

# BT139B series E

Triacs; sensitive gate

Rev. 03 — 23 September 2004

Product data sheet

## 1. Product profile

### 1.1 General description

Passivated, sensitive gate triacs in a SOT404 SMD plastic package.

### 1.2 Features

- High sensitivity in all four quadrants.

### 1.3 Applications

- General purpose bidirectional switching
- Phase control.

### 1.4 Quick reference data

- $V_{DRM} \leq 600 \text{ V}$  (BT139B-600E)
- $V_{DRM} \leq 800 \text{ V}$  (BT139B-800E)
- $I_{T(RMS)} \leq 16 \text{ A}$
- $I_{TSM} \leq 155 \text{ A}$
- $I_{GT} \leq 10 \text{ mA}$  (T2+ G+; T2+ G-; T2- G-)
- $I_{GT} \leq 25 \text{ mA}$  (T2- G+).

## 2. Pinning information

Table 1: Pinning

| Pin | Description                                      | Simplified outline           | Symbol     |
|-----|--------------------------------------------------|------------------------------|------------|
| 1   | main terminal 1 (T1)                             |                              | <br>sym051 |
| 2   | main terminal 2 (T2)                             |                              |            |
| 3   | gate (G)                                         |                              |            |
| mb  | mounting base, connected to main terminal 2 (T2) |                              |            |
|     |                                                  | SOT404 (D <sup>2</sup> -PAK) |            |

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### 3. Ordering information

Table 2: Ordering information

| Type number | Package |                                                                                                                   |         |
|-------------|---------|-------------------------------------------------------------------------------------------------------------------|---------|
|             | Name    | Description                                                                                                       | Version |
| BT139B-600E | -       | plastic single-ended surface mounted package (Philips version of D <sup>2</sup> -PAK); 3 leads (one lead cropped) | SOT404  |
| BT139B-800E |         |                                                                                                                   |         |

### 4. Limiting values

Table 3: Limiting values

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

| Symbol              | Parameter                                                       | Conditions                                                                                                            | Min   | Max  | Unit             |
|---------------------|-----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-------|------|------------------|
| V <sub>DRM</sub>    | repetitive peak off-state voltage                               |                                                                                                                       |       |      |                  |
|                     | BT139B-600E                                                     |                                                                                                                       | [1] - | 600  | V                |
|                     | BT139B-800E                                                     |                                                                                                                       | -     | 800  | V                |
| I <sub>T(RMS)</sub> | RMS on-state current                                            | full sinewave;<br>T <sub>mb</sub> ≤ 99 °C; <a href="#">Figure 4</a><br>and <a href="#">Figure 5</a>                   | -     | 16   | A                |
| I <sub>TSM</sub>    | non-repetitive peak on-state current                            | full sine wave;<br>T <sub>j</sub> = 25 °C prior to<br>surge; <a href="#">Figure 2</a> and<br><a href="#">Figure 3</a> |       |      |                  |
|                     |                                                                 | t = 20 ms                                                                                                             | -     | 155  | A                |
|                     |                                                                 | t = 16.7 ms                                                                                                           | -     | 170  | A                |
|                     |                                                                 |                                                                                                                       |       |      |                  |
| I <sup>2</sup> t    | I <sup>2</sup> t for fusing                                     | t = 10 ms                                                                                                             | -     | 120  | A <sup>2</sup> s |
| dI <sub>T</sub> /dt | repetitive rate of rise of on-state<br>current after triggering | I <sub>TM</sub> = 20 A; I <sub>G</sub> = 0.2 A;<br>dI <sub>G</sub> /dt = 0.2 A/μs                                     |       |      |                  |
|                     |                                                                 | T2+ G+                                                                                                                | -     | 50   | A/μs             |
|                     |                                                                 | T2+ G-                                                                                                                | -     | 50   | A/μs             |
|                     |                                                                 | T2- G-                                                                                                                | -     | 50   | A/μs             |
|                     |                                                                 | T2- G+                                                                                                                | -     | 10   | A/μs             |
| I <sub>GM</sub>     | peak gate current                                               |                                                                                                                       | -     | 2    | A                |
| V <sub>GM</sub>     | peak gate voltage                                               |                                                                                                                       | -     | 5    | V                |
| P <sub>GM</sub>     | peak gate power                                                 |                                                                                                                       | -     | 5    | W                |
| P <sub>G(AV)</sub>  | average gate power                                              | over any 20 ms period                                                                                                 | -     | 0.5  | W                |
| T <sub>stg</sub>    | storage temperature                                             |                                                                                                                       | -40   | +150 | °C               |
| T <sub>j</sub>      | 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.

