

Automotive-grade N-channel 300 V, 53 A, 0.037 Ω typ., MDmesh™ V Power MOSFET in a D²PAK package

Datasheet - production data

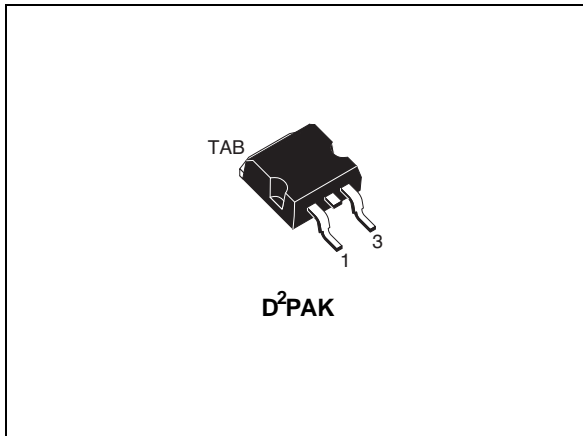
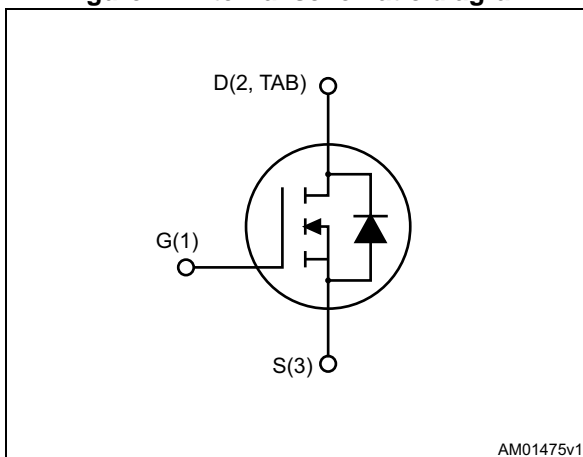


Figure 1. Internal schematic diagram



Features

Order code	V _{DS}	R _{DS(on)} max.	I _D
STB46N30M5	300 V	0.04 Ω	53 A

- Designed for automotive applications and AEC-Q101 qualified
- Amongst the best R_{DS(on)} * area
- High dv/dt capability
- Excellent switching performance
- Easy to drive
- 100% avalanche tested

Applications

- Switching applications

Description

This device is an N-channel MDmesh™ V Power MOSFET based on an innovative proprietary vertical process technology, which is combined with STMicroelectronics' well-known PowerMESH™ horizontal layout structure. The resulting product has extremely low on-resistance, which is unmatched among silicon-based Power MOSFETs, making it especially suitable for applications which require superior power density and outstanding efficiency.

Table 1. Device summary

Order code	Marking	Packages	Packaging
STB46N30M5	46N30M5	D ² PAK	Tape and reel

Contents

1	Electrical ratings	3
2	Electrical characteristics	4
2.1	Electrical characteristics (curves)	6
3	Test circuits	9
4	Package mechanical data	10
5	Packaging mechanical data	14
6	Revision history	16

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	± 25	V
I_D	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	53	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	34	A
$I_{DM}^{(1)}$	Drain current (pulsed)	212	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	250	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	15	V/ns
T_{stg}	Storage temperature	- 55 to 150	$^\circ\text{C}$
T_j	Max. operating junction temperature	150	$^\circ\text{C}$

1. Pulse width limited by safe operating area

2. $I_{SD} \leq 53\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{DS(\text{peak})} < V_{(BR)DSS}$, $V_{DD}=240\text{ V}$

Table 3. Thermal data

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

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

Table 4. Thermal data

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max)	16	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	550	mJ

2 Electrical characteristics

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

Table 5. On /off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage ($V_{GS} = 0$)	$I_D = 1\text{ mA}$	300			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = 300\text{ V}$			1	μA
		$V_{DS} = 300\text{ V}, T_C = 125\text{ °C}$			100	μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 25\text{ V}$			± 100	nA
$V_{GS(th)}$	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	$V_{GS} = 10\text{ V}, I_D = 26.5\text{ A}$		0.037	0.04	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 100\text{ V}, f = 1\text{ MHz}, V_{GS} = 0$	-	4240	-	pF
C_{oss}	Output capacitance		-	205	-	pF
C_{rss}	Reverse transfer capacitance		-	9.5	-	pF
$C_{o(tr)}^{(1)}$	Equivalent capacitance time related	$V_{DS} = 0\text{ to }240\text{ V}, V_{GS} = 0$	-	373	-	pF
$C_{o(er)}^{(2)}$	Equivalent capacitance energy related		-	202	-	pF
R_g	Gate input resistance	$f = 1\text{ MHz}, \text{ gate DC Bias} = 0, \text{ test signal level} = 20\text{ mV}, I_D = 0$	-	1.4	-	Ω
Q_g	Total gate charge	$V_{DD} = 240\text{ V}, I_D = 24\text{ A}, V_{GS} = 10\text{ V}$ (see Figure 16)	-	95	-	nC
Q_{gs}	Gate-source charge		-	23	-	nC
Q_{gd}	Gate-drain charge		-	37	-	nC

