

## Automotive-grade N-channel 40 V, 1.3 mΩ typ., 120 A STripFET™ F7 Power MOSFET in a PowerFLAT™ 5x6 package

Datasheet - production data

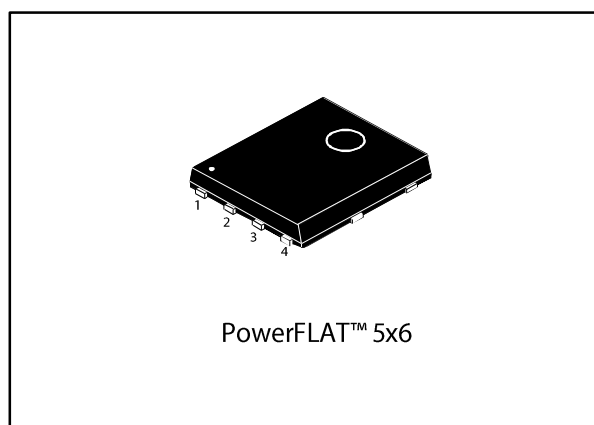
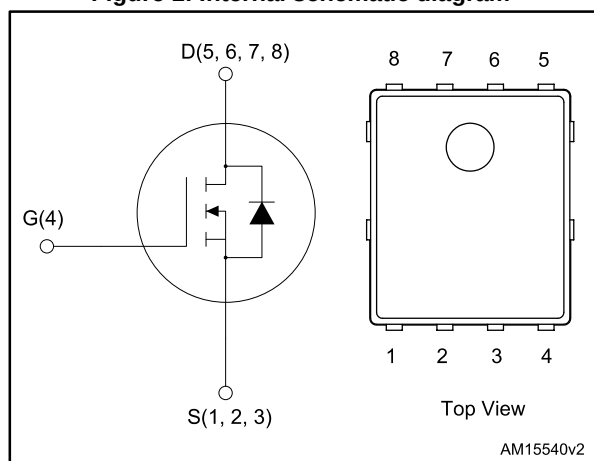


Figure 1: Internal schematic diagram



### Features

| Order code   | V <sub>DS</sub> | R <sub>DS(on)</sub> max | I <sub>D</sub> |
|--------------|-----------------|-------------------------|----------------|
| STL210N4F7AG | 40 V            | 1.6 mΩ                  | 120 A          |

- Designed for automotive applications and AEC-Q101 qualified
- Among the lowest R<sub>DS(on)</sub> on the market
- Excellent figure of merit (FoM)
- Low C<sub>rss</sub>/C<sub>iss</sub> ratio for EMI immunity
- High avalanche ruggedness
- Wettable flank package

### Applications

- Switching applications

### Description

This N-channel Power MOSFET utilizes STripFET™ F7 technology with an enhanced trench gate structure that results in very low on-state resistance, while also reducing internal capacitance and gate charge for faster and more efficient switching.

Table 1: Device summary

| Order code   | Marking | Package        | Packaging     |
|--------------|---------|----------------|---------------|
| STL210N4F7AG | 210N4F7 | PowerFLAT™ 5x6 | Tape and reel |

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## Contents

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# 1 Electrical ratings

Table 2: Absolute maximum ratings

| Symbol            | Parameter                                                                                                         | Value      | Unit             |
|-------------------|-------------------------------------------------------------------------------------------------------------------|------------|------------------|
| $V_{DS}$          | Drain-source voltage                                                                                              | 40         | V                |
| $V_{GS}$          | Gate-source voltage                                                                                               | $\pm 20$   | V                |
| $I_D^{(1)}$       | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$                                                    | 120        | A                |
| $I_D^{(1)}$       | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$                                                   | 120        | A                |
| $I_{DM}^{(1)(2)}$ | Drain current (pulsed)                                                                                            | 480        | A                |
| $P_{TOT}$         | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$                                                             | 150        | W                |
| $I_{AV}$          | Avalanche current, repetitive or not repetitive (pulse width limited by maximum junction temperature)             | 40         | A                |
| $E_{AS}$          | Single pulse avalanche energy ( $T_j = 25\text{ }^\circ\text{C}$ , $I_D = 20\text{ A}$ , $V_{DD} = 25\text{ V}$ ) | 300        | mJ               |
| $T_j$             | Operating junction temperature                                                                                    | -55 to 175 | $^\circ\text{C}$ |
| $T_{stg}$         | Storage temperature                                                                                               |            |                  |

