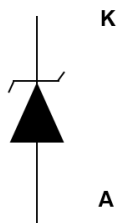
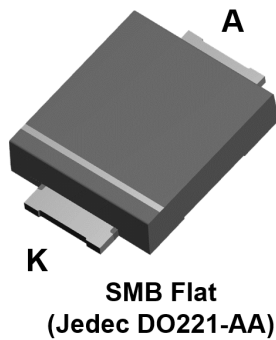


## Automotive 600 W TVS in SMB Flat



Unidirectional

| Product status link |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SMB6FY              | <a href="#">SMB6F5.0AY</a> , <a href="#">SMB6F6.0AY</a> ,<br><a href="#">SMB6F6.5AY</a> , <a href="#">SMB6F8.5AY</a> ,<br><a href="#">SMB6F10AY</a> , <a href="#">SMB6F11AY</a> ,<br><a href="#">SMB6F13AY</a> , <a href="#">SMB6F12AY</a> ,<br><a href="#">SMB6F14AY</a> , <a href="#">SMB6F15AY</a> ,<br><a href="#">SMB6F16AY</a> , <a href="#">SMB6F18AY</a> ,<br><a href="#">SMB6F20AY</a> , <a href="#">SMB6F22AY</a> ,<br><a href="#">SMB6F23AY</a> , <a href="#">SMB6F24AY</a> ,<br><a href="#">SMB6F26AY</a> , <a href="#">SMB6F28AY</a> ,<br><a href="#">SMB6F30AY</a> , <a href="#">SMB6F31AY</a> ,<br><a href="#">SMB6F33AY</a> , <a href="#">SMB6F36AY</a> ,<br><a href="#">SMB6F40AY</a> , <a href="#">SMB6F48AY</a> ,<br><a href="#">SMB6F58AY</a> , <a href="#">SMB6F64AY</a> ,<br><a href="#">SMB6F70AY</a> , <a href="#">SMB6F85AY</a> ,<br><a href="#">SMB6F100AY</a> , <a href="#">SMB6F130AY</a> ,<br><a href="#">SMB6F154AY</a> , <a href="#">SMB6F170AY</a> ,<br><a href="#">SMB6F188AY</a> |

### Features



- AEC-Q101 qualified
- Peak pulse power: 600 W (10/1000  $\mu$ s) and 4 kW (8/20  $\mu$ s)
- Flat and thin package: 1 mm
- Stand-off voltage range from 5 V to 188 V
- Unidirectional type
- Low leakage current: 0.2  $\mu$ A at 25 °C and 1  $\mu$ A at 85 °C
- Operating  $T_j$  max: 175 °C
- High power capability at  $T_j$  max.: up to 470 W (10/1000  $\mu$ s)
- Lead finishing: matte tin plating

### Complies with the following standards

- UL94, V0
- J-STD-020 MSL level 1
- J-STD-002, JESD 22-B102 E3 and MIL-STD-750, method 2026 solderable matte tin plated leads
- JESD-201 class 2 whisker test
- IPC7531 footprint
- JEDEC registered package outline
- IEC 61000-4-4 level 4:
  - 4 kV
- ISO10605, IEC 61000-4-2, C = 150 pF - R = 330  $\Omega$  exceeds level 4:
  - 30 kV (air discharge)
  - 30 kV (contact discharge)
- ISO10605 - C = 330 pF, R = 330  $\Omega$  exceeds level 4:
  - 30 kV (air discharge)
  - 30 kV (contact discharge)
- ISO7637-2 (Not applicable to parts with stand-off voltage lower than battery voltage)
  - Pulse1:  $V_S$  = -150 V
  - Pulse 2a:  $V_S$  = +112 V
  - Pulse 3a:  $V_S$  = -220 V
  - Pulse 3b:  $V_S$  = +150 V

### Description

The SMB6FxxAY series are designed to protect sensitive automotive circuits against surges defined in ISO 7637-2 and against electrostatic discharges according to ISO 10605.

The Planar technology makes it compatible with high-end circuits where low leakage current and high junction temperature are required to provide long term reliability and stability.

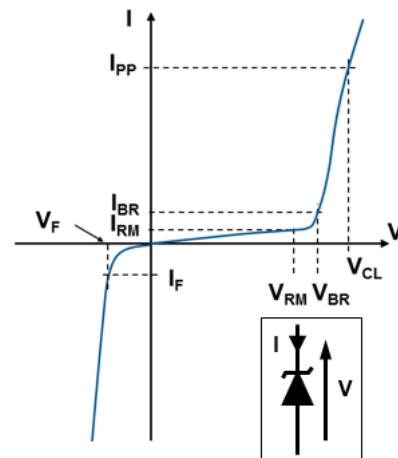
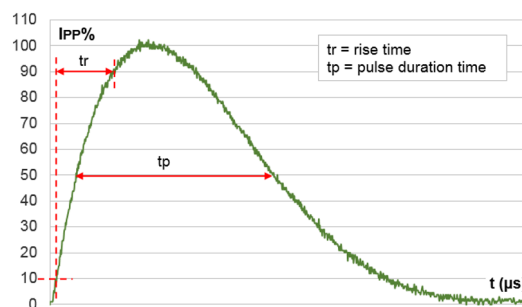
## 1 Characteristics

