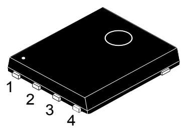
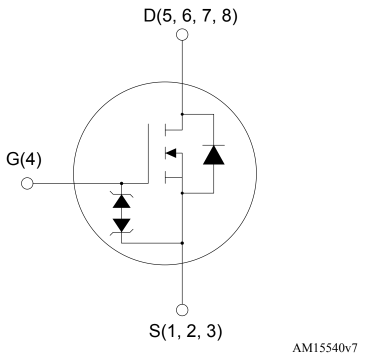
N-channel 800 V, 0.73 Ω typ., 5 A, MDmesh™ K5 Power MOSFET in a PowerFLAT™ 5x6 VHV package



PowerFLAT™ 5x6 VHV



Product status link
STL9N80K5

Product summary	
Order code	STL9N80K5
Marking	9N80K5
Package	PowerFLAT™ 5x6 VHV
Packing	Tape and reel

Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STL9N80K5	800 V	0.90 Ω	5 A

- 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.

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	±30	V
I_D	Drain current (continuous) at T_C = 25 °C	5	A
	Drain current (continuous) at T_C = 100 °C	3.2	A
I_{DM} (1)	Drain current (pulsed)	20	A
P_{TOT}	Total power dissipation at T_C = 25 °C	42	W
dv/dt (2)	Peak diode recovery voltage slope	4.5	V/ns
dv/dt (3)	MOSFET dv/dt ruggedness	50	V/ns
T_{stg}	Storage temperature range	-55 to 150	°C
T_j	Operating junction temperature range		

1. *Pulse width limited by safe operating area.*
2. *I_{SD} ≤ 7 A, di/dt ≤ 100 A/μs, $V_{DS(peak)}$ < $V_{(BR)DSS}$, V_{DD} = 640 V*
3. *V_{DS} ≤ 640 V*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	3	°C/W
$R_{thj-pcb}$ (1)	Thermal resistance junction-pcb	59	°C/W

1. *When mounted on FR-4 board of 1 inch², 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})	2.4	A
E_{AS}	Single pulse avalanche energy (starting T_j = 25 °C, I_D = I_{AR}, V_{DD} = 50 V)	200	mJ

2 Electrical characteristics

T_C = 25 °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 V, I_D = 1 mA	800			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 800 V			1	µA
		V_{GS} = 0 V, V_{DS} = 800 V, T_C = 125 °C(1)			50	µA
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, V_{GS} = ±20 V			±10	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D =100 µA	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 3.5 A		0.73	0.90	Ω

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 V, f = 1 MHz, V_{GS} = 0 V	-	340	-	pF
C_{oss}	Output capacitance		-	37	-	pF
C_{rss}	Reverse transfer capacitance		-	0.65	-	pF
$C_{o(tr)}$(1)	Time-related equivalent capacitance	V_{DS} = 0 to 640 V, V_{GS} = 0 V	-	61	-	pF
$C_{o(er)}$(2)	Energy-related equivalent capacitance		-	22	-	pF
R_g	Intrinsic gate resistance	f = 1 MHz , I_D = 0 A	-	7	-	Ω
Q_g	Total gate charge	V_{DD} = 640 V, I_D = 7 A V_{GS} = 0 to 10 V (see Figure 15. Test circuit for gate charge behavior)	-	12	-	nC
Q_{gs}	Gate-source charge		-	3.8	-	nC
Q_{gd}	Gate-drain charge		-	6.7	-	nC

1. *$C_{o(tr)}$ 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}.*
2. *$C_{o(er)}$ 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 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD}= 400 V, I_D =3.5 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 14. Test circuit for resistive load switching times and Figure 19. Switching time waveform)	-	11	-	ns
t_r	Rise time		-	5.7	-	ns
$t_{d(off)}$	Turn-off delay time		-	65.3	-	ns
t_f	Fall time		-	13.6	-	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} = 7 A, V_{GS} = 0 V	-		1.5	V
t_{rr}	Reverse recovery time	I_{SD} = 7 A, di/dt = 100 A/µs, V_{DD} = 60 V (see Figure 16. Test circuit for inductive load switching and diode recovery times)	-	292		ns
Q_{rr}	Reverse recovery charge		-	2.66		µC
I_{RRM}	Reverse recovery current		-	18.2		A
t_{rr}	Reverse recovery time	I_{SD} = 7 A, di/dt = 100 A/µs, V_{DD} = 60 V, T_j = 150 °C (see Figure 16. Test circuit for inductive load switching and diode recovery times)	-	477		ns
Q_{rr}	Reverse recovery charge		-	3.91		µC
I_{RRM}	Reverse recovery current		-	16.4		A

