



# IMPORTANT NOTICE

10 December 2015

## 1. Global joint venture starts operations as WeEn Semiconductors

Dear customer,

As from November 9th, 2015 NXP Semiconductors N.V. and Beijing JianGuang Asset Management Co. Ltd established Bipolar Power joint venture (JV), **WeEn Semiconductors**, which will be used in future Bipolar Power documents together with new contact details.

In this document where the previous NXP references remain, please use the new links as shown below.

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Thank you for your cooperation and understanding,

WeEn Semiconductors



# BT139X-600E

4Q Triac

1 May 2015

Product data sheet

## 1. General description

Planar passivated sensitive gate four quadrant triac in a SOT186A "full pack" 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 for gate triggering by low power drivers and microcontrollers.

## 2. Features and benefits

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

## 3. Applications

- General purpose motor control
- General purpose switching

## 4. Quick reference data

Table 1. Quick reference data

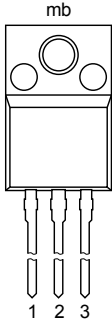
| Symbol                        | Parameter                            | Conditions                                                                                                                                                 | Min | Typ | Max | Unit |
|-------------------------------|--------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|------|
| $V_{\text{DRM}}$              | repetitive peak off-state voltage    |                                                                                                                                                            | -   | -   | 600 | V    |
| $I_{\text{TSM}}$              | non-repetitive peak on-state current | full sine wave; $T_{\text{J}(\text{init})} = 25\text{ }^{\circ}\text{C}$ ; $t_{\text{p}} = 20\text{ ms}$ ; <a href="#">Fig. 4</a> ; <a href="#">Fig. 5</a> | -   | -   | 155 | A    |
| $I_{\text{T(RMS)}}$           | RMS on-state current                 | full sine wave; $T_{\text{h}} \leq 38\text{ }^{\circ}\text{C}$ ; <a href="#">Fig. 1</a> ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 3</a>                  | -   | -   | 16  | A    |
| <b>Static characteristics</b> |                                      |                                                                                                                                                            |     |     |     |      |
| $I_{\text{GT}}$               | gate trigger current                 | $V_{\text{D}} = 12\text{ V}$ ; $I_{\text{T}} = 0.1\text{ A}$ ; $T_2+$ G+; $T_{\text{J}} = 25\text{ }^{\circ}\text{C}$ ; <a href="#">Fig. 7</a>             | -   | 2.5 | 10  | mA   |
|                               |                                      | $V_{\text{D}} = 12\text{ V}$ ; $I_{\text{T}} = 0.1\text{ A}$ ; $T_2+$ G-; $T_{\text{J}} = 25\text{ }^{\circ}\text{C}$ ; <a href="#">Fig. 7</a>             | -   | 4   | 10  | mA   |



| Symbol | Parameter | Conditions                                                                                                        | Min | Typ | Max | Unit |
|--------|-----------|-------------------------------------------------------------------------------------------------------------------|-----|-----|-----|------|
|        |           | $V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2- G-;<br>$T_j = 25\text{ }^\circ\text{C}$ ; <a href="#">Fig. 7</a> | -   | 5   | 10  | mA   |
|        |           | $V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2- G+;<br>$T_j = 25\text{ }^\circ\text{C}$ ; <a href="#">Fig. 7</a> | -   | 11  | 25  | mA   |

## 5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description             | Simplified outline                                                                                          | Graphic symbol                                                                                    |
|-----|--------|-------------------------|-------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| 1   | T1     | main terminal 1         |  <p>TO-220F (SOT186A)</p> |  <p>sym051</p> |
| 2   | T2     | main terminal 2         |                                                                                                             |                                                                                                   |
| 3   | G      | gate                    |                                                                                                             |                                                                                                   |
| mb  | n.c.   | mounting base; isolated |                                                                                                             |                                                                                                   |

