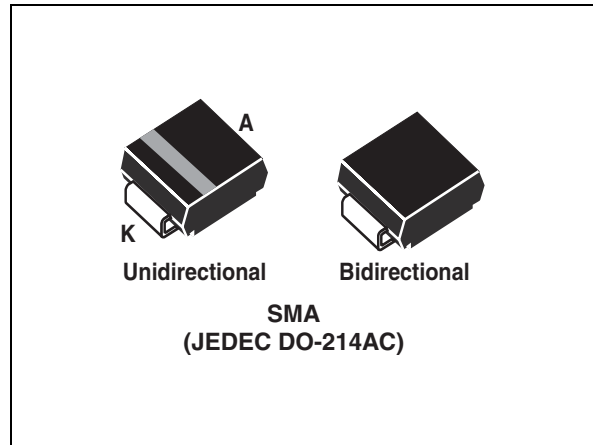


## Features

- Peak pulse power:
  - 400 W (10/1000  $\mu$ s)
  - 2.3 kW (8/20  $\mu$ s)
- Stand off voltage range: from 5 V to 188 V
- Unidirectional and bidirectional types
- Low leakage current:
  - 0.2  $\mu$ A at 25 °C
  - 1  $\mu$ A at 85 °C
- Operating  $T_{j\max}$ : 150 °C
- High power capability at  $T_{j\max}$ :
  - 270 W (10/1000  $\mu$ s)
- 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 (see Table 3 for surge level)
- MIL STD 883G, method 3015-7 Class 3B
  - 25 kV HBM (human body model)
- Resin meets UL 94, V0
- MIL-STD-750, method 2026 solderability
- EIA STD RS-481 and IEC 60286-3 packing
- IPC 7531 footprint



## Description

The SMAJ 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 generally used against surges below 400 W (10/1000  $\mu$ s).

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.

SMAJ are packaged in SMA (SMA footprint in accordance with IPC 7531 standard).

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

# 1 Characteristics

**Table 1. Absolute maximum ratings ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ )**

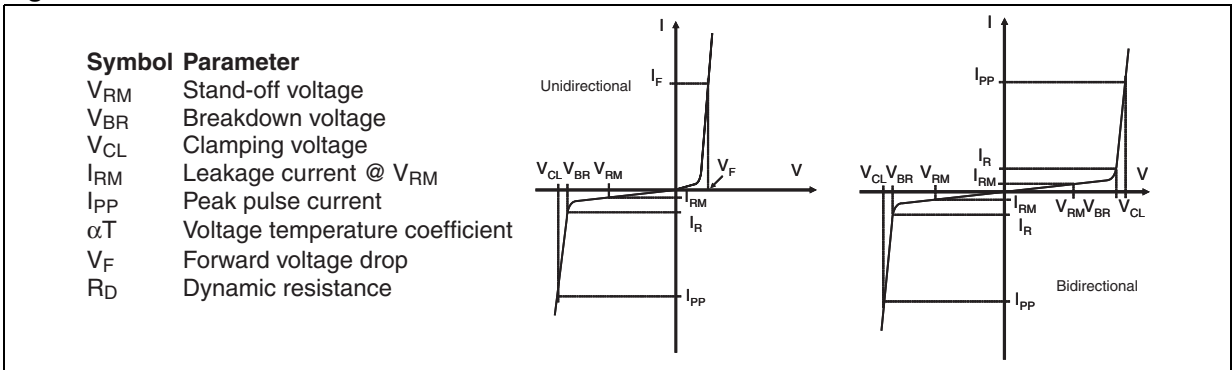
| Symbol    | Parameter                                           | Value                                  | Unit               |
|-----------|-----------------------------------------------------|----------------------------------------|--------------------|
| $P_{PP}$  | Peak pulse power dissipation <sup>(1)</sup>         | $T_j \text{ initial} = T_{amb}$<br>400 | W                  |
| $T_{stg}$ | Storage temperature range                           | -65 to +150                            | $^{\circ}\text{C}$ |
| $T_j$     | Operating junction temperature range                | -55 to +150                            | $^{\circ}\text{C}$ |
| $T_L$     | Maximum lead temperature for soldering during 10 s. | 260                                    | $^{\circ}\text{C}$ |

