

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

Datasheet - production data

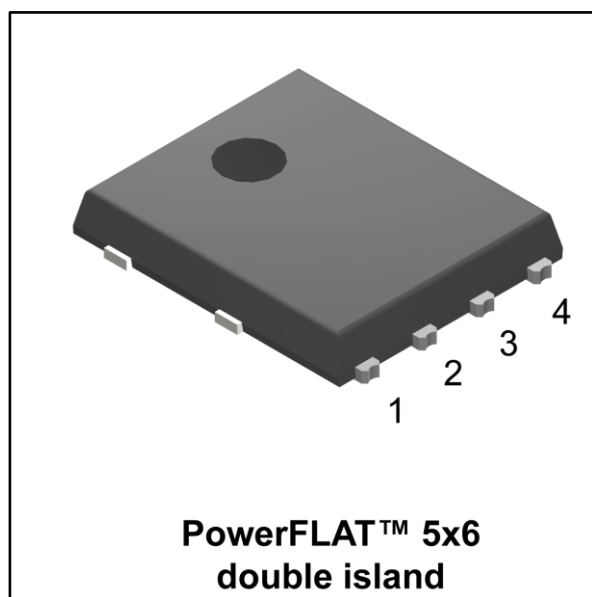
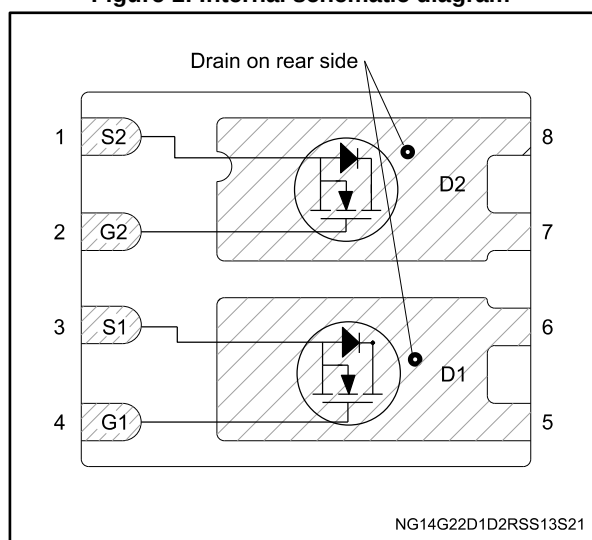


Figure 1: Internal schematic diagram



### Features

| Order code    | V <sub>DS</sub> | R <sub>DS(on)</sub> max. | I <sub>D</sub> |
|---------------|-----------------|--------------------------|----------------|
| STL76DN4LF7AG | 40 V            | 6 mΩ                     | 40 A           |



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

### Applications

- Switching applications

### Description

This dual 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                      | Packing       |
|---------------|----------|------------------------------|---------------|
| STL76DN4LF7AG | 76DN4LF7 | PowerFLAT™ 5x6 double island | Tape and reel |

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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 $T_C = 25\text{ }^{\circ}\text{C}$  | 40         | A                  |
| $I_D^{(1)}$    | Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$ | 40         | A                  |
| $I_{DM}^{(2)}$ | Drain current (pulsed)                                            | 160        | A                  |
| $P_{TOT}$      | Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$           | 71         | W                  |
| $T_j$          | Operating junction temperature range                              | -55 to 175 | $^{\circ}\text{C}$ |
| $T_{stg}$      | Storage temperature range                                         |            |                    |

**Notes:**

<sup>(1)</sup>Drain current is limited by package, the current capability of the silicon is 79 A at 25 °C and 56 A at 100 °C.

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

Table 3: Thermal data

| Symbol              | Parameter                        | Value | Unit                 |
|---------------------|----------------------------------|-------|----------------------|
| $R_{thj-case}$      | Thermal resistance junction-case | 2.1   | $^{\circ}\text{C/W}$ |
| $R_{thj-pcb}^{(1)}$ | Thermal resistance junction-pcb  | 32    | $^{\circ}\text{C/W}$ |

**Notes:**

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

## 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    | I <sub>D</sub> = 1 mA, V <sub>GS</sub> = 0 V                | 40   |      |      | V    |
| I <sub>DSS</sub>     | Zero gate voltage drain current   | V <sub>GS</sub> = 0 V<br>V <sub>DS</sub> = 40 V             |      |      | 10   | 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 | 1.5  |      | 2.5  | V    |
| R <sub>DS(on)</sub>  | Static drain-source on-resistance | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 10 A               |      | 5    | 6    | mΩ   |
|                      |                                   | V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 10 A              |      | 7    | 12   |      |

