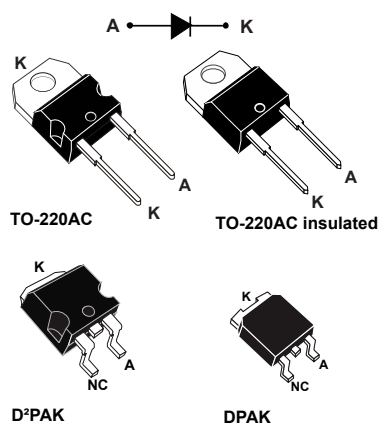


## 650 V, 6 A high surge silicon carbide power Schottky diode



### Features

- No reverse recovery charge in application current range
- Switching behavior independent of temperature
- High forward surge capability
- Insulated package TO-220AC Ins:
  - Insulated voltage: 2500 V<sub>RMS</sub>
  - Typical package capacitance: 7 pF
- Power efficient product
- ECOPACK®2 compliant component

### Applications

- Switch mode power supply
- PFC
- DCDC converters
- LLC topologies
- Boost diode

### Description

This 6 A, 650 V 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.

This **STPSC6H065** is 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.

#### Product status

**STPSC6H065**

#### Product summary

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

#### Product label



# 1 Characteristics

**Table 1. Absolute ratings (limiting values at 25 °C unless otherwise specified)**

| Symbol       | Parameter                                           |                                                                                                          | Value       | Unit |
|--------------|-----------------------------------------------------|----------------------------------------------------------------------------------------------------------|-------------|------|
| $V_{RRM}$    | Repetitive peak reverse voltage                     |                                                                                                          | 650         | V    |
| $I_{F(RMS)}$ | Forward rms current                                 |                                                                                                          | 22          | A    |
| $I_{F(AV)}$  | Average forward current                             | TO-220AC, DPAK, D <sup>2</sup> PAK, $T_c = 135\text{ °C}^{(1)}$ , DC                                     | 6           | A    |
|              |                                                     | TO-220AC Ins, $T_c = 110\text{ °C}^{(1)}$                                                                |             |      |
| $I_{FSM}$    | Surge non repetitive forward current                | $t_p = 10\text{ ms}$ sinusoidal, $T_c = 25\text{ °C}$                                                    | 60          | A    |
|              |                                                     | $t_p = 10\text{ ms}$ sinusoidal, $T_c = 125\text{ °C}$                                                   | 52          |      |
|              |                                                     | $t_p = 10\text{ }\mu\text{s}$ square, $T_c = 25\text{ °C}$                                               | 400         |      |
| $I_{FRM}$    | Repetitive peak forward current                     | TO-220AC, DPAK, D <sup>2</sup> PAK, $T_c = 135\text{ °C}^{(1)}$ , $T_j = 175\text{ °C}$ , $\delta = 0.1$ | 25          | A    |
|              |                                                     | TO-220AC Ins, $T_c = 95\text{ °C}$                                                                       |             |      |
| $T_{stg}$    | Storage temperature range                           |                                                                                                          | -55 to +175 | °C   |
| $T_j$        | Operating junction temperature range <sup>(2)</sup> |                                                                                                          | -40 to +175 | °C   |

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

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

**Table 2. Thermal resistance parameters**

| Symbol        | Parameter        |                                    | Typ. value | Max. value | Unit |
|---------------|------------------|------------------------------------|------------|------------|------|
| $R_{th(j-c)}$ | 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 3. 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    | 60   | $\mu\text{A}$ |
|             |                         | $T_j = 150\text{ °C}$ |                    | -    | 50   | 250  |               |
| $V_F^{(2)}$ | Forward voltage drop    | $T_j = 25\text{ °C}$  | $I_F = 6\text{ A}$ | -    | 1.56 | 1.75 | V             |
|             |                         | $T_j = 150\text{ °C}$ |                    | -    | 1.98 | 2.50 |               |

1.  $t_p = 10\text{ ms}$ ,  $\delta < 2\%$

2.  $t_p = 500\text{ }\mu\text{s}$ ,  $\delta < 2\%$

To evaluate the conduction losses, use the following equation:

$$P = 1.35 \times I_{F(AV)} + 0.192 \times I_{F(RMS)}^2$$

For more information, please refer to the following application notes related to the power losses :

