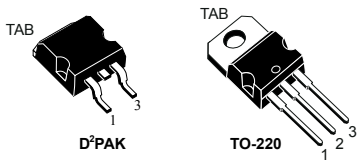
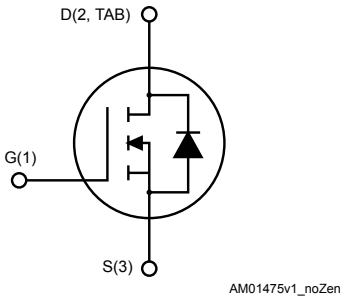
Datasheet

# N-channel 200 V, 15 mΩ, 65 A, MDmesh™ M5 Power MOSFETs in D²PAK and TO-220 packages




## Features

| Order codes | $V_{DS}$ | $R_{DS(on)}$ max. | $I_D$ |
|---|---|---|---|
| STB80N20M5 | 200 V | 20 mΩ | 65 A |
| STP80N20M5 | | | |

- Extremely low $R_{DS(on)}$
- Low gate charge and input capacitance
- Excellent switching performance
- 100% avalanche tested

## Applications

- Switching applications

## Description

These devices are N-channel Power MOSFETs based on the MDmesh™ M5 innovative vertical process technology combined with the well-known PowerMESH™ horizontal layout. The resulting products offer extremely low on-resistance, making them particularly suitable for applications requiring high power and superior efficiency.

STPOWER

| Product status links |
|---|
| STB80N20M5 |
| STP80N20M5 |

| Product summary | |
|---|---|
| **Order code: STB80N20M5** | |
| **Marking** | 80N20M5 |
| **Package** | D²PAK |
| **Packing** | Tape and reel |
| **Order code: STP80N20M5** | |
| **Marking** | 80N20M5 |
| **Package** | TO-220 |
| **Packing** | Tube |

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{GS}$ | Gate-source voltage | ±25 | V |
| $I_D$ | Drain current (continuous) at $T_C$ = 25 °C | 65 | A |
| | Drain current (continuous) at $T_C$ = 100 °C | 41 | A |
| $I_{DM}$(1) | Drain current (pulsed) | 232 | A |
| $P_{TOT}$ | Total power dissipation at $T_C$ = 25 °C | 190 | W |
| $I_{AR}$ | Avalanche current, repetitive or non-repetitive (pulse width limited by $T_{Jmax}$) | 20 | A |
| $E_{AS}$ | Single pulse avalanche energy (starting $T_j$ = 25 °C, $I_D$ = $I_{AR}$, $V_{DD}$ = 50 V) | 500 | mJ |
| dv/dt(2) | Peak diode recovery voltage slope | 15 | V/ns |
| $T_j$ | Operating junction temperature range | -55 to 150 | °C |
| $T_{stg}$ | Storage temperature range | | |

1. *Pulse width limited by safe operating area*
2. *$I_{SD}$ ≤ 65 A, di/dt ≤ 400 A/µs, $V_{DS(peak)}$ < $V_{(BR)DSS}$*

**Table 2. Thermal data**

| Symbol | Parameter | Value | | Unit |
|---|---|---|---|---|
| | | $D^2PAK$ | TO-220 | |
| $R_{thj\text{-}case}$ | Thermal resistance junction-case | 0.66 | | °C/W |
| $R_{thj\text{-}amb}$ | Thermal resistance junction-ambient | | 62.5 | °C/W |
| $R_{thj\text{-}pcb}$ | Thermal resistance junction-pcb | 30 | | °C/W |

# 2 Electrical characteristics

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

**Table 3. On/off states**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $I_D$ = 1 mA, $V_{GS}$ = 0 V | 200 | | | V |
| $I_{DSS}$ | Zero gate voltage drain current | $V_{GS}$ = 0 V, $V_{DS}$ = 200 V | | | 1 | µA |
| | | $V_{GS}$ = 0 V, $V_{DS}$ = 200 V, $T_C$ = 125 °C(1) | | | 100 | µA |
| $I_{GSS}$ | Gate-body leakage current | $V_{DS}$ = 0 V, $V_{GS}$ = ±25 V | | | 100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | 3 | 4 | 5 | V |
| $R_{DS(on)}$ | Static drain-source on resistance | $V_{GS}$ = 10 V, $I_D$ = 32.5 A | | 15 | 20 | mΩ |

