

## SMF Series



### Agency Approvals

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

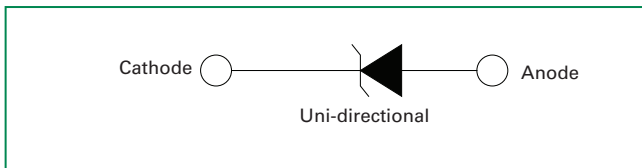
### Maximum Ratings and Thermal Characteristics ( $T_A=25^\circ\text{C}$ unless otherwise noted)

| Parameter                                                                                | Symbol         | Value      | Unit               |
|------------------------------------------------------------------------------------------|----------------|------------|--------------------|
| Peak Pulse Power Dissipation at $T_A=25^\circ\text{C}$ by 10/1000 $\mu\text{s}$ (Note 1) | $P_{PPM}$      | 200        | W                  |
| Thermal Resistance Junction- to-Ambient                                                  | $R_{THJA}$     | 220        | $^\circ\text{C/W}$ |
| Thermal Resistance Junction- to-Lead                                                     | $R_{THJL}$     | 100        | $^\circ\text{C/W}$ |
| Operating and Storage Temperature Range                                                  | $T_J, T_{STG}$ | -55 to 150 | $^\circ\text{C}$   |

**Notes:**

1. Non-repetitive current pulse, per Fig. 4 and derated above  $T_A=25^\circ\text{C}$  per Fig. 3.

### 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

- Compatible with industrial standard package SOD-123F
- For surface mounted applications to optimize board space
- Low profile: maximum height of 1.1mm.
- 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 (IEC801-2)
- EFT protection of data lines in accordance with IEC 61000-4-4 (IEC801-4)
- Low inductance, excellent clamping capability
- 200W peak pulsepower capability at 10/1000 $\mu\text{s}$  waveform, repetition rate (duty cycle): 0.01%
- Fast response time: typically less than 1.0ns from 0 Volts to  $V_{BR}$  min
- High temperature soldering:  $260^\circ\text{C}/40$  seconds at terminals
- Glass passivated junction
- Built-in strain relief
- Plastic package has underwriters laboratory flammability 94V-0
- 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
- 2nd level interconnect is Pb-free per IPC/JEDEC J-STD-609A.01

### Applications

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

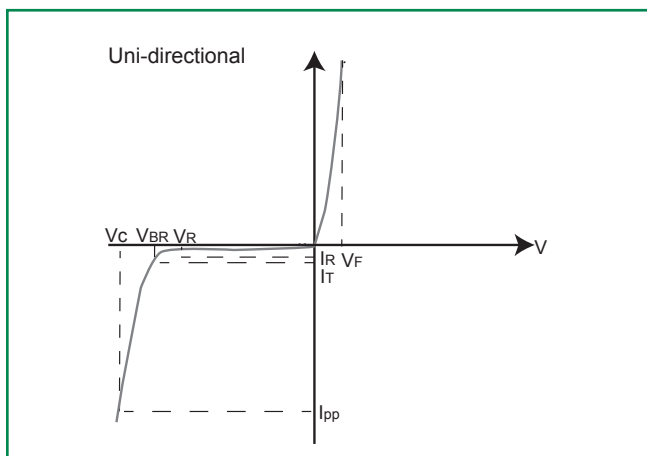
### Electrical Characteristics ( $T_A=25^{\circ}\text{C}$ unless otherwise noted)

