

N-channel 650 V, 0.090 Ω typ., 22.5 A MDmesh™ M5 Power MOSFET in a PowerFLAT™ 8x8 HV package

Datasheet - production data

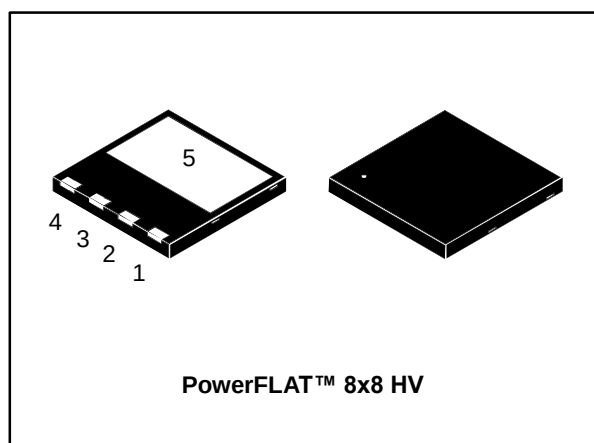
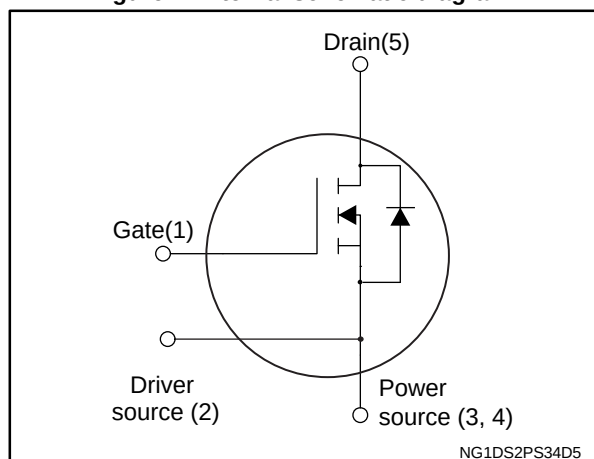


Figure 1: Internal schematic diagram



Features

Order code	$V_{DS} @ T_{Jmax}$	$R_{DS(on)}$ max.	I_D
STL38N65M5	710 V	0.105 Ω	22.5 A

- Extremely low $R_{DS(on)}$
- Low gate charge and input capacitance
- Excellent switching performance
- 100% avalanche tested

Applications

- Switching applications

Description

This device is an N-channel Power MOSFET based on the MDmesh™ M5 innovative vertical process technology combined with the well-known PowerMESH™ horizontal layout. The resulting product offers extremely low on-resistance, making it particularly suitable for applications requiring high power and superior efficiency.

Table 1: Device summary

Order code	Marking	Package	Packaging
STL38N65M5	38N65M5	PowerFLAT™ 8x8 HV	Tape and reel

Contents

1	Electrical ratings	3
2	Electrical characteristics	4
	2.1 Electrical characteristics (curves).....	6
3	Test circuits	9
4	Package information	10
	4.1 PowerFLAT™ 8x8 HV package information.....	11
	4.2 PowerFLAT™ 8x8 HV packing information.....	13
5	Revision history	15

1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	650	V
V_{GS}	Gate-source voltage	± 25	V
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	22.5	A
$I_D^{(1)}$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	16	A
$I_{DM}^{(1)(2)}$	Drain current (pulsed)	90	A
$I_D^{(3)}$	Drain current (continuous) at $T_{pcb} = 25\text{ }^\circ\text{C}$	3.5	A
$I_D^{(3)}$	Drain current (continuous) at $T_{pcb} = 100\text{ }^\circ\text{C}$	2.2	A
$P_{TOT}^{(3)}$	Total dissipation at $T_{pcb} = 25\text{ }^\circ\text{C}$	2.8	W
$P_{TOT}^{(4)}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	150	W
I_{AR}	Avalanche current, repetitive or notrepetitive (pulse width limited by T_j max)	7	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	660	mJ
$dv/dt^{(4)}$	Peak diode recovery voltage slope	15	V/ns
T_{stg}	Storage temperature	- 55 to 150	$^\circ\text{C}$
T_j	Max. operating junction temperature	150	

Notes:

⁽¹⁾The value is rated according to $R_{thj-case}$.

⁽²⁾Pulse width limited by safe operating area.

⁽³⁾When mounted on FR-4 board of 1 inch², 2oz Cu.

