

# 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                      |                                   |                         | 400         | V    |
| I <sub>F(RMS)</sub>  | Forward rms current                                  |                                   |                         | 50          | A    |
| I <sub>F(peak)</sub> | Peak working forward current<br>δ = 0.5, square wave | TO-220AC, D <sup>2</sup> PAK      | T <sub>C</sub> = 135 °C | 20          | A    |
|                      |  | TO-220FPAC                        | T <sub>C</sub> = 105 °C |             |      |
| I <sub>FSM</sub>     | Surge non repetitive forward current                 | t <sub>p</sub> = 10 ms sinusoidal |                         | 150         | A    |
| T <sub>stg</sub>     | Storage temperature range                            |                                   |                         | -65 to +175 | °C   |
| T <sub>j</sub>       | Maximum operating junction temperature               |                                   |                         | 175         | °C   |

**Table 3: Thermal parameter**

| Symbol        | Parameter        |                              | Max. value | Unit |
|---------------|------------------|------------------------------|------------|------|
| $R_{th(j-c)}$ | Junction to case | TO-220AC, D <sup>2</sup> PAK | 2.8        | °C/W |
|               |                  | TO-220FPAC                   | 5          |      |

**Table 4: Static electrical characteristics**

| Symbol      | Parameter               | Test conditions       |                     | Min. | Typ. | Max. | Unit          |
|-------------|-------------------------|-----------------------|---------------------|------|------|------|---------------|
| $I_R^{(1)}$ | Reverse leakage current | $T_j = 25\text{ °C}$  | $V_R = V_{RRM}$     | -    |      | 20   | $\mu\text{A}$ |
|             |                         | $T_j = 125\text{ °C}$ |                     | -    | 20   | 200  |               |
| $V_F^{(2)}$ | Forward voltage drop    | $T_j = 25\text{ °C}$  | $I_F = 20\text{ A}$ | -    | 1.50 | 1.70 | V             |
|             |                         | $T_j = 125\text{ °C}$ |                     | -    | 1.15 | 1.35 |               |

**Notes:**

(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:

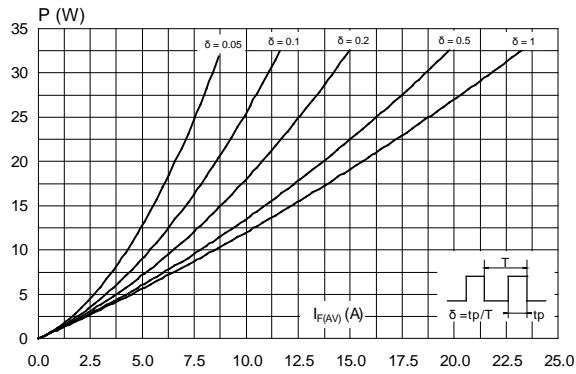
$$P = 1.05 \times I_{F(AV)} + 0.015 \times I_{F(RMS)}^2$$

Table 5: Dynamic electrical characteristics

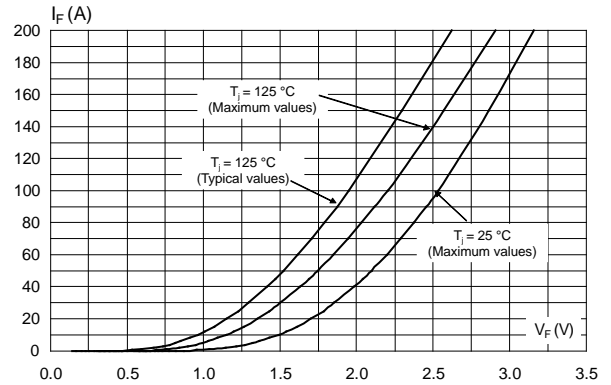
| Symbol       | Parameter                | Test conditions       |   | Min. | Typ. | Max. | Unit |
|--------------|--------------------------|-----------------------|---|------|------|------|------|
| $t_{rr}$     | Reverse recovery time    | $T_j = 25\text{ °C}$  | $I_F = 0.5\text{ A}$ ,<br>$I_{rr} = 0.25\text{ A}$ ,<br>$I_R = 1\text{ A}$                      | -    | 18   | 25   | ns   |
|              |                          |                       | $I_F = 1\text{ A}$ ,<br>$V_R = 30\text{ V}$ ,<br>$di_F/dt = -50\text{ A/}\mu\text{s}$           | -    | 35   | 45   |      |
| $t_{fr}$     | Forward recovery time    |                       | $I_F = 20\text{ A}$ ,<br>$di_F/dt = 100\text{ A/}\mu\text{s}$<br>$V_{FR} = 1.1 \times V_{Fmax}$ | -    |      | 150  | ns   |
| $V_{FP}$     | Forward recovery voltage |                       | $I_F = 20\text{ A}$ ,<br>$di_F/dt = 100\text{ A/}\mu\text{s}$                                   | -    | 1.7  | 2.5  | V    |
| $I_{RM}$     | Reverse recovery current | $T_j = 125\text{ °C}$ | $I_F = 20\text{ A}$ ,<br>$di_F/dt = -200\text{ A/}\mu\text{s}$<br>$V_R = 200\text{ V}$          | -    | 8    | 11   | A    |
| $S_{factor}$ | Softness factor          |                       |   | -    | 0.3  |      | -    |

