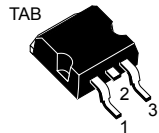
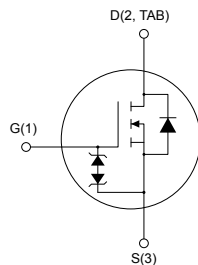



Automotive-grade N-channel 500 V, 61 mΩ typ., 38 A MDmesh™ DM6 Power MOSFET in a D²PAK package


 D²PAK


AM01475V1

Features

Order code	V _{DS}	R _{DS(on)} max.	I _D
STB47N50DM6AG	500 V	71 mΩ	38 A

- AEC-Q101 qualified 
- Fast-recovery body diode
- Lower R_{DS(on)} per area vs previous generation
- Low gate charge, input capacitance and resistance
- 100% avalanche tested
- Extremely high dv/dt ruggedness
- Zener-protected

Applications

- Switching applications

Description

This high-voltage N-channel Power MOSFET is part of the MDmesh™ DM6 fast-recovery diode series. Compared with the previous MDmesh fast generation, DM6 combines very low recovery charge (Q_{rr}), recovery time (t_{rr}) and excellent improvement in R_{DS(on)} per area with one of the most effective switching behaviors available in the market for the most demanding high-efficiency bridge topologies and ZVS phase-shift converters.

Product status link

[STB47N50DM6AG](#)

Product summary

Order code	STB47N50DM6AG
Marking	47N50DM6
Package	D ² PAK
Packing	Tape and reel

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	500	V
V_{GS}	Gate-source voltage	± 25	V
I_D	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	38	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	24	A
$I_D^{(1)}$	Drain current (pulsed)	137	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	250	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	50	V/ns
$dv/dt^{(3)}$	MOSFET dv/dt ruggedness	100	
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. $I_{SD} \leq 38\text{ A}$, $di/dt \leq 800\text{ A}/\mu\text{s}$, $V_{DS\ peak} < V_{(BR)DSS}$, $V_{DD} = 400\text{ V}$
3. $V_{DS} \leq 400\text{ V}$

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	0.5	$^\circ\text{C}/\text{W}$
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb	30	

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

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not repetitive (pulse width limited by T_{jmax})	7	A
E_{AS}	Single-pulse avalanche energy (starting $T_J = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 100\text{ V}$)	850	mJ

2 Electrical characteristics

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

Table 4. On/off-state

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$, $I_D = 1\text{ mA}$	500			V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 500\text{ V}$			5	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 500\text{ V}$, $T_C = 125\text{ °C}^{(1)}$			100	μA
I_{GSS}	Gate body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS} = \pm 25\text{ V}$			± 5	μA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$, $I_D = 19\text{ A}$		61	71	$\text{m}\Omega$

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

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	2300	-	pF
C_{oss}	Output capacitance		-	140	-	pF
C_{rss}	Reverse transfer capacitance		-	3.5	-	pF
R_G	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	1.6	-	Ω
Q_g	Total gate charge	$V_{DD} = 400\text{ V}$, $I_D = 38\text{ A}$, $V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 14. Test circuit for gate charge behavior)	-	57	-	nC
Q_{gs}	Gate-source charge		-	12	-	nC
Q_{gd}	Gate-drain charge		-	32	-	nC

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 200\text{ V}$, $I_D = 19\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ (see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	22	-	ns
t_r	Rise time		-	5.4	-	ns
$t_{d(off)}$	Turn-off delay time		-	56	-	ns
t_f	Fall time		-	8.5	-	ns

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		38	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		137	A

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 38 \text{ A}$, $V_{GS} = 0 \text{ V}$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 38 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$, $V_{DD} = 60 \text{ V}$ (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	113		ns
Q_{rr}	Reverse recovery charge		-	0.53		μC
I_{RRM}	Reverse recovery current		-	9		A
t_{rr}	Reverse recovery time	$I_{SD} = 38 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$, $V_{DD} = 60 \text{ V}$, $T_j = 150 \text{ }^\circ\text{C}$ (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	205		ns
Q_{rr}	Reverse recovery charge		-	2		μC
I_{RRM}	Reverse recovery current		-	19.5		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	$I_{GS} = \pm 1 \text{ mA}$, $I_D = 0 \text{ A}$	± 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

