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# STB46NF30, STP46NF30, STW46NF30

N-channel 300 V, 0.063  $\Omega$  typ, 42 A, STripFET™ II Power MOSFET in D<sup>2</sup>PAK, TO-220 and TO-247 packages

Datasheet — production data

## Features

| Type      | V <sub>DSS</sub> | R <sub>DS(on) max</sub> | I <sub>D</sub> | P <sub>w</sub> |
|-----------|------------------|-------------------------|----------------|----------------|
| STB46NF30 | 300 V            | < 0.075 $\Omega$        | 42 A           | 300 W          |
| STP46NF30 | 300 V            | < 0.075 $\Omega$        | 42 A           | 300 W          |
| STW46NF30 | 300 V            | < 0.075 $\Omega$        | 42 A           | 300 W          |

- Exceptional dv/dt capability
- 100% avalanche tested
- Low gate charge

## Applications

- Switching applications
  - Automotive

## Description

These Power MOSFETs have been developed using STMicroelectronics' unique STripFET process, which is specifically designed to minimize input capacitance and gate charge. This renders the devices suitable for use as primary switch in advanced high-efficiency isolated DC-DC converters for telecom and computer applications, and applications with low gate charge driving requirements.

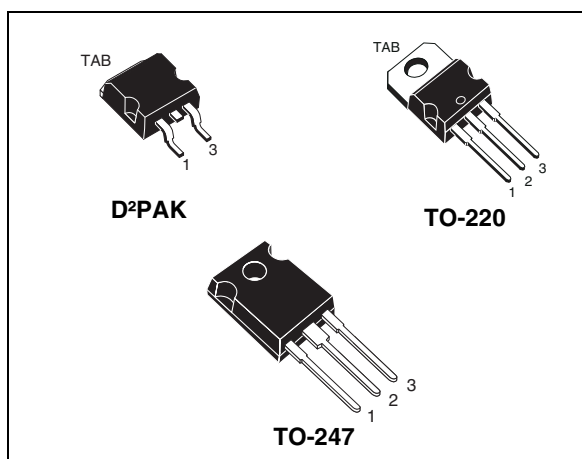


Figure 1. Internal schematic diagram

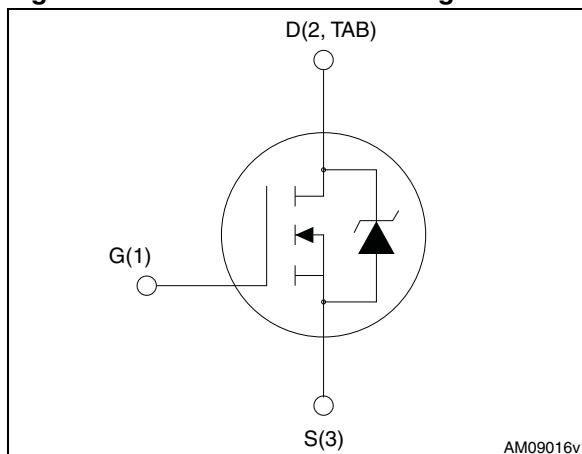


Table 1. Device summary

| Order code | Marking | Package            | Packaging     |
|------------|---------|--------------------|---------------|
| STB46NF30  | 46NF30  | D <sup>2</sup> PAK | Tape and reel |
| STP46NF30  | 46NF30  | TO-220             | Tube          |
| STW46NF30  | 46NF30  | To-247             | Tube          |

## Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol         | Parameter   | Value      | Unit                |
|----------------|---|------------|---------------------|
| $V_{DS}$       | Drain-source voltage  | 300        | V                   |
| $V_{GS}$       | Gate-source voltage   | $\pm 20$   | V                   |
| $I_D$          | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$  | 42         | A                   |
| $I_D$          | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$ | 27         | A                   |
| $I_{DM}^{(1)}$ | Drain current (pulsed)  | 168        | A                   |
| $P_{tot}$      | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$           | 300        | W                   |
|                | Derating factor   | 2          | W/ $^\circ\text{C}$ |
| $dv/dt^{(2)}$  | Peak diode recovery voltage slope                               | 10         | V/ns                |
| $T_{stg}$      | Storage temperature   | -55 to 175 | $^\circ\text{C}$    |
| $T_j$          | Max. operating junction temperature                             | 175        | $^\circ\text{C}$    |

1. Pulse width limited by safe operating area.
2.  $I_{SD} \leq 34\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq 80\% V_{(BR)DSS}$ .

**Table 3. Thermal data**

| Symbol         | Parameter                                      | Value              |        |        | Unit                      |
|----------------|--|--------------------|--------|--------|---------------------------|
|                |  | D <sup>2</sup> PAK | TO-220 | TO-247 |                           |
| $R_{thj-case}$ | Thermal resistance junction-case max           | 0.5                |        |        | $^\circ\text{C}/\text{W}$ |
| $R_{thj-amb}$  | Thermal resistance junction-ambient max        | 30                 | 62.5   | 50     | $^\circ\text{C}/\text{W}$ |
| $R_{thj-pcb}$  | Thermal resistance junction-pcb max            | 30                 |        |        | $^\circ\text{C}/\text{W}$ |
| $T_J$          | Maximum lead temperature for soldering purpose | 300                |        |        | $^\circ\text{C}$          |

**Table 4. Avalanche characteristics**

| Symbol         | Parameter  | Value | Unit |
|----------------|--|-------|------|
| $I_{AR}$       | Avalanche current, repetitive or not repetitive <sup>(1)</sup> | 26    | A    |
| $E_{AS}^{(2)}$ | Single pulse avalanche energy                                  | 290   | mJ   |

1. Pulse width limited by  $T_{jmax}$
2. Starting  $T_j = 25\text{ }^\circ\text{C}$ ,  $I_D = I_{AR}$ ,  $V_{DD} = 50\text{ V}$

**Electrical characteristics**
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## 2 Electrical characteristics

( $T_{CASE} = 25\text{ °C}$  unless otherwise specified)

**Table 5. On/off states**

| Symbol        | Parameter  | Test conditions  | Min. | Typ.  | Max.      | Unit                           |
|---------------|--|--|------|-------|-----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage                   | $I_D = 1\text{ mA}$ , $V_{GS} = 0$   | 300  |       |           | V                              |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = 300\text{ V}$<br>$V_{DS} = 300\text{ V}$ , $T_C = 125\text{ °C}$ |      |       | 1<br>10   | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$     | Gate-body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 20\text{ V}$   |      |       | $\pm 100$ | nA                             |
| $V_{GS(th)}$  | Gate threshold voltage                           | $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$                         | 2    | 3     | 4         | V                              |
| $R_{DS(on)}$  | Static drain-source on-resistance                | $V_{GS} = 10\text{ V}$ , $I_D = 17\text{ A}$                               |      | 0.063 | 0.075     | $\Omega$                       |

