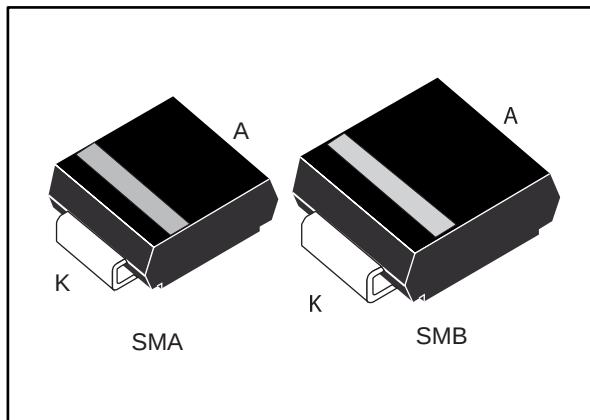


## Automotive ultrafast recovery diode

Datasheet - production data



### Description

This device that uses ST's new 400 V planar Pt doping technology, is specially suited for switching mode base drive and transistor circuits.

Packaged in SMB and SMA, it is intended for use in low voltage, high frequency inverters, freewheeling and polarity protection in automotive applications.

**Table 1: Device summary**

| Symbol          | Value  |
|-----------------|--------|
| $I_{F(AV)}$     | 1 A    |
| $V_{RRM}$       | 400 V  |
| $T_j$ (max.)    | 175 °C |
| $V_F$ (typ.)    | 0.9 V  |
| $t_{rr}$ (typ.) | 14 ns  |

### Features

- AEC-Q101 qualified 
- Negligible switching losses
- Low forward and reverse recovery times
- High junction temperature
- ECOPACK®2 compliant component

# 1 Characteristics

**Table 2: Absolute ratings (limiting values per diode at 25 °C, unless otherwise specified)**

| Symbol             | Parameter                                        |     |                                    | Value       | Unit |
|--------------------|--------------------------------------------------|-----|------------------------------------|-------------|------|
| V <sub>RRM</sub>   | Repetitive peak reverse voltage                  |     | T <sub>J</sub> = -40 °C to +175 °C | 400         | V    |
| I <sub>F(AV)</sub> | Average forward current,<br>δ = 0.5, square wave | SMA | T <sub>I</sub> = 130 °C            | 1.0         | A    |
|                    |                                                  | SMB | T <sub>I</sub> = 140 °C            |             |      |
| I <sub>FSM</sub>   | Surge non repetitive forward current             |     | t <sub>p</sub> = 10 ms sinusoidal  | 30          | A    |
|                    |                                                  |     | t <sub>p</sub> = 8.3 ms sinusoidal | 37          |      |
| T <sub>stg</sub>   | Storage temperature range                        |     |                                    | -65 to +175 | °C   |
| T <sub>j</sub>     | Operating junction temperature <sup>(1)</sup>    |     |                                    | -40 to +175 | °C   |

**Notes:**

<sup>(1)</sup> $(dP_{tot}/dT_j) < (1/R_{th(j-a)})$  condition to avoid thermal runaway for a diode on its own heatsink.

**Table 3: Thermal resistance parameters**

| Symbol        | Parameter        |     | Maximum value | Unit |
|---------------|------------------|-----|---------------|------|
| $R_{th(j-l)}$ | Junction to lead | SMA | 30            | °C/W |
|               |                  | SMB | 25            |      |

**Table 4: Static electrical characteristics ( per diode)**

| Symbol      | Parameter               | Test conditions       |                    | Min. | Typ. | Max. | Unit          |
|-------------|-------------------------|-----------------------|--------------------|------|------|------|---------------|
| $I_R^{(1)}$ | Reverse leakage current | $T_j = 25\text{ °C}$  | $V_R = V_{RRM}$    | -    |      | 5    | $\mu\text{A}$ |
|             |                         | $T_j = 125\text{ °C}$ |                    | -    | 5    | 50   |               |
| $V_F^{(2)}$ | Forward voltage drop    | $T_j = 25\text{ °C}$  | $I_F = 1\text{ A}$ | -    | 1.30 | 1.60 | V             |
|             |                         | $T_j = 100\text{ °C}$ |                    | -    | 1.05 | 1.30 |               |
|             |                         | $T_j = 150\text{ °C}$ |                    | -    | 0.90 | 1.15 |               |

