

## Triacs

## BT138 series

## GENERAL DESCRIPTION

Passivated triacs in a plastic envelope, intended for use in applications requiring high bidirectional transient and blocking voltage capability and high thermal cycling performance. Typical applications include motor control, industrial and domestic lighting, heating and static switching.

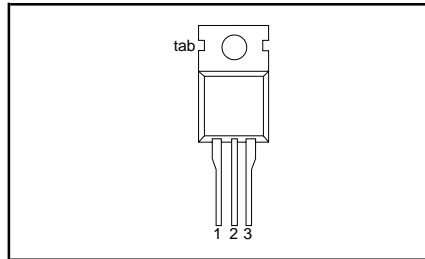
## QUICK REFERENCE DATA

| SYMBOL              | PARAMETER                            | MAX.  | MAX.  | UNIT |
|---------------------|--------------------------------------|---|---|------|
| $V_{\text{DRM}}$    | Repetitive peak off-state voltages   | <b>600</b><br><b>600F</b><br><b>600G</b><br>600 | <b>800</b><br><b>800F</b><br><b>800G</b><br>800 | V    |
| $I_{\text{T(RMS)}}$ | RMS on-state current                 | 12  | 12  | A    |
| $I_{\text{TSM}}$    | Non-repetitive peak on-state current | 95  | 95  | A    |

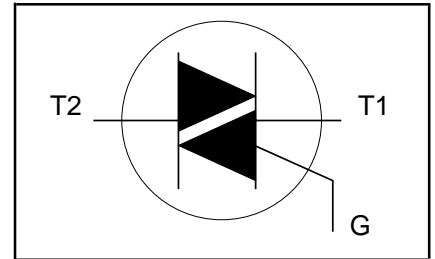
## PINNING - TO220AB

| PIN | DESCRIPTION     |
|-----|-----------------|
| 1   | main terminal 1 |
| 2   | main terminal 2 |
| 3   | gate            |
| tab | main terminal 2 |

## PIN CONFIGURATION



## SYMBOL



## LIMITING VALUES

Limiting values in accordance with the Absolute Maximum System (IEC 134).

| SYMBOL              | PARAMETER  | CONDITIONS   | MIN. | MAX.                            |                    | UNIT               |
|---------------------|--|--|------|---------------------------------|--------------------|--------------------|
| $V_{\text{DRM}}$    | Repetitive peak off-state voltages                           |  | -    | <b>-600</b><br>600 <sup>1</sup> | <b>-800</b><br>800 | V                  |
| $I_{\text{T(RMS)}}$ | RMS on-state current   | full sine wave; $T_{\text{mb}} \leq 99\text{ }^{\circ}\text{C}$  | -    | 12                              |                    | A                  |
| $I_{\text{TSM}}$    | Non-repetitive peak on-state current                         | full sine wave; $T_{\text{j}} = 25\text{ }^{\circ}\text{C}$ prior to surge<br>$t = 20\text{ ms}$                 | -    | 95                              |                    | A                  |
|                     |  | $t = 16.7\text{ ms}$   | -    | 105                             |                    | A                  |
| $I^2t$              | $I^2t$ for fusing  | $t = 10\text{ ms}$   | -    | 45                              |                    | A <sup>2</sup> s   |
| $di_{\text{T}}/dt$  | Repetitive rate of rise of on-state current after triggering | $I_{\text{TM}} = 20\text{ A}$ ; $I_{\text{G}} = 0.2\text{ A}$ ;<br>$di_{\text{G}}/dt = 0.2\text{ A}/\mu\text{s}$ | -    | 50                              |                    | A/ $\mu\text{s}$   |
|                     |  | T2+ G+   | -    | 50                              |                    | A/ $\mu\text{s}$   |
|                     |  | T2+ G-   | -    | 50                              |                    | A/ $\mu\text{s}$   |
|                     |  | T2- G-   | -    | 50                              |                    | A/ $\mu\text{s}$   |
|                     |  | T2- G+   | -    | 10                              |                    | A/ $\mu\text{s}$   |
| $I_{\text{GM}}$     | Peak gate current  |  | -    | 2                               |                    | A                  |
| $V_{\text{GM}}$     | Peak gate voltage  |  | -    | 5                               |                    | V                  |
| $P_{\text{GM}}$     | Peak gate power  |  | -    | 5                               |                    | W                  |
| $P_{\text{G(AV)}}$  | Average gate power   | over any 20 ms period  | -    | 0.5                             |                    | W                  |
| $T_{\text{stg}}$    | Storage temperature  |  | -40  | 150                             |                    | $^{\circ}\text{C}$ |
| $T_{\text{j}}$      | Operating junction temperature                               |  | -    | 125                             |                    | $^{\circ}\text{C}$ |

