# BT151X series

## Thyristors

Rev. 5 — 1 November 2011 Product data sheet

## 1. Product profile

### 1.1 General description

Passivated thyristors in a SOT186A full pack plastic package.

### 1.2 Features and benefits

- High thermal cycling performance
- High bidirectional blocking voltage capability
- Isolated mounting base.

### 1.3 Applications

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

### 1.4 Quick reference data

- $V_{DRM}$, $V_{RRM} \leq 800$ V (BT151X-800)
- $V_{DRM}$, $V_{RRM} \leq 650$ V (BT151X-650)
- $V_{DRM}$, $V_{RRM} \leq 500$ V (BT151X-500)
- $I_{T(RMS)} \leq 12$ A
- $I_{T(AV)} \leq 7.5$ A
- $I_{TSM} \leq 120$ A.

## 2. Pinning information

**Table 1. Discrete pinning**

| Pin | Description | Simplified outline | Symbol |
|---|---|---|---|
| 1 | cathode (K) | mb | A K G *sym037* |
| 2 | anode (A) | | |
| 3 | gate (G) | | |
| mb | mounting base; isolated | 1 2 3 **SOT186A (TO-220)** | |

## 3. Ordering information

**Table 2. Ordering information**

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| BT151X-500 | - | plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3 lead TO-220 'full pack' | SOT186A |
| BT151X-650 | | | |
| BT151X-800 | | | |