## 1.1 Characteristics (curves)

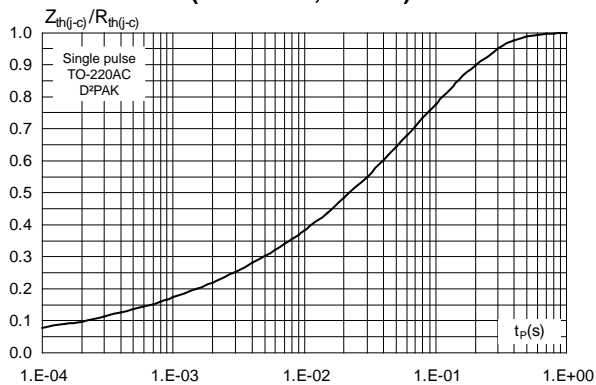
**Figure 1: Conduction losses versus average forward current**



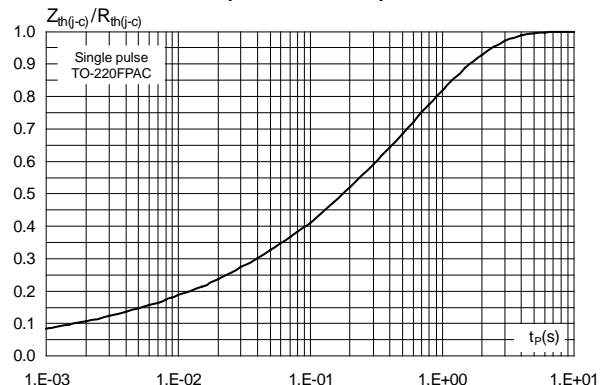
**Figure 2: Forward voltage drop versus forward current**



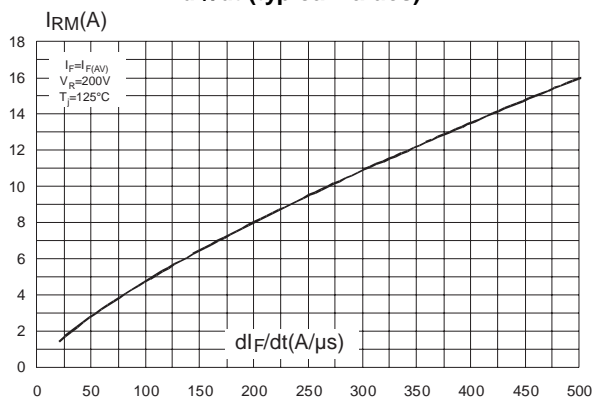
**Figure 3: Relative variation of thermal impedance junction to case versus pulse duration (TO-220AC, D<sup>2</sup>PAK)**



