

N-channel 650 V, 0.42 Ω typ., 8 A MDmesh M2 Power MOSFET in a DPAK package

Datasheet - production data

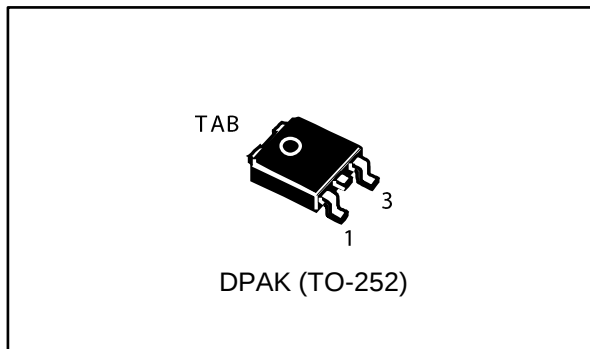
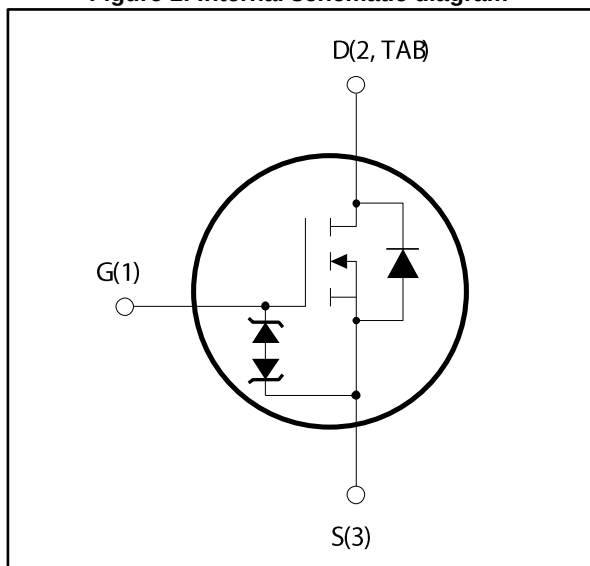


Figure 1: Internal schematic diagram



Features

Order code	V _{DS}	R _{DS(on)} max.	I _D
STD12N65M2	650 V	0.5 Ω	8 A

- Extremely low gate charge
- Excellent output capacitance (C_{oss}) profile
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications

Description

This device is an N-channel Power MOSFET developed using MDmesh™ M2 technology. Thanks to its strip layout and an improved vertical structure, the device exhibits low on-resistance and optimized switching characteristics, rendering it suitable for the most demanding high efficiency converters.

Table 1: Device summary

Order code	Marking	Package	Packing
STD12N65M2	12N65M2	DPAK	Tape and reel

Contents

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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 $T_C = 25\text{ }^{\circ}\text{C}$	8	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$	5	A
$I_{DM}^{(1)}$	Drain current (pulsed)	32	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	85	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	15	V/ns
$dv/dt^{(3)}$	MOSFET dv/dt ruggedness	50	V/ns
T_{stg}	Storage temperature	- 55 to 150	$^{\circ}\text{C}$
T_j	Operating junction temperature		

Notes:

⁽¹⁾ Pulse width limited by safe operating area.

⁽²⁾ $I_{SD} \leq 8\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$; $V_{DS\text{ peak}} < V_{(BR)DSS}$, $V_{DD} = 400\text{ V}$.

⁽³⁾ $V_{DS} \leq 520\text{ V}$

Table 3: Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	1.47	$^{\circ}\text{C}/\text{W}$
$R_{thj-pcb}$	Thermal resistance junction-pcb max ⁽¹⁾	50	$^{\circ}\text{C}/\text{W}$

Notes:

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

Table 4: Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetetive or not repetetive (pulse width limited by T_{jmax})	1.6	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25\text{ }^{\circ}\text{C}$, $I_D = I_{AR}$; $V_{DD} = 50\text{ V}$)	250	mJ

2 Electrical characteristics

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

Table 5: On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$, $I_D = 1\text{ mA}$	650			V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 650\text{ V}$			1	μA
		$V_{GS} = 0\text{ V}$, $V_{GS(DS)} = 650\text{ V}$ $T_C = 125\text{ }^{\circ}\text{C}$			100	μA
I_{GSS}	Gate-body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS} = \pm 25\text{ V}$			± 10	μA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$, $I_D = 4\text{ A}$		0.42	0.5	Ω