**Table 6. Dynamic**

| Symbol  | Parameter   | Test conditions   | Min. | Typ.                 | Max. | Unit                 |
|---|---|---|------|----------------------|------|----------------------|
| $C_{iss}$<br>$C_{oss}$<br>$C_{rss}$           | Input capacitance<br>Output capacitance<br>Reverse transfer capacitance | $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ ,<br>$V_{GS} = 0$   | -    | 3200<br>442<br>57    | -    | pF<br>pF<br>pF       |
| $t_{d(on)}$<br>$t_r$<br>$t_{d(off)}$<br>$t_f$ | Turn-on delay time<br>Rise time<br>Turn-off delay time<br>Fall time     | $V_{DD} = 150\text{ V}$ , $I_D = 17\text{ A}$<br>$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$<br>(see <a href="#">Figure 16</a> ) | -    | 25<br>38<br>80<br>46 | -    | ns<br>ns<br>ns<br>ns |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$                 | Total gate charge<br>Gate-source charge<br>Gate-drain charge            | $V_{DD} = 240\text{ V}$ , $I_D = 34\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$<br>(see <a href="#">Figure 17</a> )                           | -    | 90<br>16<br>40       | -    | nC<br>nC<br>nC       |

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**Electrical characteristics**
**Table 7. Source drain diode**

| Symbol                            | Parameter  | Test conditions  | Min. | Typ.             | Max.      | Unit          |
|-----------------------------------|--|--|------|------------------|-----------|---------------|
| $I_{SD}$<br>$I_{SDM}^{(1)}$       | Source-drain current<br>Source-drain current<br>(pulsed)                     |  | -    |                  | 34<br>136 | A<br>A        |
| $V_{SD}^{(2)}$                    | Forward on voltage   | $I_{SD} = 34\text{ A}$ , $V_{GS} = 0$  | -    |                  | 1.6       | V             |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD} = 34\text{ A}$ ,<br>$di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 60\text{ V}$<br>(see <a href="#">Figure 18</a> )                                     | -    | 215<br>1.7<br>16 |           | ns<br>nC<br>A |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD} = 34\text{ A}$ ,<br>$di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 60\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$<br>(see <a href="#">Figure 18</a> ) | -    | 252<br>2.3<br>19 |           | ns<br>nC<br>A |

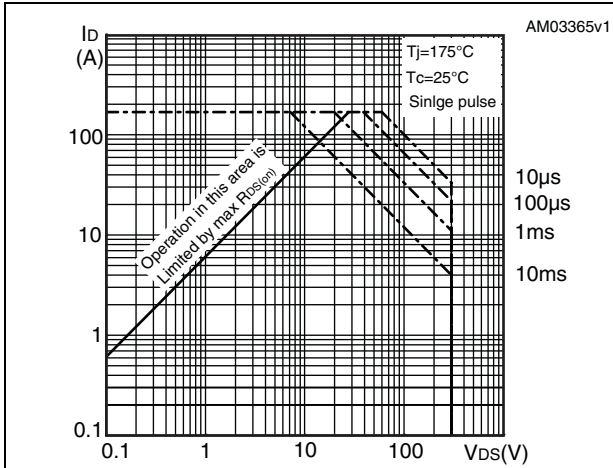
1. Pulse width limited by safe operating area.
2. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

**Electrical characteristics**

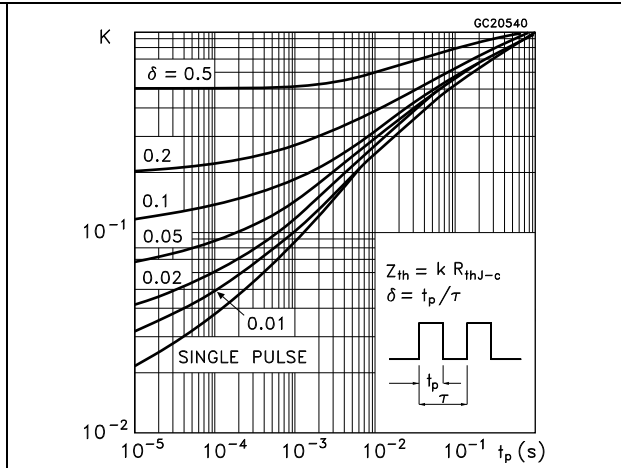
**STB46NF30, STP46NF30, STW46NF30**

**2.1 Electrical characteristics (curves)**

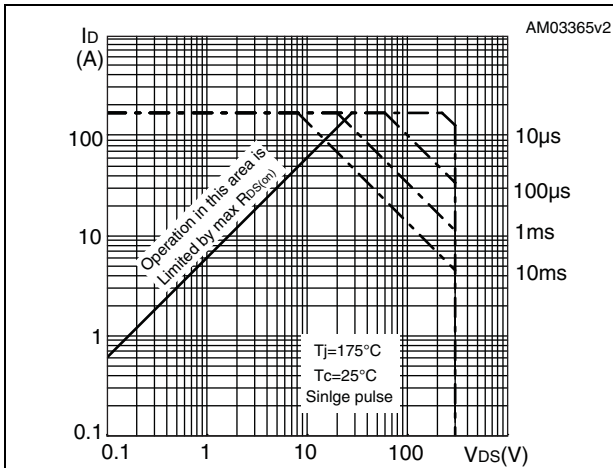
**Figure 2. Safe operating area for D<sup>2</sup>PAK and TO-220**



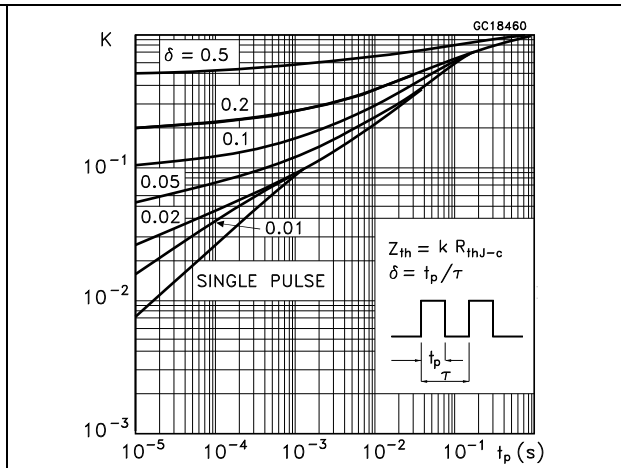
**Figure 3. Thermal impedance for D<sup>2</sup>PAK and TO-220**



