

## 1. General description

Planar passivated high commutation three quadrant triac in a SOT78 plastic package. The "series ET" triac balances the requirements of commutation performance and gate sensitivity. The "sensitive gate" "series ET" is intended for interfacing with low power drivers including microcontrollers where "high junction operating temperature" capability is required.

## 2. Features and benefits

- 3Q technology for improved noise immunity
- Direct interfacing with low power drivers and microcontrollers
- Good immunity to false turn-on by  $dV/dt$
- High commutation capability with sensitive gate
- High junction operating temperature capability
- High voltage capability
- Planar passivated for voltage ruggedness and reliability
- Triggering in three quadrants only

## 3. Applications

- Applications subject to high temperature
- Electronic thermostats (heating and cooling)
- High power motor controls e.g. washing machines and vacuum cleaners
- Refrigeration and air-conditioner compressor controls

## 4. Quick reference data

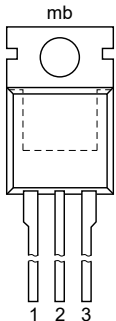

Table 1. Quick reference data

| 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; $T_{mb} \leq 126\text{ °C}$ ; <a href="#">Fig. 1</a> ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 3</a>       | -   | -   | 16  | 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> | -   | -   | 140 | A    |
|                               |                                      | full sine wave; $T_{j(\text{init})} = 25\text{ °C}$ ; $t_p = 16.7\text{ ms}$   | -   | -   | 150 | A    |
| $T_j$                         | junction temperature                 |  | -   | -   | 150 | °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>                           | 2   | -   | 10  | mA   |

| Symbol                         | Parameter                             | Conditions   | Min | Typ | Max | Unit       |
|--------------------------------|---------------------------------------|--|-----|-----|-----|------------|
|                                |                                       | $V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2+ G-;<br>$T_j = 25\text{ °C}$ ; Fig. 7  | 2   | -   | 10  | mA         |
|                                |                                       | $V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2- G-;<br>$T_j = 25\text{ °C}$ ; Fig. 7  | 2   | -   | 10  | mA         |
| $I_H$                          | holding current                       | $V_D = 12\text{ V}$ ; $T_j = 25\text{ °C}$ ; Fig. 9  | -   | -   | 15  | mA         |
| $V_T$                          | on-state voltage                      | $I_T = 18\text{ A}$ ; $T_j = 25\text{ °C}$ ; Fig. 10   | -   | 1.3 | 1.5 | V          |
| <b>Dynamic characteristics</b> |                                       |  |     |     |     |            |
| $dV_D/dt$                      | rate of rise of off-state voltage     | $V_{DM} = 402\text{ V}$ ; $T_j = 150\text{ °C}$ ; ( $V_{DM} = 67\%$ of $V_{DRM}$ ); exponential waveform; gate open circuit                                      | 20  | -   | -   | V/ $\mu$ s |
| $di_{com}/dt$                  | rate of change of commutating current | $V_D = 400\text{ V}$ ; $T_j = 150\text{ °C}$ ; $I_{T(RMS)} = 16\text{ A}$ ; $dV_{com}/dt = 20\text{ V}/\mu\text{s}$ ; (snubberless condition); gate open circuit | 0.8 | -   | -   | A/ms       |
|                                |                                       | $V_D = 400\text{ V}$ ; $T_j = 150\text{ °C}$ ; $I_{T(RMS)} = 16\text{ A}$ ; $dV_{com}/dt = 10\text{ V}/\mu\text{s}$ ; gate open circuit                          | 1.2 | -   | -   | A/ms       |
|                                |                                       | $V_D = 400\text{ V}$ ; $T_j = 150\text{ °C}$ ; $I_{T(RMS)} = 16\text{ A}$ ; $dV_{com}/dt = 1\text{ V}/\mu\text{s}$ ; 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 style="text-align: center;"><b>TO-220AB (SOT78)</b></p> |  <p style="text-align: center;"><i>sym051</i></p> |
| 2   | T2     | main terminal 2                |  |  |
| 3   | G      | gate                           |  |  |
| mb  | T2     | mounting base; main terminal 2 |  |  |

