# STD2N105K5, STP2N105K5, STU2N105K5

## N-channel 1050 V, 6 Ω typ., 1.5 A MDmesh™ K5 Power MOSFETs in DPAK, TO-220 and IPAK packages

**Datasheet - production data**

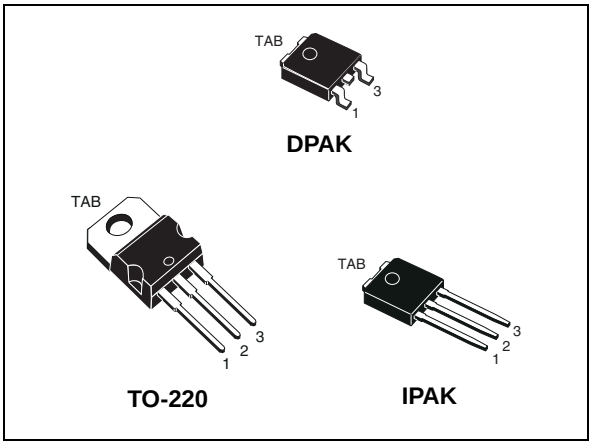
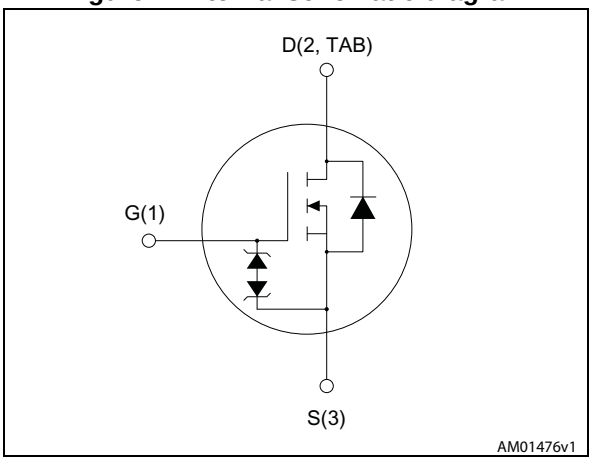



**Figure 1. Internal schematic diagram**




## Features

| Order codes | $V_{DS}$ | $R_{DS(on)}$ max | $I_D$ | $P_{TOT}$ |
|---|---|---|---|---|
| STD2N105K5 | 1050 V | 8 Ω | 1.5 A | 60 W |
| STP2N105K5 | | | | |
| STU2N105K5 | | | | |

- Industry's lowest $R_{DS(on)}$ x area
- Industry's best figure of merit (FoM)
- Ultra low gate charge
- 100% avalanche tested
- Zener-protected

## Applications

- Switching applications

## Description

These very high voltage N-channel Power MOSFETs are designed using MDmesh™ K5 technology based on an innovative proprietary vertical structure. The result is a dramatic reduction in on-resistance and ultra-low gate charge for applications requiring superior power density and high efficiency.

**Table 1. Device summary**

| Order codes | Marking | Package | Packaging |
|---|---|---|---|
| STD2N105K5 | 2N105K5 | DPAK | Tape and reel |
| STP2N105K5 | | TO-220 | Tube |
| STU2N105K5 | | IPAK | |

# Contents

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{GS}$ | Gate- source voltage | ±30 | V |
| $I_D$ | Drain current (continuous) at $T_C$ = 25 °C | 1.5 | A |
| $I_D$ | Drain current (continuous) at $T_C$ = 100 °C | 0.95 | A |
| $I_{DM}$ (1) | Drain current (pulsed) | 6 | A |
| $P_{TOT}$ | Total dissipation at $T_C$ = 25 °C | 60 | W |
| $I_{AR}$ | Max current during repetitive or single pulse avalanche | 0.5 | A |
| $E_{AS}$ | Single pulse avalanche energy (starting $T_J$ = 25 °C, $I_D$=0.5 A, $V_{DD}$= 50 V) | 90 | mJ |
| dv/dt (2) | Peak diode recovery voltage slope | 4.5 | V/ns |
| dv/dt(3) | MOSFET dv/dt ruggedness | 50 | V/ns |
| $T_j$<br>$T_{stg}$ | Operating junction temperature<br>Storage temperature | -55 to 150 | °C |

1. Pulse width limited by safe operating area.
2. $I_{SD} \leq 1.5$ A, di/dt $\leq$ 100 A/µs, $V_{DS(peak)} \leq V_{(BR)DSS}$.
3. $V_{DS} \leq 840$ V

**Table 3. Thermal data**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{thj\text{-}case}$ | Thermal resistance junction-case max | 2.08 | °C/W |
| $R_{thj\text{-}amb}$ | Thermal resistance junction-ambient max | 62.50 | °C/W |

# 2 Electrical characteristics

(Tcase =25 °C unless otherwise specified)

**Table 4. 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 | 1050 | | | V |
| $I_{DSS}$ | Zero gate voltage, drain current ($V_{GS}$ = 0) | $V_{DS}$ = 1050 V | | | 1 | µA |
| | | $V_{DS}$ = 1050 V, $T_C$=125 °C | | | 50 | µA |
| $I_{GSS}$ | Gate-body leakage current | $V_{GS}$ = ± 20 V; $V_{DS}$=0 | | | ±10 | µA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 100 µA | 3 | 4 | 5 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS}$ = 10 V, $I_D$ = 0.75 A | | 6 | 8 | Ω |

**Table 5. Dynamic**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input capacitance | $V_{DS}$ =100 V, f=1 MHz, $V_{GS}$=0 | - | 115 | - | pF |
| $C_{oss}$ | Output capacitance | | - | 15 | - | pF |
| $C_{rss}$ | Reverse transfer capacitance | | - | 0.5 | - | pF |
| $C_{o(tr)}$(1) | Equivalent capacitance time related | $V_{GS}$ = 0, $V_{DS}$ = 0 to 840 V | - | 17 | - | pF |
| $C_{o(er)}$(2) | Equivalent capacitance energy related | | - | 6 | - | pF |
| $R_G$ | Intrinsic gate resistance | f = 1 MHz open drain | - | 20 | - | Ω |
| $Q_g$ | Total gate charge | $V_{DD}$ = 840 V, $I_D$ = 1.5 A $V_{GS}$ =10 V *(see Figure 18)* | - | 10 | - | nC |
| $Q_{gs}$ | Gate-source charge | | - | 1.5 | - | nC |
| $Q_{gd}$ | Gate-drain charge | | - | 8 | - | nC |

