



# AN11172

## Mounting instructions for SOT78 (TO-220AB); SOT186A (TO-220F)

Rev. 2.0 — 21 May 2021

application note

### Document information

| Information | Content  |
|-------------|--|
| Keywords    | SOT78, SOT186A, TO-220AB, TO-220F  |
| Abstract    | This application note provides mounting instructions for SOT78 (TO-220AB) and SOT186A (TO-220F) packages |

## 1. Introduction

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This application note provides mounting instructions for SOT78 (TO-220AB) and SOT186A (TO-220F) packages.

## 2. General data and instructions

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### 2.1. General rules

1. Fasten the device to the heatsink before soldering the leads
2. Avoid stress to the leads
3. Keep mounting tool (for example, screwdriver) clear of the plastic body
4. When screw mounting, the washer must not exert any force on the plastic part of the body.

### 2.2. Mounting methods

#### Clip mounting

Mounting with a spring clip gives:

- A good thermal contact under the crystal area, and slightly lower thermal resistance than screw mounting
- Safe insulation for mains operation.

Minimum force for good heat transfer is 10 N. Maximum force to avoid damaging the device is 80 N.

#### M3 screw mounting

It is recommended that a metal washer is inserted between screw head and mounting tab. Do not use self-tapping screws.

Mounting torque for screw mounting (for thread-forming screws the values are final values):

- Minimum torque for good heat transfer is 0.55 Nm
- Maximum torque to avoid damaging the device is 0.80 Nm.

When a nut or screw is driven directly against the tab, the torques are as follows:

- Minimum torque for good heat transfer is 0.40 Nm
- Maximum torque to avoid damaging the device is 0.60 Nm.

#### Rivet mounting non-insulated

Do not pop-rivet the device to the heatsink. It is permissible to press-rivet the metal tab providing that eyelet rivets of soft material are used, and the press forces are slowly and carefully controlled.

This method is not permitted for full-pack packages (SOT186A) because it damages the plastic encapsulation insulation properties.

### 2.3. Heatsink requirements

Flatness in the mounting area: 0.02 mm maximum per 10 mm.

Deburr the mounting holes. For further information, see [Section 3](#).

## 2.4. Heatsink compound

The thermal resistance from mounting base to heatsink  $R_{th(mb-h)}$  can be reduced by applying a smear of aluminium oxide compound between the contact surfaces. Values given are of thermal resistance using this type of compound. Dow Corning 340 Heat sink compound is recommended. For insulated mounting, apply the compound to the bottom of both device and insulator. Avoid applying excess compound as the thermal resistance that results can be higher than if no compound is applied.

## 2.5. Thermal data for TO-220 packages with various heatsink mounting methods

The mounting base-to-heatsink thermal resistance  $R_{th(mb-h)}$  is package-dependent, not device dependent. It applies to all devices in a given package. The figures given in [Table 1](#) assume optimum mounting conditions (that is flat heatsink, spring clip mounted, optimum quantity of heatsink compound where applicable). However the junction-to-mounting base thermal resistance  $R_{th(j-mb)}$  is device-dependent; figures are quoted separately in each data sheet.

For full-pack (SOT186A) devices, junction-to-heatsink thermal resistance  $R_{th(j-h)}$  with and without heatsink compound are quoted separately in each data sheet.

**Table 1. Thermal resistance from mounting base to heatsink;  $R_{th(mb-h)}$**

| Mounting method  | clip  | screw |
|--|-------|-------|
|  | (K/W) |       |
| Direct with heatsink compound                                | 0.3   | 0.5   |
| Direct without heatsink compound                             | 1.4   | 1.4   |
| With heatsink compound and 0.1 mm maximum mica insulator     | 2.2   | -     |
| With heatsink compound and 0.25 mm maximum alumina insulator | 0.8   | -     |
| With heatsink compound and 0.05 mm mica insulator            | 0.8   | -     |
| insulated up to 500 V  | -     | 1.4   |
| insulated up to 800 V / 1000 V                               | -     | 1.6   |
| Without heatsink compound and 0.05 mm mica insulator         | 0.8   | -     |
| insulated up to 500 V  | -     | 3.0   |
| insulated up to 800 V / 1000 V                               | -     | 4.5   |

Additional insulators are generally not required when mounting the full-pack (SOT186A) package.

