

N-channel 800 V, 2.1 Ω typ., 2.5 A MDMesh™ K5 Power MOSFET in a PowerFLAT™ 5x6 VHV package

Datasheet – production data

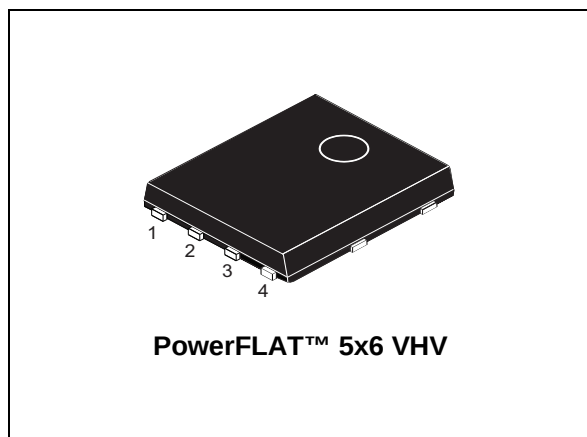
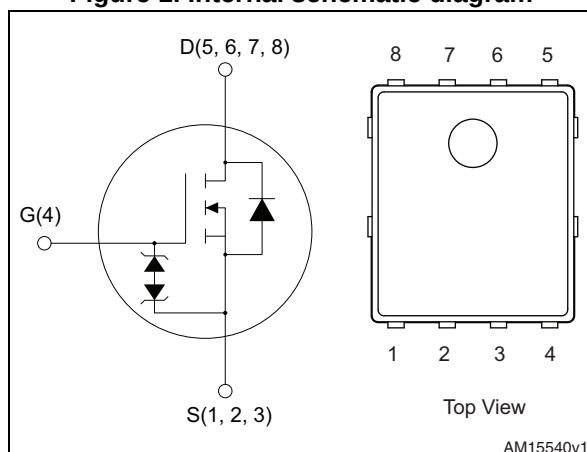


Figure 1. Internal schematic diagram



Features

Order code	V_{DS}	$R_{DS(on)max.}$	I_D
STL4N80K5	800 V	2.5 Ω	2.5 A

- Industry's lowest $R_{DS(on)} \times \text{area}$
- Industry's best figure of merit (FoM)
- Ultra low gate charge
- 100% avalanche tested
- Zener protected

Applications

- Switching applications

Description

This very high voltage N-channel Power MOSFET is designed using MDMesh™ K5 technology based on an innovative proprietary vertical structure. The result is a dramatic reduction in on-resistance and ultra-low gate charge for applications requiring superior power density and high efficiency.

Table 1. Device summary

Order code	Marking	Package	Packaging
STL4N80K5	4N80K5	PowerFLAT™ 5x6 VHV	Tape and reel

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	± 30	V
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	2.5	A
$I_D^{(1)}$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	1.55	A
$I_{DM}^{(2)}$	Drain current (pulsed)	10	A
$P_{TOT}^{(1)}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	38	W
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max)	1	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	74.5	mJ
$dv/dt^{(3)}$	Peak diode recovery voltage slope	4.5	V/ns
$dv/dt^{(4)}$	MOSFET dv/dt ruggedness	50	V/ns
T_{stg}	Storage temperature	- 55 to 150	$^\circ\text{C}$
T_j	Operating junction temperature		$^\circ\text{C}$

1. The value is limited by package.
2. Pulse width limited by safe operating area.
3. $I_{SD} \leq 2.5\text{ A}$, $di/dt \leq 100\text{ A}/\mu\text{s}$, $V_{DS(\text{peak})} \leq V_{(BR)DSS}$
4. $V_{DS} \leq 640\text{ V}$

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	3.3	$^\circ\text{C}/\text{W}$
$R_{thj-amb}^{(1)}$	Thermal resistance junction-amb max	59	$^\circ\text{C}/\text{W}$

1. When mounted on 1inch² FR-4 board, 2 oz Cu.

2 Electrical characteristics

($T_C = 25\text{ °C}$ unless otherwise specified)

