

## 1. General description

Planar passivated high commutation three quadrant triac in a SOT186A (TO-220F) "full pack" plastic package intended for use in circuits where high static and dynamic  $dV/dt$  and high  $dI/dt$  can occur. This "series B" triac will commute the full rated RMS current at the maximum rated junction temperature without the aid of a snubber.

## 2. Features and benefits

- 3Q technology for improved noise immunity
- High commutation capability with maximum false trigger immunity
- High immunity to false turn on by  $dV/dt$
- High voltage capability
- Isolated mounting base package
- Less sensitive gate for very high noise immunity
- Planar passivated for voltage ruggedness and reliability
- Triggering in three quadrants only

## 3. Applications

- General purpose motor control circuits
- Home appliances
- Rectifier-fed DC inductive loads e.g. DC motors and solenoids

## 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    |
| $I_{T(RMS)}$                  | RMS on-state current                 | full sine wave; $T_h \leq 92\text{ °C}$ ; <a href="#">Fig. 1</a> ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 3</a>           | -   | -   | 4   | A    |
| $I_{TSM}$                     | non-repetitive peak on-state current | full sine wave; $T_{j(\text{init})} = 25\text{ °C}$ ; $t_p = 20\text{ ms}$ ; <a href="#">Fig. 4</a> ; <a href="#">Fig. 5</a> | -   | -   | 25  | A    |
|                               |                                      | full sine wave; $T_{j(\text{init})} = 25\text{ °C}$ ; $t_p = 16.7\text{ ms}$   | -   | -   | 27  | A    |
| $T_j$                         | junction temperature                 |  | -   | -   | 125 | °C   |
| <b>Static characteristics</b> |                                      |  |     |     |     |      |
| $I_{GT}$                      | gate trigger current                 | $V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2+ G+; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 7</a>                           | -   | -   | 50  | mA   |

| Symbol                         | Parameter                             | Conditions  | Min  | Typ | Max | Unit             |
|--------------------------------|---------------------------------------|---|------|-----|-----|------------------|
|                                |                                       | $V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2+ G-;<br>$T_j = 25\text{ }^\circ\text{C}$ ; Fig. 7   | -    | -   | 50  | mA               |
|                                |                                       | $V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2- G-;<br>$T_j = 25\text{ }^\circ\text{C}$ ; Fig. 7   | -    | -   | 50  | mA               |
| $I_H$                          | holding current                       | $V_D = 12\text{ V}$ ; $T_j = 25\text{ }^\circ\text{C}$ ; Fig. 9   | -    | -   | 30  | mA               |
| $V_T$                          | on-state voltage                      | $I_T = 5\text{ A}$ ; $T_j = 25\text{ }^\circ\text{C}$ ; Fig. 10   | -    | 1.4 | 1.7 | V                |
| <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                                     | 1000 | -   | -   | V/ $\mu\text{s}$ |
| $dI_{com}/dt$                  | rate of change of commutating current | $V_D = 400\text{ V}$ ; $T_j = 125\text{ }^\circ\text{C}$ ; $I_{T(RMS)} = 4\text{ A}$ ; $dV_{com}/dt = 20\text{ V}/\mu\text{s}$ ; (snubberless condition); gate open circuit | 6    | -   | -   | A/ms             |

