

## 1. General description

Planar passivated high commutation three quadrant triac in a SOT186A (TO-220F) "full pack" plastic package. This "series E" triac balances the requirements of commutation performance and gate sensitivity and is intended for interfacing with low power drivers including microcontrollers.

## 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 voltage capability
- Isolated mounting base package
- Planar passivated for voltage ruggedness and reliability
- Sensitive gate for easy logic level triggering
- Triggering in three quadrants only

## 3. Applications

- Electronic thermostats (heating and cooling)
- High power motor controls e.g. washing machines and vacuum cleaners

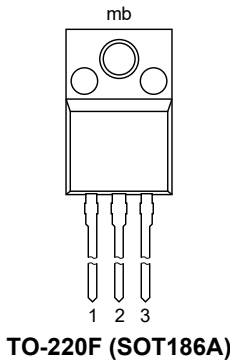
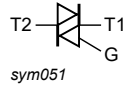
## 4. Quick reference data

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; $T_h \leq 59\text{ °C}$ ; <a href="#">Fig. 1</a> ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 3</a> | -   | -   | 12  | A    |
| <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>              | -   | -   | 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>              | -   | -   | 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>              | -   | -   | 10  | mA   |

## 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 |
| BTA312X-600E    | TO-220F | plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3-lead TO-220 "full pack" | SOT186A |
| BTA312X-600E/DG | TO-220F | plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3-lead TO-220 "full pack" | SOT186A |

## 7. Marking

Table 4. Marking codes

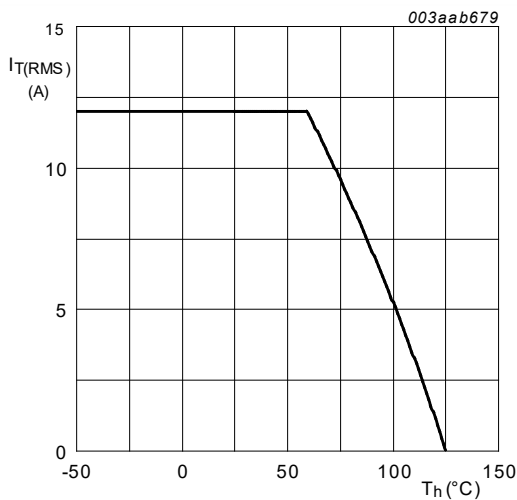
| Type number     | Marking code   |
|-----------------|----------------|
| BTA312X-600E    |                |
| BTA312X-600E/DG | BTA312X-600EDG |