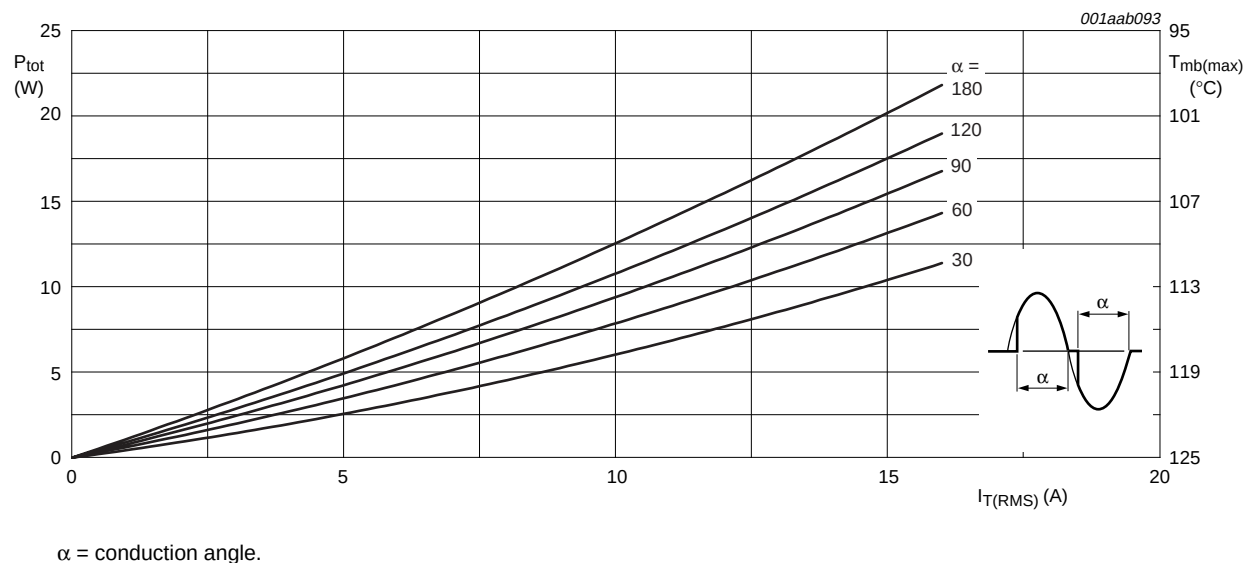


Fig 1. Total power dissipation as a function of RMS on-state current; maximum values.

