STL120N4F6AG

Automotive-grade N-channel 40 V, 2.9 mΩ typ., 55 A STripFET™ F6 Power MOSFET in a PowerFLAT™ 5x6 package

Datasheet - production data

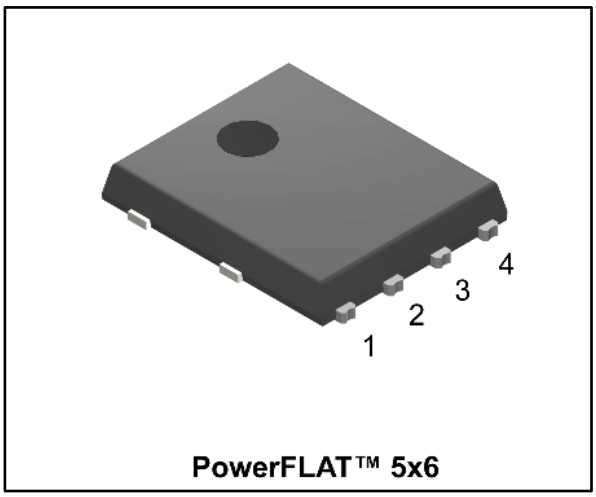
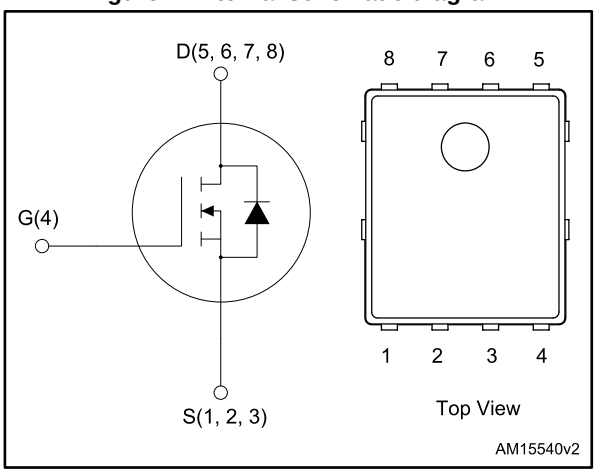


Figure 1: Internal schematic diagram



Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STL120N4F6AG	40 V	3.6 mΩ	55 A

- AEC-Q101 qualified
- Very low on-resistance
- Very low gate charge
- High avalanche ruggedness
- Low gate drive power loss
- Wettable flank package

Applications

- Switching applications

Description

This device is an N-channel Power MOSFET developed using the STripFET™ F6 technology with a new trench gate structure. The resulting Power MOSFET exhibits very low $R_{DS(on)}$ in all packages.

Table 1: Device summary

Order code	Marking	Package	Packaging
STL120N4F6AG	120N4F6	PowerFLAT™ 5x6	Tape and reel

Contents

1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	±20	V
V_{DS}	Drain-source voltage	40	V
I_D(1)	Drain current (continuous) at T_C = 25 °C	55	A
I_D(1)	Drain current (continuous) at T_C= 100 °C	55	A
I_{DM}(2)	Drain current (pulsed)	220	A
P_{TOT}	Total dissipation at T_C = 25 °C	115	W
T_{stg}	Storage temperature range	-55 to 175	°C
T_j	Operating junction temperature range		°C

Notes:

(1)Drain current is limited by package, the current capability of the silicon is 120 A at 25 °C.

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

Table 3: Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case	1.3	°C/W
$R_{thj\text{-}pcb}$(1)	Thermal resistance junction-pcb	31.3	

Notes:

(1)When mounted on 1 inch² 2 Oz. Cu board, t ≤ 10 s

Table 4: Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AV}	Avalanche current, repetitive or not repetitive (pulse width limited by maximum junction temperature)	20	A
E_{AS}	Single pulse avalanche energy (T_j = 25 °C, I_C = I_{AV}, V_{DD} = 25 V)	200	mJ

2 Electrical characteristics

(T_C= 25 °C unless otherwise specified)

Table 5: 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
		V_{GS} = 0 V, V_{DS} = 40 V, Tj = 125 °C(1)			10	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 = 13 A		2.9	3.6	mΩ

Notes:

(1)Defined by design, not subject to production test.

