



# BTA204X series D, E and F

Three quadrant triacs guaranteed commutation

Rev. 5 — 3 November 2011

Product data sheet

## 1. Product profile

### 1.1 General description

Passivated guaranteed commutation triacs in a plastic full pack package. These devices balance the requirements of commutation performance and gate sensitivity. The 'sensitive gate' E series and 'logic level' D series are intended for interfacing with low power drivers, including microcontrollers.

### 1.2 Features and benefits

- Suitable for interfacing with low power drivers, including microcontrollers
- Isolated mounting base

### 1.3 Applications

- Motor control
- High inductive loads

### 1.4 Quick reference data

- $V_{DRM} \leq 600$  V (BTA204X-600D)
- $V_{DRM} \leq 600$  V (BTA204X-600E)
- $V_{DRM} \leq 600$  V (BTA204X-600F)
- $V_{DRM} \leq 800$  V (BTA204X-800E)
- $I_{T(RMS)} \leq 4$  A
- $I_{GT} \leq 5$  mA (BTA204X-600D)
- $I_{GT} \leq 10$  mA (BTA204X-600E)
- $I_{GT} \leq 25$  mA (BTA204X-600F)

## 2. Pinning information

Table 1. Pinning

| Pin | Description              | Simplified outline | Symbol |
|-----|--------------------------|--------------------|--------|
| 1   | main terminal 1 (T1)     |                    |        |
| 2   | main terminal 2 (T2)     |                    |        |
| 3   | gate (G)                 |                    |        |
| mb  | mounting base (isolated) |                    |        |

SOT186A (TO-220F)



### 3. Ordering information

Table 2. Ordering information

| Type number  | Package |  | Version |
|--------------|---------|--|---------|
|              | Name    | Description  |         |
| BTA204X-600D | TO-220F | plastic single-ended package; isolated heatsink mounted;<br>1 mounting hole; 3 lead TO-220 'full pack' | SOT186A |
| BTA204X-600E |         |  |         |
| BTA204X-600F |         |  |         |
| BTA204X-800E |         |  |         |

