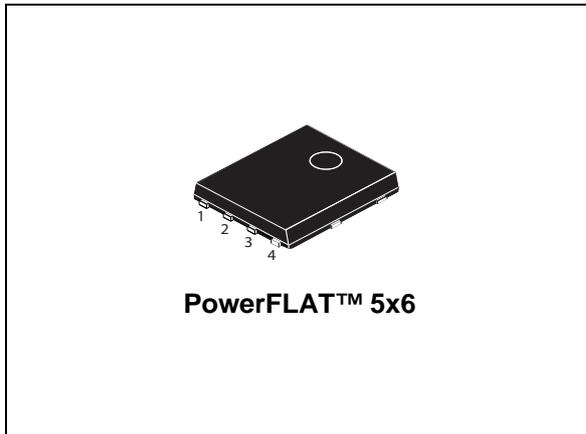


## Automotive-grade N-channel 40 V, 6.1 mΩ typ., 18 A STripFET™V Power MOSFET in a PowerFLAT™ 5x6 package

Datasheet - production data



### Features

| Order code  | V <sub>DS</sub> | R <sub>DS(on)max</sub> | I <sub>D</sub> |
|-------------|-----------------|------------------------|----------------|
| STL70N4LLF5 | 40 V            | 6.7 mΩ                 | 18 A           |

- Designed for automotive applications and AEC-Q101 qualified
- R<sub>DS(on)</sub> \* Q<sub>g</sub> industry benchmark
- Extremely low on-resistance R<sub>DS(on)</sub>
- High avalanche ruggedness
- Low gate drive power losses

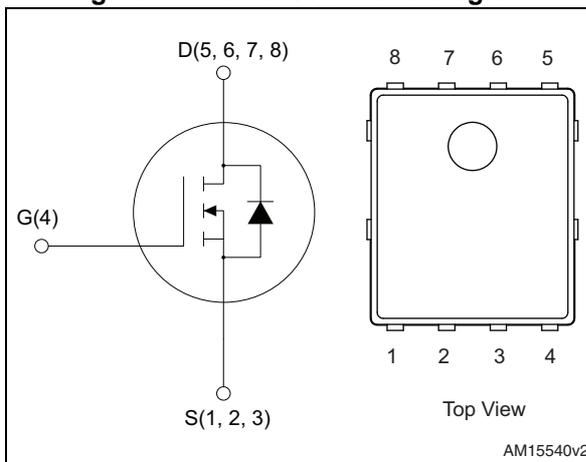
### Applications

- Switching applications

### Description

This device is an N-channel Power MOSFET developed using STMicroelectronics' STripFET™V 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.

**Figure 1. Internal schematic diagram**



**Table 1. Device summary**

| Order code  | Marking  | Package        | Packaging     |
|-------------|----------|----------------|---------------|
| STL70N4LLF5 | 70N4LLF5 | PowerFLAT™ 5x6 | Tape and reel |

# Contents

|          |   |           |
|----------|---|-----------|
| <b>1</b> | <b>Electrical ratings</b> .....           | <b>3</b>  |
| <b>2</b> | <b>Electrical characteristics</b> .....   | <b>4</b>  |
| 2.1      | Electrical characteristics (curves) ..... | 6         |
| <b>3</b> | <b>Test circuits</b> .....                | <b>8</b>  |
| <b>4</b> | <b>Package mechanical data</b> .....      | <b>9</b>  |
| <b>5</b> | <b>Packaging mechanical data</b> .....    | <b>13</b> |
| <b>6</b> | <b>Revision history</b> .....             | <b>15</b> |

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol             | Parameter  | Value      | Unit                |
|--------------------|--|------------|---------------------|
| $V_{DS}$           | Drain-source voltage   | 40         | V                   |
| $V_{GS}$           | Gate-source voltage  | $\pm 22$   | V                   |
| $I_D^{(1)}$        | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$     | 70         | A                   |
| $I_D^{(1)}$        | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$    | 44         | A                   |
| $I_D^{(2)}$        | Drain current (continuous) at $T_{pcb} = 25\text{ }^\circ\text{C}$ | 18         | A                   |
| $I_D^{(2)}$        | Drain current (continuous) at $T_{pcb}=100\text{ }^\circ\text{C}$  | 11.5       | A                   |
| $I_{DM}^{(2),(3)}$ | Drain current (pulsed)   | 72         | A                   |
| $P_{TOT}^{(1)}$    | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$              | 72         | W                   |
| $P_{TOT}^{(2)}$    | Total dissipation at $T_{pcb} = 25\text{ }^\circ\text{C}$          | 4.8        | W                   |
|                    | Derating factor <sup>(2)</sup>                                     | 0.03       | W/ $^\circ\text{C}$ |
| $T_J$              | Operating junction temperature                                     | -55 to 175 | $^\circ\text{C}$    |
| $T_{stg}$          | Storage temperature  |            |                     |

