

# 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 |                         |               |

PHILIPS

### 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             |
|-------------------------------|--------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|-----|--------------------|------------------|
| $V_{\text{DRM}}$              | repetitive peak off-state voltage                            |                                                                                                                     |     |                    |                  |
|                               | BT139-600                                                    |                                                                                                                     | -   | 600 <sup>[1]</sup> | V                |
|                               | BT139-800                                                    |                                                                                                                     | -   | 800                | V                |
| $I_{\text{T(RMS)}}$           | RMS on-state current                                         | full sine wave; $T_{\text{mb}} \leq 99\text{ °C}$ ; <a href="#">Figure 4</a> and <a href="#">Figure 5</a>           | -   | 16                 | A                |
| $I_{\text{TSM}}$              | non-repetitive peak on-state current                         | full sine wave; $T_{\text{j}} = 25\text{ °C}$ prior to surge; <a href="#">Figure 2</a> and <a href="#">Figure 3</a> |     |                    |                  |
|                               |                                                              | $t = 20\text{ ms}$                                                                                                  | -   | 155                | A                |
|                               |                                                              | $t = 16.7\text{ ms}$                                                                                                | -   | 170                | A                |
|                               |                                                              |                                                                                                                     |     |                    |                  |
| $I^2t$                        | $I^2t$ for fusing                                            | $t = 10\text{ ms}$                                                                                                  | -   | 120                | A <sup>2</sup> 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/ $\mu\text{s}$ |
|                               |                                                              | 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               | °C               |
| $T_{\text{j}}$                | 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/ $\mu\text{s}$ .

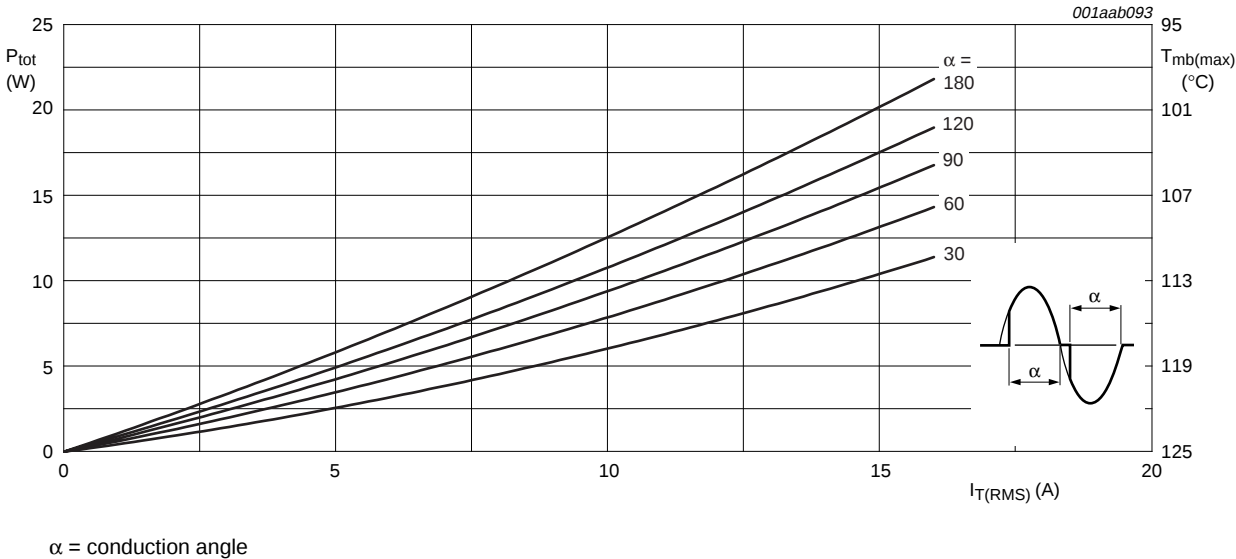


Fig 1. Total power dissipation as a function of RMS on-state current; maximum values.

