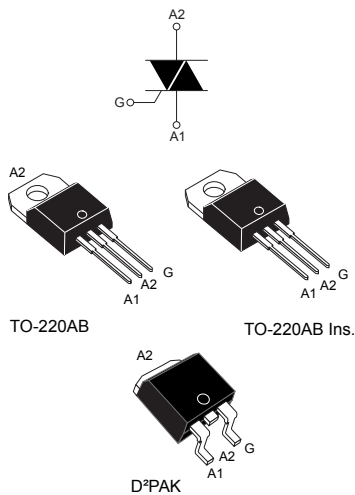




**THE DATASHEET OF  
BTA12-600TWRG**



## 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 (2011/65/EU) compliant

### Description

Available either in through-hole or surface mount packages, the BTA12, BTB12 and T12xx Triac series are suitable for general purpose mains power AC switching. They can be used as ON/OFF function in applications such as static relays, heating regulation or induction motor starting circuit. They are also recommended for phase control operations in light dimmers and appliance motors speed controllers.

The Snubberless™ versions (W suffix and T12xx) are especially recommended for use on inductive loads, because of their high commutation performance. By using an internal ceramic pad, the Snubberless™ series provide an insulated tab (rated at 2500 V<sub>RMS</sub>) complying with UL standards (file reference: E81734).

Logic Level BTA12-600TW and BTA12-600SW offer low holding current, ideal to design light dimmers for LED lamps.

#### Product status link

[BTA12](#)

[BTB12](#)

[T1205](#)

[T1210](#)

[T1235](#)

[T1250](#)

#### Product summary

|                       |                     |
|-----------------------|---------------------|
| $I_{T(RMS)}$          | 12 A                |
| $V_{DRM}/V_{RRM}$     | 600 and 800 V       |
| $I_{GT(Snubberless)}$ | 5 / 10 / 35 / 50 mA |
| $I_{GT(standard)}$    | 25 / 50             |

# 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 Hz                    | t = 20 ms              | 120                          | A                |
|                   |  | f = 60 Hz                    | $t_p = 16.7\text{ ms}$ | 126                          |                  |
| $I^2t$            | $I^2t$ value for fusing  |                              | $t_p = 10\text{ ms}$   | 78                           | A <sup>2</sup> s |
| dI/dt             | Critical rate of rise of on-state current $I_G = 2 \times I_{GT}$ , tr ≤ 100 ns          | f = 120 Hz                   | $T_j = 125\text{ °C}$  | 50                           | A/μs             |
| $V_{DSM}/V_{RSM}$ | Non repetitive surge peak off-state voltage  | $t_p = 10\text{ ms}$         | $T_j = 25\text{ °C}$   | $V_{DRM} / V_{RRM}^+$<br>100 | 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               |

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

| Symbol            | Parameter   | Quadrant     |      | T1205                | T1210                | T1235                | T1250                | Unit |
|-------------------|---|--------------|------|----------------------|----------------------|----------------------|----------------------|------|
|                   |   |              |      | BTB12-TW<br>BTA12-TW | BTB12-SW<br>BTA12-SW | BTB12-CW<br>BTA12-CW | BTB12-BW<br>BTA12-BW |      |
| $I_{GT}^{(1)}$    | $V_D = 12\text{ V}$ , $R_L = 30\text{ Ω}$                       | I - II - III | Max. | 5                    | 10                   | 35                   | 50                   | mA   |
| $V_{GT}$          |   | I - II - III | Max. | 1.3                  |                      |                      |                      | V    |
| $V_{GD}$          | $V_D = V_{DRM}$ , $R_L = 3.3\text{ kΩ}$ , $T_j = 125\text{ °C}$ | 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/μs |
| $(dI/dt)_c^{(2)}$ | $(dV/dt)_c = 0.1\text{ V/μs}$ , $T_j = 125\text{ °C}$           |              | Min. | 3.5                  | 6.5                  |                      |                      | A/ms |
|                   | $(dV/dt)_c = 10\text{ V/μs}$ , $T_j = 125\text{ °C}$            |              | 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 ( $T_j = 25\text{ }^\circ\text{C}$ , 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                |
| $V_{GD}$          | $V_D = V_{DRM}$ , $R_L = 33\text{ k}\Omega$ , $T_j = 125\text{ }^\circ\text{C}$ | 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, $T_j = 125\text{ }^\circ\text{C}$             |              | Min. | 200   | 400 | V/ $\mu\text{s}$ |
| $(dV/dt)_C^{(2)}$ | $(dI/dt)_C = 5.3\text{ A/ms}$ , $T_j = 125\text{ }^\circ\text{C}$               |              | 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          |
|---------------------|---|-----------------------------------|------|-------|---------------|
| $V_{TM}^{(1)}$      | $I_{TM} = 17\text{ A}$ , $t_p = 380\ \mu\text{s}$ | $T_j = 25\text{ }^\circ\text{C}$  | Max. | 1.55  | V             |
| $V_{TO}^{(1)}$      | threshold on-state voltage                        | $T_j = 125\text{ }^\circ\text{C}$ | Max. | 0.85  | V             |
| $R_D^{(1)}$         | Dynamic resistance                                | $T_j = 125\text{ }^\circ\text{C}$ | Max. | 35    | m $\Omega$    |
| $I_{DRM}$ $I_{RRM}$ | $V_{DRM} = V_{RRM}$                               | $T_j = 25\text{ }^\circ\text{C}$  | Max. | 5     | $\mu\text{A}$ |
|                     |   | $T_j = 125\text{ }^\circ\text{C}$ | Max. | 1     | mA            |

