# BT139B-600

## 4Q Triac

Rev.02 - 25 April 2019 Product data sheet

## 1. General description

Planar passivated four quadrant triac in a TO263 (D2PAK) surface-mountable 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.

## 2. Features and benefits

- High blocking voltage capability
- High noise immunity
- Planar passivated for voltage ruggedness and reliability
- Surface-mountable package
- Triggering in all four quadrants

## 3. Applications

- General purpose motor control
- General purpose switching

## 4. Quick reference data

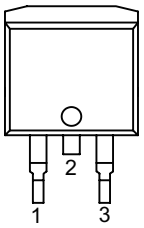
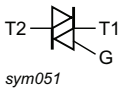
**Table 1. Quick reference data**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Absolute maximum rating** | | | | | | | |
| $V_{DRM}$ | repetitive peak off-state voltage | | | - | - | 600 | V |
| $I_{T(RMS)}$ | RMS on-state current | full sine wave; $T_{mb} \leq 99$ °C; Fig. 1; Fig. 2; Fig. 3 | | - | - | 16 | A |
| $I_{TSM}$ | non-repetitive peak on-state current | full sine wave; $T_{j(init)} = 25$ °C; $t_p = 20$ ms; Fig. 4; Fig. 5 | | - | - | 155 | A |
| | | full sine wave; $T_{j(init)} = 25$ °C; $t_p = 16.7$ ms | | - | - | 170 | A |
| $T_j$ | junction temperature | | | - | - | 125 | °C |
| **Symbol** | **Parameter** | **Conditions** | | **Min** | **Typ** | **Max** | **Unit** |
| **Static characteristics** | | | | | | | |
| $I_{GT}$ | gate trigger current | $V_D = 12$ V; $I_T = 0.1$ A; T2+ G+; $T_j = 25$ °C; Fig. 7 | | - | 5 | 35 | mA |
| | | $V_D = 12$ V; $I_T = 0.1$ A; T2+ G-; $T_j = 25$ °C; Fig. 7 | | - | 8 | 35 | mA |
| | | $V_D = 12$ V; $I_T = 0.1$ A; T2- G-; $T_j = 25$ °C; Fig. 7 | | - | 10 | 35 | mA |

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| | | $V_D$ = 12 V; $I_T$ = 0.1 A; T2- G+; $T_j$ = 25 °C; Fig. 7 | | - | 22 | 70 | mA |
| $I_H$ | holding current | $V_D$ = 12 V; $T_j$ = 25 °C; Fig. 9 | | - | 6 | 45 | mA |
| $V_T$ | on-state voltage | $I_T$ = 20 A; $T_j$ = 25 °C; Fig. 10 | | - | 1.2 | 1.6 | V |
| **Dynamic characteristics** | | | | | | | |
| $dV_D/dt$ | rate of rise of off-state voltage | $V_{DM}$ = 402 V; $T_j$ = 125 °C; ($V_{DM}$ = 67% of $V_{DRM}$); exponential waveform; gate open circuit | | 200 | 250 | - | V/µs |
| $dV_{com}/dt$ | rate of charge of commutating voltage | $V_D$ = 400 V; $T_j$ = 95 °C; $dI_{com}/dt$ = 7.2 A/ms; $I_T$ = 16 A; gate open circuit | | 10 | 20 | - | V/µs |

# 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 | Orderable part number | Packing method | Small packing quantity | Package version | Package issue date |
|---|---|---|---|---|---|---|
| BT139B-600 | TO263 | BT139B-600,118 | Reel | 800 | TO263E | 26-May-2017 |

