# STB6N80K5, STD6N80K5, STI6N80K5, STP6N80K5

## N-channel 800 V, 1.3 Ω typ., 4.5 A SuperMESH™ 5 Power MOSFET in $D^2PAK$, DPAK, $I^2PAK$ and TO-220 packages

**Datasheet ─ preliminary data**

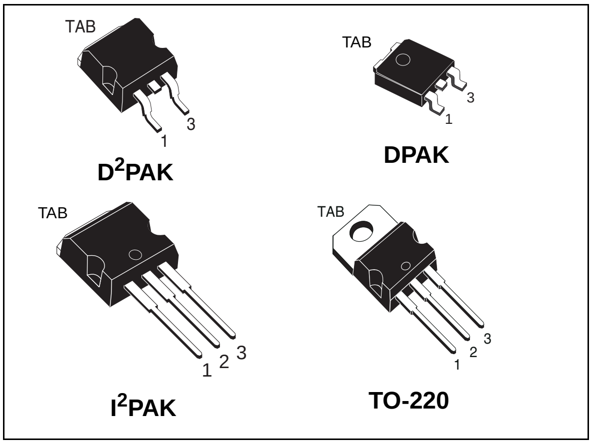
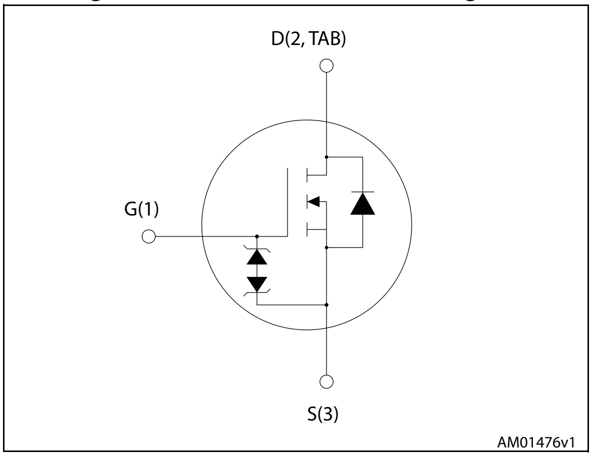



**Figure 1. Internal schematic diagram**




## Features

| Order codes | $V_{DS}$ | $R_{DS(on)}$max | $I_D$ | $P_{TOT}$ |
|---|---|---|---|---|
| STB6N80K5 | 800 V | 1.6 Ω | 4.5 A | 110 W |
| STD6N80K5 | | | | |
| STI6N80K5 | | | | |
| STP6N80K5 | | | | |

- TO-220 worldwide best $R_{DS(on)}$
- 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.

**Table 1. Device summary**

| Order code | Marking | Package | Packaging |
|---|---|---|---|
| STB6N80K5 | 6N80K5 | $D^2PAK$ | Tape and reel |
| STD6N80K5 | | DPAK | |
| STI6N80K5 | | $I^2PAK$ | Tube |
| STP6N80K5 | | TO-220 | |

# Contents

**1 Electrical ratings . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 3**

**2 Electrical characteristics . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 4**

**3 Test circuits . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 6**

**4 Package mechanical data . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 7**

**5 Packaging information . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 16**

**6 Revision history . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 19**

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{GS}$ | Gate- source voltage | 30 | V |
| $I_D$ | Drain current (continuous) at $T_C$=25 °C | 4.5 | A |
| $I_D$ | Drain current (continuous) at $T_C$=100 °C | 2.8 | A |
| $I_{DM}$ (1) | Drain current (pulsed) | 18 | A |
| $P_{TOT}$ | Total dissipation at $T_C$=25 °C | 110 | W |
| $I_{AR}$ | Max current during repetitive or single pulse avalanche (pulse width limited by $T_{jmax}$ ) | 1.5 | A |
| $E_{AS}$ | Single pulse avalanche energy (starting $T_J$=25 °C, $I_D$=$I_{AS}$, $V_{DD}$=50 V) | 150 | mJ |
| dv/dt (2) | Peak diode recovery voltage slope | 4.5 | V/ns |
| $T_j$<br>$T_{stg}$ | Operating junction temperature<br>Storage temperature | -55 to 150 | °C |

1. Pulse width limited by safe operating area.
2. $I_{SD} \leq$ 4.5 A, di/dt $\leq$ 100 A/µs, peak $V_{DS} \leq V_{(BR)DSS}$

**Table 3. Thermal data**

| Symbol | Parameter | Value | | | | Unit |
|---|---|---|---|---|---|---|
| | | $D^2PAK$ | DPAK | $I^2PAK$ | TO-220 | |
| $R_{thj\text{-}case}$ | Thermal resistance junction-case | 1.14 | | | | °C/W |
| $R_{thj\text{-}amb}$ | Thermal resistance junction-amb | | | 62.50 | 62.50 | |
| $R_{thj\text{-}pcb}$ | Thermal resistance junction-pcb minimum footprint | 30 | 50 | | | |

