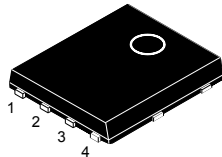
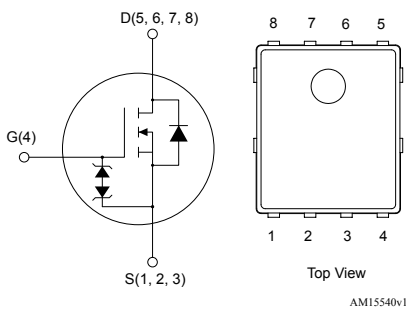


N-channel 600 V, 0.390 Ω typ., 7 A MDmesh™ M2 EP Power MOSFET in a PowerFLAT™ 5x6 HV package



PowerFLAT™ 5x6 HV



Features

Order code	$V_{DS} @ T_{Jmax}$	$R_{DS(on)}$ max.	I_D	P_{TOT}
STL15N60M2-EP	650 V	0.418 Ω	7 A	55 W

- Extremely low gate charge
- Excellent output capacitance (C_{OSS}) profile
- Very low turn-off switching losses
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications
- Tailored for very high frequency converters ($f > 150$ kHz)

Description

This device is an N-channel Power MOSFET developed using MDmesh™ M2 enhanced performance (EP) technology. Thanks to its strip layout and an improved vertical structure, the device exhibits low on-resistance, optimized switching characteristics with very low turn-off switching losses, rendering it suitable for the most demanding very high frequency converters.

Product status	
STL15N60M2-EP	
Product summary	
Order code	STL15N60M2-EP
Marking	15N60M2E
Package	PowerFLAT™ 5x6 HV
Packing	Tape and Reel

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	± 25	V
I_D	Drain current (continuous) at $T_{case} = 25\text{ }^{\circ}\text{C}$	7	A
	Drain current (continuous) at $T_{case} = 100\text{ }^{\circ}\text{C}$	4.6	
$I_{DM}^{(1)}$	Drain current (pulsed)	28	A
P_{TOT}	Total dissipation at $T_{case} = 25\text{ }^{\circ}\text{C}$	55	W
$I_{AR}^{(2)}$	Avalanche current, repetitive or not repetitive	1.5	A
$E_{AS}^{(3)}$	Single pulse avalanche energy	110	mJ
$dv/dt^{(4)}$	Peak diode recovery voltage slope	15	V/ns
$dv/dt^{(5)}$	MOSFET dv/dt ruggedness	50	
T_{stg}	Storage temperature range	-55 to 150	$^{\circ}\text{C}$
T_j	Operating junction temperature range		

1. Pulse width is limited by safe operating area.
2. Pulse width limited by T_{jmax} .
3. starting $T_j = 25\text{ }^{\circ}\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$.
4. $I_{SD} \leq 7\text{ A}$, $di/dt = 400\text{ A}/\mu\text{s}$; $V_{DS\text{ peak}} < V_{(BR)DSS}$; $V_{DD} = 400\text{ V}$.
5. $V_{DS} \leq 480\text{ V}$.

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	2.27	$^{\circ}\text{C}/\text{W}$
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb	59	

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

2 Electrical characteristics

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

Table 3. 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
		$V_{\text{GS}} = 0\text{ V}$, $V_{\text{DS}} = 600\text{ V}$, $T_{\text{case}} = 125\text{ }^{\circ}\text{C}$ ⁽¹⁾			100	
I_{GSS}	Gate-body leakage current	$V_{\text{DS}} = 0\text{ V}$, $V_{\text{GS}} = \pm 25\text{ V}$			± 10	μA
$V_{\text{GS(th)}}$	Gate threshold voltage	$V_{\text{DS}} = V_{\text{GS}}$, $I_{\text{D}} = 250\text{ }\mu\text{A}$	3.25	4	4.75	V
$R_{\text{DS(on)}}$	Static drain-source on-resistance	$V_{\text{GS}} = 10\text{ V}$, $I_{\text{D}} = 4.5\text{ A}$		0.390	0.418	Ω