Table 4. On /off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage ($V_{GS} = 0$)	$I_D = 1\text{ mA}$	800			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = 800\text{ V}$ $V_{DS} = 800\text{ V}, T_C = 125\text{ °C}$			1 50	μA μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 20\text{ V}$			± 10	μA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 100\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}, I_D = 1.5\text{ A}$		2.1	2.5	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 100\text{ V}, f = 1\text{ MHz}, V_{GS} = 0$	-	175	-	pF
C_{oss}	Output capacitance		-	20	-	pF
C_{rss}	Reverse transfer capacitance		-	1	-	pF
$C_{o(tr)}^{(1)}$	Equivalent capacitance time related	$V_{DS} = 0\text{ to }640\text{ V}, V_{GS} = 0$	-	26	-	pF
$C_{o(er)}^{(2)}$	Equivalent capacitance energy related		-	11	-	pF
R_G	Intrinsic gate resistance	$f = 1\text{ MHz}, I_D = 0$	-	15	-	Ω
Q_g	Total gate charge	$V_{DD} = 640\text{ V}, I_D = 3\text{ A}, V_{GS} = 10\text{ V}$ (see Figure 16)	-	10.5	-	nC
Q_{gs}	Gate-source charge		-	2	-	nC
Q_{gd}	Gate-drain charge		-	7.5	-	nC

1. $C_{oss\text{ eq.}}$ time related is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS}
2. $C_{oss\text{ eq.}}$ energy related is defined as a constant equivalent capacitance giving the same stored energy as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS}

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 400\text{ V}$, $I_D = 1.5\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 15), (see Figure 20)	-	16.5	-	ns
t_r	Rise time		-	15	-	ns
$t_{d(off)}$	Turn-off delay time		-	36	-	ns
t_f	Fall time		-	21	-	ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		2.5	A
I_{SDM}	Source-drain current (pulsed)		-		10	A
$V_{SD}^{(1)}$	Forward on voltage	$I_{SD} = 3\text{ A}$, $V_{GS} = 0$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 3\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ (see Figure 17)	-	242		ns
Q_{rr}	Reverse recovery charge		-	1.42		μC
I_{RRM}	Reverse recovery current		-	12		A
t_{rr}	Reverse recovery time	$I_{SD} = 3\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 17)	-	373		ns
Q_{rr}	Reverse recovery charge		-	1.98		μC
I_{RRM}	Reverse recovery current		-	10.5		A

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

Table 8. Gate-source Zener diode

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
$V_{(BR)GSO}$	Gate-source breakdown voltage	$I_{GS} = \pm 1\text{ mA}$, $I_D = 0$	30	-	-	V

The built-in back-to-back Zener diodes have been specifically designed to enhance the ESD capability of the device. The Zener voltage is appropriate for efficient and cost-effective intervention to protect the device integrity. These integrated Zener diodes thus eliminate the need for external components.