⁽⁴⁾ $I_{SD} \leq 22.5\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$; $V_{DS(peak)} < V_{(BR)DSS}$, $V_{DD} = 400\text{ V}$.

Table 3: Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	0.83	$^\circ\text{C}/\text{W}$
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb max	45	$^\circ\text{C}/\text{W}$

Notes:

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

2 Electrical characteristics

$T_C = 25\text{ }^{\circ}\text{C}$ unless otherwise specified

Table 4: On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$, $I_D = 1\text{ mA}$	650			V
I_{DSS}	Zero gate voltage Drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 650\text{ V}$			1	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 650\text{ V}$, $T_C = 125\text{ }^{\circ}\text{C}$			100	μA
I_{GSS}	Gate-body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS} = \pm 25\text{ V}$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$, $I_D = 12.5\text{ A}$		0.090	0.105	Ω

Table 5: Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	3000	-	pF
C_{oss}	Output capacitance		-	74	-	pF
C_{rss}	Reverse transfer capacitance		-	5.8	-	pF
$C_{o(er)}^{(1)}$	Equivalent output capacitance energy related	$V_{DS} = 0\text{ to }80\% V_{(BR)DSS}$, $V_{GS} = 0\text{ V}$	-	70	-	pF
$C_{o(tr)}^{(2)}$	Equivalent output capacitance time related		-	244	-	pF
R_G	Intrinsic gate resistance	$f = 1\text{ MHz}$	-	2.4	-	Ω
Q_g	Total gate charge	$V_{DD} = 520\text{ V}$, $I_D = 15\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 16 : "Gate charge test circuit")	-	71	-	nC
Q_{gs}	Gate-source charge		-	18	-	nC
Q_{gd}	Gate-drain charge		-	30	-	nC

Notes:

⁽¹⁾ $C_{o(er)}$ 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}

⁽²⁾ $C_{o(tr)}$ 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}

Table 6: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(V)}$	Voltage delay time	$V_{DD} = 400\text{ V}$, $I_D = 20\text{ A}$ $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 17 : "Test circuit for inductive load switching and diode recovery times" and Figure 20 : "Switching time waveform")	-	66	-	ns
$t_{r(V)}$	Voltage rise time		-	9	-	ns
$t_{f(i)}$	Crossing fall time		-	9	-	ns
$t_{c(off)}$	Crossing time		-	13	-	ns

Table 7: Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}^{(1)}$	Source-drain current		-		22.5	A
$I_{SDM}^{(1),(2)}$	Source-drain current (pulsed)		-		90	A
$V_{SD}^{(3)}$	Forward on voltage	$V_{GS} = 0\text{ V}$, $I_{SD} = 22.5\text{ A}$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 22.5\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 100\text{ V}$ (see Figure 17 : "Test circuit for inductive load switching and diode recovery times")	-	354		ns
Q_{rr}	Reverse recovery charge		-	6		μC
I_{RRM}	Reverse recovery current		-	34		A
t_{rr}	Reverse recovery time	$I_{SD} = 22.5\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 100\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$ (see Figure 17 : "Test circuit for inductive load switching and diode recovery times")	-	428		ns
Q_{rr}	Reverse recovery charge		-	8		μC
I_{RRM}	Reverse recovery current		-	38		A

Notes:

⁽¹⁾The value is rated according to $R_{thj-case}$ and limited by package.

