

## Automotive-grade N-channel 500 V, 0.28 $\Omega$ typ., 12 A MDmesh™ II Power MOSFET in a DPAK package

Datasheet - production data

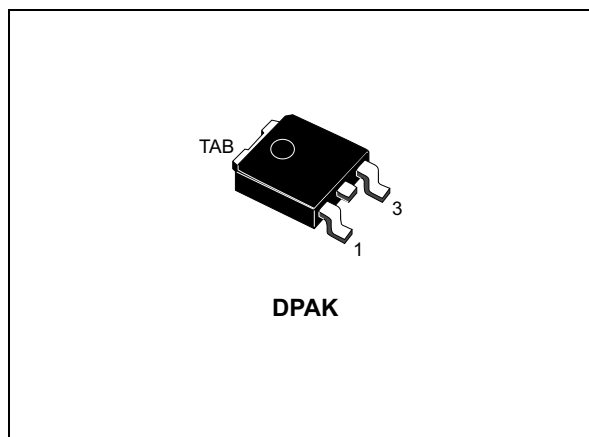
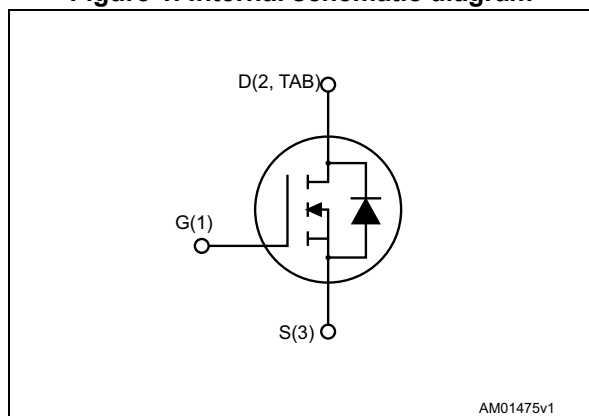


Figure 1. Internal schematic diagram



### Features

| Order code | $V_{DS} @ T_{Jmax}$ | $R_{DS(on)} max$ | $I_D$ |
|------------|---------------------|------------------|-------|
| STD14NM50N | 550 V               | 0.32 $\Omega$    | 12 A  |

- Designed for automotive applications and AEC-Q101 qualified
- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance

### Applications

- Switching applications

### Description

This device is an N-channel Power MOSFET developed using the second generation of MDmesh™ technology. This revolutionary Power MOSFET associates a vertical structure to the company's strip layout to yield one of the world's lowest on-resistance and gate charge. It is therefore suitable for the most demanding high efficiency converters.

Table 1. Device summary

| Order code | Marking | Package | Packaging     |
|------------|---------|---------|---------------|
| STD14NM50N | 14NM50N | DPAK    | Tape and reel |

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol         | Parameter                                                       | Value       | Unit             |
|----------------|-----------------------------------------------------------------|-------------|------------------|
| $V_{DS}$       | Drain-source voltage                                            | 500         | V                |
| $V_{GS}$       | Gate-source voltage                                             | $\pm 25$    | V                |
| $I_D$          | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$  | 12          | A                |
| $I_D$          | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$ | 8           | A                |
| $I_{DM}^{(1)}$ | Drain current (pulsed)                                          | 48          | A                |
| $P_{TOT}$      | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$           | 90          | W                |
| $dv/dt^{(2)}$  | Peak diode recovery voltage slope                               | 15          | V/ns             |
| $T_{stg}$      | 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.  $I_{SD} \leq 12\text{ A}$ ,  $di/dt \leq 400\text{ A/s}$ ,  $V_{DS\text{ peak}} \leq V_{(BR)DSS}$ ,  $V_{DD} = 80\% V_{(BR)DSS}$ .

**Table 3. Thermal data**

| Symbol              | Parameter                            | Value | Unit               |
|---------------------|--------------------------------------|-------|--------------------|
| $R_{thj-case}$      | Thermal resistance junction-case max | 1.39  | $^\circ\text{C/W}$ |
| $R_{thj-pcb}^{(1)}$ | Thermal resistance junction-pcb max  | 50    | $^\circ\text{C/W}$ |

1. When mounted on 1inch<sup>2</sup> FR-4 board, 2 oz Cu.

**Table 4. Avalanche data**

| Symbol   | Parameter                                                                                                            | Value | Unit |
|----------|----------------------------------------------------------------------------------------------------------------------|-------|------|
| $I_{AR}$ | Avalanche current, repetitive or not-repetitive (pulse width limited by $T_j$ max)                                   | 4     | A    |
| $E_{AS}$ | Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{ V}$ ) | 172   | mJ   |

