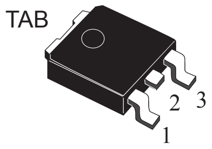
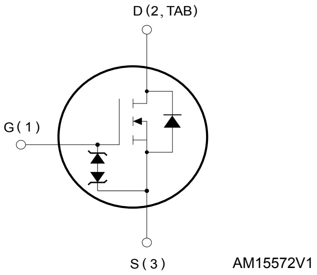
STD12N50M2

Datasheet

N-channel 500 V, 0.325 Ω typ., 10 A MDmesh™ M2 Power MOSFET in a DPAK package



DPAK



Features

Order code	V_{DS}	$R_{DS(on)}$max.	I_D
STD12N50M2	500 V	0.38 Ω	10 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.

Product status
STD12N50M2

Product summary	
Order code	STD12N50M2
Marking	12N50M2
Package	DPAK
Packing	Tape and reel

1 Electrical ratings

Table 1. **Absolute maximum ratings**

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	±30	V
I_D	Drain current (continuous) at T_C = 25 °C	10	A
I_D	Drain current (continuous) at T_C = 100 °C	7	A
I_{DM} (1)	Drain current (pulsed)	40	A
P_{TOT}	Total dissipation at T_C = 25 °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_j	Operating junction temperature range	-55 to 150	°C
T_{stg}	Storage temperature range		

1. *Pulse width limited by safe operating area.*
2. *$I_{SD} \leq 10$ A, di/dt ≤ 400 A/μs; $V_{DS\ peak} < V_{(BR)DSS}$, V_{DD} = 400 V.*
3. *$V_{DS} \leq 400$ V.*

Table 2. **Thermal data**

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

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

Table 3. **Avalanche characteristics**

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j Max)	3.5	A
E_{AS}	Single pulse avalanche energy (starting T_j = 25 °C, $I_D = I_{AR}$, V_{DD} = 50 V)	204	mJ

2 Electrical characteristics

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

Table 4. **On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	I_D = 1 mA, V_{GS} = 0 V	500			V
I_{DSS}	Zero gate voltage drain current	V_{DS} = 500 V, V_{GS} = 0 V			1	µA
		V_{DS} = 500 V, V_{GS} = 0 V, T_C = 125 °C (1)			100	µA
I_{GSS}	Gate body leakage current	V_{DS} = 0 V, V_{GS} = ±25 V			±10	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		0.325	0.38	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_{DS} = 100 V, f = 1 MHz, V_{GS} = 0 V	-	550	-	pF
C_{oss}	Output capacitance			33		
C_{rss}	Reverse transfer capacitance			1		
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{GS} = 0 V, V_{DS} = 0 to 400 V	-	125	-	pF
Rg	Gate input resistance	f = 1 MHz open drain	-	6.8	-	Ω
Q_g	Total gate charge	V_{DD} = 400 V, I_D = 10 A, V_{GS} = 0 to 10 V(see Figure 14. Test circuit for gate charge behavior)	-	15	-	nC
Q_{gs}	Gate-source charge			3		
Q_{gd}	Gate-drain charge			8.3		

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 6. **Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 250 V, I_D = 5 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	13.5	-	ns
t_r	Rise time			10.5		
$t_{d(off)}$	Turn-off delay time			8		
t_f	Fall time			34.5		

Table 7. **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	
V_{SD} (2)	Forward on voltage	I_{SD} = 10 A, V_{GS} = 0 V	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 10 A, di/dt = 100 A/µs V_{DD} = 60 V (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	276		ns
Q_{rr}	Reverse recovery charge			2.4		µC
I_{RRM}	Reverse recovery current			17.5		A
t_{rr}	Reverse recovery time	I_{SD} = 10 A, di/dt = 100 A/µs V_{DD} = 60 V, T_j = 150 °C (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	376		ns
Q_{rr}	Reverse recovery charge			3.4		µC
I_{RRM}	Reverse recovery current			18.3		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 1. Safe operating area

