



# STB2N62K3, STD2N62K3, STF2N62K3, STP2N62K3, STU2N62K3

N-channel 620 V, 3  $\Omega$  2.2 A SuperMESH3™ Power MOSFET  
in D<sup>2</sup>PAK, DPAK, TO-220FP, TO-220 and IPAK packages

Datasheet — production data

## Features

| Order codes            | V <sub>DSS</sub> | R <sub>DS(on)</sub><br>max | I <sub>D</sub> | P <sub>TOT</sub> |
|------------------------|------------------|----------------------------|----------------|------------------|
| STB2N62K3<br>STD2N62K3 | 620 V            | < 3.6 $\Omega$             | 2.2 A          | 45 W             |
| STF2N62K3              |                  |                            |                | 20 W             |
| STP2N62K3<br>STU2N62K3 |                  |                            |                | 45 W             |

- 100% avalanche tested
- Extremely high dv/dt capability
- Gate charge minimized
- Very low intrinsic capacitance
- Improved diode reverse recovery characteristics
- Zener-protected

## Applications

- Switching applications

## Description

These SuperMESH3™ Power MOSFETs are the result of improvements applied to STMicroelectronics' SuperMESH™ technology, combined with a new optimized vertical structure. These devices boast an extremely low on-resistance, superior dynamic performance and high avalanche capability, rendering them suitable for the most demanding applications.

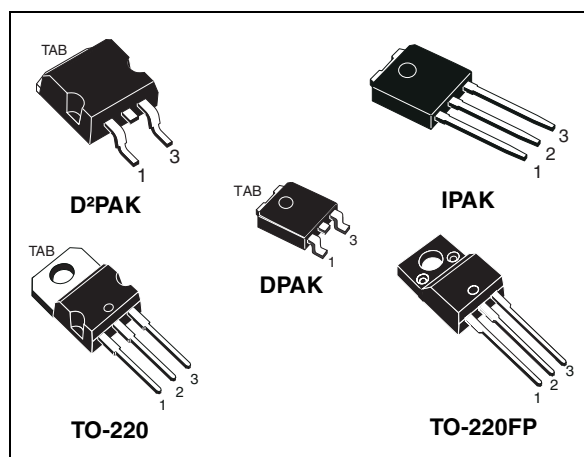


Figure 1. Internal schematic diagram

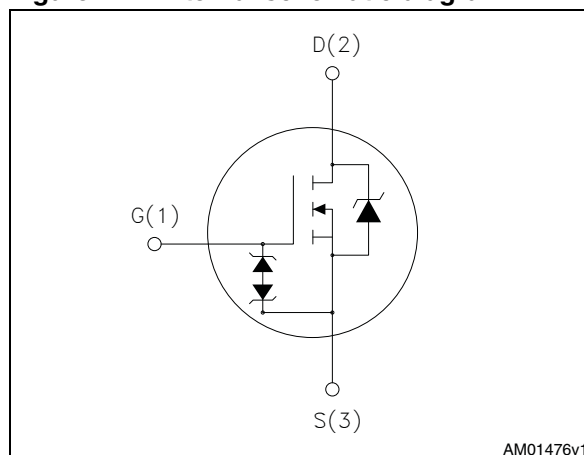


Table 1. Device summary

| Order codes                         | Marking | Package                    | Packaging     |
|-------------------------------------|---------|----------------------------|---------------|
| STB2N62K3<br>STD2N62K3              | 2N62K3  | D <sup>2</sup> PAK<br>DPAK | Tape and reel |
| STF2N62K3<br>STP2N62K3<br>STU2N62K3 | 2N62K3  | TO-220FP<br>TO-220<br>IPAK | Tube          |

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol                         | Parameter                                                                                                                  | Value                                     |                    | Unit |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|--------------------|------|
|                                |                                                                                                                            | D <sup>2</sup> PAK, DPAK,<br>TO-220, IPAK | TO-220FP           |      |
| V <sub>DS</sub>                | Drain-source voltage                                                                                                       | 620                                       |                    | V    |
| V <sub>GS</sub>                | Gate- source voltage                                                                                                       | ± 30                                      |                    | V    |
| I <sub>D</sub>                 | Drain current (continuous) at T <sub>C</sub> = 25 °C                                                                       | 2.2                                       | 2.2 <sup>(1)</sup> | A    |
| I <sub>D</sub>                 | Drain current (continuous) at T <sub>C</sub> = 100 °C                                                                      | 1                                         | 1 <sup>(1)</sup>   | A    |
| I <sub>DM</sub> <sup>(2)</sup> | Drain current (pulsed)                                                                                                     | 8.8                                       | 8.8 <sup>(1)</sup> | A    |
| P <sub>TOT</sub>               | Total dissipation at T <sub>C</sub> = 25 °C                                                                                | 45                                        | 20                 | W    |
| I <sub>AR</sub>                | Avalanche current, repetitive or not-repetitive (pulse width limited by T <sub>j</sub> max)                                | 2.2                                       |                    | A    |
| E <sub>AS</sub>                | Single pulse avalanche energy (starting T <sub>j</sub> = 25 °C, I <sub>D</sub> = I <sub>AR</sub> , V <sub>DD</sub> = 50 V) | 85                                        |                    | mJ   |
| V <sub>ISO</sub>               | Insulation withstand voltage (RMS) from all three leads to external heat sink (t=1 s; T <sub>C</sub> =25 °C)               |                                           | 2500               | V    |
| dv/dt <sup>(3)</sup>           | Peak diode recovery voltage slope                                                                                          | 12                                        |                    | V/ns |
| T <sub>stg</sub>               | Storage temperature                                                                                                        | -55 to 150                                |                    | °C   |
| T <sub>j</sub>                 | Max. operating junction temperature                                                                                        | 150                                       |                    | °C   |

1. Limited by maximum junction temperature

2. Pulse width limited by safe operating area

3. I<sub>SD</sub> ≤ 2.2 A, di/dt ≤ 400 A/μs, V<sub>DS</sub> peak ≤ V<sub>(BR)DSS</sub>, V<sub>DD</sub> = 80% V<sub>(BR)DSS</sub>

**Table 3. Thermal data**

| Symbol                | Parameter                               | Value              |      |      |        |          | Unit |
|-----------------------|-----------------------------------------|--------------------|------|------|--------|----------|------|
|                       |                                         | D <sup>2</sup> PAK | DPAK | IPAK | TO-220 | TO-220FP |      |
| R <sub>thj-case</sub> | Thermal resistance junction-case max    | 2.78               |      |      |        | 6.25     | °C/W |
| R <sub>thj-pcb</sub>  | Thermal resistance junction-pcb max     | 30                 | 50   |      |        |          | °C/W |
| R <sub>thj-amb</sub>  | Thermal resistance junction-ambient max |                    |      | 100  | 62.5   |          | °C/W |

## 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                   | $I_D = 1\text{ mA}$ , $V_{GS} = 0$                                         | 620  |      |          | V                              |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = 620\text{ V}$<br>$V_{DS} = 620\text{ V}$ , $T_C = 125\text{ °C}$ |      |      | 1<br>50  | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$     | Gate-body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 20\text{ V}$                                                 |      |      | $\pm 10$ | $\mu\text{A}$                  |
| $V_{GS(th)}$  | Gate threshold voltage                           | $V_{DS} = V_{GS}$ , $I_D = 50\text{ }\mu\text{A}$                          | 3    | 3.75 | 4.5      | V                              |
| $R_{DS(on)}$  | Static drain-source on-resistance                | $V_{GS} = 10\text{ V}$ , $I_D = 1.1\text{ A}$                              |      | 3    | 3.6      | $\Omega$                       |

