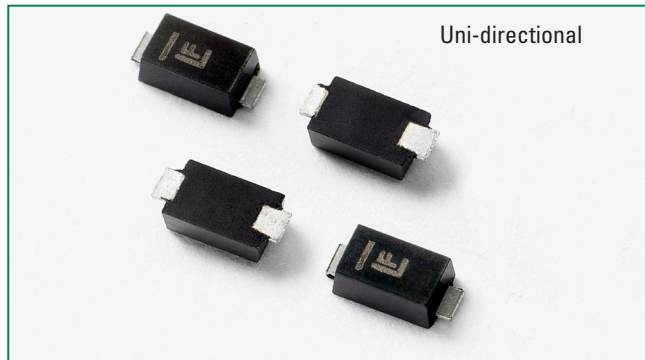


## SMF4L Series



### Agency Approvals

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

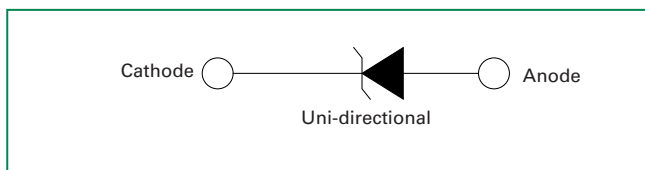
### Maximum Ratings and Thermal Characteristics ( $T_A=25^\circ\text{C}$ unless otherwise noted)

| Parameter                                                       | Symbol          | Value      | Unit               |
|-----------------------------------------------------------------|-----------------|------------|--------------------|
| Peak Pulse Power Dissipation at $T_A=25^\circ\text{C}$ (Note 1) | $P_{PPM}$       | 2000       | W                  |
|                                                                 |                 | 400        | W                  |
| Thermal Resistance Junction to Ambient                          | $R_{\theta JA}$ | 220        | $^\circ\text{C/W}$ |
| Thermal Resistance Junction to Lead                             | $R_{\theta JL}$ | 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  $T_J$  (initial)  $=25^\circ\text{C}$  per Fig. 3.
2. SMF4L5.0A~SMF4L9.0A Peak Pulse Power Dissipation is 1850W min, 2000W typical @8/20 $\mu\text{s}$
3. SMF4L5.0A~SMF4L9.0A Peak Pulse Power Dissipation is 370W min, 400W typical @ 10/1000 $\mu\text{s}$

### Functional Diagram



### Description

The SMF4L series of SOD-123FL small and flat lead low-profile plastic package is designed specifically to protect sensitive electronic equipment from voltage transients induced by lightning and other transient voltage events.

### Features

- 400W 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 0.98mm.
- Low inductance, excellent clamping capability
- For surface mounted applications to optimize board space
- 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
- High temperature soldering: 260 $^\circ\text{C}$ /40 seconds at terminals
- Glass passivated junction
- Built-in strain relief
- 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 2<sup>nd</sup> level interconnect is Pb-free and the terminal finish material is tin(Sn) (IPC/JEDEC J-STD-609A.01)

### Applications

SMF4L devices are ideal for the protection of portable devices/hard drives, notebooks,  $V_{CC}$  busses, POS terminal, SSDs, power supplies, monitors, and vulnerable circuit used in other consumer applications.

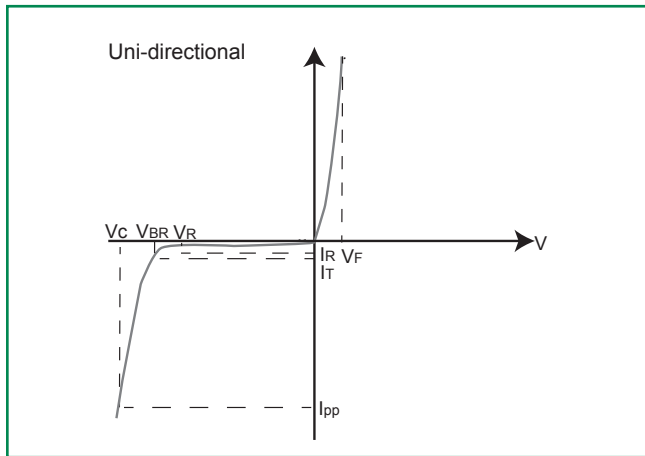
### Electrical Characteristics ( $T_A=25^\circ\text{C}$ unless otherwise noted)

