

## N-channel 650 V, 0.98 $\Omega$ typ., 5 A MDmesh™ M2 Power MOSFET in a DPAK package

Datasheet - production data

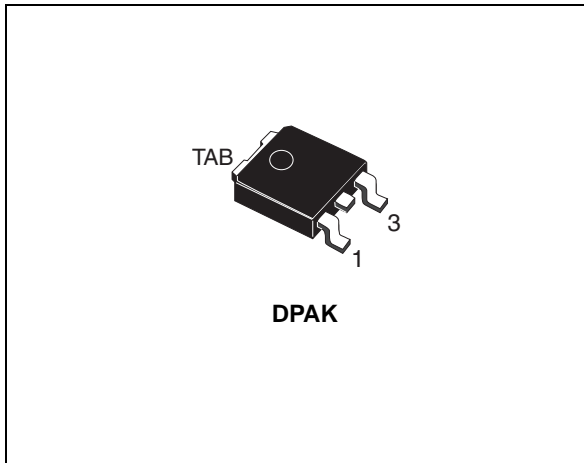
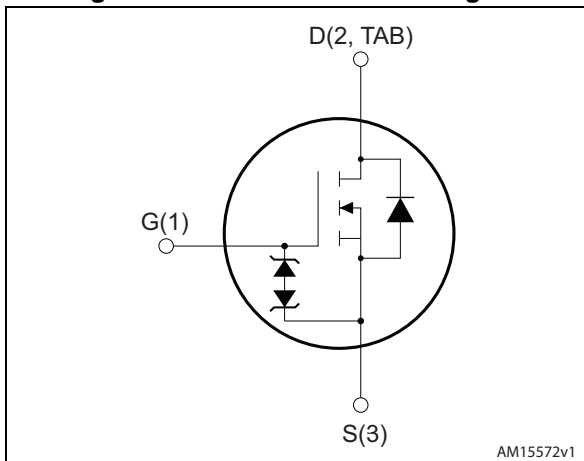


Figure 1. Internal schematic diagram



### Features

| Order code | $V_{DS}$ | $R_{DS(on)max}$ | $I_D$ |
|------------|----------|-----------------|-------|
| STD7N65M2  | 650 V    | 1.15 $\Omega$   | 5 A   |

- Extremely low gate charge
- Excellent output capacitance ( $C_{OSS}$ ) profile
- 100% avalanche tested
- Zener-protected

### Applications

- Switching applications

### Description

This device is an N-channel Power MOSFET developed using the MDmesh™ M2 technology. Thanks to the strip layout associated to an improved vertical structure, the device exhibits both low on-resistance and optimized switching characteristics. It is therefore suitable for the most demanding high efficiency converters.

Table 1. Device summary

| Order code | Marking | Package | Packaging     |
|------------|---------|---------|---------------|
| STD7N65M2  | 7N65M2  | DPAK    | Tape and reel |

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol         | Parameter   | Value       | Unit             |
|----------------|---|-------------|------------------|
| $V_{GS}$       | Gate-source voltage   | $\pm 25$    | V                |
| $I_D$          | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$  | 5           | A                |
| $I_D$          | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$ | 3.2         | A                |
| $I_{DM}^{(1)}$ | Drain current (pulsed)  | 20          | A                |
| $P_{TOT}$      | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$           | 60          | W                |
| $dv/dt^{(2)}$  | Peak diode recovery voltage slope                               | 15          | V/ns             |
| $dv/dt^{(3)}$  | MOSFET $dv/dt$ ruggedness                                       | 50          |                  |
| $T_{stg}$      | Storage temperature   | - 55 to 150 | $^\circ\text{C}$ |
| $T_j$          | Operating junction temperature                                  |             |                  |

1. Pulse width limited by safe operating area
2.  $I_{SD} \leq 5\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ;  $V_{DS\text{ peak}} < V_{(BR)DSS}$ ,  $V_{DD}=400\text{ V}$
3.  $V_{DS} \leq 520\text{ V}$

**Table 3. Thermal data**

| Symbol         | Parameter                            | Value             | Unit                      |
|----------------|--------------------------------------|-------------------|---------------------------|
| $R_{thj-case}$ | Thermal resistance junction-case max | 2.08              | $^\circ\text{C}/\text{W}$ |
| $R_{thj-pcb}$  | Thermal resistance junction-pcb max  | 50 <sup>(1)</sup> | $^\circ\text{C}/\text{W}$ |

