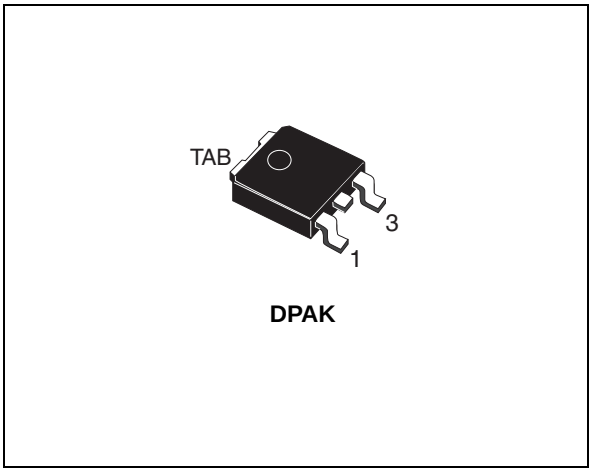
# STD7N65M2

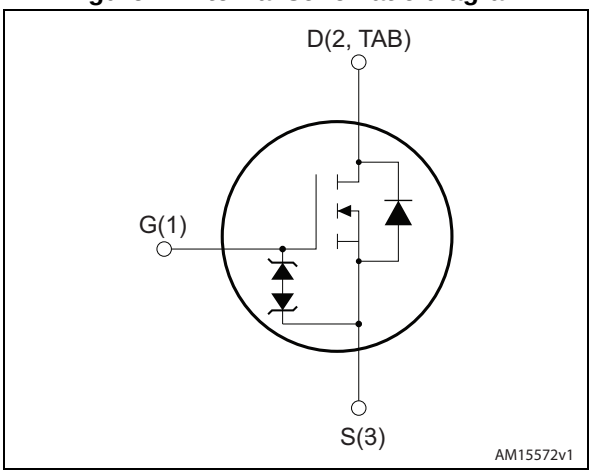
## N-channel 650 V, 0.98 Ω typ., 5 A MDmesh™ M2 Power MOSFET in a DPAK package

**Datasheet - production data**




**DPAK**

**Figure 1. Internal schematic diagram**




## Features

| Order code | $V_{DS}$ | $R_{DS(on)}$ max | $I_D$ |
|---|---|---|---|
| STD7N65M2 | 650 V | 1.15 Ω | 5 A |

- Extremely low gate charge
- Excellent output capacitance ($C_{oss}$) profile
- 100% avalanche tested
- Zener-protected

## Applications

- Switching applications

## Description

This device is an N-channel Power MOSFET developed using the MDmesh™ M2 technology. Thanks to the strip layout associated to an improved vertical structure, the device exhibits both low on-resistance and optimized switching characteristics. It is therefore suitable for the most demanding high efficiency converters.

**Table 1. Device summary**

| Order code | Marking | Package | Packaging |
|---|---|---|---|
| STD7N65M2 | 7N65M2 | DPAK | Tape and reel |



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

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{GS}$ | Gate-source voltage | ± 25 | V |
| $I_D$ | Drain current (continuous) at $T_C$ = 25 °C | 5 | A |
| $I_D$ | Drain current (continuous) at $T_C$ = 100 °C | 3.2 | A |
| $I_{DM}$(1) | Drain current (pulsed) | 20 | A |
| $P_{TOT}$ | Total dissipation at $T_C$ = 25 °C | 60 | W |
| dv/dt (2) | Peak diode recovery voltage slope | 15 | V/ns |
| dv/dt(3) | MOSFET dv/dt ruggedness | 50 | |
| $T_{stg}$ | Storage temperature | - 55 to 150 | °C |
| $T_j$ | Operating junction temperature | | |

1. Pulse width limited by safe operating area
2. $I_{SD} \leq 5$ A, di/dt $\leq 400$ A/µs; $V_{DS\ peak} < V_{(BR)DSS}$, $V_{DD}$=400 V
3. $V_{DS} \leq 520$ V

**Table 3. Thermal data**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{thj\text{-}case}$ | Thermal resistance junction-case max | 2.08 | °C/W |
| $R_{thj\text{-}pcb}$ | Thermal resistance junction-pcb max | 50(1) | °C/W |

1. When mounted on 1 inch² FR-4, 2 Oz copper board.

**Table 4. Avalanche characteristics**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $I_{AR}$ | Avalanche current, repetitive or not repetitive (pulse width limited by $T_{jmax}$ ) | 1 | A |
| $E_{AS}$ | Single pulse avalanche energy (starting $T_j$=25°C, $I_D$= $I_{AR}$; $V_{DD}$=50 V) | 103 | mJ |

# 2 Electrical characteristics

($T_C$ = 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 | $V_{GS}$ = 0, $I_D$ = 1 mA | 650 | | | V |
| $I_{DSS}$ | Zero gate voltage drain current | $V_{GS}$ = 0, $V_{DS}$ = 650 V | | | 1 | µA |
| | | $V_{GS}$ = 0, $V_{DS}$ = 650 V, $T_C$=125 °C | | | 100 | µA |
| $I_{GSS}$ | Gate-body leakage current | $V_{DS}$ = 0, $V_{GS}$ = ± 25 V | | | ±10 | 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, $I_D$ = 2.5 A | | 0.98 | 1.15 | Ω |

