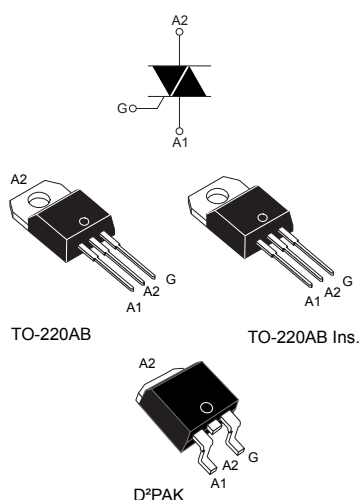


### Snubberless™, logic level and standard 16 A Triacs



#### 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, Snubberless™) capability
- BTA series UL1557 certified (file ref: 81734)
- Packages are 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 and T1610, T1635 and T1650 Triac series are suitable for general purpose mains power AC switching. They can be used as ON/OFF function in applications such as static relays, heating regulation or induction motor starting circuit. They are also recommended for phase control operations in light dimmers and appliance motors speed controllers.

The Snubberless™ versions (W suffix and T1610, T1635, T1650) are especially recommended for use on inductive loads, because of their high commutation performance.

By using an internal ceramic pad, the Snubberless™ series provide an insulated tab (rated at 2500 V<sub>RMS</sub>) complying with UL standards (file reference: E81734).

| Product status link                    |                       |
|----------------------------------------|-----------------------|
|                                        | <a href="#">BTA16</a> |
|                                        | <a href="#">BTB16</a> |
|                                        | <a href="#">T1610</a> |
|                                        | <a href="#">T1635</a> |
|                                        | <a href="#">T1650</a> |
| Product summary                        |                       |
| <b>I<sub>T(RMS)</sub></b>              | 16 A                  |
| <b>V<sub>DRM</sub>/V<sub>RSM</sub></b> | 600, 800 V            |
| <b>I<sub>GT</sub>Snubberless™</b>      | 10, 35, 50 mA         |
| <b>I<sub>GT</sub>standard</b>          | 25, 50 mA             |

# 1 Characteristics

**Table 1. Absolute maximum ratings**

| Symbol            | Parameters                                                                                             |                                     |                                     | Value                   | Unit                           |
|-------------------|--------------------------------------------------------------------------------------------------------|-------------------------------------|-------------------------------------|-------------------------|--------------------------------|
| $I_{T(RMS)}$      | RMS on-state current (full sine wave)                                                                  | TO-220AB, D <sup>2</sup> PAK        | $T_c = 100\text{ }^{\circ}\text{C}$ | 16                      | A                              |
|                   |                                                                                                        | TO-220AB Ins.                       | $T_c = 86\text{ }^{\circ}\text{C}$  |                         |                                |
| $I_{TSM}$         | Non repetitive surge peak on-state current (full cycle, $T_j$ initial = $25\text{ }^{\circ}\text{C}$ ) | F = 50 Hz                           | $t_p = 20\text{ ms}$                | 160                     | A                              |
|                   |                                                                                                        | F = 60 Hz                           | $t_p = 16.7\text{ ms}$              | 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 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 junction temperature range                                                                     |                                     |                                     |                         | -40 to +150 $^{\circ}\text{C}$ |
| $T_j$             | Operating junction temperature range                                                                   |                                     |                                     |                         | -40 to +125 $^{\circ}\text{C}$ |

**Table 2. Static electrical characteristics**

| Symbol            | Test conditions                                           | $T_j$                         |      | Value | Unit          |
|-------------------|-----------------------------------------------------------|-------------------------------|------|-------|---------------|
| $V_T^{(1)}$       | $I_{TM} = 22.5\text{ A}$ , $t_p = 380\text{ }\mu\text{s}$ | $25\text{ }^{\circ}\text{C}$  | Max. | 1.55  | V             |
| $V_{TO}^{(1)}$    | threshold on-state voltage                                | $125\text{ }^{\circ}\text{C}$ | Max. | 0.85  | V             |
| $R_D^{(1)}$       | Dynamic resistance                                        | $125\text{ }^{\circ}\text{C}$ | Max. | 25    | m $\Omega$    |
| $I_{DRM}/I_{RRM}$ | $V_{DRM} = V_{RRM}$                                       | $25\text{ }^{\circ}\text{C}$  | Max. | 5     | $\mu\text{A}$ |
|                   |                                                           | $125\text{ }^{\circ}\text{C}$ |      | 2     | mA            |

1. For both polarities of A2 referenced to A1

**Table 3. Electrical characteristics ( $T_j = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) - standard (4 quadrants)**

| Symbol         | Parameters                                                                         | Quadrant           |      | BTA16<br>BTB16 |           | Unit |
|----------------|------------------------------------------------------------------------------------|--------------------|------|----------------|-----------|------|
|                |                                                                                    |                    |      | C              | B         |      |
| $I_{GT}^{(1)}$ | $V_D = 12\text{ V}$ , $R_L = 33\ \Omega$                                           | I - II - III<br>IV | Max. | 25<br>50       | 50<br>100 | mA   |
| $V_{GT}$       |                                                                                    | All                | Max. | 1.3            |           |      |
| $V_{GD}$       | $V_D = V_{DRM}$ , $R_L = 3.3\text{ k}\Omega$ , $T_j = 125\text{ }^{\circ}\text{C}$ | All                | Min. | 0.2            |           | V    |
| $I_H^{(2)}$    | $I_T = 500\text{ mA}$                                                              |                    | Max. | 25             | 50        | mA   |
| $I_L$          | $I_G = 1.2\ I_{GT}$                                                                | I - III - IV       | Max. | 40             | 60        | mA   |
|                |                                                                                    | II                 | Max. | 80             | 120       |      |