**Notes:**

<sup>(1)</sup>Pulse test:  $t_p = 5\text{ ms}$ ,  $\delta < 2\%$

<sup>(2)</sup>Pulse test:  $t_p = 380\text{ }\mu\text{s}$ ,  $\delta < 2\%$

To evaluate the conduction losses, use the following equation:

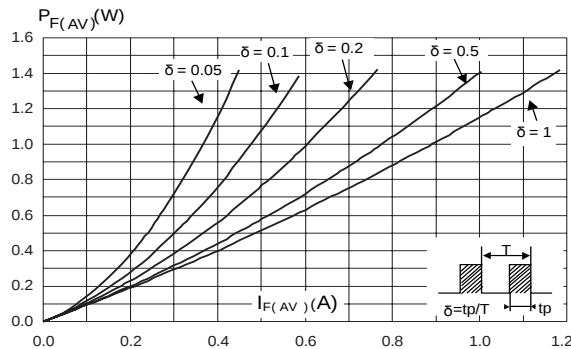
$$P = 0.9 \times I_{F(AV)} + 0.250 \times I_{F(RMS)}^2$$

Table 5: Dynamic electrical characteristics per diode ( $T_j = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)

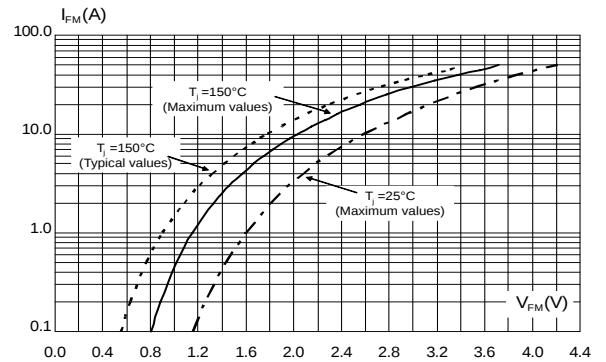
| Symbol   | Parameters               | Test conditions                                                                                                            | Min. | Typ. | Max. | Unit |
|----------|--------------------------|----------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{rr}$ | Reverse recovery time    | $I_F = 1\text{ A}$<br>$di_F/dt = -50\text{ A}/\mu\text{s}$<br>$V_R = 30\text{ V}$                                          | -    |      | 30   | ns   |
|          |                          | $I_F = 1\text{ A}$<br>$di_F/dt = -100\text{ A}/\mu\text{s}$<br>$V_R = 30\text{ V}$                                         | -    | 14   | 20   |      |
| $I_{RM}$ | Reverse recovery current | $I_F = 1\text{ A}$<br>$di_F/dt = -200\text{ A}/\mu\text{s}$<br>$V_R = 320\text{ V}$<br>$T_j = 125\text{ }^{\circ}\text{C}$ | -    | 2.5  | 3.5  | A    |
| $V_{FP}$ | Forward recovery voltage | $I_F = 1\text{ A}$<br>$di_F/dt = 100\text{ A}/\mu\text{s}$                                                                 | -    | 2.9  |      | V    |
| $t_{fr}$ | Forward recovery time    | $I_F = 1\text{ A}$<br>$di_F/dt = 100\text{ A}/\mu\text{s}$<br>$V_{FR} = 1.1 \times V_F (\text{max})$                       | -    |      | 50   | ns   |

## 1.1 Characteristics (curves)

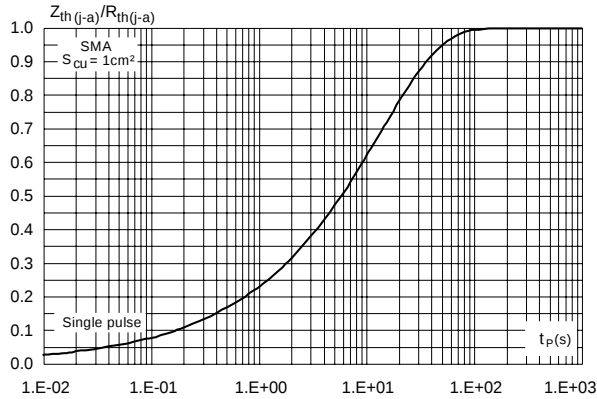
**Figure 1: Conduction losses versus average forward current**