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                                                | 30    | $^{\circ}\text{C/W}$ |
| $R_{th(j-a)}$ | Junction to ambient on printed circuit on recommended pad layout | 120   | $^{\circ}\text{C/W}$ |

**Figure 1. Electrical characteristics - definitions**



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

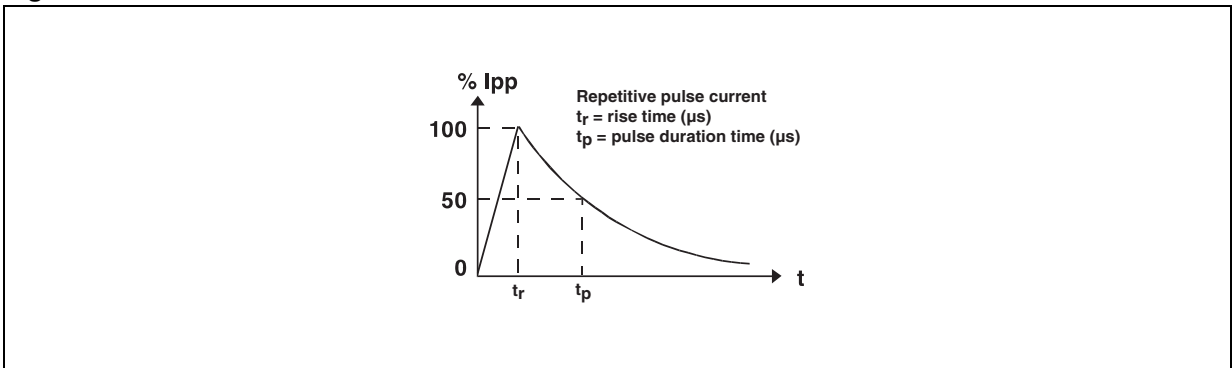


Table 3. Electrical characteristics - parameter values ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ )

| Order code  | $I_{RM} \text{ max}@V_{RM}$ |                       |     | $V_{BR} @I_R^{(1)}$ |      |    | $V_{CL} @I_{PP}$<br>10/1000 $\mu\text{s}$ |                  | $R_D^{(2)}$<br>10/1000 $\mu\text{s}$ | $V_{CL} @I_{PP}$<br>8/20 $\mu\text{s}$ |                  | $R_D^{(2)}$<br>8/20 $\mu\text{s}$ | $\alpha T^{(3)}$         |
|-------------|-----------------------------|-----------------------|-----|---------------------|------|----|-------------------------------------------|------------------|--------------------------------------|----------------------------------------|------------------|-----------------------------------|--------------------------|
|             | 25 $^{\circ}\text{C}$       | 85 $^{\circ}\text{C}$ |     | min                 | typ  |    | max                                       |                  |                                      | max                                    |                  |                                   | max                      |
|             | $\mu\text{A}$               |                       | V   | V                   |      | mA | V                                         | A <sup>(4)</sup> | $\Omega$                             | V                                      | A <sup>(4)</sup> | $\Omega$                          | 10-4/ $^{\circ}\text{C}$ |
| SMAJ5.0A/CA | 20                          | 50                    | 5   | 6.4                 | 6.74 | 10 | 9.2                                       | 43.5             | 0.049                                | 13.4                                   | 174              | 0.036                             | 5.7                      |
| SMAJ6.0A/CA | 20                          | 50                    | 6   | 6.7                 | 7.05 | 10 | 10.3                                      | 38.8             | 0.075                                | 13.7                                   | 170              | 0.037                             | 5.9                      |
| SMAJ6.5A/CA | 20                          | 50                    | 6.5 | 7.2                 | 7.58 | 10 | 11.2                                      | 35.7             | 0.091                                | 14.5                                   | 160              | 0.041                             | 6.1                      |
| SMAJ8.5A/CA | 20                          | 50                    | 8.5 | 9.4                 | 9.9  | 1  | 14.4                                      | 27.7             | 0.145                                | 19.5                                   | 124              | 0.073                             | 7.3                      |
| SMAJ10A/CA  | 0.2                         | 1                     | 10  | 11.1                | 11.7 | 1  | 17                                        | 23.5             | 0.201                                | 21.7                                   | 106              | 0.089                             | 7.8                      |
| SMAJ12A/CA  | 0.2                         | 1                     | 12  | 13.3                | 14   | 1  | 19.9                                      | 20.1             | 0.259                                | 25.3                                   | 91               | 0.116                             | 8.3                      |
| SMAJ13A/CA  | 0.2                         | 1                     | 13  | 14.4                | 15.2 | 1  | 21.5                                      | 18.6             | 0.298                                | 27.2                                   | 85               | 0.132                             | 8.4                      |
| SMAJ15A/CA  | 0.2                         | 1                     | 15  | 16.7                | 17.6 | 1  | 24.4                                      | 16.4             | 0.361                                | 32.5                                   | 71               | 0.197                             | 8.8                      |
| SMAJ18A/CA  | 0.2                         | 1                     | 18  | 20                  | 21.1 | 1  | 29.2                                      | 13.7             | 0.514                                | 39.3                                   | 59               | 0.291                             | 9.2                      |
| SMAJ20A/CA  | 0.2                         | 1                     | 20  | 22.2                | 23.4 | 1  | 32.4                                      | 12.3             | 0.637                                | 42.8                                   | 54               | 0.338                             | 9.4                      |
| SMAJ22A/CA  | 0.2                         | 1                     | 22  | 24.4                | 25.7 | 1  | 35.5                                      | 11.2             | 0.760                                | 48.3                                   | 48               | 0.444                             | 9.6                      |
| SMAJ24A/CA  | 0.2                         | 1                     | 24  | 26.7                | 28.1 | 1  | 38.9                                      | 10.3             | 0.912                                | 50                                     | 46               | 0.446                             | 9.6                      |
| SMAJ26A/CA  | 0.2                         | 1                     | 26  | 28.9                | 30.4 | 1  | 42.1                                      | 9.5              | 1.07                                 | 53.5                                   | 43               | 0.502                             | 9.7                      |
| SMAJ28A/CA  | 0.2                         | 1                     | 28  | 31.1                | 32.7 | 1  | 45.4                                      | 8.8              | 1.26                                 | 59                                     | 39               | 0.632                             | 9.8                      |
| SMAJ30A/CA  | 0.2                         | 1                     | 30  | 33.3                | 35.1 | 1  | 48.4                                      | 8.3              | 1.39                                 | 64.3                                   | 36               | 0.762                             | 9.9                      |
| SMAJ33A/CA  | 0.2                         | 1                     | 33  | 36.7                | 38.6 | 1  | 53.3                                      | 7.5              | 1.70                                 | 69.7                                   | 33               | 0.884                             | 10                       |
| SMAJ40A/CA  | 0.2                         | 1                     | 40  | 44.4                | 46.7 | 1  | 64.5                                      | 6.2              | 2.49                                 | 84                                     | 27               | 1.30                              | 10.1                     |
| SMAJ43A/CA  | 0.2                         | 1                     | 43  | 47.8                | 50.3 | 1  | 69.4                                      | 5.7              | 2.91                                 | 91                                     | 25               | 1.53                              | 10.2                     |
| SMAJ48A/CA  | 0.2                         | 1                     | 48  | 53.3                | 56.1 | 1  | 77.4                                      | 5.2              | 3.56                                 | 100                                    | 23               | 1.79                              | 10.3                     |
| SMAJ58A/CA  | 0.2                         | 1                     | 58  | 64.4                | 67.8 | 1  | 93.6                                      | 4.3              | 5.21                                 | 121                                    | 19               | 2.62                              | 10.4                     |
| SMAJ70A/CA  | 0.2                         | 1                     | 70  | 77.8                | 81.9 | 1  | 113                                       | 3.5              | 7.72                                 | 146                                    | 16               | 3.75                              | 10.5                     |
| SMAJ85A/CA  | 0.2                         | 1                     | 85  | 94                  | 99   | 1  | 137                                       | 2.9              | 11.4                                 | 178                                    | 13               | 5.70                              | 10.6                     |
| SMAJ100A/CA | 0.2                         | 1                     | 100 | 111                 | 117  | 1  | 162                                       | 2.5              | 15.7                                 | 212                                    | 11               | 8.10                              | 10.7                     |
| SMAJ130A/CA | 0.2                         | 1                     | 130 | 144                 | 152  | 1  | 209                                       | 1.9              | 26.0                                 | 265                                    | 9                | 11.7                              | 10.8                     |
| SMAJ154A/CA | 0.2                         | 1                     | 154 | 171                 | 180  | 1  | 246                                       | 1.6              | 35.6                                 | 317                                    | 7                | 18.3                              | 10.8                     |
| SMAJ170A/CA | 0.2                         | 1                     | 170 | 189                 | 199  | 1  | 275                                       | 1.4              | 47.2                                 | 353                                    | 6.5              | 22.2                              | 10.8                     |
| SMAJ188A/CA | 0.2                         | 1                     | 188 | 209                 | 220  | 1  | 328                                       | 1.4              | 69.3                                 | 388                                    | 6                | 26.2                              | 10.8                     |

