

N-channel 620 V, 1.7 Ω typ., 3.8 A SuperMESH3™ Power MOSFETs in D²PAK and DPAK packages

Datasheet - production data

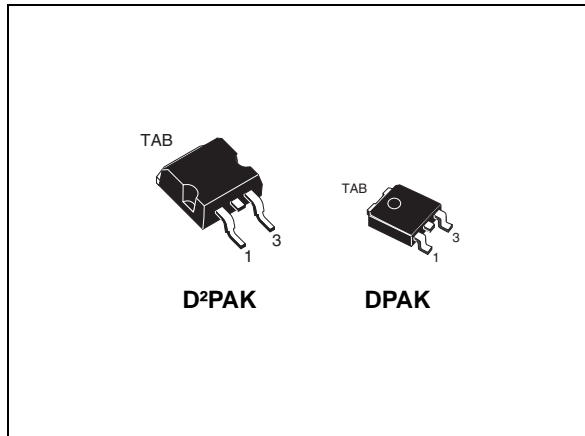
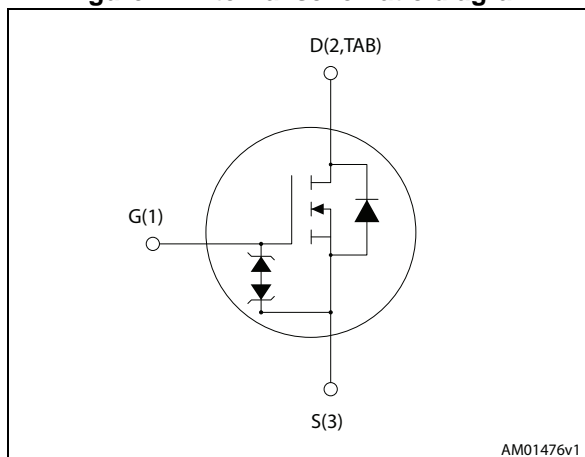


Figure 1. Internal schematic diagram



Features

| Order codes | V _{DS} | R _{DS(on)} max. | I _D | P _W |
|-------------|-----------------|--------------------------|----------------|----------------|
| STB4N62K3 | 620 V | 2 Ω | 3.8 A | 70 W |
| STD4N62K3 | | | | |

- 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.

Table 1. Device summary

| Order code | Marking | Packages | Packaging |
|------------|---------|--------------------|---------------|
| STB4N62K3 | 4N62K3 | D ² PAK | Tape and reel |
| STD4N62K3 | | DPAK | |

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1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|----------------|--|-------------|------------------|
| V_{DS} | Drain-source voltage | 620 | V |
| V_{GS} | Gate- source voltage | ± 30 | V |
| I_D | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$ | 3.8 | A |
| I_D | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$ | 2 | A |
| $I_{DM}^{(1)}$ | Drain current (pulsed) | 15.2 | A |
| P_{TOT} | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$ | 70 | W |
| I_{AR} | Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max) | 3.8 | A |
| E_{AS} | Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{V}$) | 115 | mJ |
| $V_{ESD(G-S)}$ | Gate source ESD(HBM-C = 100 pF, R = 1.5 k Ω) | 2500 | V |
| $dv/dt^{(2)}$ | Peak diode recovery voltage slope | 12 | V/ns |
| V_{ISO} | Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; $T_C = 25\text{ }^\circ\text{C}$) | | V |
| 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. $I_{SD} \leq 3.8\text{ A}$, $di/dt = 400\text{ A}/\mu\text{s}$, $V_{DD} = 80\% V_{(BR)DSS}$, $V_{DS\text{ peak}} \leq V_{(BR)DSS}$.

Table 3. Thermal data

| Symbol | Parameter | Value | | Unit |
|---------------------|--------------------------------------|--------------------|------|---------------------------|
| | | D ² PAK | DPAK | |
| $R_{thj-case}$ | Thermal resistance junction-case max | | 1.79 | $^\circ\text{C}/\text{W}$ |
| $R_{thj-pcb}^{(1)}$ | Thermal resistance junction-pcb max | 30 | 50 | $^\circ\text{C}/\text{W}$ |

1. When mounted on 1inch² FR-4 board, 2 oz Cu.

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 | $V_{GS} = 0, I_D = 1\text{ mA}$ | 620 | | | V |
| I_{DSS} | Zero gate voltage drain current | $V_{GS} = 0, V_{DS} = 620\text{V}$ | | | 1 | μA |
| | | $V_{GS} = 0, V_{DS} = 620\text{V}, T_C = 125\text{ °C}$ | | | 50 | μA |
| I_{GSS} | Gate-body leakage current | $V_{DS} = 0, V_{GS} = \pm 20\text{ V}$ | | | ± 10 | μA |
| $V_{GS(th)}$ | 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 | $V_{GS} = 10\text{ V}, I_D = 1.9\text{ A}$ | | 1.7 | 2 | Ω |

Table 5. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------------------|-------------------------------|---|------|------|------|----------|
| C_{iss} | Input capacitance | $V_{DS} = 50\text{ V}, f = 1\text{ MHz}, V_{GS} = 0$ | | 550 | | pF |
| C_{oss} | Output capacitance | | | 42 | | pF |
| C_{rss} | Reverse transfer capacitance | | | 7 | | pF |
| $C_{oss\text{ eq.}}^{(1)}$ | Equivalent output capacitance | $V_{DS} = 0\text{ to }496\text{ V}, V_{GS} = 0$ | | 27 | | pF |
| R_G | Intrinsic gate resistance | $f = 1\text{ MHz open drain}$ | 2 | 5 | 10 | Ω |
| Q_g | Total gate charge | $V_{DD} = 496\text{ V}, I_D = 3.8\text{ A}, V_{GS} = 10\text{ V}$ (see Figure 18) | | 22 | | nC |
| Q_{gs} | Gate-source charge | | | 4 | | nC |
| Q_{gd} | Gate-drain charge | | | 13 | | nC |

