# STL140N6F7

## N-channel 60 V, 2.4 mΩ typ., 140 A STripFET™ F7 Power MOSFET in a PowerFLAT™ 5x6 package

Datasheet - production data

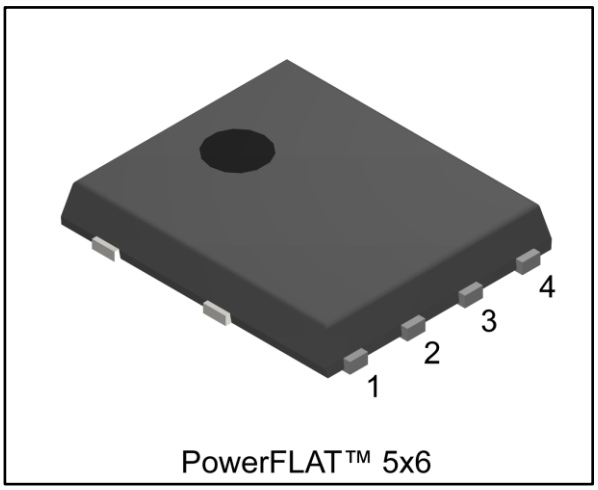
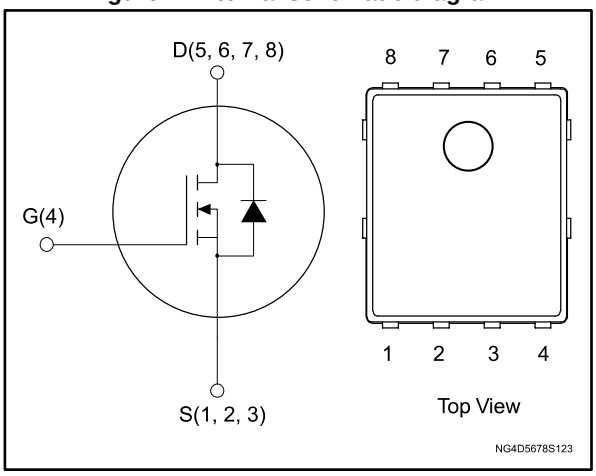



**Figure 1: Internal schematic diagram**




## Features

| Order code | $V_{DS}$ | $R_{DS(on)}$ max. | $I_D$ | $P_{TOT}$ |
|---|---|---|---|---|
| STL140N6F7 | 60 V | 2.8 mΩ | 140 A | 125 W |

- Among the lowest $R_{DS(on)}$ on the market
- Excellent FoM (figure of merit)
- Low $C_{rss}/C_{iss}$ ratio for EMI immunity
- High avalanche ruggedness

## 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 | Packing |
|---|---|---|---|
| STL140N6F7 | 140N6F7 | PowerFLAT™ 5x6 | Tape and reel |

# Contents

# 1 Electrical ratings

**Table 2: Absolute maximum ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{DS}$ | Drain-source voltage | 60 | V |
| $V_{GS}$ | Gate-source voltage | ±20 | V |
| $I_D$(1) | Drain current (continuous) at $T_{case}$ = 25 °C | 140 | A |
| | Drain current (continuous) at $T_{case}$ = 100 °C | 107 | |
| $I_{DM}$(1)(2) | Drain current (pulsed) | 560 | A |
| $I_D$(3) | Drain current (continuous) at $T_{pcb}$ = 25 °C | 30 | A |
| | Drain current (continuous) at $T_{pcb}$ = 100 °C | 21 | |
| $I_{DM}$(2)(3) | Drain current (pulsed) | 116 | A |
| $P_{TOT}$(1) | Total dissipation at $T_{case}$ = 25 °C | 125 | W |
| $P_{TOT}$(3) | Total dissipation at $T_{pcb}$ = 25 °C | 4.8 | W |
| $E_{AS}$(4) | Single pulse avalanche energy | 38 | mJ |
| $T_{stg}$ | Storage temperature range | -55 to 175 | °C |
| $T_j$ | Operating junction temperature range | | |

**Notes:**

(1) This value is rated according to $R_{thj\text{-}c}$.

(2) Pulse width is limited by safe operating area.