⁽²⁾Pulse width is limited by safe operating area

⁽³⁾Pulsed: pulse duration = 300 μs , duty cycle 1.5%

2.1 Electrical characteristics (curves)

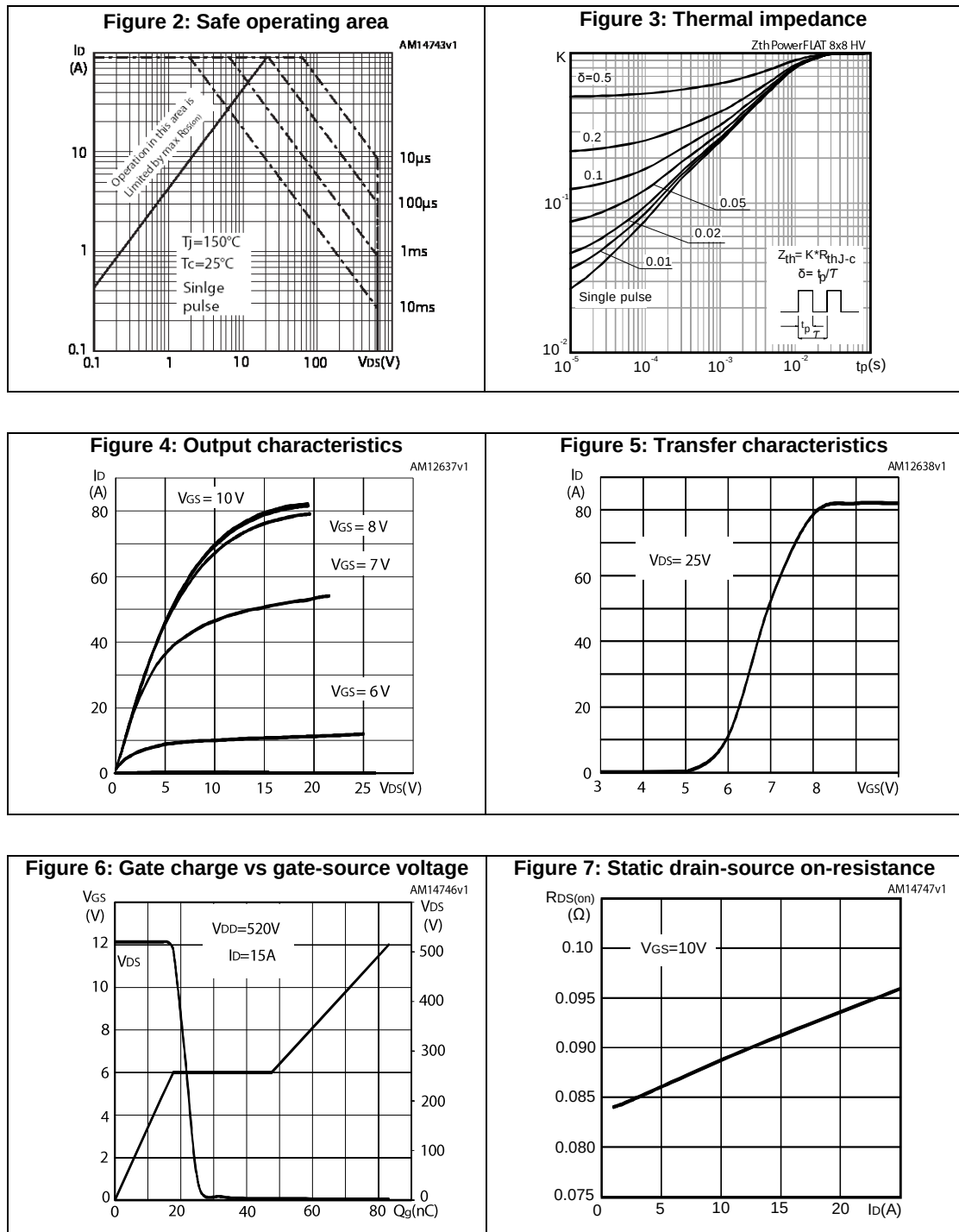


Figure 8: Capacitance variations

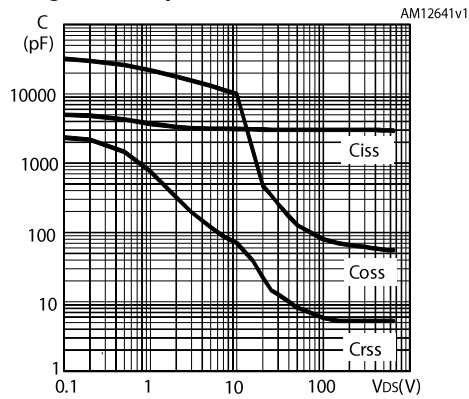


Figure 9: Normalized gate threshold voltage vs temperature

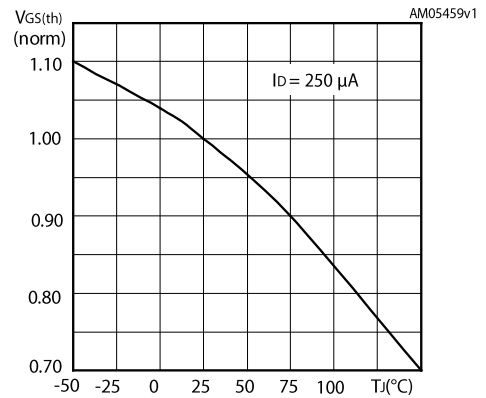


Figure 10: Normalized on-resistance vs temperature

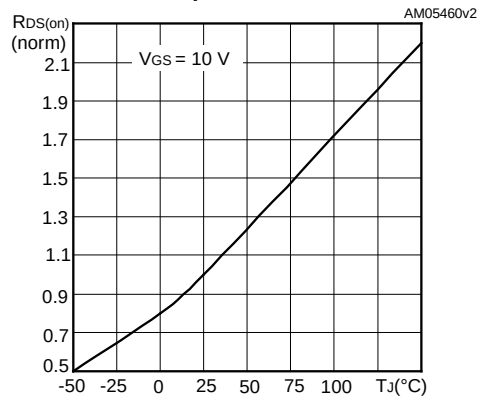


