

Automotive-grade N-channel 40 V, 2.1 mΩ typ., 120 A STripFET™ F7 Power MOSFET in a PowerFLAT™ 5x6 package

Datasheet - production data

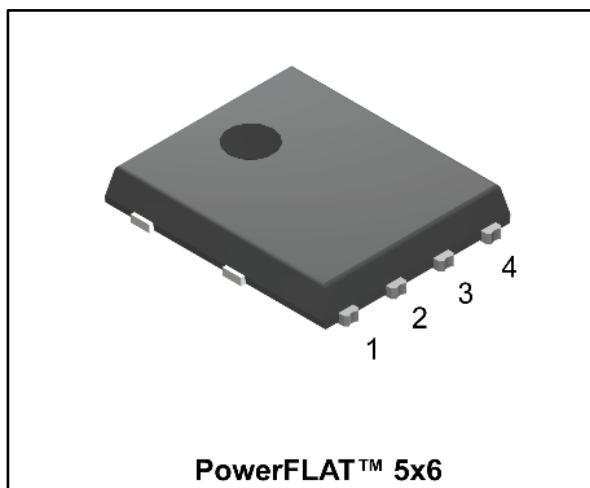
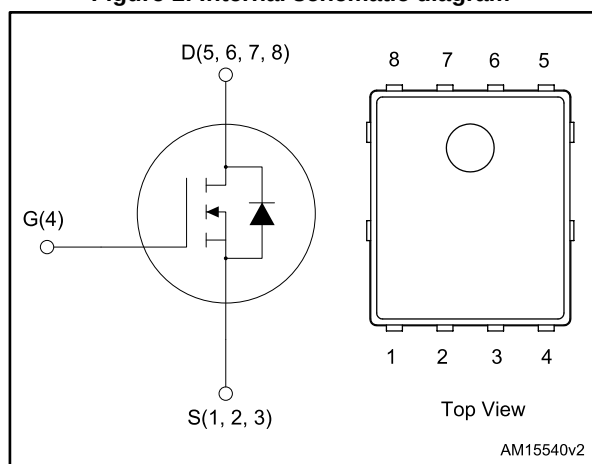


Figure 1: Internal schematic diagram



Features

Order code	V _{DS}	R _{DS(on)} max	I _D
STL140N4F7AG	40 V	2.5 mΩ	120 A



- AEC-Q101 qualified
- 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
- 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
STL140N4F7AG	140N4F7	PowerFLAT™ 5x6	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	± 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
$I_{DM}^{(2)}$	Drain current (pulsed)	480	A
$P_{TOT}^{(1)}$	Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	111	W
I_{AV}	Avalanche current, repetitive (pulse width limited by maximum junction temperature)	16	A
E_{AS}	Single pulse avalanche energy ($T_j = 25\text{ }^{\circ}\text{C}$, $I_D = I_{AV}$, $V_{DD} = 25\text{ V}$)	260	mJ
T_{stg}	Storage temperature range	-55 to 175	$^{\circ}\text{C}$
T_j	Operating junction temperature range		

Notes:

⁽¹⁾Drain current is limited by package, the current capability of the silicon is 178 A at 25 $^{\circ}\text{C}$.

⁽²⁾Pulse width is 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.	1.35	$^{\circ}\text{C/W}$

Notes:

⁽¹⁾When mounted on FR-4 board of 1 inch², 2oz Cu, $t < 10\text{ s}$

2 Electrical characteristics

(T_C = 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 V, I _D = 250 μA	40			V
I _{DSS}	Zero gate voltage drain current	V _{GS} = 0 V, V _{DS} = 40 V			1	μA
I _{GSS}	Gate-body leakage current	V _{GS} = 20 V, V _{DS} = 0 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 = 16 A		2.1	2.5	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	-	2300	-	pF
C _{oss}	Output capacitance		-	786	-	pF
C _{rss}	Reverse transfer capacitance		-	43	-	pF
Q _g	Total gate charge	V _{DD} = 20 V, I _D = 32 A, V _{GS} = 0 to 10 V (see Figure 14: "Test circuit for gate charge behavior")	-	29	-	nC
Q _{gs}	Gate-source charge		-	13	-	nC
Q _{gd}	Gate-drain charge		-	5.6	-	nC