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                                                                                             | -    | 956  | -    | pF   |
| C <sub>oss</sub> | Output capacitance           |                                                                                                                                                         | -    | 241  | -    |      |
| C <sub>rss</sub> | Reverse transfer capacitance |                                                                                                                                                         | -    | 28   | -    |      |
| Q <sub>g</sub>   | Total gate charge            | V <sub>DD</sub> = 20 V, I <sub>D</sub> = 20 A,<br>V <sub>GS</sub> = 0 to 10 V (see <a href="#">Figure 14: "Test circuit for gate charge behavior"</a> ) | -    | 17   | -    | nC   |
| Q <sub>gs</sub>  | Gate-source charge           |                                                                                                                                                         | -    | 3.2  | -    |      |
| Q <sub>gd</sub>  | Gate-drain charge            |                                                                                                                                                         | -    | 4.3  | -    |      |

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> = 32 V, I <sub>D</sub> = 10 A,<br>R <sub>G</sub> = 4.7 Ω, V <sub>GS</sub> = 10 V (see <a href="#">Figure 13: "Test circuit for resistive load switching times"</a> and <a href="#">Figure 18: "Switching time waveform"</a> ) | -    | 9    | -    | ns   |
| t <sub>r</sub>      | Rise time           |                                                                                                                                                                                                                                               | -    | 4.3  | -    |      |
| t <sub>d(off)</sub> | Turn-off delay time |                                                                                                                                                                                                                                               | -    | 39   | -    |      |
| t <sub>f</sub>      | Fall time           |                                                                                                                                                                                                                                               | -    | 10   | -    |      |

Table 7: Source-drain diode

| Symbol          | Parameter                     | Test conditions                                                                                                                                                                                | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $I_{SD}^{(1)}$  | Source-drain current          |                                                                                                                                                                                                | -    |      | 40   | A    |
| $I_{SDM}^{(2)}$ | Source-drain current (pulsed) |                                                                                                                                                                                                | -    |      | 160  | A    |
| $V_{SD}^{(3)}$  | Forward on voltage            | $I_{SD} = 40\text{ A}$ , $V_{GS} = 0\text{ V}$                                                                                                                                                 | -    |      | 1.3  | V    |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 20\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 32\text{ V}$ (see <a href="#">Figure 15: "Test circuit for inductive load switching and diode recovery times"</a> ) | -    | 27   |      | ns   |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                                                                                | -    | 19.5 |      | nC   |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                                                                                | -    | 1.4  |      | A    |

**Notes:**

(1) Drain current is limited by package, the current capability of the silicon is 79 A at 25 °C.

(2) Pulse width limited by safe operating area .

