

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 (2002/95/EC) compliant

Applications

ON/OFF or phase angle function in applications such as static relays, light dimmers and appliance motors speed controllers.

The snubberless versions (BTA/BTB...W and T12 series) are especially recommended for use on inductive loads, because of their high commutation performances. The BTA series provides an insulated tab (rated at 2500 V RMS).

Description

Available either in through-hole or surface-mount packages, the **BTA12**, **BTB12** and **T12xx** triac series is suitable for general purpose mains power AC switching.



Order code

See [Ordering information on page 11](#)

Table 1. Device summary

| Symbol | Parameter | T12xx | BTA12 ⁽¹⁾ | BTB12 |
|------------------------|-----------------------------------|----------|----------------------|------------|
| $I_{T(RMS)}$ | RMS on-state current | 12 | 12 | 12 |
| V_{DRM}/V_{RRM} | Repetitive peak off-state voltage | 600/800 | 600/800 | 600/800 |
| I_{GT} (Snubberless) | Triggering gate current | 10/35/50 | 5/10/35/50 | 5/10/35/50 |
| I_{GT} (Standard) | Triggering gate current | - | 35/50 | 35/50 |

1. Insulated

TM: Snubberless is a trademark of STMicroelectronics

1 Characteristics

Table 2. Absolute maximum ratings

| Symbol | Parameter | | | Value | Unit | |
|--------------------|--|------------------------------|---------------------|-------------------------|--------------------------------|------------|
| $I_{T(RMS)}$ | RMS on-state current (full sine wave) | $I^2PAK / D^2PAK / TO-220AB$ | $T_c = 105^\circ C$ | 12 | A | |
| | | TO-220AB Ins. | $T_c = 90^\circ C$ | | | |
| I_{TSM} | Non repetitive surge peak on-state current (full cycle, T_j initial = $25^\circ C$) | $F = 50 Hz$ | $t = 20 ms$ | 120 | A | |
| | | $F = 60 Hz$ | $t = 16.7 ms$ | 126 | | |
| I^2t | I^2t Value for fusing | $t_p = 10 ms$ | | 78 | A^2s | |
| di/dt | Critical rate of rise of on-state current $I_G = 2 \times I_{GT}$, $t_r \leq 100 ns$ | $F = 120 Hz$ | $T_j = 125^\circ C$ | 50 | $A/\mu s$ | |
| V_{DSM}/V_{RSM} | Non repetitive surge peak off-state voltage | $t_p = 10 ms$ | $T_j = 25^\circ C$ | $V_{DRM}/V_{RRM} + 100$ | V | |
| I_{GM} | Peak gate current | $t_p = 20 \mu s$ | $T_j = 125^\circ C$ | 4 | A | |
| $P_{G(AV)}$ | Average gate power dissipation | $T_j = 125^\circ C$ | | 1 | W | |
| T_{stg} T_j | Storage junction temperature range Operating junction temperature range | | | | - 40 to + 150 - 40 to + 125 | $^\circ C$ |

**Table 3. Electrical characteristics ($T_j = 25^\circ C$, unless otherwise specified)
Snubberless and logic level (3 quadrants)**

