

N-channel 650 V, 0.075 Ω typ., 22.5 A MDmesh™ M5 Power MOSFET in a PowerFLAT™ 8x8 HV package

Datasheet - production data

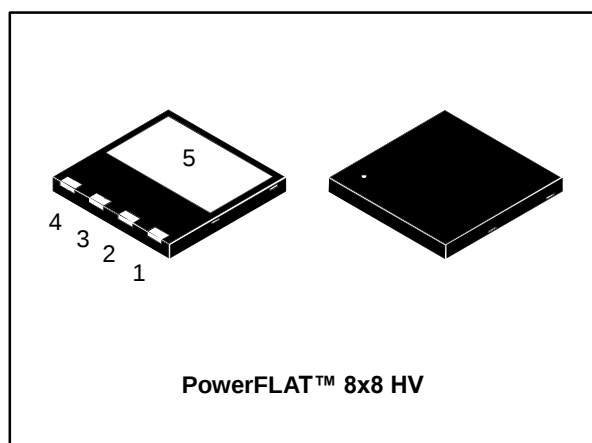
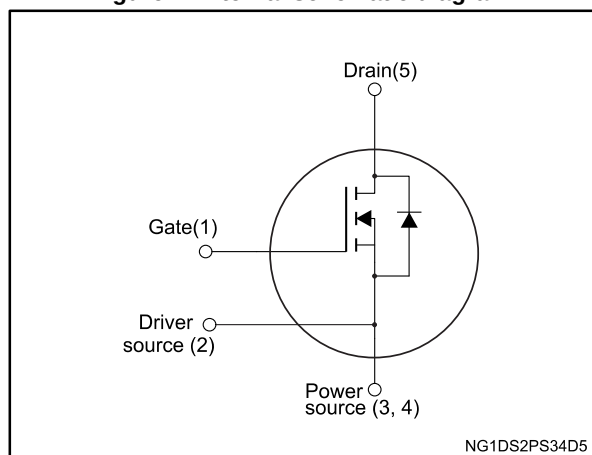


Figure 1: Internal schematic diagram



Features

Order code	V_{DS} @ $T_{Jmax.}$	$R_{DS(on)}$ max.	I_D	P_{TOT}
STL45N65M5	710 V	0.086 Ω	22.5 A	160 W

- 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	Packing
STL45N65M5	45N65M5	PowerFLAT™ 8x8 HV	Tape and reel

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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 $T_{case} = 25\text{ °C}$	22.5	A
	Drain current (continuous) at $T_{case} = 100\text{ °C}$	18	
$I_{DM}^{(1)(2)}$	Drain current (pulsed)	90	A
$P_{TOT}^{(1)}$	Total dissipation at $T_{case} = 25\text{ °C}$	160	W
$I_D^{(3)}$	Drain current (continuous) at $T_{amb} = 25\text{ °C}$	3.8	A
	Drain current (continuous) at $T_{amb} = 100\text{ °C}$	2.4	
$P_{TOT}^{(3)}$	Total dissipation at $T_{amb} = 25\text{ °C}$	2.8	W
$dv/dt^{(4)}$	Peak diode recovery voltage slope	15	V/ns
T_{stg}	Storage temperature	-55 to 150	°C
T_j	Operating junction temperature		

Notes:

- (1) The value is rated according to $R_{thj-case}$ and limited by package.
 (2) Pulse width limited by safe operating area.
 (3) When mounted on a 1-inch² FR-4, 2oz Cu board.
 (4) $I_{SD} \leq 22.5\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{DD} = 400\text{ V}$, $V_{DS(peak)} < V_{(BR)DSS}$.

Table 3: Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	0.78	°C/W
$R_{thj-amb}^{(1)}$	Thermal resistance junction-ambient	45	

Notes:

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

Table 4: Avalanche characteristics

Symbol	Parameter	Value	Unit
$I_{AR}^{(1)}$	Avalanche current, repetitive or not repetitive	8	A
$E_{AS}^{(2)}$	Single pulse avalanche energy	810	mJ

Notes:

- (1) Pulse width limited by T_{jmax} .
 (2) starting $T_j = 25\text{ °C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$.

