

1. General description

Planar passivated four quadrant triac in a SOT78 (TO-220AB) plastic package intended for use in general purpose bidirectional switching and phase control applications.

2. Features and benefits

- High voltage capability
- Least sensitive gate for highest noise immunity
- Planar passivated for voltage ruggedness and reliability
- Triggering in all four quadrants
- High minimum I_{GT} for guaranteed immunity to gate noise

3. Applications

- General purpose motor controls
- General purpose switching

4. Quick reference data

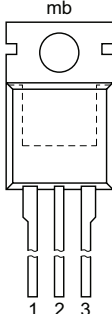
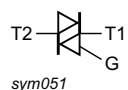
Table 1. Quick reference data

| Symbol | Parameter | Conditions | Values | | | Unit |
|--------------------------------|--------------------------------------|---|--------|-----|-----|--------------------|
| Absolute maximum rating | | | | | | |
| V_{DRM} | repetitive peak off-state voltage | | 600 | | | V |
| $I_{T(RMS)}$ | RMS on-state current | full sine wave; $T_{mb} \leq 99\text{ }^{\circ}\text{C}$; Fig. 1 ; Fig. 2 ; Fig. 3 | 16 | | | A |
| I_{TSM} | non-repetitive peak on-state current | full sine wave; $T_{j(\text{init})} = 25\text{ }^{\circ}\text{C}$; $t_p = 20\text{ ms}$; Fig. 4 ; Fig. 5 | 155 | | | A |
| | | full sine wave; $T_{j(\text{init})} = 25\text{ }^{\circ}\text{C}$; $t_p = 16.7\text{ ms}$ | 170 | | | A |
| T_j | junction temperature | | 125 | | | $^{\circ}\text{C}$ |
| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
| Static characteristics | | | | | | |
| I_{GT} | gate trigger current | $V_D = 12\text{ V}$; $I_T = 0.1\text{ A}$; T2+ G+; $T_j = 25\text{ }^{\circ}\text{C}$; Fig. 7 | 10 | - | 50 | mA |
| | | $V_D = 12\text{ V}$; $I_T = 0.1\text{ A}$; T2+ G-; $T_j = 25\text{ }^{\circ}\text{C}$; Fig. 7 | 10 | - | 50 | mA |
| | | $V_D = 12\text{ V}$; $I_T = 0.1\text{ A}$; T2- G-; $T_j = 25\text{ }^{\circ}\text{C}$; Fig. 7 | 10 | - | 50 | mA |
| | | $V_D = 12\text{ V}$; $I_T = 0.1\text{ A}$; T2- G+; $T_j = 25\text{ }^{\circ}\text{C}$; Fig. 7 | 10 | - | 100 | mA |
| I_H | holding current | $V_D = 12\text{ V}$; $T_j = 25\text{ }^{\circ}\text{C}$; Fig. 9 | - | - | 60 | mA |
| V_T | on-state voltage | $I_T = 20\text{ A}$; $T_j = 25\text{ }^{\circ}\text{C}$; Fig. 10 | - | 1.2 | 1.6 | V |

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------------------|---------------------------------------|--|-----|-----|-----|------------|
| Dynamic characteristics | | | | | | |
| dV_D/dt | rate of rise of off-state voltage | $V_{DM} = 402\text{ V}$; $T_j = 125\text{ °C}$; ($V_{DM} = 67\%$ of V_{DRM}); exponential waveform; gate open circuit | 200 | - | - | V/ μ s |
| dI_{com}/dt | rate of change of commutating current | $V_D = 400\text{ V}$; $T_j = 125\text{ °C}$; $I_{T(RMS)} = 16\text{ A}$; $dV_{com}/dt = 20\text{ V}/\mu\text{s}$; (snubberless condition); gate open circuit | 3 | 14 | - | A/ms |

5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|-----|--------|--------------------------------|--|---|
| 1 | T1 | main terminal 1 |  |  |
| 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 | |
| BT139-600G0 | 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 codes |
|-------------|---------------|
| BT139-600G0 | BT139-600G0 |