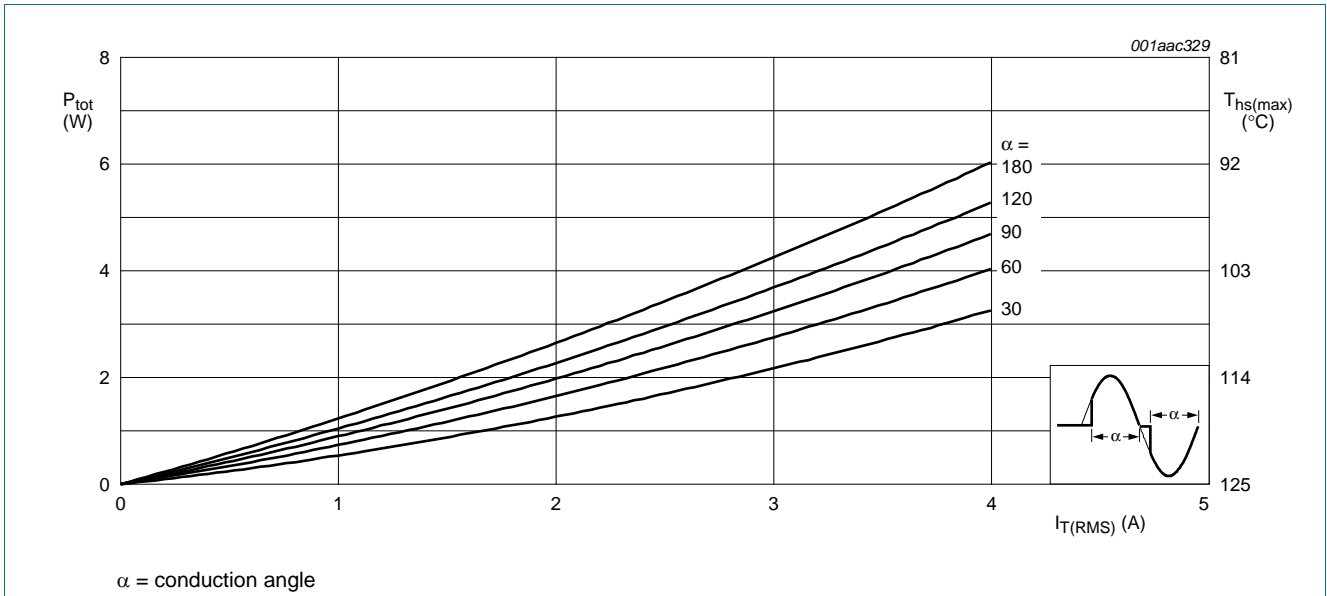
### 4. Limiting values

Table 3. Limiting values

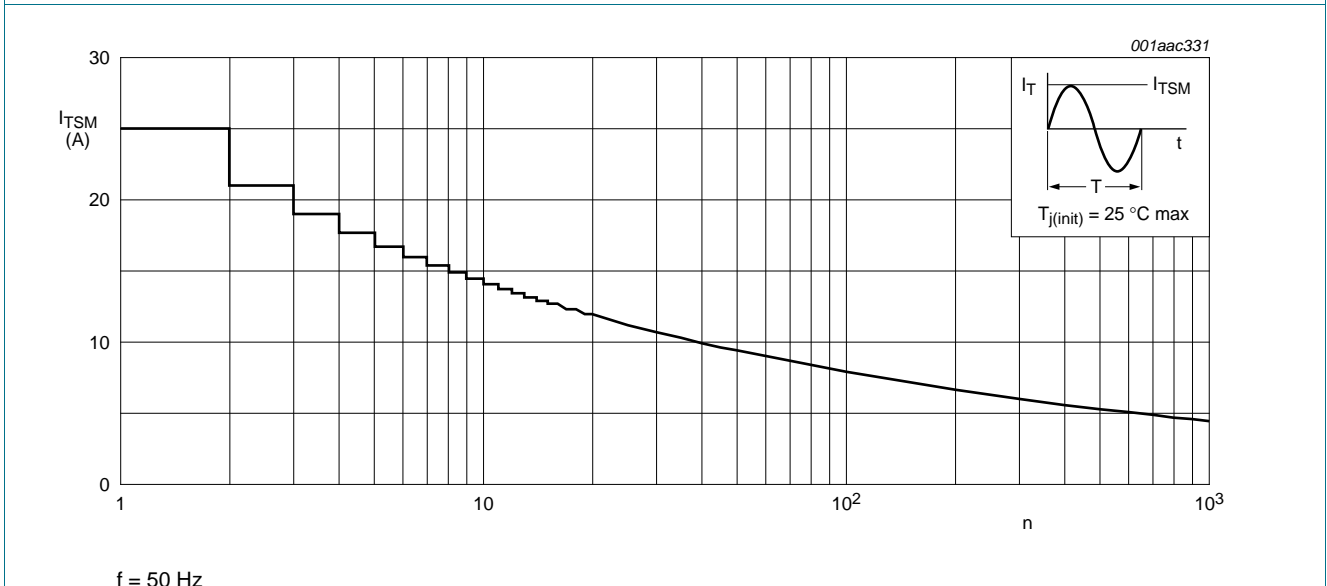
In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol              | Parameter  | Conditions   | Min   | Max  | Unit             |
|---------------------|--|--|-------|------|------------------|
| V <sub>DRM</sub>    | repetitive peak off-state voltage                            |  |       |      |                  |
|                     | BTA204X-600D   |  | [1] - | 600  | V                |
|                     | BTA204X-600E   |  | [1] - | 600  | V                |
|                     | BTA204X-600F   |  | [1] - | 600  | V                |
|                     | BTA204X-800E   |  | -     | 800  | V                |
| I <sub>T(RMS)</sub> | RMS on-state current   | full sine wave; T <sub>hs</sub> ≤ 92 °C;<br>Figure 4 and Figure 5                  | -     | 4    | A                |
| I <sub>TSM</sub>    | non-repetitive peak on-state current                         | full sine wave;<br>T <sub>j</sub> = 25 °C prior to surge;<br>Figure 2 and Figure 3 |       |      |                  |
|                     |  | t = 20 ms  | -     | 25   | A                |
|                     |  | t = 16.7 ms  | -     | 27   | A                |
| I <sup>2</sup> t    | I <sup>2</sup> t for fusing                                  | t = 10 ms  | -     | 3.1  | A <sup>2</sup> S |
| di <sub>T</sub> /dt | repetitive rate of rise of on-state current after triggering | I <sub>TM</sub> = 6 A; I <sub>G</sub> = 0.2 A;<br>di <sub>G</sub> /dt = 0.2 A/μs   | -     | 100  | A/μs             |
| I <sub>GM</sub>     | peak gate current  |  | -     | 2    | A                |
| P <sub>GM</sub>     | peak gate power  |  | -     | 5    | W                |
| P <sub>G(AV)</sub>  | average gate power   | over any 20 ms period  | -     | 0.5  | W                |
| T <sub>stg</sub>    | storage temperature  |  | -40   | +150 | °C               |
| T <sub>j</sub>      | junction temperature   |  | -     | 125  | °C               |

