

N-channel 600 V, 0.078 Ω typ., 34 A MDmesh M2 Power MOSFETs in D²PAK, TO-220 and TO-247 packages

Datasheet – production data

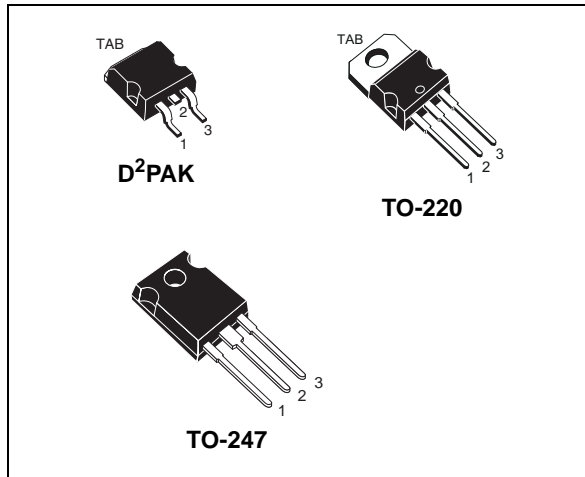
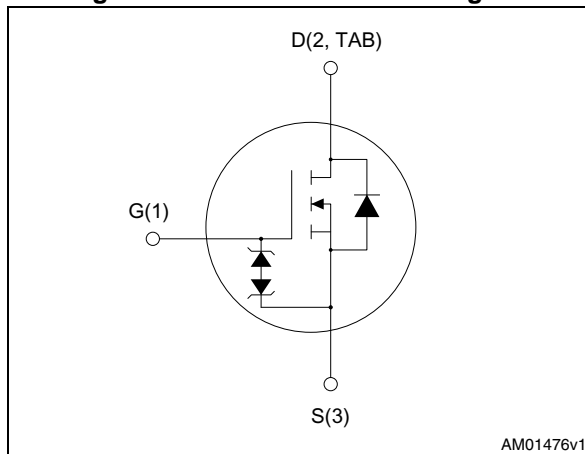


Figure 1. Internal schematic diagram



Features

| Order code | $V_{DS} @ T_{Jmax}$ | $R_{DS(on) max}$ | I_D |
|------------|---------------------|------------------|-------|
| STB40N60M2 | 650 V | 0.088 Ω | 34 A |
| STP40N60M2 | | | |
| STW40N60M2 | | | |

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

Applications

- Switching applications
- LLC converters, resonant converters

Description

These devices are N-channel Power MOSFETs developed using MDmesh™ M2 technology. Thanks to their strip layout and improved vertical structure, the devices exhibit low on-resistance and optimized switching characteristics, rendering them suitable for the most demanding high efficiency converters.

Table 1. Device summary

| Order code | Marking | Packages | Packing |
|------------|---------|--------------------|---------------|
| STB40N60M2 | 40N60M2 | D ² PAK | Tape and reel |
| STP40N60M2 | | TO-220 | Tube |
| STW40N60M2 | | TO-247 | |

Contents

| | | |
|----------|---|-----------|
| 1 | Electrical ratings | 3 |
| 2 | Electrical characteristics | 4 |
| 2.1 | Electrical characteristics (curves) | 6 |
| 3 | Test circuits | 9 |
| 4 | Package information | 10 |
| 4.1 | D ² PAK (TO-263) package information | 11 |
| 4.2 | TO-220 package information | 14 |
| 4.3 | TO-247 package information | 16 |
| 5 | Packing information | 18 |
| 6 | Revision history | 20 |

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 $T_C = 25\text{ }^\circ\text{C}$ | 34 | A |
| I_D | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$ | 22 | A |
| $I_{DM}^{(1)}$ | Drain current (pulsed) | 136 | A |
| P_{TOT} | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$ | 250 | W |
| $dv/dt^{(2)}$ | Peak diode recovery voltage slope | 15 | 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 | | $^\circ\text{C}$ |

1. Pulse width limited by safe operating area.
2. $I_{SD} \leq 34\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$; $V_{DS\text{ peak}} < V_{(BR)DSS}$, $V_{DD} = 400\text{ V}$.
3. $V_{DS} \leq 480\text{ V}$

Table 3. Thermal data

| Symbol | Parameter | Value | | | Unit |
|----------------|--|--------------------|--------|--------|---------------------------|
| | | D ² PAK | TO-220 | TO-247 | |
| $R_{thj-case}$ | Thermal resistance junction-case | 0.50 | | | $^\circ\text{C}/\text{W}$ |
| $R_{thj-pcb}$ | Thermal resistance junction-pcb ⁽¹⁾ | 30 | | | $^\circ\text{C}/\text{W}$ |
| $R_{thj-amb}$ | Thermal resistance junction-ambient | | 62.5 | 50 | $^\circ\text{C}/\text{W}$ |

1. When mounted on 1 inch² 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}) | 6 | A |
| E_{AS} | Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$; $V_{DD} = 50\text{ V}$) | 500 | 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 | $V_{GS} = 0, I_D = 1\text{ mA}$ | 600 | | | V |
| I_{DSS} | Zero gate voltage drain current | $V_{GS} = 0, V_{DS} = 600\text{ V}$ | | | 1 | μA |
| | | $V_{GS} = 0, V_{DS} = 600\text{ V}, T_C = 125\text{ °C}^{(1)}$ | | | 100 | μA |
| I_{GSS} | Gate-body leakage current | $V_{DS} = 0, V_{GS} = \pm 25\text{ V}$ | | | ± 10 | μA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$ | 2 | 3 | 4 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS} = 10\text{ V}, I_D = 17\text{ A}$ | | 0.078 | 0.088 | Ω |

1. Defined by design, not subject to production test

Table 6. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------------------|-------------------------------|--|------|------|------|----------|
| C_{iss} | Input capacitance | $V_{DS} = 100\text{ V}, f = 1\text{ MHz}, V_{GS} = 0$ | - | 2500 | - | pF |
| C_{oss} | Output capacitance | | - | 117 | - | pF |
| C_{rss} | Reverse transfer capacitance | | - | 2.4 | - | pF |
| $C_{oss\text{ eq.}}^{(1)}$ | Equivalent output capacitance | $V_{DS} = 0\text{ to }480\text{ V}, V_{GS} = 0$ | - | 342 | - | pF |
| R_G | Intrinsic gate resistance | $f = 1\text{ MHz}, I_D = 0$ | - | 4.4 | - | Ω |
| Q_g | Total gate charge | $V_{DD} = 480\text{ V}, I_D = 34\text{ A}, V_{GS} = 10\text{ V}$ (see Figure 17) | - | 57 | - | nC |
| Q_{gs} | Gate-source charge | | - | 10 | - | nC |
| Q_{gd} | Gate-drain charge | | - | 25.5 | - | 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

