

N-channel 650 V, 0.124 Ω typ., 20 A MDmesh™ M2 Power MOSFET in a PowerFLAT™ 8x8 HV package

Datasheet - production data

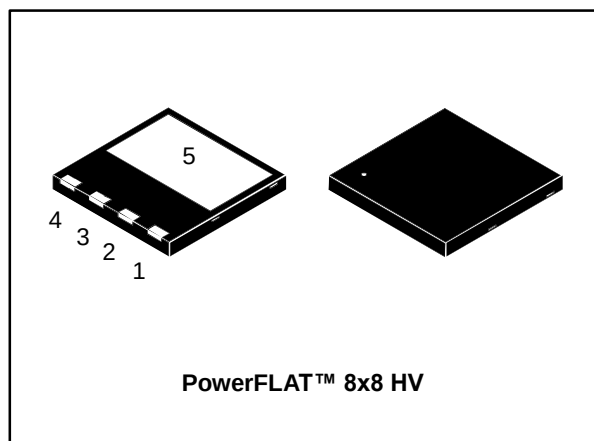
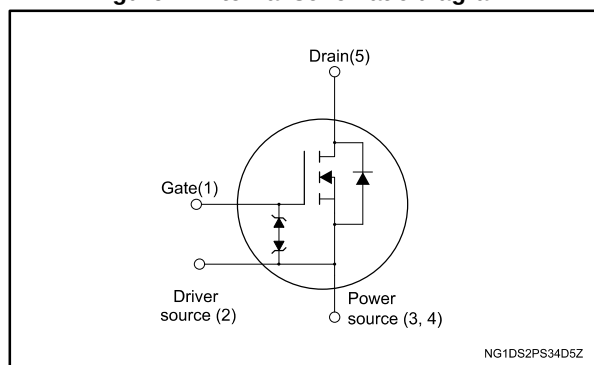


Figure 1: Internal schematic diagram



Features

Order code	V _{DS}	R _{DS(on)} max	I _D
STL33N65M2	650 V	0.154 Ω	20 A

- Extremely low gate charge
- Excellent output capacitance (C_{oss}) profile
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications

Description

This device is an N-channel Power MOSFET developed using MDmesh™ M2 technology. Thanks to its strip layout and an improved vertical structure, the device exhibits low on-resistance and optimized switching characteristics, rendering it suitable for the most demanding high efficiency converters.

Table 1: Device summary

Order code	Marking	Package	Packing
STL33N65M2	33N65M2	PowerFLAT™ 8x8 HV	Tape and reel

Contents

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1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	± 25	V
I_D	Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$	20	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$	12.6	A
$I_{DM}^{(1)}$	Drain current (pulsed)	80	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	150	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	15	V/ns
$dv/dt^{(3)}$	MOSFET dv/dt ruggedness	50	V/ns
T_{stg}	Storage temperature range	- 55 to 150	$^{\circ}\text{C}$
T_j	Operating junction temperature range		$^{\circ}\text{C}$

Notes:

⁽¹⁾Pulse width limited by safe operating area.

⁽²⁾ $I_{SD} \leq 20\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{DS(\text{peak})} < V_{(BR)DSS}$, $V_{DD} = 400\text{ V}$.

⁽³⁾ $V_{DS} \leq 520\text{ V}$.

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 inch^2 , 2oz Cu.

