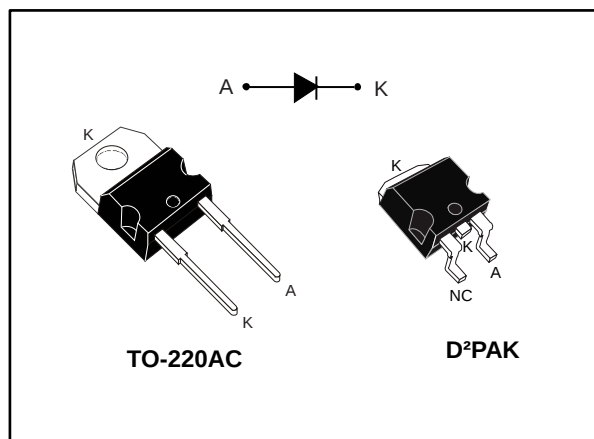


## Automotive 650 V power Schottky silicon carbide diode

Datasheet - production data



### Description

The SiC diode is an ultra high performance power Schottky diode. It is manufactured using a silicon carbide substrate. The wide band gap material allows the design of a Schottky diode structure with a 650 V rating. Due to the Schottky construction, no recovery is shown at turn-off and ringing patterns are negligible. The minimal capacitive turn-off behavior is independent of temperature.

Especially suited for use in PFC applications, this ST SiC diode will boost performance in hard switching conditions. Its high forward surge capability ensures good robustness during transient phases.

### Features

- AEC-Q101 qualified
- No or negligible reverse recovery
- Switching behavior independent of temperature
- Dedicated to PFC applications
- High forward surge capability
- PPAP capable
- Operating  $T_j$  from -40 °C to 175 °C
- ECOPACK®2 compliant component



Table 1: Device summary

| Symbol       | Value  |
|--------------|--------|
| $I_{F(AV)}$  | 10 A   |
| $V_{RRM}$    | 650 V  |
| $T_j$ (max.) | 175 °C |
| $V_F$ (typ.) | 1.30 V |

# 1 Characteristics

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

| Symbol       | Parameter                                     |                                                | Value       | Unit |
|--------------|-----------------------------------------------|------------------------------------------------|-------------|------|
| $V_{RRM}$    | Repetitive peak reverse voltage               | $T_j$ from -40 °C to 175 °C                    | 650         | V    |
| $I_{F(RMS)}$ | Forward rms current                           |                                                | 22          | A    |
| $I_{F(AV)}$  | Average forward current                       | $T_c = 150$ °C <sup>(1)</sup> , DC current     | 10          | A    |
| $I_{FRM}$    | Repetitive peak forward current               | $T_c = 150$ °C, $T_j = 175$ °C, $\delta = 0.1$ | 42          | A    |
| $I_{FSM}$    | Surge non repetitive forward current          | $t_p = 10$ ms sinusoidal, $T_c = 25$ °C        | 48          | A    |
|              |                                               | $t_p = 10$ ms sinusoidal, $T_c = 125$ °C       | 39          |      |
|              |                                               | $t_p = 10$ μs square, $T_c = 25$ °C            | 210         |      |
| $T_{stg}$    | Storage temperature range                     |                                                | -65 to +175 | °C   |
| $T_j$        | Operating junction temperature <sup>(2)</sup> |                                                | -40 to +175 | °C   |

**Notes:**

<sup>(1)</sup>Value based on  $R_{th(j-c)}$  max.