**Table 5. 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 | $V_{DS} = 50\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$                                                     | -    | 340<br>26<br>4 | -    | pF<br>pF<br>pF |
| $C_{o(tr)}^{(1)}$                   | Equivalent capacitance time related                                     | $V_{DS} = 0\text{ to }496\text{ V}$ , $V_{GS} = 0$                                                             | -    | 17             | -    | pF             |
| $R_G$                               | Intrinsic gate resistance                                               | $f = 1\text{ MHz}$ open drain                                                                                  | -    | 5              | -    | $\Omega$       |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$       | Total gate charge<br>Gate-source charge<br>Gate-drain charge            | $V_{DD} = 496\text{ V}$ , $I_D = 1.1\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$<br>(see <a href="#">Figure 20</a> ) | -    | 15<br>3<br>9   | -    | nC<br>nC<br>nC |

1. Time related is defined as a constant equivalent capacitance giving the same charging time as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DSS}$

**Table 6. Switching times**

| Symbol       | Parameter           | Test conditions                                                                                                                      | Min. | Typ. | Max. | Unit |
|--------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD} = 310\text{ V}$ , $I_D = 1.1\text{ A}$ ,<br>$R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$<br>(see <a href="#">Figure 19</a> ) | -    | 8    | -    | ns   |
| $t_r$        | Rise time           |                                                                                                                                      |      | 4.4  |      | ns   |
| $t_{d(off)}$ | Turn-off-delay time |                                                                                                                                      |      | 21   |      | ns   |
| $t_f$        | Fall time           |                                                                                                                                      |      | 22   |      | ns   |

**Table 7. Source drain diode**

| Symbol          | Parameter                     | Test conditions                                                                                                                                                | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $I_{SD}$        | Source-drain current          |                                                                                                                                                                | -    |      | 2.2  | A    |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |                                                                                                                                                                |      |      | 8.8  | A    |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD} = 2.2\text{ A}$ , $V_{GS} = 0$                                                                                                                         | -    |      | 1.6  | V    |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 2.2\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 60\text{ V}$ (see <a href="#">Figure 24</a> )                                        | -    | 200  |      | ns   |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                                                |      | 900  |      | nC   |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                                                |      | 9    |      | A    |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 2.2\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 60\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$<br>(see <a href="#">Figure 24</a> ) | -    | 240  |      | ns   |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                                                |      | 1150 |      | nC   |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                                                |      | 10   |      | A    |

1. Pulse width limited by safe operating area

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

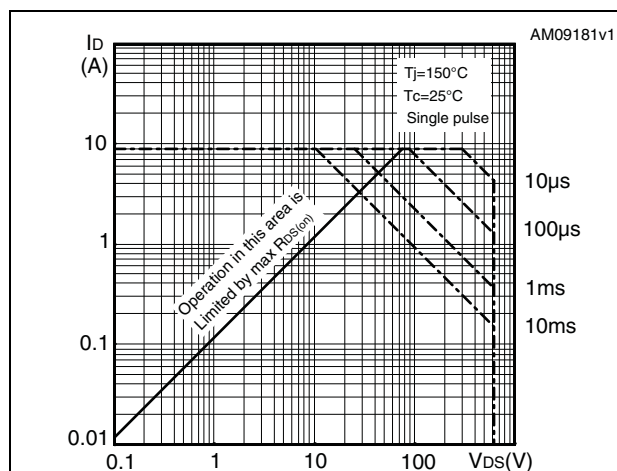
**Table 8. Gate-source Zener diode**

| Symbol     | Parameter                     | Test conditions                         | Min. | Typ. | Max. | Unit |
|------------|-------------------------------|-----------------------------------------|------|------|------|------|
| $BV_{GSO}$ | Gate-source breakdown voltage | $I_{gs} = \pm 1\text{ mA}$ (open drain) | 30   |      |      | V    |

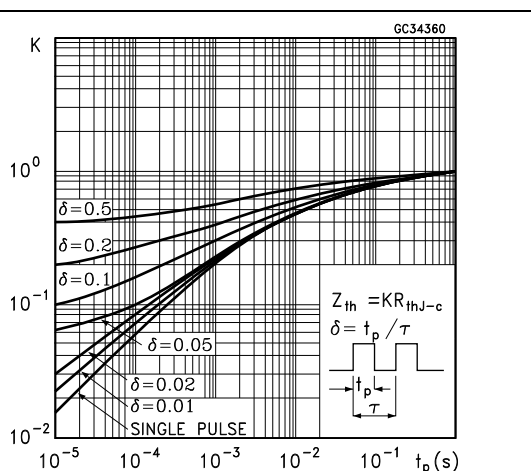
The built-in back-to-back Zener diodes have specifically been designed to enhance not only the device's ESD capability, but also to make them safely absorb possible voltage transients that may occasionally be applied from gate to source. In this respect the Zener voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components.

## 2.1 Electrical characteristics (curves)

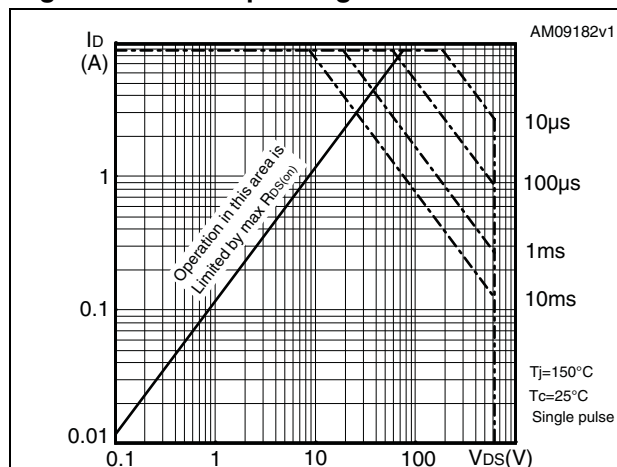
**Figure 2. Safe operating area for DPAK and IPAK**



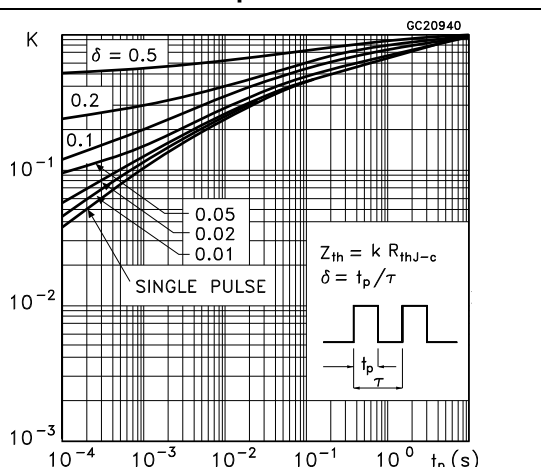
**Figure 3. Thermal impedance for DPAK and IPAK**



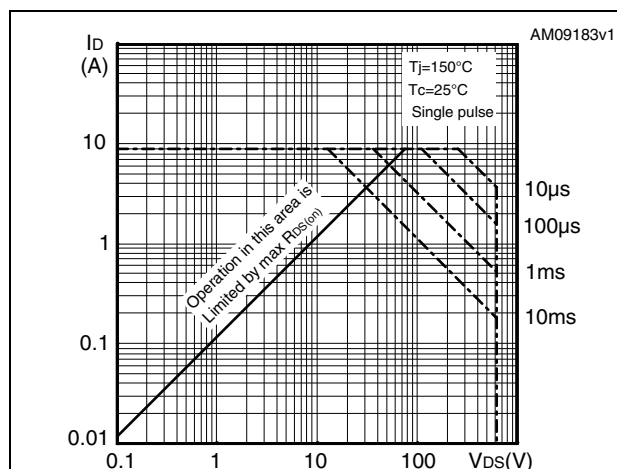
**Figure 4. Safe operating area for TO-220FP**



