

N-channel 600 V, 0.135  $\Omega$  typ., 20 A MDmesh™ II  
Power MOSFETs in D<sup>2</sup>PAK and TO-220 packages

Datasheet - production data

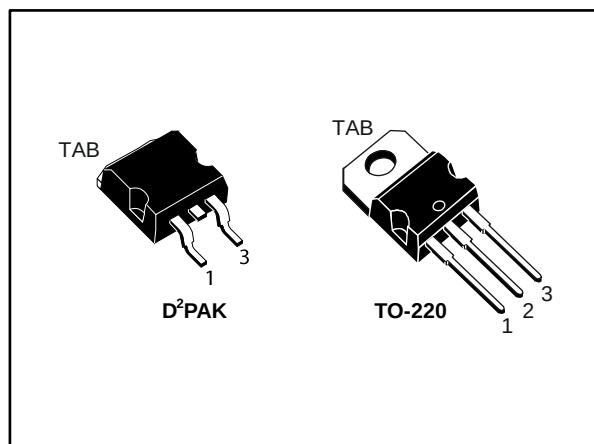
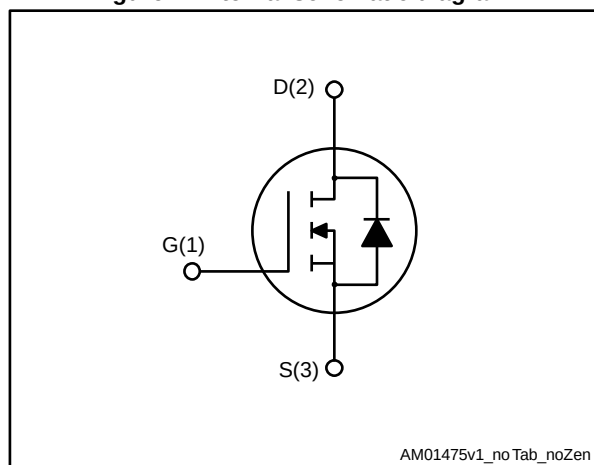


Figure 1: Internal schematic diagram



## Features

| Order code | V <sub>DS</sub> | R <sub>DS(on)</sub> max | I <sub>D</sub> |
|------------|-----------------|-------------------------|----------------|
| STB26NM60N | 600 V           | 0.165 $\Omega$          | 20 A           |
| STP26NM60N |                 |                         |                |

- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance

## Applications

- Switching applications

## Description

These devices are N-channel Power MOSFETs 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     |
|------------|---------|--------------------|---------------|
| STB26NM60N | 26NM60N | D <sup>2</sup> PAK | Tape and reel |
| STP26NM60N |         | TO-220             | Tube          |

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# 1 Electrical ratings

Table 2: Absolute maximum ratings

| Symbol         | Parameter                                                         | Value      | Unit               |
|----------------|-------------------------------------------------------------------|------------|--------------------|
| $V_{DS}$       | Drain-source voltage                                              | 600        | V                  |
| $V_{GS}$       | Gate-source voltage                                               | $\pm 30$   | V                  |
| $I_D$          | Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$  | 20         | A                  |
| $I_D$          | Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$ | 12.6       | A                  |
| $I_{DM}^{(1)}$ | Drain current (pulsed)                                            | 80         | A                  |
| $P_{TOT}$      | Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$           | 140        | W                  |
| $dv/dt^{(2)}$  | Peak diode recovery voltage slope                                 | 15         | V/ns               |
| $T_{stg}$      | Storage temperature range                                         | -55 to 150 | $^{\circ}\text{C}$ |
| $T_j$          | Operating junction temperature range                              |            |                    |

**Notes:**

<sup>(1)</sup>Pulse width limited by safe operating area.

<sup>(2)</sup> $I_{SD} \leq 20\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ,  $V_{DS(\text{peak})} \leq V_{(BR)DSS}$ ,  $V_{DD} = 80\% V_{(BR)DSS}$

Table 3: Thermal data

| Symbol                     | Parameter                           | Value              |        | Unit                        |
|----------------------------|-------------------------------------|--------------------|--------|-----------------------------|
|                            |                                     | D <sup>2</sup> PAK | TO-220 |                             |
| $R_{thj\text{-case}}$      | Thermal resistance junction-case    | 0.89               |        | $^{\circ}\text{C}/\text{W}$ |
| $R_{thj\text{-amb}}$       | Thermal resistance junction-ambient |                    | 62.5   | $^{\circ}\text{C}/\text{W}$ |
| $R_{thj\text{-pcb}}^{(1)}$ | Thermal resistance junction-pcb     | 30                 |        | $^{\circ}\text{C}/\text{W}$ |

**Notes:**

<sup>(1)</sup>When mounted on FR-4 board of 1inch<sup>2</sup>, 2oz Cu,  $t < 10\text{ s}$ .