Figure 11: Normalized V(BR)DSS vs temperature

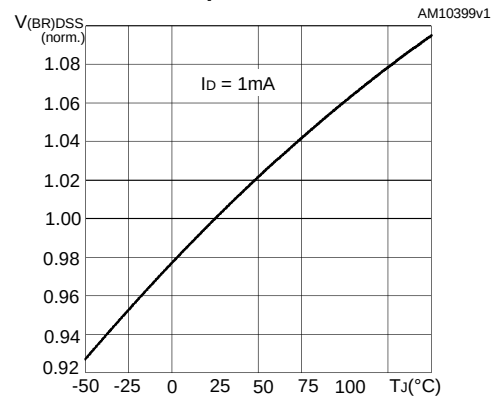


Figure 12: Output capacitance stored energy

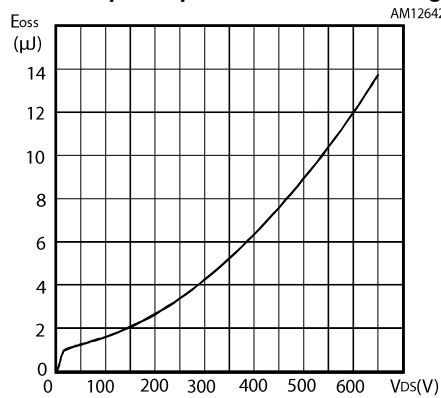


Figure 13: Source-drain diode forward characteristics

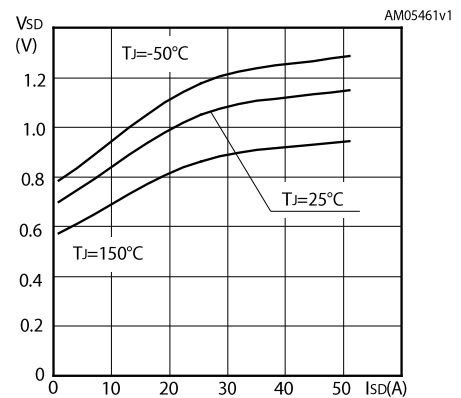
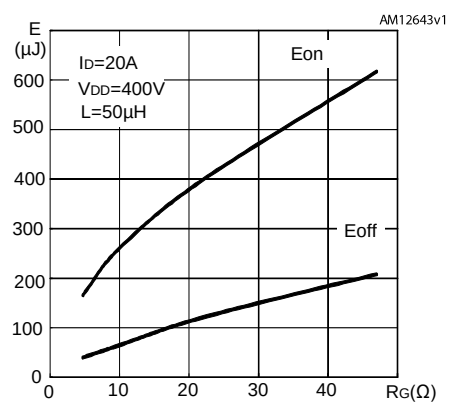


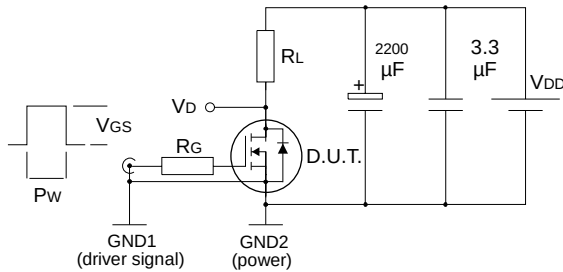
Figure 14: Switching losses vs gate resistance



The previous figure E_{on} includes reverse recovery of a SiC diode.