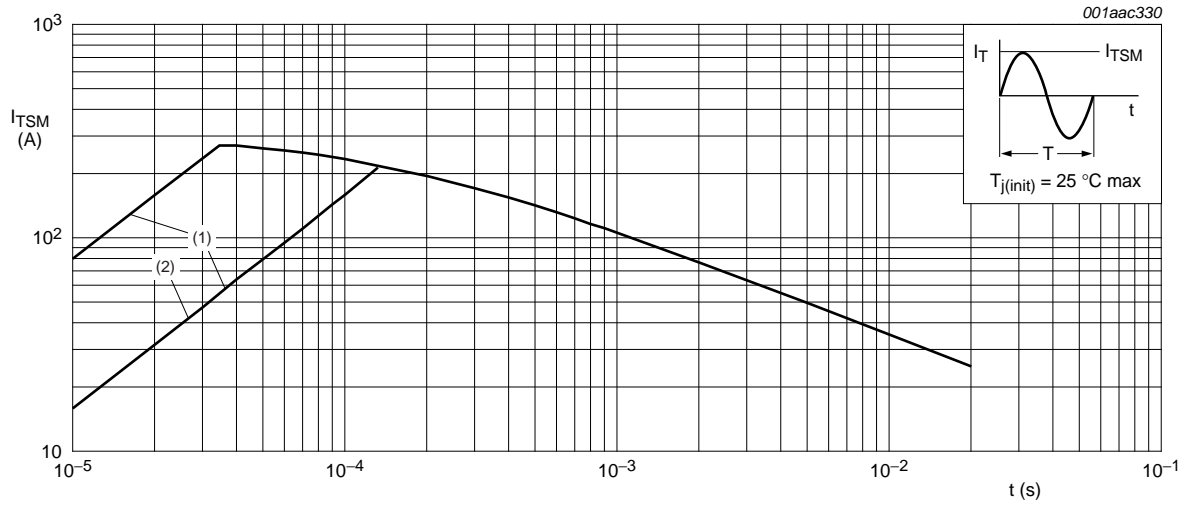
[1] Although not recommended, off-state voltages up to 800 V may be applied without damage, but the triac may switch to the on-state. The rate of rise of current should not exceed 6 A/μs.



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

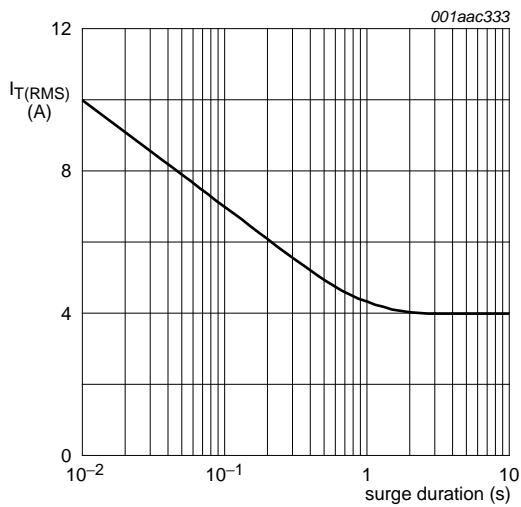


**Fig 2. Non-repetitive peak on-state current as a function of the number of sinusoidal current cycles; maximum values**



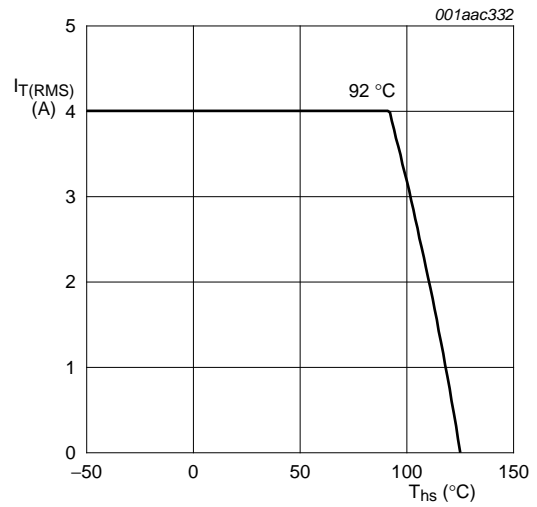
- $t_p \leq 20$  ms
- (1)  $dI_T/dt$  limit
- (2) T2- G+ quadrant