Table 6: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
t _{d(on)}	Turn-on delay time	V _{DD} = 20 V, I _D = 16 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")	-	14	-	ns
t _r	Rise time		-	6.6	-	ns
t _{d(off)}	Turn-off delay time		-	19	-	ns
t _f	Fall time		-	5.7	-	ns

Table 7: Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V _{SD} ⁽¹⁾	Forward on voltage	I _{SD} = 32 A, V _{GS} = 0 V	-		1.2	V
t _{rr}	Reverse recovery time	I _D = 32 A, di/dt = 100 A/μs, V _{DD} = 32 V (see Figure 15: "Test circuit for inductive load switching and diode recovery times")	-	55		ns
Q _{rr}	Reverse recovery charge		-	67		nC
I _{RRM}	Reverse recovery current		-	2.4		A

Notes:

⁽¹⁾Pulsed: pulse duration = 300 μs, duty cycle 1.5%

2.1 Electrical characteristics (curves)

Figure 2: Safe operating area

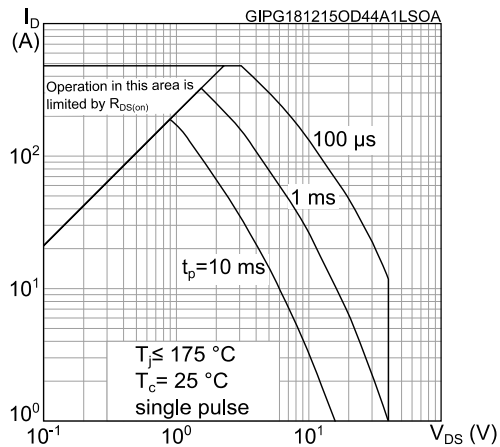