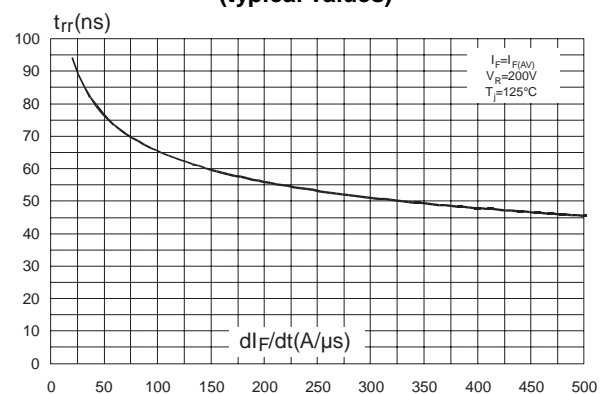
**Figure 4: Relative variation of thermal impedance junction to case versus pulse duration (TO-220FPAC)**



**Figure 5: Peak reverse recovery current versus  $di_F/dt$  (typical values)**



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



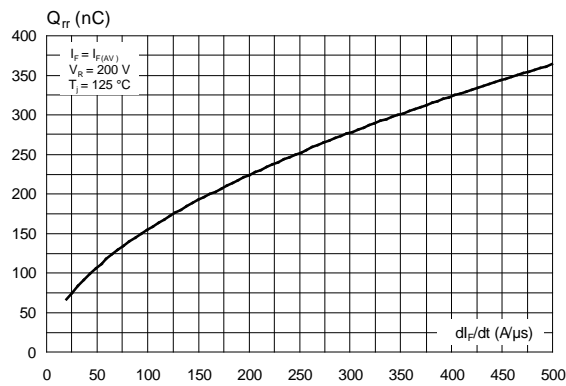
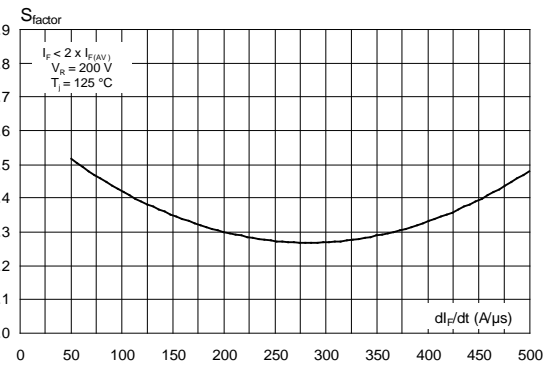
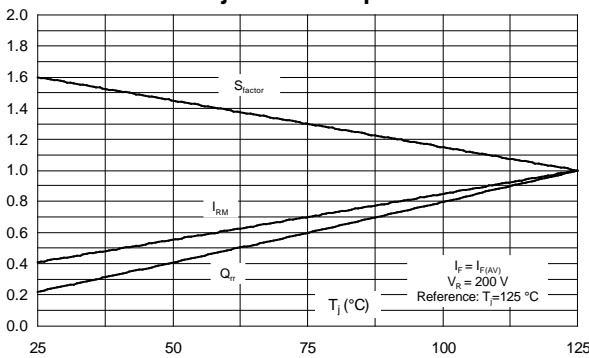
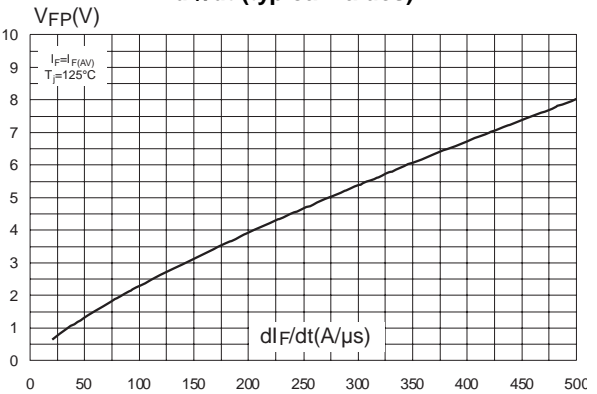
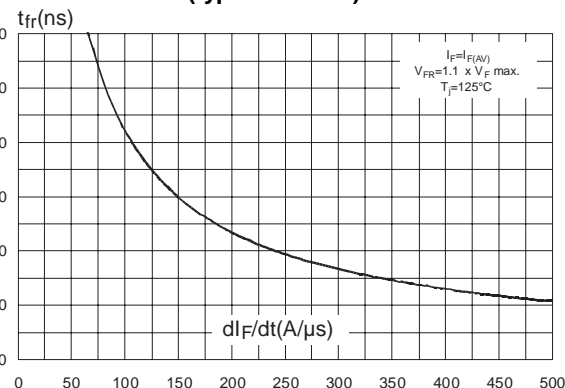
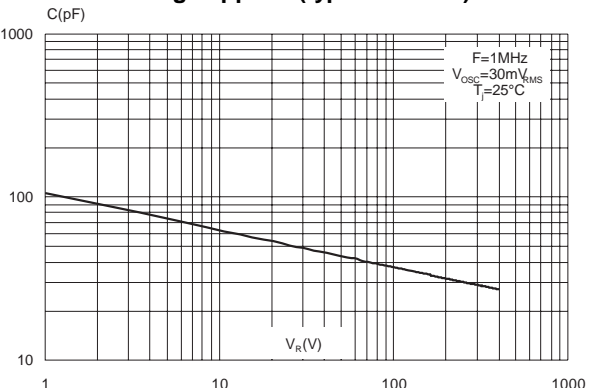
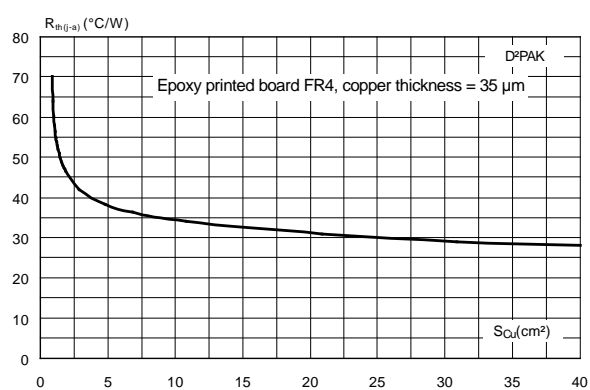
**Figure 7: Reverse recovery charges versus  $di_F/dt$  (typical values)****Figure 8: Reverse recovery softness factor versus  $di_F/dt$  (typical values)****Figure 9: Relative variation of dynamic parameters versus junction temperature****Figure 10: Transient peak forward voltage versus  $di_F/dt$  (typical values)****Figure 11: Forward recovery time versus  $di_F/dt$  (typical values)****Figure 12: Junction capacitance versus reverse voltage applied (typical values)**

