# SMBJ

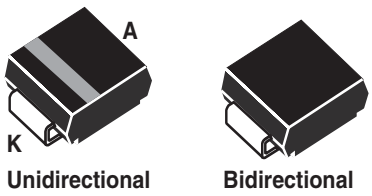
## Transil™

## Features

- Peak pulse power:
  - 600 W (10/1000 µs)
  - 4 kW (8/20 µs)
- Stand off voltage range: from 5 V to 188 V
- Unidirectional and bidirectional types
- Low leakage current:
  - 0.2 µA at 25 °C
  - 1 µA at 85 °C
- Operating $T_{j\,max}$: 150 °C
- High power capability at $T_{j\,max}$:
  - 515 W (10/1000 µs)
- JEDEC registered package outline

### Complies with the following standards

- IEC 61000-4-2 level 4:
  - 15 kV (air discharge)
  - 8 kV (contact discharge)
- IEC 61000-4-5
- MIL STD 883G, method 3015-7 Class 3B:
  - 25 kV HBM (human body model)
- Resin meets UL 94, V0
- MIL-STD-750, method 2026 soldererability
- EIA STD RS-481 and IEC 60286-3 packing
- IPC 7531 footprint




Unidirectional Bidirectional

**SMB**
**(JEDEC DO-214AA)**

## Description

The SMBJ Transil series has been designed to protect sensitive equipment against electrostatic discharges according to IEC 61000-4-2, and MIL STD 883, method 3015, and electrical over stress according to IEC 61000-4-4 and 5. These devices are more generally used against surges below 600 W (10/1000 µs).

Planar technology makes these devices suitable for high-end equipment and SMPS where low leakage current and high junction temperature are required to provide reliability and stability over time.

SMBJ are packaged in SMB (SMB footprint in accordance with IPC 7531 standard).

**TM**: Transil is a trademark of STMicroelectronics

# 1 Characteristics

**Table 1. Absolute maximum ratings ($T_{amb}$ = 25 °C)**

| Symbol | Parameter | | Value | Unit |
|---|---|---|---|---|
| $P_{PP}$ | Peak pulse power dissipation (1) | $T_j$ initial = $T_{amb}$ | 600 | W |
| $T_{stg}$ | Storage temperature range | | -65 to +150 | °C |
| $T_j$ | Operating junction temperature range | | -55 to +150 | °C |
| $T_L$ | Maximum lead temperature for soldering during 10 s. | | 260 | °C |

1. For a surge greater than the maximum values, the diode will fail in short-circuit.

**Table 2. Thermal resistances**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{th(j-l)}$ | Junction to leads | 20 | °C/W |
| $R_{th(j-a)}$ | Junction to ambient on recommended pad layout | 100 | °C/W |

**Figure 1. Electrical characteristics - definitions**

| Symbol | Parameter |
|---|---|
| $V_{RM}$ | Stand-off voltage |
| $V_{BR}$ | Breakdown voltage |
| $V_{CL}$ | Clamping voltage |
| $I_{RM}$ | Leakage current @ $V_{RM}$ |
| $I_{PP}$ | Peak pulse current |
| $\alpha T$ | Voltage temperature coefficient |
| $V_F$ | Forward voltage drop |
| $R_D$ | Dynamic resistance |

