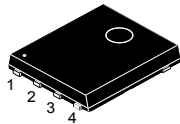
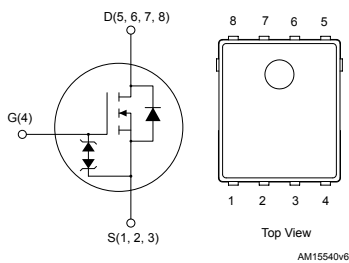


## Automotive-grade N-channel 650 V, 0.95 $\Omega$ typ., 5 A, MDmesh K5 Power MOSFET in a PowerFLAT 5x6 VHV package



PowerFLAT 5x6 VHV



### Features

Order code	$V_{DS}$	$R_{DS(on)}$ max.	$I_D$
STL7LN65K5AG	650 V	1.15 $\Omega$	5 A



- AEC-Q101 qualified
- Industry's lowest  $R_{DS(on)}$  x area
- Industry's best FoM (figure of merit)
- Ultra-low gate charge
- 100% avalanche tested
- Zener-protected

### Applications

- Switching applications

### Description

This very high voltage N-channel Power MOSFET is designed using MDmesh K5 technology based on an innovative proprietary vertical structure. The result is a dramatic reduction in on-resistance and ultra-low gate charge for applications requiring superior power density and high efficiency.



#### Product status link

[STL7LN65K5AG](#)

#### Product summary

Order code	STL7LN65K5AG
Marking	7LN65K5
Package	PowerFLAT 5x6 VHV
Packing	Tape and reel

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{GS}$	Gate-source voltage	$\pm 30$	V
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	5	A
$I_D^{(1)}$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	3.4	A
$I_D^{(2)}$	Drain current (pulsed)	20	A
$P_{TOT}$	Total power dissipation at $T_C = 25\text{ }^\circ\text{C}$	79	W
$dv/dt^{(3)}$	Peak diode recovery voltage slope	4.5	V/ns
$dv/dt^{(4)}$	MOSFET $dv/dt$ ruggedness	50	
$T_{stg}$	Storage temperature range	- 55 to 150	$^\circ\text{C}$
$T_J$	Operating junction temperature range		

- Limited by maximum junction temperature.
- Pulse width limited by safe operating area.
- $I_{SD} \leq 5\text{ A}$ ,  $di/dt$  100 A/ $\mu\text{s}$ ;  $V_{DS\text{ peak}} < V_{(BR)DSS}$ ,  $V_{DD} = 520\text{ V}$ .
- $V_{DS} \leq 520\text{ V}$ .

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJA}$	Thermal resistance, junction-to-case	1.58	$^\circ\text{C/W}$
$R_{thJB}^{(1)}$	Thermal resistance, junction-to-board	59	$^\circ\text{C/W}$

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

**Table 3. Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AR}$	Avalanche current, repetitive or not repetitive (pulse width limited by $T_{Jmax}$ )	1.5	A
$E_{AS}$	Single pulse avalanche energy (starting $T_J = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{ V}$ )	200	mJ

## 2 Electrical characteristics

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

**Table 4. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	650			V
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0\text{ V}, V_{DS} = 650\text{ V}$			1	$\mu\text{A}$
		$V_{GS} = 0\text{ V}, V_{DS} = 650\text{ V}, T_C = 125\text{ °C}^{(1)}$			50	$\mu\text{A}$
$I_{GSS}$	Gate-body leakage current	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$			$\pm 10$	$\mu\text{A}$
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 100\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}, I_D = 2.5\text{ A}$		0.95	1.15	$\Omega$

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

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 100\text{ V}, f = 1\text{ MHz}, V_{GS} = 0\text{ V}$	-	270	-	pF
$C_{oss}$	Output capacitance		-	22	-	pF
$C_{rss}$	Reverse transfer capacitance		-	0.5	-	pF
$C_{o(er)}^{(1)}$	Equivalent capacitance energy related	$V_{DS} = 0\text{ to }520\text{ V}, V_{GS} = 0\text{ V}$	-	20	-	nC
$C_{o(tr)}^{(2)}$	Equivalent capacitance time related		-	57	-	nC
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz}, I_D = 0\text{ A}$	-	7.5	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 520\text{ V}, I_D = 5\text{ A}, V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 14. Test circuit for gate charge behavior)	-	11.7	-	nC
$Q_{gs}$	Gate-source charge		-	2.7	-	nC
$Q_{gd}$	Gate-drain charge		-	7.3	-	nC

