

## Ultrafast recovery diode

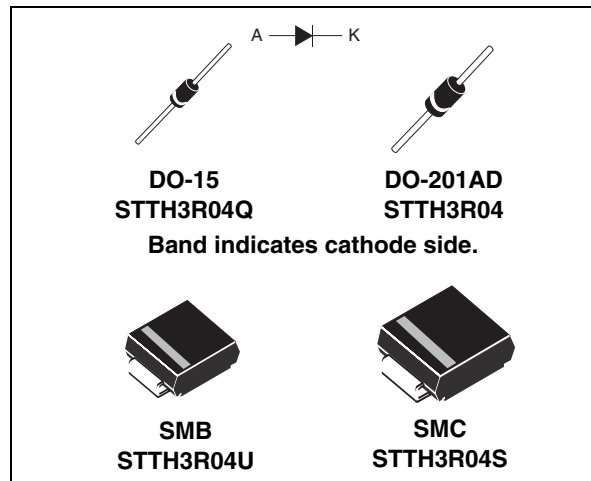
### Features

- Negligible switching losses
- Low forward and reverse recovery times
- High junction temperature

### Description

The STTH3R04 series uses ST's new 400 V planar Pt doping technology. The STTH3R04 is specially suited for switching mode base drive and transistor circuits.

Packaged in axial and surface mount packages, this device is intended for use in low voltage, high frequency inverters, free wheeling and polarity protection.



**Table 1. Device summary**

|                |        |
|----------------|--------|
| $I_{F(AV)}$    | 3 A    |
| $V_{RRM}$      | 400 V  |
| $T_j (max)$    | 175 °C |
| $V_F (typ)$    | 0.9 V  |
| $t_{rr} (typ)$ | 18 ns  |

# 1 Characteristics

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

| Symbol      | Parameter   |                                 | Value                      | Unit |   |
|-------------|---|---------------------------------|----------------------------|------|---|
| $V_{RRM}$   | Repetitive peak reverse voltage                       |                                 | 400                        | V    |   |
| $I_{F(AV)}$ | Average forward current, $\delta = 0.5$               | DO-15                           | $T_{lead} = 70\text{ °C}$  | 3.0  | A |
|             |   | DO-201AD                        | $T_{lead} = 80\text{ °C}$  |      |   |
|             |   | SMB                             | $T_{lead} = 70\text{ °C}$  |      |   |
|             |   | SMC                             | $T_{lead} = 100\text{ °C}$ |      |   |
| $I_{FSM}$   | Surge non repetitive forward current                  | $t_p = 10\text{ ms}$ Sinusoidal | 60                         | A    |   |
| $T_{stg}$   | Storage temperature range                             |                                 | -65 to +175                | °C   |   |
| $T_j$       | Maximum operating junction temperature <sup>(1)</sup> |                                 | 175                        | °C   |   |

1. On infinite heatsink with 10 mm lead length

**Table 3. Thermal parameters**

| Symbol        | Parameter        |  | Value    | Unit |      |
|---------------|------------------|--|----------|------|------|
| $R_{th(j-l)}$ | Junction to lead | Lead length = 10 mm on infinite heatsink | DO-15    | 25   | °C/W |
|               |                  |  | DO-201AD | 22   |      |
| $R_{th(j-l)}$ | Junction to lead |  | SMB      | 25   |      |
|               |                  |  | SMC      | 17   |      |

**Table 4. Static electrical characteristics**

| 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    | $T_j = 25\text{ °C}$  | $I_F = 3.0\text{ A}$ |     |     | 1.5  | V             |
|             |                         | $T_j = 100\text{ °C}$ |                      |     | 1.0 | 1.25 |               |
|             |                         | $T_j = 150\text{ °C}$ |                      |     | 0.9 | 1.15 |               |

