

# 1.5SMC Series

## Surface Mount – 1500W



### Additional Information



Resources



Accessories



Samples

### 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(Fig.2) by 10/1000us Test Waveform(Fig.4) (Note 1),(Note 2) -Single Die Parts <sup>1</sup> | $P_{PPM}$       | 1500       | W                  |
| Peak Pulse Power Dissipation(Fig.2) by 10/1000us Test Waveform(Fig.4) (Note 1), (Note 2)-Stacked Die Parts (Note 5)    | $P_{PPM}$       | 2000       | W                  |
| Power Dissipation on Infinite Heat Sink at $T_L = 50^\circ\text{C}$                                                    | $P_D$           | 6.5        | W                  |
| Peak Forward Surge Current, 8.3ms Single Half Sine Wave (Note 3)                                                       | $I_{FSM}$       | 200        | A                  |
| Maximum Instantaneous Forward Voltage at 100A for Unidirectional Only (Note 4)                                         | $V_F$           | 3.5/5.0    | V                  |
| Operating Temperature Range                                                                                            | $T_J$           | -65 to 150 | $^\circ\text{C}$   |
| Storage Temperature Range                                                                                              | $T_{STG}$       | -65 to 175 | $^\circ\text{C}$   |
| Typical Thermal Resistance Junction to Lead                                                                            | $R_{\theta JL}$ | 15         | $^\circ\text{C/W}$ |
| Typical Thermal Resistance Junction to Ambient                                                                         | $R_{\theta JA}$ | 75         | $^\circ\text{C/W}$ |

#### Notes:

1. Non-repetitive current pulse, per Fig. 4 and derated above  $T_J$  (initial)  $= 25^\circ\text{C}$  per Fig. 3.
2. Mounted on copper pad area of  $0.31 \times 0.31"$  ( $8.0 \times 8.0\text{mm}$ ) to each terminal.
3. Measured on 8.3ms single half sine wave or equivalent square wave for unidirectional device only, duty cycle=4 per minute maximum.
4.  $V_F < 3.5\text{V}$  for single die parts and  $V_F < 5.0\text{V}$  for stacked-die parts.
5. For stacked die component details, please refer to part numbers labeled by \* in Electrical Characteristics.

### Description

The 1.5SMC series is designed specifically to protect sensitive electronic equipment from voltage transients induced by lightning and other transient voltage events.

### Features & Benefits

- 1500W peak pulse power capability at 10/1000us waveform, repetition rate (duty cycles):0.01%
- Excellent clamping capability
- Low incremental surge resistance
- Typical  $I_R$  less than  $1\mu\text{A}$  when  $V_{BR} \text{ min} > 12\text{V}$
- For surface mounted applications to optimize board space
- Low profile package
- Built-in strain relief
- 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 30kV(Air), 30kV (Contact)
- ESD protection of data lines in accordance with IEC 61000-4-2
- EFT protection of data lines in accordance with IEC 61000-4-4
- Fast response time: typically less than 1.0ps from 0V to BV min
- Glass passivated chip junction
- High temperature to reflow soldering guaranteed:  $260^\circ\text{C}/30\text{sec}$
- $V_{BR} @ T_J = V_{BR} @ 25^\circ\text{C} \times (1 + \alpha_T \times (T_J - 25))$  ( $\alpha_T$ : Temperature Coefficient, typical value is 0.1%)
- Plastic package is flammability rated V-0 per Underwriters Laboratories
- Meet MSL level1, per J-STD-020, LF maximum peak of  $260^\circ\text{C}$
- Matte tin lead-free plated
- Halogen free and RoHS compliant
- Pb-free E3 means 2nd level interconnect is Pb-free and the terminal finish material is tin(Sn) (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.