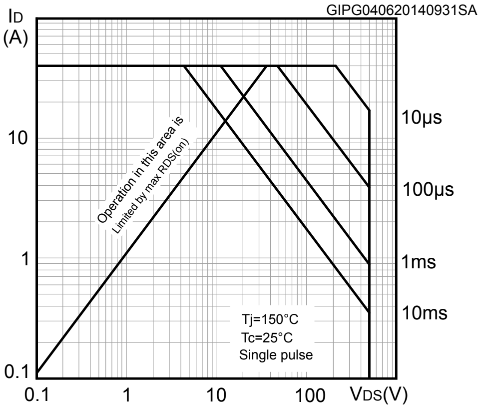


Figure 2. Thermal impedance

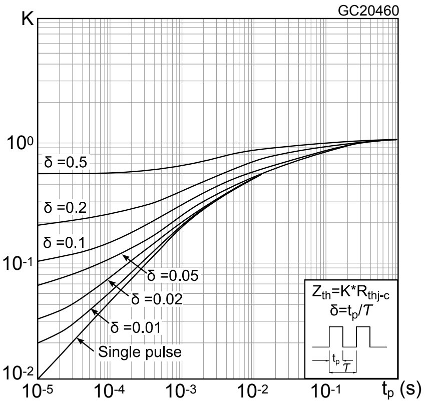


Figure 3. Output characterisics

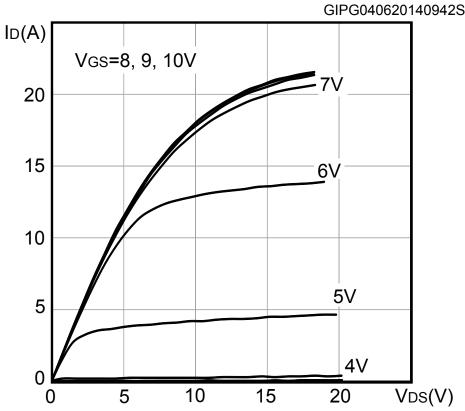


Figure 4. Transfer characteristics

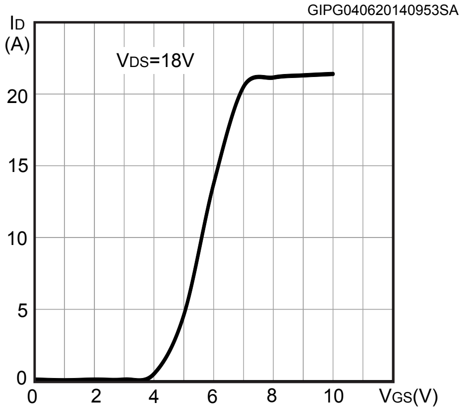


Figure 5. Gate charge vs gate-source voltage

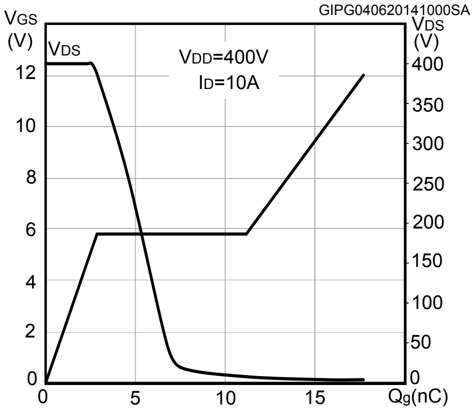


Figure 6. Static drain-source on resistance

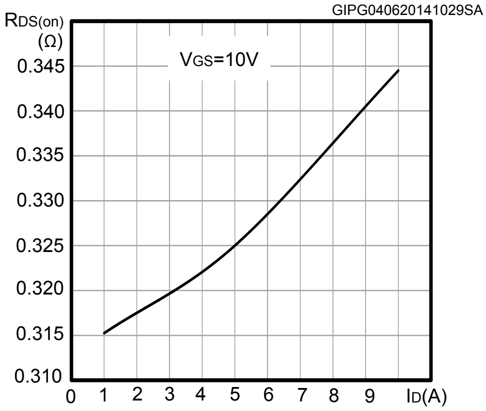


Figure 7. **Capacitance variations**