1. For both polarities of A2 referenced to A1

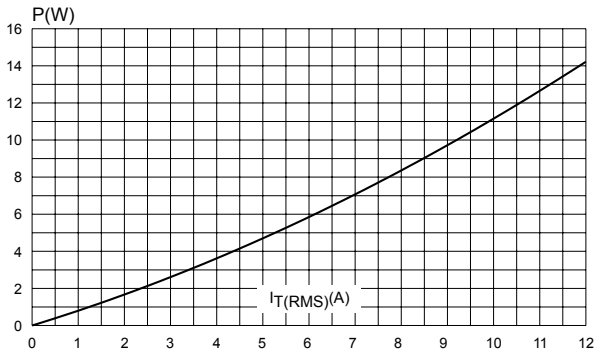
**Table 5. Thermal resistance**

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

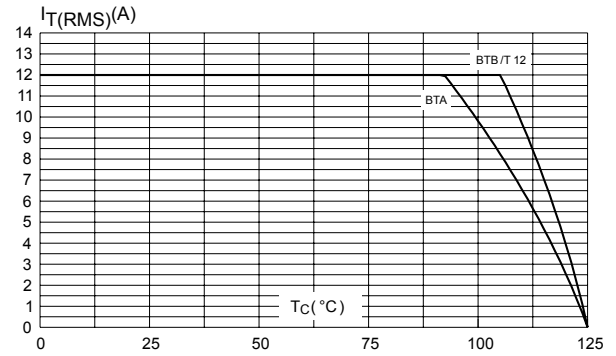
1.  $S$  = Copper surface under tab.

### 1.1 Characteristics (curves)

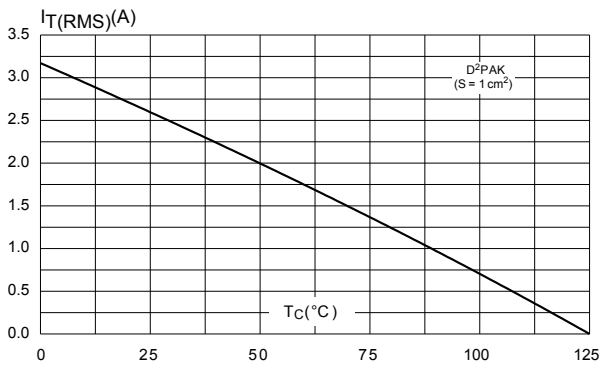
**Figure 1. Maximum power dissipation versus on-state RMS current (full cycle)**



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



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



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

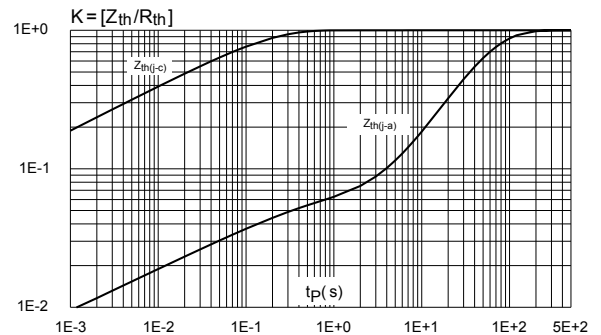


Figure 5. On-state characteristics (maximum values)

