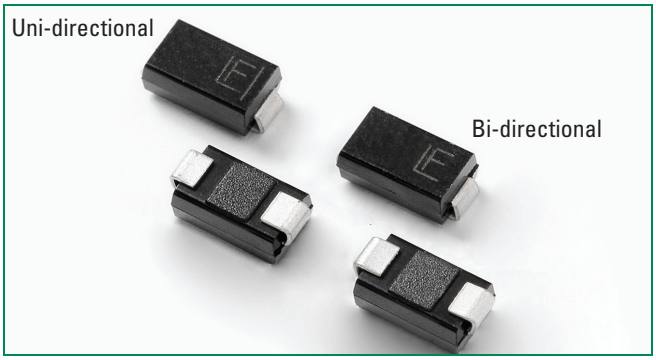
# SMAJ Series




## Agency Approvals

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

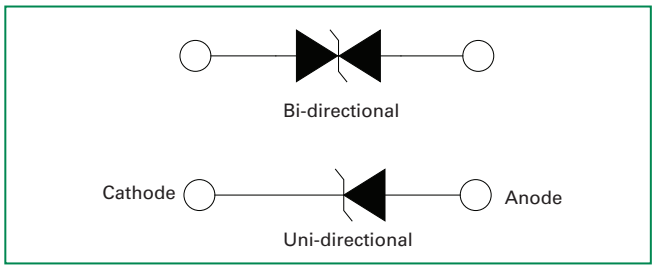
## Maximum Ratings and Thermal Characteristics ($T_A$=25°C unless otherwise noted)

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Peak Pulse Power Dissipation at $T_A$=25°C by 10/1000µs Waveform (Fig.2)(Note 1), (Note 2) | $P_{PPM}$ | 400 | W |
| Power Dissipation on Infinite Heat Sink at $T_A$=50°C | $P_{M(AV)}$ | 3.3 | W |
| Peak Forward Surge Current, 8.3ms Single Half Sine Wave (Note 3) | $I_{FSM}$ | 40 | A |
| Maximum Instantaneous Forward Voltage at 25A for Unidirectional Only (Note 4) | $V_F$ | 3.5V/6.5 | V |
| Operating Junction and Storage Temperature Range | $T_J$, $T_{STG}$ | -55 to 150 | °C |
| Typical Thermal Resistance Junction to Lead | $R_{uJL}$ | 30 | °C/W |
| Typical Thermal Resistance Junction to Ambient | $R_{uJA}$ | 120 | °C/W |

**Notes:**

1. Non-repetitive current pulse, per Fig.4 and derated above $T_A$=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. $V_F$ < 3.5V for $V_{BR} \leq$ 200V and $V_F$< 6.5V for $V_{BR} \geq$ 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 $I_R$ 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 $V_{BR}$ min
- Glass passivated junction
- Low inductance
- High temperature soldering: 260°C/40 seconds at terminals
- $V_{BR}$ @$T_J$= $V_{BR}$@25°C x (1+ $\alpha$T x ($T_J$ - 25))
  ($\alpha$T:Temperature Coefficient)
- Plastic package has underwriters laboratory flammability 94V-O
- Meet MSL level1, per J-STD-020, LF maximun 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, $V_{CC}$ bus and other vulnerable circuits used in Telecom, Computer, Industrial and Consumer electronic applications.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## Electrical Characteristics ($T_A$=25°C unless otherwise noted)

| Part Number (Uni) | Part Number (Bi) | Marking | | Reverse Stand off Voltage $V_R$ (Volts) | Breakdown Voltage $V_{BR}$ (Volts) @ $I_T$ | | Test Current $I_T$ (mA) | Maximum Clamping Voltage $V_C$ @ $I_{pp}$ (V) | Maximum Peak Pulse Current $I_{pp}$ (A) | Maximum Reverse Leakage $I_R$ @ $V_R$ (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 | WV | 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 $V_{RWM}$ of 10 volts and less, the $I_R$ limit is double.
For parts without A ($V_{BR}$ is + 10% and $V_C$ is 5% higher than with A parts).