| Symbol            | Parameters                                             | Quadrant |      | BTA16<br>BTB16 |     | Unit       |
|-------------------|--------------------------------------------------------|----------|------|----------------|-----|------------|
|                   |                                                        |          |      | C              | B   |            |
| $dV/dt^{(2)}$     | $V_D = 67 \% V_{DRM}$ gate open, $T_j = 125\text{ °C}$ |          | Min. | 200            | 400 | V/ $\mu$ s |
| $(dI/dt)_C^{(2)}$ | $(dI/dt)_C = 7\text{ A/ms}$ , $T_j = 125\text{ °C}$    |          | Min. | 5              | 10  | V/ $\mu$ s |

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

2. For both polarities of A2 referenced to A1

**Table 4. Electrical characteristics ( $T_j = 25\text{ °C}$ , unless otherwise specified) - Snubberless and logic level (3 quadrants)**

| Symbol            | Parameters                                                           | Quadrant     |      | T1610 / BTA16-<br>SW / BTB16-<br>SW | T1635 /<br>BTA16-CW /<br>BTB16-CW | T1650 /<br>BTA16-BW /<br>BTB16-BW | Unit       |
|-------------------|----------------------------------------------------------------------|--------------|------|-------------------------------------|-----------------------------------|-----------------------------------|------------|
| $I_{GT}^{(1)}$    | $V_D = 12\text{ V}$ , $R_L = 30\text{ }\Omega$                       | I - II - III | Max. | 10                                  | 35                                | 50                                | mA         |
| $V_{GT}$          |                                                                      |              | Max. | 1.3                                 |                                   |                                   | V          |
| $V_{GD}$          | $V_D = V_{DRM}$ , $R_L = 3,3\text{ k}\Omega$ , $T_j = 125\text{ °C}$ |              | Min. | 0.2                                 |                                   |                                   | V          |
| $I_H^{(2)}$       | $I_T = 500\text{ mA}$                                                |              | Max. | 15                                  | 35                                | 50                                | mA         |
| $I_L$             | $I_G = 1.2\text{ }I_{GT}$                                            | I - III      | Max. | 25                                  | 50                                | 70                                | mA         |
|                   |                                                                      | II           | Max. | 30                                  | 60                                | 80                                |            |
| $(dV/dt)^{(2)}$   | $V_D = 67 \% V_{DRM}$ gate open, $T_j = 125\text{ °C}$               |              | Min. | 40                                  | 500                               | 1000                              | V/ $\mu$ s |
| $(dI/dt)_C^{(2)}$ | $(dV/dt)_C = 0.1\text{ V}/\mu\text{s}$ , $T_j = 125\text{ °C}$       |              | Min. | 8.5                                 |                                   |                                   | A/ms       |
|                   | $(dV/dt)_C = 10\text{ V}/\mu\text{s}$ , $T_j = 125\text{ °C}$        |              |      | 3.0                                 |                                   |                                   |            |
|                   | Without snubber, $T_j = 125\text{ °C}$                               |              |      |                                     | 8.5                               | 14                                |            |

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

2. For both polarities of A2 referenced to A1

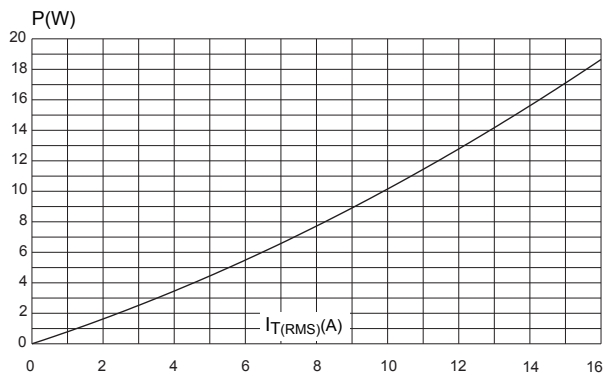
**Table 5. Thermal resistance**

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

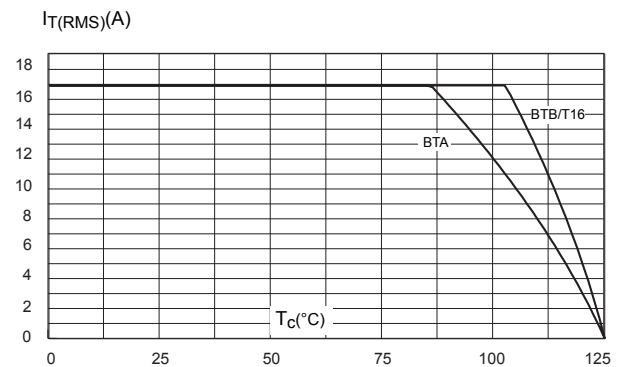
1. Copper surface under tab.

