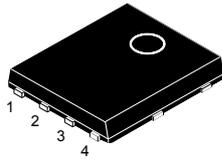
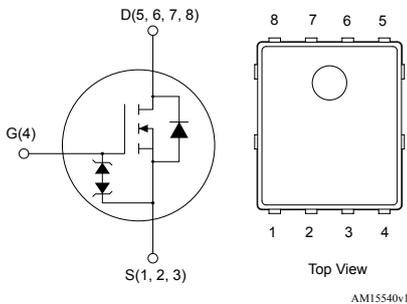


## N-channel 650 V, 0.85 $\Omega$ typ., 4.5 A MDmesh M2 Power MOSFET in a PowerFLAT 5x6 HV package


**PowerFLAT 5x6 HV**


### Features

Order code	$V_{DS}$	$R_{DS(on)}$ max.	$I_D$
STL10N65M2	650 V	1.00 $\Omega$	4.5 A

- 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.



#### Product status link

[STL10N65M2](#)

#### Product summary

<b>Order code</b>	STL10N65M2
<b>Marking</b>	10N65M2
<b>Package</b>	PowerFLAT 5x6 HV
<b>Packing</b>	Tape and reel

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{GS}$	Gate-source voltage	$\pm 25$	V
$I_D$	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
$I_{DM}^{(1)}$	Drain current pulsed	18	A
$P_{TOT}$	Total power 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
$dv/dt^{(2)}$	Peak diode recovery voltage slope	15	V/ns
$dv/dt^{(3)}$	MOSFET $dv/dt$ ruggedness	50	
$T_J$	Operating junction temperature range	-55 to 150	$^\circ\text{C}$
$T_{stg}$	Storage temperature range		

1. Pulse width is limited by safe operating area.
2.  $I_{SD} \leq 4.5\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ,  $V_{DS(peak)} \leq V_{(BR)DSS}$ ,  $V_{DD} = 400\text{ V}$ .
3.  $V_{DS} \leq 520\text{ V}$ .

**Table 2. Thermal data**

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

1. When mounted on 1 inch<sup>2</sup> FR-4 board, 2 oz Cu.

## 2 Electrical characteristics

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

**Table 3. On/off states**

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	$\mu\text{A}$
		$V_{GS} = 0\text{ V}$ , $V_{DS} = 650\text{ V}$ , $T_C = 125\text{ °C}$ <sup>(1)</sup>			100	$\mu\text{A}$
$I_{GSS}$	Gate-body leakage current	$V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 25\text{ V}$			$\pm 10$	$\mu\text{A}$
$V_{GS(th)}$	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	$\Omega$

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

**Table 4. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$	-	310	-	pF
$C_{oss}$	Output capacitance		-	18	-	pF
$C_{riss}$	Reverse transfer capacitance		-	0.9	-	pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent capacitance energy related	$V_{DS} = 0$ to $520\text{ V}$ , $V_{GS} = 0\text{ V}$	-	109	-	pF
$R_g$	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	6.6	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 520\text{ V}$ , $I_D = 5\text{ A}$	-	10.3	-	nC
$Q_{gs}$	Gate-source charge	$V_{GS} = 0$ to $10\text{ V}$	-	2.4	-	nC
$Q_{gd}$	Gate-drain charge	(see Figure 14. Test circuit for gate charge behavior)	-	4.8	-	nC

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 5. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 325\text{ V}$ , $I_D = 2.5\text{ A}$ ,	-	7.5	-	ns
$t_r$	Rise time	$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$	-	6.6	-	ns
$t_{d(off)}$	Turn-off delay time	(see Figure 13. Test circuit for resistive load switching times and	-	22.5	-	ns
$t_f$	Fall time	Figure 18. Switching time waveform)	-	18	-	ns