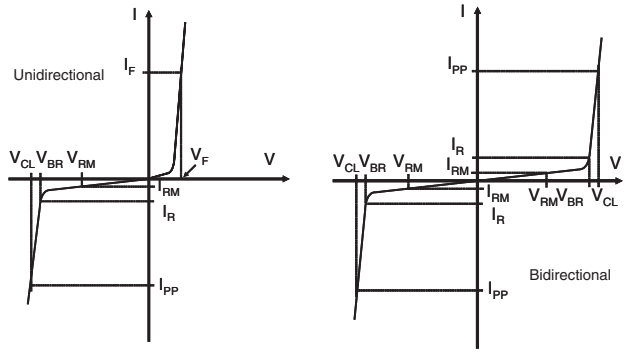



**Figure 2. Pulse definition for electrical characteristics**

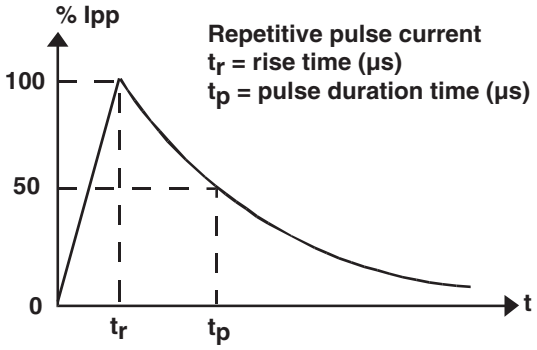


**Table 3. Electrical characteristics - parameter values ($T_{amb}$ = 25 °C)**

| Order code | $I_{RM}$ max@$V_{RM}$ | | | $V_{BR}$ @$I_R$ (1) | | | $V_{CL}$ @$I_{PP}$ 10/1000 µs | | $R_D$ (2) 10/1000 µs | $V_{CL}$ @$I_{PP}$ 8/20 µs | | $R_D$ (2) 8/20 µs | αT (3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 25 °C | 85 °C | | min | typ | | max | | | max | | | max |
| | µA | | V | V | | mA | V | A(4) | Ω | V | A(4) | Ω | 10-4/ °C |
| SMBJ5.0A/CA | 20 | 50 | 5.0 | 6.4 | 6.74 | 10 | 9.2 | 68 | 0.031 | 13.4 | 298 | 0.021 | 5.7 |
| SMBJ6.0A/CA | 20 | 50 | 6.0 | 6.7 | 7.05 | 10 | 10.3 | 61 | 0.048 | 13.7 | 290 | 0.022 | 5.9 |
| SMBJ6.5A/CA | 20 | 50 | 6.5 | 7.2 | 7.58 | 10 | 11.2 | 56 | 0.058 | 14.5 | 276 | 0.024 | 6.1 |
| SMBJ8.5A/CA | 20 | 50 | 8.5 | 9.4 | 9.9 | 1 | 14.4 | 41.7 | 0.096 | 19.5 | 205 | 0.044 | 7.3 |
| SMBJ10A/CA | 0.2 | 1 | 10 | 11.1 | 11.7 | 1 | 17 | 37 | 0.127 | 21.7 | 184 | 0.051 | 7.8 |
| SMBJ12A/CA | 0.2 | 1 | 12 | 13.3 | 14 | 1 | 19.9 | 31 | 0.168 | 25.3 | 157 | 0.068 | 8.3 |
| SMBJ13A/CA | 0.2 | 1 | 13 | 14.4 | 15.2 | 1 | 21.5 | 29 | 0.191 | 27.2 | 147 | 0.076 | 8.4 |
| SMBJ15A/CA | 0.2 | 1 | 15 | 16.7 | 17.6 | 1 | 24.4 | 25.1 | 0.236 | 32.5 | 123 | 0.114 | 8.8 |
| SMBJ16A/CA | 0.2 | 1 | 16 | 17.8 | 18.7 | 1 | 26 | 23.1 | 0.276 | 34.4 | 116 | 0.127 | 8.8 |
| SMBJ18A/CA | 0.2 | 1 | 18 | 20.0 | 21.1 | 1 | 29.2 | 21.5 | 0.328 | 39.3 | 102 | 0.168 | 9.2 |
| SMBJ20A/CA | 0.2 | 1 | 20 | 22.2 | 23.4 | 1 | 32.4 | 19.4 | 0.404 | 42.8 | 93 | 0.196 | 9.4 |
| SMBJ22A/CA | 0.2 | 1 | 22 | 24.4 | 25.7 | 1 | 35.5 | 17.7 | 0.481 | 48.3 | 83 | 0.257 | 9.6 |
| SMBJ24A/CA | 0.2 | 1 | 24 | 26.7 | 28.1 | 1 | 38.9 | 16 | 0.587 | 50 | 80 | 0.256 | 9.6 |
| SMBJ26A/CA | 0.2 | 1 | 26 | 28.9 | 30.4 | 1 | 42.1 | 14.9 | 0.683 | 53.5 | 75 | 0.288 | 9.7 |