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



$f = 50$  Hz;  $T_h \leq 92$  °C

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

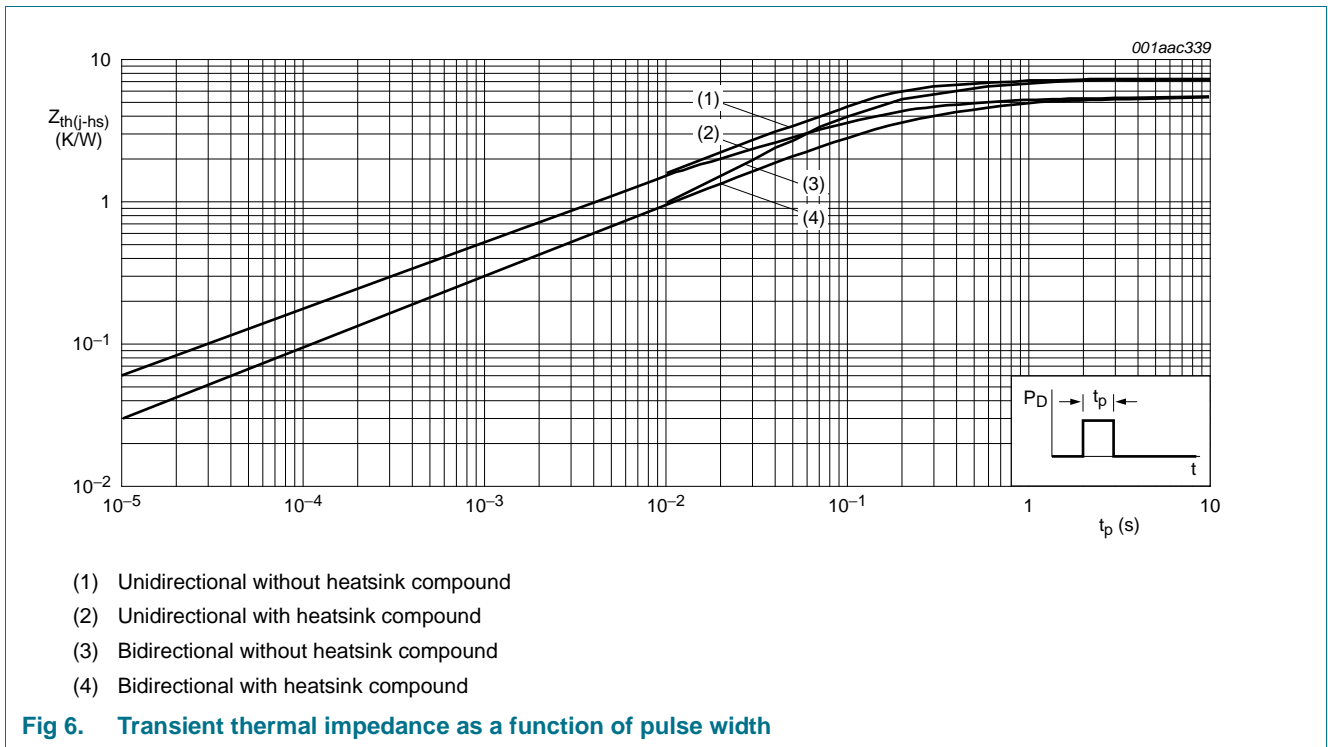


**Fig 5. RMS on-state current as a function of heatsink temperature; maximum values**

**5. Thermal characteristics**

**Table 4. Thermal characteristics**

| Symbol         | Parameter                                    | Conditions  | Min | Typ | Max | Unit |
|----------------|--|---|-----|-----|-----|------|
| $R_{th(j-hs)}$ | thermal resistance from junction to heatsink | full or half cycle with heatsink compound;<br><a href="#">Figure 6</a>    | -   | -   | 5.5 | K/W  |
|                |  | full or half cycle without heatsink compound;<br><a href="#">Figure 6</a> | -   | -   | 7.2 | K/W  |
| $R_{th(j-a)}$  | thermal resistance from junction to ambient  | in free air   | -   | 55  | -   | K/W  |