(3) Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

## 2.1 Electrical characteristics (curves)

Figure 2: Safe operating area

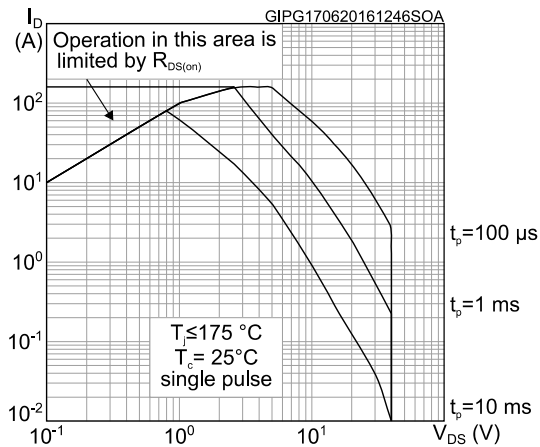


Figure 3: Thermal impedance

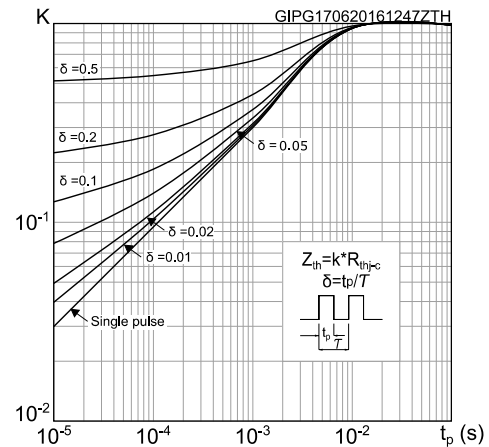


Figure 4: Output characteristics

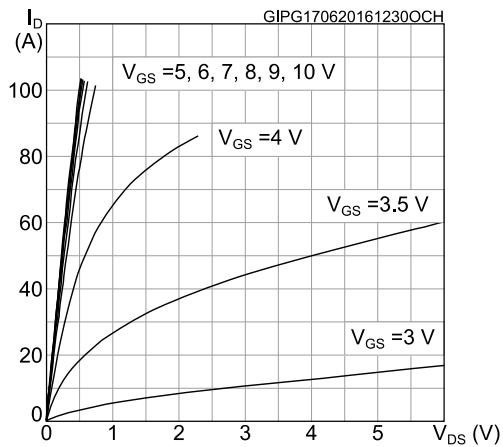


Figure 5: Transfer characteristics

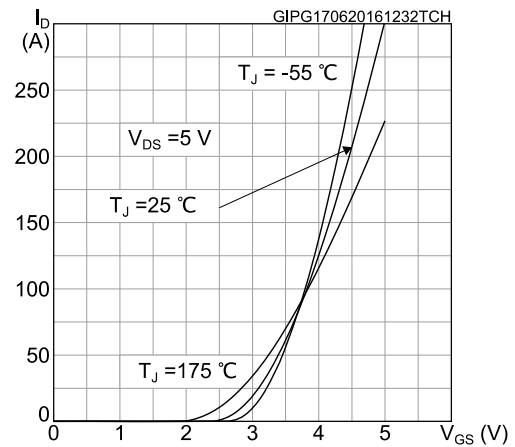


Figure 6: Gate charge vs gate-source voltage

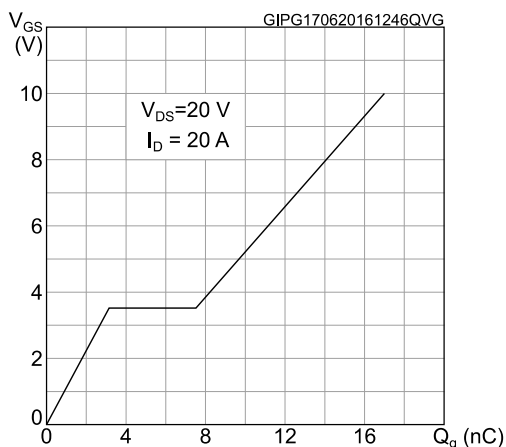


Figure 7: Static drain-source on-resistance

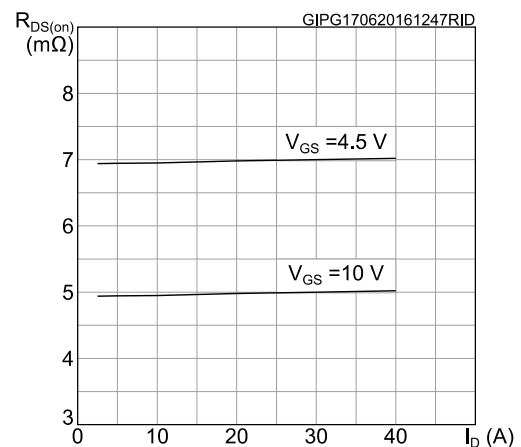


Figure 8: Capacitance variations

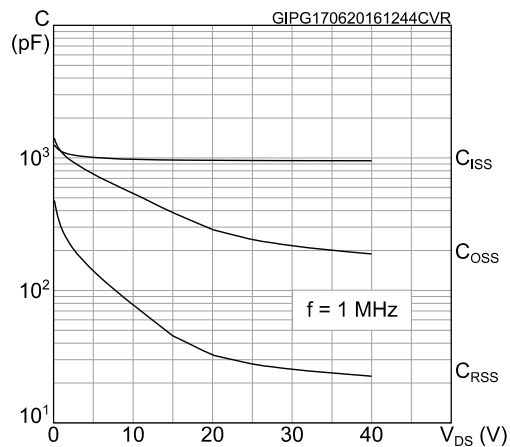


