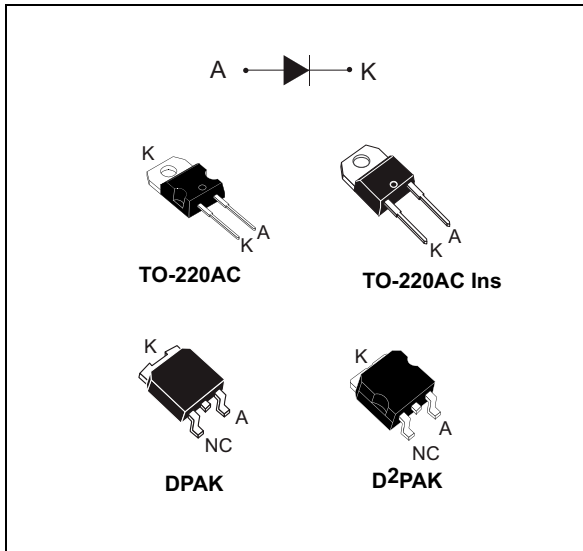


## 650 V power Schottky silicon carbide diode

Datasheet - production data



### Description

The SiC diode is an ultrahigh 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 the performance in hard switching conditions. Its high forward surge capability ensures a good robustness during transient phases.

### Features

- No reverse recovery charge in application current range
- Switching behavior independent of temperature
- Dedicated to PFC applications
- High forward surge capability
- Insulated package TO-220AC Ins:
  - Insulated voltage: 2500 V rms
  - Typical package capacitance: 7 pF

Table 1. Device summary

| Symbol       | Value  |
|--------------|--------|
| $I_{F(AV)}$  | 6 A    |
| $V_{RRM}$    | 650 V  |
| $T_j$ (max.) | 175 °C |

# 1 Characteristics

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

| Symbol              | Parameter                                     |   | Value       | Unit |
|---------------------|---|---|-------------|------|
| V <sub>RRM</sub>    | Repetitive peak reverse voltage               |   | 650         | V    |
| I <sub>F(RMS)</sub> | Forward rms current                           |   | 22          | A    |
| I <sub>F(AV)</sub>  | Average forward current                       | TO-220AC, DPAK, D <sup>2</sup> PAK, T <sub>c</sub> = 135 °C <sup>(1)</sup> , DC                               | 6           | A    |
|                     |   | TO-220AC Ins, T <sub>c</sub> = 110 °C <sup>(1)</sup> , DC   |             |      |
| I <sub>FSM</sub>    | Surge non repetitive forward current          | t <sub>p</sub> = 10 ms sinusoidal, T <sub>c</sub> = 25 °C   | 60          | A    |
|                     |   | t <sub>p</sub> = 10 ms sinusoidal, T <sub>c</sub> = 125 °C  | 52          |      |
|                     |   | t <sub>p</sub> = 10 μs square, T <sub>c</sub> = 25 °C   | 400         |      |
| I <sub>FRM</sub>    | Repetitive peak forward current               | TO-220AC, DPAK, D <sup>2</sup> PAK, T <sub>c</sub> = 135 °C <sup>(1)</sup> , T <sub>j</sub> = 175 °C, δ = 0.1 | 25          | A    |
|                     |   | TO-220AC Ins, T <sub>c</sub> = 110 °C <sup>(1)</sup> , T <sub>j</sub> = 175 °C, δ = 0.1                       |             |      |
| T <sub>stg</sub>    | Storage temperature range                     |   | -55 to +175 | °C   |
| T <sub>j</sub>      | Operating junction temperature <sup>(2)</sup> |   | -40 to +175 | °C   |

- Value based on R<sub>th(j-c)</sub> max.
- $\frac{dP_{tot}}{dT_j} < \frac{1}{R_{th(j-a)}}$  condition to avoid thermal runaway for a diode on its own heatsink

**Table 3. Thermal resistance**

| Symbol               | Parameter        |                                    | Typ. value | Max. value | Unit |
|----------------------|------------------|------------------------------------|------------|------------|------|
| R <sub>th(j-c)</sub> | Junction to case | TO-220AC, DPAK, D <sup>2</sup> PAK | 1.6        | 2.4        | °C/W |
|                      |                  | TO-220AC Ins                       | 2.9        | 4.2        |      |

**Table 4. Static electrical characteristics**

| Symbol                        | Parameter               | Tests conditions        |                                   | Min. | Typ. | Max. | Unit |
|-------------------------------|-------------------------|-------------------------|-----------------------------------|------|------|------|------|
| I <sub>R</sub> <sup>(1)</sup> | Reverse leakage current | T <sub>j</sub> = 25 °C  | V <sub>R</sub> = V <sub>RRM</sub> | -    | 5    | 60   | μA   |
|                               |                         | T <sub>j</sub> = 150 °C |                                   | -    | 50   | 250  |      |
| V <sub>F</sub> <sup>(2)</sup> | Forward voltage drop    | T <sub>j</sub> = 25 °C  | I <sub>F</sub> = 6 A              | -    | 1.56 | 1.75 | V    |
|                               |                         | T <sub>j</sub> = 150 °C |                                   | -    | 1.98 | 2.5  |      |

