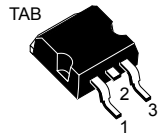
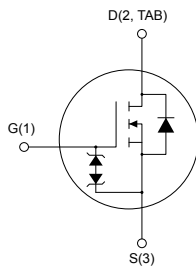


## Automotive-grade N-channel 800 V, 1.5 $\Omega$ typ., 5.2 A SuperMESH Power MOSFET in a D<sup>2</sup>PAK package



 D<sup>2</sup>PAK


AM01475V1



### Features

| Order code | V <sub>DS</sub> | R <sub>DS(on)</sub> max. | I <sub>D</sub> |
|------------|-----------------|--------------------------|----------------|
| STB9NK80Z  | 800 V           | 1.8 $\Omega$             | 5.2 A          |

- AEC-Q101 qualified 
- 100% avalanche tested
- Gate charge minimized
- Very low intrinsic capacitance
- Zener-protected

### Applications

- Switching applications

### Description

This high-voltage device is a Zener-protected N-channel Power MOSFET developed using the SuperMESH technology by STMicroelectronics, an optimization of the well-established PowerMESH. In addition to a significant reduction in on-resistance, this device is designed to ensure a high level of dv/dt capability for the most demanding applications.

#### Product status link

[STB9NK80Z](#)

#### Product summary

|                   |                    |
|-------------------|--------------------|
| <b>Order code</b> | STB9NK80Z          |
| <b>Marking</b>    | B9NK80Z            |
| <b>Package</b>    | D <sup>2</sup> PAK |
| <b>Packing</b>    | Tape and reel      |

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

| Symbol         | Parameter   | Value      | Unit |
|----------------|---|------------|------|
| $V_{DS}$       | Drain-source voltage                                  | 800        | V    |
| $V_{GS}$       | Gate-source voltage                                   | ±30        | V    |
| $I_D$          | Drain current (continuous) at $T_C = 25\text{ °C}$    | 5.2        | A    |
| $I_D$          | Drain current (continuous) at $T_C = 100\text{ °C}$   | 3.3        | A    |
| $I_{DM}^{(1)}$ | Drain current (pulsed)                                | 20.8       | A    |
| $P_{TOT}$      | Total power dissipation at $T_C = 25\text{ °C}$       | 125        | W    |
| ESD            | Gate-source human body model (C = 100 pF, R = 1.5 kΩ) | 4          | kV   |
| $dv/dt^{(2)}$  | Peak diode recovery voltage slope                     | 4.5        | V/ns |
| $T_j$          | Operating junction temperature range                  | -55 to 150 | °C   |
| $T_{stg}$      | Storage temperature range                             |            |      |

1. Pulse width limited by safe operating area.
2.  $I_{SD} \leq 5.2\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{(BR)DSS}$ .

**Table 2. Thermal data**

| Symbol         | Parameter                           | Value | Unit |
|----------------|-------------------------------------|-------|------|
| $R_{thj-case}$ | Thermal resistance junction-case    | 1     | °C/W |
| $R_{thj-amb}$  | Thermal resistance junction-ambient | 62.5  |      |

**Table 3. Avalanche characteristics**

| Symbol         | Parameter                                       | Value | Unit |
|----------------|---|-------|------|
| $I_{AR}^{(1)}$ | Avalanche current, repetitive or not-repetitive | 5.2   | A    |
| $E_{AS}^{(2)}$ | Single pulse avalanche energy                   | 210   | mJ   |

1. Pulse width limited by  $T_{jmax}$ .
2. Starting  $T_j = 25\text{ °C}$ ,  $I_D = I_{AR}$ ,  $V_{DD} = 50\text{ V}$ .

## 2 Electrical characteristics

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

**Table 4. On/off states**

| Symbol        | Parameter                         | Test conditions   | Min. | Typ. | Max.     | Unit          |
|---------------|-----------------------------------|---|------|------|----------|---------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage    | $V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$                                | 800  |      |          | V             |
| $I_{DSS}$     | Zero gate voltage drain current   | $V_{GS} = 0\text{ V}, V_{DS} = 800\text{ V}$                            |      |      | 1        | $\mu\text{A}$ |
|               |                                   | $V_{GS} = 0\text{ V}, V_{DS} = 800\text{ V}, T_C = 125\text{ °C}^{(1)}$ |      |      | 50       | $\mu\text{A}$ |
| $I_{GSS}$     | Gate-body leakage current         | $V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$                         |      |      | $\pm 10$ | $\mu\text{A}$ |
| $V_{GS(th)}$  | Gate threshold voltage            | $V_{DS} = V_{GS}, I_D = 100\text{ }\mu\text{A}$                         | 3    | 3.75 | 4.5      | V             |
| $R_{DS(on)}$  | Static drain-source on-resistance | $V_{GS} = 10\text{ V}, I_D = 2.6\text{ A}$                              |      | 1.5  | 1.8      | $\Omega$      |

