STD15N50M2AG

Automotive-grade N-channel 500 V, 0.336 Ω typ., 10 A MDmesh™ M2 Power MOSFET in a DPAK package

Datasheet - production data

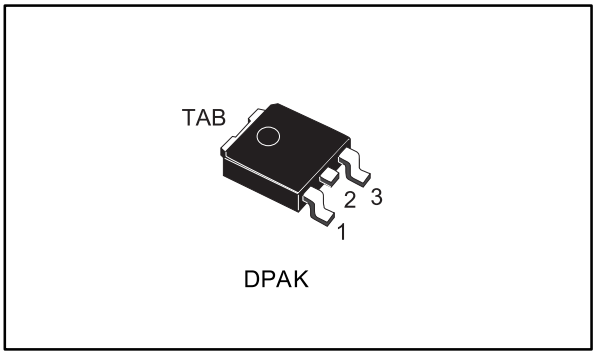
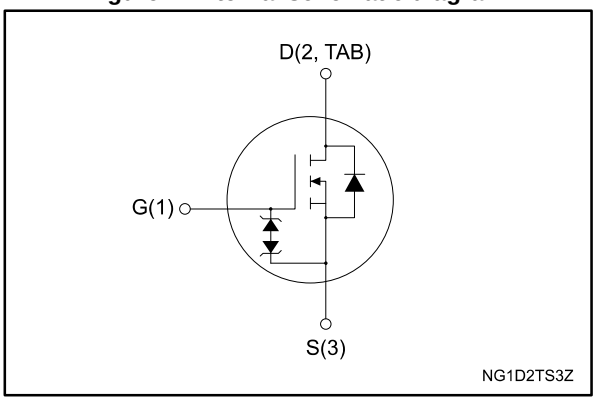


Figure 1: Internal schematic diagram



Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D	P_{TOT}
STD15N50M2AG	500 V	0.380 Ω	10 A	85 W

- Designed for automotive applications and AEC-Q101 qualified
- 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
STD15N50M2AG	15N50M2	DPAK	Tape and reel

Contents

1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	±30	V
I_D	Drain current (continuous) at T_{case} = 25 °C	10	A
	Drain current (continuous) at T_{case} = 100 °C	7	
I_{DM}(1)	Drain current (pulsed)	40	A
P_{TOT}	Total dissipation at T_{case} = 25 °C	85	W
dv/dt(2)	Peak diode recovery voltage slope	10	V/ns
dv/dt(3)	MOSFET dv/dt ruggedness	25	
T_{stg}	Storage temperature range	-55 to 150	°C
T_j	Operating junction temperature range		

Notes:

(1) Pulse width is limited by safe operating area.

(2) $I_{SD} \leq 10$ A, di/dt=800 A/µs; V_{DS} peak < $V_{(BR)DSS}$,V_{DD} = 80% $V_{(BR)DSS}$

(3) $V_{DS} \leq 400$ V.

Table 3: Thermal data

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

Notes:

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

Table 4: Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}(1)	Avalanche current, repetitive or not repetitive	3.5	A
E_{AS}(2)	Single pulse avalanche energy	200	mJ

Notes:

(1) pulse width limited by T_{jmax}

(2) starting T_j = 25 °C, $I_D = I_{AR}$, V_{DD} = 50 V.

2 Electrical characteristics

(T_{case} = 25 °C unless otherwise specified)

Table 5: Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0 V, I_D = 1 mA	500			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 500 V			1	µA
		V_{GS} = 0 V, V_{DS} = 500 V, T_{case} = 125 °C			100	
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, V_{GS} = ±25 V			±5	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 5 A		0.336	0.380	Ω

Table 6: Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 100 V, f = 1 MHz, V_{GS} = 0 V	-	530	-	pF
C_{oss}	Output capacitance		-	33	-	
C_{rss}	Reverse transfer capacitance		-	0.8	-	
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{DS} = 0 to 400 V, V_{GS} = 0 V	-	125	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz, I_D = 0 A	-	6.9	-	Ω
Q_g	Total gate charge	V_{DD} = 400 V, I_D = 9 A, V_{GS} = 10 V (see *Figure 15: "Test circuit for gate charge behavior"*)	-	13	-	nC
Q_{gs}	Gate-source charge		-	2.8	-	
Q_{gd}	Gate-drain charge		-	5.1	-	