### Functional Diagram



Bi-directional



Uni-directional

# 1.5SMC Series

## Surface Mount – 1500W

### 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    |                         |                                               |                                         |                                                         |                                                                                                     |
| 1.5SMC6.8A        | 1.5SMC6.8CA      | 6V8A    | 6V8C | 5.80                                    | 6.45                                       | 7.14   | 10                      | 10.5                                          | 144.8                                   | 1000                                                    | X                                                                                                   |
| 1.5SMC7.5A        | 1.5SMC7.5CA      | 7V5A    | 7V5C | 6.40                                    | 7.13                                       | 7.88   | 10                      | 11.3                                          | 134.5                                   | 500                                                     | X                                                                                                   |
| 1.5SMC8.2A        | 1.5SMC8.2CA      | 8V2A    | 8V2C | 7.02                                    | 7.79                                       | 8.61   | 10                      | 12.1                                          | 125.6                                   | 200                                                     | X                                                                                                   |
| 1.5SMC9.1A        | 1.5SMC9.1CA      | 9V1A    | 9V1C | 7.78                                    | 8.65                                       | 9.50   | 1                       | 13.4                                          | 113.4                                   | 50                                                      | X                                                                                                   |
| 1.5SMC10A         | 1.5SMC10CA       | 10A     | 10C  | 8.55                                    | 9.50                                       | 10.50  | 1                       | 14.5                                          | 104.8                                   | 10                                                      | X                                                                                                   |
| 1.5SMC11A         | 1.5SMC11CA       | 11A     | 11C  | 9.40                                    | 10.50                                      | 11.60  | 1                       | 15.6                                          | 97.4                                    | 5                                                       | X                                                                                                   |
| 1.5SMC12A         | 1.5SMC12CA       | 12A     | 12C  | 10.20                                   | 11.40                                      | 12.60  | 1                       | 16.7                                          | 91.0                                    | 5                                                       | X                                                                                                   |
| 1.5SMC13A         | 1.5SMC13CA       | 13A     | 13C  | 11.10                                   | 12.40                                      | 13.70  | 1                       | 18.2                                          | 83.5                                    | 1                                                       | X                                                                                                   |
| 1.5SMC15A         | 1.5SMC15CA       | 15A     | 15C  | 12.80                                   | 14.30                                      | 15.80  | 1                       | 21.2                                          | 71.7                                    | 1                                                       | X                                                                                                   |
| 1.5SMC16A         | 1.5SMC16CA       | 16A     | 16C  | 13.60                                   | 15.20                                      | 16.80  | 1                       | 22.5                                          | 67.6                                    | 1                                                       | X                                                                                                   |
| 1.5SMC18A         | 1.5SMC18CA       | 18A     | 18C  | 15.30                                   | 17.10                                      | 18.90  | 1                       | 25.2                                          | 60.3                                    | 1                                                       | X                                                                                                   |
| 1.5SMC20A         | 1.5SMC20CA       | 20A     | 20C  | 17.10                                   | 19.00                                      | 21.00  | 1                       | 27.7                                          | 54.9                                    | 1                                                       | X                                                                                                   |
| 1.5SMC22A         | 1.5SMC22CA       | 22A     | 22C  | 18.80                                   | 20.90                                      | 23.10  | 1                       | 30.6                                          | 49.7                                    | 1                                                       | X                                                                                                   |
| 1.5SMC24A         | 1.5SMC24CA       | 24A     | 24C  | 20.50                                   | 22.80                                      | 25.20  | 1                       | 33.2                                          | 45.8                                    | 1                                                       | X                                                                                                   |
| 1.5SMC27A         | 1.5SMC27CA       | 27A     | 27C  | 23.10                                   | 25.70                                      | 28.40  | 1                       | 37.5                                          | 40.5                                    | 1                                                       | X                                                                                                   |
| 1.5SMC30A         | 1.5SMC30CA       | 30A     | 30C  | 25.60                                   | 28.50                                      | 31.50  | 1                       | 41.4                                          | 36.7                                    | 1                                                       | X                                                                                                   |
| 1.5SMC33A         | 1.5SMC33CA       | 33A     | 33C  | 28.20                                   | 31.40                                      | 34.70  | 1                       | 45.7                                          | 33.3                                    | 1                                                       | X                                                                                                   |
| 1.5SMC36A         | 1.5SMC36CA       | 36A     | 36C  | 30.80                                   | 34.20                                      | 37.80  | 1                       | 49.9                                          | 30.5                                    | 1                                                       | X                                                                                                   |
| 1.5SMC39A         | 1.5SMC39CA       | 39A     | 39C  | 33.30                                   | 37.10                                      | 41.00  | 1                       | 53.9                                          | 28.2                                    | 1                                                       | X                                                                                                   |
| 1.5SMC43A         | 1.5SMC43CA       | 43A     | 43C  | 36.80                                   | 40.90                                      | 45.20  | 1                       | 59.3                                          | 25.6                                    | 1                                                       | X                                                                                                   |
| 1.5SMC47A         | 1.5SMC47CA       | 47A     | 47C  | 40.20                                   | 44.70                                      | 49.40  | 1                       | 64.8                                          | 23.5                                    | 1                                                       | X                                                                                                   |
| 1.5SMC51A         | 1.5SMC51CA       | 51A     | 51C  | 43.60                                   | 48.50                                      | 53.60  | 1                       | 70.1                                          | 21.7                                    | 1                                                       | X                                                                                                   |
| 1.5SMC56A         | 1.5SMC56CA       | 56A     | 56C  | 47.80                                   | 53.20                                      | 58.80  | 1                       | 77.0                                          | 19.7                                    | 1                                                       | X                                                                                                   |
| 1.5SMC62A         | 1.5SMC62CA       | 62A     | 62C  | 53.00                                   | 58.90                                      | 65.10  | 1                       | 85.0                                          | 17.9                                    | 1                                                       | X                                                                                                   |