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

**Table 5. Dynamic**

| Symbol                     | Parameter                     | Test conditions   | Min. | Typ. | Max. | Unit          |
|----------------------------|-------------------------------|---|------|------|------|---------------|
| $g_{fs}^{(1)}$             | Forward transconductance      | $V_{DS} = 15\text{ V}, I_D = 2.6\text{ A}$                    |      | 5    |      | S             |
| $C_{iss}$                  | Input capacitance             | $V_{DS} = 25\text{ V}, f = 1\text{ MHz}, V_{GS} = 0\text{ V}$ |      | 1138 |      | $\mu\text{F}$ |
| $C_{oss}$                  | Output capacitance            |   |      | 122  | -    |               |
| $C_{riss}$                 | Reverse transfer capacitance  |   |      | 25   |      |               |
| $C_{oss\text{ eq.}}^{(2)}$ | Equivalent output capacitance | $V_{GS} = 0\text{ V}, V_{DS} = 0\text{ V to } 640\text{ V}$   | -    | 50   | -    | $\mu\text{F}$ |
| $Q_g$                      | Total gate charge             | $V_{DD} = 640\text{ V}, I_D = 2.6\text{ A},$                  |      | 40   |      | nC            |
| $Q_{gs}$                   | Gate-source charge            | $V_{GS} = 0\text{ to } 10\text{ V}$                           |      | 7    |      |               |
| $Q_{gd}$                   | Gate-drain charge             | (see Figure 15. Test circuit for gate charge behavior)        |      | 21   |      |               |

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

2.  $C_{oss\text{ eq.}}$  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 6. Switching times**

| Symbol        | Parameter             | Test conditions   | Min. | Typ. | Max. | Unit |
|---------------|-----------------------|---|------|------|------|------|
| $t_{d(on)}$   | Turn-on delay time    | $V_{DD} = 400\text{ V}$ , $I_D = 2.6\text{ A}$ , $R_G = 4.7\ \Omega$ ,<br>$V_{GS} = 10\text{ V}$        |      | 20   |      |      |
| $t_r$         | Rise time             |   |      | 12   |      |      |
| $t_{d(off)}$  | Turn-off delay time   | (see Figure 14. Test circuit for resistive load switching times and Figure 19. Switching time waveform) |      | 45   |      |      |
| $t_f$         | Fall time             |   |      | 22   |      |      |
| $t_{r(Voff)}$ | Off-voltage rise time | $V_{DD} = 640\text{ V}$ , $I_D = 5.2\text{ A}$ ,  |      | 12   |      | ns   |
| $t_f$         | Fall time             | $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$  |      | 10   |      |      |
| $t_c$         | Cross-over time       | (see Figure 16. Test circuit for inductive load switching and diode recovery times)                     |      | 20   |      |      |

**Table 7. Source-drain diode**

| Symbol          | Parameter                     | Test conditions  | Min. | Typ. | Max. | Unit          |
|-----------------|-------------------------------|--|------|------|------|---------------|
| $I_{SD}$        | Source-drain current          |  | -    |      | 5.2  | A             |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |  | -    |      | 20.8 |               |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD} = 5.2\text{ A}$ , $V_{GS} = 0\text{ V}$  | -    |      | 1.6  | V             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 5.2\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$   | -    | 530  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       | $V_{DD} = 50\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$ (see Figure 16. Test circuit for inductive load switching and diode recovery times) | -    | 3.31 |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |  | -    | 12.5 |      | A             |

1. Pulse width is limited by safe operating area.
2. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

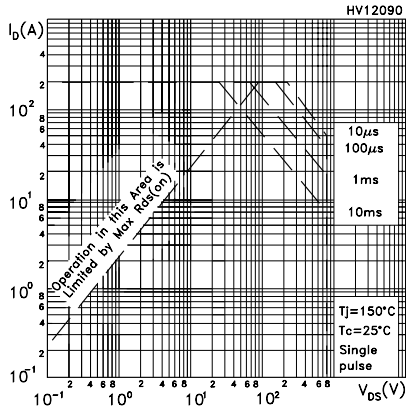
**Table 8. Gate-source Zener diode**

| Symbol        | Parameter                     | Test conditions                                 | Min. | Typ. | Max. | Unit |
|---------------|-------------------------------|---|------|------|------|------|
| $V_{(BR)GSO}$ | Gate-source breakdown voltage | $I_{GS} = \pm 1\text{ mA}$ , $I_D = 0\text{ A}$ | 30   | -    | -    | V    |