(3) This value is rated according to $R_{thj\text{-}pcb}$

(4)Starting $T_j$ =25 °C, $I_D$ = 16 A, $V_{DD}$ = 40 V

**Table 3: Thermal data**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{thj\text{-}pcb}$(1) | Thermal resistance junction-pcb | 31.3 | °C/W |
| $R_{thj\text{-}case}$ | Thermal resistance junction-case | 1.2 | |

**Notes:**

(1) When mounted on a 1-inch² FR-4 board, 2oz Cu, t < 10 s

# 2 Electrical characteristics

($T_{case}$ = 25 °C unless otherwise specified)

**Table 4: Static**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $V_{GS}$ = 0 V, $I_D$ = 1 mA | 60 | | | V |
| $I_{DSS}$ | Zero gate voltage drain current | $V_{GS}$ = 0 V, $V_{DS}$ = 60 V | | | 1 | µA |
| $I_{GSS}$ | Gate-body leakage current | $V_{DS}$ = 0 V, $V_{GS}$ = ±20 V | | | 100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | 2 | | 4 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS}$ = 10 V, $I_D$ = 15 A | | 2.4 | 2.8 | mΩ |

**Table 5: Dynamic**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input capacitance | $V_{DS}$ = 25 V, f = 1 MHz, $V_{GS}$ = 0 V | - | 3110 | - | pF |
| $C_{oss}$ | Output capacitance | | - | 1520 | - | |
| $C_{rss}$ | Reverse transfer capacitance | | - | 193 | - | |
| $Q_g$ | Total gate charge | $V_{DD}$ = 30 V, $I_D$ = 30 A, $V_{GS}$ = 0 to 10 V (see *Figure 14: "Test circuit for gate charge behavior"*) | - | 55 | - | nC |
| $Q_{gs}$ | Gate-source charge | | - | 19 | - | |
| $Q_{gd}$ | Gate-drain charge | | - | 18 | - | |

**Table 6: Switching times**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD}$ = 30 V, $I_D$ = 15 A, $R_G$ = 4.7 Ω, $V_{GS}$ = 10 V (see *Figure 13: "Test circuit for resistive load switching times"* and *Figure 18: "Switching time waveform"*) | - | 24 | - | ns |
| $t_r$ | Rise time | | - | 68 | - | |
| $t_{d(off)}$ | Turn-off delay time | | - | 39 | - | |
| $t_f$ | Fall time | | - | 20 | - | |

**Table 7: Source-drain diode**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{SD}$ (1) | Forward on voltage | $V_{GS}$ = 0 V, $I_{SD}$ = 30 A | - | | 1.2 | V |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 30 A, di/dt = 100 A/µs, $V_{DD}$ = 48 V (see *Figure 15: "Test circuit for inductive load switching and diode recovery times"*) | - | 42.4 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 38.2 | | nC |
| $I_{RRM}$ | Reverse recovery current | | - | 1.8 | | A |

**Notes:**

(1) Pulse test: pulse duration = 300 µs, duty cycle 1.5%.