<sup>1</sup> Although not recommended, off-state voltages up to 800V may be applied without damage, but the triac may switch to the on-state. The rate of rise of current should not exceed 15 A/ $\mu\text{s}$ .

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## THERMAL RESISTANCES

| SYMBOL         | PARAMETER                                       | CONDITIONS                | MIN. | TYP. | MAX. | UNIT |
|----------------|---|---------------------------|------|------|------|------|
| $R_{th\ j-mb}$ | Thermal resistance<br>junction to mounting base | full cycle                | -    | -    | 1.5  | K/W  |
| $R_{th\ j-a}$  | Thermal resistance<br>junction to ambient       | half cycle<br>in free air | -    | -    | 2.0  | K/W  |
|                |   |                           | -    | 60   | -    | K/W  |

## STATIC CHARACTERISTICS

 $T_j = 25\ ^\circ\text{C}$  unless otherwise stated

| SYMBOL   | PARAMETER                 | CONDITIONS  | MIN.             | TYP.               | MAX.                 |                      |                       | UNIT                 |
|----------|---------------------------|---|------------------|--------------------|----------------------|----------------------|-----------------------|----------------------|
| $I_{GT}$ | Gate trigger current      | <b>BT138-</b><br>$V_D = 12\ \text{V}; I_T = 0.1\ \text{A}$<br>T2+ G+<br>T2+ G-<br>T2- G-<br>T2- G+                      | -<br>-<br>-<br>- | 5<br>8<br>10<br>22 | 35<br>35<br>35<br>70 | 25<br>25<br>25<br>70 | 50<br>50<br>50<br>100 | mA<br>mA<br>mA<br>mA |
| $I_L$    | Latching current          | $V_D = 12\ \text{V}; I_{GT} = 0.1\ \text{A}$<br>T2+ G+<br>T2+ G-<br>T2- G-<br>T2- G+                                    | -<br>-<br>-<br>- | 7<br>20<br>8<br>10 | 40<br>60<br>40<br>60 | 40<br>60<br>40<br>60 | 60<br>90<br>60<br>90  | mA<br>mA<br>mA<br>mA |
| $I_H$    | Holding current           | $V_D = 12\ \text{V}; I_{GT} = 0.1\ \text{A}$  | -                | 6                  | 30                   | 30                   | 60                    | mA                   |
| $V_T$    | On-state voltage          | $I_T = 15\ \text{A}$  | -                | 1.4                | 1.65                 |                      |                       | V                    |
| $V_{GT}$ | Gate trigger voltage      | $V_D = 12\ \text{V}; I_T = 0.1\ \text{A}$<br>$V_D = 400\ \text{V}; I_T = 0.1\ \text{A};$<br>$T_j = 125\ ^\circ\text{C}$ | -<br>0.25        | 0.7<br>0.4         | 1.5<br>-             |                      |                       | V<br>V               |
| $I_D$    | Off-state leakage current | $V_D = V_{DRM(max)};$<br>$T_j = 125\ ^\circ\text{C}$  | -                | 0.1                | 0.5                  |                      |                       | mA                   |

