



# BTA12, BTB12, T12xx

12 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)
- Packages are RoHS ( 2002/95/EC) compliant

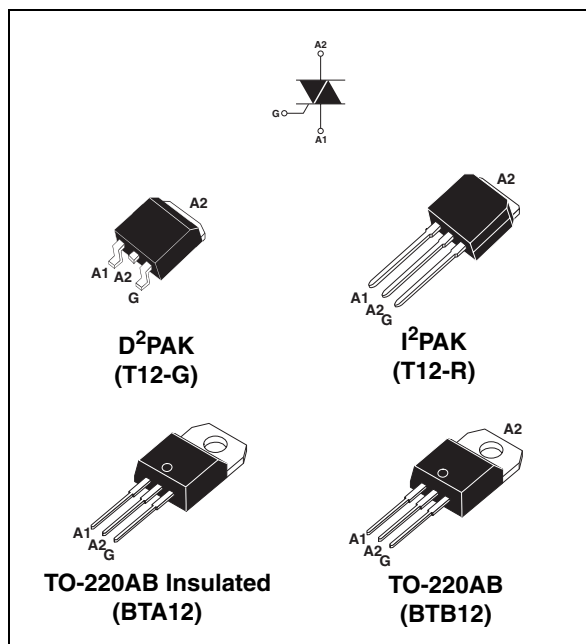
## Applications

ON/OFF or phase angle function in applications such as static relays, light dimmers and appliance motors speed controllers.

The snubberless versions (BTA/BTB...W and T12 series) are especially recommended for use on inductive loads, because of their high commutation performances. The BTA series provides an insulated tab (rated at 2500 V RMS).

## Description

Available either in through-hole or surface-mount packages, the **BTA12, BTB12 and T12xx** triac series is suitable for general purpose mains power AC switching.



## Order code

See [Ordering information on page 11](#)

**Table 1. Device summary**

| Symbol                 | Parameter                         | T12xx    | BTA12 <sup>(1)</sup> | BTB12      |
|------------------------|-----------------------------------|----------|----------------------|------------|
| $I_{T(RMS)}$           | RMS on-state current              | 12       | 12                   | 12         |
| $V_{DRM}/V_{RRM}$      | Repetitive peak off-state voltage | 600/800  | 600/800              | 600/800    |
| $I_{GT}$ (Snubberless) | Triggering gate current           | 10/35/50 | 5/10/35/50           | 5/10/35/50 |
| $I_{GT}$ (Standard)    | Triggering gate current           | -        | 35/50                | 35/50      |

1. Insulated

TM: Snubberless is a trademark of STMicroelectronics

# 1 Characteristics

**Table 2. Absolute maximum ratings**

| Symbol             | Parameter                                                                                 |                                 |                     | Value                          | Unit       |
|--------------------|-------------------------------------------------------------------------------------------|---------------------------------|---------------------|--------------------------------|------------|
| $I_{T(RMS)}$       | RMS on-state current<br>(full sine wave)                                                  | $I^2PAK / D^2PAK /$<br>TO-220AB | $T_c = 105^\circ C$ | 12                             | A          |
|                    |                                                                                           | TO-220AB Ins.                   | $T_c = 90^\circ C$  |                                |            |
| $I_{TSM}$          | Non repetitive surge peak on-state<br>current (full cycle, $T_j$ initial = $25^\circ C$ ) | F = 50 Hz                       | t = 20 ms           | 120                            | A          |
|                    |                                                                                           | F = 60 Hz                       | t = 16.7 ms         | 126                            |            |
| $I^2t$             | $I^2t$ Value for fusing                                                                   | $t_p = 10$ ms                   |                     | 78                             | $A^2s$     |
| di/dt              | Critical rate of rise of on-state current<br>$I_G = 2 \times I_{GT}$ , $t_r \leq 100$ ns  | F = 120 Hz                      | $T_j = 125^\circ C$ | 50                             | A/ $\mu s$ |
| $V_{DSM}/V_{RSM}$  | Non repetitive surge peak off-state<br>voltage                                            | $t_p = 10$ ms                   | $T_j = 25^\circ C$  | $V_{DRM}/V_{RRM}$<br>+ 100     | V          |
| $I_{GM}$           | Peak gate current                                                                         | $t_p = 20$ $\mu s$              | $T_j = 125^\circ C$ | 4                              | A          |
| $P_{G(AV)}$        | Average gate power dissipation                                                            |                                 | $T_j = 125^\circ C$ | 1                              | W          |
| $T_{stg}$<br>$T_j$ | Storage junction temperature range<br>Operating junction temperature range                |                                 |                     | - 40 to + 150<br>- 40 to + 125 | $^\circ C$ |