## 8. Limiting values

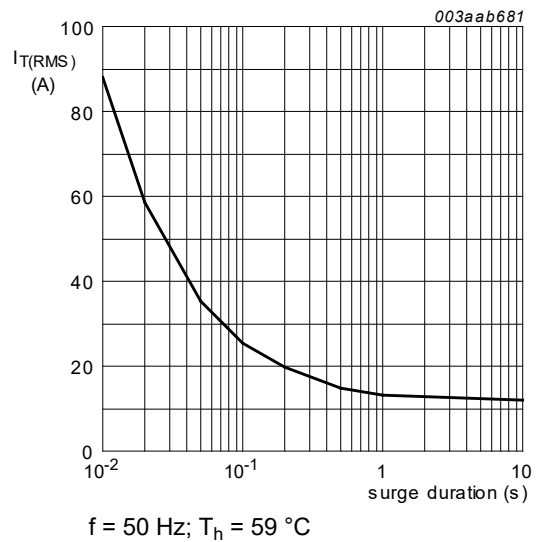
**Table 5. Limiting values**

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; $T_h \leq 59\text{ }^\circ\text{C}$ ; <a href="#">Fig. 1</a> ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 3</a>           | -   | 12  | A                      |
| $I_{TSM}$    | non-repetitive peak on-state current | full sine wave; $T_{j(\text{init})} = 25\text{ }^\circ\text{C}$ ; $t_p = 20\text{ ms}$ ; <a href="#">Fig. 4</a> ; <a href="#">Fig. 5</a> | -   | 100 | A                      |
|              |                                      | full sine wave; $T_{j(\text{init})} = 25\text{ }^\circ\text{C}$ ; $t_p = 16.7\text{ ms}$   | -   | 110 | A                      |
| $I^2t$       | $I^2t$ for fusing                    | $t_p = 10\text{ ms}$ ; SIN   | -   | 50  | $\text{A}^2\text{s}$   |
| $di_T/dt$    | rate of rise of on-state current     | $I_G = 0.2\text{ A}$   | -   | 100 | $\text{A}/\mu\text{s}$ |
| $I_{GM}$     | 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 | 150 | $^\circ\text{C}$       |
| $T_j$        | junction temperature                 |  | -   | 125 | $^\circ\text{C}$       |



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



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

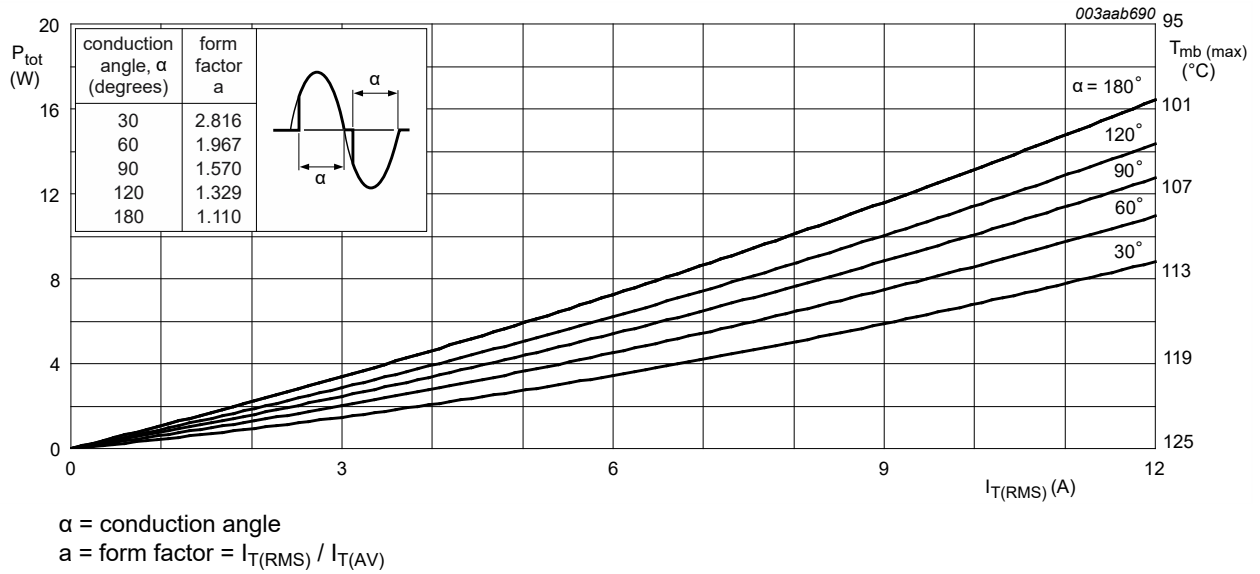


Fig. 3. Total power dissipation as a function of RMS on-state current; maximum values

