# STB26NM60N, STP26NM60N

## N-channel 600 V, 0.135 Ω typ., 20 A MDmesh™ II Power MOSFETs in D²PAK and TO-220 packages

Datasheet - production data

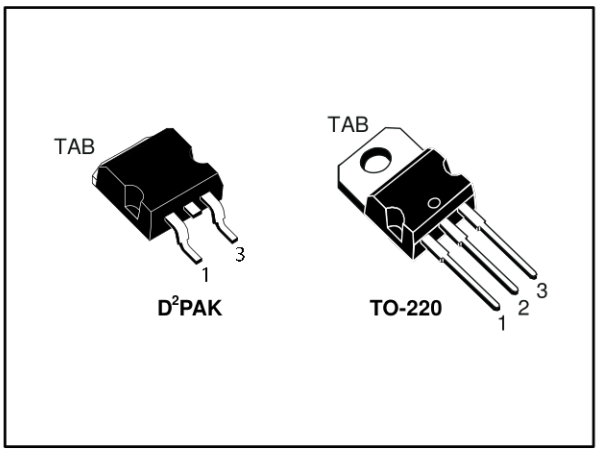
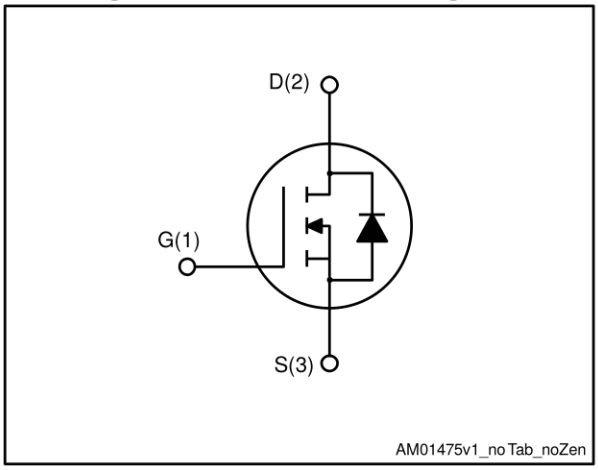



**Figure 1: Internal schematic diagram**




## Features

| Order code | $V_{DS}$ | $R_{DS(on)}$ max | $I_D$ |
|---|---|---|---|
| STB26NM60N | 600 V | 0.165 Ω | 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 | D²PAK | Tape and reel |
| STP26NM60N | | TO-220 | Tube |



This is information on a product in full production. www.st.com

# Contents

# 1 Electrical ratings

**Table 2: Absolute maximum ratings**

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

**Notes:**

(1)Pulse width limited by safe operating area.

(2)$I_{SD}$ ≤ 20 A, di/dt ≤ 400 A/µs, $V_{DS(peak)}$ ≤ $V_{(BR)DSS}$, $V_{DD}$ = 80% $V_{(BR)DSS}$

**Table 3: Thermal data**

| Symbol | Parameter | Value | | Unit |
|---|---|---|---|---|
| | | D²PAK | TO-220 | |
| $R_{thj\text{-}case}$ | Thermal resistance junction-case | 0.89 | | °C/W |
| $R_{thj\text{-}amb}$ | Thermal resistance junction-ambient | | 62.5 | °C/W |
| $R_{thj\text{-}pcb}$ (1) | Thermal resistance junction-pcb | 30 | | °C/W |

**Notes:**

(1)When mounted on FR-4 board of 1inch², 2oz Cu, t < 10 s.

**Table 4: Avalanche characteristics**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $I_{AS}$ | Single pulse avalanche current (pulse width limited by $T_{jmax}$) | 6 | A |
| $E_{AS}$ | Single pulse avalanche energy (starting $T_J$=25 °C, $I_D$=$I_{AS}$, $V_{DD}$=50 V) | 610 | mJ |

# 2 Electrical characteristics

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

**Table 5: On/off states**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $I_D$ = 1 mA, $V_{GS}$ = 0 V | 600 | | | V |
| $I_{DSS}$ | Zero gate voltage drain current | $V_{GS}$ = 0 V, $V_{DS}$ = 600 V | | | 1 | µA |
| | | $V_{GS}$ = 0 V, $V_{DS}$ = 600 V, $T_C$= 125 °C (1) | | | 100 | |
| $I_{GSS}$ | Gate-body leakage current | $V_{DS}$ = 0 V, $V_{GS}$ = ±25 V | | | ±0.1 | µA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | 2 | 3 | 4 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS}$ = 10 V, $I_D$ = 10 A | | 0.135 | 0.165 | Ω |