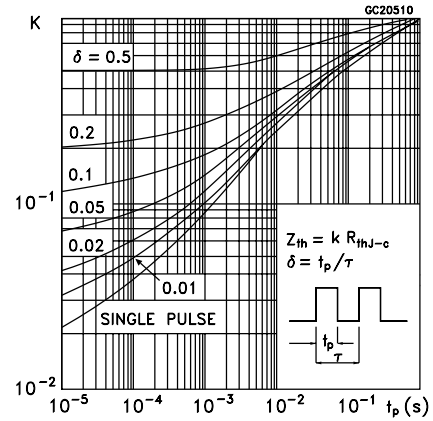
The built-in back-to-back Zener diodes are specifically designed to enhance the ESD performance of the device. The Zener voltage facilitates efficient and cost-effective device integrity protection, thus eliminating the need for additional external componentry.

## 2.1 Electrical characteristics (curves)

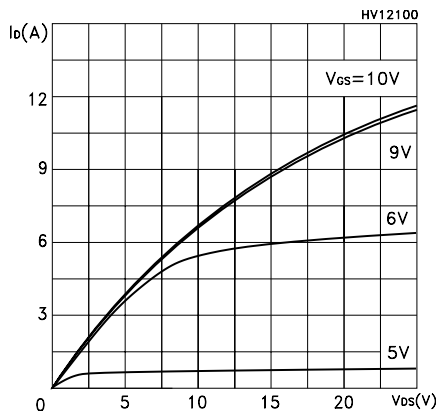
**Figure 1. Safe operating area**



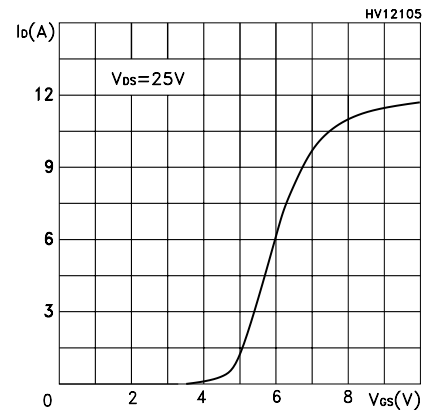
**Figure 2. Thermal impedance**



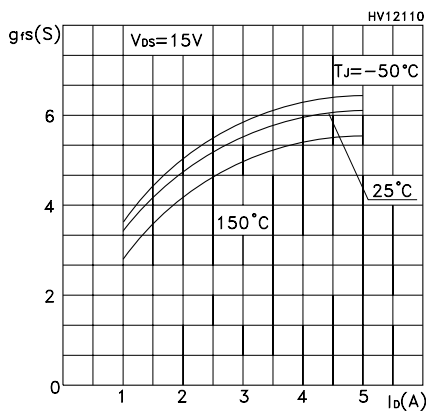
**Figure 3. Output characteristics**



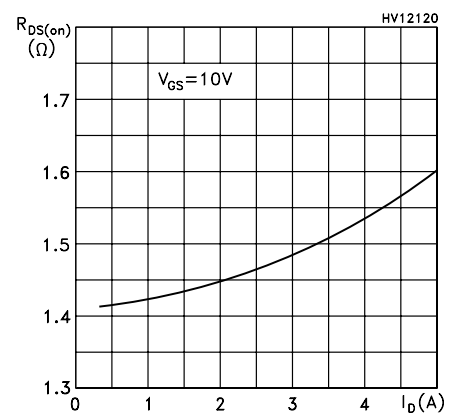
**Figure 4. Transfer characteristics**



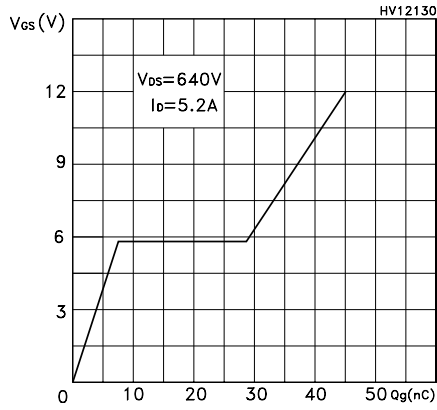
**Figure 5. Transconductance**



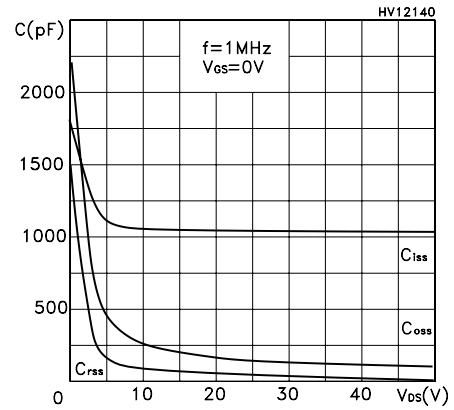
**Figure 6. Static drain-source on-resistance**