1. *Pulse width limited by safe operating area*
2. *Pulsed: pulse duration = 300 µs, 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} = ±1 mA, I_D = 0 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

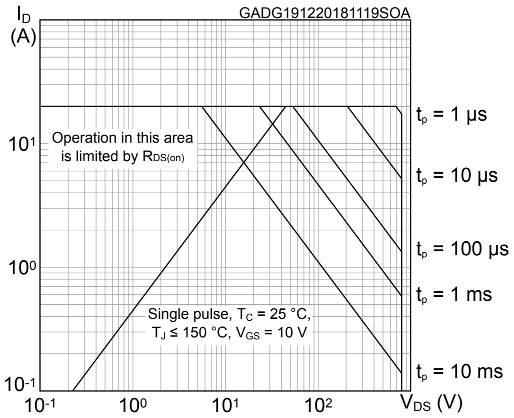


Figure 2. Thermal impedance

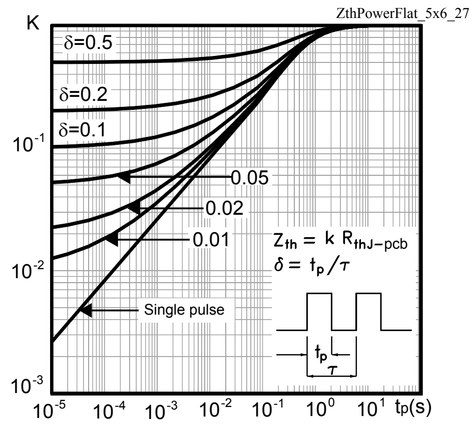


Figure 3. Output characteristics

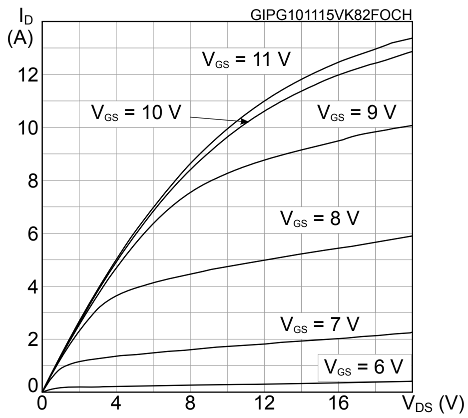


Figure 4. Transfer characteristics

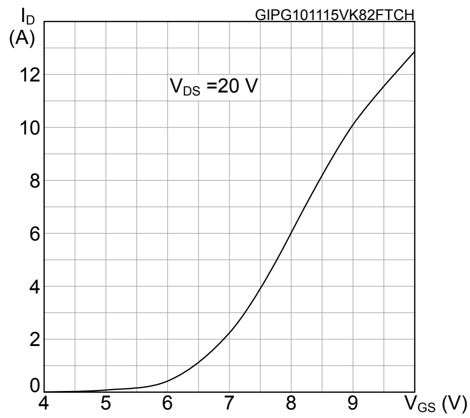


Figure 5. Gate charge vs gate-source voltage

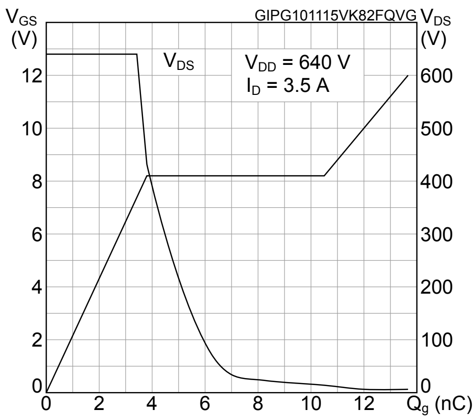


Figure 6. Static drain-source on-resistance

