

N-channel 30 V, 0.0011 Ω typ., 45 A STripFET™ VI DeepGATE™ Power MOSFET in a PowerFLAT™ 5x6 package

Datasheet — production data

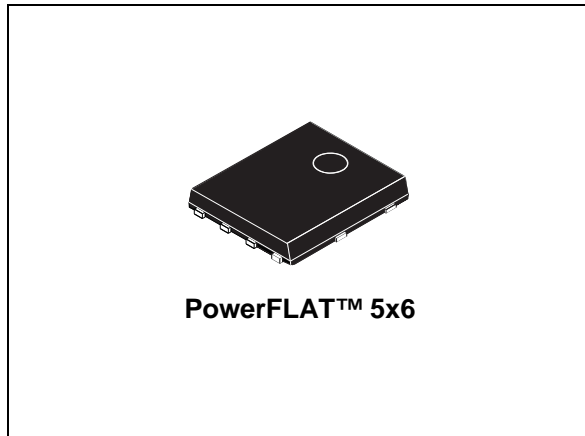
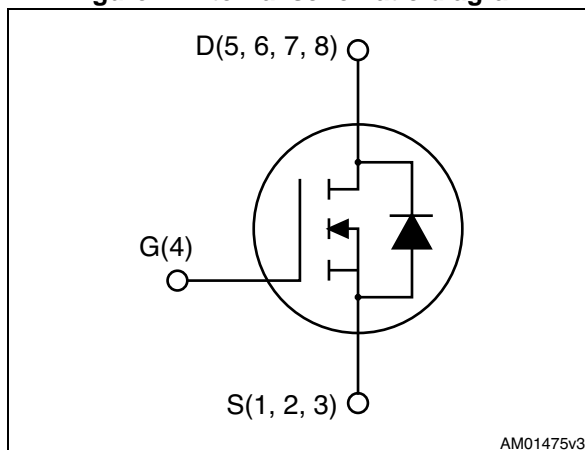


Figure 1. Internal schematic diagram



Features

Order code	V _{DSS}	R _{DS(on)} max	I _D
STL160N3LLH6	30 V	0.0013 Ω	45 A ⁽¹⁾

1. The value is rated according R_{thj-pcb}

- R_{DS(on)} * Q_g industry benchmark
- Extremely low on-resistance R_{DS(on)}
- Very low switching gate charge
- High avalanche ruggedness
- Low gate drive power losses

Applications

- Switching applications

Description

This device is an N-channel Power MOSFET developed using the 7th generation of STripFET™ DeepGATE™ technology, with a new gate structure. The resulting Power MOSFET exhibits the lowest R_{DS(on)} in all packages.

Table 1. Device summary

Order code	Marking	Package	Packaging
STL160N3LLH6	160N3LH6	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	30	V
V_{GS}	Gate-source voltage	± 20	V
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	240	A
$I_D^{(1)}$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	170	A
$I_D^{(2)}$	Drain current (continuous) at $T_{pcb} = 25\text{ }^\circ\text{C}$	45	A
$I_D^{(2)}$	Drain current (continuous) at $T_{pcb} = 100\text{ }^\circ\text{C}$	32	A
$I_{DM}^{(3)}$	Drain current (pulsed)	180	A
$P_{TOT}^{(1)}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	136	W
$P_{TOT}^{(2)}$	Total dissipation at $T_{pcb} = 25\text{ }^\circ\text{C}$	4.8	W
	Derating factor	0.03	W/ $^\circ\text{C}$
T_j	Operating junction temperature	-55 to 175	$^\circ\text{C}$
T_{stg}	Storage temperature		

1. The value is rated according to R_{thj-c} .
2. The value is rated according to $R_{thj-pcb}$.
3. Pulse width limited by safe operating area.

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case (steady state)	1.1	$^\circ\text{C}/\text{W}$
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb	31.3	$^\circ\text{C}/\text{W}$

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

Table 4. Avalanche data

Symbol	Parameter	Value	Unit
I_{AV}	Not-repetitive avalanche current (pulse width limited by T_j max)	35	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = I_{AV}$)	900	mJ

2 Electrical characteristics

($T_{CASE} = 25\text{ }^{\circ}\text{C}$ unless otherwise specified).

