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STL60P4LLF6

P-channel 40 V, 0.0115 Ω typ.,60 A STripFET™ F6 Power MOSFET in a PowerFLAT™ 5x6 package

Datasheet - production data

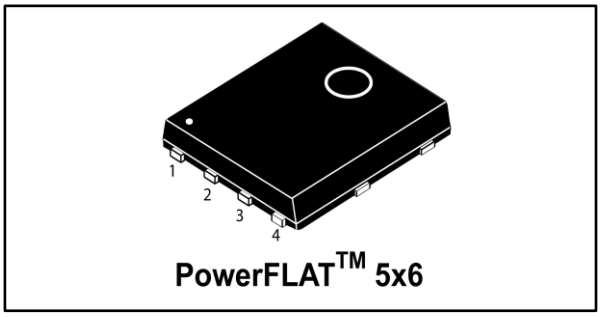
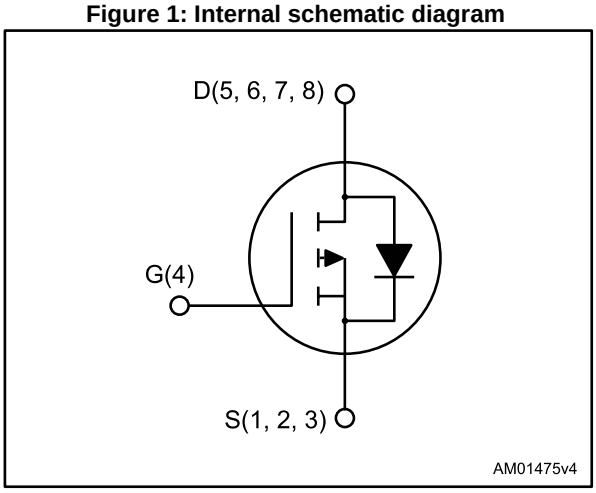


Figure 1: Internal schematic diagram



Features

Order codes	V_{DS}	$R_{DS(on)max.}$	I_D
STL60P4LLF6	40 V	0.014 Ω	60

- Very low on-resistance
- Very low gate charge
- High avalanche ruggedness
- Low gate drive power loss

Applications

Switching applications

Description

This device is a P-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 codes	Marking	Package	Packaging
STL60P4LLF6	60P4LLF6	PowerFLA™ 5x6	Tape and reel

For the P-channel Power MOSFETs the actual polarity of the voltages and the current must be reversed.

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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 °C	60	A
I_D (1)	Drain current (continuous) at T_C = 100 °C	42	A
I_D (1)(3)	Drain current (pulsed)	240	A
I_D (2)	Drain current (continuous) at T_{pcb} = 25 °C	13	
I_D (2)	Drain current (continuous) at T_{pcb} = 100 °C	9.3	A
I_{DM} (2)(3)	Drain current (pulsed)	52	A
P_{TOT} (1)	Total dissipation at T_C = 25 °C	100	W
P_{TOT} (2)	Total dissipation at T_{pcb} = 25 °C	4.8	W
	Derating factor (2)	0.03	W/°C
T_{stg}	Storage temperature	- 55 to 175	°C
T_j	Max. operating junction temperature	175	°C

Notes:

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

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

(3)Pulse width is limited by safe operating area

Table 3: Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case max.	1.5	°C/W
$R_{thj\text{-}pcb}$ (1)	Thermal resistance junction-pcb, single operation	31.3	°C/W

Notes:

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

For the P-channel Power MOSFETs the actual polarity of the voltages and the current must be reversed.