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

| Symbol                  | Test conditions                                                  | Quadrant     |      | T12xx |       |       | BTA12 / BTB12 |     |     |      | Unit       |
|-------------------------|------------------------------------------------------------------|--------------|------|-------|-------|-------|---------------|-----|-----|------|------------|
|                         |                                                                  |              |      | T1210 | T1235 | T1250 | TW            | SW  | CW  | BW   |            |
| $I_{GT}^{(1)}$          | $V_D = 12$ V                                                     | I - II - III | MAX. | 10    | 35    | 50    | 5             | 10  | 35  | 50   | mA         |
| $V_{GT}$                | $R_L = 30$ $\Omega$                                              | I - II - III | MAX. | 1.3   |       |       |               |     |     |      | V          |
| $V_{GD}$                | $V_D = V_{DRM}$<br>$R_L = 3.3$ k $\Omega$<br>$T_j = 125^\circ C$ | I - II - III | MIN. | 0.2   |       |       |               |     |     |      | V          |
| $I_H^{(2)}$             | $I_T = 100$ mA                                                   |              | MAX. | 15    | 35    | 50    | 10            | 15  | 35  | 50   | mA         |
| $I_L$                   | $I_G = 1.2 I_{GT}$                                               | I - III      | MAX. | 25    | 50    | 70    | 10            | 25  | 50  | 70   | mA         |
|                         |                                                                  | II           |      | 30    | 60    | 80    | 15            | 30  | 60  | 80   |            |
| dV/dt <sup>(2)</sup>    | $V_D = 67\% V_{DRM}$ gate open<br>$T_j = 125^\circ C$            |              | MIN. | 40    | 500   | 1000  | 20            | 40  | 500 | 1000 | V/ $\mu s$ |
| (di/dt)c <sup>(2)</sup> | (dV/dt)c = 0.1 V/ $\mu s$<br>$T_j = 125^\circ C$                 | MIN.         |      | 6.5   |       |       | 3.5           | 6.5 |     |      | A/ms       |
|                         | (dV/dt)c = 10 V/ $\mu s$<br>$T_j = 125^\circ C$                  |              |      | 2.9   |       |       | 1             | 2.9 |     |      |            |
|                         | Without snubber<br>$T_j = 125^\circ C$                           |              |      |       | 6.5   | 12    |               |     | 6.5 | 12   |            |

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 ( $T_j = 25^\circ\text{C}$ , unless otherwise specified)  
standard (4 quadrants)**

| Symbol            | Test Conditions                                                      | Quadrant           |      | BTA12 / BTB12 |           | Unit             |
|-------------------|----------------------------------------------------------------------|--------------------|------|---------------|-----------|------------------|
|                   |                                                                      |                    |      | C             | B         |                  |
| $I_{GT}^{(1)}$    | $V_D = 12\text{ V}$ $R_L = 30\ \Omega$                               | I - II - III<br>IV | MAX. | 25<br>50      | 50<br>100 | mA               |
| $V_{GT}$          |                                                                      | ALL                | MAX. | 1.3           |           | V                |
| $V_{GD}$          | $V_D = V_{DRM}$ $R_L = 3.3\text{ k}\Omega$ $T_j = 125^\circ\text{C}$ | 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            | 50        | mA               |
|                   |                                                                      | II                 |      | 80            | 100       |                  |
| $dV/dt^{(2)}$     | $V_D = 67\% V_{DRM}$ gate open $T_j = 125^\circ\text{C}$             |                    | MIN. | 200           | 400       | V/ $\mu\text{s}$ |
| $(dI/dt)_c^{(2)}$ | $(dI/dt)_c = 5.3\text{ A/ms}$ $T_j = 125^\circ\text{C}$              |                    | MIN. | 5             | 10        | V/ $\mu\text{s}$ |

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

2. for both polarities of A2 referenced to A1.

