# Contents

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{DS}$ | Drain-source voltage | 600 | V |
| $V_{GS}$ | Gate-source voltage | ± 25 | V |
| $I_D$ | Drain current (continuous) at $T_C$ = 25 °C | 11 | A |
| $I_D$ | Drain current (continuous) at $T_C$ = 100 °C | 6.93 | A |
| $I_{DM}$ (1) | Drain current (pulsed) | 44 | A |
| $P_{TOT}$ | Total dissipation at $T_C$ = 25 °C | 90 | W |
| dv/dt (2) | Peak diode recovery voltage slope | 15 | 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. $I_{SD} \leq 11$ A, di/dt $\leq$ 400 A/µs, $V_{DS\ peak} \leq V_{(BR)DSS}$, $V_{DD}$ = 80% $V_{(BR)DSS}$.

**Table 3. Thermal data**

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

**Table 4. Avalanche characteristics**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $I_{AS}$ | Avalanche current, repetitive or not-repetitive (pulse width limited by Tj max) | 3.5 | A |
| $E_{AS}$ | Single pulse avalanche energy (starting $T_J$=25 °C, $I_D$=$I_{AS}$, $V_{DD}$=50 V) | 200 | mJ |

# 2 Electrical characteristics

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

**Table 5. 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 | 600 | | | V |
| $I_{DSS}$ | Zero gate voltage drain current | $V_{GS}$ = 0, $V_{DS}$ = 600 V | | | 1 | µA |
| | | $V_{GS}$ = 0, $V_{DS}$ = 600 V, $T_C$=125 °C | | | 100 | µA |
| $I_{GSS}$ | Gate-body leakage current | $V_{DS}$ = 0, $V_{GS}$ = ± 25 V | | | ± 0.1 | µA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | 2 | 3 | 4 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS}$ = 10 V, $I_D$ = 5.5 A | | 0.28 | 0.36 | Ω |

**Table 6. Dynamic**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input capacitance | $V_{GS}$ = 0, $V_{DS}$ = 50 V, f = 1 MHz | - | 790 | - | pF |
| $C_{oss}$ | Output capacitance | | - | 60 | - | pF |
| $C_{rss}$ | Reverse transfer capacitance | | - | 3.6 | - | pF |
| $C_{oss\ eq.}$ (1) | Equivalent output capacitance | $V_{GS}$ = 0, $V_{DS}$ = 0 to 480 V | - | 135 | - | pF |
| $Q_g$ | Total gate charge | $V_{DD}$ = 480 V, $I_D$ = 11 A, $V_{GS}$ = 10 V, *(see Figure 16)* | - | 27 | - | nC |
| $Q_{gs}$ | Gate-source charge | | - | 4 | - | nC |
| $Q_{gd}$ | Gate-drain charge | | - | 14 | - | nC |
| $R_G$ | Gate input resistance | f=1 MHz open drain | - | 4.7 | - | Ω |

1. $C_{oss\ eq.}$ is defined as a constant equivalent capacitance giving the same charging time as $C_{oss}$ when $V_{DS}$ increases from 0 to 80% $V_{DS}$

**Table 7. Switching times**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD}$ = 300 V, $I_D$ = 5.5 A $R_G$ = 4.7 Ω $V_{GS}$ = 10 V *(see Figure 15)* | - | 3 | - | ns |
| $t_r$ | Rise time | | - | 8 | - | ns |
| $t_{d(off)}$ | Turn-off delay time | | - | 30 | - | ns |
| $t_f$ | Fall time | | - | 10 | - | ns |

**Table 8. Source drain diode**

| Symbol | Parameter | Test conditions | Min | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{SD}$ | Source-drain current | | - | | 11 | A |
| $I_{SDM}$ (1) | Source-drain current (pulsed) | | - | | 44 | A |
| $V_{SD}$ (2) | Forward on voltage | $I_{SD}$ = 11 A, $V_{GS}$ = 0 | - | | 1.5 | V |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 11 A, di/dt = 100 A/µs<br>$V_{DD}$ = 100 V<br>*(see Figure 17)* | - | 230 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 2 | | µC |
| $I_{RRM}$ | Reverse recovery current | | - | 18 | | A |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 11 A, di/dt = 100 A/µs<br>$V_{DD}$ = 100 V, $T_j$ = 150 °C<br>*(see Figure 17)* | - | 290 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 2.5 | | µC |
| $I_{RRM}$ | Reverse recovery current | | - | 17 | | 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 2. Safe operating area for D²PAK**

