# STBLED627, STDLED627

## N-channel 620 V, 0.95 Ω, 7.0 A Power MOSFET in D²PAK and in DPAK

**Datasheet - production data**

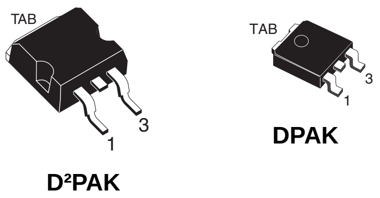
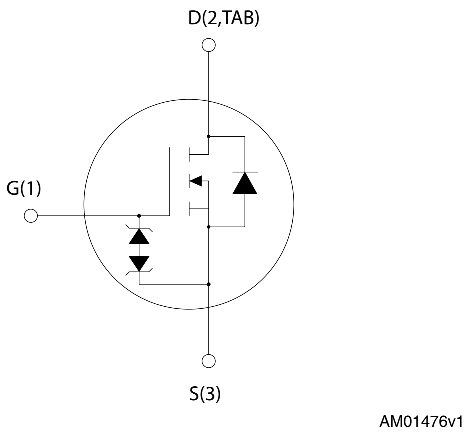



**Figure 1. Internal schematic diagram**




## Features

| Order codes | $V_{DSS}$ | $R_{DS(on)}$ max. | $I_D$ | $P_W$ |
|---|---|---|---|---|
| STBLED627 | 620 V | < 1.2 Ω | 7.0 A | 90 W |
| STDLED627 | | | | |

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

## Applications

- LED lighting applications

## Description

These Power MOSFETs boast extremely low on resistance and very good dv/dt capability, rendering them suitable for buck-boost and fyback topologies.

**Table 1. Device summary**

| Order codes | Marking | Package | Packaging |
|---|---|---|---|
| STBLED627 | LED627 | D²PAK | Tape and reel |
| STDLED627 | | DPAK | |

# Contents

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol | Parameter | Value | | Unit |
|---|---|---|---|---|
| | | D²PAK | DPAK | |
| $V_{DS}$ | Drain-source voltage | 620 | | V |
| $V_{GS}$ | Gate-source voltage | ± 30 | | V |
| $I_D$ | Drain current (continuous) at $T_C$ = 25 °C | 7.0 | | A |
| $I_D$ | Drain current (continuous) at $T_C$ = 100 °C | 4.0 | | A |
| $I_{DM}$(1) | Drain current (pulsed) | 28 | | A |
| $P_{TOT}$ | Total dissipation at $T_C$ = 25 °C | 90 | | W |
| $I_{AR}$(2) | Avalanche current, repetitive or not-repetitive | 5.5 | | A |
| $E_{AS}$(3) | Single pulse avalanche energy | 140 | | mJ |
| ESD | Gate-source human body model<br>(R =1.5 kΩ, C = 100 pF) | 2.5 | | kV |
| dv/dt(4) | Peak diode recovery voltage slope | 12 | | V/ns |
| $T_{stg}$ | Storage temperature | -55 to 150 | | °C |
| $T_j$ | Max. operating junction temperature | 150 | | °C |

1. Pulse width limited by safe operating area.
2. Pulse width limited by $T_j$ max.
3. Starting $T_j$ = 25 °C, $I_D$ = $I_{AR}$, $V_{DD}$ = 50 V.
4. $I_{SD}$ ≤ 5.5 A, di/dt ≤ 400 A/µs, $V_{DD}$ = 80% $V_{(BR)DSS}$.

**Table 3. Thermal data**

| Symbol | Parameter | D²PAK | DPAK | Unit |
|---|---|---|---|---|
| $R_{thj\text{-}case}$ | Thermal resistance junction-case max. | 1.39 | | °C/W |
| $R_{thj\text{-}pcb}$(1) | Thermal resistance junction-pcb max. | 30 | 50 | °C/W |

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

# 2 Electrical characteristics

($T_C$ = 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 | $I_D$ = 1 mA, $V_{GS}$ = 0 | 620 | | | V |
| $I_{DSS}$ | Zero gate voltage drain current ($V_{GS}$ = 0) | $V_{DS}$ = 620 V<br>$V_{DS}$ = 620 V, $T_C$ = 125 °C | | | 0.8<br>50 | µA<br>µA |
| $I_{GSS}$ | Gate-body leakage current ($V_{DS}$ = 0) | $V_{GS}$ = ± 20 V | | | ± 9 | µA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 50 µA | 3 | 3.6 | 4.5 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS}$ = 10 V, $I_D$ = 2.8 A | | 0.95 | 1.2 | Ω |

**Table 5. Dynamic**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input capacitance | $V_{DS}$ = 50 V, f = 1 MHz, $V_{GS}$ = 0 | - | 890 | - | pF<br>pF<br>pF |
| $C_{oss}$ | Output capacitance | | - | 110 | - | |
| $C_{rss}$ | Reverse transfer capacitance | | - | 18 | - | |
| $C_{oss(er)}$ (1) | Equivalent output capacitance energy related | $V_{GS}$ = 0, $V_{DS}$ = 0 to 480 V | - | 28 | - | pF |
| $C_{oss(tr)}$ (2) | Equivalent output capacitance time related | | - | 63 | - | pF |
| $R_G$ | Intrinsic gate resistance | f = 1 MHz open drain | - | 3.5 | - | Ω |
| $Q_g$ | Total gate charge | $V_{DD}$ = 496 V, $I_D$ = 5.5 A, $V_{GS}$ = 10 V (see *Figure 18*) | - | 35 | - | nC |
| $Q_{gs}$ | Gate-source charge | | - | 4.5 | - | nC |
| $Q_{gd}$ | Gate-drain charge | | - | 23 | - | nC |

