

# BTA316X series B, C and E

16 A Three-quadrant triacs high commutation

Rev. 01 — 11 April 2007

Product data sheet

## 1. Product profile

### 1.1 General description

Passivated, new generation, high commutation triacs in a SOT186A isolated full pack plastic package

### 1.2 Features

- Very high commutation performance maximized at each gate sensitivity
- High immunity to dV/dt
- High isolation voltage
- Wide range of gate sensitivities

### 1.3 Applications

- High power motor control - e.g. washing machines and vacuum cleaners
- Refrigeration and air conditioning compressors
- Non-linear rectifier-fed motor loads
- Electronic thermostats

### 1.4 Quick reference data

- $V_{DRM} \leq 600$  V (BTA316X-600B/C/E)
- $I_{GT} \leq 50$  mA (BTA316X series B)
- $V_{DRM} \leq 800$  V (BTA316X-800B/C/E)
- $I_{GT} \leq 35$  mA (BTA316X series C)
- $I_{TSM} \leq 140$  A ( $t = 20$  ms)
- $I_{GT} \leq 10$  mA (BTA316X series E)
- $I_{T(RMS)} \leq 16$  A

## 2. Pinning information

Table 1. Pinning

| Pin | Description             | Simplified outline       | Symbol        |
|-----|-------------------------|--------------------------|---------------|
| 1   | main terminal 1 (T1)    | <p>SOT186A (TO-220F)</p> | <p>sym051</p> |
| 2   | main terminal 2 (T2)    |                          |               |
| 3   | gate (G)                |                          |               |
| mb  | mounting base; isolated |                          |               |

### 3. Ordering information

**Table 2.** Ordering information

| Type number  | Package |                                                                                                     | Version |
|--------------|---------|-----------------------------------------------------------------------------------------------------|---------|
|              | Name    | Description                                                                                         |         |
| BTA316X-600B | TO-220F | plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3-lead TO-220 'full pack' | SOT186A |
| BTA316X-600C |         |                                                                                                     |         |
| BTA316X-600E |         |                                                                                                     |         |
| BTA316X-800B |         |                                                                                                     |         |
| BTA316X-800C |         |                                                                                                     |         |
| BTA316X-800E |         |                                                                                                     |         |

### 4. Limiting values

**Table 3.** 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    | BTA316X-600B; BTA316X-600C; BTA316X-600E                                                                    | [1] - | 600  | V                      |
|                     |                                      | BTA316X-800B; BTA316X-800C; BTA316X-800E                                                                    | -     | 800  | V                      |
| $I_{\text{T(RMS)}}$ | RMS on-state current                 | full sine wave; $T_h \leq 45^\circ\text{C}$ ; see <a href="#">Figure 4</a> and <a href="#">5</a>            | -     | 16   | A                      |
| $I_{\text{TSM}}$    | non-repetitive peak on-state current | full sine wave; $T_j = 25^\circ\text{C}$ prior to surge; see <a href="#">Figure 2</a> and <a href="#">3</a> |       |      |                        |
|                     |                                      | $t = 20\text{ ms}$                                                                                          | -     | 140  | A                      |
|                     |                                      | $t = 16.7\text{ ms}$                                                                                        | -     | 150  | A                      |
| $I^2t$              | $I^2t$ for fusing                    | $t = 10\text{ ms}$                                                                                          | -     | 98   | $\text{A}^2\text{s}$   |
| $di_T/dt$           | rate of rise of on-state current     | $I_{\text{TM}} = 20\text{ A}$ ; $I_G = 0.2\text{ A}$ ; $di_G/dt = 0.2\text{ A}/\mu\text{s}$                 | -     | 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 | $^\circ\text{C}$       |
| $T_j$               | junction temperature                 |                                                                                                             | -     | 125  | $^\circ\text{C}$       |

[1] Although not recommended, off-state voltages up to 800 V may be applied without damage, but the triac may switch to the on-state. The rate of rise of current should not exceed 15 A/ $\mu\text{s}$ .

