

# 1 Characteristics

**Table 1. Absolute maximum ratings**

| Symbol             | Parameters                                                                                      |                               |                        | Value                    | Unit             |
|--------------------|-------------------------------------------------------------------------------------------------|-------------------------------|------------------------|--------------------------|------------------|
| $I_{T(RMS)}$       | RMS on-state current (full sine wave)                                                           | D <sup>2</sup> PAK / TO-220AB | $T_c = 100\text{ °C}$  | 25                       | A                |
|                    |                                                                                                 | TO-220AB Ins.                 | $T_c = 75\text{ °C}$   |                          |                  |
| $I_{TSM}$          | Non repetitive surge peak on-state current (full cycle, $T_j$ initial = 25 °C)                  | f = 60 Hz                     | $t_p = 16,7\text{ ms}$ | 260                      | A                |
|                    |                                                                                                 | f = 50 Hz                     | $t_p = 20\text{ ms}$   | 250                      |                  |
| $I^2t$             | $I^2t$ value for fusing                                                                         | $t_p = 10\text{ ms}$          |                        | 340                      | A <sup>2</sup> s |
| di/dt              | Critical rate of rise of on-state current<br>$I_G = 2 \times I_{GT}$ , $t_r \leq 100\text{ ns}$ | f = 120 Hz                    | $T_j = 125\text{ °C}$  | 50                       | A/ $\mu$ s       |
| $V_{DSM}, V_{RSM}$ | Non repetitive surge peak off-state voltage                                                     | $t_p = 10\text{ ms}$          | $T_j = 25\text{ °C}$   | $V_{DRM}, V_{RRM} + 100$ | V                |
| $V_{DRM}, V_{RRM}$ | Repetitive peak off-state voltage                                                               | $T_j = 25\text{ °C}$          |                        | 600 or 800               | V                |
| $I_{GM}$           | Peak gate current                                                                               | $t_p = 20\text{ }\mu$ s       | $T_j = 125\text{ °C}$  | 4                        | A                |
| $P_{G(AV)}$        | Average gate power dissipation                                                                  | $T_j = 125\text{ °C}$         |                        | 1                        | W                |
| $T_{stg}$          | Storage junction temperature range                                                              |                               |                        |                          | -40 to +150 °C   |
| $T_j$              | Operating junction temperature range                                                            |                               |                        |                          | -40 to +125 °C   |
| $T_L$              | Maximum lead temperature for soldering during 10 s                                              |                               |                        |                          | 260 °C           |
| $V_{INS}$          | Insulation RMS voltage, 1 minute                                                                |                               |                        |                          | 2.5 kV           |

**Table 2. Electrical characteristics ( $T_j = 25\text{ °C}$ , unless otherwise specified) - Snubberless (3 quadrants) T25, BTA24-XXXXW, BTB24-XXXXW**

| Symbol                 | Parameters                                                           | Quadrant     |      | T25   | BTA/BTB |      | Unit       |
|------------------------|----------------------------------------------------------------------|--------------|------|-------|---------|------|------------|
|                        |                                                                      |              |      | T2535 | CW      | BW   |            |
| $I_{GT}^{(1)}$         | $V_D = 12\text{ V}$ , $R_L = 33\text{ }\Omega$                       | I - II - III | Max. | 35    | 35      | 50   | mA         |
| $V_{GT}$               |                                                                      | I - II - III | Max. | 1.3   |         |      | V          |
| $V_{GD}$               | $V_D = V_{DRM}$ , $R_L = 3.3\text{ k}\Omega$ , $T_j = 125\text{ °C}$ | I - II - III | Min. | 0.2   |         |      | V          |
| $I_H^{(2)}$            | $I_T = 500\text{ mA}$                                                |              | Max. | 50    | 50      | 75   | mA         |
| $I_L$                  | $I_G = 1.2 I_{GT}$                                                   | I - III      | Max. | 70    | 70      | 80   | mA         |
|                        |                                                                      | II           | Max. | 80    | 80      | 100  |            |
| dV/dt <sup>(2)</sup>   | $V_D = 67\text{ % } V_{DRM}$ gate open, $T_j = 125\text{ °C}$        |              | Min. | 500   | 500     | 1000 | V/ $\mu$ s |
| (di/dt) <sup>(2)</sup> | Without snubber                                                      |              | 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 3. Electrical characteristics ( $T_j = 25\text{ °C}$ , unless otherwise specified) - standard (4 quadrants)  
 BTB24-800B, BTB24-600B**