| SMBJ28A/CA | 0.2 | 1 | 28 | 31.1 | 32.7 | 1 | 45.4 | 13.8 | 0.802 | 59 | 68 | 0.363 | 9.8 |
| SMBJ30A/CA | 0.2 | 1 | 30 | 33.3 | 35.1 | 1 | 48.4 | 13 | 0.888 | 64.3 | 62 | 0.443 | 9.9 |
| SMBJ33A/CA | 0.2 | 1 | 33 | 36.7 | 38.6 | 1 | 53.3 | 11.8 | 1.08 | 69.7 | 57 | 0.512 | 10.0 |
| SMBJ36A/CA | 0.2 | 1 | 36 | 40.0 | 42.1 | 1 | 58.1 | 10.3 | 1.35 | 76 | 52 | 0.611 | 10.0 |
| SMBJ40A/CA | 0.2 | 1 | 40 | 44.4 | 46.7 | 1 | 64.5 | 9.7 | 1.59 | 84 | 48 | 0.728 | 10.1 |
| SMBJ48A/CA | 0.2 | 1 | 48 | 53.3 | 56.1 | 1 | 77.4 | 8.1 | 2.28 | 100 | 40 | 1.03 | 10.3 |
| SMBJ58A/CA | 0.2 | 1 | 58 | 64.4 | 67.8 | 1 | 93.6 | 6.7 | 3.34 | 121 | 33 | 1.51 | 10.4 |
| SMBJ70A/CA | 0.2 | 1 | 70 | 77.8 | 81.9 | 1 | 113 | 5.5 | 4.91 | 146 | 27 | 2.22 | 10.5 |
| SMBJ85A/CA | 0.2 | 1 | 85 | 94 | 99 | 1 | 137 | 4.6 | 7.18 | 178 | 22.5 | 3.29 | 10.6 |
| SMBJ100A/CA | 0.2 | 1 | 100 | 111 | 117 | 1 | 162 | 3.8 | 10.3 | 212 | 19 | 4.69 | 10.7 |
| SMBJ130A/CA | 0.2 | 1 | 130 | 144 | 152 | 1 | 209 | 3 | 16.5 | 265 | 15 | 7.03 | 10.8 |
| SMBJ154A/CA | 0.2 | 1 | 154 | 171 | 180 | 1 | 246 | 2.4 | 23.8 | 317 | 12.6 | 10.2 | 10.8 |
| SMBJ170A/CA | 0.2 | 1 | 170 | 189 | 199 | 1 | 275 | 2.2 | 30.0 | 353 | 11.3 | 12.7 | 10.8 |
| SMBJ188A/CA | 0.2 | 1 | 188 | 209 | 220 | 1 | 328 | 2 | 48.5 | 388 | 10.3 | 15.2 | 10.8 |

1. Pulse test : $t_p$ < 50 ms
2. To calculate maximum clamping voltage at other surge level,use the following formula: $V_{CLmax} = V_{CL} - R_D \times (I_{PP} - I_{PPappli})$ where $I_{PPappli}$ is the surge current in the application
3. To calculate $V_{BR}$ or $V_{CL}$ versus junction temperature, use the following formulas:
   $V_{BR}$ @ $T_J$ = $V_{BR}$ @ 25°C x (1 + αT x ($T_J$ – 25))
   $V_{CL}$ @ $T_J$ = $V_{CL}$ @ 25°C x (1 + αT x ($T_J$ – 25))
4. Surge capability given for both directions for unidirectional and bidirectional types.

