

# 1 Characteristics

**Table 1. Absolute maximum ratings ( $T_j = 25\text{ °C}$  unless otherwise stated)**

| Symbol            | Parameter                                                                                   |                              |                        | Value                     | Unit        |
|-------------------|---------------------------------------------------------------------------------------------|------------------------------|------------------------|---------------------------|-------------|
| $I_{T(RMS)}$      | RMS on-state current (full sine wave)                                                       | TO-220AB, D <sup>2</sup> PAK | $T_c = 105\text{ °C}$  | 12                        | A           |
|                   |                                                                                             | TO-220AB Ins.                | $T_c = 90\text{ °C}$   |                           |             |
| $I_{TSM}$         | Non repetitive surge peak on-state current (full cycle, $T_j$ initial = $25\text{ °C}$ )    | $f = 50\text{ Hz}$           | $t = 20\text{ ms}$     | 120                       | A           |
|                   |                                                                                             | $f = 60\text{ Hz}$           | $t_p = 16.7\text{ ms}$ | 126                       |             |
| $I^2t$            | $I^2t$ value for fusing                                                                     |                              |                        | $t_p = 10\text{ ms}$      | $A^2s$      |
| $di/dt$           | Critical rate of rise of on-state current $I_G = 2 \times I_{GT}$ , $tr \leq 100\text{ ns}$ | $f = 120\text{ Hz}$          | $T_j = 125\text{ °C}$  | 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           |
| $I_{GM}$          | 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               | $^{\circ}C$ |
| $T_j$             | Operating junction temperature range                                                        |                              |                        | -40 to +125               | $^{\circ}C$ |

**Table 2. Electrical characteristics ( $T_j = 25\text{ °C}$ , unless otherwise specified) - Snubberless™ and logic level (3 quadrants)**

| Symbol          | Parameter                                                            | Quadrant     |      | T1205<br>BTB12-TW<br>BTA12-TW | T1210<br>BTB12-SW<br>BTA12-SW | T1235<br>BTB12-CW<br>BTA12-CW | T1250<br>BTB12-BW<br>BTA12-BW | Unit      |
|-----------------|----------------------------------------------------------------------|--------------|------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-----------|
| $I_{GT}^{(1)}$  | $V_D = 12\text{ V}$ , $R_L = 30\text{ }\Omega$                       | I - II - III | Max. | 5                             | 10                            | 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         |
| $I_H^{(2)}$     | $I_T = 100\text{ mA}$                                                | I - II - III | Max. | 10                            | 15                            | 35                            | 50                            | mA        |
| $I_L^{(2)}$     | $I_G = 1.2 \times I_{GT}$                                            | I - III      | Max. | 10                            | 25                            | 50                            | 70                            | mA        |
|                 |                                                                      | II           | Max. | 15                            | 30                            | 60                            | 80                            |           |
| $dV/dt^{(2)}$   | $V_D = 67\% V_{DRM}$ , gate open, $T_j = 125\text{ °C}$              |              | Max. | 20                            | 40                            | 500                           | 1000                          | $V/\mu s$ |
| $(di/dt)^{(2)}$ | $(dV/dt)_c = 0.1\text{ V}/\mu s$ , $T_j = 125\text{ °C}$             |              | Min. | 3.5                           | 6.5                           |                               |                               | A/ms      |
|                 | $(dV/dt)_c = 10\text{ V}/\mu s$ , $T_j = 125\text{ °C}$              |              | Min. | 1.0                           | 2.9                           |                               |                               |           |
|                 | Without snubber, $T_j = 125\text{ °C}$                               |              | Min. |                               |                               | 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 3. Electrical characteristics ( $T_j = 25^\circ\text{C}$ , unless otherwise specified) - Standard Triac (4 quadrants)**

