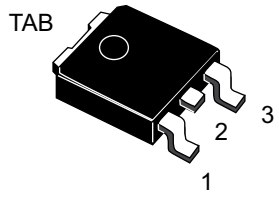
# STD86N3LH5

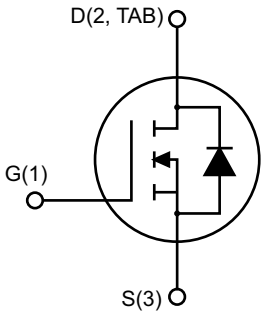
## Automotive-grade N-channel 30 V, 0.0045 Ω typ, 80 A STripFET H5 Power MOSFET in a DPAK package

**Datasheet - production data**




**DPAK**

**Figure 1. Internal schematic diagram**




## Features

| Order code | $V_{DSS}$ | $R_{DS(on)}$ max | $I_D$ |
|---|---|---|---|
| STD86N3LH5 | 30 V | < 0.005 Ω | 80 A |

- Designed for automotive applications and AEC-Q101 qualified
- Low on-resistance $R_{DS(on)}$
- High avalanche ruggedness
- Low gate drive power losses

## Application

- Switching applications

## Description

This device is an N-channel Power MOSFET developed using STMicroelectronics' STripFET™ H5 technology. The device has been optimized to achieve very low on-state resistance, contributing to a FoM that is among the best in its class.

**Table 1. Device summary**

| Order code | Marking | Package | Packaging |
|---|---|---|---|
| STD86N3LH5 | 86N3LH5 | DPAK | Tape and reel |



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 ($V_{GS}$ = 0 V) | 30 | V |
| $V_{DS}$ | Drain-source voltage ($V_{GS}$ = 0 V) @ $T_{JMAX}$ | 35 | V |
| $V_{GS}$ | Gate-source voltage | ± 20 | V |
| $I_D$ (1) | Drain current (continuous) at $T_C$ = 25 °C | 80 | A |
| $I_D$ | Drain current (continuous) at $T_C$ = 100 °C | 55 | A |
| $I_{DM}$ (2) | Drain current (pulsed) | 320 | A |
| $P_{TOT}$ | Total dissipation at $T_C$ = 25 °C | 70 | W |
| | Derating factor | 0.47 | W/°C |
| $E_{AS}$ (3) | Single pulse avalanche energy | 165 | mJ |
| $T_{stg}$ | Storage temperature | -55 to 175 | °C |
| $T_j$ | Max. operating junction temperature | 175 | °C |

1. Limited by wire bonding
2. Pulse width limited by safe operating area
3. Starting Tj = 25°C, $I_D$ = 40 A, $V_{DD}$ = 25 V

**Table 3. Thermal resistance**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{thj\text{-}case}$ | Thermal resistance junction-case max | 2.14 | °C/W |
| $R_{thj\text{-}pcb}$ (1) | Thermal resistance junction-pcb max | 50 | °C/W |

1. When mounted on 1 inch² FR-4 Oz Cu board

# 2 Electrical characteristics

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

**Table 4. Static**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-source breakdown Voltage | $I_D$ = 250 µA, $V_{GS}$= 0 V | 30 | - | - | V |
| $I_{DSS}$ | Zero gate voltage drain current ($V_{GS}$ = 0 V) | $V_{DS}$ = 20 V<br>$V_{DS}$ = 20 V,Tc = 125 °C | - | - | 1<br>10 | µA<br>µA |
| $I_{GSS}$ | Gate body leakage current ($V_{DS}$ = 0 V) | $V_{GS}$ = ± 20 V | - | - | ±100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | 1 | 1.8 | 2.5 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS}$ = 10 V, $I_D$ = 40 A | - | 0.0045 | 0.005 | Ω |
| | | $V_{GS}$ = 5 V, $I_D$ = 40 A | - | 0.0055 | 0.0065 | Ω |

**Table 5. Dynamic**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input capacitance | $V_{DS}$ = 25 V, f=1 MHz, $V_{GS}$ = 0 V | - | 1850 | - | pF |
| $C_{oss}$ | Output capacitance | | - | 380 | - | pF |
| $C_{rss}$ | Reverse transfer capacitance | | - | 58 | - | pF |
| $Q_g$ | Total gate charge | $V_{DD}$ = 15 V, $I_D$ = 80 A<br>$V_{GS}$ = 5 V<br>*Figure 16* | - | 14 | - | nC |
| $Q_{gs}$ | Gate-source charge | | - | 6.8 | - | nC |
| $Q_{gd}$ | Gate-drain charge | | - | 4.7 | - | nC |
| $Q_{gs1}$ | Pre $V_{th}$ gate-to-source charge | $V_{DD}$ = 15 V, $I_D$ = 80 A<br>$V_{GS}$ = 5 V<br>*Figure 16* | - | 2.3 | - | nC |
| $Q_{gs2}$ | Post $V_{th}$ gate-to-source charge | | - | 4.5 | - | nC |
| $R_G$ | Gate input resistance | f = 1 MHz gate bias<br>Bias = 0 test signal<br>level = 20 mV, open drain | - | 1.2 | - | Ω |