**Table 1. Absolute maximum ratings ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ )**

| Symbol    | Parameter                                          |                                                          | Value       | Unit               |
|-----------|----------------------------------------------------|----------------------------------------------------------|-------------|--------------------|
| $V_{PP}$  | Peak pulse voltage                                 | ISO10605 (C = 330 pF, R = 330 $\Omega$ ):                |             |                    |
|           |                                                    | Contact discharge                                        | 30          | kV                 |
|           |                                                    | Air discharge                                            | 30          |                    |
|           |                                                    | ISO10605 / IEC 61000-4-2 (C = 150 pF, R = 330 $\Omega$ ) |             |                    |
|           |                                                    | Contact discharge                                        | 30          |                    |
|           |                                                    | Air discharge                                            | 30          |                    |
| $P_{PP}$  | Peak pulse power dissipation                       | 10/1000 $\mu\text{s}$ , $T_j$ initial = $T_{amb}$        | 600         | W                  |
| $T_{stg}$ | Storage temperature range                          |                                                          | -65 to +175 | $^{\circ}\text{C}$ |
| $T_j$     | Operating junction temperature range               |                                                          | -55 to +175 | $^{\circ}\text{C}$ |
| $T_L$     | Maximum lead temperature for soldering during 10 s |                                                          | 260         | $^{\circ}\text{C}$ |

**Figure 1. Electrical characteristics - parameter definitions**

$V_{RM}$  Maximum stand-off voltage  
 $I_{RM}$  Maximum leakage current @  $V_{RM}$   
 $V_R$  Stand-off voltage  
 $I_R$  Leakage current @  $V_R$   
 $V_{BR}$  Breakdown voltage @  $I_{BR}$   
 $I_{BR}$  Breakdown current  
 $V_{CL}$  Clamping voltage @  $I_{PP}$   
 $I_{PP}$  Peak pulse current  
 $R_D$  Dynamic resistance  
 $V_F$  Forward voltage drop @  $I_F$   
 $I_F$  Forward current  
 $\alpha T$  Voltage temperature coefficient