| Symbol | Test conditions | Quadrant | | T12xx | | | BTA12 / BTB12 | | | | Unit |
|-------------------|---|--------------|------|-------|-------|-------|---------------|-----|-----|------|-----------|
| | | | | T1210 | T1235 | T1250 | TW | SW | CW | BW | |
| $I_{GT}^{(1)}$ | $V_D = 12 V$ $R_L = 30 \Omega$ | I - II - III | MAX. | 10 | 35 | 50 | 5 | 10 | 35 | 50 | mA |
| V_{GT} | | I - II - III | MAX. | 1.3 | | | | | | V | |
| V_{GD} | $V_D = V_{DRM}$ $R_L = 3.3 k\Omega$ $T_j = 125^\circ C$ | I - II - III | MIN. | 0.2 | | | | | | V | |
| $I_H^{(2)}$ | $I_T = 100 mA$ | | MAX. | 15 | 35 | 50 | 10 | 15 | 35 | 50 | mA |
| I_L | $I_G = 1.2 I_{GT}$ | I - III | MAX. | 25 | 50 | 70 | 10 | 25 | 50 | 70 | mA |
| | | II | | 30 | 60 | 80 | 15 | 30 | 60 | 80 | |
| $dV/dt^{(2)}$ | $V_D = 67 \% V_{DRM}$ gate open $T_j = 125^\circ C$ | | MIN. | 40 | 500 | 1000 | 20 | 40 | 500 | 1000 | $V/\mu s$ |
| $(di/dt)_c^{(2)}$ | $(dV/dt)_c = 0.1 V/\mu s$ $T_j = 125^\circ C$ | | MIN. | 6.5 | | | 3.5 | 6.5 | | | A/ms |
| | $(dV/dt)_c = 10 V/\mu s$ $T_j = 125^\circ C$ | | | 2.9 | | | 1 | 2.9 | | | |
| | Without snubber $T_j = 125^\circ C$ | | | | 6.5 | 12 | | | 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 4. Electrical characteristics ($T_j = 25^\circ\text{C}$, unless otherwise specified) standard (4 quadrants)

| Symbol | Test Conditions | Quadrant | | BTA12 / BTB12 | | Unit |
|-------------------|---|--------------------|------|---------------|-----------|------------------|
| | | | | C | B | |
| $I_{GT}^{(1)}$ | $V_D = 12\text{ V}$ $R_L = 30\ \Omega$ | I - II - III IV | MAX. | 25 50 | 50 100 | mA |
| V_{GT} | | ALL | MAX. | 1.3 | | V |
| V_{GD} | $V_D = V_{DRM}$ $R_L = 3.3\text{ k}\Omega$ $T_j = 125^\circ\text{ C}$ | ALL | MIN. | 0.2 | | V |
| $I_H^{(2)}$ | $I_T = 500\text{ mA}$ | | MAX. | 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/ μs |
| $(dI/dt)_c^{(2)}$ | $(dI/dt)_c = 5.3\text{ A/ms}$ $T_j = 125^\circ\text{ C}$ | | MIN. | 5 | 10 | V/ μs |

1. Minimum I_{GT} is guaranteed at 5% of I_{GT} max.
2. for both polarities of A2 referenced to A1.

Table 5. Static characteristics

| Symbol | Test conditions | | | Value | Unit | |
|------------------------|------------------------|--------------------------|----------------------------|-------|------|---------------|
| $V_T^{(1)}$ | $I_{TM} = 17\text{ A}$ | $t_p = 380\ \mu\text{s}$ | $T_j = 25^\circ\text{ C}$ | MAX. | 1.55 | V |
| $V_{i0}^{(1)}$ | Threshold voltage | | $T_j = 125^\circ\text{ C}$ | MAX. | 0.85 | V |
| $R_d^{(1)}$ | Dynamic resistance | | $T_j = 125^\circ\text{ C}$ | MAX. | 35 | m Ω |
| I_{DRM} I_{RRM} | $V_{DRM} = V_{RRM}$ | | $T_j = 25^\circ\text{ C}$ | MAX. | 5 | μA |
| | | | $T_j = 125^\circ\text{ C}$ | | 1 | mA |

1. for both polarities of A2 referenced to A1

Table 6. Thermal resistance

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

1. Copper surface under tab.

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

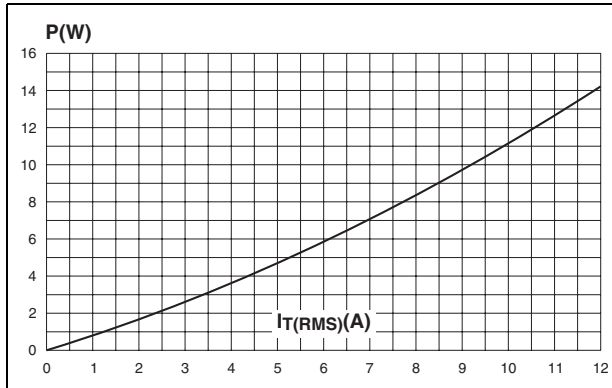


Figure 2. RMS on-state current versus case temperature (full cycle)