| 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    |                         |                                     |                                                         |                                         |                                               |                                                                                                     |
| SMF4L5.0A   | KE           | 6.40                                       | 7.00   | 10                      | 5.0                                 | 800                                                     | 40.1                                    | 9.2                                           | X                                                                                                   |
| SMF4L6.0A   | KG           | 6.67                                       | 7.37   | 10                      | 6.0                                 | 800                                                     | 35.9                                    | 10.3                                          | X                                                                                                   |
| SMF4L6.5A   | KK           | 7.22                                       | 7.98   | 10                      | 6.5                                 | 500                                                     | 33.1                                    | 11.2                                          | X                                                                                                   |
| SMF4L7.0A   | KM           | 7.78                                       | 8.60   | 10                      | 7.0                                 | 200                                                     | 30.9                                    | 12.0                                          | X                                                                                                   |
| SMF4L7.5A   | KP           | 8.33                                       | 9.21   | 1                       | 7.5                                 | 100                                                     | 28.7                                    | 12.9                                          | X                                                                                                   |
| SMF4L8.0A   | KR           | 8.89                                       | 9.83   | 1                       | 8.0                                 | 50                                                      | 27.2                                    | 13.6                                          | X                                                                                                   |
| SMF4L8.5A   | KT           | 9.44                                       | 10.40  | 1                       | 8.5                                 | 20                                                      | 25.7                                    | 14.4                                          | X                                                                                                   |
| SMF4L9.0A   | KV           | 10.00                                      | 11.10  | 1                       | 9.0                                 | 10                                                      | 24.1                                    | 15.4                                          | X                                                                                                   |
| SMF4L10A    | KX           | 11.10                                      | 12.30  | 1                       | 10                                  | 5                                                       | 23.5                                    | 17.0                                          | X                                                                                                   |
| SMF4L11A    | KZ           | 12.20                                      | 13.50  | 1                       | 11                                  | 1                                                       | 22.0                                    | 18.2                                          | X                                                                                                   |
| SMF4L12A    | LE           | 13.30                                      | 14.70  | 1                       | 12                                  | 1                                                       | 20.1                                    | 19.9                                          | X                                                                                                   |
| SMF4L13A    | LG           | 14.40                                      | 15.90  | 1                       | 13                                  | 1                                                       | 18.6                                    | 21.5                                          | X                                                                                                   |
| SMF4L14A    | LK           | 15.60                                      | 17.20  | 1                       | 14                                  | 1                                                       | 17.2                                    | 23.2                                          | X                                                                                                   |
| SMF4L15A    | LM           | 16.70                                      | 18.50  | 1                       | 15                                  | 1                                                       | 16.4                                    | 24.4                                          | X                                                                                                   |
| SMF4L16A    | LP           | 17.80                                      | 19.70  | 1                       | 16                                  | 1                                                       | 15.4                                    | 26.0                                          | X                                                                                                   |
| SMF4L17A    | LR           | 18.90                                      | 20.90  | 1                       | 17                                  | 1                                                       | 14.5                                    | 27.6                                          | X                                                                                                   |
| SMF4L18A    | LT           | 20.00                                      | 22.10  | 1                       | 18                                  | 1                                                       | 13.7                                    | 29.2                                          | X                                                                                                   |
| SMF4L20A    | LV           | 22.20                                      | 24.50  | 1                       | 20                                  | 1                                                       | 12.3                                    | 32.4                                          | X                                                                                                   |
| SMF4L22A    | LX           | 24.40                                      | 26.90  | 1                       | 22                                  | 1                                                       | 11.3                                    | 35.5                                          | X                                                                                                   |
| SMF4L24A    | LZ           | 26.70                                      | 29.50  | 1                       | 24                                  | 1                                                       | 10.3                                    | 38.9                                          | X                                                                                                   |
| SMF4L26A    | ME           | 28.90                                      | 31.90  | 1                       | 26                                  | 1                                                       | 9.5                                     | 42.1                                          | X                                                                                                   |
| SMF4L28A    | MG           | 31.10                                      | 34.40  | 1                       | 28                                  | 1                                                       | 8.8                                     | 45.4                                          | X                                                                                                   |
| SMF4L30A    | MK           | 33.30                                      | 36.80  | 1                       | 30                                  | 1                                                       | 8.3                                     | 48.4                                          | X                                                                                                   |
| SMF4L33A    | MM           | 36.70                                      | 40.60  | 1                       | 33                                  | 1                                                       | 7.5                                     | 53.3                                          | X                                                                                                   |
| SMF4L36A    | MP           | 40.00                                      | 44.20  | 1                       | 36                                  | 1                                                       | 6.9                                     | 58.1                                          | X                                                                                                   |
| SMF4L40A    | MR           | 44.40                                      | 49.10  | 1                       | 40                                  | 1                                                       | 6.2                                     | 64.5                                          | X                                                                                                   |
| SMF4L43A    | MT           | 47.80                                      | 52.80  | 1                       | 43                                  | 1                                                       | 5.8                                     | 69.4                                          | X                                                                                                   |
| SMF4L45A    | MV           | 50.00                                      | 55.30  | 1                       | 45                                  | 1                                                       | 5.5                                     | 72.7                                          | X                                                                                                   |
| SMF4L48A    | MX           | 53.30                                      | 58.90  | 1                       | 48                                  | 1                                                       | 5.2                                     | 77.4                                          | X                                                                                                   |
| SMF4L51A    | MZ           | 56.70                                      | 62.70  | 1                       | 51                                  | 1                                                       | 4.9                                     | 82.4                                          | X                                                                                                   |
| SMF4L54A    | NE           | 60.00                                      | 66.30  | 1                       | 54                                  | 1                                                       | 4.6                                     | 87.1                                          | X                                                                                                   |
| SMF4L58A    | NG           | 64.40                                      | 71.20  | 1                       | 58                                  | 1                                                       | 4.3                                     | 93.6                                          | X                                                                                                   |
| SMF4L60A    | NK           | 66.70                                      | 73.70  | 1                       | 60                                  | 1                                                       | 4.1                                     | 96.8                                          | X                                                                                                   |
| SMF4L64A    | NM           | 71.10                                      | 78.60  | 1                       | 64                                  | 1                                                       | 3.9                                     | 103.0                                         | X                                                                                                   |
| SMF4L70A    | NP           | 77.80                                      | 86.00  | 1                       | 70                                  | 1                                                       | 3.5                                     | 113.0                                         | X                                                                                                   |
| SMF4L75A    | NR           | 83.30                                      | 92.10  | 1                       | 75                                  | 1                                                       | 3.3                                     | 121.0                                         | X                                                                                                   |
| SMF4L78A    | NT           | 86.70                                      | 95.80  | 1                       | 78                                  | 1                                                       | 3.2                                     | 126.0                                         | X                                                                                                   |
| SMF4L85A    | NV           | 94.40                                      | 104.00 | 1                       | 85                                  | 1                                                       | 2.9                                     | 137.0                                         | X                                                                                                   |

