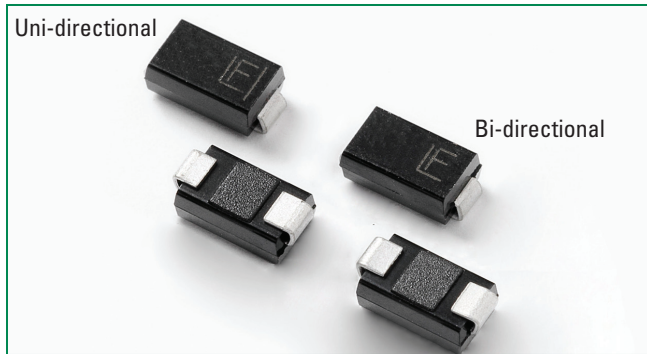


## SMAJ Series



### Agency Approvals

| AGENCY | AGENCY FILE NUMBER |
|--------|--------------------|
|        | E230531            |

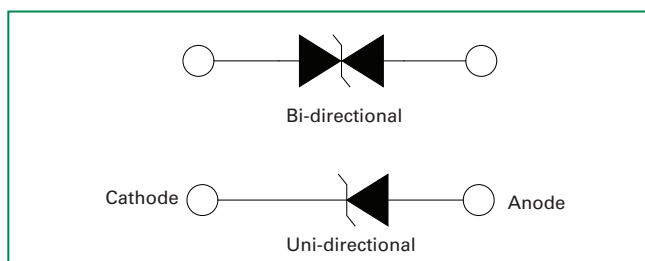
### Maximum Ratings and Thermal Characteristics (T<sub>A</sub>=25°C unless otherwise noted)

| Parameter                                                                                            | Symbol                            | Value      | Unit |
|------------------------------------------------------------------------------------------------------|-----------------------------------|------------|------|
| Peak Pulse Power Dissipation at T <sub>A</sub> =25°C by 10/1000µs Waveform (Fig.2)(Note 1), (Note 2) | P <sub>PPM</sub>                  | 400        | W    |
| Power Dissipation on Infinite Heat Sink at T <sub>A</sub> =50°C                                      | P <sub>MAV</sub>                  | 3.3        | W    |
| Peak Forward Surge Current, 8.3ms Single Half Sine Wave (Note 3)                                     | I <sub>FSM</sub>                  | 40         | A    |
| Maximum Instantaneous Forward Voltage at 25A for Unidirectional Only (Note 4)                        | V <sub>F</sub>                    | 3.5V/6.5   | V    |
| Operating Junction and Storage Temperature Range                                                     | T <sub>J</sub> , T <sub>STG</sub> | -55 to 150 | °C   |
| Typical Thermal Resistance Junction to Lead                                                          | R <sub>θJL</sub>                  | 30         | °C/W |
| Typical Thermal Resistance Junction to Ambient                                                       | R <sub>θJA</sub>                  | 120        | °C/W |

#### Notes:

1. Non-repetitive current pulse, per Fig.4 and derated above T<sub>A</sub>=25°C per Fig. 3.
2. Mounted on 5.0x5.0mm copper pad to each terminal.
3. Measured on 8.3ms single half sine wave or equivalent square wave for unidirectional device only.
4. V<sub>F</sub> < 3.5V for V<sub>BR</sub> ≤ 200V and V<sub>F</sub> < 6.5V for V<sub>BR</sub> ≥ 201V.

### Functional Diagram



### Description

The SMAJ series is designed specifically to protect sensitive electronic equipment from voltage transients induced by lightning and other transient voltage events.

### Features

- Excellent clamping capability
- Typical I<sub>R</sub> less than 1µA above 12V
- For surface mounted applications to optimize board space
- Low profile package
- Typical failure mode is short from over-specified voltage or current
- Whisker test is conducted based on JEDEC JESD201A per its table 4a and 4c
- IEC-61000-4-2 ESD 15kV(Air), 8kV (Contact)
- ESD protection of data lines in accordance with IEC 61000-4-2 (IEC801-2)
- EFT protection of data lines in accordance with IEC 61000-4-4 (IEC801-4)
- Built-in strain relief
- 400W Peak pulsepower capability at 10/1000µs waveform, repetition rate (duty cycle): 0.01 %
- Fast response time: typically less than 1.0ps from 0 Volts to V<sub>BR</sub> min
- Glass passivated junction
- Low inductance
- High temperature soldering: 260°C/40 seconds at terminals
- V<sub>BR</sub> @T<sub>J</sub> = V<sub>BR</sub> @25°C x (1 + α T x (T<sub>J</sub> - 25)) (α T: Temperature Coefficient)
- Plastic package has underwriters laboratory flammability 94V-0
- Meet MSL level1, per J-STD-020, LF maximum peak of 260°C
- Matte tin lead-free Plated
- Halogen free and RoHS compliant
- 2nd level interconnect is Pb-free per IPC/JEDEC J-STD-609A.01