**Table 5. Static characteristics**

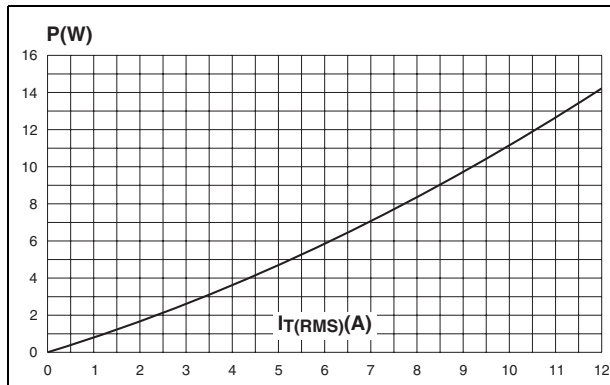
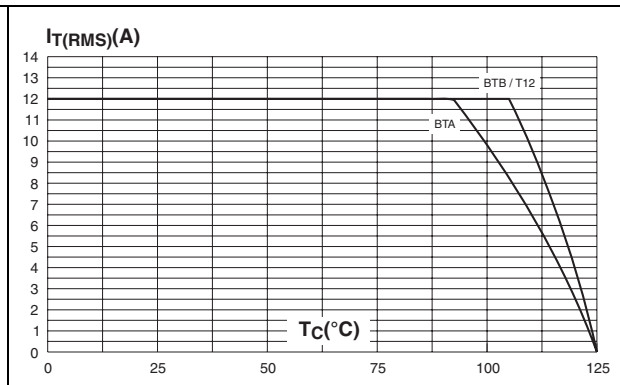
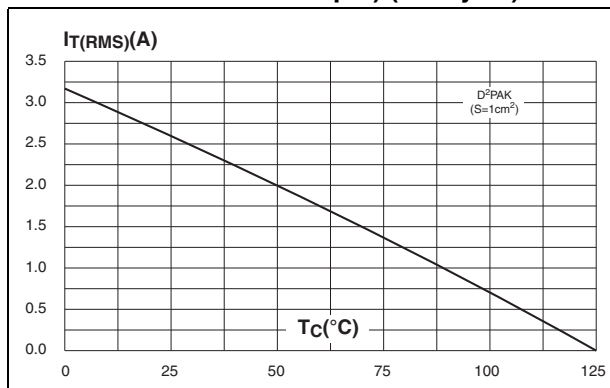
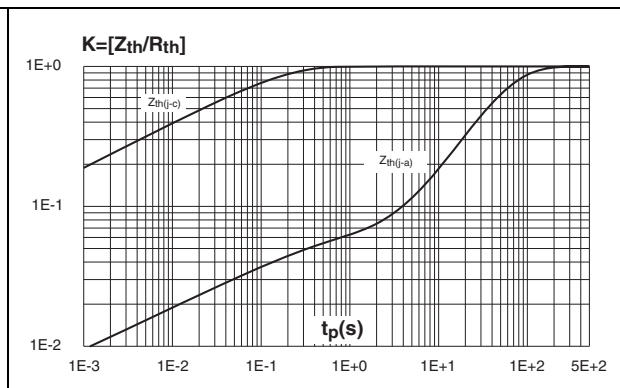
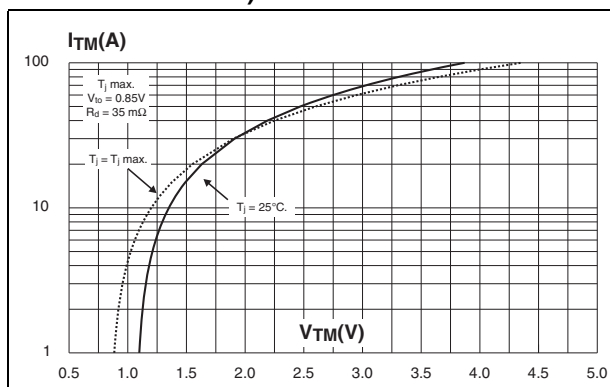
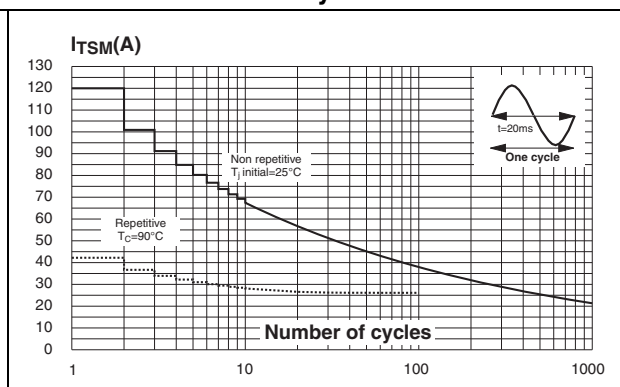
| Symbol                 | Test conditions                                          |                            |      | Value | Unit |
|------------------------|----------------------------------------------------------|----------------------------|------|-------|------|
| $V_T^{(1)}$            | $I_{TM} = 17\text{ A}$<br>$t_p = 380\text{ }\mu\text{s}$ | $T_j = 25^\circ\text{ C}$  | MAX. | 1.55  | V    |
| $V_{t0}^{(1)}$         | Threshold voltage                                        | $T_j = 125^\circ\text{ C}$ | MAX. | 0.85  | V    |
| $R_d^{(1)}$            | Dynamic resistance                                       | $T_j = 125^\circ\text{ C}$ | MAX. | 35    | mΩ   |
| $I_{DRM}$<br>$I_{RRM}$ | $V_{DRM} = V_{RRM}$                                      | $T_j = 25^\circ\text{ C}$  | MAX. | 5     | μA   |
|                        |                                                          | $T_j = 125^\circ\text{ C}$ |      | 1     | mA   |