Notes:

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 250 V, I_D = 4.5 A, R_G = 4.7 Ω, V_{GS} = 10 V (see *Figure 14: "Test circuit for resistive load switching times"* and *Figure 19: "Switching time waveform"*)	-	10	-	ns
t_r	Rise time		-	3.2	-	
$t_{d(off)}$	Turn-off delay time		-	84	-	
t_f	Fall time		-	8.8	-	

Table 8: Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		10	A
I_{SDM}(1)	Source-drain current (pulsed)		-		40	A
V_{SD}(2)	Forward on voltage	V_{GS} = 0 V, I_{SD} = 10 A	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 9 A, di/dt = 100 A/µs, V_{DD} = 100 V (see *Figure 16: "Test circuit for inductive load switching and diode recovery times"*)	-	230		ns
Q_{rr}	Reverse recovery charge		-	2		µC
I_{RRM}	Reverse recovery current		-	17.4		A
t_{rr}	Reverse recovery time	I_{SD} = 9 A, di/dt = 100 A/µs, V_{DD} = 100 V, T_j = 150 °C (see *Figure 16: "Test circuit for inductive load switching and diode recovery times"*)	-	310		ns
Q_{rr}	Reverse recovery charge		-	2.7		µC
I_{RRM}	Reverse recovery current		-	17.5		A

Notes:

(1) Pulse width is limited by safe operating area.

(2) Pulse test: pulse duration = 300 µs, duty cycle 1.5%.

Table 9: Gate-source Zener diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)GSO}$	Gate-source breakdown voltage	I_{GS} = ±250 µA, I_D = 0 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 2: Safe operating area

