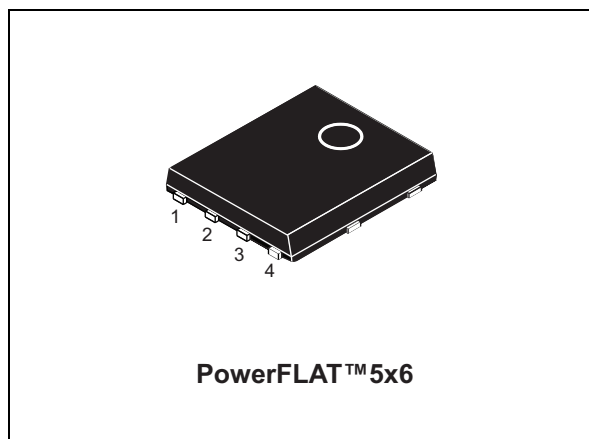


## N-channel 30 V, 0.0038 $\Omega$ typ., 24 A STripFET™ VI DeepGATE™ Power MOSFET in PowerFLAT™ 5x6 package

Datasheet - production data



### Features

| Order code  | V <sub>DS</sub> | R <sub>DS(on)</sub> max. | I <sub>D</sub> |
|-------------|-----------------|--------------------------|----------------|
| STL90N3LLH6 | 30 V            | 0.0045 $\Omega$          | 24 A<br>(1)    |

1. The value is rated according R<sub>thj-pcb</sub>

- 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
- Very low switching gate charge

### Applications

- Switching applications

### Description

This device is an N-channel Power MOSFET developed using the 6<sup>th</sup> generation of STripFET™ DeepGATE™ technology, with a new gate structure. The resulting Power MOSFET exhibits the lowest R<sub>DS(on)</sub> in all packages.

Figure 1. Internal schematic diagram

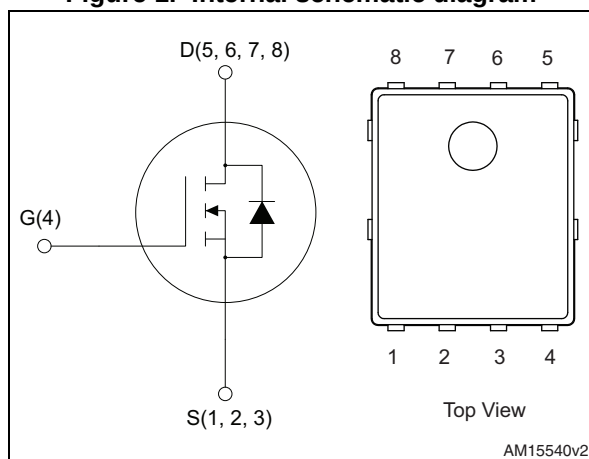


Table 1. Device summary

| Order code  | Marking  | Packages       | Packaging     |
|-------------|----------|----------------|---------------|
| STL90N3LLH6 | 90N3LLH6 | PowerFLAT™ 5x6 | Tape and reel |

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2      **Electrical characteristics** ..... 4

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4      **Package mechanical data** ..... 9

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol             | Parameter                                                           | Value      | Unit                |
|--------------------|---------------------------------------------------------------------|------------|---------------------|
| $V_{DS}$           | Drain-source voltage                                                | 30         | V                   |
| $V_{GS}$           | Gate-source voltage                                                 | $\pm 20$   | V                   |
| $I_D^{(1)}$        | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$      | 90         | A                   |
| $I_D^{(1)}$        | Drain current (continuous) at $T_C = 70\text{ }^\circ\text{C}$      | 67.5       | A                   |
| $I_D^{(1)}$        | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$     | 56.2       | A                   |
| $I_D^{(2)}$        | Drain current (continuous) at $T_{pcb} = 25\text{ }^\circ\text{C}$  | 24         | A                   |
| $I_D^{(2)}$        | Drain current (continuous) at $T_{pcb} = 70\text{ }^\circ\text{C}$  | 18         | A                   |
| $I_D^{(2)}$        | Drain current (continuous) at $T_{pcb} = 100\text{ }^\circ\text{C}$ | 15         | A                   |
| $I_{DM}^{(2)(3)}$  | Drain current (pulsed)                                              | 96         | A                   |
| $I_{DM}^{(1)(3)}$  | Drain current (pulsed)                                              | 360        | A                   |
| $P_{TOT}^{(1)}$    | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$               | 60         | W                   |
| $P_{TOT}^{(2)}$    | Total dissipation at $T_{pcb} = 25\text{ }^\circ\text{C}$           | 4          | W                   |
|                    | Derating factor                                                     | 0.03       | W/ $^\circ\text{C}$ |
| $T_J$<br>$T_{stg}$ | Operating junction temperature<br>Storage temperature               | -55 to 150 | $^\circ\text{C}$    |