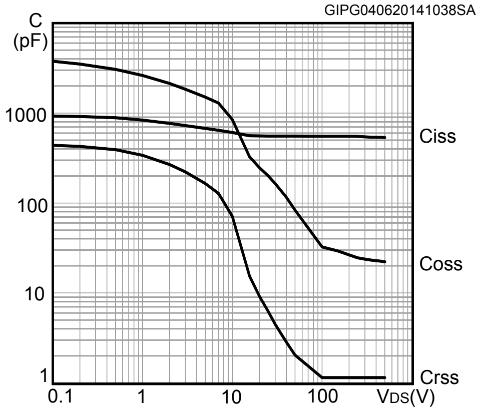


Figure 8. **Output capacitance stored energy**

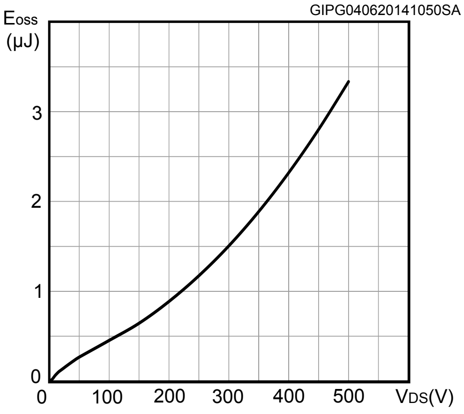


Figure 9. **Normalized gate threshold voltage vs temperature**

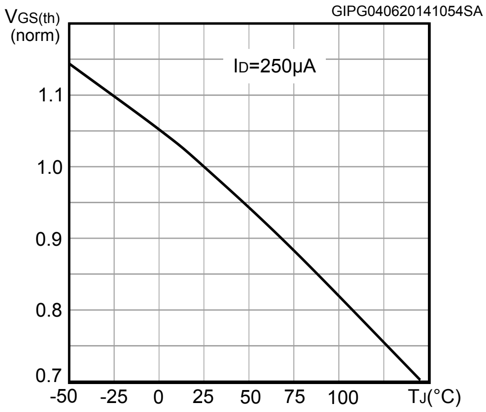


Figure 10. **Normalized on-resistance vs temperature**

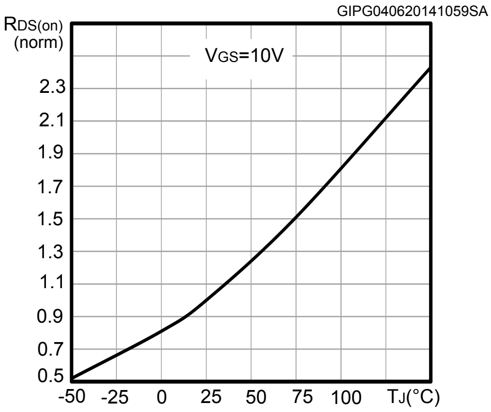


Figure 11. **Normalized $V_{(BR)DSS}$ vs temperature**

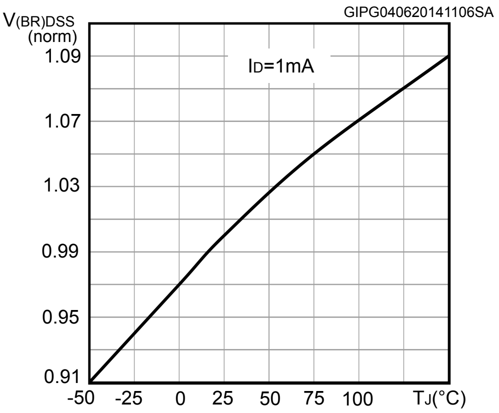
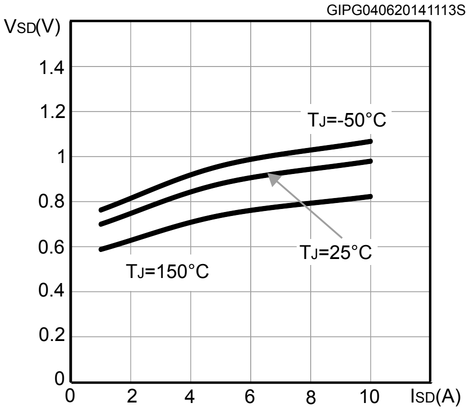