- AN604: Calculation of conduction losses in a power rectifier
- AN4021: Calculation of reverse losses on a power diode

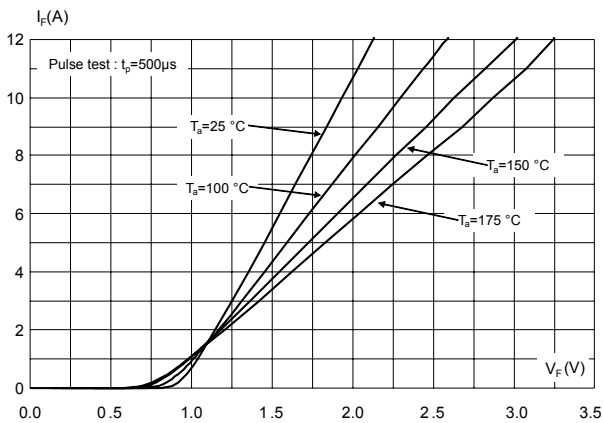
**Table 4. Dynamic electrical characteristics**

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

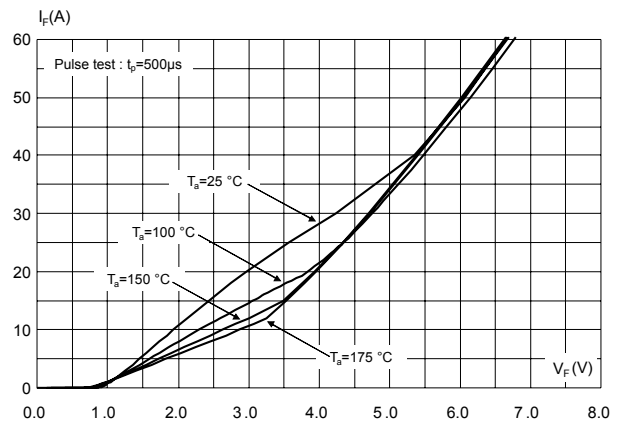
1.  
 Most accurate value for the capacitive charge:  $Q_{cj}(V_R) = \int_0^{V_R} C_j(V) dV$

## 1.1 Characteristics (curves)

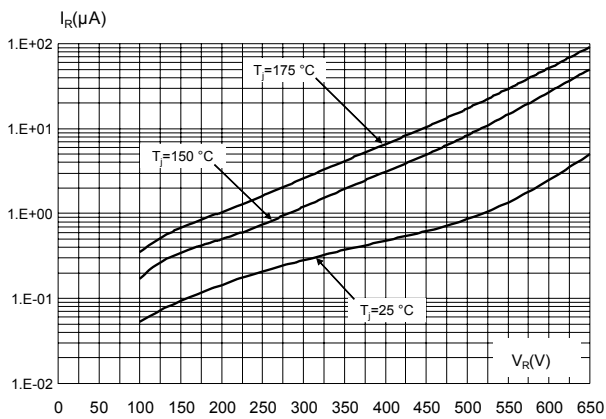
**Figure 1. Forward voltage drop versus forward current (typical values, low level)**



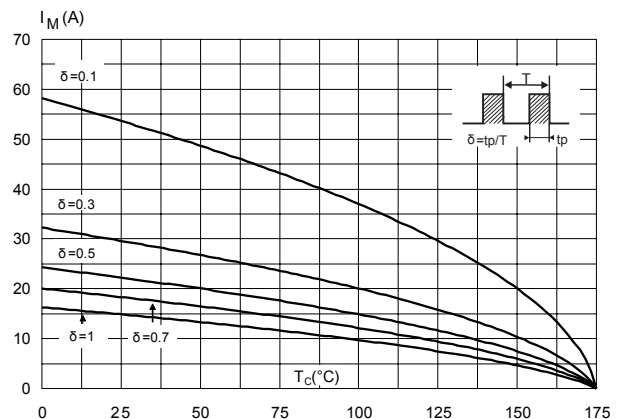
**Figure 2. Forward voltage drop versus forward current (typical values, high level)**