**Table 6. 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	$I_{SD} = 5 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$ ,	-	276		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 60 \text{ V}$	-	1.7		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	12.5		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 5 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$ ,	-	312		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 60 \text{ V}$ , $T_J = 150 \text{ }^\circ\text{C}$	-	1.9		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	12.4		A

1. Pulse width is limited by safe operating area.
2. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

## 2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

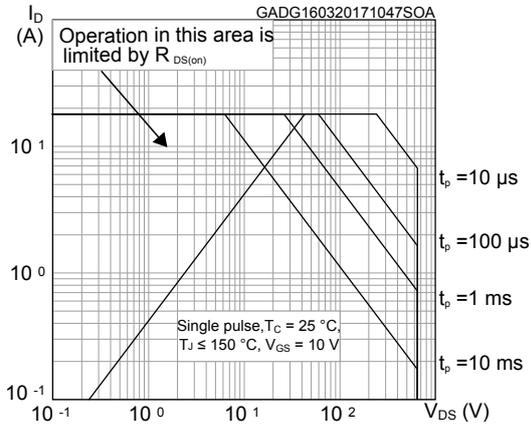


Figure 2. Thermal impedance

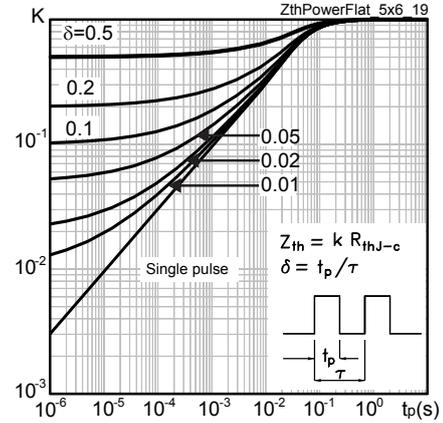


Figure 3. Output characteristics

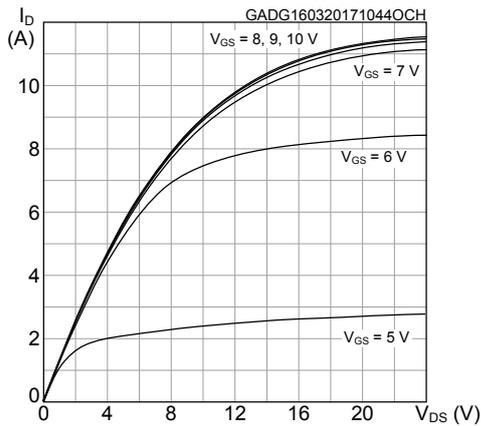


Figure 4. Transfer characteristics

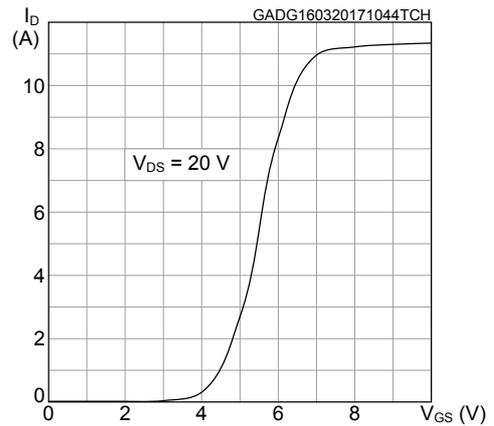


Figure 5. Gate charge vs gate-source voltage

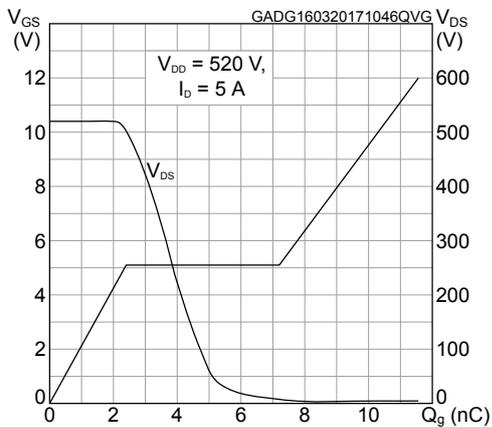


Figure 6. Static drain-source on-resistance

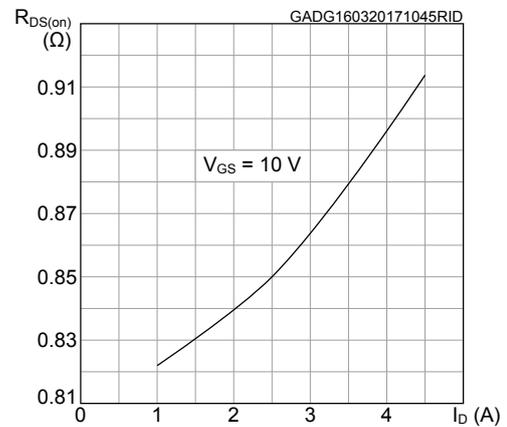


Figure 7. Capacitance variations

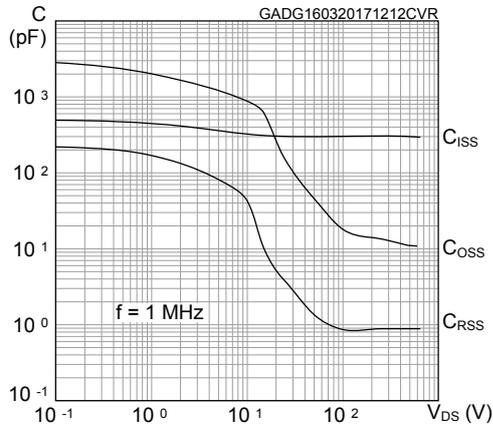


Figure 8. Output capacitance stored energy

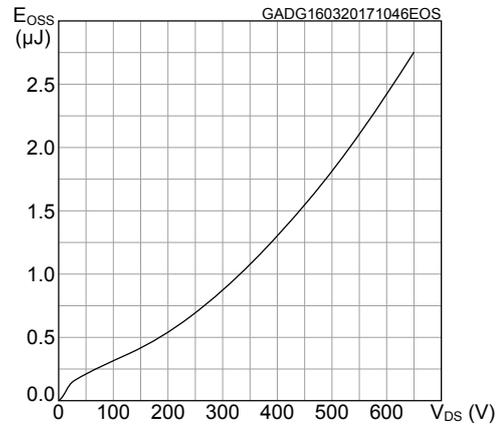


Figure 9. Normalized gate threshold voltage vs temperature