- $C_{o(tr)}$ is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80% V_{DS} .
- $C_{o(er)}$ is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80% V_{DS} .

Table 7. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
$t_{d(v)}$	Voltage delay time	$V_{DD} = 240\text{ V}$, $I_D = 32\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 15)	-	66	-	ns
$t_{r(v)}$	Voltage rise time		-	15	-	ns
$t_{f(i)}$	Current fall time		-	24	-	ns
$t_{c(off)}$	Crossing time		-	22.5	-	ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		53	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		212	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 53\text{ A}$, $V_{GS} = 0$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 48\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ (see Figure 20)	-	223		ns
Q_{rr}	Reverse recovery charge		-	2.5		μC
I_{RRM}	Reverse recovery current		-	23		A
t_{rr}	Reverse recovery time	$I_{SD} = 48\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$ (see Figure 20)	-	280		ns
Q_{rr}	Reverse recovery charge		-	3.9		μC
I_{RRM}	Reverse recovery current		-	28		A

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

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

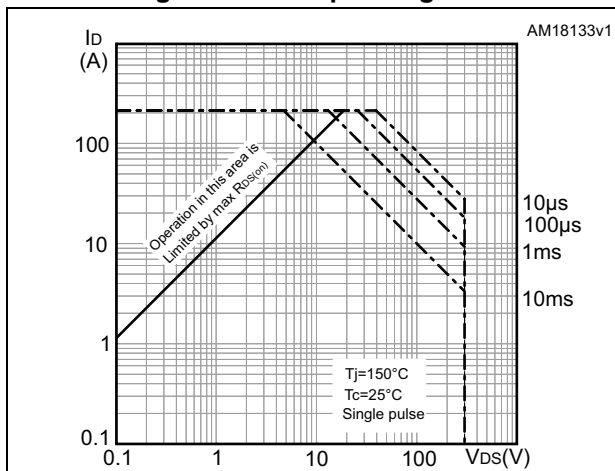


Figure 3. Thermal impedance

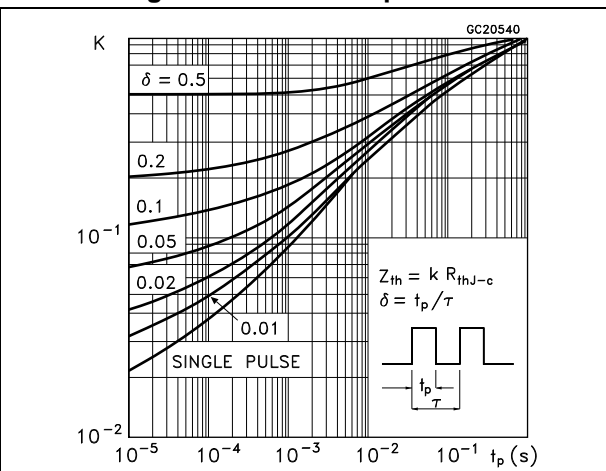


Figure 4. Output characteristics

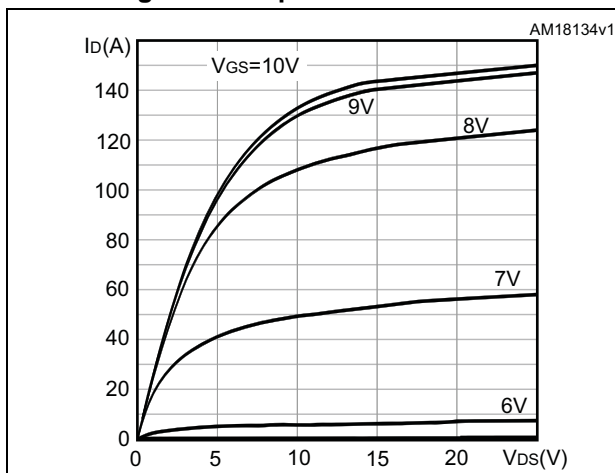


Figure 5. Transfer characteristics

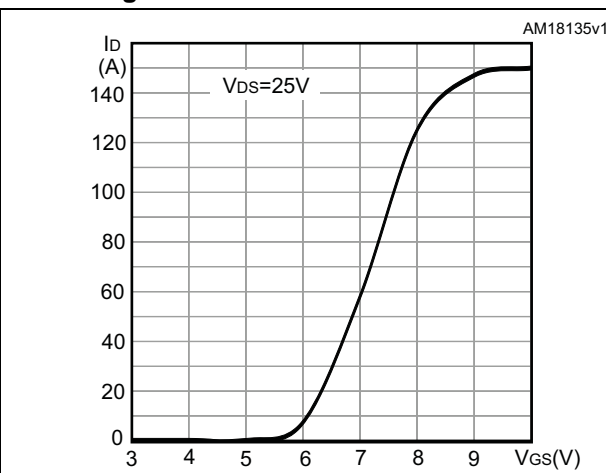