## 2.1 Electrical characteristics (curves)

**Figure 2: Safe operating area**

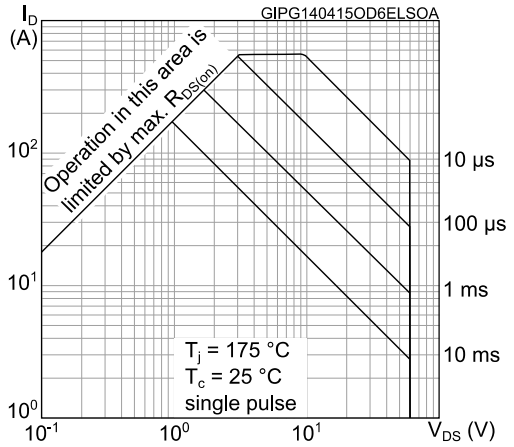



**Figure 3: Thermal impedance**

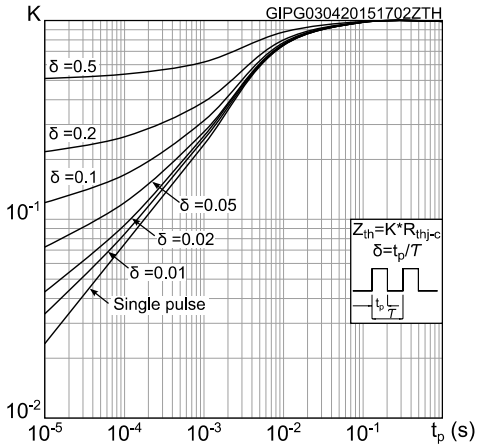



**Figure 4: Output characteristics**

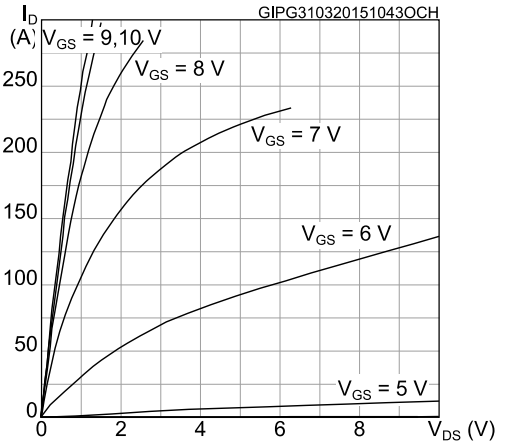



**Figure 5: Transfer characteristics**

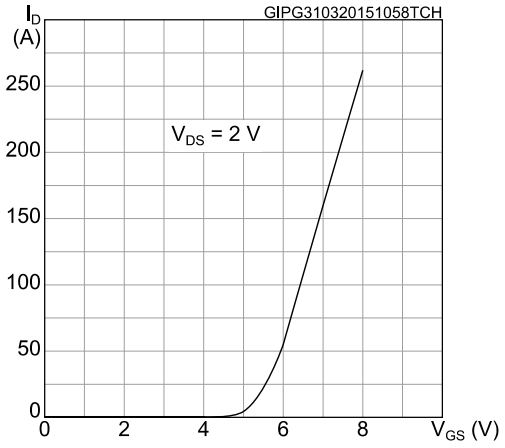



**Figure 6: Gate charge vs gate-source voltage**

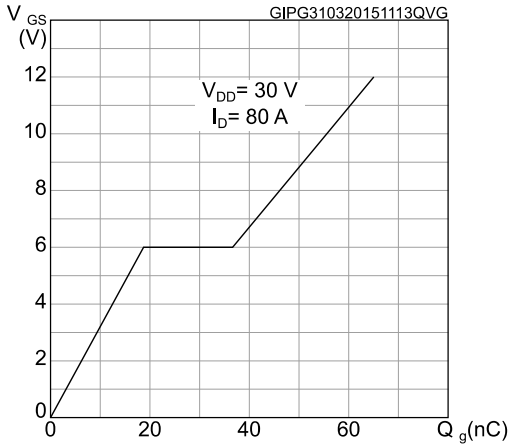