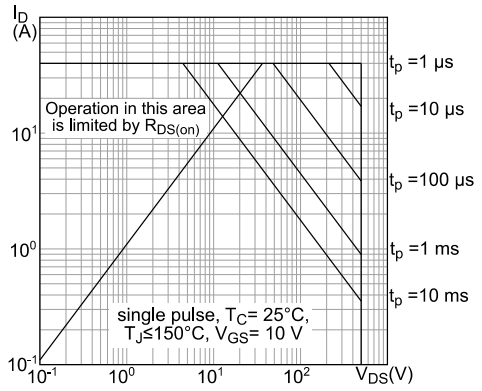


Figure 3: Thermal impedance

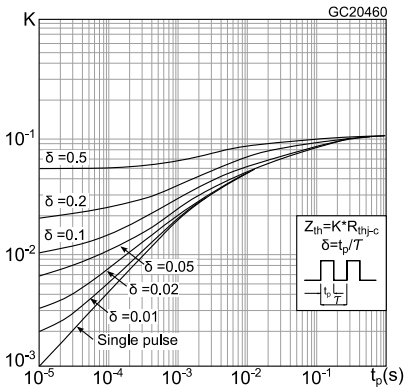


Figure 4: Output characteristics

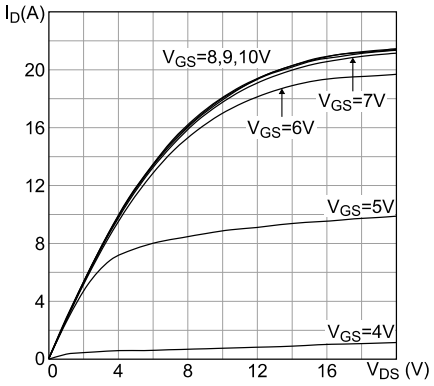


Figure 5: Transfer characteristics

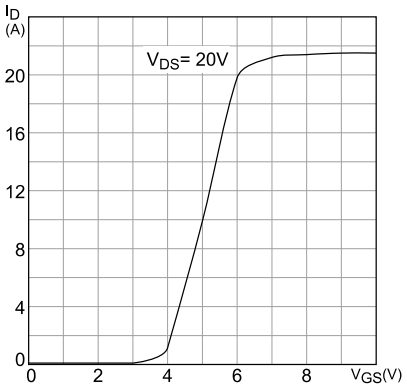


Figure 6: Gate charge vs gate-source voltage

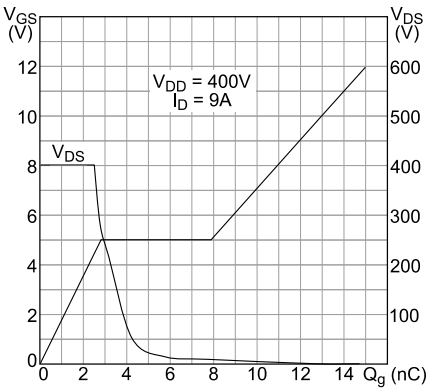


Figure 7: Static drain-source on-resistance

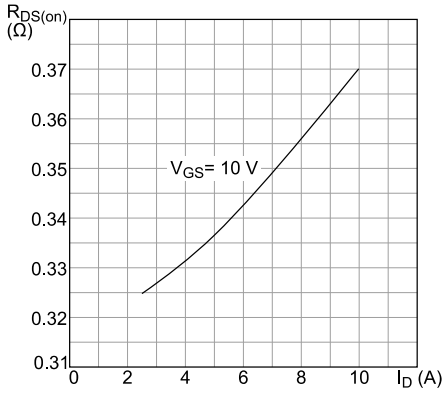


Figure 8: Capacitance variations

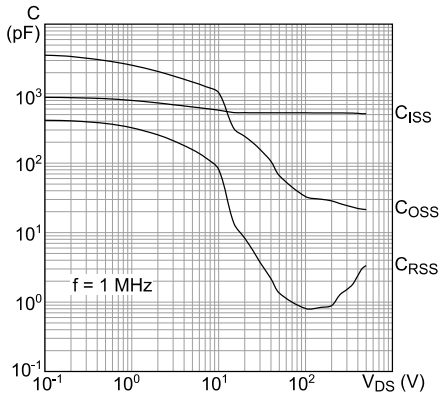


Figure 9: Normalized gate threshold voltage vs temperature

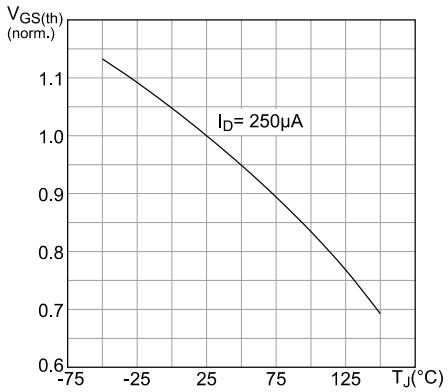


Figure 10: Normalized on-resistance vs temperature

Figure 11: Normalized V(BR)DSS vs temperature

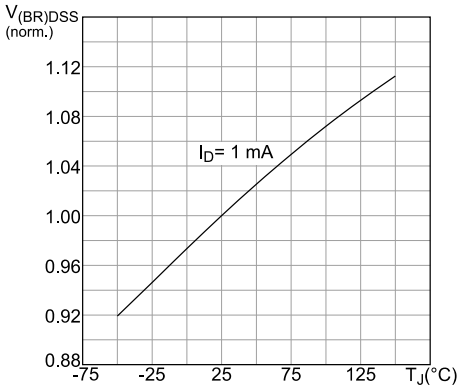


Figure 12: Output capacitance stored energy

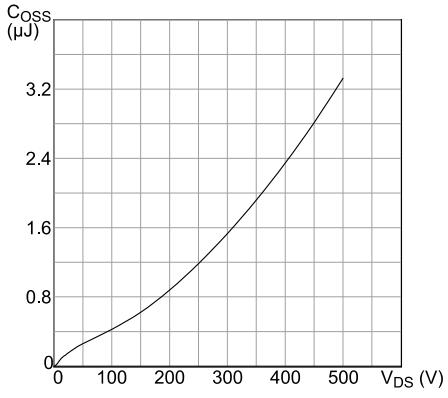
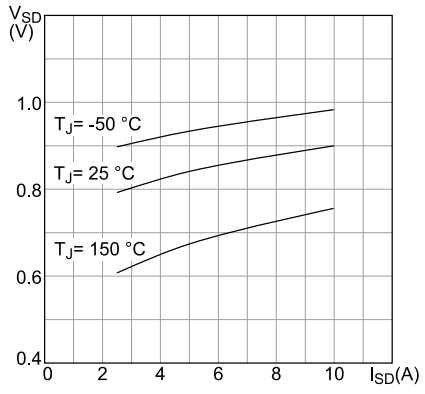