Figure 6. Gate charge vs gate-source voltage

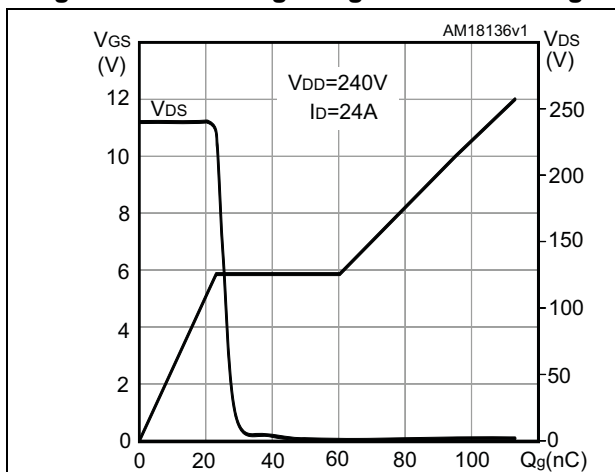


Figure 7. Static drain-source on-resistance

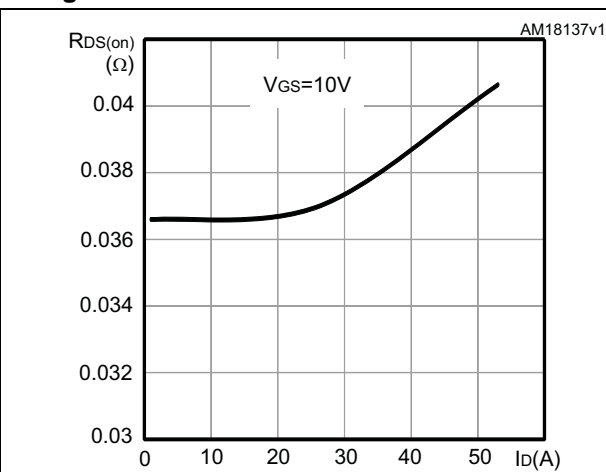


Figure 8. Capacitance variations

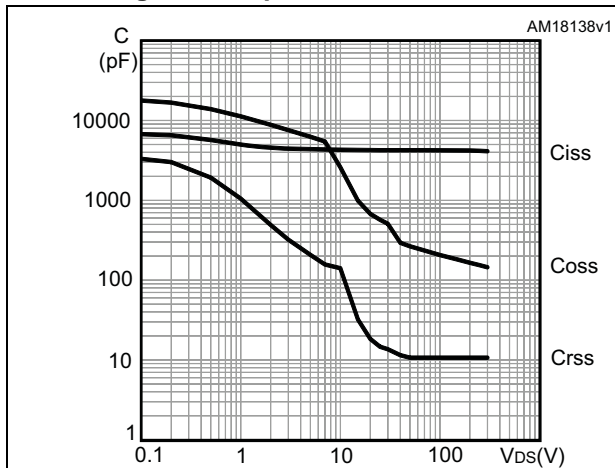


Figure 9. Output capacitance stored energy

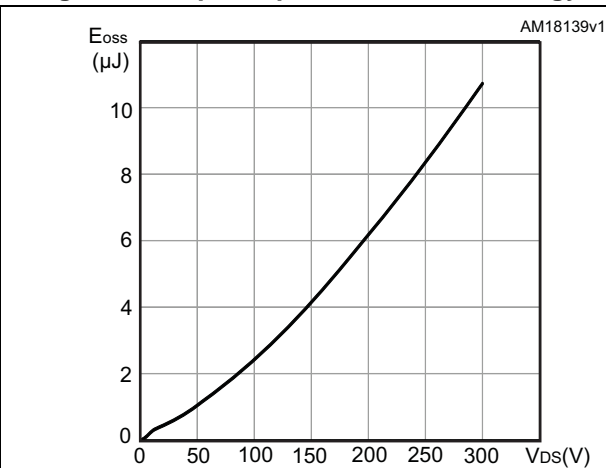


Figure 10. Normalized gate threshold voltage vs temperature

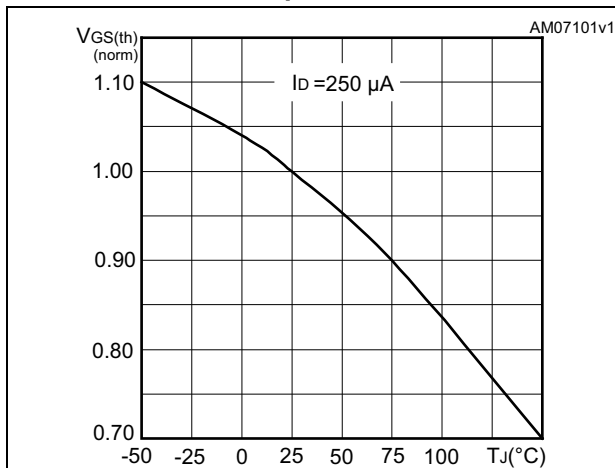


Figure 11. Normalized on-resistance vs temperature

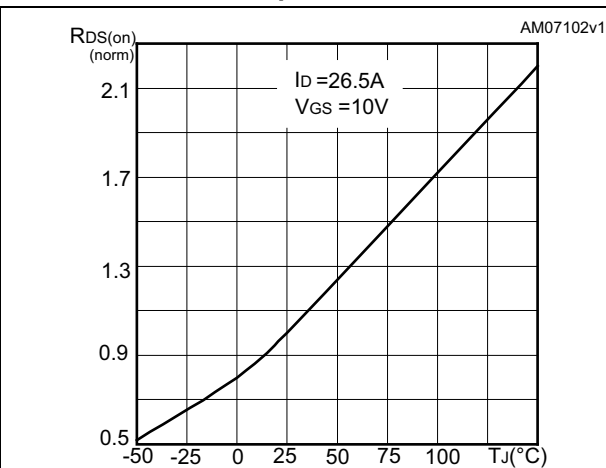


Figure 12. Normalized V(BR)DSS vs temperature

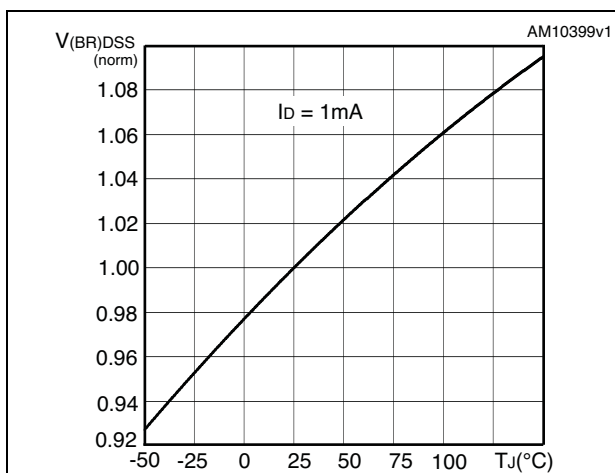


Figure 13. Source-drain diode forward characteristics

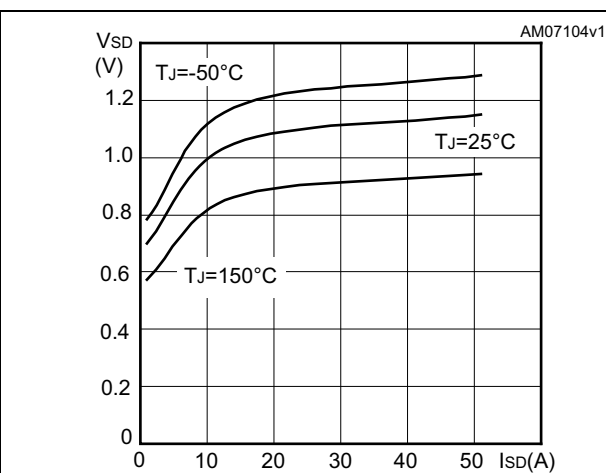
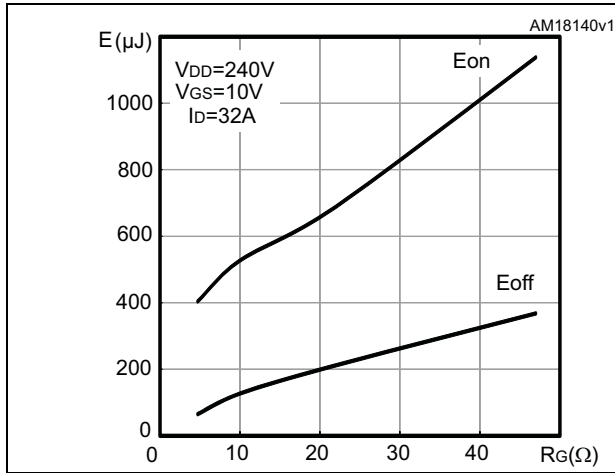