**Figure 5. Thermal impedance for TO-220FP**



**Figure 6. Safe operating area for TO-220 and D<sup>2</sup>PAK**



**Figure 7. Thermal impedance for TO-220 and D<sup>2</sup>PAK**

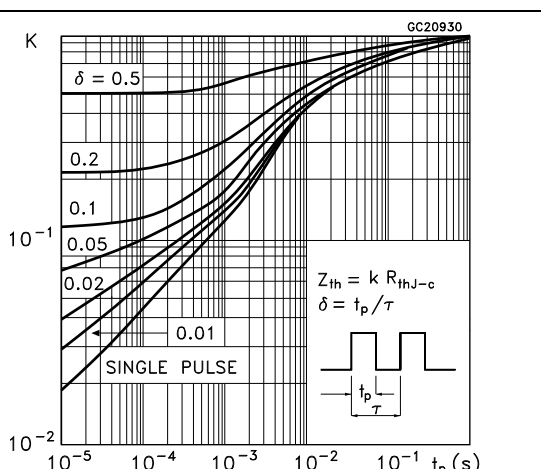


Figure 8. Output characteristics

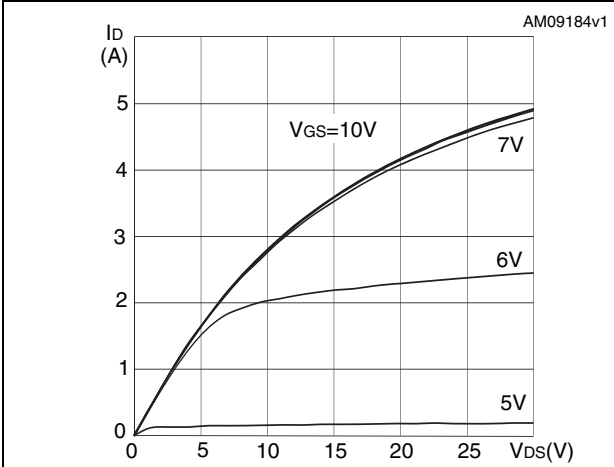


Figure 9. Transfer characteristics

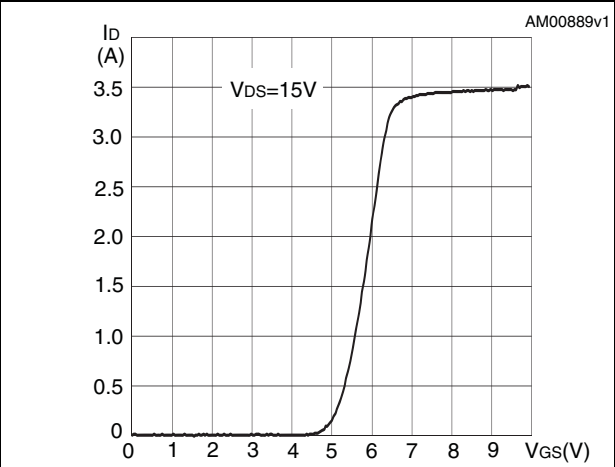


Figure 10. Gate charge vs gate-source voltage

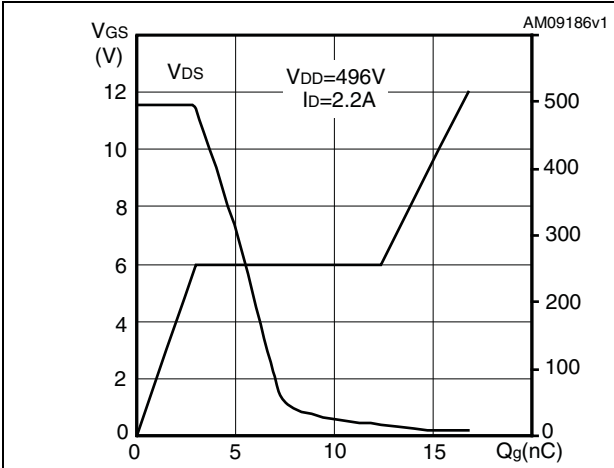


Figure 11. Static drain-source on-resistance

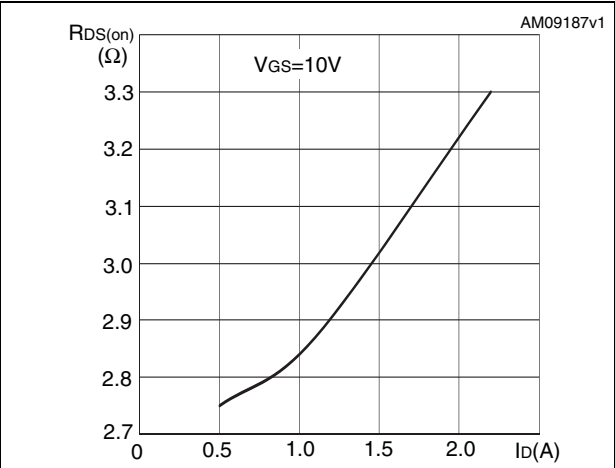


Figure 12. Capacitance variations

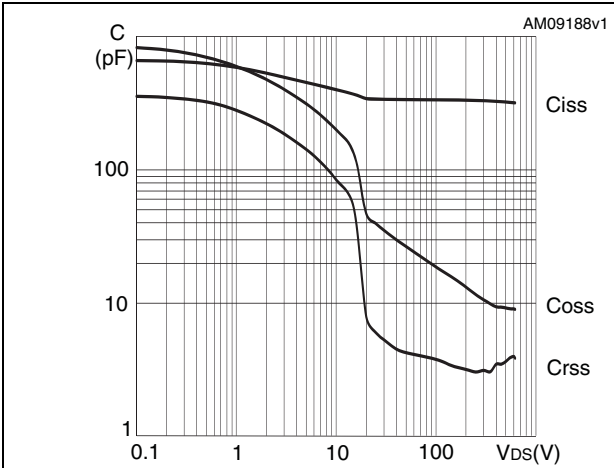


Figure 13. Output capacitance stored energy

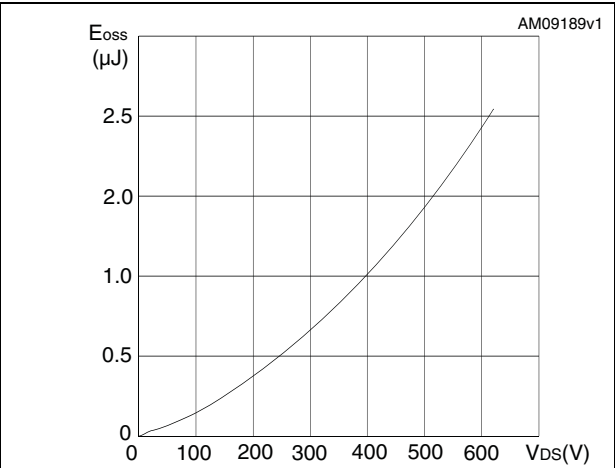


Figure 14. Normalized gate threshold voltage vs temperature

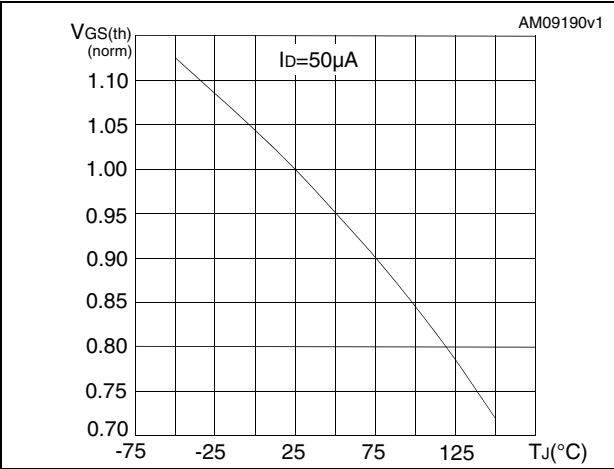