1. Energy related is defined as a constant equivalent capacitance giving the same stored energy as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DSS}$

2. Time related is defined as a constant equivalent capacitance giving the same stored energy as  $C_{oss}$  when  $V_{DS}$  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	$V_{DD} = 300\text{ V}, I_D = 2.5\text{ A}$ $R_G = 4.7\text{ }\Omega, V_{GS} = 10\text{ V}$ (see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	7.4	-	ns
$t_r$	Rise time		-	9.2	-	ns
$t_{d(off)}$	Turn-off delay time		-	19.8	-	ns
$t_f$	Fall time		-	16.4	-	ns

**Table 7. Source-drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		5	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		20	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 5\text{ A}$ , $V_{GS} = 0\text{ V}$	-		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 15. Test circuit for inductive load switching and diode recovery times)	-	282		ns
$Q_{rr}$	Reverse recovery charge		-	1.97		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	14		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 15. Test circuit for inductive load switching and diode recovery times)	-	415		ns
$Q_{rr}$	Reverse recovery charge		-	2.70		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	13		A

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

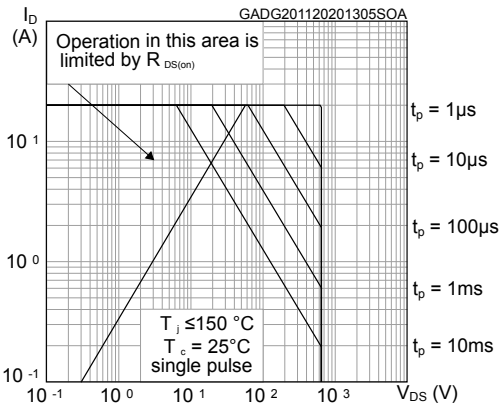
**Table 8. Gate-source Zener diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)GSO}$	Gate-source breakdown voltage	$I_{GS} = \pm 1\text{ mA}$ , $I_D = 0\text{ A}$	30		-	V

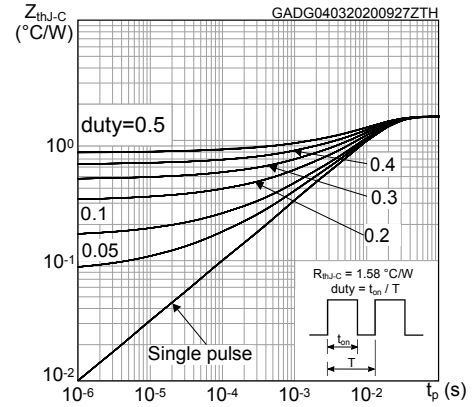
The built-in back-to-back Zener diodes are specifically designed to enhance the ESD performance of the device. The Zener voltage facilitates efficient and cost-effective device integrity protection, thus eliminating the need for additional external componentry.

## 2.1 Electrical characteristics (curves)

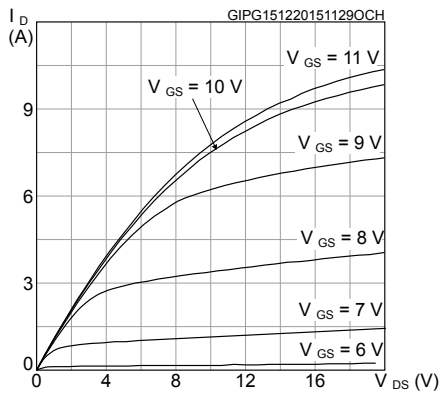
**Figure 1. Safe operating area**



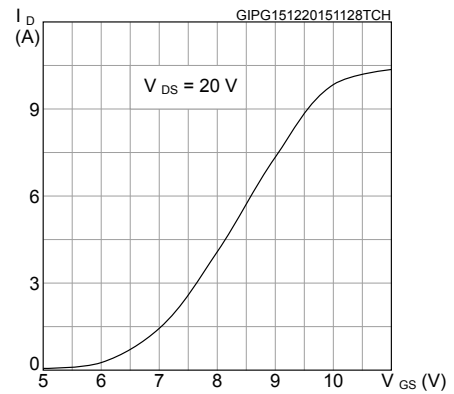
**Figure 2. Maximum transient thermal impedance**