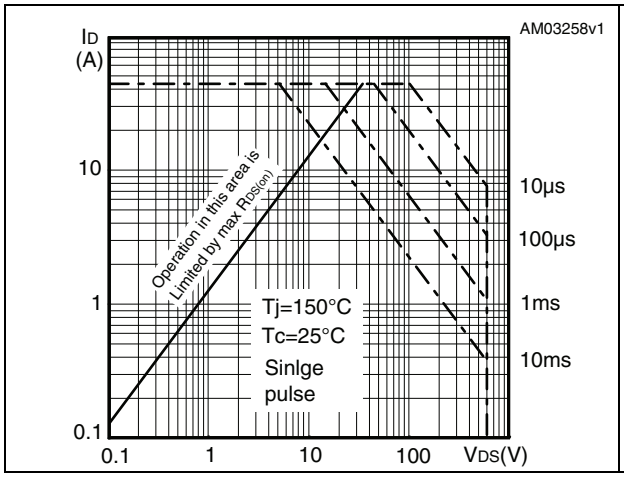



**Figure 3. Thermal impedance for D²PAK**

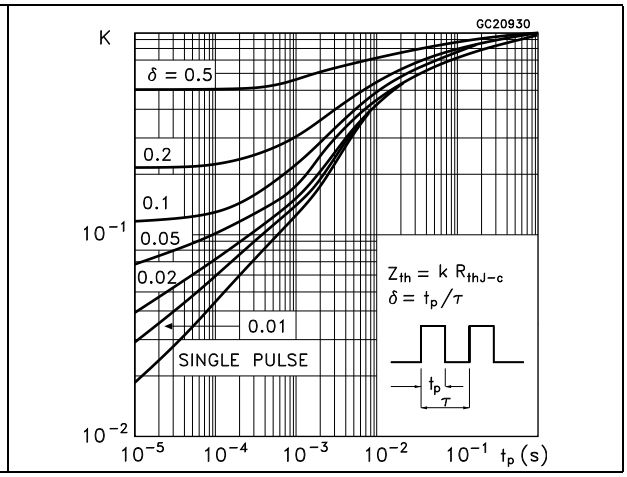



**Figure 4. Safe operating area for DPAK**

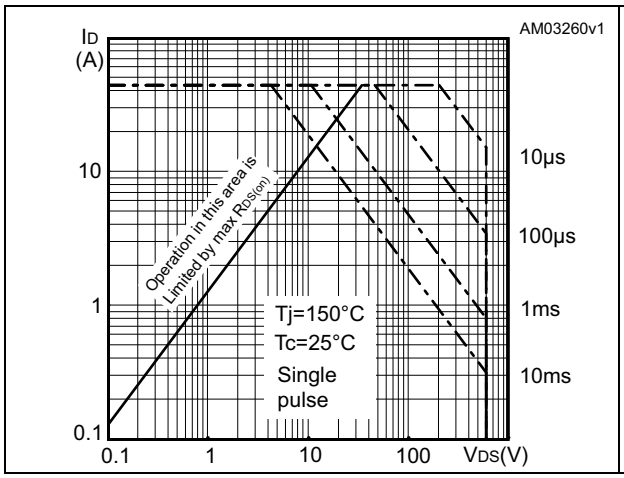



**Figure 5. Thermal impedance for DPAK**

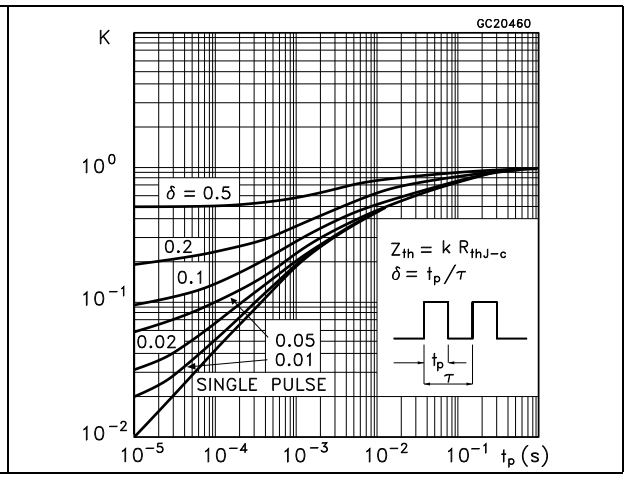



**Figure 6. Output characteristics**

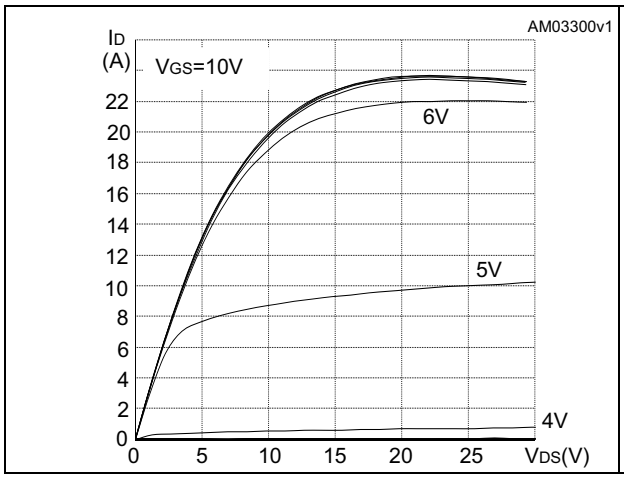



**Figure 7. Transfer characteristics**

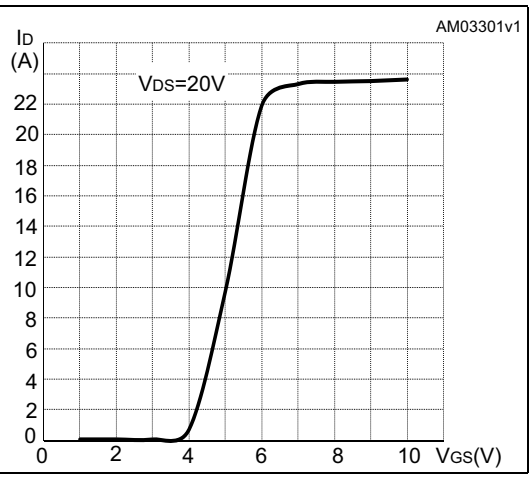


**Figure 8. Normalized $V_{(BR)DSS}$ vs temperature**

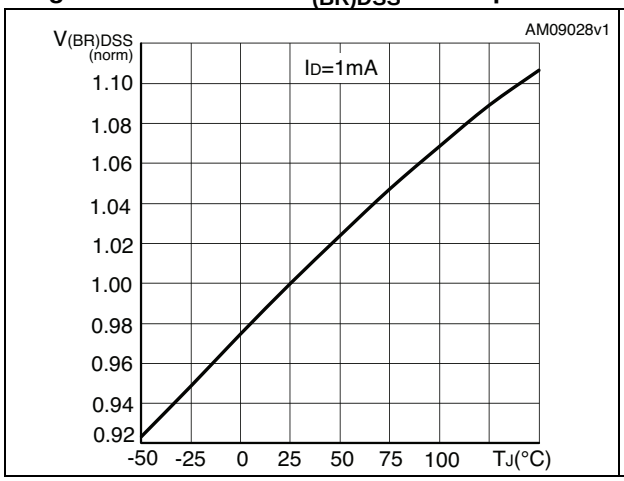