**Figure 2. Pulse definition for electrical characteristics**


**Table 2. Electrical characteristics - parameter values ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)**

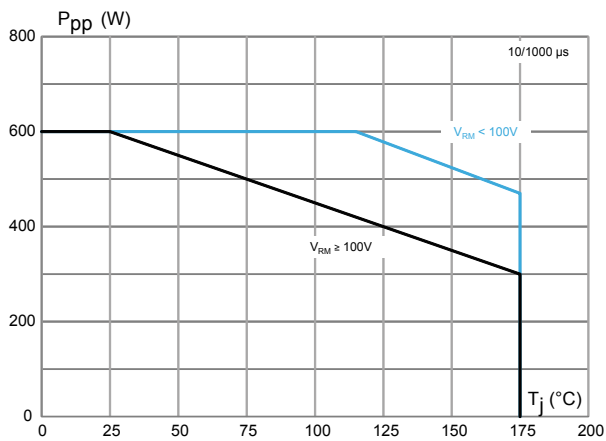
| Type       | $I_{RM}$ max at $V_{RM}$ |                       |     | $V_{BR}$ at $I_{BR}^{(1)}$ |      |      |    | 10 / 1000 $\mu\text{s}$ |                |          | 8 / 20 $\mu\text{s}$ |                |          | $\alpha T$                 |
|------------|--------------------------|-----------------------|-----|----------------------------|------|------|----|-------------------------|----------------|----------|----------------------|----------------|----------|----------------------------|
|            |                          |                       |     |                            |      |      |    | $V_{CL}^{(2)(3)}$       | $I_{PP}^{(4)}$ | $R_D$    | $V_{CL}^{(2)(3)}$    | $I_{PP}^{(4)}$ | $R_D$    |                            |
|            | 25 $^{\circ}\text{C}$    | 85 $^{\circ}\text{C}$ |     | Min.                       | Typ. | Max. |    | Max.                    |                | Max.     | Max.                 |                | Max.     | Max.                       |
|            | $\mu\text{A}$            |                       | V   | V                          |      |      | mA | V                       | A              | $\Omega$ | V                    | A              | $\Omega$ | $10^{-4}/^{\circ}\text{C}$ |
| SMB6F5.0AY | 20                       | 50                    | 5.0 | 6.4                        | 6.74 | 7.1  | 10 | 9.2                     | 68             | 0.031    | 13.4                 | 298            | 0.021    | 5.7                        |
| SMB6F6.0AY | 20                       | 50                    | 6.0 | 6.7                        | 7.05 | 7.4  | 10 | 10.3                    | 61             | 0.048    | 13.7                 | 290            | 0.022    | 5.9                        |
| SMB6F6.5AY | 20                       | 50                    | 6.5 | 7.2                        | 7.58 | 8    | 10 | 11.2                    | 56             | 0.057    | 14.5                 | 276            | 0.024    | 6.1                        |
| SMB6F8.5AY | 20                       | 50                    | 8.5 | 9.4                        | 9.9  | 10.4 | 1  | 14.4                    | 41.7           | 0.096    | 19.5                 | 205            | 0.044    | 7.3                        |
| SMB6F10AY  | 0.2                      | 1                     | 10  | 11.1                       | 11.7 | 12.3 | 1  | 17                      | 37             | 0.127    | 21.7                 | 184            | 0.051    | 7.8                        |
| SMB6F11AY  | 0.2                      | 1                     | 11  | 12.3                       | 13   | 13.7 | 1  | 18                      | 33.8           | 0.127    | 24.2                 | 1665           | 0.064    | 8.1                        |
| SMB6F12AY  | 0.2                      | 1                     | 12  | 13.3                       | 14   | 14.7 | 1  | 19.9                    | 31             | 0.168    | 25.3                 | 157            | 0.068    | 8.3                        |
| SMB6F13AY  | 0.2                      | 1                     | 13  | 14.4                       | 15.2 | 16   | 1  | 21.5                    | 29             | 0.190    | 27.2                 | 147            | 0.076    | 8.4                        |
| SMB6F14AY  | 0.2                      | 1                     | 14  | 15.7                       | 16.5 | 17.3 | 1  | 23.1                    | 26             | 0.223    | 29                   | 136            | 0.086    | 8.6                        |
| SMB6F15AY  | 0.2                      | 1                     | 15  | 16.7                       | 17.6 | 18.5 | 1  | 24.4                    | 25.1           | 0.235    | 32.5                 | 123            | 0.114    | 8.8                        |
| SMB6F16AY  | 0.2                      | 1                     | 16  | 17.9                       | 18.8 | 19.8 | 1  | 26                      | 23.1           | 0.268    | 34.7                 | 115            | 0.130    | 9.0                        |
| SMB6F18AY  | 0.2                      | 1                     | 18  | 20                         | 21.1 | 22.2 | 1  | 29.2                    | 21.5           | 0.326    | 39.3                 | 102            | 0.168    | 9.2                        |
| SMB6F20AY  | 0.2                      | 1                     | 20  | 22.2                       | 23.4 | 24.6 | 1  | 32.4                    | 19.4           | 0.402    | 42.8                 | 93             | 0.196    | 9.4                        |
| SMB6F22AY  | 0.2                      | 1                     | 22  | 24.4                       | 25.7 | 27   | 1  | 35.5                    | 17.7           | 0.480    | 48.3                 | 83             | 0.257    | 9.6                        |
| SMB6F23AY  | 0.2                      | 1                     | 23  | 25.7                       | 27   | 28.4 | 1  | 37.8                    | 16.4           | 0.573    | 49.2                 | 81             | 0.257    | 9.6                        |
| SMB6F24AY  | 0.2                      | 1                     | 24  | 26.7                       | 28.1 | 29.5 | 1  | 38.9                    | 16             | 0.588    | 50                   | 80             | 0.256    | 9.6                        |
| SMB6F26AY  | 0.2                      | 1                     | 26  | 28.9                       | 30.4 | 31.9 | 1  | 42.1                    | 14.9           | 0.685    | 53.5                 | 75             | 0.288    | 9.7                        |
| SMB6F28AY  | 0.2                      | 1                     | 28  | 31.1                       | 32.7 | 34.3 | 1  | 45.4                    | 13.8           | 0.804    | 59                   | 68             | 0.363    | 9.8                        |
| SMB6F30AY  | 0.2                      | 1                     | 30  | 33.2                       | 35   | 36.8 | 1  | 48.4                    | 13             | 0.885    | 64.3                 | 62             | 0.442    | 9.9                        |
| SMB6F31AY  | 0.2                      | 1                     | 31  | 34.2                       | 36   | 37.8 | 1  | 50.2                    | 12.3           | 1.01     | 65                   | 61             | 0.45     | 9.9                        |
| SMB6F33AY  | 0.2                      | 1                     | 33  | 36.7                       | 38.6 | 40.5 | 1  | 53.3                    | 11.8           | 1.08     | 69.7                 | 57             | 0.512    | 10                         |
| SMB6F36AY  | 0.2                      | 1                     | 36  | 40                         | 42.1 | 44.2 | 1  | 58.1                    | 10.3           | 1.35     | 76                   | 52             | 0.612    | 10                         |
| SMB6F40AY  | 0.2                      | 1                     | 40  | 44.4                       | 46.7 | 49   | 1  | 64.5                    | 9.7            | 1.60     | 84                   | 48             | 0.729    | 10.1                       |
| SMB6F48AY  | 0.2                      | 1                     | 48  | 53.2                       | 56   | 58.8 | 1  | 77.4                    | 8.1            | 2.28     | 100                  | 40             | 1.03     | 10.3                       |
| SMB6F58AY  | 0.2                      | 1                     | 58  | 64.6                       | 68   | 71.4 | 1  | 93.6                    | 6.7            | 3.34     | 121                  | 33             | 1.51     | 10.4                       |
| SMB6F64AY  | 0.2                      | 1                     | 64  | 71.1                       | 74.8 | 78.6 | 1  | 103                     | 5.8            | 4.17     | 134                  | 30             | 1.84     | 10.5                       |
| SMB6F70AY  | 0.2                      | 1                     | 70  | 77.9                       | 82   | 86.1 | 1  | 113                     | 5.5            | 4.91     | 146                  | 27             | 2.22     | 10.5                       |
| SMB6F85AY  | 0.2                      | 1                     | 85  | 95                         | 100  | 105  | 1  | 137                     | 4.6            | 7.17     | 178                  | 22.5           | 3.29     | 10.6                       |
| SMB6F100AY | 0.2                      | 1                     | 100 | 111                        | 117  | 123  | 1  | 162                     | 3.8            | 10.3     | 212                  | 19             | 4.68     | 10.7                       |
| SMB6F130AY | 0.2                      | 1                     | 130 | 144                        | 152  | 160  | 1  | 209                     | 3              | 16.3     | 265                  | 15             | 7        | 10.8                       |
| SMB6F154AY | 0.2                      | 1                     | 154 | 171                        | 180  | 189  | 1  | 246                     | 2.4            | 23.8     | 317                  | 12.6           | 10.2     | 10.8                       |
| SMB6F170AY | 0.2                      | 1                     | 170 | 190                        | 200  | 210  | 1  | 275                     | 2.2            | 30       | 353                  | 11.3           | 12.7     | 10.8                       |
| SMB6F188AY | 0.2                      | 1                     | 188 | 209                        | 220  | 231  | 1  | 328                     | 2              | 48.5     | 388                  | 10.3           | 15.2     | 10.8                       |