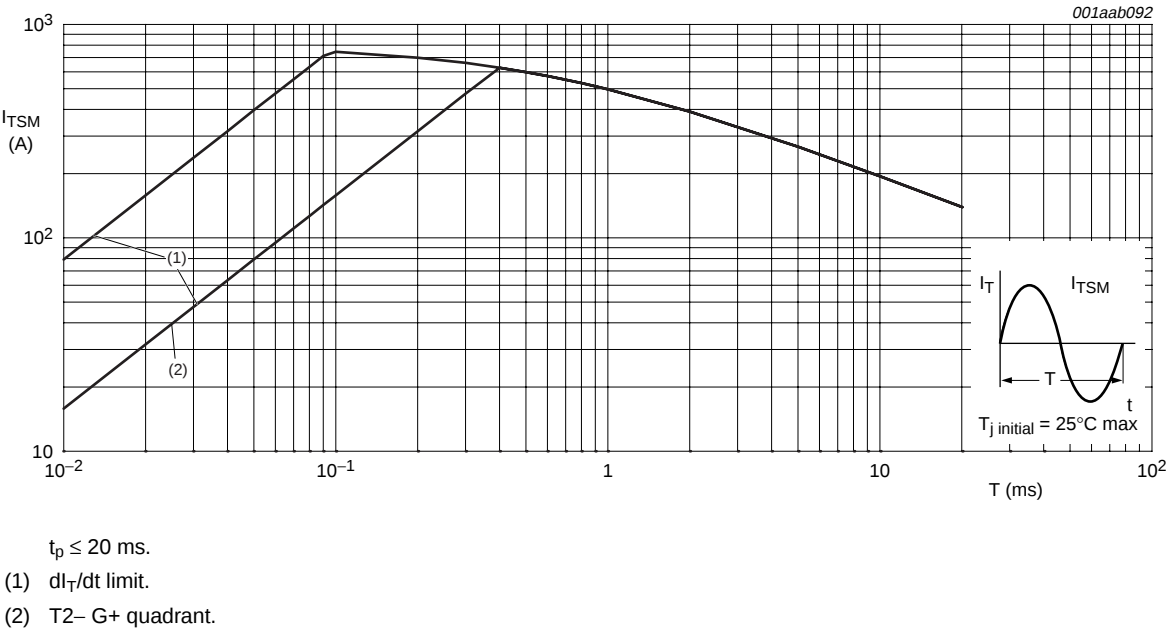


Fig 2. Non-repetitive peak on-state current as a function of pulse width; maximum values.