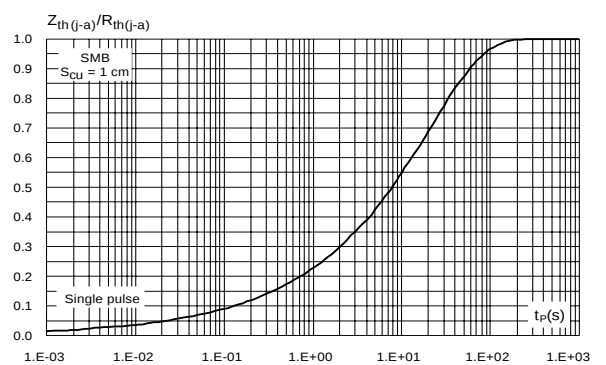
**Figure 2: Forward voltage drop versus forward current**



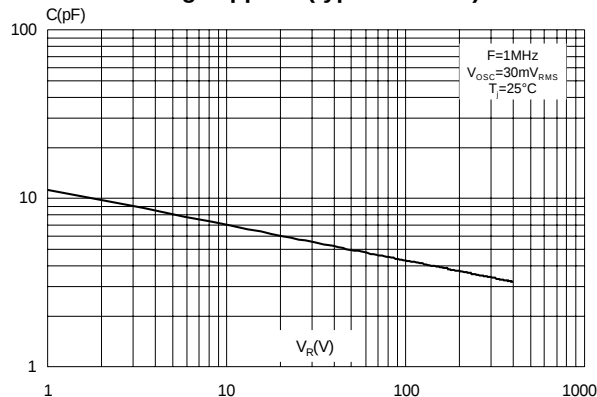
**Figure 3: Relative variation of thermal impedance junction to case ambient versus pulse duration (SMA)**



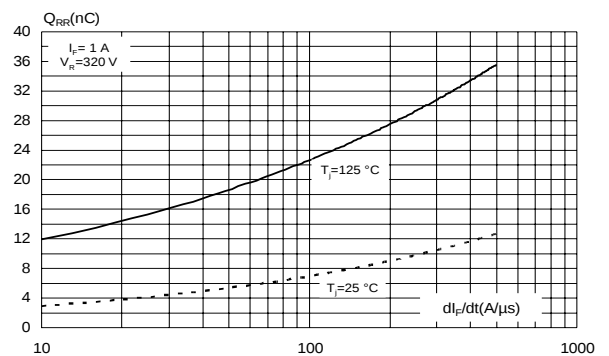
**Figure 4: Relative variation of thermal impedance junction to case ambient versus pulse duration (SMB)**