Table 4: Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or notrepetitive (pulse width limited by T_{jmax})	2.2	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25\text{ }^{\circ}\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	600	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 = 1 mA	650			V
I _{DSS}	Zero gate voltage drain current	V _{GS} = 0 V, V _{DS} = 650 V			1	μA
		V _{GS} = 0 V, V _{DS} = 650 V, T _C = 125 °C ⁽¹⁾			100	μA
I _{GSS}	Gate-body leakage current	V _{DS} = 0 V, V _{GS} = ± 25 V			±10	μA
V _{GS(th)}	Gate threshold voltage	V _{DS} = V _{GS} , I _D = 250 μA	2	3	4	V
R _{DS(on)}	Static drain-source on- resistance	V _{GS} = 10 V, I _D = 10 A		0.124	0.154	Ω

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} = 100 V, f = 1 MHz, V _{GS} = 0	-	1790	-	pF
C _{oss}	Output capacitance		-	75	-	pF
C _{rss}	Reverse transfer capacitance		-	2	-	pF
C _{oss eq.} ⁽¹⁾	Equivalent output capacitance	V _{DS} = 0 to 520 V, V _{GS} = 0	-	380	-	pF
Q _g	Total gate charge	V _{DD} = 520 V, I _D = 24 A	-	41.5	-	nC
Q _{gs}	Gate-source charge	V _{GS} = 10 V	-	6.8	-	nC
Q _{gd}	Gate-drain charge	(see Figure 15: "Gate charge test circuit")	-	18	-	nC

Notes:

⁽¹⁾C_{oss eq.} 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 7: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
t _{d(on)}	Turn-on delay time	V _{DD} = 325 V, I _D = 12 A R _G = 4.7 Ω, V _{GS} = 10 V (see Figure 14: "Switching times test circuit for resistive load" and Figure 19: "Switching time waveform")	-	13.5	-	ns
t _r	Voltage rise time		-	11.5	-	ns
t _{d(off)}	Turn-off delay time		-	72.5	-	ns
t _f	Current fall time		-	11.5	-	ns

Table 8: Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		20	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		80	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 24\text{ A}$, $V_{GS} = 0\text{ V}$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 24\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ (see Figure 16: "Test circuit for inductive load switching and diode recovery times")	-	426		ns
Q_{rr}	Reverse recovery charge		-	7		μC
I_{RRM}	Reverse recovery current		-	33.5		A
t_{rr}	Reverse recovery time	$I_{SD} = 24\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 16: "Test circuit for inductive load switching and diode recovery times")	-	544		ns
Q_{rr}	Reverse recovery charge		-	10		μC
I_{RRM}	Reverse recovery current		-	36.5		A

Notes:

