



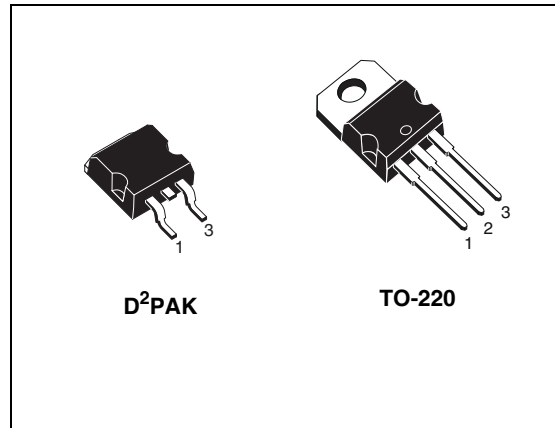
# STB80N20M5 STP80N20M5

N-channel 200 V, 0.019  $\Omega$ , 61 A, TO-220, D<sup>2</sup>PAK  
MDmesh™ V Power MOSFET

## Features

| Type       | V <sub>DSS</sub> @<br>T <sub>Jmax</sub> | R <sub>DS(on)</sub><br>max | I <sub>D</sub> |
|------------|---|----------------------------|----------------|
| STB80N20M5 | 200 V                                   | < 0.023 $\Omega$           | 61 A           |
| STP80N20M5 |   |                            | 61 A           |

- Amongst the best R<sub>DS(on)</sub> \* area
- High dv/dt capability
- Excellent switching performance
- Easy to drive
- 100% avalanche tested



## Application

Switching applications

## Description

The devices are N-channel MDmesh™ V Power MOSFET based on an innovative proprietary vertical process technology, which is combined with STMicroelectronics' well-known PowerMESH™ horizontal layout structure. The resulting product has extremely low on-resistance, which is unmatched among silicon-based Power MOSFETs, making it especially suitable for applications which require superior power density and outstanding efficiency.

Figure 1. Internal schematic diagram

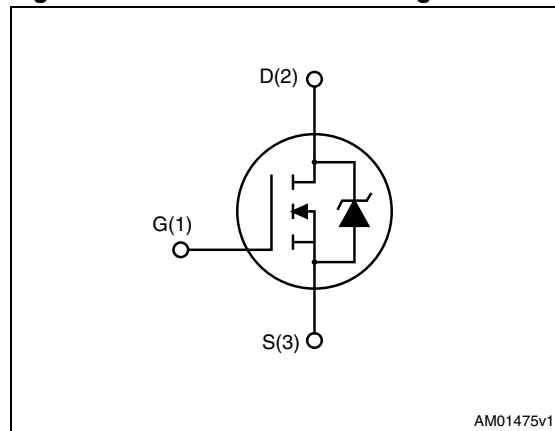


Table 1. Device summary

| Order codes | Marking | Package            | Packaging     |
|-------------|---------|--------------------|---------------|
| STB80N20M5  | 80N20M5 | D <sup>2</sup> PAK | Tape and reel |
| STP80N20M5  | 80N20M5 | TO-220             | Tube          |

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# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol         | Parameter  | Value       | Unit             |
|----------------|--|-------------|------------------|
| $V_{GS}$       | Gate-source voltage  | $\pm 25$    | V                |
| $I_D$          | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$   | 61          | A                |
| $I_D$          | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$  | 38          | A                |
| $I_{DM}^{(1)}$ | Drain current (pulsed)   | 244         | A                |
| $P_{TOT}$      | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$  | 190         | W                |
| $I_{AR}$       | Avalanche current, repetitive or not-repetitive (pulse width limited by $T_j$ max)                                   | 20          | A                |
| $E_{AS}$       | Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{ V}$ ) | 500         | mJ               |
| $dv/dt^{(2)}$  | Peak diode recovery voltage slope  | 15          | V/ns             |
| $T_{stg}$      | Storage temperature  | - 55 to 150 | $^\circ\text{C}$ |
| $T_j$          | Max. operating junction temperature  | 150         | $^\circ\text{C}$ |

1. Pulse width limited by safe operating area

2.  $I_{SD} \leq 61\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ;  $V_{Peak} < V_{(BR)DSS}$

