

N-channel 650 V, 0.85 Ω typ., 4.5 A MDmesh M2 Power MOSFET in a PowerFLAT™ 5x6 HV package

Datasheet - production data

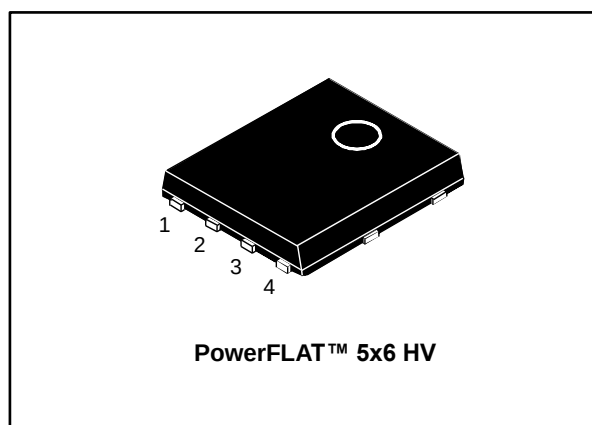
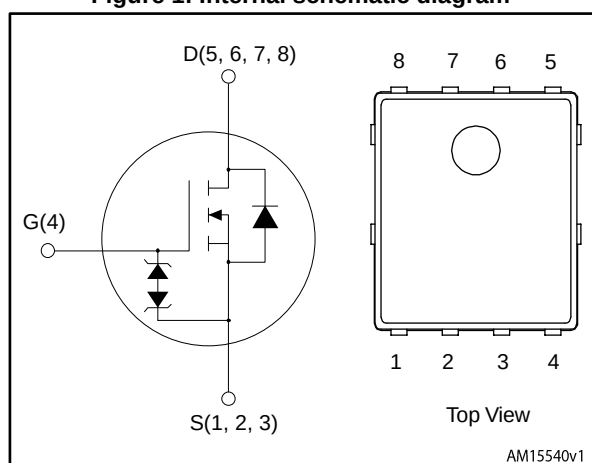


Figure 1: Internal schematic diagram



Features

Order code	V _{DS}	R _{DS(on)} max.	I _D
STL10N65M2	650 V	1.00 Ω	4.5 A

- Extremely low gate charge
- Lower R_{DS(on)} x area vs previous generation
- Low gate input resistance
- 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
STL10N65M2	10N65M2	PowerFLAT™ 5x6 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 $T_C = 25\text{ }^\circ\text{C}$	4.5	A
	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	2.8	A
$I_{DM}^{(2)}$	Drain current pulsed	18	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	48	W
I_{AR}	Avalanche current, repetitive or non-repetitive (pulse width limited by T_j max)	0.9	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	95	mJ
$dv/dt^{(3)}$	Peak diode recovery voltage slope	15	V/ns
$dv/dt^{(4)}$	MOSFET dv/dt ruggedness	50	
T_j	Operating junction temperature range	-55 to 150	$^\circ\text{C}$
T_{stg}	Storage temperature range		

Notes:

⁽¹⁾The value is limited by package.

⁽²⁾Pulse width is limited by safe operating area.

⁽³⁾ $I_{SD} \leq 4.5\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{DS(\text{peak})} \leq V_{(BR)DSS}$, $V_{DD} = 80\% V_{(BR)DSS}$

⁽⁴⁾ $V_{DS} \leq 520\text{ V}$

Table 3: Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-case}}$	Thermal resistance junction-case	2.6	$^\circ\text{C}/\text{W}$
$R_{thj\text{-pcb}}^{(1)}$	Thermal resistance junction-pcb	50	$^\circ\text{C}/\text{W}$

Notes:

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

2 Electrical characteristics

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

Table 4: On/off-state

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
		$V_{GS} = 0\text{ V}$, $V_{DS} = 650\text{ V}$ $T_C = 125\text{ }^{\circ}\text{C}$ ⁽¹⁾			100	μA
I_{GSS}	Gate-body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS} = \pm 25\text{ V}$			± 10	μA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$, $I_D = 2.5\text{ A}$		0.85	1.00	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	$V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	315	-	pF
C_{oss}	Output capacitance		-	18	-	pF
C_{rss}	Reverse transfer capacitance		-	0.86	-	pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent capacitance energy related	$V_{DS} = 0\text{ to }520\text{ V}$, $V_{GS} = 0\text{ V}$	-	109	-	pF
R_g	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	6.6	-	Ω
Q_g	Total gate charge	$V_{DD} = 520\text{ V}$, $I_D = 5\text{ A}$ $V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 15: "Test circuit for gate charge behavior")	-	10.3	-	nC
Q_{gs}	Gate-source charge		-	2.4	-	nC
Q_{gd}	Gate-drain charge		-	4.8	-	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_{DS} .