1. It 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. It is defined as a constant equivalent capacitance giving the same storage 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 | $V_{DD}$ = 310 V, $I_D$ = 2.75 A, $R_G$ = 4.7 Ω, $V_{GS}$ = 10 V (see *Figure 17*) | - | 22 | - | ns |
| $t_r$ | Rise time | | - | 12 | - | ns |
| $t_{d(off)}$ | Turn-off-delay time | | - | 49 | - | ns |
| $t_f$ | Fall time | | - | 20 | - | ns |

**Table 7. Source-drain diode**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{SD}$ | Source-drain current | | - | | 5.5 | A |
| $I_{SDM}$(1) | Source-drain current (pulsed) | | | | 27 | A |
| $V_{SD}$(2) | Forward on voltage | $I_{SD}$ = 5.5 A, $V_{GS}$ = 0 | - | | 1.5 | V |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 5.5 A, di/dt = 100 A/µs $V_{DD}$ = 60 V (see *Figure 22*) | - | 290 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 1900 | | nC |
| $I_{RRM}$ | Reverse recovery current | | - | 13.5 | | A |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 5.5 A, di/dt = 100 A/µs $V_{DD}$ = 60 V, $T_j$ = 150 °C (see *Figure 22*) | - | 335 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 2400 | | nC |
| $I_{RR}$ | Reverse recovery current | | - | 14.5 | | 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 ($I_D$ = 0) | Igs = ± 1 mA | 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 D²PAK**