## DYNAMIC CHARACTERISTICS

 $T_j = 25\ ^\circ\text{C}$  unless otherwise stated

| SYMBOL        | PARAMETER   | CONDITIONS  | MIN. |    |     | TYP. | MAX. | UNIT             |
|---------------|---|---|------|----|-----|------|------|------------------|
| $dV_D/dt$     | Critical rate of rise of<br>off-state voltage     | <b>BT138-</b><br>$V_{DM} = 67\% V_{DRM(max)};$<br>$T_j = 125\ ^\circ\text{C};$ exponential<br>waveform; gate open<br>circuit                  | 100  | 50 | 200 | 250  | -    | V/ $\mu\text{s}$ |
| $dV_{com}/dt$ | Critical rate of change of<br>commutating voltage | $V_{DM} = 400\ \text{V}; T_j = 95\ ^\circ\text{C};$<br>$I_{T(RMS)} = 12\ \text{A};$<br>$dI_{com}/dt = 5.4\ \text{A/ms};$ gate<br>open circuit | -    | -  | 10  | 20   | -    | V/ $\mu\text{s}$ |
| $t_{gt}$      | Gate controlled turn-on<br>time                   | $I_{TM} = 16\ \text{A}; V_D = V_{DRM(max)};$<br>$I_G = 0.1\ \text{A}; dI_G/dt = 5\ \text{A}/\mu\text{s}$                                      | -    | -  | -   | 2    | -    | $\mu\text{s}$    |

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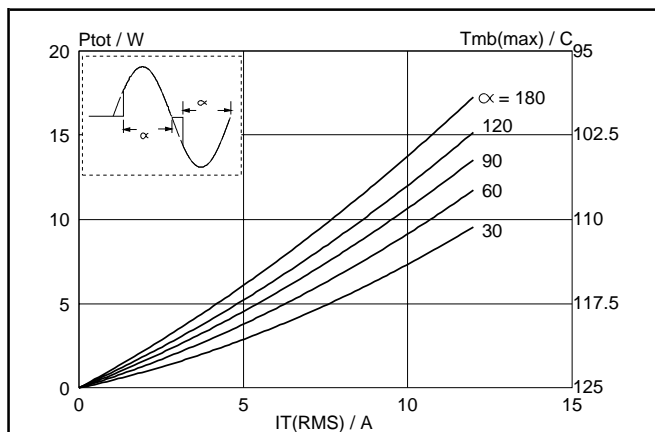


Fig.1. Maximum on-state dissipation,  $P_{tot}$ , versus rms on-state current,  $I_{T(RMS)}$ , where  $\alpha$  = conduction angle.

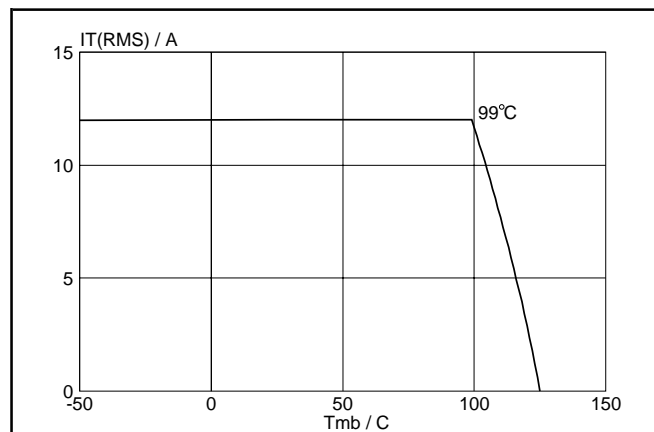


Fig.4. Maximum permissible rms current  $I_{T(RMS)}$ , versus mounting base temperature  $T_{mb}$ .

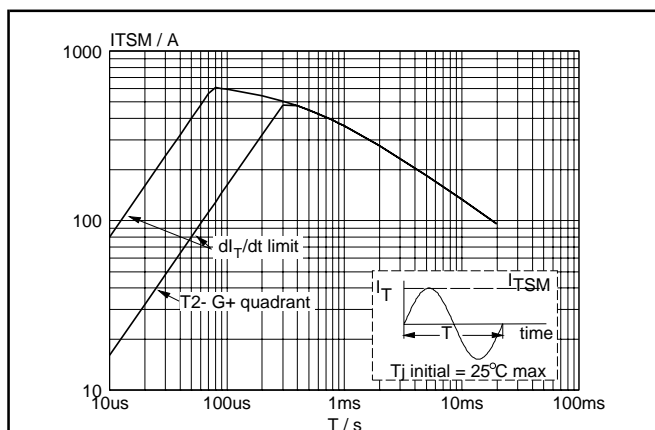


Fig.2. Maximum permissible non-repetitive peak on-state current  $I_{TSM}$ , versus pulse width  $t_p$ , for sinusoidal currents,  $t_p \leq 20$  ms.