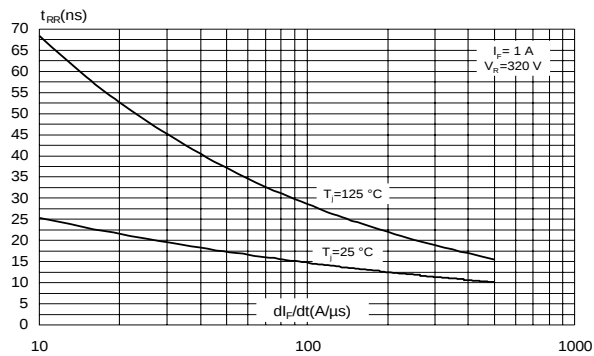
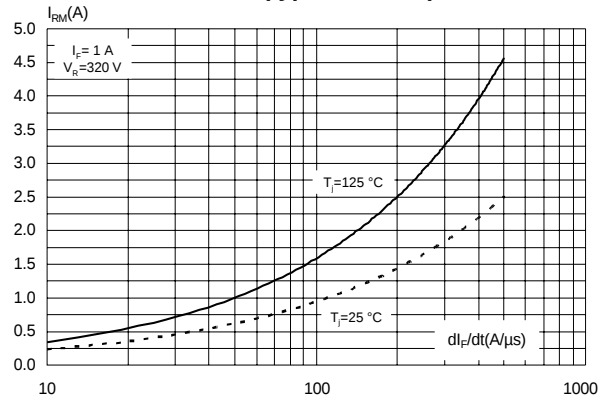
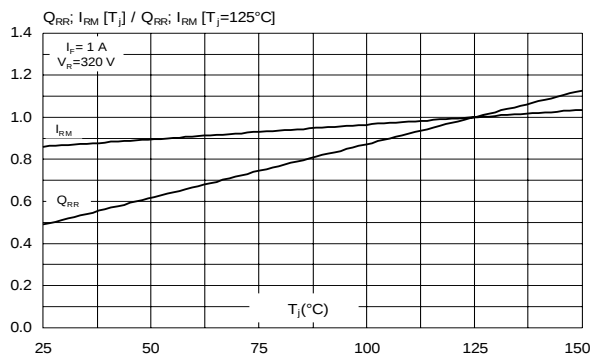
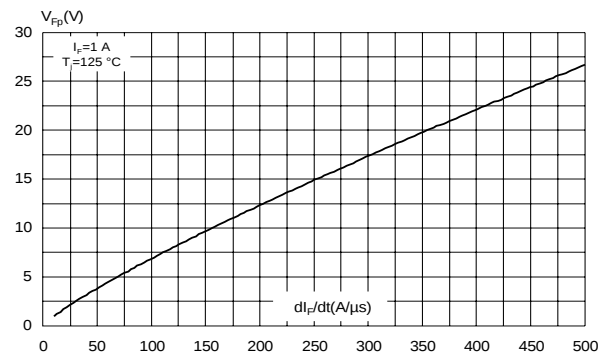
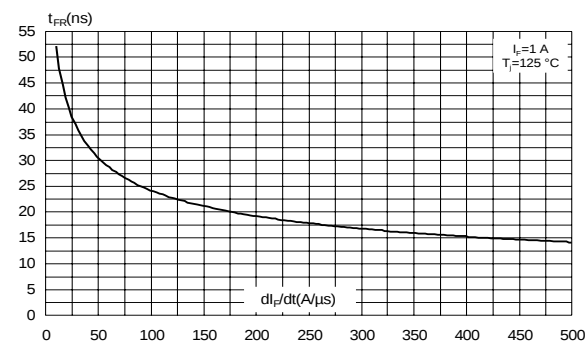
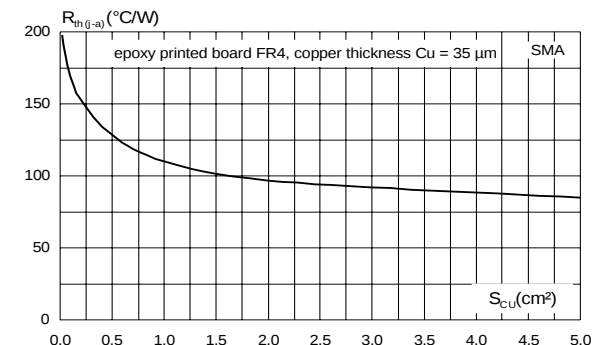


**Figure 5: Junction capacitance versus reverse voltage applied (typical values)**

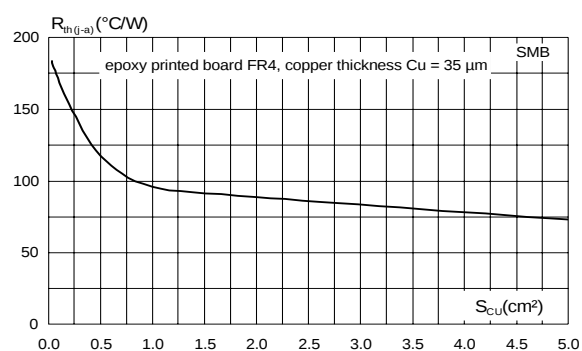


**Figure 6: Reverse recovery charges versus  $di_F / dt$  (typical values)**



**Figure 7: Reverse recovery time versus  $dl_F / dt$  (typical values)****Figure 8: Peak reverse recovery current versus  $dl_F / dt$  (typical values)****Figure 9: Relative variation of dynamic parameters versus junction temperature****Figure 10: Transient peak forward voltage versus  $dl_F / dt$  (typical values)****Figure 11: Forward recovery time versus  $dl_F / dt$  (typical values)****Figure 12: Thermal resistance junction to ambient total versus copper surface under each lead (SMA)**