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

**Table 4. Avalanche characteristics**

| Symbol   | Parameter  | Value | Unit |
|----------|--|-------|------|
| $I_{AR}$ | Avalanche current, repetitive or not repetitive (pulse width limited by $T_{jmax}$ )                           | 1     | A    |
| $E_{AS}$ | Single pulse avalanche energy (starting $T_j=25\text{ }^\circ\text{C}$ , $I_D=I_{AR}$ ; $V_{DD}=50\text{ V}$ ) | 103   | 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    | $V_{GS} = 0, I_D = 1\text{ mA}$                          | 650  |      |          | V             |
| $I_{DSS}$     | Zero gate voltage drain current   | $V_{GS} = 0, V_{DS} = 650\text{ V}$                      |      |      | 1        | $\mu\text{A}$ |
|               |                                   | $V_{GS} = 0, V_{DS} = 650\text{ V}, T_C = 125\text{ °C}$ |      |      | 100      | $\mu\text{A}$ |
| $I_{GSS}$     | Gate-body leakage current         | $V_{DS} = 0, V_{GS} = \pm 25\text{ V}$                   |      |      | $\pm 10$ | $\mu\text{A}$ |
| $V_{GS(th)}$  | 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 | $V_{GS} = 10\text{ V}, I_D = 2.5\text{ A}$               |      | 0.98 | 1.15     | $\Omega$      |

**Table 6. Dynamic**

| Symbol                     | Parameter                     | Test conditions   | Min. | Typ. | Max. | Unit     |
|----------------------------|-------------------------------|---|------|------|------|----------|
| $C_{iss}$                  | Input capacitance             | $V_{DS} = 100\text{ V}, f = 1\text{ MHz}, V_{GS} = 0$   | -    | 270  | -    | pF       |
| $C_{oss}$                  | Output capacitance            |   | -    | 14.5 | -    | pF       |
| $C_{riss}$                 | Reverse transfer capacitance  |   | -    | 0.8  | -    | pF       |
| $C_{oss\text{ eq.}}^{(1)}$ | Equivalent output capacitance | $V_{DS} = 0\text{ to }520\text{ V}, V_{GS} = 0$   | -    | 108  | -    | pF       |
| $R_G$                      | Intrinsic gate resistance     | $f = 1\text{ MHz open drain}$   | -    | 7    | -    | $\Omega$ |
| $Q_g$                      | Total gate charge             | $V_{DD} = 520\text{ V}, I_D = 5\text{ A}, V_{GS} = 10\text{ V}$<br>(see <a href="#">Figure 15</a> ) | -    | 9    | -    | nC       |
| $Q_{gs}$                   | Gate-source charge            |   | -    | 2.3  | -    | nC       |
| $Q_{gd}$                   | Gate-drain charge             |   | -    | 4.3  | -    | 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%  $V_{DSS}$

**Table 7. Switching times**

| Symbol       | Parameter           | Test conditions   | Min. | Typ. | Max. | Unit |
|--------------|---------------------|---|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD} = 325\text{ V}, I_D = 2.5\text{ A}, R_G = 4.7\text{ }\Omega, V_{GS} = 10\text{ V}$<br>(see <a href="#">Figure 14</a> and <a href="#">19</a> ) | -    | 8    | -    | ns   |
| $t_r$        | Rise time           |   | -    | 20   | -    | ns   |
| $t_{d(off)}$ | Turn-off delay time |   | -    | 30   | -    | ns   |
| $t_f$        | Fall time           |   | -    | 20   | -    | ns   |

Table 8. Source drain diode

| Symbol          | Parameter                     | Test conditions  | Min. | Typ. | Max. | Unit          |
|-----------------|-------------------------------|--|------|------|------|---------------|
| $I_{SD}$        | Source-drain current          |  | -    |      | 5    | A             |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |  | -    |      | 20   | A             |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD} = 5 \text{ A}$ , $V_{GS} = 0$  | -    |      | 1.6  | V             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 5 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$<br>$V_{DD} = 60 \text{ V}$ (see <a href="#">Figure 19</a> )   | -    | 275  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       |  | -    | 1.62 |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |  | -    | 11.8 |      | A             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 5 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$<br>$V_{DD} = 60 \text{ V}$ , $T_j = 150 \text{ }^\circ\text{C}$<br>(see <a href="#">Figure 19</a> ) | -    | 430  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       |  | -    | 2.54 |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |  | -    | 11.9 |      | 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)