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 (drain, steady state) | 2.08  | $^\circ\text{C/W}$ |
| $R_{thj-pcb}^{(1)}$ | Thermal resistance junction-ambient                    | 31.3  | $^\circ\text{C/W}$ |

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

**Table 4. Avalanche characteristics**

| Symbol   | Parameter                                                                                                                  | Value | Unit |
|----------|----------------------------------------------------------------------------------------------------------------------------|-------|------|
| $E_{AS}$ | Single pulse avalanche energy<br>(starting $T_J = 25\text{ }^\circ\text{C}$ , $I_D = 12\text{ A}$ ; $L = 1.25\text{ mH}$ ) | 90    | 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                   | $I_D = 250\text{ }\mu\text{A}$ , $V_{GS} = 0$      | 30   |        |           | V             |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = 30\text{ V}$ ,                           |      |        | 1         | $\mu\text{A}$ |
|               |                                                  | $V_{DS} = 30\text{ V}$ $T_C = 125\text{ °C}$       |      |        | 10        | $\mu\text{A}$ |
| $I_{GSS}$     | Gate body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 20\text{ V}$                         |      |        | $\pm 100$ | nA            |
| $V_{GS(th)}$  | Gate threshold voltage                           | $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$ | 1    | 1.7    | 2.5       | V             |
| $R_{DS(on)}$  | Static drain-source on-resistance                | $V_{GS} = 10\text{ V}$ , $I_D = 12\text{ A}$       |      | 0.0038 | 0.0045    | $\Omega$      |
|               |                                                  | $V_{GS} = 4.5\text{ V}$ , $I_D = 12\text{ A}$      |      | 0.0057 | 0.0073    | $\Omega$      |

**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>$V_{GS} = 0$                              | 1350 | 1690 | 2030 | pF       |
| $C_{oss}$ | Output capacitance           |                                                                                            | 230  | 290  | 350  | pF       |
| $C_{rss}$ | Reverse transfer capacitance |                                                                                            | 140  | 176  | 210  | pF       |
| $Q_g$     | Total gate charge            | $V_{DD} = 15\text{ V}$ , $I_D = 24\text{ A}$<br>$V_{GS} = 4.5\text{ V}$<br>(see Figure 14) |      | 17   |      | nC       |
| $Q_{gs}$  | Gate-source charge           |                                                                                            |      | 8    |      | nC       |
| $Q_{gd}$  | Gate-drain charge            |                                                                                            |      | 6    |      | nC       |
| $R_G$     | Gate input resistance        | $f = 1\text{ MHz}$ Gate DC Bias = 0<br>Test signal level = 20 mV open drain                | 1.25 | 1.7  | 2    | $\Omega$ |

**Table 7. Switching times**

| Symbol       | Parameter           | Test conditions                                                                                                         | Min. | Typ. | Max. | Unit |
|--------------|---------------------|-------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD} = 15\text{ V}$ , $I_D = 12\text{ A}$ ,<br>$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$<br>(see Figure 13) | -    | 9.5  | -    | ns   |
| $t_r$        | Rise time           |                                                                                                                         | -    | 30   | -    | ns   |
| $t_{d(off)}$ | Turn-off delay time |                                                                                                                         | -    | 37   | -    | ns   |
| $t_f$        | Fall time           |                                                                                                                         | -    | 12   | -    | ns   |