1. Time related is defined as a constant equivalent capacitance giving the same charging time as $C_{oss}$ when $V_{DS}$ increases from 0 to 80% $V_{DSS}$
2. energy related is defined as a constant equivalent capacitance giving the same stored energy 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 | $V_{DD}$ = 525 V, $I_D$ = 0.75 A, $R_G$ = 4.7 Ω, $V_{GS}$ = 10 V *(see Figure 17)* | - | 14.5 | - | ns |
| $t_r$ | Rise time | | - | 8.5 | - | ns |
| $t_{d(off)}$ | Turn-off-delay time | | - | 35 | - | ns |
| $t_f$ | Fall time | | - | 38.5 | - | ns |

**Table 7. Source drain diode**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| $I_{SD}$ | Source-drain current | | - | | 1.5 | A |
| $I_{SDM}$ (1) | Source-drain current (pulsed) | | - | | 6 | A |
| $V_{SD}$ (2) | Forward on voltage | $I_{SD}$ = 1.5 A, $V_{GS}$ = 0 | - | | 1.5 | V |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 1.5 A, di/dt = 100 A/µs $V_{DD}$= 60 V *(see Figure 19)* | - | 326 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 1.19 | | µC |
| $I_{RRM}$ | Reverse recovery current | | - | 7.3 | | A |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 1.5 A, di/dt = 100 A/µs $V_{DD}$= 60 V $T_J$ = 150 °C *(see Figure 19)* | - | 525 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 1.83 | | µC |
| $I_{RRM}$ | Reverse recovery current | | - | 7 | | A |

1. Pulse width limited by safe operating area
2. Pulsed: pulse duration = 300 µs, 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 | $I_{GS}$ = ± 1mA, $I_D$=0 | 30 | - | - | V |

The built-in back-to-back Zener diodes have specifically been designed to enhance the device's ESD capability. In this respect the Zener voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components.

