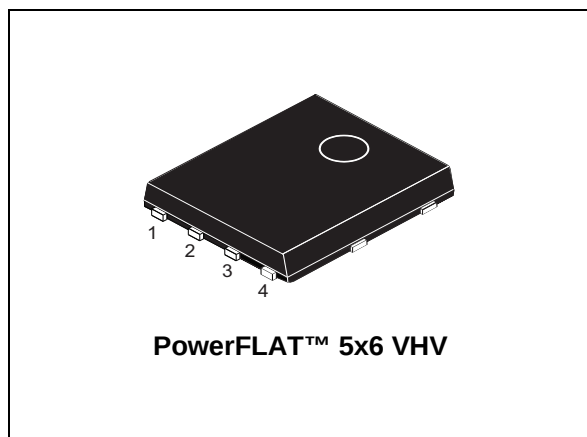
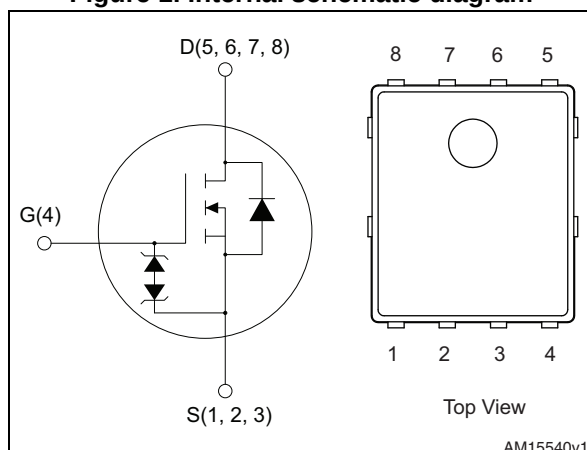


## N-channel 800 V, 2.1 $\Omega$ typ., 2.5 A MDMesh™ K5 Power MOSFET in a PowerFLAT™ 5x6 VHV package

Datasheet – production data



**Figure 1. Internal schematic diagram**



### Features

| Order code | $V_{DS}$ | $R_{DS(on)max.}$ | $I_D$ |
|------------|----------|------------------|-------|
| STL4N80K5  | 800 V    | 2.5 $\Omega$     | 2.5 A |

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

### Applications

- Switching applications

### Description

This very high voltage N-channel Power MOSFET is 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 code | Marking | Package            | Packaging     |
|------------|---------|--------------------|---------------|
| STL4N80K5  | 4N80K5  | PowerFLAT™ 5x6 VHV | Tape and reel |

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol          | Parameter                                                                                                            | Value       | Unit             |
|-----------------|----------------------------------------------------------------------------------------------------------------------|-------------|------------------|
| $V_{GS}$        | Gate-source voltage                                                                                                  | $\pm 30$    | V                |
| $I_D^{(1)}$     | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$                                                       | 2.5         | A                |
| $I_D^{(1)}$     | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$                                                      | 1.55        | A                |
| $I_{DM}^{(2)}$  | Drain current (pulsed)                                                                                               | 10          | A                |
| $P_{TOT}^{(1)}$ | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$                                                                | 38          | W                |
| $I_{AR}$        | Avalanche current, repetitive or not-repetitive (pulse width limited by $T_j$ max)                                   | 1           | A                |
| $E_{AS}$        | Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{ V}$ ) | 74.5        | mJ               |
| $dv/dt^{(3)}$   | Peak diode recovery voltage slope                                                                                    | 4.5         | V/ns             |
| $dv/dt^{(4)}$   | MOSFET $dv/dt$ ruggedness                                                                                            | 50          | V/ns             |
| $T_{stg}$       | Storage temperature                                                                                                  | - 55 to 150 | $^\circ\text{C}$ |
| $T_j$           | Operating junction temperature                                                                                       |             | $^\circ\text{C}$ |

1. The value is limited by package.
2. Pulse width limited by safe operating area.
3.  $I_{SD} \leq 2.5\text{ A}$ ,  $di/dt \leq 100\text{ A}/\mu\text{s}$ ,  $V_{DS(\text{peak})} \leq V_{(BR)DSS}$
4.  $V_{DS} \leq 640\text{ V}$

**Table 3. Thermal data**

| Symbol                     | Parameter                            | Value | Unit                      |
|----------------------------|--------------------------------------|-------|---------------------------|
| $R_{thj\text{-case}}$      | Thermal resistance junction-case max | 3.3   | $^\circ\text{C}/\text{W}$ |
| $R_{thj\text{-amb}}^{(1)}$ | Thermal resistance junction-amb max  | 59    | $^\circ\text{C}/\text{W}$ |