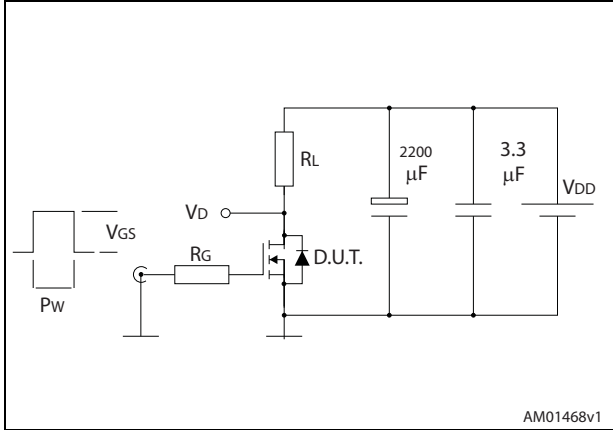
Figure 14. Switching losses vs gate resistance (1)



1. E_{on} including reverse recovery of a SiC diode

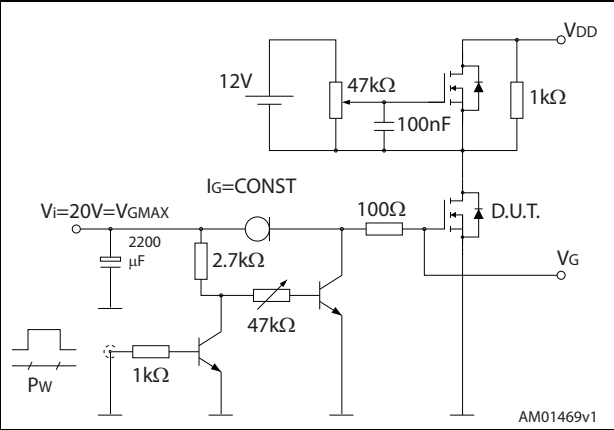
3 Test circuits

Figure 15. Switching times test circuit for resistive load



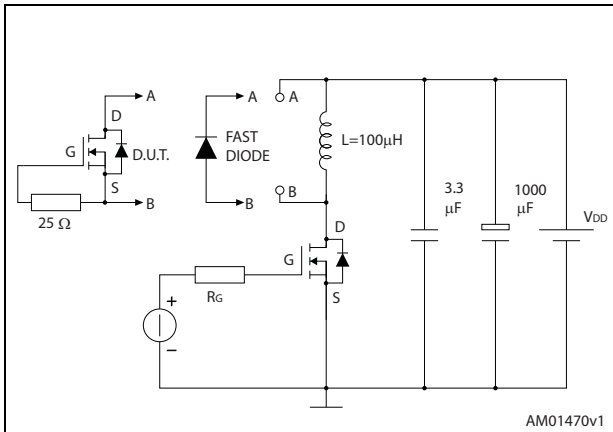
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Figure 16. Gate charge test circuit



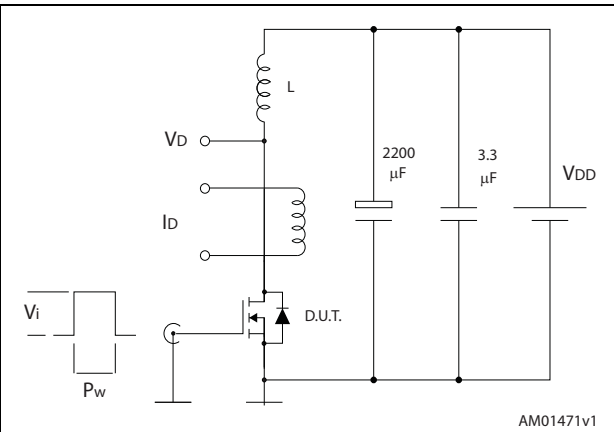
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Figure 17. Test circuit for inductive load switching and diode recovery times



