

## N-channel 800 V, 1.50 $\Omega$ typ., 3 A MDmesh™ K5 Power MOSFET in a PowerFLAT™ 5x6 VHV package

Datasheet - production data

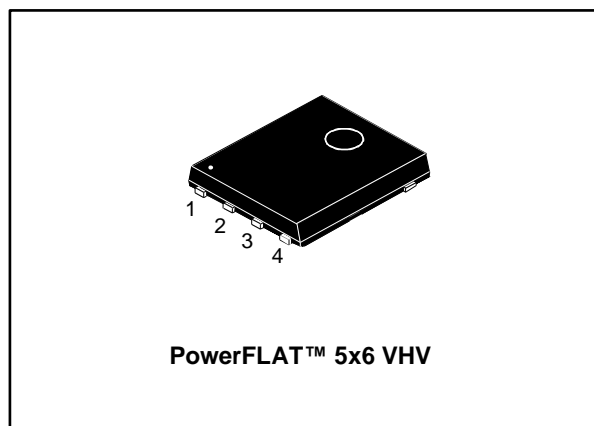
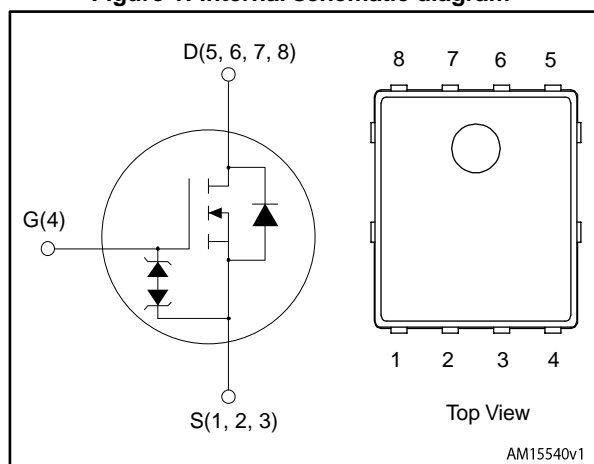


Figure 1: Internal schematic diagram



### Features

Order code	V <sub>DS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>
STL5N80K5	800 V	1.75 $\Omega$	3 A

- Industry's lowest R<sub>DS(on)</sub> 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.

Table 1: Device summary

Order code	Marking	Package	Packing
STL5N80K5	5N80K5	PowerFLAT™ 5x6 VHV	Tape and reel

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# 1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
$V_{GS}$	Gate-source voltage	$\pm 30$	V
$I_D$	Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$	3	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$	1.8	A
$I_D^{(1)}$	Drain current (pulsed)	12	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	38	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	4.5	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		

**Notes:**

(1) Pulse width limited by safe operating area.

(2)  $I_{SD} \leq 4\text{ A}$ ,  $di/dt = 100\text{ A}/\mu\text{s}$ ;  $V_{DS\text{ peak}} < V_{(BR)DSS}$ ,  $V_{DD} = 640\text{ V}$ .(3)  $V_{DS} \leq 640\text{ V}$ .

Table 3: Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	3.3	$^{\circ}\text{C}/\text{W}$
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb	59	$^{\circ}\text{C}/\text{W}$

**Notes:**(1) When mounted on FR-4 board of 1 inch<sup>2</sup>, 2 oz Cu

Table 4: Avalanche characteristics

Symbol	Parameter	Value	Unit
$I_{AR}$	Avalanche current, repetitive or not repetitive (pulse width limited by $T_{jmax}$ )	1.2	A
$E_{AS}$	Single pulse avalanche energy (starting $T_j = 25\text{ }^{\circ}\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{ V}$ )	165	mJ

## 2 Electrical characteristics

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

**Table 5: On/off-state**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$ , $I_D = 1\text{ mA}$	800			V
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$ , $V_{DS} = 800\text{ V}$			1	$\mu\text{A}$
		$V_{GS} = 0\text{ V}$ , $V_{DS} = 800\text{ V}$ $T_C = 125\text{ }^{\circ}\text{C}$ <sup>(1)</sup>			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	$V_{DD} = V_{GS}$ , $I_D = 100\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$ , $I_D = 2\text{ A}$		1.50	1.75	$\Omega$

**Notes:**

<sup>(1)</sup>Defined by design, not subject to production test.

