

## N-channel 500 V, 0.299 $\Omega$ typ., 11 A MDmesh™ DM2 Power MOSFET in a DPAK package

Datasheet - production data

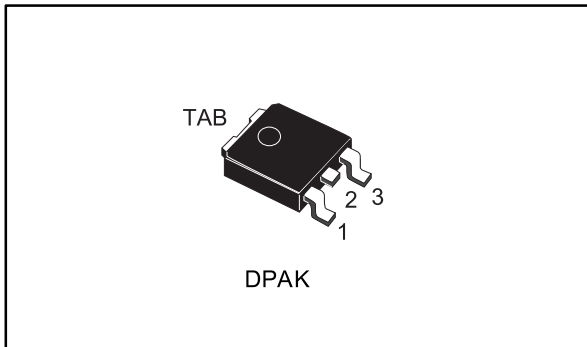
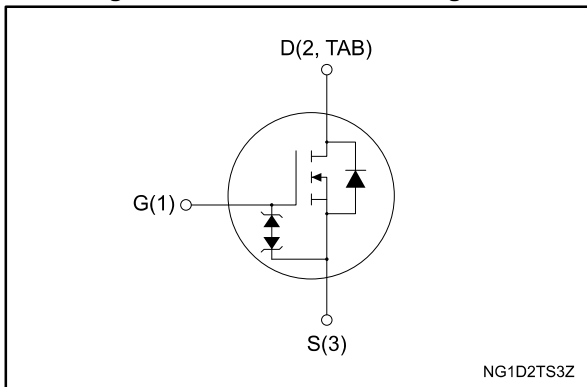


Figure 1: Internal schematic diagram



### Features

Order code	V <sub>DS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>
STD12N50DM2	500 V	0.350 $\Omega$	11 A

- Fast-recovery body diode
- Extremely low gate charge and input capacitance
- Low on-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 DM2 fast recovery diode series. It offers very low recovery charge and time (Q<sub>rr</sub>, t<sub>rr</sub>) combined with low R<sub>DS(on)</sub>, rendering it suitable for the most demanding high efficiency converters and ideal for bridge topologies and ZVS phase-shift converters.

Table 1: Device summary

Order code	Marking	Package	Packing
STD12N50DM2	12N50DM2	DPAK	Tape and reel

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## Contents

<b>1</b>	<b>Electrical ratings .....</b>	<b>3</b>
<b>2</b>	<b>Electrical characteristics .....</b>	<b>4</b>
	2.1 Electrical characteristics (curves) .....	6
<b>3</b>	<b>Test circuits .....</b>	<b>8</b>
<b>4</b>	<b>Package information .....</b>	<b>9</b>
	4.1 DPAK package information .....	10
	4.2 Packing information.....	13
<b>5</b>	<b>Revision history .....</b>	<b>15</b>

# 1 Electrical ratings

**Table 2: Absolute maximum ratings**

Symbol	Parameter	Value	Unit
V <sub>GS</sub>	Gate-source voltage	±25	V
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 25 °C	11	A
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 100 °C	8	
I <sub>DM</sub> <sup>(1)</sup>	Drain current (pulsed)	44	A
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25 °C	110	W
dv/dt <sup>(2)</sup>	Peak diode recovery voltage slope	40	V/ns
dv/dt <sup>(3)</sup>	MOSFET dv/dt ruggedness	50	V/ns
T <sub>stg</sub>	Storage temperature range	-55 to 150	°C
T <sub>j</sub>	Operating junction temperature range		

**Notes:**

(1) Pulse width limited by safe operating area.

(2) I<sub>SD</sub> ≤ 11 A, di/dt ≤ 400 A/μs; V<sub>DS peak</sub> < V<sub>(BR)DSS</sub>, V<sub>DD</sub> = 80% V<sub>(BR)DSS</sub>

(3) V<sub>DS</sub> ≤ 400 V

**Table 3: Thermal data**

Symbol	Parameter	Value	Unit
R <sub>thj-case</sub>	Thermal resistance junction-case max	1.14	°C/W
R <sub>thj-pcb</sub> <sup>(1)</sup>	Thermal resistance junction-pcb max	50	