## 2.6. Soldering

Recommendations for devices with a maximum storage temperature rating  $\leq 175$  °C:

### Dip or wave soldering

Maximum permissible solder temperature is 260 °C at a distance from the body of > 5 mm and for a total contact time with soldering bath or waves of < 7 s

### Hand soldering

Maximum permissible temperature is 275 °C at a distance from the body of > 3 mm and for a total contact time with the soldering iron of < 5 s.

The body of the device must not touch anything with a temperature > 200 °C.

It is not permitted to solder the metal tab of the device to a heatsink.

Avoid any force on body and leads during or after soldering; do not correct the position of the device or of its leads after soldering.

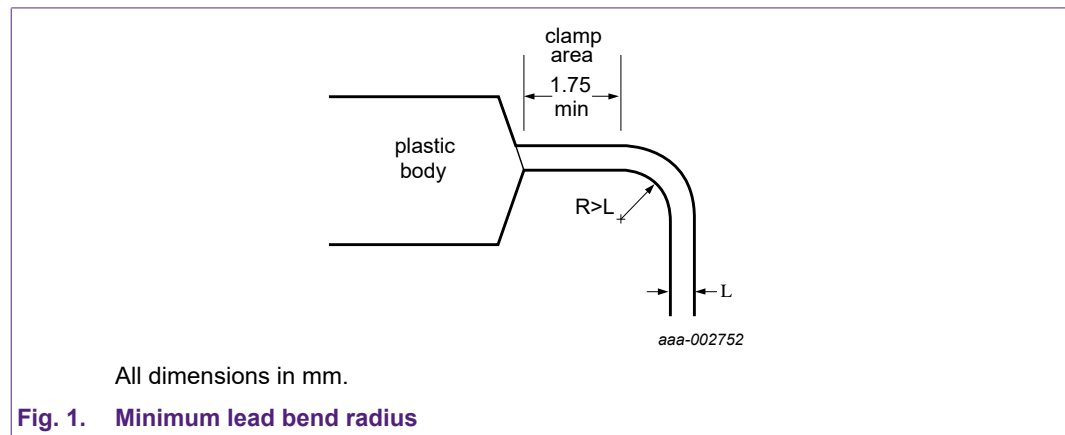
## 2.7. Lead bending

Maximum permissible tensile force on the body for 5 seconds is 20 N.

The leads can be bent, twisted or straightened. To keep forces within the above mentioned limits, always clamp the leads rigidly near the body during bending. This prevents damage to the seal of the leads within the plastic body.

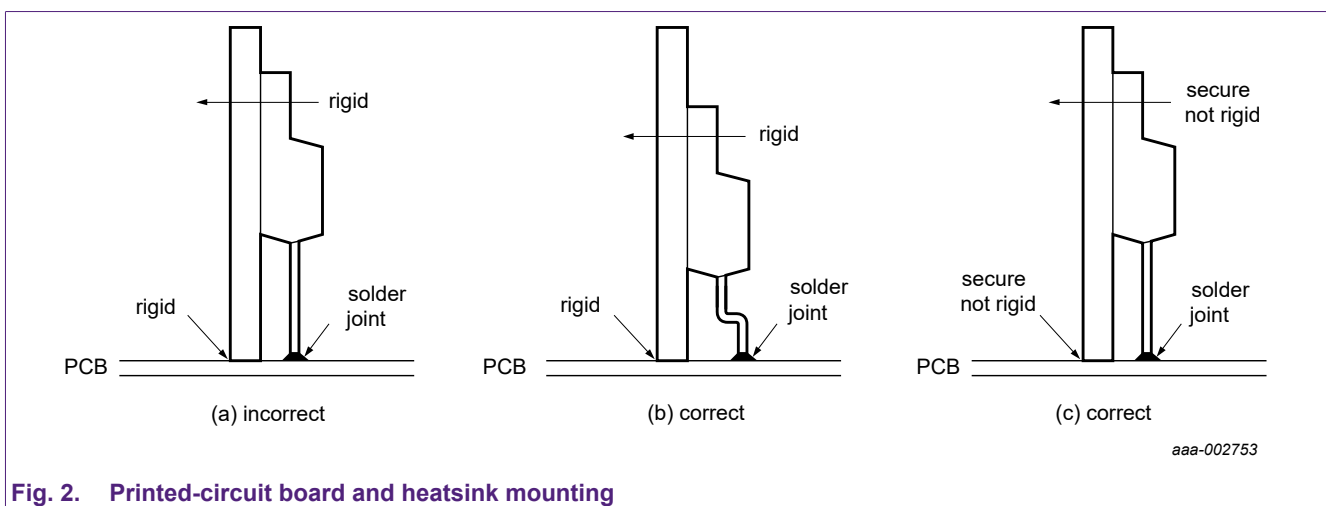
Leads can be bent as near to the body as required, but allow an adequate length of minimum 1.75 mm from the body to the start of a bend radius for clamping.