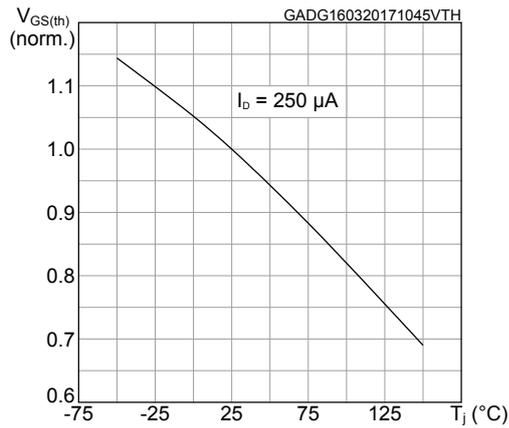


Figure 10. Normalized on-resistance vs temperature

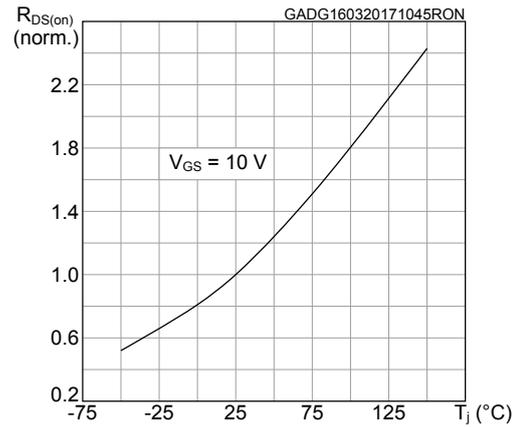


Figure 11. Normalized V(BR)DSS vs temperature

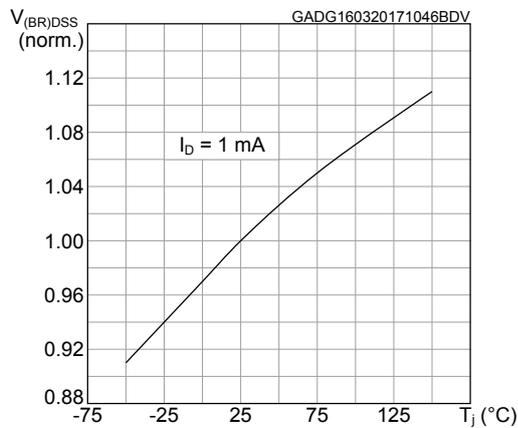
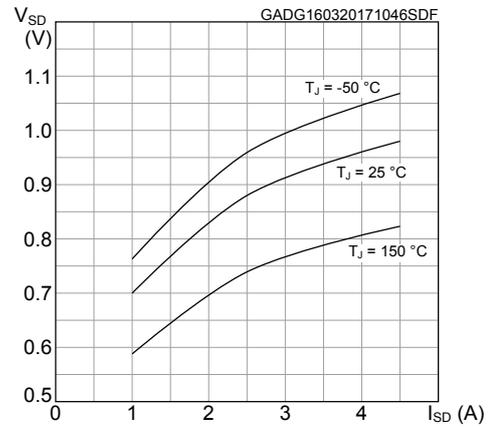
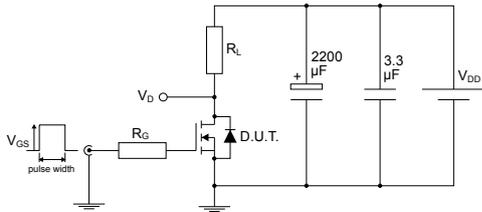


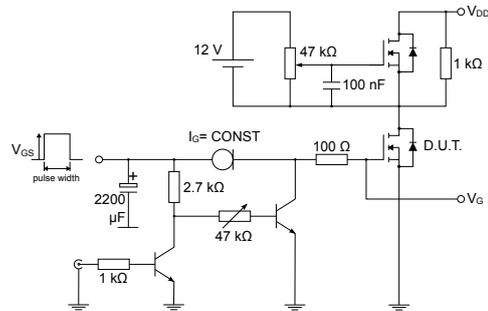
Figure 12. Source-drain diode forward characteristics



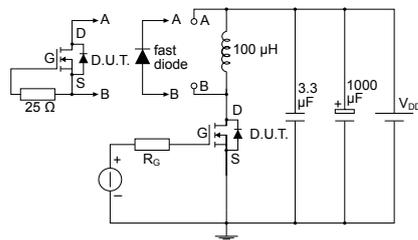
### 3 Test circuits

**Figure 13. Test circuit for resistive load switching times**


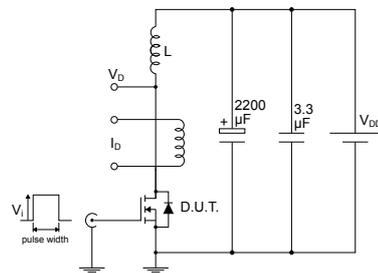
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**Figure 14. Test circuit for gate charge behavior**


