# STD7N80K5, STF7N80K5, STP7N80K5

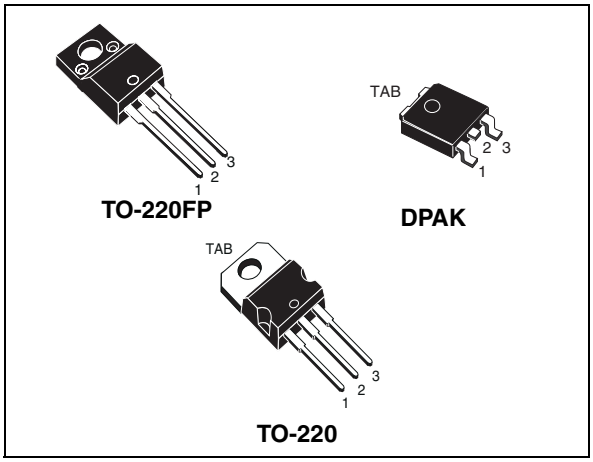
N-channel 800 V, 0.95 Ω typ., 6 A Zener-protected SuperMESH™ 5 Power MOSFET in a TO-220FP, DPAK and TO-220 packages

**Datasheet — preliminary data**

## Features

| Type | $V_{DSS}$ | $R_{DS(on)}$max | $I_D$ | $P_{TOT}$ |
|---|---|---|---|---|
| STD7N80K5 | 800 V | < 1.2 Ω | 6 A | 110 W |
| STF7N80K5 | | | | 25 W |
| STP7N80K5 | | | | 110 W |

- Worldwide best FOM (figure of merit)
- Ultra low gate charge
- 100% avalanche tested
- Zener-protected




## Applications

- Switching applications

## Description

These devices are N-channel Zener-protected Power MOSFETs realized in SuperMESH™5, a revolutionary avalanche-rugged very high voltage Power MOSFET technology based on an innovative proprietary vertical structure. The result is a drastic reduction in on-resistance and ultra low gate charge for applications which require superior power density and high efficiency.

**Figure 1. Internal schematic diagram**

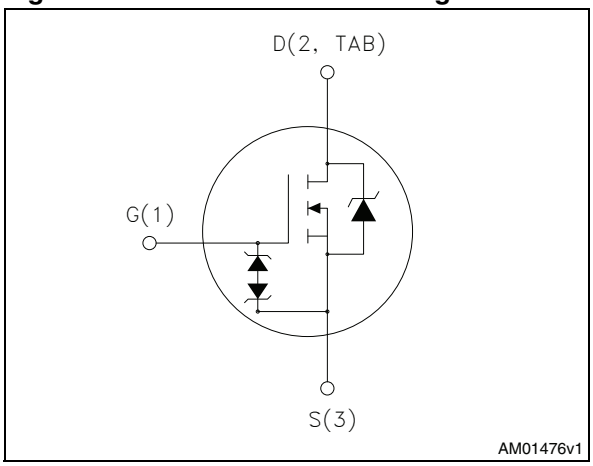



**Table 1. Device summary**

| Order codes | Marking | Package | Packaging |
|---|---|---|---|
| STD7N80K5 | 7N80K5 | DPAK | Tape and reel |
| STF7N80K5 | | TO-220FP | Tube |
| STP7N80K5 | | TO-220 | Tube |

# Contents

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol | Parameter | Value | | Unit |
|---|---|---|---|---|
| | | DPAK, TO-220 | TO-220FP | |
| $V_{GS}$ | Gate- source voltage | ± 30 | | V |
| $I_D$ | Drain current (continuous) at $T_C$ = 25 °C | 6 | 6(1) | A |
| $I_D$ | Drain current (continuous) at $T_C$ = 100 °C | 3.8 | 3.8 (1) | A |
| $I_{DM}$ (2) | Drain current (pulsed) | 24 | 24 (1) | A |
| $P_{TOT}$ | Total dissipation at $T_C$ = 25 °C | 110 | 25 | W |
| $I_{AR}$ | Max current during repetitive or single pulse avalanche (pulse width limited by $T_{jmax}$ ) | TBD | | A |
| $E_{AS}$ | Single pulse avalanche energy (starting $T_J$ = 25 °C, $I_D$=$I_{AS}$, $V_{DD}$= 50 V) | TBD | | mJ |
| $V_{iso}$ | Insulation withstand voltage (RMS) from all three leads to external heat sink (t=1 s;$T_C$=25 °C) | | 2500 | V |
| dv/dt (3) | Peak diode recovery voltage slope | TBD | | V/ns |
| $T_j$ $T_{stg}$ | Operating junction temperature Storage temperature | -55 to 150 | | °C |