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, I_D = 250 µA	40			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0, V_{DS} = 40 V			1	µA
		V_{GS} = 0, V_{DS} = 40 V, T_C = 125 °C			10	µA
I_{GSS}	Gate-body leakage current	V_{DS} = 0, V_{GS} = ± 20 V			±100	nA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	1			V
$R_{DS(on)}$	Static drain source on-resistance	V_{GS} = 10 V, I_D = 6.5 A		0.0115	0.014	Ω
		V_{GS} = 4.5 V, I_D = 6.5 A		0.015	0.019	Ω

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	-	3525	-	pF
C_{OSS}	Output capacitance			344		pF
C_{rss}	Reverse transfer capacitance			238		pF
Q_g	Total gate charge	V_{DD}= 20 V, I_D = 13 A, V_{GS} = 4.5 V		34		nC
Q_{gs}	Gate-source charge			11.3		nC
Q_{gd}	Gate-drain charge			13.8		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 = 6.5 A, R_G = 4.7 Ω, V_{GS} = 10 V	-	49.4	-	ns
t_r	Rise time		-	60.6	-	ns
$t_{d(off)}$	Turn-off delay time		-	170	-	ns
t_f	Fall time		-	20	-	ns

Table 7: Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{SD} (1)	Forward on voltage	I_{SD} = 6.5 A, V_{GS} = 0	-		1.1	V
t_{rr}	Reverse recovery time	I_{SD} = 13 A, di/dt = 100 A/µs V_{DD} = 24 V, T_j =150 °C	-	29		ns
Q_{rr}	Reverse recovery charge		-	27.6		nC
I_{RRM}	Reverse recovery current		-	1.9		A

Notes:

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

For the P-channel Power MOSFETs the actual polarity of the voltages and the current must be reversed.