Figure 3: Thermal impedance

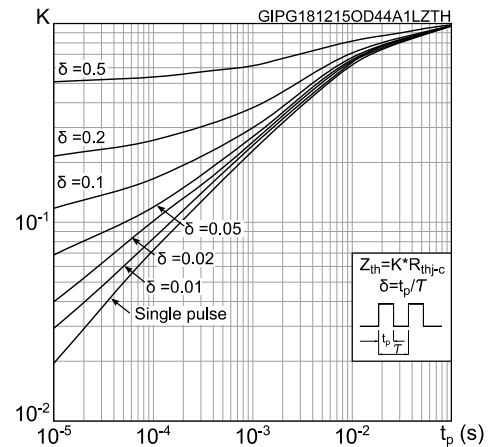


Figure 4: Output characteristics

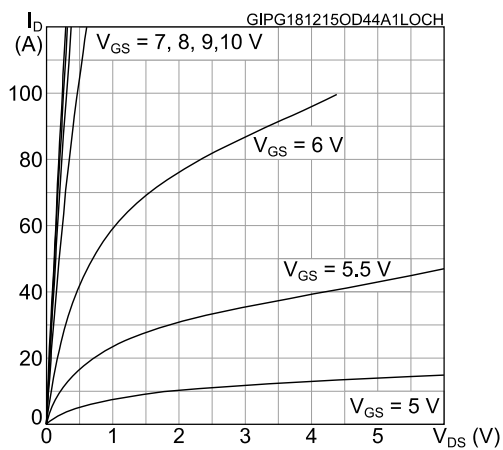


Figure 5: Transfer characteristics

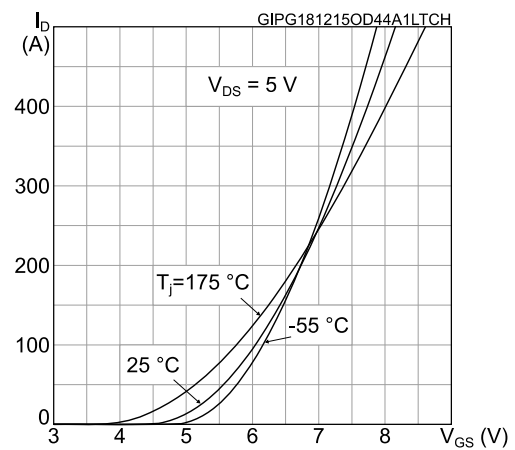


Figure 6: Gate charge vs gate-source voltage

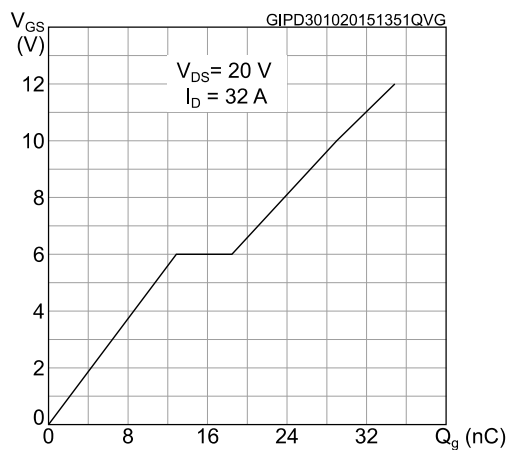


Figure 7: Static drain-source on-resistance

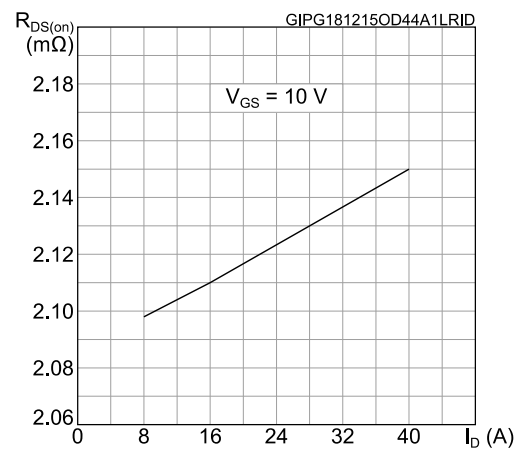


Figure 8: Capacitance variations

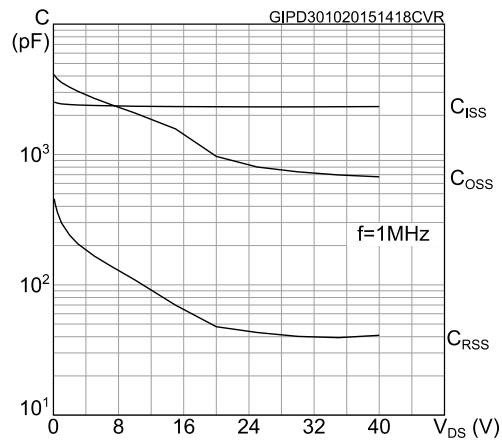


Figure 9: Normalized gate threshold voltage vs temperature

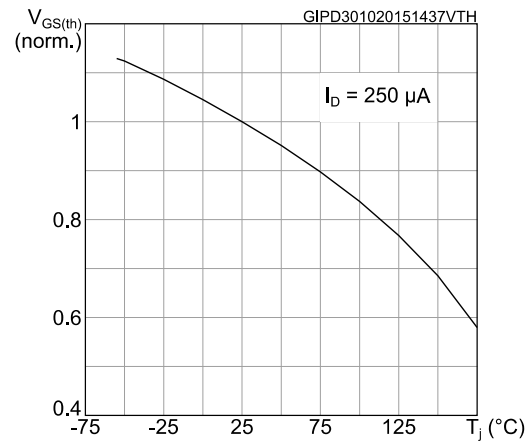


Figure 10: Normalized on-resistance vs temperature

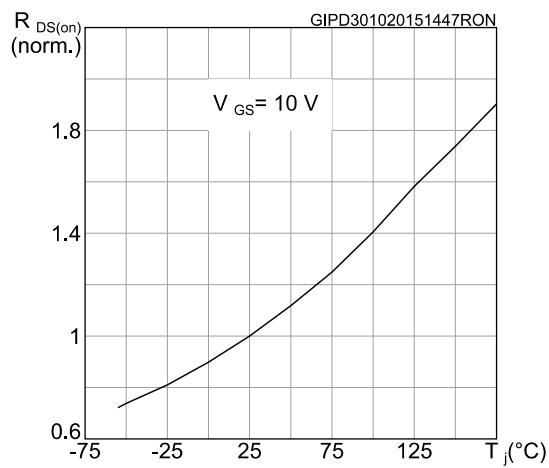
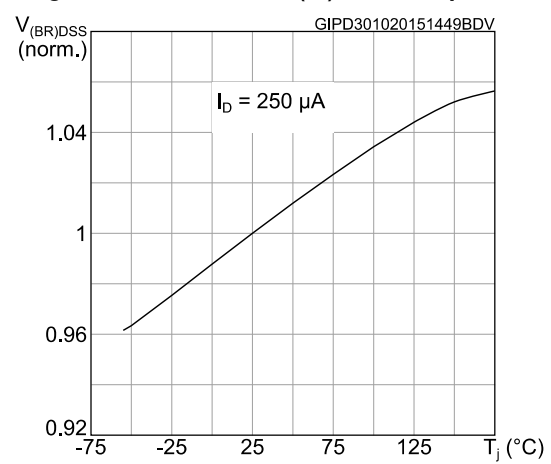
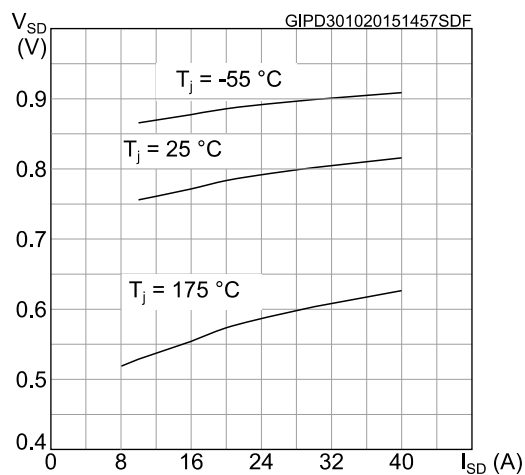
Figure 11: Normalized $V_{(BR)DSS}$ vs temperature