**Table 3. Thermal data**

| Symbol         | Parameter                                      | Value  |                    | Unit                      |
|----------------|--|--------|--------------------|---------------------------|
|                |  | TO-220 | D <sup>2</sup> PAK |                           |
| $R_{thj-case}$ | Thermal resistance junction-case max           | 0.66   |                    | $^\circ\text{C}/\text{W}$ |
| $R_{thj-amb}$  | Thermal resistance junction-ambient max        | 62.50  |                    | $^\circ\text{C}/\text{W}$ |
| $R_{thj-pcb}$  | Thermal resistance junction-pcb max            |        | 30                 | $^\circ\text{C}/\text{W}$ |
| $T_l$          | Maximum lead temperature for soldering purpose | 300    |                    | $^\circ\text{C}$          |

## 2 Electrical characteristics

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

**Table 4. On /off states**

| Symbol        | Parameter  | Test conditions  | Min. | Typ.  | Max.     | Unit                           |
|---------------|--|--|------|-------|----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage                   | $I_D = 1\text{ mA}$ , $V_{GS} = 0$   | 200  |       |          | V                              |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = \text{max rating}$<br>$V_{DS} = \text{max rating}$ , $T_C = 125\text{ °C}$ |      |       | 1<br>100 | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$     | Gate-body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 25\text{ V}$   |      |       | 100      | nA                             |
| $V_{GS(th)}$  | Gate threshold voltage                           | $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$                                   | 3    | 4     | 5        | V                              |
| $R_{DS(on)}$  | Static drain-source on resistance                | $V_{GS} = 10\text{ V}$ , $I_D = 30.5\text{ A}$                                       |      | 0.019 | 0.023    | $\Omega$                       |

**Table 5. Dynamic**

| Symbol            | Parameter                             | Test conditions   | Min. | Typ. | Max. | Unit     |
|-------------------|---------------------------------------|---|------|------|------|----------|
| $C_{iss}$         | Input capacitance                     | $V_{DS} = 50\text{ V}$ , $f = 1\text{ MHz}$ ,<br>$V_{GS} = 0$   | -    | 4329 | -    | pF       |
| $C_{oss}$         | Output capacitance                    |   |      | 275  |      | pF       |
| $C_{rss}$         | Reverse transfer capacitance          |   |      | 39   |      | pF       |
| $C_{o(tr)}^{(1)}$ | Equivalent capacitance time related   | $V_{DS} = 0\text{ to }160\text{ V}$ , $V_{GS} = 0$  | -    | 709  | -    | pF       |
| $C_{o(er)}^{(2)}$ | Equivalent capacitance energy related |   |      | 280  |      | pF       |
| $R_G$             | Intrinsic gate resistance             | $f = 1\text{ MHz}$ open drain   | -    | 1.9  | -    | $\Omega$ |
| $Q_g$             | Total gate charge                     | $V_{DD} = 160\text{ V}$ , $I_D = 30.5\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$<br>(see <a href="#">Figure 15</a> ) | -    | 104  | -    | nC       |
| $Q_{gs}$          | Gate-source charge                    |   |      | 23   |      | nC       |
| $Q_{gd}$          | Gate-drain charge                     |   |      | 53   |      | nC       |

- $C_{o(tr)}$  is a constant capacitance value that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .
- $C_{o(er)}$  is a constant capacitance value that gives the same stored energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

Table 6. Switching times

| Symbol       | Parameter          | Test conditions                                   | Min. | Typ. | Max. | Unit |
|--------------|--------------------|---|------|------|------|------|
| $t_{d(v)}$   | Voltage delay time | $V_{DD} = 160 \text{ V}$ , $I_D = 61 \text{ A}$ , |      | 66   |      | ns   |
| $t_{r(v)}$   | Voltage rise time  | $R_G = 4.7 \Omega$ , $V_{GS} = 10 \text{ V}$      | -    | 31   | -    | ns   |
| $t_{f(i)}$   | Current fall time  | (see <a href="#">Figure 16</a> )                  |      | 131  |      | ns   |
| $t_{c(off)}$ | Crossing time      | (see <a href="#">Figure 19</a> )                  |      | 176  |      | ns   |

