# SM6TY

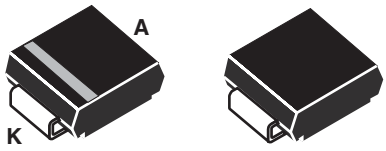
## Automotive 600 W Transil™

## Features

- peak pulse power:
  - 600 W (10/1000 µs)
  - 4 kW (8/20 µs)
- stand-off voltage range: from 6.4 V to 58 V
- unidirectional and bidirectional types
- low leakage current:
  - 0.2 µA at 25 °C
  - 1 µA at 85 °C
- operating $T_{j\ max}$: 150 °C
- high power capability at $T_{j\ max}$:
  - 515 W (10/1000 µs)
- JEDEC registered package outline
- resin meets UL 94, V0
- ECOPACK®2 compliant components
- AEC-Q101 qualified

### Complies with the following standards

- IEC 61000-4-2 level 4:
  - 15 kV (air discharge)
  - 8 kV (contact discharge)
- ISO 10605, C = 330 pF, R = 330 Ω:
  - 15 kV (air discharge)
  - 8 kV (contact discharge)
- ISO 7637-2 (for pulse 1 and 2a, applicable only to parts with stand-off voltage ($V_{RM}$) lower than the average battery voltage: 13.5 V):
  - Pulse 1: $V_S$ = -100 V
  - Pulse 2a: $V_S$ = +50 V
  - Pulse 3a: $V_S$ = -150 V
  - Pulse 3b: $V_S$ = +100 V




**Unidirectional** **Bidirectional**

**SMB**
**(JEDEC DO-214AA)**

## Description

The SM6TY Transil series has been designed to protect sensitive automotive circuits against surges defined in ISO 7637-2 and against electrostatic discharges according to IEC 61000-4-2 and ISO 10605.

The planar technology makes this device compatible with high-end circuits where low leakage current and high junction temperature are required to provide reliability and stability over time. SM6TY are packaged in SMB (SMB footprint in accordance with IPC 7531 standard).

**TM**: Transil is a trademark of STMicroelectronics

# 1 Characteristics

**Table 1. Absolute maximum ratings ($T_{amb}$ = 25 °C)**

| Symbol | Parameter | | Value | Unit |
|---|---|---|---|---|
| $V_{PP}$ | Peak pulse voltage | ISO 10605 (C = 330 pF, R = 330 Ω)<br>Contact discharge<br>Air discharge<br>IEC 61000-4-2<br>Contact discharge<br>Air discharge | <br>30<br>30<br><br>30<br>30 | kV |
| $P_{PP}$ | Peak pulse power dissipation(1) | $T_j$ initial = $T_{amb}$ | 600 | W |
| $T_j$ | Operating junction temperature range | | -55 to 150 | |
| $T_{stg}$ | Storage temperature range | | -65 to 150 | °C |
| $T_L$ | Maximum lead temperature for soldering during 10 s. | | 260 | |

1. For a surge greater than the maximum values, the diode will fail in short-circuit.

**Table 2. Thermal resistance**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{th(j-l)}$ | Junction to leads | 20 | °C/W |
| $R_{th(j-a)}$ | Junction to ambient on printed circuit on recommended pad layout | 100 | °C/W |

**Figure 1. Electrical characteristics - definitions**

| Symbol | Parameter |
|---|---|
| $V_{RM}$ | Stand-off voltage |
| $V_{BR}$ | Breakdown voltage |
| $V_{CL}$ | Clamping voltage |
| $I_{RM}$ | Leakage current @ $V_{RM}$ |
| $I_{PP}$ | Peak pulse current |
| $\alpha T$ | Voltage temperature coefficient |
| $V_F$ | Forward voltage drop |
| $R_D$ | Dynamic resistance |