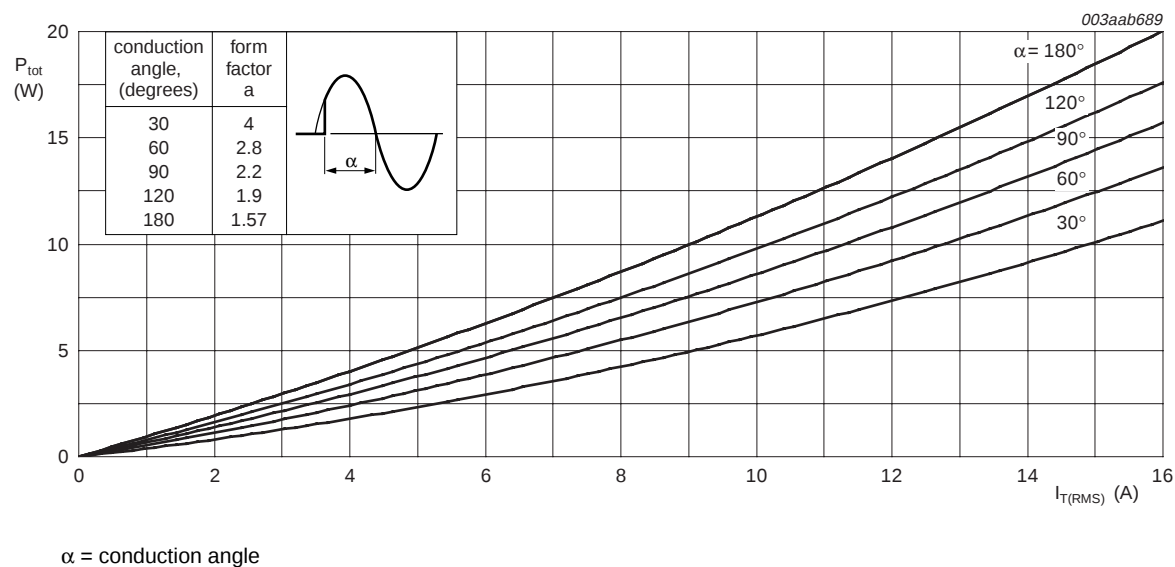


Fig 1. Total power dissipation as a function of RMS on-state current; maximum values