2 Electrical characteristics

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

Table 5: Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(\text{BR})\text{DSS}}$	Drain-source breakdown voltage	$V_{\text{GS}} = 0\text{ V}$, $I_{\text{D}} = 1\text{ mA}$	650			V
I_{DSS}	Zero gate voltage drain current	$V_{\text{GS}} = 0\text{ V}$, $V_{\text{DS}} = 650\text{ V}$			1	μA
		$V_{\text{GS}} = 0\text{ V}$, $V_{\text{DS}} = 650\text{ V}$, $T_{\text{case}} = 125\text{ }^{\circ}\text{C}$			100	μA
I_{GSS}	Gate-body leakage current	$V_{\text{DS}} = 0\text{ V}$, $V_{\text{GS}} = \pm 25\text{ V}$			± 100	nA
$V_{\text{GS(th)}}$	Gate threshold voltage	$V_{\text{DS}} = V_{\text{GS}}$, $I_{\text{D}} = 250\text{ }\mu\text{A}$	3	4	5	V
$R_{\text{DS(on)}}$	Static drain-source on-resistance	$V_{\text{GS}} = 10\text{ V}$, $I_{\text{D}} = 14.5\text{ A}$		0.075	0.086	Ω

Table 6: Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ISS}	Input capacitance	$V_{\text{DS}} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{\text{GS}} = 0\text{ V}$	-	3470	-	pF
C_{OSS}	Output capacitance		-	82	-	
C_{RSS}	Reverse transfer capacitance		-	7	-	
$C_{\text{o(er)}}^{(1)}$	Equivalent output capacitance energy related	$V_{\text{GS}} = 0\text{ V}$, $V_{\text{DS}} = 0\text{ to }520\text{ V}$	-	79	-	pF
$C_{\text{o(tr)}}^{(2)}$	Equivalent output capacitance time related		-	280	-	
R_{G}	Intrinsic gate resistance	$f = 1\text{ MHz}$, $I_{\text{D}} = 0\text{ A}$	-	2	-	Ω
Q_{g}	Total gate charge	$V_{\text{DD}} = 520\text{ V}$, $I_{\text{D}} = 17.5\text{ A}$, $V_{\text{GS}} = 10\text{ V}$ (see Figure 16: "Gate charge test circuit")	-	82	-	nC
Q_{gs}	Gate-source charge		-	18.5	-	
Q_{gd}	Gate-drain charge		-	35	-	

Notes:

(1) 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}

(2) 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}

Table 7: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{\text{d(v)}}$	Voltage delay time	$V_{\text{DD}} = 400\text{ V}$, $I_{\text{D}} = 22.5\text{ A}$ $R_{\text{G}} = 4.7\text{ }\Omega$, $V_{\text{GS}} = 10\text{ V}$ (see Figure 20: "Switching time waveform")	-	79.5	-	ns
$t_{\text{r(v)}}$	Voltage rise time		-	11	-	
$t_{\text{f(i)}}$	Current fall time		-	9.3	-	
$t_{\text{c(off)}}$	Crossing time		-	16	-	

Table 8: 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")	-	346		ns
Q_{rr}	Reverse recovery charge		-	6		μC
I_{RRM}	Reverse recovery current		-	35		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")	-	432		ns
Q_{rr}	Reverse recovery charge		-	8.4		μC
I_{RRM}	Reverse recovery current		-	39		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) Pulse test: pulse duration = 300 μs , duty cycle 1.5%.

