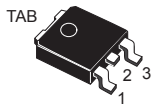
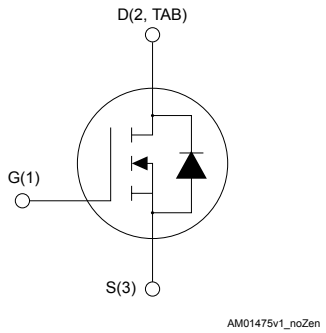
Automotive-grade N-channel 600 V, 800 mΩ typ., 5 A MDmesh II Power MOSFET in a DPAK package



DPAK



Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D	Package
STD7ANM60N	600 V	900 mΩ	5 A	DPAK

- AEC-Q101 qualified
- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance

Applications

- Switching applications

Description

This device is an N-channel Power MOSFET developed using the second generation of MDmesh technology. This revolutionary Power MOSFET associates a vertical structure to the company's strip layout to yield one of the world's lowest on-resistance and gate charge. It is therefore suitable for the most demanding high efficiency converters.

Product status link
STD7ANM60N

Product summary	
Order code	STD7ANM60N
Marking	7ANM60N
Package	DPAK
Packing	Tape and reel

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	600	V
V_{GS}	Gate-source voltage	±25	V
I_D	Drain current (continuous) at T_C = 25 °C	5	A
I_D	Drain current (continuous) at T_C = 100 °C	3	A
I_{DM} (1)	Drain current (pulsed)	20	A
P_{TOT}	Total power dissipation at T_C = 25 °C	45	W
dv/dt (2)	Peak diode recovery voltage slope	15	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} ≤ 5 A, di/dt ≤ 400 A/µs, $V_{DS}(peak)$ ≤ $V_{(BR)DSS}$, V_{DD} = 80% $V_{(BR)DSS}$.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case	2.78	°C/W
R_{thJA} (1)	Thermal resistance, junction-to-ambient	50	°C/W

1. *When mounted on 1inch² FR-4 board, 2 oz Cu.*

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_J max.)	2	A
E_{AS}	Single pulse avalanche energy (starting T_J = 25 °C, I_D = I_{AR}, V_{DD} = 50 V)	119	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	600			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 600 V			1	µA
		V_{GS} = 0 V, V_{DS} = 600 V, T_C = 125 °C (1)			100	µA
I_{GSS}	Gate body leakage current	V_{DS} = 0 V, V_{GS} = ±20 V			±100	nA
$V_{GS(th)}$	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 = 2.5 A		800	900	mΩ

1. *Specified by design, not tested in production.*

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 50 V, f = 1 MHz, V_{GS} = 0 V	-	363	-	pF
C_{oss}	Output capacitance		-	24.6	-	pF
C_{rss}	Reverse transfer capacitance		-	1.1	-	pF
$C_{oss\ eq.}$ (1)	Equivalent capacitance time related	V_{DS} = 0 to 480 V, V_{GS} = 0 V	-	130	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz open drain	-	5.4	-	Ω
Q_g	Total gate charge	V_{DD} = 480 V, I_D = 5 A, V_{GS} = 0 to 10 V (see Figure 13. Test circuit for gate charge behavior)	-	14	-	nC
Q_{gs}	Gate-source charge		-	2.7	-	nC
Q_{gd}	Gate-drain charge		-	7.7	-	nC

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} = 300 V, I_D = 2.5 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 12. Test circuit for resistive load switching times and Figure 17. Switching time waveform)	-	7	-	ns
t_r	Rise time		-	10	-	ns
$t_{d(off)}$	Turn-off delay time		-	26	-	ns
t_f	Fall time		-	12	-	ns

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		5	A
I_{SDM} (1)	Source-drain current (pulsed)		-		20	A
V_{SD} (2)	Forward on voltage	I_{SD} = 5 A, V_{GS} = 0 V	-		1.3	V
t_{rr}	Reverse recovery time	I_{SD} = 5 A, di/dt = 100 A/µs	-	213		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 60 V (see Figure 14. Test circuit for inductive load switching and diode recovery times)	-	1.5		µC
I_{RRM}	Reverse recovery current		-	14		A
t_{rr}	Reverse recovery time	I_{SD} = 5 A, di/dt = 100 A/µs	-	265		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 60 V, T_j = 150 °C(see Figure 14. Test circuit for inductive load switching and diode recovery times)	-	1.8		µC
I_{RRM}	Reverse recovery current		-	14		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

