STL140N4F7AG

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

Datasheet - production data

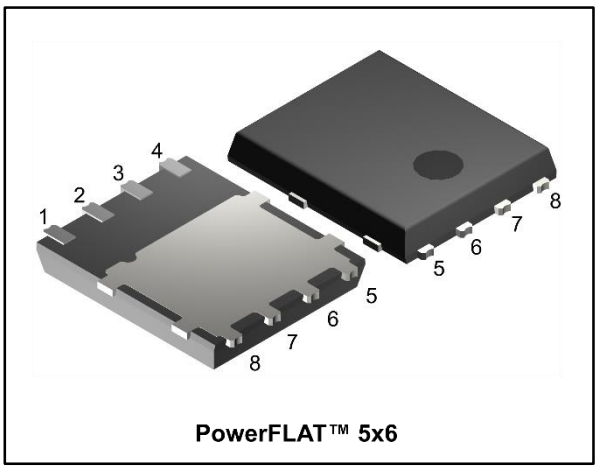
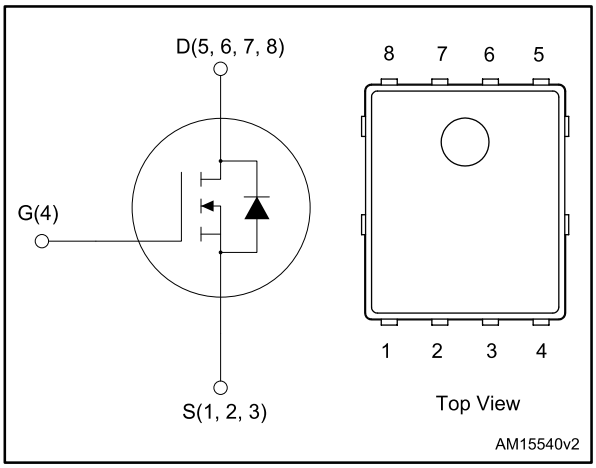


Figure 1: Internal schematic diagram



Features

Order code	V_{DS}	$R_{DS(on)}$ max	I_D
STL140N4F7AG	40 V	2.5 mΩ	120 A

- Designed for automotive applications and AEC-Q101 qualified
- Among the lowest $R_{DS(on)}$ on the market
- Excellent figure of merit (FoM)
- 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	Packing
STL140N4F7AG	140N4F7	PowerFLAT™ 5x6	Tape and reel

Contents

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 °C	120	A
I_D (1)	Drain current (continuous) at T_C = 100 °C	120	A
I_{DM} (1)(2)	Drain current (pulsed)	480	A
P_{TOT} (1)	Total dissipation at T_C = 25 °C	111	W
I_{AV}	Avalanche current, repetitive (pulse width limited by maximum junction temperature)	32	A
E_{AS}	Single pulse avalanche energy (T_j= 25 °C, I_D= 16A, V_{DD}= 25V)	260	mJ
T_{stg}	Storage temperature	-55 to 175	°C
T_j	Operating junction temperature		

Notes:

(1) Drain current is limited by package, the current capability of the silicon is 178 A at 25 °C

(2) Pulse width limited by safe operating area.

Table 3: Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}pcb}$ (1)	Thermal resistance junction-pcb max.	31.3	°C/W
$R_{thj\text{-}case}$	Thermal resistance junction-case max.	1.35	°C/W

Notes:

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

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= 250µA	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} = 0V			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} = 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 (curve)