2.1 Electrical characteristics (curves)

Figure 2: Safe operating area

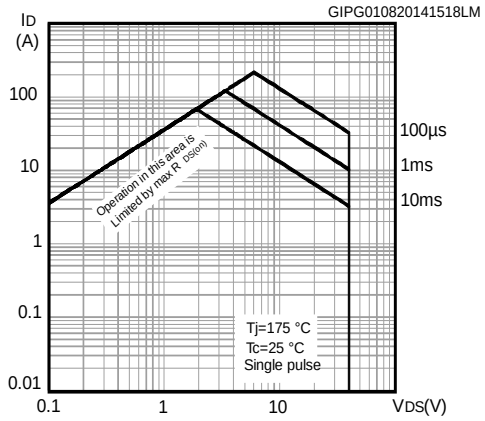


Figure 3: Thermal impedance

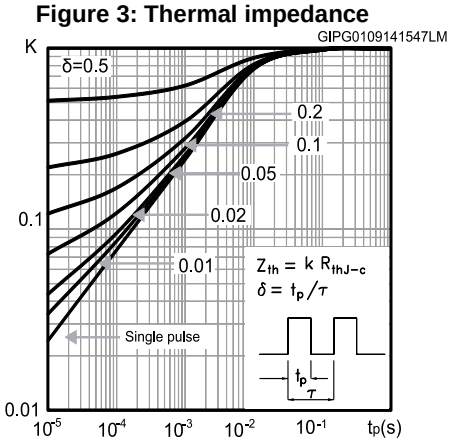


Figure 4: Output characteristics

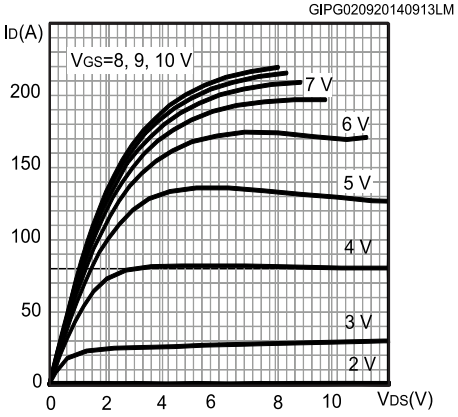


Figure 5: Transfer characteristics

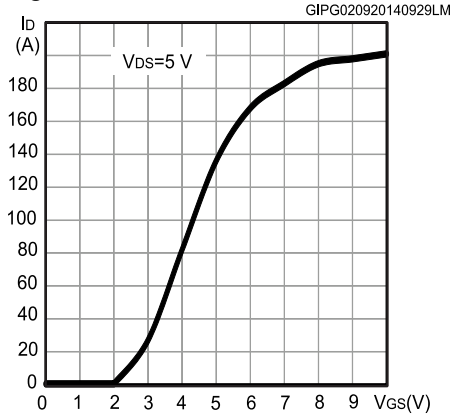


Figure 6: Gate charge vs gate-source voltage

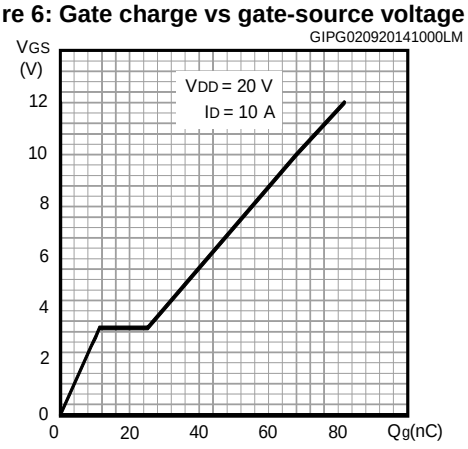


Figure 7: Static drain-source on-resistance