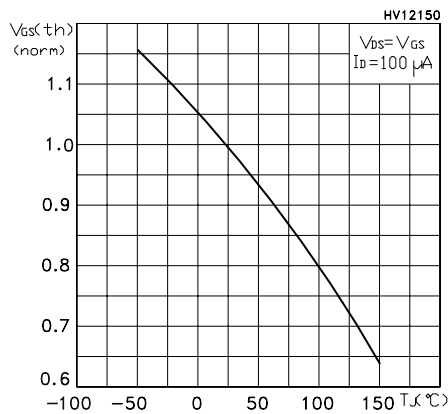
**Figure 7. Gate charge vs gate-source voltage**



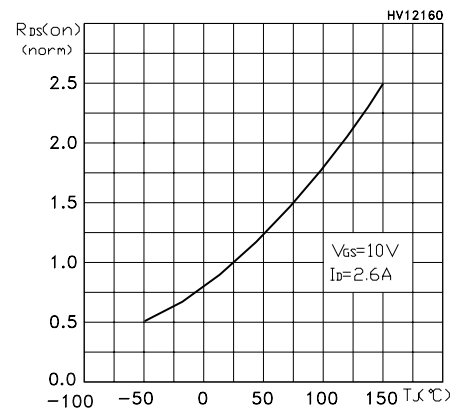
**Figure 8. Capacitance variations**



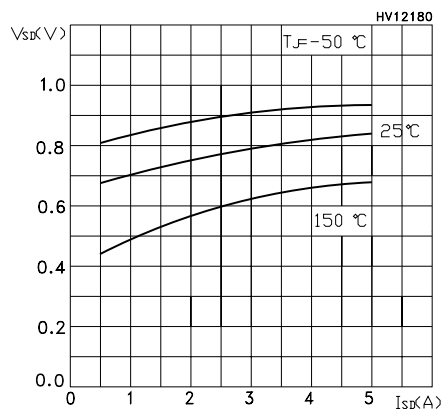
**Figure 9. Normalized gate threshold voltage vs temperature**



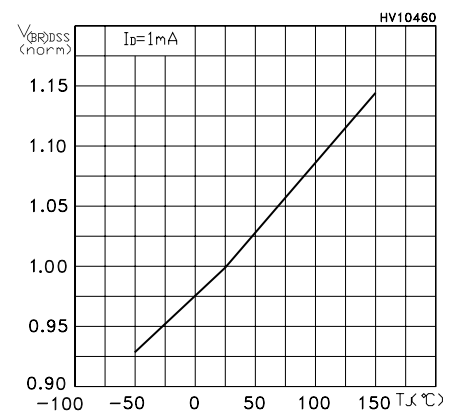
**Figure 10. Normalized on-resistance vs temperature**



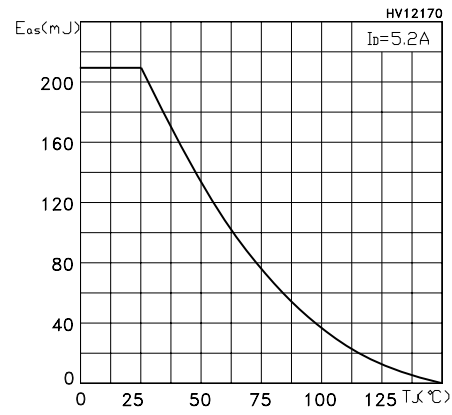
**Figure 11. Source-drain diode forward characteristics**



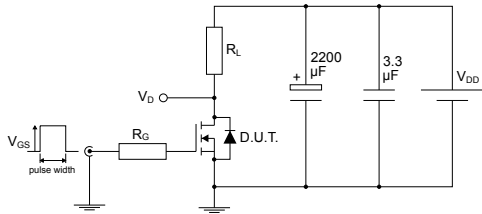
**Figure 12. Normalized breakdown voltage vs temperature**