The internal radius of bend must never be less than the thickness of the lead. A minimum radius of at least  $1.5 \times$  lead thickness is preferred; see Fig. 1. Surface cracks in the plating on the lead are common when a radius less than  $1.5 \times$  lead thickness is used. Although exposing the copper material, these cracks do not affect the mechanical strength of the lead.



## 2.8. Additional guidelines

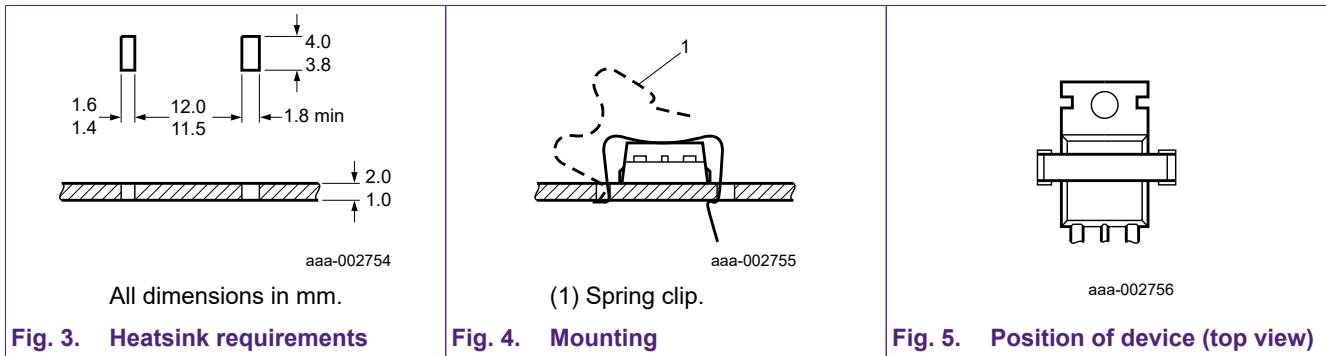
It is recommended that, where a device is rigidly secured to a heatsink which is in turn rigidly secured to a PCB, a bend is formed into the leads to act as an expansion loop. This prevents differential expansion of the mounting parts transferring stress to the soldering joint, as shown in Fig. 2. It is only necessary where the device is mounted so rigidly that expansion forces are transmitted through the assembly.



### 3. Instructions for clip mounting

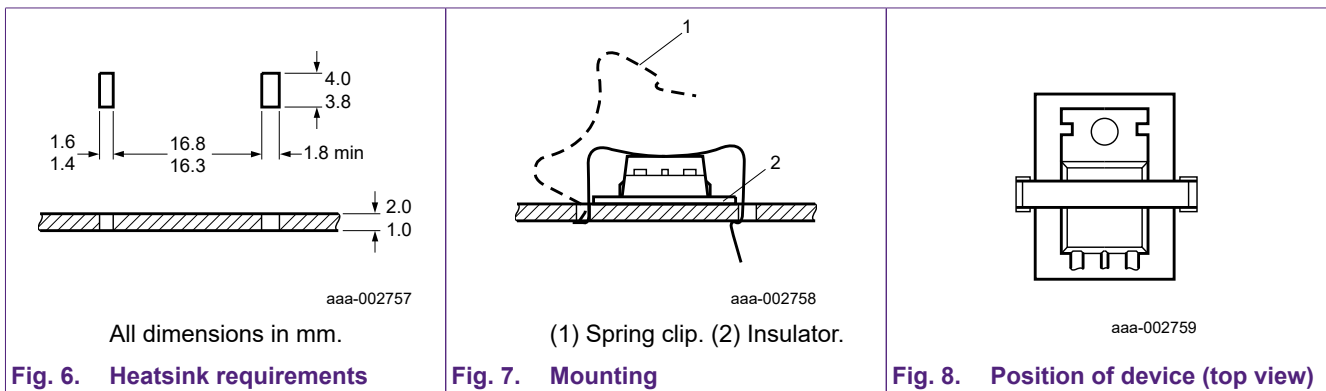
#### 3.1. Direct mounting with spring clip

1. Apply heatsink compound to the mounting base, then place the device on the heatsink
2. Push the short end of the clip into the narrow slot in the heatsink with the clip at an angle of 10° to 30° to the vertical; see [Fig. 3](#) and [Fig. 4](#).
3. Push down the clip over the device until the long end of the clip snaps into the wide slot in the heatsink. The clip must bear on the plastic body, not on the tab; see [Fig. 5](#).