### Applications

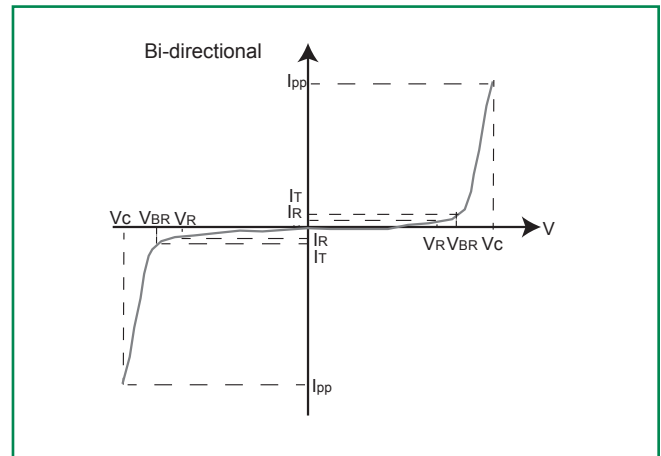
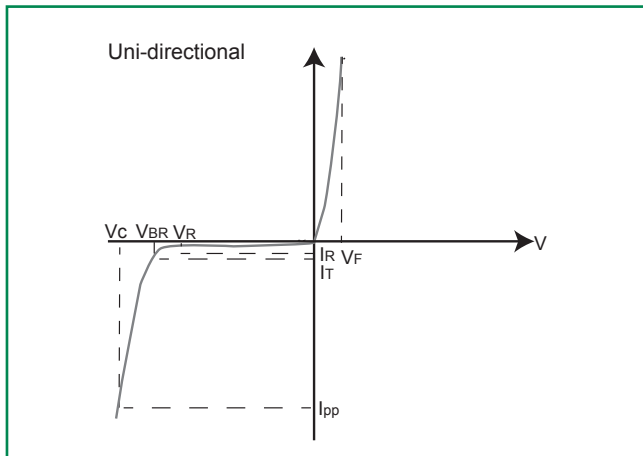
TVS devices are ideal for the protection of I/O Interfaces, V<sub>CC</sub> bus and other vulnerable circuits used in Telecom, Computer, Industrial and Consumer electronic applications.