8. Limiting values

Table 5. Limiting values

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

| Symbol | Parameter | Conditions | Values | Unit |
|--------------|--------------------------------------|--|------------|------------------------|
| V_{DRM} | repetitive peak off-state voltage | | 600 | V |
| $I_{T(RMS)}$ | RMS on-state current | full sine wave; $T_{mb} \leq 99\text{ }^{\circ}\text{C}$; Fig 1 ; Fig 2 ; Fig 3 | 16 | A |
| I_{TSM} | non-repetitive peak on-state current | full sine wave; $T_{j(init)} = 25\text{ }^{\circ}\text{C}$; $t_p = 20\text{ ms}$; Fig 4 ; Fig 5 | 155 | A |
| | | full sine wave; $T_{j(init)} = 25\text{ }^{\circ}\text{C}$; $t_p = 16.7\text{ ms}$ | 170 | A |
| I^2t | I^2t for fusing | $t_p = 10\text{ ms}$; sine-wave pulse | 120 | A^2s |
| di_T/dt | rate of rise of on-state current | $I_G = 0.2\text{ A}$ | 50 | $\text{A}/\mu\text{s}$ |
| | | $I_G = 0.2\text{ A}$ | 50 | $\text{A}/\mu\text{s}$ |
| | | $I_G = 0.2\text{ A}$ | 50 | $\text{A}/\mu\text{s}$ |
| | | $I_G = 0.2\text{ A}$ | 10 | $\text{A}/\mu\text{s}$ |
| I_{GM} | peak gate current | | 2 | A |
| 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 to 150 | $^{\circ}\text{C}$ |
| T_j | junction temperature | | 125 | $^{\circ}\text{C}$ |

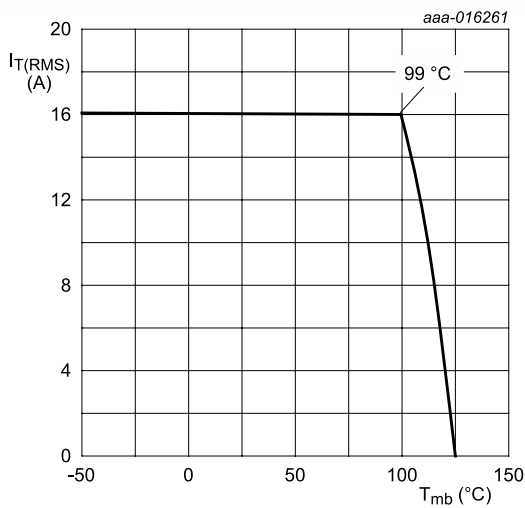
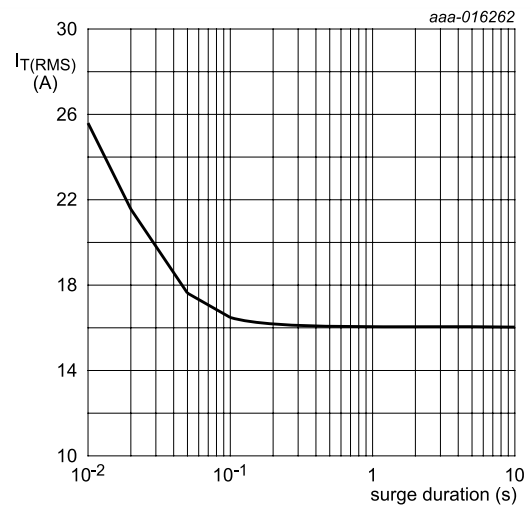


