

## SMAJ Series



Uni-directional



Bi-directional

### Agency Approvals

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

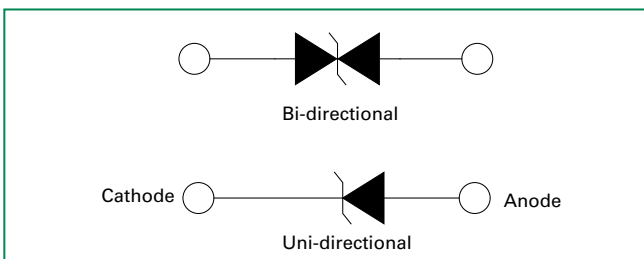
### Maximum Ratings and Thermal Characteristics ( $T_A=25^\circ\text{C}$ unless otherwise noted)

| Parameter                                                                                                          | Symbol          | Value      | Unit               |
|--------------------------------------------------------------------------------------------------------------------|-----------------|------------|--------------------|
| Peak Pulse Power Dissipation at $T_A=25^\circ\text{C}$ by 10x1000 $\mu\text{s}$ Waveform (Fig.2)(Note 1), (Note 2) | $P_{PPM}$       | 400        | W                  |
| Power Dissipation on Infinite Heat Sink at $T_A=50^\circ\text{C}$                                                  | $P_{M(AV)}$     | 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                                                                   | $T_J, T_{STG}$  | -65 to 150 | $^\circ\text{C}$   |
| Typical Thermal Resistance Junction to Lead                                                                        | $R_{\theta JL}$ | 30         | $^\circ\text{C/W}$ |
| Typical Thermal Resistance Junction to Ambient                                                                     | $R_{\theta JA}$ | 120        | $^\circ\text{C/W}$ |

#### Notes:

1. Non-repetitive current pulse, per Fig.4 and derated above  $T_A=25^\circ\text{C}$  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.  $V_F < 3.5\text{V}$  for  $V_{BR} \leq 200\text{V}$  and  $V_F < 6.5\text{V}$  for  $V_{BR} \geq 201\text{V}$ .

### 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  $1\mu\text{A}$  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  $10 \times 1000\mu\text{s}$  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:  $260^\circ\text{C}/40$  seconds at terminals
- Typical maximum temperature coefficient  $\Delta V_{BR} = 0.1\% \times V_{BR}@25^\circ\text{C} \times \Delta T$
- Plastic package has underwriters laboratory flammability 94V-0
- Matte tin lead-free Plated
- Halogen free and RoHS compliant

### Applications

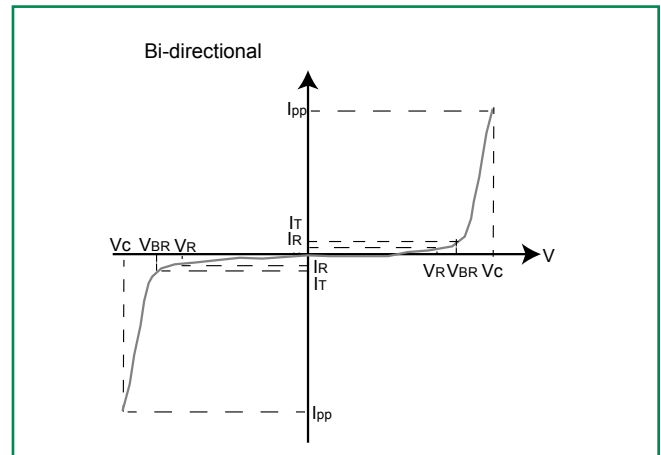
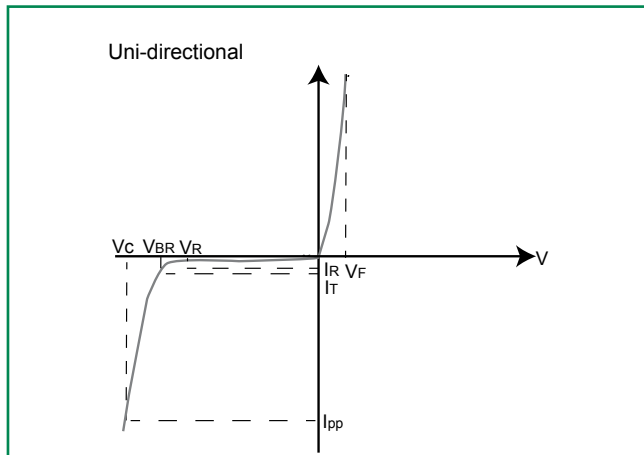
TVS devices are ideal for the protection of I/O Interfaces,  $V_{CC}$  bus and other vulnerable circuits used in Telecom, Computer, Industrial and Consumer electronic applications.