**Notes:**

<sup>(1)</sup>Drain current is limited by package, the current capability of the silicon is 229 A at 25  $^\circ\text{C}$ .

<sup>(2)</sup>Pulse width limited by safe operating area

Table 3: Thermal data

| Symbol              | Parameter                             | Value | Unit               |
|---------------------|---------------------------------------|-------|--------------------|
| $R_{thj-pcb}^{(1)}$ | Thermal resistance junction-pcb max.  | 31.3  | $^\circ\text{C/W}$ |
| $R_{thj-case}$      | Thermal resistance junction-case max. | 1.0   | $^\circ\text{C/W}$ |

**Notes:**

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

## 2 Electrical characteristics

(T<sub>C</sub> = 25 °C unless otherwise specified)

Table 4: On /off states

| Symbol               | Parameter                         | Test conditions                                             | Min. | Typ. | Max. | Unit |
|----------------------|-----------------------------------|-------------------------------------------------------------|------|------|------|------|
| V <sub>(BR)DSS</sub> | Drain-source breakdown voltage    | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA              | 40   |      |      | V    |
| I <sub>DSS</sub>     | Zero gate voltage drain current   | V <sub>GS</sub> = 0 V<br>V <sub>DS</sub> = 40 V             |      |      | 1    | μA   |
| I <sub>GSS</sub>     | Gate-body leakage current         | V <sub>GS</sub> = 20 V, V <sub>DS</sub> = 0 V               |      |      | 100  | nA   |
| V <sub>GS(th)</sub>  | Gate threshold voltage            | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA | 2    |      | 4    | V    |
| R <sub>DS(on)</sub>  | Static drain-source on-resistance | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 16 A               |      | 1.3  | 1.6  | mΩ   |

Table 5: Dynamic

| Symbol           | Parameter                    | Test conditions                                                                                                                                       | Min. | Typ. | Max. | Unit |
|------------------|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| C <sub>iss</sub> | Input capacitance            | V <sub>DS</sub> = 25 V, f = 1 MHz,<br>V <sub>GS</sub> = 0 V                                                                                           | -    | 3600 | -    | pF   |
| C <sub>oss</sub> | Output capacitance           |                                                                                                                                                       | -    | 1240 | -    | pF   |
| C <sub>rss</sub> | Reverse transfer capacitance |                                                                                                                                                       | -    | 56   | -    | pF   |
| Q <sub>g</sub>   | Total gate charge            | V <sub>DD</sub> = 20 V, I <sub>D</sub> = 40 A,<br>V <sub>GS</sub> = 10 V<br>(see <a href="#">Figure 14: "Test circuit for gate charge behavior"</a> ) | -    | 43   | -    | nC   |
| Q <sub>gs</sub>  | Gate-source charge           |                                                                                                                                                       | -    | 19   | -    | nC   |
| Q <sub>gd</sub>  | Gate-drain charge            |                                                                                                                                                       | -    | 5    | -    | nC   |

