

# 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/μs             |
| $V_{DSM}, V_{RSM}$ | 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                                                                               | $t_p = 20\text{ μs}$          | $T_j = 125\text{ °C}$  | 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   |      |
| $I_{GT}^{(1)}$         | $V_D = 12\text{ V}$ , $R_L = 33\text{ Ω}$                       | I - II - III | Max. | 35    | 35      | 50   | mA   |
| $V_{GT}$               |                                                                 | I - II - III | Max. | 1.3   |         |      | V    |
| $V_{GD}$               | $V_D = V_{DRM}$ , $R_L = 3.3\text{ kΩ}$ , $T_j = 125\text{ °C}$ | 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>   | $V_D = 67\%$ $V_{DRM}$ gate open, $T_j = 125\text{ °C}$         |              | Min. | 500   | 500     | 1000 | V/μs |
| (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

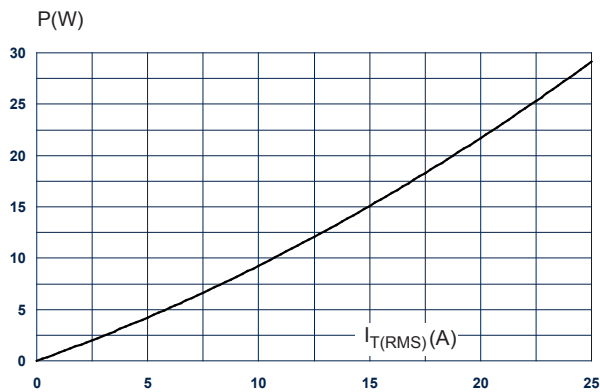
**Table 5. Thermal resistance**

| 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    |                      |

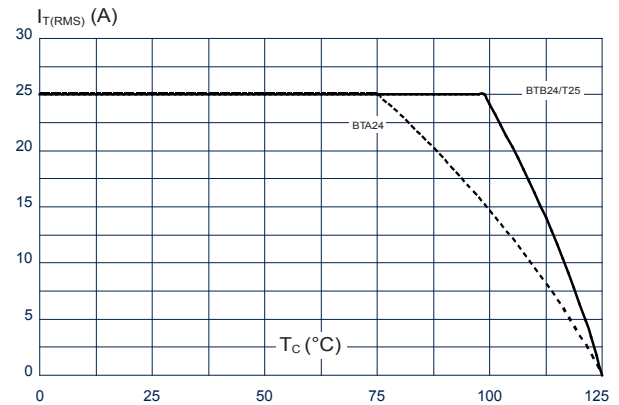
1.  $S$  = Copper surface under tab.

## 1.1 Characteristics (curves)

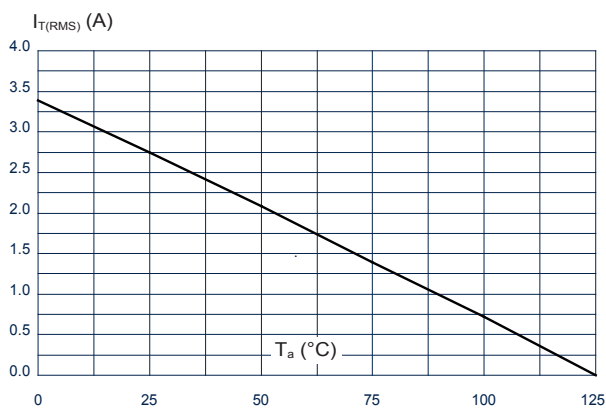
**Figure 1. Maximum power dissipation versus on-state RMS current (full cycle)**