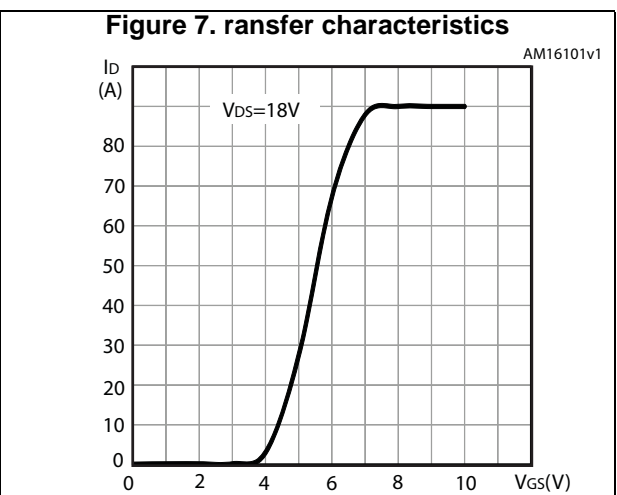
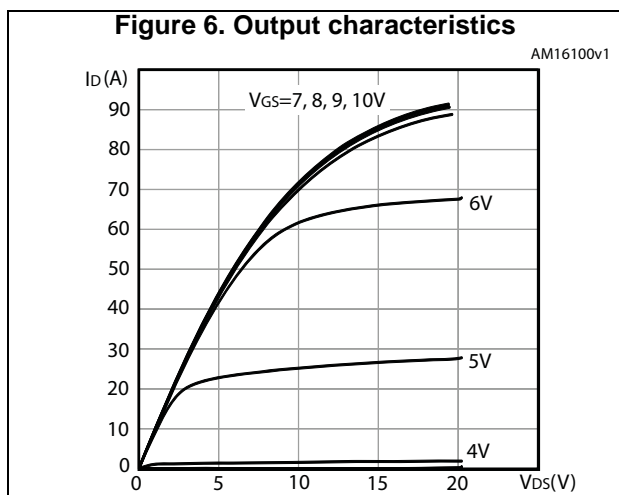
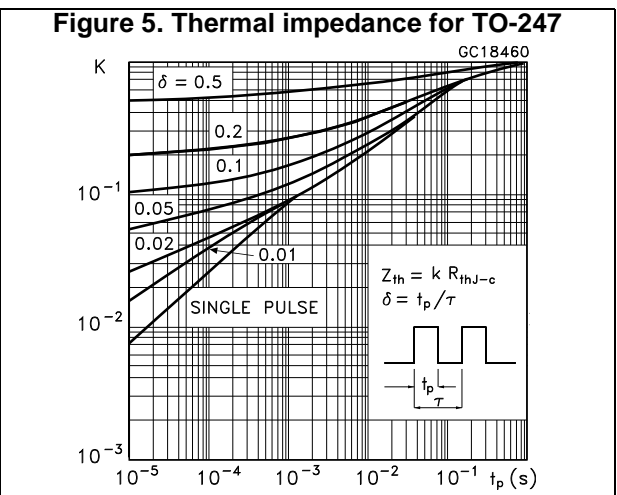
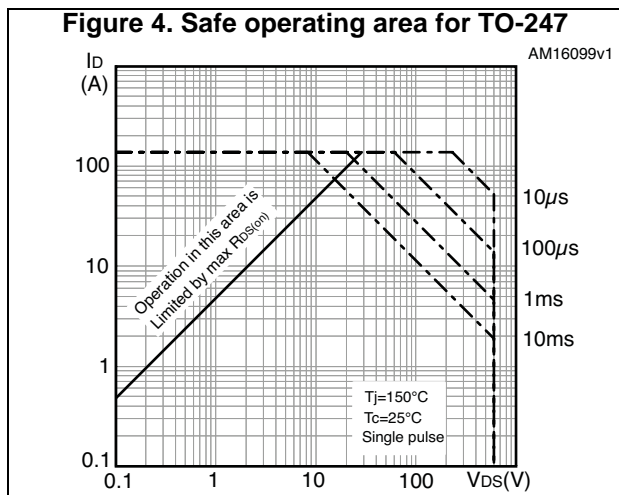
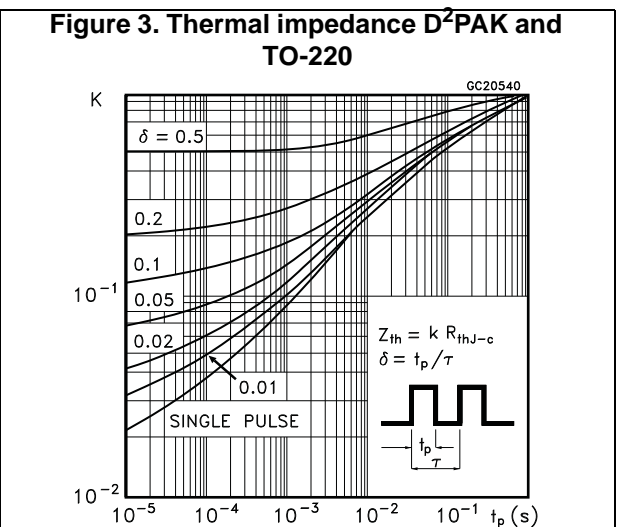
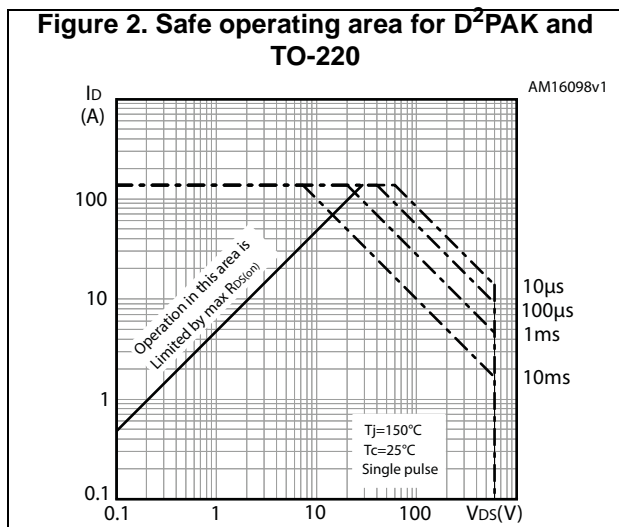
| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--------------|---------------------|--|------|------|------|------|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD} = 300\text{ V}$, $I_D = 34\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 16 and Figure 21) | - | 20.5 | - | ns |
| t_r | Rise time | | - | 13.5 | - | ns |
| $t_{d(off)}$ | Turn-off-delay time | | - | 96 | - | ns |
| t_f | Fall time | | - | 11 | - | ns |

