

N-channel 600 V, 0.400 Ω typ., 6.5 A MDmesh™ M2 Power MOSFET in a PowerFLAT 5x6 HV package

Datasheet - production data

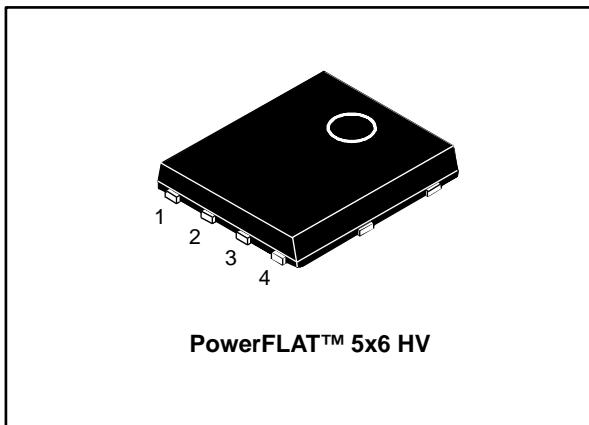
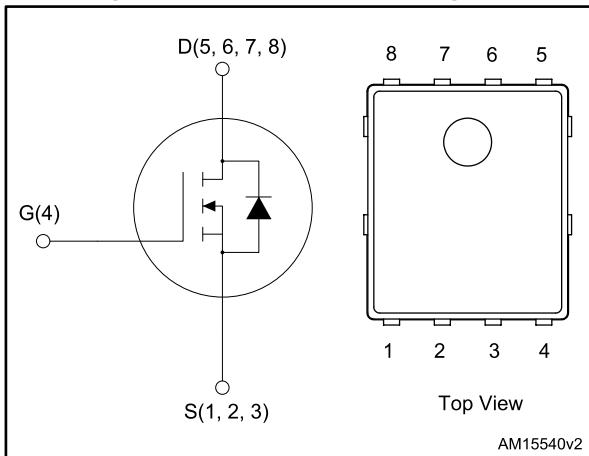


Figure 1: Internal schematic diagram



Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D	P_{TOT}
STL12N60M2	600 V	0.495 Ω	6.5 A	52 W

- 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
STL12N60M2	12N60M2	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 $T_{case} = 25^\circ C$	6.5	A
	Drain current (continuous) at $T_{case} = 100^\circ C$	4.1	
$I_{DM}^{(2)}$	Drain current (pulsed)	26	A
P_{TOT}	Total dissipation at $T_{case} = 25^\circ C$	52	W
$dv/dt^{(3)}$	Peak diode recovery voltage slope	15	V/ns
$dv/dt^{(4)}$	MOSFET dv/dt ruggedness	50	
T_{stg}	Storage temperature	-55 to 150	$^\circ C$
T_j	Operating junction temperature		

Notes:

- (1) Limited by maximum junction temperature.
- (2) Pulse width is limited by safe operating area.
- (3) $I_{SD} \leq 6.5$ A, $di/dt=400$ A/ μ s; $V_{DS}(\text{peak}) < V_{(BR)DSS}$, $V_{DD} = 80\%$ $V_{(BR)DSS}$.
- (4) $V_{DS} \leq 480$ V.

Table 3: Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	2.4	$^\circ C/W$
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb	50	

Notes:

- (1) When mounted on a 1-inch² FR-4, 2 Oz copper board.

Table 4: Avalanche characteristics

Symbol	Parameter	Value	Unit
$I_{AR}^{(1)}$	Avalanche current, repetitive or not repetitive	1.6	A
$E_{AR}^{(2)}$	Single pulse avalanche energy	120	mJ

Notes:

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

2 Electrical characteristics

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

Table 5: Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(\text{BR})\text{DSS}}$	Drain-source breakdown voltage	$V_{\text{GS}} = 0 \text{ V}$, $I_{\text{D}} = 1 \text{ mA}$	600			V
I_{DSS}	Zero gate voltage drain current	$V_{\text{GS}} = 0 \text{ V}$, $V_{\text{DS}} = 600 \text{ V}$			1	μA
		$V_{\text{GS}} = 0 \text{ V}$, $V_{\text{DS}} = 600 \text{ V}$, $T_{\text{case}} = 125^\circ\text{C}$			100	
I_{GSS}	Gate-body leakage current	$V_{\text{DS}} = 0 \text{ V}$, $V_{\text{GS}} = \pm 25 \text{ V}$			± 10	μA
$V_{\text{GS}(\text{th})}$	Gate threshold voltage	$V_{\text{DS}} = V_{\text{GS}}$, $I_{\text{D}} = 250 \mu\text{A}$	2	3	4	V
$R_{\text{DS}(\text{on})}$	Static drain-source on-resistance	$V_{\text{GS}} = 10 \text{ V}$, $I_{\text{D}} = 4.5 \text{ A}$		0.400	0.495	Ω

