

# BT169 series

## Thyristors logic level

Rev. 5 — 30 September 2011

Product data sheet

## 1. Product profile

### 1.1 General description

Passivated, sensitive gate thyristors in a SOT54 plastic package.

### 1.2 Features and benefits

- Designed to be interfaced directly to microcontrollers, logic integrated circuits and other low power gate trigger circuits.

### 1.3 Applications

- General purpose switching and phase control applications.

### 1.4 Quick reference data

- $V_{\text{DRM}}, V_{\text{RRM}} \leq 200 \text{ V}$  (BT169B)
- $V_{\text{DRM}}, V_{\text{RRM}} \leq 400 \text{ V}$  (BT169D)
- $V_{\text{DRM}}, V_{\text{RRM}} \leq 600 \text{ V}$  (BT169G)
- $I_{\text{T(RMS)}} \leq 0.8 \text{ A}$
- $I_{\text{T(AV)}} \leq 0.5 \text{ A}$
- $I_{\text{TSM}} \leq 8 \text{ A}$

## 2. Pinning information

Table 1. Discrete pinning

| Pin | Description | Simplified outline | Symbol                  |
|-----|-------------|--------------------|-------------------------|
| 1   | anode (a)   | <br>SOT54 (TO-92)  | <br>A — G — K<br>sym037 |
| 2   | gate (g)    |                    |                         |
| 3   | cathode (k) |                    |                         |

### 3. Ordering information

**Table 2. Ordering information**

| Type number | Package |   | Version |
|-------------|---------|---|---------|
|             | Name    | Description   |         |
| BT169B      | -       | plastic single-ended leaded (through hole) package; 3 leads | SOT54   |
| BT169D      |         |   |         |
| BT169G      |         |   |         |

### 4. Limiting values

**Table 3. Limiting values**

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

| Symbol             | Parameter  | Conditions   | Min   | Max  | Unit             |
|--------------------|--|--|-------|------|------------------|
| $V_{DRM}, V_{RRM}$ | repetitive peak off-state voltages                           |  |       |      |                  |
|                    | BT169B   |  | [1] - | 200  | V                |
|                    | BT169D   |  | [1] - | 400  | V                |
|                    | BT169G   |  | [1] - | 600  | V                |
| $I_{T(AV)}$        | average on-state current                                     | half sine wave;<br>$T_{lead} \leq 83\text{ °C}$ ;<br>see <a href="#">Figure 1</a>                                | -     | 0.5  | A                |
| $I_{T(RMS)}$       | RMS on-state current   | all conduction angles;<br>see <a href="#">Figure 4</a> and <a href="#">5</a>                                     | -     | 0.8  | A                |
| $I_{TSM}$          | non-repetitive peak on-state current                         | half sine wave;<br>$T_j = 25\text{ °C}$ prior to<br>surge;<br>see <a href="#">Figure 2</a> and <a href="#">3</a> |       |      |                  |
|                    |  | $t = 10\text{ ms}$   | -     | 8    | A                |
|                    |  | $t = 8.3\text{ ms}$  | -     | 9    | A                |
| $I^2t$             | $I^2t$ for fusing  | $t = 10\text{ ms}$   | -     | 0.32 | A <sup>2</sup> s |
| $di_T/dt$          | repetitive rate of rise of on-state current after triggering | $I_{TM} = 2\text{ A}$ ; $I_G = 10\text{ mA}$ ;<br>$di_G/dt = 100\text{ mA}/\mu\text{s}$                          | -     | 50   | A/ $\mu\text{s}$ |
| $I_{GM}$           | peak gate current  |  | -     | 1    | A                |
| $V_{GM}$           | peak gate voltage  |  | -     | 5    | V                |
| $V_{RGM}$          | peak reverse gate voltage                                    |  | -     | 5    | V                |
| $P_{GM}$           | peak gate power  |  | -     | 2    | W                |
| $P_{G(AV)}$        | average gate power   | over any 20 ms period  | -     | 0.1  | 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 thyristor may switch to the on-state. The rate of rise of current should not exceed 15 A/ $\mu\text{s}$ .

