



BT139 series

Triacs

Rev. 04.00 — 6 July 2004

Product data sheet

1. Product profile

1.1 General description

Passivated triacs in a SOT78 plastic package, intended for use in applications requiring high bidirectional transient and blocking voltage capability.

1.2 Features

- High thermal cycling performance.

1.3 Applications

- Motor control
- Industrial and domestic lighting, heating and static switching.

1.4 Quick reference data

- $V_{\text{DRM}} \leq 600 \text{ V}$ (BT139-600)
- $V_{\text{DRM}} \leq 600 \text{ V}$ (BT139-600F)
- $V_{\text{DRM}} \leq 800 \text{ V}$ (BT139-800)
- $V_{\text{DRM}} \leq 800 \text{ V}$ (BT139-800F)
- $V_{\text{DRM}} \leq 800 \text{ V}$ (BT139-800G)
- $I_{\text{T(RMS)}} \leq 16 \text{ A}$
- $I_{\text{TSM}} \leq 155 \text{ A}$.

2. Pinning information

Table 1: Discrete pinning

| Pin | Description | Simplified outline | Symbol |
|-----|-----------------|-------------------------|---------------|
| 1 | main terminal 1 | <p>SOT78 (TO-220AB)</p> | <p>sym051</p> |
| 2 | main terminal 2 | | |
| 3 | gate | | |
| mb | main terminal 2 | | |

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3. Ordering information

Table 2: Ordering information

| Type number | Package | | |
|-------------|----------|--|---------|
| | Name | Description | Version |
| BT139-600 | TO-220AB | plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB | SOT78 |
| BT139-600F | | | |
| BT139-800 | | | |
| BT139-800F | | | |
| BT139-800G | | | |