## 6. Ordering information

Table 3. Ordering information

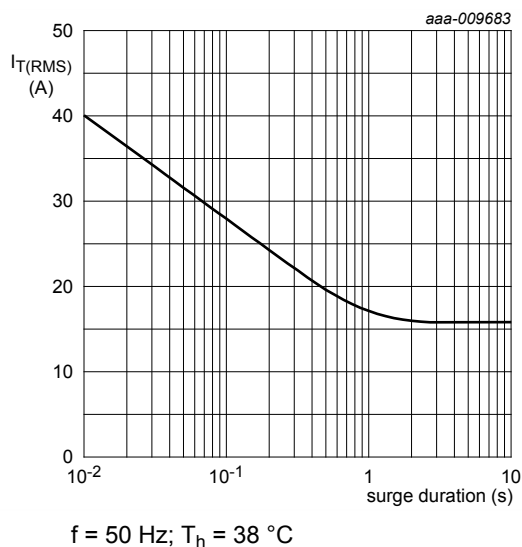
| Type number | Package |                                                                                                     |         |
|-------------|---------|-----------------------------------------------------------------------------------------------------|---------|
|             | Name    | Description                                                                                         | Version |
| BT139X-600E | TO-220F | plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3-lead TO-220 "full pack" | SOT186A |

## 7. Limiting values

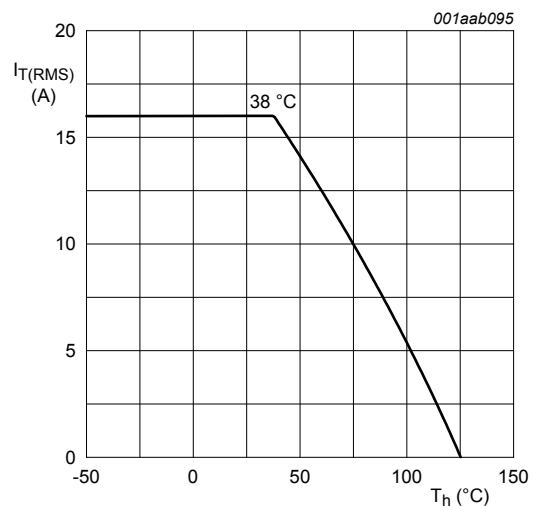
**Table 4. Limiting values**

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

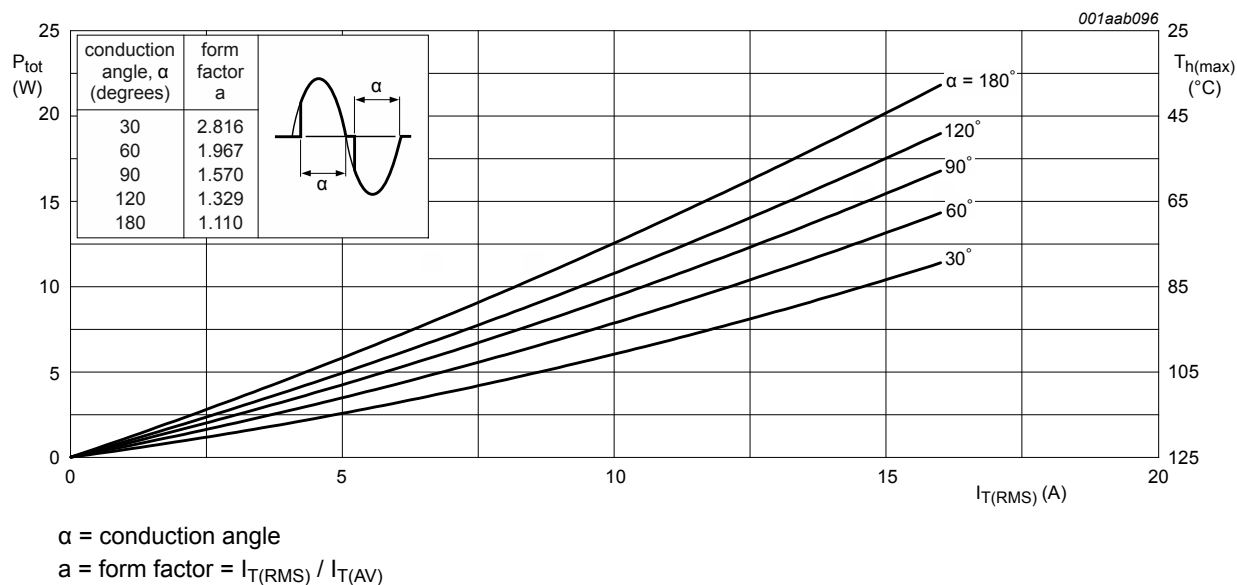
| Symbol              | Parameter                            | Conditions                                                                                                                       | Min | Max | Unit                   |
|---------------------|--------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|-----|-----|------------------------|
| $V_{\text{DRM}}$    | repetitive peak off-state voltage    |                                                                                                                                  | -   | 600 | V                      |
| $I_{\text{T(RMS)}}$ | RMS on-state current                 | full sine wave; $T_h \leq 38^\circ\text{C}$ ; <a href="#">Fig. 1</a> ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 3</a>           | -   | 16  | A                      |
| $I_{\text{TSM}}$    | non-repetitive peak on-state current | full sine wave; $T_{\text{j(init)}} = 25^\circ\text{C}$ ; $t_p = 20\text{ ms}$ ; <a href="#">Fig. 4</a> ; <a href="#">Fig. 5</a> | -   | 155 | A                      |
|                     |                                      | full sine wave; $T_{\text{j(init)}} = 25^\circ\text{C}$ ; $t_p = 16.7\text{ ms}$                                                 | -   | 170 | A                      |
| $I^2t$              | $I^2t$ for fusing                    | $t_p = 10\text{ ms}$ ; SIN                                                                                                       | -   | 120 | $\text{A}^2\text{s}$   |
| $dl_T/dt$           | rate of rise of on-state current     | $I_G = 20\text{ mA}$ ; T2+ G+                                                                                                    | -   | 50  | $\text{A}/\mu\text{s}$ |
|                     |                                      | $I_G = 20\text{ mA}$ ; T2+ G-                                                                                                    | -   | 50  | $\text{A}/\mu\text{s}$ |
|                     |                                      | $I_G = 50\text{ mA}$ ; T2- G+                                                                                                    | -   | 10  | $\text{A}/\mu\text{s}$ |
|                     |                                      | $I_G = 20\text{ mA}$ ; T2- G-                                                                                                    | -   | 50  | $\text{A}/\mu\text{s}$ |
| $I_{\text{GM}}$     | peak gate current                    |                                                                                                                                  | -   | 2   | A                      |
| $P_{\text{GM}}$     | 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 | $^\circ\text{C}$       |
| $T_j$               | junction temperature                 |                                                                                                                                  | -   | 125 | $^\circ\text{C}$       |