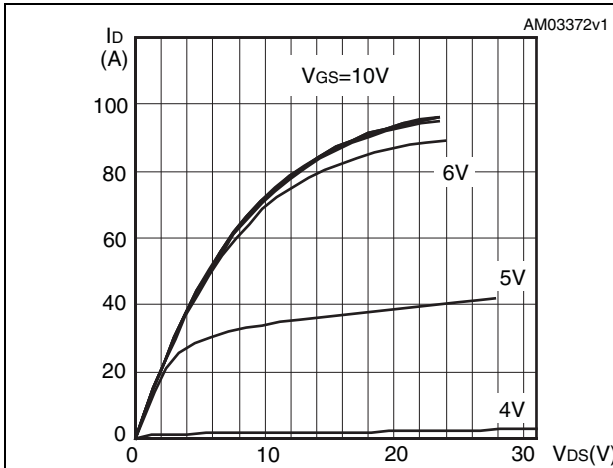
**Figure 4. Safe operating area for TO-247**



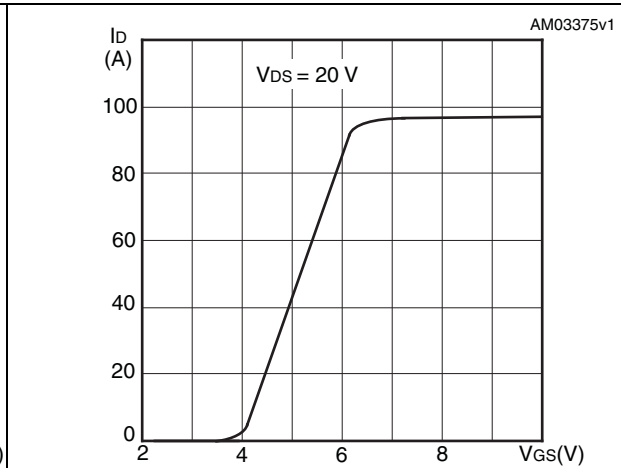
**Figure 5. Thermal impedance for TO-247**



**Figure 6. Output characteristics**



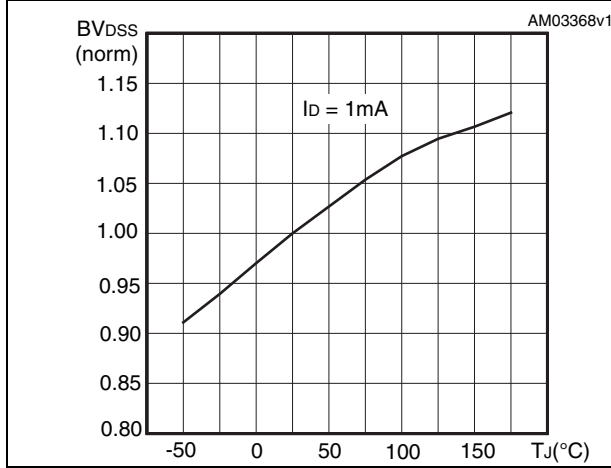
**Figure 7. Transfer characteristics**



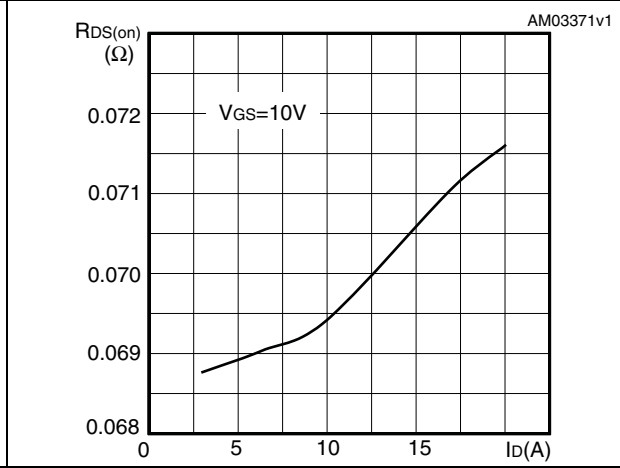
**STB46NF30, STP46NF30, STW46NF30**

**Electrical characteristics**

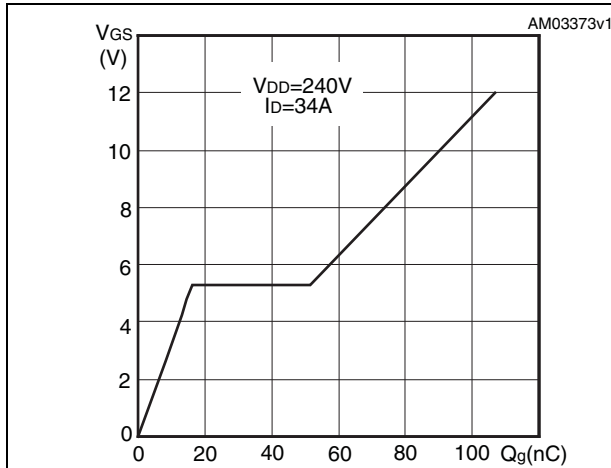
**Figure 8. Normalized  $BV_{DSS}$  vs temperature**



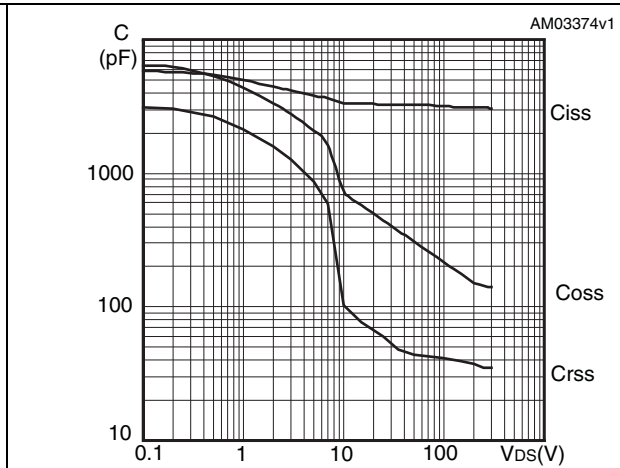
**Figure 9. Static drain source on-resistance**



