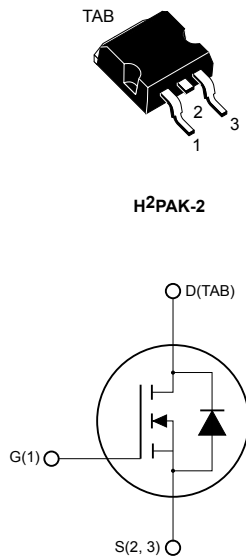


Automotive-grade N-channel 1200 V, 7.25 Ω typ., 1.5 A, MDmesh K5 Power MOSFET in an H²PAK-2 package



 H²PAK-2

DTG1523NZ



Features

Order code	V _{DS}	R _{DS(on)} max.	I _D	P _{TOT}
STH2N120K5-2AG	1200 V	10 Ω	1.5 A	60 W

- 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

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

STH2N120K5-2AG

Product summary⁽¹⁾

Order code	STH2N120K5-2AG
Marking	2N120K5
Package	H ² PAK-2
Packing	Tape and reel

1. HTRB test was performed at 80% of V_{(BR)DSS} according to AEC-Q101 rev. C. All other tests were performed according to AEC-Q101 rev. D.

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 $T_C = 25\text{ }^\circ\text{C}$	1.5	A
	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	1	
$I_{DM}^{(1)}$	Drain current (pulsed)	2.5	A
P_{TOT}	Total power dissipation at $T_C = 25\text{ }^\circ\text{C}$	60	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	$^\circ\text{C}$
T_J	Operating junction temperature range		

1. Pulse width is limited by safe operating area.
2. $I_{SD} \leq 1.5\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DS}(\text{peak}) < V_{(BR)DSS}$; $V_{DD} = 80\% V_{(BR)DSS}$.
3. $V_{DS} \leq 960\text{ V}$.

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	2.08	$^\circ\text{C}/\text{W}$
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb	30	

1. When mounted on an 1-inch² FR-4, 2 Oz copper board.

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
$I_{AR}^{(1)}$	Avalanche current, repetitive or not repetitive	0.5	A
$E_{AS}^{(2)}$	Single pulse avalanche energy	80	mJ

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

2 Electrical characteristics

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

Table 4. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	1200			V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}, V_{DS} = 1200\text{ V}$			0.5	μA
		$V_{GS} = 0\text{ V}, V_{DS} = 1200\text{ V}, T_C = 125\text{ }^\circ\text{C}^{(1)}$			100	
I_{GSS}	Gate-body leakage current	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 100\text{ }\mu\text{A}$	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}, I_D = 0.5\text{ A}$		7.25	10	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	$V_{DS} = 100\text{ V}, f = 1\text{ MHz}, V_{GS} = 0\text{ V}$	-	124	-	pF
C_{oss}	Output capacitance		-	13	-	
C_{riss}	Reverse transfer capacitance		-	0.5	-	
$C_{o(tr)}^{(1)}$	Time-related equivalent capacitance	$V_{GS} = 0\text{ V}, V_{DS} = 0\text{ to }960\text{ V}$	-	15	-	pF
$C_{o(er)}^{(2)}$	Energy-related equivalent capacitance		-	5	-	
R_G	Intrinsic gate resistance	$f = 1\text{ MHz}, I_D = 0\text{ A}$	-	16	-	Ω
Q_g	Total gate charge	$V_{DD} = 960\text{ V}, I_D = 1.5\text{ A}, V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 13. Test circuit for gate charge behavior)	-	5.3	-	nC
Q_{gs}	Gate-source charge		-	0.8	-	
Q_{gd}	Gate-drain charge		-	3.5	-	

- $C_{o(tr)}$ is a constant capacitance value giving the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .
- $C_{o(er)}$ is a constant capacitance value giving 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	$V_{DD} = 600\text{ V}, I_D = 0.75\text{ A},$ $R_G = 4.7\text{ }\Omega, V_{GS} = 10\text{ V}$ (see Figure 12. Test circuit for resistive load switching times and Figure 17. Switching time waveform)	-	10.3	-	ns
t_r	Rise time		-	7.8	-	
$t_{d(off)}$	Turn-off delay time		-	34	-	
t_f	Fall time		-	39	-	