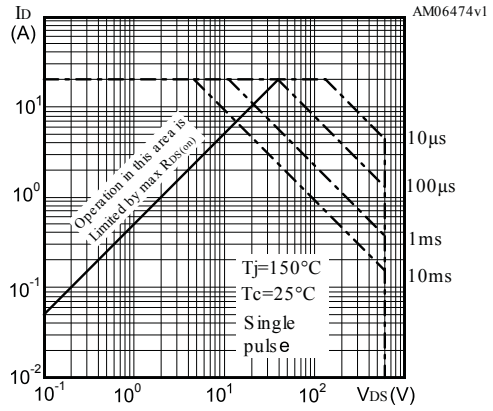


Figure 2. Thermal impedance

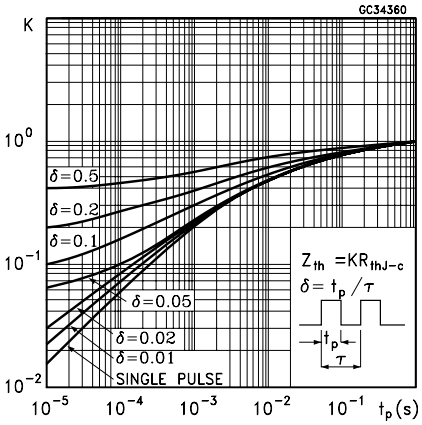


Figure 3. Output characterisics

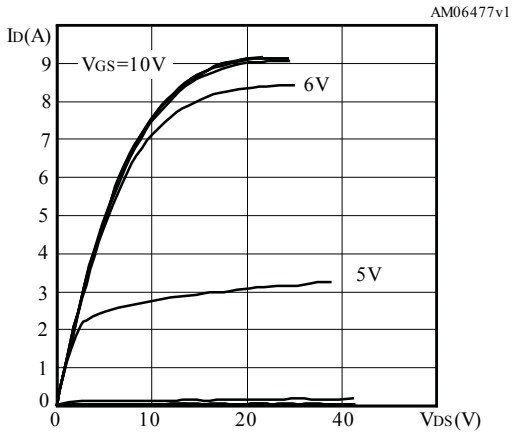


Figure 4. Transfer characteristics

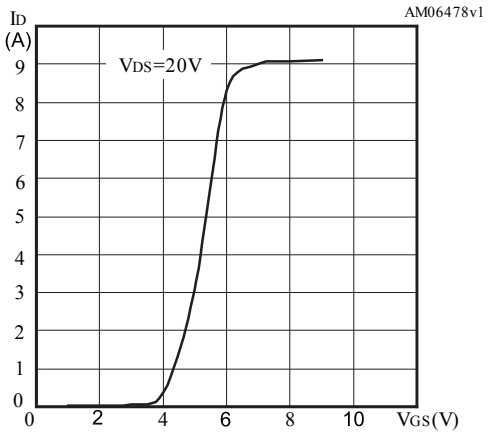


Figure 5. Gate charge vs gate-source voltage

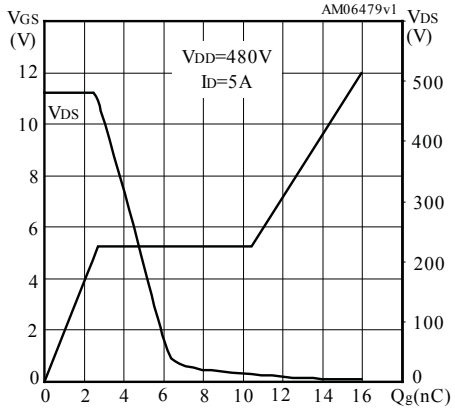


Figure 6. Static drain-source on-resistance