| Symbol            | Parameters                                                     | Quadrant     |      | Value | Unit       |
|-------------------|----------------------------------------------------------------|--------------|------|-------|------------|
| $I_{GT}^{(1)}$    | $V_D = 12\text{ V}, R_L = 33\text{ }\Omega$                    | I - II - III | Max. | 50    | mA         |
|                   |                                                                | IV           |      | 100   |            |
| $V_{GT}$          |                                                                | All          | Max. | 1.3   | V          |
| $V_{GD}$          | $V_D = V_{DRM}, R_L = 3.3\text{ k}\Omega, T_j = 125\text{ °C}$ | All          | Min. | 0.2   | V          |
| $I_H^{(2)}$       | $I_T = 500\text{ mA}$                                          |              | Max. | 80    | mA         |
| $I_L$             | $I_G = 1.2\text{ }I_{GT}$                                      | I - III - IV | Max. | 70    | mA         |
|                   |                                                                | II           | Max. | 160   |            |
| $dV/dt^{(2)}$     | $V_D = 67\text{ }\% V_{DRM}$ gate open, $T_j = 125\text{ °C}$  |              | Min. | 500   | V/ $\mu$ s |
| $(dV/dt)_c^{(2)}$ | $(dI/dt)_c = 13.3\text{ A/ms}, T_j = 125\text{ °C}$            |              | Min. | 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. Static electrical characteristics**

| Symbol            | Test conditions                                | $T_j$  |      | Value | Unit       |
|-------------------|------------------------------------------------|--------|------|-------|------------|
| $V_{TM}^{(1)}$    | $I_{TM} = 35\text{ A}, t_p = 380\text{ }\mu$ s | 25 °C  | Max. | 1.55  | V          |
| $V_{TO}^{(1)}$    | threshold on-state voltage                     | 125 °C | Max. | 0.85  | V          |
| $R_D^{(1)}$       | Dynamic resistance                             | 125 °C | Max. | 16    | m $\Omega$ |
| $I_{DRM}/I_{RRM}$ | $V_T = V_{DRM}, V_T = V_{RRM}$                 | 25 °C  | Max. | 5     | $\mu$ A    |
|                   |                                                | 125 °C |      | 3     | mA         |

1. For both polarities of A2 referenced to A1

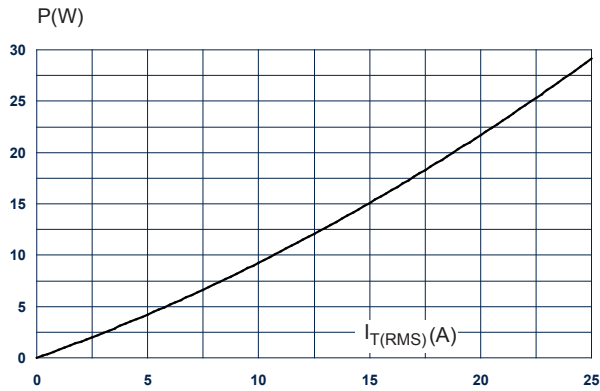
**Table 5. Thermal resistance**

| Symbol        | Parameters                                       |                               |      | Value | Unit                 |
|---------------|--------------------------------------------------|-------------------------------|------|-------|----------------------|
| $R_{th(j-c)}$ | Junction to case (AC)                            | D <sup>2</sup> PAK / TO-220AB | Max. | 0.8   | $^{\circ}\text{C/W}$ |
|               |                                                  | TO-220AB insulated            |      | 1.7   |                      |
| $R_{th(j-a)}$ | Junction to ambient, $S^{(1)} = 2.5\text{ cm}^2$ | D <sup>2</sup> PAK            | Typ. | 45    |                      |
|               | Junction to ambient                              | TO-220AB / TO-220AB insulated |      | 60    |                      |