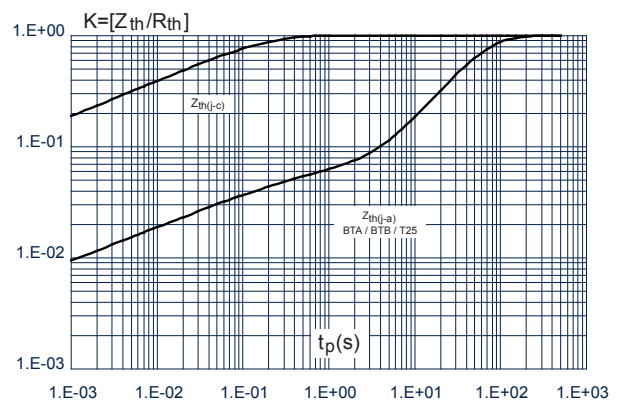
**Figure 2. RMS on-state current versus case temperature (full cycle)**



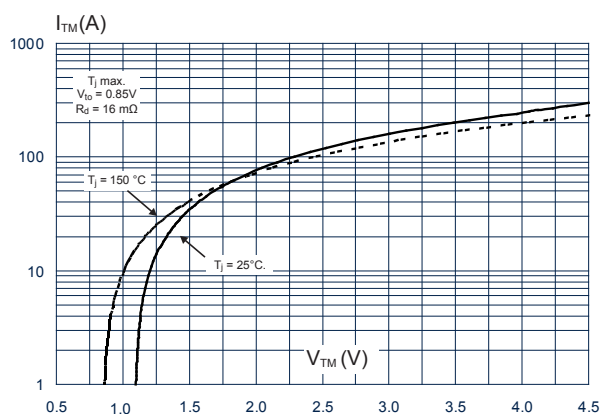
**Figure 3. RMS on-state current versus ambient temperature (full cycle) D<sup>2</sup>PAK**



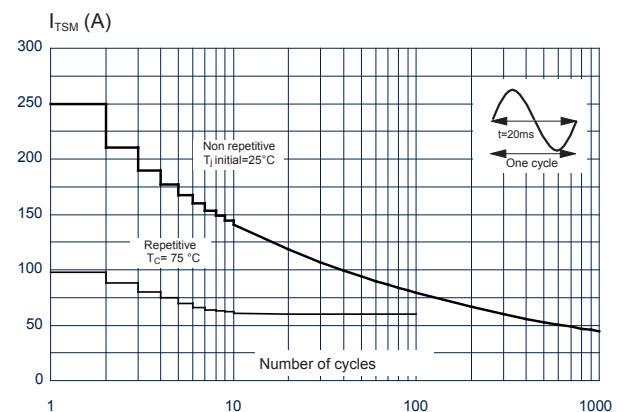
**Figure 4. Relative variation of thermal impedance versus pulse duration**



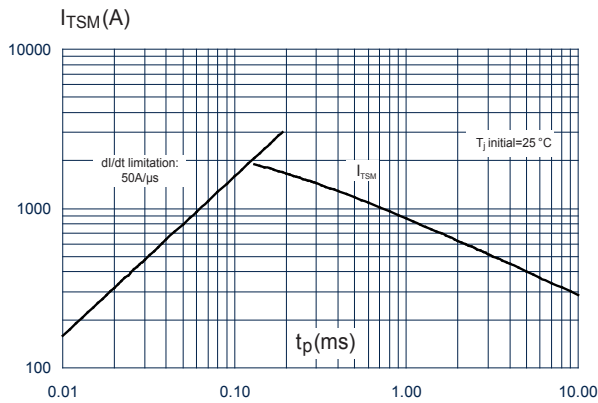
**Figure 5. On-state characteristics (maximum values)**



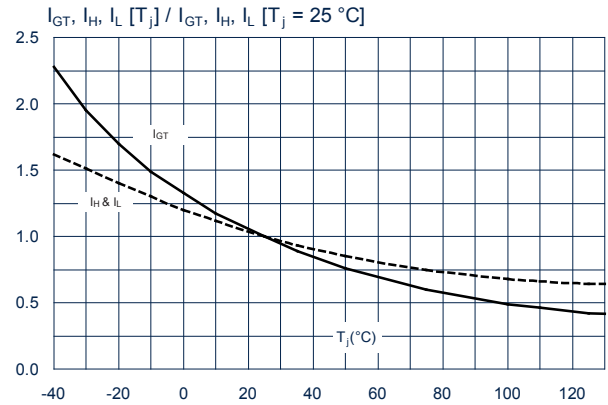
**Figure 6. Surge peak on-state current versus number of cycles**