### Electrical Characteristics (T<sub>A</sub>=25°C unless otherwise noted)

| Part Number (Uni) | Part Number (Bi) | Marking |    | Reverse Stand off Voltage V <sub>R</sub> (Volts) | Breakdown Voltage V <sub>BR</sub> (Volts) @ I <sub>T</sub> |        | Test Current I <sub>T</sub> (mA) | Maximum Clamping Voltage V <sub>C</sub> @ I <sub>CP</sub> (V) | Maximum Peak Pulse Current I <sub>PP</sub> (A) | Maximum Reverse Leakage I <sub>R</sub> @ V <sub>R</sub> (μA) | Agency Approval  |
|-------------------|------------------|---------|----|--------------------------------------------------|------------------------------------------------------------|--------|----------------------------------|---------------------------------------------------------------|------------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
|                   |                  | UNI     | BI |                                                  | MIN                                                        | MAX    |                                  |                                                               |                                                |                                                              |                                                                                                     |
| SMAJ5.0A          | SMAJ5.0CA        | AE      | WE | 5.0                                              | 6.40                                                       | 7.00   | 10                               | 9.2                                                           | 43.5                                           | 800                                                          | X                                                                                                   |
| SMAJ6.0A          | SMAJ6.0CA        | AG      | WG | 6.0                                              | 6.67                                                       | 7.37   | 10                               | 10.3                                                          | 38.8                                           | 800                                                          | X                                                                                                   |
| SMAJ6.5A          | SMAJ6.5CA        | AK      | WK | 6.5                                              | 7.22                                                       | 7.98   | 10                               | 11.2                                                          | 35.7                                           | 500                                                          | X                                                                                                   |
| SMAJ7.0A          | SMAJ7.0CA        | AM      | WM | 7.0                                              | 7.78                                                       | 8.60   | 10                               | 12.0                                                          | 33.3                                           | 200                                                          | X                                                                                                   |
| SMAJ7.5A          | SMAJ7.5CA        | AP      | WP | 7.5                                              | 8.33                                                       | 9.21   | 1                                | 12.9                                                          | 31.0                                           | 100                                                          | X                                                                                                   |
| SMAJ8.0A          | SMAJ8.0CA        | AR      | WR | 8.0                                              | 8.89                                                       | 9.83   | 1                                | 13.6                                                          | 29.4                                           | 50                                                           | X                                                                                                   |
| SMAJ8.5A          | SMAJ8.5CA        | AT      | WT | 8.5                                              | 9.44                                                       | 10.40  | 1                                | 14.4                                                          | 27.8                                           | 20                                                           | X                                                                                                   |
| SMAJ9.0A          | SMAJ9.0CA        | AV      | VW | 9.0                                              | 10.00                                                      | 11.10  | 1                                | 15.4                                                          | 26.0                                           | 10                                                           | X                                                                                                   |
| SMAJ10A           | SMAJ10CA         | AX      | WX | 10.0                                             | 11.10                                                      | 12.30  | 1                                | 17.0                                                          | 23.5                                           | 5                                                            | X                                                                                                   |
| SMAJ11A           | SMAJ11CA         | AZ      | WZ | 11.0                                             | 12.20                                                      | 13.50  | 1                                | 18.2                                                          | 22.0                                           | 1                                                            | X                                                                                                   |
| SMAJ12A           | SMAJ12CA         | BE      | XE | 12.0                                             | 13.30                                                      | 14.70  | 1                                | 19.9                                                          | 20.1                                           | 1                                                            | X                                                                                                   |
| SMAJ13A           | SMAJ13CA         | BG      | XG | 13.0                                             | 14.40                                                      | 15.90  | 1                                | 21.5                                                          | 18.6                                           | 1                                                            | X                                                                                                   |
| SMAJ14A           | SMAJ14CA         | BK      | XK | 14.0                                             | 15.60                                                      | 17.20  | 1                                | 23.2                                                          | 17.2                                           | 1                                                            | X                                                                                                   |
| SMAJ15A           | SMAJ15CA         | BM      | XM | 15.0                                             | 16.70                                                      | 18.50  | 1                                | 24.4                                                          | 16.4                                           | 1                                                            | X                                                                                                   |
| SMAJ16A           | SMAJ16CA         | BP      | XP | 16.0                                             | 17.80                                                      | 19.70  | 1                                | 26.0                                                          | 15.4                                           | 1                                                            | X                                                                                                   |
| SMAJ17A           | SMAJ17CA         | BR      | XR | 17.0                                             | 18.90                                                      | 20.90  | 1                                | 27.6                                                          | 14.5                                           | 1                                                            | X                                                                                                   |
| SMAJ18A           | SMAJ18CA         | BT      | XT | 18.0                                             | 20.00                                                      | 22.10  | 1                                | 29.2                                                          | 13.7                                           | 1                                                            | X                                                                                                   |
| SMAJ20A           | SMAJ20CA         | BV      | XV | 20.0                                             | 22.20                                                      | 24.50  | 1                                | 32.4                                                          | 12.3                                           | 1                                                            | X                                                                                                   |
| SMAJ22A           | SMAJ22CA         | BX      | XX | 22.0                                             | 24.40                                                      | 26.90  | 1                                | 35.5                                                          | 11.3                                           | 1                                                            | X                                                                                                   |
| SMAJ24A           | SMAJ24CA         | BZ      | XZ | 24.0                                             | 26.70                                                      | 29.50  | 1                                | 38.9                                                          | 10.3                                           | 1                                                            | X                                                                                                   |
| SMAJ26A           | SMAJ26CA         | CE      | YE | 26.0                                             | 28.90                                                      | 31.90  | 1                                | 42.1                                                          | 9.5                                            | 1                                                            | X                                                                                                   |
| SMAJ28A           | SMAJ28CA         | CG      | YG | 28.0                                             | 31.10                                                      | 34.40  | 1                                | 45.4                                                          | 8.8                                            | 1                                                            | X                                                                                                   |
| SMAJ30A           | SMAJ30CA         | CK      | YK | 30.0                                             | 33.30                                                      | 36.80  | 1                                | 48.4                                                          | 8.3                                            | 1                                                            | X                                                                                                   |
| SMAJ33A           | SMAJ33CA         | CM      | YM | 33.0                                             | 36.70                                                      | 40.60  | 1                                | 53.3                                                          | 7.5                                            | 1                                                            | X                                                                                                   |
| SMAJ36A           | SMAJ36CA         | CP      | YP | 36.0                                             | 40.00                                                      | 44.20  | 1                                | 58.1                                                          | 6.9                                            | 1                                                            | X                                                                                                   |
| SMAJ40A           | SMAJ40CA         | CR      | YR | 40.0                                             | 44.40                                                      | 49.10  | 1                                | 64.5                                                          | 6.2                                            | 1                                                            | X                                                                                                   |
