

N-channel 500 V, 0.299 Ω typ., 11 A MDmesh™ DM2 Power MOSFET in a DPAK package

Datasheet - production data

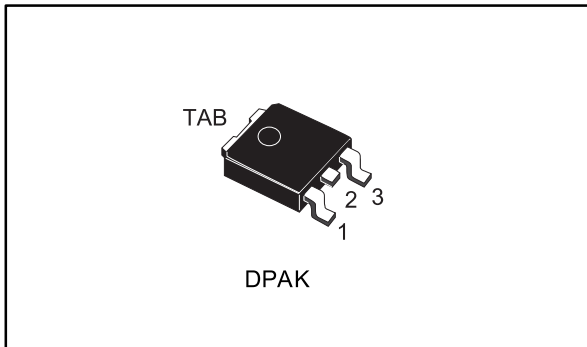
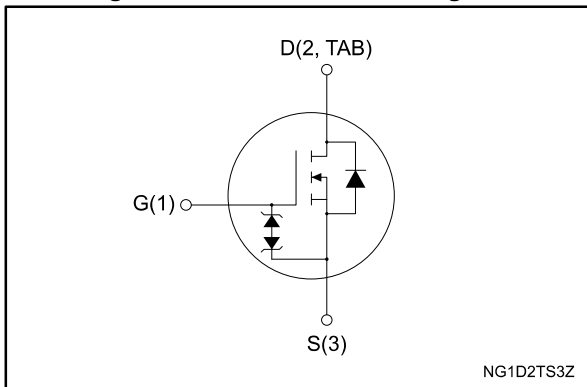


Figure 1: Internal schematic diagram



Features

| Order code | V _{DS} | R _{DS(on)} max. | I _D |
|-------------|-----------------|--------------------------|----------------|
| STD12N50DM2 | 500 V | 0.350 Ω | 11 A |

- Fast-recovery body diode
- Extremely low gate charge and input capacitance
- Low on-resistance
- 100% avalanche tested
- Extremely high dv/dt ruggedness
- Zener-protected

Applications

- Switching applications

Description

This high voltage N-channel Power MOSFET is part of the MDmesh DM2 fast recovery diode series. It offers very low recovery charge and time (Q_{rr}, t_{rr}) combined with low R_{DS(on)}, rendering it suitable for the most demanding high efficiency converters and ideal for bridge topologies and ZVS phase-shift converters.

Table 1: Device summary

| Order code | Marking | Package | Packing |
|-------------|----------|---------|---------------|
| STD12N50DM2 | 12N50DM2 | DPAK | Tape and reel |

Contents

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1 Electrical ratings

Table 2: Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|----------------|---|------------|------------------|
| V_{GS} | Gate-source voltage | ± 25 | V |
| I_D | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$ | 11 | A |
| I_D | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$ | 8 | |
| $I_{DM}^{(1)}$ | Drain current (pulsed) | 44 | A |
| P_{TOT} | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$ | 110 | W |
| $dv/dt^{(2)}$ | Peak diode recovery voltage slope | 40 | V/ns |
| $dv/dt^{(3)}$ | MOSFET dv/dt ruggedness | 50 | V/ns |
| T_{stg} | Storage temperature range | -55 to 150 | $^\circ\text{C}$ |
| T_j | Operating junction temperature range | | |

Notes:

(1) Pulse width limited by safe operating area.

(2) $I_{SD} \leq 11\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$; $V_{DS\ peak} < V_{(BR)DSS}$, $V_{DD} = 80\% V_{(BR)DSS}$

(3) $V_{DS} \leq 400\text{ V}$

Table 3: Thermal data

| Symbol | Parameter | Value | Unit |
|---------------------|--------------------------------------|-------|---------------------------|
| $R_{thj-case}$ | Thermal resistance junction-case max | 1.14 | $^\circ\text{C}/\text{W}$ |
| $R_{thj-pcb}^{(1)}$ | Thermal resistance junction-pcb max | 50 | |

Notes:

(1) When mounted on a 1-inch² FR-4, 2 oz Cu board

Table 4: Avalanche characteristics

| Symbol | Parameter | Value | Unit |
|----------|--|-------|------|
| I_{AR} | Avalanche current, repetitive or not repetitive (pulse width limited by T_{jmax}) | 2.5 | A |
| E_{AS} | Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$) | 320 | mJ |

2 Electrical characteristics

($T_C = 25\text{ °C}$ unless otherwise specified).