**Notes:**

(1) When mounted on a 1-inch<sup>2</sup> FR-4, 2 oz Cu board

**Table 4: Avalanche characteristics**

Symbol	Parameter	Value	Unit
I <sub>AR</sub>	Avalanche current, repetitive or not repetitive (pulse width limited by T <sub>jmax</sub> )	2.5	A
E <sub>AS</sub>	Single pulse avalanche energy (starting T <sub>j</sub> = 25 °C, I <sub>D</sub> = I <sub>AR</sub> , V <sub>DD</sub> = 50 V)	320	mJ

## 2 Electrical characteristics

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

**Table 5: Static**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$ , $I_D = 1\text{ mA}$	500			V
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$ , $V_{DS} = 500\text{ V}$			1	$\mu\text{A}$
		$V_{GS} = 0\text{ V}$ , $V_{DS} = 500\text{ V}$ , $T_C = 125\text{ °C}^{(1)}$			100	$\mu\text{A}$
$I_{GSS}$	Gate-body leakage current	$V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 25\text{ V}$			$\pm 10$	$\mu\text{A}$
$V_{GS(th)}$	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	$V_{GS} = 10\text{ V}$ , $I_D = 5.5\text{ A}$		0.299	0.350	$\Omega$

**Notes:**

<sup>(1)</sup>Defined by design, not subject to production test.

**Table 6: Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$	-	628	-	pF
$C_{oss}$	Output capacitance		-	38	-	pF
$C_{rss}$	Reverse transfer capacitance		-	1.2	-	pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{DS} = 0\text{ V to } 400\text{ V}$ , $V_{GS} = 0\text{ V}$	-	69	-	pF
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz open drain}$	-	7	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 400\text{ V}$ , $I_D = 11\text{ A}$ , $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 15: "Test circuit for gate charge behavior"</a> )	-	16	-	nC
$Q_{gs}$	Gate-source charge		-	4.6	-	nC
$Q_{gd}$	Gate-drain charge		-	7	-	nC

**Notes:**

<sup>(1)</sup>  $C_{oss\text{ eq.}}$  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	$V_{DD} = 250\text{ V}$ , $I_D = 5.5\text{ A}$ $R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 14: "Test circuit for resistive load switching times"</a> and <a href="#">Figure 19: "Switching time waveform"</a> )	-	12.5	-	ns
$t_r$	Rise time		-	9	-	ns
$t_{d(off)}$	Turn-off-delay time		-	28	-	ns
$t_f$	Fall time		-	9.8	-	ns

Table 8: Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		11	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		44	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0\text{ V}$ , $I_{SD} = 11\text{ A}$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 11\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ (see <a href="#">Figure 16</a> : "Test circuit for inductive load switching and diode recovery times")	-	140		ns
$Q_{rr}$	Reverse recovery charge		-	0.707		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	10.1		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 11\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$ (see <a href="#">Figure 16</a> : "Test circuit for inductive load switching and diode recovery times")	-	190		ns
$Q_{rr}$	Reverse recovery charge		-	1.111		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	11.7		A