Figure 12. **Source-drain diode forward characteristics**



3 Test circuits

Figure 13. Test circuit for resistive load switching times

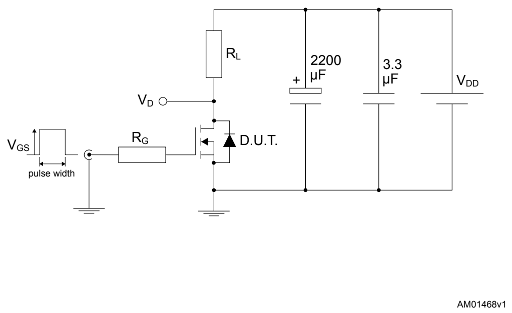


Figure 14. Test circuit for gate charge behavior

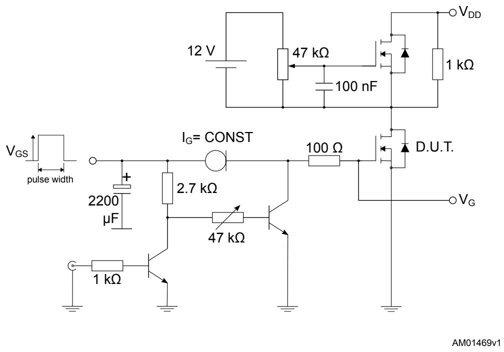


Figure 15. Test circuit for inductive load switching and diode recovery times

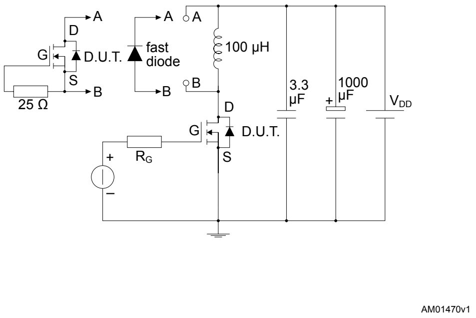


Figure 16. Unclamped inductive load test circuit

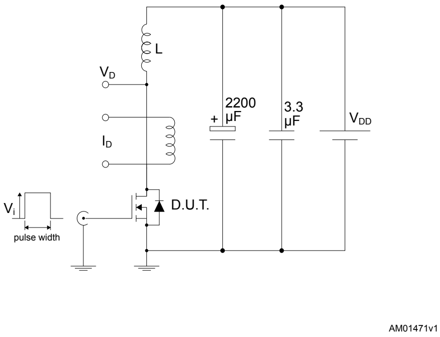


Figure 17. Unclamped inductive waveform

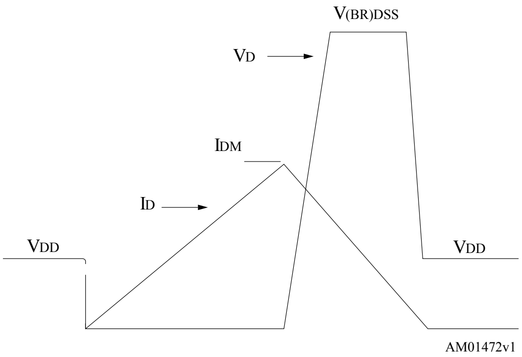
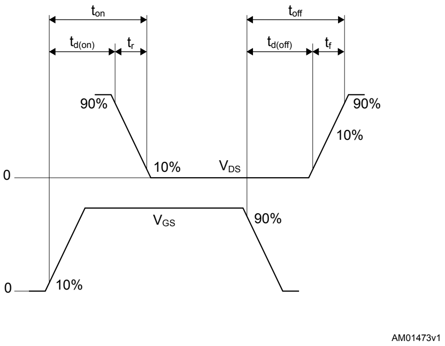


Figure 18. Switching time waveform



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 19. **DPAK (TO-252) type A2 package outline**