Table 6: Switching times

| Symbol              | Parameter           | Test conditions                                                                                                                                                                                                                                     | Min. | Typ. | Max. | Unit |
|---------------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| t <sub>d(on)</sub>  | Turn-on delay time  | V <sub>DD</sub> = 20 V, I <sub>D</sub> = 20 A,<br>R <sub>G</sub> = 4.7 Ω, V <sub>GS</sub> = 10 V<br>(see <a href="#">Figure 13: "Test circuit for resistive load switching times"</a><br>and <a href="#">Figure 18: "Switching time waveform"</a> ) | -    | 27   | -    | ns   |
| t <sub>r</sub>      | Rise time           |                                                                                                                                                                                                                                                     | -    | 6    | -    | ns   |
| t <sub>d(off)</sub> | Turn-off delay time |                                                                                                                                                                                                                                                     | -    | 34   | -    | ns   |
| t <sub>f</sub>      | Fall time           |                                                                                                                                                                                                                                                     | -    | 6    | -    | ns   |

Table 7: Source-drain diode

| Symbol         | Parameter                | Test conditions                                                                                                                                                                              | Min. | Typ. | Max. | Unit |
|----------------|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $V_{SD}^{(1)}$ | Forward on voltage       | $I_{SD} = 40\text{ A}$ , $V_{GS} = 0\text{ V}$                                                                                                                                               | -    |      | 1.2  | V    |
| $t_{rr}$       | Reverse recovery time    | $I_D = 40\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 32\text{ V}$<br>(see <a href="#">Figure 15: "Test circuit for inductive load switching and diode recovery times"</a> ) | -    | 53   |      | ns   |
| $Q_{rr}$       | Reverse recovery charge  |                                                                                                                                                                                              | -    | 71   |      | nC   |
| $I_{RRM}$      | Reverse recovery current |                                                                                                                                                                                              | -    | 2.7  |      | A    |