Figure 2: Safe operating area

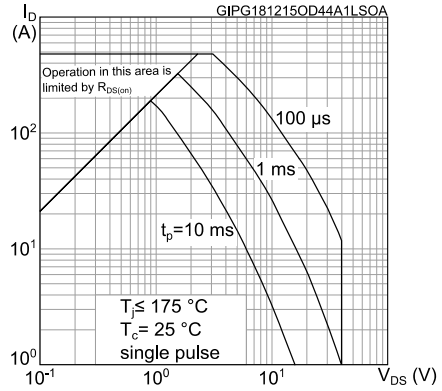


Figure 3: Thermal impedance

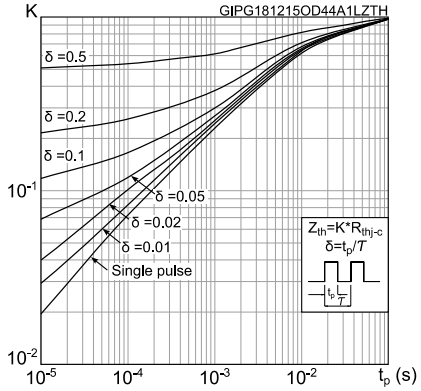


Figure 4: Output characteristics

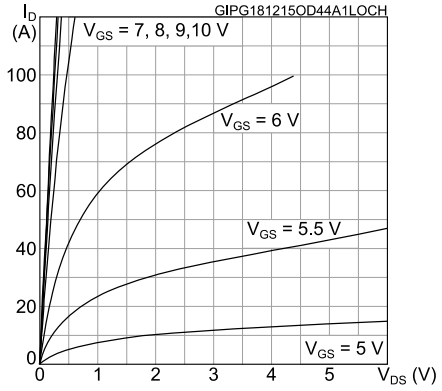


Figure 5: Transfer characteristics

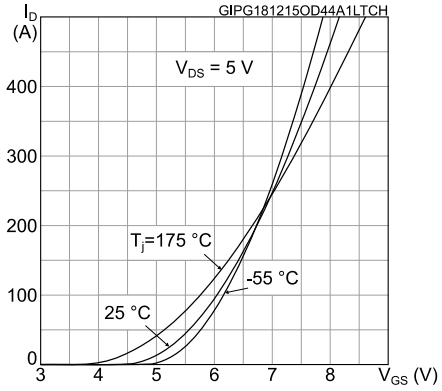


Figure 6: Gate charge vs gate-source voltage

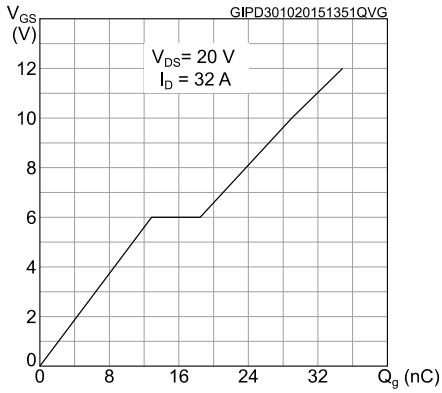


Figure 7: Static drain-source on-resistance

