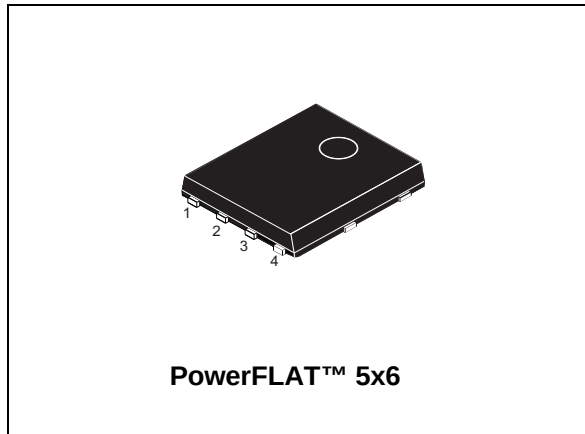
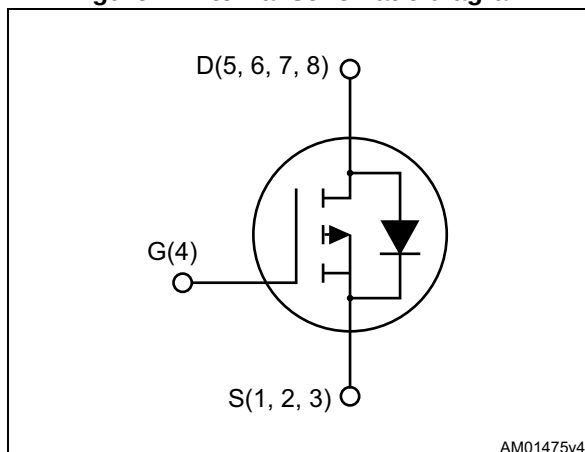


## P-channel 60 V, 0.13 $\Omega$ typ., 12 A STripFET™ F6 Power MOSFET in a PowerFLAT™ 5x6 package

Datasheet - production data



**Figure 1. Internal schematic diagram**



### Features

| Order code | $V_{DS}$ | $R_{DS(on)max}$      | $I_D$ |
|------------|----------|----------------------|-------|
| STL12P6F6  | 60 V     | 0.16 $\Omega$ @ 10 V | 12 A  |

- Very low on-resistance
- Very low gate charge
- High avalanche ruggedness
- Low gate drive power loss

### Applications

- Switching applications

### Description

This device is an P-channel Power MOSFET developed using the STripFET™ F6 technology, with a new trench gate structure. The resulting Power MOSFET exhibits a very low  $R_{DS(on)}$  in all packages.

**Table 1. Device summary**

| Order code | Marking | Package       | Packaging     |
|------------|---------|---------------|---------------|
| STL12P6F6  | 12P6F6  | PowerFLAT 5x6 | Tape and reel |

**Note:** For the P-channel Power MOSFET the actual polarity of the voltages and the current must be reversed.

Contents

1      **Electrical ratings** ..... 3

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

      2.1    Electrical characteristics (curves) ..... 6

3      **Test circuits** ..... 8

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

5      **Packaging mechanical data** ..... 13

6      **Revision history** ..... 15



# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol            | Parameter                                                           | Value      | Unit             |
|-------------------|---------------------------------------------------------------------|------------|------------------|
| $V_{DS}$          | Drain-source voltage                                                | 60         | V                |
| $V_{GS}$          | Gate-source voltage                                                 | $\pm 20$   | V                |
| $I_D^{(1)}$       | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$      | 12         | A                |
| $I_D^{(1)}$       | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$     | 8.5        | A                |
| $I_{DM}^{(1)(2)}$ | Drain current (pulsed)                                              | 48         | A                |
| $I_D^{(3)}$       | Drain current (continuous) at $T_{pcb} = 25\text{ }^\circ\text{C}$  | 4          | A                |
| $I_D^{(3)}$       | Drain current (continuous) at $T_{pcb} = 100\text{ }^\circ\text{C}$ | 2.8        | A                |
| $P_{TOT}^{(1)}$   | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$               | 75         | W                |
| $P_{TOT}^{(3)}$   | Total dissipation at $T_{pcb} = 25\text{ }^\circ\text{C}$           | 4.8        | W                |
| $T_j$             | Operating junction temperature                                      | -55 to 175 | $^\circ\text{C}$ |
| $T_{stg}$         | Storage temperature                                                 |            | $^\circ\text{C}$ |