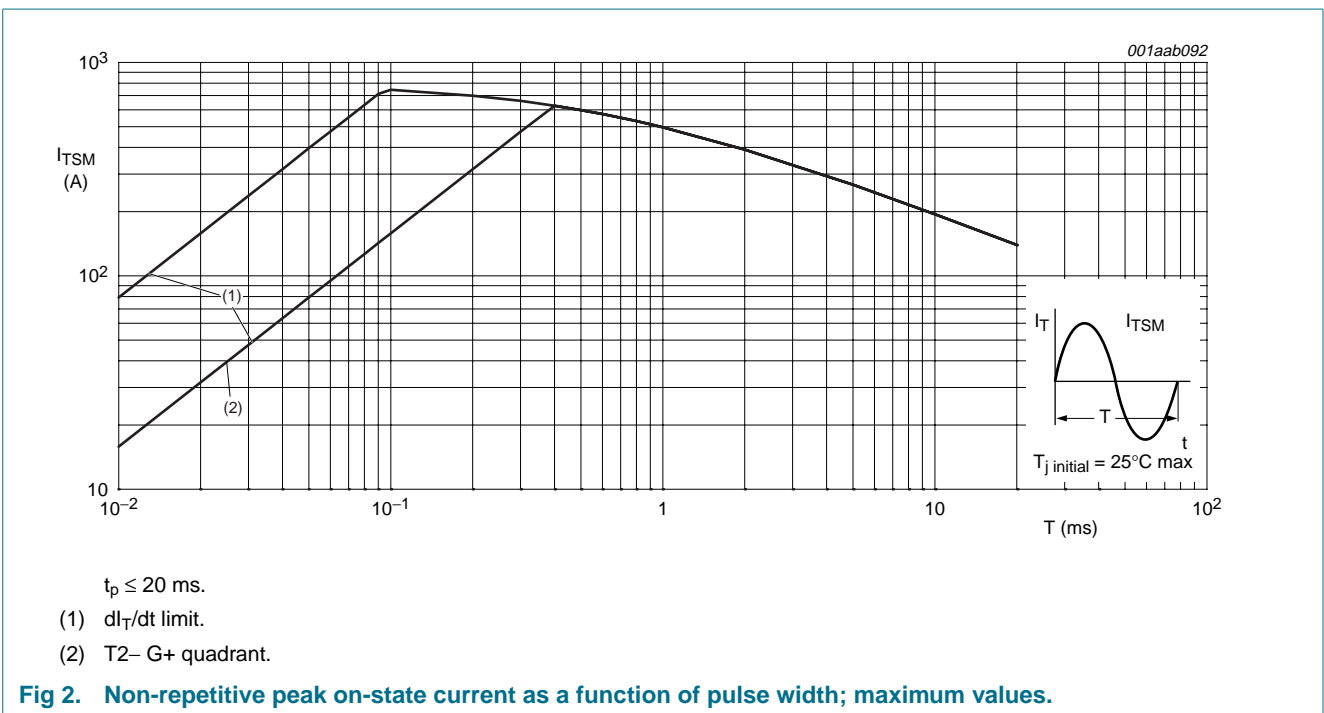
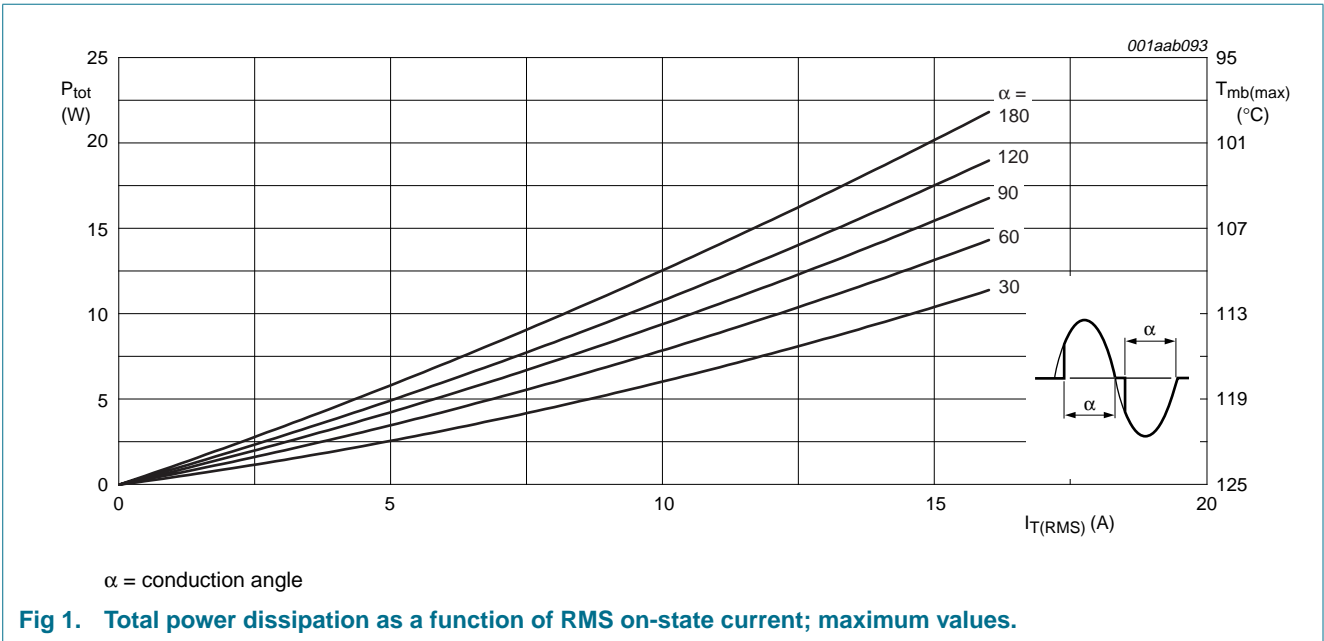
4. Limiting values

