

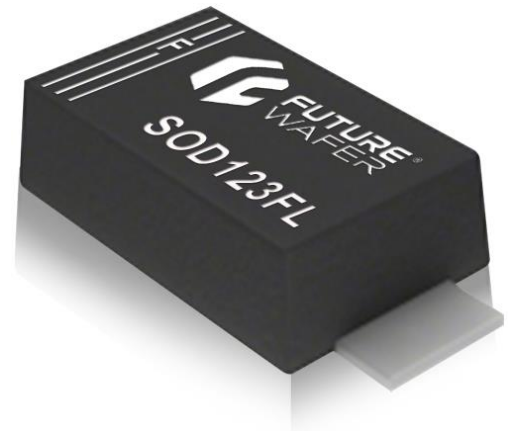
## 1. Synopsis

### 1-1. General Description

The NVS4M Series Has Been Designed To Protect Sensitive Equipment Against Electro-Static Discharges According to IEC 61000-4-2, MIL STD 883 Method 3015, And Electrical Over Stress Such as IEC 61000-4-4 and 5. They Are Generally For Surges Below 400 W 10/1000  $\mu$ s.

This Technology Makes It Compatible With High-End Equipment And SMPS Where Low Leakage Current And High Junction Temperature Are Required To Provide Reliability And Stability Over Time. Their Low Clamping Voltages Provide a Better Safety Margin to Protect Sensitive Circuits With Extended Life Time Expectancy.

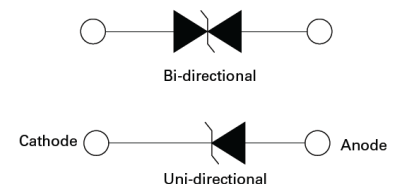
Packaged in SOD123FL, This Minimizes PCB Space Consumption.



SOD123FL

### 1-2. Feature List

- Bi / Uni-Directional Configurations
- Plastic Package Has Underwriters
- Glass Passivated Chip Junction in SOD123FL Package
- 400 Watts Peak Pulse Power (  $t_p = 10/1000\mu$ S )
- Halogen Free and RoHS Compliant
- Fast Response Time: Typically Less Than 1.0ps From 0 Volts to V(BR) For Uni-Directional and 5.0ns For Bi-Directional Types
- High Temperature Soldering Guaranteed: 250°C / 10 Seconds at Terminals



### 1-3. Applications

- Power Supply Protection
- Industrial Application
- Power Manager

### 1-4. IEC Compatibility

- EN61000-4
- 61000-4-2(ESD): Contact:  $>\pm 30$ KV, Air:  $>\pm 30$ KV
- 61000-4-4(EFT)
- 61000-4-5(Surge): 10/1000 $\mu$ S

### 1-5. Mechanical Characteristics

- Molded JEDEC SOD123FL Package
- Packing: Tape and Reel
- Flammability Rating UL 94V-0
- Halogen Free
- JEDEC MSL Classification: Level 1