**Figure 9. Static drain-source on-resistance**

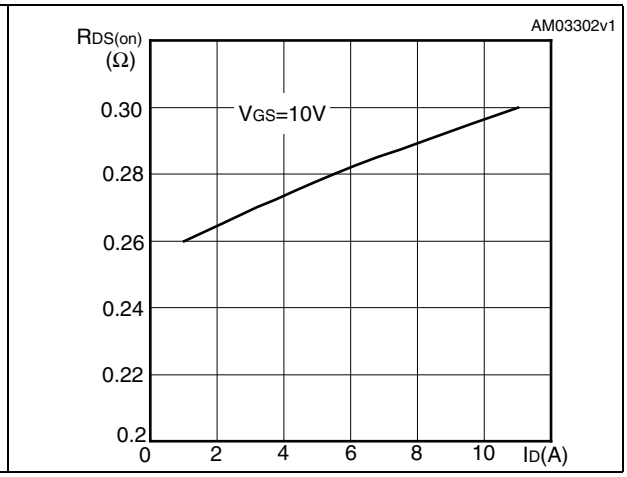



**Figure 10. Gate charge vs gate-source voltage**

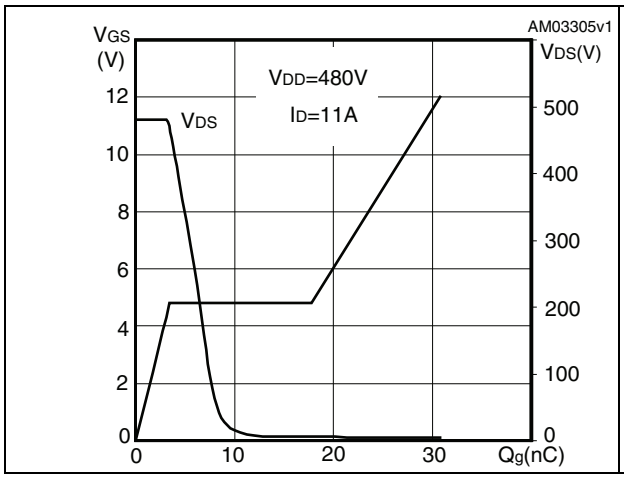



**Figure 11. Capacitance variations**

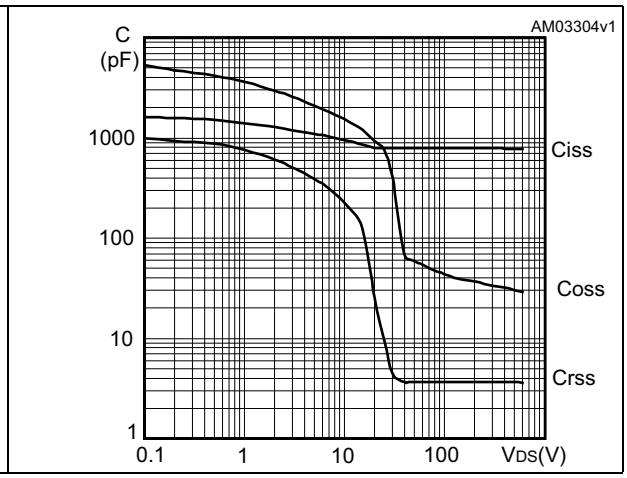



**Figure 12. Normalized gate threshold voltage vs temperature**

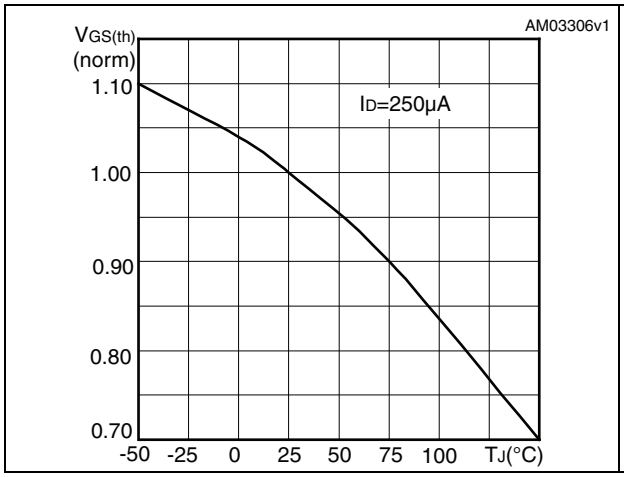



**Figure 13. Normalized on-resistance vs temperature**

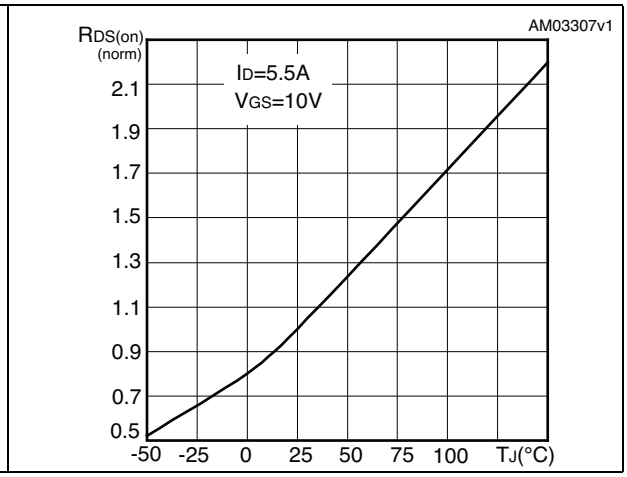
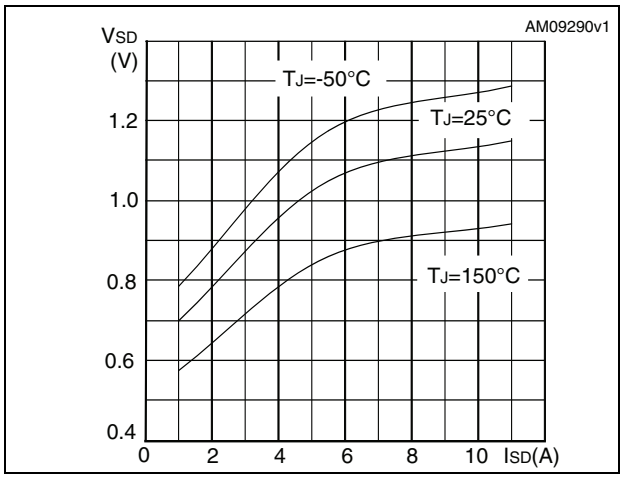