**6. Isolation characteristics**

**Table 5. Isolation limiting values and characteristics**

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

| Symbol     | Parameter   | Conditions   | Min | Typ | Max  | Unit |
|------------|---|--|-----|-----|------|------|
| $V_{isol}$ | RMS isolation voltage from all three terminals to external heatsink | $f = 50\text{ Hz to }60\text{ Hz}$ ; sinusoidal waveform; R.H. $\leq 65\%$ ; clean and dust free | -   | -   | 2500 | V    |
| $C_{isol}$ | capacitance from pin 2 to external heatsink                         | $f = 1\text{ MHz}$   | -   | 10  | -    | pF   |

**7. Static characteristics**

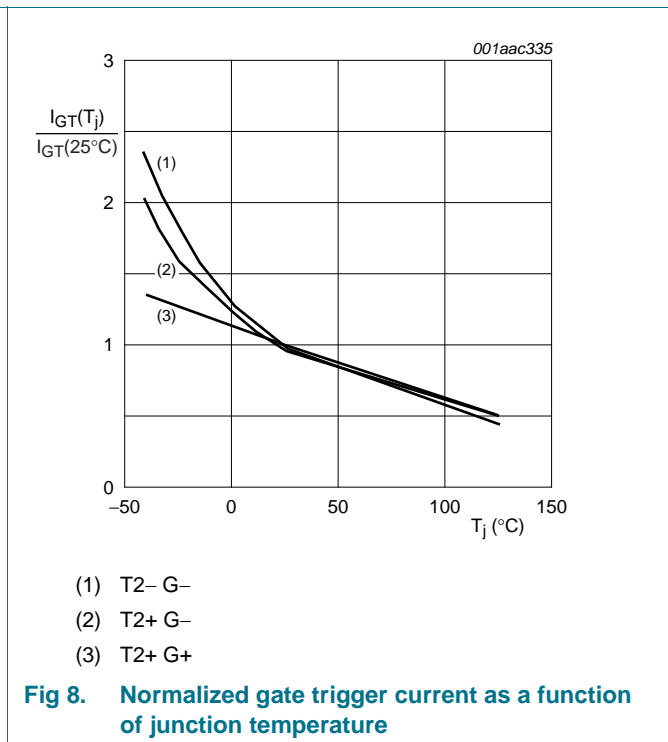
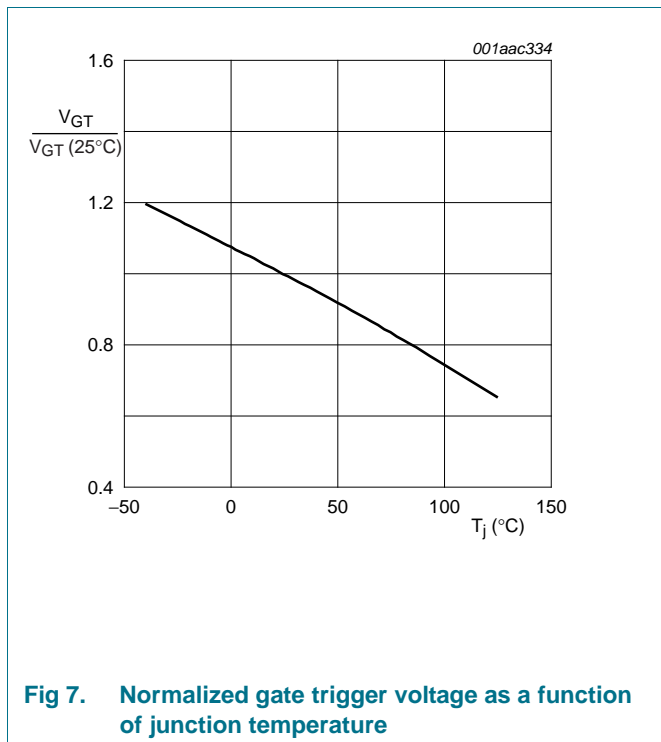
**Table 6. Static characteristics**  
*T<sub>j</sub> = 25 °C unless otherwise specified.*

