

1 Characteristics

Table 1. Absolute maximum ratings

| Symbol | Parameters | Value | Unit | |
|-------------------|---|--|-------------------------|------------------|
| $I_{T(RMS)}$ | RMS on-state current (full sine wave) | TO-220AB, D ² PAK $T_c = 100\text{ °C}$ | 16 | A |
| | | TO-220AB Ins. $T_c = 86\text{ °C}$ | | |
| I_{TSM} | Non repetitive surge peak on-state current (full cycle, T_j initial = 25 °C) | F = 50 Hz $t_p = 20\text{ ms}$ | 160 | A |
| | | F = 60 Hz $t_p = 16.7\text{ ms}$ | 168 | |
| I^2t | I^2t value for fusing | $t_p = 10\text{ ms}$ | 144 | A ² s |
| di/dt | Critical rate of rise of on-state current $I_G = 2 \times I_{GT}$, $t_r \leq 100\text{ ns}$ | F = 120 Hz $T_j = 125\text{ °C}$ | 50 | A/ μ 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 | °C |
| T_j | Operating junction temperature range | | -40 to +125 | °C |

Table 2. Static electrical characteristics

| Symbol | Test conditions | T_j | | Value | Unit |
|-------------------|---|--------|------|-------|------------|
| $V_T^{(1)}$ | $I_{TM} = 22.5\text{ A}$, $t_p = 380\text{ }\mu$ 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. | 25 | m Ω |
| I_{DRM}/I_{RRM} | $V_{DRM} = V_{RRM}$ | 25 °C | Max. | 5 | μ A |
| | | 125 °C | | 2 | mA |

1. For both polarities of A2 referenced to A1

Table 3. Electrical characteristics ($T_j = 25\text{ °C}$, unless otherwise specified) - standard (4 quadrants)

| Symbol | Parameters | Quadrant | | BTA16 BTB16 | | Unit |
|----------------|--|--------------|------|----------------|-----|------|
| | | | | C | B | |
| $I_{GT}^{(1)}$ | $V_D = 12\text{ V}$, $R_L = 33\text{ }\Omega$ | I - II - III | Max. | 25 | 50 | mA |
| | | IV | | 50 | 100 | |
| V_{GT} | | All | Max. | 1.3 | | V |
| V_{GD} | $V_D = V_{DRM}$, $R_L = 3.3\text{ k}\Omega$, $T_j = 125\text{ °C}$ | 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 | 60 | mA |
| | | II | Max. | 80 | 120 | |

| Symbol | Parameters | Quadrant | | BTA16 BTB16 | | Unit |
|-------------------|---|----------|------|----------------|-----|------------------|
| | | | | C | B | |
| $dV/dt^{(2)}$ | $V_D = 67\% V_{DRM}$ gate open, $T_j = 125\text{ }^\circ\text{C}$ | | Min. | 200 | 400 | V/ μs |
| $(dI/dt)_c^{(2)}$ | $(dI/dt)_c = 7\text{ A/ms}$, $T_j = 125\text{ }^\circ\text{C}$ | | 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 4. Electrical characteristics ($T_j = 25\text{ }^\circ\text{C}$, unless otherwise specified) - Snubberless and logic level (3 quadrants)

| Symbol | Parameters | Quadrant | | T1610 / BTA16- SW / BTB16- SW | T1635 / BTA16-CW / BTB16-CW | T1650 / BTA16-BW / BTB16-BW | Unit |
|-------------------|--|--------------|------|-------------------------------------|-----------------------------------|-----------------------------------|------------------|
| $I_{GT}^{(1)}$ | $V_D = 12\text{ V}$, $R_L = 30\ \Omega$ | I - II - III | Max. | 10 | 35 | 50 | mA |
| V_{GT} | | | Max. | 1.3 | | | V |
| V_{GD} | $V_D = V_{DRM}$, $R_L = 3,3\text{ k}\Omega$, $T_j = 125\text{ }^\circ\text{C}$ | | Min. | 0.2 | | | V |
| $I_H^{(2)}$ | $I_T = 500\text{ mA}$ | | Max. | 15 | 35 | 50 | mA |
| I_L | $I_G = 1.2\ I_{GT}$ | I - III | Max. | 25 | 50 | 70 | mA |
| | | II | Max. | 30 | 60 | 80 | |
| $(dV/dt)^{(2)}$ | $V_D = 67\% V_{DRM}$ gate open, $T_j = 125\text{ }^\circ\text{C}$ | | Min. | 40 | 500 | 1000 | V/ μs |
| $(dI/dt)_c^{(2)}$ | $(dV/dt)_c = 0.1\text{ V}/\mu\text{s}$, $T_j = 125\text{ }^\circ\text{C}$ | | | 8.5 | | | A/ms |
| | $(dV/dt)_c = 10\text{ V}/\mu\text{s}$, $T_j = 125\text{ }^\circ\text{C}$ | | Min. | 3.0 | | | |
| | Without snubber, $T_j = 125\text{ }^\circ\text{C}$ | | | | 8.5 | 14 | |