1. Limited by package.
2. Pulse width limited by safe operating area.
3. $I_{SD}$ ≤ 6 A, di/dt ≤ 100 A/µs, $V_{Peak}$ ≤$V_{(BR)DSS}$

**Table 3. Thermal data**

| Symbol | Parameter | Value | | | Unit |
|---|---|---|---|---|---|
| | | TO-220 | DPAK | TO-220FP | |
| Rthj-case | Thermal resistance junction-case max | 1.14 | | 5 | °C/W |
| Rthj-amb | Thermal resistance junction-amb max | 62.5 | | 62.5 | |
| Rthj-pcb(1) | Thermal resistance junction-pcb max | | 50 | | |

1. When mounted on 1 inch² FR-4, 2 Oz copper board.

# 2 Electrical characteristics

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

**Table 4. On/off states**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage ($V_{GS}$= 0) | $I_D$ = 1 mA | 800 | | | V |
| $I_{DSS}$ | Zero gate voltage drain current ($V_{GS}$ = 0) | $V_{DS}$ = 800 V<br>$V_{DS}$ = 800 V, Tc=125 °C | | | 1<br>50 | µA<br>µA |
| $I_{GSS}$ | Gate body leakage current ($V_{DS}$ = 0) | $V_{GS}$ = ± 20 V | | | ±10 | µA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 100 µA | 3 | 4 | 5 | V |
| $R_{DS(on)}$ | Static drain-source on resistance | $V_{GS}$ = 10 V, $I_D$= 3 A | | 0.95 | 1.2 | Ω |

**Table 5. Dynamic**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input capacitance | $V_{DS}$ =100 V, f=1 MHz, $V_{GS}$=0 | - | 355 | - | pF |
| $C_{oss}$ | Output capacitance | | | 30 | | pF |
| $C_{rss}$ | Reverse transfer capacitance | | | 1 | | pF |
| $C_{o(tr)}$(1) | Equivalent capacitance time related | $V_{GS}$ = 0, $V_{DS}$ = 0 to 640 V | - | TBD | - | pF |
| $C_{o(er)}$(2) | Equivalent capacitance energy related | | - | TBD | - | pF |
| $R_G$ | Intrinsic gate resistance | f = 1MHz open drain | - | 3 | - | Ω |
| $Q_g$ | Total gate charge | $V_{DD}$ = 640 V, $I_D$ = 6 A | - | 10 | - | nC |
| $Q_{gs}$ | Gate-source charge | $V_{GS}$ =10 V | | TBD | | nC |
| $Q_{gd}$ | Gate-drain charge | *(see Figure 3)* | | TBD | | 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% $V_{DSS}$
2. Energy related is defined as a constant equivalent capacitance giving the same stored energy 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 |
|---|---|---|---|---|---|---|
| $t_{d(on)}$<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 | $V_{DD}$ = 400 V, $I_D$ = 3 A,<br>$R_G$=4.7 Ω, $V_{GS}$=10 V<br>*(see Figure 5)* | - | TBD<br>TBD<br>TBD<br>TBD | - | ns<br>ns<br>ns<br>ns |

**Table 7. Source drain diode**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{SD}$<br>$I_{SDM}$ | Source-drain current<br>Source-drain current (pulsed) | | - | | 6<br>24 | A<br>A |
| $V_{SD}$ (1) | Forward on voltage | $I_{SD}$= 6 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 | $I_{SD}$= 6 A, $V_{DD}$= 60 V<br>di/dt = 100 A/µs,<br>*(see Figure 4)* | - | TBD<br>TBD<br>TBD | | ns<br>µC<br>A |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD}$= 6 A,$V_{DD}$= 60 V<br>di/dt=100 A/µs,<br>Tj=150 °C<br>*(see Figure 4)* | - | TBD<br>TBD<br>TBD | | ns<br>µC<br>A |

