

# 1 Characteristics

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

| Symbol              | Parameter                                    |                                                  |                         |           | Value       | Unit |
|---------------------|----------------------------------------------|--------------------------------------------------|-------------------------|-----------|-------------|------|
| V <sub>RRM</sub>    | Repetitive peak reverse voltage              |                                                  |                         |           | 300         | V    |
| I <sub>F(RMS)</sub> | Forward rms current                          |                                                  |                         |           | 30          | A    |
| I <sub>F(AV)</sub>  | Average forward current δ = 0.5, square wave | TO-220AB, D <sup>2</sup> PAK, I <sup>2</sup> PAK | T <sub>C</sub> = 140 °C | Per diode | 10          | A    |
|                     |                                              | TO-220FPAB                                       | T <sub>C</sub> = 115 °C |           |             |      |
|                     |                                              | All types                                        | Per device              |           | 20          |      |
| I <sub>FSM</sub>    | Surge non repetitive forward current         | t <sub>p</sub> = 10 ms sinusoidal                |                         |           | 110         | A    |
| T <sub>stg</sub>    | Storage temperature range                    |                                                  |                         |           | -65 to +175 | °C   |
| T <sub>j</sub>      | Maximum operating junction temperature       |                                                  |                         |           | 175         | °C   |

**Table 2. Thermal resistance parameters**

| Symbol        | Parameter        |                                                  |           | Value | Unit |
|---------------|------------------|--------------------------------------------------|-----------|-------|------|
| $R_{th(j-c)}$ | Junction to case | TO-220AB, D <sup>2</sup> PAK, I <sup>2</sup> PAK | Per diode | 2.5   | °C/W |
|               |                  | TO-220FPAB                                       |           | 4.6   |      |
|               |                  | TO-220AB, D <sup>2</sup> PAK, I <sup>2</sup> PAK | Total     | 1.3   |      |
|               |                  | TO-220FPAB                                       |           | 4.0   |      |
| $R_{th(c)}$   | Coupling         | TO-220AB, D <sup>2</sup> PAK, I <sup>2</sup> PAK |           | 0.1   | °C/W |
|               |                  | TO-220FPAB                                       |           | 3.5   |      |

For more information, please refer to the following application note:

- AN5088: Rectifiers thermal management, handling and mounting recommendations

When the diodes 1 and 2 are used simultaneously:

$$\Delta T_j (\text{diode1}) = P_{(\text{diode1})} \times R_{th(j-c)} (\text{per diode}) + P_{(\text{diode2})} \times R_{th(c)}$$

**Table 3. Static electrical characteristics (per diode)**

| Symbol      | Parameter               | Test conditions       |                      | Min. | Typ. | Max. | Unit          |
|-------------|-------------------------|-----------------------|----------------------|------|------|------|---------------|
| $I_R^{(1)}$ | Reverse leakage current | $T_j = 25\text{ °C}$  | $V_R = 300\text{ V}$ | -    |      | 20   | $\mu\text{A}$ |
|             |                         | $T_j = 125\text{ °C}$ |                      | -    | 30   | 300  |               |
| $V_F^{(2)}$ | Forward voltage drop    | $T_j = 25\text{ °C}$  | $I_F = 10\text{ A}$  | -    |      | 1.25 | V             |
|             |                         | $T_j = 125\text{ °C}$ |                      | -    | 0.85 | 1.0  |               |

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:

$$P = 0.75 \times I_{F(AV)} + 0.025 \times I_F^2 (\text{RMS})$$

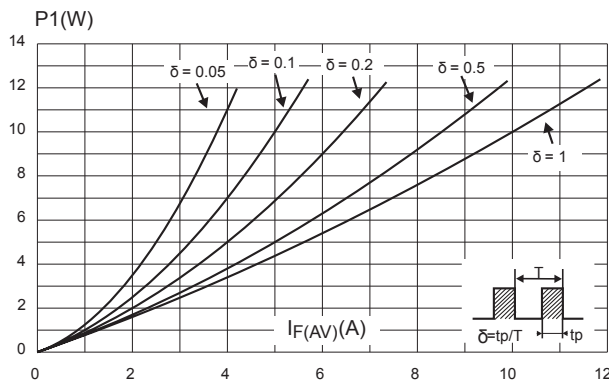
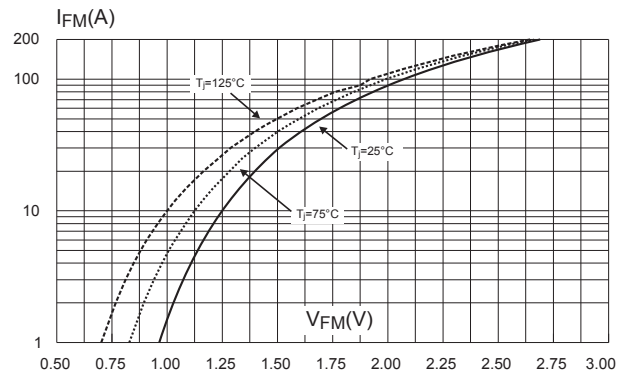
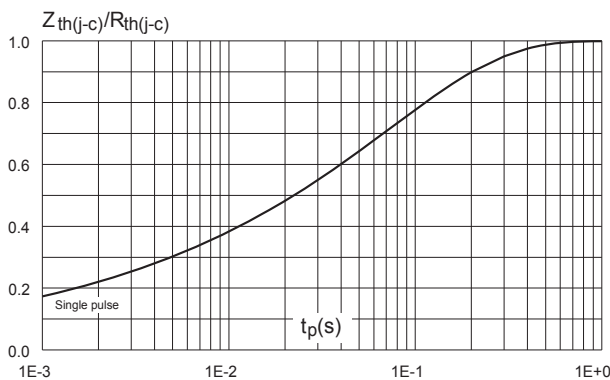
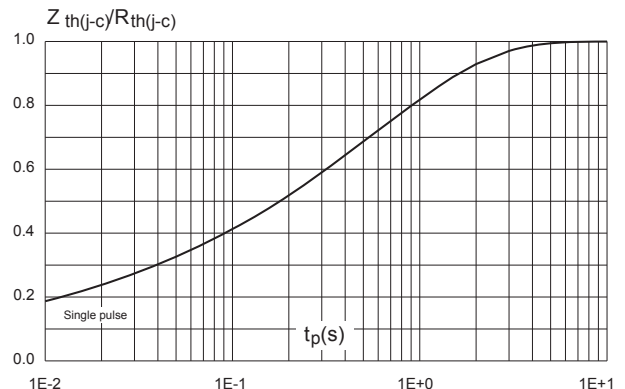
For more information, please refer to the following application notes related to the power losses:

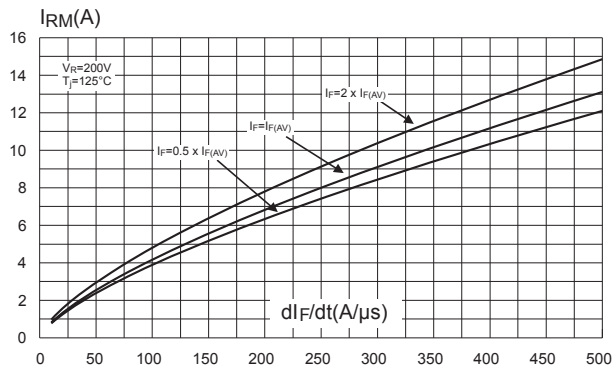
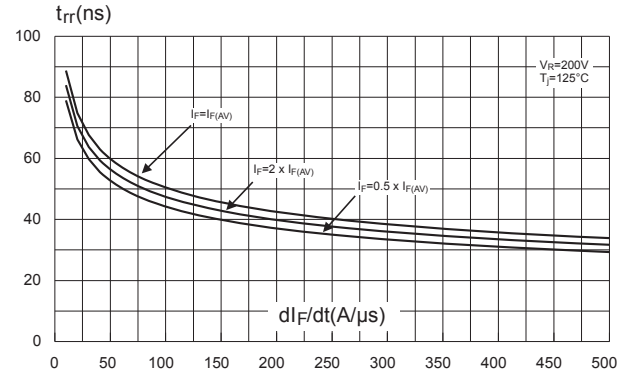
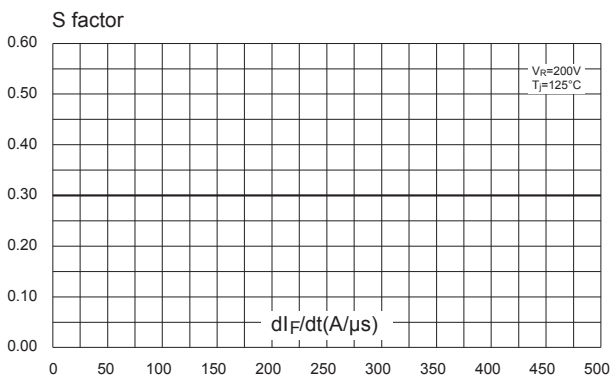
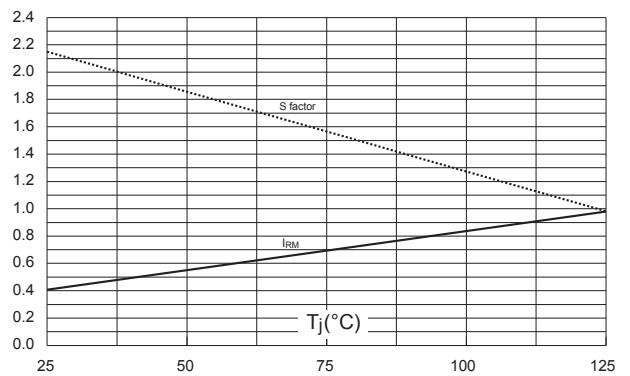
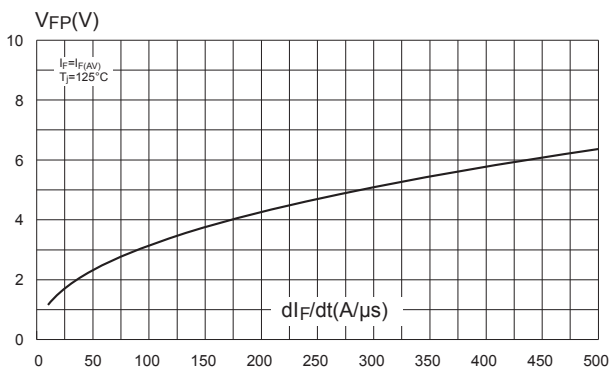
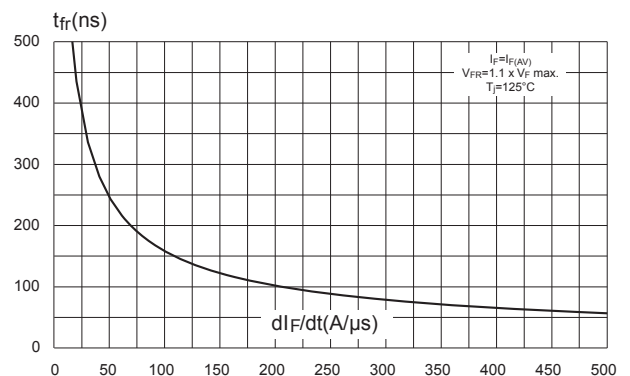
- AN604: Calculation of conduction losses in a power rectifier
- AN4021: Calculation of reverse losses in a power diode