**Notes:**

(1) Pulse width is limited by safe operating area

(2) Pulse test: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

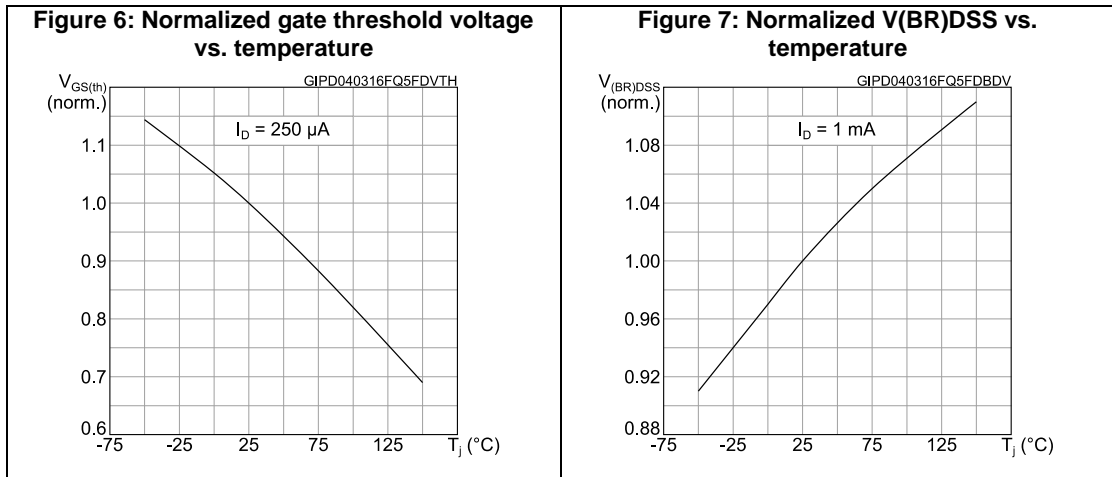
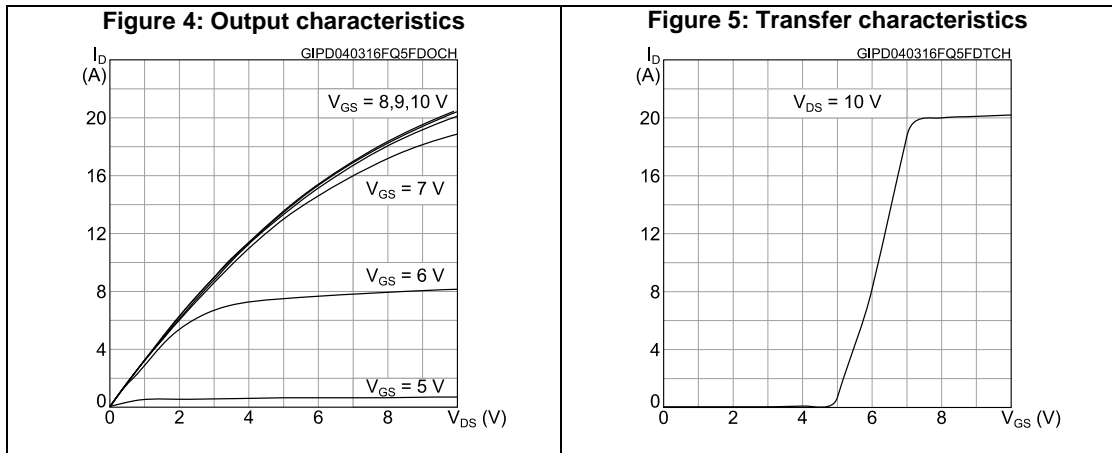
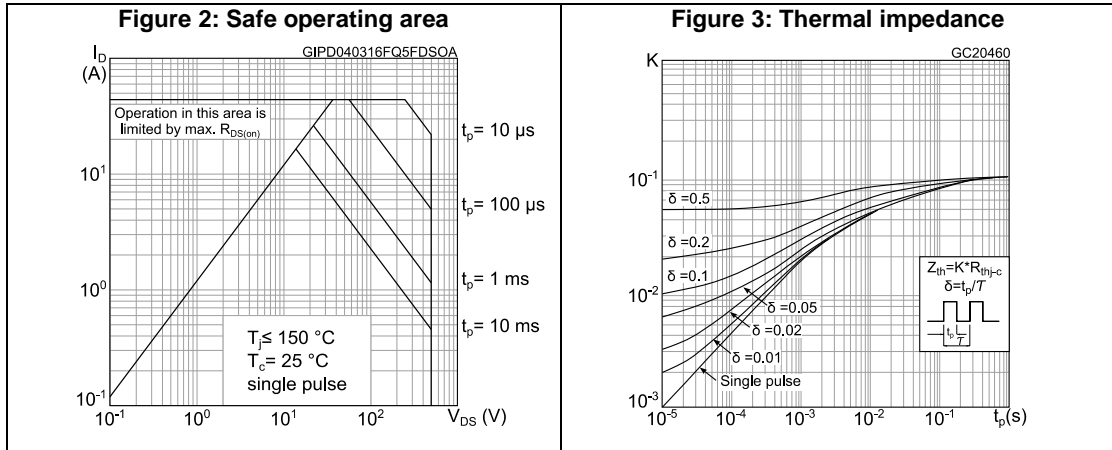