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

Table 5. Thermal resistance

| Symbol | Parameters | Value | Unit |
|---------------|--|-------------------------------|------|
| $R_{th(j-c)}$ | Max. junction to case (AC) | TO-220AB / D ² PAK | 1.2 |
| | | TO-220AB insulated | 2.1 |
| $R_{th(j-a)}$ | Junction to ambient (S = 2 cm ²) | D ² PAK | 45 |
| | Junction to ambient | TO-220AB / TO-220AB ins | 60 |

1. Copper surface under tab.

1.1 Characteristics (curves)

Figure 2. Maximum power dissipation versus on-state RMS current (full cycle)

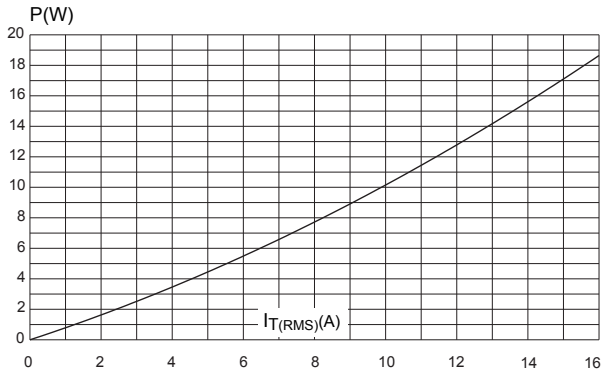


Figure 3. RMS on-state current versus case temperature (full cycle)

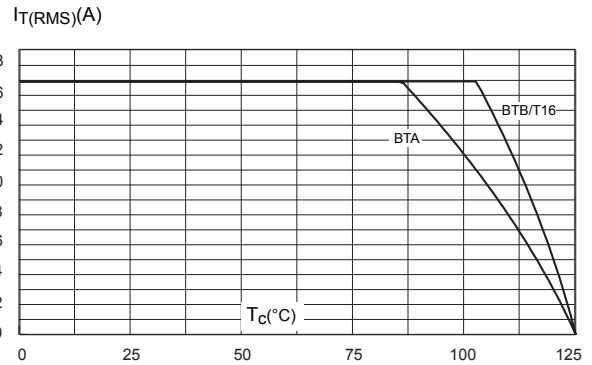


Figure 4. On-state rms current versus ambient temperature (full cycle)

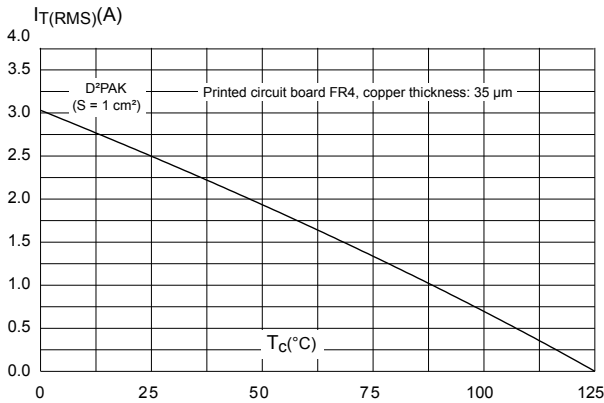


Figure 5. Relative variation of thermal impedance versus pulse duration

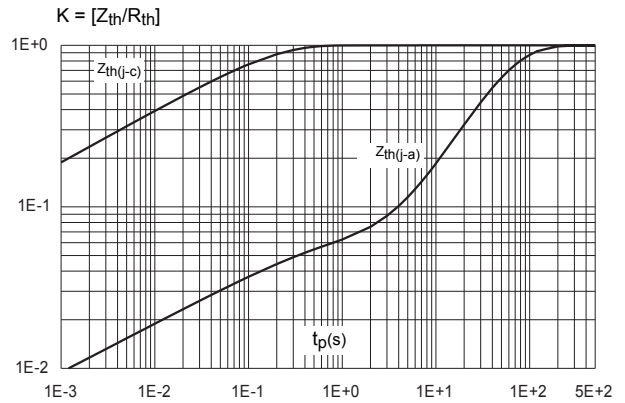


Figure 6. On-state characteristics (maximum values)