1. When mounted on 1inch<sup>2</sup> FR-4 board, 2 oz Cu.

## 2 Electrical characteristics

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

**Table 4. On /off states**

| Symbol        | Parameter                                        | Test conditions                                                         | Min. | Typ. | Max.     | Unit                           |
|---------------|--------------------------------------------------|-------------------------------------------------------------------------|------|------|----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage ( $V_{GS} = 0$ )  | $I_D = 1\text{ mA}$                                                     | 800  |      |          | V                              |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = 800\text{ V}$<br>$V_{DS} = 800\text{ V}, T_C = 125\text{ °C}$ |      |      | 1<br>50  | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$     | Gate-body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 20\text{ V}$                                              |      |      | $\pm 10$ | $\mu\text{A}$                  |
| $V_{GS(th)}$  | Gate threshold voltage                           | $V_{DS} = V_{GS}, I_D = 100\text{ }\mu\text{A}$                         | 3    | 4    | 5        | V                              |
| $R_{DS(on)}$  | Static drain-source on-resistance                | $V_{GS} = 10\text{ V}, I_D = 1.5\text{ A}$                              |      | 2.1  | 2.5      | $\Omega$                       |

**Table 5. Dynamic**

| Symbol            | Parameter                             | Test conditions                                                                                     | Min. | Typ. | Max. | Unit     |
|-------------------|---------------------------------------|-----------------------------------------------------------------------------------------------------|------|------|------|----------|
| $C_{iss}$         | Input capacitance                     | $V_{DS} = 100\text{ V}, f = 1\text{ MHz}, V_{GS} = 0$                                               | -    | 175  | -    | pF       |
| $C_{oss}$         | Output capacitance                    |                                                                                                     | -    | 20   | -    | pF       |
| $C_{rss}$         | Reverse transfer capacitance          |                                                                                                     | -    | 1    | -    | pF       |
| $C_{o(tr)}^{(1)}$ | Equivalent capacitance time related   | $V_{DS} = 0\text{ to }640\text{ V}, V_{GS} = 0$                                                     | -    | 26   | -    | pF       |
| $C_{o(er)}^{(2)}$ | Equivalent capacitance energy related |                                                                                                     | -    | 11   | -    | pF       |
| $R_G$             | Intrinsic gate resistance             | $f = 1\text{ MHz}, I_D = 0$                                                                         | -    | 15   | -    | $\Omega$ |
| $Q_g$             | Total gate charge                     | $V_{DD} = 640\text{ V}, I_D = 3\text{ A}, V_{GS} = 10\text{ V}$<br>(see <a href="#">Figure 16</a> ) | -    | 10.5 | -    | nC       |
| $Q_{gs}$          | Gate-source charge                    |                                                                                                     | -    | 2    | -    | nC       |
| $Q_{gd}$          | Gate-drain charge                     |                                                                                                     | -    | 7.5  | -    | nC       |

1.  $C_{oss\text{ eq.}}$  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.  $C_{oss\text{ eq.}}$  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  | $V_{DD} = 400\text{ V}$ , $I_D = 1.5\text{ A}$ ,<br>$R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$<br>(see <a href="#">Figure 15</a> ),<br>(see <a href="#">Figure 20</a> ) | -    | 16.5 | -   | ns   |
| $t_r$        | Rise time           |                                                                                                                                                                           | -    | 15   | -   | ns   |
| $t_{d(off)}$ | Turn-off delay time |                                                                                                                                                                           | -    | 36   | -   | ns   |
| $t_f$        | Fall time           |                                                                                                                                                                           | -    | 21   | -   | ns   |

Table 7. Source drain diode

| Symbol         | Parameter                     | Test conditions                                                                                                                                              | Min. | Typ. | Max. | Unit          |
|----------------|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $I_{SD}$       | Source-drain current          |                                                                                                                                                              | -    |      | 2.5  | A             |
| $I_{SDM}$      | Source-drain current (pulsed) |                                                                                                                                                              | -    |      | 10   | A             |
| $V_{SD}^{(1)}$ | Forward on voltage            | $I_{SD} = 3\text{ A}$ , $V_{GS} = 0$                                                                                                                         | -    |      | 1.5  | V             |
| $t_{rr}$       | Reverse recovery time         | $I_{SD} = 3\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 60\text{ V}$ (see <a href="#">Figure 17</a> )                                        | -    | 242  |      | ns            |
| $Q_{rr}$       | Reverse recovery charge       |                                                                                                                                                              | -    | 1.42 |      | $\mu\text{C}$ |
| $I_{RRM}$      | Reverse recovery current      |                                                                                                                                                              | -    | 12   |      | A             |
| $t_{rr}$       | Reverse recovery time         | $I_{SD} = 3\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 60\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$<br>(see <a href="#">Figure 17</a> ) | -    | 373  |      | ns            |
| $Q_{rr}$       | Reverse recovery charge       |                                                                                                                                                              | -    | 1.98 |      | $\mu\text{C}$ |
| $I_{RRM}$      | Reverse recovery current      |                                                                                                                                                              | -    | 10.5 |      | A             |

1. Pulsed: pulse duration = 300  $\mu\text{s}$ , 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 | $I_{GS} = \pm 1\text{ mA}$ , $I_D = 0$ | 30  | -    | -   | V    |

The built-in back-to-back Zener diodes have been specifically designed to enhance the ESD capability of the device. The Zener voltage is appropriate for efficient and cost-effective intervention to protect the device integrity. These integrated Zener diodes thus eliminate the need for external components.