**Table 6. Switching on/off (inductive load)**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD}$ = 15 V, $I_D$ = 40 A, $R_G$ = 4.7 Ω, $V_{GS}$ = 5 V *Figure 15* | - | 6 | - | ns |
| $t_r$ | Rise time | | - | 14 | - | ns |
| $t_{d(off)}$ | Turn-off delay time | | - | 23.6 | - | ns |
| $t_f$ | Fall time | | - | 10.8 | - | ns |

**Table 7. Source drain diode**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{SD}$<br>$I_{SDM}$(1) | Source-drain current<br>Source-drain current (pulsed) | | - | | 80<br>320 | A<br>A |
| $V_{SD}$(2) | Forward on voltage | $I_{SD}$ = 40 A, $V_{GS}$ = 0 | - | | 1.1 | V |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 80 A, di/dt = 100 A/µs, $V_{DD}$ = 20 V *Figure 17* | - | 31.8 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 26.1 | | nC |
| $I_{RRM}$ | Reverse recovery current | | - | 1.6 | | 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 2. Safe operating area**

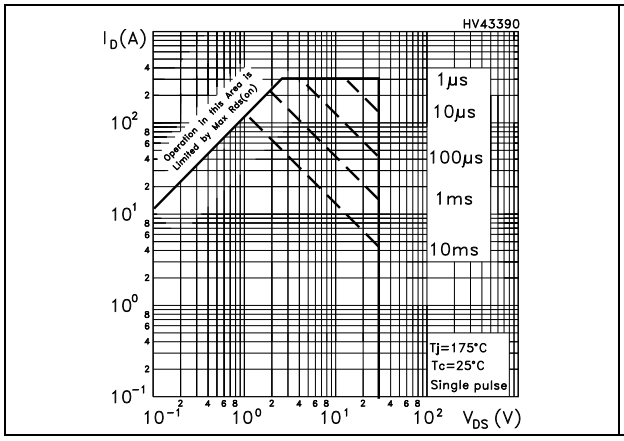



**Figure 3. Thermal impedance**

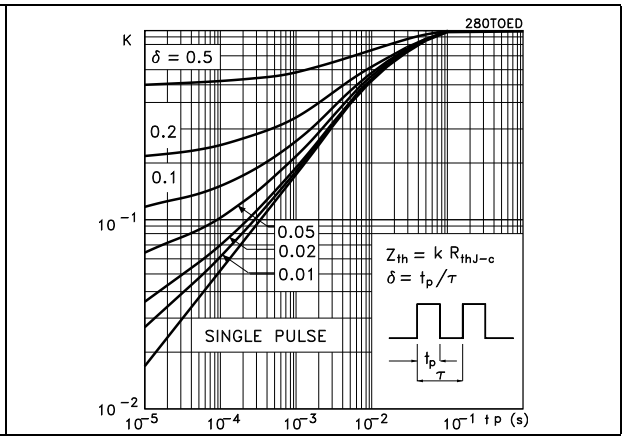



**Figure 4. Output characteristics**

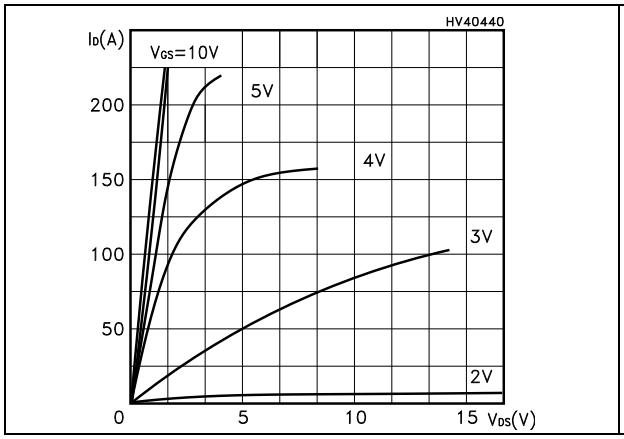



**Figure 5. Transfer characteristics**

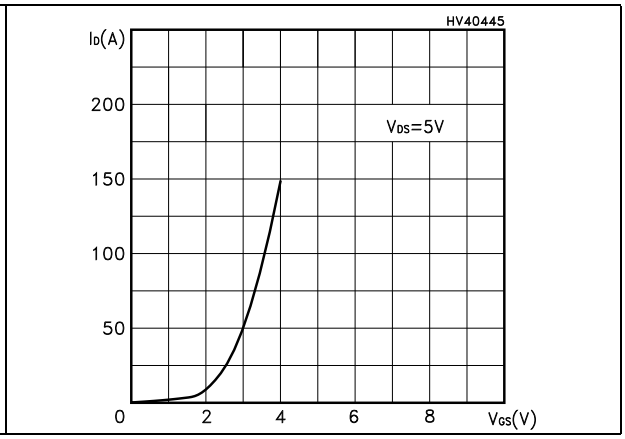



