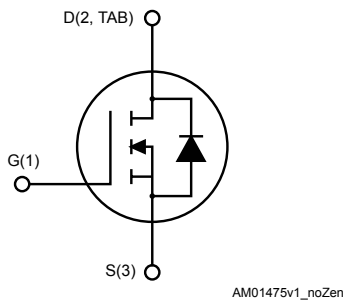
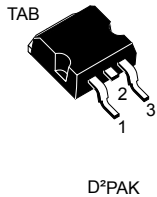


Automotive-grade N-channel 650 V, 0.058 Ω typ., 42 A MDmesh™ M5 Power MOSFET in a D²PAK package



Features

Order code	V _{DS}	R _{DS(on)} max.	I _D	P _{TOT}
STB43N65M5	650 V	0.063 Ω	42 A	250 W

- AEC-Q101 qualified 
- Extremely low R_{DS(on)}
- Low gate charge and input capacitance
- Excellent switching performance
- 100% avalanche tested

Applications

- Switching applications

Description

This device is an N-channel Power MOSFET based on the MDmesh™ M5 innovative vertical process technology combined with the well-known PowerMESH™ horizontal layout. The resulting product offers extremely low on-resistance, making it particularly suitable for applications requiring high power and superior efficiency.

Product status link

[STB43N65M5](#)

Product summary

Order code	STB43N65M5
Marking	43N65M5
Package	D ² PAK
Packing	Tape and reel

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	± 25	V
I_D	Drain current (continuous) at $T_{case} = 25\text{ }^{\circ}\text{C}$	42	A
	Drain current (continuous) at $T_{case} = 100\text{ }^{\circ}\text{C}$	26.5	
$I_{DM}^{(1)}$	Drain current (pulsed)	168	A
P_{TOT}	Total power dissipation at $T_{case} = 25\text{ }^{\circ}\text{C}$	250	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	15	V/ns
$dv/dt^{(3)}$	MOSFET dv/dt ruggedness	50	
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. $I_{SD} \leq 42\text{ A}$, $di/dt = 150\text{ A}/\mu\text{s}$; $V_{DS\text{ peak}} < V_{(BR)DSS}$; $V_{DD} = 80\% V_{(BR)DSS}$.
3. $V_{DS} \leq 520\text{ V}$.

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 a 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	7	A
$E_{AS}^{(2)}$	Single pulse avalanche energy	650	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

($T_{\text{case}} = 25\text{ }^{\circ}\text{C}$ unless otherwise specified).

Table 4. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(\text{BR})\text{DSS}}$	Drain-source breakdown voltage	$V_{\text{GS}} = 0\text{ V}$, $I_{\text{D}} = 1\text{ mA}$	650			V
I_{DSS}	Zero gate voltage drain current	$V_{\text{GS}} = 0\text{ V}$, $V_{\text{DS}} = 650\text{ V}$			1	μA
		$V_{\text{GS}} = 0\text{ V}$, $V_{\text{DS}} = 650\text{ V}$, $T_{\text{case}} = 125\text{ }^{\circ}\text{C}^{(1)}$			100	
I_{GSS}	Gate-body leakage current	$V_{\text{DS}} = 0\text{ V}$, $V_{\text{GS}} = \pm 25\text{ V}$			± 100	nA
$V_{\text{GS(th)}}$	Gate threshold voltage	$V_{\text{DS}} = V_{\text{GS}}$, $I_{\text{D}} = 250\text{ }\mu\text{A}$	3	4	5	V
$R_{\text{DS(on)}}$	Static drain-source on-resistance	$V_{\text{GS}} = 10\text{ V}$, $I_{\text{D}} = 21\text{ A}$		0.058	0.063	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	$V_{\text{DS}} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{\text{GS}} = 0\text{ V}$	-	4400	-	pF
C_{oss}	Output capacitance		-	100	-	
C_{rss}	Reverse transfer capacitance		-	5.3	-	
$C_{\text{oss eq.}}^{(1)}$	Equivalent output capacitance	$V_{\text{DS}} = 0\text{ to }520\text{ V}$, $V_{\text{GS}} = 0\text{ V}$	-	300	-	pF
R_{G}	Intrinsic gate resistance	$f = 1\text{ MHz}$, $I_{\text{D}} = 0\text{ A}$	-	1.2	-	Ω
Q_{g}	Total gate charge	$V_{\text{DD}} = 520\text{ V}$, $I_{\text{D}} = 21\text{ A}$, $V_{\text{GS}} = 0\text{ to }10\text{ V}$ (see Figure 15. Test circuit for gate charge behavior)	-	100	-	nC
Q_{gs}	Gate-source charge		-	23	-	
Q_{gd}	Gate-drain charge		-	40	-	