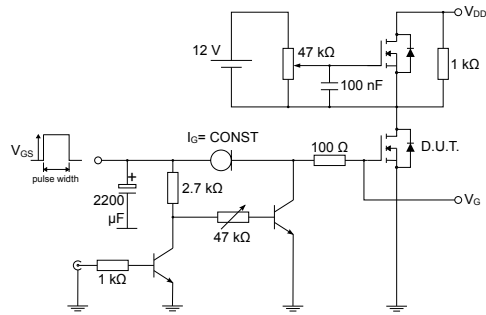
**Figure 13. Maximum avalanche energy vs temperature**



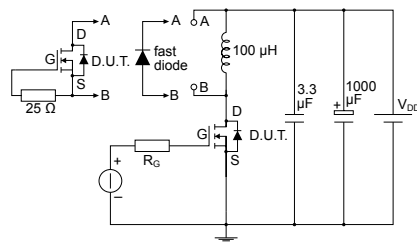
### 3 Test circuits

**Figure 14. Test circuit for resistive load switching times**


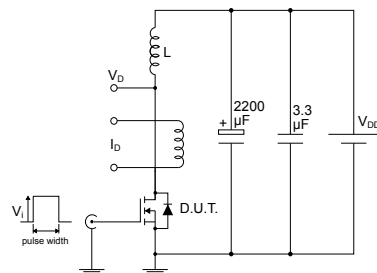
AM01468v1

**Figure 15. Test circuit for gate charge behavior**


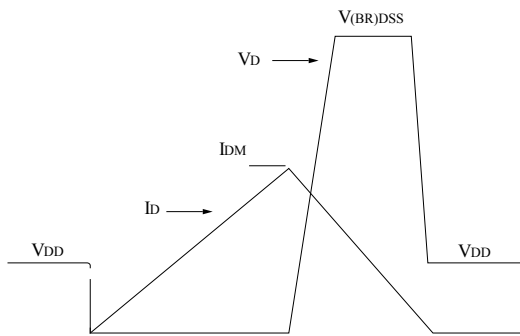
AM01469v1

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


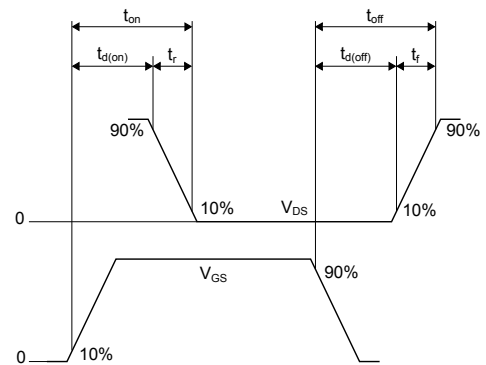
AM01470v1

**Figure 17. Unclamped inductive load test circuit**


AM01471v1

**Figure 18. Unclamped inductive waveform**


AM01472v1