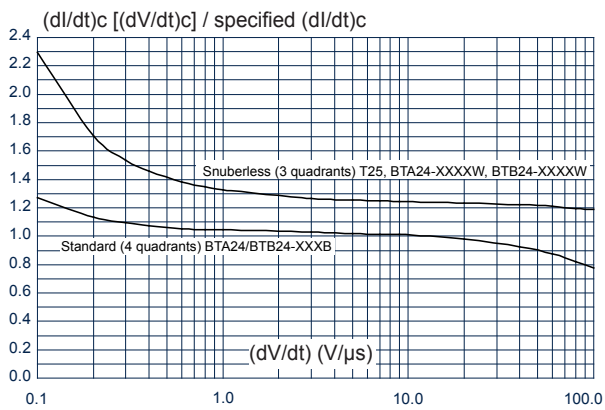
**Figure 7. Non-repetitive surge peak on-state current for a sinusoidal pulse with width  $t_p < 10$  ms**



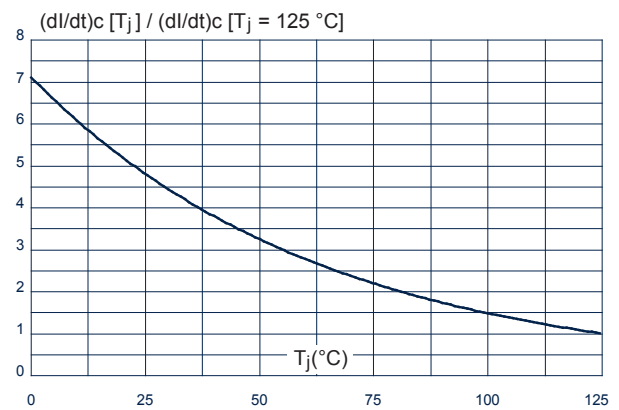
**Figure 8. Relative variation of gate trigger current, holding and latching current versus junction temperature**



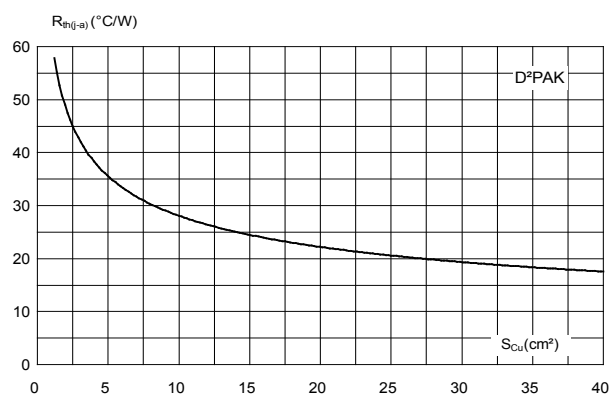
**Figure 9. Relative variation of critical rate of decrease of main current versus  $(dV/dt)_c$  (typical values)**