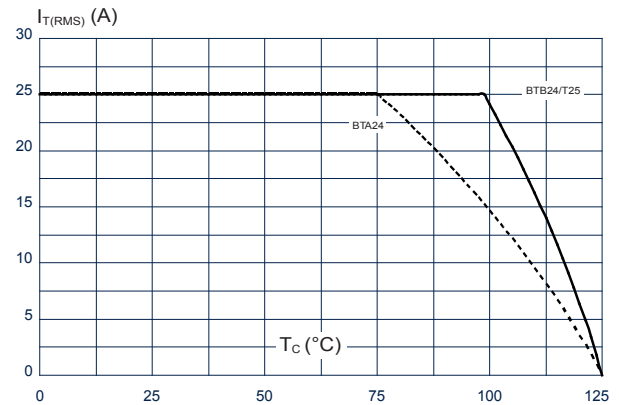
1.  $S$  = Copper surface under tab.

## 1.1 Characteristics (curves)

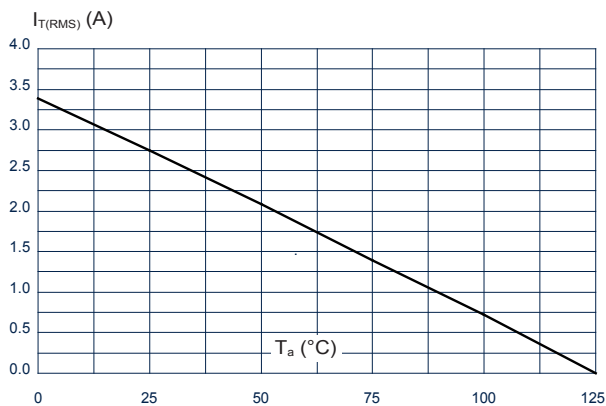
**Figure 1. Maximum power dissipation versus on-state RMS current (full cycle)**



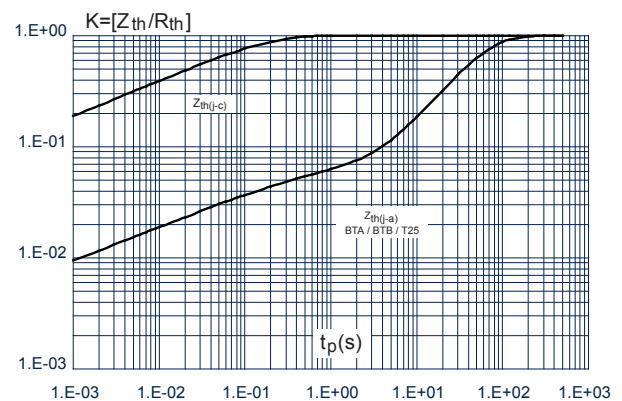
**Figure 2. RMS on-state current versus case temperature (full cycle)**



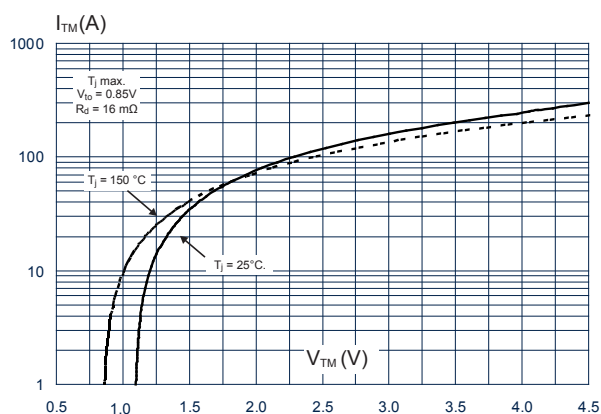
**Figure 3. RMS on-state current versus ambient temperature (full cycle) D<sup>2</sup>PAK**



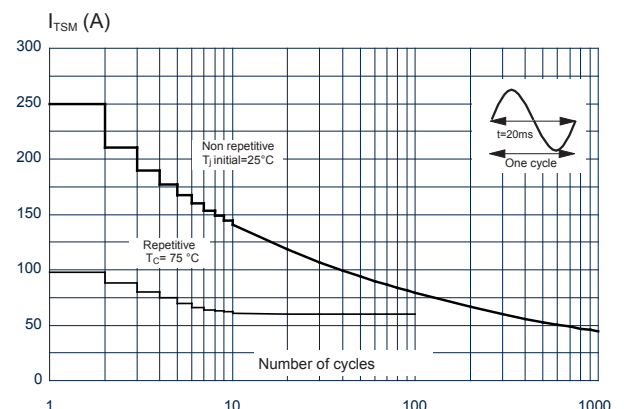
**Figure 4. Relative variation of thermal impedance versus pulse duration**