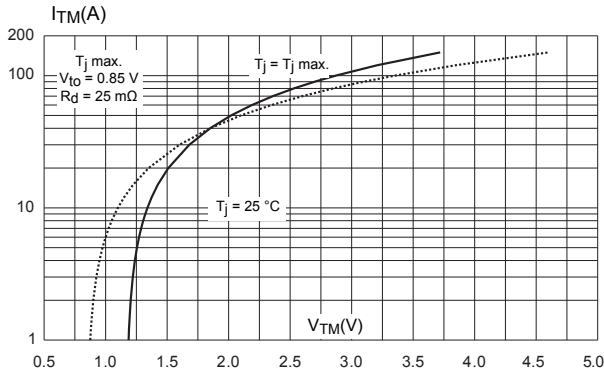


Figure 7. Surge peak on-state current versus number of cycles

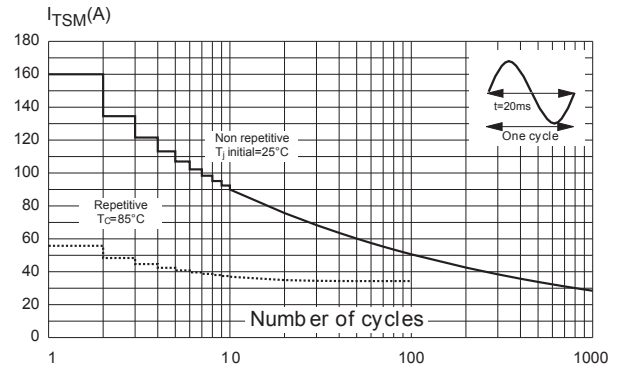


Figure 8. Non-repetitive surge peak on-state current for a sinusoidal

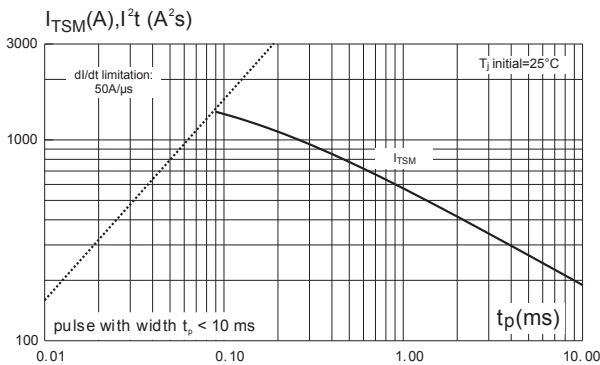


Figure 9. Relative variation of gate trigger current

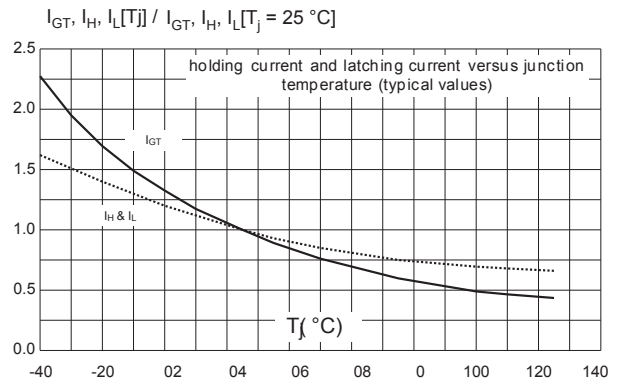


Figure 10. Relative variation of critical rate of decrease of main current versus (dV/dt)_c (typical values)