| Symbol            | Parameter                                                         | Quadrant     |      | Value |     | Unit             |
|-------------------|-------------------------------------------------------------------|--------------|------|-------|-----|------------------|
|                   |                                                                   |              |      | C     | B   |                  |
| $I_{GT}^{(1)}$    | $V_D = 12\text{ V}, R_L = 30\ \Omega$                             | I - II - III | Max. | 25    | 50  | mA               |
|                   |                                                                   | IV           |      | 50    | 100 |                  |
| $V_{GT}$          |                                                                   | All          | Max. | 1.3   |     | V                |
| $V_{GD}$          | $V_D = V_{DRM}, R_L = 33\text{ k}\Omega, T_j = 125^\circ\text{C}$ | All          | Min. | 0.2   |     | V                |
| $I_H^{(2)}$       | $I_T = 500\text{ mA}$                                             | I - II - III | 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/ $\mu\text{s}$ |
| $(dV/dt)_C^{(2)}$ | $(dI/dt)_C = 5.3\text{ A/ms}, T_j = 125^\circ\text{C}$            |              | 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 4. Static electrical characteristics**

| Symbol             | Test conditions                                |                           |      | Value | Unit          |
|--------------------|------------------------------------------------|---------------------------|------|-------|---------------|
| $V_{TM}^{(1)}$     | $I_{TM} = 17\text{ A}, t_p = 380\ \mu\text{s}$ | $T_j = 25^\circ\text{C}$  | Max. | 1.55  | V             |
| $V_{TO}^{(1)}$     | threshold on-state voltage                     | $T_j = 125^\circ\text{C}$ | Max. | 0.85  | V             |
| $R_D^{(1)}$        | Dynamic resistance                             | $T_j = 125^\circ\text{C}$ | Max. | 35    | m $\Omega$    |
| $I_{DRM}\ I_{RRM}$ | $V_{DRM} = V_{RRM}$                            | $T_j = 25^\circ\text{C}$  | Max. | 5     | $\mu\text{A}$ |
|                    |                                                | $T_j = 125^\circ\text{C}$ | Max. | 1     | mA            |

1. For both polarities of A2 referenced to A1

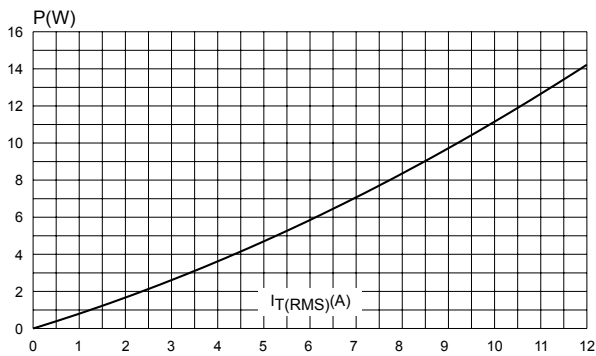
**Table 5. Thermal resistance**

| Symbol               | Parameter                                     |                          |                               |      | Value | Unit |
|----------------------|-----------------------------------------------|--------------------------|-------------------------------|------|-------|------|
| R <sub>th(j-c)</sub> | Max. junction to case thermal resistance (AC) |                          | D <sup>2</sup> PAK / TO-220AB | Max. | 1.4   | °C/W |
|                      |                                               |                          | TO-220AB insulated            | Max. | 2.3   |      |
| R <sub>th(j-a)</sub> | Junction to ambient                           | S = 2 cm² <sup>(1)</sup> | D <sup>2</sup> PAK            | Typ. | 45    | °C/W |
|                      | Junction to ambient                           |                          | TO-220AB / TO-220AB insulated | Typ. | 60    |      |

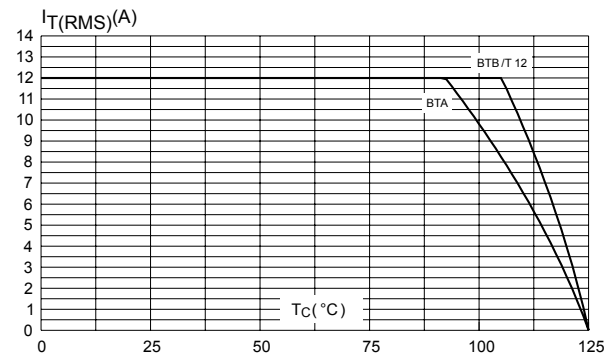
1.  $S$  = Copper surface under tab.