**Notes:**

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

**Table 6: Dynamic**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input capacitance | $V_{DS}$ = 50 V, f = 1 MHz, $V_{GS}$ = 0 V | - | 1800 | - | pF |
| $C_{oss}$ | Output capacitance | | - | 115 | - | pF |
| $C_{rss}$ | Reverse transfer capacitance | | - | 6 | - | pF |
| $C_{oss\ eq.}$ (1) | Equivalent output capacitance | $V_{GS}$ = 0 V, $V_{DS}$ = 0 to 480 V | - | 310 | - | pF |
| $Q_g$ | Total gate charge | $V_{DD}$ = 480 V, $I_D$ = 20 A, $V_{GS}$ = 10 V (see *Figure 14: "Test circuit for gate charge behavior"*) | - | 60 | - | nC |
| $Q_{gs}$ | Gate-source charge | | - | 8.5 | - | nC |
| $Q_{gd}$ | Gate-drain charge | | - | 30 | - | nC |
| $R_G$ | Gate input resistance | f=1 MHz, $I_D$=0 A | - | 2.8 | - | Ω |

**Notes:**

(1)$C_{oss\ eq.}$ 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 | $V_{DD}$ = 300 V, $I_D$ = 10 A, $R_G$ = 4.7 Ω, $V_{GS}$ = 10 V (see *Figure 13: "Test circuit for resistive load switching times"* and *Figure 18: "Switching time waveform"*) | - | 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 A, $V_{GS}$ = 0 | - | | 1.5 | V |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 20 A, di/dt = 100 A/µs $V_{DD}$ = 60 V (see *Figure 15: "Test circuit for inductive load switching and diode recovery times"*) | - | 370 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 5.8 | | µC |
| $I_{RRM}$ | Reverse recovery current | | - | 31.6 | | A |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 20 A, di/dt = 100 A/µs $V_{DD}$ = 60 V, $T_j$ = 150 °C (see *Figure 15: "Test circuit for inductive load switching and diode recovery times"*) | - | 450 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 7.5 | | µC |
| $I_{RRM}$ | Reverse recovery current | | - | 32.5 | | A |

**Notes:**

(1)Pulse width limited by safe operating area.

(2)Pulsed: pulse duration = 300 µs, duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