Figure 2. Safe operating area

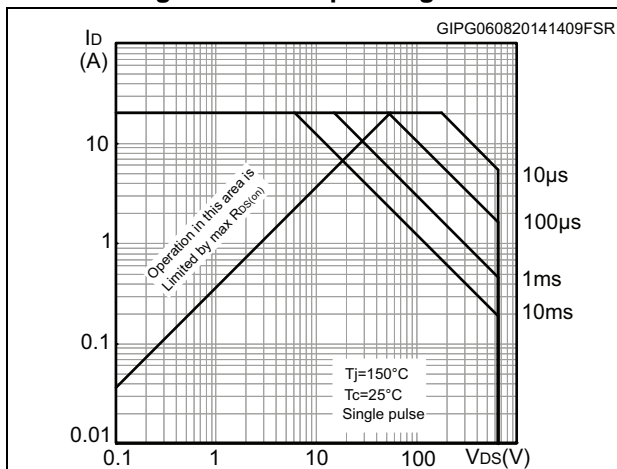


Figure 3. Thermal impedance

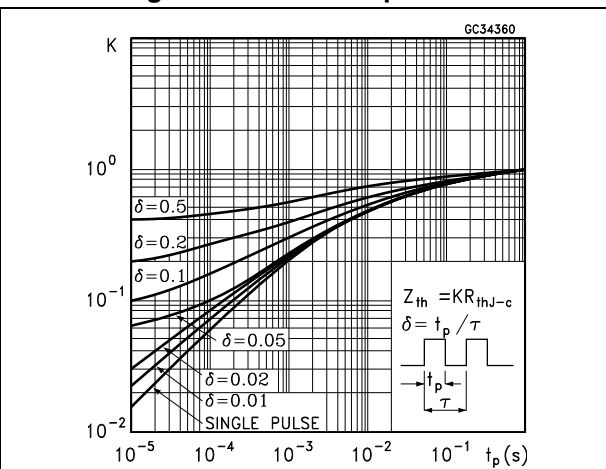


Figure 4. Output characteristics

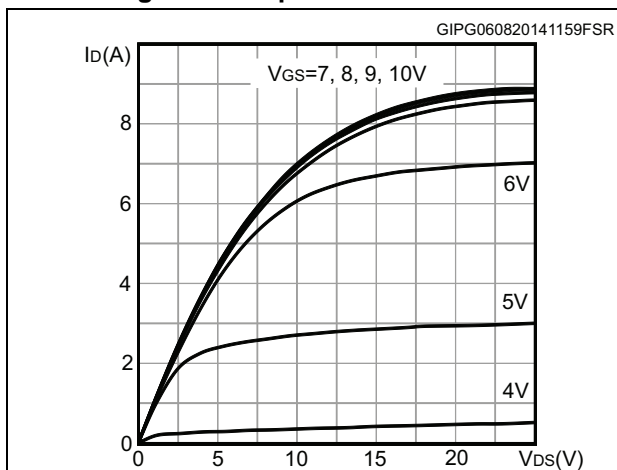


Figure 5. Transfer characteristics

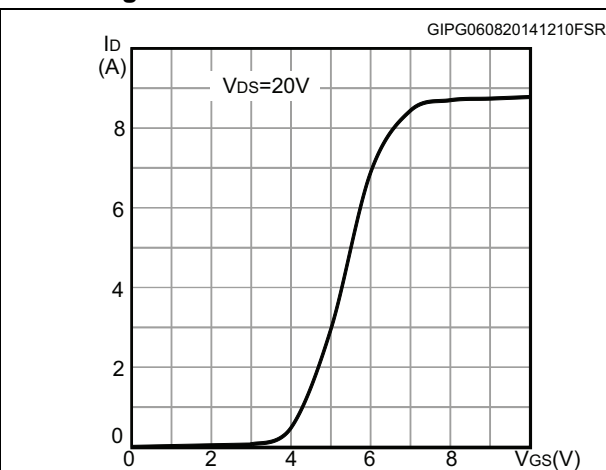


Figure 6. Gate charge vs gate-source voltage

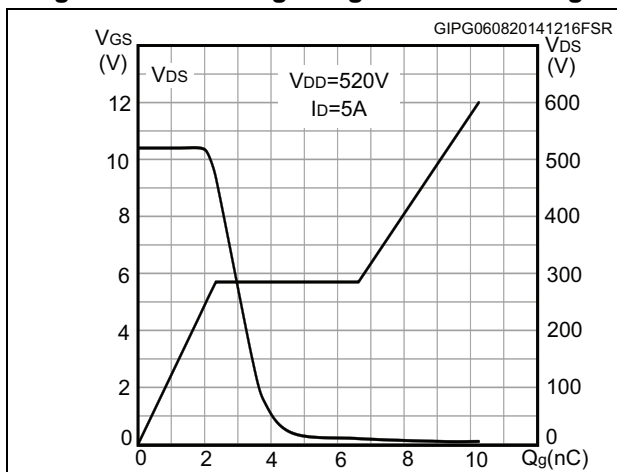


Figure 7. Static drain-source on-resistance

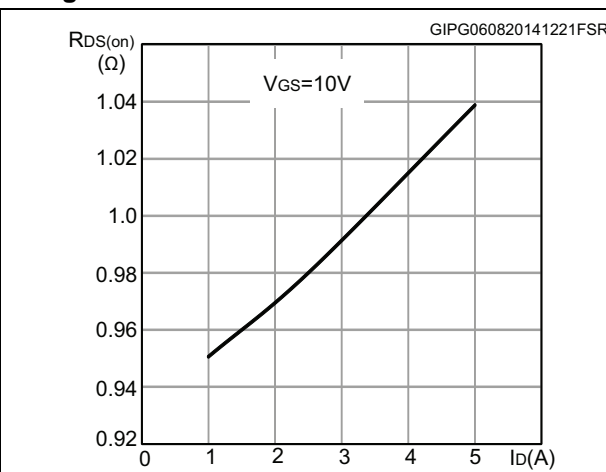