1. Pulsed: pulse duration = 300µs, duty cycle 1.5%

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

| Symbol | Parameter | Test conditions | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| $BV_{GSO}$ | Gate-source breakdown voltage | Igs ± 1mA, (open drain) | 30 | - | - | V |

The built-in back-to-back Zener diodes have been specifically designed to enhance not only the device's ESD capability, but also to make them capable of safely absorbing any voltage transients that may occasionally be applied from gate to source. In this respect, the Zener voltage is appropriate to achieve efficient and cost-effective protection of device integrity. The integrated Zener diodes thus eliminate the need for external components.

# 3 Test circuits

**Figure 2. Switching times test circuit for resistive load**

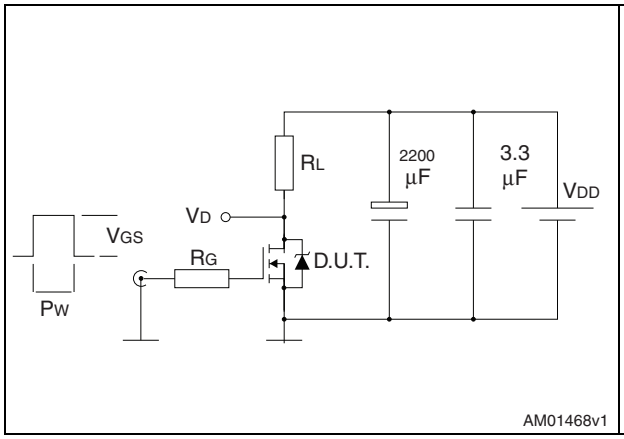



**Figure 3. Gate charge test circuit**

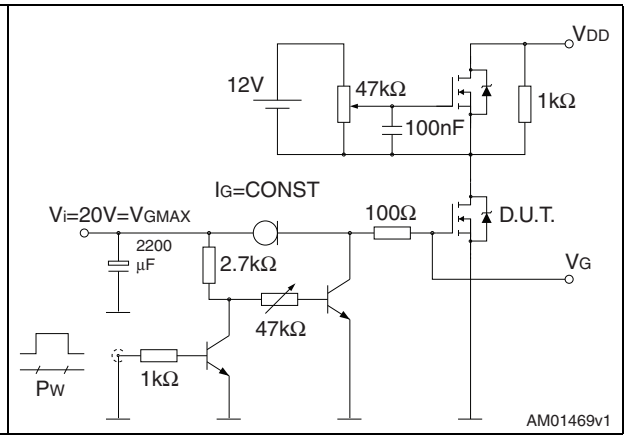



**Figure 4. Test circuit for inductive load switching and diode recovery times**

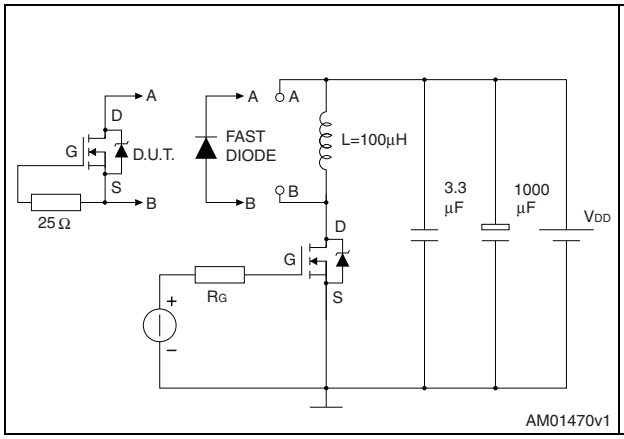



**Figure 5. Unclamped inductive load test circuit**

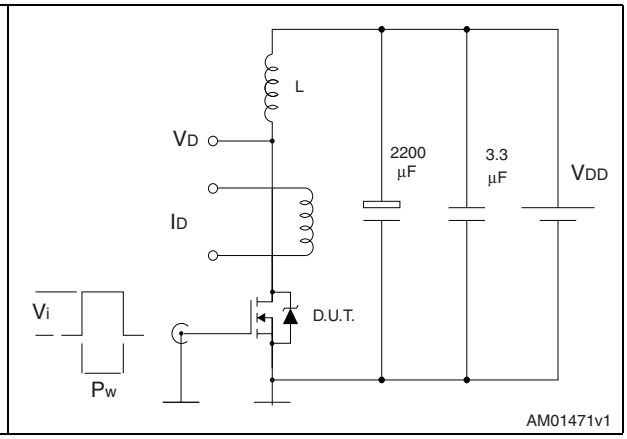



**Figure 6. Unclamped inductive waveform**

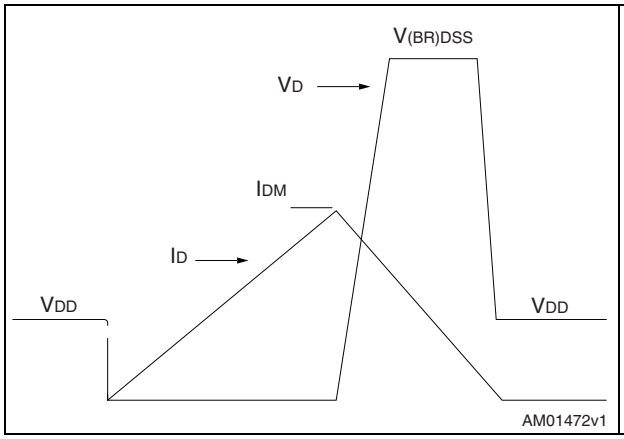
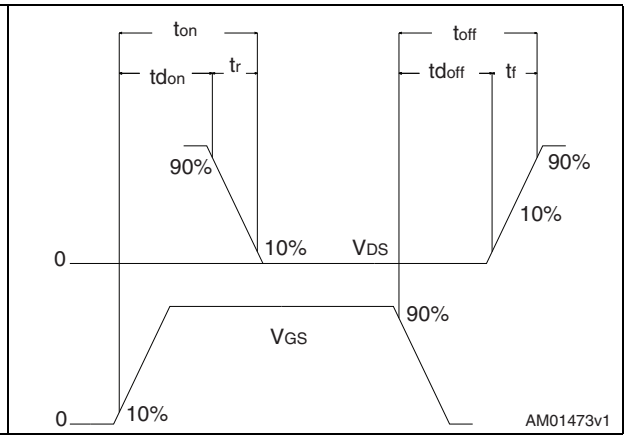



**Figure 7. Switching time waveform**



# 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*. ECOPACK® is an ST trademark.

Table 9. 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 8. TO-220FP drawing**