Table 7. Source drain diode

| Symbol          | Parameter                     | Test conditions   | Min. | Typ. | Max. | Unit          |
|-----------------|-------------------------------|---|------|------|------|---------------|
| $I_{SD}$        | Source-drain current          |   | -    |      | 61   | A             |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |   | -    |      | 244  | A             |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD} = 61 \text{ A}$ , $V_{GS} = 0$                        | -    |      | 1.6  | V             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 61 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$ | -    | 176  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       | $V_{DD} = 60 \text{ V}$ (see <a href="#">Figure 19</a> )      | -    | 1.4  |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |   |      | 16   |      | A             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 61 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$ | -    | 218  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       | $V_{DD} = 60 \text{ V}$ , $T_j = 150 \text{ }^\circ\text{C}$  | -    | 2    |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      | (see <a href="#">Figure 19</a> )                              |      | 19   |      | A             |

1. Pulse width limited by safe operating area

2. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

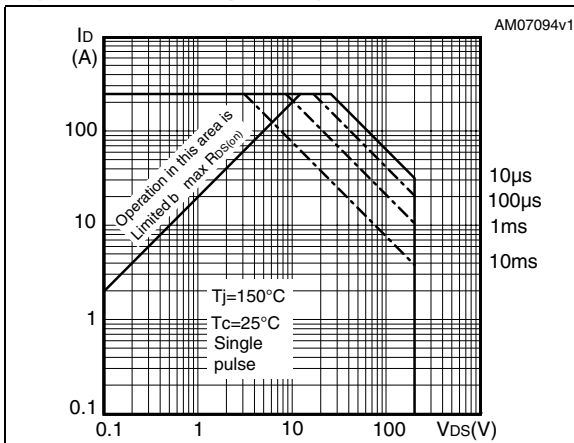


Figure 3. Thermal impedance

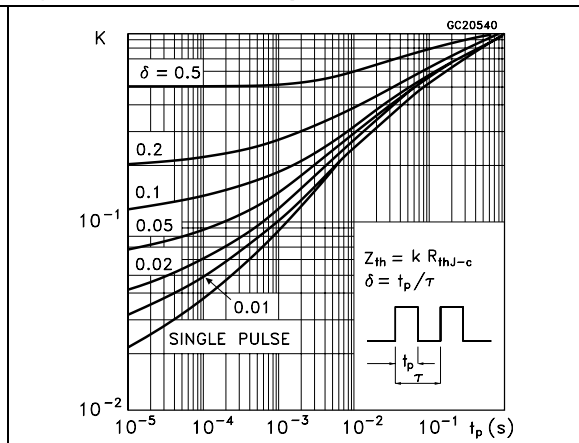


Figure 4. Output characteristics