## 6. Ordering information

Table 3. Ordering information

| Type number     | Package  |  | Version |
|-----------------|----------|--|---------|
|                 | Name     | Description  |         |
| BTA316-600ET    | TO-220AB | plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB | SOT78   |
| BTA316-600ET/DG | TO-220AB | plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB | SOT78   |

## 7. Marking

Table 4. Marking codes

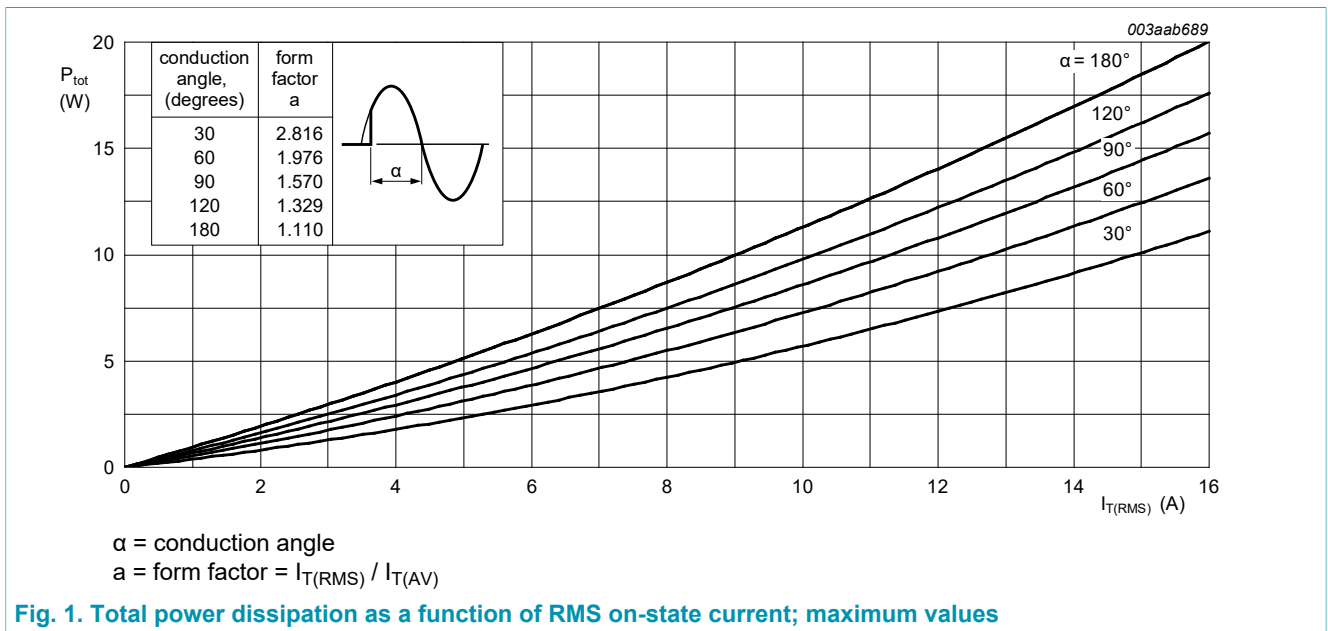
| Type number     | Marking code   |
|-----------------|----------------|
| BTA316-600ET    |                |
| BTA316-600ET/DG | BTA316-600ETDG |

### 8. Limiting values

**Table 5. 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>mb</sub> ≤ 126 °C; Fig. 1; Fig. 2; Fig. 3                     | -   | 16  | 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 | -   | 140 | A                |
|                     |                                      | full sine wave; T <sub>j(init)</sub> = 25 °C; t <sub>p</sub> = 16.7 ms               | -   | 150 | A                |
| I <sup>2</sup> t    | I <sup>2</sup> t for fusing          | t <sub>p</sub> = 10 ms; SIN  | -   | 98  | 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                 |  | -   | 150 | °C               |