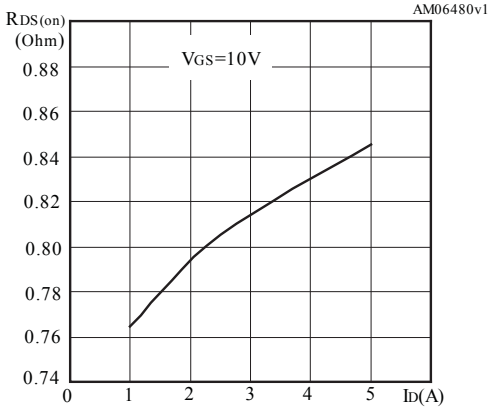


Figure 7. Capacitance variations

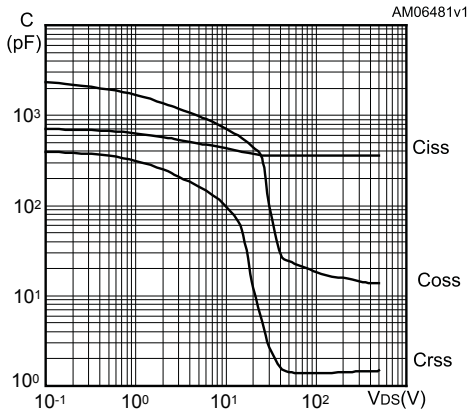


Figure 8. Output capacitance stored energy

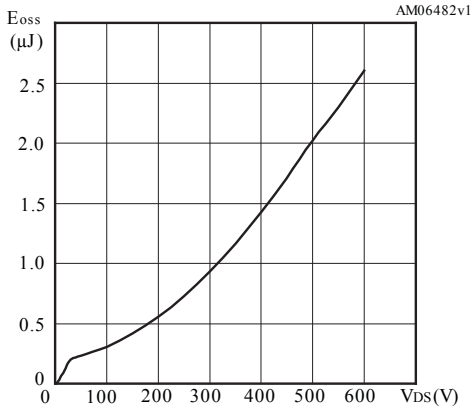


Figure 9. Normalized gate threshold voltage vs temperature

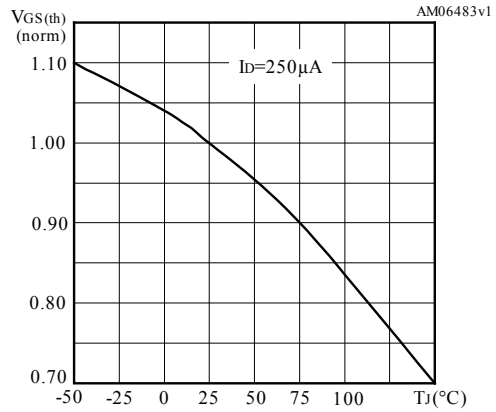


Figure 10. Normalized on-resistance vs temperature

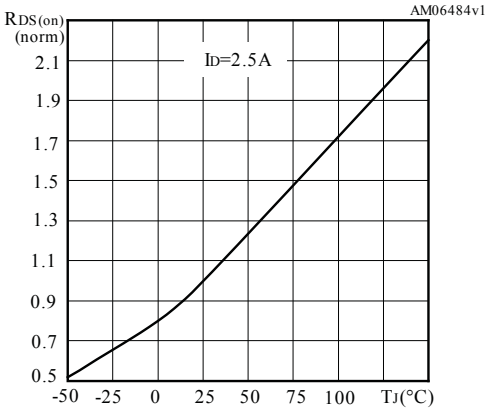
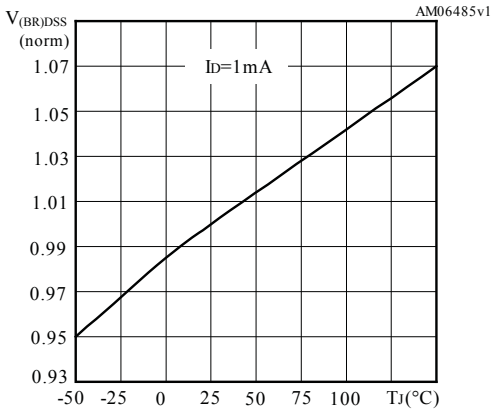