## 2.1 Electrical characteristics (curves)

**Figure 2. Safe operating area for DPAK and IPAK**

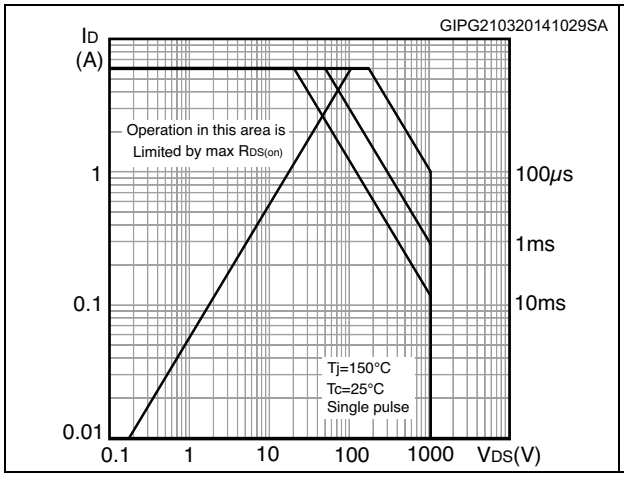



**Figure 3. Thermal impedance for DPAK and IPAK**

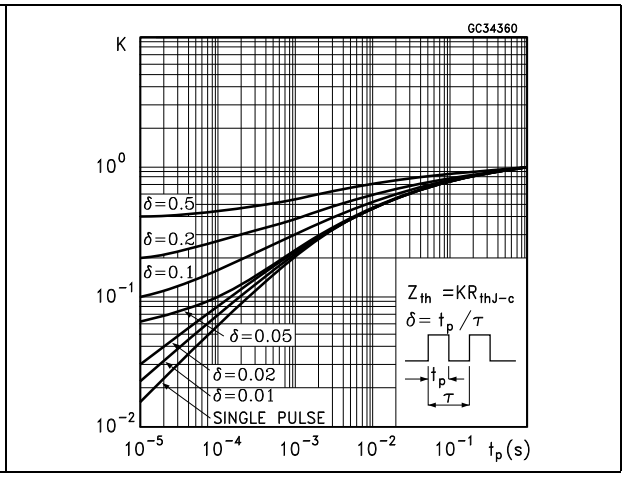



**Figure 4. Safe operating area for TO-220**

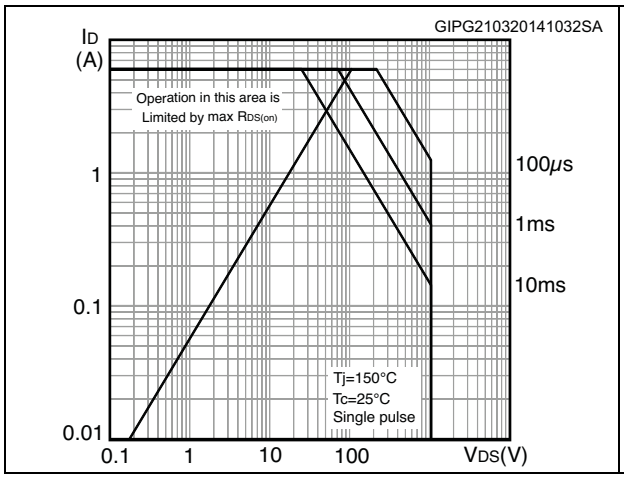



**Figure 5. Thermal impedance for TO-220**

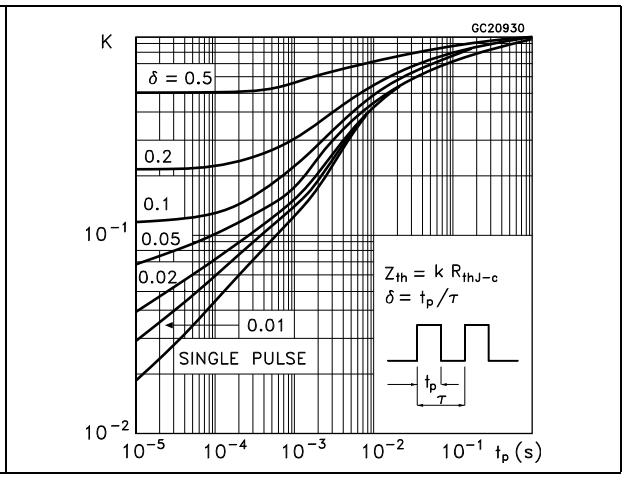



**Figure 6. Output characteristics**

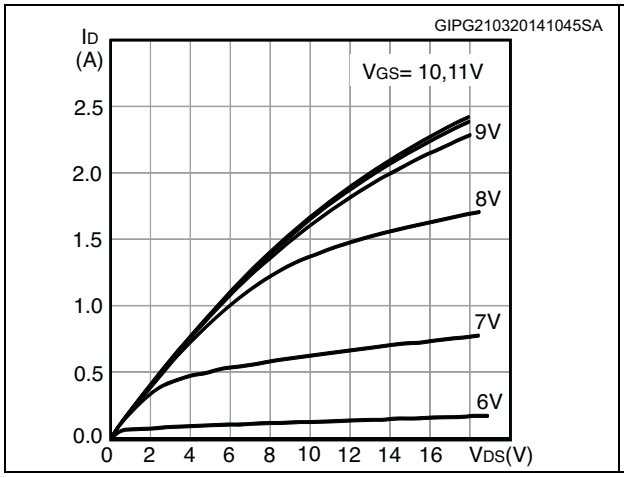



**Figure 7. Transfer characteristics**

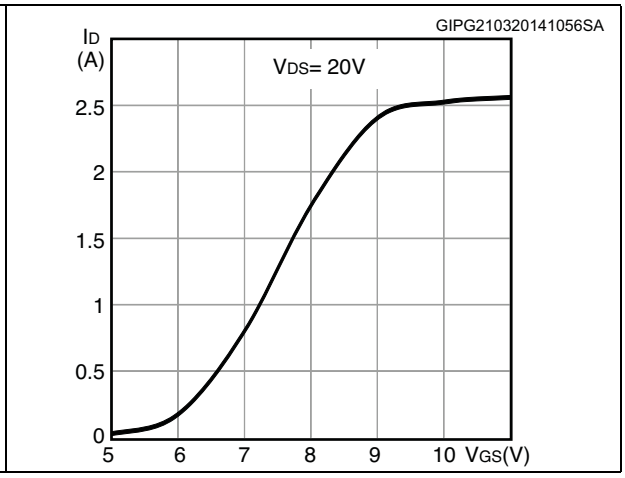


**Figure 8. Gate charge vs gate-source voltage**

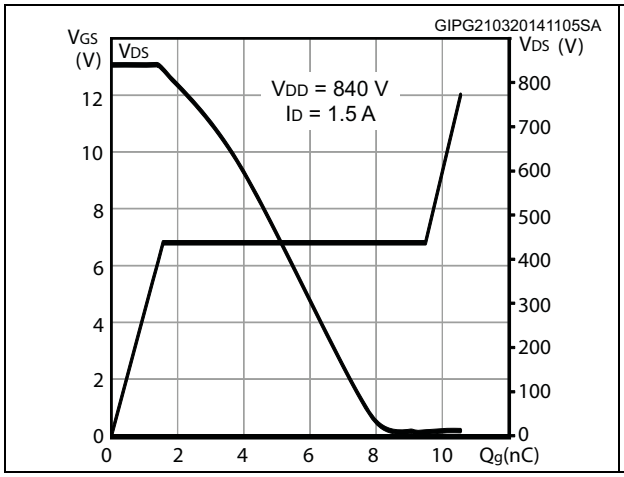