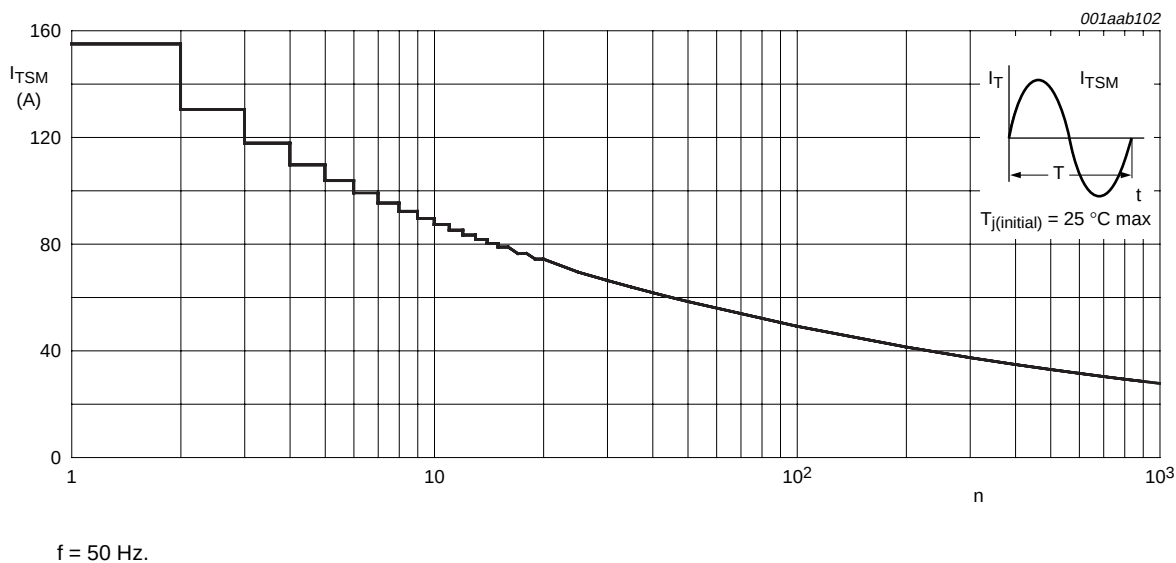
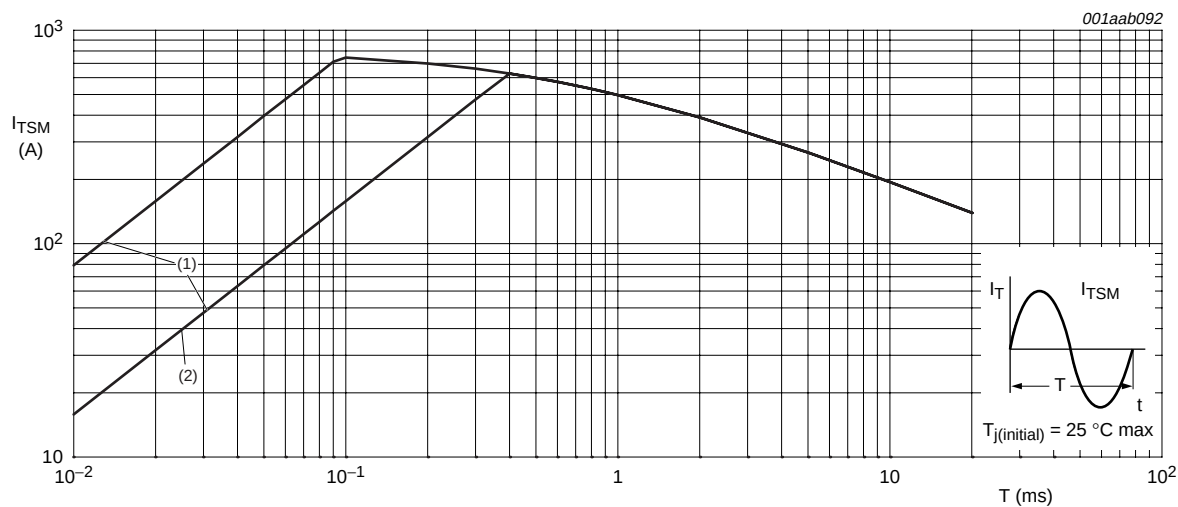
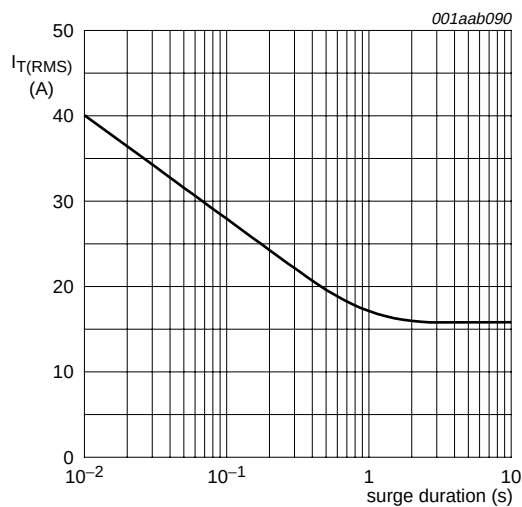


Fig 2. Non-repetitive peak on-state current as a function of the number (n) of sinusoidal current cycles; maximum values.