Table 6: Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{\text{DS}} = 100 \text{ V}$, $f = 1 \text{ MHz}$, $V_{\text{GS}} = 0 \text{ V}$	-	538	-	pF
C_{oss}	Output capacitance		-	29	-	
C_{rss}	Reverse transfer capacitance		-	1.1	-	
$C_{\text{oss eq.}}^{(1)}$	Equivalent output capacitance	$V_{\text{DS}} = 0$ to 480 V , $V_{\text{GS}} = 0 \text{ V}$	-	106	-	pF
R_{G}	Intrinsic gate resistance	$f = 1 \text{ MHz}$, $I_{\text{D}} = 0 \text{ A}$	-	7	-	Ω
Q_{g}	Total gate charge	$V_{\text{DD}} = 400 \text{ V}$, $I_{\text{D}} = 9 \text{ A}$, $V_{\text{GS}} = 10 \text{ V}$ (see Figure 15: "Gate charge test circuit")	-	16	-	nC
Q_{gs}	Gate-source charge		-	2.3	-	
Q_{gd}	Gate-drain charge		-	8.5	-	

Notes:

⁽¹⁾ $C_{\text{oss eq.}}$ 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
$t_{\text{d}(\text{on})}$	Turn-on delay time	$V_{\text{DD}} = 300 \text{ V}$, $I_{\text{D}} = 4.5 \text{ A}$ $R_{\text{G}} = 4.7 \Omega$, $V_{\text{GS}} = 10 \text{ V}$ (see Figure 14: "Switching times test circuit for resistive load" and Figure 19: "Switching time waveform")	-	9.2	-	ns
t_{r}	Rise time		-	9.2	-	
$t_{\text{d}(\text{off})}$	Turn-off delay time		-	56	-	
t_{f}	Fall time		-	18	-	

Table 8: Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		9	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		36	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0 \text{ V}$, $I_{SD} = 9 \text{ A}$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 9 \text{ A}$, $dI/dt = 100 \text{ A}/\mu\text{s}$, $V_{DD} = 60 \text{ V}$ (see Figure 16: "Test circuit for inductive load switching and diode recovery times")	-	284		ns
Q_{rr}	Reverse recovery charge		-	2.4		μC
I_{RRM}	Reverse recovery current		-	17		A
t_{rr}	Reverse recovery time	$I_{SD} = 9 \text{ A}$, $dI/dt = 100 \text{ A}/\mu\text{s}$, $V_{DD} = 60 \text{ V}$, $T_j = 150 \text{ }^\circ\text{C}$ (see Figure 16: "Test circuit for inductive load switching and diode recovery times")	-	404		ns
Q_{rr}	Reverse recovery charge		-	3.5		μC
I_{RRM}	Reverse recovery current		-	17.5		A

Notes:

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

(2) Pulse test: pulse duration = 300 μs , duty cycle 1.5%.

