



# STL7NM60N

N-channel 600 V, 0.805  $\Omega$ , 5.8 A PowerFLAT™ 5x5 MDmesh™ II Power MOSFET

## Features

| Order code | V <sub>DSS</sub> @ T <sub>JMAX</sub> | R <sub>DS(on)</sub> max. | I <sub>D</sub>       |
|------------|--------------------------------------|--------------------------|----------------------|
| STL7NM60N  | 650 V                                | < 0.90 $\Omega$          | 5.8 A <sup>(1)</sup> |

1. The value is rated according Rthj-case

- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance

## Application

- Switching applications

## Description

This device is an N-channel Power MOSFET developed using the second generation of MDmesh™ technology. This revolutionary Power MOSFET associates a vertical structure to the company's strip layout to yield one of the world's lowest on-resistance and gate charge. It is therefore suitable for the most demanding high efficiency converters.

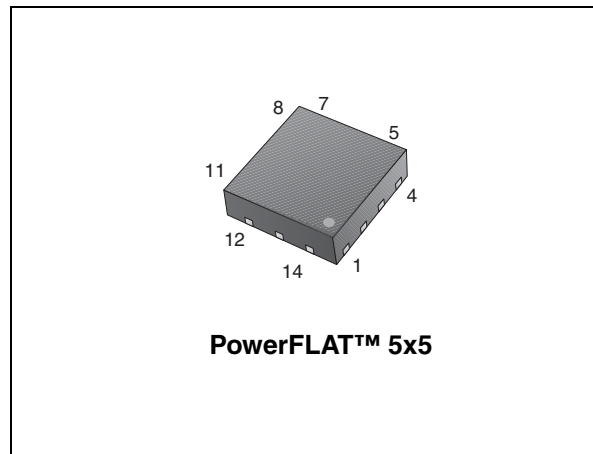


Figure 1. Internal schematic diagram

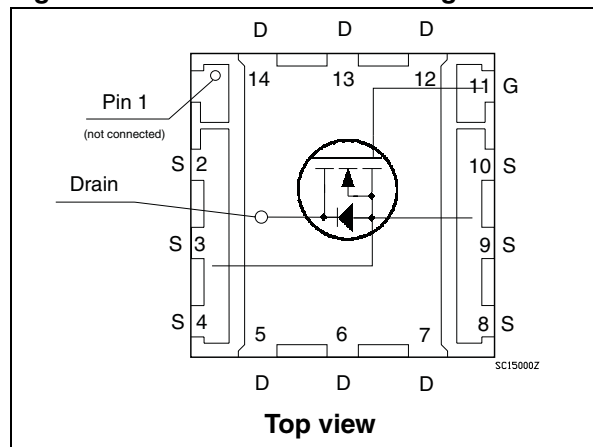


Table 1. Device summary

| Order code | Marking | Package        | Packaging     |
|------------|---------|----------------|---------------|
| STL7NM60N  | 7NM60N  | PowerFLAT™ 5x5 | 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>Revision history</b> .....             | <b>12</b> |

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol             | Parameter  | Value      | Unit             |
|--------------------|--|------------|------------------|
| $V_{DS}$           | Drain-source voltage   | 600        | V                |
| $V_{GS}$           | Gate-source voltage  | $\pm 25$   | V                |
| $I_D^{(1)}$        | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$     | 5.8        | A                |
| $I_D^{(1)}$        | Drain current (continuous) at $T_C=100\text{ }^\circ\text{C}$      | 3.7        | A                |
| $I_D^{(2)}$        | Drain current (continuous) at $T_{amb} = 25\text{ }^\circ\text{C}$ | 1.4        | A                |
| $I_D^{(2)}$        | Drain current (continuous) at $T_{amb}=100\text{ }^\circ\text{C}$  | 0.9        | A                |
| $I_{DM}^{(2)(3)}$  | Drain current (pulsed)   | 5.6        | A                |
| $P_{TOT}^{(2)}$    | Total dissipation at $T_{amb} = 25\text{ }^\circ\text{C}$          | 4          | W                |
| $P_{TOT}^{(1)}$    | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$              | 68         | W                |
| $I_{AS}$           | Avalanche current, repetitive or not-repetitive <sup>(3)</sup>     | 2          | A                |
| $E_{AS}$           | Single pulse avalanche energy <sup>(4)</sup>                       | 119        | mJ               |
| $dv/dt^{(5)}$      | Peak diode recovery voltage slope                                  | 15         | V/ns             |
| $T_J$<br>$T_{stg}$ | Operating junction temperature<br>storage temperature              | -55 to 150 | $^\circ\text{C}$ |

