



# STB200N6F3, STI200N6F3 STP200N6F3

N-channel 60 V, 3 mΩ, 120 A D<sup>2</sup>PAK, TO-220, I<sup>2</sup>PAK  
STripFET™ Power MOSFET

## Features

| Type       | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub>       | P <sub>w</sub> |
|------------|------------------|---------------------|----------------------|----------------|
| STB200N6F3 | 60 V             | < 3.5 mΩ            | 120 A <sup>(1)</sup> | 330 W          |
| STI200N6F3 | 60 V             | < 3.8 mΩ            | 120 A <sup>(1)</sup> | 330 W          |
| STP200N6F3 | 60 V             | < 3.8 mΩ            | 120 A <sup>(1)</sup> | 330 W          |

1. Value limited by wire bonding

- Ultra low on-resistance
- 100% avalanche tested

## Application

- Switching applications

## Description

This STripFET™ III Power MOSFET technology is among the latest improvements, which have been especially tailored to minimize on-state resistance providing superior switching performance.

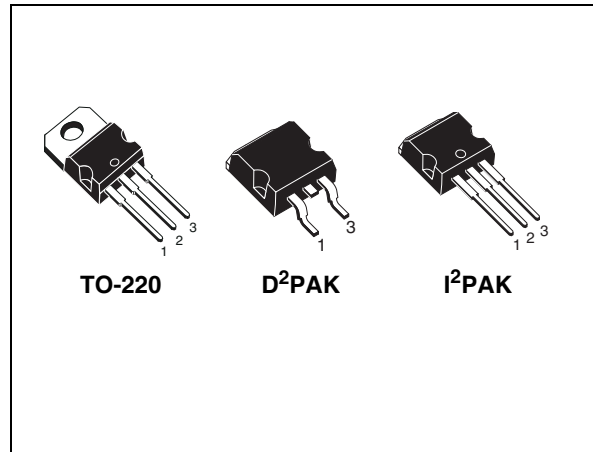


Figure 1. Internal schematic diagram

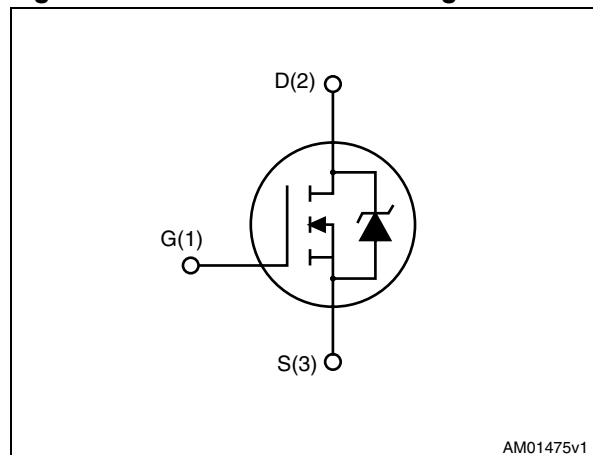


Table 1. Device summary

| Order codes | Marking | Package            | Packaging     |
|-------------|---------|--------------------|---------------|
| STB200N6F3  | 200N6F3 | D <sup>2</sup> PAK | Tape and reel |
| STI200N6F3  | 200N6F3 | I <sup>2</sup> PAK | Tube          |
| STP200N6F3  | 200N6F3 | TO-220             | Tube          |

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol             | Parameter                                              | Value      | Unit                |
|--------------------|--------------------------------------------------------|------------|---------------------|
| $V_{DS}$           | Drain-source voltage ( $V_{GS}=0$ )                    | 60         | V                   |
| $V_{GS}$           | Gate-source voltage                                    | $\pm 20$   | V                   |
| $I_D^{(1)}$        | Drain current (continuous) at $T_C = 25^\circ\text{C}$ | 120        | A                   |
| $I_D^{(1)}$        | Drain current (continuous) at $T_C=100^\circ\text{C}$  | 120        | A                   |
| $I_{DM}^{(2)}$     | Drain current (pulsed)                                 | 480        | A                   |
| $P_{TOT}$          | Total dissipation at $T_C = 25^\circ\text{C}$          | 330        | W                   |
|                    | Derating factor                                        | 2.2        | W/ $^\circ\text{C}$ |
| $E_{AS}^{(3)}$     | Single pulse avalanche energy                          | 918        | mJ                  |
| $T_j$<br>$T_{stg}$ | Operating junction temperature<br>storage temperature  | -55 To 175 | $^\circ\text{C}$    |

1. Current limited by package.
2. Pulse width limited by safe operating area.
3. Starting  $T_j = 25^\circ\text{C}$ ,  $I_D = 60\text{ A}$ ,  $V_{DD} = 35\text{ V}$  (see Figure 18 and Figure 19)

**Table 3. Thermal data**

| Symbol              | Parameter                                      | TO-220/l <sup>2</sup> PAK | D <sup>2</sup> PAK | Unit               |
|---------------------|------------------------------------------------|---------------------------|--------------------|--------------------|
| $R_{thj-case}$      | Thermal resistance junction-case               | 0.45                      |                    | $^\circ\text{C/W}$ |
| $R_{thj-a}$         | Thermal resistance junction-ambient max        | 62.5                      |                    | $^\circ\text{C/W}$ |
| $R_{thj-pcb}^{(1)}$ | Thermal resistance junction-ambient max        |                           | 50                 | $^\circ\text{C/W}$ |
| $T_l$               | Maximum lead temperature for soldering purpose | 300                       |                    | $^\circ\text{C}$   |