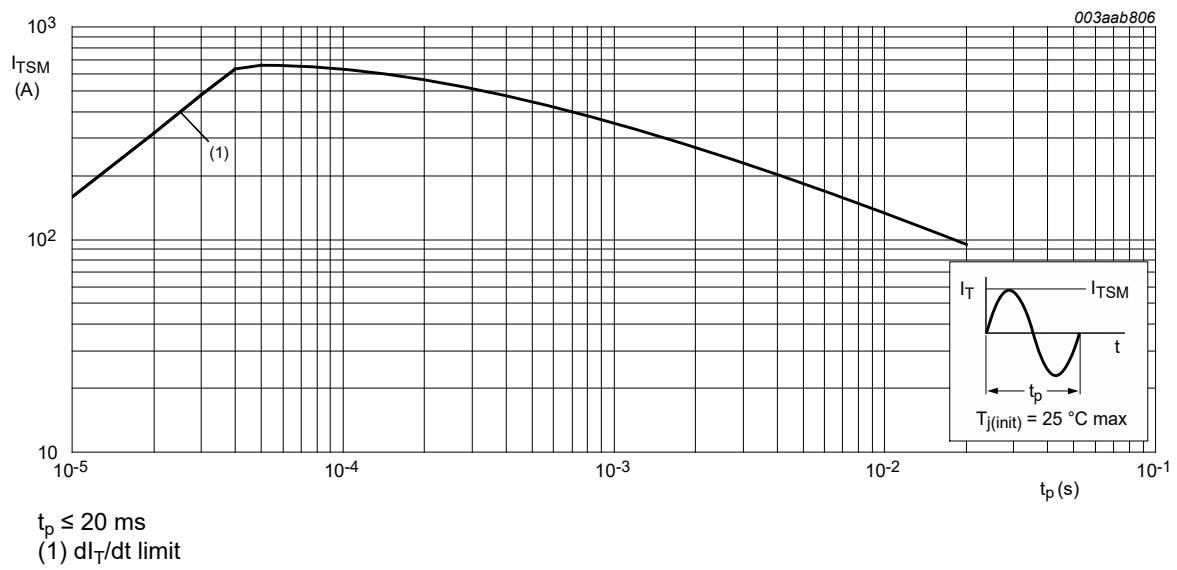
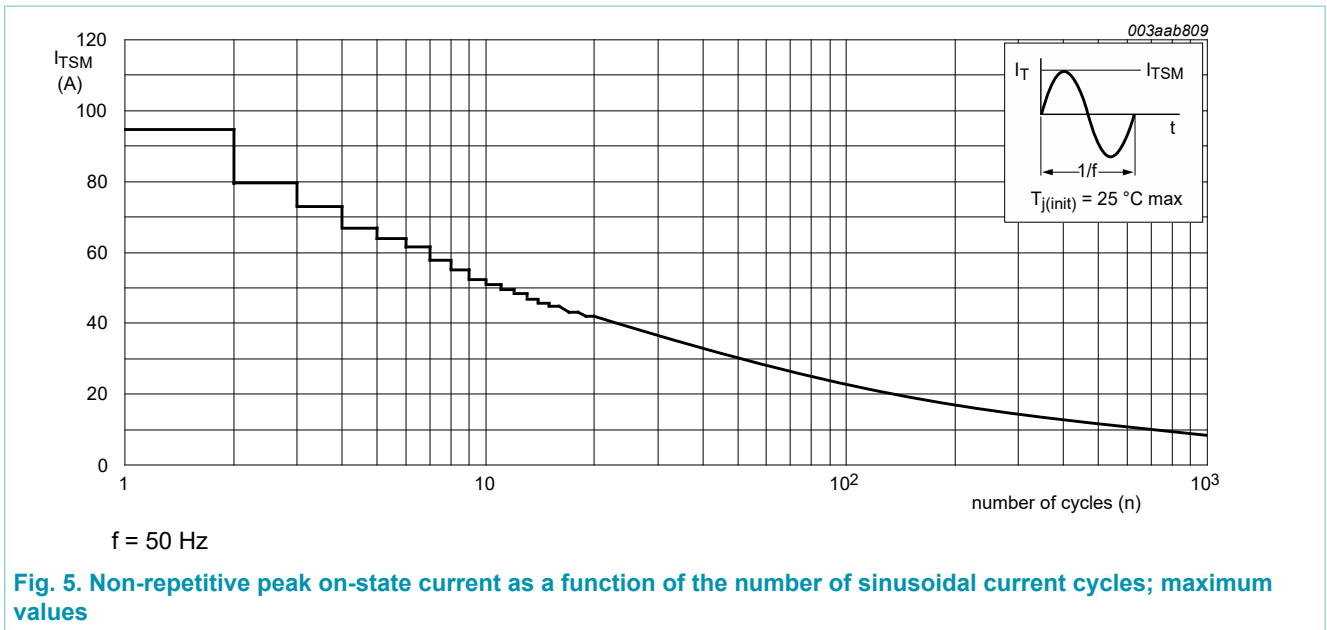