**Figure 9. Static drain-source on-resistance**

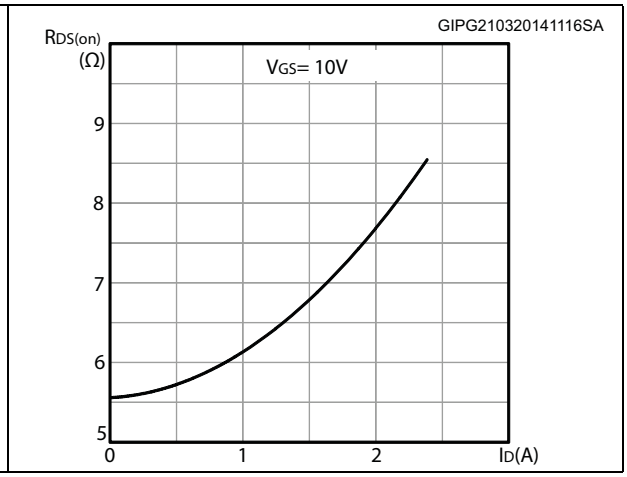



**Figure 10. Capacitance variations**

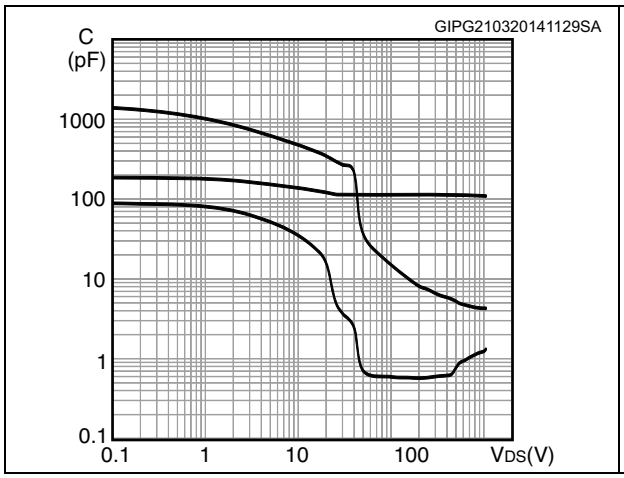



**Figure 11. Output capacitance stored energy**

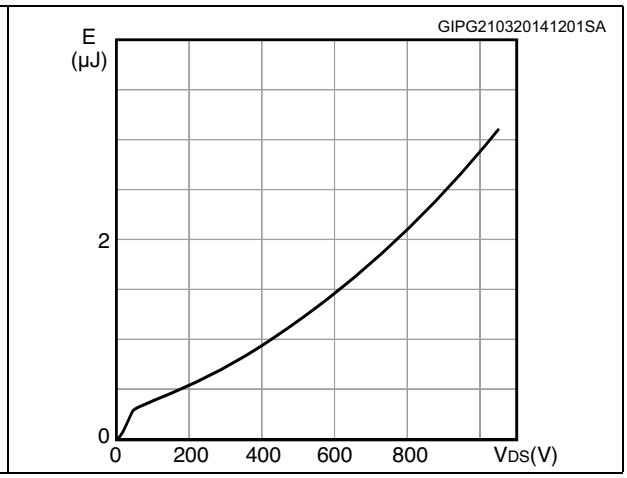



**Figure 12. Normalized gate threshold voltage vs temperature**

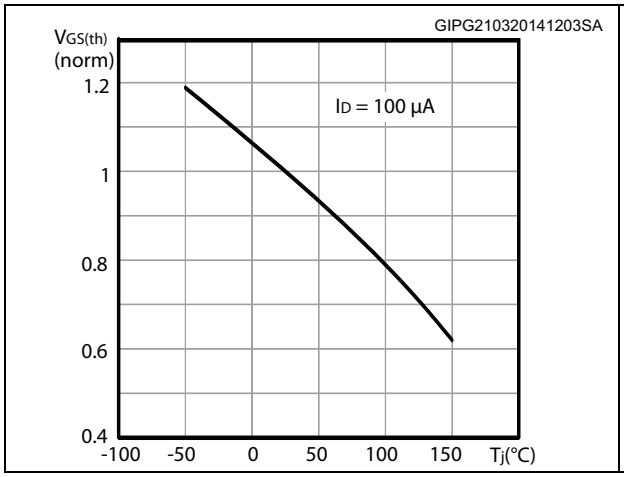



**Figure 13. Normalized on-resistance vs temperature**

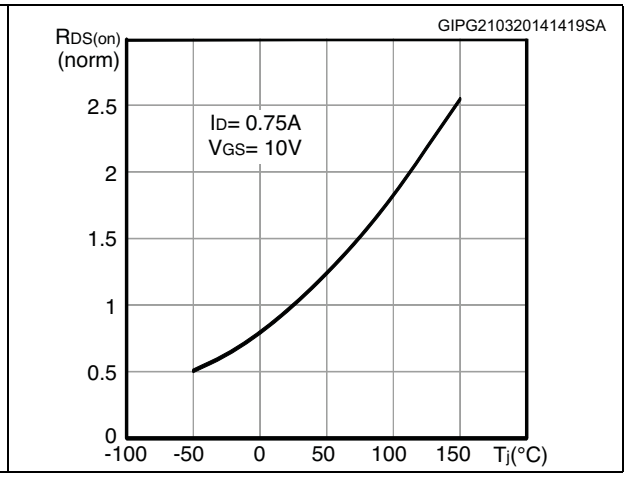


**Figure 14. Source-drain diode forward characteristics**

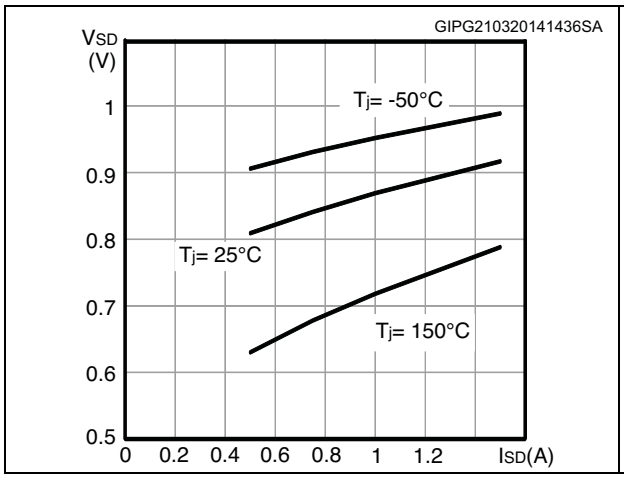



**Figure 15. Normalized $V_{(BR)DSS}$ vs temperature**

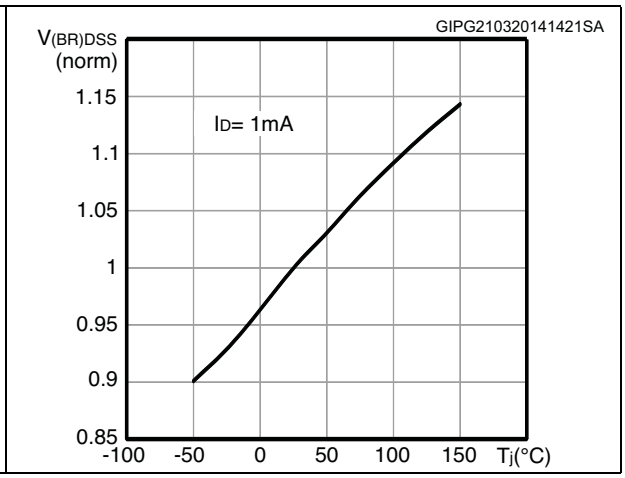
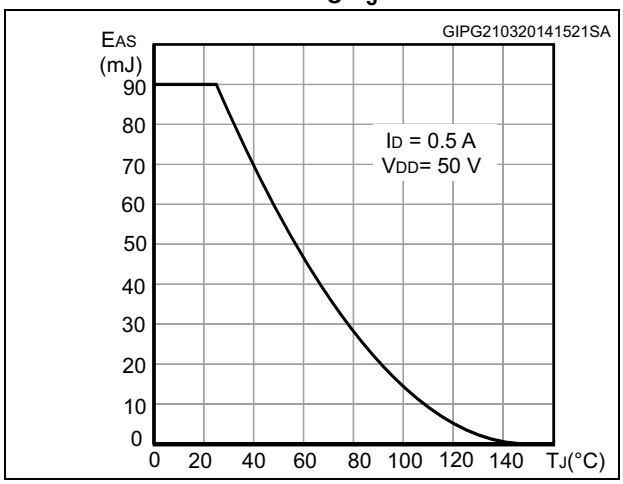