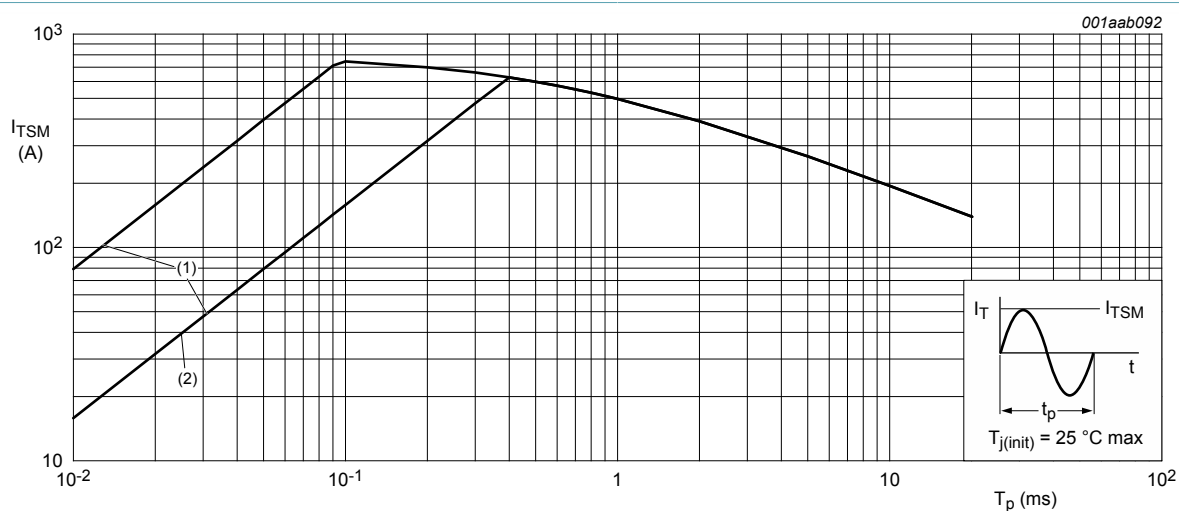
**Fig. 1. RMS on-state current as a function of surge duration; maximum values**