#### 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.
- 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 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**

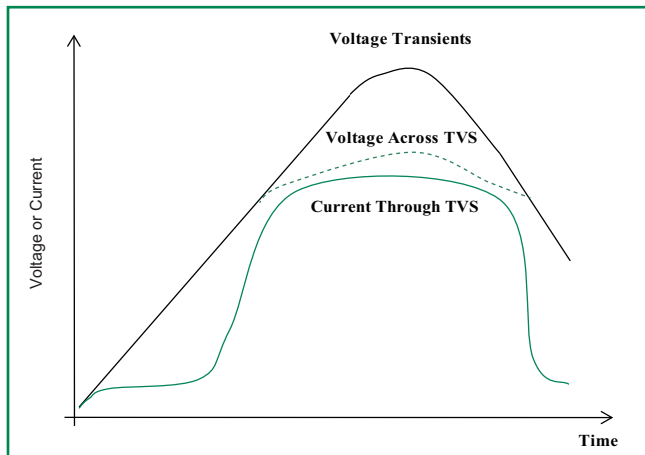
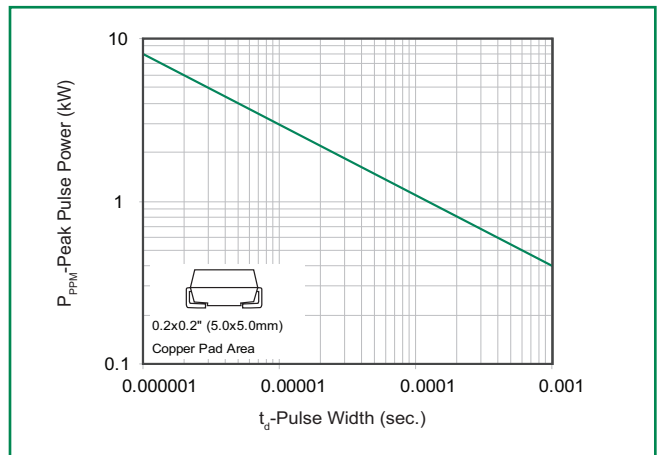


**Figure 2 - Peak Pulse Power Rating Curve**



continues on next page.