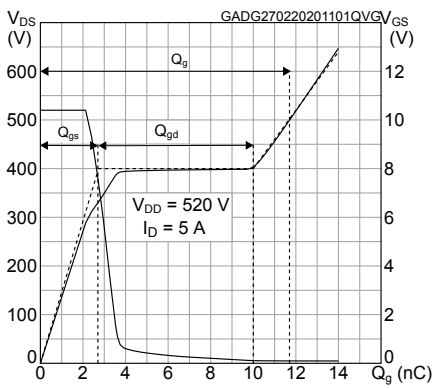
**Figure 3. Typical output characteristics**



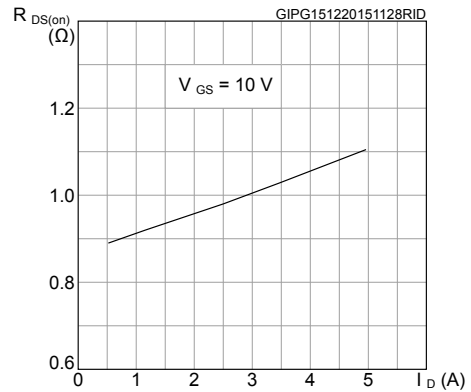
**Figure 4. Typical transfer characteristics**



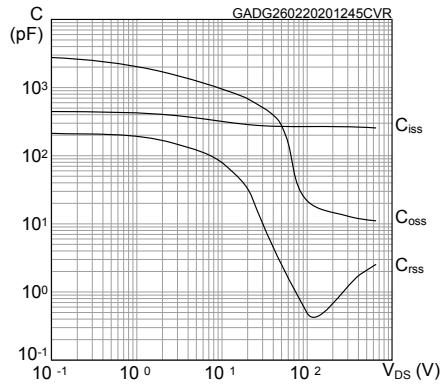
**Figure 5. Typical gate charge characteristics**



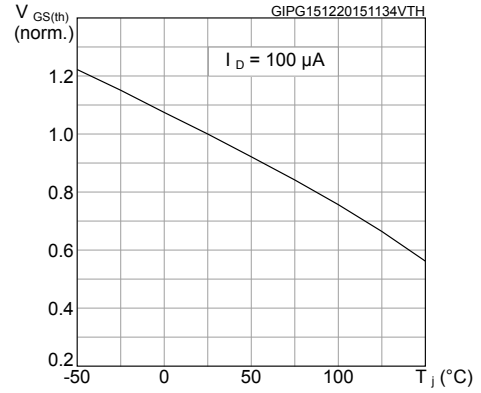
**Figure 6. Typical drain-source on-resistance**



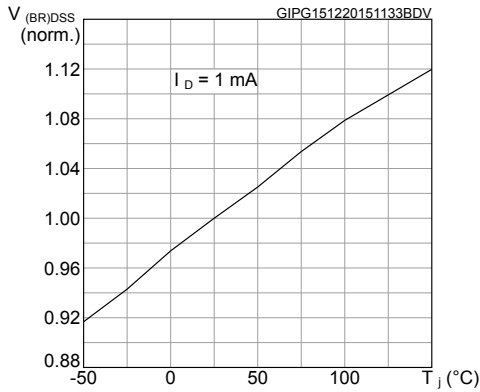
**Figure 7. Typical capacitance characteristics**



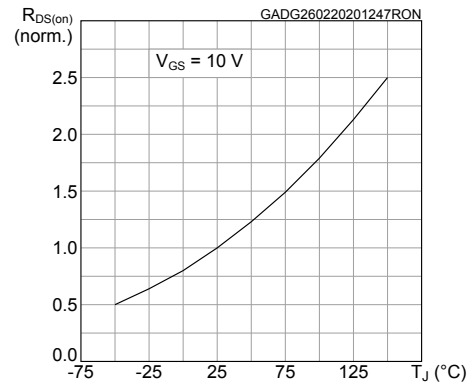
**Figure 8. Normalized gate threshold vs temperature**