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

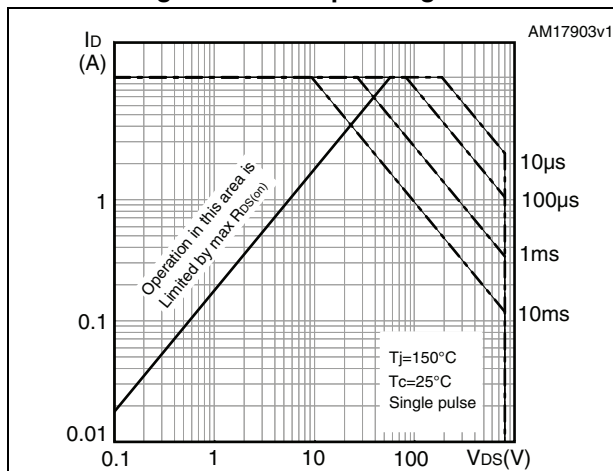


Figure 3. Thermal impedance

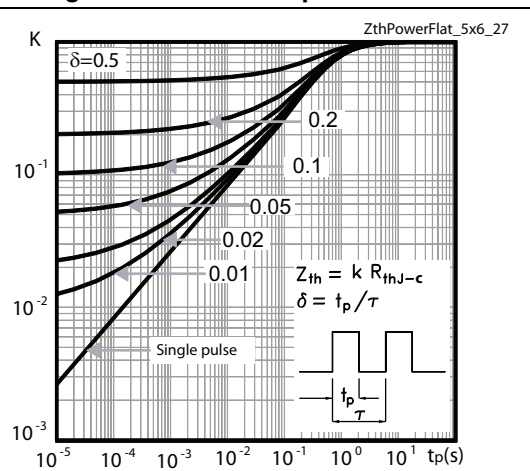


Figure 4. Output characteristics

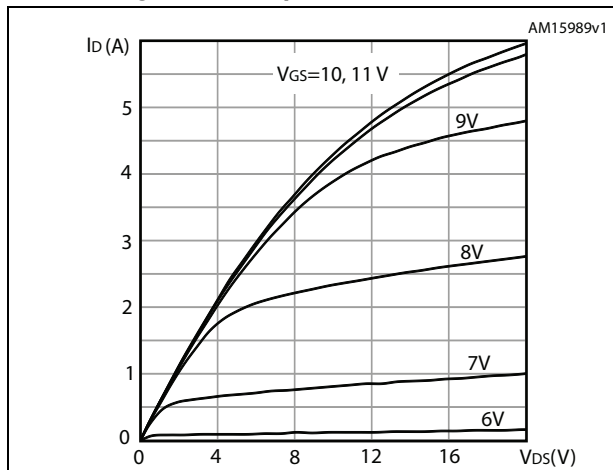


Figure 5. Transfer characteristics

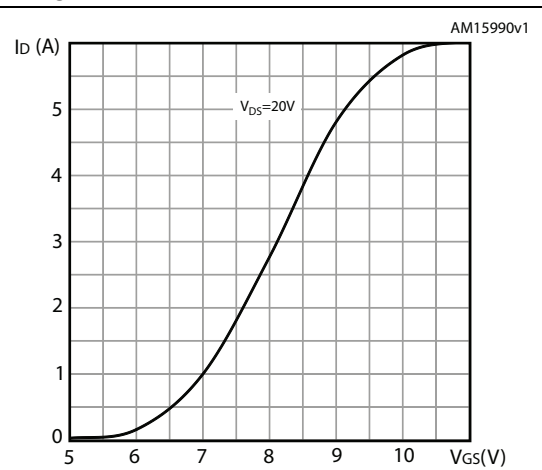


Figure 6. Gate charge vs gate-source voltage

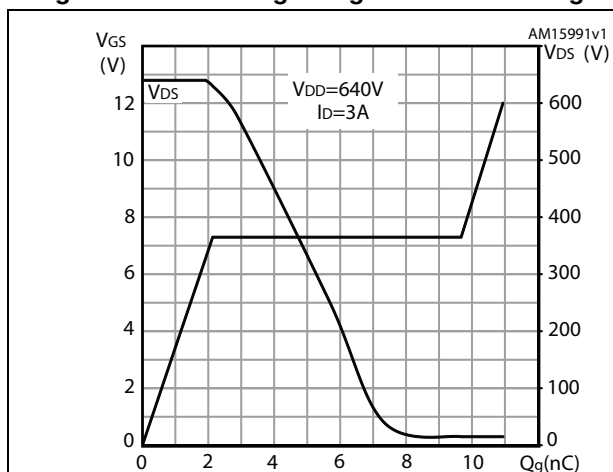


Figure 7. Static drain-source on-resistance

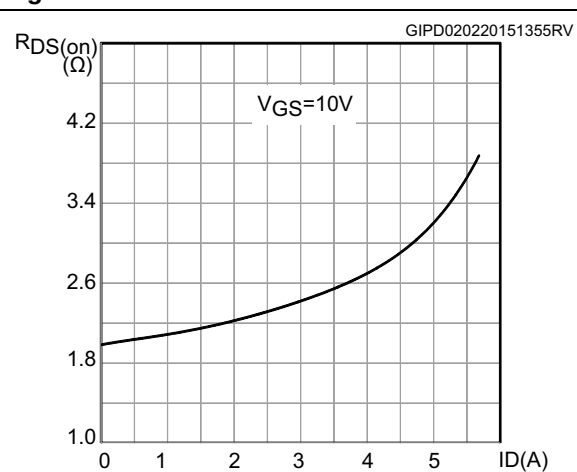


Figure 8. Capacitance variations