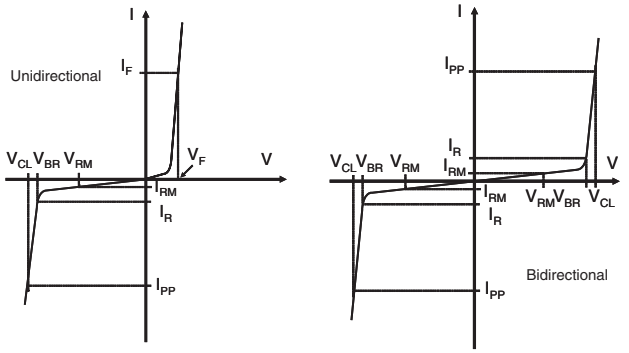



**Figure 2. Pulse definition for electrical characteristics**

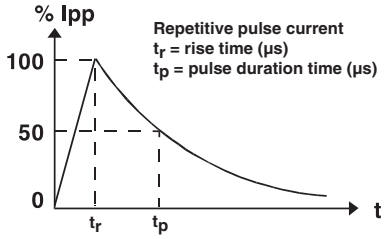


**Table 3. Electrical characteristics, typical values unless otherwise stated ($T_{amb}$ = 25 °C)**

| Order code | $I_{RM}$ max@$V_{RM}$ | | | $V_{BR}$ @$I_R$ (1) | | | $V_{CL}$ @$I_{PP}$ 10/1000 µs | | $R_D$ (2) 10/1000 µs | $V_{CL}$ @$I_{PP}$ 8/20 µs | | $R_D$ (2) 8/20 µs | αT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 25 °C | 85 °C | | min. | typ. | | max. | | | max. | | | max. |
| | µA | | V | V | | mA | V(3) | A(4) | Ω | V(3) | A(4) | Ω | 10-4/ °C |
| SM6T7V5AY | 20 | 50 | 6.4 | 7.13 | 7.5 | 10 | 11.3 | 53 | 0.065 | 14.5 | 276 | 0.024 | 6.1 |
| SM6T18AY/CAY | 0.2 | 1 | 15.3 | 17.1 | 18 | 1 | 25.2 | 24 | 0.263 | 32.5 | 123 | 0.111 | 8.8 |
| SM6T22AY/CAY | 0.2 | 1 | 18.8 | 20.9 | 22 | 1 | 30.6 | 20 | 0.375 | 39.3 | 102 | 0.159 | 9.2 |
| SM6T24AY/CAY | 0.2 | 1 | 20.5 | 22.8 | 24 | 1 | 33.2 | 18 | 0.444 | 42.8 | 93 | 0.189 | 9.4 |
| SM6T27AY/CAY | 0.2 | 1 | 23.1 | 25.7 | 27 | 1 | 37.5 | 16 | 0.569 | 48.3 | 83 | 0.240 | 9.6 |
| SM6T30AY/CAY | 0.2 | 1 | 25.6 | 28.5 | 30 | 1 | 41.5 | 14.5 | 0.690 | 53.5 | 75 | 0.293 | 9.7 |
| SM6T33AY/CAY | 0.2 | 1 | 28.2 | 31.4 | 33 | 1 | 45.7 | 13.1 | 0.840 | 59.0 | 68 | 0.357 | 9.8 |
| SM6T36AY/CAY | 0.2 | 1 | 30.8 | 34.2 | 36 | 1 | 49.9 | 12 | 1.01 | 64.3 | 62 | 0.427 | 9.9 |
| SM6T39AY/CAY | 0.2 | 1 | 33.3 | 37.1 | 39 | 1 | 53.9 | 11.1 | 1.16 | 69.7 | 57 | 0.504 | 10.0 |
| SM6T42CAY | 0.2 | 1 | 36 | 40 | 42.1 | 1 | 58.1 | 10.3 | 1.35 | 76 | 52 | 0.611 | 10.0 |
| SM6T47AY/CAY | 0.2 | 1 | 40 | 44.4 | 46.7 | 1 | 64.5 | 9.7 | 1.59 | 84 | 48 | 0.728 | 10.1 |
| SM6T68AY/CAY | 0.2 | 1 | 58.1 | 64.6 | 68 | 1 | 92 | 6.5 | 3.17 | 121 | 33 | 1.503 | 10.4 |

1. Pulse test : $t_p$ < 50 ms
2. To calculate maximum clamping voltage at another surge level, use the following formula:
   $V_{CLmax} = V_{CL} - R_D \times (I_{PP} - I_{PPappli})$ where $I_{PPappli}$ is the surge current in the application.
3. To calculate $V_{BR}$ or $V_{CL}$ versus junction temperature, use the following formulas:
   $V_{BR}$ @ $T_J = V_{BR}$ @ 25°C x (1 + αT x ($T_J$ - 25))
   $V_{CL}$ @ $T_J = V_{CL}$ @ 25°C x (1 + αT x ($T_J$ - 25))
4. Surge capability given for both directions for unidirectional and bidirectional types.