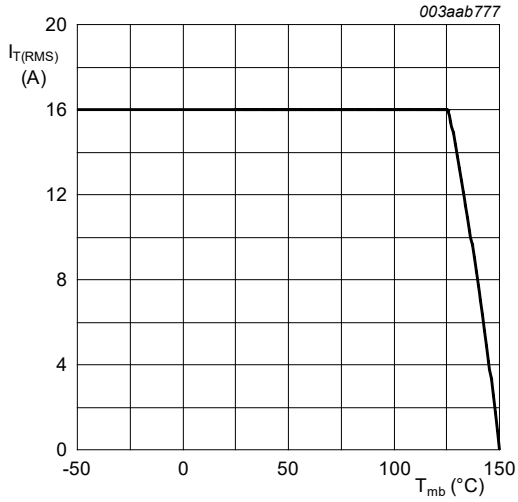
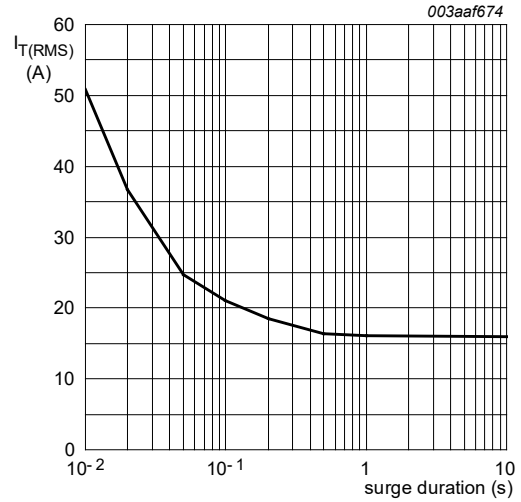
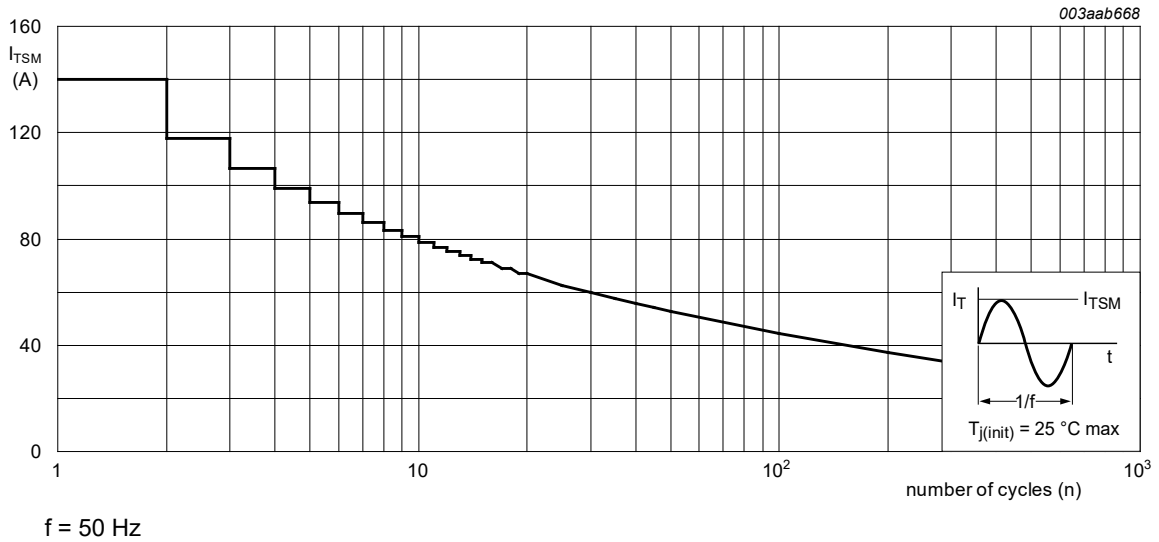


Fig. 2. RMS on-state current as a function of mounting base temperature; maximum values