⁽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

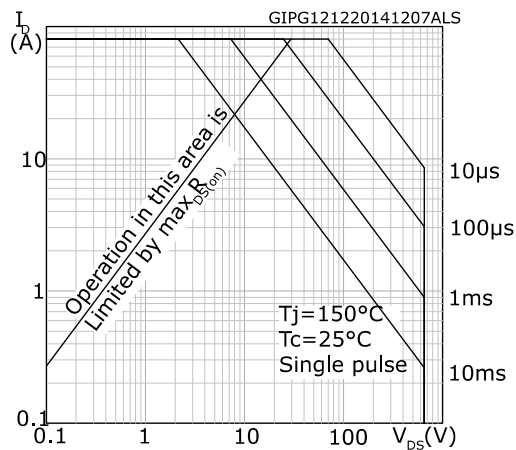


Figure 3: Thermal impedance

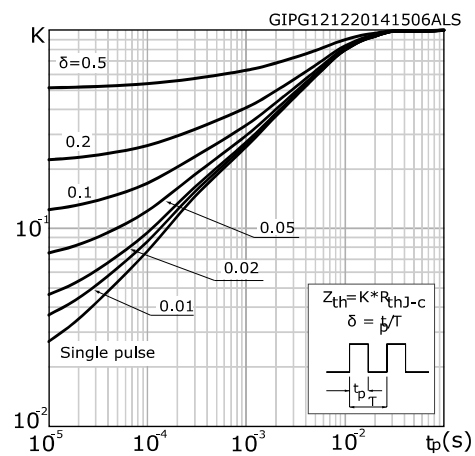


Figure 4: Output characteristics

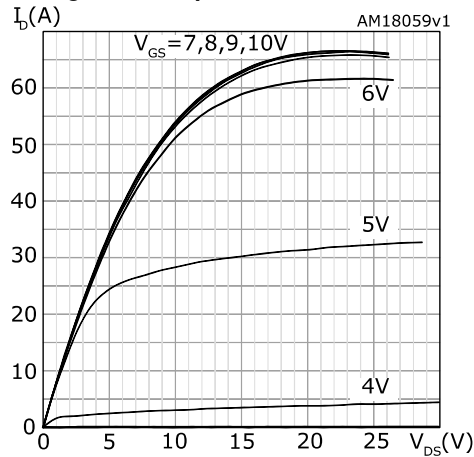


Figure 5: Transfer characteristics

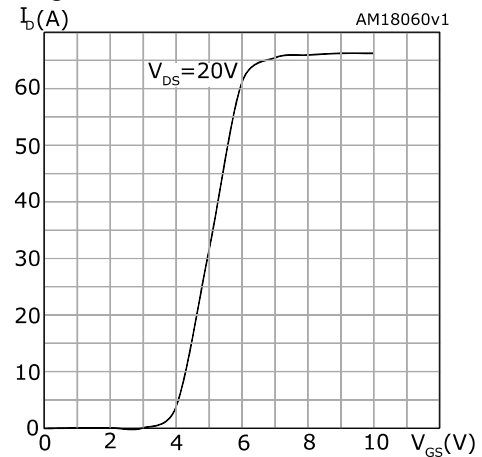


Figure 6: Gate charge vs gate-source voltage

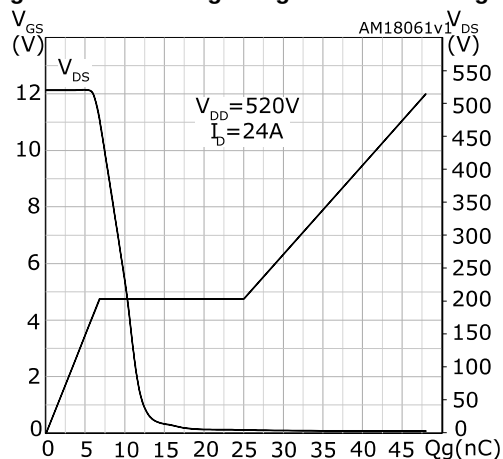


Figure 7: Static drain-source on-resistance

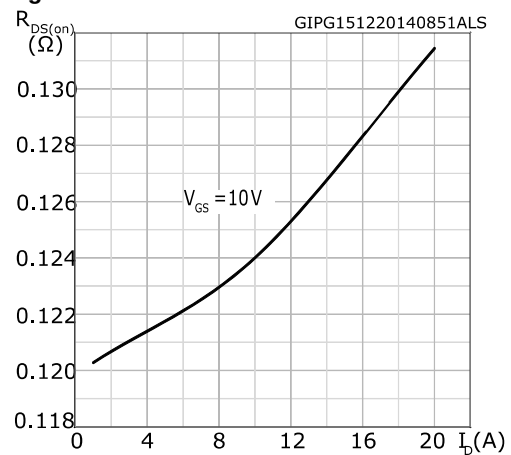