## **2. Contents**

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### 3. Electrical Property

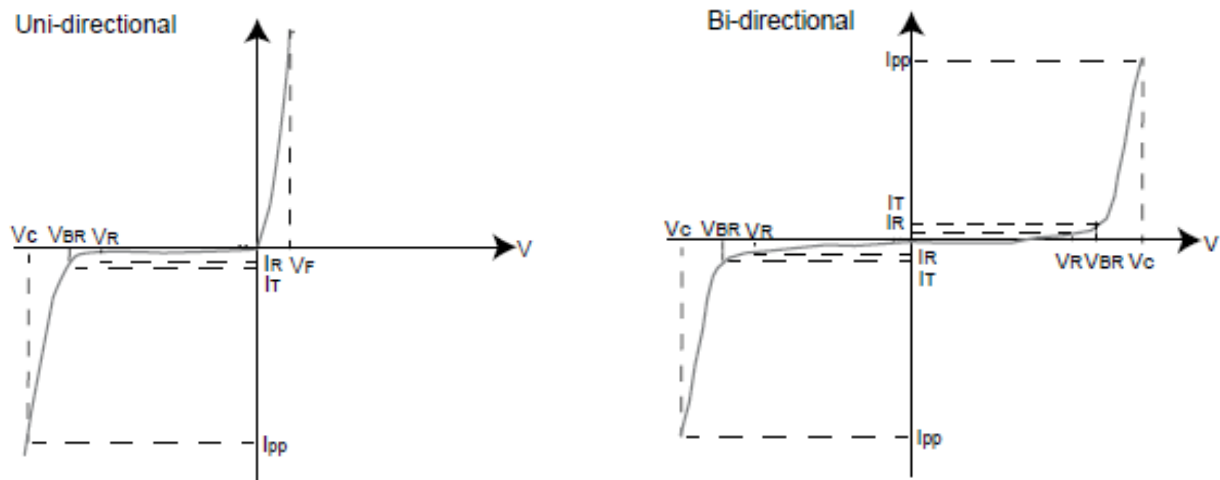
#### 3-1. Absolute Maximum Ratings

| Maximum Ratings@25°C Unless Otherwise Specified                             |           |                          |          |       |
|-----------------------------------------------------------------------------|-----------|--------------------------|----------|-------|
| Parameter                                                                   | Symbol    |                          | Value    | Units |
| Peak Pulse Power                                                            | $P_{PP}$  | ( $t_p = 10/1000\mu s$ ) | 400      | W     |
|                                                                             |           | ( $t_p = 8/20\mu s$ )    | 2400     |       |
| Peak Forward Surge Current,8.3mS Signal Half Sine Wave Uni-Directional Only | $I_{FSM}$ |                          | 40       | A     |
| Maximum Instantaneous Forward Voltage at 100A For Uni-Direction Only        | $V_F$     |                          | 3.5      | V     |
| Power Dissipation on Infinite Heatsink                                      | $P_D$     |                          | 1        | W     |
| Peak Pulse Voltage (IEC61000-4-2 Contact)                                   | $V_{PP}$  |                          | ± 30     | KV    |
| Operating Temperature                                                       | $T_J$     |                          | -65~+150 | °C    |
| Storage Temperature                                                         | $T_{STG}$ |                          |          |       |

#### 3-2. Electrical Characteristics (Tamb=25°C)

| Part Number                                                          |            | Reverse Stand-off Voltage | Breakdown Voltage |        | Test Current | Reverse Leakage | Max. Clamp Voltage | Peak Pulse Current      | Marking |     |
|----------------------------------------------------------------------|------------|---------------------------|-------------------|--------|--------------|-----------------|--------------------|-------------------------|---------|-----|
|                                                                      |            | $V_{RWM}$                 | $V_{BR} @ I_T$    |        | $I_T$        | $I_R @ V_{RWM}$ | $V_C @ I_{PP}$     | $I_{PP} (10/1000\mu s)$ |         |     |
| Uni                                                                  | Bi         | V                         | Min. V            | Max. V | mA           | $\mu A$         | V                  | A                       | Uni     | Bi  |
| <b>400W Surface Mount Transient Voltage Suppressors NVS4M Series</b> |            |                           |                   |        |              |                 |                    |                         |         |     |
| NVS4M5.0A                                                            | NVS4M5.0CA | 5.0                       | 6.46              | 7.14   | 10.0         | 2.0             | 9.2                | 43.5                    | A1      | FA1 |
| NVS4M6.0A                                                            | NVS4M6.0CA | 6.0                       | 6.65              | 7.35   | 10.0         | 2.0             | 10.3               | 38.8                    | A2      | FA2 |
| NVS4M6.5A                                                            | NVS4M6.5CA | 6.5                       | 7.13              | 7.88   | 10.0         | 2.0             | 11.2               | 37.5                    | A3      | FA3 |
| NVS4M8.5A                                                            | NVS4M8.5CA | 8.5                       | 9.50              | 10.50  | 1.0          | 0.2             | 14.4               | 27.7                    | A4      | FA4 |