**Table 6. Dynamic**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input capacitance | $V_{DS}$ = 100 V, f = 1 MHz, $V_{GS}$ = 0 | - | 270 | - | pF |
| $C_{oss}$ | Output capacitance | | - | 14.5 | - | pF |
| $C_{rss}$ | Reverse transfer capacitance | | - | 0.8 | - | pF |
| $C_{oss\ eq.}$ (1) | Equivalent output capacitance | $V_{DS}$ = 0 to 520 V, $V_{GS}$ = 0 | - | 108 | - | pF |
| $R_G$ | Intrinsic gate resistance | f = 1 MHz open drain | - | 7 | - | Ω |
| $Q_g$ | Total gate charge | $V_{DD}$ = 520 V, $I_D$ = 5 A, $V_{GS}$ = 10 V (see *Figure 15*) | - | 9 | - | nC |
| $Q_{gs}$ | Gate-source charge | | - | 2.3 | - | nC |
| $Q_{gd}$ | Gate-drain charge | | - | 4.3 | - | nC |

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% $V_{DSS}$

**Table 7. Switching times**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD}$ = 325 V, $I_D$ = 2.5 A, $R_G$ = 4.7 Ω, $V_{GS}$ = 10 V (see *Figure 14* and *19*) | - | 8 | - | ns |
| $t_r$ | Rise time | | - | 20 | - | ns |
| $t_{d(off)}$ | Turn-off delay time | | - | 30 | - | ns |
| $t_f$ | Fall time | | - | 20 | - | ns |

**Table 8. Source drain diode**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{SD}$ | Source-drain current | | - | | 5 | A |
| $I_{SDM}$ (1) | Source-drain current (pulsed) | | - | | 20 | A |
| $V_{SD}$ (2) | Forward on voltage | $I_{SD}$ = 5 A, $V_{GS}$ = 0 | - | | 1.6 | V |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 5 A, di/dt = 100 A/µs $V_{DD}$ = 60 V (see *Figure 19*) | - | 275 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 1.62 | | µC |
| $I_{RRM}$ | Reverse recovery current | | - | 11.8 | | A |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 5 A, di/dt = 100 A/µs $V_{DD}$ = 60 V, $T_j$ = 150 °C (see *Figure 19*) | - | 430 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 2.54 | | µC |
| $I_{RRM}$ | Reverse recovery current | | - | 11.9 | | 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**

