

## 25 A standard and Snubberless™ triacs

### Features

- High current triac
- Low thermal resistance with clip bonding
- High commutation (4 quadrant) or very high commutation (3 quadrant) capability
- BTA series UL1557 certified (File ref: 81734)
- Packages are RoHS (2002/95/EC) compliant

### Applications

Applications include the ON/OFF function in applications such as static relays, heating regulation, induction motor starting circuits, etc., or for phase control operation in light dimmers, motor speed controllers, and similar.

The snubberless versions (BTA/BTB...W and T25 series) are especially recommended for use on inductive loads, due to their high commutation performances. The BTA series provides an insulated tab (rated at 2500 V<sub>RMS</sub>).

### Description

Available either in through-hole or surface-mount packages, the **BTA24**, **BTB24**, **BTA25**, **BTA26**, **BTB26** and **T25** triac series is suitable for general purpose mains power AC switching.



**Table 1. Device summary**

| Symbol                 | Parameter                         | BTA24 <sup>(1)</sup> | BTB24     | BTA25 <sup>(1)</sup> | BTA26 <sup>(1)</sup>     | BTB26 | T25       | Unit |
|------------------------|-----------------------------------|----------------------|-----------|----------------------|--------------------------|-------|-----------|------|
| $I_{T(RMS)}$           | RMS on-state current              | 25                   | 25        | 25                   | 25                       | 25    | 25        | A    |
| $V_{DRM}/V_{RRM}$      | Repetitive peak off-state voltage | 600 / 800            | 600 / 800 | 600 / 800            | 600 <sup>(2)</sup> / 800 | 600   | 600 / 800 | V    |
| $I_{GT}$ (Snubberless) | Triggering gate current           | 35 / 50              | 35 / 50   | 50                   | 35 / 50                  | -     | 35        | mA   |
| $I_{GT}$ (Standard)    | Triggering gate current           | -                    | 50        | 50                   | 50                       | 50    | -         | mA   |

1. Insulated packages

2. 600 V version available only with  $I_{GT} = 50$  mA (Snubberless and Standard)

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 (full sine wave)  | TOP3                          | $T_c = 105^\circ C$ | 25                             | A                |
|                    |  | D <sup>2</sup> PAK / TO-220AB | $T_c = 100^\circ C$ |                                |                  |
|                    |  | RD91 Ins/ TOP3 Ins.           | $T_c = 100^\circ C$ |                                |                  |
|                    |  | TO-220AB Ins.                 | $T_c = 75^\circ C$  |                                |                  |
| $I_{TSM}$          | Non repetitive surge peak on-state current (full cycle, $T_j$ initial = $25^\circ C$ )   | F = 50 Hz                     | t = 20 ms           | 250                            | A                |
|                    |  | F = 60 Hz                     | t = 16.7 ms         | 260                            |                  |
| $I^2t$             | $I^2t$ Value for fusing  | $t_p = 10$ ms                 |                     | 340                            | A <sup>2</sup> s |
| dI/dt              | Critical rate of rise of on-state current<br>$I_G = 2 \times I_{GT}$ , $t_r \leq 100$ ns | F = 120 Hz                    | $T_j = 125^\circ C$ | 50                             | A/ $\mu$ s       |
| $V_{DSM}/V_{RSM}$  | Non repetitive surge peak off-state voltage  | $t_p = 10$ ms                 | $T_j = 25^\circ C$  | $V_{DRM}/V_{RRM} + 100$        | 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) T25, BTA/BTB24...W, BTA25...W, BTA26...W**