- t<sub>p</sub> = 10 ms, δ < 2%
- t<sub>p</sub> = 500 μs, δ < 2%

To evaluate the conduction losses use the following equation:  $P = 1.35 \times I_{F(AV)} + 0.192 \times I_{F(RMS)}^2$

Table 5. Other parameters

| Symbol         | Parameter               | Test conditions  | Typ. | Unit |
|----------------|-------------------------|--|------|------|
| $Q_{cj}^{(1)}$ | Total capacitive charge | $V_R = 400\text{ V}$   | 18   | nC   |
| $C_j$          | Total capacitance       | $V_R = 0\text{ V}, T_C = 25\text{ }^\circ\text{C}, F = 1\text{ MHz}$   | 300  | pF   |
|                |                         | $V_R = 400\text{ V}, T_C = 25\text{ }^\circ\text{C}, F = 1\text{ MHz}$ | 30   |      |

1. Most accurate value for the capacitive charge:  $Q_{cj} = \int_0^{V_{OUT}} C_j(V_R).dv_R$

Figure 1. Forward voltage drop versus forward current (typical values, low level)

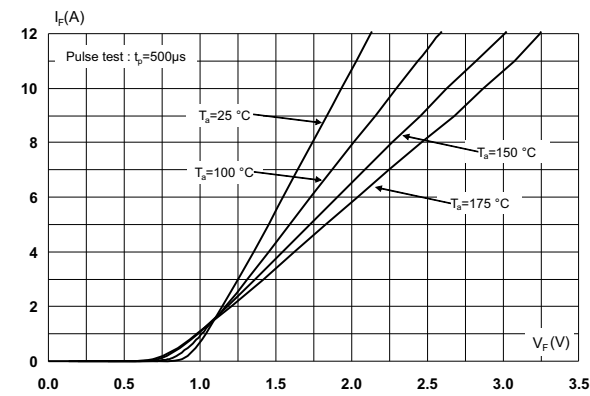


Figure 2. Forward voltage drop versus forward current (typical values, high level)

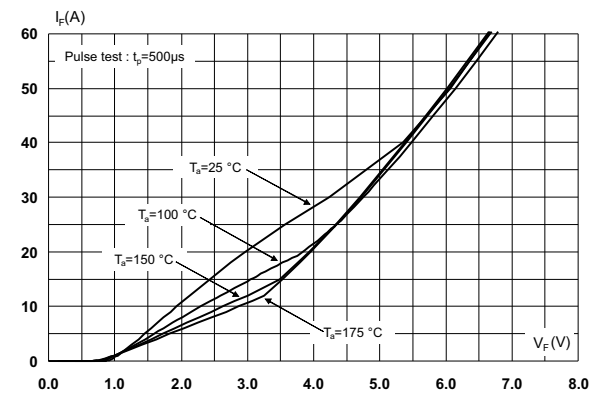


Figure 3. Reverse leakage current versus reverse voltage applied (typical values)

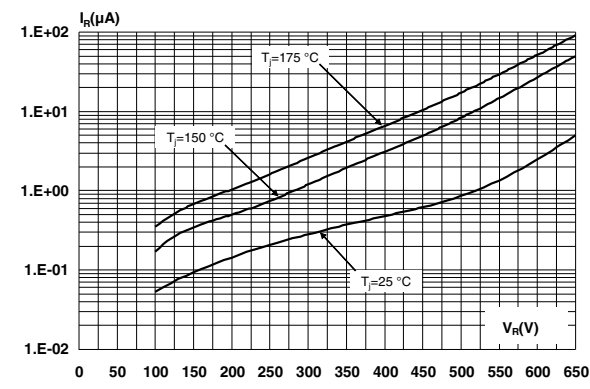
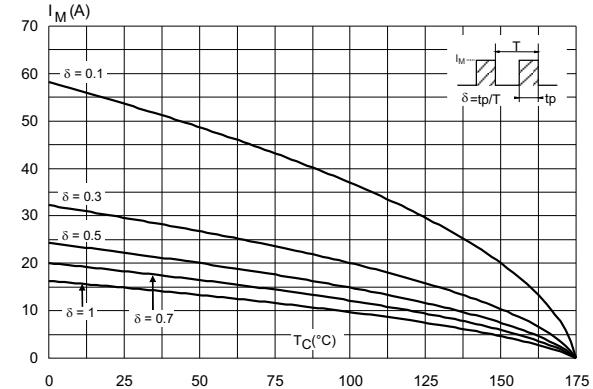
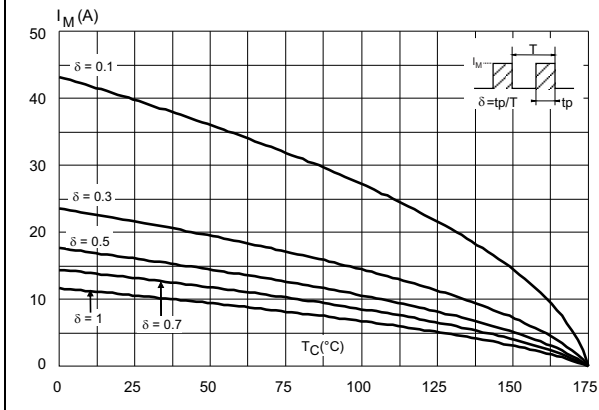