**Figure 19. Switching time waveform**


AM01473v1



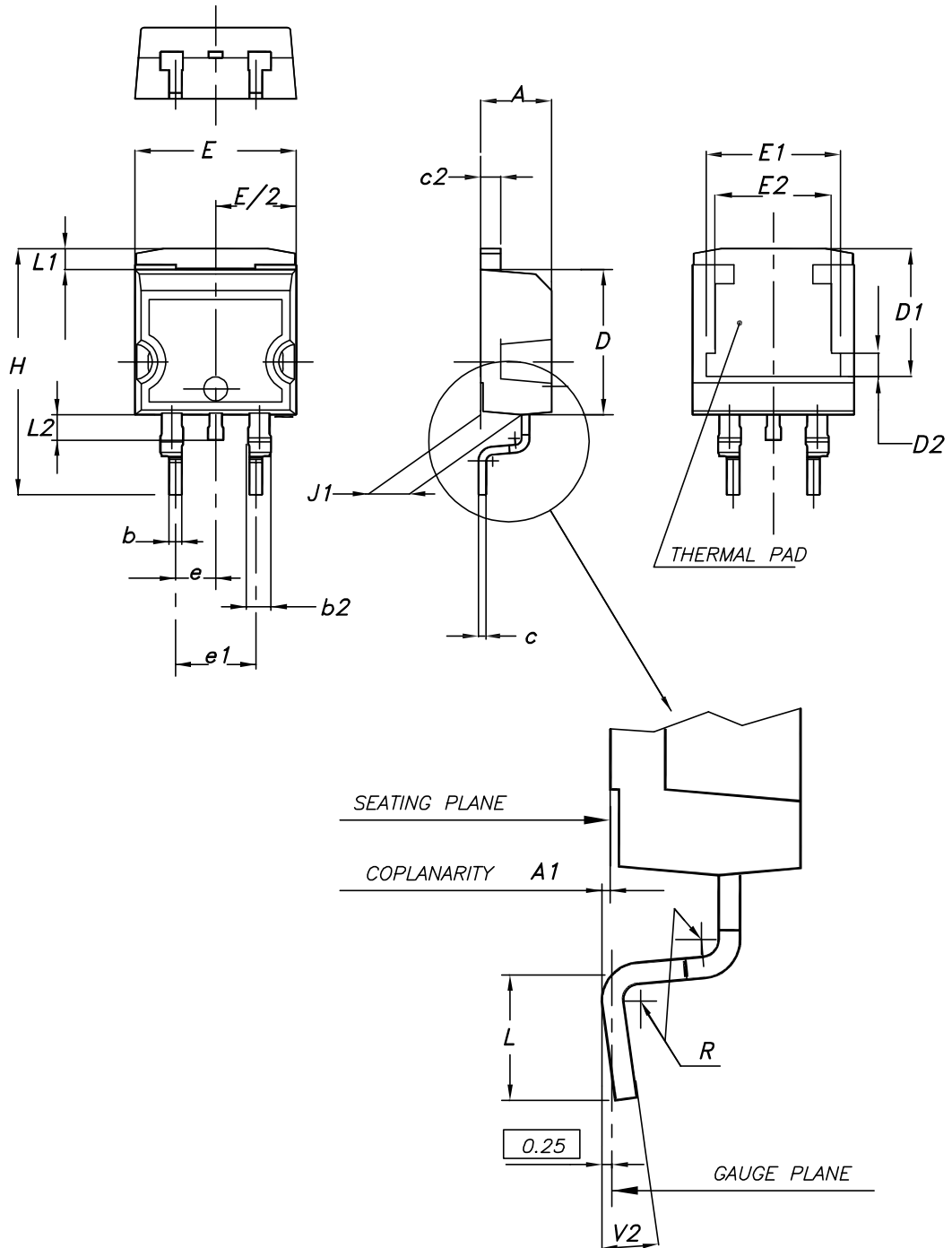
## 4 Package information

---

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](http://www.st.com). ECOPACK is an ST trademark.

### 4.1 D<sup>2</sup>PAK (TO-263) type A package information

Figure 20. D<sup>2</sup>PAK (TO-263) type A package outline

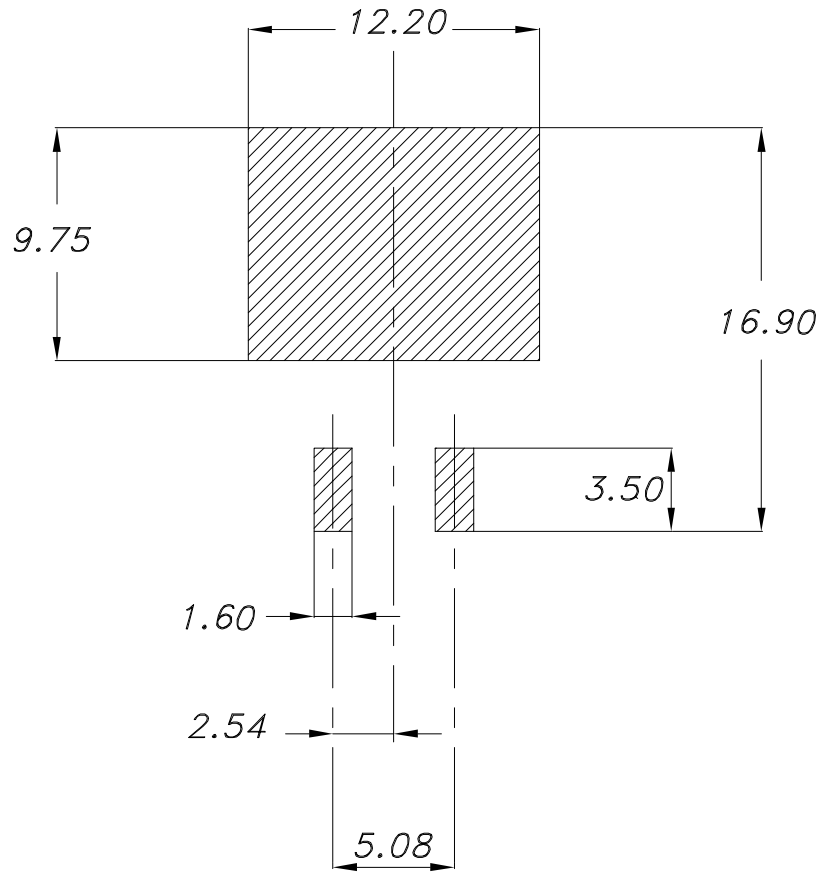


0079457\_26

**Table 9. D<sup>2</sup>PAK (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    | 10.00 |      | 10.40 |
| E1   | 8.30  | 8.50 | 8.70  |
| 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    |       | 0.40 |       |
| V2   | 0°    |      | 8°    |