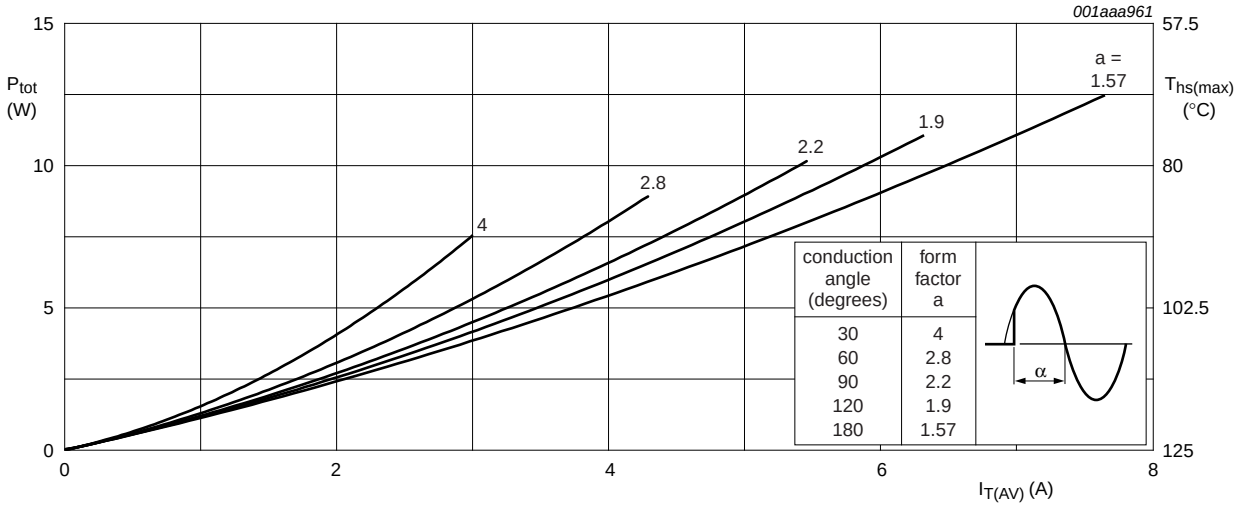
## 4. Limiting values

**Table 3. Limiting values**

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

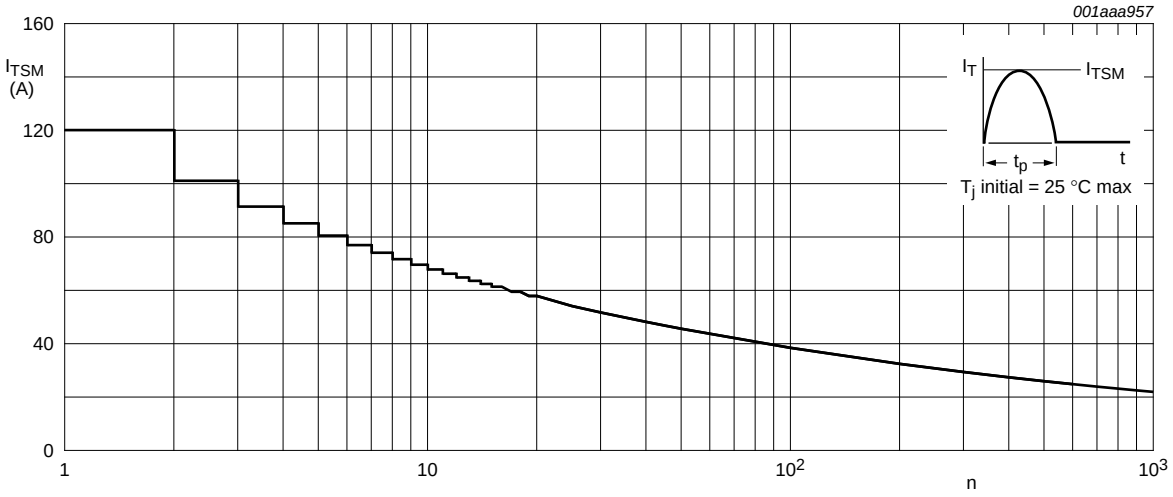
| Symbol | Parameter | Conditions | | Min | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{DRM}$, $V_{RRM}$ | repetitive peak off-state voltage | | | | | |
| | BT151X-500 | | [1] | - | 500 | V |
| | BT151X-650 | | [1] | - | 650 | V |
| | BT151X-800 | | | - | 800 | V |
| $I_{T(AV)}$ | average on-state current | half sinewave; $T_{hs} \leq 69$ °C; Figure 1 | | - | 7.5 | A |
| $I_{T(RMS)}$ | RMS on-state current | all conduction angles; Figure 4 and Figure 5 | | - | 12 | A |
| $I_{TSM}$ | non-repetitive peak on-state current | half sinewave; $T_j$ = 25 °C prior to surge; Figure 2 and Figure 3 | | | | |
| | | t = 10 ms | | - | 120 | A |
| | | t = 8.3 ms | | - | 132 | A |
| $I^2t$ | $I^2t$ for fusing | t = 10 ms | | - | 72 | $A^2s$ |
| $dI_T/dt$ | repetitive rate of rise of on-state current after triggering | $I_{TM}$ = 20 A; $I_G$ = 50 mA; $dI_G/dt$ 50 mA/µs | | - | 50 | A/µs |
| $I_{GM}$ | peak gate current | | | - | 2 | A |
| $V_{RGM}$ | peak reverse 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 | °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/µs.