# 7. Marking

**Table 4. Marking codes**

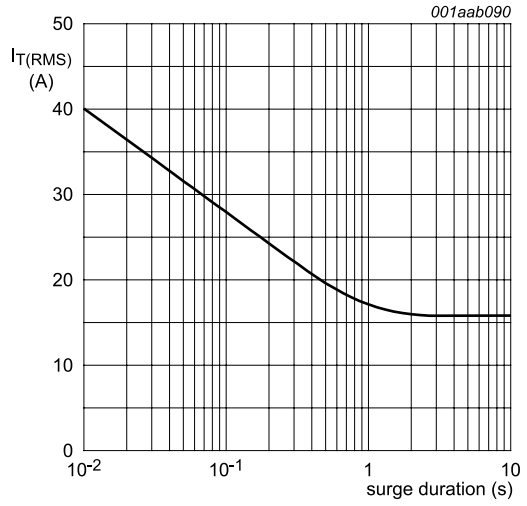
| Type number | Marking codes |
|---|---|
| BT139B-600 | BT139B-600 |

# 8. Limiting values

**Table 5. Limiting values**

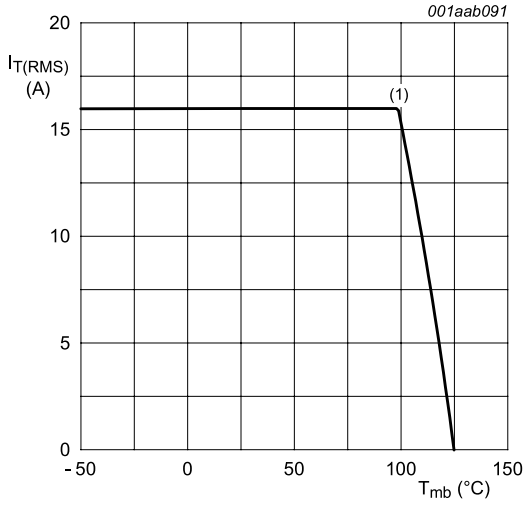
*In accordance with the Absolute Maximum Rating System (IEC 60134).*

| Symbol | Parameter | Conditions | | Min | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{DRM}$ | repetitive peak off-state voltage | | | - | 600 | V |
| $I_{T(RMS)}$ | RMS on-state current | full sine wave; $T_{mb} \leq 99$ °C; Fig 1; Fig 2; Fig 3 | | - | 16 | A |
| $I_{TSM}$ | non-repetitive peak on-state current | full sine wave; $T_{j(init)} = 25$ °C; $t_p = 20$ ms; Fig 4; Fig 5 | | - | 155 | A |
| | | full sine wave; $T_{j(init)} = 25$ °C; $t_p = 16.7$ ms | | - | 170 | A |
| $I^2t$ | $I^2t$ for fusing | $t_p = 10$ ms; SIN | | - | 120 | $A^2s$ |
| $dI_T/dt$ | rate of rise of on-state current | $I_G = 140$ mA | | - | 50 | A/µs |
| $I_{GM}$ | 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 | 150 | °C |
| $T_j$ | junction temperature | | | - | 125 | °C |



