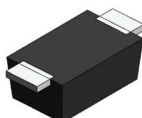


# SMF

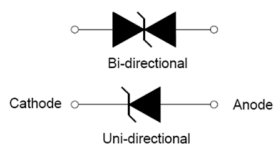
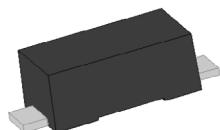
## Automotive grade 400 W Transient voltage suppressor



### Product features

- Automotive grade (AEC-Q101 qualified)
- Low profile SOD-123FL package
- Excellent clamping capability
- High reliability application
- 400 W peak pulse power capability at 10/1000  $\mu$ s waveform
- Typical  $I_R$  less than 1  $\mu$ A above 10 V
- Fast response time: typically less than 1.0 ps from 0 V to  $V_{BR}$  minimum
- Plastic package meets UL 94 V-0 flammability rating
- Meets moisture sensitivity level (MSL) level 1
- Terminal: tin plated, solderable per J-STD-002

### PIN configuration



### Applications

- Automotive chassis and safety systems
- Advanced driver assistance systems (ADAS)
- Communication and infotainment systems
- Network systems and body electronics
- Power Train controls
- xEV and battery systems

### Environmental compliance and general specifications

- AEC-Q101 qualified



### Ordering part number

|                                          | SMF | 5.0 | C | A | L | H |
|------------------------------------------|-----|-----|---|---|---|---|
| Family name                              |     |     |   |   |   |   |
| $V_R$ voltage                            |     |     |   |   |   |   |
| Bi-/Uni-Directional<br>(Blank=Uni, C=Bi) |     |     |   |   |   |   |
| Voltage tolerance                        |     |     |   |   |   |   |
| $P_{PP}$ (400 W version)                 |     |     |   |   |   |   |
| High reliability application             |     |     |   |   |   |   |

### Alternate ordering part number

|                                                | SMFE | 5-0 | C | A | L | H |
|------------------------------------------------|------|-----|---|---|---|---|
| Family name                                    |      |     |   |   |   |   |
| $V_R$ voltage<br>("-" indicates decimal point) |      |     |   |   |   |   |
| Bi-/Uni-Directional<br>(Blank=Uni, C=Bi)       |      |     |   |   |   |   |
| Voltage tolerance                              |      |     |   |   |   |   |
| $P_{PP}$ (400 W version)                       |      |     |   |   |   |   |
| High reliability application                   |      |     |   |   |   |   |



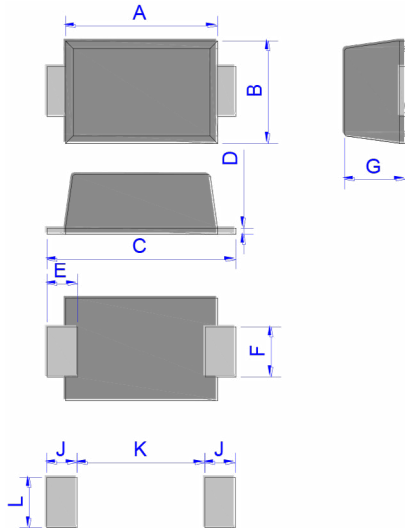
Powering Business Worldwide

## Absolute maximum ratings

(+25 °C, RH=45%-75%, unless otherwise noted)

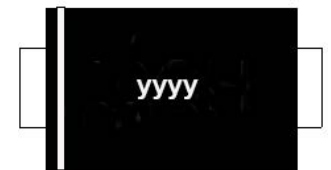
| Parameter                                                        | Symbol          | Value       | Unit |
|------------------------------------------------------------------|-----------------|-------------|------|
| Storage operating junction temperature range                     | $T_{STG}/T_J$   | -55 to +150 | °C   |
| Peak pulse power dissipation on 10/1000 $\mu$ s waveform         | $P_{PP}$        | 400         | W    |
| Maximum instantaneous forward voltage at 20 A for unidirectional | $V_F$           | 5.0         | V    |
| Typical thermal resistance junction to lead                      | $R_{\theta JL}$ | 100         | °C/W |
| Typical thermal resistance junction to ambient                   | $R_{\theta JA}$ | 220         | °C/W |