Table 5: Static

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|-----------------------------------|---|------|-------|----------|---------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $V_{GS} = 0\text{ V}$, $I_D = 1\text{ mA}$ | 500 | | | V |
| I_{DSS} | Zero gate voltage drain current | $V_{GS} = 0\text{ V}$, $V_{DS} = 500\text{ V}$ | | | 1 | μA |
| | | $V_{GS} = 0\text{ V}$, $V_{DS} = 500\text{ V}$, $T_C = 125\text{ °C}^{(1)}$ | | | 100 | μA |
| I_{GSS} | Gate-body leakage current | $V_{DS} = 0\text{ V}$, $V_{GS} = \pm 25\text{ V}$ | | | ± 10 | μA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$ | 3 | 4 | 5 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS} = 10\text{ V}$, $I_D = 5.5\text{ A}$ | | 0.299 | 0.350 | Ω |

Notes:

⁽¹⁾Defined by design, not subject to production test.

Table 6: Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------------------|-------------------------------|--|------|------|------|----------|
| C_{iss} | Input capacitance | $V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$ | - | 628 | - | pF |
| C_{oss} | Output capacitance | | - | 38 | - | pF |
| C_{rSS} | Reverse transfer capacitance | | - | 1.2 | - | pF |
| $C_{oss\text{ eq.}}^{(1)}$ | Equivalent output capacitance | $V_{DS} = 0\text{ V to } 400\text{ V}$, $V_{GS} = 0\text{ V}$ | - | 69 | - | pF |
| R_G | Intrinsic gate resistance | $f = 1\text{ MHz open drain}$ | - | 7 | - | Ω |
| Q_g | Total gate charge | $V_{DD} = 400\text{ V}$, $I_D = 11\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 15: "Test circuit for gate charge behavior") | - | 16 | - | nC |
| Q_{gs} | Gate-source charge | | - | 4.6 | - | nC |
| Q_{gd} | Gate-drain charge | | - | 7 | - | nC |

Notes:

⁽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 7: Switching times

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--------------|---------------------|---|------|------|------|------|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD} = 250\text{ V}$, $I_D = 5.5\text{ A}$ $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ (see Figure 14: "Test circuit for resistive load switching times" and Figure 19: "Switching time waveform") | - | 12.5 | - | ns |
| t_r | Rise time | | - | 9 | - | ns |
| $t_{d(off)}$ | Turn-off-delay time | | - | 28 | - | ns |
| t_f | Fall time | | - | 9.8 | - | 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 | $V_{GS} = 0\text{ V}$, $I_{SD} = 11\text{ A}$ | - | | 1.6 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 11\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$ (see Figure 16 : "Test circuit for inductive load switching and diode recovery times") | - | 140 | | ns |
| Q_{rr} | Reverse recovery charge | | - | 0.707 | | μC |
| I_{RRM} | Reverse recovery current | | - | 10.1 | | A |
| t_{rr} | Reverse recovery time | $I_{SD} = 11\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 16 : "Test circuit for inductive load switching and diode recovery times") | - | 190 | | ns |
| Q_{rr} | Reverse recovery charge | | - | 1.111 | | μC |
| I_{RRM} | Reverse recovery current | | - | 11.7 | | A |

Notes:

(1) Pulse width is limited by safe operating area

(2) Pulse test: pulse duration = 300 μs , duty cycle 1.5%

2.1 Electrical characteristics (curves)

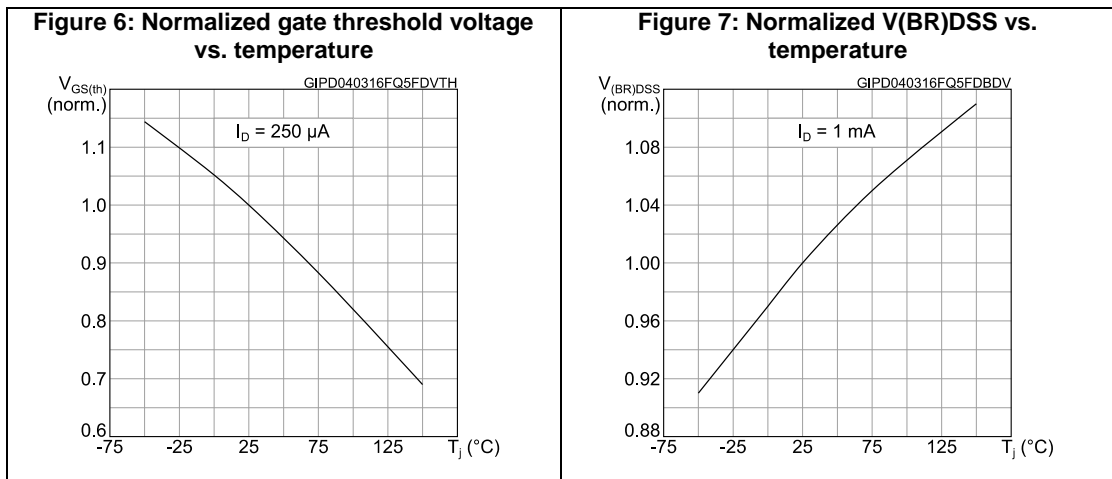
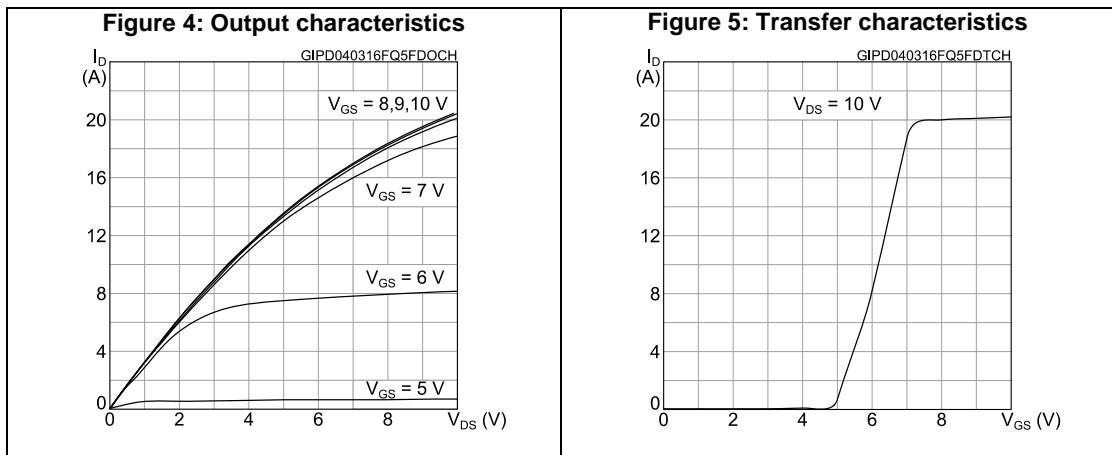
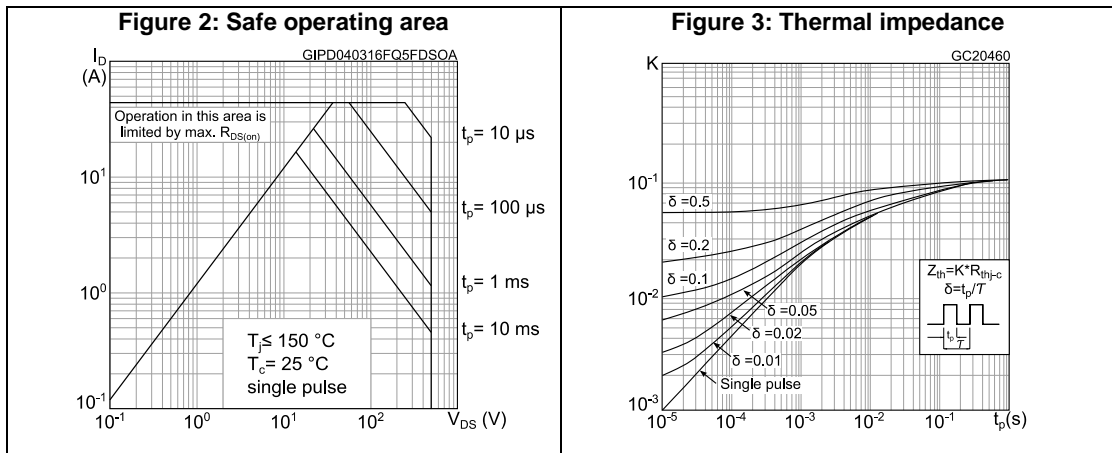