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

**Table 3. Thermal data**

| Symbol              | Parameter                            | Value | Unit               |
|---------------------|--------------------------------------|-------|--------------------|
| $R_{thj-case}$      | Thermal resistance junction-case max | 2     | $^\circ\text{C/W}$ |
| $R_{thj-pcb}^{(1)}$ | Thermal resistance junction-pcb max  | 31.3  | $^\circ\text{C/W}$ |

1. When mounted on FR-4 board of  $15\text{ mm}^2$ , 2 Oz Cu,  $t < 10\text{ sec}$

**Note:** For the P-channel Power MOSFET actual polarity of voltages and current has to be reversed.

## 2 Electrical characteristics

(T<sub>case</sub> = 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     | $V_{GS} = 0, I_D = 250 \mu A$                   | 60   |      |           | V        |
| $I_{DSS}$     | Zero gate voltage drain current    | $V_{GS} = 0, V_{DS} = 60 V$                     |      |      | 1         | $\mu A$  |
|               |                                    | $V_{GS} = 0, V_{DS} = 60 V, T_C = 125 ^\circ C$ |      |      | 10        | $\mu A$  |
| $I_{GSS}$     | Gate-body leakage current          | $V_{DS} = 0, V_{GS} = \pm 20 V$                 |      |      | $\pm 100$ | nA       |
| $V_{GS(th)}$  | Gate threshold voltage             | $V_{DS} = V_{GS}, I_D = 250 \mu A$              | 2    |      | 4         | V        |
| $R_{DS(on)}$  | Static drain-source on- resistance | $V_{GS} = 10 V, I_D = 1.5 A$                    |      | 0.13 | 0.16      | $\Omega$ |

**Table 5. Dynamic**

| Symbol    | Parameter                    | Test conditions                                                               | Min. | Typ. | Max. | Unit |
|-----------|------------------------------|-------------------------------------------------------------------------------|------|------|------|------|
| $C_{iss}$ | Input capacitance            | $V_{GS} = 0, V_{DS} = 48 V, f = 1 MHz$                                        | -    | 340  | -    | pF   |
| $C_{oss}$ | Output capacitance           |                                                                               | -    | 40   | -    | pF   |
| $C_{rss}$ | Reverse transfer capacitance |                                                                               | -    | 20   | -    | pF   |
| $Q_g$     | Total gate charge            | $V_{DD} = 30 V, I_D = 3 A, V_{GS} = 10 V$<br>(see <a href="#">Figure 14</a> ) | -    | 6.4  | -    | nC   |
| $Q_{gs}$  | Gate-source charge           |                                                                               | -    | 1.7  | -    | nC   |
| $Q_{gd}$  | Gate-drain charge            |                                                                               | -    | 1.7  | -    | nC   |

**Table 6. Switching times**

| Symbol       | Parameter           | Test conditions                                                                                   | Min. | Typ. | Max. | Unit |
|--------------|---------------------|---------------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD} = 48 V, I_D = 1.5 A, R_G = 4.7 \Omega, V_{GS} = 10 V$<br>(see <a href="#">Figure 13</a> ) | -    | 64   | -    | ns   |
| $t_r$        | Rise time           |                                                                                                   | -    | 5.3  | -    | ns   |
| $t_{d(off)}$ | Turn-off delay time |                                                                                                   | -    | 14   | -    | ns   |
| $t_f$        | Fall time           |                                                                                                   | -    | 3.7  | -    | ns   |

**Note:** For the P-channel Power MOSFET actual polarity of voltages and current has to be reversed.

Table 7. Source drain diode

| Symbol          | Parameter                     | Test conditions                                           | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|-----------------------------------------------------------|------|------|------|------|
| $I_{SD}$        | Source-drain current          |                                                           | -    |      | 12   | A    |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |                                                           | -    |      | 48   | A    |
| $V_{SD}^{(2)}$  | Forward on voltage            | $V_{GS} = 0, I_{SD} = 3 \text{ A}$                        | -    |      | 1.1  | V    |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 5 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s}$ | -    | 20   |      | ns   |
| $Q_{rr}$        | Reverse recovery charge       | $V_{DD} = 16 \text{ V}, T_j = 150 \text{ }^\circ\text{C}$ | -    | 17.8 |      | nC   |
| $I_{RRM}$       | Reverse recovery current      | (see <a href="#">Figure 15</a> )                          | -    | 1.8  |      | A    |