1. $C_{\text{oss eq.}}$ 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
$t_{\text{d(on)}}$	Turn-on delay time	$V_{\text{DD}} = 400\text{ V}$, $I_{\text{D}} = 28\text{ A}$, $R_{\text{G}} = 4.7\text{ }\Omega$, $V_{\text{GS}} = 10\text{ V}$ (see Figure 14. Test circuit for resistive load switching times and Figure 19. Switching time waveform)	-	73	-	ns
t_{r}	Rise time		-	15	-	
$t_{\text{d(off)}}$	Turn-off delay time		-	12	-	
t_{f}	Fall time		-	19	-	

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		42	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		168	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0\text{ V}$, $I_{SD} = 42\text{ A}$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 42\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 100\text{ V}$ (see Figure 16. Test circuit for inductive load switching and diode recovery times)	-	420		ns
Q_{rr}	Reverse recovery charge		-	8		μC
I_{RRM}	Reverse recovery current		-	40		A
t_{rr}	Reverse recovery time	$I_{SD} = 42\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 100\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$ (see Figure 16. Test circuit for inductive load switching and diode recovery times)	-	530		ns
Q_{rr}	Reverse recovery charge		-	12		μC
I_{RRM}	Reverse recovery current		-	44		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

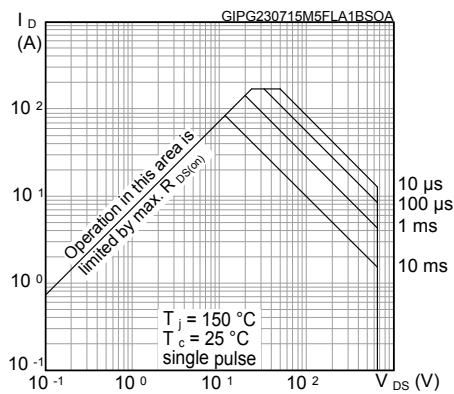


Figure 2. Thermal impedance

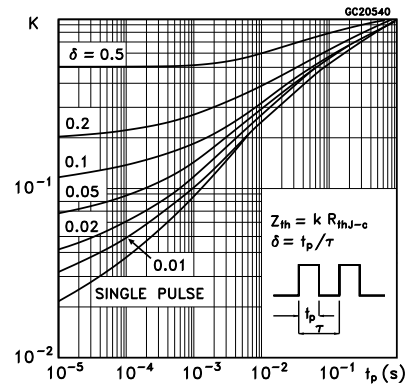


Figure 3. Output characteristics

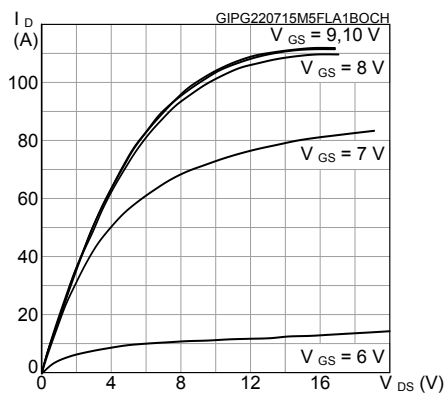


Figure 4. Transfer characteristics

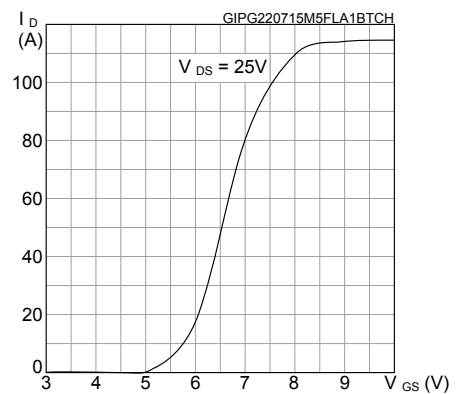


Figure 5. Gate charge vs gate-source voltage

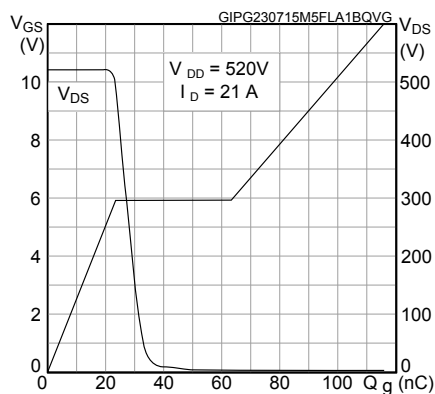


Figure 6. Static drain-source on-resistance

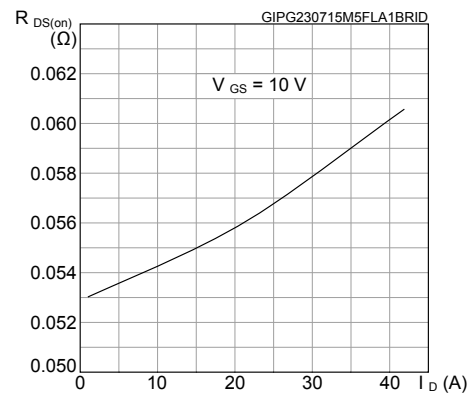


Figure 7. Capacitance variations

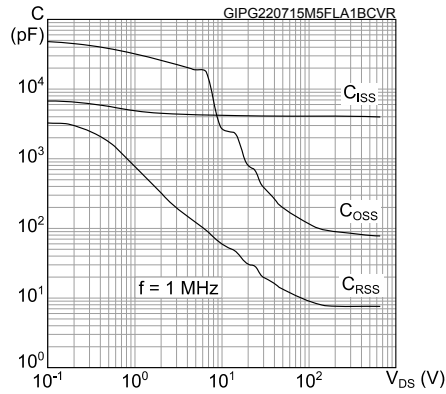


Figure 8. Normalized gate threshold voltage vs temperature

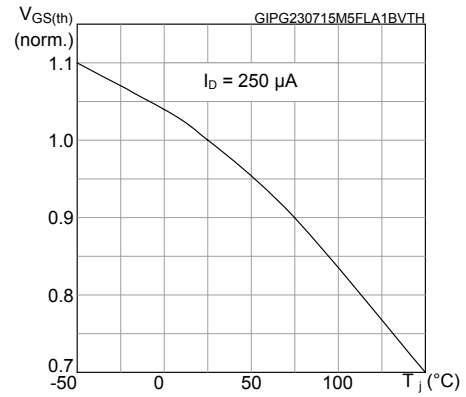


Figure 9. Normalized on-resistance vs temperature

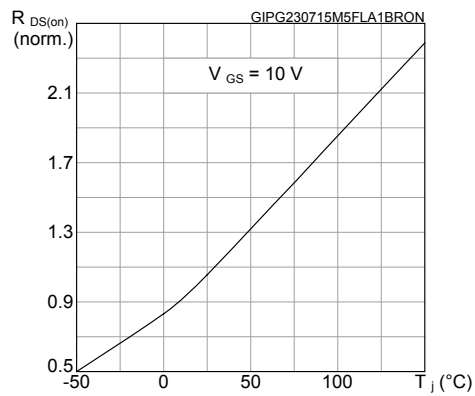


Figure 10. Normalized $V_{(BR)DSS}$ vs temperature

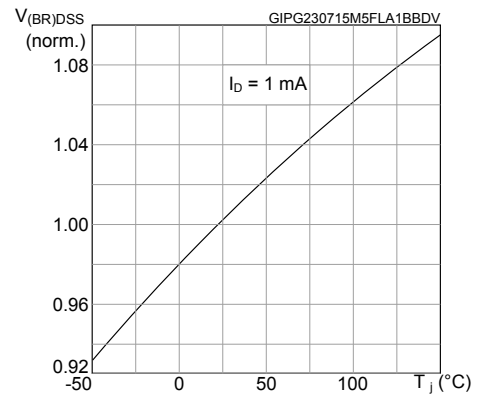


Figure 11. Output capacitance stored energy

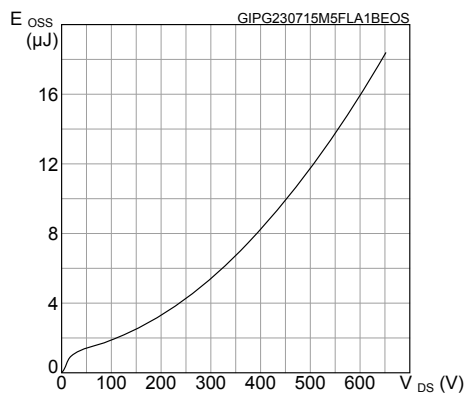


Figure 12. Source-drain diode forward characteristics

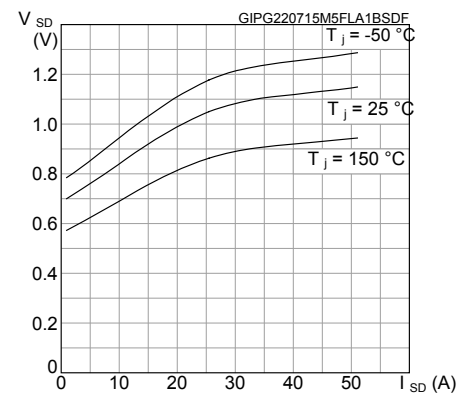
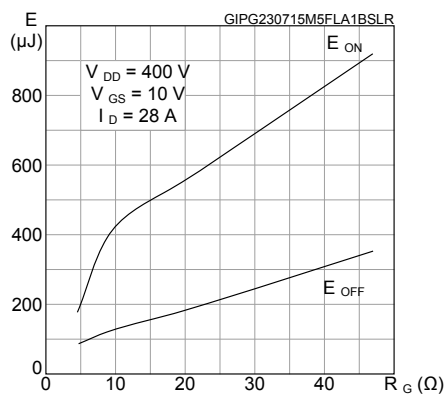
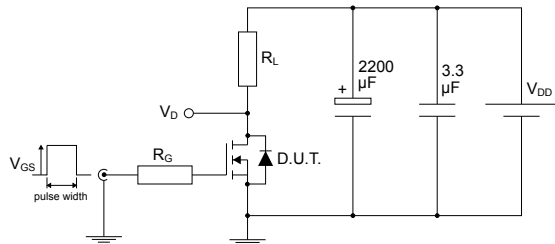


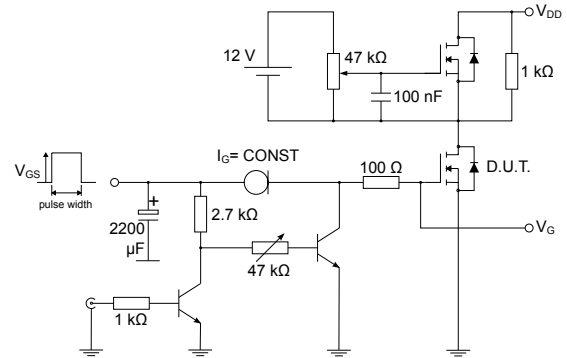
Figure 13. Switching energy vs gate resistance (E_{on} including reverse recovery of a SiC diode)



