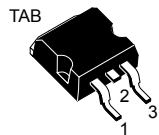
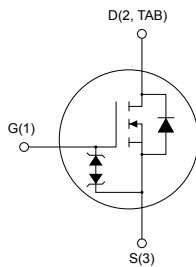


Automotive-grade N-channel 800 V, 1.5 Ω typ., 5.2 A SuperMESH Power MOSFET in a D²PAK package


 D²PAK



AM01475V1


Product status link
[STB9NK80Z](#)
Product summary

Order code	STB9NK80Z
Marking	B9NK80Z
Package	D ² PAK
Packing	Tape and reel

Features

Order code	V _{DS}	R _{DS(on)} max.	I _D
STB9NK80Z	800 V	1.8 Ω	5.2 A

- AEC-Q101 qualified 
- 100% avalanche tested
- Gate charge minimized
- Very low intrinsic capacitance
- Zener-protected

Applications

- Switching applications

Description

This high-voltage device is a Zener-protected N-channel Power MOSFET developed using the SuperMESH technology by STMicroelectronics, an optimization of the well-established PowerMESH. In addition to a significant reduction in on-resistance, this device is designed to ensure a high level of dv/dt capability for the most demanding applications.

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	800	V
V_{GS}	Gate-source voltage	± 30	V
I_D	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	5.2	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	3.3	A
$I_{DM}^{(1)}$	Drain current (pulsed)	20.8	A
P_{TOT}	Total power dissipation at $T_C = 25\text{ }^\circ\text{C}$	125	W
ESD	Gate-source human body model (C = 100 pF, R = 1.5 k Ω)	4	kV
$dv/dt^{(2)}$	Peak diode recovery voltage slope	4.5	V/ns
T_j	Operating junction temperature range	-55 to 150	$^\circ\text{C}$
T_{stg}	Storage temperature range		

1. Pulse width limited by safe operating area.
2. $I_{SD} \leq 5.2\text{ A}$, $di/dt \leq 200\text{ A}/\mu\text{s}$, $V_{DD} \leq V_{(BR)DSS}$.

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	1	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient	62.5	

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
$I_{AR}^{(1)}$	Avalanche current, repetitive or not-repetitive	5.2	A
$E_{AS}^{(2)}$	Single pulse avalanche energy	210	mJ

1. Pulse width limited by T_{jmax} .
2. Starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$.

2 Electrical characteristics

($T_{CASE} = 25\text{ °C}$ unless otherwise specified)

Table 4. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$, $I_D = 1\text{ mA}$	800			V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 800\text{ V}$			1	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 800\text{ V}$, $T_C = 125\text{ °C}$ ⁽¹⁾			50	μA
I_{GSS}	Gate-body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS} = \pm 20\text{ V}$			± 10	μA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 100\text{ }\mu\text{A}$	3	3.75	4.5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$, $I_D = 2.6\text{ A}$		1.5	1.8	Ω

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

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
g_{fs} ⁽¹⁾	Forward transconductance	$V_{DS} = 15\text{ V}$, $I_D = 2.6\text{ A}$		5		S
C_{iss}	Input capacitance	$V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	1138	-	μF
C_{oss}	Output capacitance			122		
C_{riss}	Reverse transfer capacitance			25		
$C_{oss\text{ eq.}}$ ⁽²⁾	Equivalent output capacitance	$V_{GS} = 0\text{ V}$, $V_{DS} = 0\text{ V to } 640\text{ V}$	-	50	-	μF
Q_g	Total gate charge	$V_{DD} = 640\text{ V}$, $I_D = 2.6\text{ A}$, $V_{GS} = 0\text{ to } 10\text{ V}$ (see Figure 15. Test circuit for gate charge behavior)	-	40	-	nC
Q_{gs}	Gate-source charge			7		
Q_{gd}	Gate-drain charge			21		

1. Pulsed: pulse duration=300 μs , duty cycle 1.5%.

2. $C_{oss\text{ eq.}}$ 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 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 400\text{ V}$, $I_D = 2.6\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 14. Test circuit for resistive load switching times and Figure 19. Switching time waveform)	-	20	-	ns
t_r	Rise time			12		
$t_{d(off)}$	Turn-off delay time			45		
t_f	Fall time			22		
$t_{r(voff)}$	Off-voltage rise time	$V_{DD} = 640\text{ V}$, $I_D = 5.2\text{ A}$,	-	12	-	ns
t_f	Fall time	$R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$		10		
t_c	Cross-over time	(see Figure 16. Test circuit for inductive load switching and diode recovery times)		20		

