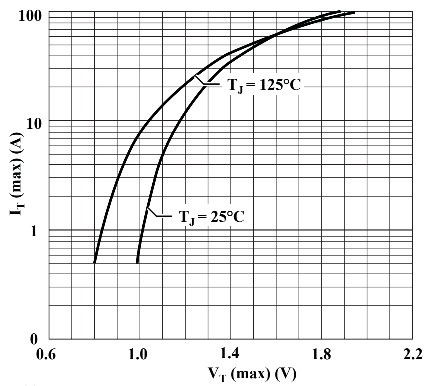


**Commutation Timing Diagrams**

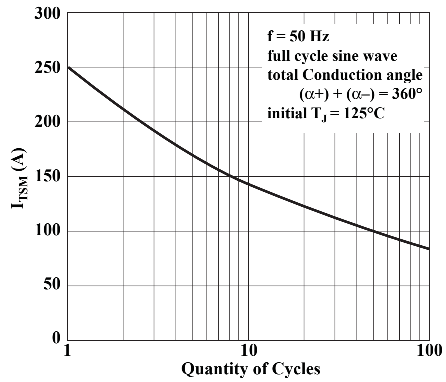


## Performance Characteristics at $T_A$ = 25°C

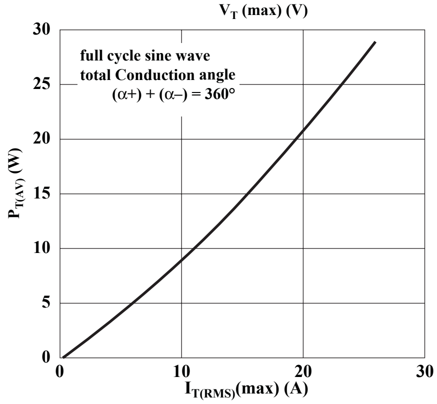
Maximum On-State Current versus Maximum On-State Voltage