1. Pulse test:  $t_p = 5\text{ ms}$ ,  $\delta < 2\%$

2. Pulse test:  $t_p = 380\text{ }\mu\text{s}$ ,  $\delta < 2\%$

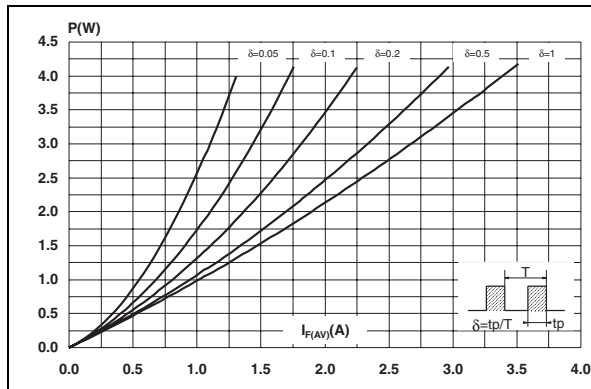
To evaluate the conduction losses use the following equation:

$$P = 0.9 \times I_{F(AV)} + 0.083 \times I_{F(RMS)}^2$$

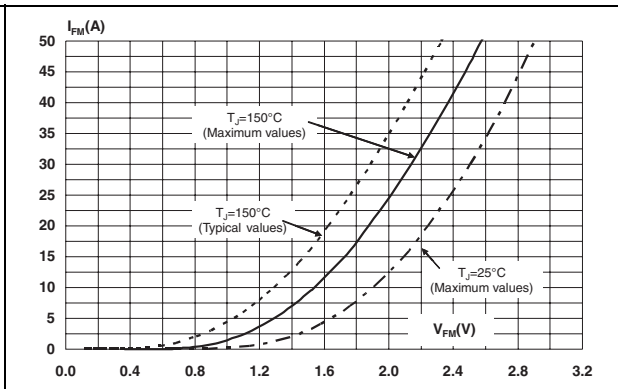
**Table 5. Dynamic characteristics (T<sub>j</sub> = 25 °C unless otherwise stated)**

| Symbol          | Parameter                | Test conditions  | Min | Typ | Max | Unit |
|-----------------|--------------------------|--|-----|-----|-----|------|
| t <sub>rr</sub> | Reverse recovery time    | I <sub>F</sub> = 1 A, di <sub>F</sub> /dt = -50 A/μs, V <sub>R</sub> = 30 V, T <sub>j</sub> = 25 °C                      |     |     | 35  | ns   |
|                 |                          | I <sub>F</sub> = 1 A, di <sub>F</sub> /dt = -100 A/μs, V <sub>R</sub> = 30 V, T <sub>j</sub> = 25 °C                     |     | 18  | 25  |      |
| I <sub>RM</sub> | Reverse recovery current | I <sub>F</sub> = 3.0 A, di <sub>F</sub> /dt = -200 A/μs, V <sub>R</sub> = 320 V, T <sub>j</sub> = 125 °C                 |     | 4   | 5.5 | A    |
| t <sub>fr</sub> | Forward recovery time    | I <sub>F</sub> = 3.0 A di <sub>F</sub> /dt = 100 A/μs V <sub>FR</sub> = 1.1 x V <sub>Fmax</sub> , T <sub>j</sub> = 25 °C |     |     | 75  | ns   |
| V <sub>FP</sub> | Forward recovery voltage | I <sub>F</sub> = 3.0 A di <sub>F</sub> /dt = 100 A/μs  |     | 2.5 |     | V    |

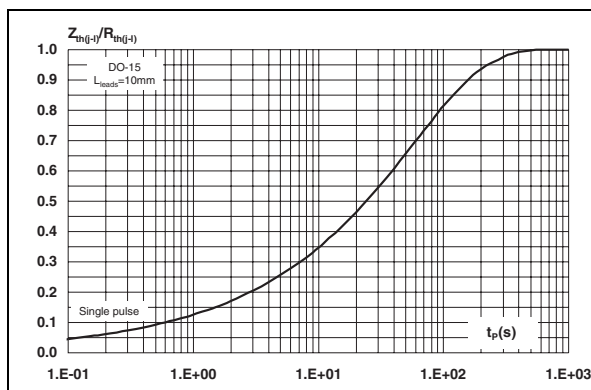
**Figure 1. Conduction losses versus average forward current**



