



# BT139-600E

## 4Q Triac

Rev. 05 — 24 March 2011

Product data sheet

## 1. Product profile

### 1.1 General description

Planar passivated sensitive gate four quadrant triac in a SOT78 (TO-220AB) plastic package 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. This sensitive gate "series E" triac is intended to be interfaced directly to microcontrollers, logic integrated circuits and other low power gate trigger circuits.

### 1.2 Features and benefits

- Direct triggering from low power drivers and logic ICs
- High blocking voltage capability
- Planar passivated for voltage ruggedness and reliability
- Sensitive gate
- Triggering in all four quadrants

### 1.3 Applications

- General purpose motor control
- General purpose switching

### 1.4 Quick reference data

Table 1. Quick reference data

| Symbol       | Parameter                            | Conditions   | Min | Typ | Max | Unit |
|--------------|--------------------------------------|--|-----|-----|-----|------|
| $V_{DRM}$    | repetitive peak off-state voltage    |  | -   | -   | 600 | V    |
| $I_{TSM}$    | non-repetitive peak on-state current | full sine wave; $T_{j(\text{init})} = 25\text{ °C}$ ; $t_p = 20\text{ ms}$ ; see <a href="#">Figure 4</a> ; see <a href="#">Figure 5</a> | -   | -   | 155 | A    |
| $I_{T(RMS)}$ | RMS on-state current                 | full sine wave; $T_{mb} \leq 99\text{ °C}$ ; see <a href="#">Figure 1</a> ; see <a href="#">Figure 2</a> ; see <a href="#">Figure 3</a>  | -   | -   | 16  | A    |

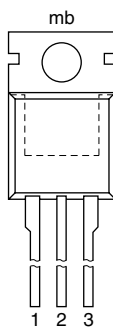
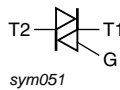


Table 1. Quick reference data ...continued

| Symbol                        | Parameter            | Conditions   | Min | Typ | Max | Unit |
|-------------------------------|----------------------|--|-----|-----|-----|------|
| <b>Static characteristics</b> |                      |  |     |     |     |      |
| $I_{GT}$                      | gate trigger current | $V_D = 12\text{ V}; I_T = 0.1\text{ A}; T2+ G+;$<br>$T_j = 25\text{ }^\circ\text{C};$ see <a href="#">Figure 7</a> | -   | 2.5 | 10  | mA   |
|                               |                      | $V_D = 12\text{ V}; I_T = 0.1\text{ A}; T2+ G-;$<br>$T_j = 25\text{ }^\circ\text{C};$ see <a href="#">Figure 7</a> | -   | 4   | 10  | mA   |
|                               |                      | $V_D = 12\text{ V}; I_T = 0.1\text{ A}; T2- G-;$<br>$T_j = 25\text{ }^\circ\text{C};$ see <a href="#">Figure 7</a> | -   | 5   | 10  | mA   |
|                               |                      | $V_D = 12\text{ V}; I_T = 0.1\text{ A}; T2- G+;$<br>$T_j = 25\text{ }^\circ\text{C};$ see <a href="#">Figure 7</a> | -   | 11  | 25  | mA   |

## 2. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description                    | Simplified outline   | Graphic symbol   |
|-----|--------|--------------------------------|--|--|
| 1   | T1     | main terminal 1                |  |  |
| 2   | T2     | main terminal 2                |  |  |
| 3   | G      | gate                           |  |  |
| mb  | T2     | mounting base; main terminal 2 |  |  |

SOT78 (TO-220AB)

## 3. Ordering information

Table 3. Ordering information

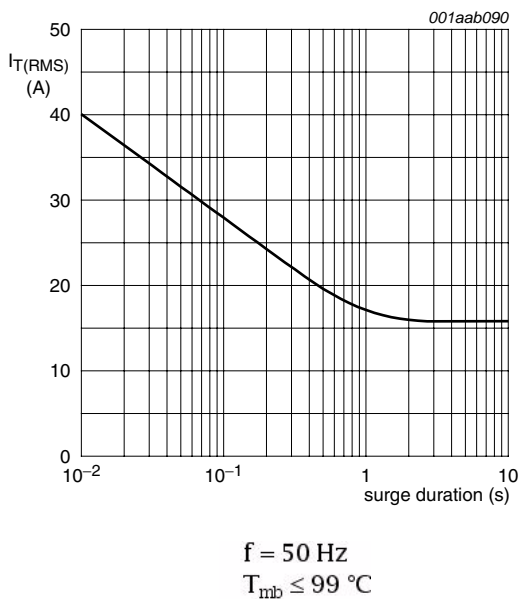
| Type number   | Package  |  |         |
|---------------|----------|--|---------|
|               | Name     | Description  | Version |
| BT139-600E    | TO-220AB | plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB | SOT78   |
| BT139-600E/DG | TO-220AB | plastic single-ended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