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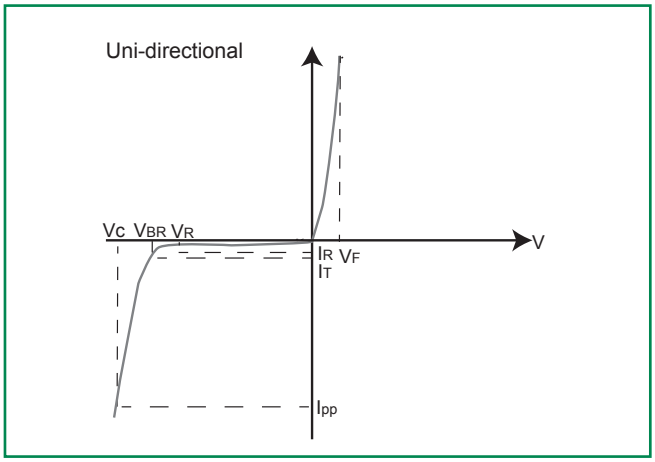
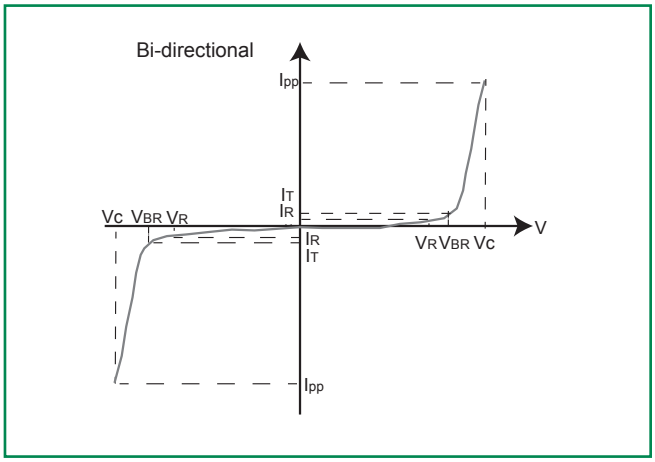
## I-V Curve Characteristics

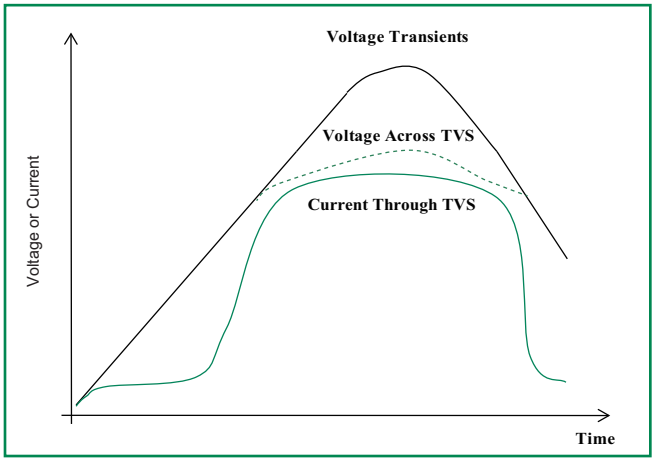


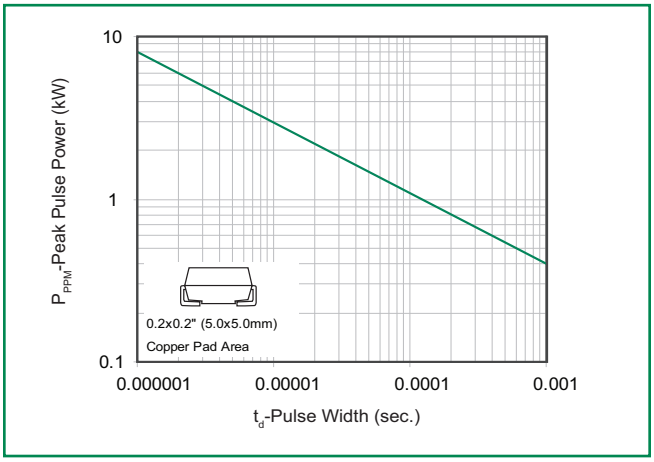

**$P_{PPM}$ Peak Pulse Power Dissipation** – Max power dissipation
**$V_R$ Stand-off Voltage** – Maximum voltage that can be applied to the TVS without operation
**$V_{BR}$ Breakdown Voltage** – Maximum voltage that flows though the TVS at a specified test current ($I_T$)
**$V_C$ Clamping Voltage** – Peak voltage measured across the suppressor at a specified Ippm (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°C unless otherwise noted)