<sup>(2)</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 parameters**

| Symbol        | Parameter        | Value |      | Unit |
|---------------|------------------|-------|------|------|
|               |                  | Typ.  | Max. |      |
| $R_{th(j-c)}$ | Junction to case | 1.0   | 1.5  | °C/W |

**Table 4: Static electrical characteristics**

| Symbol               | Parameter               | Test conditions |                 | Min. | Typ. | Max. | Unit |
|----------------------|-------------------------|-----------------|-----------------|------|------|------|------|
| $I_R$ <sup>(1)</sup> | Reverse leakage current | $T_j = 25$ °C   | $V_R = V_{RRM}$ | -    | 7    | 130  | μA   |
|                      |                         | $T_j = 150$ °C  |                 | -    | 53   | 900  |      |
| $V_F$ <sup>(2)</sup> | Forward voltage drop    | $T_j = 25$ °C   | $I_F = 10$ A    | -    | 1.30 | 1.45 | V    |
|                      |                         | $T_j = 150$ °C  |                 | -    | 1.45 | 1.65 |      |
|                      |                         | $T_j = 175$ °C  |                 | -    | 1.50 |      |      |

**Notes:**

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

<sup>(2)</sup>Pulse test:  $t_p = 500$  μs,  $\delta < 2\%$

To evaluate the conduction losses, use the following equation:

$$P = 0.97 \times I_{F(AV)} + 0.068 \times I_{F(RMS)}^2$$

Table 5: Dynamic electrical characteristics

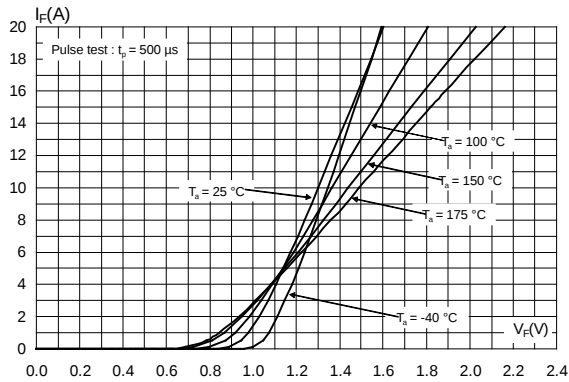
| Symbol         | Parameter               | Test conditions                                                           | Typ. | Unit |
|----------------|-------------------------|---------------------------------------------------------------------------|------|------|
| $Q_{cj}^{(1)}$ | Total capacitive charge | $V_R = 400 \text{ V}$                                                     | 34   | nC   |
| $C_j$          | Total capacitance       | $V_R = 0 \text{ V}, T_c = 25 \text{ }^\circ\text{C}, F = 1 \text{ MHz}$   | 670  | pF   |
|                |                         | $V_R = 400 \text{ V}, T_c = 25 \text{ }^\circ\text{C}, F = 1 \text{ MHz}$ | 55   |      |

**Notes:**

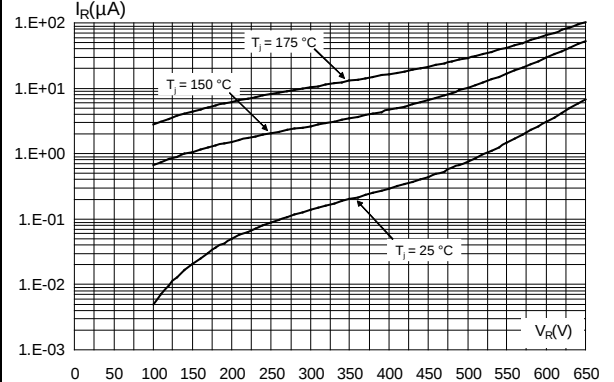
<sup>(1)</sup>Most accurate value for the capacitive charge:  $Q_{cj}(V_R) = \int_0^{V_R} C_j(V) dV$

## 1.1 Characteristics (curves)

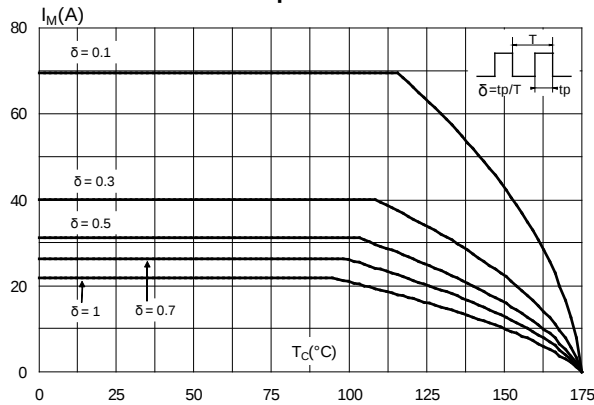
**Figure 1: Forward voltage drop versus forward current (typical values)**