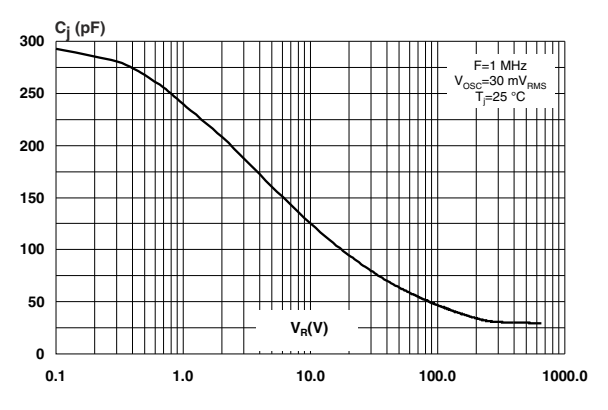
Figure 4. Peak forward current versus case temperature (TO-220AC, DPAK, D<sup>2</sup>PAK)



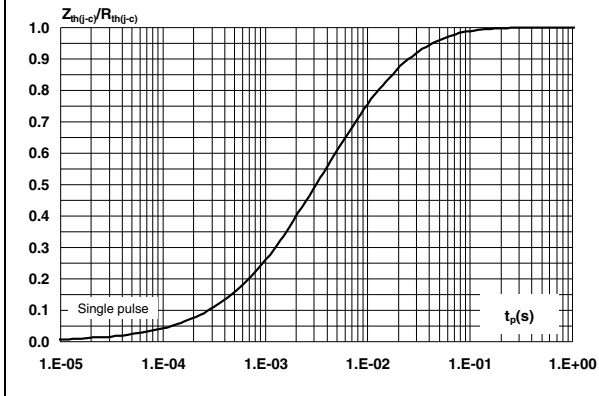
**Figure 5. Peak forward current versus case temperature (TO-220AC Ins)**



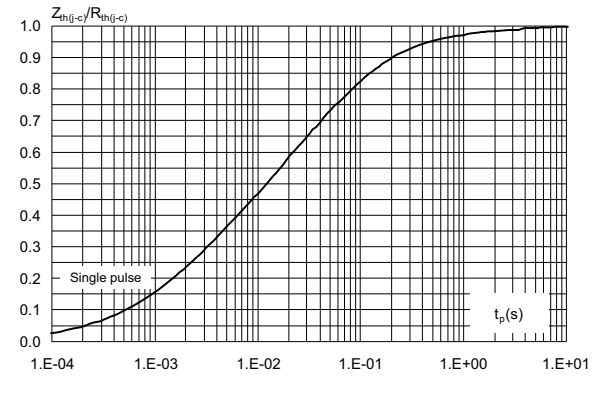
**Figure 6. Junction capacitance versus reverse voltage applied (typical values)**



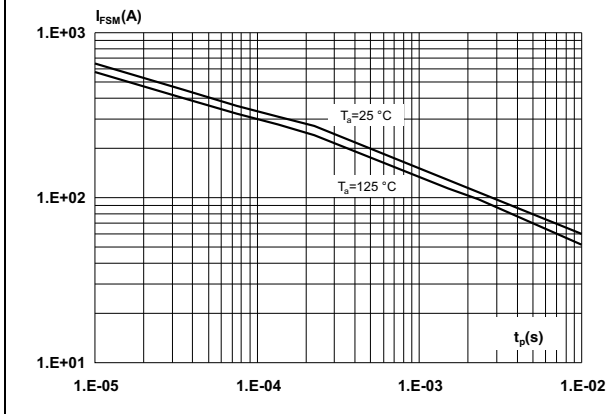
**Figure 7. Relative variation of thermal impedance junction to case versus pulse duration (TO-220AC, DPAK and D<sup>2</sup>PAK)**



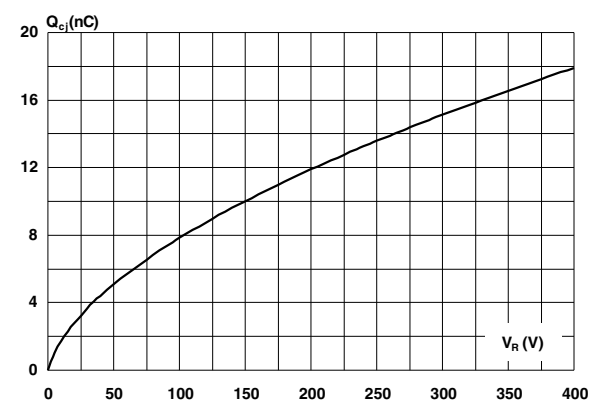
**Figure 8. Relative variation of thermal impedance junction to case versus pulse duration (TO-220AC Ins)**