### Figure 1 - TVS Transients Clamping Waveform




### Figure 2 - Peak Pulse Power Rating Curve

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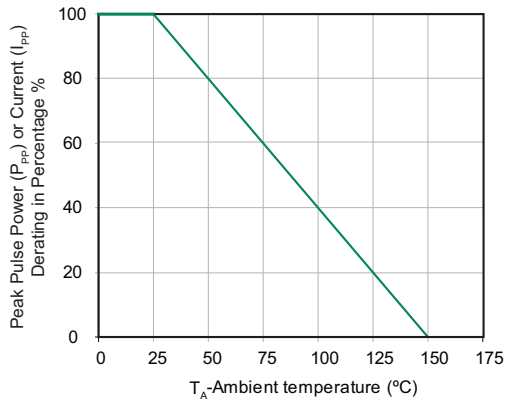
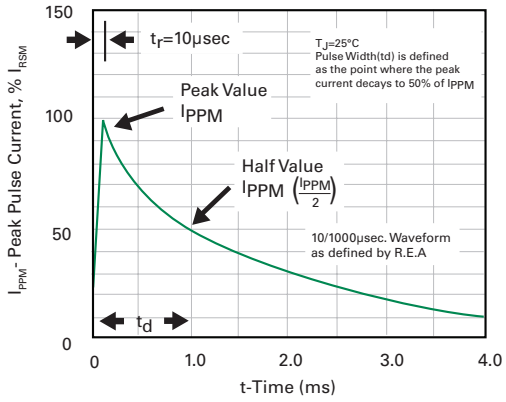
## Ratings and Characteristic Curves ($T_A$=25°C unless otherwise noted) (Continued)

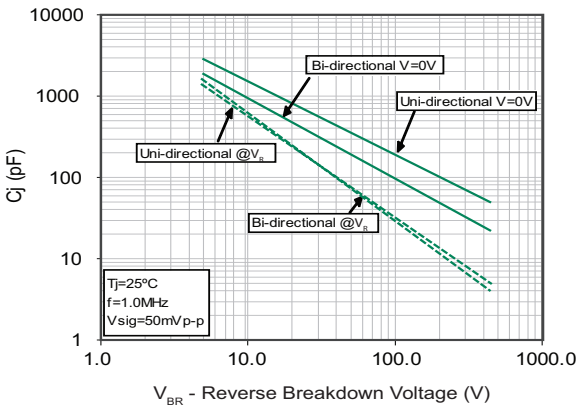
### Figure 3 - Pulse Derating Curve



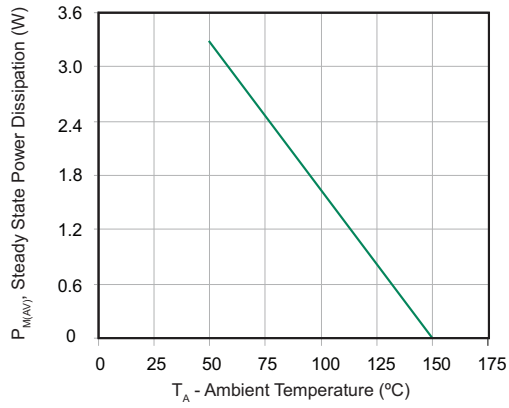

### Figure 4 - Pulse Waveform



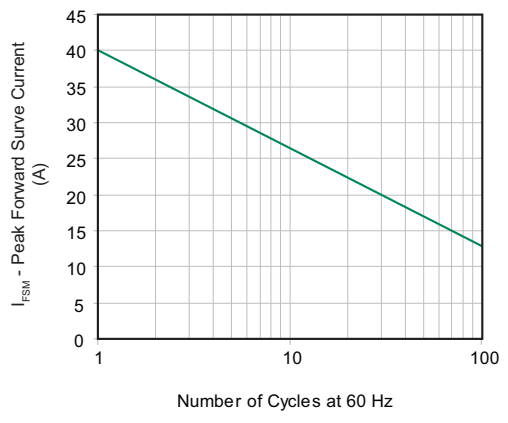

### Figure 5 - Typical Junction Capacitance




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




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





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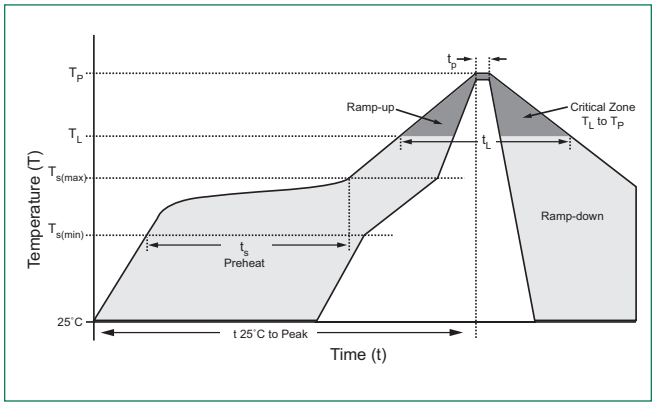
## Soldering Parameters

| 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 ($T_P$) | | $260^{+0/-5}$ °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