1. When mounted on 1 inch<sup>2</sup> FR4 2oz Cu.

## 2 Electrical characteristics

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

**Table 4. On/off states**

| Symbol        | Parameter                                        | Test conditions                                                                                            | Min. | Typ.     | Max.       | Unit                                 |
|---------------|--------------------------------------------------|------------------------------------------------------------------------------------------------------------|------|----------|------------|--------------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage                   | $I_D = 250\text{ }\mu\text{A}$ , $V_{GS} = 0$                                                              | 60   |          |            | V                                    |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = \text{max rating}$ ,<br>$V_{DS} = \text{max rating}$ , @ $125^{\circ}\text{C}$                   |      |          | 10<br>100  | $\mu\text{A}$<br>$\mu\text{A}$       |
| $I_{GSS}$     | Gate body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 20\text{ V}$                                                                                 |      |          | $\pm 200$  | nA                                   |
| $V_{GS(th)}$  | Gate threshold voltage                           | $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$                                                         | 2    |          | 4          | V                                    |
| $R_{DS(on)}$  | Static drain-source on resistance                | $V_{GS} = 10\text{ V}$ , $I_D = 60\text{ A}$<br><b>D<sup>2</sup>PAK</b><br><b>TO-220, I<sup>2</sup>PAK</b> |      | 3<br>3.3 | 3.5<br>3.8 | $\text{m}\Omega$<br>$\text{m}\Omega$ |

**Table 5. Dynamic**

| Symbol       | Parameter                    | Test conditions                                                                                                                     | Min. | Typ. | Max. | Unit |
|--------------|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $C_{iss}$    | Input capacitance            | $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ ,<br>$V_{GS} = 0$                                                                       | -    | 6265 | -    | pF   |
| $C_{oss}$    | Output capacitance           |                                                                                                                                     |      | 1295 |      | pF   |
| $C_{rss}$    | Reverse transfer capacitance |                                                                                                                                     |      | 43   |      | pF   |
| $t_{d(on)}$  | Turn-on delay time           | $V_{DD} = 30\text{ V}$ , $I_D = 60\text{ A}$<br>$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$<br>(see Figure 15,<br>Figure 20) | -    | 26   | -    | ns   |
| $t_r$        | Rise time                    |                                                                                                                                     |      | 75   |      | ns   |
| $t_{d(off)}$ | Turn-off delay time          |                                                                                                                                     |      | 86   |      | ns   |
| $t_f$        | Fall time                    |                                                                                                                                     |      | 14   |      | ns   |
| $Q_g$        | Total gate charge            | $V_{DD} = 30\text{ V}$ , $I_D = 120\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$ ,<br>(see Figure 16)                                      | -    | 101  | -    | nC   |
| $Q_{gs}$     | Gate-source charge           |                                                                                                                                     |      | 36   |      | nC   |
| $Q_{gd}$     | Gate-drain charge            |                                                                                                                                     |      | 25.2 |      | nC   |

**Table 6. Source drain diode**

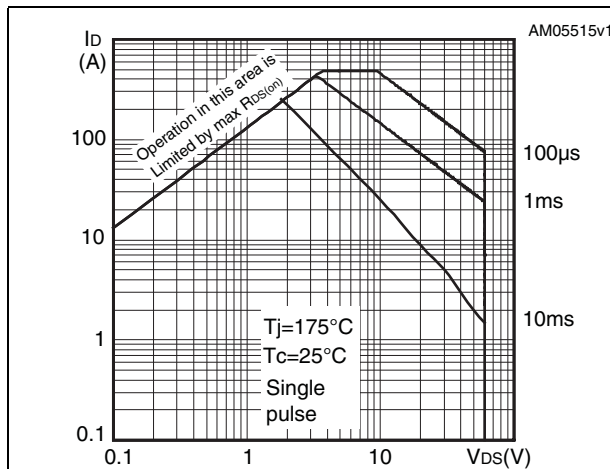
| Symbol                            | Parameter                                                                    | Test conditions                                                                                                                                                 | Min. | Typ.               | Max.       | Unit          |
|-----------------------------------|------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------------------|------------|---------------|
| $I_{SD}$<br>$I_{SDM}^{(1)}$       | Source-drain current<br>Source-drain current<br>(pulsed)                     |                                                                                                                                                                 | -    |                    | 120<br>480 | A<br>A        |
| $V_{SD}^{(2)}$                    | Forward on voltage                                                           | $I_{SD}=120\text{ A}$ , $V_{GS}=0$                                                                                                                              | -    |                    | 1.5        | V             |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD}=120\text{ A}$ ,<br>$di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD}=48\text{ V}$ , $T_j=150\text{ }^{\circ}\text{C}$<br>(see <a href="#">Figure 17</a> ) | -    | 67<br>177.6<br>5.3 |            | ns<br>nC<br>A |