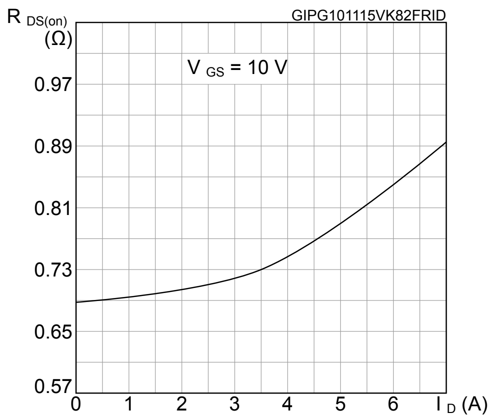


Figure 7. Capacitance variations

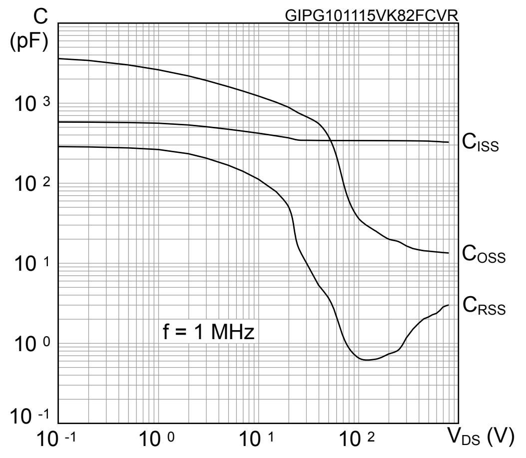


Figure 8. Normalized gate threshold voltage vs temperature

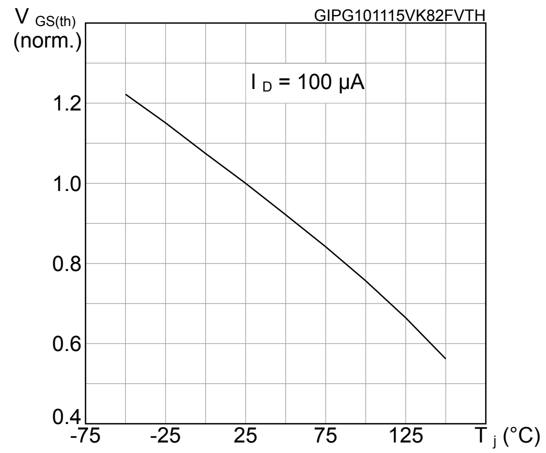


Figure 9. Normalized on-resistance vs temperature

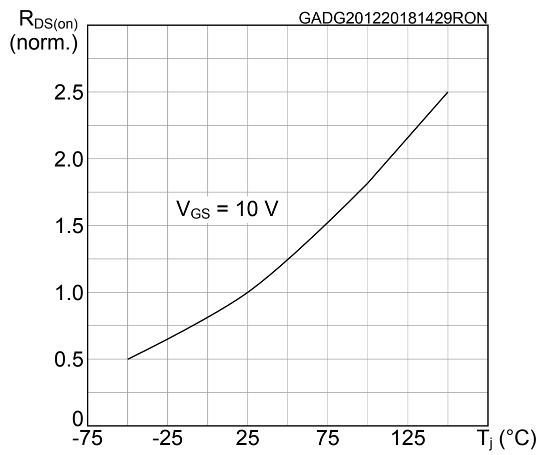


Figure 10. Normalized $V_{(BR)DSS}$ vs temperature

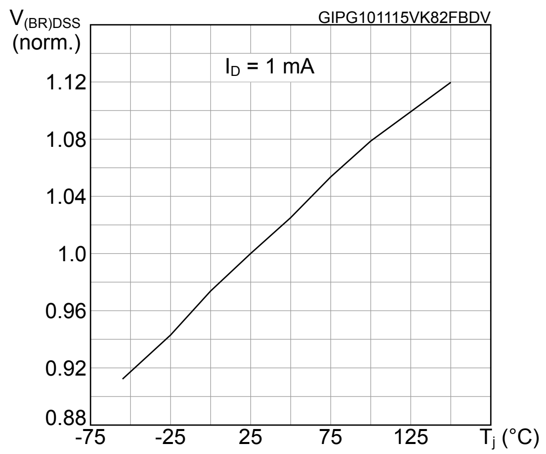


Figure 11. Output capacitance stored energy

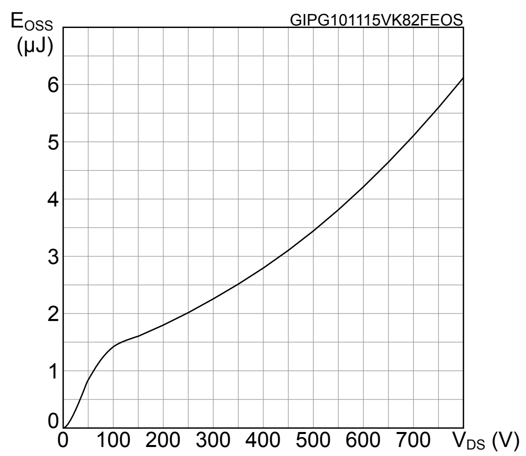


Figure 12. Source-drain diode forward characteristics

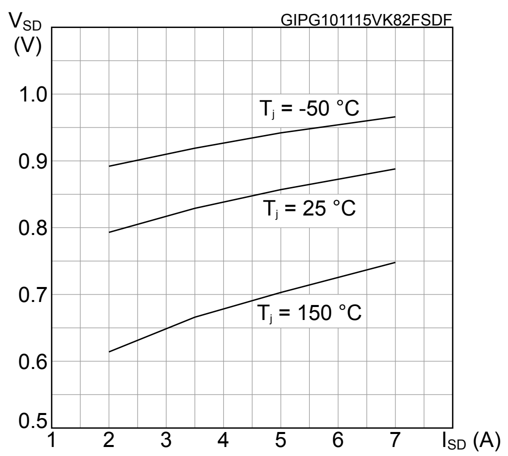
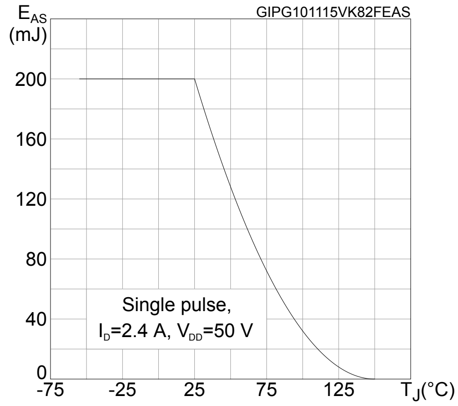