## 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 |
| BTA204X-600B | 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 <sub>DRM</sub>    | repetitive peak off-state voltage    |  | -   | 600 | V                |
| I <sub>T(RMS)</sub> | RMS on-state current                 | full sine wave; T <sub>h</sub> ≤ 92 °C; Fig. 1; Fig. 2; Fig. 3                       | -   | 4   | A                |
| I <sub>TSM</sub>    | non-repetitive peak on-state current | full sine wave; T <sub>j(init)</sub> = 25 °C; t <sub>p</sub> = 20 ms; Fig. 4; Fig. 5 | -   | 25  | A                |
|                     |                                      | full sine wave; T <sub>j(init)</sub> = 25 °C; t <sub>p</sub> = 16.7 ms               | -   | 27  | A                |
| I <sup>2</sup> t    | I <sup>2</sup> t for fusing          | t <sub>p</sub> = 10 ms; SIN  | -   | 3.1 | A <sup>2</sup> s |
| di <sub>T</sub> /dt | rate of rise of on-state current     | I <sub>G</sub> = 0.2 A   | -   | 100 | A/μs             |
| I <sub>GM</sub>     | peak gate current                    |  | -   | 2   | A                |
| P <sub>GM</sub>     | peak gate power                      |  | -   | 5   | W                |
| P <sub>G(AV)</sub>  | average gate power                   | over any 20 ms period  | -   | 0.5 | W                |
| T <sub>stg</sub>    | storage temperature                  |  | -40 | 150 | °C               |
| T <sub>j</sub>      | junction temperature                 |  | -   | 125 | °C               |

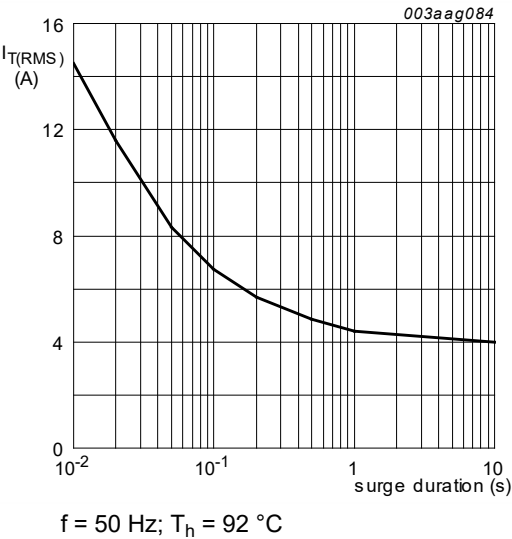


Fig. 1. RMS on-state current as a function of surge duration; maximum values

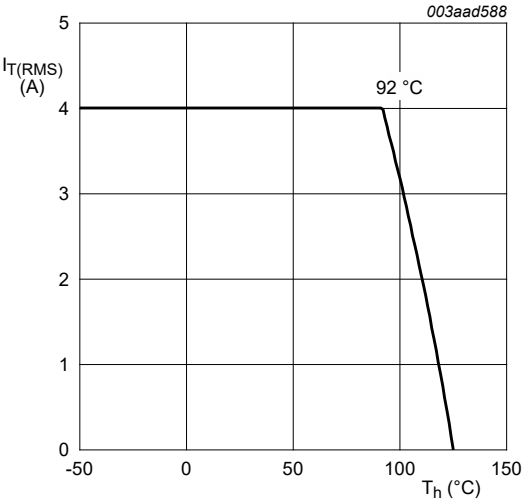


Fig. 2. RMS on-state current as a function of heatsink temperature; maximum values