Table 5. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 250\text{ }\mu\text{A}$, $V_{GS} = 0$	30			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = 30\text{ V}$, $V_{DS} = 30\text{ V}$ at $T_C = 125\text{ }^{\circ}\text{C}$			1 10	μA μA
I_{GSS}	Gate body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 20\text{ V}$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	1			V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$, $I_D = 17.5\text{ A}$		0.0011	0.0013	Ω
		$V_{GS} = 4.5\text{ V}$, $I_D = 17.5\text{ A}$		0.0016	0.0020	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$	-	6375	-	pF
C_{oss}	Output capacitance		-	1230	-	pF
C_{rss}	Reverse transfer capacitance		-	675	-	pF
Q_g	Total gate charge	$V_{DD} = 15\text{ V}$, $I_D = 35\text{ A}$ $V_{GS} = 4.5\text{ V}$ (see Figure 14)	-	61.5	-	nC
Q_{gs}	Gate-source charge		-	20		nC
Q_{gd}	Gate-drain charge		-	24		nC
R_G	Gate input resistance	$f = 1\text{ MHz}$ gate DC bias = 0 test signal level = 20 mV open drain	-	1.4	-	Ω

Table 7. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 15\text{ V}$, $I_D = 17.5\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ (see Figure 13)	-	22.5	-	ns
t_r	Rise time		-	32	-	ns
$t_{d(off)}$	Turn-off delay time		-	107.5	-	ns
t_f	Fall time		-	54	-	ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		45	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		180	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 35\text{ A}$, $V_{GS}=0$	-		1.1	V
t_{rr}	Reverse recovery time	$I_{SD} = 35\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD}=25\text{ V}$	-	37.2		ns
Q_{rr}	Reverse recovery charge		-	36		nC
I_{RRM}	Reverse recovery current		-	1.9		A