Figure 13. **Maximum avalanche energy vs starting T_J**



3 Test circuits

Figure 14. Test circuit for resistive load switching times

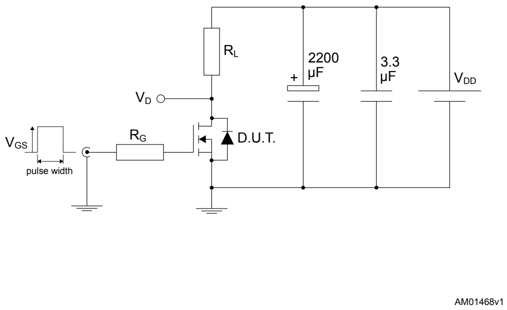


Figure 15. Test circuit for gate charge behavior

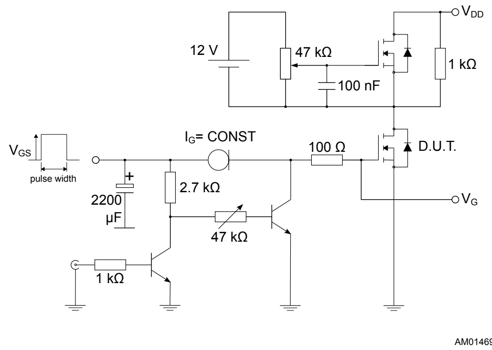


Figure 16. Test circuit for inductive load switching and diode recovery times

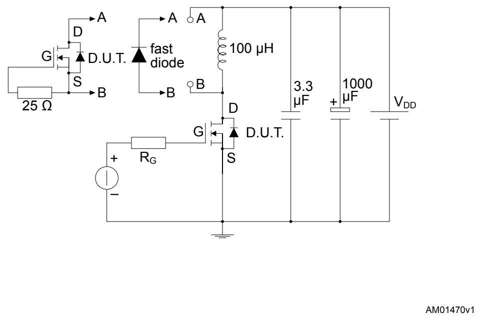


Figure 17. Unclamped inductive load test circuit

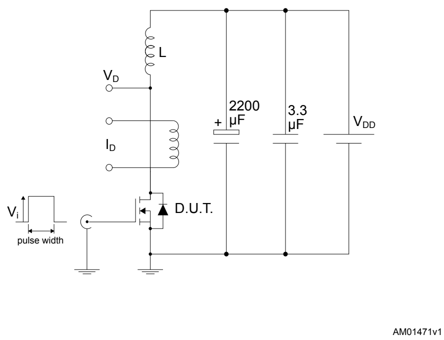


Figure 18. Unclamped inductive waveform

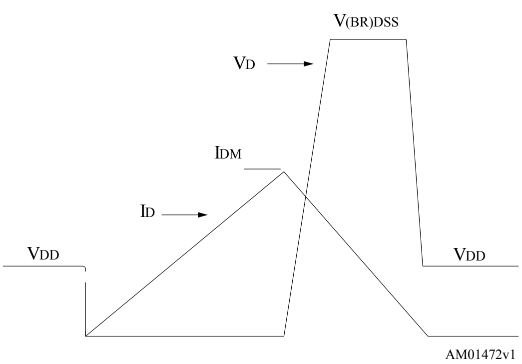
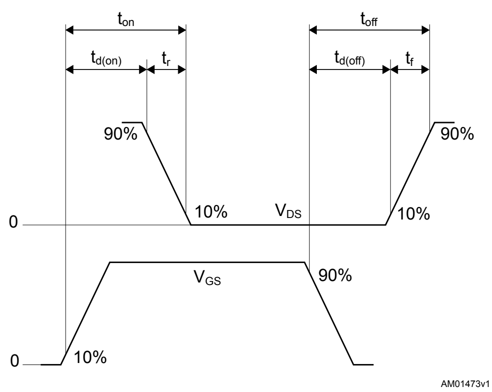