1. To calculate  $V_{BR}$  versus  $T_j$ :  $V_{BR}$  at  $T_j = V_{BR}$  at  $25\text{ }^{\circ}\text{C} \times (1 + \alpha T \times (T_j - 25))$
2. To calculate  $V_{CL}$  versus  $T_j$ :  $V_{CL}$  at  $T_j = V_{CL}$  at  $25\text{ }^{\circ}\text{C} \times (1 + \alpha T \times (T_j - 25))$
3. To calculate  $V_{CL}$  max versus  $I_{PPappli}$ :  $V_{CLmax} = V_{BRmax} + R_D \times I_{PPappli}$

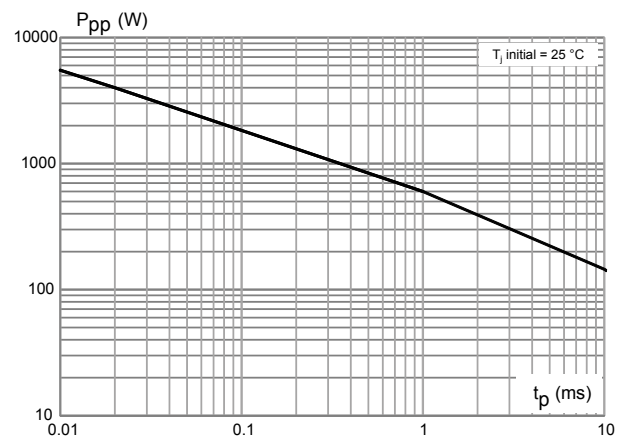
4. Surge capability given for both directions

## 1.1 Characteristics (curves)

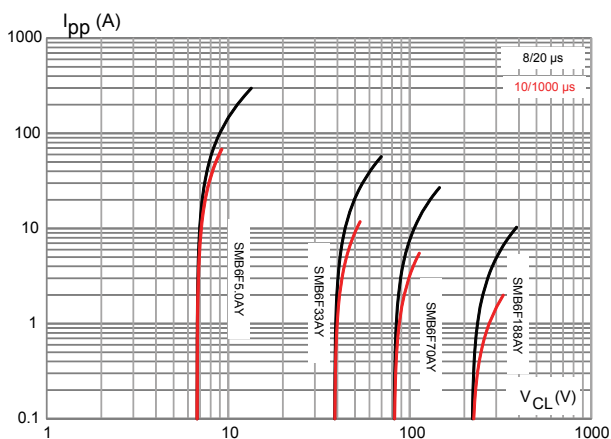
**Figure 3. Maximum peak power dissipation versus initial junction temperature**



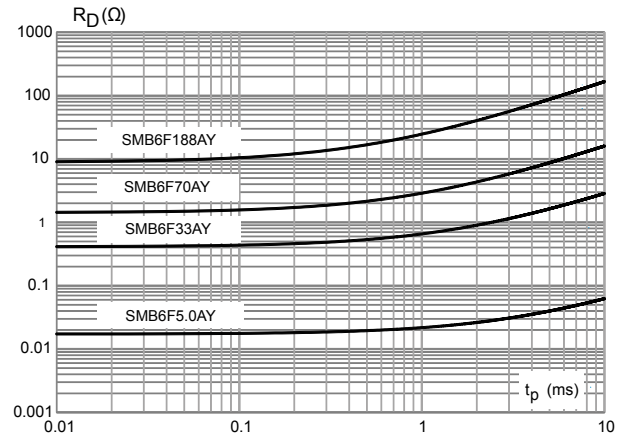
**Figure 4. Maximum peak pulse power versus exponential pulse duration**



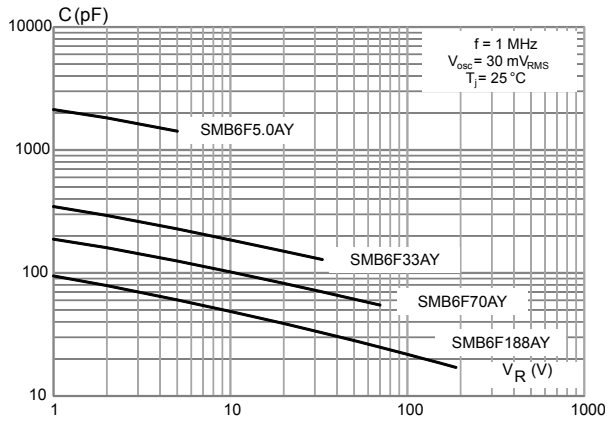
**Figure 5. Maximum peak pulse current versus clamping voltage**