**Figure 14. Source-drain diode forward characteristics**



# 3 Test circuits

**Figure 15. Switching times test circuit for resistive load**

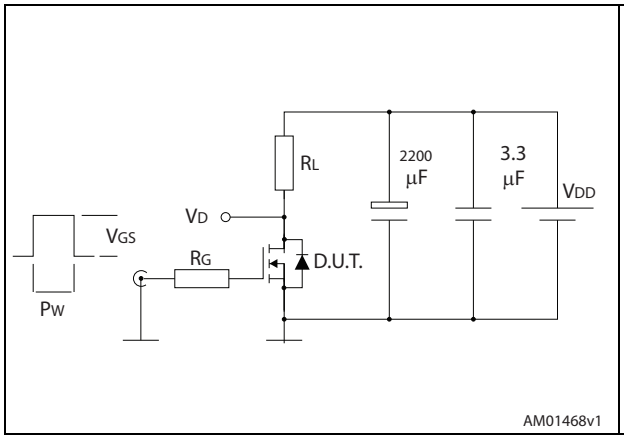



**Figure 16. Gate charge test circuit**

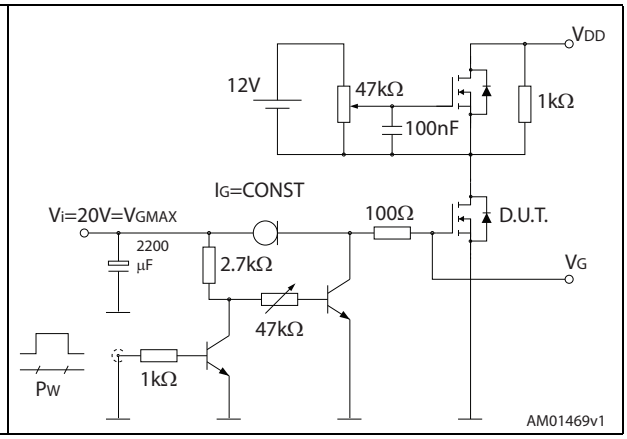



**Figure 17. Test circuit for inductive load switching and diode recovery times**

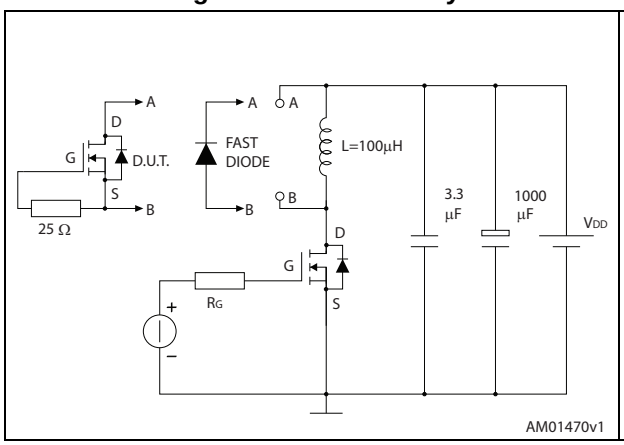



**Figure 18. Unclamped inductive load test circuit**

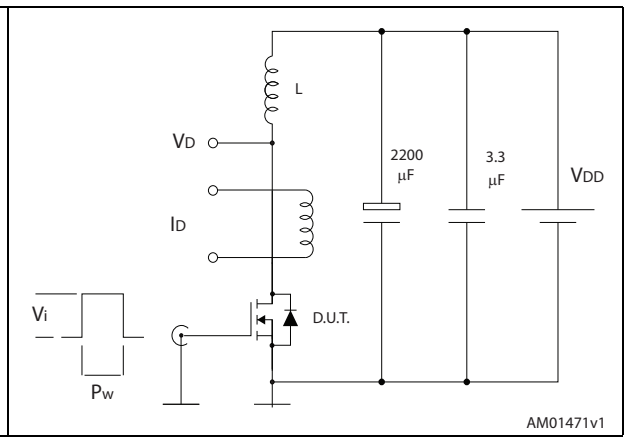



**Figure 19. Unclamped inductive waveform**

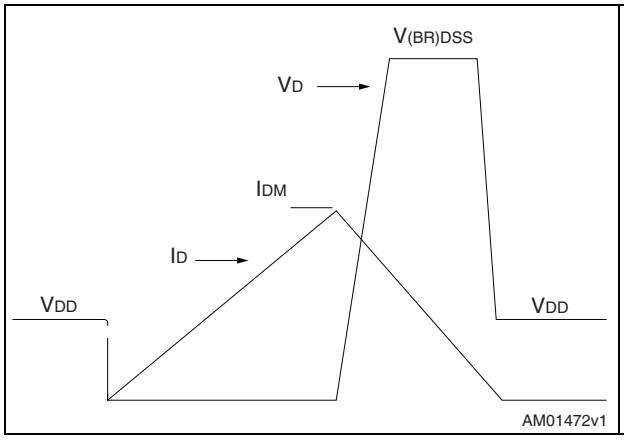
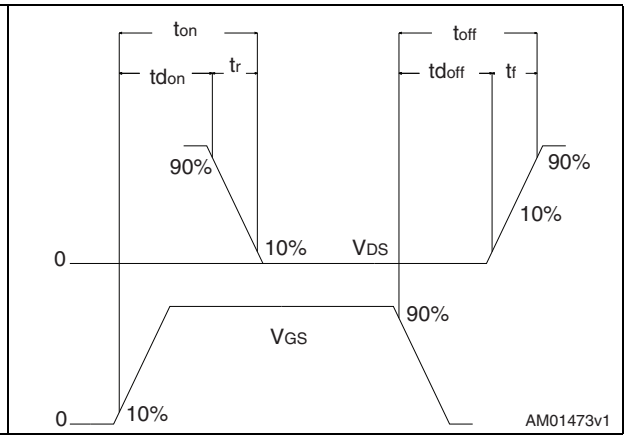



**Figure 20. Switching time waveform**



# 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 package information

**Figure 21. D²PAK (TO-263) type A package outline**

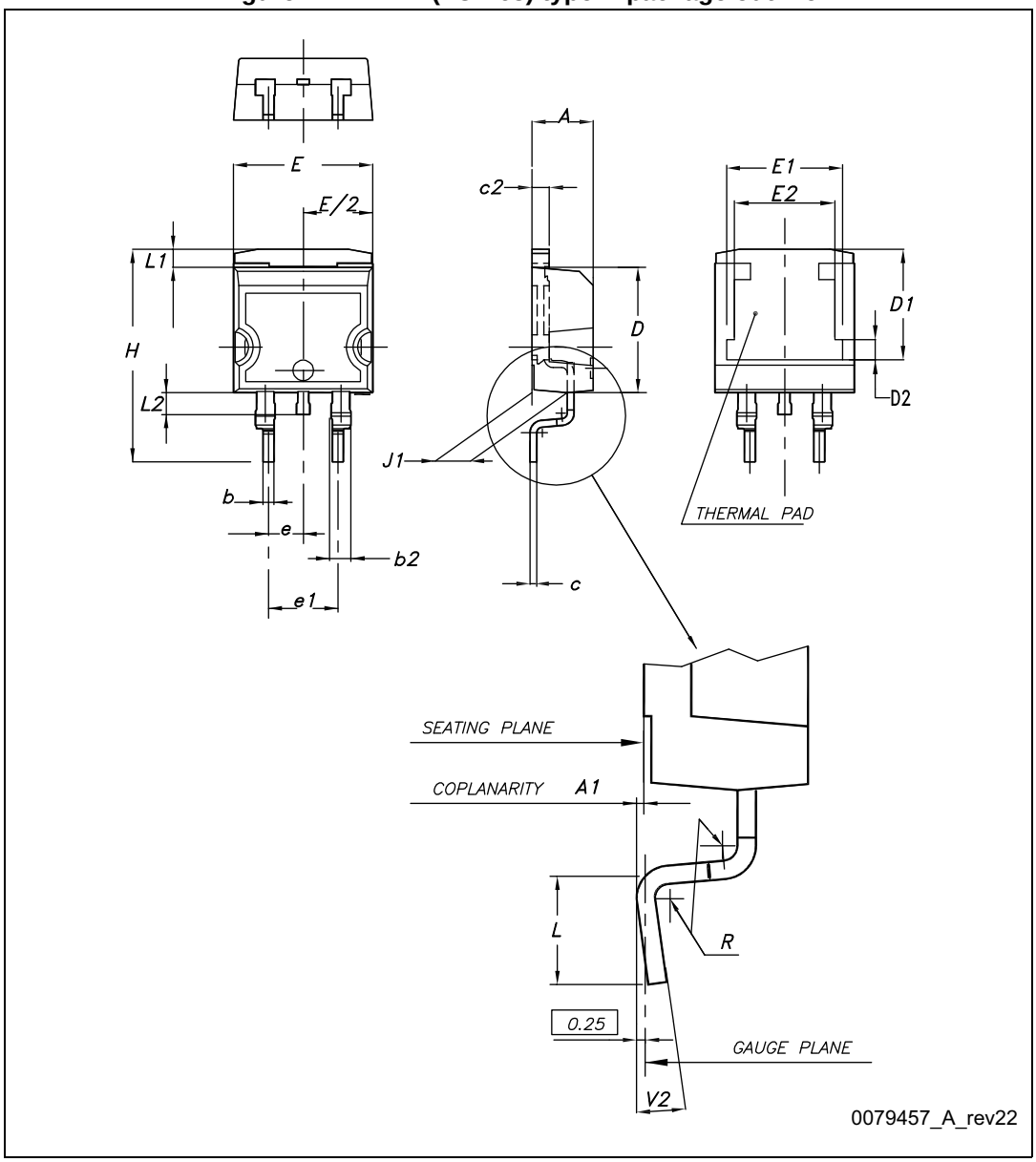


Table 9. D²PAK (TO-263) type A package mechanical data

| 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 | | 10.40 |
| E1 | 8.50 | 8.70 | 8.90 |
| E2 | 6.85 | 7.05 | 7.25 |
| 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 22. D²PAK (TO-263) type B package outline