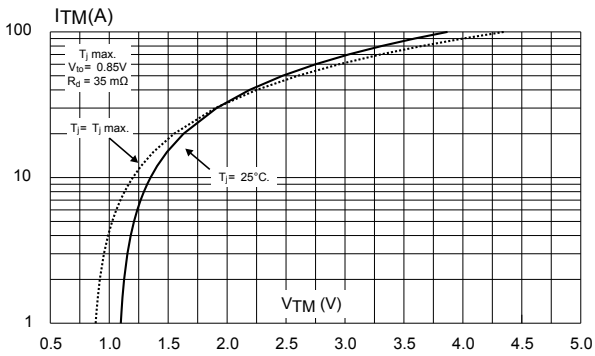


Figure 6. Surge peak on-state current versus number of cycles

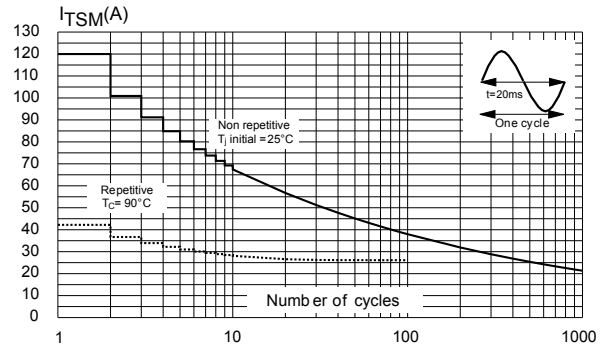


Figure 7. Non repetitive surge peak on-state current for a sinusoidal pulse

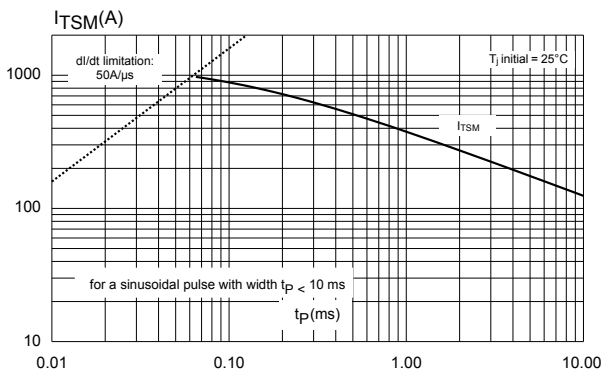
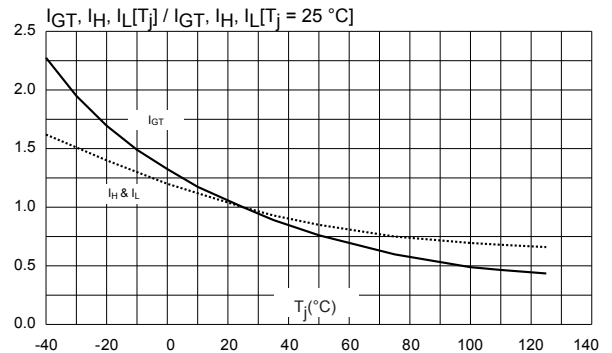
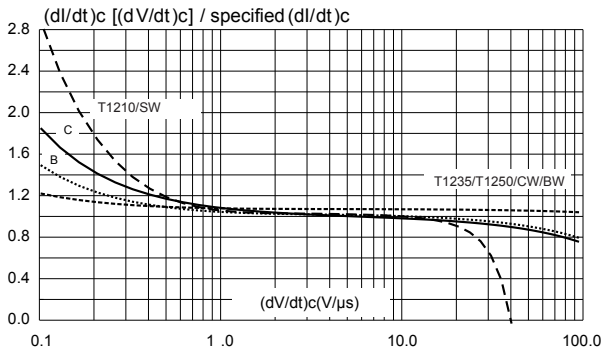


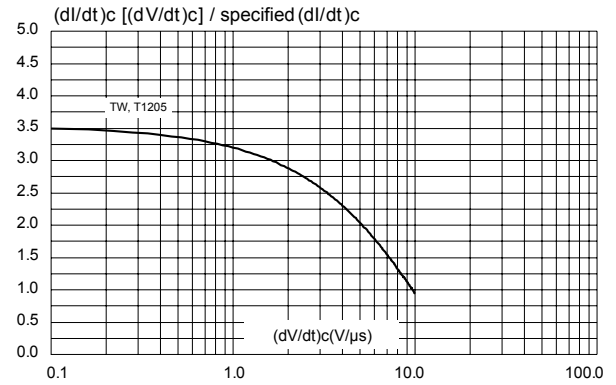
Figure 8. Relative variation of gate trigger current holding current and latching current versus junction temperature (typical values)