Figure 8: Capacitance variations

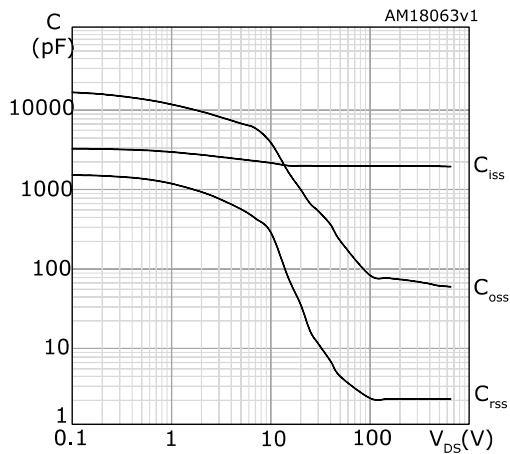


Figure 9: Output capacitance stored energy

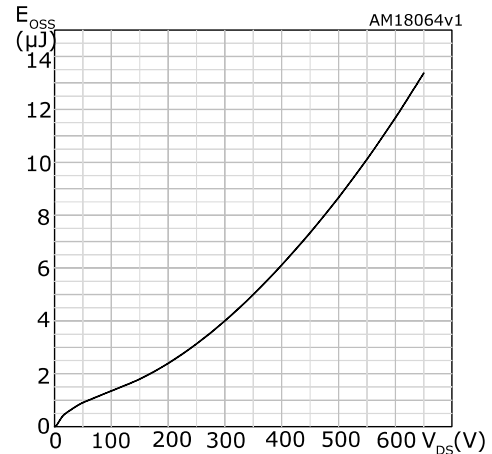


Figure 10: Normalized gate threshold voltage vs temperature

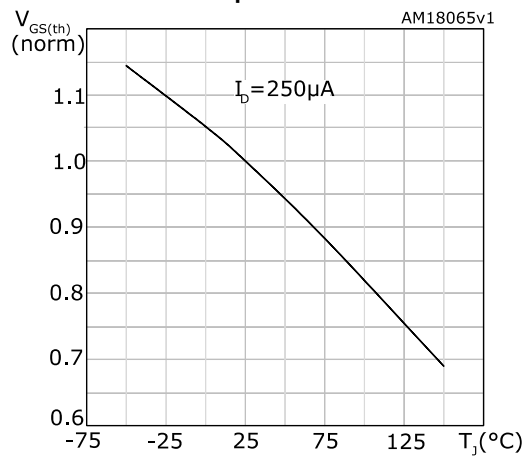


Figure 11: Normalized on-resistance vs temperature

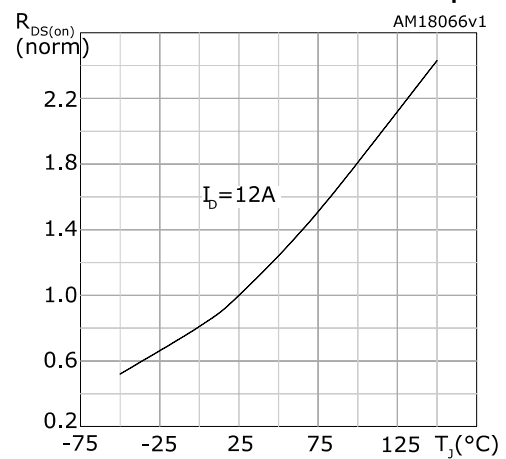
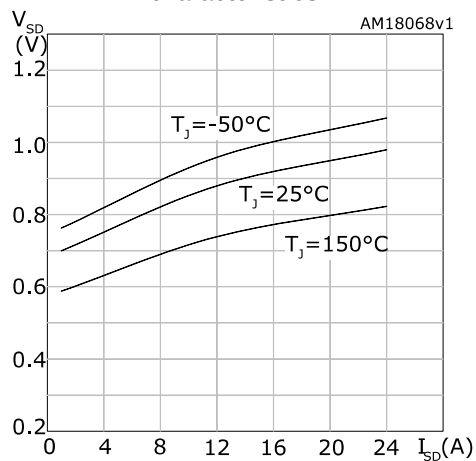
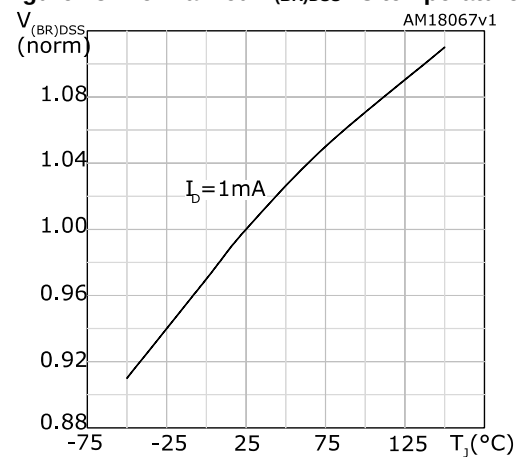
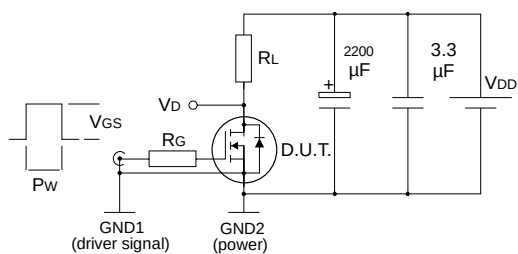