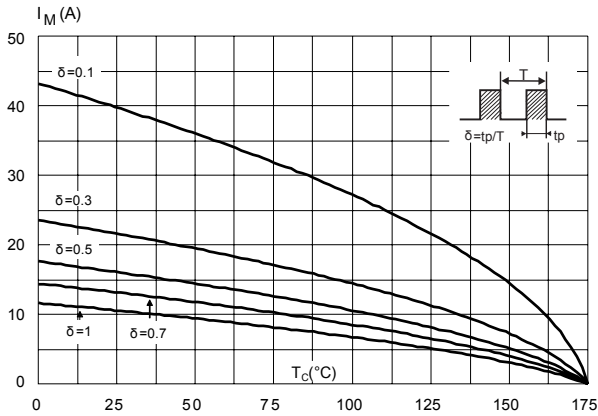
**Figure 3. Reverse leakage current versus reverse voltage applied (typical values)**



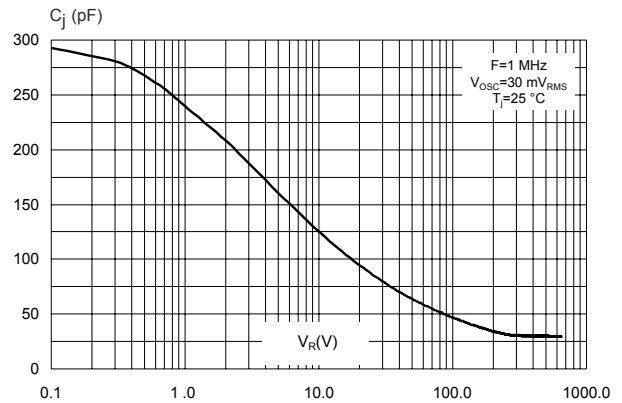
**Figure 4. Peak forward current versus case temperature (TO-220AC, DPAK, D²PAK)**



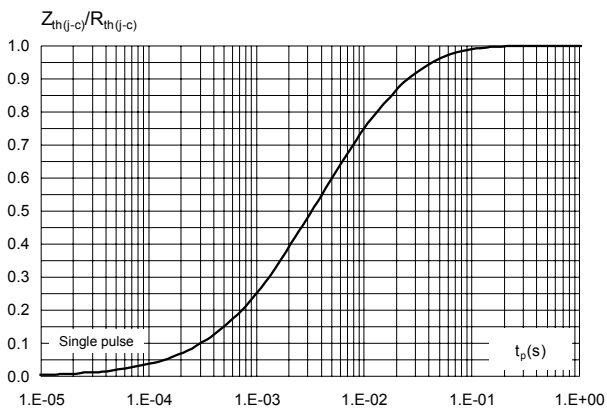
**Figure 5. Peak forward current versus case temperature (TO-220AC Ins)**



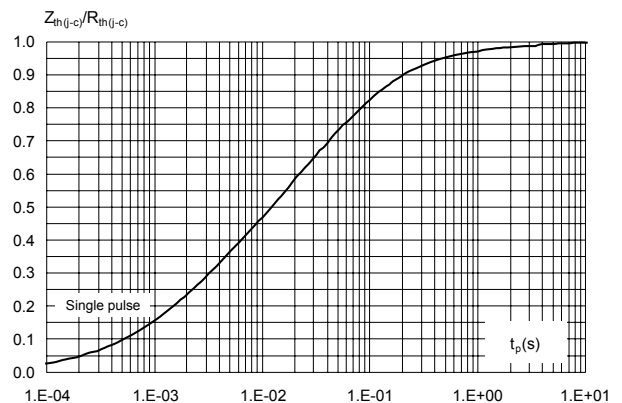
**Figure 6. Junction capacitance versus reverse voltage applied (typical values)**