Figure 9: Normalized gate threshold voltage vs temperature

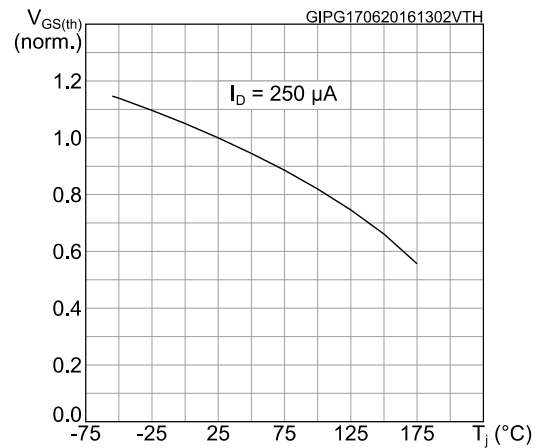


Figure 10: Normalized on-resistance vs temperature

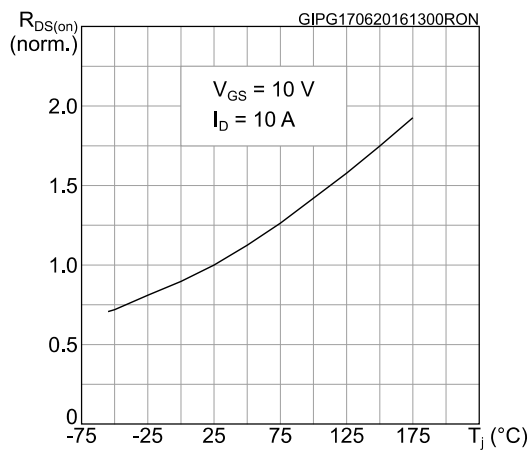
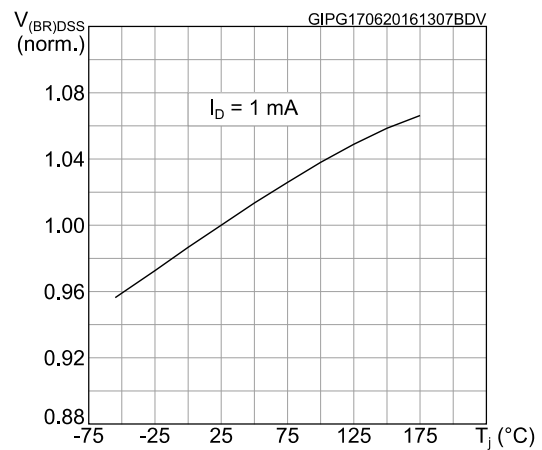
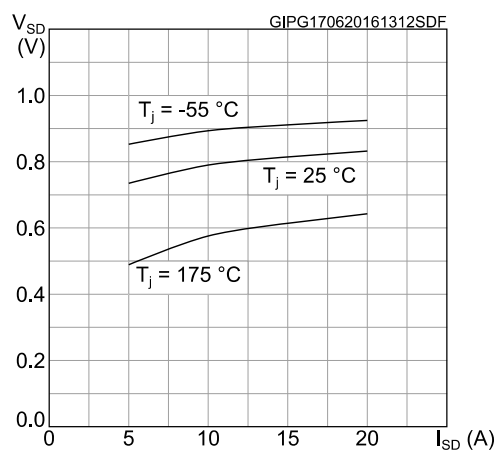
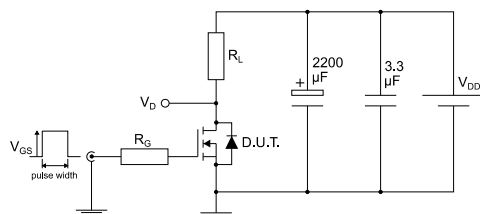
Figure 11: Normalized  $V_{(BR)DSS}$  vs temperature

Figure 12: Source-drain diode forward characteristics



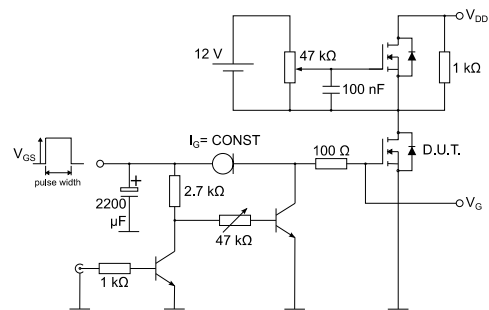
### 3 Test circuits

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



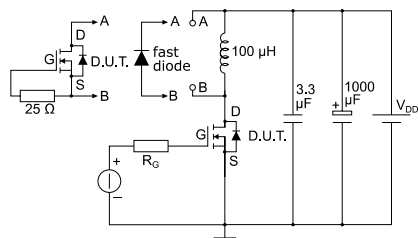
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**Figure 14: Test circuit for gate charge behavior**