### Electrical Characteristics ( $T_A=25^\circ\text{C}$ 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 $I_R$ @ $V_R$ ( $\mu\text{A}$ ) | 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  $V_{RWM}$  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).

### 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 current 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

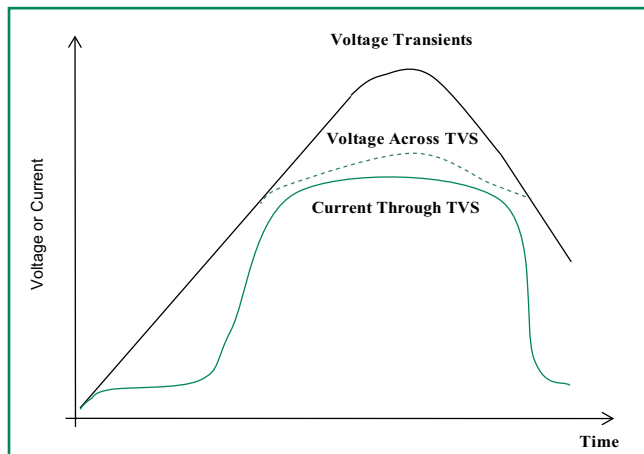
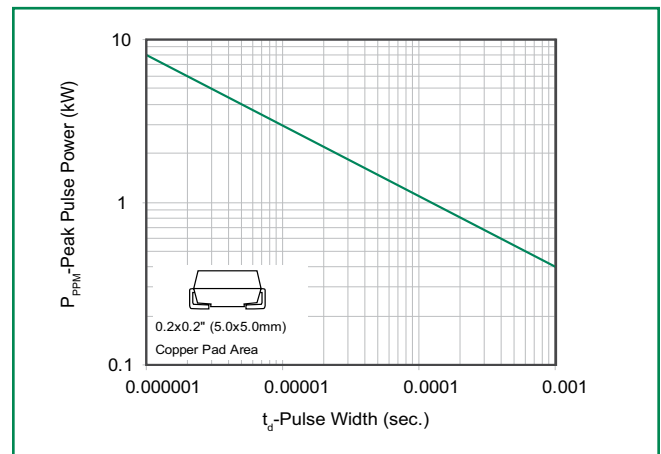