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		1.5	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		2.5	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0\text{ V}$, $I_{SD} = 1.5\text{ A}$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 1.5\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$,	-	350		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 60\text{ V}$	-	1.35		μC
I_{RRM}	Reverse recovery current	(see Figure 14. Test circuit for inductive load switching and diode recovery times)	-	7.7		A
t_{rr}	Reverse recovery time	$I_{SD} = 1.5\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$,	-	600		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 60\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$	-	2.09		μC
I_{RRM}	Reverse recovery current	(see Figure 14. Test circuit for inductive load switching and diode recovery times)	-	7.7		A

1. Pulse width is limited by safe operating area.
2. Pulse test: pulse duration = 300 μs , duty cycle 1.5%.

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

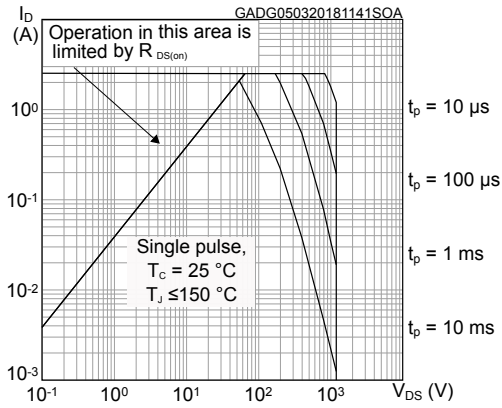


Figure 2. Thermal impedance

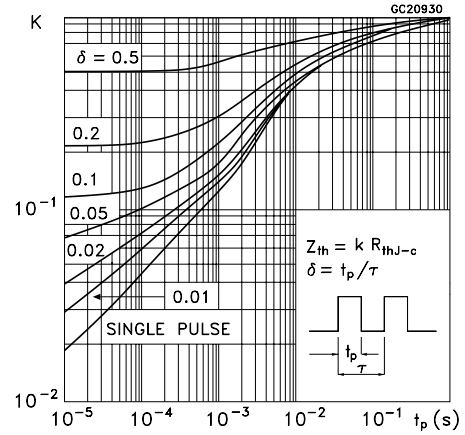


Figure 3. Output characteristics

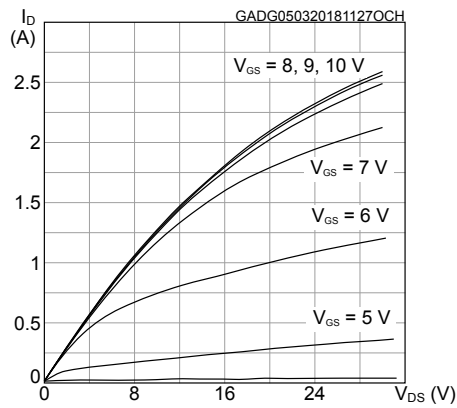


Figure 4. Transfer characteristics

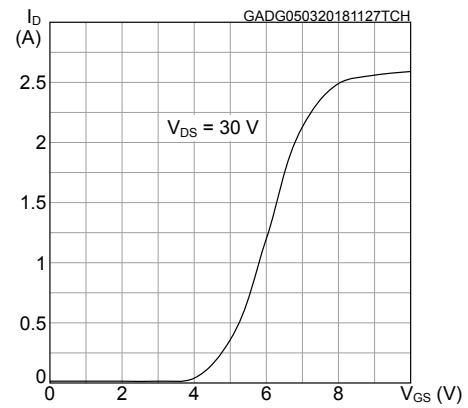


Figure 5. Gate charge vs gate-source voltage