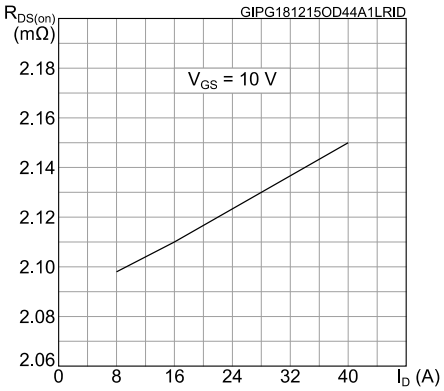


Figure 8: Capacitance variations

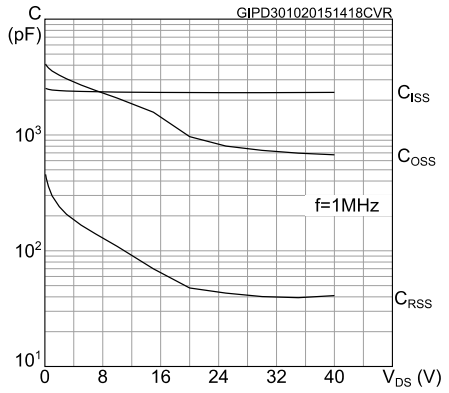


Figure 9: Normalized gate threshold voltage vs temperature

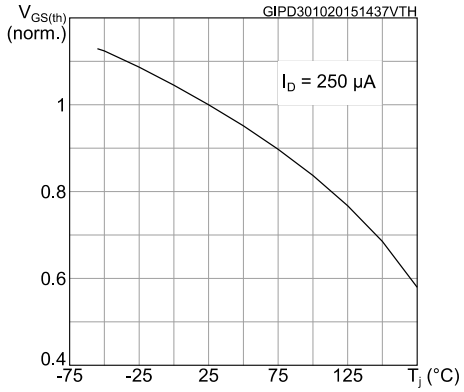


Figure 10: Normalized on-resistance vs temperature

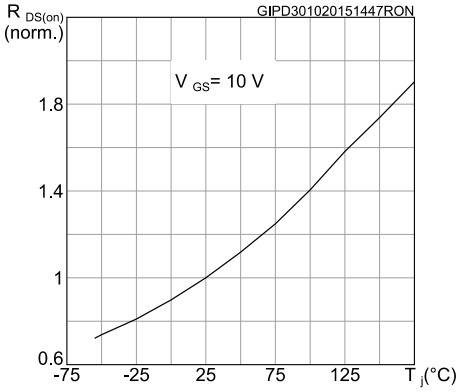


Figure 11: Normalized V(BR)DSS vs temperature

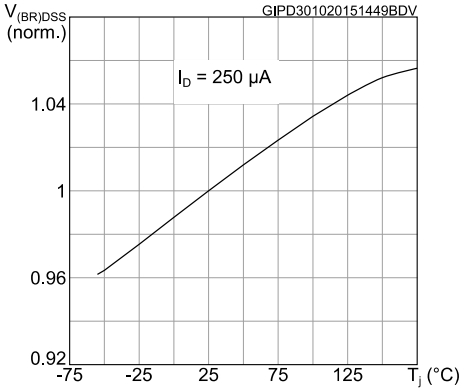
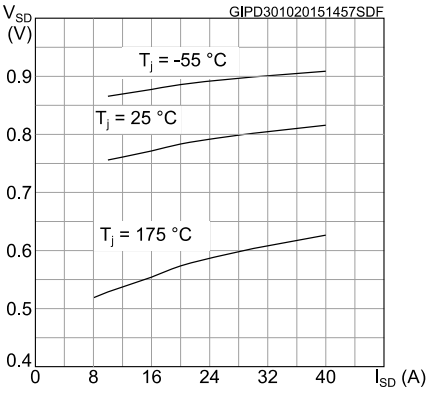