2.1 Electrical characteristics (curves)

Figure 2: Safe operating area

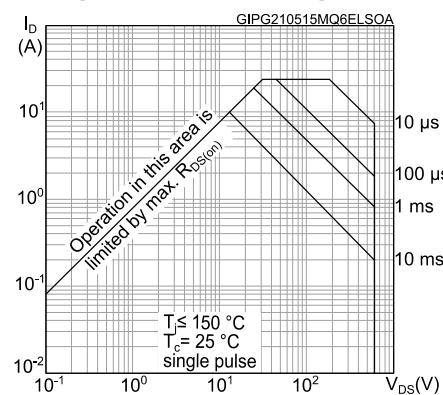


Figure 3: Thermal impedance

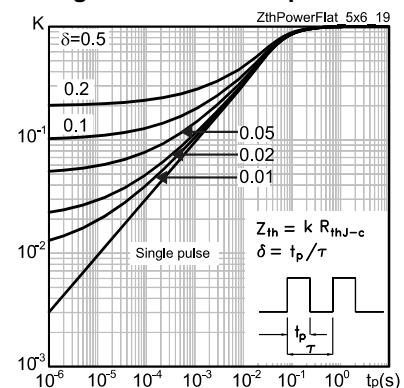


Figure 4: Output characteristics

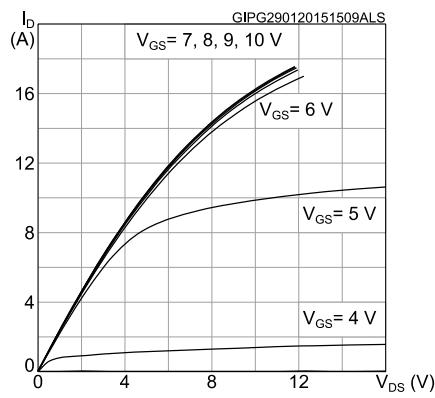


Figure 5: Transfer characteristics

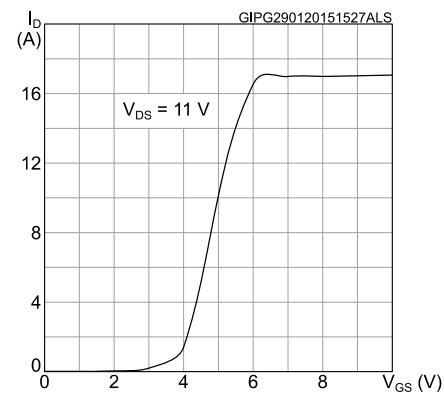


Figure 6: Gate charge vs gate-source voltage

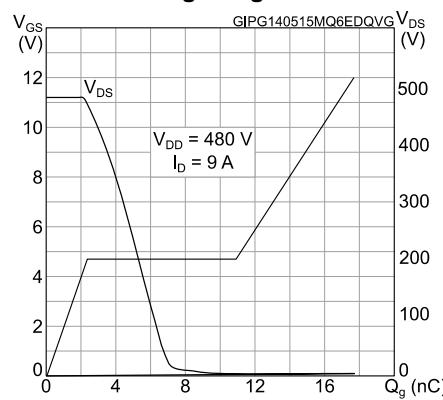


Figure 7: Static drain-source on-resistance

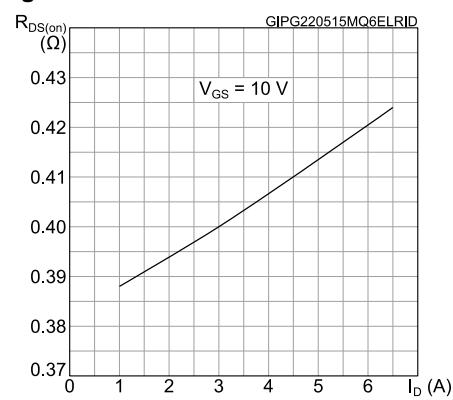