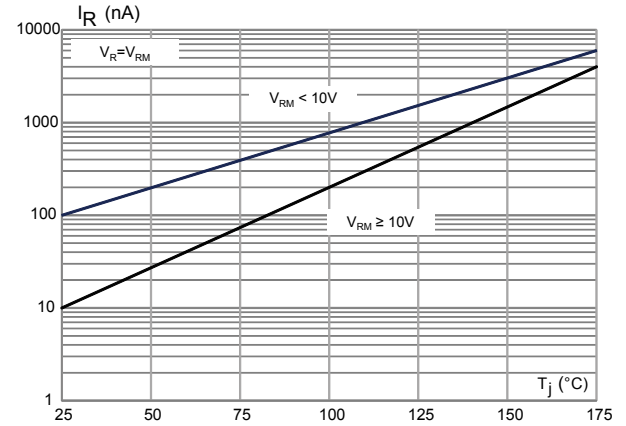
**Figure 6. Dynamic resistance versus pulse duration**



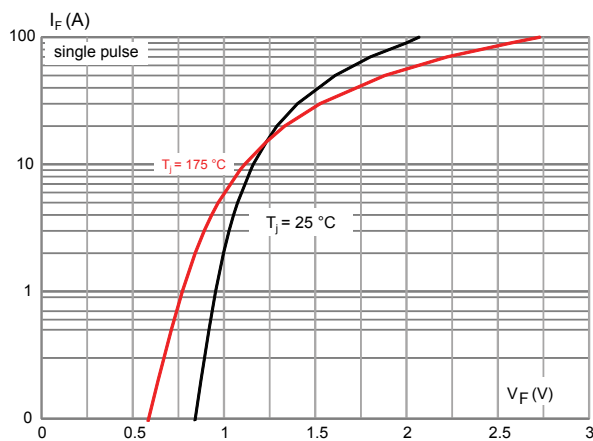
**Figure 7. Junction capacitance versus reverse applied voltage (unidirectional types)**



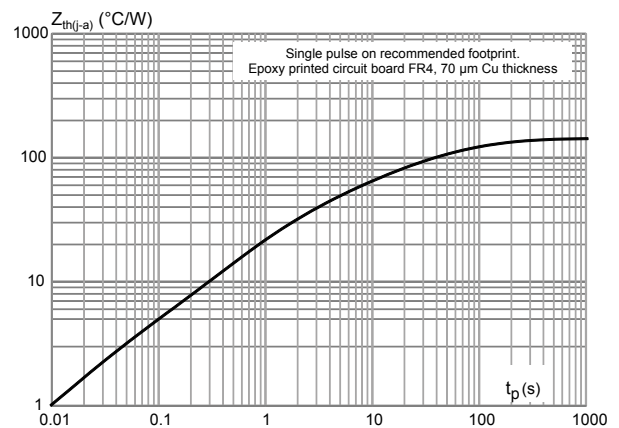
**Figure 8. Leakage current versus junction temperature**



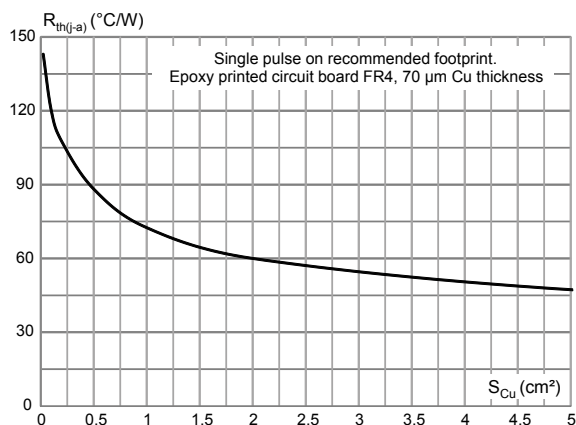
**Figure 9. Peak forward voltage drop versus peak forward current**



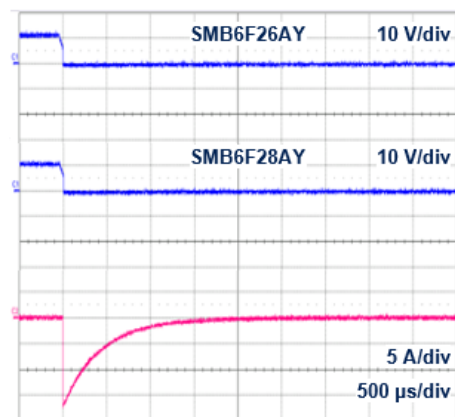
**Figure 10. Thermal impedance junction to ambient versus pulse duration**



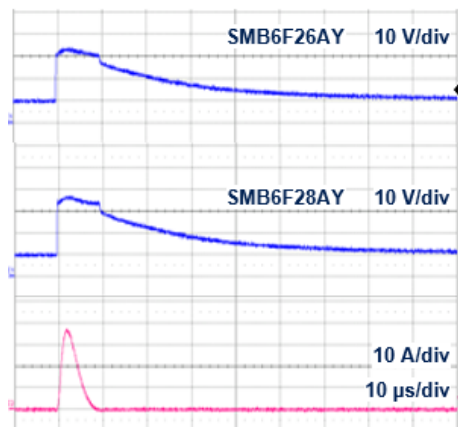
**Figure 11. Thermal resistance junction to ambient versus copper area under each lead (SMB Flat)**



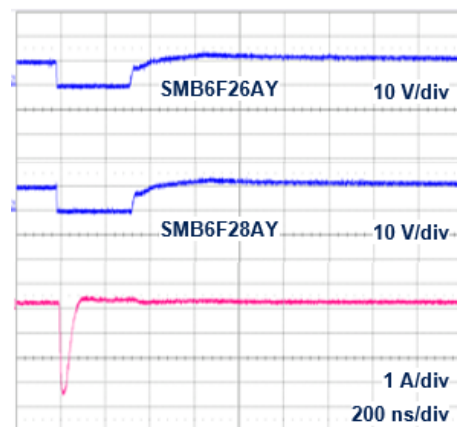
**Figure 12. ISO7637-2 pulse 1: V\_s = -150 V with 12 V battery**