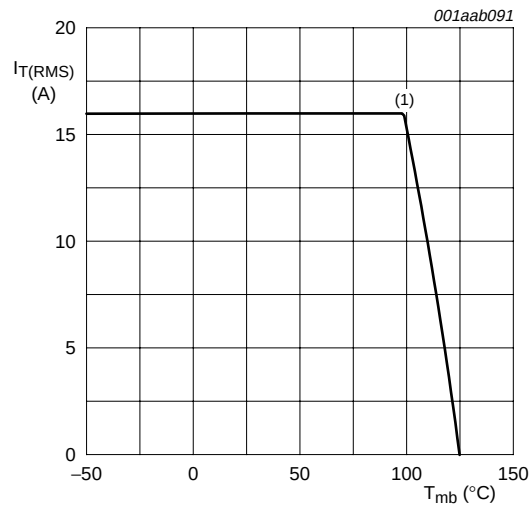
- $t_p \leq 20\text{ ms}$ .
- (1)  $dI_T/dt$  limit.
- (2) T2- G+ quadrant.

Fig 3. Non-repetitive peak on-state current as a function of pulse width; maximum values.



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

Fig 4. RMS on-state current as a function of surge duration; maximum values.



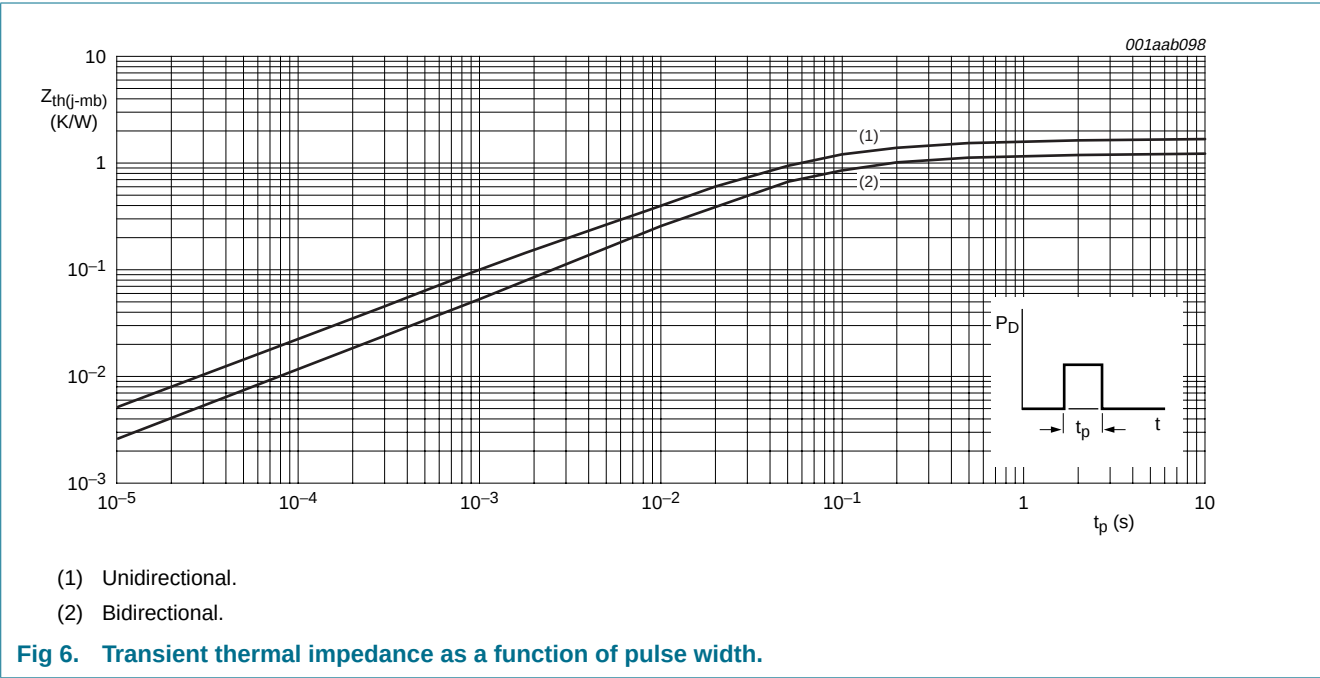
(1)  $T_{mb} = 99\text{ }^{\circ}\text{C}$ .