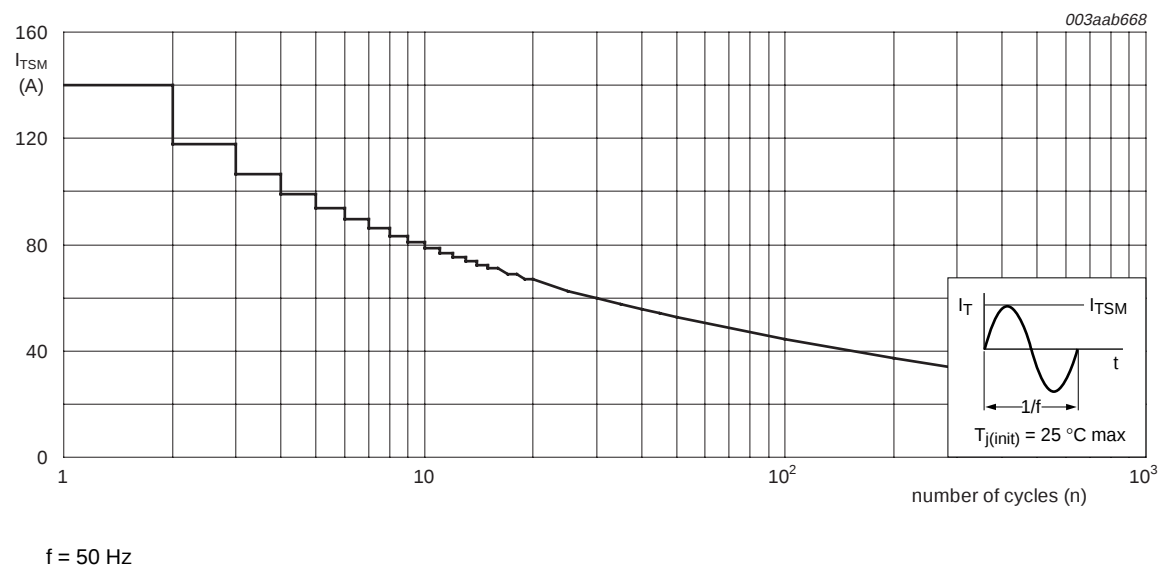
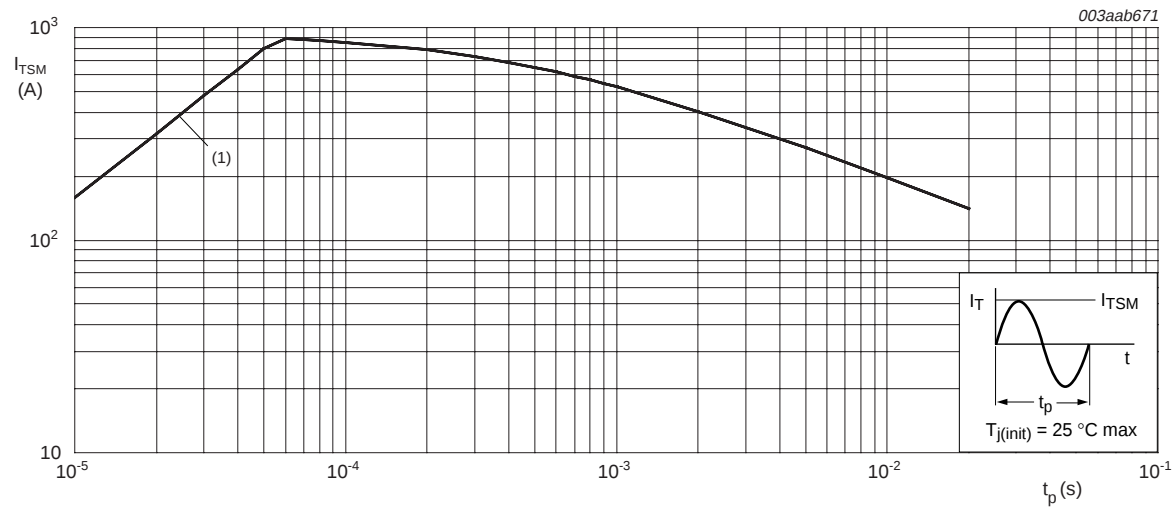
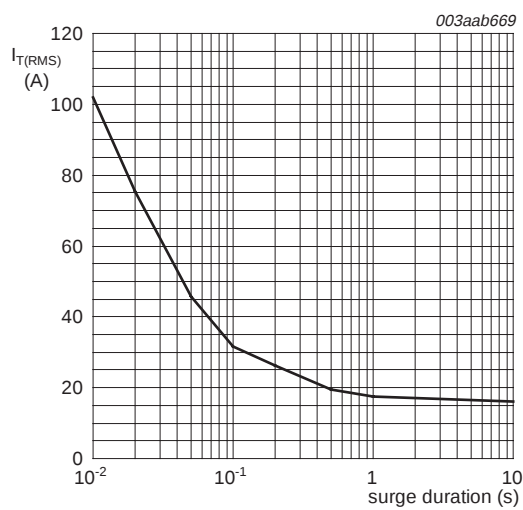


Fig 2. Non-repetitive peak on-state current as a function of the number of sinusoidal current cycles; maximum values



$t_p \leq 20\text{ ms}$   
 (1)  $di_T/dt$  limit

Fig 3. Non-repetitive peak on-state current as a function of pulse duration; maximum values