1. Pulse width limited by safe operating area.

2. Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

**Note:** For the P-channel Power MOSFET actual polarity of voltages and current has to be reversed.

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

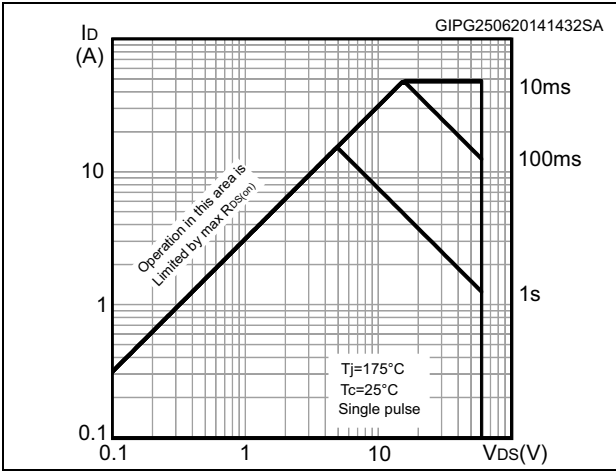


Figure 3. Thermal impedance

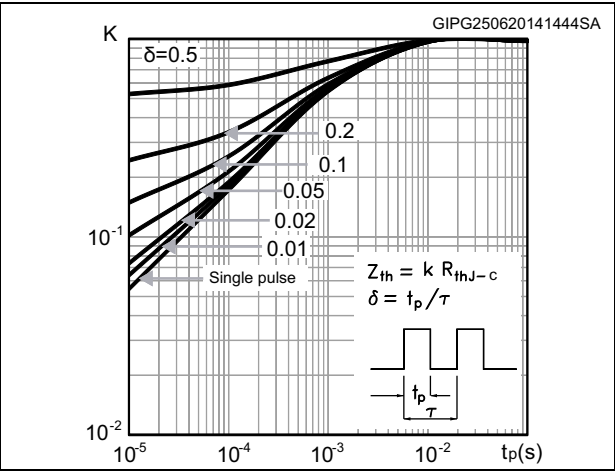