Figure 11. Normalized $V_{(BR)DSS}$ vs temperature



3 Test circuits

Figure 12. Test circuit for resistive load switching times

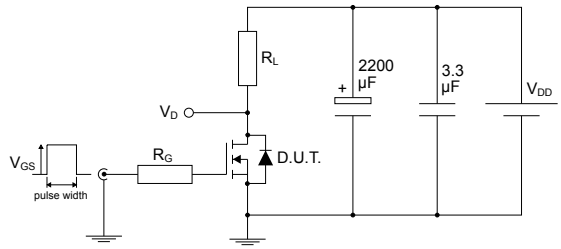


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Figure 13. Test circuit for gate charge behavior

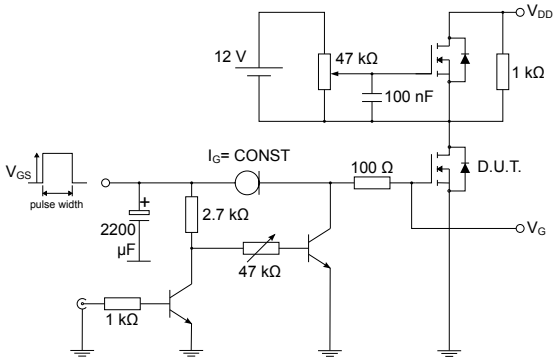

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Figure 14. Test circuit for inductive load switching and diode recovery times

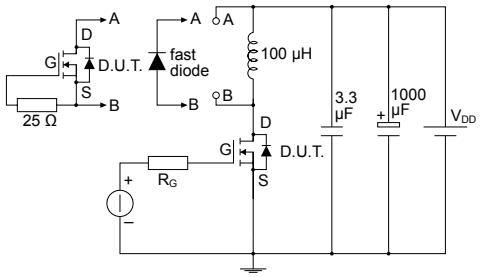

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Figure 15. Unclamped inductive load test circuit

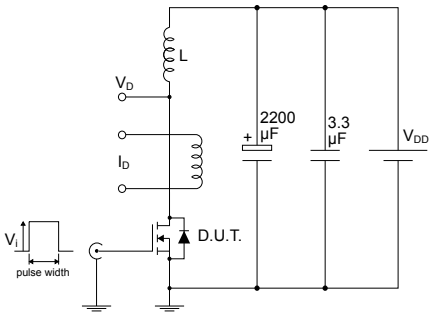

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Figure 16. Unclamped inductive waveform

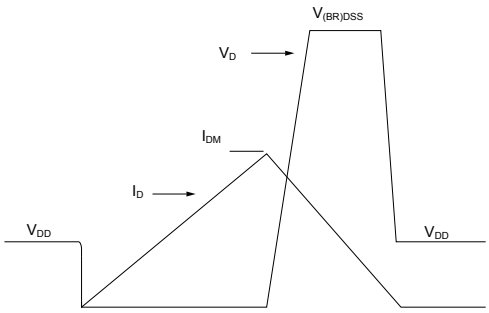

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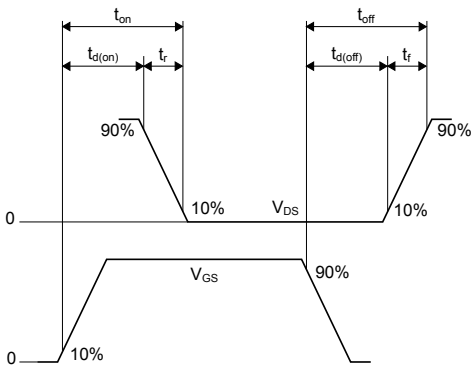
Figure 17. Switching time waveform



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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 18. DPAK (TO-252) type A package outline