Figure 12: Source-drain diode forward characteristics



3 Test circuits

Figure 13: Test circuit for resistive load switching times

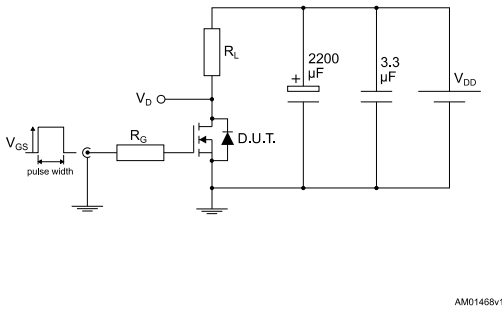


Figure 14: Test circuit for gate charge behavior

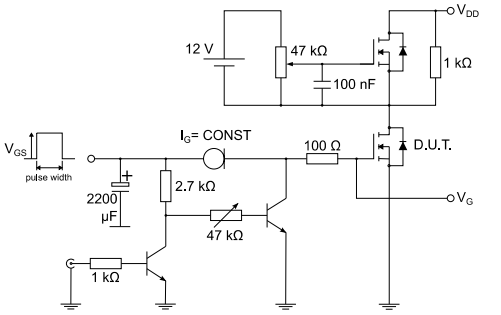


Figure 15: Test circuit for inductive load switching and diode recovery times

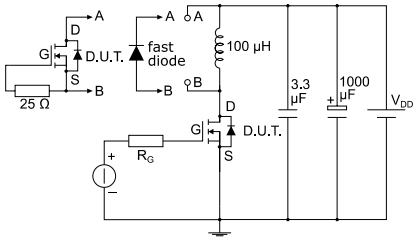


Figure 16: Unclamped inductive load test circuit

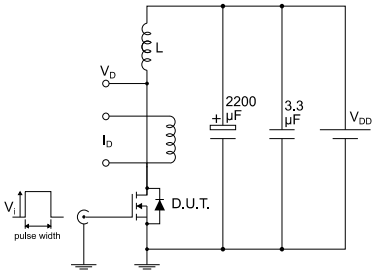


Figure 17: Unclamped inductive waveform

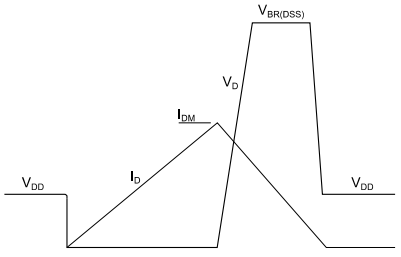
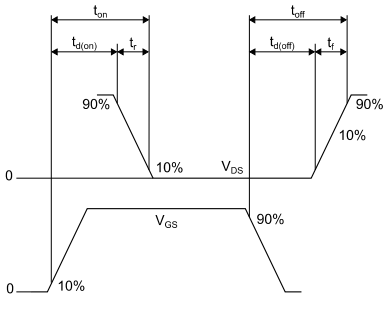