Figure 8: Static drain-source on-resistance

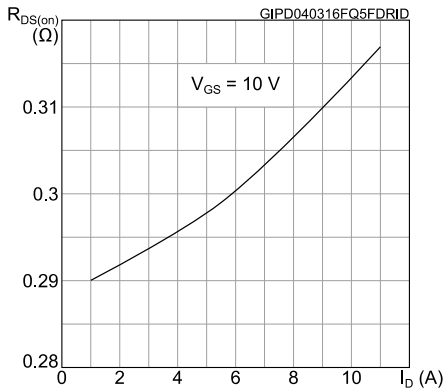


Figure 9: Normalized on-resistance vs. temperature

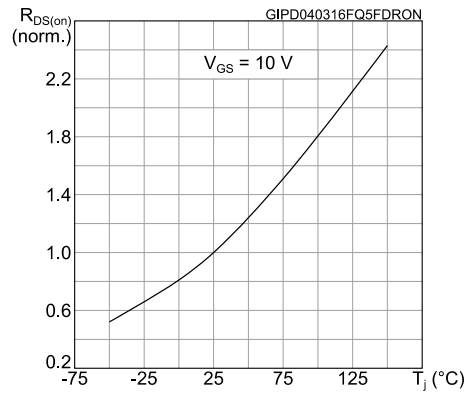


Figure 10: Gate charge vs. gate-source voltage

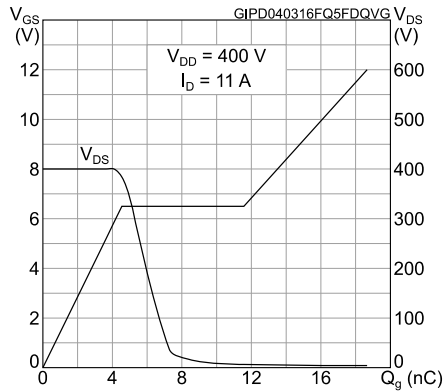


Figure 11: Capacitance variations

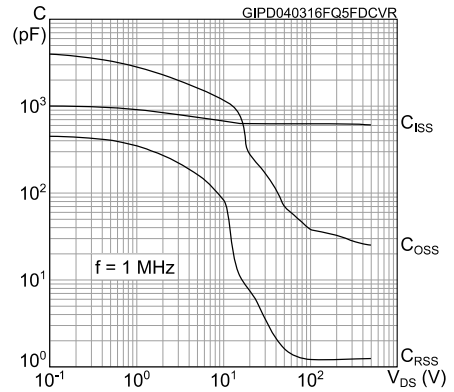


Figure 12: Output capacitance stored energy

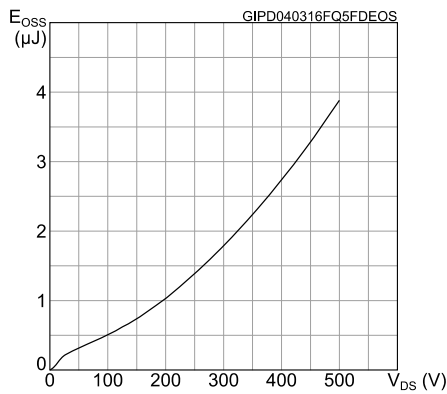
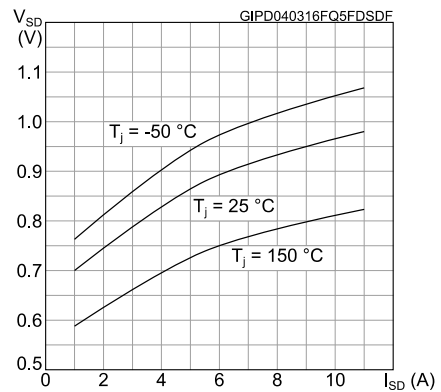
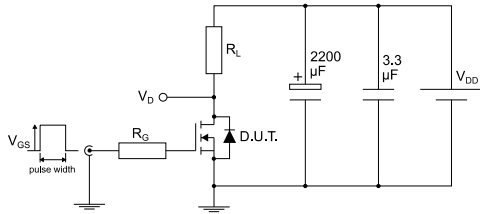