**Figure 3. Peak power dissipation versus initial junction temperature (typical values)**

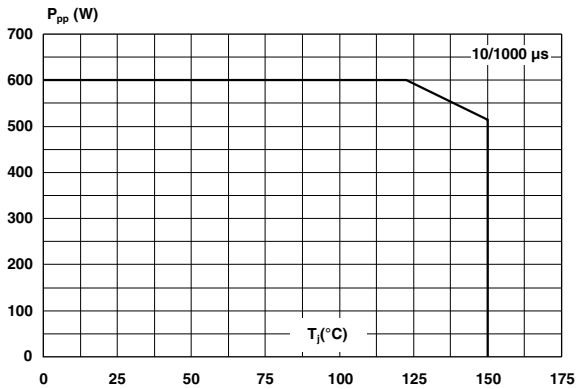



**Figure 4. Peak pulse power versus exponential pulse duration**

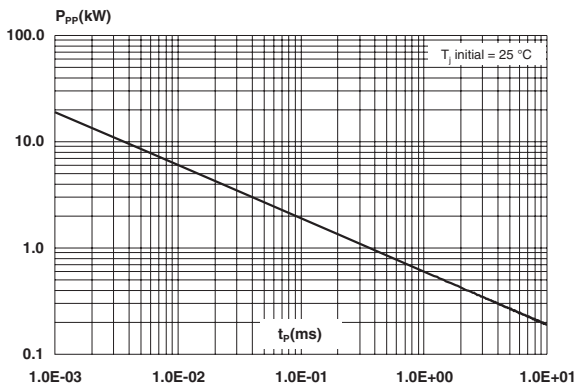


**Figure 5. Clamping voltage versus peak pulse current exponential waveform (maximum values)**

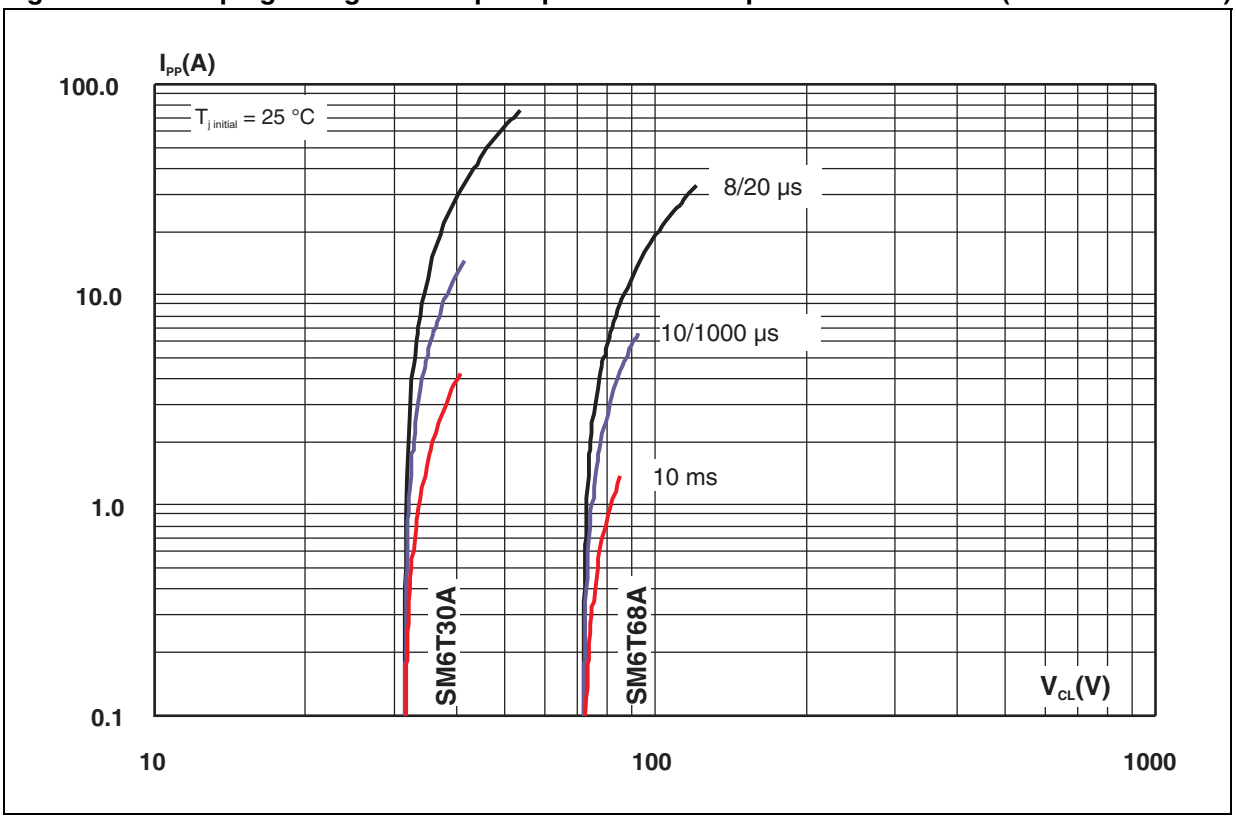