**Notes:**

<sup>(1)</sup>Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

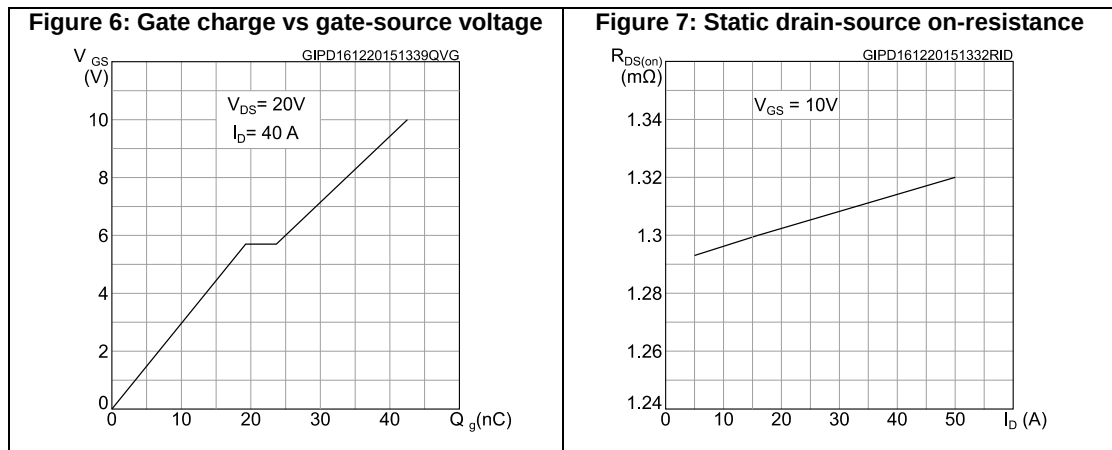
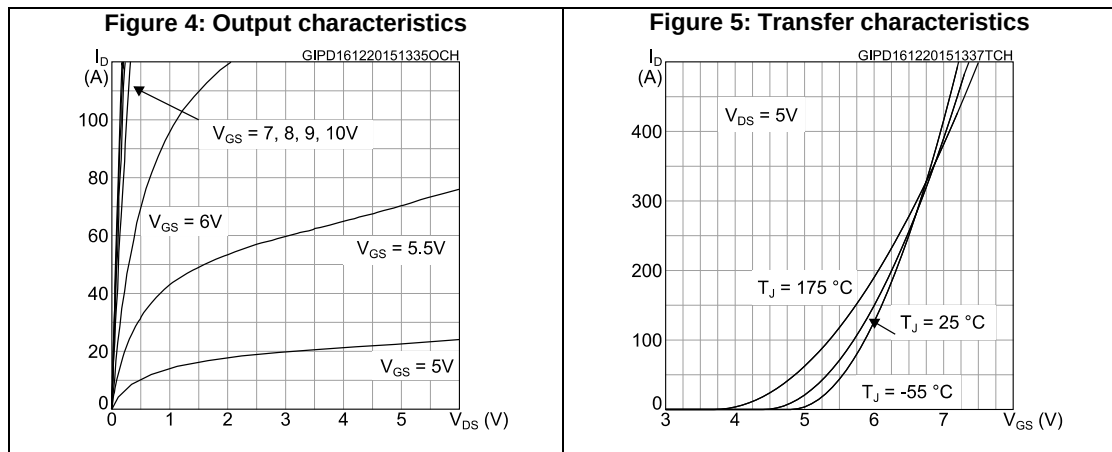
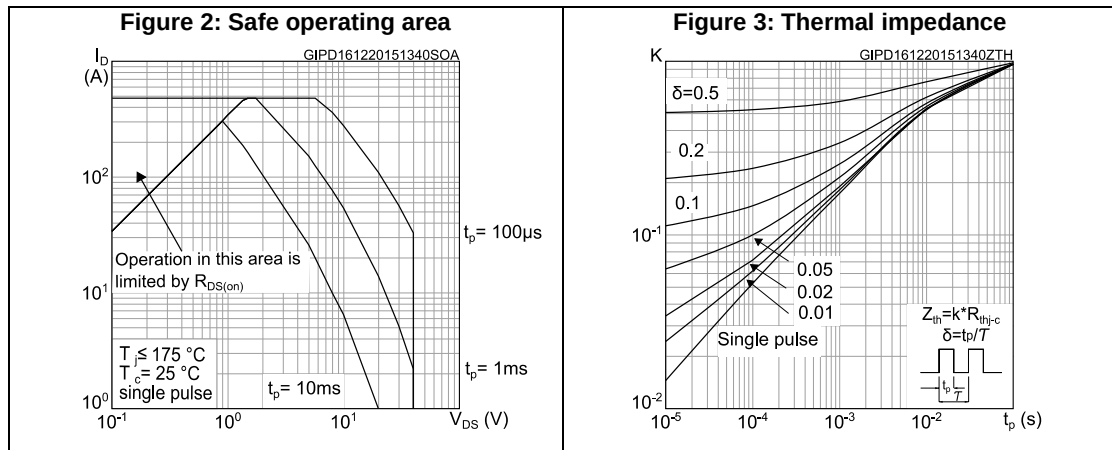