1. $C_{oss\text{ eq.}}$ 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 | $V_{DD} = 300\text{ V}$, $I_D = 1.9\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 17) | - | 10 | - | ns |
| t_r | Rise time | | - | 9 | - | ns |
| $t_{d(off)}$ | Turn-off-delay time | | - | 29 | - | ns |
| t_f | Fall time | | - | 19 | - | ns |

Table 7. Source drain diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|--|------|------|------|---------------|
| I_{SD} | Source-drain current | | - | | 3.8 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | - | | 15.2 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $I_{SD} = 3.8\text{ A}$, $V_{GS} = 0$ | - | | 1.6 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 3.8\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ (see Figure 22) | - | 220 | | ns |
| Q_{rr} | Reverse recovery charge | | - | 1.4 | | μC |
| I_{RRM} | Reverse recovery current | | - | 13 | | A |
| t_{rr} | Reverse recovery time | $I_{SD} = 3.8\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 22) | - | 270 | | ns |
| Q_{rr} | Reverse recovery charge | | - | 1.9 | | μC |
| I_{RRM} | Reverse recovery current | | - | 14 | | 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 | $I_{GS} = \pm 1\text{ mA}$, $I_D = 0$ | 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.

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for D²PAK

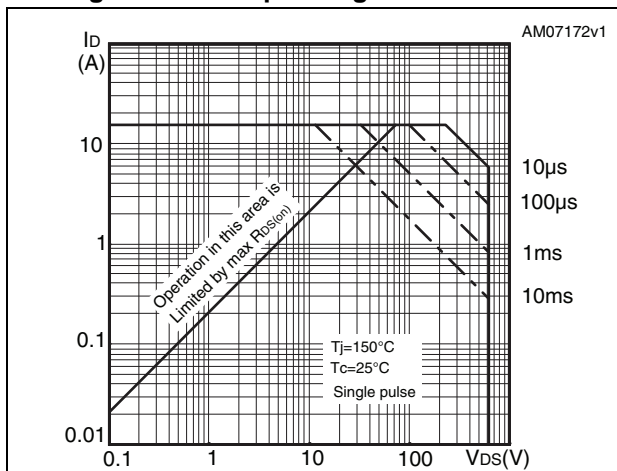


Figure 3. Thermal impedance for D²PAK

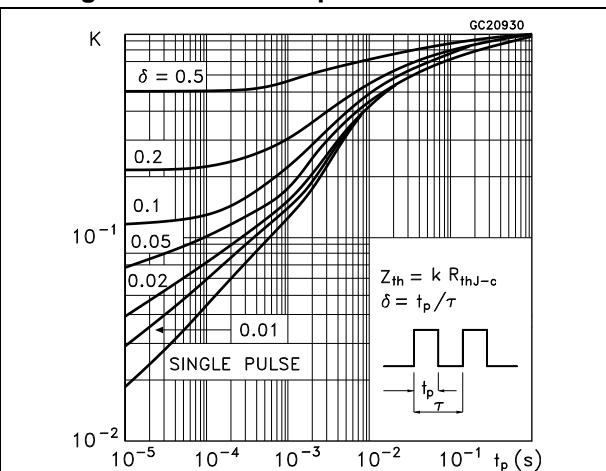


Figure 4. Safe operating area for DPAK

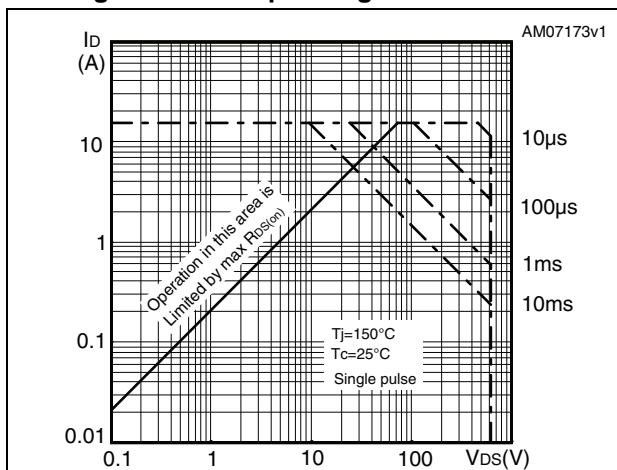


Figure 5. Thermal impedance for DPAK

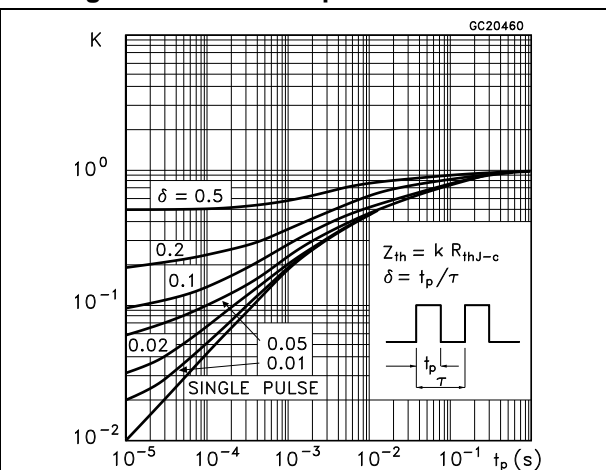


Figure 6. Output characteristics

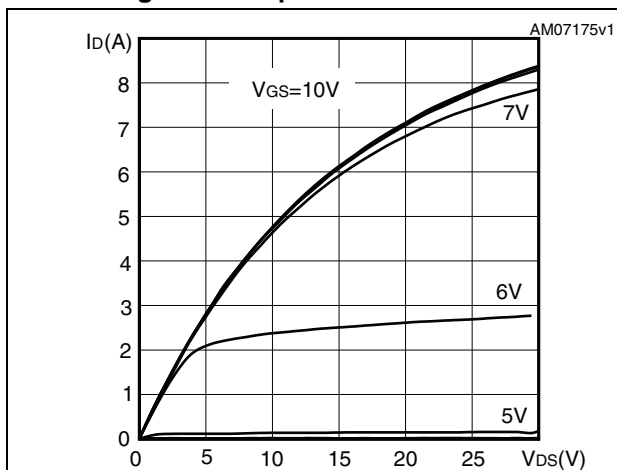


Figure 7. Transfer characteristics

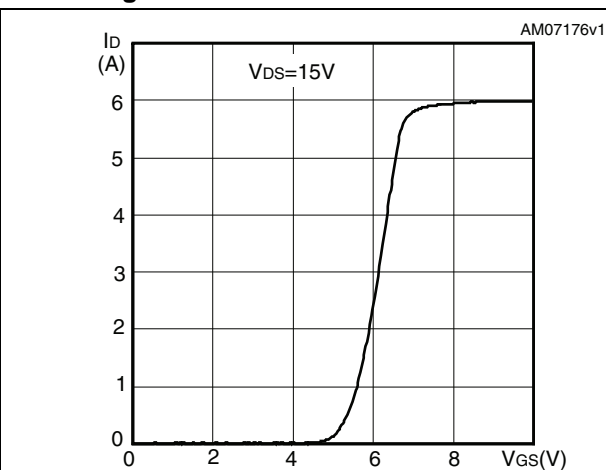


Figure 8. Gate charge vs gate-source voltage