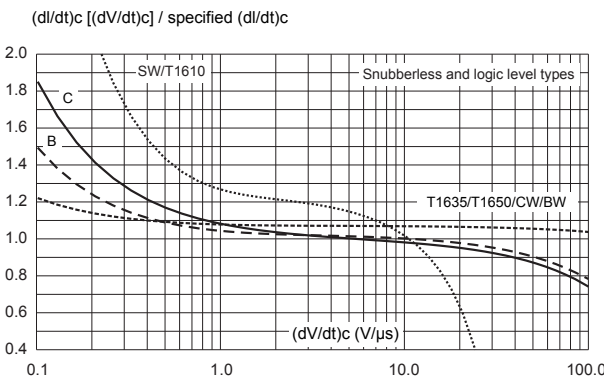


Figure 11. Relative variation of critical rate of decrease of main current versus (junction temperature (typical values)

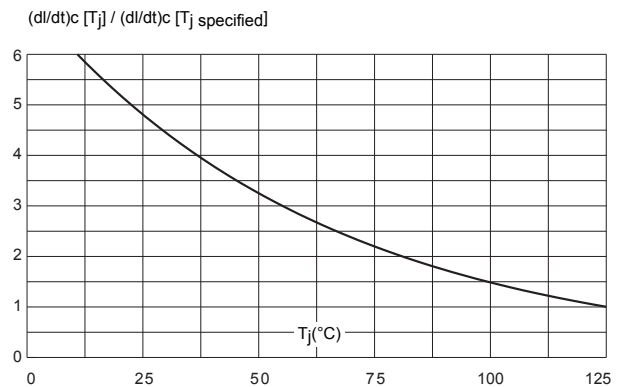
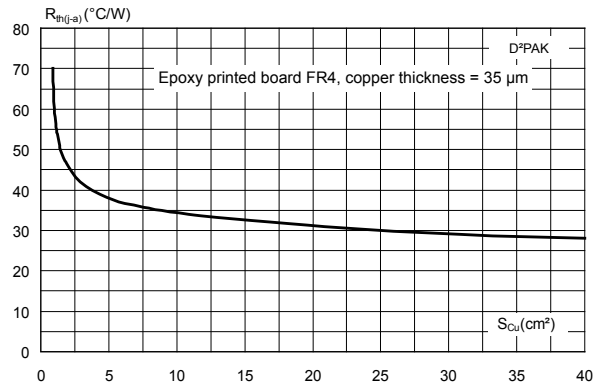


Figure 12. D²PAK thermal resistance junction to ambient versus copper surface under tab