| NVS4M10A                                                             | NVS4M10CA  | 10.0                      | 11.40             | 12.60  | 1.0          | 0.2             | 17.0               | 23.5                    | A5      | FA5 |
| NVS4M12A                                                             | NVS4M12CA  | 12.0                      | 13.30             | 14.70  | 1.0          | 0.2             | 19.9               | 20.1                    | A6      | FA6 |
| NVS4M13A                                                             | NVS4M13CA  | 13.0                      | 14.25             | 15.75  | 1.0          | 0.2             | 21.5               | 18.6                    | A7      | FA7 |
| NVS4M15A                                                             | NVS4M15CA  | 15.0                      | 17.10             | 18.90  | 1.0          | 0.2             | 24.4               | 16.4                    | A8      | FA8 |
| NVS4M18A                                                             | NVS4M18CA  | 18.0                      | 20.90             | 23.10  | 1.0          | 0.2             | 29.2               | 14.0                    | A9      | FA9 |
| NVS4M20A                                                             | NVS4M20CA  | 20.0                      | 22.80             | 25.20  | 1.0          | 0.2             | 32.4               | 12.5                    | AA/CV   | FAA |
| NVS4M24A                                                             | NVS4M24CA  | 24.0                      | 26.60             | 29.40  | 1.0          | 0.2             | 38.9               | 10.5                    | AB/SZ   | FAB |
| NVS4M26A                                                             | NVS4M26CA  | 26.0                      | 28.50             | 31.50  | 1.0          | 0.2             | 42.1               | 9.5                     | AC/DE   | FAC |
| NVS4M28A                                                             | NVS4M28CA  | 28.0                      | 31.35             | 34.65  | 1.0          | 0.2             | 45.4               | 8.8                     | AD/DG   | FAD |
| NVS4M33A                                                             | NVS4M33CA  | 33.0                      | 35.15             | 38.85  | 1.0          | 0.2             | 53.3               | 7.5                     | AE/DM   | FAE |
| NVS4M36A                                                             | NVS4M36CA  | 36.0                      | 38.00             | 42.00  | 1.0          | 0.2             | 58.1               | 6.9                     | AF/DP   | FAF |
| NVS4M40A                                                             | NVS4M40CA  | 40.0                      | 47.80             | 52.80  | 1.0          | 0.2             | 69.4               | 5.8                     | AL      | FAL |
| NVS4M43A                                                             | NVS4M43CA  | 43.0                      | 50.00             | 55.30  | 1.0          | 0.2             | 72.7               | 5.5                     | AS      | FAS |
| NVS4M45A                                                             | NVS4M45CA  | 45.0                      | 53.30             | 58.90  | 1.0          | 0.2             | 77.4               | 5.2                     | AR      | FAR |
| NVS4M48A                                                             | NVS4M48CA  | 48.0                      | 53.20             | 58.80  | 1.0          | 0.2             | 77.4               | 5.2                     | AG/DX   | FAG |
| NVS4M51A                                                             | NVS4M51CA  | 51.0                      | 56.72             | 62.69  | 1.0          | 0.2             | 82.4               | 4.9                     | AH/DG   | FAH |
| NVS4M58A                                                             | NVS4M58CA  | 58.0                      | 64.41             | 71.19  | 1.0          | 0.2             | 93.6               | 4.3                     | AI/EG   | FAI |