## 1.1 Characteristics (curves)

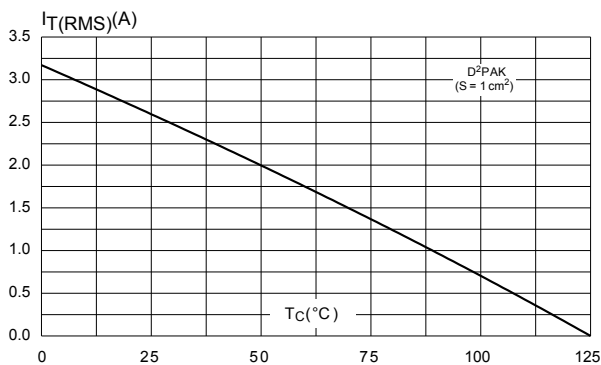
**Figure 1. Maximum power dissipation versus on-state RMS current (full cycle)**



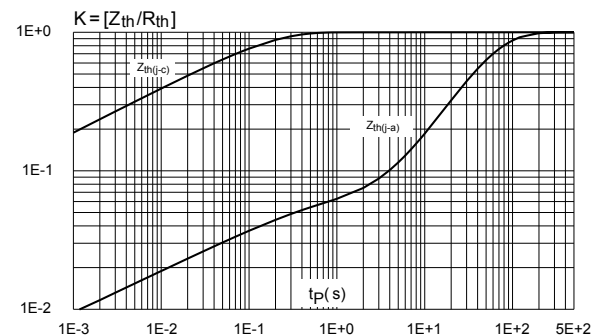
**Figure 2. RMS on-state current versus case temperature (full cycle)**



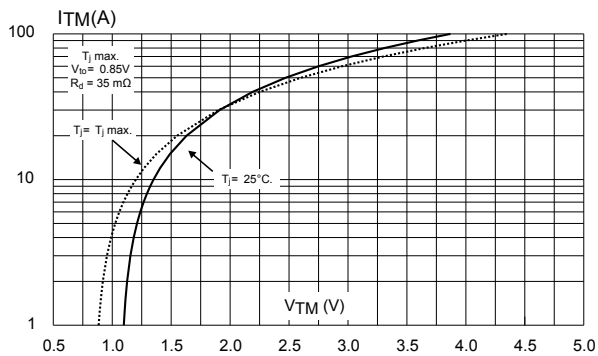
**Figure 3. RMS on-state current versus ambient temperature (printed circuit board FR4, copper thickness: 35  $\mu$ m) (full cycle)**



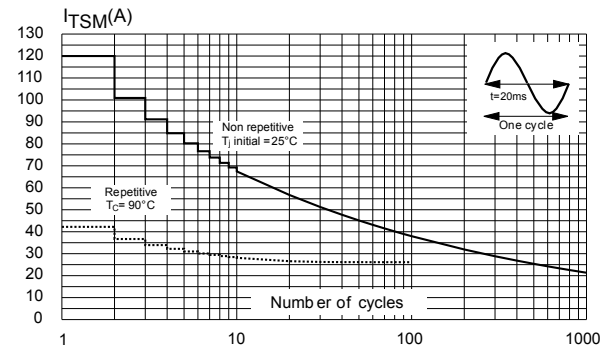
**Figure 4. Relative variation of thermal impedance versus pulse duration**



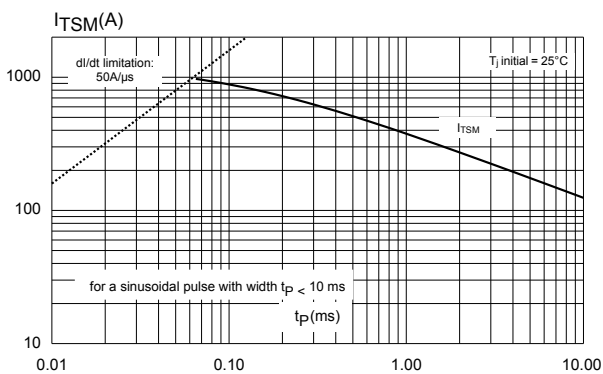
**Figure 5. On-state characteristics (maximum values)**



