

N-channel 600 V, 0.115 Ω typ., 21 A MDmesh™ DM2 Power MOSFET in a PowerFLAT™ 8x8 HV package

Datasheet - production data

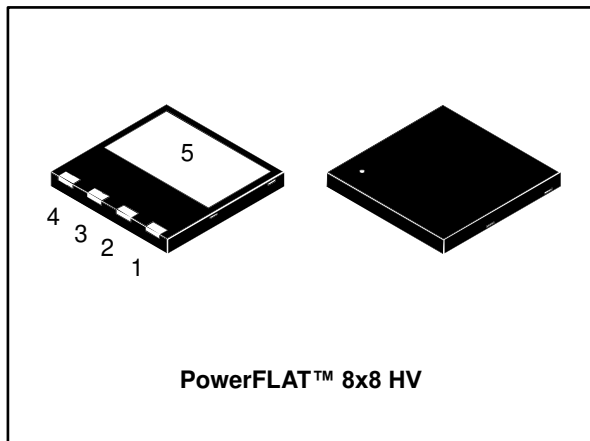
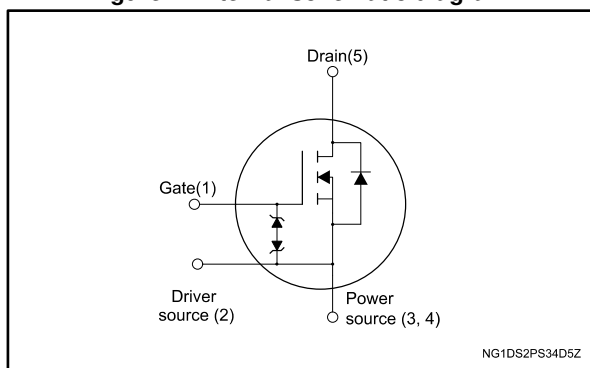


Figure 1: Internal schematic diagram



Features

Order code	$V_{DS} @ T_{Jmax}$	$R_{DS(on)max}$	I_D
STL33N60DM2	650 V	0.140 Ω	21 A

- Fast-recovery body diode
- Extremely low gate charge and input capacitance
- Low on-resistance
- 100% avalanche tested
- Extremely high dv/dt ruggedness
- Zener-protected

Applications

- Switching applications

Description

This high voltage N-channel Power MOSFET is part of the MDmesh™ DM2 fast recovery diode series. It offers very low recovery charge (Q_{rr}) and time (t_{rr}) combined with low $R_{DS(on)}$, rendering it suitable for the most demanding high efficiency converters and ideal for bridge topologies and ZVS phase-shift converters.

Table 1: Device summary

Order code	Marking	Package	Packaging
STL33N60DM2	33N60DM2	PowerFLAT™ 8x8 HV	Tape and reel

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1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	± 25	V
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	21	A
$I_D^{(1)}$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	15	A
$I_{DM}^{(1)(2)}$	Drain current (pulsed)	84	A
$P_{TOT}^{(1)}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	150	W
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max)	4.5	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	570	mJ
$dv/dt^{(3)}$	Peak diode recovery voltage slope	50	V/ns
$dv/dt^{(4)}$	MOSFET dv/dt ruggedness	50	V/ns
T_{stg}	Storage temperature range	- 55 to 150	$^\circ\text{C}$
T_j	Operating junction temperature range		

Notes:

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

⁽²⁾ Pulse width limited by safe operating area.

⁽³⁾ $I_{SD} \leq 21\text{ A}$, $di/dt \leq 900\text{ A}/\mu\text{s}$, $V_{DS(peak)} < V_{(BR)DSS}$, $V_{DD} = 400\text{ V}$.

⁽⁴⁾ $V_{DS} \leq 480\text{ V}$.