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

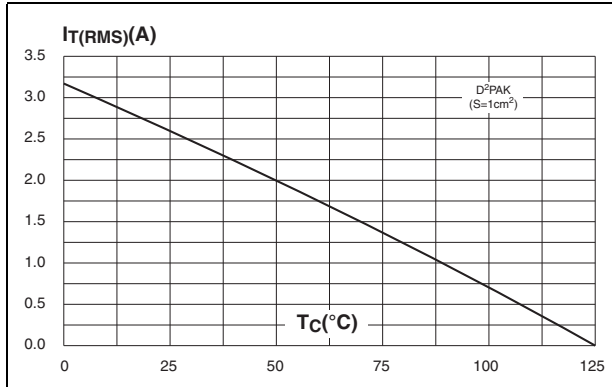


Figure 4. Relative variation of thermal impedance versus pulse duration



Figure 5. On-state characteristics (maximum values)

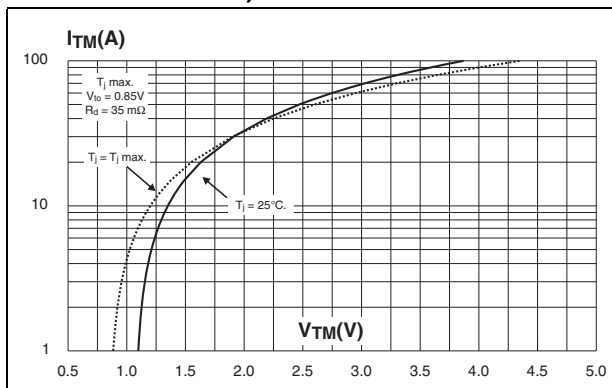


Figure 6. Surge peak on-state current versus number of cycles

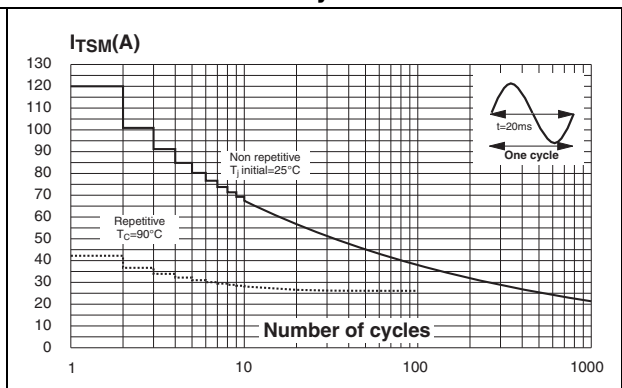


Figure 7. Non-repetitive surge peak on-state current for a sinusoidal pulse with width $t_p < 10$ ms and corresponding value of I^2t

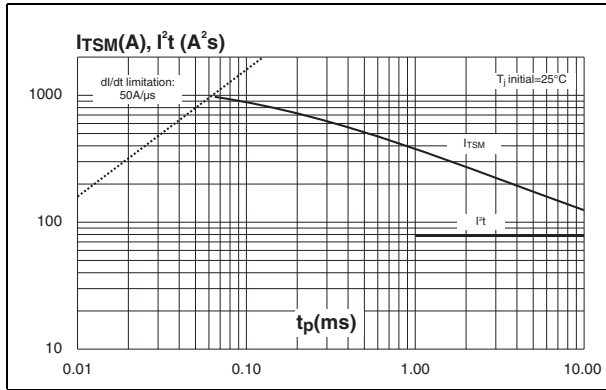


Figure 8. Figure 8: Relative variation of gate trigger current, holding current and latching current versus junction temperature (typical values)

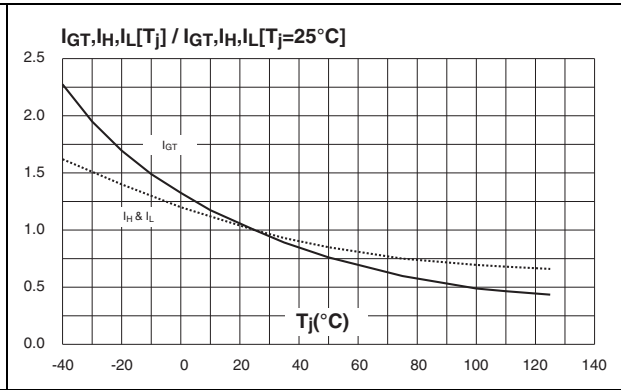


Figure 9. Relative variation of critical rate of decrease of main current versus $(dV/dt)_c$ (typical values) (BW/CW/T1210/T1235)