Figure 8: Capacitance variations

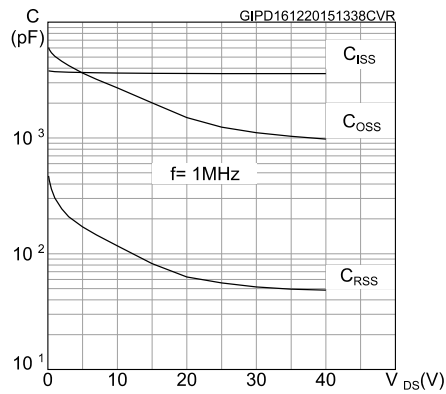


Figure 9: Normalized on-resistance vs temperature

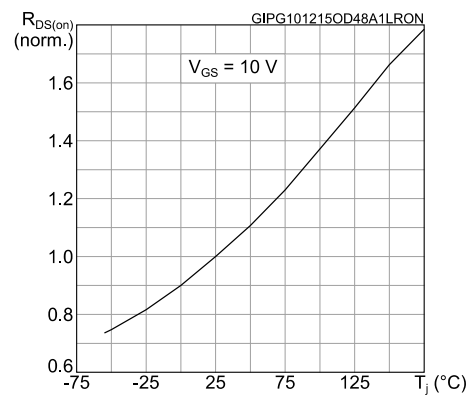


Figure 10: Normalized V(BR)DSS vs temperature

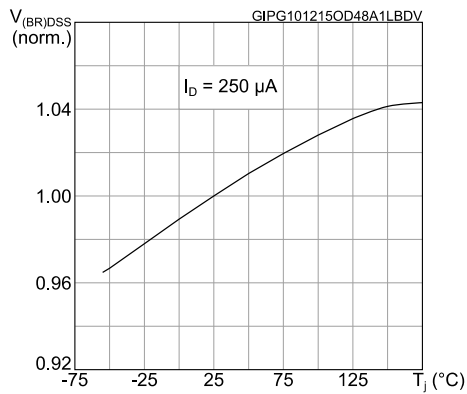


Figure 11: Normalized gate threshold voltage vs temperature

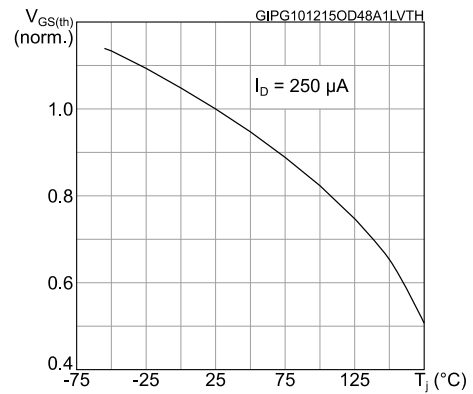
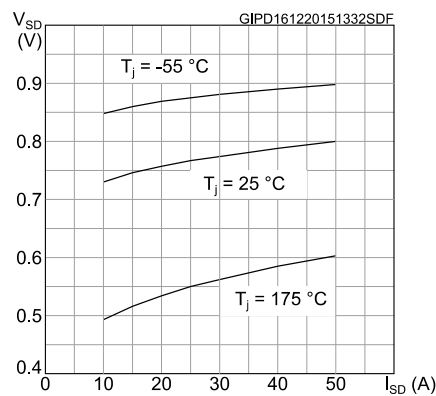
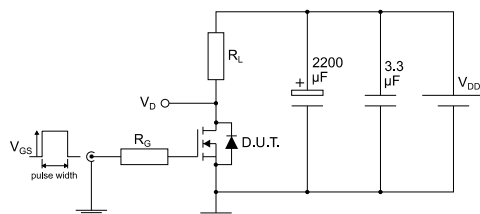


Figure 12: Source-drain diode forward characteristics



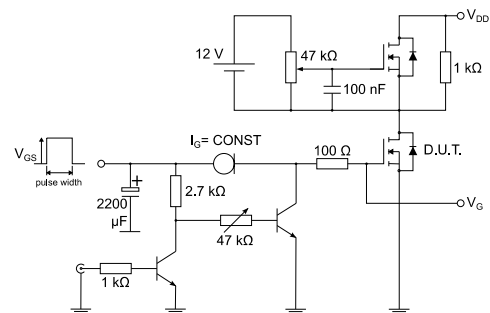
### 3 Test circuits

**Figure 13: Test circuit for resistive load switching times**



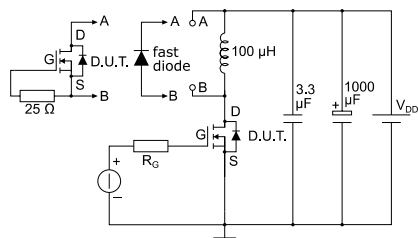
AM01468v1

**Figure 14: Test circuit for gate charge behavior**



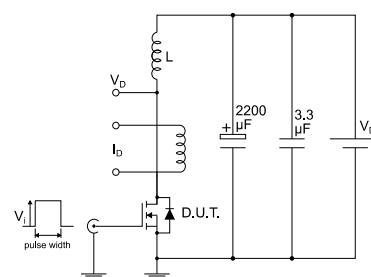
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**Figure 15: Test circuit for inductive load switching and diode recovery times**