# 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<br>$T_j$=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, $I_D$=2 A | | 1.3 | 1.6 | 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 | - | 255 | - | pF |
| $C_{oss}$ | Output capacitance | | - | 20 | - | pF |
| $C_{rss}$ | Reverse transfer capacitance | | - | 0.8 | - | pF |
| $C_{o(tr)}$(1) | Equivalent capacitance time related | $V_{GS}$ = 0, $V_{DS}$ = 0 | - | TBD | - | pF |
| $C_{o(er)}$(2) | Equivalent capacitance energy related | | - | TBD | - | pF |
| $R_G$ | Intrinsic gate resistance | f=1MHz, $I_D$=0 | - | 5 | - | Ω |
| $Q_g$ | Total gate charge | $V_{DD}$=640 V, $I_D$=4.5 A<br>$V_{GS}$ =10 V | - | 7.5 | - | nC |
| $Q_{gs}$ | Gate-source charge | | - | TBD | - | nC |
| $Q_{gd}$ | Gate-drain charge | | - | 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 |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD}$=400 V, $I_D$=2 A, $R_G$=4.7 Ω, $V_{GS}$=10 V | - | TBD | - | ns |
| $t_r$ | Rise time | | - | TBD | - | ns |
| $t_{d(off)}$ | Turn-off delay time | | - | TBD | - | ns |
| $t_f$ | Fall time | | - | TBD | - | ns |

**Table 7. Source drain diode**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{SD}$ | Source-drain current | | - | | 4.5 | A |
| $I_{SDM}$(1) | Source-drain current (pulsed) | | - | | 18 | A |
| $V_{SD}$(2) | Forward on voltage | $I_{SD}$=4.5 A, $V_{GS}$=0 | - | | 1.5 | V |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$=4.5 A, $V_{DD}$= 60 V di/dt =100 A/µs, | - | 445 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 8.2 | | µC |
| $I_{RRM}$ | Reverse recovery current | | - | 37 | | A |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$=4.5 A,$V_{DD}$=60 V di/dt=100 A/µs, Tj=150 °C | - | 580 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 10 | | µC |
| $I_{RRM}$ | Reverse recovery current | | - | 35 | | A |

1. Pulse width limited by safe operating area
2. Pulsed: pulse duration = 300 µs, duty cycle 1.5%

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

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{(BR)GSO}$ | Gate-source breakdown voltage | $I_{GS}$=± 1mA, $I_D$=0 | 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**