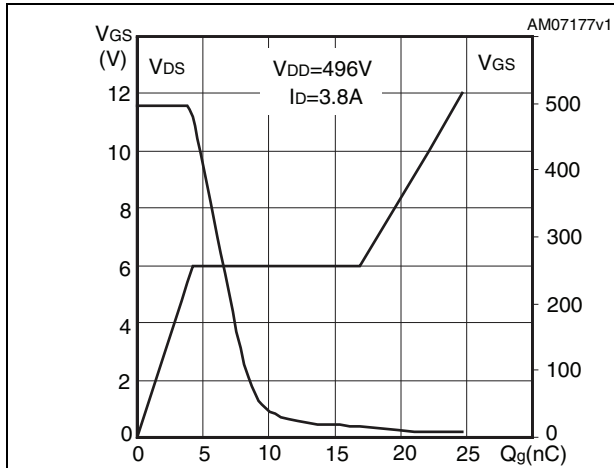


Figure 9. Static drain-source on resistance

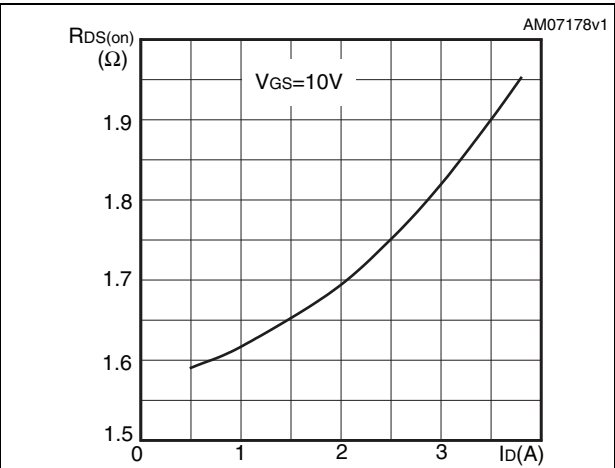


Figure 10. Capacitance variations

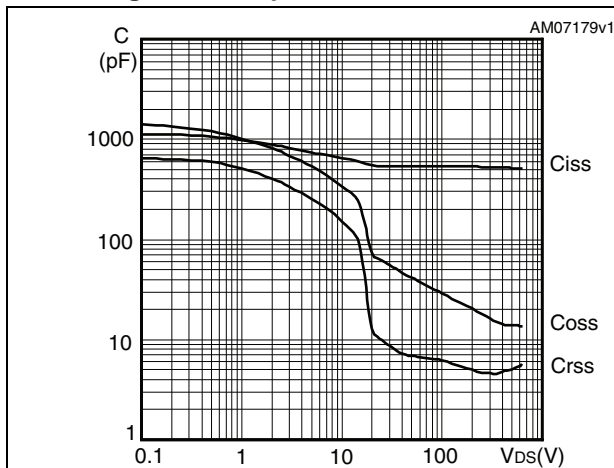


Figure 11. Output capacitance stored energy

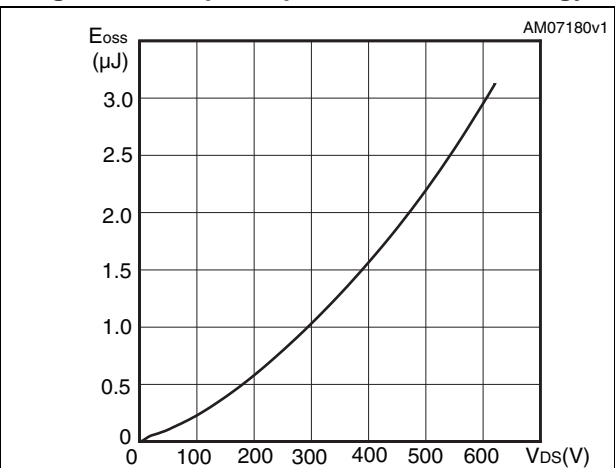


Figure 12. Normalized gate threshold voltage vs temperature

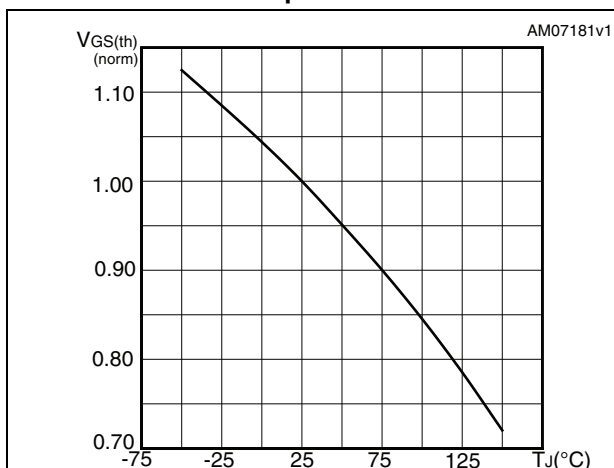


Figure 13. Normalized on-resistance vs temperature

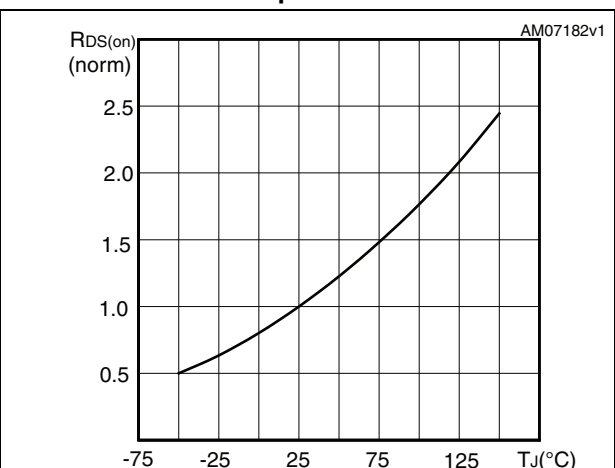


Figure 14. Maximum avalanche energy vs starting Tj

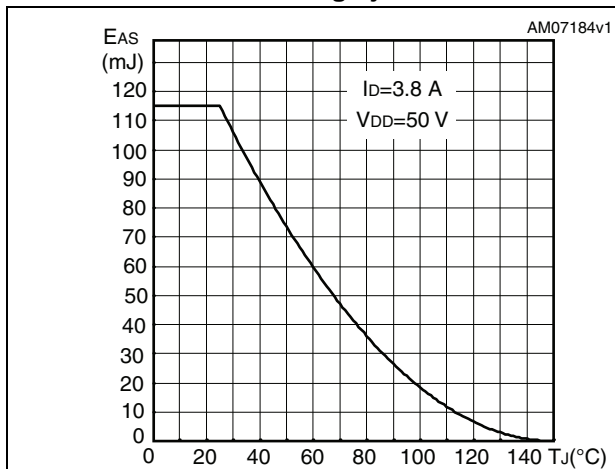


Figure 15. Normalized BV_{DSS} vs temperature

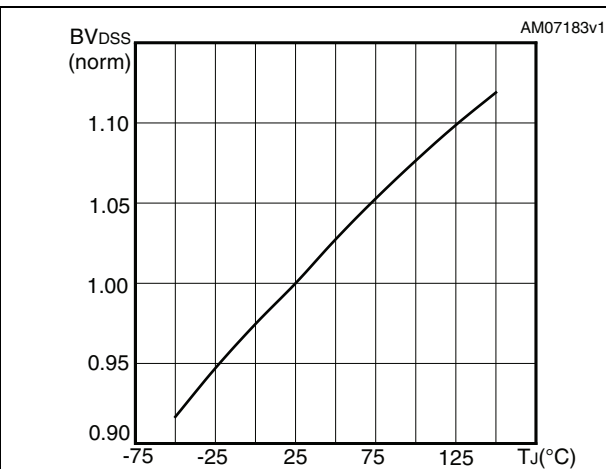
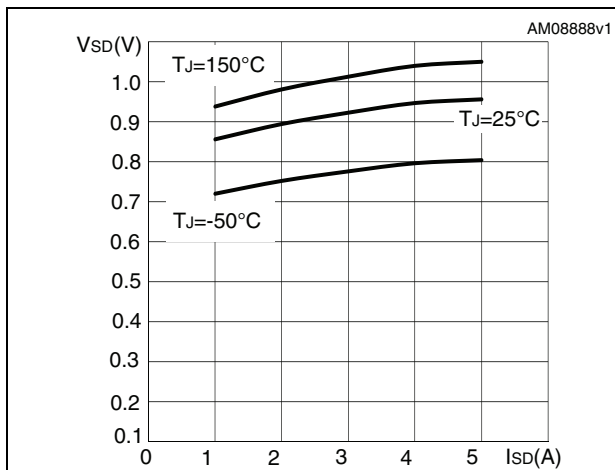


Figure 16. Source-drain diode forward characteristics



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 (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 23. D²PAK (TO-263) drawing