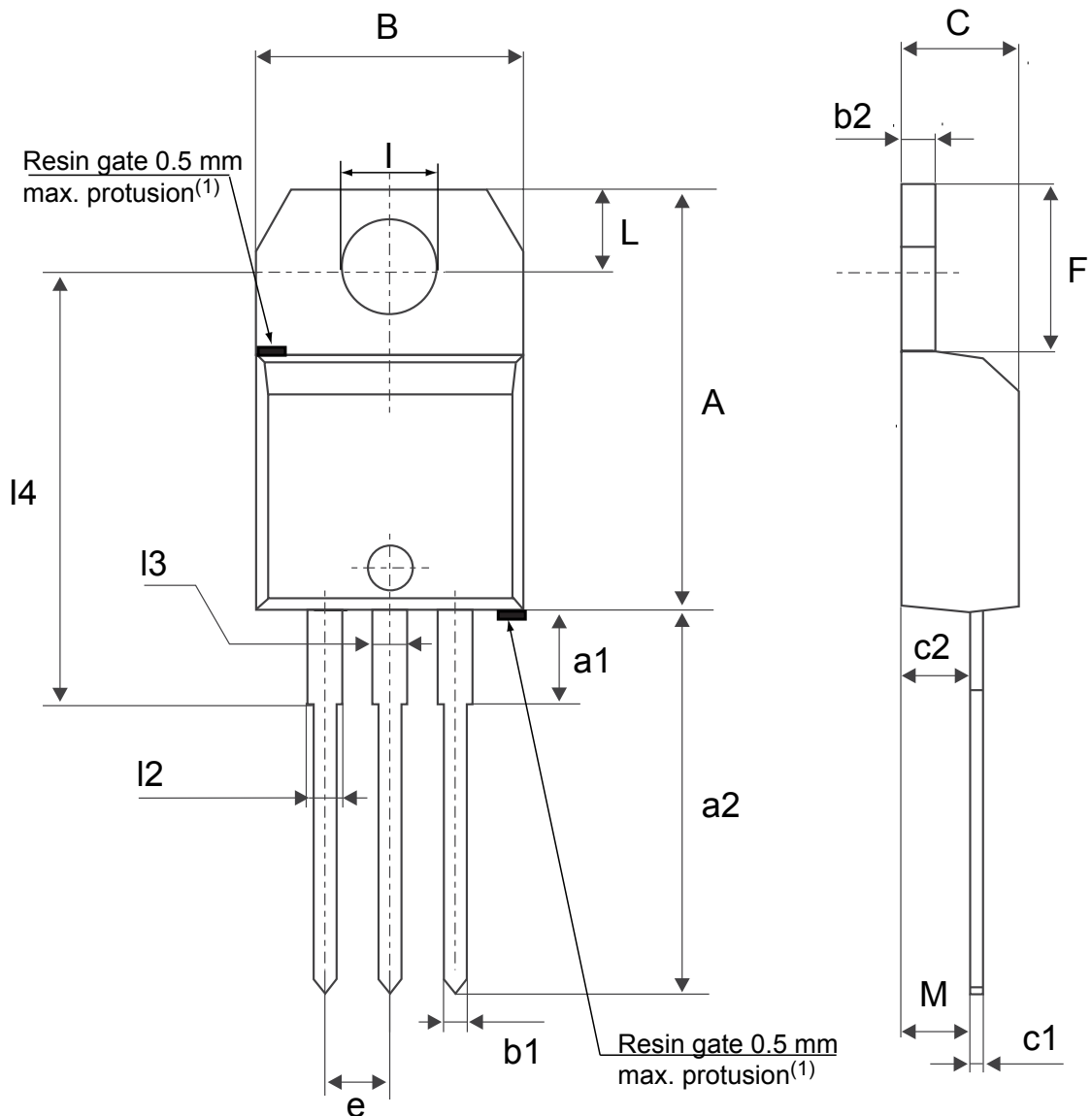
2 Package information

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. ECOPACK® is an ST trademark.

2.1 TO-220AB Insulated and non 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 13. TO-220AB Insulated and non Insulated package outline



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

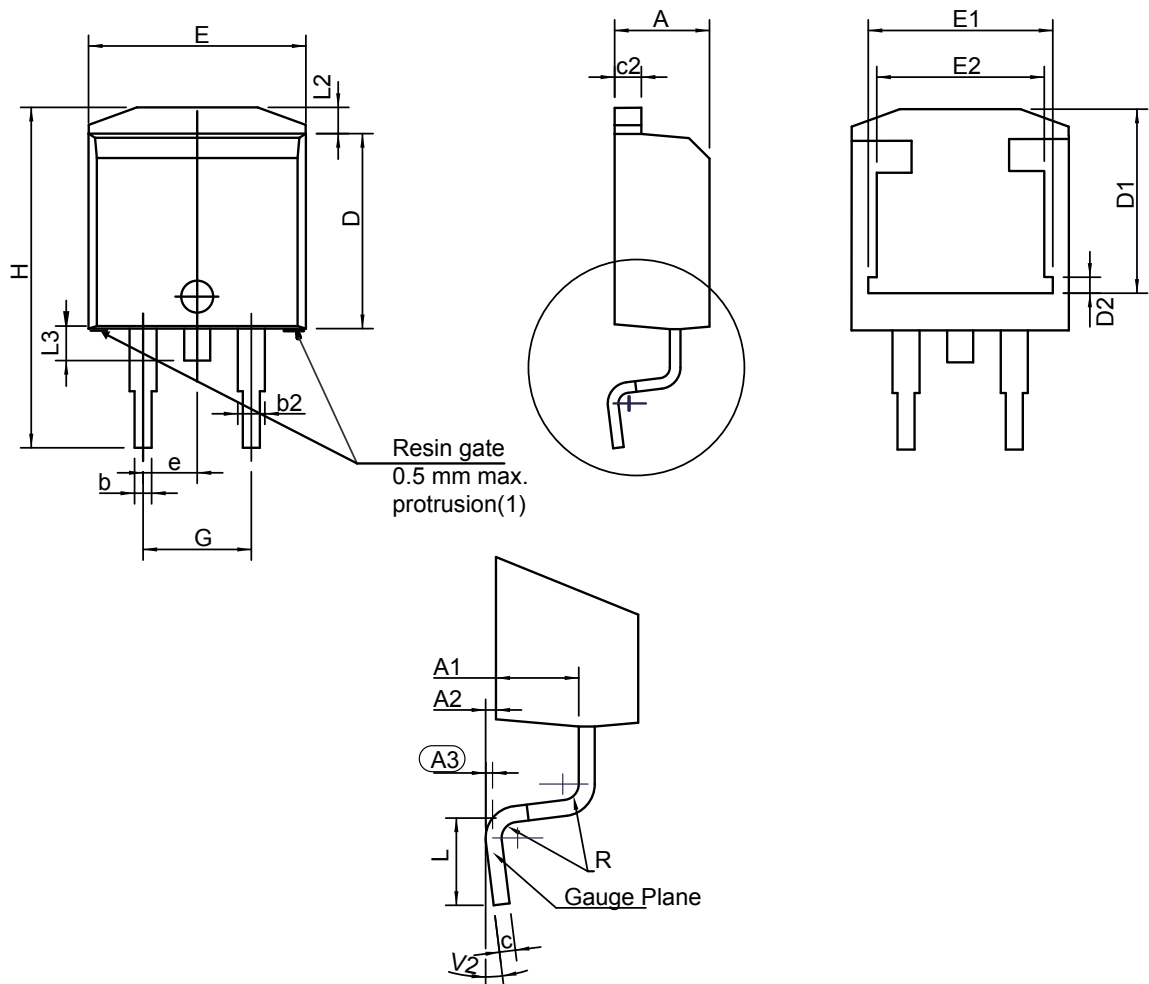
Table 6. TO-220AB Insulated and non Insulated package mechanical data