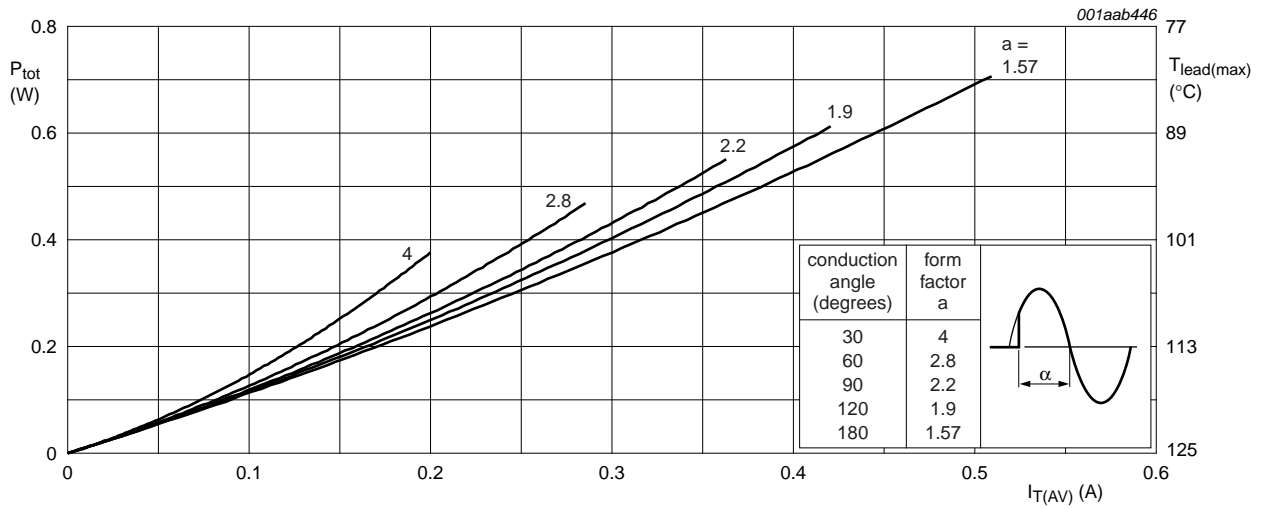


Fig 1. Total power dissipation as a function of average on-state current; maximum values.