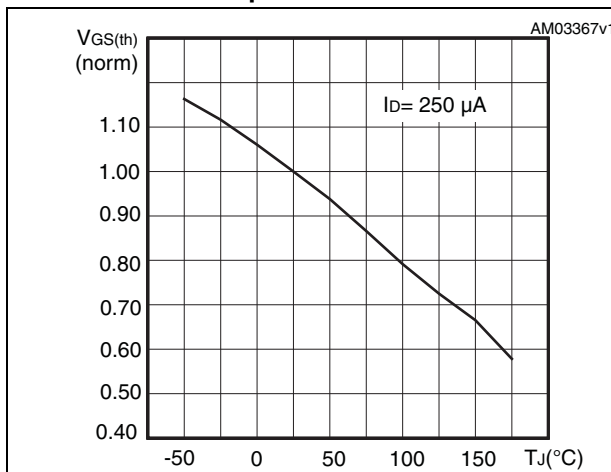
**Figure 10. Gate charge vs gate-source voltage**



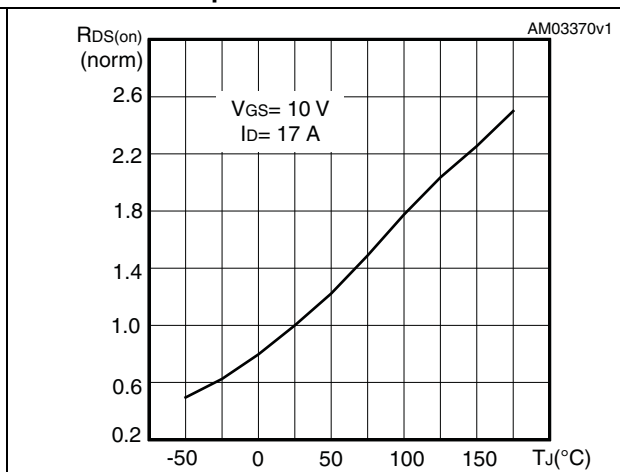
**Figure 11. Capacitance variations**



**Figure 12. Normalized gate threshold voltage vs temperature**



**Figure 13. Normalized on resistance vs temperature**

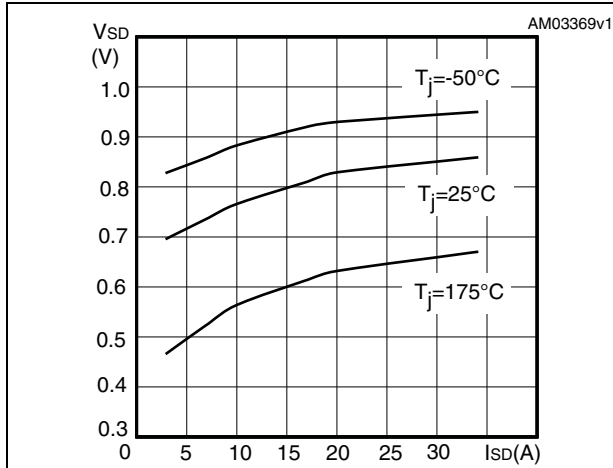




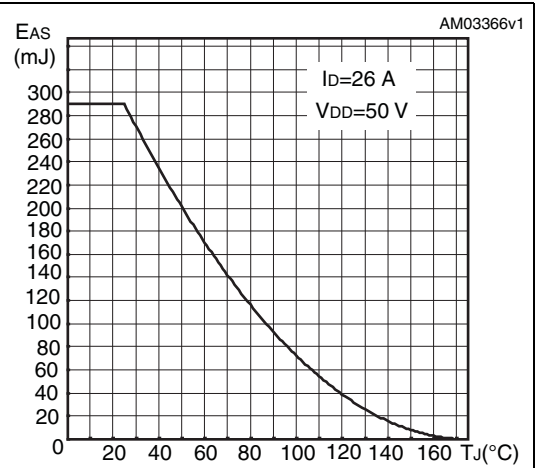
**Electrical characteristics**

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**Figure 14. Source-drain diode forward characteristics**