Table 8. Source drain diode

| Symbol          | Parameter                     | Test conditions                                                                          | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|------------------------------------------------------------------------------------------|------|------|------|------|
| $I_{SD}$        | Source-drain current          |                                                                                          | -    |      | 24   | A    |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |                                                                                          | -    |      | 96   | A    |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD} = 24\text{ A}$ , $V_{GS}=0$                                                      | -    |      | 1.1  | V    |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 12\text{ A}$ ,<br>$di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD}=25\text{ V}$ | -    | 24   |      | ns   |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                          | -    | 16.8 |      | nC   |
| $I_{RRM}$       | Reverse recovery current      |                                                                                          | -    | 1.4  |      | 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

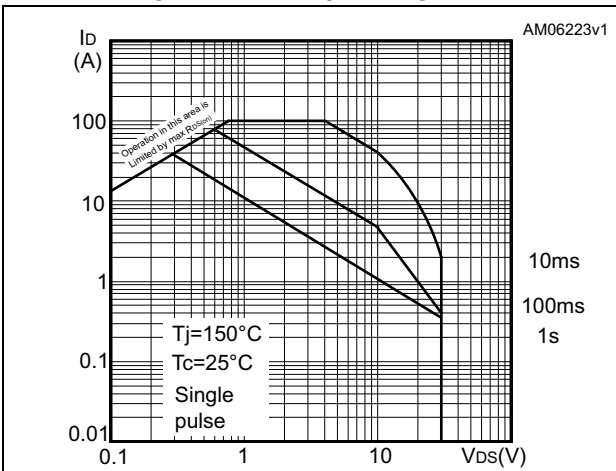


Figure 3. Thermal impedance

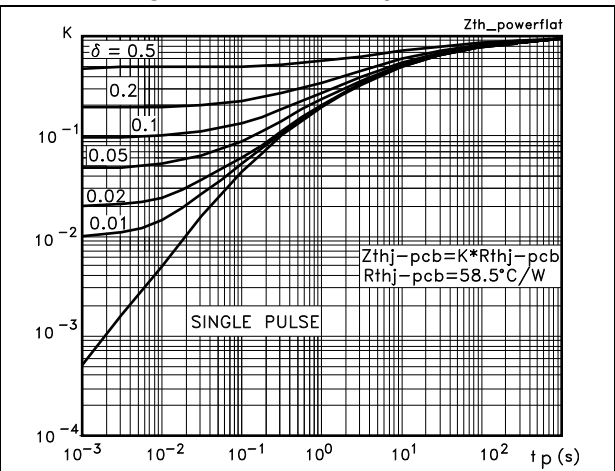


Figure 4. Output characteristics

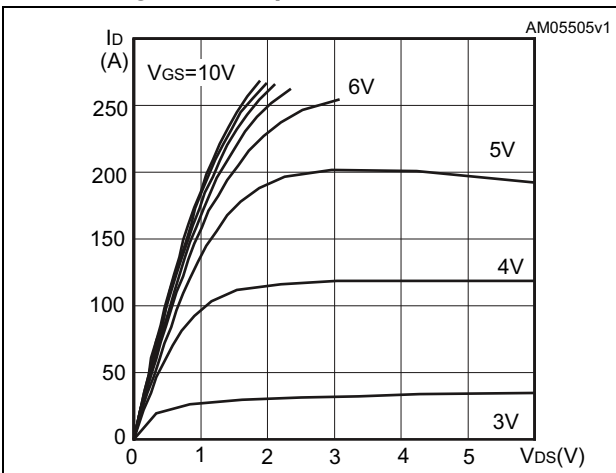


Figure 5. Transfer characteristics

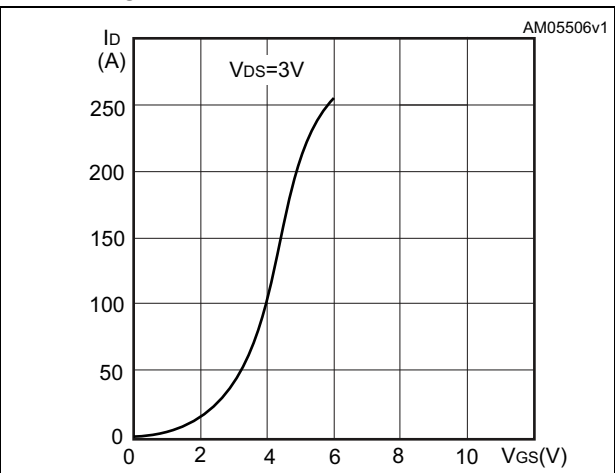


Figure 6. Normalized  $BV_{DSS}$  vs temperature

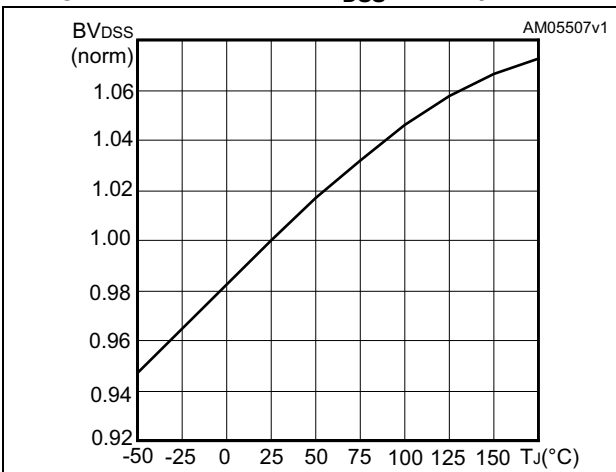


Figure 7. Static drain-source on-resistance

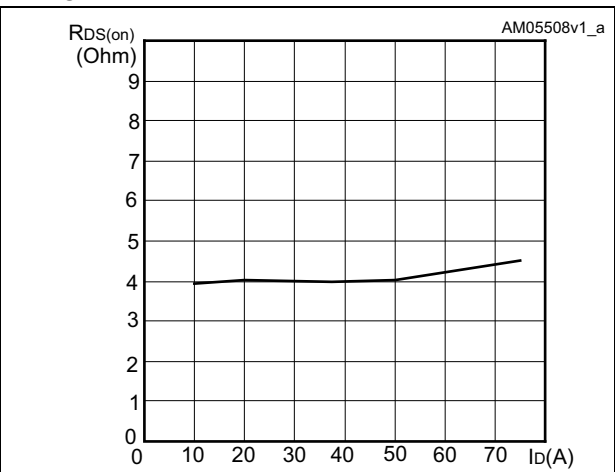


Figure 8. Gate charge vs gate-source voltage

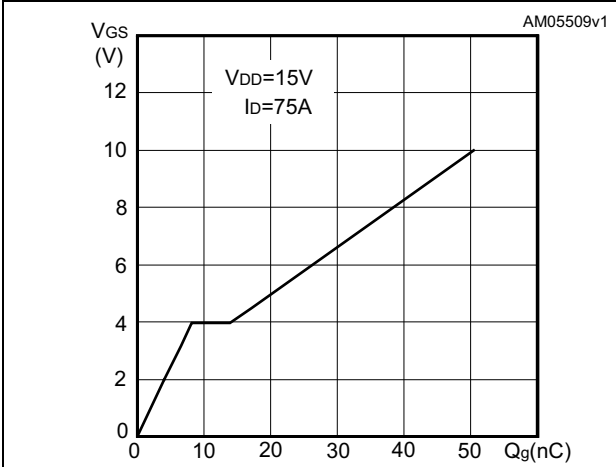