1. The value is rated according  $R_{thj-case}$ .
2. When mounted on FR-4 board of 1inch<sup>2</sup>, 2oz Cu,  $t < 10$  sec
3. Pulse width limited by  $T_{jmax}$
4. Starting  $T_j = 25\text{ }^\circ\text{C}$ ,  $I_D = I_{AS}$ ,  $V_{DD} = 50$  V
5.  $I_{SD} \leq 5.8$  A,  $dv/dt \leq 400$  A/ $\mu\text{s}$ ,  $V_{DS\ peak} \leq V_{(BR)DSS}$ ,  $V_{DD} = 80\% V_{(BR)DSS}$ .

**Table 3. Thermal resistance**

| Symbol              | Parameter                             | Value | Unit               |
|---------------------|---------------------------------------|-------|--------------------|
| $R_{thj-case}$      | Thermal resistance junction-case max. | 1.85  | $^\circ\text{C/W}$ |
| $R_{thj-amb}^{(1)}$ | Thermal resistance junction-amb max.  | 31.3  | $^\circ\text{C/W}$ |

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

## 2 Electrical characteristics

( $T_{CASE}=25^{\circ}C$  unless otherwise specified)

**Table 4. On/off states**

| Symbol        | Parameter                                      | Test conditions   | Min. | Typ.  | Max.     | Unit                           |
|---------------|--|---|------|-------|----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage ( $V_{GS}=0$ )  | $I_D = 1 \text{ mA}$  | 600  |       |          | V                              |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS}=0$ ) | $V_{DS} = 600 \text{ V}$ ,<br>$V_{DS} = 600 \text{ V}$ , $T_c = 125^{\circ}C$ |      |       | 1<br>100 | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$     | Gate body leakage current ( $V_{DS}=0$ )       | $V_{GS} = \pm 25 \text{ V}$   |      |       | 100      | nA                             |
| $V_{GS(th)}$  | Gate threshold voltage                         | $V_{DS}=V_{GS}$ , $I_D = 250 \mu\text{A}$                                     | 2    | 3     | 4        | V                              |
| $R_{DS(on)}$  | Static drain-source on resistance              | $V_{GS}=10 \text{ V}$ , $I_D=2.5 \text{ A}$                                   |      | 0.805 | 0.90     | $\Omega$                       |

**Table 5. Dynamic**

| Symbol                    | Parameter                     | Test conditions   | Min. | Typ. | Max. | Unit     |
|---------------------------|-------------------------------|---|------|------|------|----------|
| $C_{iss}$                 | Input capacitance             | $V_{DS} = 50\text{V}$ , $f=1 \text{ MHz}$ ,<br>$V_{GS}=0$                   | -    | 363  | -    | pF       |
| $C_{oss}$                 | Output capacitance            |   |      | 24.6 |      |          |
| $C_{rss}$                 | Reverse transfer capacitance  |   |      | 1.1  |      |          |
| $C_{oss \text{ eq. (1)}}$ | Output equivalent capacitance | $V_{GS}=0$ , $V_{DS}=0$ to 480 V  | -    | 130  | -    | pF       |
| $R_g$                     | Gate input resistance         | $f=1 \text{ MHz}$ gate DC bias=0<br>test signal level = 20 mV<br>open drain | -    | 5.4  | -    | $\Omega$ |
| $Q_g$                     | Total gate charge             | $V_{DD}=480 \text{ V}$ , $I_D = 5 \text{ A}$                                | -    | 14   | -    | nC       |
| $Q_{gs}$                  | Gate-source charge            | $V_{GS}=10 \text{ V}$   |      | 2.7  |      |          |
| $Q_{gd}$                  | Gate-drain charge             | (see Figure 15)   |      | 2.7  |      |          |

1.  $C_{oss \text{ eq.}}$  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 6. Switching times**

| Symbol       | Parameter           | Test conditions   | Min. | Typ. | Max. | Unit |
|--------------|---------------------|---|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD}=300 \text{ V}$ , $I_D = 2.5 \text{ A}$ ,<br>$R_G = 4.7 \Omega$ , $V_{GS} = 10 \text{ V}$<br>(see Figure 14) |      | 7    |      | ns   |
| $t_r$        | Rise time           |   |      | 10   |      |      |
| $t_{d(off)}$ | Turn-off delay time |   |      | 26   |      |      |
| $t_f$        | Fall time           |   |      | 12   |      |      |