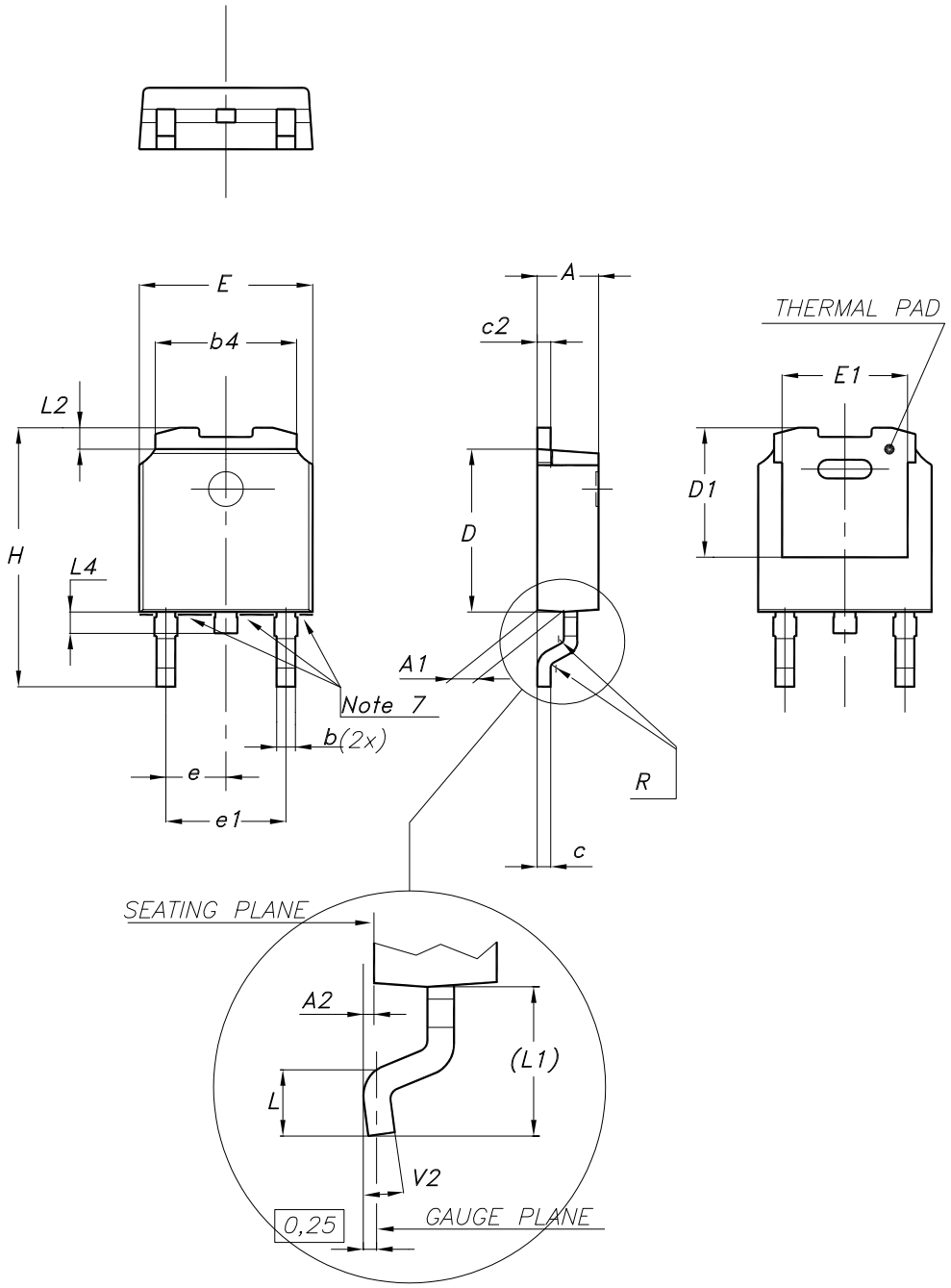

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Table 8. **DPAK (TO-252) type A mechanical data**

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	4.95	5.10	5.25
E	6.40		6.60
E1	4.60	4.70	4.80
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 A2 package information