**Figure 7: Static drain-source on-resistance**

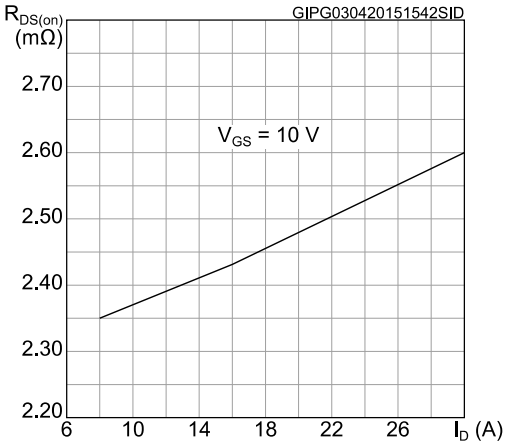


**Figure 8: Capacitance variations**

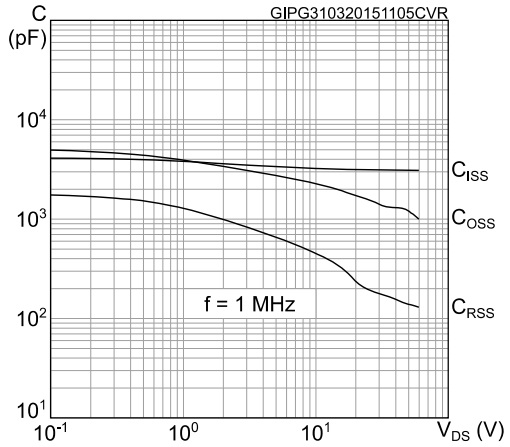



**Figure 9: Normalized gate threshold voltage vs temperature**

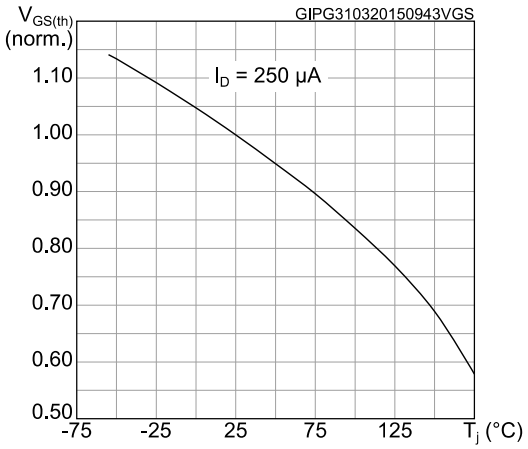



**Figure 10: Normalized on-resistance vs temperature**

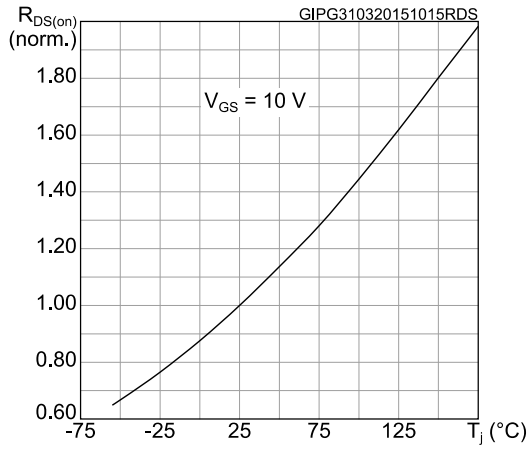



**Figure 11: Normalized V(BR)DSS vs temperature**

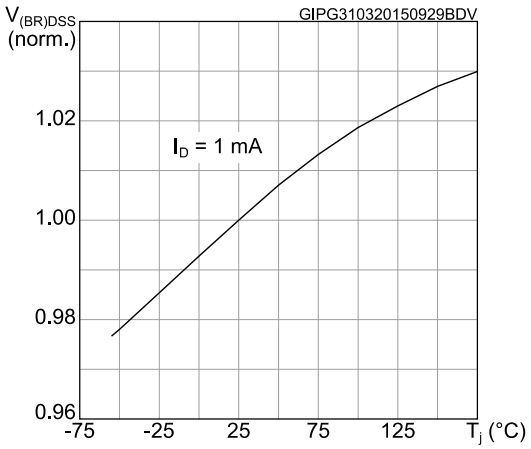
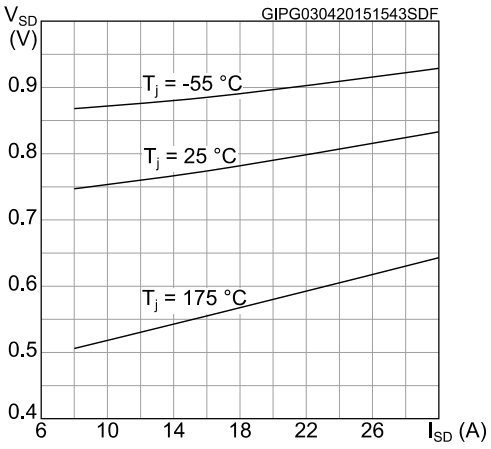