| Ref. | Dimensions | | | | | |
|------|-------------|-------|-------|--------|--------|--------|
| | Millimeters | | | Inches | | |
| | 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.

2.2 D²PAK package information

Figure 14. D²PAK package outline



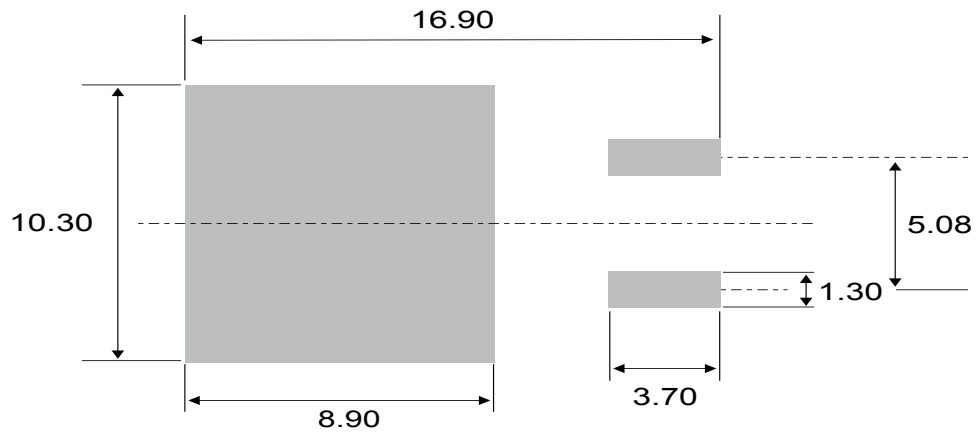
(1) Resin gate position accepted in one of the two positions or in the symmetrical opposites

Table 7. D²PAK package mechanical data

| Ref. | Dimensions | | | | | |
|------|-------------|------|-------|--------|--------|--------|
| | Millimeters | | | Inches | | |
| | 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 15. D²PAK recommended footprint (dimensions are in mm)



3 Ordering information

Figure 16. Ordering information scheme (BTA16 and BTB16 series)