**Figure 16.Maximum avalanche energy vs starting $T_J$**



# 3 Test circuits

**Figure 17. Switching times test circuit for resistive load**

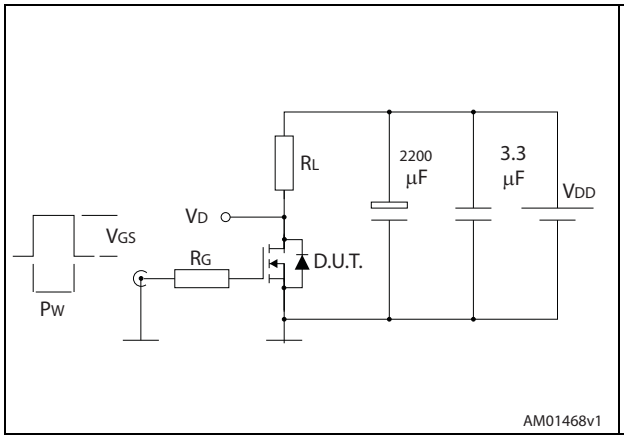



**Figure 18. Gate charge test circuit**

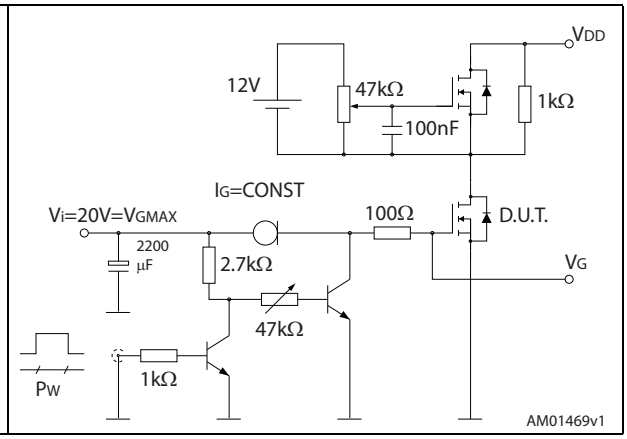



**Figure 19. Test circuit for inductive load switching and diode recovery times**

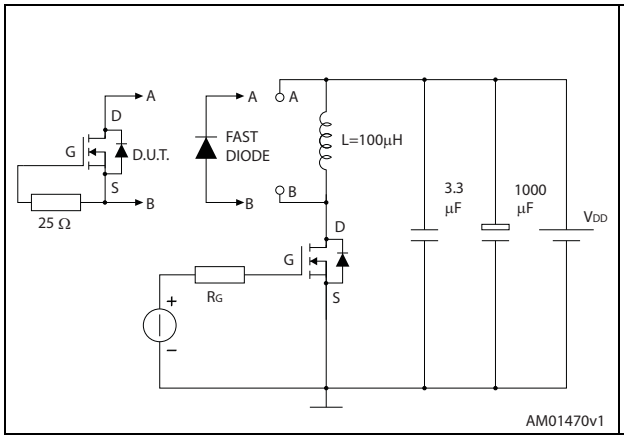



**Figure 20. Unclamped inductive load test circuit**

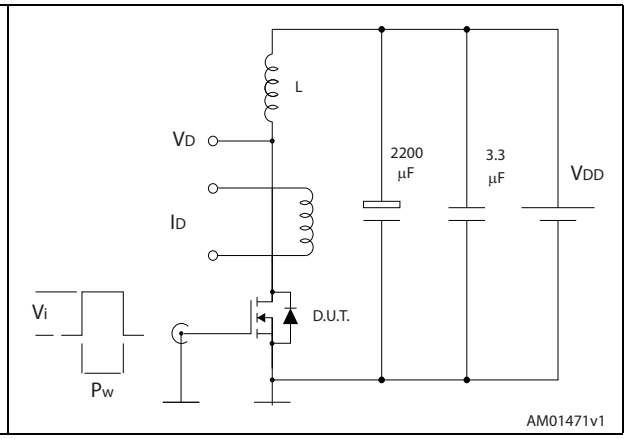



**Figure 21. Unclamped inductive waveform**

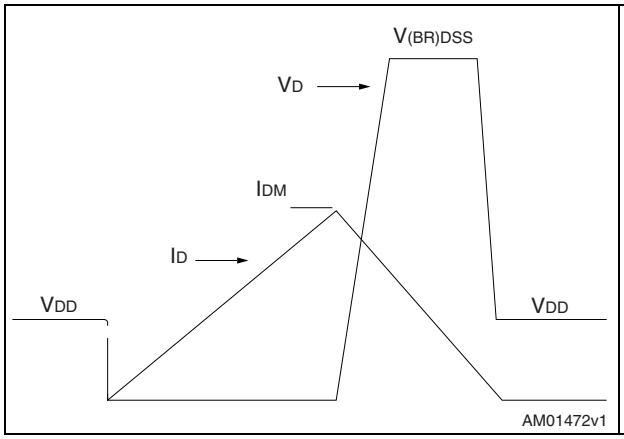
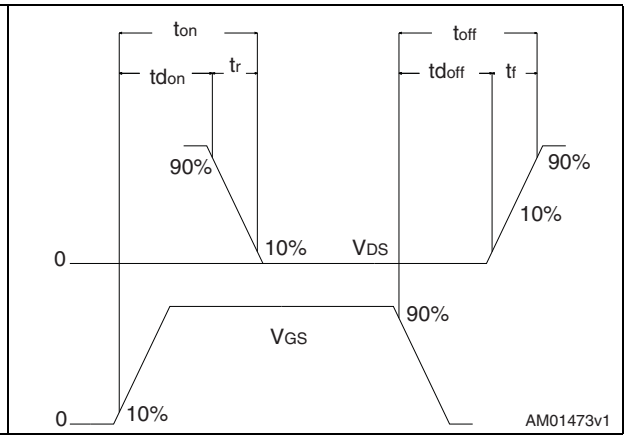