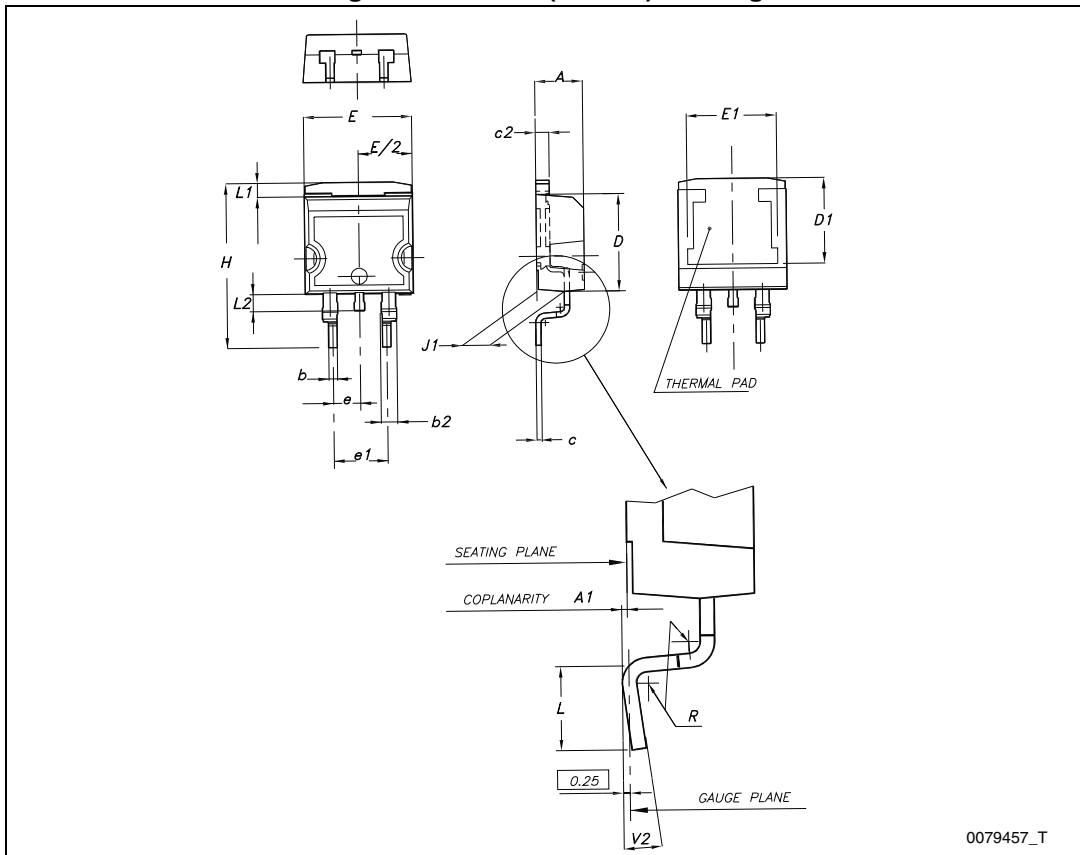
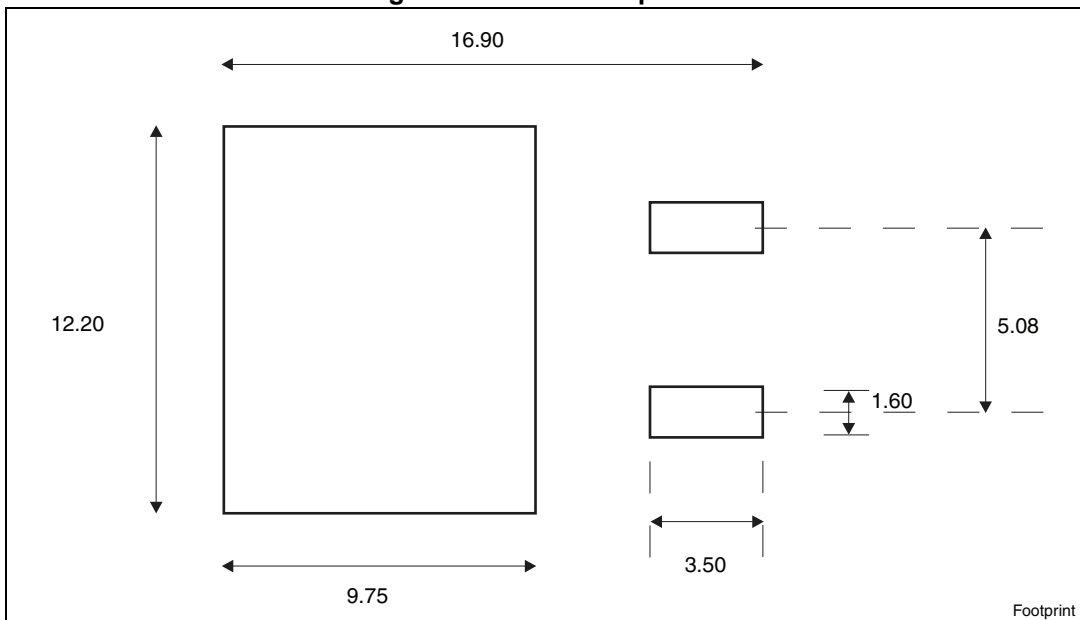


Figure 24. D²PAK footprint^(a)



a. All dimension are in millimeters

Table 10. DPAK (TO-252) type A 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 25. DPAK (TO-252) type A drawing

