STL33N60DM2

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

Datasheet - production data

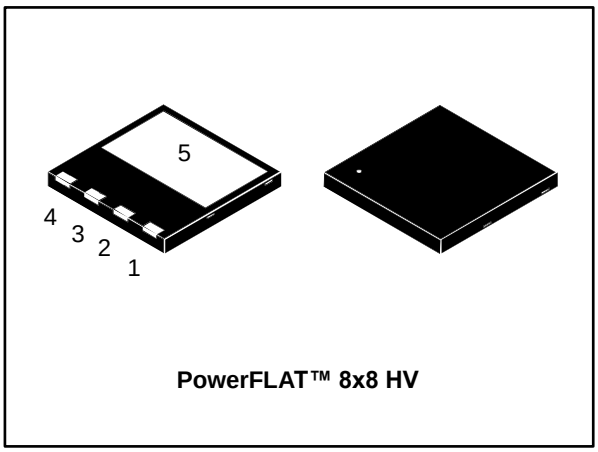
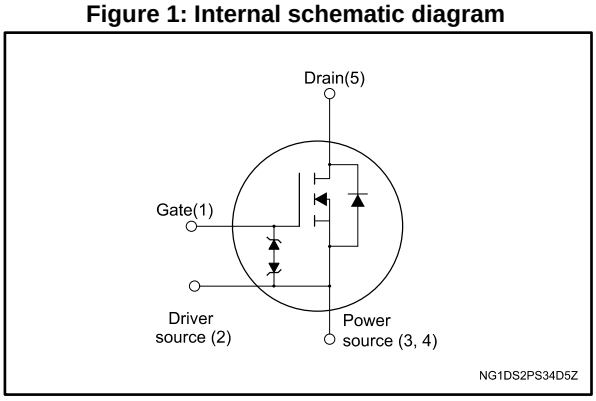


Figure 1: Internal schematic diagram



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 °C	21	A
I_D (1)	Drain current (continuous) at T_C = 100 °C	15	A
I_{DM} (1), (2)	Drain current (pulsed)	84	A
P_{TOT} (1)	Total dissipation at T_C = 25 °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 °C, I_D = I_{AR}, V_{DD} = 50 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	°C
T_j	Operating junction temperature range		

Notes:

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

(2)Pulse width limited by safe operating area.

(3)I_{SD} ≤ 21 A, di/dt ≤ 900 A/µs, $V_{DS(peak)}$ < $V_{(BR)DSS}$, V_{DD} = 400 V.

(4)V_{DS} ≤ 480 V.

Table 3: Thermal data

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

Notes:

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

2 Electrical characteristics

(T_C = 25 °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 mA	600			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0, V_{DS} = 600 V			1	µA
		V_{GS} = 0, V_{DS} = 600 V, T_C=125 °C(1)			100	µA
I_{GSS}	Gate-body leakage current	V_{DS} = 0, V_{GS} = ± 25 V			±10	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	3	4	5	V
$R_{DS(on)}$	Static drain-source on- resistance	V_{GS} = 10 V, I_D = 10.5 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 V, f = 1 MHz, V_{GS} = 0	-	1870	-	pF
C_{oss}	Output capacitance		-	87	-	pF
C_{rss}	Reverse transfer capacitance		-	2	-	pF
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{DS} = 0 to 480 V, V_{GS} = 0	-	157	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz, I_D=0 A	-	4.5	-	Ω
Q_g	Total gate charge	V_{DD} = 480 V, I_D = 21 A V_{GS} = 10 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)Coss eq. is defined as a constant equivalent capacitance giving the same charging time as Coss when VDS 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 V, I_D = 10.5 A R_G = 4.7 Ω, V_{GS} = 10 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 A, V_{GS} = 0	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 21 A, di/dt = 100 A/µs V_{DD} = 100 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 A, di/dt = 100 A/µs V_{DD} = 100 V, T_j = 150 °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 $R_{thj\text{-}case}$ 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} = ±250 µA, I_D = 0 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 2: Safe operating area