Table 6: Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS}= 25 V, f = 1 MHz, V_{GS} = 0 V	-	3700	-	pF
C_{oss}	Output capacitance		-	625	-	pF
C_{rss}	Reverse transfer capacitance		-	295	-	pF
Q_g	Total gate charge	V_{DD} = 20 V, I_D = 26 A, V_{GS} = 0 to 10 V (see *Figure 14: "Test circuit for gate charge behavior"*)	-	63	-	nC
Q_{gs}	Gate-source charge		-	19	-	nC
Q_{gd}	Gate-drain charge		-	15	-	nC
R_G	Intrinsic gate resistance	f = 1 MHz, I_D = 0 A	-	1.5	-	Ω

Table 7: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 20 V, I_D = 13 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"*)	-	20	-	ns
t_r	Rise time		-	70	-	ns
$t_{d(off)}$	Turn-off-delay time		-	40	-	ns
t_f	Fall time		-	20	-	ns

Table 8: Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		55	A
I_{SDM} (1)	Source-drain current (pulsed)		-		220	A
V_{SD} (2)	Forward on voltage	V_{GS} = 0 V, I_{SD} = 13 A	-		1.1	V
t_{rr}	Reverse recovery time	I_{SD} = 26 A, di/dt = 100 A/µs, V_{DD} = 25 V (see *Figure 15: "Test circuit for inductive load switching and diode recovery times"*)	-	40		ns
Q_{rr}	Reverse recovery charge		-	5.6		nC
I_{RRM}	Reverse recovery current		-	2.8		A

Notes:

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

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

2.1 Electrical characteristics (curves)

Figure 2: Safe operating area

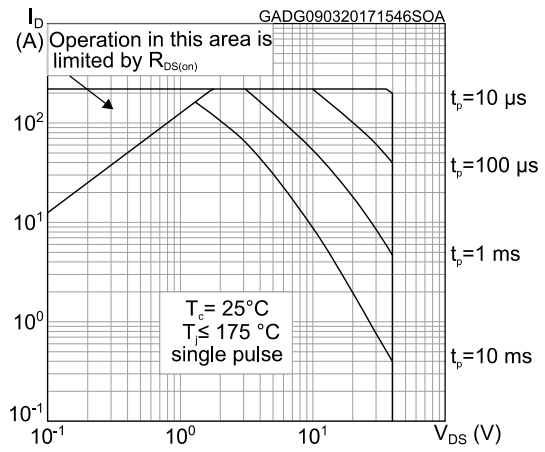


Figure 3: Thermal impedance

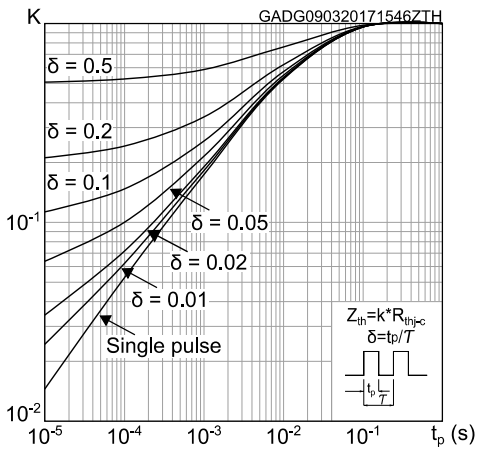


Figure 4: Output characteristics

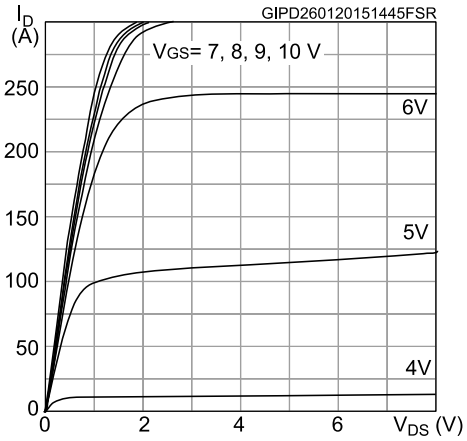


Figure 5: Transfer characteristics

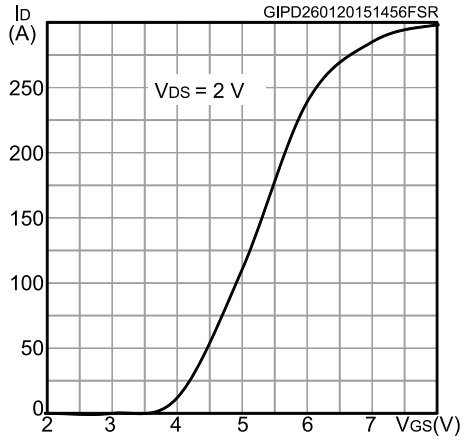


Figure 6: Gate charge vs gate-source voltage

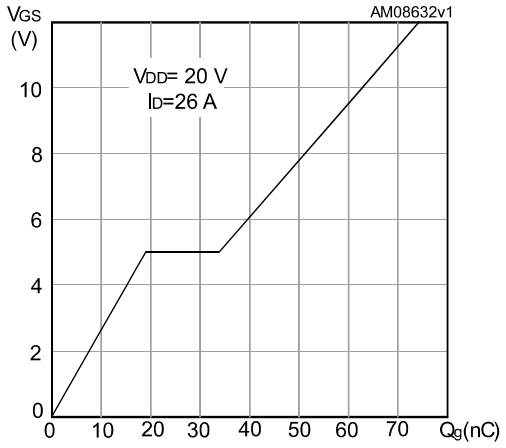