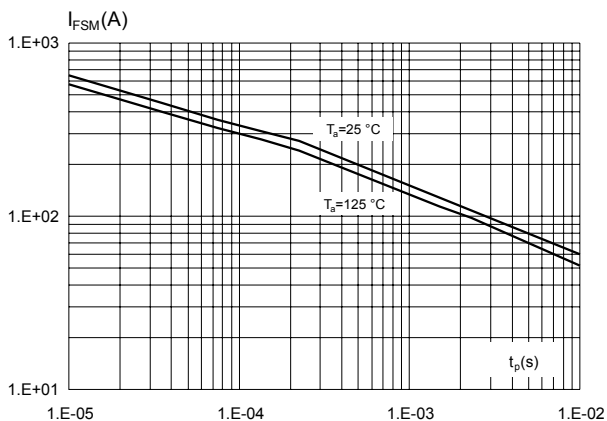
**Figure 7. Relative variation of thermal impedance junction to case versus pulse duration (TO-220AC, DPAK and D<sup>2</sup>PAK)**



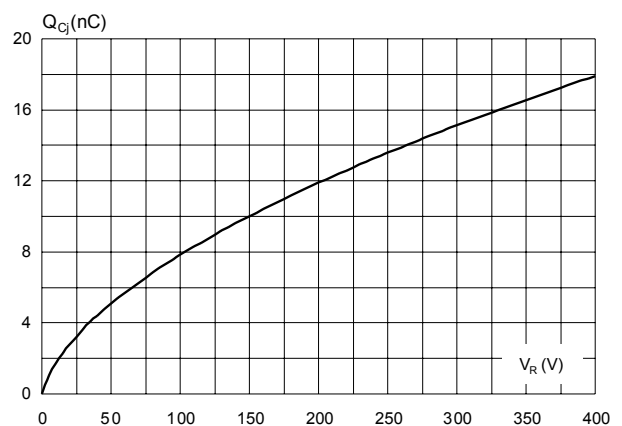
**Figure 8. Relative variation of thermal impedance junction to case versus pulse duration (TO-220AC Ins)**