1. *Defined by design, not subject to production test.*

**Table 4. Dynamic**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input capacitance | $V_{DS}$ = 50 V, f = 1 MHz, $V_{GS}$ = 0 V | - | 4080 | - | pF |
| $C_{oss}$ | Output capacitance | | | 290 | | |
| $C_{rss}$ | Reverse transfer capacitance | | | 50 | | |
| $C_{o(tr)}$(1) | Time-related equivalent capacitance | $V_{DS}$ = 0 to 160 V, $V_{GS}$ = 0 V | - | 740 | - | pF |
| $C_{o(er)}$(2) | Energy-related equivalent capacitance | | - | 295 | - | pF |
| Rg | Gate input resistance | f = 1 MHz open drain | - | 2 | - | Ω |
| $Q_g$ | Total gate charge | $V_{DD}$ = 160 V, $I_D$ = 32.5 A, $V_{GS}$ = 0 to 10 V (see Figure 14. Test circuit for gate charge behavior) | - | 108 | - | nC |
| $Q_{gs}$ | Gate-source charge | | | 23 | | |
| $Q_{gd}$ | Gate-drain charge | | | 62 | | |

1. *$C_{o(tr)}$ 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. *$C_{o(er)}$ 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 5. Switching times**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(v)}$ | Voltage delay time | $V_{DD}$ = 160 V, $I_D$ = 65 A, $R_G$ = 4.7 Ω, $V_{GS}$ = 10 V (see Figure 15. Test circuit for inductive load switching and diode recovery times and Figure 18. Switching time waveform) | - | 83 | - | ns |
| $t_{r(v)}$ | Voltage rise time | | | 26 | | |
| $t_{f(i)}$ | Current fall time | | | 46 | | |
| $t_{c(off)}$ | Crossing time | | | 77 | | |

**Table 6. Source drain diode**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{SD}$ | Source-drain current | | - | | 65 | A |
| $I_{SDM}$ (1) | Source-drain current (pulsed) | | | | 232 | |
| $V_{SD}$ (2) | Forward on voltage | $I_{SD}$ = 65 A, $V_{GS}$ = 0 V | - | | 1.6 | V |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 65 A, di/dt = 100 A/µs, $V_{DD}$ = 60 V (see Figure 15. Test circuit for inductive load switching and diode recovery times) | - | 178 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | | 1.4 | | µC |
| $I_{RRM}$ | Reverse recovery current | | | 16 | | A |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 65 A, di/dt = 100 A/µs, $V_{DD}$ = 60 V, $T_j$ = 150 °C (see Figure 15. Test circuit for inductive load switching and diode recovery times) | - | 219 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | | 2.1 | | µC |
| $I_{RRM}$ | Reverse recovery current | | | 20 | | A |