Figure 13: Source-drain diode forward characteristics



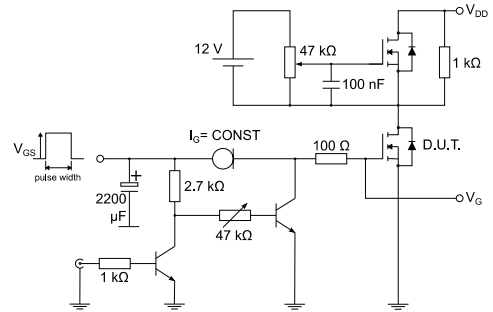
3 Test circuits

Figure 14: Test circuit for resistive load switching times



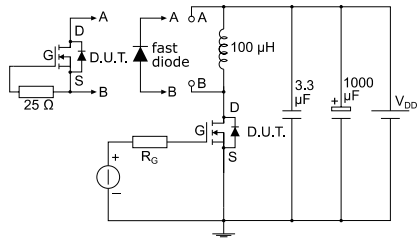
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Figure 15: Test circuit for gate charge behavior



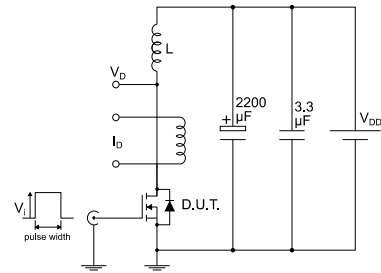
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Figure 16: Test circuit for inductive load switching and diode recovery times



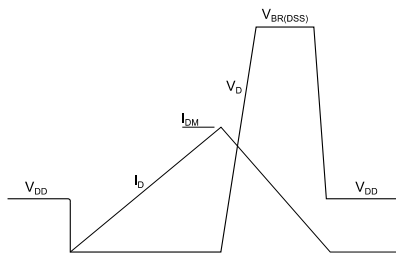
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Figure 17: Unclamped inductive load test circuit



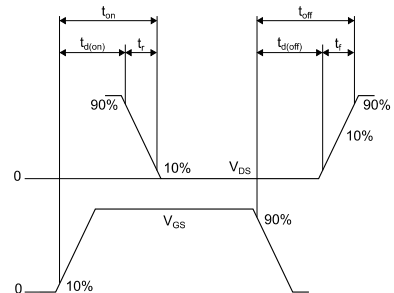
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Figure 18: Unclamped inductive waveform