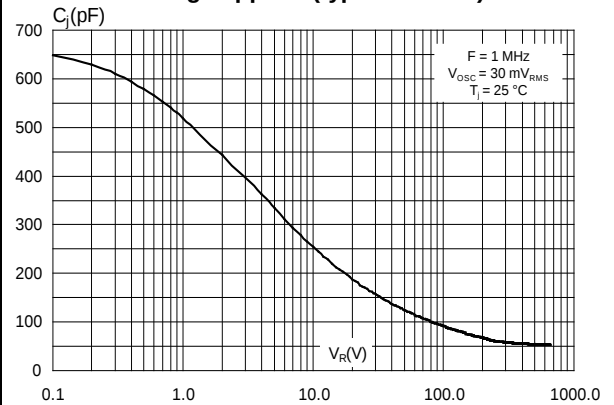
**Figure 2: Reverse leakage current versus reverse voltage applied (typical values)**



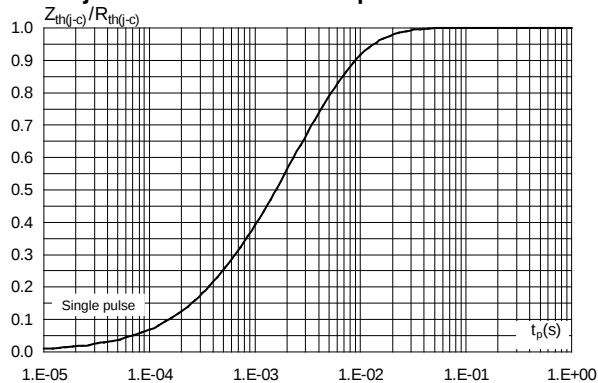
**Figure 3: Peak forward current versus case temperature**



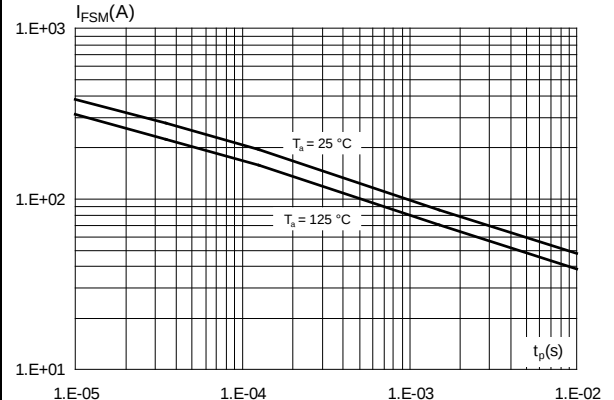
**Figure 4: Junction capacitance versus reverse voltage applied (typical values)**



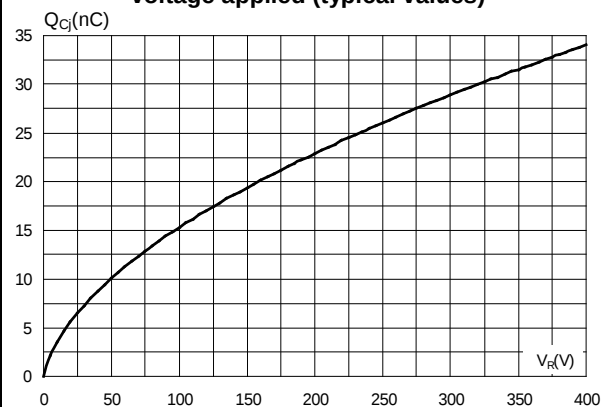
**Figure 5: Relative variation of thermal impedance junction to case versus pulse duration**