Table 7. Source drain diode

| Symbol                            | Parameter  | Test conditions  | Min | Typ.             | Max | Unit          |
|-----------------------------------|--|--|-----|------------------|-----|---------------|
| $I_{SD}$                          | Source-drain current   |  | -   |                  | 5.8 | A             |
| $I_{SDM}^{(1)(2)}$                | Source-drain current (pulsed)  |  | -   |                  | 23  | A             |
| $V_{SD}^{(3)}$                    | Forward on voltage   | $I_{SD}=5\text{ A}$ , $V_{GS}=0$   | -   |                  | 1.3 | V             |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD}=5\text{ A}$ ,<br>$di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 60\text{ V}$<br>(see Figure 16)                                     | -   | 213<br>1.5<br>14 |     | ns<br>nC<br>A |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD}=5\text{ A}$ ,<br>$di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 60\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$<br>(see Figure 16) | -   | 265<br>1.8<br>14 |     | ns<br>nC<br>A |

1. Pulse width limited by safe operating area.
2. When mounted on FR-4 board of 1inch<sup>2</sup>, 2 oz Cu.
3. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

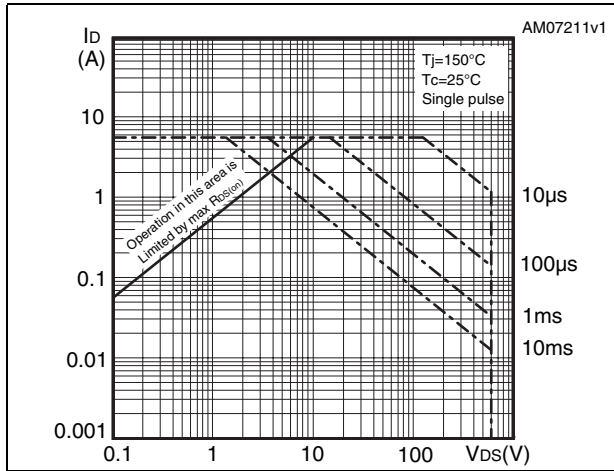


Figure 3. Thermal impedance

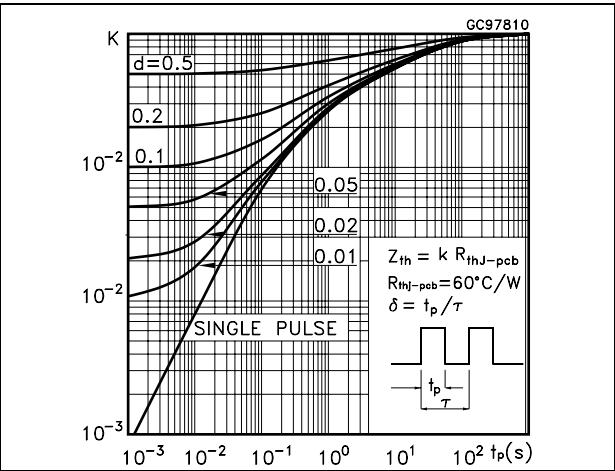


Figure 4. Output characteristics

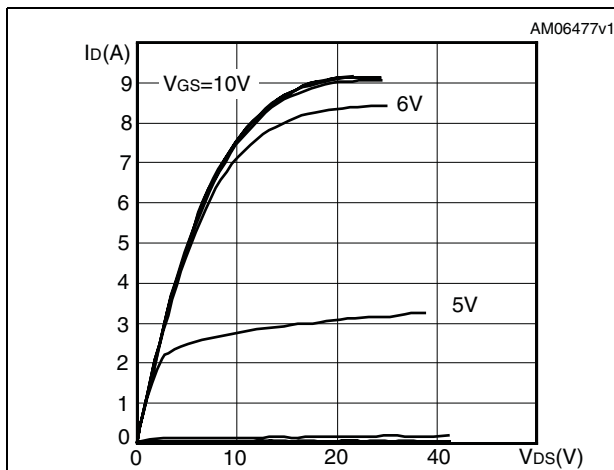


Figure 5. Transfer characteristics