1. Pulse width limited by safe operating area.
2. Pulsed: pulse duration=300 μs , duty cycle 1.5%.

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

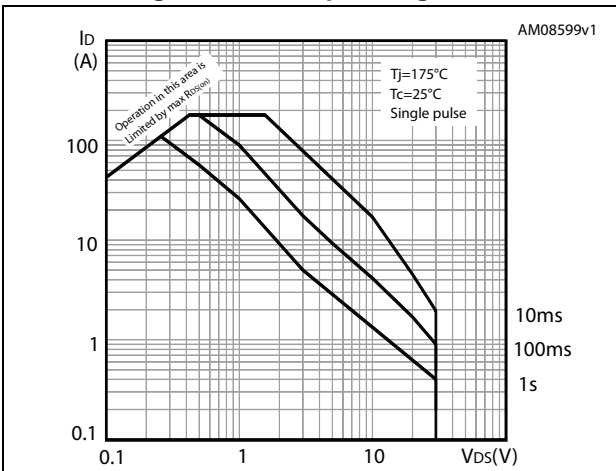


Figure 3. Thermal impedance

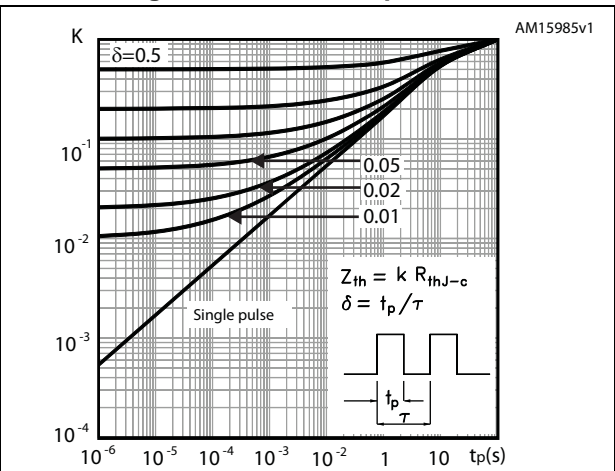


Figure 4. Output characteristics

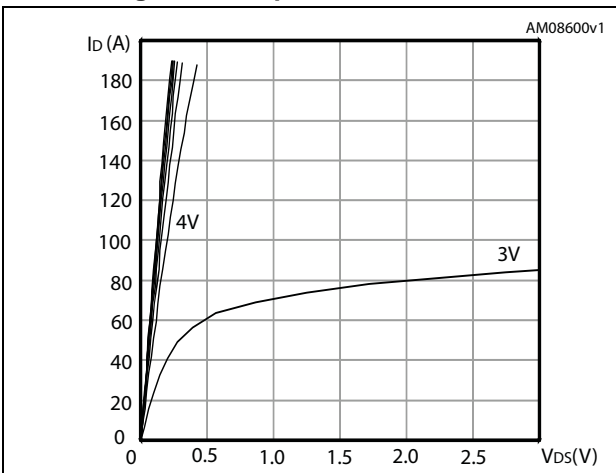


Figure 5. Transfer characteristics

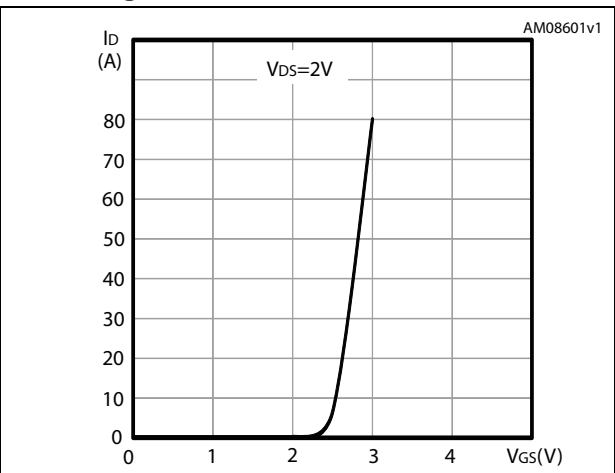


Figure 6. Normalized $B_{V_{DS}}$ vs temperature

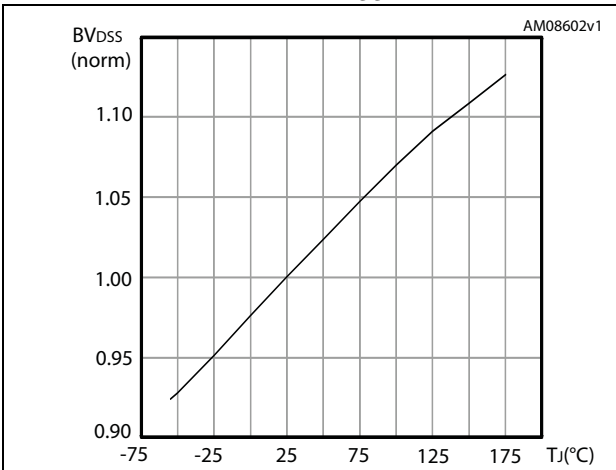