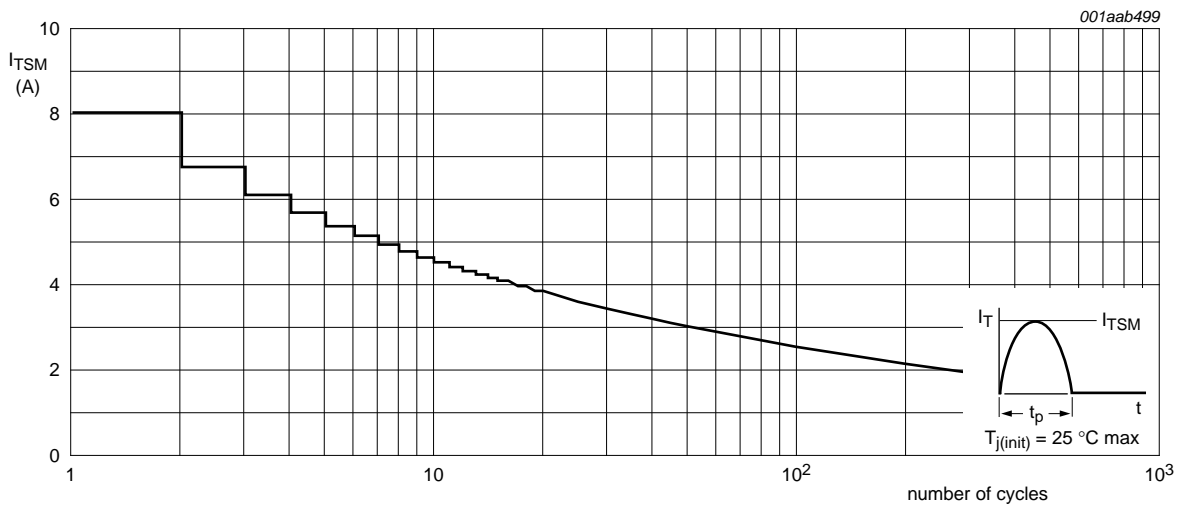
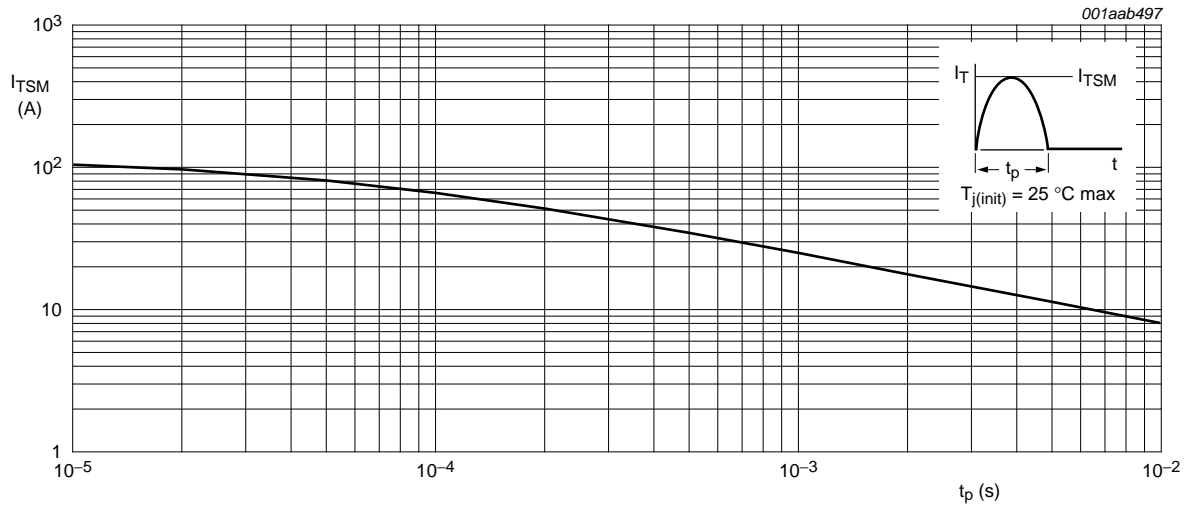
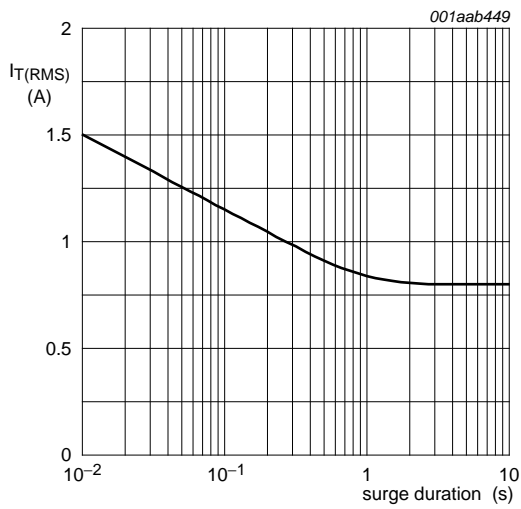


Fig 2. Non-repetitive peak on-state current as a function of the number of sinusoidal current cycles; maximum values.



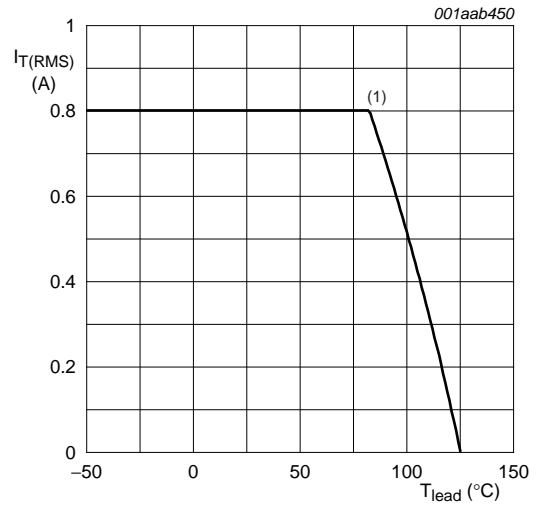
$t_p \leq 10\text{ ms}$ .