#### 3.2. Insulated mounting with spring clip

1. Apply heatsink compound to the bottom of both device and insulator, then place the device with the insulator on the heatsink.
2. Push the short end of the clip into the narrow slot in the heatsink with the clip at an angle of 10° to 30° to the vertical; see [Fig. 6](#), [Fig. 7](#) and [Fig. 8](#).
3. Push down the clip over the device until the long end of the clip snaps into the wide slot in the heatsink. The clip must bear on the plastic body, not on the tab. Ensure that the device is centered on the mica insulator to prevent unwanted movement.



## 4. Instructions for screw mounting

### 4.1. Direct mounting with screw and spacing washer

#### Through heatsink with nut

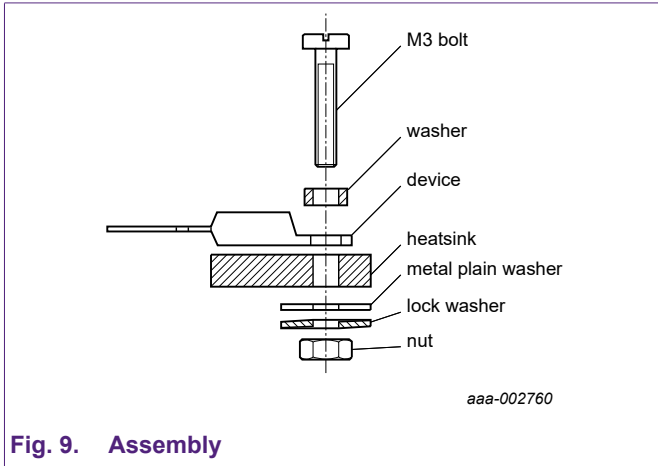


Fig. 9. Assembly

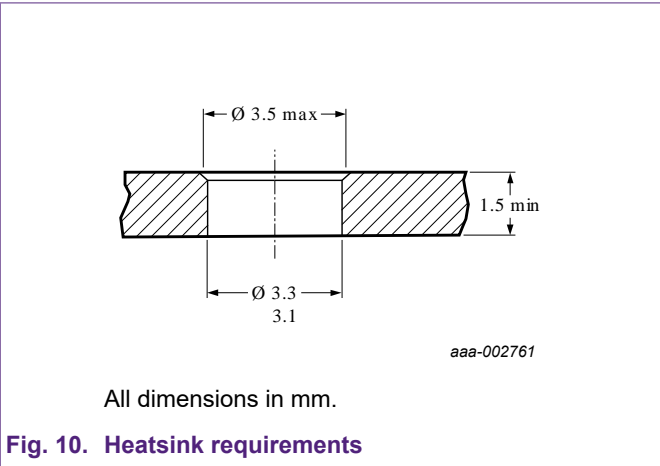


Fig. 10. Heatsink requirements

All dimensions in mm.