### 4. Limiting values

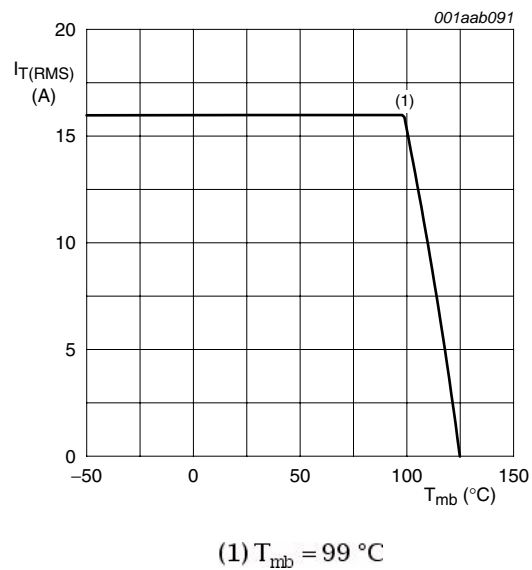
**Table 4. Limiting values**

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

| Symbol       | Parameter                            | Conditions  | Min | Max | Unit                   |
|--------------|--------------------------------------|---|-----|-----|------------------------|
| $V_{DRM}$    | repetitive peak off-state voltage    |   | -   | 600 | V                      |
| $I_{T(RMS)}$ | RMS on-state current                 | full sine wave; $T_{mb} \leq 99\text{ }^{\circ}\text{C}$ ;<br>see <a href="#">Figure 1</a> ; see <a href="#">Figure 2</a> ; see <a href="#">Figure 3</a>  | -   | 16  | A                      |
| $I_{TSM}$    | non-repetitive peak on-state current | full sine wave; $T_{j(\text{init})} = 25\text{ }^{\circ}\text{C}$ ; $t_p = 20\text{ ms}$ ;<br>see <a href="#">Figure 4</a> ; see <a href="#">Figure 5</a> | -   | 155 | A                      |
|              |                                      | full sine wave; $T_{j(\text{init})} = 25\text{ }^{\circ}\text{C}$ ; $t_p = 16.7\text{ ms}$  | -   | 170 | A                      |
| $I^2t$       | $I^2t$ for fusing                    | $t_p = 10\text{ ms}$ ; sine-wave pulse  | -   | 120 | $\text{A}^2\text{s}$   |
| $di_T/dt$    | rate of rise of on-state current     | $I_T = 20\text{ A}$ ; $I_G = 0.2\text{ A}$ ; $di_G/dt = 0.2\text{ A}/\mu\text{s}$ ;<br>T2+ G+   | -   | 50  | $\text{A}/\mu\text{s}$ |
|              |                                      | $I_T = 20\text{ A}$ ; $I_G = 0.2\text{ A}$ ; $di_G/dt = 0.2\text{ A}/\mu\text{s}$ ;<br>T2+ G-   | -   | 50  | $\text{A}/\mu\text{s}$ |
|              |                                      | $I_T = 20\text{ A}$ ; $I_G = 0.2\text{ A}$ ; $di_G/dt = 0.2\text{ A}/\mu\text{s}$ ;<br>T2- G-   | -   | 50  | $\text{A}/\mu\text{s}$ |
|              |                                      | $I_T = 20\text{ A}$ ; $I_G = 0.2\text{ A}$ ; $di_G/dt = 0.2\text{ A}/\mu\text{s}$ ;<br>T2- G+   | -   | 10  | $\text{A}/\mu\text{s}$ |
| $I_{GM}$     | peak gate current                    |   | -   | 2   | A                      |
| $V_{GM}$     | peak gate voltage                    |   | -   | 5   | V                      |
| $P_{GM}$     | peak gate power                      |   | -   | 5   | W                      |
| $P_{G(AV)}$  | average gate power                   | over any 20 ms period   | -   | 0.5 | W                      |
| $T_{stg}$    | storage temperature                  |   | -40 | 150 | $^{\circ}\text{C}$     |
| $T_j$        | junction temperature                 |   | -   | 125 | $^{\circ}\text{C}$     |