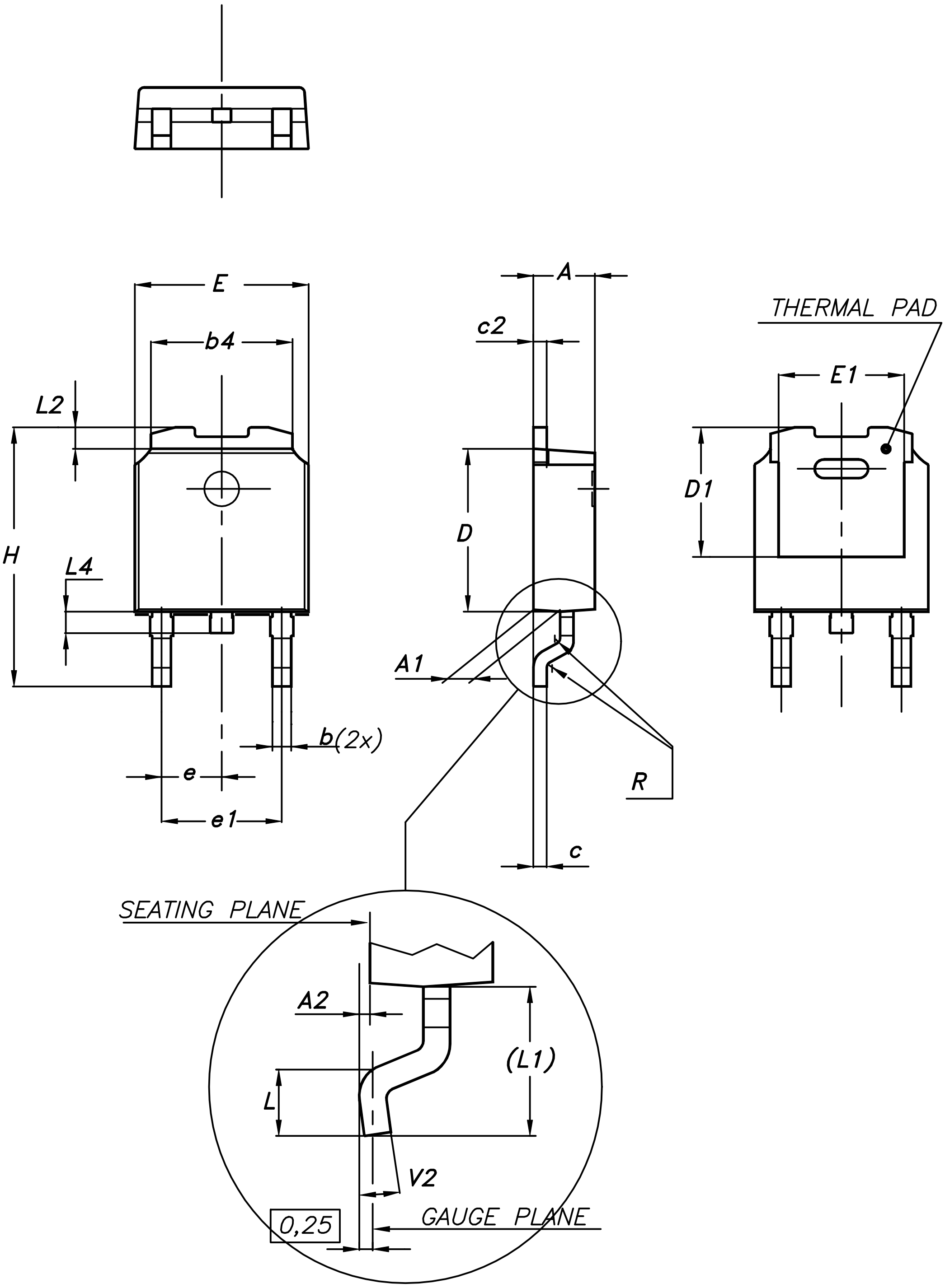


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Table 8. **DPAK (TO-252) type A2 mechanical data**

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	2.159	2.286	2.413
e1	4.445	4.572	4.699
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°