Figure 7: Static drain-source on-resistance

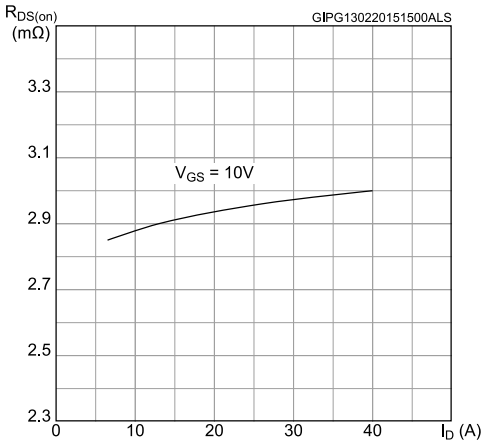


Figure 8: Capacitance variations

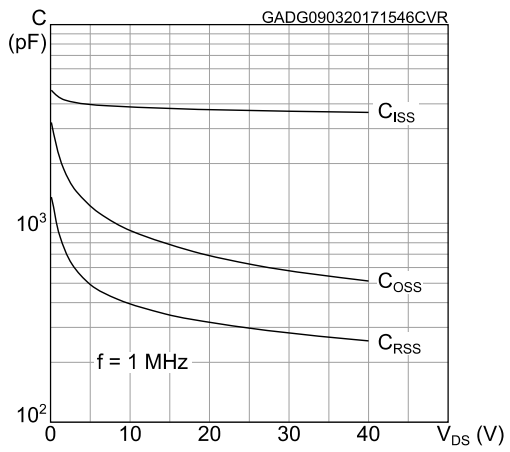


Figure 9: Normalized $V_{(BR)DSS}$ vs temperature

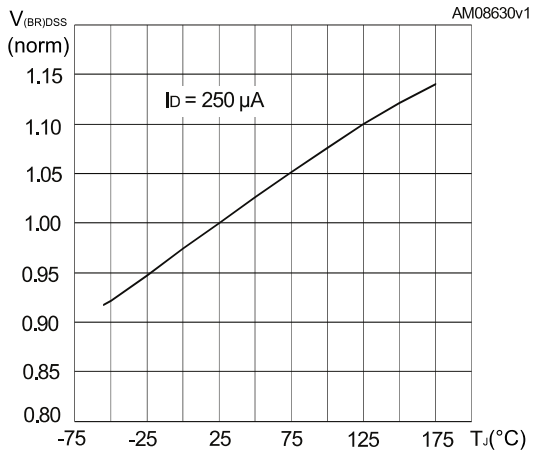


Figure 10: Normalized gate threshold voltage vs temperature

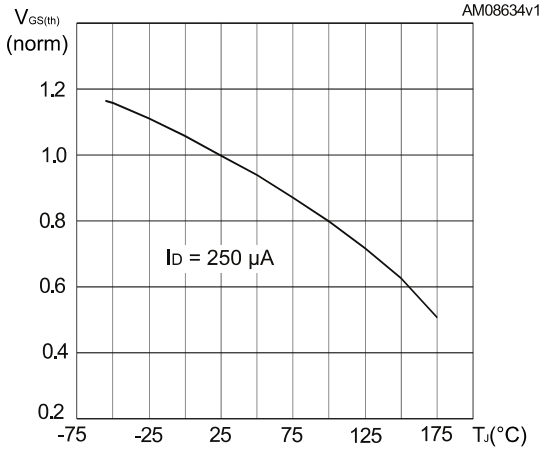


Figure 11: Normalized on-resistance vs. temperature

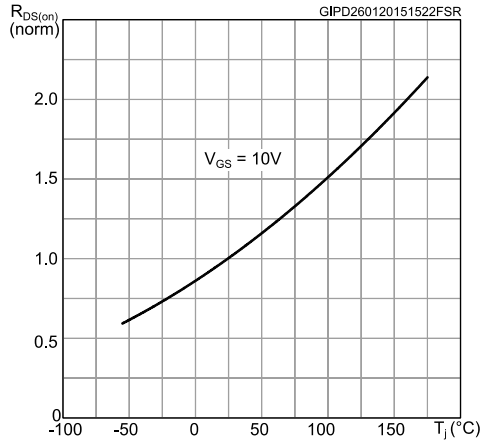
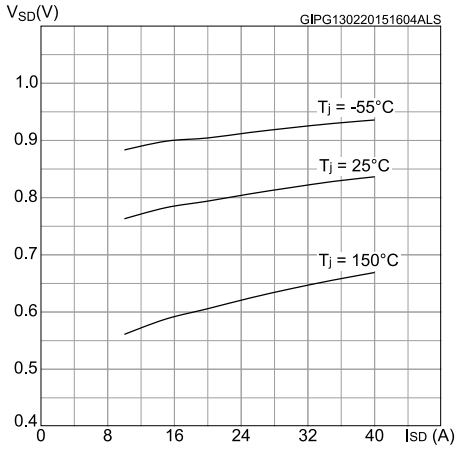