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

Table 4. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{\text{DS}} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{\text{GS}} = 0\text{ V}$	-	590	-	pF
C_{oss}	Output capacitance		-	30	-	
C_{rss}	Reverse transfer capacitance		-	1.1	-	
$C_{\text{oss eq.}}^{(1)}$	Equivalent output capacitance	$V_{\text{DS}} = 0\text{ to }480\text{ V}$, $V_{\text{GS}} = 0\text{ V}$	-	148	-	pF
R_{G}	Intrinsic gate resistance	$f = 1\text{ MHz}$, $I_{\text{D}} = 0\text{ A}$	-	7	-	Ω
Q_{g}	Total gate charge	$V_{\text{DD}} = 480\text{ V}$, $I_{\text{D}} = 11\text{ A}$, $V_{\text{GS}} = 0\text{ to }10\text{ V}$ (see Figure 15. Test circuit for gate charge behavior)	-	17	-	nC
Q_{gs}	Gate-source charge		-	3.1	-	
Q_{gd}	Gate-drain charge		-	7.3	-	

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 5. Switching energy

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E_{OFF}	Turn-off energy (from 90% V_{GS} to 0% I_{D})	$V_{\text{DD}} = 400\text{ V}$, $I_{\text{D}} = 1.5\text{ A}$, $R_{\text{G}} = 4.7\text{ }\Omega$, $V_{\text{GS}} = 10\text{ V}$	-	4.7	-	μJ
		$V_{\text{DD}} = 400\text{ V}$, $I_{\text{D}} = 3.5\text{ A}$, $R_{\text{G}} = 4.7\text{ }\Omega$, $V_{\text{GS}} = 10\text{ V}$	-	5.2	-	

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300\text{ V}$, $I_D = 5.5\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 14. Test circuit for resistive load switching times and Figure 19. Switching time waveform)	-	11	-	ns
t_r	Rise time		-	10	-	
$t_{d(off)}$	Turn-off delay time		-	40	-	
t_f	Fall time		-	15	-	

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		7	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		28	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0\text{ V}$, $I_{SD} = 7\text{ A}$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 11\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$ (see Figure 16. Test circuit for inductive load switching and diode recovery times)	-	280		ns
Q_{rr}	Reverse recovery charge		-	2.7		μC
I_{RRM}	Reverse recovery current	$I_{SD} = 11\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 16. Test circuit for inductive load switching and diode recovery times)	-	19.5		A
t_{rr}	Reverse recovery time		-	400		ns
Q_{rr}	Reverse recovery charge		-	3.8		μC
I_{RRM}	Reverse recovery current		-	19		A