Figure 19. Switching time waveform



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 VHV mechanical data

Figure 20. PowerFLAT™ 5x6 VHV package outline

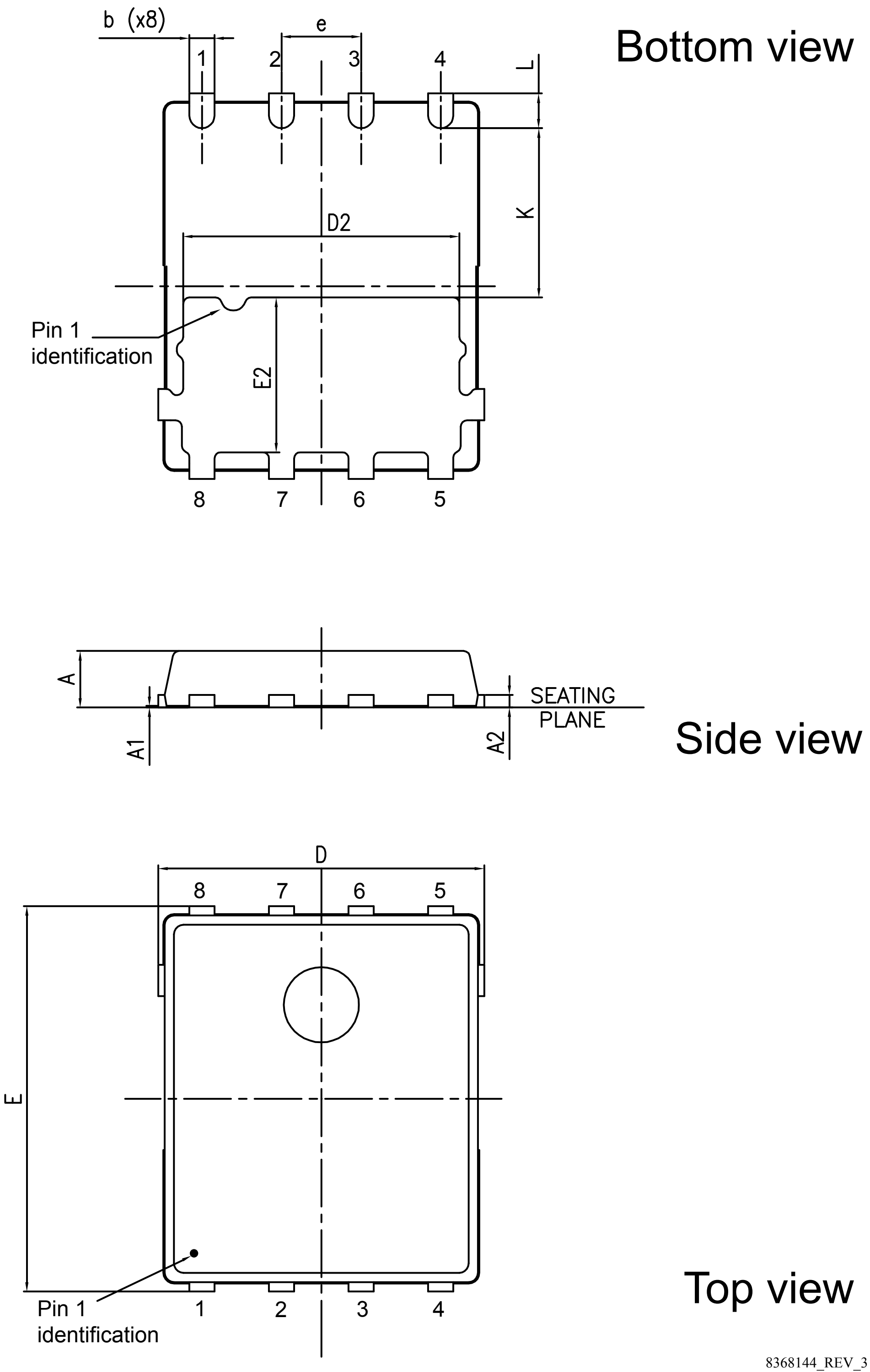
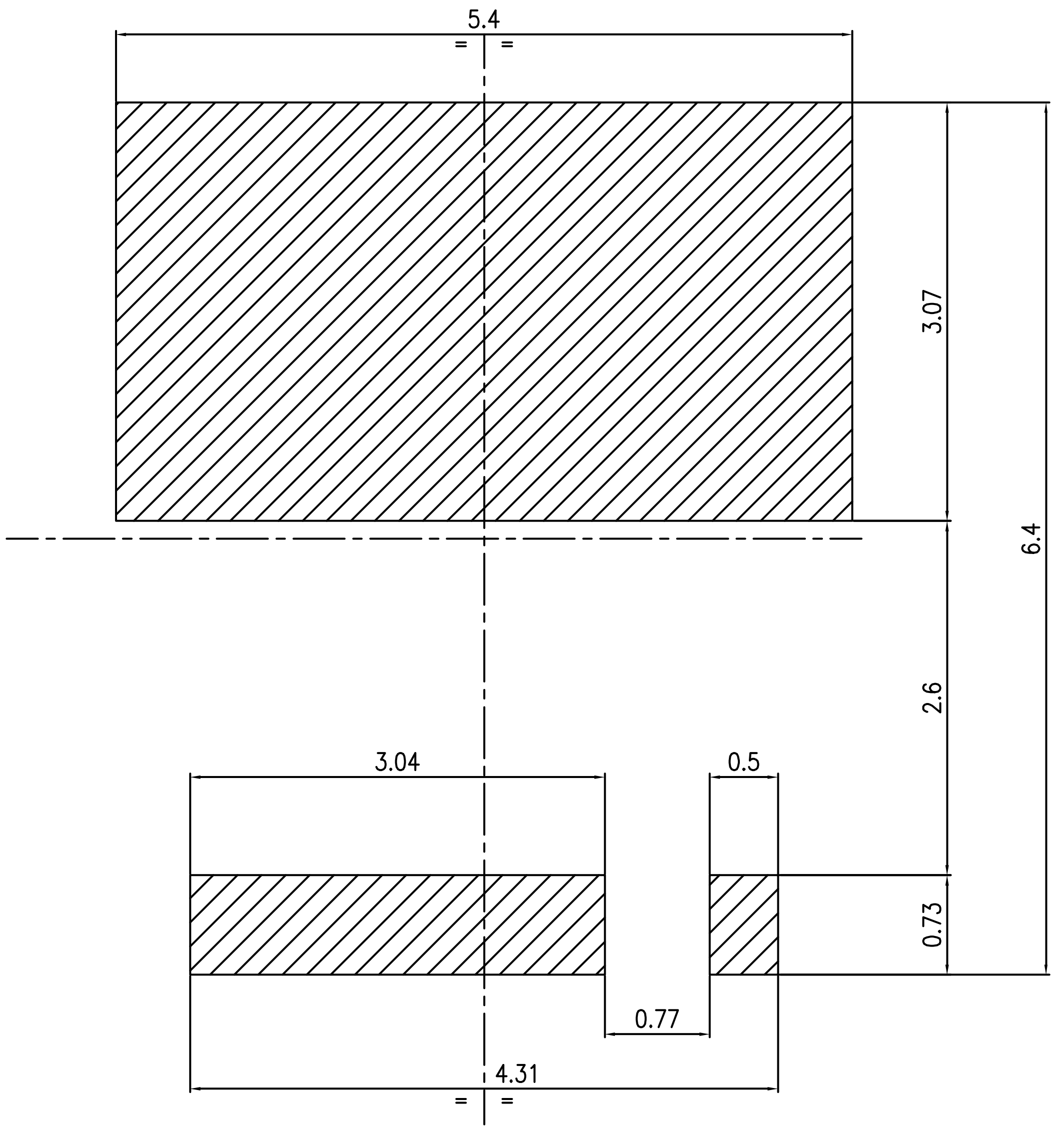