Figure 9. Capacitance variations

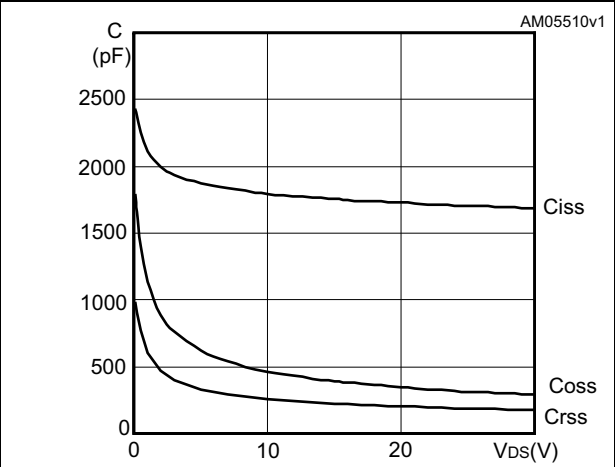


Figure 10. Normalized gate threshold voltage vs temperature

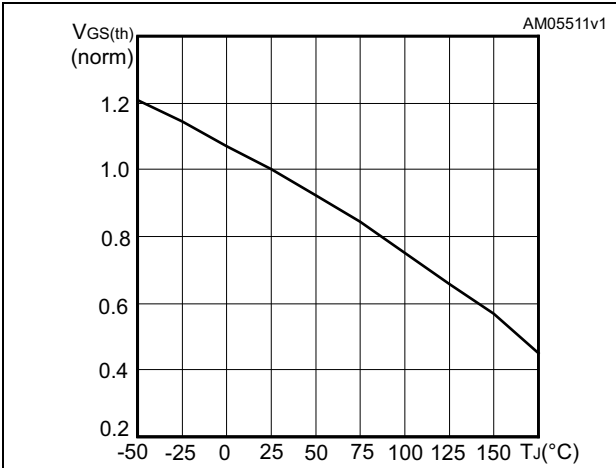


Figure 11. Normalized on-resistance vs temperature

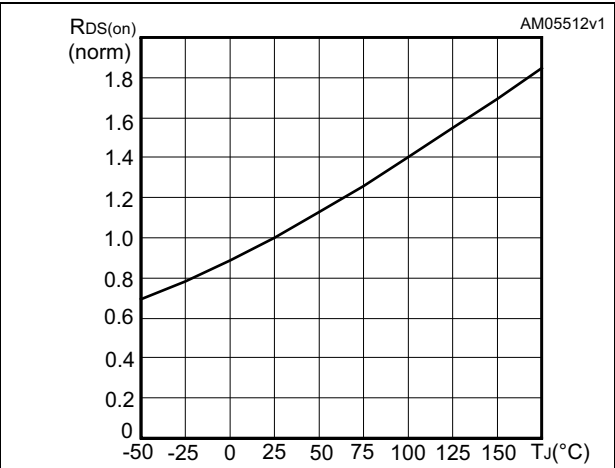
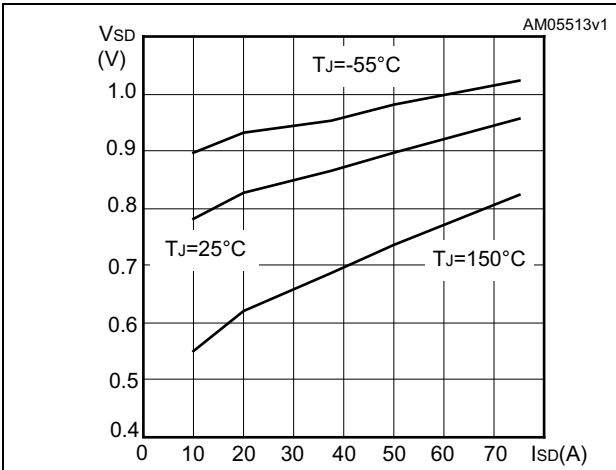


Figure 12. Source-drain diode forward characteristics





## 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 C-B mechanical data

| Dim. | mm   |      |      |
|------|------|------|------|
|      | Min. | Typ. | Max. |
| A    | 0.80 | 0.83 | 0.93 |
| A1   | 0    | 0.02 | 0.05 |
| A3   |      | 0.20 |      |
| b    | 0.35 | 0.40 | 0.47 |
| D    |      | 5.00 |      |
| D1   |      | 4.75 |      |
| D2   | 4.15 | 4.20 | 4.25 |
| E    |      | 6.00 |      |
| E1   |      | 5.75 |      |
| E2   | 3.43 | 3.48 | 3.53 |
| E4   | 2.58 | 2.63 | 2.68 |
| e    |      | 1.27 |      |
| L    | 0.70 | 0.80 | 0.90 |