**Figure 6. ISO 7637-2 pulse 1 response ($V_S$ = -100 V)**

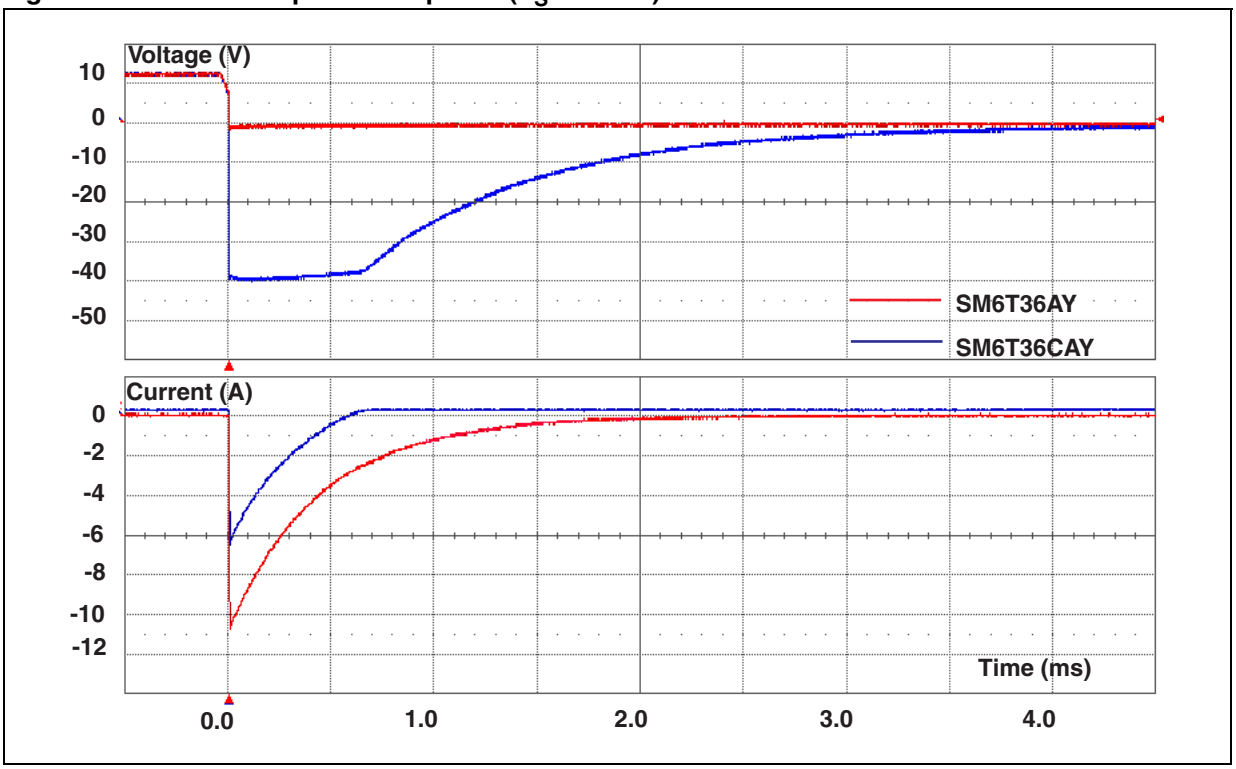


**Figure 7. ISO 7637-2 pulse 2a response ($V_S$ = 50 V)**

