

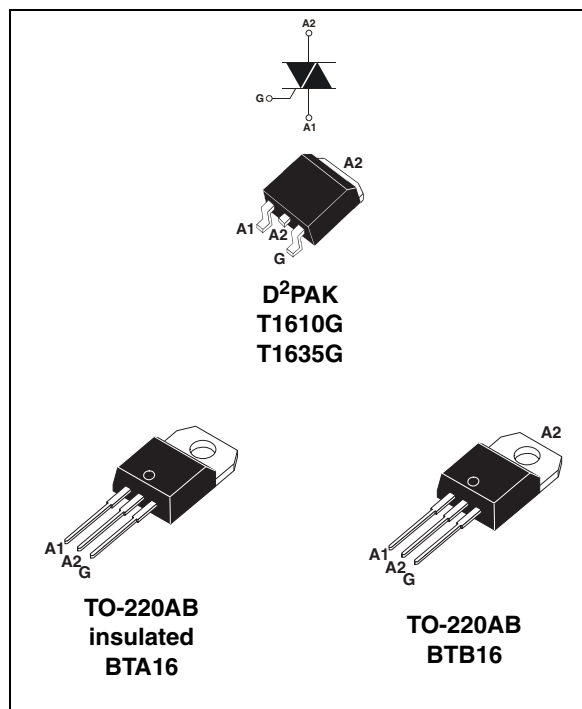
## 16 A Snubberless™, logic level and standard Triacs

### Features

- Medium current Triac
- Low thermal resistance with clip bonding
- Low thermal resistance insulation ceramic for insulated BTA
- High commutation (4Q) or very high commutation (3Q) capability
- BTA series UL1557 certified (File ref: 81734)
- RoHS ( 2002/95/EC) compliant
- Insulated tab (BTA series, rated at 2500 V<sub>RMS</sub>)

### Applications

- Snubberless versions (BTA/BTB...W and T1635) especially recommended for use on inductive loads, because of their high commutation performances
- On/off or phase angle function in applications such as static relays, light dimmers and appliance motor speed controllers



### Description

Available either in through-hole or surface-mount packages, the BTA16, BTB16, T1610 and T1635 Triacs series are suitable for general purpose mains power AC switching.

**Table 1. Device summary**

| Symbol                 | Parameter                         | BTA16 <sup>(1)</sup> | BTB16   | T1610   | T1635   |
|------------------------|-----------------------------------|----------------------|---------|---------|---------|
| $I_{T(RMS)}$           | On-state rms current              | 16                   | 16      | 16      | 16      |
| $V_{DRM}/V_{RRM}$      | Repetitive peak off-state voltage | 600/800              | 600/800 | 600/800 | 600/800 |
| $I_{GT}$ (Snubberless) | Triggering gate current           | 35/50                | 35/50   | -       | 35      |
| $I_{GT}$ (logic level) | Triggering gate current           | 10                   | 10      | 10      | -       |
| $I_{GT}$ (standard)    | Triggering gate current           | 25/50                | 25/50   | -       | -       |