**Fig 1. RMS on-state current as a function of surge duration; maximum values**



**Fig 2. RMS on-state current as a function of mounting base temperature; maximum values**

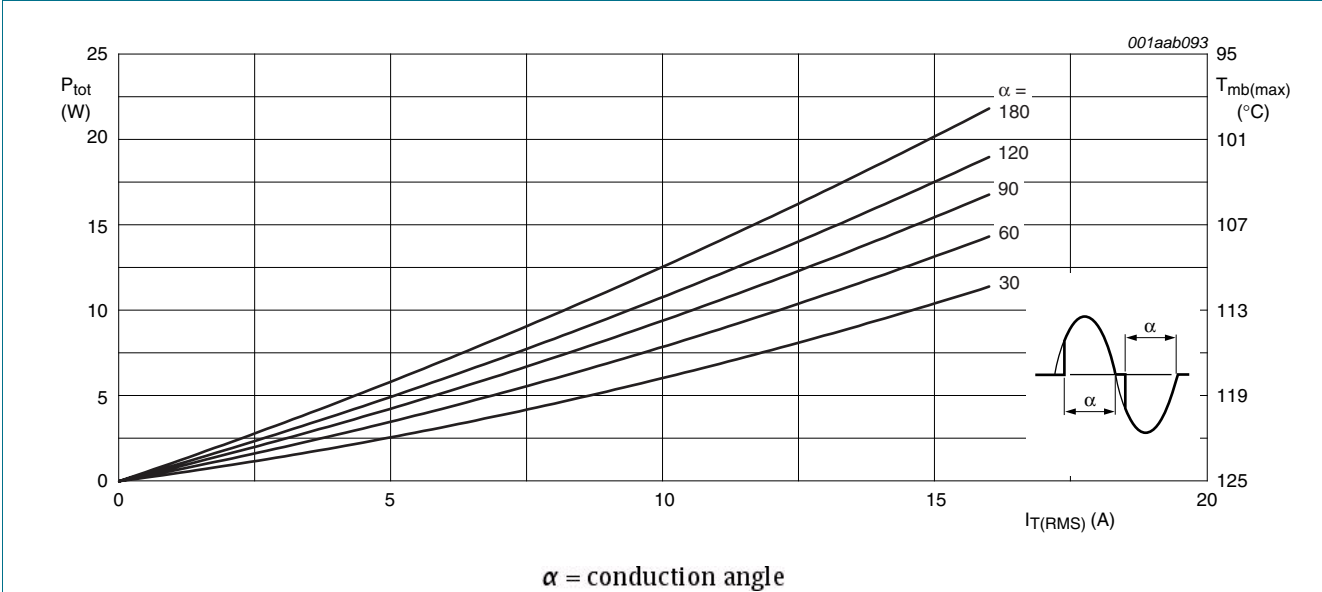


Fig 3. Total power dissipation as a function of RMS on-state current; maximum values.