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

**Table 3. Thermal resistance**

| Symbol              | Parameter                        | Value | Unit                      |
|---------------------|----------------------------------|-------|---------------------------|
| $R_{thj-case}$      | Thermal resistance junction-case | 2.08  | $^\circ\text{C}/\text{W}$ |
| $R_{thj-pcb}^{(1)}$ | Thermal resistance junction-pcb  | 31.3  | $^\circ\text{C}/\text{W}$ |

1. When mounted on FR-4 board of 1inch<sup>2</sup>, 2oz Cu,  $t < 10$  sec.

**Table 4. Avalanche data**

| Symbol   | Parameter   | Value | Unit |
|----------|---|-------|------|
| $I_{AV}$ | Not-repetitive avalanche current,<br>(pulse width limited by $T_J$ max)   | 9     | A    |
| $E_{AS}$ | Single pulse avalanche energy<br>(starting $T_J = 25\text{ }^\circ\text{C}$ , $I_D = I_{AV}$ , $V_{DD} = 24\text{ V}$ ) | 1090  | mJ   |

## 2 Electrical characteristics

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

**Table 5. On/off states**

| Symbol        | Parameter  | Test conditions   | Min. | Typ.       | Max.      | Unit                   |
|---------------|--|---|------|------------|-----------|------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage ( $V_{GS} = 0$ )  | $I_D = 250\ \mu A$  | 40   |            |           | V                      |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = 40\text{ V}$ ,<br>$V_{DS} = 40\text{ V}, T_C = 125\text{ °C}$               |      |            | 1<br>10   | $\mu A$<br>$\mu A$     |
| $I_{GSS}$     | Gate body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 22\text{ V}$  |      |            | $\pm 100$ | nA                     |
| $V_{GS(th)}$  | Gate threshold voltage                           | $V_{DS} = V_{GS}, I_D = 250\ \mu A$   | 1    |            |           | V                      |
| $R_{DS(on)}$  | Static drain-source on-resistance                | $V_{GS} = 10\text{ V}, I_D = 9\text{ A}$<br>$V_{GS} = 4.5\text{ V}, I_D = 9\text{ A}$ |      | 6.1<br>7.6 | 6.7<br>9  | $m\Omega$<br>$m\Omega$ |

**Table 6. Dynamic**

| Symbol    | Parameter                    | Test conditions   | Min. | Typ. | Max. | Unit |
|-----------|------------------------------|---|------|------|------|------|
| $C_{iss}$ | Input capacitance            | $V_{DS} = 25\text{ V}, f = 1\text{ MHz},$<br>$V_{GS} = 0$                           | -    | 1570 | -    | pF   |
| $C_{oss}$ | Output capacitance           |   | -    | 257  | -    | pF   |
| $C_{rss}$ | Reverse transfer capacitance |   | -    | 32   | -    | pF   |
| $Q_g$     | Total gate charge            | $V_{DD} = 15\text{ V}, I_D = 18\text{ A}$<br>$V_{GS} = 4.5\text{ V}$<br>(Figure 14) | -    | 12.9 | -    | nC   |
| $Q_{gs}$  | Gate-source charge           |   | -    | 3.9  | -    | nC   |
| $Q_{gd}$  | Gate-drain charge            |   | -    | 5.3  | -    | nC   |
| $R_G$     | Gate input resistance        | $f = 1\text{ MHz}$ Gate DC Bias = 0<br>Test signal level = 20 mV<br>$I_D = 0$       | -    | 1.5  | -    | W    |

**Table 7. Switching times**

| Symbol       | Parameter           | Test conditions   | Min. | Typ. | Max. | Unit |
|--------------|---------------------|---|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD} = 15\text{ V}, I_D = 9\text{ A},$<br>$R_G = 4.7\ \Omega, V_{GS} = 10\text{ V}$<br>(Figure 13) | -    | 14   | -    | ns   |
| $t_r$        | Rise time           |   | -    | 42   | -    | ns   |
| $t_{d(off)}$ | Turn-off delay time |   | -    | 37   | -    | ns   |
| $t_f$        | Fall time           |   | -    | 5.2  | -    | ns   |

Table 8. Source drain diode

| Symbol          | Parameter                     | Test conditions   | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|---|------|------|------|------|
| $I_{SD}$        | Source-drain current          |   | -    |      | 18   | A    |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |   | -    |      | 72   | A    |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD} = 18 \text{ A}, V_{GS} = 0$   | -    |      | 1.1  | V    |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 18 \text{ A},$<br>$di/dt = 100 \text{ A}/\mu\text{s},$<br>$V_{DD} = 25 \text{ V}, T_J = 150 \text{ }^\circ\text{C}$ | -    | 27.2 |      | ns   |
| $Q_{rr}$        | Reverse recovery charge       |   | -    | 24.5 |      | nC   |
| $I_{RRM}$       | Reverse recovery current      |   | -    | 1.8  |      | A    |

1. Pulse width limited by safe operating area.
2. Pulsed: pulse duration=300 $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