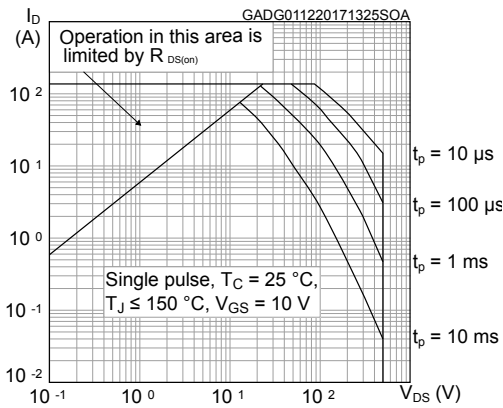


Figure 2. Normalized thermal impedance

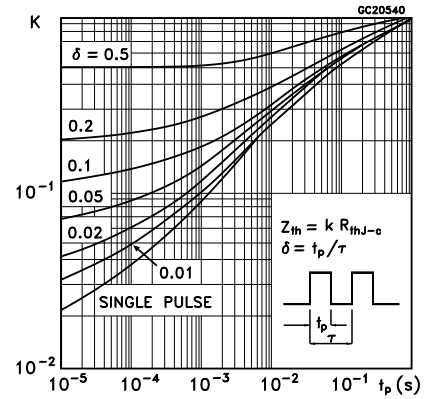


Figure 3. Output characteristics

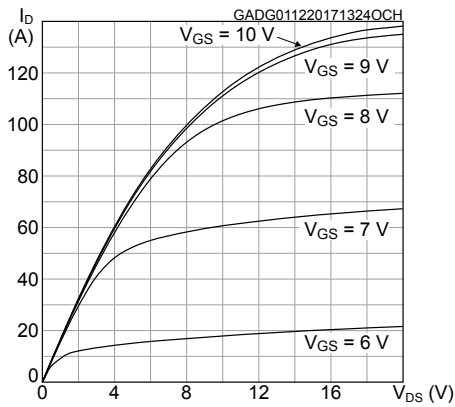


Figure 4. Transfer characteristics

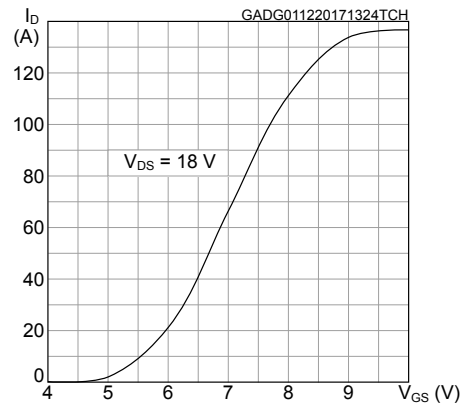


Figure 5. Gate charge vs gate-source voltage

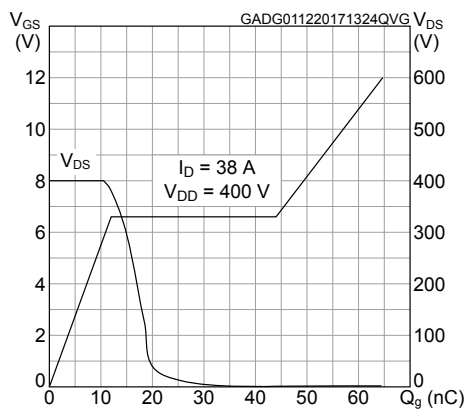


Figure 6. Static drain-source on-resistance

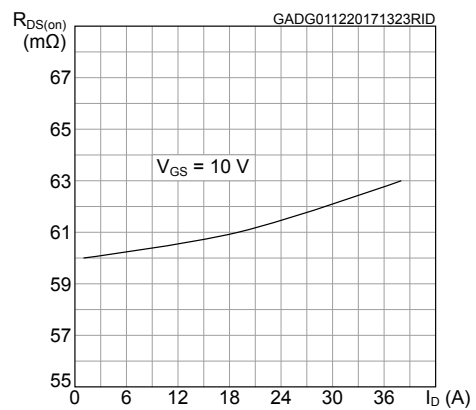


Figure 7. Capacitance variations