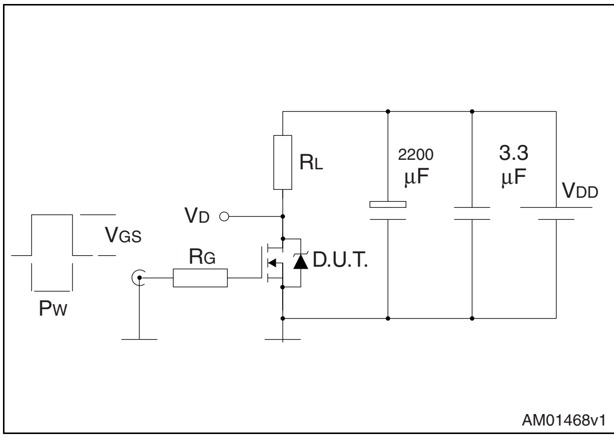



**Figure 3. Gate charge test circuit**

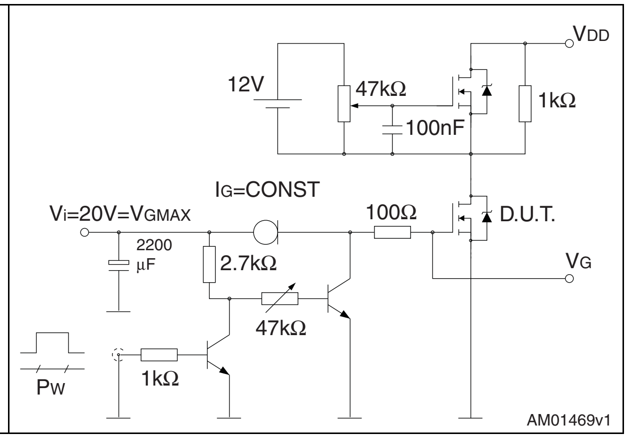



**Figure 4. Test circuit for inductive load switching and diode recovery times**

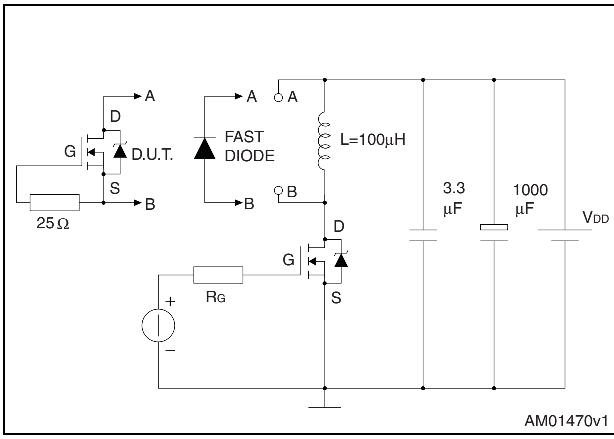



**Figure 5. Unclamped inductive load test circuit**

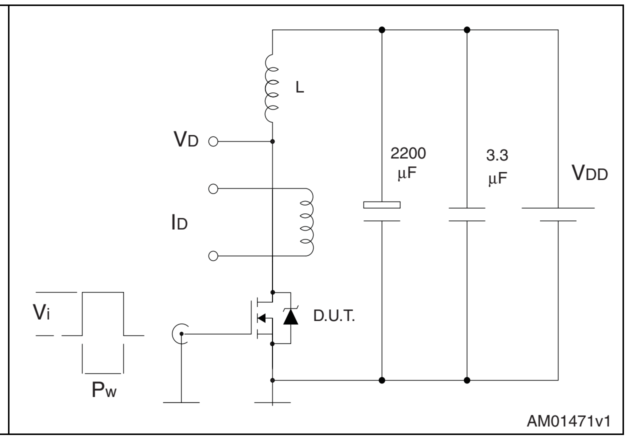



**Figure 6. Unclamped inductive waveform**

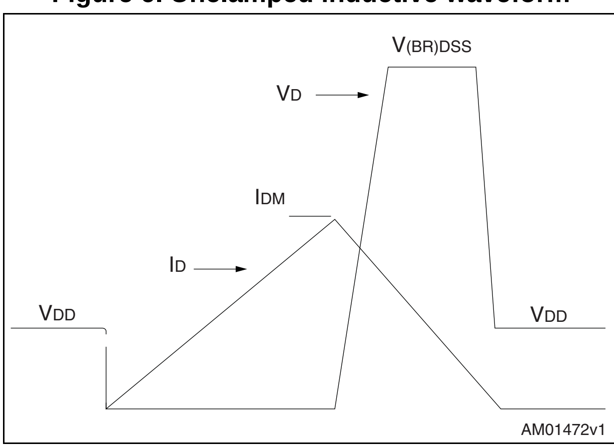
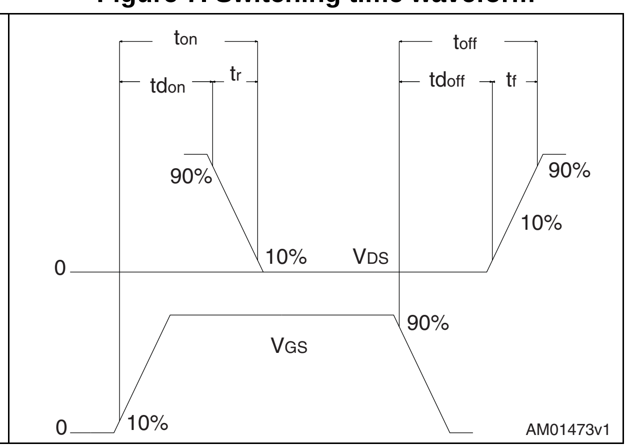



**Figure 7. Switching time waveform**



# 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. D²PAK 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 8. D²PAK drawing**