| Part Number | Marking Code | Breakdown Voltage $V_{BR}$ (Volts) @ $I_T$ |        | Test Current $I_T$ (mA) | Reverse Stand off Voltage $V_R$ (V) | Maximum Reverse Leakage @ $V_R$ $I_R$ ( $\mu\text{A}$ ) | Maximum Peak Pulse Current $I_{pp}$ (A) | Maximum Clamping Voltage @ $I_{pp}$ $V_C$ (V) | Agency Approval  |
|-------------|--------------|--------------------------------------------|--------|-------------------------|-------------------------------------|---------------------------------------------------------|-----------------------------------------|-----------------------------------------------|-----------------------------------------------------------------------------------------------------|
|             |              | MIN                                        | MAX    |                         |                                     |                                                         |                                         |                                               |                                                                                                     |
| SMF5.0A     | AE           | 6.40                                       | 7.00   | 10                      | 5.0                                 | 400                                                     | 21.7                                    | 9.2                                           | X                                                                                                   |
| SMF6.0A     | AG           | 6.67                                       | 7.37   | 10                      | 6.0                                 | 400                                                     | 19.4                                    | 10.3                                          | X                                                                                                   |
| SMF6.5A     | AK           | 7.22                                       | 7.98   | 10                      | 6.5                                 | 250                                                     | 17.9                                    | 11.2                                          | X                                                                                                   |
| SMF7.0A     | AM           | 7.78                                       | 8.60   | 10                      | 7.0                                 | 100                                                     | 16.7                                    | 12.0                                          | X                                                                                                   |
| SMF7.5A     | AP           | 8.33                                       | 9.21   | 1                       | 7.5                                 | 50                                                      | 15.5                                    | 12.9                                          | X                                                                                                   |
| SMF8.0A     | AR           | 8.89                                       | 9.83   | 1                       | 8.0                                 | 25                                                      | 14.7                                    | 13.6                                          | X                                                                                                   |
| SMF8.5A     | AT           | 9.44                                       | 10.40  | 1                       | 8.5                                 | 10                                                      | 13.9                                    | 14.4                                          | X                                                                                                   |
| SMF9.0A     | AV           | 10.00                                      | 11.10  | 1                       | 9.0                                 | 5                                                       | 13.0                                    | 15.4                                          | X                                                                                                   |
| SMF10A      | AX           | 11.10                                      | 12.30  | 1                       | 10                                  | 2.5                                                     | 11.8                                    | 17.0                                          | X                                                                                                   |
| SMF11A      | AZ           | 12.20                                      | 13.50  | 1                       | 11                                  | 2.5                                                     | 11.0                                    | 18.2                                          | X                                                                                                   |
| SMF12A      | BE           | 13.30                                      | 14.70  | 1                       | 12                                  | 2.5                                                     | 10.1                                    | 19.9                                          | X                                                                                                   |
| SMF13A      | BG           | 14.40                                      | 15.90  | 1                       | 13                                  | 1.0                                                     | 9.3                                     | 21.5                                          | X                                                                                                   |
| SMF14A      | BK           | 15.60                                      | 17.20  | 1                       | 14                                  | 1.0                                                     | 8.6                                     | 23.2                                          | X                                                                                                   |
| SMF15A      | BM           | 16.70                                      | 18.50  | 1                       | 15                                  | 1.0                                                     | 8.2                                     | 24.4                                          | X                                                                                                   |
| SMF16A      | BP           | 17.80                                      | 19.70  | 1                       | 16                                  | 1.0                                                     | 7.7                                     | 26.0                                          | X                                                                                                   |
| SMF17A      | BR           | 18.90                                      | 20.90  | 1                       | 17                                  | 1.0                                                     | 7.2                                     | 27.6                                          | X                                                                                                   |
| SMF18A      | BT           | 20.0 0                                     | 22.10  | 1                       | 18                                  | 1.0                                                     | 6.8                                     | 29.2                                          | X                                                                                                   |
| SMF20A      | BV           | 22.20                                      | 24.50  | 1                       | 20                                  | 1.0                                                     | 6.2                                     | 32.4                                          | X                                                                                                   |
| SMF22A      | BX           | 24.40                                      | 26.90  | 1                       | 22                                  | 1.0                                                     | 5.6                                     | 35.5                                          | X                                                                                                   |
| SMF24A      | BZ           | 26.70                                      | 29.50  | 1                       | 24                                  | 1.0                                                     | 5.1                                     | 38.9                                          | X                                                                                                   |
| SMF26A      | CE           | 28.90                                      | 31.90  | 1                       | 26                                  | 1.0                                                     | 4.8                                     | 42.1                                          | X                                                                                                   |
| SMF28A      | CG           | 31.10                                      | 34.40  | 1                       | 28                                  | 1.0                                                     | 4.4                                     | 45.4                                          | X                                                                                                   |
| SMF30A      | CK           | 33.30                                      | 36.80  | 1                       | 30                                  | 1.0                                                     | 4.1                                     | 48.4                                          | X                                                                                                   |
| SMF33A      | CM           | 36.70                                      | 40.60  | 1                       | 33                                  | 1.0                                                     | 3.8                                     | 53.3                                          | X                                                                                                   |
| SMF36A      | CP           | 40.0 0                                     | 44.20  | 1                       | 36                                  | 1.0                                                     | 3.4                                     | 58.1                                          | X                                                                                                   |
| SMF40A      | CR           | 44.40                                      | 49.10  | 1                       | 40                                  | 1.0                                                     | 3.1                                     | 64.5                                          | X                                                                                                   |
| SMF43A      | CT           | 47.80                                      | 52.80  | 1                       | 43                                  | 1.0                                                     | 2.9                                     | 69.4                                          | X                                                                                                   |
| SMF45A      | CV           | 50.00                                      | 55.30  | 1                       | 45                                  | 1.0                                                     | 2.8                                     | 72.7                                          | X                                                                                                   |
| SMF48A      | CX           | 53.30                                      | 58.90  | 1                       | 48                                  | 1.0                                                     | 2.6                                     | 77.4                                          | X                                                                                                   |
| SMF51A      | CZ           | 56.70                                      | 62.70  | 1                       | 51                                  | 1.0                                                     | 2.4                                     | 82.4                                          | X                                                                                                   |
| SMF54A      | DE           | 60.00                                      | 66.30  | 1                       | 54                                  | 1.0                                                     | 2.3                                     | 87.1                                          | X                                                                                                   |
| SMF58A      | RG           | 64.40                                      | 71.20  | 1                       | 58                                  | 1.0                                                     | 2.1                                     | 93.6                                          | X                                                                                                   |
| SMF60A      | RK           | 66.70                                      | 73.70  | 1                       | 60                                  | 1.0                                                     | 1.8                                     | 96.8                                          | X                                                                                                   |
| SMF64A      | RM           | 71.10                                      | 78.60  | 1                       | 64                                  | 1.0                                                     | 1.7                                     | 103.0                                         | X                                                                                                   |
| SMF70A      | RP           | 77.80                                      | 86.00  | 1                       | 70                                  | 1.0                                                     | 1.5                                     | 113.0                                         | X                                                                                                   |
| SMF75A      | RR           | 83.30                                      | 92.10  | 1                       | 75                                  | 1.0                                                     | 1.4                                     | 121.0                                         | X                                                                                                   |
| SMF78A      | RT           | 86.70                                      | 95.80  | 1                       | 78                                  | 1.0                                                     | 1.4                                     | 126.0                                         | X                                                                                                   |
| SMF85A      | RV           | 94.40                                      | 104.00 | 1                       | 85                                  | 1.0                                                     | 1.3                                     | 137.0                                         | X                                                                                                   |