2.1 Electrical characteristics (curves)

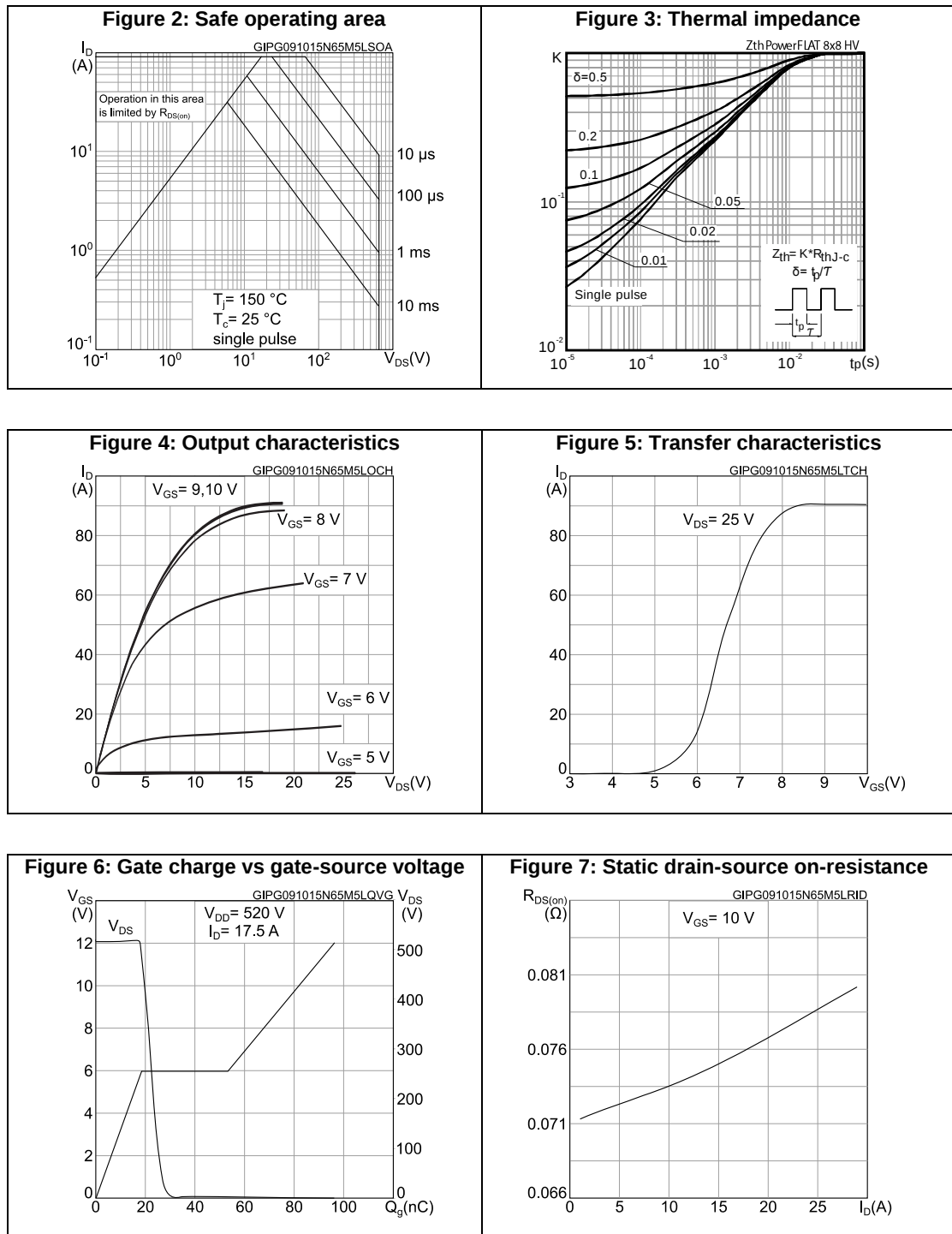


Figure 8: Capacitance variations

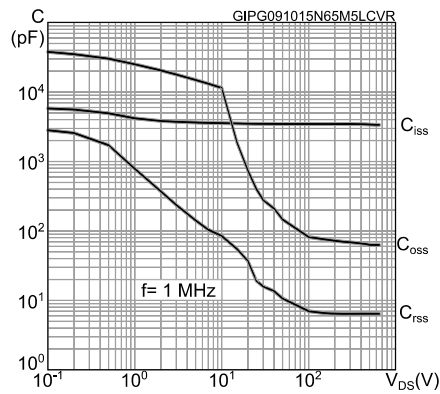


Figure 9: Output capacitance stored energy

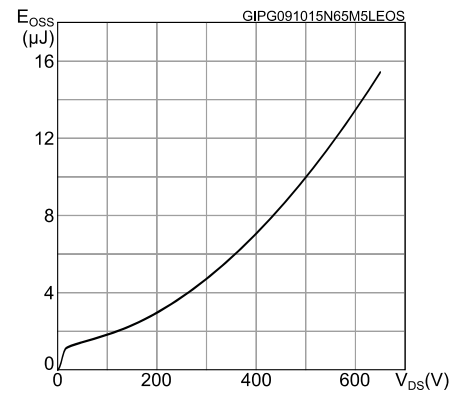


Figure 10: Normalized gate threshold voltage vs temperature

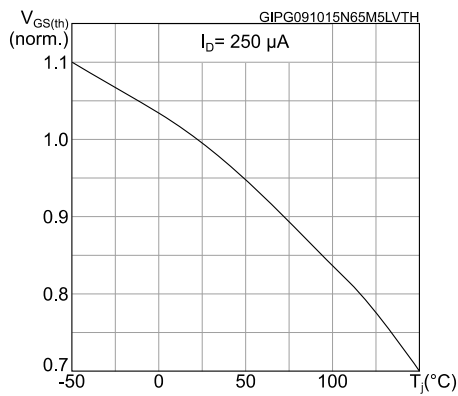