Table 4: Avalanche characteristics

| Symbol   | Parameter                                                                                                              | Value | Unit |
|----------|------------------------------------------------------------------------------------------------------------------------|-------|------|
| $I_{AS}$ | Single pulse avalanche current (pulse width limited by $T_{j\text{max}}$ )                                             | 6     | A    |
| $E_{AS}$ | Single pulse avalanche energy (starting $T_j = 25\text{ }^{\circ}\text{C}$ , $I_D = I_{AS}$ , $V_{DD} = 50\text{ V}$ ) | 610   | mJ   |

## 2 Electrical characteristics

(T<sub>CASE</sub> = 25 °C unless otherwise specified)

**Table 5: On/off states**

| Symbol               | Parameter                         | Test conditions                                                                        | Min. | Typ.  | Max.  | Unit |
|----------------------|-----------------------------------|----------------------------------------------------------------------------------------|------|-------|-------|------|
| V <sub>(BR)DSS</sub> | Drain-source breakdown voltage    | I <sub>D</sub> = 1 mA, V <sub>GS</sub> = 0 V                                           | 600  |       |       | V    |
| I <sub>DSS</sub>     | Zero gate voltage drain current   | V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 600 V                                         |      |       | 1     | μA   |
|                      |                                   | V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 600 V, T <sub>C</sub> = 125 °C <sup>(1)</sup> |      |       | 100   |      |
| I <sub>GSS</sub>     | Gate-body leakage current         | V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ±25 V                                         |      |       | ±0.1  | μA   |
| V <sub>GS(th)</sub>  | Gate threshold voltage            | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA                            | 2    | 3     | 4     | V    |
| R <sub>DS(on)</sub>  | Static drain-source on-resistance | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 10 A                                          |      | 0.135 | 0.165 | Ω    |

**Notes:**

<sup>(1)</sup>Defined by design, not subject to production test.

**Table 6: Dynamic**

| Symbol                              | Parameter                     | Test conditions                                                                                                                                        | Min. | Typ. | Max. | Unit |
|-------------------------------------|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| C <sub>iss</sub>                    | Input capacitance             | V <sub>DS</sub> = 50 V, f = 1 MHz,<br>V <sub>GS</sub> = 0 V                                                                                            | -    | 1800 | -    | pF   |
| C <sub>oss</sub>                    | Output capacitance            |                                                                                                                                                        | -    | 115  | -    | pF   |
| C <sub>rss</sub>                    | Reverse transfer capacitance  |                                                                                                                                                        | -    | 6    | -    | pF   |
| C <sub>oss eq.</sub> <sup>(1)</sup> | Equivalent output capacitance | V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 0 to 480 V                                                                                                    | -    | 310  | -    | pF   |
| Q <sub>g</sub>                      | Total gate charge             | V <sub>DD</sub> = 480 V, I <sub>D</sub> = 20 A,<br>V <sub>GS</sub> = 10 V<br>(see <a href="#">Figure 14: "Test circuit for gate charge behavior"</a> ) | -    | 60   | -    | nC   |
| Q <sub>gs</sub>                     | Gate-source charge            |                                                                                                                                                        | -    | 8.5  | -    | nC   |
| Q <sub>gd</sub>                     | Gate-drain charge             |                                                                                                                                                        | -    | 30   | -    | nC   |
| R <sub>G</sub>                      | Gate input resistance         | f = 1 MHz, I <sub>D</sub> = 0 A                                                                                                                        | -    | 2.8  | -    | Ω    |

**Notes:**

<sup>(1)</sup>C<sub>oss eq.</sub> is defined as a constant equivalent capacitance giving the same charging time as C<sub>oss</sub> when V<sub>DS</sub> increases from 0 to 80% V<sub>DS</sub>

Table 7: Switching times

| Symbol       | Parameter           | Test conditions                                                                                                                                                                                                                                 | Min. | Typ. | Max. | Unit |
|--------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD} = 300\text{ V}$ , $I_D = 10\text{ A}$ , $R_G = 4.7\ \Omega$ ,<br>$V_{GS} = 10\text{ V}$<br>(see <a href="#">Figure 13: "Test circuit for resistive load switching times"</a> and <a href="#">Figure 18: "Switching time waveform"</a> ) | -    | 13   | -    | ns   |
| $t_r$        | Rise time           |                                                                                                                                                                                                                                                 | -    | 25   | -    | ns   |
| $t_{d(off)}$ | Turn-off delay time |                                                                                                                                                                                                                                                 | -    | 85   | -    | ns   |
| $t_f$        | Fall time           |                                                                                                                                                                                                                                                 | -    | 50   | -    | ns   |

Table 8: Source-drain diode

| Symbol          | Parameter                     | Test conditions                                                                                                                                                                                                                     | Min. | Typ. | Max. | Unit          |
|-----------------|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $I_{SD}$        | Source-drain current          |                                                                                                                                                                                                                                     | -    |      | 20   | A             |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |                                                                                                                                                                                                                                     | -    |      | 80   | A             |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD} = 20\text{ A}$ , $V_{GS} = 0$                                                                                                                                                                                               | -    |      | 1.5  | V             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 20\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 60\text{ V}$<br>(see <a href="#">Figure 15: "Test circuit for inductive load switching and diode recovery times"</a> )                                     | -    | 370  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                                                                                                                     | -    | 5.8  |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                                                                                                                     | -    | 31.6 |      | A             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 20\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 60\text{ V}$ , $T_J = 150\text{ }^\circ\text{C}$<br>(see <a href="#">Figure 15: "Test circuit for inductive load switching and diode recovery times"</a> ) | -    | 450  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                                                                                                                     | -    | 7.5  |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                                                                                                                     | -    | 32.5 |      | A             |