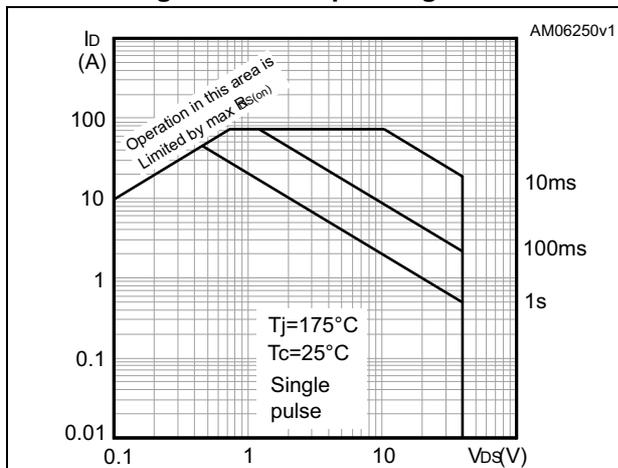


Figure 3. Thermal impedance

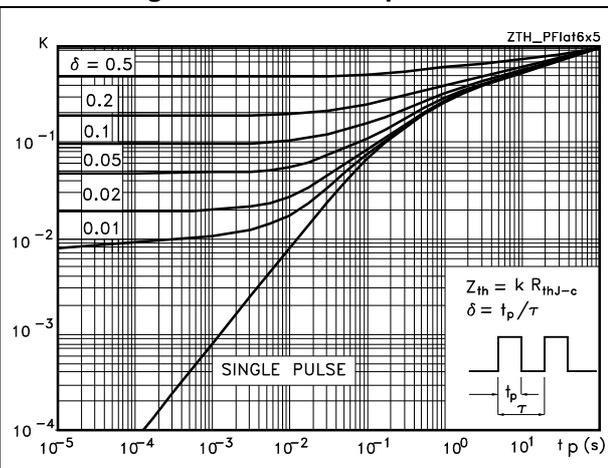


Figure 4. Output characteristics

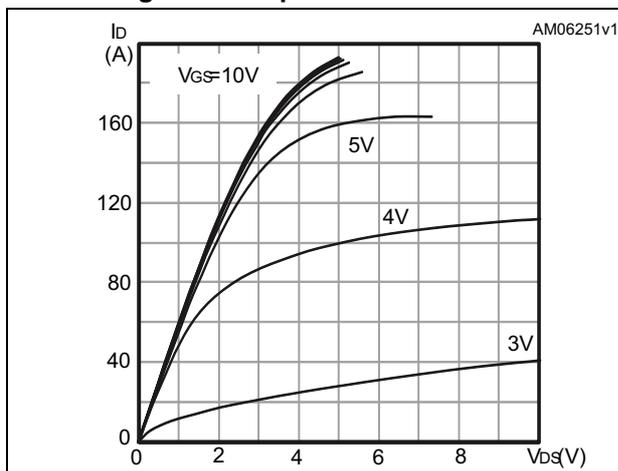


Figure 5. Transfer characteristics

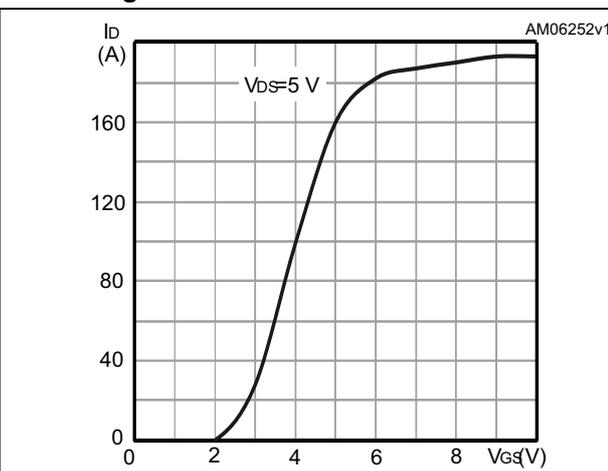


Figure 6. Normalized BV<sub>DSS</sub> vs temperature

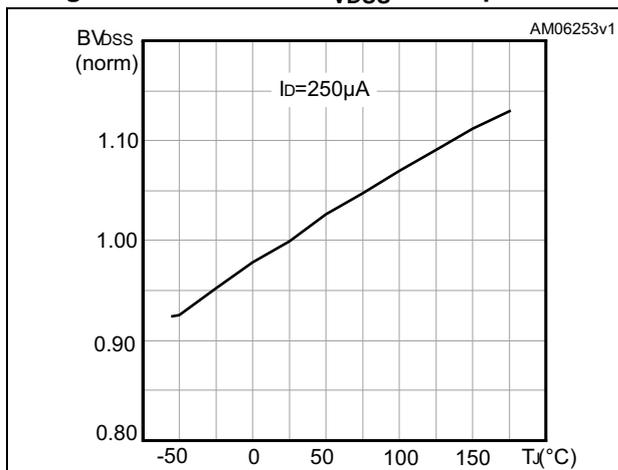


Figure 7. Static drain-source on-resistance