#### Into tapped heatsink

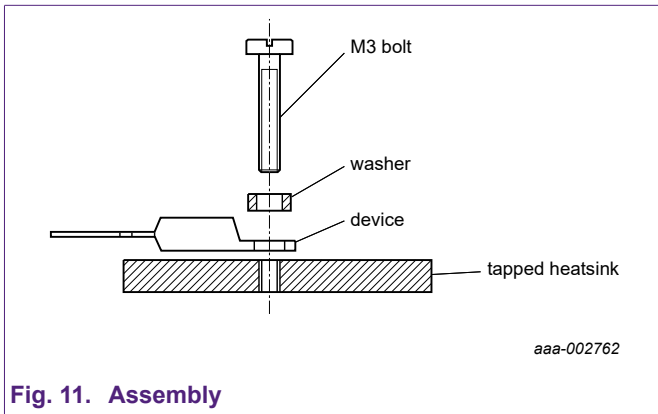


Fig. 11. Assembly

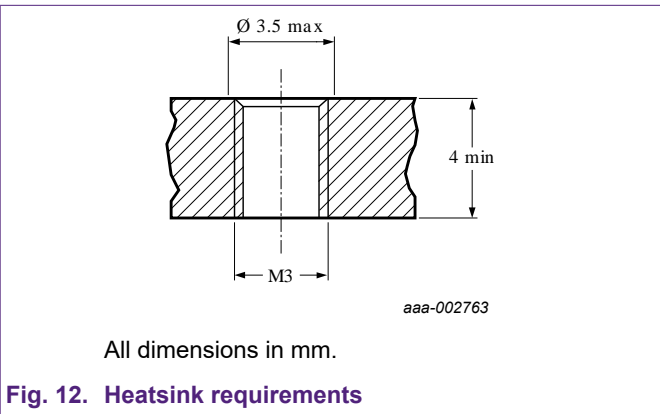


Fig. 12. Heatsink requirements

All dimensions in mm.

### 4.2. Insulated mounting with screw and spacing washer

Not recommended where mounting tab is at mains voltage. Not applicable to full-pack packages (SOT186A).