$f = 50\text{ Hz};$   
 $T_h = 45\text{ }^{\circ}\text{C}$

Fig 4. RMS on-state current as a function of surge duration; maximum values

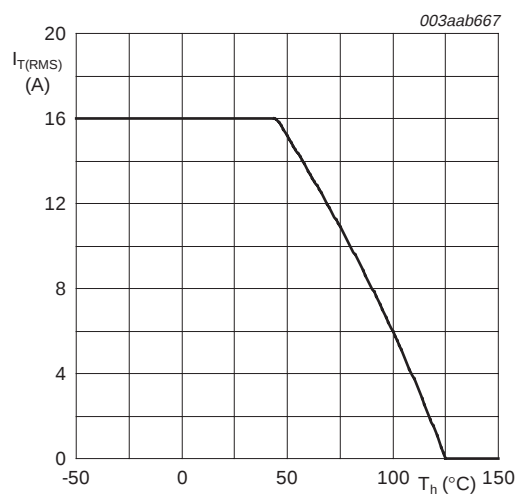
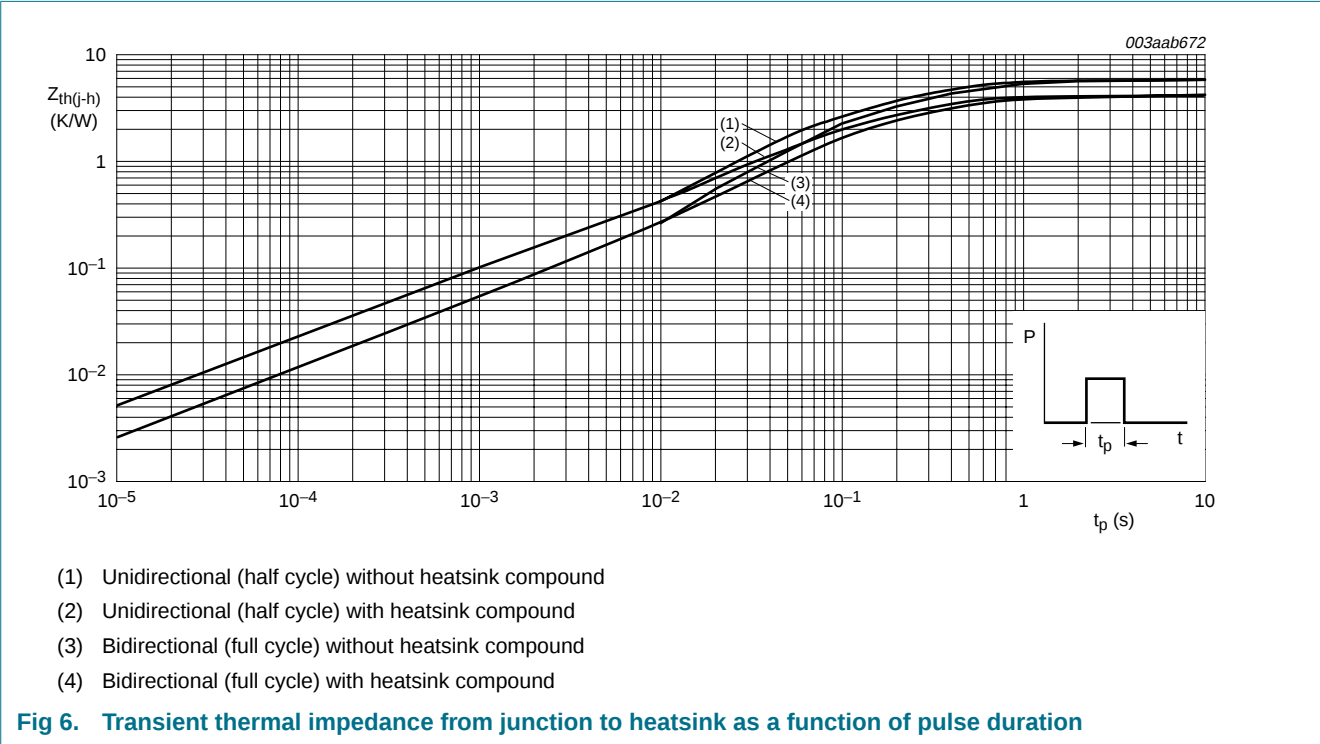


Fig 5. RMS on-state current as a function of heatsink temperature; maximum values

5. Thermal characteristics

Table 4. Thermal characteristics

| Symbol               | Parameter                                    | Conditions                                                                 | Min | Typ | Max | Unit |
|----------------------|----------------------------------------------|----------------------------------------------------------------------------|-----|-----|-----|------|
| R <sub>th(j-h)</sub> | thermal resistance from junction to heatsink | full or half cycle without heatsink compound; see <a href="#">Figure 6</a> | -   | -   | 5.5 | K/W  |
|                      |                                              | full or half cycle with heatsink compound; see <a href="#">Figure 6</a>    | -   | -   | 4.0 | K/W  |
| R <sub>th(j-a)</sub> | thermal resistance from junction to ambient  | in free air                                                                | -   | 55  | -   | K/W  |



6. Isolation characteristics

Table 5. Isolation limiting values and characteristics

$T_h = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

| Symbol                 | Parameter             | Conditions                                                                                                             | Min | Typ | Max  | Unit |
|------------------------|-----------------------|------------------------------------------------------------------------------------------------------------------------|-----|-----|------|------|
| V <sub>isol(RMS)</sub> | RMS isolation voltage | from all three terminals to external heatsink; f = 50 Hz to 60 Hz; sinusoidal waveform; RH ≤ 65 %; clean and dust free | -   | -   | 2500 | V    |
| C <sub>isol</sub>      | isolation capacitance | from pin 2 to external heatsink; f = 1 MHz                                                                             | -   | 10  | -    | pF   |