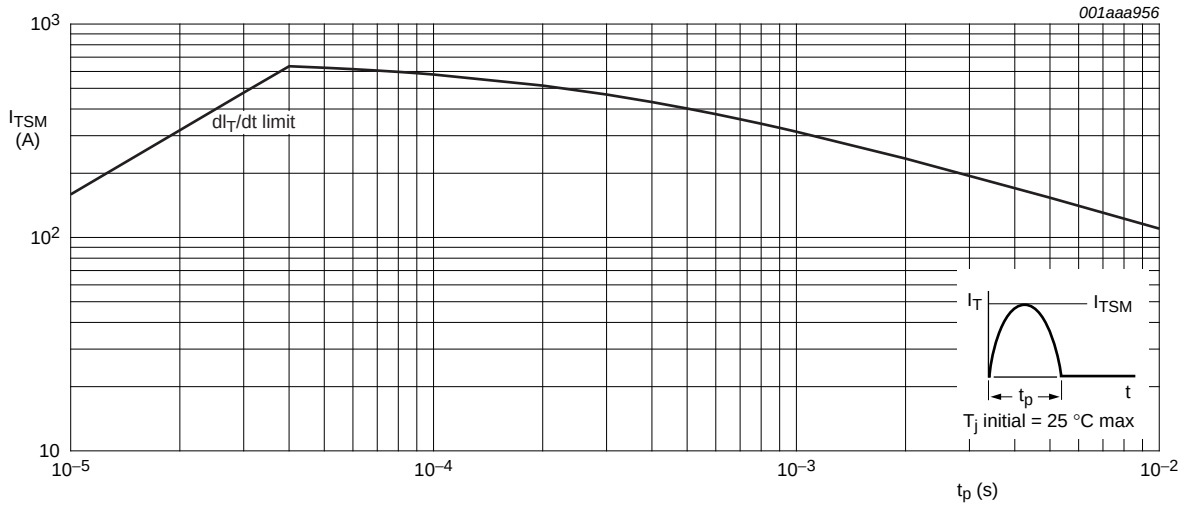

a = form factor = $I_{T(RMS)}/I_{T(AV)}$.

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



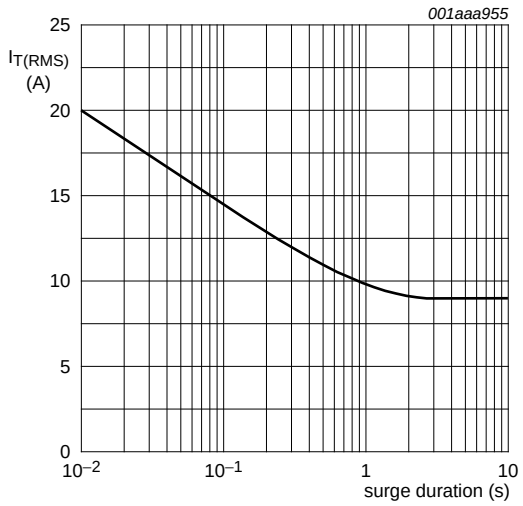

f = 50 Hz.

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




$t_p \leq 10$ ms.

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




f = 50 Hz; $T_{hs} \leq 87$ °C.

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

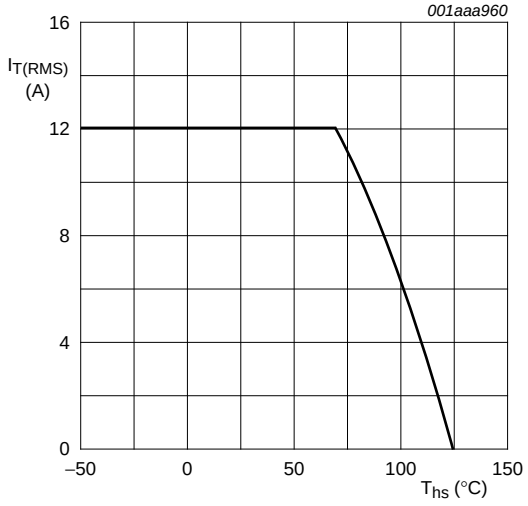
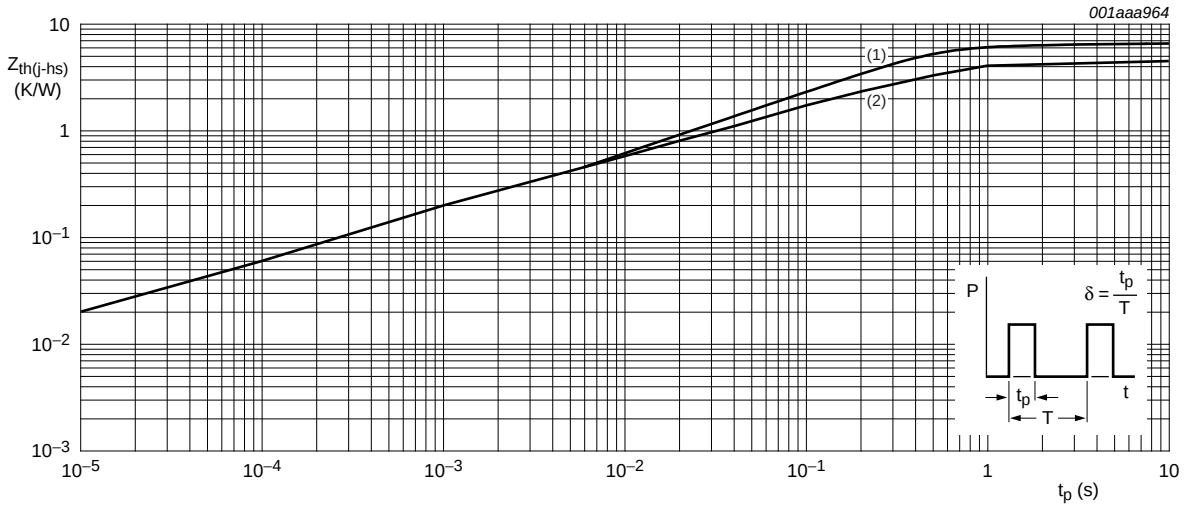