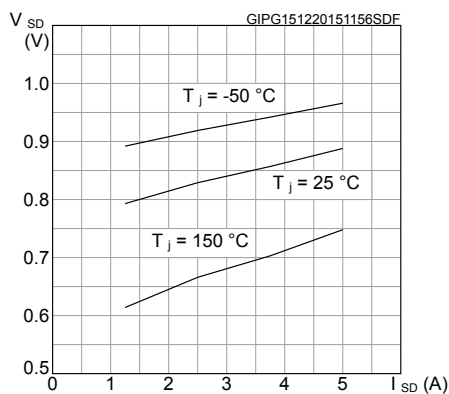
**Figure 9. Normalized breakdown voltage vs temperature**



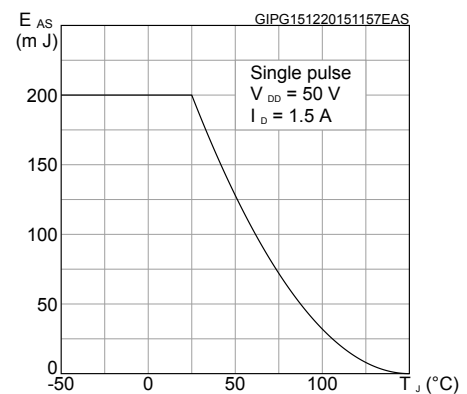
**Figure 10. Normalized on-resistance vs temperature**



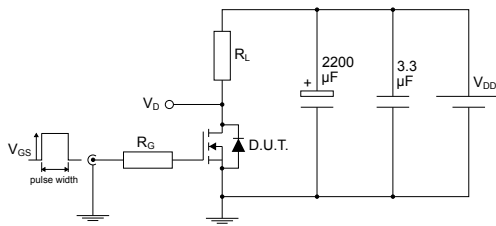
**Figure 11. Typical reverse diode forward characteristics**



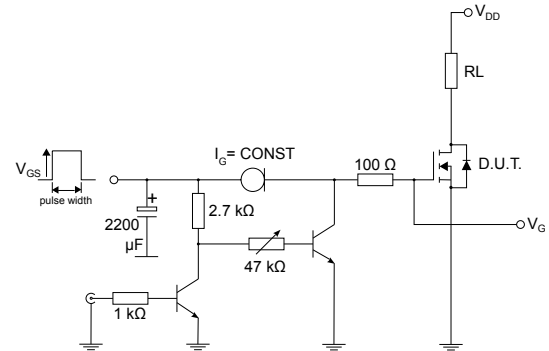
**Figure 12. Maximum avalanche energy vs temperature**