Table 3: Thermal data

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

Notes:

⁽¹⁾ When mounted on FR-4 board of inch^2 , 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	$V_{GS} = 0, I_D = 1\text{ mA}$	600			V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0, V_{DS} = 600\text{ V}$			1	μA
		$V_{GS} = 0, V_{DS} = 600\text{ V}, T_C = 125\text{ }^{\circ}\text{C}^{(1)}$			100	μA
I_{GSS}	Gate-body leakage current	$V_{DS} = 0, V_{GS} = \pm 25\text{ V}$			± 10	μA
$V_{GS(th)}$	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	$V_{GS} = 10\text{ V}, I_D = 10.5\text{ A}$		0.115	0.140	Ω

Notes:

⁽¹⁾ Defined by design, not subject to production test.

Table 5: Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 100\text{ V}, f = 1\text{ MHz}, V_{GS} = 0$	-	1870	-	pF
C_{oss}	Output capacitance		-	87	-	pF
C_{rss}	Reverse transfer capacitance		-	2	-	pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{DS} = 0\text{ to }480\text{ V}, V_{GS} = 0$	-	157	-	pF
R_G	Intrinsic gate resistance	$f = 1\text{ MHz}, I_D = 0\text{ A}$	-	4.5	-	Ω
Q_g	Total gate charge	$V_{DD} = 480\text{ V}, I_D = 21\text{ A}$ $V_{GS} = 10\text{ V}$ (see Figure 15: "Gate charge test circuit")	-	43	-	nC
Q_{gs}	Gate-source charge		-	9.8	-	nC
Q_{gd}	Gate-drain charge		-	21.4	-	nC

Notes:

⁽¹⁾ $C_{oss\text{ eq.}}$ 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 6: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300\text{ V}$, $I_D = 10.5\text{ A}$ $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 14: "Switching times test circuit for resistive load")	-	17	-	ns
t_r	Rise time		-	8	-	ns
$t_{d(off)}$	Turn-off delay time		-	62	-	ns
t_f	Fall time		-	9	-	ns

Table 7: Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}^{(1)}$	Source-drain current		-		21	A
$I_{SDM}^{(1)(2)}$	Source-drain current (pulsed)		-		84	A
$V_{SD}^{(3)}$	Forward on voltage	$I_{SD} = 21\text{ A}$, $V_{GS} = 0$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 21\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$ (see Figure 16: "Test circuit for inductive load switching and diode recovery times")	-	120		ns
Q_{rr}	Reverse recovery charge		-	0.53		μC
I_{RRM}	Reverse recovery current		-	8.8		A
t_{rr}	Reverse recovery time	$I_{SD} = 21\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 16: "Test circuit for inductive load switching and diode recovery times")	-	316		ns
Q_{rr}	Reverse recovery charge		-	2.85		μC
I_{RRM}	Reverse recovery current		-	18		A

Notes:

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

⁽²⁾Pulse width limited by safe operating area

⁽³⁾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	$I_{GS} = \pm 250\ \mu\text{A}$, $I_D = 0\text{ A}$	± 30	-	-	V

The built-in back-to-back Zener diodes are specifically designed to enhance the ESD performance of the device. The Zener voltage facilitates efficient and cost-effective device integrity protection, thus eliminating the need for additional external componentry.