| Symbol                              | Test Conditions   | Quadrant            |      | T25   | BTA/BTB |      | Unit       |
|-------------------------------------|---|---------------------|------|-------|---------|------|------------|
|                                     |   |                     |      | T2535 | CW      | BW   |            |
| $I_{GT}^{(1)}$                      | $V_D = 12$ V $R_L = 33$ $\Omega$                              | I - II - III        | MAX. | 35    | 35      | 50   | mA         |
| $V_{GT}$                            |   | I - II - III        | MAX. | 1.3   |         |      | V          |
| $V_{GD}$                            | $V_D = V_{DRM}$ $R_L = 3.3$ k $\Omega$<br>$T_j = 125^\circ C$ | I - II - III        | MIN. | 0.2   |         |      | V          |
| $I_H^{(2)}$                         | $I_T = 500$ mA  |                     | MAX. | 50    | 50      | 75   | mA         |
| $I_L$                               | $I_G = 1.2$ $I_{GT}$  | I - III             | MAX. | 70    | 70      | 80   | mA         |
|                                     |   | II                  |      | 80    | 80      | 100  |            |
| dV/dt <sup>(2)</sup>                | $V_D = 67\%$ $V_{DRM}$ gate open                              | $T_j = 125^\circ C$ | MIN. | 500   | 500     | 1000 | V/ $\mu$ s |
| (dI/dt) <sub>c</sub> <sup>(2)</sup> | Without snubber   | $T_j = 125^\circ C$ | MIN. | 13    | 13      | 22   | A/ms       |

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), BTB24...B, BTA25...B, BTA26...B, BTB26...B**

| Symbol            | Test Conditions   | Quadrant                  |      | Value | Unit             |
|-------------------|---|---------------------------|------|-------|------------------|
| $I_{GT}^{(1)}$    | $V_D = 12\text{ V}$ $R_L = 33\ \Omega$                                | I - II - III              | MAX. | 50    | mA               |
|                   |   | IV                        |      | 100   |                  |
| $V_{GT}$          |   | 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. | 80    | mA               |
| $I_L$             | $I_G = 1.2\ I_{GT}$   | I - III - IV              | MAX. | 70    | mA               |
|                   |   | II                        |      | 160   |                  |
| $dV/dt^{(2)}$     | $V_D = 67\ \%V_{DRM}$ gate open                                       | $T_j = 125^\circ\text{C}$ | MIN. | 500   | V/ $\mu\text{s}$ |
| $(dV/dt)_c^{(2)}$ | $(dI/dt)_c = 13.3\ \text{A/ms}$                                       | $T_j = 125^\circ\text{C}$ | MIN. | 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 |               |
|------------------------|-------------------------|--------------------------|---------------------------|-------|------|---------------|
| $V_{TM}^{(1)}$         | $I_{TM} = 35\ \text{A}$ | $t_p = 380\ \mu\text{s}$ | $T_j = 25^\circ\text{C}$  | 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.  | 16   | m $\Omega$    |
| $I_{DRM}$<br>$I_{RRM}$ | $V_{DRM} = V_{RRM}$     |                          | $T_j = 25^\circ\text{C}$  | MAX.  | 5    | $\mu\text{A}$ |
|                        |                         |                          | $T_j = 125^\circ\text{C}$ |       | 3    | 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) | TOP 3  | 0.6   | $^\circ\text{C/W}$ |
|               |                       | D <sup>2</sup> PAK / TO-220AB                              | 0.8   |                    |
|               |                       | RD91 Insulated / TOP3 Insulated                            | 0.9   |                    |
|               |                       | TO-220AB Insulated   | 1.7   |                    |
| $R_{th(j-a)}$ | Junction to ambient   | <sup>(1)</sup> S = 1 cm <sup>2</sup><br>D <sup>2</sup> PAK | 45    | $^\circ\text{C/W}$ |
|               |                       | TOP3 / TOP3 Insulated                                      | 50    |                    |
|               |                       | TO-220AB / TO-220AB Insulated                              | 60    |                    |

1. S = 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. D<sup>2</sup>PAK 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