1. Insulated

**TM:** Snubberless is a trademark of STMicroelectronics

# 1 Characteristics

**Table 2. Absolute maximum ratings**

| Symbol            | Parameter                                                                                                    |                                  |                                     | Value                   | Unit             |
|-------------------|--------------------------------------------------------------------------------------------------------------|----------------------------------|-------------------------------------|-------------------------|------------------|
| $I_{T(RMS)}$      | On-state rms current<br>(full sine wave)                                                                     | D <sup>2</sup> PAK /<br>TO-220AB | $T_c = 100\text{ }^{\circ}\text{C}$ | 16                      | A                |
|                   |                                                                                                              | TO-220AB<br>insulated            | $T_c = 86\text{ }^{\circ}\text{C}$  |                         |                  |
| $I_{TSM}$         | Non repetitive surge peak on-state<br>current<br>(full cycle, $T_j$ initial = $25\text{ }^{\circ}\text{C}$ ) | F = 50 Hz                        | t = 20 ms                           | 160                     | A                |
|                   |                                                                                                              | F = 60 Hz                        | t = 16.7 ms                         | 168                     |                  |
| $I^2t$            | $I^2t$ value for fusing                                                                                      | $t_p = 10\text{ ms}$             |                                     | 144                     | A <sup>2</sup> s |
| dI/dt             | Critical rate of rise of on-state current<br>$I_G = 2 \times I_{GT}$ , $t_r \leq 100\text{ ns}$              | F = 120 Hz                       | $T_j = 125\text{ }^{\circ}\text{C}$ | 50                      | A/ $\mu$ s       |
| $V_{DSM}/V_{RSM}$ | Non repetitive surge peak off-state<br>voltage                                                               | $t_p = 10\text{ ms}$             | $T_j = 25\text{ }^{\circ}\text{C}$  | $V_{DRM}/V_{RRM} + 100$ | V                |
| $I_{GM}$          | Peak gate current                                                                                            | $t_p = 20\text{ }\mu\text{s}$    | $T_j = 125\text{ }^{\circ}\text{C}$ | 4                       | A                |
| $P_{G(AV)}$       | Average gate power dissipation                                                                               |                                  | $T_j = 125\text{ }^{\circ}\text{C}$ | 1                       | W                |
| $T_{stg}$         | Storage temperature range                                                                                    |                                  |                                     | -40 to + 150            |                  |
| $T_j$             | Maximum operating junction temperature                                                                       |                                  |                                     | -40 to + 125            |                  |

**Table 3. Electrical characteristics ( $T_j = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)  
Snubberless and logic level (3 quadrants)**

| Symbol                              | Test conditions                                                                      | Quadrant                            |      | T1610 | T1635 | BTA16 / BTB16 |     |      | Unit       |
|-------------------------------------|--------------------------------------------------------------------------------------|-------------------------------------|------|-------|-------|---------------|-----|------|------------|
|                                     |                                                                                      |                                     |      |       |       | SW            | CW  | BW   |            |
| $I_{GT}^{(1)}$                      | $V_D = 12\text{ V}$<br>$R_L = 33\text{ }\Omega$                                      | I - II - III                        | Max. | 10    | 35    | 10            | 35  | 50   | mA         |
| $V_{GT}$                            |                                                                                      | I - II - III                        | Max. | 1.3   |       |               |     |      | V          |
| $V_{GD}$                            | $V_D = V_{DRM}$<br>$R_L = 3.3\text{ k}\Omega$<br>$T_j = 125\text{ }^{\circ}\text{C}$ | I - II - III                        | Min. | 0.2   |       |               |     |      | V          |
| $I_H^{(2)}$                         | $I_T = 500\text{ mA}$                                                                |                                     | Max. | 15    | 35    | 15            | 35  | 50   | mA         |
| $I_L$                               | $I_G = 1.2 I_{GT}$                                                                   | I - III                             | Max. | 25    | 50    | 25            | 50  | 70   | mA         |
|                                     |                                                                                      | II                                  |      | 30    | 60    | 30            | 60  | 80   |            |
| dV/dt <sup>(2)</sup>                | $V_D = 67\text{ }\%V_{DRM}$<br>gate open                                             | $T_j = 125\text{ }^{\circ}\text{C}$ | Min. | 40    | 500   | 40            | 500 | 1000 | V/ $\mu$ s |
| (dI/dt) <sub>c</sub> <sup>(2)</sup> | (dV/dt) <sub>c</sub> = 0.1 V/ $\mu$ s                                                | $T_j = 125\text{ }^{\circ}\text{C}$ | Min. | 8.5   | -     | 8.5           | -   | -    | A/ms       |
|                                     | (dV/dt) <sub>c</sub> = 10 V/ $\mu$ s                                                 | $T_j = 125\text{ }^{\circ}\text{C}$ |      | 3.0   | -     | 3.0           | -   | -    |            |
|                                     | Without snubber                                                                      | $T_j = 125\text{ }^{\circ}\text{C}$ |      | -     | 8.5   | -             | 8.5 | 14   |            |