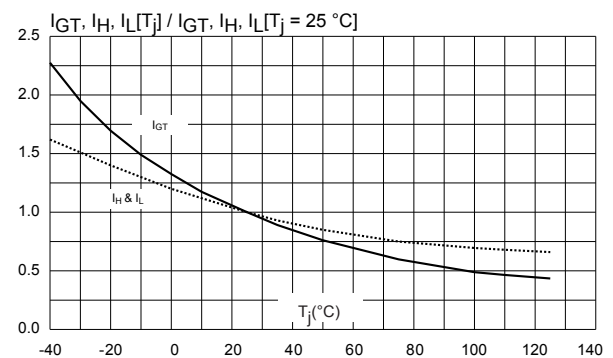
**Figure 6. Surge peak on-state current versus number of cycles**



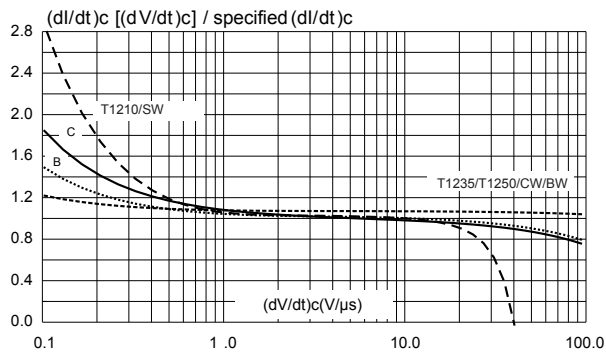
**Figure 7. Non repetitive surge peak on-state current for a sinusoidal pulse**



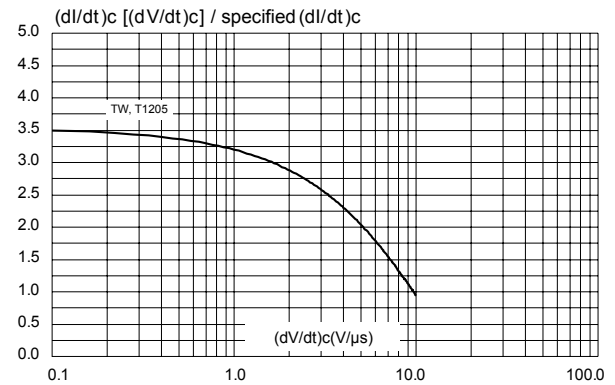
**Figure 8. Relative variation of gate trigger current holding current and latching current versus junction temperature (typical values)**



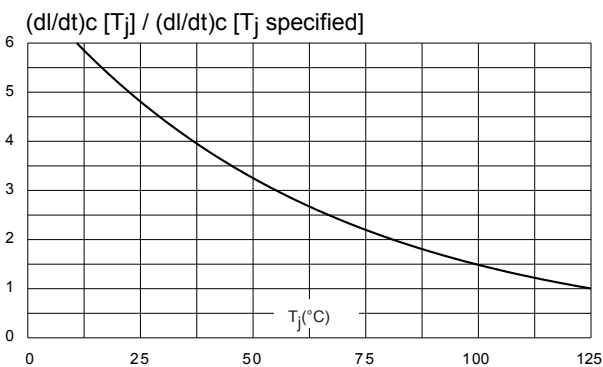
**Figure 9. Relative variation of critical rate of decrease of main current versus  $(dV/dt)_c$  (typical values)**



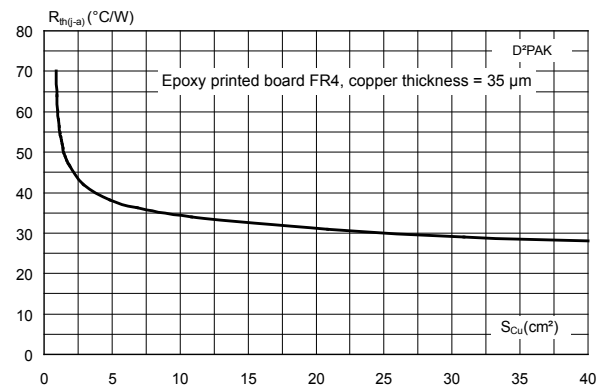
**Figure 10. Relative variation of critical rate of decrease of main current versus  $(dV/dt)_c$  (typical values)(TW)**