**Figure 2: Safe operating area**

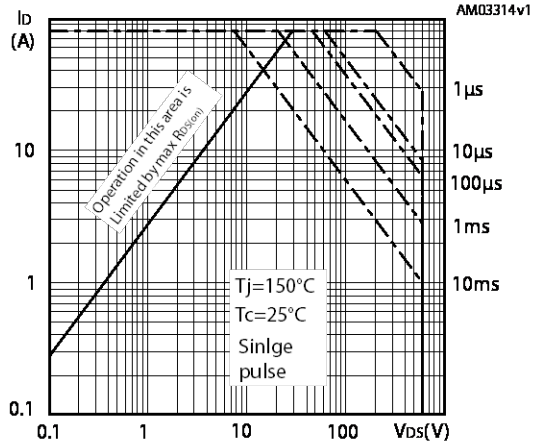



**Figure 3: Thermal impedance**

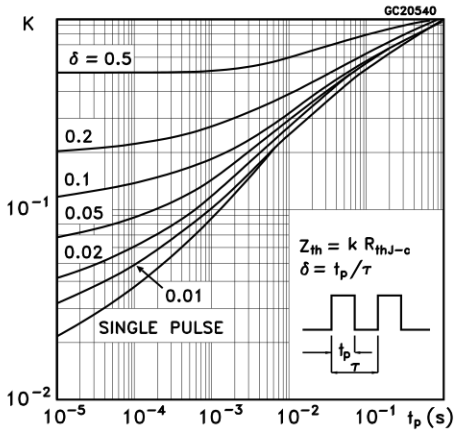



**Figure 4: Output characteristics**

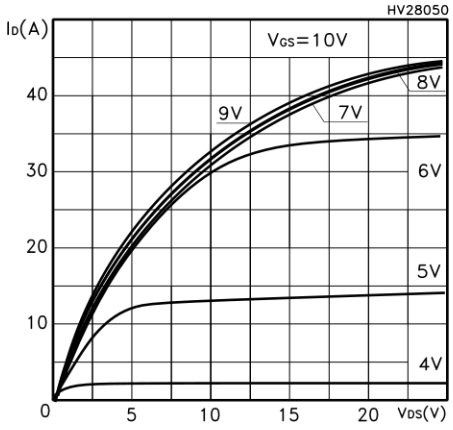



**Figure 5: Transfer characteristics**

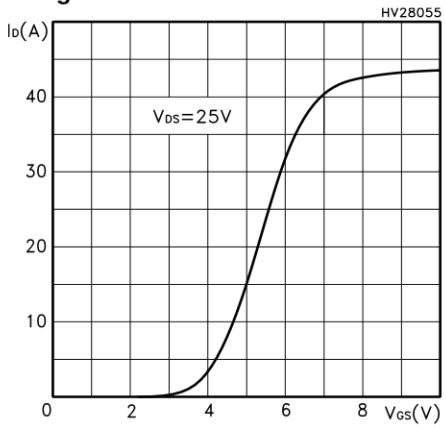



**Figure 6: Gate charge vs gate-source voltage**

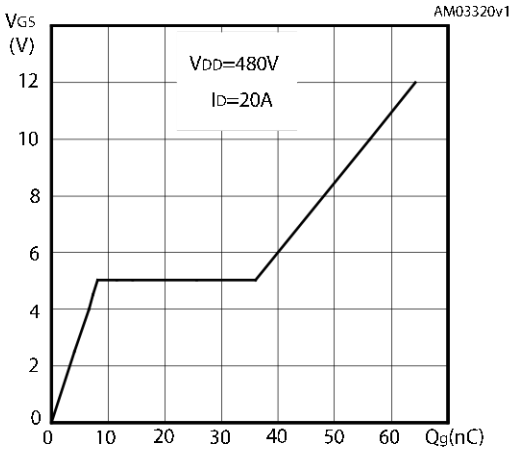



**Figure 7: Static drain-source on-resistance**

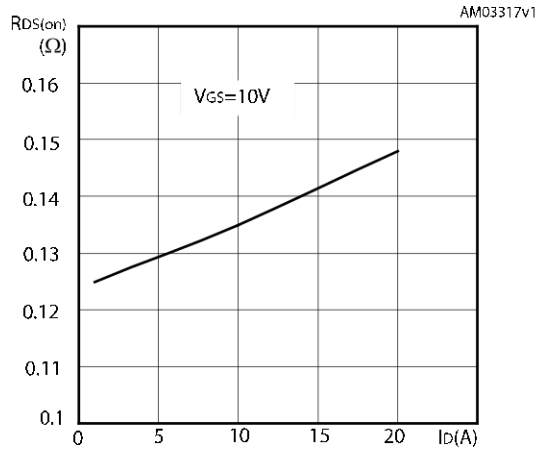