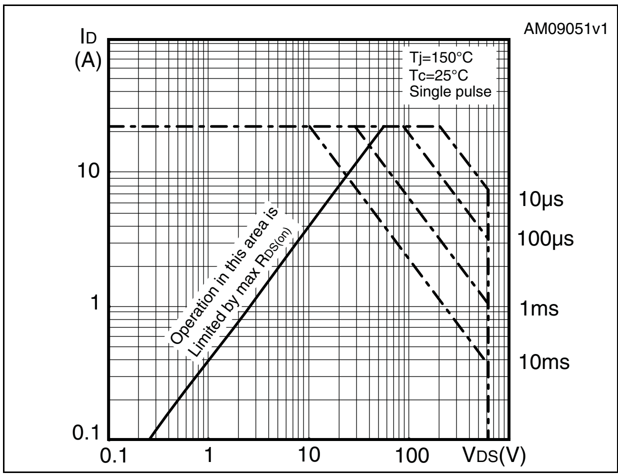



**Figure 3. Thermal impedance for D²PAK**

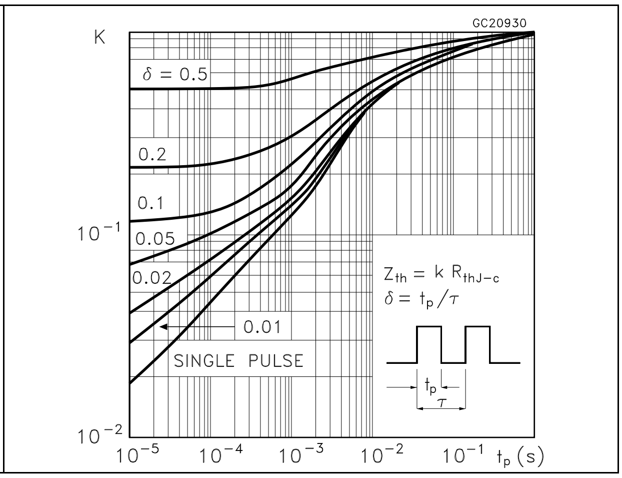



**Figure 4. Safe operating area for DPAK**

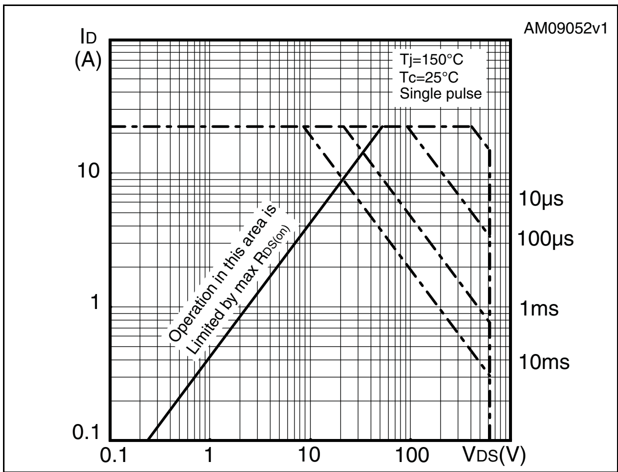



**Figure 5. Thermal impedance for DPAK**

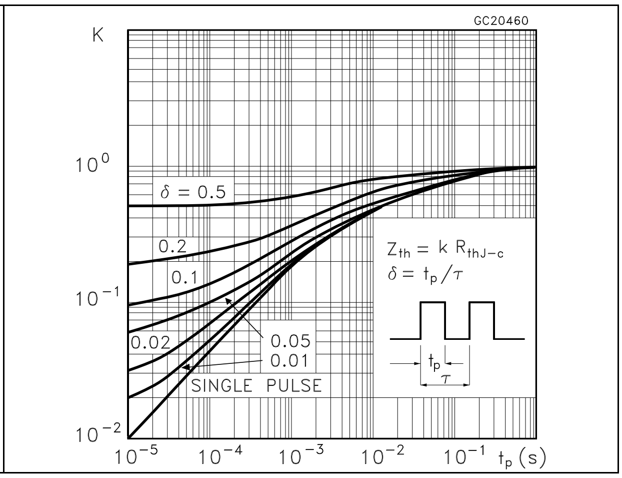



**Figure 6. Output characteristics**

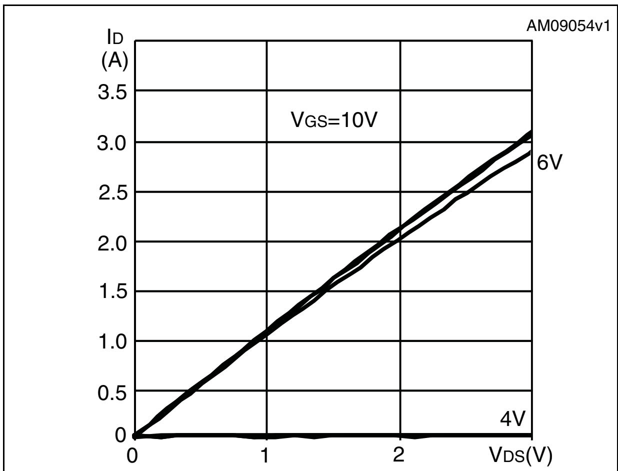



**Figure 7. Transfer characteristics**

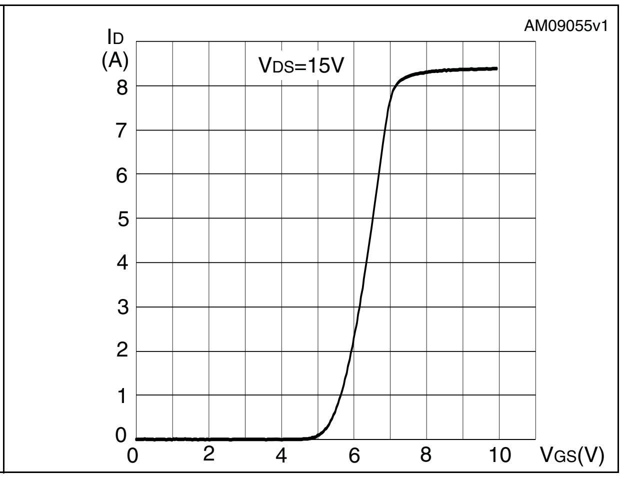


Figure 8. Gate charge vs gate-source voltage

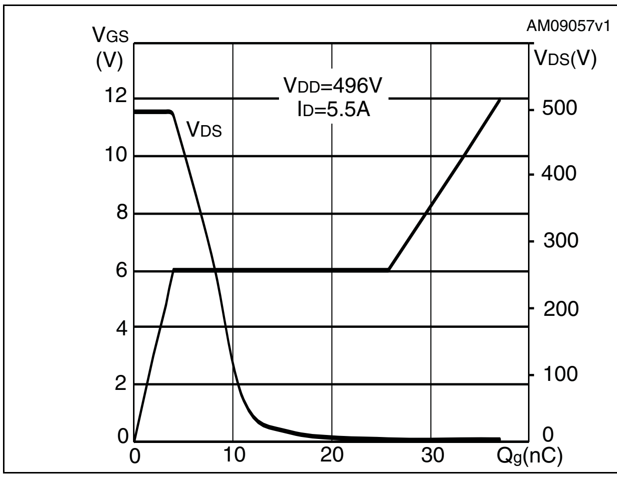



Figure 9. Static drain-source on-resistance

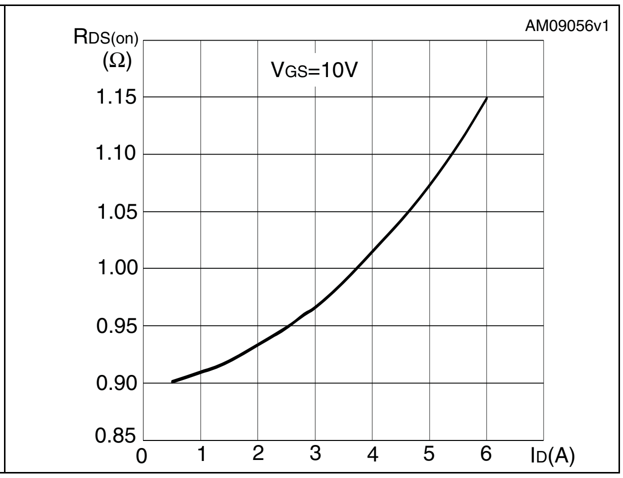