Table 6: Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{GS} = 0\text{ V}$, $V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$	-	535	-	pF
C_{oss}	Output capacitance		-	25	-	pF
C_{rss}	Reverse transfer capacitance		-	1.1	-	pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{GS} = 0\text{ V}$, $V_{DS} = 0\text{ to }520\text{ V}$	-	144	-	pF
R_G	Intrinsic gate resistance	$f = 1\text{ MHz}$, open drain	-	7	-	Ω
Q_g	Total gate charge	$V_{DD} = 520\text{ V}$, $I_D = 8\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 15 : "Gate charge test circuit")	-	16.5	-	nC
Q_{gs}	Gate-source charge		-	2.6	-	nC
Q_{gd}	Gate-drain charge		-	8.5	-	nC

Notes:

⁽¹⁾ $C_{oss\text{ eq.}}$ 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 7: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 325 \text{ V}$, $I_D = 4 \text{ A}$, $R_G = 4.7 \text{ } \Omega$, $V_{GS} = 10 \text{ V}$ (see Figure 14: "Switching times test circuit for resistive load" and Figure 19: "Switching time waveform")	-	9	-	ns
t_r	Rise time		-	7	-	ns
$t_{d(off)}$	Turn-off delay time		-	34	-	ns
t_f	Fall time		-	13.5	-	ns

Table 8: Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		8	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		32	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0 \text{ V}$, $I_{SD} = 8 \text{ A}$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 8 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$, $V_{DD} = 60 \text{ V}$ (see Figure 16: "Test circuit for inductive load switching and diode recovery times")	-	313		ns
Q_{rr}	Reverse recovery charge		-	2.7		μC
I_{RRM}	Reverse recovery current		-	17		A
t_{rr}	Reverse recovery time	$I_{SD} = 8 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$, $V_{DD} = 60 \text{ V}$, $T_j = 150 \text{ }^\circ\text{C}$ (see Figure 16: "Test circuit for inductive load switching and diode recovery times")	-	462		ns
Q_{rr}	Reverse recovery charge		-	4.1		μC
I_{RRM}	Reverse recovery current		-	17.5		A