**Figure 9. Non-repetitive peak surge forward current versus pulse duration (sinusoidal waveform)**



**Figure 10. Total capacitive charges versus reverse voltage applied (typical values)**



## 2 Package information

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

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

### 2.1 TO-220AC package information

Figure 11. TO-220AC package outline

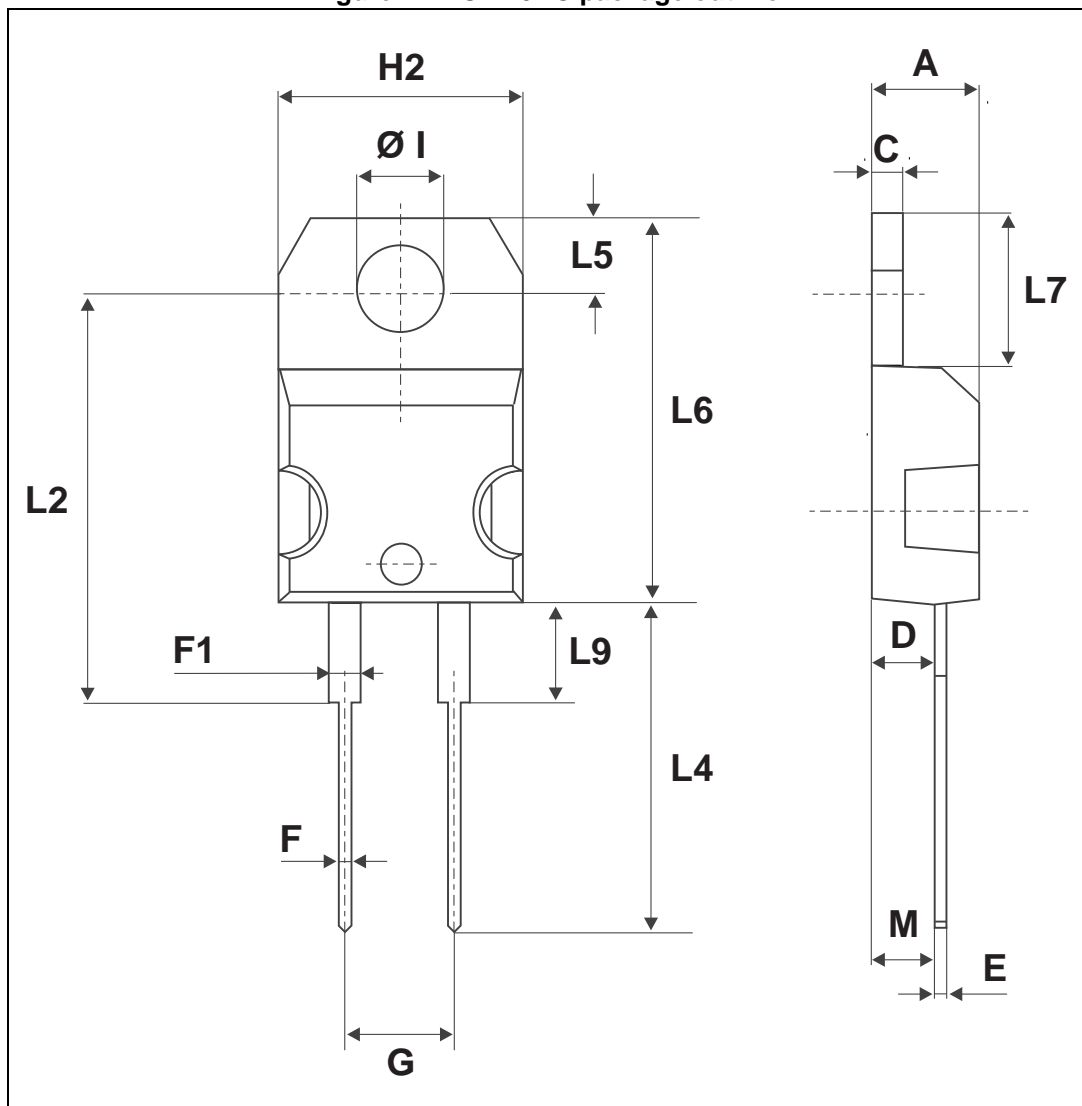


Table 6. TO-220AC package mechanical data

| 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. |       |
| Diam. I | 3.75        | 3.85  | 0.147      | 0.151 |