**Figure 15. Avalanche energy vs starting T<sub>j</sub>**

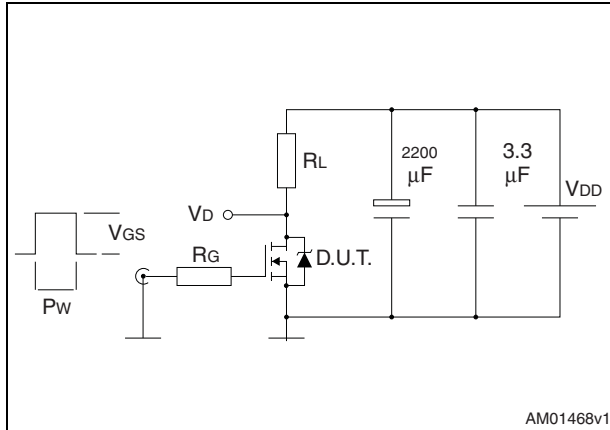


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Test circuits

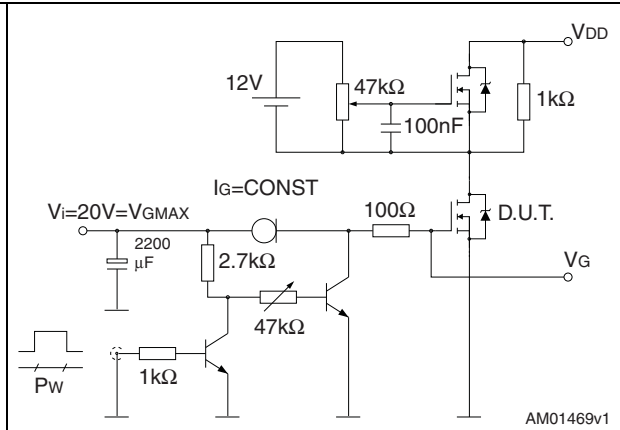
### 3 Test circuits

Figure 16. Switching times test circuit for resistive load



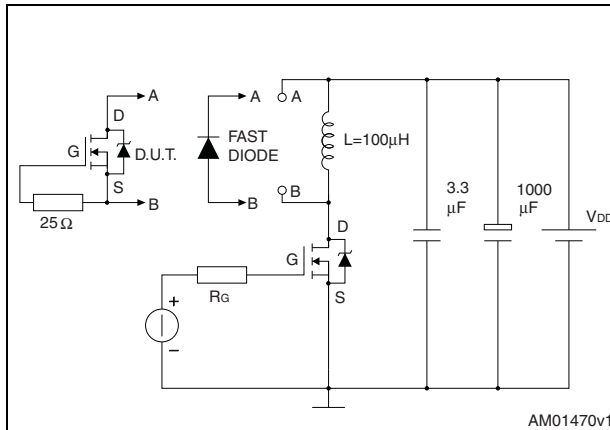
AM01468v1

Figure 17. Gate charge test circuit



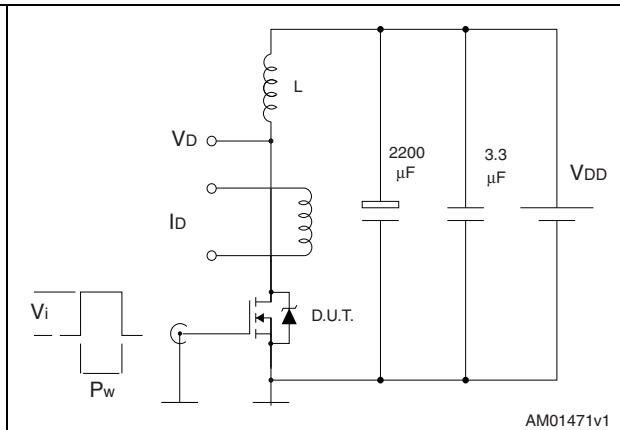
AM01469v1

Figure 18. Test circuit for inductive load switching and diode recovery times



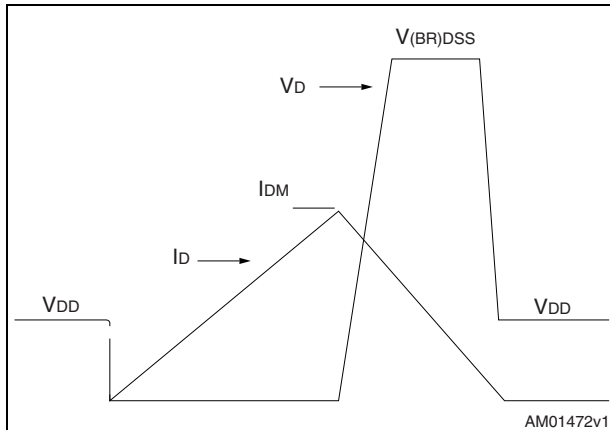
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Figure 19. Unclamped inductive load test circuit



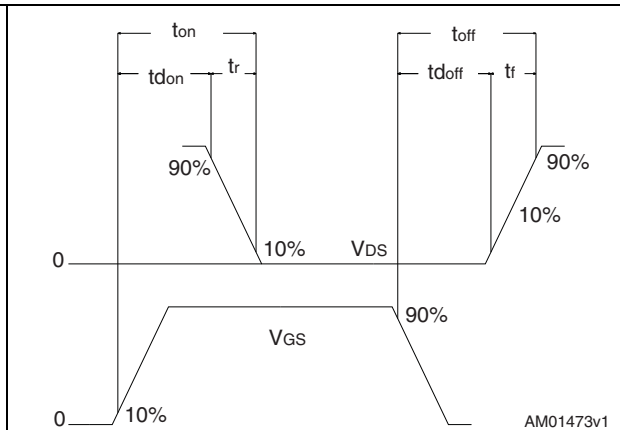
AM01471v1

Figure 20. Unclamped inductive waveform



AM01472v1

Figure 21. Switching time waveform



AM01473v1

Package mechanical data

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## 4 Package mechanical data

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 is an ST trademark.

**Table 8. D<sup>2</sup>PAK (TO-263) mechanical data**

| Dim. | mm   |      |       |
|------|------|------|-------|
|      | Min. | Typ. | Max.  |
| A    | 4.40 |      | 4.60  |
| A1   | 0.03 |      | 0.23  |
| b    | 0.70 |      | 0.93  |
| b2   | 1.14 |      | 1.70  |
| c    | 0.45 |      | 0.60  |
| c2   | 1.23 |      | 1.36  |
| D    | 8.95 |      | 9.35  |
| D1   | 7.50 |      |       |
| E    | 10   |      | 10.40 |
| E1   | 8.50 |      |       |
| e    |      | 2.54 |       |
| e1   | 4.88 |      | 5.28  |
| H    | 15   |      | 15.85 |
| J1   | 2.49 |      | 2.69  |
| L    | 2.29 |      | 2.79  |
| L1   | 1.27 |      | 1.40  |
| L2   | 1.30 |      | 1.75  |
| R    |      | 0.4  |       |
| V2   | 0°   |      | 8°    |