Fig. 4. Non-repetitive peak on-state current as a function of pulse duration; maximum values



## 9. Thermal characteristics

Table 6. Thermal characteristics

| Symbol        | Parameter  | Conditions  | Min | Typ | Max | Unit |
|---------------|--|---|-----|-----|-----|------|
| $R_{th(j-h)}$ | thermal resistance from junction to heatsink         | full cycle or half cycle; with heatsink compound; Fig. 6    | -   | -   | 4   | K/W  |
|               |  | full cycle or half cycle; without heatsink compound; Fig. 6 | -   | -   | 5.5 | K/W  |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient free air | in free air   | -   | 55  | -   | K/W  |

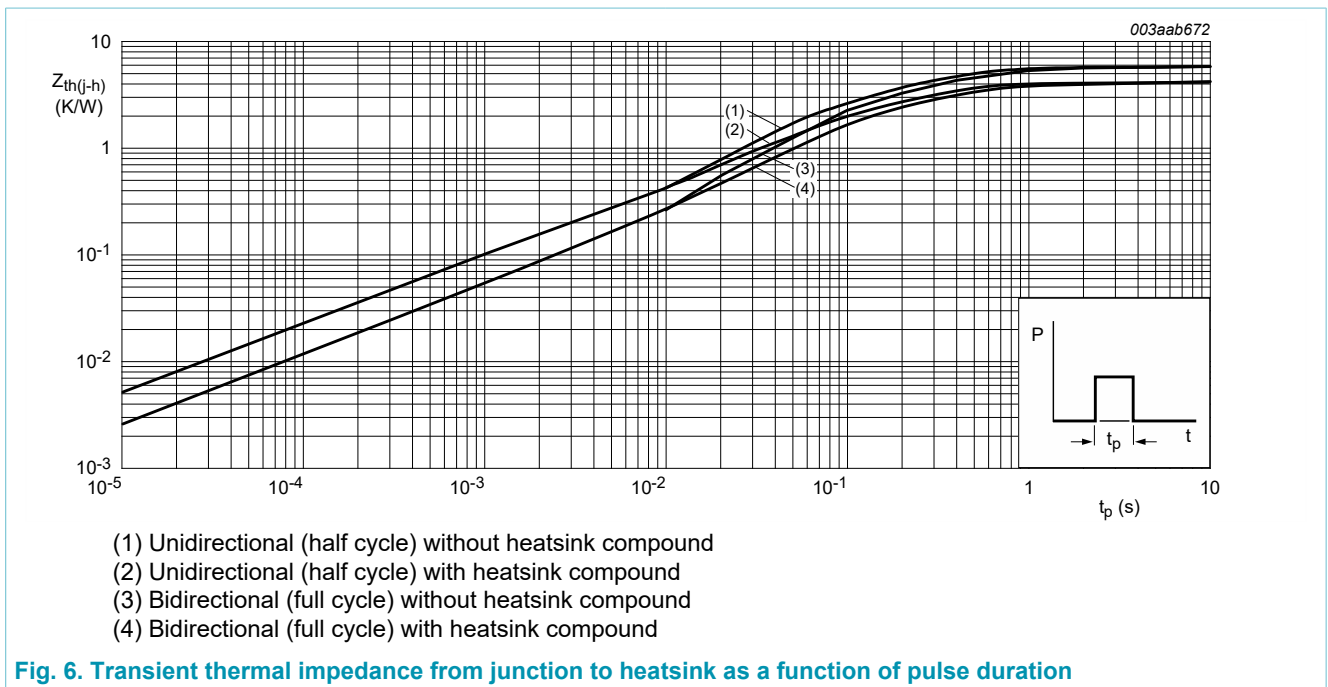


Fig. 6. Transient thermal impedance from junction to heatsink as a function of pulse duration