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



$f = 50\text{ Hz}$ ;  $T_{lead} \leq 83\text{ °C}$ .

**Fig 4. RMS on-state current as a function of surge duration for sinusoidal currents.**



(1)  $T_{lead} = 83\text{ °C}$ .

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

### 5. Thermal characteristics

Table 4. Thermal characteristics

| Symbol           | Parameter                                   | Conditions   | Min | Typ | Max | Unit |
|------------------|---|--|-----|-----|-----|------|
| $R_{th(j-lead)}$ | thermal resistance from junction to lead    |  | -   | -   | 60  | K/W  |
| $R_{th(j-a)}$    | thermal resistance from junction to ambient | printed-circuit board mounted;<br>lead length = 4 mm | -   | 150 | -   | K/W  |

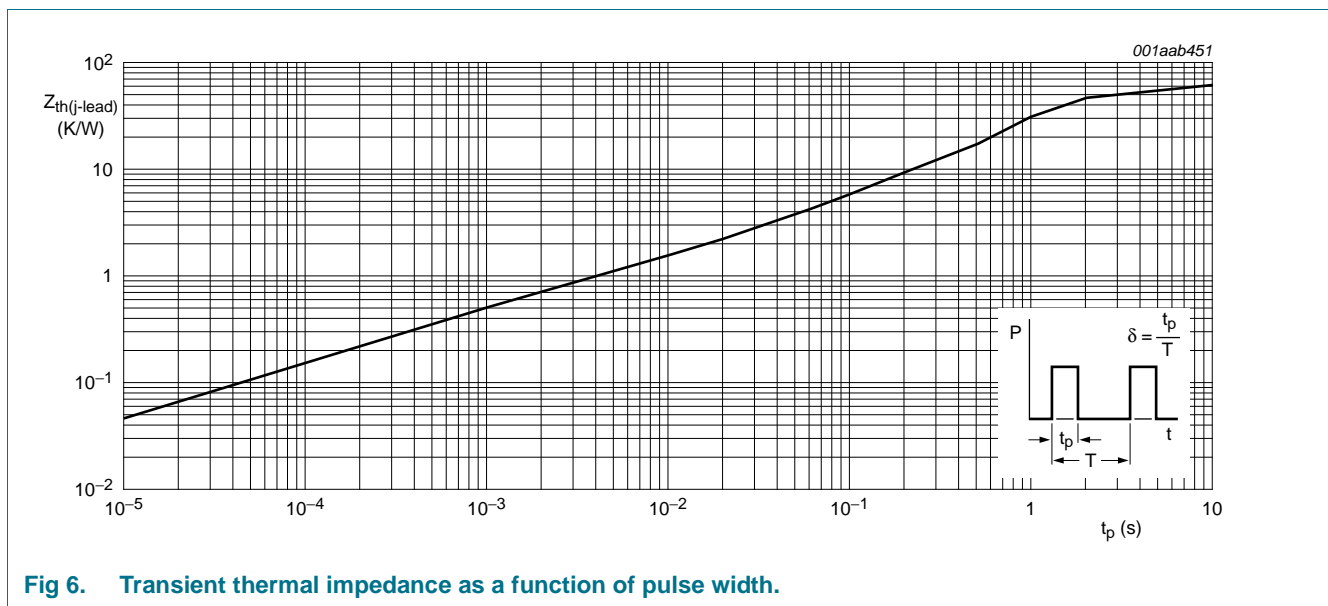


Fig 6. Transient thermal impedance as a function of pulse width.