**Figure 12: Source-drain diode forward characteristics**



# 3 Test circuits

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

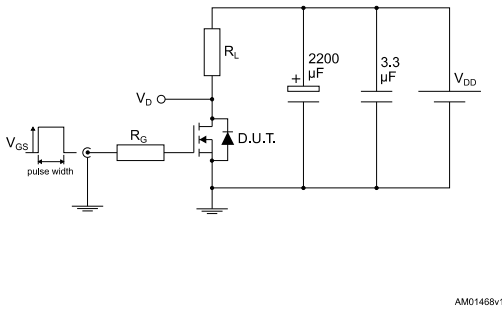



**Figure 14: Test circuit for gate charge behavior**

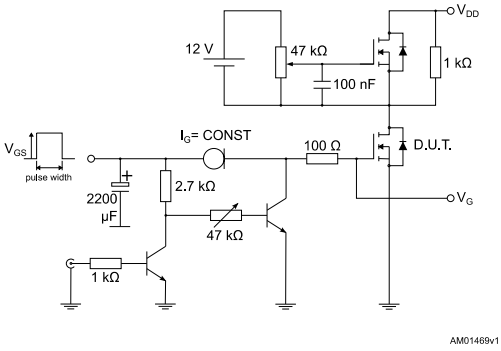



**Figure 15: Test circuit for inductive load switching and diode recovery times**

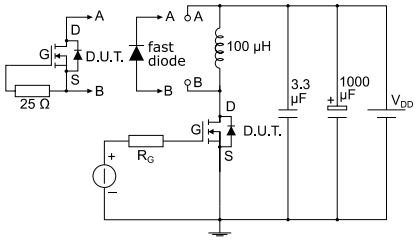



**Figure 16: Unclamped inductive load test circuit**

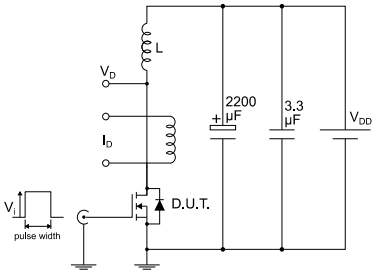



**Figure 17: Unclamped inductive waveform**

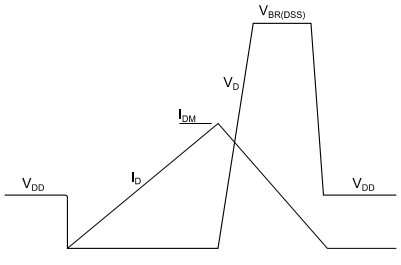
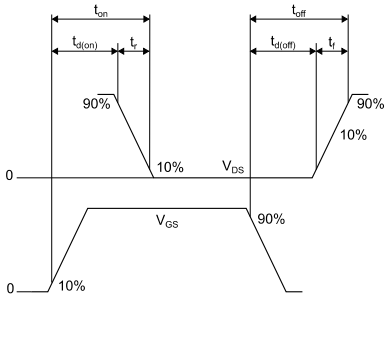