**Figure 8: Capacitance variations**

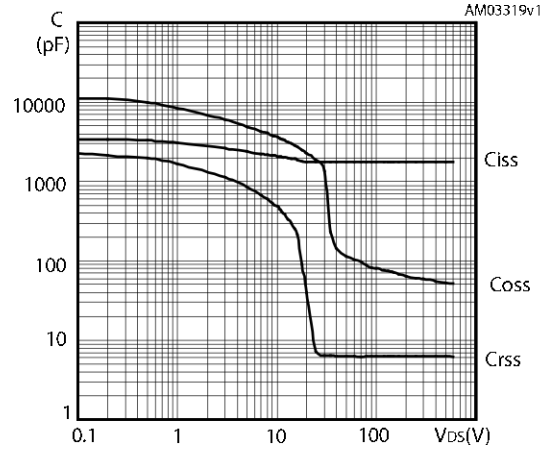



**Figure 9: Source-drain diode forward characteristics**

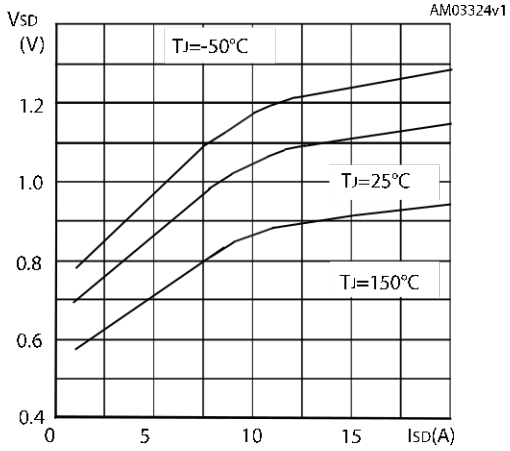



**Figure 10: Normalized gate threshold voltage vs temperature**

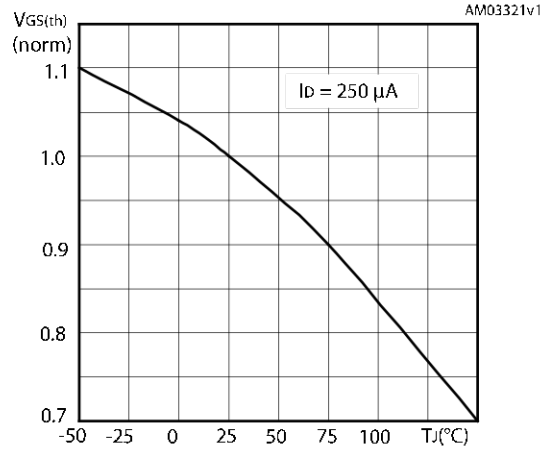



**Figure 11: Normalized on-resistance vs temperature**

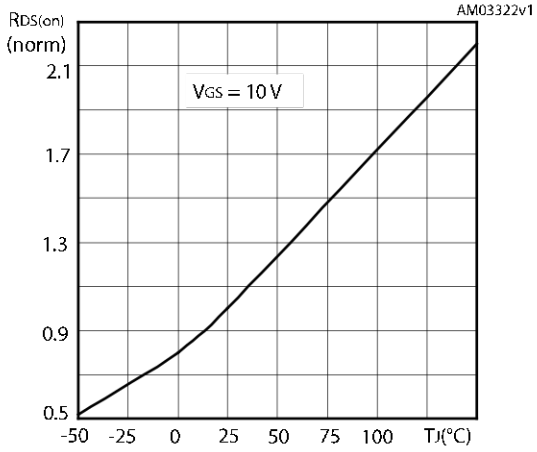
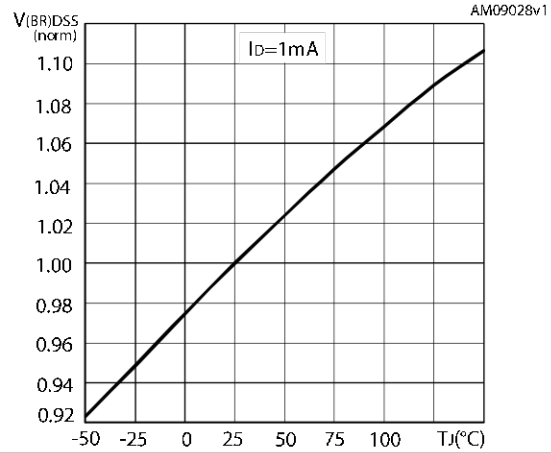



**Figure 12: Normalized $V_{(BR)DSS}$ vs temperature**



# 3 Test circuits

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