## 6. Characteristics

**Table 5. Characteristics**

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

| Symbol                         | Parameter                                  | Conditions   | Min | Typ  | Max | Unit                   |
|--------------------------------|--|--|-----|------|-----|------------------------|
| <b>Static characteristics</b>  |  |  |     |      |     |                        |
| $I_{GT}$                       | gate trigger current                       | $V_D = 12\text{ V}$ ; $I_T = 10\text{ mA}$ ;<br>gate open circuit; see <a href="#">Figure 8</a>  | -   | 50   | 200 | $\mu\text{A}$          |
| $I_L$                          | latching current                           | $V_D = 12\text{ V}$ ; $I_{GT} = 0.5\text{ mA}$ ;<br>$R_{GK} = 1\text{ k}\Omega$ ; see <a href="#">Figure 10</a>  | -   | 2    | 6   | $\text{mA}$            |
| $I_H$                          | holding current                            | $V_D = 12\text{ V}$ ; $I_{GT} = 0.5\text{ mA}$ ;<br>$R_{GK} = 1\text{ k}\Omega$ ; see <a href="#">Figure 11</a>  | -   | 2    | 5   | $\text{mA}$            |
| $V_T$                          | on-state voltage                           | $I_T = 1.2\text{ A}$   | -   | 1.25 | 1.7 | $\text{V}$             |
| $V_{GT}$                       | gate trigger voltage                       | $I_T = 10\text{ mA}$ ; gate open circuit;<br>see <a href="#">Figure 7</a>  | -   | -    | -   | -                      |
|                                |  | $V_D = 12\text{ V}$  | -   | 0.5  | 0.8 | $\text{V}$             |
|                                |  | $V_D = V_{DRM(max)}$ ; $T_j = 125\text{ °C}$   | 0.2 | 0.3  | -   | $\text{V}$             |
| $I_D, I_R$                     | off-state leakage current                  | $V_D = V_{DRM(max)}$ ; $V_R = V_{RRM(max)}$ ;<br>$T_j = 125\text{ °C}$ ; $R_{GK} = 1\text{ k}\Omega$   | -   | 0.05 | 0.1 | $\text{mA}$            |
| <b>Dynamic characteristics</b> |  |  |     |      |     |                        |
| $dV_D/dt$                      | critical rate of rise of off-state voltage | $V_{DM} = 67\% V_{DRM(max)}$ ; $T_j = 125\text{ °C}$ ;<br>exponential waveform;<br>see <a href="#">Figure 12</a>   | -   | -    | -   | -                      |
|                                |  | $R_{GK} = 1\text{ k}\Omega$  | 500 | 800  | -   | $\text{V}/\mu\text{s}$ |
|                                |  | gate open circuit  | -   | 25   | -   | $\text{V}/\mu\text{s}$ |
| $t_{gt}$                       | gate controlled turn-on time               | $I_{TM} = 2\text{ A}$ ; $V_D = V_{DRM(max)}$ ;<br>$I_G = 10\text{ mA}$ ; $dI_G/dt = 0.1\text{ A}/\mu\text{s}$  | -   | 2    | -   | $\mu\text{s}$          |
| $t_q$                          | circuit commuted turn-off time             | $V_D = 67\% V_{DRM(max)}$ ; $T_j = 125\text{ °C}$ ;<br>$I_{TM} = 1.6\text{ A}$ ; $V_R = 35\text{ V}$ ;<br>$dI_{TM}/dt = 30\text{ A}/\mu\text{s}$ ; $dV_D/dt = 2\text{ V}/\mu\text{s}$ ;<br>$R_{GK} = 1\text{ k}\Omega$ | -   | 100  | -   | $\mu\text{s}$          |

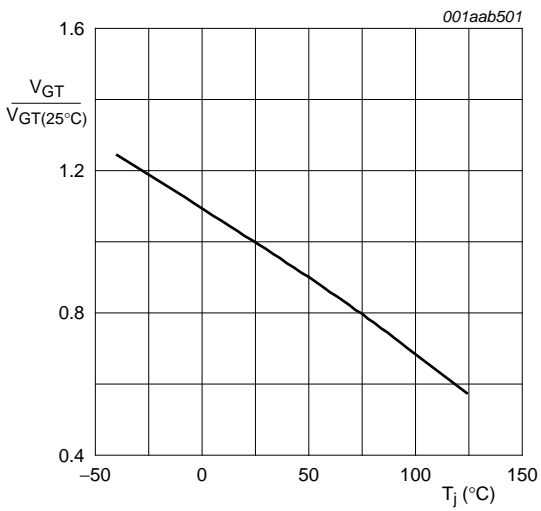


Fig 7. Normalized gate trigger voltage as a function of junction temperature.