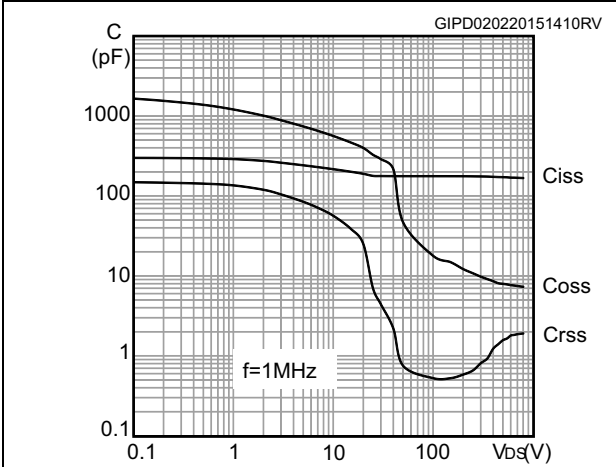


Figure 9. Output capacitance stored energy

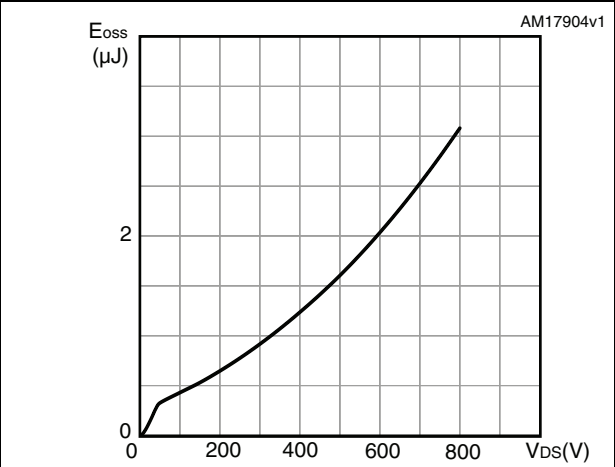


Figure 10. Normalized gate threshold voltage vs. temperature

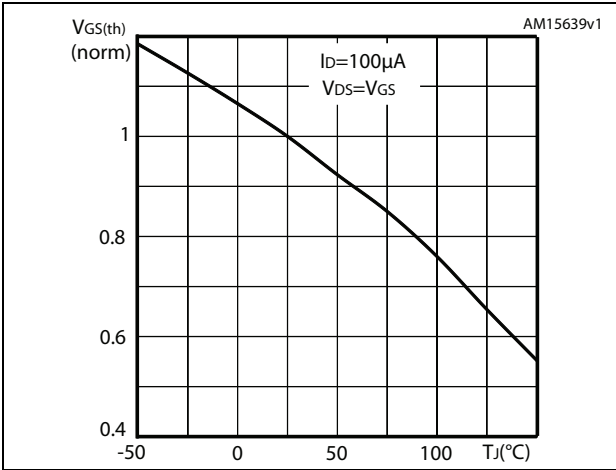


Figure 11. Normalized on-resistance vs. temperature

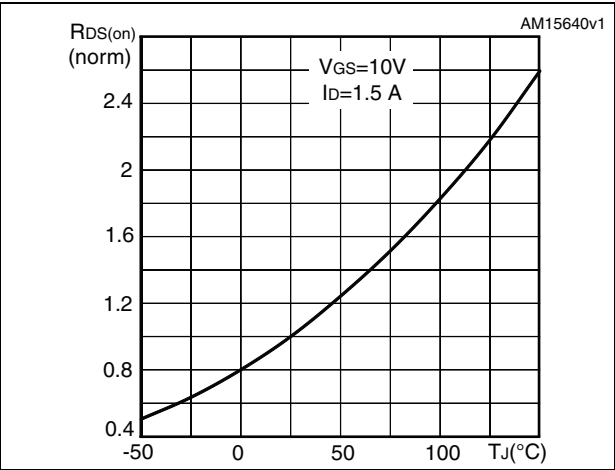


Figure 12. Drain-source diode forward characteristics

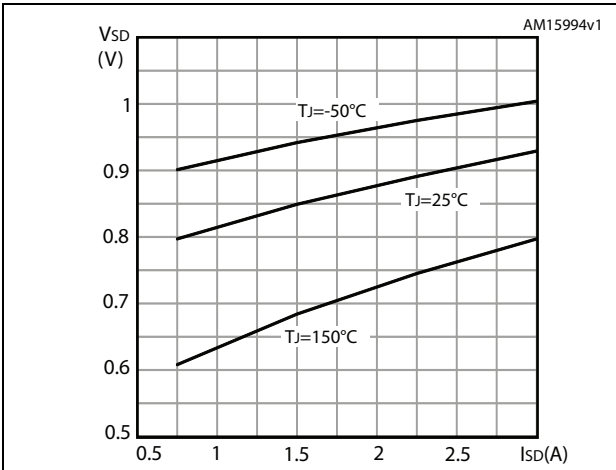


Figure 13. Normalized  $V_{DS}$  vs. temperature

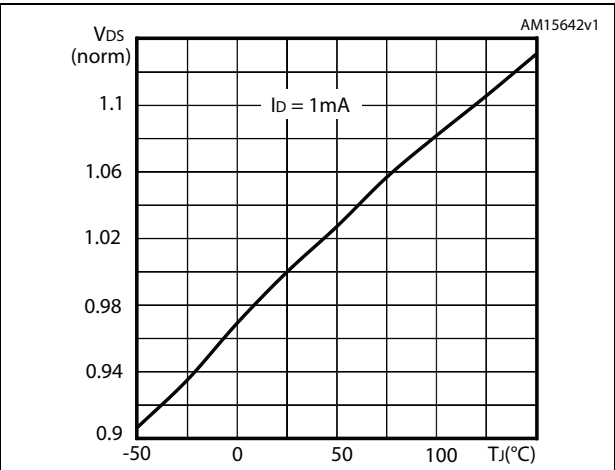
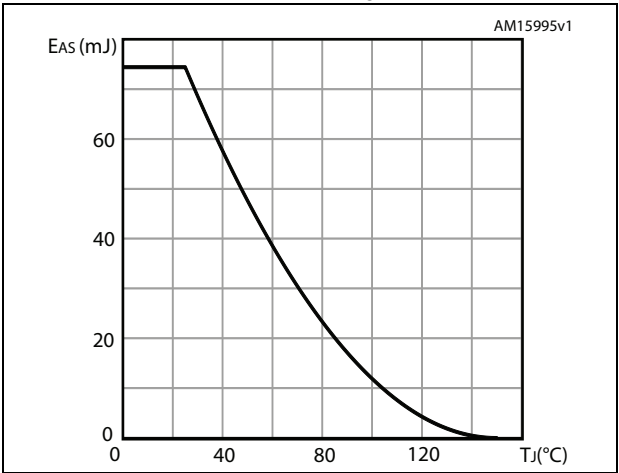