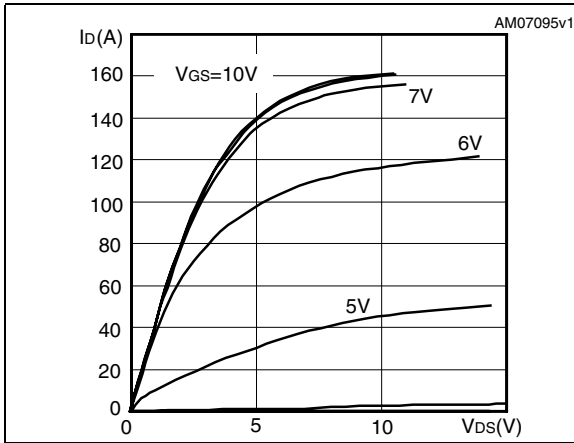


Figure 5. Transfer characteristics

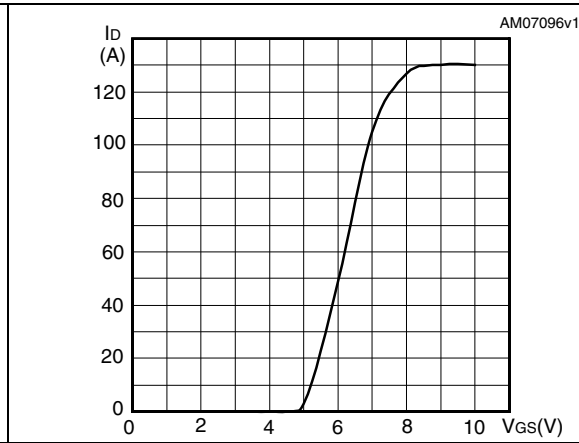


Figure 6. Gate charge vs gate-source voltage

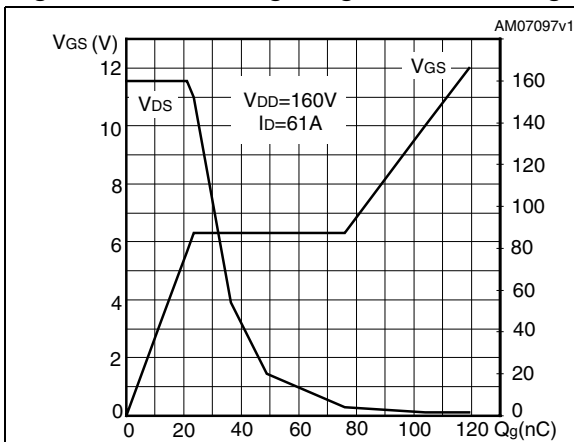


Figure 7. Static drain-source on resistance

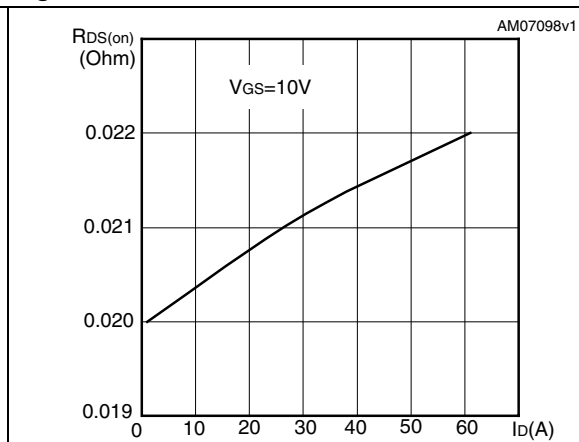


Figure 8. Capacitance variations

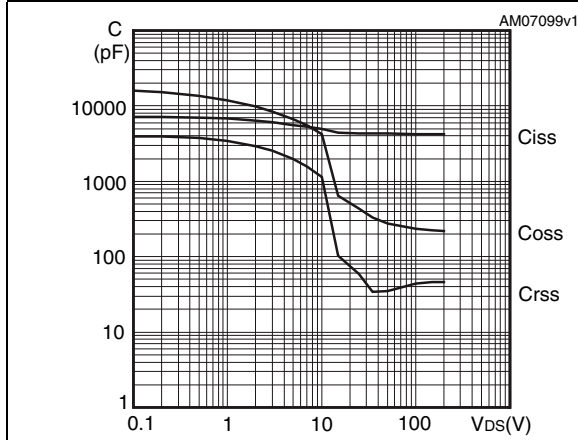


Figure 9. Output capacitance stored energy

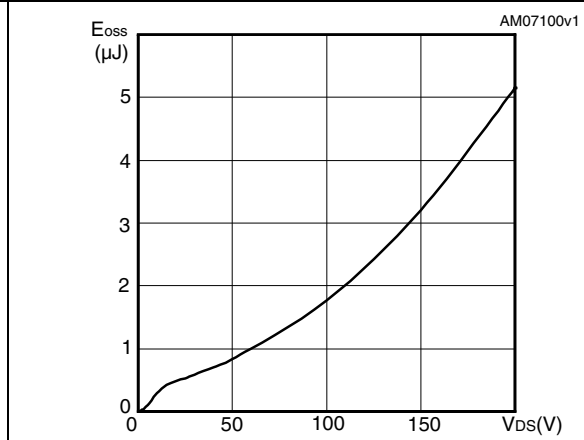


Figure 10. Normalized gate threshold voltage vs temperature

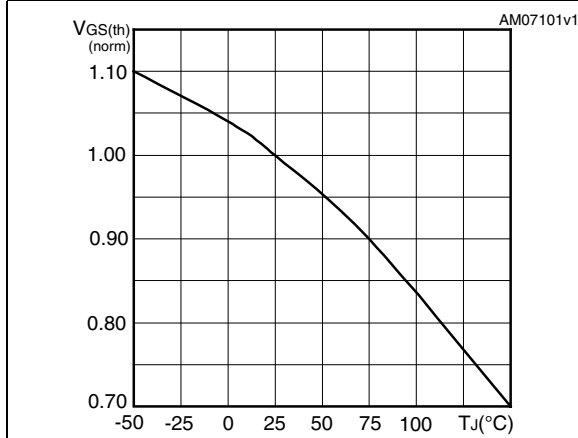


Figure 11. Normalized on resistance vs temperature

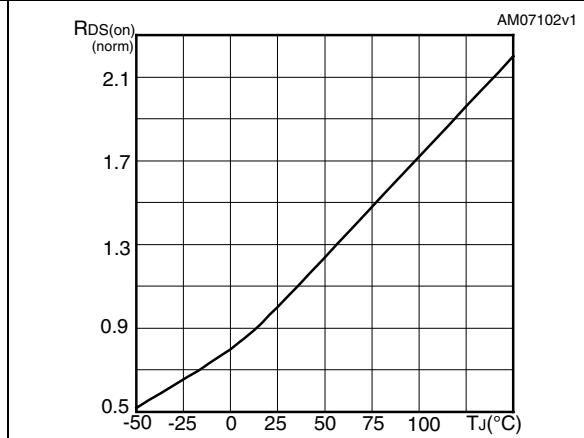


Figure 12. Source-drain diode forward characteristics

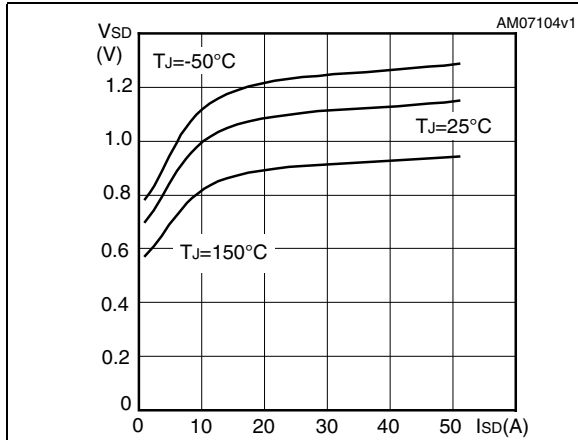
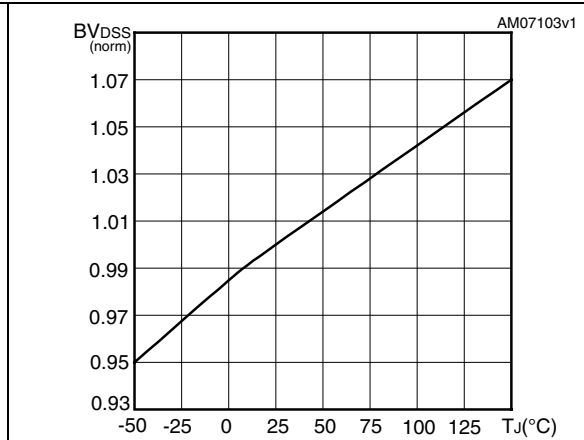