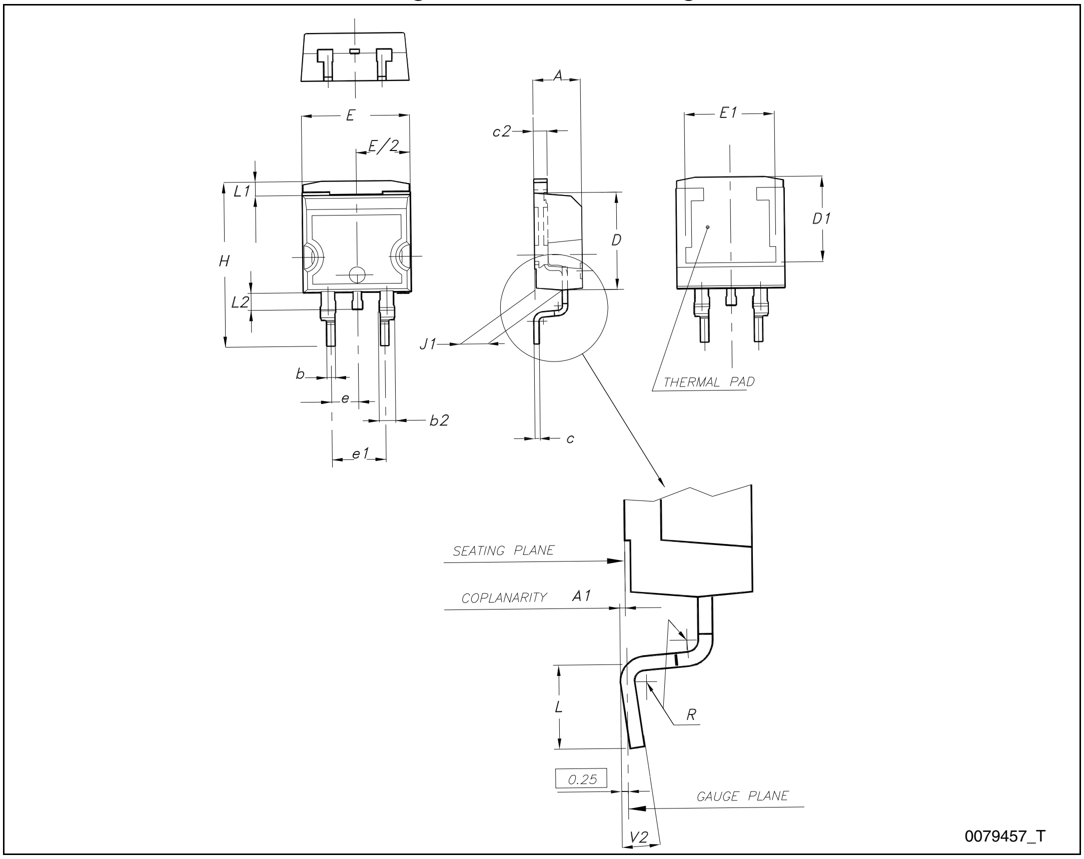
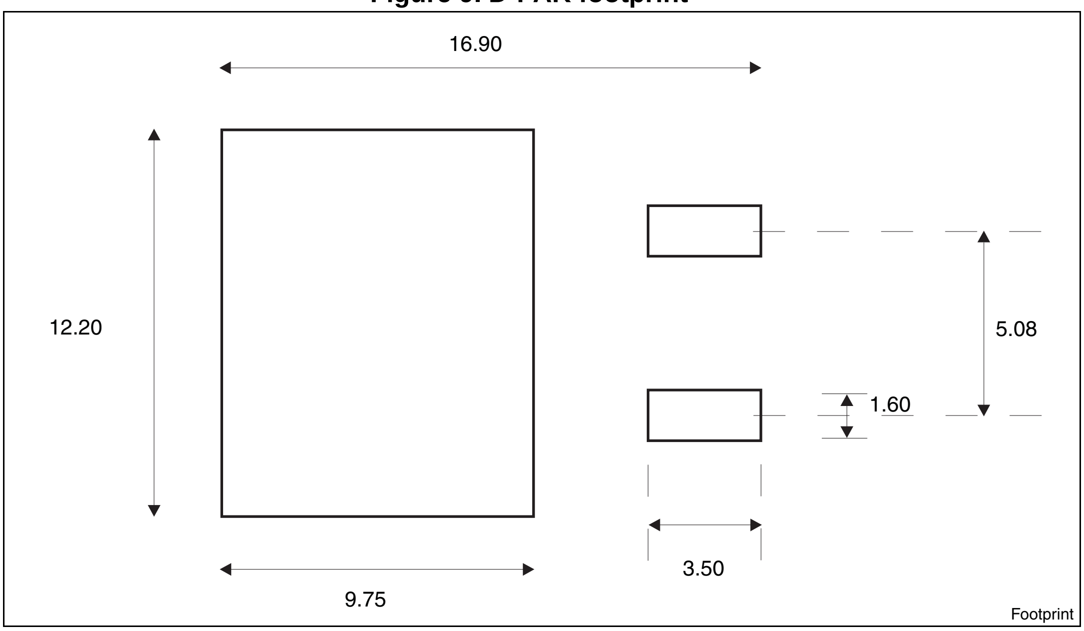



**Figure 9. D²PAK footprint**[a]




a. All dimension are in millimeters

**Table 10. DPAK 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 | 1.00 | | 1.50 |
| (L1) | | 2.80 | |
| L2 | | 0.80 | |
| L4 | 0.60 | | 1.00 |
| R | | 0.20 | |
| V2 | 0° | | 8° |

