

## 1. General description

Planar passivated high commutation three quadrant triac in a SOT78 (TO-220AB) plastic package. This "series ET" triac balances the requirements of commutation performance and gate sensitivity and is intended for interfacing with low power drivers including microcontrollers. It is used in applications 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
- Sensitive gate for easy logic level triggering
- Triggering in three quadrants only

## 3. Applications

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

## 4. Quick reference data

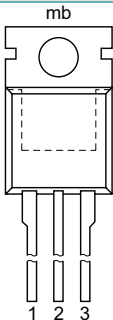
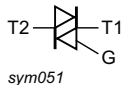
Table 1. Quick reference data

| Symbol              | Parameter                            | Conditions                                                                                                                                     | Min | Typ | Max | Unit |
|---------------------|--------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|------|
| $V_{\text{DRM}}$    | repetitive peak off-state voltage    |                                                                                                                                                | -   | -   | 800 | V    |
| $I_{\text{T(RMS)}}$ | RMS on-state current                 | full sine wave; $T_{\text{mb}} \leq 131\text{ }^{\circ}\text{C}$ ;<br><a href="#">Fig. 1</a> ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 3</a> | -   | -   | 10  | A    |
| $I_{\text{TSM}}$    | non-repetitive peak on-state current | full sine wave; $T_{\text{j(init)}} = 25\text{ }^{\circ}\text{C}$ ; $t_p = 20\text{ ms}$ ;<br><a href="#">Fig. 4</a> ; <a href="#">Fig. 5</a>  | -   | -   | 100 | A    |

| Symbol                  | Parameter                             | Conditions                                                                                                                              |  | Min | Typ | Max | Unit |
|-------------------------|---------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|--|-----|-----|-----|------|
| Static characteristics  |                                       |                                                                                                                                         |  |     |     |     |      |
| I <sub>GT</sub>         | gate trigger current                  | V <sub>D</sub> = 12 V; I <sub>T</sub> = 0.1 A; T2+ G+<br>T <sub>j</sub> = 25 °C; <a href="#">Fig. 7</a>                                 |  | 0.5 | -   | 10  | mA   |
|                         |                                       | V <sub>D</sub> = 12 V; I <sub>T</sub> = 0.1 A; T2+ G-<br>T <sub>j</sub> = 25 °C; <a href="#">Fig. 7</a>                                 |  | 0.5 | -   | 10  | mA   |
|                         |                                       | V <sub>D</sub> = 12 V; I <sub>T</sub> = 0.1 A; T2- G-<br>T <sub>j</sub> = 25 °C; <a href="#">Fig. 7</a>                                 |  | 0.5 | -   | 10  | mA   |
| Dynamic characteristics |                                       |                                                                                                                                         |  |     |     |     |      |
| dV <sub>D</sub> /dt     | rate of rise of off-state voltage     | V <sub>DM</sub> = 536 V; T <sub>j</sub> = 150 °C; (V <sub>DM</sub> = 67% of V <sub>DRM</sub> ); exponential waveform; gate open circuit |  | 50  | -   | -   | V/μs |
| dI <sub>com</sub> /dt   | rate of change of commutating current | V <sub>D</sub> = 400 V; T <sub>j</sub> = 150 °C; I <sub>T(RMS)</sub> = 10 A; dV <sub>com</sub> /dt = 20 V/μs; gate open circuit         |  | 5   | -   | -   | A/ms |

## 5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description                    | Simplified outline                                                                  | Graphic symbol                                                                                  |
|-----|--------|--------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| 1   | T1     | main terminal 1                |  | <br>sym051 |
| 2   | T2     | main terminal 2                |                                                                                     |                                                                                                 |
| 3   | G      | gate                           |                                                                                     |                                                                                                 |
| mb  | T2     | mounting base; main terminal 2 |                                                                                     |                                                                                                 |

