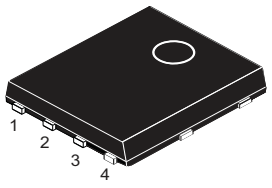
# STL220N3LLH7

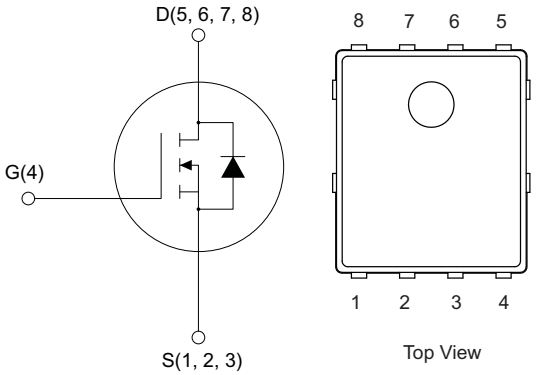
## N-channel 30 V, 0.00081 Ω typ., 50 A STripFET™ VII DeepGATE™ Power MOSFET in a PowerFLAT™ 5x6 package

**Datasheet - production data**




**PowerFLAT™5x6**

**Figure 1. Internal schematic diagram**




## Features

| Order code | $V_{DS}$ | $R_{DS(on)}$ max | $I_D$ |
|---|---|---|---|
| STL220N3LLH7 | 30 V | 0.0011 Ω | 50 A |

- Very low on-resistance
- Very low $Q_g$
- High avalanche ruggedness

## Applications

- Switching applications

## Description

This device exhibits low on-state resistance and capacitance for improved conduction and switching performance.

**Table 1. Device summary**

| Order code | Marking | Package | Packaging |
|---|---|---|---|
| STL220N3LLH7 | 220N3LL7 | PowerFLAT™ 5x6 | Tape and reel |

# Contents

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{DS}$ | Drain-source voltage | 30 | V |
| $V_{GS}$ | Gate-source voltage | ± 20 | V |
| $I_D$ (1) | Drain current (continuous) at $T_C$ = 25 °C | 220 | A |
| $I_D$ (1) | Drain current (continuous) at $T_C$ = 100 °C | 160 | A |
| $I_{DM}$ (1)(2) | Drain current (pulsed) | 880 | A |
| $I_D$ (3) | Drain current (continuous) at $T_{pcb}$ = 25 °C | 50 | A |
| $I_D$ (3) | Drain current (continuous) at $T_{pcb}$ = 100 °C | 32 | A |
| $I_{DM}$ (2)(3) | Drain current (pulsed) | 200 | A |
| $P_{TOT}$ (1) | Total dissipation at $T_C$ = 25 °C | 113 | W |
| $P_{TOT}$ (3) | Total dissipation at $T_{pcb}$ = 25 °C | 4 | W |
| $T_j$ | Max. operating junction temperature | -55 to 150 | °C |

1. This value is rated according to $R_{thj\text{-}c}$
2. Pulse width limited by safe operating area.
3. This value is rated according to $R_{thj\text{-}pcb}$

**Table 3. Thermal data**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{thj\text{-}pcb}$ (1) | Thermal resistance junction-pcb max | 31.3 | °C/W |
| $R_{thj\text{-}case}$ | Thermal resistance junction-case max | 1.1 | °C/W |

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

# 2 Electrical characteristics

($T_C$ = 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 | $I_D$ = 250 µA, $V_{GS}$ = 0 | 30 | | | V |
| $I_{DSS}$ | Zero gate voltage drain current | $V_{GS}$ = 0 V<br>$V_{DS}$ = 24 V | | | 1 | µA |
| $I_{GSS}$ | Gate-body leakage current | $V_{GS}$ = ± 20 V, $V_{DS}$ = 0 | | | ±100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | 1.2 | | 2.2 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS}$ = 10 V, $I_D$ = 25 A | | 0.00081 | 0.0011 | Ω |
| | | $V_{GS}$ = 4.5 V, $I_D$ = 25 A | | 0.00115 | 0.0015 | 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 | - | 8650 | - | pF |
| $C_{oss}$ | Output capacitance | | - | 2400 | - | pF |
| $C_{rss}$ | Reverse transfer capacitance | | - | 72 | - | pF |
| $Q_g$ | Total gate charge | $V_{DD}$ = 15 V, $I_D$ = 50 A, $V_{GS}$ = 4.5 V (see *Figure 14*) | - | 46 | - | nC |
| $Q_{gs}$ | Gate-source charge | | - | 26 | - | nC |
| $Q_{gd}$ | Gate-drain charge | | - | 10 | - | nC |
| $R_g$ | Intrinsic gate resistance | f=1 MHz | - | 0.61 | 1.8 | Ω |