**Figure 6. Normalized $B_{VDSS}$ vs temperature**

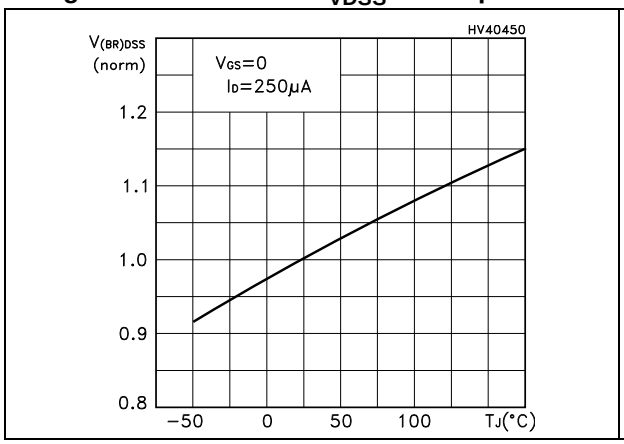



**Figure 7. Static drain-source on resistance**

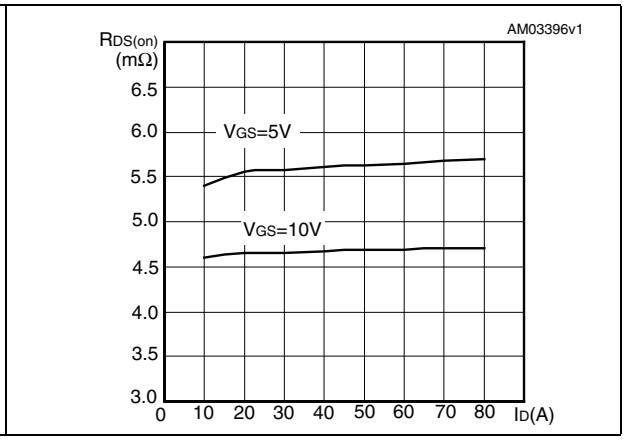


**Figure 8. Gate charge vs gate-source voltage**

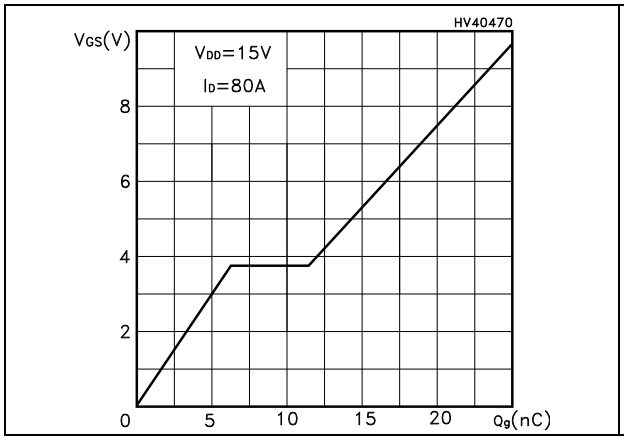



**Figure 9. Capacitance variations**

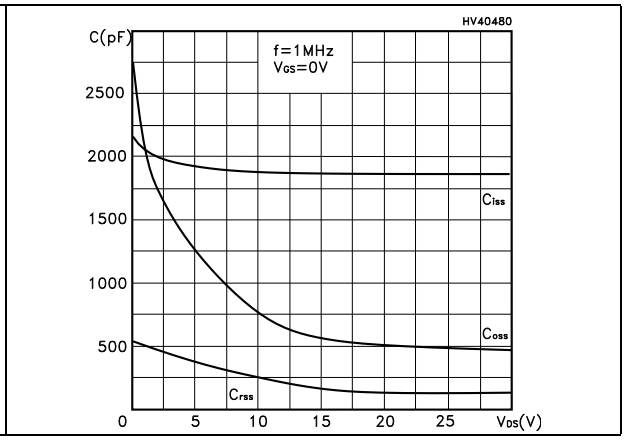



**Figure 10. Normalized gate threshold voltage vs temperature**

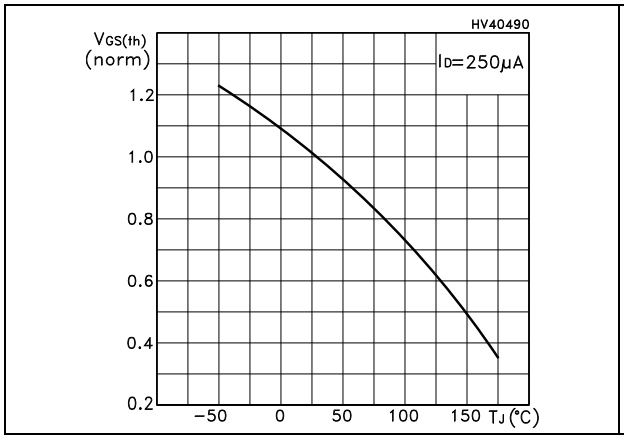



**Figure 11. Normalized on resistance vs temperature**

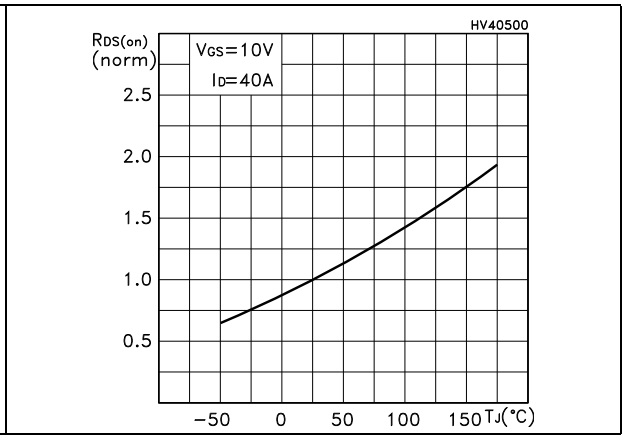
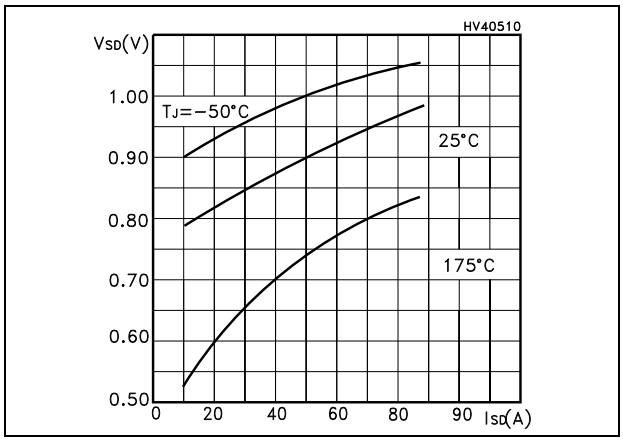