Table 6: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 325 \text{ V}$, $I_D = 2.5 \text{ A}$, $R_G = 4.7 \text{ } \Omega$, $V_{GS} = 10 \text{ V}$ (see Figure 14: "Test circuit for resistive load switching times" and Figure 19: "Switching time waveform")	-	7.5	-	ns
t_r	Rise time		-	6.6	-	ns
$t_{d(off)}$	Turn-off delay time		-	22.5	-	ns
t_f	Fall time		-	18	-	ns

Table 7: Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		4.5	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		18	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 4.5 \text{ A}$, $V_{GS} = 0 \text{ V}$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 5 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$, $V_{DD} = 60 \text{ V}$ (see Figure 16: "Test circuit for inductive load switching and diode recovery times")	-	276		ns
Q_{rr}	Reverse recovery charge		-	1.7		μC
I_{RRM}	Reverse recovery current		-	12.5		A
t_{rr}	Reverse recovery time	$I_{SD} = 5 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$, $V_{DD} = 60 \text{ V}$, $T_J = 150 \text{ } ^\circ\text{C}$ (see Figure 16: "Test circuit for inductive load switching and diode recovery times")	-	312		ns
Q_{rr}	Reverse recovery charge		-	1.9		μC
I_{RRM}	Reverse recovery current		-	12.4		A

Notes:

⁽¹⁾Pulse width is 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

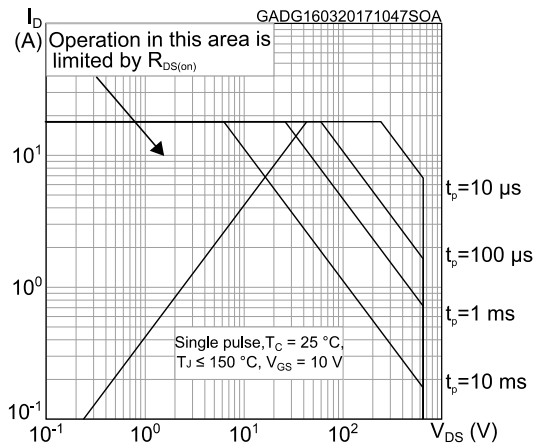


Figure 3: Thermal impedance

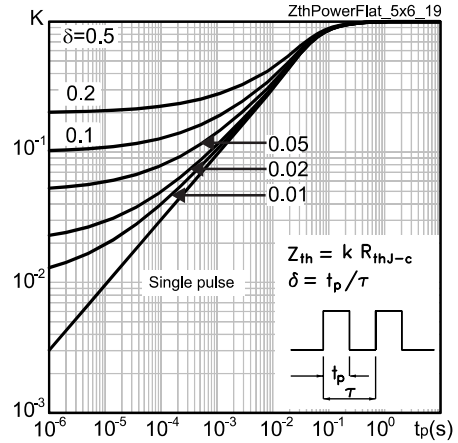


Figure 4: Output characteristics

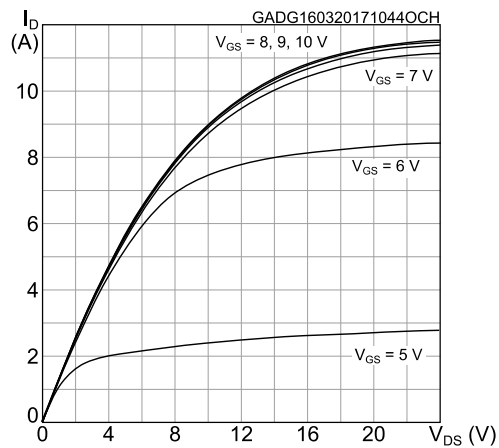


Figure 5: Transfer characteristics

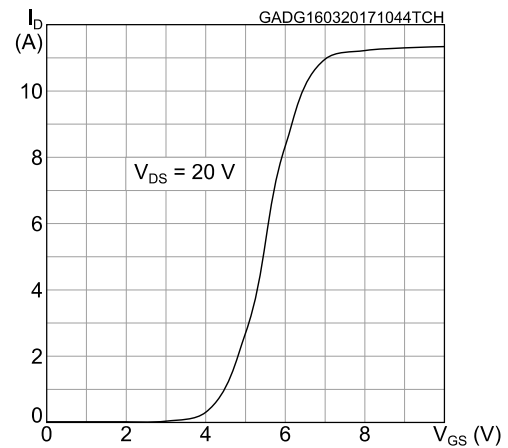


Figure 6: Gate charge vs gate-source voltage

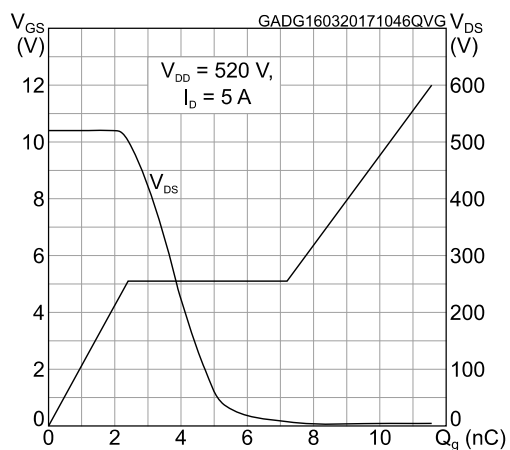


Figure 7: Static drain-source on-resistance

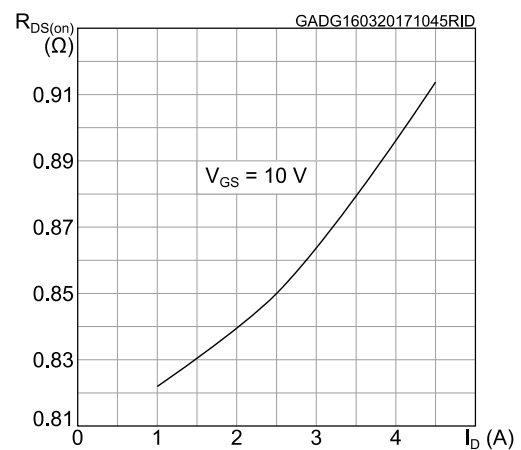