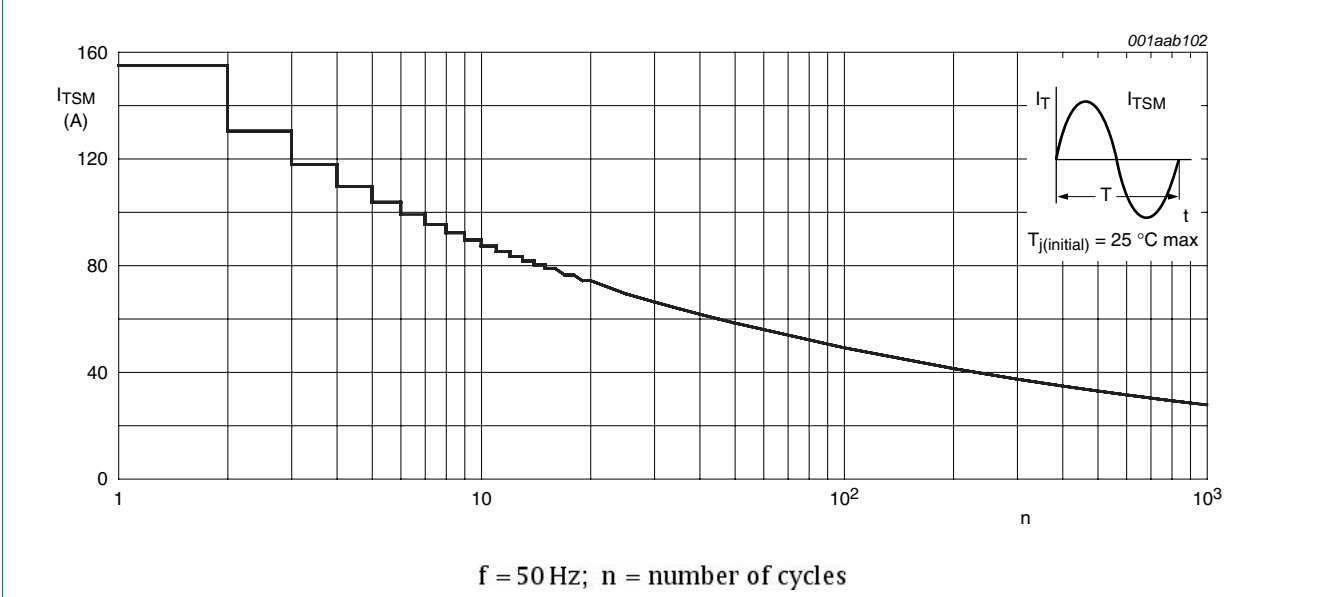
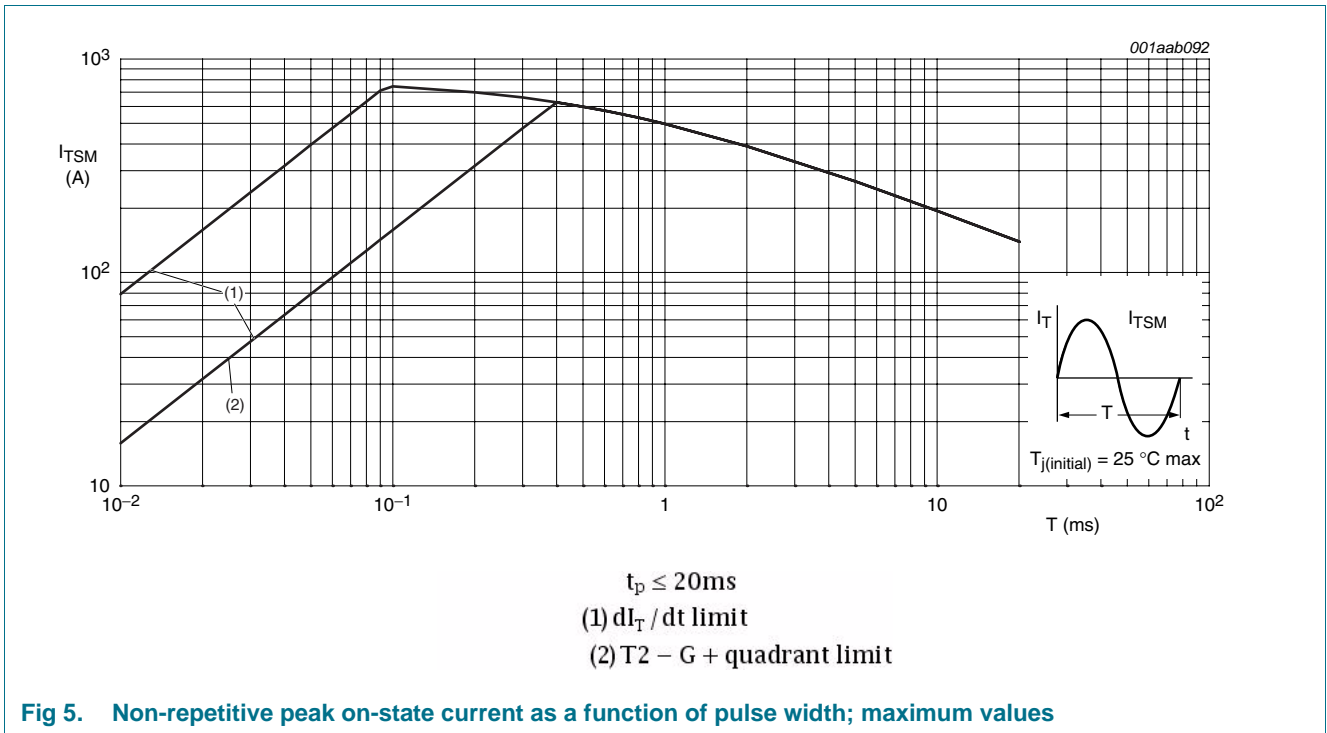