**Notes:**

(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

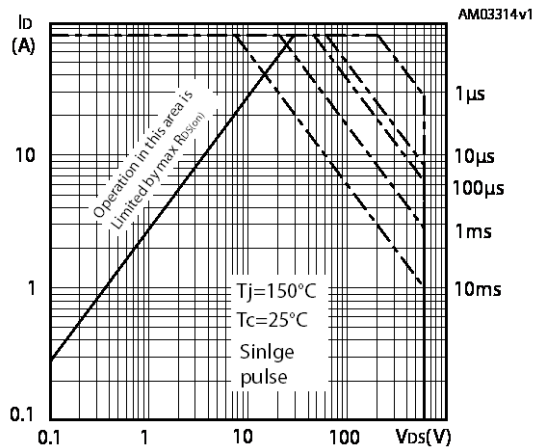


Figure 3: Thermal impedance

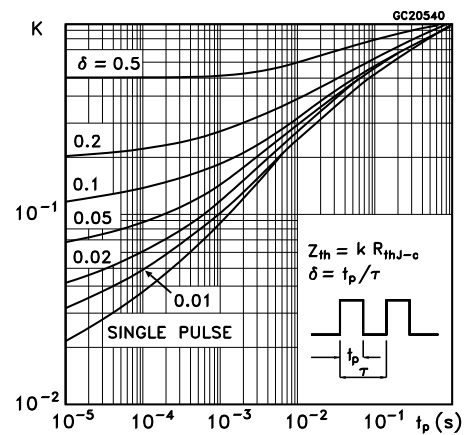


Figure 4: Output characteristics

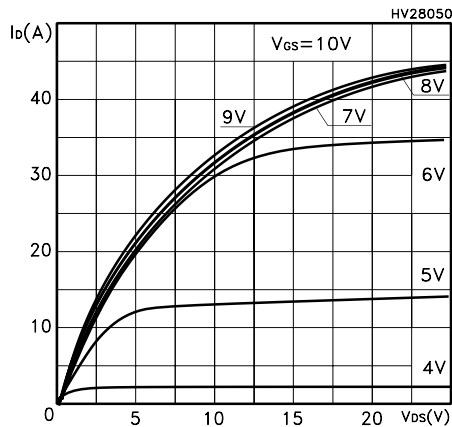


Figure 5: Transfer characteristics

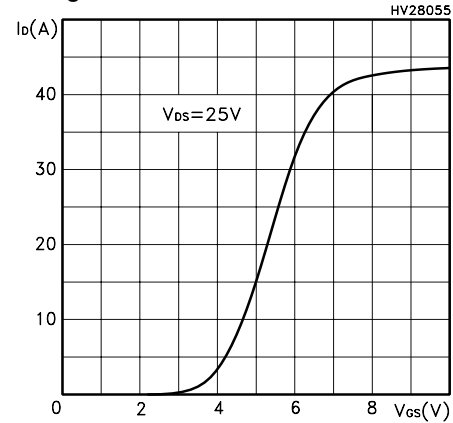


Figure 6: Gate charge vs gate-source voltage

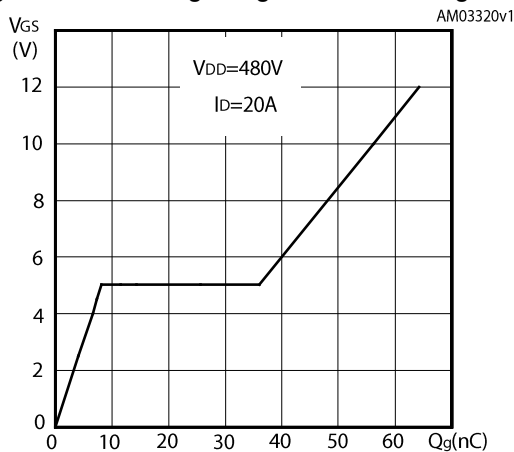


Figure 7: Static drain-source on-resistance