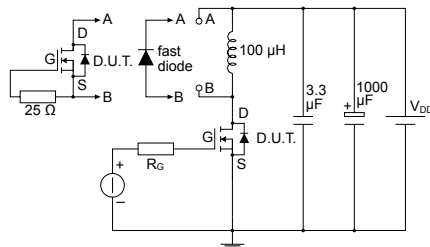
### 3 Test circuits

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


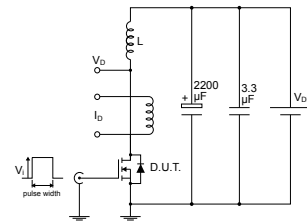
AM01468v1

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


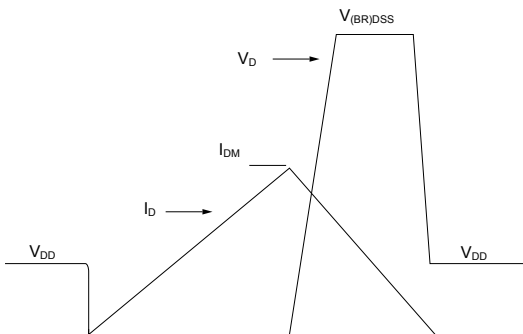
AM01469v10

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


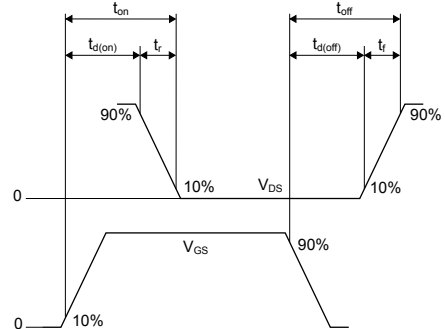
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**Figure 16. Unclamped inductive load test circuit**


AM01471v1

**Figure 17. Unclamped inductive waveform**


AM01472v1

**Figure 18. Switching time waveform**


AM01473v1

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## 4 Package information

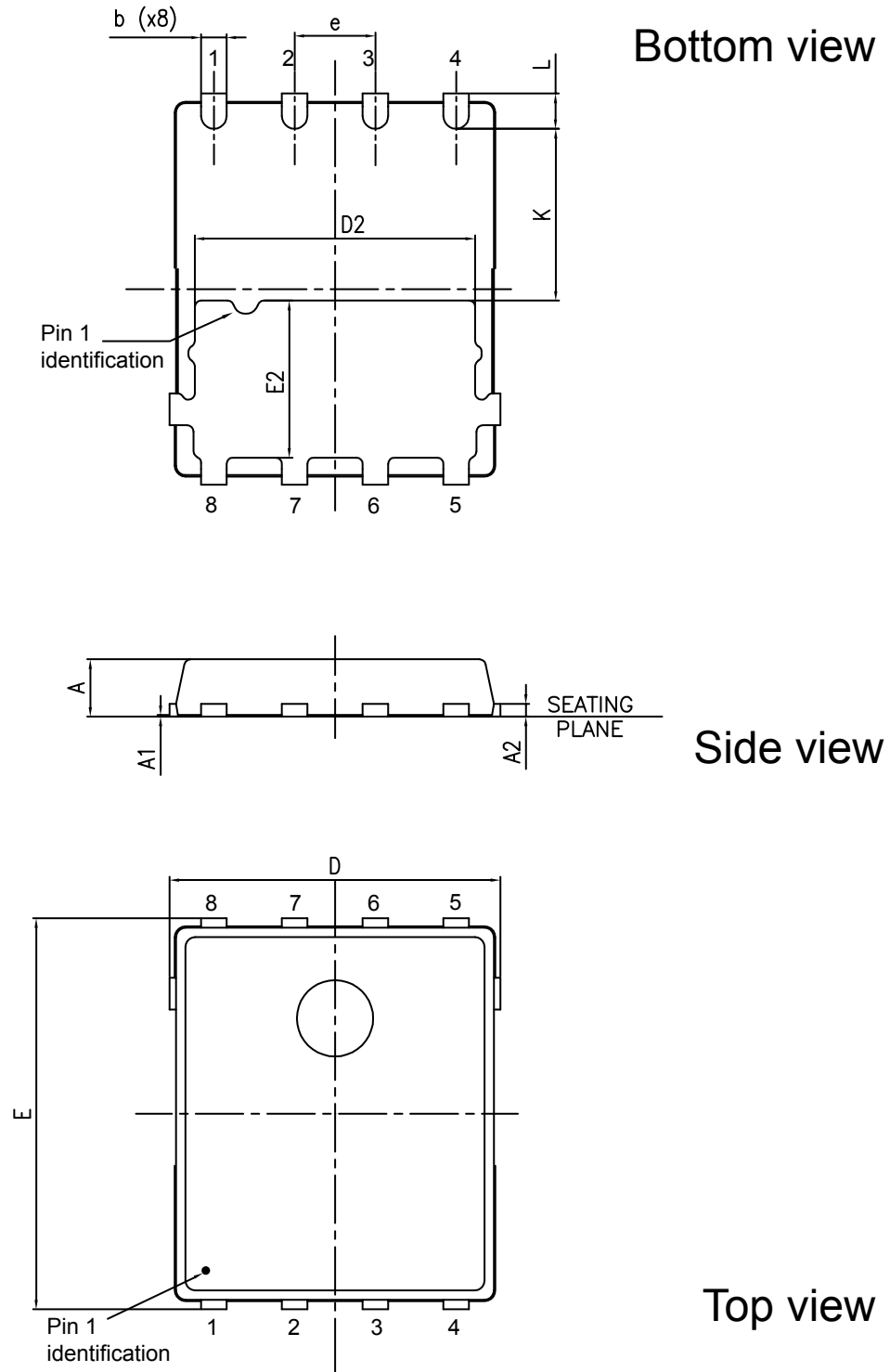
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In order to meet environmental requirements, ST offers these devices in different grades of **ECOPACK** packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.