Figure 12: Source-drain diode forward characteristics

Figure 13: Normalized $V_{(BR)DSS}$ vs temperature

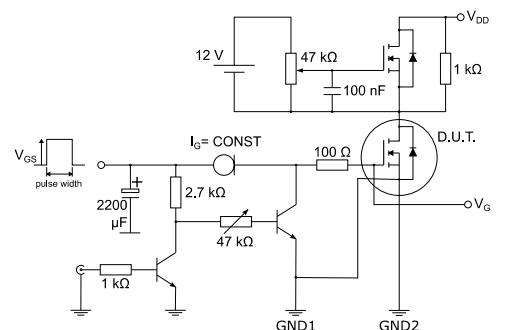
3 Test circuits

Figure 14: Switching times test circuit for resistive load



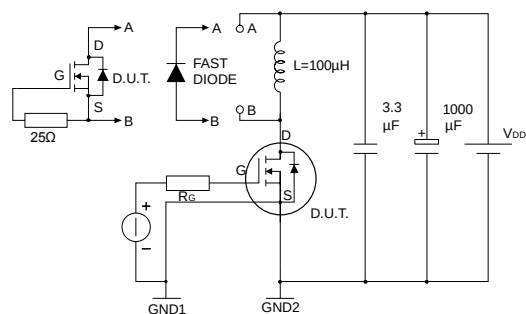
AM15855v1

Figure 15: Gate charge test circuit



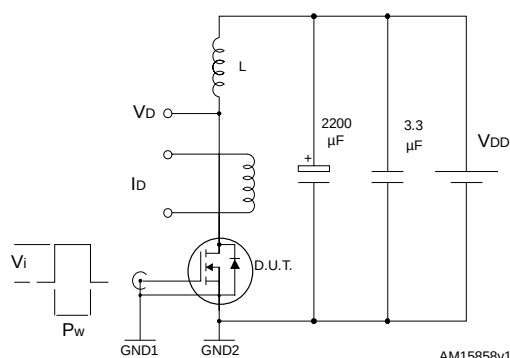
AM01469v2

Figure 16: Test circuit for inductive load switching and diode recovery times



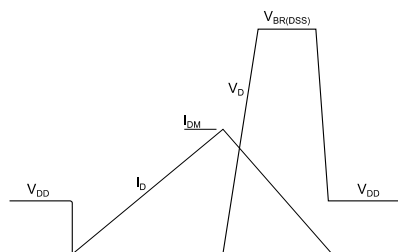
AM15857v1

Figure 17: Unclamped inductive load test circuit



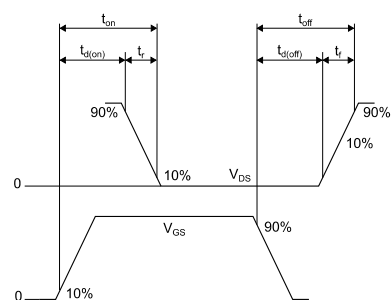
AM15858v1

Figure 18: Unclamped inductive waveform



AM01472v1

Figure 19: Switching time waveform



AM01473v1

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 20: PowerFLAT™ 8x8 HV package outline