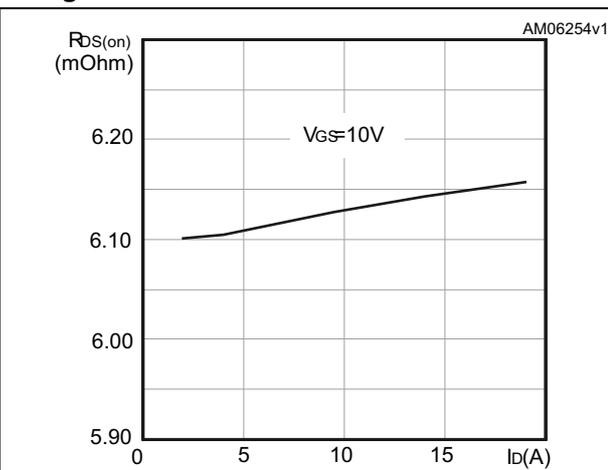


Figure 8. Gate charge vs gate-source voltage

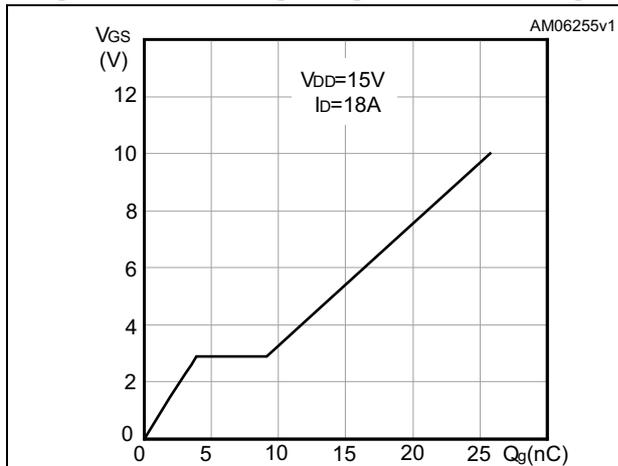


Figure 9. Capacitance variations

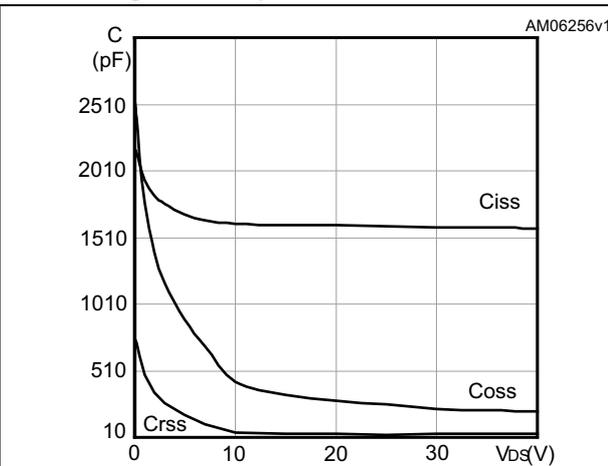


Figure 10. Normalized gate threshold voltage vs temperature

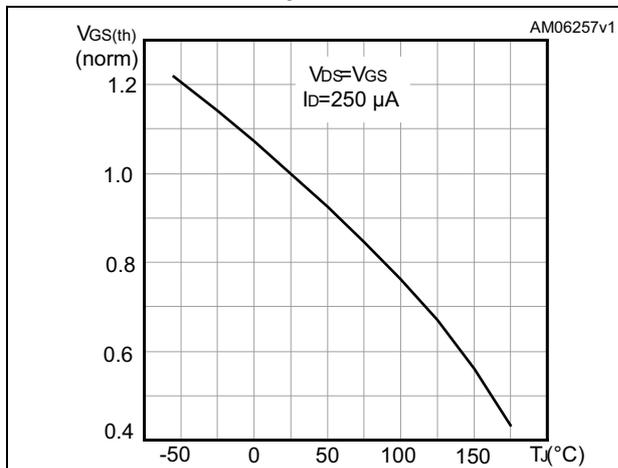


Figure 11. Normalized on-resistance vs temperature

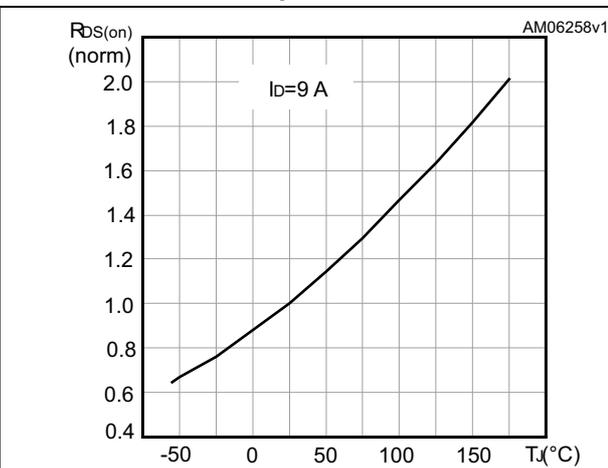
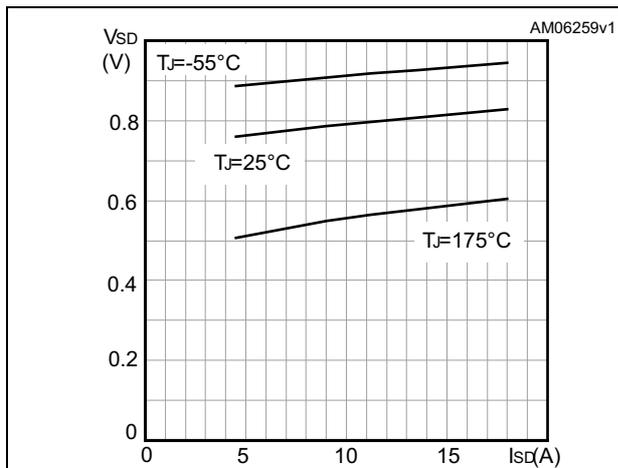