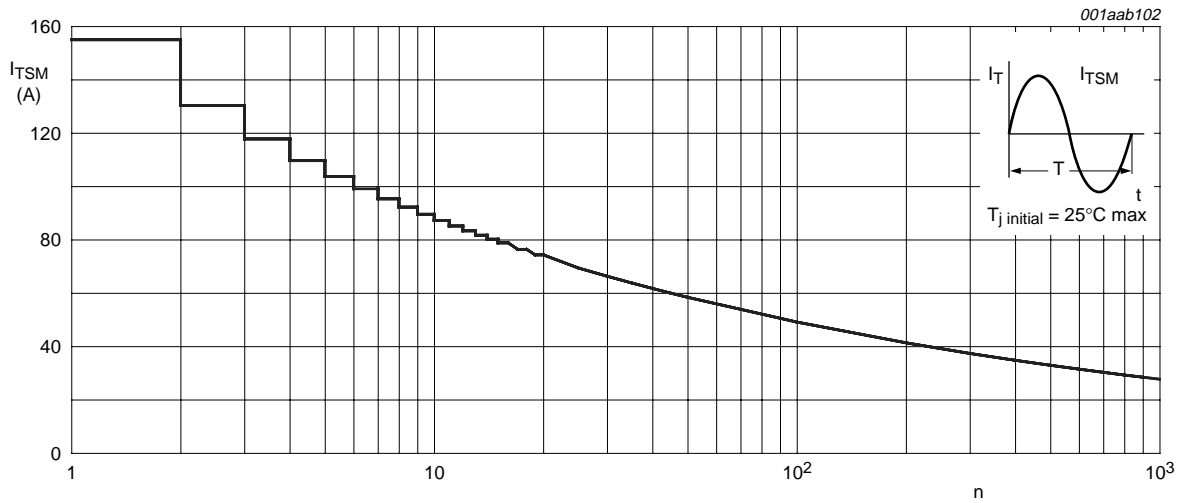
Table 3: Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol | Parameter | Conditions | Min | Max | Unit |
|-------------------------------|--|--|-----|---------|------------------|
| V_{DRM} | repetitive peak off-state voltage | | | | |
| | | | - | 600 [1] | V |
| | | | - | 800 | V |
| $I_{\text{T(RMS)}}$ | RMS on-state current | full sine wave; $T_{\text{mb}} \leq 99\text{ °C}$; Figure 4 and Figure 5 | - | 16 | A |
| I_{TSM} | non-repetitive peak on-state current | full sine wave; $T_{\text{j}} = 25\text{ °C}$ prior to surge; Figure 2 and Figure 3 | | | |
| | | $t = 20\text{ ms}$ | - | 155 | A |
| | | $t = 16.7\text{ ms}$ | - | 170 | A |
| I^2t | I^2t for fusing | $t = 10\text{ ms}$ | - | 120 | A ² s |
| $di_{\text{T}}/dt_{\text{T}}$ | repetitive rate of rise of on-state current after triggering | $I_{\text{TM}} = 20\text{ A}$; $I_{\text{G}} = 0.2\text{ A}$; $di_{\text{G}}/dt = 0.2\text{ A}/\mu\text{s}$ | | | |
| | | T2+ G+ | - | 50 | A/ μs |
| | | T2+ G- | - | 50 | A/ μs |
| | | T2- G- | - | 50 | A/ μs |
| | | T2- G+ | - | 10 | A/ μs |
| I_{GM} | peak gate current | | - | 2 | A |
| V_{GM} | peak gate voltage | | - | 5 | V |
| P_{GM} | peak gate power | | - | 5 | W |
| $P_{\text{G(AV)}}$ | average gate power | over any 20 ms period | - | 0.5 | W |
| T_{stg} | storage temperature | | -40 | +150 | °C |
| T_{j} | junction temperature | | - | 125 | °C |

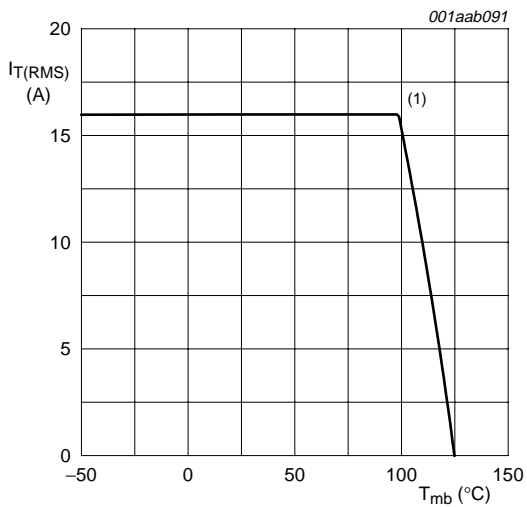
[1] Although not recommended, off-state voltages up to 800 V may be applied without damage, but the triac may switch to the on-state. The rate of rise of current should not exceed 15 A/ μs .





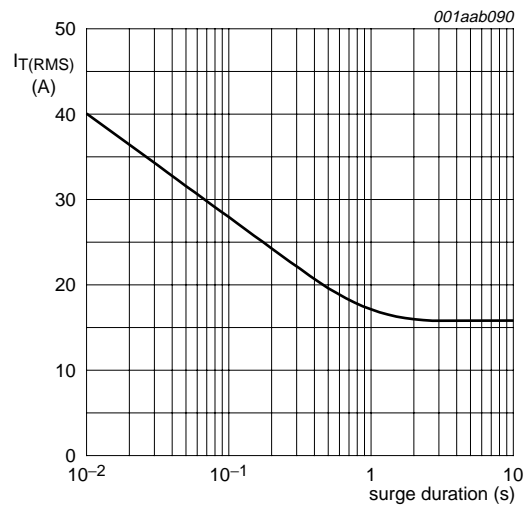
f = 50 Hz.