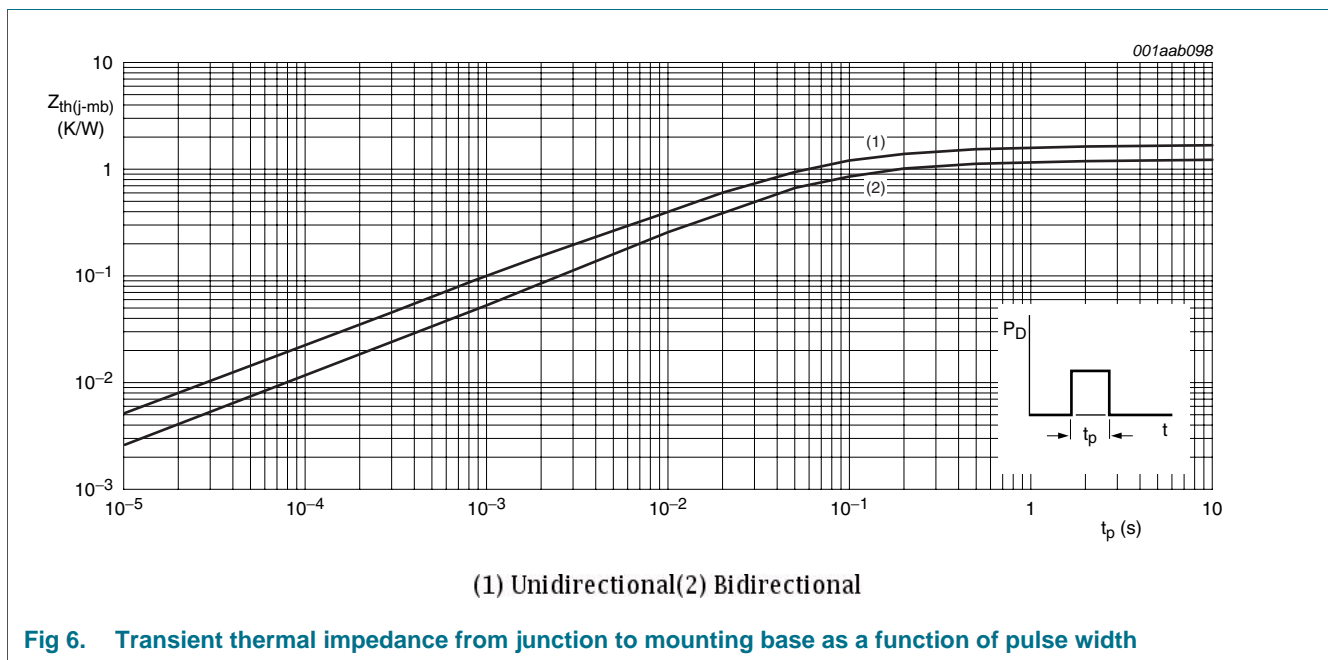
Fig 4. Non-repetitive peak on-state current as a function of the number of sinusoidal current cycles; maximum values



