

# SMF Series

## Surface Mount – 200W



### 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 at $T_A=25^{\circ}\text{C}$ <sup>1</sup> | $P_{PPM}$       | 1000       | W                           |
| 8/20 $\mu\text{s}$  |                 | 200        |                             |
| 10/1000 $\mu\text{s}$ <sup>2</sup>                                    |                 |            |                             |
| Power Dissipation On Infinite Heat Sink at $T_L=50^{\circ}\text{C}$   | $P_D$           | 1          | W                           |
| Thermal Resistance Junction- to- Ambient                              | $R_{\theta JA}$ | 220        | $^{\circ}\text{C}/\text{W}$ |
| Thermal Resistance Junction- to- Lead                                 | $R_{\theta JL}$ | 100        | $^{\circ}\text{C}/\text{W}$ |
| Operating Temperature Range   | $T_J$           | -65 to 150 | $^{\circ}\text{C}$          |
| Storage Temperature Range   | $T_{STG}$       | -65 to 175 | $^{\circ}\text{C}$          |

#### Notes:

- Non-repetitive current pulse, per Fig. 4 and derated above  $T_J$  (initial)  $=25^{\circ}\text{C}$  per Fig. 3.
- SMF90A-SMF100A Peak Pulse Power Dissipation is 170W min, 200W typical @ 10/1000 $\mu\text{s}$

### Description

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

SMF package is 50% smaller in footprint when compare to SMA package and delivering one of the low height profiles (1.1mm) in the industry.

### Features & Benefits

- 200W peak pulsepower capability at 10/1000 $\mu\text{s}$  waveform, repetition rate (duty cycle): 0.01%
- Compatible with industrial standard package SOD-123FL
- Low profile: maximum height of 1.1mm.
- Low inductance, excellent clamping capability
- For surface mounted applications to optimize board space
- High temperature to reflow soldering guaranteed:  $260^{\circ}\text{C}/30\text{sec}$
- 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 1.0ns from 0 Volts to  $V_{BR\ min}$
- Glass passivated junction
- Built-in strain relief
- Plastic package is flammability rated V-0 per UL 94
- 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)
- UL Recognized to UL 497B as an Isolated Loop Circuit Protector.

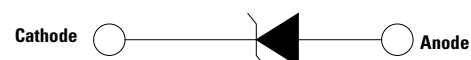
### Applications

SMF series is ideal for the protection of I/O interfaces,  $V_{CC}$  bus and other vulnerable circuit used in cellular phones, portable electronics, business machines, power supplies and other consumer applications.