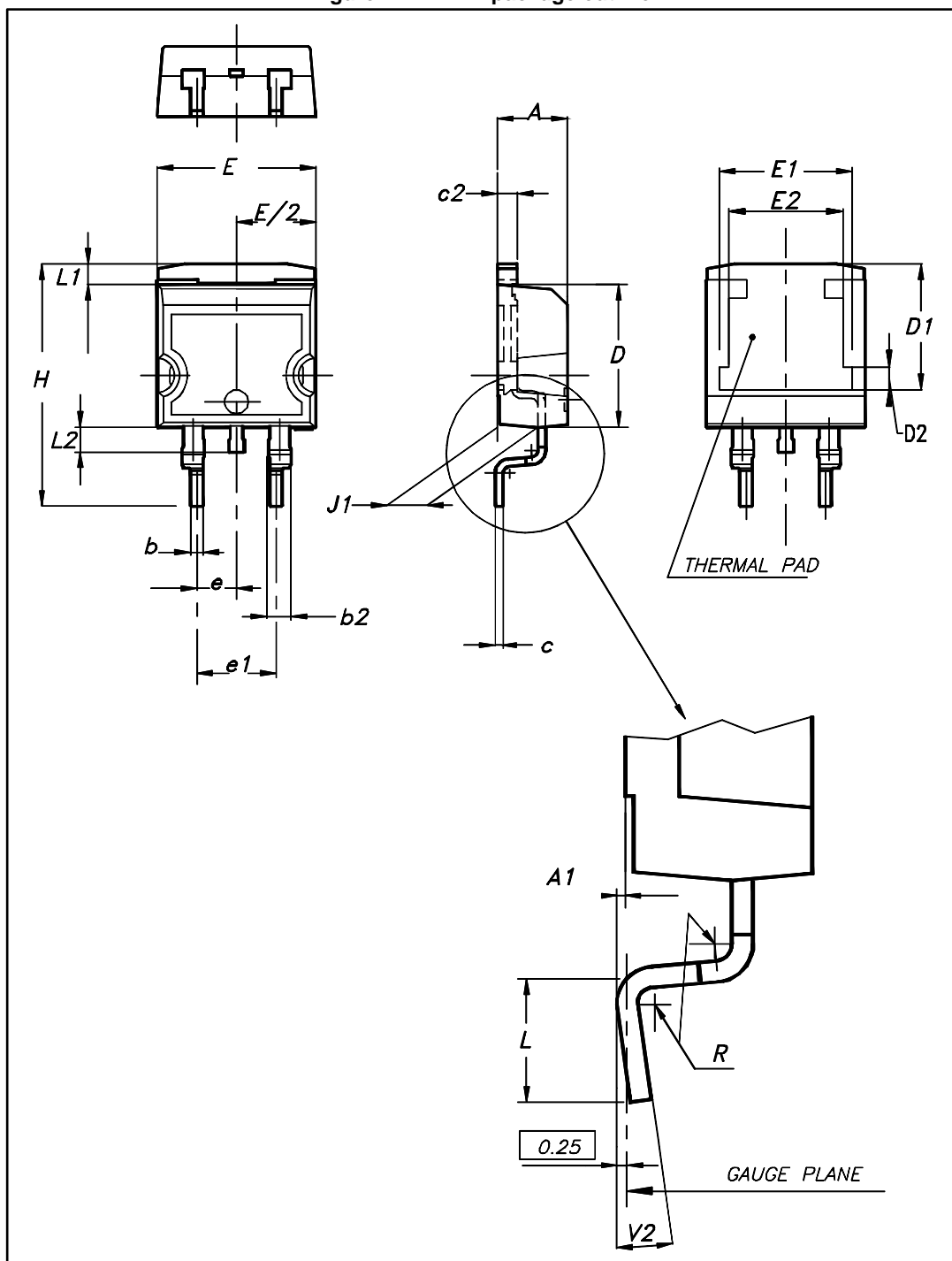
Figure 13: Thermal resistance junction to ambient versus copper surface under tab for D<sup>2</sup>PAK