**Table 6: Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$	-	177	-	pF
$C_{oss}$	Output capacitance		-	15	-	pF
$C_{rss}$	Reverse transfer capacitance		-	0.3	-	pF
$C_{o(tr)}$ <sup>(1)</sup>	Equivalent capacitance time related	$V_{GS} = 0\text{ V}$ , $V_{DS} = 0\text{ to }640\text{ V}$	-	33	-	pF
$C_{o(er)}$ <sup>(2)</sup>	Equivalent capacitance energy related		-	12	-	pF
$R_g$	Intrinsic gate resistance	$f = 1\text{ MHz}$ , $I_D = 0\text{ A}$	-	16	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 640\text{ V}$ , $I_D = 4\text{ A}$ $V_{GS} = 0\text{ to }10\text{ V}$ (see <a href="#">Figure 15: "Test circuit for gate charge behavior"</a> )	-	5	-	nC
$Q_{gs}$	Gate-source charge		-	1.7	-	nC
$Q_{gd}$	Gate-drain charge		-	2.9	-	nC

**Notes:**

<sup>(1)</sup> $C_{o(tr)}$  is a constant capacitance value that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

<sup>(2)</sup> $C_{o(er)}$  is a constant capacitance value that gives the same stored energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

Table 7: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 400\text{ V}$ , $I_D = 2\text{ A}$ , $R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 14: "Test circuit for resistive load switching times"</a> and <a href="#">Figure 19: "Switching time waveform"</a> )	-	12.7	-	ns
$t_r$	Rise time		-	11.7	-	ns
$t_{d(off)}$	Turn-off delay time		-	23	-	ns
$t_f$	Fall time		-	14.8	-	ns

Table 8: Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		3	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		12	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 3\text{ A}$ , $V_{GS} = 0\text{ V}$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 4\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ (see <a href="#">Figure 16: "Test circuit for inductive load switching and diode recovery times"</a> )	-	265		ns
$Q_{rr}$	Reverse recovery charge		-	1.59		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	12		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 4\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ , $T_J = 150\text{ }^\circ\text{C}$ (see <a href="#">Figure 16: "Test circuit for inductive load switching and diode recovery times"</a> )	-	386		ns
$Q_{rr}$	Reverse recovery charge		-	2.18		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	11.3		A

**Notes:**<sup>(1)</sup>Pulse width limited by safe operating area<sup>(2)</sup>Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

Table 9: 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 2: Safe operating area