Figure 18: Switching time waveform



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

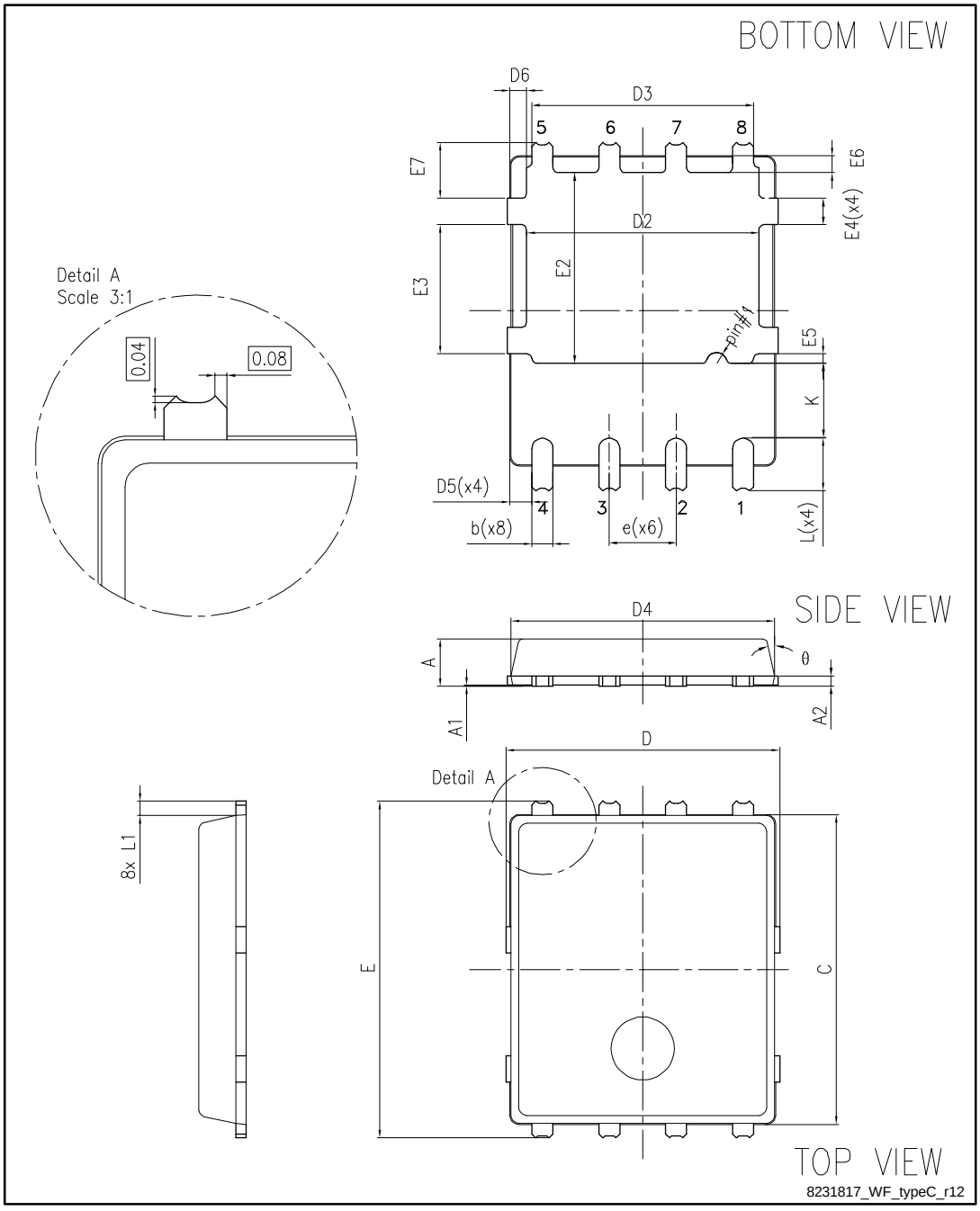
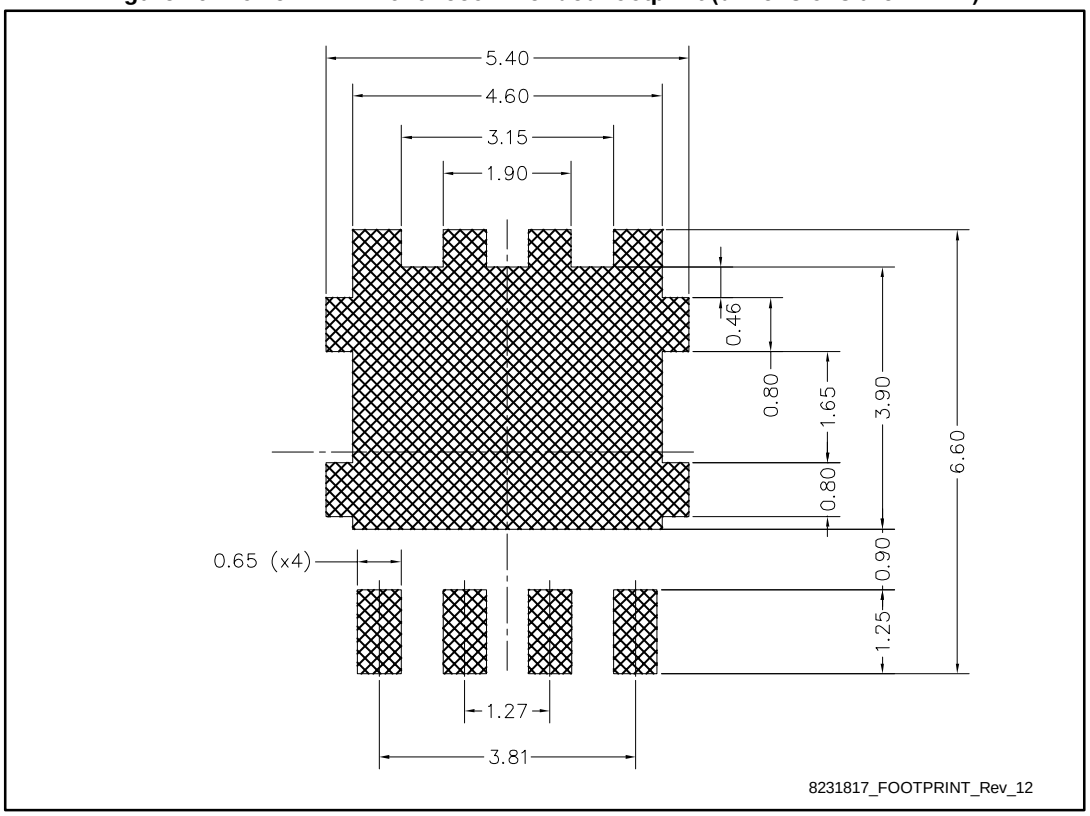