**Figure 12. Source-drain diode forward characteristics**



# 3 Test circuit

**Figure 13. Switching times test circuit for resistive load**

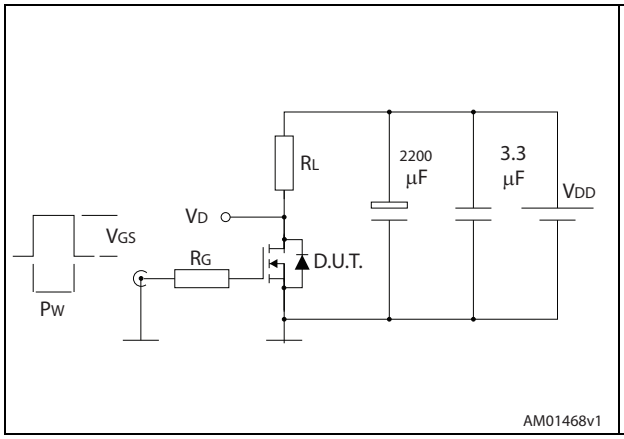



**Figure 14. Gate charge test circuit**

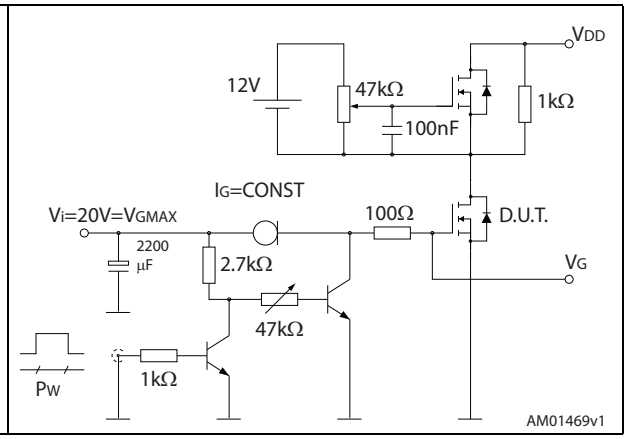



**Figure 15. Test circuit for inductive load switching and diode recovery times**

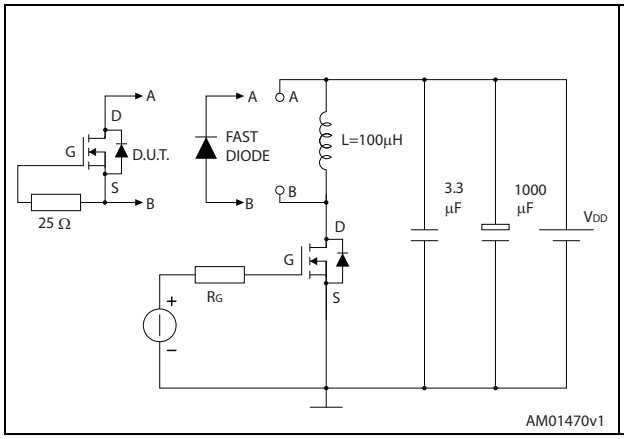



**Figure 16. Unclamped inductive load test circuit**

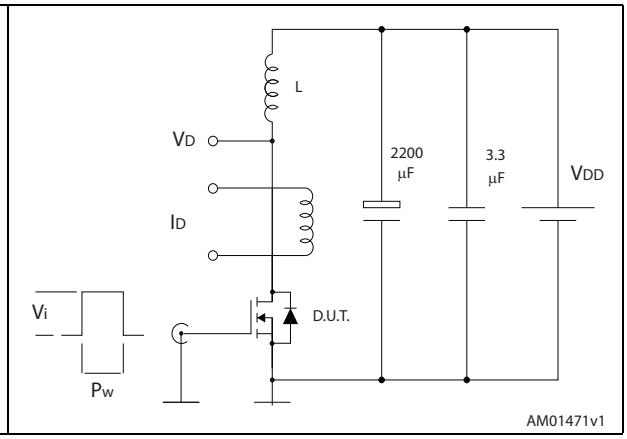



**Figure 17. Unclamped inductive waveform**

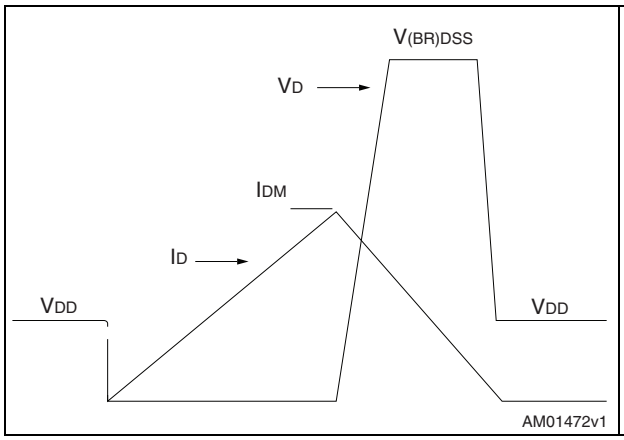



**Figure 18. Switching time waveform**

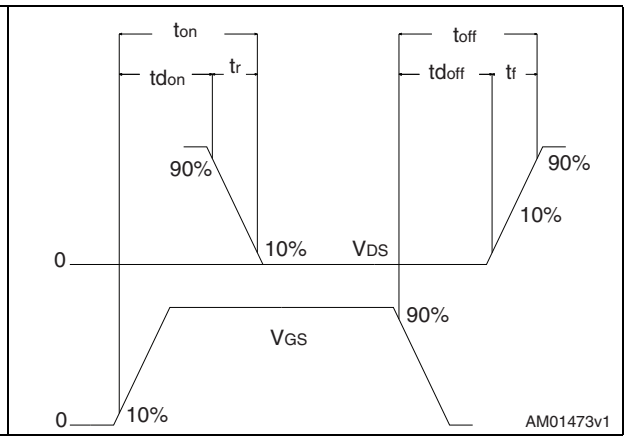
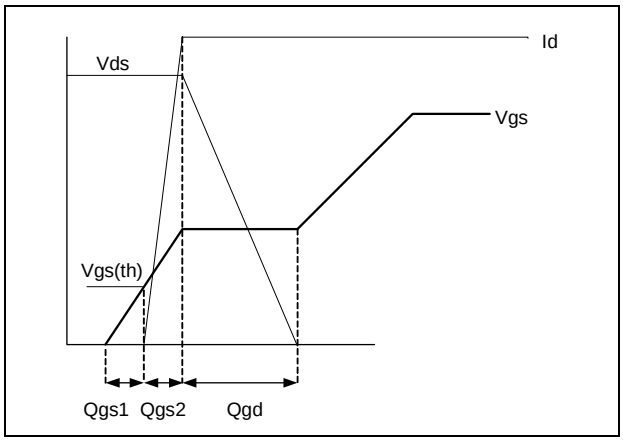