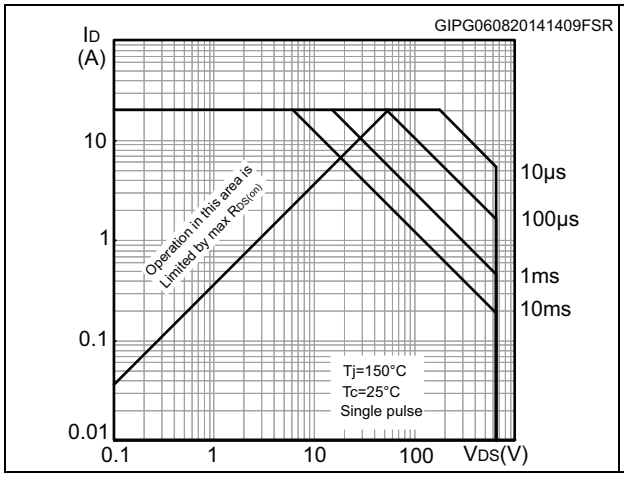



**Figure 3. Thermal impedance**

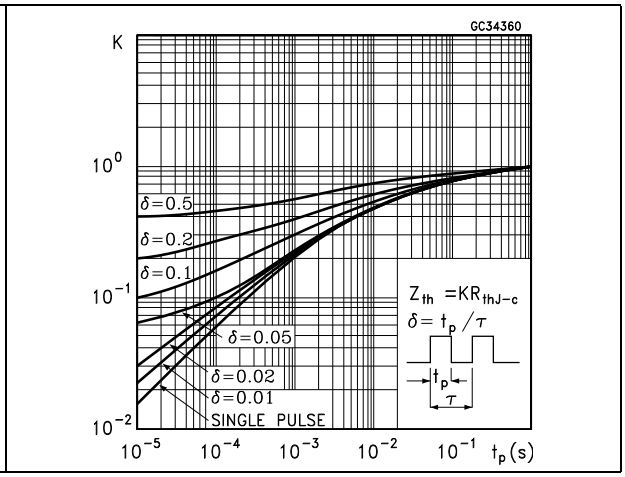



**Figure 4. Output characteristics**

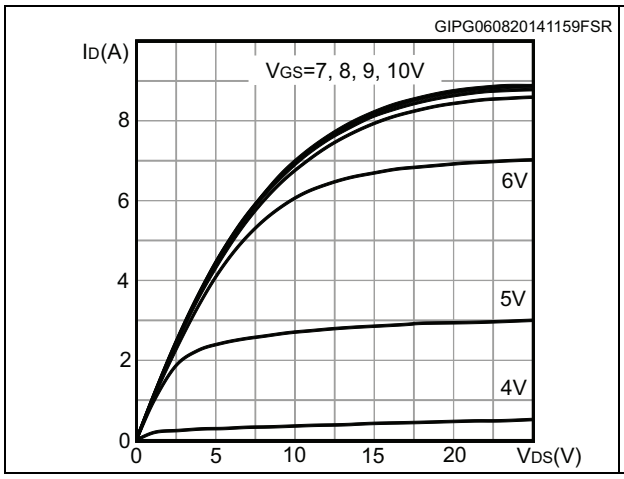



**Figure 5. Transfer characteristics**

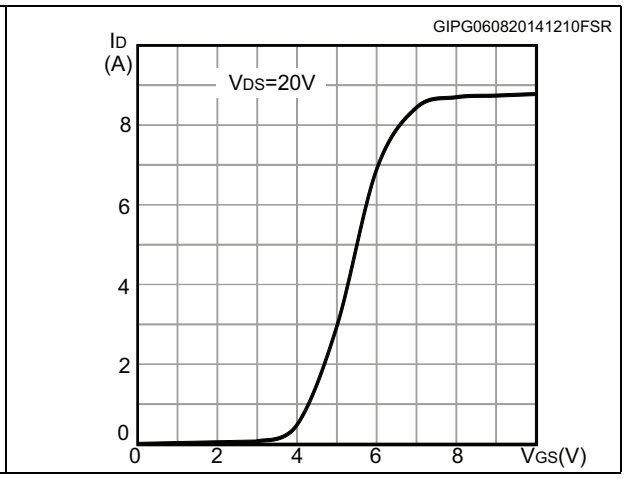



**Figure 6. Gate charge vs gate-source voltage**

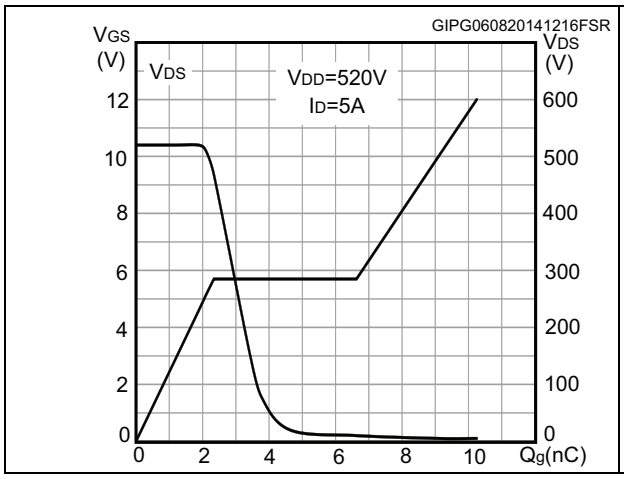



**Figure 7. Static drain-source on-resistance**

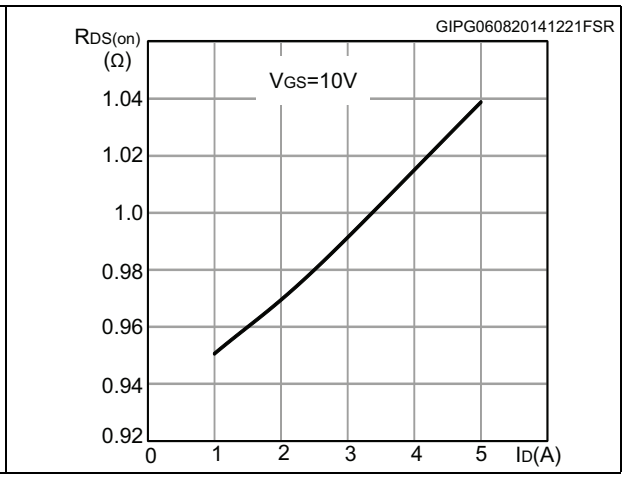