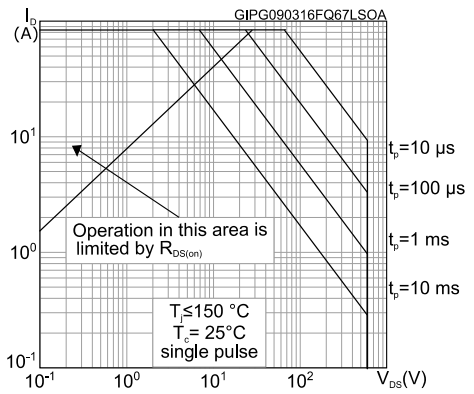


Figure 3: Thermal impedance

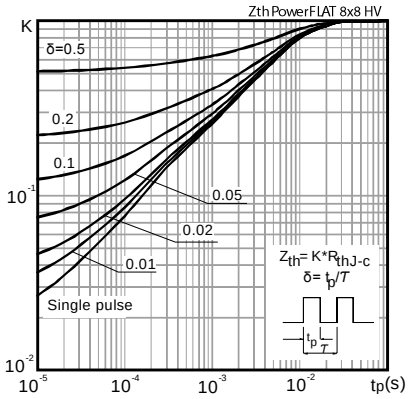


Figure 4: Output characteristics

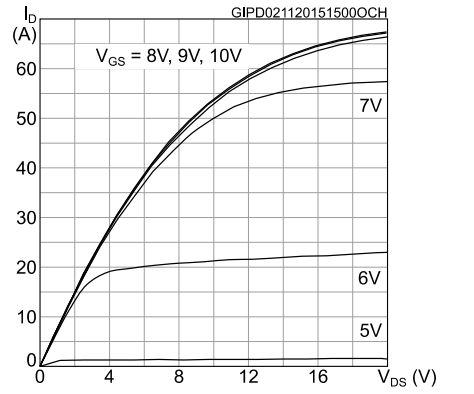


Figure 5: Transfer characteristics

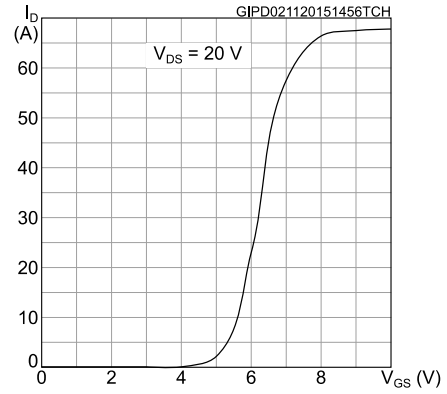


Figure 6: Gate charge vs gate-source voltage

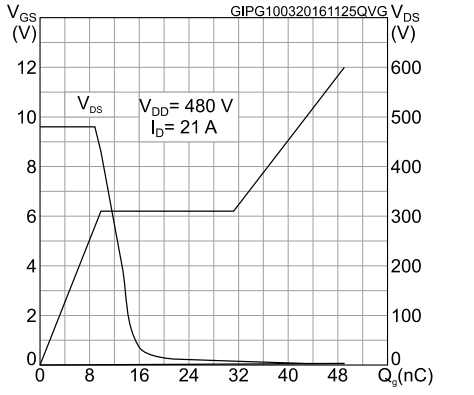


Figure 7: Static drain-source on-resistance

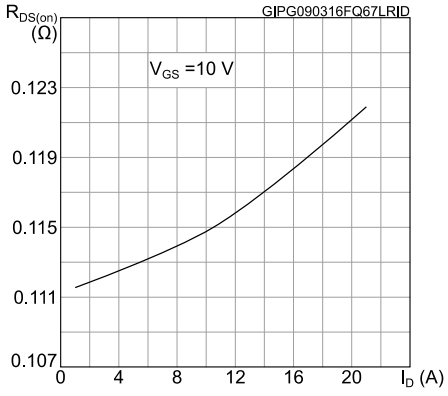


Figure 8: Capacitance variations