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

2.1 Electrical characteristics (curves)

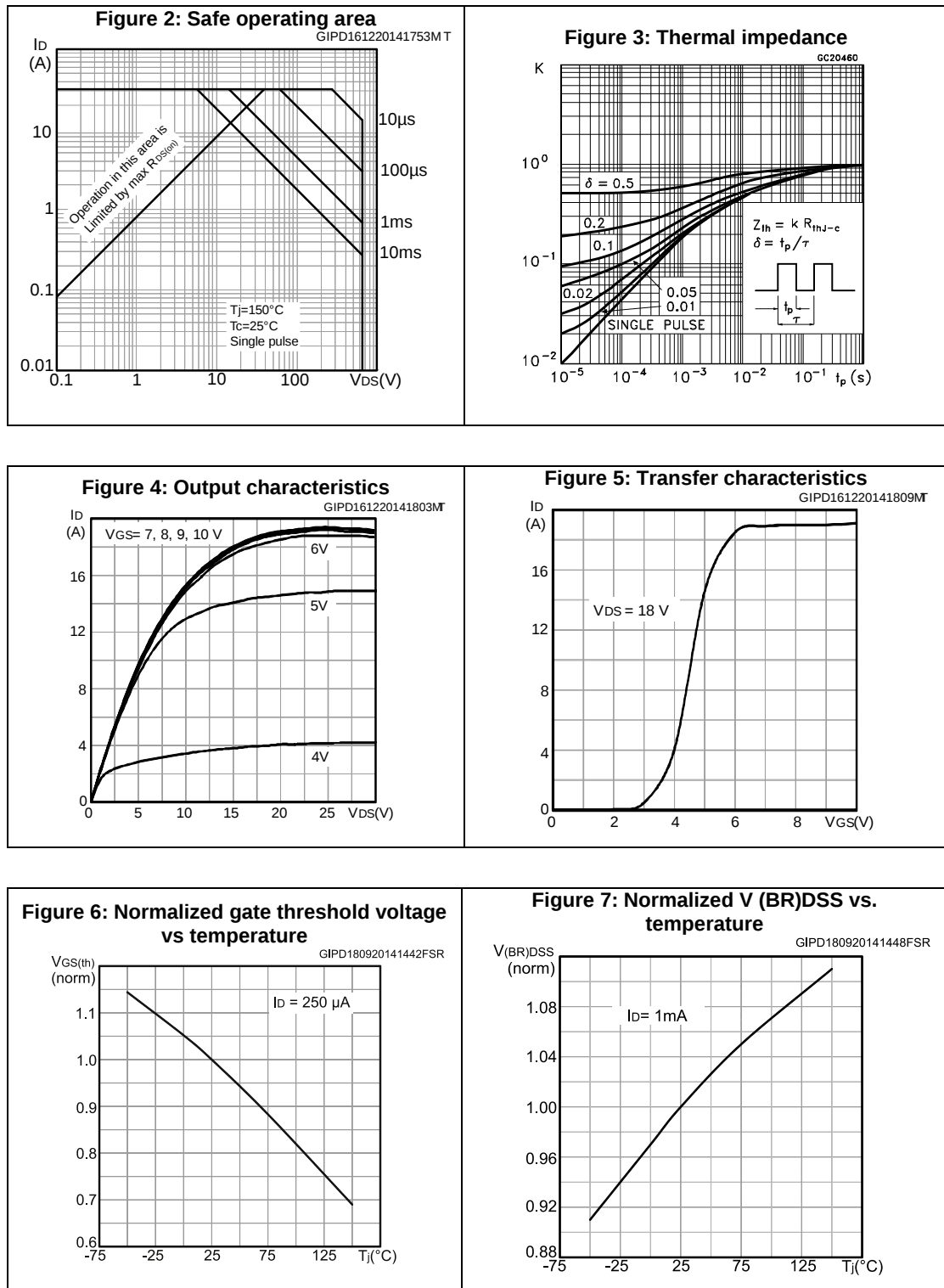


Figure 8: Static drain-source on-resistance

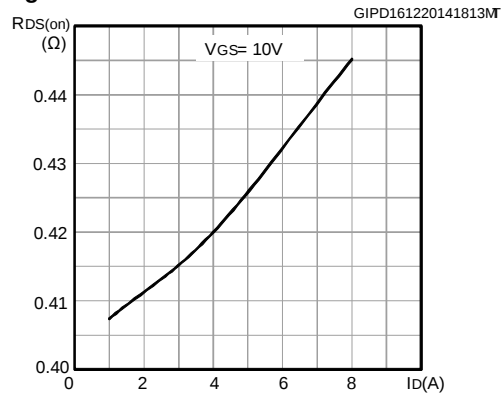


Figure 9: Normalized on-resistance vs temperature

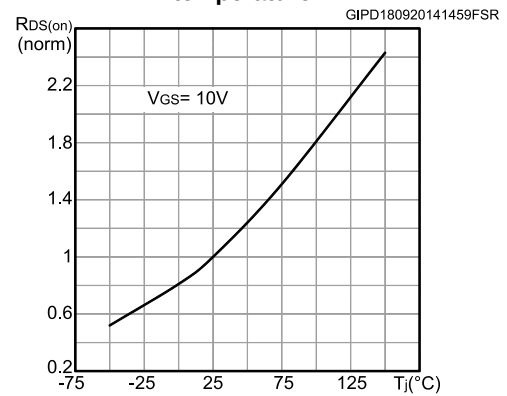