**Figure 22. Switching time waveform**



# 4 Package mechanical data

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 DPAK, STD2N105K5

**Figure 23. DPAK (TO-252) type A drawing**

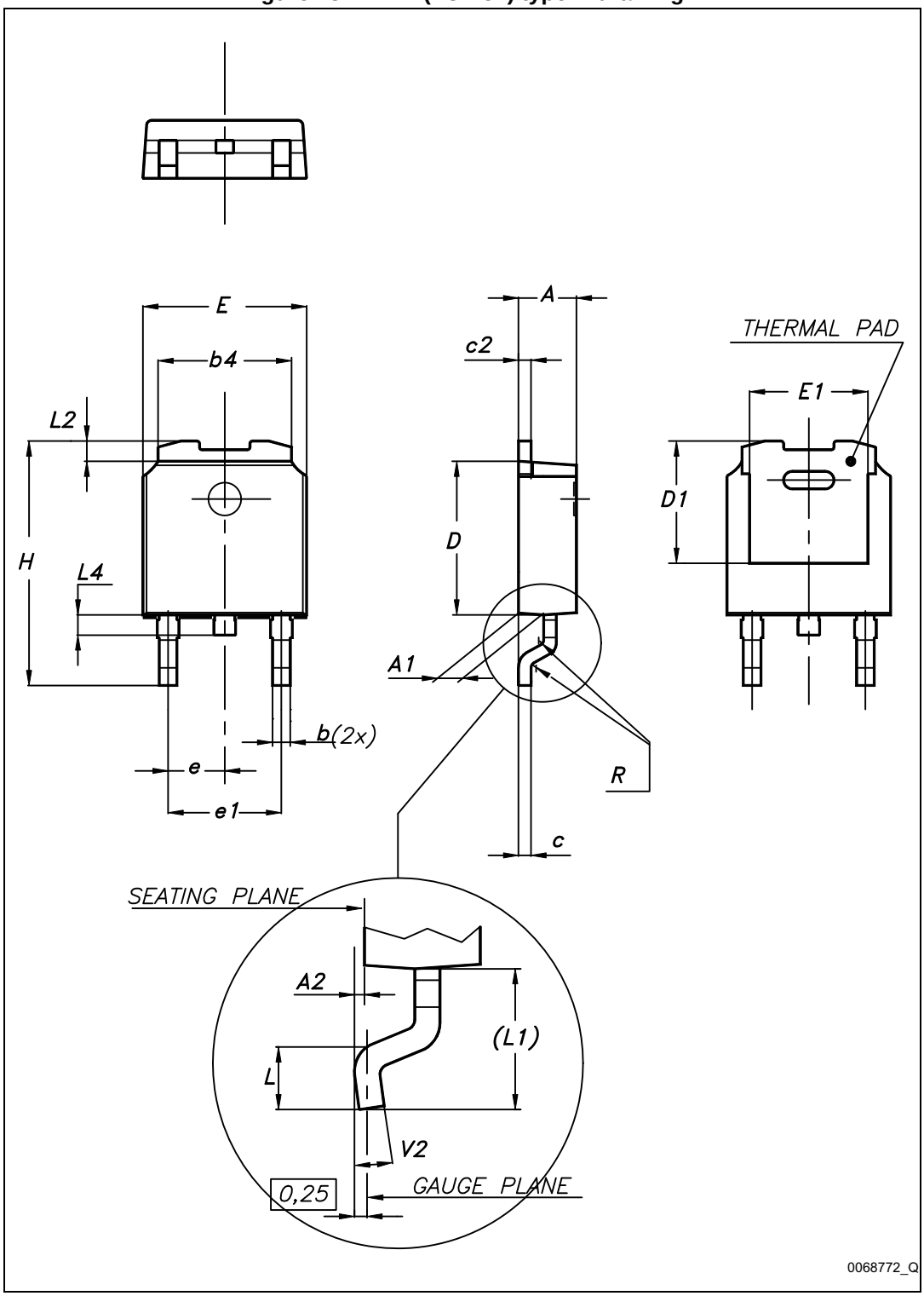
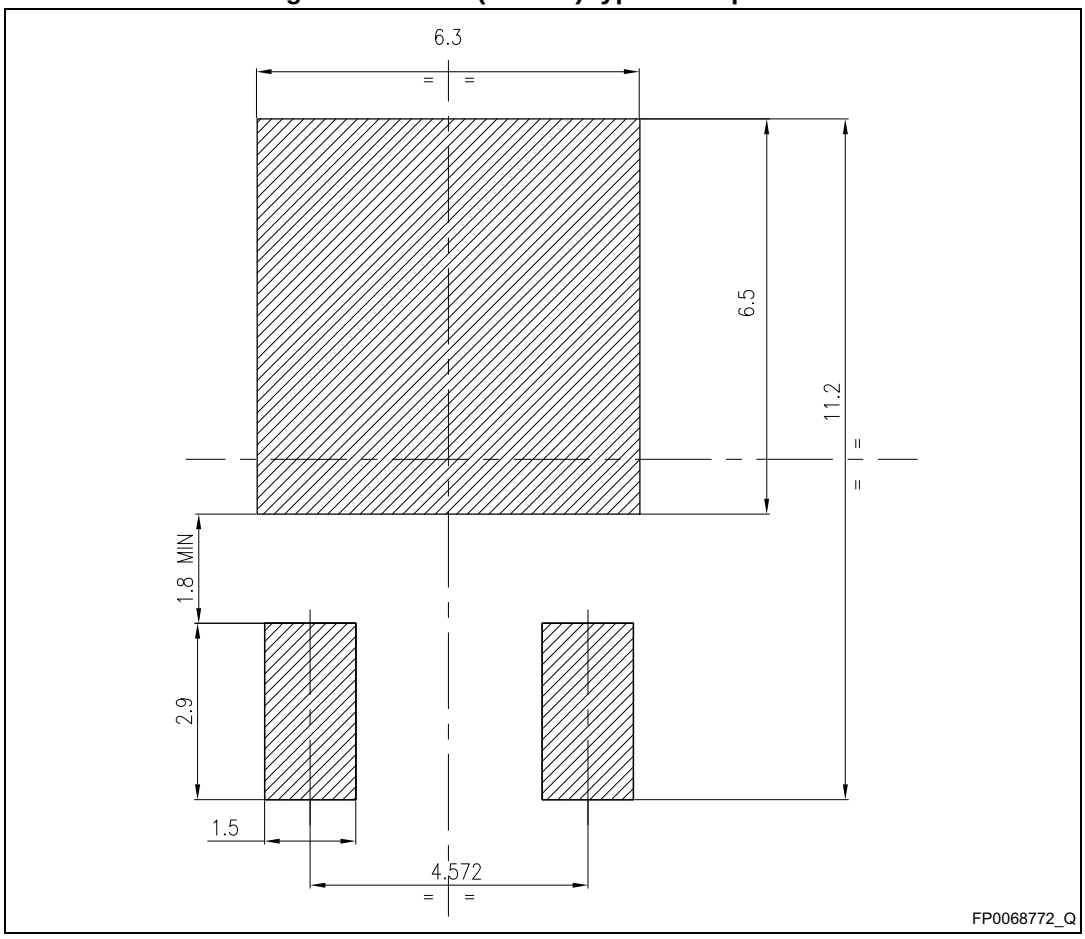


Table 9. DPAK (TO-252) type A mechanical data

| 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 | | 5.10 | |
| E | 6.40 | | 6.60 |
| E1 | | 4.70 | |
| e | | 2.28 | |
| e1 | 4.40 | | 4.60 |
| H | 9.35 | | 10.10 |
| L | 1.00 | | 1.50 |
| L1 | | 2.80 | |
| L2 | | 0.80 | |
| L4 | 0.60 | | 1.00 |
| R | | 0.20 | |
| V2 | 0° | | 8° |