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		5.2	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		20.8	
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 5.2\text{ A}$, $V_{GS} = 0\text{ V}$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 5.2\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$	-	530		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 50\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 16. Test circuit for inductive load switching and diode recovery times)	-	3.31		μC
I_{RRM}	Reverse recovery current		-	12.5		A

1. Pulse width is 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	$I_{GS} = \pm 1\text{ mA}$, $I_D = 0\text{ A}$	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

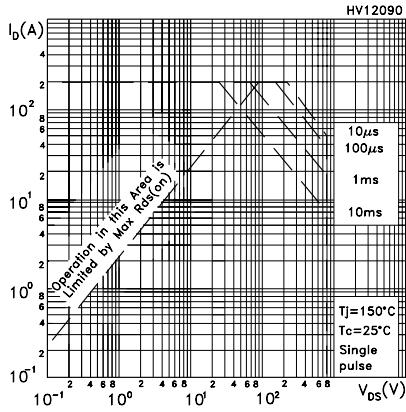


Figure 2. Thermal impedance

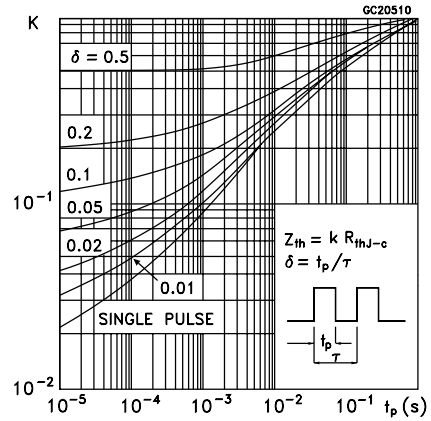


Figure 3. Output characteristics