Figure 7. Static drain-source on-resistance

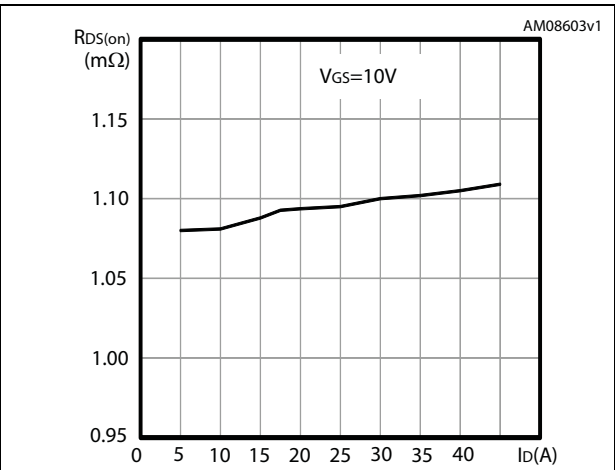


Figure 8. Gate charge vs gate-source voltage

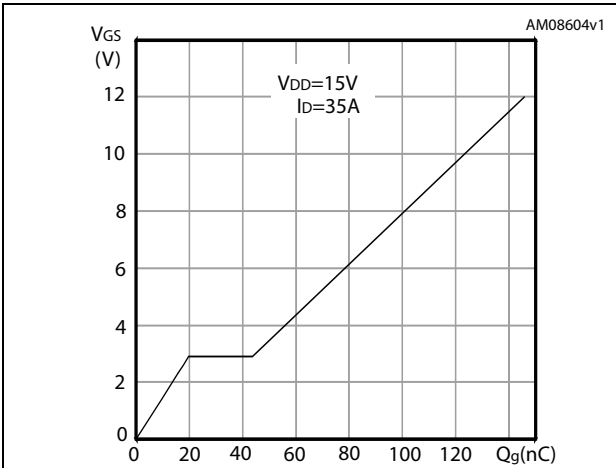


Figure 9. Capacitance variations

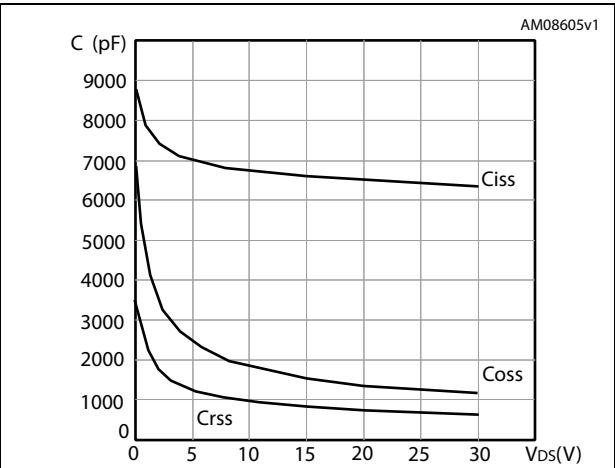


Figure 10. Normalized gate threshold voltage vs temperature

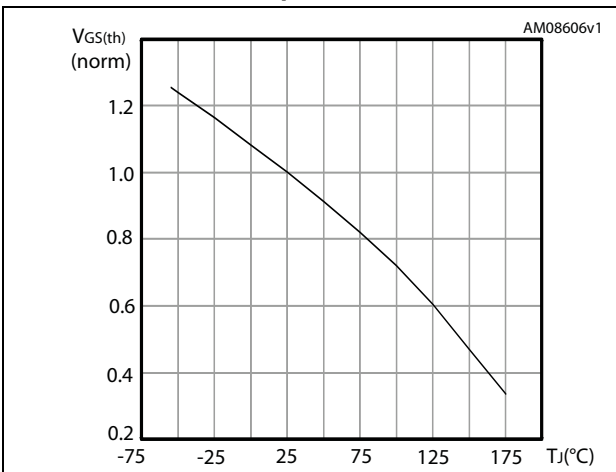


Figure 11. Normalized on-resistance vs temperature

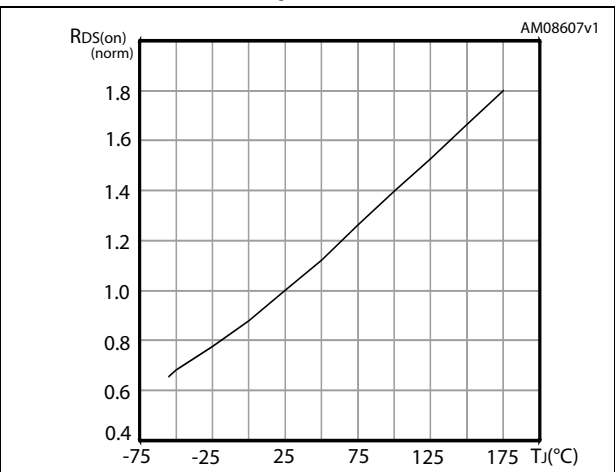
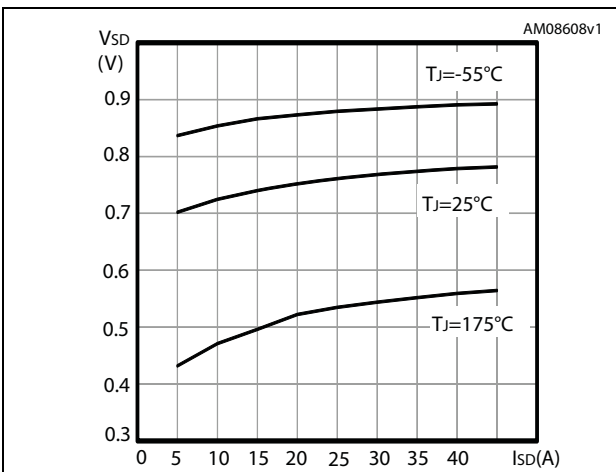