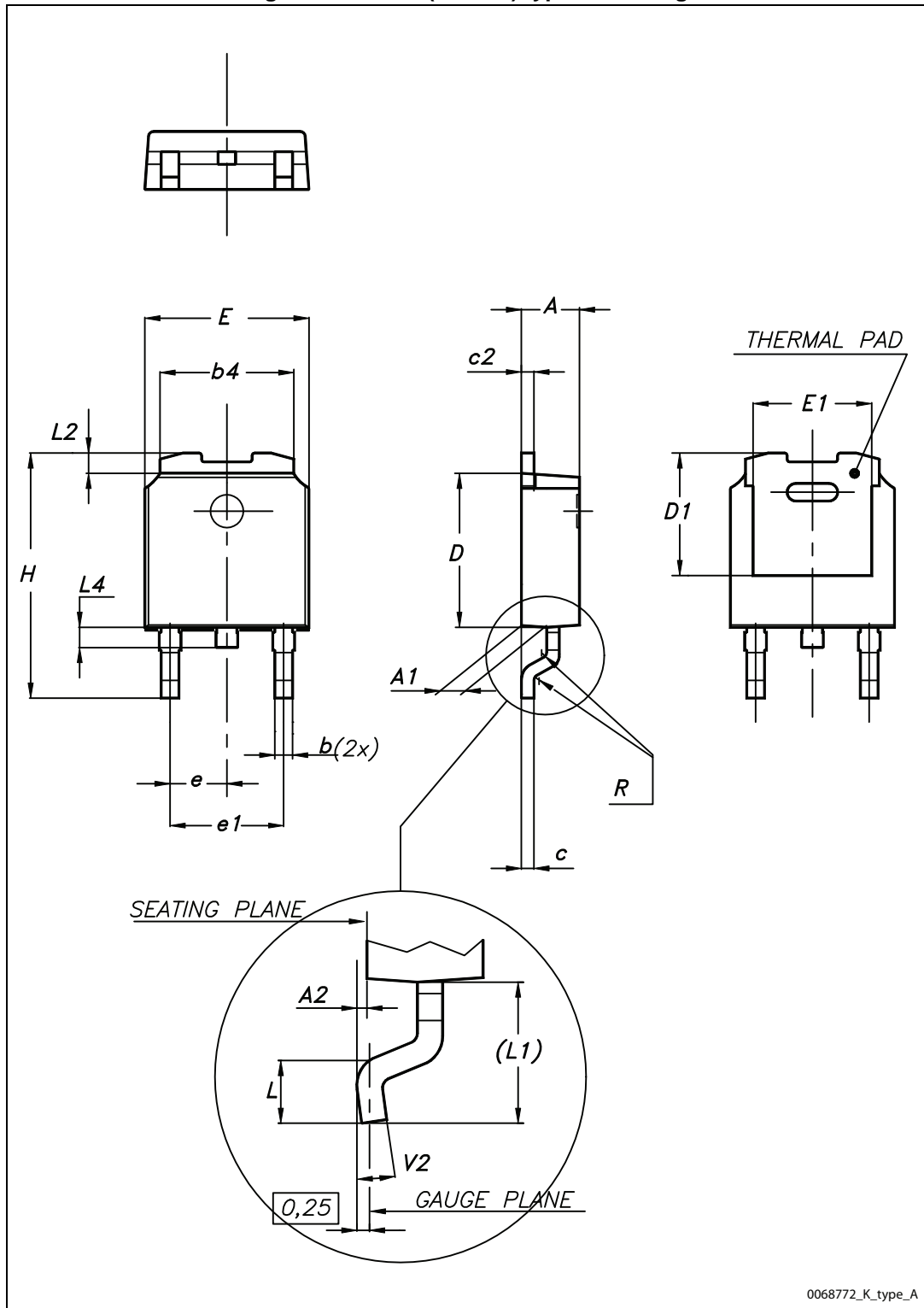


Table 11. DPAK (TO-252) type E mechanical data

| Dim. | mm | | |
|------|------|-------|-------|
| | Min. | Typ. | Max. |
| A | 2.18 | | 2.39 |
| A2 | | | 0.13 |
| b | 0.65 | | 0.884 |
| b4 | 4.95 | | 5.46 |
| c | 0.46 | | 0.61 |
| c2 | 0.46 | | 0.60 |
| D | 5.97 | | 6.22 |
| D1 | 5.21 | | |
| E | 6.35 | | 6.73 |
| E1 | 4.32 | | |
| e | | 2.286 | |
| e1 | | 4.572 | |
| H | 9.94 | | 10.34 |
| L | 1.50 | | 1.78 |
| L1 | | 2.74 | |
| L2 | 0.89 | | 1.27 |
| L4 | | | 1.02 |