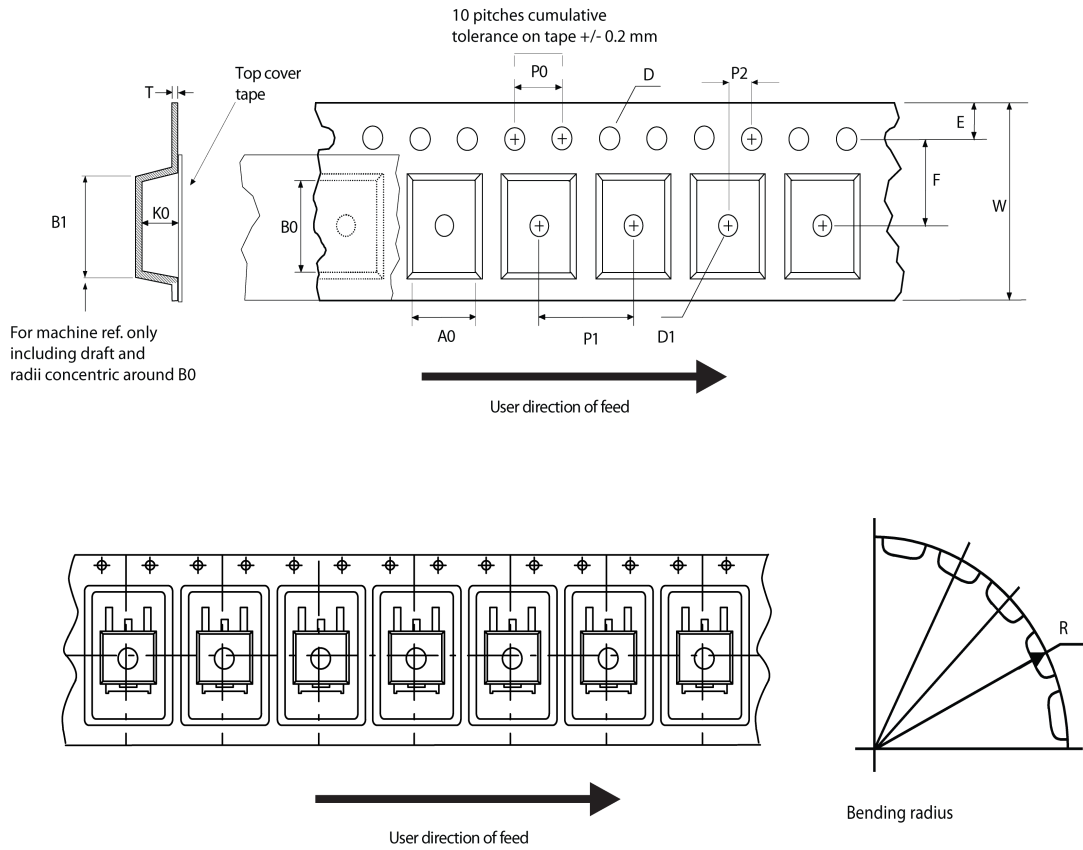
Figure 21. D<sup>2</sup>PAK (TO-263) recommended footprint (dimensions are in mm)