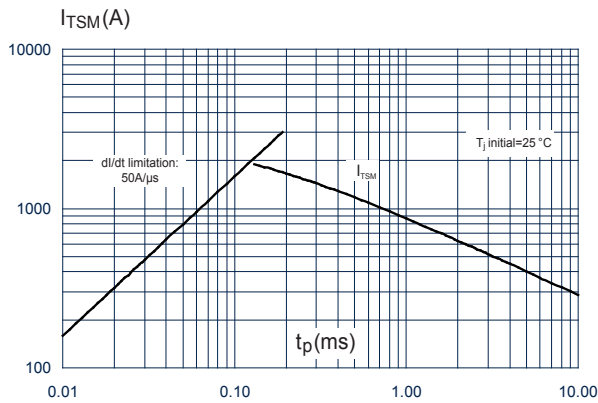
**Figure 5. On-state characteristics (maximum values)**



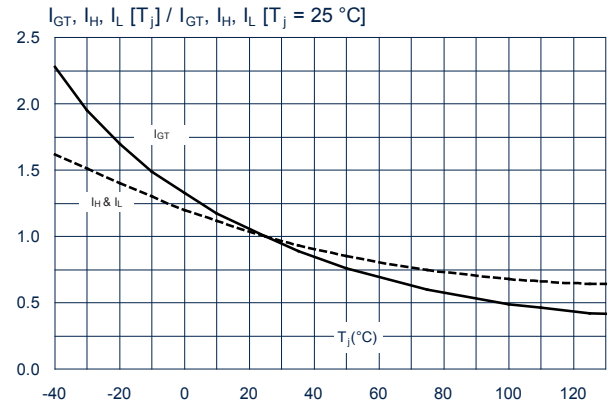
**Figure 6. Surge peak on-state current versus number of cycles**



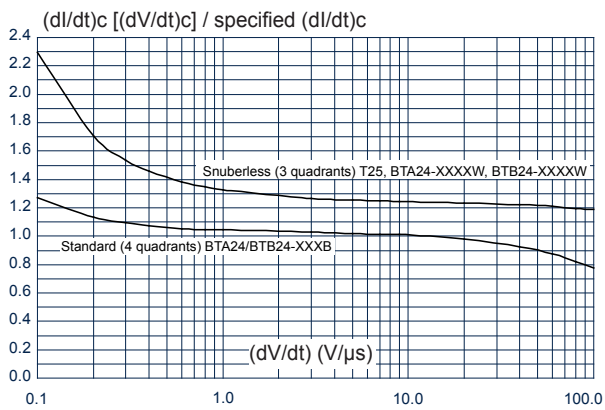
**Figure 7. Non-repetitive surge peak on-state current for a sinusoidal pulse with width  $t_p < 10$  ms**



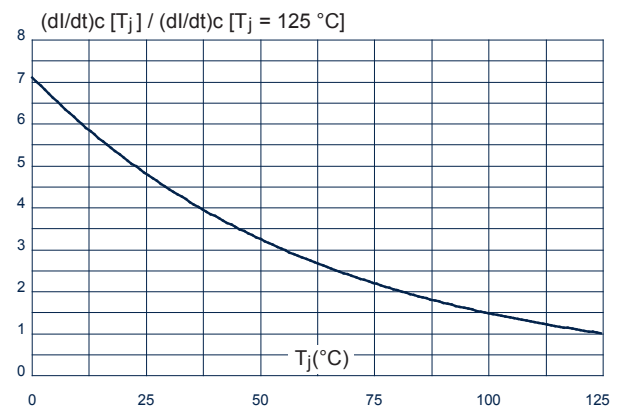
**Figure 8. Relative variation of gate trigger current, holding and latching current versus junction temperature**