## 1.1 Characteristics (curves)

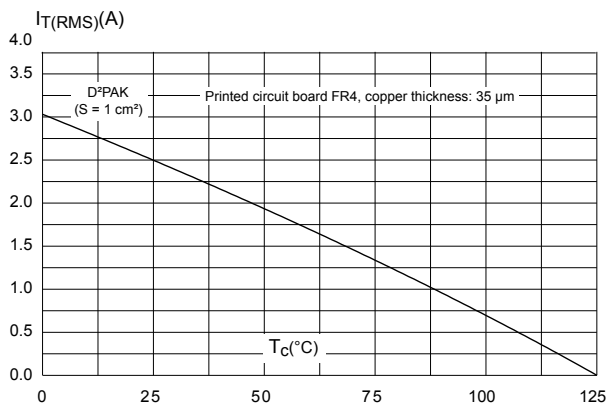
**Figure 2. Maximum power dissipation versus on-state RMS current (full cycle)**



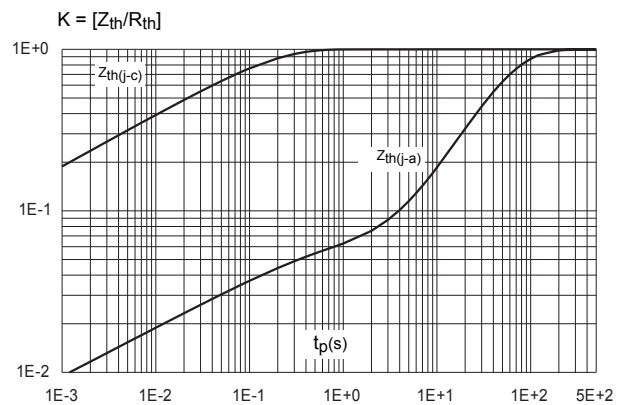
**Figure 3. RMS on-state current versus case temperature (full cycle)**

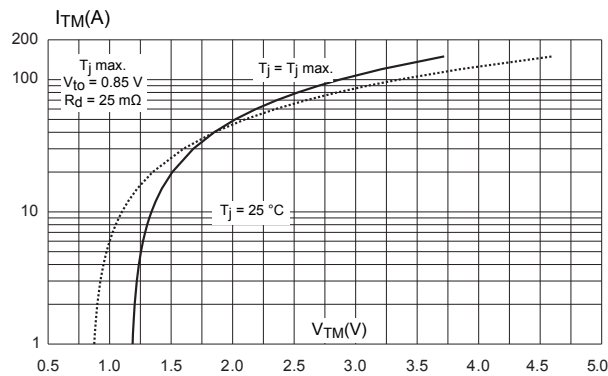
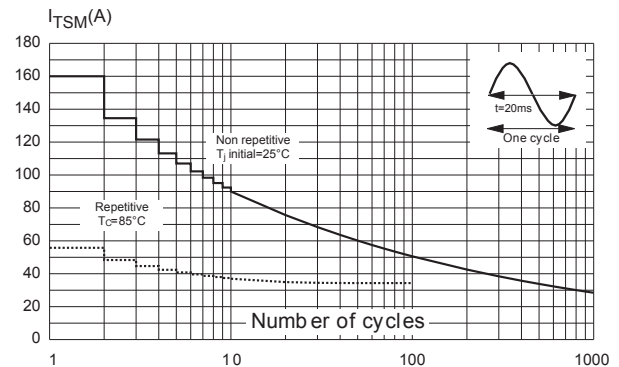
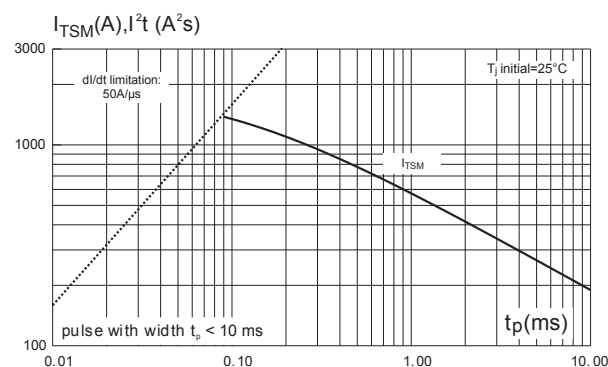
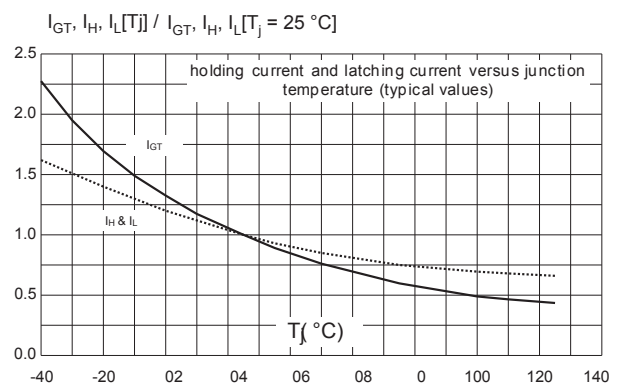
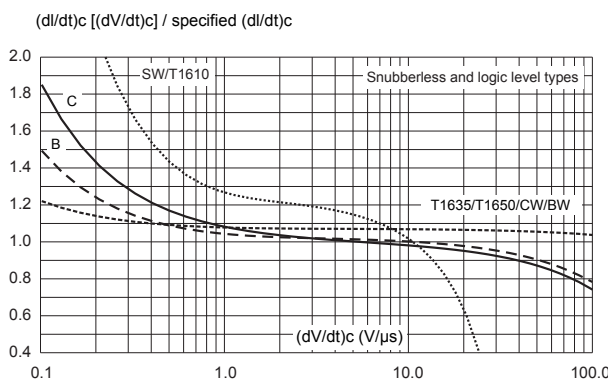
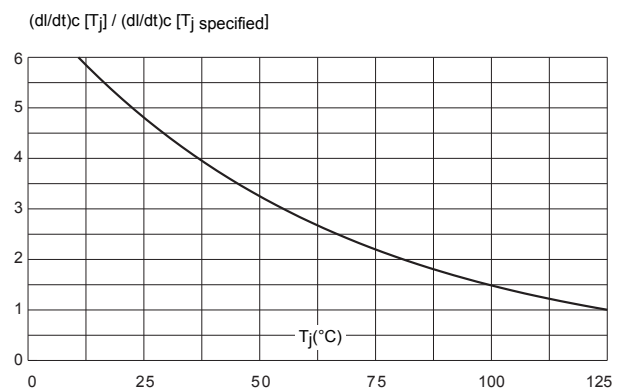