Figure 8. Capacitance variations

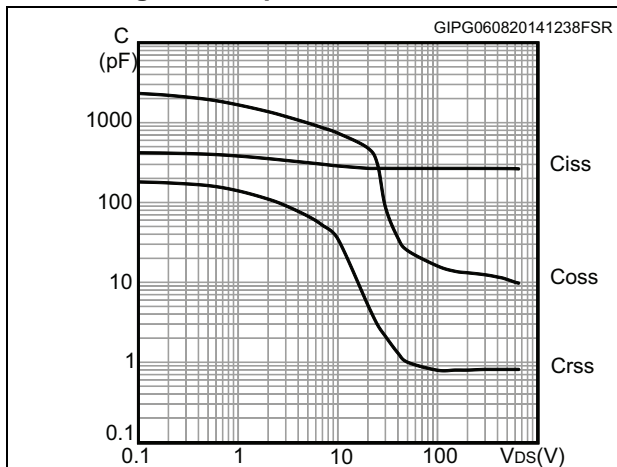


Figure 9. Output capacitance stored energy

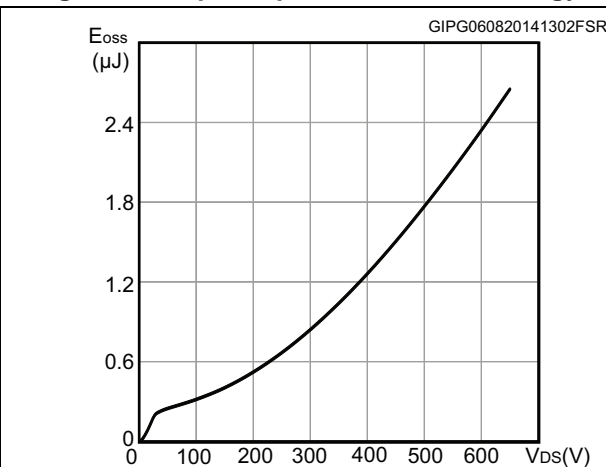


Figure 10. Normalized gate threshold voltage vs temperature

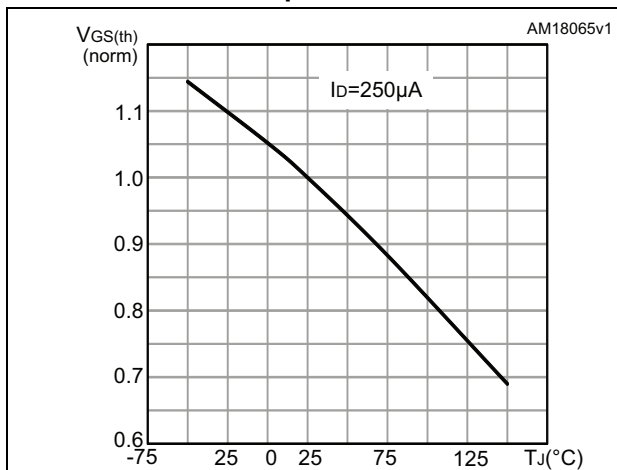


Figure 11. Normalized on-resistance vs temperature

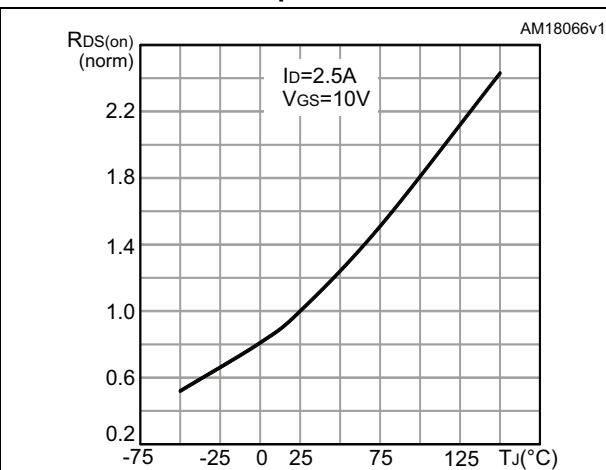


Figure 12. Source-drain diode forward characteristics

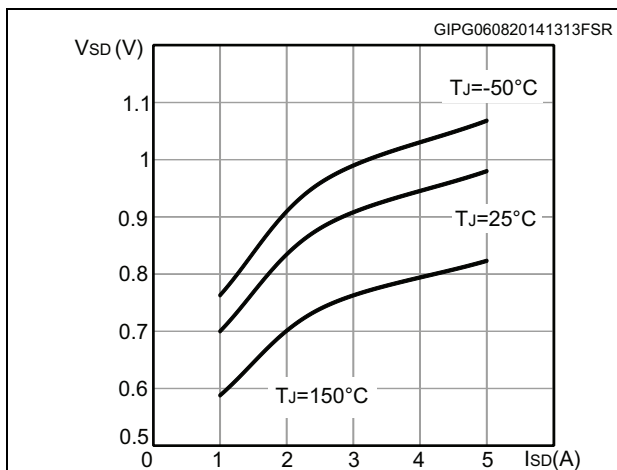
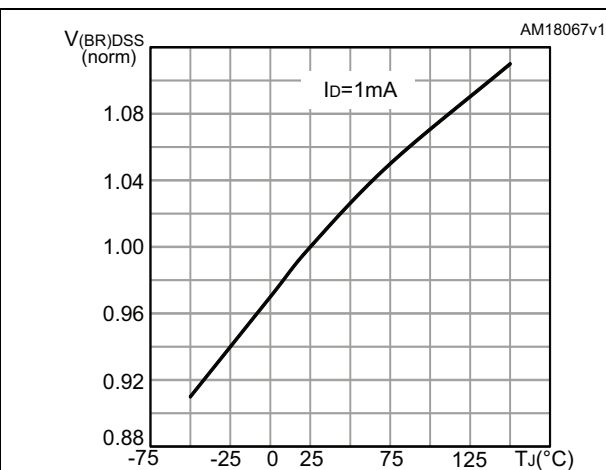