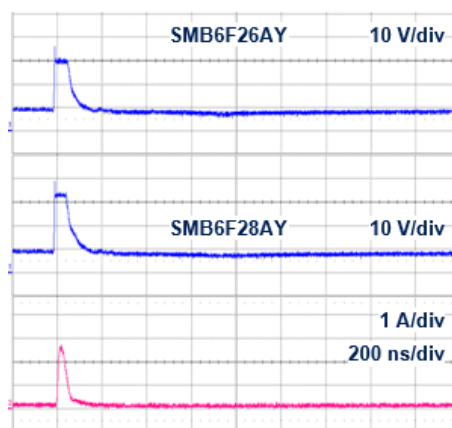
**Figure 13.** ISO7637-2 pulse 2a:  $V_s = +112\text{ V}$  with 12 V battery



**Figure 14.** ISO7637-2 pulse 3a:  $V_s = -220\text{ V}$  with 12 V battery



**Figure 15.** ISO7637-2 pulse 3b:  $V_s = +150\text{ V}$  with 12 V battery



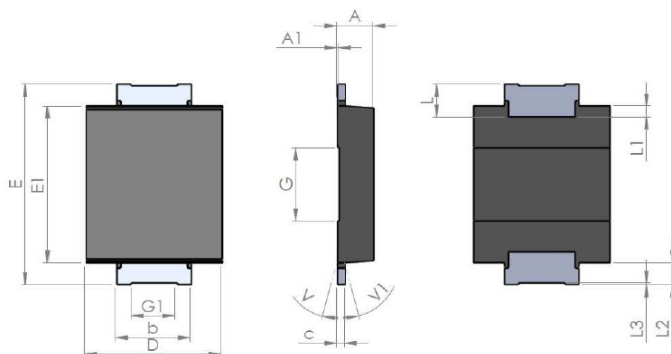
## 2 Package information

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In order to meet environmental requirements, ST offers these devices in different grades of **ECOPACK** packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.

## 2.1 SMB Flat package information

**Figure 16. SMB Flat package outline**

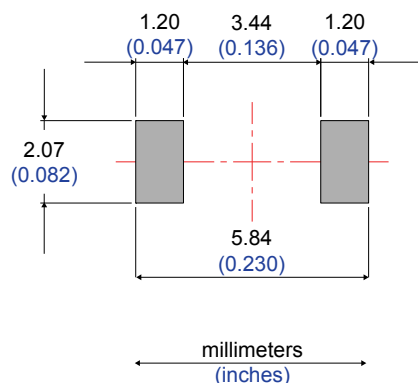


**Table 3. SMB Flat mechanical data**

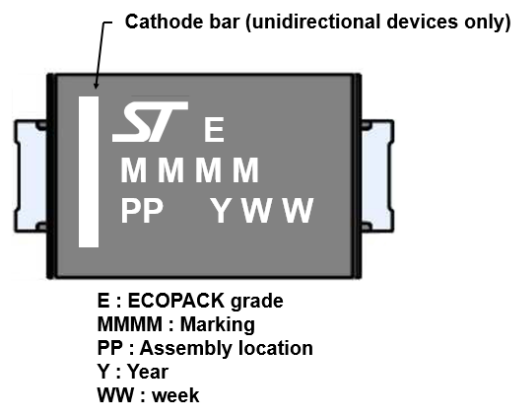
| Ref. | Dimensions  |      |      |                       |       |       |
|------|-------------|------|------|-----------------------|-------|-------|
|      | Millimeters |      |      | Inches <sup>(1)</sup> |       |       |
|      | Min.        | Typ. | Max. | Min.                  | Typ.  | Max.  |
| A    | 0.90        |      | 1.10 | 0.035                 |       | 0.044 |
| A1   |             | 0.05 |      |                       | 0.002 |       |
| b    | 1.95        |      | 2.20 | 0.076                 |       | 0.087 |
| c    | 0.15        |      | 0.40 | 0.005                 |       | 0.016 |
| D    | 3.30        |      | 3.95 | 0.129                 |       | 0.156 |
| E    | 5.20        |      | 5.60 | 0.204                 |       | 0.221 |
| E1   | 4.05        |      | 4.60 | 0.159                 |       | 0.182 |
| G    |             | 2.00 |      |                       | 0.079 |       |
| G1   |             | 1.20 |      |                       | 0.047 |       |
| L    | 0.75        |      | 1.20 | 0.029                 |       | 0.048 |
| L1   |             | 0.30 |      |                       | 0.012 |       |
| L2   |             | 0.60 |      |                       | 0.024 |       |
| L3   | 0.02        |      |      | 0.000                 |       |       |
| V    |             |      | 8°   |                       |       | 8°    |
| V1   |             |      | 8°   |                       |       | 8°    |

1. Values in inches are converted from mm and rounded to 3 decimal digits.

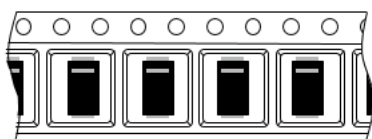
**Figure 17. Footprint recommendations, dimensions in mm (inches)**