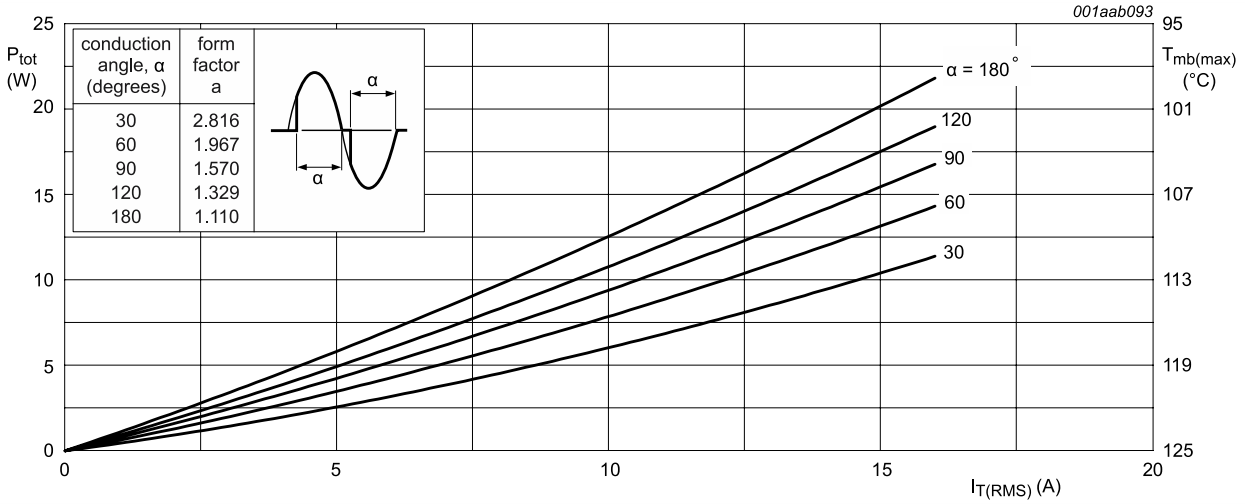

f = 50 Hz; $T_{mb}$ = 99 °C

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




(1) $T_{mb}$ = 99 °C

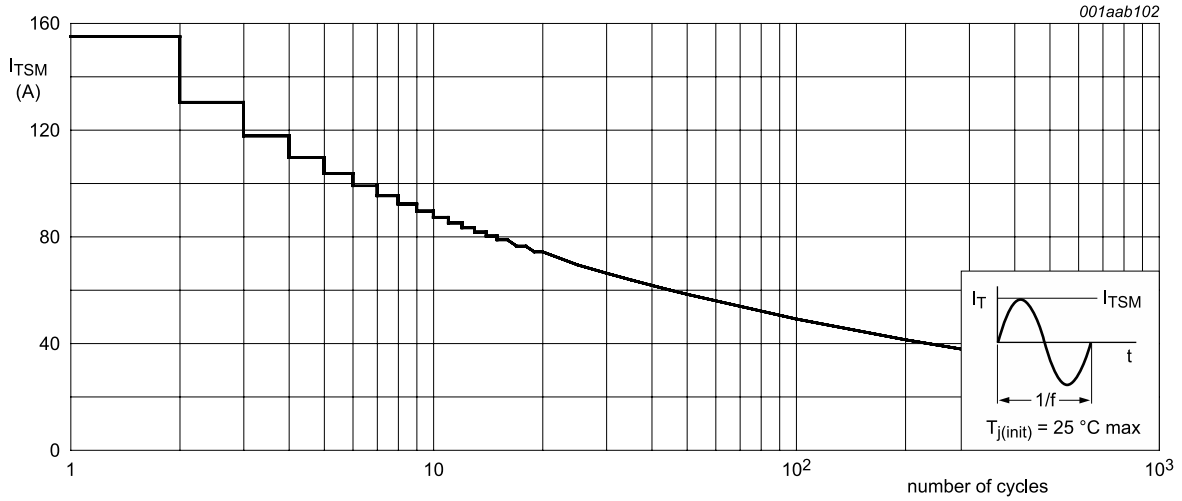
**Fig. 2. RMS on-state current as a function of mounting base temperature; maximum values**