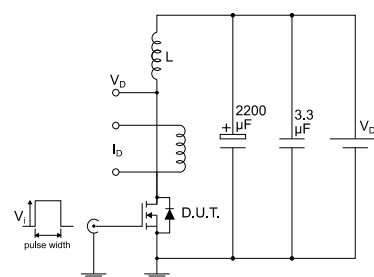
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**Figure 15: Test circuit for inductive load switching and diode recovery times**



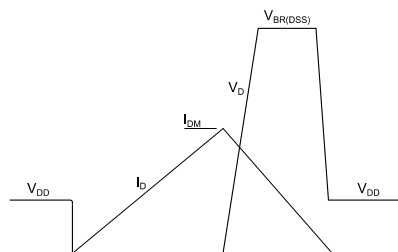
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**Figure 16: Unclamped inductive load test circuit**



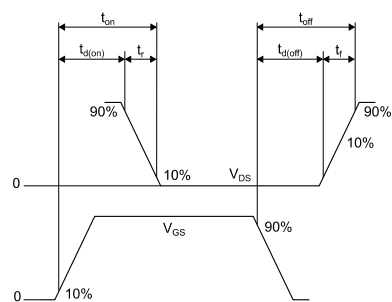
AM01471v1

**Figure 17: Unclamped inductive waveform**



AM01472v1

**Figure 18: Switching time waveform**



AM01473v1



## 4 Package information

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 double island WF type C package information