| SMAJ43A           | SMAJ43CA         | CT      | YT | 43.0                                             | 47.80                                                      | 52.80  | 1                                | 69.4                                                          | 5.8                                            | 1                                                            | X                                                                                                   |
| SMAJ45A           | SMAJ45CA         | CV      | YV | 45.0                                             | 50.00                                                      | 55.30  | 1                                | 72.7                                                          | 5.5                                            | 1                                                            | X                                                                                                   |
| SMAJ48A           | SMAJ48CA         | CX      | YX | 48.0                                             | 53.30                                                      | 58.90  | 1                                | 77.4                                                          | 5.2                                            | 1                                                            | X                                                                                                   |
| SMAJ51A           | SMAJ51CA         | CZ      | YZ | 51.0                                             | 56.70                                                      | 62.70  | 1                                | 82.4                                                          | 4.9                                            | 1                                                            | X                                                                                                   |
| SMAJ54A           | SMAJ54CA         | RE      | ZE | 54.0                                             | 60.00                                                      | 66.30  | 1                                | 87.1                                                          | 4.6                                            | 1                                                            | X                                                                                                   |
| SMAJ58A           | SMAJ58CA         | RG      | ZG | 58.0                                             | 64.40                                                      | 71.20  | 1                                | 93.6                                                          | 4.3                                            | 1                                                            | X                                                                                                   |
| SMAJ60A           | SMAJ60CA         | RK      | ZK | 60.0                                             | 66.70                                                      | 73.70  | 1                                | 96.8                                                          | 4.1                                            | 1                                                            | X                                                                                                   |
| SMAJ64A           | SMAJ64CA         | RM      | ZM | 64.0                                             | 71.10                                                      | 78.60  | 1                                | 103.0                                                         | 3.9                                            | 1                                                            | X                                                                                                   |
| SMAJ70A           | SMAJ70CA         | RP      | ZP | 70.0                                             | 77.80                                                      | 86.00  | 1                                | 113.0                                                         | 3.5                                            | 1                                                            | X                                                                                                   |
| SMAJ75A           | SMAJ75CA         | RR      | ZR | 75.0                                             | 83.30                                                      | 92.10  | 1                                | 121.0                                                         | 3.3                                            | 1                                                            | X                                                                                                   |
| SMAJ78A           | SMAJ78CA         | RT      | ZT | 78.0                                             | 86.70                                                      | 95.80  | 1                                | 126.0                                                         | 3.2                                            | 1                                                            | X                                                                                                   |
| SMAJ85A           | SMAJ85CA         | RV      | ZV | 85.0                                             | 94.40                                                      | 104.00 | 1                                | 137.0                                                         | 2.9                                            | 1                                                            | X                                                                                                   |
| SMAJ90A           | SMAJ90CA         | RX      | ZX | 90.0                                             | 100.00                                                     | 111.00 | 1                                | 146.0                                                         | 2.7                                            | 1                                                            | X                                                                                                   |
| SMAJ100A          | SMAJ100CA        | RZ      | ZZ | 100.0                                            | 111.00                                                     | 123.00 | 1                                | 162.0                                                         | 2.5                                            | 1                                                            | X                                                                                                   |
| SMAJ110A          | SMAJ110CA        | SE      | VE | 110.0                                            | 122.00                                                     | 135.00 | 1                                | 177.0                                                         | 2.3                                            | 1                                                            | X                                                                                                   |
| SMAJ120A          | SMAJ120CA        | SG      | VG | 120.0                                            | 133.00                                                     | 147.00 | 1                                | 193.0                                                         | 2.1                                            | 1                                                            | X                                                                                                   |
| SMAJ130A          | SMAJ130CA        | SK      | VK | 130.0                                            | 144.00                                                     | 159.00 | 1                                | 209.0                                                         | 1.9                                            | 1                                                            | X                                                                                                   |
| SMAJ150A          | SMAJ150CA        | SM      | VM | 150.0                                            | 167.00                                                     | 185.00 | 1                                | 243.0                                                         | 1.6                                            | 1                                                            | X                                                                                                   |
| SMAJ160A          | SMAJ160CA        | SP      | VP | 160.0                                            | 178.00                                                     | 197.00 | 1                                | 259.0                                                         | 1.5                                            | 1                                                            | X                                                                                                   |
| SMAJ170A          | SMAJ170CA        | SR      | VR | 170.0                                            | 189.00                                                     | 209.00 | 1                                | 275.0                                                         | 1.5                                            | 1                                                            | X                                                                                                   |
| SMAJ180A          | SMAJ180CA        | ST      | VT | 180.0                                            | 201.00                                                     | 222.00 | 1                                | 292.0                                                         | 1.4                                            | 1                                                            |                                                                                                     |
| SMAJ200A          | SMAJ200CA        | SV      | VV | 200.0                                            | 224.00                                                     | 247.00 | 1                                | 324.0                                                         | 1.2                                            | 1                                                            |                                                                                                     |
| SMAJ220A          | SMAJ220CA        | SX      | VX | 220.0                                            | 246.00                                                     | 272.00 | 1                                | 356.0                                                         | 1.1                                            | 1                                                            |                                                                                                     |
| SMAJ250A          | SMAJ250CA        | SZ      | VZ | 250.0                                            | 279.00                                                     | 309.00 | 1                                | 405.0                                                         | 1.0                                            | 1                                                            |                                                                                                     |
| SMAJ300A          | SMAJ300CA        | TE      | UE | 300.0                                            | 335.00                                                     | 371.00 | 1                                | 486.0                                                         | 0.8                                            | 1                                                            |                                                                                                     |
| SMAJ350A          | SMAJ350CA        | TG      | UG | 350.0                                            | 391.00                                                     | 432.00 | 1                                | 567.0                                                         | 0.7                                            | 1                                                            |                                                                                                     |
| SMAJ400A          | SMAJ400CA        | TK      | UK | 400.0                                            | 447.00                                                     | 494.00 | 1                                | 648.0                                                         | 0.6                                            | 1                                                            |                                                                                                     |
| SMAJ440A          | SMAJ440CA        | TM      | UM | 440.0                                            | 492.00                                                     | 543.00 | 1                                | 713.0                                                         | 0.6                                            | 1                                                            |                                                                                                     |