**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**



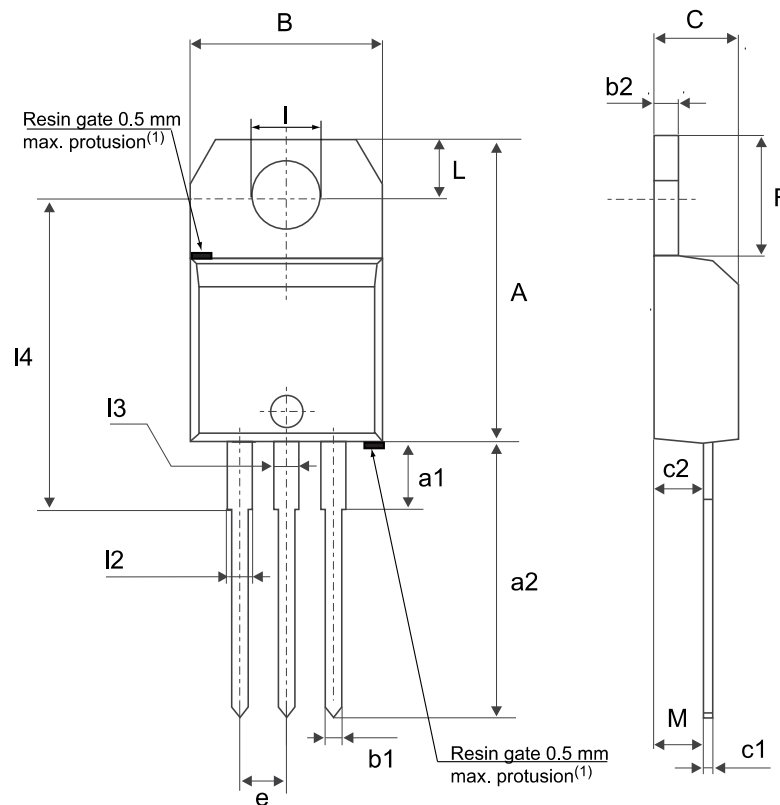
## 2 Package information

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**

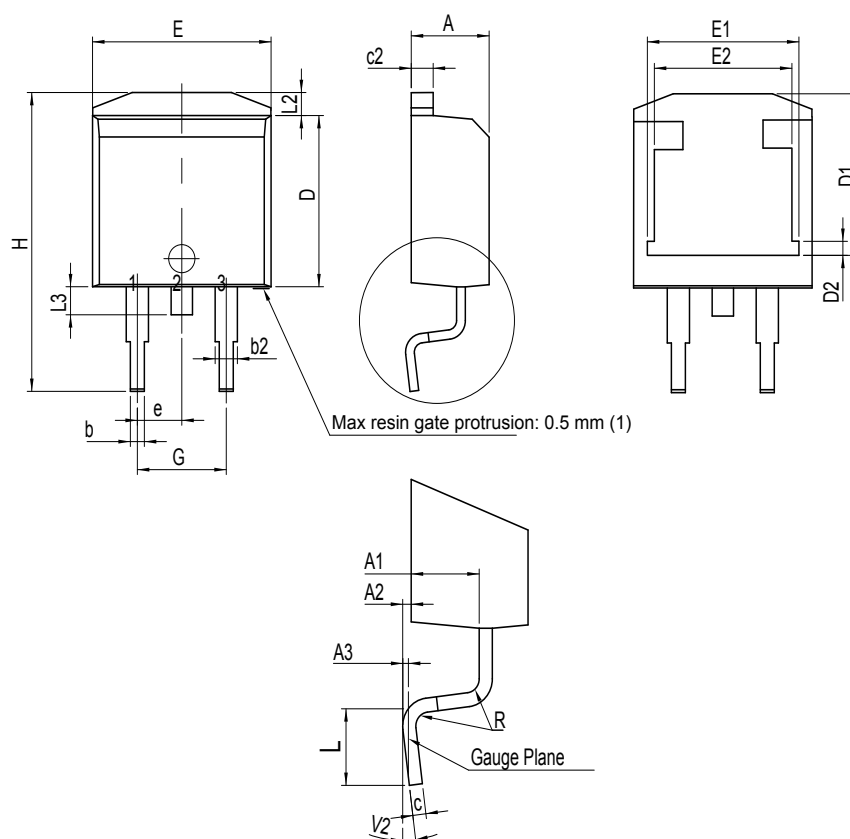
| Ref. | Dimensions  |       |       |                       |        |        |
|------|-------------|-------|-------|-----------------------|--------|--------|
|      | Millimeters |       |       | Inches <sup>(1)</sup> |        |        |
|      | Min.        | Typ.  | Max.  | Min.                  | 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