Figure 8: Capacitance variations

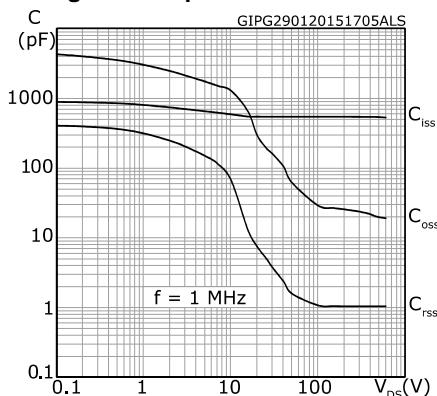


Figure 9: Normalized gate threshold voltage vs temperature

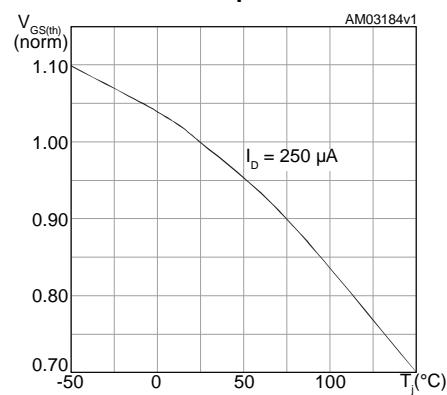


Figure 10: Normalized on-resistance vs temperature

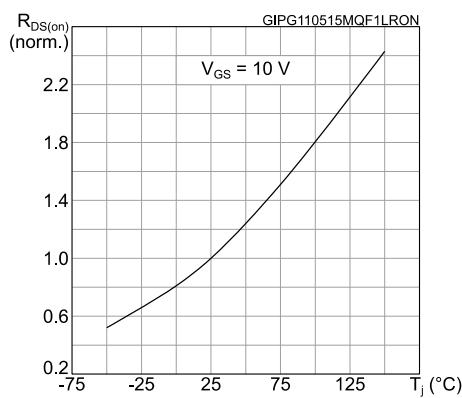


Figure 11: Normalized V(BR)DSS vs temperature

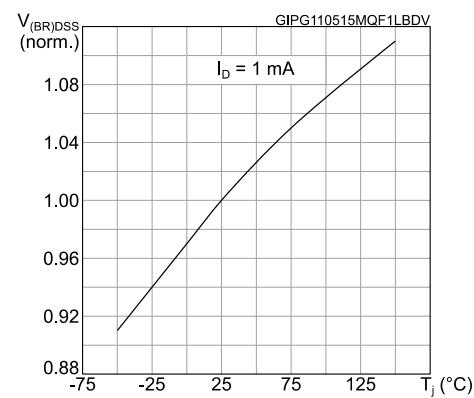


Figure 12: Output capacitance stored energy

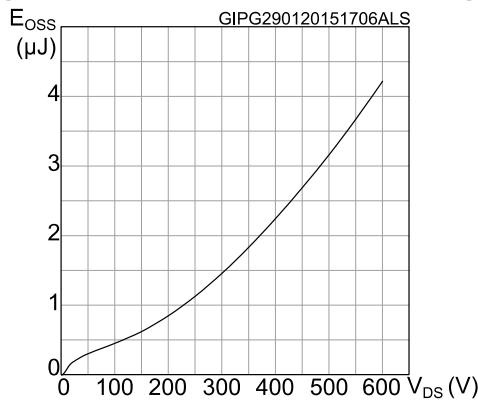
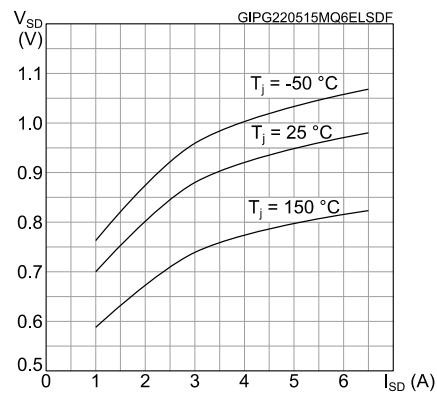