## 6. Ordering information

Table 3. Ordering information

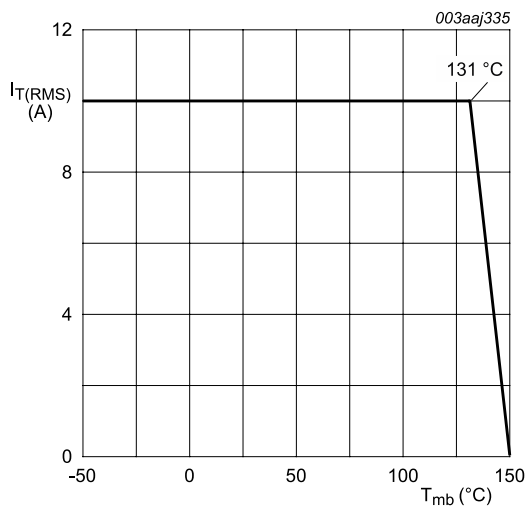
| Type number  | Package  |                                                                                  |         |
|--------------|----------|----------------------------------------------------------------------------------|---------|
|              | Name     | Description                                                                      | Version |
| BTA410-800ET | TO-220AB | plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB | SOT78   |

## 7. Limiting values

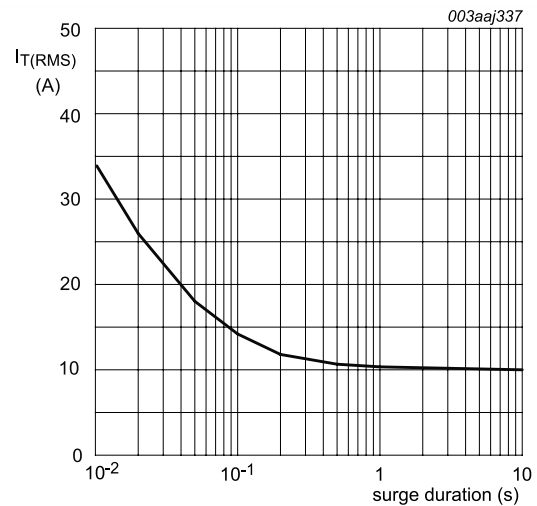
**Table 4. Limiting values**

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

| Symbol              | Parameter                            | Conditions                                                                                                                                             | Min | Max | Unit                   |
|---------------------|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|------------------------|
| $V_{\text{DRM}}$    | repetitive peak off-state voltage    |                                                                                                                                                        | -   | 800 | V                      |
| $I_{\text{T(RMS)}}$ | RMS on-state current                 | full sine wave; $T_{\text{mb}} \leq 131\text{ }^{\circ}\text{C}$ ;<br><a href="#">Fig. 1</a> ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 3</a>         | -   | 10  | A                      |
| $I_{\text{TSM}}$    | non-repetitive peak on-state current | full sine wave; $T_{\text{j(init)}} = 25\text{ }^{\circ}\text{C}$ ; $t_{\text{p}} = 20\text{ ms}$ ;<br><a href="#">Fig. 4</a> ; <a href="#">Fig. 5</a> | -   | 100 | A                      |
|                     |                                      | full sine wave; $T_{\text{j(init)}} = 25\text{ }^{\circ}\text{C}$ ; $t_{\text{p}} = 16.7\text{ ms}$                                                    | -   | 110 | A                      |
| $I^2t$              | $I^2t$ for fusing                    | $t_{\text{p}} = 10\text{ms}$ ; sine-wave pulse                                                                                                         | -   | 50  | $\text{A}^2\text{s}$   |
| $dI_{\text{T}}/dt$  | rate of rise of on-state current     | $I_{\text{G}} = 20\text{ mA}$                                                                                                                          | -   | 100 | $\text{A}/\mu\text{s}$ |
| $I_{\text{GM}}$     | 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 | $^{\circ}\text{C}$     |
| $T_{\text{j}}$      | junction temperature                 |                                                                                                                                                        | -   | 150 | $^{\circ}\text{C}$     |



**Fig. 1. RMS on-state current as a function of mounting base temperature; maximum values**



**Fig. 2. RMS on-state current as a function of surge duration; maximum values**  
 $f = 50\text{Hz}$ ;  $T_{\text{mb}} = 131\text{ }^{\circ}\text{C}$