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

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

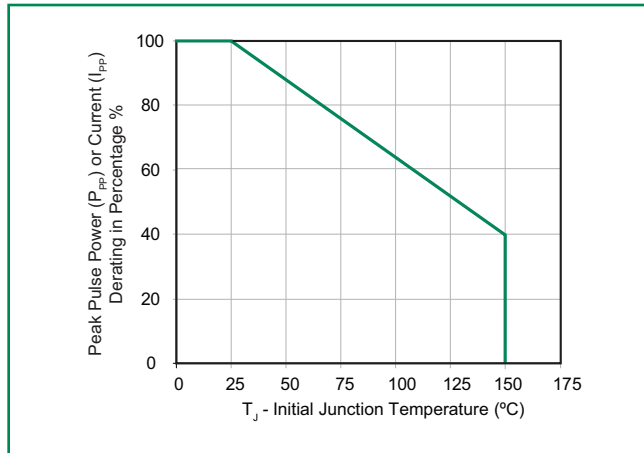


**Figure 4 - Pulse Waveform - 10/1000 $\mu\text{s}$**

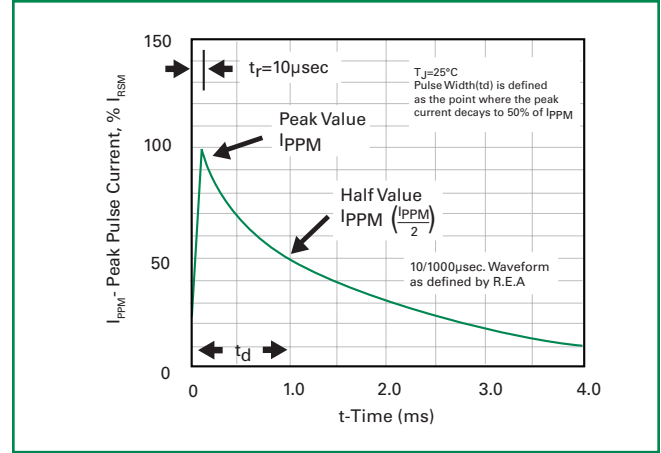


**Figure 5 - Forward Voltage**

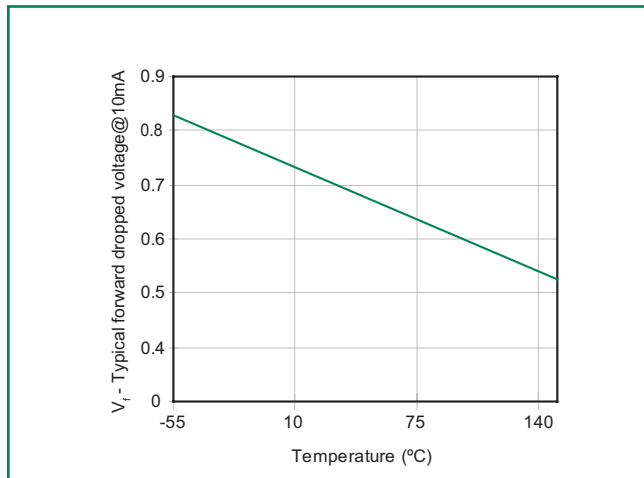