Figure 15. Normalized on-resistance vs temperature

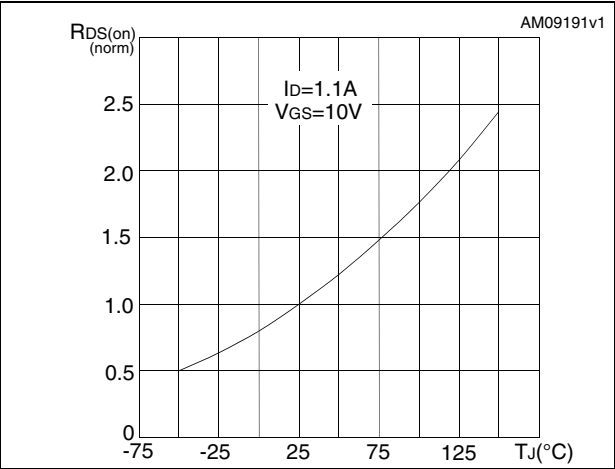


Figure 16. Source-drain diode forward characteristics

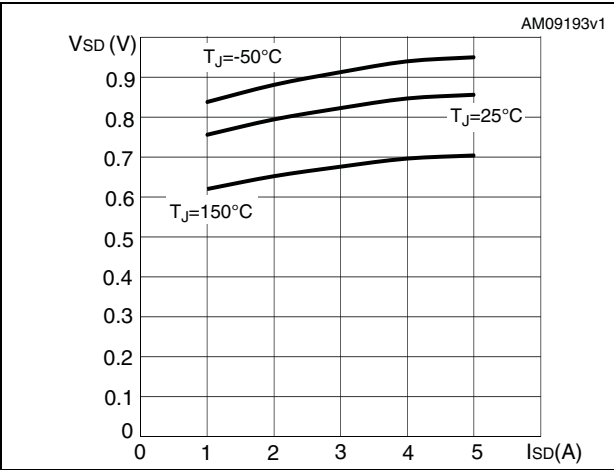


Figure 17. Normalized  $B_{VDSS}$  vs temperature

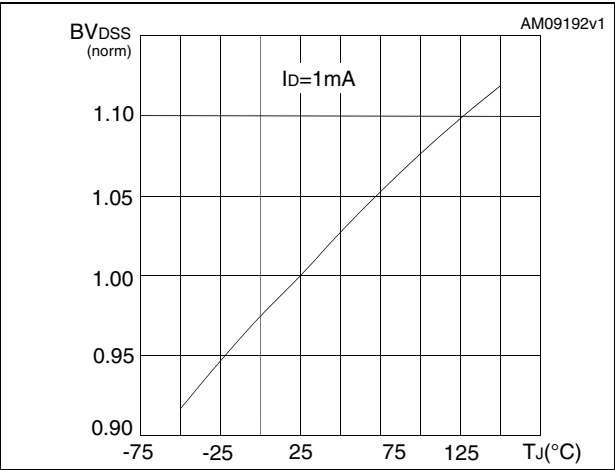
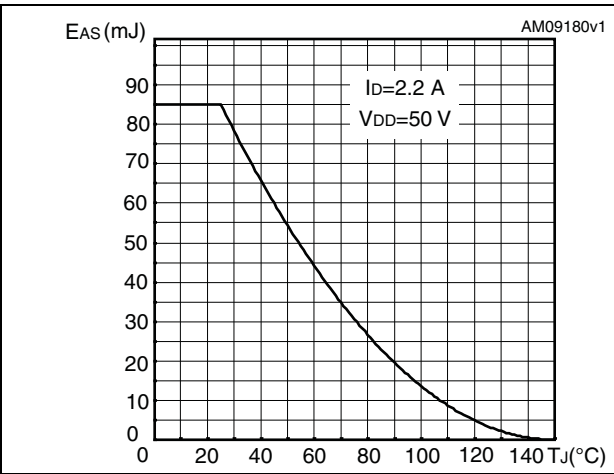


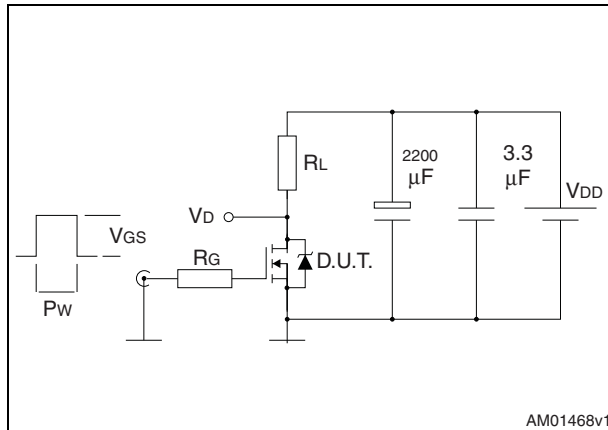
Figure 18. Maximum avalanche energy vs starting  $T_j$



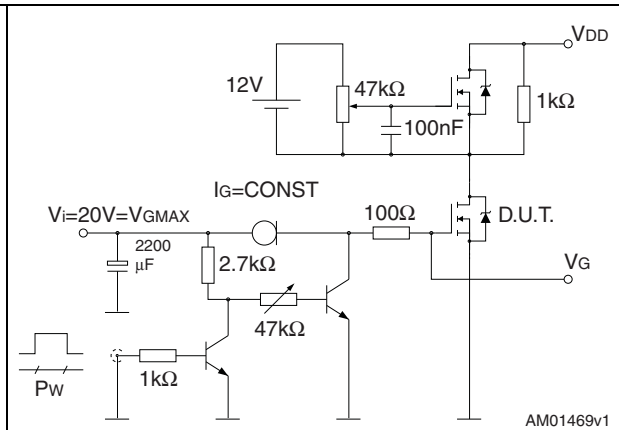


### 3 Test circuits

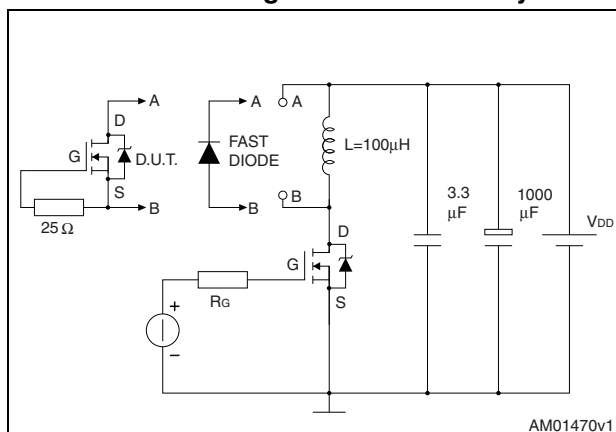
**Figure 19. Switching times test circuit for resistive load**



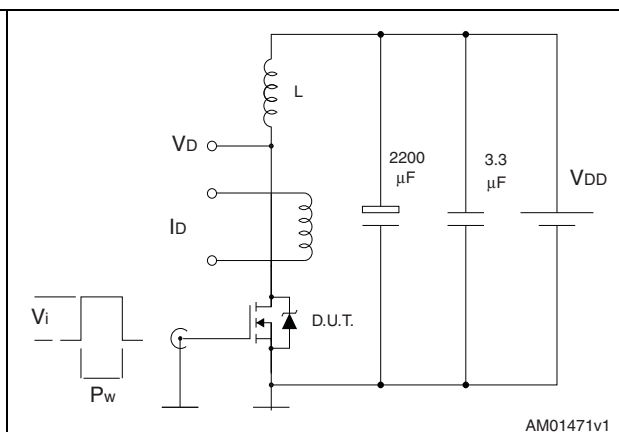
**Figure 20. Gate charge test circuit**



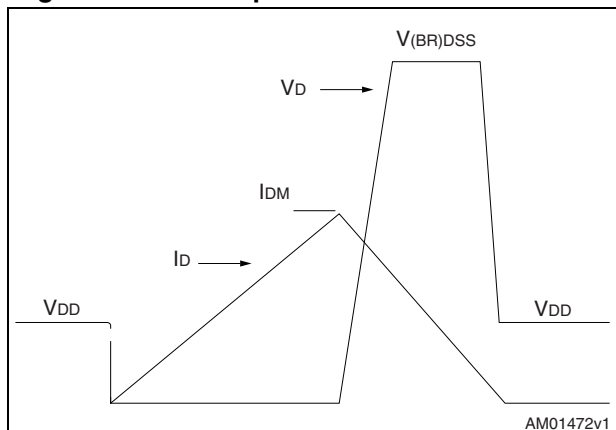
**Figure 21. Test circuit for inductive load switching and diode recovery times**