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



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



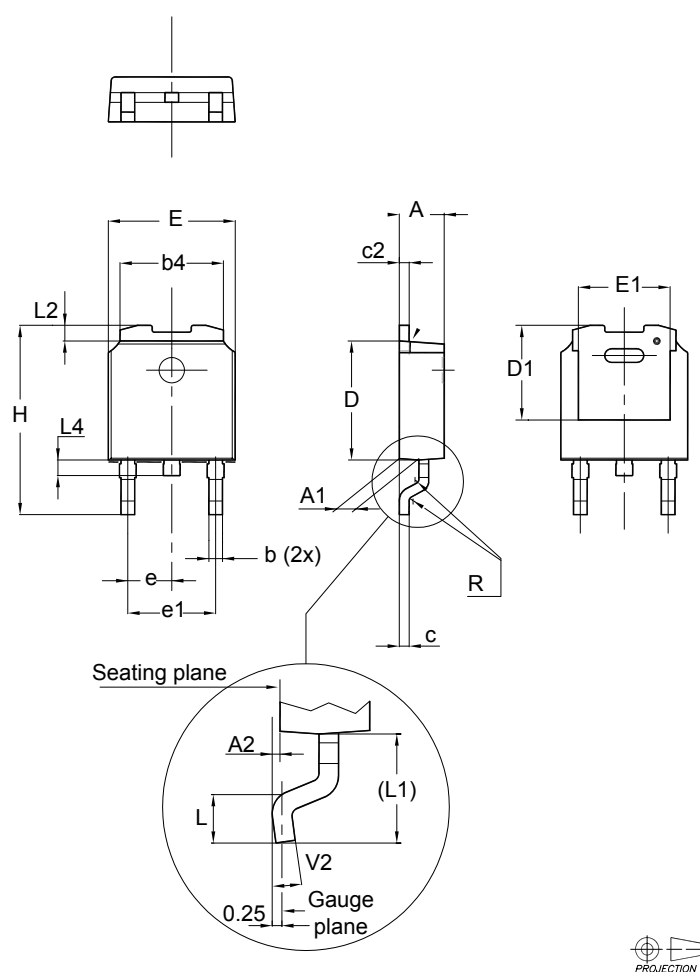
## 2 Package information

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 DPAK package information

- Epoxy meets UL94, V0

**Figure 11. DPAK package outline**

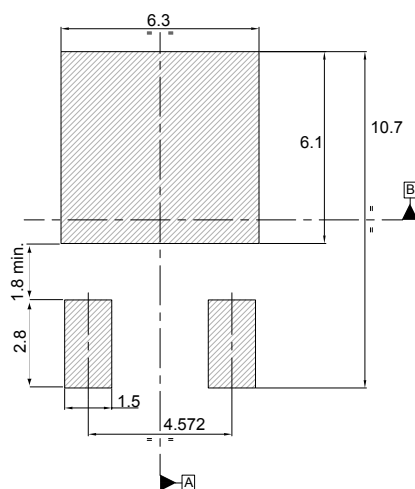


### Table 5. DPAK mechanical data

| Dim. | Dimensions  |       |       |                       |       |       |
|------|-------------|-------|-------|-----------------------|-------|-------|
|      | Millimeters |       |       | Inches <sup>(1)</sup> |       |       |
|      | Min.        | Typ.  | Max.  | Min.                  | Typ.  | Max.  |
| A    | 2.20        |       | 2.40  | 0.087                 |       | 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  | 0.205                 |       | 0.213 |
| c    | 0.45        |       | 0.60  | 0.018                 |       | 0.024 |
| c2   | 0.48        |       | 0.60  | 0.019                 |       | 0.024 |
| D    | 6.00        |       | 6.20  | 0.236                 |       | 0.244 |
| D1   | 4.95        | 5.10  | 5.25  | 0.195                 | 0.201 | 0.207 |
| E    | 6.40        |       | 6.60  | 0.252                 |       | 0.260 |
| E1   | 4.60        | 4.70  | 4.80  | 0.181                 | 0.185 | 0.189 |
| e    | 2.159       | 2.286 | 2.413 | 0.085                 | 0.090 | 0.095 |
| e1   | 4.445       | 4.572 | 4.699 | 0.175                 | 0.180 | 0.185 |
| H    | 9.35        |       | 10.10 | 0.368                 |       | 0.398 |
| L    | 1.00        |       | 1.50  | 0.039                 |       | 0.059 |
| (L1) | 2.60        | 2.80  | 3.00  | 0.102                 | 0.110 | 0.118 |
| L2   | 0.65        | 0.80  | 0.95  | 0.026                 | 0.031 | 0.037 |
| L4   | 0.60        |       | 1.00  | 0.024                 |       | 0.039 |
| R    |             | 0.20  |       |                       | 0.008 |       |
| V2   | 0°          |       | 8°    | 0°                    |       | 8°    |