Fig 3. Non-repetitive peak on-state current as a function of number of sinusoidal current cycles; maximum values.



(1) $T_{mb} = 99\text{ }^{\circ}\text{C}$.

Fig 4. RMS on-state current as a function of mounting base temperature; maximum values.



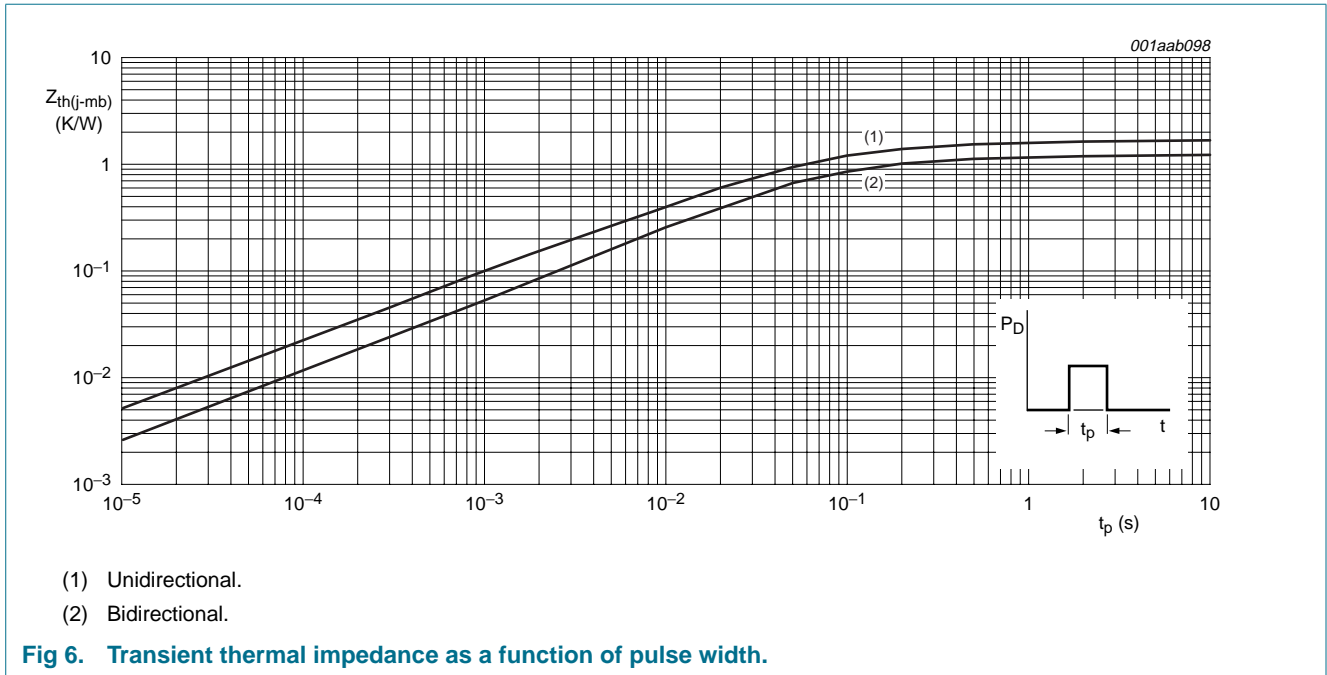
f = 50 Hz; $T_{mb} \leq 99\text{ }^{\circ}\text{C}$.

Fig 5. RMS on-state current as a function of surge duration; maximum values.

5. Thermal characteristics

Table 4: Thermal characteristics

| Symbol | Parameter | Conditions | Typ | Max | Unit |
|----------------|--|-------------------------------------|-----|-----|------|
| $R_{th(j-mb)}$ | thermal resistance junction to mounting base | full cycle Figure 6 | - | 1.2 | K/W |
| | | half cycle Figure 6 | - | 1.7 | K/W |
| $R_{th(j-a)}$ | thermal resistance junction to ambient | in free air | 60 | - | K/W |