Figure 13: Source- drain diode forward characteristics



3 Test circuits

Figure 14: Switching times test circuit for resistive load

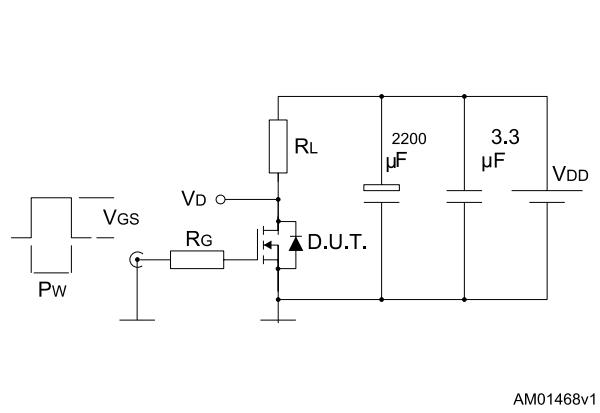


Figure 15: Gate charge test circuit

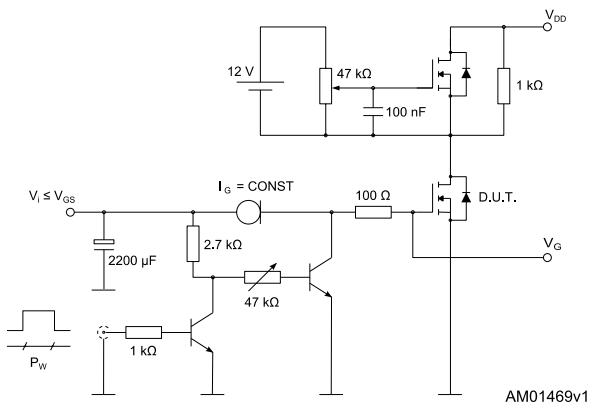


Figure 16: Test circuit for inductive load switching and diode recovery times

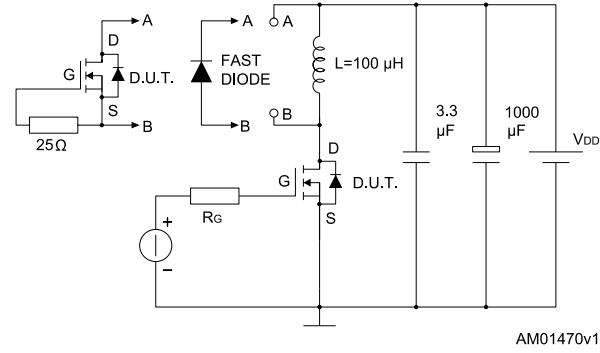


Figure 17: Unclamped inductive load test circuit

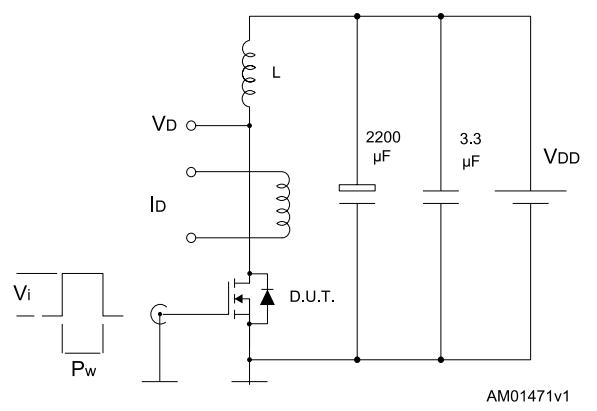


Figure 18: Unclamped inductive waveform

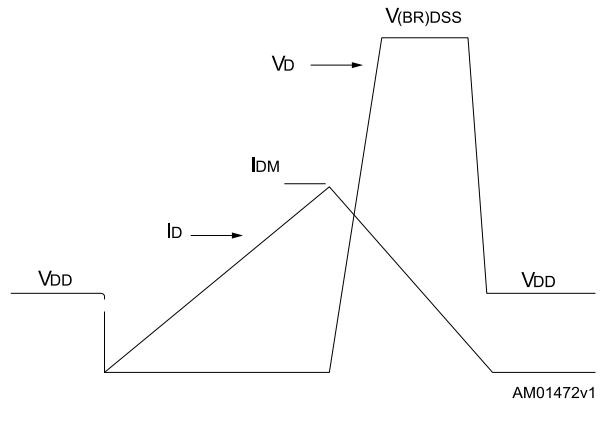
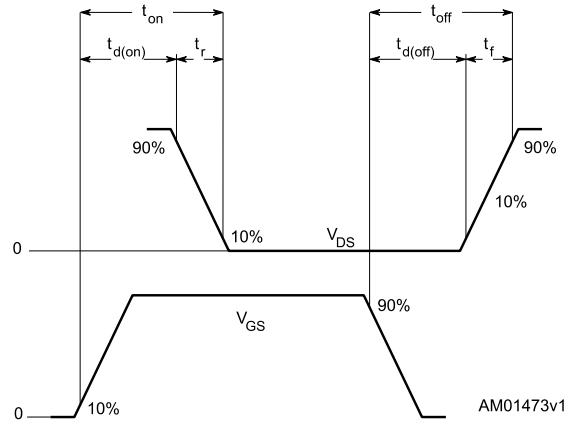