Figure 12. Source-drain diode forward characteristics



### 3 Test circuits

Figure 13. Switching times test circuit for resistive load

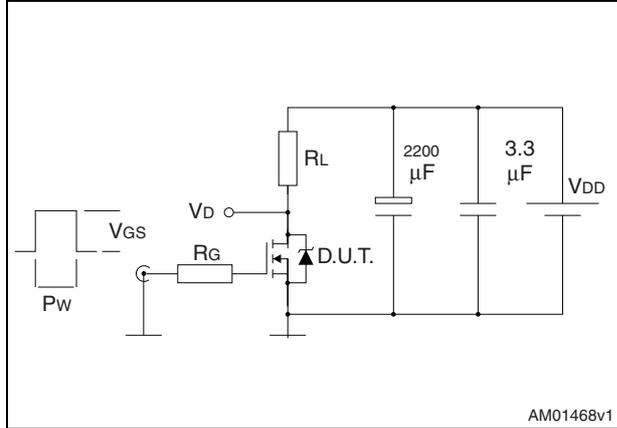


Figure 14. Gate charge test circuit

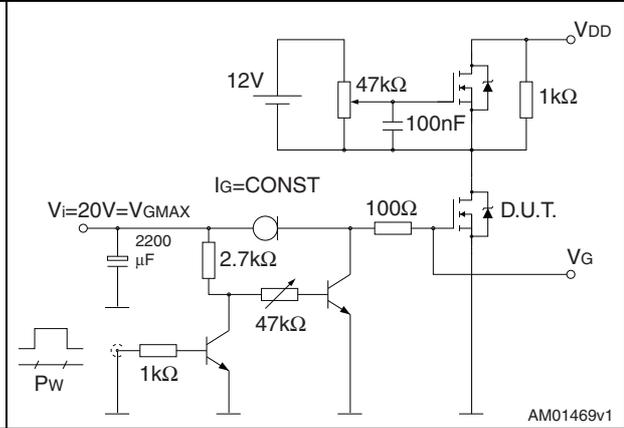


Figure 15. Test circuit for inductive load switching and diode recovery times

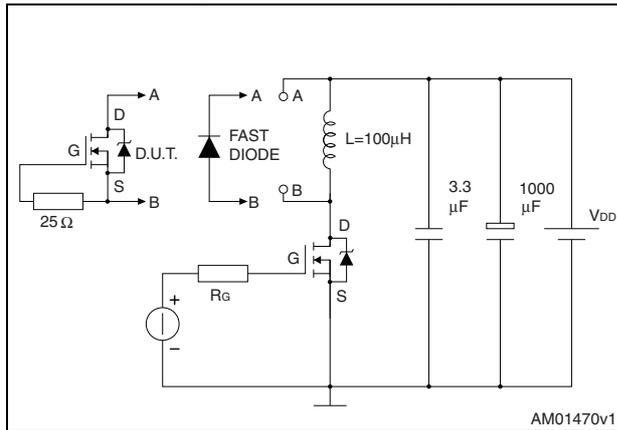