Figure 12. Source-drain diode forward characteristics



3 Test circuits

Figure 13. Switching times test circuit for resistive load

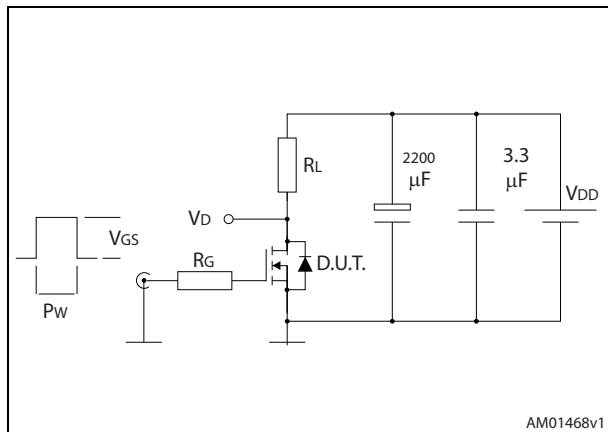


Figure 14. Gate charge test circuit

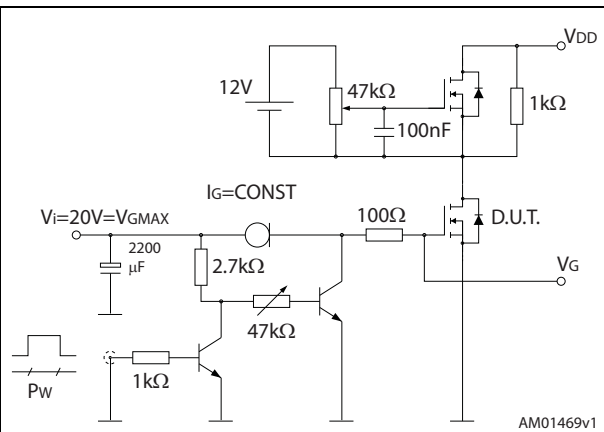


Figure 15. Test circuit for inductive load switching and diode recovery times

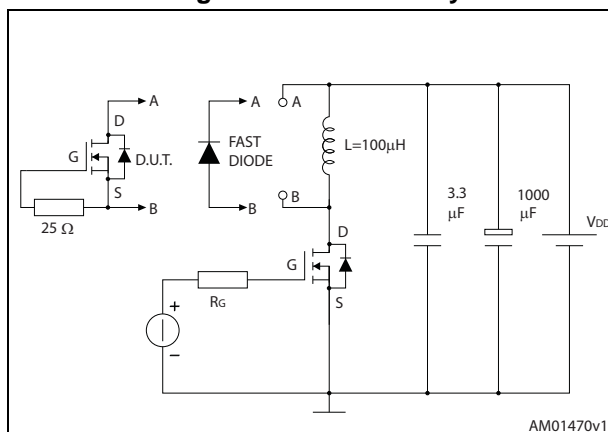


Figure 16. Unclamped inductive load test circuit

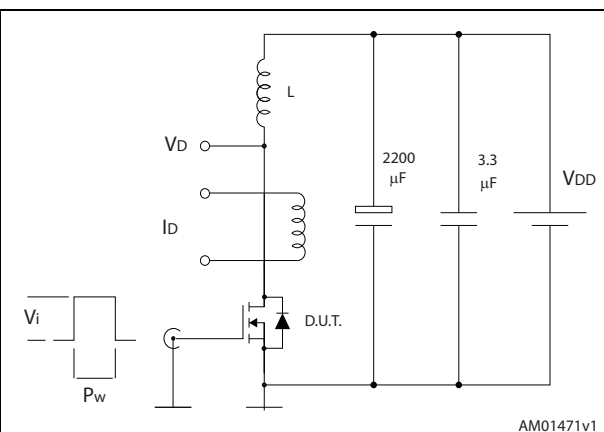


Figure 17. Unclamped inductive waveform

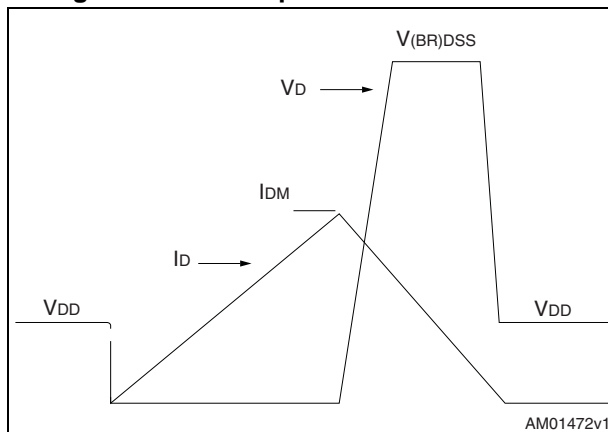
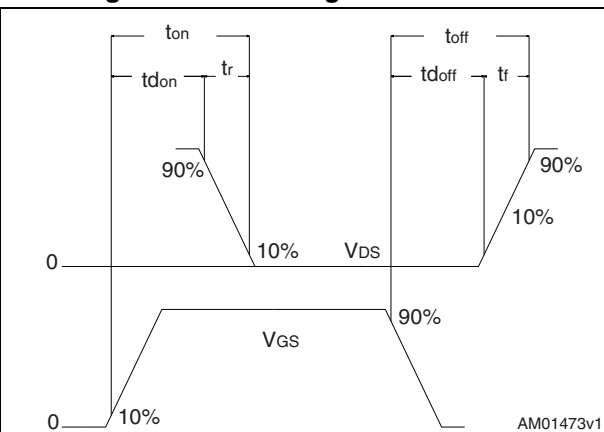


Figure 18. Switching time waveform



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.

Table 9. PowerFLAT™ 5x6 type S-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
D		5.20	
E		6.15	
D2	4.11		4.31
E2	3.50		3.70
e		1.27	
e1		0.65	
L	0.715		1.015
K	1.05		1.35