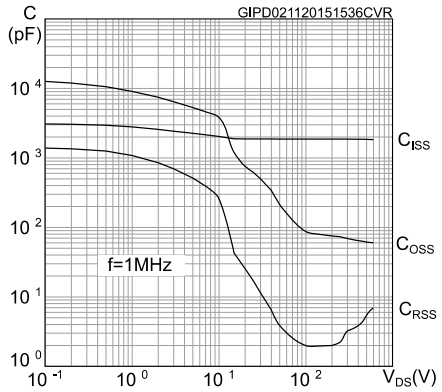


Figure 9: Normalized gate threshold voltage vs temperature

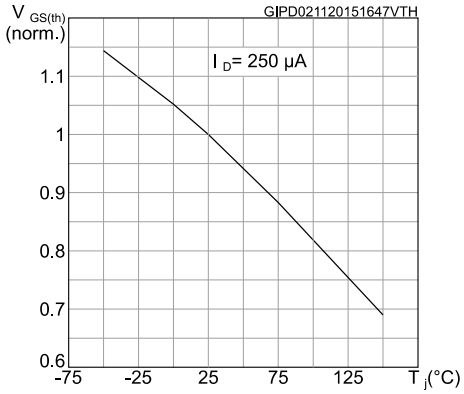


Figure 10: Normalized on-resistance vs temperature

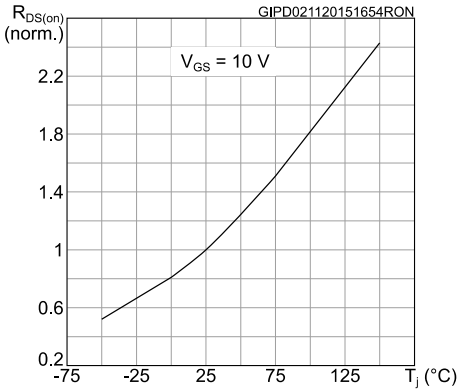


Figure 11: Normalized $V_{(BR)DSS}$ vs temperature

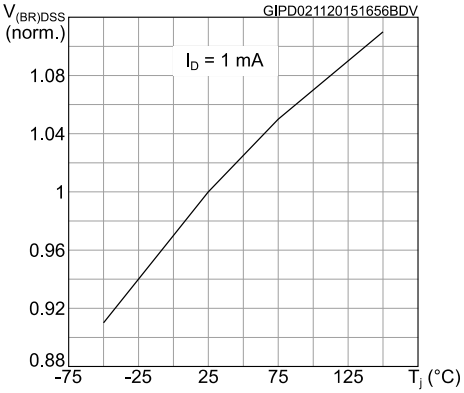


Figure 12: Output capacitance stored energy

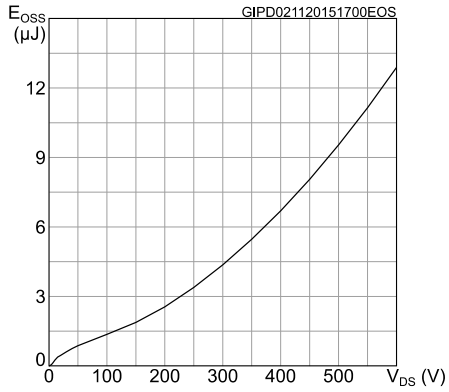
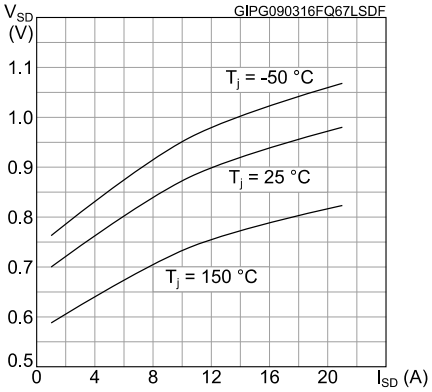