1. Pulse width limited by safe operating area

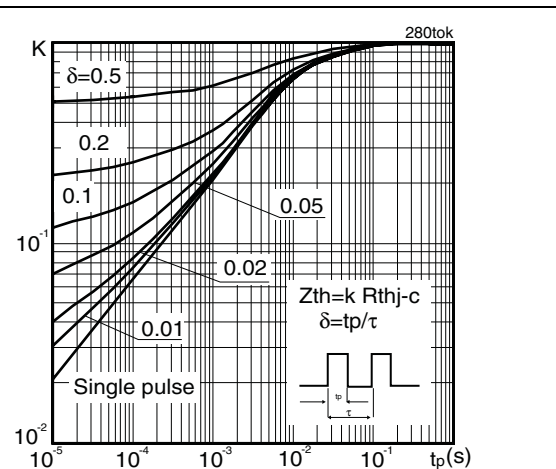
2. Pulsed: pulse duration = 300 $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

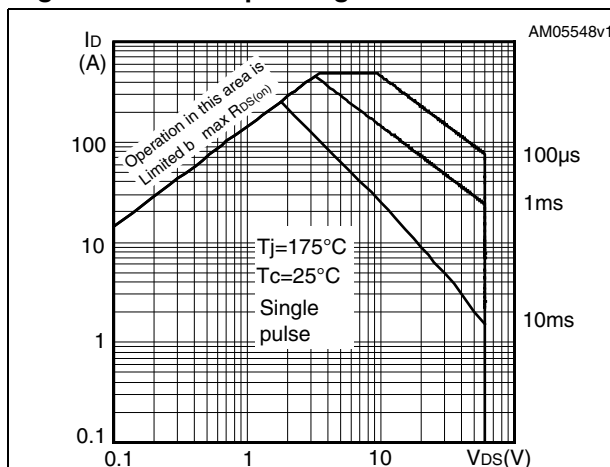
**Figure 2. Safe operating area for TO-220, I<sup>2</sup>PAK**



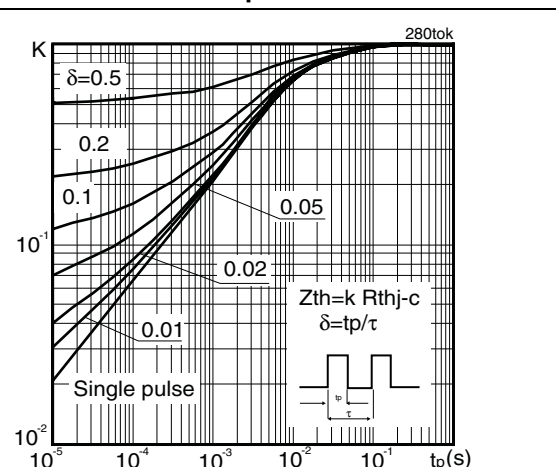
**Figure 3. Thermal impedance for TO-220, I<sup>2</sup>PAK**



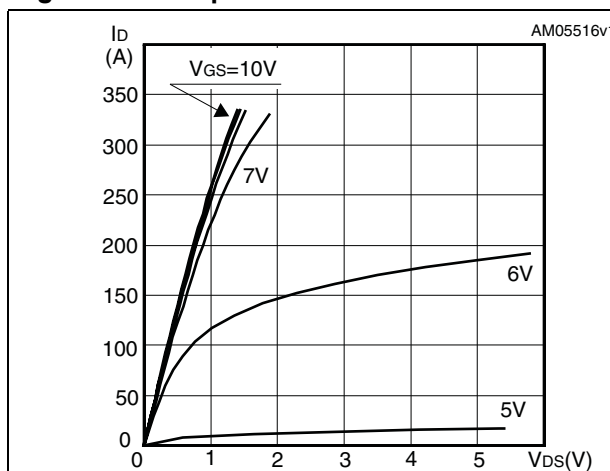
**Figure 4. Safe operating area for D<sup>2</sup>PAK**