Table 8: PowerFLAT™ 5x6 WF type C mechanical data

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°

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



4.2 PowerFLAT™ 5x6 packing information

Figure 21: PowerFLAT™ 5x6 WF tape

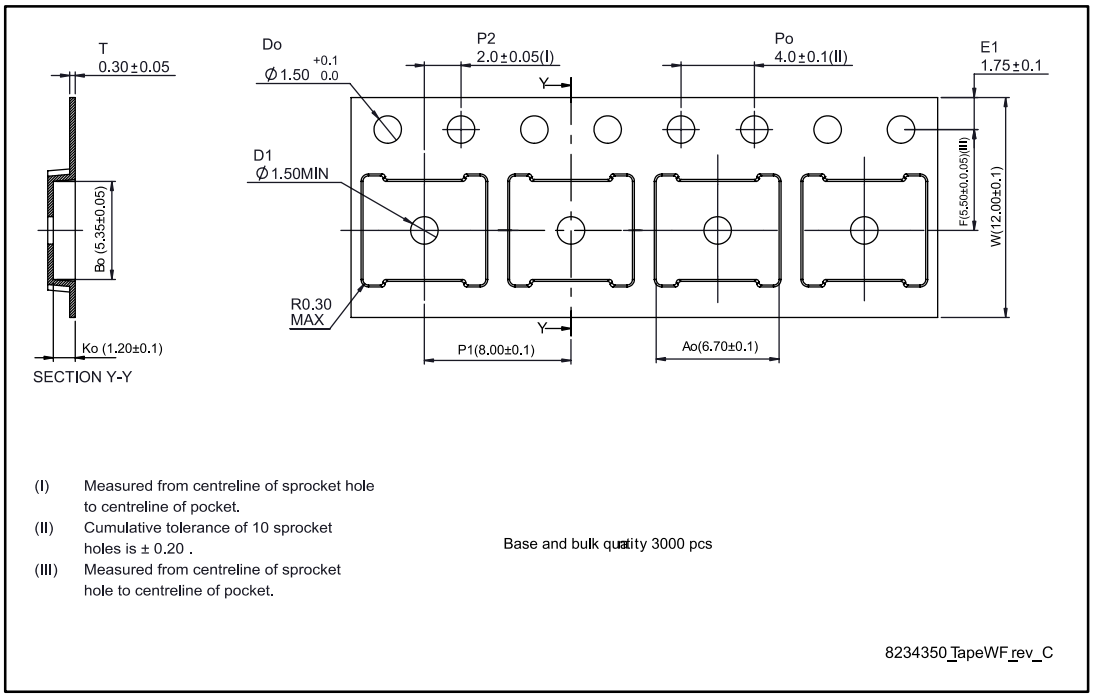