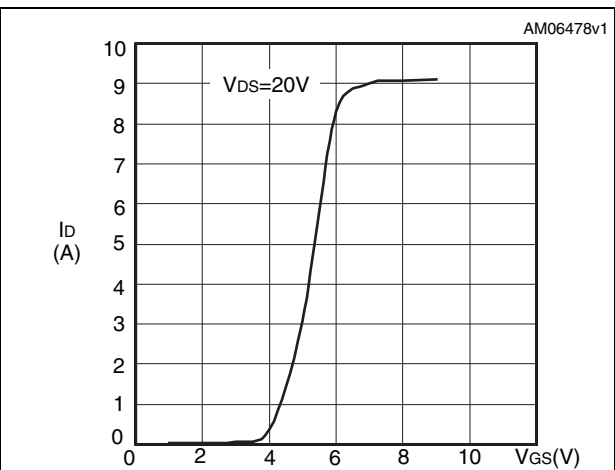


Figure 6. Gate charge vs gate-source voltage

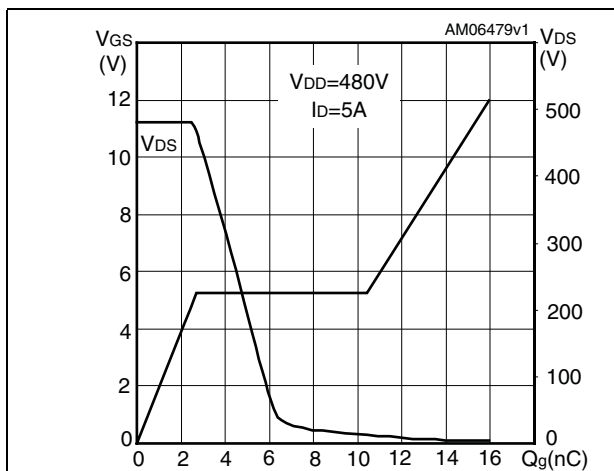


Figure 7. Static drain-source on resistance

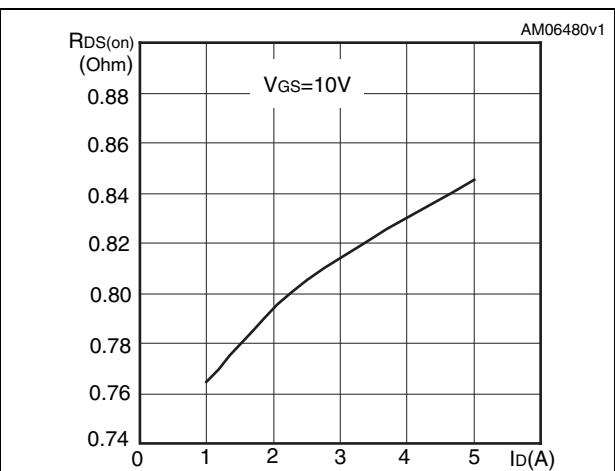


Figure 8. Capacitance variations

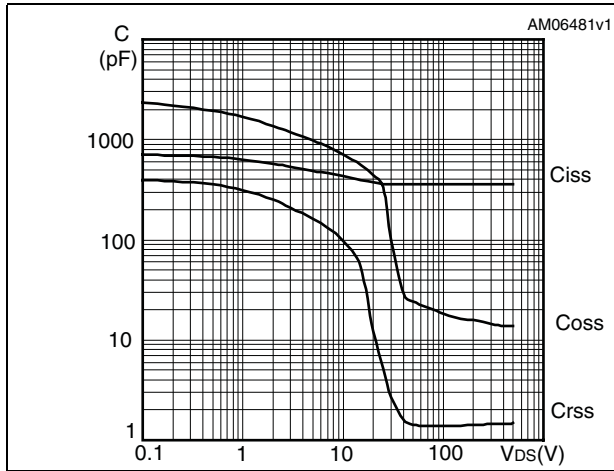


Figure 9. Output capacitance stored energy

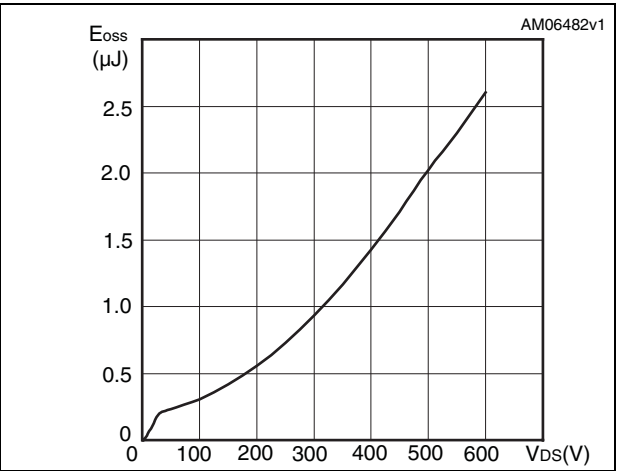


Figure 10. Normalized gate threshold voltage vs temperature

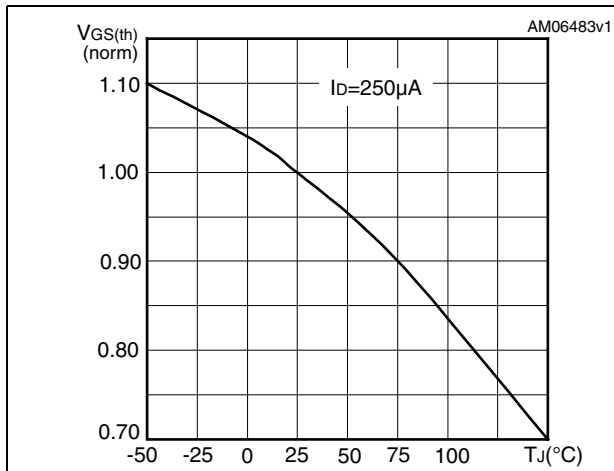


Figure 11. Normalized on resistance vs temperature

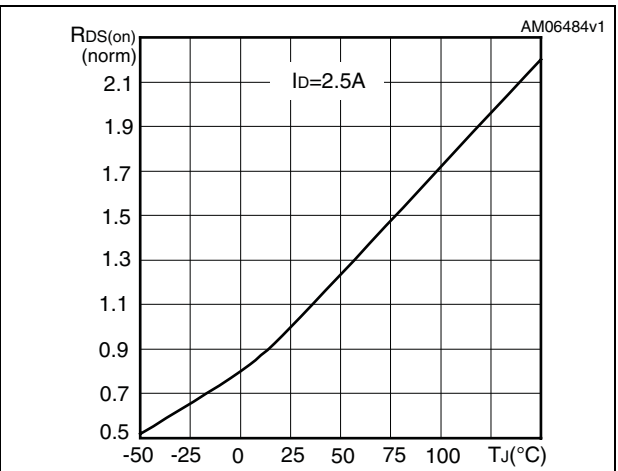


Figure 12. Normalized B<sub>VDS</sub> vs temperature

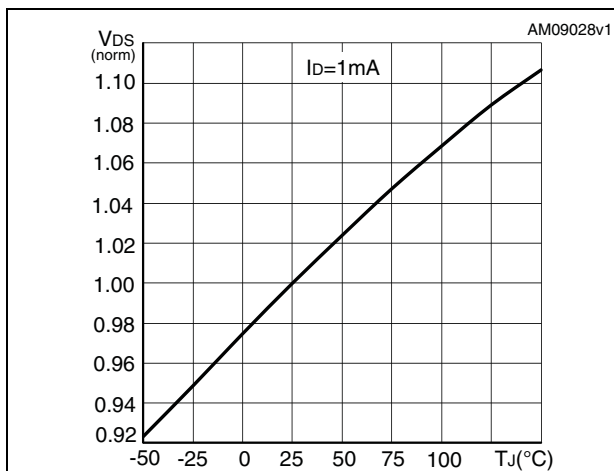
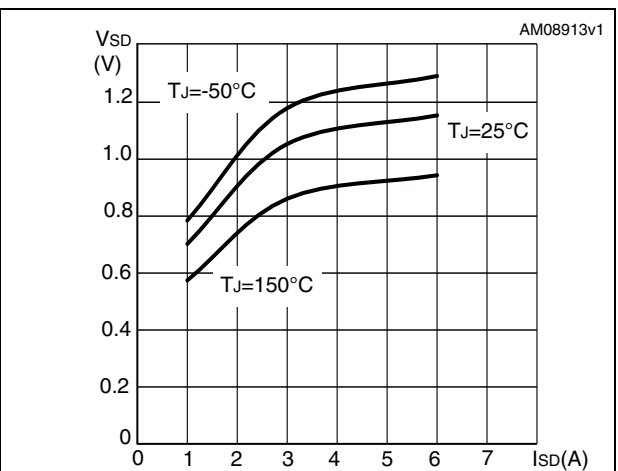
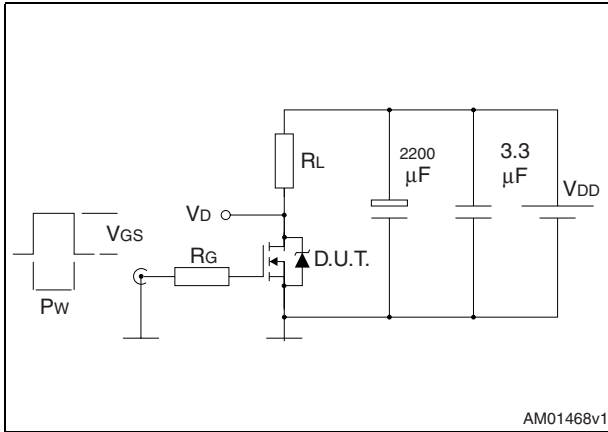