## 7. Static characteristics

**Table 6. Static characteristics**

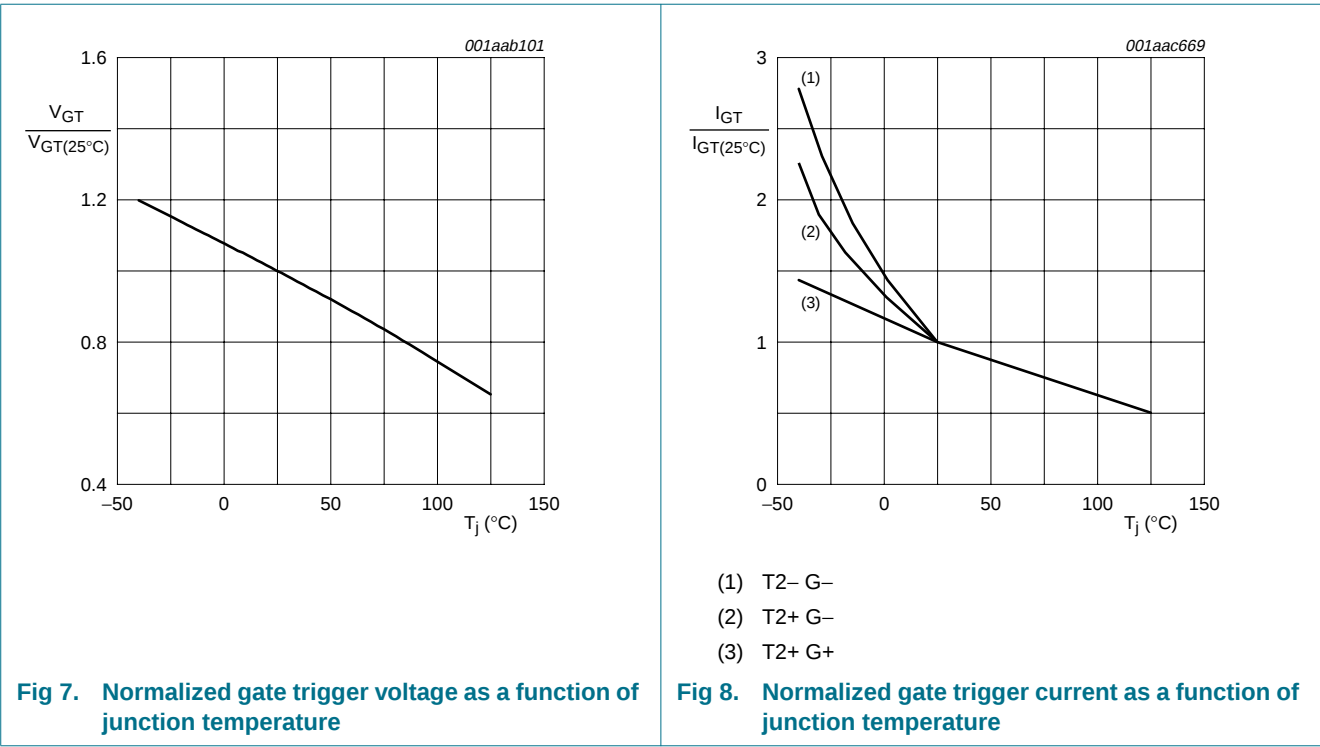
$T_j = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