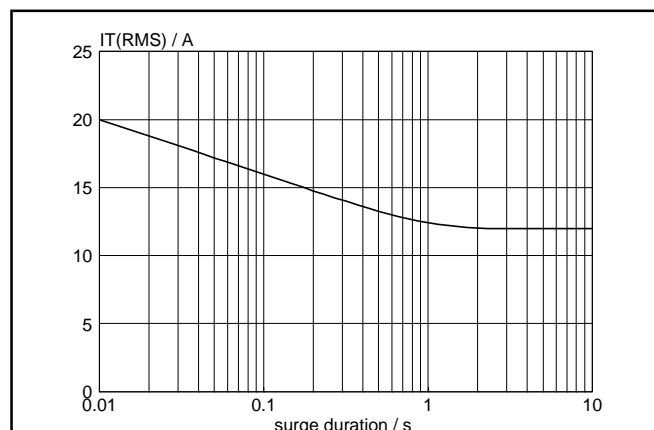


Fig.5. Maximum permissible repetitive rms on-state current  $I_{T(RMS)}$ , versus surge duration, for sinusoidal currents,  $f = 50$  Hz;  $T_{mb} \leq 99^\circ\text{C}$ .

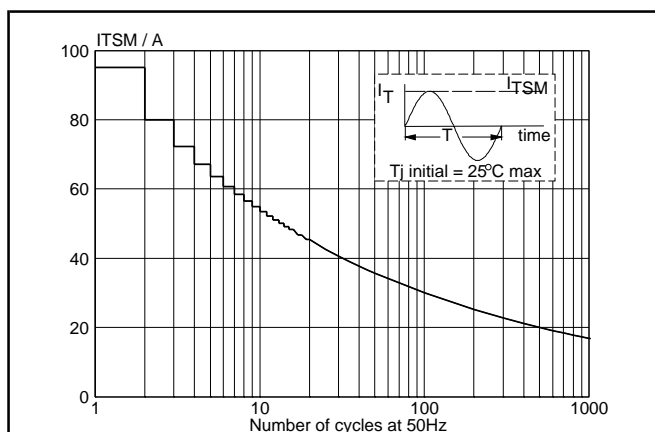


Fig.3. Maximum permissible non-repetitive peak on-state current  $I_{TSM}$ , versus number of cycles, for sinusoidal currents,  $f = 50$  Hz.

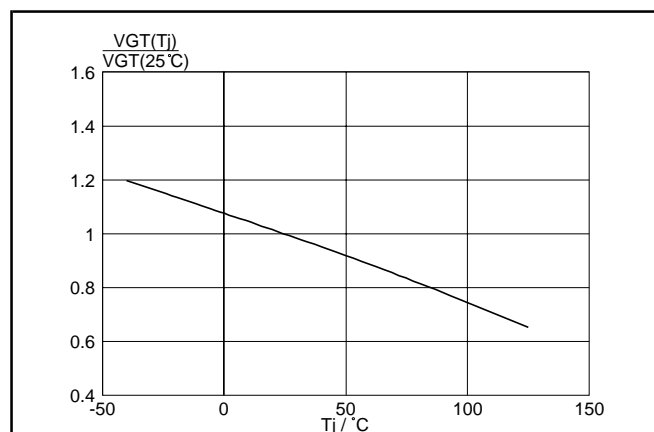


Fig.6. Normalised gate trigger voltage  $V_{GT}(T_j)/V_{GT}(25^\circ\text{C})$ , versus junction temperature  $T_j$ .