Fig. 1. RMS on-state current as a function of mounting base temperature



$f = 50\text{ Hz}$; $T_{mb} = 99\text{ }^{\circ}\text{C}$

Fig. 2. RMS on-state current as a function of surge duration; maximum values

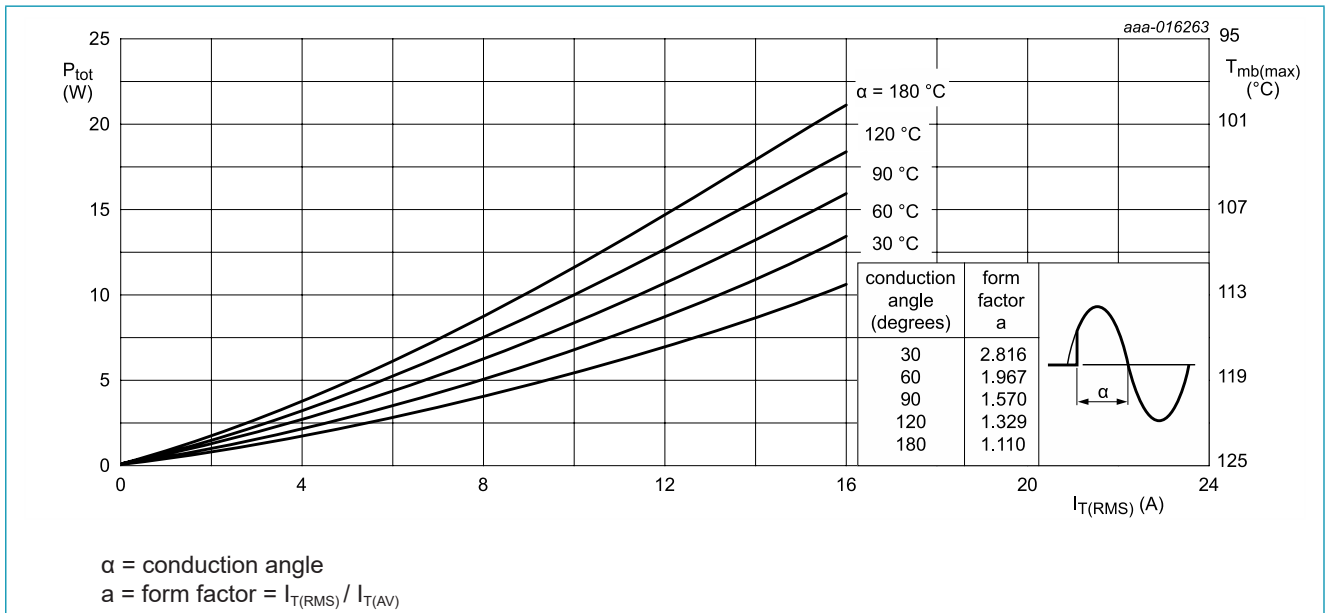


Fig. 3. Total power dissipation as a function of RMS on-state current; maximum values