### 3-3. I-V Curve Characteristics



|                        |                                                                                                                                |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| <b>P<sub>PPM</sub></b> | <b>Peak Pulse Power Dissipation</b> -Max Power Dissipation                                                                     |
| <b>V<sub>R</sub></b>   | <b>Stand-off Voltage</b> -Maximum Voltage That Can be Applied to The TVS Without Operation                                     |
| <b>I<sub>R</sub></b>   | <b>Reverse Leakage Current</b> -Current Measured at V <sub>R</sub>                                                             |
| <b>V<sub>F</sub></b>   | <b>Forward Voltage Drop for Uni-directional</b>                                                                                |
| <b>V<sub>BR</sub></b>  | <b>Breakdown Voltage</b> -Maximum Voltage that Flows Though the TVS at a Specified Test Current (I <sub>T</sub> )              |
| <b>V<sub>C</sub></b>   | <b>Clamping Voltage</b> -Peak Voltage Measured Across the Suppressor at a Specified I <sub>ppm</sub><br>(Peak Impulse Current) |

**3-4. Ratings and Characteristics Curve** ( $T_A=25^\circ\text{C}$  unless otherwise noted)

Fig 1. Peak Pulse Power Dissipation  
vs. Initial Junction Temperature

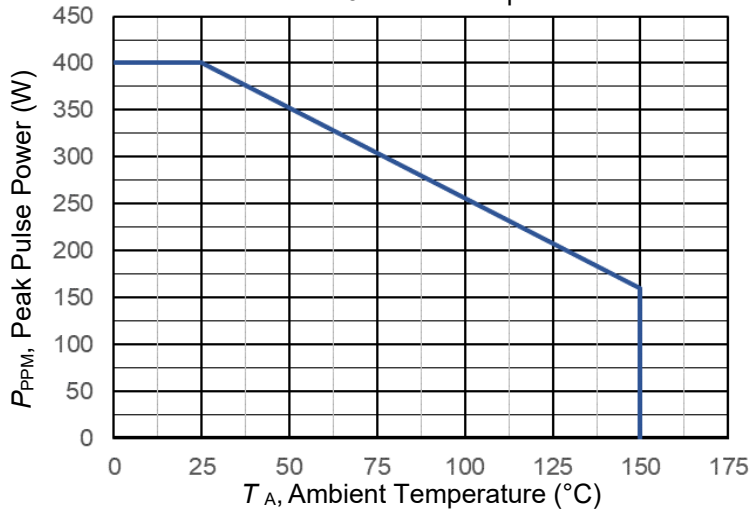


Fig 2. Peak Pulse Power Rating Curve

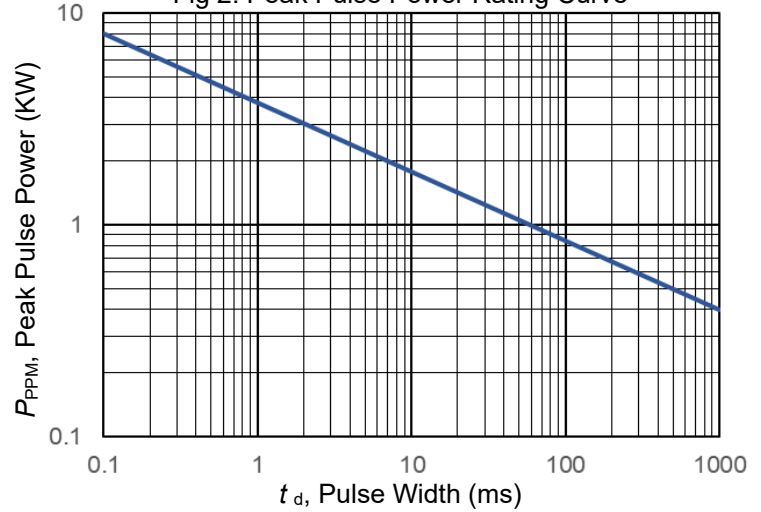


Fig 3. Peak Forward Voltage Drop  
vs. Peak Forward Current

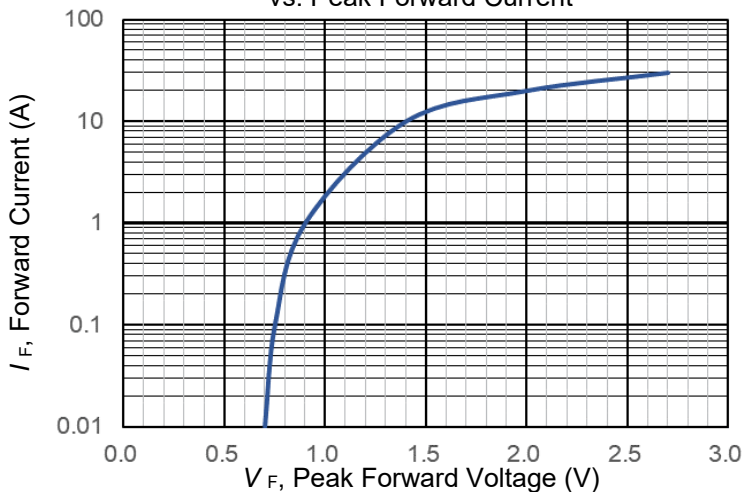


Fig 4. Maximum Non-repetitive Forward  
Surge Current Uni-direction Only

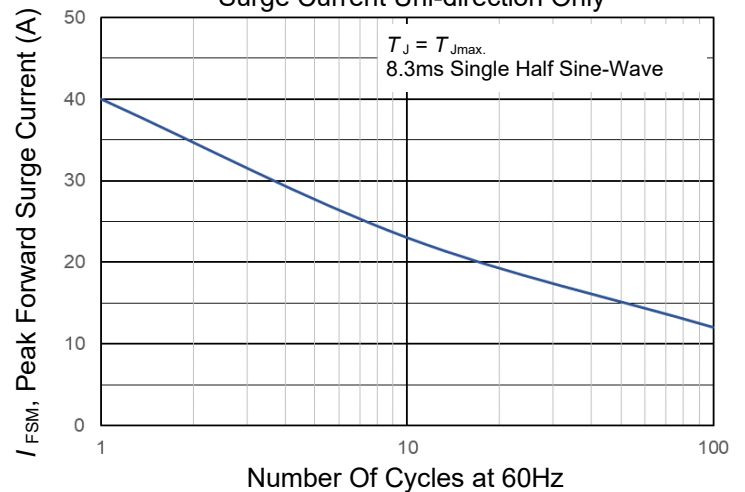


Fig 5. Forward Voltage Curve

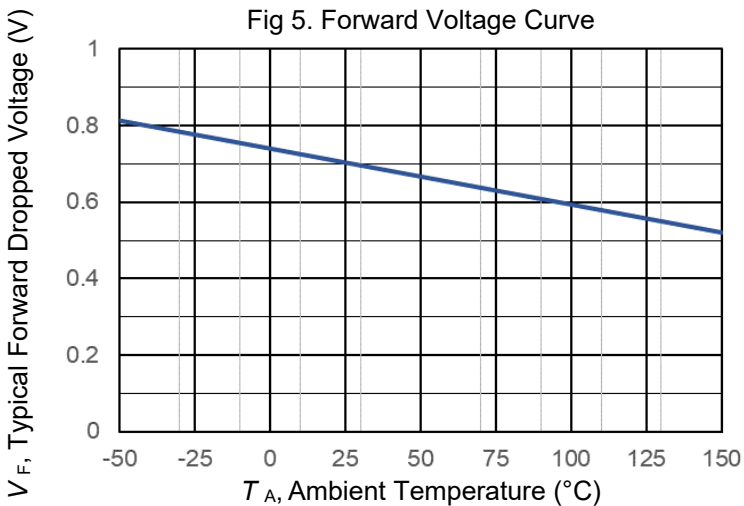
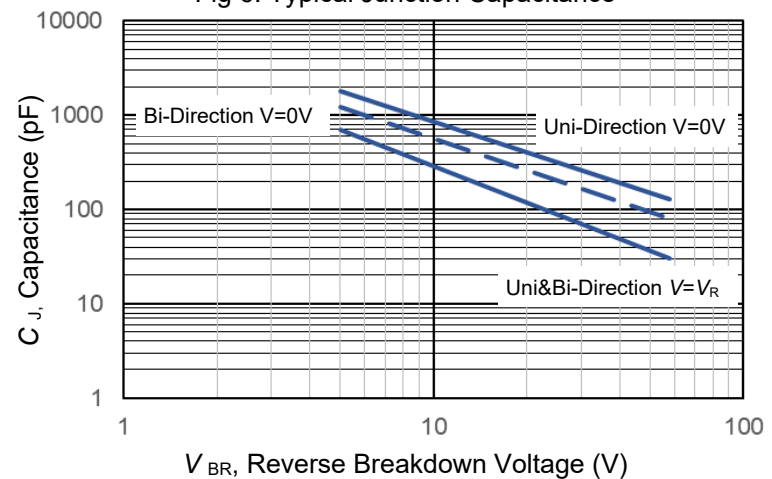