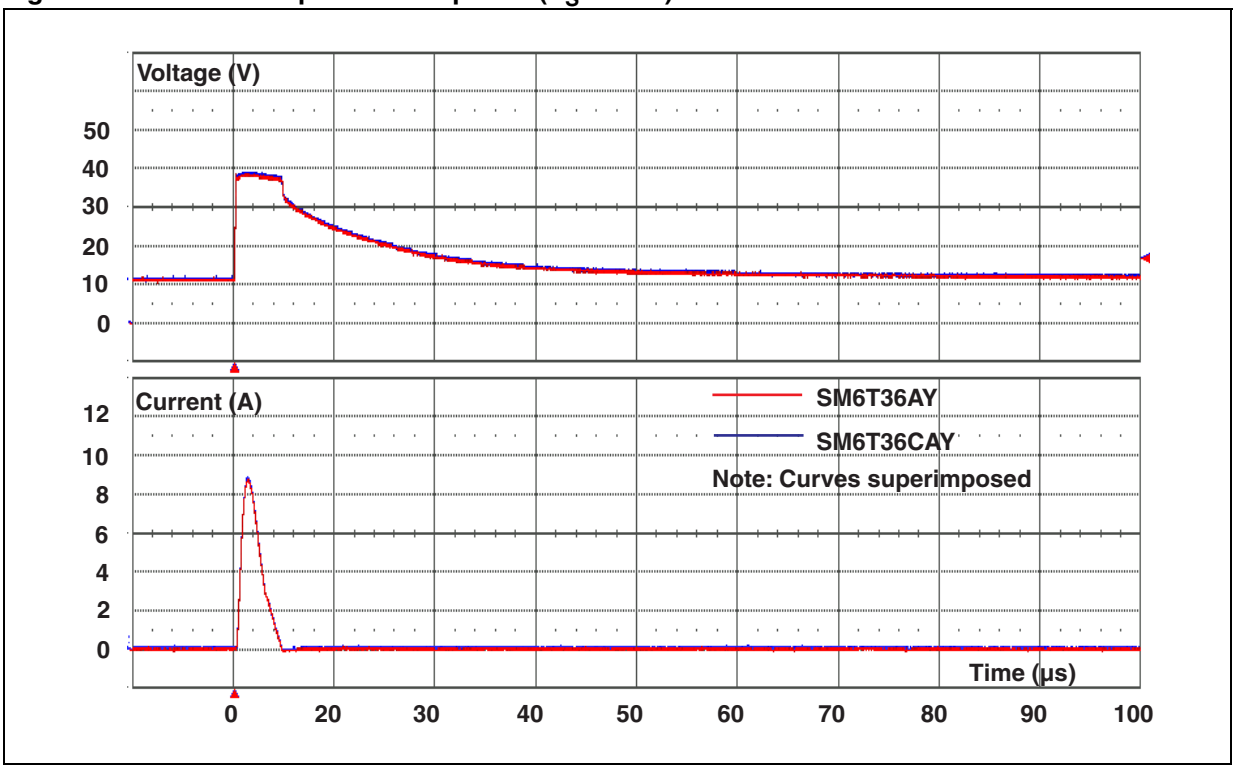



**Figure 8. ISO 7637-2 pulse 3a response ($V_S$ = -150 V)**

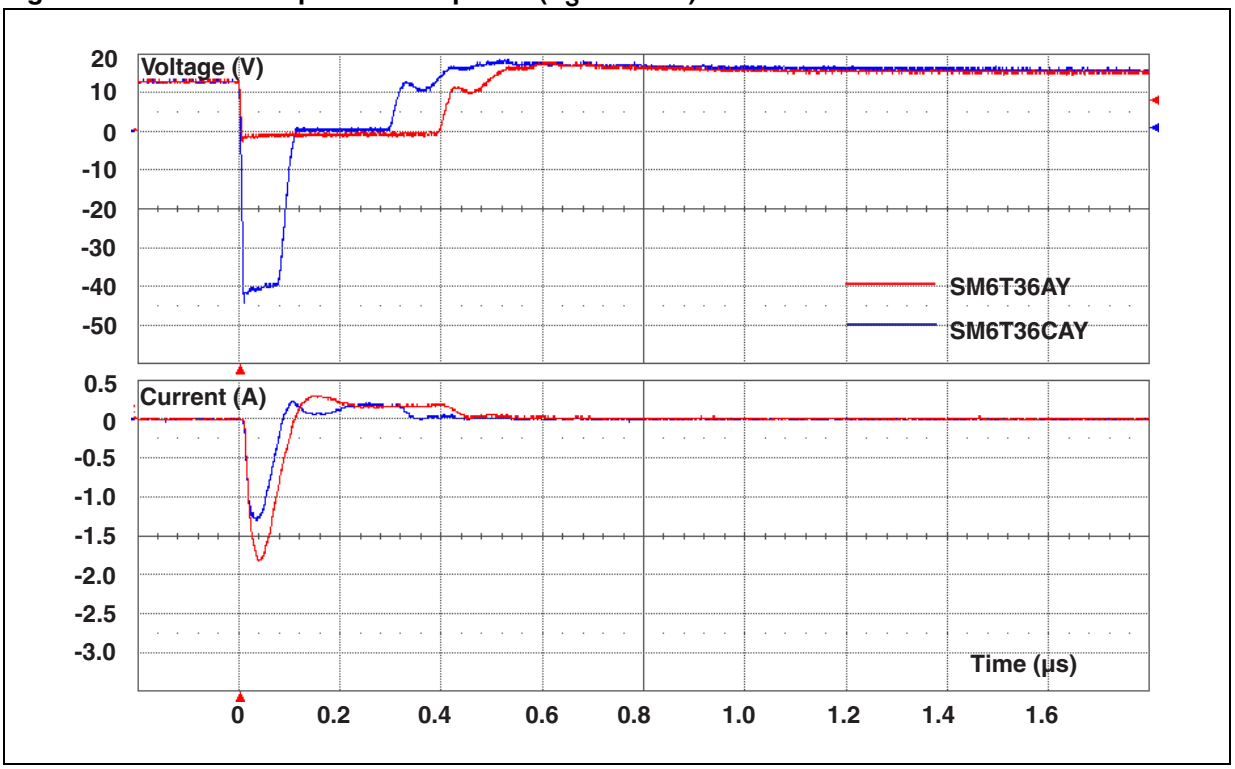
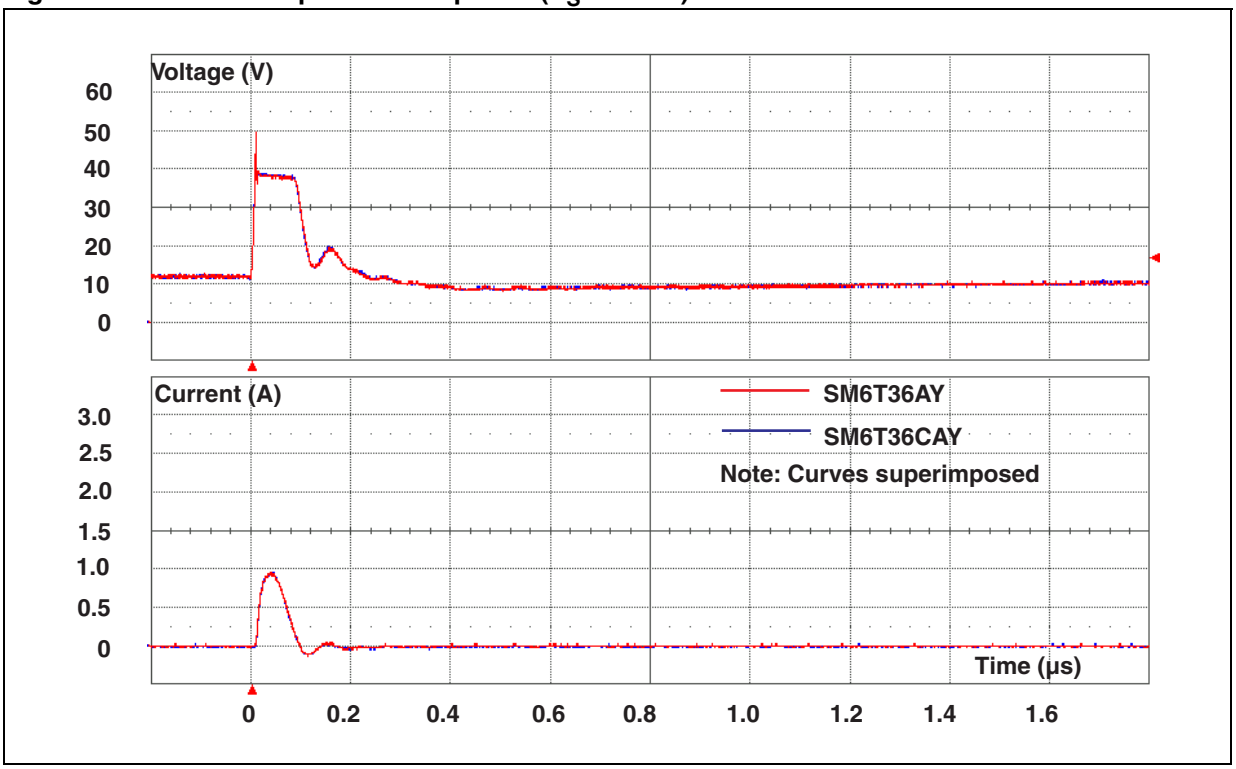