**Table 6. Switching times**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD}$ = 15 V, $I_D$ = 25 A, $R_G$ = 4.7 Ω, $V_{GS}$ = 4.5 V | - | 55 | - | ns |
| $t_r$ | Rise time | | - | 115 | - | ns |
| $t_{d(off)}$ | Turn-off delay time | | - | 70 | - | ns |
| $t_f$ | Fall time | | - | 51 | - | ns |

**Table 7. Source drain diode**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{SD}$ | Source-drain current | | - | | 50 | A |
| $I_{SDM}$ (1) | Source-drain current (pulsed) | | - | | 200 | A |
| $V_{SD}$ (2) | Forward on voltage | $I_{SD}$ = 50 A, $V_{GS}$ = 0 | - | | 1 | V |
| $t_{rr}$ | Reverse recovery time | $I_D$ = 50 A, di/dt = 100 A/µs $V_{DD}$ = 24 V | - | 66 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 101 | | nC |
| $I_{RRM}$ | Reverse recovery current | | - | 3.1 | | 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**

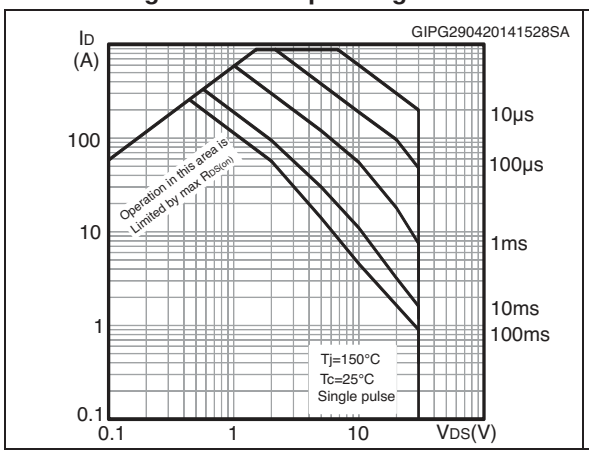



**Figure 3. Thermal impedance**

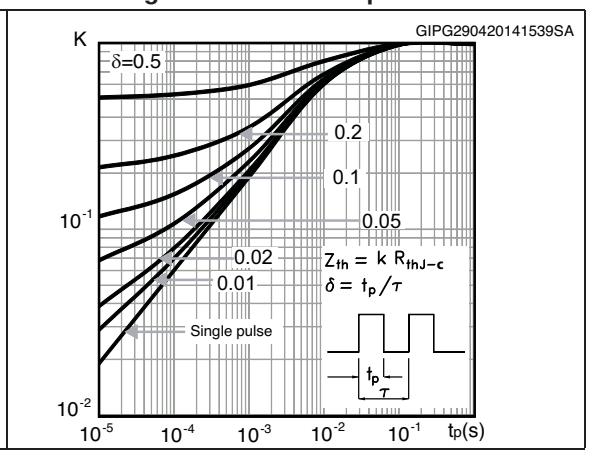



**Figure 4. Output characteristics**

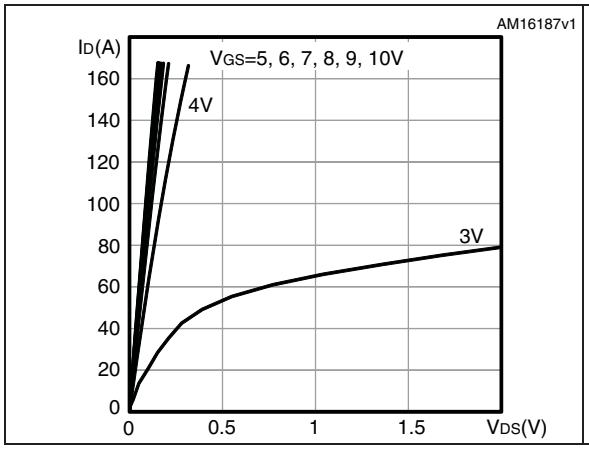



**Figure 5. Transfer characteristics**

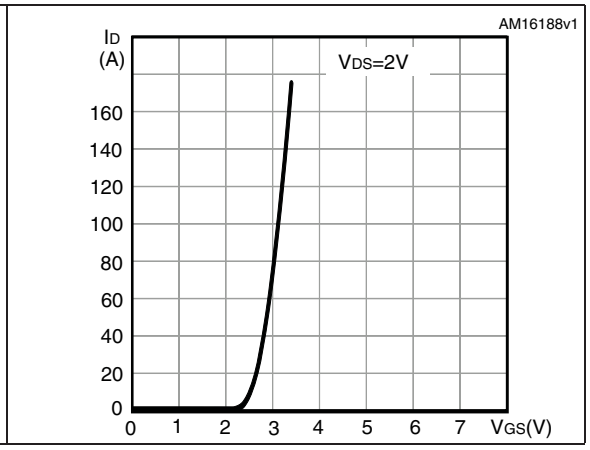