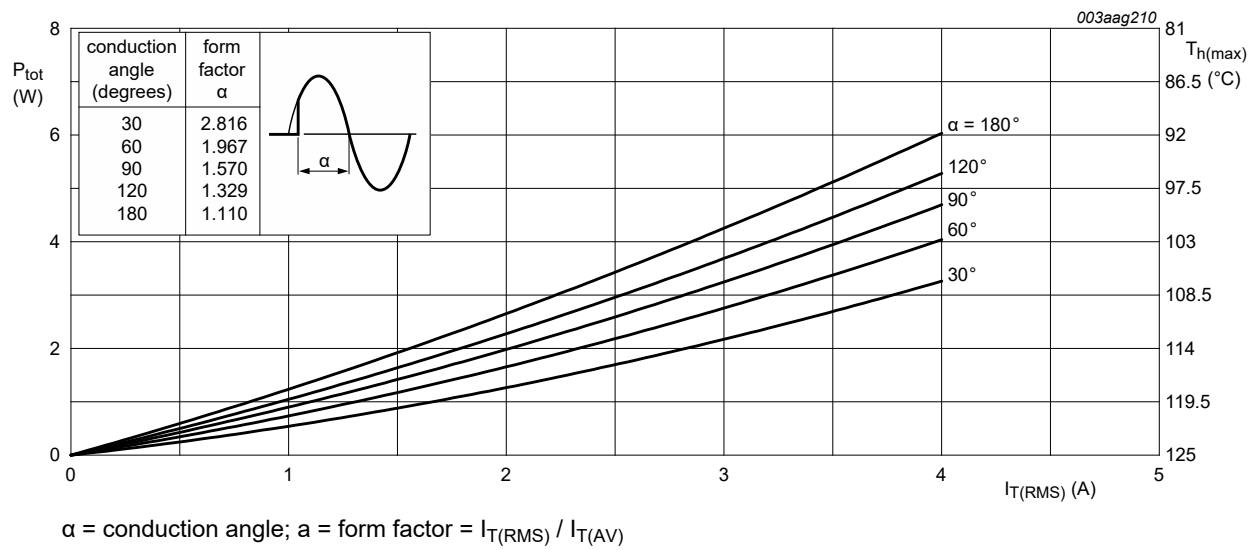


Fig. 3. Total power dissipation as a function of RMS on-state current; maximum values

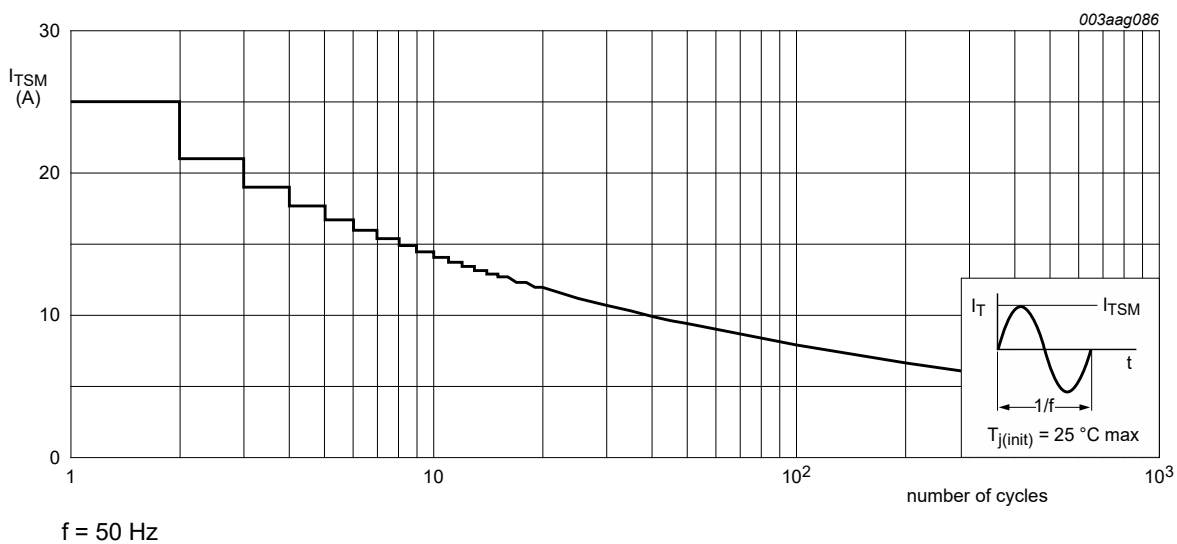
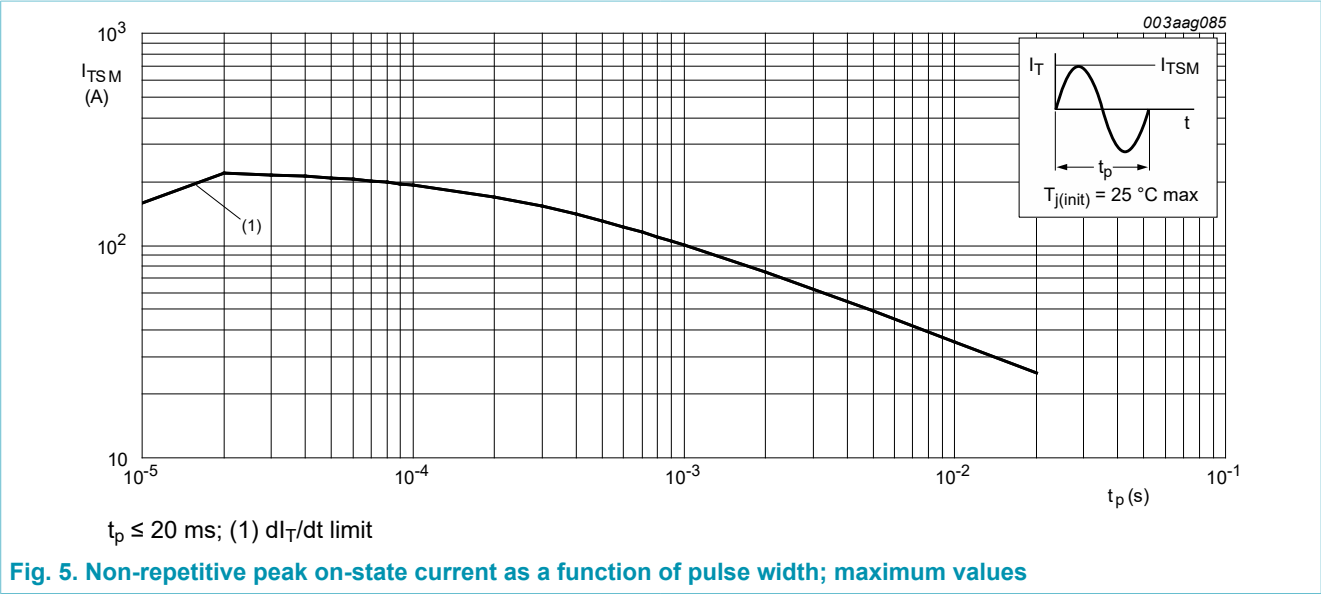