1. Inches dimensions given for reference only

**Figure 12. DPAK recommended footprint (dimensions are in mm)**

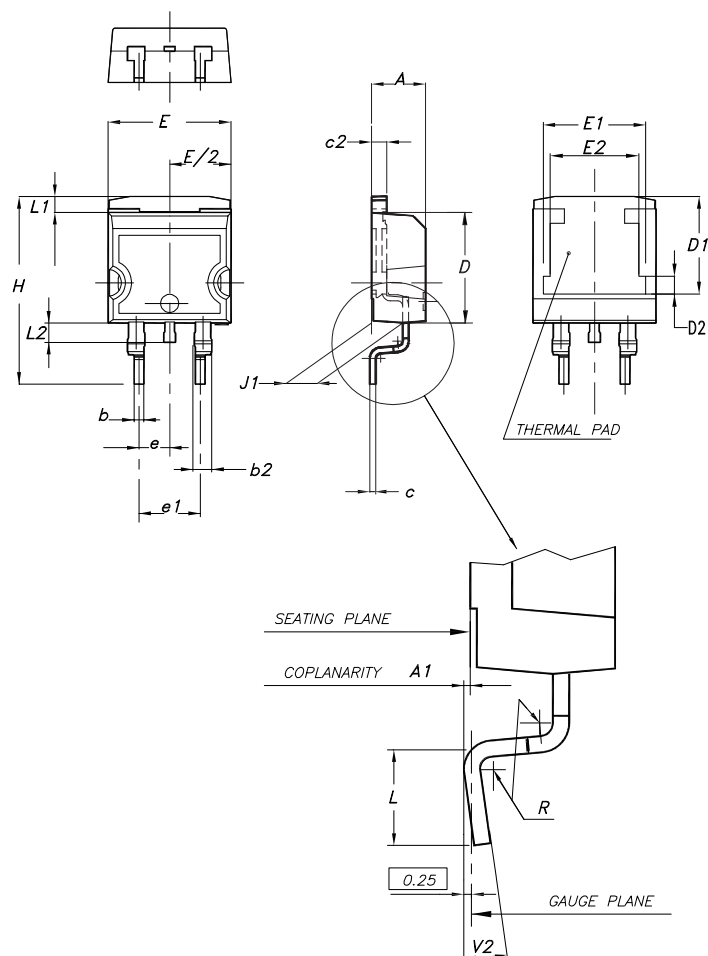


The device must be positioned within  $\begin{array}{|c|c|c|c|} \hline \oplus & 0 & 05 & A & B \\ \hline \end{array}$

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

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

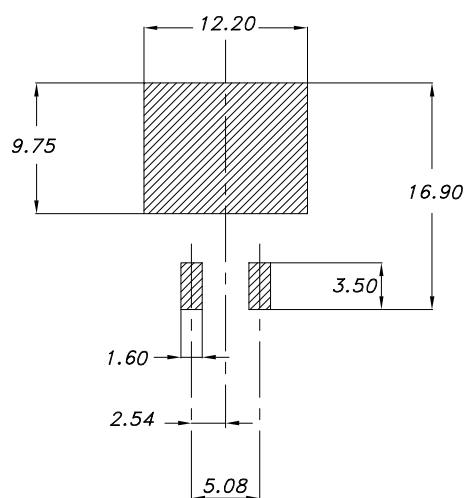
Figure 13. D<sup>2</sup>PAK package outline



**Note:** This package drawing may slightly differ from the physical package. However, all the specified dimensions are guaranteed.

**Table 6. D<sup>2</sup>PAK package mechanical data**

| Ref. | Dimensions  |      |       |                             |       |       |
|------|-------------|------|-------|-----------------------------|-------|-------|
|      | Millimeters |      |       | Inches (for reference only) |       |       |
|      | 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    | 10.00       |      | 10.40 | 0.394                       |       | 0.409 |
| E1   | 8.30        | 8.50 | 8.70  | 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    | 15.00       |      | 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    |             | 0.40 |       |                             | 0.015 |       |
| V2   | 0°          |      | 8°    | 0°                          |       | 8°    |