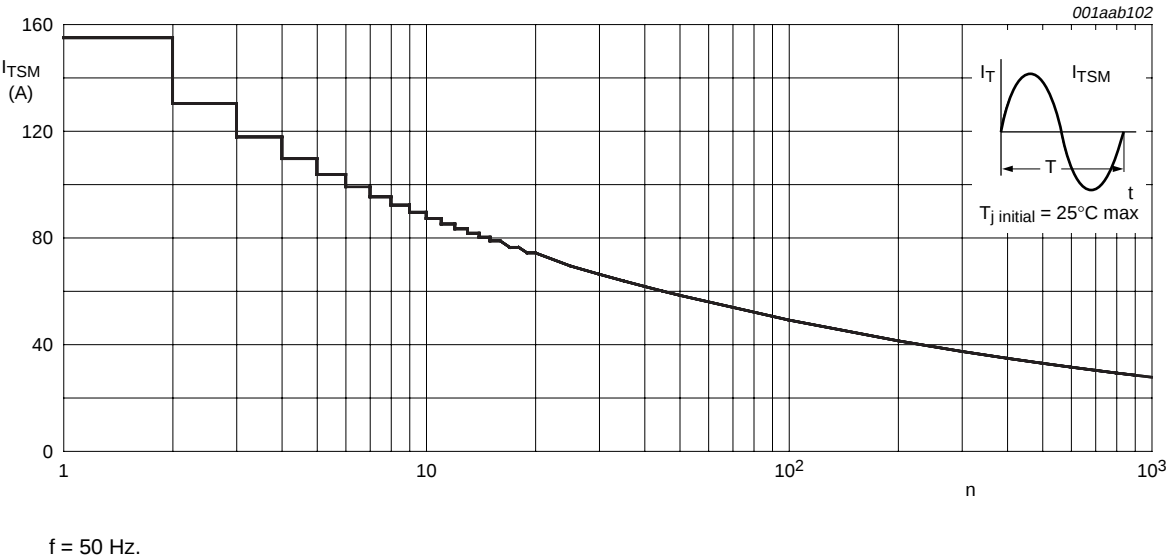


Fig 3. Non-repetitive peak on-state current as a function of number of sinusoidal current cycles; maximum values.

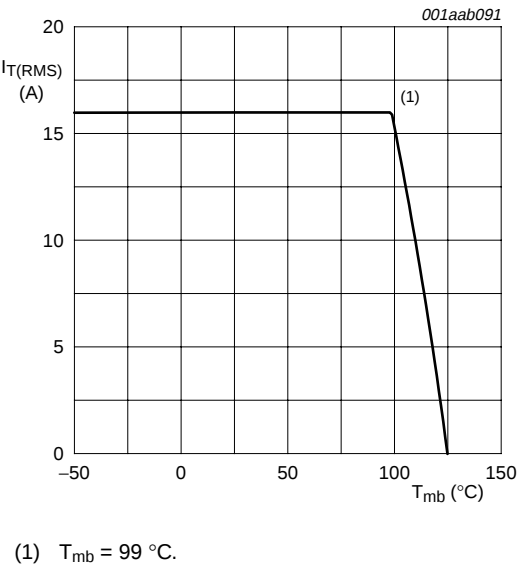


Fig 4. RMS on-state current as a function of mounting base temperature; maximum values.