Figure 12: Source-drain diode forward characteristics



3 Test circuits

Figure 13: Test circuit for resistive load switching times

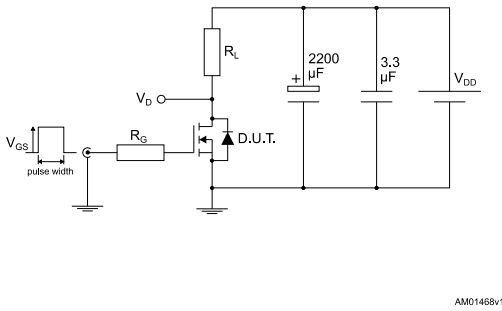


Figure 14: Test circuit for gate charge behavior

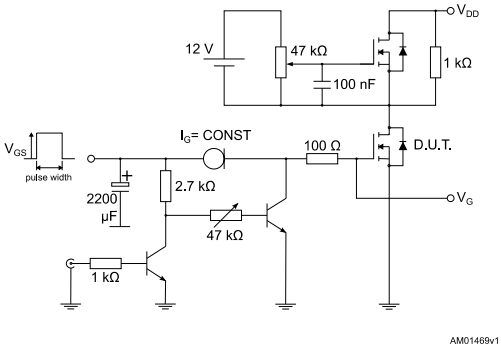


Figure 15: Test circuit for inductive load switching and diode recovery times

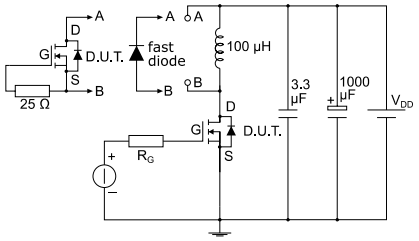


Figure 16: Unclamped inductive load test circuit

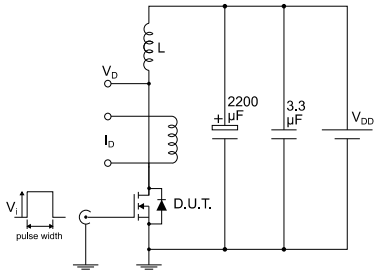


Figure 17: Unclamped inductive waveform

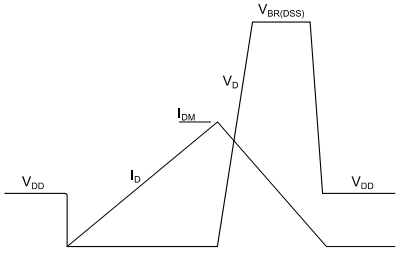
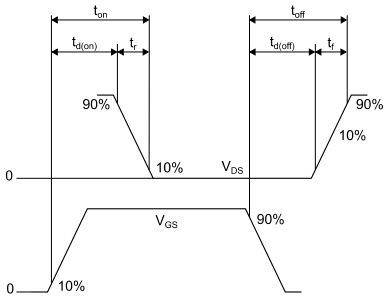


Figure 18: Switching time waveform



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 WF type R package information