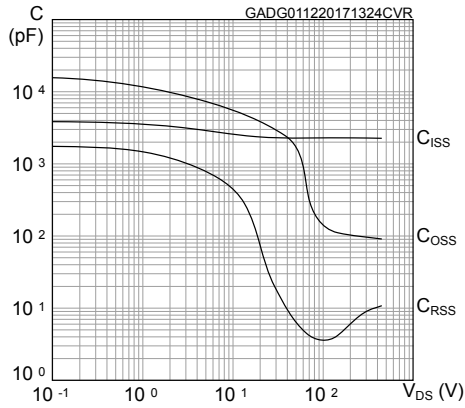


Figure 8. Normalized gate threshold voltage vs temperature

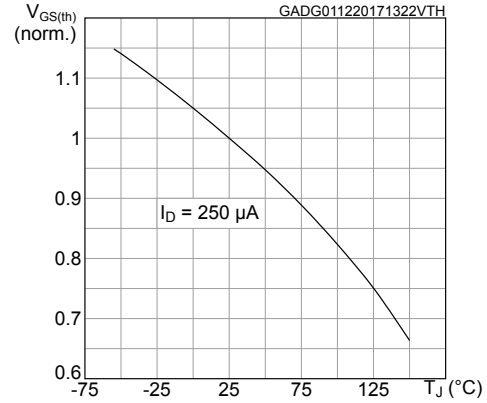


Figure 9. Normalized on-resistance vs temperature

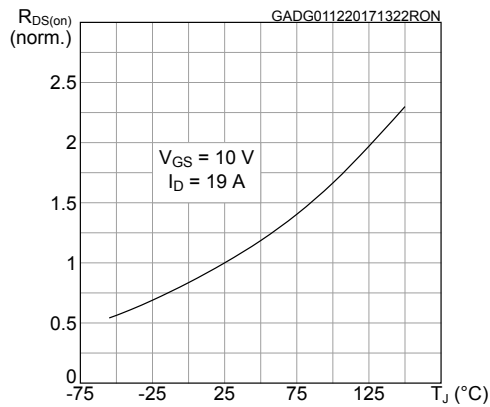


Figure 10. Normalized $V_{(BR)DSS}$ vs temperature

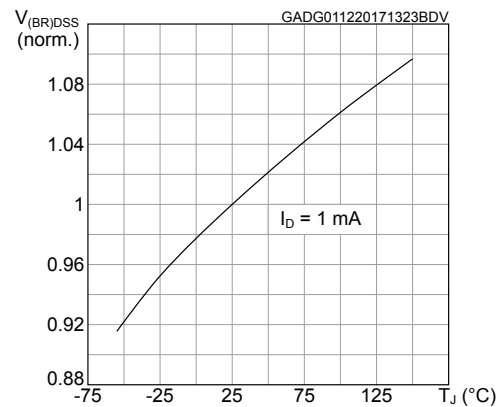


Figure 11. Source-drain diode forward characteristics

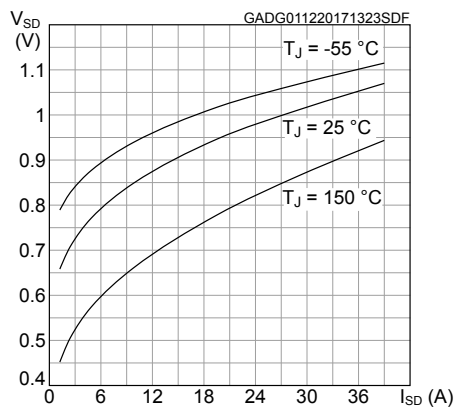
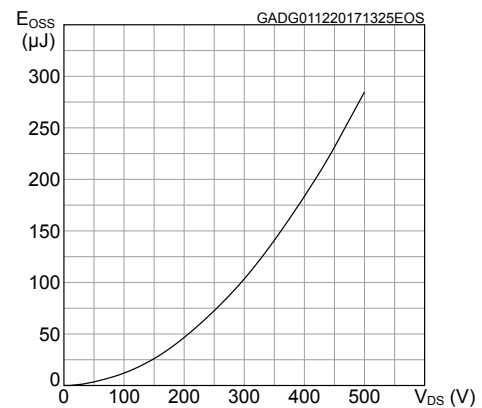
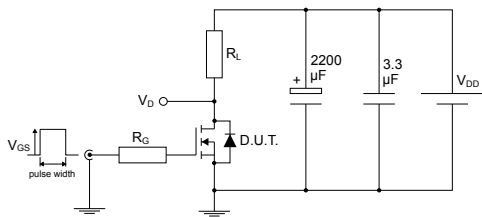