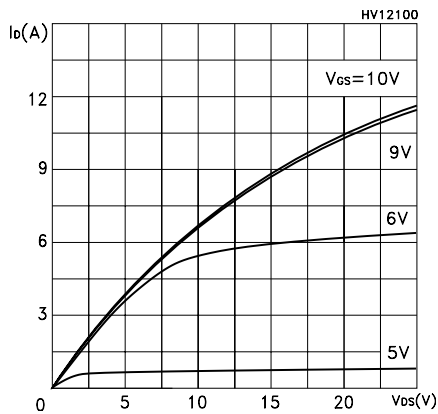


Figure 4. Transfer characteristics

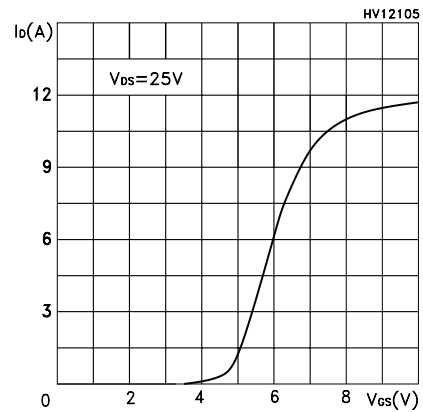


Figure 5. Transconductance

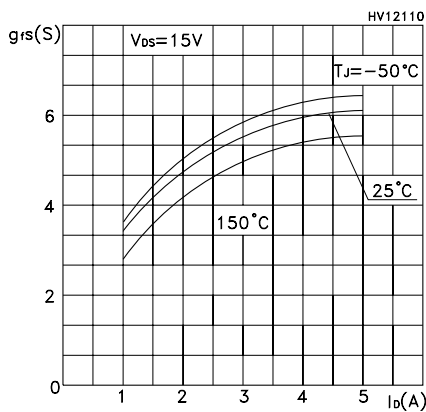


Figure 6. Static drain-source on-resistance

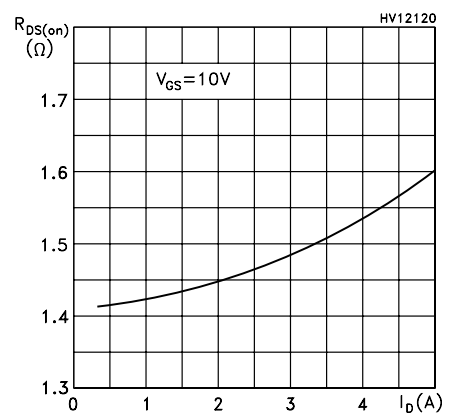


Figure 7. Gate charge vs gate-source voltage

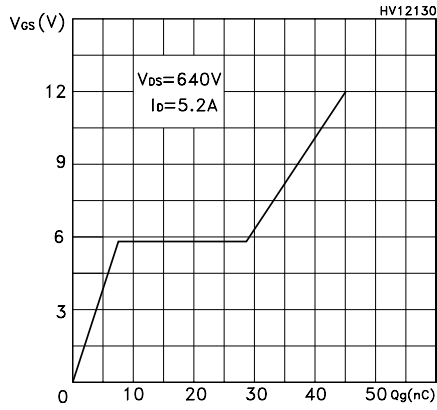


Figure 8. Capacitance variations

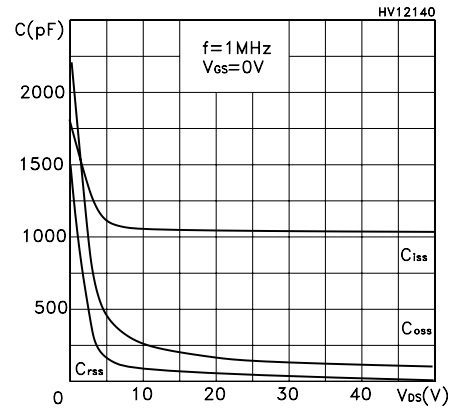


Figure 9. Normalized gate threshold voltage vs temperature

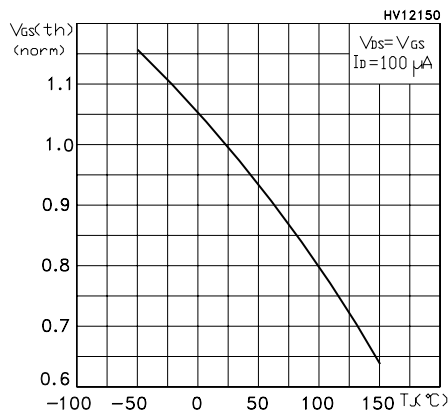


Figure 10. Normalized on-resistance vs temperature

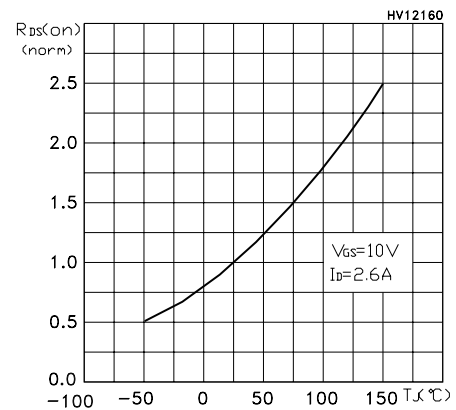


Figure 11. Source-drain diode forward characteristics

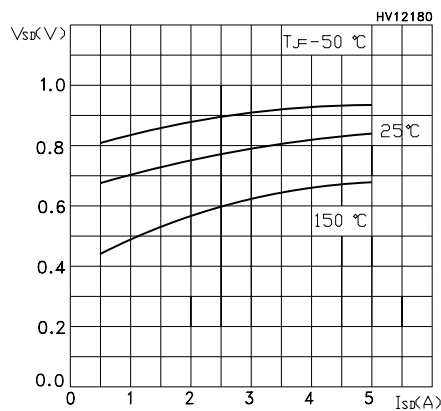


Figure 12. Normalized breakdown voltage vs temperature

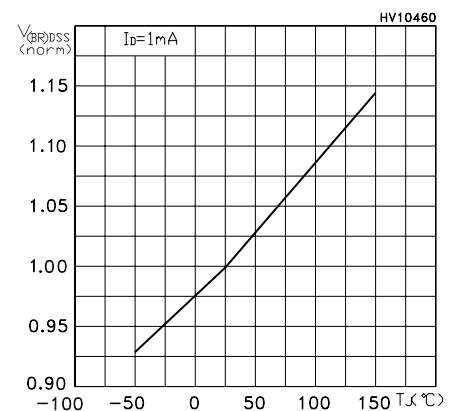
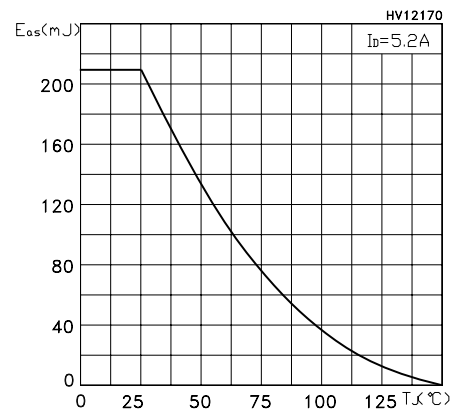