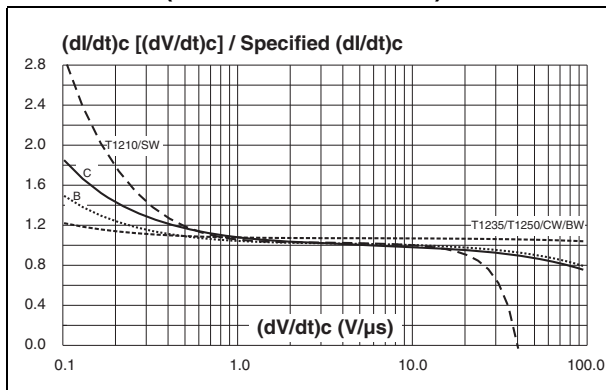


Figure 10. Relative variation of critical rate of decrease of main current versus $(dV/dt)_c$ (typical values) (TW)

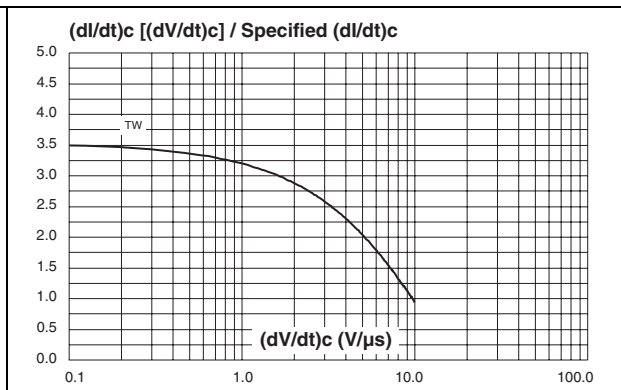


Figure 11. Relative variation of critical rate of decrease of main current versus junction temperature

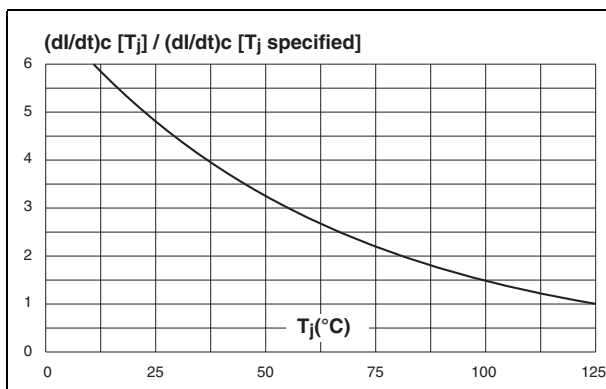
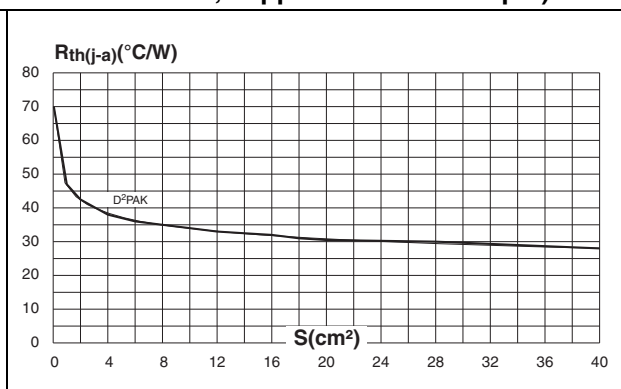


Figure 12. D²PAK thermal resistance junction to ambient versus copper surface under tab (printed circuit board FR4, copper thickness: 35 μm)