**Figure 5. Thermal impedance for D<sup>2</sup>PAK**



**Figure 6. Output characteristics**



**Figure 7. Transfer characteristics**

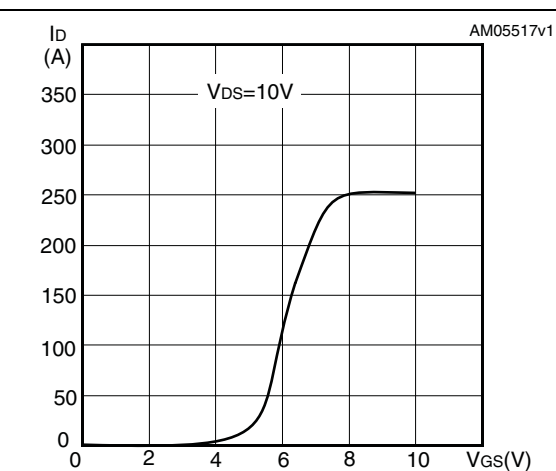


Figure 8. Normalized  $B_{V_{DS}}$  vs temperature

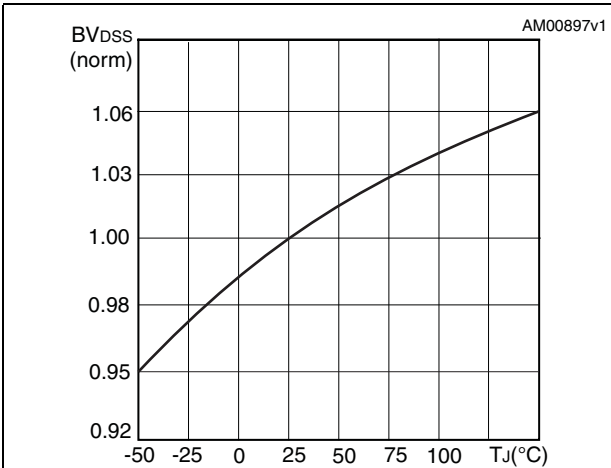


Figure 9. Static drain-source on resistance

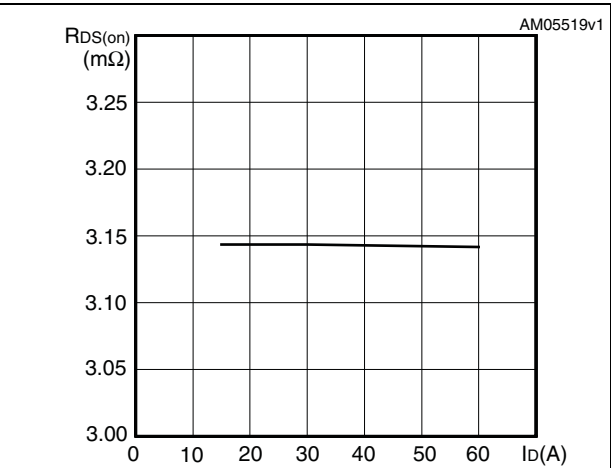


Figure 10. Gate charge vs gate-source voltage

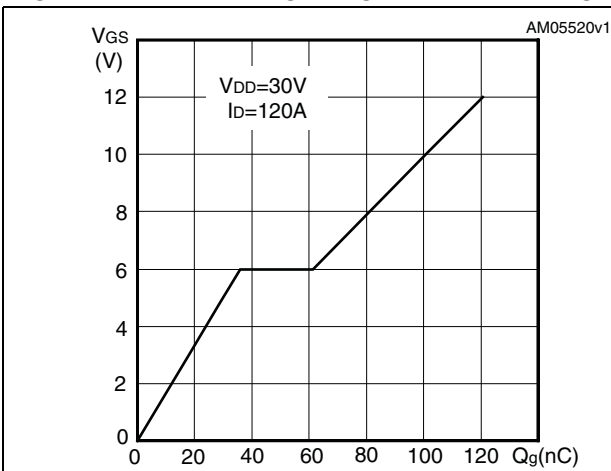


Figure 11. Capacitance variations

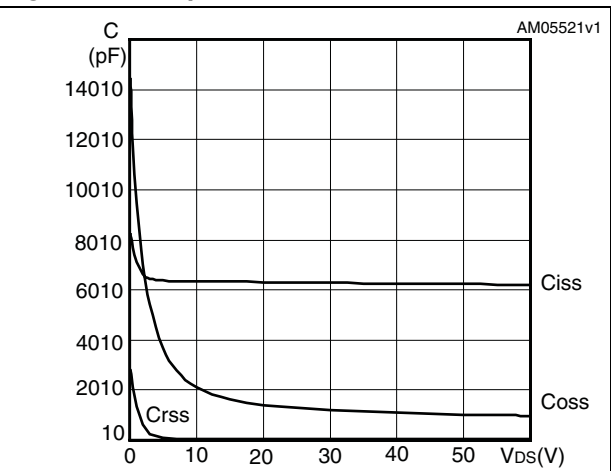