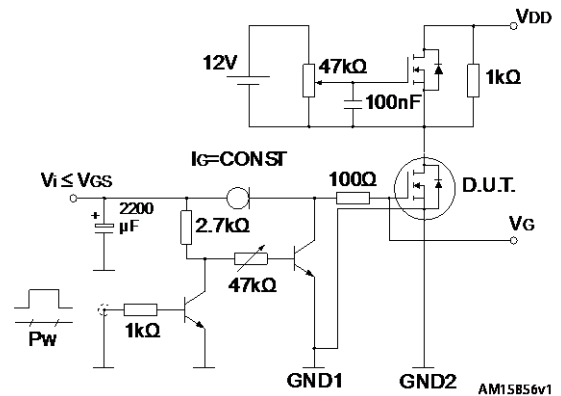
3 Test circuits

Figure 15: Switching times test circuit for resistive load



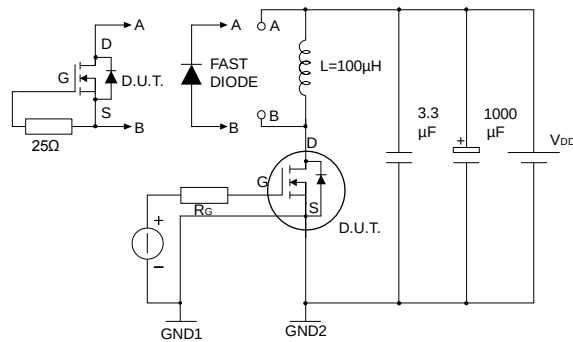
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Figure 16: Gate charge test circuit



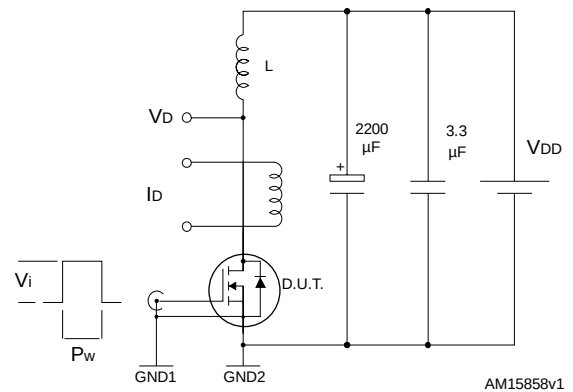
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Figure 17: Test circuit for inductive load switching and diode recovery times



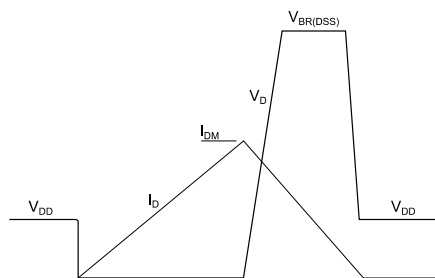
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Figure 18: Unclamped inductive load test circuit



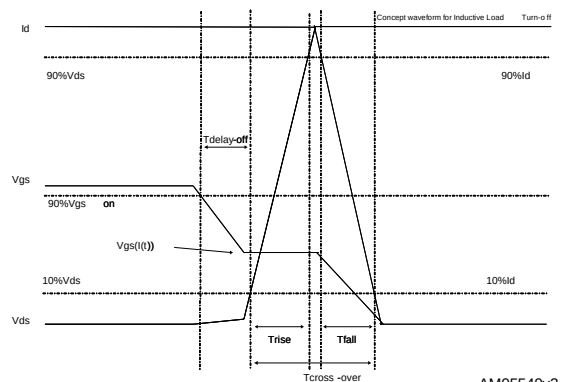
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Figure 19: Unclamped inductive waveform



AM01472v1

Figure 20: Switching time waveform



AM05540v2

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™ 8x8 HV package information