Fig 5. RMS on-state current as a function of mounting base temperature; maximum values.

5. Thermal characteristics

Table 4: Thermal characteristics

| Symbol         | Parameter                                         | Conditions                                   | Min | Typ | Max | Unit |
|----------------|---------------------------------------------------|----------------------------------------------|-----|-----|-----|------|
| $R_{th(j-mb)}$ | thermal resistance from junction to mounting base | full cycle; <a href="#">Figure 6</a>         | -   | -   | 1.2 | K/W  |
|                |                                                   | half cycle; <a href="#">Figure 6</a>         | -   | -   | 1.7 | K/W  |
| $R_{th(j-a)}$  | thermal resistance from junction to ambient       | minimum footprint; FR4 printed-circuit board | -   | 55  | -   | K/W  |

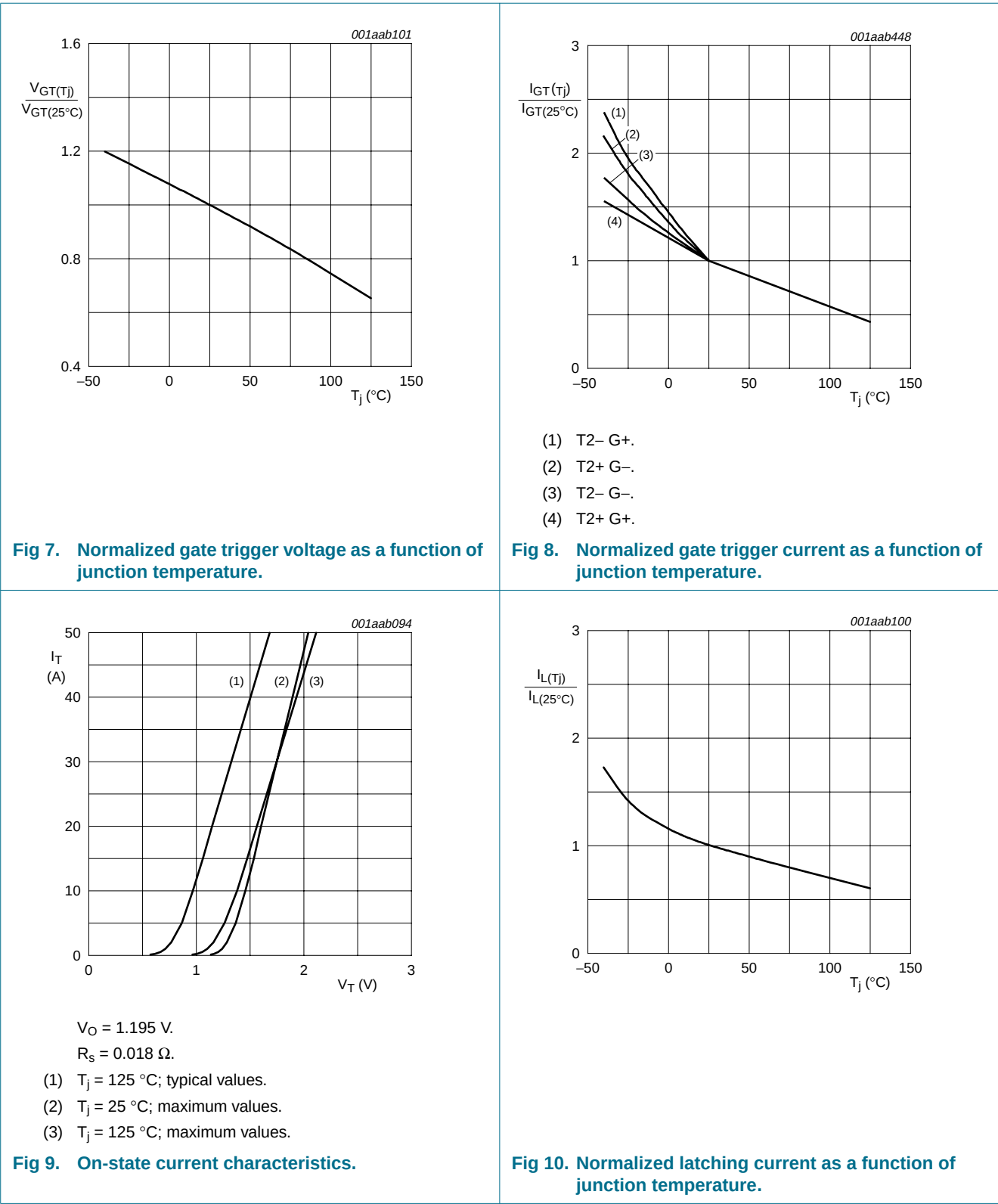


## 6. Characteristics

**Table 5: Characteristics**

$T_j = 25\text{ °C}$  unless otherwise specified.

| Symbol                         | Parameter                                  | Conditions                                                                                                | Min  | Typ | Max | Unit             |
|--------------------------------|--------------------------------------------|-----------------------------------------------------------------------------------------------------------|------|-----|-----|------------------|
| <b>Static characteristics</b>  |                                            |                                                                                                           |      |     |     |                  |
| $I_{GT}$                       | gate trigger current                       | $V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; <a href="#">Figure 8</a>                                     |      |     |     |                  |
|                                |                                            | T2+ G+                                                                                                    | -    | 2.5 | 10  | mA               |
|                                |                                            | T2+ G-                                                                                                    | -    | 4   | 10  | mA               |
|                                |                                            | T2- G-                                                                                                    | -    | 5   | 10  | mA               |
|                                |                                            | T2- G+                                                                                                    | -    | 11  | 25  | mA               |