**Figure 6. Gate charge vs gate-source voltage**

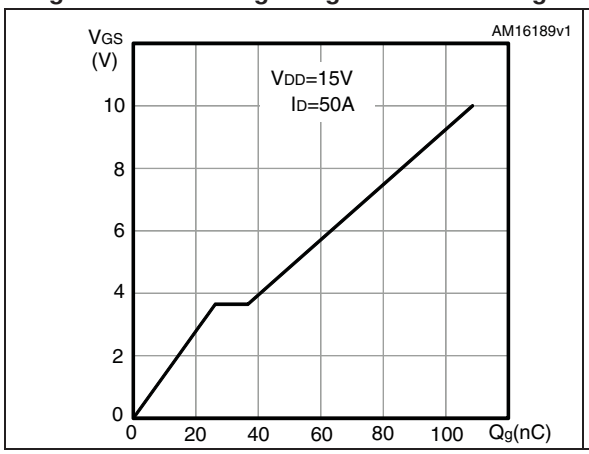



**Figure 7. Static drain-source on-resistance**

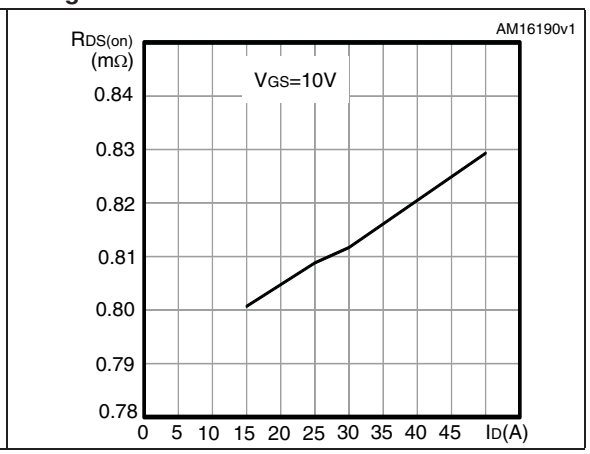


**Figure 8. Capacitance variations**

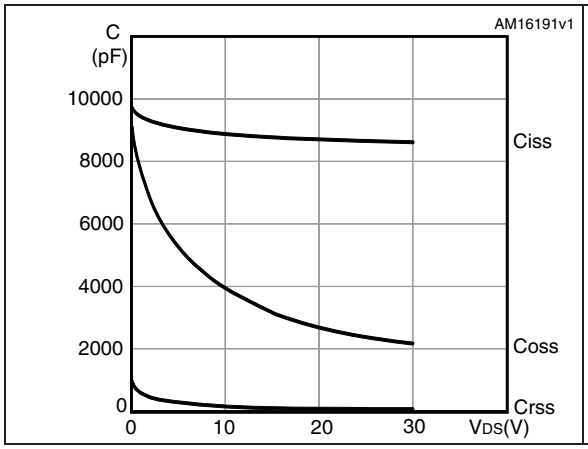



**Figure 9. Normalized gate threshold voltage vs temperature**

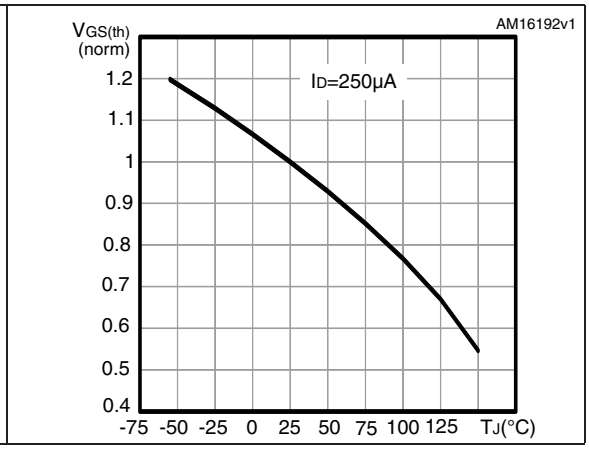



**Figure 10. Normalized on-resistance vs temperature**

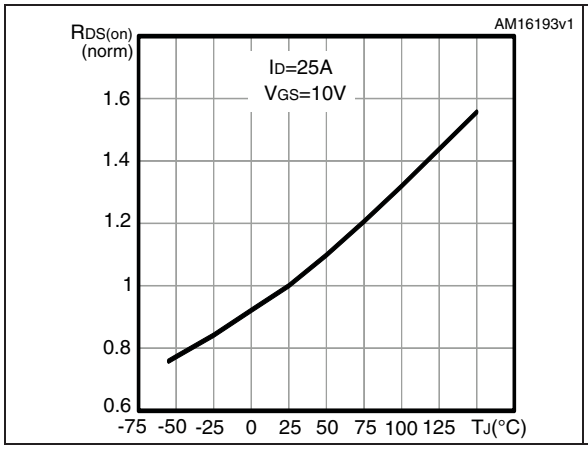



**Figure 11. Normalized $V_{(BR)DSS}$ vs temperature**

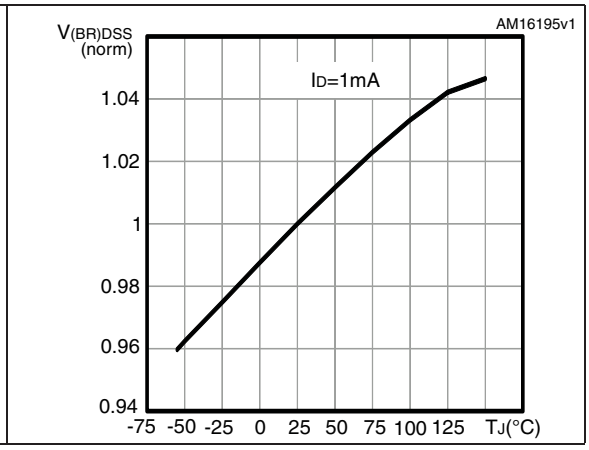
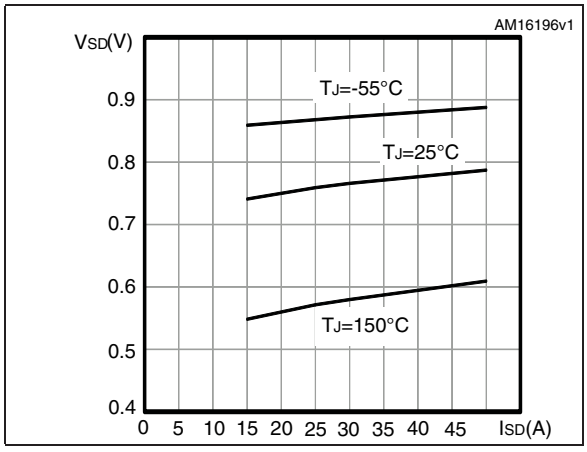