Table 9. **PowerFLAT™ 5x6 VHV package mechanical data**

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

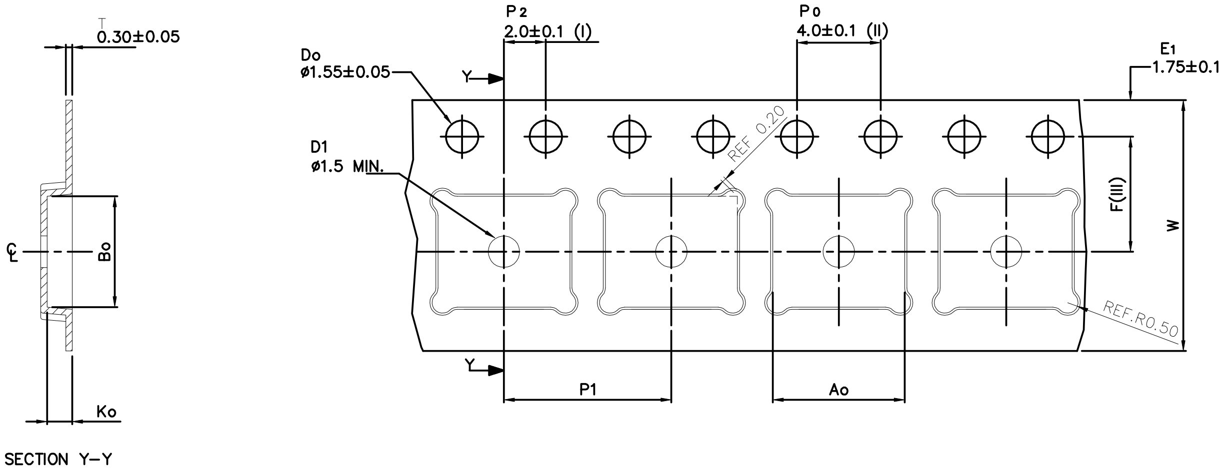
Figure 21. PowerFLAT™ 5x6 VHV recommended footprint (dimensions are in mm)



8368144_REV_3_footprint

4.2 PowerFLAT™ 5x6 packing information

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



Ao	6.30 +/− 0.1
Bo	5.30 +/− 0.1
Ko	1.20 +/− 0.1
F	5.50 +/− 0.1
P1	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 ±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**