Figure 4. Output characteristics

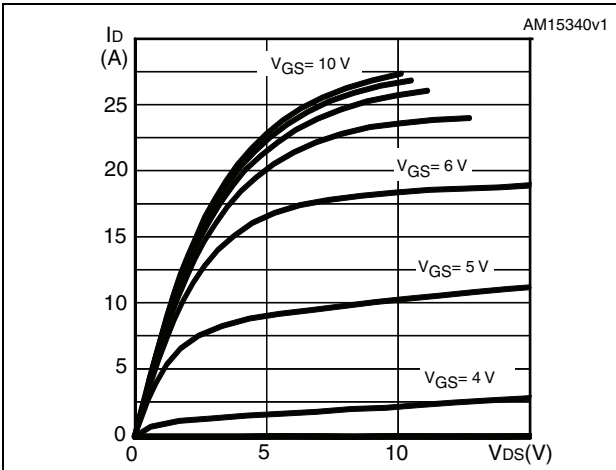


Figure 5. Transfer characteristics

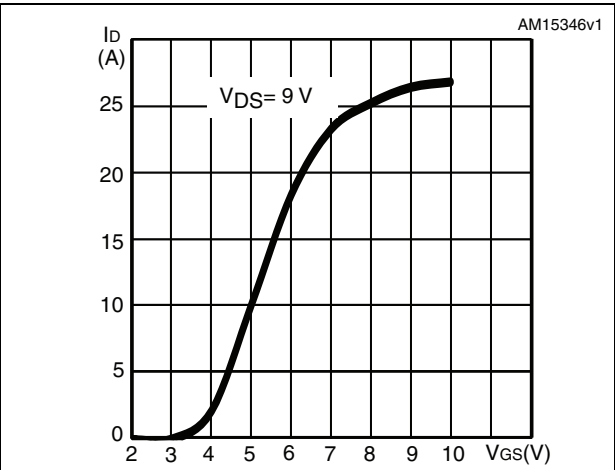


Figure 6. Gate charge vs gate-source voltage

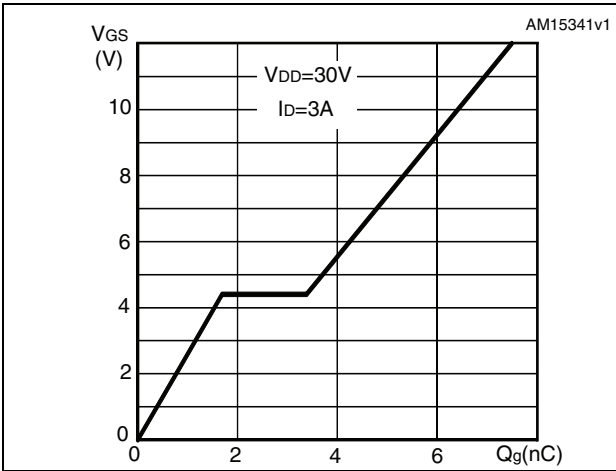


Figure 7. Static drain-source on-resistance

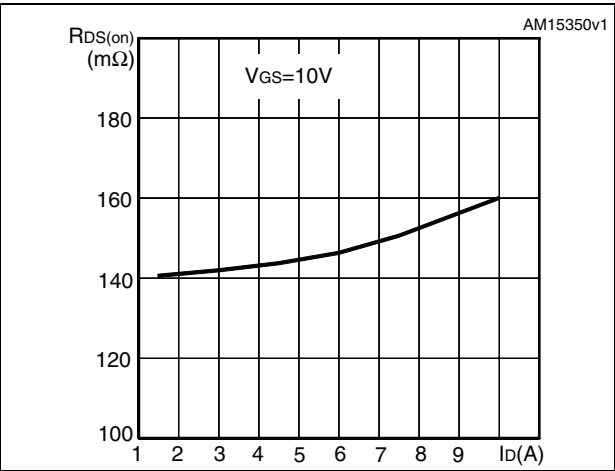


Figure 8. Capacitance variations

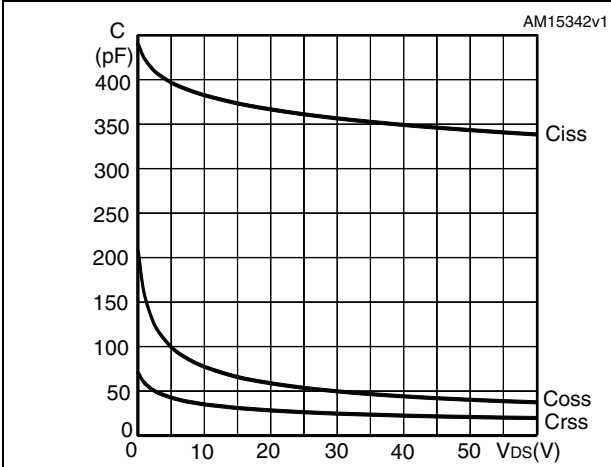