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



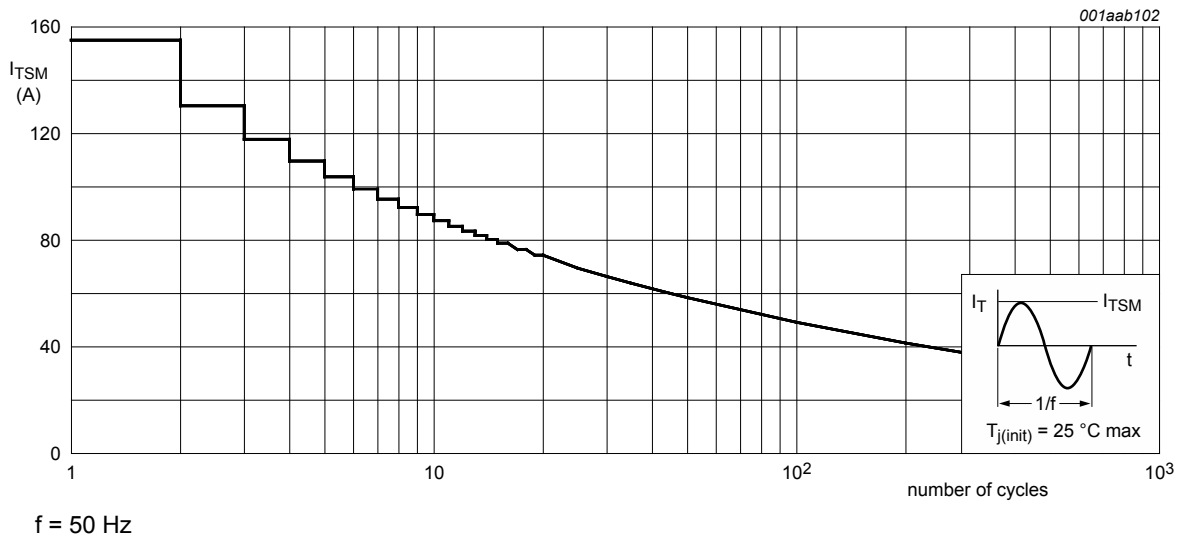
**Fig. 3. Total power dissipation as a function of RMS on-state current; maximum values**