Figure 16. Unclamped inductive load test circuit

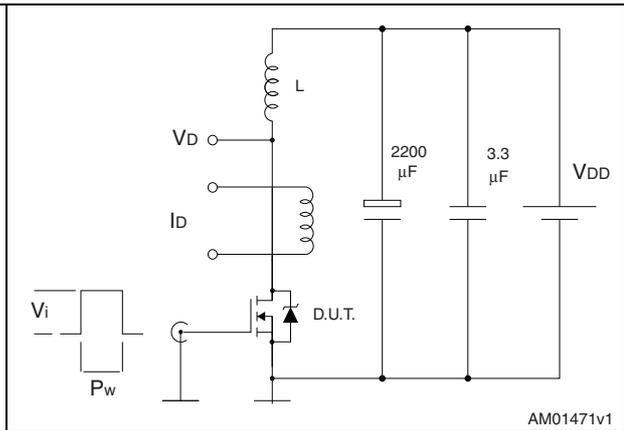


Figure 17. Unclamped inductive waveform

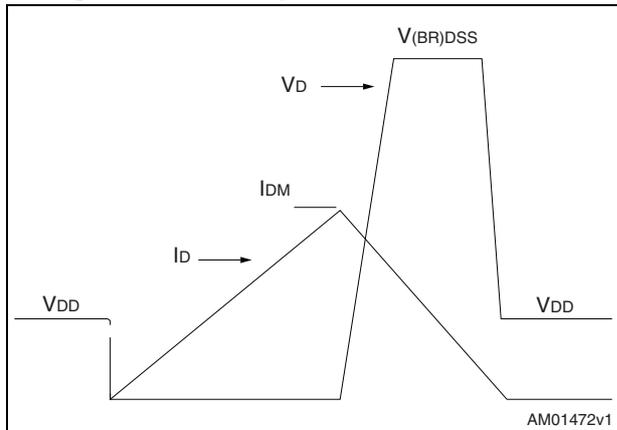
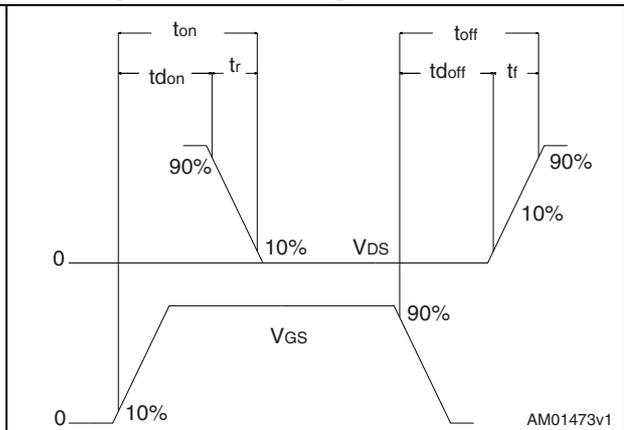


Figure 18. Switching time waveform



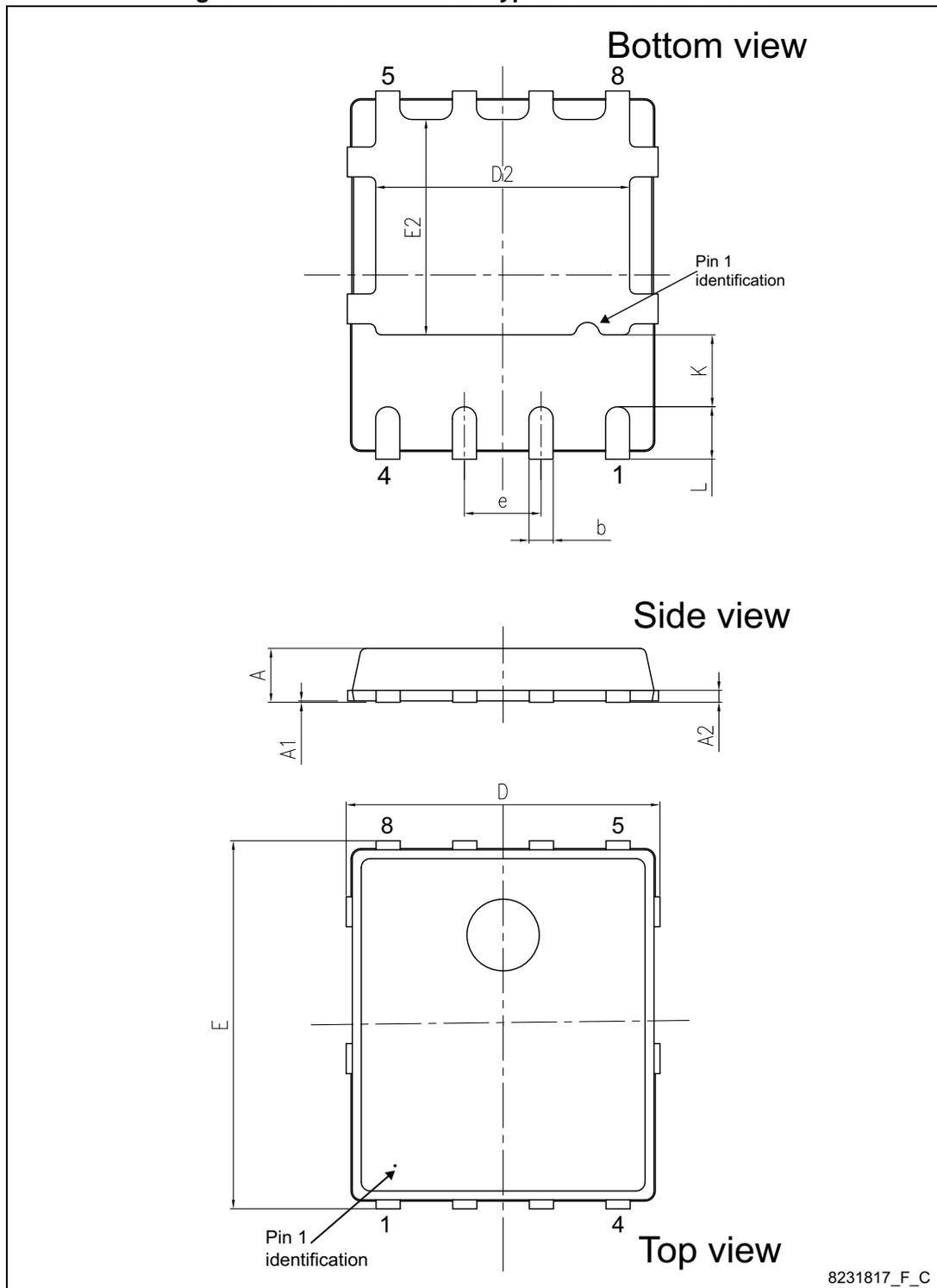
## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