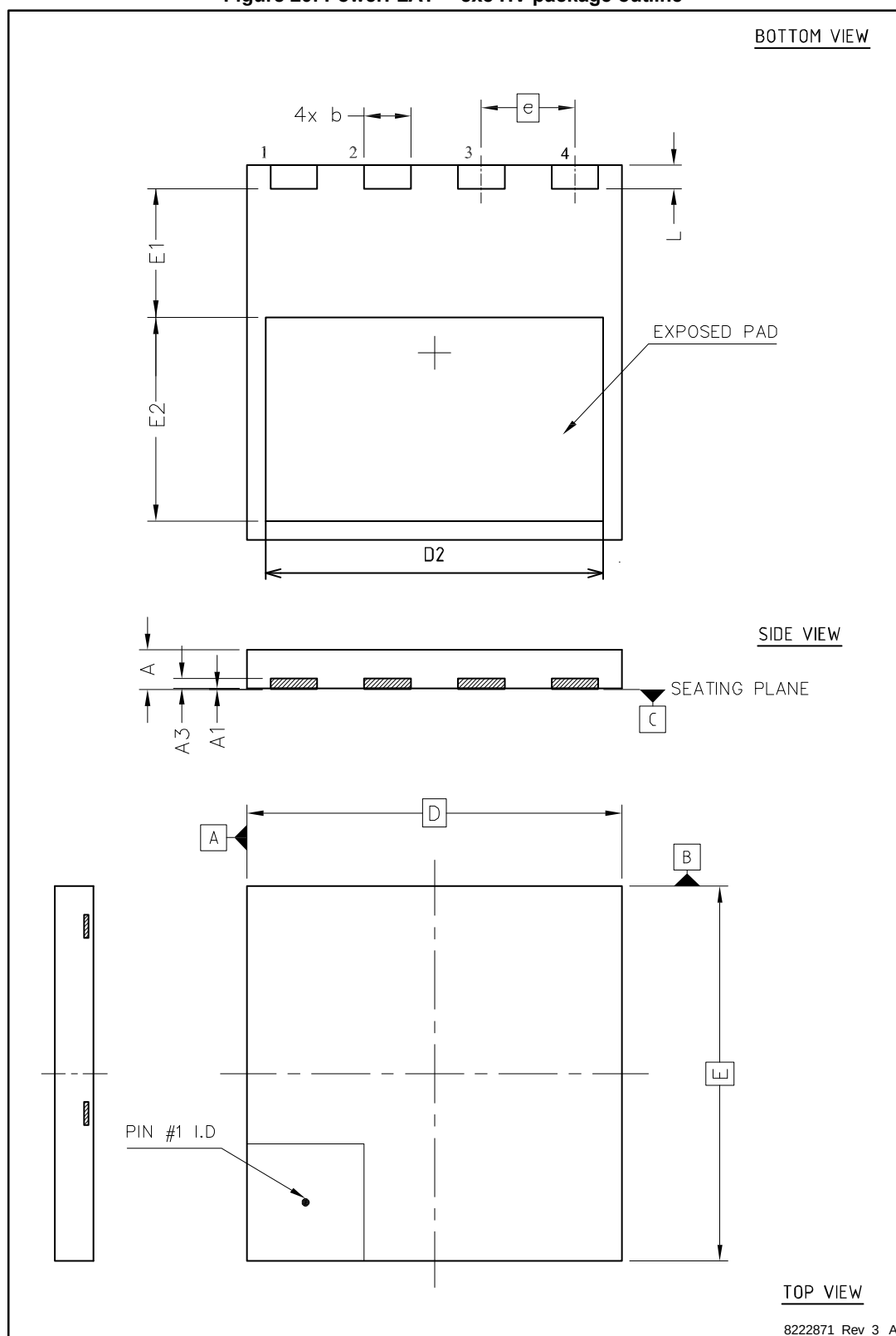