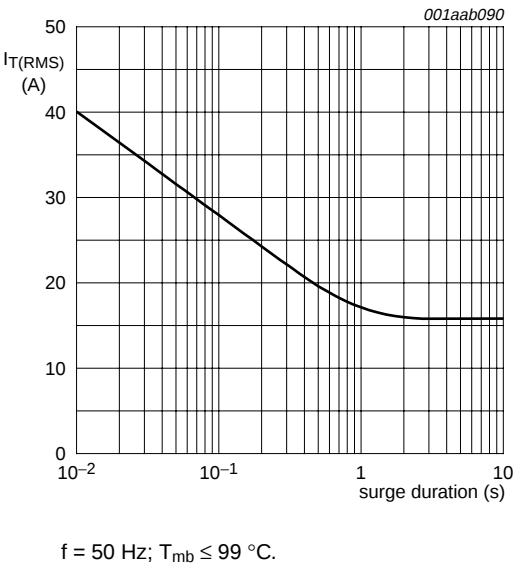
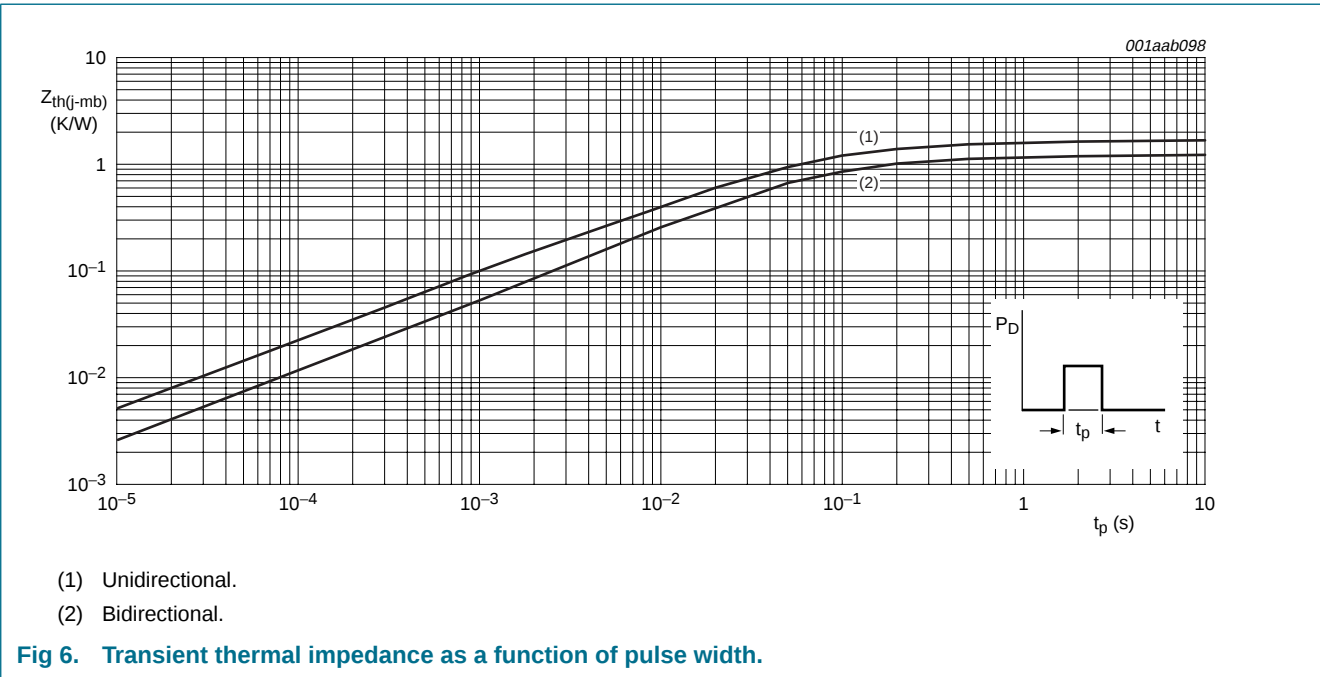


Fig 5. RMS on-state current as a function of surge duration; maximum values.

## 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 <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 junction to ambient       | in free air                         | 60  | -   | K/W  |



6. Static characteristics

**Table 5: Static characteristics**  
*T<sub>j</sub> = 25 °C unless otherwise stated.*

| Symbol          | Parameter            | Conditions                                                                      | BT139 |     |     | BT139-F |     |     | BT139-G |     |     | Unit |
|-----------------|----------------------|---------------------------------------------------------------------------------|-------|-----|-----|---------|-----|-----|---------|-----|-----|------|
|                 |                      |                                                                                 | Min   | Typ | Max | Min     | Typ | Max | Min     | Typ | Max |      |
| I <sub>GT</sub> | gate trigger current | V <sub>D</sub> = 12 V;<br>I <sub>T</sub> = 0.1 A;<br><a href="#">Figure 8</a>   |       |     |     |         |     |     |         |     |     |      |
|                 |                      | 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 <sub>L</sub>  | latching current     | V <sub>D</sub> = 12 V;<br>I <sub>GT</sub> = 0.1 A;<br><a href="#">Figure 9</a>  |       |     |     |         |     |     |         |     |     |      |
|                 |                      | 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 <sub>H</sub>  | holding current      | V <sub>D</sub> = 12 V;<br>I <sub>GT</sub> = 0.1 A;<br><a href="#">Figure 10</a> | -     | 6   | 45  | -       | 6   | 45  | -       | 6   | 60  | mA   |
| V <sub>T</sub>  | on-state voltage     | I <sub>T</sub> = 20 A;<br><a href="#">Figure 11</a>                             | -     | 1.2 | 1.6 | -       | 1.2 | 1.6 | -       | 1.2 | 1.6 | V    |