Figure 26. DPAK (TO-252) type E drawing

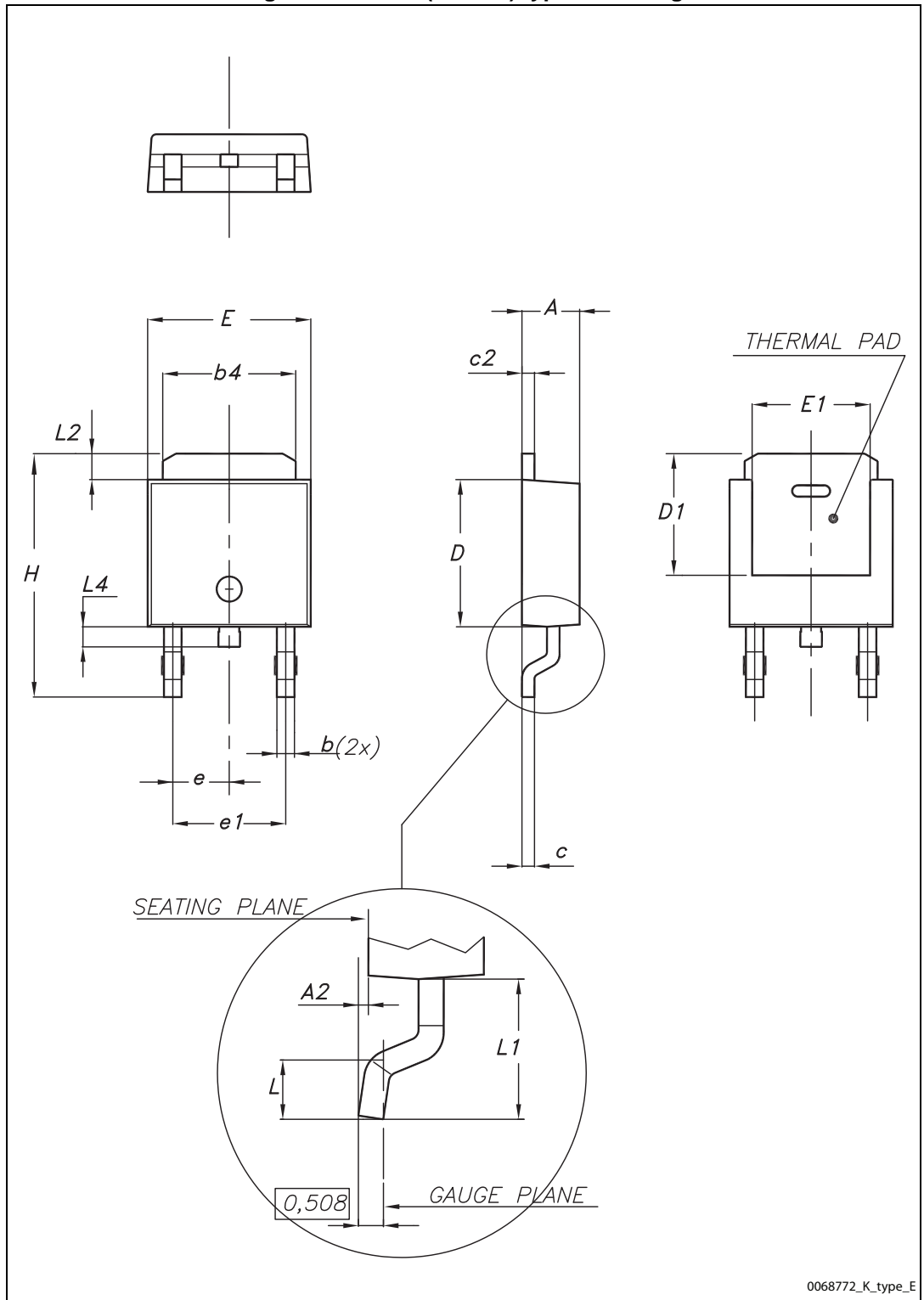
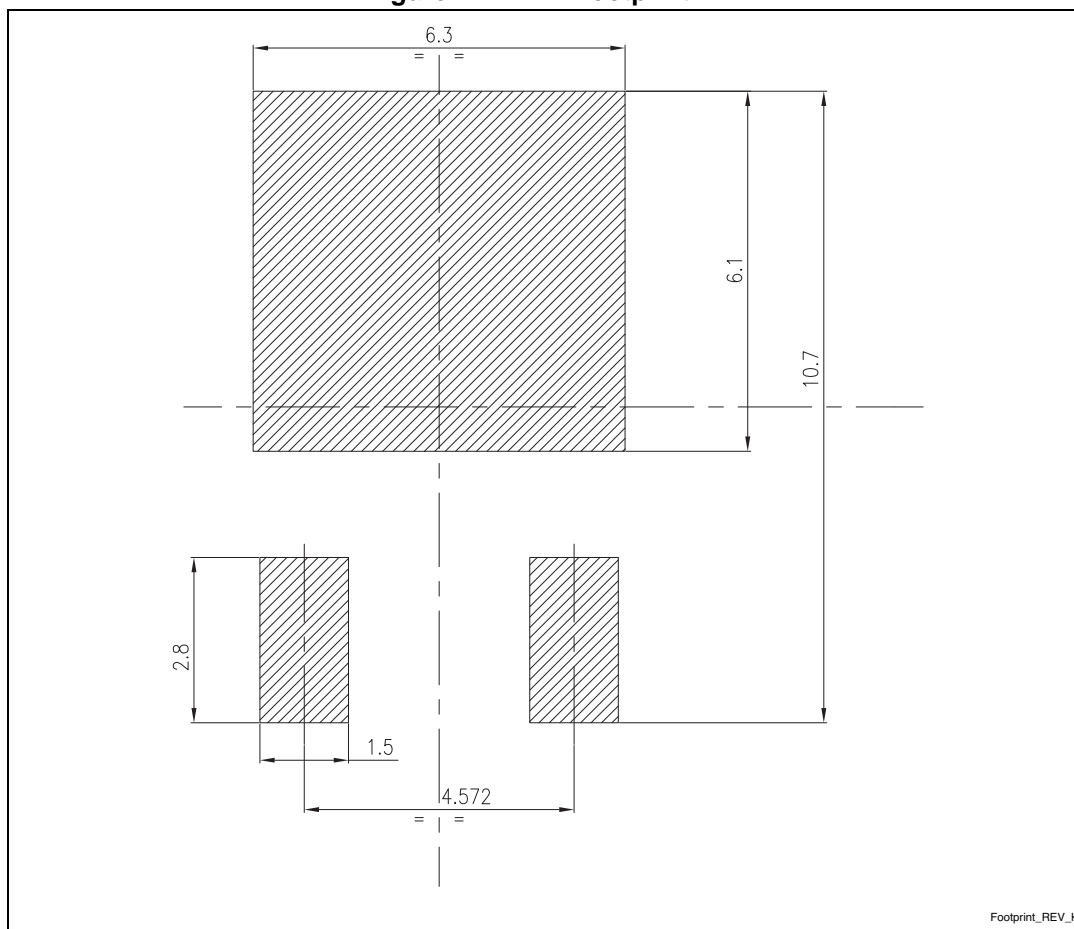


Figure 27. DPAK footprint (b)



Footprint_REV_K

b. All dimensions are in millimeters

5 Packaging mechanical data

Table 12. D²PAK (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 | | | |

Table 13. 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 |

Table 13. DPAK (TO-252) tape and reel mechanical data (continued)

| Tape | | | Reel | | |
|------|------|------|------|------|------|
| Dim. | mm | | Dim. | mm | |
| | Min. | Max. | | Min. | Max. |
| P2 | 1.9 | 2.1 | | | |
| R | 40 | | | | |
| T | 0.25 | 0.35 | | | |
| W | 15.7 | 16.3 | | | |

Figure 28. Tape for D²PAK (TO-263) and DPAK (TO-252)