AM01472v1

Figure 19: Switching time waveform



AM01473v1

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 DPAK package information

Figure 20: DPAK (TO-252) type A2 package outline

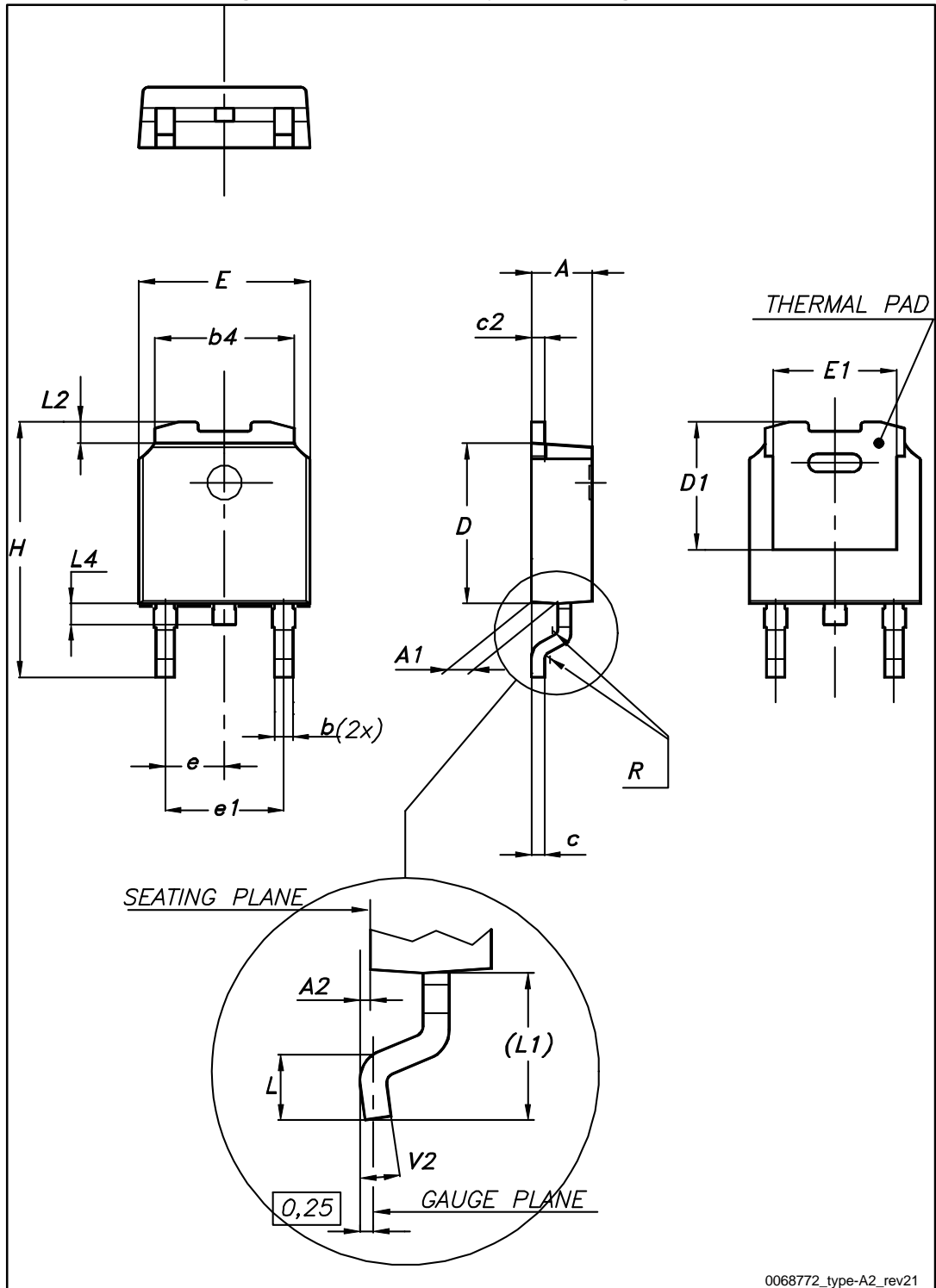
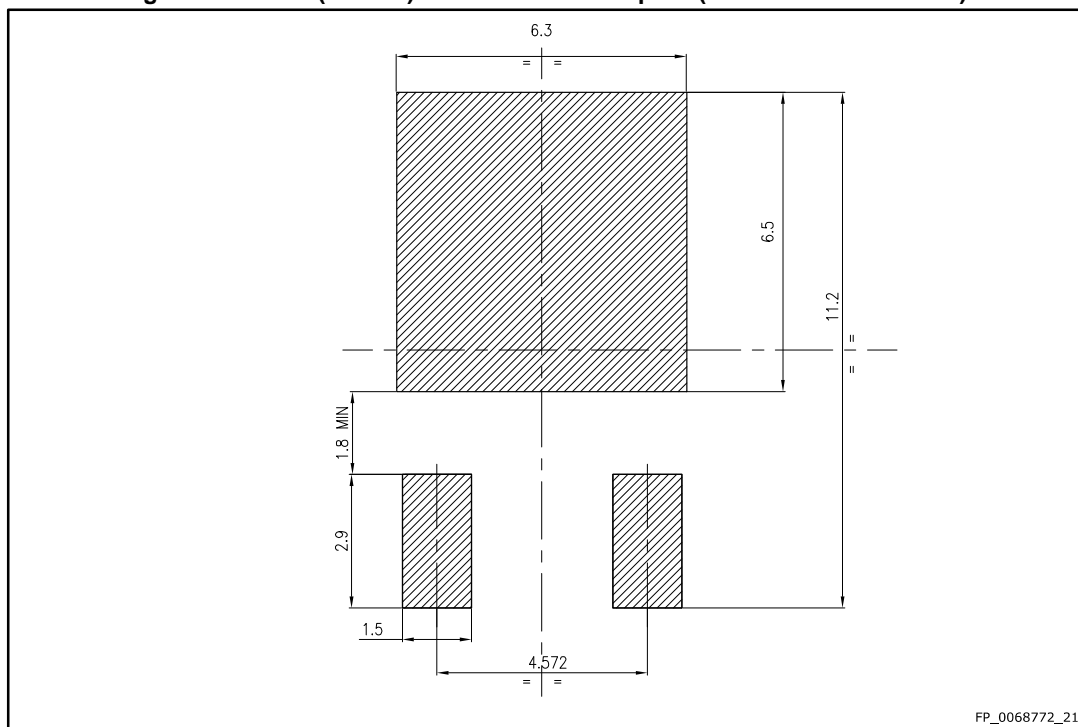