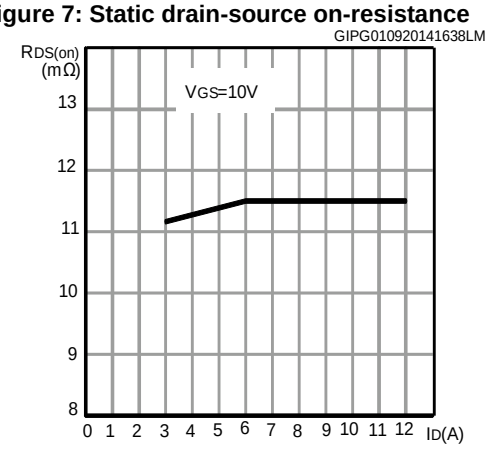


Figure 8: Capacitance variation

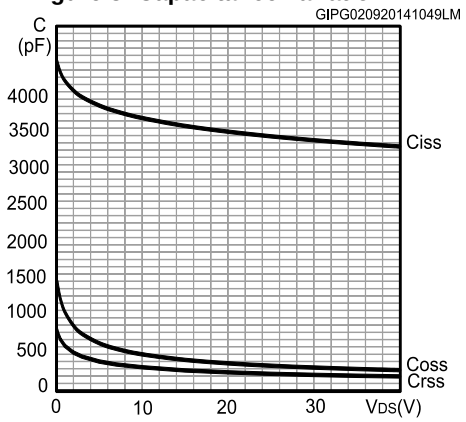


Figure 9: Normalized gate threshold voltage vs temperature

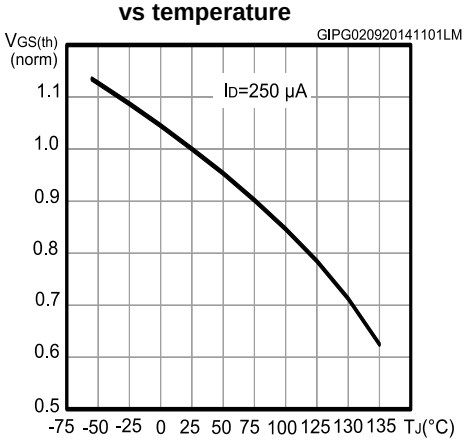


Figure 10: Normalized on-resistance vs temperature

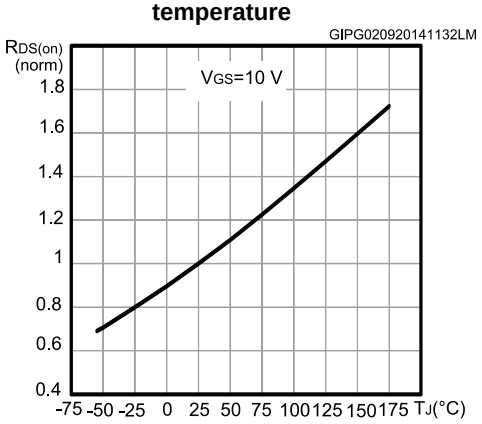


Figure 11: Normalized VBR(DSS) vs temperature

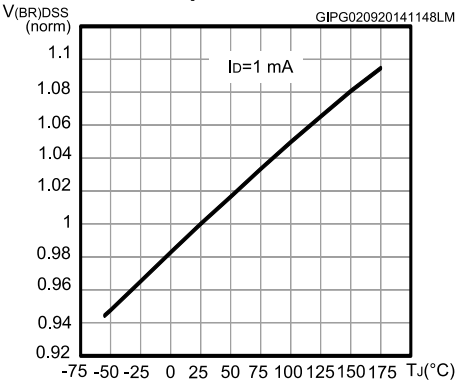
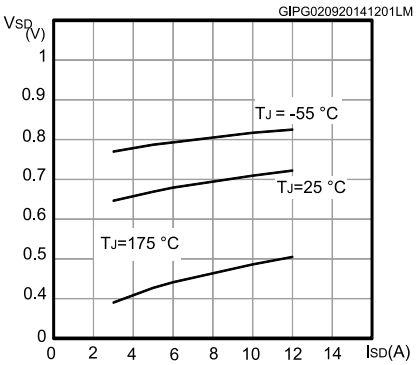