Figure 10. Capacitance variations

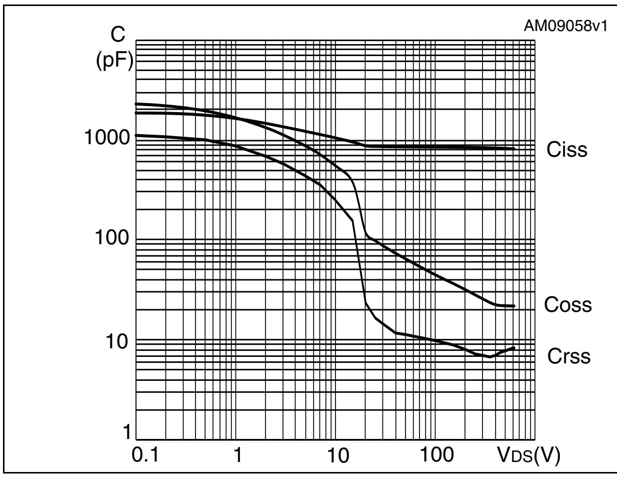



Figure 11. Output capacitance stored energy

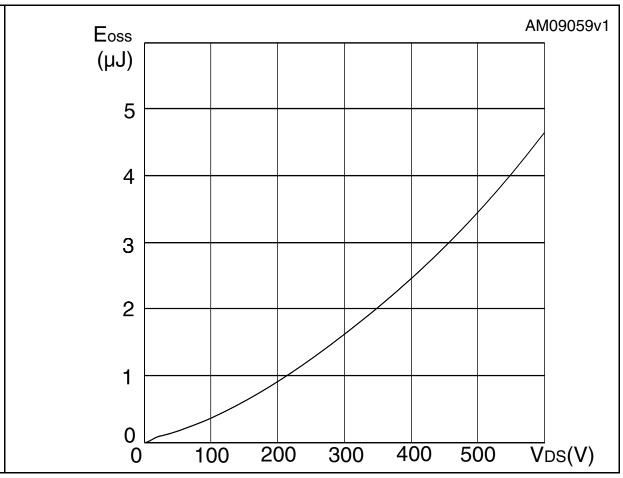



Figure 12. Normalized gate threshold voltage vs temperature

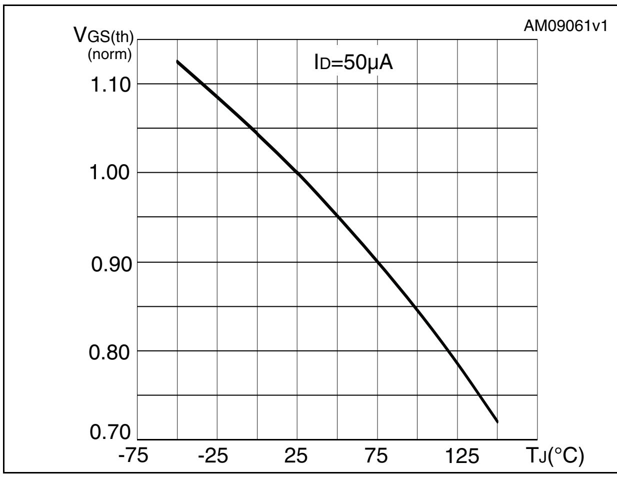



Figure 13. Normalized on-resistance vs temperature

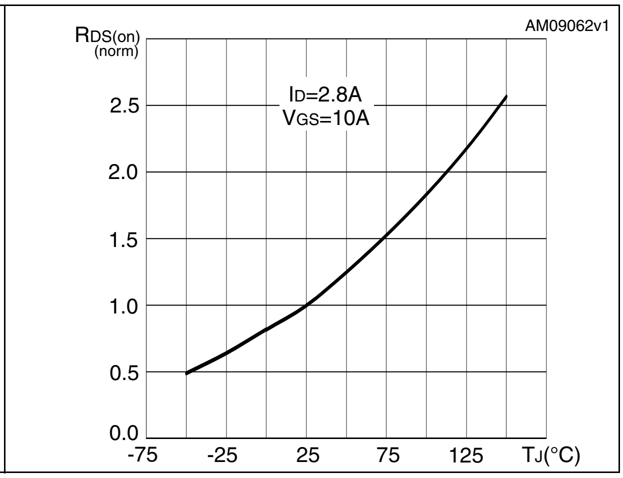


**Figure 14. Normalized $B_{VDSS}$ vs temperature**

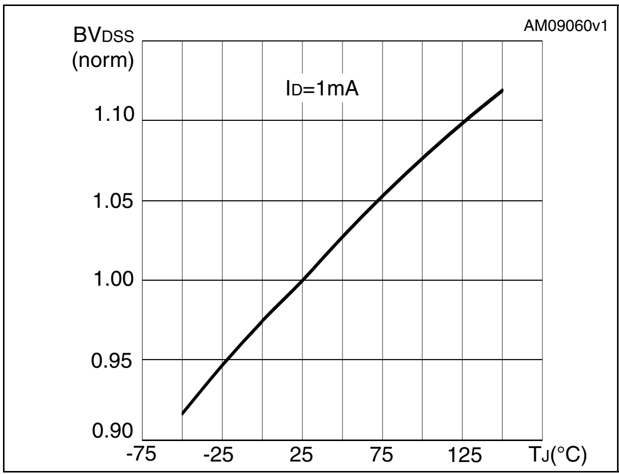



**Figure 15. Source-drain diode forward characteristics**

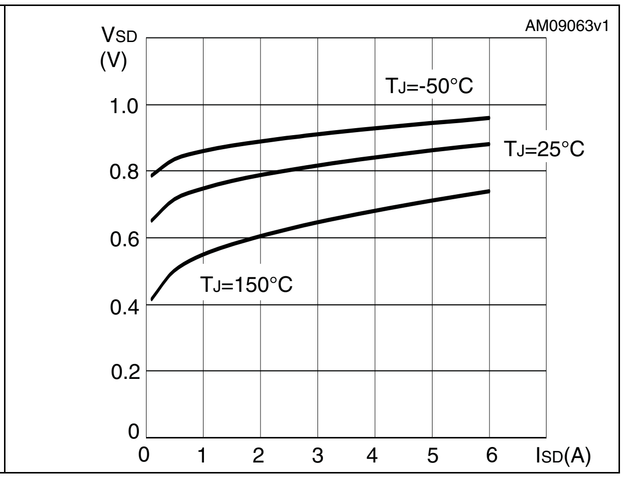
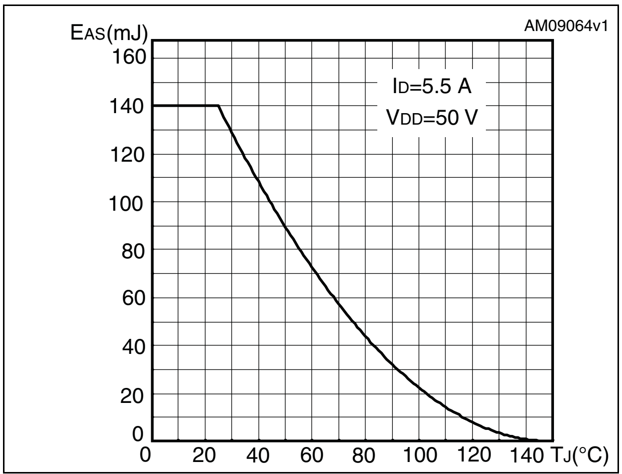