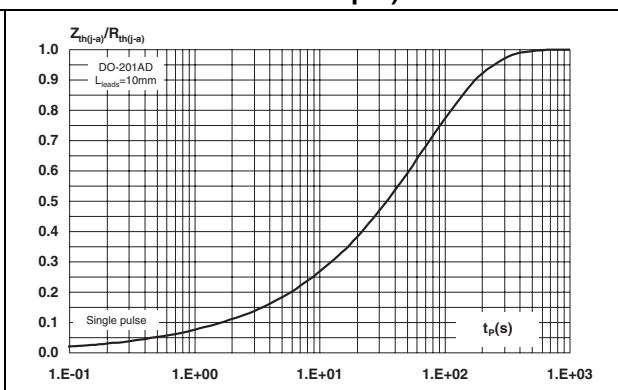
**Figure 2. Forward voltage drop versus forward current**



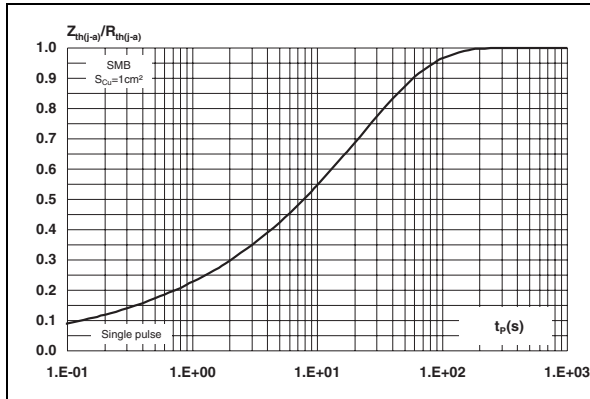
**Figure 3. Relative variation of thermal impedance junction to lead versus pulse duration, DO-15 (epoxy FR4, copper thickness = 35 μm)**



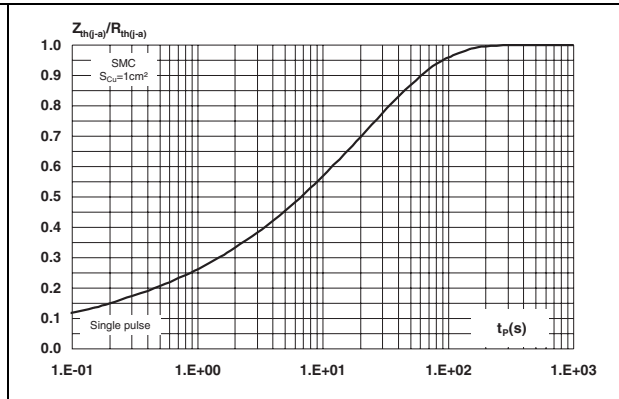
**Figure 4. Relative variation of thermal impedance junction to ambient versus pulse duration, DO-201AD (epoxy FR4, copper thickness = 35 μm)**



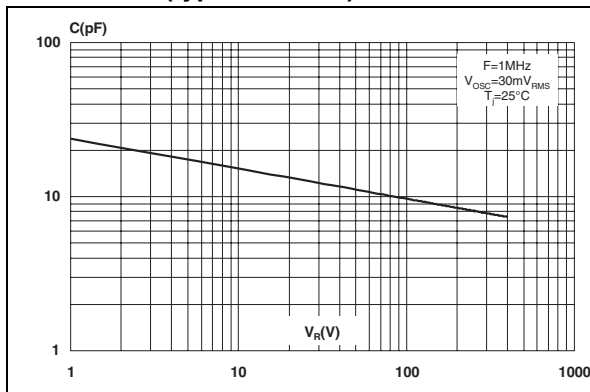
**Figure 5. Relative variation of thermal impedance junction to ambient versus pulse duration, SMB (epoxy FR4, copper thickness = 35 μm)**