Figure 12: Source-drain diode forward characteristics



3 Test circuits

Figure 13: Switching times test circuit for resistive load

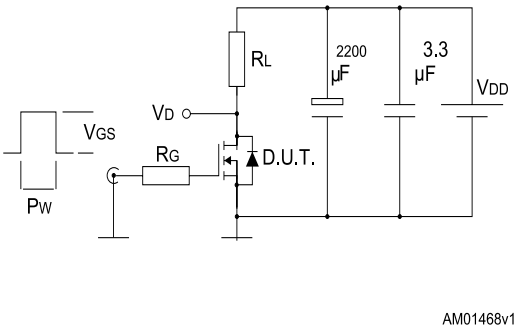


Figure 14: Gate charge test circuit

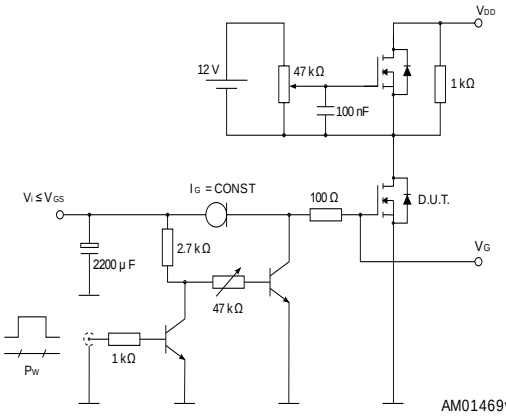


Figure 15: Test circuit for inductive load switching and diode recovery times

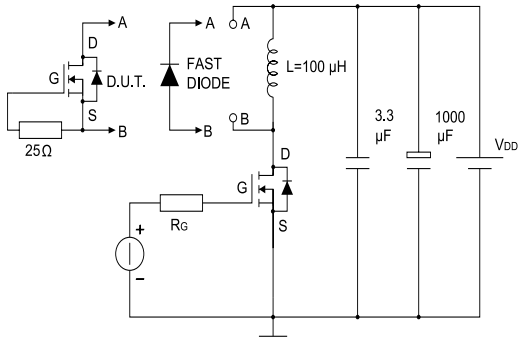


Figure 16: Unclamped inductive load test circuit

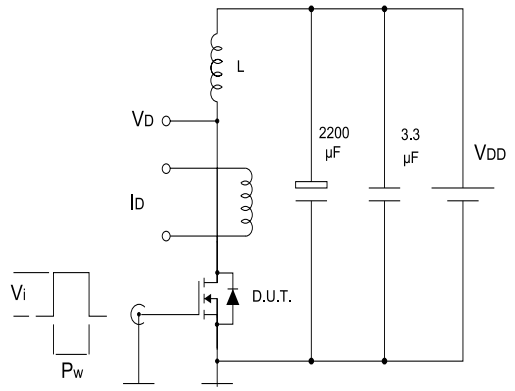


Figure 17: Unclamped inductive waveform

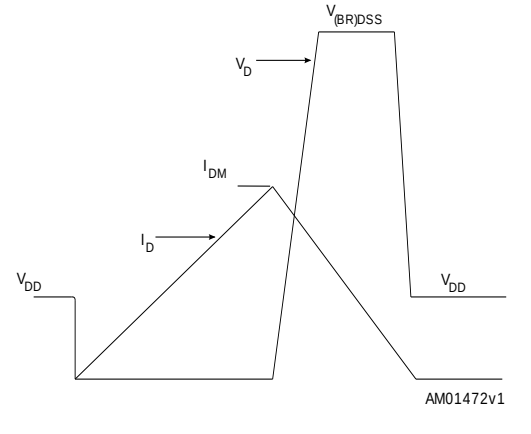
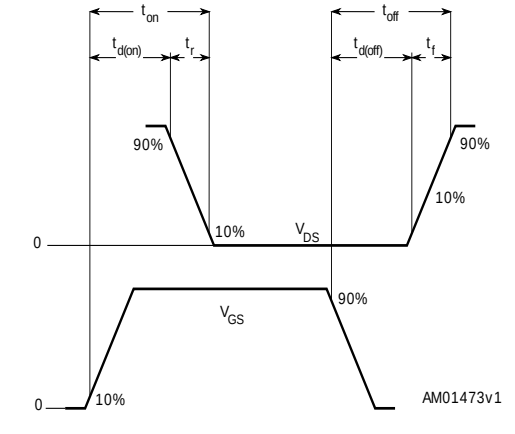