**Fig 5. RMS on-state current as a function of heatsink temperature; maximum values**

## 5. Thermal characteristics

**Table 4. Thermal characteristics**

| Symbol | Parameter | Conditions | Typ | Max | Unit |
|---|---|---|---|---|---|
| $R_{th(j-hs)}$ | thermal resistance from junction to heatsink | Figure 6 | | | |
| | | with heatsink compound | - | 4.5 | K/W |
| | | without heatsink compound | - | 6.5 | K/W |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | in free air | 55 | - | K/W |




(1) Without heatsink compound.

(2) With heatsink compound.

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

## 6. Isolation characteristics

**Table 5. Isolation limiting values and characteristics**

*$T_{hs}$ = 25 °C unless otherwise specified*

| Symbol | Parameter | Conditions | Typ | Max | Unit |
|---|---|---|---|---|---|
| $V_{isol}$ | RMS isolation voltage from all three terminals to external heatsink | f = 50 to 60 Hz; sinusoidal waveform; R.H. ≤ 65%; clean and dust free | - | 2500 | V |
| $C_{isol}$ | capacitance from pin 2 to external heatsink | f = 1 MHz | 10 | - | pF |

# 7. Characteristics

**Table 6. Characteristics**

*$T_j$ = 25 °C unless otherwise stated*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Static characteristics** | | | | | | |
| $I_{GT}$ | gate trigger current | $V_D$ = 12 V; $I_T$ = 0.1 A; Figure 8 | - | 2 | 15 | mA |
| $I_L$ | latching current | $V_D$ = 12 V; $I_{GT}$ = 0.1 A; Figure 10 | - | 10 | 40 | mA |
| $I_H$ | holding current | $V_D$ = 12 V; $I_{GT}$ = 0.1 A; Figure 11 | - | 7 | 20 | mA |
| $V_T$ | on-state voltage | $I_T$ = 23 A; Figure 9 | - | 1.4 | 1.75 | V |
| $V_{GT}$ | gate trigger voltage | $V_D$ = 12 V; $I_T$ = 0.1 A; Figure 7 | - | 0.6 | 1.5 | V |
| | | $V_D$ = $V_{DRM(max)}$; $I_T$ = 0.1 A; $T_j$ = 125 °C | 0.25 | 0.4 | - | V |
| $I_D$, $I_R$ | off-state leakage current | $V_D$ = $V_{DRM(max)}$; $V_R$ = $V_{RRM(max)}$; $T_j$ = 125 °C | - | 0.1 | 0.5 | mA |
| **Dynamic characteristics** | | | | | | |
| $dV_D/dt$ | critical rate of rise of off-state voltage | $V_{DM}$ = 67% $V_{DRM(max)}$; $T_j$ = 125 °C; exponential waveform; Figure 12 | | | | |
| | | gate open circuit | 50 | 130 | - | V/µs |
| | | $R_{GK}$ = 100 Ω | 200 | 1000 | - | V/µs |
| $t_{gt}$ | gate controlled turn-on time | $I_{TM}$ = 40 A; $V_D$ = $V_{DRM(max)}$; $I_G$ = 0.1 A; $dI_G/dt$ = 5 A/µs | - | 2 | - | µs |
| $t_q$ | circuit commuted turn-on time | $V_D$ = 67% $V_{DRM(max)}$; $T_j$ = 125 °C; $I_{TM}$ = 20 A; $V_R$ = 25 V; $dI_{TM}/dt$ = 30 A/µs; $dV_D/dt$ = 50 V/µs; $R_{GK}$ = 100 Ω | - | 70 | - | µs |