**Figure 10. DPAK drawing**

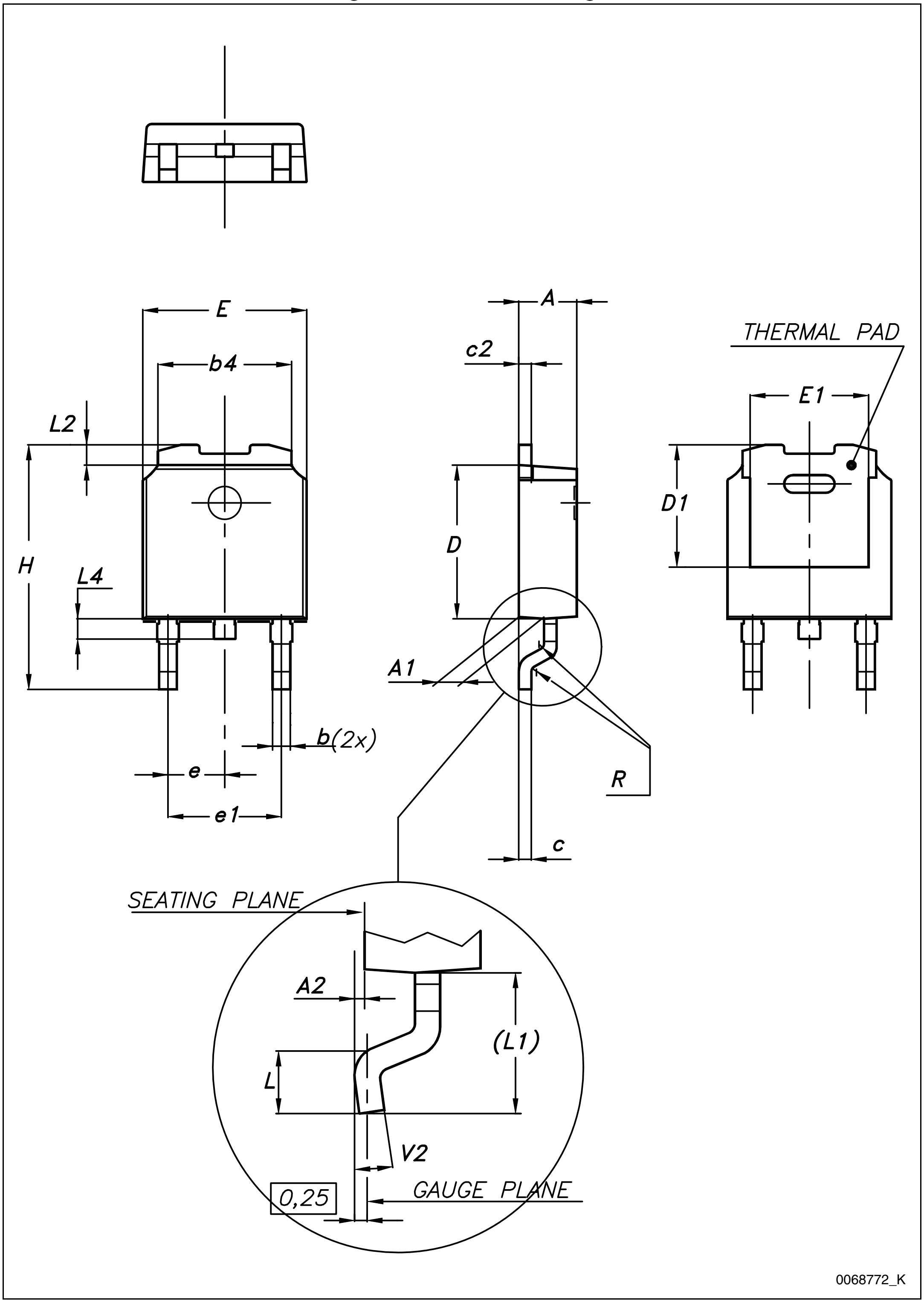
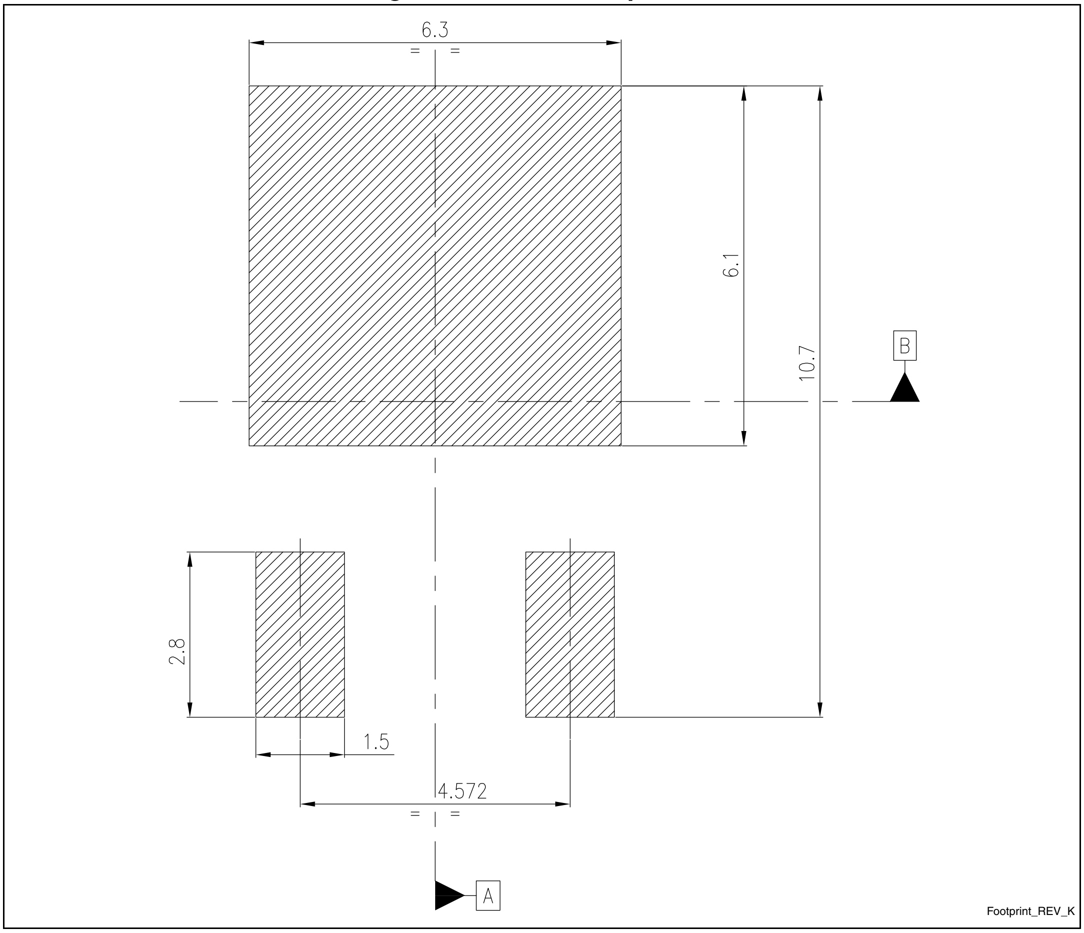