## 2.2 TO-220AC ins package information

Figure 12. TO-220AC Ins package outline

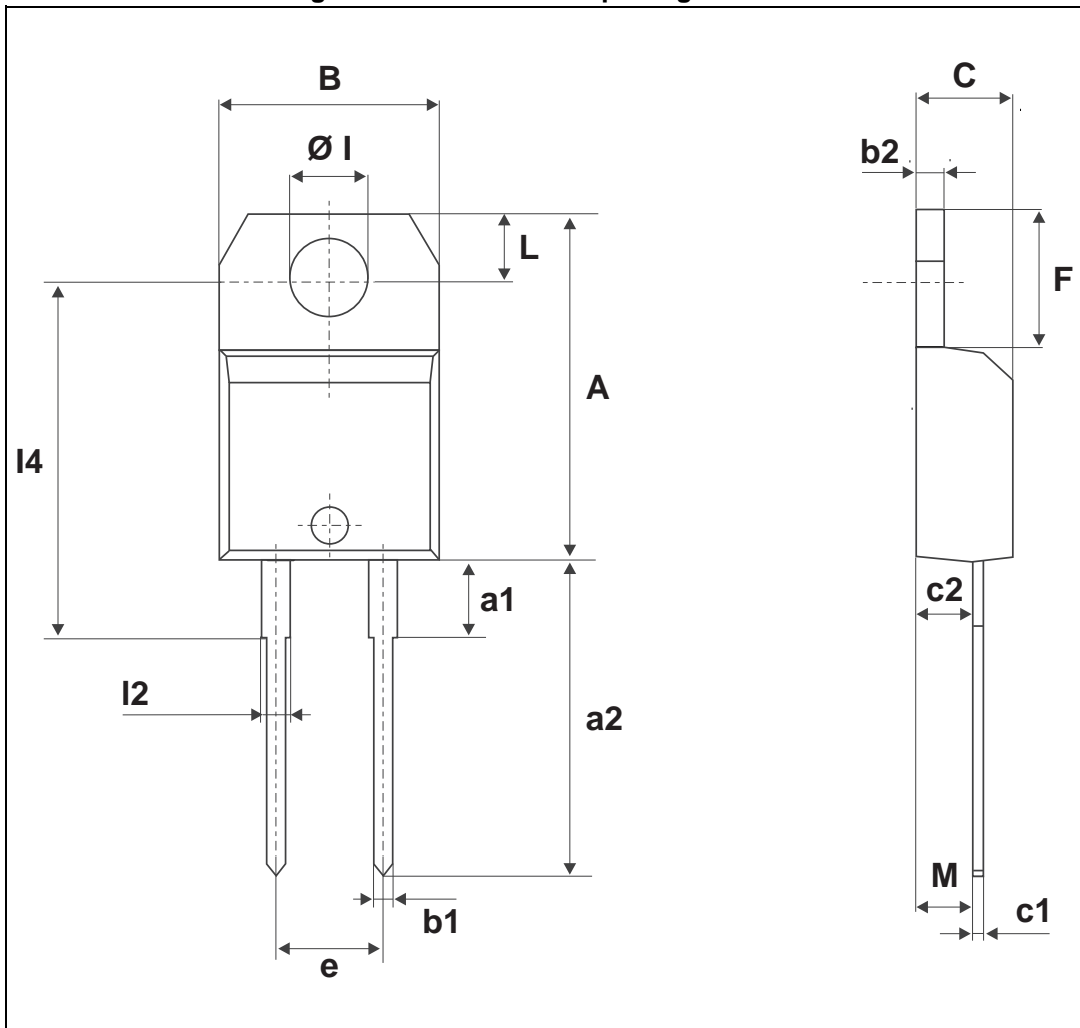


Table 7. TO-220AC Ins package mechanical data

| Ref. | Dimensions  |       |       |        |       |       |
|------|-------------|-------|-------|--------|-------|-------|
|      | Millimeters |       |       | Inches |       |       |
|      | Min.        | Typ.  | Max.  | Min.   | Typ.  | Max.  |
| A    | 15.20       |       | 15.90 | 0.598  |       | 0.625 |
| a1   |             | 3.75  |       |        | 0.147 |       |
| a2   | 13.00       |       | 14.00 | 0.511  |       | 0.551 |
| B    | 10.00       |       | 10.40 | 0.393  |       | 0.409 |
| b1   | 0.61        |       | 0.88  | 0.024  |       | 0.034 |
| b2   | 1.23        |       | 1.32  | 0.048  |       | 0.051 |
| C    | 4.40        |       | 4.60  | 0.173  |       | 0.181 |
| c1   | 0.49        |       | 0.70  | 0.019  |       | 0.027 |
| c2   | 2.40        |       | 2.72  | 0.094  |       | 0.107 |
| e    | 4.80        |       | 5.40  | 0.189  |       | 0.212 |
| F    | 6.20        |       | 6.60  | 0.244  |       | 0.259 |
| ØI   | 3.75        |       | 3.85  | 0.147  |       | 0.151 |
| I4   | 15.80       | 16.40 | 16.80 | 0.622  | 0.646 | 0.661 |
| L    | 2.65        |       | 2.95  | 0.104  |       | 0.116 |
| I2   | 1.14        |       | 1.70  | 0.044  |       | 0.066 |
| M    |             | 2.60  |       |        | 0.102 |       |