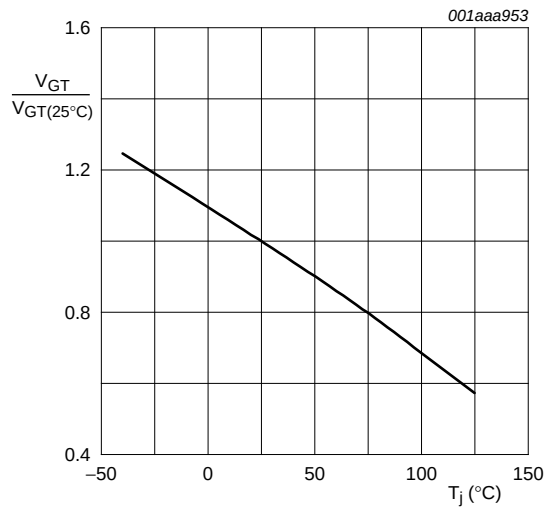



**Fig 7. Normalized gate trigger voltage as a function of junction temperature**

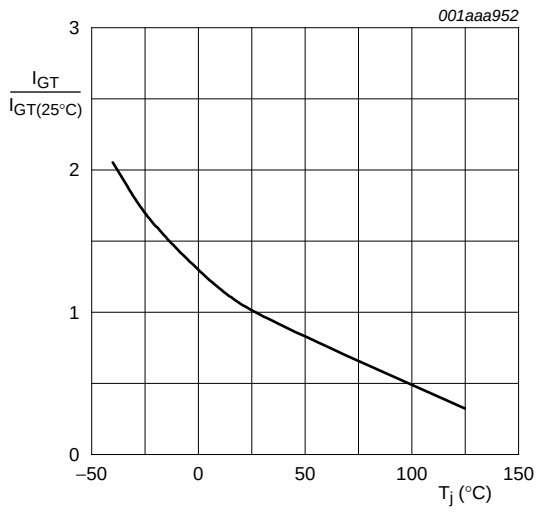
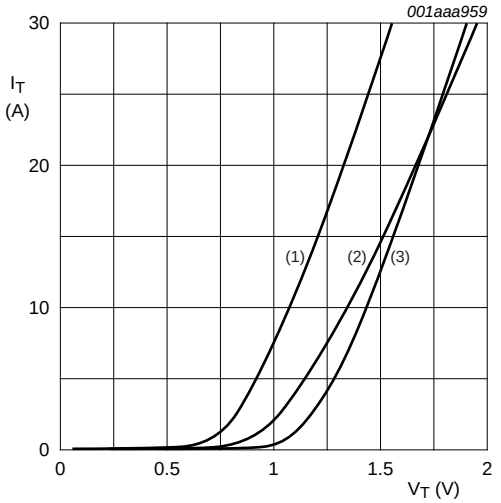



**Fig 8. Normalized gate trigger current as a function of junction temperature**




$V_O$ = 1.06 V.