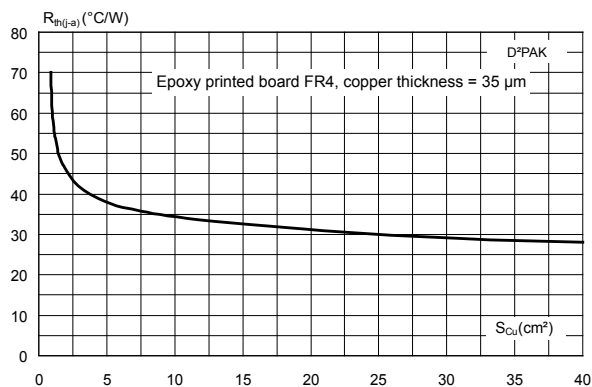
**Figure 4. On-state rms current versus ambient temperature (full cycle)**



**Figure 5. Relative variation of thermal impedance versus pulse duration**



**Figure 6. On-state characteristics (maximum values)**

**Figure 7. Surge peak on-state current versus number of cycles**

**Figure 8. Non-repetitive surge peak on-state current for a sinusoidal**

**Figure 9. Relative variation of gate trigger current**

**Figure 10. Relative variation of critical rate of decrease of main current versus (dV/dt)\_c (typical values)**

**Figure 11. Relative variation of critical rate of decrease of main current versus (junction temperature (typical values)**


**Figure 12. D<sup>2</sup>PAK thermal resistance junction to ambient versus copper surface under tab**


## **2 Package information**

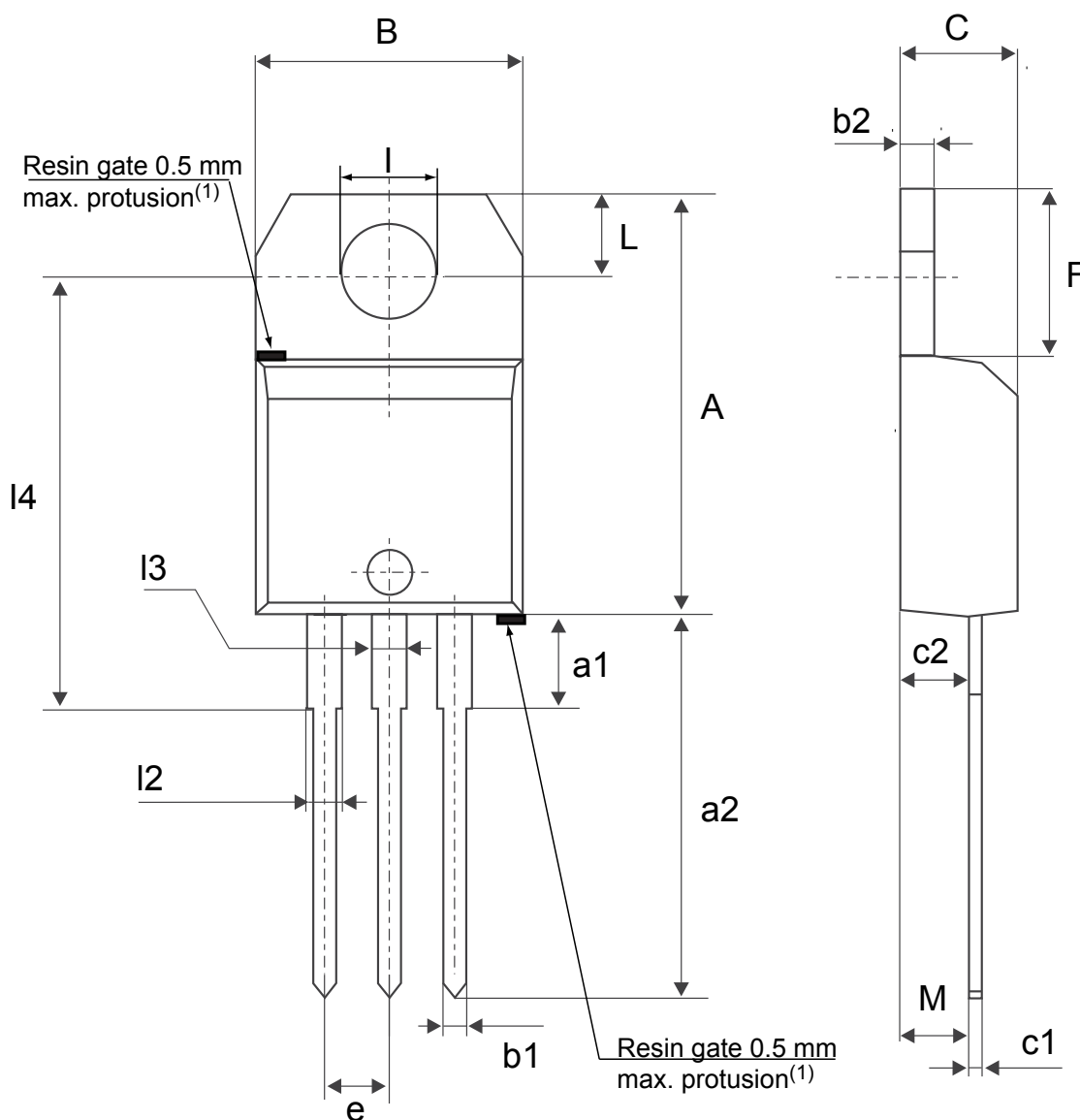
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In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com).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