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

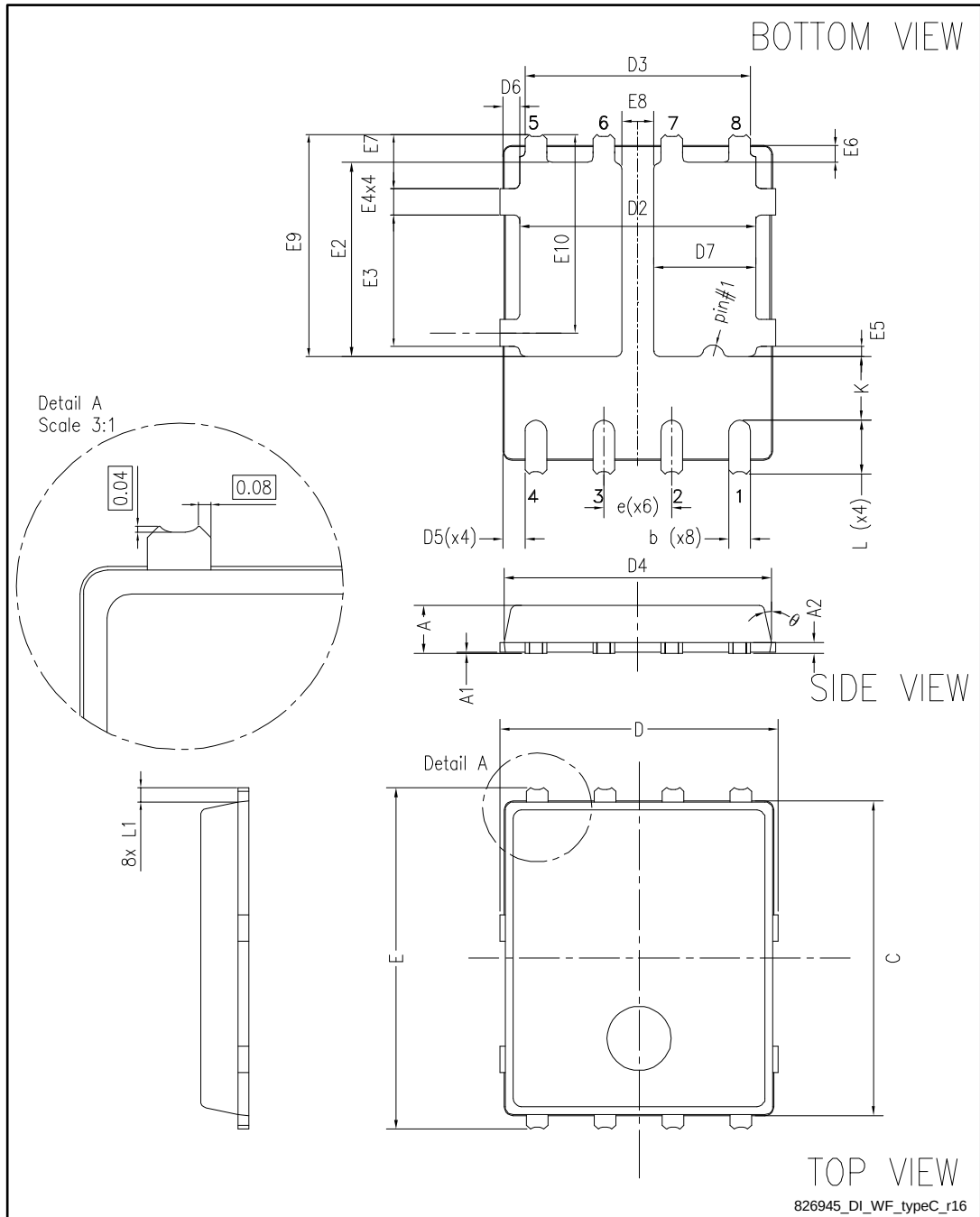
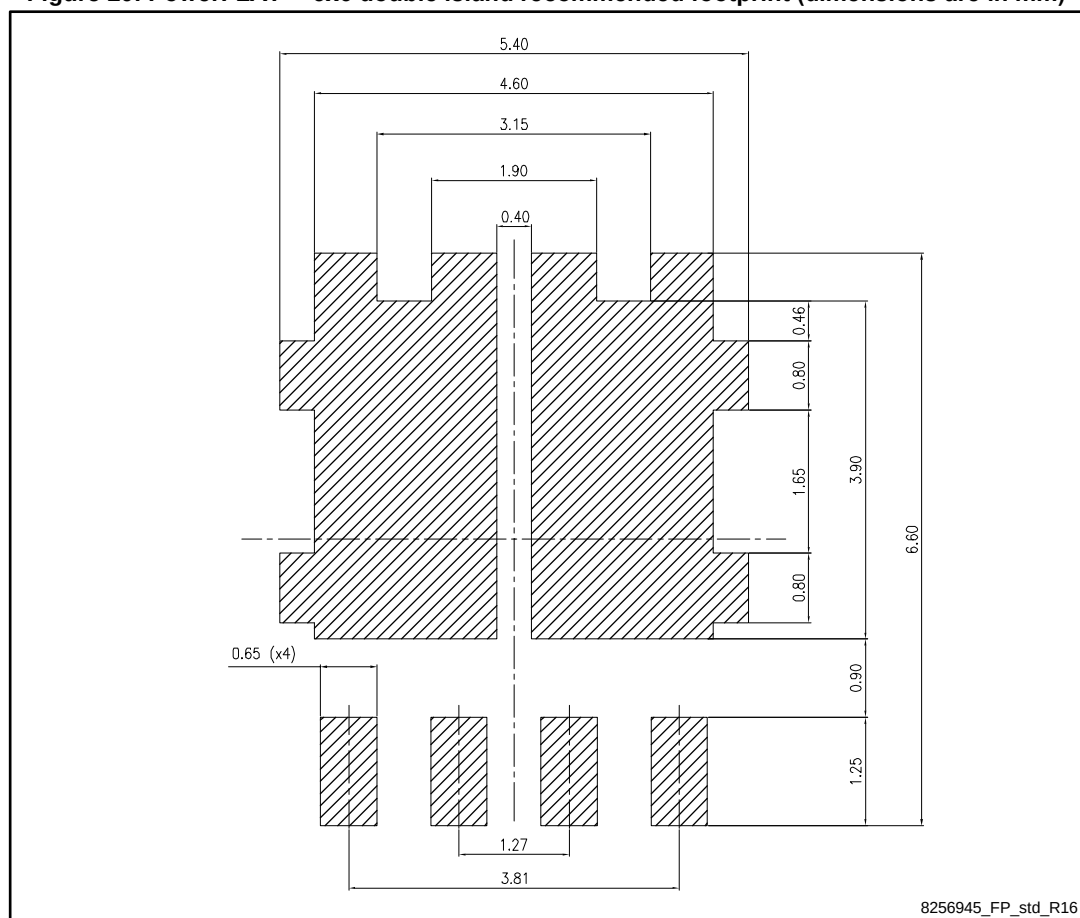