Figure 9. Normalized  $V_{(BR)DSS}$  vs temperature

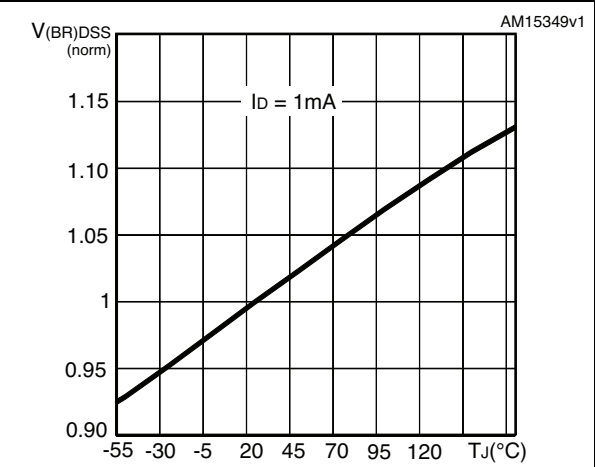


Figure 10. Normalized gate threshold voltage vs temperature

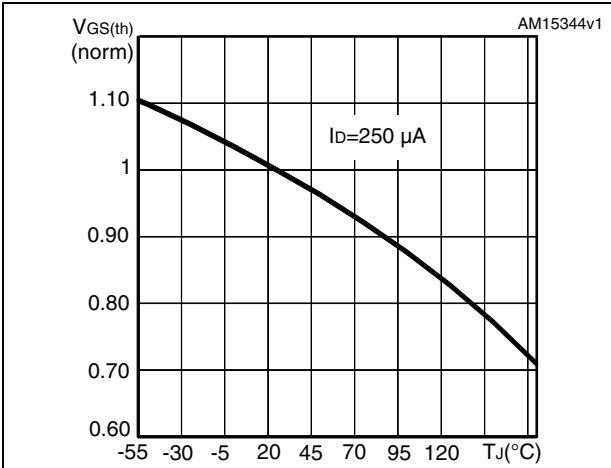


Figure 11. Normalized on-resistance vs temperature

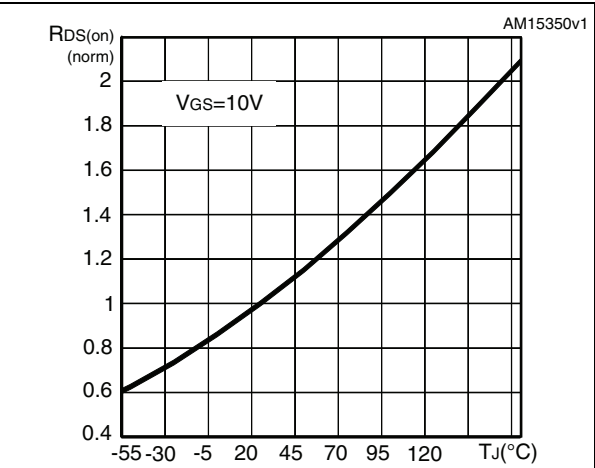
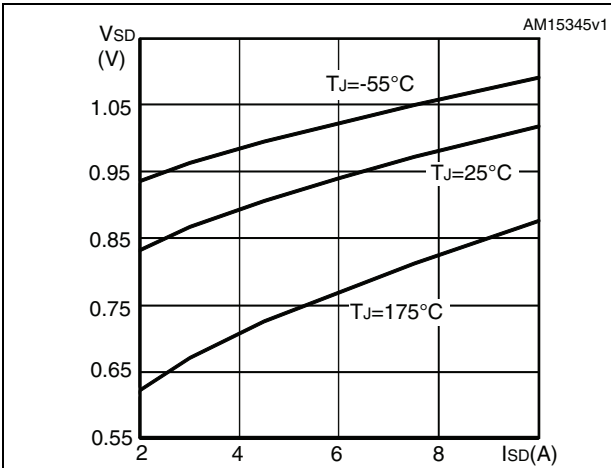
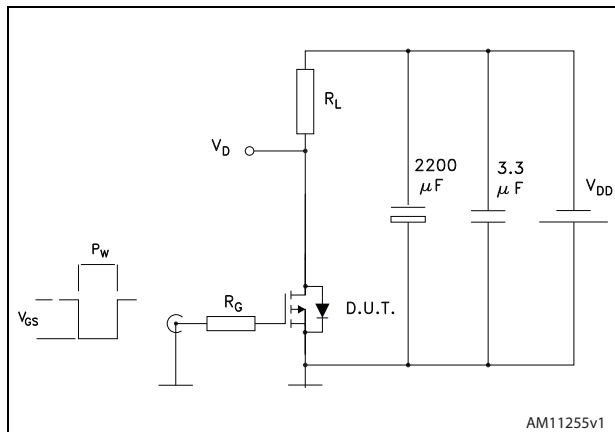