## 4.1 PowerFLAT 5x6 VHV mechanical data

Figure 19. PowerFLAT 5x6 VHV package outline

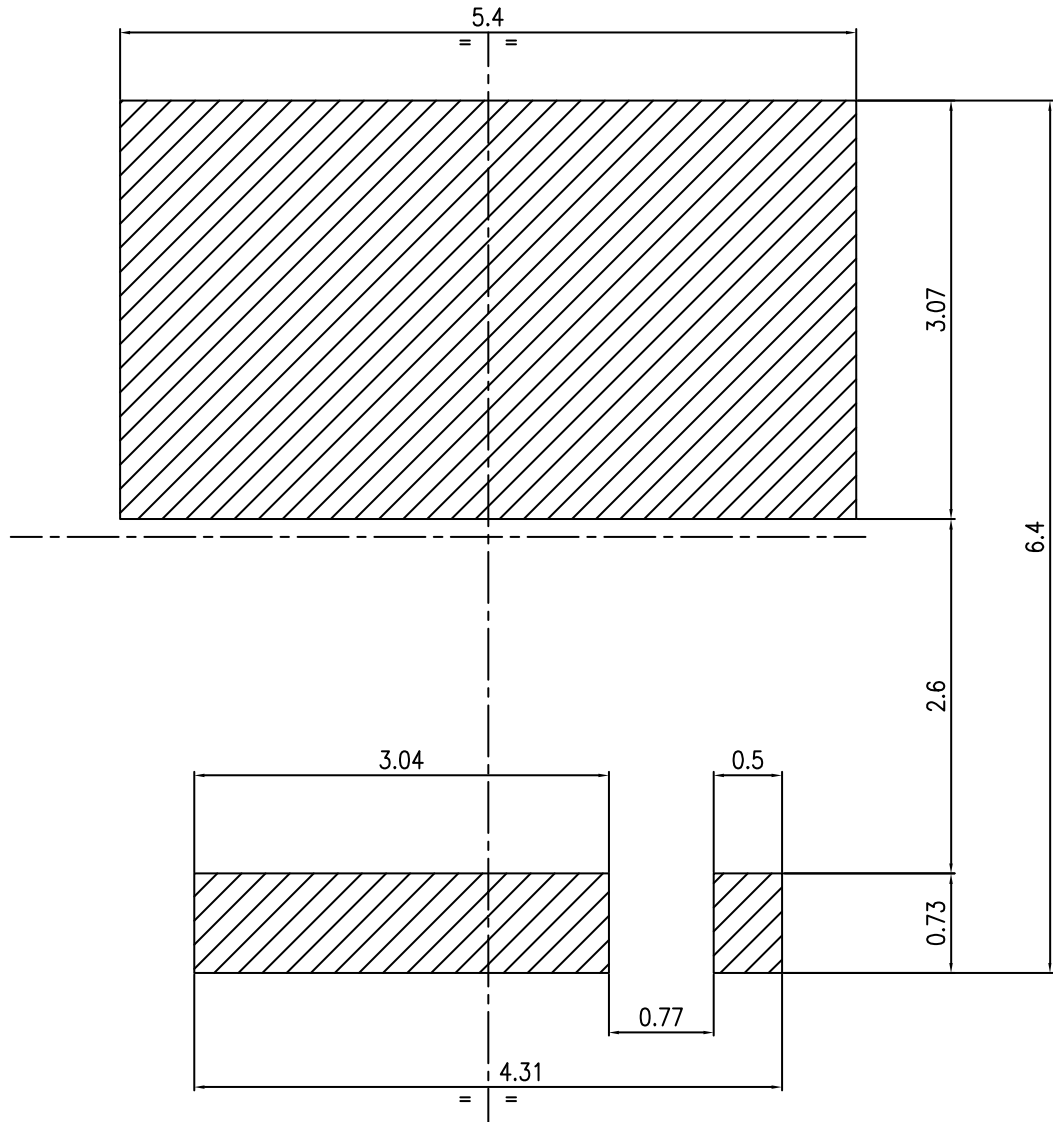


8368144\_REV\_3

**Table 9. PowerFLAT 5x6 VHV package 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	2.40	2.50	2.60
e		1.27	
L	0.50	0.55	0.60
K	2.60	2.70	2.80