Figure 18: Switching time waveform



4 Package mechanical data

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 S-R drawings

Figure 19: PowerFLAT™ 5x6 drawings

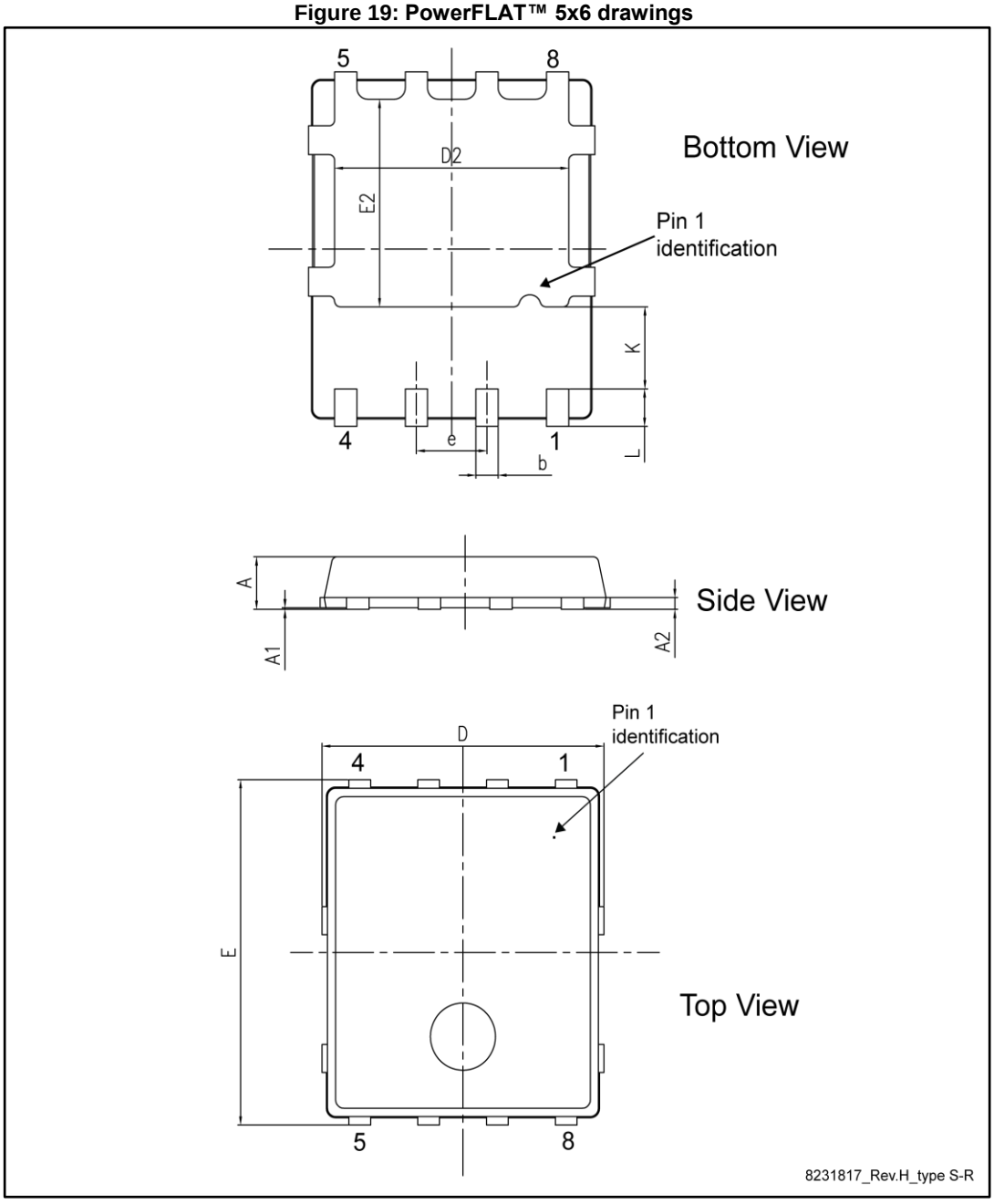
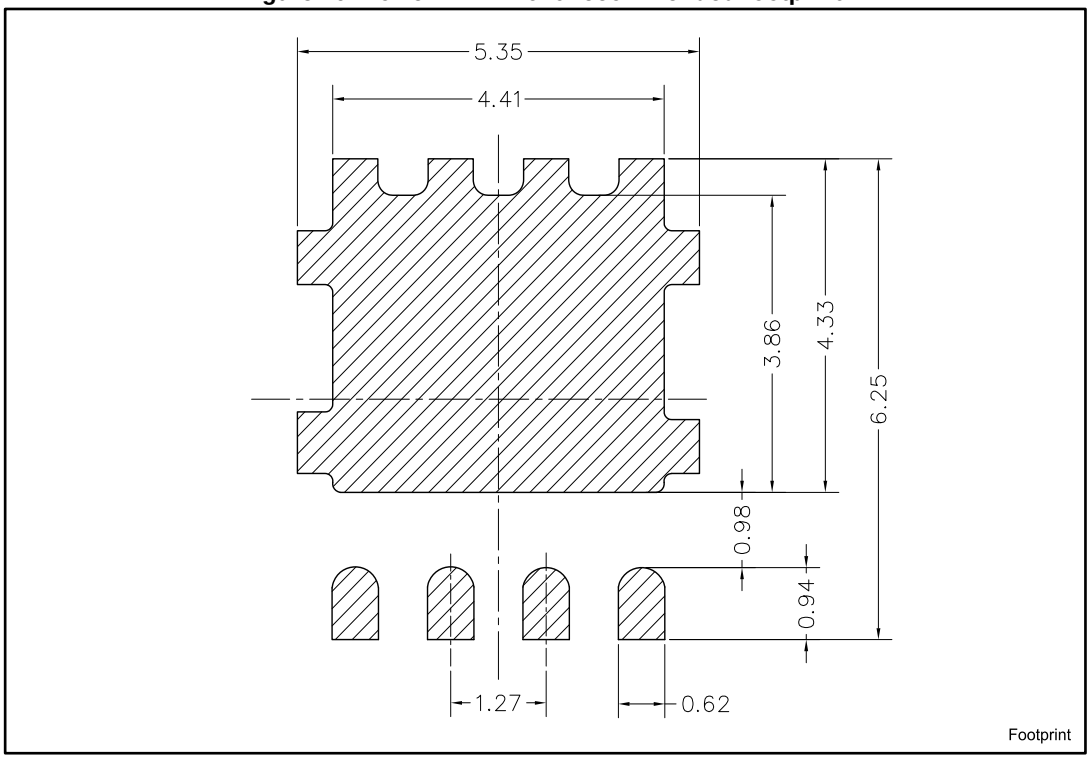