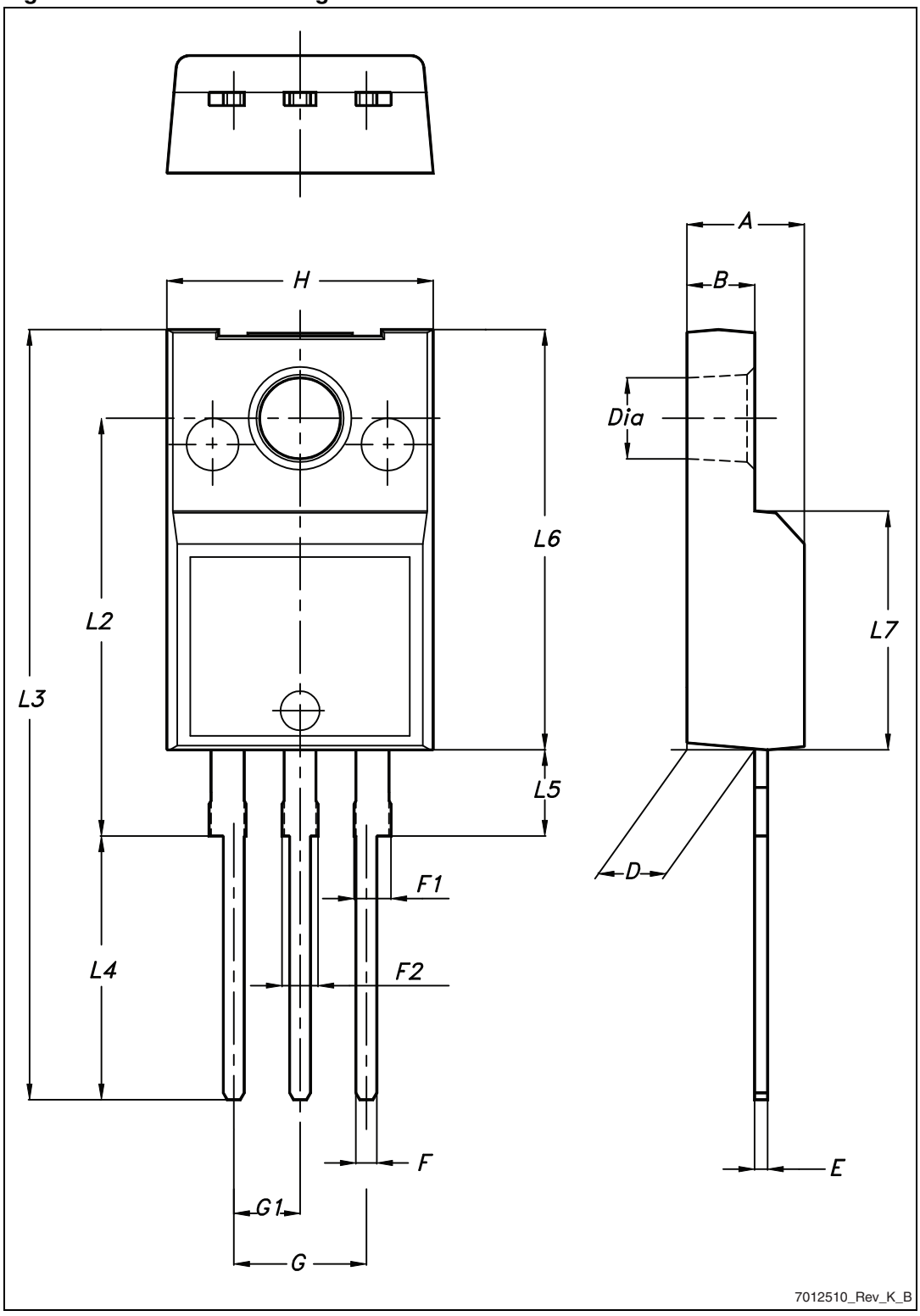


Table 10. DPAK (TO-252) mechanical data

| 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 | | |
| L1 | | 2.80 | |
| L2 | | 0.80 | |
| L4 | 0.60 | | 1 |
| R | | 0.20 | |
| V2 | 0° | | 8° |