**Figure 12. Source-drain diode forward characteristics**



# 3 Test circuits

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

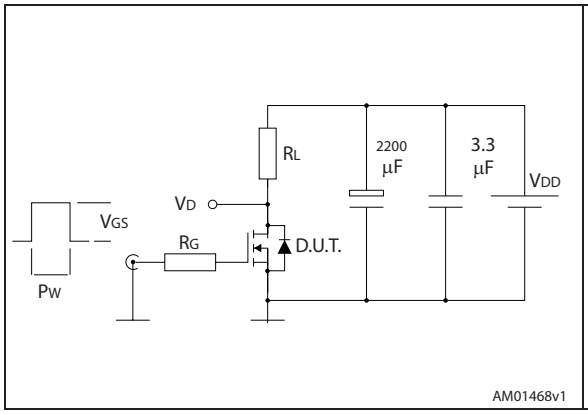



**Figure 14. Gate charge test circuit**

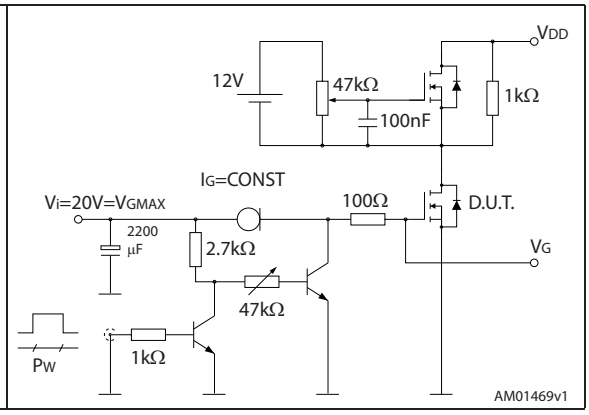



**Figure 15. Test circuit for inductive load switching and diode recovery times**

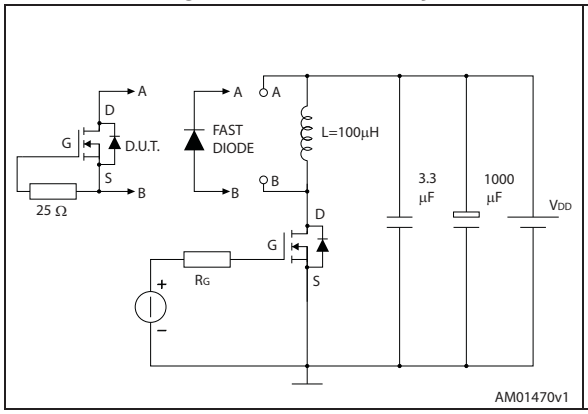



**Figure 16. Unclamped inductive load test circuit**

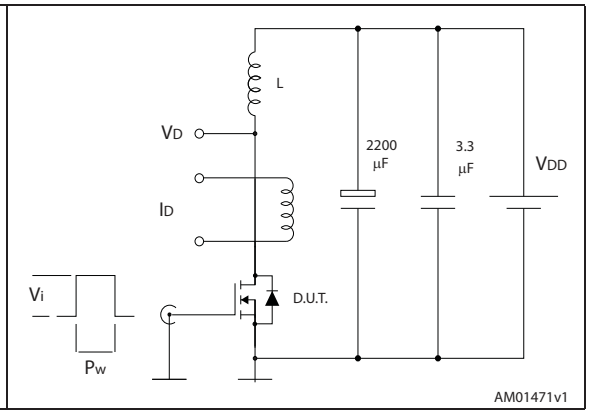



**Figure 17. Unclamped inductive waveform**

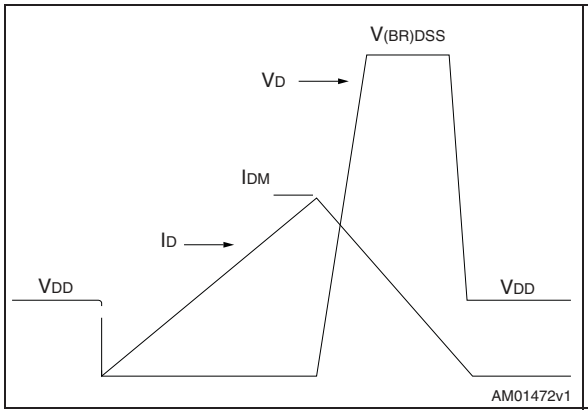
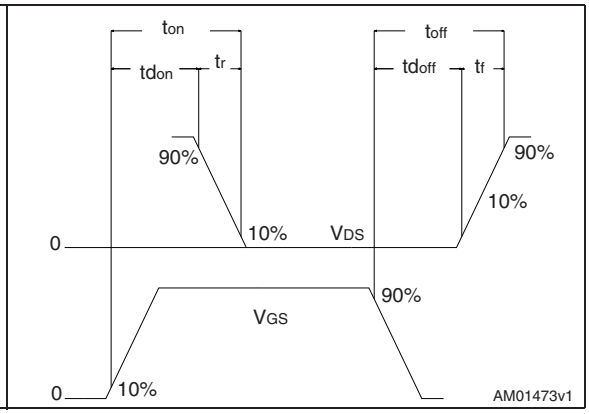