## Mechanical parameters, pad layout- mm/inches



| Dimension | Millimeters |         | Inches  |          |
|-----------|-------------|---------|---------|----------|
|           | Minimum     | Maximum | Minimum | Maximum  |
| A         | 2.60        | 3.00    | 0.102   | 0.118    |
| B         | 1.60        | 2.00    | 0.063   | 0.079    |
| C         | 3.45        | 3.95    | 0.136   | 0.156    |
| D         | 0.10        | 0.25    | 0.004   | 0.010    |
| E         | 0.30        | 0.90    | 0.012   | 0.035    |
| F         | 0.80        | 1.20    | 0.031   | 0.047    |
| G         | 0.70        | 1.00    | 0.0275  | • 0.0393 |
| J         | 1.30        | -       | 0.051   | -        |
| K         | -           | 1.70    | -       | 0.067    |
| L         | 1.30        | -       | 0.051   | -        |

## Part marking



Cathode band (uni-polar only)

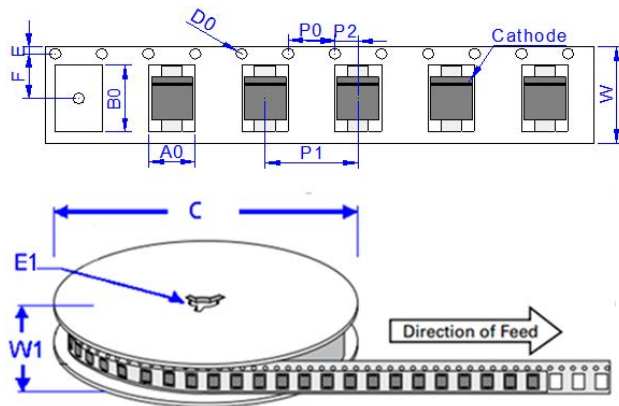
Part marking:

yyyy= Placeholder- refer to "Marking" listed in Electrical characteristics table for actual marking

## Packaging information - mm/inches

Drawing not to scale.

Supplied in tape and reel packaging, 3,000 parts per 7" diameter reel (EIA-481 compliant)



| Dimensions | Millimeters | Inches        |
|------------|-------------|---------------|
| A0         | 1.95 ± 0.3  | 0.077 ± 0.012 |
| B0         | 3.95 ± 0.3  | 0.156 ± 0.012 |
| C          | 178.0       | 7.0           |
| D0         | 1.55 ± 0.1  | 0.061 ± 0.004 |
| E          | 1.75 ± 0.2  | 0.069 ± 0.008 |
| E1         | 13.3 ± 0.3  | 0.524 ± 0.012 |
| F          | 3.50 ± 0.2  | 0.138 ± 0.008 |
| P0         | 4.00 ± 0.2  | 0.157 ± 0.008 |
| P1         | 4.00 ± 0.2  | 0.157 ± 0.008 |
| P2         | 2.00 ± 0.2  | 0.079 ± 0.008 |
| W          | 8.0 ± 0.2   | 0.315 ± 0.008 |
| W1         | 11.5 ± 1.0  | 0.453 ± 0.039 |

Electrical specifications (+25 °C)