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

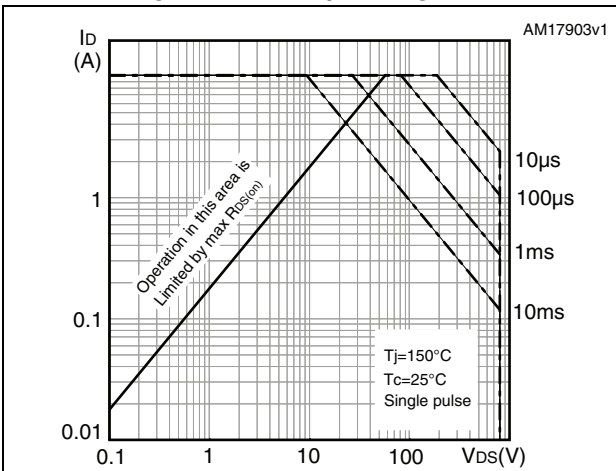


Figure 3. Thermal impedance

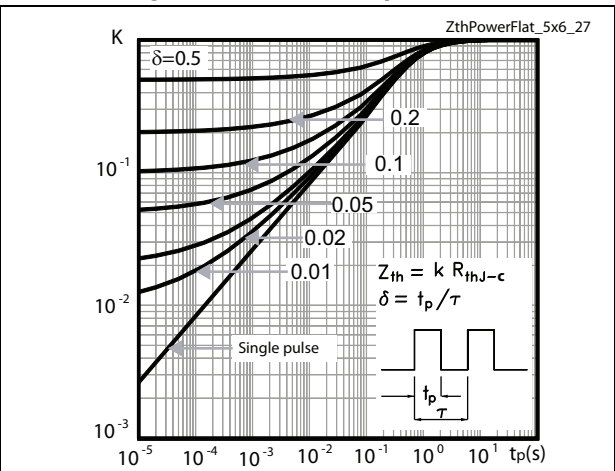


Figure 4. Output characteristics

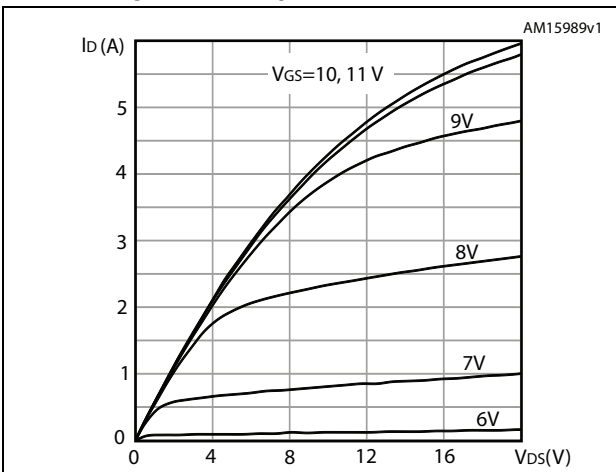


Figure 5. Transfer characteristics

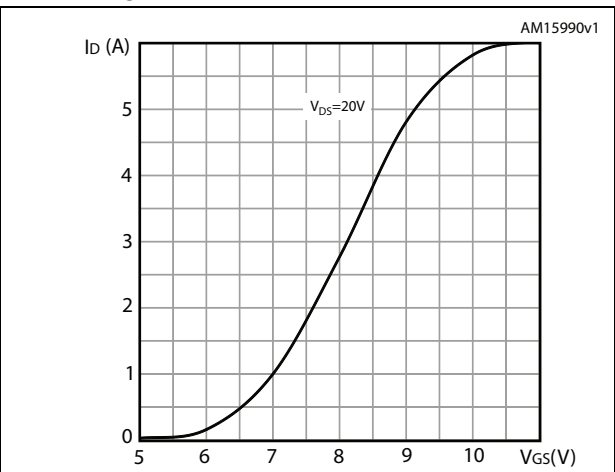


Figure 6. Gate charge vs gate-source voltage