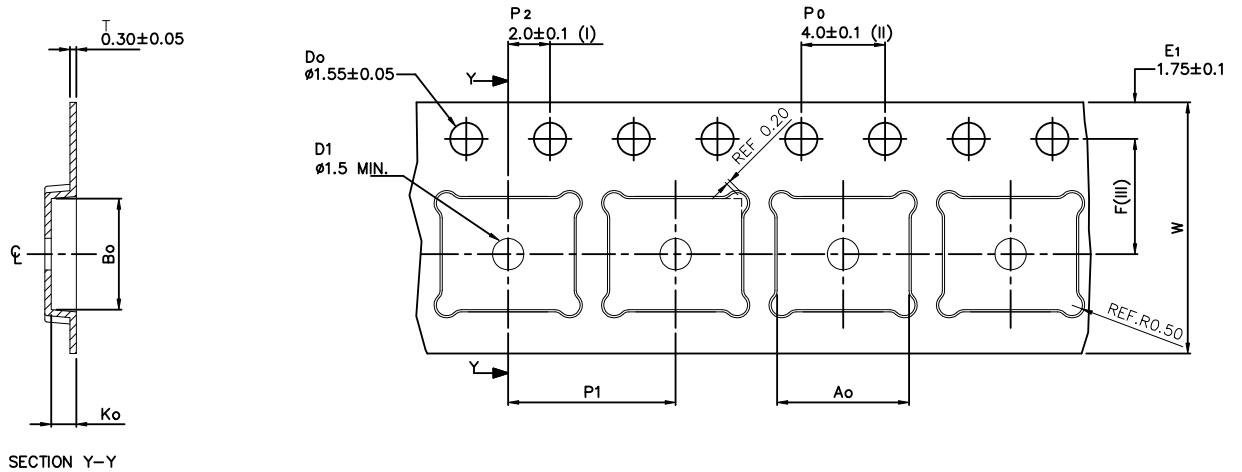
Figure 20. PowerFLAT 5x6 VHV recommended footprint (dimensions are in mm)



8368144\_REV\_3\_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.

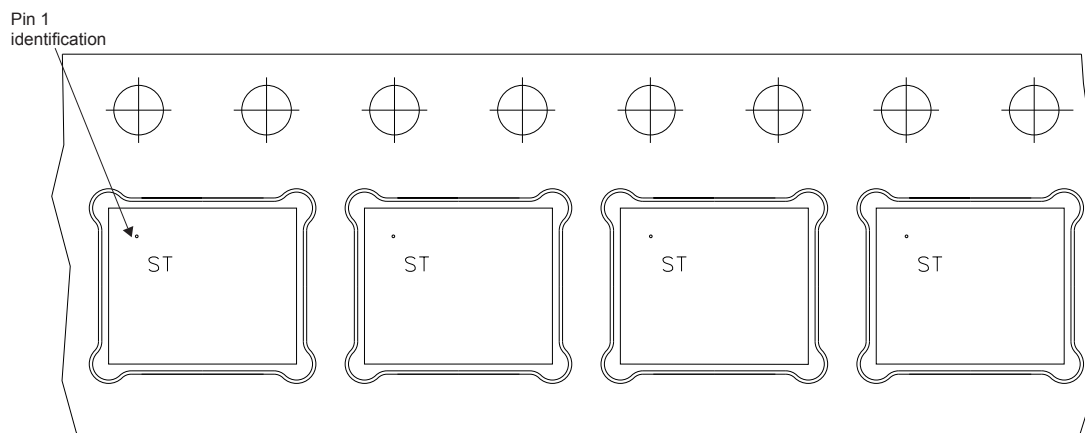
(II) Cumulative tolerance of 10 sprocket holes is  $\pm 0.20$ .