Figure 8: Static drain-source on-resistance

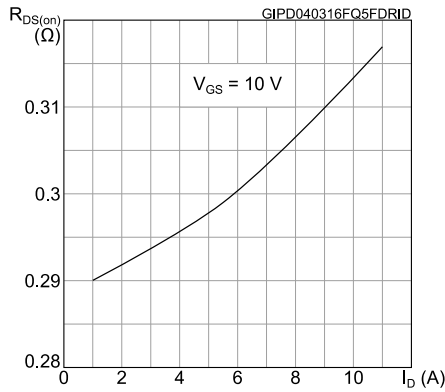


Figure 9: Normalized on-resistance vs. temperature

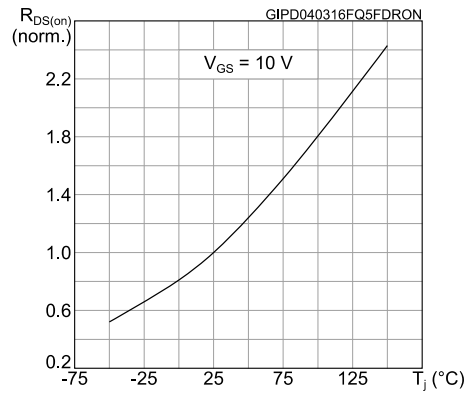


Figure 10: Gate charge vs. gate-source voltage

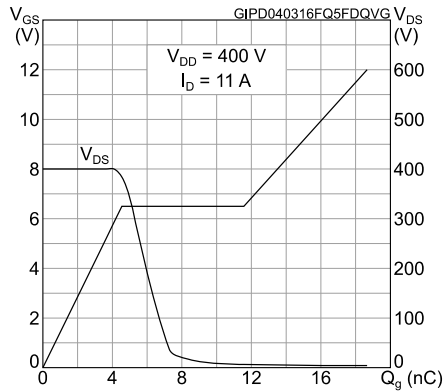


Figure 11: Capacitance variations

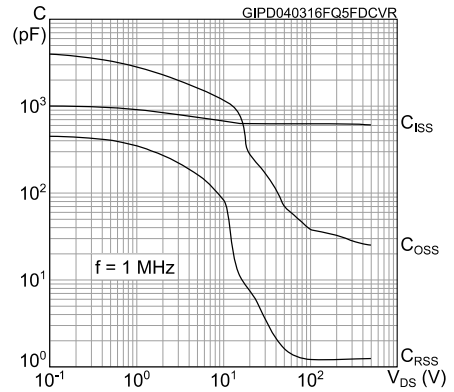


Figure 12: Output capacitance stored energy

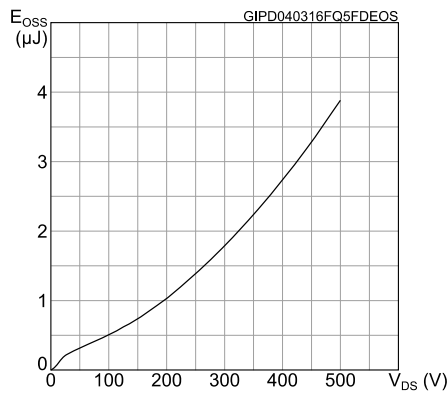
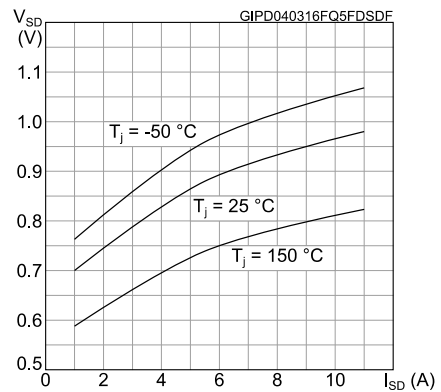