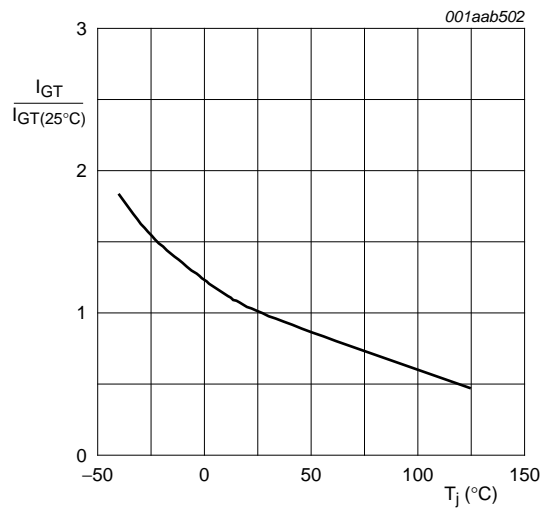
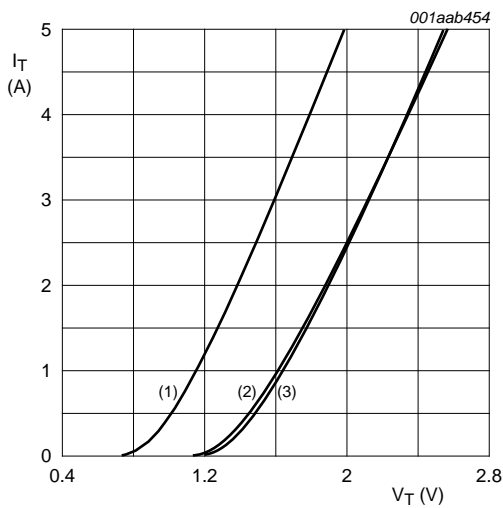
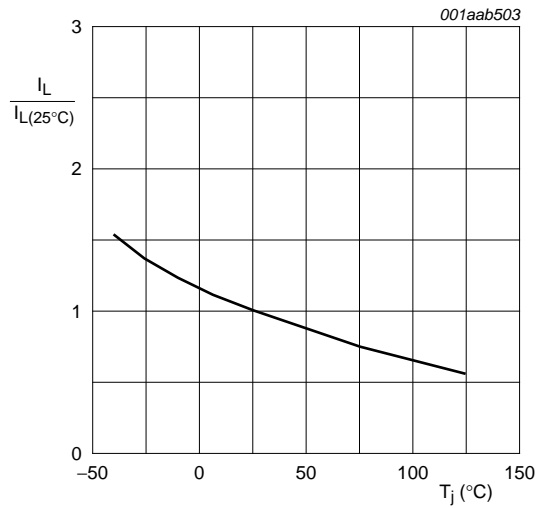


Fig 8. Normalized gate trigger current as a function of junction temperature.