Table 8: PowerFLAT™ 5x6 double island WF type C mechanical data

| 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  | 6.10  |
| D    | 5.00  | 5.20  | 5.40  |
| D2   | 4.15  |       | 4.45  |
| D3   | 4.05  | 4.20  | 4.35  |
| D4   | 4.80  | 5.00  | 5.10  |
| D5   | 0.25  | 0.40  | 0.55  |
| D6   | 0.15  | 0.30  | 0.45  |
| D7   | 1.68  |       | 1.98  |
| 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   | 0.20  | 0.325 | 0.45  |
| E7   | 0.85  | 1.00  | 1.15  |
| E8   | 0.55  |       | 0.75  |
| E9   | 4.00  | 4.20  | 4.40  |
| E10  | 3.55  | 3.70  | 3.85  |
| L    | 0.90  | 1.00  | 1.10  |
| L1   | 0.175 | 0.275 | 0.375 |
| K    | 1.05  |       | 1.35  |
| Θ    | 0°    |       | 12°   |

Figure 20: PowerFLAT™ 5x6 double island recommended footprint (dimensions are in mm)



## 4.2 Packing information

Figure 21: PowerFLAT™ 5x6 WF tape (dimensions are in mm)

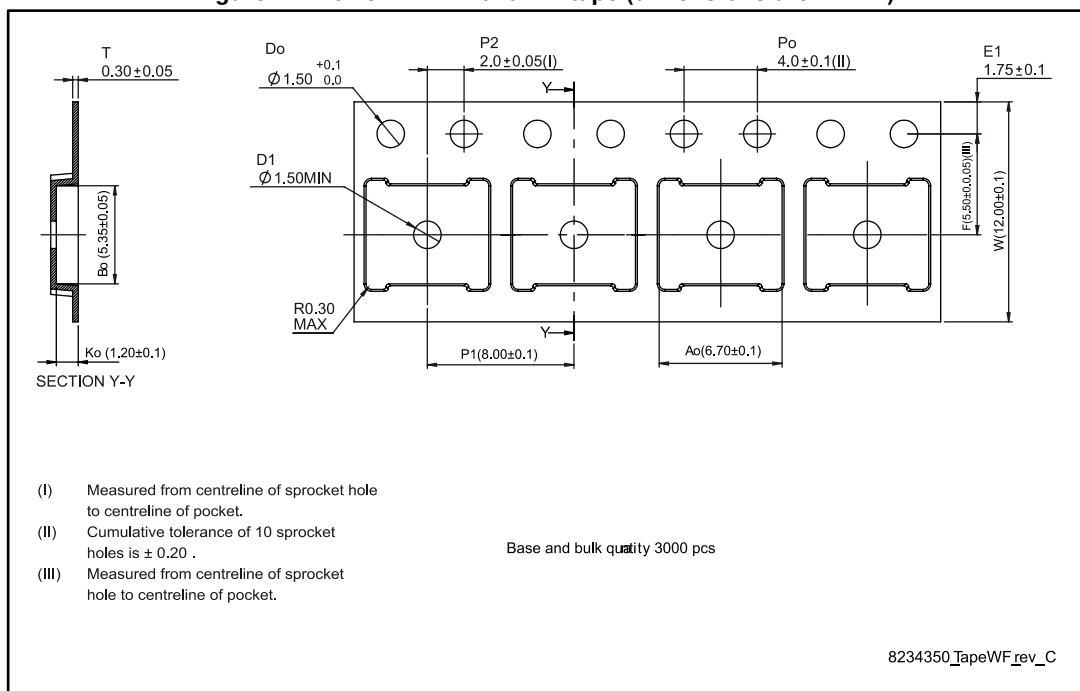
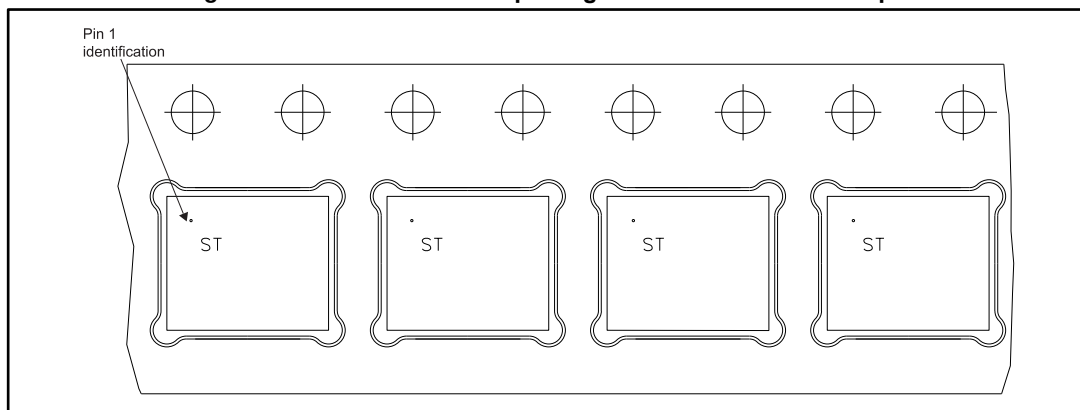
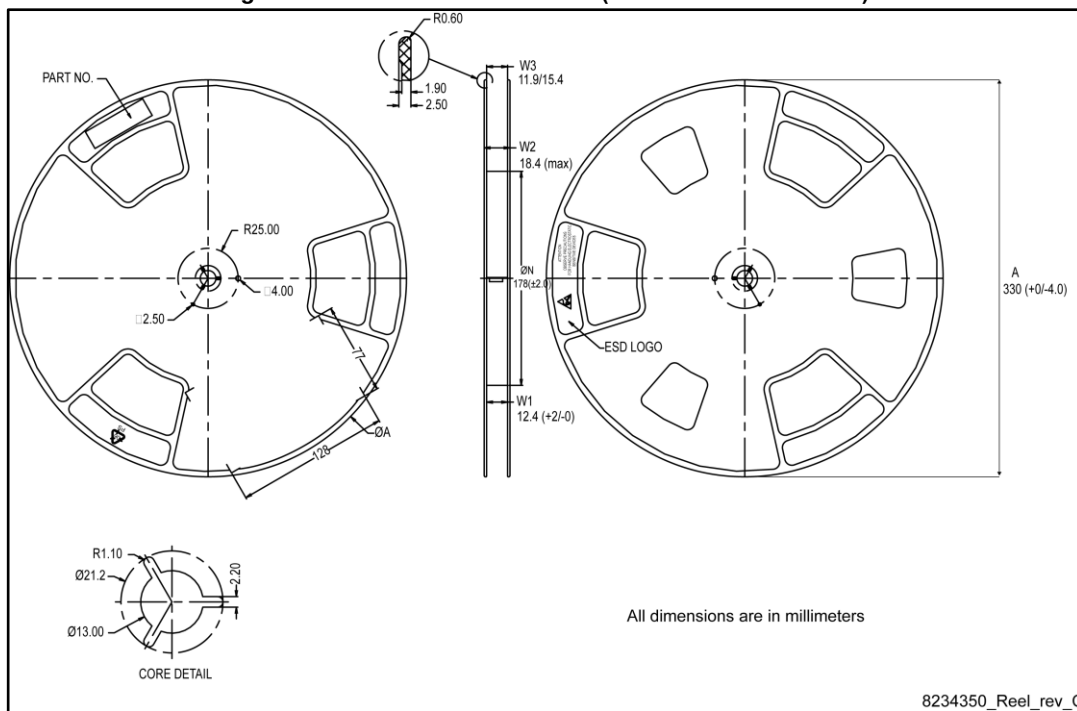