## 10. Isolation characteristics

Table 7. Isolation characteristics

| Symbol          | Parameter             | Conditions   | Min | Typ | Max  | Unit |
|-----------------|-----------------------|--|-----|-----|------|------|
| $V_{isol(RMS)}$ | RMS isolation voltage | from all terminals to external heatsink; sinusoidal waveform; clean and dust free; $50\text{ Hz} \leq f \leq 60\text{ Hz}$ ; $RH \leq 65\%$ ; $T_h = 25\text{ }^\circ\text{C}$ | -   | -   | 2500 | V    |
| $C_{isol}$      | isolation capacitance | from main terminal 2 to external heatsink; $f = 1\text{ MHz}$ ; $T_h = 25\text{ }^\circ\text{C}$   | -   | 10  | -    | pF   |

## 11. Characteristics

Table 8. 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>   | -    | -   | 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>   | -    | -   | 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>   | -    | -   | 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                  | $V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; $T_j = 25\text{ °C}$ ;<br><a href="#">Fig. 11</a>  | -    | 0.7 | 1   | V          |
|                                |                                       | $V_D = 400\text{ V}$ ; $I_T = 0.1\text{ A}$ ; $T_j = 125\text{ °C}$ ;<br><a href="#">Fig. 11</a>  | 0.25 | 0.4 | -   | V          |
| $I_D$                          | off-state current                     | $V_D = 600\text{ V}$ ; $T_j = 125\text{ °C}$  | -    | 0.1 | 0.5 | mA         |
| <b>Dynamic characteristics</b> |                                       |   |      |     |     |            |
| $dV_D/dt$                      | rate of rise of off-state voltage     | $V_{DM} = 402\text{ V}$ ; $T_j = 125\text{ °C}$ ; ( $V_{DM} = 67\%$ of $V_{DRM}$ ); exponential waveform; gate open circuit   | 50   | -   | -   | V/ $\mu$ s |
| $dI_{com}/dt$                  | rate of change of commutating current | $V_D = 400\text{ V}$ ; $T_j = 125\text{ °C}$ ; $I_{T(RMS)} = 12\text{ A}$ ;<br>$dV_{com}/dt = 20\text{ V}/\mu\text{s}$ ; (snubberless condition); gate open circuit | 3    | -   | -   | A/ms       |
|                                |                                       | $V_D = 400\text{ V}$ ; $T_j = 125\text{ °C}$ ; $I_{T(RMS)} = 12\text{ A}$ ;<br>$dV_{com}/dt = 10\text{ V}/\mu\text{s}$ ; gate open circuit                          | 6    | -   | -   | A/ms       |
|                                |                                       | $V_D = 400\text{ V}$ ; $T_j = 125\text{ °C}$ ; $I_{T(RMS)} = 12\text{ A}$ ;<br>$dV_{com}/dt = 1\text{ V}/\mu\text{s}$ ; gate open circuit                           | 10   | -   | -   | A/ms       |