1. Minimum  $I_{GT}$  is guaranteed at 5% of  $I_{GT\text{ max}}$

2. For both polarities of A2 referenced to A1

**Table 4. Electrical characteristics ( $T_j = 25\text{ °C}$ , unless otherwise specified) standard (4 quadrants)**

| Symbol            | Test conditions                                                  | Quadrant              |      | BTA16 / BTB16 |           | Unit       |
|-------------------|------------------------------------------------------------------|-----------------------|------|---------------|-----------|------------|
|                   |                                                                  |                       |      | C             | B         |            |
| $I_{GT}^{(1)}$    | $V_D = 12\text{ V}$ $R_L = 33\text{ }\Omega$                     | I - II - III<br>IV    | Max. | 25<br>50      | 50<br>100 | mA         |
| $V_{GT}$          |                                                                  | ALL                   | Max. | 1.3           |           | V          |
| $V_{GD}$          | $V_D = V_{DRM}$ $R_L = 3.3\text{ k}\Omega$ $T_j = 125\text{ °C}$ | ALL                   | Min. | 0.2           |           | V          |
| $I_H^{(2)}$       | $I_T = 500\text{ mA}$                                            |                       | Max. | 25            | 50        | mA         |
| $I_L$             | $I_G = 1.2\text{ }I_{GT}$                                        | I - III - IV          | Max. | 40            | 60        | mA         |
|                   |                                                                  | II                    |      | 80            | 120       |            |
| $dV/dt^{(2)}$     | $V_D = 67\text{ \% }V_{DRM}$ gate open                           | $T_j = 125\text{ °C}$ | Min. | 200           | 400       | V/ $\mu$ s |
| $(dV/dt)_c^{(2)}$ | $(dI/dt)_c = 7\text{ A/ms}$                                      | $T_j = 125\text{ °C}$ | Min. | 5             | 10        | V/ $\mu$ s |

1. Minimum  $I_{GT}$  is guaranteed at 5% of  $I_{GT}\text{ max}$

2. For both polarities of A2 referenced to A1

**Table 5. Static characteristics**

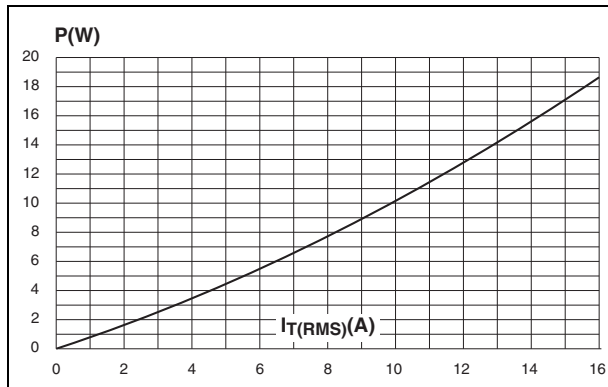
| Symbol                 | Test conditions                                   |                       |      | Value | Unit       |
|------------------------|---------------------------------------------------|-----------------------|------|-------|------------|
| $V_T^{(2)}$            | $I_{TM} = 22.5\text{ A}$ $t_p = 380\text{ }\mu$ s | $T_j = 25\text{ °C}$  | Max. | 1.55  | V          |
| $V_{to}^{(2)}$         | Threshold voltage                                 | $T_j = 125\text{ °C}$ | Max. | 0.85  | V          |
| $R_d^{(2)}$            | Dynamic resistance                                | $T_j = 125\text{ °C}$ | Max. | 25    | m $\Omega$ |
| $I_{DRM}$<br>$I_{RRM}$ | $V_{DRM} = V_{RRM}$                               | $T_j = 25\text{ °C}$  | Max. | 5     | $\mu$ A    |
|                        |                                                   | $T_j = 125\text{ °C}$ |      | 2     | mA         |