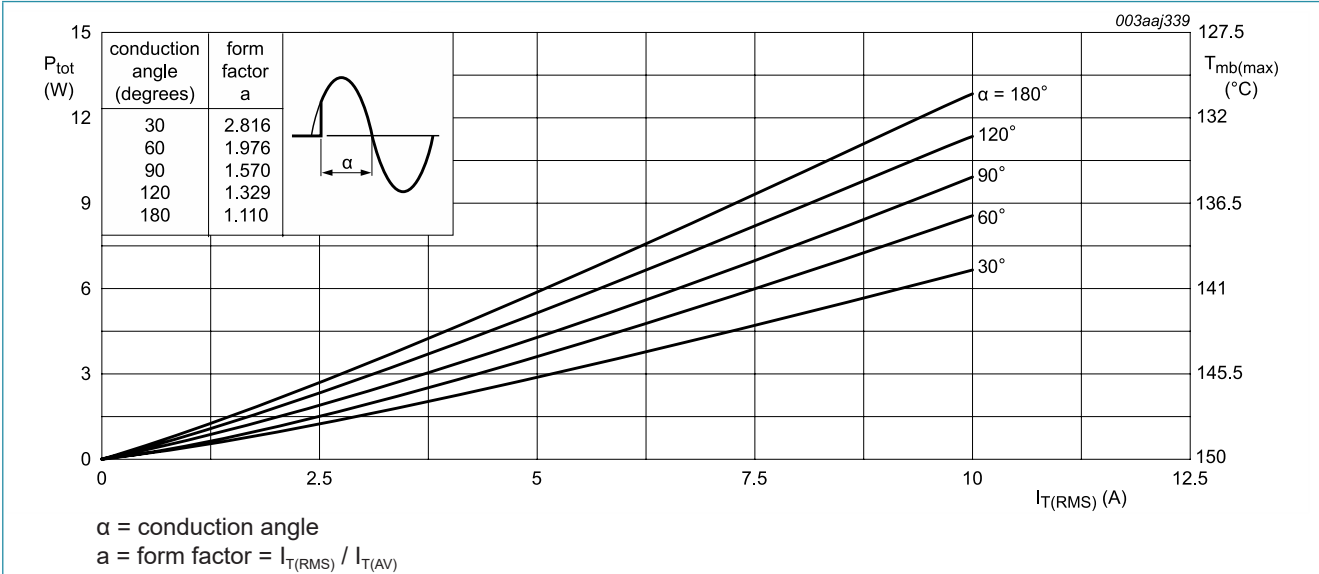


Fig. 3. Total power dissipation as a function of RMS on-state current; maximum values