1. for both polarities of A2 referenced to A1

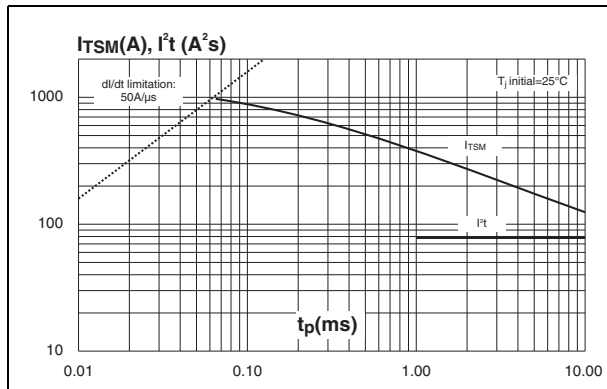
**Table 6. Thermal resistance**

| Symbol        | Parameter             |                                                     | Value | Unit               |
|---------------|-----------------------|-----------------------------------------------------|-------|--------------------|
| $R_{th(j-c)}$ | Junction to case (AC) | I <sup>2</sup> PAK / D <sup>2</sup> PAK / TO-220AB  | 1.4   | $^\circ\text{C/W}$ |
|               |                       | TO-220AB insulated                                  | 2.3   |                    |
| $R_{th(j-a)}$ | Junction to ambient   | $S^{(1)} = 1\text{ cm}^2$ D <sup>2</sup> PAK        | 45    | $^\circ\text{C/W}$ |
|               |                       | TO-220AB / I <sup>2</sup> PAK<br>TO-220AB insulated | 60    |                    |

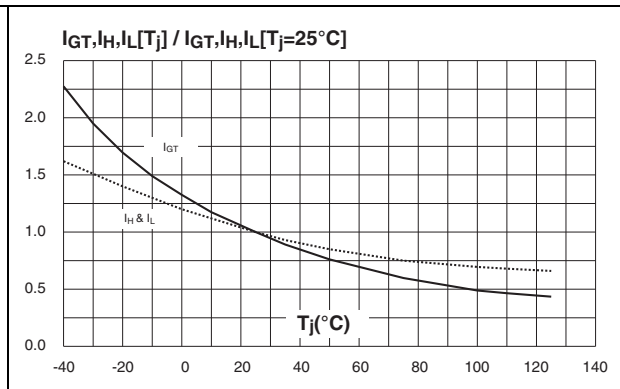
1. Copper surface under tab.