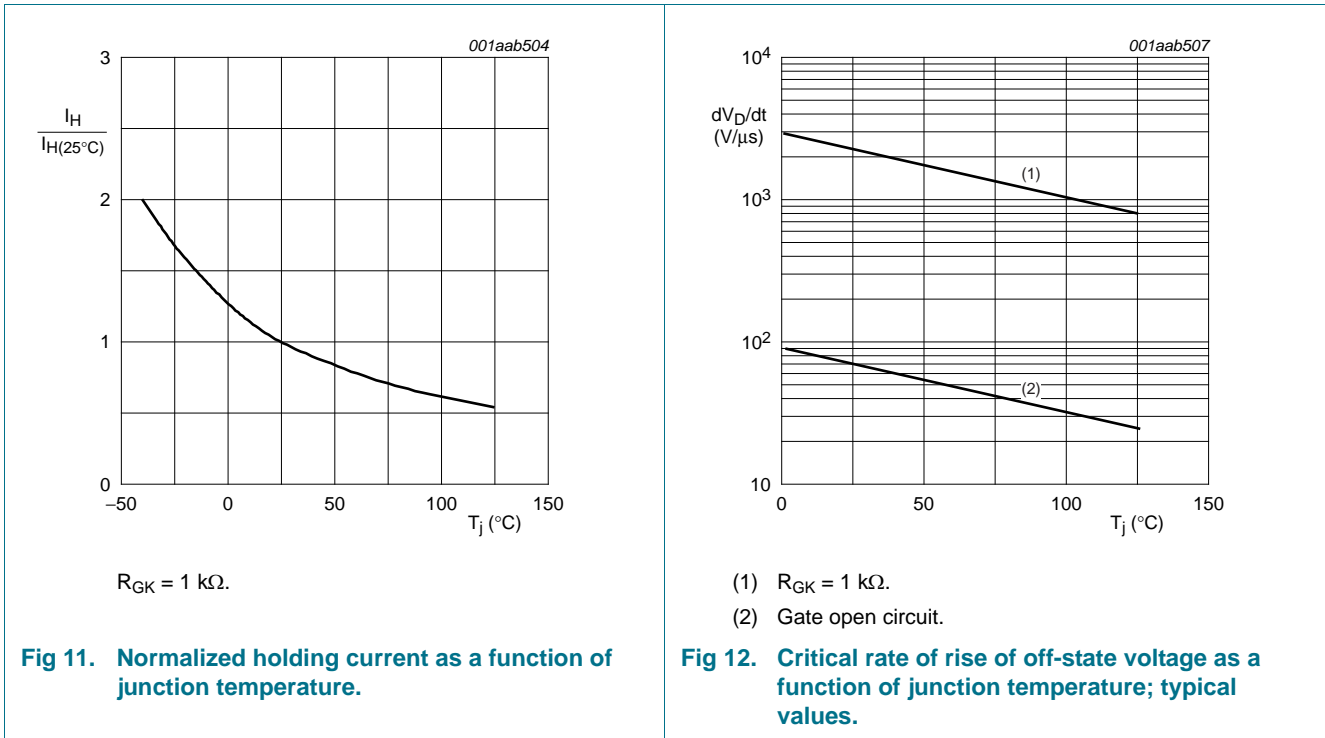
$V_O = 1.067 \text{ V.}$   
 $R_S = 0.187 \text{ }\Omega.$   
 (1)  $T_j = 125 \text{ }^\circ\text{C;}$  typical values.  
 (2)  $T_j = 125 \text{ }^\circ\text{C;}$  maximum values.  
 (3)  $T_j = 25 \text{ }^\circ\text{C;}$  maximum values.

Fig 9. On-state current characteristics.



$R_{GK} = 1 \text{ k}\Omega.$

Fig 10. Normalized latching current as a function of junction temperature.



## 7. Package information

Epoxy meets requirements of UL94 V-0 at 1/8 inch.