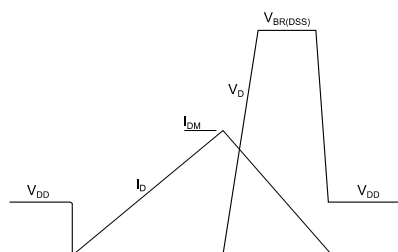
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**Figure 16: Unclamped inductive load test circuit**



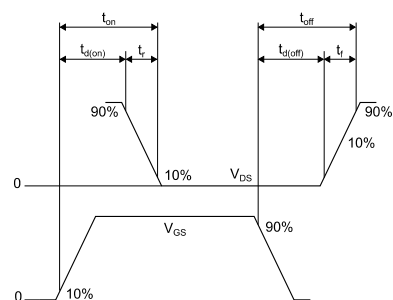
AM01471v1

**Figure 17: Unclamped inductive waveform**



AM01472v1

**Figure 18: Switching time waveform**



AM01473v1



## 4 Package mechanical data

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

### 4.1 PowerFLAT™ 5x6 WF type C package information

Figure 19: PowerFLAT™ 5x6 WF type C package outline

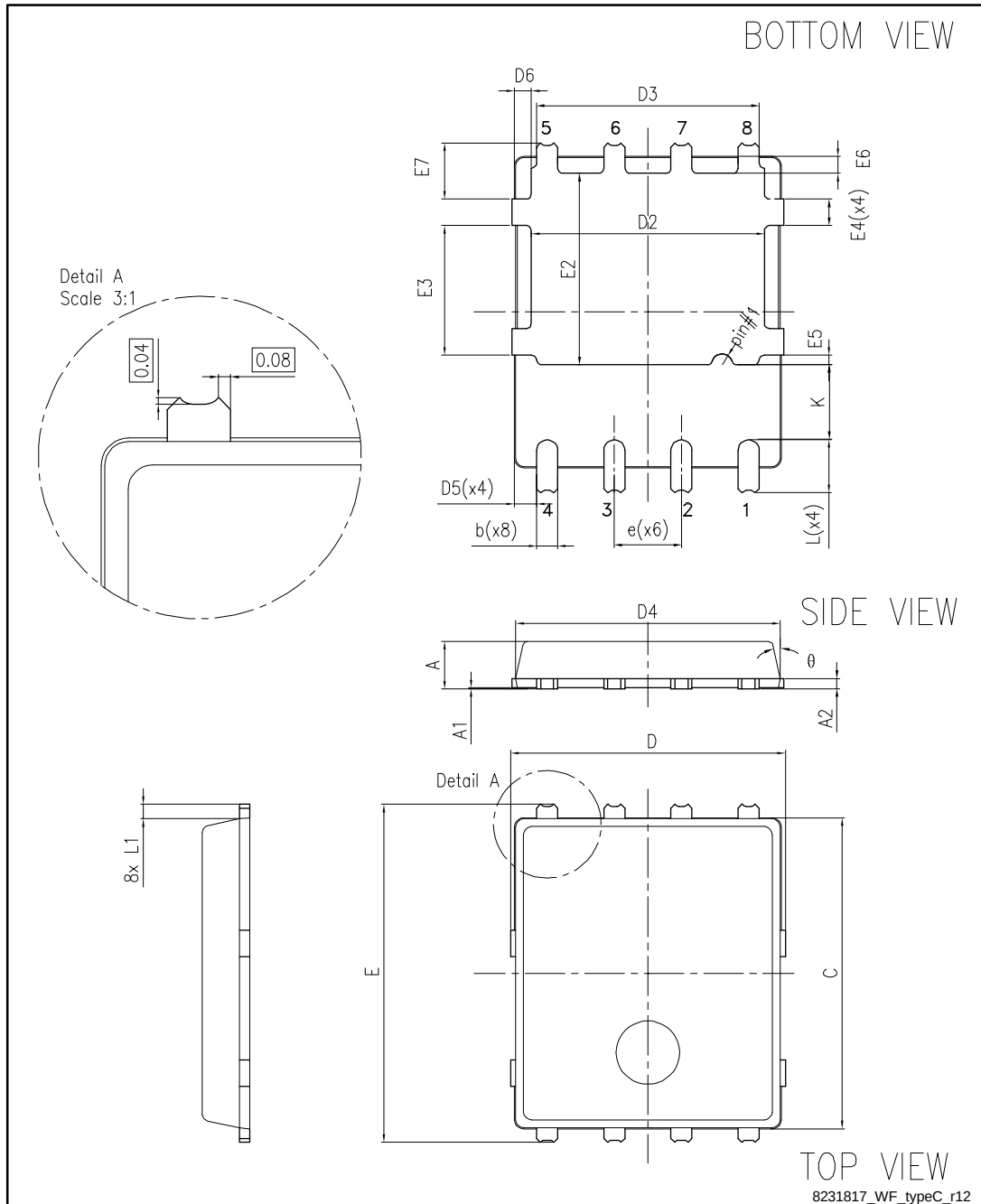


Table 8: PowerFLAT™ 5x6 WF type C mechanical data

| Dim. | mm    |       |       |
|------|-------|-------|-------|
|      | Min.  | Typ.  | Max.  |
| A    | 0.80  |       | 1.00  |
| A1   | 0.02  |       | 0.05  |
| A2   |       | 0.25  |       |
| b    | 0.30  |       | 0.50  |