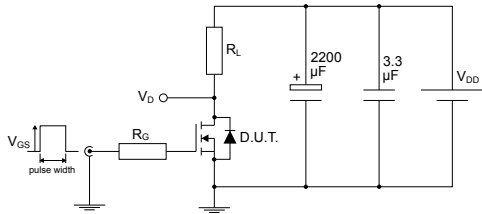


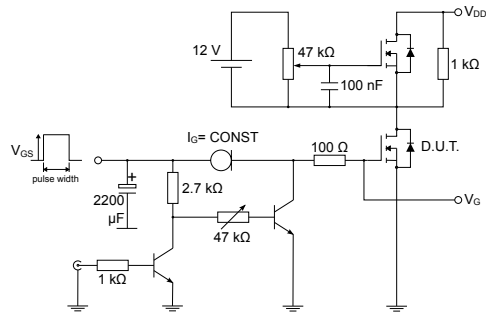
Figure 13. Maximum avalanche energy vs temperature



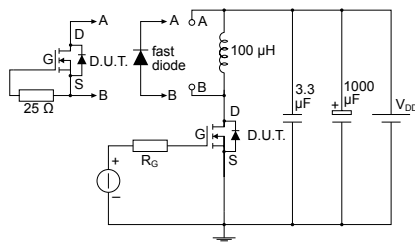
3 Test circuits

Figure 14. Test circuit for resistive load switching times


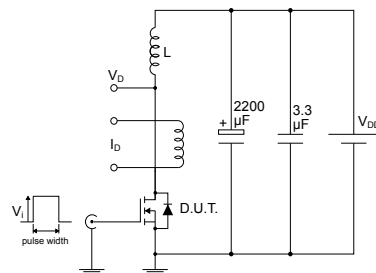
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Figure 15. Test circuit for gate charge behavior


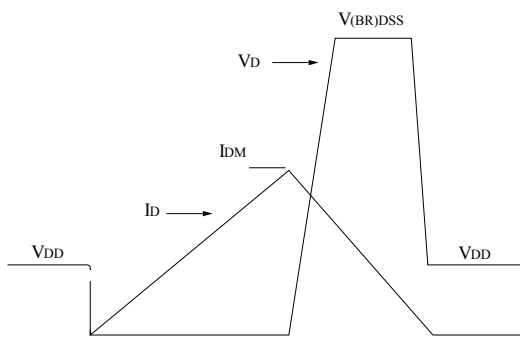
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Figure 16. Test circuit for inductive load switching and diode recovery times


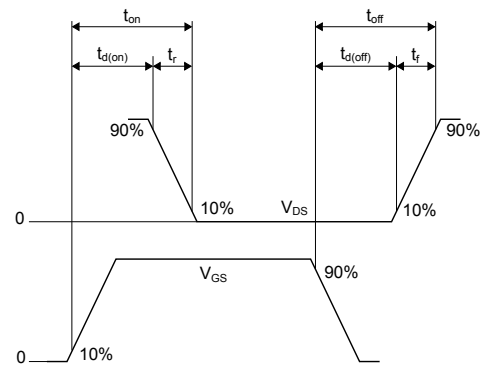
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Figure 17. Unclamped inductive load test circuit


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Figure 18. Unclamped inductive waveform


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Figure 19. Switching time waveform