## 2.1 TO-220AB Insulated and non Insulated package information

- Epoxy meets UL 94,V0
- Cooling method: by conduction (C)
- Recommended torque value: 0.55 N·m
- Maximum torque value: 0.70 N·m

**Figure 13.** TO-220AB Insulated and non Insulated package outline



(1) Resin gate position accepted in one of the two positions or in the symmetrical opposites.

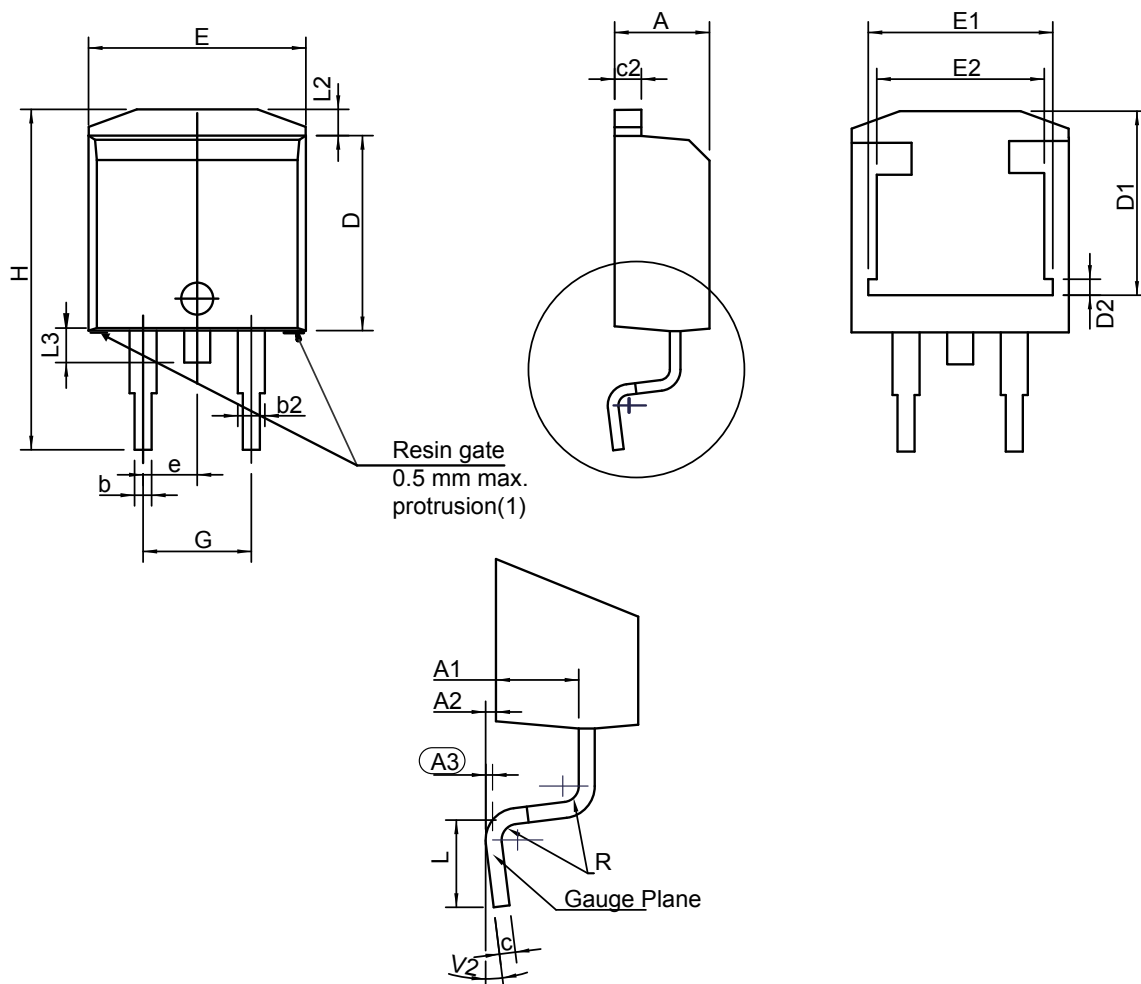
**Table 6. TO-220AB Insulated and non Insulated package mechanical data**