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Package mechanical data

Figure 22. D<sup>2</sup>PAK (TO-263) drawing

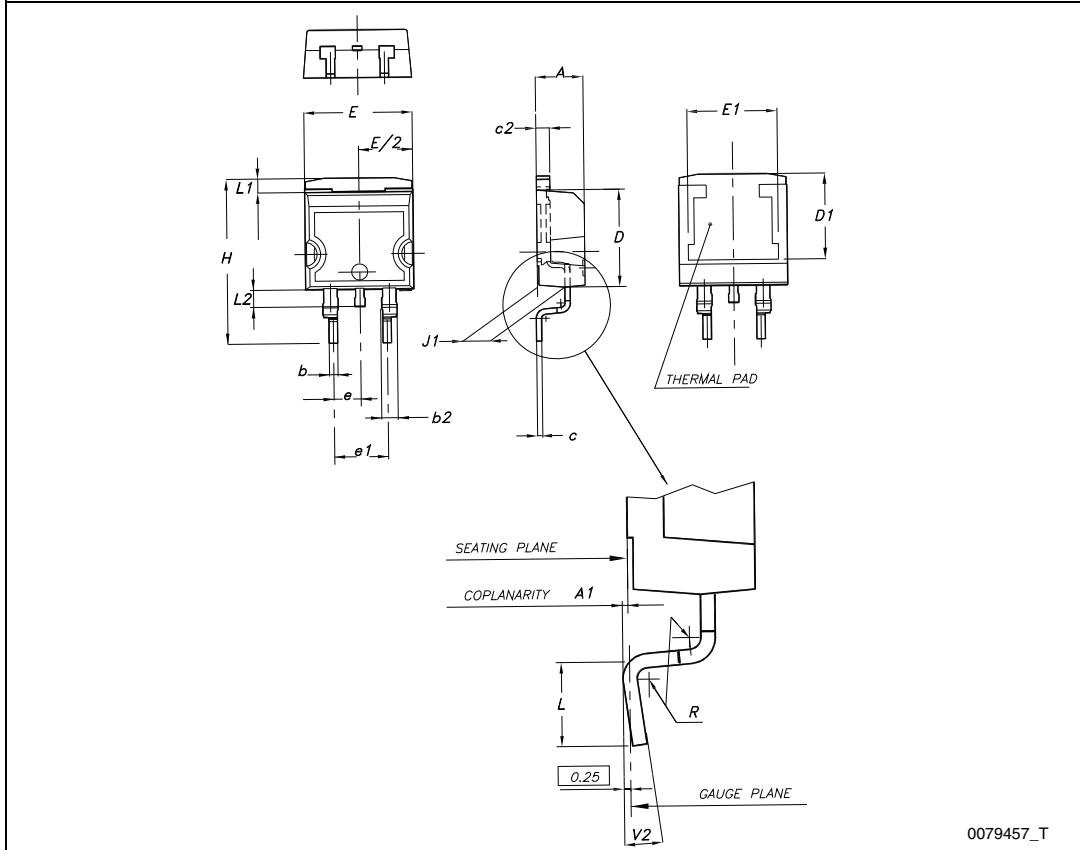
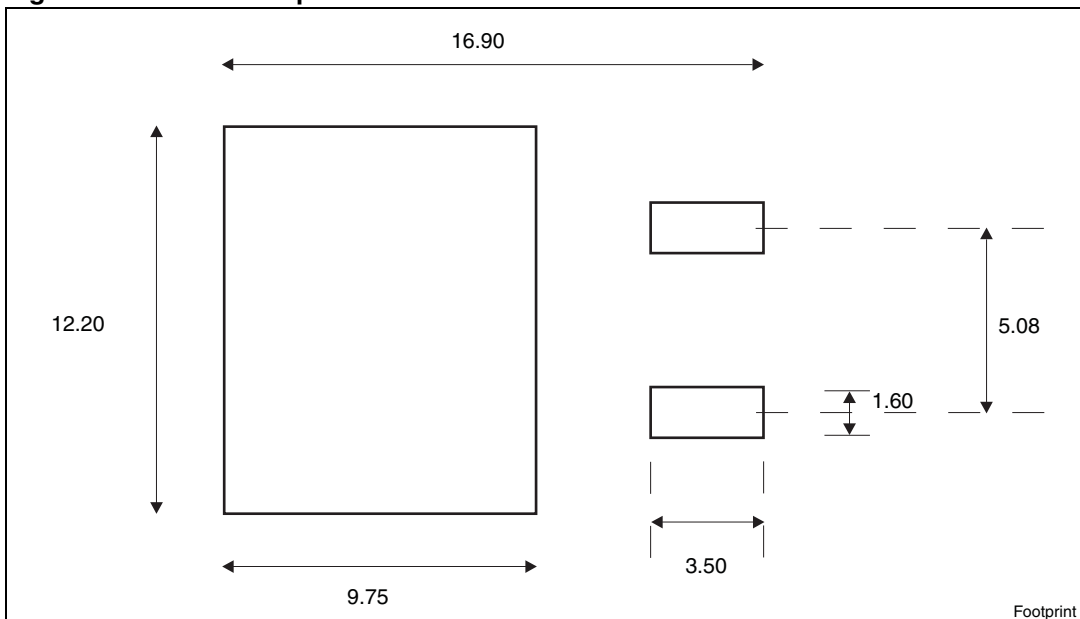


Figure 23. D<sup>2</sup>PAK footprint<sup>(a)</sup>



a. All dimension are in millimeters

Package mechanical data

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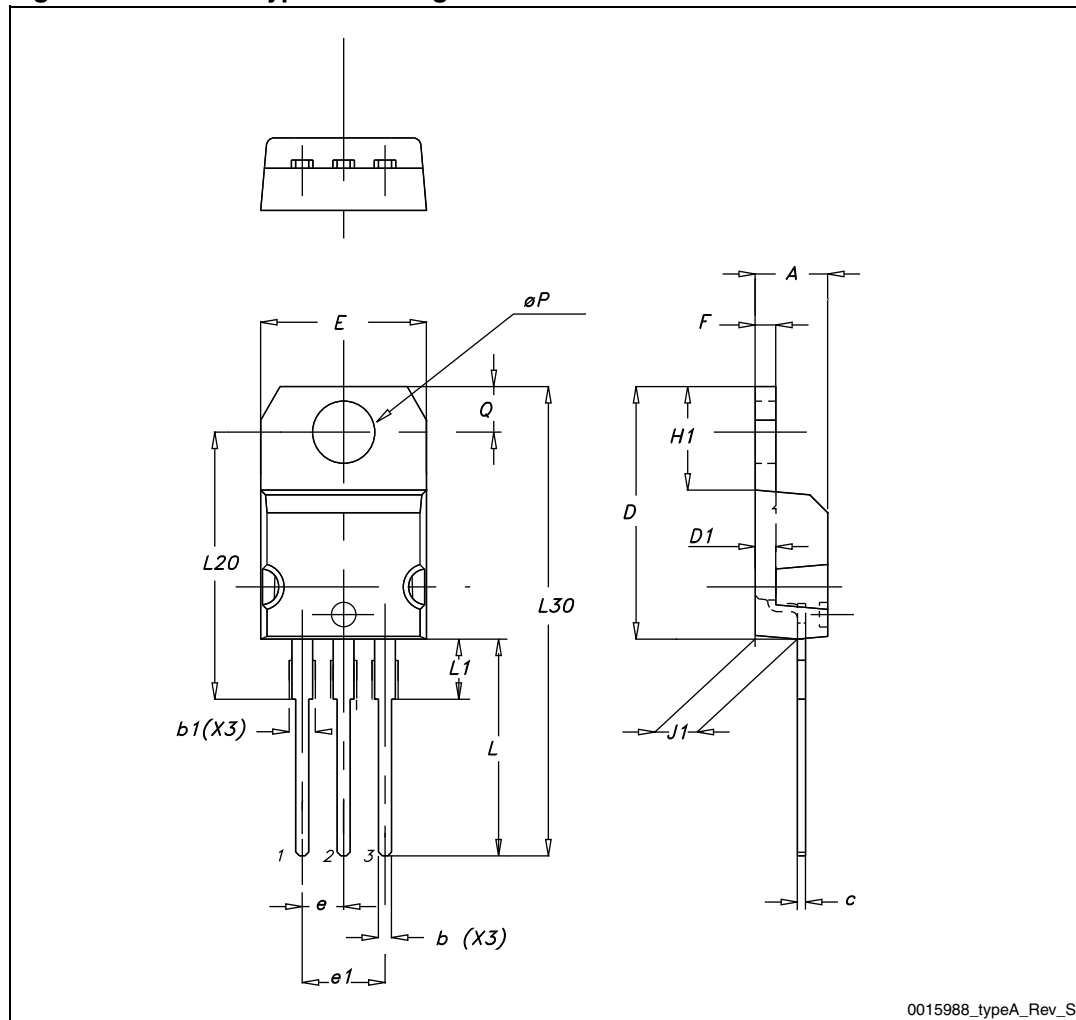
Table 9. TO-220 type A mechanical data