Figure 14. Maximum avalanche energy vs.  
starting  $T_J$



### 3 Test circuits

Figure 15. Switching times test circuit for resistive load

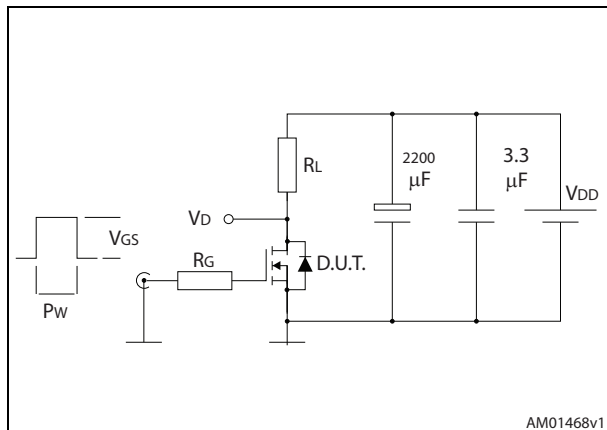


Figure 16. Gate charge test circuit

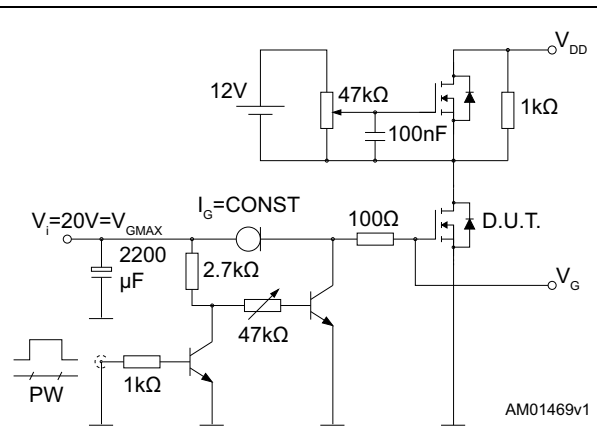


Figure 17. Test circuit for inductive load switching and diode recovery times



Figure 18. Unclamped inductive load test circuit

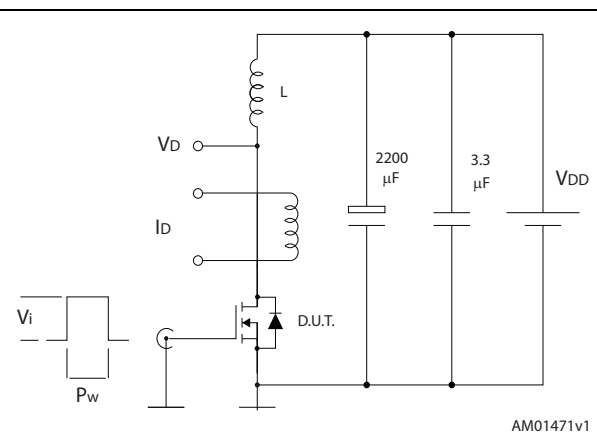


Figure 19. Unclamped inductive waveform

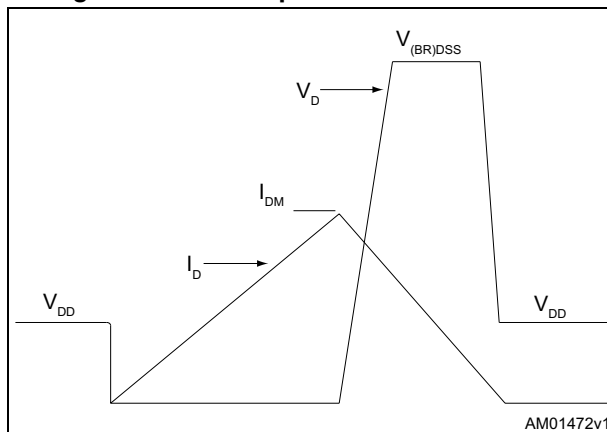
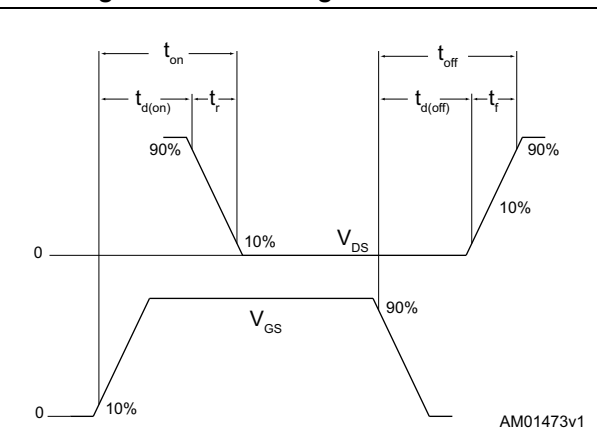