**Figure 3. Peak pulse power dissipation versus initial junction temperature**

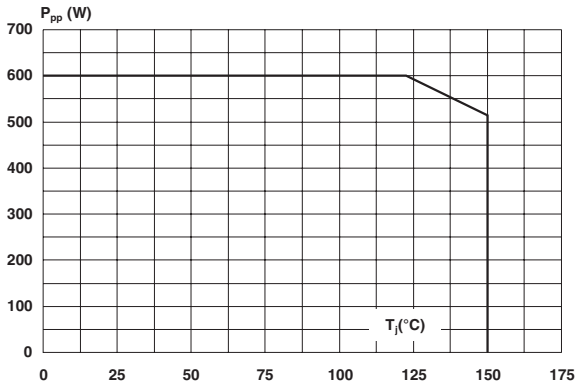



**Figure 4. Peak pulse power versus exponential pulse duration ($T_j$ initial = 25 °C)**

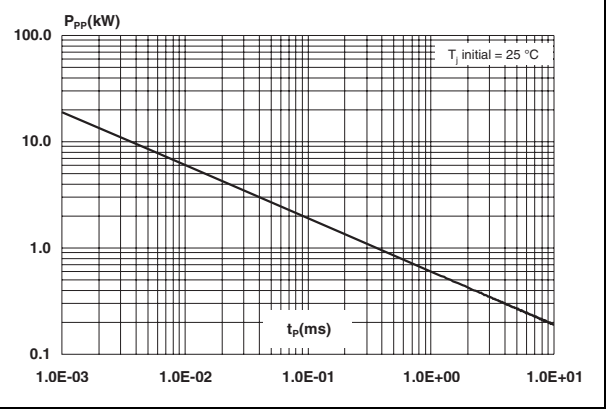



**Figure 5. Clamping voltage versus peak pulse current (exponential waveform, maximum values)**

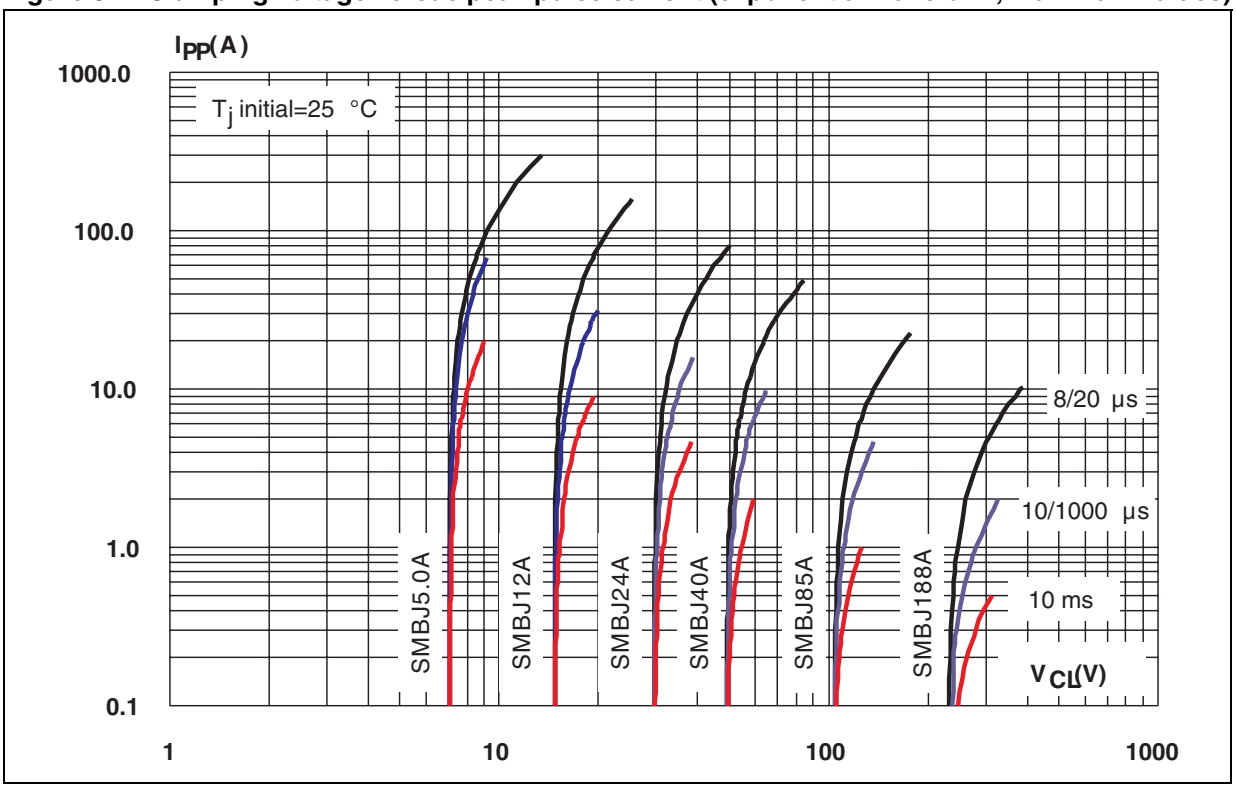