**Figure 11. DPAK footprint [(b)]**




b. All dimensions are in millimeters

**Table 11. I²PAK mechanical data**

| DIM. | mm. | | |
|---|---|---|---|
| | min. | typ. | max. |
| A | 4.40 | | 4.60 |
| A1 | 2.40 | | 2.72 |
| b | 0.61 | | 0.88 |
| b1 | 1.14 | | 1.70 |
| c | 0.49 | | 0.70 |
| c2 | 1.23 | | 1.32 |
| D | 8.95 | | 9.35 |
| e | 2.40 | | 2.70 |
| e1 | 4.95 | | 5.15 |
| E | 10 | | 10.40 |
| L | 13 | | 14 |
| L1 | 3.50 | | 3.93 |
| L2 | 1.27 | | 1.40 |

**Figure 12. I²PAK drawing**

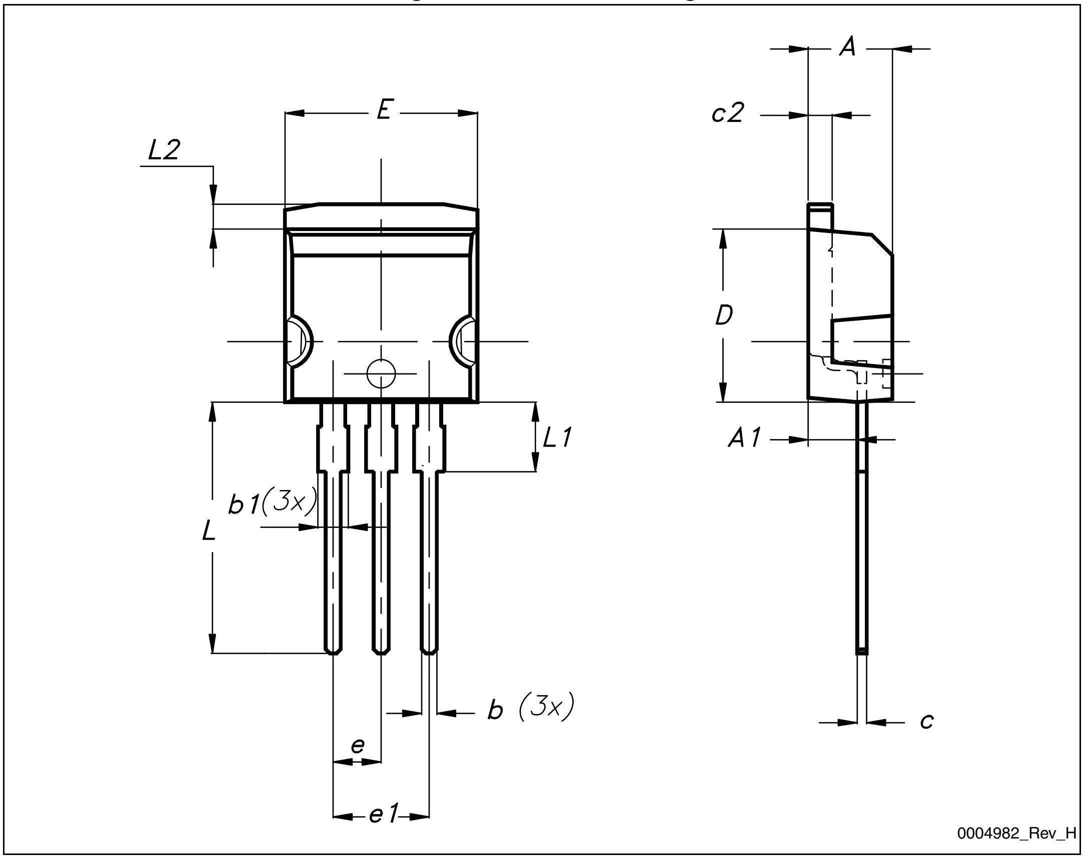
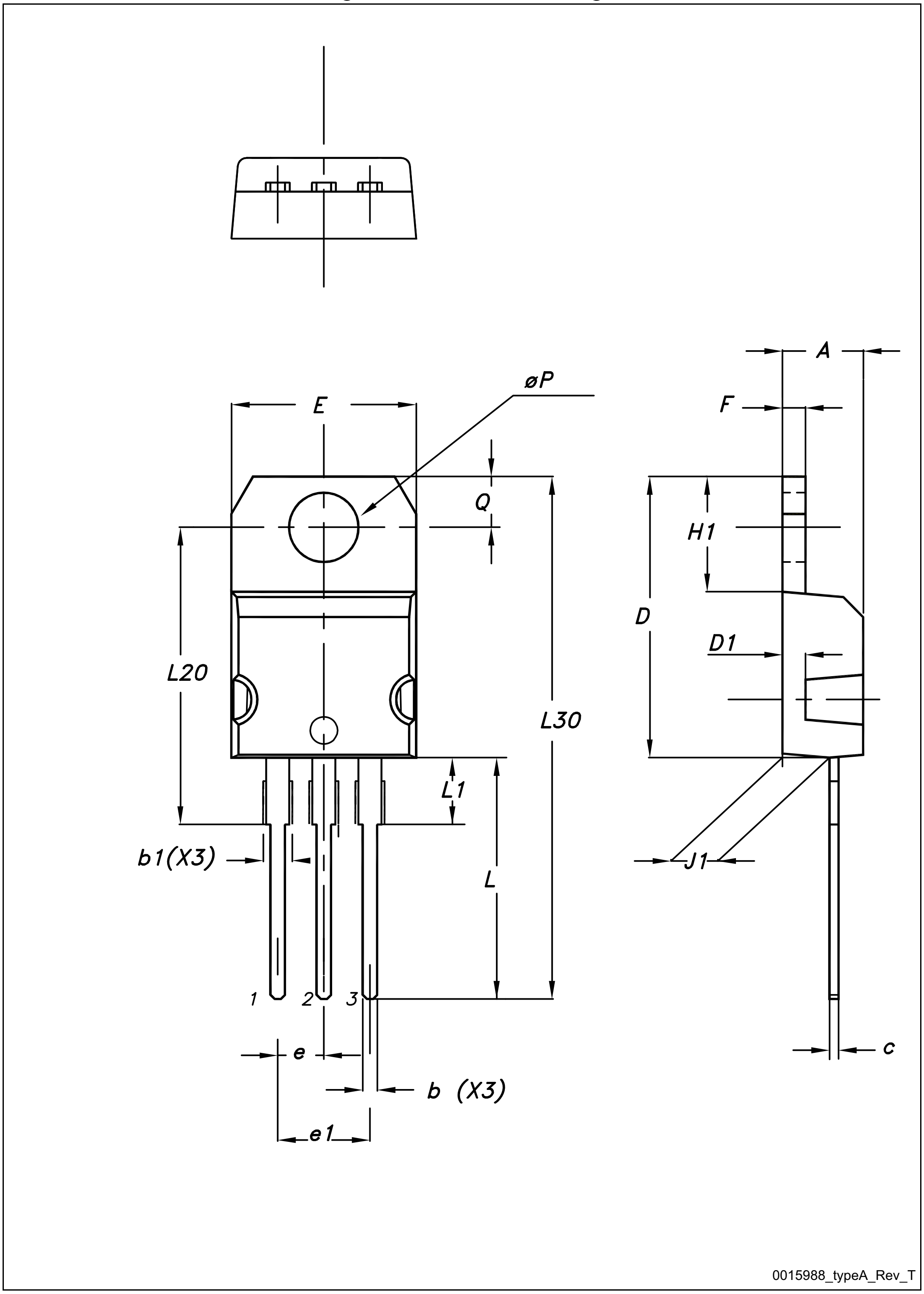