Figure 12. Source-drain diode forward characteristics

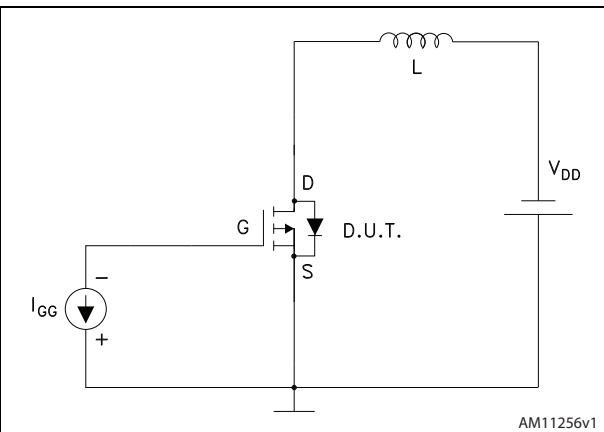


### 3 Test circuits

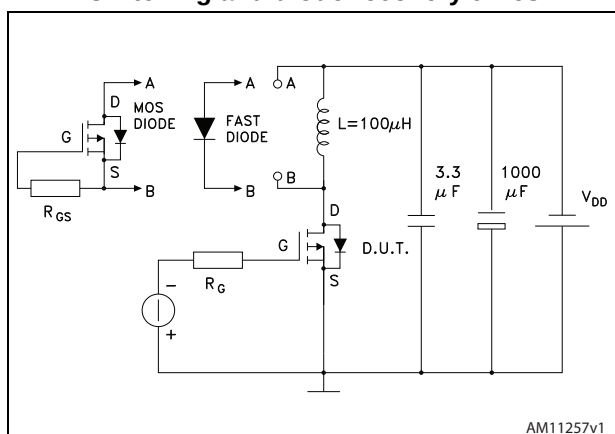
**Figure 13. Switching times test circuit for resistive load**