Figure 20. Switching time waveform



## 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.

Figure 21. PowerFLAT™ 5x6 VHV

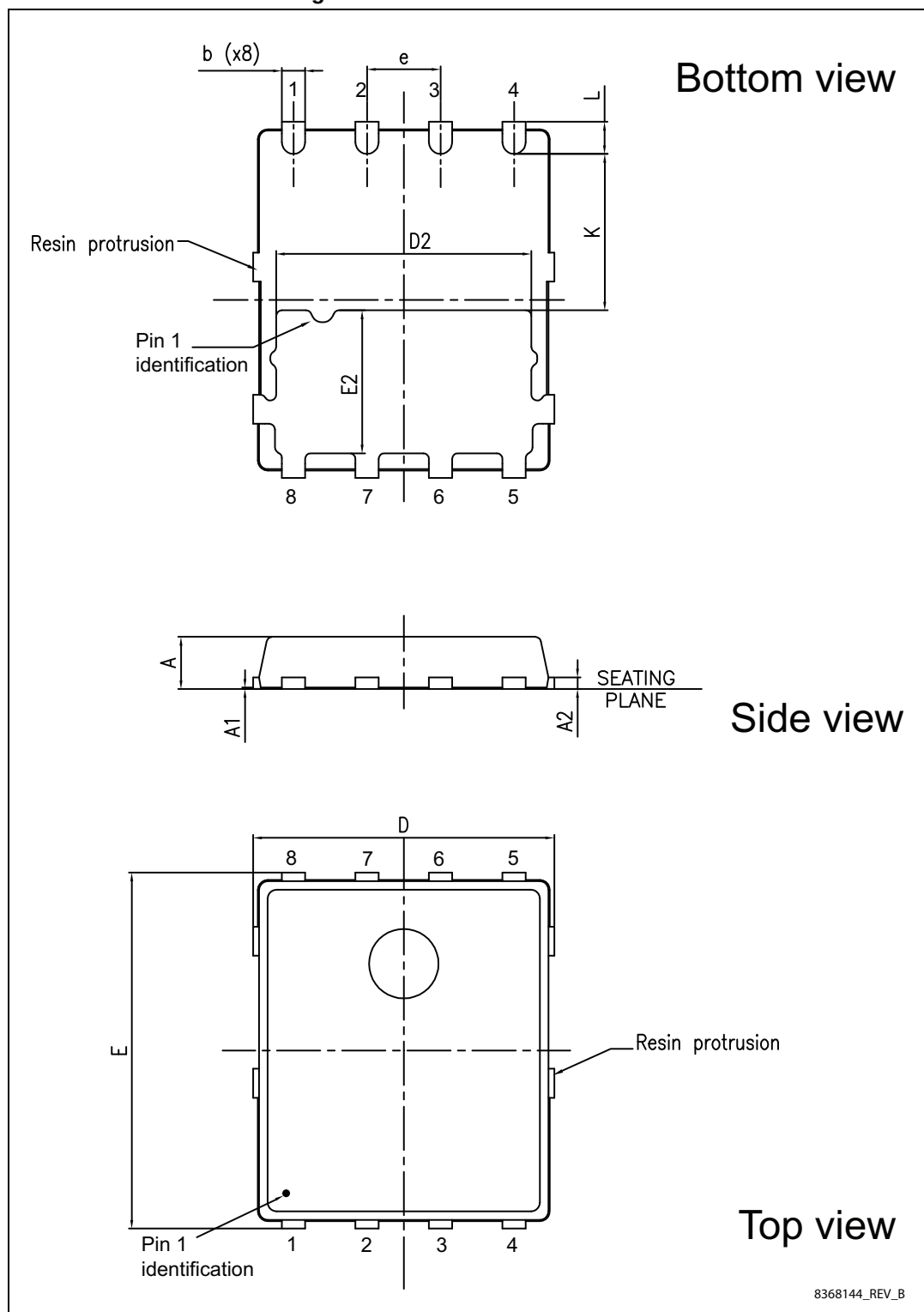
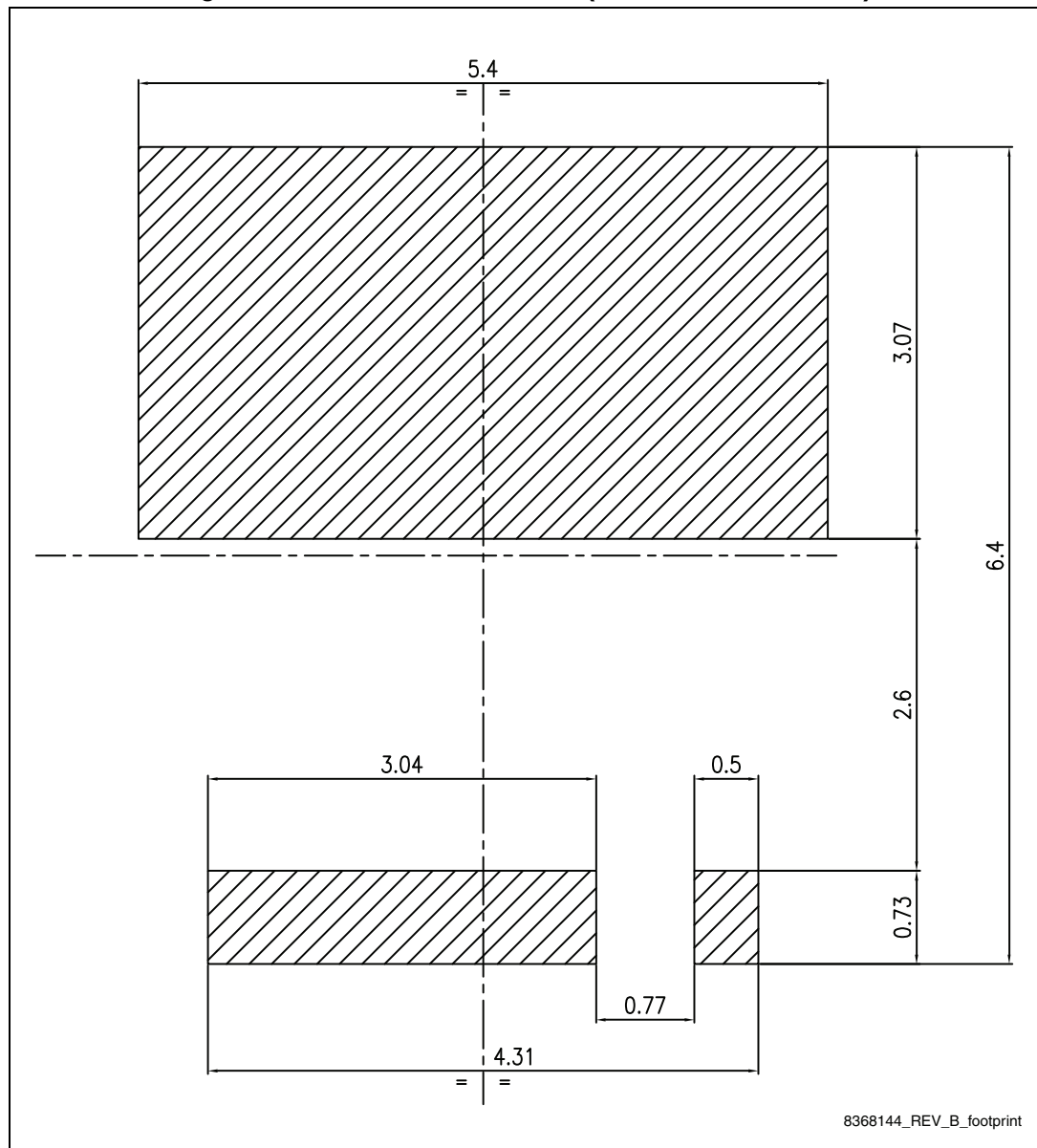