**Figure 24. DPAK (TO-252) type A footprint [(a)]**




a. All dimensions are in millimeters

## 4.2 TO-220, STP2N105K5

**Figure 25. TO-220 type A drawing**

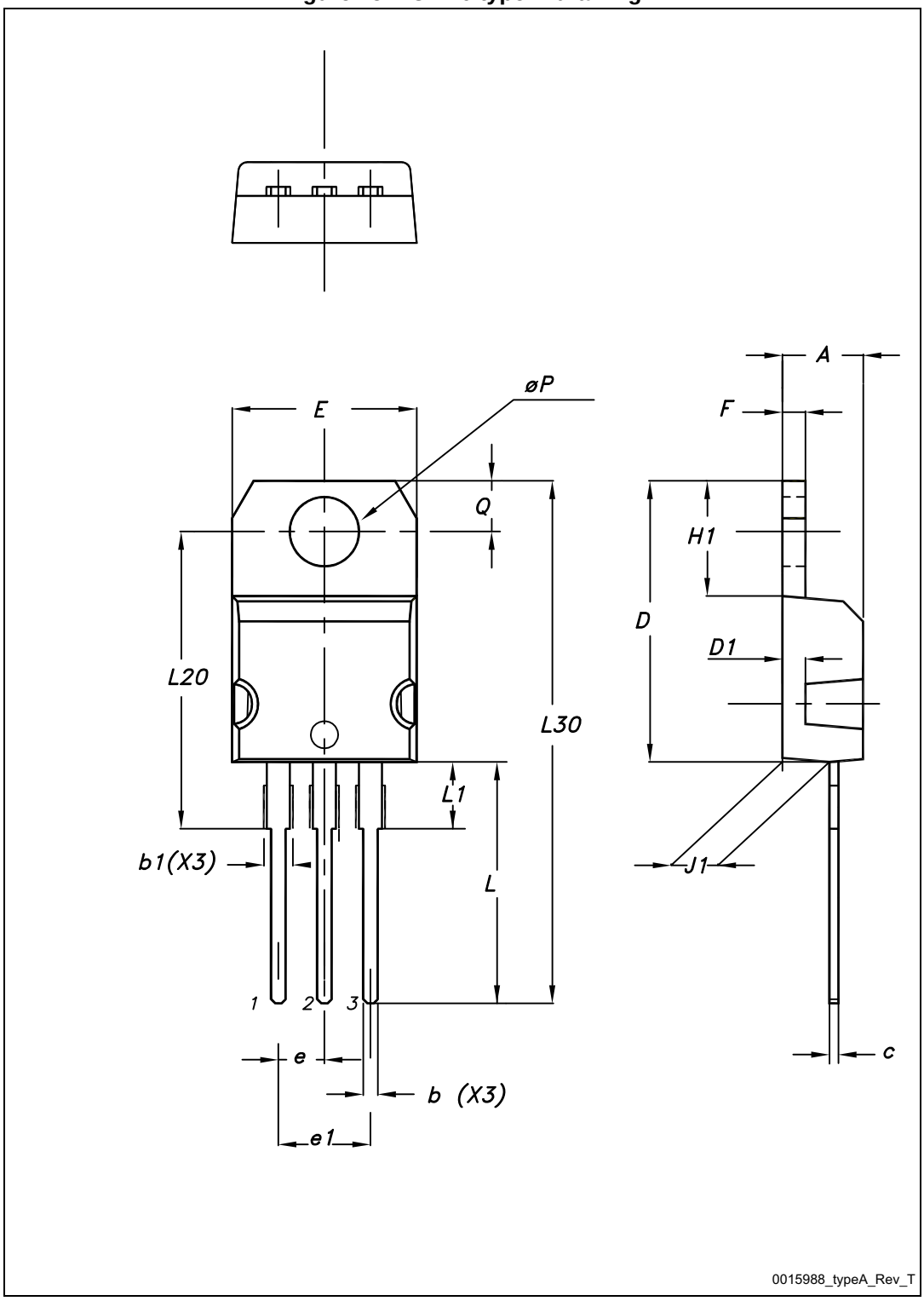


**Table 10. TO-220 type A mechanical data**

| 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 | |
| ∅P | 3.75 | | 3.85 |
| Q | 2.65 | | 2.95 |

## 4.3 IPAK, STU2N105K5

Figure 26. IPAK (TO-251) drawing

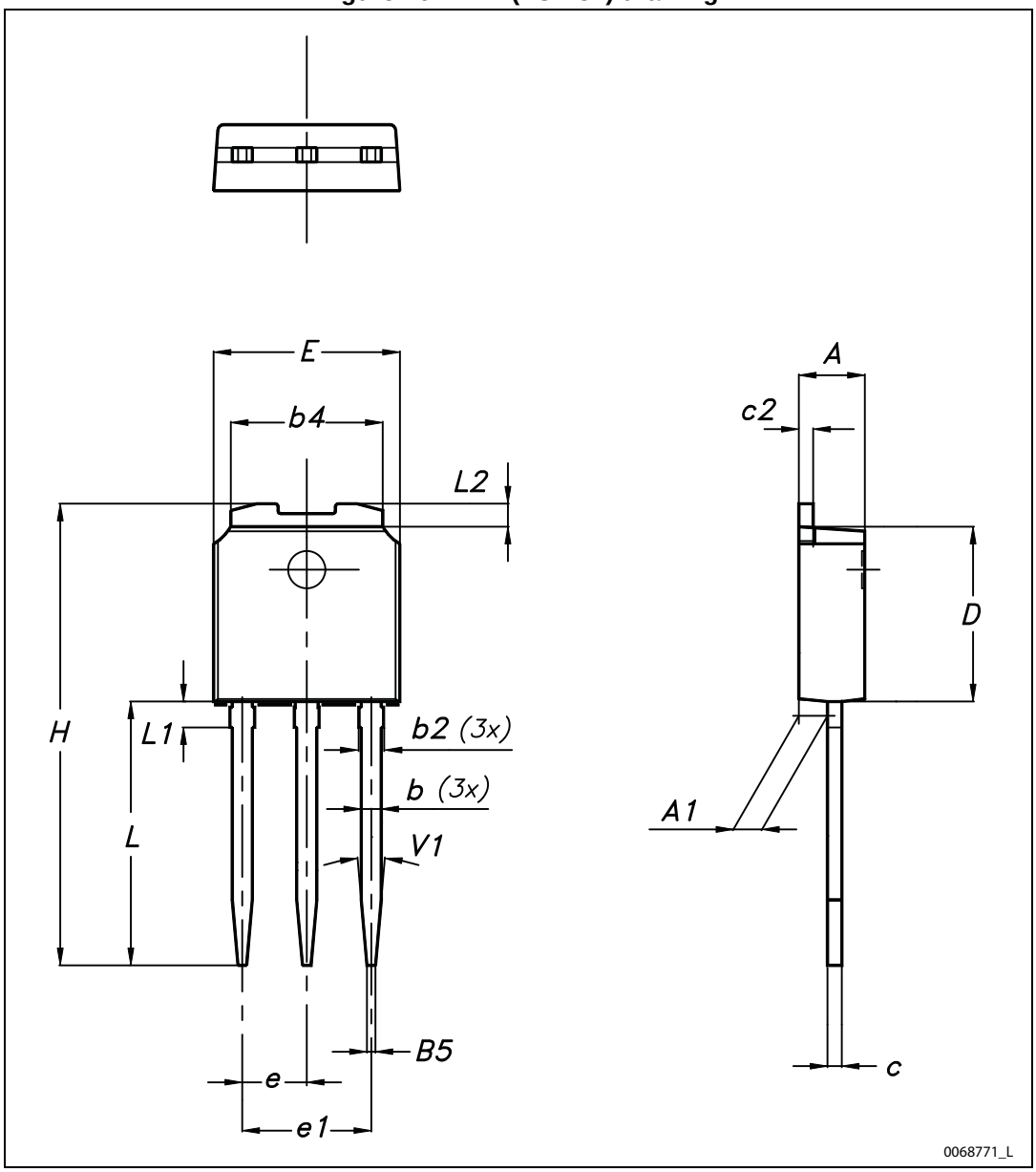


**Table 11. IPAK (TO-251) type A mechanical data**

| DIM | mm. | | |
|---|---|---|---|
| | min. | typ. | max. |
| A | 2.20 | | 2.40 |
| A1 | 0.90 | | 1.10 |
| b | 0.64 | | 0.90 |
| b2 | | | 0.95 |
| b4 | 5.20 | | 5.40 |
| B5 | | 0.30 | |
| c | 0.45 | | 0.60 |
| c2 | 0.48 | | 0.60 |
| D | 6.00 | | 6.20 |
| E | 6.40 | | 6.60 |
| e | | 2.28 | |
| e1 | 4.40 | | 4.60 |
| H | | 16.10 | |
| L | 9.00 | | 9.40 |
| L1 | 0.80 | | 1.20 |
| L2 | | 0.80 | 1.00 |
| V1 | | 10° | |