Figure 13. Normalized BV<sub>DSS</sub> vs temperature



### 3 Test circuits

Figure 14. Switching times test circuit for resistive load

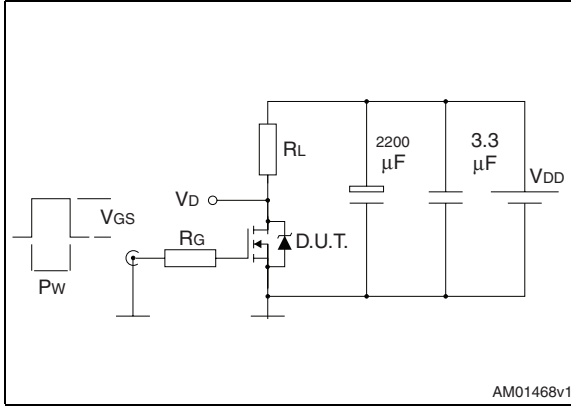


Figure 15. Gate charge test circuit

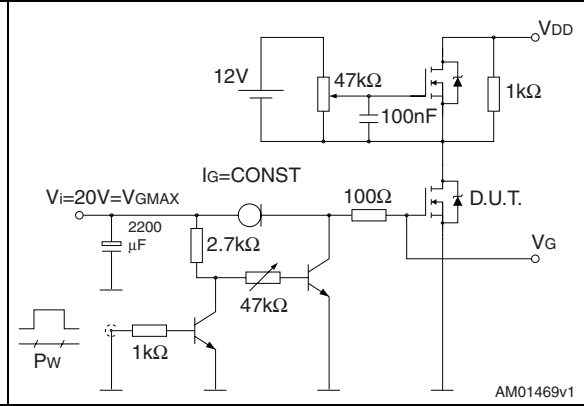


Figure 16. Test circuit for inductive load switching and diode recovery times

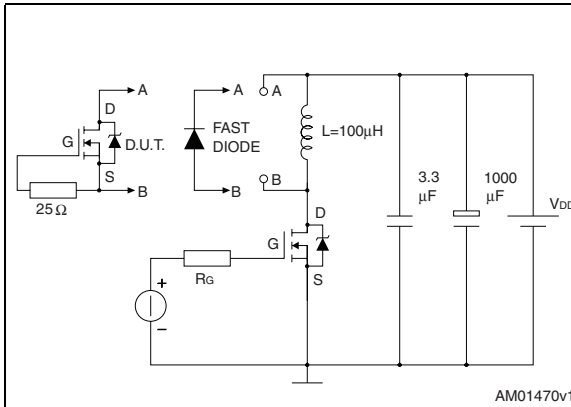


Figure 17. Unclamped inductive load test circuit

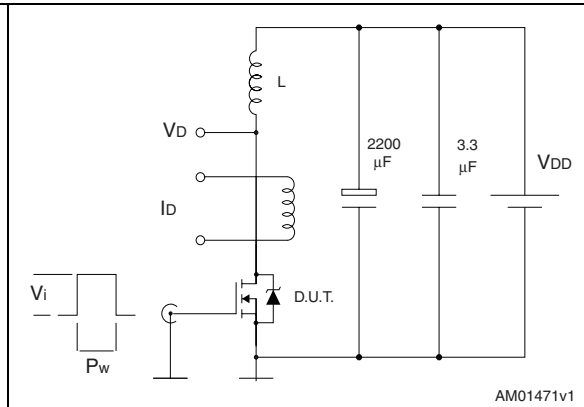


Figure 18. Unclamped inductive waveform

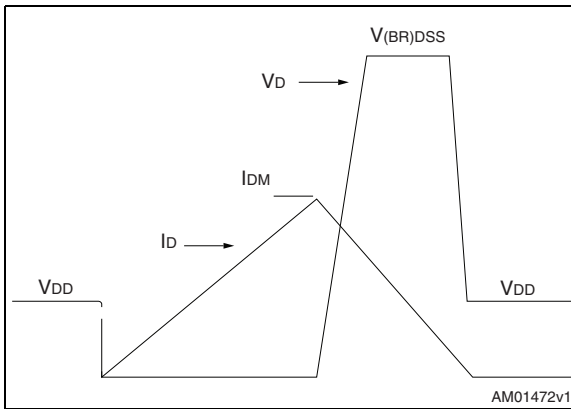
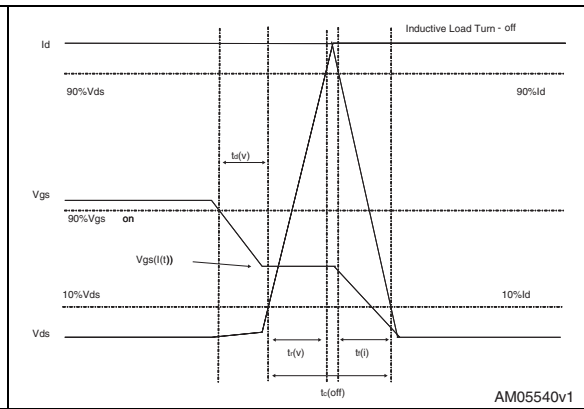