## 5. Thermal characteristics

**Table 5. Thermal characteristics**

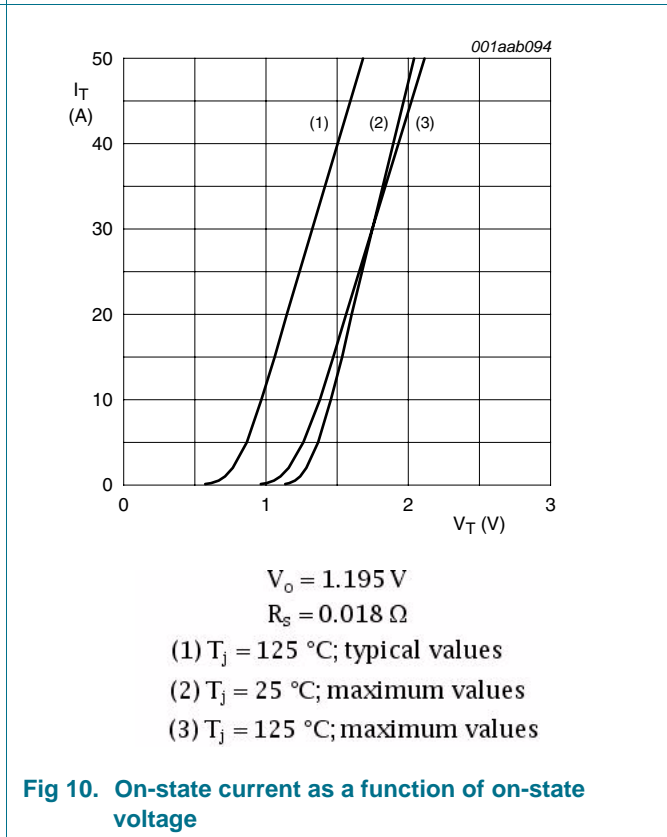
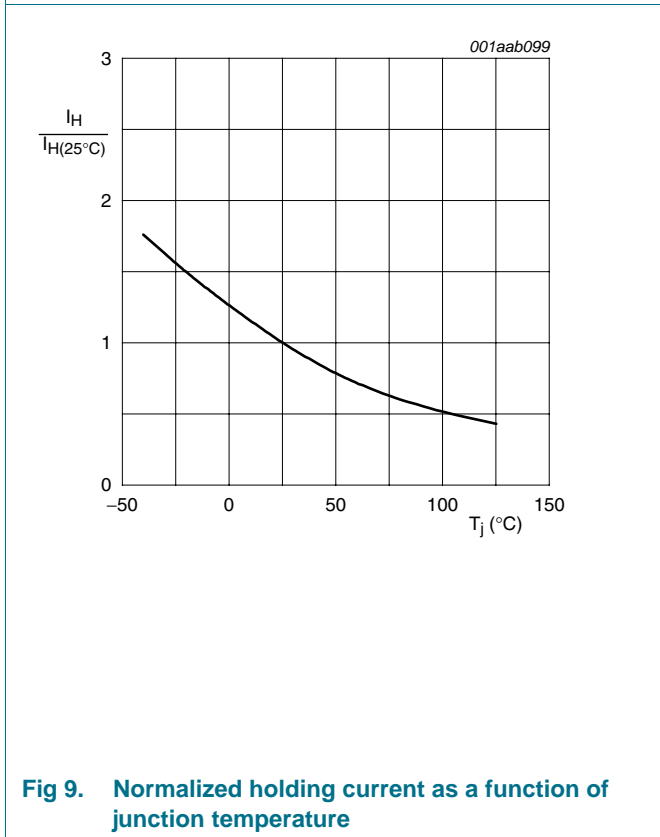
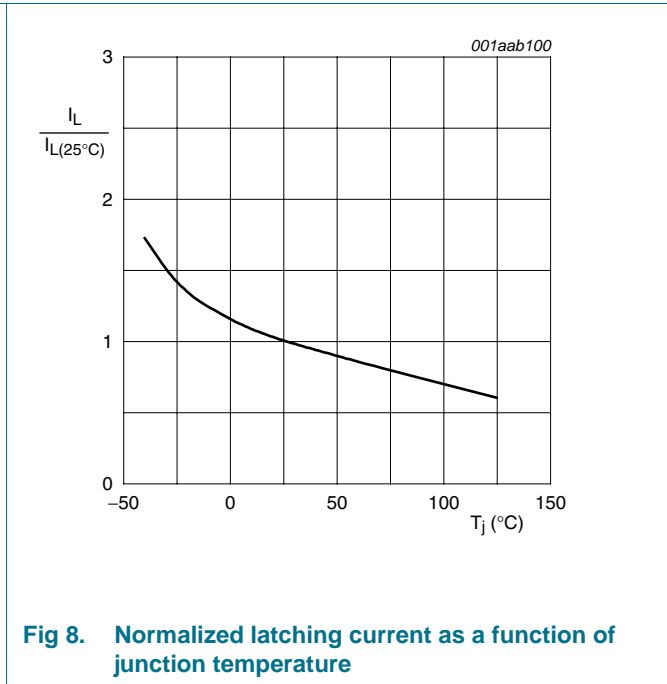
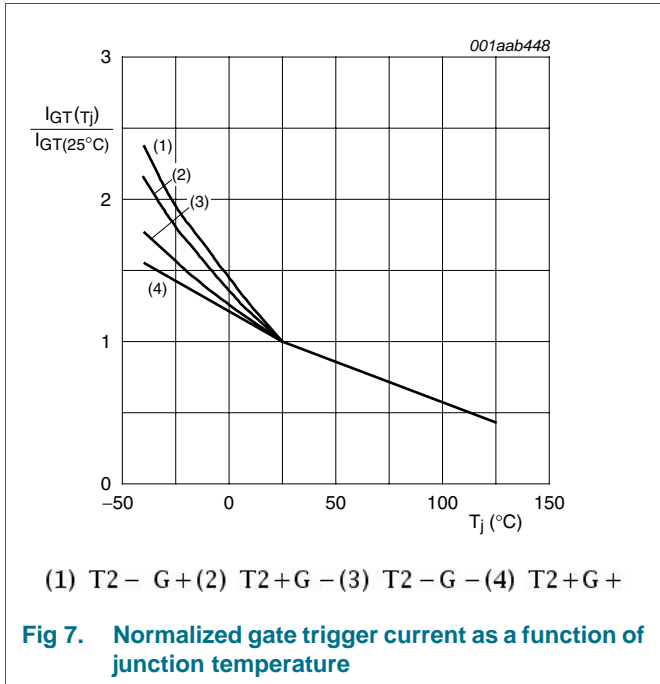
| Symbol         | Parameter   | Conditions                               | Min | Typ | Max | Unit |
|----------------|---|--|-----|-----|-----|------|
| $R_{th(j-mb)}$ | thermal resistance from junction to mounting base | half cycle; see <a href="#">Figure 6</a> | -   | -   | 1.7 | K/W  |
|                |   | full cycle; see <a href="#">Figure 6</a> | -   | -   | 1.2 | K/W  |
| $R_{th(j-a)}$  | thermal resistance from junction to ambient       | in free air                              | -   | 60  | -   | K/W  |