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

## 2.1 Electrical characteristics (curves)

**Figure 1. Safe operating area**

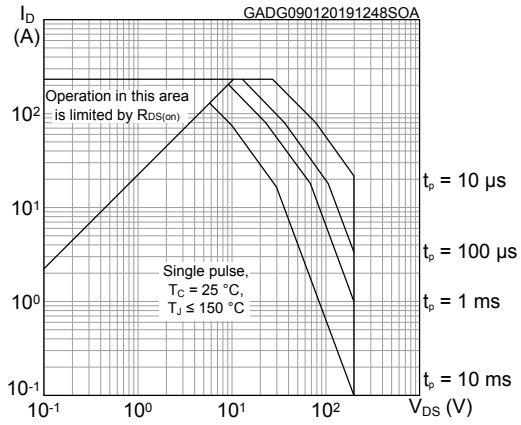



**Figure 2. Thermal impedance**

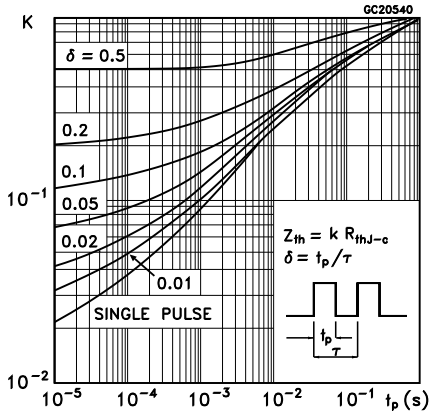



**Figure 3. Output characteristics**

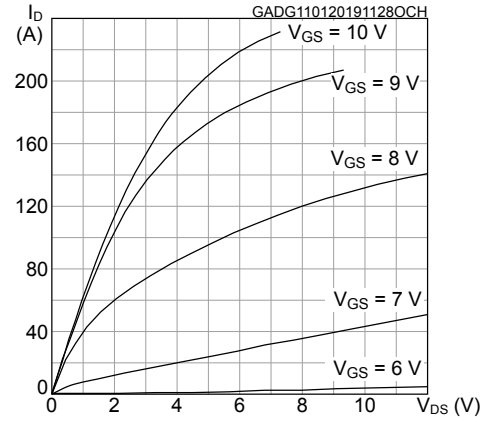



**Figure 4. Transfer characteristics**

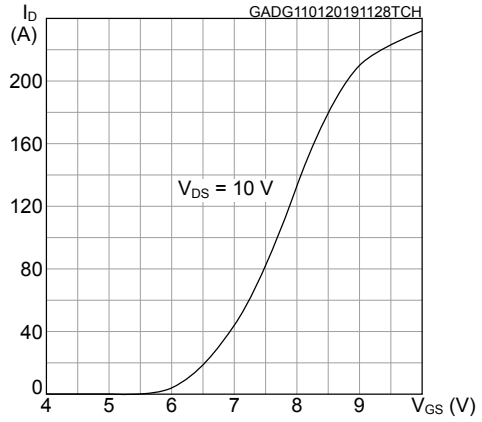



**Figure 5. Gate charge vs gate-source voltage**

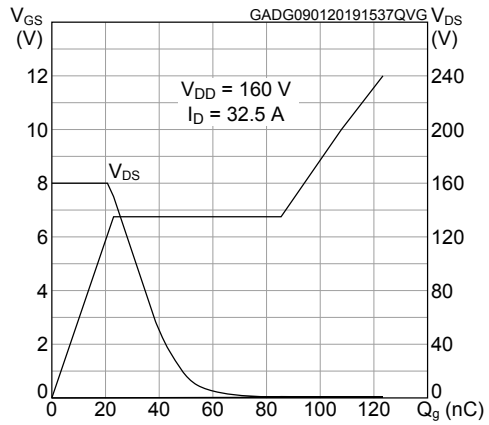



**Figure 6. Static drain-source on-resistance**

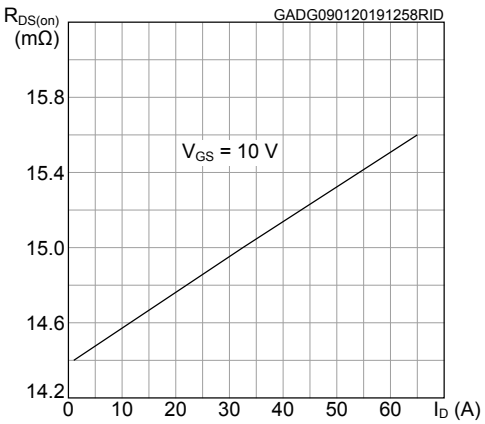