**Figure 1. Maximum power dissipation versus RMS on-state current (full cycle)****Figure 2. RMS on-state current versus case temperature (full cycle)****Figure 3. RMS on-state current versus ambient temperature (printed circuit board FR4, copper thickness: 35μm) (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**

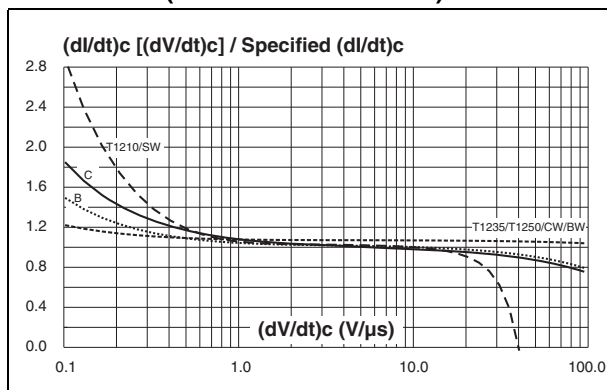
**Figure 7.** Non-repetitive surge peak on-state current for a sinusoidal pulse with width  $t_p < 10$  ms and corresponding value of  $I^2t$



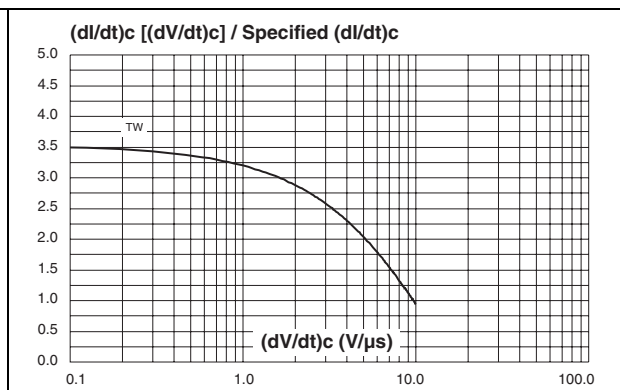
**Figure 8.** Figure 8: Relative variation of gate trigger current, holding current and latching current versus junction temperature (typical values)



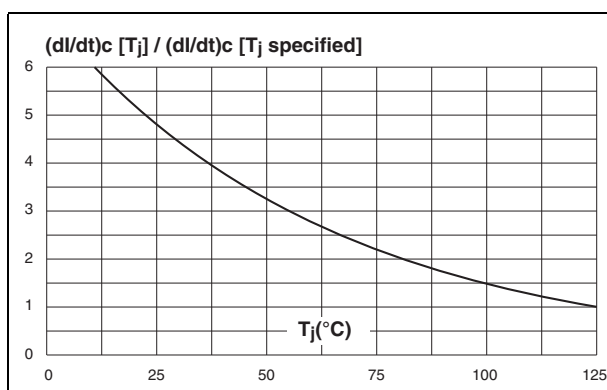
**Figure 9.** Relative variation of critical rate of decrease of main current versus  $(dV/dt)_c$  (typical values) (BW/CW/T1210/T1235)



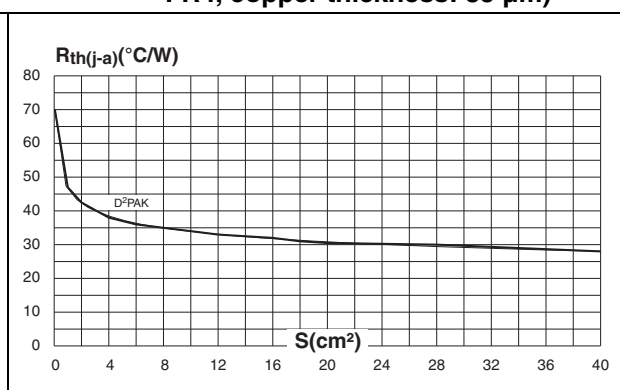
**Figure 10.** Relative variation of critical rate of decrease of main current versus  $(dV/dt)_c$  (typical values) (TW)



**Figure 11.** Relative variation of critical rate of decrease of main current versus junction temperature



**Figure 12.** D²PAK thermal resistance junction to ambient versus copper surface under tab (printed circuit board FR4, copper thickness: 35 μm)