**Figure 19. Gate charge waveform**



# 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.

Figure 20. DPAK (TO-252) type A2 outline

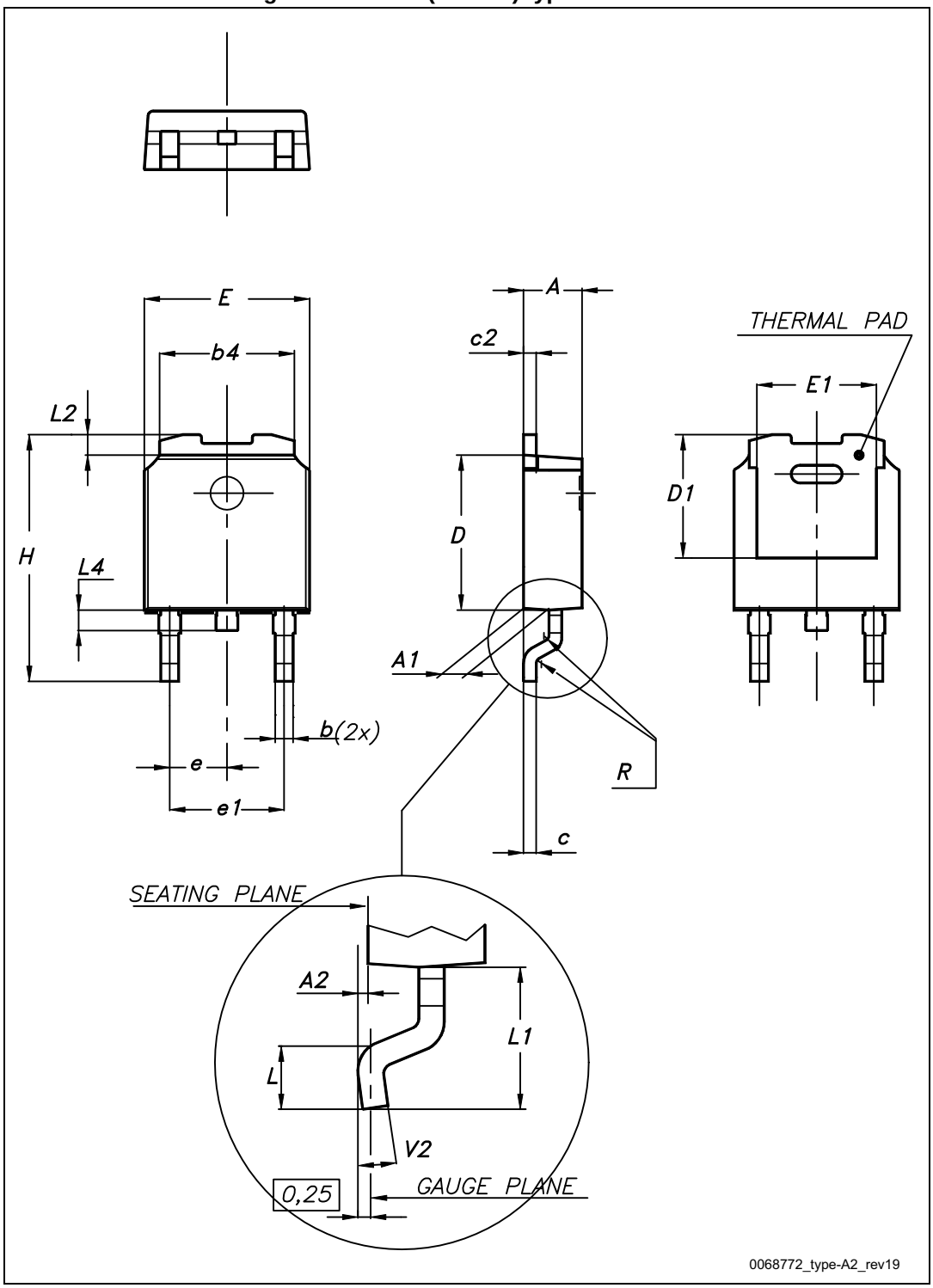
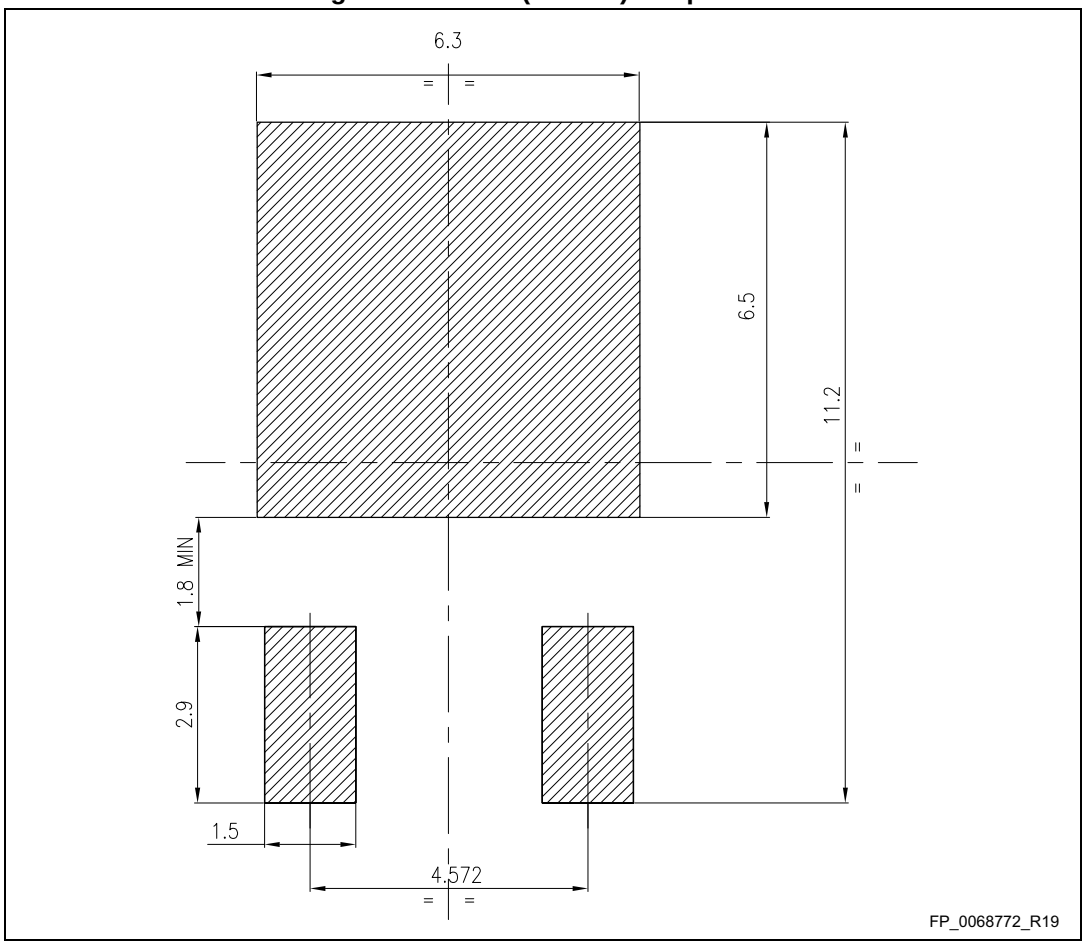