**Figure 7. Capacitance variations**

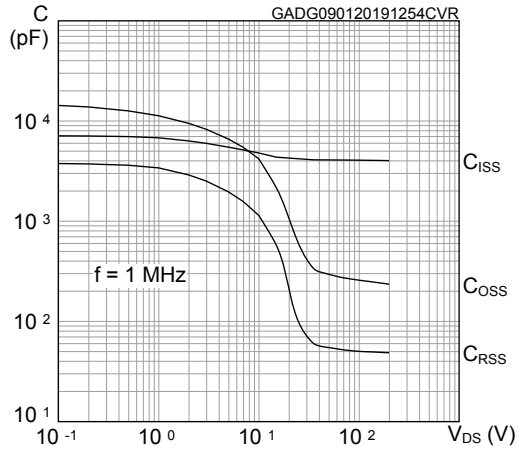



**Figure 8. Output capacitance stored energy**

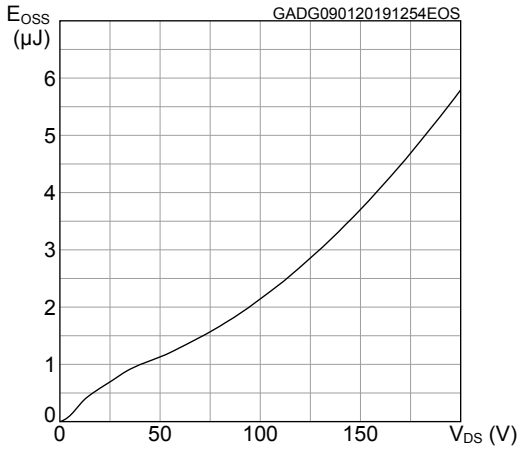



**Figure 9. Normalized gate threshold voltage vs temperature**

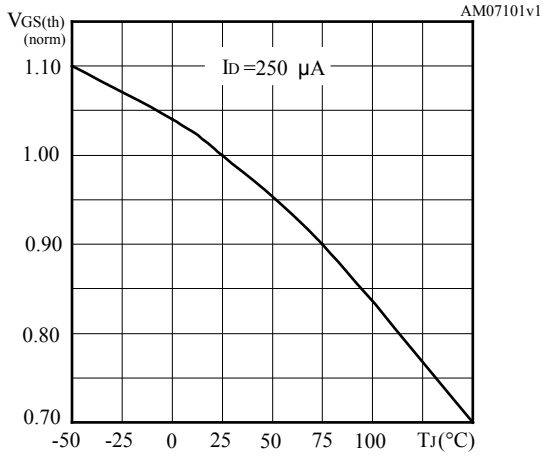



**Figure 10. Normalized on-resistance vs temperature**

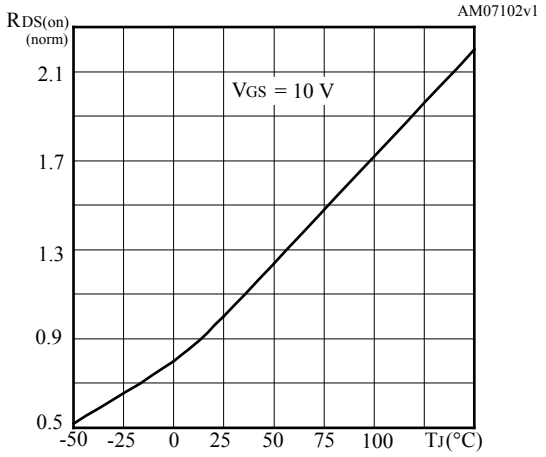



**Figure 11. Normalized $V_{(BR)DSS}$ vs temperature**

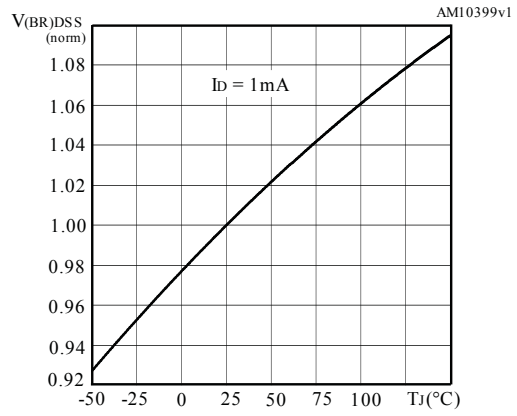
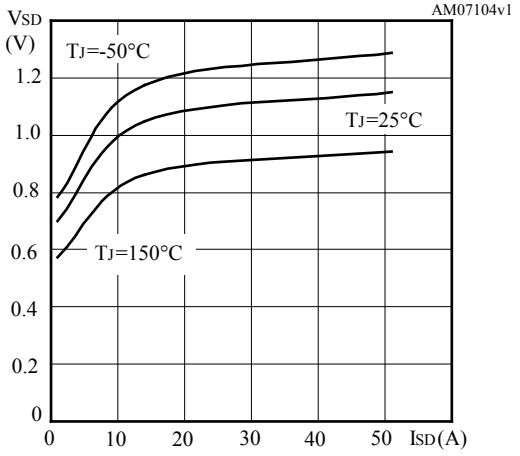