| C    | 5.80  | 6.00  | 6.20  |
| D    | 5.00  | 5.20  | 5.40  |
| D2   | 4.15  |       | 4.45  |
| D3   | 4.05  | 4.20  | 4.35  |
| D4   | 4.80  | 5.0   | 5.20  |
| D5   | 0.25  | 0.4   | 0.55  |
| D6   | 0.15  | 0.3   | 0.45  |
| e    |       | 1.27  |       |
| E    | 6.20  | 6.40  | 6.60  |
| E2   | 3.50  |       | 3.70  |
| E3   | 2.35  |       | 2.55  |
| E4   | 0.40  |       | 0.60  |
| E5   | 0.08  |       | 0.28  |
| E6   | 0.2   | 0.325 | 0.450 |
| E7   | 0.85  | 1.00  | 1.15  |
| K    | 1.05  |       | 1.35  |
| L    | 0.90  | 1.00  | 1.10  |
| L1   | 0.175 | 0.275 | 0.375 |
| θ    | 0°    |       | 12°   |

[illegible]

SECTION Y-Y

(I) Measured from centreline of sprocket hole to centreline of pocket.

(II) Cumulative tolerance of 10 sprocket holes is  $\pm 0.20$ .

(III) Measured from centreline of sprocket hole to centreline of pocket.