## 2 Ordering information scheme

Figure 13. BTA12 and BTB12 series

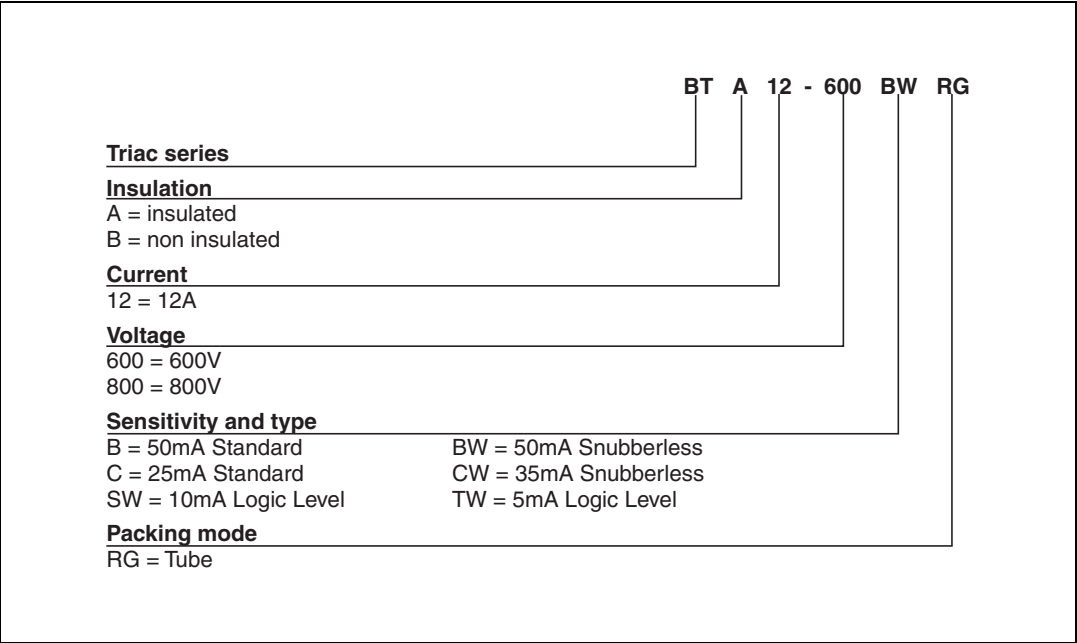


Figure 14. T12xx series

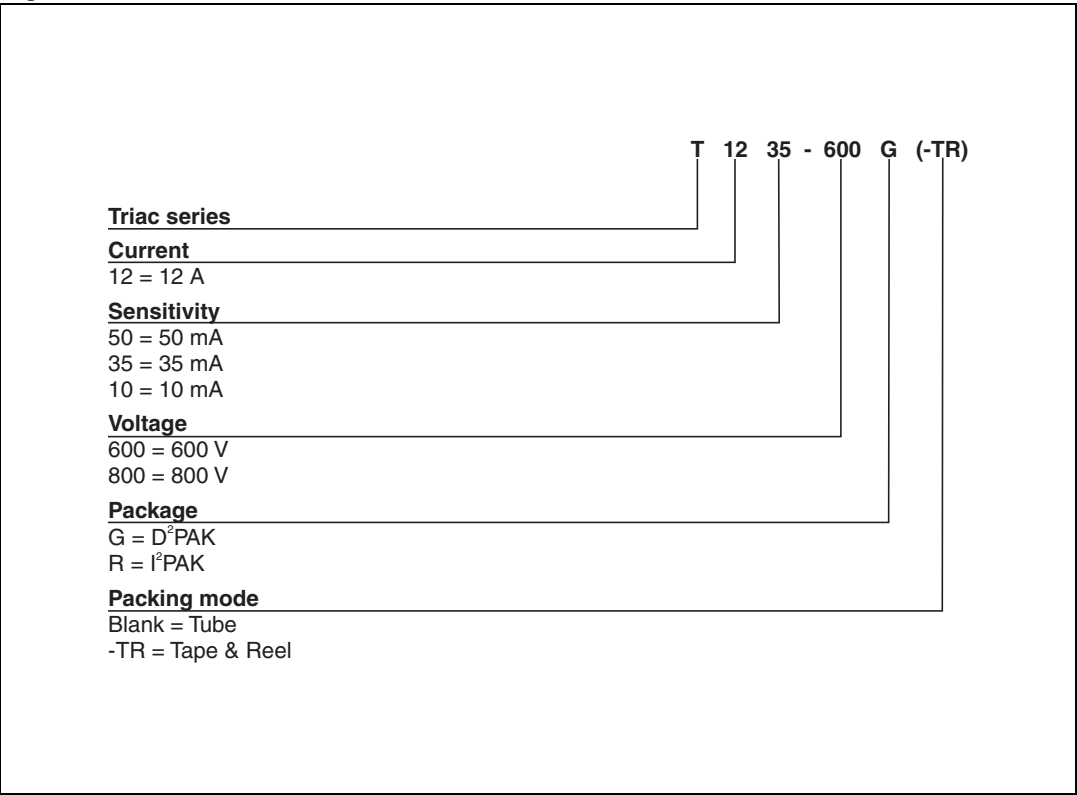


Table 7. Product selector

| Order code <sup>(1)</sup> | Voltage (xxx) |       | Sensitivity | Type        | Package            |
|---------------------------|---------------|-------|-------------|-------------|--------------------|
|                           | 600 V         | 800 V |             |             |                    |
| BTA/BTB12-xxxBRG          | X             | X     | 50 mA       | Standard    | TO-220AB           |
| BTA/BTB12-xxxBWRG         | X             | X     | 50 mA       | Snubberless | TO-220AB           |
| BTA/BTB12-xxxCRG          | X             | X     | 25 mA       | Standard    | TO-220AB           |
| BTA/BTB12-xxxCWRG         | X             | X     | 35 mA       | Snubberless | TO-220AB           |