**Figure 16. Maximum avalanche energy vs temperature**



# 3 Test circuits

Figure 17. Switching times test circuit for resistive load

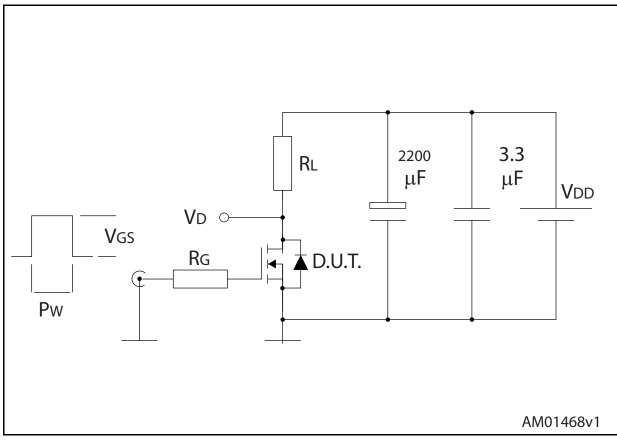



Figure 18. Gate charge test circuit

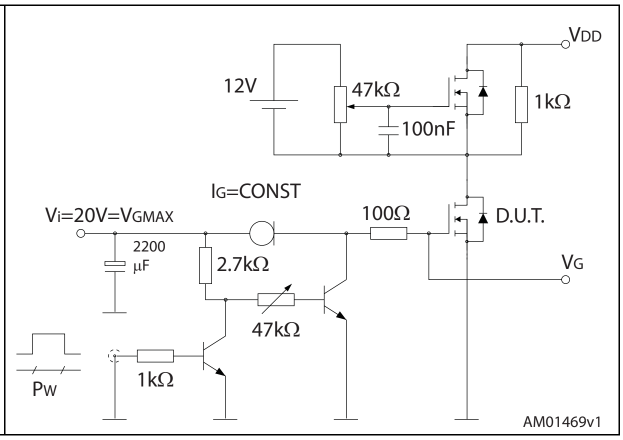



Figure 19. Test circuit for inductive load switching and diode recovery times

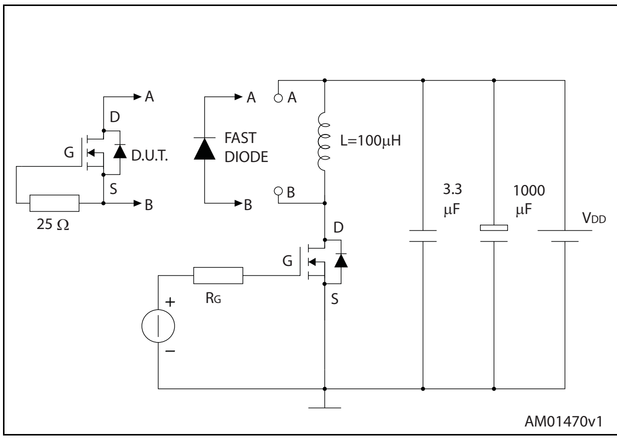



Figure 20. Unclamped Inductive load test circuit