## 2 Electrical characteristics

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

**Table 5. On /off states**

| Symbol        | Parameter                         | Test conditions                                          | Min. | Typ. | Max.      | Unit          |
|---------------|-----------------------------------|----------------------------------------------------------|------|------|-----------|---------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage    | $V_{GS} = 0, I_D = 1\text{ mA}$                          | 500  |      |           | V             |
| $I_{DSS}$     | Zero gate voltage drain current   | $V_{GS} = 0, V_{DS} = 500\text{ V}$                      |      |      | 1         | $\mu\text{A}$ |
|               |                                   | $V_{GS} = 0, V_{DS} = 500\text{ V}, T_C = 125\text{ °C}$ |      |      | 100       | $\mu\text{A}$ |
| $I_{GSS}$     | Gate-body leakage current         | $V_{DS} = 0, V_{GS} = \pm 25\text{ V}$                   |      |      | $\pm 100$ | nA            |
| $V_{GS(th)}$  | Gate threshold voltage            | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$          | 2    | 3    | 4         | V             |
| $R_{DS(on)}$  | Static drain-source on-resistance | $V_{GS} = 10\text{ V}, I_D = 6\text{ A}$                 |      | 0.28 | 0.32      | $\Omega$      |

**Table 6. Dynamic**

| Symbol                     | Parameter                     | Test conditions                                                                                   | Min. | Typ. | Max. | Unit     |
|----------------------------|-------------------------------|---------------------------------------------------------------------------------------------------|------|------|------|----------|
| $C_{iss}$                  | Input capacitance             | $V_{GS} = 0, V_{DS} = 50\text{ V}, f = 1\text{ MHz}$                                              | -    | 816  | -    | pF       |
| $C_{oss}$                  | Output capacitance            |                                                                                                   | -    | 60   | -    | pF       |
| $C_{rss}$                  | Reverse transfer capacitance  |                                                                                                   | -    | 3    | -    | pF       |
| $C_{oss\text{ eq.}}^{(1)}$ | Equivalent output capacitance | $V_{GS} = 0, V_{DS} = 0\text{ to }50\text{ V}$                                                    | -    | 157  | -    | pF       |
| $R_G$                      | Intrinsic gate resistance     | $f = 1\text{ MHz open drain}$                                                                     | -    | 4.5  | -    | $\Omega$ |
| $Q_g$                      | Total gate charge             | $V_{DD} = 400\text{ V}, I_D = 12\text{ A}, V_{GS} = 10\text{ V}$ (see <a href="#">Figure 13</a> ) | -    | 27   | -    | nC       |
| $Q_{gs}$                   | Gate-source charge            |                                                                                                   | -    | 5    | -    | nC       |
| $Q_{gd}$                   | Gate-drain charge             |                                                                                                   | -    | 15   | -    | 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%  $V_{DS}$

Table 7. Switching times

| Symbol       | Parameter           | Test conditions                                                                                                                     | Min. | Typ. | Max. | Unit |
|--------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD} = 400\text{ V}$ , $I_D = 12\text{ A}$ ,<br>$R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$<br>(see <a href="#">Figure 13</a> ) | -    | 12   | -    | ns   |
| $t_r$        | Rise time           |                                                                                                                                     | -    | 16   | -    | ns   |
| $t_{d(off)}$ | Turn-off-delay time |                                                                                                                                     | -    | 42   | -    | ns   |
| $t_f$        | Fall time           |                                                                                                                                     | -    | 22   | -    | ns   |