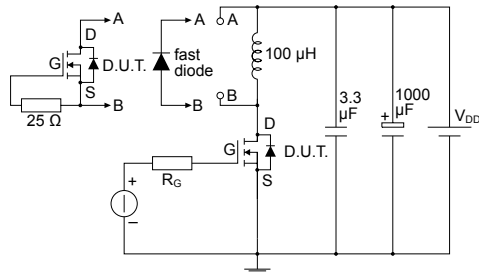
3 Test circuits

Figure 14. Test circuit for resistive load switching times


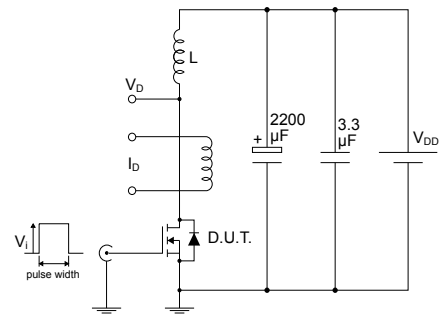
AM01468v1

Figure 15. Test circuit for gate charge behavior


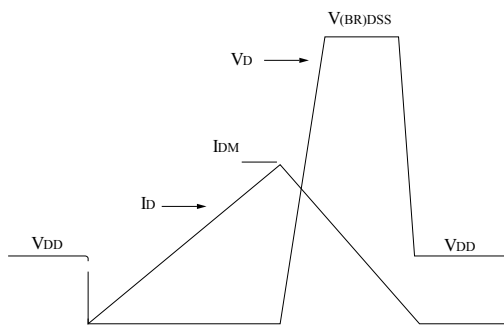
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Figure 16. Test circuit for inductive load switching and diode recovery times


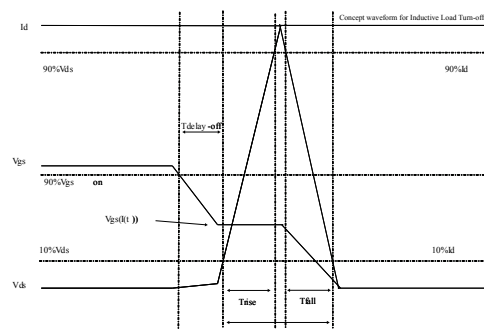
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Figure 17. Unclamped inductive load test circuit