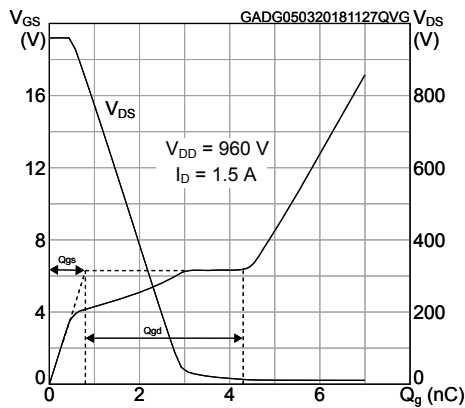


Figure 6. Static drain-source on-resistance

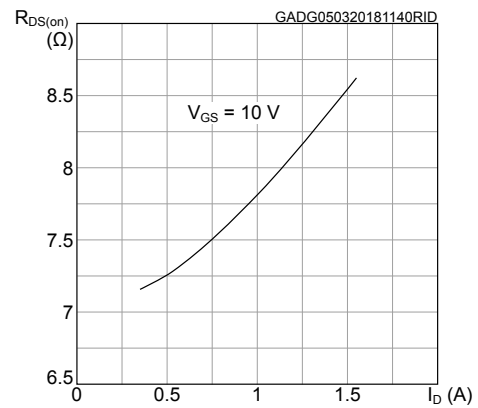


Figure 7. Capacitance variations

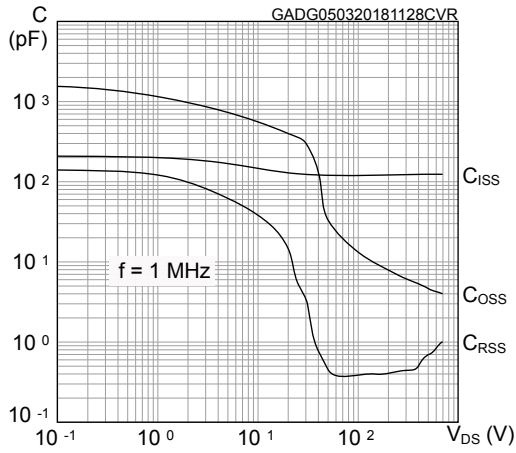


Figure 8. Normalized gate threshold voltage vs temperature

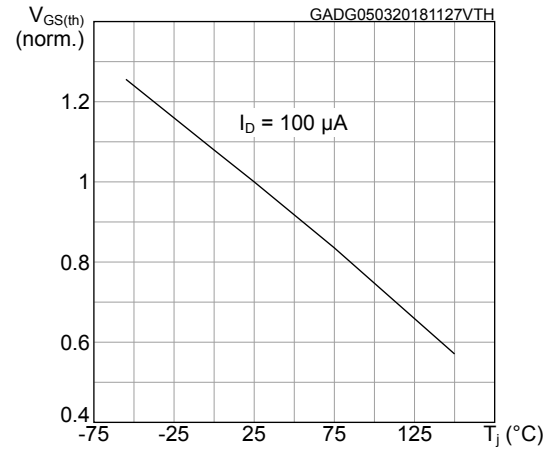


Figure 9. Normalized on-resistance vs temperature

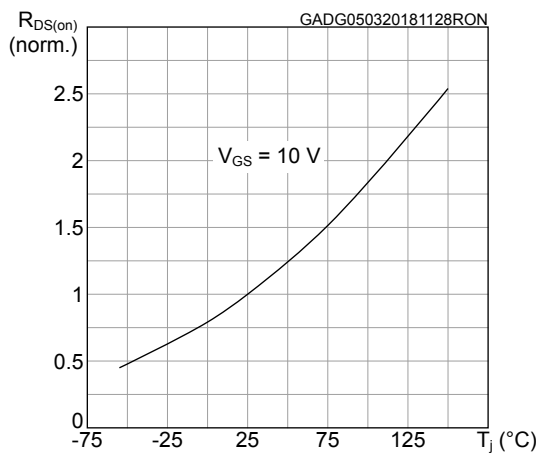


Figure 10. Normalized $V_{(BR)DSS}$ vs temperature

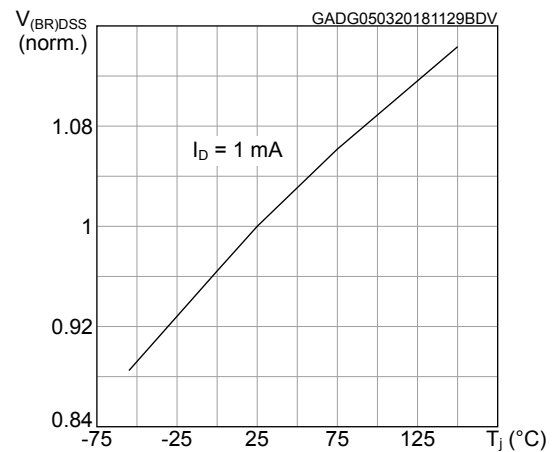
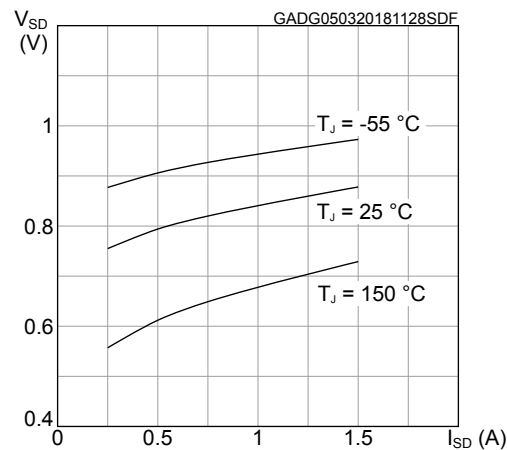
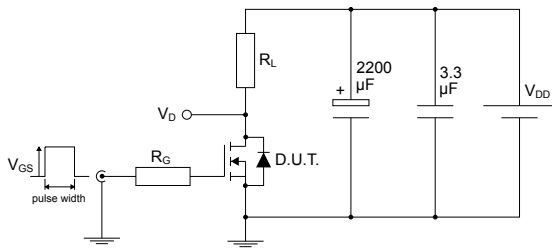


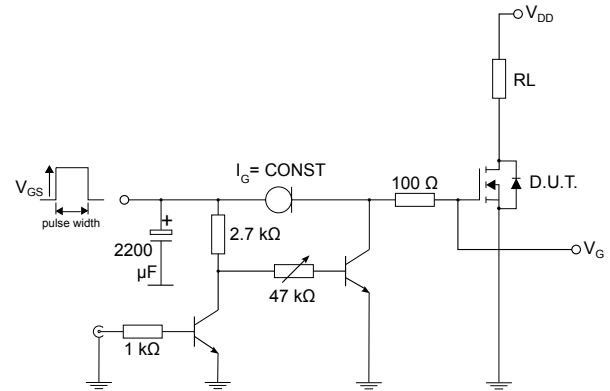
Figure 11. Source-drain diode forward characteristics