**Figure 6. Junction capacitance versus reverse applied voltage for unidirectional types (typical values)**

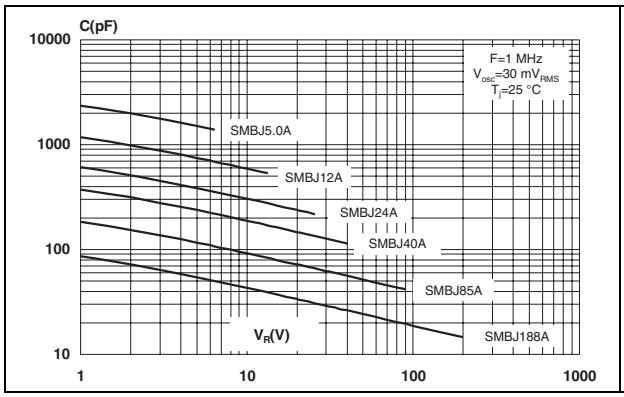



**Figure 7. Junction capacitance versus reverse applied voltage for bidirectional types (typical values)**

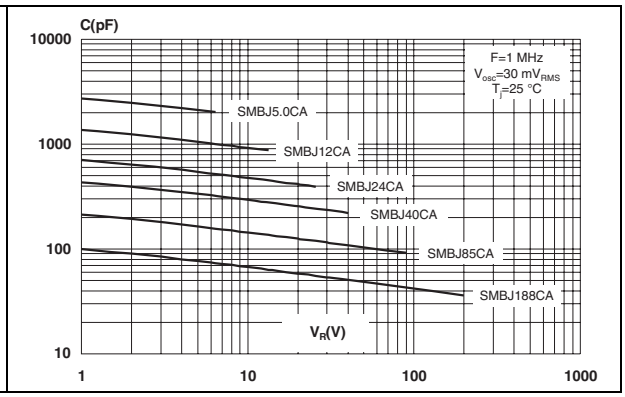



**Figure 8. Peak forward voltage drop versus peak forward current (typical values)**

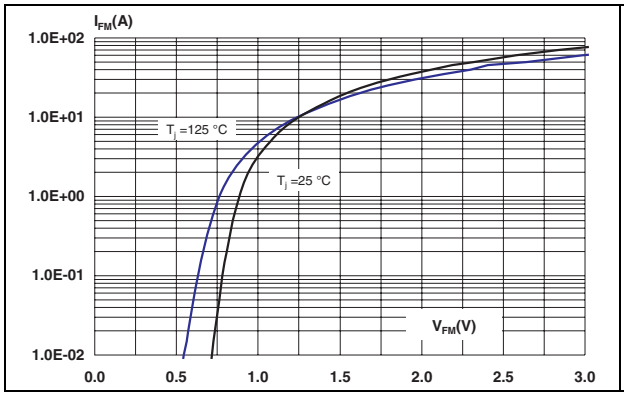