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



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



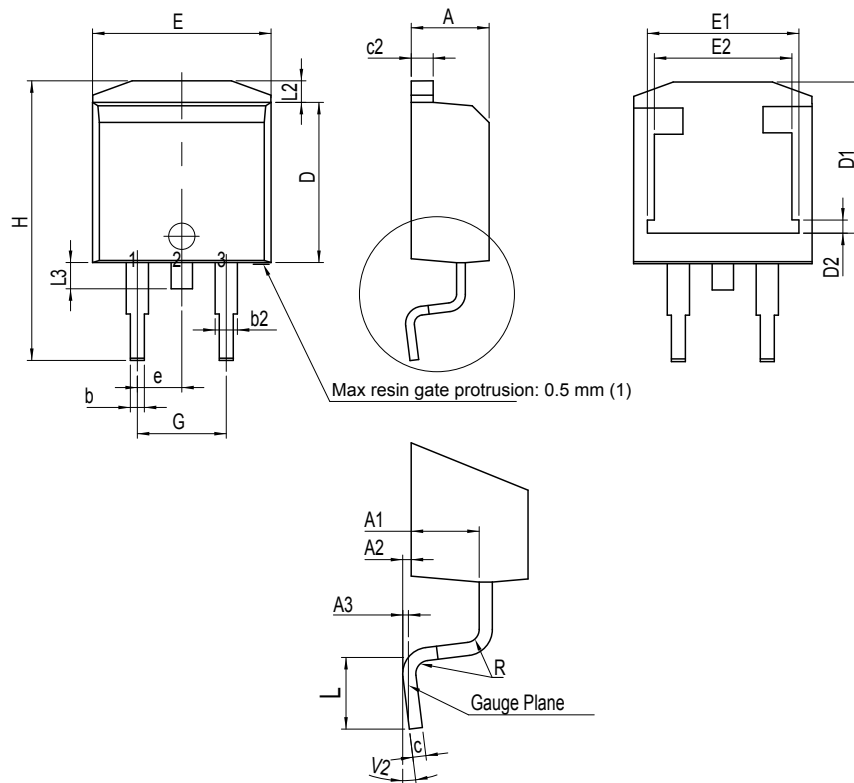
## 2 Package information

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

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

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



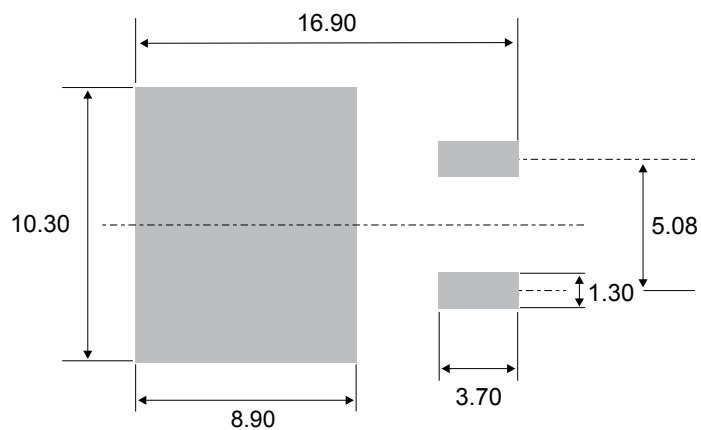
(1) Resin gate is accepted in each of position shown on the drawing, or their symmetrical.

**Table 6. 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        |      |       | 0.1                   |        |        |
| 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 14. D<sup>2</sup>PAK recommended footprint (dimensions are in mm)