**Figure 18: Switching time waveform**



# 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***. ECOPACK® is an ST trademark.

## 4.1 PowerFLAT™ 5x6 type C package information

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

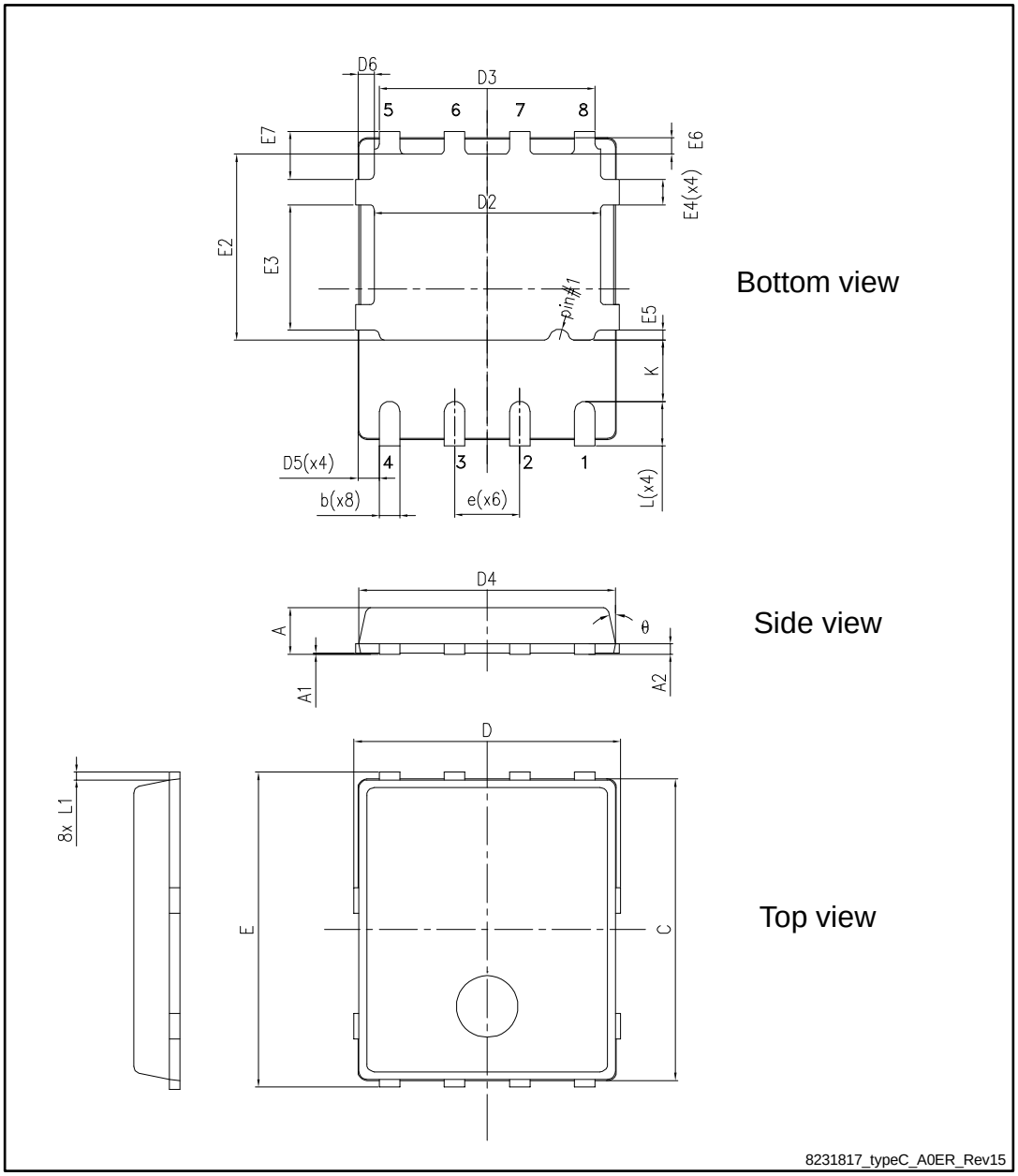
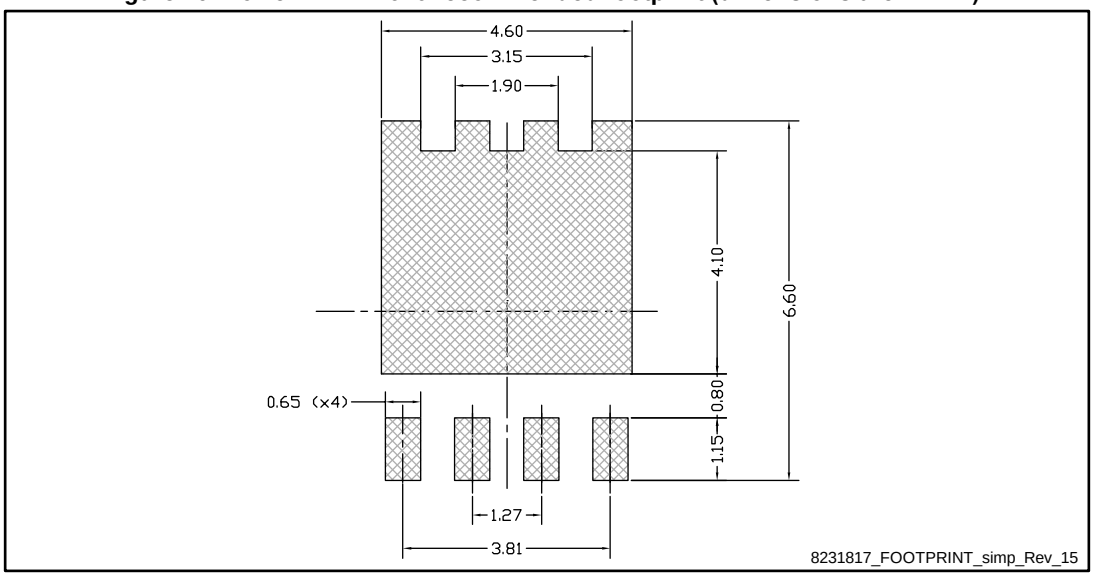