Figure 11: Normalized on-resistance vs. temperature

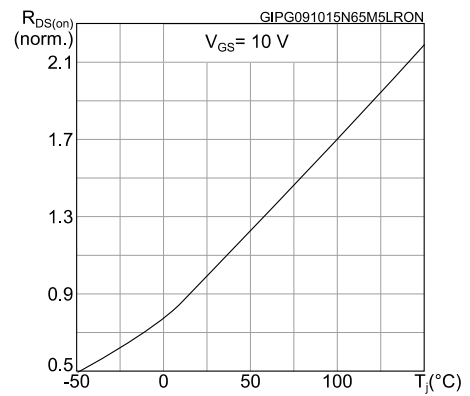


Figure 12: Drain-source diode forward characteristics

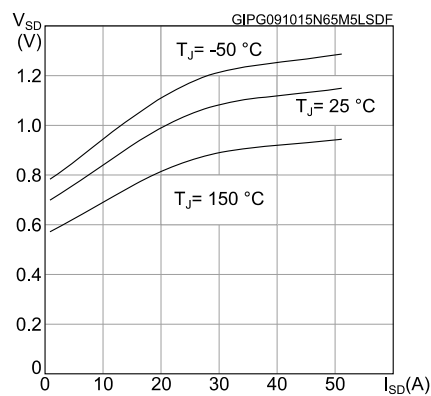


Figure 13: Normalized V(BR)DSS vs temperature

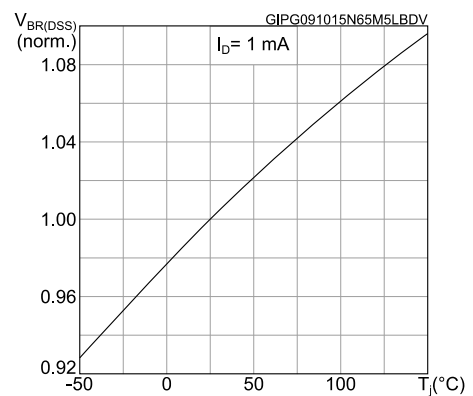
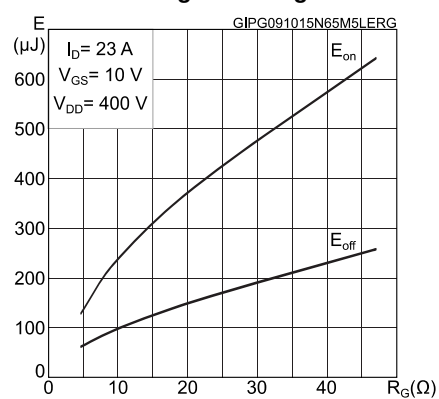
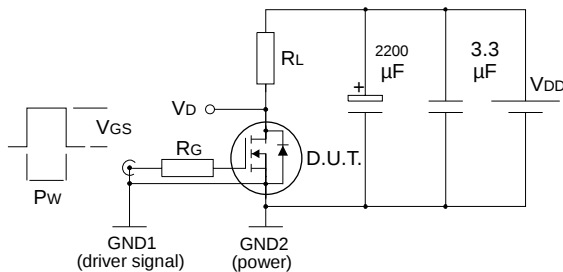