#### Functional Diagram



Bi-directional



Uni-directional

# SMF Series

## Surface Mount – 200W

### Electrical Characteristics ( $T_A=25^\circ\text{C}$ unless otherwise noted)

| Part Number |          | Marking Code |    | Breakdown Voltage VBR (Volts) @ IT |        | Test Current IT (mA) | Reverse Stand off Voltage VR (V) | Maximum Reverse Leakage @ VR IR ( $\mu\text{A}$ ) | Maximum Peak Pulse Current Ipp (A) $10^*1000\text{us}$ | Maximum Clamping Voltage @Ipp VC (V) $10^*1000\text{us}$ | Agency Approval |    |
|-------------|----------|--------------|----|------------------------------------|--------|----------------------|----------------------------------|---|--|--|-----------------|----|
| Uni         | Bi       | Uni          | Bi | MIN                                | MAX    |                      |                                  |   |  |  | Uni             | Bi |
| SMF5.0A     | SMF5.0CA | AE           | HE | 6.40                               | 7.00   | 10                   | 5.0                              | 400   | 21.7   | 9.2  | X               | X  |
| SMF6.0A     | SMF6.0CA | AG           | HG | 6.67                               | 7.37   | 10                   | 6.0                              | 400   | 19.4   | 10.3   | X               | X  |
| SMF6.5A     | SMF6.5CA | AK           | HK | 7.22                               | 7.98   | 10                   | 6.5                              | 250   | 17.9   | 11.2   | X               | X  |
| SMF7.0A     | SMF7.0CA | AM           | HM | 7.78                               | 8.60   | 10                   | 7.0                              | 100   | 16.7   | 12.0   | X               | X  |
| SMF7.5A     | SMF7.5CA | AP           | HP | 8.33                               | 9.21   | 1                    | 7.5                              | 50  | 15.5   | 12.9   | X               | X  |
| SMF8.0A     | SMF8.0CA | AR           | HR | 8.89                               | 9.83   | 1                    | 8.0                              | 25  | 14.7   | 13.6   | X               | X  |
| SMF8.5A     | SMF8.5CA | AT           | HT | 9.44                               | 10.40  | 1                    | 8.5                              | 10  | 13.9   | 14.4   | X               | X  |
| SMF9.0A     | SMF9.0CA | AV           | HV | 10.00                              | 11.10  | 1                    | 9.0                              | 2.5   | 13.0   | 15.4   | X               | X  |
| SMF10A      | SMF10CA  | AX           | HX | 11.10                              | 12.30  | 1                    | 10                               | 2.5   | 11.8   | 17.0   | X               | X  |
| SMF11A      | SMF11CA  | AZ           | HZ | 12.20                              | 13.50  | 1                    | 11                               | 2.5   | 11.0   | 18.2   | X               | X  |
| SMF12A      | SMF12CA  | BE           | IE | 13.30                              | 14.70  | 1                    | 12                               | 2.5   | 10.1   | 19.9   | X               | X  |
| SMF13A      | SMF13CA  | BG           | IG | 14.40                              | 15.90  | 1                    | 13                               | 1.0   | 9.3  | 21.5   | X               | X  |
| SMF14A      | SMF14CA  | BK           | IK | 15.60                              | 17.20  | 1                    | 14                               | 1.0   | 8.6  | 23.2   | X               | X  |
| SMF15A      | SMF15CA  | BM           | IM | 16.70                              | 18.50  | 1                    | 15                               | 1.0   | 8.2  | 24.4   | X               | X  |
| SMF16A      | SMF16CA  | BP           | IP | 17.80                              | 19.70  | 1                    | 16                               | 1.0   | 7.7  | 26.0   | X               | X  |
| SMF17A      | SMF17CA  | BR           | IR | 18.90                              | 20.90  | 1                    | 17                               | 1.0   | 7.2  | 27.6   | X               | X  |
| SMF18A      | SMF18CA  | BT           | IT | 20.0 0                             | 22.10  | 1                    | 18                               | 1.0   | 6.8  | 29.2   | X               | X  |
| SMF20A      | SMF20CA  | BV           | IV | 22.20                              | 24.50  | 1                    | 20                               | 1.0   | 6.2  | 32.4   | X               | X  |
| SMF22A      | SMF22CA  | BX           | IX | 24.40                              | 26.90  | 1                    | 22                               | 1.0   | 5.6  | 35.5   | X               | X  |
| SMF24A      | SMF24CA  | BZ           | IZ | 26.70                              | 29.50  | 1                    | 24                               | 1.0   | 5.1  | 38.9   | X               | X  |
| SMF26A      | SMF26CA  | CE           | JE | 28.90                              | 31.90  | 1                    | 26                               | 1.0   | 4.8  | 42.1   | X               | X  |
| SMF28A      | SMF28CA  | CG           | JG | 31.10                              | 34.40  | 1                    | 28                               | 1.0   | 4.4  | 45.4   | X               | X  |
| SMF30A      | SMF30CA  | CK           | JK | 33.30                              | 36.80  | 1                    | 30                               | 1.0   | 4.1  | 48.4   | X               | X  |