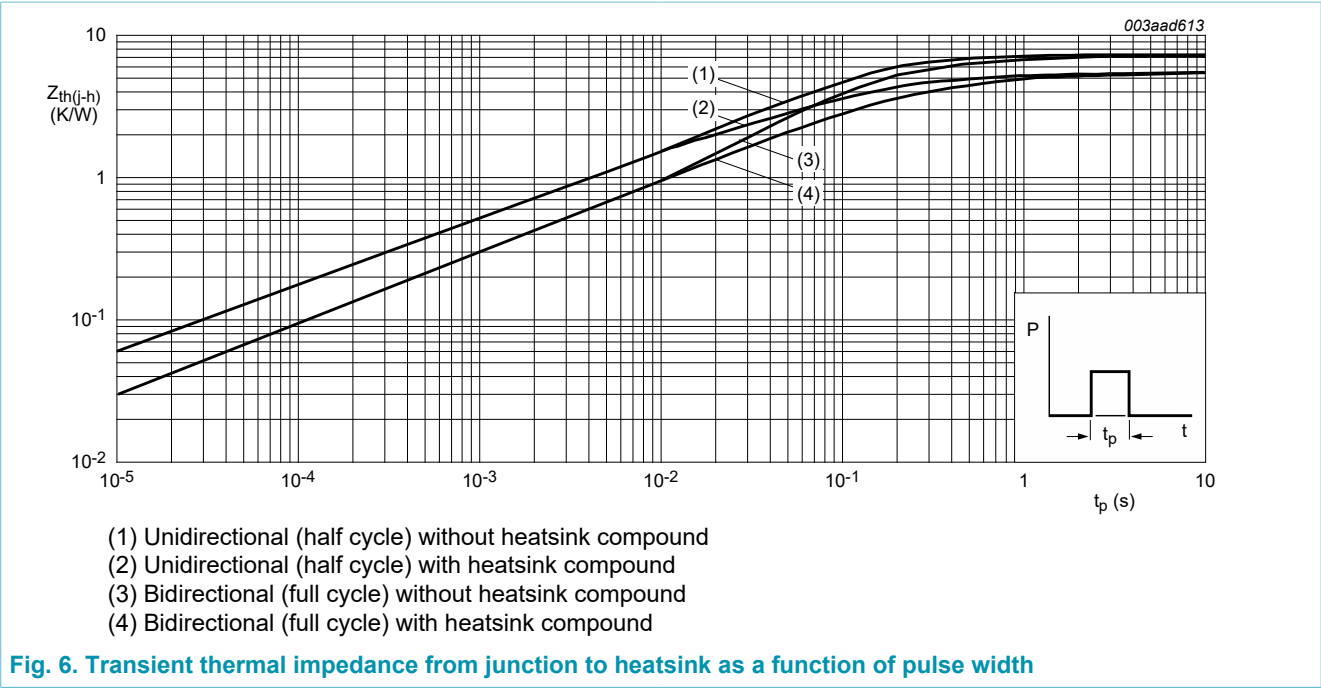
Fig. 4. Non-repetitive peak on-state current as a function of the number of sinusoidal current cycles; maximum values