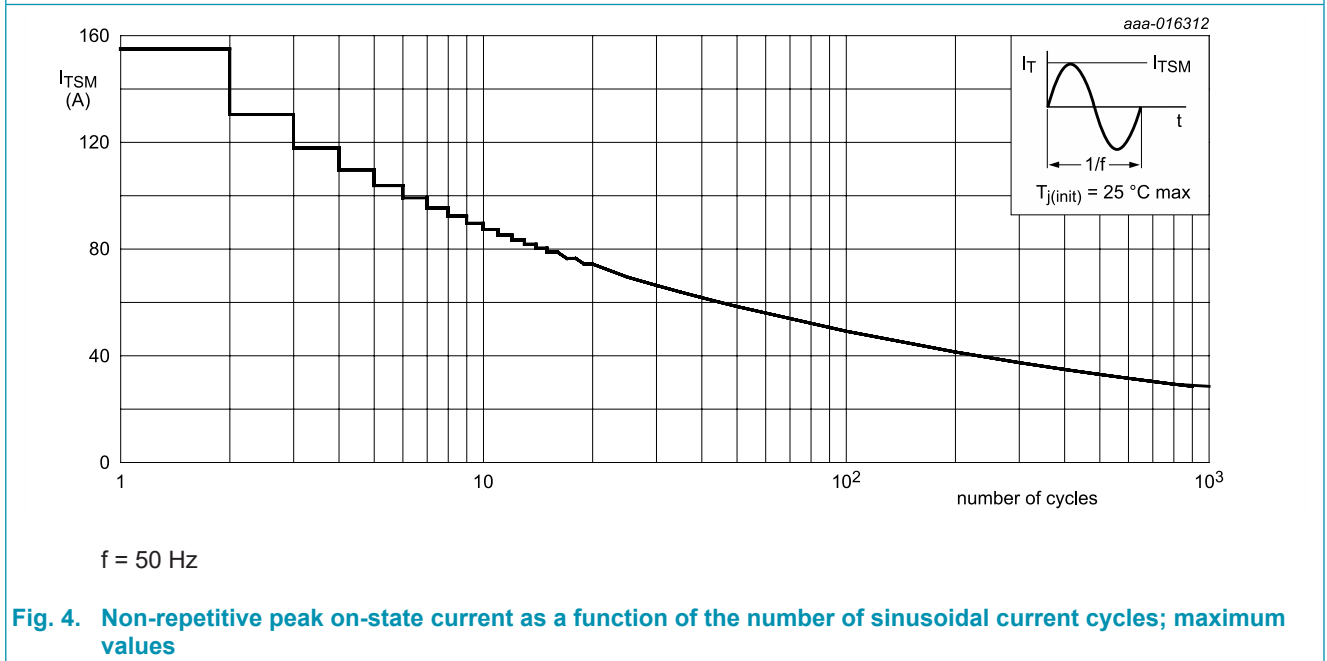


Fig. 4. Non-repetitive peak on-state current as a function of the number of sinusoidal current cycles; maximum values

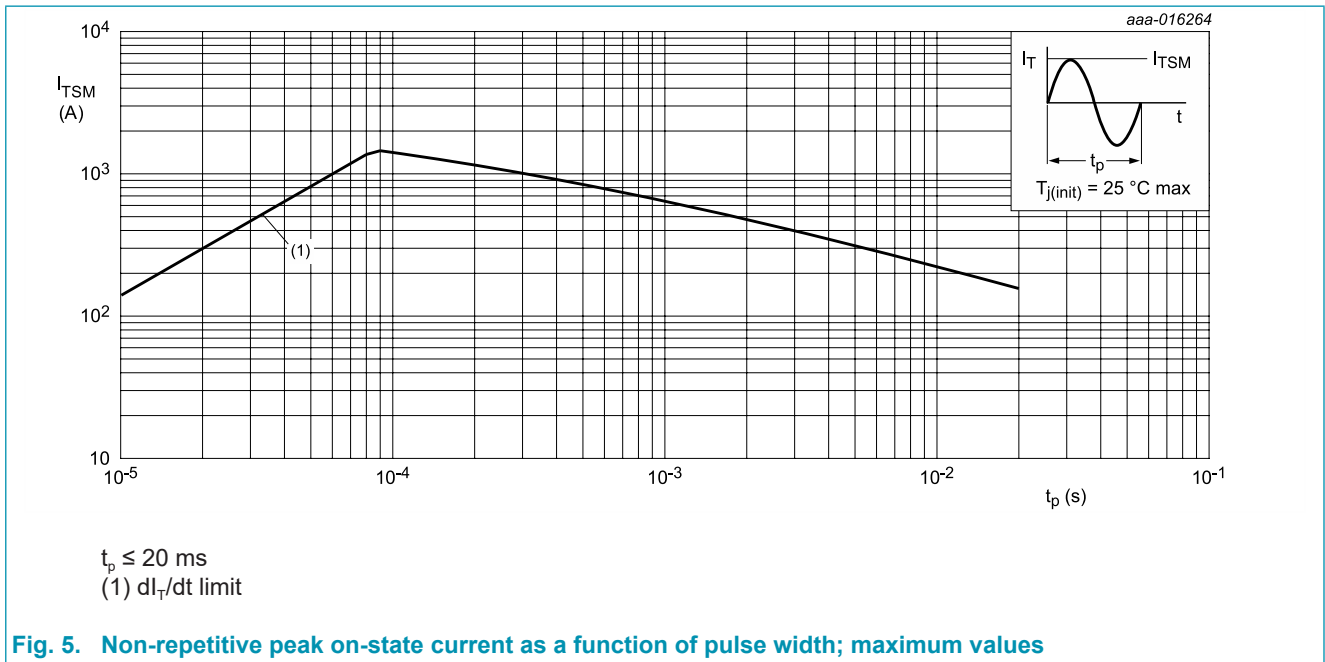


Fig. 5. Non-repetitive peak on-state current as a function of pulse width; maximum values

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; Fig.6 | - | - | 1.2 | K/W |
| | | half cycle | - | - | 1.7 | K/W |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | in free air | - | 60 | - | K/W |