2.2 Electrical characteristics (curves)

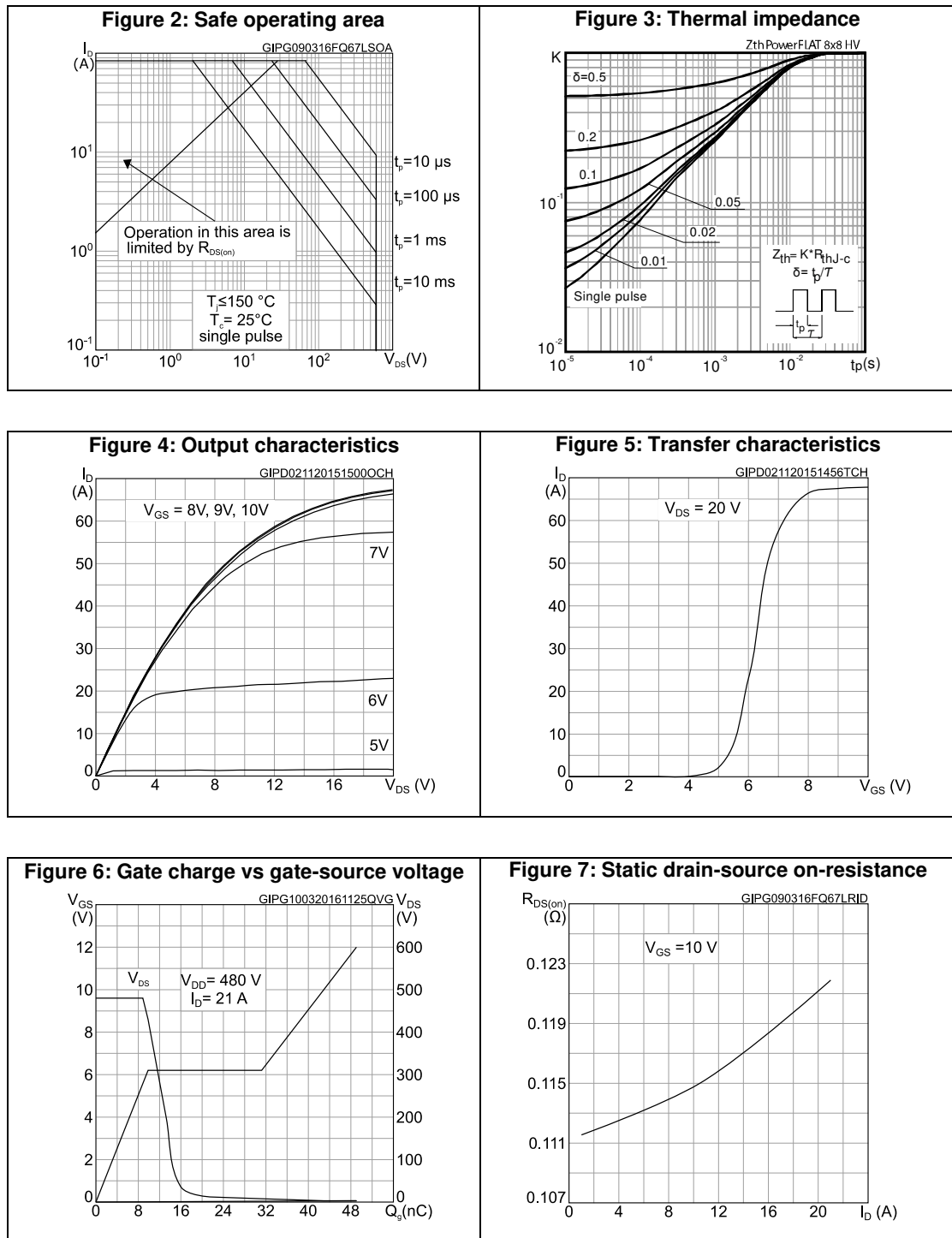


Figure 8: Capacitance variations

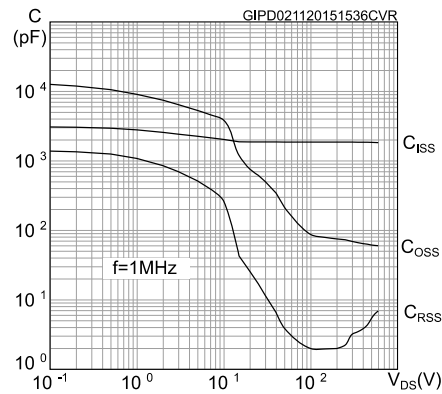


Figure 9: Normalized gate threshold voltage vs temperature

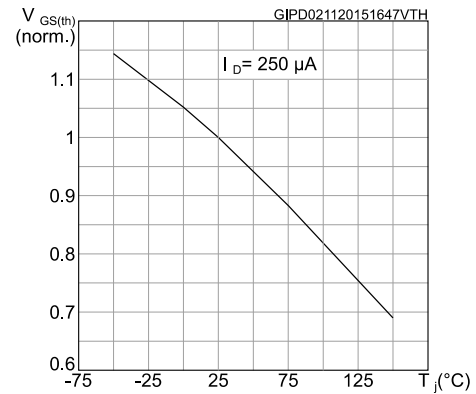


Figure 10: Normalized on-resistance vs temperature