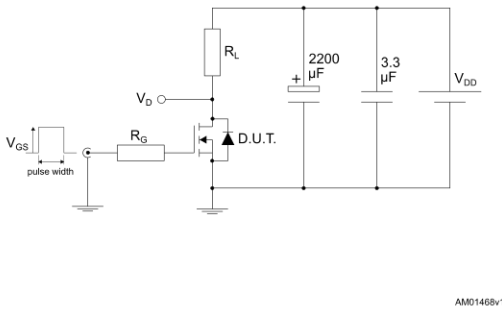



**Figure 14: Test circuit for gate charge behavior**

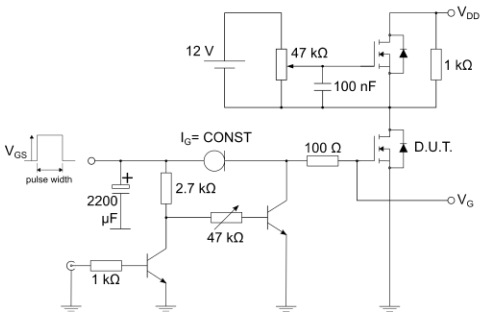



**Figure 15: Test circuit for inductive load switching and diode recovery times**

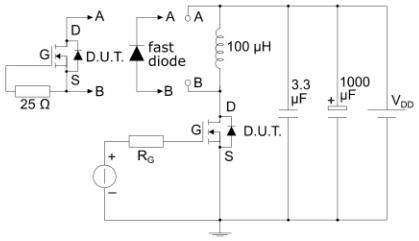



**Figure 16: Unclamped inductive load test circuit**

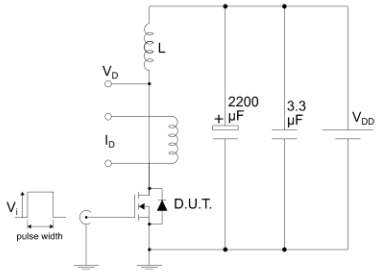



**Figure 17: Unclamped inductive waveform**

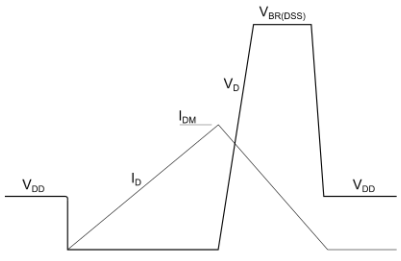
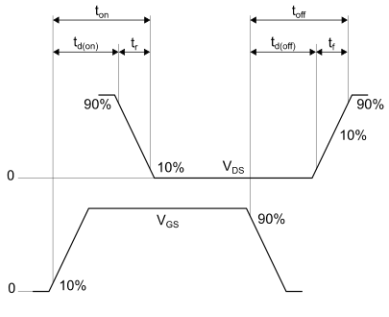