4.2 DPAK (TO-252) type C2 package information

Figure 20. **DPAK (TO-252) type C2 package outline**

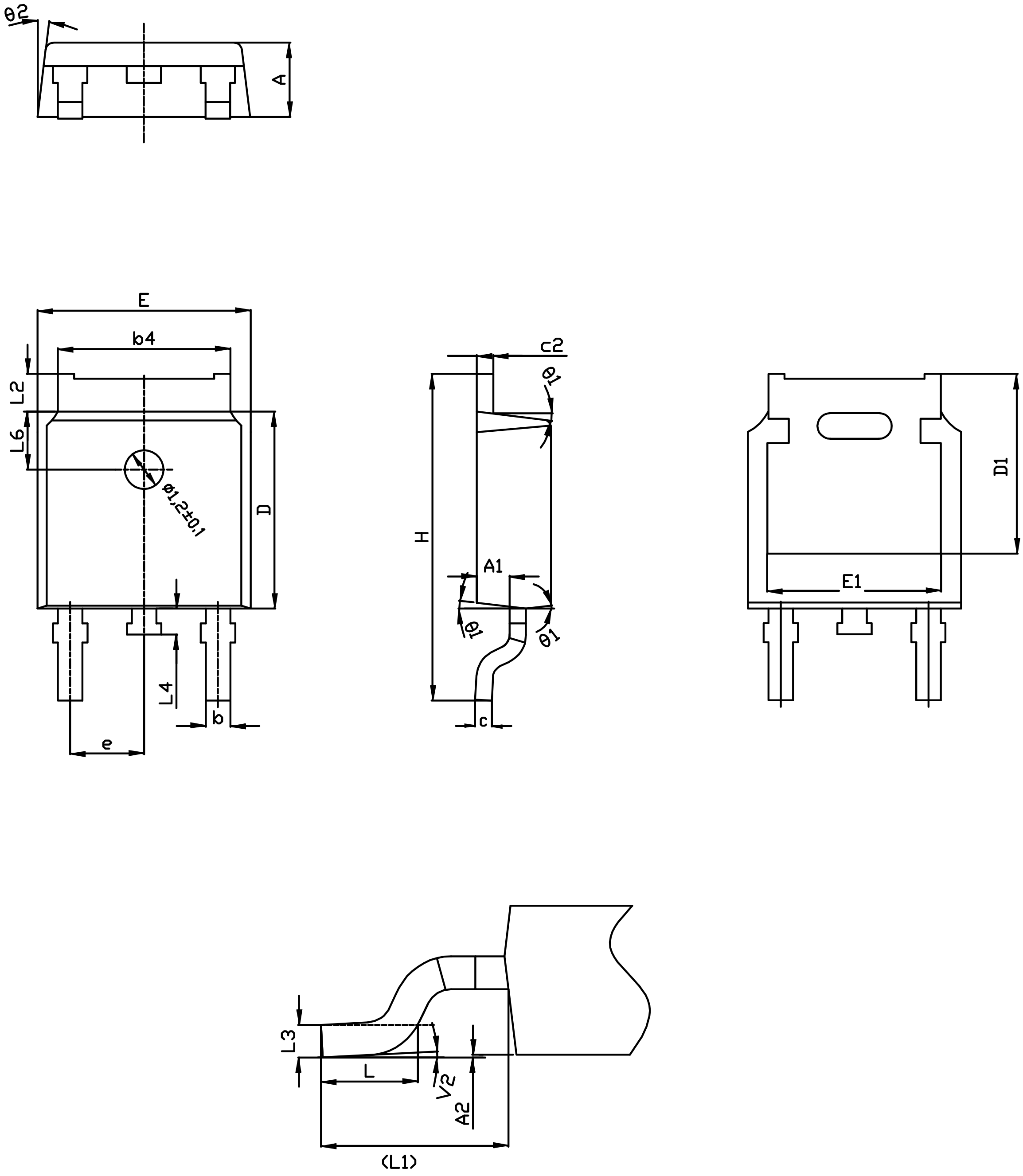

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Table 9. **DPAK (TO-252) type C2 mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	2.20	2.30	2.38
A1	0.90	1.01	1.10
A2	0.00		0.10
b	0.72		0.85
b4	5.13	5.33	5.46
c	0.47		0.60
c2	0.47		0.60
D	6.00	6.10	6.20
D1	5.10		5.60
E	6.50	6.60	6.70
E1	5.20		5.50
e	2.186	2.286	2.386
H	9.80	10.10	10.40
L	1.40	1.50	1.70
L1		2.90 REF	
L2	0.90		1.25
L3		0.51 BSC	
L4	0.60	0.80	1.00
L6		1.80 BSC	
θ1	5°	7°	9°
θ2	5°	7°	9°
V2	0°		8°