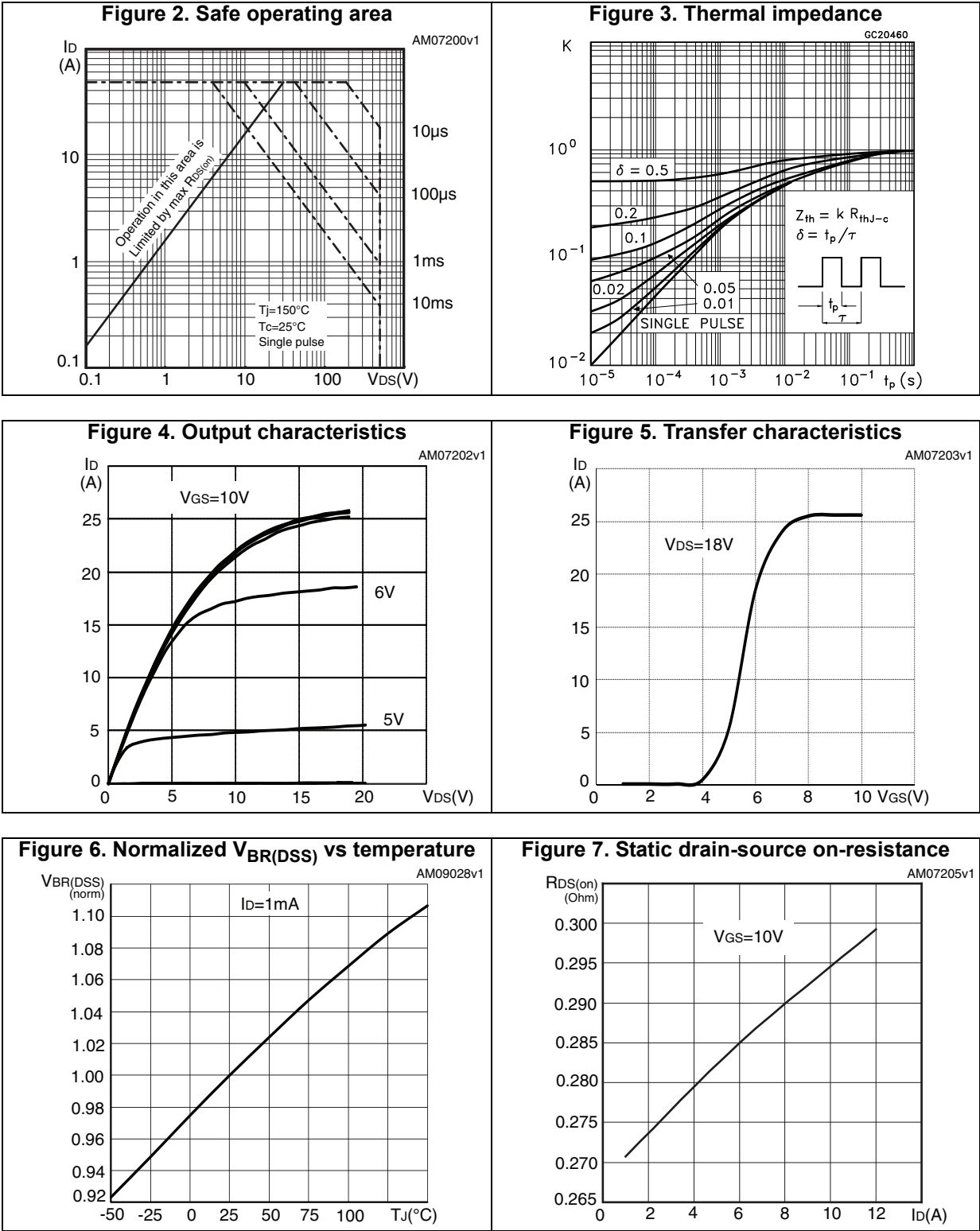
Table 8. Source drain diode

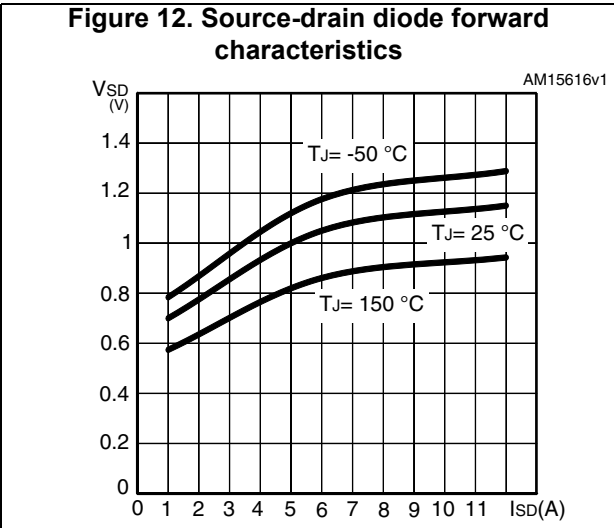
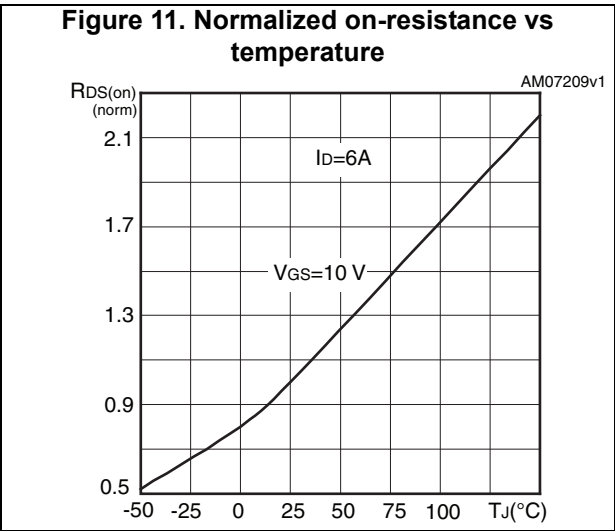
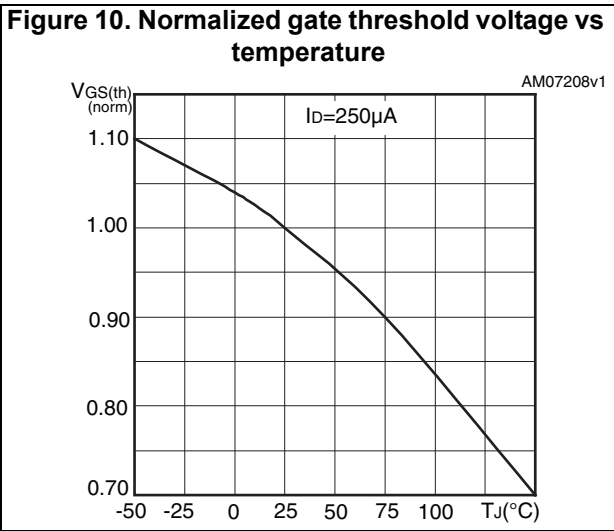
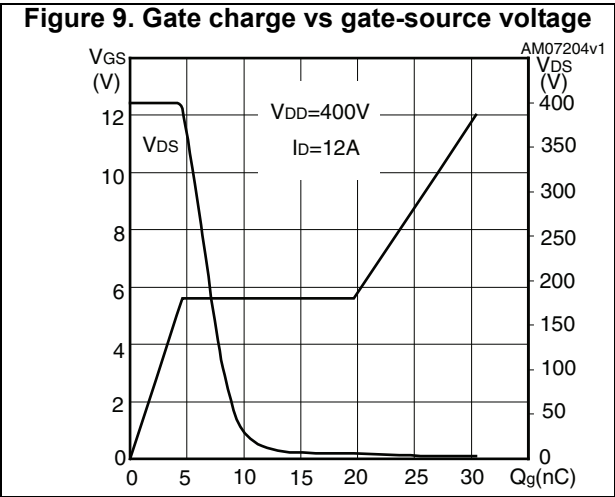
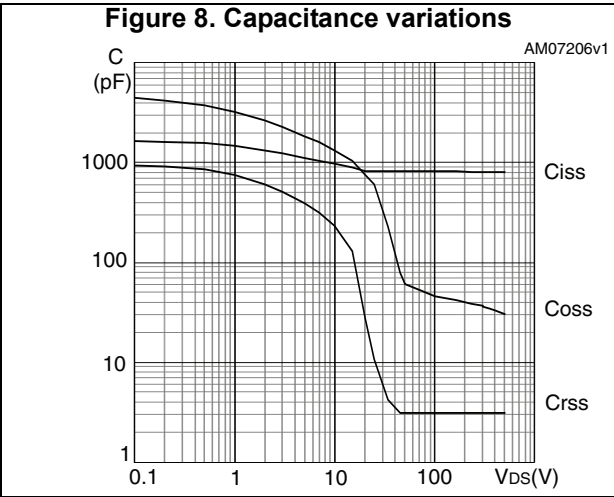
| Symbol          | Parameter                     | Test conditions                                                                                                                                                 | Min. | Typ. | Max. | Unit          |
|-----------------|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $I_{SD}$        | Source-drain current          |                                                                                                                                                                 | -    |      | 12   | A             |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |                                                                                                                                                                 | -    |      | 48   | A             |
| $V_{SD}^{(2)}$  | Forward on voltage            | $V_{GS} = 0$ , $I_{SD} = 12\text{ A}$                                                                                                                           | -    |      | 1.6  | V             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 12\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 60\text{ V}$<br>(see <a href="#">Figure 17</a> )                                     | -    | 252  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                                                 | -    | 2.8  |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                                                 | -    | 22   |      | A             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 12\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 60\text{ V}$ , $T_J = 150\text{ }^\circ\text{C}$<br>(see <a href="#">Figure 17</a> ) | -    | 300  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                                                 | -    | 3.3  |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                                                 | -    | 22.2 |      | A             |