**Figure 9. DPAK (TO-252) drawing**

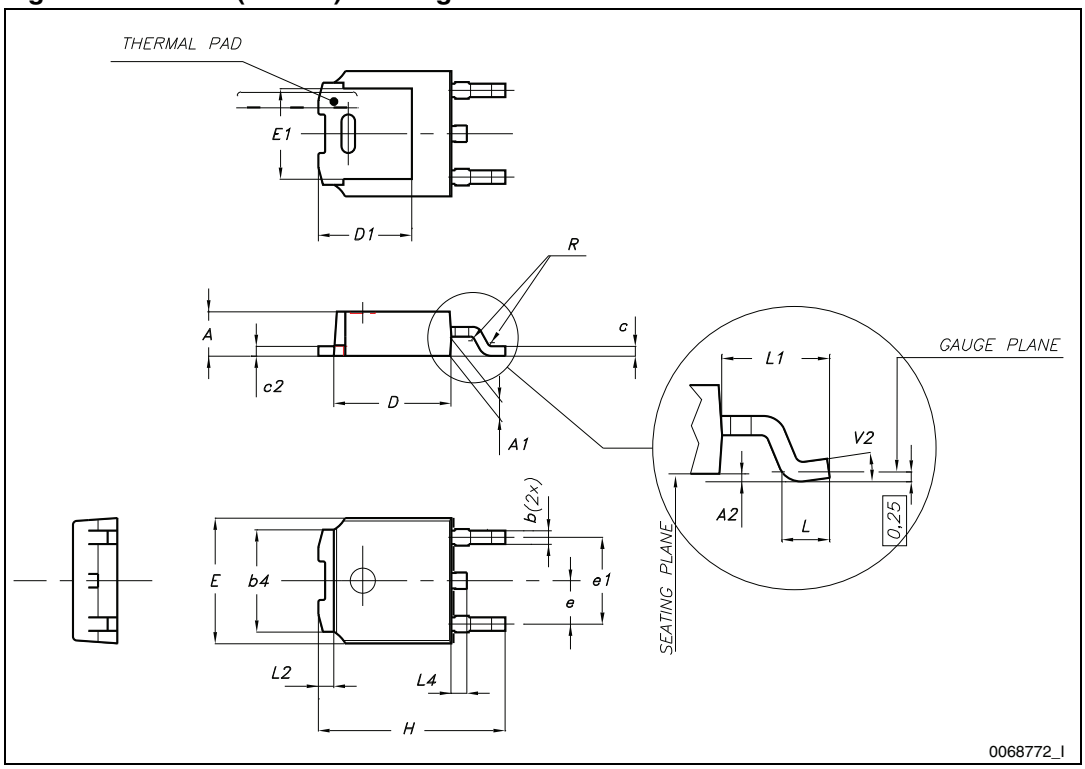
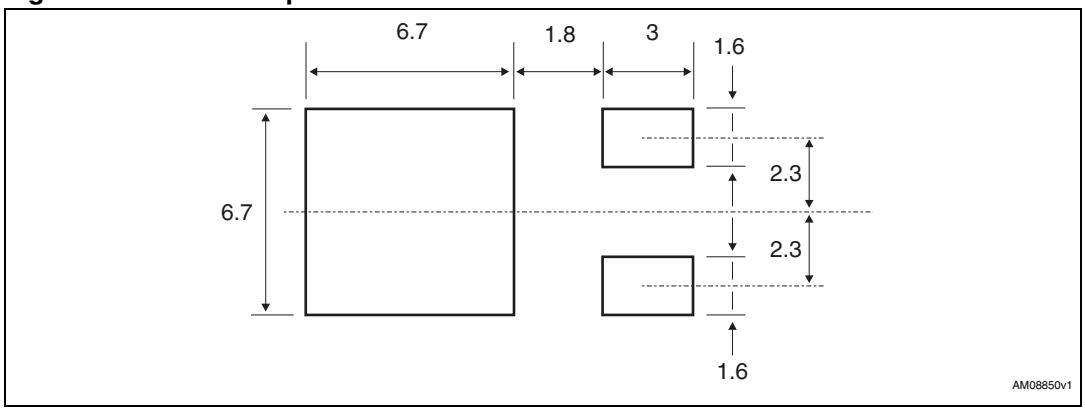