Table 5: Static characteristics ...continued

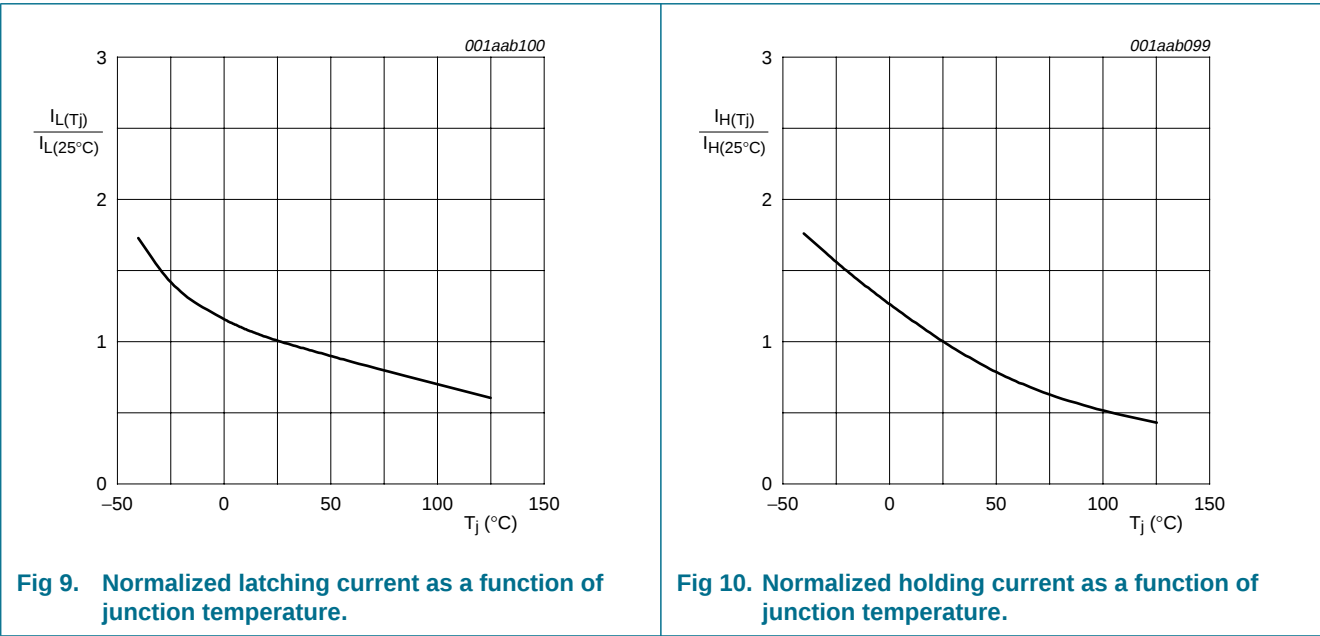
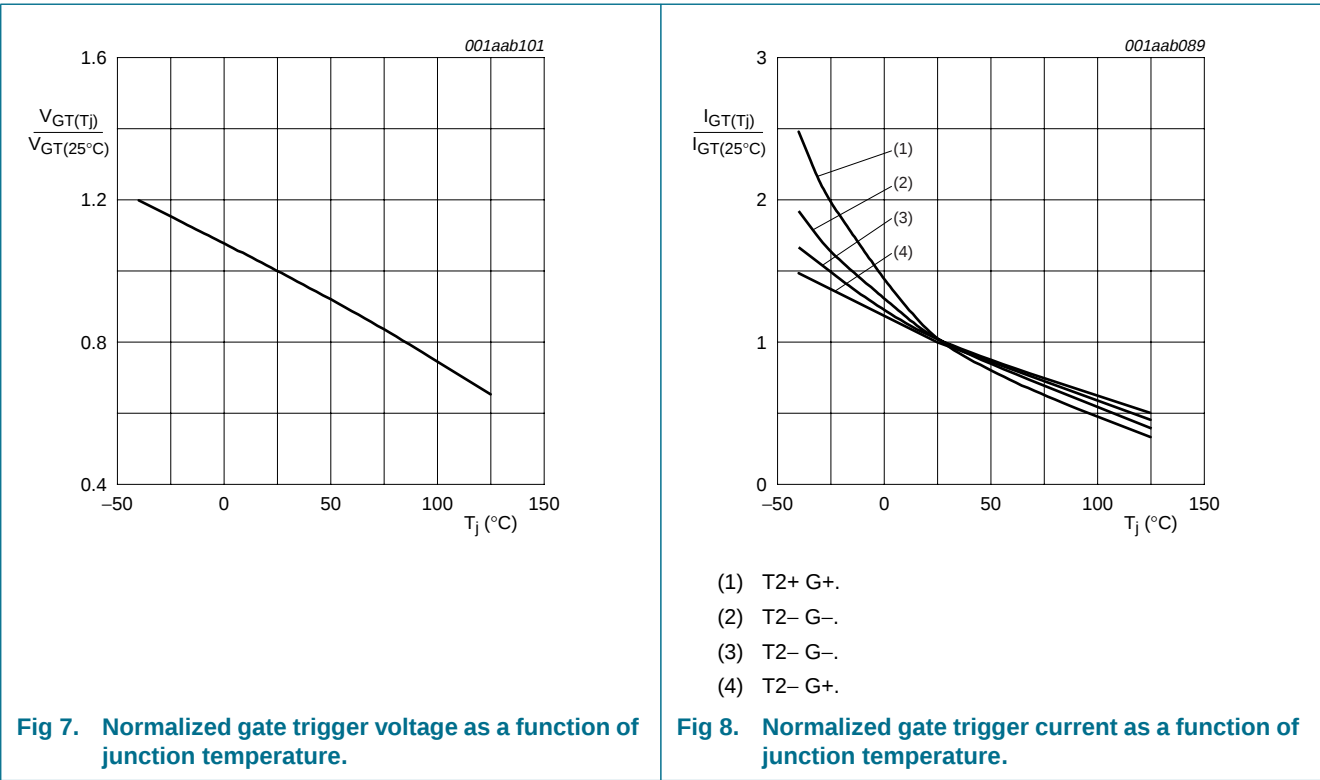
 $T_j = 25\text{ }^{\circ}\text{C}$  unless otherwise stated.