Figure 13: Source-drain diode forward characteristics



3 Test circuits

Figure 14: Test circuit for resistive load switching times

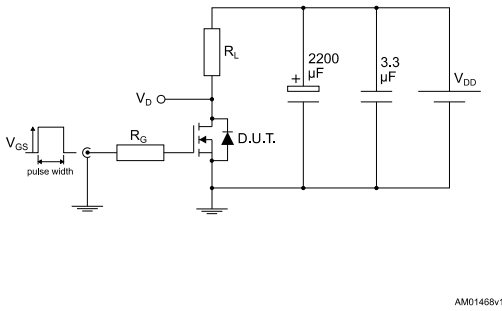


Figure 15: Test circuit for gate charge behavior

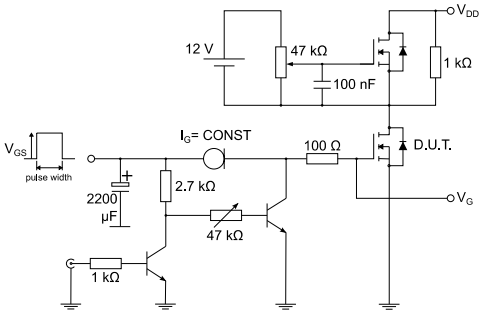


Figure 16: Test circuit for inductive load switching and diode recovery times

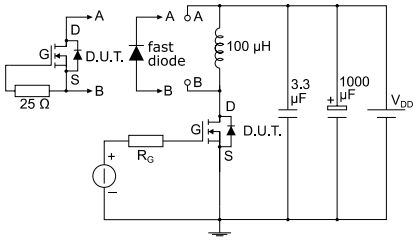


Figure 17: Unclamped inductive load test circuit

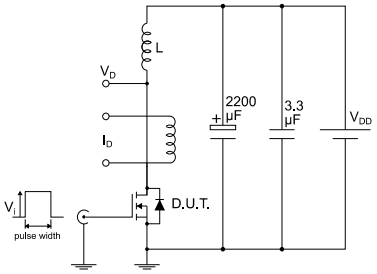


Figure 18: Unclamped inductive waveform

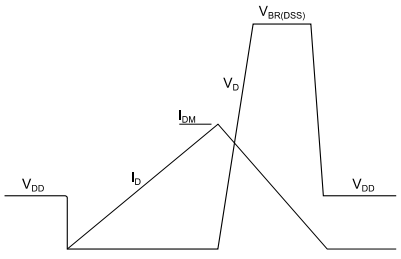
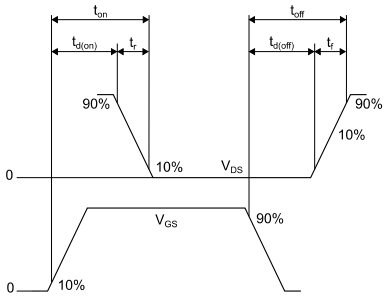