Figure 2 - Peak Pulse Power Rating Curve



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

**Figure 3 - Pulse Derating Curve**

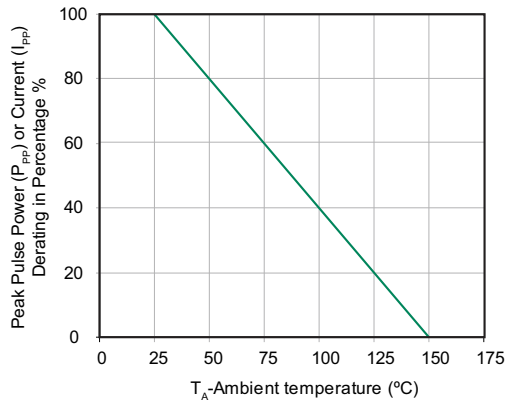


**Figure 4 - Pulse Waveform**

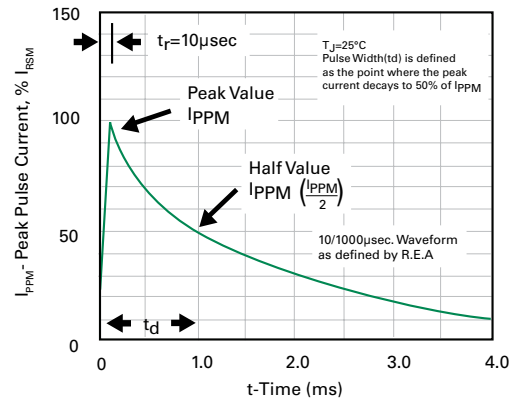


**Figure 5 - Typical Junction Capacitance**

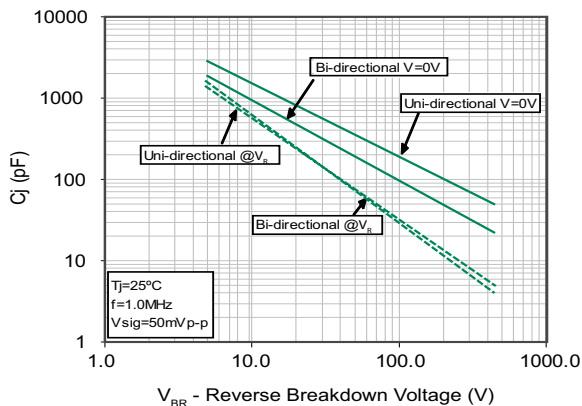


**Figure 6 - Steady State Power Dissipation Derating Curve**

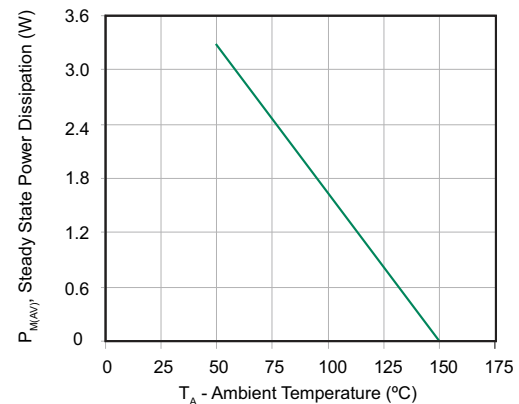
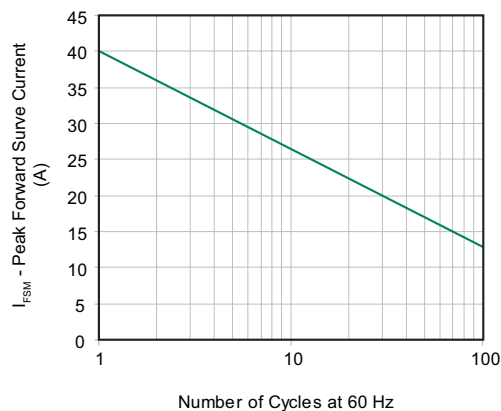
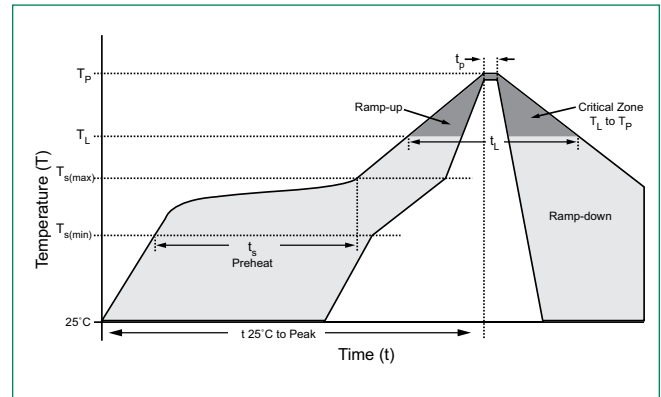


**Figure 7 - Maximum Non-Repetitive Forward Surge Current Uni-Directional Only**



### 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 $^{+0/-5}$ °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              |