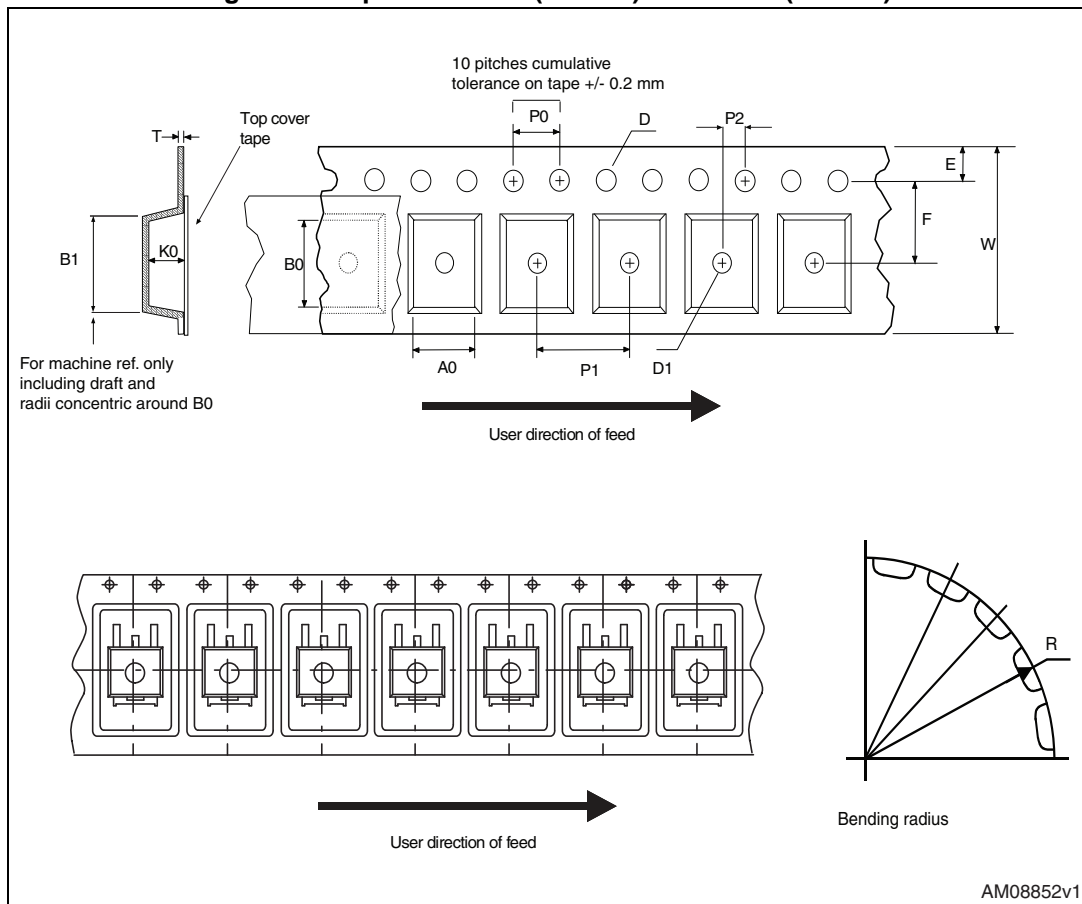
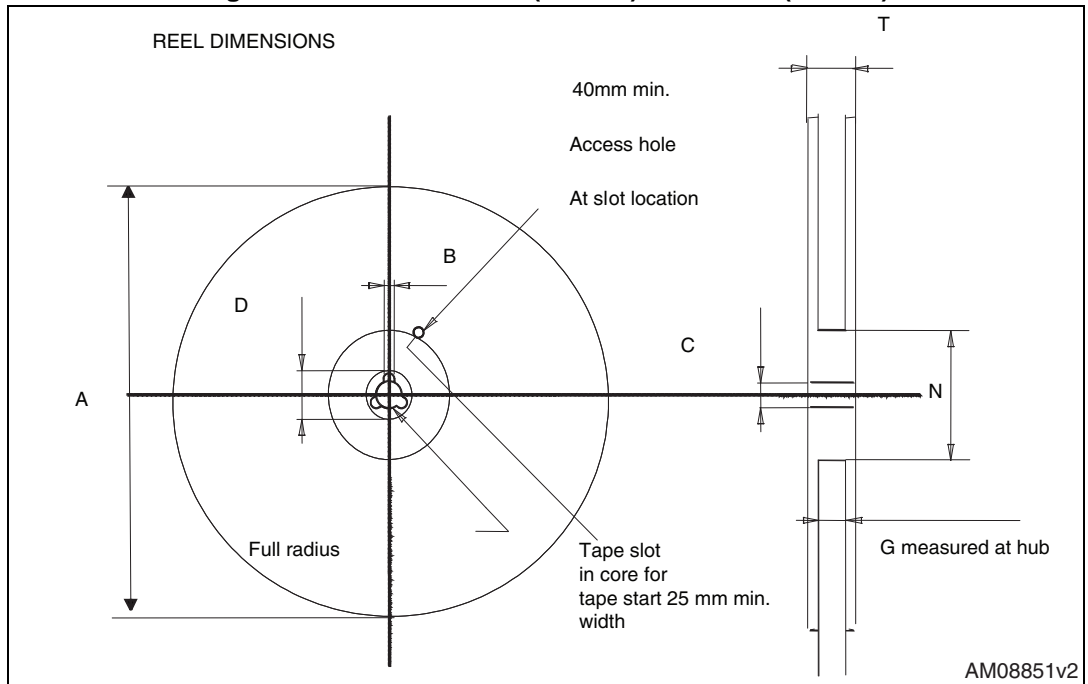


Figure 29. Reel for D²PAK (TO-263) and DPAK (TO-252)



6 Revision history

Table 14. Document revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 16-Dec-2010 | 1 | First release. |
| 26-Apr-2012 | 2 | Added min and max values for R_G in Table 5: Dynamic and Section 5: Packaging mechanical data . Updated Section 4: Package mechanical data . Minor text changes. |
| 09-Sep-2013 | 3 | – Updated: Section 4: Package mechanical data – Minor text changes |

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