**Figure 9. Relative variation of thermal impedance, junction to ambient, versus pulse duration**

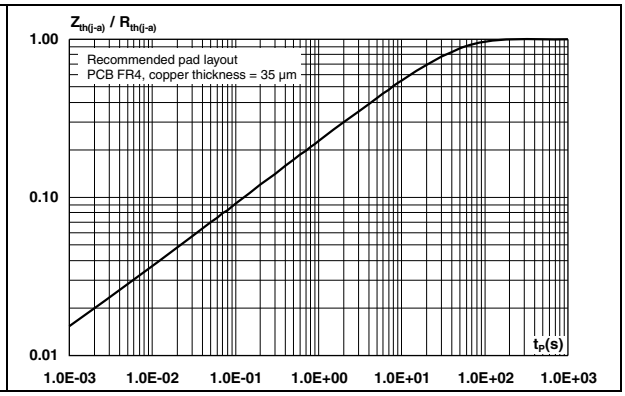



**Figure 10. Thermal resistance, junction to ambient, versus copper surface under each lead**

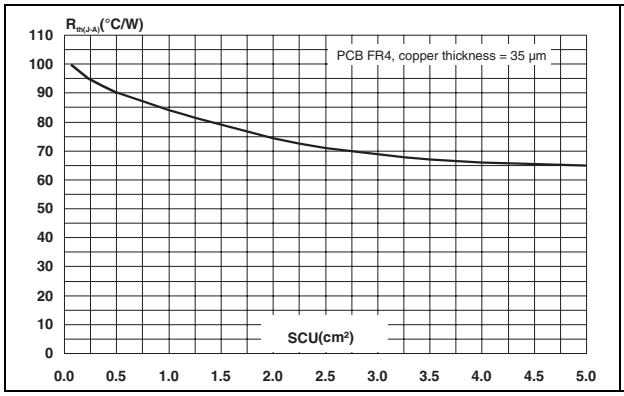
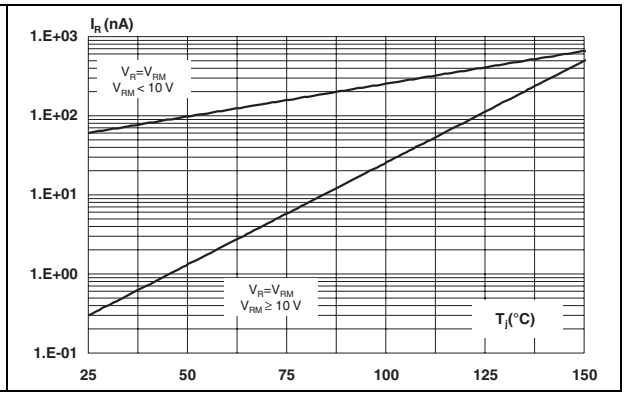
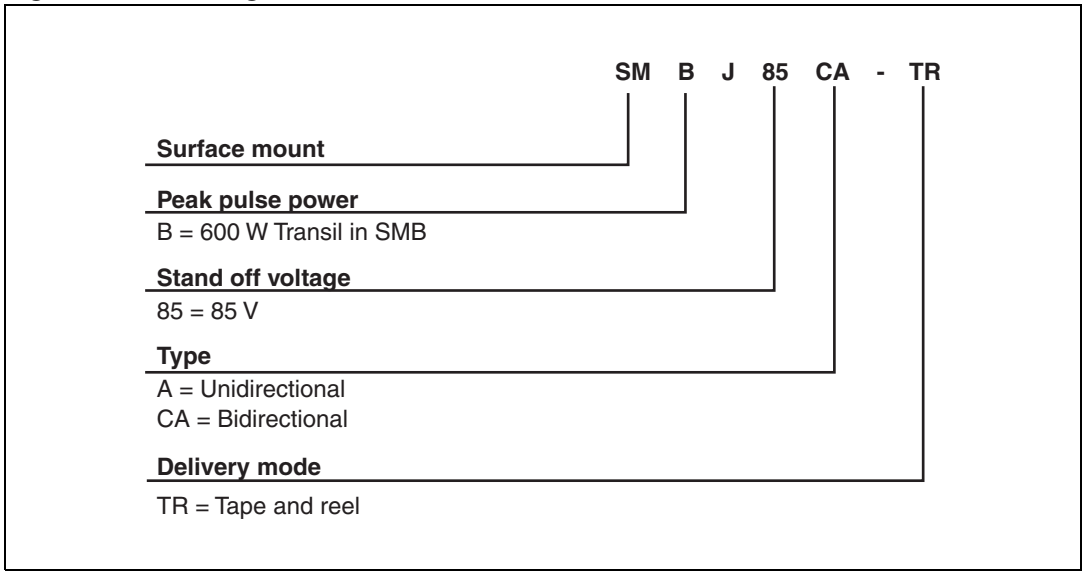