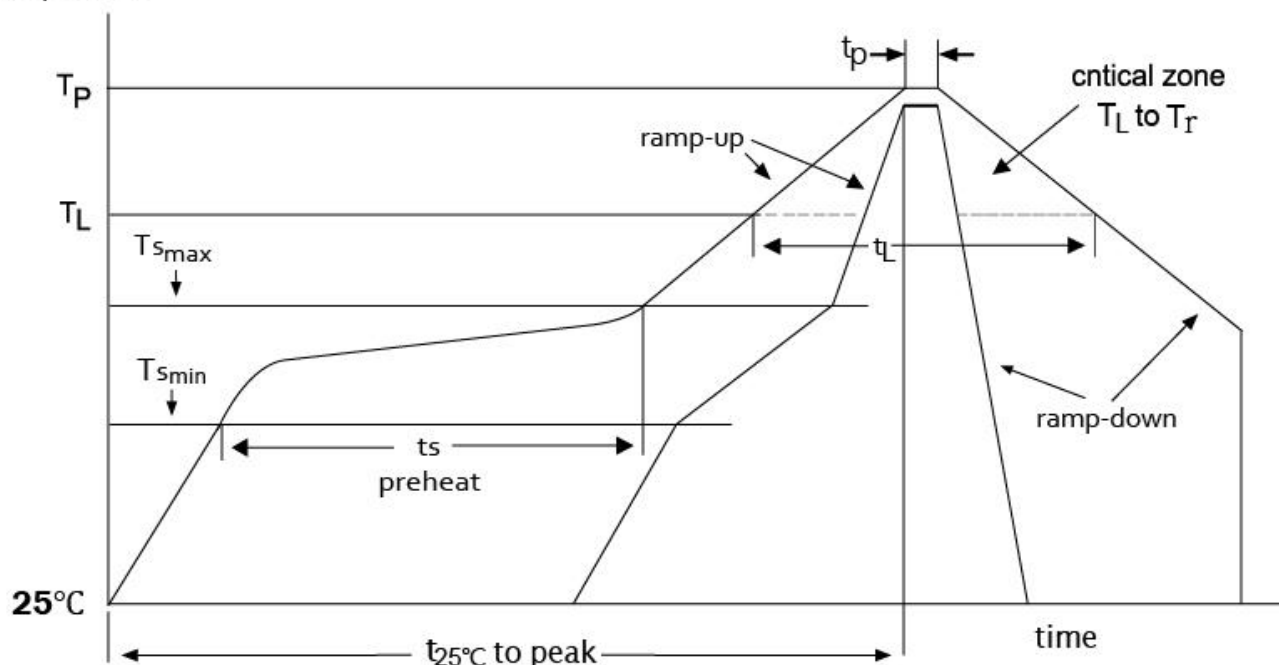
Fig 6. Typical Junction Capacitance



#### 4. Soldering Parameters

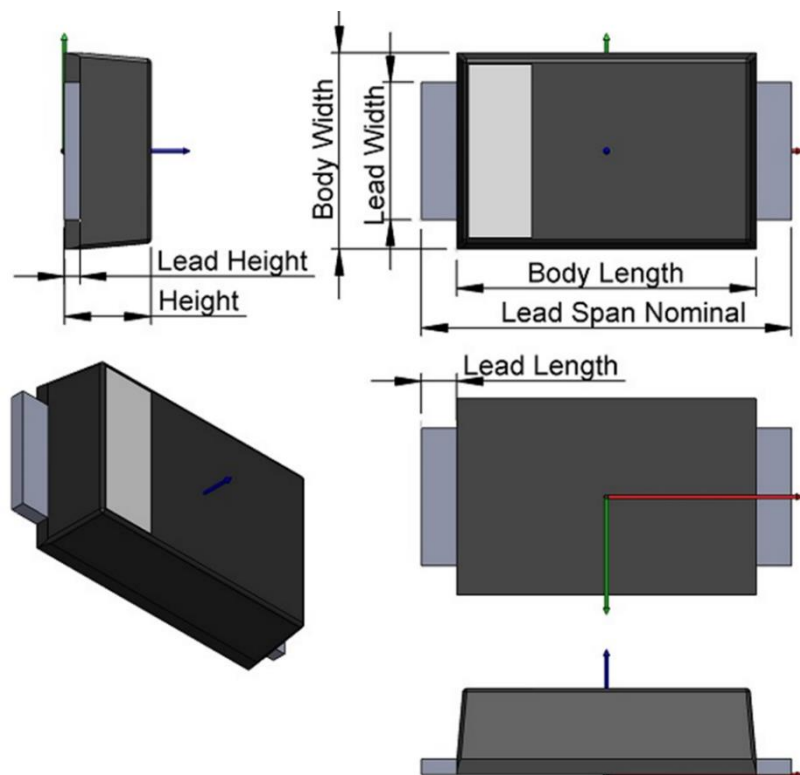
| Profile Feature                                               | SnPb eutectic assembly | Pb-free assembly  |
|---------------------------------------------------------------|------------------------|-------------------|
| Average ramp-up rate (T <sub>smax</sub> to T <sub>p</sub> )   | 3 °C/s maximum         | 3 °C/s maximum    |
| Preheat                                                       |                        |                   |
| Temperature minimum (T <sub>smin</sub> )                      | 100 °C                 | 150 °C            |
| Temperature maximum (T <sub>smax</sub> )                      | 150 °C                 | 200 °C            |
| Time (t <sub>smin</sub> to t <sub>smax</sub> )                | 60 s to 120 s          | 60 s to 180 s     |
| Time maintained above                                         |                        |                   |
| Temperature (T <sub>L</sub> )                                 | 183 °C                 | 217 °C            |
| Time (t <sub>L</sub> )                                        | 60 s to 150 s          | 60 s to 150 s     |
| Peak/classification temperature (T)                           | 235 °C                 | 260 °C            |
| Number of allowed reflow cycles                               | 3                      | 3                 |
| Time within 5 °C of actual peak temperature (t <sub>p</sub> ) | 10 s to 30 s           | 20 s to 40 s      |
| Ramp-down rate                                                | 6 °C/s maximum         | 6 °C/s maximum    |
| Time 25 °C to peak temperature                                | 6 minutes maximum      | 8 minutes maximum |

temperature



## 5. Package Information

### 5-1. Dimension

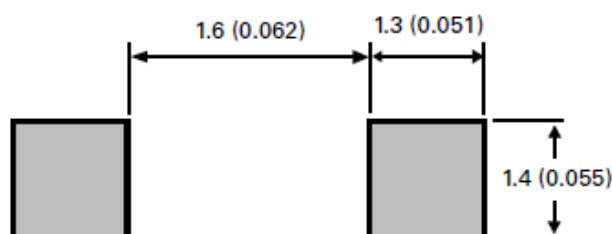


**SOD-123FL (mm)**

| Dim               | Min  | Max  |
|-------------------|------|------|
| Body Length       | 2.50 | 2.90 |
| Lead Span Nominal | 3.40 | 3.90 |
| Lead Width        | 0.70 | 1.20 |
| Body Width        | 1.50 | 2.00 |
| Height            | 0.90 | 1.40 |
| Lead Height       | 0.10 | 0.20 |
| Lead Length       | 0.35 | 0.90 |