Figure 22: PowerFLAT™ 5x6 package orientation in carrier tape

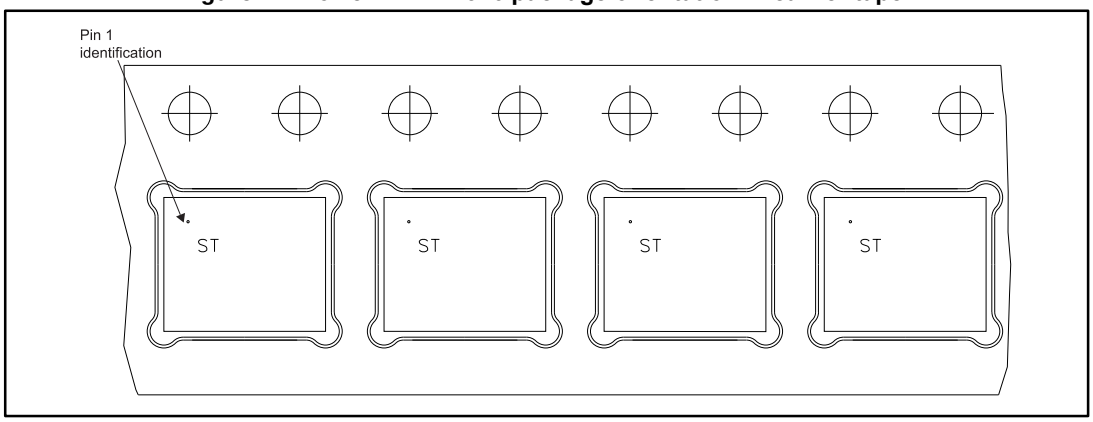
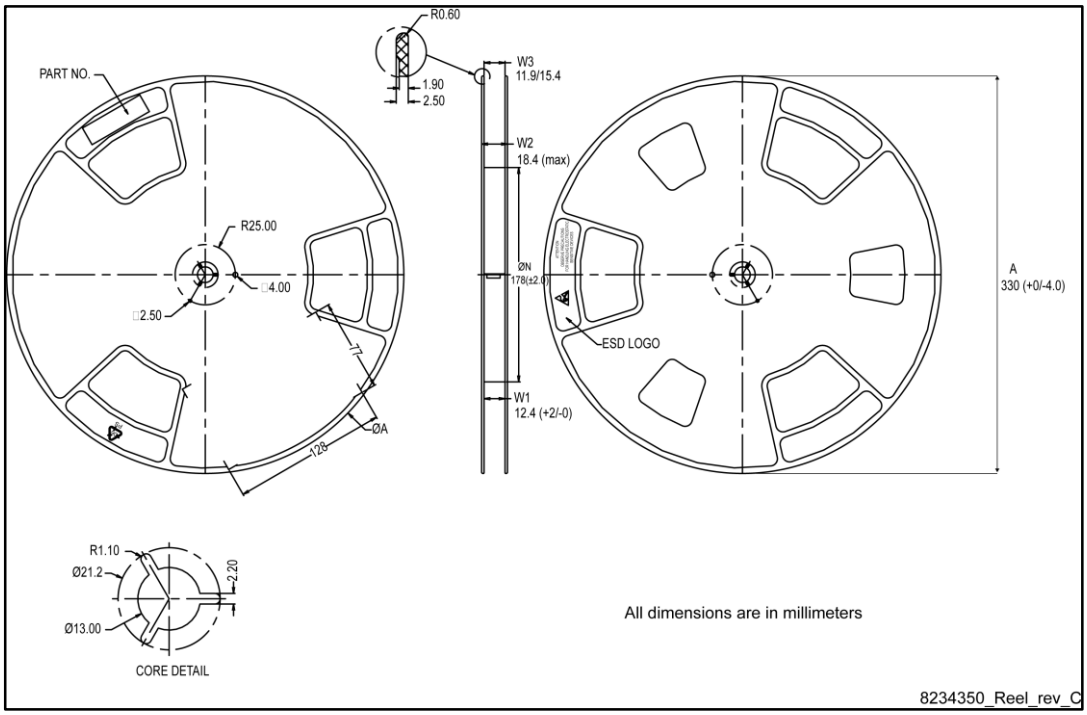


Figure 23: PowerFLAT™ 5x6 reel



5 Revision history

Table 9: Document revision history

Date	Revision	Changes
14-Jan-2015	1	First release.

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