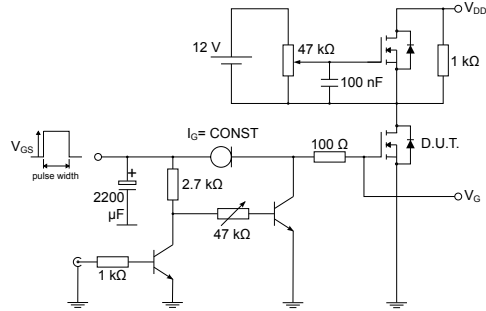
Figure 12. Output capacitance stored energy



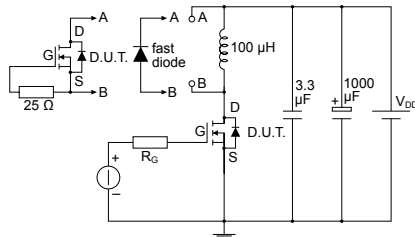
3 Test circuits

Figure 13. Test circuit for resistive load switching times


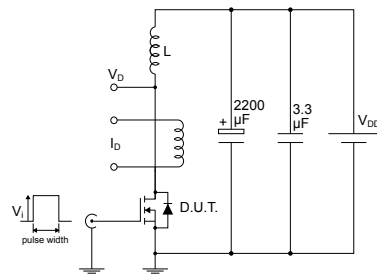
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Figure 14. Test circuit for gate charge behavior


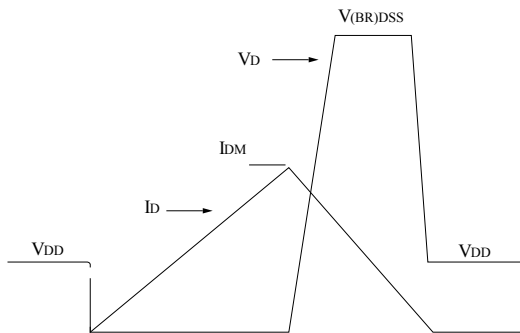
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Figure 15. Test circuit for inductive load switching and diode recovery times


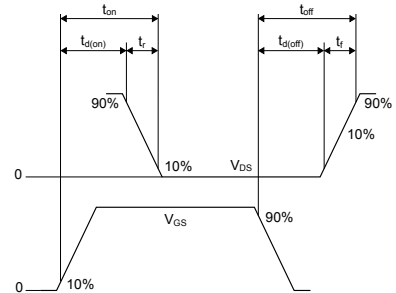
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Figure 16. Unclamped inductive load test circuit


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Figure 17. Unclamped inductive waveform