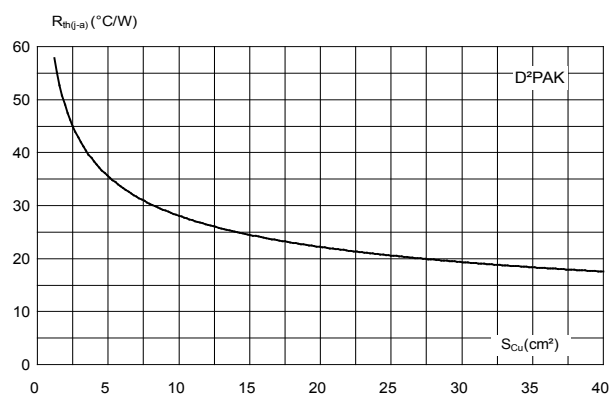
**Figure 9. Relative variation of critical rate of decrease of main current versus  $(dV/dt)_c$  (typical values)**



**Figure 10. Relative variation of critical rate of decrease of main current versus junction temperature (typical values)**



**Figure 11. D<sup>2</sup>PAK thermal resistance junction to ambient versus copper surface under tab**



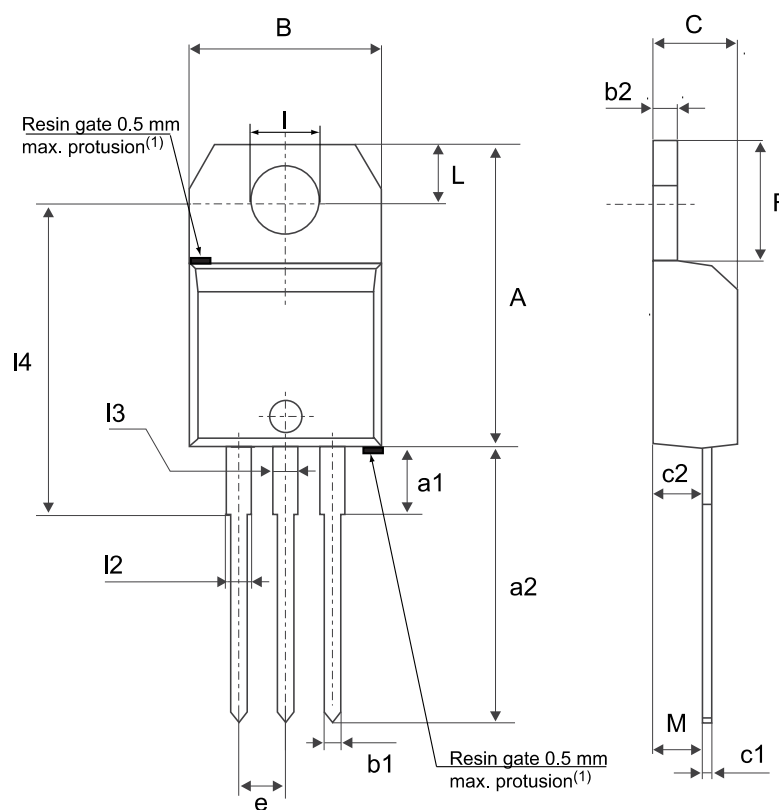
## 2 Package information

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 package information

- Molding compound resin is halogen free and meets UL94 flammability standard, level V0
- Lead-free plating package leads
- Recommended torque: 0.4 to 0.6 N·m