Unit:mm

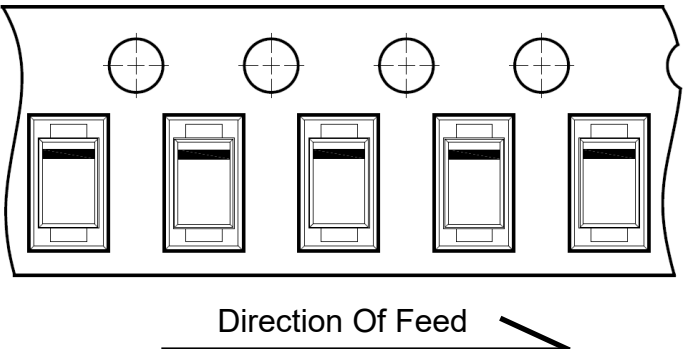
### 5-2. PCB Pad Layout Recommendation



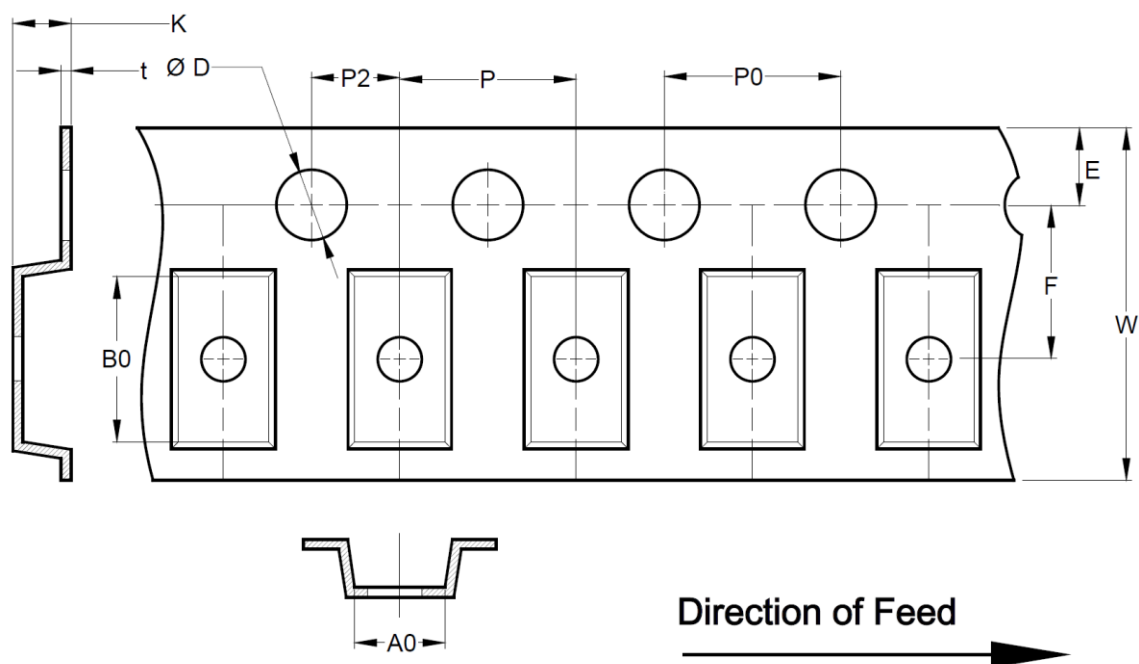
Unit:mm

## 6. Packing

### 6-1. Taping and Reel Specification

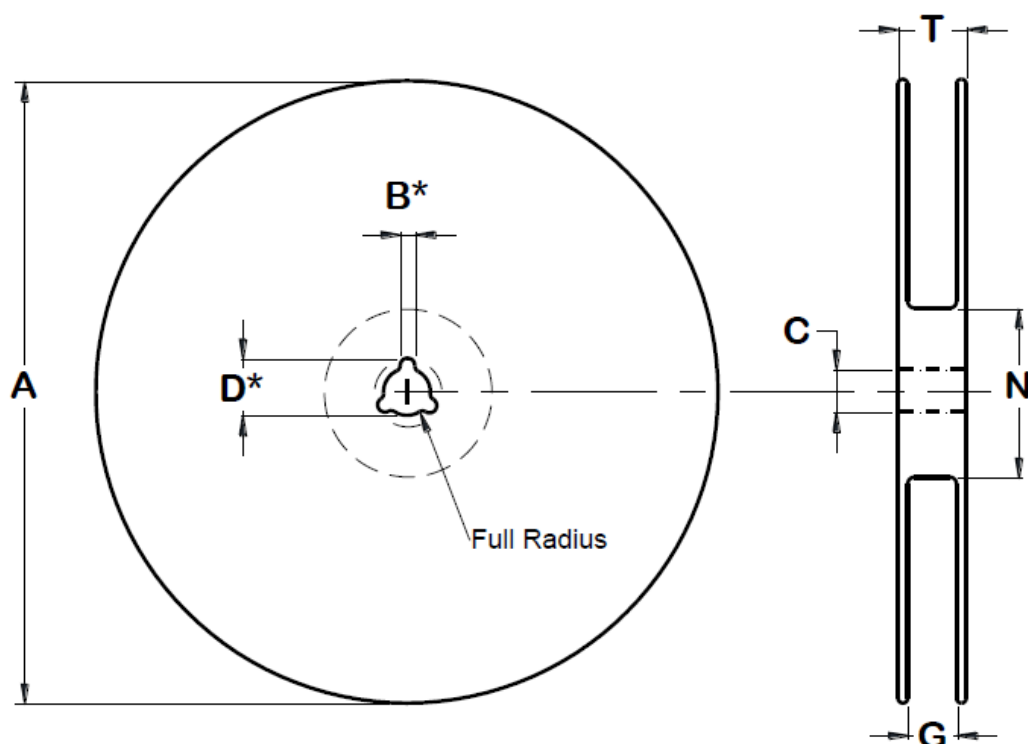
| Taping Width | Tape Orientation                                                                   |
|--------------|------------------------------------------------------------------------------------|
| 8mm          |  |

### 6-2. Embossed Carrier Tape Specification



| Unit:mm            |                                                                                                                                                                                                                                 |               |               |               |               |              |               |              |              |              |               |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------------|---------------|---------------|--------------|---------------|--------------|--------------|--------------|---------------|
| Dimension          | W                                                                                                                                                                                                                               | A0            | B0            | D             | E             | F            | K             | P            | P0           | P2           | t             |
| Value              | 8 mm                                                                                                                                                                                                                            | 2.05<br>±0.10 | 3.75<br>±0.20 | 1.50<br>+0.10 | 1.75<br>±0.10 | 3.5<br>±0.05 | 1.32<br>±0.10 | 4.0<br>±0.10 | 4.0<br>±0.10 | 2.0<br>±0.05 | 0.23<br>±0.02 |
| A0 /<br>B0 /<br>K0 | Determined by Component Size. The Clearance Between The Component And The Cavity Must Comply to The Rotational and Lateral Movement Requirement Provided in Figures in The "Maximum Component Movement in Tape Pocket" Section. |               |               |               |               |              |               |              |              |              |               |