**Figure 8. Capacitance variations**

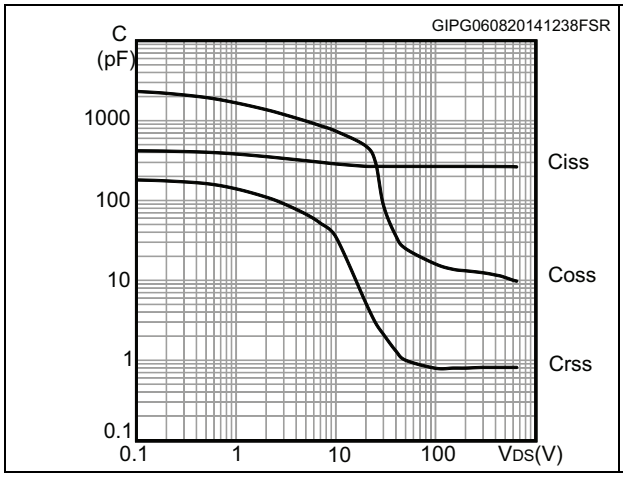



**Figure 9. Output capacitance stored energy**

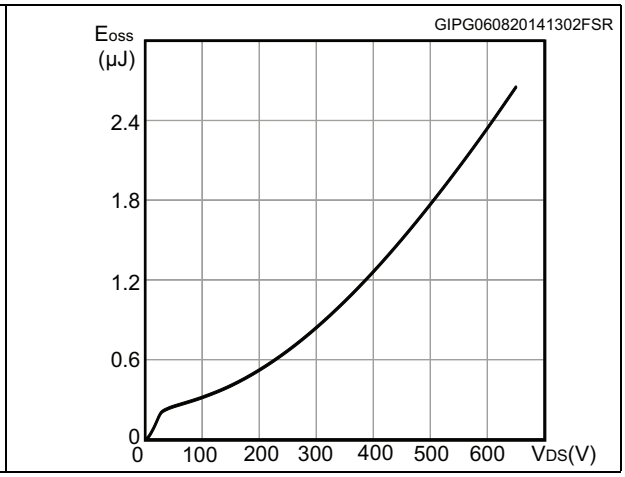



**Figure 10. Normalized gate threshold voltage vs temperature**

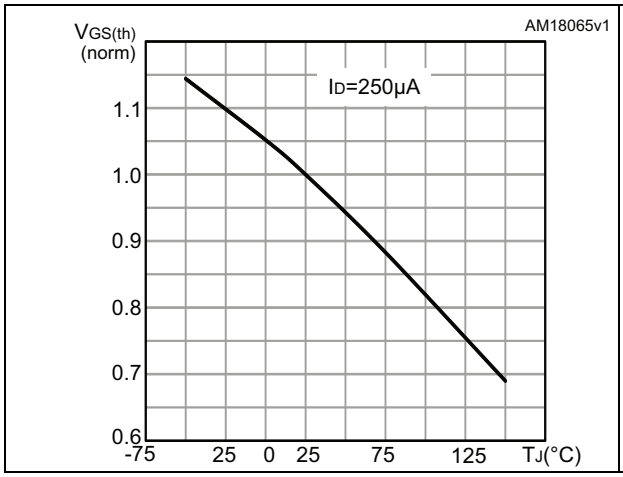



**Figure 11. Normalized on-resistance vs temperature**

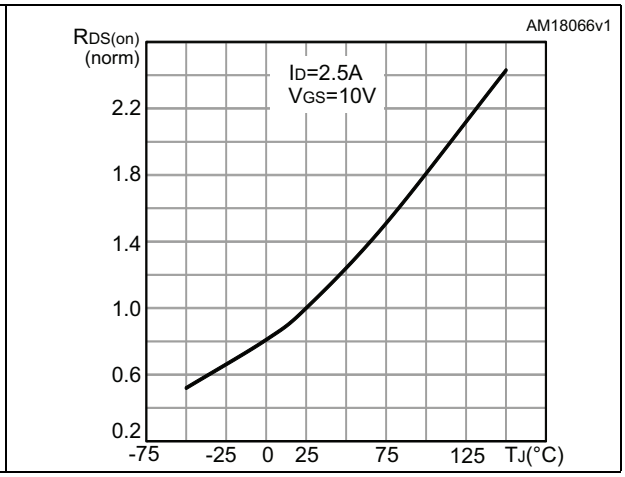



**Figure 12. Source-drain diode forward characteristics**

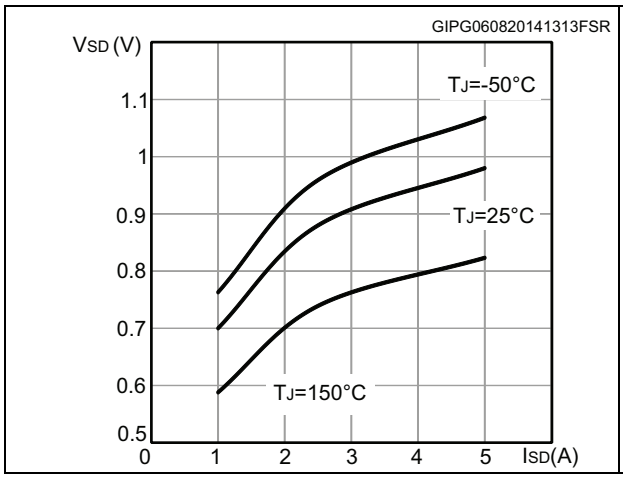
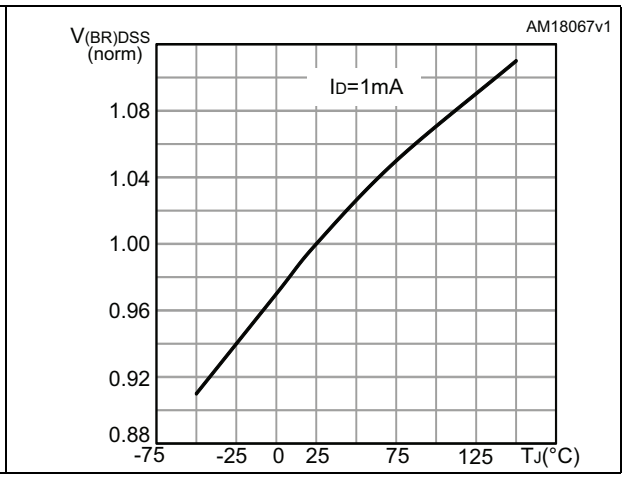