Figure 13. Source-drain diode forward characteristics



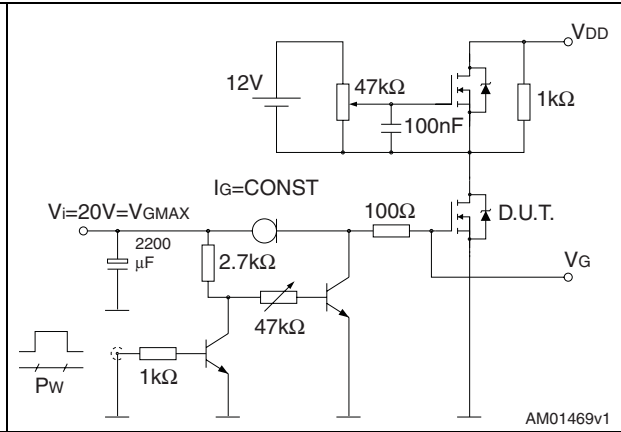
### 3 Test circuits

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



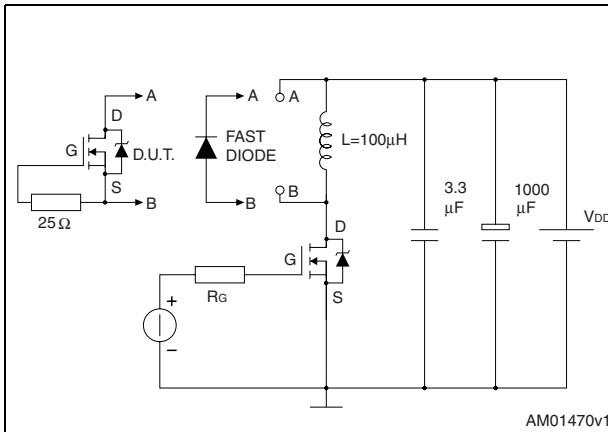
AM01468v1

**Figure 15. Gate charge test circuit**



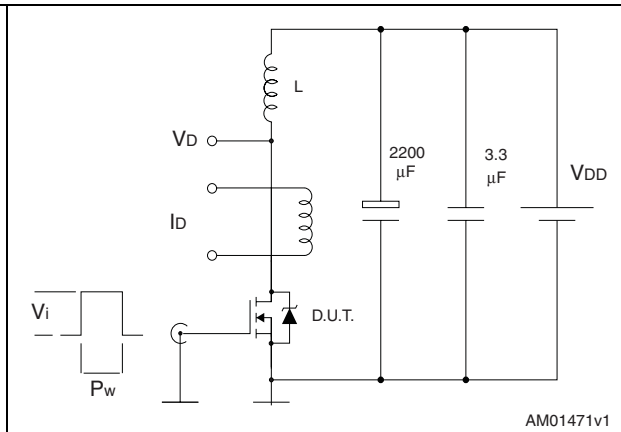
AM01469v1

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



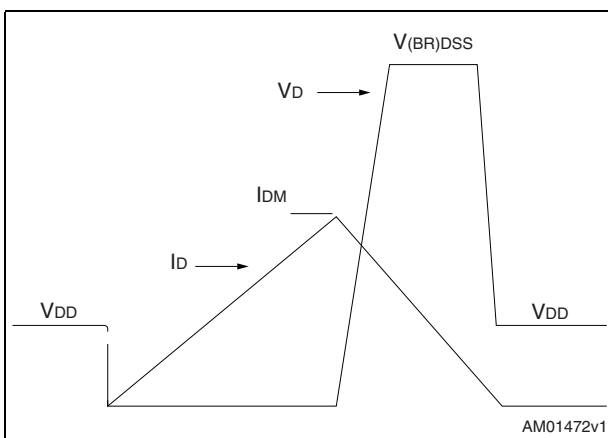
AM01470v1

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



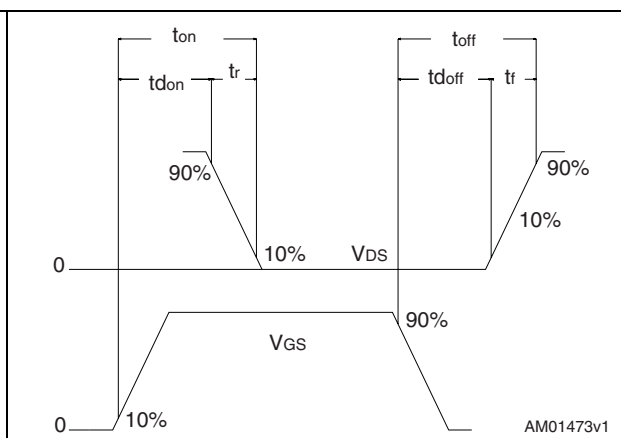
AM01471v1

**Figure 18. Unclamped inductive waveform**



AM01472v1

**Figure 19. Switching time waveform**



AM01473v1



## 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 8. PowerFLAT™ 5x5 mechanical dimensions

| Dim. | mm   |      |      |
|------|------|------|------|
|      | Min. | Typ. | Max. |
| A    | 0.80 | 0.90 | 1.0  |
| A1   | 0    | 0.02 | 0.05 |
| A3   |      | 0.24 |      |
| D    | 4.90 | 5.0  | 5.10 |
| E    | 4.90 | 5.0  | 5.10 |
| E2   | 2.49 | 2.57 | 2.64 |
| e    | 1.22 | 1.27 | 1.32 |
| b    | 0.43 | 0.51 | 0.58 |
| c    | 0.64 | 0.71 | 0.79 |