**Figure 13: Thermal resistance junction to ambient total versus copper surface under each lead (SMB)**



## 2 Package information

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 SMA package information

Figure 14: SMA package outline

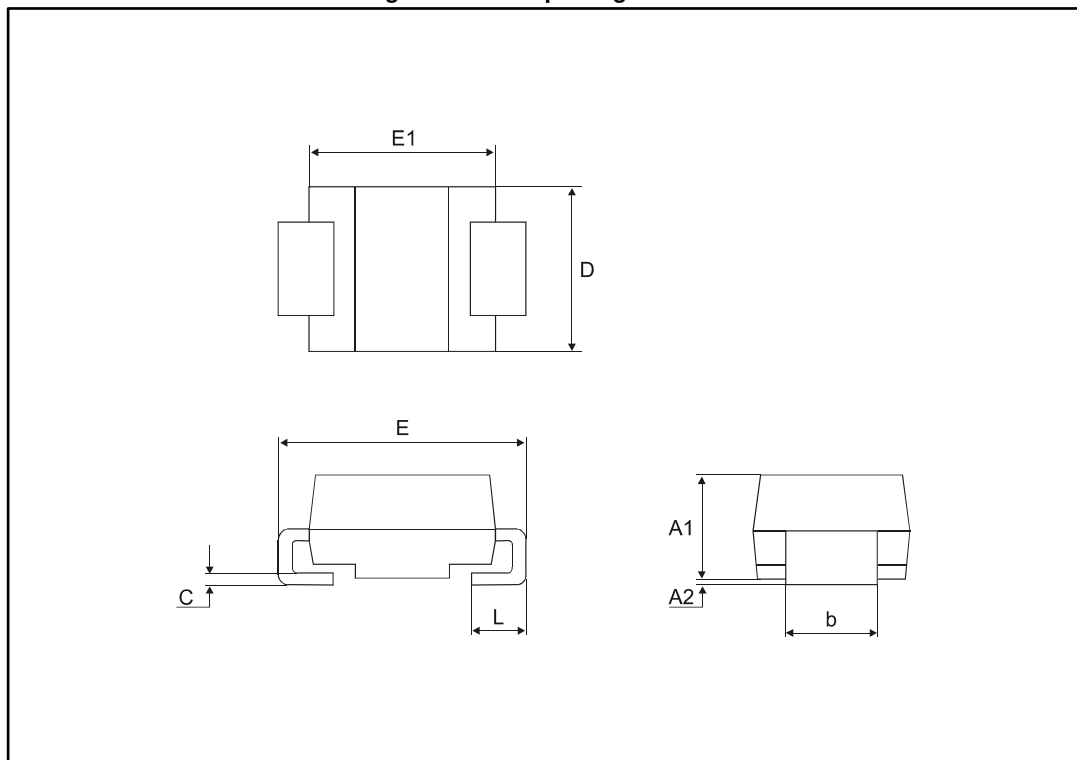
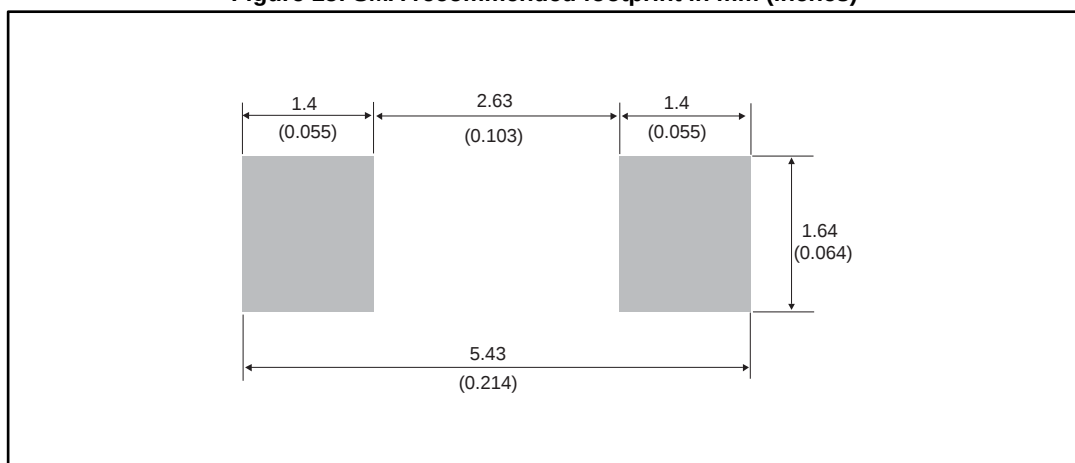