1. Pulse test :  $t_p < 50\text{ ms}$
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:  
 $V_{BR} @ T_J = V_{BR} @ 25^{\circ}\text{C} \times (1 + \alpha T \times (T_J - 25))$ ,  
 $V_{CL} @ T_J = V_{CL} @ 25^{\circ}\text{C} \times (1 + \alpha T \times (T_J - 25))$
4. Surge capability given for both directions for unidirectional and bidirectional types.

Figure 3. Peak pulse power dissipation versus initial junction temperature

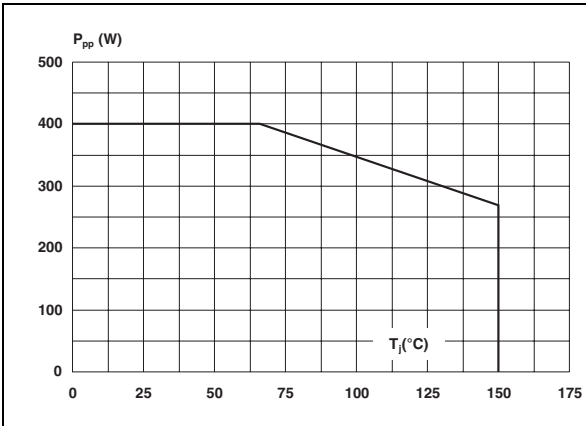


Figure 4. Peak pulse power versus exponential pulse duration ( $T_j$  initial = 25° C)