Figure 22: PowerFLAT™ 5x6 package orientation in carrier tape



**Figure 23: PowerFLAT™ 5x6 reel (dimensions are in mm)**



## 5 Revision history

**Table 9: Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 20-Apr-2016 | 1        | First release.                                                                                                                                                                                                                                                                                                                                                                                             |
| 23-Jun-2016 | 2        | Modified: title, features and description in cover page.<br>Modified: <i>Table 4: "On/Off states"</i> , <i>Table 5: "Dynamic"</i> , <i>Table 6: "Switching times"</i> and <i>Table 7: "Source-drain diode"</i> .<br>Added: <i>Section 4.1: "Electrical characteristics (curves)"</i> .<br>Updated: <i>Section 6.1: "PowerFLAT 5x6 double island WF type C package information"</i> .<br>Minor text changes |
| 27-Jul-2016 | 3        | Updated <i>Table 4: "On/Off states"</i> .                                                                                                                                                                                                                                                                                                                                                                  |
| 16-Dec-2016 | 4        | Updated <i>Section 4: "Package information"</i> .<br>Minor text changes                                                                                                                                                                                                                                                                                                                                    |
| 27-Jul-2017 | 5        | Updated title and features in cover page.<br>Document status updated from preliminary to production data.                                                                                                                                                                                                                                                                                                  |

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