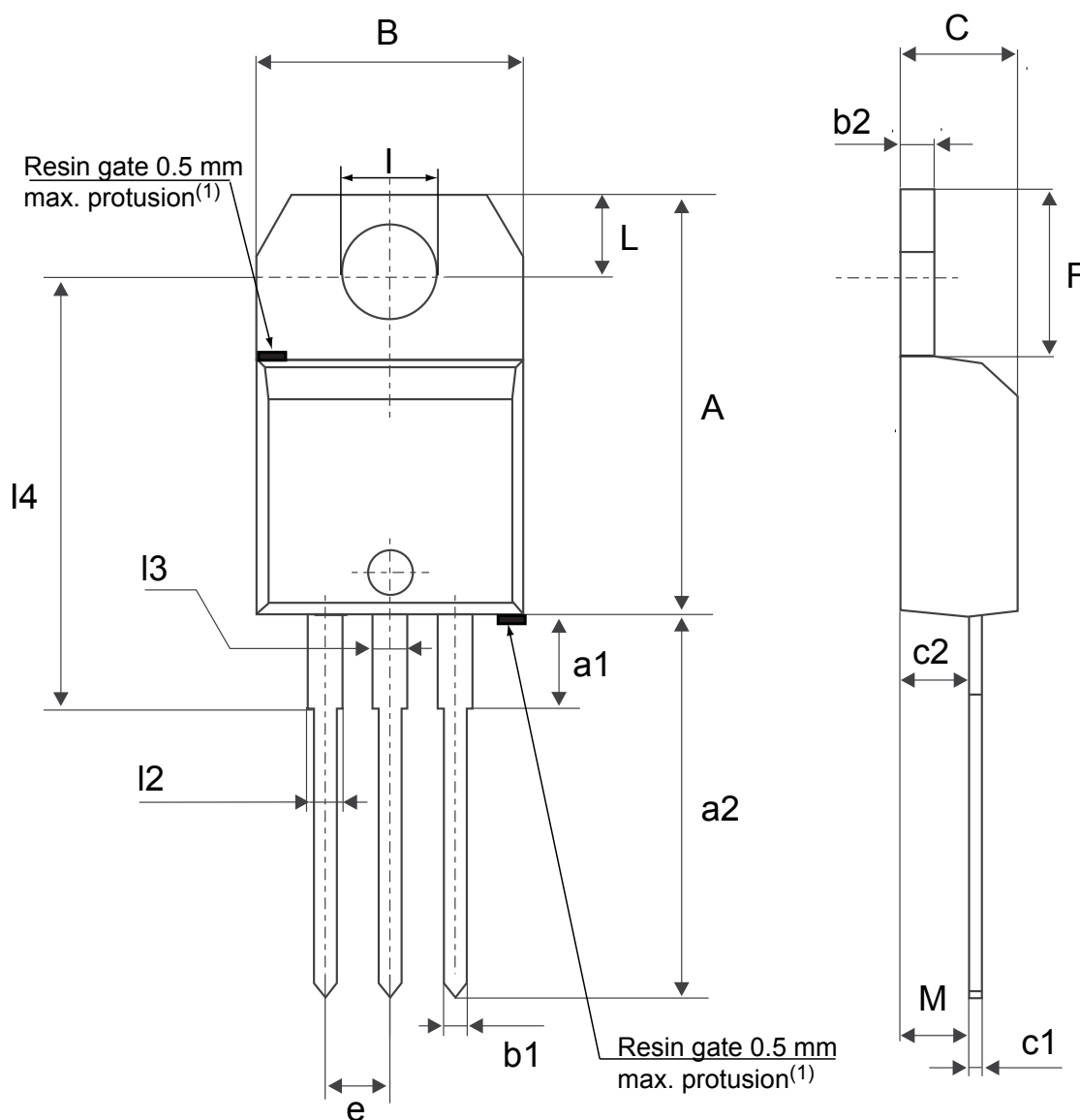




## 2.2 TO-220AB insulated package information

- 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 15. TO-220AB insulated and non insulated package outline**