1. Pulse width limited by safe operating area

2. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

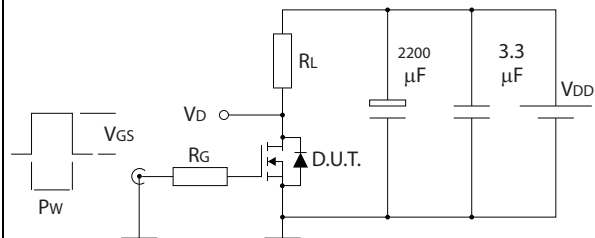
2.1 Electrical characteristics (curves)





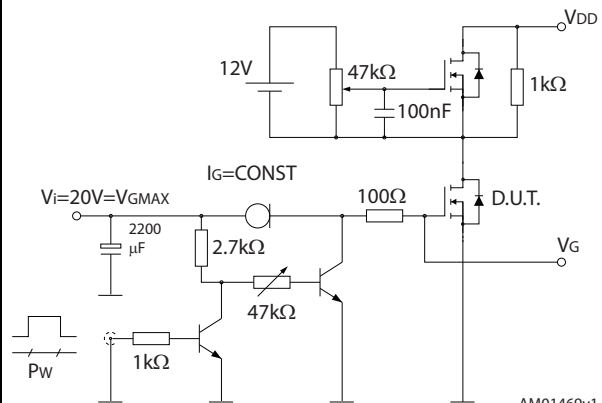
### 3 Test circuits

**Figure 13. Switching times test circuit for resistive load**



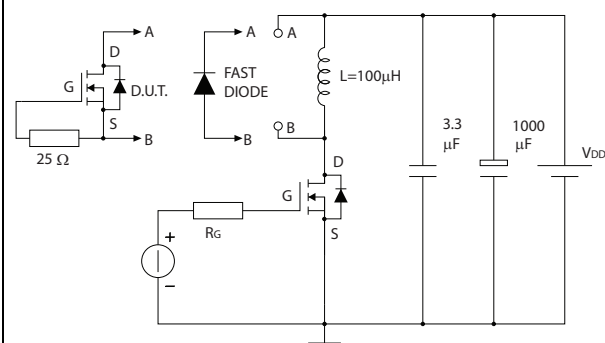
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**Figure 14. Gate charge test circuit**



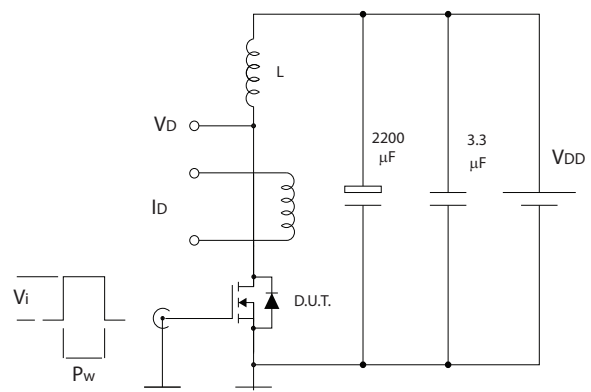
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**Figure 15. Test circuit for inductive load switching and diode recovery times**



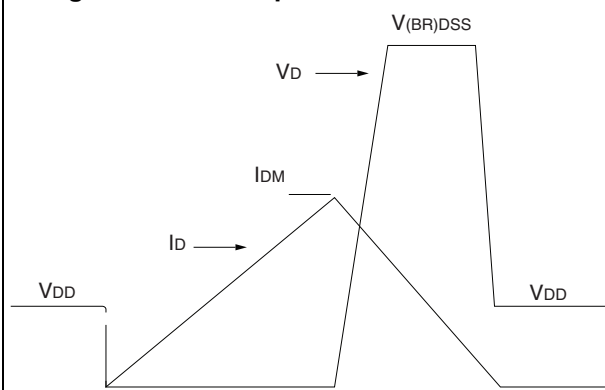
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**Figure 16. Unclamped inductive load test circuit**



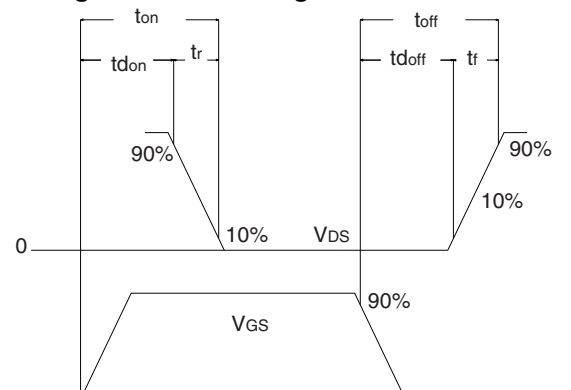
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**Figure 17. Unclamped inductive waveform**