| 1.5SMC68A         | 1.5SMC68CA       | 68A     | 68C  | 58.10                                   | 64.60                                      | 71.40  | 1                       | 92.0                                          | 16.5                                    | 1                                                       | X                                                                                                   |
| 1.5SMC75A         | 1.5SMC75CA       | 75A     | 75C  | 64.10                                   | 71.30                                      | 78.80  | 1                       | 103.0                                         | 14.8                                    | 1                                                       | X                                                                                                   |
| 1.5SMC82A         | 1.5SMC82CA       | 82A     | 82C  | 70.10                                   | 77.90                                      | 86.10  | 1                       | 113.0                                         | 13.5                                    | 1                                                       | X                                                                                                   |
| 1.5SMC91A         | 1.5SMC91CA       | 91A     | 91C  | 77.80                                   | 86.50                                      | 95.50  | 1                       | 125.0                                         | 12.2                                    | 1                                                       | X                                                                                                   |
| 1.5SMC100A        | 1.5SMC100CA      | 100A    | 100C | 85.50                                   | 95.00                                      | 105.00 | 1                       | 137.0                                         | 11.1                                    | 1                                                       | X                                                                                                   |
| 1.5SMC110A        | 1.5SMC110CA      | 110A    | 110C | 94.00                                   | 105.00                                     | 116.00 | 1                       | 152.0                                         | 10.0                                    | 1                                                       | X                                                                                                   |
| 1.5SMC120A        | 1.5SMC120CA      | 120A    | 120C | 102.00                                  | 114.00                                     | 126.00 | 1                       | 165.0                                         | 9.2                                     | 1                                                       | X                                                                                                   |
| 1.5SMC130A        | 1.5SMC130CA      | 130A    | 130C | 111.00                                  | 124.00                                     | 137.00 | 1                       | 179.0                                         | 8.5                                     | 1                                                       | X                                                                                                   |
| 1.5SMC150A        | 1.5SMC150CA      | 150A    | 150C | 128.00                                  | 143.00                                     | 158.00 | 1                       | 207.0                                         | 7.3                                     | 1                                                       | X                                                                                                   |
| 1.5SMC160A        | 1.5SMC160CA      | 160A    | 160C | 136.00                                  | 152.00                                     | 168.00 | 1                       | 219.0                                         | 6.9                                     | 1                                                       | X                                                                                                   |
| 1.5SMC170A        | 1.5SMC170CA      | 170A    | 170C | 145.00                                  | 162.00                                     | 179.00 | 1                       | 234.0                                         | 6.5                                     | 1                                                       | X                                                                                                   |
| 1.5SMC180A        | 1.5SMC180CA      | 180A    | 180C | 154.00                                  | 171.00                                     | 189.00 | 1                       | 246.0                                         | 6.2                                     | 1                                                       | X                                                                                                   |
| 1.5SMC200A        | 1.5SMC200CA      | 200A    | 200C | 171.00                                  | 190.00                                     | 210.00 | 1                       | 274.0                                         | 5.5                                     | 1                                                       | X                                                                                                   |
| 1.5SMC220A        | 1.5SMC220CA      | 220A    | 220C | 185.00                                  | 209.00                                     | 231.00 | 1                       | 328.0                                         | 4.6                                     | 1                                                       | X                                                                                                   |
| 1.5SMC250A        | 1.5SMC250CA      | 250A    | 250C | 214.00                                  | 237.00                                     | 263.00 | 1                       | 344.0                                         | 4.4                                     | 1                                                       | X                                                                                                   |
| 1.5SMC300A        | 1.5SMC300CA      | 300A    | 300C | 256.00                                  | 285.00                                     | 315.00 | 1                       | 414.0                                         | 3.7                                     | 1                                                       | X                                                                                                   |
| 1.5SMC350A*       | 1.5SMC350CA*     | 350A    | 350C | 300.00                                  | 332.00                                     | 368.00 | 1                       | 482.0                                         | 4.2                                     | 1                                                       | X                                                                                                   |
| 1.5SMC400A*       | 1.5SMC400CA*     | 400A    | 400C | 342.00                                  | 380.00                                     | 420.00 | 1                       | 548.0                                         | 3.7                                     | 1                                                       | X                                                                                                   |
| 1.5SMC440A*       | 1.5SMC440CA*     | 440A    | 440C | 376.00                                  | 418.00                                     | 462.00 | 1                       | 602.0                                         | 3.4                                     | 1                                                       | X                                                                                                   |
| 1.5SMC480A*       | 1.5SMC480CA*     | 480A    | 480C | 408.00                                  | 456.00                                     | 504.00 | 1                       | 658.0                                         | 3.1                                     | 1                                                       | X                                                                                                   |
| 1.5SMC510A*       | 1.5SMC510CA*     | 510A    | 510C | 434.00                                  | 485.00                                     | 535.00 | 1                       | 698.0                                         | 2.9                                     | 1                                                       | X                                                                                                   |
| 1.5SMC530A*       | 1.5SMC530CA*     | 530A    | 530C | 451.00                                  | 503.50                                     | 556.50 | 1                       | 725.0                                         | 2.8                                     | 1                                                       | X                                                                                                   |
| 1.5SMC540A*       | 1.5SMC540CA*     | 540A    | 540C | 460.00                                  | 513.00                                     | 567.00 | 1                       | 740.0                                         | 2.8                                     | 1                                                       | X                                                                                                   |
| 1.5SMC550A*       | 1.5SMC550CA*     | 550A    | 550C | 468.00                                  | 522.50                                     | 577.50 | 1                       | 760.0                                         | 2.7                                     | 1                                                       | X                                                                                                   |
| 1.5SMC600A*       | 1.5SMC600CA*     | 600A    | 600C | 512.00                                  | 570.00                                     | 630.00 | 1                       | 828.0                                         | 2.5                                     | 1                                                       | -                                                                                                   |
| 1.5SMC650A*       | -                | 650A    | -    | 553.00                                  | 618.00                                     | 682.00 | 1                       | 897.0                                         | 2.3                                     | 1                                                       | -                                                                                                   |