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 1. Safe operating area

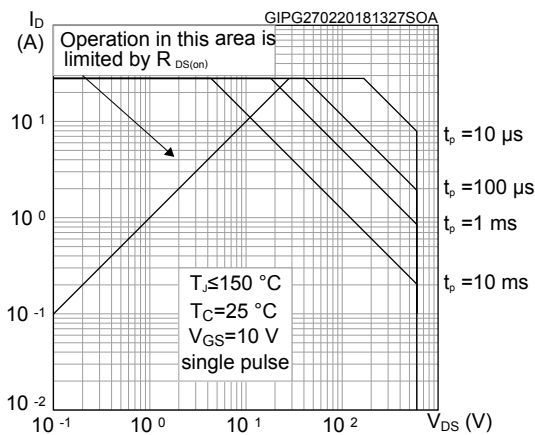


Figure 2. Thermal impedance

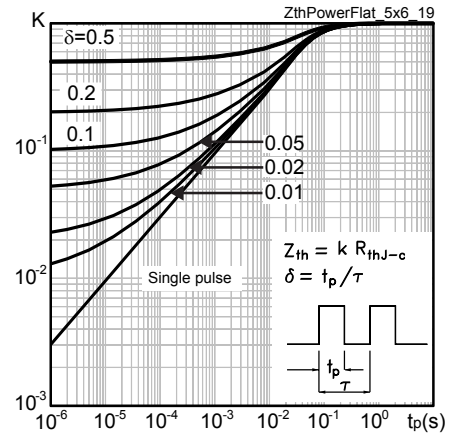


Figure 3. Output characteristics

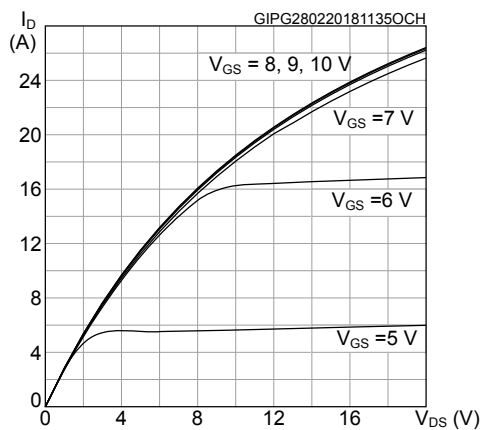


Figure 4. Transfer characteristics

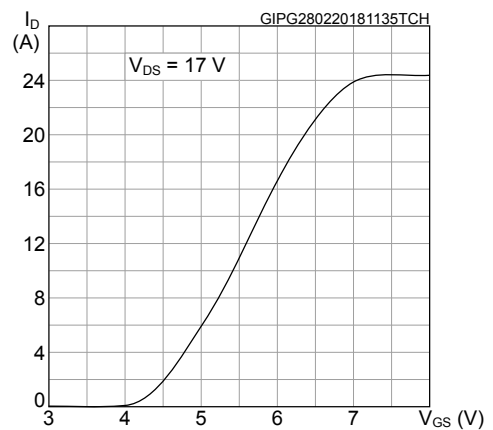


Figure 5. Gate charge vs gate-source voltage

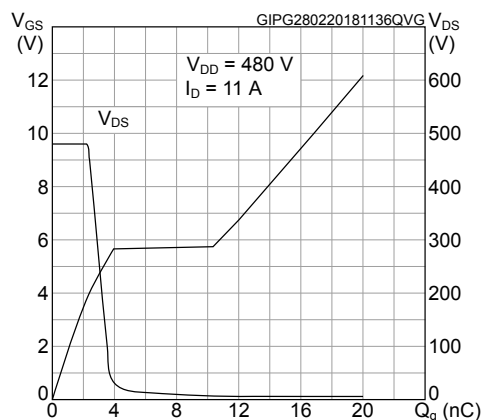


Figure 6. Static drain-source on-resistance

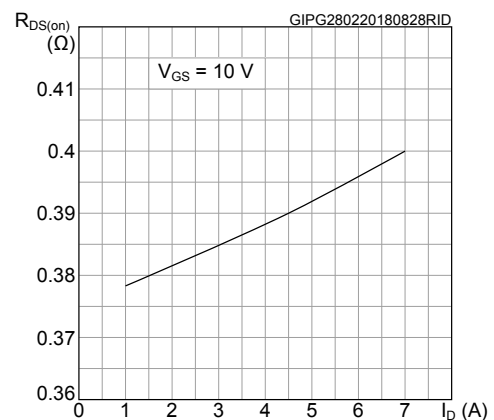


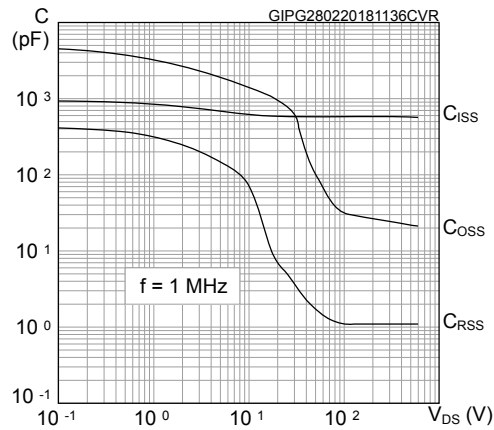