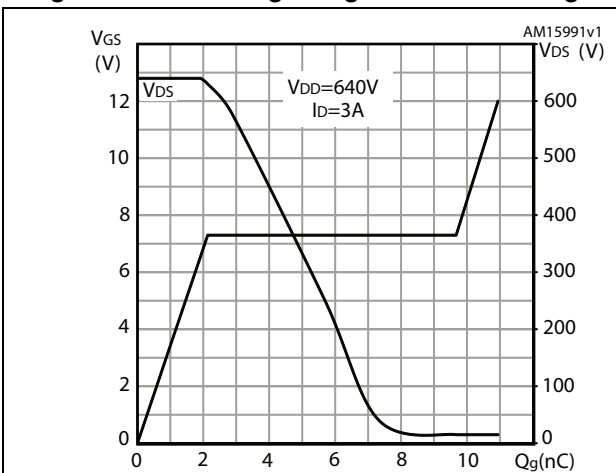


Figure 7. Static drain-source on-resistance

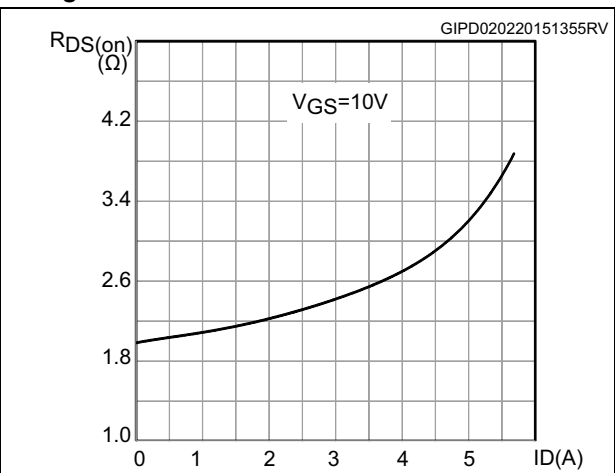


Figure 8. Capacitance variations

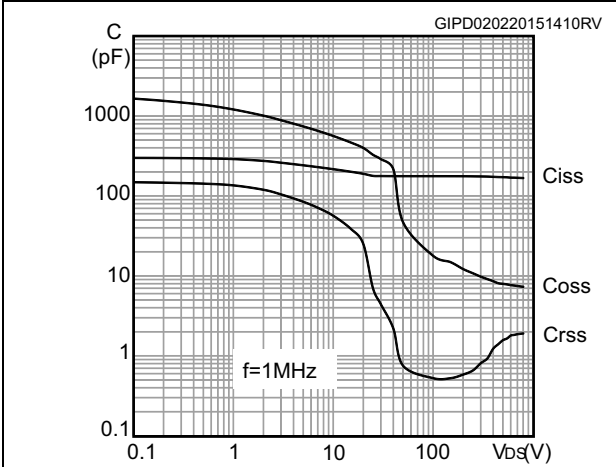


Figure 9. Output capacitance stored energy

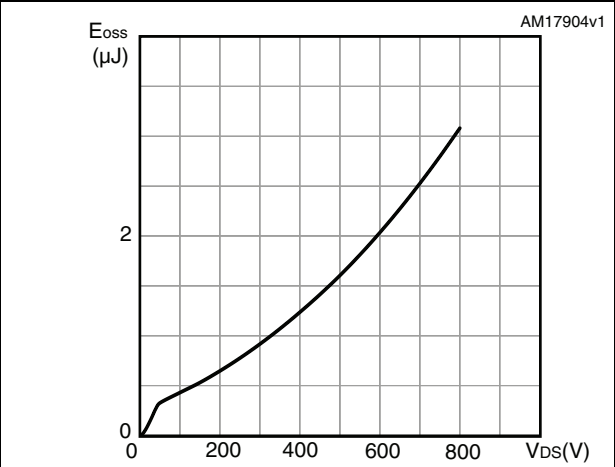


Figure 10. Normalized gate threshold voltage vs. temperature