Table 8. Source drain diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|---|------|------|------|---------------|
| I_{SD} | Source-drain current | | - | 34 | | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | - | 136 | | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $I_{SD} = 34\text{ A}$, $V_{GS} = 0$ | - | | 1.6 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 34\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ (see Figure 18) | - | 440 | | ns |
| Q_{rr} | Reverse recovery charge | | - | 8.2 | | μC |
| I_{RRM} | Reverse recovery current | | - | 37 | | A |
| t_{rr} | Reverse recovery time | $I_{SD} = 34\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 18) | - | 568 | | ns |
| Q_{rr} | Reverse recovery charge | | - | 11.5 | | μC |
| I_{RRM} | Reverse recovery current | | - | 40.5 | | A |

1. Pulse width limited by safe operating area.
2. Pulsed: pulse duration = 300 μs , duty cycle 1.5%

2.1 Electrical characteristics (curves)



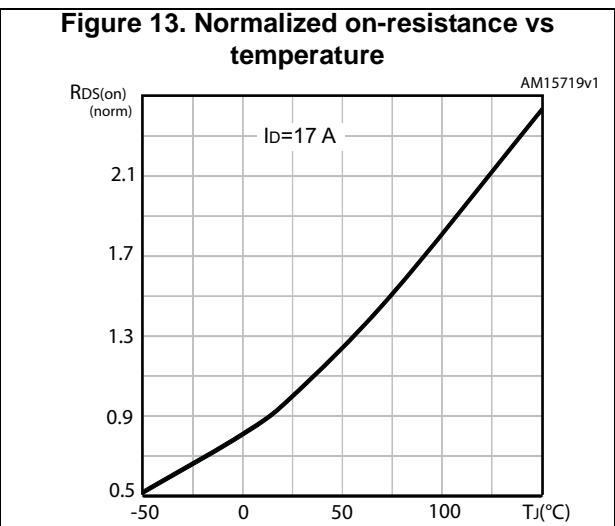
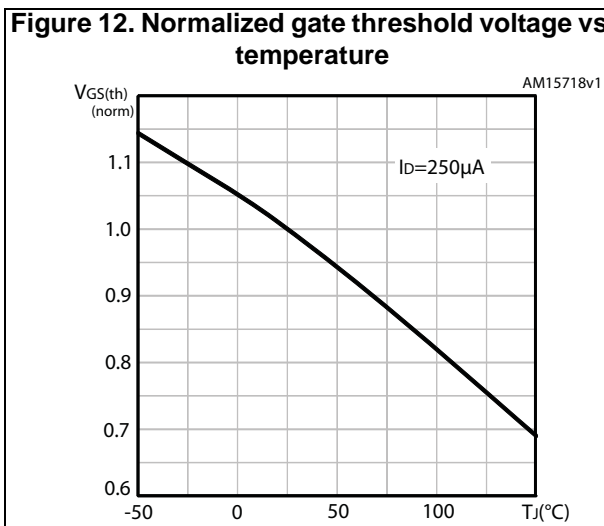
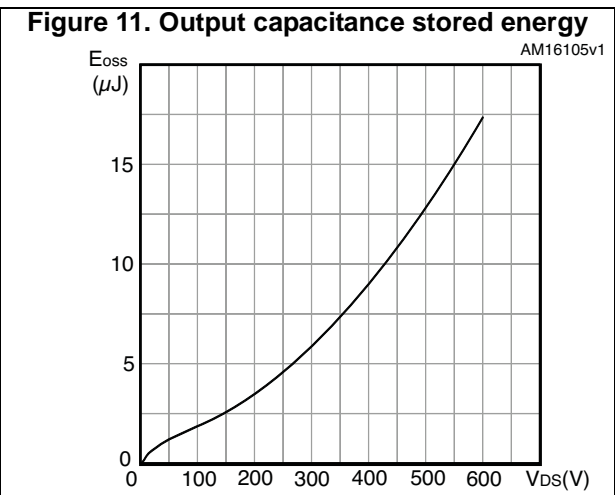
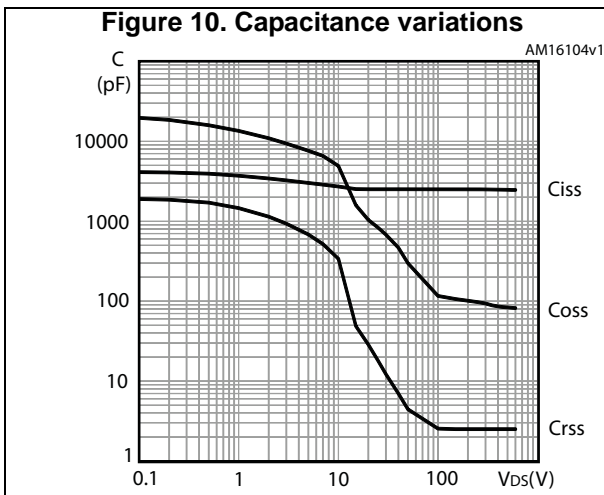
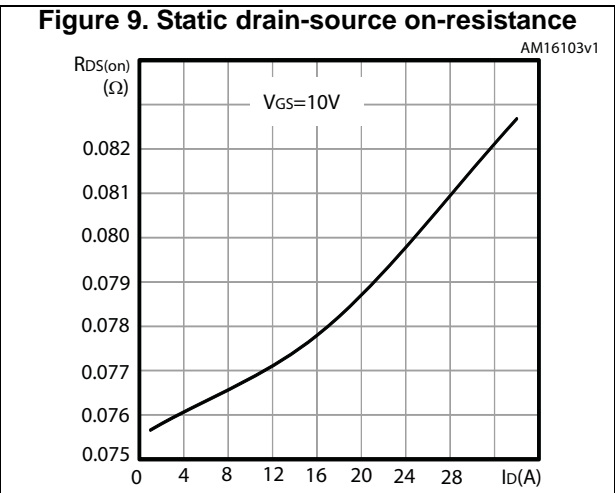
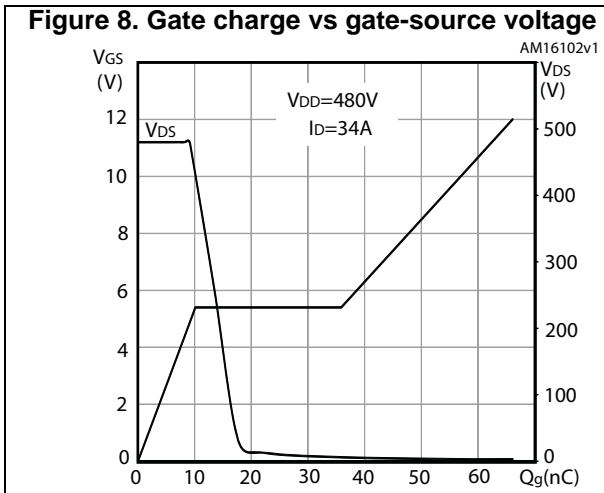