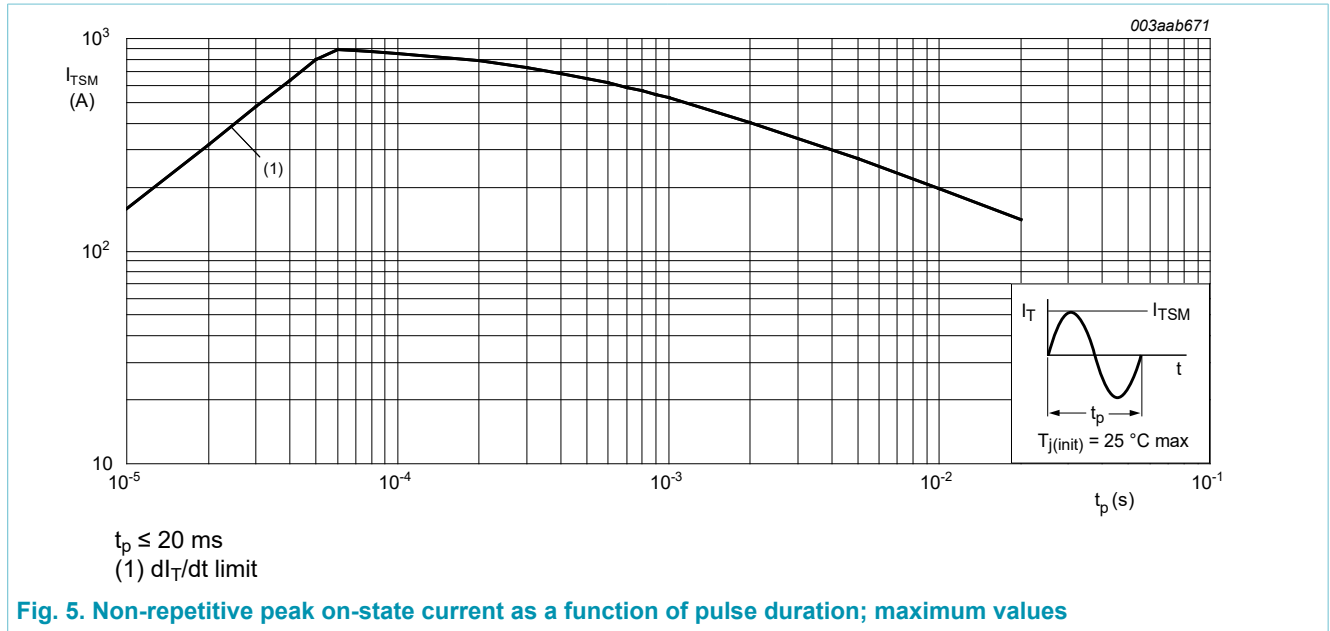
f = 50 Hz; T<sub>mb</sub> = 126 °C

Fig. 3. RMS on-state current as a function of surge duration; maximum values



f = 50 Hz

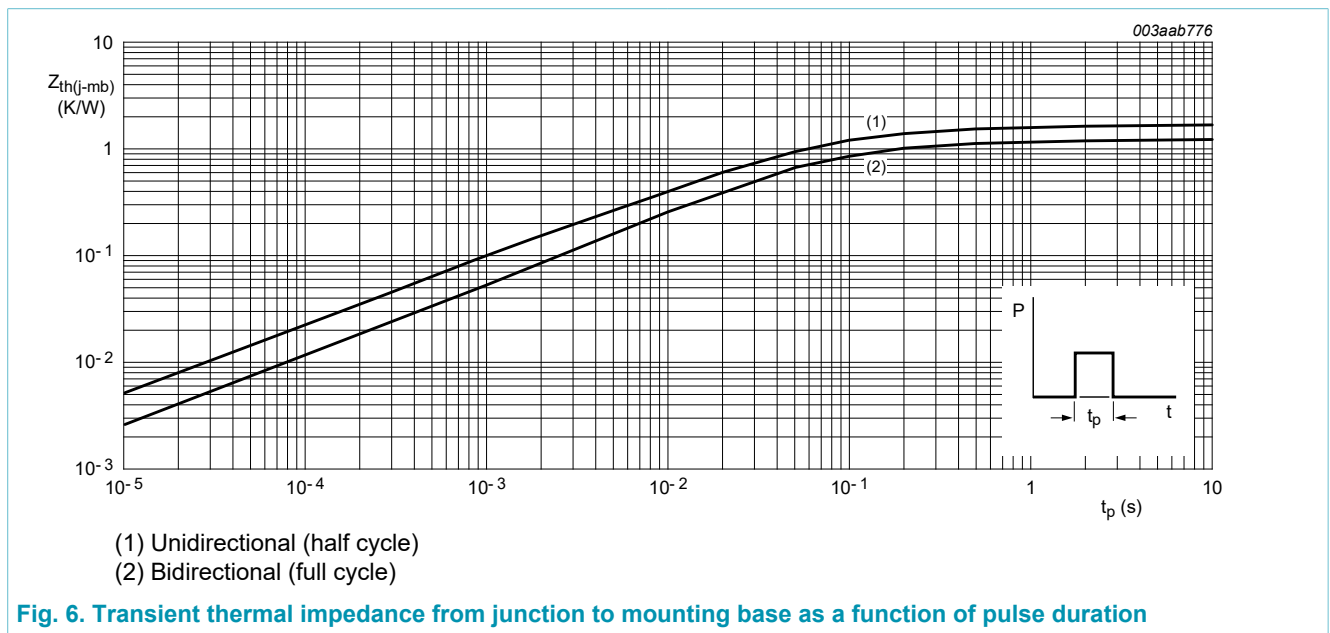
Fig. 4. Non-repetitive peak on-state current as a function of the number of sinusoidal current cycles; maximum values