Figure 10: Gate charge vs. gate-source voltage

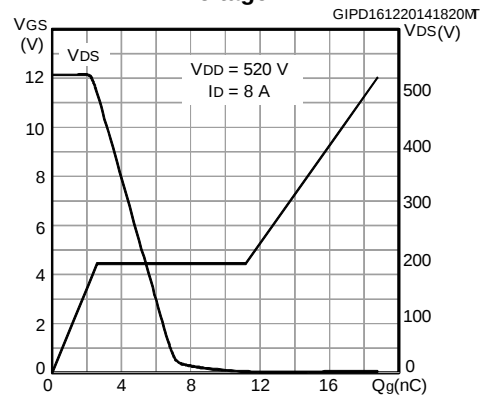


Figure 11: Capacitance variations

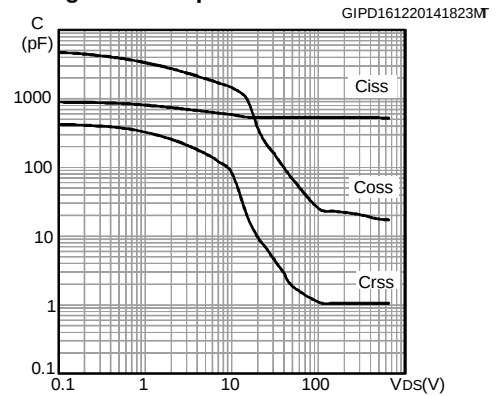


Figure 12: Turn-off switching loss vs drain current

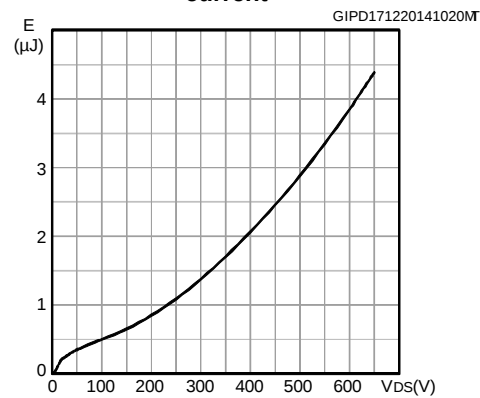
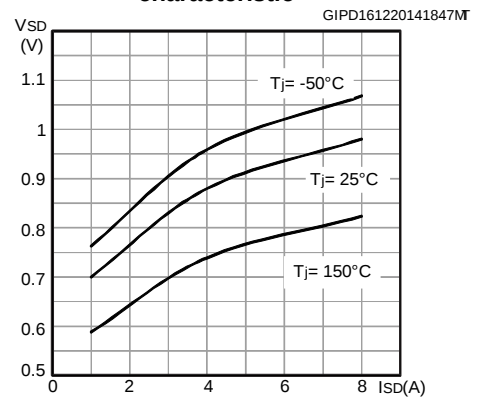