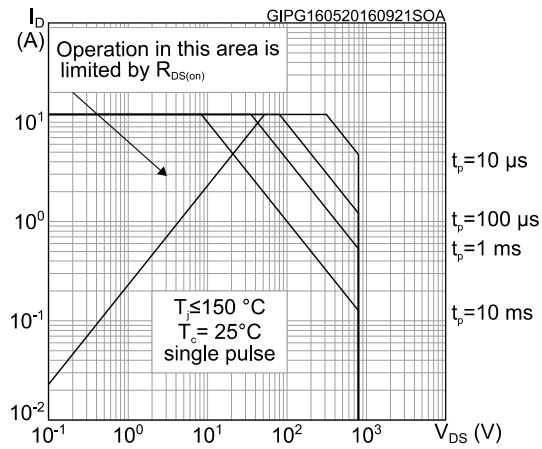


Figure 3: Thermal impedance

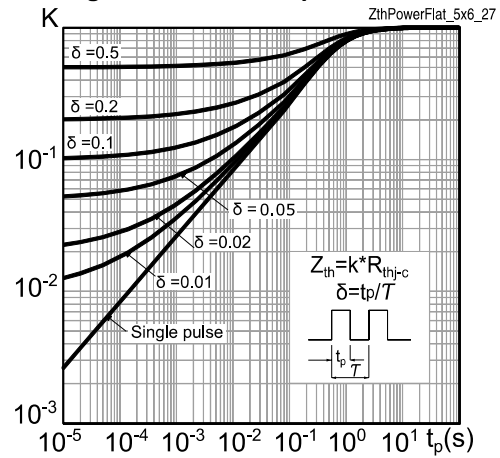


Figure 4: Output characteristics

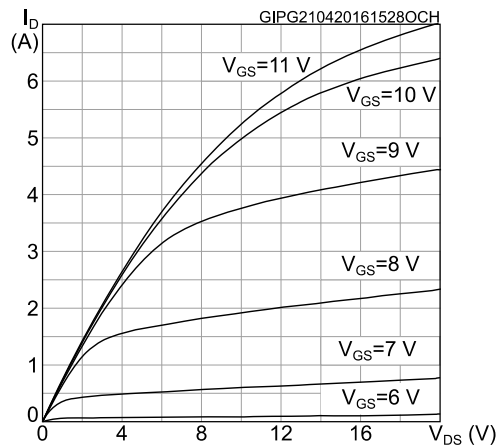


Figure 5: Transfer characteristics

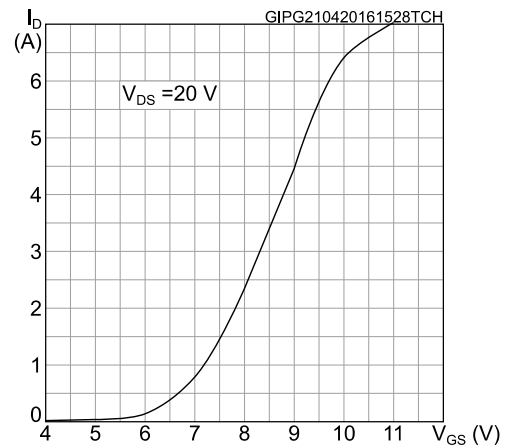


Figure 6: Gate charge vs gate-source voltage

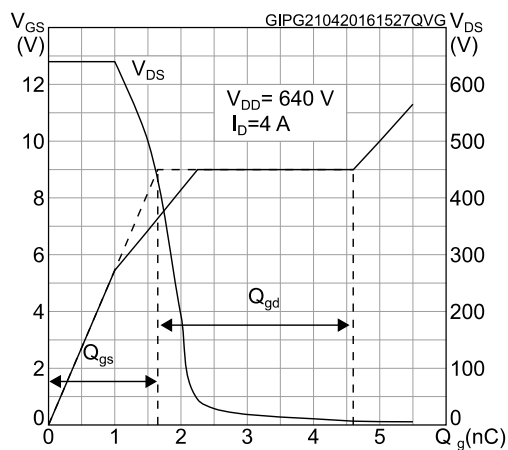


Figure 7: Static drain-source on-resistance

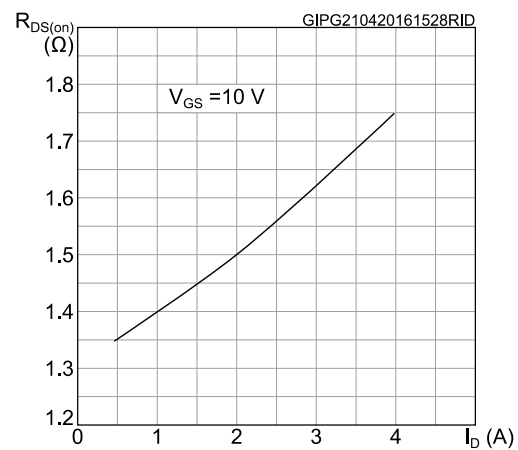


Figure 8: Capacitance variations