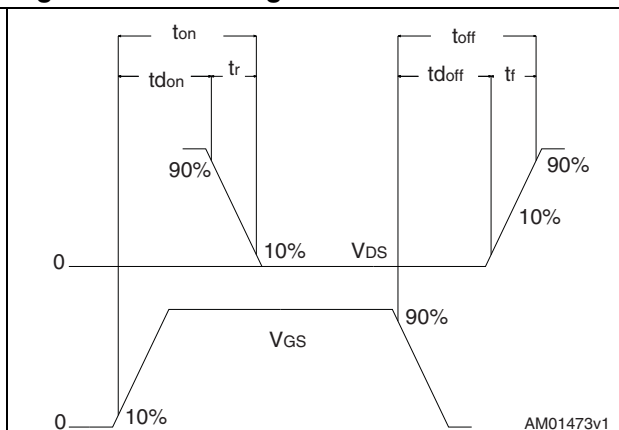
**Figure 22. Unclamped inductive load test circuit**



**Figure 23. Unclamped inductive waveform**



**Figure 24. 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.

Table 9. 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°    |

Figure 25. D<sup>2</sup>PAK (TO-263) drawing

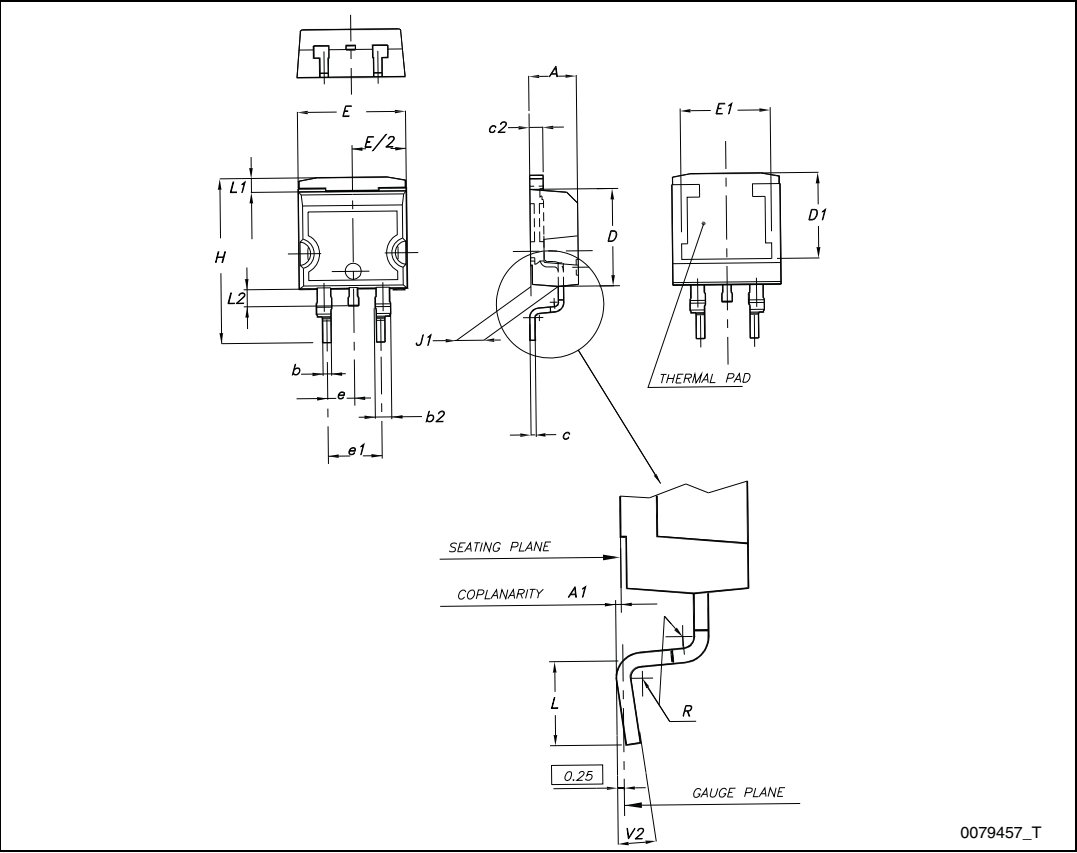
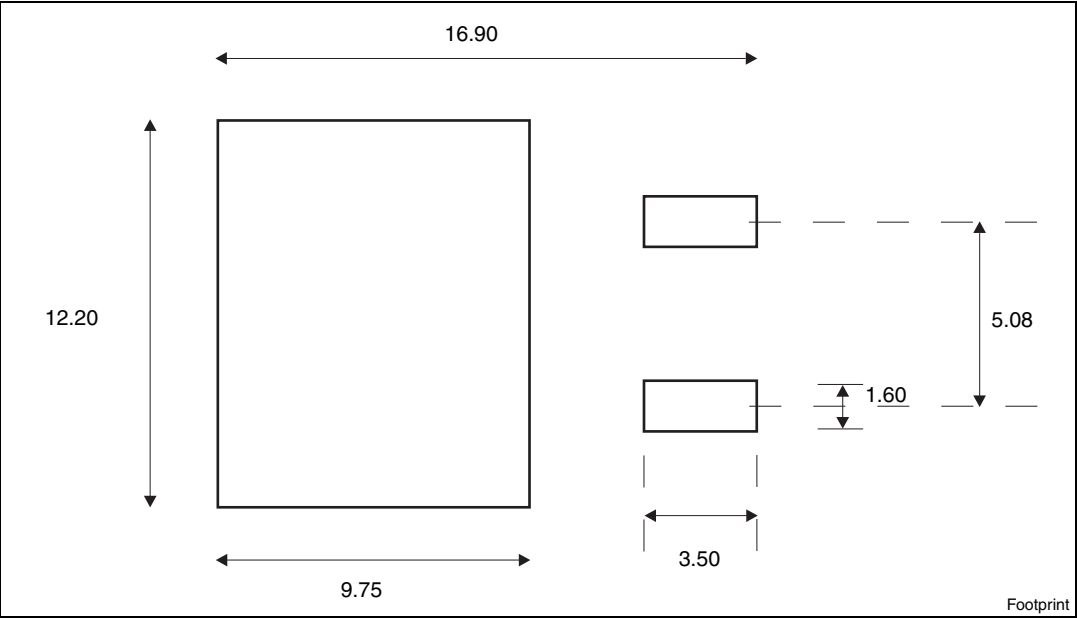


Figure 26. D<sup>2</sup>PAK footprint<sup>(a)</sup>



a. All dimensions are in millimeters

Table 10. DPAK (TO-252) mechanical data

| Dim. | mm   |      |       |
|------|------|------|-------|
|      | Min. | Typ. | Max.  |
| A    | 2.20 |      | 2.40  |
| A1   | 0.90 |      | 1.10  |
| A2   | 0.03 |      | 0.23  |
| b    | 0.64 |      | 0.90  |
| b4   | 5.20 |      | 5.40  |
| c    | 0.45 |      | 0.60  |
| c2   | 0.48 |      | 0.60  |
| D    | 6.00 |      | 6.20  |
| D1   |      | 5.10 |       |
| E    | 6.40 |      | 6.60  |
| E1   |      | 4.70 |       |
| e    |      | 2.28 |       |
| e1   | 4.40 |      | 4.60  |
| H    | 9.35 |      | 10.10 |
| L    | 1    |      | 1.50  |
| L1   |      | 2.80 |       |
| L2   |      | 0.80 |       |
| L4   | 0.60 |      | 1     |
| R    |      | 0.20 |       |
| V2   | 0°   |      | 8°    |