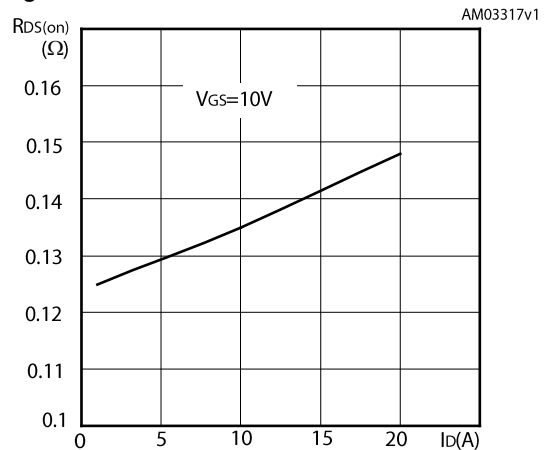


Figure 8: Capacitance variations

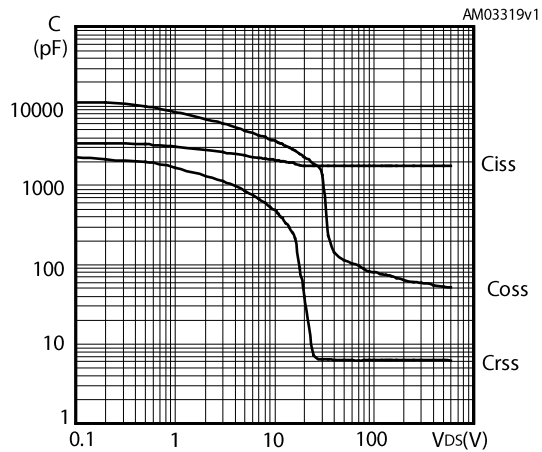


Figure 9: Source-drain diode forward characteristics

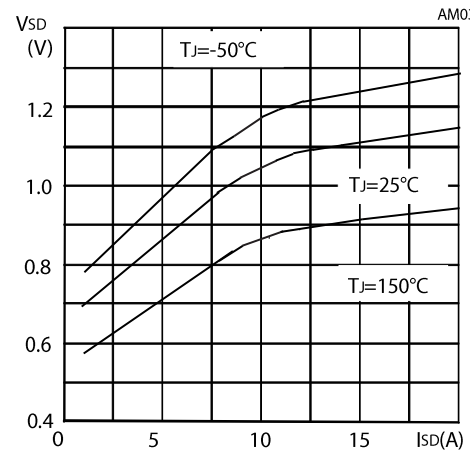


Figure 10: Normalized gate threshold voltage vs temperature

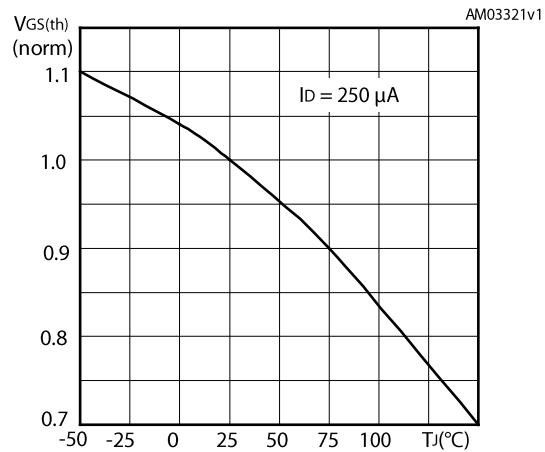


Figure 11: Normalized on-resistance vs temperature

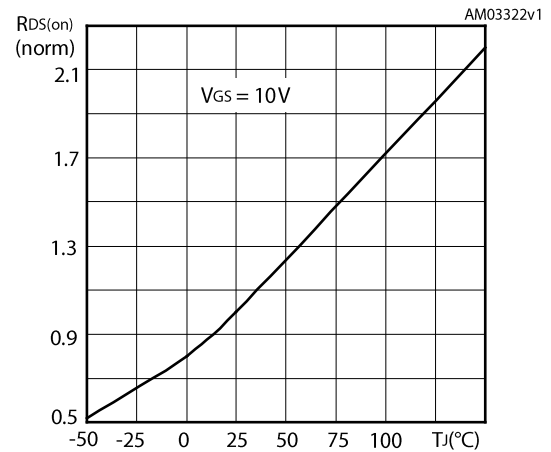
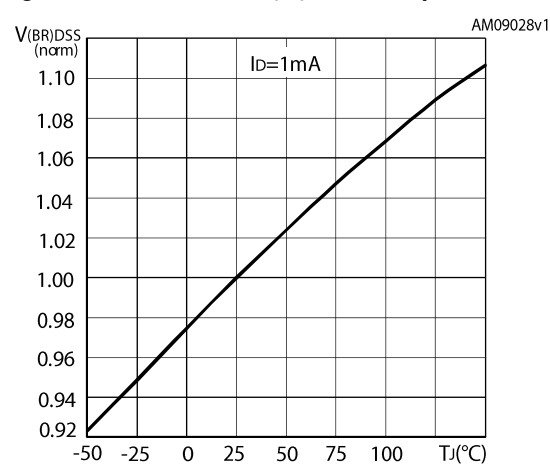
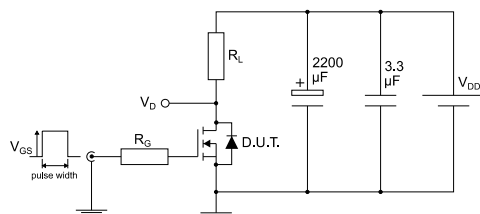