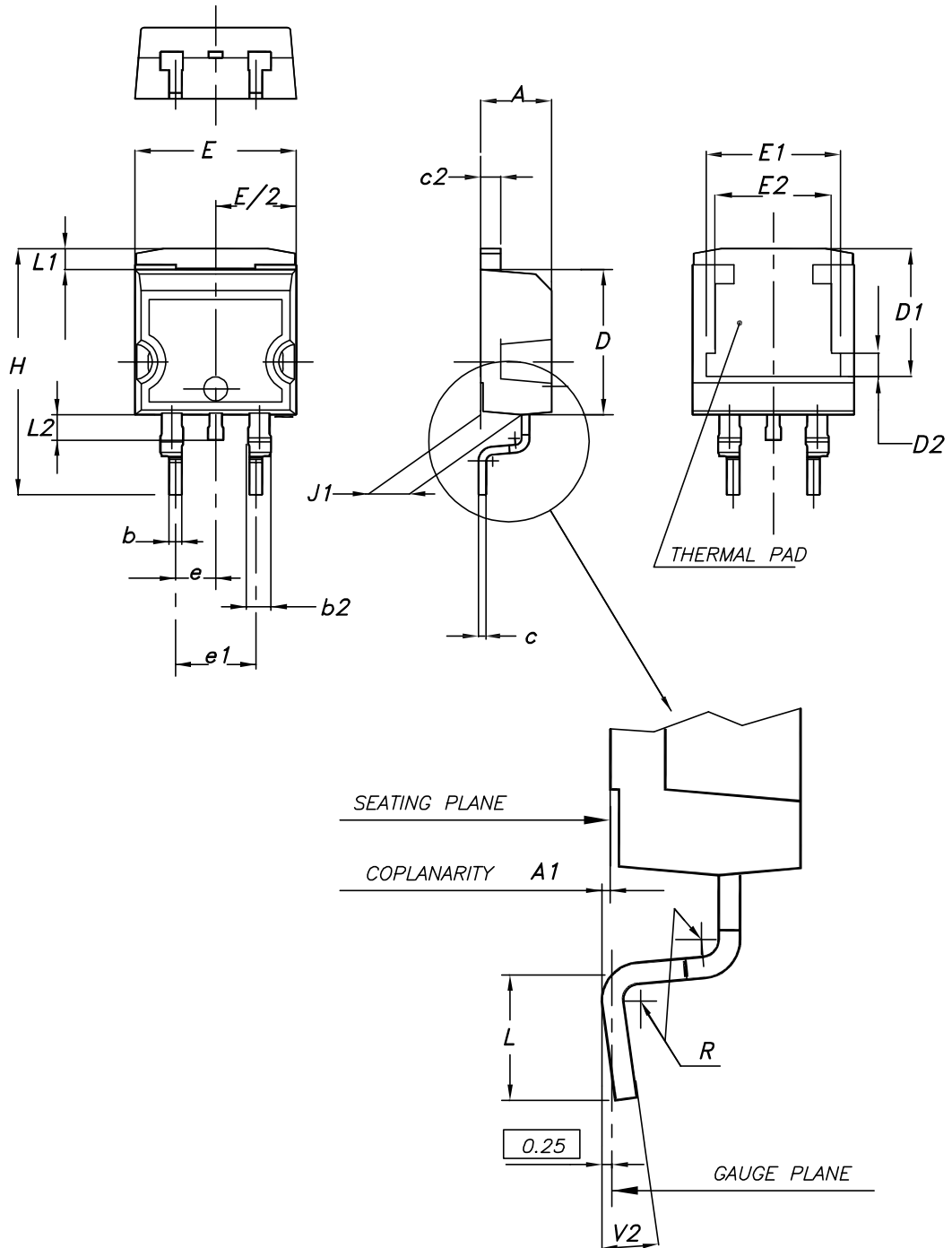
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4 Package information

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 D²PAK (TO-263) type A package information