AM01472v1

**Figure 18. 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](http://www.st.com). ECOPACK® is an ST trademark.

## 4.1 DPAK package information

Figure 19. DPAK (TO-252) type A2 package outline

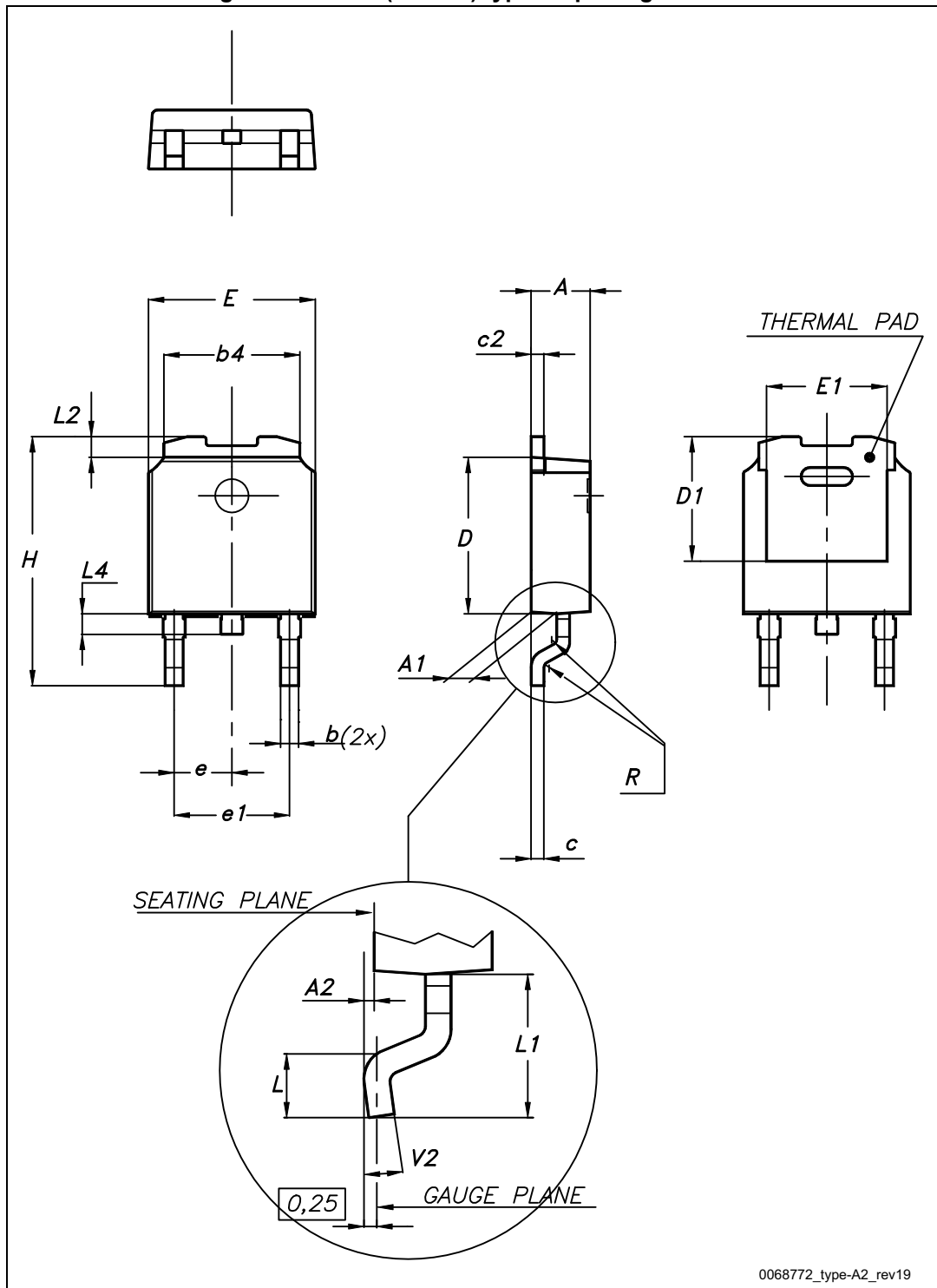
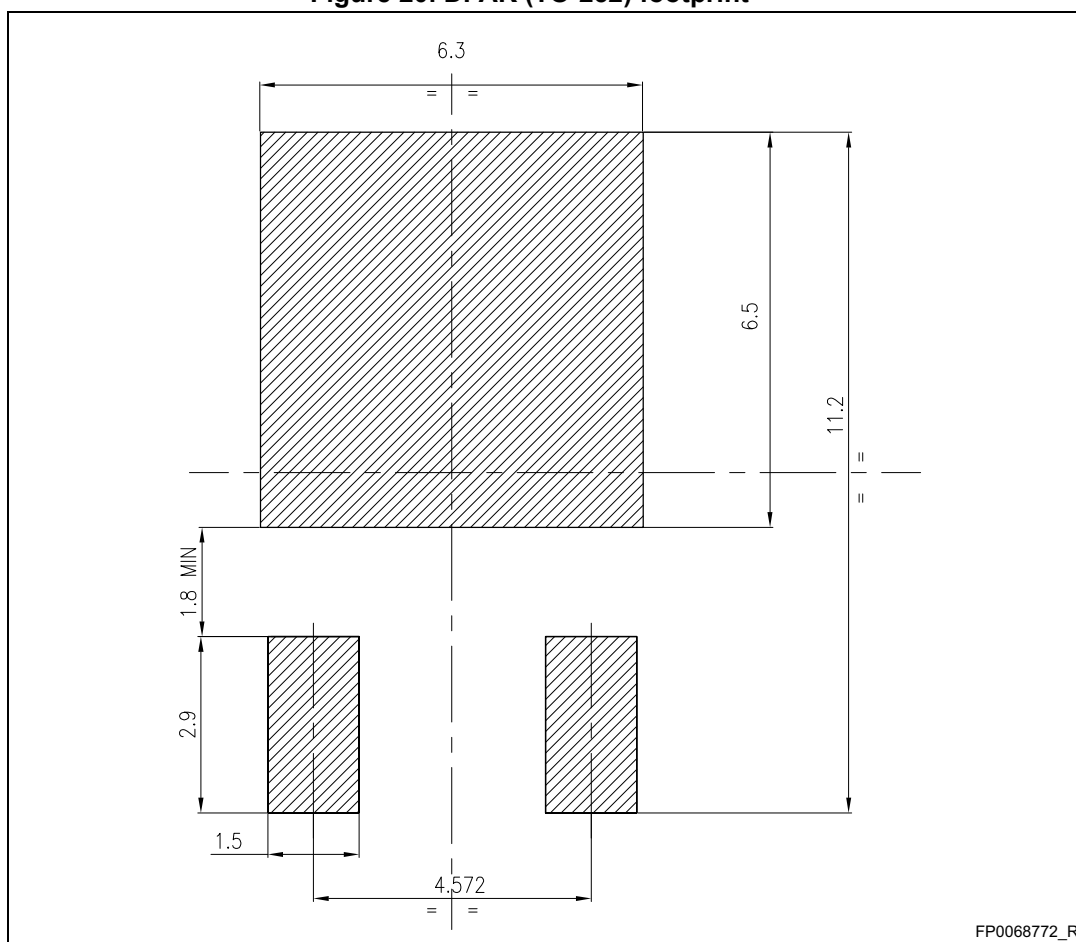