**Figure 10. DPAK footprint[a]**

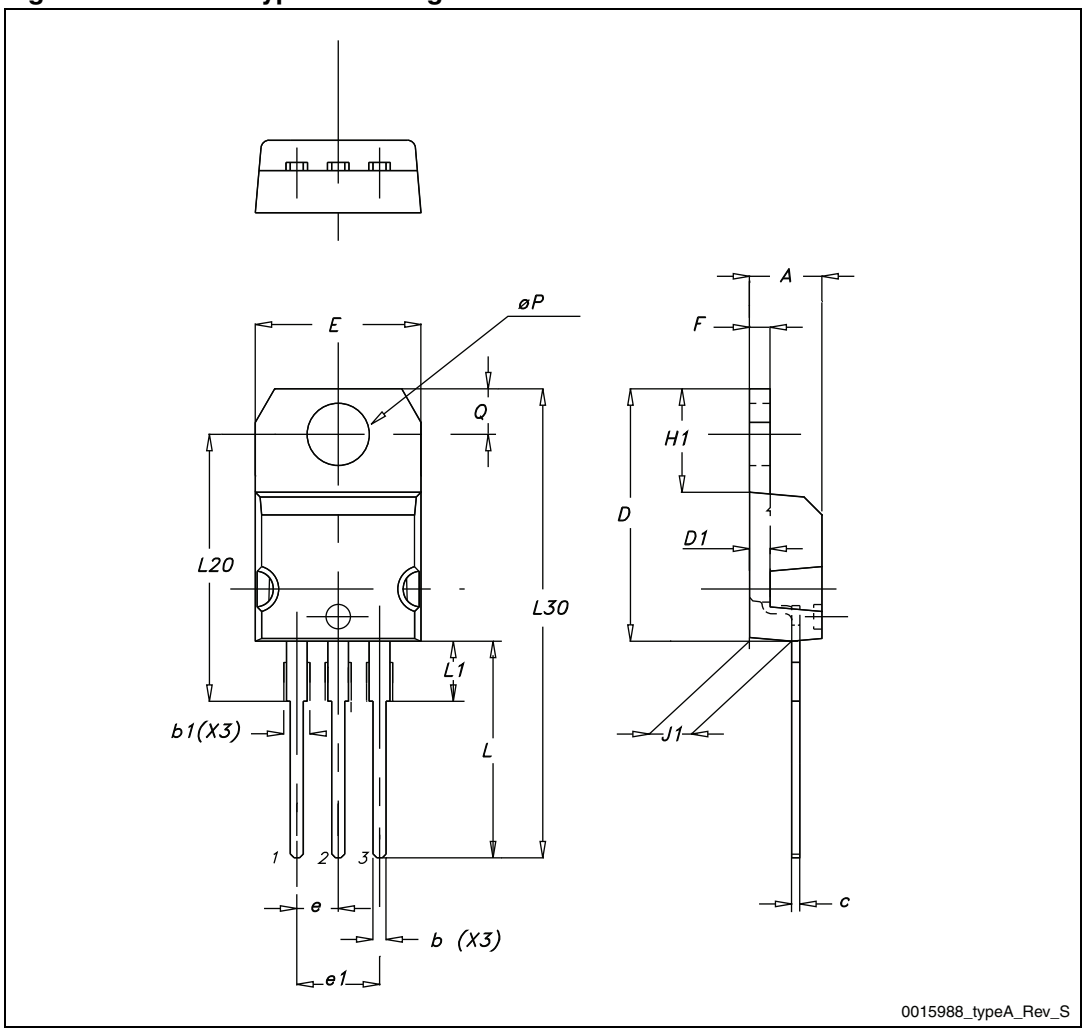



a. All dimensions are in millimeters

Table 11. 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 |

**Figure 11. TO-220 type A drawing**



# 5 Packaging information

Table 12. 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 | | | |