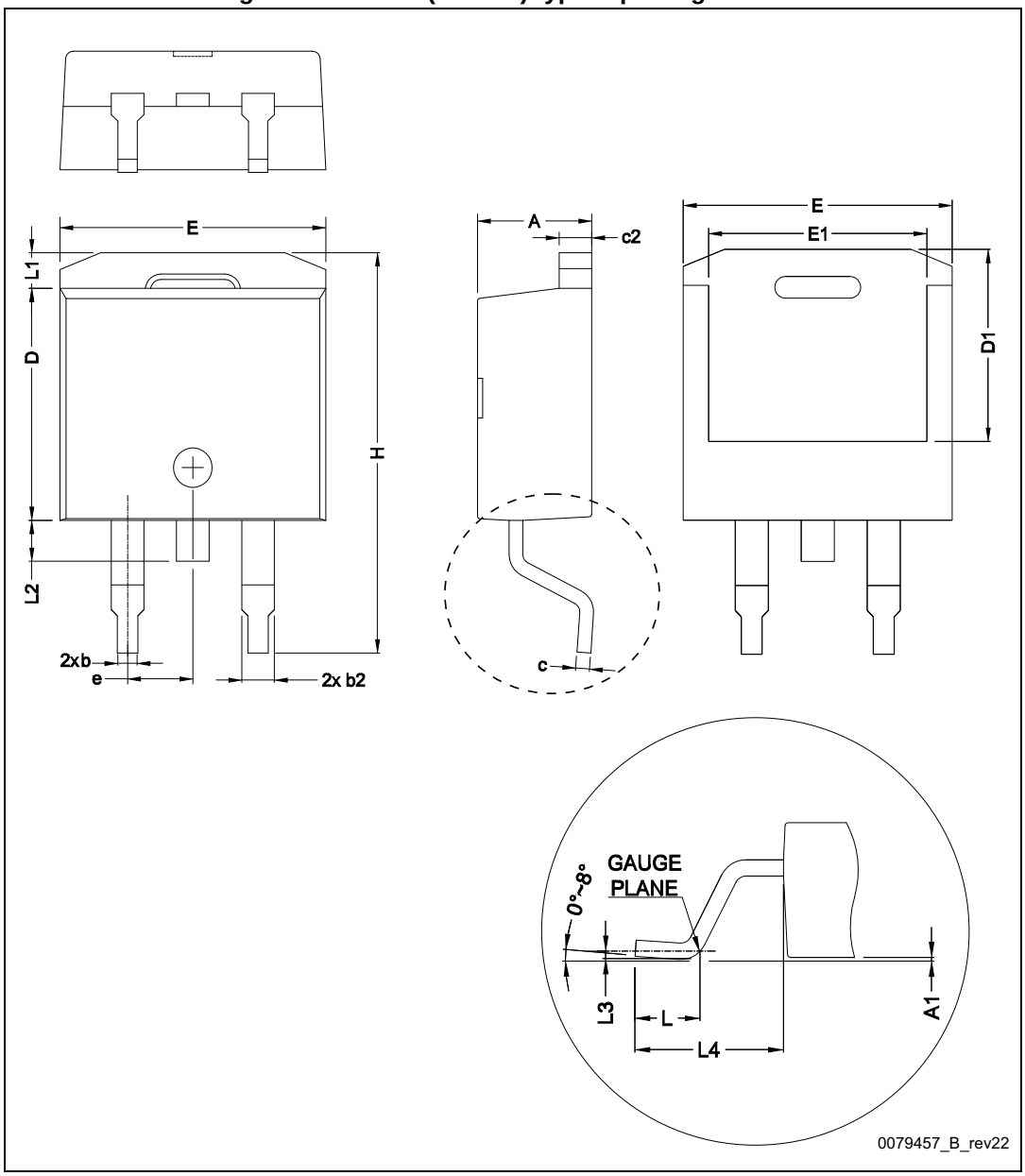
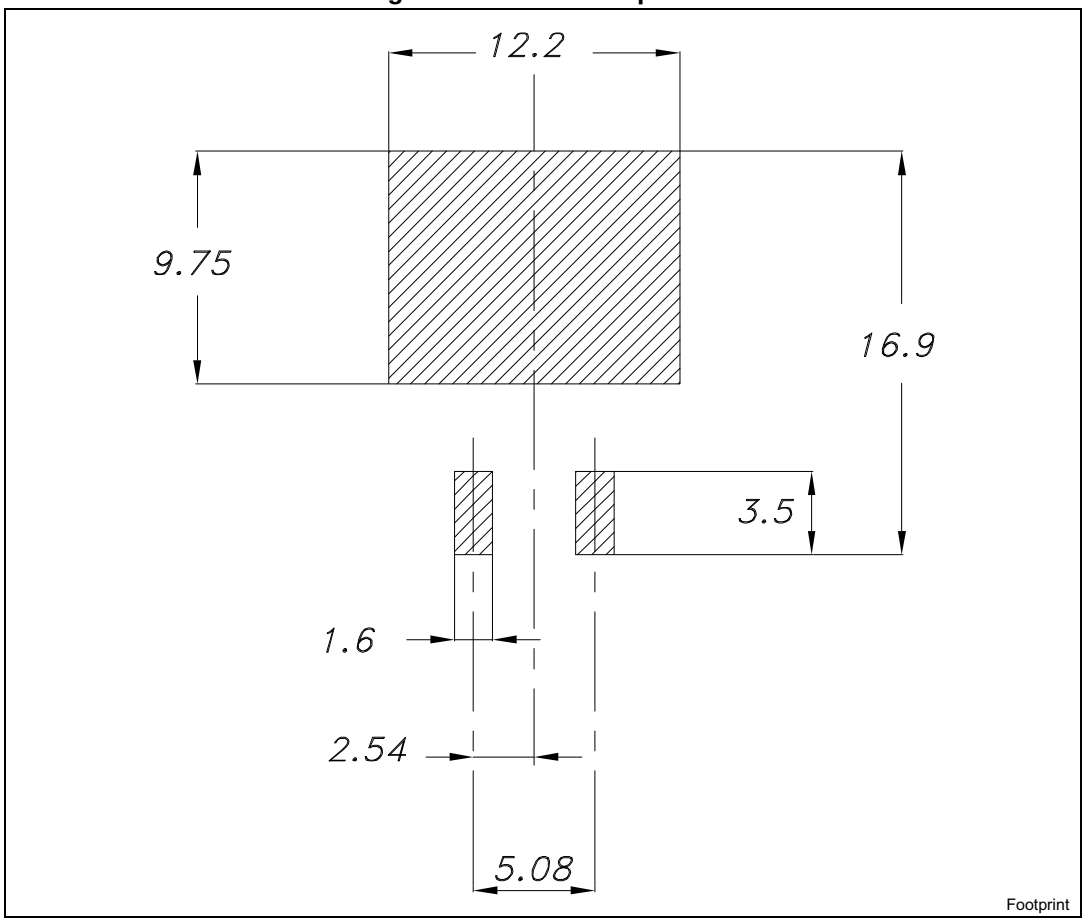