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

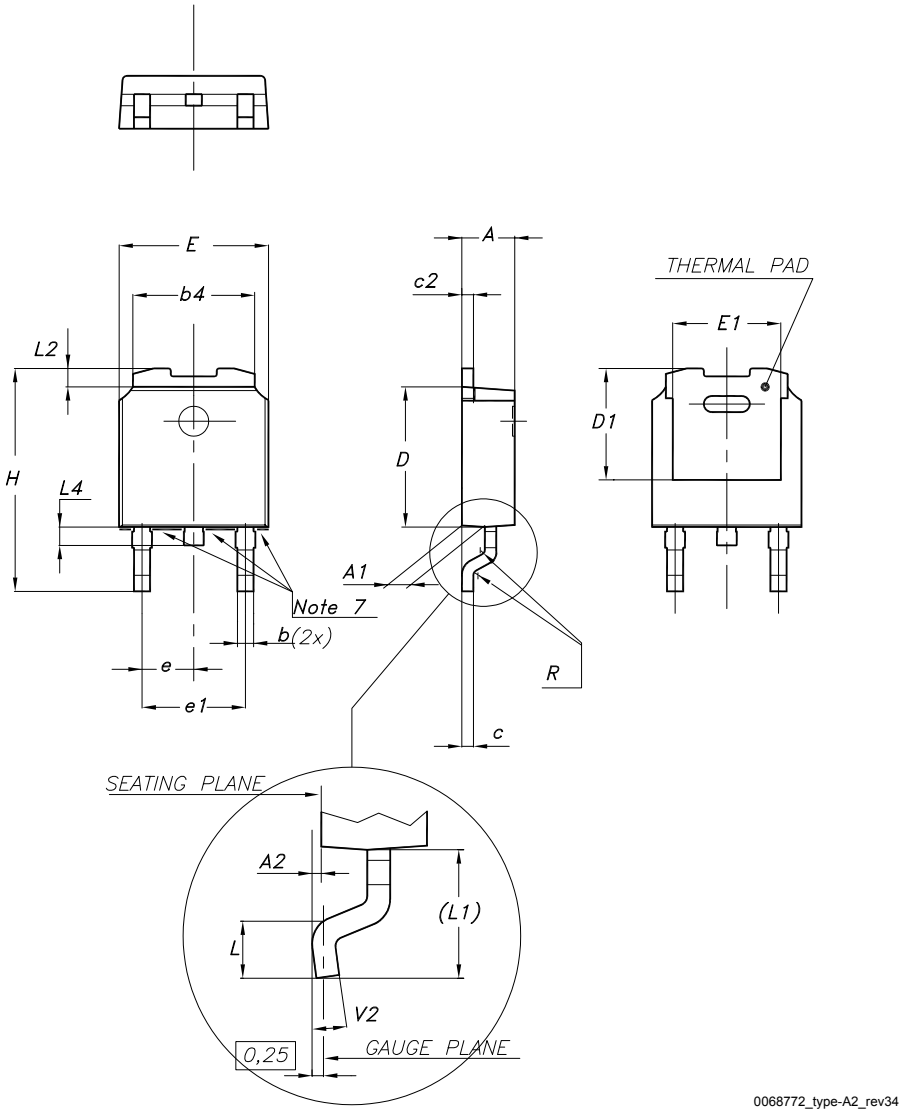
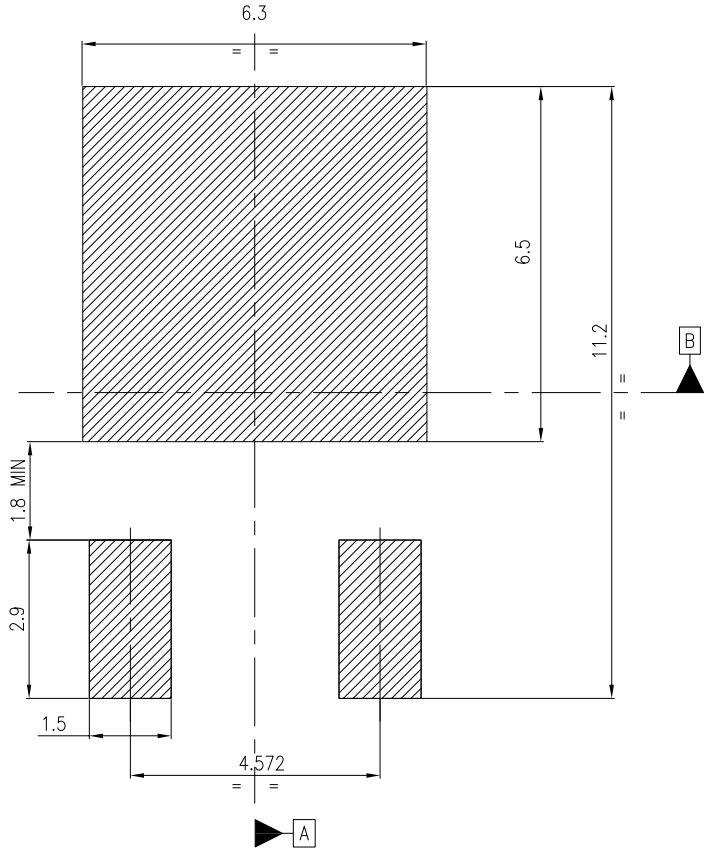