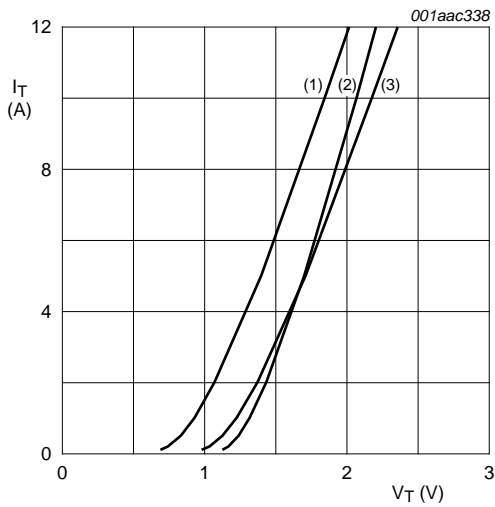
| Symbol          | Parameter                 | Conditions  | BTA204X-600D |     |     | BTA204X-600E |     |     | BTA204X-600F |     |     | Unit |
|-----------------|---------------------------|---|--------------|-----|-----|--------------|-----|-----|--------------|-----|-----|------|
|                 |                           |   | Min          | Typ | Max | Min          | Typ | Max | Min          | Typ | Max |      |
| I <sub>GT</sub> | gate trigger current      | V <sub>D</sub> = 12 V;<br>I <sub>T</sub> = 0.1 A;<br><a href="#">Figure 8</a>   |              |     |     |              |     |     |              |     |     |      |
|                 |                           | T2+ G+  | -            | -   | 5   | -            | -   | 10  | -            | -   | 25  | mA   |
|                 |                           | T2+ G-  | -            | -   | 5   | -            | -   | 10  | -            | -   | 25  | mA   |
|                 |                           | T2- G-  | -            | -   | 5   | -            | -   | 10  | -            | -   | 25  | mA   |
| I <sub>L</sub>  | latching current          | V <sub>D</sub> = 12 V;<br>I <sub>GT</sub> = 0.1 A;<br><a href="#">Figure 10</a> |              |     |     |              |     |     |              |     |     |      |
|                 |                           | T2+ G+  | -            | -   | 6   | -            | -   | 12  | -            | -   | 20  | mA   |
|                 |                           | T2+ G-  | -            | -   | 9   | -            | -   | 18  | -            | -   | 30  | mA   |
|                 |                           | T2- G-  | -            | -   | 6   | -            | -   | 12  | -            | -   | 20  | mA   |
| I <sub>H</sub>  | holding current           | V <sub>D</sub> = 12 V;<br>I <sub>GT</sub> = 0.1 A;<br><a href="#">Figure 11</a> | -            | -   | 6   | -            | -   | 12  | -            | -   | 20  | mA   |
| V <sub>T</sub>  | on-state voltage          | I <sub>T</sub> = 5 A;<br><a href="#">Figure 9</a>                               | -            | 1.4 | 1.7 | -            | 1.4 | 1.7 | -            | 1.4 | 1.7 | V    |
| V <sub>GT</sub> | gate trigger voltage      | V <sub>D</sub> = 12 V;<br>I <sub>T</sub> = 0.1 A;<br><a href="#">Figure 7</a>   | -            | 0.7 | 1.5 | -            | 0.7 | 1.5 | -            | 0.7 | 1.5 | V    |
|                 |                           | V <sub>D</sub> = 400 V;<br>I <sub>T</sub> = 0.1 A;<br>T <sub>j</sub> = 125 °C   | 0.25         | 0.4 | -   | 0.25         | 0.4 | -   | 0.25         | 0.4 | -   | V    |
| I <sub>D</sub>  | off-state leakage current | V <sub>D</sub> = V <sub>DRM(max)</sub> ;<br>T <sub>j</sub> = 125 °C             | -            | 0.1 | 0.5 | -            | 0.1 | 0.5 | -            | 0.1 | 0.5 | mA   |