α = conduction angle

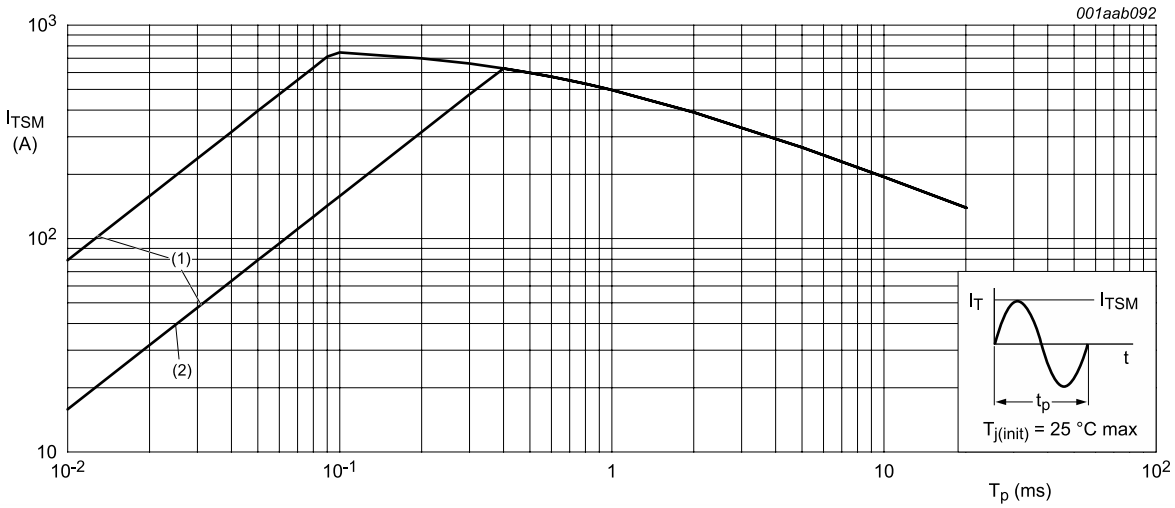
a = form factor = $I_{T(RMS)}$ / $I_{T(AV)}$

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



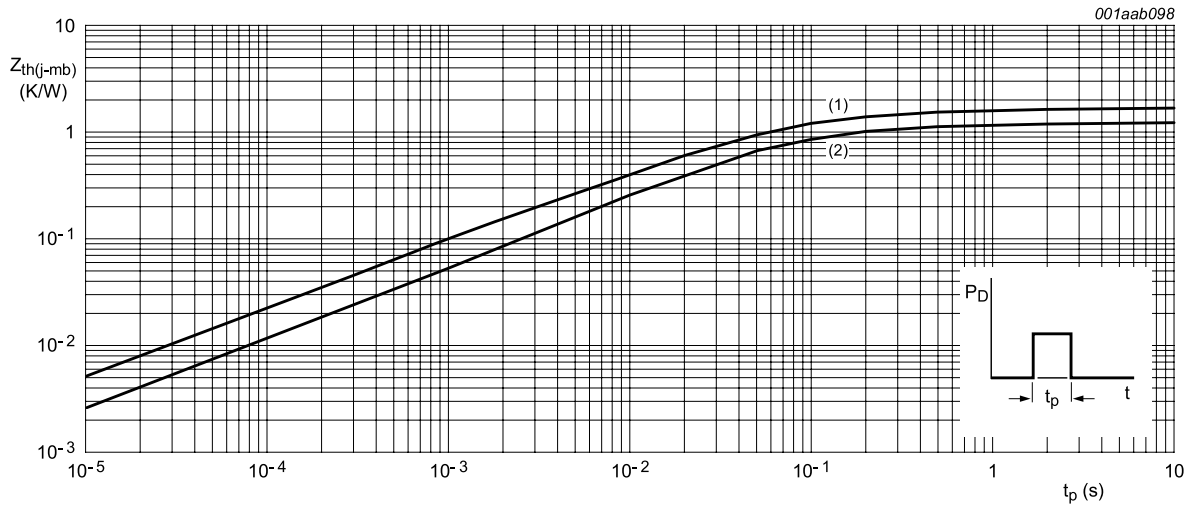

$t_p \leq 20$ ms
(1) $dI_T/dt$ limit
(2) T2- G+ quadrant limit

**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; Fig 6 | | - | - | 1.7 | K/W |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient free air | minimum footprint; FR4 board | | - | 55 | - | K/W |