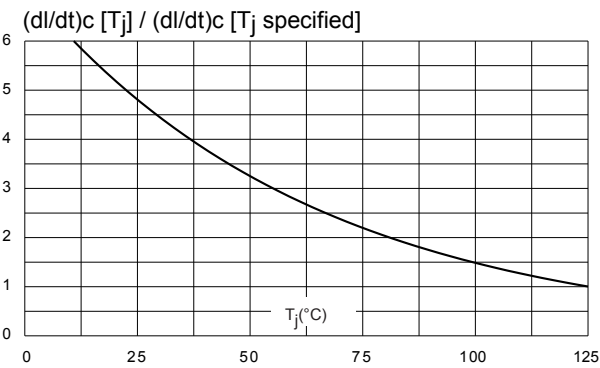
**Figure 9. Relative variation of critical rate of decrease of main current versus (dV/dt)<sub>c</sub> (typical values)**



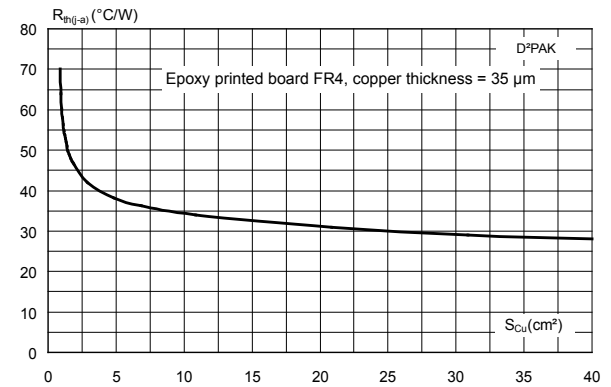
**Figure 10. Relative variation of critical rate of decrease of main current versus (dV/dt)<sub>c</sub> (typical values)(TW)**