8. Thermal characteristics

Table 5. Thermal characteristics

| Symbol               | Parameter  | Conditions   | Min | Typ | Max | Unit |
|----------------------|--|--|-----|-----|-----|------|
| R <sub>th(j-h)</sub> | thermal resistance from junction to heatsink         | full cycle or half cycle; with heatsink compound; Fig. 6 | -   | -   | 5.5 | K/W  |
|                      |  | full cycle or half cycle; without heatsink compound      | -   | -   | 7.2 | K/W  |
| R <sub>th(j-a)</sub> | thermal resistance from junction to ambient free air | in free air  | -   | 55  | -   | K/W  |



9. Isolation characteristics

Table 6. Isolation characteristics

| Symbol                 | Parameter             | Conditions  | Min | Typ | Max  | Unit |
|------------------------|-----------------------|---|-----|-----|------|------|
| V <sub>isol(RMS)</sub> | RMS isolation voltage | from all terminals to external heatsink; sinusoidal waveform; clean and dust free; 50 Hz ≤ f ≤ 60 Hz; RH ≤ 65 %; T <sub>h</sub> = 25 °C | -   | -   | 2500 | V    |
| C <sub>isol</sub>      | isolation capacitance | from main terminal 2 to external heatsink; f = 1 MHz; T <sub>h</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>   |  | -    | -   | 50  | 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>   |  | -    | -   | 50  | 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>   |  | -    | -   | 50  | 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>   |  | -    | -   | 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>   |  | -    | -   | 45  | 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>   |  | -    | -   | 30  | mA               |
| $I_H$                          | holding current                       | $V_D = 12\text{ V}$ ; $T_j = 25\text{ }^\circ\text{C}$ ; <a href="#">Fig. 9</a>   |  | -    | -   | 30  | mA               |
| $V_T$                          | on-state voltage                      | $I_T = 5\text{ A}$ ; $T_j = 25\text{ }^\circ\text{C}$ ; <a href="#">Fig. 10</a>   |  | -    | 1.4 | 1.7 | 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                                     |  | 1000 | -   | -   | V/ $\mu\text{s}$ |
| $dI_{com}/dt$                  | rate of change of commutating current | $V_D = 400\text{ V}$ ; $T_j = 125\text{ }^\circ\text{C}$ ; $I_{T(RMS)} = 4\text{ A}$ ; $dV_{com}/dt = 20\text{ V}/\mu\text{s}$ ; (snubberless condition); gate open circuit |  | 6    | -   | -   | A/ms             |