#### Notes:

1.  $V_{BR}$  measured after  $I_T$  applied for 300 $\mu\text{s}$ ,  $I_T$  = square wave pulse or equivalent.
2. 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.

## 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 ( $I_T$ )

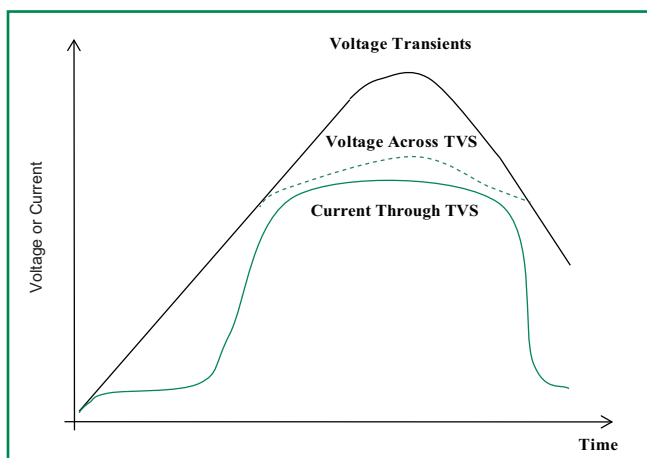
**$V_C$  Clamping Voltage** – Peak voltage measured across the suppressor at a specified  $I_{ppm}$  (peak impulse current)

**$I_R$  Reverse Leakage Current** – Current measured at  $V_R$

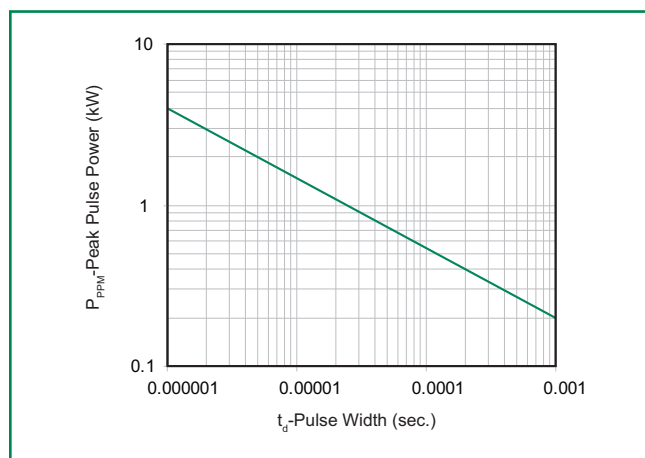
**$V_F$  Forward Voltage Drop for Uni-directional**