Figure 19. Switching time waveform



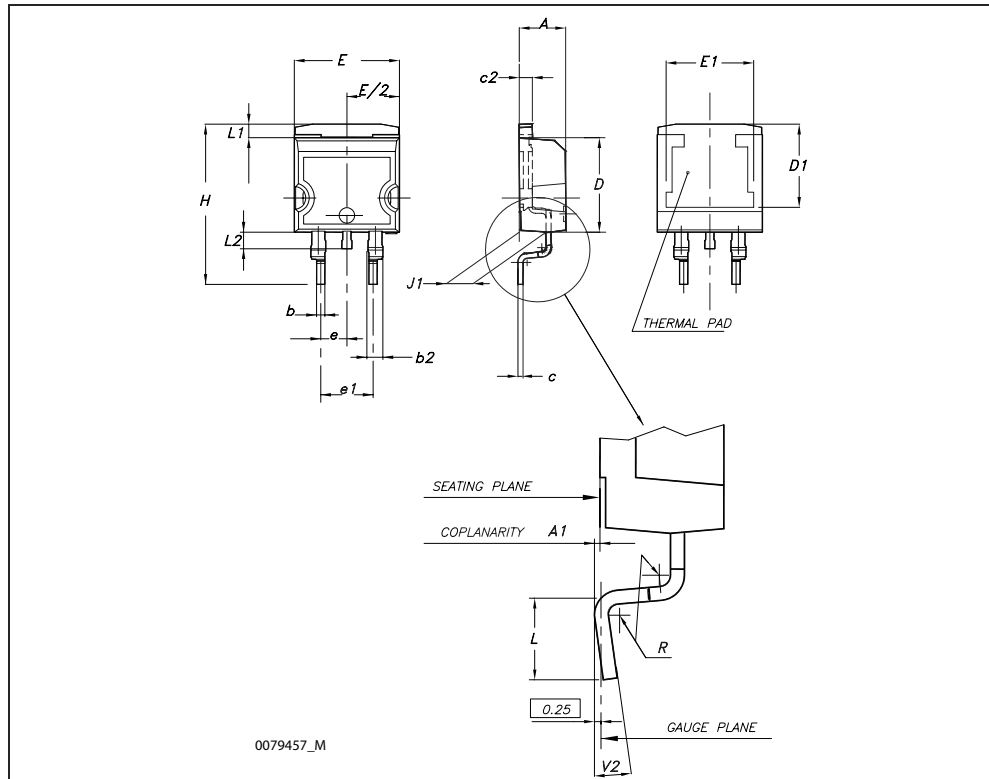


## 4 Package mechanical data

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.

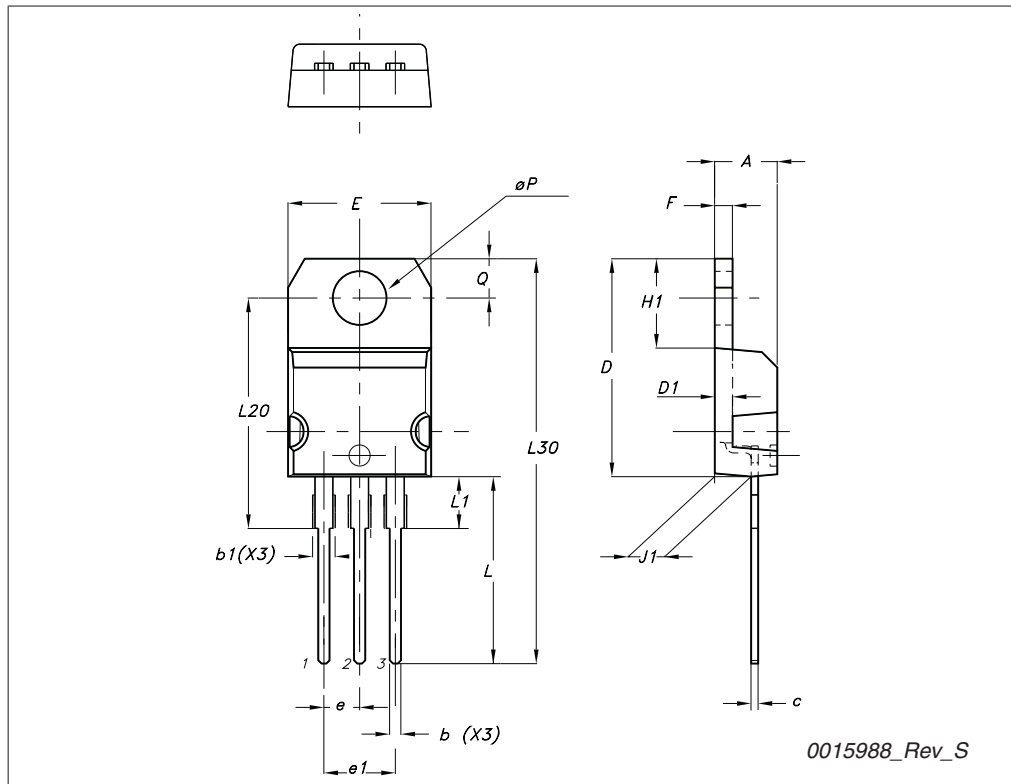
D<sup>2</sup>PAK (TO-263) mechanical data