Table 9. DPAK (TO-252) type A2 mechanical data

| 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 20. DPAK (TO-252) footprint (a)



a. All dimensions are in millimeters

5 Packing mechanical data

Figure 21. Tape

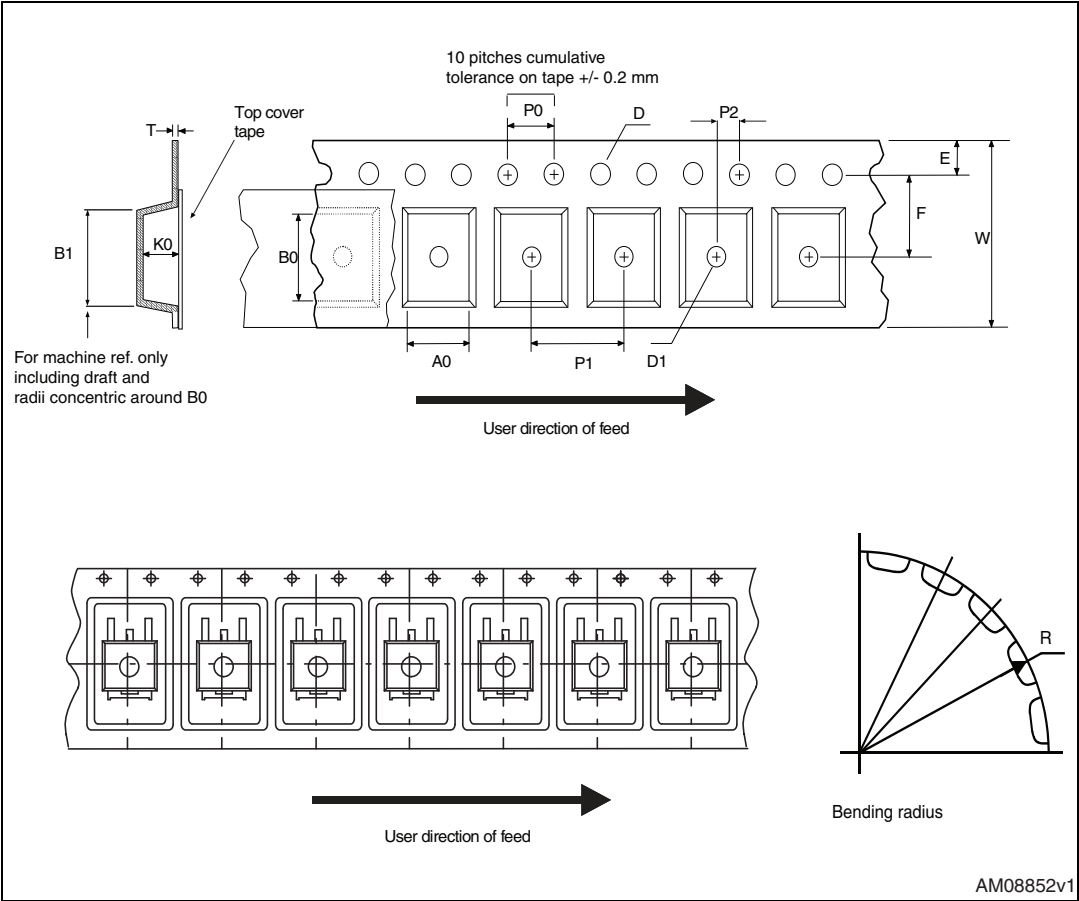
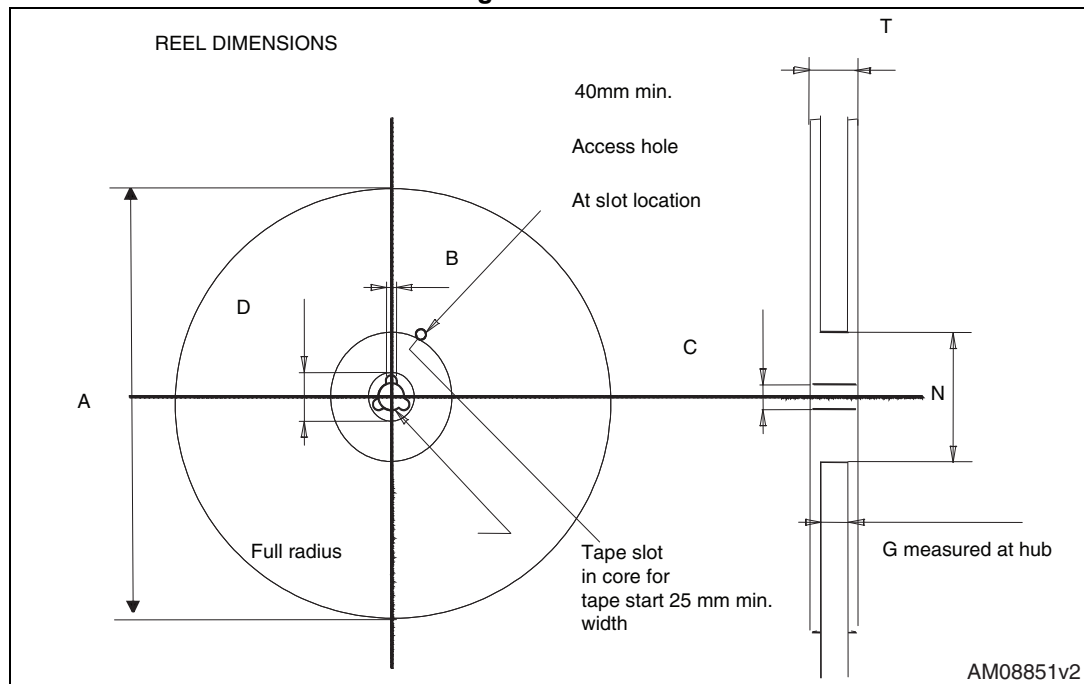


Figure 22. Reel

Table 10. D<sup>2</sup>PAK (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 |          |      |      |

## 6 Revision history

Table 11. Document revision history

| Date        | Revision | Changes                                                                         |
|-------------|----------|---------------------------------------------------------------------------------|
| 27-Jun-2014 | 1        | First release.                                                                  |
| 03-Sep-2015 | 2        | Updated <i>DPAK package information</i> .<br>Minor text changes.                |
| 09-Sep-2015 | 3        | Updated figure and table MD for DPAK package information<br>Minor text changes. |

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