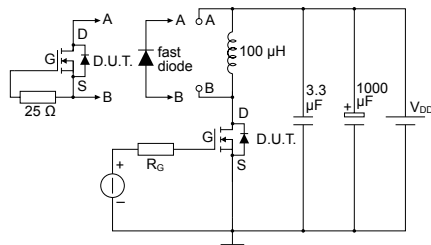
3 Test circuits

Figure 12. Test circuit for resistive load switching times


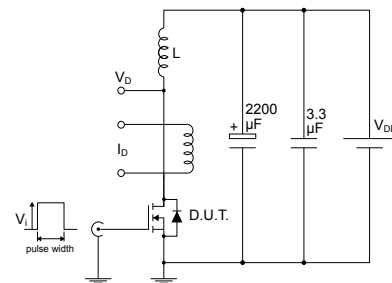
AM01468v1

Figure 13. Test circuit for gate charge behavior


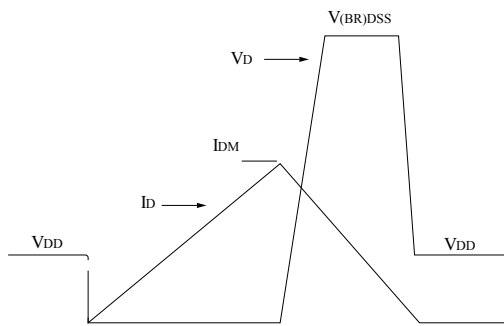
AM01469v10

Figure 14. Test circuit for inductive load switching and diode recovery times


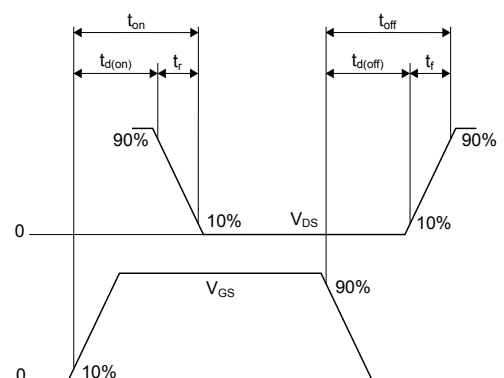
AM01470v1

Figure 15. Unclamped inductive load test circuit


AM01471v1

Figure 16. Unclamped inductive waveform


AM01472v1

Figure 17. Switching time waveform


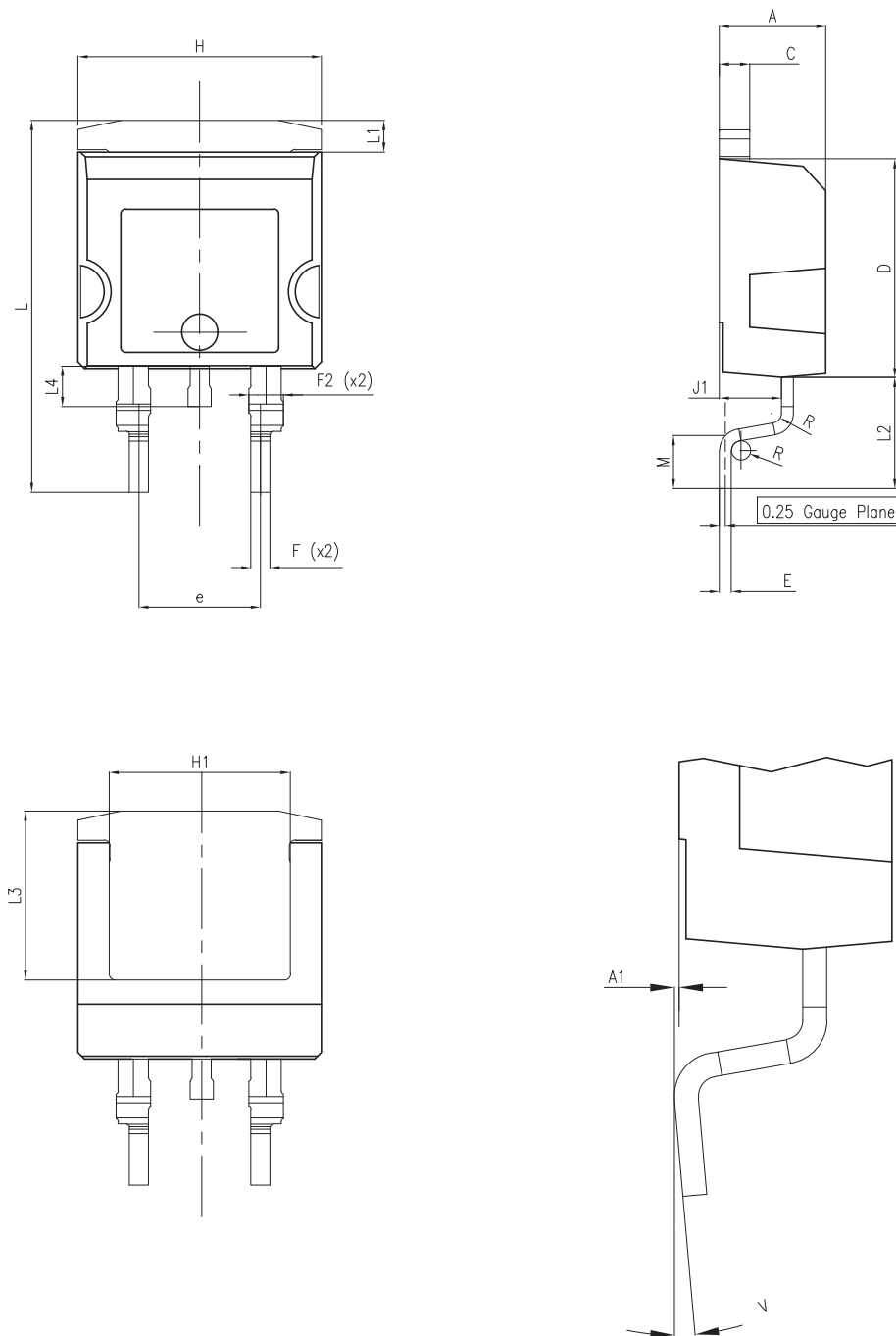