Table 9. PowerFLAT™ 5x6 VHV mechanical data

| DIM | mm.  |      |      |
|-----|------|------|------|
|     | min. | typ. | max. |
| A   | 0.80 |      | 1.00 |
| A1  | 0.02 |      | 0.05 |
| A2  |      | 0.25 |      |
| b   | 0.30 |      | 0.50 |
| D   | 5.00 | 5.20 | 5.40 |
| E   | 5.95 | 6.15 | 6.35 |
| D2  | 4.30 | 4.40 | 4.50 |
| E2  | 2.40 | 2.50 | 2.60 |
| e   |      | 1.27 |      |
| L   | 0.50 | 0.55 | 0.60 |
| K   | 2.60 | 2.70 | 2.80 |

**Figure 22. PowerFLAT™ 5x6 VHV (dimensions are in mm)**



5 Packaging mechanical data

Figure 23. PowerFLAT™ 5x6 tape

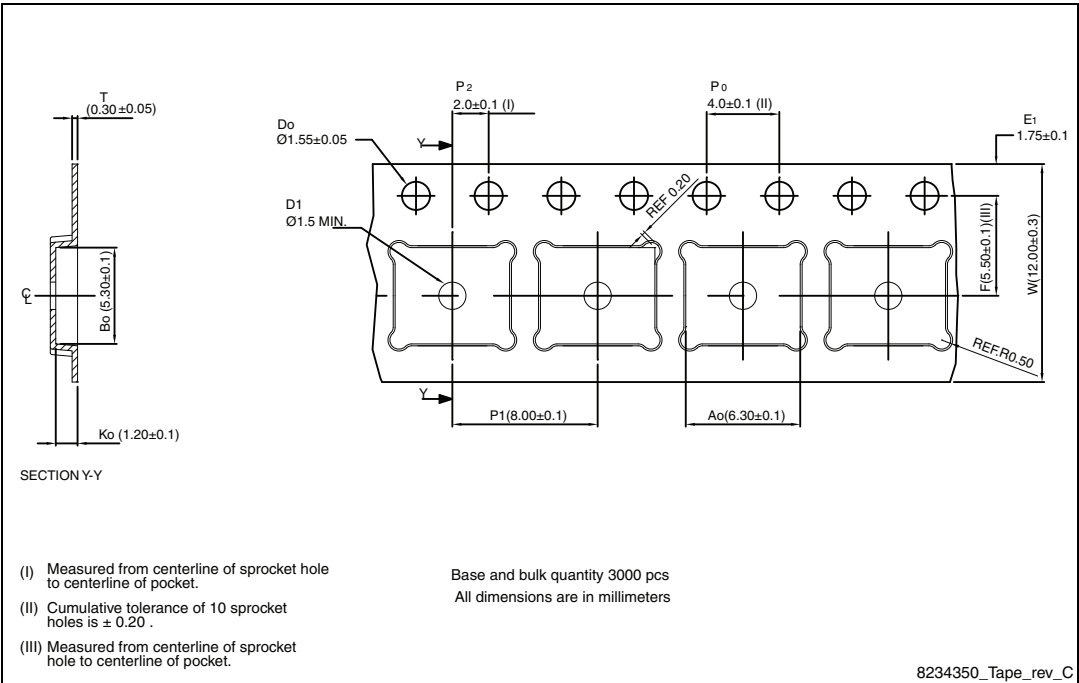
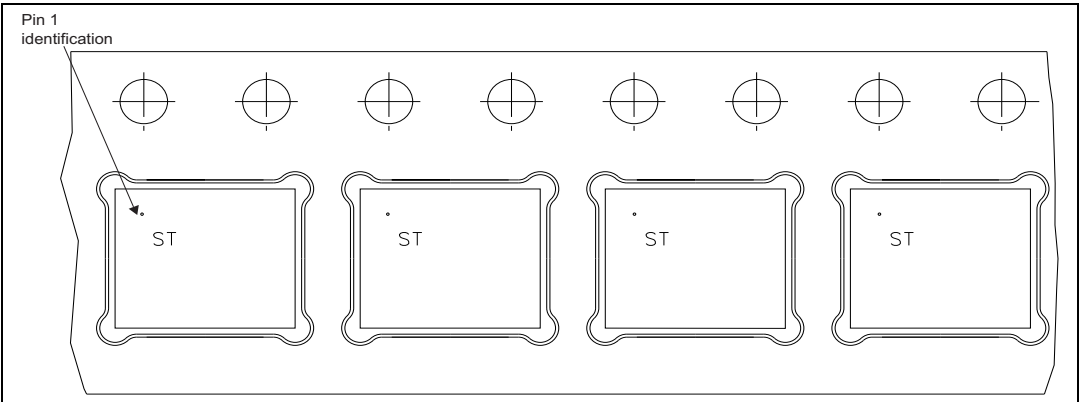


Figure 24. PowerFLAT™ 5x6 package orientation in carrier tape





## 6 Revision history

**Table 10. Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                                                                                                                            |
|-------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 22-Nov-2013 | 1        | First release.                                                                                                                                                                                                                                                                                                                     |
| 14-May-2015 | 2        | Updated title, features and description in cover page.<br>Updated <a href="#">3: Test circuits</a> .<br>Updated <a href="#">Figure 7.: Static drain-source on-resistance</a> , <a href="#">Figure 8.: Capacitance variations</a> and <a href="#">Figure 14.: Maximum avalanche energy vs. starting TJ</a> .<br>Minor text changes. |

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