## 9. Thermal characteristics

Table 6. Thermal characteristics

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

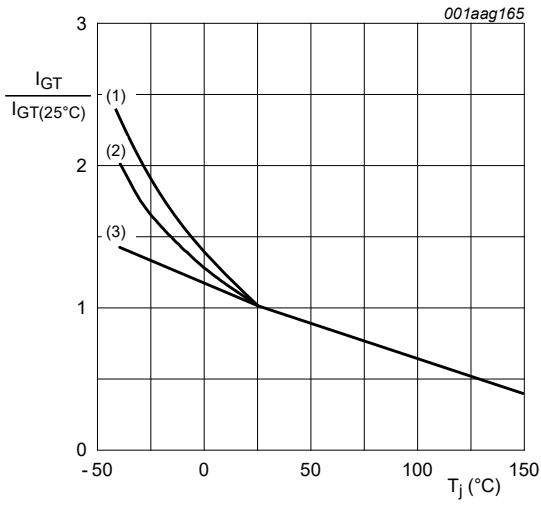


## 10. Characteristics

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>$T_j = 25\text{ °C}$ ; <a href="#">Fig. 7</a>   | 2    | -   | 10  | mA         |
|                                |                                       | $V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2+ G-;<br>$T_j = 25\text{ °C}$ ; <a href="#">Fig. 7</a>   | 2    | -   | 10  | mA         |
|                                |                                       | $V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2- G-;<br>$T_j = 25\text{ °C}$ ; <a href="#">Fig. 7</a>   | 2    | -   | 10  | mA         |
| $I_L$                          | latching current                      | $V_D = 12\text{ V}$ ; $I_G = 0.1\text{ A}$ ; T2+ G+;<br>$T_j = 25\text{ °C}$ ; <a href="#">Fig. 8</a>   | -    | -   | 25  | mA         |
|                                |                                       | $V_D = 12\text{ V}$ ; $I_G = 0.1\text{ A}$ ; T2+ G-;<br>$T_j = 25\text{ °C}$ ; <a href="#">Fig. 8</a>   | -    | -   | 30  | mA         |
|                                |                                       | $V_D = 12\text{ V}$ ; $I_G = 0.1\text{ A}$ ; T2- G-;<br>$T_j = 25\text{ °C}$ ; <a href="#">Fig. 8</a>   | -    | -   | 30  | mA         |
| $I_H$                          | holding current                       | $V_D = 12\text{ V}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 9</a>   | -    | -   | 15  | mA         |
| $V_T$                          | on-state voltage                      | $I_T = 18\text{ A}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 10</a>  | -    | 1.3 | 1.5 | V          |
| $V_{GT}$                       | gate trigger voltage                  | $V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; $T_j = 25\text{ °C}$ ;<br><a href="#">Fig. 11</a>  | -    | 0.8 | 1   | V          |
|                                |                                       | $V_D = 400\text{ V}$ ; $I_T = 0.1\text{ A}$ ; $T_j = 150\text{ °C}$ ;<br><a href="#">Fig. 11</a>  | 0.25 | 0.4 | -   | V          |
| $I_D$                          | off-state current                     | $V_D = 600\text{ V}$ ; $T_j = 150\text{ °C}$  | -    | 0.1 | 0.5 | mA         |
| <b>Dynamic characteristics</b> |                                       |   |      |     |     |            |
| $dV_D/dt$                      | rate of rise of off-state voltage     | $V_{DM} = 402\text{ V}$ ; $T_j = 150\text{ °C}$ ; ( $V_{DM} = 67\%$ of $V_{DRM}$ ); exponential waveform; gate open circuit   | 20   | -   | -   | V/ $\mu$ s |
| $dI_{com}/dt$                  | rate of change of commutating current | $V_D = 400\text{ V}$ ; $T_j = 150\text{ °C}$ ; $I_{T(RMS)} = 16\text{ A}$ ;<br>$dV_{com}/dt = 20\text{ V}/\mu\text{s}$ ; (snubberless condition); gate open circuit | 0.8  | -   | -   | A/ms       |
|                                |                                       | $V_D = 400\text{ V}$ ; $T_j = 150\text{ °C}$ ; $I_{T(RMS)} = 16\text{ A}$ ;<br>$dV_{com}/dt = 10\text{ V}/\mu\text{s}$ ; gate open circuit                          | 1.2  | -   | -   | A/ms       |
|                                |                                       | $V_D = 400\text{ V}$ ; $T_j = 150\text{ °C}$ ; $I_{T(RMS)} = 16\text{ A}$ ;<br>$dV_{com}/dt = 1\text{ V}/\mu\text{s}$ ; gate open circuit                           | 6    | -   | -   | A/ms       |