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

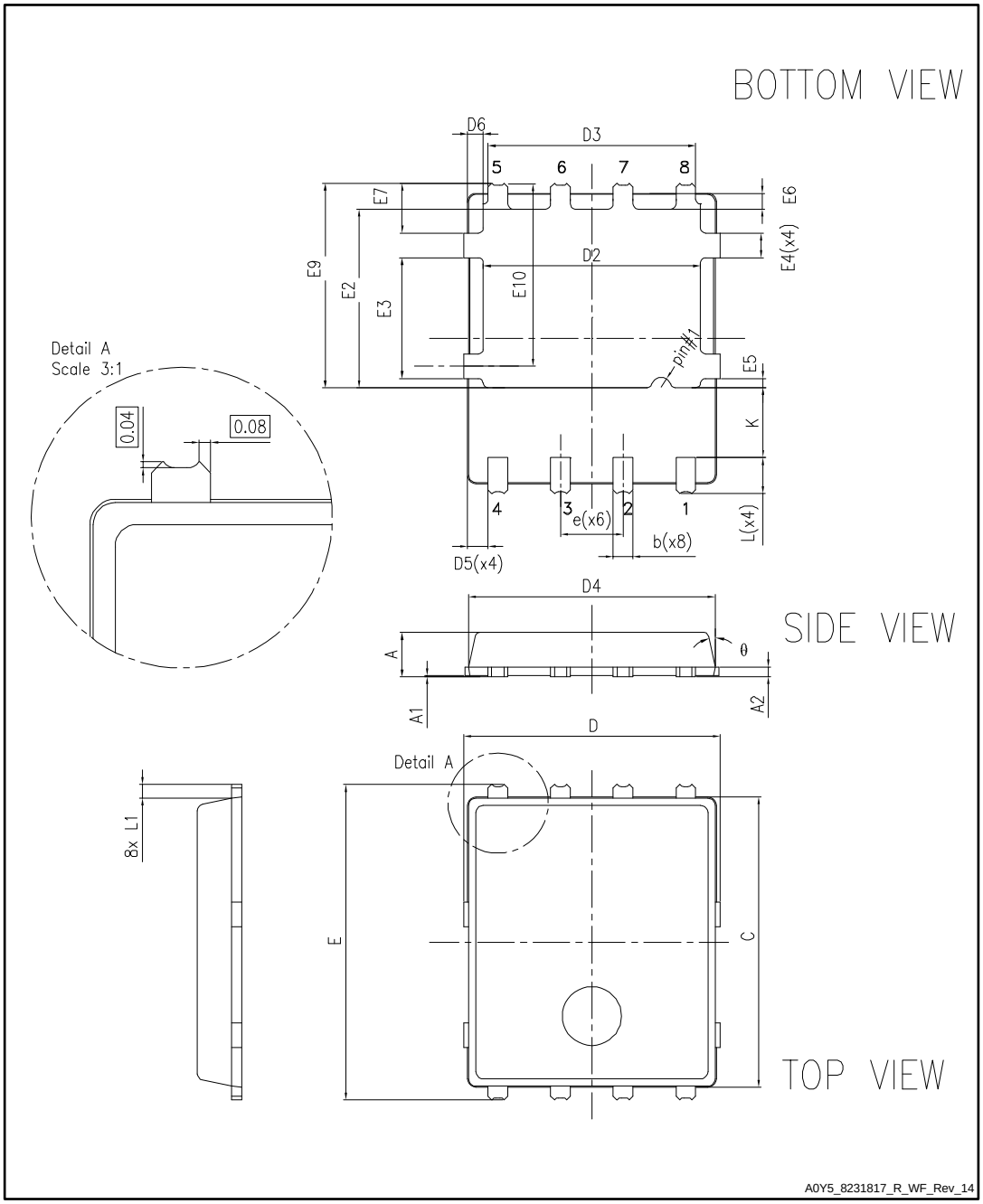
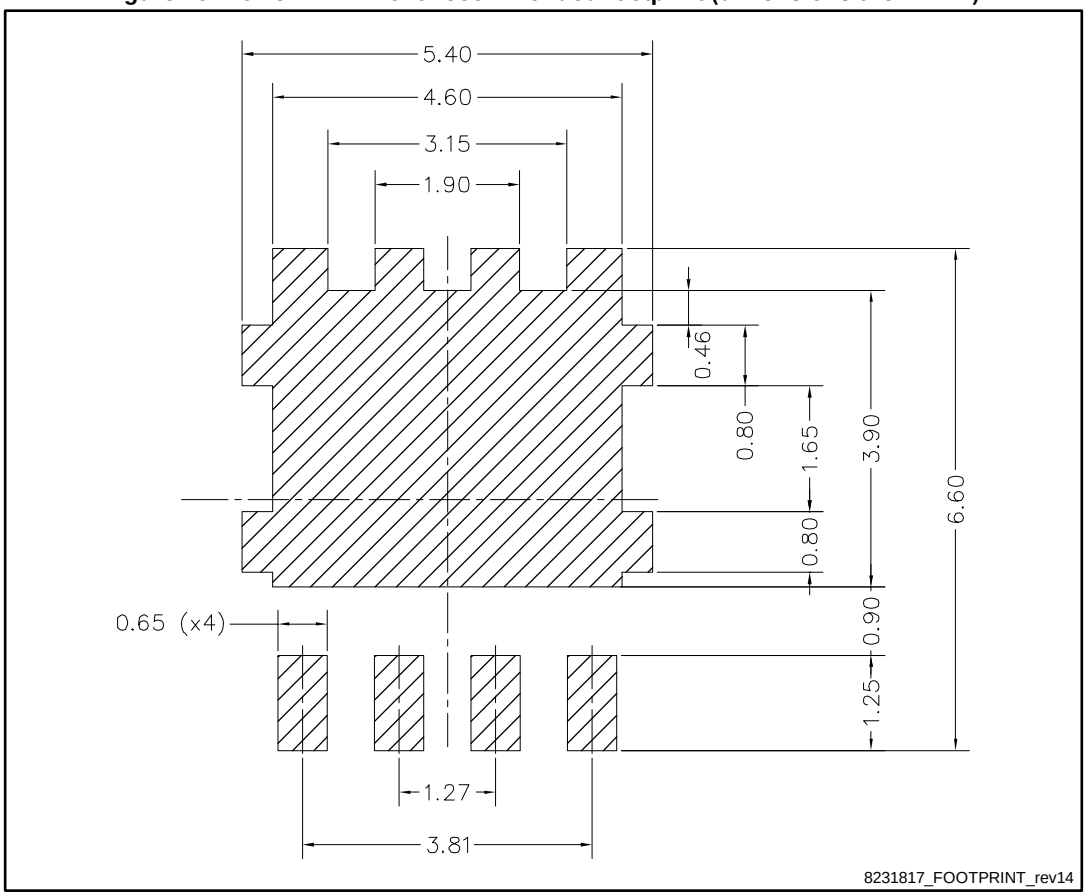