For bidirectional type having  $V_R$  of 10 volts and less, the  $I_R$  limit is double.

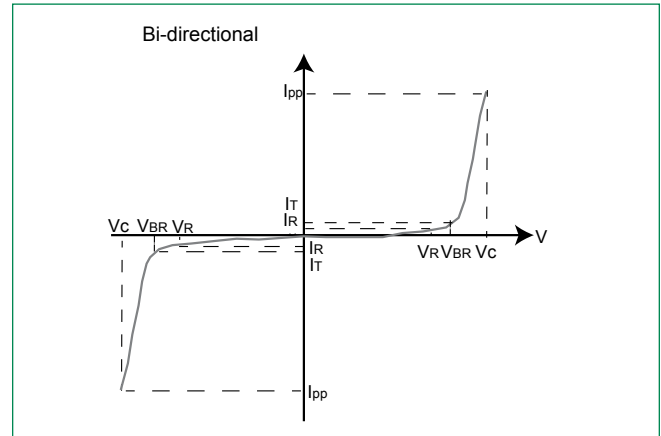
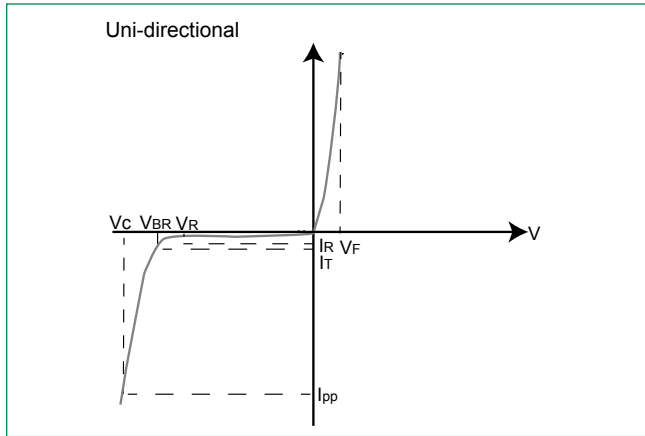
For parts without A, the  $V_{BR}$  is  $\pm 10\%$  and  $V_C$  is 5% higher than with A parts, the parts without A are currently available, but not recommended for new designs. The parts with A are preferred.