Figure 14. Normalized $V_{(BR)DSS}$ vs temperature

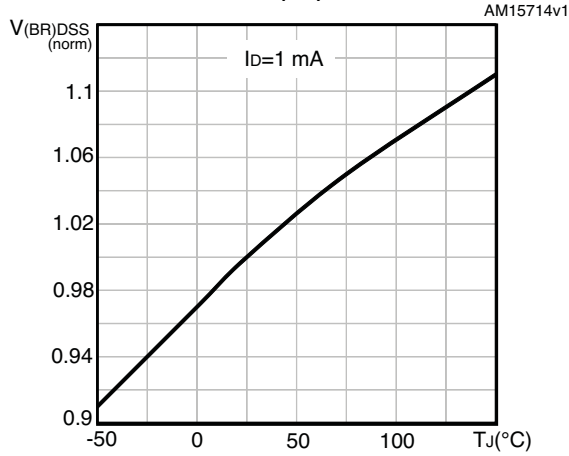
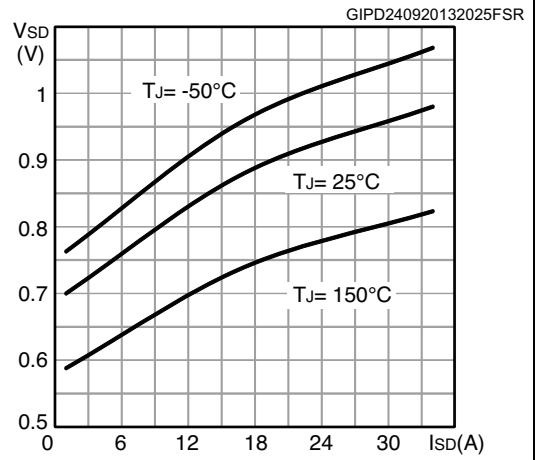
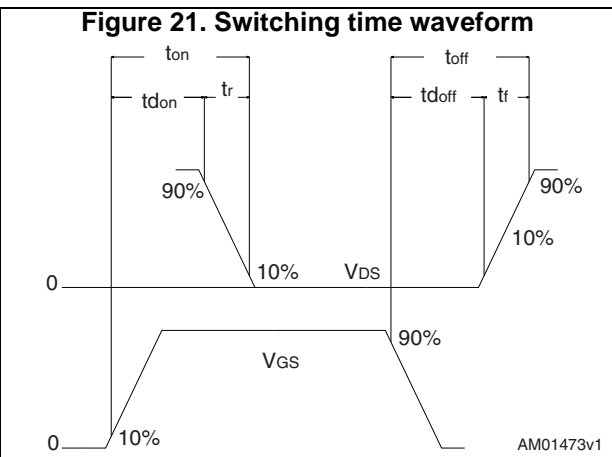
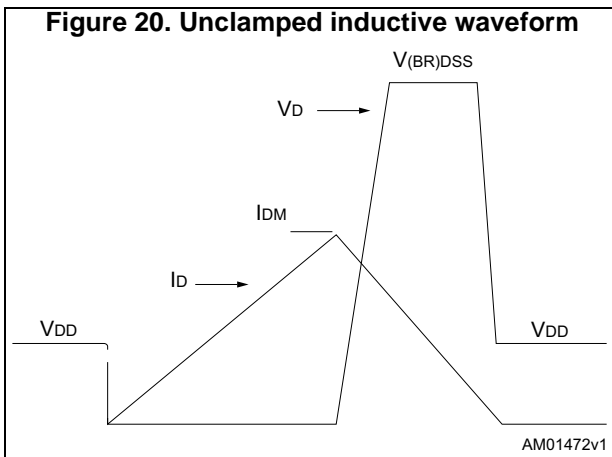
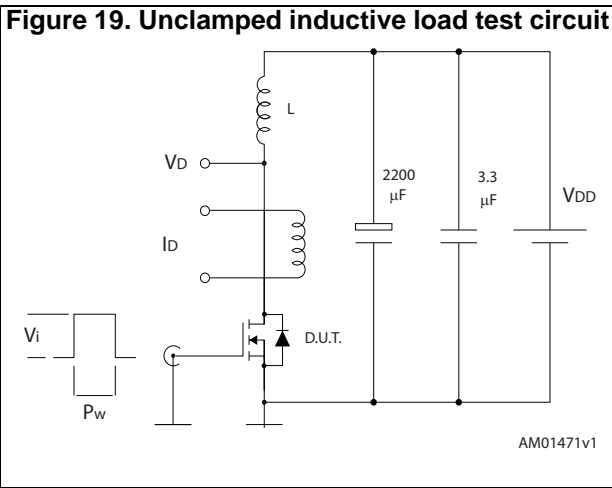
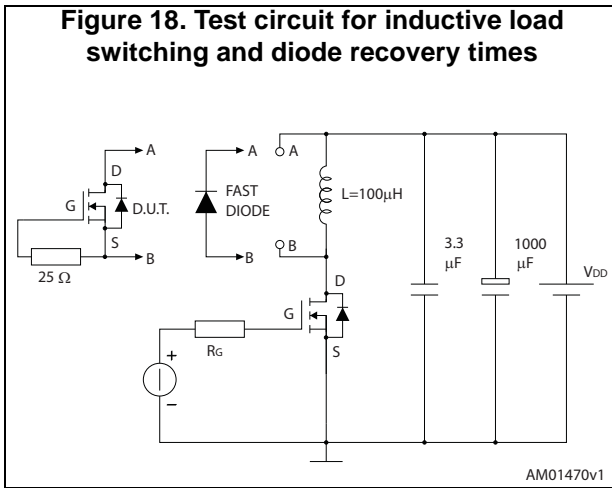
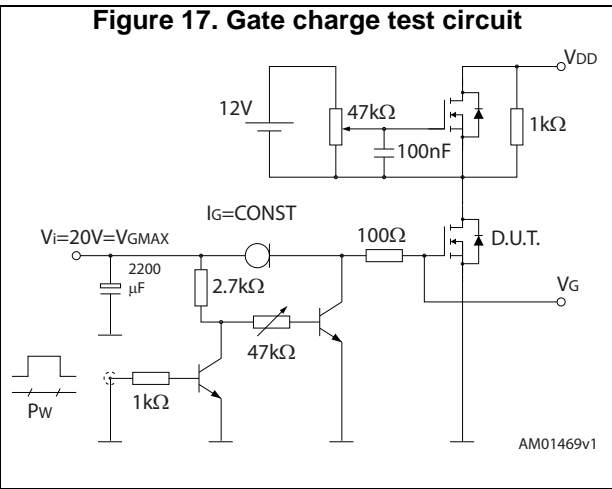
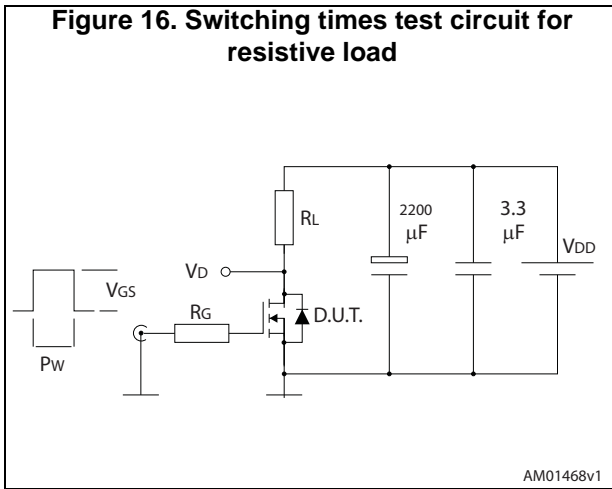