**Figure 9. ISO 7637-2 pulse 3b response ($V_S$ = 100 V)**




*Note: ISO7637-2 pulses responses are not applicable for products with a stand off voltage lower than the average battery voltage (13.5 V).*

**Figure 10. Junction capacitance versus reverse applied voltage for unidirectional types (typical values)**

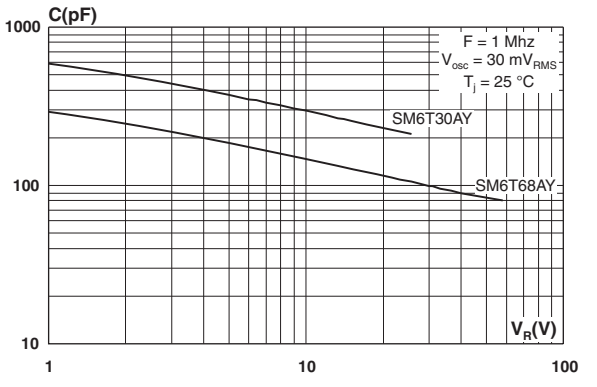



**Figure 11. Junction capacitance versus reverse applied voltage for bidirectional types (typical values)**

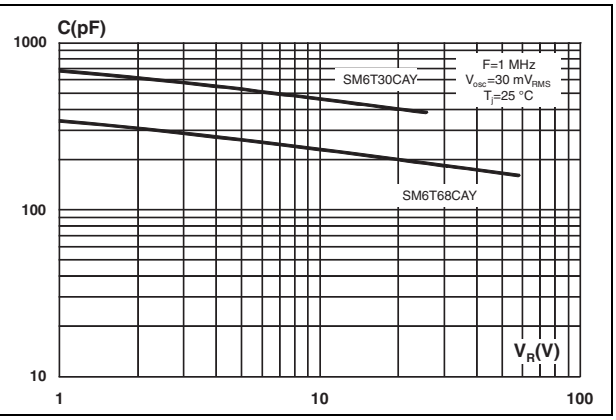


**Figure 12. Relative variation of thermal impedance, junction to ambient, versus pulse duration**

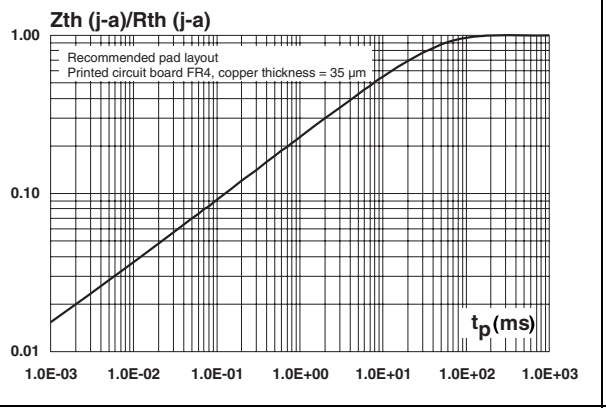



**Figure 13. Thermal resistance junction to ambient versus copper surface under each lead**

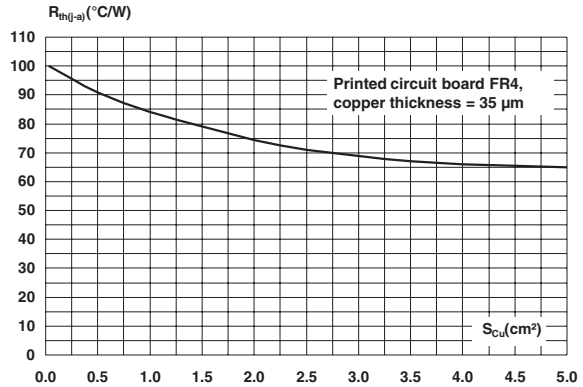



**Figure 14. Leakage current versus junction temperature (typical values)**

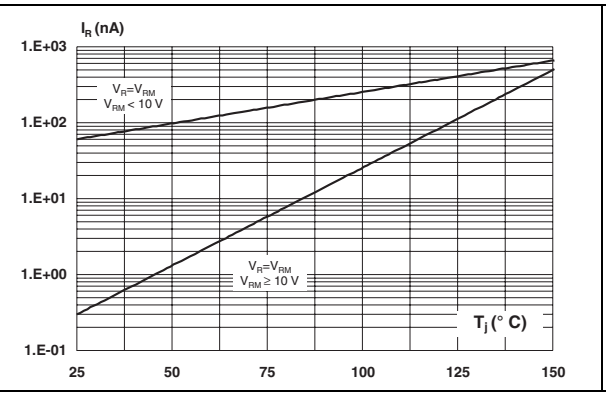
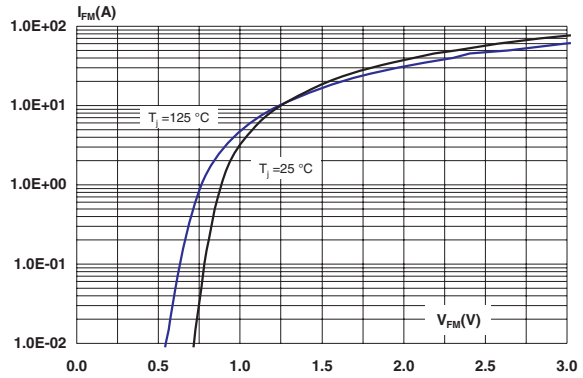