For stack-die parts, use \* to label the part number.

# 1.5SMC Series

## Surface Mount – 1500W

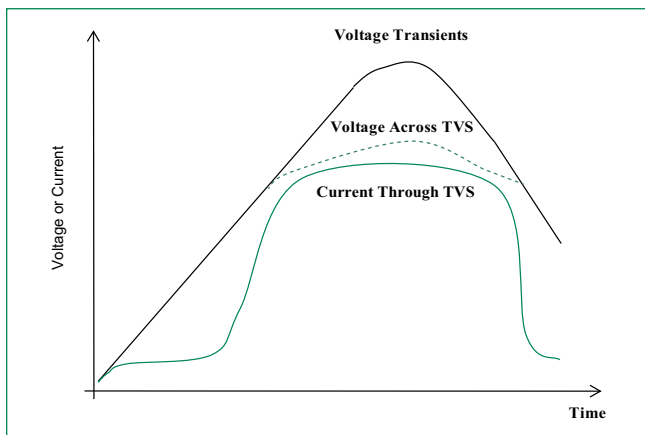
### I-V Curve Characteristics



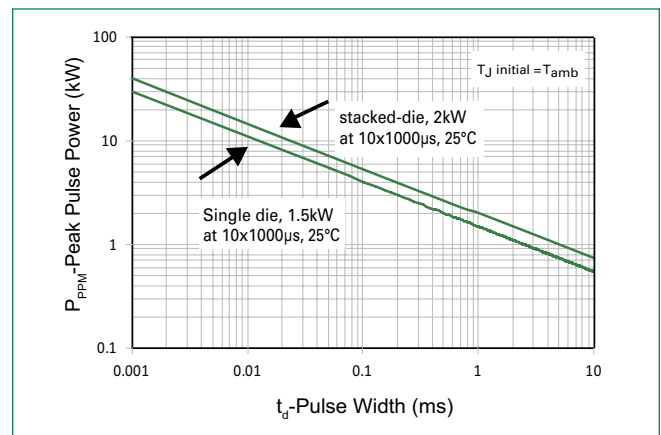
**$P_{PPM}$  Peak Pulse Power Dissipation** -- Max power dissipation  
 **$V_R$  Stand-off Voltage** -- Maximum voltage that can be applied to the TVS without operation  
 **$V_{BR}$  Breakdown Voltage** -- Maximum voltage that flows through the TVS at a specified test current ( $I_T$ )  
 **$V_C$  Clamping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