Figure 12: Source-drain diode forward characteristics



3 Test circuits

Figure 13: Test circuit for resistive load switching times

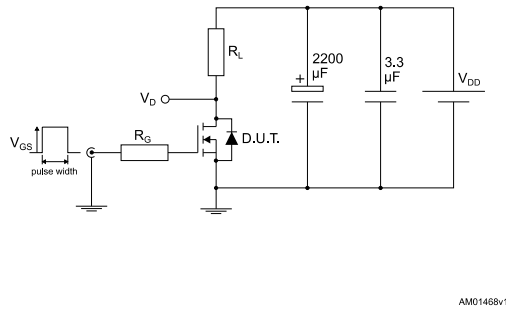


Figure 14: Test circuit for gate charge behavior

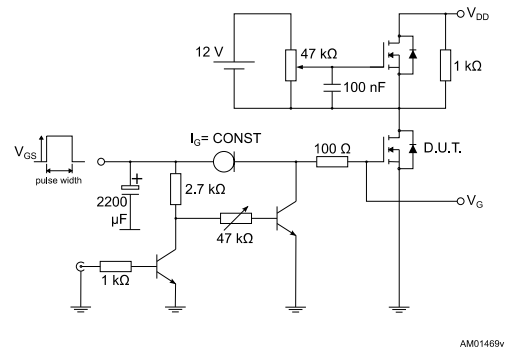


Figure 15: Test circuit for inductive load switching and diode recovery times

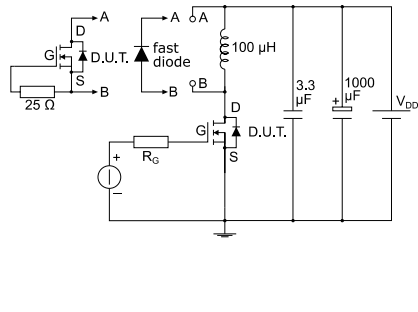


Figure 16: Unclamped inductive load test circuit

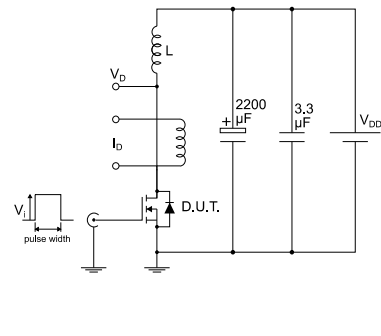


Figure 17: Unclamped inductive waveform

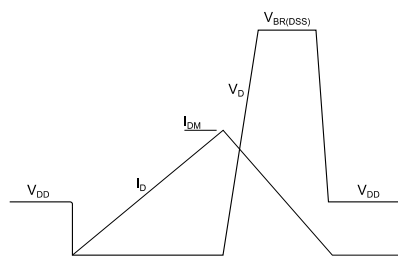
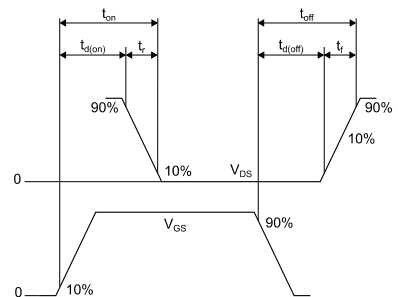