## 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.

- Cooling method: by conduction (C)
- Epoxy meets UL94, V0
- Recommended torque value: 0.55 N.m (for TO-220AC and TO-220FPAC)
- Maximum torque value: 0.70 N.m (for TO-220AC and TO-220FPAC)

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

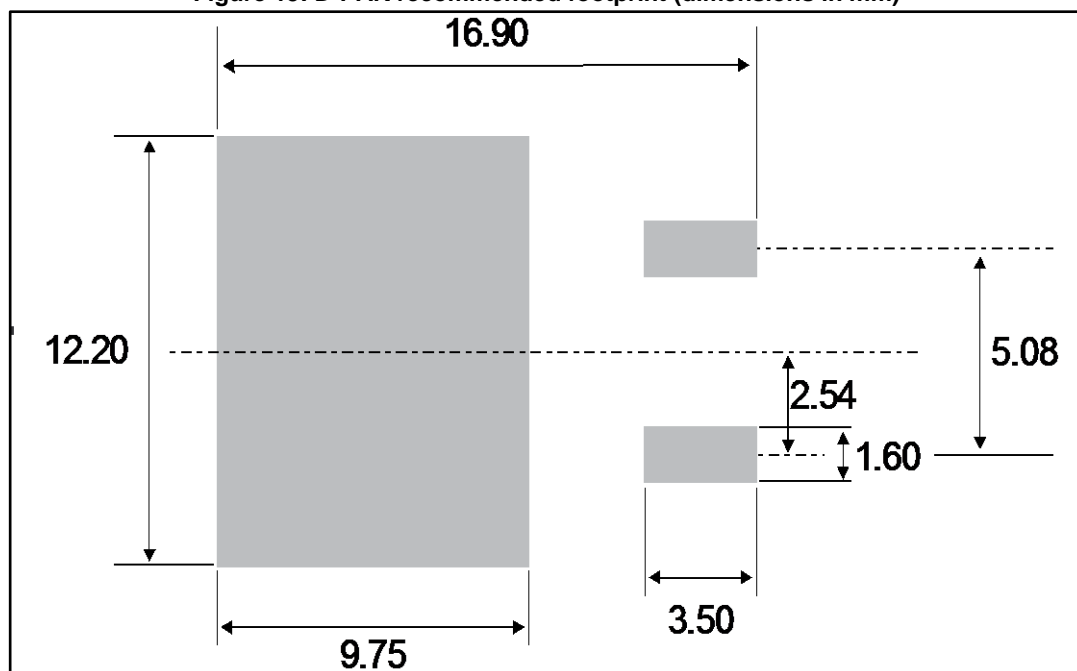
Figure 14: D<sup>2</sup>PAK package outline