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

**Figure 1 - TVS Transients Clamping Waveform**



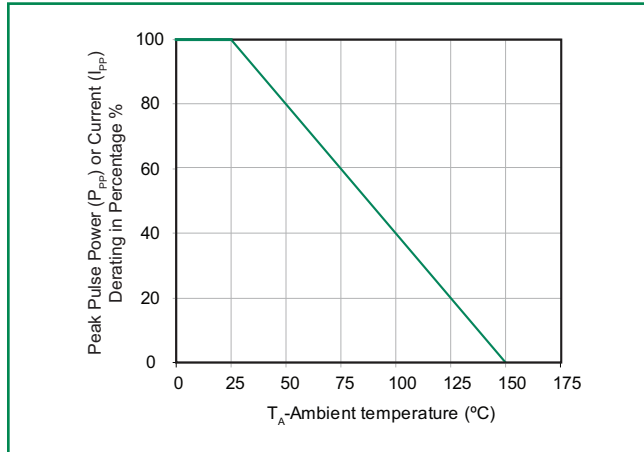
**Figure 2 - Peak Pulse Power Rating Curve**



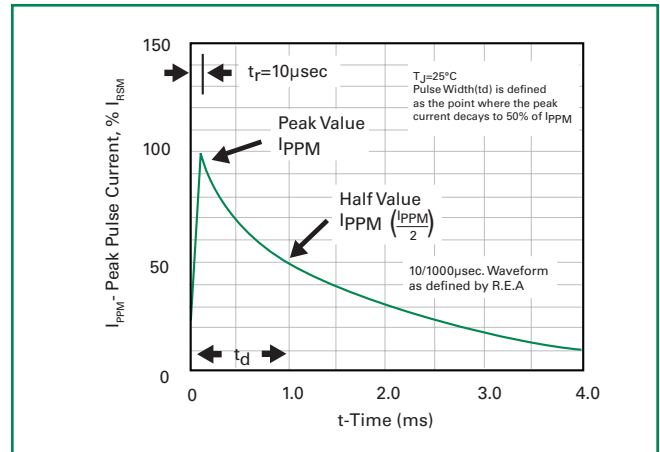
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**Ratings and Characteristic Curves** ( $T_A=25^\circ\text{C}$  unless otherwise noted) (Continued)

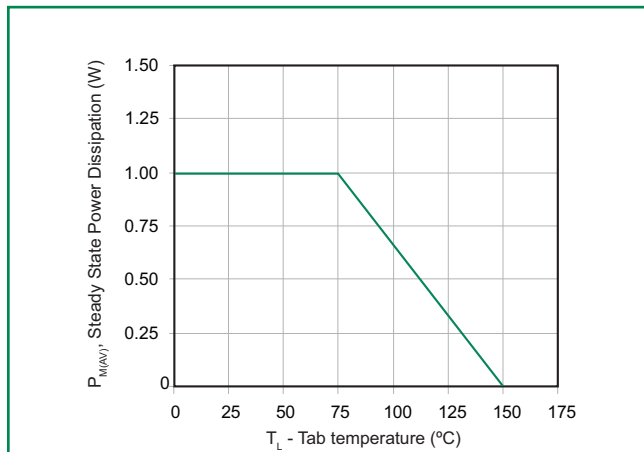
**Figure 3 - Pulse Derating Curve**



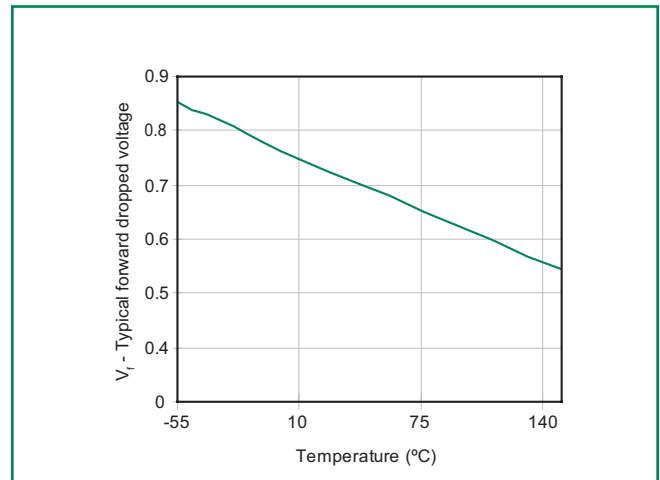
**Figure 4 - Pulse Waveform - 10/1000 $\mu$ S**