**Figure 12. Tape**

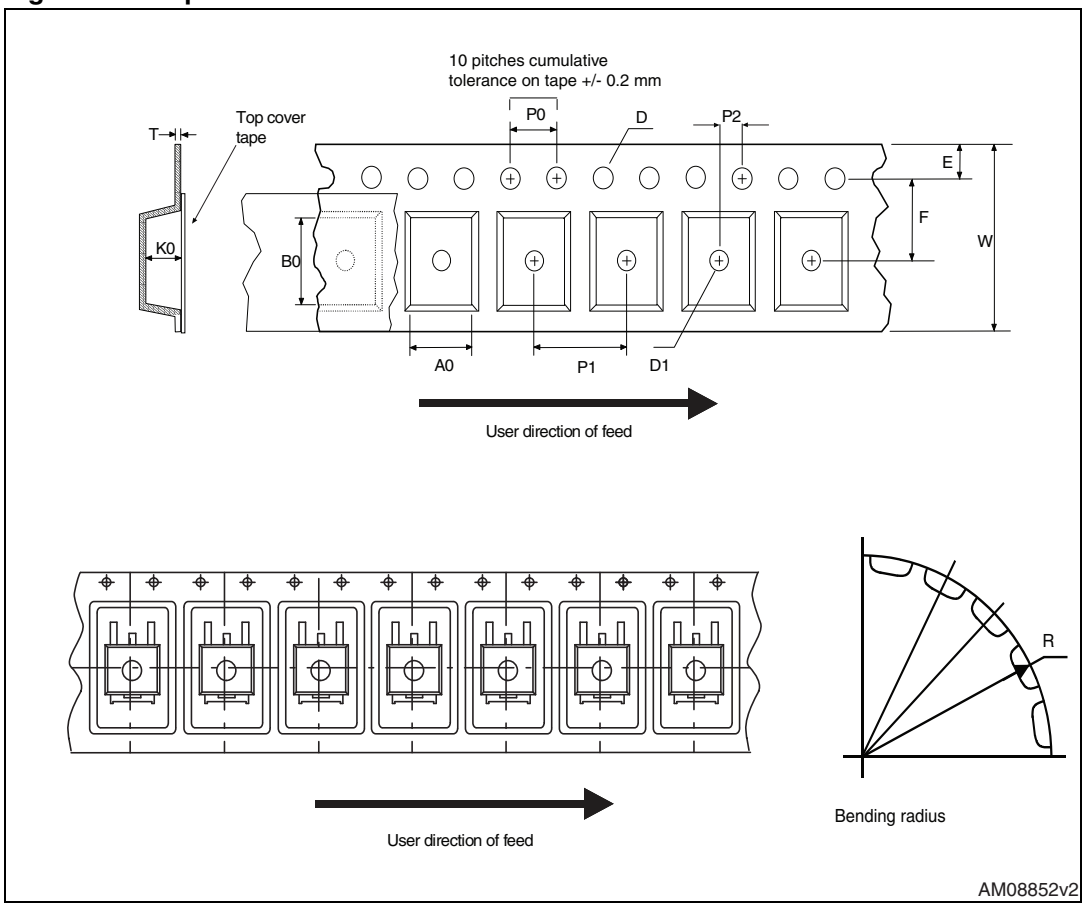
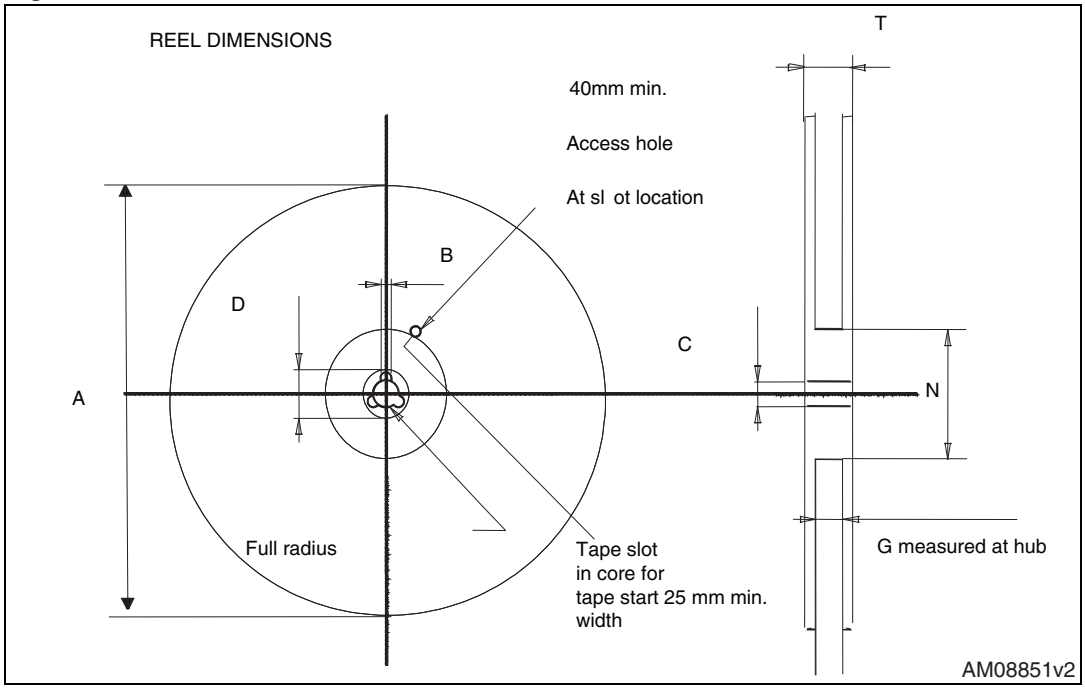



**Figure 13. Reel**



# 6 Revision history

Table 13. Document revision history

| Date | Revision | Changes |
|---|---|---|
| 17-Jul-2012 | 1 | First release. |
| 17-Oct-2012 | 2 | – Minor text changes in cover page<br>– Modified: title and $I_D$ value in cover page |