$$t_p \leq 20 \text{ ms}$$

(1)  $dl_T/dt$  limit

(2) T2- G+ quadrant limit

**Fig. 4. Non-repetitive peak on-state current as a function of pulse width; maximum values**

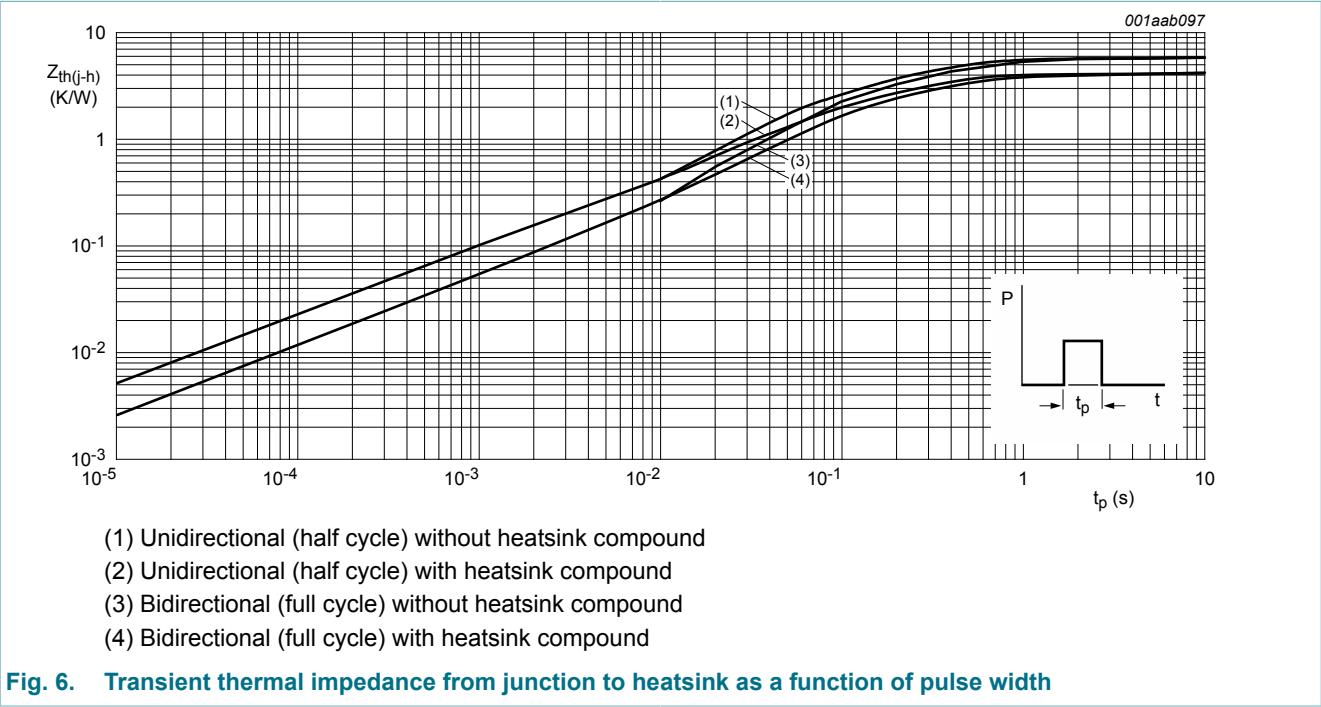


**Fig. 5.** Non-repetitive peak on-state current as a function of the number of sinusoidal current cycles; maximum values

8. Thermal characteristics

Table 5. Thermal characteristics

| Symbol        | Parameter                                    | Conditions                                           | Min | Typ | Max | Unit |
|---------------|----------------------------------------------|------------------------------------------------------|-----|-----|-----|------|
| $R_{th(j-h)}$ | thermal resistance from junction to heatsink | full or half cycle with heatsink compound; Fig. 6    | -   | -   | 4   | K/W  |
|               |                                              | full or half cycle without heatsink compound; Fig. 6 | -   | -   | 5.5 | K/W  |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient  | in free air                                          | -   | 55  | -   | K/W  |