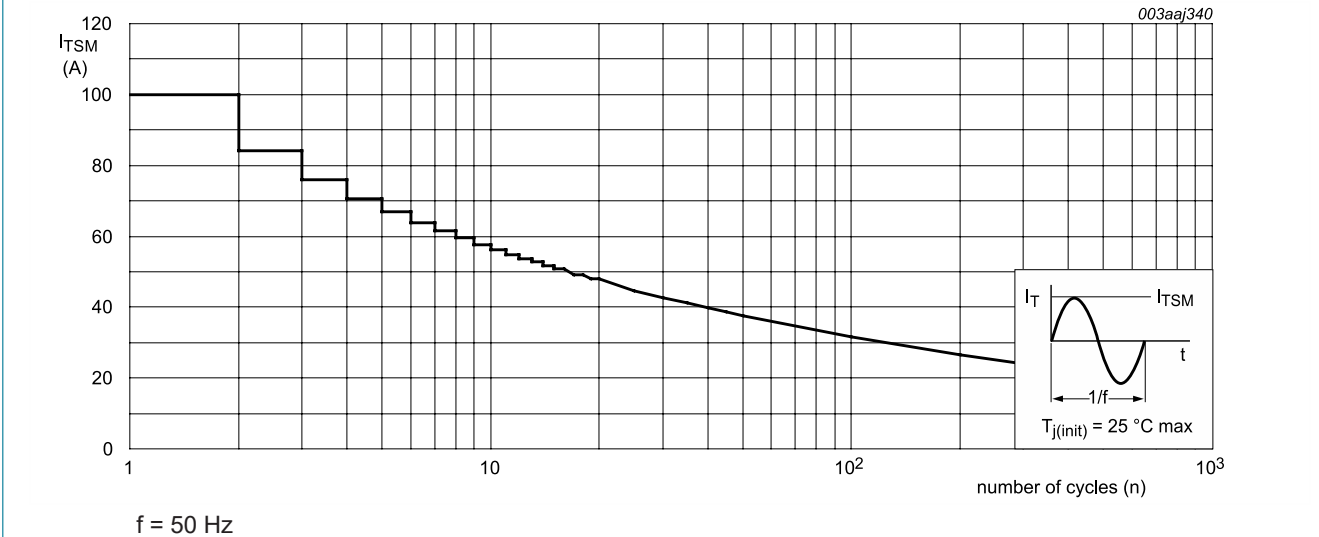


Fig. 4. Non-repetitive peak on-state current as a function of the number of sinusoidal current cycles; maximum values

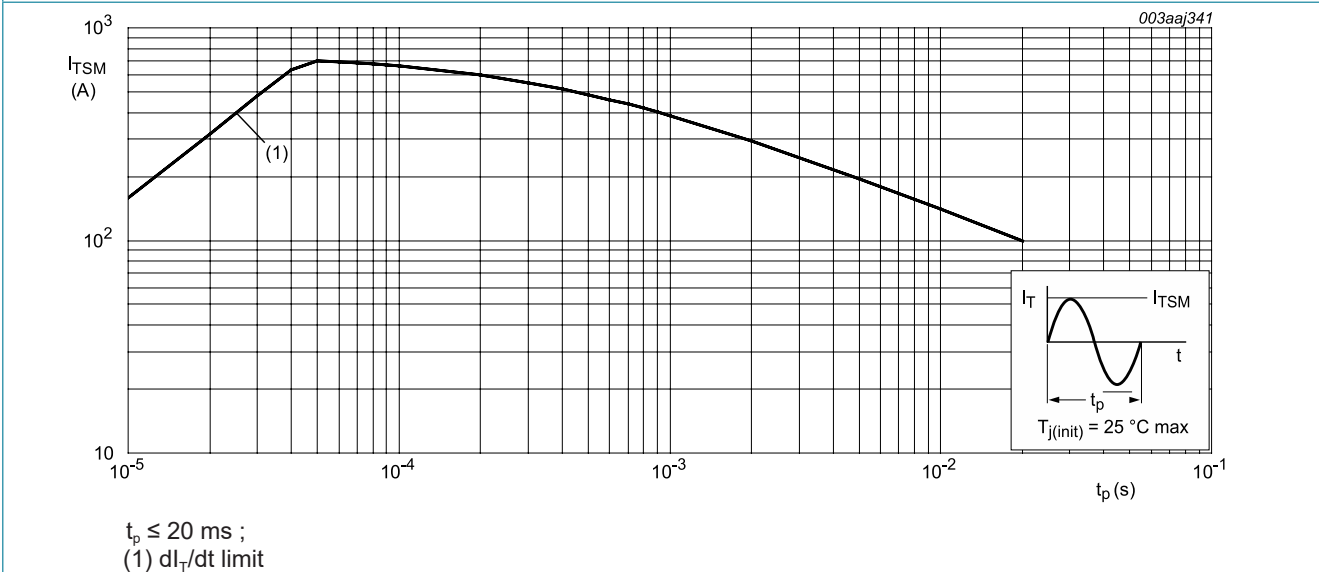
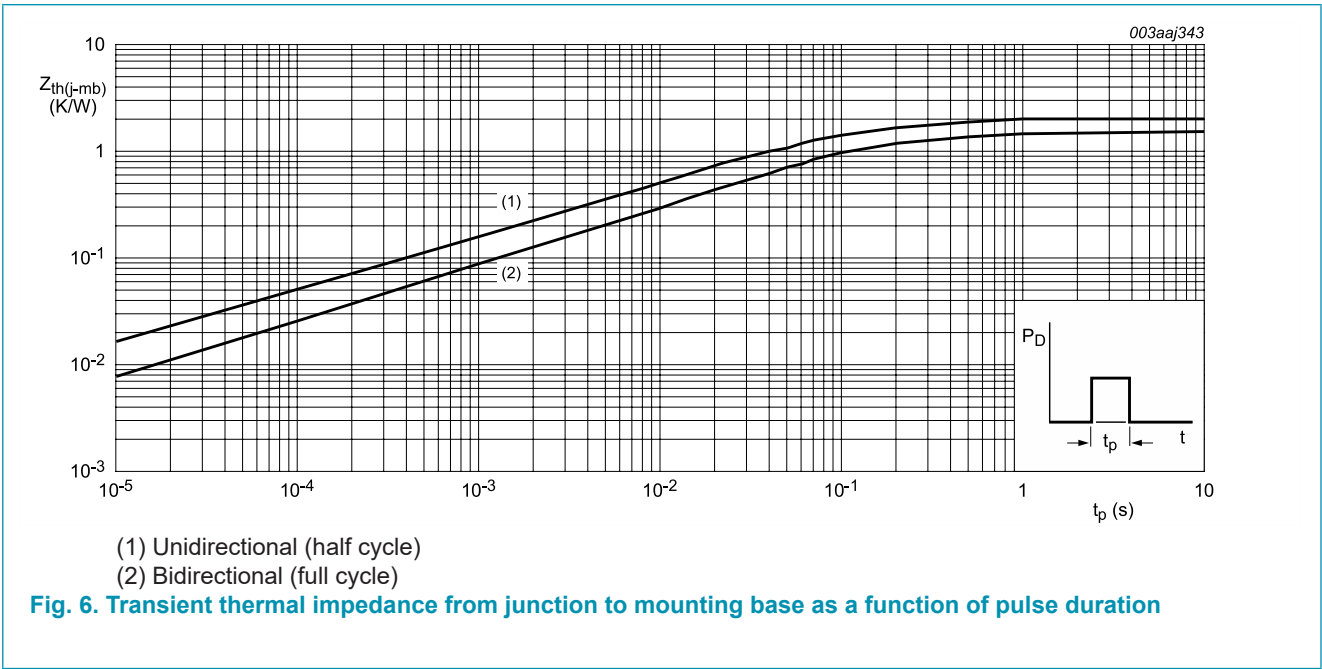