Figure 19. PowerFLAT™ 5x6 type S-C mechanical data

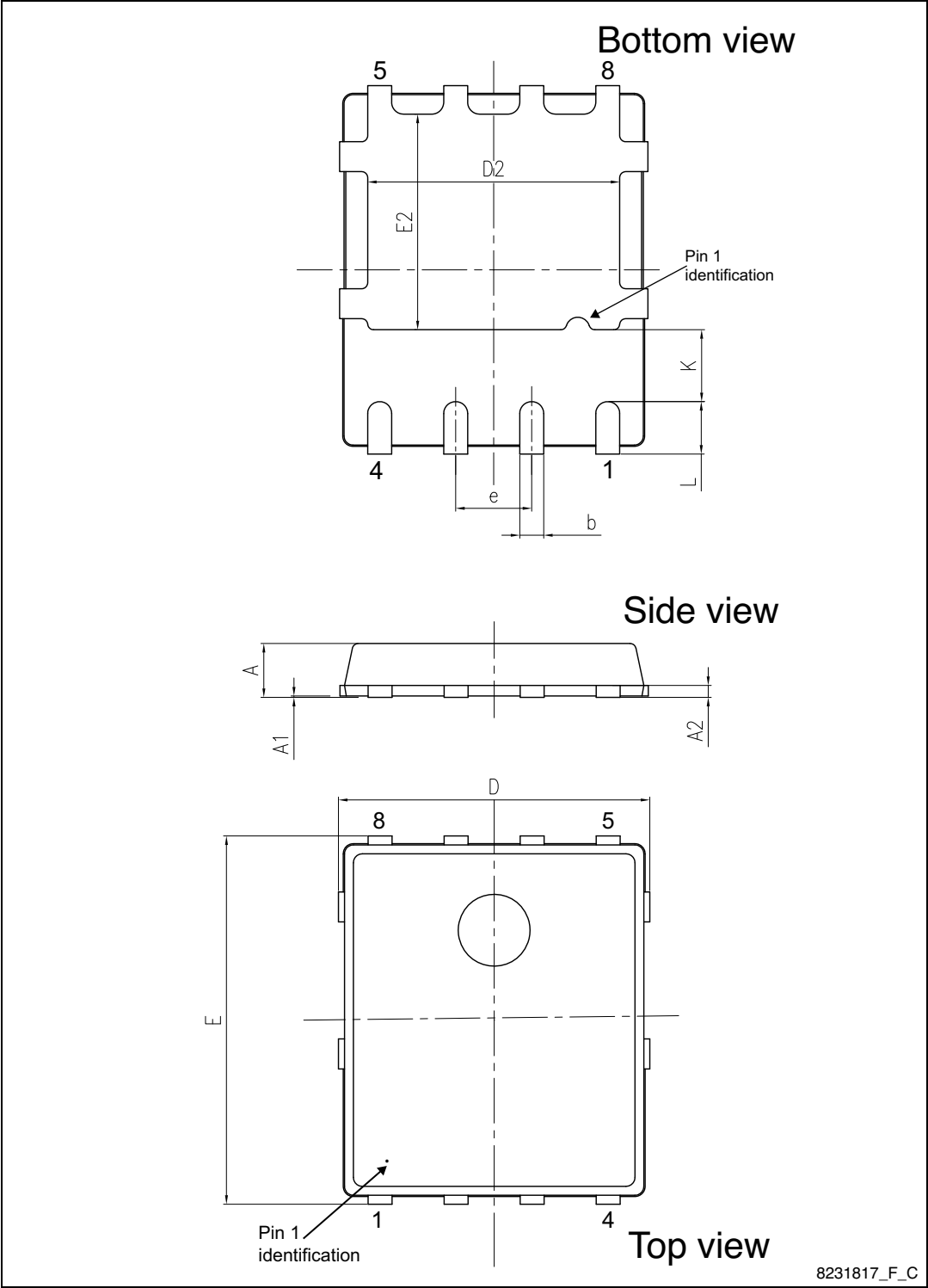
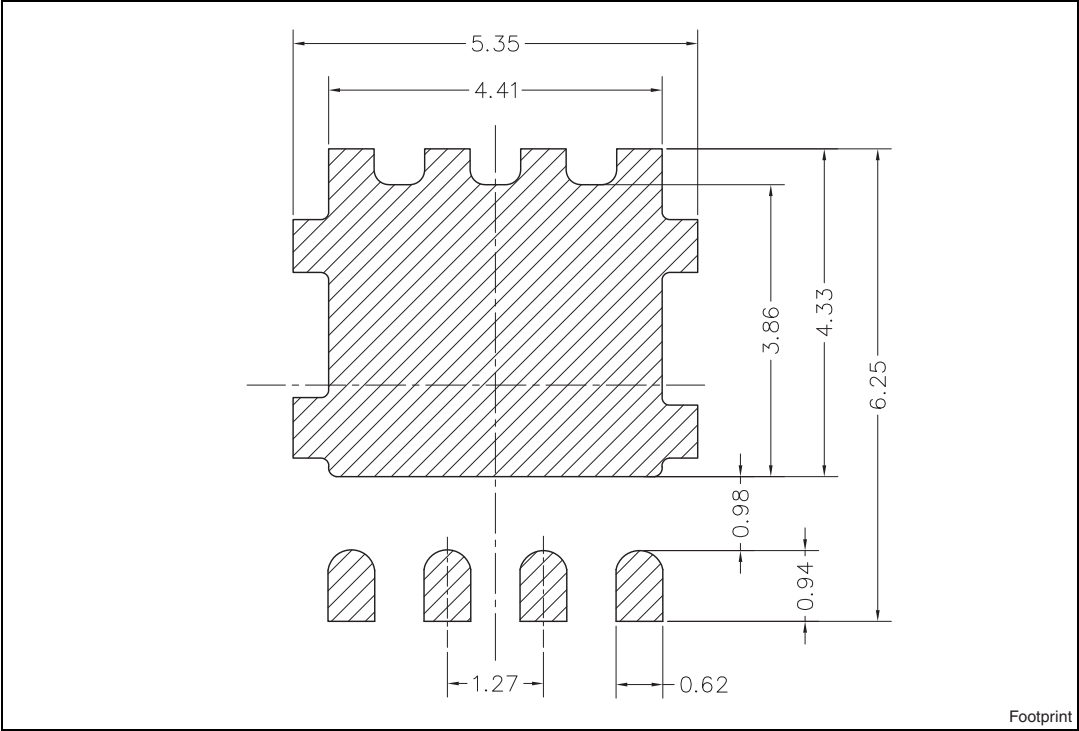