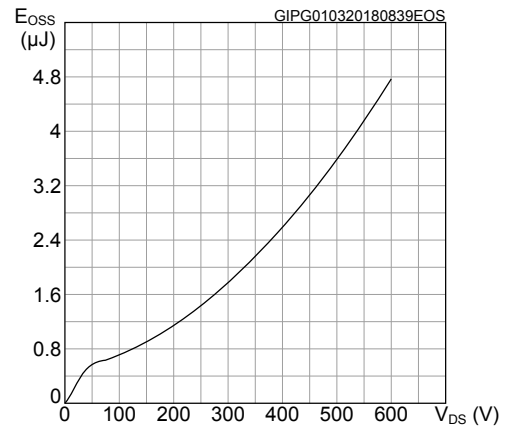
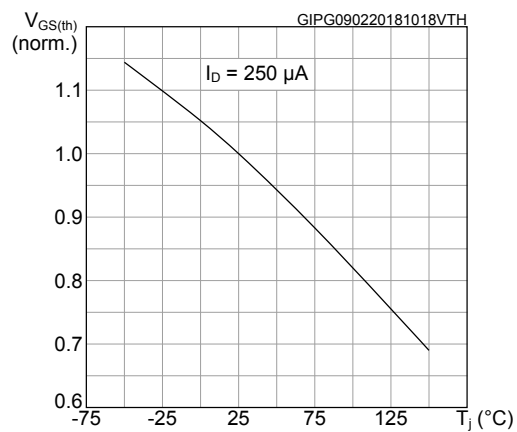
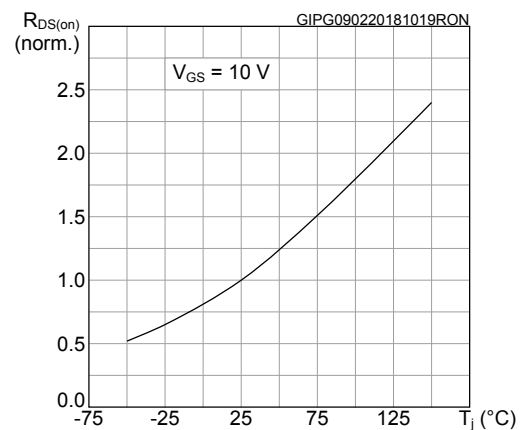
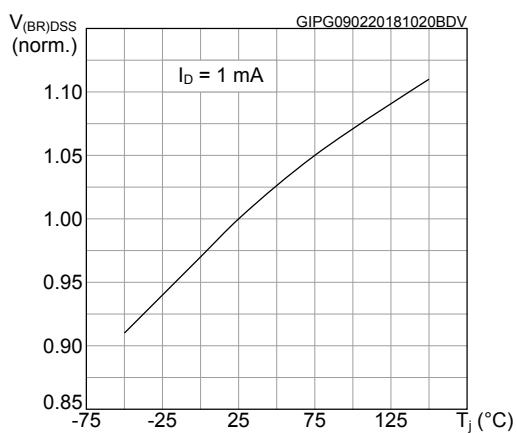
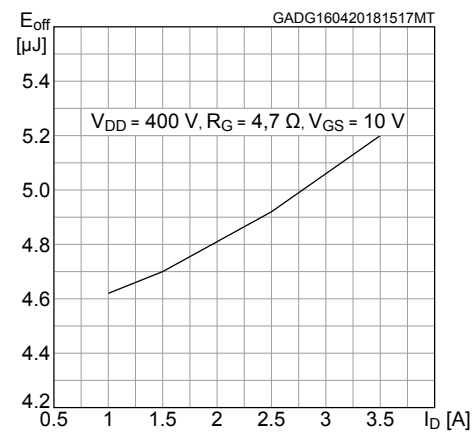
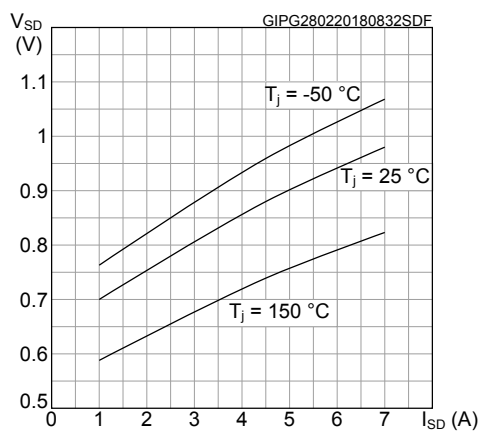
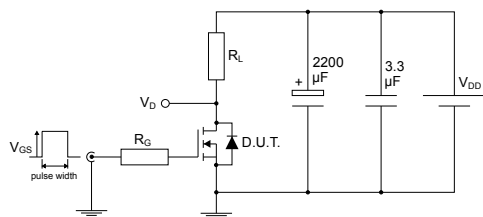
Figure 7. Capacitance variations

Figure 8. Output capacitance stored energy

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. Turn-off switching energy vs drain current


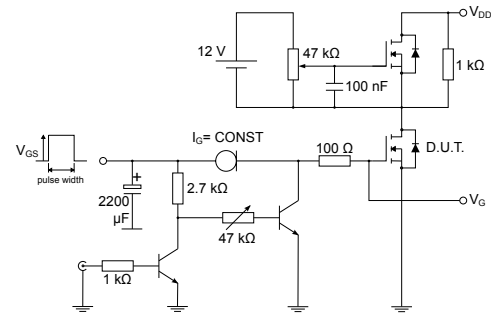
Figure 13. Source-drain diode forward characteristics