**Figure 18. Switching time waveform**



# 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.

**Figure 19. PowerFLAT™ 5x6 type S-C mechanical data**

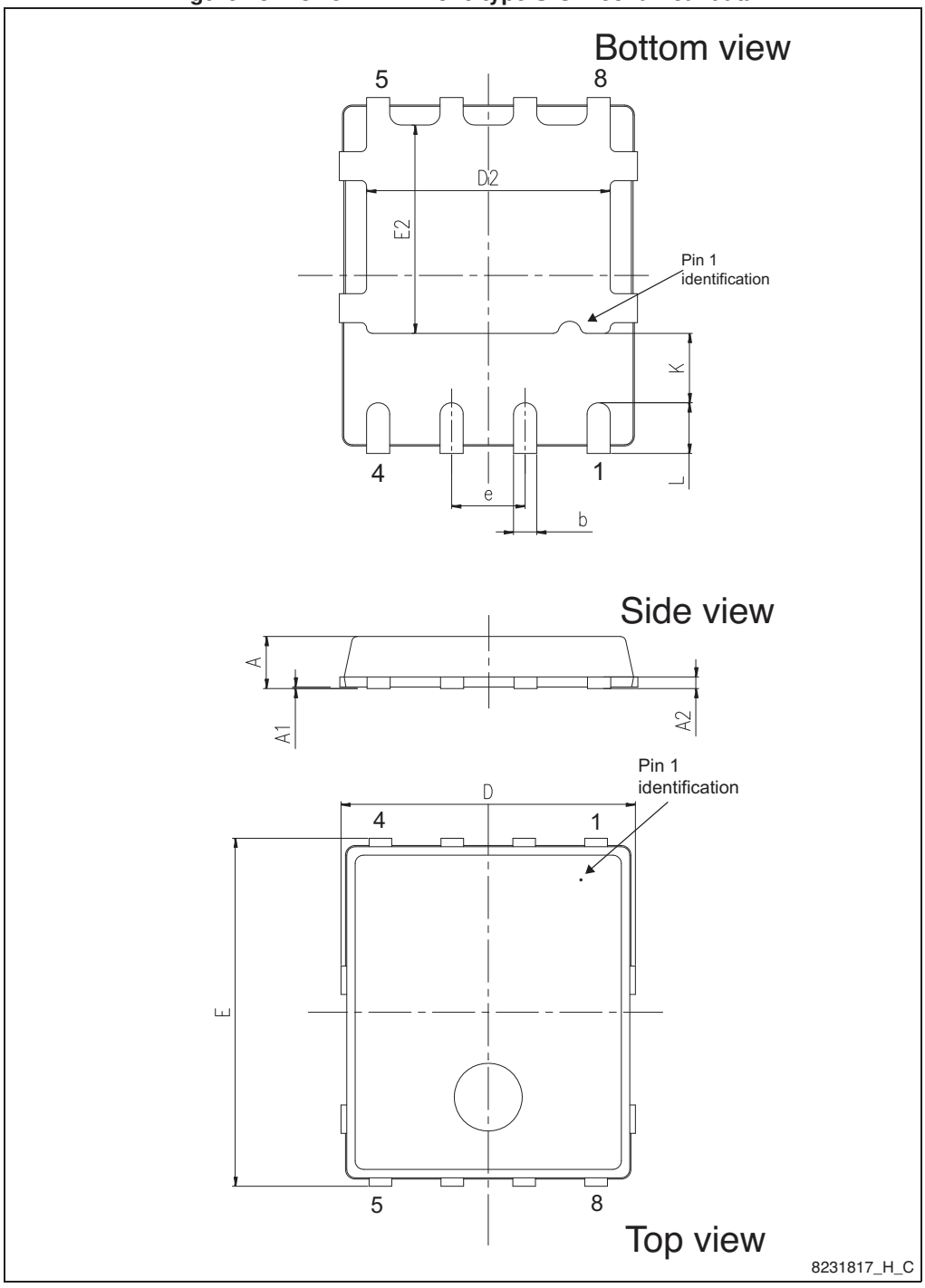
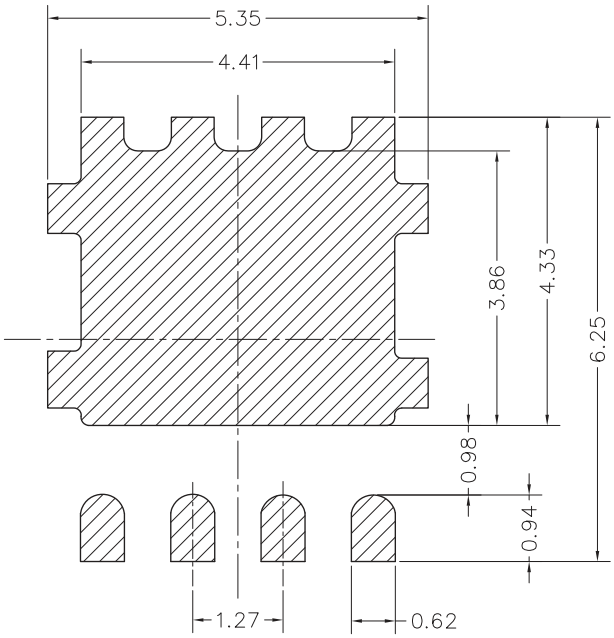