For bidirectional type having V<sub>RWM</sub> of 10 volts and less, the I<sub>R</sub> limit is double.  
 For parts without A (V<sub>BR</sub> is + 10% and V<sub>C</sub> is 5% higher than with A parts).

## I-V Curve Characteristics



**$P_{PPM}$  Peak Pulse Power Dissipation** – Max power dissipation

**$V_R$  Stand-off Voltage** – Maximum voltage that can be applied to the TVS without operation

**$V_{BR}$  Breakdown Voltage** – Maximum voltage that flows through the TVS at a specified test current ( $I_T$ )

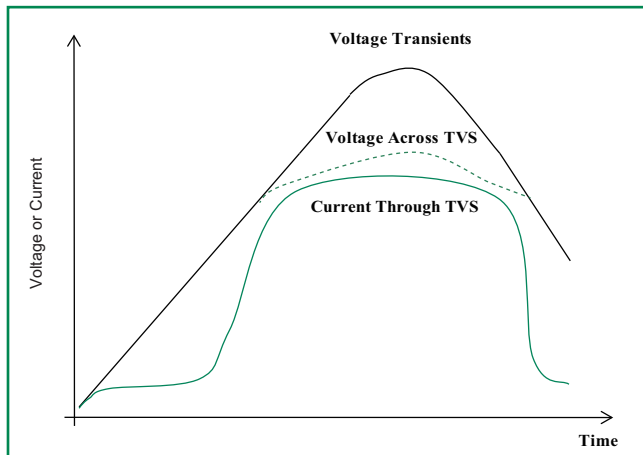
**$V_C$  Clamping Voltage** – Peak voltage measured across the suppressor at a specified  $I_{PPM}$  (peak impulse current)