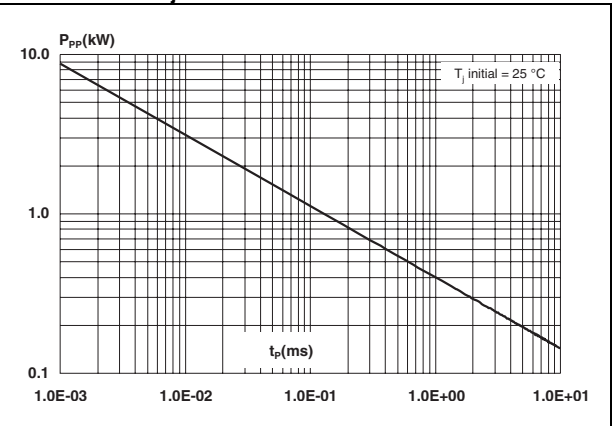
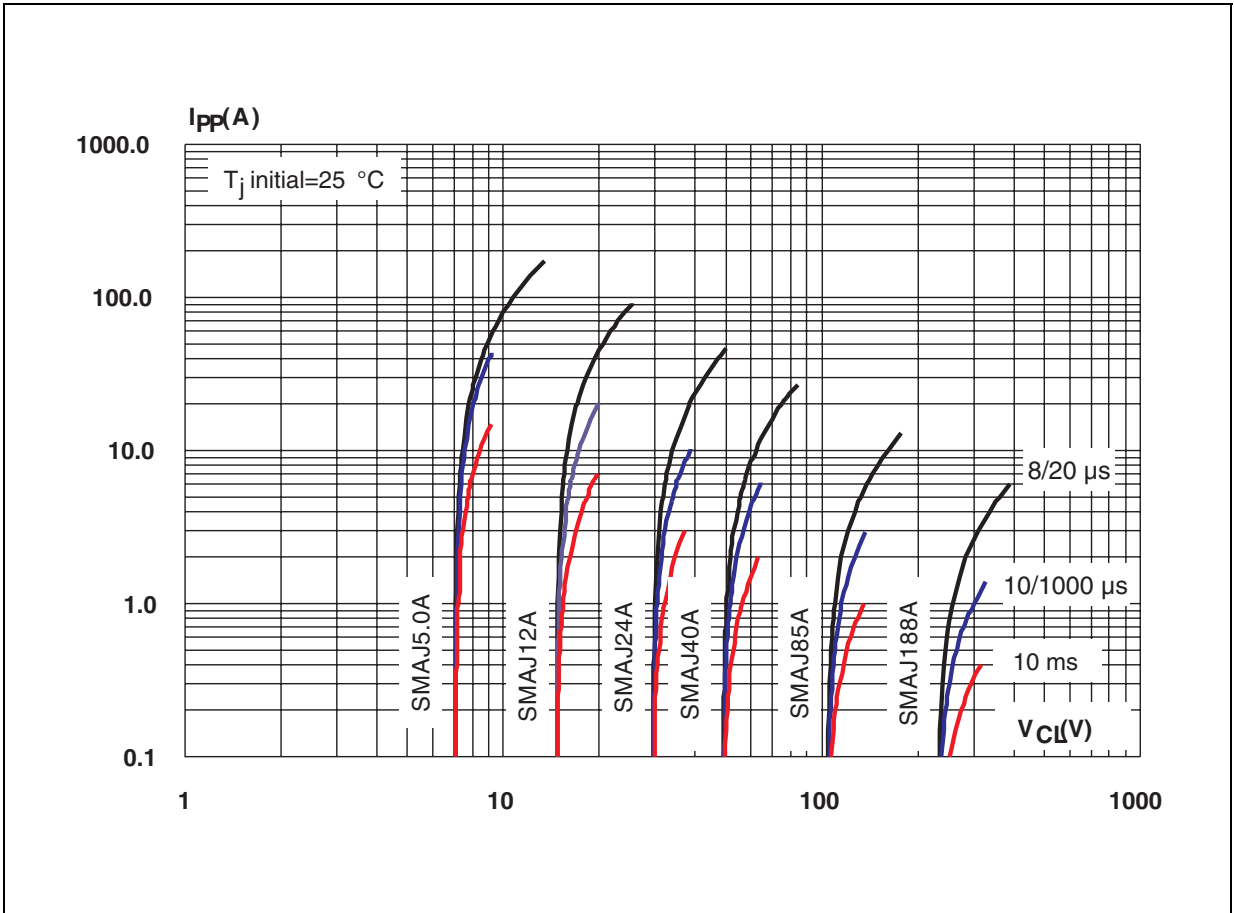
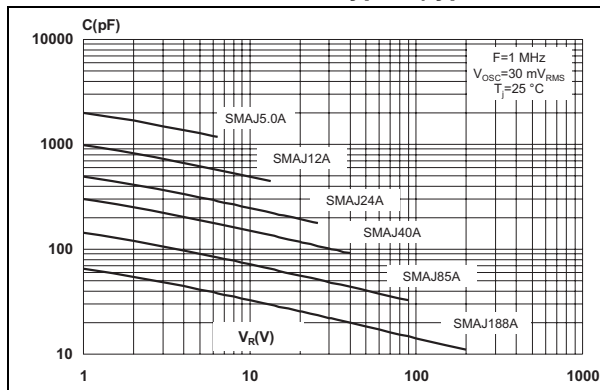


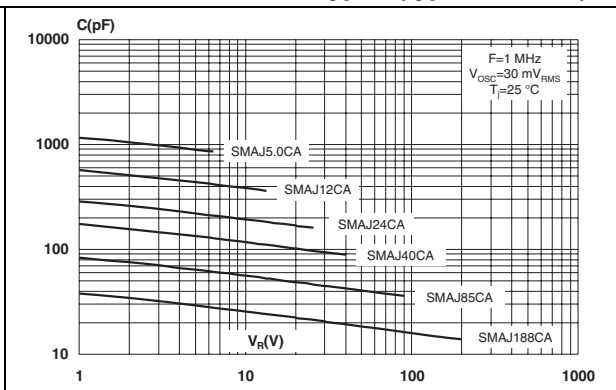
Figure 5. Clamping voltage versus peak pulse current (exponential waveform, maximum values)