- (1) T2- G-
- (2) T2+ G-
- (3) T2+ G+

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

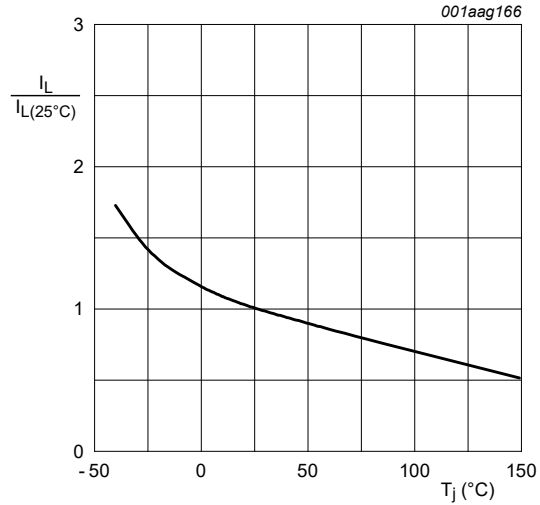


Fig. 8. Normalized latching current as a function of junction temperature

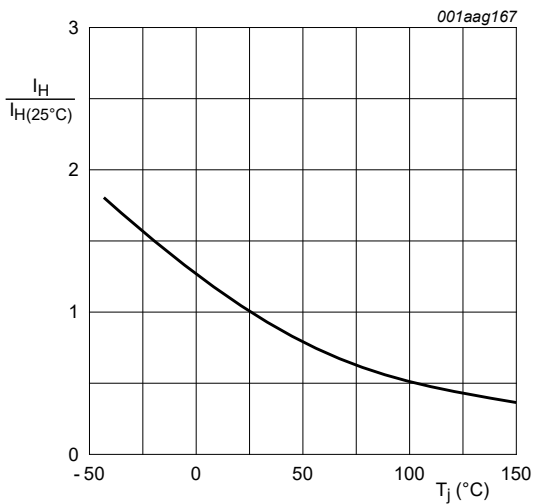
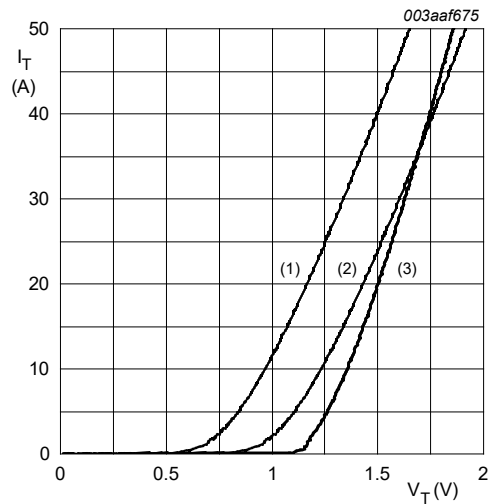


Fig. 9. Normalized holding current as a function of junction temperature



$V_o = 1.024 \text{ V}; R_s = 0.021 \Omega$

- (1)  $T_j = 150 \text{ }^\circ\text{C}$ ; typical values
- (2)  $T_j = 150 \text{ }^\circ\text{C}$ ; maximum values
- (3)  $T_j = 25 \text{ }^\circ\text{C}$ ; maximum values