Table 10. D²PAK (TO-263) type B package mechanical data

| Dim. | mm | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 4.36 | | 4.60 |
| A1 | 0 | | 0.25 |
| b | 0.70 | | 0.93 |
| b2 | 1.14 | | 1.70 |
| c | 0.38 | | 0.694 |
| c1 | 0.38 | | 0.534 |
| c2 | 1.19 | | 1.36 |
| D | 8.6 | | 9.35 |
| D1 | 6.9 | | |
| E | 10 | | 10.55 |
| E1 | 8.1 | | |
| e | | 2.54 | |
| H | 15 | | 15.85 |
| L | 1.9 | | 2.79 |
| L1 | | | 1.65 |
| L2 | | | 1.78 |
| L3 | | 0.25 | |
| L4 | 4.78 | | 5.28 |

**Figure 23. D²PAK footprint[(a)]**




a. All dimension are in millimeters

## 4.2 DPAK package information

Figure 24. DPAK (TO-252) type A2 package outline

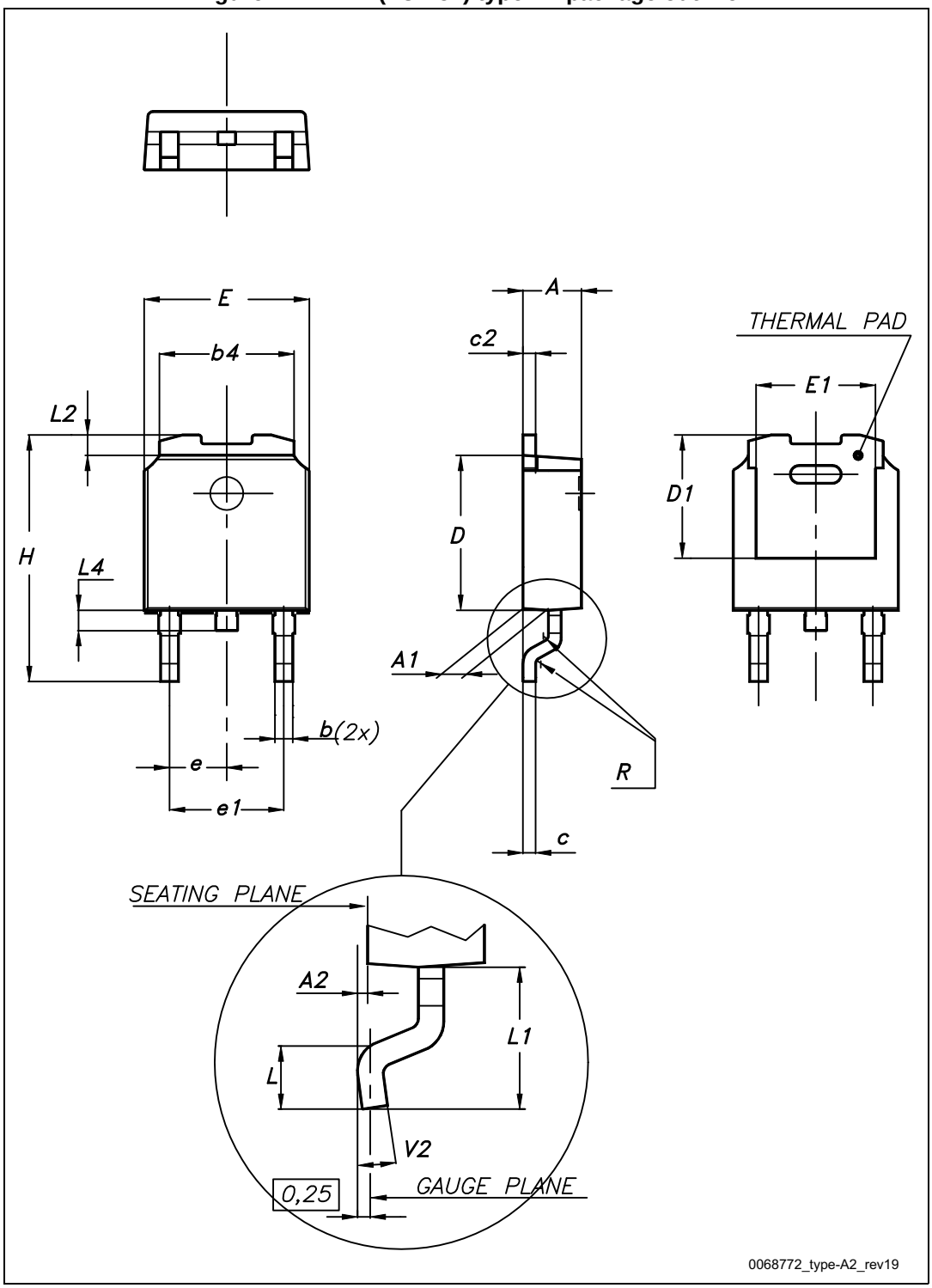


Table 11. DPAK (TO-252) type A2 package mechanical data

| 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 | 4.95 | 5.10 | 5.25 |
| E | 6.40 | | 6.60 |
| E1 | 5.10 | 5.20 | 5.30 |
| e | 2.16 | 2.28 | 2.40 |
| e1 | 4.40 | | 4.60 |
| H | 9.35 | | 10.10 |
| L | 1.00 | | 1.50 |
| L1 | 2.60 | 2.80 | 3.00 |
| L2 | 0.65 | 0.80 | 0.95 |
| L4 | 0.60 | | 1.00 |
| R | | 0.20 | |
| V2 | 0° | | 8° |