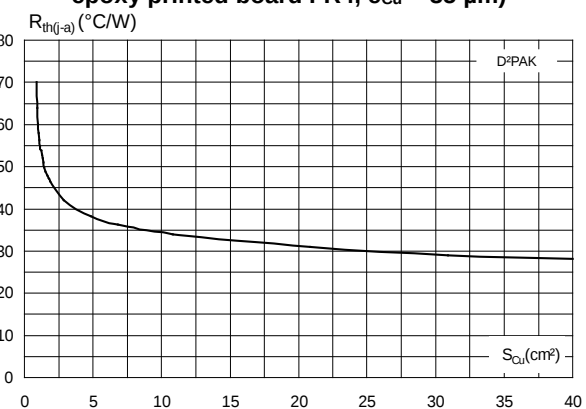
**Figure 6: Non-repetitive peak surge forward current versus pulse duration (sinusoidal waveform)**



**Figure 7: Total capacitive charges versus reverse voltage applied (typical values)**



**Figure 8: Thermal resistance junction to ambient versus copper surface under tab (typical values, epoxy printed board FR4,  $e_{Cu} = 35 \mu m$ )**



## 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.

- Epoxy meets UL94, V0
- Cooling method: by conduction (C)
- Recommended torque value: 0.55 N·m
- Maximum torque value: 0.7 N·m