Figure 12. Normalized gate threshold voltage vs temperature

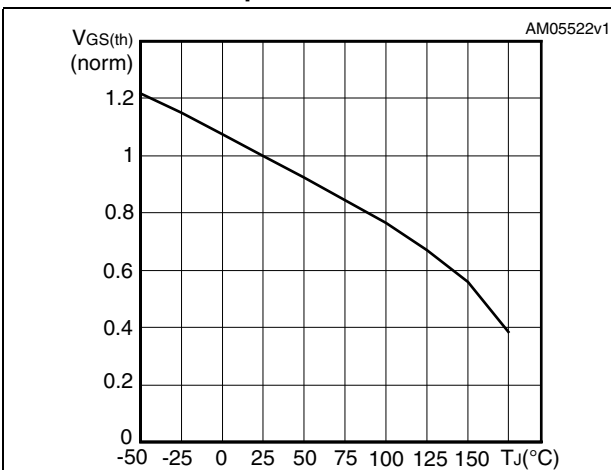


Figure 13. Normalized on resistance vs temperature

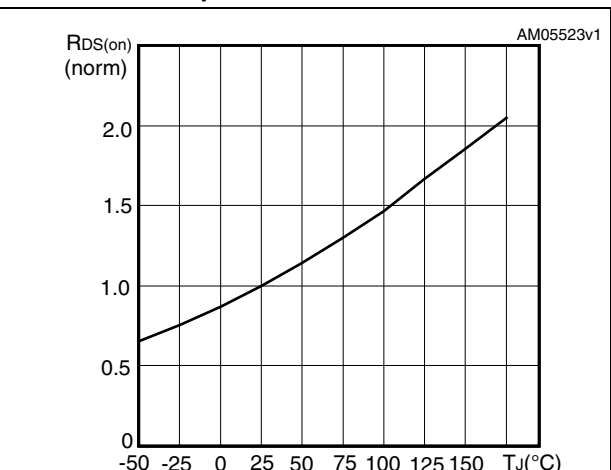
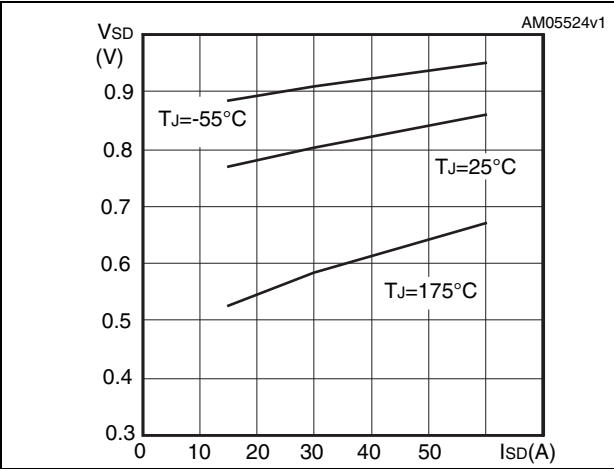


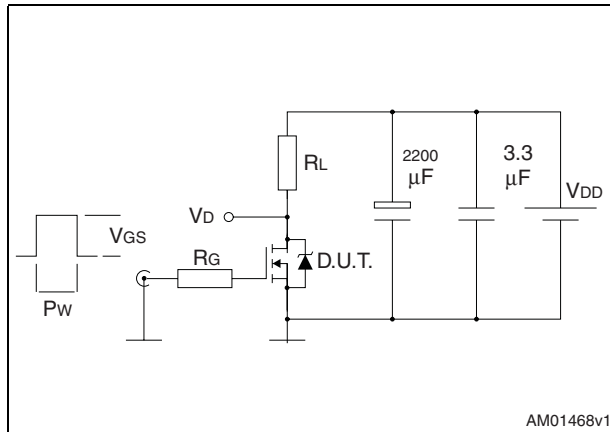
Figure 14. Source-drain diode forward characteristics



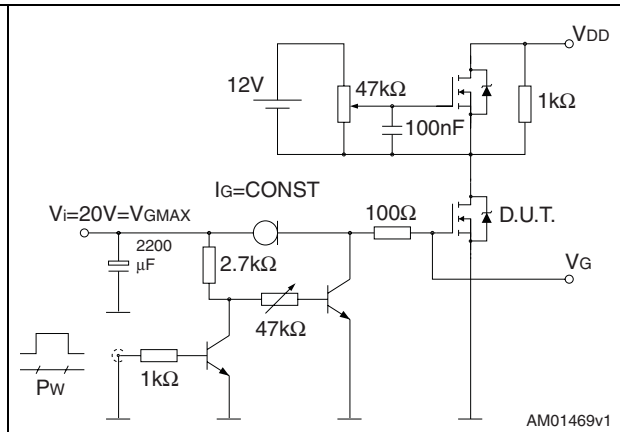


### 3 Test circuits

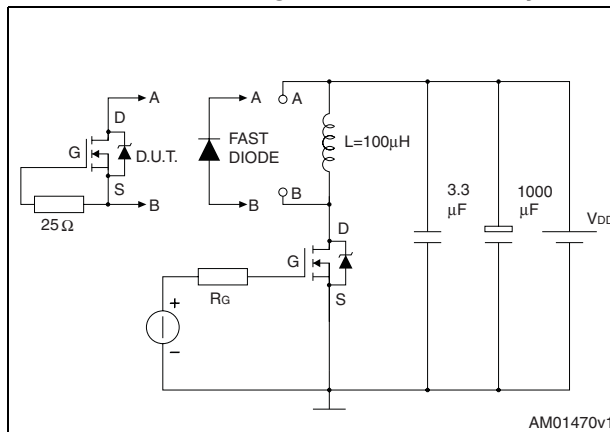
**Figure 15. Switching times test circuit for resistive load**