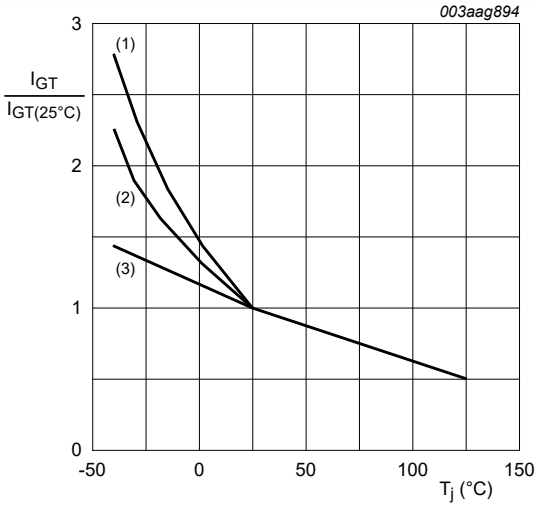


Fig. 7. Normalized gate trigger current as a function of junction temperature

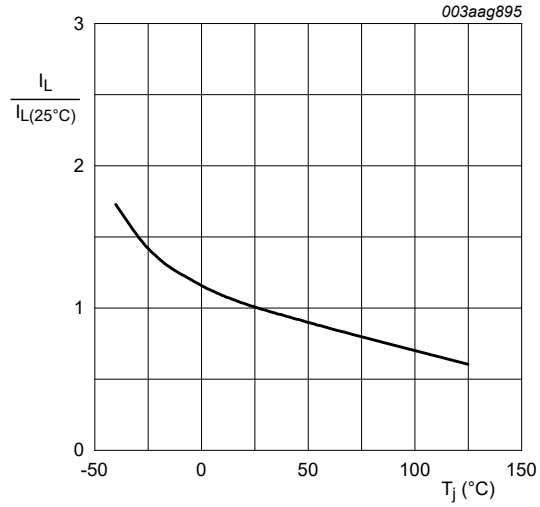


Fig. 8. Normalized latching current as a function of junction temperature

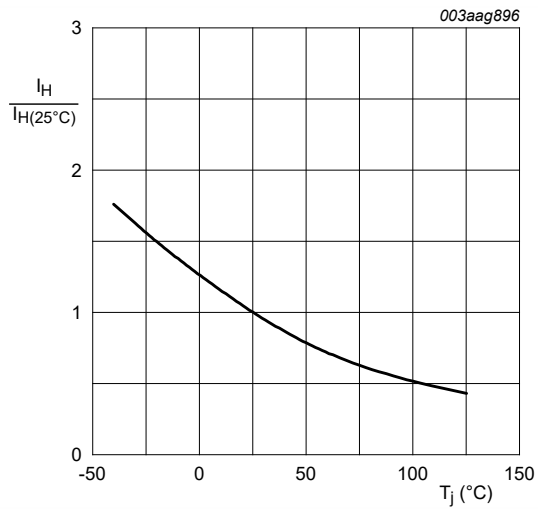
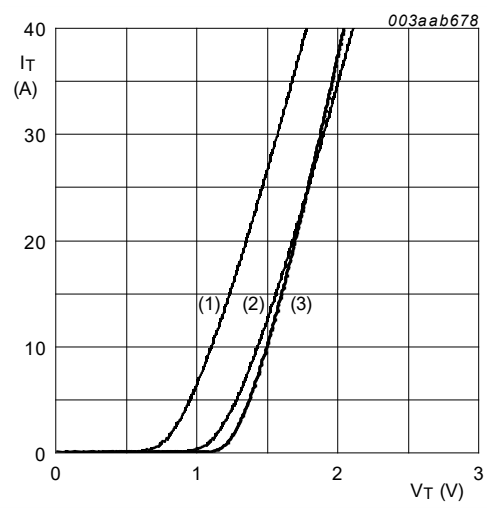