6. Static characteristics

Table 5: Static characteristics

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

| Symbol | Parameter | Conditions | BT139 | | | BT139-F | | | BT139-G | | | Unit | |
|----------|----------------------|---|--------|-----|-----|---------|-----|-----|---------|-----|-----|------|----|
| | | | Min | Typ | Max | Min | Typ | Max | Min | Typ | Max | | |
| I_{GT} | gate trigger current | $V_D = 12\text{ V};$ $I_T = 0.1\text{ A};$ Figure 8 | T2+ G+ | - | 5 | 35 | - | 5 | 25 | - | 5 | 50 | mA |
| | | | T2+ G- | - | 8 | 35 | - | 8 | 25 | - | 8 | 50 | mA |
| | | | T2- G- | - | 10 | 35 | - | 10 | 25 | - | 10 | 50 | mA |
| | | | T2- G+ | - | 22 | 70 | - | 22 | 70 | - | 22 | 100 | mA |
| I_L | latching current | $V_D = 12\text{ V};$ $I_{GT} = 0.1\text{ A};$ Figure 9 | T2+ G+ | - | 7 | 40 | - | 7 | 40 | - | 7 | 60 | mA |
| | | | T2+ G- | - | 20 | 60 | - | 20 | 60 | - | 20 | 90 | mA |
| | | | T2- G- | - | 8 | 40 | - | 8 | 40 | - | 8 | 60 | mA |
| | | | T2- G+ | - | 10 | 60 | - | 10 | 60 | - | 10 | 90 | mA |
| I_H | holding current | $V_D = 12\text{ V};$ $I_{GT} = 0.1\text{ A};$ Figure 10 | - | 6 | 45 | - | 6 | 45 | - | 6 | 60 | mA | |
| V_T | on-state voltage | $I_T = 20\text{ A};$ Figure 11 | - | 1.2 | 1.6 | - | 1.2 | 1.6 | - | 1.2 | 1.6 | V | |