$R_S$ = 0.0304 Ω.

(1) $T_j$ = 125 °C; typical values.

(2) $T_j$ = 125 °C; maximum values.

(3) $T_j$ = 25 °C; maximum values.

**Fig 9. On-state current characteristics**

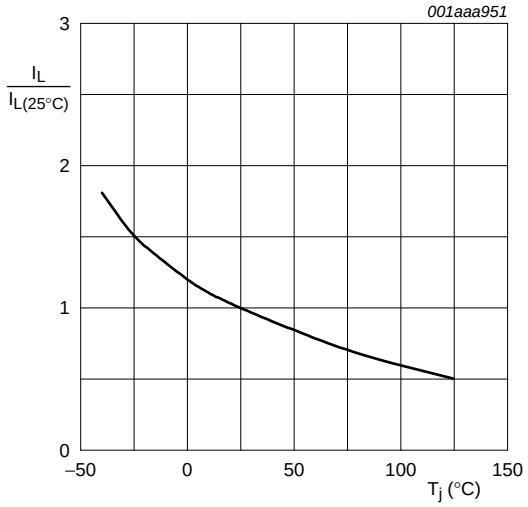



**Fig 10. Normalized latching current as a function of junction temperature**

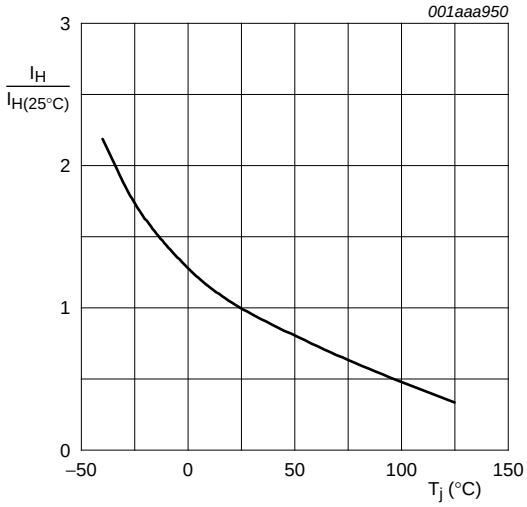
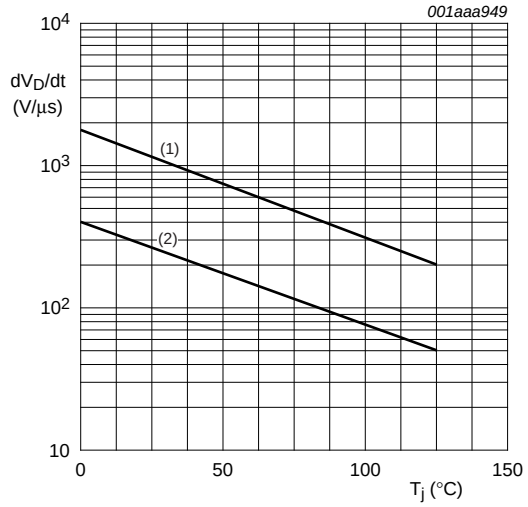



**Fig 11. Normalized holding current as a function of junction temperature**




(1) $R_{GK}$ = 100 Ω.

(2) Gate open circuit.