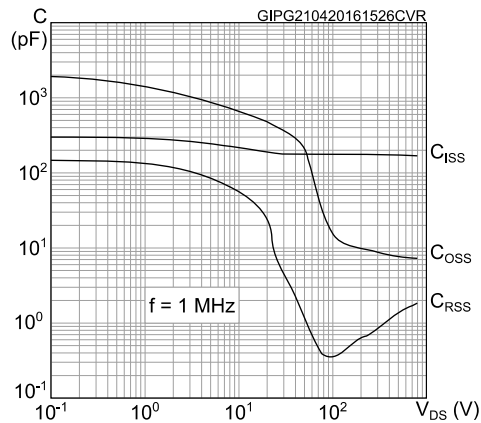


Figure 9: Normalized gate threshold voltage vs temperature

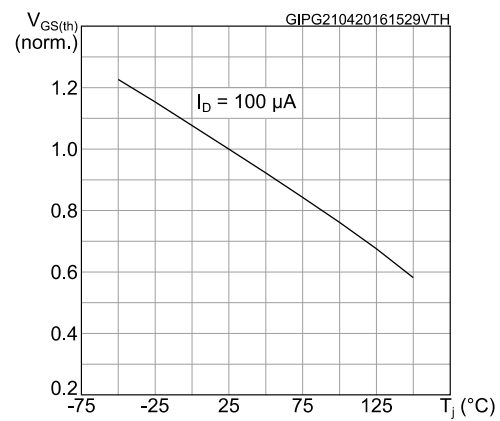


Figure 10: Normalized on-resistance vs temperature

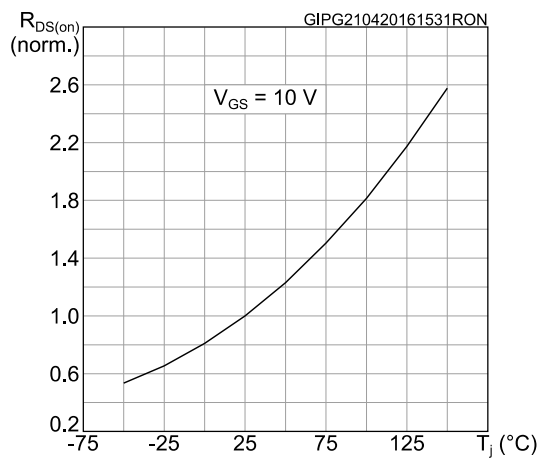
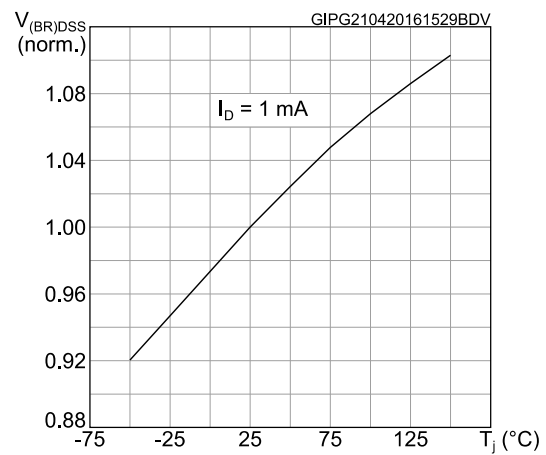
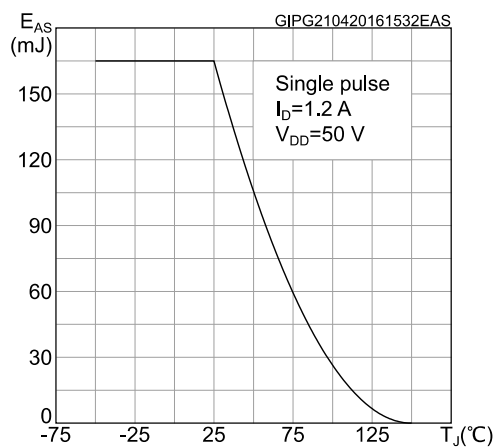
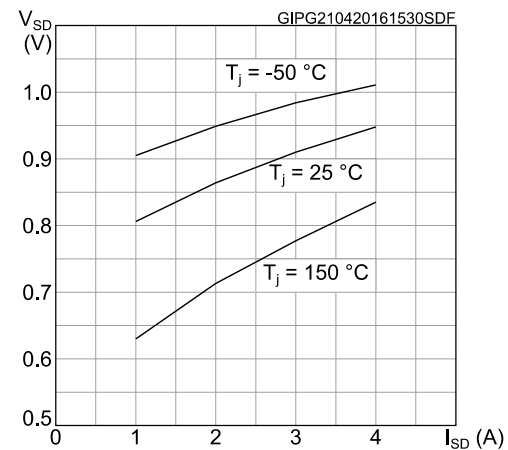
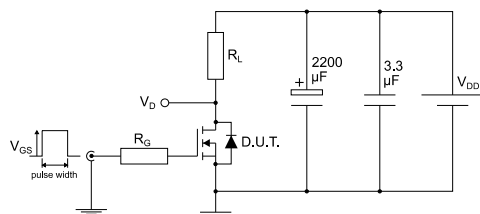
Figure 11: Normalized  $V_{(BR)DSS}$  vs temperatureFigure 12: Maximum avalanche energy vs starting  $T_J$ 