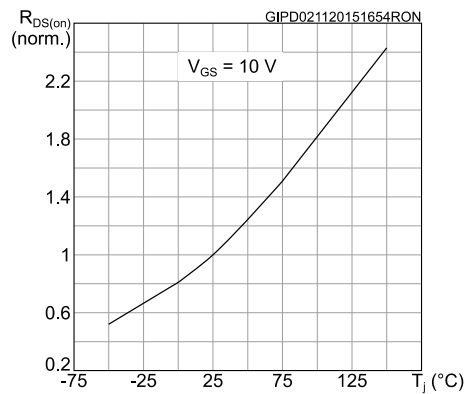
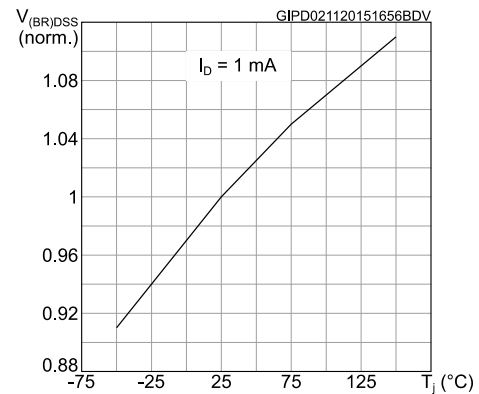
Figure 11: Normalized $V_{(BR)DSS}$ vs temperature

Figure 12: Output capacitance stored energy

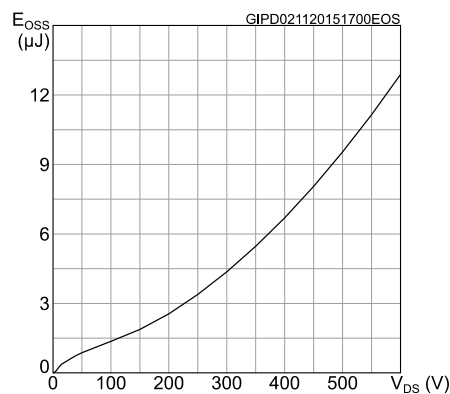
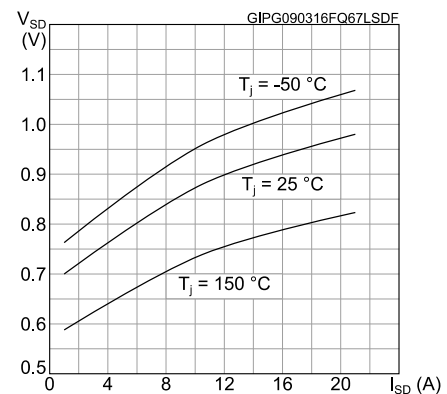
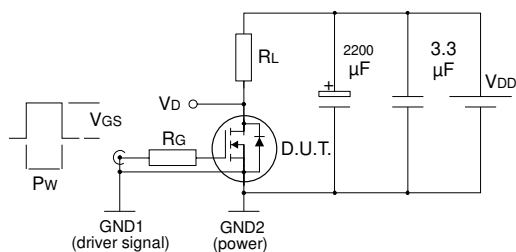