Table 6: SMA package mechanical data

| Ref. | Dimensions  |      |        |       |
|------|-------------|------|--------|-------|
|      | Millimeters |      | Inches |       |
|      | Min.        | Max. | Min.   | Max.  |
| A1   | 1.90        | 2.45 | 0.075  | 0.097 |
| A2   | 0.05        | 0.20 | 0.002  | 0.008 |
| b    | 1.25        | 1.65 | 0.049  | 0.065 |
| c    | 0.15        | 0.40 | 0.006  | 0.016 |
| D    | 2.25        | 2.90 | 0.089  | 0.114 |
| E    | 4.80        | 5.35 | 0.189  | 0.211 |
| E1   | 3.95        | 4.60 | 0.156  | 0.181 |
| L    | 0.75        | 1.50 | 0.030  | 0.059 |

Figure 15: SMA recommended footprint in mm (inches)



## 2.2 SMB package information

Figure 16: SMB package outline

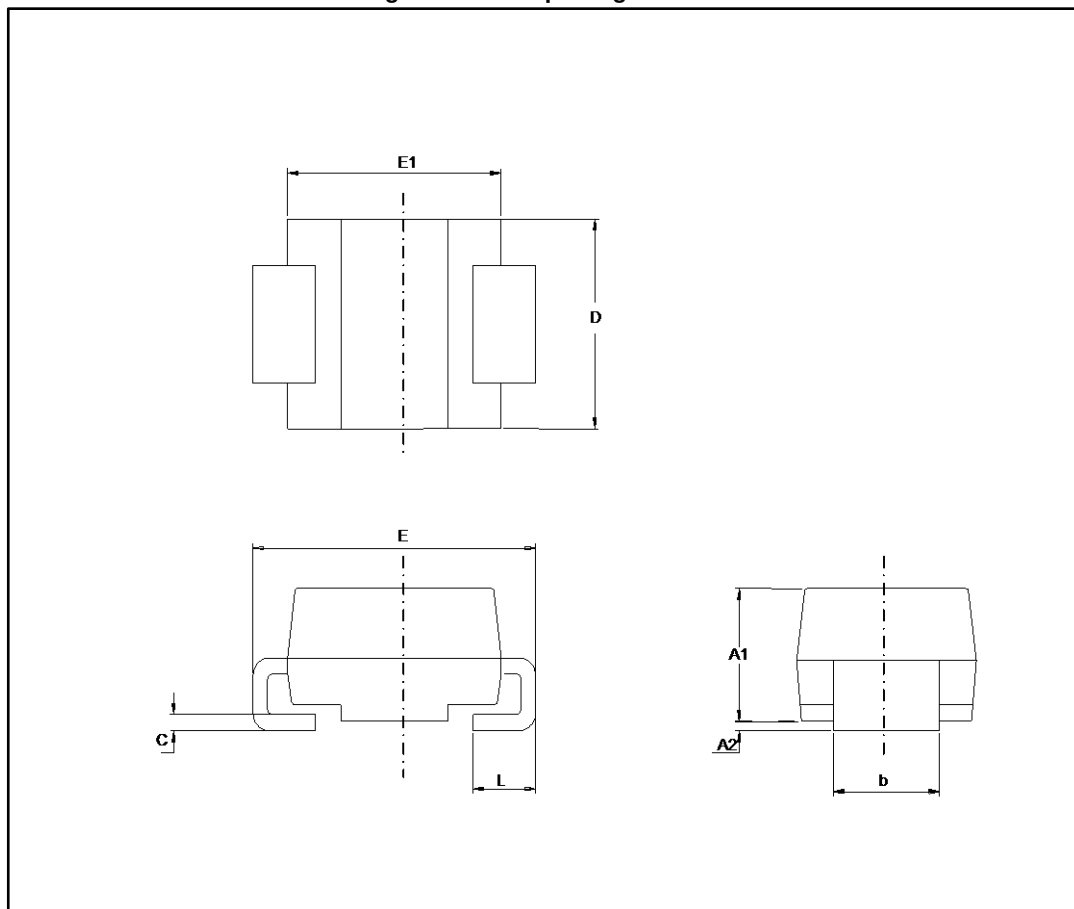
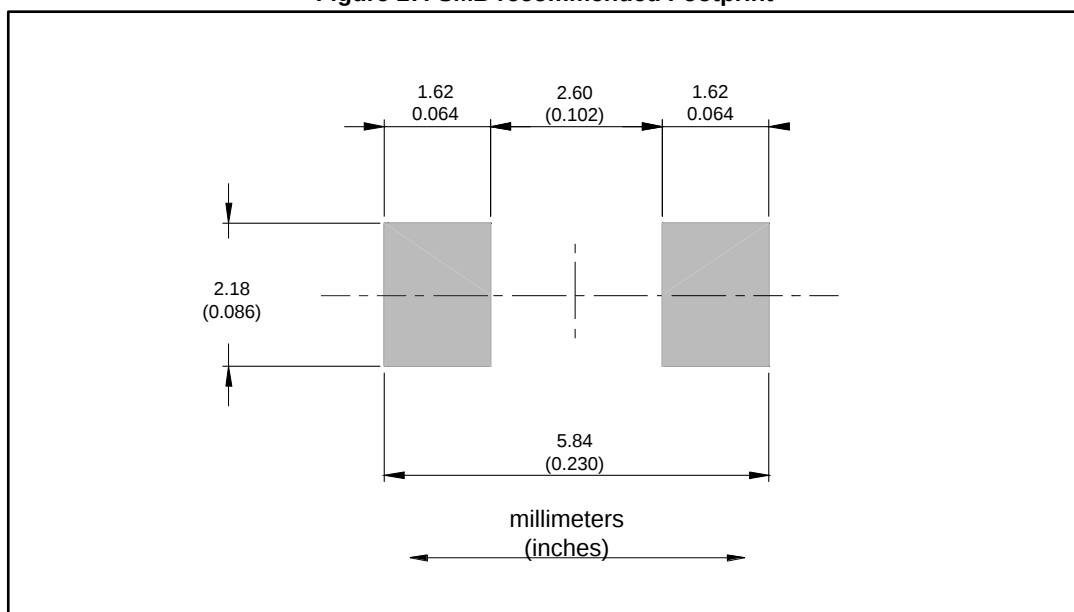