| $I_L$                          | latching current                           | $V_D = 12\text{ V}$ ; $I_{GT} = 0.1\text{ A}$ ; <a href="#">Figure 10</a>                                 |      |     |     |                  |
|                                |                                            | T2+ G+                                                                                                    | -    | 3.2 | 30  | mA               |
|                                |                                            | T2+ G-                                                                                                    | -    | 16  | 40  | mA               |
|                                |                                            | T2- G-                                                                                                    | -    | 4   | 30  | mA               |
|                                |                                            | T2- G+                                                                                                    | -    | 5.5 | 40  | mA               |
| $I_H$                          | holding current                            | $V_D = 12\text{ V}$ ; $I_{GT} = 0.1\text{ A}$ ; <a href="#">Figure 11</a>                                 | -    | 4   | 45  | mA               |
| $V_T$                          | on-state voltage                           | $I_T = 20\text{ A}$ ; <a href="#">Figure 9</a>                                                            | -    | 1.2 | 1.6 | V                |
| $V_{GT}$                       | gate trigger voltage                       | $V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; <a href="#">Figure 7</a>                                     | -    | 0.7 | 1.5 | V                |
|                                |                                            | $V_D = 400\text{ V}$ ; $I_T = 0.1\text{ A}$ ; $T_j = 125\text{ °C}$                                       | 0.25 | 0.4 | -   | V                |
| $I_D$                          | off-state leakage current                  | $V_D = V_{DRM(max)}$ ; $T_j = 125\text{ °C}$                                                              | -    | 0.1 | 0.5 | mA               |
| <b>Dynamic characteristics</b> |                                            |                                                                                                           |      |     |     |                  |
| $dV_D/dt$                      | critical rate of rise of off-state voltage | $V_{DM} = 67\% V_{DRM(max)}$ ; $T_j = 125\text{ °C}$ ; exponential waveform; gate open circuit            | -    | 50  | -   | V/ $\mu\text{s}$ |
| $t_{gt}$                       | 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   | -   | $\mu\text{s}$    |