AM01472v1

Figure 18. Switching time waveform


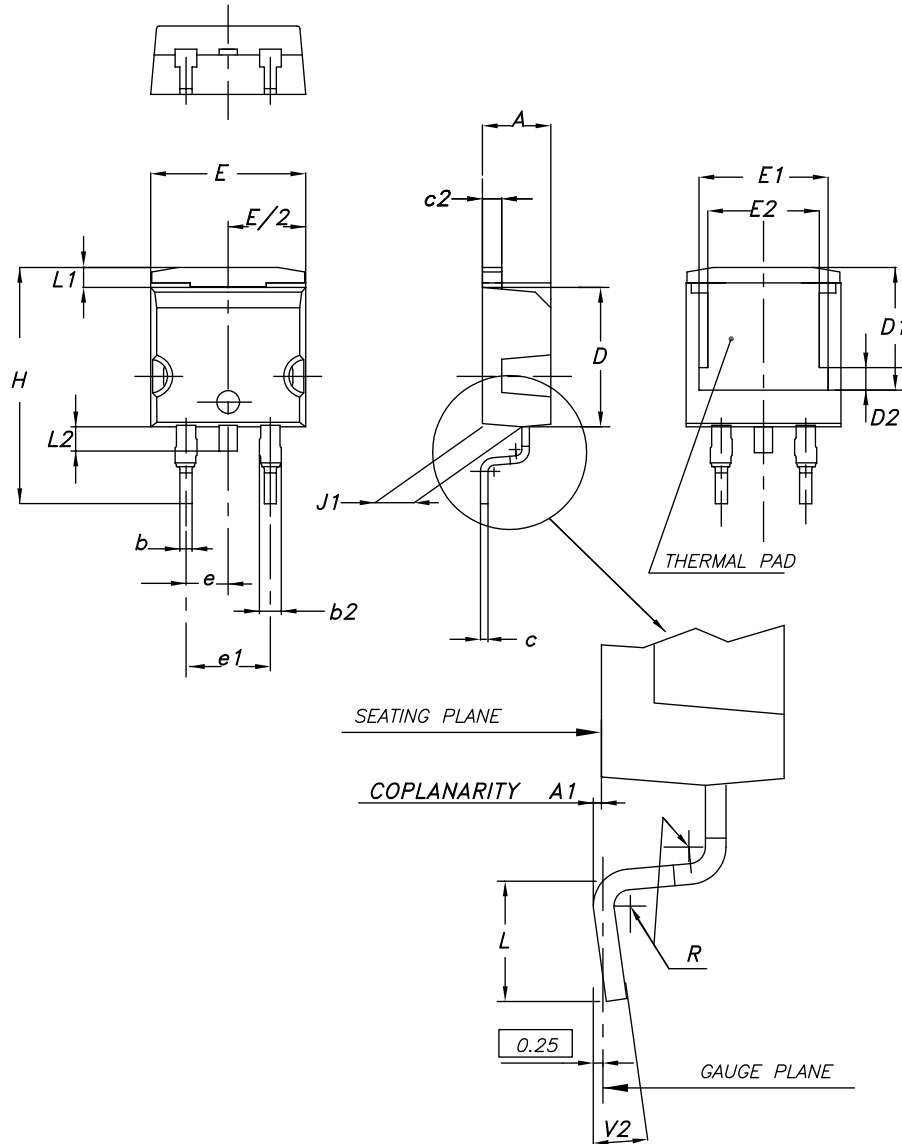
AM01473v1

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 D²PAK (TO-263) type A2 package information

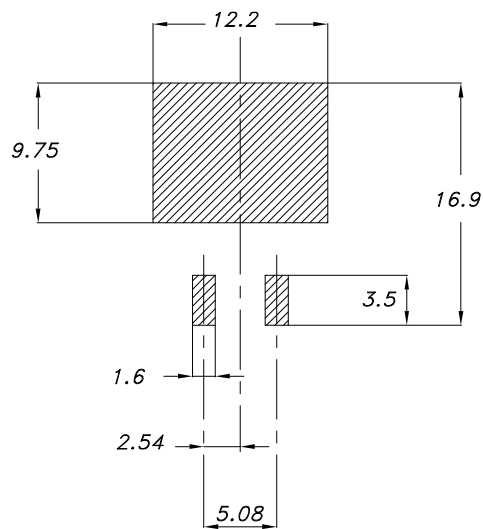
Figure 19. D²PAK (TO-263) type A2 package outline



0079457_A2_25

Table 9. D²PAK (TO-263) type A2 package mechanical data

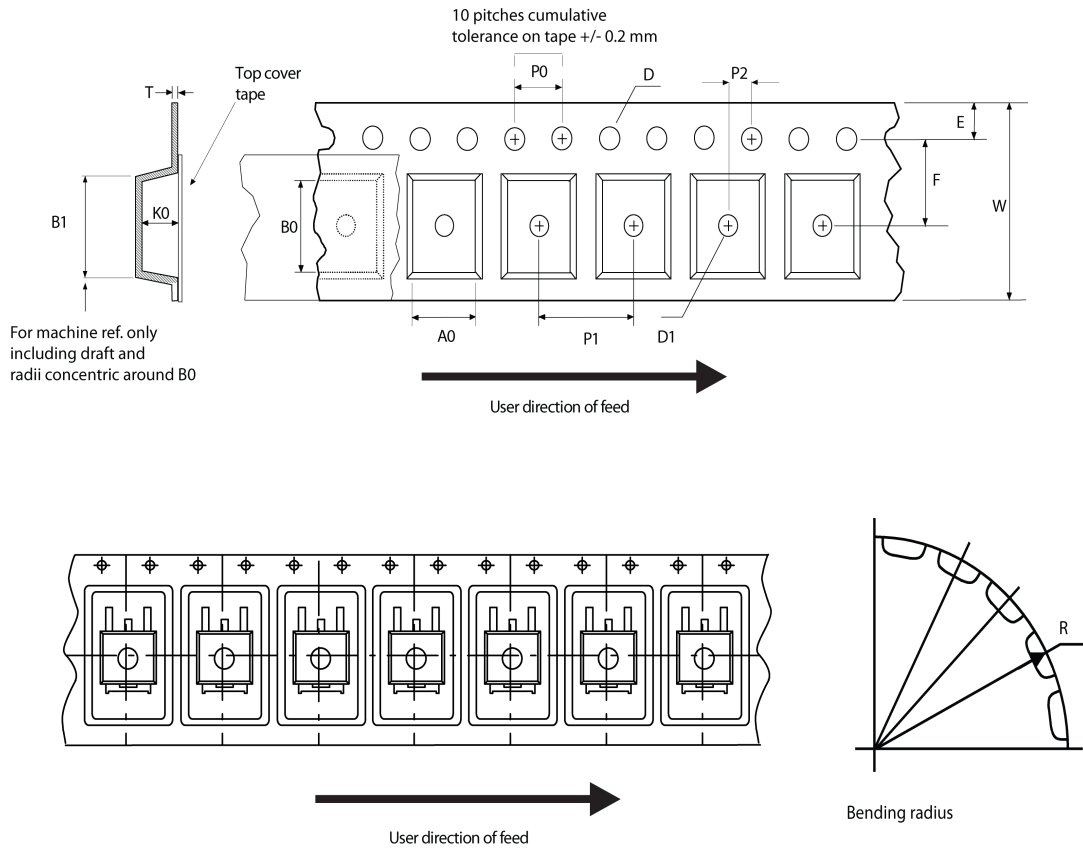
Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50	7.75	8.00
D2	1.10	1.30	1.50
E	10.00		10.40
E1	8.70	8.90	9.10
E2	7.30	7.50	7.70
e		2.54	
e1	4.88		5.28
H	15.00		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.40	
V2	0°		8°