**Table 4. Recovery characteristics (per diode)**

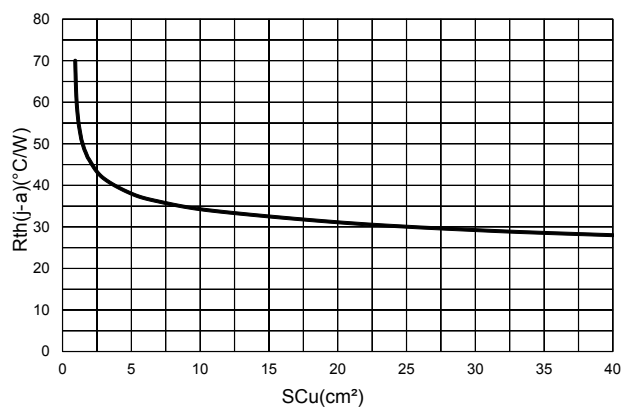
| Symbol   | Parameter                | Test conditions           |                                                                                       | Min. | Typ. | Max. | Unit |
|----------|--------------------------|---------------------------|---------------------------------------------------------------------------------------|------|------|------|------|
| $t_{rr}$ | Reverse recovery time    | $T_J = 25^\circ\text{C}$  | $I_F = 0.5\text{ A}, I_{rr} = 0.25\text{ A}, I_R = 1\text{ A}$                        | -    |      | 25   | ns   |
|          |                          |                           | $I_F = 1\text{ A}, V_R = 30\text{ V}, dI_F/dt = -50\text{ A}/\mu\text{s}$             | -    |      | 35   |      |
| $t_{fr}$ | Forward recovery time    | $T_J = 25^\circ\text{C}$  | $I_F = 10\text{ A}, V_{FR} = 1.1 \times V_{Fmax}, dI_F/dt = 100\text{ A}/\mu\text{s}$ | -    |      | 230  | ns   |
| $V_{FP}$ | Peak forward voltage     | $T_J = 25^\circ\text{C}$  | $I_F = 10\text{ A}, dI_F/dt = 100\text{ A}/\mu\text{s}$                               | -    |      | 3.5  | V    |
| $I_{RM}$ | Reverse recovery current | $T_J = 125^\circ\text{C}$ | $I_F = 10\text{ A}, V_{CC} = 200\text{ V}, dI_F/dt = -200\text{ A}/\mu\text{s}$       | -    |      | 8    | A    |
| S factor | Softness factor          |                           |                                                                                       | -    | 0.3  | -    |      |