Figure 15. Source-drain diode forward vs temperature



3 Test circuits



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 (TO-263) package information

Figure 22. D²PAK (TO-263) type A package outline

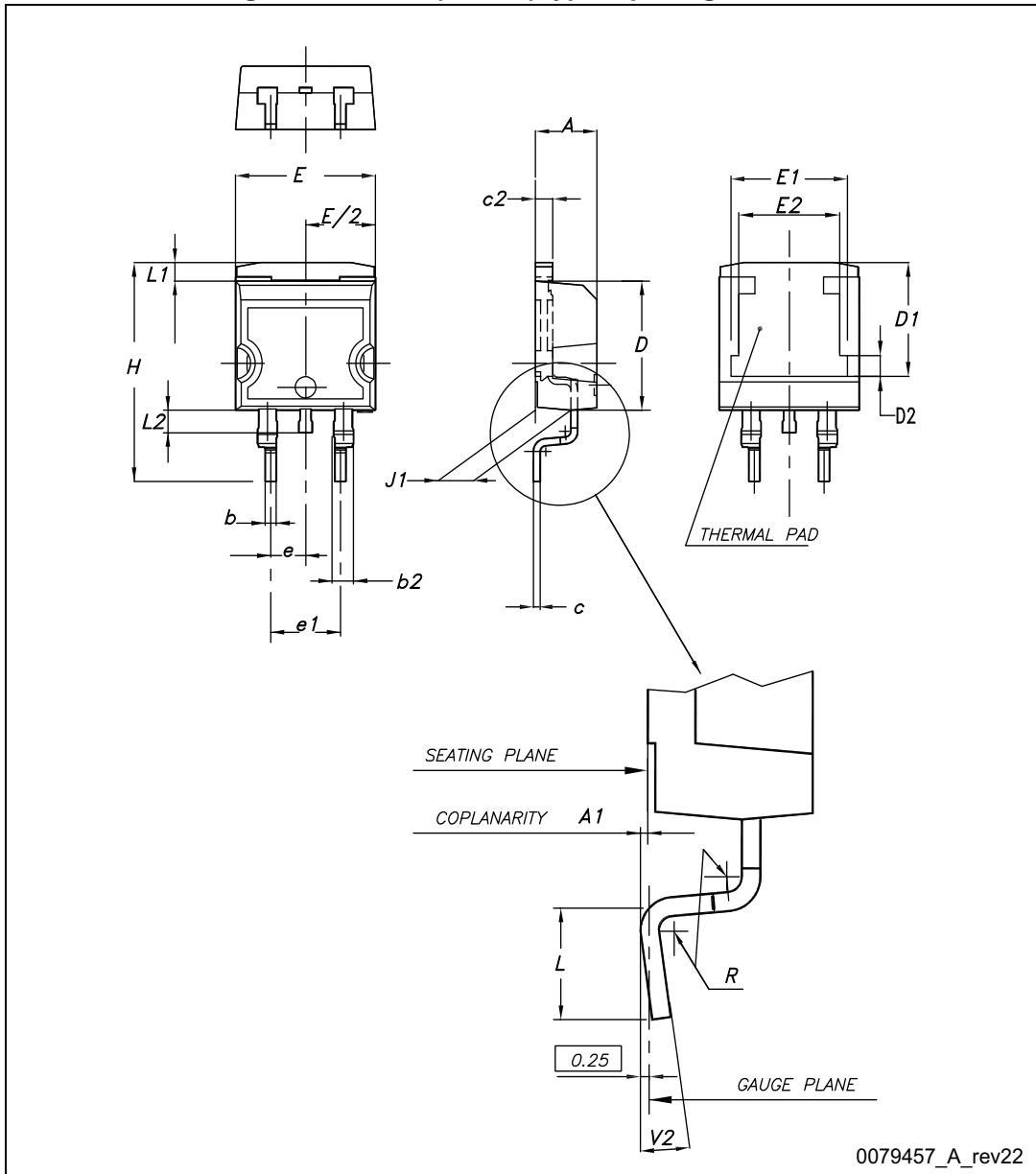
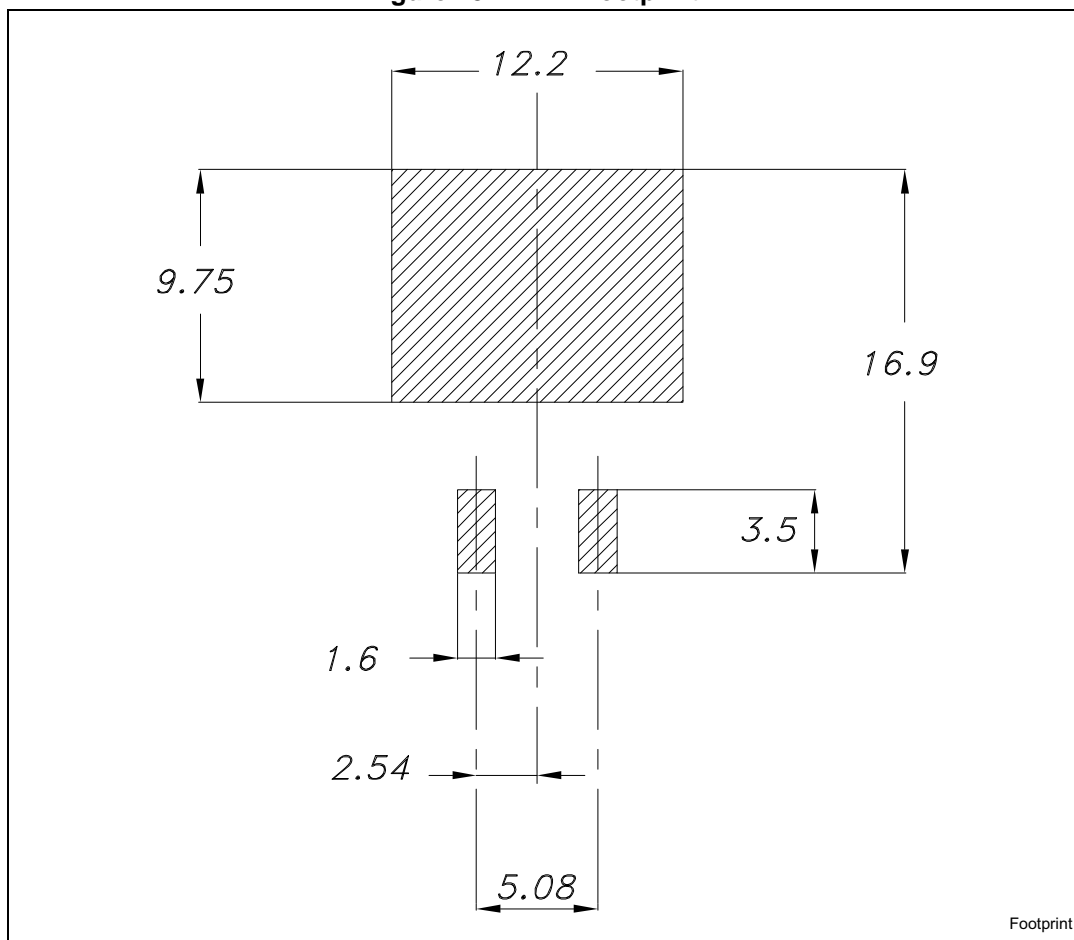