Figure 13. Normalized V(BR)DSS vs temperature



### 3 Test circuits

Figure 14. Switching times test circuit for resistive load



Figure 15. Gate charge test circuit



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



Figure 17. Unclamped inductive load test circuit



Figure 18. Unclamped inductive waveform

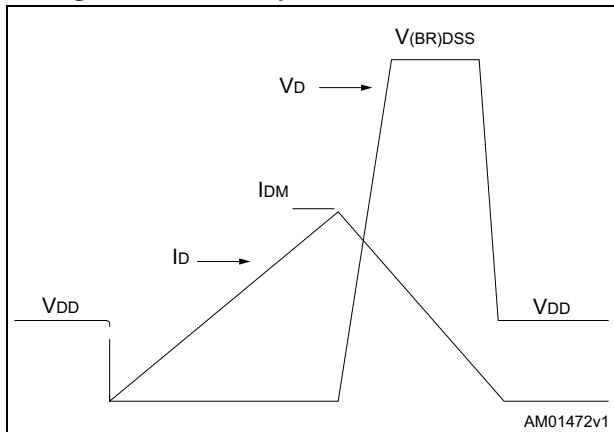


Figure 19. Switching time waveform





## 4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

### 4.1 DPAK (TO-252) type A package information

Figure 20. DPAK (TO-252) type A package outline

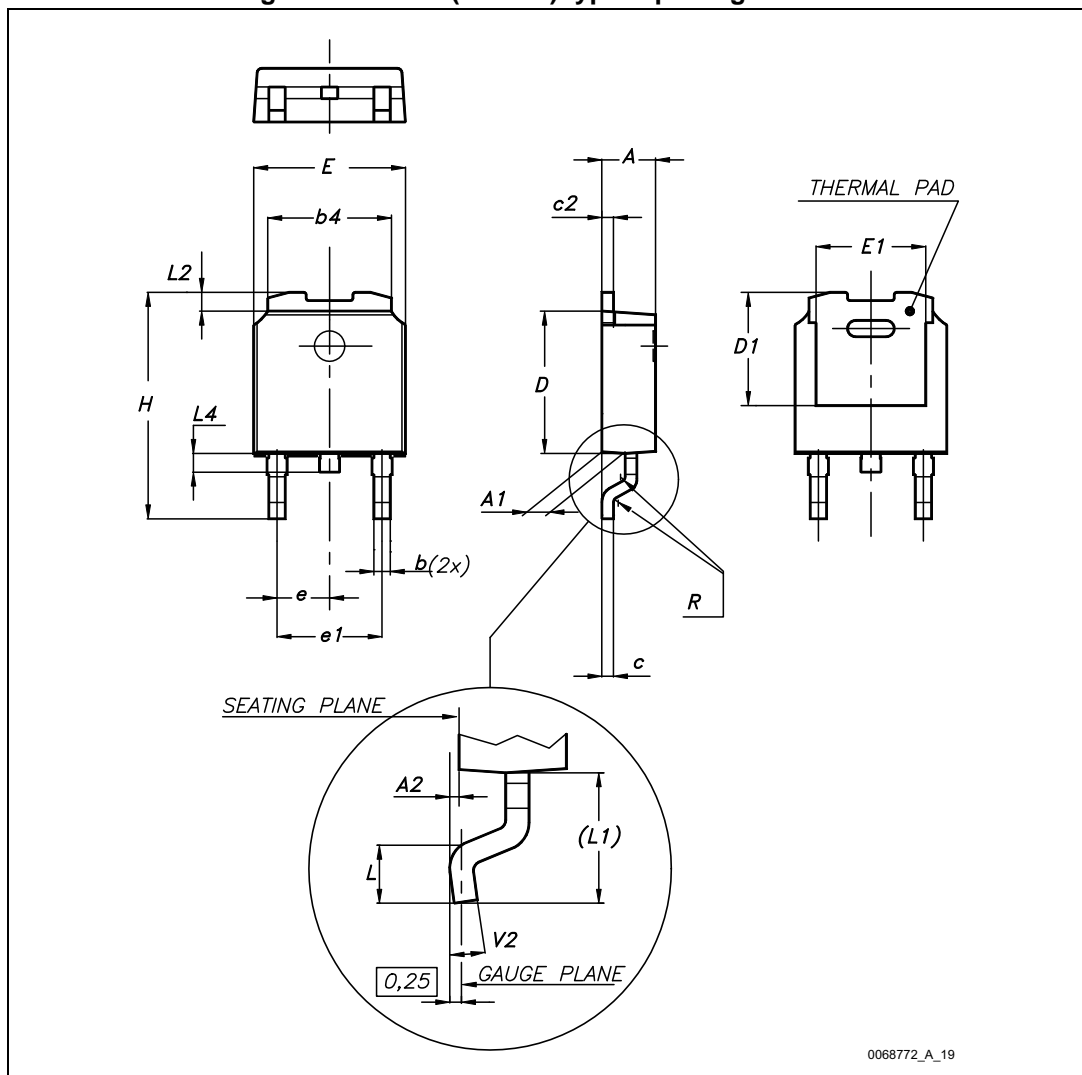


Table 9. DPAK (TO-252) type A package mechanical data