**Figure 18. Marking layout (refer to ordering information table for marking)**



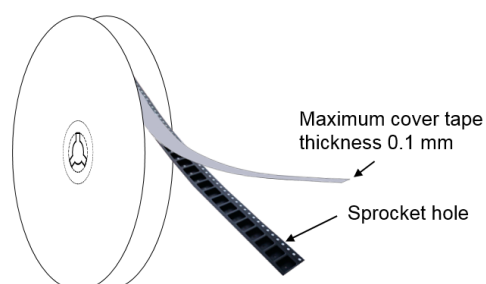
**Figure 19. Package orientation in reel**



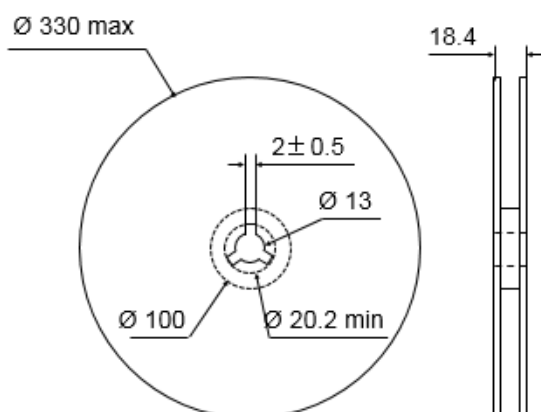
Taped according to EIA-481

Note: Pocket dimensions are not on scale  
Pocket shape may vary depending on package  
On bidirectional devices, marking and logo may be not always in the same direction

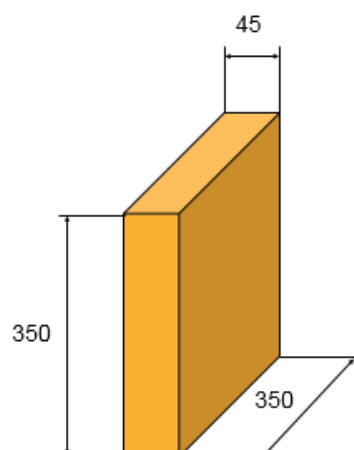
**Figure 20. Tape and reel orientation**

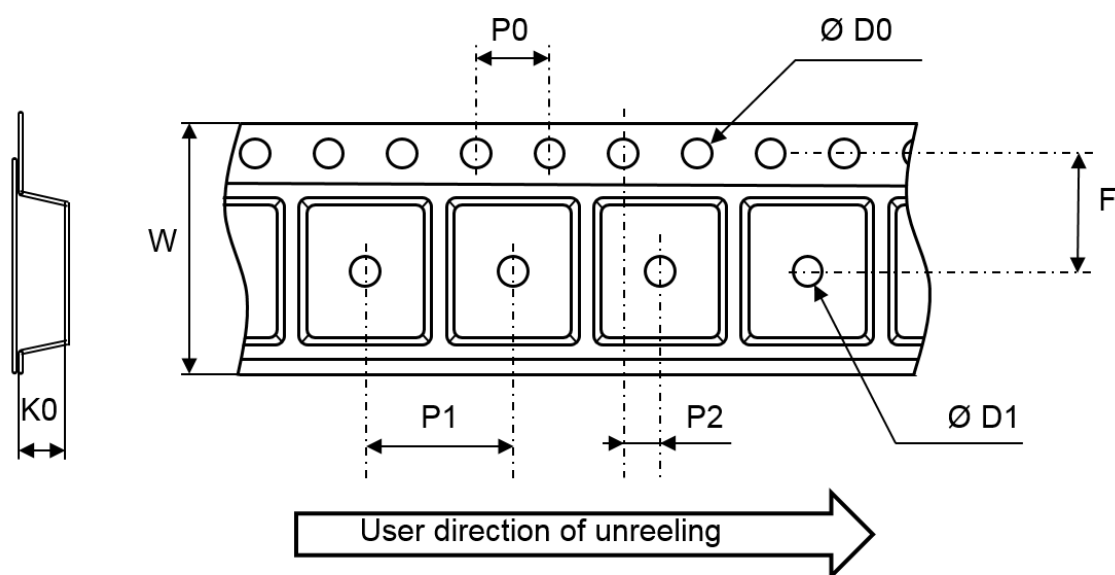


**Figure 21. Reel dimensions (mm)**



**Figure 22. Inner box dimensions (mm)**



**Figure 23. Tape and reel outline**


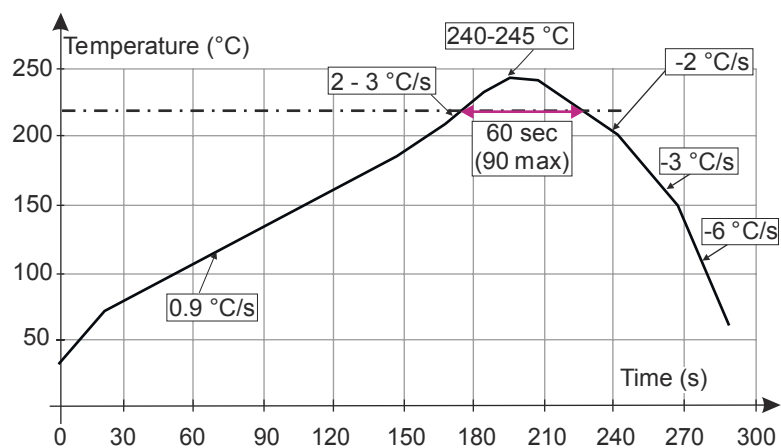
Note: Pocket dimensions are not on scale  
Pocket shape may vary depending on package