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

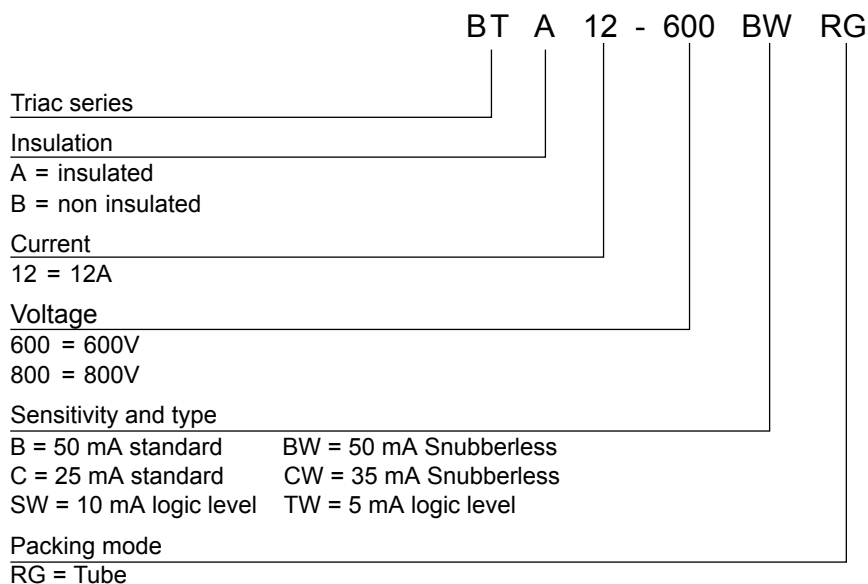
**Table 7. TO-220AB insulated and non insulated package mechanical data**

| 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 |
| 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 |        |

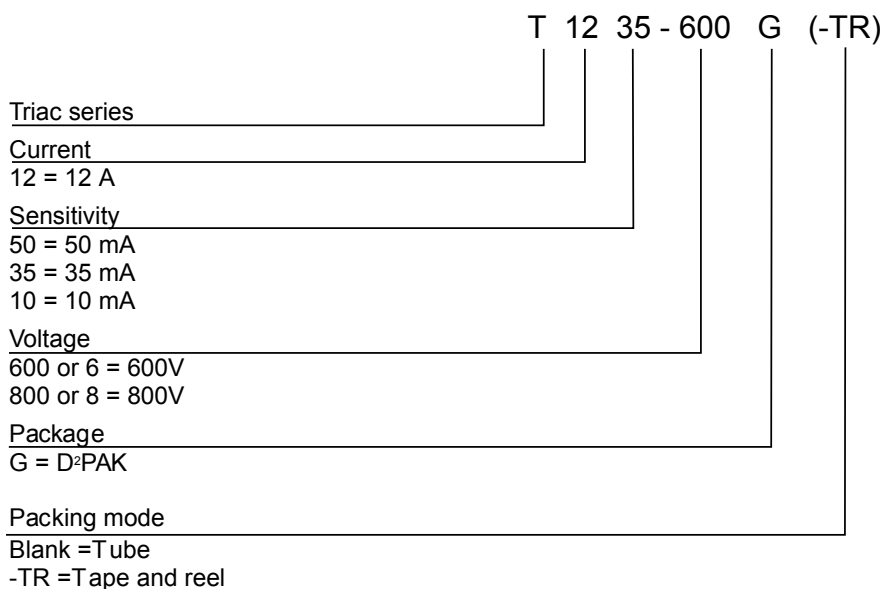
1. Inch dimensions are for reference only.