Figure 13: Source-drain diode forward characteristics



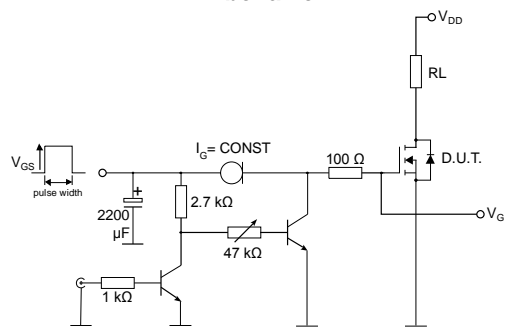
### 3 Test circuits

**Figure 14: Test circuit for resistive load switching times**



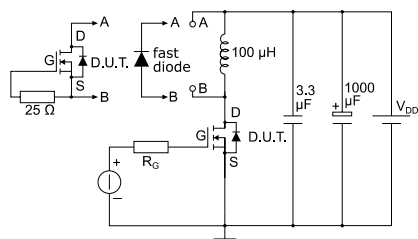
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**Figure 15: Test circuit for gate charge behavior**



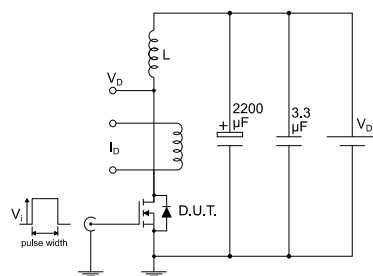
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**Figure 16: Test circuit for inductive load switching and diode recovery times**



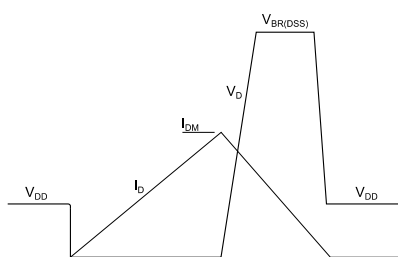
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**Figure 17: Unclamped inductive load test circuit**



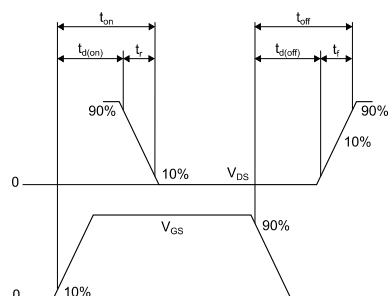
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**Figure 18: Unclamped inductive waveform**