## 8. Dynamic characteristics

**Table 7. Dynamic characteristics**

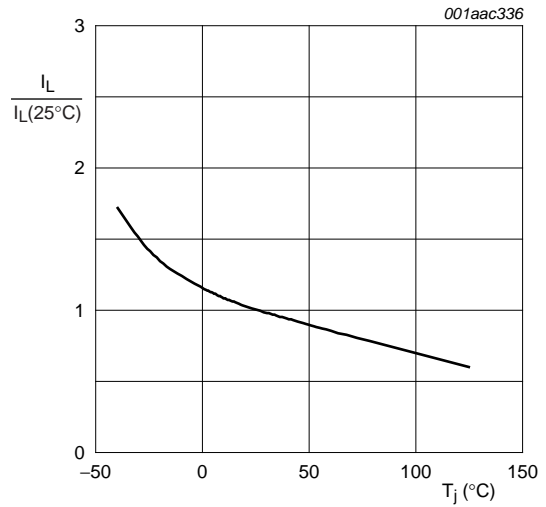
| Symbol        | Parameter                                      | Conditions   | BTA204X-600D |     |     | BTA204X-600E |     |     | BTA204X-600F |     |     | Unit             |
|---------------|--|--|--------------|-----|-----|--------------|-----|-----|--------------|-----|-----|------------------|
|               |  |  | Min          | Typ | Max | Min          | Typ | Max | Min          | Typ | Max |                  |
| $dV_D/dt$     | critical rate of rise of off-state voltage     | $V_{DM} = 67\%$<br>$V_{DRM(max)}$ ;<br>$T_j = 125\text{ }^\circ\text{C}$ ;<br>exponential waveform; gate open circuit  | 20           | -   | -   | 30           | -   | -   | 50           | -   | -   | V/ $\mu\text{s}$ |
| $dI_{com}/dt$ | critical rate of change of commutating current | $V_{DM} = 400\text{ V}$ ;<br>$T_j = 125\text{ }^\circ\text{C}$ ;<br>$I_{T(RMS)} = 4\text{ A}$ ;<br>$dV_{com}/dt = 10\text{ V}/\mu\text{s}$ ;<br>gate open circuit  | 1.1          | -   | -   | 2.1          | -   | -   | 3            | -   | -   | A/ $\mu\text{s}$ |
|               |  | $V_{DM} = 400\text{ V}$ ;<br>$T_j = 125\text{ }^\circ\text{C}$ ;<br>$I_{T(RMS)} = 4\text{ A}$ ;<br>$dV_{com}/dt = 0.1\text{ V}/\mu\text{s}$ ;<br>gate open circuit | 4.5          | -   | -   | 8            | -   | -   | 15           | -   | -   | A/ $\mu\text{s}$ |
| $t_{gt}$      | 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   | -   | $\mu\text{s}$    |



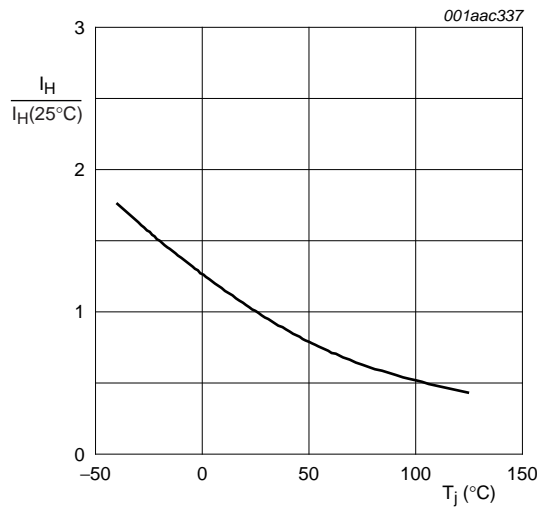


$V_O = 1.27\text{ V}$   
 $R_S = 0.091\ \Omega$   
 (1)  $T_j = 125\text{ }^\circ\text{C}$ ; typical values  
 (2)  $T_j = 25\text{ }^\circ\text{C}$ ; maximum values  
 (3)  $T_j = 125\text{ }^\circ\text{C}$ ; maximum values