**Figure 14. Gate charge test circuit**



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





## 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 16. PowerFLAT™ 5x6 type S-R drawing

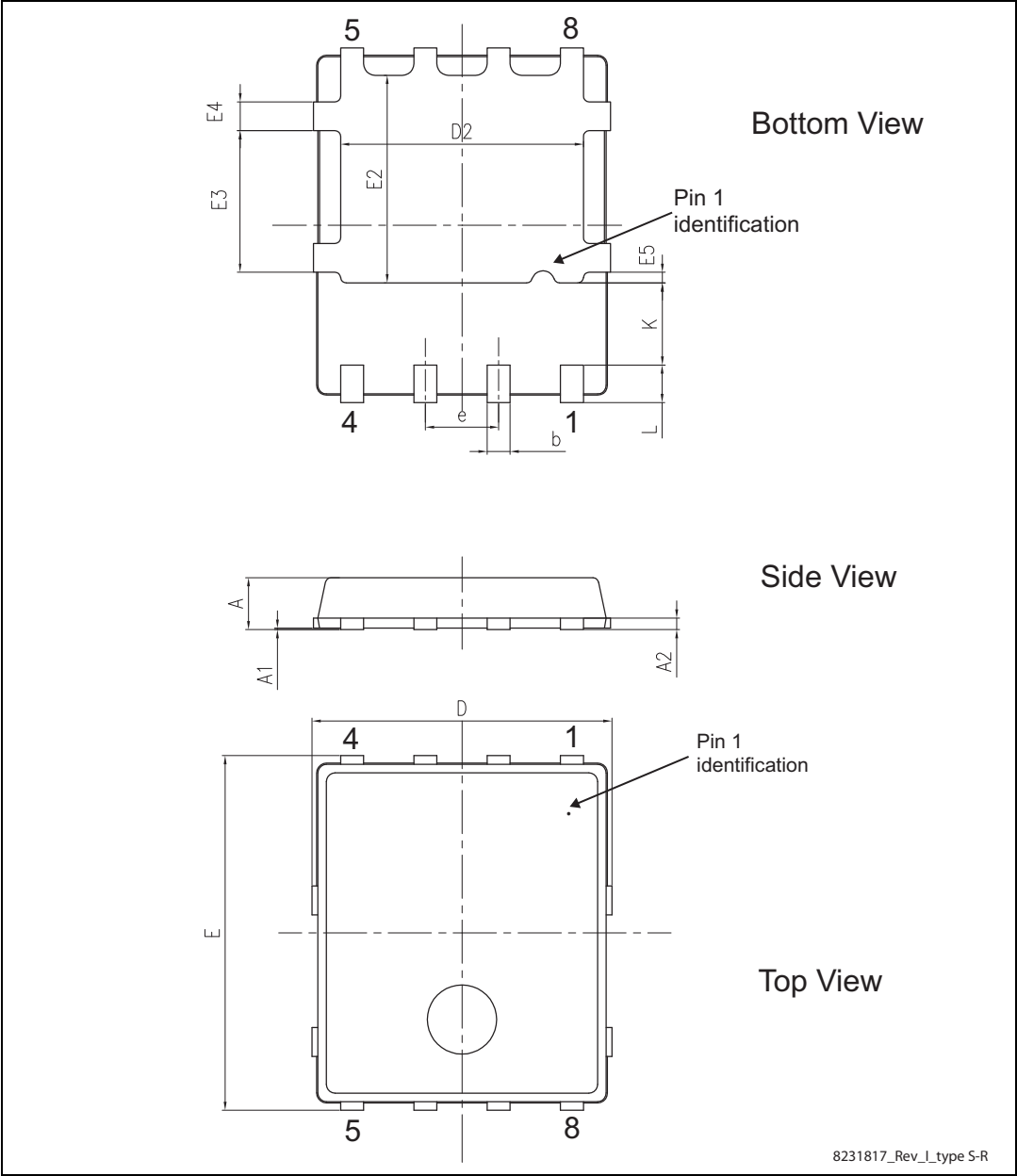


Table 8. PowerFLAT 5x6 type S-R mechanical data

| 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  |
| D2   | 4.11  |      | 4.31  |
| E    | 5.95  | 6.15 | 6.35  |
| e    |       | 1.27 |       |
| E2   | 3.50  |      | 3.70  |
| E3   | 2.35  |      | 2.55  |
| E4   | 0.40  |      | 0.60  |
| E5   | 0.08  |      | 0.28  |
| K    | 1.275 |      | 1.575 |
| L    | 0.60  |      | 0.80  |

Technical drawing of a stepped block. The top view shows a rectangular block with a width of 4.45 and a depth of 3.90. The front view shows a block with a total height of 6.60. The top surface is divided into four sections, each 0.65 wide (total 2.60). The bottom surface is divided into four sections, each 1.27 wide (total 5.08). The block is hatched with a cross-hatch pattern.