Table 9: DPAK (TO-252) type A2 mechanical data

| 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 21: DPAK (TO-252) recommended footprint (dimensions are in mm)



4.2 Packing information

Figure 22: DPAK (TO-252) tape outline

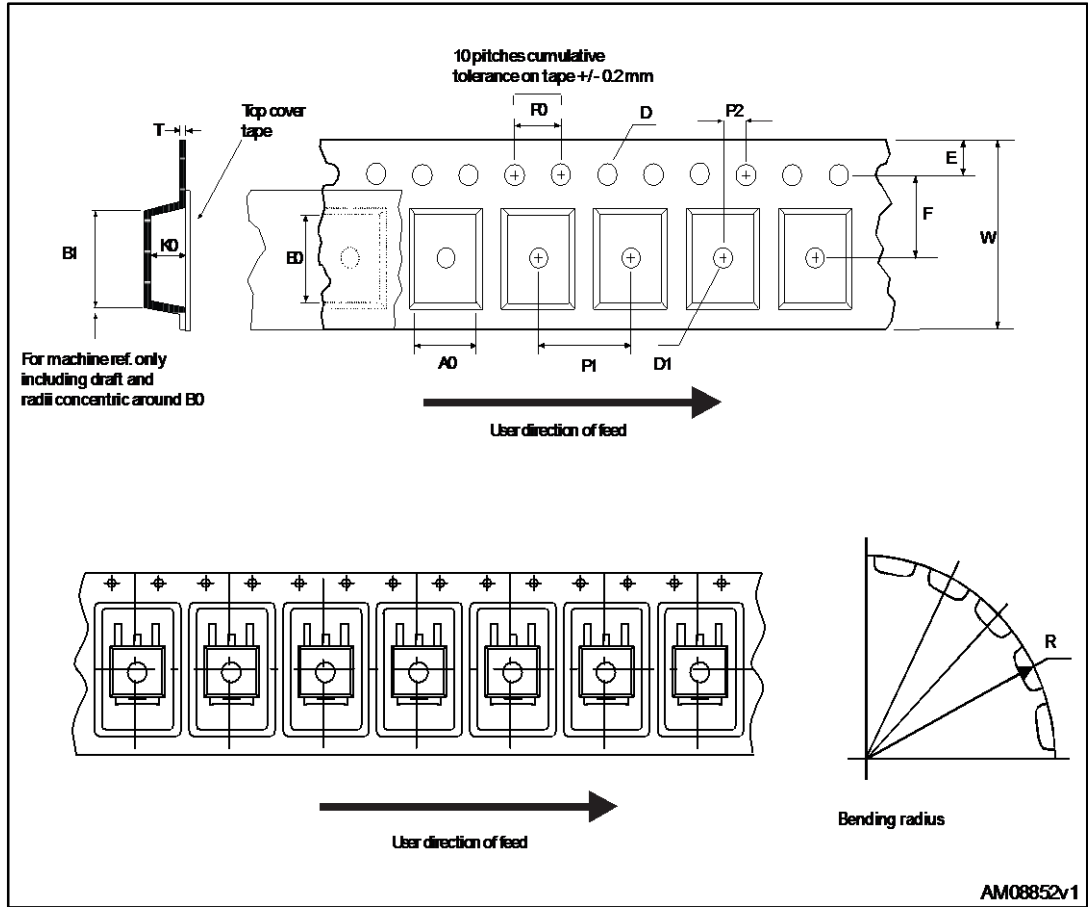
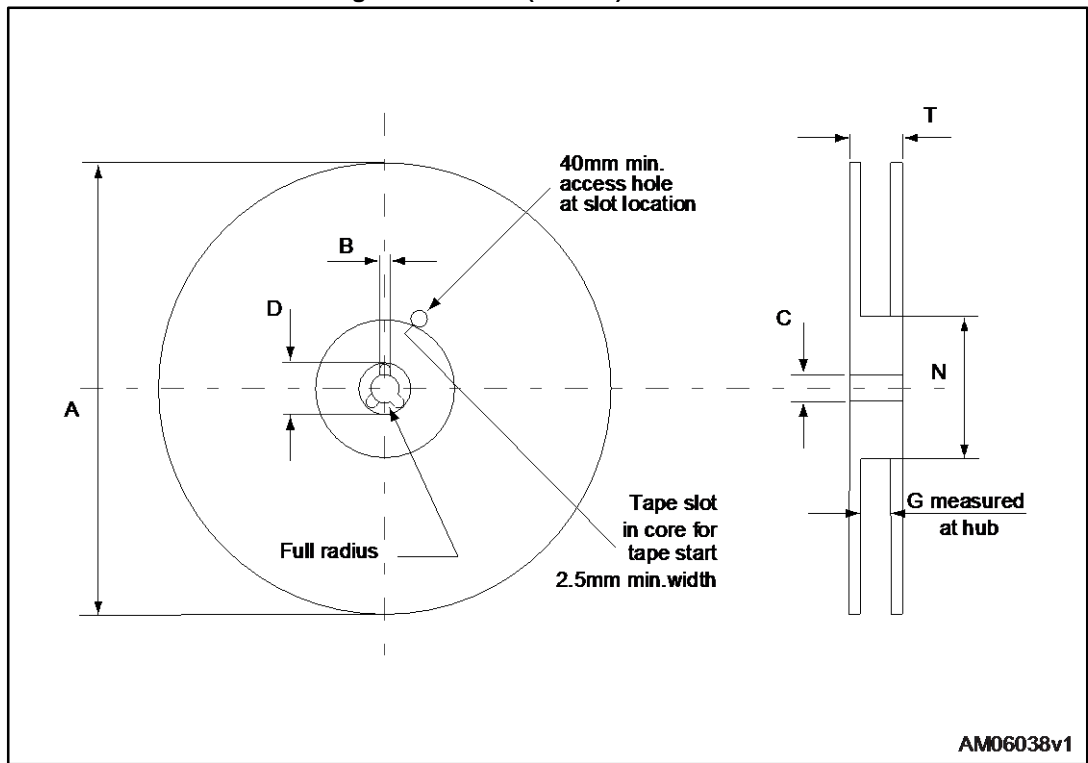


Figure 23: DPAK (TO-252) reel outline



AM06038v1

Table 10: 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 | | | |

5 Revision history

Table 11: Document revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 26-Aug-2014 | 1 | First release. |
| 07-Mar-2016 | 2 | Text and formatting changes throughout document In Section 1: "Electrical ratings" : - updated Table 4: "Avalanche characteristics" In Section 2: "Electrical characteristics" - updated Table 6: "Dynamic" , Table 7: "Switching times" and Table 8: "Source drain diode" Added Section 2.1: "Electrical characteristics (curves)" Updated Section 4: "Package information" |

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