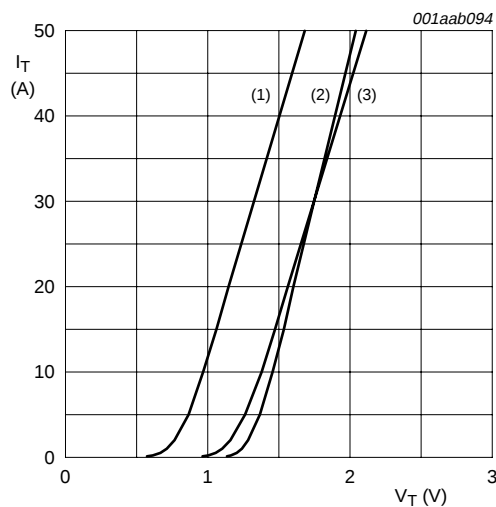
| Symbol   | Parameter                 | Conditions                                                                            | BT139 |     |     | BT139-F |     |     | BT139-G |     |     | Unit |
|----------|---------------------------|---------------------------------------------------------------------------------------|-------|-----|-----|---------|-----|-----|---------|-----|-----|------|
|          |                           |                                                                                       | Min   | Typ | Max | Min     | Typ | Max | Min     | Typ | Max |      |
| $V_{GT}$ | gate trigger voltage      | $V_D = 12\text{ V};$<br>$I_T = 0.1\text{ A};$<br><a href="#">Figure 7</a>             | -     | 0.7 | 1.5 | -       | 0.7 | 1.5 | -       | 0.7 | 1.5 | V    |
|          |                           | $V_D = 400\text{ V};$<br>$I_T = 0.1\text{ A};$<br>$T_j = 125\text{ }^{\circ}\text{C}$ | 0.25  | 0.4 | -   | 0.25    | 0.4 | -   | 0.25    | 0.4 | -   | V    |
| $I_D$    | off-state leakage current | $V_D = V_{DRM(max)};$<br>$T_j = 125\text{ }^{\circ}\text{C}$                          | -     | 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     | $V_{DM} = 67\text{ }%$<br>$V_{DRM(max)};$<br>$T_j = 125\text{ }^{\circ}\text{C};$<br>exponential waveform; gate open circuit                            | 200   | 250 | -   | 50      | 250 | -   | 200     | 250 | -   | V/ $\mu\text{s}$ |
| $dV_{com}/dt$ | critical rate of change of commutating voltage | $V_{DM} = 400\text{ V};$<br>$T_j = 95\text{ }^{\circ}\text{C};$<br>$I_{T(RMS)} = 16\text{ A};$<br>$dI_{com}/dt = 7.2\text{ A/ms};$<br>gate open circuit | 10    | 20  | -   | -       | 20  | -   | 10      | 20  | -   | V/ $\mu\text{s}$ |
| $t_{gt}$      | gate controlled turn-on time                   | $I_{TM} = 20\text{ A};$<br>$V_D = V_{DRM(max)};$<br>$I_G = 0.1\text{ A};$<br>$dI_G/dt = 5\text{ A}/\mu\text{s}$                                         |       | 2   | -   | -       | 2   | -   |         | 2   | -   | $\mu\text{s}$    |