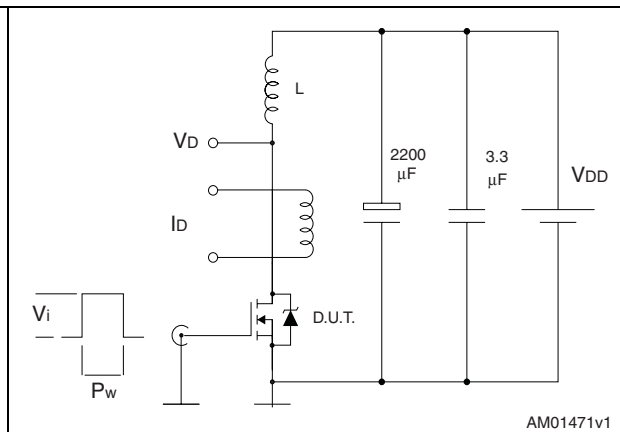
**Figure 16. Gate charge test circuit**



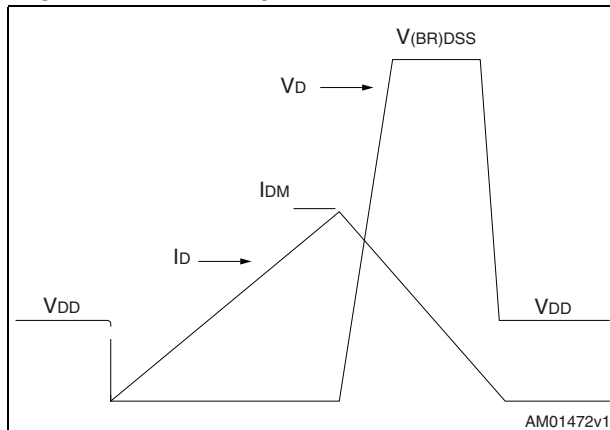
**Figure 17. Test circuit for inductive load switching and diode recovery times**



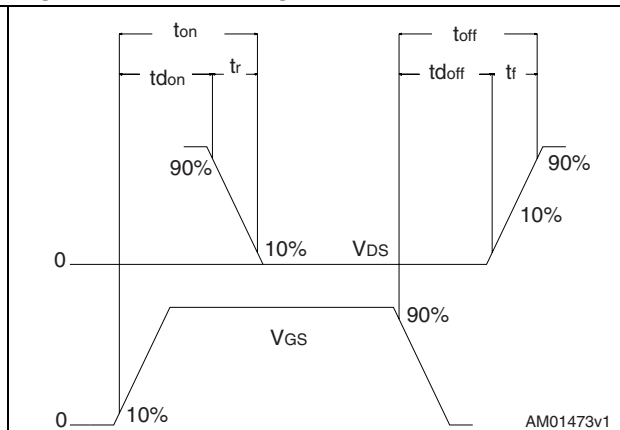
**Figure 18. Unclamped inductive load test circuit**



**Figure 19. Unclamped inductive waveform**



**Figure 20. Switching time waveform**

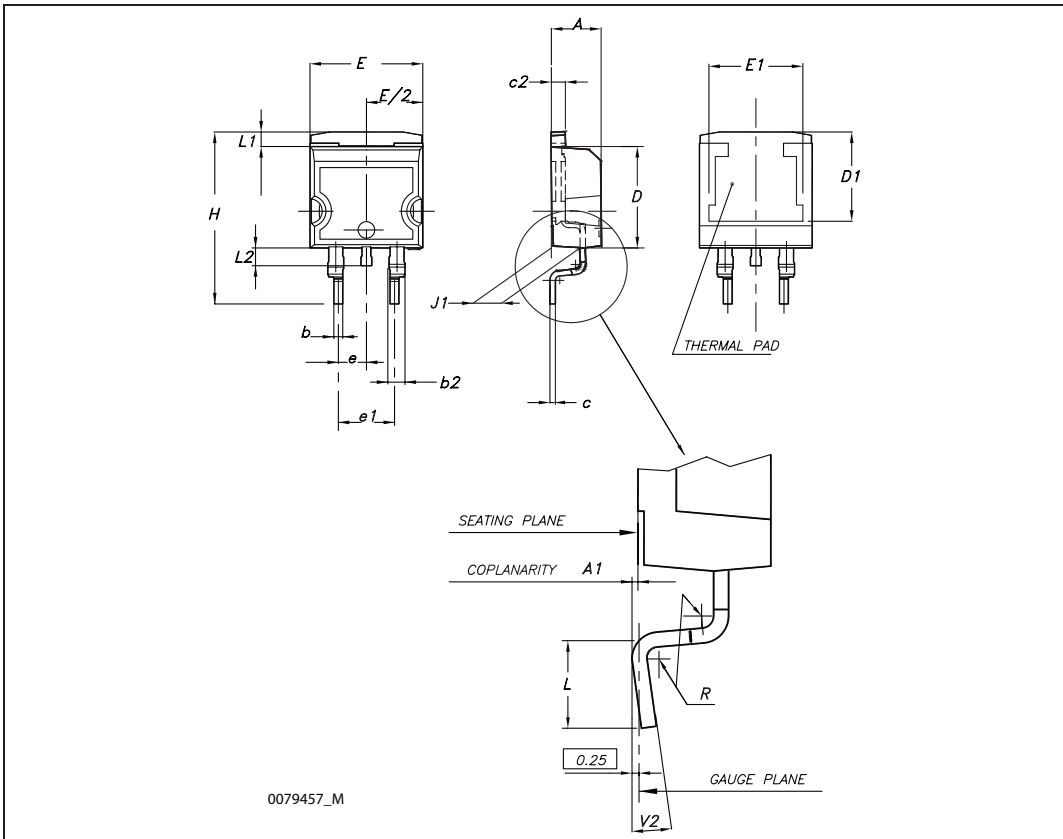


## 4 Package mechanical data

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.