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 |       |
|      | Min.        | Max.  | Min.   | Max.  |
| A    | 4.36        | 4.60  | 0.172  | 0.181 |
| A1   | 0.00        | 0.25  | 0.000  | 0.010 |
| b    | 0.70        | 0.93  | 0.028  | 0.037 |
| b2   | 1.14        | 1.70  | 0.045  | 0.067 |
| c    | 0.38        | 0.69  | 0.015  | 0.027 |
| c2   | 1.19        | 1.36  | 0.047  | 0.053 |
| D    | 8.60        | 9.35  | 0.339  | 0.368 |
| D1   | 6.90        | 8.00  | 0.272  | 0.311 |
| D2   | 1.10        | 1.50  | 0.043  | 0.060 |
| E    | 10.00       | 10.55 | 0.394  | 0.415 |
| E1   | 8.10        | 8.90  | 0.319  | 0.346 |
| E2   | 6.85        | 7.25  | 0.266  | 0.282 |
| e    | 2.54 typ.   |       | 0.100  |       |
| e1   | 4.88        | 5.28  | 0.190  | 0.205 |
| H    | 15.00       | 15.85 | 0.591  | 0.624 |
| J1   | 2.49        | 2.90  | 0.097  | 0.112 |
| L    | 1.90        | 2.79  | 0.075  | 0.110 |
| L1   | 1.27        | 1.65  | 0.049  | 0.065 |
| L2   | 1.30        | 1.78  | 0.050  | 0.070 |
| R    | 0.4 typ.    |       | 0.015  |       |
| V2   | 0°          | 8°    | 0°     | 8°    |



Figure 15: D<sup>2</sup>PAK recommended footprint (dimensions in mm)