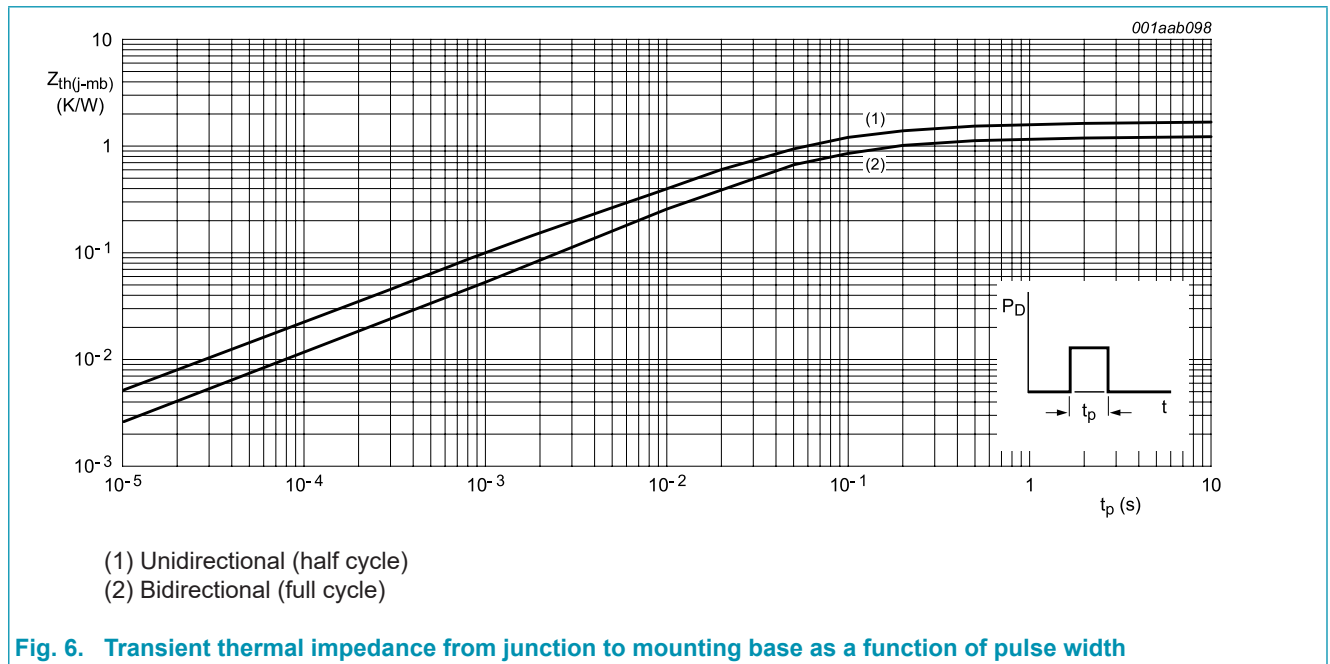
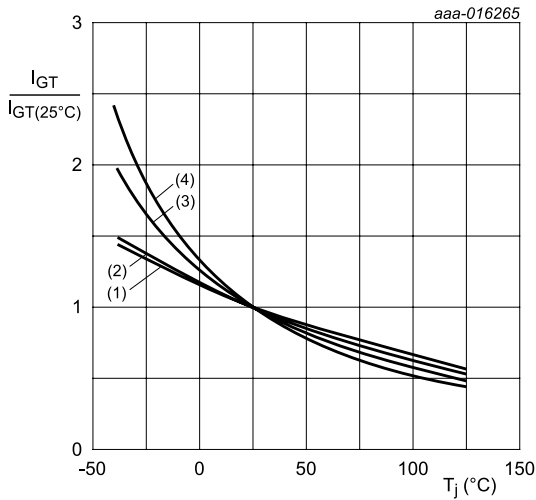


Fig. 6. Transient thermal impedance from junction to mounting base as a function of pulse width