Table 8: PowerFLAT™ 5x6 type S-R mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	0.80		1.00
A1	0.02		0.05
A2		0.25	
b	0.30		0.50
D	5.00	5.20	5.40
E	5.95	6.15	6.35
D2	4.11		4.31
E2	3.50		3.70
e		1.27	
L	0.60		0.80
K	1.275		1.575

Figure 20: PowerFLAT™ 5x6 recommended footprint



5 Packaging mechanical data

Figure 21: PowerFLAT™ 5x6 tape

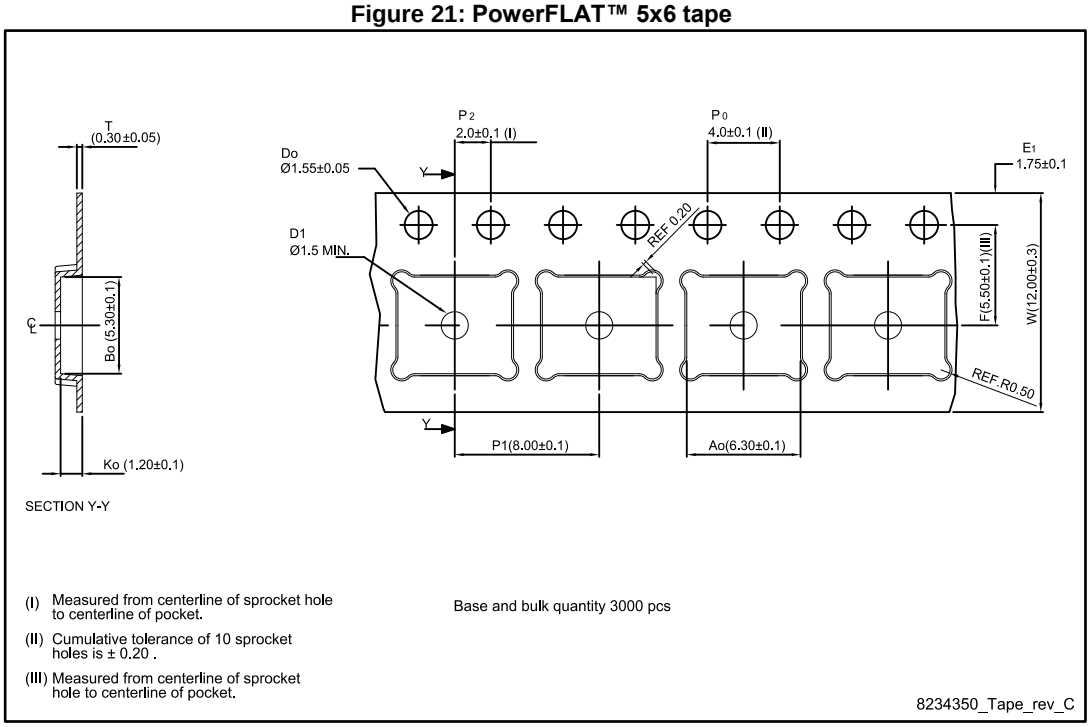