**Table 6. Thermal resistance**

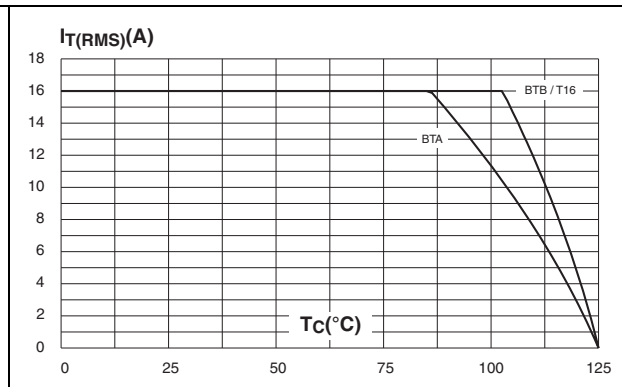
| Symbol        | Parameter             |                                              | Value | Unit                 |
|---------------|-----------------------|----------------------------------------------|-------|----------------------|
| $R_{th(j-c)}$ | Junction to case (AC) | D <sup>2</sup> PAK / TO-220AB                | 1.2   | $^{\circ}\text{C/W}$ |
|               |                       | TO-220AB insulated                           | 2.1   |                      |
| $R_{th(j-a)}$ | Junction to ambient   | $S^{(1)} = 1\text{ cm}^2$ D <sup>2</sup> PAK | 45    | $^{\circ}\text{C/W}$ |
|               |                       | TO-220AB / TO-220AB insulated                | 60    |                      |

1. S = Copper surface under tab

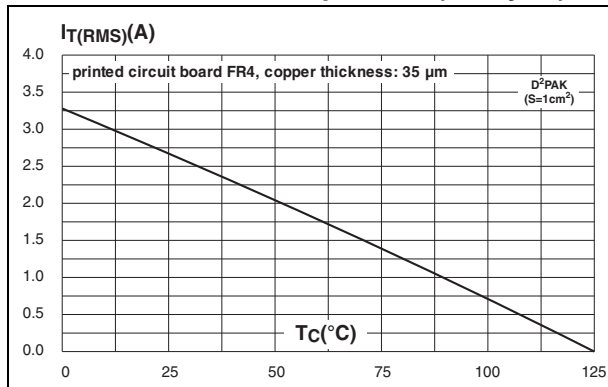
**Figure 1. Maximum power dissipation versus on-state rms current (full cycle)**



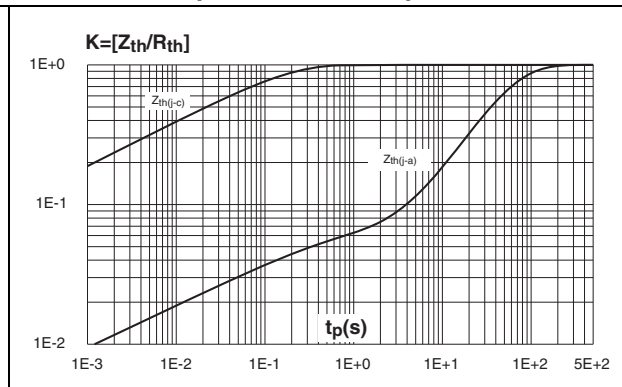
**Figure 2. On-state rms current versus case temperature (full cycle)**



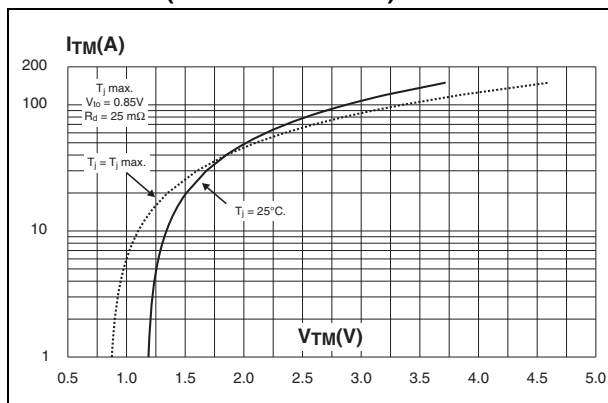
**Figure 3. On-state rms current versus ambient temperature (full cycle)**