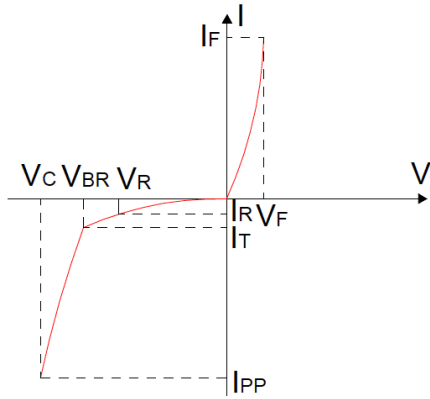
| Part number |           | Marking |       | V <sub>R</sub> | I <sub>R</sub> @ V <sub>R</sub> | V <sub>BR</sub> @ I <sub>T</sub> |         | I <sub>T</sub> | V <sub>C</sub> @ I <sub>PP</sub> | I <sub>PP</sub> |
|-------------|-----------|---------|-------|----------------|---------------------------------|----------------------------------|---------|----------------|----------------------------------|-----------------|
| Uni-polar   | Bi-polar  | Uni     | Bi    | (V)            | max (μA)                        | min (V)                          | max (V) | (mA)           | max (V)                          | (A)             |
| SMF5.0ALH   | /         | AEH     | /     | 5              | 40                              | 6.4                              | 7       | 10             | 9.2                              | 40.1            |
| SMF6.0ALH   | /         | AGH     | /     | 6              | 40                              | 6.67                             | 7.37    | 10             | 10.3                             | 35.9            |
| SMF6.5ALH   | /         | AKH     | /     | 6.5            | 30                              | 7.22                             | 7.98    | 10             | 11.2                             | 33.1            |
| SMF7.0ALH   | /         | AMH     | /     | 7              | 30                              | 7.78                             | 8.6     | 10             | 12                               | 30.9            |
| SMF7.5ALH   | /         | APH     | /     | 7.5            | 30                              | 8.33                             | 9.21    | 1              | 12.9                             | 28.7            |
| SMF8.0ALH   | /         | ARH     | /     | 8              | 20                              | 8.89                             | 9.83    | 1              | 13.6                             | 27.2            |
| SMF9.0ALH   | /         | AVH     | /     | 9              | 5                               | 10                               | 11.1    | 1              | 15.4                             | 24.1            |
| SMF10ALH    | SMF10CALH | AXH     | 10CLH | 10             | 2                               | 11.1                             | 12.3    | 1              | 17                               | 23.5            |
| SMF11ALH    | SMF11CALH | AZH     | 11CLH | 11             | 1                               | 12.2                             | 13.5    | 1              | 18.2                             | 22              |
| SMF12ALH    | SMF12CALH | BEH     | 12CLH | 12             | 1                               | 13.3                             | 14.7    | 1              | 19.9                             | 20.1            |
| SMF13ALH    | SMF13CALH | BGH     | 13CLH | 13             | 1                               | 14.4                             | 15.9    | 1              | 21.5                             | 18.6            |
| SMF14ALH    | SMF14CALH | BKH     | 14CLH | 14             | 1                               | 15.6                             | 17.2    | 1              | 23.2                             | 17.2            |
| SMF15ALH    | SMF15CALH | BMH     | 15CLH | 15             | 1                               | 16.7                             | 18.5    | 1              | 24.4                             | 16.4            |
| SMF17ALH    | /         | BRH     | /     | 17             | 1                               | 18.9                             | 20.9    | 1              | 27.6                             | 14.5            |
| SMF18ALH    | SMF18CALH | BTH     | 18CLH | 18             | 1                               | 20                               | 22.1    | 1              | 29.2                             | 13.7            |
| SMF20ALH    | SMF20CALH | BVH     | 20CLH | 20             | 1                               | 22.2                             | 24.5    | 1              | 32.4                             | 12.3            |
| SMF22ALH    | SMF22CALH | BXH     | 22CLH | 22             | 1                               | 24.4                             | 26.9    | 1              | 35.5                             | 11.3            |
| SMF24ALH    | SMF24CALH | BZH     | 24CLH | 24             | 1                               | 26.7                             | 29.5    | 1              | 38.9                             | 10.3            |
| SMF26ALH    | SMF26CALH | CEH     | 26CLH | 26             | 1                               | 28.9                             | 31.9    | 1              | 42.1                             | 9.5             |
| SMF28ALH    | SMF28CALH | CGH     | 28CLH | 28             | 1                               | 31.1                             | 34.4    | 1              | 45.4                             | 8.8             |
| SMF30ALH    | SMF30CALH | CKH     | 30CLH | 30             | 1                               | 33.3                             | 36.8    | 1              | 48.4                             | 8.3             |
| SMF33ALH    | SMF33CALH | CMH     | 33CLH | 33             | 1                               | 36.7                             | 40.6    | 1              | 53.3                             | 7.5             |
| SMF36ALH    | SMF36CALH | CPH     | 36CLH | 36             | 1                               | 40                               | 44.2    | 1              | 58.1                             | 6.9             |
| SMF40ALH    | SMF40CALH | CRH     | 40CLH | 40             | 1                               | 44.4                             | 49.1    | 1              | 64.5                             | 6.2             |
| SMF43ALH    | SMF43CALH | CTH     | 43CLH | 43             | 1                               | 47.8                             | 52.8    | 1              | 69.4                             | 5.8             |
| SMF45ALH    | SMF45CALH | CVH     | 45CLH | 45             | 1                               | 50                               | 55.3    | 1              | 72.7                             | 5.5             |
| SMF48ALH    | SMF48CALH | CXH     | 48CLH | 48             | 1                               | 53.3                             | 58.9    | 1              | 77.4                             | 5.2             |
| SMF51ALH    | /         | CZH     | /     | 51             | 1                               | 56.7                             | 62.7    | 1              | 82.4                             | 4.9             |
| SMF58ALH    | /         | DEH     | /     | 58             | 1                               | 64.4                             | 71.2    | 1              | 93.6                             | 4.3             |
| SMF60ALH    | /         | DGH     | /     | 60             | 1                               | 66.7                             | 73.7    | 1              | 96.8                             | 4.1             |
| SMF64ALH    | /         | DMH     | /     | 64             | 1                               | 71.1                             | 78.6    | 1              | 103                              | 3.9             |
| SMF70ALH    | /         | DPH     | /     | 70             | 1                               | 77.8                             | 86      | 1              | 113                              | 3.5             |
| SMF75ALH    | /         | DRH     | /     | 75             | 1                               | 83.3                             | 92.1    | 1              | 121                              | 3.3             |
| SMF78ALH    | /         | DTH     | /     | 78             | 1                               | 86.7                             | 95.8    | 1              | 126                              | 3.2             |
| SMF85ALH    | /         | DVH     | /     | 85             | 1                               | 94.4                             | 104     | 1              | 137                              | 2.9             |