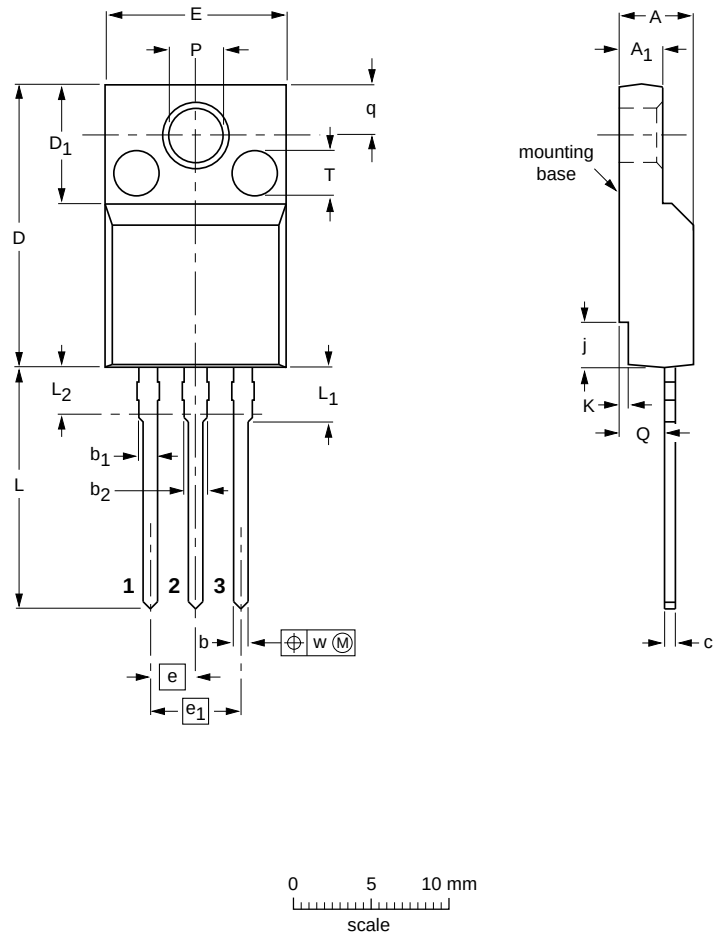
**Fig 12. Critical rate of rise of off-state voltage as a function of junction temperature; minimum values**

## 8. Package information

Epoxy meets requirements of UL94 V-0 at $\frac{1}{8}$ inch.

## 9. Package outline

**Plastic single-ended package; isolated heatsink mounted;**
**1 mounting hole; 3-lead TO-220 'full pack'** **SOT186A**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A | $A_1$ | b | $b_1$ | $b_2$ | c | D | $D_1$ | E | e | $e_1$ | j | K | L | $L_1$ | $L_2$ (1) max. | P | Q | q | T (2) | w |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 4.6<br>4.0 | 2.9<br>2.5 | 0.9<br>0.7 | 1.1<br>0.9 | 1.4<br>1.0 | 0.7<br>0.4 | 15.8<br>15.2 | 6.5<br>6.3 | 10.3<br>9.7 | 2.54 | 5.08 | 2.7<br>1.7 | 0.6<br>0.4 | 14.4<br>13.5 | 3.30<br>2.79 | 3 | 3.2<br>3.0 | 2.6<br>2.3 | 3.0<br>2.6 | 2.5 | 0.4 |

**Notes**

1. Terminal dimensions within this zone are uncontrolled.
2. Both recesses are ∅ 2.5 × 0.8 max. depth

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT186A | | 3-lead TO-220F | | | | ~~02-04-09~~<br>06-02-14 |

**Fig 13. Package outline SOT186A (TO-220)**

## 10. Revision history

**Table 7. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| BT151X_SER v.5 | 20111101 | Product data sheet | | BT151X_SERIES v.4 |
| Modifications: | • The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.<br>• Legal texts have been adapted to the new company name where appropriate. | | | |
| BT151X_SERIES v.4 | 20040609 | Product data sheet | | BT151X_SERIES v.3 |
| BT151X_SERIES v.3 | 20030901 | Product specification | | BT151X_SERIES v.2 |
| BT151X_SERIES v.2 | 19990601 | Product specification | | BT151X_SERIES v.1 |
| BT151X_SERIES v.1 | 19970901 | Product specification | | - |

# 11. Legal information

## 11.1 Data sheet status

| Document status[1][2] | Product status[3] | 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".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

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