**Figure 15. Peak forward voltage drop versus peak forward current (typical values)**

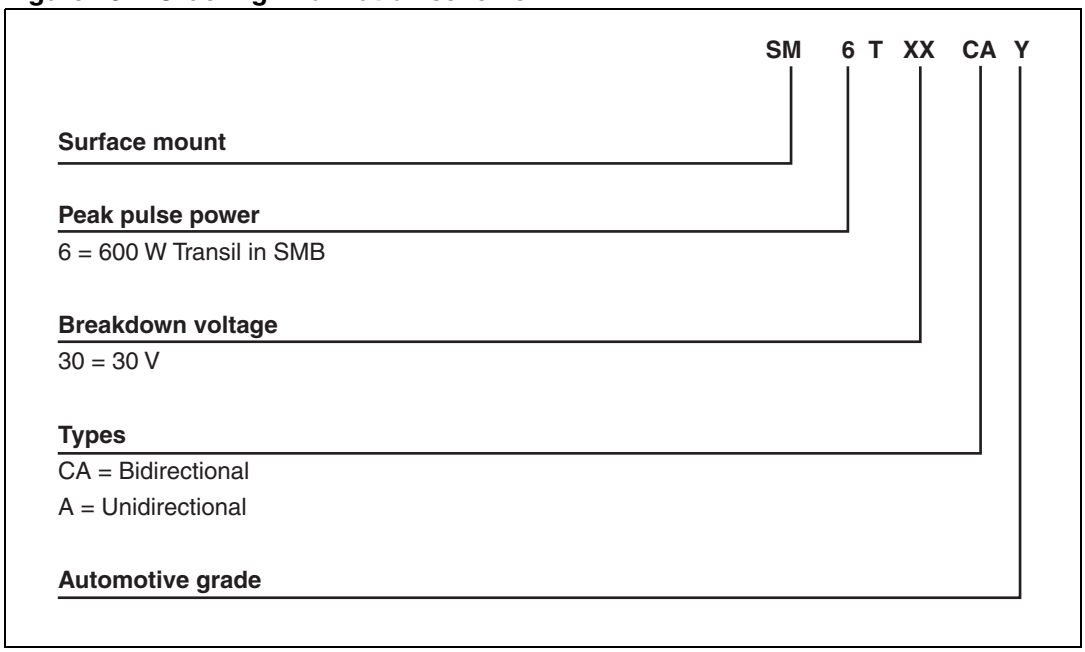


# 2 Application and design guidelines

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

# 3 Ordering information scheme

**Figure 16. Ordering information scheme**

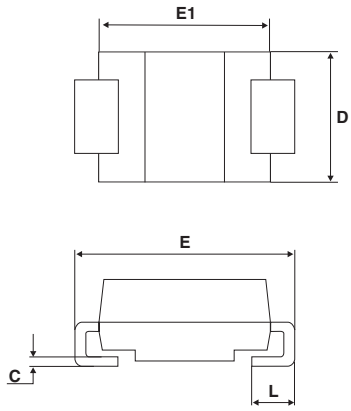


# 4 Packaging information

- Case: JEDEC DO-214AA molded plastic over planar junction
- Terminals: solder plated, solderable as per MIL-STD-750, Method 2026
- Polarity: for unidirectional types the band indicates cathode
- Flammability: epoxy meets UL 94, V0
- RoHS package

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. ECOPACK® is an ST trademark.

**Table 4. SMB dimensions**




| Ref. | Dimensions | | | |
|---|---|---|---|---|
| | Millimeters | | Inches | |
| | Min. | Max. | Min. | Max. |
| A1 | 1.90 | 2.45 | 0.075 | 0.096 |
| A2 | 0.05 | 0.20 | 0.002 | 0.008 |
| b | 1.95 | 2.20 | 0.077 | 0.087 |
| c | 0.15 | 0.40 | 0.006 | 0.016 |
| D | 3.30 | 3.95 | 0.130 | 0.156 |
| E | 5.10 | 5.60 | 0.201 | 0.220 |
| E1 | 4.05 | 4.60 | 0.159 | 0.181 |
| L | 0.75 | 1.50 | 0.030 | 0.059 |

**Figure 17. SMB footprint dimensions in mm (inches)**

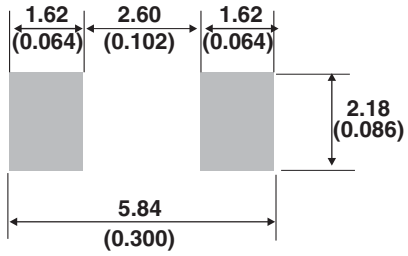
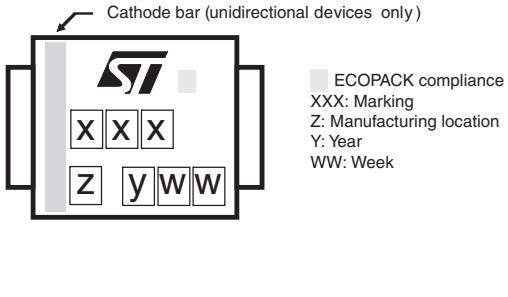



**Figure 18. Marking layout(1)**




1. Marking layout can vary according to assembly location.

**Table 5. Marking**

| Order code | Marking | Order code | Marking |
|---|---|---|---|
| SM6T7V5AY | DGY | | |
| SM6T18AY | EEY | SM6T18CAY | MEY |
| SM6T22AY | EKY | SM6T22CAY | MKY |
| SM6T24AY | EMY | SM6T24CAY | MMY |
| SM6T27AY | EPY | SM6T27CAY | MPY |
| SM6T30AY | ERY | SM6T30CAY | MRY |
| SM6T33AY | ETY | SM6T33CAY | MTY |
| SM6T36AY | EVY | SM6T36CAY | MVY |
| SM6T39AY | EXY | SM6T39CAY | MXY |
| | | SM6T42CAY | NAY |
| SM6T47AY | FAY | SM6T47CAY | NBY |
| SM6T68AY | FQY | SM6T68CAY | NQY |

# 5 Ordering information

**Table 6. Ordering information**

| Order code | Marking | Package | Weight | Base qty | Delivery mode |
|---|---|---|---|---|---|
| SM6TxxxAy/CAy(1) | See *Table 5 on page 10* | SMB | 0.11 g | 2500 | Tape and reel |

1. Where xxx is nominal value of $V_{BR}$ and A or CA indicates unidirectional or bidirectional version. See *Table 3* for list of available devices and their order codes

# 6 Revision history

**Table 7. Document revision history**

| Date | Revision | Changes |
|---|---|---|
| 15-Sep-2010 | 1 | Initial release. |

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