Table 8: PowerFLAT™ 5x6 type C package mechanical data

| 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 | 5.00 | 5.20 |
| D5 | 0.25 | 0.40 | 0.55 |
| D6 | 0.15 | 0.30 | 0.45 |
| e | | 1.27 | |
| E | 5.95 | 6.15 | 6.35 |
| 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 | 0.75 | 0.90 | 1.05 |
| K | 1.05 | | 1.35 |
| L | 0.725 | | 1.025 |
| L1 | 0.05 | 0.15 | 0.25 |
| θ | 0° | | 12° |

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



## 4.2 PowerFLAT™ 5x6 packing information

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

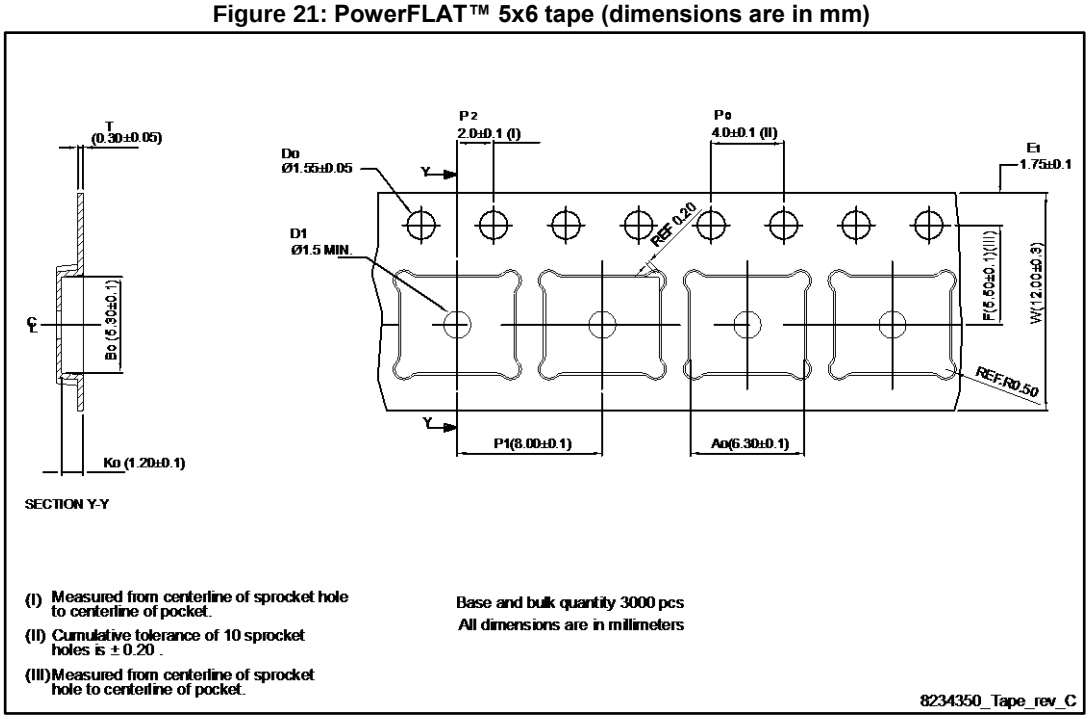



**Figure 22: PowerFLAT™ 5x6 package orientation in carrier tape**

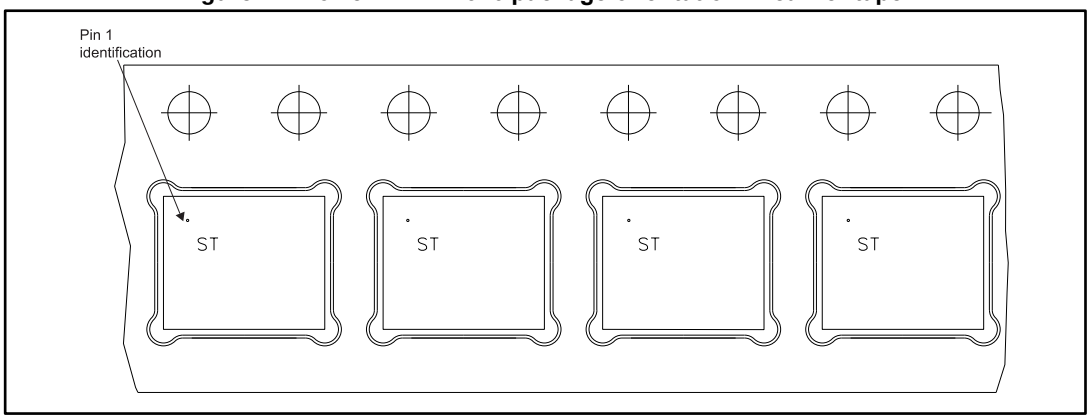
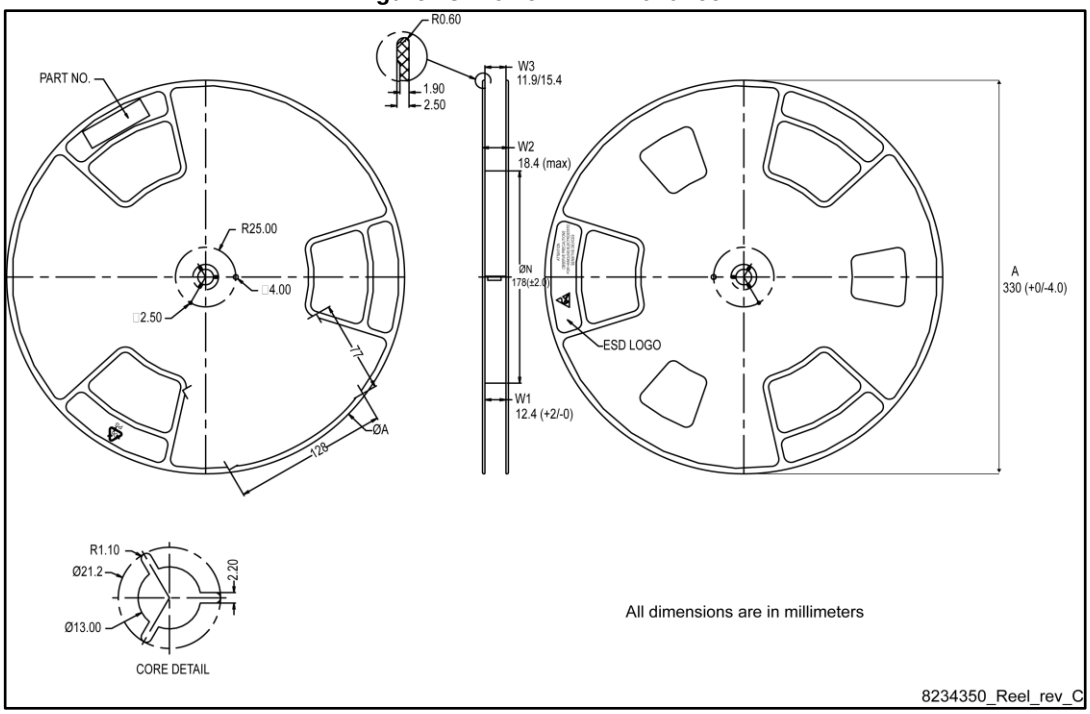


**Figure 23: PowerFLAT™ 5x6 reel**



# 5 Revision history

**Table 9: Document revision history**

| Date | Revision | Changes |
|---|---|---|
| 02-Aug-2013 | 1 | First release. |
| 18-Mar-2014 | 2 | Updated VDS value in Table 2: Absolute maximum ratings and Table 4: On /off states.<br>Updated Section 4: Package mechanical data.<br>Minor text changes. |
| 09-Apr-2015 | 3 | Text edits and formatting changes throughout document<br>On cover page:<br>-updated title description<br>-updated device 'Features' and 'Description'<br>Updated section 1 Electrical ratings<br>Updated section 2 Electrical characteristics<br>Added section 2.1 Electrical characteristics (curves)<br>Updated and renamed Section 4 Package information (was Package mechanical data)<br>Updated and renamed Section 4.2 Packing information (was Section 5 Packaging mechanical data) |
| 19-May-2015 | 4 | In section 2.1 Electrical characteristics (curves):<br>- Updated Figure 24: Capacitance variations |
| 21-Apr-2017 | 5 | Added $E_{AS}$ in *Table 2: "Absolute maximum ratings"*<br>Updated *Section 4.1: "PowerFLAT™ 5x6 type C package information"*<br>Minor text changes. |

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