



# THE DATASHEET OF SMF58CA



### SMF Series



#### Agency Approvals

| Agency  | Agency File Number |
|---|--------------------|
|  | E230531            |

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

| Parameter   | Symbol           | Value      | Unit |
|---|------------------|------------|------|
| Peak Pulse Power Dissipation at T <sub>A</sub> =25°C (Note 1) | P <sub>PPM</sub> | 1000       | W    |
|   |                  | 200        |      |
| Power Dissipation On Infinite Heat Sink at TL=50°C            | P <sub>D</sub>   | 1          | W    |
| Thermal Resistance Junction- to- Ambient                      | R <sub>θJA</sub> | 220        | °C/W |
| Thermal Resistance Junction- to- Lead                         | R <sub>θJL</sub> | 100        | °C/W |
| Operating Temperature Range                                   | T <sub>J</sub>   | -65 to 150 | °C   |
| Storage Temperature Range                                     | T <sub>STG</sub> | -65 to 175 | °C   |

#### Notes:

1. Non-repetitive current pulse, per Fig. 4 and derated above T<sub>J</sub> (initial) =25°C per Fig. 3.
2. SMF90A-SMF100A Peak Pulse Power Dissipation is 170W min, 200W typical @ 10/1000µs

#### Functional Diagram



#### 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

- 200W peak pulsepower capability at 10/1000µs 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°C/430sec
- 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<sub>BR</sub> 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°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.

#### Additional Information



#### Applications

SMF devices are ideal for the protection of I/O interfaces, V<sub>CC</sub> bus and other vulnerable circuit used in cellular phones, portable devices, business machines, power supplies and other consumer applications.

### Electrical Characteristics (T<sub>A</sub>=25°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 (µA) | Maximum Peak Pulse Current Ipp (A) 10*1000us | Maximum Clamping Voltage @Ipp VC (V) 10*1000us | 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               | -  |
| SMF6.0A     | SMF6.0CA | AG           | HG | 6.67                               | 7.37   | 10                   | 6.0                              | 400                                  | 19.4   | 10.3   | X               | -  |
| SMF6.5A     | SMF6.5CA | AK           | HK | 7.22                               | 7.98   | 10                   | 6.5                              | 250                                  | 17.9   | 11.2   | X               | -  |
| SMF7.0A     | SMF7.0CA | AM           | HM | 7.78                               | 8.60   | 10                   | 7.0                              | 100                                  | 16.7   | 12.0   | X               | -  |
| SMF7.5A     | SMF7.5CA | AP           | HP | 8.33                               | 9.21   | 1                    | 7.5                              | 50                                   | 15.5   | 12.9   | X               | -  |
| SMF8.0A     | SMF8.0CA | AR           | HR | 8.89                               | 9.83   | 1                    | 8.0                              | 25                                   | 14.7   | 13.6   | X               | -  |
| SMF8.5A     | SMF8.5CA | AT           | HT | 9.44                               | 10.40  | 1                    | 8.5                              | 10                                   | 13.9   | 14.4   | X               | -  |
| SMF9.0A     | SMF9.0CA | AV           | HV | 10.00                              | 11.10  | 1                    | 9.0                              | 2.5                                  | 13.0   | 15.4   | X               | -  |
| SMF10A      | SMF10CA  | AX           | HX | 11.10                              | 12.30  | 1                    | 10                               | 2.5                                  | 11.8   | 17.0   | X               | -  |
| SMF11A      | SMF11CA  | AZ           | HZ | 12.20                              | 13.50  | 1                    | 11                               | 2.5                                  | 11.0   | 18.2   | X               | -  |
| SMF12A      | SMF12CA  | BE           | IE | 13.30                              | 14.70  | 1                    | 12                               | 2.5                                  | 10.1   | 19.9   | X               | -  |
| SMF13A      | SMF13CA  | BG           | IG | 14.40                              | 15.90  | 1                    | 13                               | 1.0                                  | 9.3  | 21.5   | X               | -  |
| SMF14A      | SMF14CA  | BK           | IK | 15.60                              | 17.20  | 1                    | 14                               | 1.0                                  | 8.6  | 23.2   | X               | -  |
| SMF15A      | SMF15CA  | BM           | IM | 16.70                              | 18.50  | 1                    | 15                               | 1.0                                  | 8.2  | 24.4   | X               | -  |
| SMF16A      | SMF16CA  | BP           | IP | 17.80                              | 19.70  | 1                    | 16                               | 1.0                                  | 7.7  | 26.0   | X               | -  |
| SMF17A      | SMF17CA  | BR           | IR | 18.90                              | 20.90  | 1                    | 17                               | 1.0                                  | 7.2  | 27.6   | X               | -  |
| SMF18A      | SMF18CA  | BT           | IT | 20.00                              | 22.10  | 1                    | 18                               | 1.0                                  | 6.8  | 29.2   | X               | -  |
| SMF20A      | SMF20CA  | BV           | IV | 22.20                              | 24.50  | 1                    | 20                               | 1.0                                  | 6.2  | 32.4   | X               | -  |
| SMF22A      | SMF22CA  | BX           | IX | 24.40                              | 26.90  | 1                    | 22                               | 1.0                                  | 5.6  | 35.5   | X               | -  |
| SMF24A      | SMF24CA  | BZ           | IZ | 26.70                              | 29.50  | 1                    | 24                               | 1.0                                  | 5.1  | 38.9   | X               | -  |
| SMF26A      | SMF26CA  | CE           | JE | 28.90                              | 31.90  | 1                    | 26                               | 1.0                                  | 4.8  | 42.1   | X               | -  |
| SMF28A      | SMF28CA  | CG           | JG | 31.10                              | 34.40  | 1                    | 28                               | 1.0                                  | 4.4  | 45.4   | X               | -  |
| SMF30A      | SMF30CA  | CK           | JK | 33.30                              | 36.80  | 1                    | 30                               | 1.0                                  | 4.1  | 48.4   | X               | -  |
| SMF33A      | SMF33CA  | CM           | JM | 36.70                              | 40.60  | 1                    | 33                               | 1.0                                  | 3.8  | 53.3   | X               | -  |
| SMF36A      | SMF36CA  | CP           | JP | 40.00                              | 44.20  | 1                    | 36                               | 1.0                                  | 3.4  | 58.1   | X               | -  |
| SMF40A      | SMF40CA  | CR           | JR | 44.40                              | 49.10  | 1                    | 40                               | 1.0                                  | 3.1  | 64.5   | X               | -  |
| SMF43A      | SMF43CA  | CT           | JT | 47.80                              | 52.80  | 1                    | 43                               | 1.0                                  | 2.9  | 69.4   | X               | -  |
| SMF45A      | SMF45CA  | CV           | JV | 50.00                              | 55.30  | 1                    | 45                               | 1.0                                  | 2.8  | 72.7   | X               | -  |
| SMF48A      | SMF48CA  | CX           | JX | 53.30                              | 58.90  | 1                    | 48                               | 1.0                                  | 2.6  | 77.4   | X               | -  |
| SMF51A      | SMF51CA  | CZ           | JZ | 56.70                              | 62.70  | 1                    | 51                               | 1.0                                  | 2.4  | 82.4   | X               | -  |
| SMF54A      | SMF54CA  | DE           | KE | 60.00                              | 66.30  | 1                    | 54                               | 1.0                                  | 2.3  | 87.1   | X               | -  |
| SMF58A      | SMF58CA  | RG           | KG | 64.40                              | 71.20  | 1                    | 58                               | 1.0                                  | 2.1  | 93.6   | -               | -  |
| SMF60A      | SMF60CA  | RK           | KK | 66.70                              | 73.70  | 1                    | 60                               | 1.0                                  | 2.1  | 96.8   | -               | -  |
| SMF64A      | SMF64CA  | RM           | KM | 71.10                              | 78.60  | 1                    | 64                               | 1.0                                  | 1.9  | 103.0  | -               | -  |
| SMF70A      | SMF70CA  | RP           | KP | 77.80                              | 86.00  | 1                    | 70                               | 1.0                                  | 1.7  | 113.0  | -               | -  |
| SMF75A      | SMF75CA  | RR           | KR | 83.30                              | 92.10  | 1                    | 75                               | 1.0                                  | 1.6  | 121.0  | -               | -  |
| SMF78A      | SMF78CA  | RT           | KT | 86.70                              | 95.80  | 1                    | 78                               | 1.0                                  | 1.6  | 126.0  | -               | -  |
| SMF85A      | SMF85CA  | RV           | KV | 94.40                              | 104.00 | 1                    | 85                               | 1.0                                  | 1.5  | 137.0  | -               | -  |
| 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:**