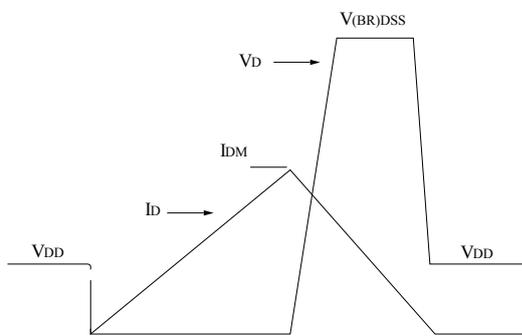
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**Figure 15. Test circuit for inductive load switching and diode recovery times**


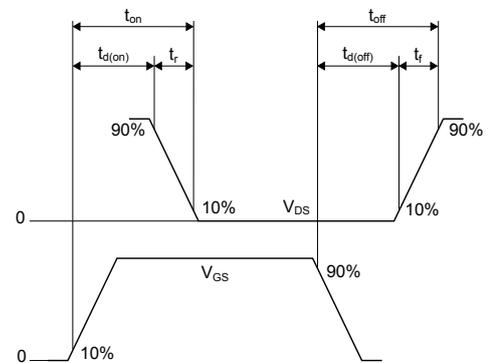
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**Figure 16. Unclamped inductive load test circuit**