AM01473v1

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. ECOPACK is an ST trademark.

4.1 H²PAK-2 package information

Figure 18. H²PAK-2 package outline

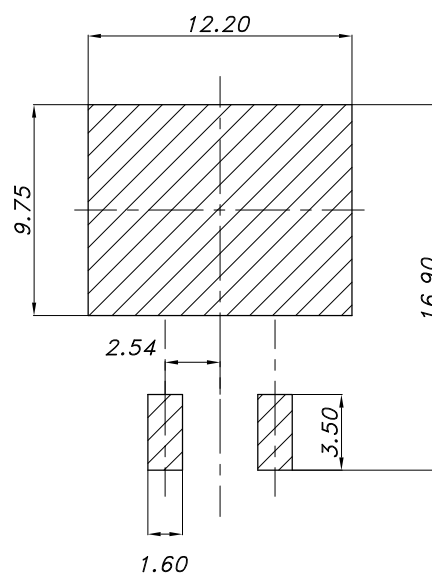


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Table 8. H²PAK-2 package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.30		4.70
A1	0.03		0.20
C	1.17		1.37
D	8.95		9.35
e	4.98		5.18
E	0.50		0.90
F	0.78		0.85
F2	1.14		1.70
H	10.00		10.40
H1	7.40	-	7.80
J1	2.49		2.69
L	15.30		15.80
L1	1.27		1.40
L2	4.93		5.23
L3	6.85		7.25
L4	1.50		1.70
M	2.60		2.90
R	0.20		0.60
V	0°		8°