**Figure 18: Switching time waveform**



# 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) type A package information

**Figure 19: D²PAK (TO-263) type A package outline**

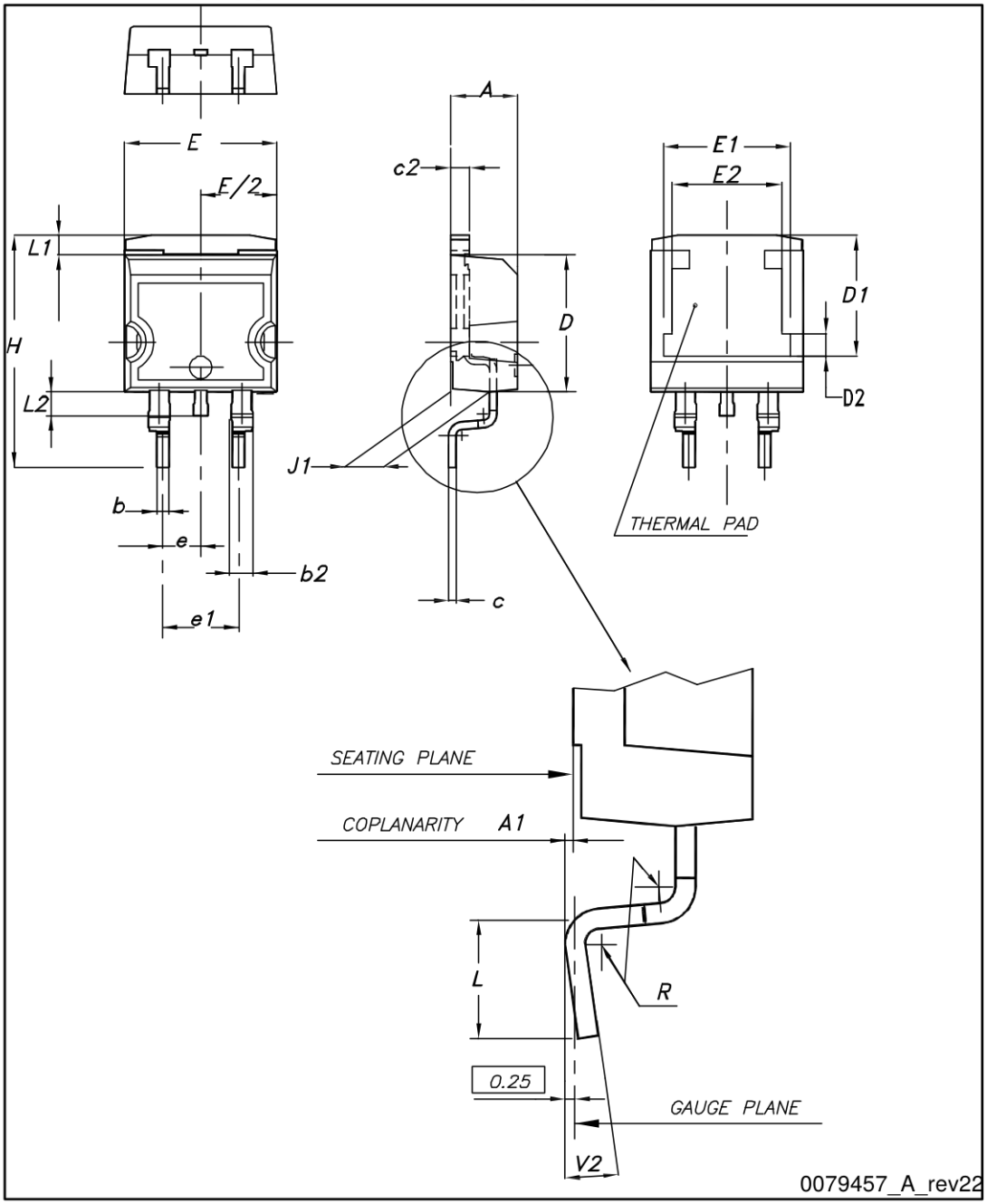
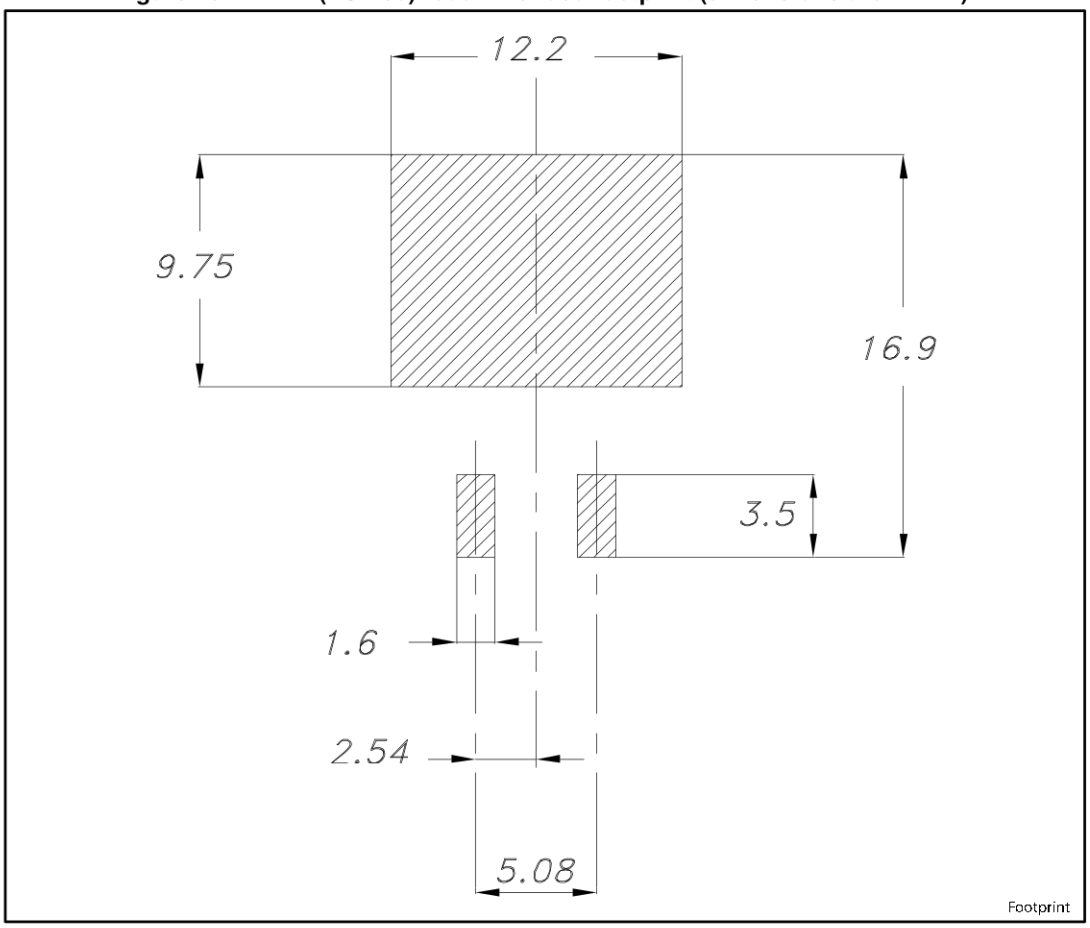