Figure 18: Switching time waveform

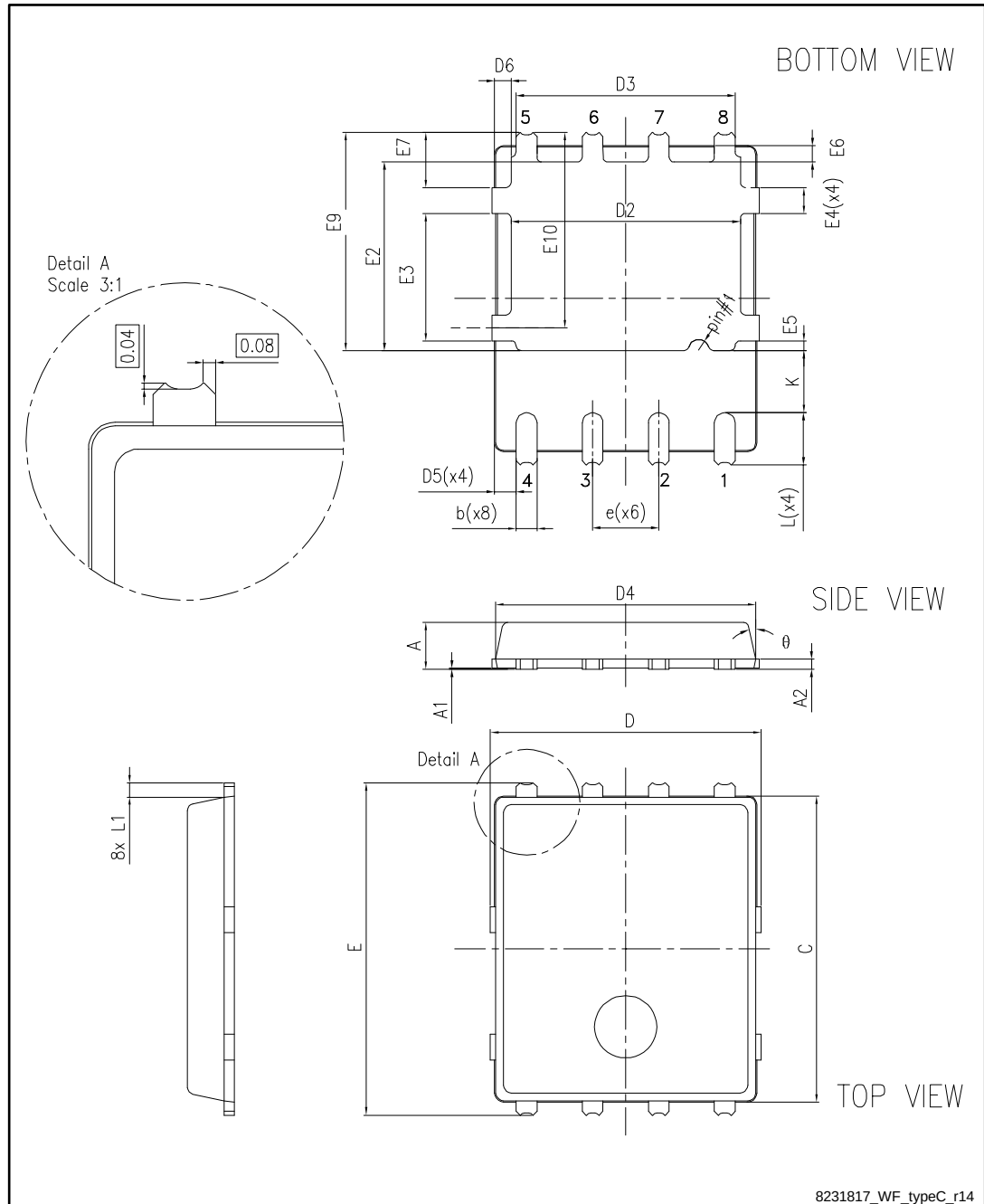


4 Package information

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 package information

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

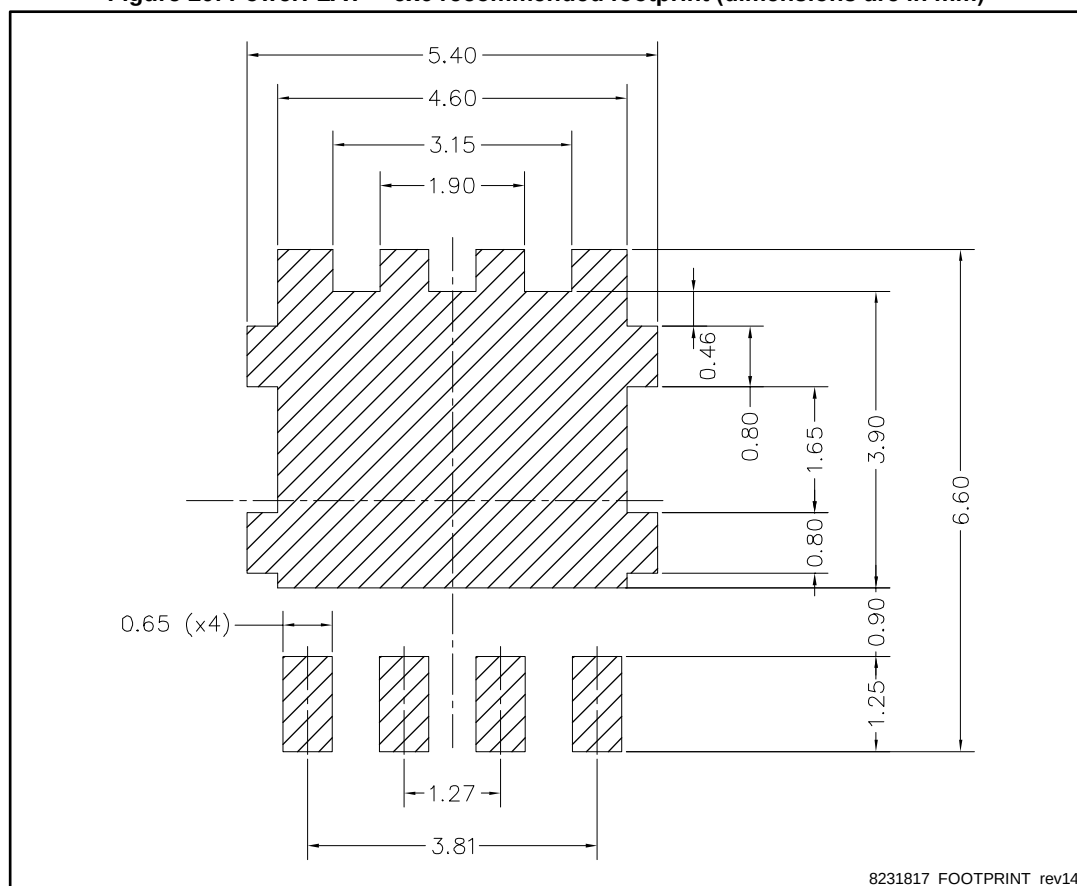


8231817_WF_typeC_r14

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	6.10
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
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
E9	4.00	4.20	4.40
E10	3.55	3.70	3.85
K	1.05		1.35
L	0.90	1.00	1.10
L1	0.175	0.275	0.375
θ	0°		12°