Table 8. PowerFLAT™ 5x6 type S-C mechanical data

| Dim. | mm | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 0.80 | | 1.00 |
| A1 | 0.02 | | 0.05 |
| A2 | | 0.25 | |
| b | 0.30 | | 0.50 |
| D | | 5.20 | |
| E | | 6.15 | |
| D2 | 4.11 | | 4.31 |
| E2 | 3.50 | | 3.70 |
| e | | 1.27 | |
| e1 | | 0.65 | |
| L | 0.715 | | 1.015 |
| K | 1.05 | | 1.35 |

Figure 20. PowerFLAT™ 5x6 recommended footprint (dimensions in mm)



# 5 Packaging mechanical data

**Figure 21. PowerFLAT™ 5x6 tape(a)**

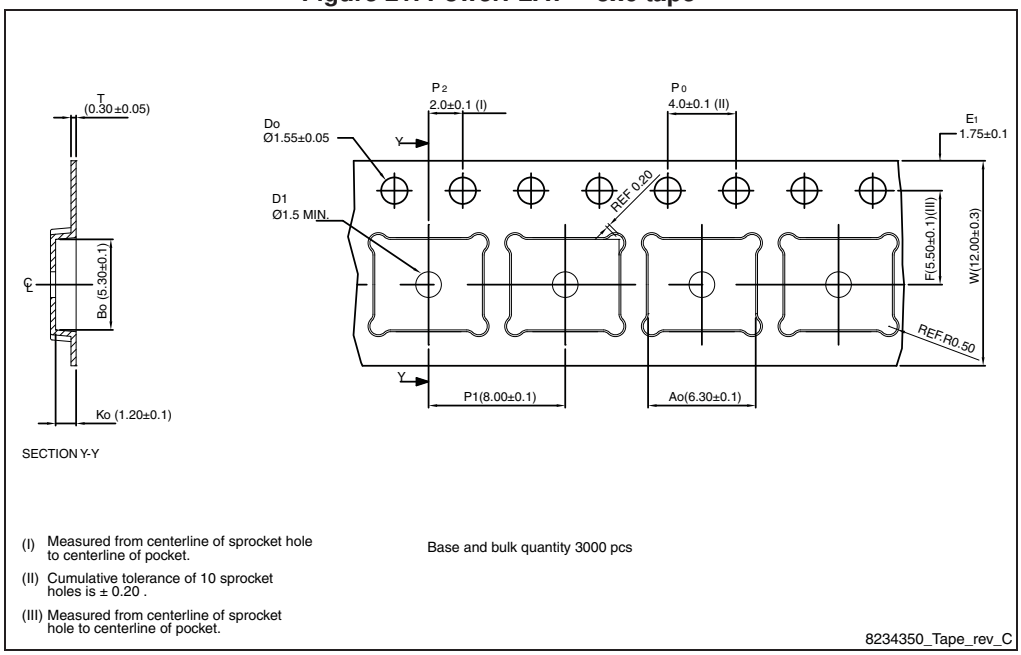
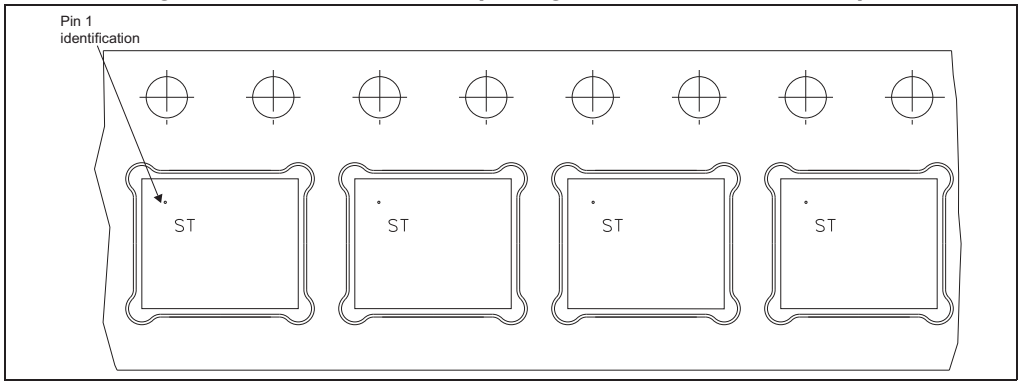
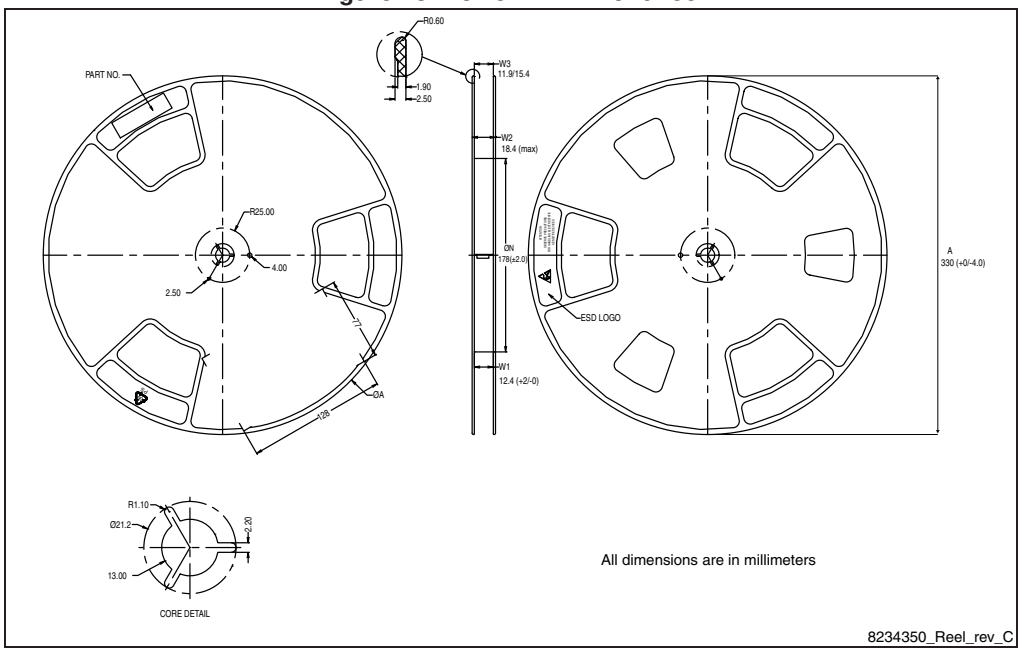



**Figure 22. PowerFLAT™ 5x6 package orientation in carrier tape**




a. All dimensions are in millimeters.

**Figure 23. PowerFLAT™ 5x6 reel**



# 6 Revision history

Table 9. Document revision history

| Date | Revision | Changes |
|---|---|---|
| 04-Jun-2013 | 1 | First release. |
| 11-Jun-2013 | 2 | – Changed: *Description*<br>– Minor text changes |
| 08-Nov-2013 | 3 | – Modified: title, $I_D$ (Drain current (continuous) at $T_{pcb}$ = 100 °C), $P_{TOT}$ (Total dissipation at $T_C$ and $T_{pcb}$ = 25 °C) and $T_J$ values in *Table 2*, $R_{thj\text{-}case}$ value in *Table 3*, $V_{(BR)DSS}$ and $V_{GS(th)}$ test conditions, $R_{DS(on)}$ typical values, the entire typical values in *Table 5*, *6*, $R_G$ value in *Table 6*, $V_{dd}$ and typical values in *Table 7*<br>– Updated: *Section 4: Package mechanical data* and *Section 5: Packaging mechanical data* |
| 08-May-2014 | 4 | – Inserted: $R_g$ parameter in *Table 5*<br>– Minor text changes |

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