9. Isolation characteristics

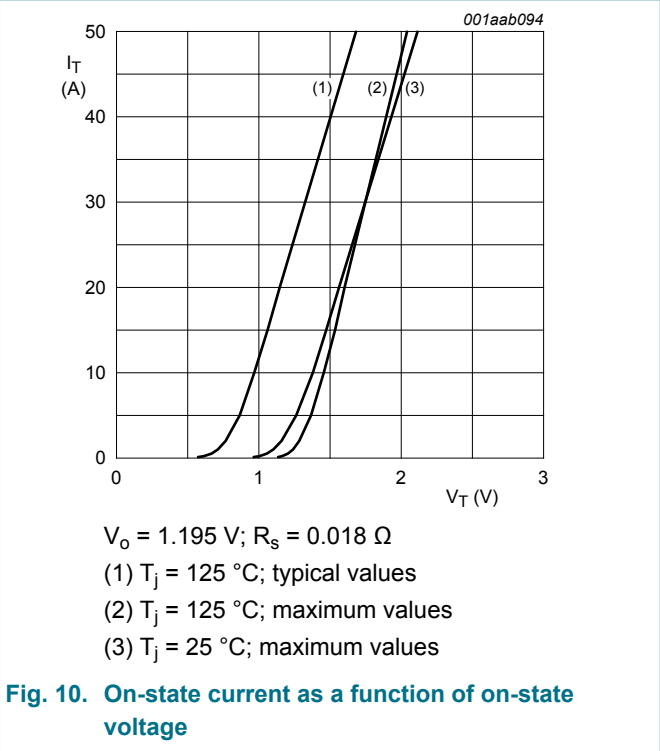
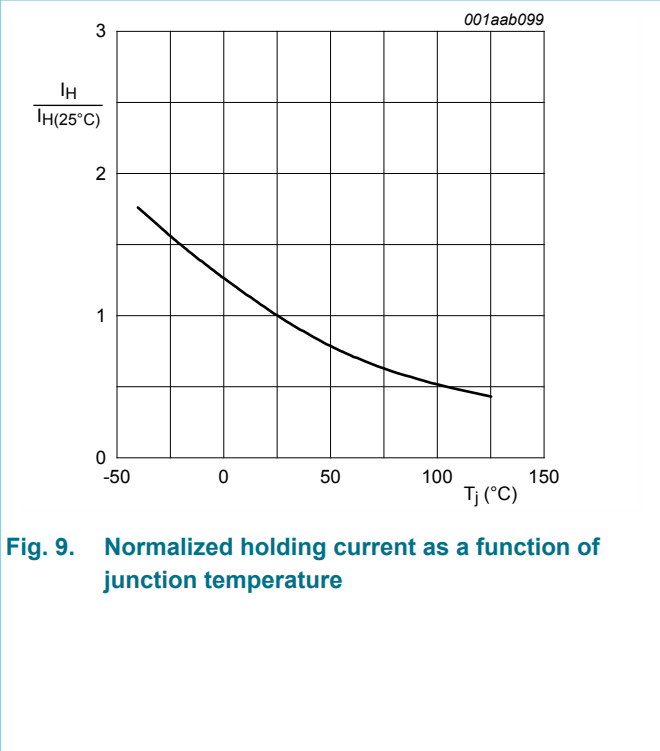
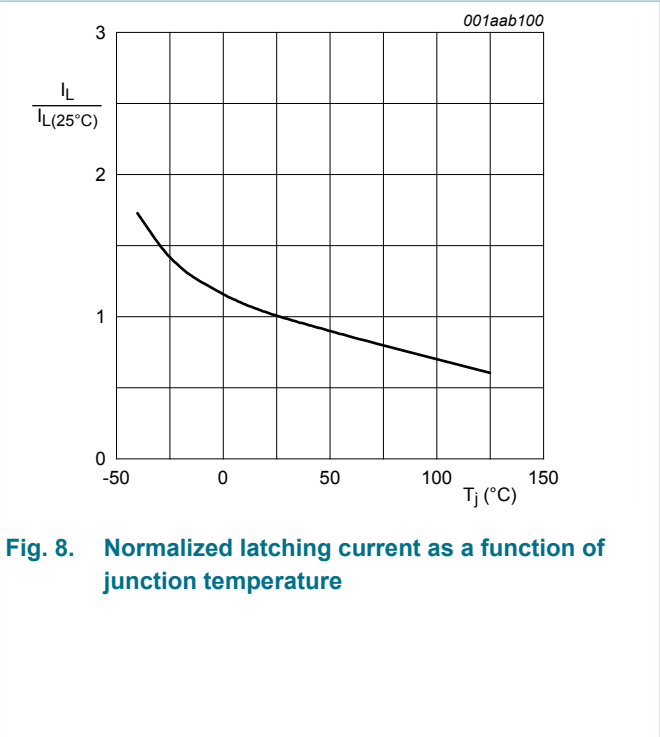
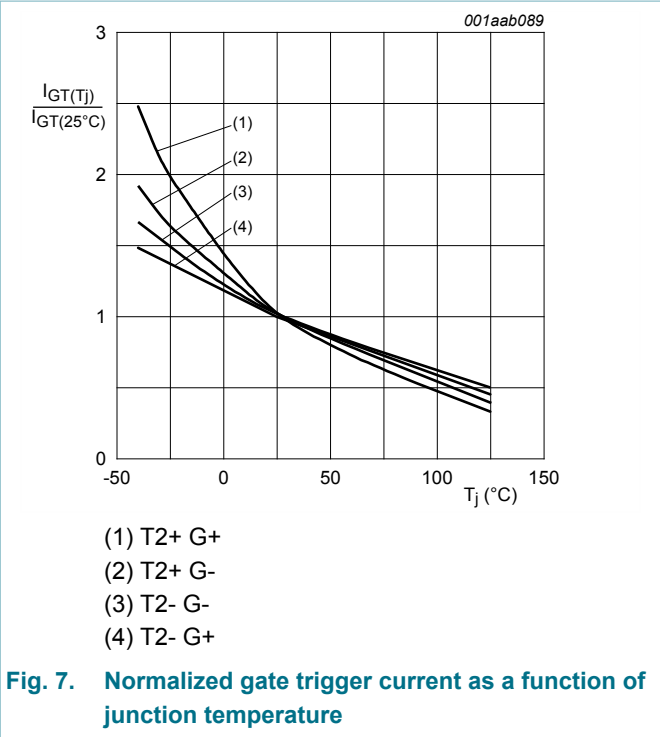
Table 6. Isolation characteristics

| Symbol          | Parameter             | Conditions                                                                                                                              | Min | Typ | Max  | Unit |
|-----------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-----|-----|------|------|
| $V_{isol(RMS)}$ | RMS isolation voltage | from all terminals to external heatsink; sinusoidal waveform; clean and dust free; 50 Hz ≤ f ≤ 60 Hz; RH ≤ 65 %; T <sub>n</sub> = 25 °C | -   | -   | 2500 | V    |
| $C_{isol}$      | isolation capacitance | from main terminal 2 to external heatsink; f = 1 MHz; T <sub>n</sub> = 25 °C                                                            | -   | 10  | -    | pF   |