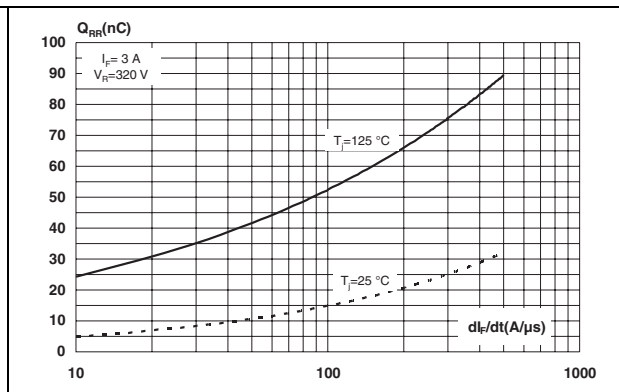
**Figure 6. Relative variation of thermal impedance junction to ambient versus pulse duration, SMC**



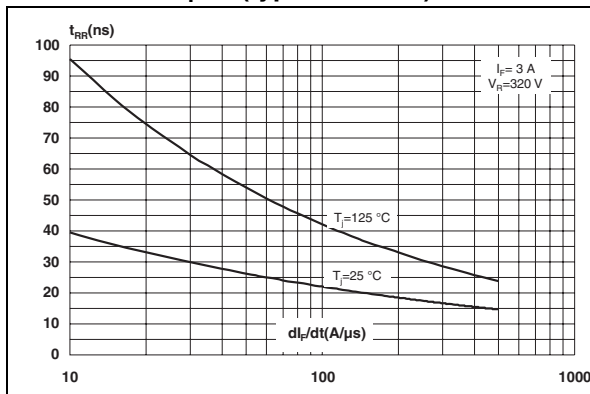
**Figure 7. Junction capacitance versus reverse voltage applied (typical values)**



**Figure 8. Reverse recovery charges versus  $di_F/dt$  (typical values)**



**Figure 9. Reverse recovery time versus  $di_F/dt$  (typical values)**



**Figure 10. Peak reverse recovery current versus  $di_F/dt$  (typical values)**

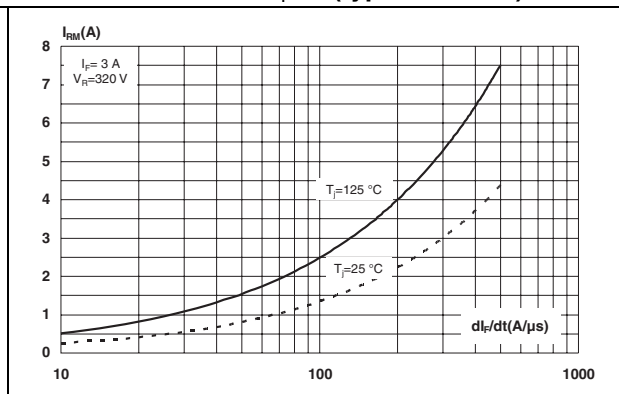


Figure 11. Relative variations of dynamic parameters versus junction temperature

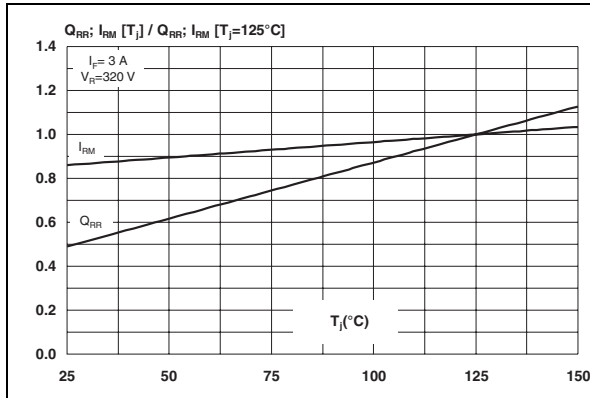


Figure 12. Transient peak forward voltage versus  $di_F/dt$  (typical values)

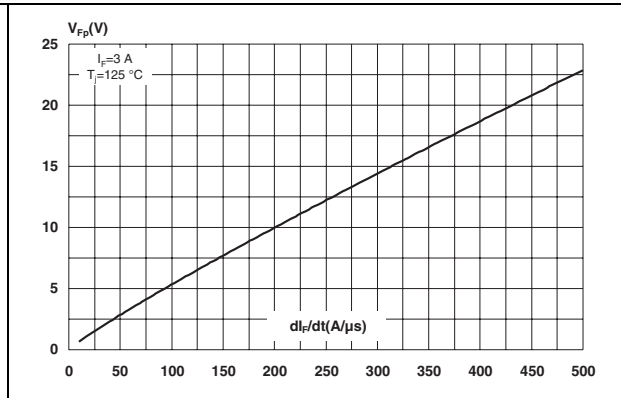


Figure 13. Forward recovery time versus  $di_F/dt$  (typical values)