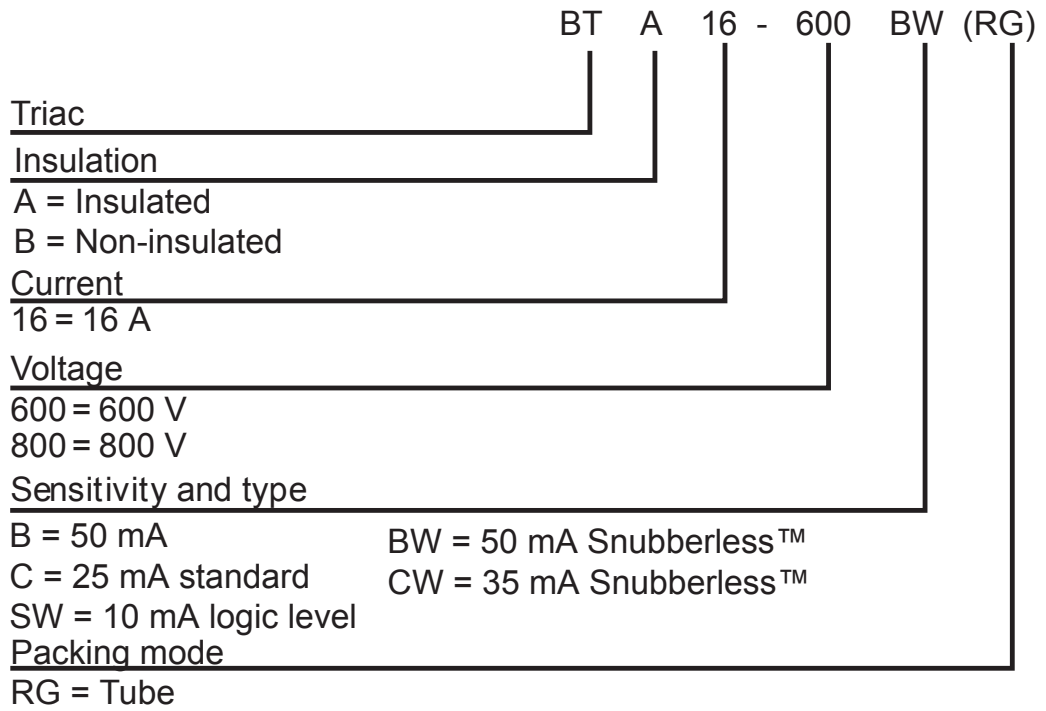
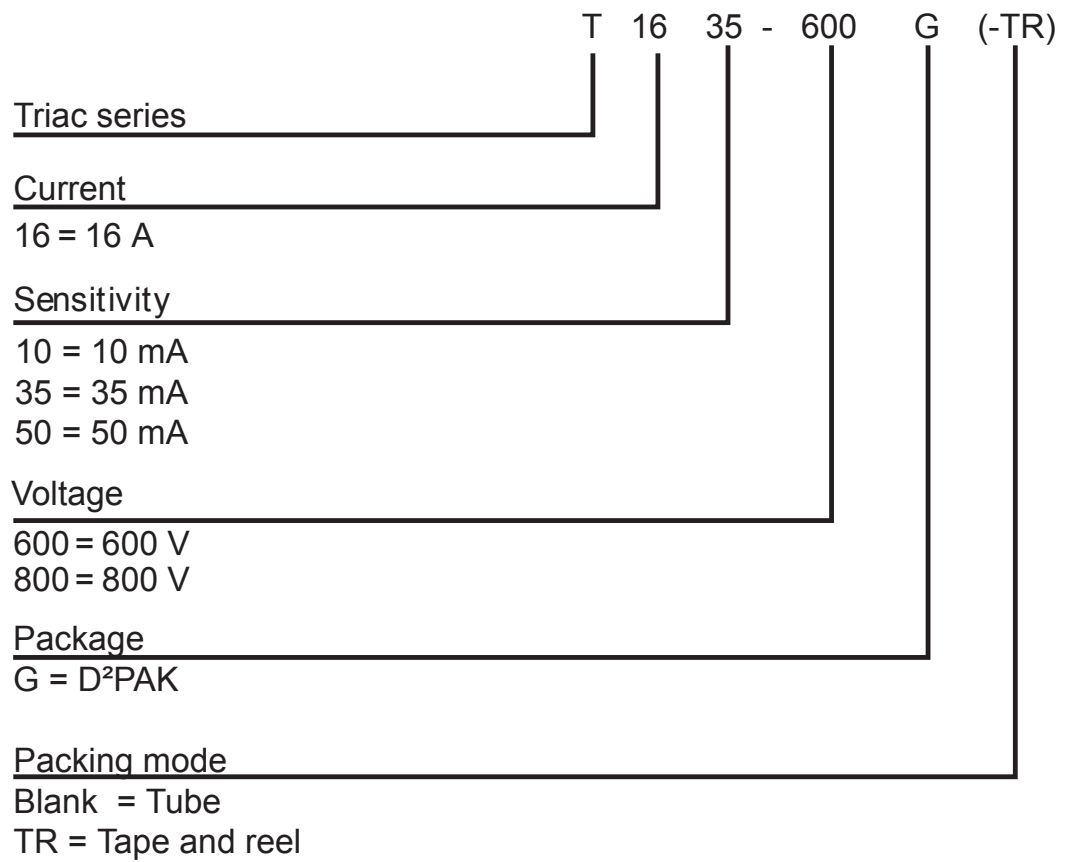