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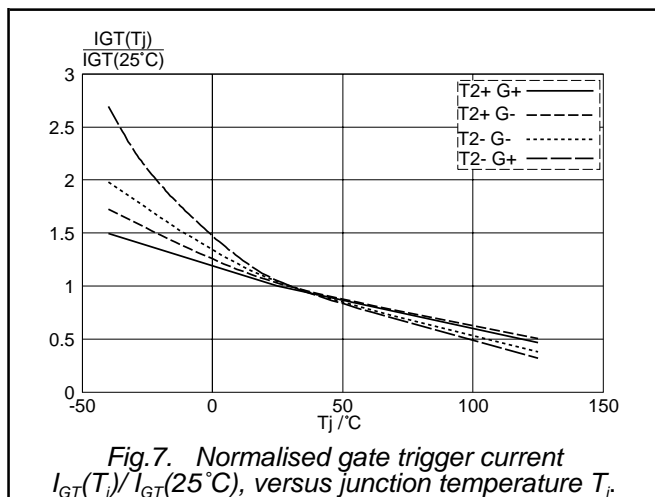


Fig. 7. Normalised gate trigger current  $I_{GT}(T_j)/I_{GT}(25^\circ\text{C})$ , versus junction temperature  $T_j$ .

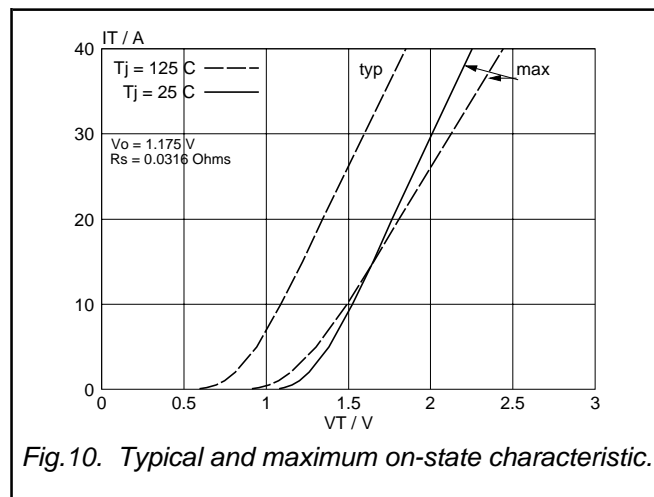


Fig. 10. Typical and maximum on-state characteristic.

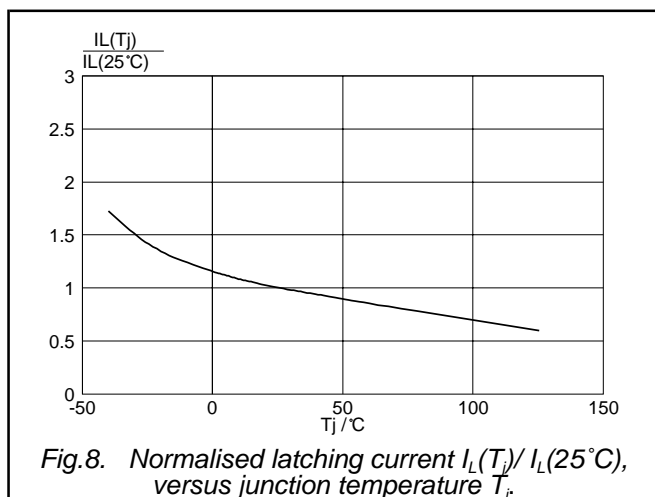


Fig. 8. Normalised latching current  $I_L(T_j)/I_L(25^\circ\text{C})$ , versus junction temperature  $T_j$ .