| 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   | 4.60 | 4.70 | 4.80  |
| 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°    |

### 4.2 DPAK (TO-252) type C package information

Figure 21. DPAK (TO-252) type C package outline

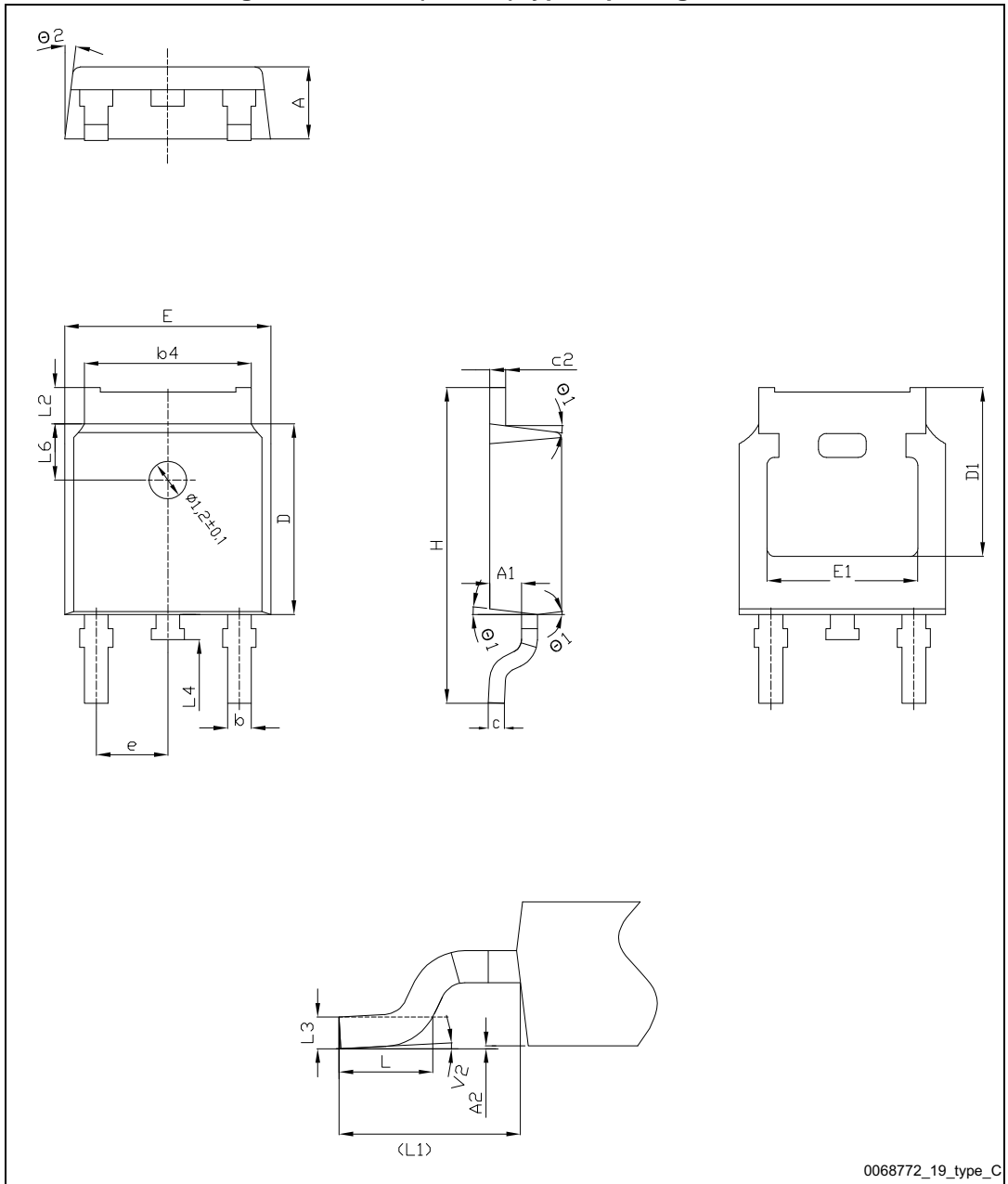
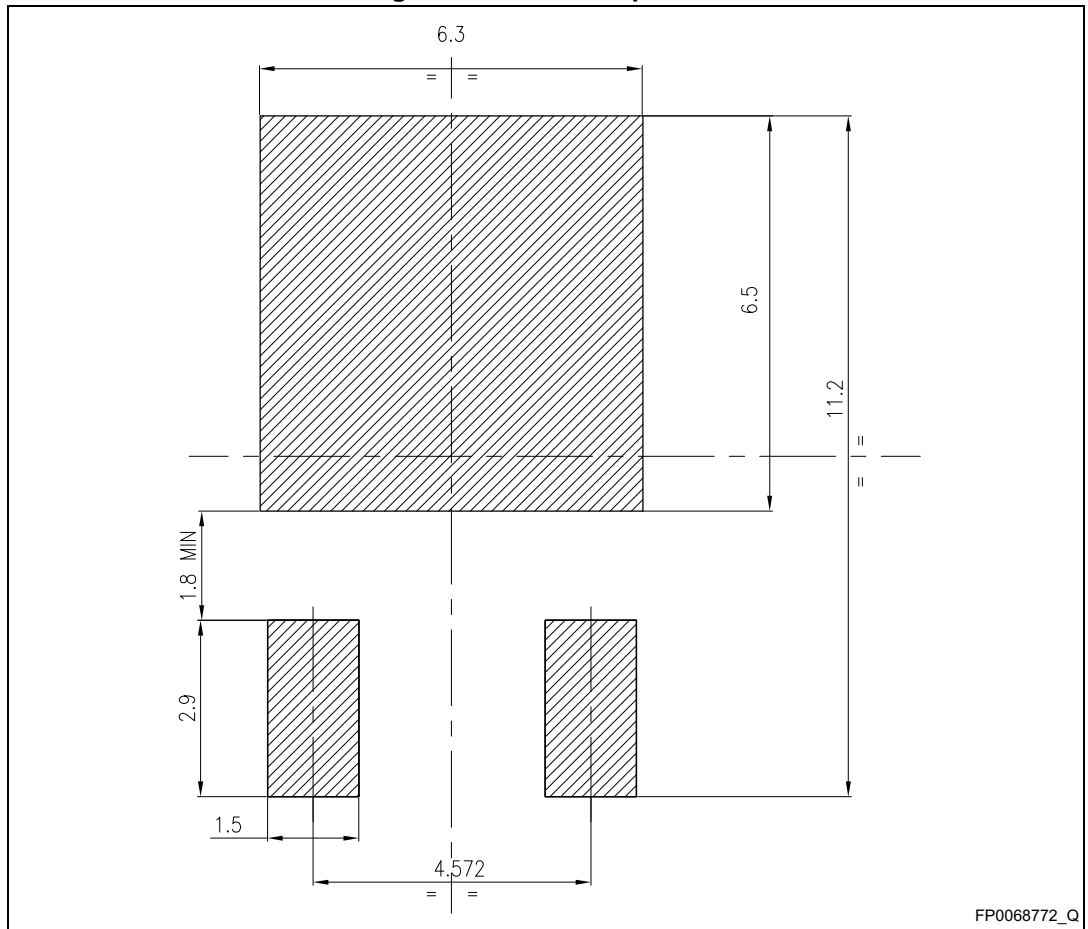