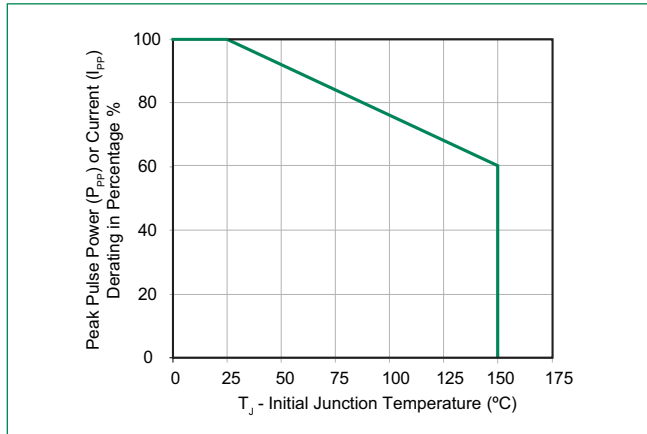


# 1.5SMC Series

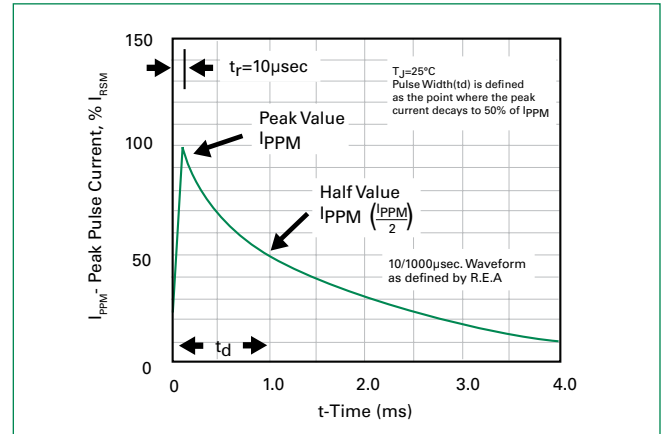
## Surface Mount – 1500W

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

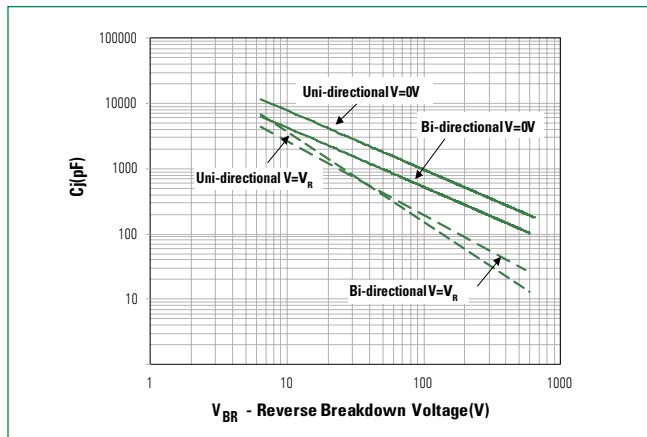
**Figure 3: Peak Pulse Power Derating Curve**



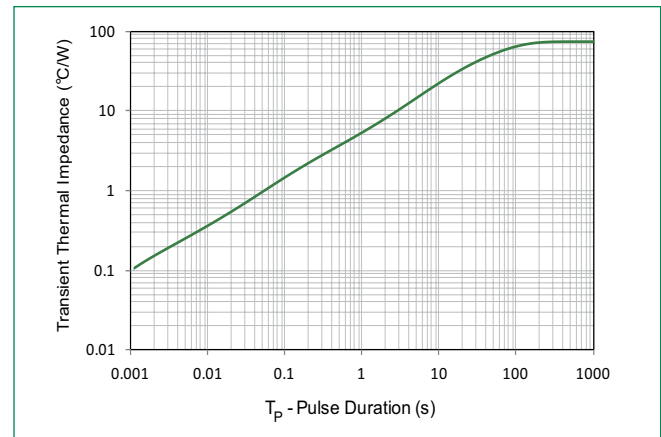
**Figure 4: Pulse Waveform**



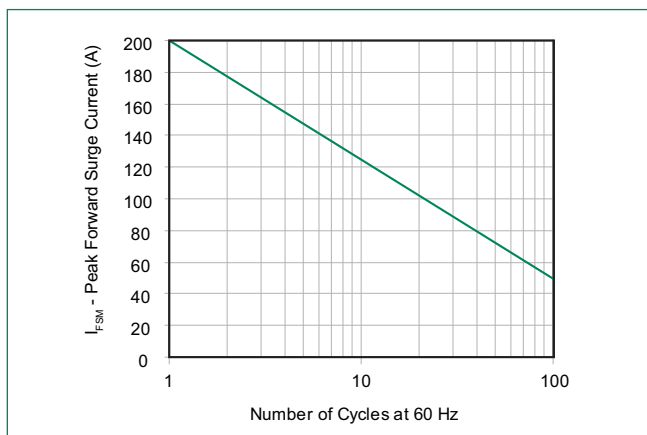
**Figure 5: Typical Junction Capacitance**



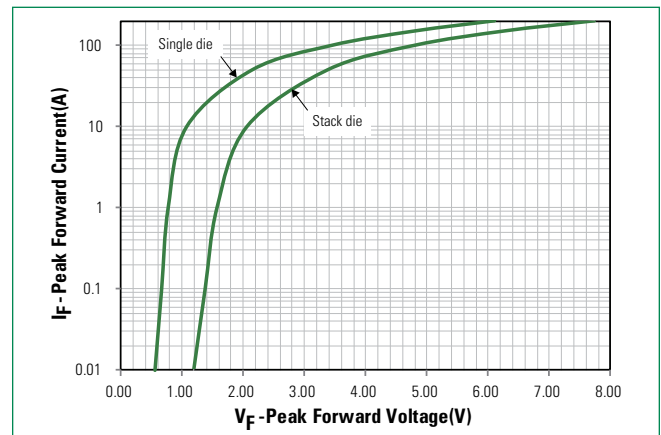
**Figure 6: Typical Transient Thermal Impedance**