Figure 13: Source- drain diode forward characteristics



3 Test circuits

Figure 14: Switching times test circuit for resistive load

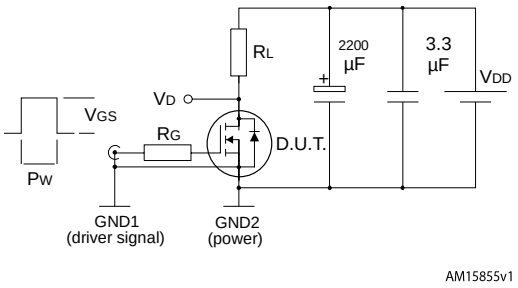


Figure 15: Gate charge test circuit

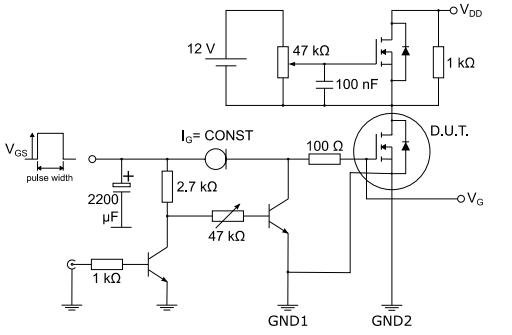


Figure 16: Test circuit for inductive load switching and diode recovery times

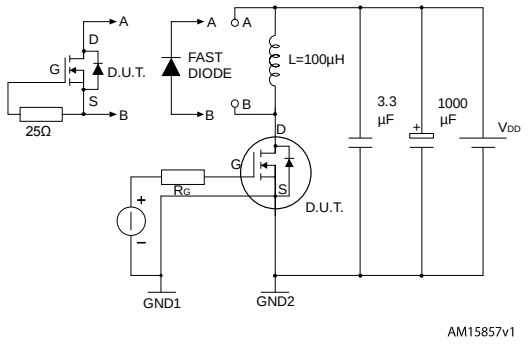


Figure 17: Unclamped inductive load test circuit

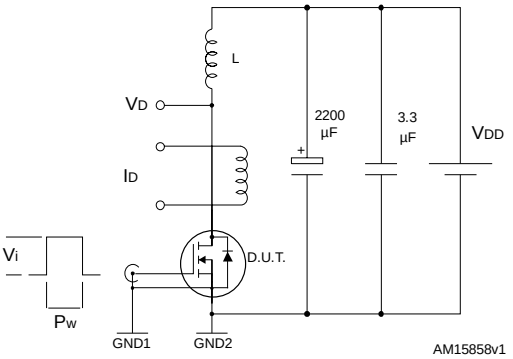


Figure 18: Unclamped inductive waveform

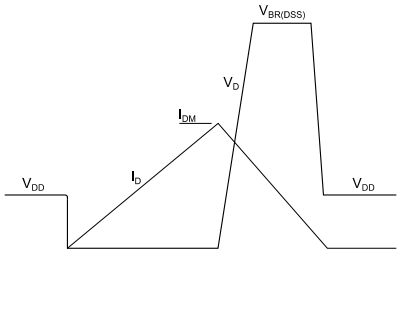
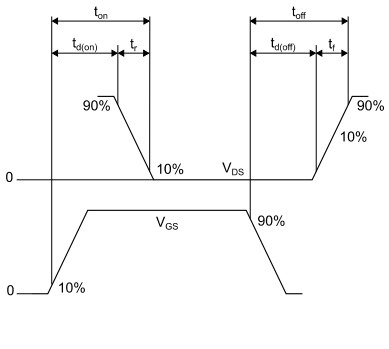


Figure 19: Switching time waveform



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.