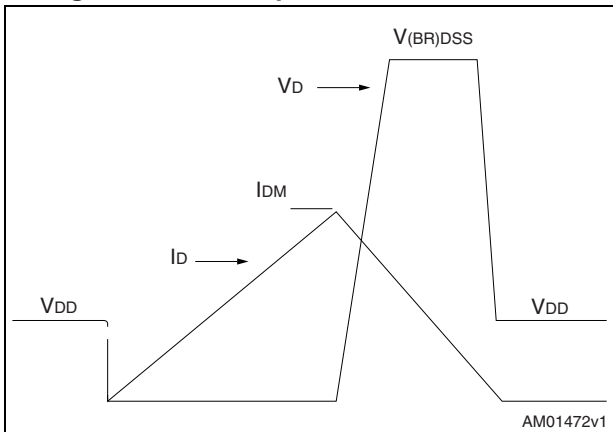
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Figure 18. Unclamped inductive load test circuit



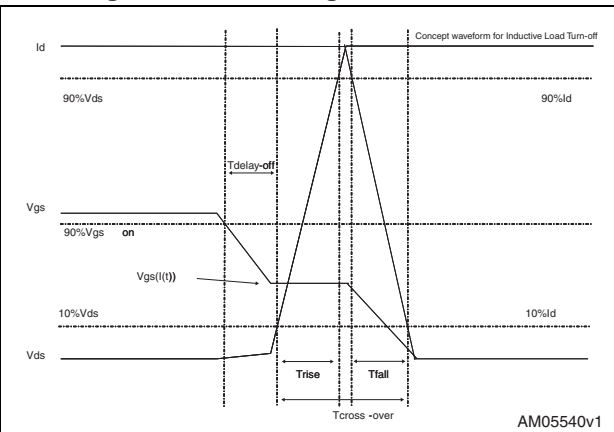
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Figure 19. Unclamped inductive waveform



AM01472v1

Figure 20. Switching time waveform

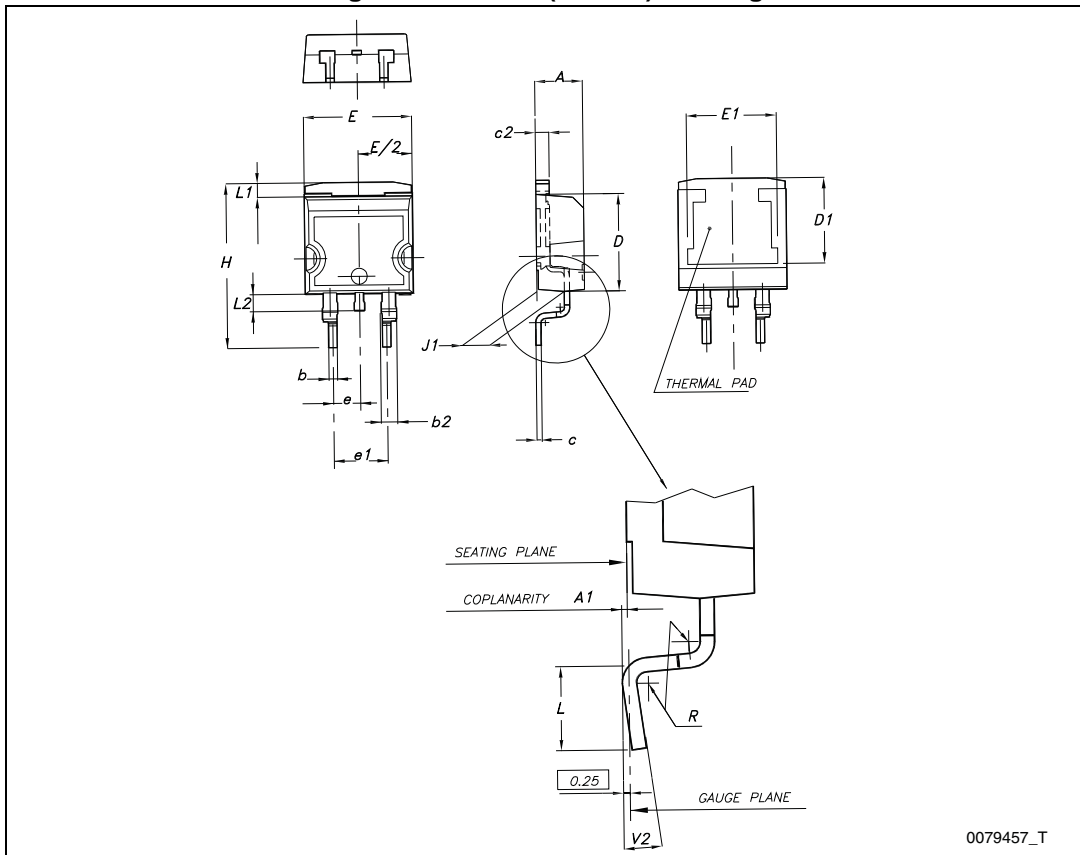


AM05540v1

4 Package mechanical data

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.