Figure 14: Switching loss vs. gate resistance⁽¹⁾**Notes:**

⁽¹⁾ E_{on} including reverse recovery of a SiC diode

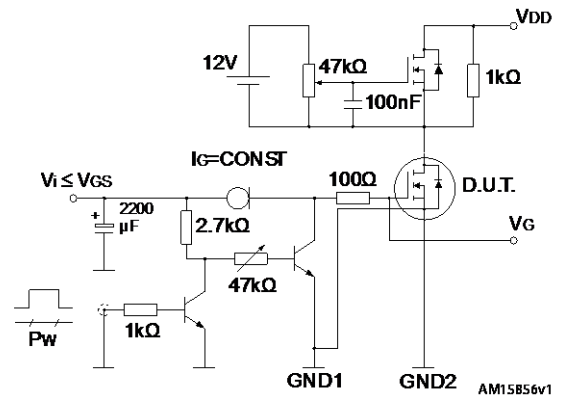
3 Test circuits

Figure 15: Switching times test circuit for resistive load



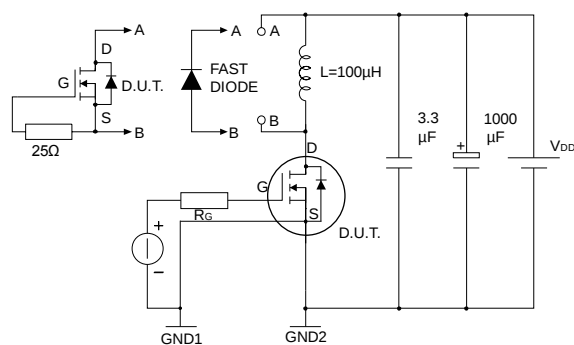
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Figure 16: Gate charge test circuit



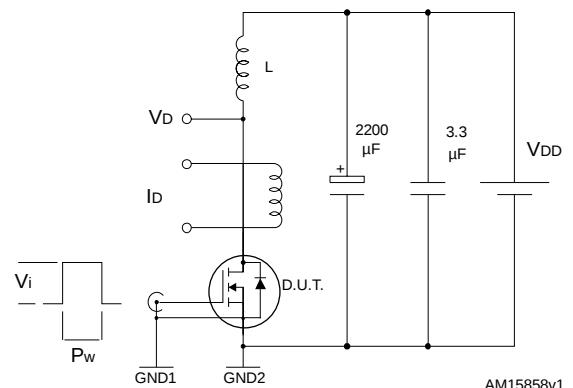
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Figure 17: Test circuit for inductive load switching and diode recovery times



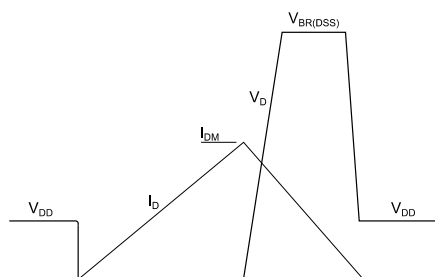
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Figure 18: Unclamped inductive load test circuit



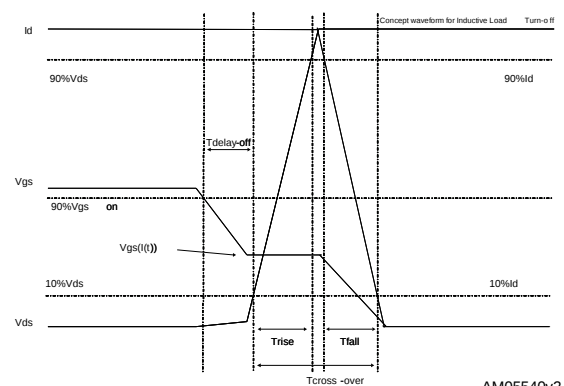
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Figure 19: Unclamped inductive waveform