Figure 20. D²PAK (TO-263) type A package outline

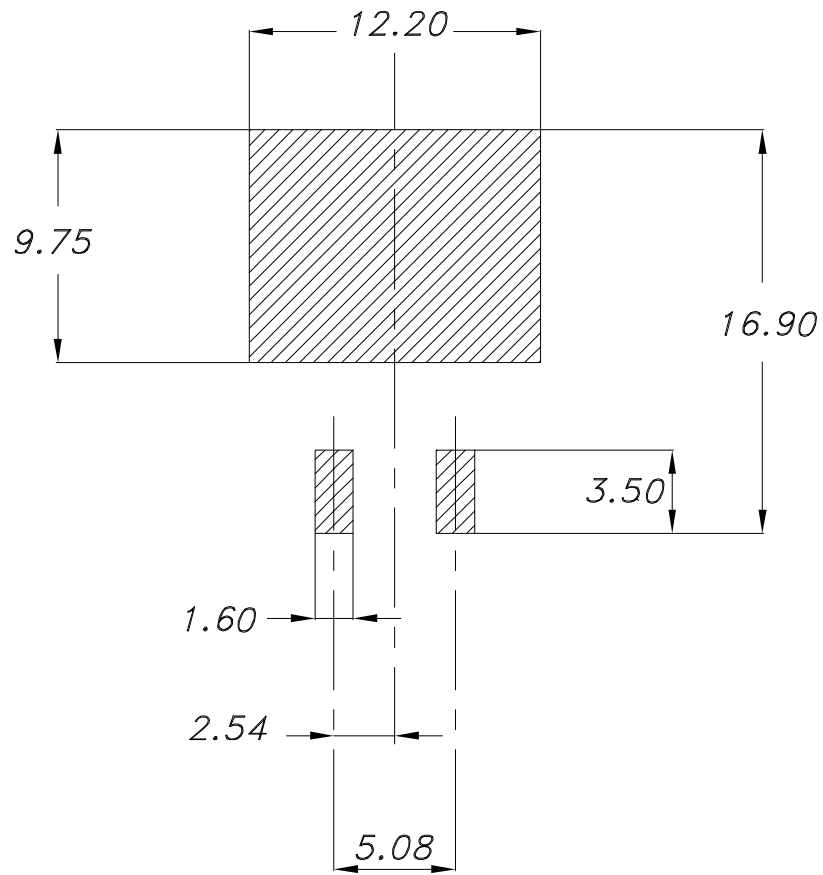


0079457_26

Table 9. D²PAK (TO-263) type A package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50	7.75	8.00
D2	1.10	1.30	1.50
E	10.00		10.40
E1	8.30	8.50	8.70
E2	6.85	7.05	7.25
e		2.54	
e1	4.88		5.28
H	15.00		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.40	
V2	0°		8°

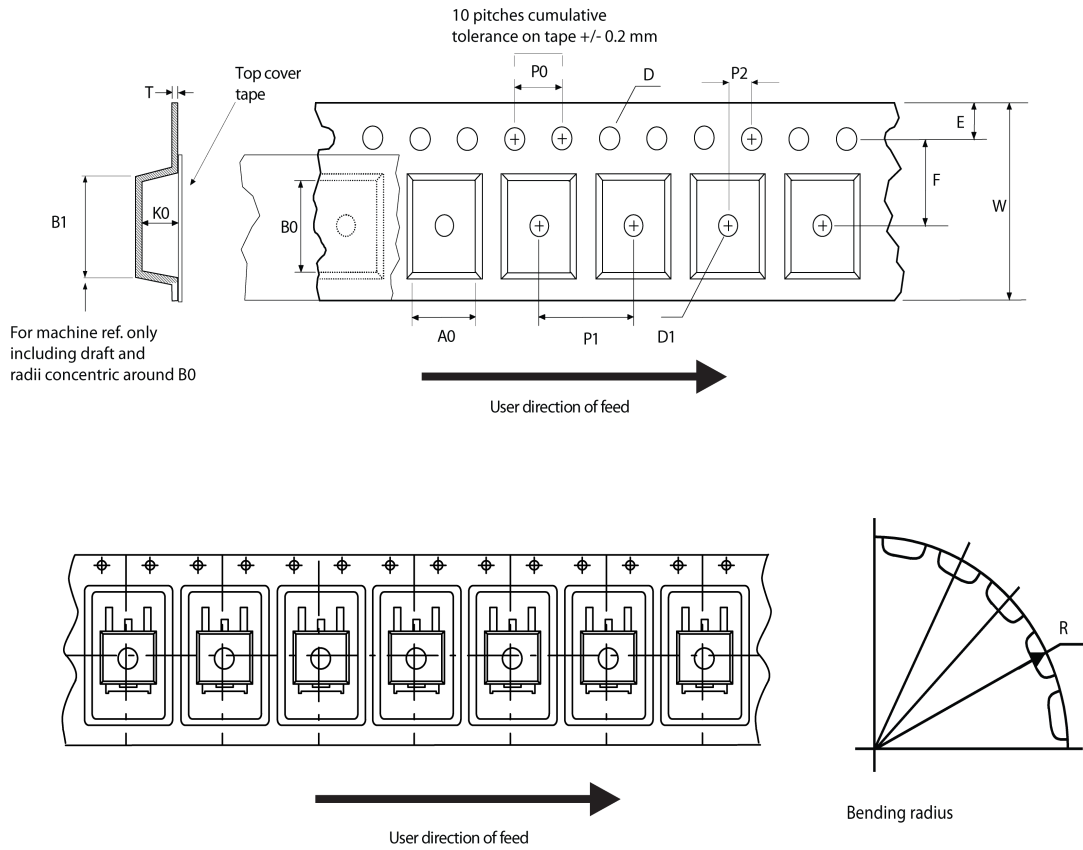
Figure 21. D²PAK (TO-263) recommended footprint (dimensions are in mm)