Figure 19: Switching time waveform



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 A2 package information

Figure 20: DPAK (TO-252) type A2 package outline

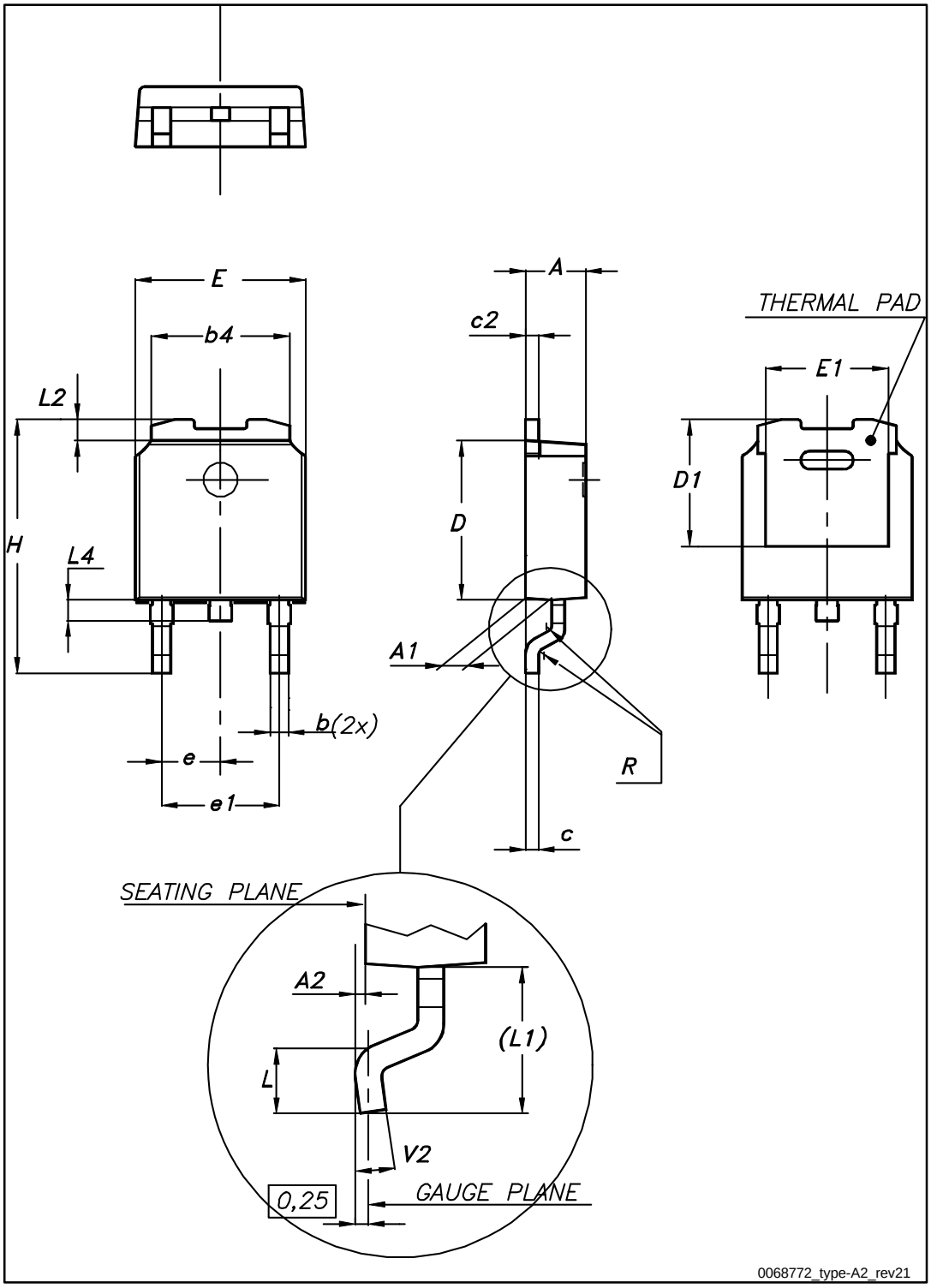
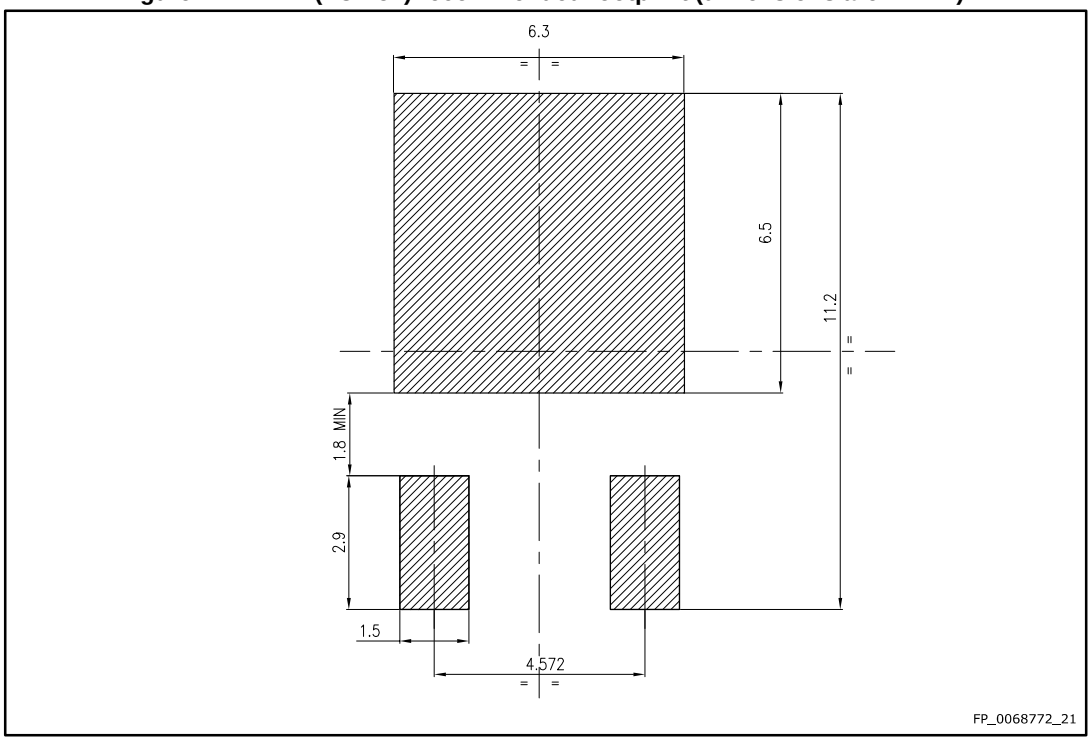