## 1.1 Characteristics (curves)

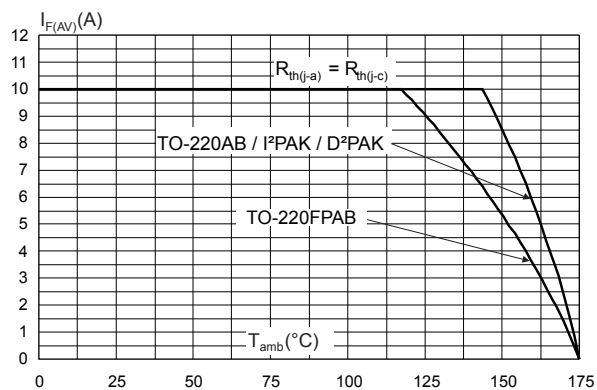
**Figure 1. Conduction losses versus average forward current (per diode)**

**Figure 2. Forward voltage drop versus forward current (maximum values, per diode)**

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

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


**Figure 5. Peak reverse recovery current versus  $dl_F/dt$  (typical values, per diode)**

**Figure 6. Reverse recovery time versus  $dl_F/dt$  (typical values, per diode)**

**Figure 7. Softness factor versus  $dl_F/dt$  (typical values, per diode)**

**Figure 8. Relative variation of dynamic parameters versus junction temperature (reference:  $T_J = 125^\circ C$ )**

**Figure 9. Transient peak forward voltage versus  $dl_F/dt$  (typical values, per diode) (TO-220AB)**

**Figure 10. Forward recovery time versus  $dl_F/dt$  (typical values, per diode)**


**Figure 11.** Thermal resistance, junction to ambient, versus copper surface under tab (epoxy printed board FR4,  $e_{Cu} = 35\mu m$ ) (D<sup>2</sup>PAK)