### 2.1 TO-220AC package information

Figure 9: TO-220AC package outline

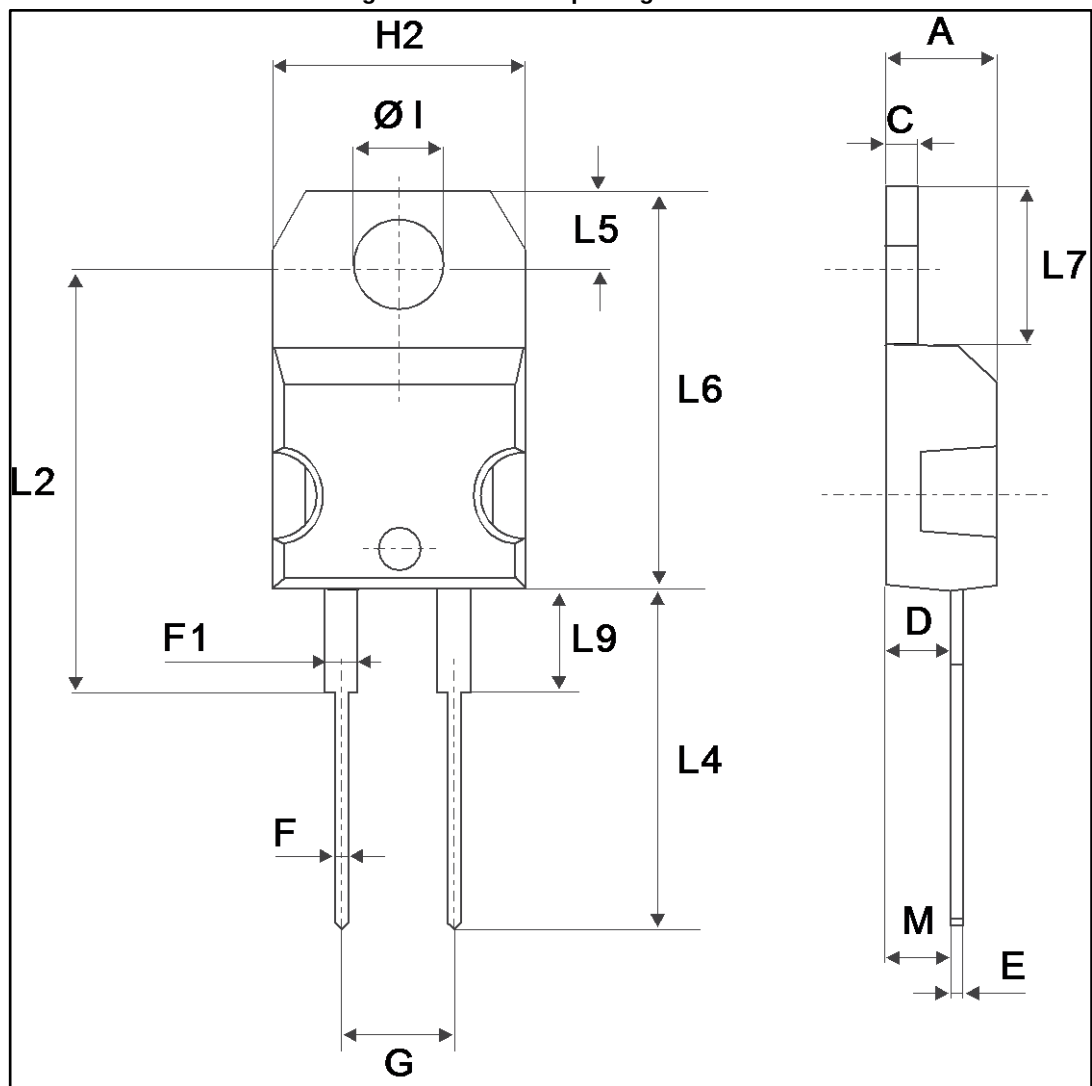


Table 6: TO-220AC package mechanical data

| Ref. | Dimensions  |       |            |       |
|------|-------------|-------|------------|-------|
|      | Millimeters |       | Inches     |       |
|      | Min.        | Max.  | Min.       | Max.  |
| A    | 4.40        | 4.60  | 0.173      | 0.181 |
| C    | 1.23        | 1.32  | 0.048      | 0.051 |
| D    | 2.40        | 2.72  | 0.094      | 0.107 |
| E    | 0.49        | 0.70  | 0.019      | 0.027 |
| F    | 0.61        | 0.88  | 0.024      | 0.034 |
| F1   | 1.14        | 1.70  | 0.044      | 0.066 |
| G    | 4.95        | 5.15  | 0.194      | 0.202 |
| H2   | 10.00       | 10.40 | 0.393      | 0.409 |
| L2   | 16.40 typ.  |       | 0.645 typ. |       |
| L4   | 13.00       | 14.00 | 0.511      | 0.551 |
| L5   | 2.65        | 2.95  | 0.104      | 0.116 |
| L6   | 15.25       | 15.75 | 0.600      | 0.620 |
| L7   | 6.20        | 6.60  | 0.244      | 0.259 |
| L9   | 3.50        | 3.93  | 0.137      | 0.154 |
| M    | 2.6 typ.    |       | 0.102 typ. |       |
| ØI   | 3.75        | 3.85  | 0.147      | 0.151 |