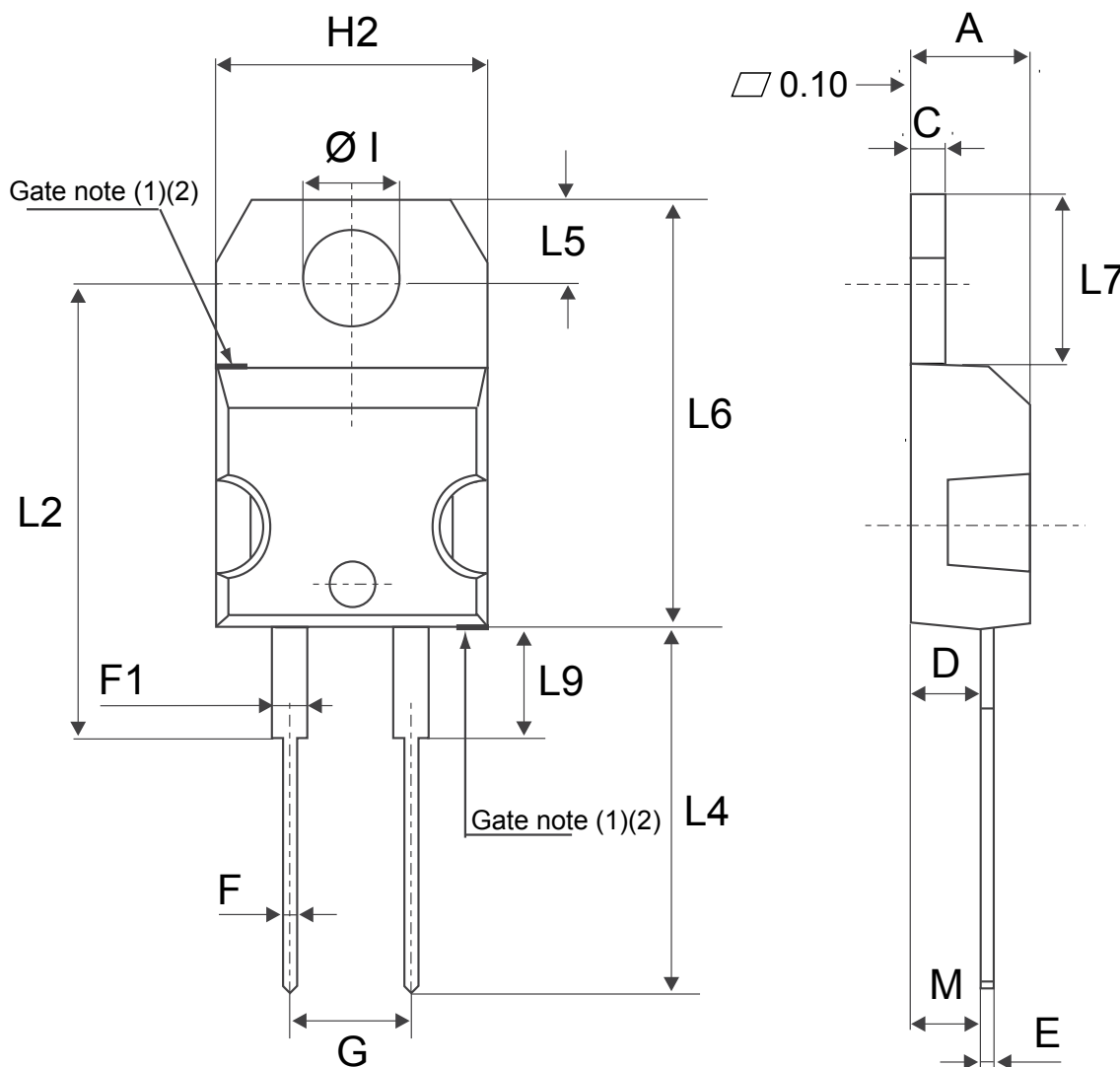
**Figure 14. D<sup>2</sup>PAK recommended footprint (dimensions are in mm)**


Footprint\_26

## 2.3 TO-220AC package information

- Epoxy meets UL 94,V0
- Cooling method: by conduction (C)
- Recommended torque value: 0.55 N·m
- Maximum torque value: 0.70 N·m

**Figure 15. TO-220AC package outline**



(1) :Max resin gate protusion 0.5 mm

(2) :Resin gate position is accepted in each of the two positions shown on the drawings or their symmetrical