**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**



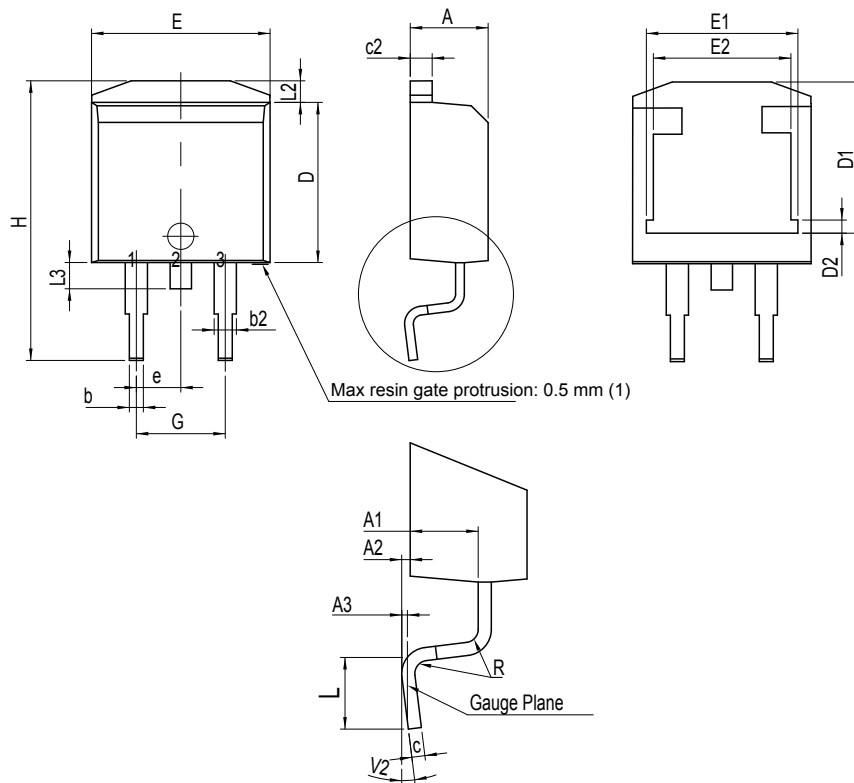
## 2 Package information

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



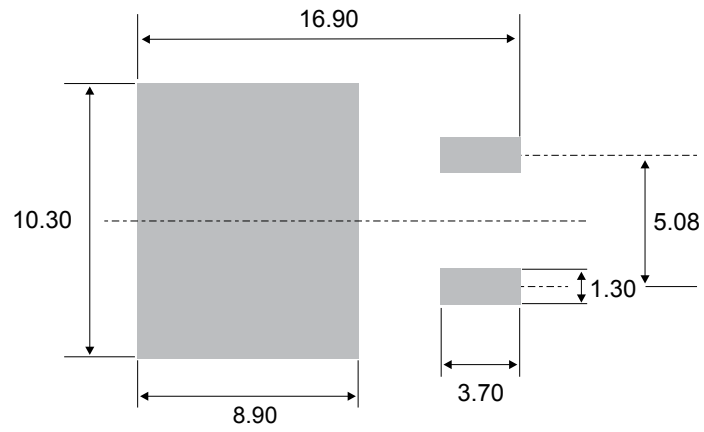
(1) Resin gate is accepted in each of position shown on the drawing, or their symmetrical.

**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)





**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 |
| l    | 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.

### 3 Ordering information

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

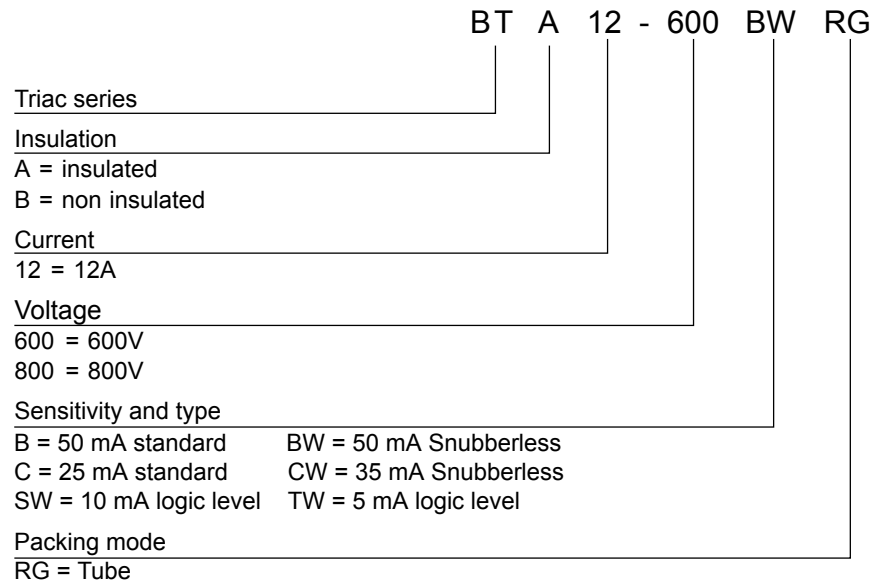
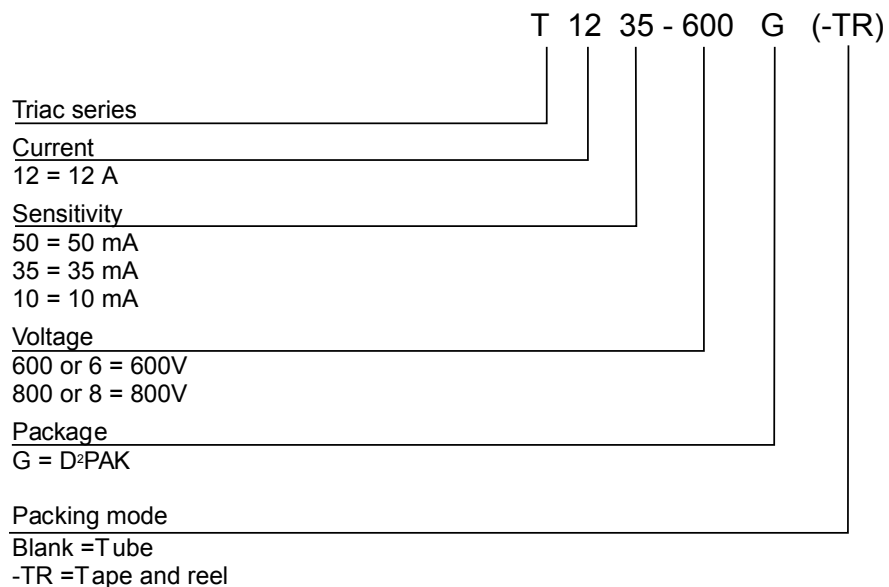


Figure 17. Ordering information scheme (T12 series)



**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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