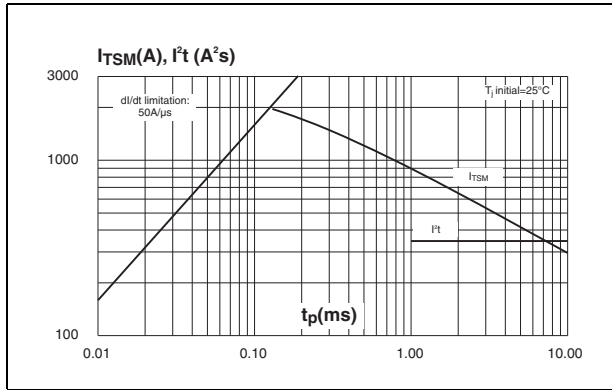
Figure 5. On-state characteristics (maximum values)



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



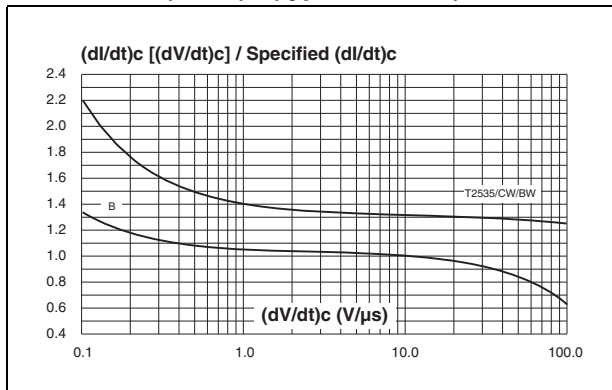
**Figure 7. Non-repetitive surge peak on-state current for a sinusoidal pulse with width  $t_p < 10$  ms and corresponding value of  $I^2t$**



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



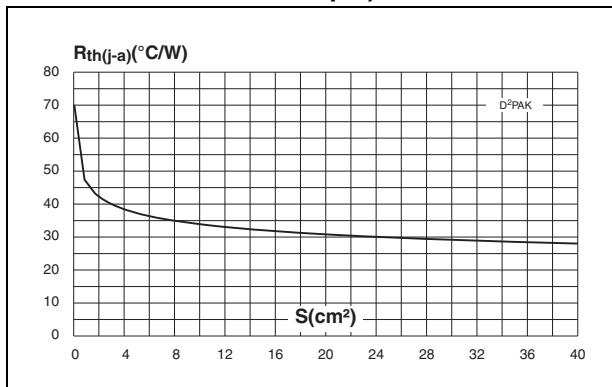
**Figure 9. Relative variation of critical rate of decrease of main current versus  $(dV/dt)_c$  (typical values)**



**Figure 10. Relative variation of critical rate of decrease of main current versus  $T_j$**



**Figure 11. D<sup>2</sup>PAK thermal resistance junction to ambient versus copper surface under tab (printed circuit board FR4, copper thickness: 35  $\mu$ m)**



## 2 Ordering information scheme

Figure 12. BTA and BTB series



Figure 13. T25 series



### 3 Package information

- Epoxy meets UL94,V0
- Cooling method: C
- Recommended torque value: 0.4 - 0.5 Nm (TO-220AB), 0.9 - 1.2 Nm (TOP3 and RD91)
- Maximum torque value for BTB24 is 0.5 Nm

Table 7. 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. D<sup>2</sup>PAK footprint dimensions (in millimeters)



Table 8. RD91 dimensions

| REF. | DIMENSIONS  |       |        |       |
|------|-------------|-------|--------|-------|
|      | Millimeters |       | Inches |       |
|      | Min.        | Max.  | Min.   | Max.  |
| A    |             | 40.00 |        | 1.575 |
| A1   | 29.90       | 30.30 | 1.177  | 1.193 |
| A2   |             | 22.00 |        | 0.867 |
| B    |             | 27.00 |        | 1.063 |
| B1   | 13.50       | 16.50 | 0.531  | 0.650 |
| B2   |             | 24.00 |        | 0.945 |
| C    |             | 14.00 |        | 0.551 |
| C1   |             | 3.50  |        | 0.138 |
| C2   | 1.95        | 3.00  | 0.077  | 0.118 |
| E3   | 0.70        | 0.90  | 0.027  | 0.035 |
| F    | 4.00        | 4.50  | 0.157  | 0.177 |
| I    | 11.20       | 13.60 | 0.441  | 0.535 |
| L1   | 3.10        | 3.50  | 0.122  | 0.138 |
| L2   | 1.70        | 1.90  | 0.067  | 0.075 |
| N1   | 33°         | 43°   | 33°    | 43°   |
| N2   | 28°         | 38°   | 28°    | 38°   |