| SMF33A      | SMF33CA  | CM           | JM | 36.70                              | 40.60  | 1                    | 33                               | 1.0   | 3.8  | 53.3   | X               | X  |
| SMF36A      | SMF36CA  | CP           | JP | 40.00                              | 44.20  | 1                    | 36                               | 1.0   | 3.4  | 58.1   | X               | X  |
| SMF40A      | SMF40CA  | CR           | JR | 44.40                              | 49.10  | 1                    | 40                               | 1.0   | 3.1  | 64.5   | X               | X  |
| SMF43A      | SMF43CA  | CT           | JT | 47.80                              | 52.80  | 1                    | 43                               | 1.0   | 2.9  | 69.4   | X               | X  |
| SMF45A      | SMF45CA  | CV           | JV | 50.00                              | 55.30  | 1                    | 45                               | 1.0   | 2.8  | 72.7   | X               | X  |
| SMF48A      | SMF48CA  | CX           | JX | 53.30                              | 58.90  | 1                    | 48                               | 1.0   | 2.6  | 77.4   | X               | X  |
| SMF51A      | SMF51CA  | CZ           | JZ | 56.70                              | 62.70  | 1                    | 51                               | 1.0   | 2.4  | 82.4   | X               | X  |
| SMF54A      | SMF54CA  | DE           | KE | 60.00                              | 66.30  | 1                    | 54                               | 1.0   | 2.3  | 87.1   | X               | X  |
| SMF58A      | SMF58CA  | RG           | KG | 64.40                              | 71.20  | 1                    | 58                               | 1.0   | 2.1  | 93.6   | X               | X  |
| SMF60A      | SMF60CA  | RK           | KK | 66.70                              | 73.70  | 1                    | 60                               | 1.0   | 2.1  | 96.8   | X               | X  |
| SMF64A      | SMF64CA  | RM           | KM | 71.10                              | 78.60  | 1                    | 64                               | 1.0   | 1.9  | 103.0  | X               | X  |
| SMF70A      | SMF70CA  | RP           | KP | 77.80                              | 86.00  | 1                    | 70                               | 1.0   | 1.7  | 113.0  | X               | X  |
| SMF75A      | SMF75CA  | RR           | KR | 83.30                              | 92.10  | 1                    | 75                               | 1.0   | 1.6  | 121.0  | X               | X  |
| SMF78A      | SMF78CA  | RT           | KT | 86.70                              | 95.80  | 1                    | 78                               | 1.0   | 1.6  | 126.0  | X               | X  |
| SMF85A      | SMF85CA  | RV           | KV | 94.40                              | 104.00 | 1                    | 85                               | 1.0   | 1.5  | 137.0  | X               | X  |
| SMF90A      | -        | RW           | -  | 100.00                             | 111.00 | 1                    | 90                               | 1.0   | 1.2  | 146.0  | -               | -  |
| SMF100A     | -        | RX           | -  | 111.00                             | 123.00 | 1                    | 100                              | 1.0   | 1.1  | 162.0  | -               | -  |
| SMF110A     | -        | SE           | -  | 122.00                             | 135.00 | 1                    | 110                              | 1.0   | 1.1  | 177.0  | -               | -  |
| SMF120A     | -        | SG           | -  | 133.00                             | 147.00 | 1                    | 120                              | 1.0   | 1.0  | 193.0  | -               | -  |
| SMF130A     | -        | SK           | -  | 144.00                             | 159.00 | 1                    | 130                              | 1.0   | 1.0  | 209.0  | -               | -  |
| SMF150A     | -        | SM           | -  | 167.00                             | 185.00 | 1                    | 150                              | 1.0   | 0.8  | 243.0  | -               | -  |
| SMF160A     | -        | SP           | -  | 178.00                             | 197.00 | 1                    | 160                              | 1.0   | 0.8  | 259.0  | -               | -  |
| SMF170A     | -        | SR           | -  | 189.00                             | 209.00 | 1                    | 170                              | 1.0   | 0.7  | 275.0  | -               | -  |
| SMF180A     | -        | ST           | -  | 201.00                             | 222.00 | 1                    | 180                              | 1.0   | 0.7  | 292.0  | -               | -  |
| SMF188A     | -        | SV           | -  | 209.00                             | 231.00 | 1                    | 188                              | 1.0   | 0.7  | 304.0  | -               | -  |
| SMF200A     | -        | SX           | -  | 224.00                             | 247.00 | 1                    | 200                              | 1.0   | 0.6  | 324.0  | -               | -  |
| SMF220A     | -        | SZ           | -  | 246.00                             | 272.00 | 1                    | 220                              | 1.0   | 0.6  | 356.0  | -               | -  |
| SMF250A     | -        | TE           | -  | 279.00                             | 309.00 | 1                    | 250                              | 1.0   | 0.5  | 405.0  | -               | -  |