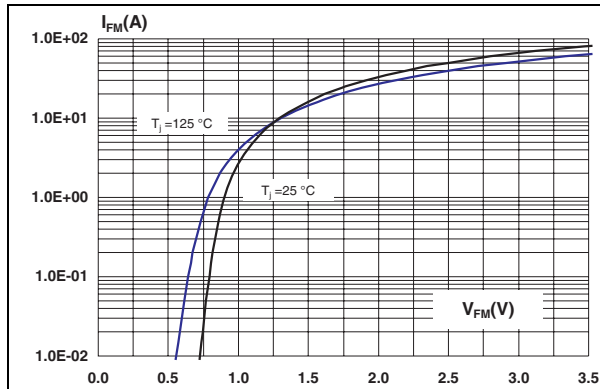
**Figure 6. Junction capacitance versus reverse applied voltage for unidirectional types (typical values)**



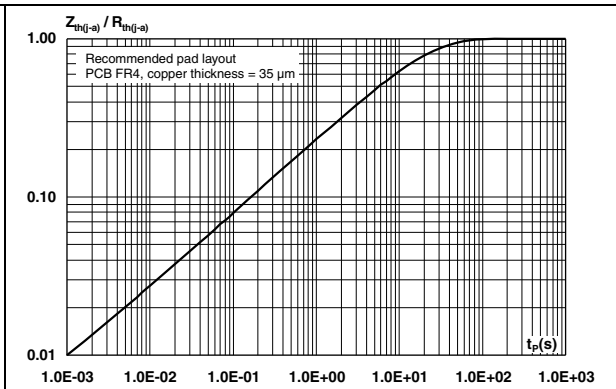
**Figure 7. Junction capacitance versus reverse applied voltage for bidirectional types (typical values)**



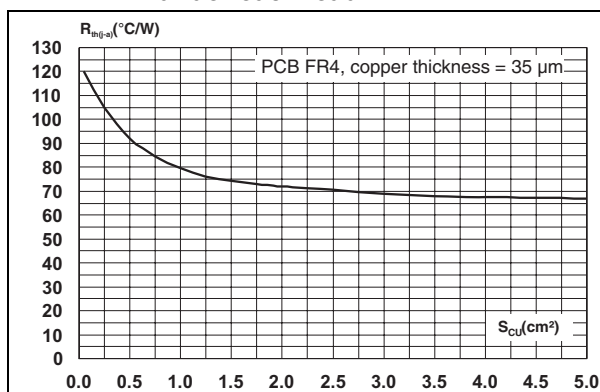
**Figure 8. Peak forward voltage drop versus peak forward current (typical values)**



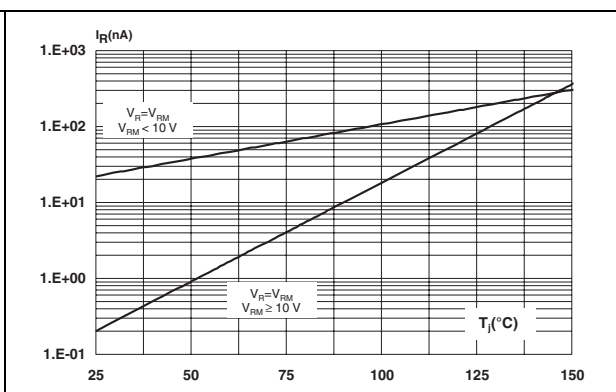
**Figure 9. Relative variation of thermal impedance, junction to ambient, versus pulse duration**