**Figure 11. Leakage current versus junction temperature (typical values)**



# 2 Ordering information scheme

**Figure 12. Ordering information scheme**

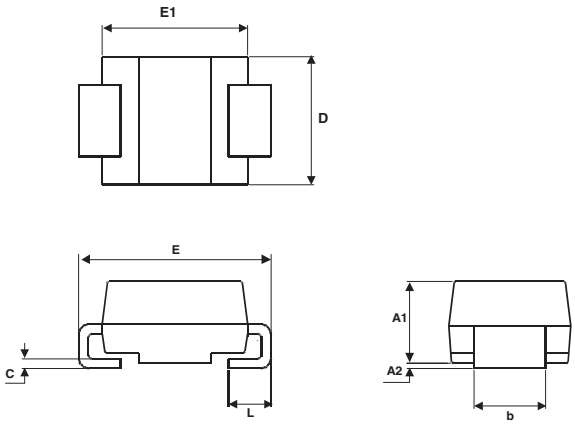


# 3 Package information

- Case: JEDEC DO-214AA molded plastic over planar junction
- Terminals: solder plated - solderable per MIL-STD-750, Method 2026
- Polarity: for unidirectional types the band indicates cathode
- Flammability: epoxy is rated UL94V-0
- RoHS package

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.

**Table 4. SMB dimensions**




| Ref. | Dimensions | | | |
|---|---|---|---|---|
| | Millimeters | | Inches | |
| | Min. | Max. | Min. | Max. |
| A1 | 1.90 | 2.45 | 0.075 | 0.096 |
| A2 | 0.05 | 0.20 | 0.002 | 0.008 |
| b | 1.95 | 2.20 | 0.077 | 0.087 |
| c | 0.15 | 0.40 | 0.006 | 0.016 |
| D | 3.30 | 3.95 | 0.130 | 0.156 |
| E | 5.10 | 5.60 | 0.201 | 0.220 |
| E1 | 4.05 | 4.60 | 0.159 | 0.181 |
| L | 0.75 | 1.50 | 0.030 | 0.059 |

**Figure 13. Footprint dimensions in mm (inches)**

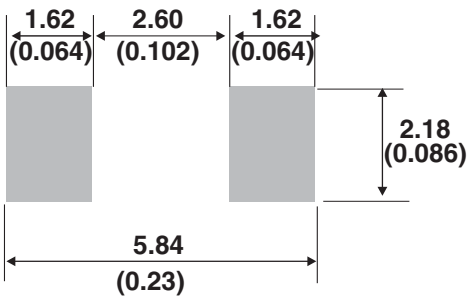
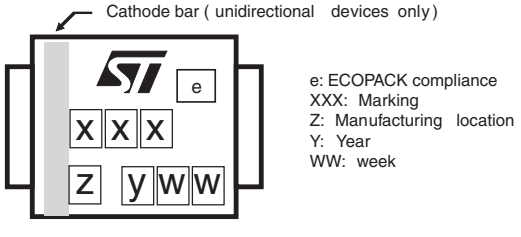