| Ref. | Dimensions  |       |       |        |        |        |
|------|-------------|-------|-------|--------|--------|--------|
|      | Millimeters |       |       | Inches |        |        |
|      | Min.        | Typ.  | Max.  | Min.   | Typ.   | Max.   |
| A    | 15.20       |       | 15.90 | 0.5984 |        | 0.6260 |
| a1   |             | 3.75  |       |        | 0.1476 |        |
| a2   | 13.00       |       | 14.00 | 0.5118 |        | 0.5512 |
| B    | 10.00       |       | 10.40 | 0.3937 |        | 0.4094 |
| b1   | 0.61        |       | 0.88  | 0.0240 |        | 0.0346 |
| b2   | 1.23        |       | 1.32  | 0.0484 |        | 0.0520 |
| C    | 4.40        |       | 4.60  | 0.1732 |        | 0.1811 |
| c1   | 0.49        |       | 0.70  | 0.0193 |        | 0.0276 |
| c2   | 2.40        |       | 2.72  | 0.0945 |        | 0.1071 |
| e    | 2.40        |       | 2.70  | 0.0945 |        | 0.1063 |
| F    | 6.20        |       | 6.60  | 0.2441 |        | 0.2598 |
| I    | 3.73        |       | 3.88  | 0.1469 |        | 0.1528 |
| L    | 2.65        |       | 2.95  | 0.1043 |        | 0.1161 |
| I2   | 1.14        |       | 1.70  | 0.0449 |        | 0.0669 |
| I3   | 1.14        |       | 1.70  | 0.0449 |        | 0.0669 |
| I4   | 15.80       | 16.40 | 16.80 | 0.6220 | 0.6457 | 0.6614 |
| M    |             | 2.6   |       |        | 0.1024 |        |

1. Inch dimensions are for reference only.

## 2.2 D<sup>2</sup>PAK package information

**Figure 14. D<sup>2</sup>PAK package outline**



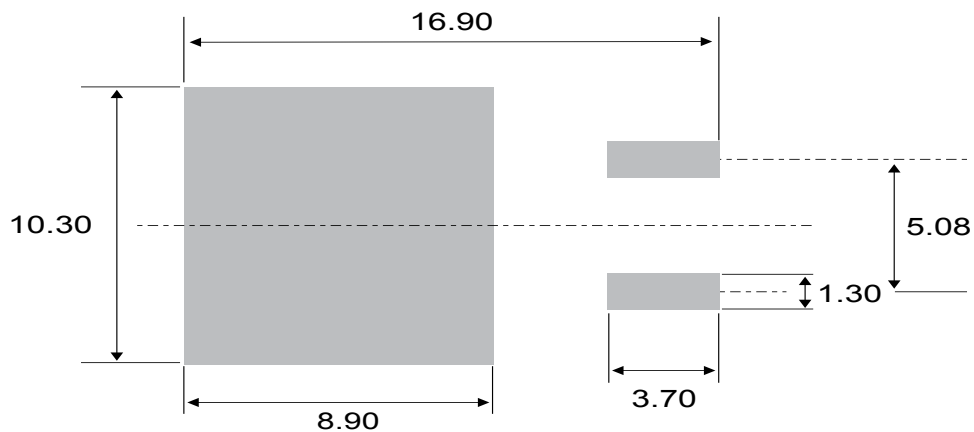
(1) Resin gate position accepted in one of the two positions or in the symmetrical opposites

**Table 7. D<sup>2</sup>PAK package mechanical data**

| Ref. | Dimensions  |      |       |        |        |        |
|------|-------------|------|-------|--------|--------|--------|
|      | Millimeters |      |       | Inches |        |        |
|      | Min.        | Typ. | Max.  | Min.   | Typ.   | Max.   |
| A    | 4.30        |      | 4.60  | 0.1693 |        | 0.1811 |
| A1   | 2.49        |      | 2.69  | 0.0980 |        | 0.1059 |
| A2   | 0.03        |      | 0.23  | 0.0012 |        | 0.0091 |
| A3   |             | 0.25 |       |        | 0.0098 |        |
| b    | 0.70        |      | 0.93  | 0.0276 |        | 0.0366 |
| b2   | 1.25        |      | 1.7   | 0.0492 |        | 0.0669 |
| c    | 0.45        |      | 0.60  | 0.0177 |        | 0.0236 |
| c2   | 1.21        |      | 1.36  | 0.0476 |        | 0.0535 |
| D    | 8.95        |      | 9.35  | 0.3524 |        | 0.3681 |
| D1   | 7.50        |      | 8.00  | 0.2953 |        | 0.3150 |
| D2   | 1.30        |      | 1.70  | 0.0512 |        | 0.0669 |
| e    | 2.54        |      |       | 0.1    |        |        |
| E    | 10.00       |      | 10.28 | 0.3937 |        | 0.4047 |
| E1   | 8.30        |      | 8.70  | 0.3268 |        | 0.3425 |
| E2   | 6.85        |      | 7.25  | 0.2697 |        | 0.2854 |
| G    | 4.88        |      | 5.28  | 0.1921 |        | 0.2079 |
| H    | 15          |      | 15.85 | 0.5906 |        | 0.6240 |
| L    | 1.78        |      | 2.28  | 0.0701 |        | 0.0898 |
| L2   | 1.27        |      | 1.40  | 0.0500 |        | 0.0551 |
| L3   | 1.40        |      | 1.75  | 0.0551 |        | 0.0689 |
| R    |             | 0.40 |       |        | 0.0157 |        |
| V2   | 0°          |      | 8°    | 0°     |        | 8°     |