Figure 21. D²PAK (TO-263) drawing

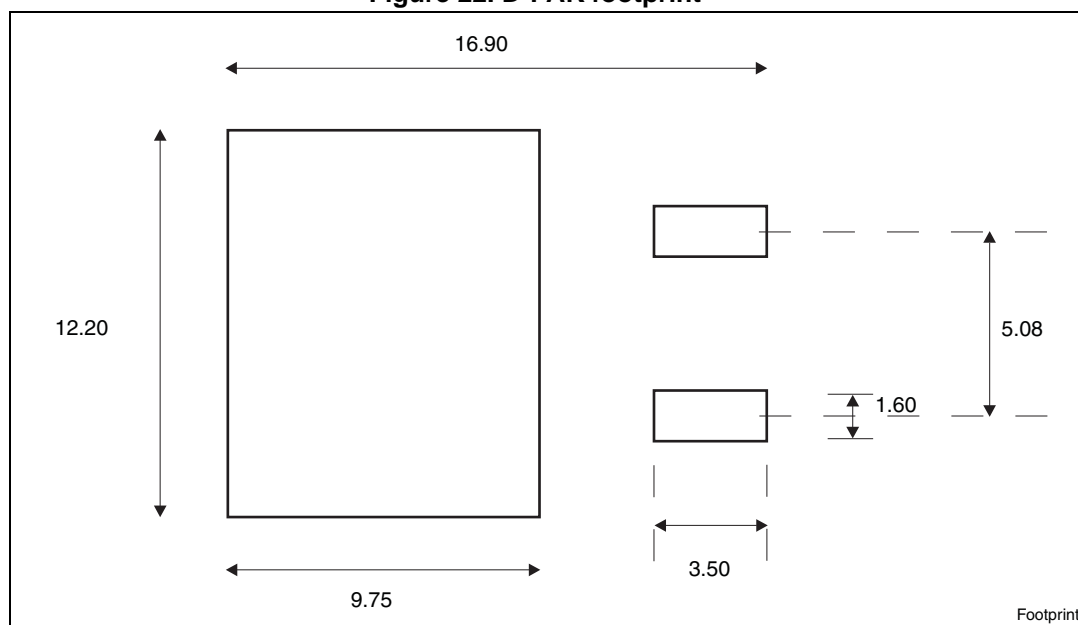


0079457_T

Table 9. D²PAK (TO-263) 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		
E	10		10.40
E1	8.50		
e		2.54	
e1	4.88		5.28
H	15		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.4	
V2	0°		8°

Figure 22. D²PAK footprint^(a)