**Figure 12. TO-220AB package outline**



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

**Table 6. TO-220AB package mechanical data**

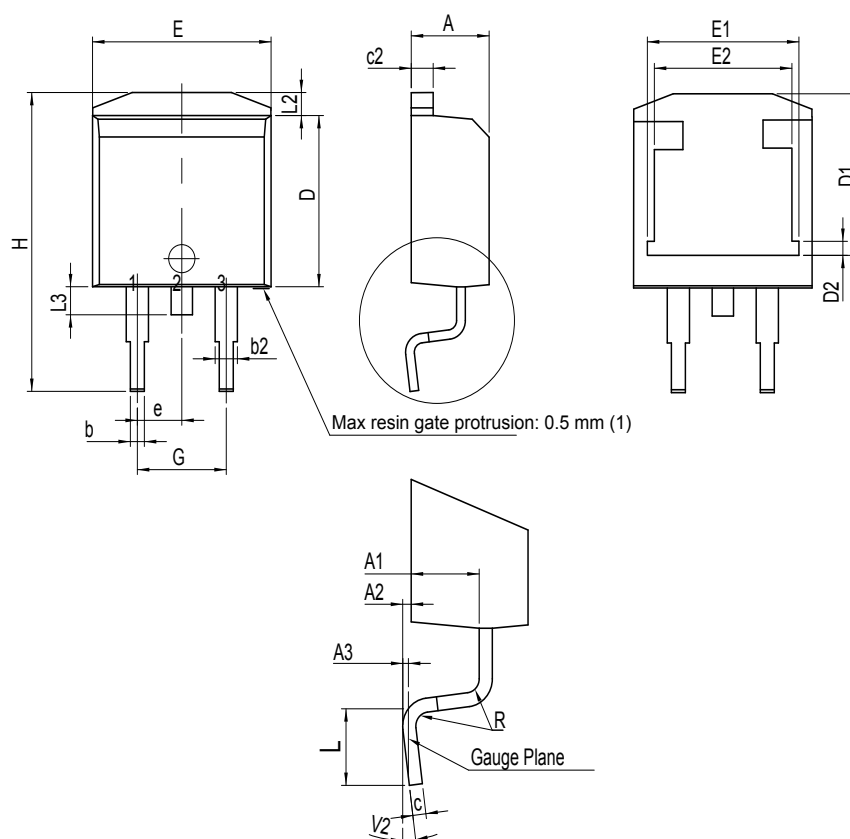
| Ref. | Dimensions  |       |       |                       |        |        |
|------|-------------|-------|-------|-----------------------|--------|--------|
|      | Millimeters |       |       | Inches <sup>(1)</sup> |        |        |
|      | Min.        | Typ.  | Max.  | Min.                  | 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 |
| l2   | 1.14        |       | 1.70  | 0.0449                |        | 0.0669 |
| l3   | 1.14        |       | 1.70  | 0.0449                |        | 0.0669 |
| l4   | 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

- ECOPACK2 compliant
- Lead-free package leads finishing
- Molding compound resin is halogen-free and meets UL94 flammability standard level V0

**Figure 13. D<sup>2</sup>PAK package outline**



(1) Resin gate is accepted in each of position shown on the drawing, or their symmetrical.

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

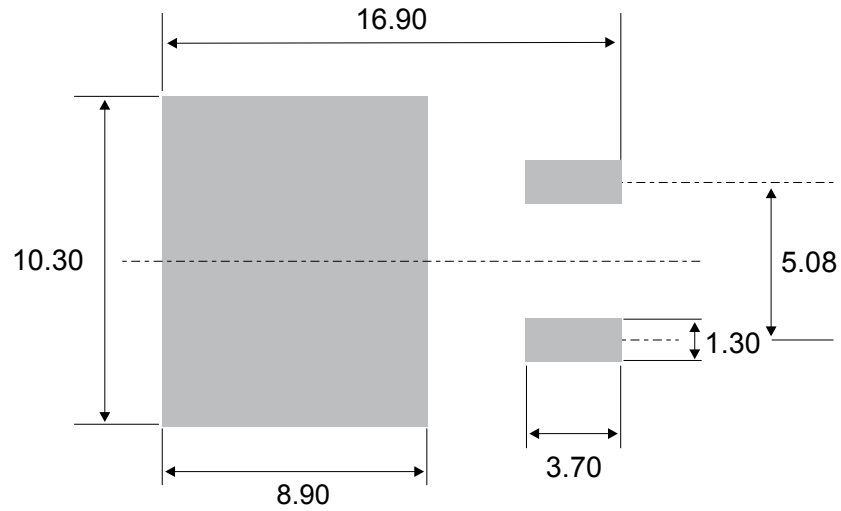
| Ref.              | Dimensions  |      |       |                       |        |        |
|-------------------|-------------|------|-------|-----------------------|--------|--------|
|                   | Millimeters |      |       | Inches <sup>(1)</sup> |        |        |
|                   | 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        |      |       | 0.10000               |        |        |
| 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                | 1.19        |      | 1.40  | 0.0468                |        | 0.0551 |
| L3                | 1.40        |      | 1.75  | 0.0551                |        | 0.0689 |
| R                 |             | 0.40 |       |                       | 0.0157 |        |
| V2 <sup>(2)</sup> | 0°          |      | 8°    | 0°                    |        | 8°     |