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

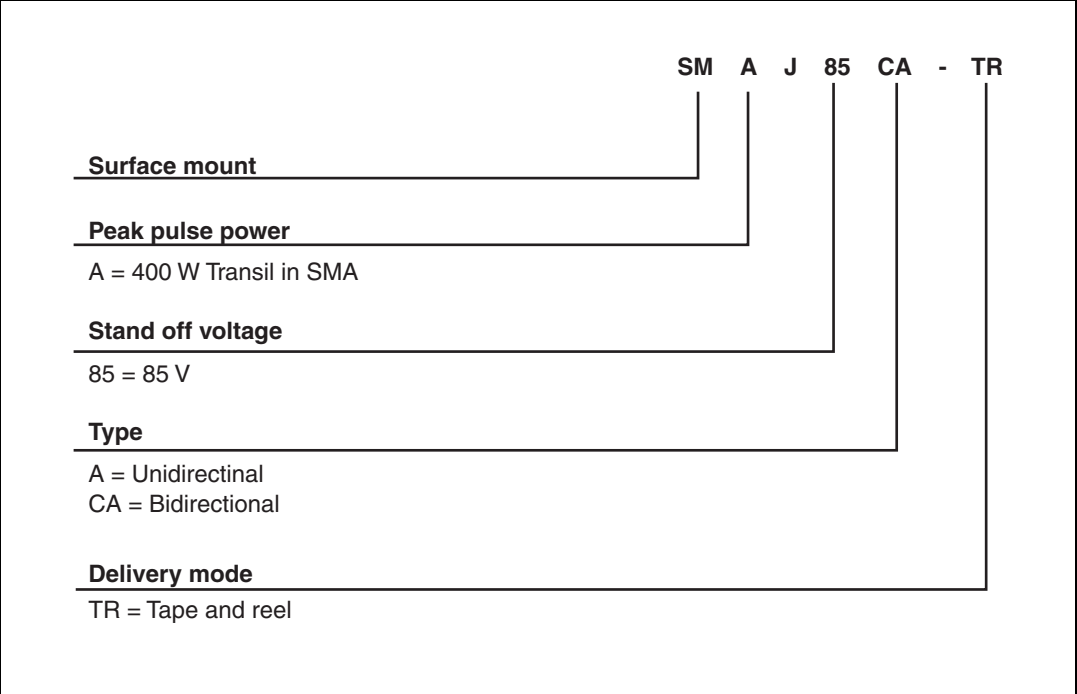


**Figure 11. Leakage current versus junction temperature (typical values)**



## 2 Ordering information scheme

Figure 12. Ordering information scheme



### 3 Package information

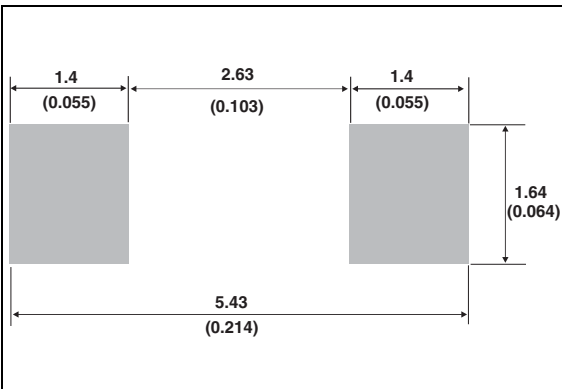
- Case: JEDEC DO-214AC molded plastic over planar junction
- Terminals: solder plated, solderable per MIL-STD-750, Method 2026
- Polarity: for unidirectional types the band indicates cathode.
- Flammability: epoxy is rated UL94V-0
- RoHS package

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](http://www.st.com). ECOPACK® is an ST trademark.

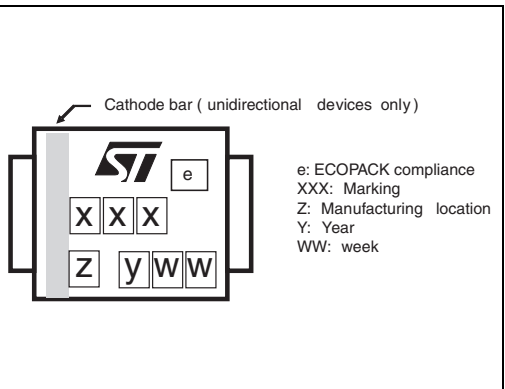
**Table 4. SMA dimensions**

| Ref. | Dimensions  |      |        |       |
|------|-------------|------|--------|-------|
|      | Millimeters |      | Inches |       |
|      | Min.        | Max. | Min.   | Max.  |
| A1   | 1.90        | 2.45 | 0.075  | 0.094 |
| A2   | 0.05        | 0.20 | 0.002  | 0.008 |
| b    | 1.25        | 1.65 | 0.049  | 0.065 |
| c    | 0.15        | 0.40 | 0.006  | 0.016 |
| D    | 2.25        | 2.90 | 0.089  | 0.114 |
| E    | 4.80        | 5.35 | 0.189  | 0.211 |
| E1   | 3.95        | 4.60 | 0.156  | 0.181 |
| L    | 0.75        | 1.50 | 0.030  | 0.059 |