Figure 20. PowerFLAT™ 5x6 recommended footprint (dimensions in mm)



5 Packaging mechanical data

Figure 21. PowerFLAT™ 5x6 tape^(a)

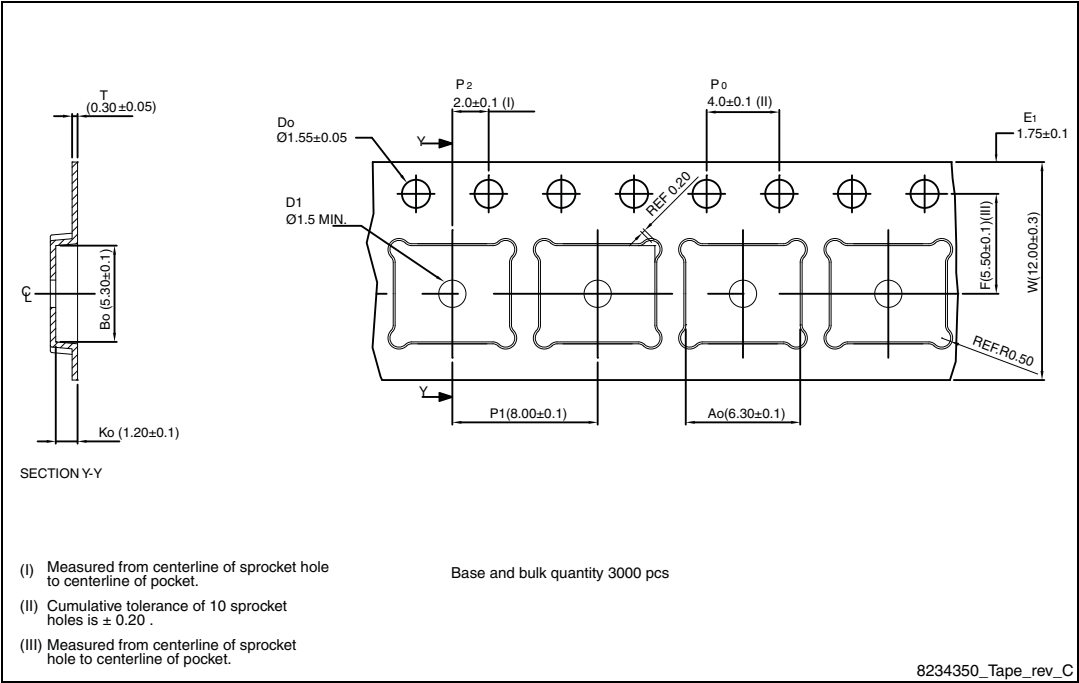
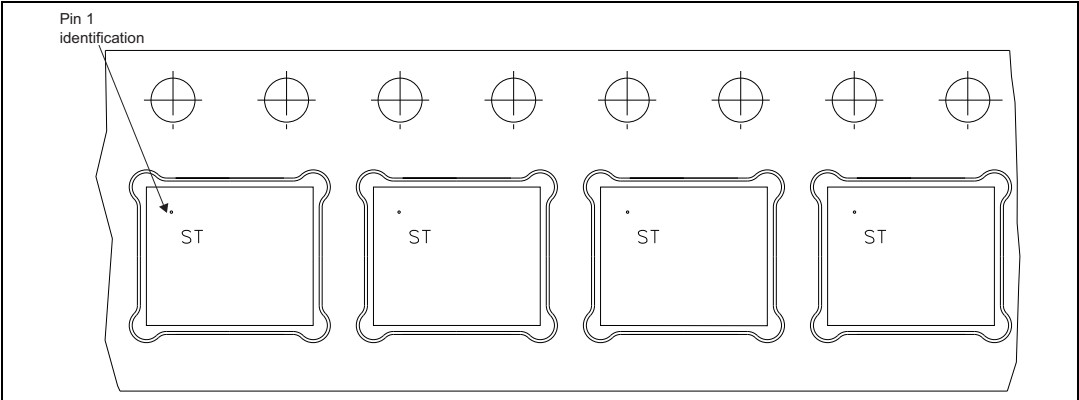
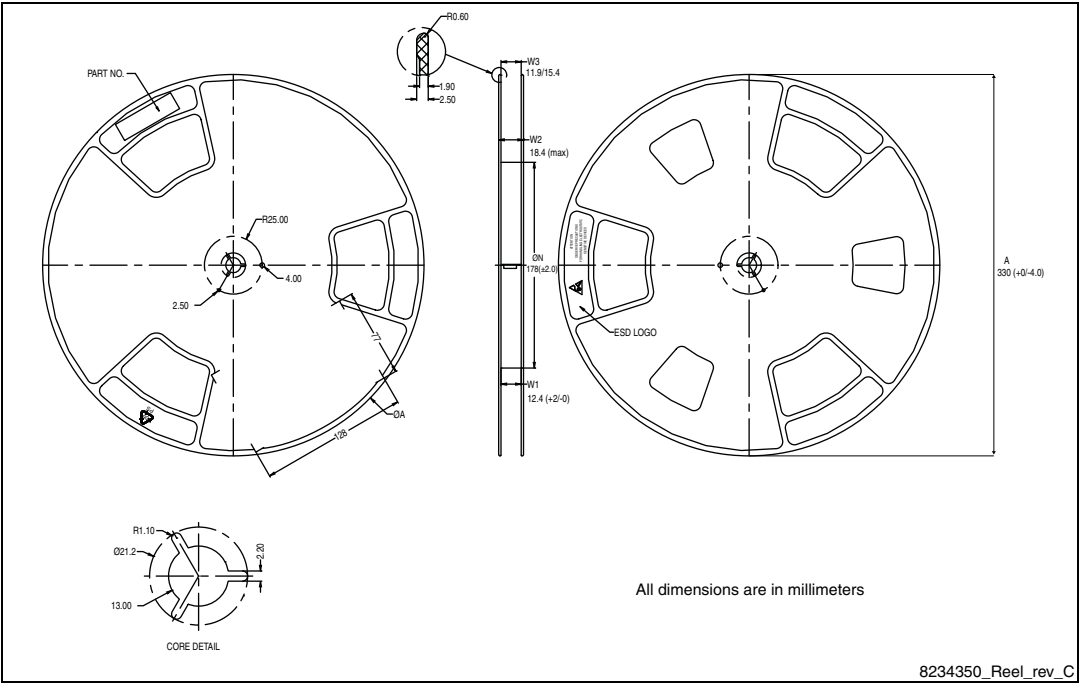