8. Package outline

Plastic single-ended leaded (through hole) package; 3 leads

SOT54

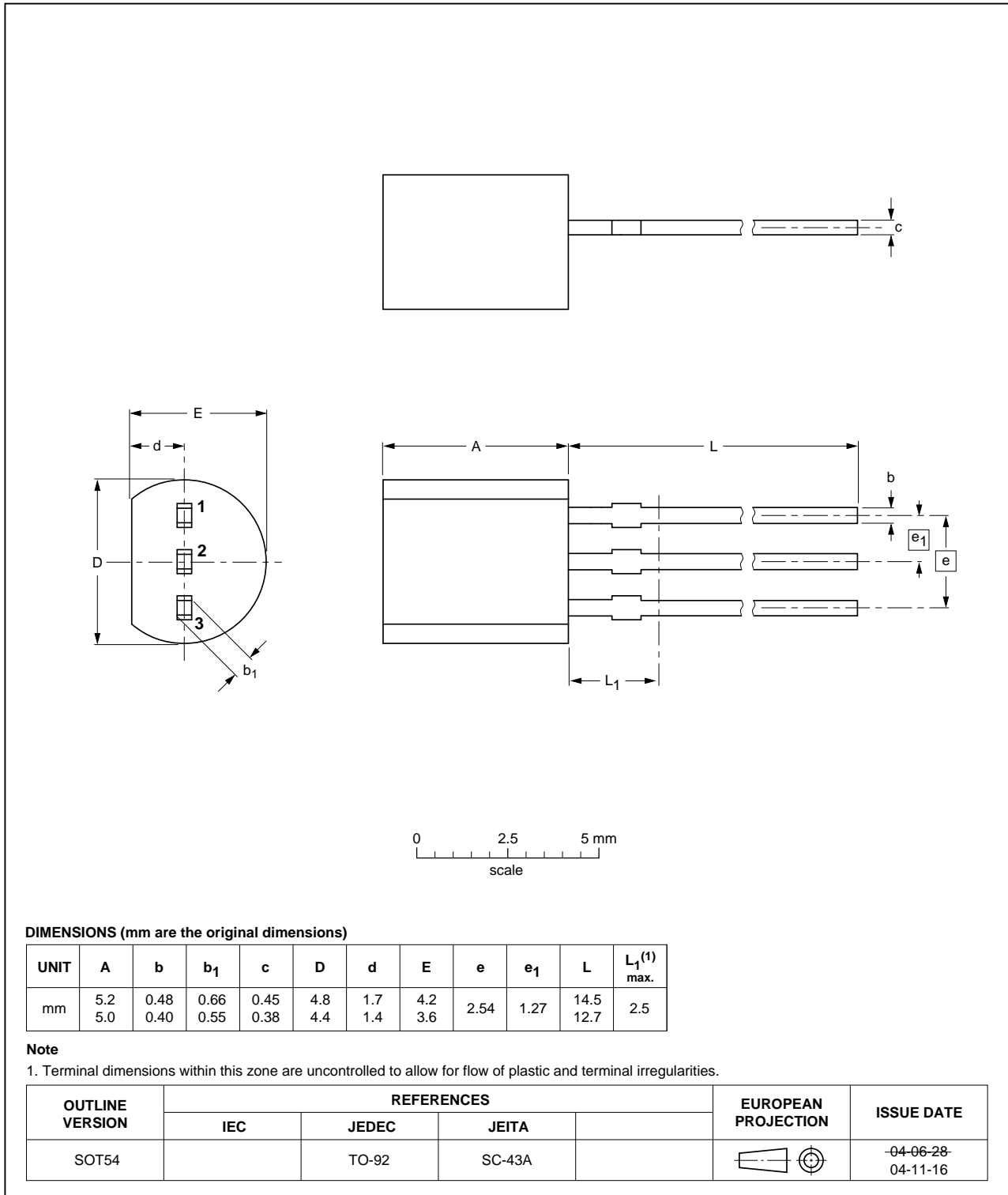


Fig 13. Package outline SOT54 (TO-92).

## 9. Revision history

**Table 6. Revision history**

| Document ID      | Release date  | Data sheet status     | Change notice | Order number   | Supersedes       |
|------------------|---|-----------------------|---------------|----------------|------------------|
| BT169_SERIES v.5 | 20110930  | Product data sheet    | -             | 9397 750 13512 | BT169_SERIES v.4 |
| Modifications:   | <ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> </ul>   |                       |               |                |                  |
| BT169_SERIES v.4 | 20040823  | Product data sheet    | -             | 9397 750 13512 | BT169_SERIES v.3 |
| 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> <li>Section 1.4 "Quick reference data": BT169E obsolete, removed from list.</li> <li>Table 2 "Ordering information": BT169E obsolete, removed from table.</li> <li>Table 3 "Limiting values": BT169E obsolete, removed from table.</li> </ul> |                       |               |                |                  |
| BT169_SERIES v.3 | 20010902  | Product specification | -             | not applicable | BT169_SERIES v.2 |
| BT169_SERIES v.2 | 20010901  | Product specification | -             | not applicable | BT169_SERIES v.1 |
| BT169_SERIES v.1 | 19970901  | Product specification | -             | not applicable | -                |

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### 10.1 Data sheet status

| Document status <sup>[1][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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