Table 9. 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 19. PowerFLAT™ 5x6 type S-C mechanical data



8231817\_F\_C

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

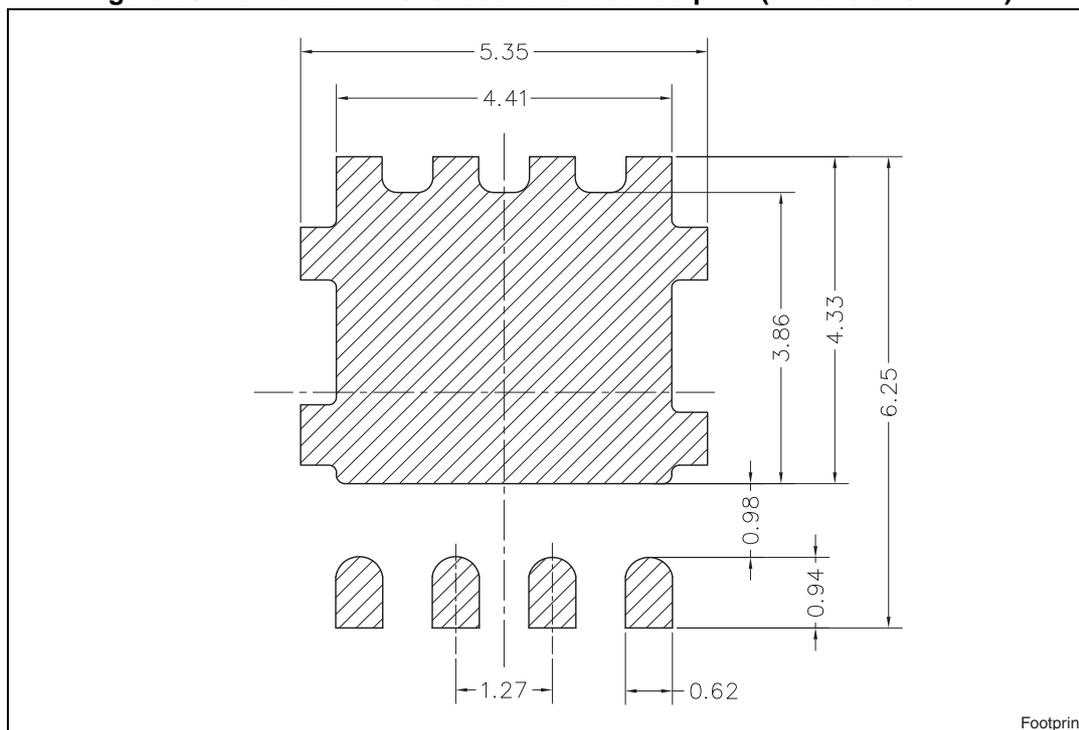
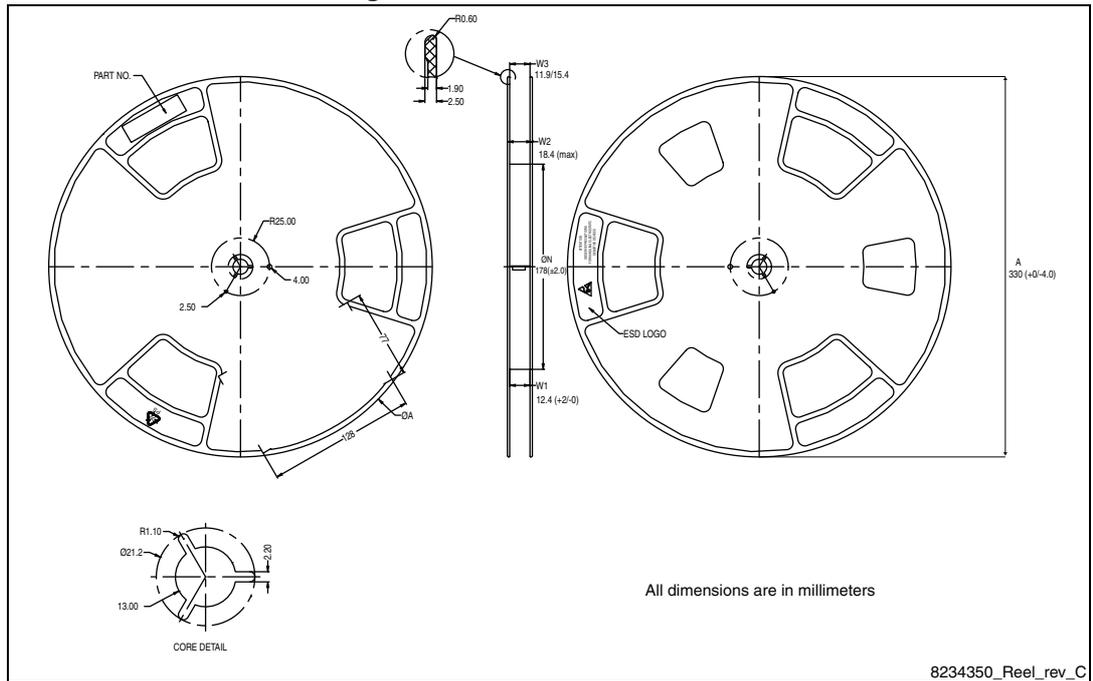