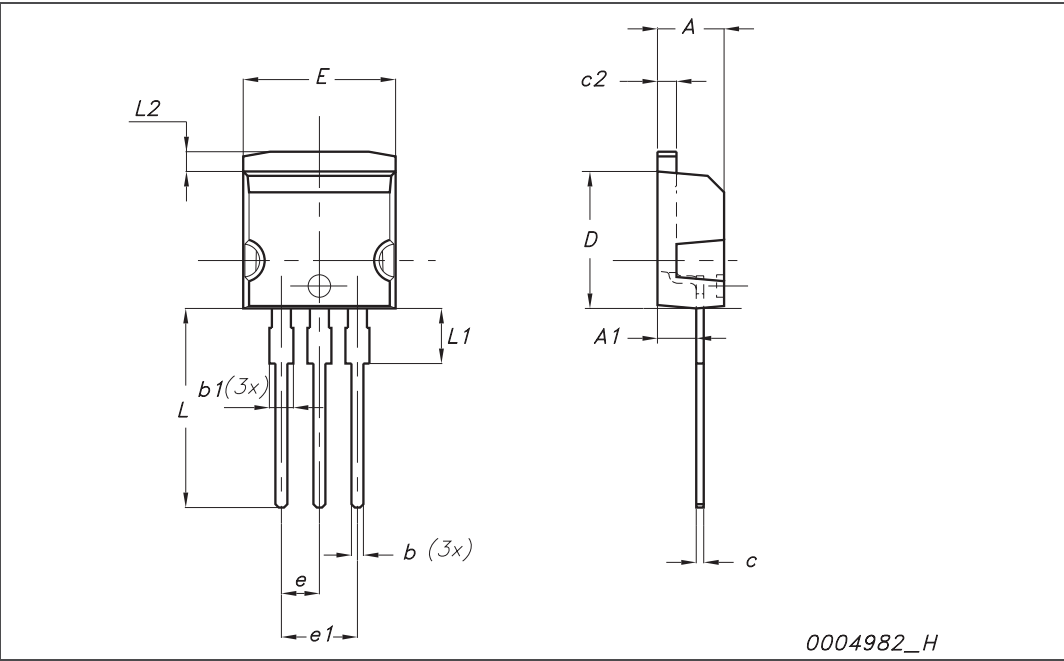
D<sup>2</sup>PAK (TO-263) mechanical data

| 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°    |



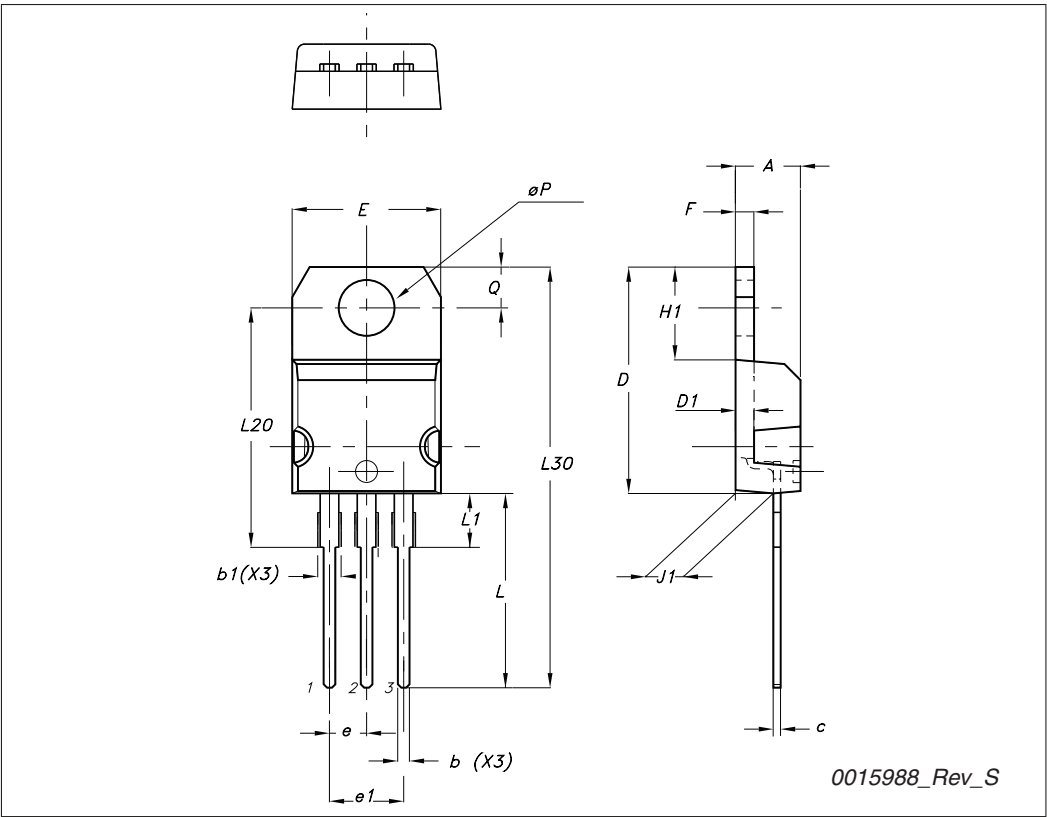
I<sup>2</sup>PAK (TO-262) mechanical data