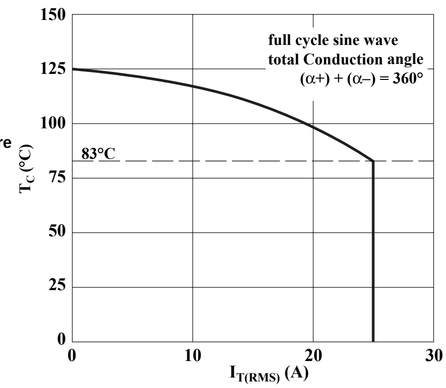

Surge On-State Current versus Quantity of Cycles



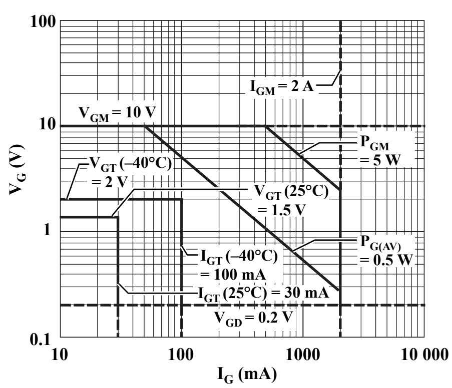

On-State Average Power Dissipation versus Maximum On-State RMS Current



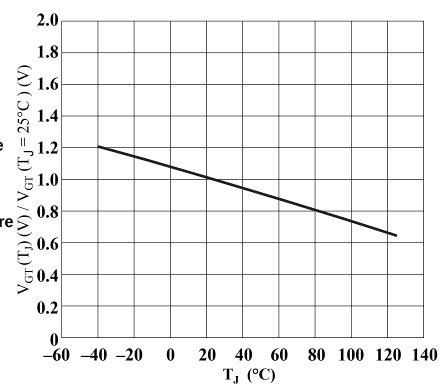

Case Temperature versus On-State RMS Current



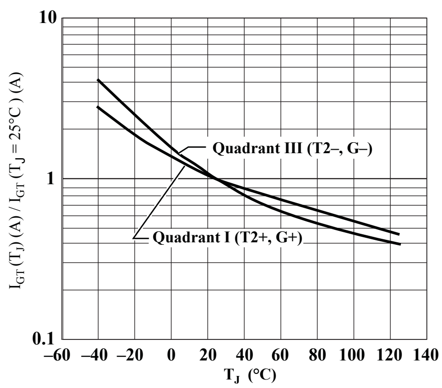

Gate Voltage versus Gate Current



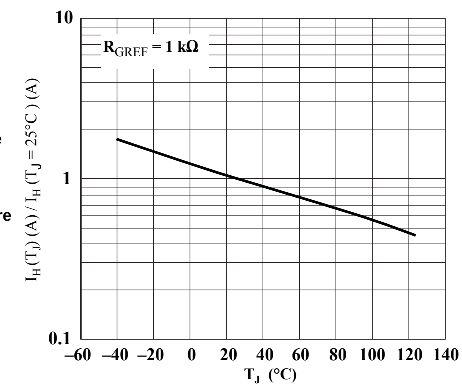

Proportional Change of Typical Trigger Voltage versus Junction Temperature

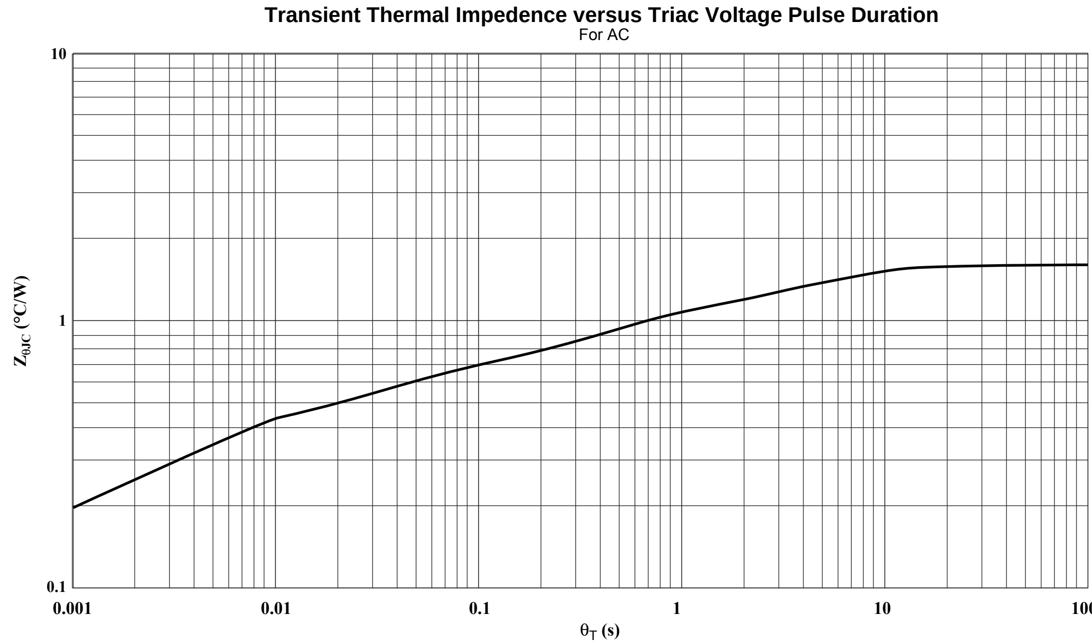



Proportional Change of Typical Trigger Current versus Junction Temperature

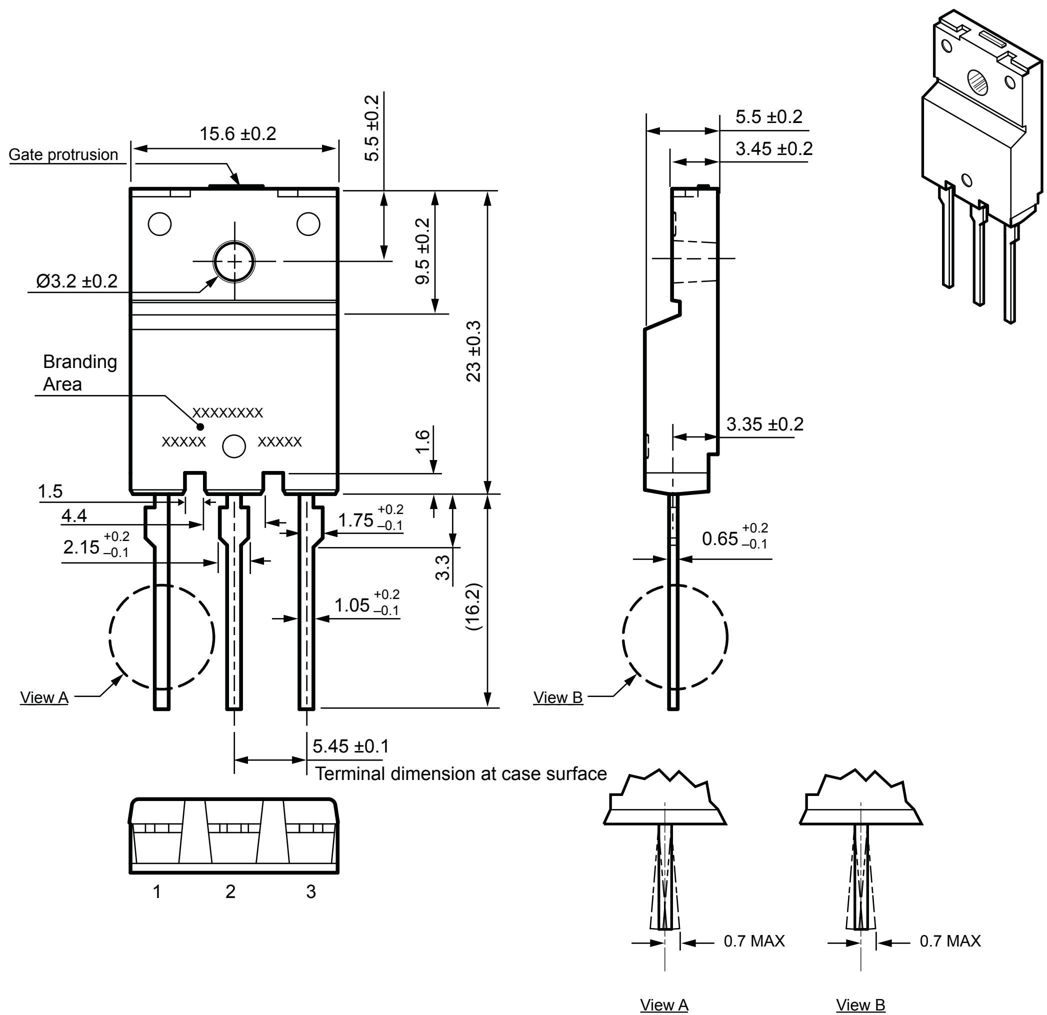



Proportional Change of Typical Holding Current versus Junction Temperature




Transient Thermal Impedence versus Triac Voltage Pulse Duration
For AC
10
1
0.1
0.001
0.01
0.1
1
10
100
$Z_{\theta JC}$ (°C/W)
$\theta_T$ (s)

### TO-3PF Package Outline Drawing




Gate burr: 0.3 mm (max.), mold flash may appear at opposite side
Terminal core material: Cu
Terminal treatment: Ni plating and Pb-free solder dip
Leadform: 700
Package: TO-3PF (FM100)

Dimensions in millimeters

Branding codes (exact appearance at manufacturer discretion):
1st line, type: MA25xB
2nd line left, lot: *YM*
Where: Y is the last digit of the year of manufacture
M is the month (*1* to *9, O, N, D*)
2nd line right, lot: *DD*
Where: DD is the date

*Leadframe plating Pb-free. Device meets RoHS requirements.*

Because reliability can be affected adversely by improper storage environments and handling methods, please observe the following cautions.

**Cautions for Storage**

- Ensure that storage conditions comply with the standard temperature (5°C to 35°C) and the standard relative humidity (around 40% to 75%); avoid storage locations that experience extreme changes in temperature or humidity.
- Avoid locations where dust or harmful gases are present and avoid direct sunlight.
- Reinspect for rust on leads and solderability of the products that have been stored for a long time.

**Cautions for Testing and Handling**

When tests are carried out during inspection testing and other standard test periods, protect the products from power surges from the testing device, shorts between the product pins, and wrong connections. Ensure all test parameters are within the ratings specified by Sanken for the products.