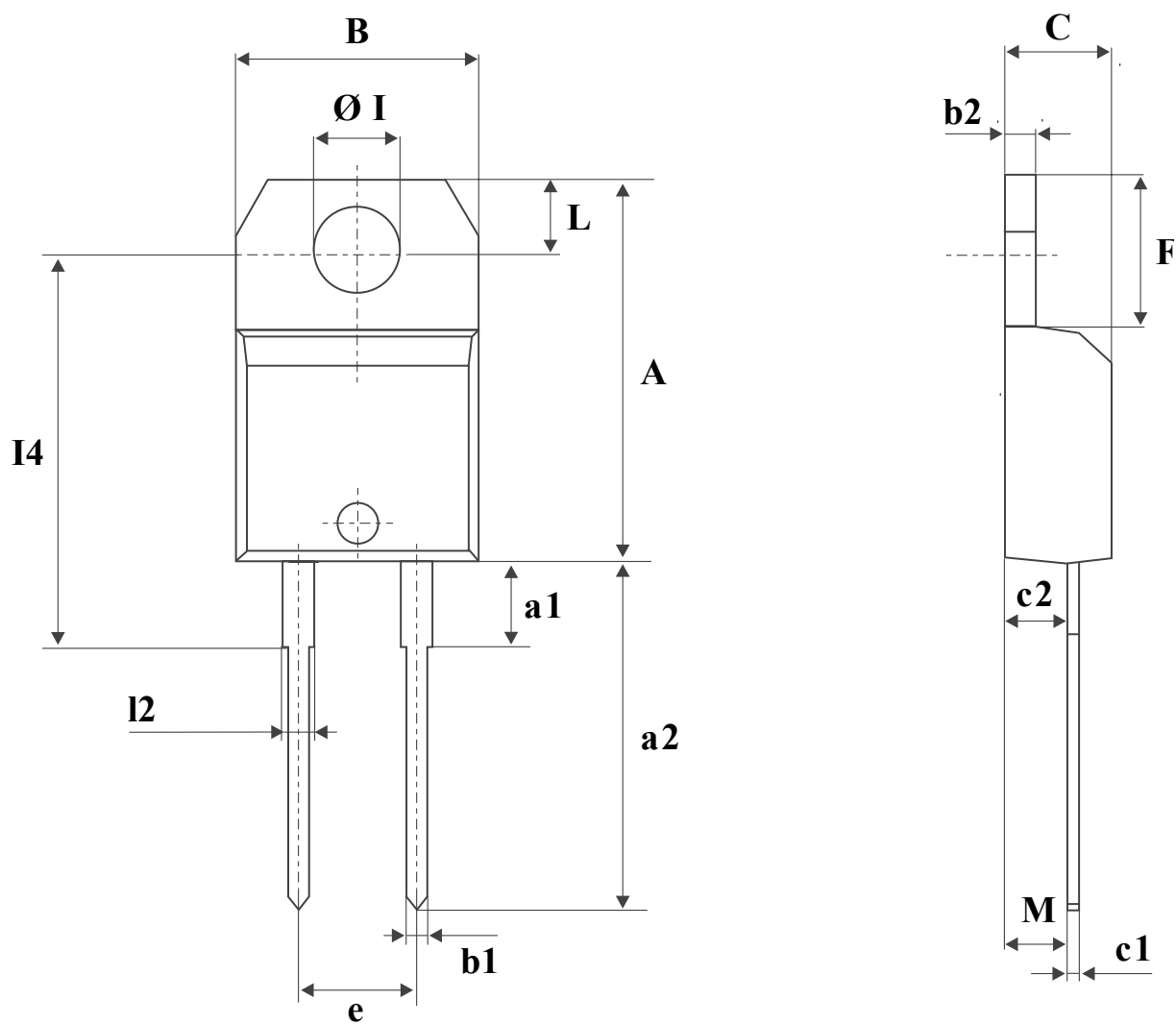
**Table 7. TO-220AC package mechanical data**

| Ref. | Dimensions  |       |                             |       |
|------|-------------|-------|-----------------------------|-------|
|      | Millimeters |       | Inches (for reference only) |       |
|      | 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    | 2.60 typ.   |       | 0.102 typ.                  |       |
| Diam | 3.75        | 3.85  | 0.147                       | 0.151 |

## 2.4 TO-220AC Ins. package information

- Epoxy meets UL 94,V0
- Cooling method: by conduction (C)
- Recommended torque value: 0.55 N·m
- Maximum torque value: 0.70 N·m

**Figure 16.** TO-220AC Ins. package outline



**Table 8.** TO-220AC Ins. package mechanical data

| Ref. | Dimensions  |       |       |                             |       |       |
|------|-------------|-------|-------|-----------------------------|-------|-------|
|      | Millimeters |       |       | Inches (for reference only) |       |       |
|      | 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 |
| L    | 2.65        |       | 2.95  | 0.104                       |       | 0.116 |
| l2   | 1.14        |       | 1.70  | 0.044                       |       | 0.066 |
| l4   | 15.80       | 16.40 | 16.80 | 0.622                       | 0.645 | 0.661 |
| M    |             | 2.60  |       |                             | 0.102 |       |
| Øl   | 3.75        |       | 3.85  | 0.147                       |       | 0.151 |

### 3 Ordering Information

**Table 9. 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 |

## Revision history

**Table 10. Document revision history**

| Date        | Version | 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 9.                                                         |
| 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.                                                                                                   |
| 25-Jan-2019 | 8       | Updated D <sup>2</sup> PAK package information. Added Section Applications and Section Sustainable technology program. |
| 09-Jan-2020 | 9       | Updated Features.                                                                                                      |

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