**Figure 13. Normalized $V_{(BR)DSS}$ vs temperature**



# 3 Test circuits

**Figure 14. Switching times test circuit for resistive load**

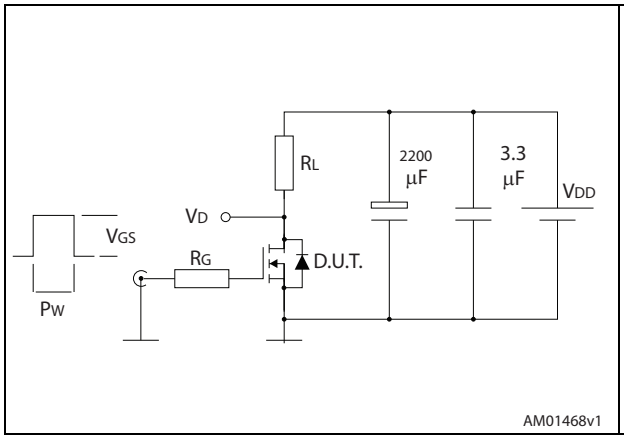



**Figure 15. Gate charge test circuit**

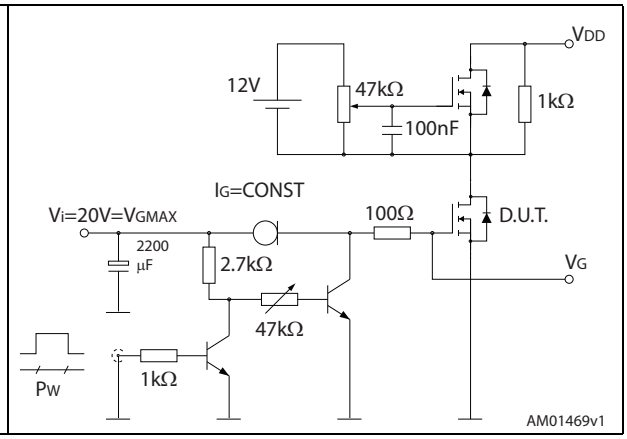



**Figure 16. Test circuit for inductive load switching and diode recovery times**

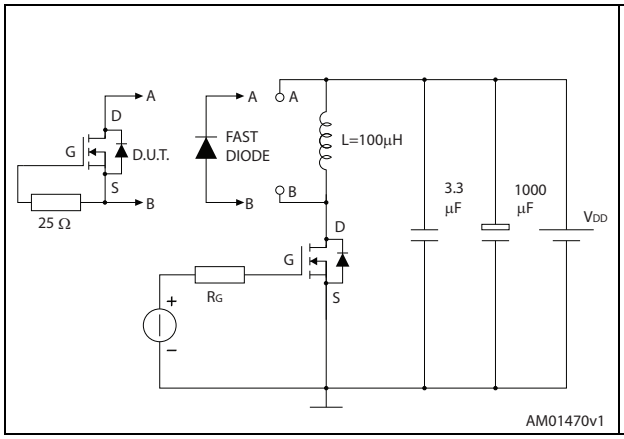



**Figure 17. Unclamped inductive load test circuit**

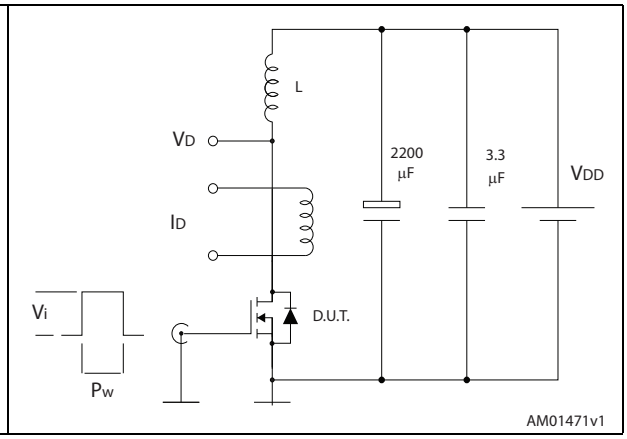



**Figure 18. Unclamped inductive waveform**

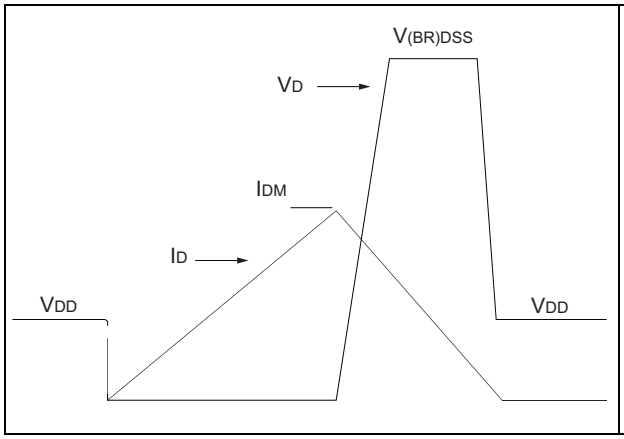
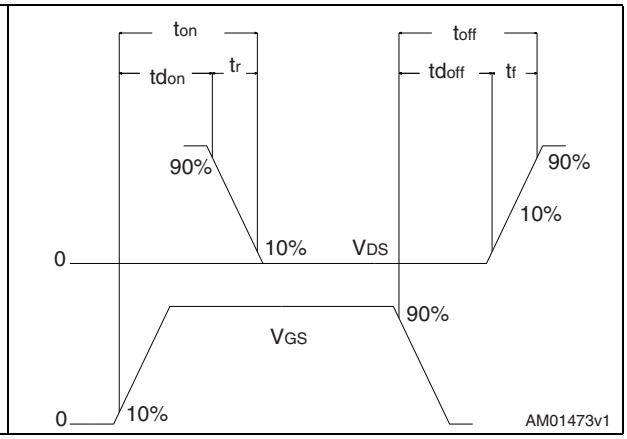