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 package outline

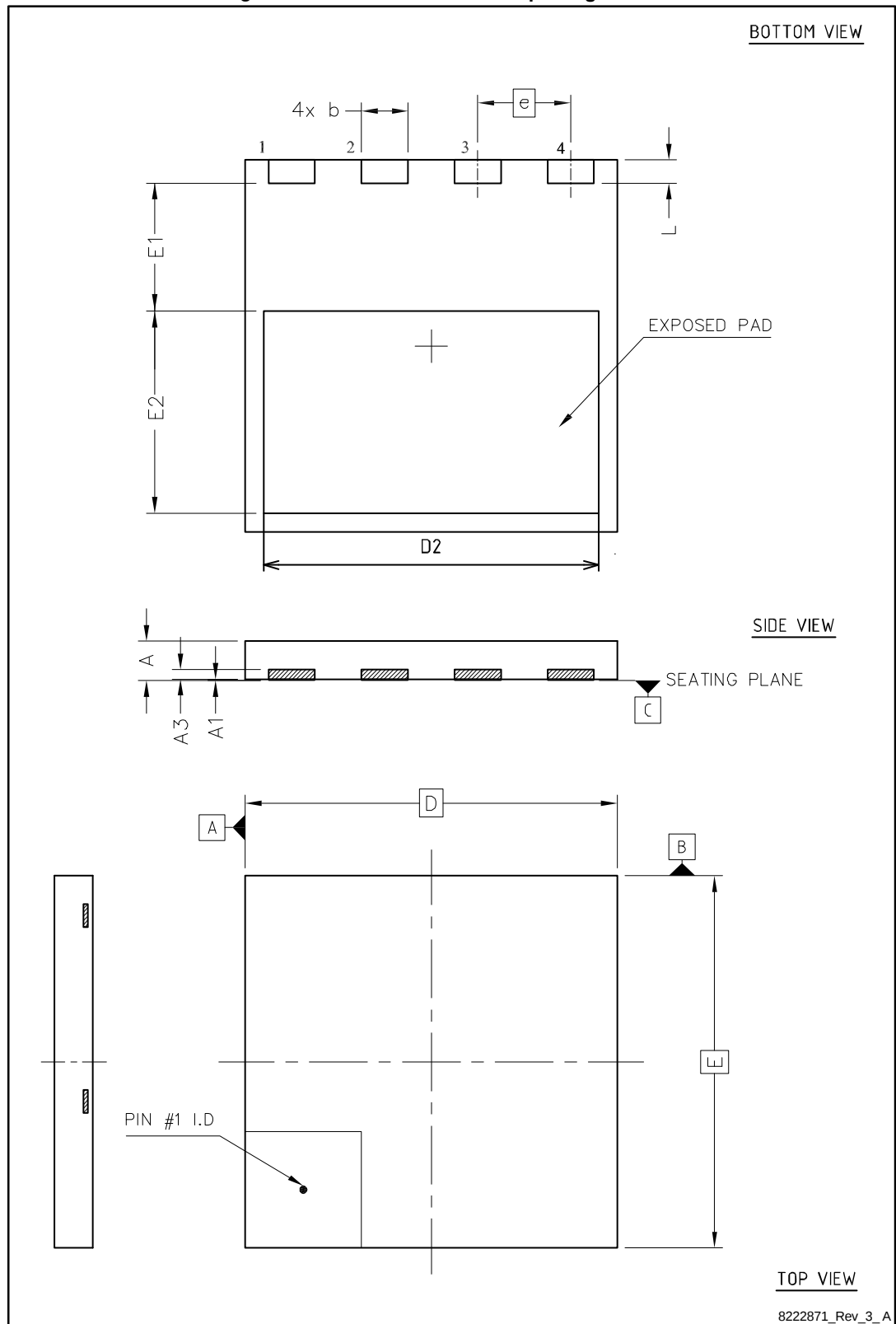
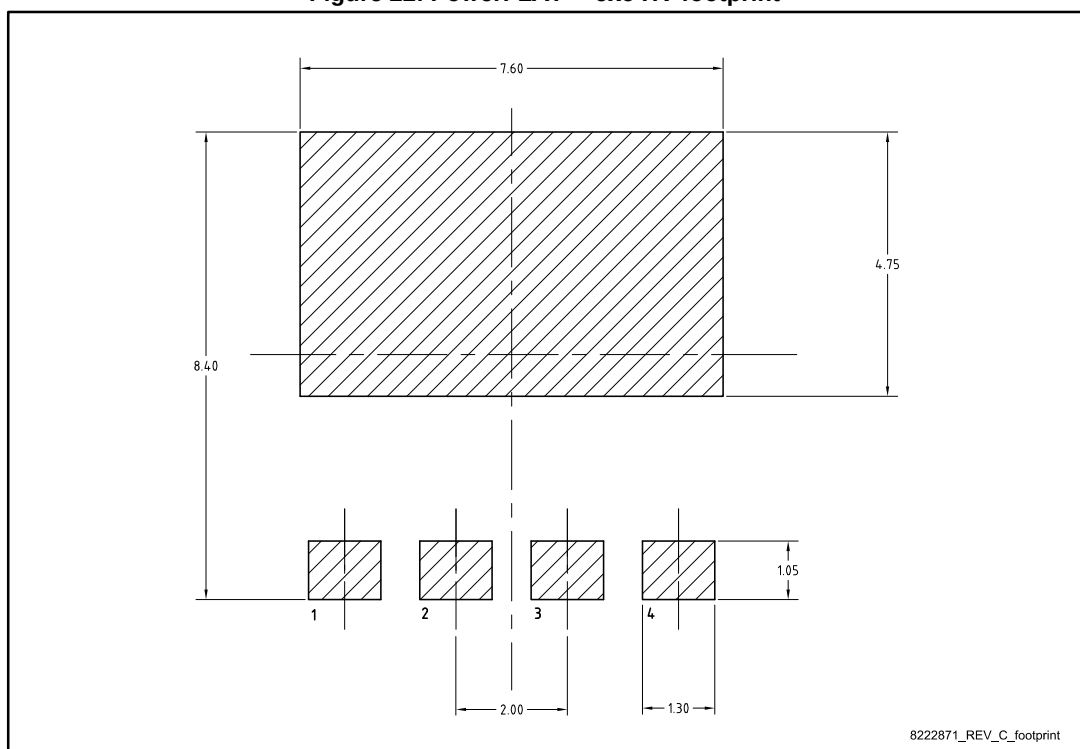