Table 9. D²PAK (TO-263) type A mechanical data

| 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 | 10.00 | | 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 | 15.00 | | 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 footprint^(a)



a. All dimension are in millimeters

4.2 TO-220 package information

Figure 24. TO-220 type A package outline

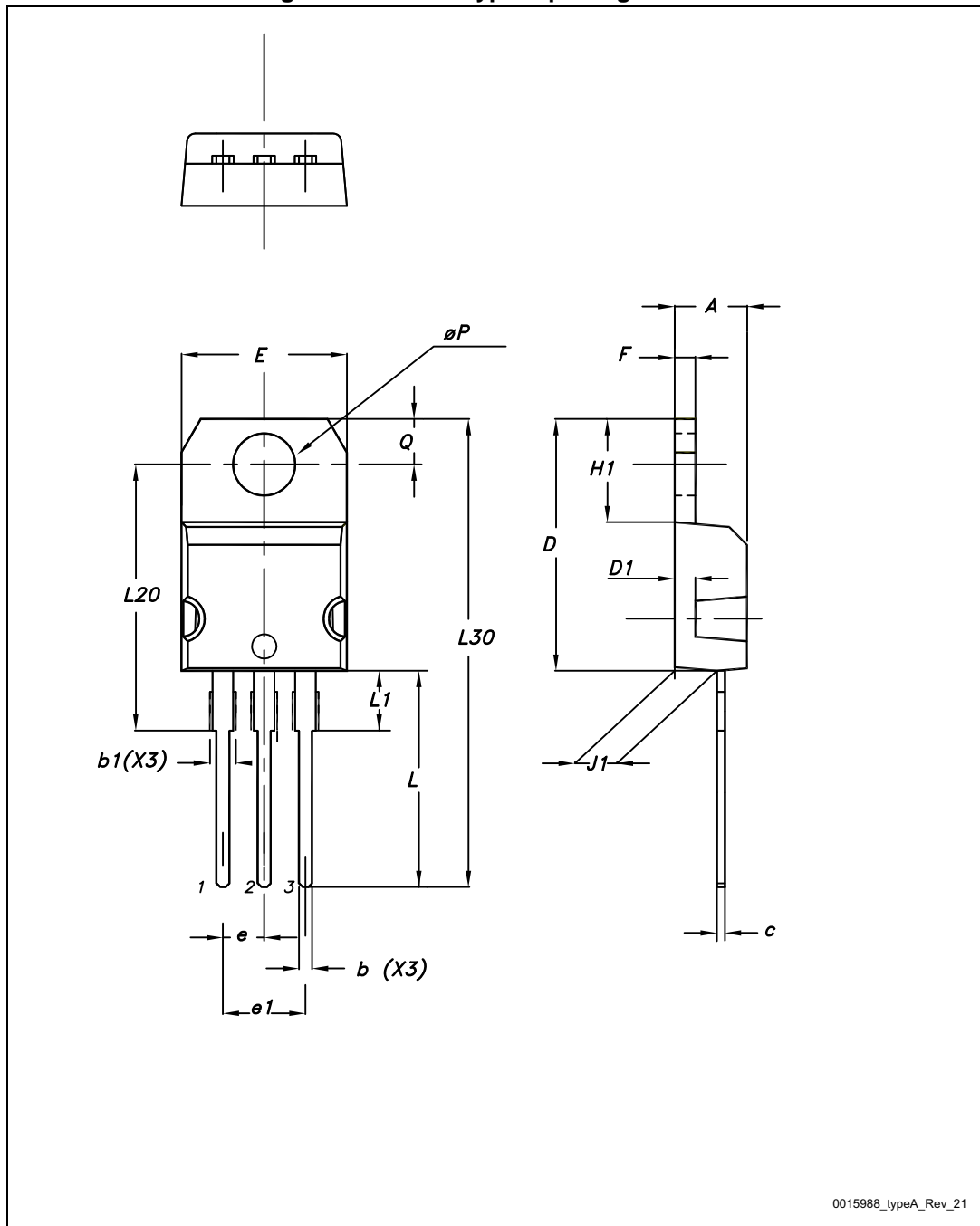


Table 10. TO-220 type A mechanical data

| Dim. | mm | | |
|------|-------|-------|-------|
| | Min. | Typ. | Max. |
| A | 4.40 | | 4.60 |
| b | 0.61 | | 0.88 |
| b1 | 1.14 | | 1.70 |
| c | 0.48 | | 0.70 |
| D | 15.25 | | 15.75 |
| D1 | | 1.27 | |
| E | 10 | | 10.40 |
| e | 2.40 | | 2.70 |
| e1 | 4.95 | | 5.15 |
| F | 1.23 | | 1.32 |