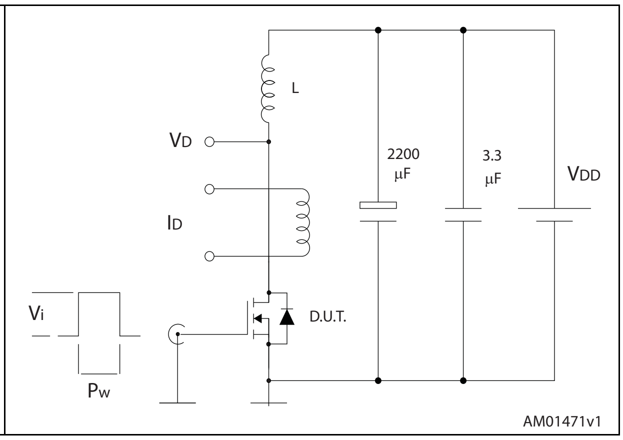



Figure 21. Unclamped inductive waveform

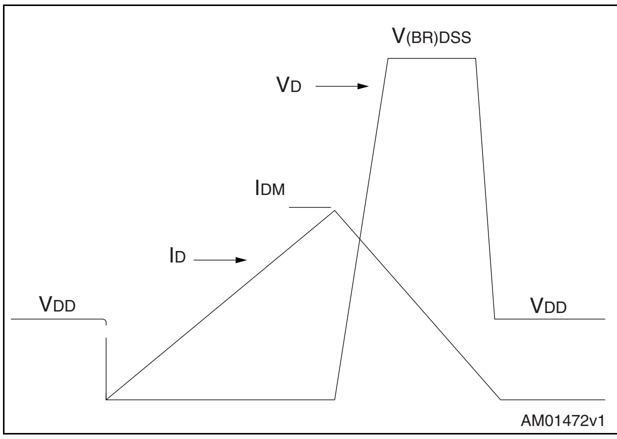
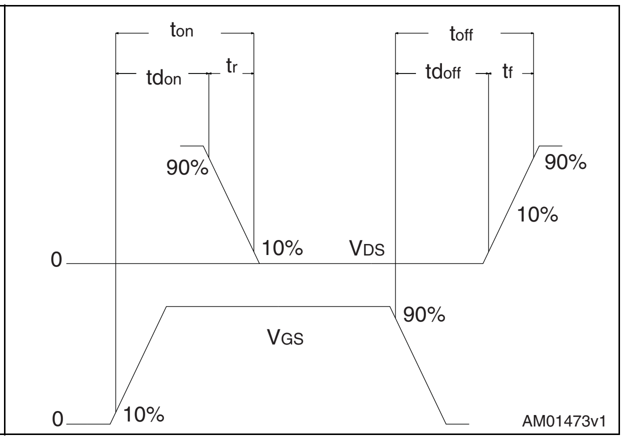



Figure 22. Switching time waveform



# 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 (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) drawings

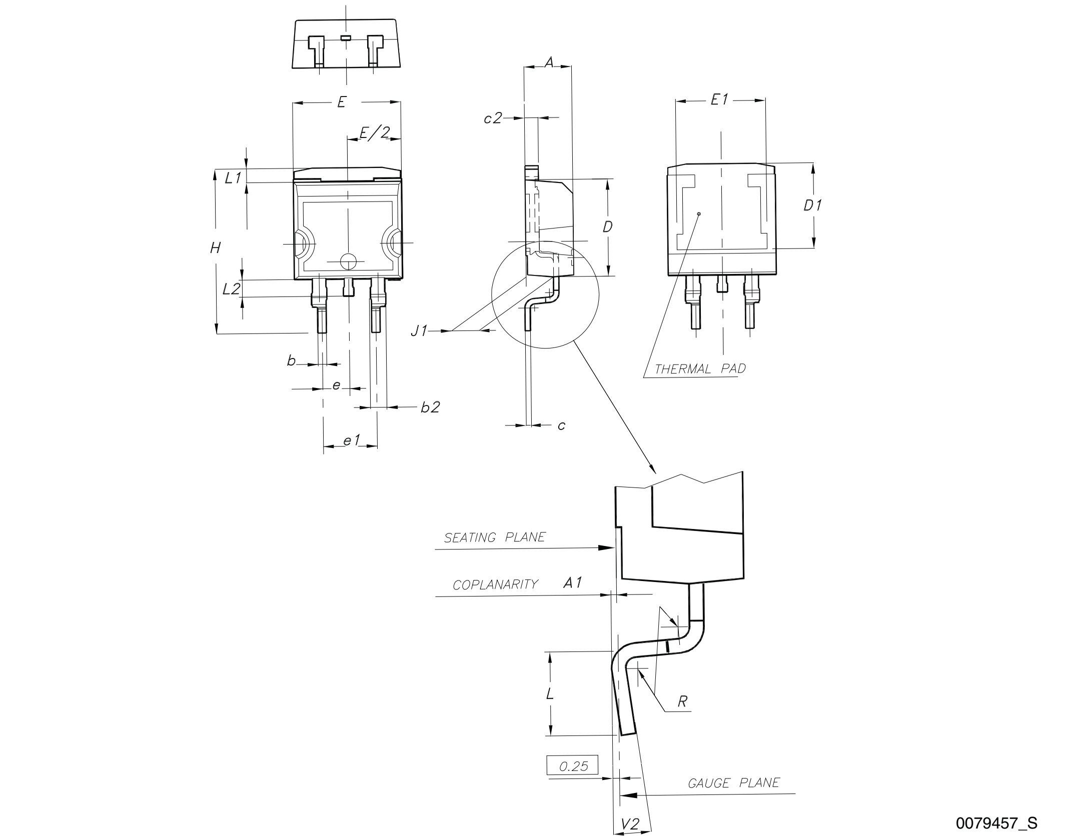
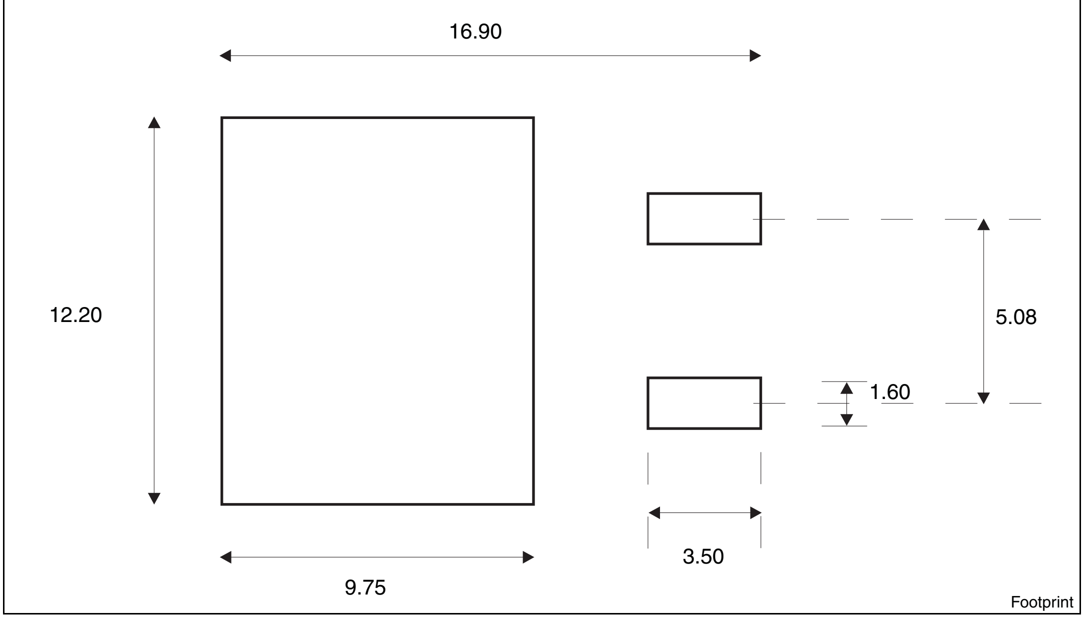