1. Dimensions in inches are given for reference only

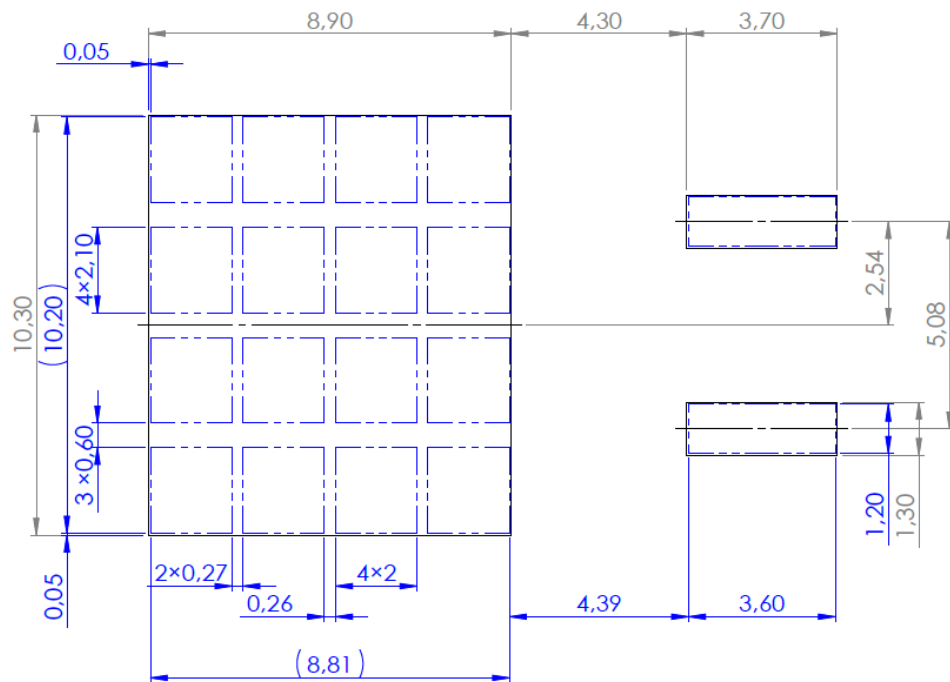
2. Degrees



**Figure 14. D<sup>2</sup>PAK recommended footprint (dimensions are in mm)**

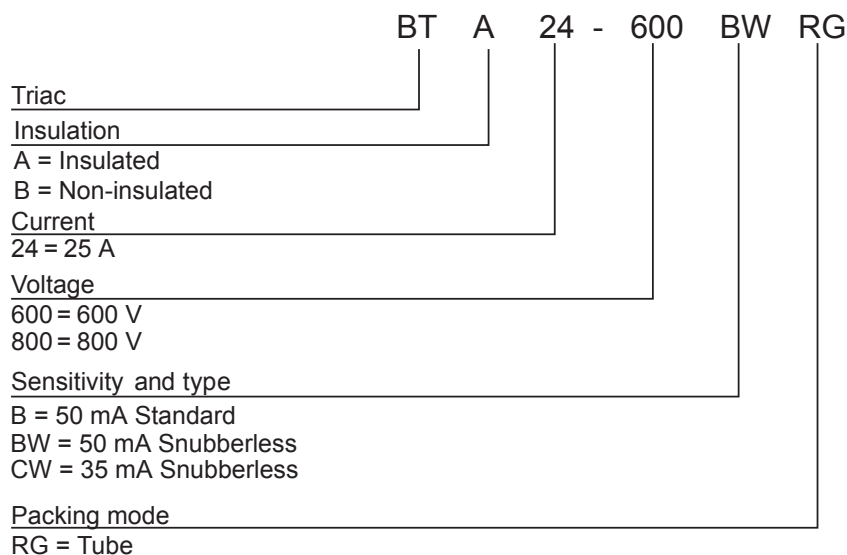


**Figure 15. D<sup>2</sup>PAK stencil definitions (dimensions are in mm)**

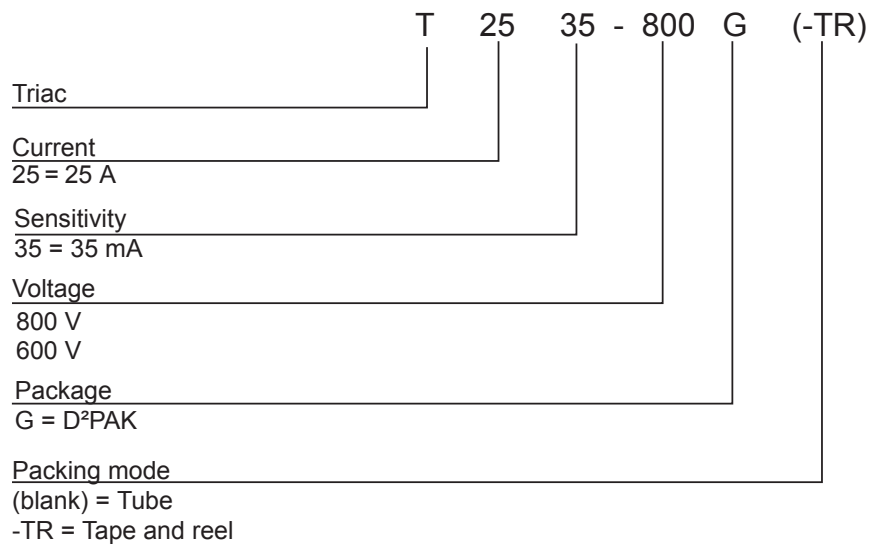


### 3 Ordering information

**Figure 16. Ordering information scheme (BTA24 and BTB24 series)**



**Figure 17. Ordering information scheme (T25 series)**



**Table 8. Ordering information**

| Order code    | Marking     | Package            | Weigh<br>t | Base<br>qty. | Delivery mode |
|---------------|-------------|--------------------|------------|--------------|---------------|
| BTA24-600BWRG | BTA24 600BW | TO-220AB insulated | 2.3 g      | 50           | Tube          |
| BTA24-600CWRG | BTA24 600CW |                    |            |              |               |
| BTA24-800BWRG | BTA24 800BW |                    |            |              |               |
| BTA24-800CWRG | BTA24 800CW |                    |            |              |               |
| BTB24-600BRG  | BTB24 600B  | TO-220AB           |            |              |               |
| BTB24-600BWRG | BTB24 600BW |                    |            |              |               |
| BTB24-600CWRG | BTB24 600CW |                    |            |              |               |
| BTB24-800BRG  | BTB24 800B  |                    |            |              |               |
| BTB24-800BWRG | BTB24 800BW |                    |            |              |               |
| BTB24-800CWRG | BTB24 800CW |                    |            |              |               |
| T2535-600G    | T2535 600G  | D <sup>2</sup> PAK | 1.5 g      | 50           | Tube          |
| T2535-600G-TR | T2535 600G  |                    |            | 2500         | Tape and reel |
| T2535-800G    | T2535 800G  |                    |            | 50           | Tube          |
| T2535-800G-TR | T2535 800G  |                    |            | 2500         | Tape and reel |

## Revision history

**Table 9. Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                            |
|-------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Oct-2002    | 6A       | Previous update.                                                                                                                                                                                                                   |
| 13-Feb-2006 | 7        | TO-220AB delivery mode changed from bulk to tube.<br>ECOPACK statement added.                                                                                                                                                      |
| 31-May-2006 | 8        | Reformatted to current standard. Tc in figure 3 changed to Tamb                                                                                                                                                                    |
| 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: Ordering information scheme on page 6 to simplify product selection.<br>Thermal resistance values updated in Table 6 and Figure 2. Graphic for I2t updated in Figure 7. |
| 28-Jul-2021 | 11       | Removed RD91, TOP3 insulated and TOP3 package information. Put in separate specification.<br>Minor text changes.                                                                                                                   |
| 29-Sep-2021 | 12       | Updated <a href="#">Table 2</a> .                                                                                                                                                                                                  |

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