AM01471v1

Figure 18. Unclamped inductive waveform


AM01472v1

Figure 19. Switching time waveform


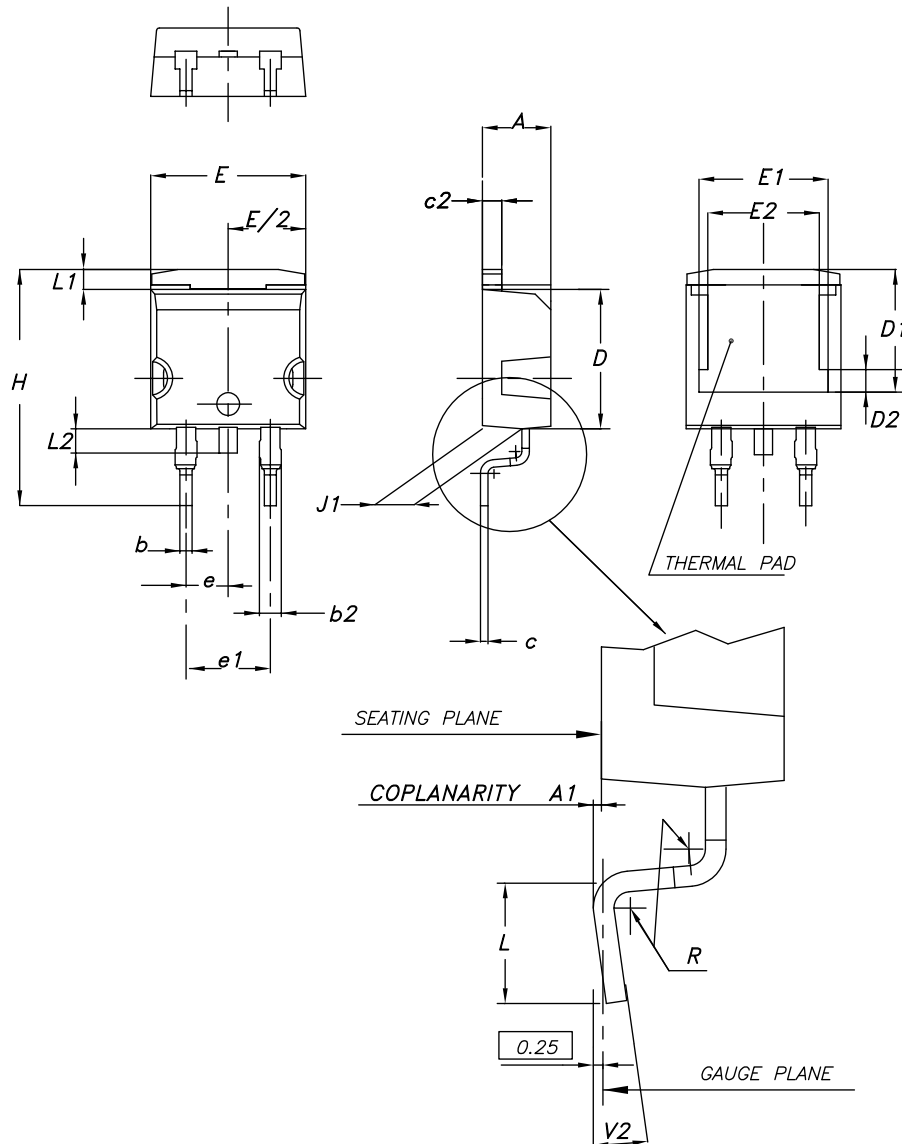
AM05540v2

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