**Figure 12.** Average forward current versus ambient temperature ( $\delta = 0.5$ , per diode)



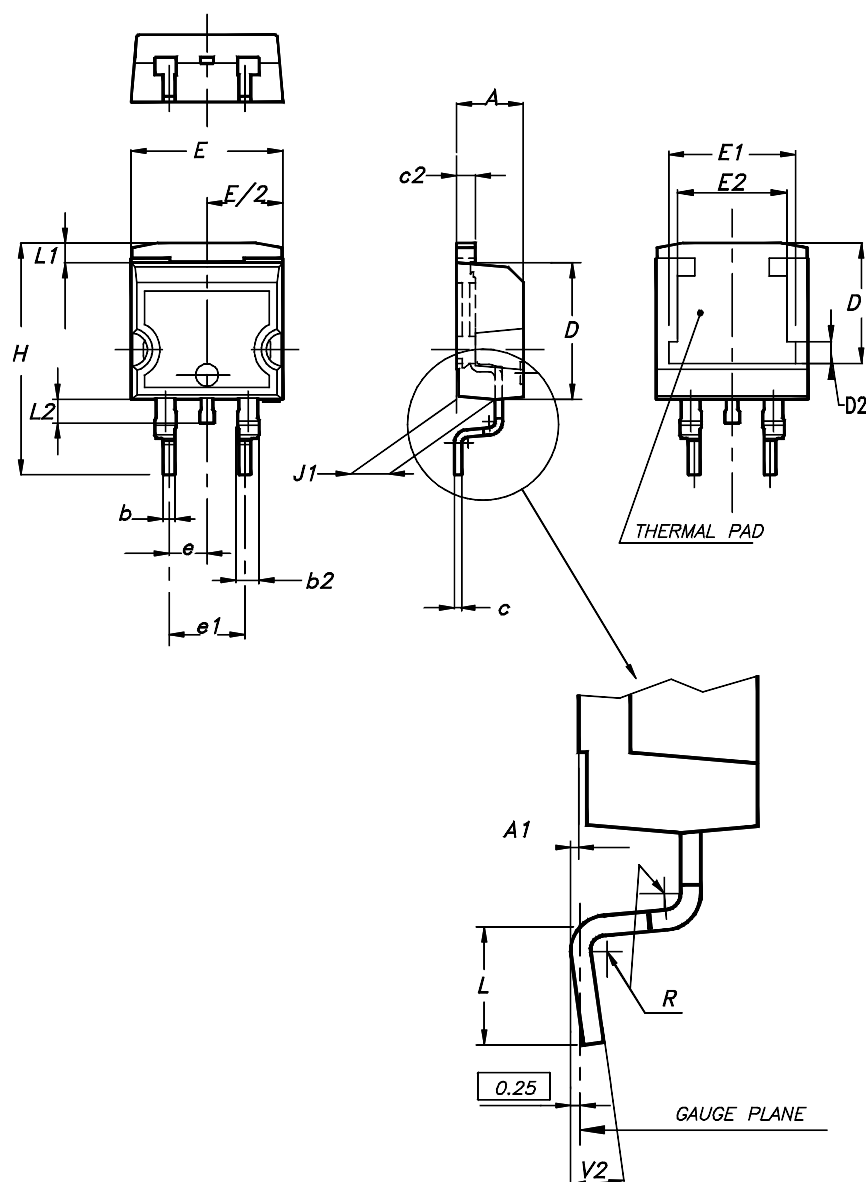
## 2 Package information

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

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

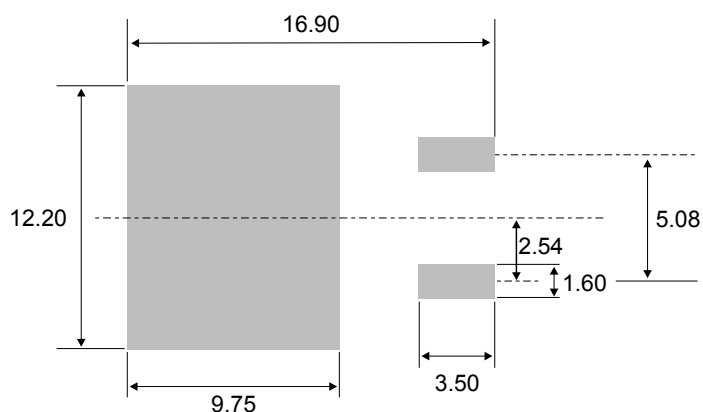
**Figure 13. D<sup>2</sup>PAK package outline**



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

**Table 5. D<sup>2</sup>PAK package mechanical data**

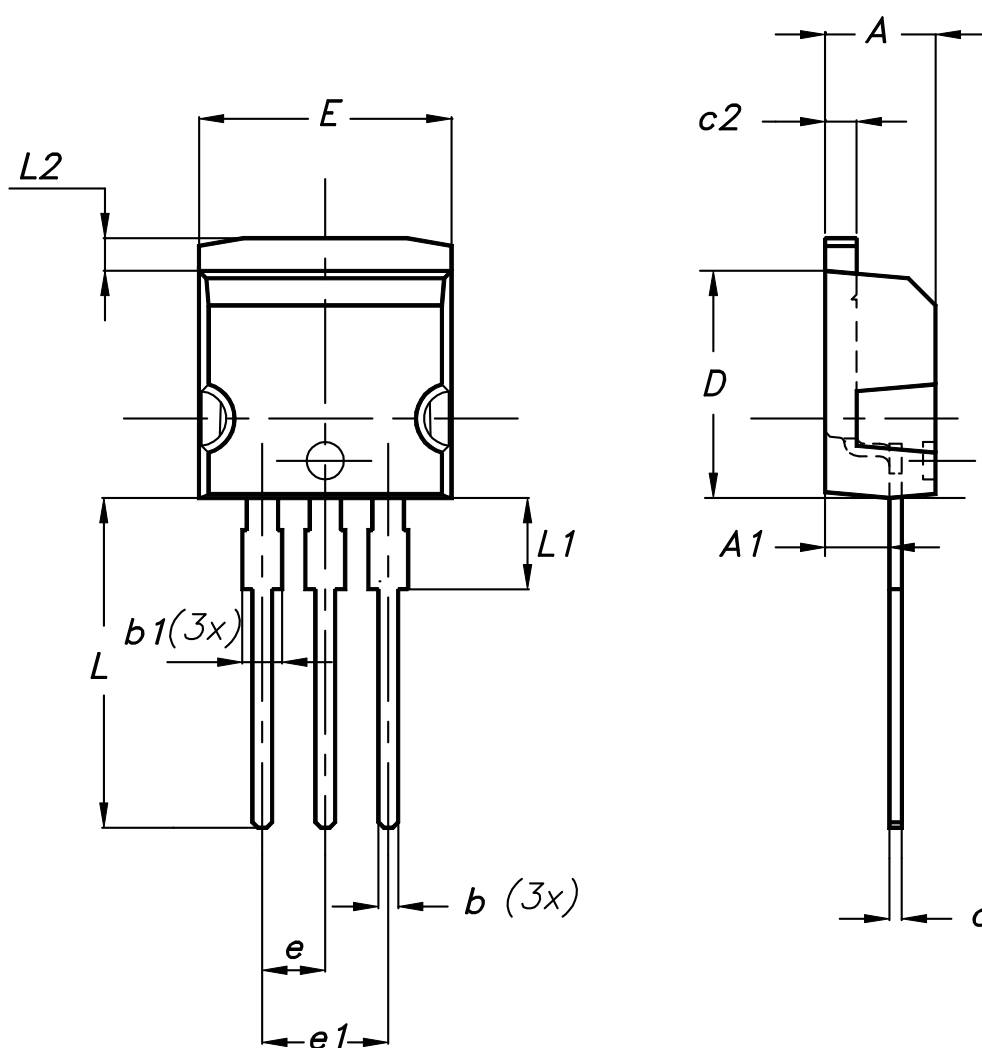
| Ref. | Dimensions  |       |                             |       |
|------|-------------|-------|-----------------------------|-------|
|      | Millimeters |       | Inches (for reference only) |       |
|      | Min.        | Max.  | Min.                        | Max.  |
| A    | 4.36        | 4.60  | 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 14. D<sup>2</sup>PAK recommended footprint (dimensions in mm)**