Fig. 5. Non-repetitive peak on-state current as a function of pulse duration; maximum values

8. Thermal characteristics

Table 5. Thermal characteristics

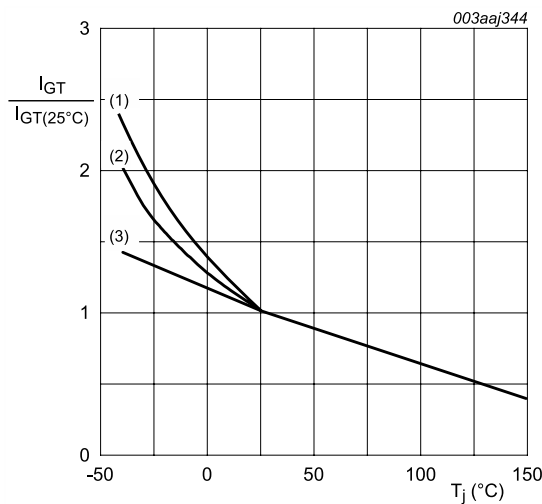
| Symbol         | Parameter                                         | Conditions         |  | Min | Typ | Max | Unit |
|----------------|---------------------------------------------------|--------------------|--|-----|-----|-----|------|
| $R_{th(j-mb)}$ | thermal resistance from junction to mounting base | full cycle; Fig. 6 |  | -   | -   | 1.5 | K/W  |
|                |                                                   | half cycle; Fig. 6 |  | -   | -   | 2   | K/W  |
| $R_{th(j-a)}$  | thermal resistance from junction to ambient       | in free air        |  | -   | 60  | -   | K/W  |