**Figure 25. DPAK (TO-252) type C2 outline**

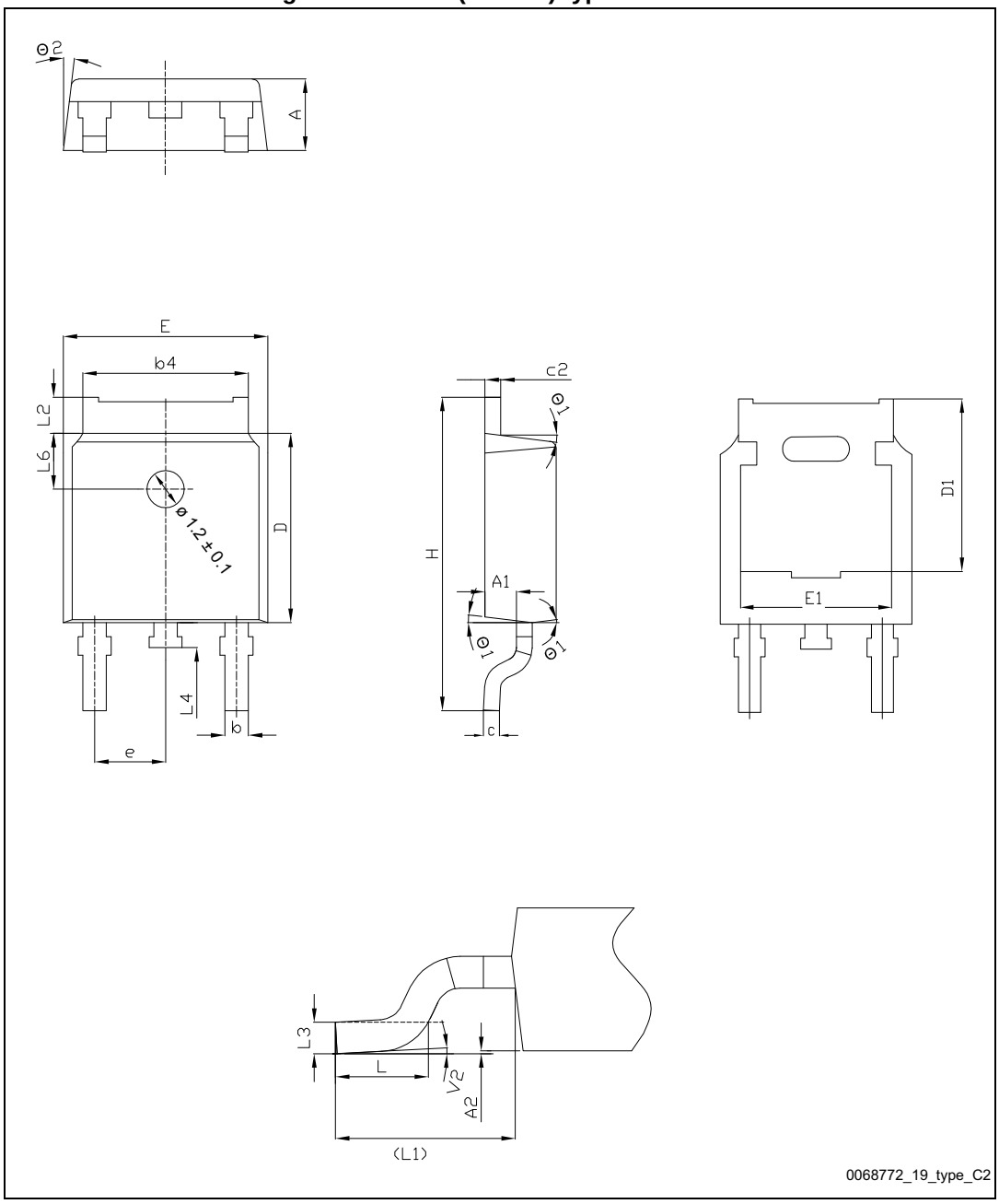
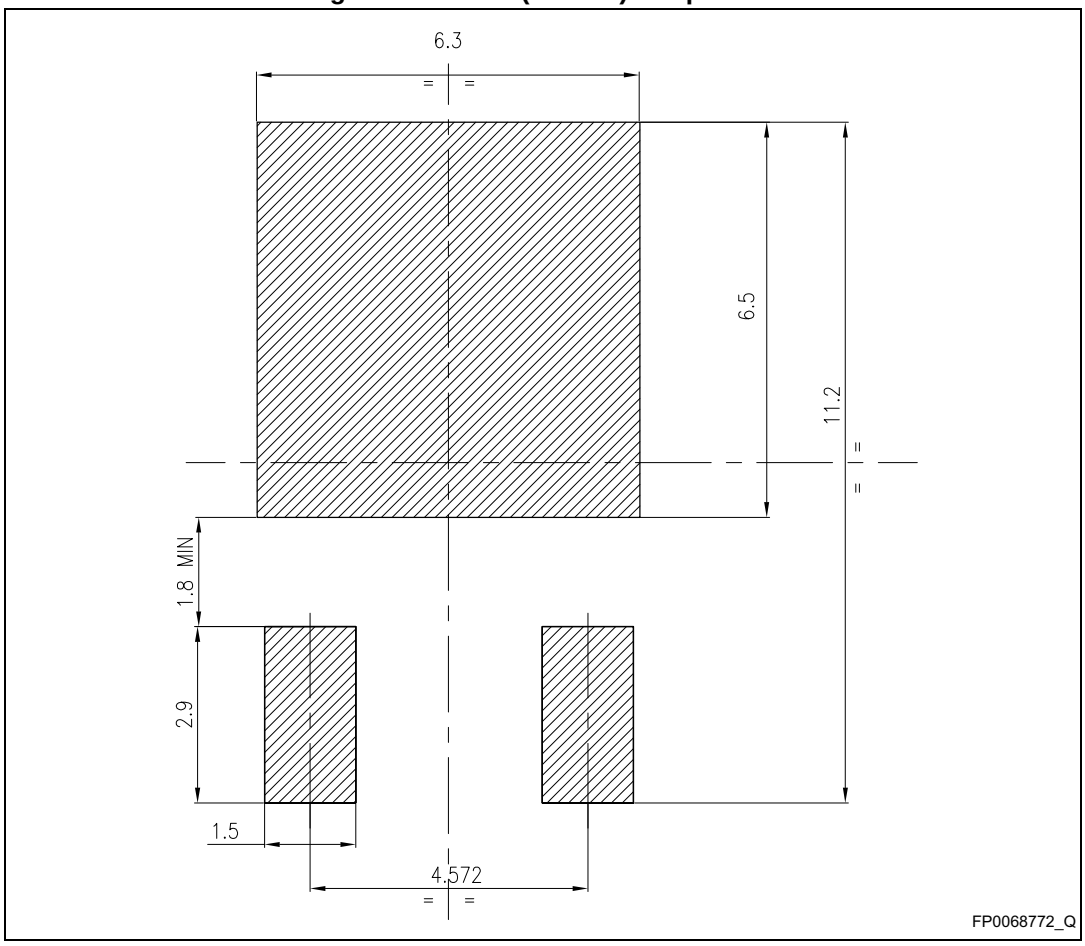