**$I_R$  Reverse Leakage Current** – Current measured at  $V_R$

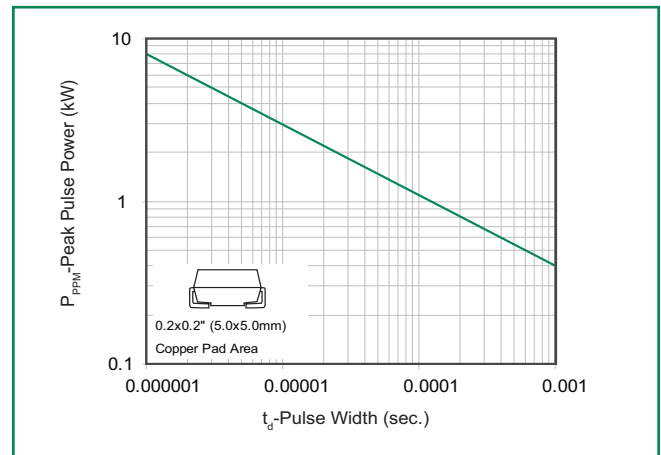
**$V_F$  Forward Voltage Drop for Uni-directional**

## Ratings and Characteristic Curves ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

**Figure 1 - TVS Transients Clamping Waveform**



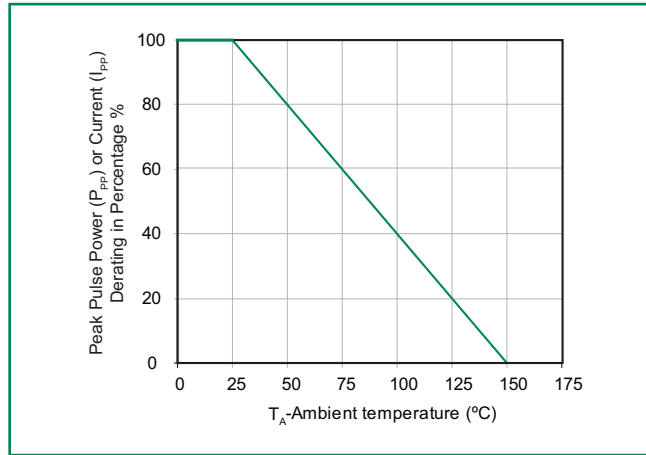
**Figure 2 - Peak Pulse Power Rating Curve**



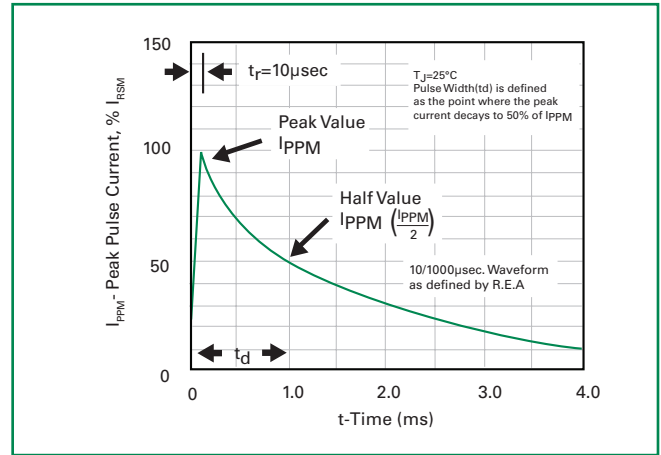
continues on next page.