**Figure 12. Source-drain diode forward characteristics**



# 3 Test circuits

**Figure 13. Test circuit for resistive load switching times**

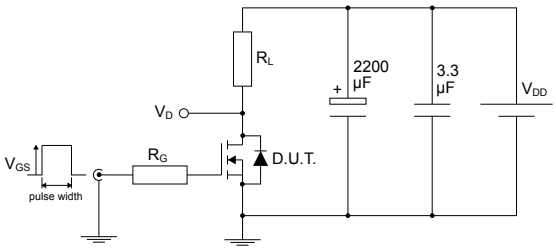



**Figure 14. Test circuit for gate charge behavior**

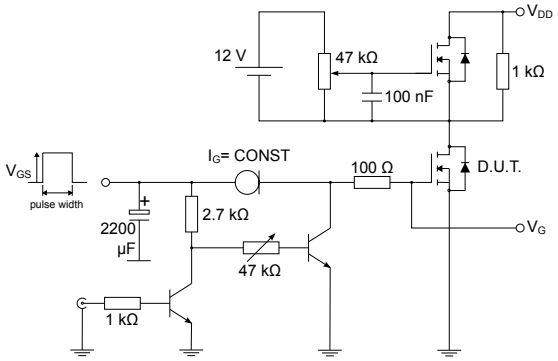



**Figure 15. Test circuit for inductive load switching and diode recovery times**

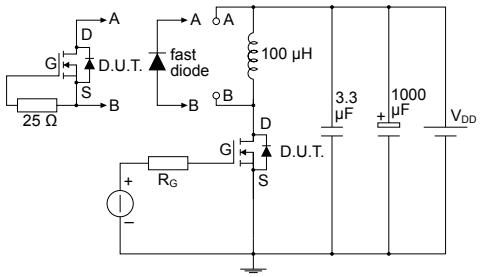



**Figure 16. Unclamped inductive load test circuit**

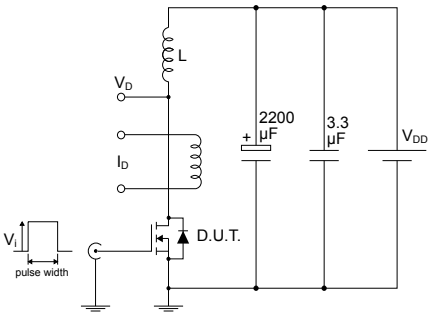



**Figure 17. Unclamped inductive waveform**

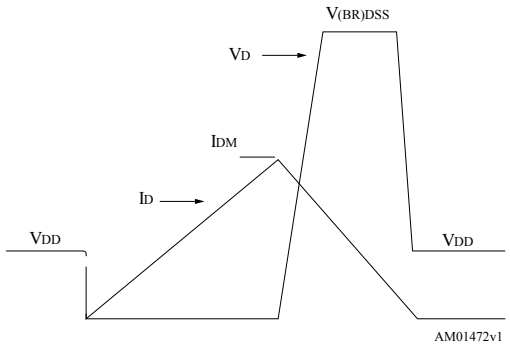
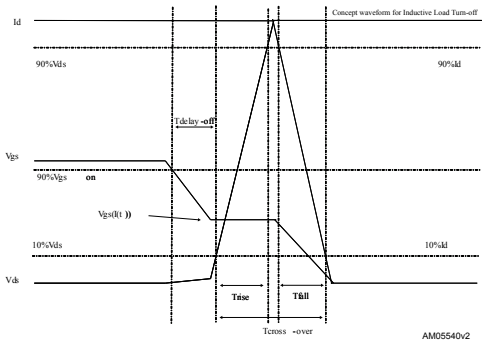



**Figure 18. Switching time waveform**



# 4 Package information

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.