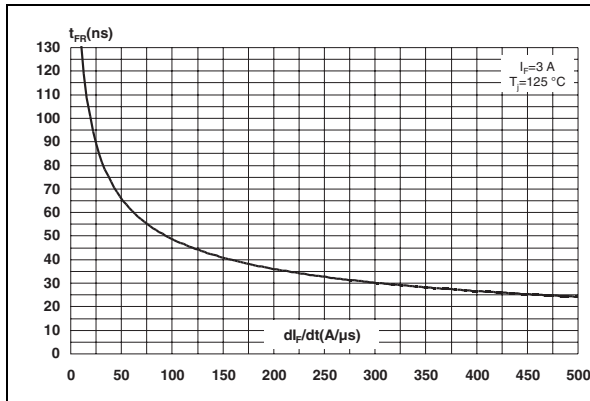


Figure 14. Thermal resistance versus lead length, DO-15

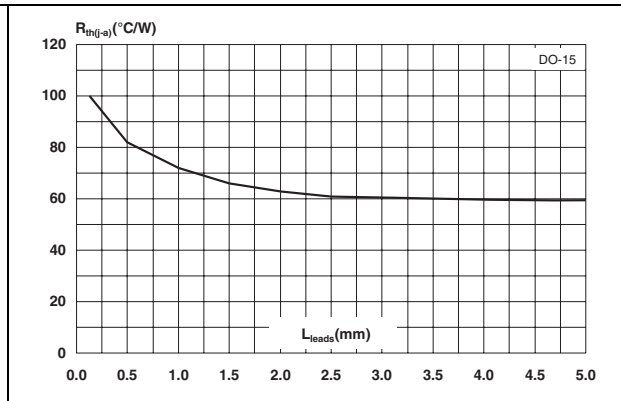


Figure 15. Thermal resistance junction to ambient versus copper surface under each lead, DO-201AD (epoxy FR4, copper thickness = 35 μm)

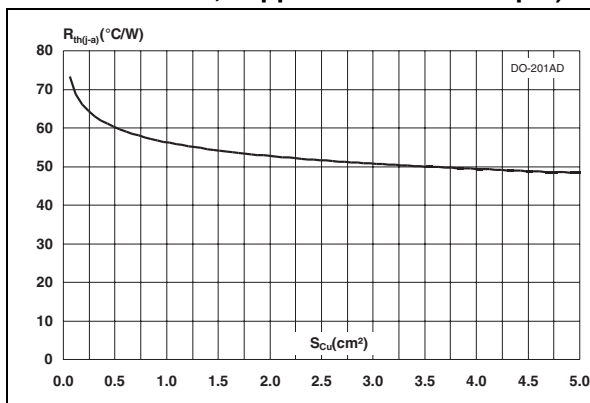
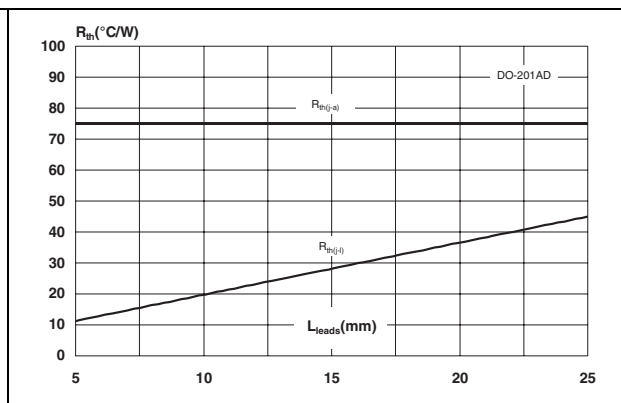
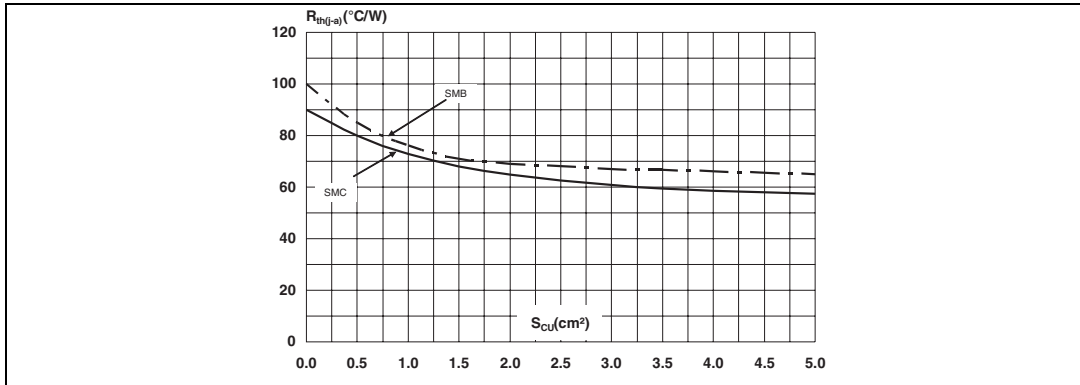