Table 9. TOP3 (insulated and non\_insulated) dimensions

| REF. | DIMENSIONS  |      |       |        |       |       |
|------|-------------|------|-------|--------|-------|-------|
|      | Millimeters |      |       | Inches |       |       |
|      | Min.        | Typ. | Max.  | Min.   | Typ.  | Max.  |
| A    | 4.4         |      | 4.6   | 0.173  |       | 0.181 |
| B    | 1.45        |      | 1.55  | 0.057  |       | 0.061 |
| C    | 14.35       |      | 15.60 | 0.565  |       | 0.614 |
| D    | 0.5         |      | 0.7   | 0.020  |       | 0.028 |
| E    | 2.7         |      | 2.9   | 0.106  |       | 0.114 |
| F    | 15.8        |      | 16.5  | 0.622  |       | 0.650 |
| G    | 20.4        |      | 21.1  | 0.815  |       | 0.831 |
| H    | 15.1        |      | 15.5  | 0.594  |       | 0.610 |
| J    | 5.4         |      | 5.65  | 0.213  |       | 0.222 |
| K    | 3.4         |      | 3.65  | 0.134  |       | 0.144 |
| ØL   | 4.08        |      | 4.17  | 0.161  |       | 0.164 |
| P    | 1.20        |      | 1.40  | 0.047  |       | 0.055 |
| R    |             | 4.60 |       |        | 0.181 |       |



Table 10. TO-220AB (insulated and non-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 |       |

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## 4 Ordering information

**Table 11. Ordering information**

| Ordering type      | Marking         | Package            | Weight | Base qty | Delivery mode |
|--------------------|-----------------|--------------------|--------|----------|---------------|
| BTA/BTB24-xxxxyzRG | BTA/BTB24 xxxyz | TO-220AB           | 2.3 g  | 50       | Tube          |
| BTA25-xxxxyz       | BTA25xxxxyz     | RD91               | 20 g   | 25       | Bulk          |
| BTA26-xxxxyzRG     | BTA26xxxxyz     | TOP3 Ins.          | 4.5 g  | 30       | Tube          |
| BTB26-600BRG       | BTB26600B       | TOP3               | 4.5 g  | 30       | Tube          |
| T2535-xxxG         | T2535 xxxG      | D <sup>2</sup> PAK | 1.5 g  | 50       | Tube          |
| T2535-xxxG-TR      | T2535 xxxG      |                    |        | 1000     | Tape and reel |

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

## 5 Revision history

**Table 12. Revision history**

| Date        | Revision | Description of changes   |
|-------------|----------|--|
| Oct-2002    | 6A       | Previous update.   |
| 13-Feb-2006 | 7        | TO-220AB delivery mode changed from bulk to tube. ECOPACK statement added.   |
| 31-May-2006 | 8        | Reformatted to current standard. $T_c$ in figure 3 changed to $T_{amb}$  |
| 31-Jul-2006 | 9        | Typing error corrected on page 1 (BTB124 instead of BTB24)   |
| 05-Jul-2007 | 10       | Added BTB26-600BRG. Restructured cover page and section 2: <a href="#">Ordering information scheme on page 6</a> to simplify product selection. Thermal resistance values updated in <a href="#">Table 6</a> and <a href="#">Figure 2</a> . Graphic for $I^2t$ updated in <a href="#">Figure 7</a> . |

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