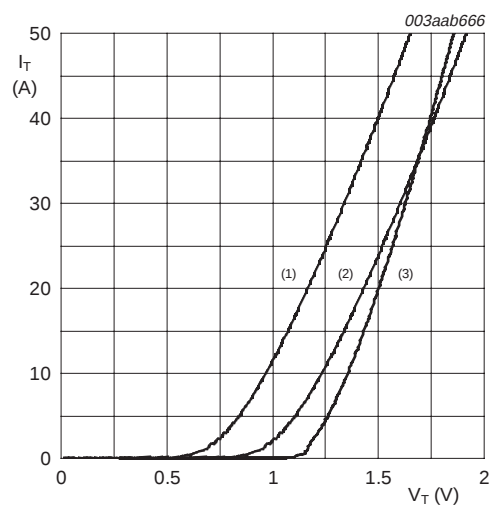
| Symbol   | Parameter            | Conditions                                                                            | BTA316X-600B<br>BTA316X-800B |     |     | BTA316X-600C<br>BTA316X-800C |     |     | BTA316X-600E<br>BTA316X-800E |     |     | Unit |
|----------|----------------------|---------------------------------------------------------------------------------------|------------------------------|-----|-----|------------------------------|-----|-----|------------------------------|-----|-----|------|
|          |                      |                                                                                       | Min                          | Typ | Max | Min                          | Typ | Max | Min                          | Typ | Max |      |
| $I_{GT}$ | gate trigger current | $V_D = 12\text{ V};$<br>$I_T = 0.1\text{ A};$<br>see <a href="#">Figure 8</a>         |                              |     |     |                              |     |     |                              |     |     |      |
|          |                      | T2+ G+                                                                                | 2                            | -   | 50  | 2                            | -   | 35  | -                            | -   | 10  | mA   |
|          |                      | T2+ G-                                                                                | 2                            | -   | 50  | 2                            | -   | 35  | -                            | -   | 10  | mA   |
|          |                      | T2- G-                                                                                | 2                            | -   | 50  | 2                            | -   | 35  | -                            | -   | 10  | mA   |
| $I_L$    | latching current     | $V_D = 12\text{ V};$<br>$I_{GT} = 0.1\text{ A};$<br>see <a href="#">Figure 10</a>     |                              |     |     |                              |     |     |                              |     |     |      |
|          |                      | T2+ G+                                                                                | -                            | -   | 60  | -                            | -   | 50  | -                            | -   | 25  | mA   |
|          |                      | T2+ G-                                                                                | -                            | -   | 90  | -                            | -   | 60  | -                            | -   | 30  | mA   |
|          |                      | T2- G-                                                                                | -                            | -   | 60  | -                            | -   | 50  | -                            | -   | 30  | mA   |
| $I_H$    | holding current      | $V_D = 12\text{ V};$<br>$I_{GT} = 0.1\text{ A};$<br>see <a href="#">Figure 11</a>     | -                            | -   | 60  | -                            | -   | 35  | -                            | -   | 15  | mA   |
| $V_T$    | on-state voltage     | $I_T = 18\text{ A};$<br>see <a href="#">Figure 9</a>                                  | -                            | 1.3 | 1.5 | -                            | 1.3 | 1.5 | -                            | 1.3 | 1.5 | V    |
| $V_{GT}$ | gate trigger voltage | $V_D = 12\text{ V};$<br>$I_T = 0.1\text{ A};$<br>see <a href="#">Figure 7</a>         | -                            | 0.8 | 1.5 | -                            | 0.8 | 1.5 | -                            | 0.8 | 1.5 | V    |
|          |                      | $V_D = 400\text{ V};$<br>$I_T = 0.1\text{ A};$<br>$T_j = 125\text{ }^{\circ}\text{C}$ | 0.25                         | 0.4 | -   | 0.25                         | 0.4 | -   | 0.25                         | 0.4 | -   | V    |
| $I_D$    | off-state current    | $V_D = V_{DRM(max)};$<br>$T_j = 125\text{ }^{\circ}\text{C}$                          | -                            | 0.1 | 0.5 | -                            | 0.1 | 0.5 | -                            | 0.1 | 0.5 | mA   |