**Notes:**

- $V_{BR}$  measured after  $I_T$  applied for 300 $\mu\text{s}$ ,  $I_T$  = square wave pulse or equivalent.
- Surge current waveform per 10/1000 $\mu\text{s}$  exponential wave and derated per Fig.2.

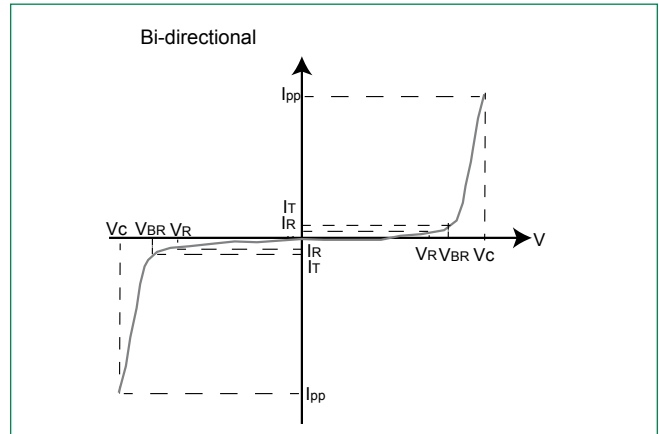
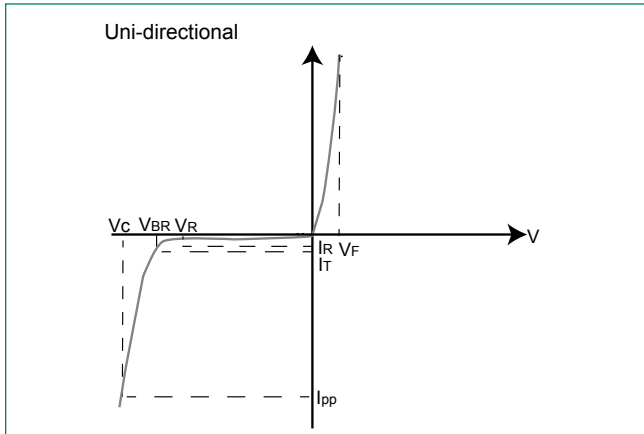
3. All terms and symbols are consistent with ANSI/IEEE C62.35.

4. For bidirectional type having VR of 10 volts and less, the IR limit is double.

# SMF Series

## Surface Mount – 200W

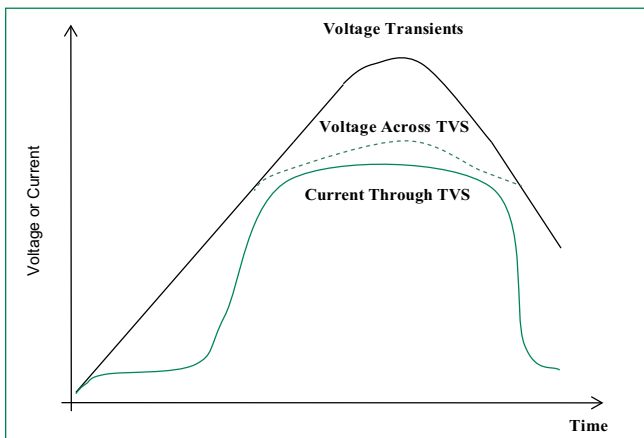
### I-V Curve Characteristics



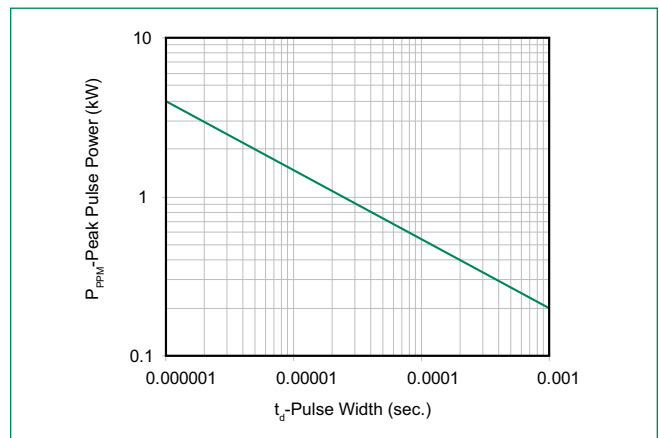
- $P_{PPM}$  **Peak Pulse Power Dissipation** – Max power dissipation
- $V_R$  **Stand-off Voltage** – Maximum voltage that can be applied to the TVS without operation
- $V_{BR}$  **Breakdown Voltage** – Maximum voltage that flows though the TVS at a specified test current ( $I_T$ )
- $V_C$  **Clamping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