Figure 12: Normalized V(BR)DSS vs temperature



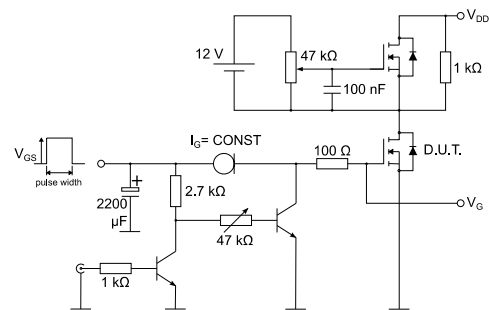
### 3 Test circuits

**Figure 13: Test circuit for resistive load switching times**



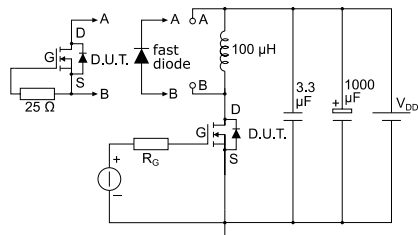
AM01468v1

**Figure 14: Test circuit for gate charge behavior**



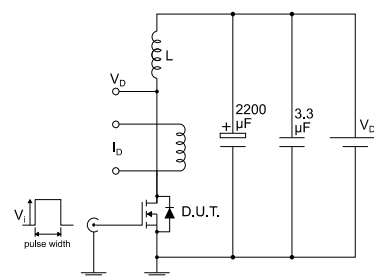
AM01469v1

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



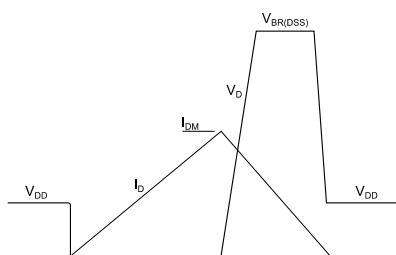
AM01470v1

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



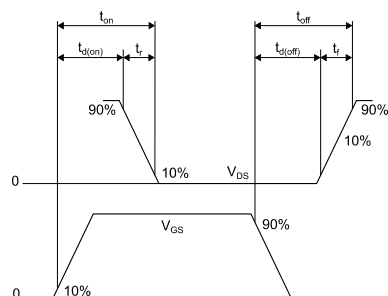
AM01471v1

**Figure 17: Unclamped inductive waveform**



AM01472v1

**Figure 18: Switching time waveform**



AM01473v1

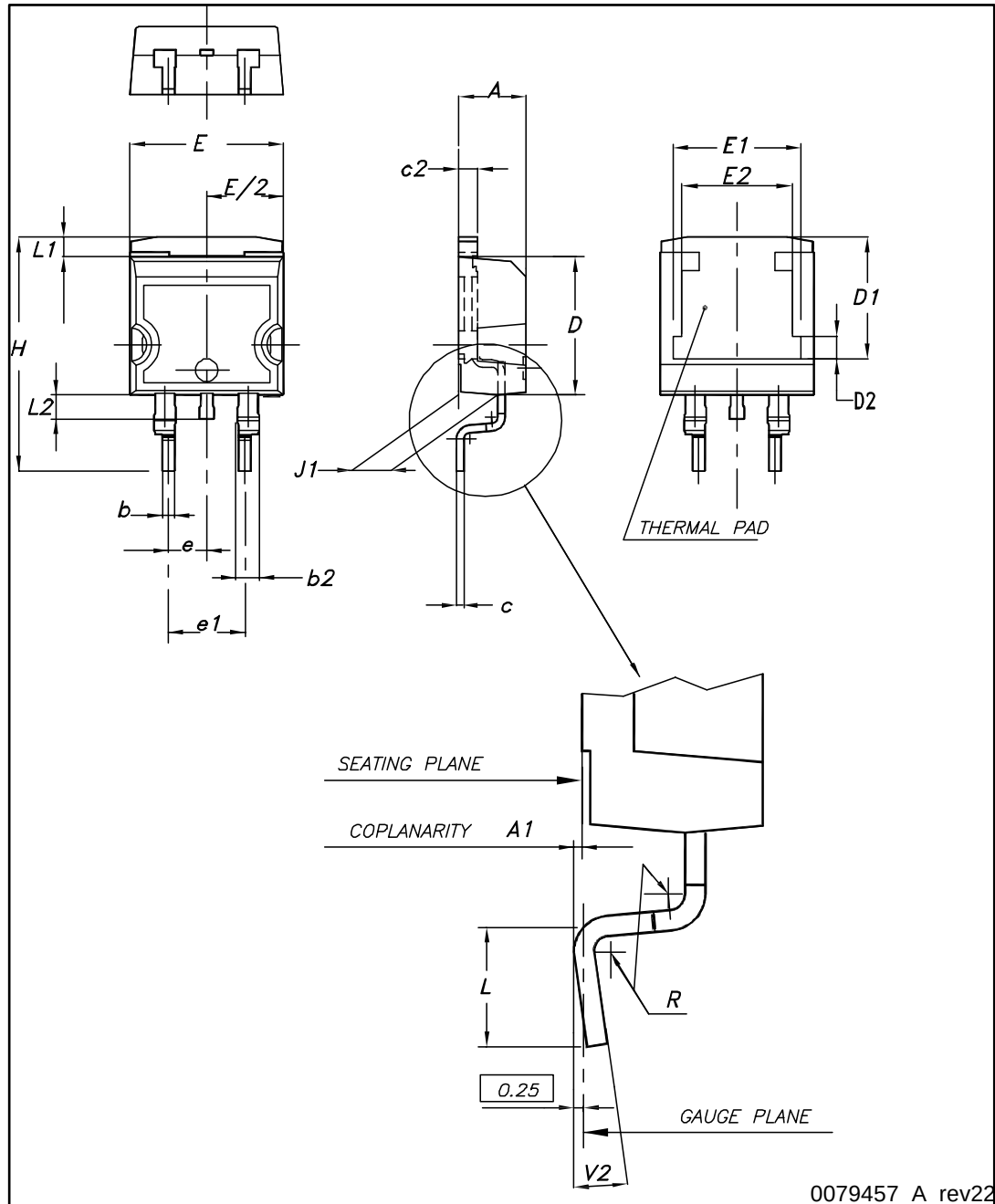


## 4 Package information

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 D2PAK (TO-263) type A package information