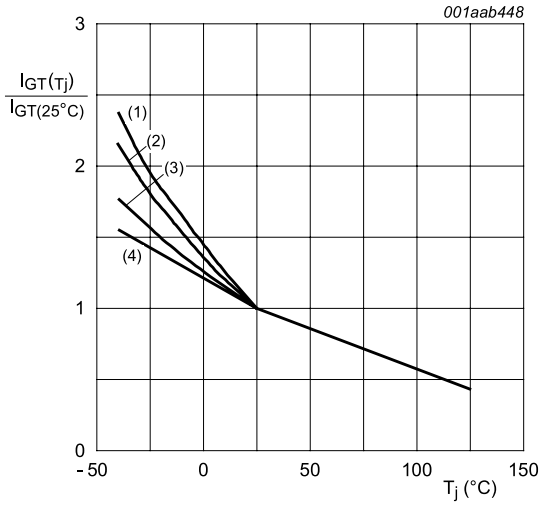

(1) Unidirectional (half cycle)
(2) Bidirectional (full cycle)

**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 V; $I_T$ = 0.1 A; T2+ G+; $T_j$ = 25 °C; Fig. 7 | | - | 5 | 35 | mA |
| | | $V_D$ = 12 V; $I_T$ = 0.1 A; T2+ G-; $T_j$ = 25 °C; Fig. 7 | | - | 8 | 35 | mA |
| | | $V_D$ = 12 V; $I_T$ = 0.1 A; T2- G-; $T_j$ = 25 °C; Fig. 7 | | - | 10 | 35 | mA |
| | | $V_D$ = 12 V; $I_T$ = 0.1 A; T2- G+; $T_j$ = 25 °C; Fig. 7 | | - | 22 | 70 | mA |
| $I_L$ | latching current | $V_D$ = 12 V; $I_G$ = 0.1 A; T2+ G+; $T_j$ = 25 °C; Fig. 8 | | - | 7 | 40 | mA |
| | | $V_D$ = 12 V; $I_G$ = 0.1 A; T2+ G-; $T_j$ = 25 °C; Fig. 8 | | - | 20 | 60 | mA |
| | | $V_D$ = 12 V; $I_G$ = 0.1 A; T2- G-; $T_j$ = 25 °C; Fig. 8 | | - | 8 | 40 | mA |
| | | $V_D$ = 12 V; $I_G$ = 0.1 A; T2- G+; $T_j$ = 25 °C; Fig. 8 | | - | 10 | 60 | mA |
| $I_H$ | holding current | $V_D$ = 12 V; $T_j$ = 25 °C; Fig. 9 | | - | 6 | 45 | mA |
| $V_T$ | on-state voltage | $I_T$ = 20 A; $T_j$ = 25 °C; Fig. 10 | | - | 1.2 | 1.6 | V |
| $V_{GT}$ | gate trigger voltage | $V_D$ = 12 V; $I_T$ = 0.1 A; $T_j$ = 25 °C; Fig. 11 | | - | 0.7 | 1 | V |
| | | $V_D$ = 400 V; $I_T$ = 0.1 A; $T_j$ = 125 °C; Fig. 11 | | 0.25 | 0.4 | - | V |
| $I_D$ | off-state current | $V_D$ = 600 V; $T_j$ = 125 °C | | - | 0.1 | 0.5 | mA |
| **Dynamic characteristics** | | | | | | | |
| $dV_D/dt$ | rate of rise of off-state voltage | $V_{DM}$ = 402 V; $T_j$ = 125 °C; ($V_{DM}$ = 67% of $V_{DRM}$); exponential waveform; gate open circuit | | 200 | 250 | - | V/µs |
| $dV_{com}/dt$ | rate of charge of commutating voltage | $V_D$ = 400 V; $T_j$ = 95 °C; $dI_{com}/dt$ = 7.2 A/ms; $I_T$ = 16 A; gate open circuit | | 10 | 20 | - | V/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**