Figure 24. D²PAK footprint[(a)]




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 25. DPAK (TO-252) drawings**

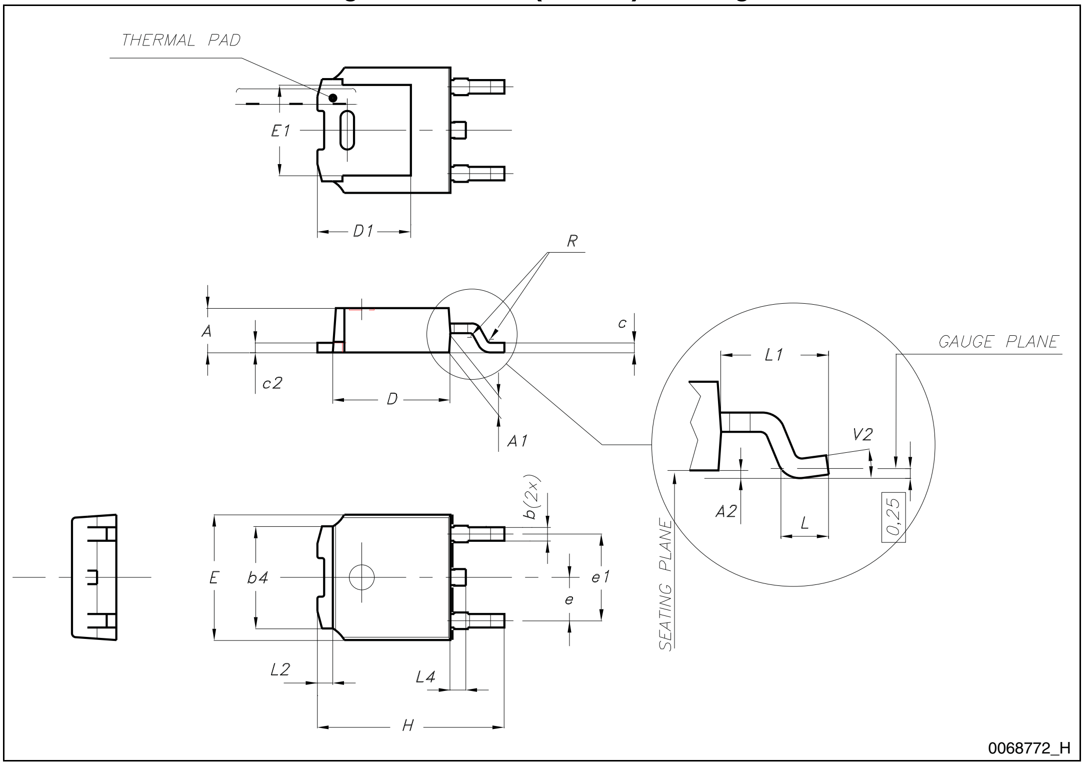
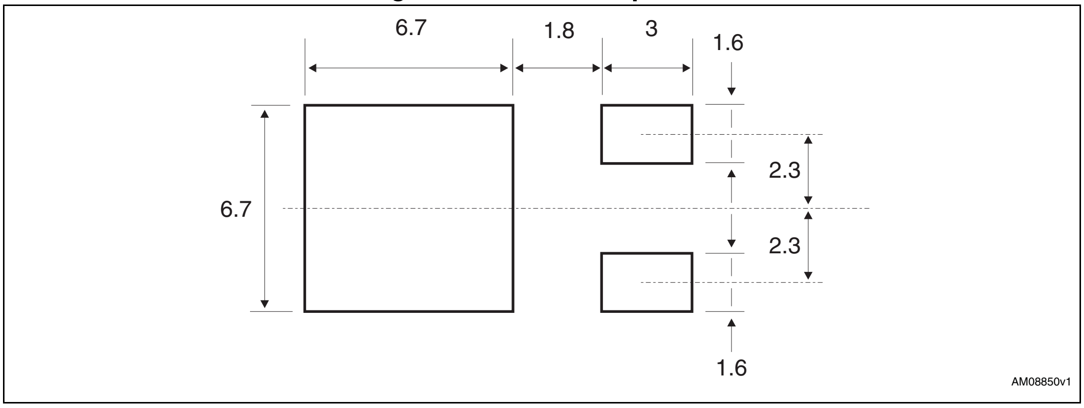



**Figure 26. DPAK footprint[(b)]**




b. All dimensions are in millimeters.