# SMF Series

## Surface Mount – 200W

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

Figure 3: Peak Pulse Power Derating Curve

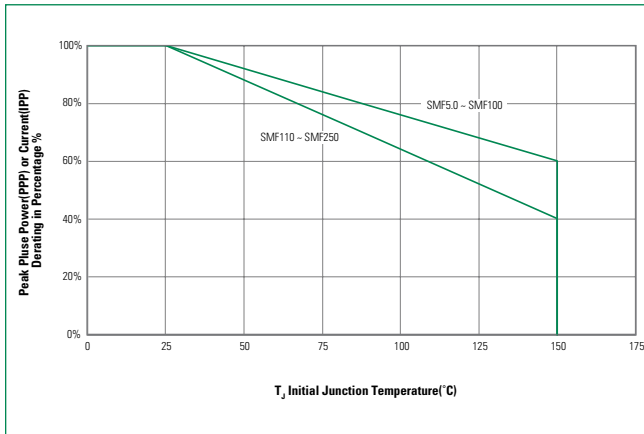


Figure 4: Pulse Waveform - 10/1000 $\mu\text{s}$

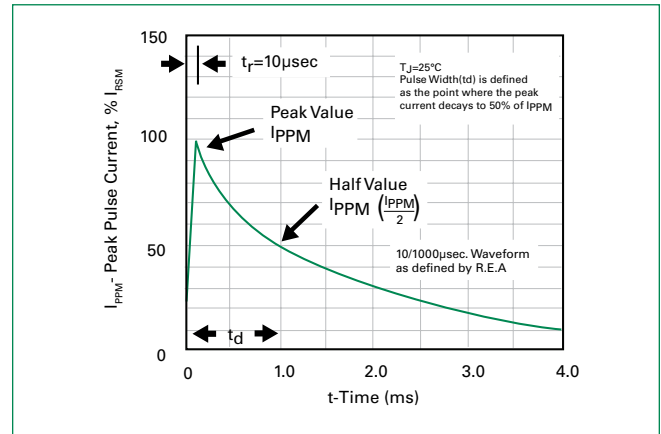


Figure 5: Forward Voltage

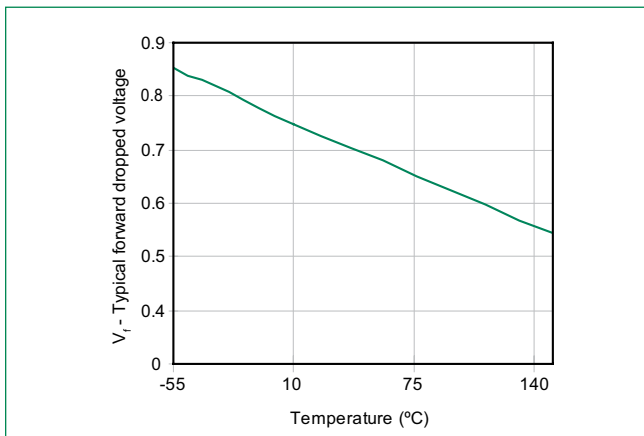


Figure 6: Typical Junction Capacitance

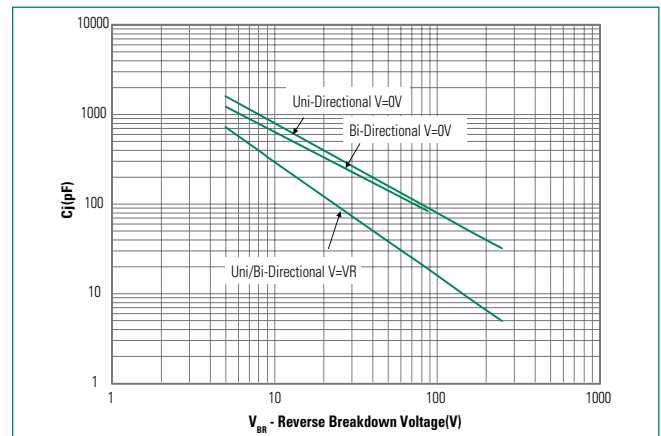


Figure 7: Peak Forward Voltage Drop vs. Peak Forward Current

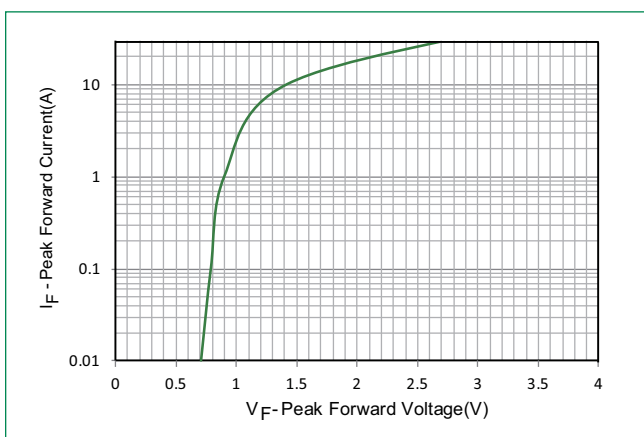
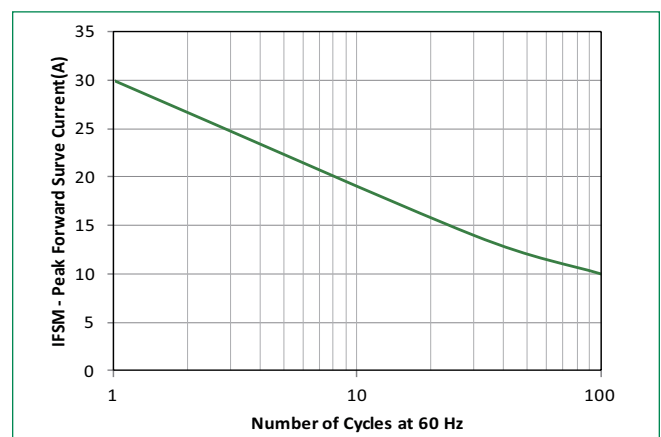


Figure 8: Maximum Non-Repetitive Forward Surge Current Uni-Directional Only