Figure 20. D²PAK (TO-263) recommended footprint (dimensions are in mm)


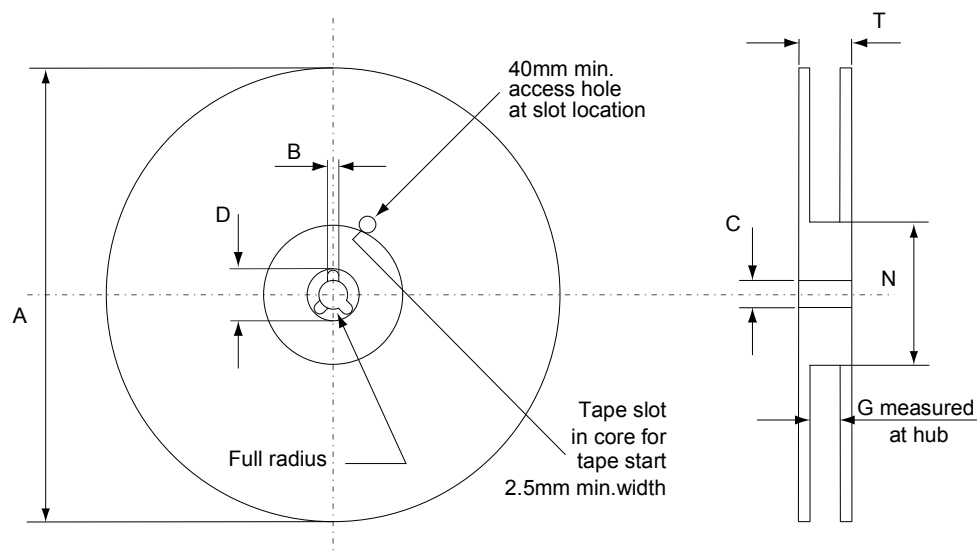
Footprint

4.2 D²PAK packing information

Figure 21. D²PAK tape outline



AM08852v1

Figure 22. 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			
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 11. Document revision history

Date	Revision	Changes
21-Apr-2017	1	Initial release.
24-May-2017	2	Modified title. Modified <i>Table 2: "Absolute maximum ratings"</i> , <i>Table 4: "Avalanche characteristics"</i> , <i>Table 5: "On/off-state"</i> , <i>Table 6: "Dynamic"</i> , <i>Table 7: "Switching times"</i> , <i>Table 8: "Source-drain diode"</i> and <i>Table 9: "Gatesource Zener diode"</i> . Minor text changes.
06-Dec-2017	3	Updated document title. Updated <i>Table 4: "Avalanche characteristics"</i> and <i>Table 5: "On/off state"</i> . Added <i>Section 2.1: "Electrical characteristics (curves)"</i> . Updated <i>Section 4: "Package information"</i> . Minor text changes
21-05-2018	4	Removed maturity status indication from cover page. The document status is production data. Updated title and features list on cover page. Minor text changes

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