Note: Standard part numbers listed

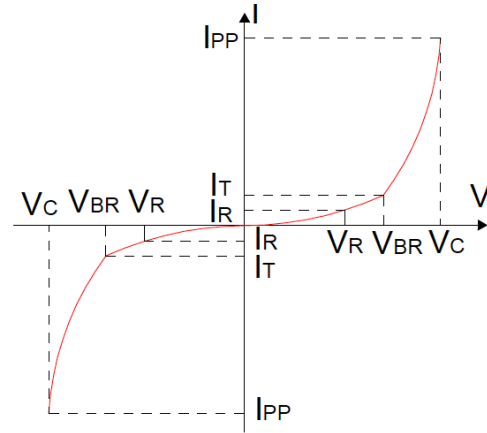
Alternate part numbers have the addition of an E and a "-" for the "." where applicable. Example standard part number SMF5.0ALH, Alternate part number SMFE5-0ALH

**Ratings and V-I characteristic curves** (+25 °C unless otherwise noted)

**V- I curve characteristics (Uni-directional)**



**V- I curve characteristics (Bi-directional)**



Surge waveform: 10/1000  $\mu$ s

$V_R$ : Stand-off voltage – Maximum voltage that can be applied

$V_{BR}$ : Breakdown voltage

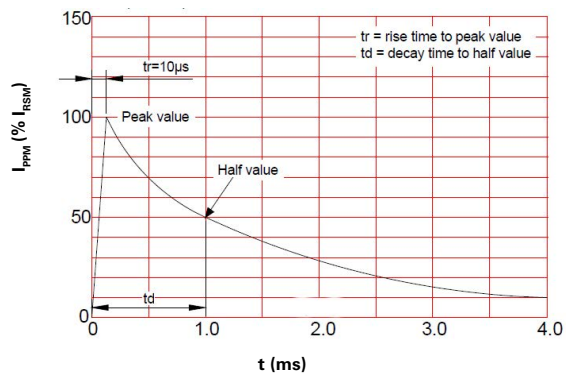
$V_C$ : Clamping voltage – Peak voltage measured across the suppressor at a specified  $I_{PP}$