Figure 16. Thermal resistance versus lead length, DO-201AD



**Figure 17. Thermal resistance junction to ambient versus copper surface under each lead, SMB, SMC (epoxy FR4, copper thickness = 35 μm)**



## 2 Package information

- Epoxy meets UL94, V0
- Cooling method: by conduction (C)

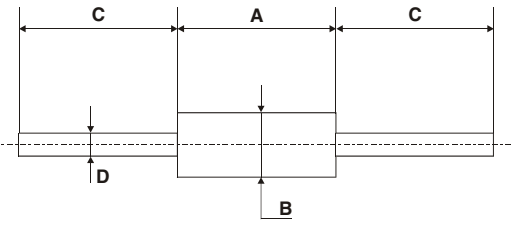
In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at [www.st.com](http://www.st.com).

**Table 6. DO201AD dimensions**

| Ref.         | Dimensions  |      |        |       |
|--------------|---|------|--------|-------|
|              | Millimeters   |      | Inches |       |
|              | Min.  | Max. | Min.   | Max.  |
| A            |   | 9.50 |        | 0.374 |
| B            | 25.40   |      | 1.000  |       |
| C            |   | 5.30 |        | 0.209 |
| D            |   | 1.30 |        | 0.051 |
| E            |   | 1.25 |        | 0.049 |
| <b>Notes</b> | 1 - The lead diameter $\varnothing D$ is not controlled over zone E<br>2 - The minimum length which must stay straight between the right angles after bending is 0.59" (15mm) |      |        |       |

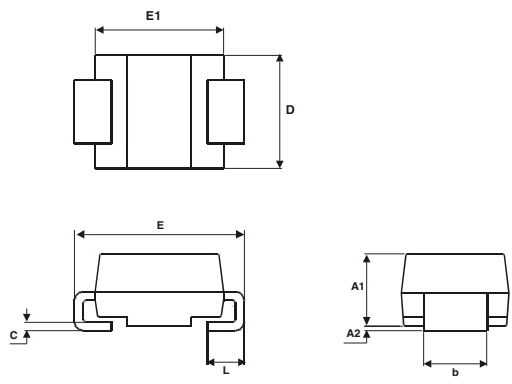
**Table 7. DO-15 dimensions**

| Ref. | Dimensions  |      |        |       |
|------|-------------|------|--------|-------|
|      | Millimeters |      | Inches |       |
|      | Min.        | Max. | Min.   | Max.  |
| A    | 6.05        | 6.75 | 0.238  | 0.266 |
| B    | 2.95        | 3.53 | 0.116  | 0.139 |
| C    | 26          | 31   | 1.024  | 1.220 |
| D    | 0.71        | 0.88 | 0.028  | 0.035 |