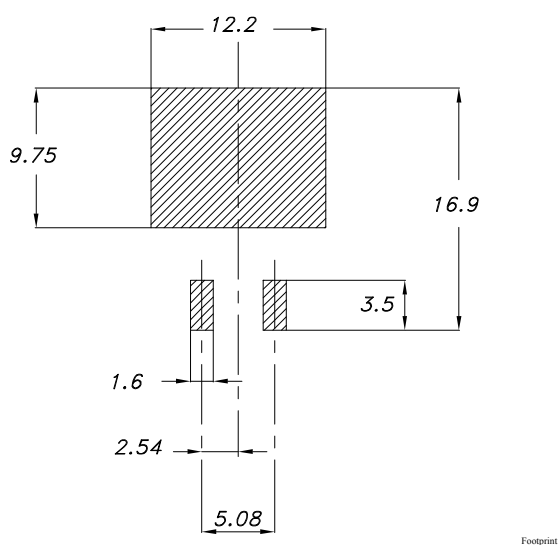
Figure 20. D²PAK (TO-263) type A2 package outline



0079457_A2_25

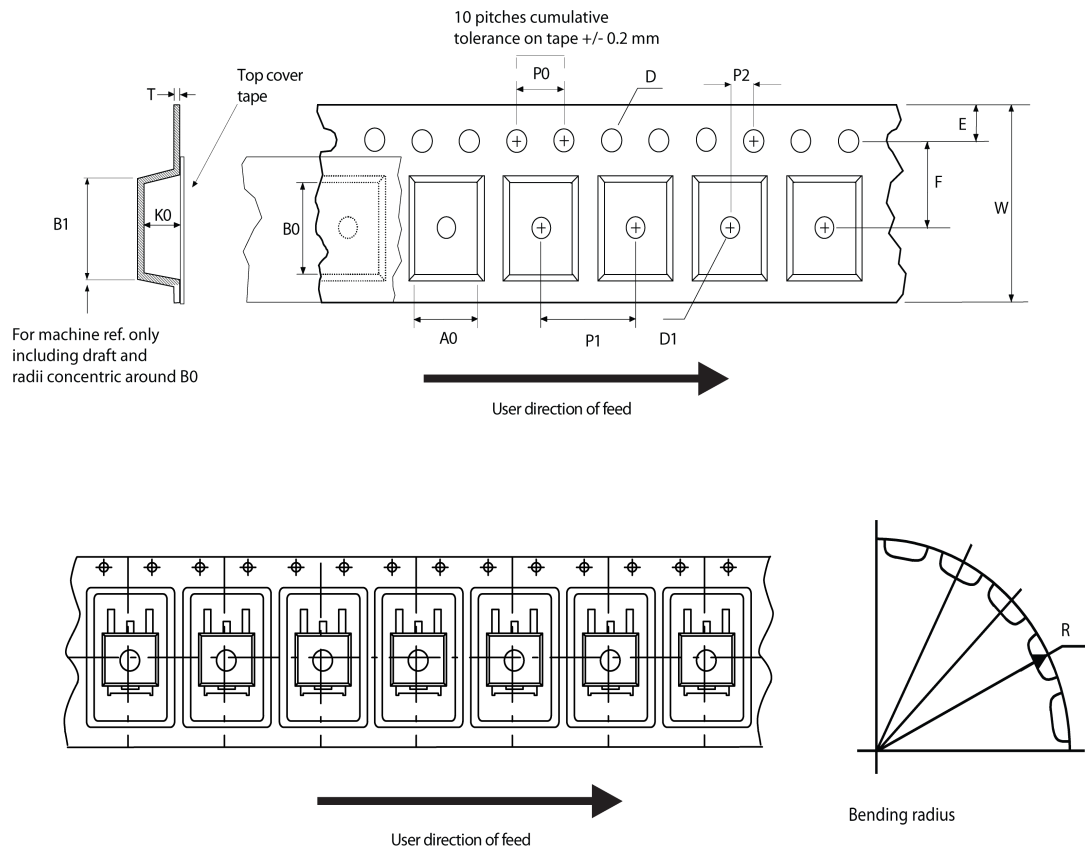
Table 8. D²PAK (TO-263) type A2 package mechanical data