**Figure 19. Switching time waveform**



# 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 DPAK (TO-252) type A package information

**Figure 20. DPAK (TO-252) type A package outline**

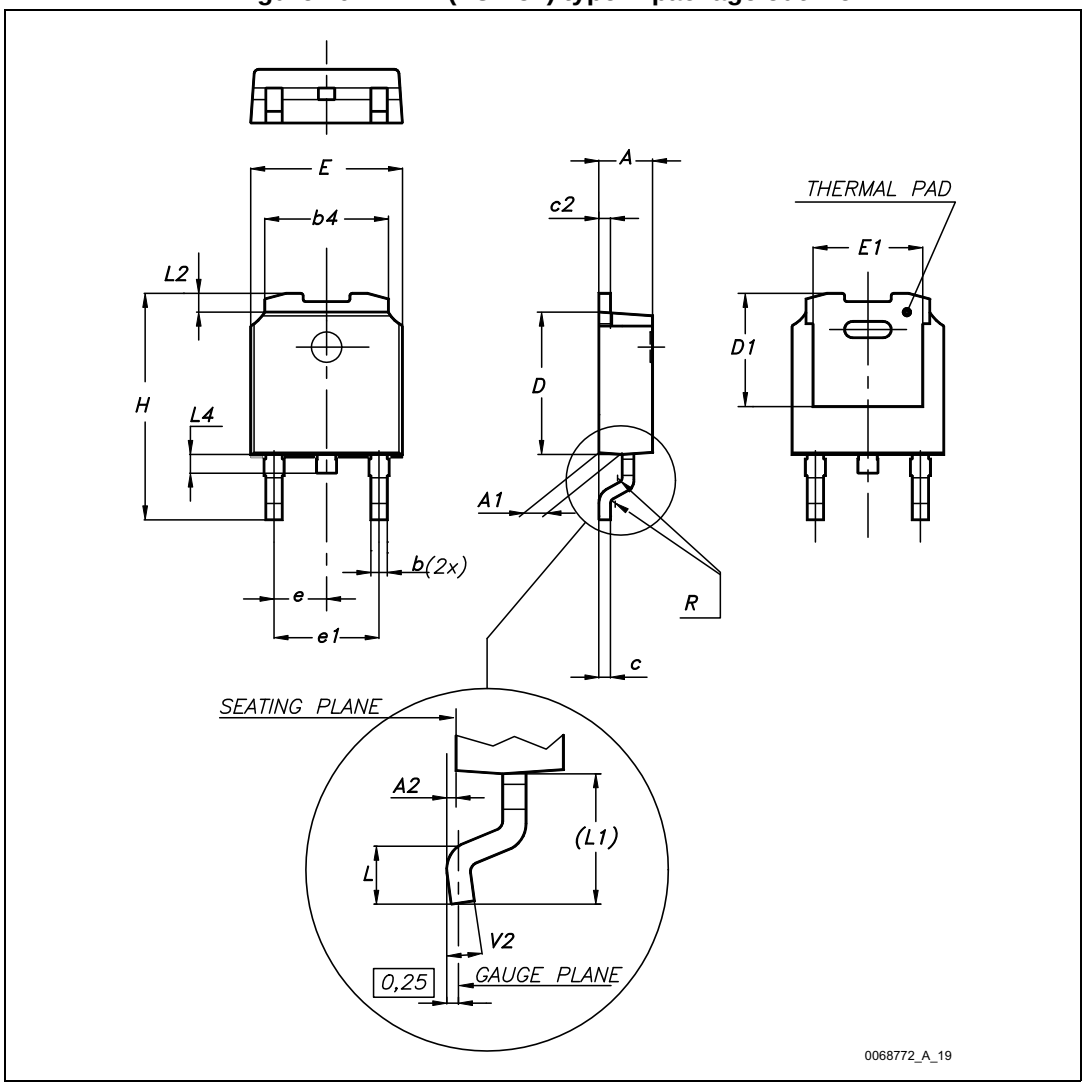


**Table 9. DPAK (TO-252) type A package mechanical data**

| 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 | 4.60 | 4.70 | 4.80 |
| 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° |