### 2.3 DPAK package information

Figure 13. DPAK package outline

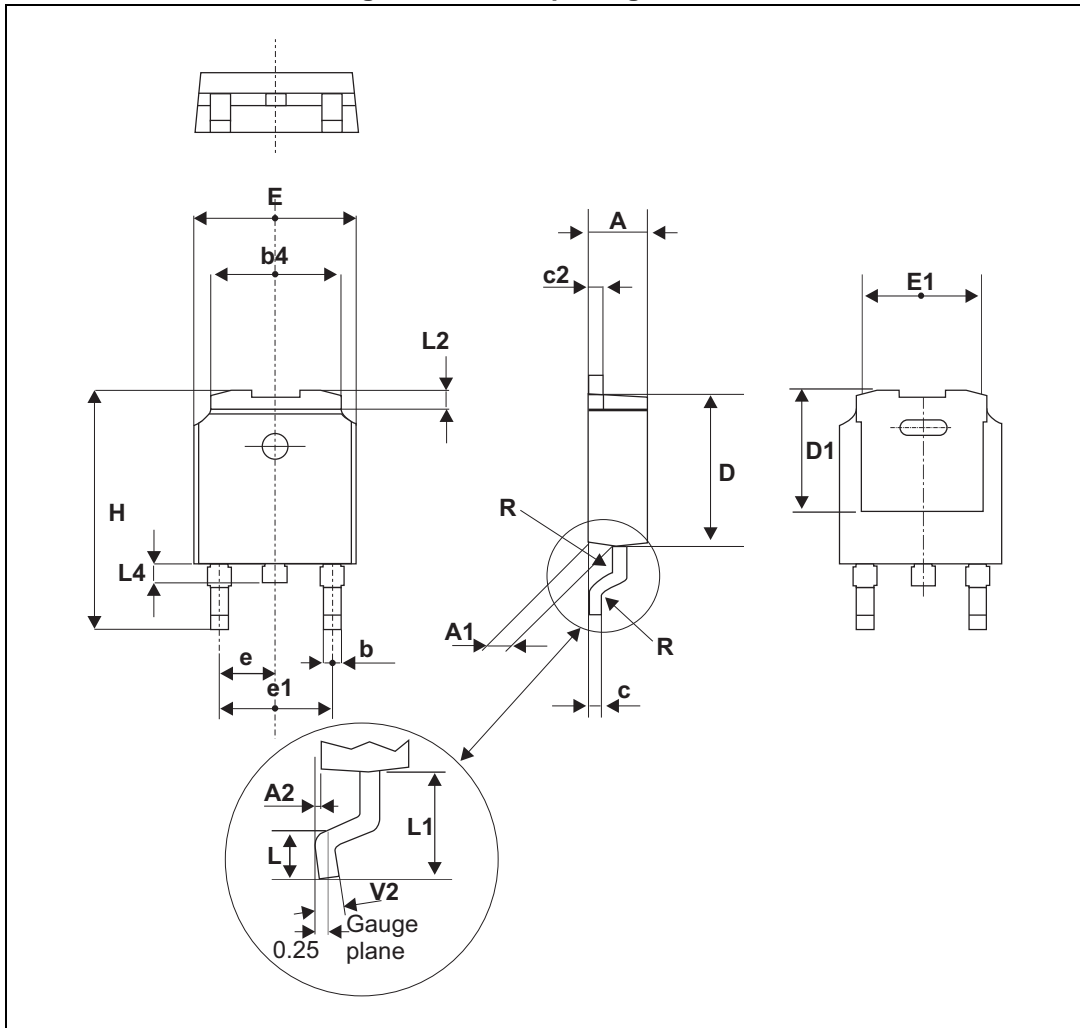
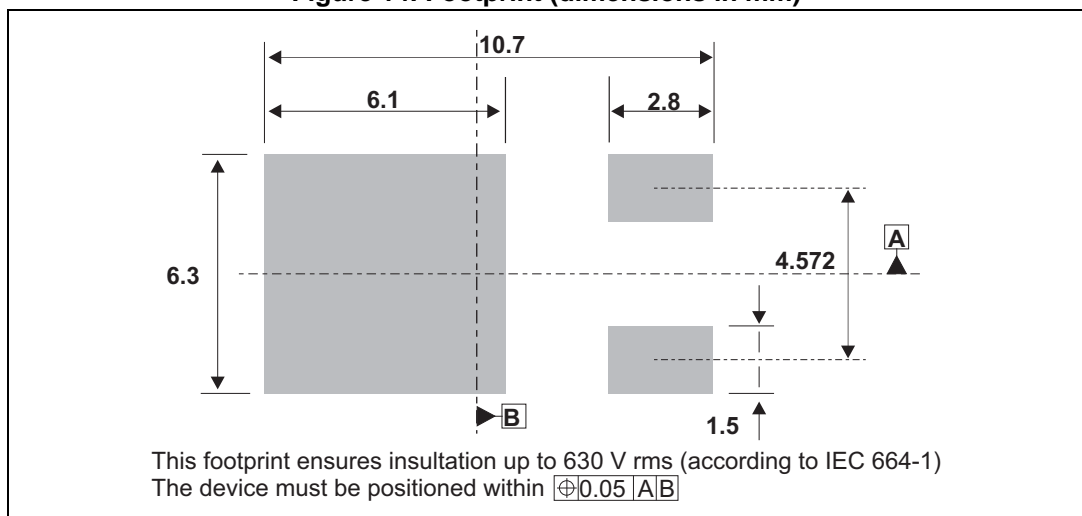


Table 8. DPAK package mechanical data

| Ref. | Dimensions  |      |       |        |       |       |
|------|-------------|------|-------|--------|-------|-------|
|      | Millimeters |      |       | Inches |       |       |
|      | Min.        | Typ. | Max.  | Min.   | Typ.  | Max.  |
| A    | 2.20        |      | 2.40  | 0.086  |       | 0.094 |
| A1   | 0.90        |      | 1.10  | 0.035  |       | 0.043 |
| A2   | 0.03        |      | 0.23  | 0.001  |       | 0.009 |
| b    | 0.64        |      | 0.90  | 0.025  |       | 0.035 |
| b4   | 5.20        |      | 5.40  | 0.204  |       | 0.212 |
| c    | 0.45        |      | 0.60  | 0.017  |       | 0.023 |
| c2   | 0.48        |      | 0.60  | 0.018  |       | 0.023 |
| D    | 6.00        |      | 6.20  | 0.236  |       | 0.244 |
| D1   |             | 5.10 |       |        | 0.201 |       |
| E    | 6.40        |      | 6.60  | 0.251  |       | 0.259 |
| E1   |             | 4.70 |       |        | 0.185 |       |
| e    |             | 2.28 |       |        | 0.090 |       |
| e1   | 4.40        |      | 4.60  | 0.173  |       | 0.181 |
| H    | 9.35        |      | 10.10 | 0.368  |       | 0.397 |
| L    | 1.00        |      | 1.50  | 0.039  |       | 0.059 |
| L1   |             | 2.80 |       |        | 0.11  |       |
| L2   |             | 0.80 |       |        | 0.032 |       |
| L4   | 0.60        |      | 1.00  | 0.023  |       | 0.039 |
| R    |             | 0.2  |       |        | 0.008 |       |
| V2   | 0°          |      | 8°    | 0°     |       | 8°    |