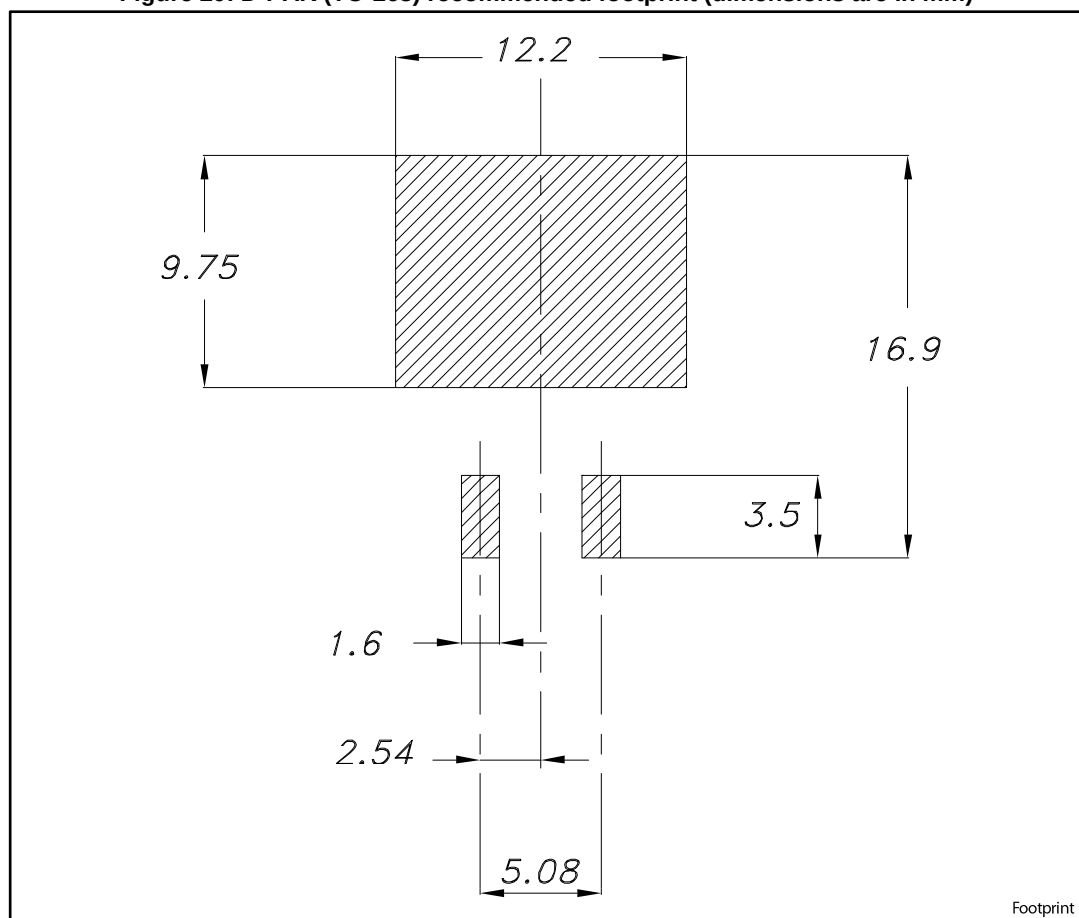
Figure 19: D<sup>2</sup>PAK (TO-263) type A package outline



0079457\_A\_rev22

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   |      | 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   |      | 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 20: D<sup>2</sup>PAK (TO-263) recommended footprint (dimensions are in mm)