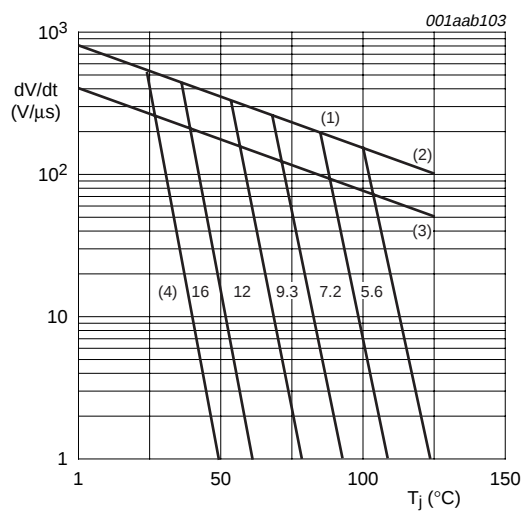


$V_O = 1.06 \text{ V}$ .

$R_S = 0.0304 \text{ } \Omega$ .

- (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.**



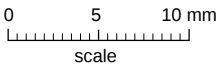
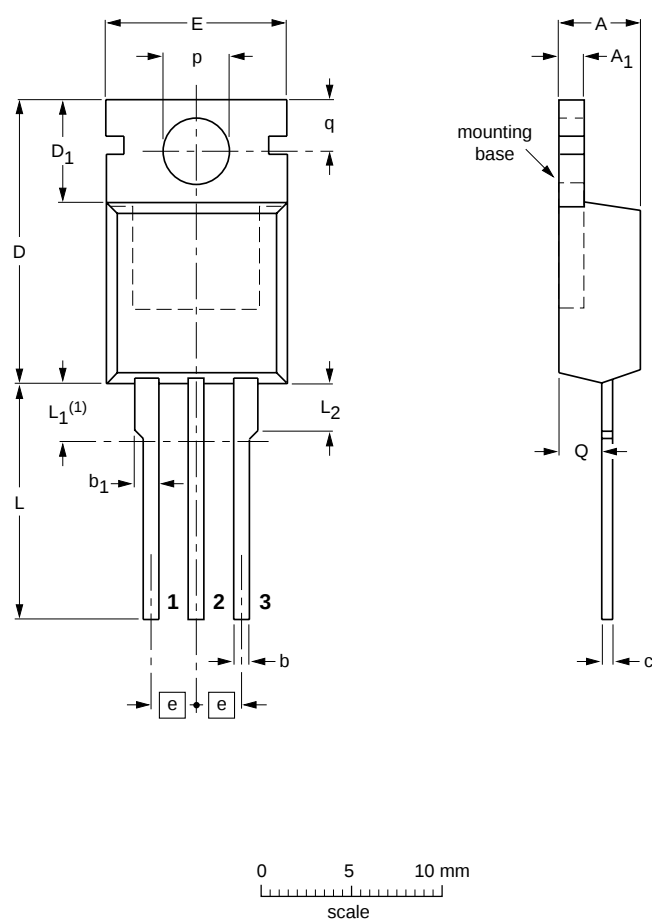
The triac should commute when the  $dI_T/dt$  is below the value on the appropriate curve for pre-commutation  $dI_T/dt$ .