## 2.2 TO-220AC package information

Figure 16: TO-220AC package outline

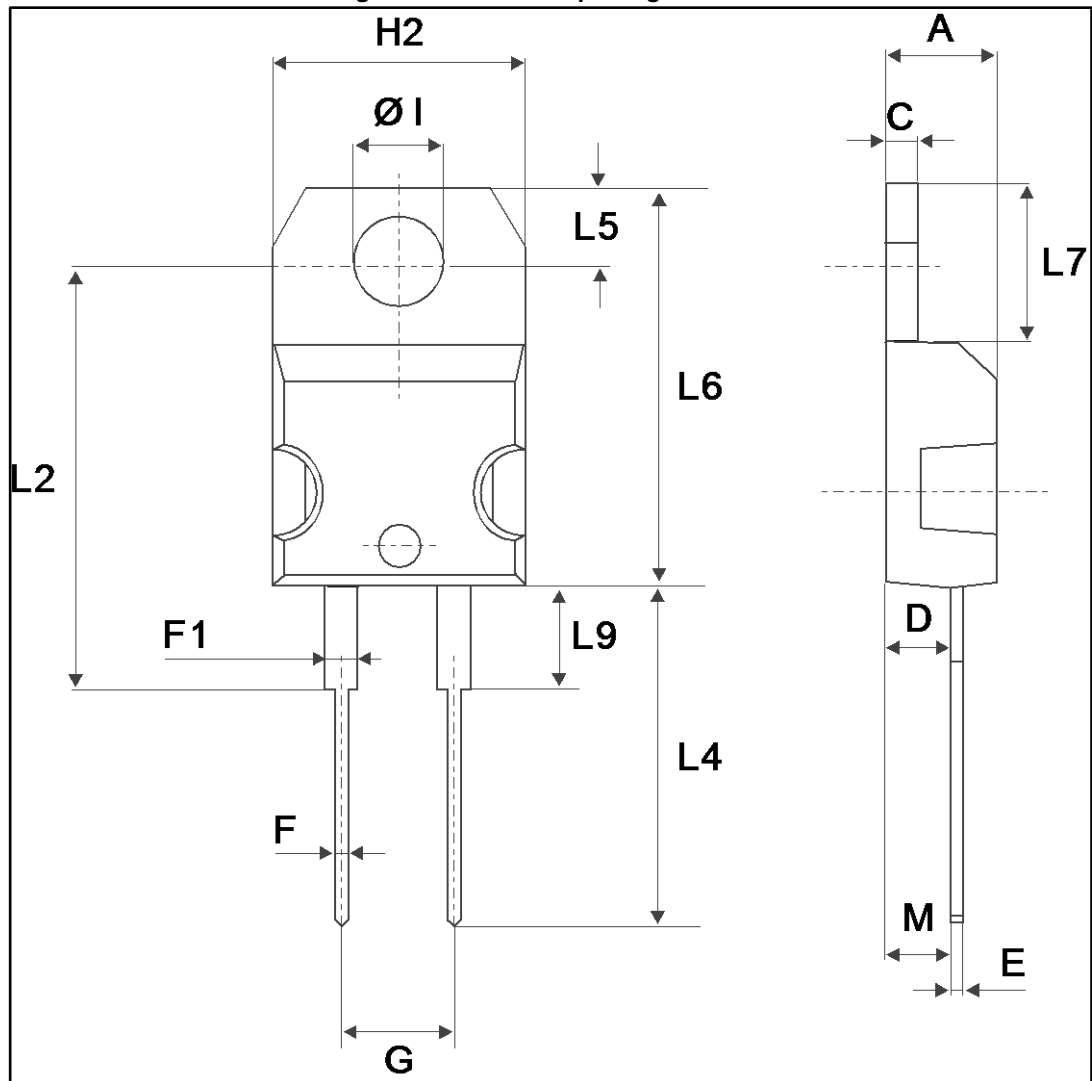


Table 7: TO-220AC package mechanical data

| 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 |

## 2.3 TO-220FPAC package information

Figure 17: TO-220FPAC package outline

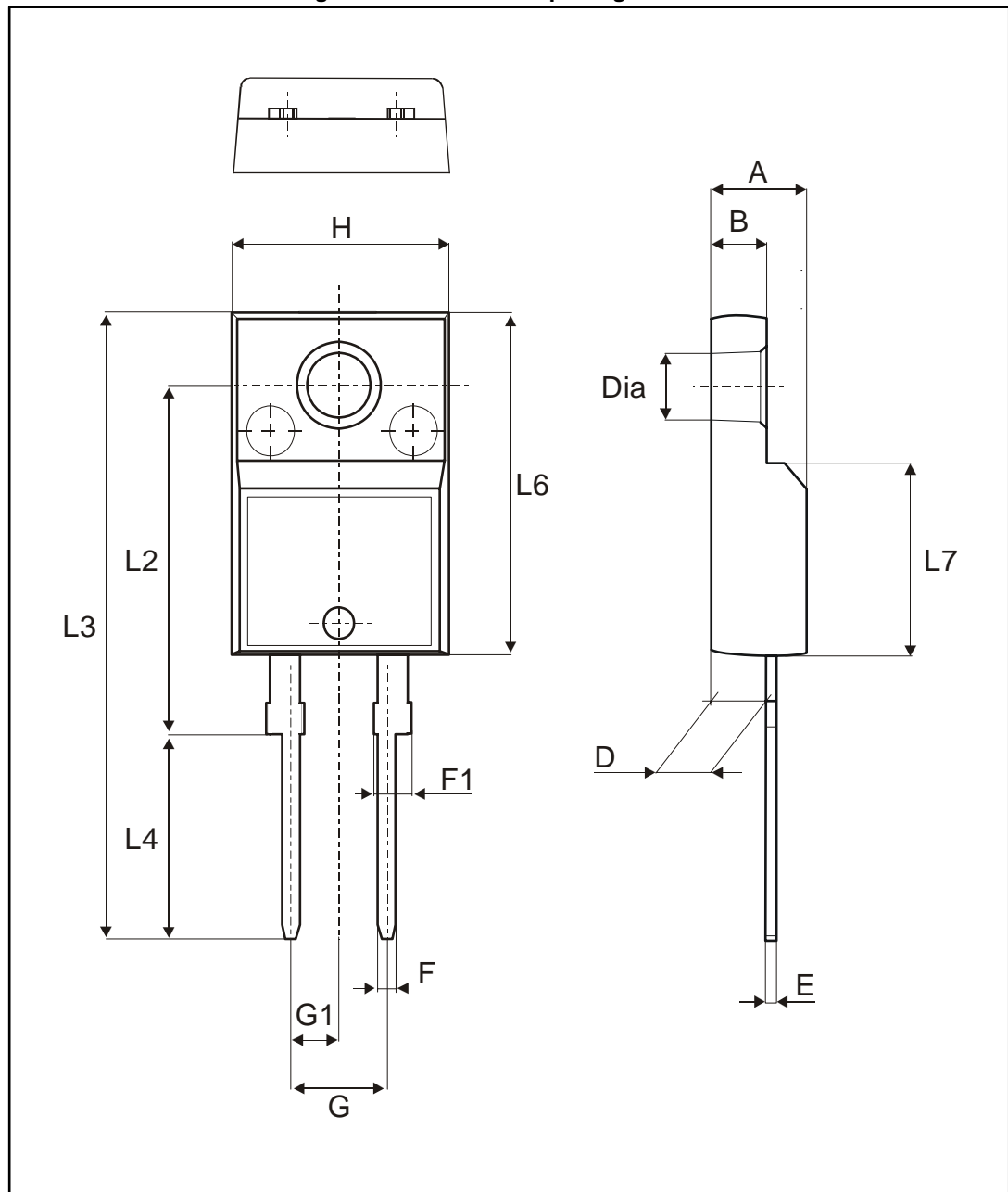


Table 8: TO-220FPAC package mechanical data

| Ref. | Dimensions  |       |            |       |
|------|-------------|-------|------------|-------|
|      | Millimeters |       | Inches     |       |
|      | Min.        | Max.  | Min.       | Max.  |
| A    | 4.40        | 4.60  | 0.173      | 0.181 |
| B    | 2.50        | 2.70  | 0.098      | 0.106 |
| D    | 2.50        | 2.75  | 0.098      | 0.108 |
| E    | 0.45        | 0.70  | 0.018      | 0.027 |
| F    | 0.75        | 1.00  | 0.030      | 0.039 |
| F1   | 1.15        | 1.70  | 0.045      | 0.067 |
| G    | 4.95        | 5.20  | 0.195      | 0.205 |
| G1   | 2.40        | 2.70  | 0.094      | 0.106 |
| H    | 10.00       | 10.40 | 0.393      | 0.409 |
| L2   | 16.00 typ.  |       | 0.630 typ. |       |
| L3   | 28.60       | 30.60 | 0.126      | 1.205 |