10. Characteristics

Table 7. Characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------------------|---------------------------------------|---|-----|------|-----|------------------------|
| Static characteristics | | | | | | |
| I_{GT} | gate trigger current | $V_D = 12\text{ V}; I_T = 0.1\text{ A}; T_2+ G+;$ $T_J = 25\text{ }^\circ\text{C};$ Fig. 7 | 10 | - | 50 | mA |
| | | $V_D = 12\text{ V}; I_T = 0.1\text{ A}; T_2+ G-;$ $T_J = 25\text{ }^\circ\text{C};$ Fig. 7 | 10 | - | 50 | mA |
| | | $V_D = 12\text{ V}; I_T = 0.1\text{ A}; T_2- G-;$ $T_J = 25\text{ }^\circ\text{C};$ Fig. 7 | 10 | - | 50 | mA |
| | | $V_D = 12\text{ V}; I_T = 0.1\text{ A}; T_2- G+;$ $T_J = 25\text{ }^\circ\text{C};$ Fig. 7 | 10 | - | 100 | mA |
| I_L | latching current | $V_D = 12\text{ V}; I_G = 0.1\text{ A}; T_2+ G+;$ $T_J = 25\text{ }^\circ\text{C};$ Fig. 8 | - | - | 60 | mA |
| | | $V_D = 12\text{ V}; I_G = 0.1\text{ A}; T_2+ G-;$ $T_J = 25\text{ }^\circ\text{C};$ Fig. 8 | - | - | 90 | mA |
| | | $V_D = 12\text{ V}; I_G = 0.1\text{ A}; T_2- G-;$ $T_J = 25\text{ }^\circ\text{C};$ Fig. 8 | - | - | 60 | mA |
| | | $V_D = 12\text{ V}; I_G = 0.1\text{ A}; T_2- G+;$ $T_J = 25\text{ }^\circ\text{C};$ Fig. 8 | - | - | 90 | mA |
| I_H | holding current | $V_D = 12\text{ V}; T_J = 25\text{ }^\circ\text{C};$ Fig. 9 | - | - | 60 | mA |
| V_T | on-state voltage | $I_T = 20\text{ A}; T_J = 25\text{ }^\circ\text{C};$ Fig. 10 | - | 1.2 | 1.6 | V |
| V_{GT} | gate trigger voltage | $V_D = 12\text{ V}; I_T = 0.1\text{ A}; T_J = 25\text{ }^\circ\text{C};$ Fig. 11 | - | 0.7 | 1 | V |
| | | $V_D = 400\text{ V}; I_T = 0.1\text{ A}; T_J = 125\text{ }^\circ\text{C};$ Fig. 11 | 0.2 | 0.45 | - | V |
| I_D | off-state current | $V_D = 600\text{ V}; T_J = 25\text{ }^\circ\text{C}$ | - | - | 10 | μA |
| | | $V_D = 600\text{ V}; T_J = 125\text{ }^\circ\text{C}$ | - | 0.1 | 0.5 | mA |
| Dynamic characteristics | | | | | | |
| 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 | 200 | - | - | $\text{V}/\mu\text{s}$ |
| dI_{com}/dt | rate of change of commutating current | $V_D = 400\text{ V}; T_J = 125\text{ }^\circ\text{C}; I_{T(RMS)} = 16\text{ A};$ $dV_{com}/dt = 20\text{ V}/\mu\text{s};$ (snubberless condition); gate open circuit | 3 | 14 | - | A/ms |
| t_{gt} | gate-controlled turn-on time | $I_{TM} = 20\text{ A}; V_D = 600\text{ V}; I_G = 0.1\text{ mA};$ $dI_G/dt = 5\text{ A}/\mu\text{s}$ | - | 2 | - | μs |