# 5 Packaging mechanical data

**Table 11. 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 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 27. Tape for DPAK (TO-252) and D²PAK (TO-263)**

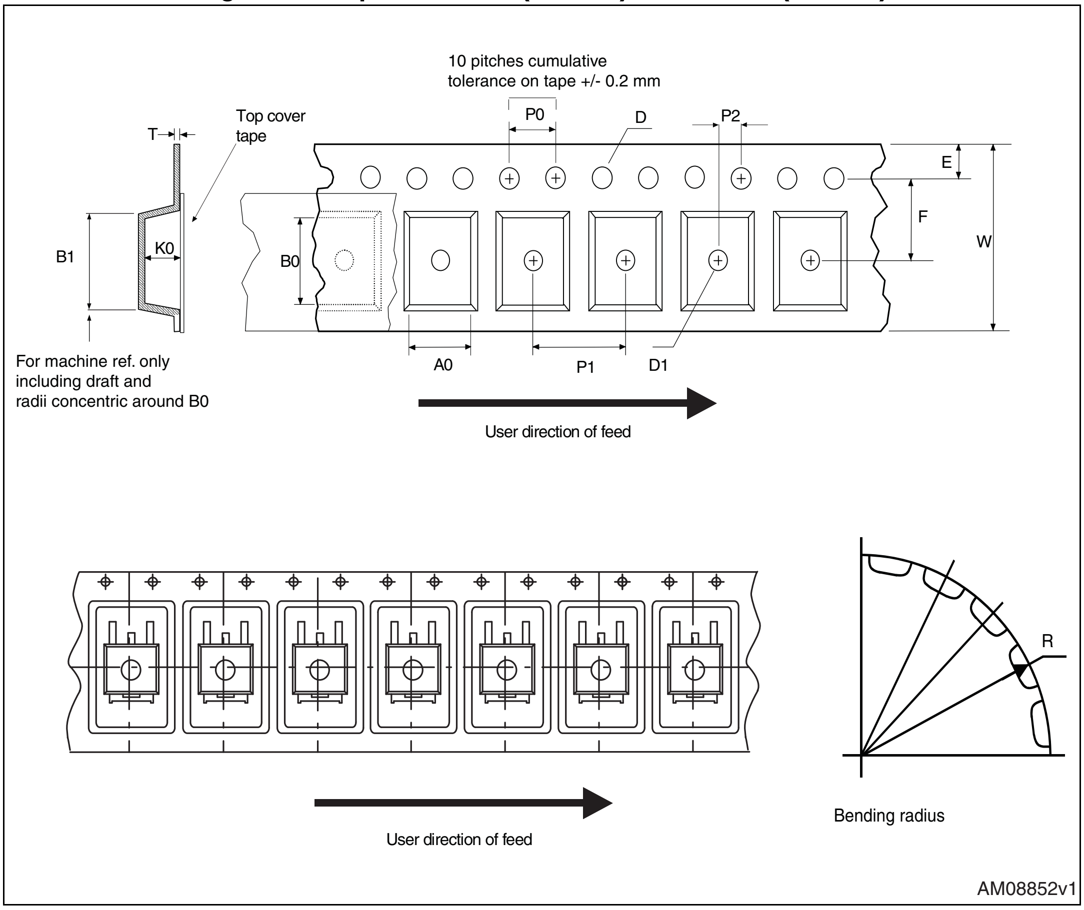
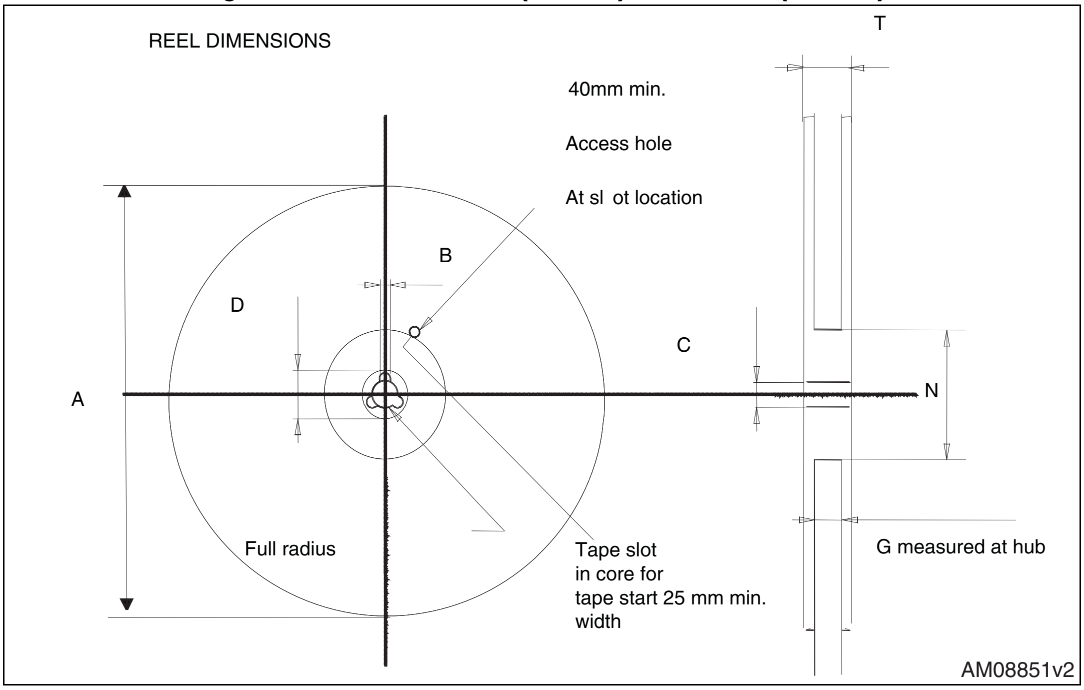



**Figure 28. Reel for DPAK (TO-252) and D²PAK (TO-263)**



# 6 Revision history

**Table 13. Document revision history**

| Date | Revision | Changes |
|---|---|---|
| 29-Aug-2013 | 1 | First release. |