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°

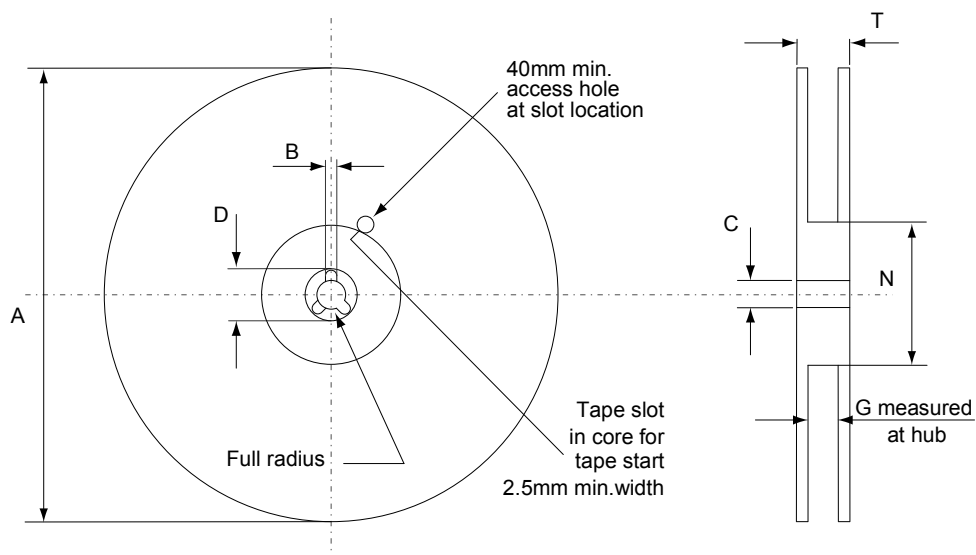
Figure 21. D²PAK (TO-263) recommended footprint (dimensions are in mm)


4.2 D²PAK packing information

Figure 22. D²PAK tape outline



AM08852v1

Figure 23. D²PAK reel outline


AM06038v1

Table 9. 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 10. Document revision history

Date	Revision	Changes
23-Jul-2015	1	Initial release.
13-Nov-2018	2	Updated features in cover page. Updated Section 3 Test circuits and Section 4.1 D²PAK (TO-263) type A2 package information . Minor text changes.

Contents

1	Electrical ratings	2
2	Electrical characteristics.....	3
2.1	Electrical characteristics (curves)	5
3	Test circuits	8
4	Package information.....	9
4.1	D ² PAK (TO-263) type A2 package information	9
4.2	D ² PAK packing information	11
	Revision history	14

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