## 9. Characteristics

Table 6. 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>                                                            |  | 0.5  | -   | 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>                                                            |  | 0.5  | -   | 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>                                                            |  | 0.5  | -   | 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>                                                            |  | -    | -   | 25  | 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                      | $I_T = 15\text{ A}$ ; $T_J = 25\text{ °C}$ ; <a href="#">Fig. 10</a>                                                                                             |  | -    | 1.3 | 1.6 | V          |
| $V_{GT}$                       | gate trigger voltage                  | $V_D = 12\text{ V}$ ; $T_J = 25\text{ °C}$ ; <a href="#">Fig. 11</a>                                                                                             |  | -    | 0.7 | 1   | V          |
|                                |                                       | $V_D = 400\text{ V}$ ; $T_J = 150\text{ °C}$ ; <a href="#">Fig. 11</a>                                                                                           |  | 0.25 | 0.4 | -   | V          |
| $I_D$                          | off-state current                     | $V_D = 800\text{ V}$ ; $T_J = 150\text{ °C}$                                                                                                                     |  | -    | 0.4 | 2   | mA         |
| <b>Dynamic characteristics</b> |                                       |                                                                                                                                                                  |  |      |     |     |            |
| $dV_D/dt$                      | rate of rise of off-state voltage     | $V_{DM} = 536\text{ V}$ ; $T_J = 150\text{ °C}$ ; ( $V_{DM} = 67\%$ of $V_{DRM}$ ); exponential waveform; gate open circuit                                      |  | 50   | -   | -   | V/ $\mu$ s |
| $dI_{com}/dt$                  | rate of change of commutating current | $V_D = 400\text{ V}$ ; $T_J = 150\text{ °C}$ ; $I_{T(RMS)} = 10\text{ A}$ ; $dV_{com}/dt = 20\text{ V}/\mu\text{s}$ ; (snubberless condition); gate open circuit |  | 2    | -   | -   | A/ms       |
|                                |                                       | $V_D = 400\text{ V}$ ; $T_J = 150\text{ °C}$ ; $I_{T(RMS)} = 10\text{ A}$ ; $dV_{com}/dt = 10\text{ V}/\mu\text{s}$ ; gate open circuit                          |  | 3.5  | -   | -   | A/ms       |
|                                |                                       | $V_D = 400\text{ V}$ ; $T_J = 150\text{ °C}$ ; $I_{T(RMS)} = 10\text{ A}$ ; $dV_{com}/dt = 1\text{ V}/\mu\text{s}$ ; gate open circuit                           |  | 5    | -   | -   | A/ms       |



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

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

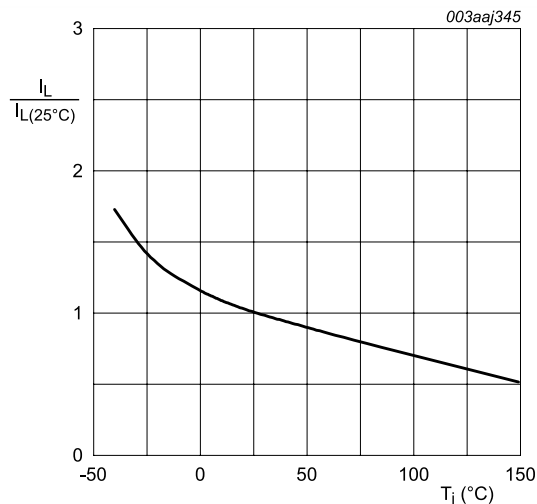


Fig. 8. Normalized latching current as a function of junction temperature

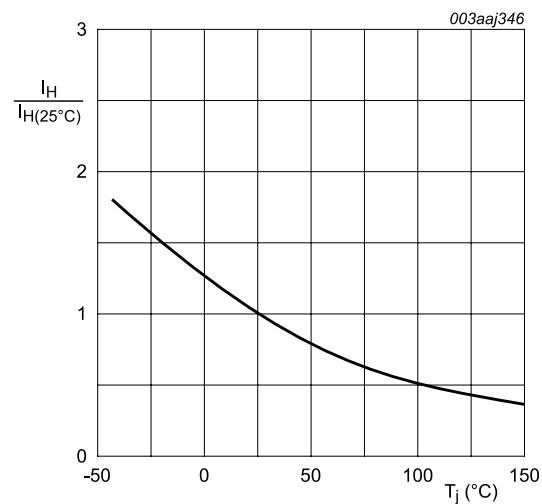
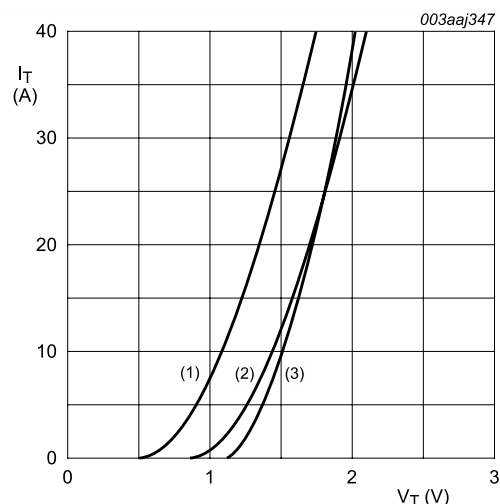