Figure 13: Source-drain diode forward characteristics



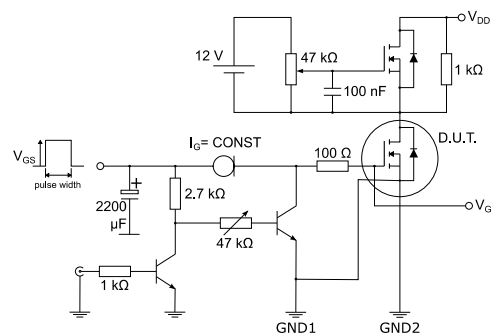
3 Test circuits

Figure 14: Switching times test circuit for resistive load



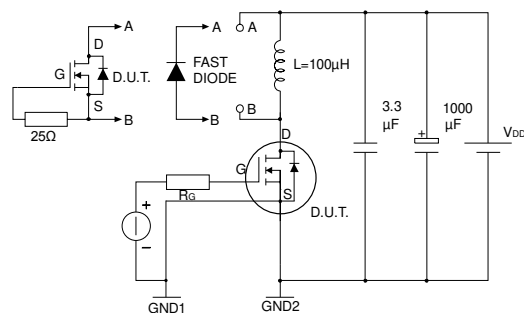
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Figure 15: Gate charge test circuit



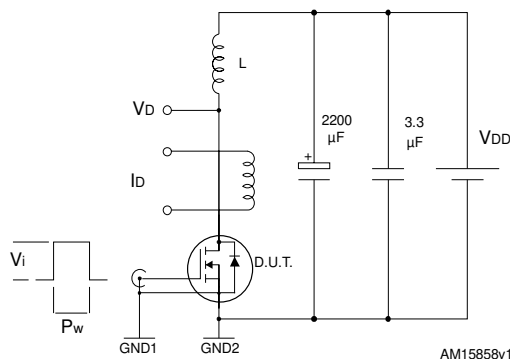
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Figure 16: Test circuit for inductive load switching and diode recovery times



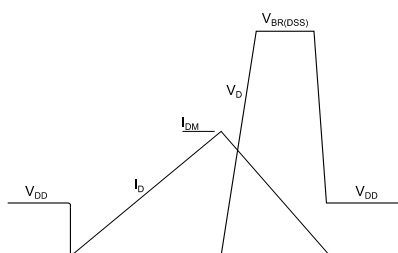
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Figure 17: Unclamped inductive load test circuit



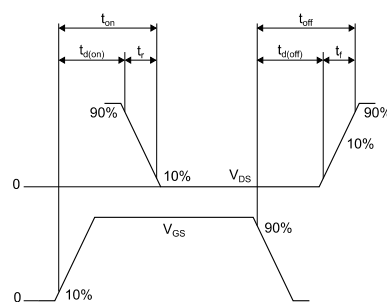
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Figure 18: Unclamped inductive waveform



AM01472v1

Figure 19: Switching time waveform



AM01473v1

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.