| BTA/BTB12-xxxSWRG         | X             | X     | 10 mA       | Logic Level | TO-220AB           |
| BTA/BTB12-xxxTWRG         | X             | X     | 5 mA        | Logic Level | TO-220AB           |
| T1210-800G                | -             | X     | 10 mA       | Logic Level | D <sup>2</sup> PAK |
| T1235-xxxG                | X             | X     | 35 mA       | Snubberless | D <sup>2</sup> PAK |
| T1235-xxxR                | X             | X     | 35 mA       | Snubberless | I <sup>2</sup> PAK |
| T1250-600G                | X             | -     | 50 mA       | Snubberless | D <sup>2</sup> PAK |

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

### 3 Packaging information

- Epoxy meets UL94, V0

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: [www.st.com](http://www.st.com).

**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 15. Footprint (dimensions in mm)**

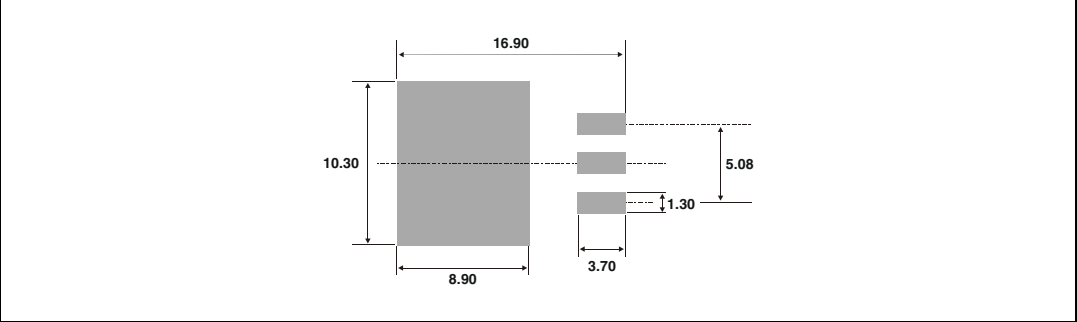
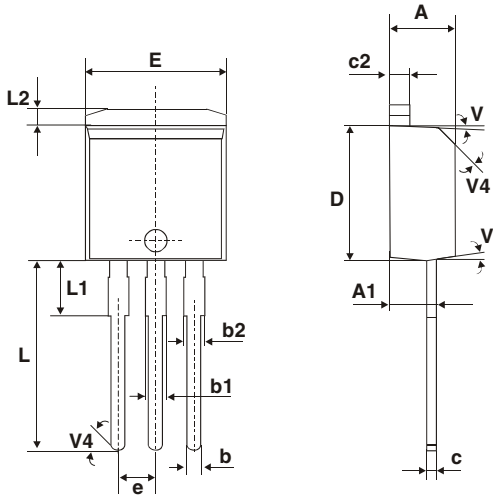