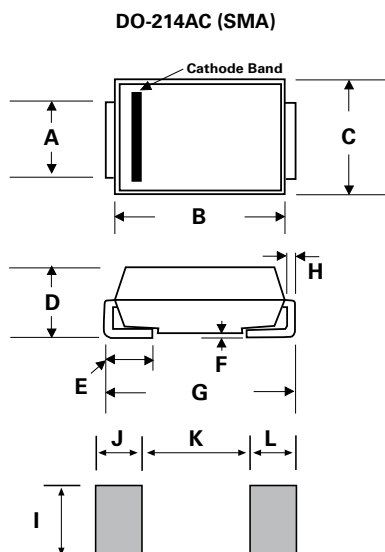
### Physical Specifications

|                 |                                                              |
|-----------------|--------------------------------------------------------------|
| <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-B102D          |

### Environmental Specifications

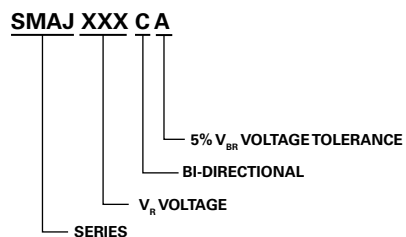
|                           |             |
|---------------------------|-------------|
| <b>Temperature Cycle</b>  | JESD22-A104 |
| <b>Pressure Cooker</b>    | JESD22-A102 |
| <b>High Temp. Storage</b> | JESD22-A103 |
| <b>HTRB</b>               | JESD22-A108 |
| <b>Thermal Shock</b>      | JESD22-A106 |

### Dimensions

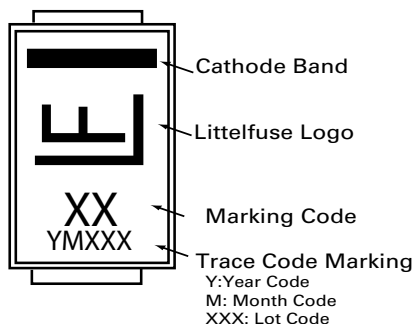


| Dimensions | Inches |       | Millimeters |       |
|------------|--------|-------|-------------|-------|
|            | Min    | Max   | Min         | Max   |
| A          | 0.049  | 0.065 | 1.250       | 1.650 |
| B          | 0.157  | 0.177 | 3.990       | 4.500 |
| C          | 0.100  | 0.110 | 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



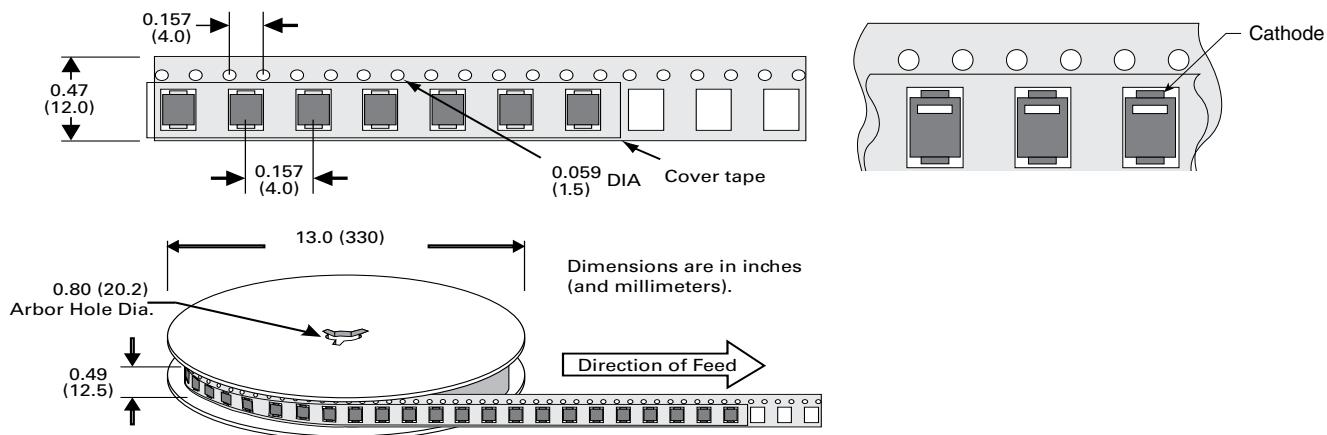
### Part Marking System



### Packaging

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

### Tape and Reel Specification





Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

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