**Ratings and Characteristic Curves** ( $T_A=25^\circ\text{C}$  unless otherwise noted) (Continued)

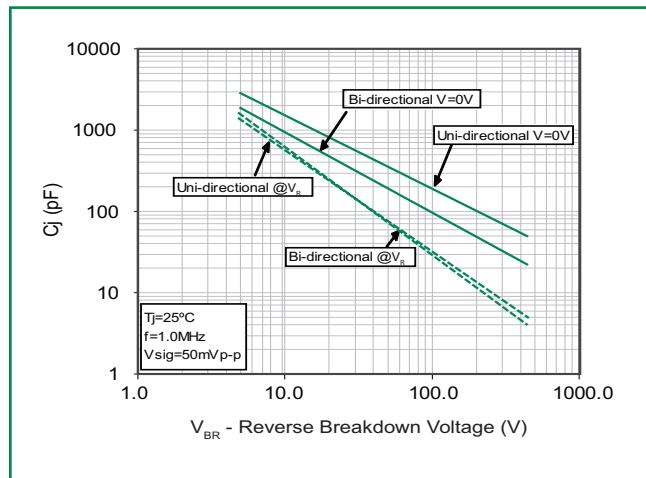
**Figure 3 - Pulse Derating Curve**



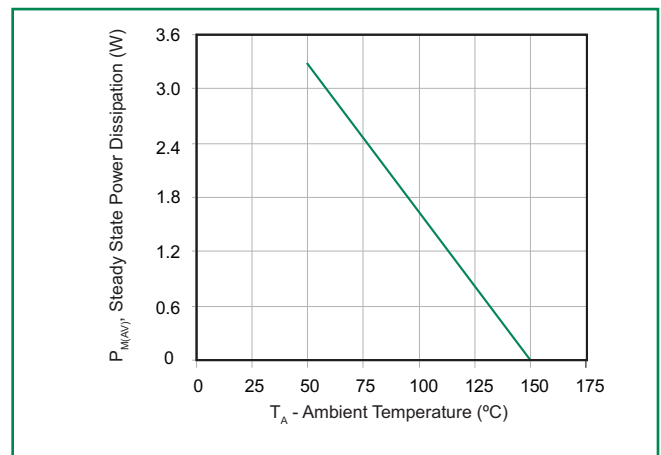
**Figure 4 - Pulse Waveform**



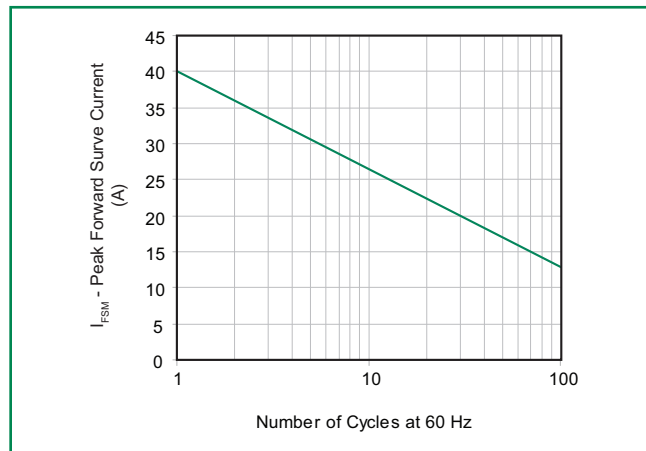
**Figure 5 - Typical Junction Capacitance**



**Figure 6 - Steady State Power Dissipation Derating Curve**



**Figure 7 - Maximum Non-Repetitive Forward Surge Current Uni-Directional Only**



## Soldering Parameters

|                                                       |                                    |                         |
|-------------------------------------------------------|------------------------------------|-------------------------|
| Reflow Condition                                      |                                    | Lead-free assembly      |
| Pre Heat                                              | - Temperature Min ( $T_{s(min)}$ ) | 150°C                   |
|                                                       | - Temperature Max ( $T_{s(max)}$ ) | 200°C                   |
|                                                       | - Time (min to max) ( $t_s$ )      | 60 – 180 secs           |
| Average ramp up rate (Liquidus Temp ( $T_L$ ) to peak |                                    | 3°C/second max          |
| $T_{s(max)}$ to $T_L$ - Ramp-up Rate                  |                                    | 3°C/second max          |
| Reflow                                                | - Temperature ( $T_L$ ) (Liquidus) | 217°C                   |
|                                                       | - Time (min to max) ( $t_s$ )      | 60 – 150 seconds        |
| Peak Temperature ( $T_p$ )                            |                                    | 260 <sup>+0/-5</sup> °C |
| Time within 5°C of actual peak Temperature ( $t_p$ )  |                                    | 20 – 40 seconds         |
| Ramp-down Rate                                        |                                    | 6°C/second max          |
| Time 25°C to peak Temperature ( $T_p$ )               |                                    | 8 minutes Max.          |
| Do not exceed                                         |                                    | 280°C                   |