## 10. Characteristics

Table 7. 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+;<br>$T_j = 25\text{ }^\circ\text{C}$ ; <a href="#">Fig. 7</a>                       |  | -    | 2.5 | 10  | mA               |
|                                |                                   | $V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2+ G-;<br>$T_j = 25\text{ }^\circ\text{C}$ ; <a href="#">Fig. 7</a>                       |  | -    | 4   | 10  | mA               |
|                                |                                   | $V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2- G-;<br>$T_j = 25\text{ }^\circ\text{C}$ ; <a href="#">Fig. 7</a>                       |  | -    | 5   | 10  | mA               |
|                                |                                   | $V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2- G+;<br>$T_j = 25\text{ }^\circ\text{C}$ ; <a href="#">Fig. 7</a>                       |  | -    | 11  | 25  | mA               |
| $I_L$                          | latching current                  | $V_D = 12\text{ V}$ ; $I_G = 0.1\text{ A}$ ; T2+ G+;<br>$T_j = 25\text{ }^\circ\text{C}$ ; <a href="#">Fig. 8</a>                       |  | -    | 3.2 | 30  | mA               |
|                                |                                   | $V_D = 12\text{ V}$ ; $I_G = 0.1\text{ A}$ ; T2+ G-;<br>$T_j = 25\text{ }^\circ\text{C}$ ; <a href="#">Fig. 8</a>                       |  | -    | 16  | 40  | mA               |
|                                |                                   | $V_D = 12\text{ V}$ ; $I_G = 0.1\text{ A}$ ; T2- G-;<br>$T_j = 25\text{ }^\circ\text{C}$ ; <a href="#">Fig. 8</a>                       |  | -    | 4   | 30  | mA               |
|                                |                                   | $V_D = 12\text{ V}$ ; $I_G = 0.1\text{ A}$ ; T2- G+;<br>$T_j = 25\text{ }^\circ\text{C}$ ; <a href="#">Fig. 8</a>                       |  | -    | 5.5 | 40  | mA               |
| $I_H$                          | holding current                   | $V_D = 12\text{ V}$ ; $T_j = 25\text{ }^\circ\text{C}$ ; <a href="#">Fig. 9</a>                                                         |  | -    | 4   | 45  | mA               |
| $V_T$                          | on-state voltage                  | $I_T = 20\text{ A}$ ; $T_j = 25\text{ }^\circ\text{C}$ ; <a href="#">Fig. 10</a>                                                        |  | -    | 1.2 | 1.6 | V                |
| $V_{GT}$                       | gate trigger voltage              | $V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; $T_j = 25\text{ }^\circ\text{C}$ ;<br><a href="#">Fig. 11</a>                              |  | -    | 0.7 | 1   | V                |
|                                |                                   | $V_D = 400\text{ V}$ ; $I_T = 0.1\text{ A}$ ; $T_j = 125\text{ }^\circ\text{C}$ ;<br><a href="#">Fig. 11</a>                            |  | 0.25 | 0.4 | -   | V                |
| $I_D$                          | off-state current                 | $V_D = 600\text{ V}$ ; $T_j = 125\text{ }^\circ\text{C}$                                                                                |  | -    | 0.1 | 0.5 | mA               |
| <b>Dynamic characteristics</b> |                                   |                                                                                                                                         |  |      |     |     |                  |
| $dV_D/dt$                      | rate of rise of off-state voltage | $V_{DM} = 402\text{ V}$ ; $T_j = 125\text{ }^\circ\text{C}$ ; ( $V_{DM} = 67\%$ of $V_{DRM}$ ); exponential waveform; gate open circuit |  | -    | 50  | -   | V/ $\mu\text{s}$ |
| $t_{gt}$                       | gate-controlled turn-on time      | $I_{TM} = 20\text{ A}$ ; $V_D = 600\text{ V}$ ; $I_G = 0.1\text{ A}$ ; $dI_G/dt = 5\text{ A}/\mu\text{s}$                               |  | -    | 2   | -   | $\mu\text{s}$    |