Figure 19: Switching time waveform



4 Package 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

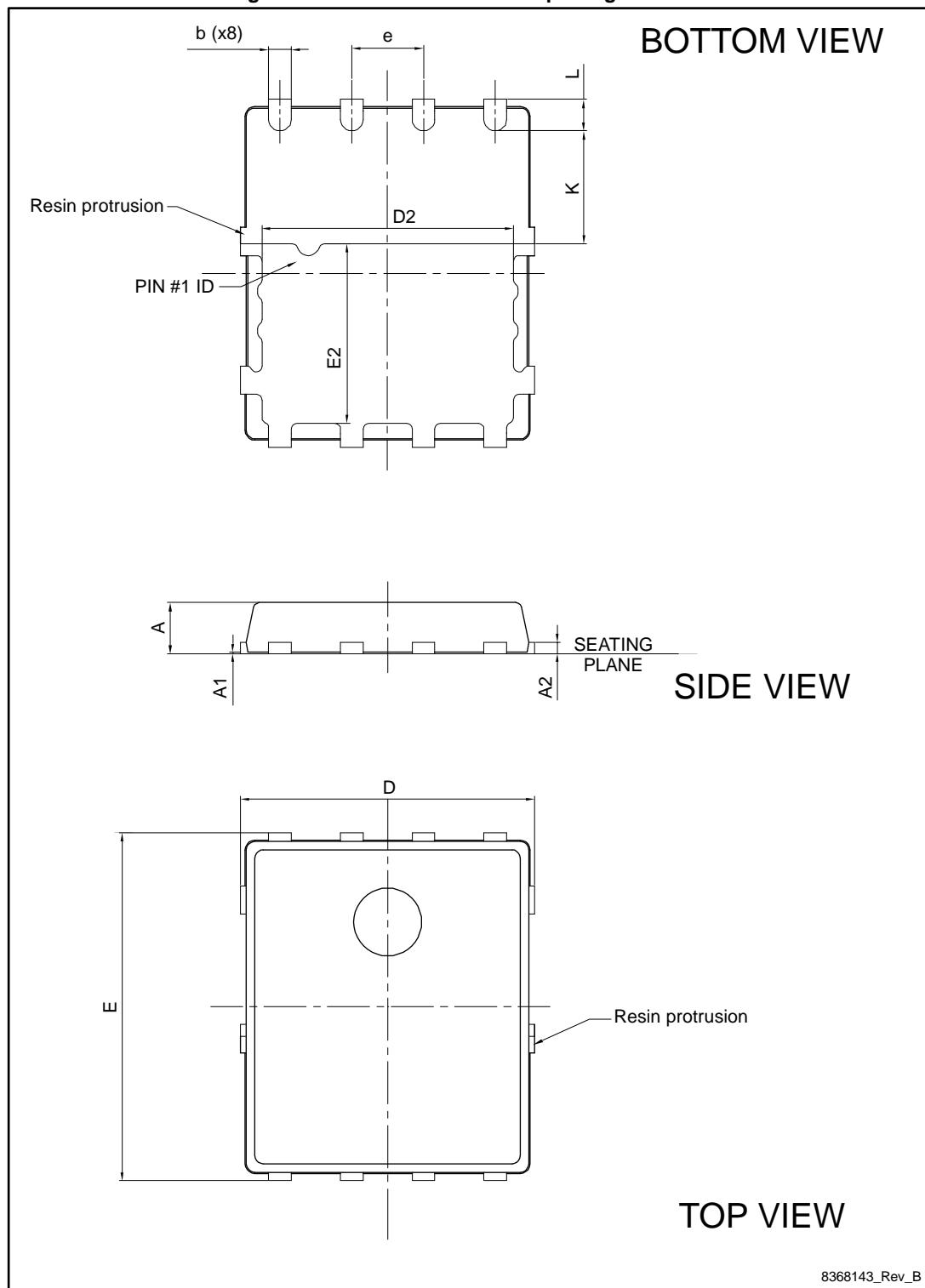
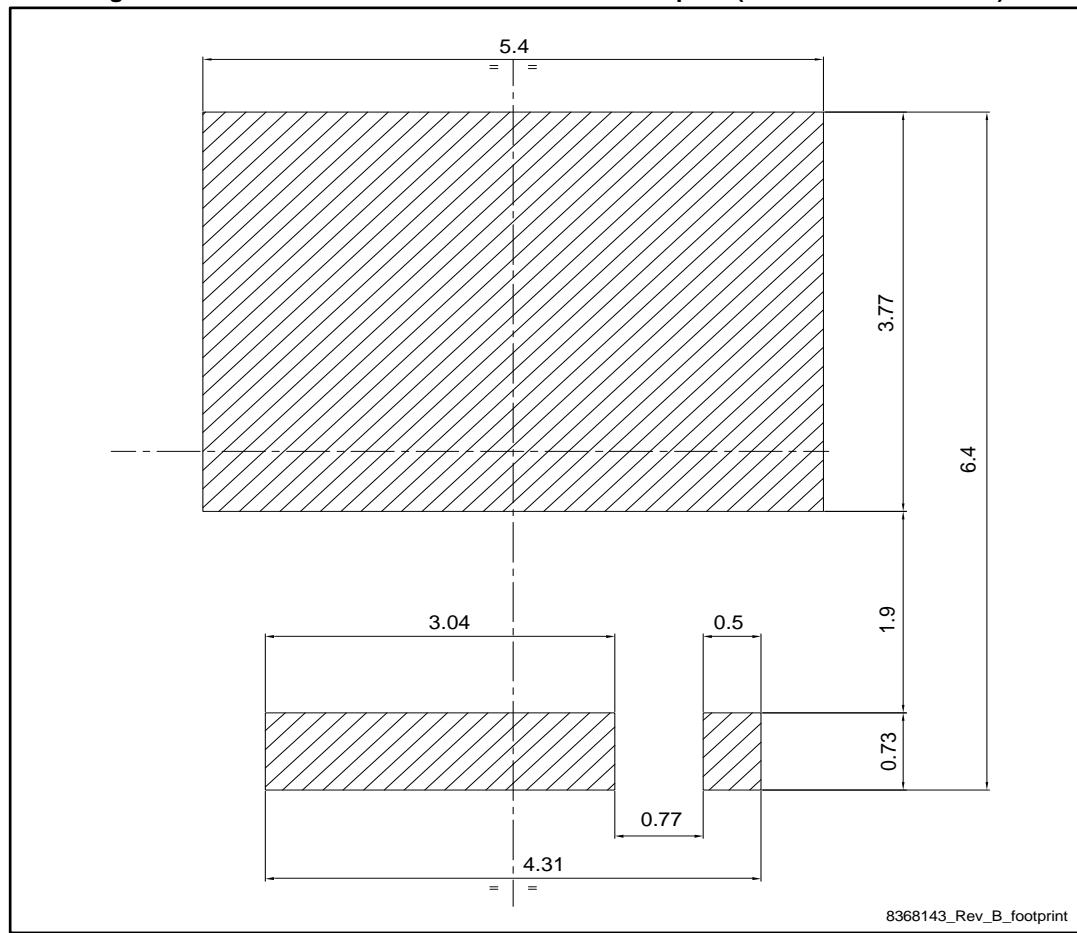