Figure 19. H²PAK-2 recommended footprint

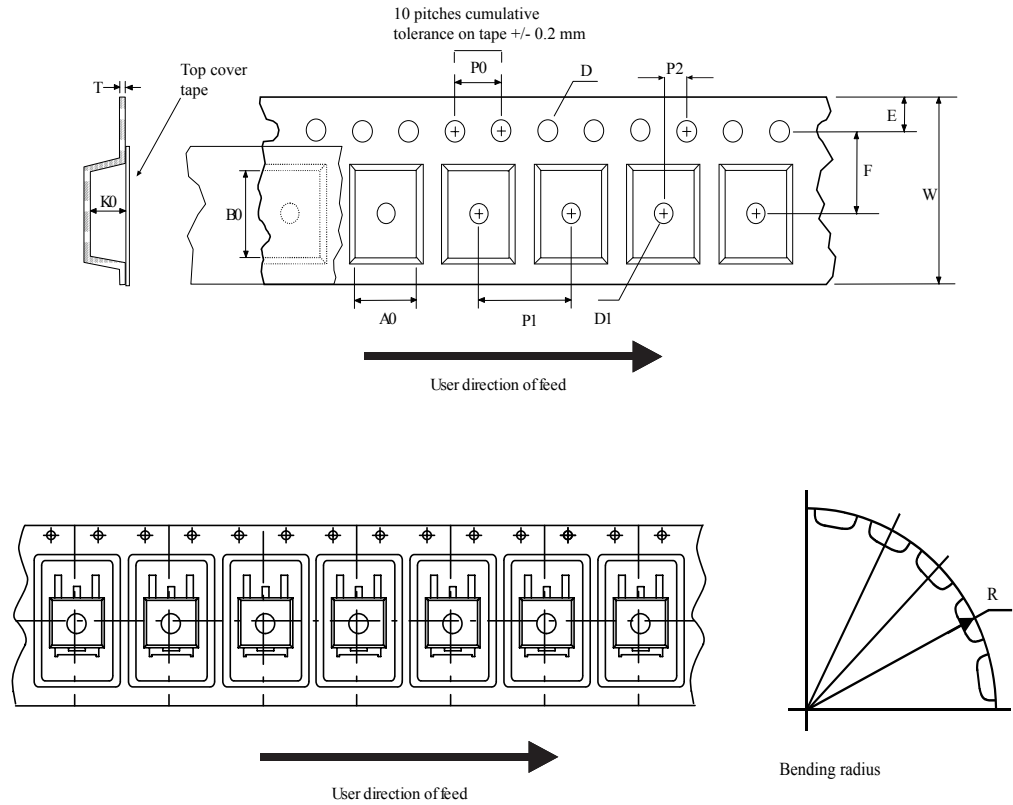


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Note: Dimensions are in mm.

4.2 Packing information

Figure 20. Tape outline



AM08852v2

Figure 21. Reel outline

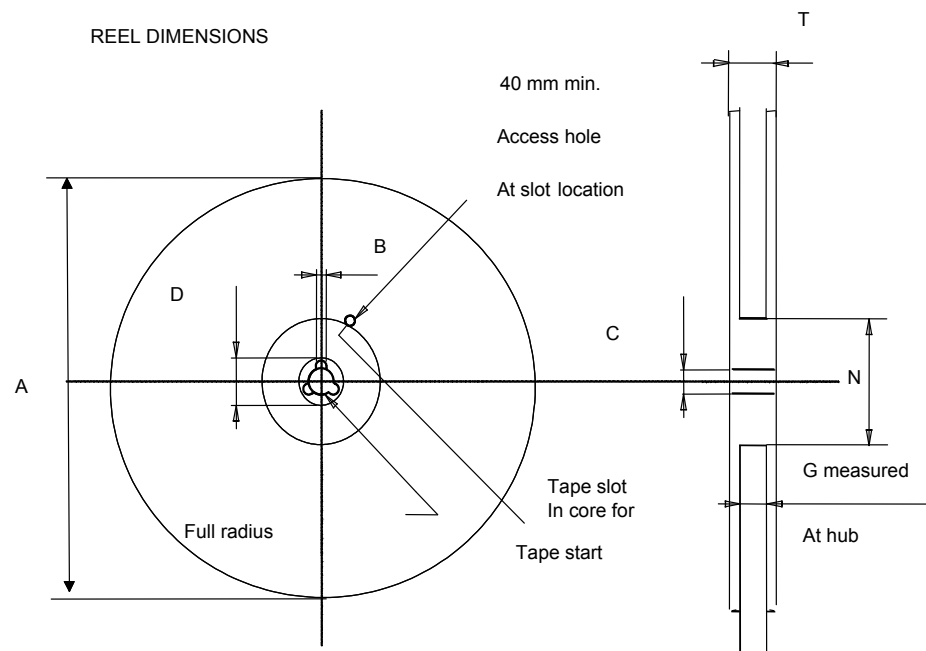


Table 9. Tape and reel mechanical data

Dim.	Tape		Dim.	Reel	
	mm			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			
P1	11.9	12.1	Base quantity		1000
P2	1.9	2.1	Bulk quantity		1000
R	50				
T	0.25	0.35			
W	23.7	24.3			

Revision history

Table 10. Document revision history

Date	Version	Changes
23-Mar-2018	1	Initial release. The document status is preliminary data.
30-Jul-2018	2	The document status was promoted from preliminary to production data. Updated title and features on cover page.
31-Jul-2018	3	Updated the current table. The date for revision 2 was erroneously reported as "19-Jun-2018" instead of "30-Jul-2018".
05-Sep-2018	4	Updated I_{DSS} parameter in <i>Table 4. Static</i> .
16-Jun-2020	5	Updated Section 4 Package information .

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