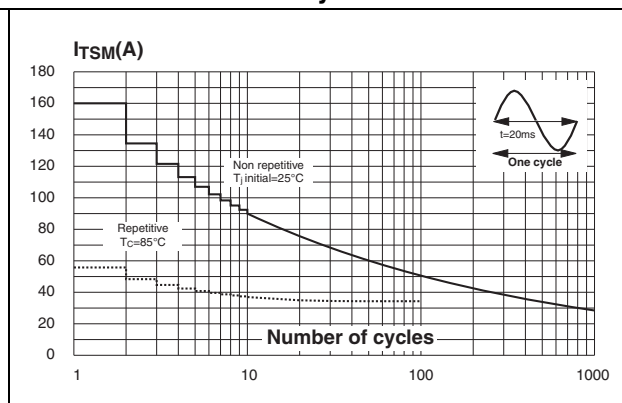
**Figure 4. Relative variation of thermal impedance versus pulse duration**

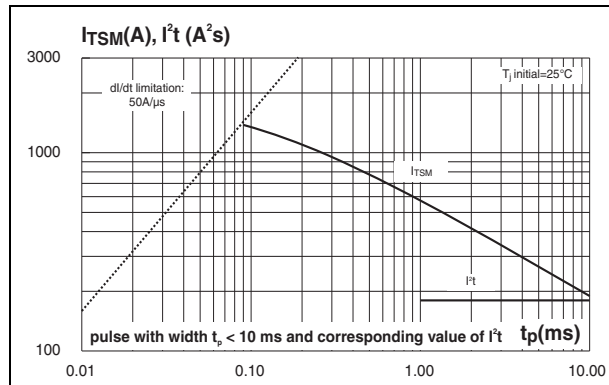
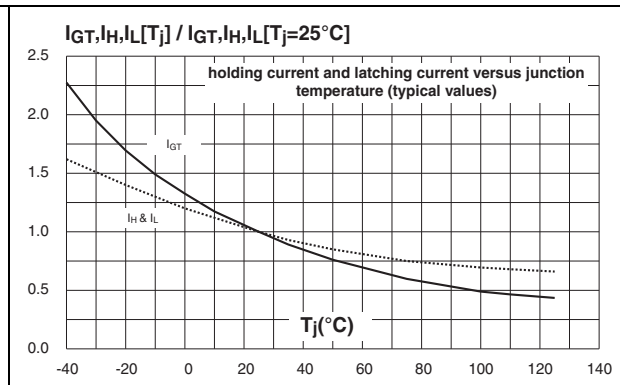
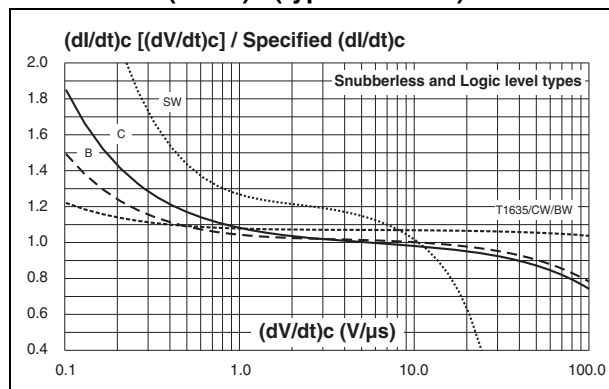
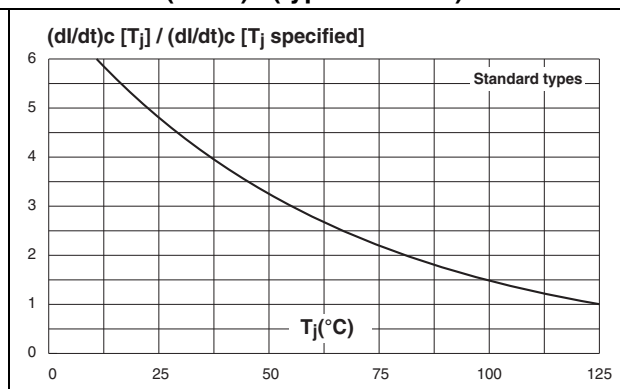
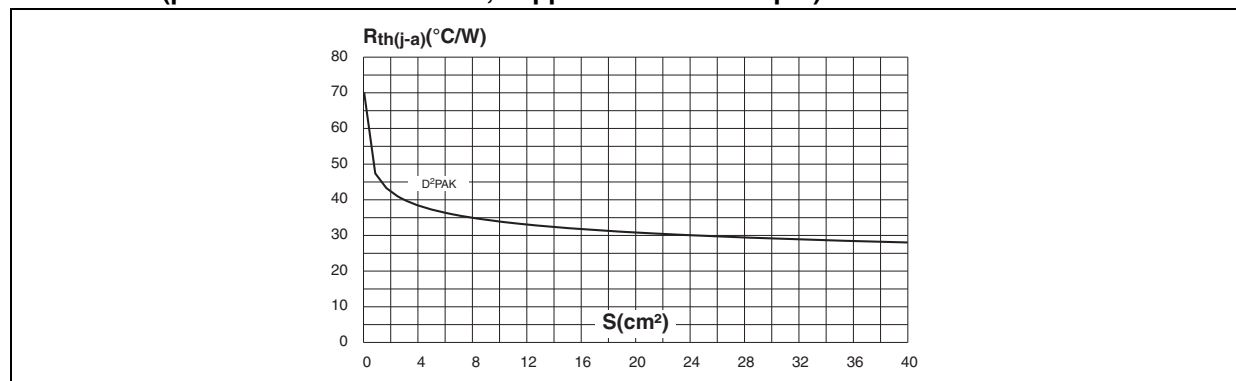