Fig. 9. Normalized holding current as a function of junction temperature



- $V_o = 1.142 \text{ V}; R_s = 0.027 \Omega$
- (1)  $T_J = 150^{\circ}\text{C}$ ; typical values
  - (2)  $T_J = 150^{\circ}\text{C}$ ; maximum values
  - (3)  $T_J = 25^{\circ}\text{C}$ ; maximum values

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

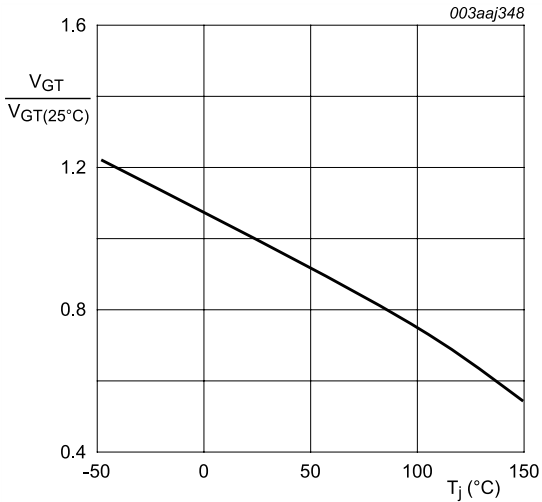
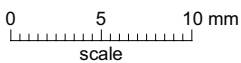
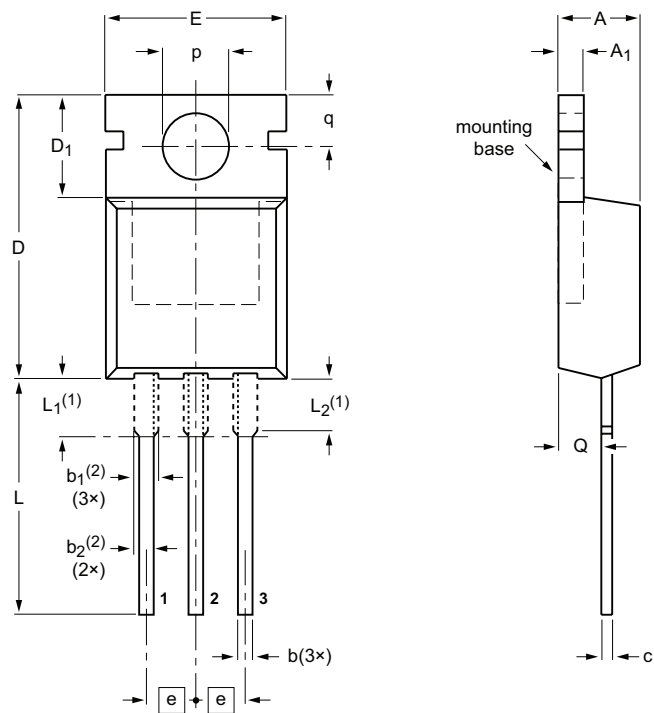


Fig. 11. Normalized gate trigger voltage as a function of junction temperature

10. Package outline

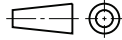
Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB SOT78



DIMENSIONS (mm are the original dimensions)

| UNIT | A          | A <sub>1</sub> | b          | b <sub>1</sub> <sup>(2)</sup> | b <sub>2</sub> <sup>(2)</sup> | c          | D            | D <sub>1</sub> | E           | e    | L            | L <sub>1</sub> <sup>(1)</sup> | L <sub>2</sub> <sup>(1)</sup><br>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
- Lead shoulder designs may vary.
  - Dimension includes excess dambar.

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

## 11. 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: 10 August 2018

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