Figure 8: Capacitance variations

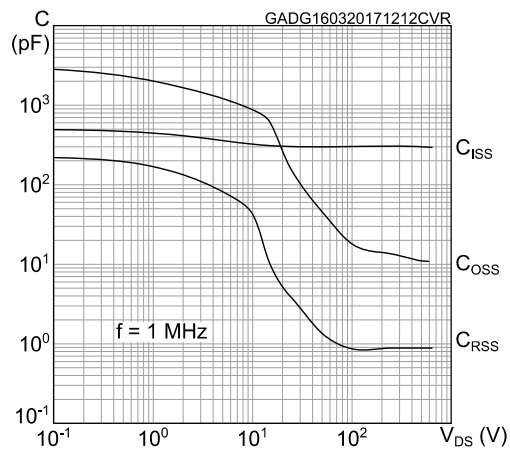


Figure 9: Output capacitance stored energy

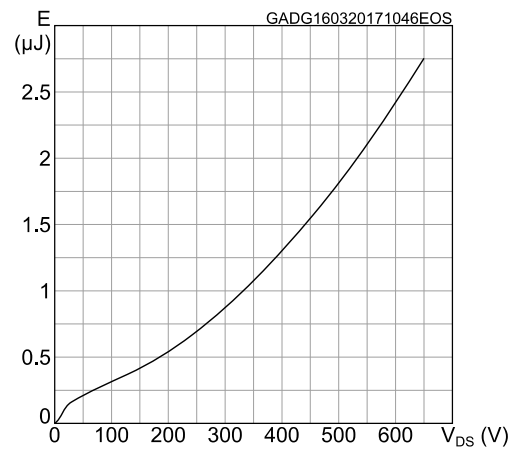


Figure 10: Normalized gate threshold voltage vs temperature

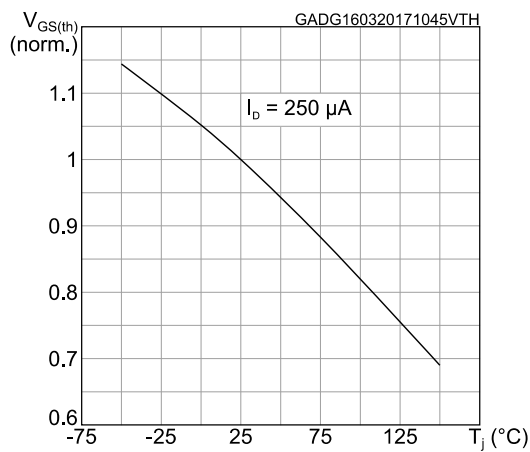


Figure 11: Normalized on-resistance vs temperature

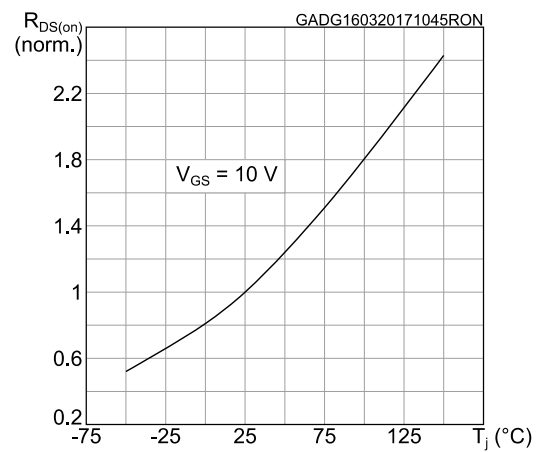
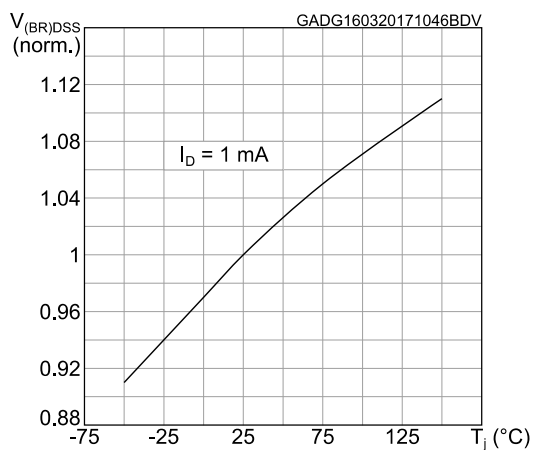
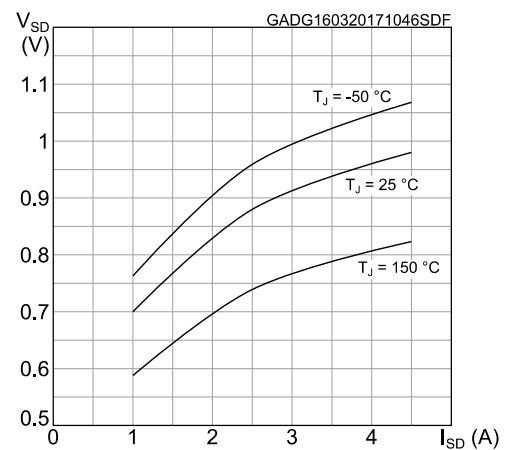
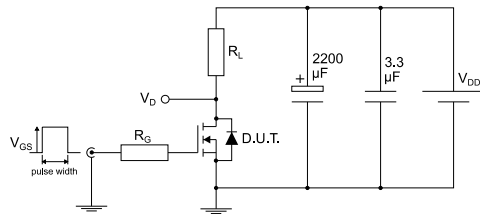
Figure 12: Normalized $V_{(BR)DSS}$ vs temperature