**Figure 5. On-state characteristics (maximum values)**



**Figure 6. Surge peak on-state current versus number of cycles**



**Figure 7. Non-repetitive surge peak on-state current for a sinusoidal****Figure 8. Relative variation of gate trigger current****Figure 9. Relative variation of critical rate of decrease of main current versus (dV/dt)c (typical values)****Figure 10. Relative variation of critical rate of decrease of main current versus (dV/dt)c (typical values)****Figure 11. D<sup>2</sup>PAK thermal resistance junction to ambient versus copper surface under tab (printed circuit board FR4, copper thickness: 35 μm)**

## 2 Ordering information

Figure 12. Ordering information scheme (BTA16 and BTB16 series)

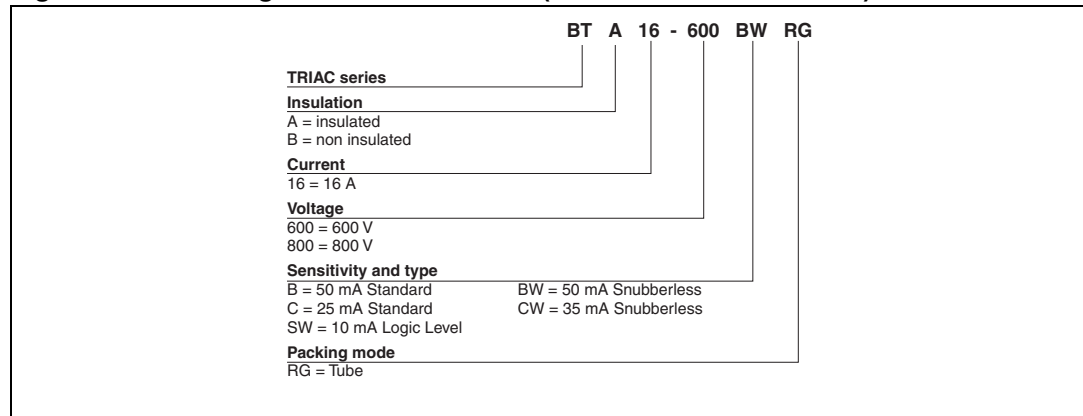


Figure 13. Ordering information scheme (T16 series)