Table 5: Static characteristics ...continued

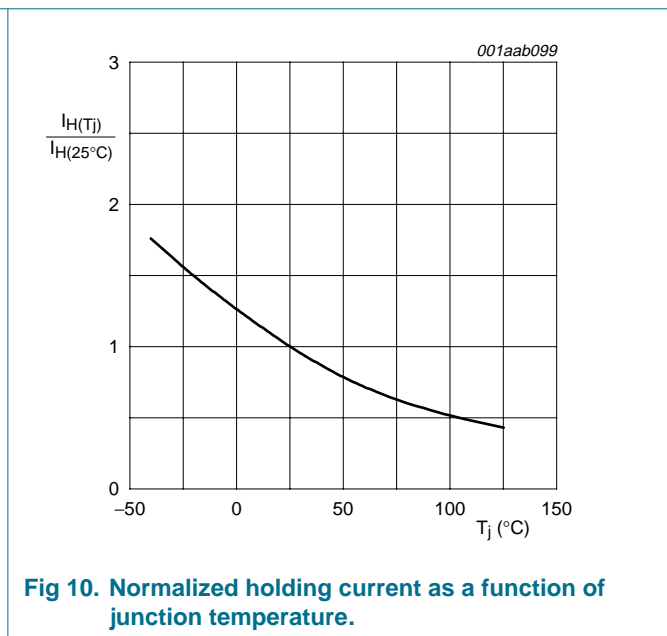
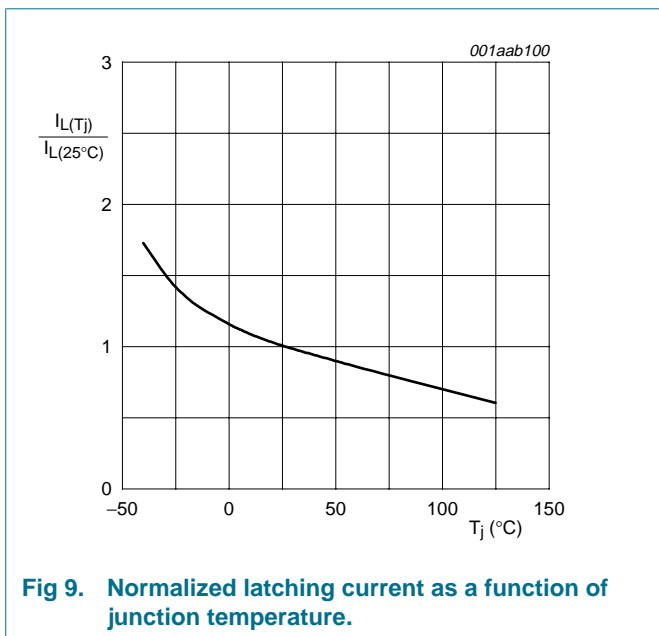
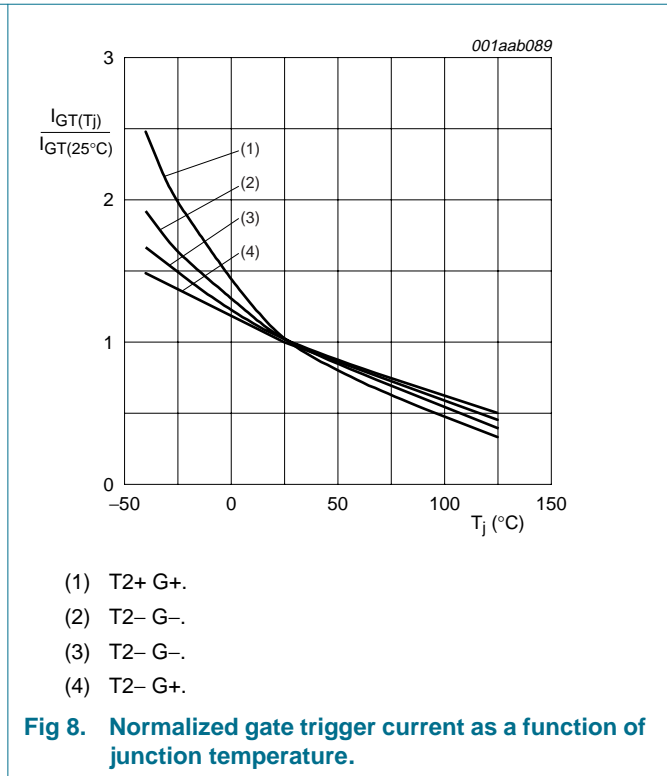
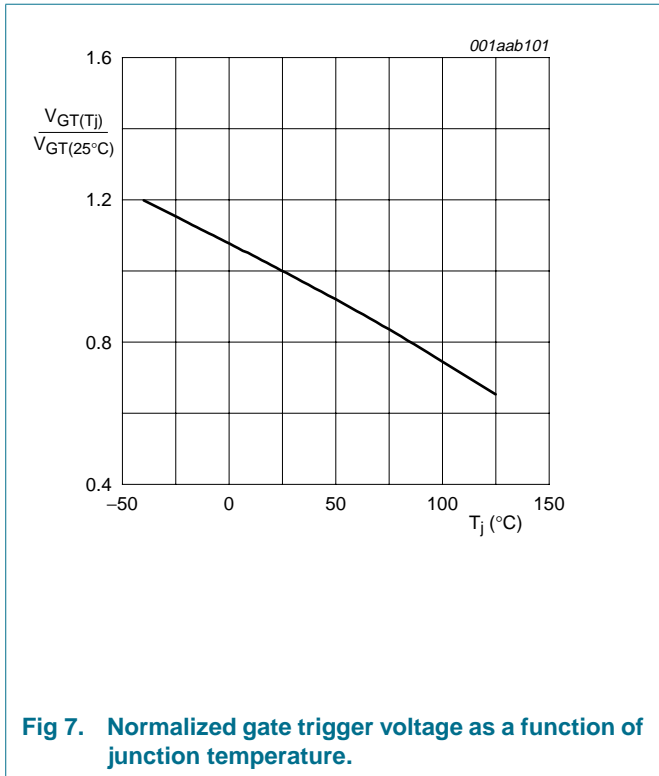
 $T_j = 25\text{ }^\circ\text{C}$ unless otherwise stated.

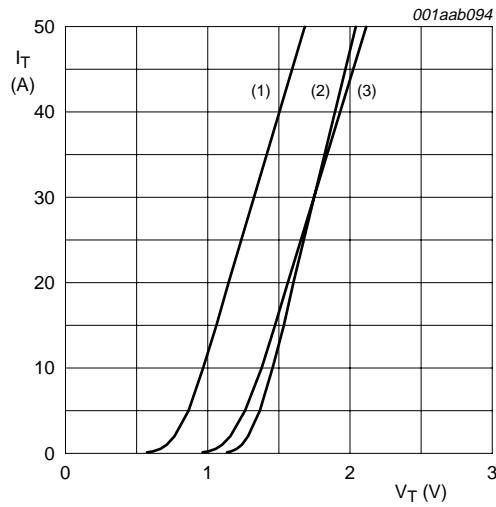
| Symbol | Parameter | Conditions | BT139 | | | BT139-F | | | BT139-G | | | Unit |
|----------|---------------------------|---|-------|-----|-----|---------|-----|-----|---------|-----|-----|------|
| | | | Min | Typ | Max | Min | Typ | Max | Min | Typ | Max | |
| V_{GT} | gate trigger voltage | $V_D = 12\text{ V};$ $I_T = 0.1\text{ A};$ Figure 7 | - | 0.7 | 1.5 | - | 0.7 | 1.5 | - | 0.7 | 1.5 | V |
| | | $V_D = 400\text{ V};$ $I_T = 0.1\text{ A};$ $T_j = 125\text{ }^\circ\text{C}$ | 0.25 | 0.4 | - | 0.25 | 0.4 | - | 0.25 | 0.4 | - | V |
| I_D | off-state leakage current | $V_D = V_{DRM(max)};$ $T_j = 125\text{ }^\circ\text{C}$ | - | 0.1 | 0.5 | - | 0.1 | 0.5 | - | 0.1 | 0.5 | mA |