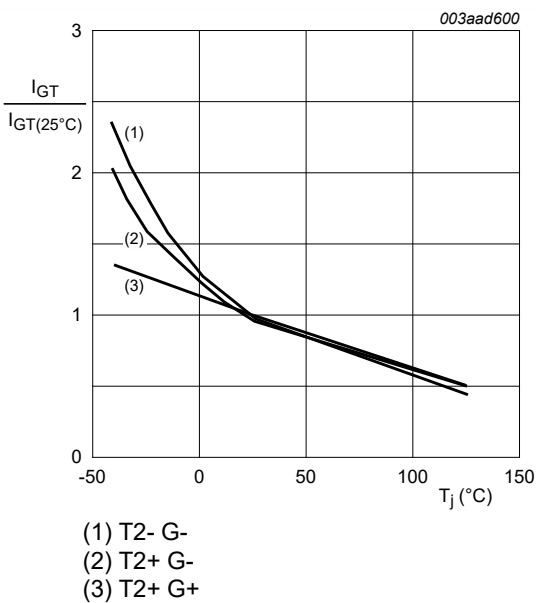


Fig. 7. Normalized gate trigger current as a function of junction temperature

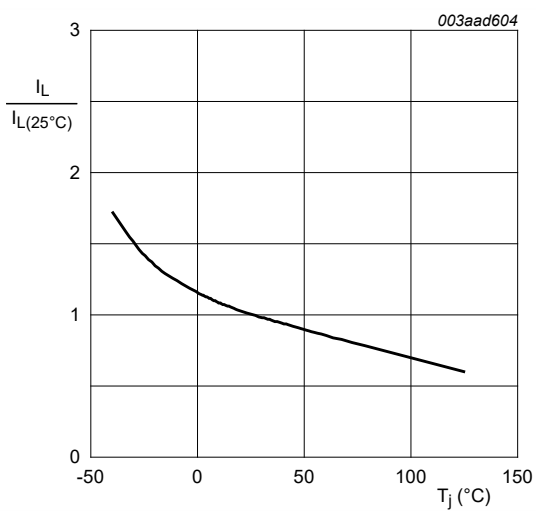


Fig. 8. Normalized latching current as a function of junction temperature

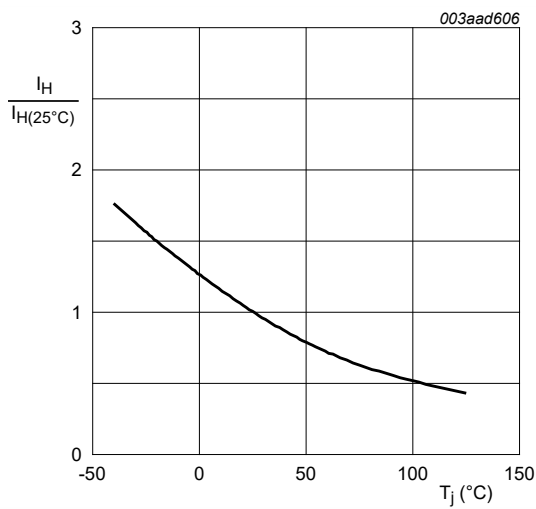
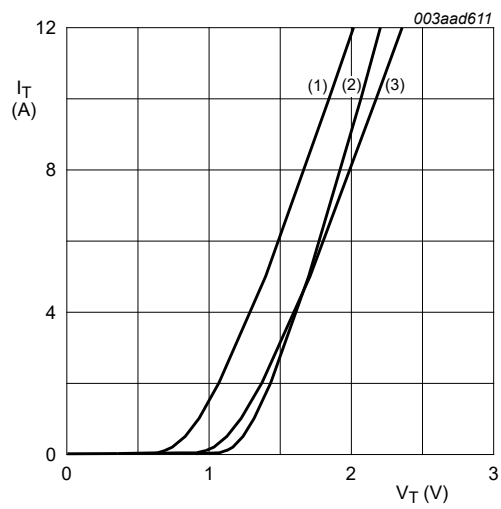


Fig. 9. Normalized holding current as a function of junction temperature



$V_o = 1.27 \text{ V}$ ;  $R_s = 0.091 \text{ }\Omega$   
(1)  $T_j = 125^{\circ}\text{C}$ ; typical values  
(2)  $T_j = 125^{\circ}\text{C}$ ; maximum values  
(3)  $T_j = 25^{\circ}\text{C}$ ; maximum values

Fig. 10. On-state current as a function of on-state voltage





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

11. Package outline



## 12. Legal information

### 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. |
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