**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

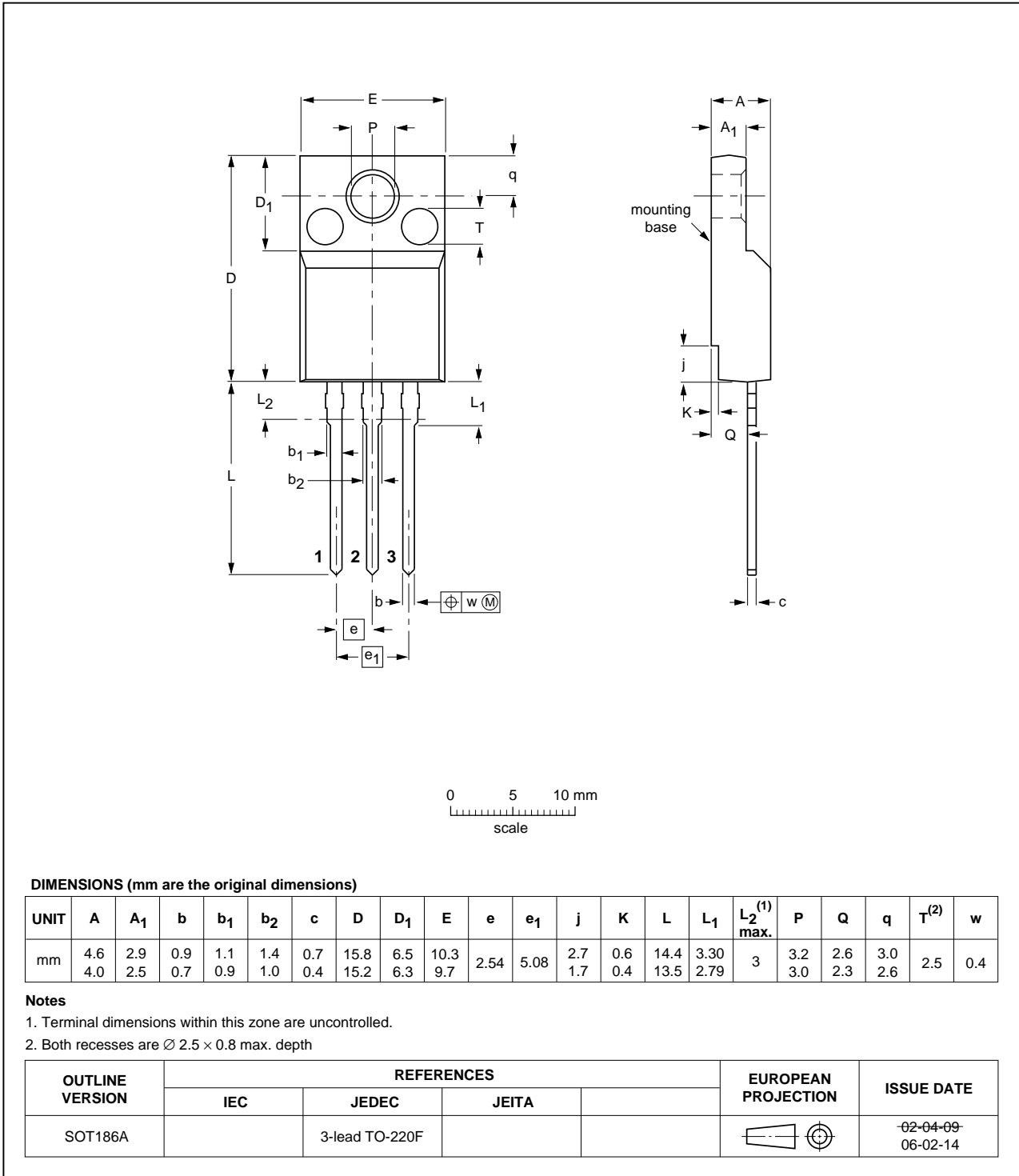
Refer to mounting instructions for F-pack packages. Epoxy meets UL94 V-0 at 1/8 inch.



**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               |
|--------------------------|---|-----------------------|---------------|--------------------------|
| BTA204X_SER_D_E_F v.5    | 20111103  | Product data sheet    | -             | BTA204X_SER_D_E_F v.4    |
| Modifications:           | <ul style="list-style-type: none"> <li>• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li> <li>• Legal texts have been adapted to the new company name where appropriate.</li> </ul> |                       |               |                          |
| BTA204X_SER_D_E_F v.4    | 20050317  | Product data sheet    | -             | BTA204X_SERIES_D_E_F v.3 |
| BTA204X_SERIES_D_E_F v.3 | 20030501  | Product specification | -             | BTA204X_SERIES_D_E_F v.2 |
| BTA204X_SERIES_D_E_F v.2 | 19981201  | Product specification | -             | BTA204X_SERIES_D_E_F v.1 |
| BTA204X_SERIES_D_E_F v.1 | 19971001  | Product specification | -             | -                        |

## 12. Legal information

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|-----------------------------------|-------------------------------|---|
| 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: 3 November 2011

Document identifier: BTA204X\_SER\_D\_E\_F