## 4.2 DPAK (TO-252) type C package information

**Figure 21. DPAK (TO-252) type C package outline**

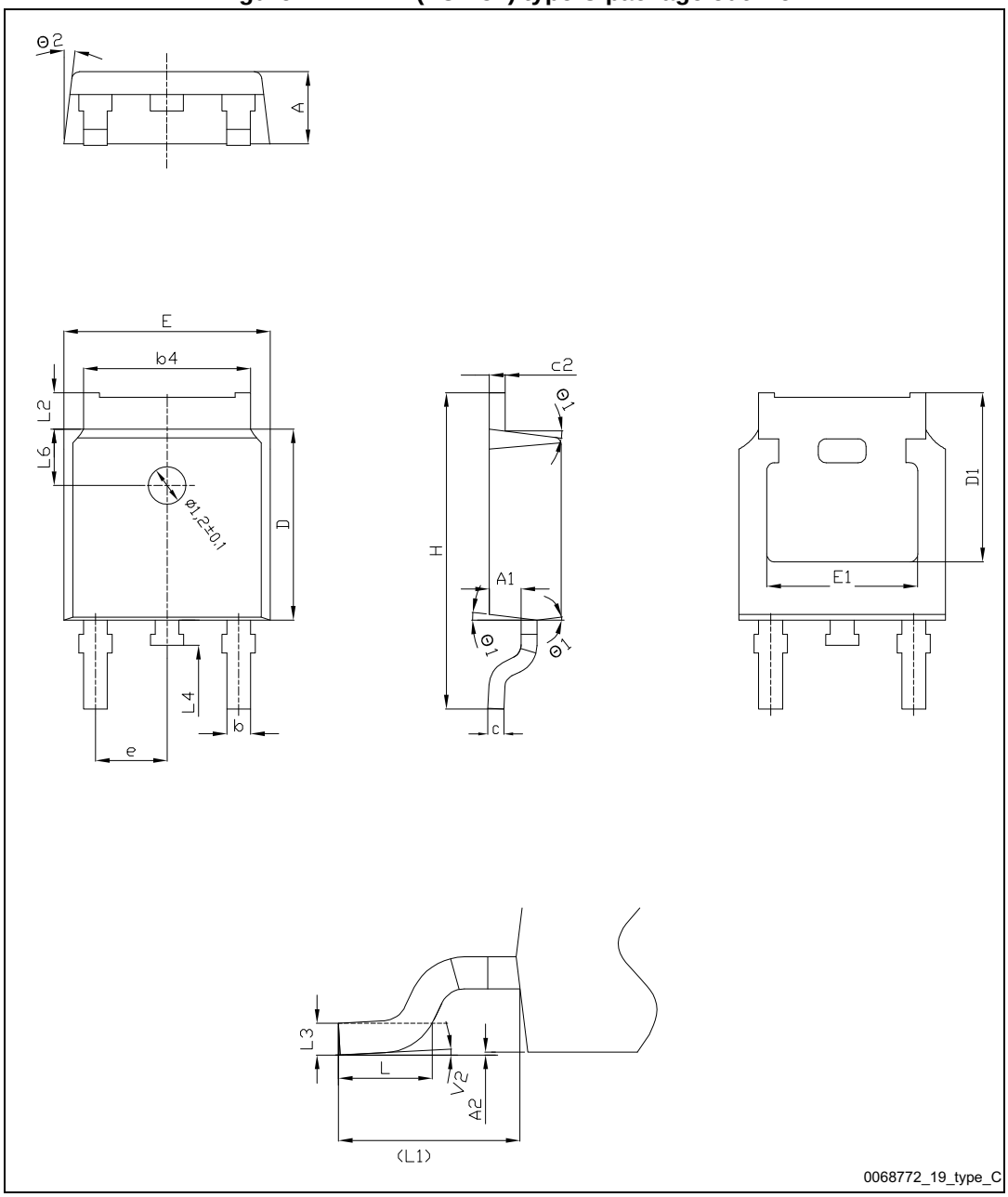
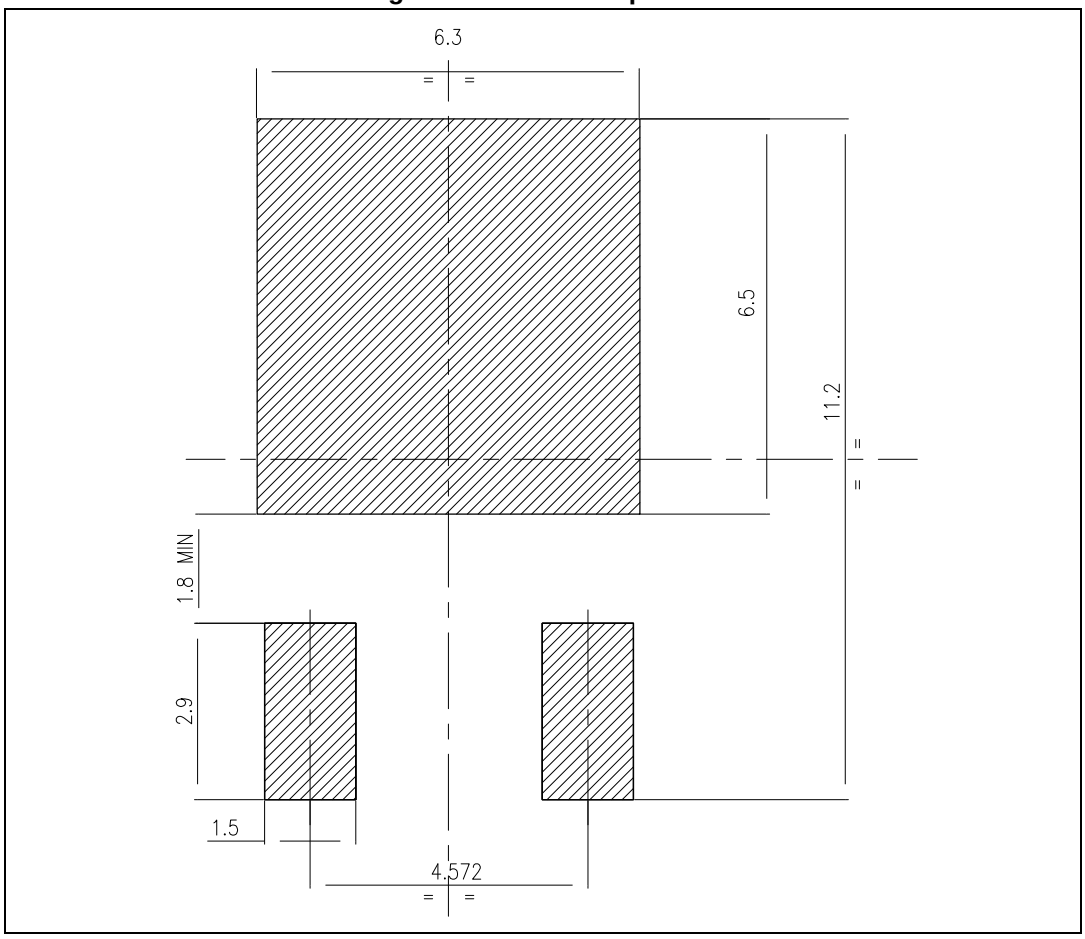


**Table 10. DPAK (TO-252) type C package mechanical data**

| Dim. | mm | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 2.20 | 2.30 | 2.38 |
| A1 | 0.90 | 1.01 | 1.10 |
| A2 | 0.00 | | 0.10 |
| b | 0.72 | | 0.85 |
| b4 | 5.13 | 5.33 | 5.46 |
| c | 0.47 | | 0.60 |
| c2 | 0.47 | | 0.60 |
| D | 6.00 | 6.10 | 6.20 |
| D1 | 5.25 | | |
| E | 6.50 | 6.60 | 6.70 |
| e | 2.186 | 2.286 | 2.386 |
| E1 | 4.70 | | |
| H | 9.80 | 10.10 | 10.40 |
| L | 1.40 | 1.50 | 1.70 |
| L1 | 2.90 REF | | |
| L2 | 0.90 | | 1.25 |
| L3 | 0.51 BSC | | |
| L4 | 0.60 | 0.80 | 1.00 |
| L6 | 1.80 BSC | | |
| Θ1 | 5° | 7° | 9° |
| Θ2 | 5° | 7° | 9° |
| V2 | 0° | | 8° |