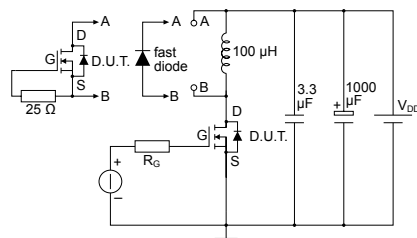
3 Test circuits

Figure 14. Test circuit for resistive load switching times


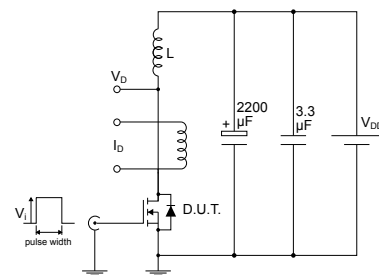
AM01468v1

Figure 15. Test circuit for gate charge behavior


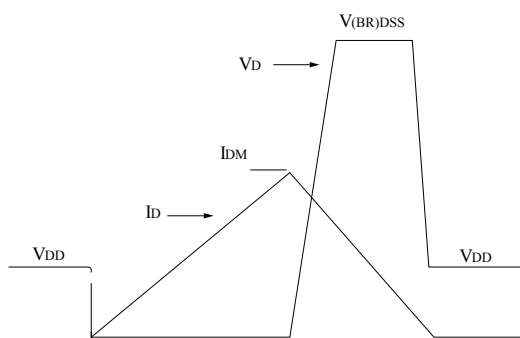
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Figure 16. Test circuit for inductive load switching and diode recovery times


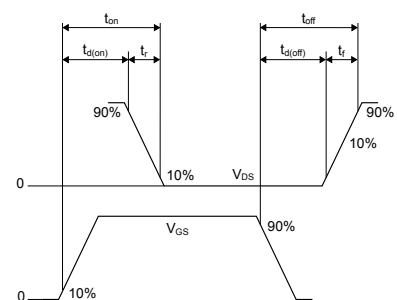
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Figure 17. Unclamped inductive load test circuit


AM01471v1

Figure 18. Unclamped inductive waveform


AM01472v1

Figure 19. Switching time waveform


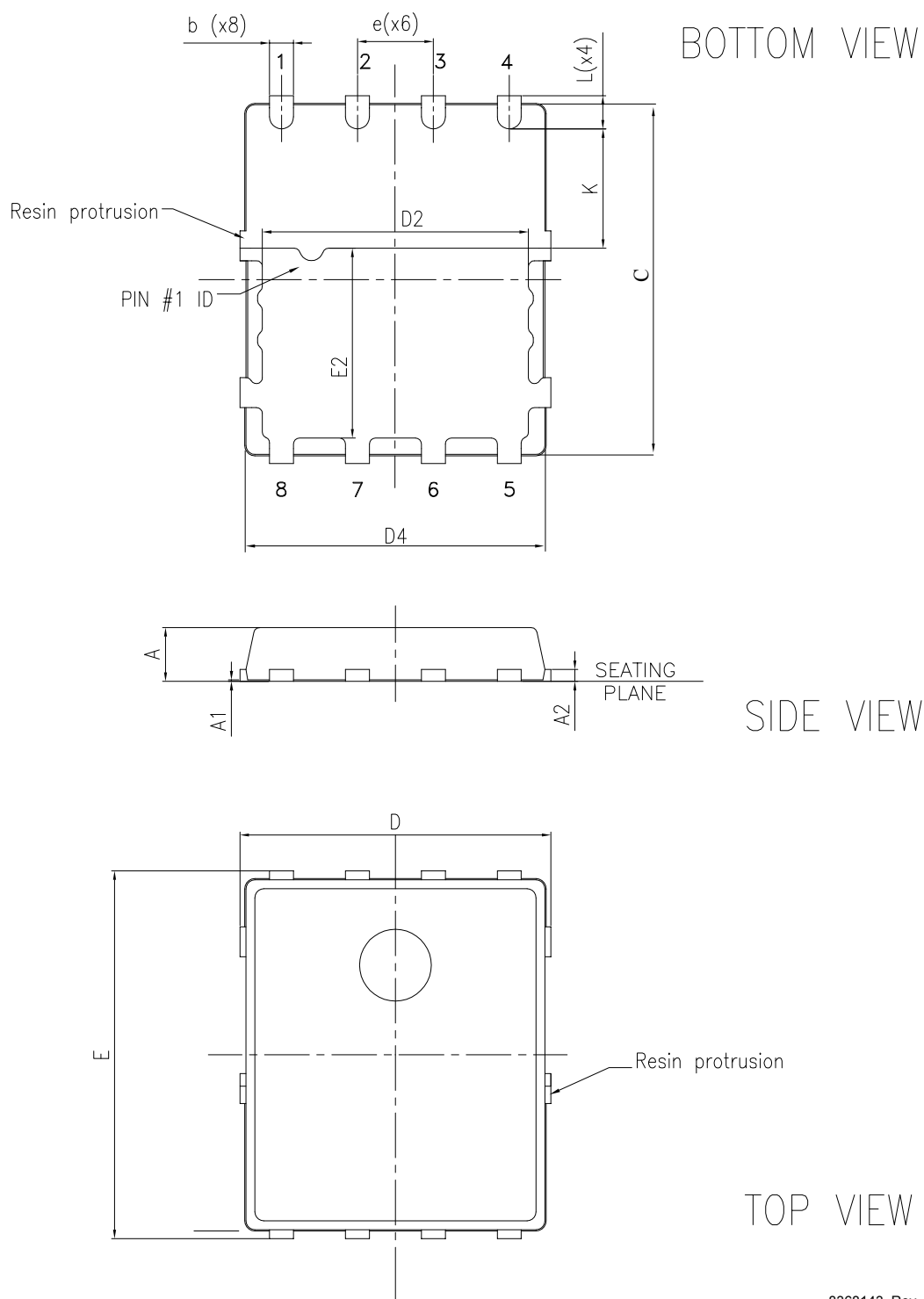
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4 Package information