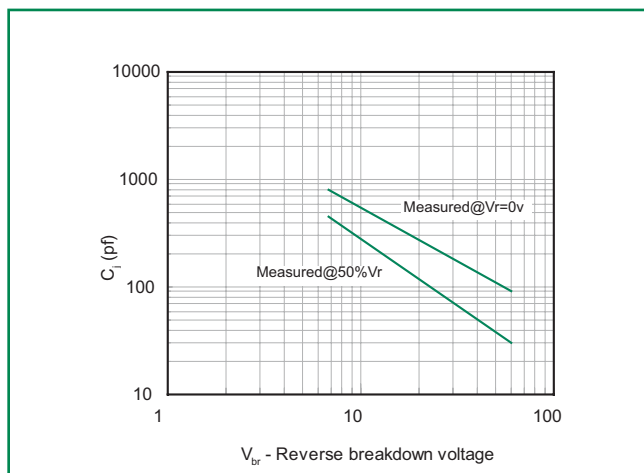
**Figure 5 - Steady State Power Dissipation Derating Curve**



**Figure 6 - Forward Voltage**

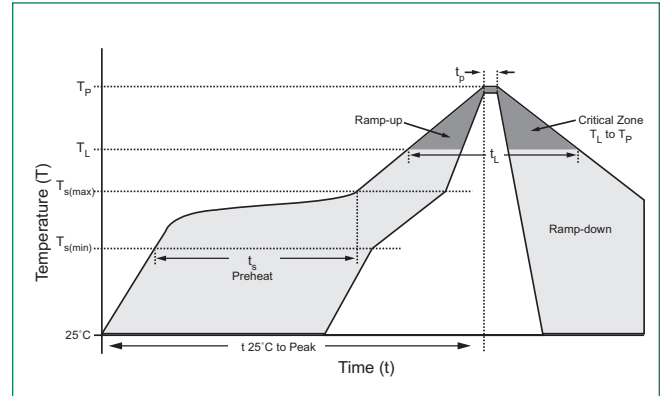


**Figure 7 -  $C_i$  vs. Working Peak Reverse Voltage**



### 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 <sup>+0/-5</sup> °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                                         |                                    | 260°C                   |



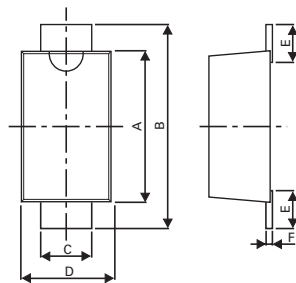
### Physical Specifications

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

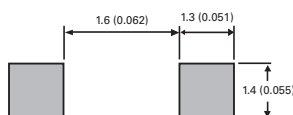
### Environmental Specifications

|                            |                          |
|----------------------------|--------------------------|
| <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-B106              |

### Dimensions - SOD-123F Package

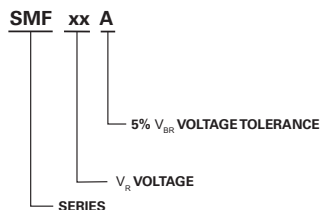


Mounting Pad Layout

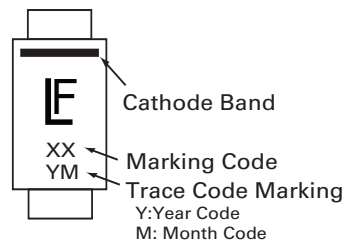


| Dimensions | Millimeters |      | Inches |        |
|------------|-------------|------|--------|--------|
|            | Min         | Max  | Min    | Max    |
| A          | 2.50        | 2.90 | 0.0984 | 0.1142 |
| B          | 3.40        | 3.90 | 0.1339 | 0.1535 |
| C          | 0.70        | 1.20 | 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 | 0.0000 | 0.0039 |
| H          | 0.95        | 1.10 | 0.0374 | 0.0433 |

### Part Numbering System



### Part Marking System



### Packaging Options

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

### Tape and Reel Specification