## 8. Dynamic characteristics

Table 7. Dynamic characteristics

| Symbol        | Parameter                             | Conditions                                                                                                                                                     | BTA316X-600B<br>BTA316X-800B |     |     | BTA316X-600C<br>BTA316X-800C |     |     | BTA316X-600E<br>BTA316X-800E |     |     | Unit             |
|---------------|---------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|-----|-----|------------------------------|-----|-----|------------------------------|-----|-----|------------------|
|               |                                       |                                                                                                                                                                | Min                          | Typ | Max | Min                          | Typ | Max | Min                          | Typ | Max |                  |
| $dV_D/dt$     | rate of rise of off-state voltage     | $V_{DM} = 0.67 \times V_{DRM(max)}$ ;<br>$T_j = 125\text{ }^{\circ}\text{C}$ ;<br>exponential waveform; gate open circuit                                      | 1000                         | -   | -   | 500                          | -   | -   | 60                           | -   | -   | V/ $\mu\text{s}$ |
| $di_{com}/dt$ | rate of change of commutating current | $V_{DM} = 400\text{ V}$ ;<br>$T_j = 125\text{ }^{\circ}\text{C}$ ;<br>$I_{T(RMS)} = 16\text{ A}$ ;<br>without snubber;<br>gate open circuit                    | 20                           | -   | -   | 15                           | -   | -   | 5                            | -   | -   | A/ms             |
|               |                                       | $V_{DM} = 400\text{ V}$ ;<br>$T_j = 125\text{ }^{\circ}\text{C}$ ;<br>$I_{T(RMS)} = 16\text{ A}$ ;<br>$dV/dt = 10\text{ V}/\mu\text{s}$ ;<br>gate open circuit | -                            | -   | -   | -                            | -   | -   | 8                            | -   | -   | A/ms             |
|               |                                       | $V_{DM} = 400\text{ V}$ ;<br>$T_j = 125\text{ }^{\circ}\text{C}$ ;<br>$I_{T(RMS)} = 16\text{ A}$ ;<br>$dV/dt = 1\text{ V}/\mu\text{s}$ ; gate open circuit     | -                            | -   | -   | -                            | -   | -   | 12                           | -   | -   | A/ms             |
| $t_{gt}$      | gate-controlled turn-on time          | $I_{TM} = 20\text{ A}$ ;<br>$V_D = V_{DRM(max)}$ ;<br>$I_G = 0.1\text{ A}$ ;<br>$di_G/dt = 5\text{ A}/\mu\text{s}$                                             | -                            | 2   | -   | -                            | 2   | -   | -                            | 2   | -   | $\mu\text{s}$    |





$V_0 = 1.024 \text{ V}$

$R_s = 0.021 \text{ } \Omega$

- (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 9. On-state current as a function of on-state voltage

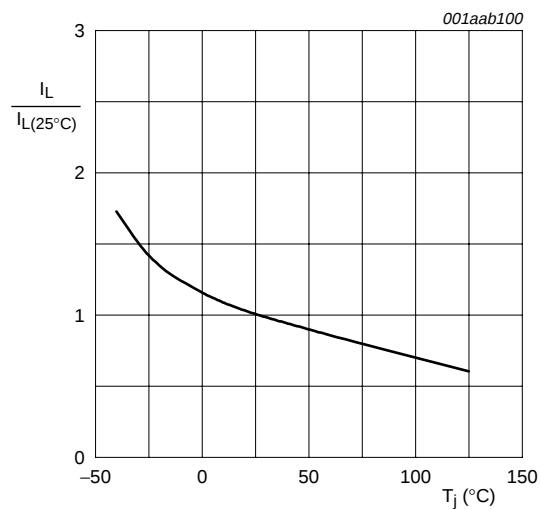


Fig 10. Normalized latching current as a function of junction temperature

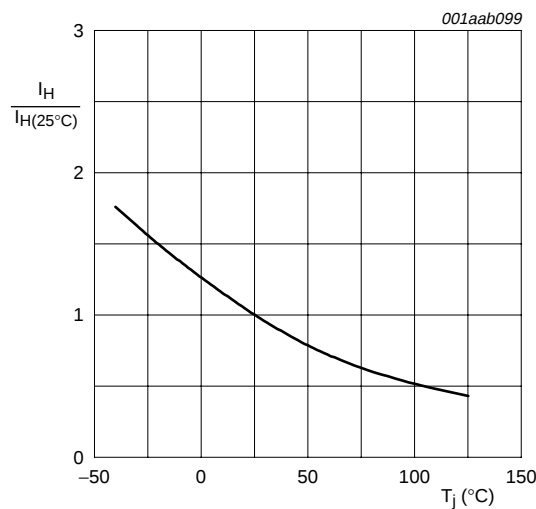


Fig 11. Normalized holding current as a function of junction temperature

## 9. Package information

Epoxy meets UL94 V-0 at 3.175 mm

10. Package outline

Plastic single-ended package; isolated heatsink mounted;  
1 mounting hole; 3-lead TO-220 'full pack'