Figure 27. DPAK (TO-252) drawing

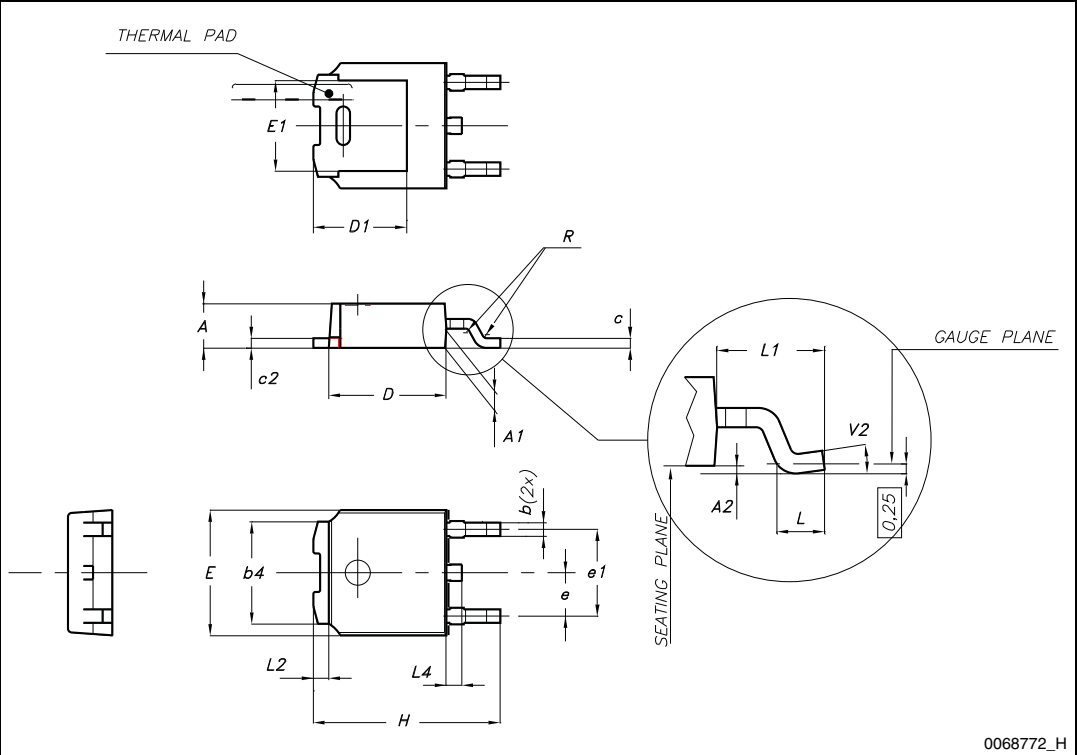
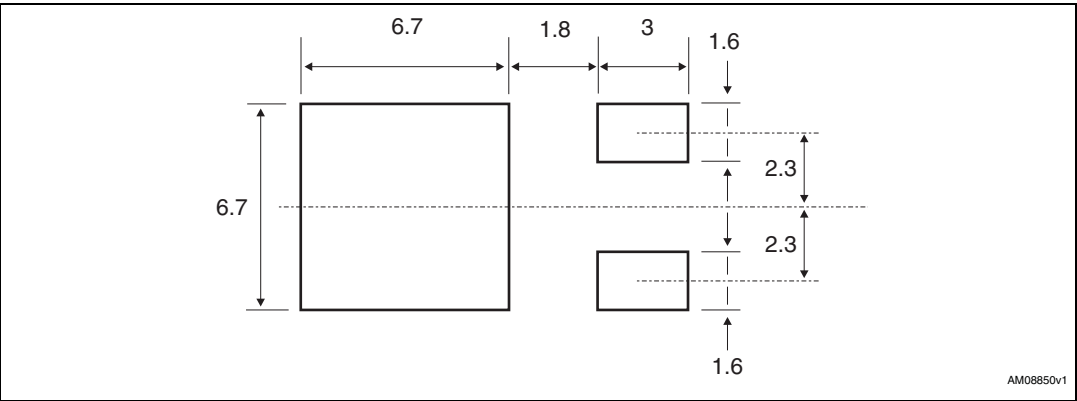


Figure 28. DPAK footprint<sup>(b)</sup>



b. All dimensions are in millimeters

Table 11. TO-220FP mechanical data

| Dim. | mm   |      |      |
|------|------|------|------|
|      | Min. | Typ. | Max. |
| A    | 4.4  |      | 4.6  |
| B    | 2.5  |      | 2.7  |
| D    | 2.5  |      | 2.75 |
| E    | 0.45 |      | 0.7  |
| F    | 0.75 |      | 1    |
| F1   | 1.15 |      | 1.70 |
| F2   | 1.15 |      | 1.70 |
| G    | 4.95 |      | 5.2  |
| G1   | 2.4  |      | 2.7  |
| H    | 10   |      | 10.4 |
| L2   |      | 16   |      |
| L3   | 28.6 |      | 30.6 |
| L4   | 9.8  |      | 10.6 |
| L5   | 2.9  |      | 3.6  |
| L6   | 15.9 |      | 16.4 |
| L7   | 9    |      | 9.3  |
| Dia  | 3    |      | 3.2  |