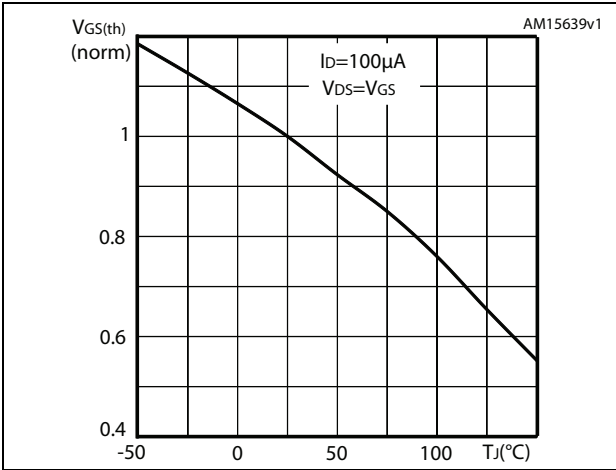


Figure 11. Normalized on-resistance vs. temperature

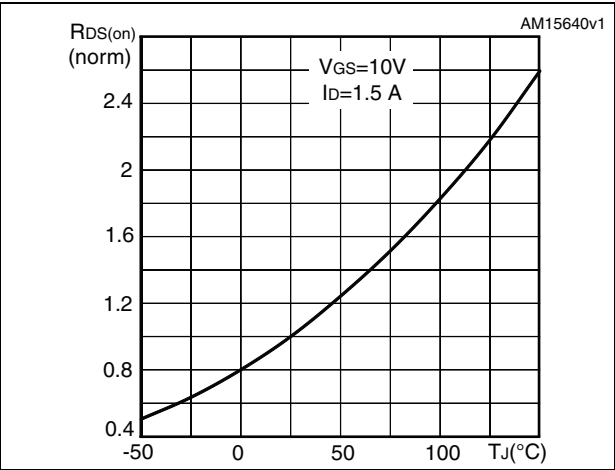


Figure 12. Drain-source diode forward characteristics

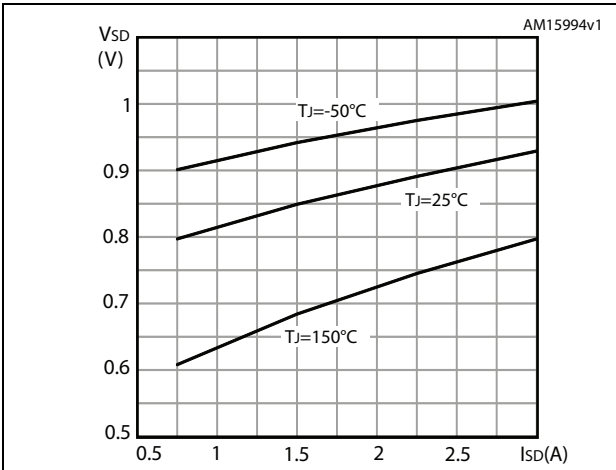


Figure 13. Normalized V_{DS} vs. temperature

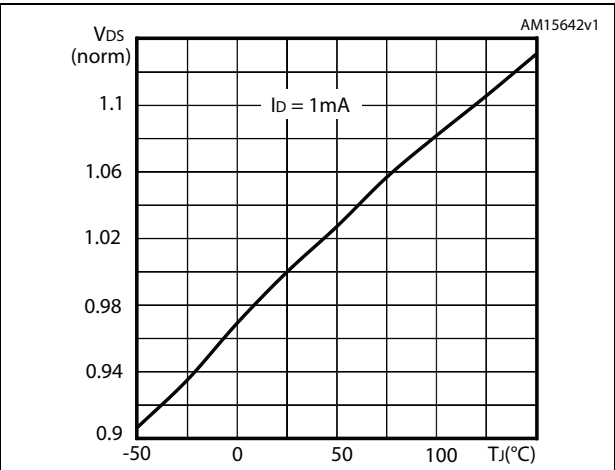
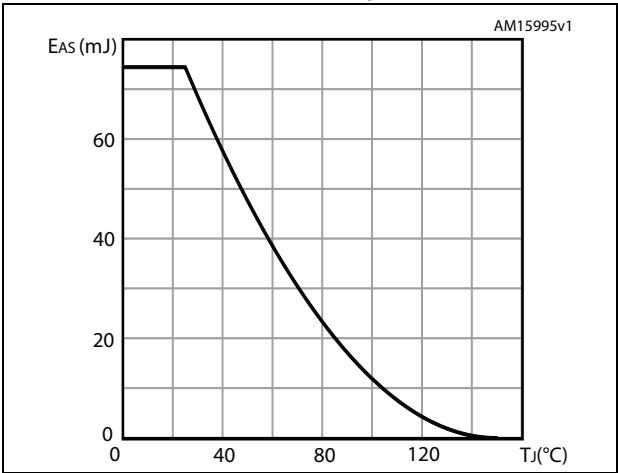