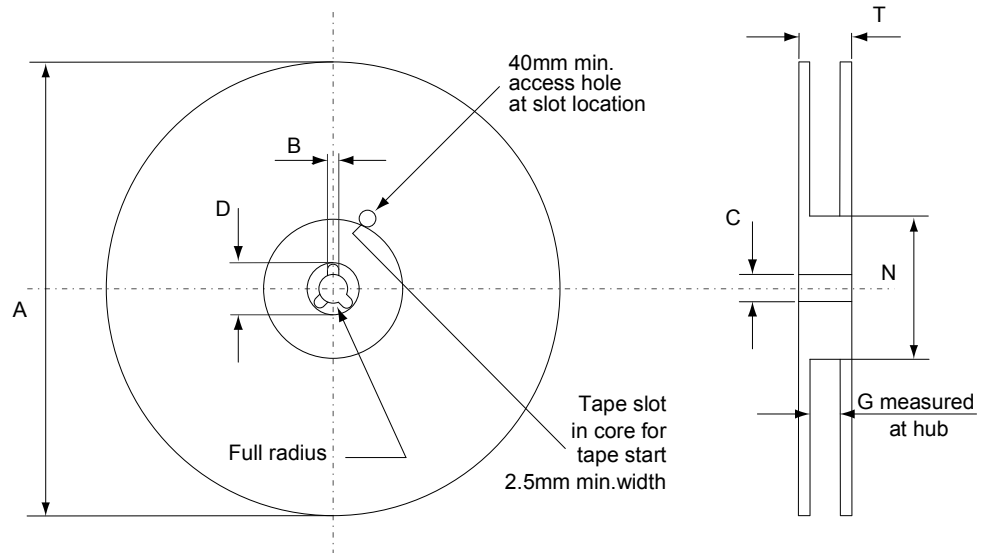
Footprint_26

4.2 D²PAK packing information

Figure 22. D²PAK tape outline



AM08852v1

Figure 23. D²PAK reel outline


AM06038v1

Table 10. D²PAK tape and reel mechanical data

Tape			Reel			
Dim.	mm		Dim.	mm		
	Min.	Max.		Min.	Max.	
A0	10.5	10.7	A		330	
B0	15.7	15.9	B	1.5		
D	1.5	1.6	C	12.8	13.2	
D1	1.59	1.61	D	20.2		
E	1.65	1.85	G	24.4	26.4	
F	11.4	11.6	N	100		
K0	4.8	5.0	T		30.4	
P0	3.9	4.1	Base quantity Bulk quantity			
P1	11.9	12.1				1000
P2	1.9	2.1				1000
R	50					
T	0.25	0.35				
W	23.7	24.3				

Revision history

Table 11. Document revision history

Date	Version	Changes
05-Jun-2013	1	First issue.
12-Jul-2013	2	Document status promoted from preliminary to production data.
21-Oct-2019	3	Modified Table 5. Dynamic and Section 4.1 D²PAK (TO-263) type A package information . Minor text changes.

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