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

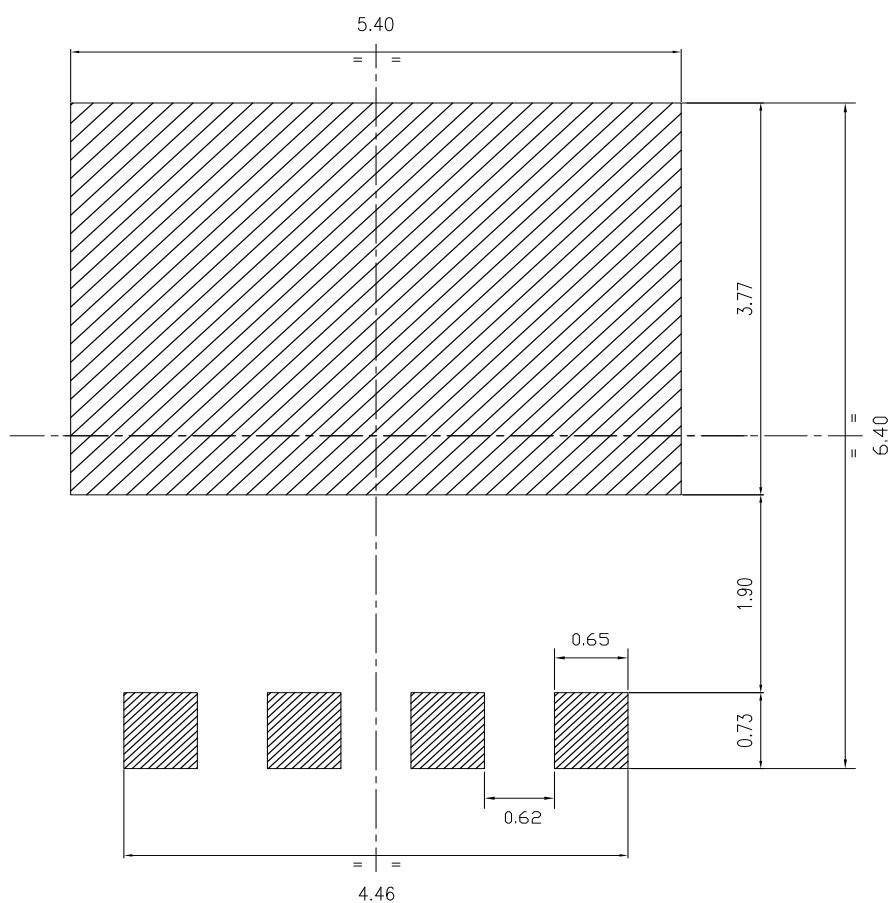
Figure 20. PowerFLAT™ 5x6 HV package outline