## 4.2 D2PAK packaging information

Figure 21: Tape outline

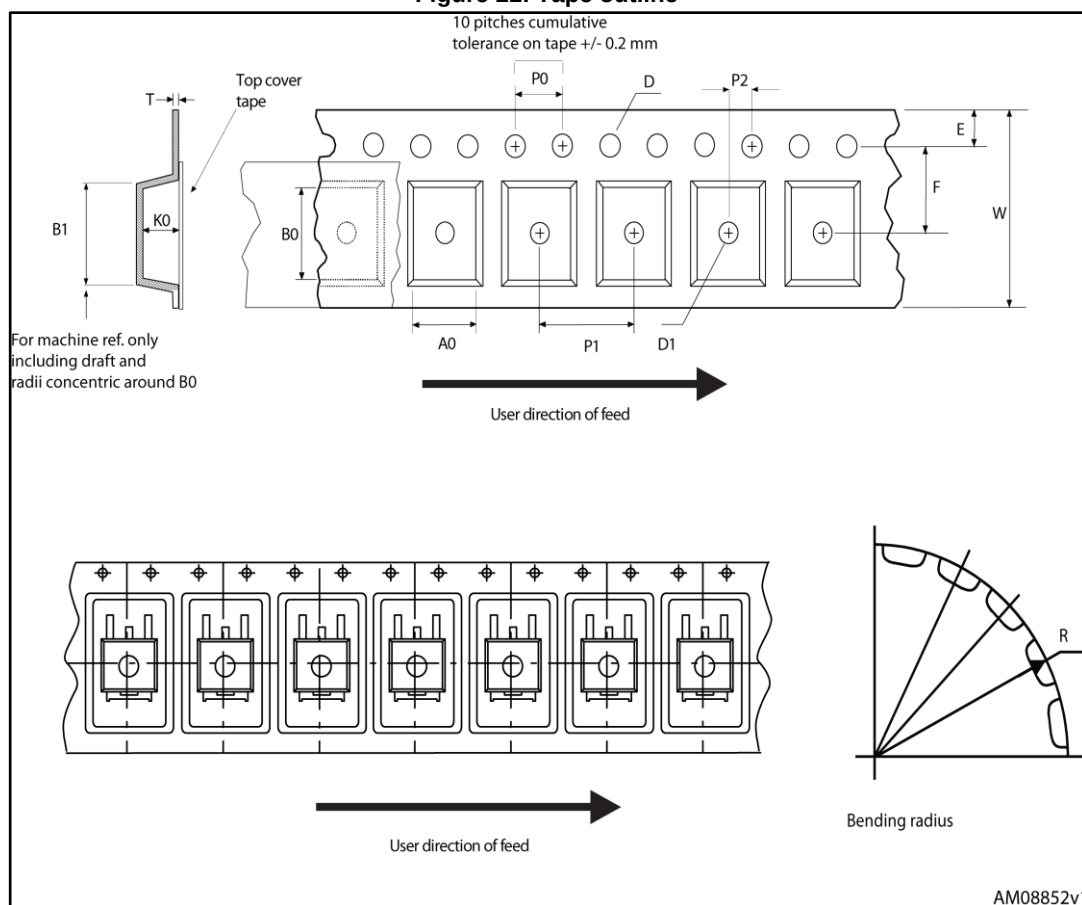
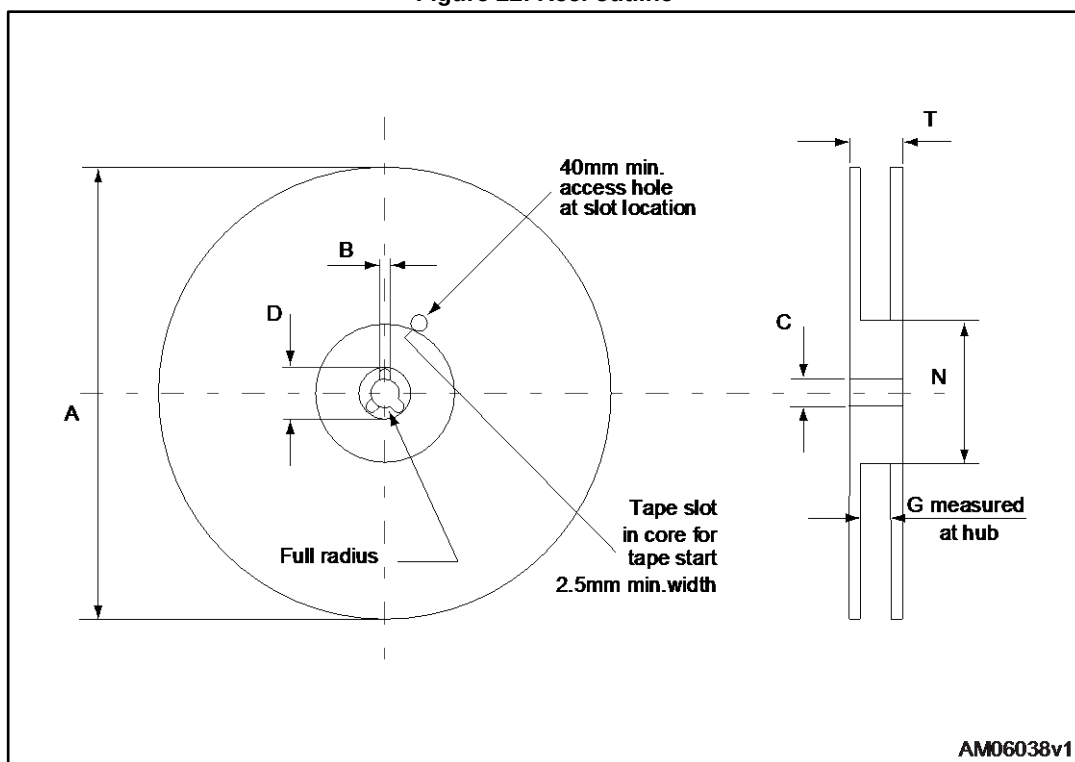


Figure 22: Reel outline

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 |               |      |      |