Base and bulk quantity 3000 pcs

8234350\_TapeWF\_rev\_C

Figure 22: PowerFLAT™ 5x6 package orientation in carrier tape

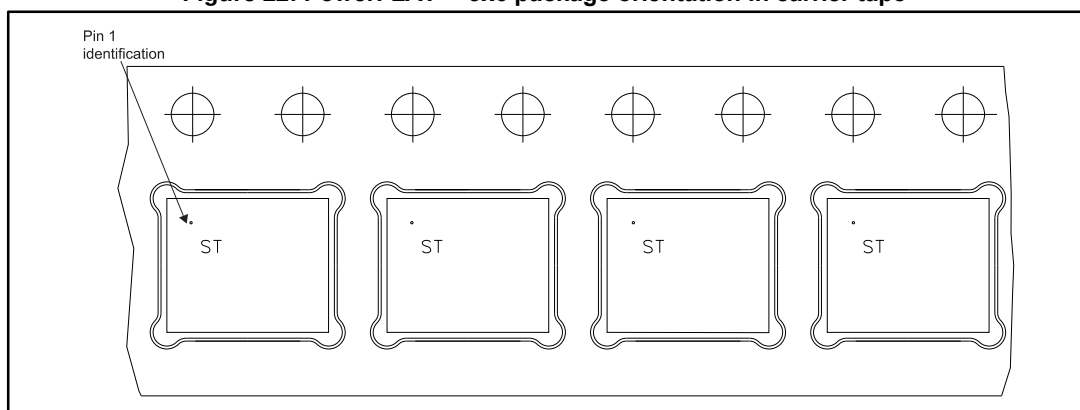
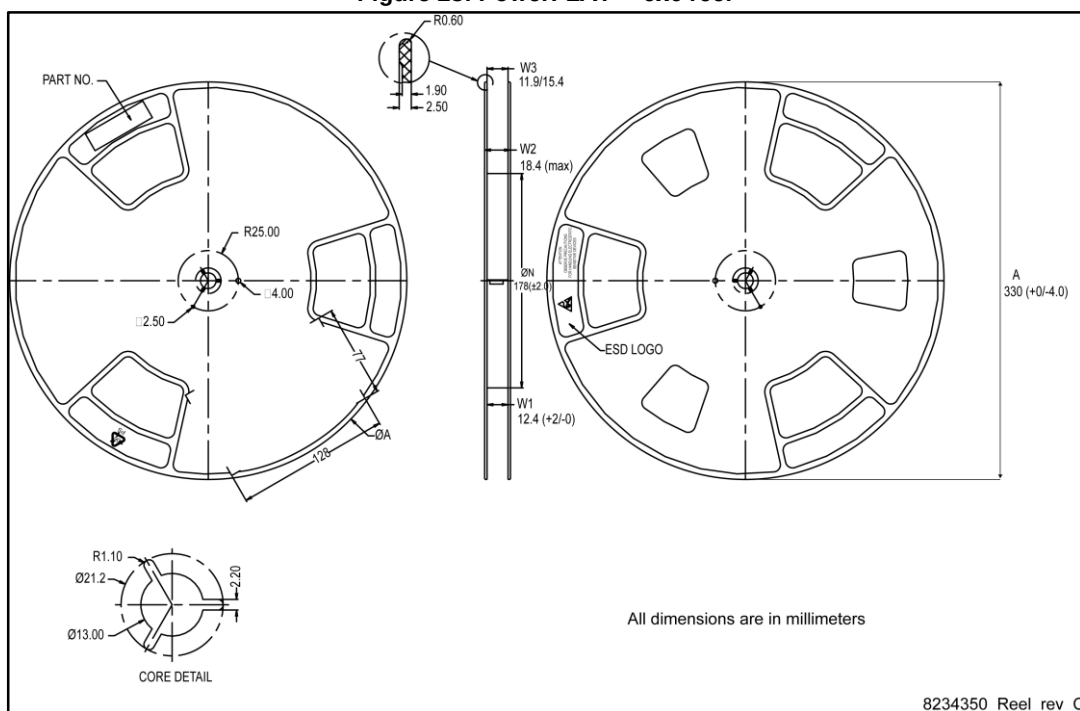


Figure 23: PowerFLAT™ 5x6 reel



## 5 Revision history

Table 9: Document revision history

| Date        | Revision | Changes        |
|-------------|----------|----------------|
| 07-Jan-2016 | 1        | First release. |

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