8368143_Rev_3

Table 8. PowerFLAT™ 5x6 HV mechanical data

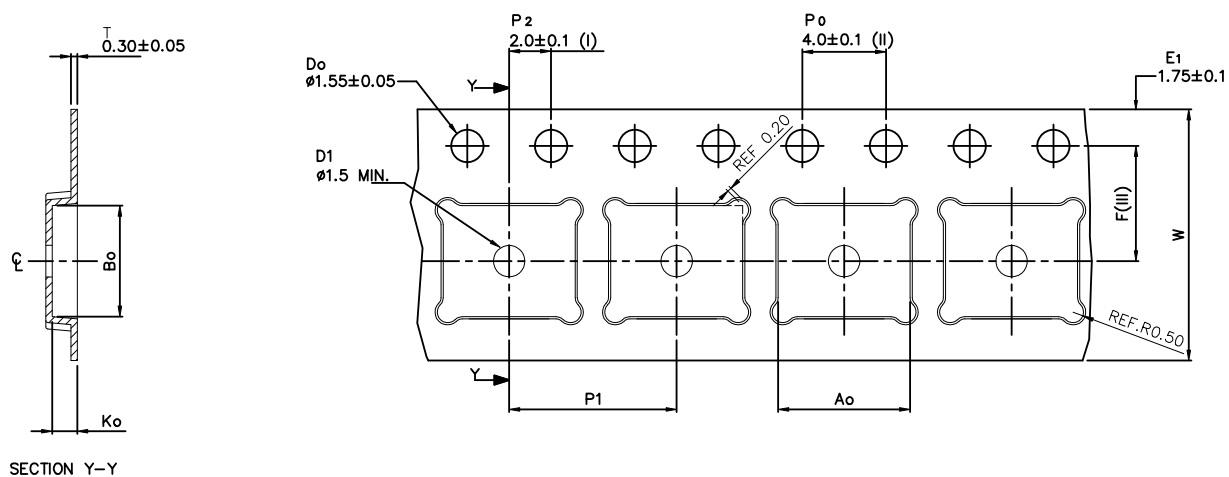
Dim.	mm		
	Min.	Typ.	Max.
A	0.80		1.00
A1	0.02		0.05
A2		0.25	
b	0.30		0.50
C	5.8	6	6.1
D	5.10	5.20	5.30
E	6.05	6.15	6.25
E2	3.10	3.20	3.30
D2	4.30	4.40	4.50
D4	4.8	5	5.1
e		1.27	
L	0.50	0.55	0.60
K	1.90	2.00	2.10

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


8368143_Rev_3_footprint

4.2 PowerFLAT™ 5x6 packing information

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



Ao	6.30 $\pm$ 0.1
Bo	5.30 $\pm$ 0.1
Ko	1.20 $\pm$ 0.1
F	5.50 $\pm$ 0.1
P1	8.00 $\pm$ 0.1
W	12.00 $\pm$ 0.3

- (I) Measured from centreline of sprocket hole to centreline of pocket.
- (II) Cumulative tolerance of 10 sprocket holes is ± 0.20 .
- (III) Measured from centreline of sprocket hole to centreline of pocket