Figure 22. PowerFLAT™ 5x6 package orientation in carrier tape.



a. All dimensions are in millimeters.

Figure 23. PowerFLAT™ 5x6 reel



6 Revision history

Table 10. Document revision history

Date	Revision	Changes
10-Nov-2010	1	First release.
10-Nov-2011	2	Section 4: Package mechanical data has been updated. Minor text changes.
31-Jul-2013	3	<ul style="list-style-type: none"> – Modified: I_D in the title and in the Features Table, Table 5, Table 6 and Table 7 – Modified: values on the Table 2, $R_{thj-case}$ on the Table 3, max values for the I_{SD} and I_{SDM} on Table 8 – Updated: Section 4: Package mechanical data – Inserted: Section 5: Packaging mechanical data – Modified: Figure 13, Figure 14, Figure 15 and Figure 16 – Minor text changes
09-Aug-2013	4	<ul style="list-style-type: none"> – Modified: drain current (continuous) at $T_C = 100\text{ °C}$ value and drain current (continuous) at $T_{pcb}=100\text{ °C}$ value – Modified: test conditions of $R_{DS(on)}$ – Modified: I_D in Table 6 and Table 7 – Modified: I_{SD} in Table 8 – Modified: Figure 2, Figure 3, Figure 4, Figure 5, Figure 7, Figure 12, Figure 13, Figure 14, Figure 15 and Figure 16 – Updated: Section 4: Package mechanical data – Minor text changes
24-Sep-2013	5	<ul style="list-style-type: none"> – Modified: marking in Table 1 – Minor text changes

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