$I_R$ : Reverse leakage current

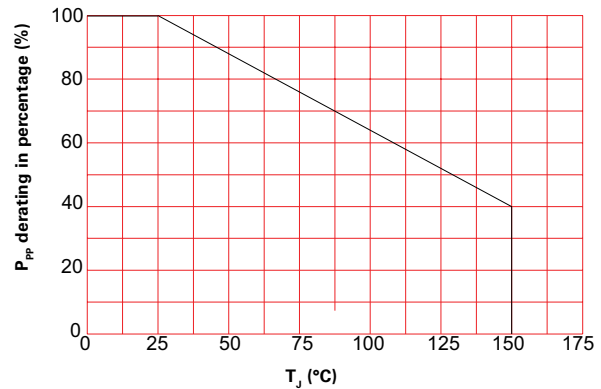
$I_T$ : Test current

$V_F$ : Forward voltage drop for Uni-directional

**Pulse waveform**



**Pulse derating curve**



## Solder reflow profile



**Table 1 - Standard SnPb solder ( $T_C$ )**

| Package thickness | Volume mm <sup>3</sup> <350 | Volume mm <sup>3</sup> ≥350 |
|-------------------|-----------------------------|-----------------------------|
| <2.5 mm           | 235 °C                      | 220 °C                      |
| ≥2.5 mm           | 220 °C                      | 220 °C                      |

**Table 2 - Lead (Pb) free solder ( $T_C$ )**

| Package thickness | Volume mm <sup>3</sup> <350 | Volume mm <sup>3</sup> 350 - 2000 | Volume mm <sup>3</sup> >2000 |
|-------------------|-----------------------------|-----------------------------------|------------------------------|
| <1.6 mm           | 260 °C                      | 260 °C                            | 260 °C                       |
| 1.6 - 2.5 mm      | 260 °C                      | 250 °C                            | 245 °C                       |
| >2.5 mm           | 250 °C                      | 245 °C                            | 245 °C                       |

## Reference J-STD-020

| Profile feature                                                                   | Standard SnPb solder | Lead (Pb) free solder |
|-----------------------------------------------------------------------------------|----------------------|-----------------------|
| Preheat and soak                                                                  |                      |                       |
| • Temperature min. ( $T_{smin}$ )                                                 | 100 °C               | 150 °C                |
| • Temperature max. ( $T_{smax}$ )                                                 | 150 °C               | 200 °C                |
| • Time ( $T_{smin}$ to $T_{smax}$ ) ( $t_s$ )                                     | 60-120 seconds       | 60 - 180 seconds      |
| Ramp up rate $T_L$ to $T_p$                                                       | 3 °C/ second max.    | 3 °C/ second max.     |
| Liquidous temperature ( $T_L$ )                                                   | 183 °C               | 217 °C                |
| Time ( $t_L$ ) maintained above $T_L$                                             | 60-150 seconds       | 60-150 seconds        |
| Peak package body temperature ( $T_p$ )*                                          | Table 1              | Table 2 (+0, -5 °C)   |
| Time ( $t_p$ )* within 5 °C of the specified classification temperature ( $T_C$ ) | 20 seconds*          | 40 seconds*           |
| Ramp-down rate ( $T_p$ to $T_L$ )                                                 | 6 °C/ second max.    | 6 °C/ second max.     |
| Time 25 °C to peak temperature                                                    | 6 minutes max.       | 8 minutes max.        |

\* Tolerance for peak profile temperature ( $T_p$ ) is defined as a supplier minimum and a user maximum.

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