### 3 Ordering information

**Figure 16. Ordering information scheme (BTA12 and BTB12 series)**



**Figure 17. Ordering information scheme (T12 series)**



**Table 8. Product selector**

| Part number | Voltage (xxx) |     | Sensitivity | Type         | Package            |
|-------------|---------------|-----|-------------|--------------|--------------------|
|             | 600           | 800 |             |              |                    |
| BTB12-600C  | X             |     | 25 mA       | Standard     | TO-220AB           |
| BTB12-600B  | X             |     | 50 mA       | Standard     | TO-220AB           |
| BTB12-600TW | X             |     | 5 mA        | Snubberless™ | TO-220AB           |
| BTB12-600SW | X             |     | 10 mA       | Snubberless™ | TO-220AB           |
| BTB12-xxxCW | X             | X   | 35 mA       | Snubberless™ | TO-220AB           |
| BTB12-600BW | X             |     | 50 mA       | Snubberless™ | TO-220AB           |
| BTA12-600C  | X             |     | 25 mA       | Standard     | TO-220AB Ins.      |
| BTA12-xxxB  | X             | X   | 50 mA       | Standard     | TO-220AB Ins.      |
| BTA12-600TW | X             |     | 5 mA        | Snubberless™ | TO-220AB Ins.      |
| BTA12-xxxSW | X             | X   | 10 mA       | Snubberless™ | TO-220AB Ins.      |
| BTA12-xxxCW | X             | X   | 35 mA       | Snubberless™ | TO-220AB Ins.      |
| BTA12-xxxBW | X             | X   | 50 mA       | Snubberless™ | TO-220AB Ins.      |
| T1205-600G  | X             |     | 5 mA        | Snubberless™ | D <sup>2</sup> PAK |
| T1210-6G    | X             |     | 10 mA       | Snubberless™ | D <sup>2</sup> PAK |
| T1210-800G  |               | X   | 10 mA       | Snubberless™ | D <sup>2</sup> PAK |
| T1235-xxxG  | X             | X   | 35 mA       | Snubberless™ | D <sup>2</sup> PAK |
| T1250-600G  | X             |     | 50 mA       | Snubberless™ | D <sup>2</sup> PAK |

**Table 9. Ordering information**

| Order code    | Marking     | Package            | Weight | Base qty. | Delivery mode     |
|---------------|-------------|--------------------|--------|-----------|-------------------|
| BTA12-600BRG  | BTA12-600B  | TO-220AB Ins.      | 1.9 g  | 50        | Tube              |
| BTA12-600BWRG | BTA12-600BW |                    |        |           |                   |
| BTA12-600CRG  | BTA12-600C  |                    |        |           |                   |
| BTA12-600CWRG | BTA12-600CW |                    |        |           |                   |
| BTA12-600SWRG | BTA12-600SW |                    |        |           |                   |
| BTA12-600TWRG | BTA12-600TW |                    |        |           |                   |
| BTA12-800BRG  | BTA12-800B  |                    |        |           |                   |
| BTA12-800BWRG | BTA12-800BW |                    |        |           |                   |
| BTA12-800CWRG | BTA12-800CW |                    |        |           |                   |
| BTA12-800SWRG | BTA12-800SW |                    |        |           |                   |
| BTB12-600BRG  | BTB12-600B  | TO-220AB           |        |           |                   |
| BTB12-600BWRG | BTB12-600BW |                    |        |           |                   |
| BTB12-600CRG  | BTB12-600C  |                    |        |           |                   |
| BTB12-600CWRG | BTB12-600CW |                    |        |           |                   |
| BTB12-600SWRG | BTB12-600SW |                    |        |           |                   |
| BTB12-600TWRG | BTB12-600TW |                    |        |           |                   |
| BTB12-800CWRG | BTB12-800CW |                    |        |           |                   |
| T1205-600G-TR | T1205-600G  | D <sup>2</sup> PAK | 1.38 g | 1000      | Tape and reel 13" |
| T1210-6G-TR   | T1210-6G    |                    |        |           |                   |
| T1210-800G-TR | T1210-800G  |                    |        |           |                   |
| T1235-600G-TR | T1235-600G  |                    |        |           |                   |
| T1235-800G-TR | T1235-800G  |                    |        |           |                   |
| T1250-600G-TR | T1250-600G  |                    |        |           |                   |
| T1210-6G      | T1210-6G    |                    |        | 50        | Tube              |
| T1235-600G    | T1235-600G  |                    |        |           |                   |

**Table 10. Document revision history**

| Date        | Revision | Changes                                                                                                                                                                     |
|-------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sep-2002    | 6A       | Last update.                                                                                                                                                                |
| 15-Mar-2005 | 7        | 1. I2PAK 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.                                                                                                                              |
| 02-Feb-2017 | 10       | Removed I <sup>2</sup> PAK package.<br>Updated Figure 7: "Non-repetitive surge peak on-state current" and Table 9: "Product selector" and Table 10: "Ordering information". |
| 9-Aug-2018  | 11       | Updated D <sup>2</sup> PAK package information and <a href="#">Figure 10</a> . Updated <a href="#">Section Product status / summary</a> .                                   |
| 07-Feb-2019 | 12       | Updated links syntax.                                                                                                                                                       |

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