Table 9: D²PAK (TO-263) type A package mechanical data

| 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: D²PAK (TO-263) recommended footprint (dimensions are in mm)



## 4.2 D2PAK packaging information

**Figure 21: Tape outline**

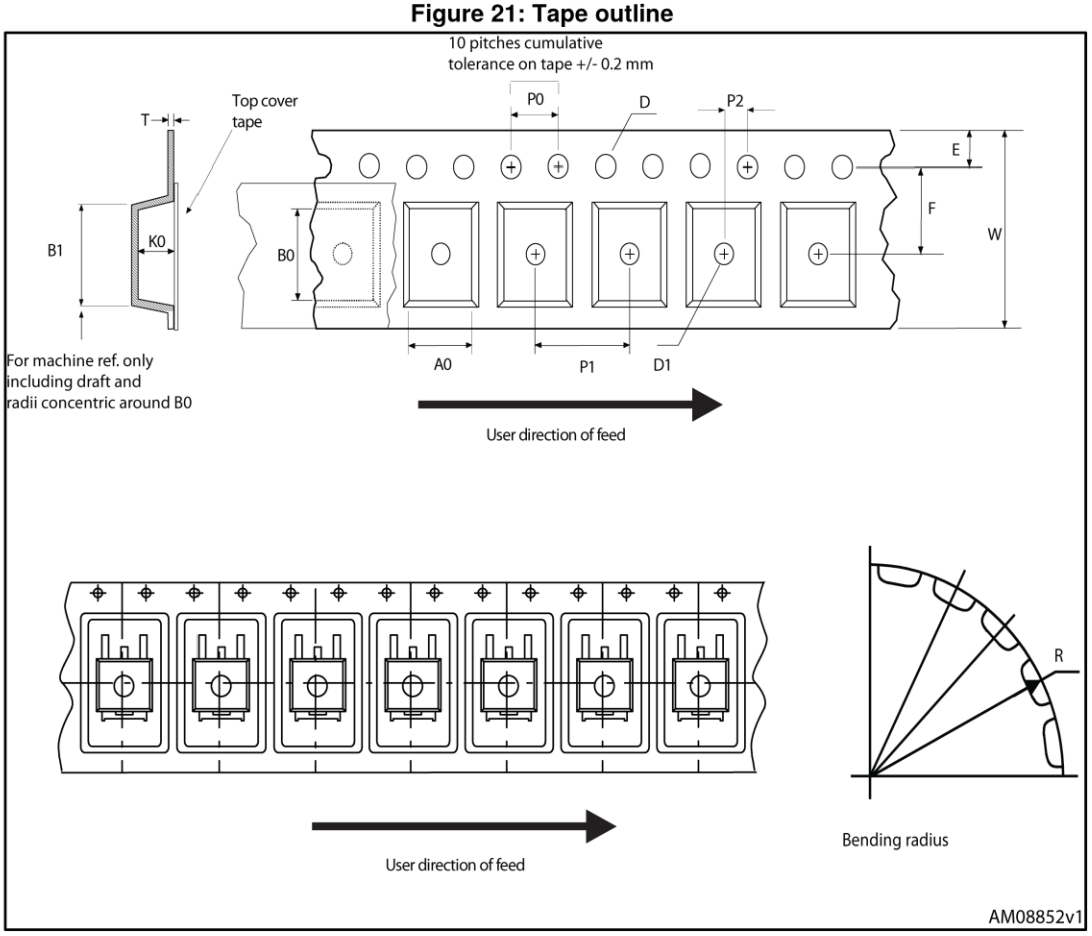


Figure 22: Reel outline

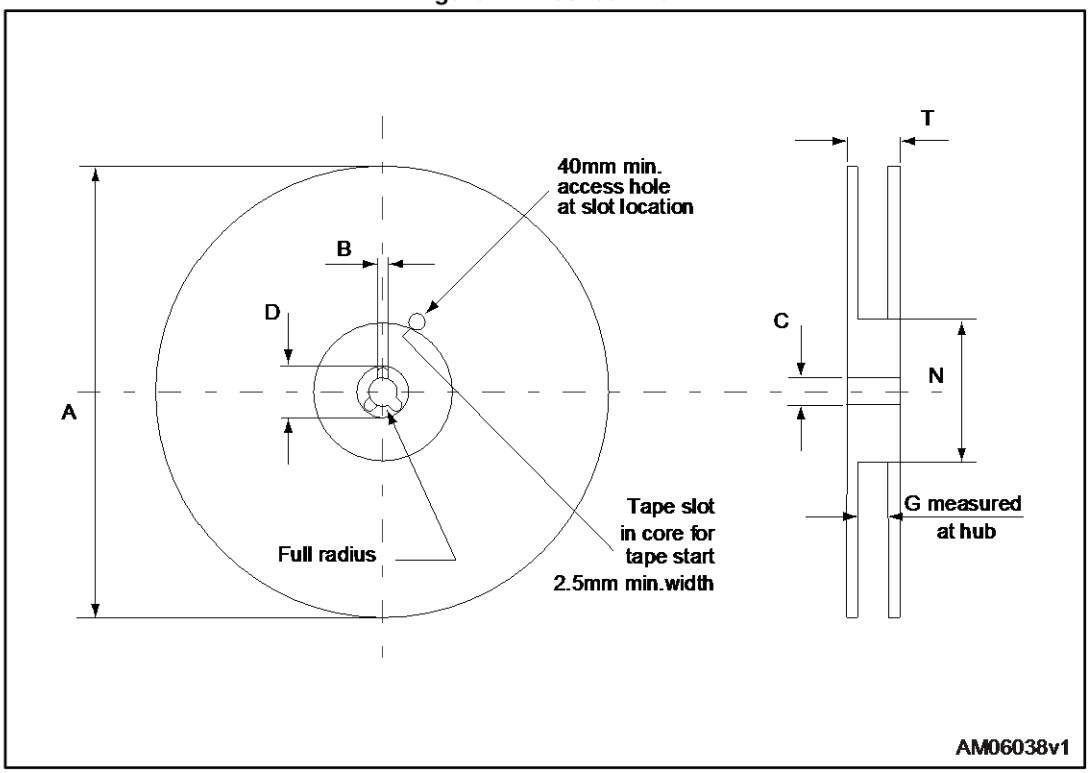



Table 10: D²PAK tape and reel mechanical data

| 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

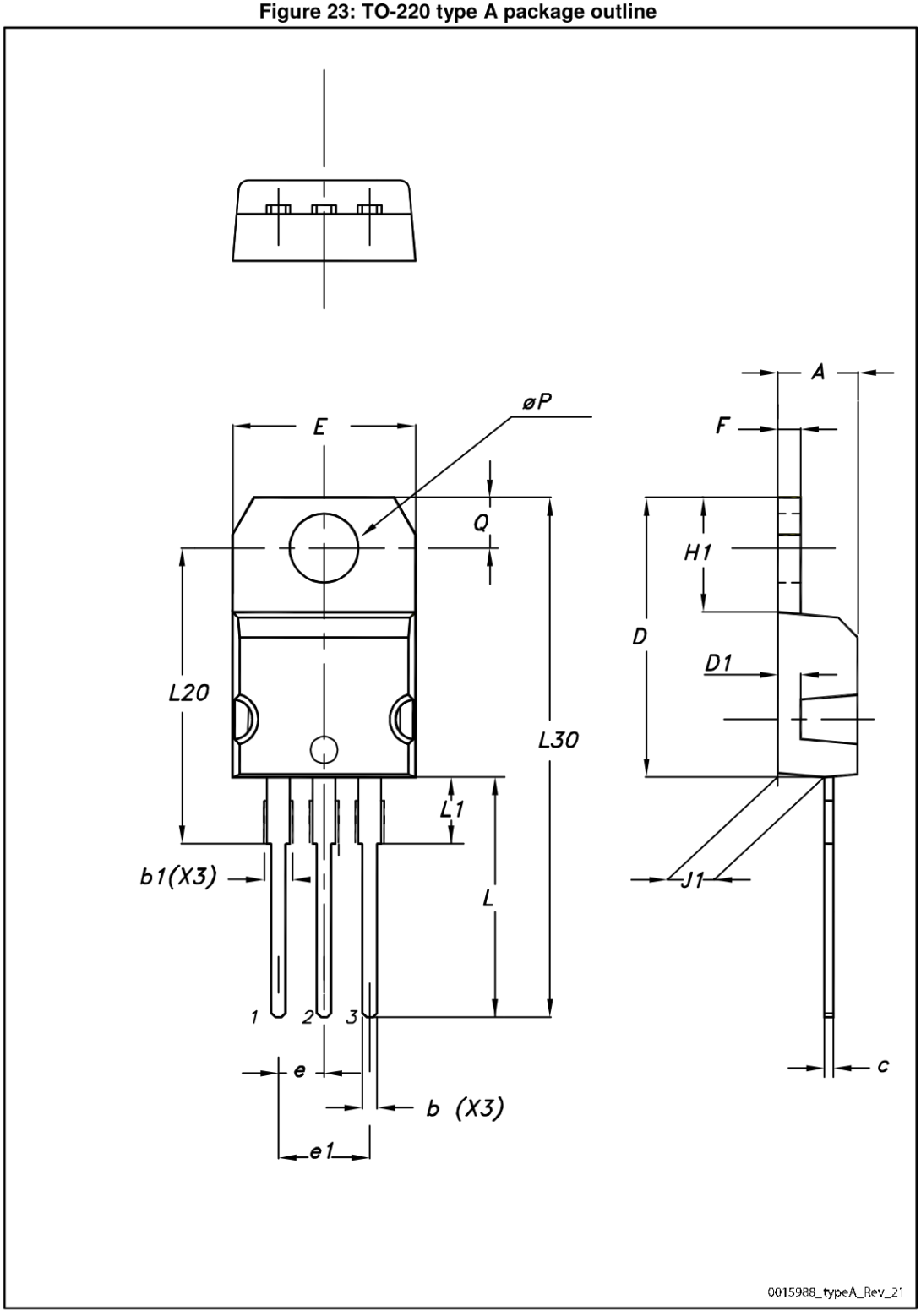


Table 11: TO-220 type A mechanical data

| 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: D²PAK |
| 20-Jun-2011 | 3 | Inserted device in I²PAK. |
| 13-Mar-2012 | 4 | Updated $P_{TOT}$ and derating factor in *Table 2*.<br>Update $R_{thj\text{-}case}$ for TO-220FP in *Table 3*.<br>Update *Figure 10* and *Figure 15*.<br>Update *Section 5: Packaging mechanical data*. |
| 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: $V_{GS}$ value in *Table 2*. |
| 12-Dec-2016 | 7 | The part number STF26NM60N has been moved to a separate datasheet.<br>Modified *Table 2: "Absolute maximum ratings"*, *Table 3: "Thermal data"*, *Table 5: "On/off states"*, *Table 6: "Dynamic"* and *Table 7: "Switching times"*.<br>Modified *Section 2.1: "Electrical characteristics (curves)"*.<br>Minor text changes. |

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