Figure 21: PowerFLAT™ 8x8 HV drawing

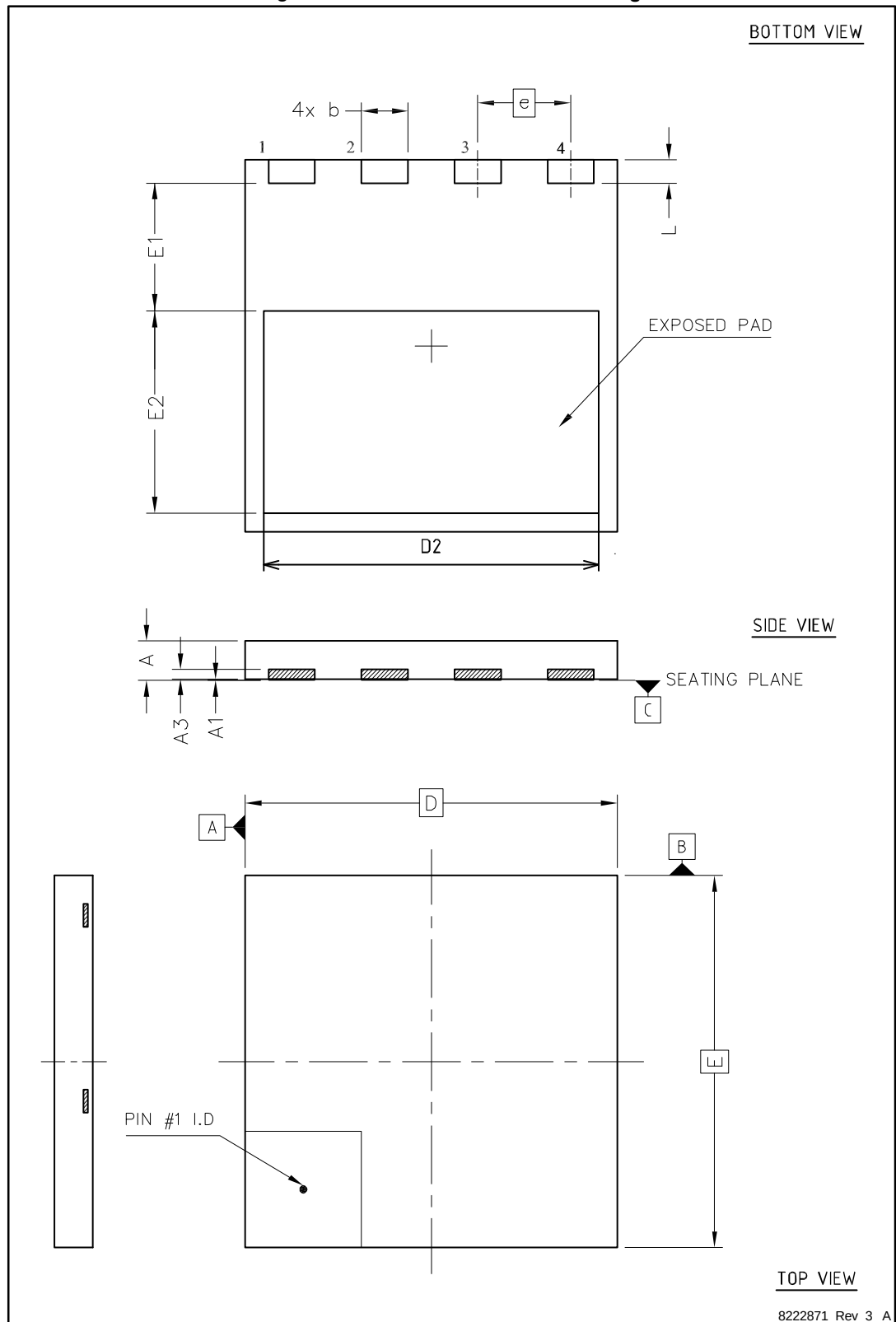
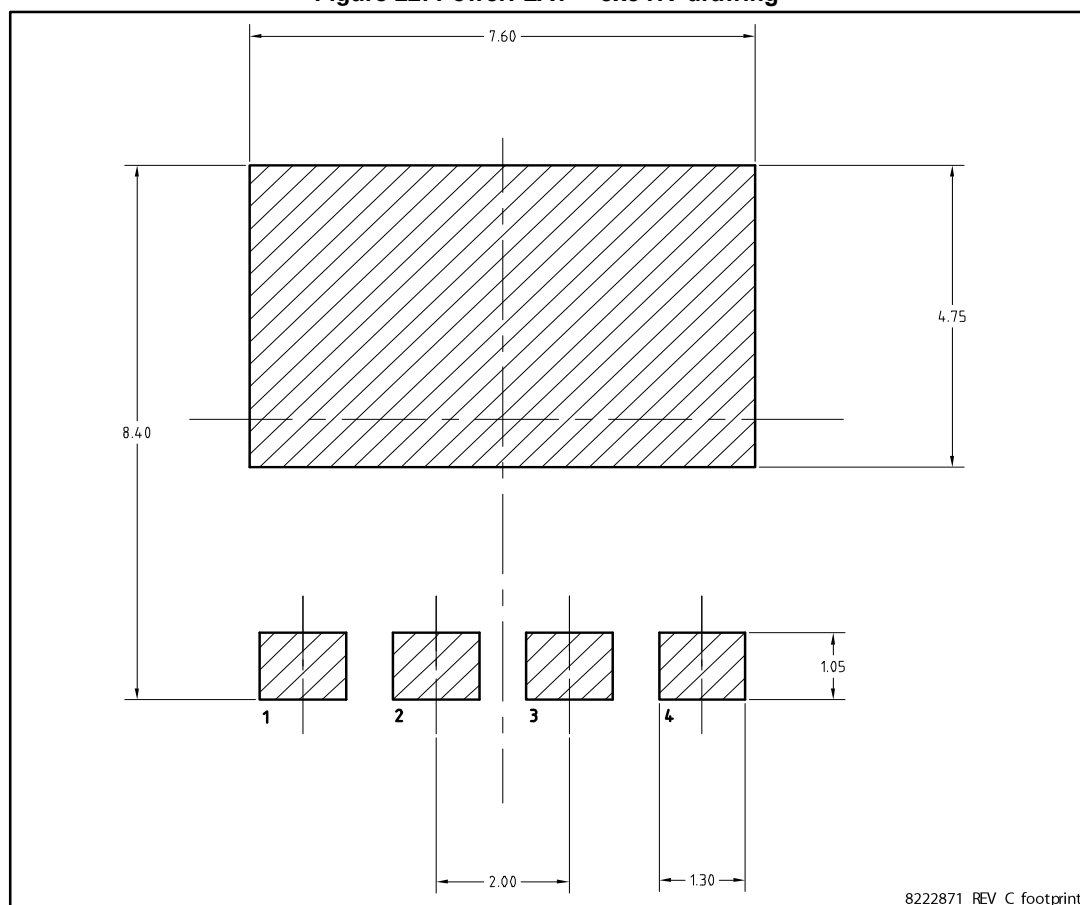