SOT186A

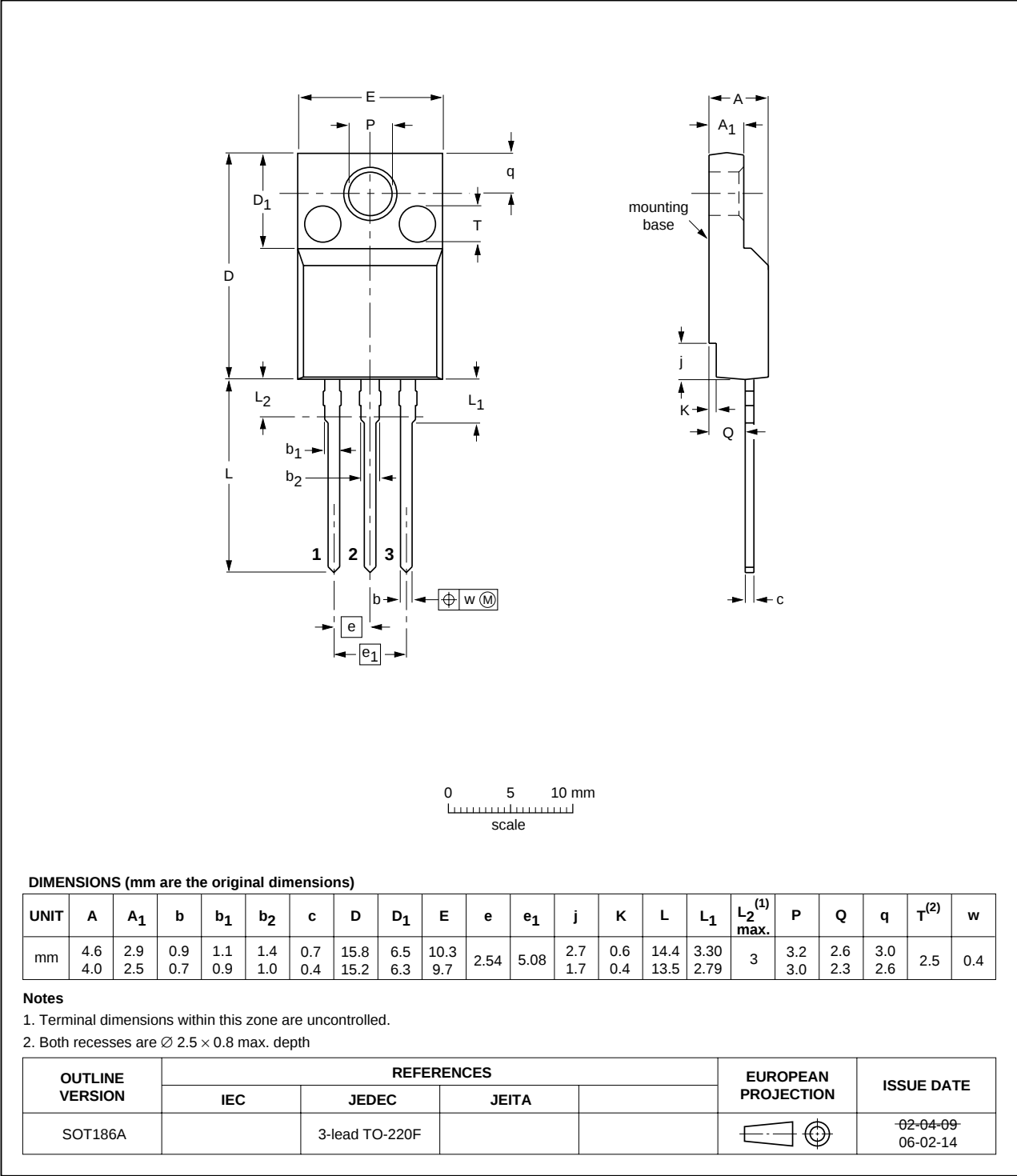


Fig 12. Package outline SOT186A (TO-220F)

11. Revision history

Table 8. Revision history

| Document ID         | Release date | Data sheet status  | Change notice | Supersedes |
|---------------------|--------------|--------------------|---------------|------------|
| BTA316X_SER_B_C_E_1 | 20070411     | Product data sheet | -             | -          |

## 12. Legal information

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| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | 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.

[2] The term 'short data sheet' is explained in section "Definitions".

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