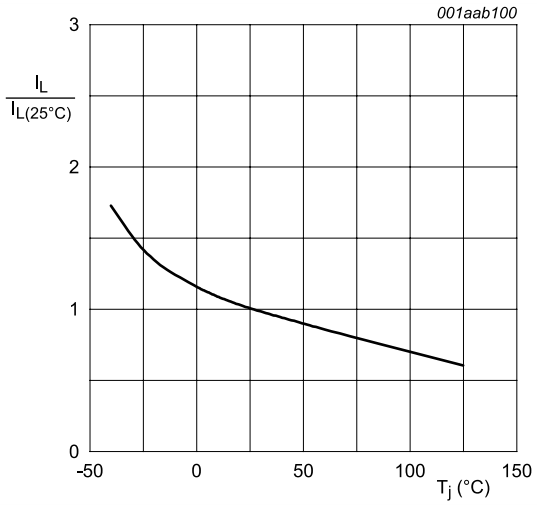



**Fig. 8. Normalized latching current as a function of junction temperature**

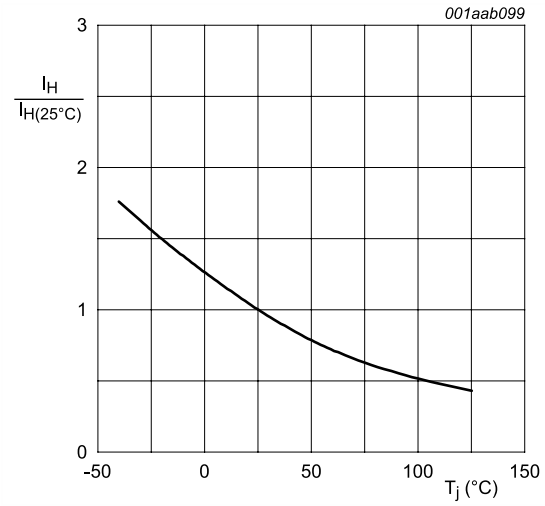
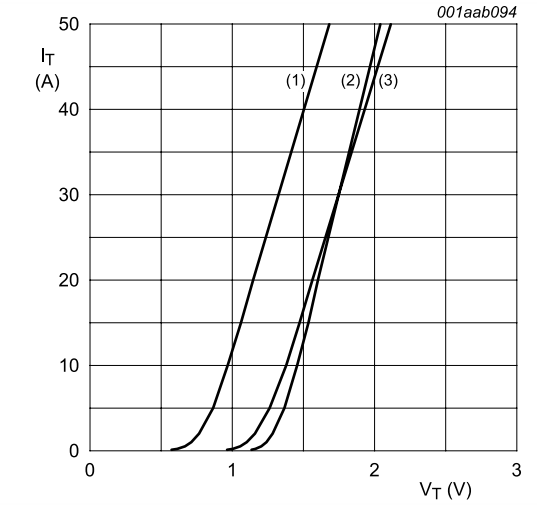



**Fig. 9. Normalized holding current as a function of junction temperature**




$V_o$ = 1.195 V; $R_s$ = 0.018 Ω
(1) $T_j$ = 125 °C; typical values
(2) $T_j$ = 125 °C; maximum values
(3) $T_j$ = 25 °C; maximum values