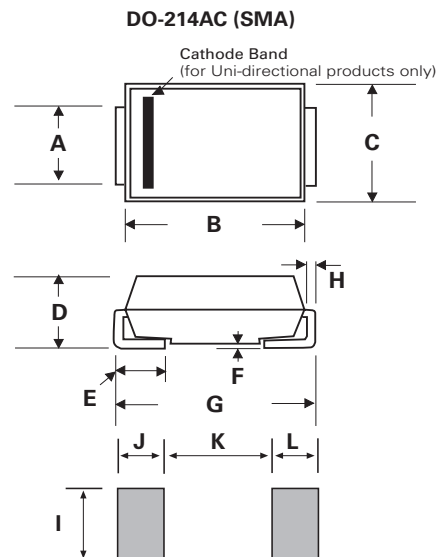
## Physical Specifications

|                 |                                                              |
|-----------------|--------------------------------------------------------------|
| <b>Weight</b>   | 0.002 ounce, 0.061 gram                                      |
| <b>Case</b>     | JEDEC DO-214AC Molded Plastic over glass passivated junction |
| <b>Polarity</b> | Color band denotes cathode except Bipolar                    |
| <b>Terminal</b> | Matte Tin-plated leads, Solderable per JESD22-B102           |

## Environmental Specifications

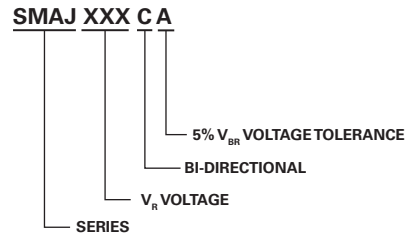
|                            |                          |
|----------------------------|--------------------------|
| <b>High Temp. Storage</b>  | JESD22-A103              |
| <b>HTRB</b>                | JESD22-A108              |
| <b>Temperature Cycling</b> | JESD22-A104              |
| <b>MSL</b>                 | JEDEC-J-STD-020, Level 1 |
| <b>H3TRB</b>               | JESD22-A101              |
| <b>RSH</b>                 | JESD22-B106              |

## Dimensions

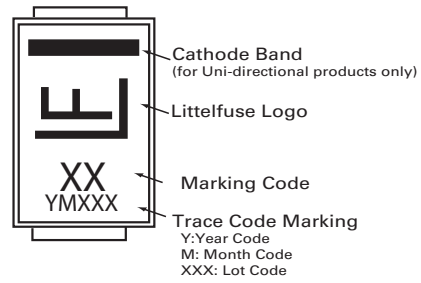


| Dimensions | Inches |       | Millimeters |       |
|------------|--------|-------|-------------|-------|
|            | Min    | Max   | Min         | Max   |
| A          | 0.049  | 0.065 | 1.250       | 1.650 |
| B          | 0.157  | 0.177 | 3.990       | 4.500 |
| C          | 0.100  | 0.110 | 2.540       | 2.790 |
| D          | 0.078  | 0.090 | 1.980       | 2.290 |
| E          | 0.030  | 0.060 | 0.780       | 1.520 |
| F          | -      | 0.008 | -           | 0.203 |
| G          | 0.194  | 0.208 | 4.930       | 5.280 |
| H          | 0.006  | 0.012 | 0.152       | 0.305 |
| I          | 0.070  | -     | 1.800       | -     |
| J          | 0.082  | -     | 2.100       | -     |
| K          | -      | 0.090 | -           | 2.300 |
| L          | 0.082  | -     | 2.100       | -     |

### Part Numbering System



### Part Marking System



### Packaging

| Part number | Component Package | Quantity | Packaging Option                 | Packaging Specification |
|-------------|-------------------|----------|----------------------------------|-------------------------|
| SMAJ-xxxXX  | DO-214AC          | 5000     | Tape & Reel - 12mm tape/13" reel | EIA STD RS-481          |

### Tape and Reel Specification