Table 9: PowerFLAT™ 5x6 WF type R mechanical data

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	0.4	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	0.20	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	1.275		1.575
L	0.725	0.825	0.925
L1	0.175	0.275	0.375
Θ	0°		12°

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



4.2 PowerFLAT™ 5x6 WF packing information

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

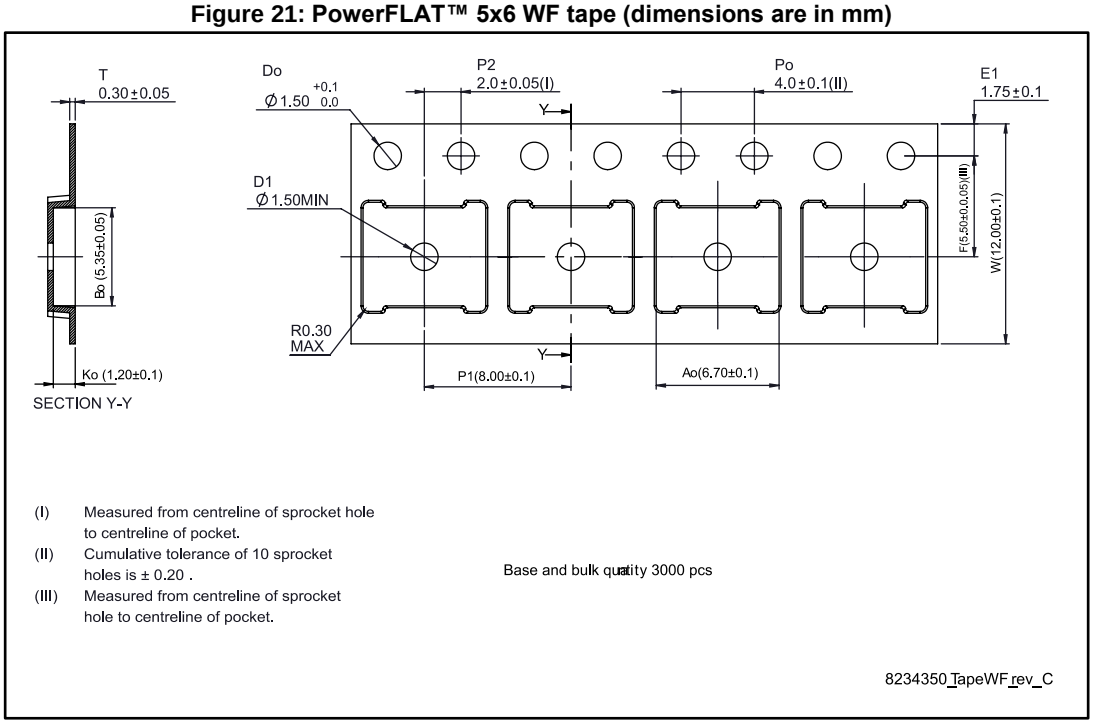


Figure 22: PowerFLAT™ 5x6 package orientation in carrier tape

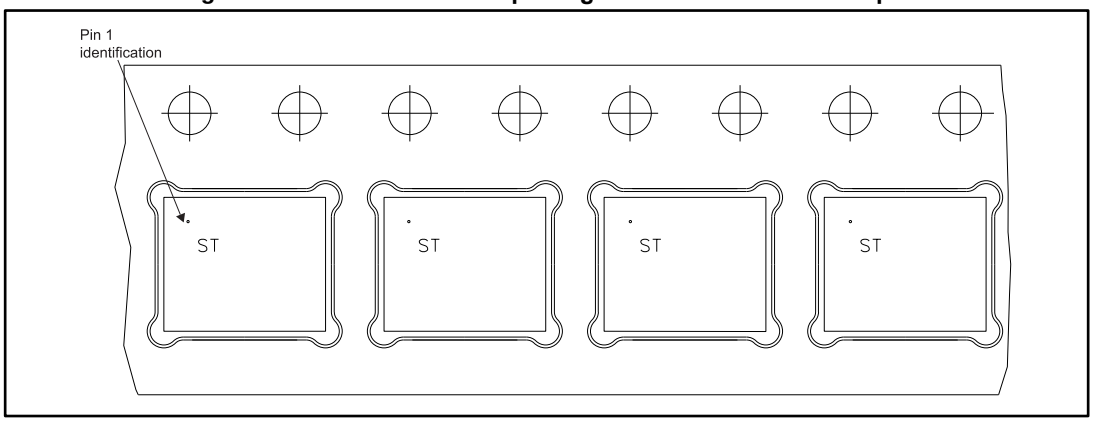
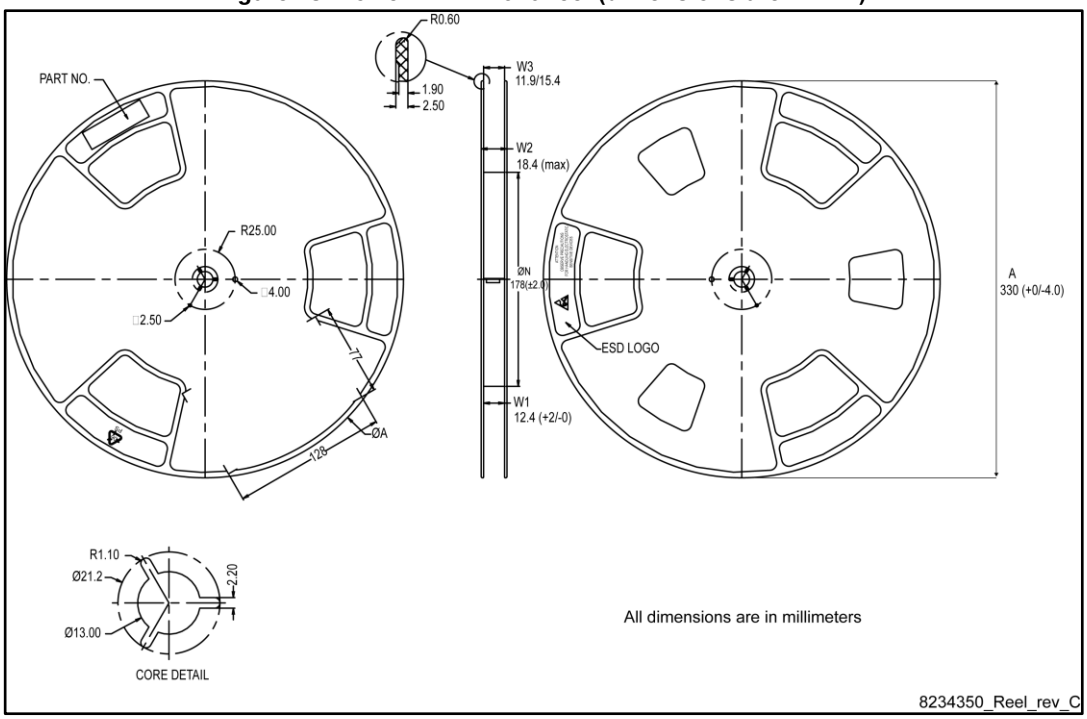


Figure 23: PowerFLAT™ 5x6 reel (dimensions are in mm)



5 Revision history

Table 10: Document revision history

Date	Revision	Changes
19-Feb-2015	1	First release.
11-Apr-2016	2	Updated *Table 2: "Absolute maximum ratings"* Minor text changes.
10-Jan-2017	3	Updated *Table 2: "Absolute maximum ratings"* and *Table 8: "Source drain diode"*. Updated *Figure 6: "Gate charge vs gate-source voltage"* and *Figure 8: "Capacitance variations"*. Minor text changes
09-Mar-2017	4	Updated *Table 2: "Absolute maximum ratings"* and *Table 3: "Thermal data"*. Updated *Figure 2: "Safe operating area"*, *Figure 3: "Thermal impedance"* and *Figure 8: "Capacitance variations"*. Added *Figure 9: "Normalized V(BR)DSS vs temperature"* and *Figure 10: "Normalized gate threshold voltage vs temperature"*. Minor text changes

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