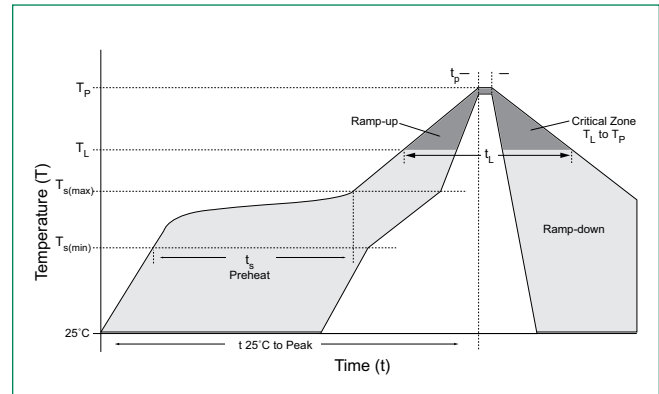


# SMF Series

## Surface Mount – 200W

### 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                   |



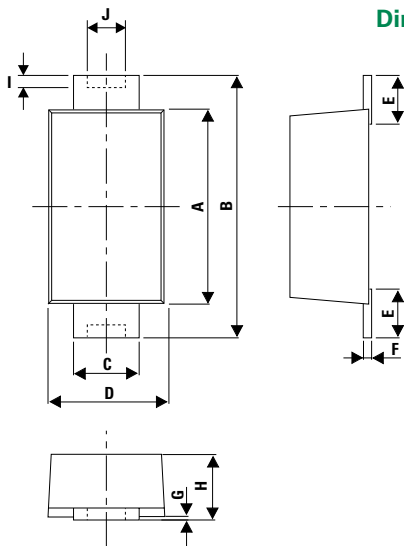
### Physical Specifications

|                 |  |
|-----------------|--|
| <b>Case</b>     | SOD-123FL 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 |

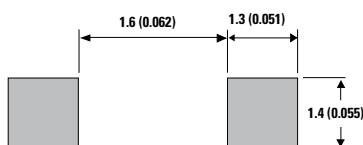
### Environmental Specifications

|                            |                          |
|----------------------------|--------------------------|
| <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-A111              |