| Dim. | mm    |       |       |
|------|-------|-------|-------|
|      | Min.  | Typ.  | Max.  |
| A    | 4.40  |       | 4.60  |
| b    | 0.61  |       | 0.88  |
| b1   | 1.14  |       | 1.70  |
| c    | 0.48  |       | 0.70  |
| D    | 15.25 |       | 15.75 |
| D1   |       | 1.27  |       |
| E    | 10    |       | 10.40 |
| e    | 2.40  |       | 2.70  |
| e1   | 4.95  |       | 5.15  |
| F    | 1.23  |       | 1.32  |
| H1   | 6.20  |       | 6.60  |
| J1   | 2.40  |       | 2.72  |
| L    | 13    |       | 14    |
| L1   | 3.50  |       | 3.93  |
| L20  |       | 16.40 |       |
| L30  |       | 28.90 |       |
| ØP   | 3.75  |       | 3.85  |
| Q    | 2.65  |       | 2.95  |

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**Package mechanical data**

**Figure 24. TO-220 type A drawing**



Package mechanical data

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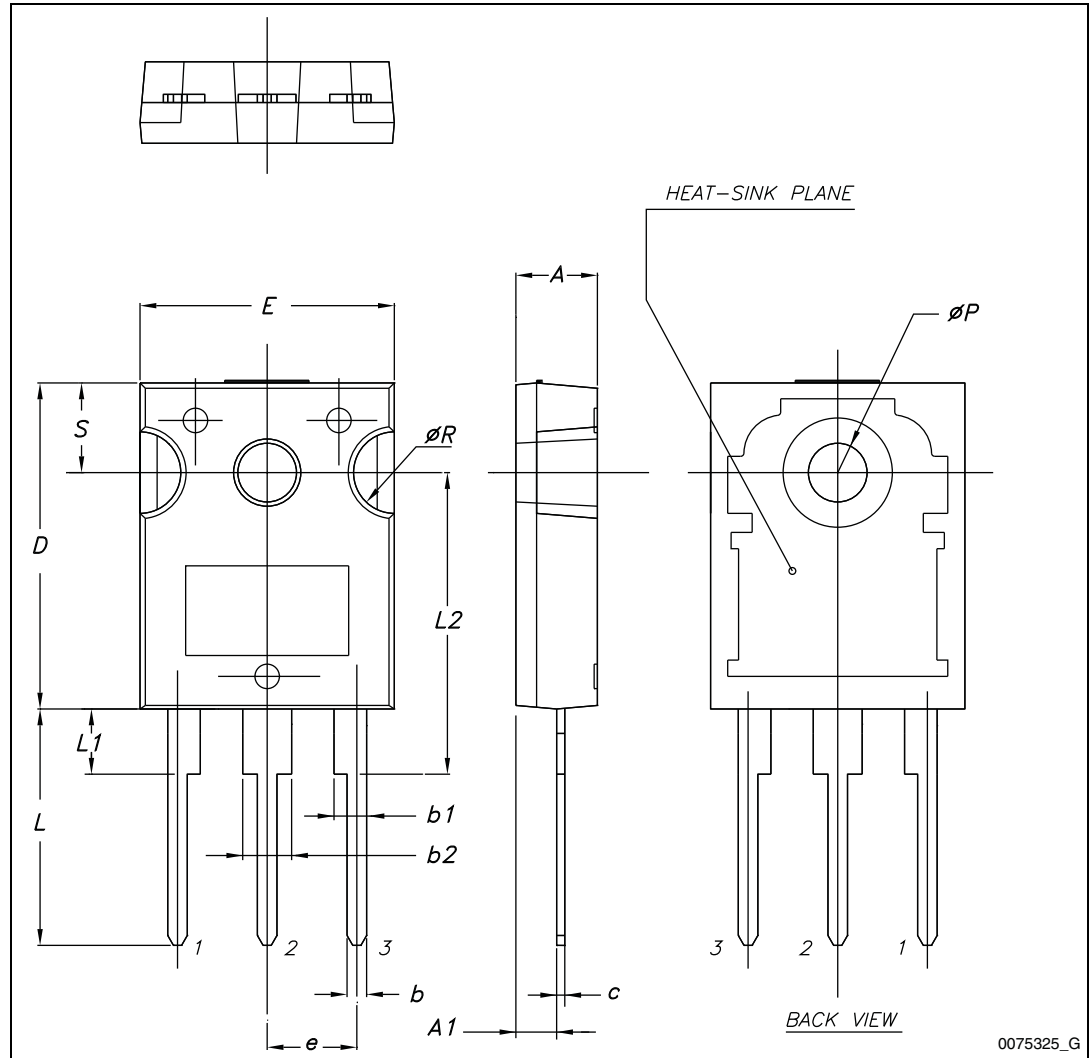
Table 10. TO-247 mechanical data

| Dim. | mm.   |       |       |
|------|-------|-------|-------|
|      | Min.  | Typ.  | Max.  |
| A    | 4.85  |       | 5.15  |
| A1   | 2.20  |       | 2.60  |
| b    | 1.0   |       | 1.40  |
| b1   | 2.0   |       | 2.40  |
| b2   | 3.0   |       | 3.40  |
| c    | 0.40  |       | 0.80  |
| D    | 19.85 |       | 20.15 |
| E    | 15.45 |       | 15.75 |
| e    | 5.30  | 5.45  | 5.60  |
| L    | 14.20 |       | 14.80 |
| L1   | 3.70  |       | 4.30  |
| L2   |       | 18.50 |       |
| ØP   | 3.55  |       | 3.65  |
| ØR   | 4.50  |       | 5.50  |
| S    | 5.30  | 5.50  | 5.70  |