Table 7: SMB package mechanical data

| Ref. | Dimensions  |      |        |        |
|------|-------------|------|--------|--------|
|      | Millimeters |      | Inches |        |
|      | Min.        | Max. | Min.   | Max.   |
| A1   | 1.90        | 2.45 | 0.0748 | 0.0965 |
| A2   | 0.05        | 0.20 | 0.0020 | 0.0079 |
| b    | 1.95        | 2.20 | 0.0768 | 0.0867 |
| c    | 0.15        | 0.40 | 0.0059 | 0.0157 |
| D    | 3.30        | 3.95 | 0.1299 | 0.1556 |
| E    | 5.10        | 5.60 | 0.2008 | 0.2205 |
| E1   | 4.05        | 4.60 | 0.1594 | 0.1811 |
| L    | 0.75        | 1.50 | 0.0295 | 0.0591 |

Figure 17: SMB recommended Footprint



### 3 Ordering information

Table 8: Ordering information

| Order code | Marking | Package | Weight  | Base qty. | Delivery mode |
|------------|---------|---------|---------|-----------|---------------|
| STTH1R04AY | HR4Y    | SMA     | 0.068 g | 5000      | Tape and reel |
| STTH1R04UY | BR4Y    | SMB     | 0.12 g  | 2500      | Tape and reel |

### 4 Revision history

Table 9: Document revision history

| Date        | Revision | Changes                                                                                                                |
|-------------|----------|------------------------------------------------------------------------------------------------------------------------|
| 09-Jul-2013 | 1        | First issue                                                                                                            |
| 16-Mar-2017 | 2        | Updated <a href="#">Table 2: "Absolute ratings (limiting values per diode at 25 °C, unless otherwise specified)"</a> . |

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