## 4.1 D²PAK (TO-263) type A2 package information

Figure 19. D²PAK (TO-263) type A2 package outline

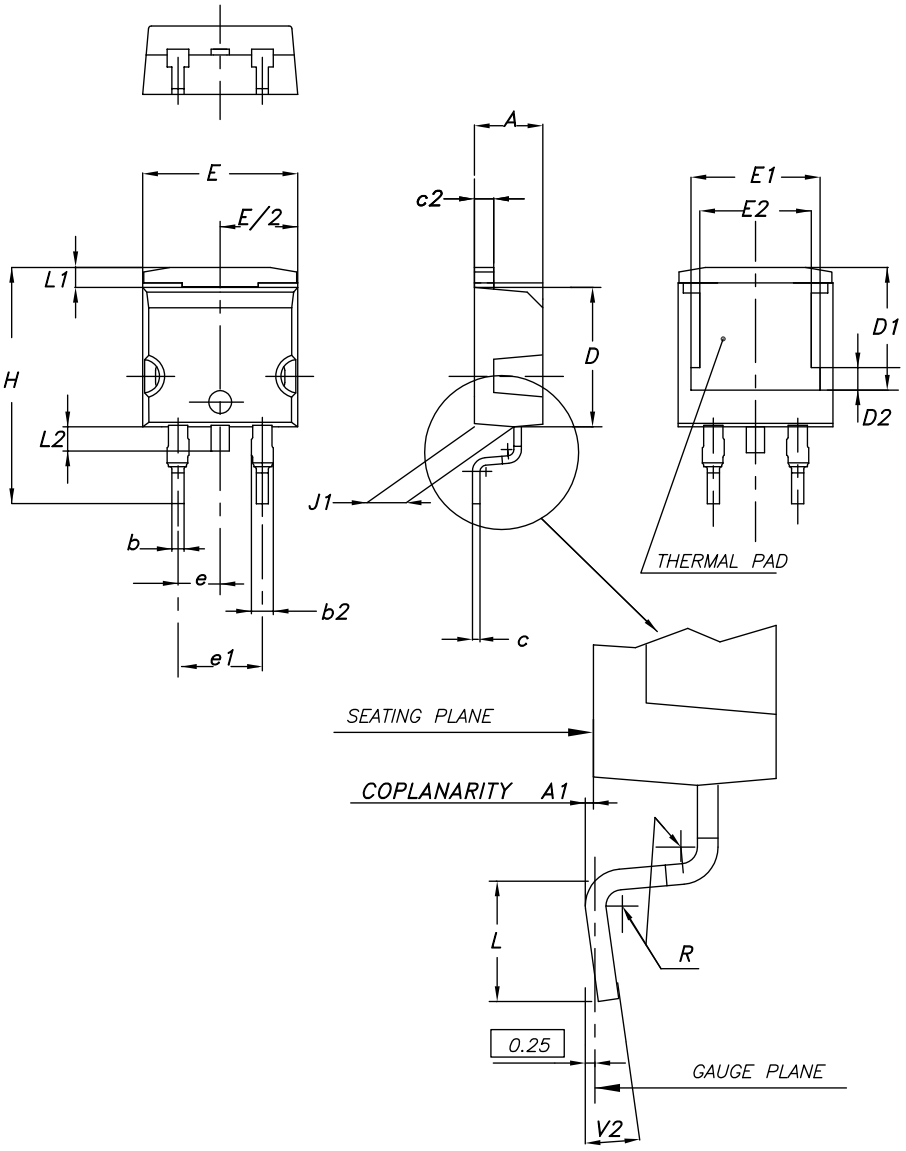
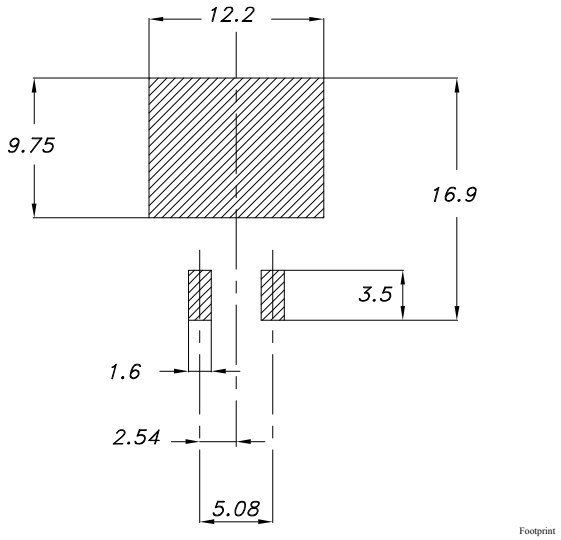


Table 7. **D²PAK (TO-263) type A2 package mechanical data**

| 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 | 7.75 | 8.00 |
| D2 | 1.10 | 1.30 | 1.50 |
| E | 10.00 | | 10.40 |
| E1 | 8.70 | 8.90 | 9.10 |
| E2 | 7.30 | 7.50 | 7.70 |
| e | | 2.54 | |
| e1 | 4.88 | | 5.28 |
| H | 15.00 | | 15.85 |
| J1 | 2.49 | | 2.69 |
| L | 2.29 | | 2.79 |
| L1 | 1.27 | | 1.40 |
| L2 | 1.30 | | 1.75 |
| R | | 0.40 | |
| V2 | 0° | | 8° |