Table 9: PowerFLAT™ 5x6 HV mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	0.80		1.00
A1	0.02		0.05
A2		0.25	
b	0.30		0.50
D	5.00	5.20	5.40
E	5.95	6.15	6.35
D2	4.30	4.40	4.50
E2	3.10	3.20	3.30
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)

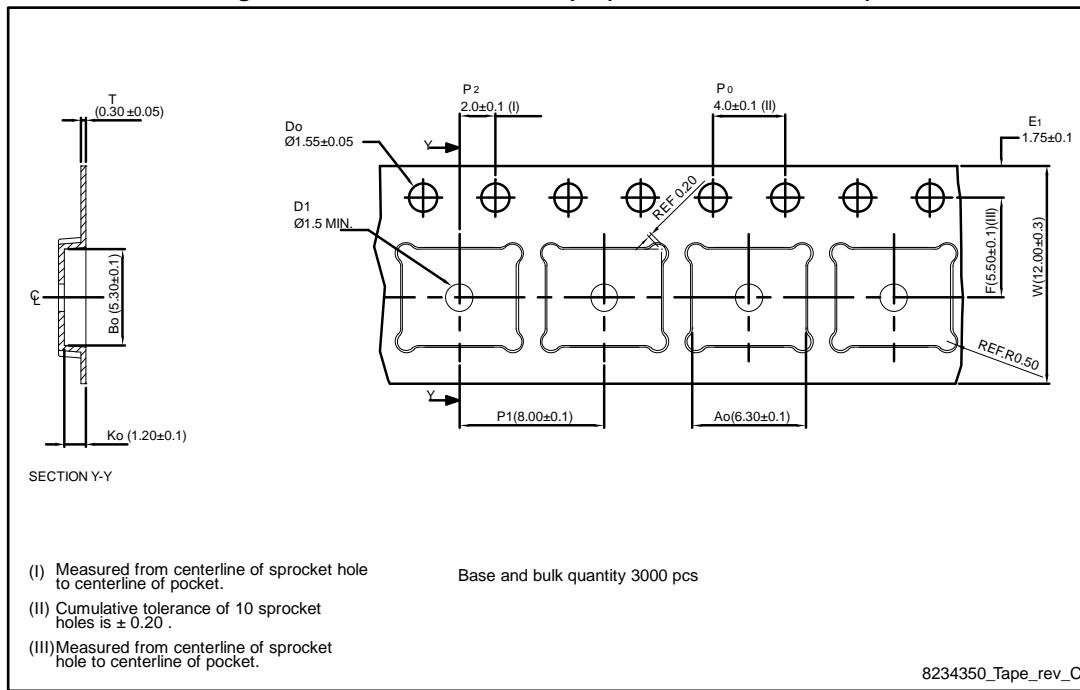


Figure 23: PowerFLAT™ 5x6 package orientation in carrier tape

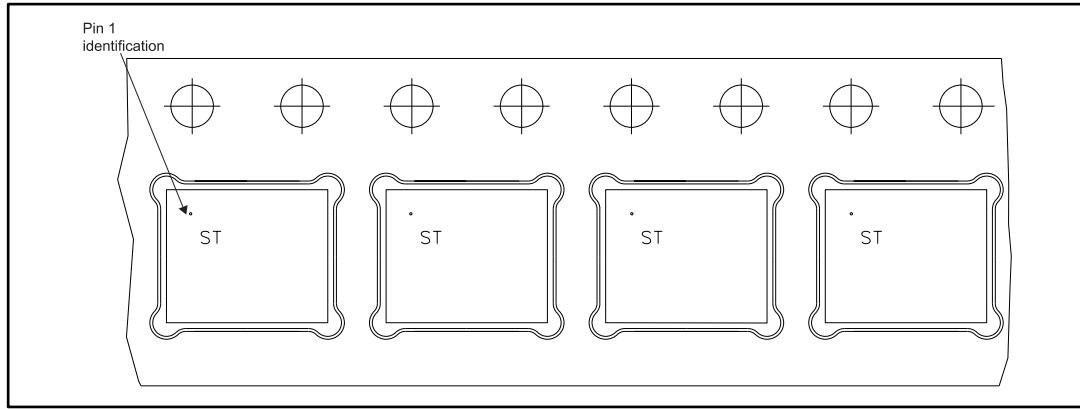
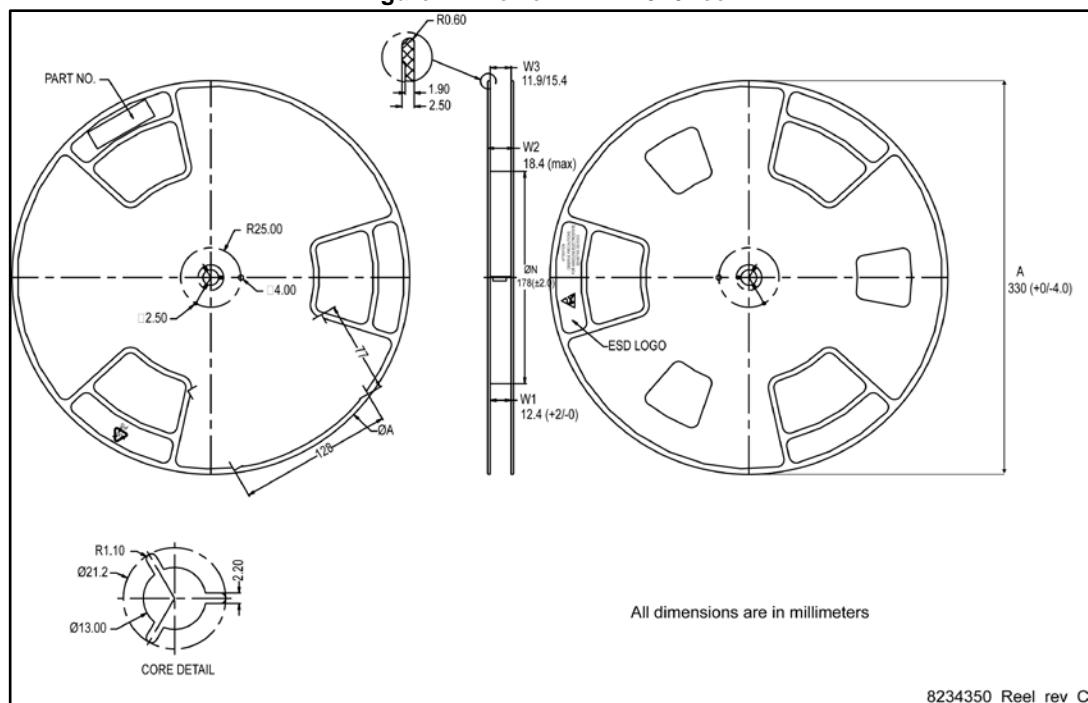


Figure 24: PowerFLAT™ 5x6 reel



5 Revision history

Table 10: Document revision history

Date	Revision	Changes
22-May-2015	1	First release.

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