Figure 20. PowerFLAT™ 5x5 mechanical drawing

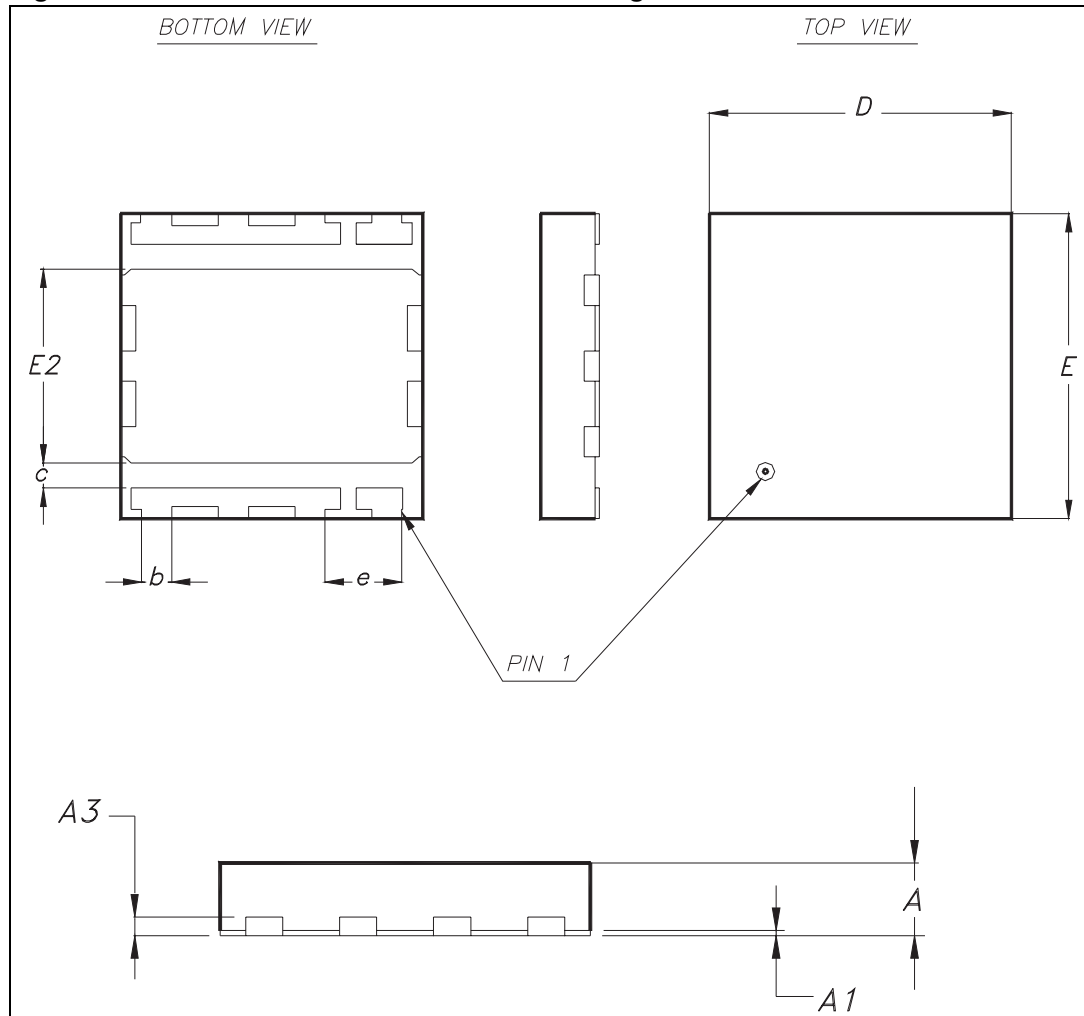
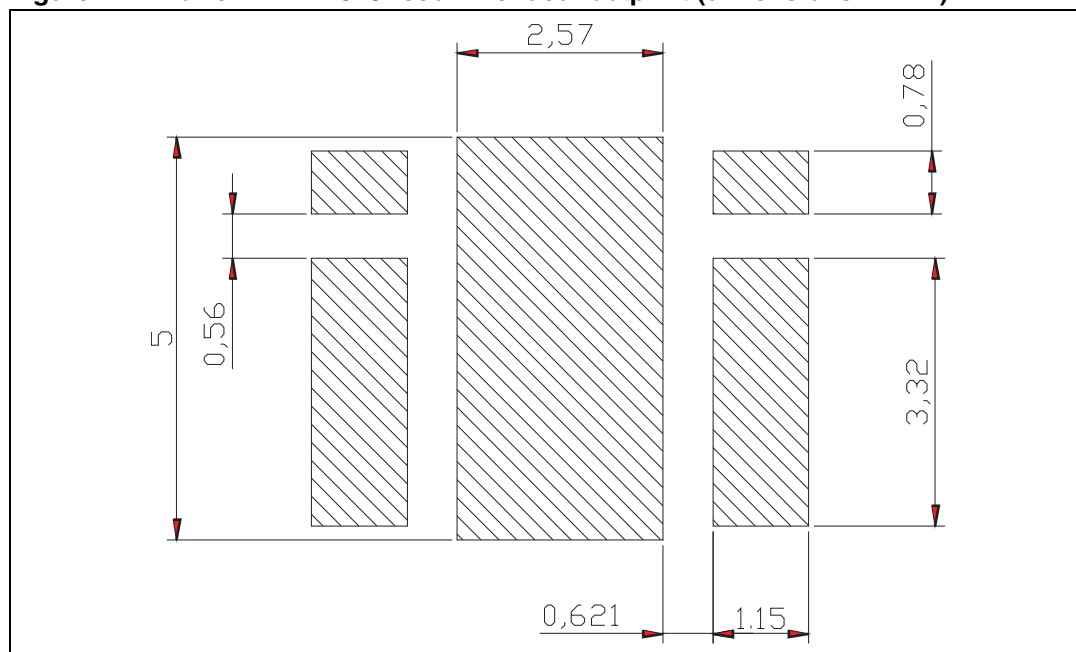


Figure 21. PowerFLAT™ 5x5 recommended footprint (dimensions in mm)



## 5 Revision history

**Table 9. Document revision history**

| Date        | Revision | Changes  |
|-------------|----------|--|
| 18-Jan-2011 | 1        | First release.   |
| 10-Nov-2011 | 2        | Updated <a href="#">Figure 1: Internal schematic diagram</a> in cover page.<br>Updated <a href="#">Table 2: Absolute maximum ratings</a> and <a href="#">Section 4: Package mechanical data</a> .<br>Minor text changes. |

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