Figure 14. Footprint (dimensions in mm)



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

Figure 15. D<sup>2</sup>PAK package outline

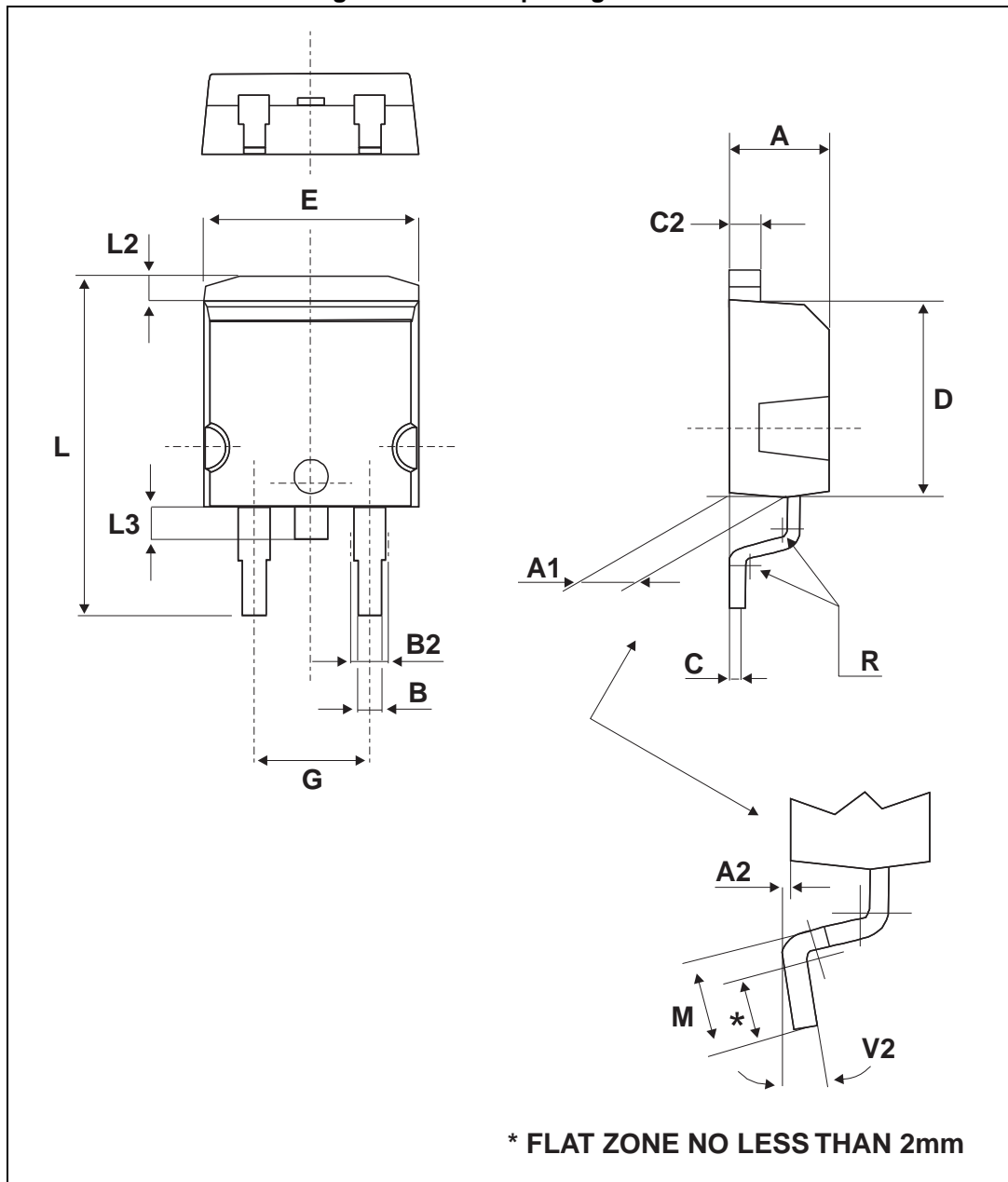
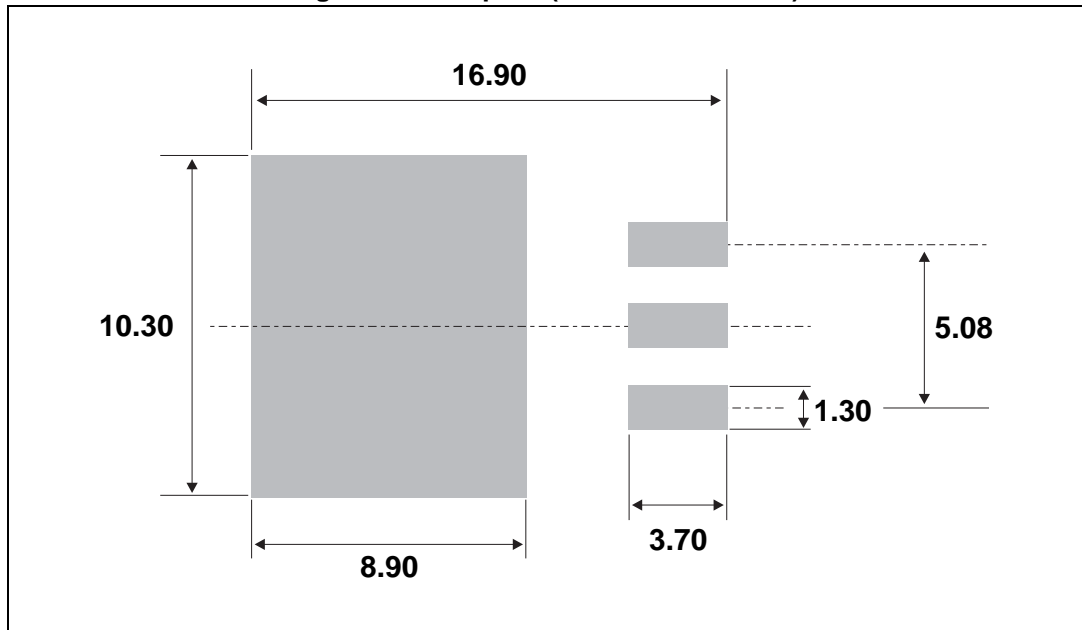