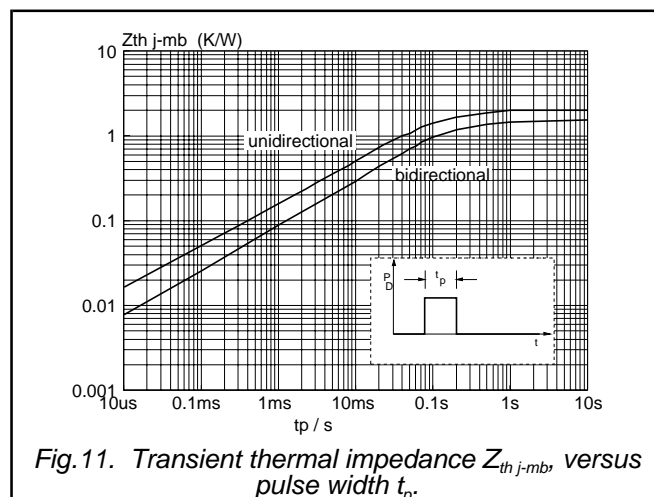


Fig. 11. Transient thermal impedance  $Z_{th\ j-mb}$ , versus pulse width  $t_p$ .

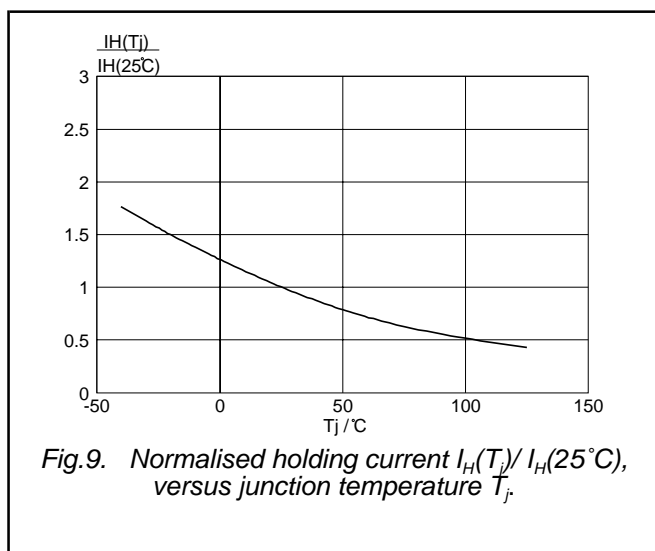


Fig. 9. Normalised holding current  $I_H(T_j)/I_H(25^\circ\text{C})$ , versus junction temperature  $T_j$ .

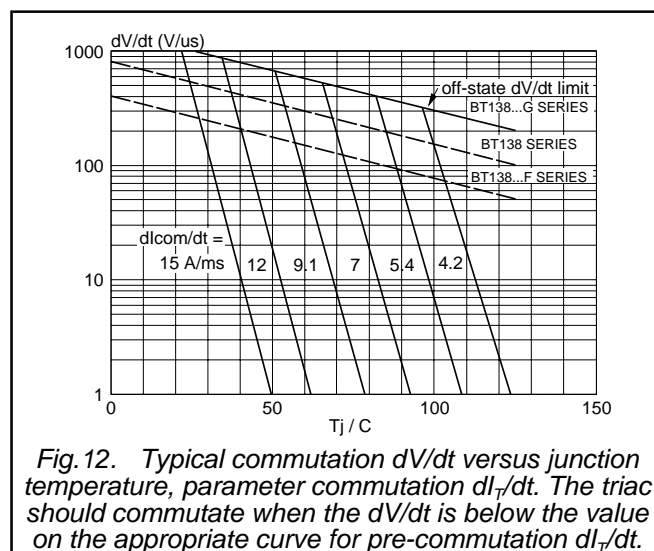


Fig. 12. Typical commutation  $dV/dt$  versus junction temperature, parameter commutation  $dI_T/dt$ . The triac should commute when the  $dV/dt$  is below the value on the appropriate curve for pre-commutation  $dI_T/dt$ .