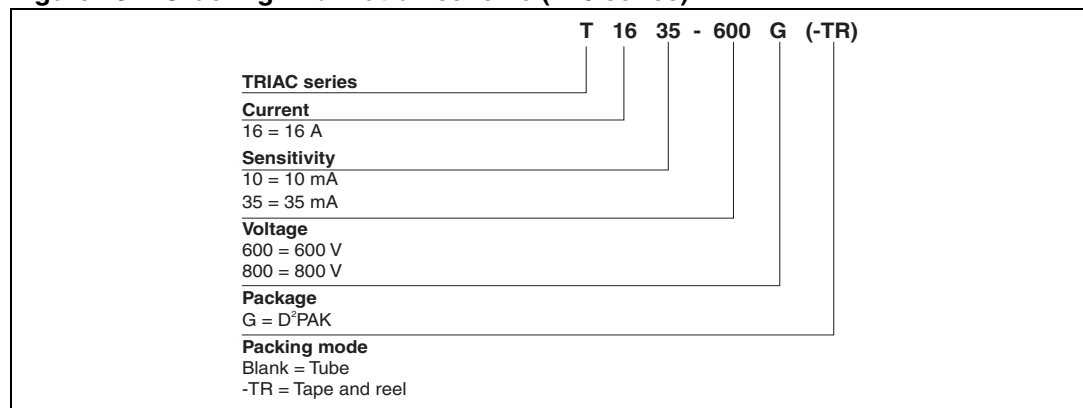


Table 7. Product selector

| Device <sup>(1)</sup> | Voltage (xxx) |       | Sensitivity | Type        | Package            |
|-----------------------|---------------|-------|-------------|-------------|--------------------|
|                       | 600 V         | 800 V |             |             |                    |
| BTA/BTB16-xxxB        | X             | X     | 50 mA       | Standard    | TO-220AB           |
| BTA/BTB16-xxxBW       | X             | X     | 50 mA       | Snubberless | TO-220AB           |
| BTA/BTB16-xxxC        | X             |       | 25 mA       | Standard    | TO-220AB           |
| BTA/BTB16-xxxCW       | X             | X     | 35 mA       | Snubberless | TO-220AB           |
| BTA/BTB16-xxxSW       | X             | X     | 10 mA       | Logic level | TO-220AB           |
| T1610-xxxG            | X             | X     | 10 mA       | Logic level | D <sup>2</sup> PAK |
| T1635-xxxG            | X             | X     | 35 mA       | Snubberless | D <sup>2</sup> PAK |

1. **BTB**: non insulated TO-220AB package

### 3 Package information

- Epoxy meets UL94, V0
- Recommended torque value: 0.4 to 0.6 N·m

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK® is an ST trademark.

**Table 8. D<sup>2</sup>PAK dimensions**

| Ref. | Dimensions  |      |       |        |       |       |
|------|-------------|------|-------|--------|-------|-------|
|      | Millimeters |      |       | Inches |       |       |
|      | Min.        | Typ. | Max.  | Min.   | Typ.  | Max.  |
| A    | 4.30        |      | 4.60  | 0.169  |       | 0.181 |
| A1   | 2.49        |      | 2.69  | 0.098  |       | 0.106 |
| A2   | 0.03        |      | 0.23  | 0.001  |       | 0.009 |
| B    | 0.70        |      | 0.93  | 0.027  |       | 0.037 |
| B2   | 1.25        | 1.40 |       | 0.048  | 0.055 |       |
| C    | 0.45        |      | 0.60  | 0.017  |       | 0.024 |
| C2   | 1.21        |      | 1.36  | 0.047  |       | 0.054 |
| D    | 8.95        |      | 9.35  | 0.352  |       | 0.368 |
| E    | 10.00       |      | 10.28 | 0.393  |       | 0.405 |
| G    | 4.88        |      | 5.28  | 0.192  |       | 0.208 |
| L    | 15.00       |      | 15.85 | 0.590  |       | 0.624 |
| L2   | 1.27        |      | 1.40  | 0.050  |       | 0.055 |
| L3   | 1.40        |      | 1.75  | 0.055  |       | 0.069 |
| R    | 0.40        |      |       | 0.016  |       |       |
| V2   | 0°          |      | 8°    | 0°     |       | 8°    |