**Figure 22. DPAK footprint [(a)]**




a. All dimensions are in millimeters

# 5 Packaging mechanical data

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

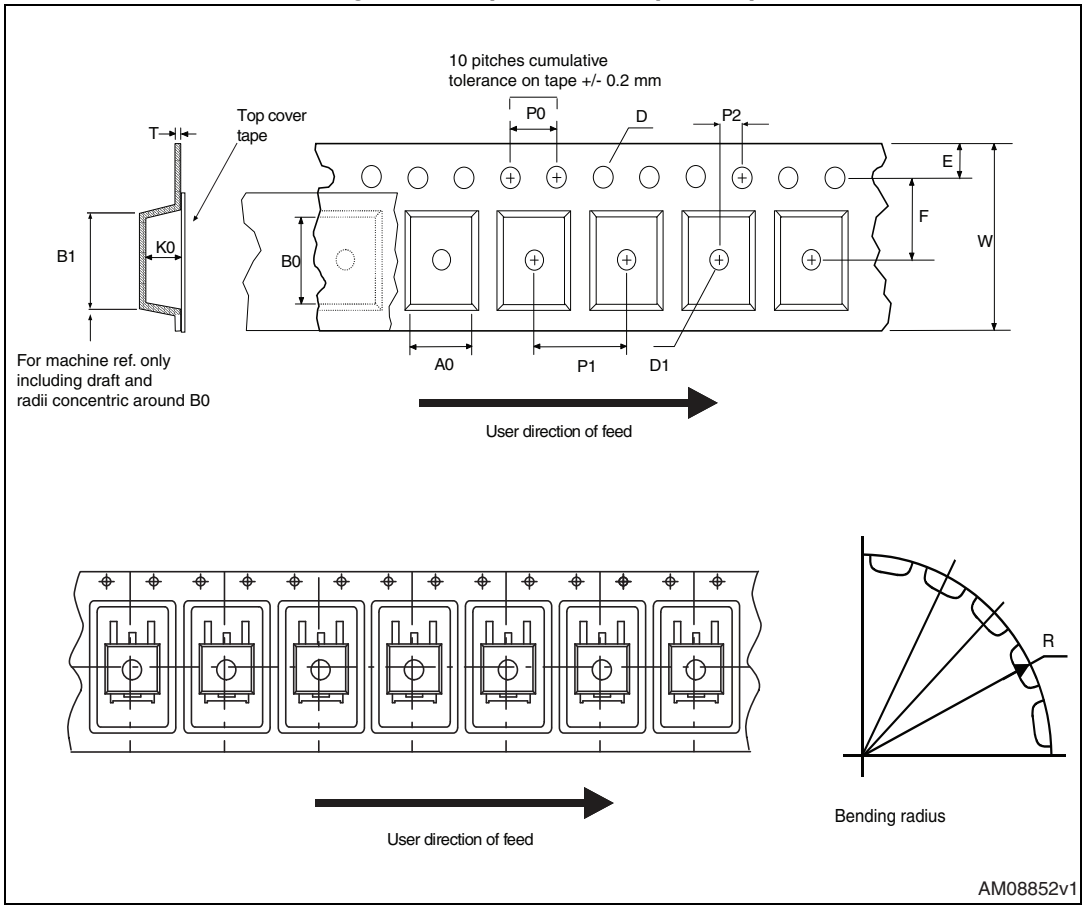


**Figure 24. Reel for DPAK (TO-252)**

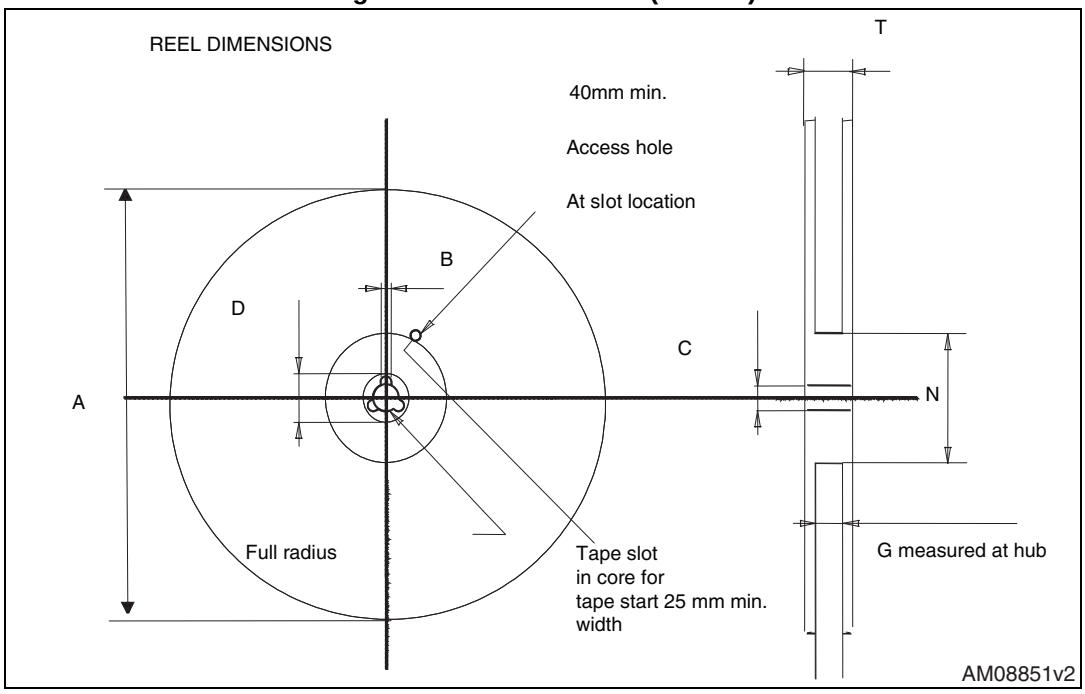



**Table 11. DPAK (TO-252) tape and reel mechanical data**

| 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 12. Document revision history

| Date | Revision | Changes |
|---|---|---|
| 07-Aug-2014 | 1 | First release. |
| 06-May-2015 | 2 | Document status promoted from preliminary to production data.<br>Updated *Section 4: Package information*. |

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