Table 9. D<sup>2</sup>PAK package mechanical data

| Ref. | Dimensions  |       |       |        |       |       |
|------|-------------|-------|-------|--------|-------|-------|
|      | Millimeters |       |       | Inches |       |       |
|      | Min.        | Typ.  | Max.  | Min.   | Typ.  | Max.  |
| A    | 4.40        | 4.60  | 0.173 | 0.181  | A     | 4.40  |
| A1   | 2.49        | 2.69  | 0.098 | 0.106  | A1    | 2.49  |
| A2   | 0.03        | 0.23  | 0.001 | 0.009  | A2    | 0.03  |
| B    | 0.70        | 0.93  | 0.027 | 0.037  | B     | 0.70  |
| B2   | 1.14        | 1.70  | 0.045 | 0.067  | B2    | 1.14  |
| C    | 0.45        | 0.60  | 0.017 | 0.024  | C     | 0.45  |
| C2   | 1.23        | 1.36  | 0.048 | 0.054  | C2    | 1.23  |
| D    | 8.95        | 9.35  | 0.352 | 0.368  | D     | 8.95  |
| E    | 10.00       | 10.40 | 0.393 | 0.409  | E     | 10.00 |
| G    | 4.88        | 5.28  | 0.192 | 0.208  | G     | 4.88  |
| L    | 15.00       | 15.85 | 0.590 | 0.624  | L     | 15.00 |
| L2   | 1.27        | 1.40  | 0.050 | 0.055  | L2    | 1.27  |
| L3   | 1.40        | 1.75  | 0.055 | 0.069  | L3    | 1.40  |
| M    | 2.40        | 3.20  | 0.094 | 0.126  | M     | 2.40  |
| R    |             | 0.40  |       |        | 0.016 |       |
| V2   | 0°          |       | 8°    | 0°     |       | 8°    |

Figure 16. Footprint (dimensions in mm)



### 3 Ordering information

**Table 10. Ordering information**

| Order code     | Marking       | Package            | Weight | Base qty | Delivery mode |
|----------------|---------------|--------------------|--------|----------|---------------|
| STPSC6H065D    | STPSC6H065D   | TO-220AC           | 1.86 g | 50       | Tube          |
| STPSC6H065DI   | STPSC 6H065DI | TO-220AC Ins       | 2.12 g | 50       | Tube          |
| STPSC6H065G-TR | STPSC6H065G   | D <sup>2</sup> PAK | 1.48 g | 1000     | Tape and reel |
| STPSC6H065B-TR | STPSC 6H065   | DPAK               | 0.32 g | 2500     | Tape and reel |

### 4 Revision history

**Table 11. Document revision history**

| Date        | Revision | Changes  |
|-------------|----------|--|
| 18-Jun-2012 | 1        | First issue.   |
| 31-Aug-2012 | 2        | Added diode configuration graphic on front page. Updated value of $Q_{cj}$ and footnote equation in Table 5. |
| 10-Oct-2012 | 3        | Added Max. value in Table 3.   |
| 07-Nov-2013 | 4        | Updated Figure 1, Figure 2, Figure 13, Figure 14, and Table 8.   |
| 07-Jan-2014 | 5        | Added TO-220AC Ins package.  |
| 22-Jul-2015 | 6        | Updated Table 10 and reformatted to current standard.  |
| 22-Feb-2016 | 7        | Updated cover image.   |

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