7. Dynamic characteristics

Table 6: Dynamic characteristics

| Symbol | Parameter | Conditions | BT139 | | | BT139-F | | | BT139-G | | | Unit |
|---------------|--|---|-------|-----|-----|---------|-----|-----|---------|-----|-----|------------------|
| | | | Min | Typ | Max | Min | Typ | Max | Min | Typ | Max | |
| dV_D/dt | critical rate of rise of off-state voltage | $V_{DM} = 67\text{ }%$ $V_{DRM(max)};$ $T_j = 125\text{ }^\circ\text{C};$ exponential waveform; gate open circuit | 200 | 250 | - | 50 | 250 | - | 200 | 250 | - | V/ μs |
| dV_{com}/dt | critical rate of change of commutating voltage | $V_{DM} = 400\text{ V};$ $T_j = 95\text{ }^\circ\text{C};$ $I_{T(RMS)} = 16\text{ A};$ $dI_{com}/dt = 7.2\text{ A/ms};$ gate open circuit | 10 | 20 | - | - | 20 | - | 10 | 20 | - | V/ μs |
| t_{gt} | gate controlled turn-on time | $I_{TM} = 20\text{ A};$ $V_D = V_{DRM(max)};$ $I_G = 0.1\text{ A};$ $dI_G/dt = 5\text{ A}/\mu\text{s}$ | | 2 | - | - | 2 | - | | 2 | - | μs |

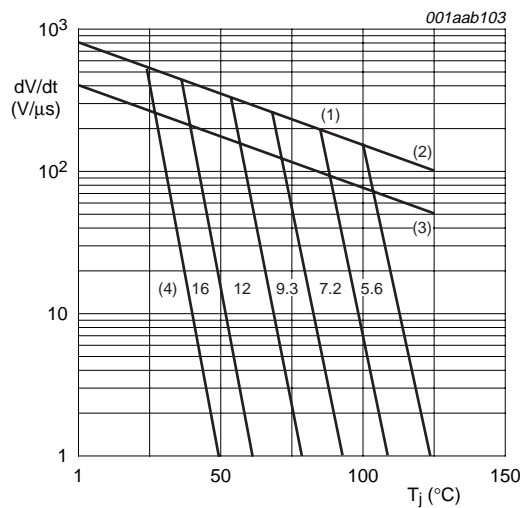




$V_O = 1.06 \text{ V.}$
 $R_S = 0.0304 \Omega.$

- (1) $T_j = 125 \text{ }^\circ\text{C}$; typical values.
- (2) $T_j = 25 \text{ }^\circ\text{C}$; maximum values.
- (3) $T_j = 125 \text{ }^\circ\text{C}$; maximum values.

Fig 11. On-state current characteristics.



The triac should commute when the dI_T/dt is below the value on the appropriate curve for pre-commutation dI_T/dt .

- (1) BT139 SERIES.
- (2) BT139...G SERIES.
- (3) BT139...F SERIES.
- (4) $dI_{com}/dt = 20 \text{ A/ms.}$

Fig 12. Critical rate of change of commutating voltage as a function of junction temperature; minimum values.