## 2.2 D<sup>2</sup>PAK package information

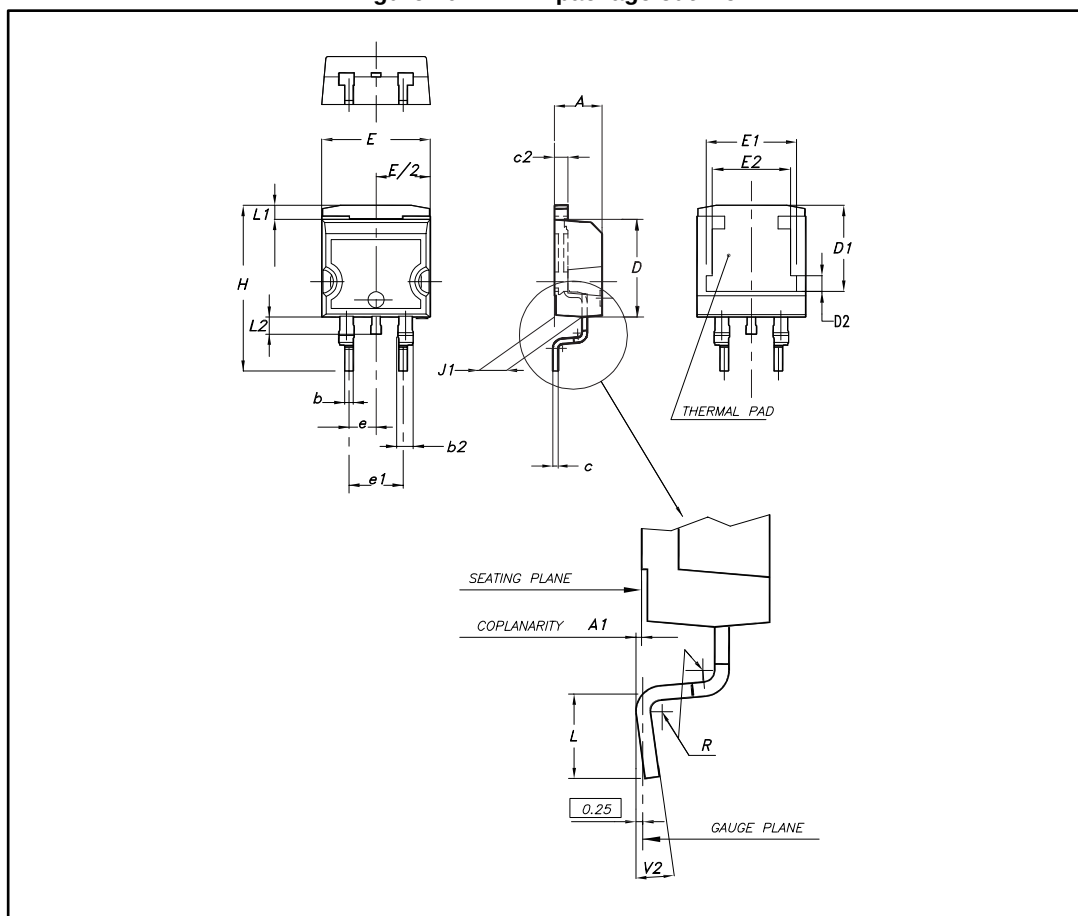
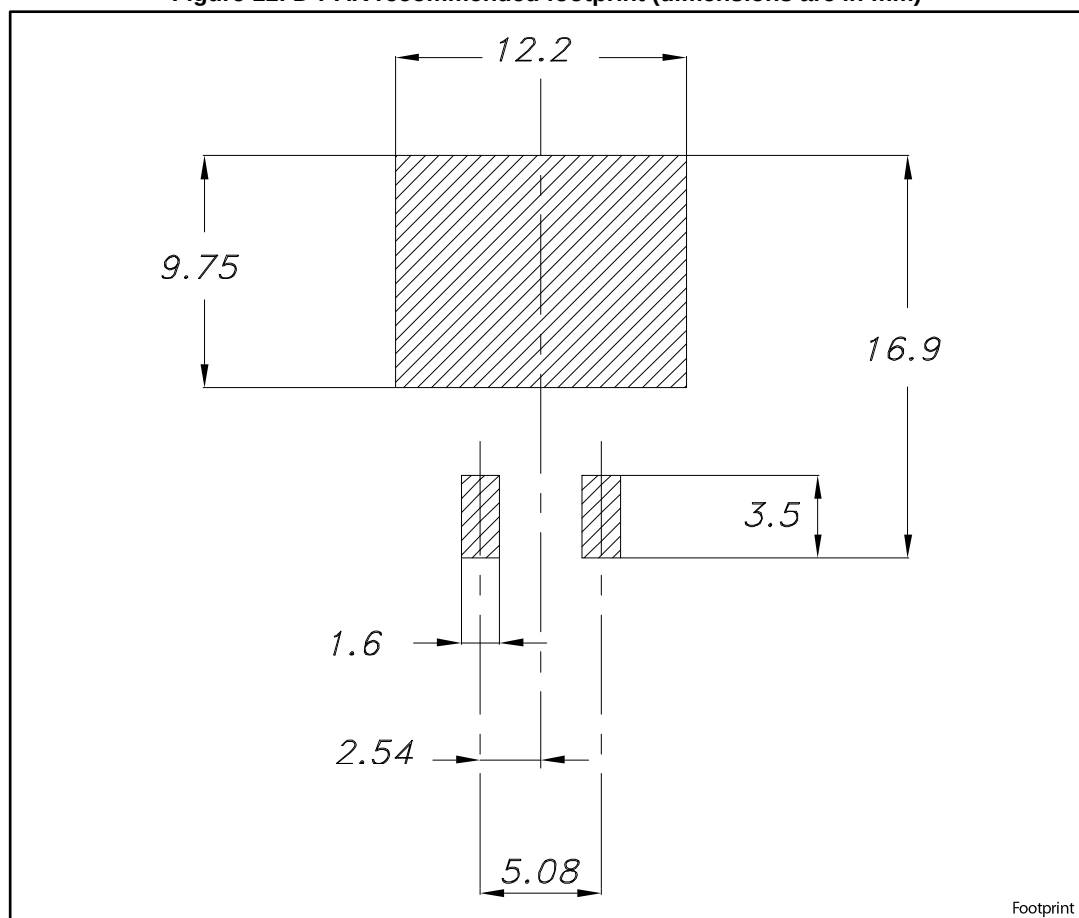
Figure 10: D<sup>2</sup>PAK package outline