## 6. Characteristics

Table 6. Characteristics

| Symbol                         | Parameter                         | Conditions   | Min  | Typ | Max | Unit       |
|--------------------------------|-----------------------------------|--|------|-----|-----|------------|
| <b>Static characteristics</b>  |                                   |  |      |     |     |            |
| $I_{GT}$                       | gate trigger current              | $V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2+ G+; $T_j = 25\text{ °C}$ ; see <a href="#">Figure 7</a> | -    | 2.5 | 10  | mA         |
|                                |                                   | $V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2+ G-; $T_j = 25\text{ °C}$ ; see <a href="#">Figure 7</a> | -    | 4   | 10  | mA         |
|                                |                                   | $V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2- G-; $T_j = 25\text{ °C}$ ; see <a href="#">Figure 7</a> | -    | 5   | 10  | mA         |
|                                |                                   | $V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2- G+; $T_j = 25\text{ °C}$ ; see <a href="#">Figure 7</a> | -    | 11  | 25  | mA         |
| $I_L$                          | latching current                  | $V_D = 12\text{ V}$ ; $I_G = 0.1\text{ A}$ ; T2+ G+; $T_j = 25\text{ °C}$ ; see <a href="#">Figure 8</a> | -    | 3.2 | 30  | mA         |
|                                |                                   | $V_D = 12\text{ V}$ ; $I_G = 0.1\text{ A}$ ; T2+ G-; $T_j = 25\text{ °C}$ ; see <a href="#">Figure 8</a> | -    | 16  | 40  | mA         |
|                                |                                   | $V_D = 12\text{ V}$ ; $I_G = 0.1\text{ A}$ ; T2- G-; $T_j = 25\text{ °C}$ ; see <a href="#">Figure 8</a> | -    | 4   | 30  | mA         |
|                                |                                   | $V_D = 12\text{ V}$ ; $I_G = 0.1\text{ A}$ ; T2- G+; $T_j = 25\text{ °C}$ ; see <a href="#">Figure 8</a> | -    | 5.5 | 40  | mA         |
| $I_H$                          | holding current                   | $V_D = 12\text{ V}$ ; $T_j = 25\text{ °C}$ ; see <a href="#">Figure 9</a>                                | -    | 4   | 45  | mA         |
| $V_T$                          | on-state voltage                  | $I_T = 20\text{ A}$ ; $T_j = 25\text{ °C}$ ; see <a href="#">Figure 10</a>                               | -    | 1.2 | 1.6 | V          |
| $V_{GT}$                       | gate trigger voltage              | $V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; $T_j = 25\text{ °C}$ ; see <a href="#">Figure 11</a>        | -    | 0.7 | 1.5 | V          |
|                                |                                   | $V_D = 400\text{ V}$ ; $I_T = 0.1\text{ A}$ ; $T_j = 125\text{ °C}$ ; see <a href="#">Figure 11</a>      | 0.25 | 0.4 | -   | V          |
| $I_D$                          | off-state current                 | $V_D = 600\text{ V}$ ; $T_j = 125\text{ °C}$   | -    | 0.1 | 0.5 | mA         |
| <b>Dynamic characteristics</b> |                                   |  |      |     |     |            |
| $dV_D/dt$                      | rate of rise of off-state voltage | $V_{DM} = 402\text{ V}$ ; $T_j = 125\text{ °C}$ ; exponential waveform; gate open circuit                | -    | 50  | -   | V/ $\mu$ s |
| $t_{gt}$                       | gate-controlled turn-on time      | $I_{TM} = 20\text{ A}$ ; $V_D = 600\text{ V}$ ; $I_G = 0.1\text{ A}$ ; $dI_G/dt = 5\text{ A}/\mu$ s      | -    | 2   | -   | $\mu$ s    |





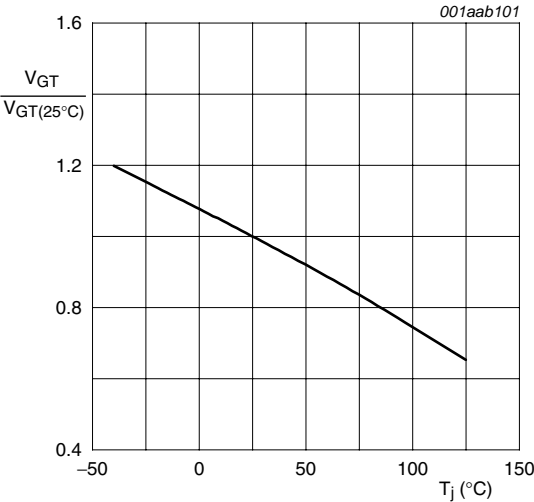


Fig 11. Normalized gate trigger voltage as a function of junction temperature

7. Package outline

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

SOT78



Fig 12. Package outline SOT78 (TO-220AB)

## 8. Revision history

Table 7. Revision history

| Document ID    | Release date                  | Data sheet status  | Change notice | Supersedes      |
|----------------|-------------------------------|--------------------|---------------|-----------------|
| BT139-600E v.5 | 20110324                      | Product data sheet | -             | BT139-600E v.4  |
| Modifications: | • Various changes to content. |                    |               |                 |
| BT139-600E v.4 | 20110224                      | Product data sheet | -             | BT139_SER_E v.3 |

## 9. Legal information

### 9.1 Data sheet status

| Document status <sup>[1]</sup> <sup>[2]</sup> | Product status <sup>[3]</sup> | Definition  |
|---|-------------------------------|---|
| Objective [short] data sheet                  | Development                   | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet                | Qualification                 | This document contains data from the preliminary specification.                       |
| Product [short] data sheet                    | Production                    | This document contains the product specification.                                     |

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

[2] The term 'short data sheet' is explained in section "Definitions".

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