Figure 13: Source-drain diode forward characteristics



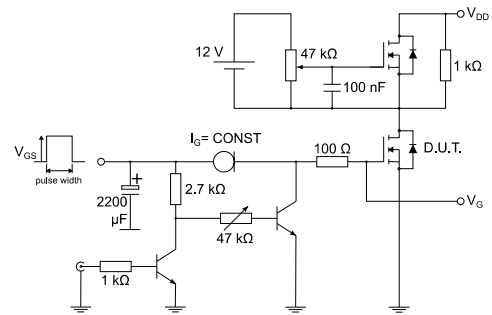
3 Test circuits

Figure 14: Test circuit for resistive load switching times



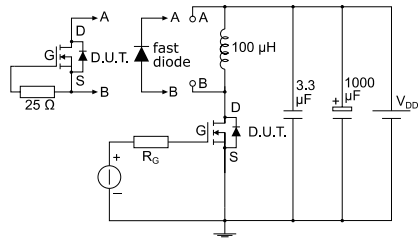
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Figure 15: Test circuit for gate charge behavior



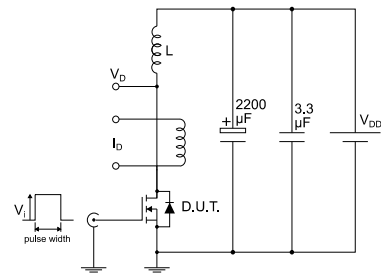
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Figure 16: Test circuit for inductive load switching and diode recovery times



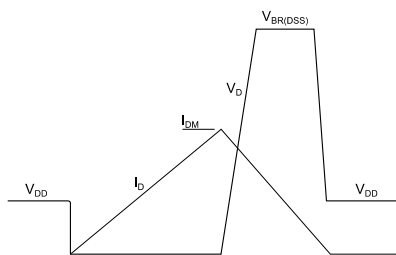
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Figure 17: Unclamped inductive load test circuit



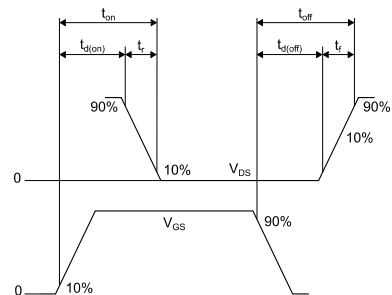
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Figure 18: Unclamped inductive waveform