a. All dimension are in millimeters

5 Packaging mechanical data

Figure 23. Tape

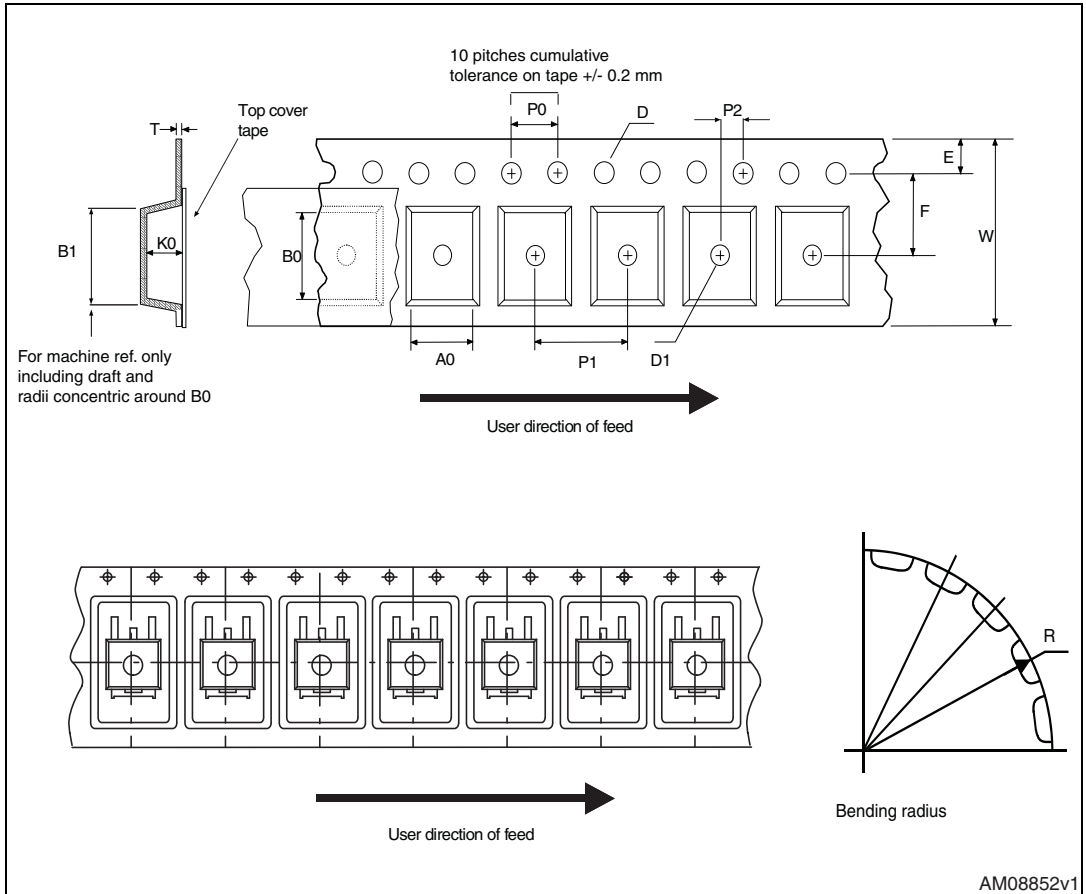


Figure 24. Reel

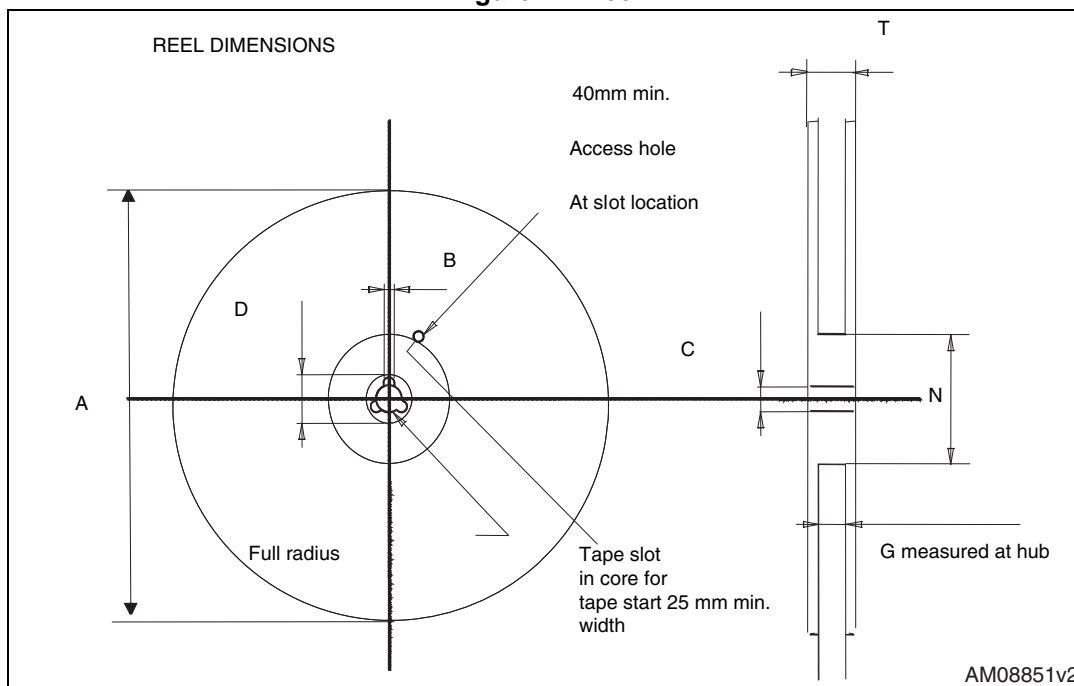


Table 10. D²PAK (TO-263) tape and reel mechanical data

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 qty	1000
P2	1.9	2.1		Bulk qty	1000
R	50				
T	0.25	0.35			
W	23.7	24.3			

6 Revision history

Table 11. Document revision history

Date	Revision	Changes
24-Mar-2014	1	Initial release.
11-Apr-2014	2	– Document status promoted from preliminary data to production data – Minor text changes

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