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



4.2 PowerFLAT™ 5x6 packing information

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

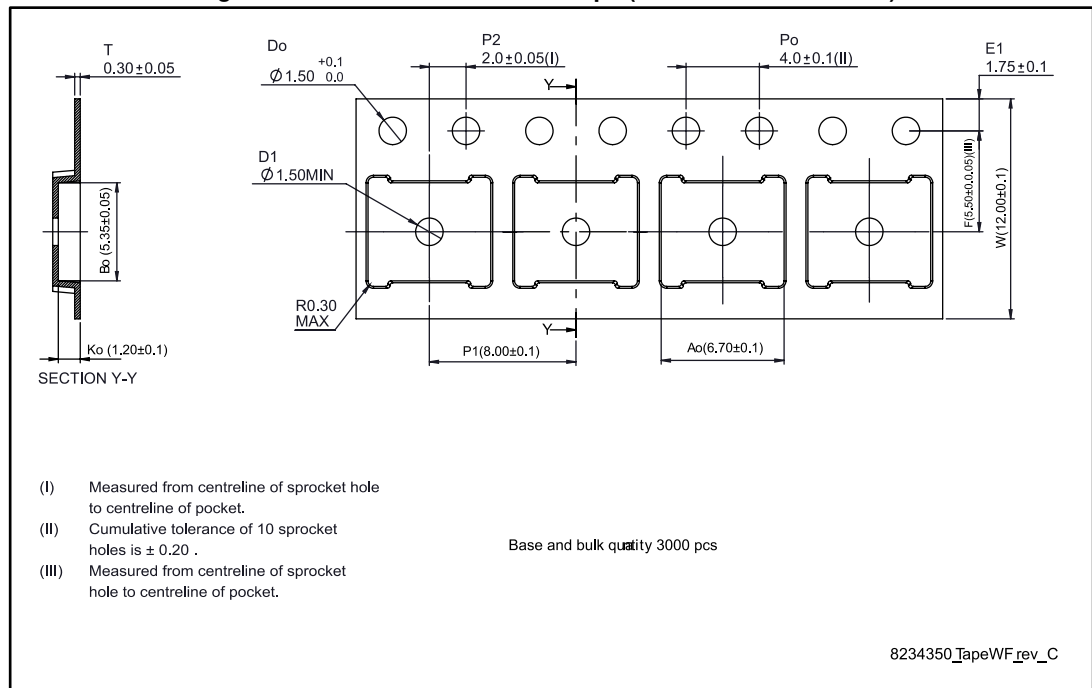


Figure 22: PowerFLAT™ 5x6 package orientation in carrier tape

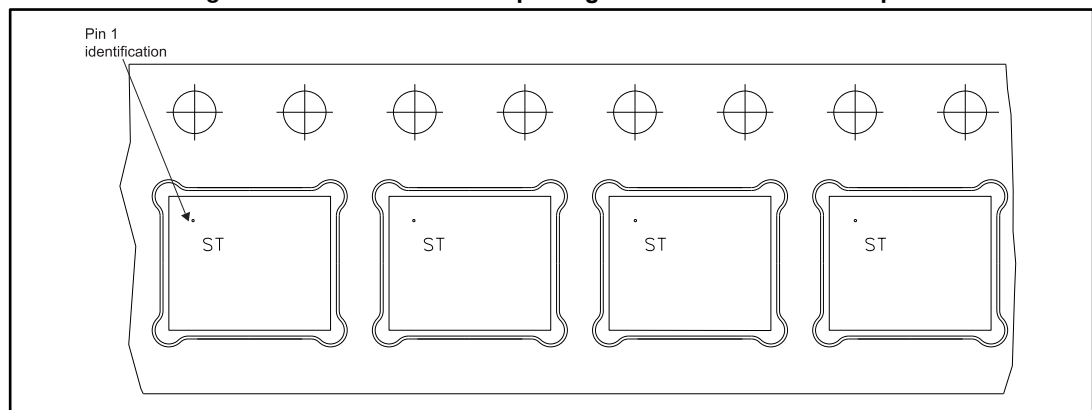
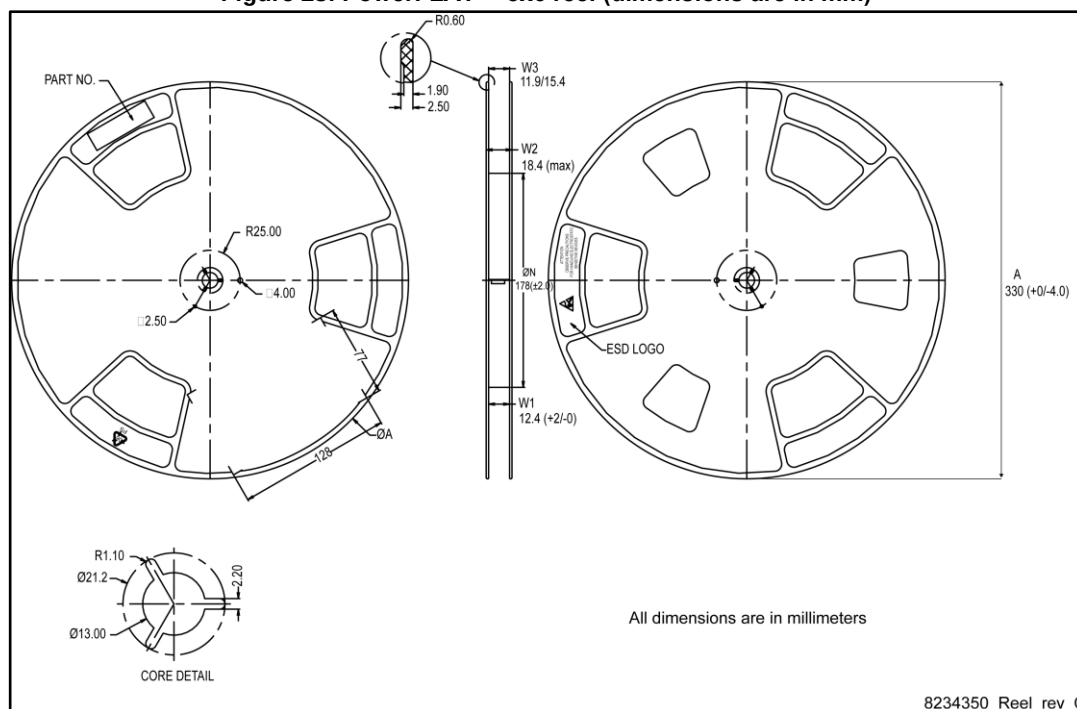


Figure 23: PowerFLAT™ 5x6 reel (dimensions are in mm)



5 Revision history

Table 9: Document revision history

Date	Revision	Changes
14-Jan-2015	1	First release
15-Feb-2017	2	Updated package silhouette on cover page and Section 4: "Package information" . Updated Table 2: "Absolute maximum ratings" . Minor text changes

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