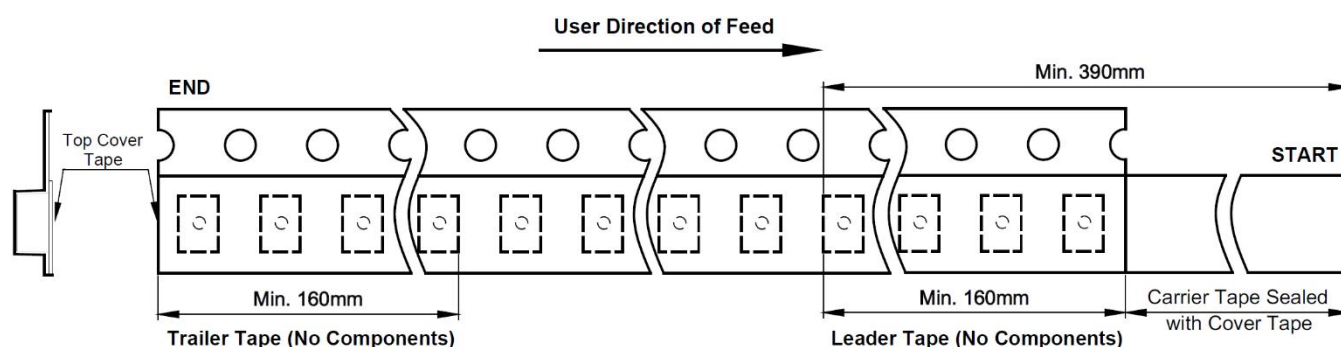
### 6-3. Surface Mount Reel Specification



Unit:mm

| Dimension | Tape Width | Reel Size | A         | B             | C              | D            | N        | G                | T    |
|-----------|------------|-----------|-----------|---------------|----------------|--------------|----------|------------------|------|
| Value     | 8 mm       | 7"        | 178<br>±2 | 2.0<br>+0.5-0 | 13<br>+0.5-0.2 | 20.5<br>±0.2 | 55<br>±5 | 8.4<br>+1.5/-0.0 | 14.4 |

### 6-4. Tape Leader and Trailer Specification



## 7. Family Members

| Part Number         | Component Package | Watts       | Working Voltage $V_{RWM}(V)$ |
|---------------------|-------------------|-------------|------------------------------|
| SMF Series          | <b>SOD-123FL</b>  | 300W        | 5.0V ~ 190V                  |
| <b>NVS4M Series</b> |                   | <b>400W</b> | <b>5.0V ~ 58V</b>            |
| NVS4D Series        | DFN2020-3L        | 400W        | 3.3V ~ 58V                   |
| SMAJ Series         | SMAJ              | 400W        | 5.0V ~ 190V                  |
| SMA6J Series        |                   | 600W        | 12V ~ 58V                    |
| NVS6A Series        | SMAF              | 600W        | 12V ~ 58V                    |
| SMBJ Series         | SMBJ              | 600W        | 5.0V ~ 190V                  |
| SMB10J Series       |                   | 1000W       |                              |
| NVS15B Series       | SMBF              | 1500W       | 5.0V ~ 58V                   |
| SMPJ Series         | TO-277            | 1500W       | 5.0V ~ 200V                  |
| SMCJ Series         | SMCJ              | 1500W       | 5.0V ~ 190V                  |
| 2.0SMCJ Series      |                   | 2000W       |                              |
| 3.0SMCJ Series      |                   | 3000W       |                              |
| 4.0SMCJ Series      |                   | 4000W       | 12V ~ 58V                    |
| 5.0SMCJ Series      |                   | 5000W       | 12V ~ 170V                   |
| 6KA Series          |                   | 6600W       | 21V ~ 58V                    |
| 5KP Series          | P600              | 5000W       | 5.0V ~ 180V                  |
| 10KP Series         |                   | 10000W      | 17V ~ 180V                   |
| 15KP Series         |                   | 15000W      |                              |
| 20KP Series         |                   | 20000W      | 20V ~ 180V                   |

## 8. Ordering Information

| Part Number | Marking Code | Quantity | Component Package | Packaging Option                   |
|-------------|--------------|----------|-------------------|------------------------------------|
| NVS4MxxA    | Series       | 3,000PCS | SOD-123FL         | Tape & Reel -<br>8mm tape / 7"reel |
| NVS4MxxCA   |              |          |                   |                                    |

## 9. Version

### 9-1. History

| Version | Date        | File No. | Recording                     | Basis  |
|---------|-------------|----------|-------------------------------|--------|
| A       | 01-Dec-2017 | F117492  | New Create                    | Market |
| B       | 01-Jun-2019 |          | Update Company Information    | System |
| C       | 23-Sep-2019 |          | Update New Model Year Marking | System |
| 2.0     | 11-Apr-2021 |          | Update Version                | System |
| 2.1     | 15-Jul-2021 |          | Update Version                | System |