- (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



DIMENSIONS (mm are the original dimensions)

| UNIT | A          | A <sub>1</sub> | b          | b <sub>1</sub> | c          | D            | D <sub>1</sub> | E           | e    | L            | L <sub>1</sub> <sup>(1)</sup> | L <sub>2</sub><br>max. | p          | q          | Q          |
|------|------------|----------------|------------|----------------|------------|--------------|----------------|-------------|------|--------------|-------------------------------|------------------------|------------|------------|------------|
| mm   | 4.5<br>4.1 | 1.39<br>1.27   | 0.9<br>0.6 | 1.3<br>1.0     | 0.7<br>0.4 | 15.8<br>15.2 | 6.4<br>5.9     | 10.3<br>9.7 | 2.54 | 15.0<br>13.5 | 3.30<br>2.79                  | 3.0                    | 3.8<br>3.6 | 3.0<br>2.7 | 2.6<br>2.2 |

Note  
1. Terminals in this zone are not tinned.

| OUTLINE<br>VERSION | REFERENCES |                 |       |  | EUROPEAN<br>PROJECTION | ISSUE DATE           |
|--------------------|------------|-----------------|-------|--|------------------------|----------------------|
|                    | IEC        | JEDEC           | JEITA |  |                        |                      |
| SOT78              |            | 3-lead TO-220AB | SC-46 |  |                        | 01-02-16<br>03-01-22 |

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 <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.

## 11. 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.

**Application information** — Applications that are described herein for any of these products are for illustrative purposes only. Philips Semiconductors make no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

## 12. Disclaimers

**Life support** — These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips Semiconductors customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips Semiconductors for any damages resulting from such application.

**Right to make changes** — Philips Semiconductors reserves the right to make changes in the products - including circuits, standard cells, and/or software - described or contained herein in order to improve design and/or performance. When the product is in full production (status 'Production'), relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN). Philips Semiconductors assumes no responsibility or liability for the use of any of these products, conveys no license or title under any patent, copyright, or mask work right to these products, and makes no representations or warranties that these products are free from patent, copyright, or mask work right infringement, unless otherwise specified.

## 13. Contact information

For additional information, please visit: <http://www.semiconductors.philips.com>

For sales office addresses, send an email to: [sales.addresses@www.semiconductors.philips.com](mailto:sales.addresses@www.semiconductors.philips.com)



14. Contents

1    **Product profile** ..... 1

1.1    General description..... 1

1.2    Features ..... 1

1.3    Applications ..... 1

1.4    Quick reference data..... 1

2    **Pinning information**..... 1

3    **Ordering information**..... 2

4    **Limiting values**..... 2

5    **Thermal characteristics** ..... 3

6    **Static characteristics** ..... 3

7    **Dynamic characteristics** ..... 4

8    **Package outline** ..... 9

9    **Revision history**..... 10

10    **Data sheet status**..... 11

11    **Definitions** ..... 11

12    **Disclaimers**..... 11

13    **Contact information** .....11