**Figure 14. Marking layout(1)**




1. Marking layout can vary according to assembly location.

**Table 5. Marking**

| Order code | Marking | Order code | Marking |
|---|---|---|---|
| SMBJ5.0A-TR | BUZ | SMBJ5.0CA-TR | BBZ |
| SMBJ6.0A-TR | BUA | SMBJ6.0CA-TR | BBA |
| SMBJ6.5A-TR | BUB | SMBJ6.5CA-TR | BBB |
| SMBJ8.5A-TR | BUC | SMBJ8.5CA-TR | BBC |
| SMBJ10A-TR | BUD | SMBJ10CA-TR | BBD |
| SMBJ12A-TR | BUE | SMBJ12CA-TR | BBE |
| SMBJ13A-TR | BUF | SMBJ13CA-TR | BBF |
| SMBJ15A-TR | BUG | SMBJ15CA-TR | BBG |
| SMBJ16A-TR | CUG | SMBJ16CA-TR | CBG |
| SMBJ18A-TR | BUH | SMBJ18CA-TR | BBH |
| SMBJ20A-TR | BUI | SMBJ20CA-TR | BBI |
| SMBJ22A-TR | BVA | SMBJ22CA-TR | CBH |
| SMBJ24A-TR | BUJ | SMBJ24CA-TR | BBJ |
| SMBJ26A-TR | BUK | SMBJ26CA-TR | BBK |
| SMBJ28A-TR | BUL | SMBJ28CA-TR | BBL |
| SMBJ30A-TR | BUM | SMBJ30CA-TR | BBM |
| SMBJ33A-TR | BUN | SMBJ33CA-TR | BBN |
| SMBJ36A-TR | CUN | SMBJ36CA-TR | CBN |
| SMBJ40A-TR | CUJ | SMBJ40CA-TR | CBJ |
| SMBJ43A-TR | CUW | SMBJ43CA-TR | CBW |
| SMBJ48A-TR | BUW | SMBJ48CA-TR | BBW |
| SMBJ58A-TR | BUO | SMBJ58CA-TR | BBO |
| SMBJ70A-TR | CUM | SMBJ70CA-TR | CBM |
| SMBJ85A-TR | BUQ | SMBJ85CA-TR | BBQ |
| SMBJ100A-TR | CUQ | SMBJ100CA-TR | CBQ |
| SMBJ130A-TR | BUS | SMBJ130CA-TR | BBS |
| SMBJ154A-TR | BUT | SMBJ154CA-TR | BBT |
| SMBJ170A-TR | BUU | SMBJ170CA-TR | BBU |
| SMBJ188A-TR | BUV | SMBJ188CA-TR | BBV |

# 4 Ordering information

**Table 6. Order codes**

| Order code | Marking | Package | Weight | Base qty | Delivery mode |
|---|---|---|---|---|---|
| SMBJxxxA/CA-TR(1) | See *Table 5 on page 8* | SMB | 0.11 g | 2500 | Tape and reel |

1. Where xxx is nominal value of $V_{BR}$ and A or CA indicates unidirectional or bidirectional version. See *Table 3* for list of available devices and their order codes

# 5 Revision history

**Table 7. Document revision history**

| Date | Revision | Changes |
|---|---|---|
| Oct-2001 | 4 | Previous issue |
| 10-Feb-2005 | 5 | Reformatted to current template. Added directional (uni and bi) indications to graphics. Added ECOPACK statement. |
| 16-Nov-2006 | 6 | Add part numbers SMBJ36A-TR and SMBJ36CA-TR in *Table 3*. |
| 14-May-2009 | 7 | Reformatted to current standards. Updated ECOPACK statement. Added part number SMBJ43CA/A |
| 17-Sep-2009 | 8 | Document updated for low leakage current. |
| 09-Jul-2010 | 9 | Changed timescale in *Figure 9*. |
| 20-Oct-2010 | 10 | Updated *Figure 13*. |

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