AM01471v1

**Figure 17. Unclamped inductive waveform**


AM01472v1

**Figure 18. Switching time waveform**


AM01473v1

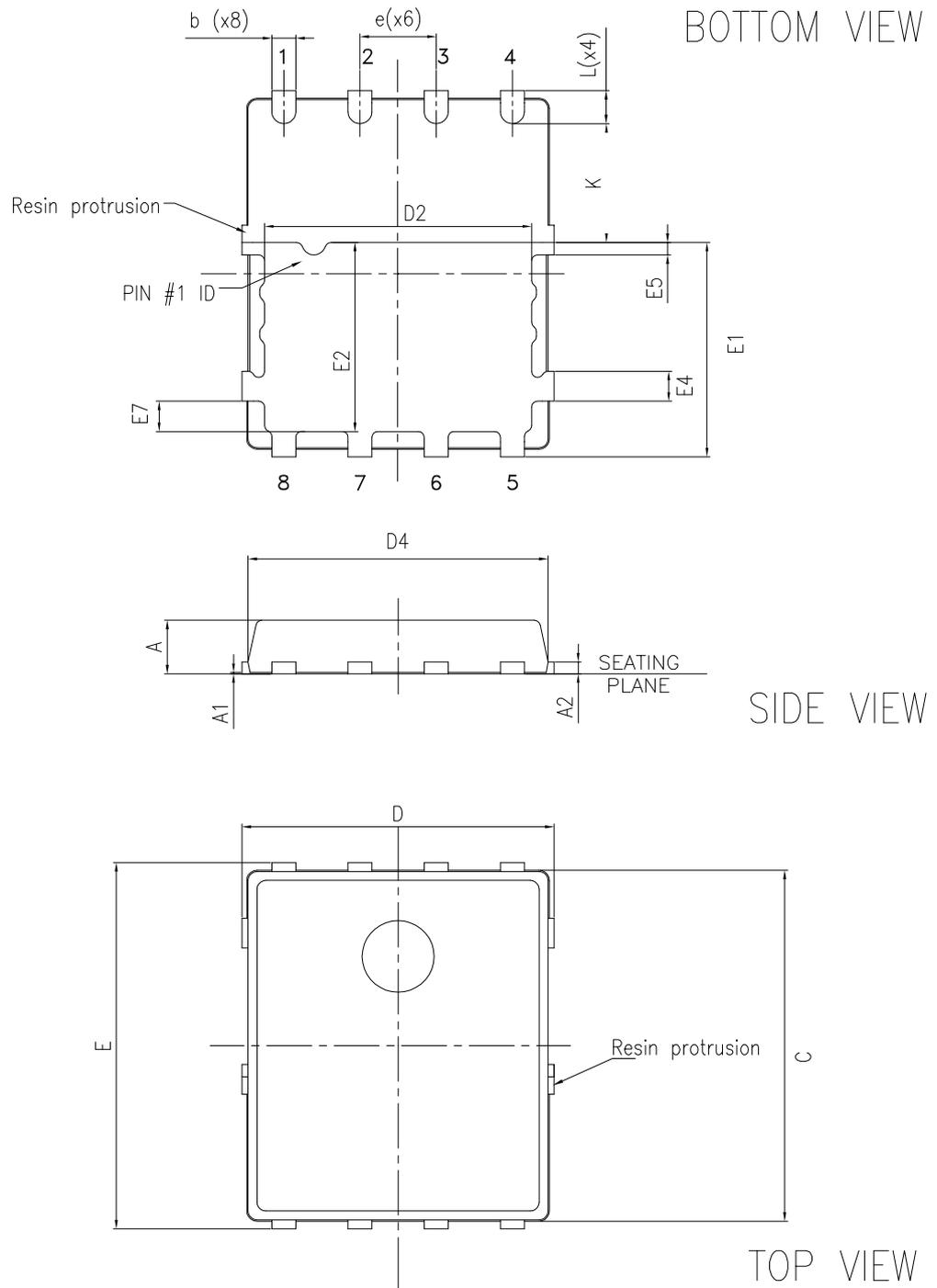
## 4 Package information

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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](http://www.st.com). ECOPACK is an ST trademark.

### 4.1 PowerFLAT 5x6 HV package information

Figure 19. PowerFLAT 5x6 HV package outline

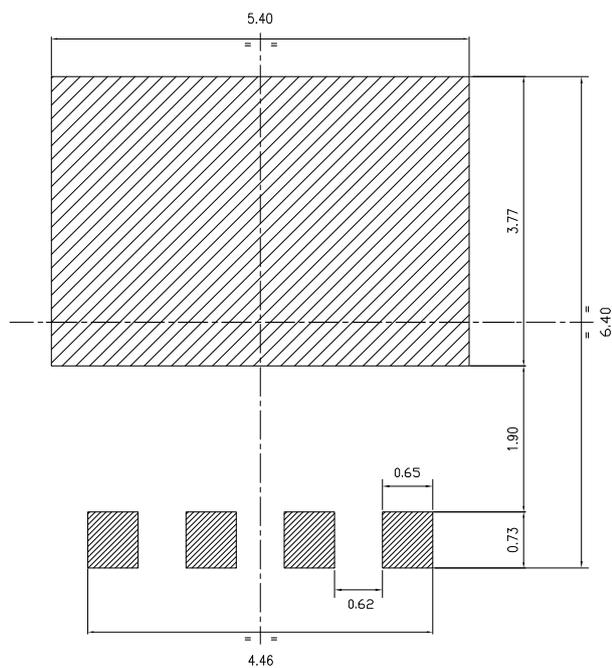


8368143\_Rev\_4

**Table 7. 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	5.60	5.80	6.00
D	5.10	5.20	5.30
D2	4.30	4.40	4.50
D4	4.60	4.80	5.00
E	6.05	6.15	6.25
E1	3.50	3.60	3.70
E2	3.10	3.20	3.30
E4	0.40	0.50	0.60
E5	0.10	0.20	0.30
E7	0.40	0.50	0.60
e		1.27	
L	0.50	0.55	0.60
K	1.90	2.00	2.10