**Figure 6 - Typical Junction Capacitance**

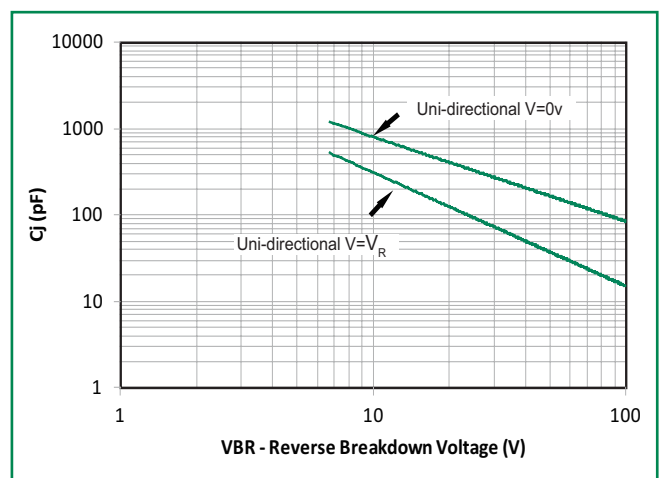


**Figure 7 - Peak Forward Voltage Drop vs. Peak Forward Current**

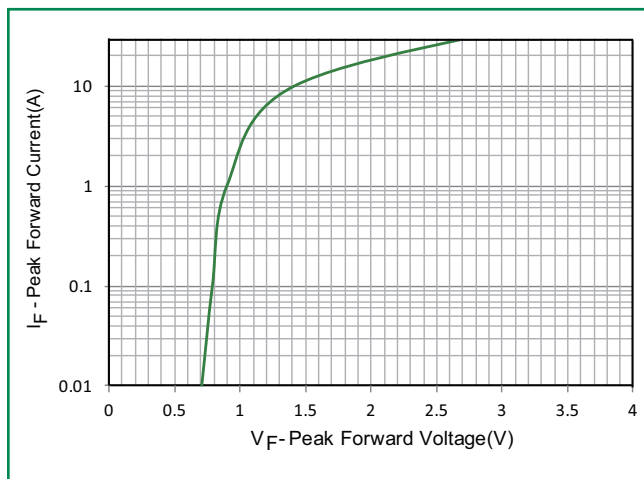
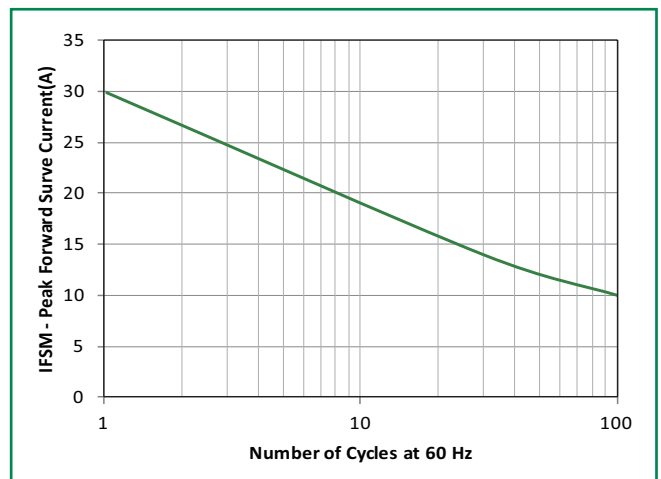
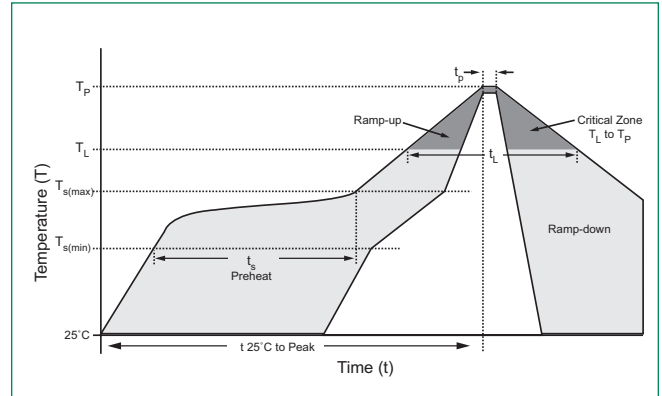