| H1 | 6.20 | | 6.60 |
| J1 | 2.40 | | 2.72 |
| L | 13 | | 14 |
| L1 | 3.50 | | 3.93 |
| L20 | | 16.40 | |
| L30 | | 28.90 | |
| øP | 3.75 | | 3.85 |
| Q | 2.65 | | 2.95 |

4.3 TO-247 package information

Figure 25. TO-247 package outline

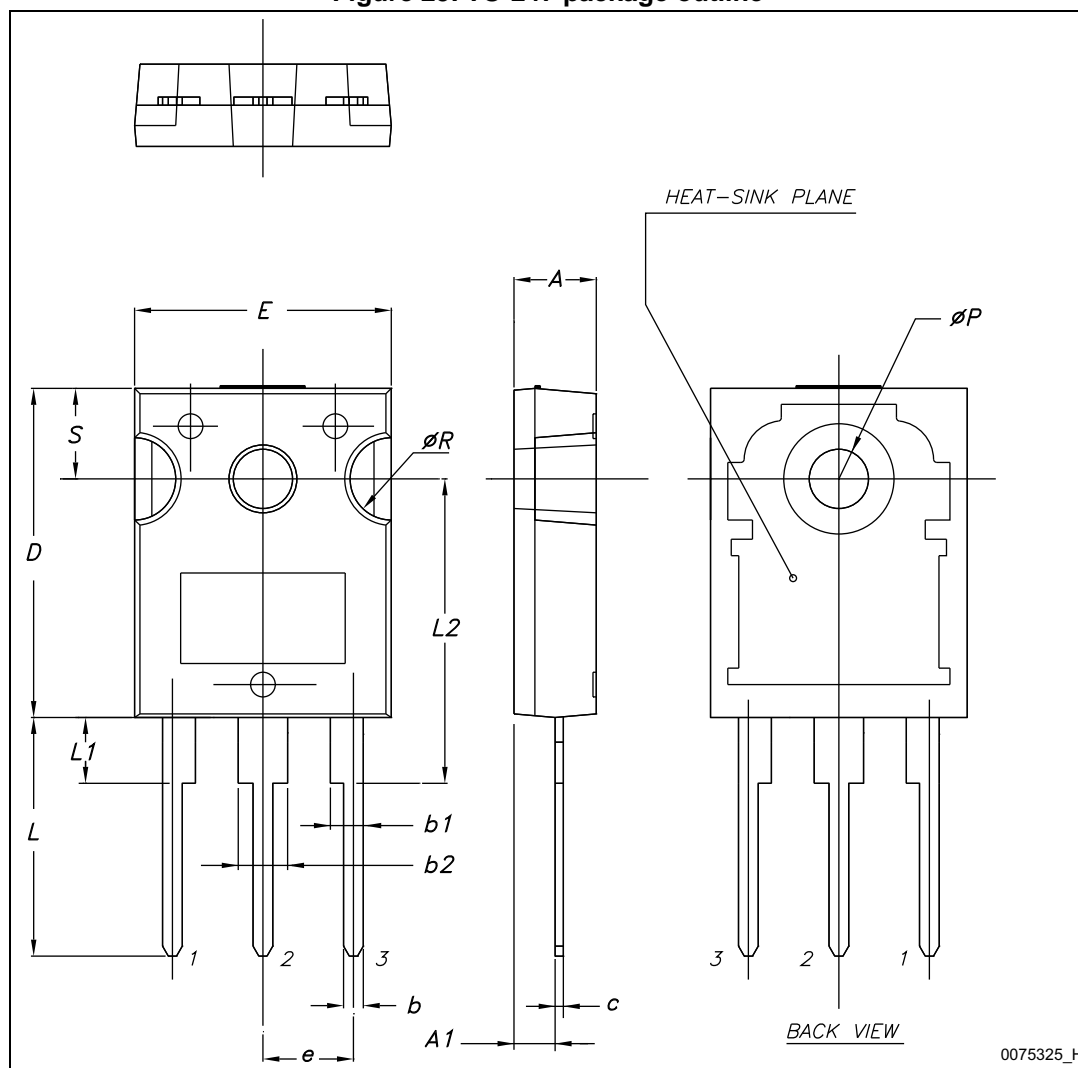


Table 11. TO-247 package mechanical data

| Dim. | mm. | | |
|------|-------|-------|-------|
| | Min. | Typ. | Max. |
| A | 4.85 | | 5.15 |
| A1 | 2.20 | | 2.60 |
| b | 1.0 | | 1.40 |
| b1 | 2.0 | | 2.40 |
| b2 | 3.0 | | 3.40 |
| c | 0.40 | | 0.80 |
| D | 19.85 | | 20.15 |
| E | 15.45 | | 15.75 |
| e | 5.30 | 5.45 | 5.60 |
| L | 14.20 | | 14.80 |
| L1 | 3.70 | | 4.30 |
| L2 | | 18.50 | |
| ØP | 3.55 | | 3.65 |
| ØR | 4.50 | | 5.50 |
| S | 5.30 | 5.50 | 5.70 |