4.1 PowerFLAT™ 8x8 HV package mechanical data

Figure 20: PowerFLAT™ 8x8 HV package outline

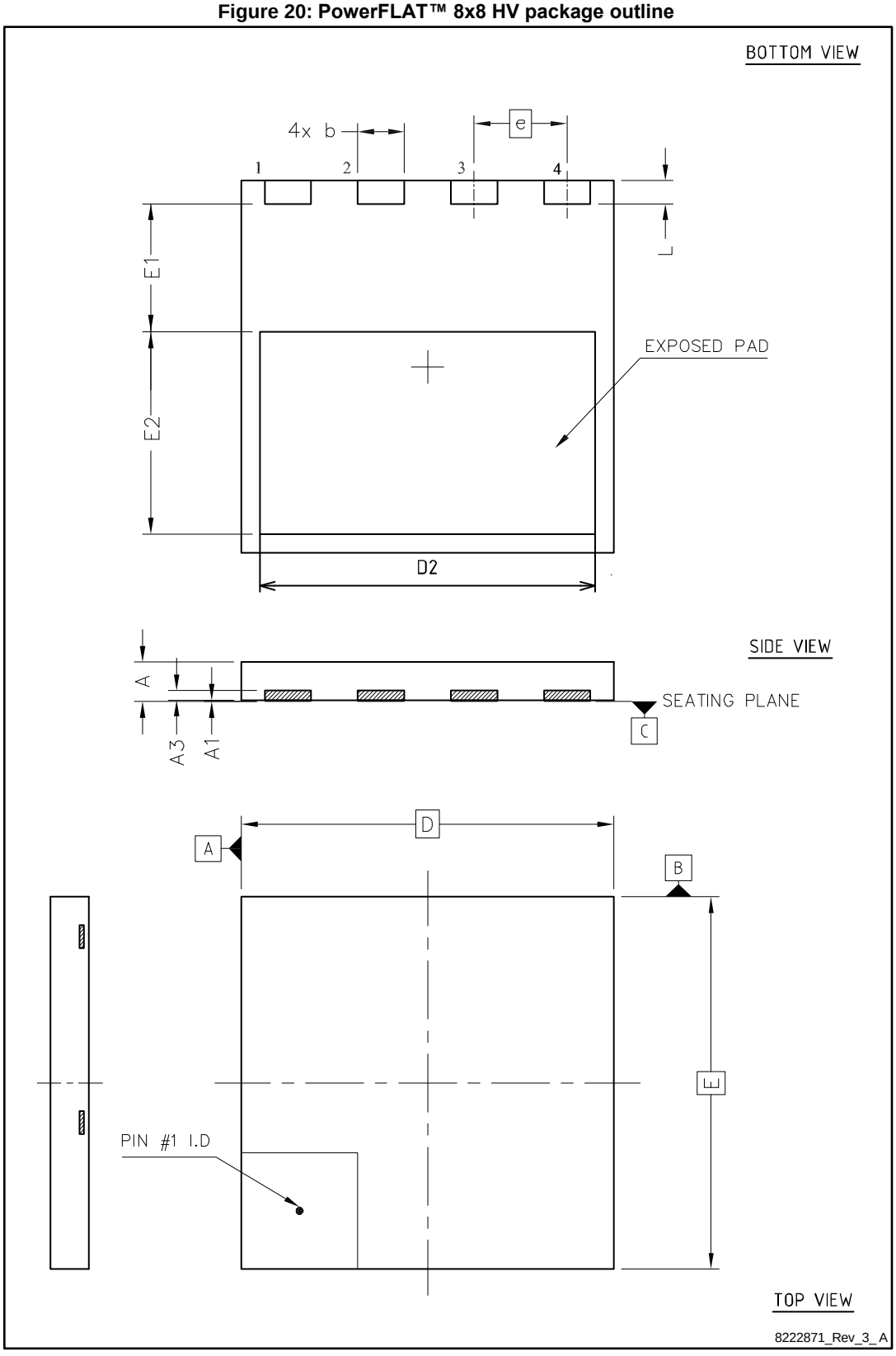
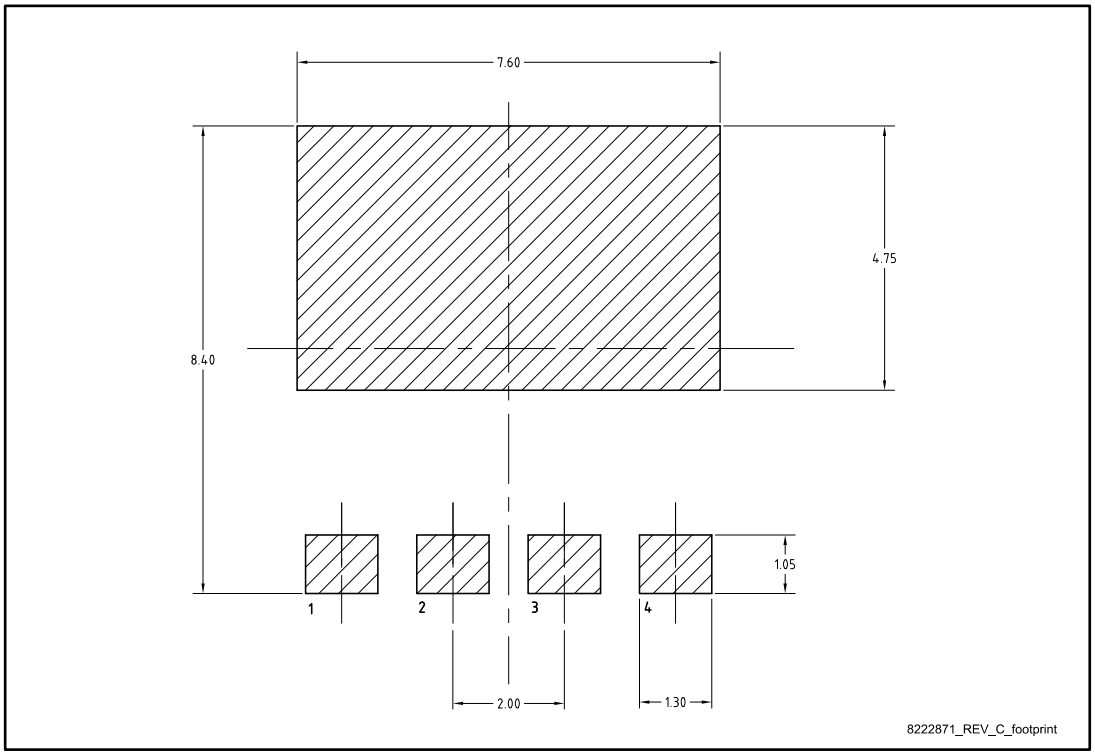