**Figure 8 - Maximum Non-Repetitive Forward Surge Current Uni-Directional Only**



### Soldering Parameters

|                                                        |                                    |                         |
|--------------------------------------------------------|------------------------------------|-------------------------|
| 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 ( $T_A$ ) to peak) |                                    | 3°C/second max          |
| $T_{s(max)}$ to $T_A$ - Ramp-up Rate                   |                                    | 3°C/second max          |
| Reflow                                                 | - Temperature ( $T_A$ ) (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                   |



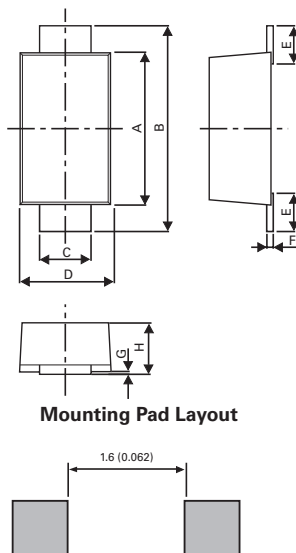
### Physical Specifications

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

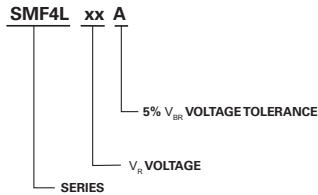
|                            |                          |
|----------------------------|--------------------------|
| <b>High Temp. Storage</b>  | JESD22-A103              |
| <b>HTRB</b>                | JESD22-A108              |
| <b>Temperature Cycling</b> | JESD22-A104              |
| <b>MSL</b>                 | JEDEC-J-STD-020, Level 1 |
| <b>H3TRB</b>               | JESD22-A101              |
| <b>RSH</b>                 | JESD22-A111              |

### Dimensions - SOD-123FL Package

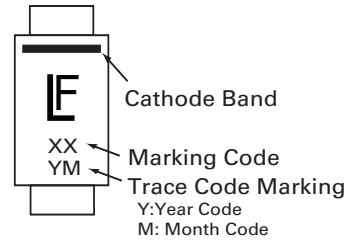


| Dimensions | Millimeters |      | Inches |       |
|------------|-------------|------|--------|-------|
|            | Min         | Max  | Min    | Max   |
| A          | 2.90        | 3.10 | 0.114  | 0.122 |
| B          | 3.50        | 3.90 | 0.138  | 0.154 |
| C          | 0.85        | 1.05 | 0.033  | 0.041 |
| D          | 1.70        | 2.00 | 0.067  | 0.079 |
| E          | 0.43        | 0.83 | 0.017  | 0.033 |
| F          | 0.10        | 0.25 | 0.004  | 0.010 |
| G          | 0.00        | 0.10 | 0.000  | 0.004 |
| H          | 0.90        | 0.98 | 0.035  | 0.039 |

### Part Numbering System



### Part Marking System



### Packaging Options

| Part number | Component Package | Quantity | Packaging Option               | Packaging Specification |
|-------------|-------------------|----------|--------------------------------|-------------------------|
| SMF4LXXX    | SOD-123FL         | 3000     | Tape & Reel – 8mm tape/7" reel | EIA RS-481              |

### Tape and Reel Specification