8. Package outline

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB

SOT78

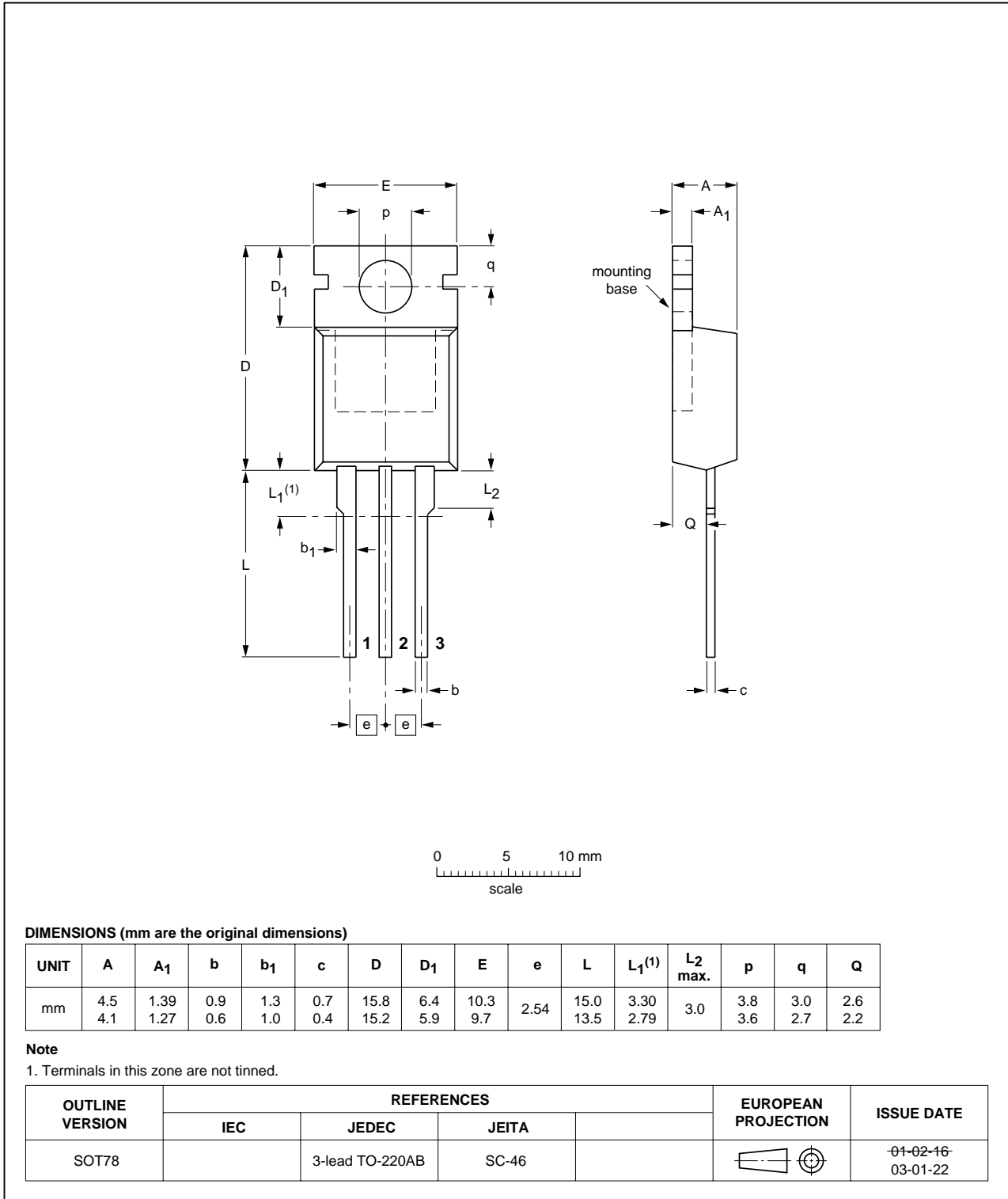


Fig 13. Package outline.

9. Revision history

Table 7: Revision history

| Document ID | Release date | Data sheet status | Change notice | Order number | Supersedes |
|----------------|---|-----------------------|---------------|----------------|----------------|
| BT139_SERIES_4 | 20040706 | Product data sheet | - | 9397 750 13358 | BT139_SERIES_3 |
| Modifications: | Data sheet updated to latest standards. | | | | |
| BT139_SERIES_3 | 20030401 | Product specification | - | - | BT139_SERIES_2 |
| BT139_SERIES_2 | 20010701 | Product specification | - | - | BT139_SERIES_1 |
| BT139_SERIES_1 | 19970901 | Product specification | - | - | - |

10. Data sheet status

| Level | Data sheet status ^[1] | Product status ^[2] ^[3] | Definition |
|-------|----------------------------------|--|--|
| I | 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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[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

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Limiting values definition — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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