Figure 14. Maximum avalanche energy vs. starting T_J



3 Test circuits

Figure 15. Switching times test circuit for resistive load

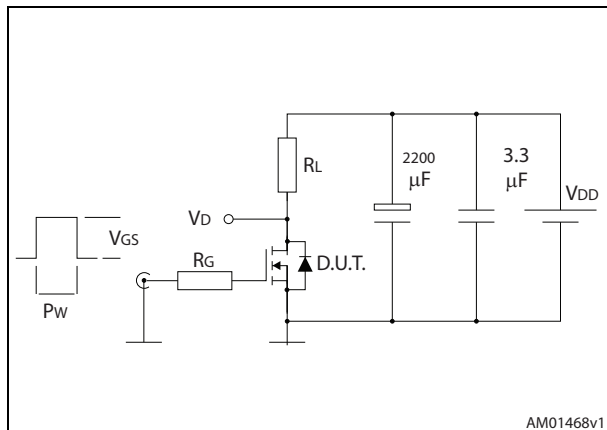


Figure 16. Gate charge test circuit

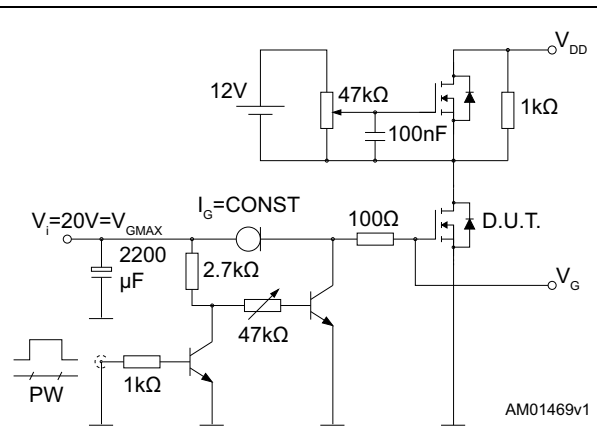


Figure 17. Test circuit for inductive load switching and diode recovery times



Figure 18. Unclamped inductive load test circuit

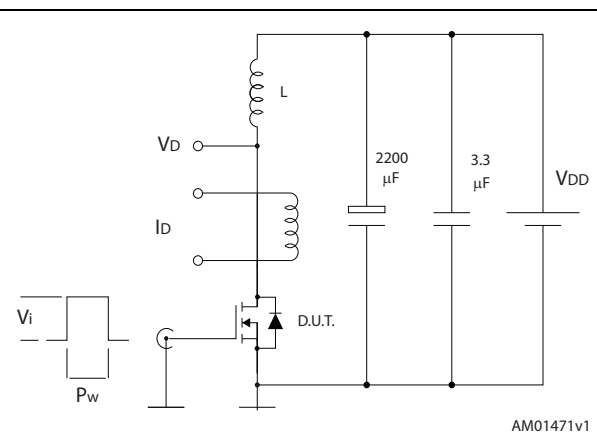


Figure 19. Unclamped inductive waveform

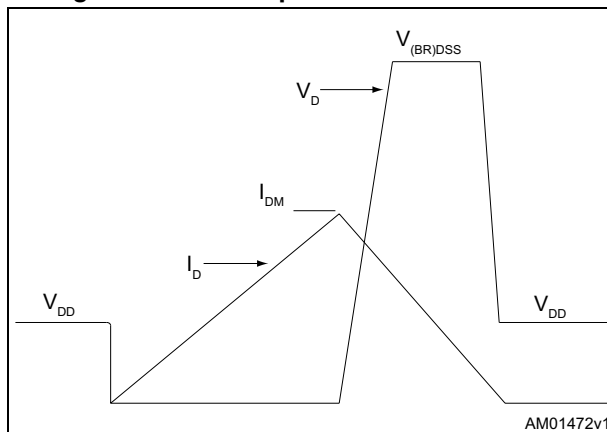
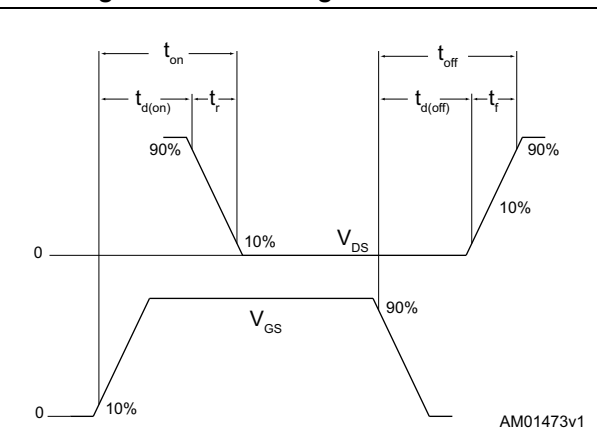


Figure 20. Switching time waveform



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.