# 5 Packaging mechanical data

Figure 18. PowerFLAT™ 5x6 tape<sup>(a)</sup>

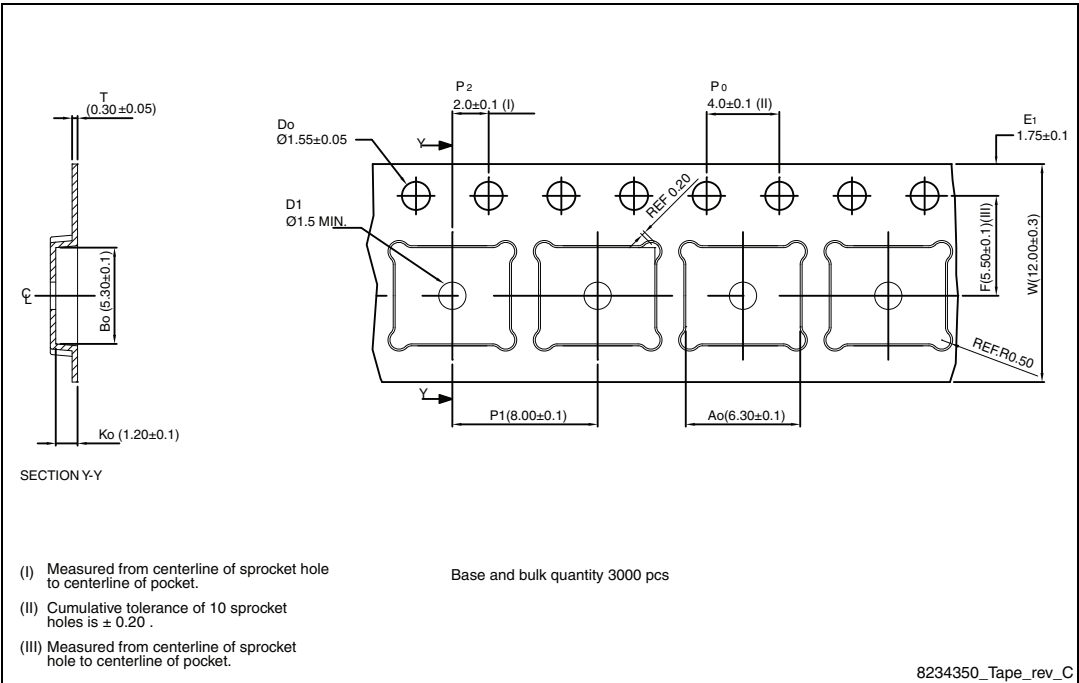
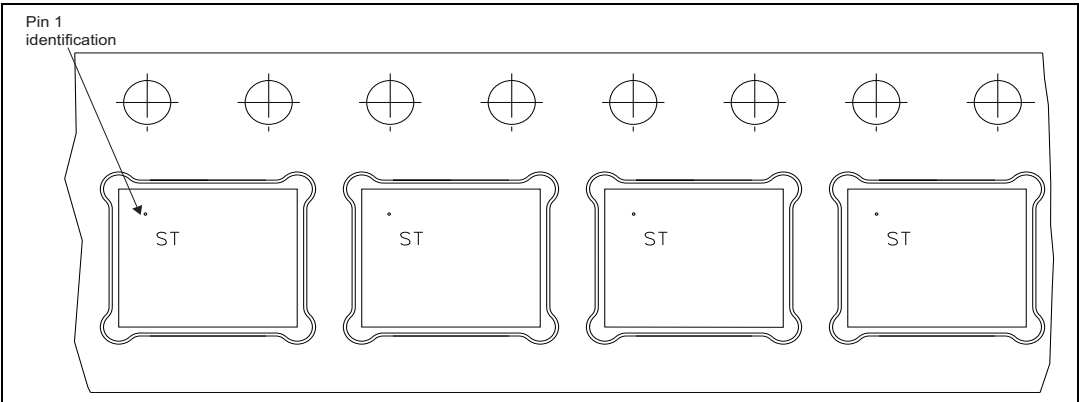


Figure 19. PowerFLAT™ 5x6 package orientation in carrier tape



a. All dimensions are in millimeters.

Technical drawing of a circular reel, showing top, side, and core detail views.

**Top View (Left):** Shows a circular reel with a central hub and six rectangular compartments. Dimensions include: R25.00 (outer radius), 4.00 (inner radius), 2.50 (width of central hole), 1.00 (width of compartment), 1.00 (width of compartment), 1.00 (width of compartment), 1.00 (width of compartment), 1.00 (width of compartment), 1.00 (width of compartment).

**Side View (Right):** Shows the profile of the reel. Dimensions include: W3 11.9/15.4 (total width), W2 18.4 (max) (width of central hub), W1 12.4 (+0/-0) (width of compartment), 1.00 (height of central hub), 1.00 (height of compartment), 1.00 (height of compartment), 1.00 (height of compartment), 1.00 (height of compartment), 1.00 (height of compartment).

**Core Detail (Bottom Left):** Shows a cross-section of the reel core. Dimensions include: R1.10 (radius of core), Ø1.2 (diameter of core), 13.00 (width of core), 2.30 (width of core).

**ESD LOGO (Bottom Right):** A circular logo with the text "ESD LOGO" and "ESD PROTECTIVE DEVICE".

**Dimensions:** All dimensions are in millimeters.

## 6 Revision history

**Table 9. Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 20-Mar-2013 | 1        | First release.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 14-Jul-2014 | 2        | <ul style="list-style-type: none"><li>– Modified: <math>I_D</math> and <math>I_{DM}</math> values in <a href="#">Table 2</a></li><li>– Modified: the entire typical values in <a href="#">Table 6</a></li><li>– Modified: <math>I_{SD}</math> and <math>I_{SDM}</math> max values in <a href="#">Table 7</a></li><li>– Added: <a href="#">Section 2.1: Electrical characteristics (curves)</a></li><li>– Updated: <a href="#">Section 4: Package mechanical data</a></li><li>– Minor text changes</li></ul> |

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