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

## 4.1 PowerFLAT™ 5x6 VHV mechanical data

Figure 20: PowerFLAT™ 5x6 VHV package outline

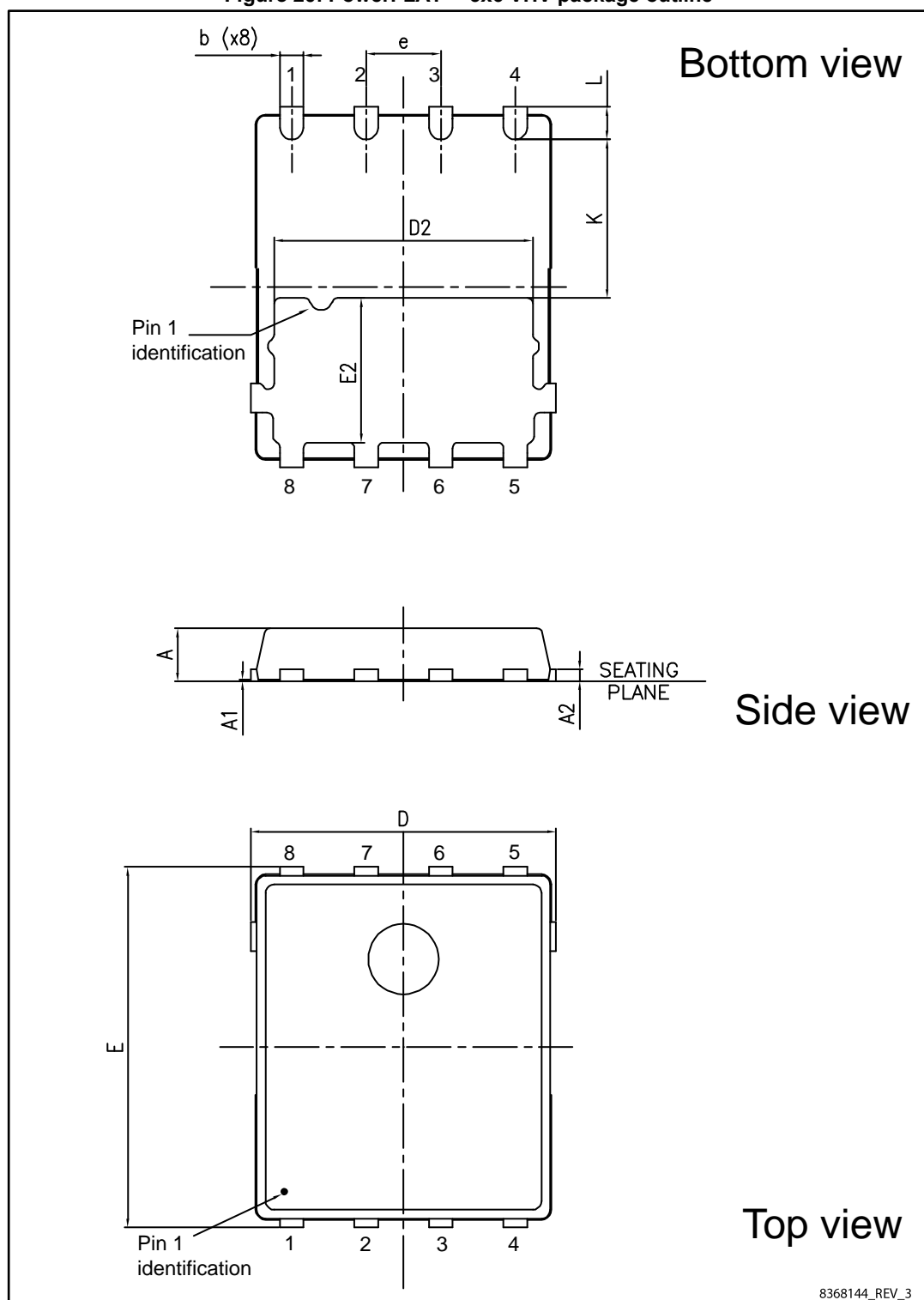
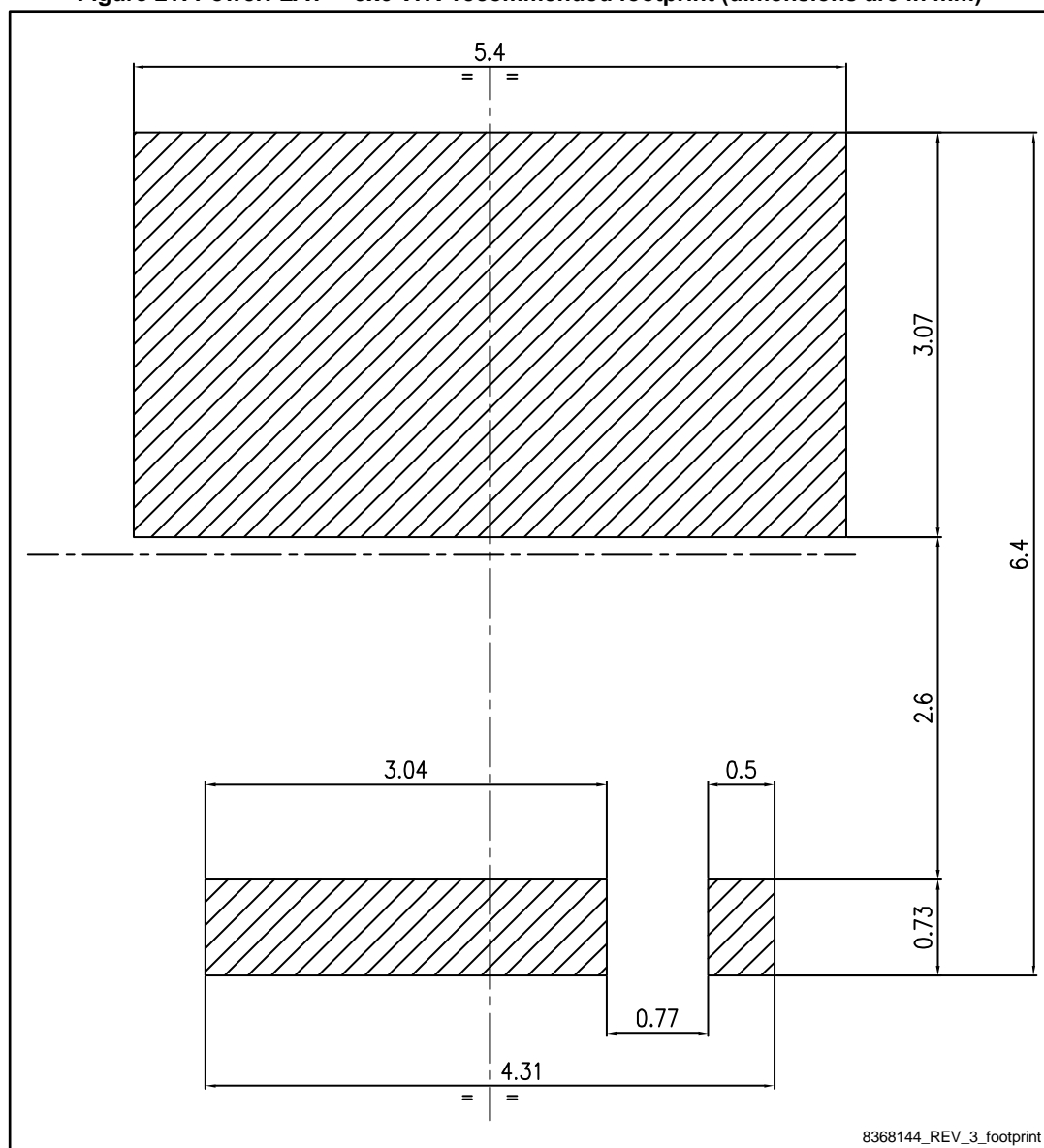