Table 12. DPAK (TO-252) type C2 package mechanical data

| Dim. | mm | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 2.20 | 2.30 | 2.38 |
| A1 | 0.90 | 1.01 | 1.10 |
| A2 | 0.00 | | 0.10 |
| b | 0.72 | | 0.85 |
| b4 | 5.13 | 5.33 | 5.46 |
| c | 0.47 | | 0.60 |
| c2 | 0.47 | | 0.60 |
| D | 6.00 | 6.10 | 6.20 |
| D1 | 5.25 | - | - |
| E | 6.50 | 6.60 | 6.70 |
| E1 | 5.20 | - | - |
| e | 2.186 | 2.286 | 2.386 |
| H | 9.80 | 10.10 | 10.40 |
| L | 1.40 | 1.50 | 1.70 |
| L1 | 2.90 REF | | |
| L2 | 0.90 | - | 1.25 |
| L3 | 0.51 BSC | | |
| L4 | 0.60 | 0.80 | 1.00 |
| L6 | 1.80 BSC | | |
| Θ1 | 5° | 7° | 9° |
| Θ2 | 5° | 7° | 9° |
| V2 | 0° | | 8° |

**Figure 26. DPAK (TO-252) footprint [(b)]**




b. All dimensions are in millimeters

# 5 Packing information

**Figure 27. Tape**

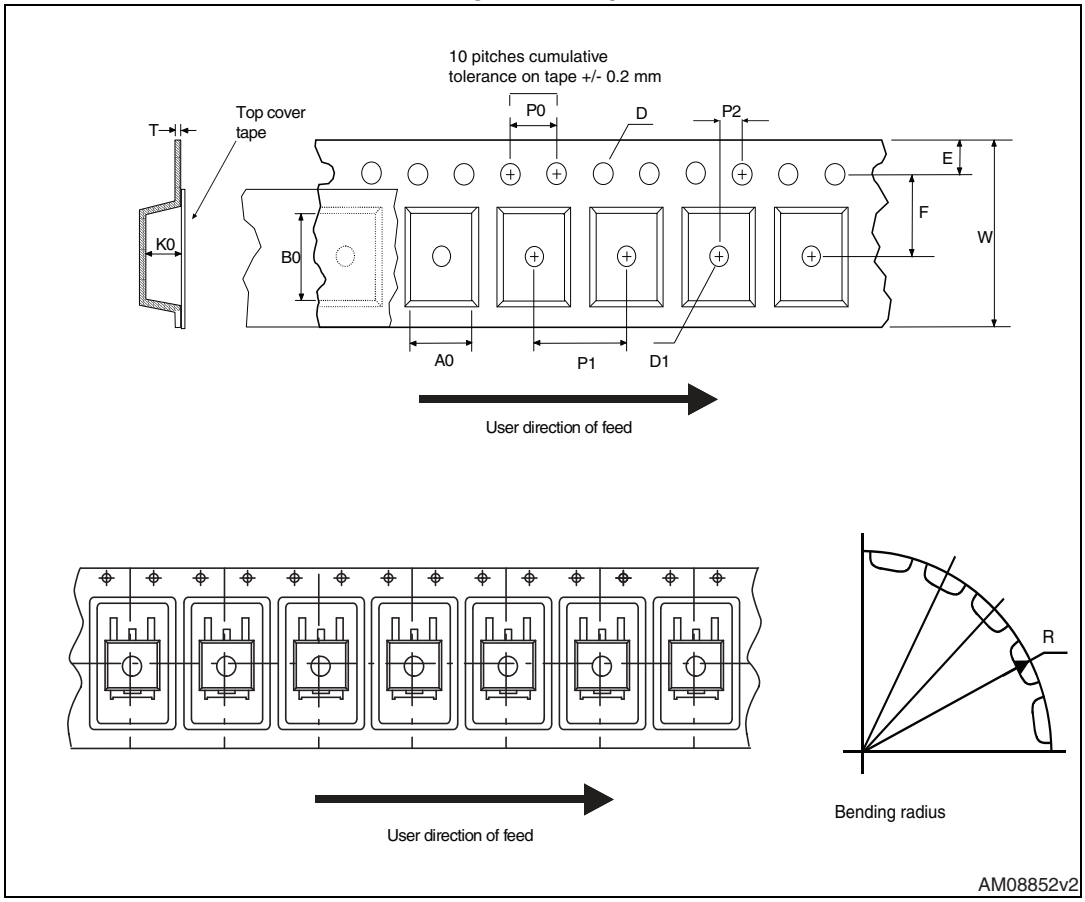


**Figure 28. Reel**

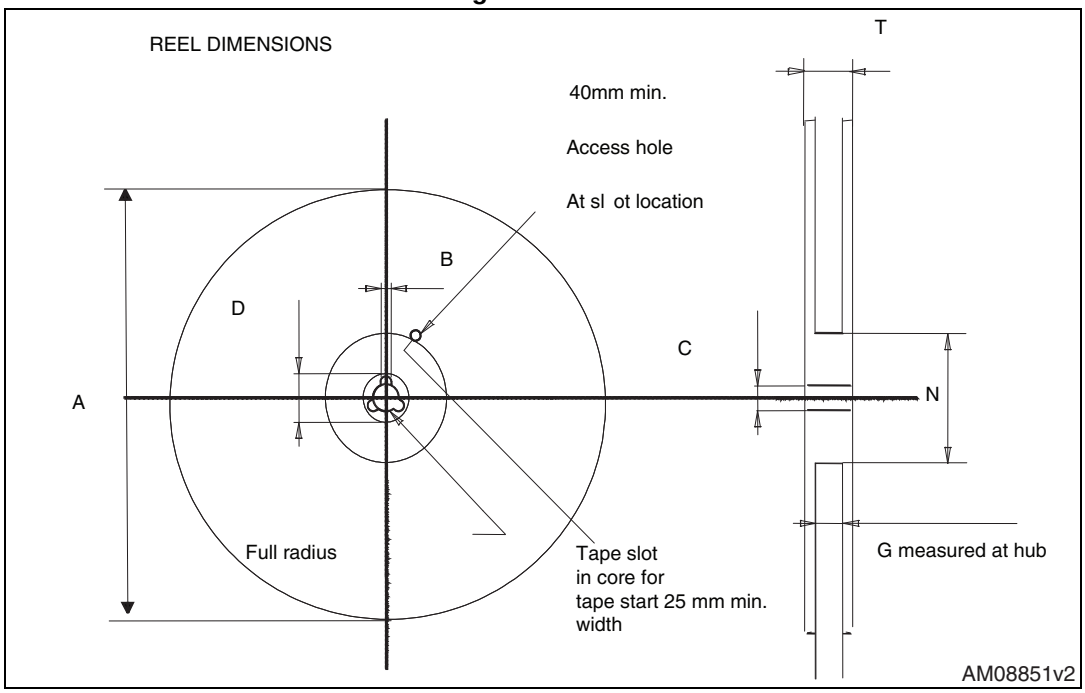



**Table 13. D²PAK (TO-263) tape and reel mechanical data**

| 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 14. 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 | | | |

# 6 Revision history

Table 15. Document revision history

| Date | Revision | Changes |
|---|---|---|
| 18-Dec-2012 | 1 | First release |
| 10-Jul-2014 | 2 | – Updated: *Section 3: Test circuits*<br>– Updated: *Section 4: Package information*<br>– Minor text changes |
| 19-Jun-2015 | 3 | – Updated *4: Package information*<br>– Minor text changes |