Fig. 9. Normalized holding current as a function of junction temperature



$V_o = 1.164 \text{ V}; R_s = 0.027 \Omega$

- (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



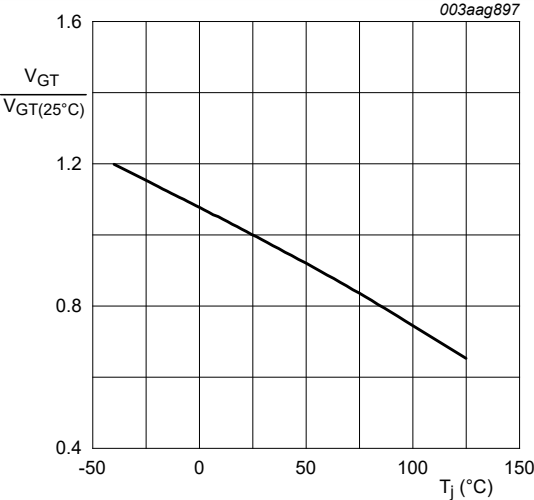


Fig. 11. Normalized gate trigger voltage as a function of junction temperature

## 12. Package outline

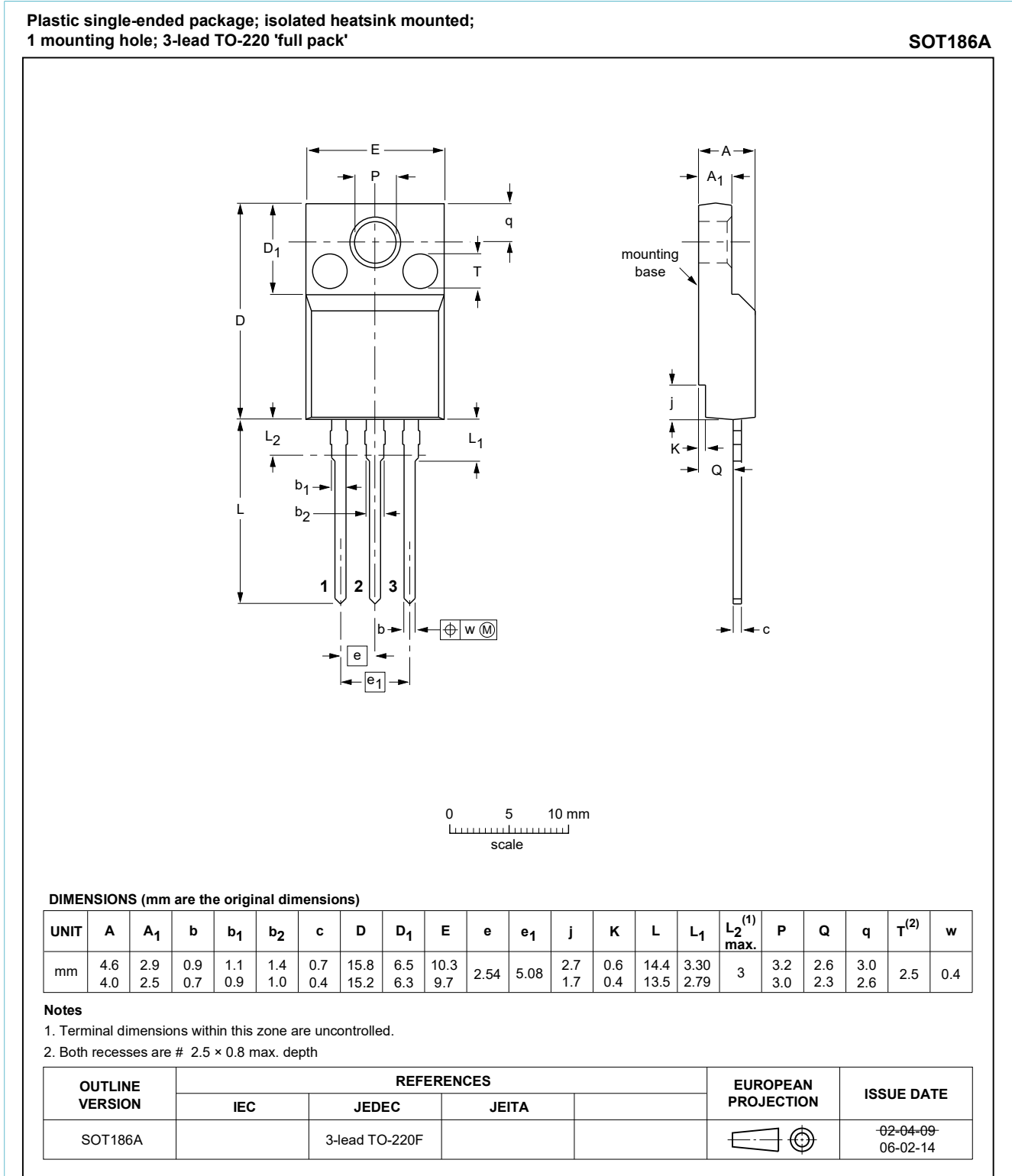


Fig. 12. Package outline TO-220F (SOT186A)

## 13. 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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| 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.
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