Figure 23. PowerFLAT™ 5x6 reel



## 6 Revision history

**Table 10. Document revision history**

| Date        | Revision | Changes   |
|-------------|----------|---|
| 01-Dec-2008 | 1        | First release   |
| 18-Jul-2011 | 2        | <p><i>Section 4: Package mechanical data</i> has been modified:</p> <ul style="list-style-type: none"> <li>– Added <i>Table 9: PowerFLAT™ 5x6 type S-C mechanical data</i></li> <li>– Added <i>Figure 19: PowerFLAT™ 5x6 type S-C mechanical data</i></li> <li>– Added PowerFLAT™ 5x6 type C-B mechanical data</li> <li>– Added PowerFLAT™ 5x6 type C-B drawing</li> <li>– Minor text changes.</li> </ul> |
| 21-Dec-2011 | 3        | <i>Section 4: Package mechanical data</i> has been modified.  |
| 25-Jan-2013 | 4        | <ul style="list-style-type: none"> <li>– <i>Table 1: Device summary</i> has been updated.</li> <li>– Minor text changes.</li> <li>– Changed: <i>Figure 1</i></li> <li>– Added: <i>Section 5: Packaging mechanical data</i></li> </ul>   |
| 12-Feb-2013 | 5        | <ul style="list-style-type: none"> <li>– Updated <math>T_J</math> and <math>T_{stg}</math> in <i>Table 2: Absolute maximum ratings</i>.</li> <li>– Updated <i>Section 4: Package mechanical data</i> and <i>Figure 22: PowerFLAT™ 5x6 package orientation in carrier tape..</i></li> </ul>  |
| 24-May-2013 | 6        | <ul style="list-style-type: none"> <li>– Modified: title and <i>Section 4: Package mechanical data</i></li> <li>– Minor text changes</li> </ul>   |

**Please Read Carefully:**

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

**UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.**

**ST PRODUCTS ARE NOT AUTHORIZED FOR USE IN WEAPONS. NOR ARE ST PRODUCTS DESIGNED OR AUTHORIZED FOR USE IN: (A) SAFETY CRITICAL APPLICATIONS SUCH AS LIFE SUPPORTING, ACTIVE IMPLANTED DEVICES OR SYSTEMS WITH PRODUCT FUNCTIONAL SAFETY REQUIREMENTS; (B) AERONAUTIC APPLICATIONS; (C) AUTOMOTIVE APPLICATIONS OR ENVIRONMENTS, AND/OR (D) AEROSPACE APPLICATIONS OR ENVIRONMENTS. WHERE ST PRODUCTS ARE NOT DESIGNED FOR SUCH USE, THE PURCHASER SHALL USE PRODUCTS AT PURCHASER'S SOLE RISK, EVEN IF ST HAS BEEN INFORMED IN WRITING OF SUCH USAGE, UNLESS A PRODUCT IS EXPRESSLY DESIGNATED BY ST AS BEING INTENDED FOR "AUTOMOTIVE, AUTOMOTIVE SAFETY OR MEDICAL" INDUSTRY DOMAINS ACCORDING TO ST PRODUCT DESIGN SPECIFICATIONS. PRODUCTS FORMALLY ESCC, QML OR JAN QUALIFIED ARE DEEMED SUITABLE FOR USE IN AEROSPACE BY THE CORRESPONDING GOVERNMENTAL AGENCY.**

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2013 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

[www.st.com](http://www.st.com)