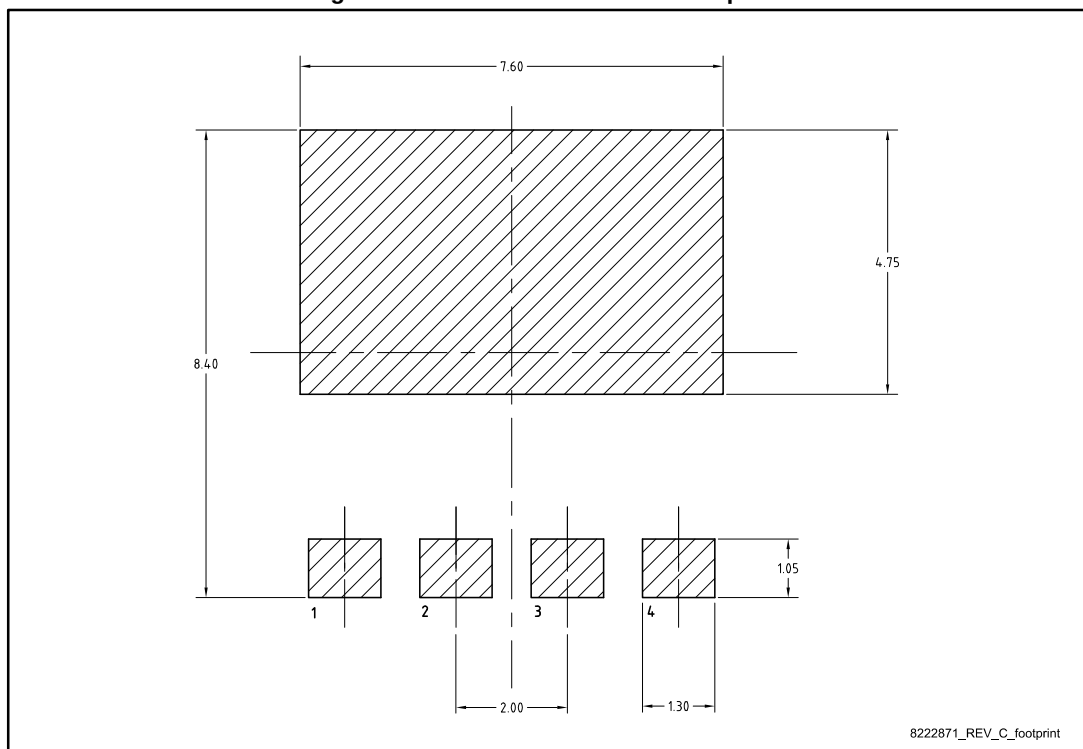