**Table 4. Tape and reel mechanical data**

| Ref. | Dimensions  |      |      |
|------|-------------|------|------|
|      | Millimeters |      |      |
|      | Min.        | Typ. | Max. |
| ØD0  | 1.45        | 1.50 | 1.55 |
| ØD1  | 1.5         |      |      |
| F    | 5.4         | 5.5  | 5.6  |
| K0   | 1.2         | 1.3  | 1.4  |
| P0   | 3.9         | 4.0  | 4.1  |
| P1   | 7.9         | 8.0  | 8.1  |
| P2   | 1.9         | 2.0  | 2.1  |
| W    | 11.7        | 12.0 | 12.3 |

## 2.2 Reflow profile

**Figure 24.** ST ECOPACK recommended soldering reflow profile for PCB mounting



**Note:** Minimize air convection currents in the reflow oven to avoid component movement. Maximum soldering profile corresponds to the latest IPC/JEDEC J-STD-020.

### **3 Application and design guidelines**

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More information is available in the application note AN2689 “Protection of automotive electronics from electrical hazards, guidelines for design and component selection”.

## 4 Ordering information

Figure 25. Ordering information scheme

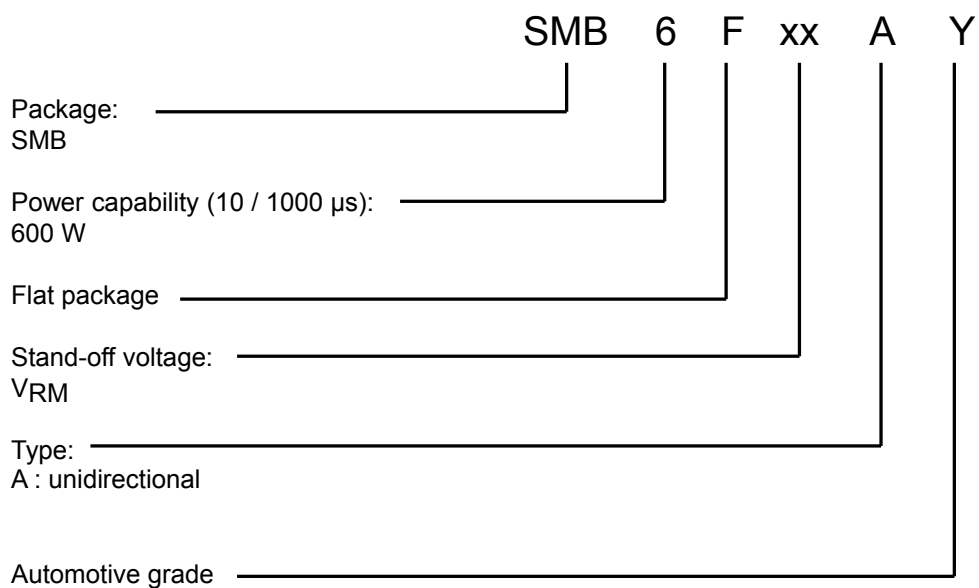


Table 5. Ordering information

| Order code | Marking                               | Package  | Weight | Base qty. | Delivery mode |
|------------|---------------------------------------|----------|--------|-----------|---------------|
| SMB6FxxAY  | See <a href="#">Table 6. Marking.</a> | SMB Flat | 56 mg  | 5000      | Tape and reel |

## 4.1 Marking

**Table 6. Marking**

| Order code | Marking |
|------------|---------|
| SMB6F5.0AY | 7AIY    |
| SMB6F6.0AY | 7AKY    |
| SMB6F6.5AY | 7ALY    |
| SMB6F8.5AY | 7APY    |
| SMB6F10AY  | 7ASY    |
| SMB6F11AY  | 7AUY    |
| SMB6F12AY  | 7AWY    |
| SMB6F13AY  | 7AYY    |
| SMB6F14AY  | 7BAY    |
| SMB6F15AY  | 7BCY    |
| SMB6F16AY  | 7BEY    |
| SMB6F18AY  | 7BIY    |
| SMB6F20AY  | 7BMY    |
| SMB6F22AY  | 7BOY    |
| SMB6F23AY  | 7BPY    |
| SMB6F24AY  | 7BQY    |
| SMB6F26AY  | 7BSY    |
| SMB6F28AY  | 7BUY    |
| SMB6F30AY  | 7BWY    |
| SMB6F31AY  | 7BXY    |
| SMB6F33AY  | 7BZY    |
| SMB6F36AY  | 7CCY    |
| SMB6F40AY  | 7CGY    |
| SMB6F48AY  | 7COY    |
| SMB6F58AY  | 7CYY    |
| SMB6F64AY  | 7DEY    |
| SMB6F70AY  | 7DKY    |
| SMB6F85AY  | 7DZY    |
| SMB6F100AY | 7EOY    |
| SMB6F130AY | 7FSY    |
| SMB6F154AY | 7GQY    |
| SMB6F170AY | 7HGY    |
| SMB6F188AY | 7HYY    |

## Revision history

**Table 7. Document revision history**

| Date        | Revision | Changes               |
|-------------|----------|-----------------------|
| 11-Jan-2019 | 1        | Initial release.      |
| 09-Sep-2019 | 2        | Added 64 V device.    |
| 07-Jan-2020 | 3        | Updated links syntax. |

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