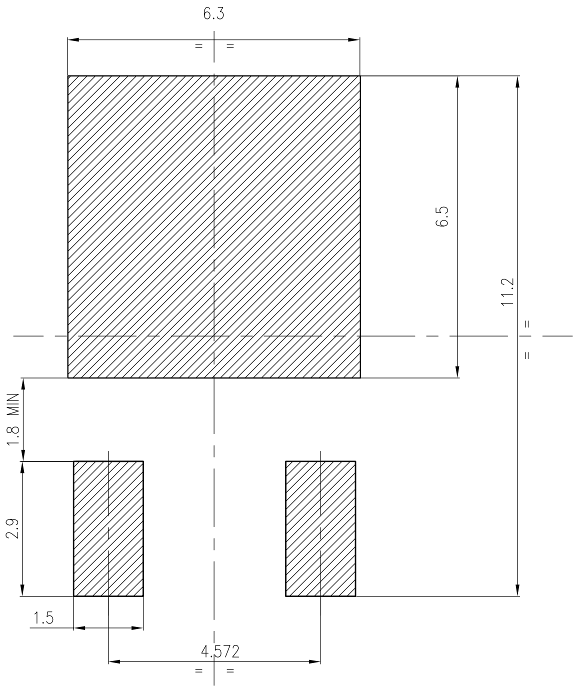

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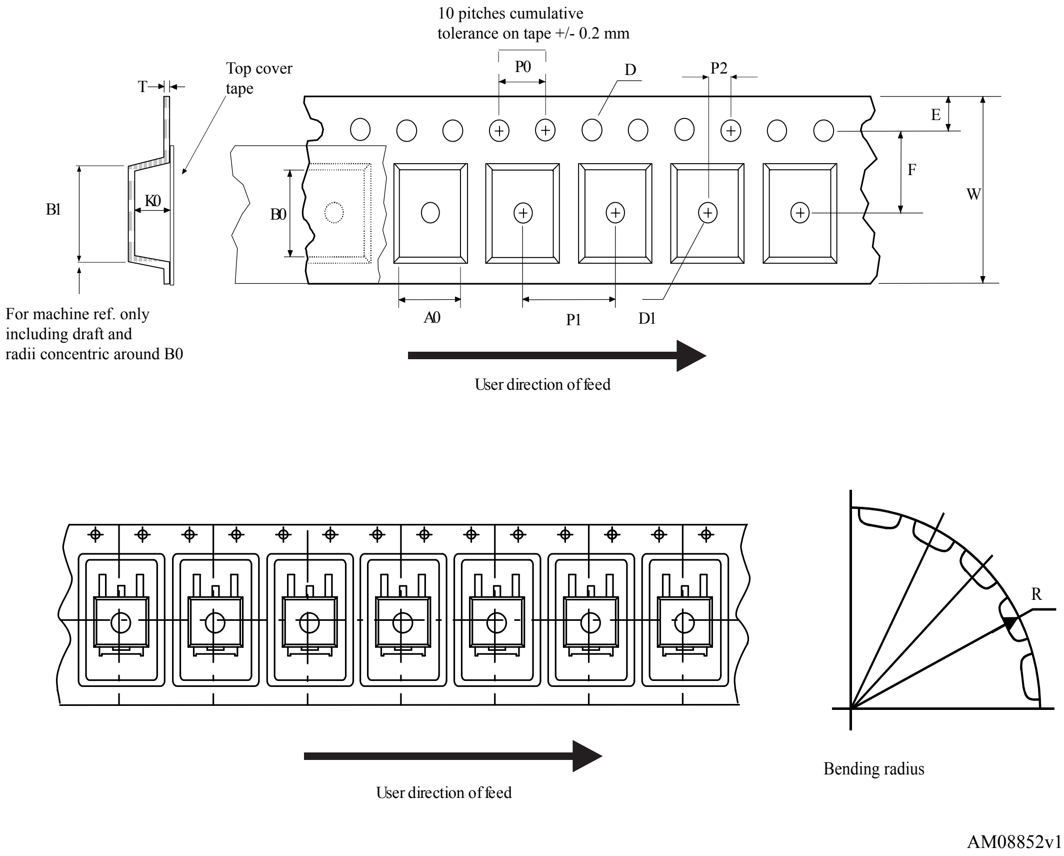
Figure 21. **DPAK (TO-252) recommended footprint (dimensions are in mm)**