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



**Figure 8: Peak Forward Voltage Drop vs Peak Forward Current (Typical Values)**

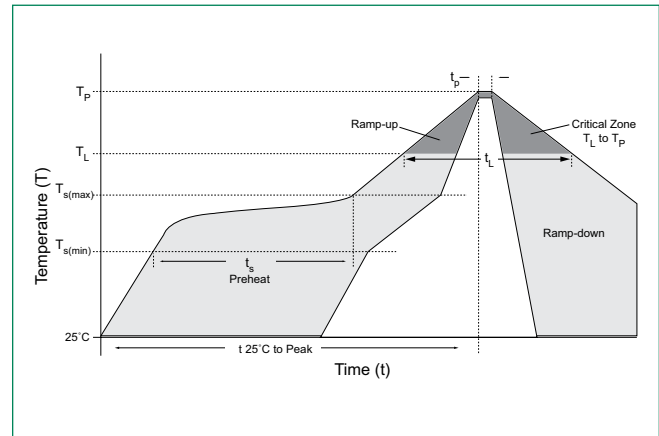


# 1.5SMC Series

## Surface Mount – 1500W

### Soldering Parameters

|                                                                       |                                    |                         |
|-----------------------------------------------------------------------|------------------------------------|-------------------------|
| <b>Reflow Condition</b>                                               |                                    | Lead-free assembly      |
| <b>Pre Heat</b>                                                       | - Temperature Min ( $T_{s(min)}$ ) | 150°C                   |
|                                                                       | - Temperature Max ( $T_{s(max)}$ ) | 200°C                   |
|                                                                       | - Time (min to max) ( $t_s$ )      | 60 – 120 secs           |
| <b>Average ramp up rate (Liquidus Temp (<math>T_L</math>) to peak</b> |                                    | 3°C/second max          |
| <b><math>T_{s(max)}</math> to <math>T_L</math> - Ramp-up Rate</b>     |                                    | 3°C/second max          |
| <b>Reflow</b>                                                         | - Temperature ( $T_L$ ) (Liquidus) | 217°C                   |
|                                                                       | - Time (min to max) ( $t_L$ )      | 60 – 150 seconds        |
| <b>Peak Temperature (<math>T_p</math>)</b>                            |                                    | 260 <sup>+0/-5</sup> °C |
| <b>Time within 5°C of actual peak Temperature (<math>t_p</math>)</b>  |                                    | 30 seconds max          |
| <b>Ramp-down Rate</b>                                                 |                                    | 6°C/second max          |
| <b>Time 25°C to peak Temperature (<math>T_p</math>)</b>               |                                    | 8 minutes Max.          |
| <b>Do not exceed</b>                                                  |                                    | 260°C                   |



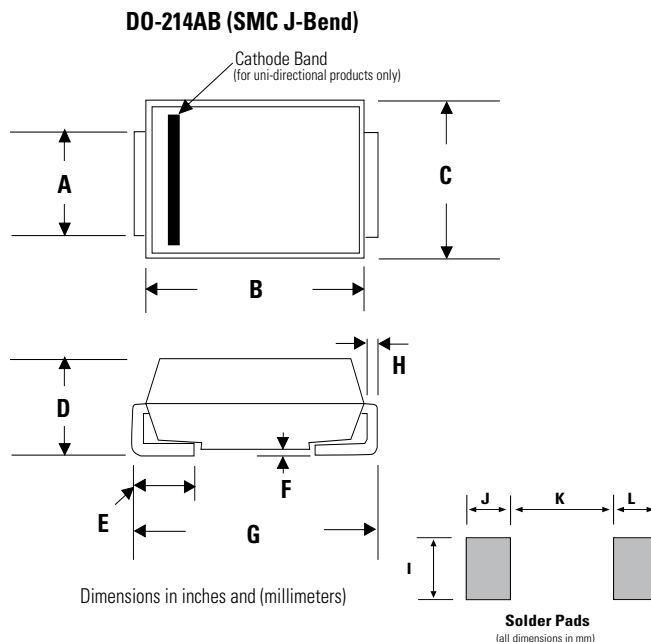
### Physical Specifications

|                 |                                                                   |
|-----------------|-------------------------------------------------------------------|
| <b>Weight</b>   | 0.007 ounce, 0.21 grams                                           |
| <b>Case</b>     | JEDEC DO214AB. Molded plastic body over glass passivated junction |
| <b>Polarity</b> | Color band denotes positive end (cathode) except Bidirectional.   |
| <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-A111              |