Figure 22: PowerFLAT™ 5x6 package orientation in carrier tape

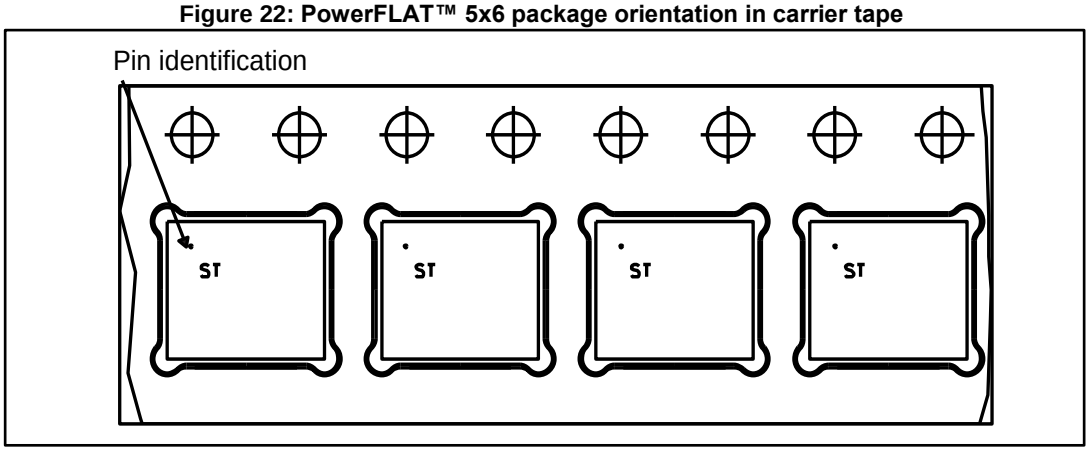
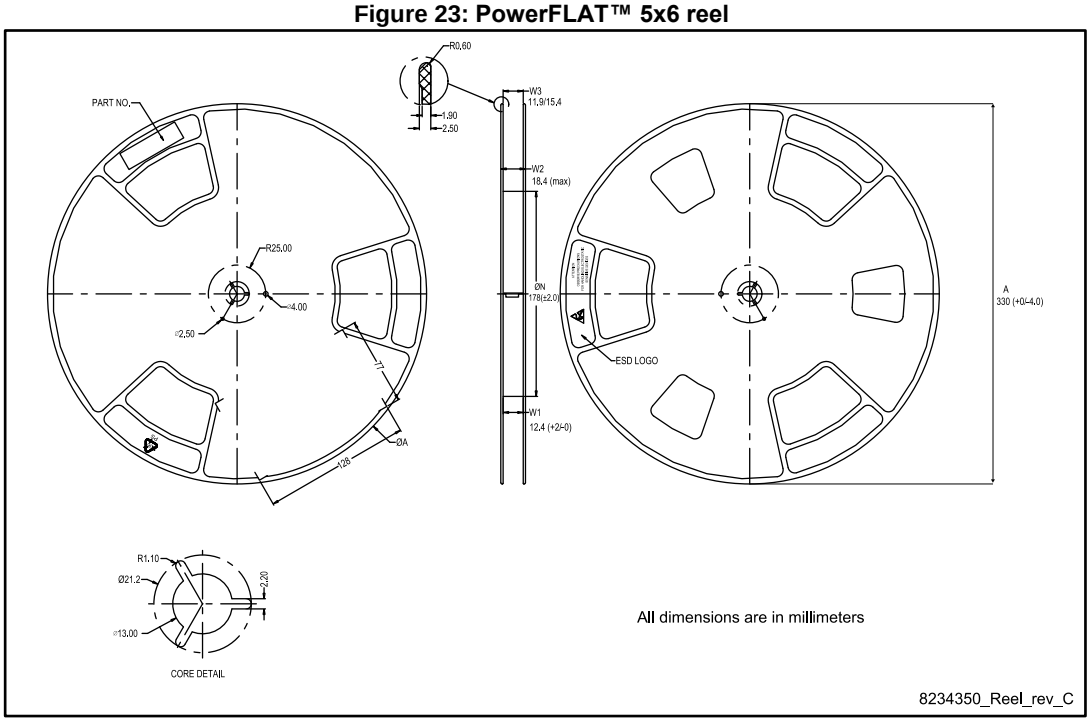


Figure 23: PowerFLAT™ 5x6 reel



6 Revision history

Table 9: Document revision history

Date	Revision	Changes
04-Sep-2014	1	Initial release.
16-Dec-2014	2	Document status promoted from preliminary data to production data. Minor text changes.

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