2 Ordering information scheme

Figure 13. BTA12 and BTB12 series



Figure 14. T12xx series



Table 7. Product selector

| Order code ⁽¹⁾ | Voltage (xxx) | | Sensitivity | Type | Package |
|---------------------------|---------------|-------|-------------|-------------|--------------------|
| | 600 V | 800 V | | | |
| BTA/BTB12-xxxBRG | X | X | 50 mA | Standard | TO-220AB |
| BTA/BTB12-xxxBWRG | X | X | 50 mA | Snubberless | TO-220AB |
| BTA/BTB12-xxxCRG | X | X | 25 mA | Standard | TO-220AB |
| BTA/BTB12-xxxCWRG | X | X | 35 mA | Snubberless | TO-220AB |
| BTA/BTB12-xxxSWRG | X | X | 10 mA | Logic Level | TO-220AB |
| BTA/BTB12-xxxTWRG | X | X | 5 mA | Logic Level | TO-220AB |
| T1210-800G | - | X | 10 mA | Logic Level | D ² PAK |
| T1235-xxxG | X | X | 35 mA | Snubberless | D ² PAK |
| T1235-xxxR | X | X | 35 mA | Snubberless | I ² PAK |
| T1250-600G | X | - | 50 mA | Snubberless | D ² PAK |

1. **BTB**: non insulated TO-220AB package

3 Packaging information

- Epoxy meets UL94, V0

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com.

Table 8. D²PAK dimensions

| Ref. | Dimensions | | | | | |
|------|-------------|------|-------|--------|-------|-------|
| | Millimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 4.30 | | 4.60 | 0.169 | | 0.181 |
| A1 | 2.49 | | 2.69 | 0.098 | | 0.106 |
| A2 | 0.03 | | 0.23 | 0.001 | | 0.009 |
| B | 0.70 | | 0.93 | 0.027 | | 0.037 |
| B2 | 1.25 | 1.40 | | 0.048 | 0.055 | |
| C | 0.45 | | 0.60 | 0.017 | | 0.024 |
| C2 | 1.21 | | 1.36 | 0.047 | | 0.054 |
| D | 8.95 | | 9.35 | 0.352 | | 0.368 |
| E | 10.00 | | 10.28 | 0.393 | | 0.405 |
| G | 4.88 | | 5.28 | 0.192 | | 0.208 |
| L | 15.00 | | 15.85 | 0.590 | | 0.624 |
| L2 | 1.27 | | 1.40 | 0.050 | | 0.055 |
| L3 | 1.40 | | 1.75 | 0.055 | | 0.069 |
| R | 0.40 | | | 0.016 | | |
| V2 | 0° | | 8° | 0° | | 8° |

Figure 15. Footprint (dimensions in mm)

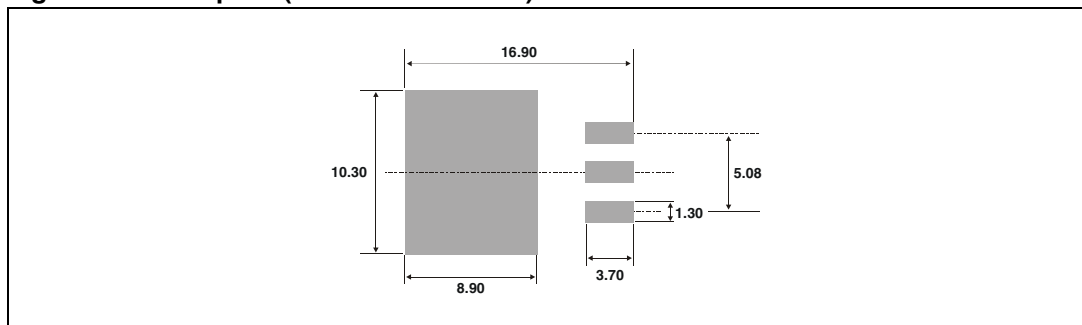
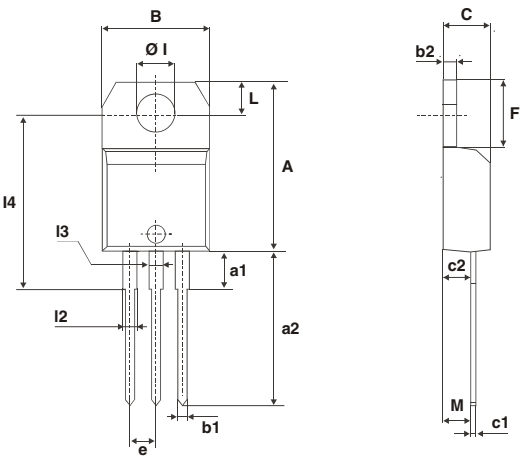