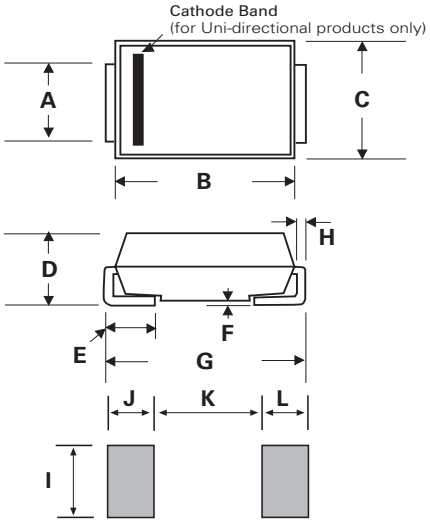
| | |
|---|---|
| **Weight** | 0.002 ounce, 0.061 gram |
| **Case** | JEDEC DO-214AC Molded Plastic over glass passivated junction |
| **Polarity** | Color band denotes cathode except Bipolar |
| **Terminal** | Matte Tin-plated leads, Solderable per JESD22-B102 |

## Environmental Specifications

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

## Dimensions

**DO-214AC (SMA)**




| 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 | - |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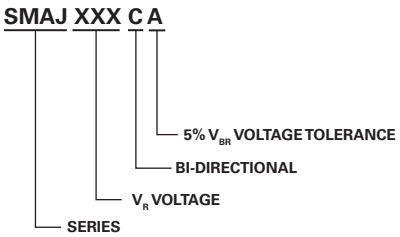
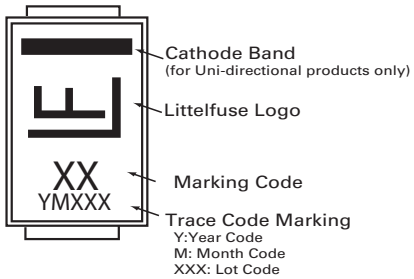
## Part Numbering System



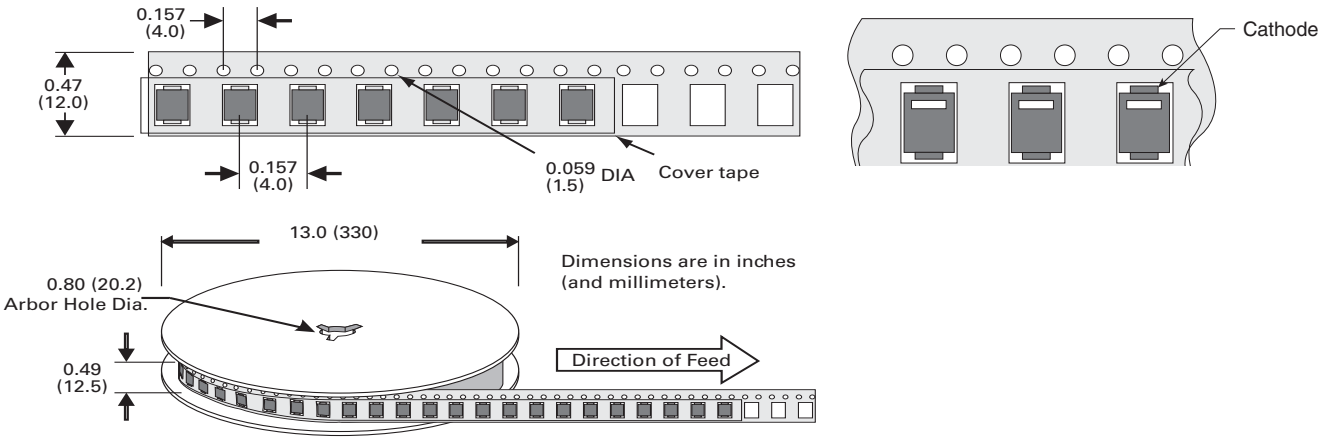

## Part Marking System




## 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





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