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



**Figure 14. Marking layout<sup>(1)</sup>**



1. Marking layout can vary according to assembly location.

Table 5. Marking

| Order code  | Marking | Order code   | Marking |
|-------------|---------|--------------|---------|
| SMAJ5.0A-TR | AE      | SMAJ5.0CA-TR | AA      |
| SMAJ6.0A-TR | DUB     | SMAJ6.0CA-TR | DBB     |
| SMAJ6.5A-TR | DUC     | SMAJ6.5CA-TR | DBC     |
| SMAJ8.5A-TR | DUH     | SMAJ8.5CA-TR | DBH     |
| SMAJ10A-TR  | AX      | SMAJ10CA-TR  | AC      |
| SMAJ12A-TR  | DUK     | SMAJ12CA-TR  | DBK     |
| SMAJ13A-TR  | BG      | SMAJ13CA-TR  | BH      |
| SMAJ15A-TR  | BM      | SMAJ15CA-TR  | AJ      |
| SMAJ18A-TR  | DUQ     | SMAJ18CA-TR  | DBQ     |
| SMAJ20A-TR  | DUR     | SMAJ20CA-TR  | DBR     |
| SMAJ22A-TR  | DUS     | SMAJ22CA-TR  | DBS     |
| SMAJ24A-TR  | DUT     | SMAJ24CA-TR  | DBT     |
| SMAJ26A-TR  | DUU     | SMAJ26CA-TR  | DBU     |
| SMAJ28A-TR  | CG      | SMAJ28CA-TR  | CH      |
| SMAJ30A-TR  | CK      | SMAJ30CA-TR  | CL      |
| SMAJ33A-TR  | CM      | SMAJ33CA-TR  | CN      |
| SMAJ40A-TR  | DUZ     | SMAJ40CA-TR  | DBZ     |
| SMAJ43A-TR  | EUA     | SMAJ43CA-TR  | EBA     |
| SMAJ48A-TR  | CX      | SMAJ48CA-TR  | CY      |
| SMAJ58A-TR  | EUF     | SMAJ58CA-TR  | EBF     |
| SMAJ70A-TR  | EUI     | SMAJ70CA-TR  | EBI     |
| SMAJ85A-TR  | EUL     | SMAJ85CA-TR  | EBL     |
| SMAJ100A-TR | EUN     | SMAJ100CA-TR | EBN     |
| SMAJ130A-TR | EUQ     | SMAJ130CA-TR | EBQ     |
| SMAJ154A-TR | EUT     | SMAJ154CA-TR | EBT     |
| SMAJ170A-TR | SR      | SMAJ170CA-TR | SS      |
| SMAJ188A-TR | EUV     | SMAJ188CA-TR | EBV     |

## 4 Ordering information

**Table 6. Ordering information**

| Order code                    | Marking                               | Package | Weight  | Base qty | Delivery mode |
|-------------------------------|---------------------------------------|---------|---------|----------|---------------|
| SMAJxxxA/CA-TR <sup>(1)</sup> | See <a href="#">Table 5 on page 8</a> | SMA     | 0.071 g | 5000     | 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                                                                                         |
|----------------|----------|-------------------------------------------------------------------------------------------------|
| September-1998 | 5B       | Previous update.                                                                                |
| 02-Aug-2004    | 6        | SMA package dimensions update. Reference A1 max. changed from 2.70mm (0.106) to 2.03mm (0.080). |
| 10-Dec-2004    | 7        | Template layout update. No content change.                                                      |
| 10-Feb-2006    | 8        | Added unidirectional marking on cover page and Figure 14. Changed Figure 13. Foot print.        |
| 14-May-2009    | 9        | Updated ECOPACK statement. Reformatted to current standards.                                    |
| 17-Sep-2009    | 10       | Document updated for low leakage current.                                                       |
| 05-Nov-2009    | 11       | Corrected typographical error in <a href="#">Package information</a> .                          |
| 09-Jul-2010    | 12       | Changed timescale in <a href="#">Figure 9</a> .                                                 |

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