AM01472v1

Figure 19: Switching time waveform



AM01473v1

4 Package 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™ 5x6 HV package information

Figure 20: PowerFLAT™ 5x6 HV package outline

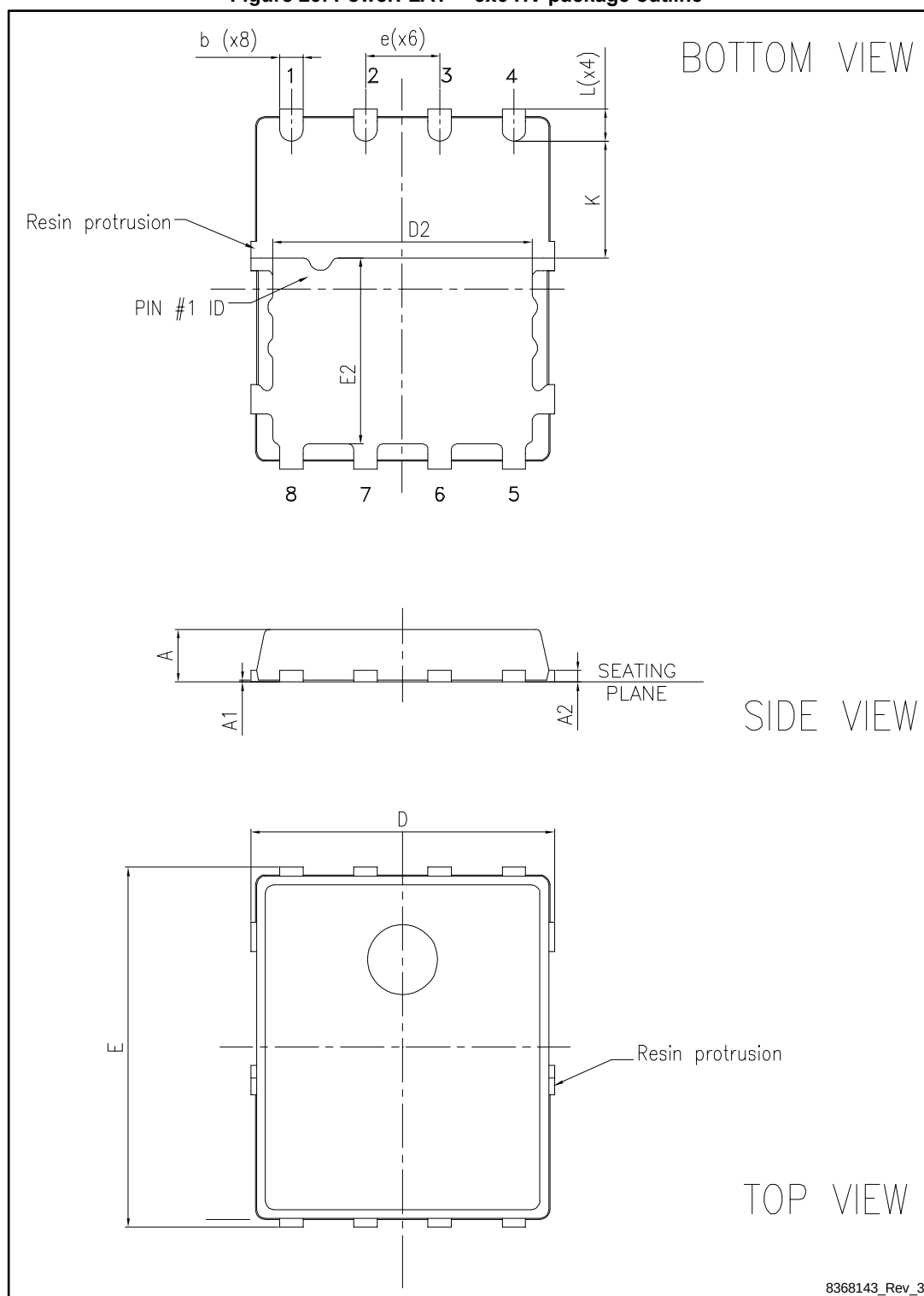
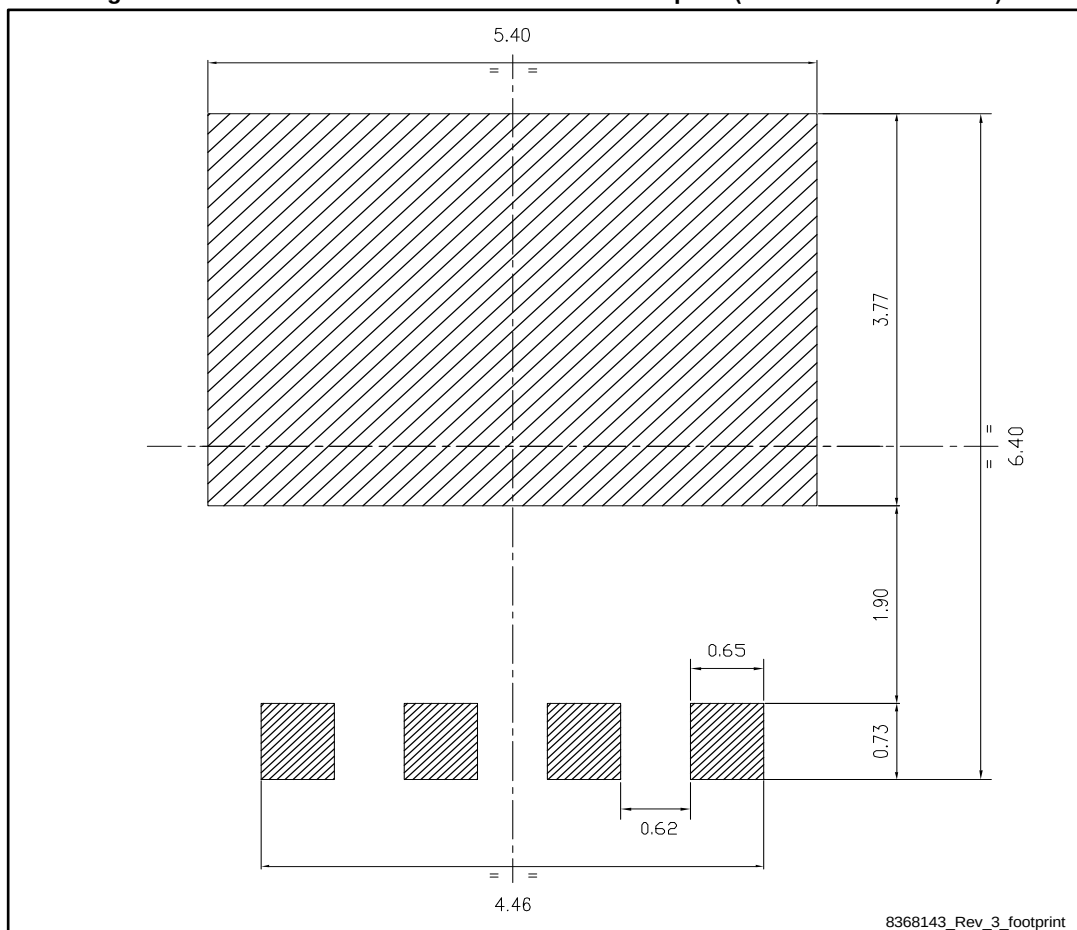