Figure 29. TO-220FP drawing

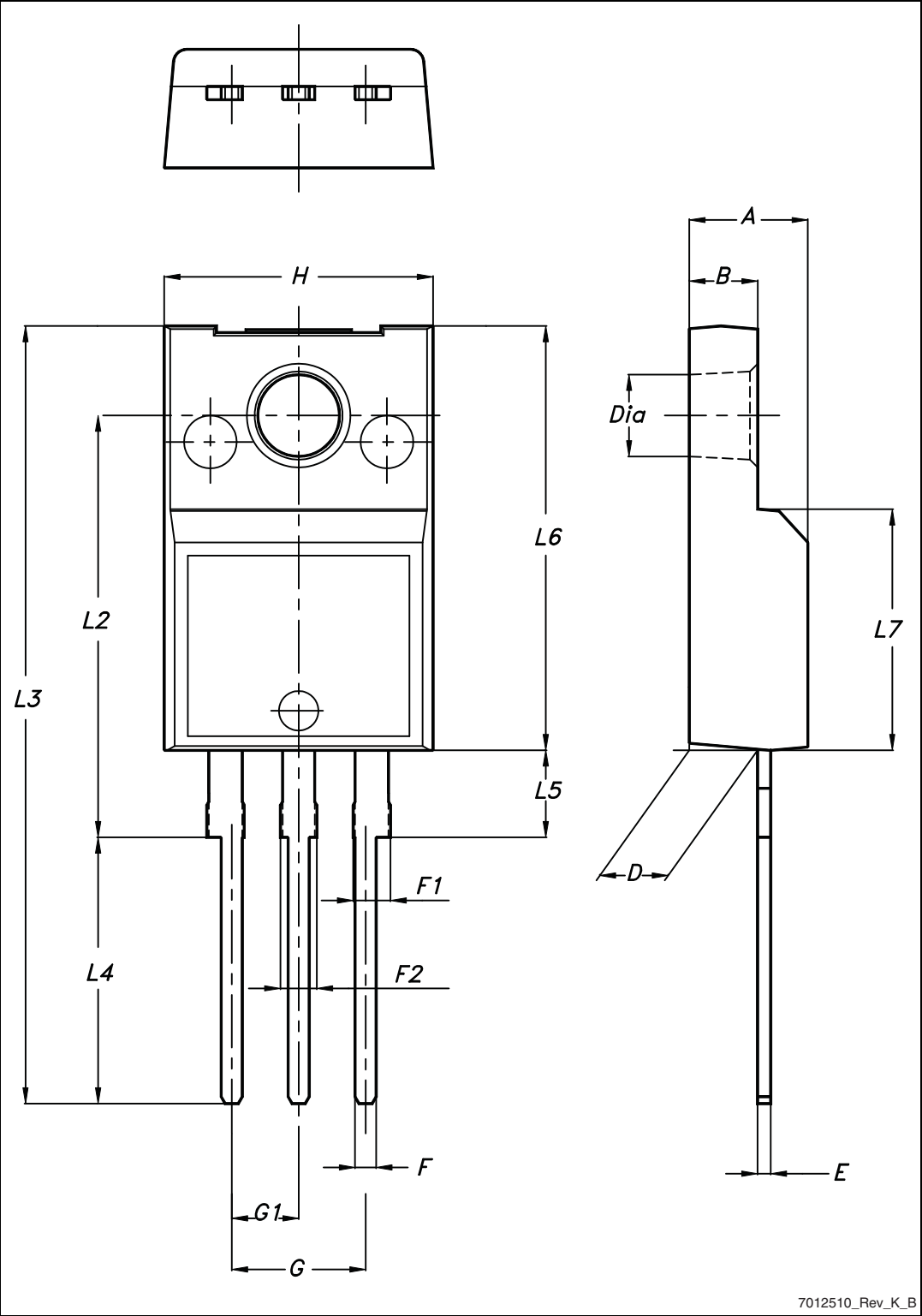




Table 12. TO-220 type A mechanical data

| 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  |

Figure 30. TO-220 type A drawing

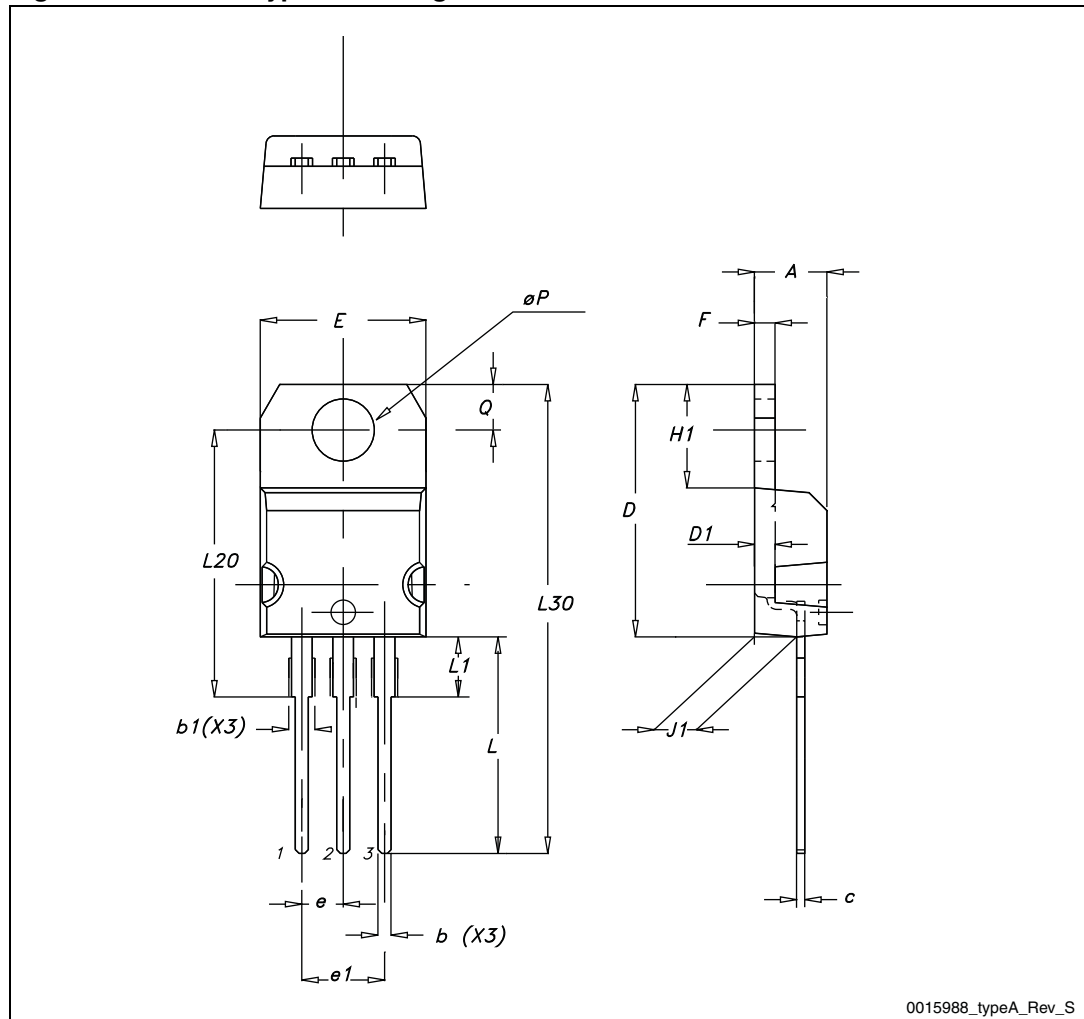
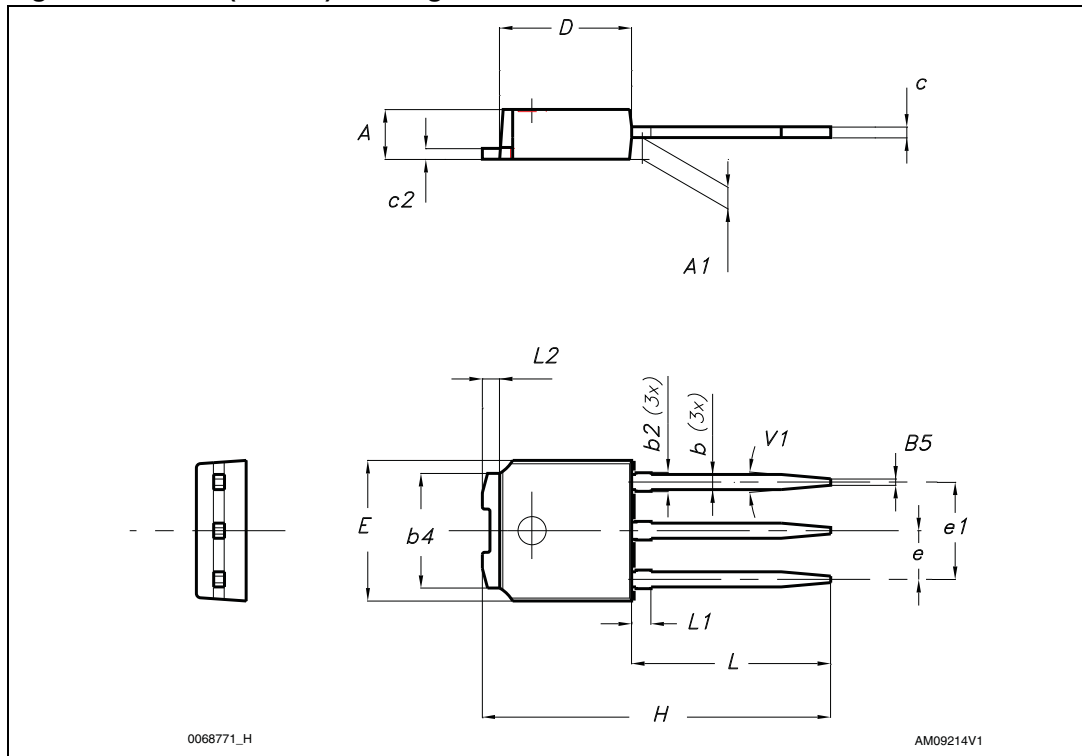


Table 13. IPAK (TO-251) mechanical data

| DIM. | mm.  |       |      |
|------|------|-------|------|
|      | min. | typ   | max. |
| A    | 2.20 |       | 2.40 |
| A1   | 0.90 |       | 1.10 |
| b    | 0.64 |       | 0.90 |
| b2   |      |       | 0.95 |
| b4   | 5.20 |       | 5.40 |
| B5   |      | 0.3   |      |
| c    | 0.45 |       | 0.60 |
| c2   | 0.48 |       | 0.60 |
| D    | 6.00 |       | 6.20 |
| E    | 6.40 |       | 6.60 |
| e    |      | 2.28  |      |
| e1   | 4.40 |       | 4.60 |
| H    |      | 16.10 |      |
| L    | 9.00 |       | 9.40 |
| L1   | 0.80 |       | 1.20 |
| L2   |      | 0.80  | 1.00 |
| V1   |      | 10 °  |      |