### 4.3 TO-220 type A package information

Figure 23: TO-220 type A package outline

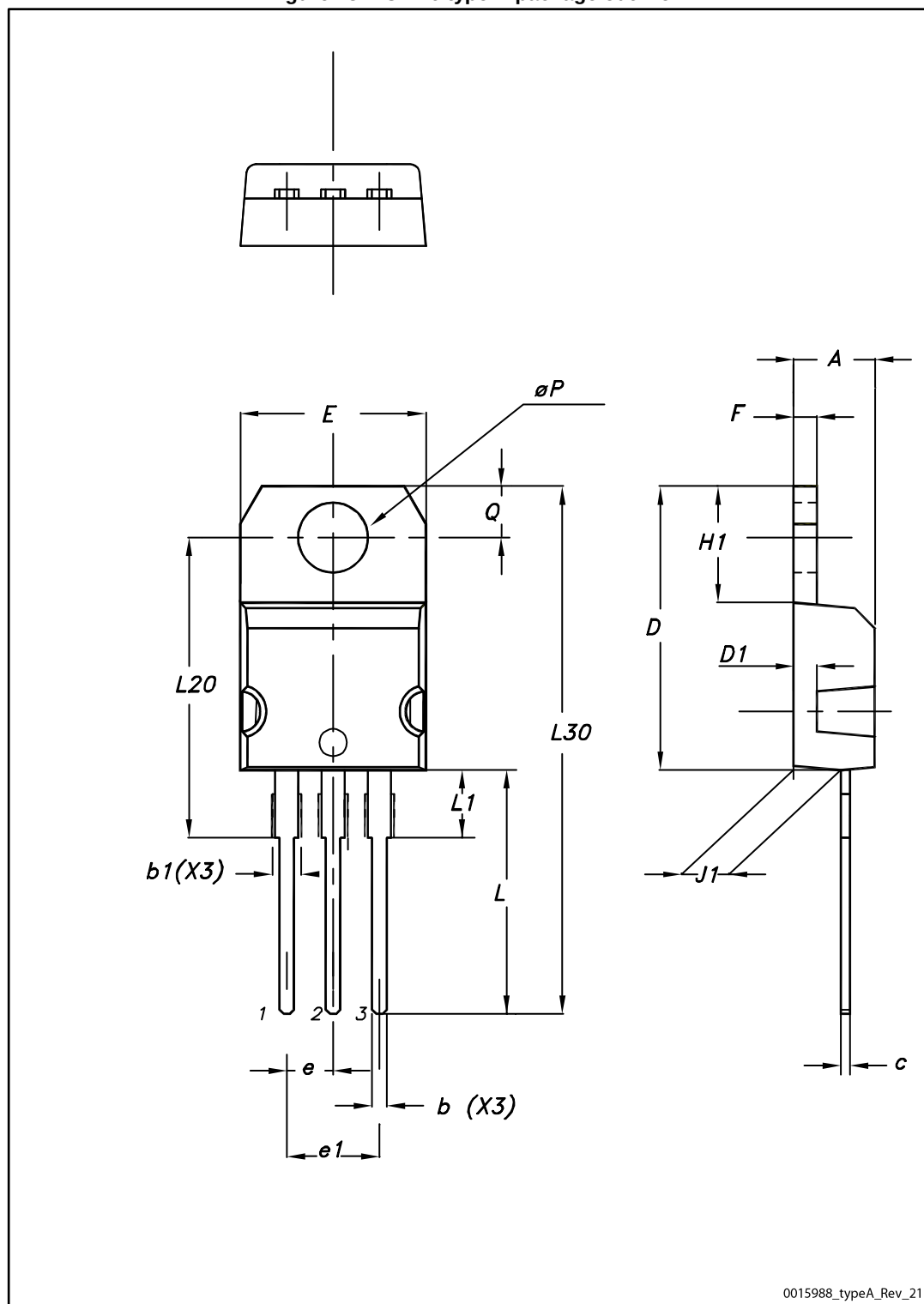


Table 11: TO-220 type A mechanical data

| Dim. | mm    |       |       |
|------|-------|-------|-------|
|      | Min.  | Typ.  | Max.  |
| A    | 4.40  |       | 4.60  |
| b    | 0.61  |       | 0.88  |
| b1   | 1.14  |       | 1.55  |
| c    | 0.48  |       | 0.70  |
| D    | 15.25 |       | 15.75 |
| D1   |       | 1.27  |       |
| E    | 10.00 |       | 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    | 13.00 |       | 14.00 |
| L1   | 3.50  |       | 3.93  |
| L20  |       | 16.40 |       |
| L30  |       | 28.90 |       |
| øP   | 3.75  |       | 3.85  |
| Q    | 2.65  |       | 2.95  |

## 5 Revision history

Table 12: Document revision history

| Date        | Revision | Changes                                                                                                                                                                                                                                                                                                                                                         |
|-------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 29-Apr-2009 | 1        | First release.                                                                                                                                                                                                                                                                                                                                                  |
| 17-Dec-2009 | 2        | Added new package, mechanical data: D <sup>2</sup> PAK                                                                                                                                                                                                                                                                                                          |
| 20-Jun-2011 | 3        | Inserted device in I <sup>2</sup> PAK.                                                                                                                                                                                                                                                                                                                          |
| 13-Mar-2012 | 4        | Updated P <sub>TOT</sub> and derating factor in <i>Table 2</i> .<br>Update R <sub>thj-case</sub> for TO-220FP in <i>Table 3</i> .<br>Update <i>Figure 10</i> and <i>Figure 15</i> .<br>Update <i>Section 5: Packaging mechanical data</i> .                                                                                                                     |
| 20-Jun-2012 | 5        | Updated title on the cover page.<br>Minor text changes.                                                                                                                                                                                                                                                                                                         |
| 09-Sep-2013 | 6        | – The part numbers STI26NM60N and STW26NM60N have been moved to the separate datasheets<br>– Modified: V <sub>GS</sub> value in <i>Table 2</i> .                                                                                                                                                                                                                |
| 12-Dec-2016 | 7        | The part number STF26NM60N has been moved to a separate datasheet.<br>Modified <i>Table 2: "Absolute maximum ratings"</i> , <i>Table 3: "Thermal data"</i> , <i>Table 5: "On/off states"</i> , <i>Table 6: "Dynamic"</i> and <i>Table 7: "Switching times"</i> .<br>Modified <i>Section 2.1: "Electrical characteristics (curves)"</i> .<br>Minor text changes. |



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