Figure 20. **D²PAK (TO-263) recommended footprint (dimensions are in mm)**




Footprint

## 4.2 D²PAK packing information

Figure 21. D²PAK tape outline

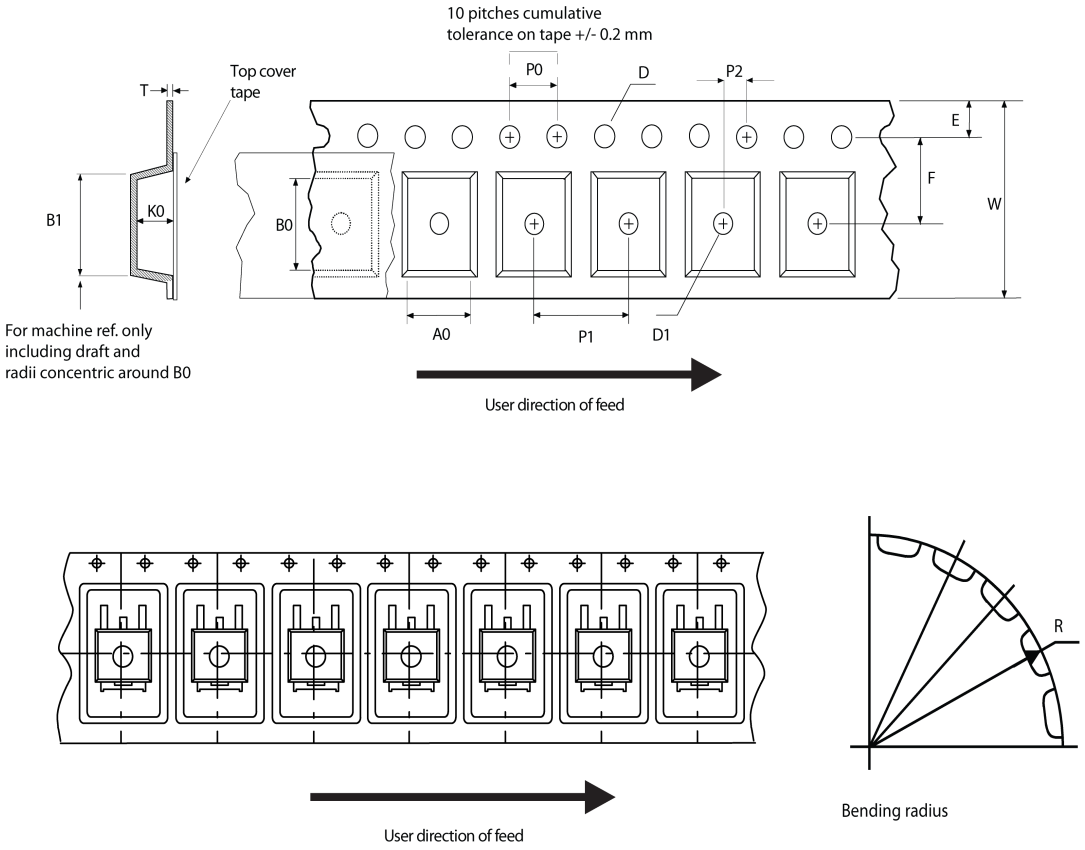
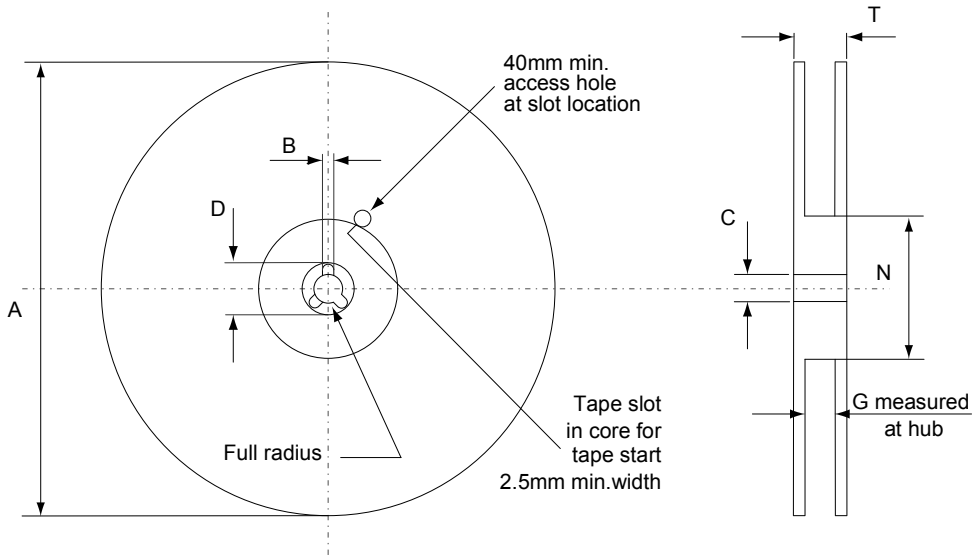


Figure 22. **D²PAK reel outline**




AM06038v1

Table 8. **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 quantity | | 1000 |
| P2 | 1.9 | 2.1 | Bulk quantity | | 1000 |
| R | 50 | | | | |
| T | 0.25 | 0.35 | | | |
| W | 23.7 | 24.3 | | | |