Figure 13: Source-drain diode forward characteristics



### 3 Test circuits

**Figure 14: Test circuit for resistive load switching times**



AM01468v1

**Figure 15: Test circuit for gate charge behavior**



AM01469v1

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



AM01470v1

**Figure 17: Unclamped inductive load test circuit**



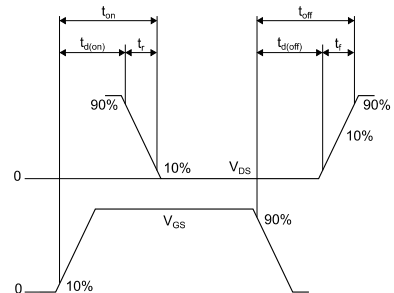
AM01471v1

**Figure 18: Unclamped inductive waveform**



AM01472v1

**Figure 19: 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](http://www.st.com). ECOPACK® is an ST trademark.

### 4.1 DPAK package information

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

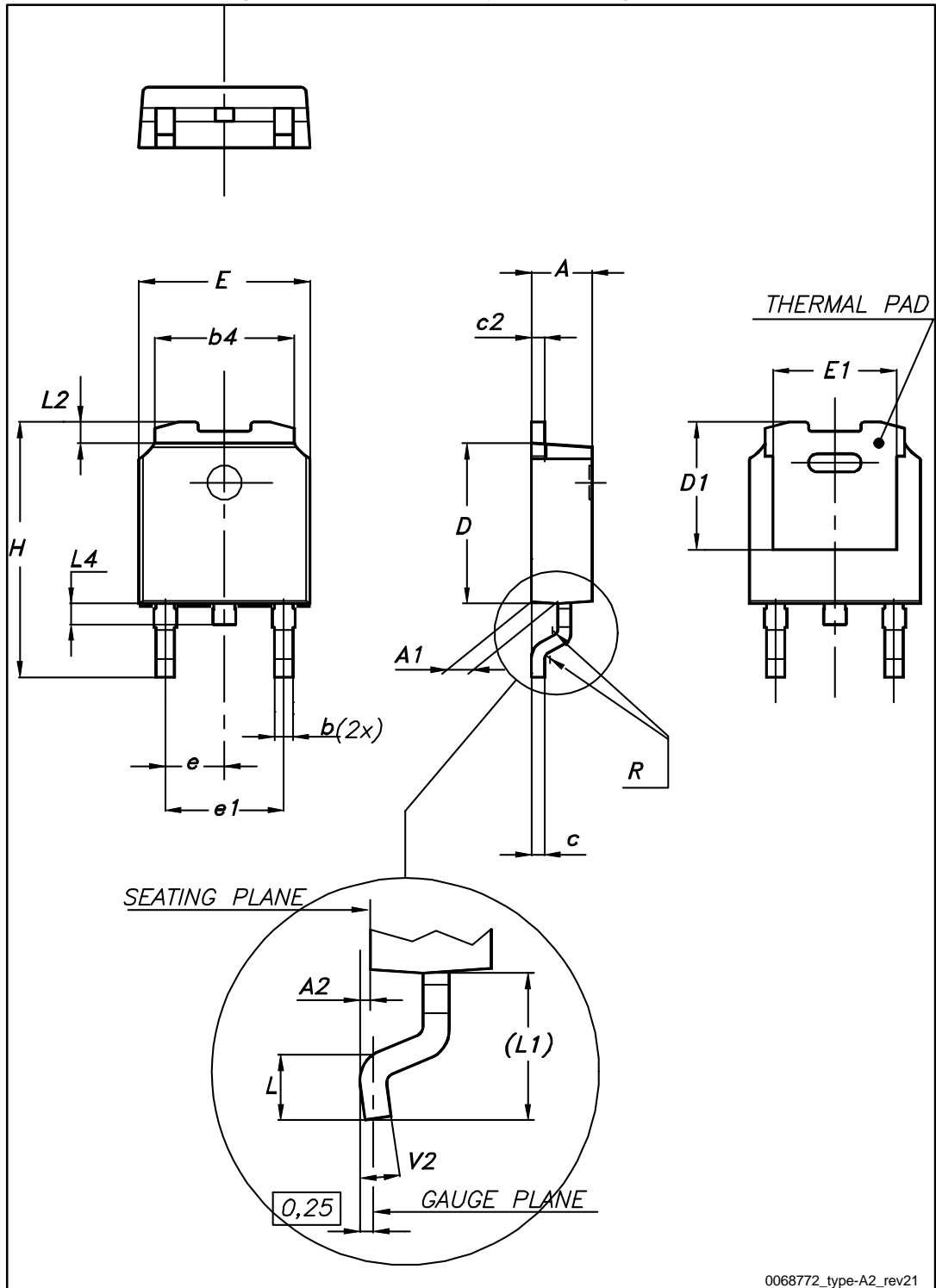
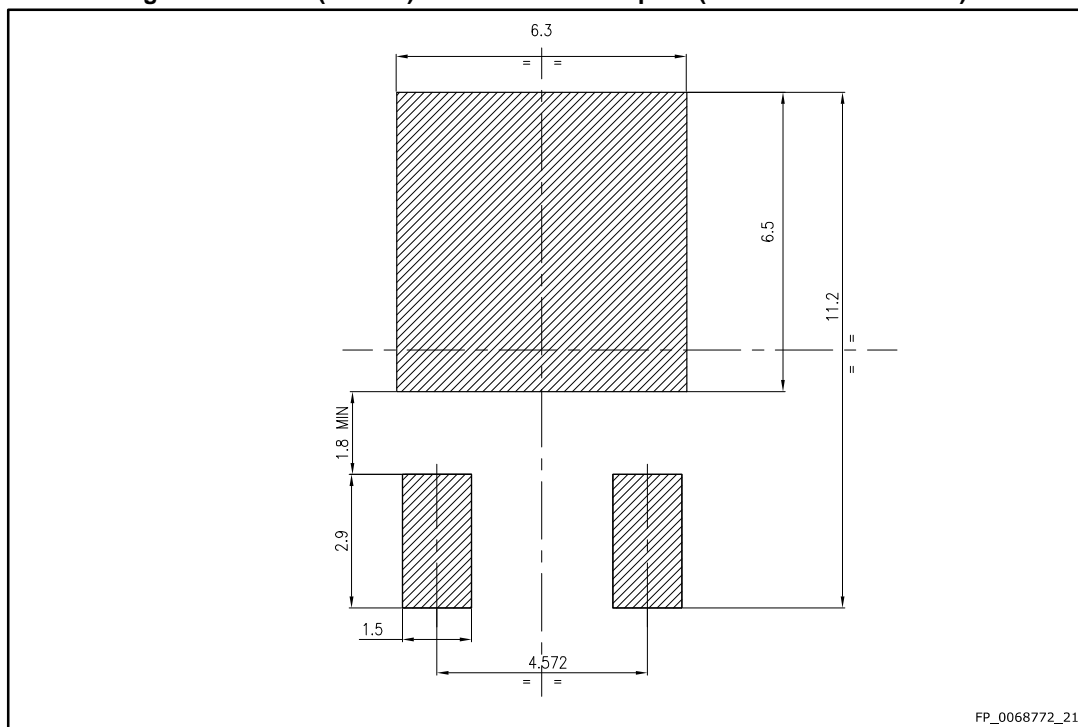