### Dimensions - SOD-123FL Package



### Mounting Pad Layout

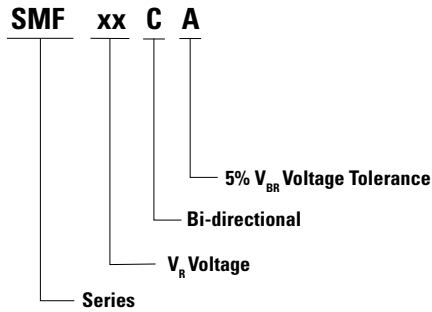


| Dimensions | Millimeters |      | Inches |        |
|------------|-------------|------|--------|--------|
|            | Min         | Max  | Min    | Max    |
| A          | 2.50        | 3.10 | 0.0984 | 0.1220 |
| B          | 3.40        | 3.90 | 0.1339 | 0.1535 |
| C          | 0.70        | 1.20 | 0.0275 | 0.0472 |
| D          | 1.50        | 2.00 | 0.0591 | 0.0787 |
| E          | 0.35        | 0.90 | 0.0138 | 0.0354 |
| F          | 0.05        | 0.26 | 0.0020 | 0.0102 |
| G          | 0.00        | 0.10 | 0.000  | 0.0039 |
| H          | 0.90        | 1.10 | 0.0354 | 0.0433 |
| I          | 0.00        | 0.20 | 0.000  | 0.008  |
| J          | 0.40        | 0.60 | 0.016  | 0.024  |

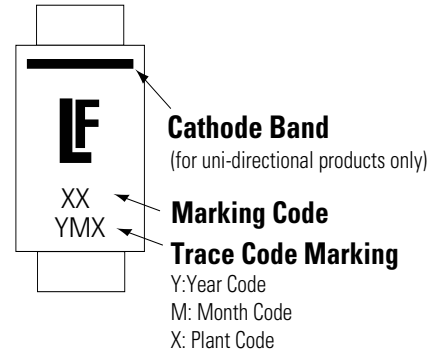
# SMF Series

## Surface Mount – 200W

### Part Numbering System



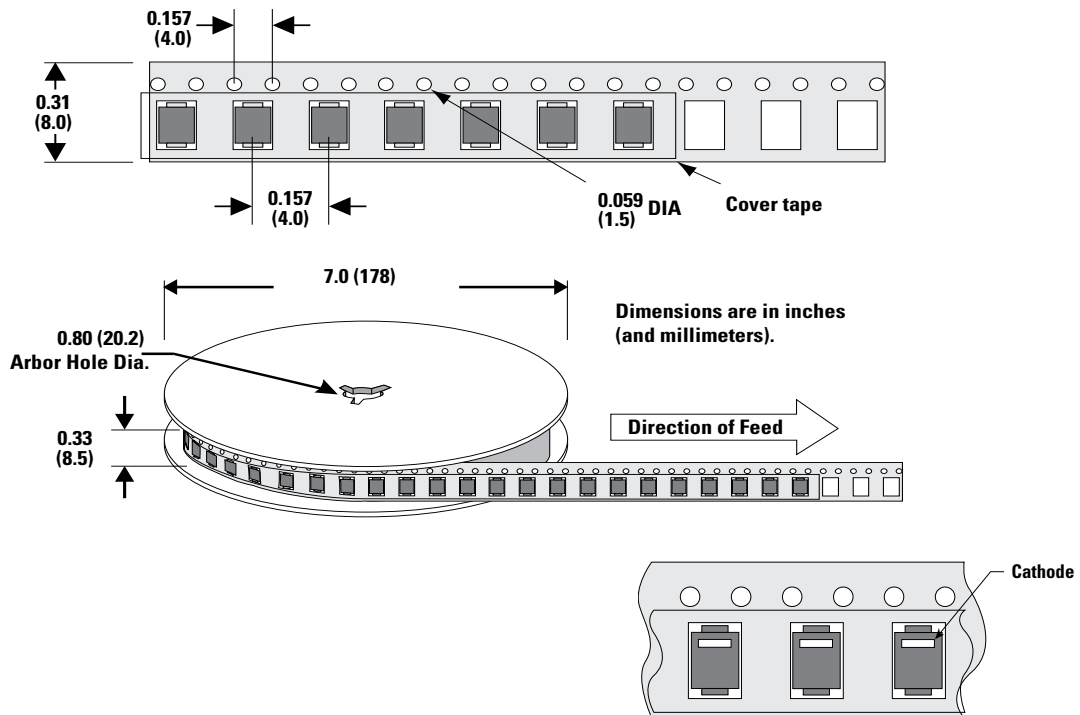
### Part Marking System



### Packaging Options

| Part number | Component Package | Quantity | Packaging Option                | Packaging Specification |
|-------------|-------------------|----------|---------------------------------|-------------------------|
| SMFXXX      | SOD-123FL         | 3000     | Tape & Reel – 8mm tape/7" reel  | EIA RS-481              |
| SMFXXX-T13  | SOD-123FL         | 10000    | Tape & Reel – 8mm tape/13" reel | EIA RS-481              |

### Tape and Reel Specification



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