Table 9: PowerFLAT™ 8x8 HV mechanical data

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

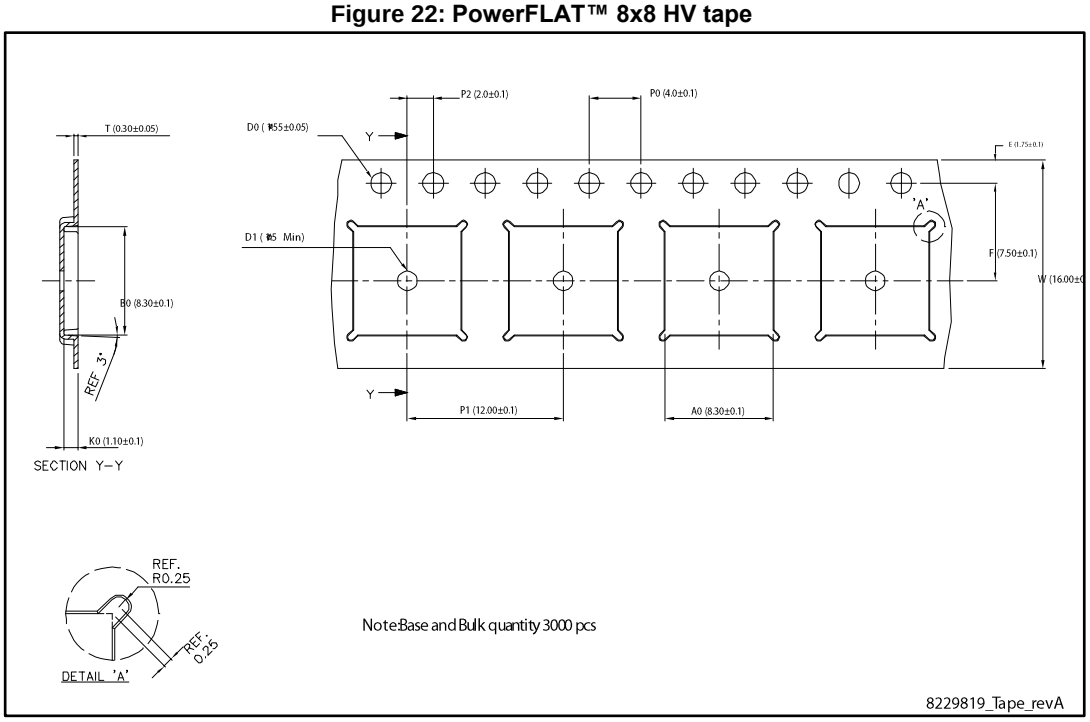


Figure 23: PowerFLAT™ 8x8 HV package orientation in carrier tape