Table 9: PowerFLAT™ 8x8 HV mechanical data

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

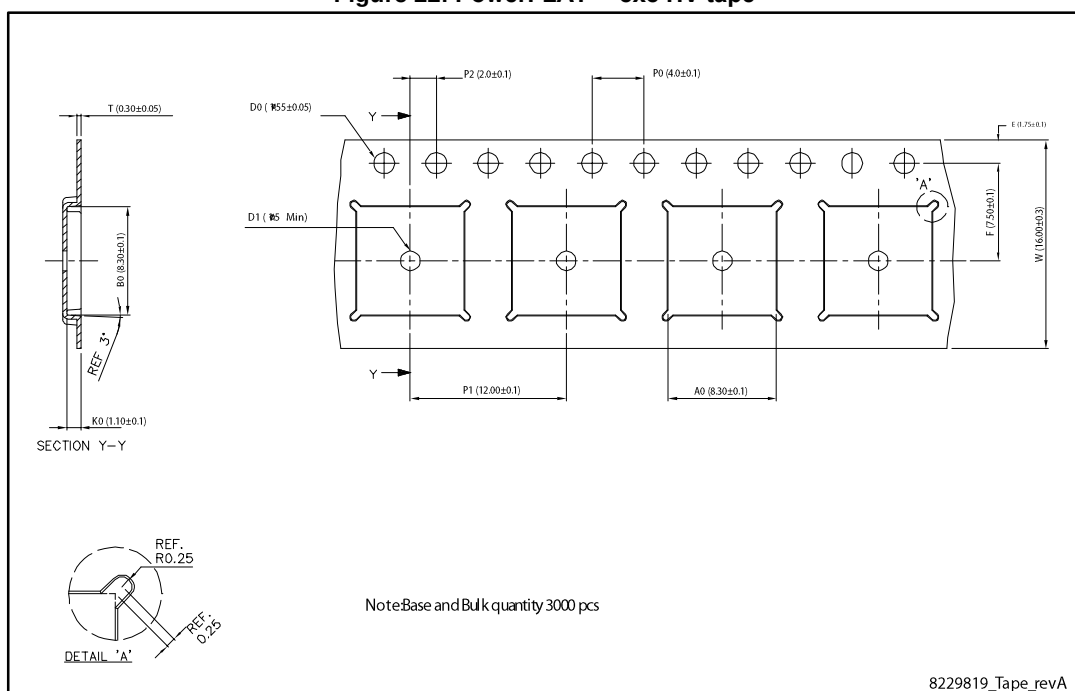
Figure 21: PowerFLAT™ 8x8 HV footprint



All dimensions are in millimeters.

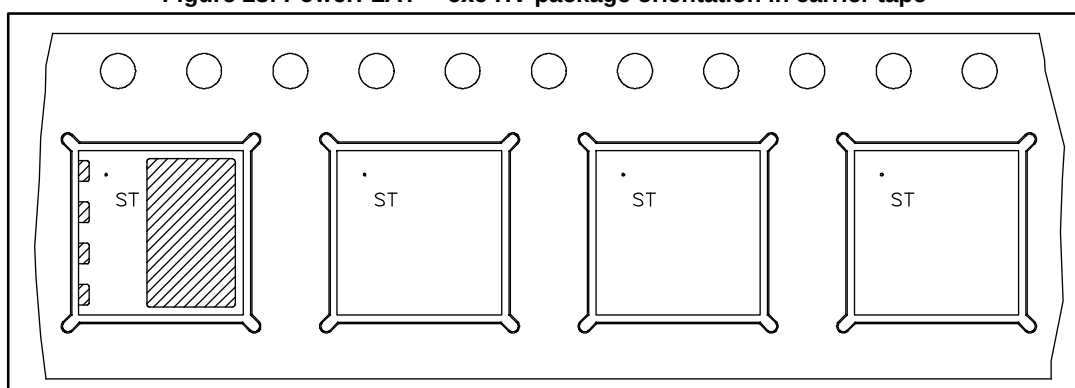
4.2 PowerFLAT™ 8x8 HV packing information

Figure 22: PowerFLAT™ 8x8 HV tape



All dimensions are in millimeters.

Figure 23: PowerFLAT™ 8x8 HV package orientation in carrier tape





All dimensions are in millimeters.

5 Revision history

Table 10: Document revision history

Date	Revision	Changes
26-Jun-2013	1	First release.
23-Jul-2014	2	Text edits throughout document. On cover page, updated title, features and description. Updated Table 2: Absolute maximum ratings. Updated Table 3: Thermal data. Added Table 4: Avalanche characteristics. Updated Table 5: On /off states. Updated Table 6: Dynamic. Updated Table 7: Switching times. Updated Table 8: Source drain diode.
13-Apr-2016	3	Updated cover image and Figure 1: "Internal schematic diagram" . Updated Section 3: "Test circuits" . Added footnote in Table 5: "On /off states" . Removed footnote in Table 8: "Source drain diode" . Updated Section 4: "Package information" . Minor text changes.

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