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

- Epoxy meets UL 94, V0
- Cooling method: by conduction (C)

**Figure 15. I<sup>2</sup>PAK package outline**



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

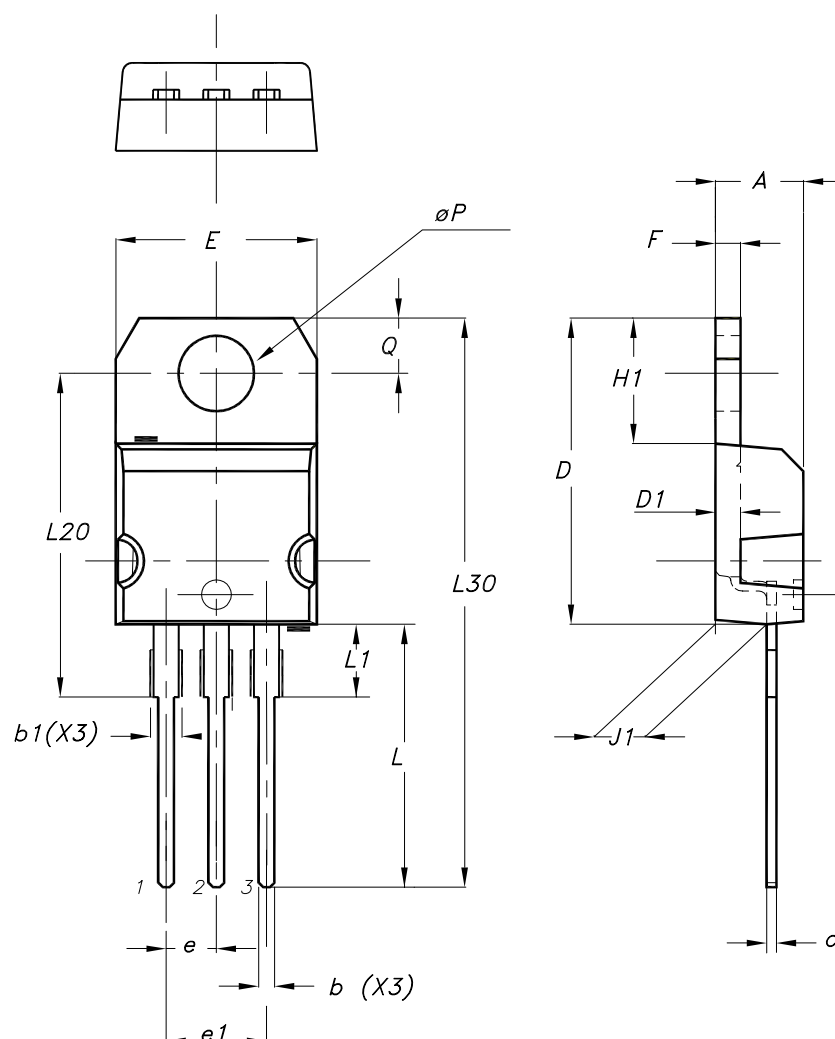
| Ref. | Dimensions  |       |                             |       |
|------|-------------|-------|-----------------------------|-------|
|      | Millimeters |       | Inches (for reference only) |       |
|      | Min.        | Max.  | Min.                        | Max.  |
| A    | 4.40        | 4.60  | 0.173                       | 0.181 |
| A1   | 2.40        | 2.72  | 0.094                       | 0.107 |
| b    | 0.61        | 0.88  | 0.024                       | 0.035 |
| b1   | 1.14        | 1.70  | 0.044                       | 0.067 |
| c    | 0.49        | 0.70  | 0.019                       | 0.028 |
| c2   | 1.23        | 1.32  | 0.048                       | 0.052 |
| D    | 8.95        | 9.35  | 0.352                       | 0.368 |
| e    | 2.40        | 2.70  | 0.094                       | 0.106 |
| e1   | 4.95        | 5.15  | 0.195                       | 0.203 |
| E    | 10.00       | 10.40 | 0.394                       | 0.409 |
| L    | 13.00       | 14.00 | 0.512                       | 0.551 |
| L1   | 3.50        | 3.93  | 0.138                       | 0.155 |
| L2   | 1.27        | 1.40  | 0.050                       | 0.055 |