5 Packing information

Figure 26. Tape

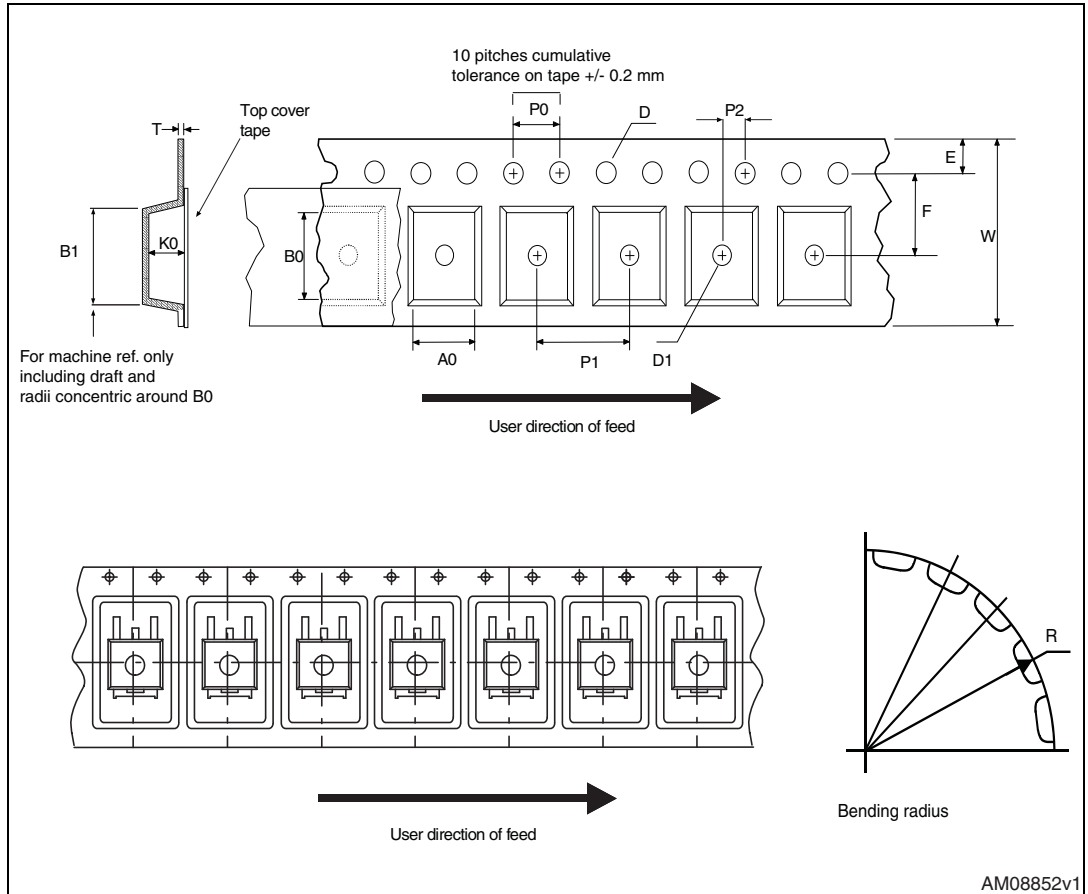
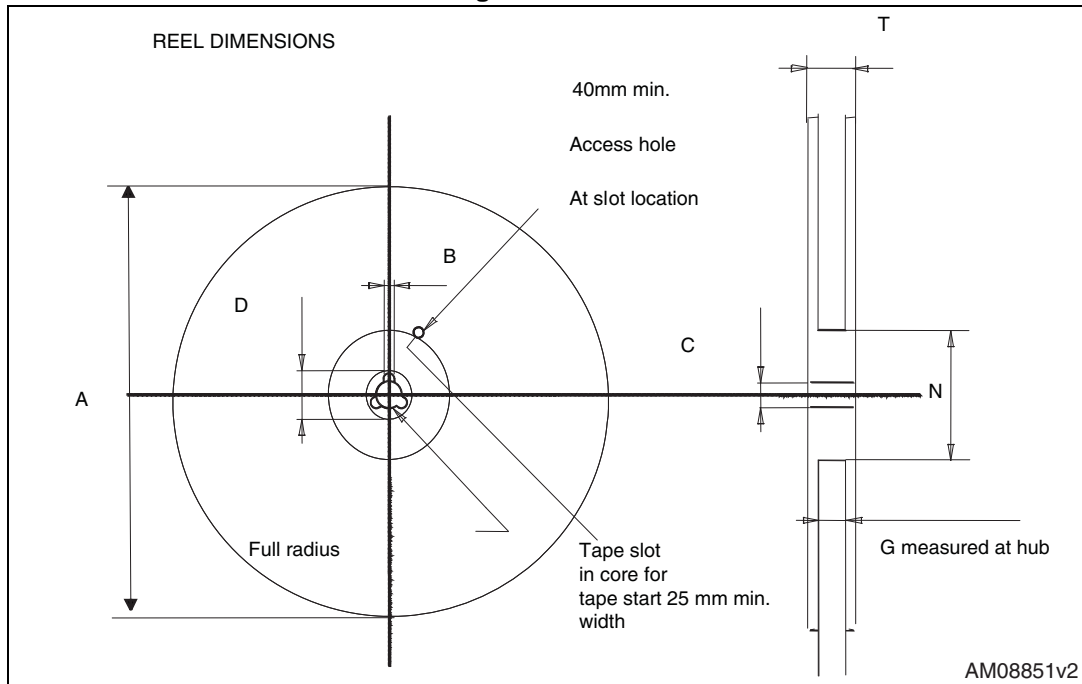


Figure 27. Reel



AM08851v2

Table 12. 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 | | | |

6 Revision history

Table 13. Document revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 01-Jul-2013 | 1 | First release. |
| 23-Sep-2013 | 2 | <ul style="list-style-type: none"> – Added: TO-220FP and I²PAKFP packages – Inserted: V_{ISO} in <i>Table 2</i> – Modified: values in <i>Table 4</i>, the entire typical values in <i>Table 6</i>, <i>7</i> and <i>8</i> – Updated: <i>Section 4: Package mechanical data</i>. – Minor text changes |
| 13-May-2014 | 3 | <ul style="list-style-type: none"> – The part numbers STB40N60M2 and STP40N60M2 have been moved to a separate datasheet – Minor text changes |
| 09-Aug-2016 | 4 | <p>Updated title, features and description in cover page.</p> <p>Updated <i>Table 2: Absolute maximum ratings</i>, <i>Table 5: On /off states</i> and <i>Table 8: Source drain diode</i>.</p> <p>Updated <i>Section 4.1: D²PAK (TO-263) package information</i> and <i>Section 4.2: TO-220 package information</i>.</p> <p>Minor text changes.</p> |

IMPORTANT NOTICE – PLEASE READ CAREFULLY

STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST's terms and conditions of sale in place at the time of order acknowledgement.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of Purchasers' products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2016 STMicroelectronics – All rights reserved