### Dimensions

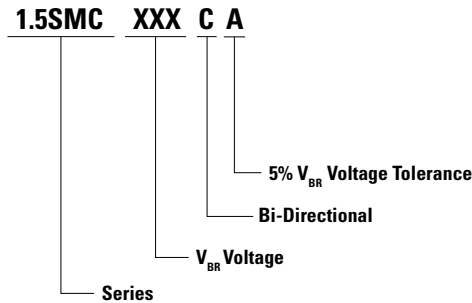


| Dimensions | Inches |       | Millimeters |       |
|------------|--------|-------|-------------|-------|
|            | Min    | Max   | Min         | Max   |
| <b>A</b>   | 0.114  | 0.126 | 2.900       | 3.200 |
| <b>B</b>   | 0.260  | 0.280 | 6.600       | 7.110 |
| <b>C</b>   | 0.220  | 0.245 | 5.590       | 6.220 |
| <b>D</b>   | 0.079  | 0.103 | 2.060       | 2.620 |
| <b>E</b>   | 0.030  | 0.060 | 0.760       | 1.520 |
| <b>F</b>   | -      | 0.008 | -           | 0.203 |
| <b>G</b>   | 0.305  | 0.320 | 7.750       | 8.130 |
| <b>H</b>   | 0.006  | 0.012 | 0.152       | 0.305 |
| <b>I</b>   | 0.129  | -     | 3.300       | -     |
| <b>J</b>   | 0.094  | -     | 2.400       | -     |
| <b>K</b>   | -      | 0.165 | -           | 4.200 |
| <b>L</b>   | 0.094  | -     | 2.400       | -     |

# 1.5SMC Series

Surface Mount – 1500W

Part Numbering System



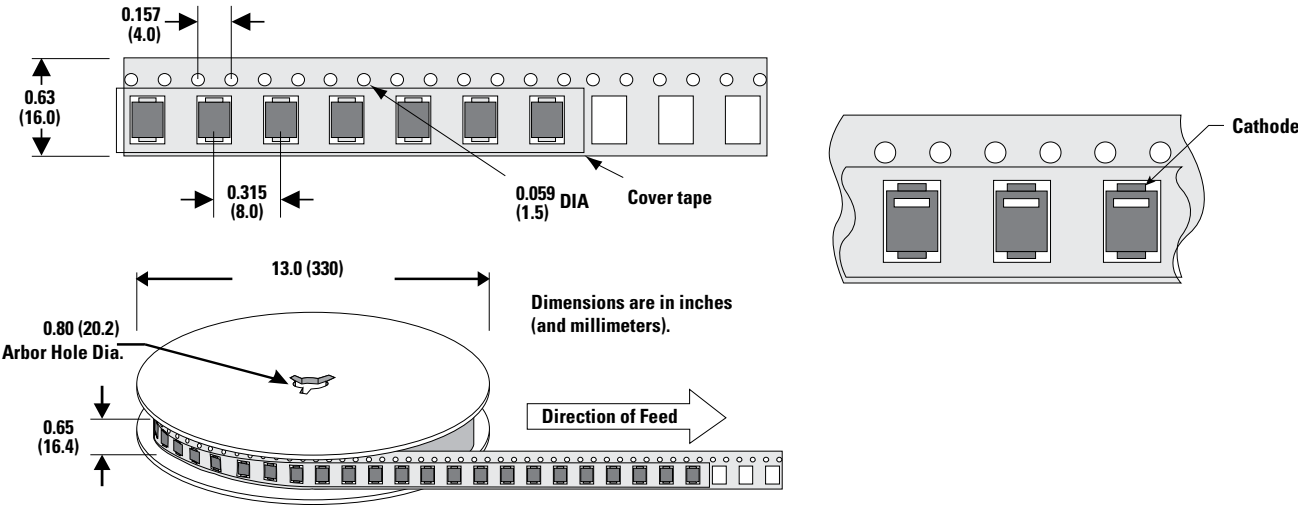
Part Marking System



Packaging

| Part number | Component Package | Quantity | Packaging Option                 | Packaging Specification |
|-------------|-------------------|----------|----------------------------------|-------------------------|
| 1.5SMCxxxXX | DO-214AB          | 3000     | Tape & Reel - 16mm tape/13" reel | EIA STD RS-481          |

Tape and Reel Specification



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