4.1 PowerFLAT™ 8x8 HV package mechanical data

Figure 20: PowerFLAT™ 8x8 HV package outline

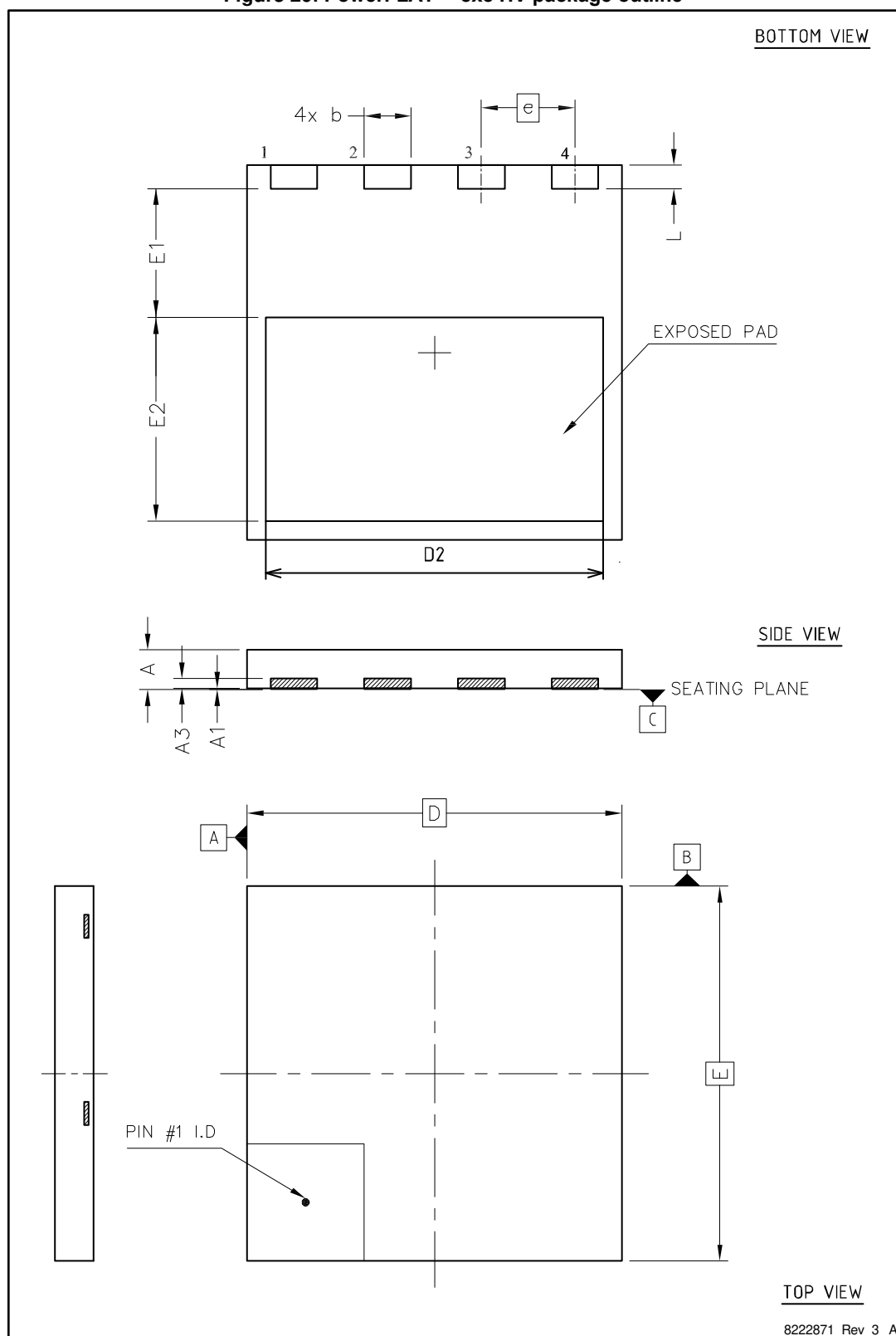
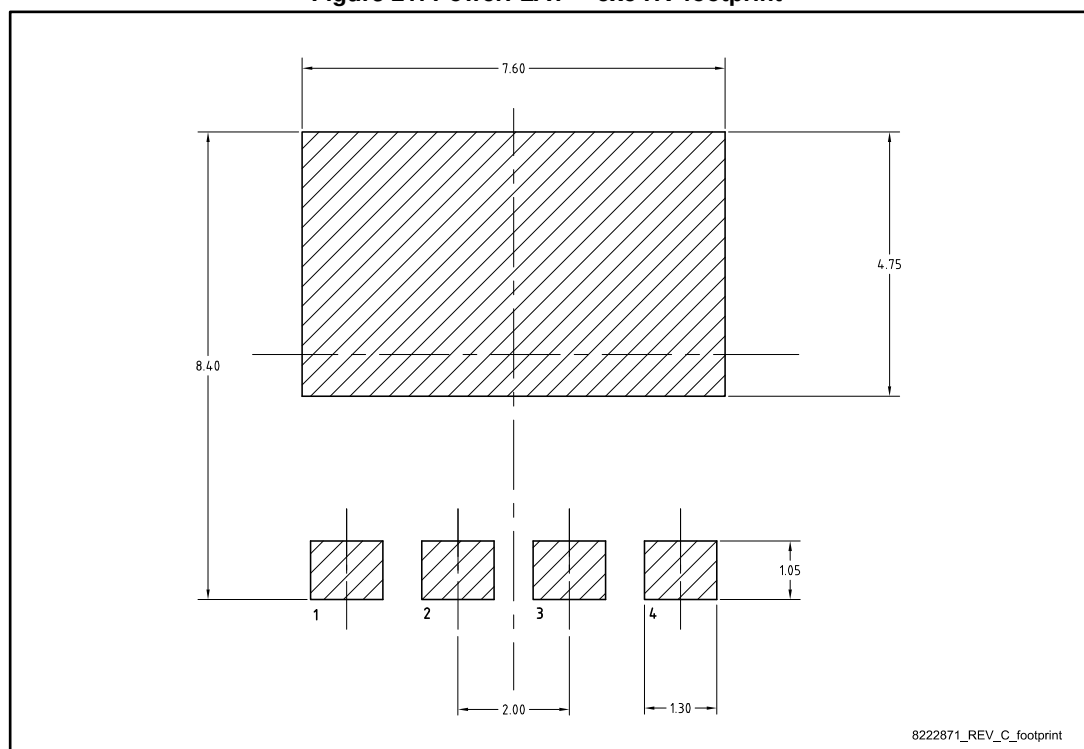