Figure 13: Source-drain diode forward characteristic



3 Test circuits

Figure 14: Switching times test circuit for resistive load

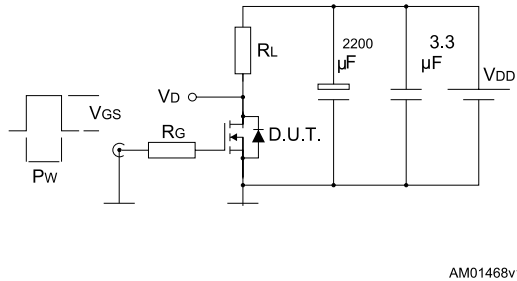


Figure 15: Gate charge test circuit

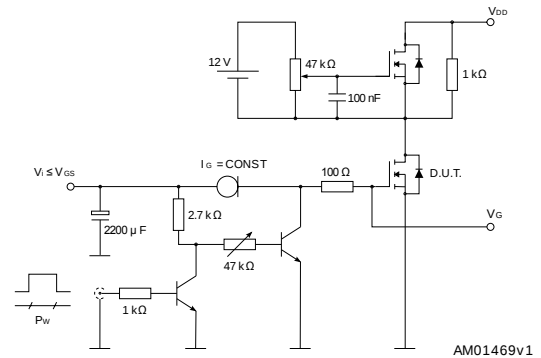


Figure 16: Test circuit for inductive load switching and diode recovery times

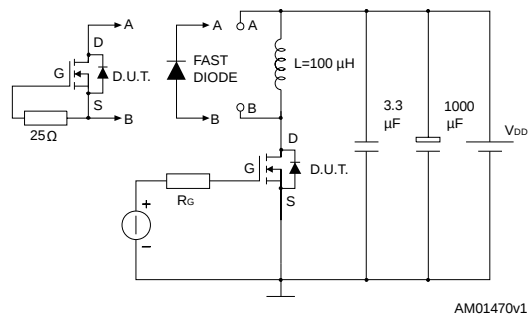


Figure 17: Unclamped inductive load test circuit

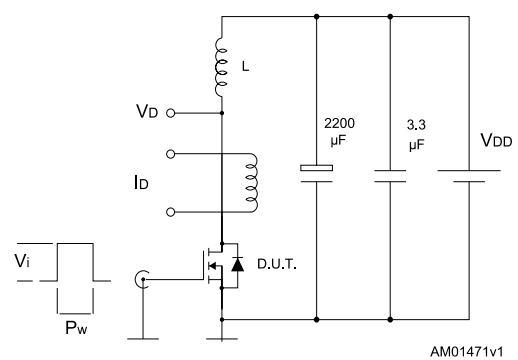


Figure 18: Unclamped inductive waveform

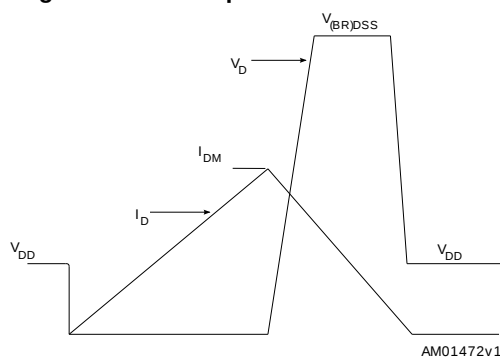
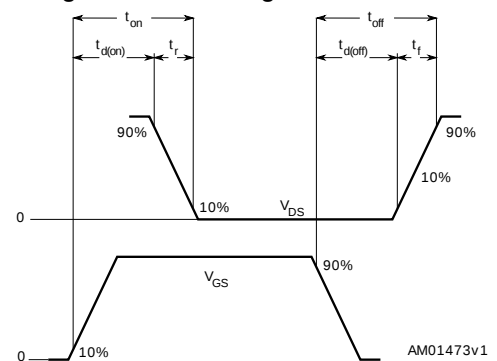