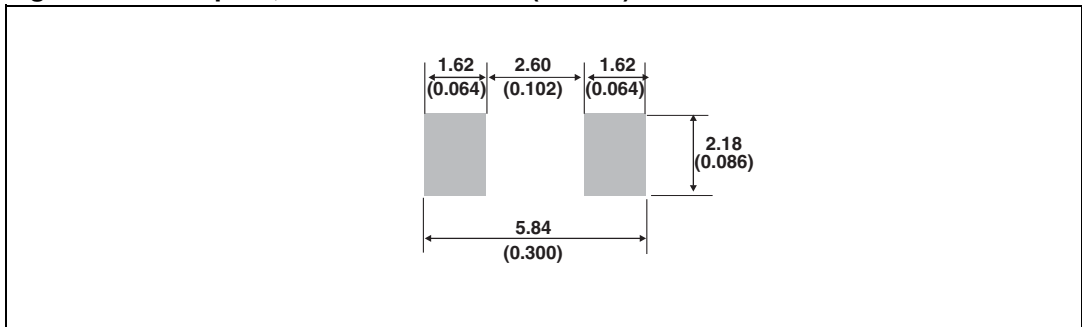


**Table 8. SMB dimensions**

| 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 |



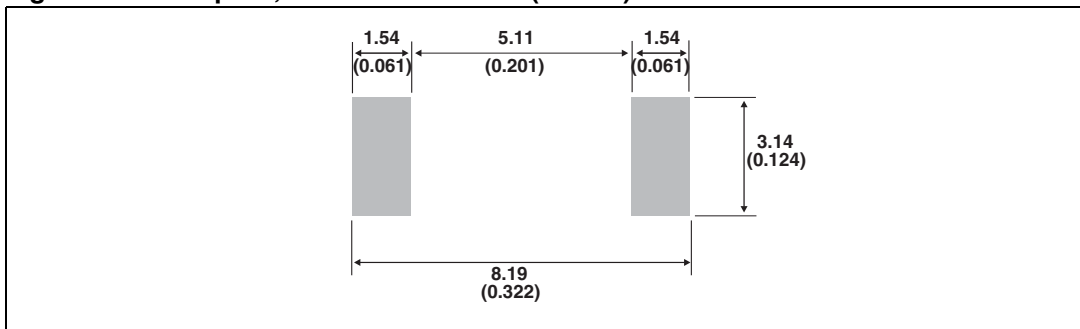
**Figure 18. Footprint, dimensions in mm (inches)**



**Table 9. SMC 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    | 2.90        | 3.20 | 0.114  | 0.126 |
| c    | 0.15        | 0.40 | 0.006  | 0.016 |
| D    | 5.55        | 6.25 | 0.218  | 0.246 |
| E    | 7.75        | 8.15 | 0.305  | 0.321 |
| E1   | 6.60        | 7.15 | 0.260  | 0.281 |
| E2   | 4.40        | 4.70 | 0.173  | 0.185 |
| L    | 0.75        | 1.50 | 0.030  | 0.059 |

**Figure 19. Footprint, dimensions in mm (inches)**





### 3 Ordering information

Table 10. Ordering information

| Order code  | Marking   | Package  | Weight  | Base qty | Delivery mode |
|-------------|-----------|----------|---------|----------|---------------|
| STTH3R04    | STTH3R04  | DO-201AD | 1.16 g  | 600      | Ammopack      |
| STTH3R04RL  | STTH3R04  | DO-201AD | 1.16g   | 1900     | Tape and reel |
| STTH3R04Q   | STTH3R04Q | DO-15    | 0.4 g   | 1000     | Ammopack      |
| STTH3R04QRL | STTH3R04Q | DO-15    | 0.4 g   | 6000     | Tape and reel |
| STTH3R04S   | R4S       | SMC      | 0.243 g | 2500     | Tape and reel |
| STTH3R04U   | 3R4U      | SMB      | 0.12 g  | 2500     | Tape and reel |

### 4 Revision history

Table 11. Document revision history

| Date        | Revision | Description of changes |
|-------------|----------|------------------------|
| 30-May-2008 | 1        | First issue            |

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