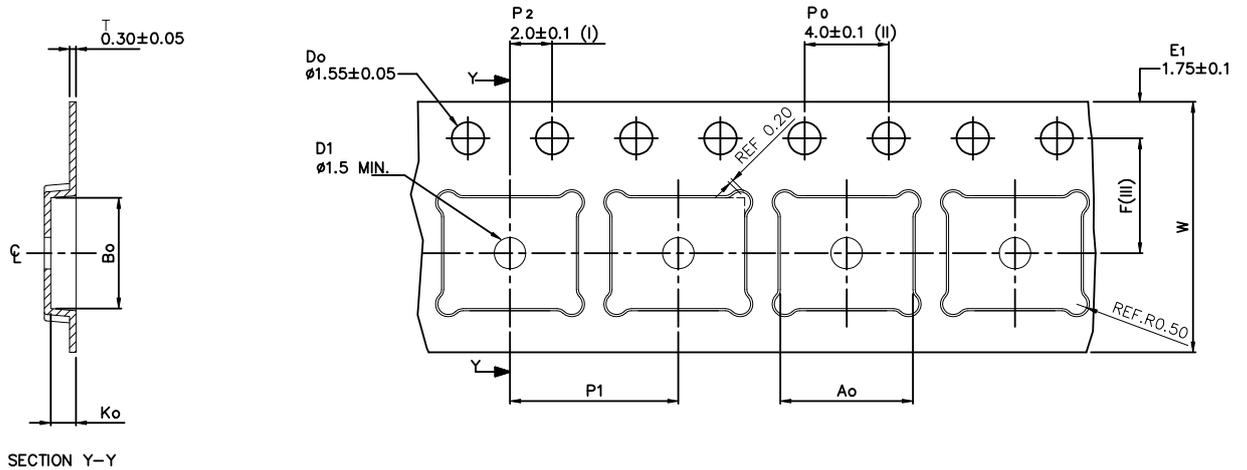
**Figure 20. PowerFLAT™ 5x6 HV recommended footprint (dimensions are in mm)**



8368143\_Rev\_4\_footprint

## 4.2 PowerFLAT 5x6 packing information

Figure 21. PowerFLAT 5x6 tape (dimensions are in mm)



$A_0$	6.30	+/- 0.1
$B_0$	5.30	+/- 0.1
$K_0$	1.20	+/- 0.1
$F$	5.50	+/- 0.1
$P_1$	8.00	+/- 0.1
$W$	12.00	+/- 0.3

(I) Measured from centreline of sprocket hole to centreline of pocket.

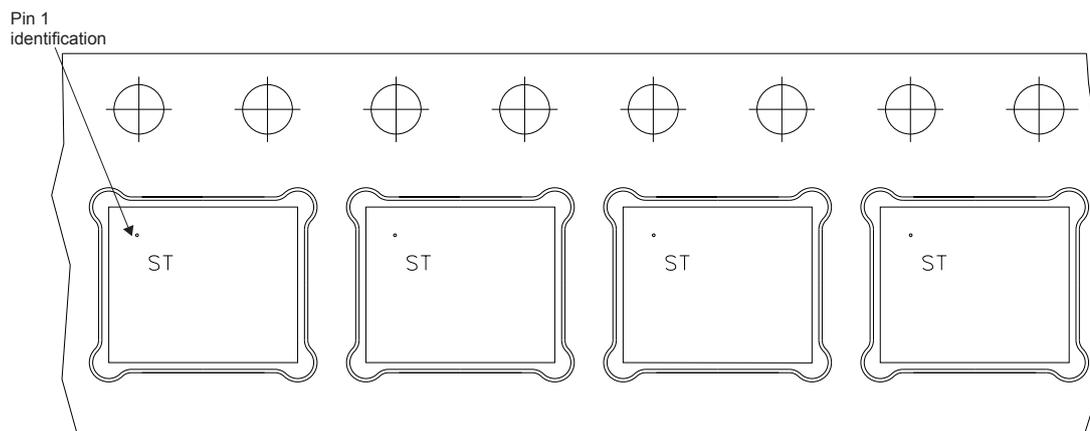
(II) Cumulative tolerance of 10 sprocket holes is  $\pm 0.20$ .