Figure 19: Switching time waveform

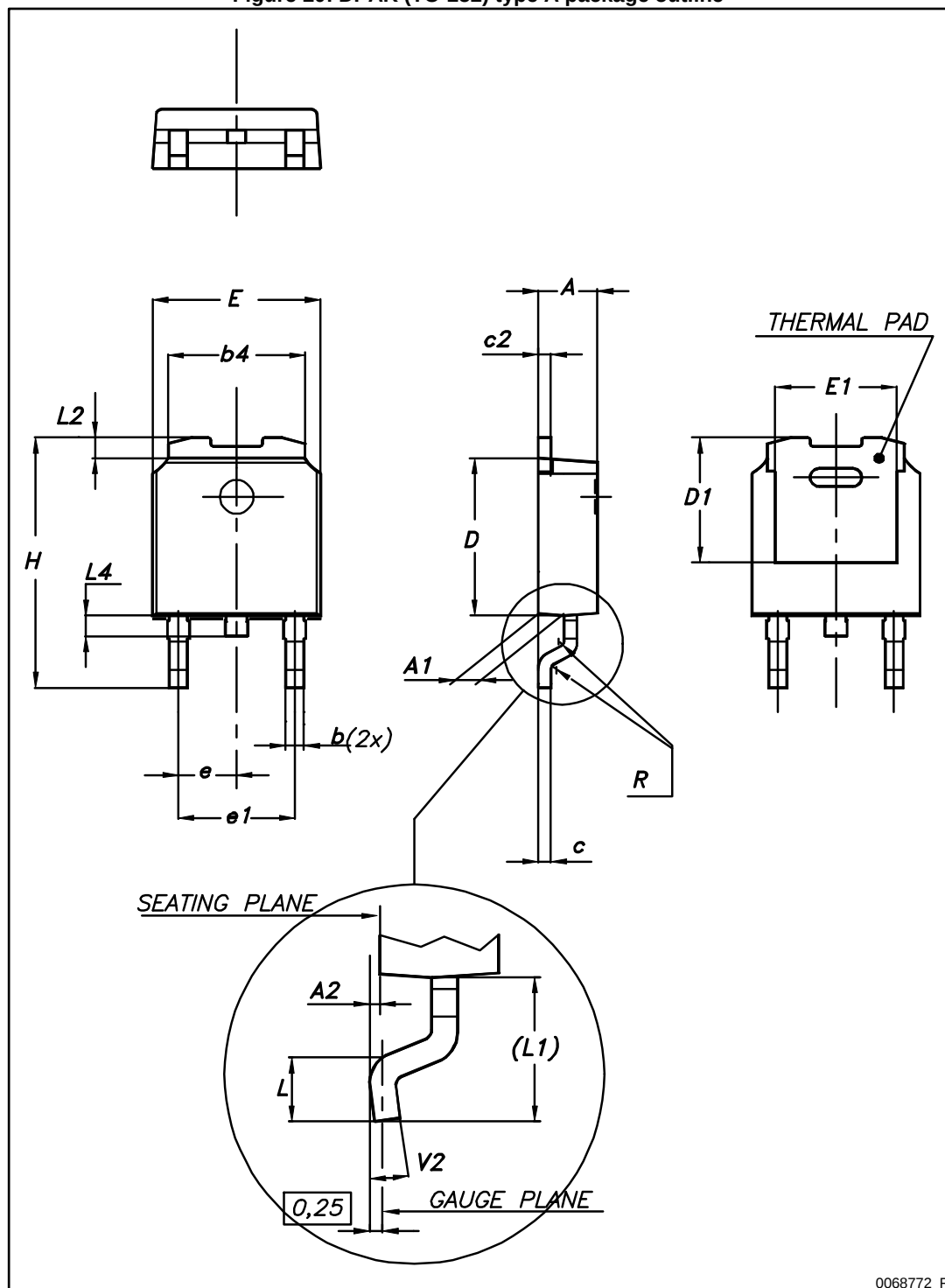


4 Package information

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 DPAK (TO-252) type A package information