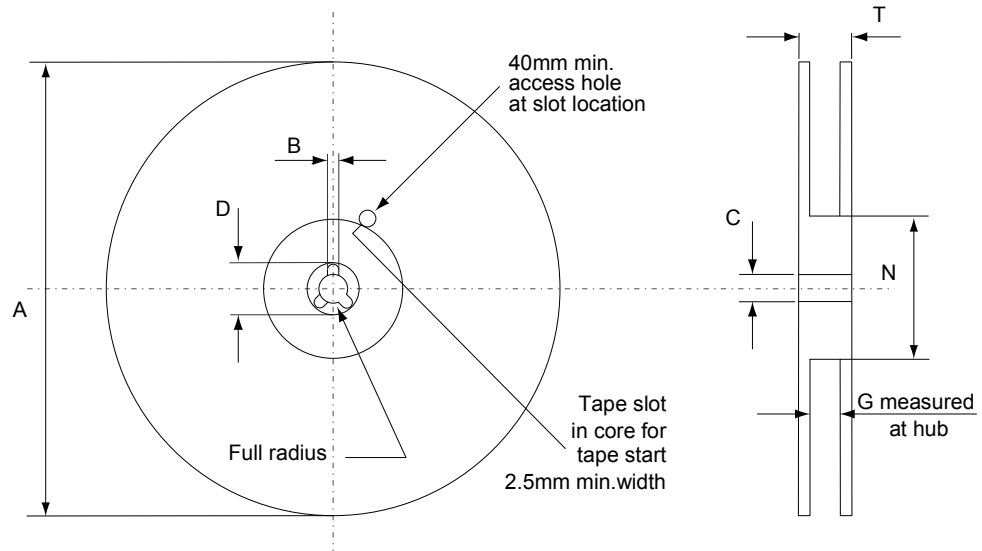
Footprint\_26

## 4.2 D<sup>2</sup>PAK packing information

**Figure 22. D<sup>2</sup>PAK tape outline**



AM08852v1

**Figure 23. D<sup>2</sup>PAK reel outline**


AM06038v1

**Table 10. D<sup>2</sup>PAK 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 quantity |      | 1000 |
| P2   | 1.9  | 2.1  | Bulk quantity |      | 1000 |
| R    | 50   |      |               |      |      |
| T    | 0.25 | 0.35 |               |      |      |
| W    | 23.7 | 24.3 |               |      |      |

## Revision history

**Table 11. Document revision history**

| Date        | Version | Changes   |
|-------------|---------|---|
| 05-Jun-2013 | 1       | First issue.  |
| 12-Jul-2013 | 2       | Document status promoted from preliminary to production data.   |
| 21-Oct-2019 | 3       | Modified <a href="#">Table 5. Dynamic</a> and <a href="#">Section 4.1 D<sup>2</sup>PAK (TO-263) type A package information</a> .<br>Minor text changes. |

---

## Contents

|            |  |           |
|------------|--|-----------|
| <b>1</b>   | <b>Electrical ratings</b> .....                              | <b>2</b>  |
| <b>2</b>   | <b>Electrical characteristics</b> .....                      | <b>3</b>  |
| <b>2.1</b> | Electrical characteristics (curves) .....                    | <b>5</b>  |
| <b>3</b>   | <b>Test circuits</b> .....                                   | <b>8</b>  |
| <b>4</b>   | <b>Package information</b> .....                             | <b>9</b>  |
| <b>4.1</b> | D <sup>2</sup> PAK (TO-263) type A package information ..... | <b>9</b>  |
| <b>4.2</b> | D <sup>2</sup> PAK packing information .....                 | <b>12</b> |
|            | <b>Revision history</b> .....                                | <b>15</b> |



**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. For additional information about ST trademarks, please refer to [www.st.com/trademarks](http://www.st.com/trademarks). 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.

© 2019 STMicroelectronics – All rights reserved

## X-ON Electronics

Largest Supplier of Electrical and Electronic Components

*Click to view similar products for [MOSFET](#) category:*

*Click to view products by [STMicroelectronics](#) manufacturer:*

Other Similar products are found below :

[614233C](#) [648584F](#) [IRFD120](#) [JANTX2N5237](#) [2N7000](#) [FCA20N60\\_F109](#) [FDZ595PZ](#) [2SK2545\(Q,T\)](#) [405094E](#) [423220D](#)  
[TPCC8103,L1Q\(CM](#) [MIC4420CM-TR](#) [VN1206L](#) [614234A](#) [715780A](#) [NTNS3166NZT5G](#) [SSM6J414TU,LF\(T](#) [751625C](#)  
[IPS70R2K0CEAKMA1](#) [BUK954R8-60E](#) [DMN3404LQ-7](#) [NTE6400](#) [SQJ402EP-T1-GE3](#) [2SK2614\(TE16L1,Q\)](#) [2N7002KW-FAI](#)  
[DMN1017UCP3-7](#) [EFC2J004NUZTDG](#) [ECH8691-TL-W](#) [FCAB21350L1](#) [P85W28HP2F-7071](#) [DMN1053UCP4-7](#) [NTE221](#) [NTE2384](#)  
[NTE2903](#) [NTE2941](#) [NTE2945](#) [NTE2946](#) [NTE2960](#) [NTE2967](#) [NTE2969](#) [NTE2976](#) [NTE455](#) [NTE6400A](#) [NTE2910](#) [NTE2916](#) [NTE2956](#)  
[NTE2911](#) [TK10A80W,S4X\(S](#) [SSM6P69NU,LF](#) [DMP22D4UFO-7B](#)