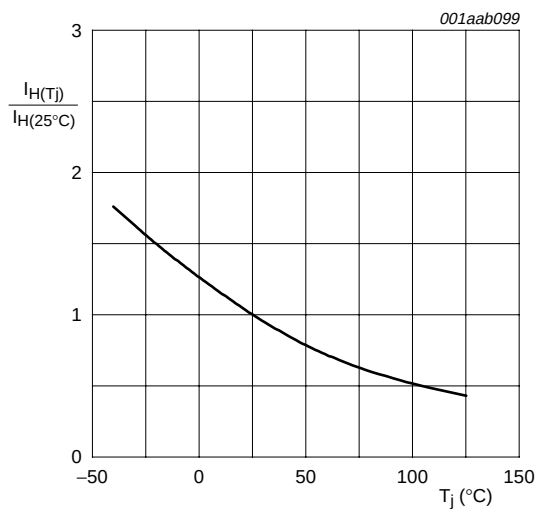


Fig 11. Normalized holding current as a function of junction temperature.

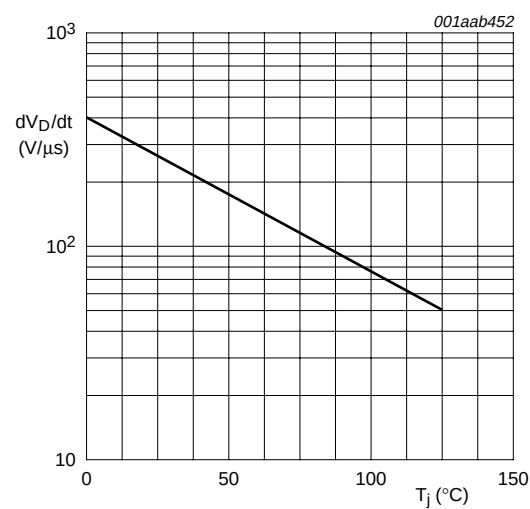


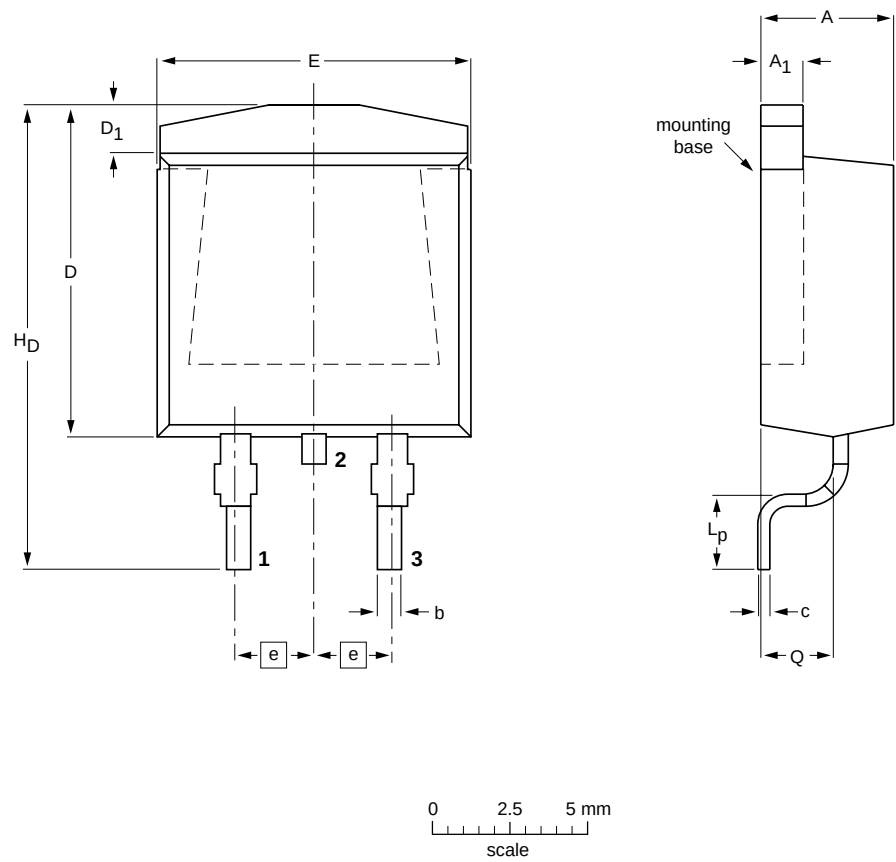
Fig 12. Critical rate of rise of off-state voltage as a function of junction temperature; minimum values.



7. Package outline

Plastic single-ended surface mounted package (Philips version of D<sup>2</sup>-PAK); 3 leads  
(one lead cropped)

SOT404



DIMENSIONS (mm are the original dimensions)

| UNIT | A            | A <sub>1</sub> | b            | c            | D <sub>max.</sub> | D <sub>1</sub> | E             | e    | L <sub>p</sub> | H <sub>D</sub> | Q            |
|------|--------------|----------------|--------------|--------------|-------------------|----------------|---------------|------|----------------|----------------|--------------|
| mm   | 4.50<br>4.10 | 1.40<br>1.27   | 0.85<br>0.60 | 0.64<br>0.46 | 11                | 1.60<br>1.20   | 10.30<br>9.70 | 2.54 | 2.90<br>2.10   | 15.80<br>14.80 | 2.60<br>2.20 |

| OUTLINE<br>VERSION | REFERENCES |       |      |  | EUROPEAN<br>PROJECTION | ISSUE DATE            |
|--------------------|------------|-------|------|--|------------------------|-----------------------|
|                    | IEC        | JEDEC | EIAJ |  |                        |                       |
| SOT404             |            |       |      |  |                        | -99-06-25<br>01-02-12 |

Fig 13. Package outline; SOT404 (D<sup>2</sup>-PAK).

8. Revision history

Table 6: Revision history

| Document ID                                                                                                                                                                               | Release date | Data sheet status     | Change notice | Doc. number    | Supersedes        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------------------|---------------|----------------|-------------------|
| BT139B_SERIES_E_3                                                                                                                                                                         | 20040923     | Product data sheet    | -             | 9397 750 13438 | BT139B_SERIES_E_2 |
| Modifications:                                                                                                                                                                            |              |                       |               |                |                   |
| <ul style="list-style-type: none"><li>The format of this data sheet has been redesigned to comply with the new presentation and information standard of Philips Semiconductors.</li></ul> |              |                       |               |                |                   |
| BT139B_SERIES_E_2                                                                                                                                                                         | 20010701     | Product specification | -             | -              | BT139B_SERIES_E_1 |
| BT139B_SERIES_E_1                                                                                                                                                                         | 19970301     | Product specification | -             | -              | -                 |

## 9. Data sheet status

| Level | Data sheet status <sup>[1]</sup> | Product status <sup>[2] [3]</sup> | 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.                                                                                                    |
| II    | Preliminary data                 | Qualification                     | This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.             |
| III   | Product data                     | Production                        | This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN). |

[1] Please consult the most recently issued data sheet before initiating or completing a design.

[2] The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.

[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

## 10. Definitions

**Short-form specification** — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

**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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