Figure 20: DPAK (TO-252) type A package outline

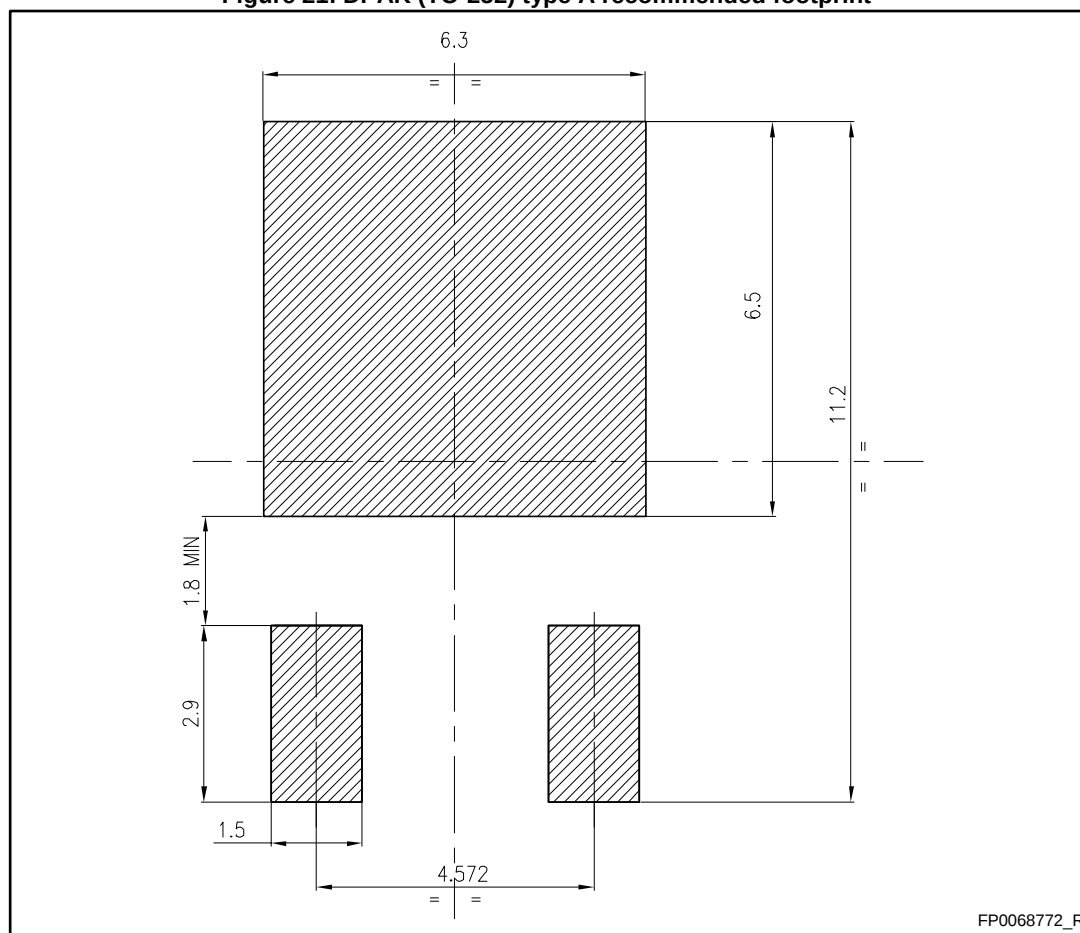


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Table 9: DPAK (TO-252) type A mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1		5.10	
E	6.40		6.60
E1		4.70	
e		2.28	
e1	4.40		4.60
H	9.35		10.10
L	1.00		1.50
L1		2.80	
L2		0.80	
L4	0.60		1.00
R		0.20	
V2	0°		8°

Figure 21: DPAK (TO-252) type A recommended footprint



All dimensions are in mm

4.2 DPAK (TO-252) packing information

Figure 22: Tape for DPAK (TO-252)