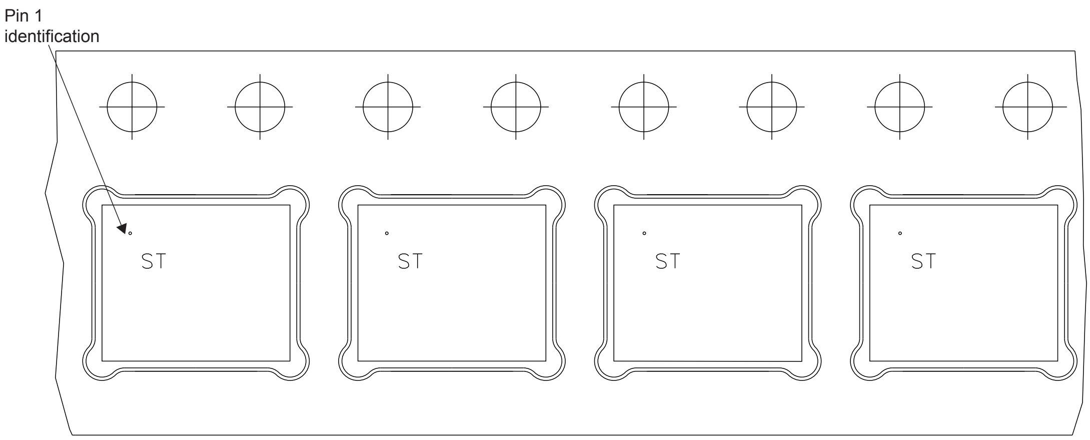
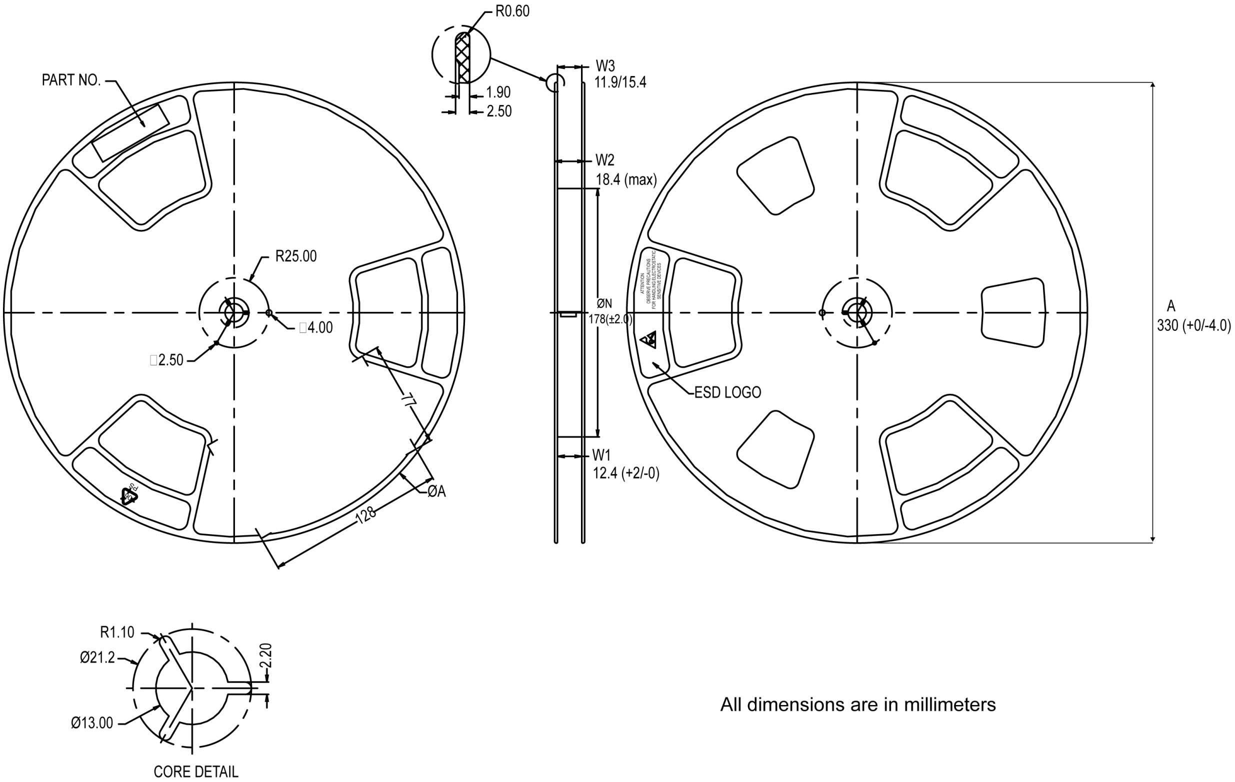


Figure 24. PowerFLAT™ 5x6 reel



All dimensions are in millimeters

8234350_Reel_rev_C

Revision history

Table 10. **Document revision history**

Date	Version	Changes
20-Dec-2018	1	First release.

Contents