## 2.3 TO-220AB 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-220AB package outline**



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

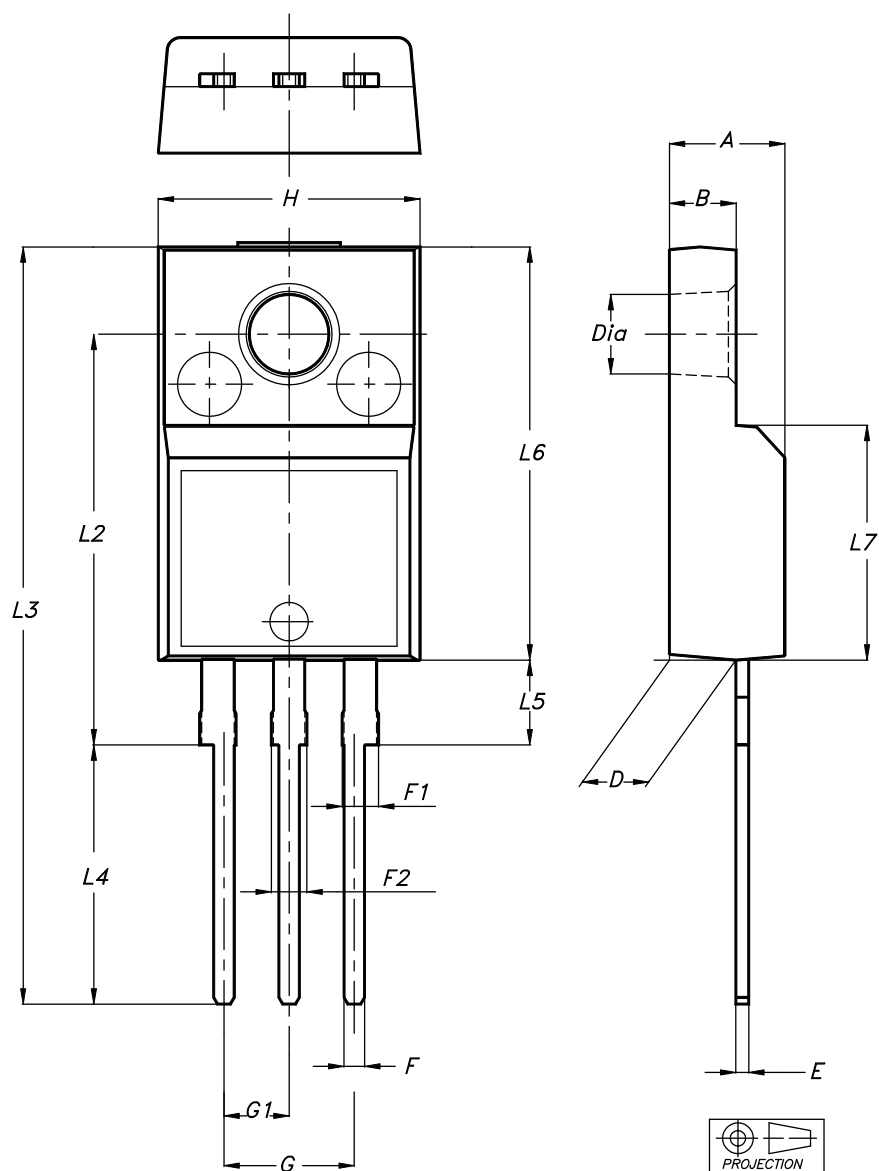
| Ref. | Dimensions  |      |                             |       |
|------|-------------|------|-----------------------------|-------|
|      | Millimeters |      | Inches (for reference only) |       |
|      | Min.        | Max. | Min.                        | Max.  |
| A    | 4.40        | 4.60 | 0.173                       | 0.181 |
| b    | 0.61        | 0.88 | 0.240                       | 0.035 |
| b1   | 1.14        | 1.55 | 0.045                       | 0.061 |