**Remarks About Using Silicone Grease with a Heatsink**

- When silicone grease is used in mounting the products on a heatsink, it shall be applied evenly and thinly. If more silicone grease than required is applied, it may produce excess stress.
- Volatile-type silicone greases may crack after long periods of time, resulting in reduced heat radiation effect. Silicone greases with low consistency (hard grease) may cause cracks in the mold resin when screwing the products to a heatsink.

  Our recommended silicone greases for heat radiation purposes, which will not cause any adverse effect on the product life, are indicated below:

| Type | Suppliers |
|---|---|
| G746 | Shin-Etsu Chemical Co., Ltd. |
| YG6260 | Momentive Performance Materials Inc. |
| SC102 | Dow Corning Toray Co., Ltd. |

**Cautions for Mounting to a Heatsink**

- When the flatness around the screw hole is insufficient, such as when mounting the products to a heatsink that has an extruded (burred) screw hole, the products can be damaged, even with a lower than recommended screw torque. For mounting the products, the mounting surface flatness should be 0.05 mm or less.
- Please select suitable screws for the product shape. Do not use a flat-head machine screw because of the stress to the products. Self-tapping screws are not recommended. When using self-tapping screws, the screw may enter the hole diagonally, not vertically, depending on the conditions of hole before threading or the work situation. That may stress the products and may cause failures.
- Recommended screw torque: 0.490 to 0.686 N●m (5 to 7 kgf●cm).
- For tightening screws, if a tightening tool (such as a driver) hits the products, the package may crack, and internal stress fractures may occur, which shorten the lifetime of the electrical elements and can cause catastrophic failure. Tightening with an air driver makes a substantial impact. In addition, a screw torque higher than the set torque can be applied and the package may be damaged. Therefore, an electric driver is recommended.

  When the package is tightened at two or more places, first pre-tighten with a lower torque at all places, then tighten with the specified torque. When using a power driver, torque control is mandatory.

**Soldering**

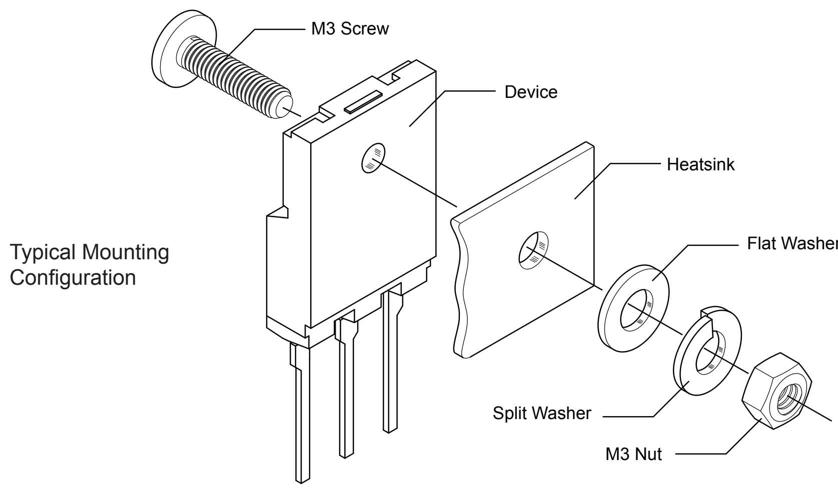
- When soldering the products, please be sure to minimize the working time, within the following limits:

  260±5°C 10±1 s (Flow, 2 times)

  380±10°C 3.5±0.5 s (Soldering iron, 1 time)
- Soldering should be at a distance of at least 1.5 mm from the body of the products.

**Electrostatic Discharge**

- When handling the products, the operator must be grounded. Grounded wrist straps worn should have at least 1 MΩ of resistance from the operator to ground to prevent shock hazard, and it should be placed near the operator.
- Workbenches where the products are handled should be grounded and be provided with conductive table and floor mats.
- When using measuring equipment such as a curve tracer, the equipment should be grounded.
- When soldering the products, the head of soldering irons or the solder bath must be grounded in order to prevent leak voltages generated by them from being applied to the products.
- The products should always be stored and transported in Sanken shipping containers or conductive containers, or be wrapped in aluminum foil.


M3 Screw
Device
Heatsink
Flat Washer
Typical Mounting Configuration
Split Washer
M3 Nut

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