Table 8: PowerFLAT™ 8x8 HV mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	0.75	0.85	0.95
A1	0.00		0.05
A3	0.10	0.20	0.30
b	0.90	1.00	1.10
D	7.90	8.00	8.10
E	7.90	8.00	8.10
D2	7.10	7.20	7.30
E1	2.65	2.75	2.85
E2	4.25	4.35	4.45
e		2.00	
L	0.40	0.50	0.60

Figure 22: PowerFLAT™ 8x8 HV drawing



All the dimensions are in millimeters.

4.2 PowerFLAT™ 8x8 HV packing information

Figure 23: PowerFLAT™ 8x8 HV tape

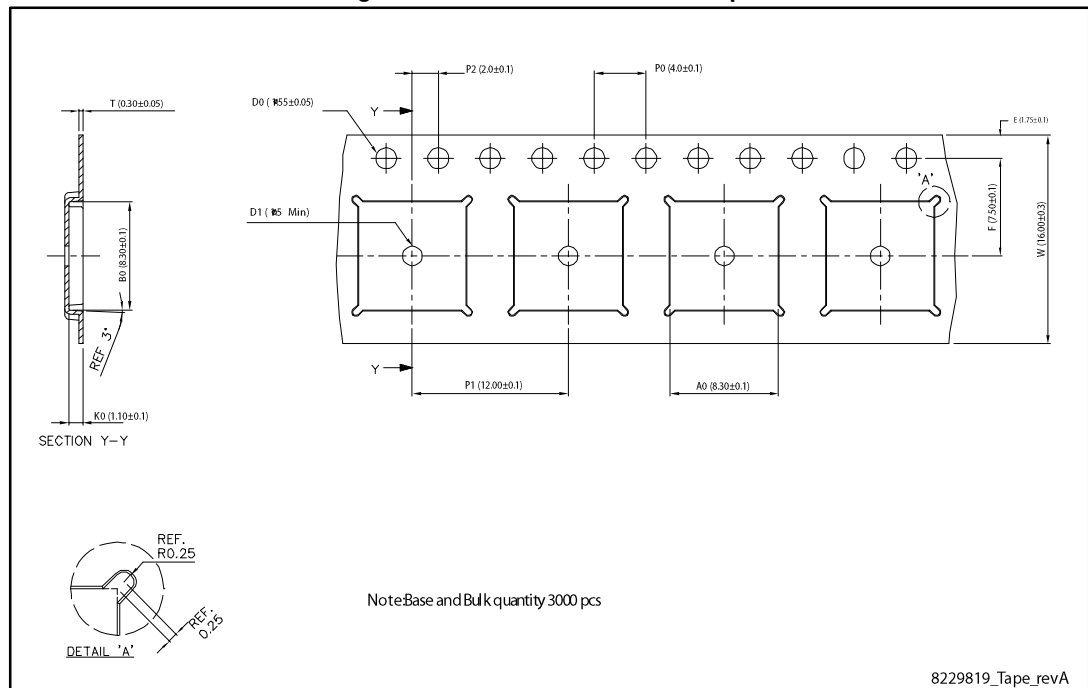


Figure 24: PowerFLAT™ 8x8 HV package orientation in carrier tape