Figure 21. PowerFLAT™ 5x6 VHV

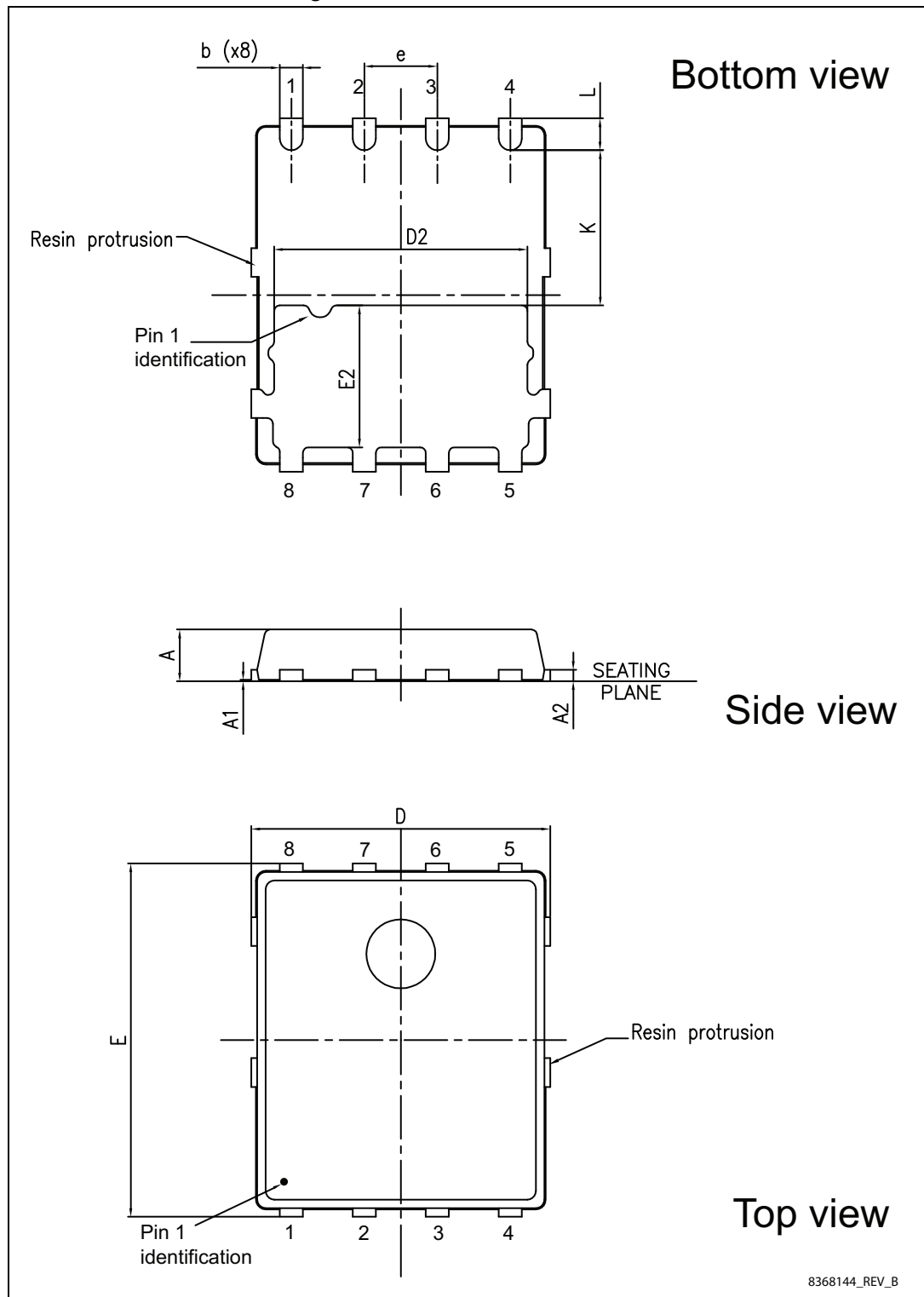
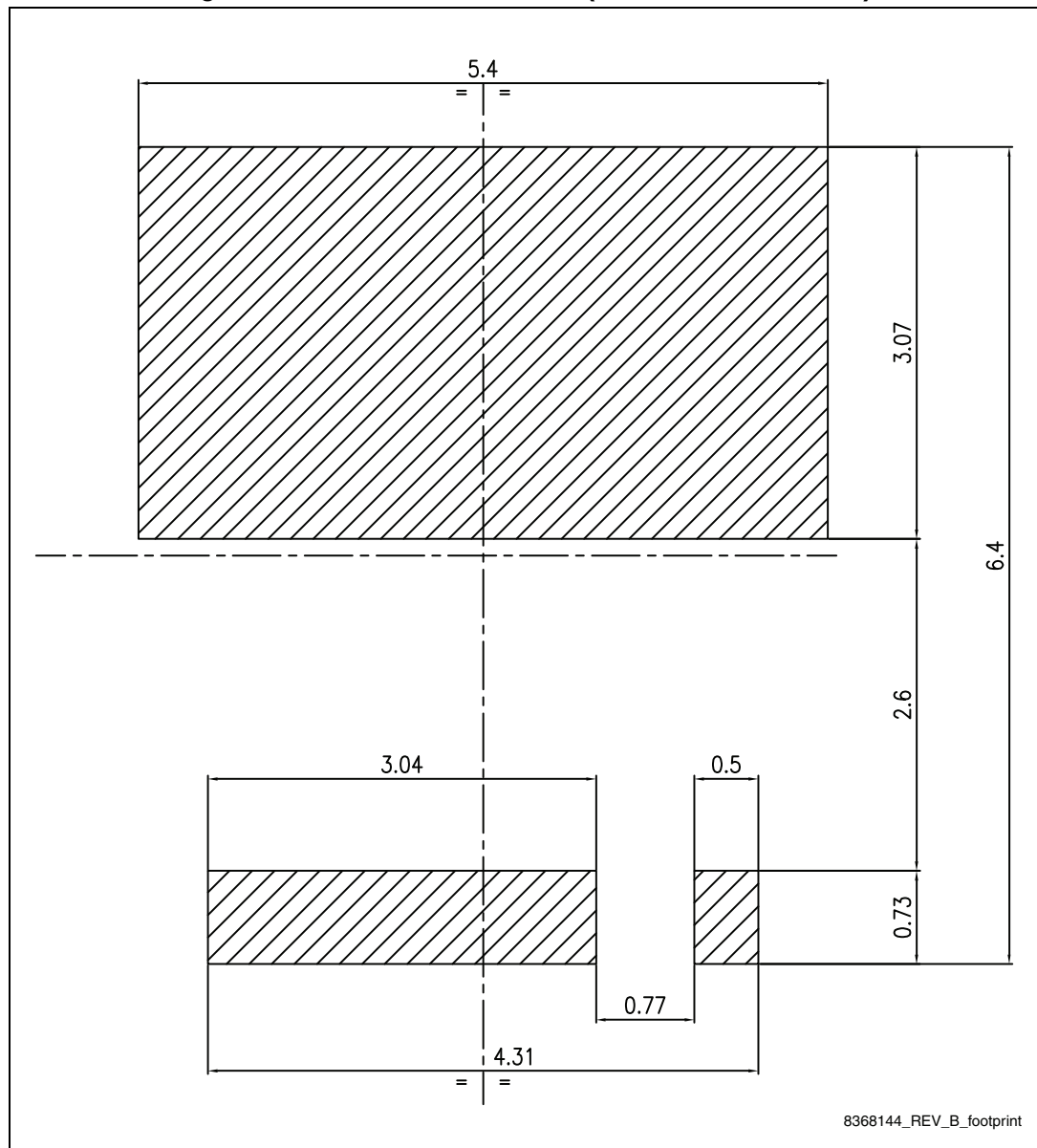


Table 9. PowerFLAT™ 5x6 VHV mechanical data

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	4.30	4.40	4.50
E2	2.40	2.50	2.60
e		1.27	
L	0.50	0.55	0.60
K	2.60	2.70	2.80