Table 9. I²PAK dimensions

| Ref. | Dimensions | | | | | |
|------|-------------|------|-------|--------|-------|-------|
| | Millimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 4.30 | | 4.60 | 0.169 | | 0.181 |
| A1 | 2.49 | | 2.69 | 0.098 | | 0.106 |
| b | 0.70 | | 0.93 | 0.028 | | 0.037 |
| b1 | 1.20 | | 1.38 | 0.047 | | 0.054 |
| b2 | 1.25 | 1.40 | | 0.049 | 0.055 | |
| c | 0.45 | | 0.60 | 0.018 | | 0.024 |
| c2 | 1.21 | | 1.36 | 0.048 | | 0.054 |
| D | 8.95 | | 9.35 | 0.352 | | 0.368 |
| e | 2.44 | | 2.64 | 0.096 | | 0.104 |
| E | 10.00 | | 10.28 | 0.394 | | 0.405 |
| L | 13.10 | | 13.60 | 0.516 | | 0.535 |
| L1 | | 3.75 | | | 0.148 | |
| L2 | 1.27 | | 1.40 | 0.050 | | 0.055 |
| V | | 5° | | | 5° | |
| V4 | | 45° | | | 45° | |

Table 10. TO-220AB dimensions (insulated and non-insulated)



| Ref. | Dimensions | | | | | |
|------|-------------|-------|-------|--------|-------|-------|
| | Millimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 15.20 | | 15.90 | 0.598 | | 0.625 |
| a1 | | 3.75 | | | 0.147 | |
| a2 | 13.00 | | 14.00 | 0.511 | | 0.551 |
| B | 10.00 | | 10.40 | 0.393 | | 0.409 |
| b1 | 0.61 | | 0.88 | 0.024 | | 0.034 |
| b2 | 1.23 | | 1.32 | 0.048 | | 0.051 |
| C | 4.40 | | 4.60 | 0.173 | | 0.181 |
| c1 | 0.49 | | 0.70 | 0.019 | | 0.027 |
| c2 | 2.40 | | 2.72 | 0.094 | | 0.107 |
| e | 2.40 | | 2.70 | 0.094 | | 0.106 |
| F | 6.20 | | 6.60 | 0.244 | | 0.259 |
| ØI | 3.75 | | 3.85 | 0.147 | | 0.151 |
| I4 | 15.80 | 16.40 | 16.80 | 0.622 | 0.646 | 0.661 |
| L | 2.65 | | 2.95 | 0.104 | | 0.116 |
| I2 | 1.14 | | 1.70 | 0.044 | | 0.066 |
| I3 | 1.14 | | 1.70 | 0.044 | | 0.066 |
| M | | 2.60 | | | 0.102 | |

4 Ordering information

Table 11. Ordering information

| Order code | Marking | Package | Weight | Base qty | Delivery mode |
|-------------------|------------------|--------------------|--------|----------|---------------|
| BTA/BTB12-xxxzyRG | BTA/BTB12-xxxzyz | TO-220AB | 2.3 g | 50 | Tube |
| T1210-xxxG-TR | T1210-xxxG | D ² PAK | 1.5 g | 1000 | Tape and reel |
| T1235-xxxG | T1235xxxG | D ² PAK | 1.5 g | 50 | Tube |
| T1235-xxxG-TR | T1235xxxG | | | 1000 | Tape and reel |
| T1235-xxxR | T1235-xxxR | I ² PAK | 1.5 g | 50 | Tube |
| T1250-xxxG-TR | T1250xxxG | D ² PAK | 1.5 g | 1000 | Tape and reel |

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

5 Revision history

Table 12. Revision history

| Date | Revision | Changes |
|-------------|----------|--|
| Sep-2002 | 6A | Last update. |
| 25-Mar-2005 | 7 | 1. I ² PAK package added. 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 |

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