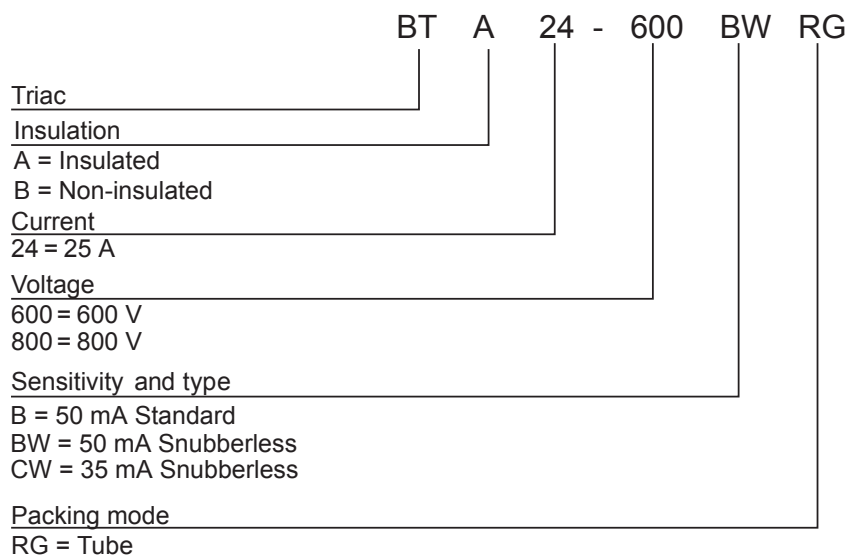
Technical drawing of a stepped profile (Figure 1.10). The profile consists of a main rectangular section and two smaller rectangular sections attached to its right side. The dimensions are as follows:

- Overall width: 16.90
- Overall height: 10.30
- Width of the main section: 8.90
- Width of the top-right section: 3.70
- Width of the bottom-right section: 3.70
- Height of the top-right section: 5.08
- Height of the bottom-right section: 1.30

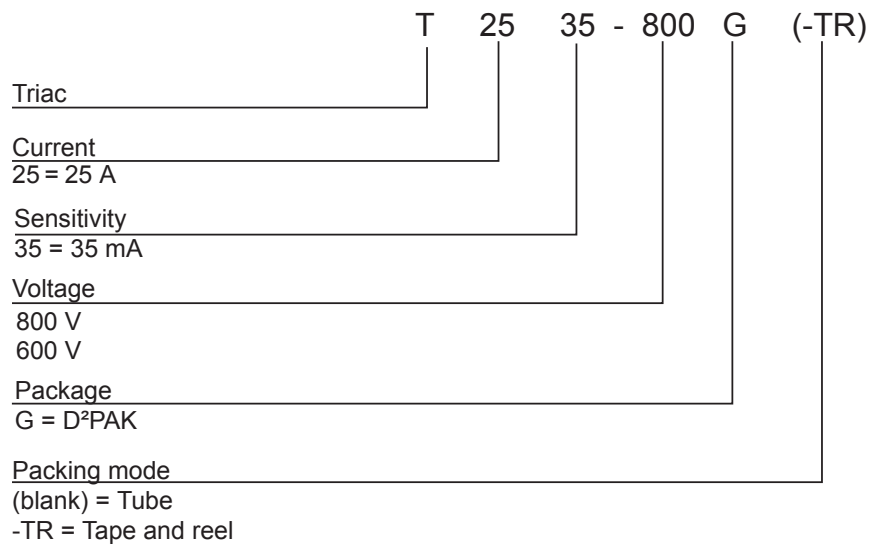
Technical drawing of a rectangular plate with a grid of 12 squares (3 rows by 4 columns). The plate has a total width of 8,90 and a total height of 10,30. The grid is composed of 12 squares, each with a side length of 2,20. The plate has a thickness of 0,05. The drawing shows the plate from the front and side views. The front view shows the grid and the dimensions. The side view shows the thickness and the height of the plate. The drawing is in a technical style with dimension lines and numerical values.

### 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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