| Ref. | Dimensions  |       |                             |       |
|------|-------------|-------|-----------------------------|-------|
|      | Millimeters |       | Inches (for reference only) |       |
|      | Min.        | Max.  | Min.                        | Max.  |
| c    | 0.48        | 0.70  | 0.019                       | 0.028 |
| D    | 15.25       | 15.75 | 0.600                       | 0.620 |
| D1   | 1.27 typ.   |       | 0.050 typ.                  |       |
| E    | 10.00       | 10.40 | 0.394                       | 0.409 |
| e    | 2.40        | 2.70  | 0.094                       | 0.106 |
| e1   | 4.95        | 5.15  | 0.195                       | 0.203 |
| F    | 1.23        | 1.32  | 0.048                       | 0.052 |
| H1   | 6.20        | 6.60  | 0.244                       | 0.260 |
| J1   | 2.40        | 2.72  | 0.094                       | 0.107 |
| L    | 13.00       | 14.00 | 0.512                       | 0.551 |
| L1   | 3.50        | 3.93  | 0.138                       | 0.155 |
| L20  | 16.40 typ.  |       | 0.646 typ.                  |       |
| L30  | 28.90 typ.  |       | 1.138 typ.                  |       |
| θP   | 3.75        | 3.85  | 0.148                       | 0.152 |
| Q    | 2.65        | 2.95  | 0.104                       | 0.116 |

## 2.4 TO-220FPAB 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 17. TO-220FPAB package outline**



**Table 8. TO-220FPAB package mechanical data**

| Ref. | Dimensions  |       |                             |        |
|------|-------------|-------|-----------------------------|--------|
|      | Millimeters |       | Inches (for reference only) |        |
|      | Min.        | Max.  | Min.                        | Max.   |
| A    | 4.40        | 4.60  | 0.1739                      | 0.1818 |
| B    | 2.50        | 2.70  | 0.0988                      | 0.1067 |
| D    | 2.50        | 2.75  | 0.0988                      | 0.1087 |
| E    | 0.45        | 0.70  | 0.0178                      | 0.0277 |
| F    | 0.75        | 1.00  | 0.0296                      | 0.0395 |
| F1   | 1.15        | 1.70  | 0.0455                      | 0.0672 |
| F2   | 1.15        | 1.70  | 0.0455                      | 0.0672 |
| G    | 4.95        | 5.20  | 0.1957                      | 0.2055 |
| G1   | 2.40        | 2.70  | 0.0949                      | 0.1067 |
| H    | 10.00       | 10.40 | 0.3953                      | 0.4111 |
| L2   | 16.00 typ.  |       | 0.6324 typ.                 |        |
| L3   | 28.60       | 30.60 | 1.1304                      | 1.2095 |
| L4   | 9.80        | 10.60 | 0.3874                      | 0.4190 |
| L5   | 2.90        | 3.60  | 0.1146                      | 0.1423 |
| L6   | 15.90       | 16.40 | 0.6285                      | 0.6482 |
| L7   | 9.00        | 9.30  | 0.3557                      | 0.3676 |
| Dia  | 3.00        | 3.20  | 0.1186                      | 0.1265 |

### 3 Ordering information

**Table 9. Ordering information**

| Order code    | Marking     | Package            | Weight | Base qty. | Delivery mode |
|---------------|-------------|--------------------|--------|-----------|---------------|
| STTH2003CT    | STTH2003CT  | TO-220AB           | 1.95 g | 50        | Tube          |
| STTH2003CG    | STTH2003CG  | D <sup>2</sup> PAK | 1.38 g | 50        | Tube          |
| STTH2003CG-TR | STTH2003CG  | D <sup>2</sup> PAK | 1.38 g | 1000      | Tape and reel |
| STTH2003CFP   | STTH2003CFP | TO-220FPAB         | 1.90 g | 50        | Tube          |
| STTH2003CR    | STTH2003CR  | I <sup>2</sup> PAK | 1.50 g | 50        | Tube          |

## Revision history

**Table 10. Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                            |
|-------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Aug-2003    | 7G       | Previous release                                                                                                                                                                                                   |
| 26-Mar-2007 | 8        | Removed ISOWATT package                                                                                                                                                                                            |
| 11-Feb-2011 | 9        | Updated base quantity for tape and reel delivery.<br>Corrected temperature in <i>Table 1</i> . Added warning paragraph above <i>Table 7</i> .                                                                      |
| 06-Sep-2011 | 10       | Updated <i>Table 2</i> . Added <i>Figure 12</i> .                                                                                                                                                                  |
| 28-May-2015 | 11       | Updated features, <i>Table 1: "Device summary"</i> and packages silhouette in cover page.<br>Updated <i>Section 1: "Characteristics"</i> .<br>Updated <i>Section 2.2: "D<sup>2</sup>PAK package information"</i> . |
| 07-Aug-2018 | 12       | Updated I <sup>2</sup> PAK package information.<br>Minor text changes to improve readability.                                                                                                                      |

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