| Dim | mm   |      |       | inch  |       |       |
|-----|------|------|-------|-------|-------|-------|
|     | 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  | 0.027 |       | 0.037 |
| b2  | 1.14 |      | 1.70  | 0.045 |       | 0.067 |
| c   | 0.45 |      | 0.60  | 0.017 |       | 0.024 |
| c2  | 1.23 |      | 1.36  | 0.048 |       | 0.053 |
| D   | 8.95 |      | 9.35  | 0.352 |       | 0.368 |
| D1  | 7.50 |      |       | 0.295 |       |       |
| E   | 10   |      | 10.40 | 0.394 |       | 0.409 |
| E1  | 8.50 |      |       | 0.334 |       |       |
| e   |      | 2.54 |       |       | 0.1   |       |
| e1  | 4.88 |      | 5.28  | 0.192 |       | 0.208 |
| H   | 15   |      | 15.85 | 0.590 |       | 0.624 |
| J1  | 2.49 |      | 2.69  | 0.099 |       | 0.106 |
| L   | 2.29 |      | 2.79  | 0.090 |       | 0.110 |
| L1  | 1.27 |      | 1.40  | 0.05  |       | 0.055 |
| L2  | 1.30 |      | 1.75  | 0.051 |       | 0.069 |
| R   |      | 0.4  |       |       | 0.016 |       |
| V2  | 0°   |      | 8°    | 0°    |       | 8°    |



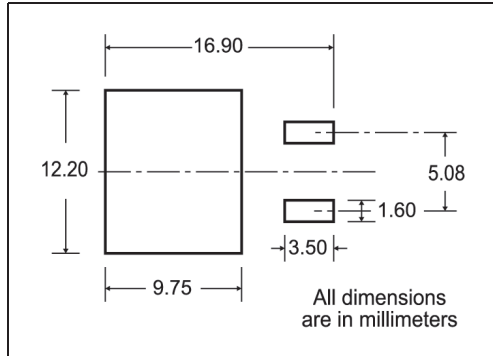
TO-220 type A mechanical data

| 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 |       |
| ∅P  | 3.75  |       | 3.85  |
| Q   | 2.65  |       | 2.95  |



# 5 Packaging mechanical data

## D<sup>2</sup>PAK FOOTPRINT



## TAPE AND REEL SHIPMENT

**TAPE MECHANICAL DATA**

| DIM. | mm   |      | inch   |        |
|------|------|------|--------|--------|
|      | MIN. | MAX. | MIN.   | MAX.   |
| A0   | 10.5 | 10.7 | 0.413  | 0.421  |
| B0   | 15.7 | 15.9 | 0.618  | 0.626  |
| D    | 1.5  | 1.6  | 0.059  | 0.063  |
| D1   | 1.59 | 1.61 | 0.062  | 0.063  |
| E    | 1.65 | 1.85 | 0.065  | 0.073  |
| F    | 11.4 | 11.6 | 0.449  | 0.456  |
| K0   | 4.8  | 5.0  | 0.189  | 0.197  |
| P0   | 3.9  | 4.1  | 0.153  | 0.161  |
| P1   | 11.9 | 12.1 | 0.468  | 0.476  |
| P2   | 1.9  | 2.1  | 0.075  | 0.082  |
| R    | 50   |      | 1.574  |        |
| T    | 0.25 | 0.35 | 0.0098 | 0.0137 |
| W    | 23.7 | 24.3 | 0.933  | 0.956  |

**REEL MECHANICAL DATA**

| DIM. | mm   |      | inch  |        |
|------|------|------|-------|--------|
|      | MIN. | MAX. | MIN.  | MAX.   |
| A    |      | 330  |       | 12.992 |
| B    | 1.5  |      | 0.059 |        |
| C    | 12.8 | 13.2 | 0.504 | 0.520  |
| D    | 20.2 |      | 0.795 |        |
| G    | 24.4 | 26.4 | 0.960 | 1.039  |
| N    | 100  |      | 3.937 |        |
| T    |      | 30.4 |       | 1.197  |

| BASE QTY | BULK QTY |
|----------|----------|
| 1000     | 1000     |

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

User Direction of Feed

FEED DIRECTION

Bending radius R min.

## 6 Revision history

Table 8. Document revision history

| Date        | Revision | Changes   |
|-------------|----------|---|
| 01-Jul-2009 | 1        | First release   |
| 03-Jul-2010 | 2        | Document status promoted from preliminary data to datasheet |

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