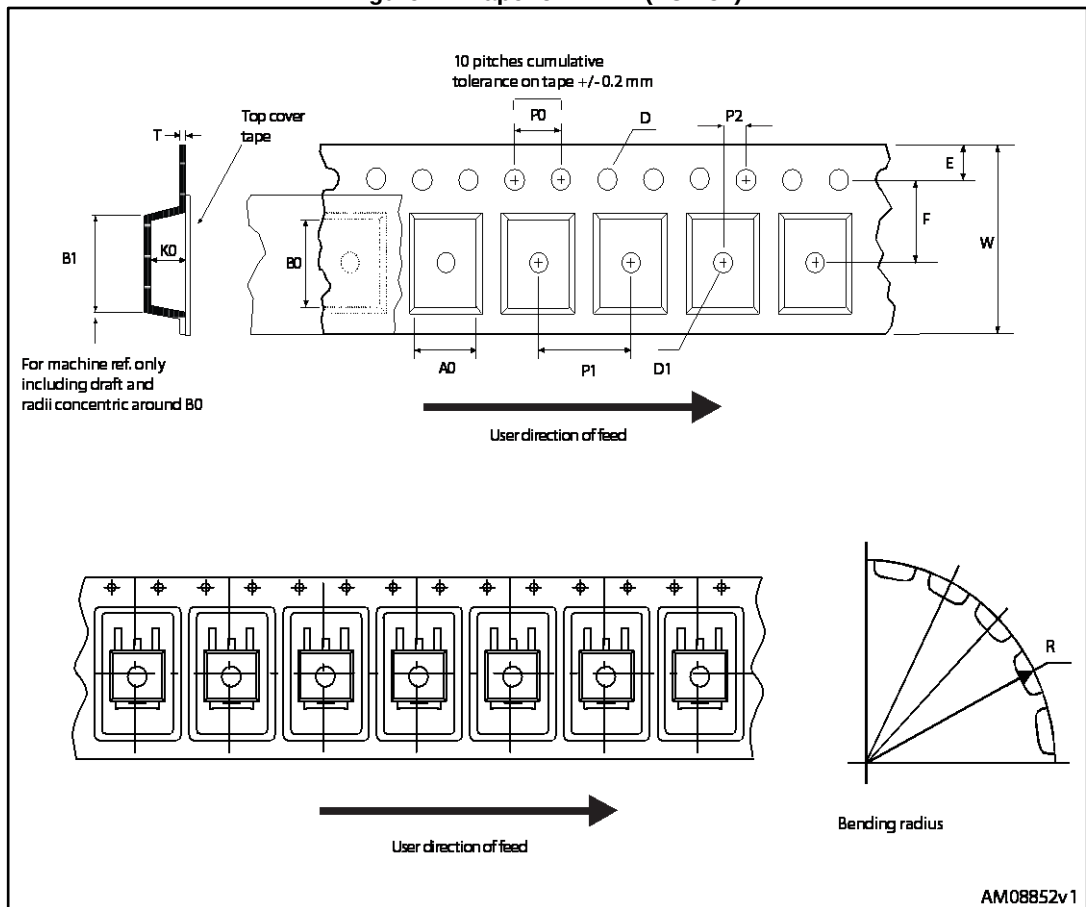


Figure 23: Reel for DPAK (TO-252)

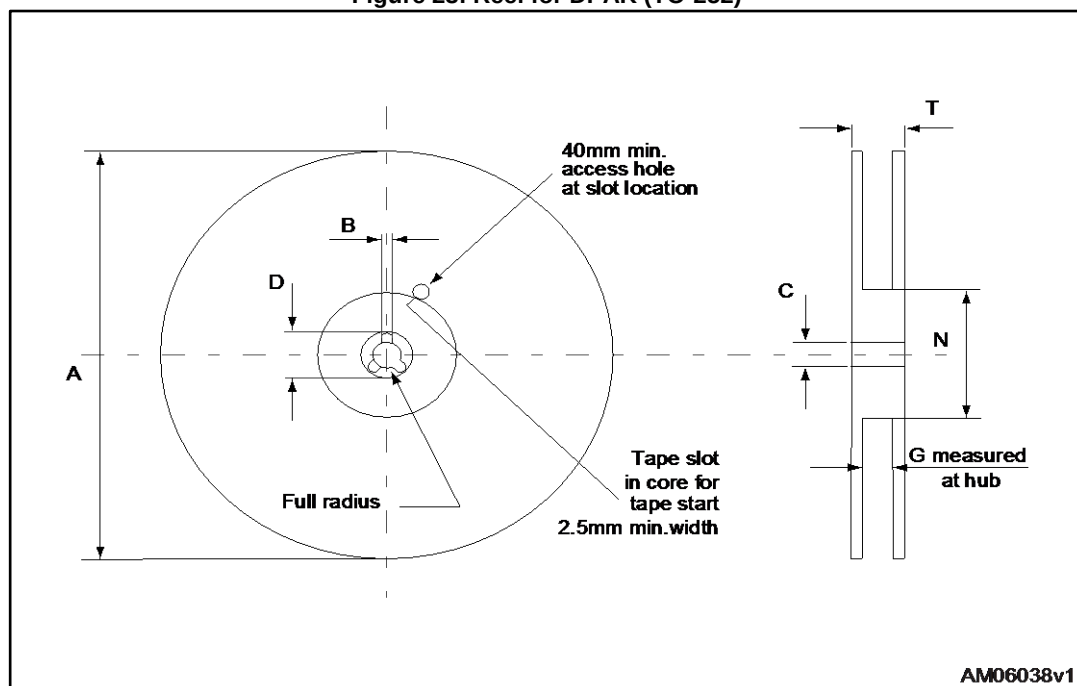


Table 10: DPAK (TO-252) tape and reel mechanical data

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	6.8	7	A		330
B0	10.4	10.6	B	1.5	
B1		12.1	C	12.8	13.2
D	1.5	1.6	D	20.2	
D1	1.5		G	16.4	18.4
E	1.65	1.85	N	50	
F	7.4	7.6	T		22.4
K0	2.55	2.75			
P0	3.9	4.1	Base qty.		2500
P1	7.9	8.1	Bulk qty.		2500
P2	1.9	2.1			
R	40				
T	0.25	0.35			
W	15.7	16.3			

5 Revision history

Table 11: Document revision history

Date	Revision	Changes
16-Dec-2014	1	First release.
12-Feb-2015	2	Updated features in cover page. Updated Table 4: "Avalanche characteristics" , Table 7: "Switching times" , Figure 2: "Safe operating area" and Section 5.1: "DPAK (TO-252) type A package information" . Minor text changes.

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