Table 9: DPAK (TO-252) type A2 mechanical data

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 Packing information

Figure 22: DPAK (TO-252) tape outline

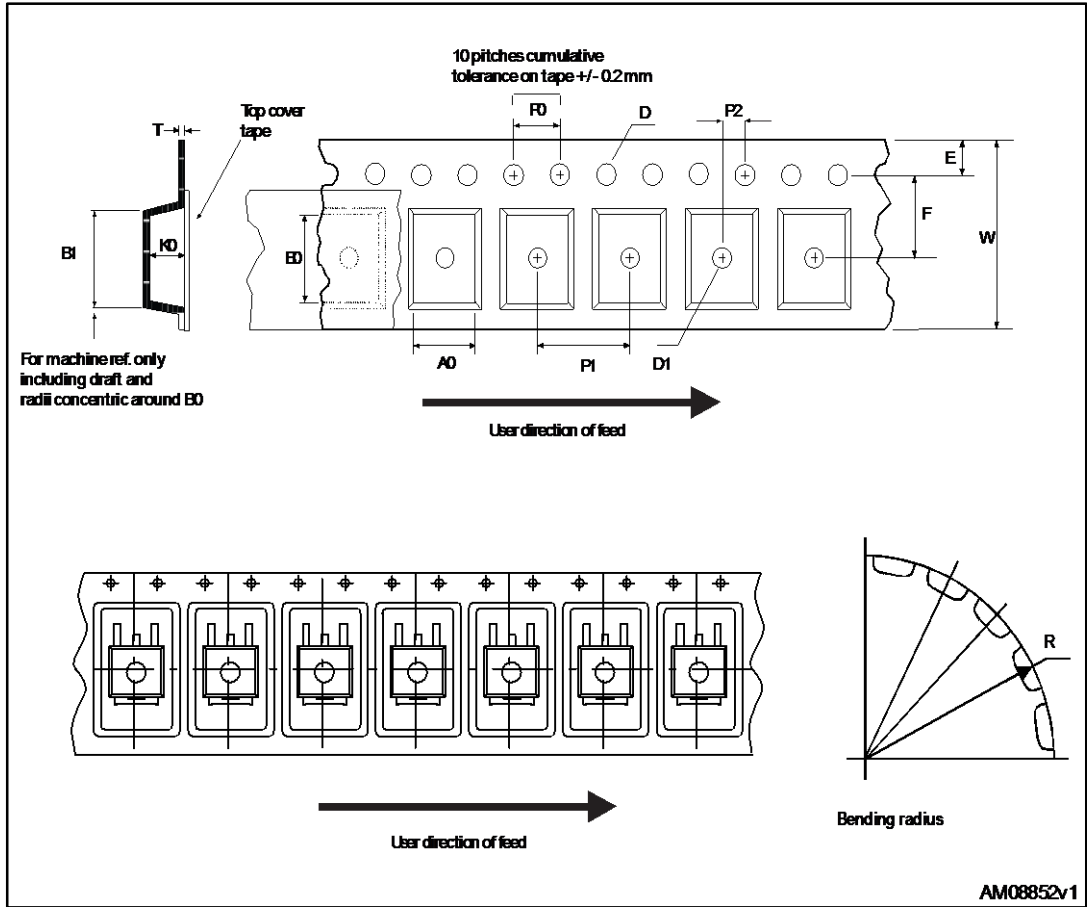


Figure 23: DPAK (TO-252) reel outline

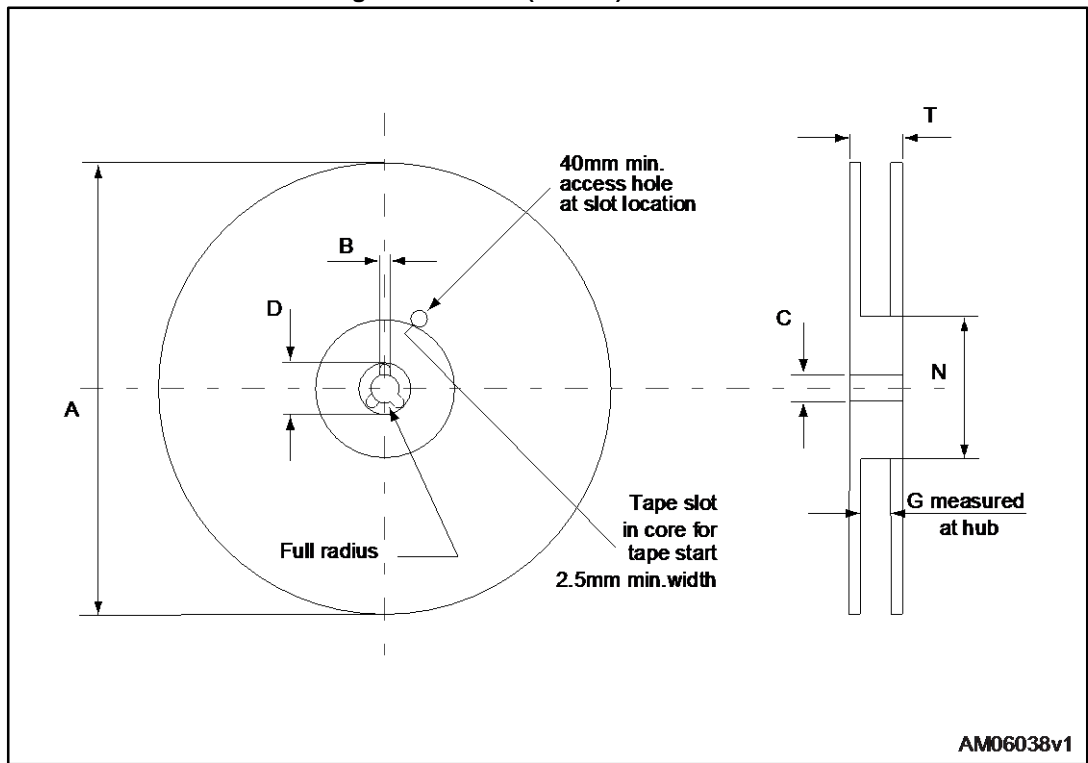


Table 10: DPAK (TO-252) tape and reel mechanical data

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
26-Aug-2014	1	First release.
07-Mar-2016	2	Text and formatting changes throughout document In <a href="#">Section 1: "Electrical ratings"</a> : - updated <a href="#">Table 4: "Avalanche characteristics"</a> In <a href="#">Section 2: "Electrical characteristics"</a> - updated <a href="#">Table 6: "Dynamic"</a> , <a href="#">Table 7: "Switching times"</a> and <a href="#">Table 8: "Source drain diode"</a> Added <a href="#">Section 2.1: "Electrical characteristics (curves)"</a> Updated <a href="#">Section 4: "Package information"</a>

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