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## MECHANICAL DATA

Dimensions in mm

Net Mass: 2 g

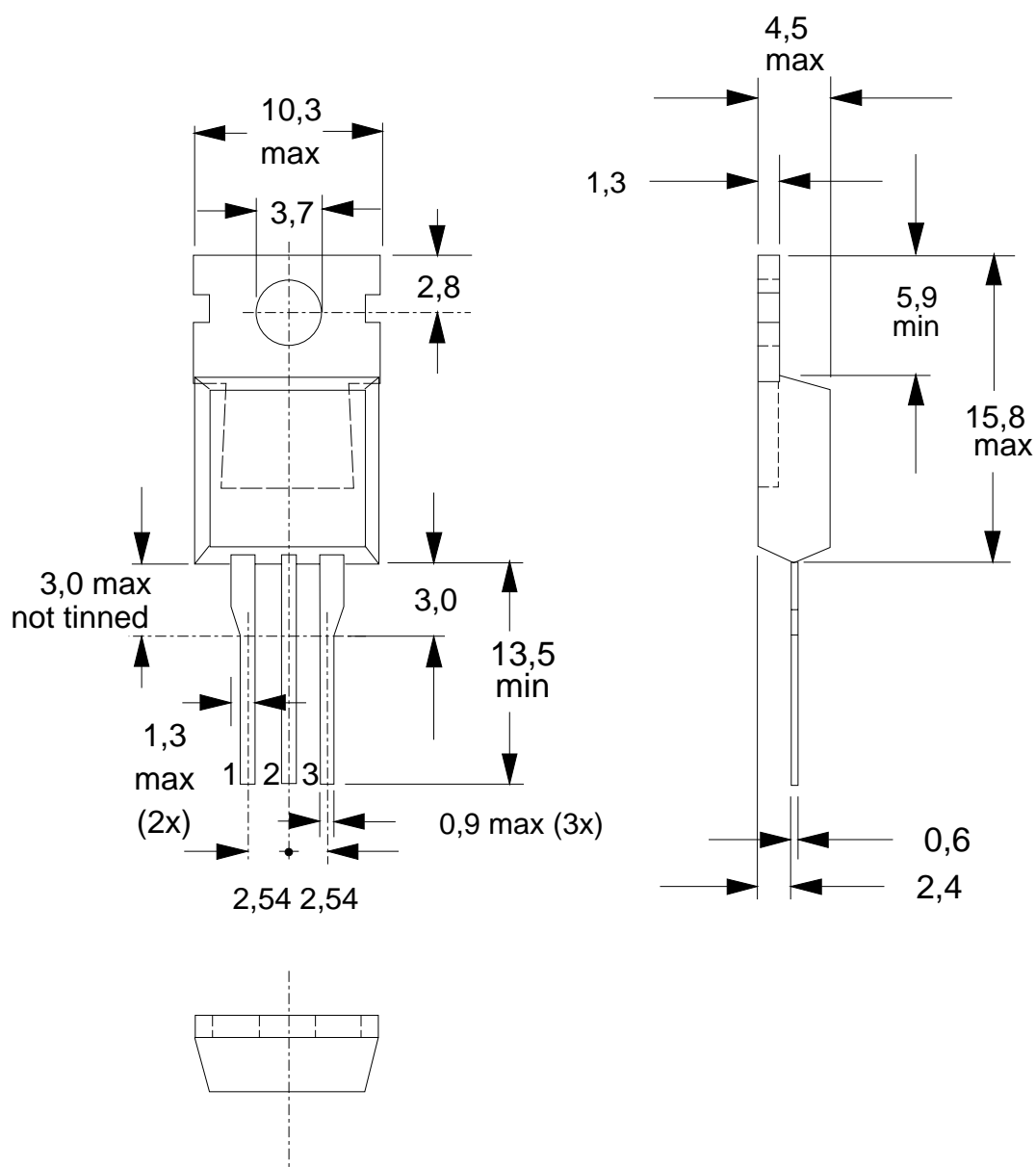


Fig.13. SOT78 (TO220AB). pin 2 connected to mounting base.

## Notes

1. Refer to mounting instructions for SOT78 (TO220) envelopes.
2. Epoxy meets UL94 V0 at 1/8".

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**DEFINITIONS**

| <b>DATA SHEET STATUS</b>   |                                   |   |
|--|-----------------------------------|---|
| <b>DATA SHEET STATUS<sup>2</sup></b>   | <b>PRODUCT STATUS<sup>3</sup></b> | <b>DEFINITIONS</b>  |
| Objective data   | Development                       | This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice  |
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| <b>Application information</b>   |                                   |   |
| Where application information is given, it is advisory and does not form part of the specification.  |                                   |   |
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