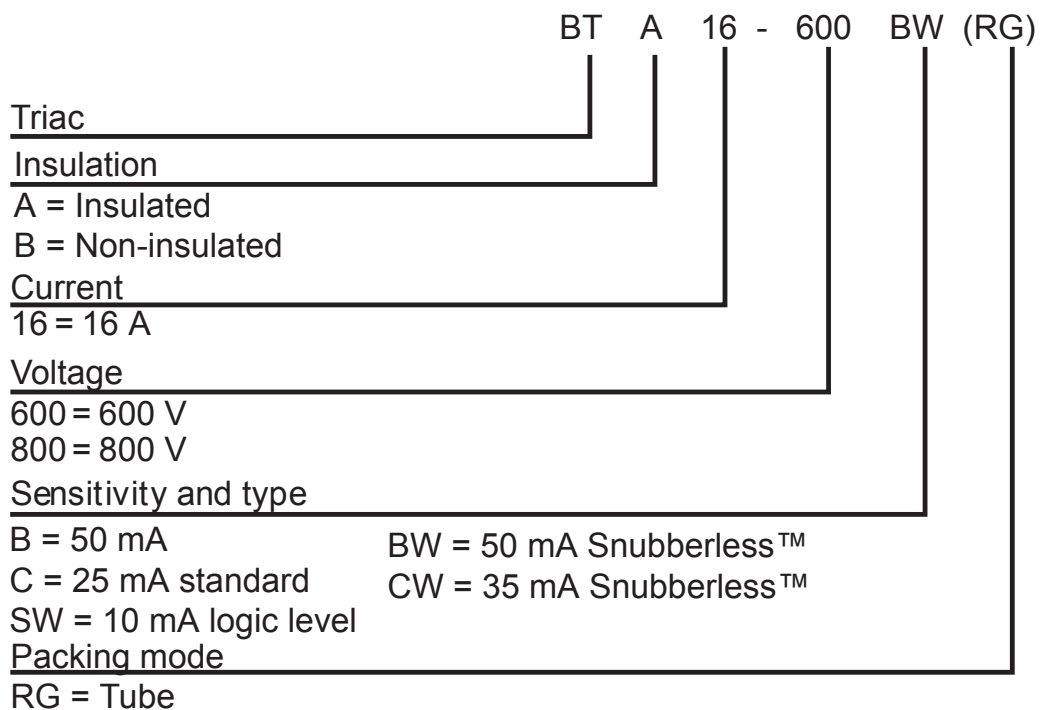
1. Dimensions in inches are given for reference only

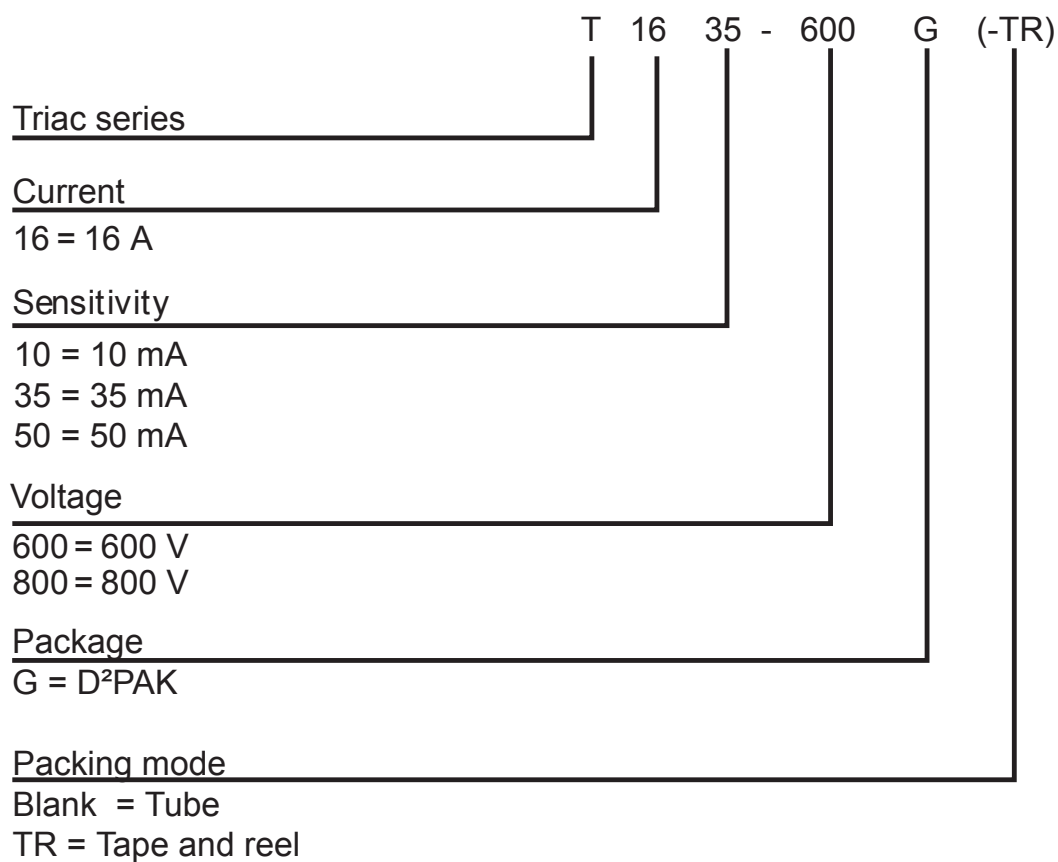
Figure 15. D<sup>2</sup>PAK recommended footprint (dimensions are in mm)