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

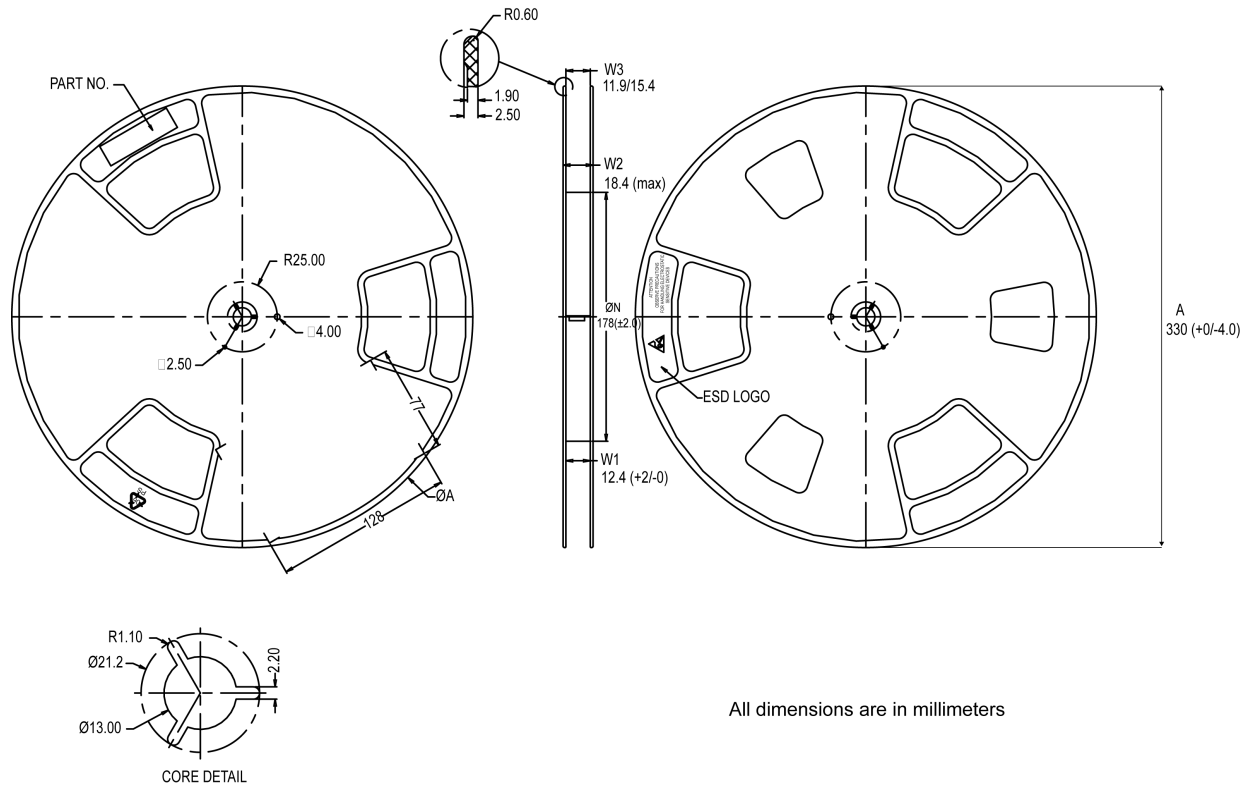
Base and bulk quantity 3000 pcs  
All dimensions are in millimeters

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 10. Document revision history**

Date	Version	Changes
04-Mar-2020	1	First release.
20-Nov-2020	2	Updated <a href="#">Figure 1. Safe operating area.</a> Minor text changes.

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