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

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

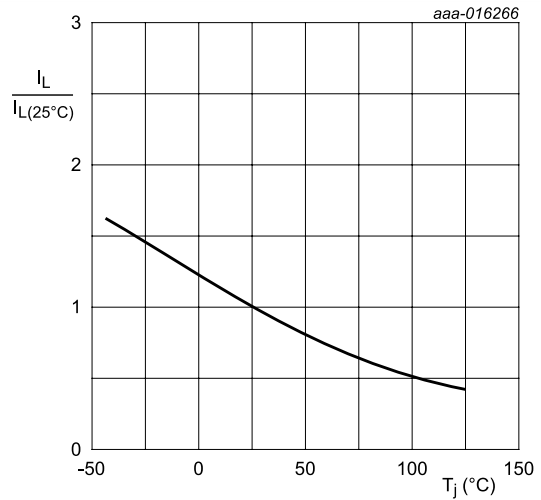


Fig. 8. Normalized latching current as a function of junction temperature

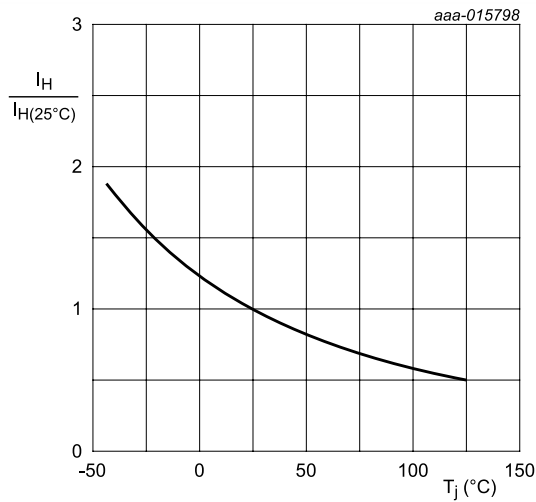
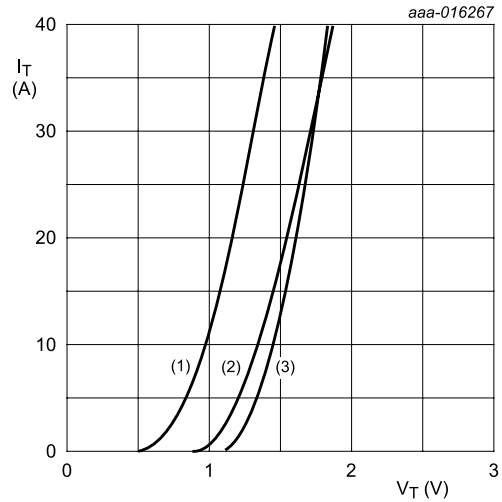


Fig. 9. Normalized holding current as a function of junction temperature



- $V_o = 1.275 \text{ V}; R_s = 0.011 \Omega$
- (1) $T_j = 125 \text{ }^\circ\text{C}$; typical values
 - (2) $T_j = 125 \text{ }^\circ\text{C}$; maximum values
 - (3) $T_j = 25 \text{ }^\circ\text{C}$; maximum values

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

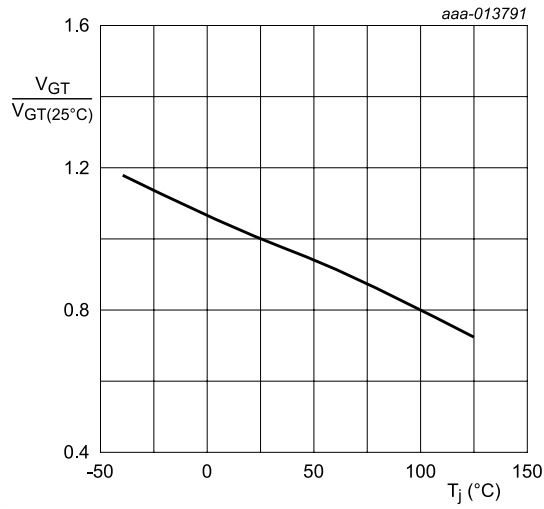


Fig. 11. Normalized gate trigger voltage as a function of junction temperature

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 ₁ | b | b ₁ (2) | b ₂ (2) | c | D | D ₁ | E | e | L | L ₁ (1) | L ₂ (1) max. | p | q | Q |
|------|------------|----------------|------------|--------------------|--------------------|------------|--------------|----------------|-------------|------|--------------|--------------------|----------------------------|------------|------------|------------|
| mm | 4.7 4.1 | 1.40 1.25 | 0.9 0.6 | 1.6 1.0 | 1.3 1.0 | 0.7 0.4 | 16.0 15.2 | 6.6 5.9 | 10.3 9.7 | 2.54 | 15.0 12.8 | 3.30 2.79 | 3.0 | 3.8 3.5 | 3.0 2.7 | 2.6 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 08-06-13 |

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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Date of release: 22 March 2018