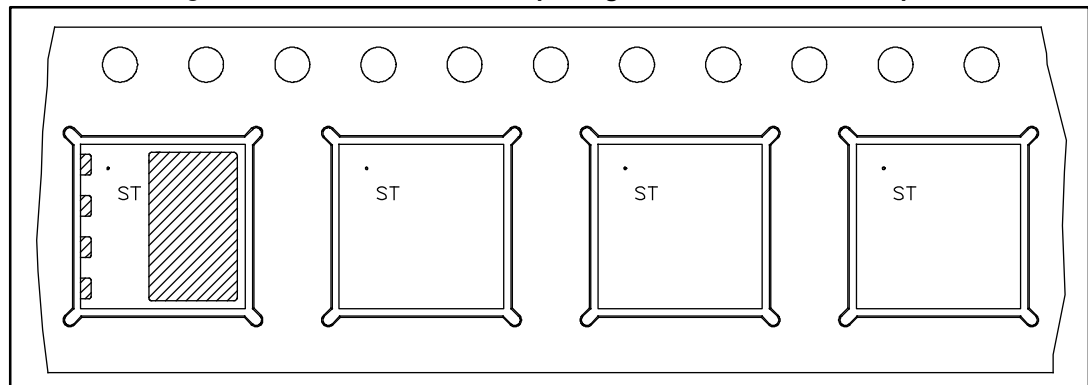
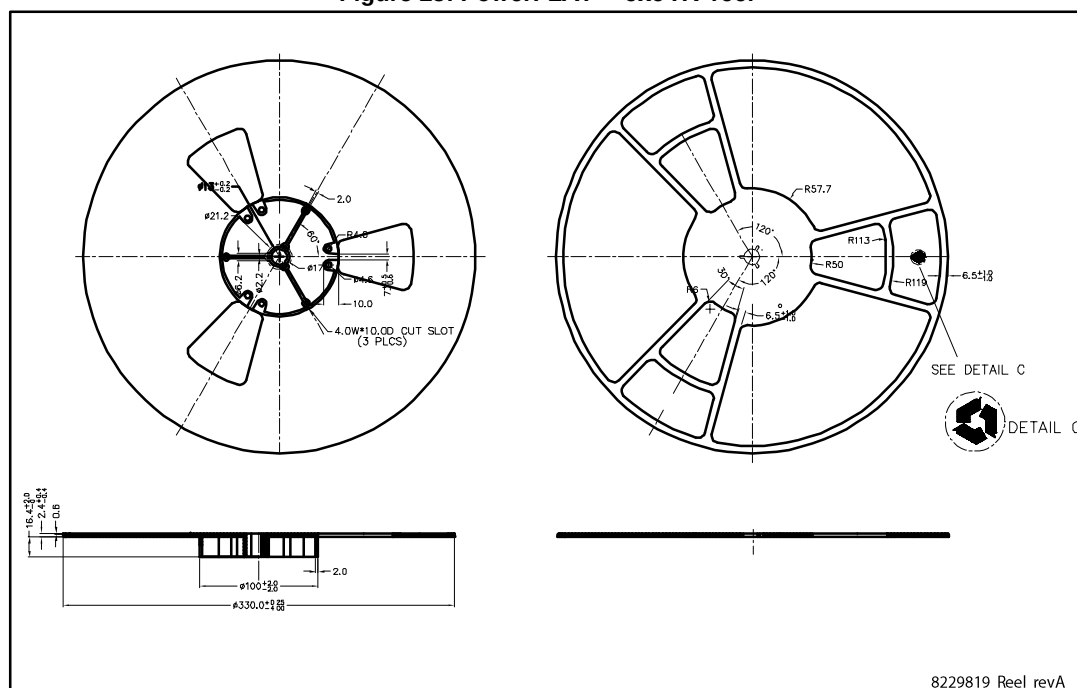


Figure 25: PowerFLAT™ 8x8 HV reel



5 Revision history

Table 9: Document revision history

Date	Revision	Changes
17-Jan-2013	1	First release.
27-Aug-2015	2	Updated title, features, internal schematic and description on cover page. Document status promoted from preliminary to production data. Updated package information. Minor text changes.

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