Table 12. TO-220 mechanical data

| 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 13. TO-220 drawing**



# 5 Packaging information

Table 13. D²PAK 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 | | | |

**Table 14. DPAK 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 14. Tape for D²PAK and DPAK

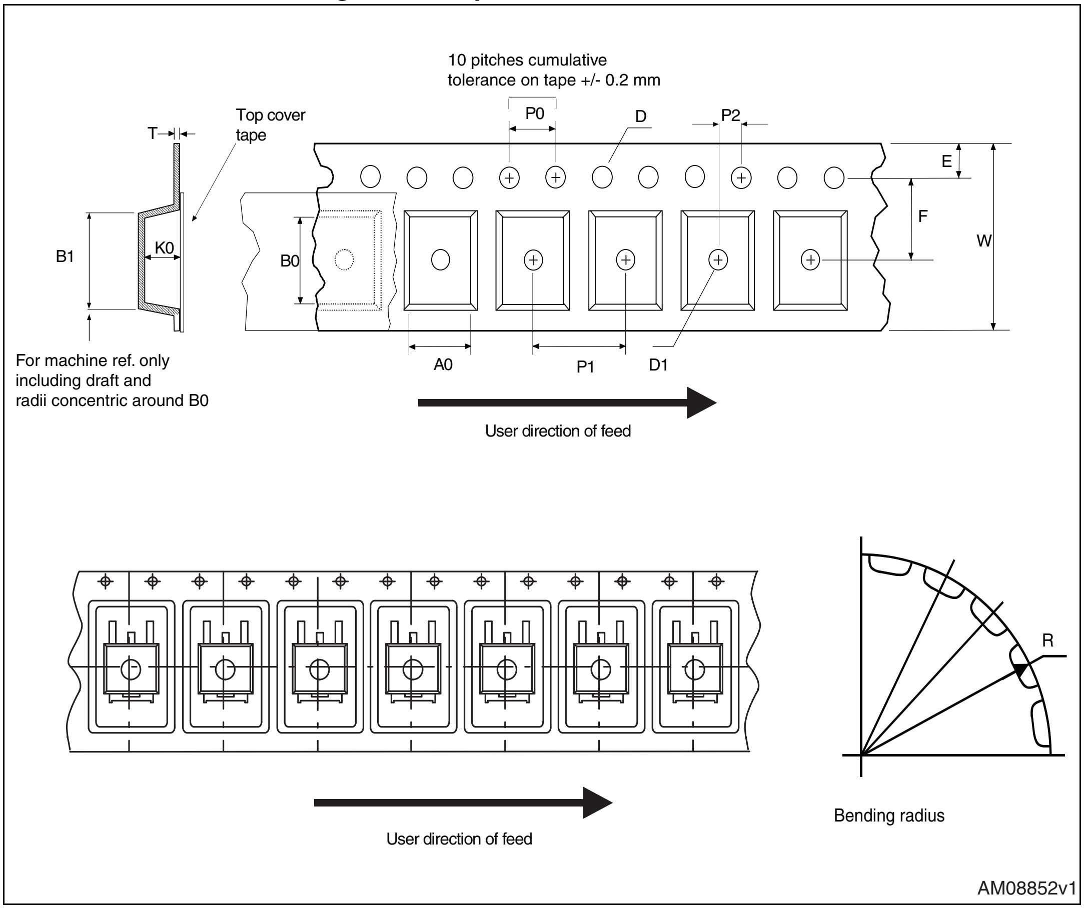
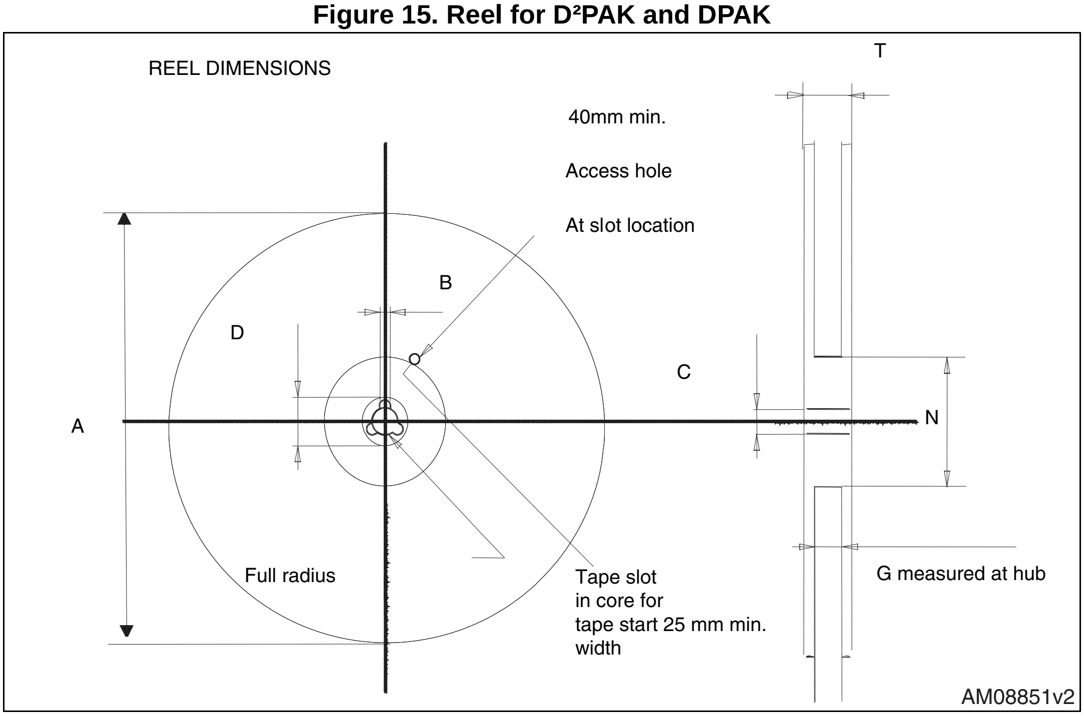



Figure 15. Reel for D²PAK and DPAK



# 6 Revision history

**Table 15. Document revision history**

| Date | Revision | Changes |
|---|---|---|
| 28-May-2013 | 1 | First release. |