Base and bulk quantity 3000 pcs
All dimensions are in millimeters

8234350_Tape_rev_C

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

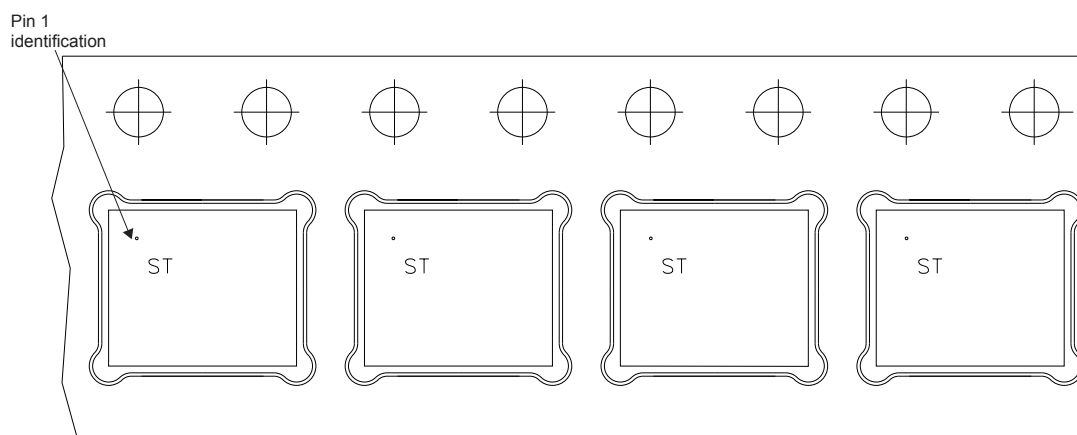
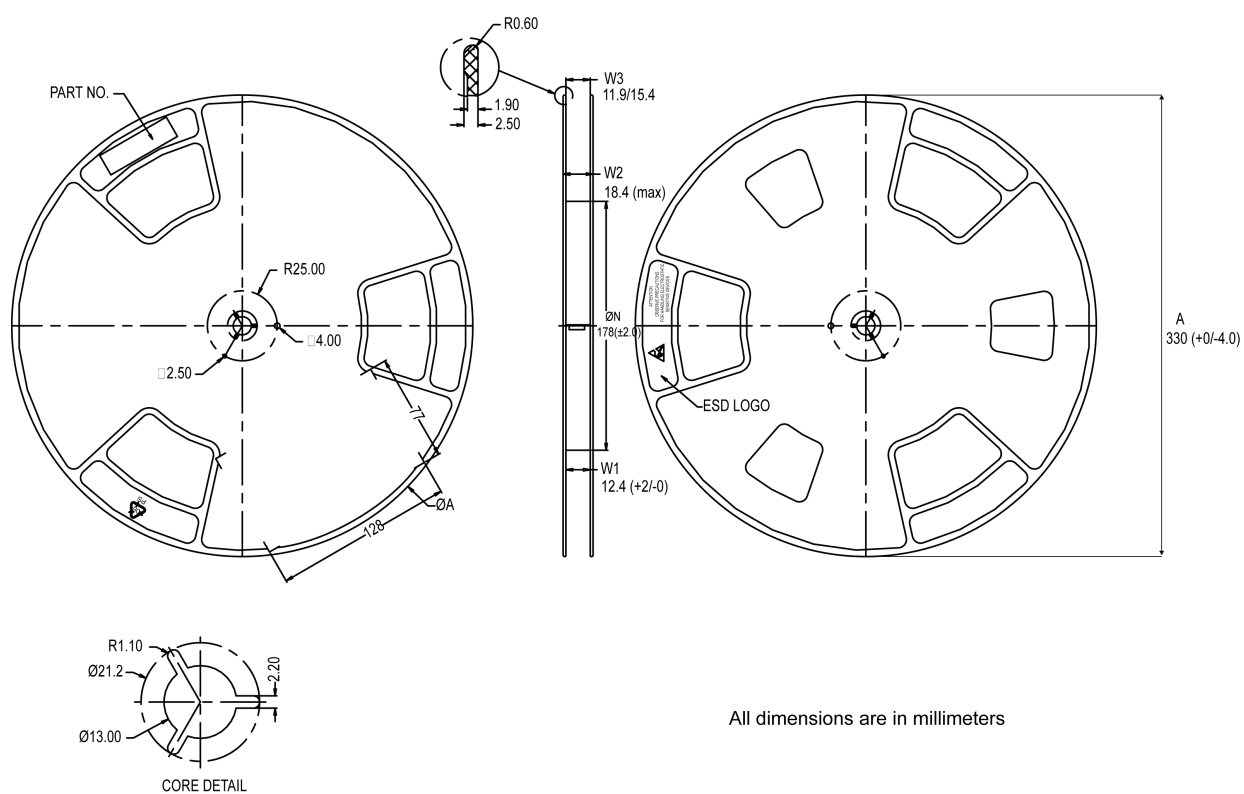


Figure 24. PowerFLAT™ 5x6 reel



8234350_Reel_rev_C

Revision history

Table 9. Document revision history

Date	Revision	Changes
15-Jun-2015	1	First release.
06-Mar-2018	2	Removed maturity status indication from cover page. The document status is production data. Modified <i>Table 3. Static</i> . Modified the entire <i>Section 2.1 Electrical characteristics (curves)</i> . Minor text changes.
15-May-2018	3	Added note in <i>Table 4. Dynamic</i> . Updated <i>Table 5. Switching energy</i> and <i>Figure 12. Turn-off switching energy vs drain current</i> . Minor text changes.

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