Figure 17. Ordering information scheme (T8 series)



3.1 Product selector

Table 8. Product selector

| Part Number | | Sensitivity | Type | Package |
|-------------|-------------|-------------|--------------|--------------------|
| 600 | 800 | | | |
| BTB16-600C | | 35 mA | Standard | TO-220AB |
| BTB16-600B | BTB16-800B | 50 mA | Standard | TO-220AB |
| BTB16-600SW | BTB16-800SW | 10 mA | Snubberless™ | TO-220AB |
| BTB16-600CW | BTB16-800CW | 35 mA | Snubberless™ | TO-220AB |
| BTB16-600BW | BTB16-800BW | 50 mA | Snubberless™ | TO-220AB |
| BTA16-600C | | 35 mA | Standard | TO-220AB Ins. |
| BTA16-600B | BTA16-800B | 50 mA | Standard | TO-220AB Ins. |
| BTA16-600SW | BTA16-800SW | 10 mA | Snubberless™ | TO-220AB Ins. |
| BTA16-600CW | BTA16-800CW | 35 mA | Snubberless™ | TO-220AB Ins. |
| BTA16-600BW | BTA16-800BW | 50 mA | Snubberless™ | TO-220AB Ins. |
| T1610-600G | T1610-800G | 10 mA | Snubberless™ | D ² PAK |
| T1635-600G | T1635-800G | 35 mA | Snubberless™ | D ² PAK |
| T1650-600G | | 50 mA | Snubberless™ | D ² PAK |

3.2 Ordering information

Table 9. Ordering information

| Order code | Marking | Package | Weight | Base qty. | Delivery mode |
|---------------|-------------|--------------------|--------|-----------|---------------|
| BTA16-600BRG | BTA16-600B | TO-220AB Ins. | 2.30 | 50 | Tube |
| BTA16-600BWRG | BTA16-600BW | | | | |
| BTA16-600CRG | BTA16-600C | | | | |
| BTA16-600CWRG | BTA16-600CW | | | | |
| BTA16-600SWRG | BTA16-600SW | | | | |
| BTA16-800BRG | BTA16-800B | | | | |
| BTA16-800BWRG | BTA16-800BW | | | | |
| BTA16-800CWRG | BTA16-800CW | | | | |
| BTA16-800SWRG | BTA16-800SW | | | | |
| BTB16-600BRG | BTB16-600B | TO-220AB | | | Tube |
| BTB16-600BWRG | BTB16-600BW | | | | |
| BTB16-600CRG | BTB16-600C | | | | |
| BTB16-600CWRG | BTB16-600CW | | | | |
| BTB16-600SWRG | BTB16-600SW | | | | |
| BTB16-800BRG | BTB16-800B | | | | |
| BTB16-800BWRG | BTB16-800BW | | | | |
| BTB16-800CWRG | BTB16-800CW | | | | |
| BTB16-800SWRG | BTB16-800SW | | | | |
| T1610-600G-TR | T1610-600G | D ² PAK | 1.50 | 1000 | Tape and reel |
| T1610-800G-TR | T1610-800G | | | | |
| T1635-600G-TR | T1635-600G | | | | |
| T1635-800G-TR | T1635-800G | | | | |
| T1650-600G-TR | T1650-600G | | | | |
| T1635-600G | T1635-600G | | | 50 | Tube |

Revision history

Table 10. Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| Oct-2002 | 6A | Last update. |
| 13-Feb-2006 | 7 | TO-220AB delivery mode changed from bulk to tube. ECOPACK statement added. |
| 03-Jul-2009 | 8 | Added part number T1610. |
| 04-Dec-2009 | 9 | Updated value for V_{DSM} / V_{RSM} in Table 2. Updated temperature in Table 2 from 15 °C to 86 °C. |
| 11-Mar-2010 | 10 | Updated value for V_{DSM} / V_{RSM} in Table 2. Updated temperature in Table 2 from 15 °C to 86 °C. |
| 30-May-2018 | 11 | Updated Section • Product status / summary . Added T1650 package information. |

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