| Dim | mm   |     |       | inch  |     |       |
|-----|------|-----|-------|-------|-----|-------|
|     | Min  | Typ | Max   | Min   | Typ | 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 |     | 0.034 |
| b1  | 1.14 |     | 1.70  | 0.044 |     | 0.066 |
| c   | 0.49 |     | 0.70  | 0.019 |     | 0.027 |
| 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  | 0.194 |     | 0.202 |
| E   | 10   |     | 10.40 | 0.393 |     | 0.410 |
| L   | 13   |     | 14    | 0.511 |     | 0.551 |
| L1  | 3.50 |     | 3.93  | 0.137 |     | 0.154 |
| L2  | 1.27 |     | 1.40  | 0.050 |     | 0.055 |



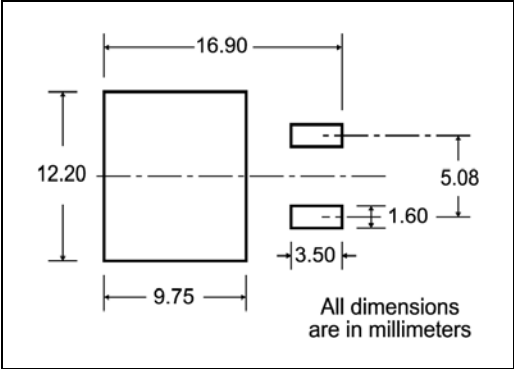
TO-220 type A mechanical data

| 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  |

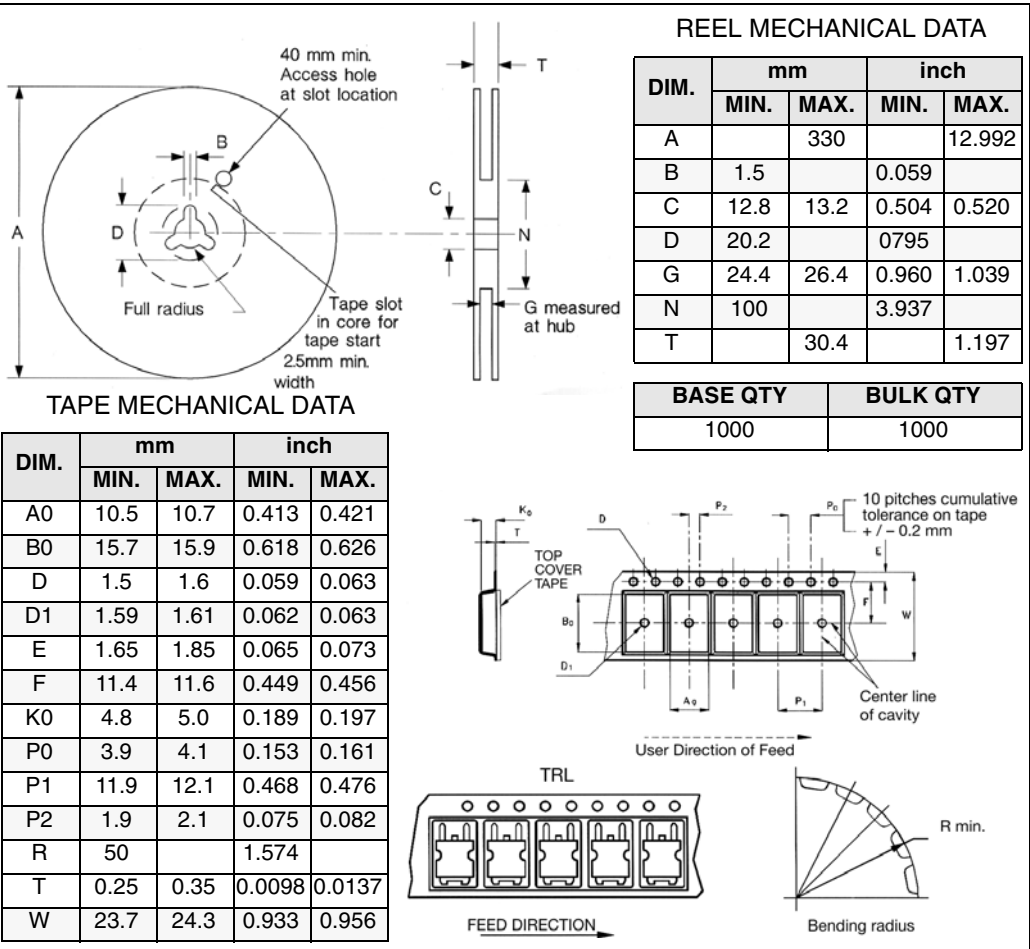


# 5 Packaging mechanical data

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



## TAPE AND REEL SHIPMENT



\* on sales type

## 6 Revision history

**Table 7. Document revision history**

| <b>Date</b> | <b>Revision</b> | <b>Changes</b>                                               |
|-------------|-----------------|--------------------------------------------------------------|
| 20-Apr-2009 | 1               | First version.                                               |
| 18-Nov-2009 | 2               | Document status promoted from preliminary data to datasheet. |

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