# 5 Packaging mechanical data

**Figure 27. Tape**

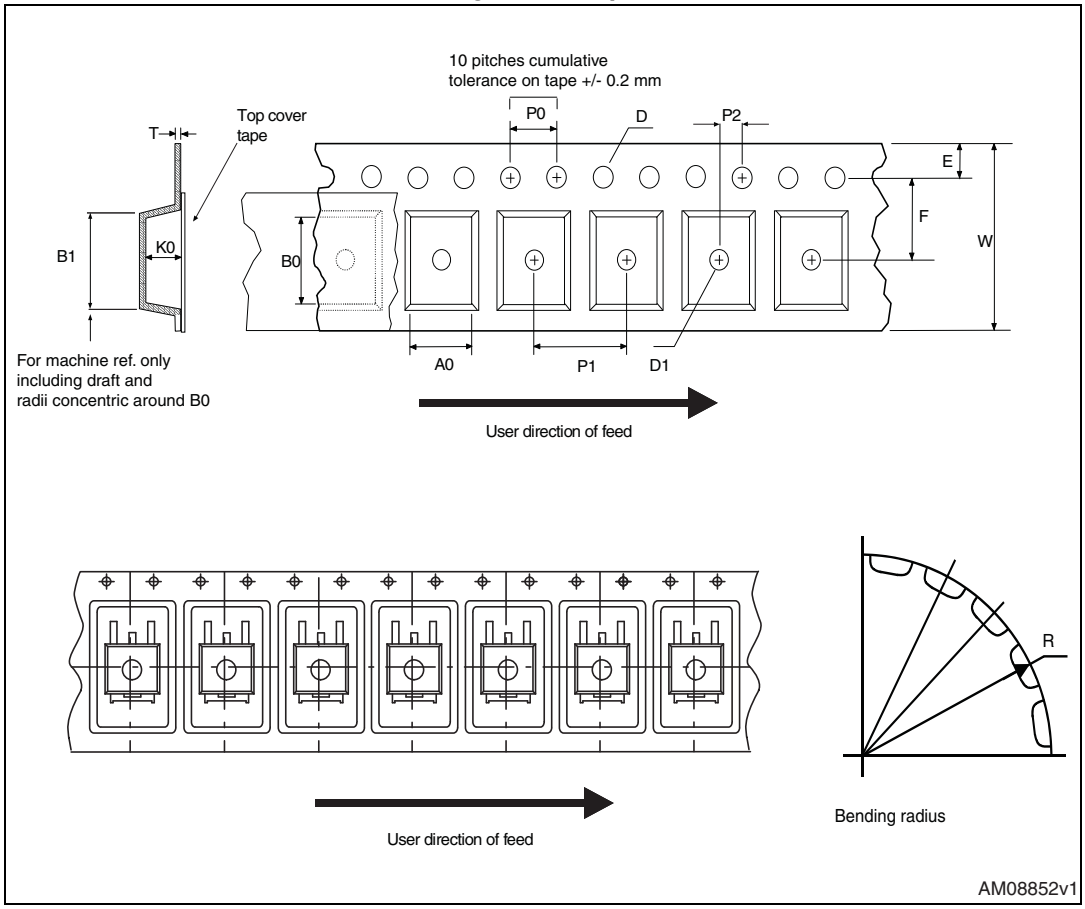


**Figure 28. Reel**

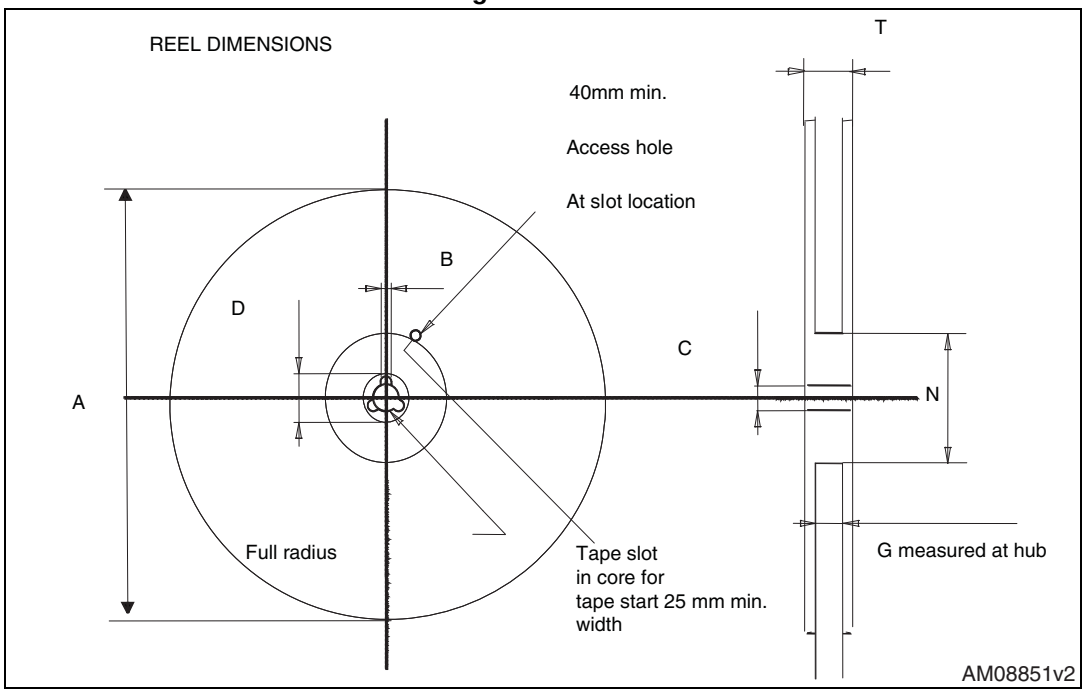



**Table 12. DPAK (TO-252) tape and reel mechanical data**

| 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 13. Document revision history

| Date | Revision | Changes |
|---|---|---|
| 08-May-2014 | 1 | First release. |
| 14-Nov-2014 | 2 | Document status promoted from preliminary to production data.<br>Updated title, features and description in cover page.<br>Updated *Figure 9: Static drain-source on-resistance*, *Section 4.1: DPAK, STD2N105K5* and *Section 4.3: IPAK, STU2N105K5*.<br>Minor text changes. |
| 19-Nov-2004 | 3 | Updated $V_{GS}$ in *Table 2: Absolute maximum ratings* and $I_{GSS}$ in *Table 4: On /off states*. |

单击下面可查看定价，库存，交付和生命周期等信息

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