## 4.3 TO-220 type A package information

Figure 23. **TO-220 type A package outline**

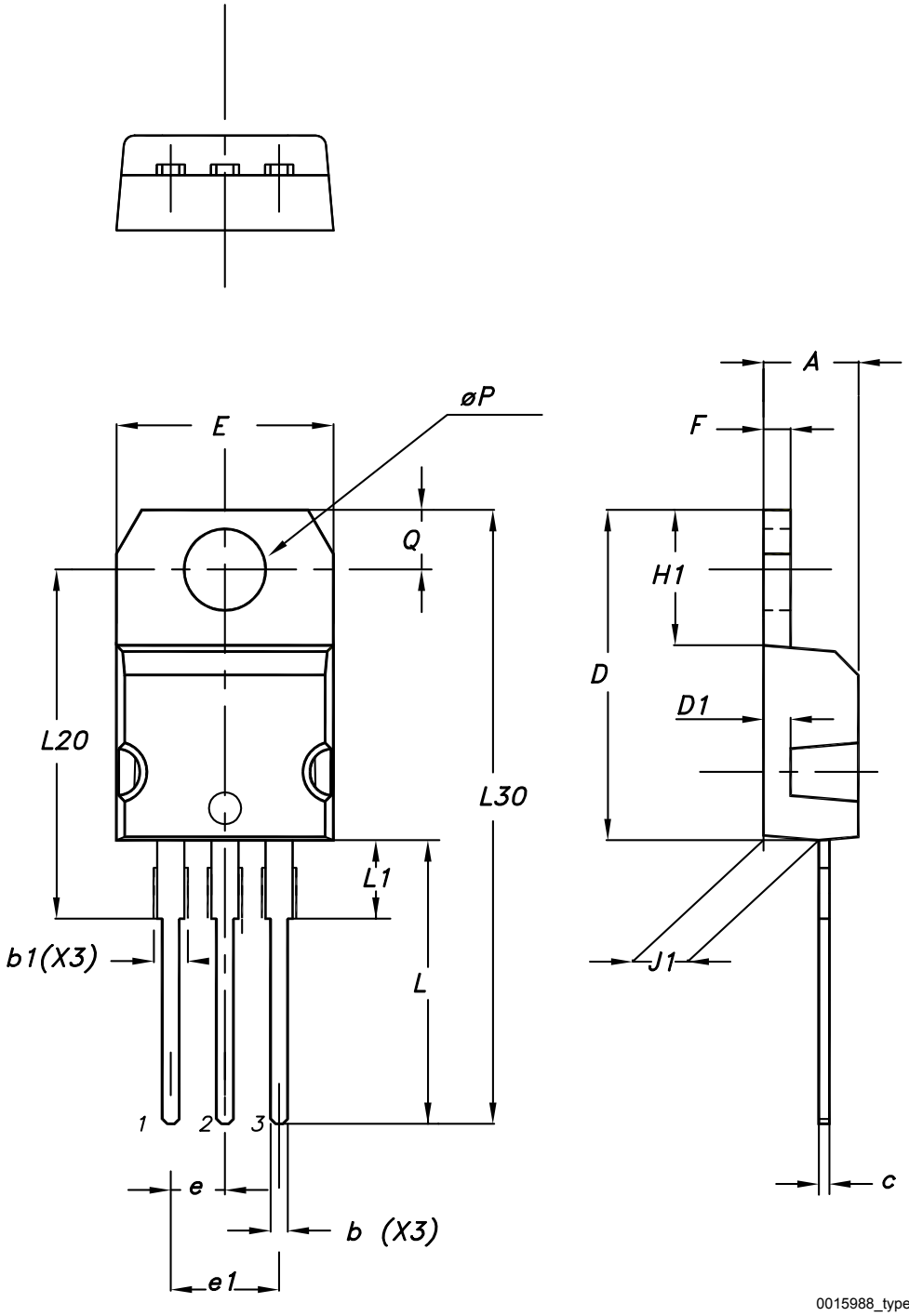


Table 9. **TO-220 type A package mechanical data**

| Dim. | mm | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 4.40 | | 4.60 |
| b | 0.61 | | 0.88 |
| b1 | 1.14 | | 1.55 |
| c | 0.48 | | 0.70 |
| D | 15.25 | | 15.75 |
| D1 | | 1.27 | |
| E | 10.00 | | 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 | 13.00 | | 14.00 |
| L1 | 3.50 | | 3.93 |
| L20 | | 16.40 | |
| L30 | | 28.90 | |
| øP | 3.75 | | 3.85 |
| Q | 2.65 | | 2.95 |

## Revision history

Table 10. **Document revision history**

| Date | Version | Changes |
|---|---|---|
| 01-Jul-2009 | 1 | First release |
| 03-Jul-2010 | 2 | Document status promoted from preliminary data to datasheet |
| 16-Jan-2019 | 3 | Updated title, features and internal schematic diagram on cover page.<br>Updated Section 1 Electrical ratings, Section 2 Electrical characteristics and Section 4.1 D²PAK (TO-263) type A2 package information.<br>Minor text changes. |

# Contents