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Package mechanical data

Figure 25. TO-247 drawing



0075325\_G



## 5 Packaging mechanical data

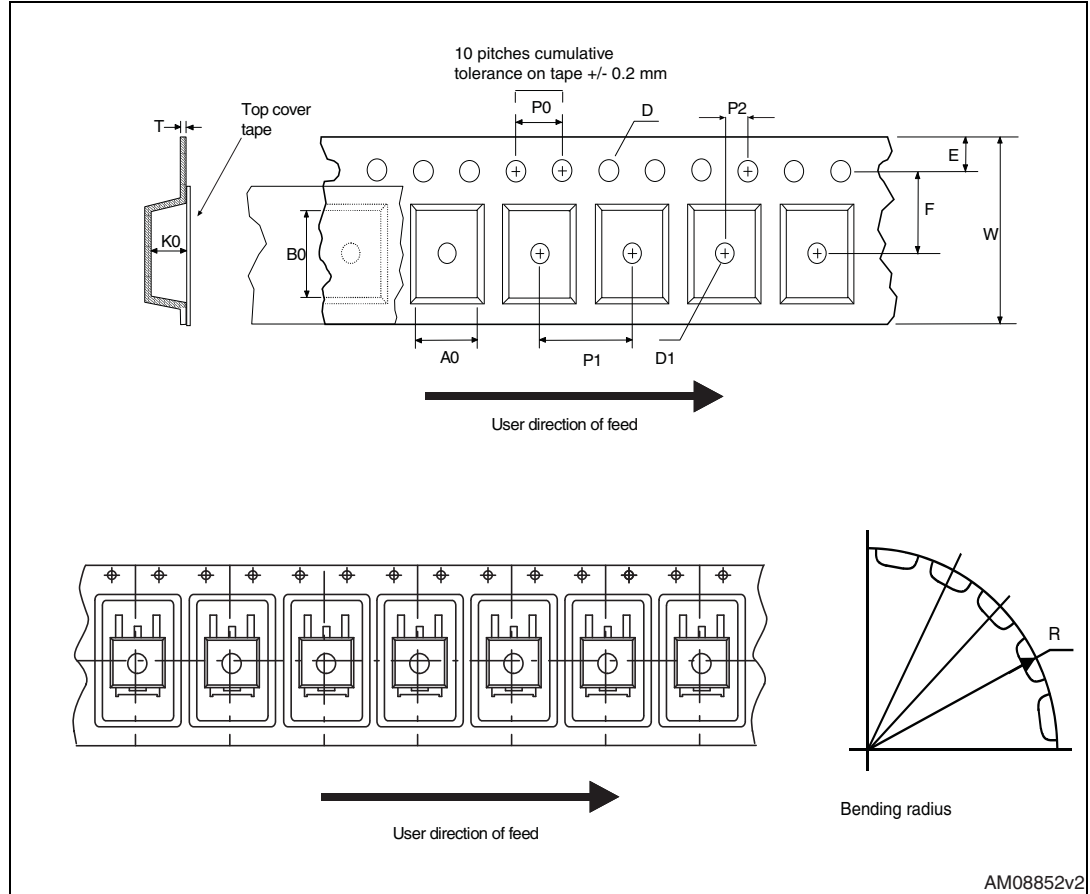
Table 11. D<sup>2</sup>PAK (TO-263) tape and reel mechanical data

| Tape |      |      | Reel     |      |      |
|------|------|------|----------|------|------|
| Dim. | mm   |      | Dim.     | mm   |      |
|      | Min. | Max. |          | Min. | Max. |
| A0   | 10.5 | 10.7 | A        |      | 330  |
| B0   | 15.7 | 15.9 | B        | 1.5  |      |
| D    | 1.5  | 1.6  | C        | 12.8 | 13.2 |
| D1   | 1.59 | 1.61 | D        | 20.2 |      |
| E    | 1.65 | 1.85 | G        | 24.4 | 26.4 |
| F    | 11.4 | 11.6 | N        | 100  |      |
| K0   | 4.8  | 5.0  | T        |      | 30.4 |
| P0   | 3.9  | 4.1  |          |      |      |
| P1   | 11.9 | 12.1 | Base qty |      | 1000 |
| P2   | 1.9  | 2.1  | Bulk qty |      | 1000 |
| R    | 50   |      |          |      |      |
| T    | 0.25 | 0.35 |          |      |      |
| W    | 23.7 | 24.3 |          |      |      |

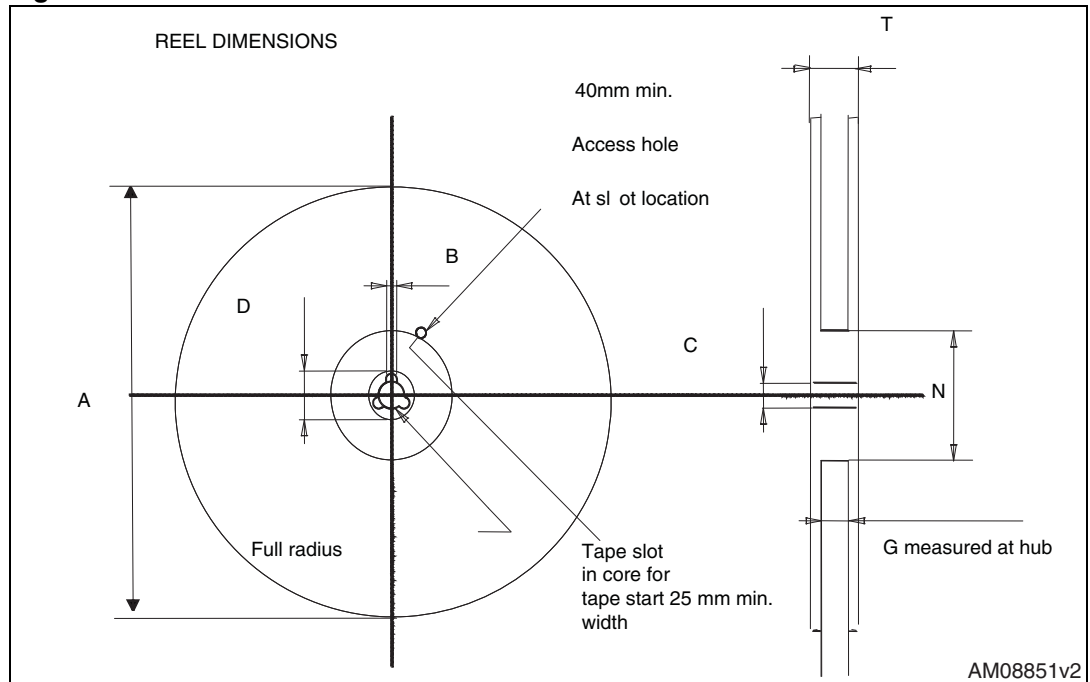
**STB46NF30, STP46NF30, STW46NF30**

**Packaging mechanical data**

**Figure 26. Tape**



**Figure 27. Reel**



## 6 Revision history

Table 12. Document revision history

| Date        | Revision | Changes        |
|-------------|----------|----------------|
| 28-Sep-2012 | 1        | First release. |

**STB46NF30, STP46NF30, STW46NF30**

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