**Figure 14. Footprint (dimensions in mm)**

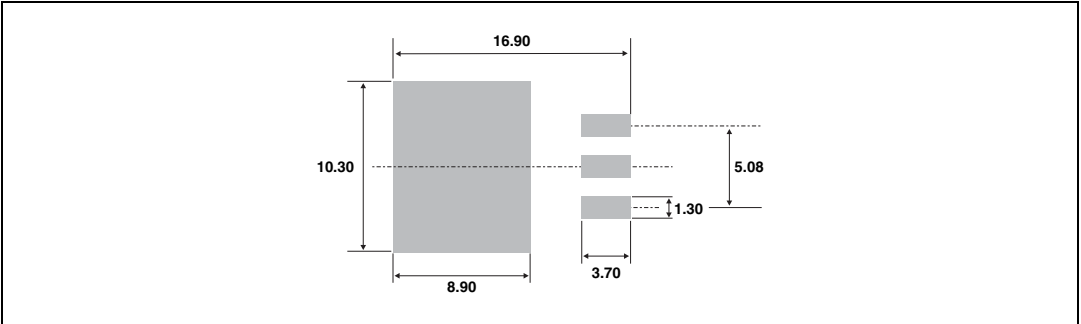


Table 9. TO-220AB (non-insulated and insulated) dimensions

| Ref. | Dimensions  |       |       |        |       |       |
|------|-------------|-------|-------|--------|-------|-------|
|      | Millimeters |       |       | Inches |       |       |
|      | Min.        | Typ.  | Max.  | Min.   | Typ.  | Max.  |
| A    | 15.20       |       | 15.90 | 0.598  |       | 0.625 |
| a1   |             | 3.75  |       |        | 0.147 |       |
| a2   | 13.00       |       | 14.00 | 0.511  |       | 0.551 |
| B    | 10.00       |       | 10.40 | 0.393  |       | 0.409 |
| b1   | 0.61        |       | 0.88  | 0.024  |       | 0.034 |
| b2   | 1.23        |       | 1.32  | 0.048  |       | 0.051 |
| C    | 4.40        |       | 4.60  | 0.173  |       | 0.181 |
| c1   | 0.49        |       | 0.70  | 0.019  |       | 0.027 |
| c2   | 2.40        |       | 2.72  | 0.094  |       | 0.107 |
| e    | 2.40        |       | 2.70  | 0.094  |       | 0.106 |
| F    | 6.20        |       | 6.60  | 0.244  |       | 0.259 |
| ØI   | 3.75        |       | 3.85  | 0.147  |       | 0.151 |
| I4   | 15.80       | 16.40 | 16.80 | 0.622  | 0.646 | 0.661 |
| L    | 2.65        |       | 2.95  | 0.104  |       | 0.116 |
| I2   | 1.14        |       | 1.70  | 0.044  |       | 0.066 |
| I3   | 1.14        |       | 1.70  | 0.044  |       | 0.066 |
| M    |             | 2.60  |       |        | 0.102 |       |



## 4 Ordering information

**Table 10. Ordering information**

| Order code <sup>(1)</sup> | Marking <sup>(1)</sup> | Package            | Weight | Base qty | Delivery mode |
|---------------------------|------------------------|--------------------|--------|----------|---------------|
| BTA16-xxxzyRG             | BTA16xxxzy             | TO-220AB           | 2.3 g  | 50       | Tube          |
| BTB16-xxxzyRG             | BTB16xxxzy             | TO-220AB           | 2.3 g  | 50       | Tube          |
| T1610-xxxG-TR             | T1610xxxG              | D <sup>2</sup> PAK | 1.5 g  | 1000     | Tape and reel |
| T1635-xxxG                | T1635xxxG              |                    |        | 50       | Tube          |
| T1635-xxxG-TR             | T1635xxxG              |                    |        | 1000     | Tape and reel |

1. xxx = voltage, y = sensitivity, z = type

## 5 Revision history

**Table 11. Document revision history**

| Date        | Revision | Changes                                                                                                                              |
|-------------|----------|--------------------------------------------------------------------------------------------------------------------------------------|
| Oct-2002    | 6A       | Last update.                                                                                                                         |
| 13-Feb-2006 | 7        | TO-220AB delivery mode changed from bulk to tube.<br>ECOPACK statement added.                                                        |
| 03-Jul-2009 | 8        | Added part number T1610.                                                                                                             |
| 11-Mar-2010 | 9        | Updated value for $V_{DSM}/V_{RSM}$ in <a href="#">Table 2</a> . Updated temperature in <a href="#">Table 2</a> from 15 °C to 86 °C. |

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