#### Through heatsink with nut

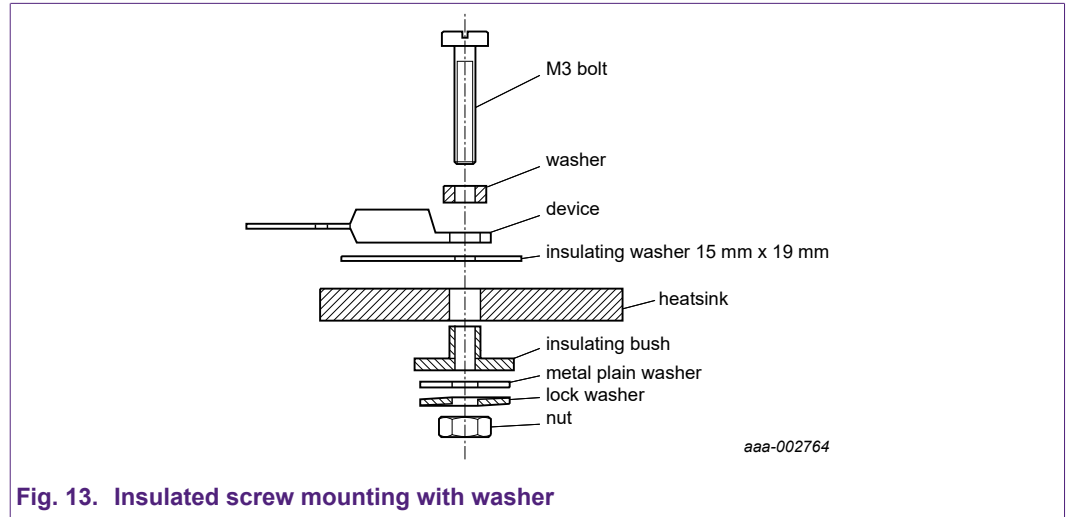


Fig. 13. Insulated screw mounting with washer

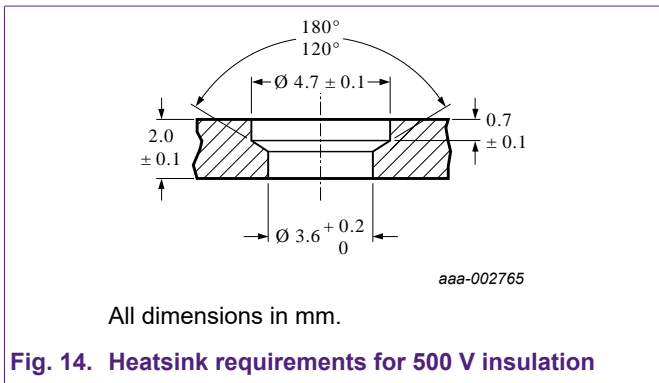


Fig. 14. Heatsink requirements for 500 V insulation

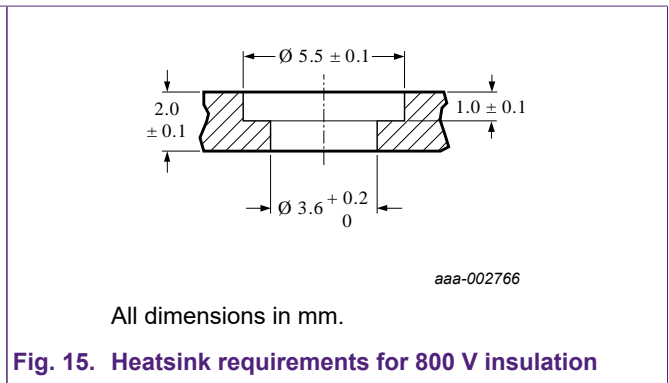


Fig. 15. Heatsink requirements for 800 V insulation

Into tapped heatsink

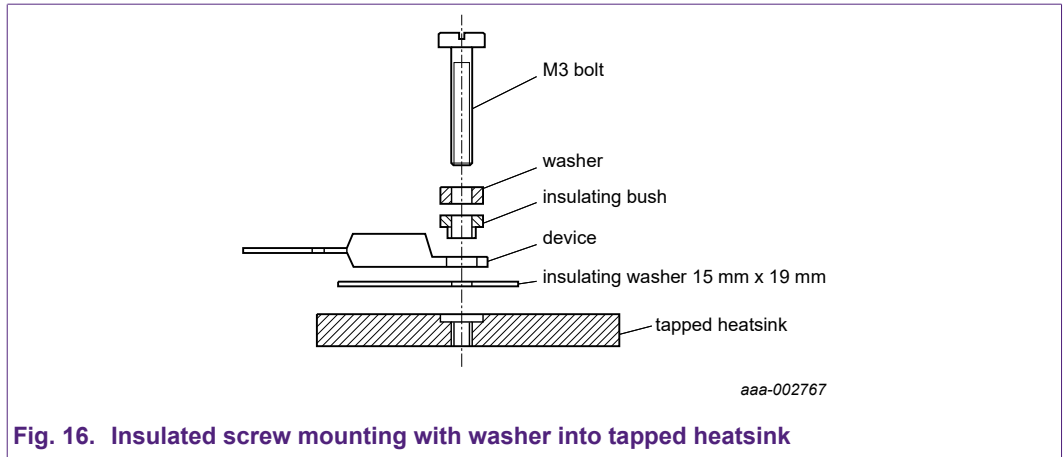
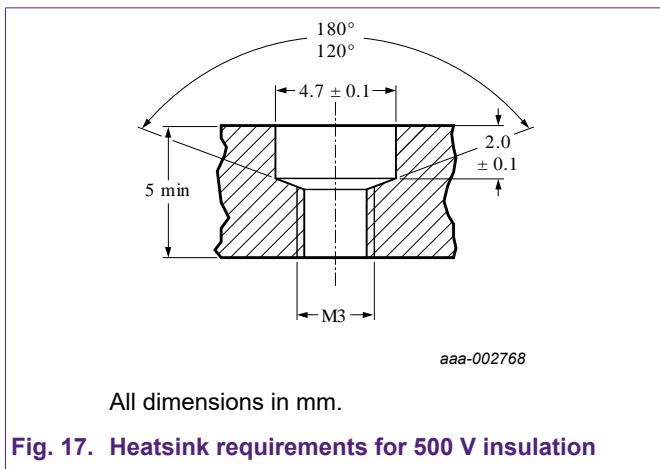
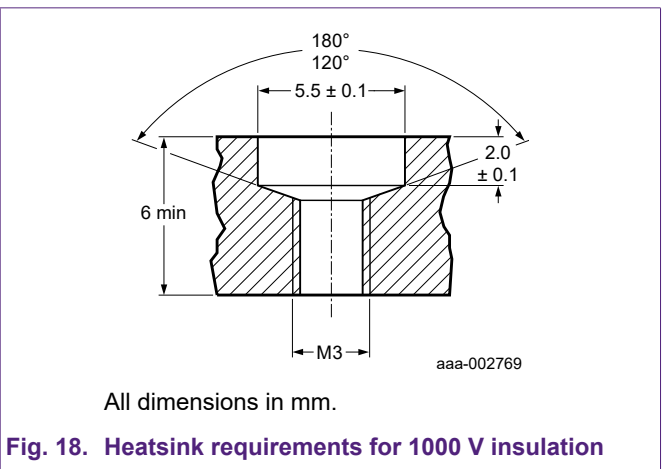


Fig. 16. Insulated screw mounting with washer into tapped heatsink



All dimensions in mm.

Fig. 17. Heatsink requirements for 500 V insulation



All dimensions in mm.

Fig. 18. Heatsink requirements for 1000 V insulation

5. Revision history

Table 2. Revision history

| Revision number | Date       | Description   |
|-----------------|------------|---|
| 2.0             | 2021-05-21 | Document revised to use latest Nexperia branding and legal information. |
| 1.0             | 2012-05-29 | initial version   |



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