Table 8. DPAK (TO-252) type A2 mechanical data

| 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 | 5.10 | 5.20 | 5.30 |
| 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° |

**Figure 21. DPAK (TO-252) footprint [(a)]**




a. All dimensions are in millimeters

# 5 Packing information

**Figure 22. Tape for DPAK (TO-252)**

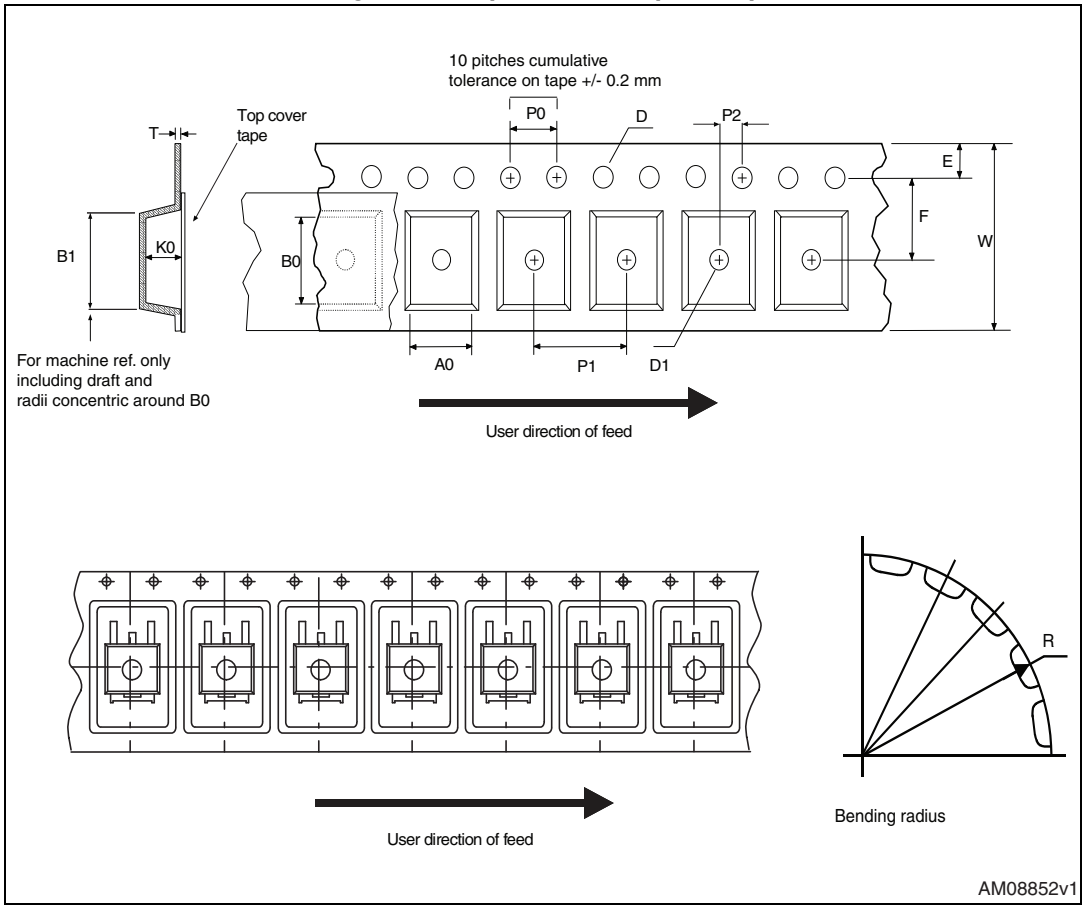


**Figure 23. Reel for DPAK (TO-252)**

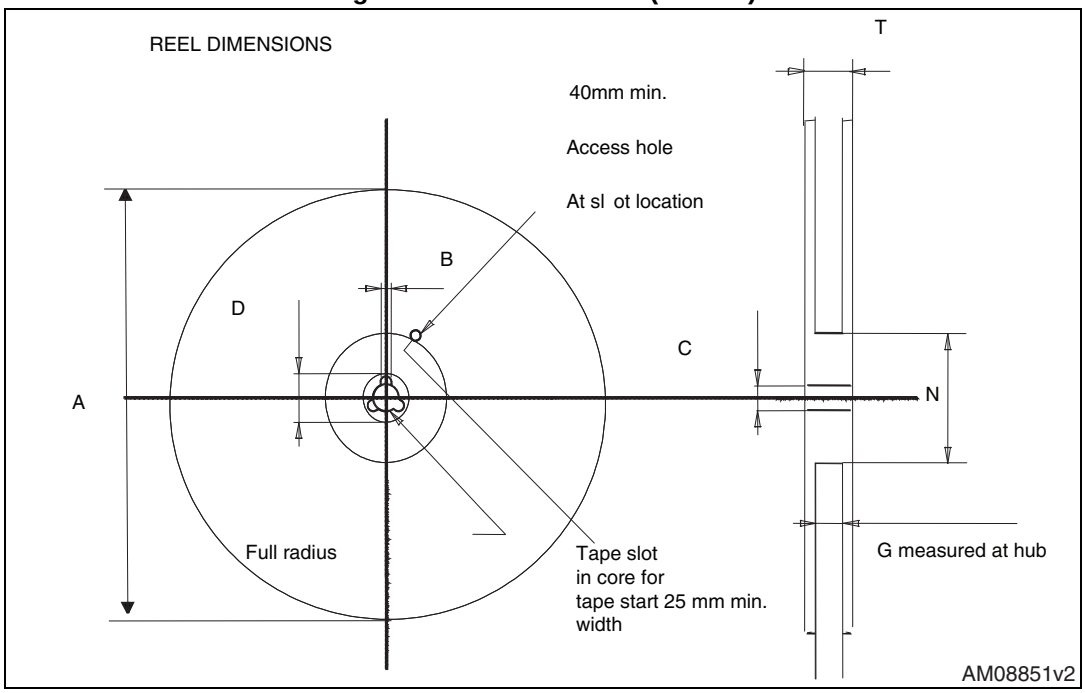



**Table 9. DPAK (TO-252) tape and reel mechanical data**

| 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 10. Document revision history

| Date | Revision | Changes |
|---|---|---|
| 10-Apr-2009 | 1 | First release. |
| 22-Mar-2011 | 2 | $V_{GS}$ value has been corrected in *Table 2* and *Table 4*. |
| 13-May-2015 | 3 | Updated title, features and description in cover page.<br>Updated *Section 4: Package information*. |

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