Table 10: DPAK (TO-252) type A2 mechanical data

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	4.95	5.10	5.25
E	6.40		6.60
E1	5.10	5.20	5.30
e	2.16	2.28	2.40
e1	4.40		4.60
H	9.35		10.10
L	1.00		1.50
L1	2.60	2.80	3.00
L2	0.65	0.80	0.95
L4	0.60		1.00
R		0.20	
V2	0°		8°

Figure 21: DPAK (TO-252) recommended footprint (dimensions are in mm)



4.2 DPAK (TO-252) packing information

Figure 22: DPAK (TO-252) tape outline

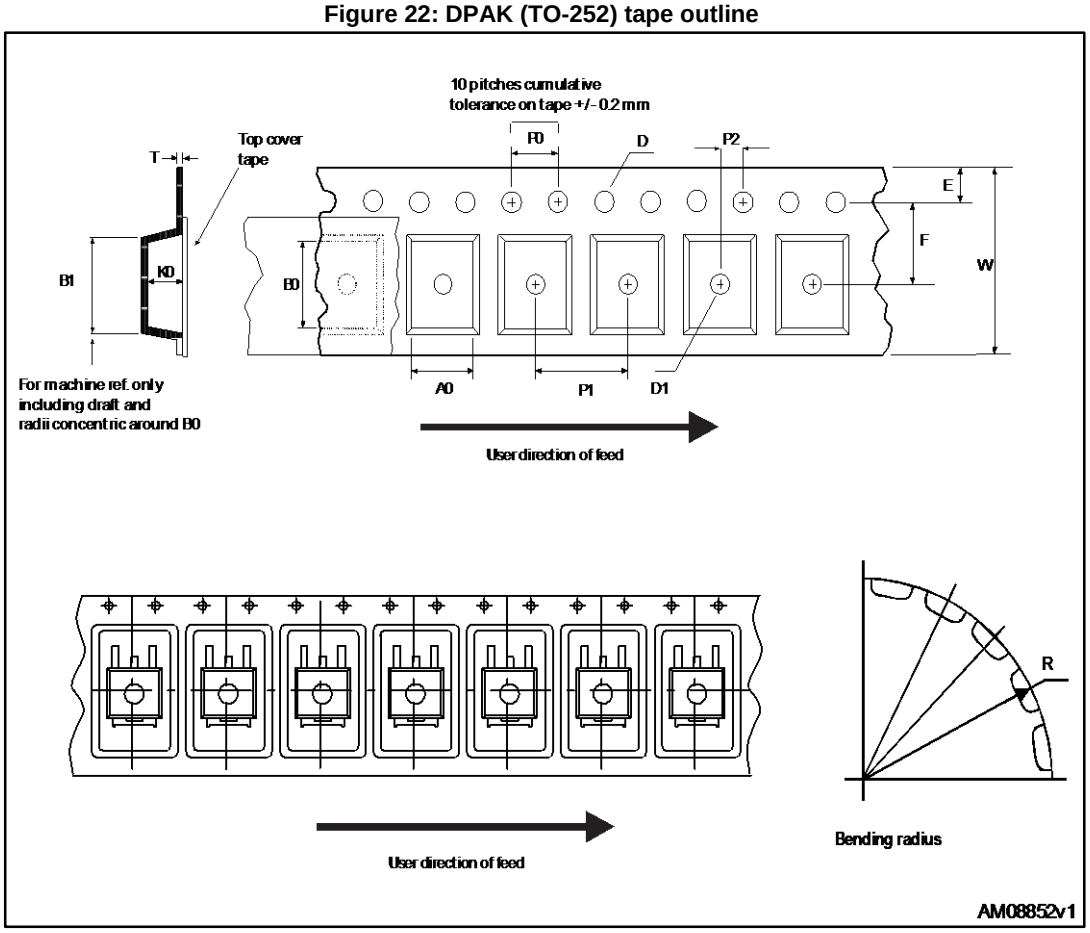


Figure 23: DPAK (TO-252) reel outline

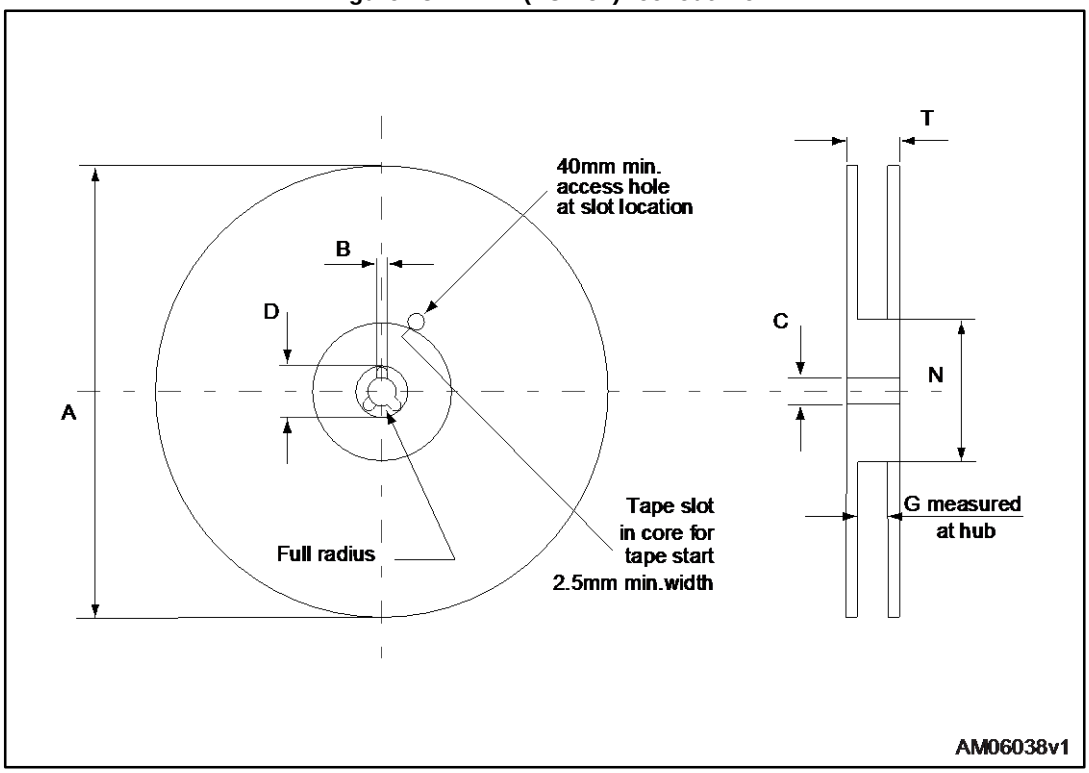


Table 11: DPAK (TO-252) tape and reel mechanical data

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 12: Document revision history

Date	Revision	Changes
13-Apr-2015	1	First release.
07-May-2016	2	Minor text edits Document status promoted to production data Updated *Section 1: "Electrical ratings"* Updated *Section 2: "Electrical characteristics"* Updated *Section 2.1: "Electrical characteristics (curves)"* Updated *Section 4.1: "DPAK (TO-252) type A2 package information"*

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