Table 9. I<sup>2</sup>PAK dimensions

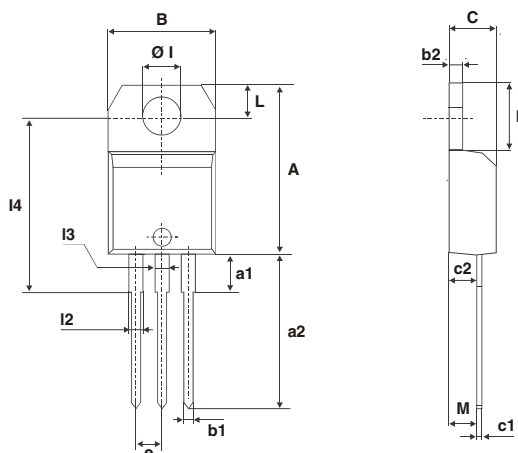
| Ref. | Dimensions  |      |       |        |       |       |
|------|-------------|------|-------|--------|-------|-------|
|      | Millimeters |      |       | Inches |       |       |
|      | Min.        | Typ. | Max.  | Min.   | Typ.  | Max.  |
| A    | 4.30        |      | 4.60  | 0.169  |       | 0.181 |
| A1   | 2.49        |      | 2.69  | 0.098  |       | 0.106 |
| b    | 0.70        |      | 0.93  | 0.028  |       | 0.037 |
| b1   | 1.20        |      | 1.38  | 0.047  |       | 0.054 |
| b2   | 1.25        | 1.40 |       | 0.049  | 0.055 |       |
| c    | 0.45        |      | 0.60  | 0.018  |       | 0.024 |
| c2   | 1.21        |      | 1.36  | 0.048  |       | 0.054 |
| D    | 8.95        |      | 9.35  | 0.352  |       | 0.368 |
| e    | 2.44        |      | 2.64  | 0.096  |       | 0.104 |
| E    | 10.00       |      | 10.28 | 0.394  |       | 0.405 |
| L    | 13.10       |      | 13.60 | 0.516  |       | 0.535 |
| L1   |             | 3.75 |       |        | 0.148 |       |
| L2   | 1.27        |      | 1.40  | 0.050  |       | 0.055 |
| V    |             | 5°   |       |        | 5°    |       |
| V4   |             | 45°  |       |        | 45°   |       |



The technical drawing illustrates the I<sup>2</sup>PAK package dimensions. The top view shows a rectangular package with dimensions E (width), L (length), and L2 (lead length). It also shows the lead width b, lead spacing b1, and lead thickness b2. The side view shows the package height D, lead height A, lead thickness A1, and lead width c. The lead angle V is shown at the base of the lead, and V4 is shown at the top of the lead. The lead length L1 is also indicated.

Table 10. TO-220AB dimensions (insulated and non-insulated)

| 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 |
| l4   | 15.80       | 16.40 | 16.80 | 0.622  | 0.646 | 0.661 |
| L    | 2.65        |       | 2.95  | 0.104  |       | 0.116 |
| l2   | 1.14        |       | 1.70  | 0.044  |       | 0.066 |
| l3   | 1.14        |       | 1.70  | 0.044  |       | 0.066 |
| M    |             | 2.60  |       |        | 0.102 |       |



## 4 Ordering information

**Table 11. Ordering information**

| Order code        | Marking         | Package            | Weight | Base qty | Delivery mode |
|-------------------|-----------------|--------------------|--------|----------|---------------|
| BTA/BTB12-xxxzyRG | BTA/BTB12-xxxzy | TO-220AB           | 2.3 g  | 50       | Tube          |
| T1210-xxxG-TR     | T1210-xxxG      | D <sup>2</sup> PAK | 1.5 g  | 1000     | Tape and reel |
| T1235-xxxG        | T1235xxxG       | D <sup>2</sup> PAK | 1.5 g  | 50       | Tube          |
| T1235-xxxG-TR     | T1235xxxG       |                    |        | 1000     | Tape and reel |
| T1235-xxxR        | T1235-xxxR      | I <sup>2</sup> PAK | 1.5 g  | 50       | Tube          |
| T1250-xxxG-TR     | T1250xxxG       | D <sup>2</sup> PAK | 1.5 g  | 1000     | Tape and reel |

Note: xxx = voltage, y = sensitivity, z = type

## 5 Revision history

**Table 12. Revision history**

| Date        | Revision | Changes                                                                                      |
|-------------|----------|----------------------------------------------------------------------------------------------|
| Sep-2002    | 6A       | Last update.                                                                                 |
| 25-Mar-2005 | 7        | 1. I <sup>2</sup> PAK package added.<br>2. TO-220AB delivery mode changed from bulk to tube. |
| 27-May-2005 | 8        | T1210 added                                                                                  |
| 28-Sep-2007 | 9        | Reformatted to current standards. T1250 added                                                |

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