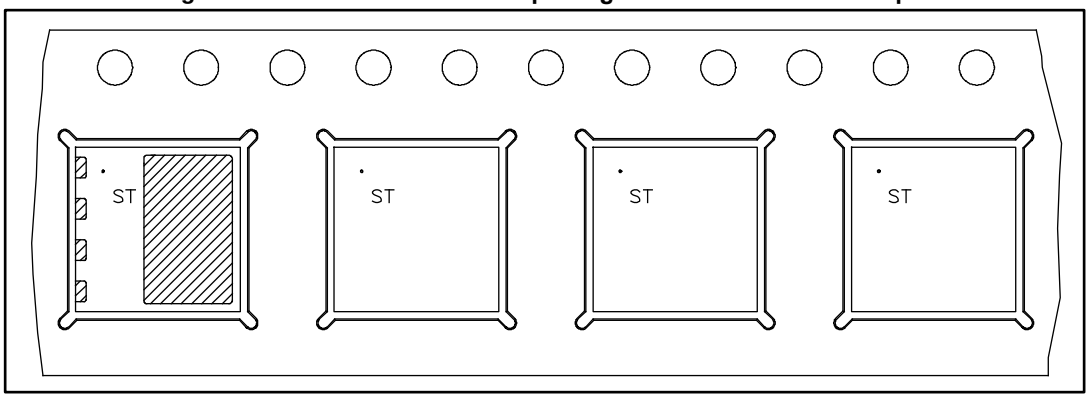
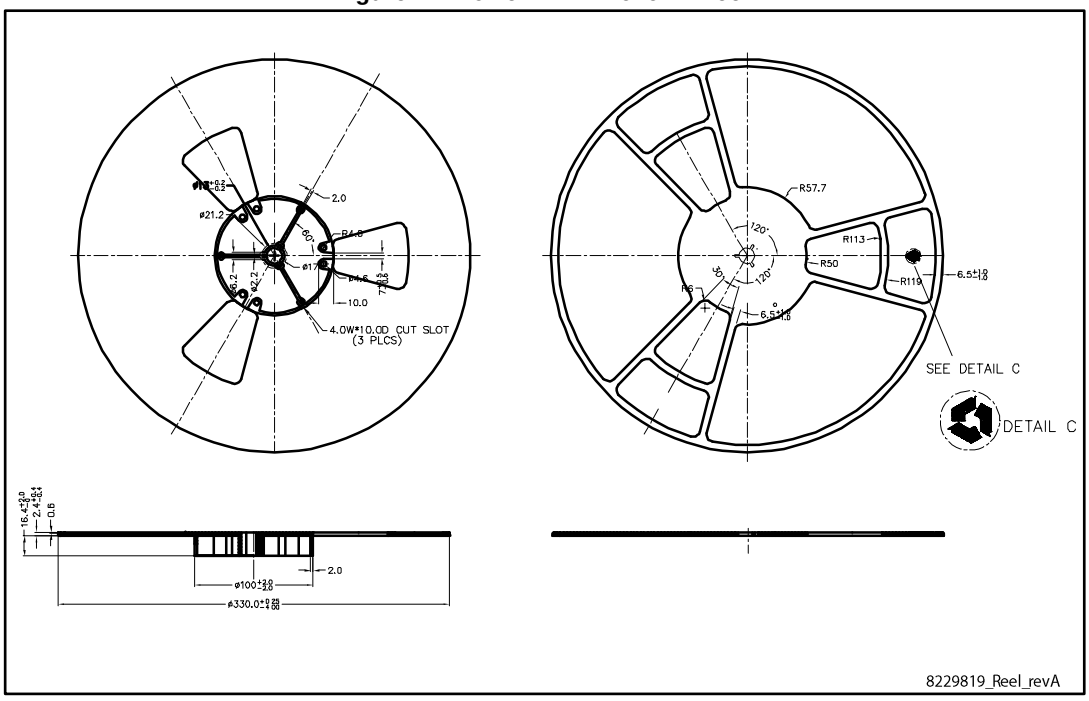


Figure 24: PowerFLAT™ 8x8 HV reel



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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