(III) Measured from centreline of sprocket hole to centreline of pocket

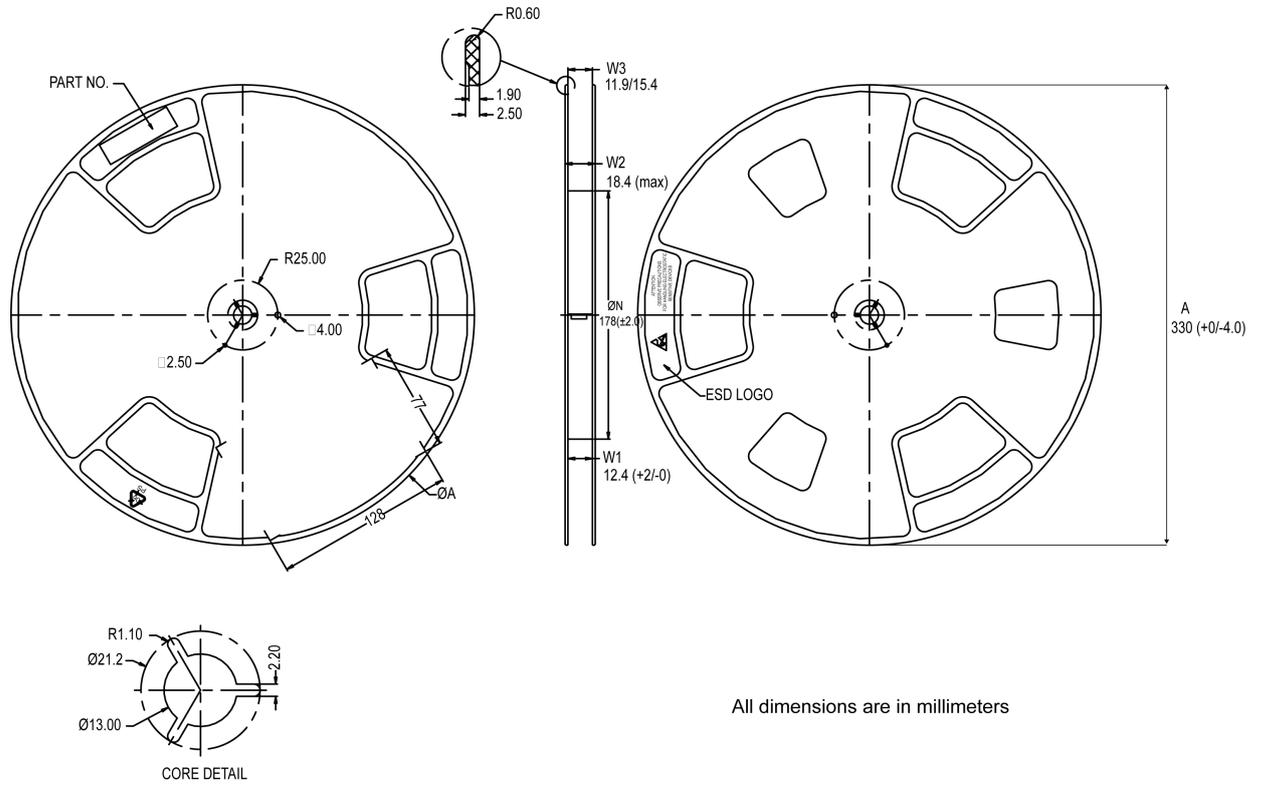
Base and bulk quantity 3000 pcs  
All dimensions are in millimeters

8234350\_Tape\_rev\_C

Figure 22. PowerFLAT 5x6 package orientation in carrier tape



**Figure 23. PowerFLAT 5x6 reel**



All dimensions are in millimeters

8234350\_Reel\_rev\_C

## Revision history

**Table 8. Document revision history**

Date	Revision	Changes
16-Mar-2017	1	First release
20-Jun-2019	2	Removed maturity status indication from cover page. The document status is production data. Updated <a href="#">Table 1. Absolute maximum ratings</a> and <a href="#">Table 4. Dynamic</a> . Minor text changes.

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