Table 9: PowerFLAT™ 8x8 HV mechanical data

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 22: PowerFLAT™ 8x8 HV footprint



All dimensions are in millimeters.

4.2 PowerFLAT 8x8 HV packing information

Figure 23: PowerFLAT™ 8x8 HV tape

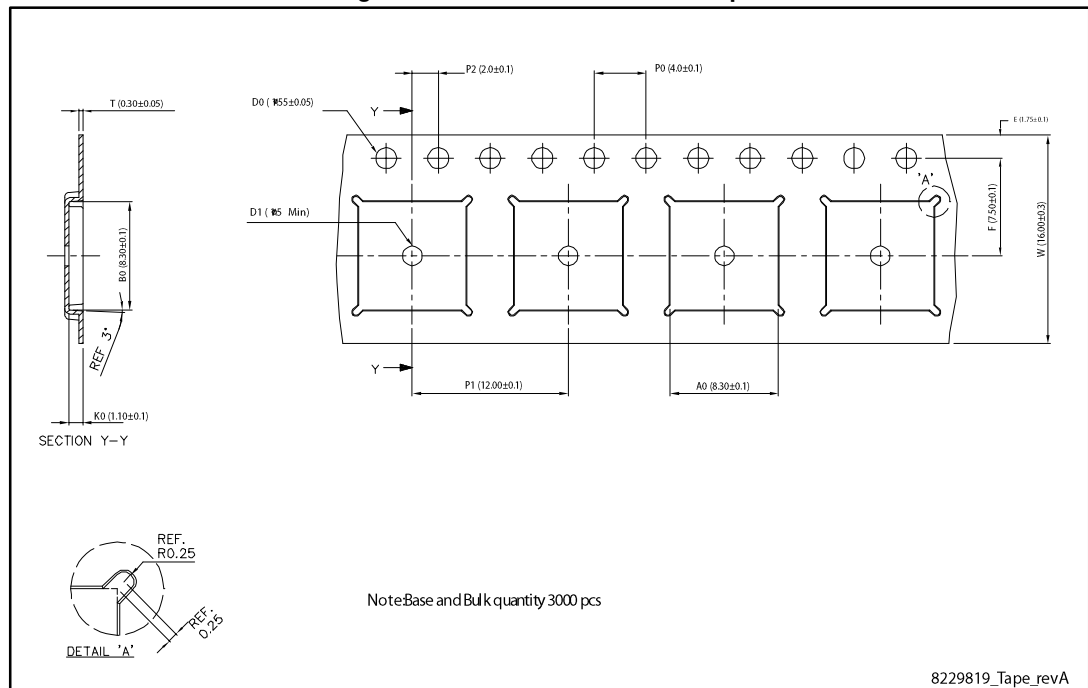


Figure 24: PowerFLAT™ 8x8 HV package orientation in carrier tape

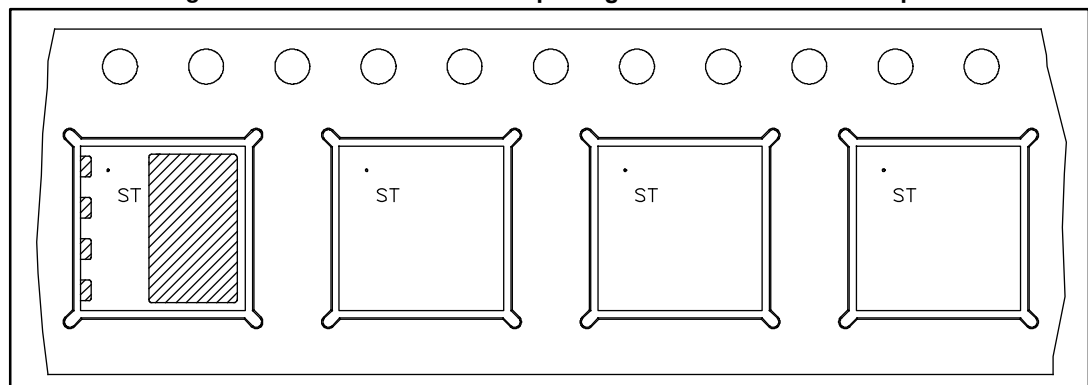
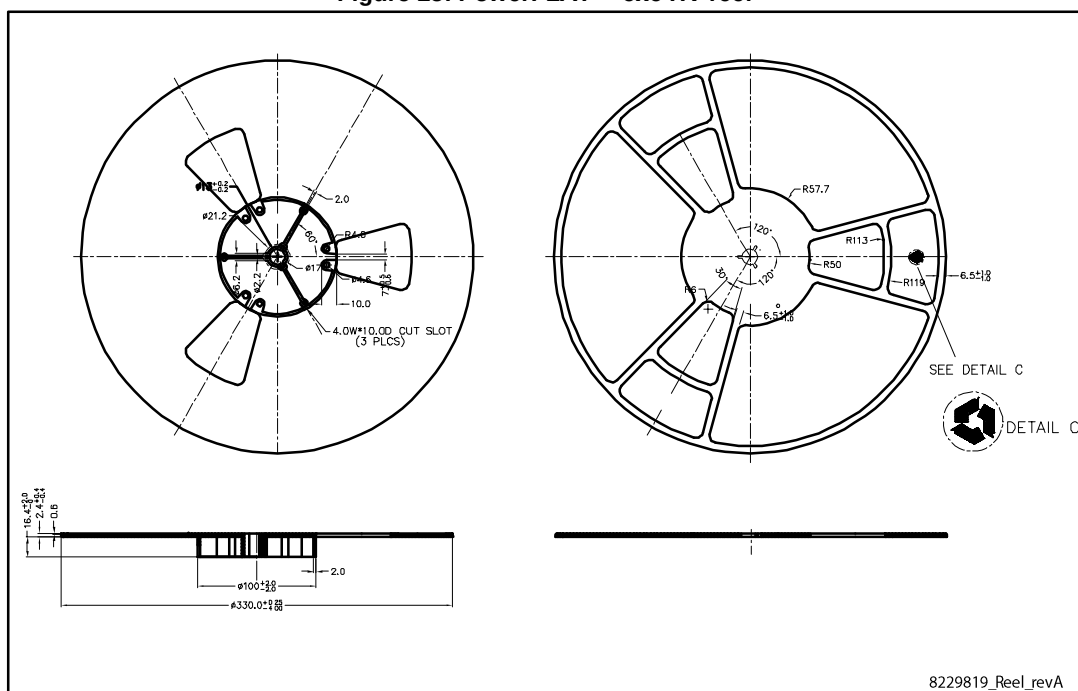


Figure 25: PowerFLAT™ 8x8 HV reel



5 Revision history

Table 10: Document revision history

Date	Revision	Changes
20-Sep-2012	1	First release.
09-Oct-2015	2	Text and formatting changes throughout document Datasheet status changed from preliminary to production data In section Electrical ratings: - added table Avalanche characteristics In section Electrical characteristics: - renamed table Static (was On /off states) Updated section Test circuits Updated and renamed section Package information (was Package mechanical data)

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Телефон: 8 (812) 309-75-97 (многоканальный)

Факс: 8 (812) 320-03-32

Электронная почта: ocean@oceanchips.ru

Web: <http://oceanchips.ru/>

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А