Figure 31. IPAK (TO-251) drawing



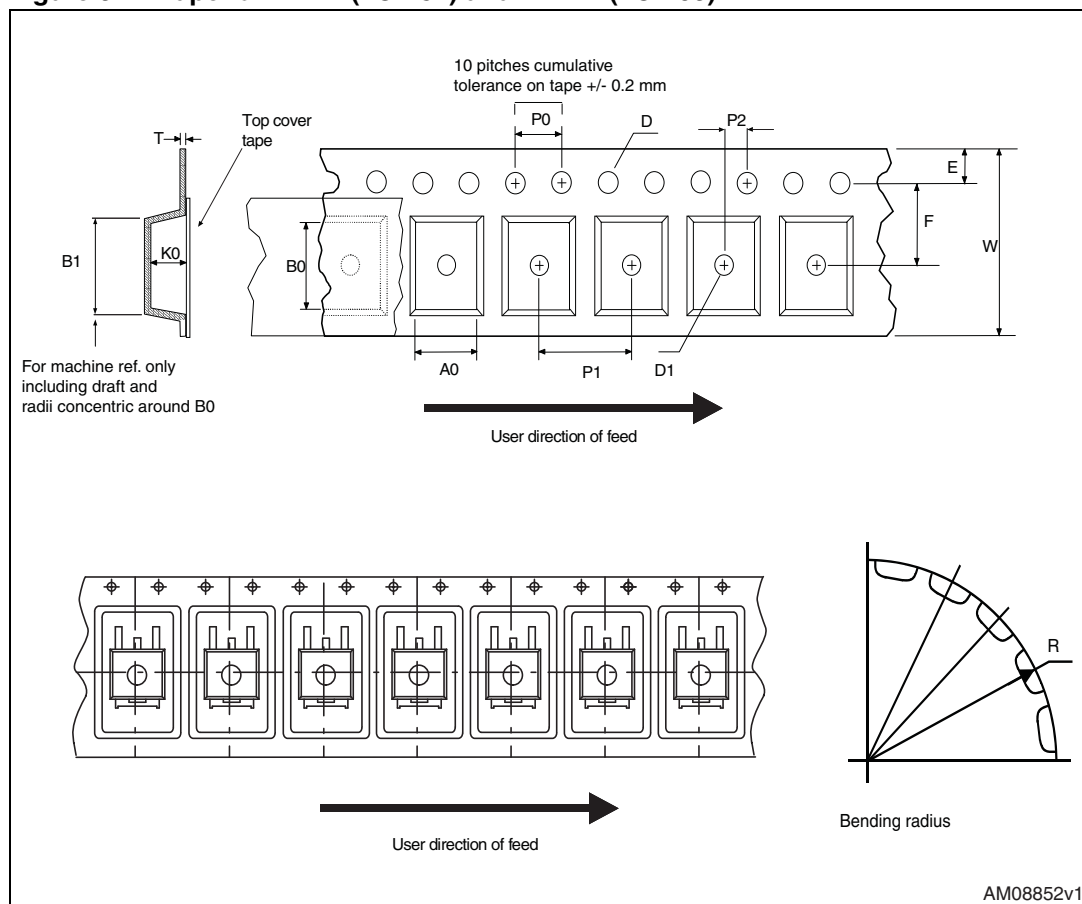
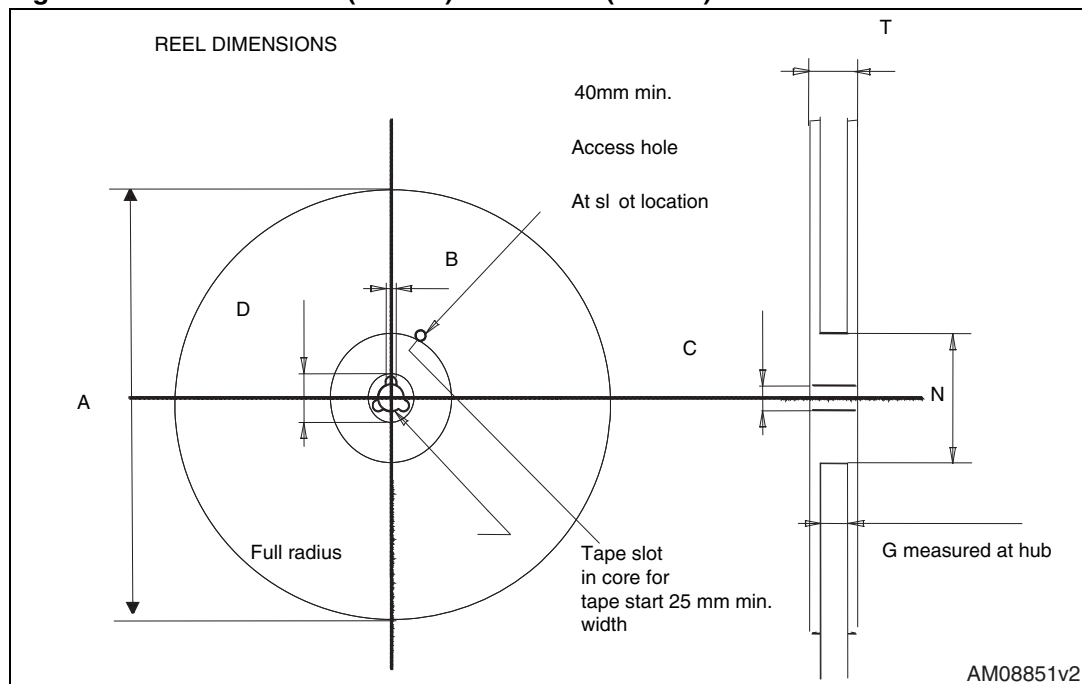
## 5 Packaging mechanical data

Table 14. DPAK (TO-252) tape and reel mechanical data

| Tape |      |      | Reel      |      |      |
|------|------|------|-----------|------|------|
| Dim. | mm   |      | Dim.      | mm   |      |
|      | Min. | Max. |           | Min. | Max. |
| A0   | 6.8  | 7    | A         |      | 330  |
| B0   | 10.4 | 10.6 | B         | 1.5  |      |
| B1   |      | 12.1 | C         | 12.8 | 13.2 |
| D    | 1.5  | 1.6  | D         | 20.2 |      |
| D1   | 1.5  |      | G         | 16.4 | 18.4 |
| E    | 1.65 | 1.85 | N         | 50   |      |
| F    | 7.4  | 7.6  | T         |      | 22.4 |
| K0   | 2.55 | 2.75 |           |      |      |
| P0   | 3.9  | 4.1  | Base qty. |      | 2500 |
| P1   | 7.9  | 8.1  | Bulk qty. |      | 2500 |
| P2   | 1.9  | 2.1  |           |      |      |
| R    | 40   |      |           |      |      |
| T    | 0.25 | 0.35 |           |      |      |
| W    | 15.7 | 16.3 |           |      |      |

Table 15. 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 |          |      |      |

Figure 32. Tape for DPAK (TO-252) and D<sup>2</sup>PAK (TO-263)Figure 33. Reel for DPAK (TO-252) and D<sup>2</sup>PAK (TO-263)

## 6 Revision history

**Table 16. Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                                        |
|-------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31-May-2011 | 1        | First release                                                                                                                                                                                                                                  |
| 20-Mar-2012 | 2        | Added new package: D <sup>2</sup> PAK<br>– <a href="#">Table 1: Device summary</a> , <a href="#">Section 4: Package mechanical data</a><br>and <a href="#">Section 5: Packaging mechanical data</a> have been modified.<br>Minor text changes. |



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