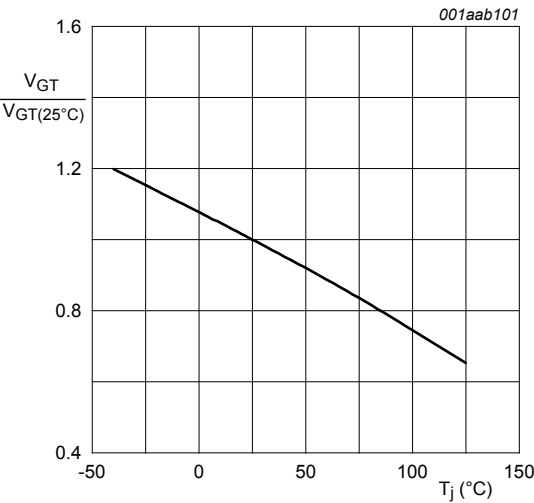


Fig. 11. Normalized gate trigger voltage as a function of junction temperature

11. Package outline

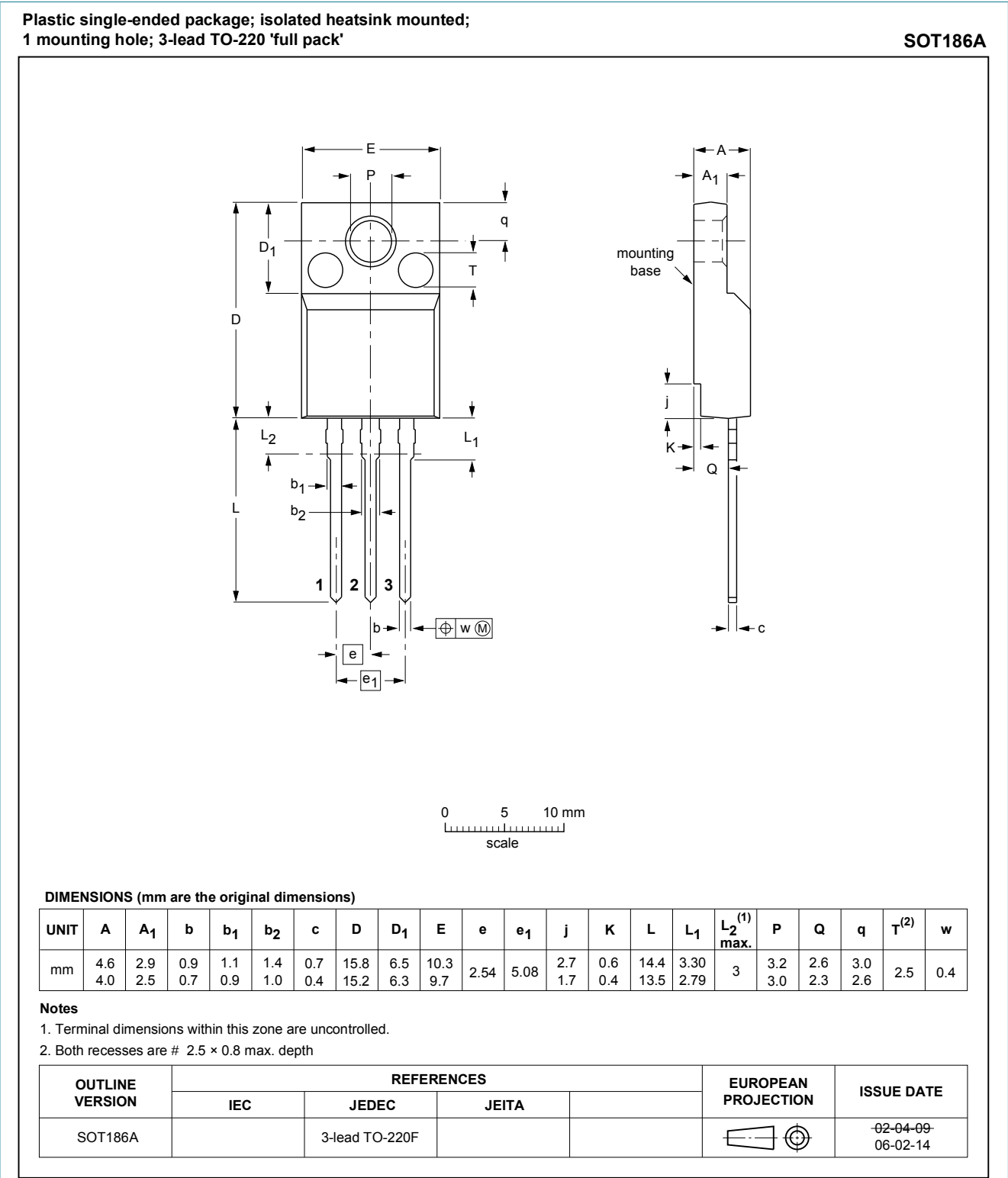


Fig. 12. Package outline TO-220F (SOT186A)

## 12. Legal information

### 12.1 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".
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