Table 10. DPAK (TO-252) type C package mechanical data

| 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  |
| e    | 2.186    | 2.286 | 2.386 |
| E1   | 4.70     |       |       |
| 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 22. DPAK footprint (a)



a. All dimensions are in millimeters

# 5 Packaging mechanical data

Figure 23. Tape for DPAK (TO-252)

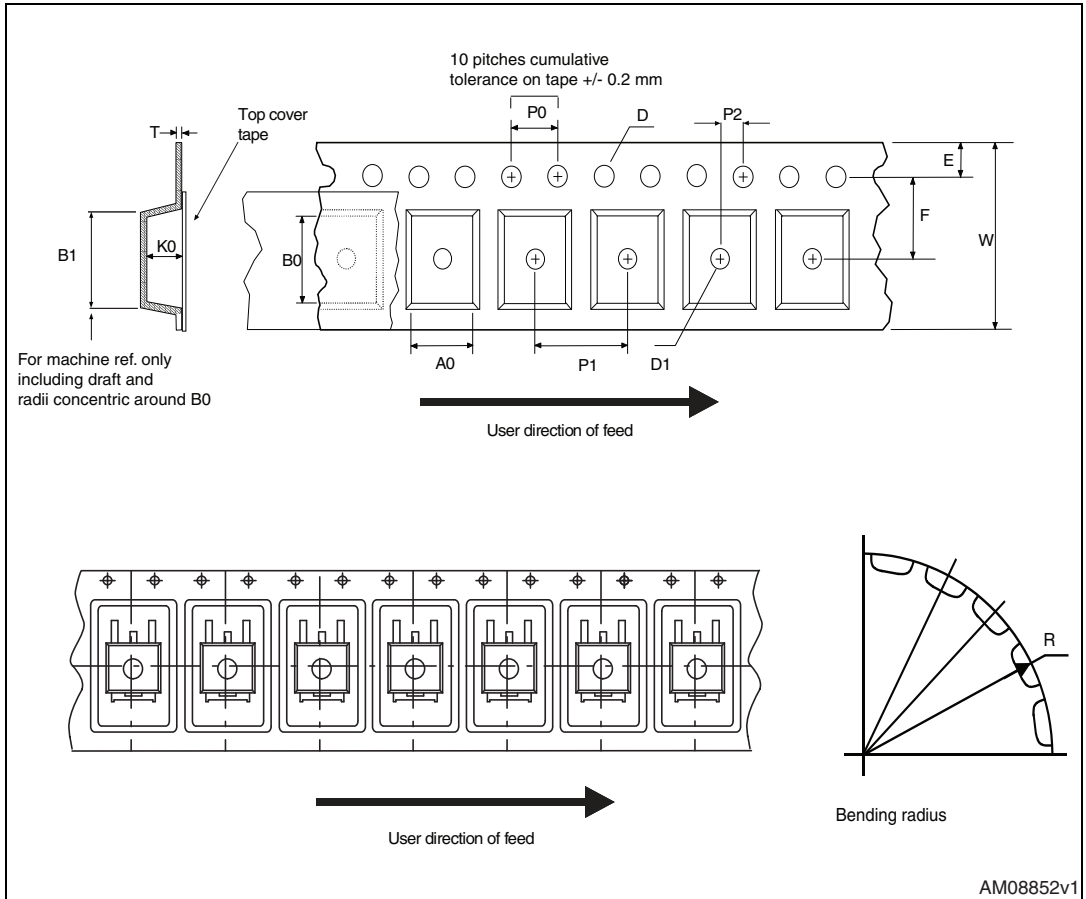


Figure 24. Reel for DPAK (TO-252)

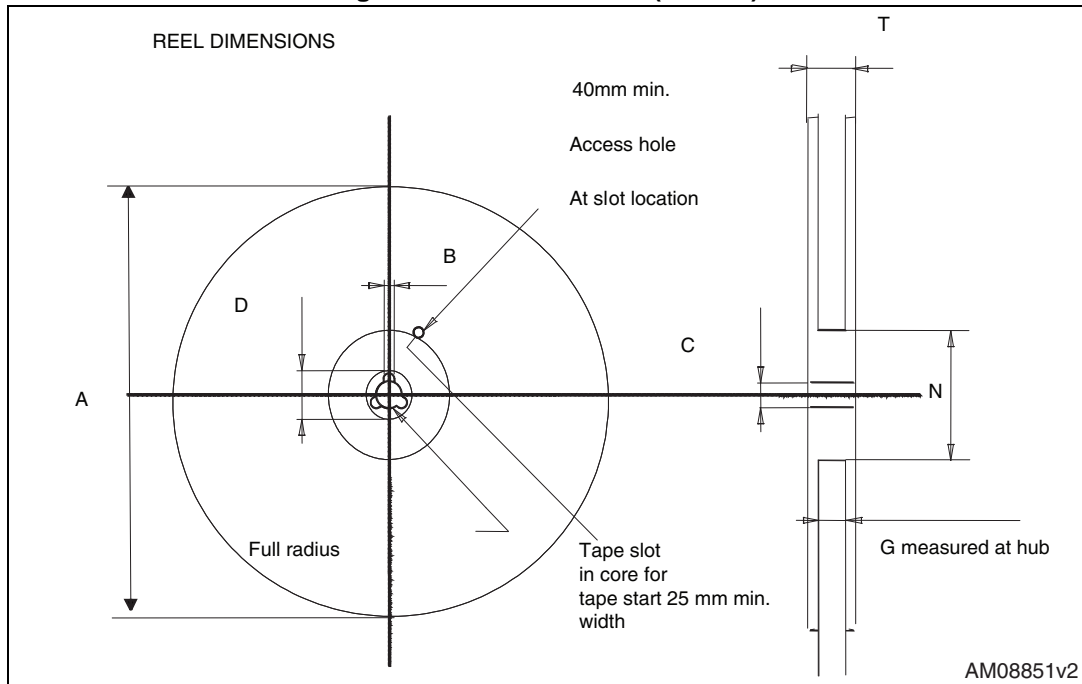


Table 11. DPAK (TO-252) tape and reel mechanical data

| 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 12. Document revision history

| Date        | Revision | Changes   |
|-------------|----------|---|
| 07-Aug-2014 | 1        | First release.  |
| 06-May-2015 | 2        | Document status promoted from preliminary to production data.<br>Updated <a href="#">Section 4: Package information</a> . |



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- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



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