Figure 22. PowerFLAT™ 5x6 VHV (dimensions are in mm)



5 Packaging mechanical data

Figure 23. PowerFLAT™ 5x6 tape

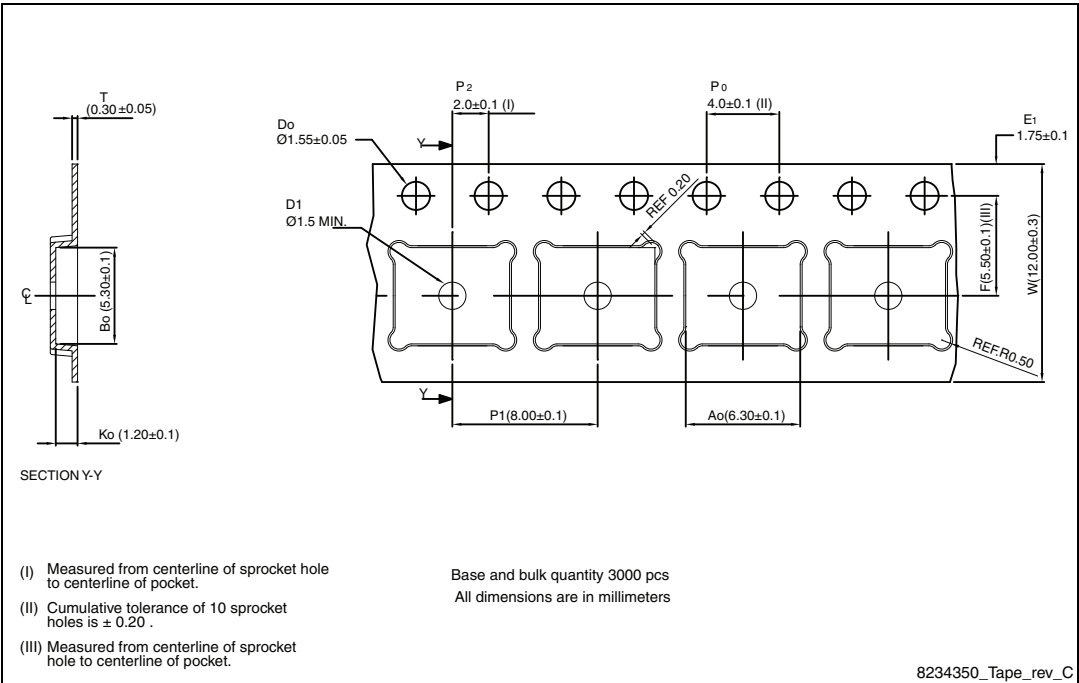
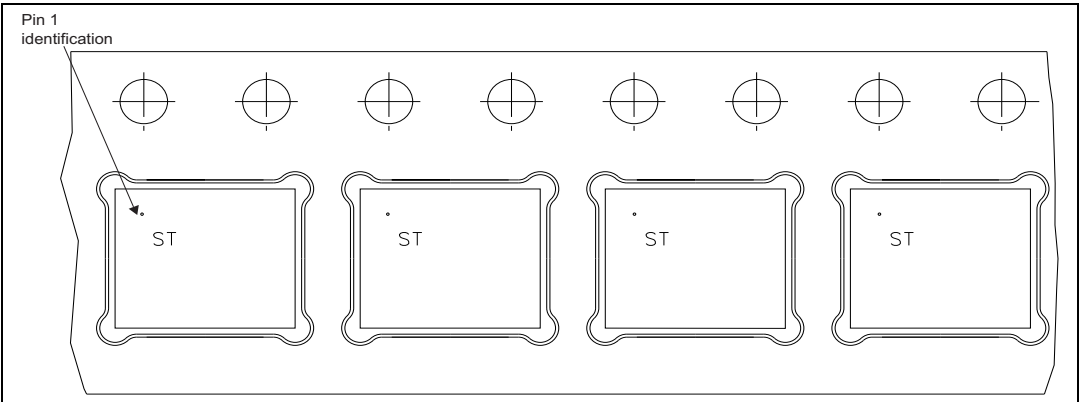


Figure 24. PowerFLAT™ 5x6 package orientation in carrier tape



6 Revision history

Table 10. Document revision history

Date	Revision	Changes
22-Nov-2013	1	First release.
14-May-2015	2	Updated title, features and description in cover page. Updated 3: Test circuits . Updated Figure 7.: Static drain-source on-resistance , Figure 8.: Capacitance variations and Figure 14.: Maximum avalanche energy vs. starting TJ . Minor text changes.

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