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

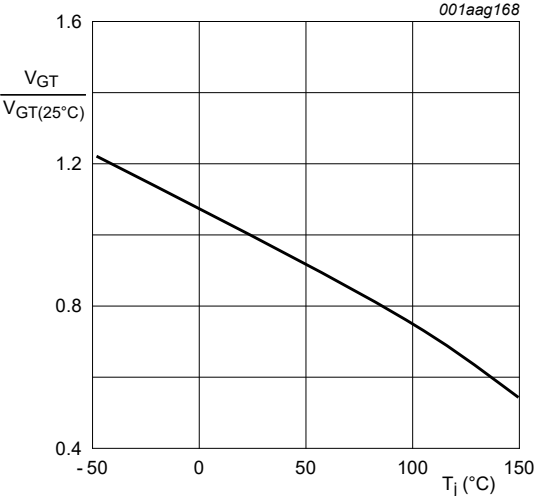
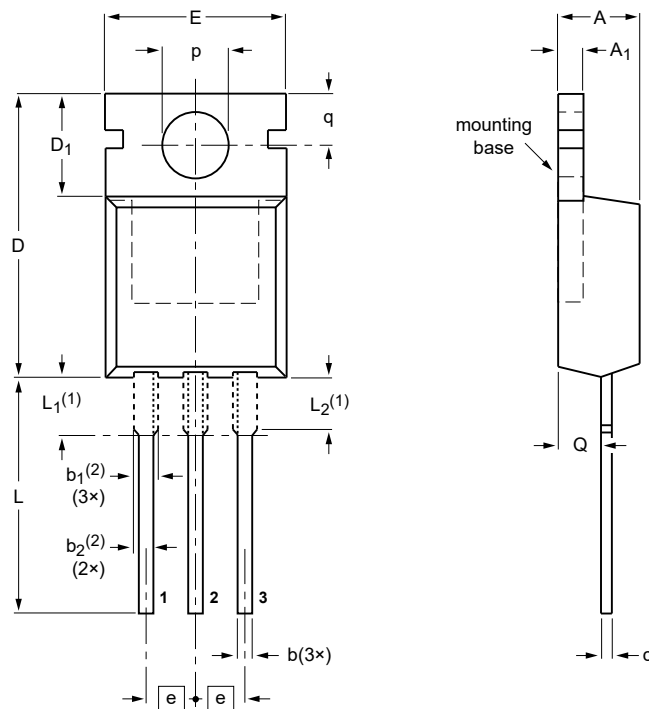


Fig. 11. Normalized gate trigger voltage as a function of junction temperature

### 11. Package outline

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB SOT78



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

| UNIT | A          | A <sub>1</sub> | b          | b <sub>1</sub> (2) | b <sub>2</sub> (2) | c          | D            | D <sub>1</sub> | E           | e    | L            | L <sub>1</sub> (1) | L <sub>2</sub> (1) max. | p          | q          | Q          |
|------|------------|----------------|------------|--------------------|--------------------|------------|--------------|----------------|-------------|------|--------------|--------------------|-------------------------|------------|------------|------------|
| mm   | 4.7<br>4.1 | 1.40<br>1.25   | 0.9<br>0.6 | 1.6<br>1.0         | 1.3<br>1.0         | 0.7<br>0.4 | 16.0<br>15.2 | 6.6<br>5.9     | 10.3<br>9.7 | 2.54 | 15.0<br>12.8 | 3.30<br>2.79       | 3.0                     | 3.8<br>3.5 | 3.0<br>2.7 | 2.6<br>2.2 |

**Notes**

- 1. Lead shoulder designs may vary.
- 2. Dimension includes excess dambar.

| OUTLINE VERSION | REFERENCES |                 |       | EUROPEAN PROJECTION | ISSUE DATE           |
|-----------------|------------|-----------------|-------|---------------------|----------------------|
|                 | IEC        | JEDEC           | JEITA |                     |                      |
| SOT78           |            | 3-lead TO-220AB | SC-46 |                     | 08-04-23<br>08-06-13 |

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

## 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. |
| 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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Date of release: 12 September 2018

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