Table 10: PowerFLAT™ 5x6 VHV package mechanical data

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



## 4.2 PowerFLAT™ 5x6 packing information

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

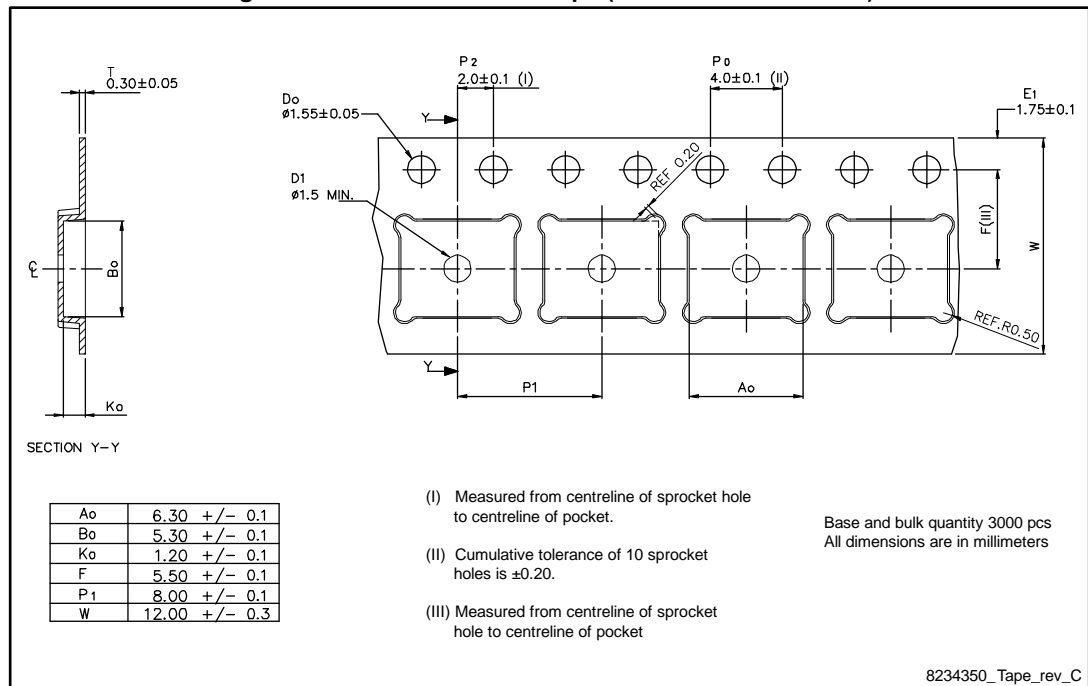
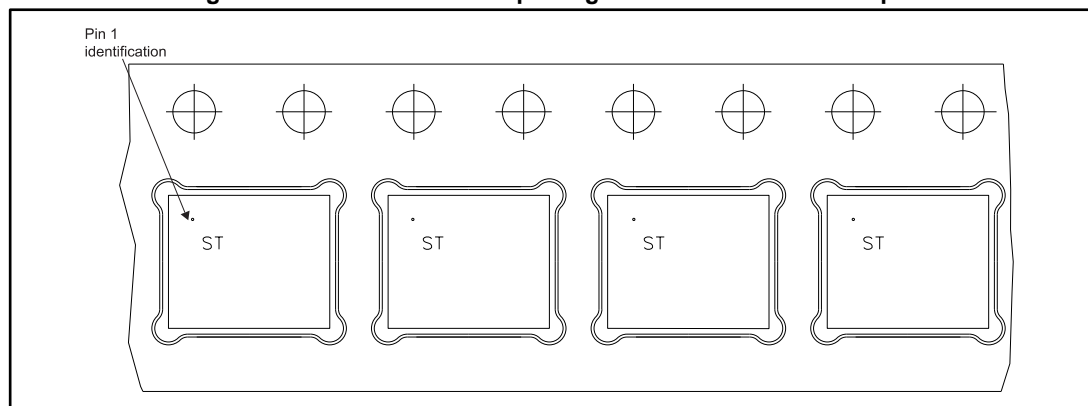


Figure 23: PowerFLAT™ 5x6 package orientation in carrier tape



Technical drawing of a 35mm film reel, showing front, side, and core detail views. Dimensions are in millimeters.

**Front View (Left):** Shows the circular reel with a central hub. Dimensions include: PART NO. (pointing to a label area), R25.00 (outer radius),  $\varnothing 4.00$  (central hole diameter),  $\varnothing 2.50$  (inner hole diameter), and  $\sqrt{28}$  (diagonal dimension).

**Side View (Right):** Shows the reel's profile. Dimensions include: W3 11.9/15.4 (top width), W2 18.4 (max) (middle width), 2N 178( $\pm 2.0$ ) (total length), W1 12.4 ( $\pm 2/0$ ) (bottom width), and A 330 ( $\pm 0/4.0$ ) (overall diameter).

**Core Detail (Bottom Left):** Shows the central hub detail. Dimensions include: R1.10 (fillet radius),  $\varnothing 21.2$  (outer diameter),  $\varnothing 13.00$  (inner diameter), and 2.20 (height).

**ESD LOGO:** A logo is present on the left side of the reel, indicating Electrostatic Discharge protection.

**Notes:** All dimensions are in millimeters.

## 5 Revision history

**Table 11: Document revision history**

Date	Revision	Changes
12-Nov-2015	1	First release.
16-May-2016	2	Modified: features in cover page Modified: <i>Table 2: "Absolute maximum ratings", Table 3: "Thermal data", Table 4: "Avalanche characteristics", Table 5: "On/off-state", Table 6: "Dynamic", Table 7: "Switching times" and Table 8: "Source-drain diode"</i> Added: <i>Section 3.1: "Electrical characteristics (curves)"</i> Minor text changes
24-Apr-2017	3	Updated silhouette on cover page. Updated <a href="#">Section 4.1: "PowerFLAT™ 5x6 VHV mechanical data"</a> . Minor text changes.

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