| L4   | 9.80        | 10.60 | 0.386      | 0.417 |
| L6   | 15.90       | 16.40 | 0.626      | 0.646 |
| L7   | 9.00        | 9.30  | 0.354      | 0.366 |
| Dia. | 3.00        | 3.20  | 0.118      | 0.126 |

### 3 Ordering information

Table 9: Ordering information

| Order code    | Marking     | Package            | Weight | Base qty. | Delivery mode |
|---------------|-------------|--------------------|--------|-----------|---------------|
| STTH20R04G-TR | STTH20R04G  | D <sup>2</sup> PAK | 1.38 g | 1000      | Tape and reel |
| STTH20R04FP   | STTH20R04FP | TO-220FPAC         | 1.90 g | 50        | Tube          |
| STTH20R04D    | STTH20R04D  | TO-220AC           | 1.87 g | 50        | Tube          |

### 4 Revision history

Table 10: Document revision history

| Date        | Revision | Changes  |
|-------------|----------|--|
| 08-Nov-2007 | 1        | First issue.   |
| 16-Aug-2017 | 2        | Updated features and package silhouette.<br>Updated <a href="#">Section 1: "Characteristics"</a> , <a href="#">Section 1.1: "Characteristics (curves)"</a> and <a href="#">Section 3: "Ordering information"</a> . |

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