### 3 Ordering information

**Figure 16. Ordering information scheme (BTA16 and BTB16 series)**



**Figure 17. Ordering information scheme (T8 series)**


### 3.1 Product selector

**Table 8. Product selector**

| Part Number |             | Sensitivity | Type         | Package            |
|-------------|-------------|-------------|--------------|--------------------|
| 600         | 800         |             |              |                    |
| BTB16-600C  |             | 35 mA       | Standard     | TO-220AB           |
| BTB16-600B  | BTB16-800B  | 50 mA       | Standard     | TO-220AB           |
| BTB16-600SW | BTB16-800SW | 10 mA       | Snubberless™ | TO-220AB           |
| BTB16-600CW | BTB16-800CW | 35 mA       | Snubberless™ | TO-220AB           |
| BTB16-600BW | BTB16-800BW | 50 mA       | Snubberless™ | TO-220AB           |
| BTA16-600C  |             | 35 mA       | Standard     | TO-220AB Ins.      |
| BTA16-600B  | BTA16-800B  | 50 mA       | Standard     | TO-220AB Ins.      |
| BTA16-600SW | BTA16-800SW | 10 mA       | Snubberless™ | TO-220AB Ins.      |
| BTA16-600CW | BTA16-800CW | 35 mA       | Snubberless™ | TO-220AB Ins.      |
| BTA16-600BW | BTA16-800BW | 50 mA       | Snubberless™ | TO-220AB Ins.      |
| T1610-600G  | T1610-800G  | 10 mA       | Snubberless™ | D <sup>2</sup> PAK |
| T1635-600G  | T1635-800G  | 35 mA       | Snubberless™ | D <sup>2</sup> PAK |
| T1650-600G  |             | 50 mA       | Snubberless™ | D <sup>2</sup> PAK |

## 3.2 Ordering information

**Table 9. Ordering information**

| Order code    | Marking     | Package            | Weight | Base qty. | Delivery mode |
|---------------|-------------|--------------------|--------|-----------|---------------|
| BTA16-600BRG  | BTA16-600B  | TO-220AB Ins.      | 2.30   | 50        | Tube          |
| BTA16-600BWRG | BTA16-600BW |                    |        |           |               |
| BTA16-600CRG  | BTA16-600C  |                    |        |           |               |
| BTA16-600CWRG | BTA16-600CW |                    |        |           |               |
| BTA16-600SWRG | BTA16-600SW |                    |        |           |               |
| BTA16-800BRG  | BTA16-800B  |                    |        |           |               |
| BTA16-800BWRG | BTA16-800BW |                    |        |           |               |
| BTA16-800CWRG | BTA16-800CW |                    |        |           |               |
| BTA16-800SWRG | BTA16-800SW |                    |        |           |               |
| BTB16-600BRG  | BTB16-600B  | TO-220AB           | 2.30   | 50        | Tube          |
| BTB16-600BWRG | BTB16-600BW |                    |        |           |               |
| BTB16-600CRG  | BTB16-600C  |                    |        |           |               |
| BTB16-600CWRG | BTB16-600CW |                    |        |           |               |
| BTB16-600SWRG | BTB16-600SW |                    |        |           |               |
| BTB16-800BRG  | BTB16-800B  |                    |        |           |               |
| BTB16-800BWRG | BTB16-800BW |                    |        |           |               |
| BTB16-800CWRG | BTB16-800CW |                    |        |           |               |
| BTB16-800SWRG | BTB16-800SW |                    |        |           |               |
| T1610-600G-TR | T1610-600G  | D <sup>2</sup> PAK | 1.50   | 1000      | Tape and reel |
| T1610-800G-TR | T1610-800G  |                    |        |           |               |
| T1635-600G-TR | T1635-600G  |                    |        |           |               |
| T1635-800G-TR | T1635-800G  |                    |        |           |               |
| T1650-600G-TR | T1650-600G  |                    |        |           |               |
| T1635-600G    | T1635-600G  |                    |        | 50        | Tube          |

## Revision history

**Table 10. Document revision history**

| Date        | Revision | Changes                                                                                               |
|-------------|----------|-------------------------------------------------------------------------------------------------------|
| Oct-2002    | 6A       | Last update.                                                                                          |
| 13-Feb-2006 | 7        | TO-220AB delivery mode changed from bulk to tube. ECOPACK statement added.                            |
| 03-Jul-2009 | 8        | Added part number T1610.                                                                              |
| 04-Dec-2009 | 9        | Updated value for $V_{DSM} / V_{RSM}$ in Table 2. Updated temperature in Table 2 from 15 °C to 86 °C. |
| 11-Mar-2010 | 10       | Updated value for $V_{DSM} / V_{RSM}$ in Table 2. Updated temperature in Table 2 from 15 °C to 86 °C. |
| 30-May-2018 | 11       | Updated <a href="#">Section • Product status / summary</a> . Added T1650 package information.         |

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