4.3 DPAK (TO-252) packing information

Figure 22. **DPAK (TO-252) tape outline**



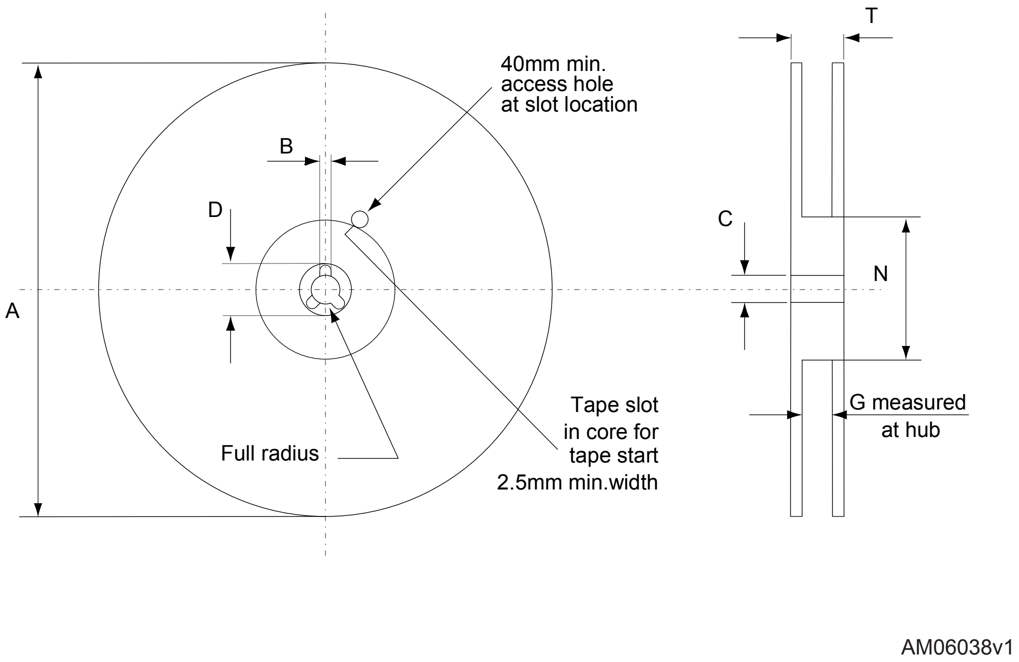


Figure 23. **DPAK (TO-252) reel outline**

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			

Revision history

Table 11. **Document revision history**

Date	Version	Changes
12-Mar-2014	1	First release.
17-Jun-2014	2	– Modified: title – Modified: dv/dt values – Modified: values in Table 4 – Modified: the entire typical values in *Table 5, 6, 7* and *8* – Added: *Section 2.1: Electrical characteristics (curves)* – Updated: *Section 4: Package mechanical data* – Minor text changes
12-Nov-2014	3	– Document status promoted from preliminary to production data. – Updated title, features and description in cover page.
09-Dec-2014	4	– Updated V_{GS} in *Table 2: Absolute maximum ratings.* – Updated *Section 4: Package mechanical data.*
02-May-2018	5	Removed maturity status indication from cover page. The document status is production data. Updated Section 2 Electrical characteristics and Section 4 Package information. Minor text changes.

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