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

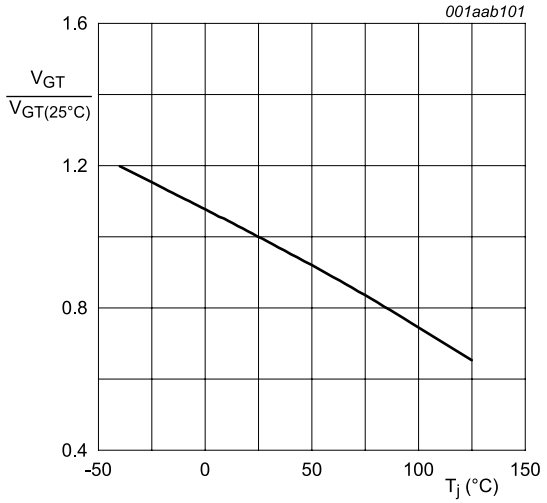
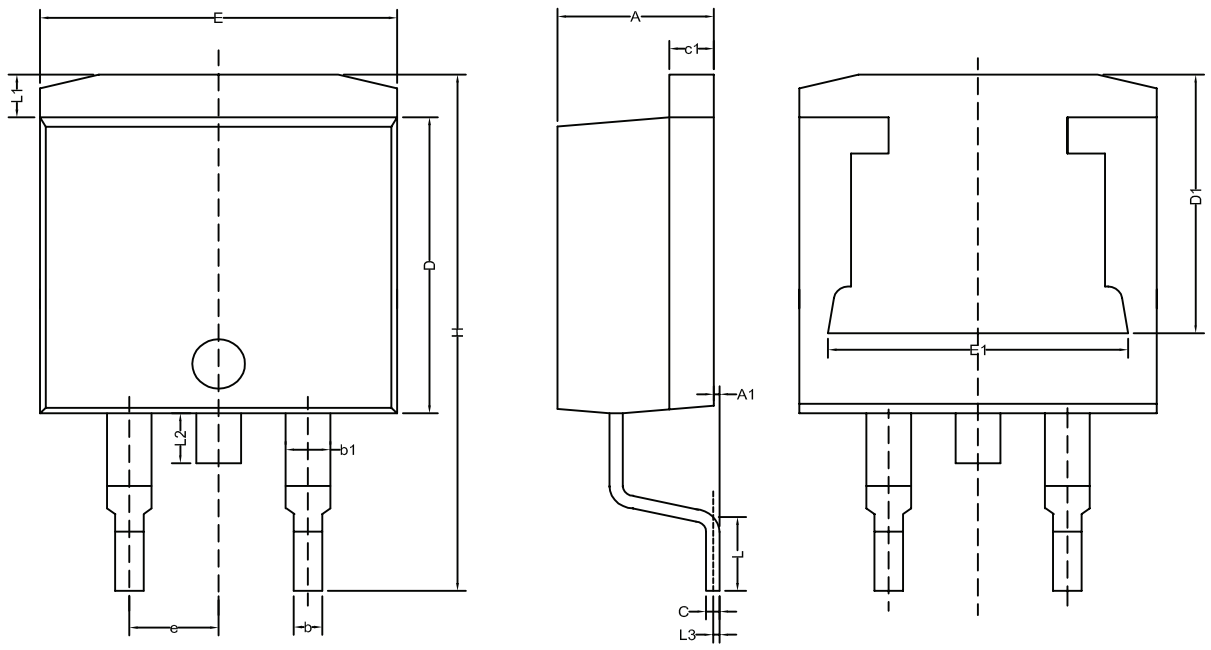
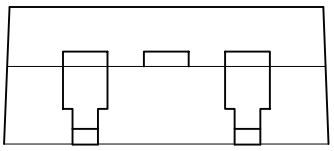



**Fig. 11. Normalized gate trigger voltage as a function of junction temperature**

## 11. Package outline

Plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped) TO263



| Unit | | A | A1 | b | b1 | c | c1 | D | D1 | E | E1 | e | H | L | L1 | L2 | L3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MM | min | 4.35 | 0.00 | 0.69 | 1.14 | 0.38 | 1.14 | 8.50 | 7.50 | 10.00 | 8.25 | 2.54 (BSC) | 14.60 | 2.50 | 1.00 | 1.27 | 0.25 (BSC.) |
| | max | 4.75 | 0.15 | 0.99 | 1.73 | 0.61 | 1.40 | 9.02 | 8.00 | 10.40 | 8.80 | | 15.60 | 2.79 | 1.65 | 1.78 | |

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