1. V<sub>BR</sub> measured after I<sub>T</sub> applied for 300µs, I<sub>T</sub> = square wave pulse or equivalent.
2. Surge current waveform per 10/1000µs 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.

**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 ( $T_A=25^\circ C$  unless otherwise noted)**

**Figure 1 - TVS Transients Clamping Waveform**



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



**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**



### 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                   |



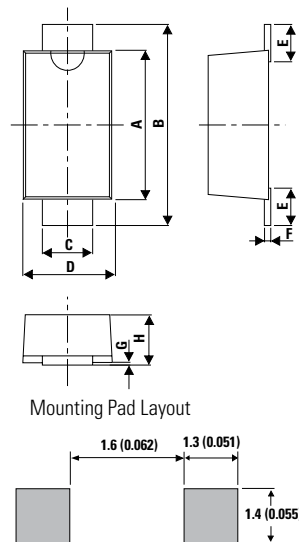
### Physical Specifications

|                 |  |
|-----------------|--|
| <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



| Dimensions | Millimeters      |      | Inches |        |        |
|------------|------------------|------|--------|--------|--------|
|            | Min              | Max  | Min    | Max    |        |
| <b>A</b>   | SMF5.0A~SMF100A  | 2.50 | 2.90   | 0.0984 | 0.1142 |
|            | SMF110A~SMF250A  | 2.90 | 3.10   | 0.1142 | 0.1220 |
|            | SMF5.0CA~SMF85CA |      |        |        |        |
| <b>B</b>   |                  | 3.40 | 3.90   | 0.1339 | 0.1535 |
| <b>C</b>   |                  | 0.70 | 1.20   | 0.0275 | 0.0472 |
| <b>D</b>   |                  | 1.50 | 2.00   | 0.0591 | 0.0787 |
| <b>E</b>   |                  | 0.35 | 0.90   | 0.0138 | 0.0354 |
| <b>F</b>   |                  | 0.05 | 0.26   | 0.0020 | 0.0102 |
| <b>G</b>   |                  | 0.00 | 0.10   | 0.000  | 0.0039 |
| <b>H</b>   | SMF5.0A~SMF100A  | 0.95 | 1.10   | 0.0374 | 0.0433 |
|            | SMF110A~SMF250A  | 0.90 | 1.08   | 0.0354 | 0.0425 |
|            | SMF5.0CA~SMF85CA |      |        |        |        |

**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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