Table 7: D<sup>2</sup>PAK package mechanical data

| Ref. | Dimensions  |      |       |        |       |       |
|------|-------------|------|-------|--------|-------|-------|
|      | Millimeters |      |       | Inches |       |       |
|      | Min.        | Typ. | Max.  | Min.   | Typ.  | Max.  |
| A    | 4.40        |      | 4.60  | 0.173  |       | 0.181 |
| A1   | 0.03        |      | 0.23  | 0.001  |       | 0.009 |
| b    | 0.70        |      | 0.93  | 0.028  |       | 0.037 |
| b2   | 1.14        |      | 1.70  | 0.045  |       | 0.067 |
| c    | 0.45        |      | 0.60  | 0.018  |       | 0.024 |
| c2   | 1.23        |      | 1.36  | 0.048  |       | 0.053 |
| D    | 8.95        |      | 9.35  | 0.352  |       | 0.368 |
| D1   | 7.50        | 7.75 | 8.00  | 0.295  | 0.305 | 0.315 |
| D2   | 1.10        | 1.30 | 1.50  | 0.043  | 0.051 | 0.060 |
| E    | 10          |      | 10.40 | 0.394  |       | 0.409 |
| E1   | 8.50        | 8.70 | 8.90  | 0.335  | 0.343 | 0.346 |
| E2   | 6.85        | 7.05 | 7.25  | 0.266  | 0.278 | 0.282 |
| e    |             | 2.54 |       |        | 0.100 |       |
| e1   | 4.88        |      | 5.28  | 0.190  |       | 0.205 |
| H    | 15          |      | 15.85 | 0.591  |       | 0.624 |
| J1   | 2.49        |      | 2.69  | 0.097  |       | 0.106 |
| L    | 2.29        |      | 2.79  | 0.090  |       | 0.110 |
| L1   | 1.27        |      | 1.40  | 0.049  |       | 0.055 |
| L2   | 1.30        |      | 1.75  | 0.050  |       | 0.069 |
| R    |             | 0.4  |       |        | 0.015 |       |
| V2   | 0°          |      | 8°    | 0°     |       | 8°    |

Figure 11: D<sup>2</sup>PAK recommended footprint (dimensions are in mm)

### 3 Ordering information

Table 8: Ordering information

| Order code      | Marking    | Package            | Weight | Base qty. | Delivery mode |
|-----------------|------------|--------------------|--------|-----------|---------------|
| STPSC10065DY    | PSC10065DY | TO-220AC           | 1.86 g | 50        | Tube          |
| STPSC10065GY-TR | PSC10065GY | D <sup>2</sup> PAK | 1.48 g | 1000      | Tape and reel |

### 4 Revision history

Table 9: Document revision history

| Date        | Revision | Changes                                                       |
|-------------|----------|---------------------------------------------------------------|
| 13-Jun-2017 | 1        | First issue.                                                  |
| 18-Jul-2017 | 2        | Updated <i>Table 4: "Static electrical characteristics"</i> . |
| 09-Nov-2017 | 3        | Added D <sup>2</sup> PAK package.                             |

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