Figure 19. PowerFLAT™ 5x6 type C-B drawing

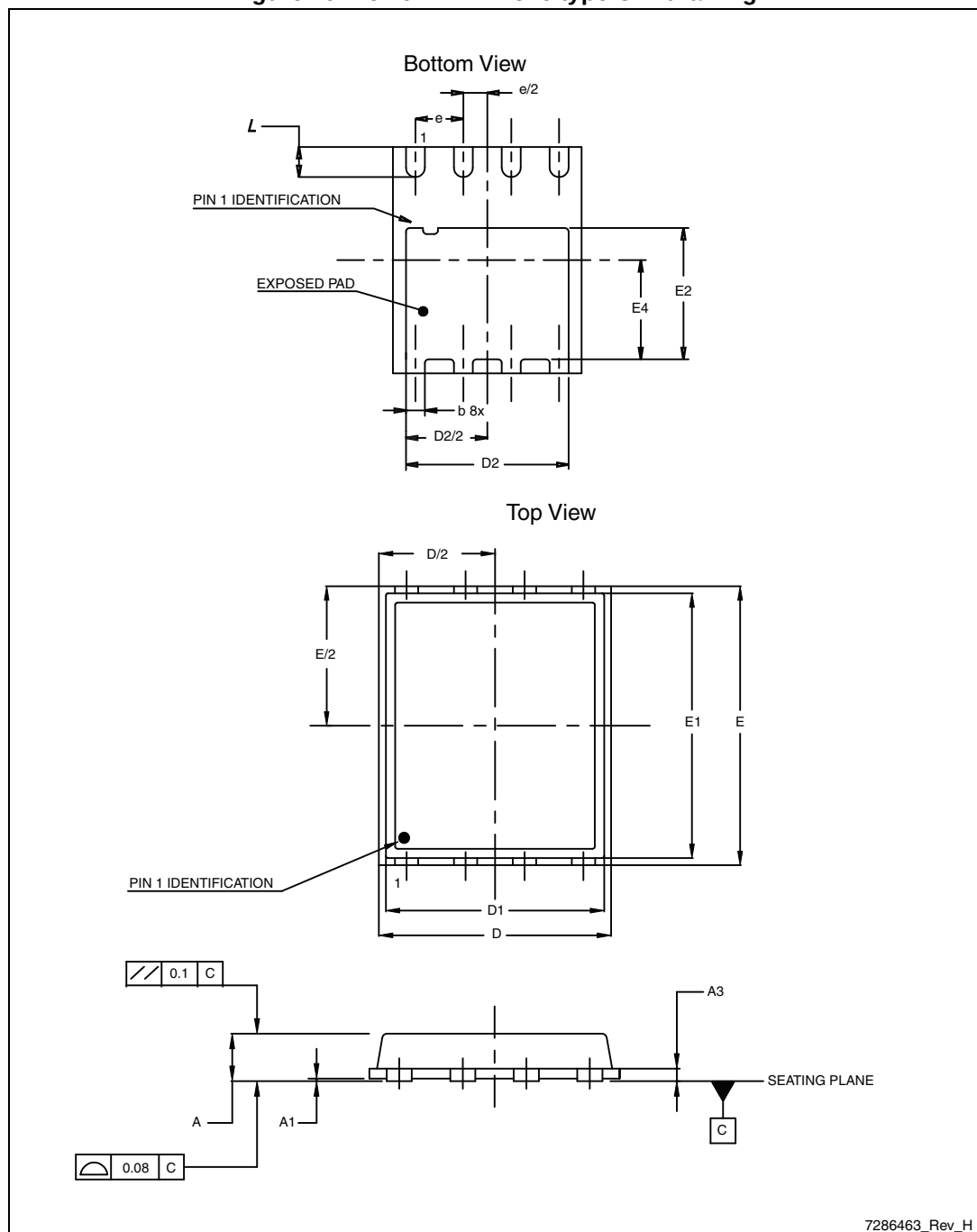


Table 10. PowerFLAT™ 5x6 type S-C mechanical data

| 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 type S-C mechanical data

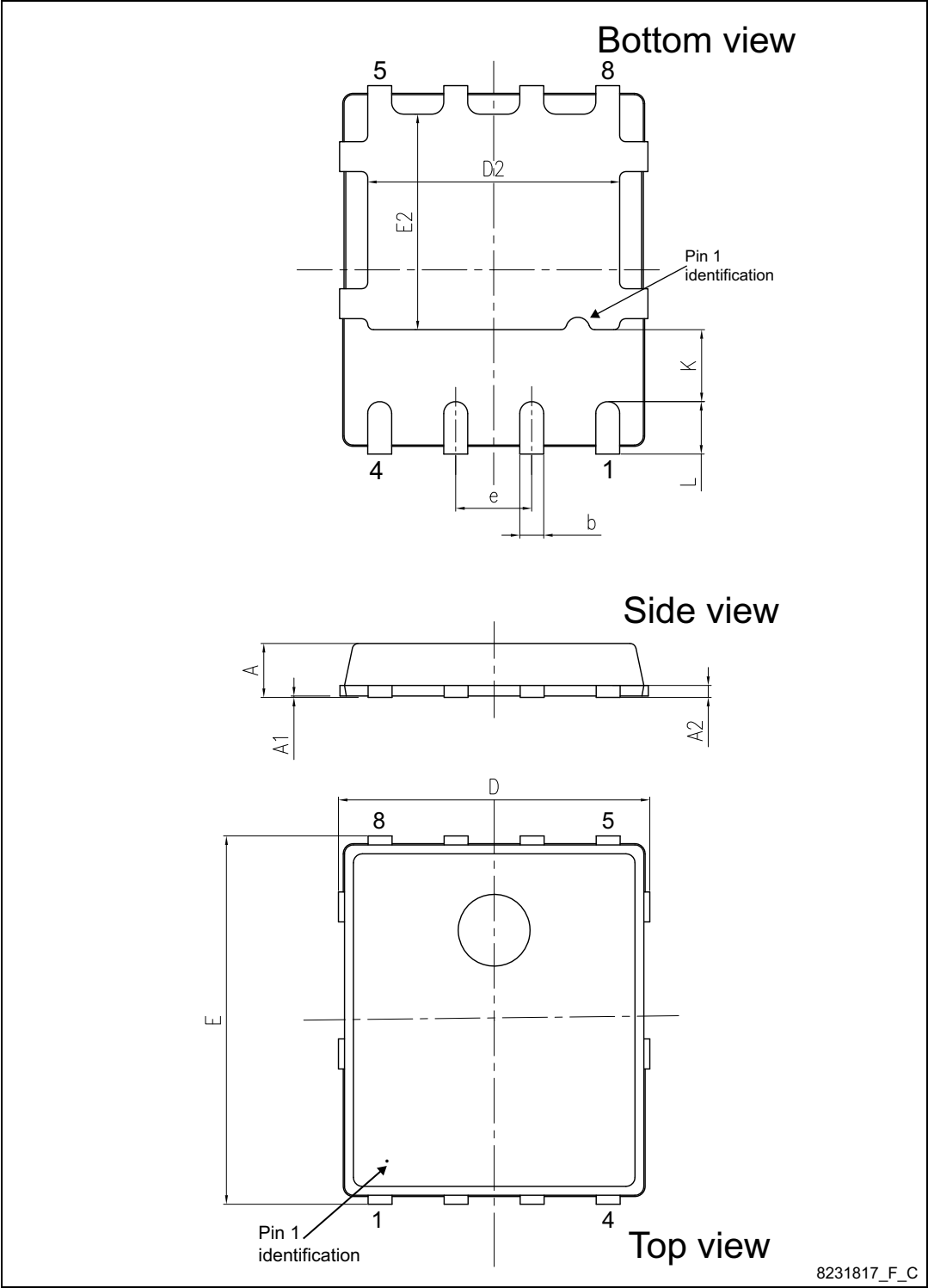
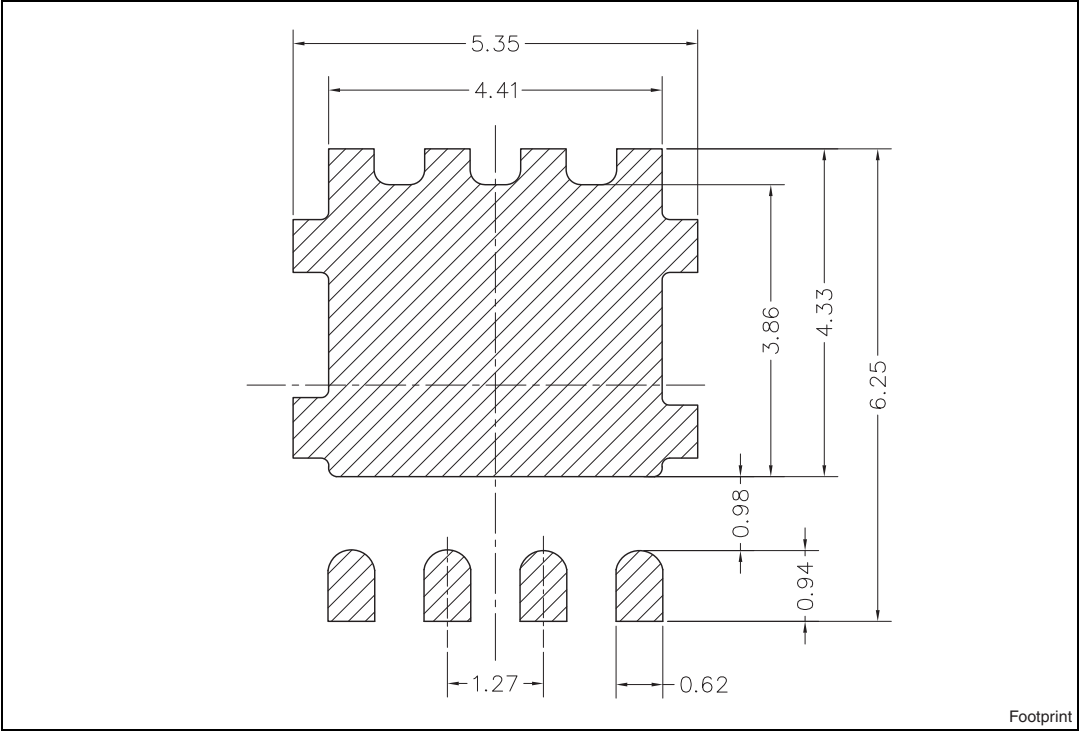


Figure 21. PowerFLAT™ 5x6 recommended footprint (dimensions in mm)



## 5 Revision history

**Table 11. Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10-Apr-2009 | 1        | First release                                                                                                                                                                                                                                                                                                                                                                                             |
| 17-Mar-2010 | 2        | – Inserted new values on <a href="#">Table 5</a> , <a href="#">Table 6</a> and <a href="#">Table 8</a><br>– Document status promoted from preliminary data to datasheet.                                                                                                                                                                                                                                  |
| 10-Nov-2011 | 3        | Inserted $I_D$ value @ 70 °C, in <a href="#">Table 2: Absolute maximum ratings</a> .<br><a href="#">Section 4: Package mechanical data</a> has been updated.<br>Minor text changes.                                                                                                                                                                                                                       |
| 03-Sep-2013 | 4        | – Updated: title and <a href="#">Figure 1</a> in the cover page.<br>– Updated: <a href="#">Section 4: Package mechanical data</a><br>– Updated: <a href="#">Figure 13</a> , <a href="#">14</a> , <a href="#">15</a> and <a href="#">16</a><br>– Added new <a href="#">Table 4: Avalanche characteristics</a> .<br>– Minor text changes<br>– Document status promoted from preliminary to production data. |

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