Table 8: PowerFLAT™ 5x6 HV mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	0.80		1.00
A1	0.02		0.05
A2		0.25	
b	0.30		0.50
D	5.10	5.20	5.30
E	6.05	6.15	6.25
E2	3.10	3.20	3.30
D2	4.30	4.40	4.50
e		1.27	
L	0.50	0.55	0.60
K	1.90	2.00	2.10

Figure 21: PowerFLAT™ 5x6 HV recommended footprint (dimensions are in mm)



4.2 PowerFLAT™ 5x6 packing information

Figure 22: PowerFLAT™ 5x6 tape (dimensions are in mm)

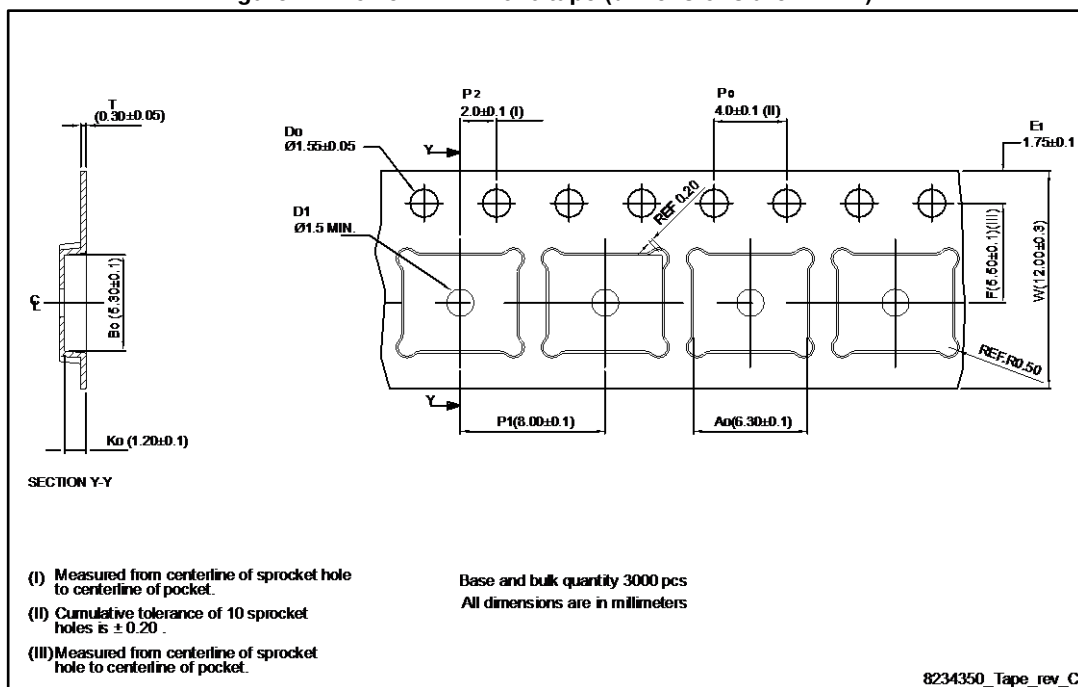


Figure 23: PowerFLAT™ 5x6 package orientation in carrier tape

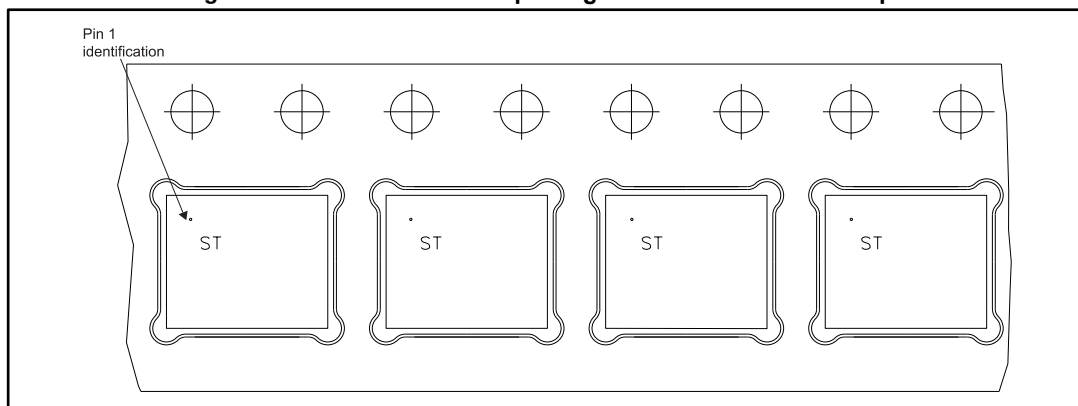
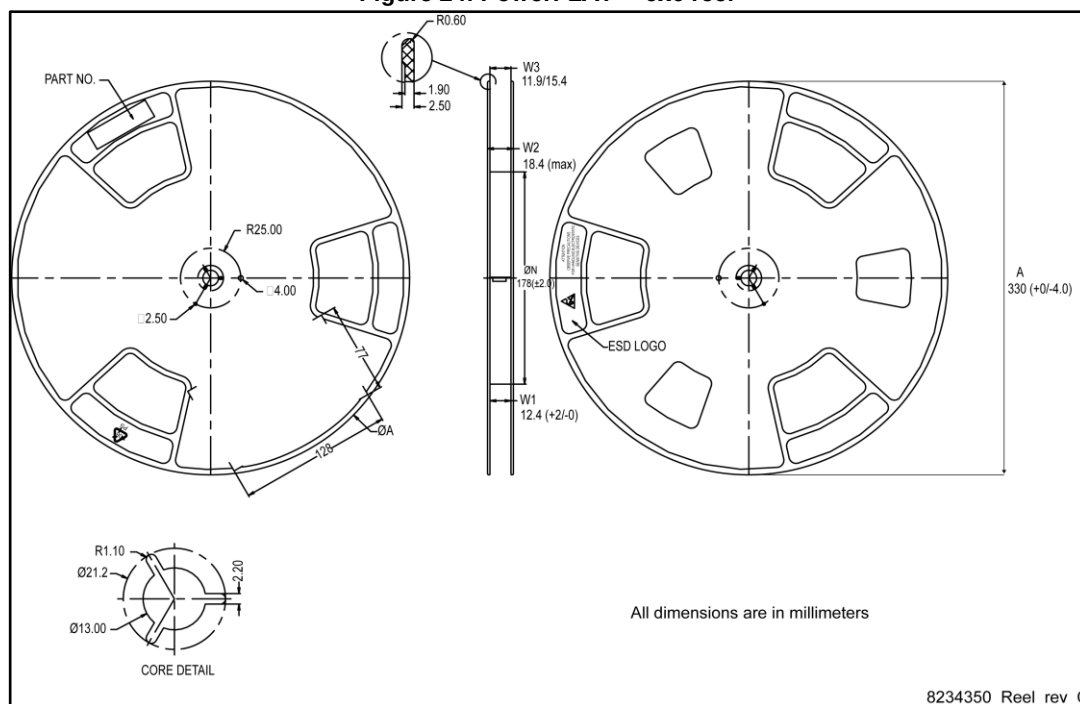


Figure 24: PowerFLAT™ 5x6 reel



5 Revision history

Table 9: Document revision history

Date	Revision	Changes
16-Mar-2017	1	First release

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