Table 9: PowerFLAT™ 8x8 HV mechanical data

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

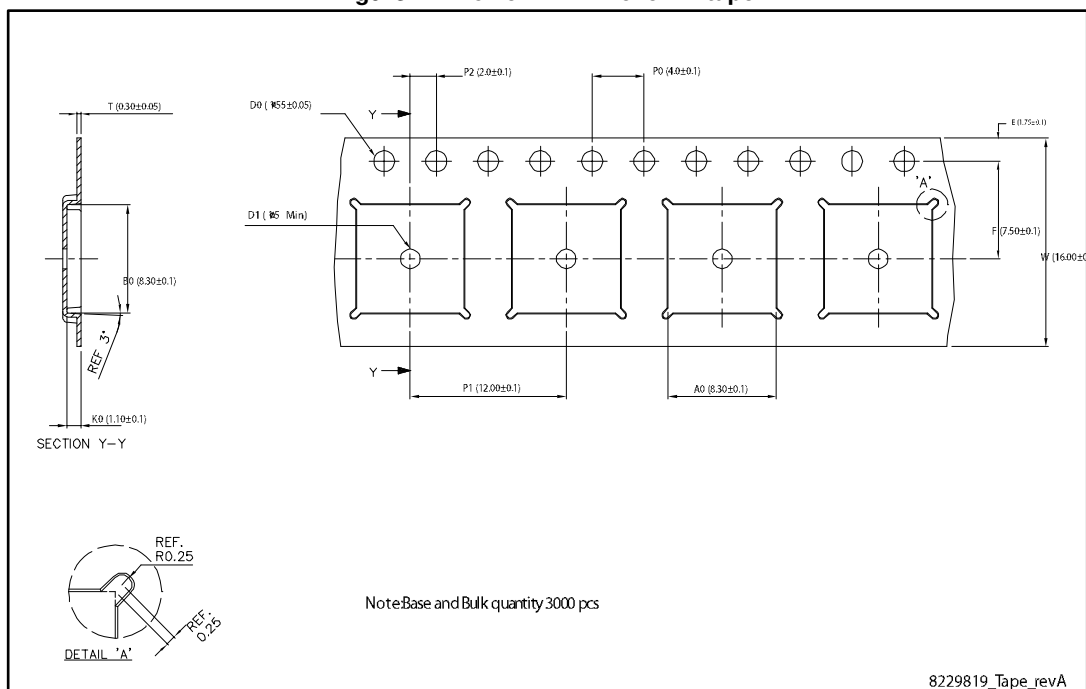


Figure 23: PowerFLAT™ 8x8 HV package orientation in carrier tape

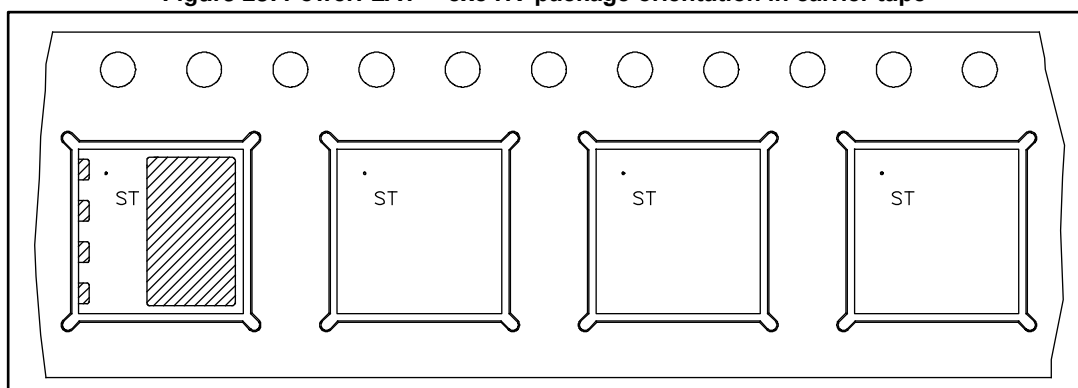
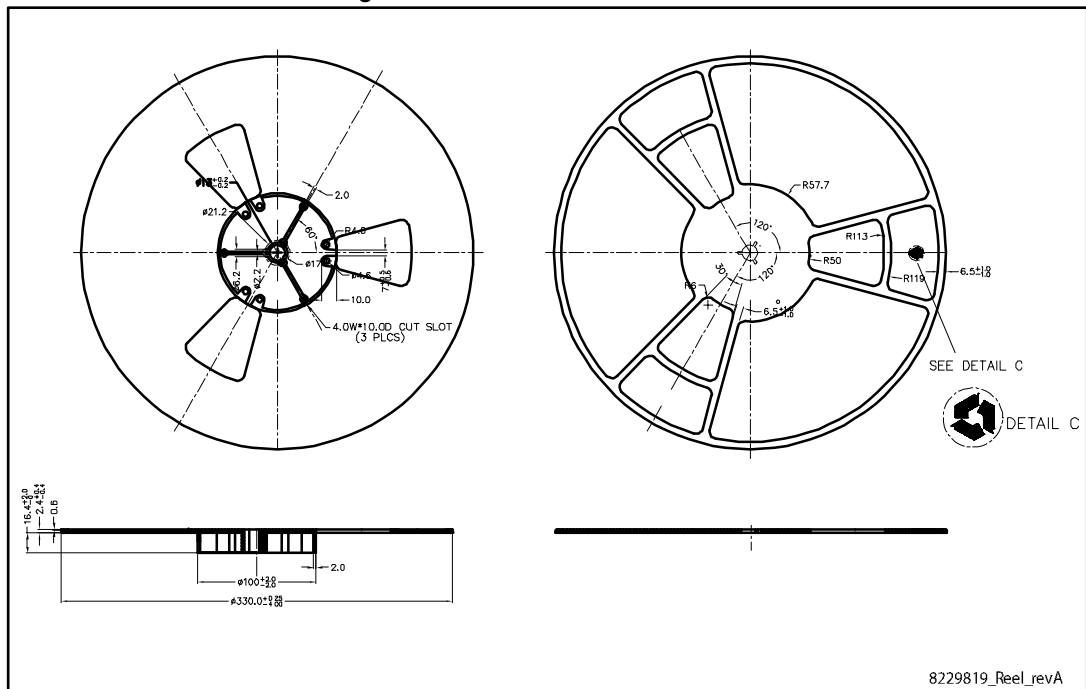


Figure 24: PowerFLAT™ 8x8 HV reel



5 Revision history

Table 10: Document revision history

Date	Revision	Changes
08-Aug-2014	1	First release.
09-Mar-2016	2	Updated title and internal schematic in cover page. Document status promoted from preliminary data to production data. Modified: Table 2: "Absolute maximum ratings" , Table 4: "On /off states" , Table 5: "Dynamic" , Table 6: "Switching times" and Table 7: "Source drain diode" Added: Section 4.1: "Electrical characteristics (curves)" Updated: Section 6.1: "PowerFLAT™ 8x8 HV package mechanical data" Minor text changes

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