Table 9. **DPAK (TO-252) type A2 mechanical data**

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	2.159	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°

Figure 20. DPAK (TO-252) recommended footprint (dimensions are in mm)



Notes:

1) This footprint is able to ensure insulation up to 630 Vrms (according to CEI IEC 664−1)

2) The device must be positioned within ⌖ 0.05 A B

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4.3 DPAK packing information

Figure 21. **DPAK (TO-252) tape outline**

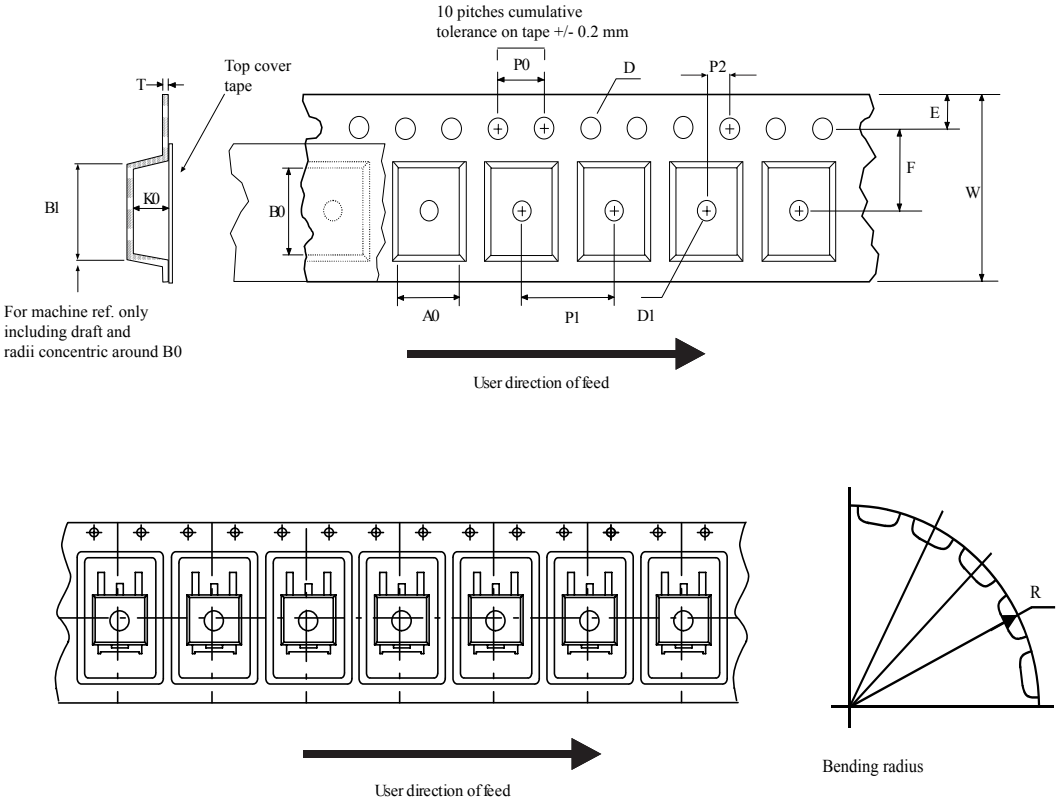

Figure 22. **DPAK (TO-252) reel outline**

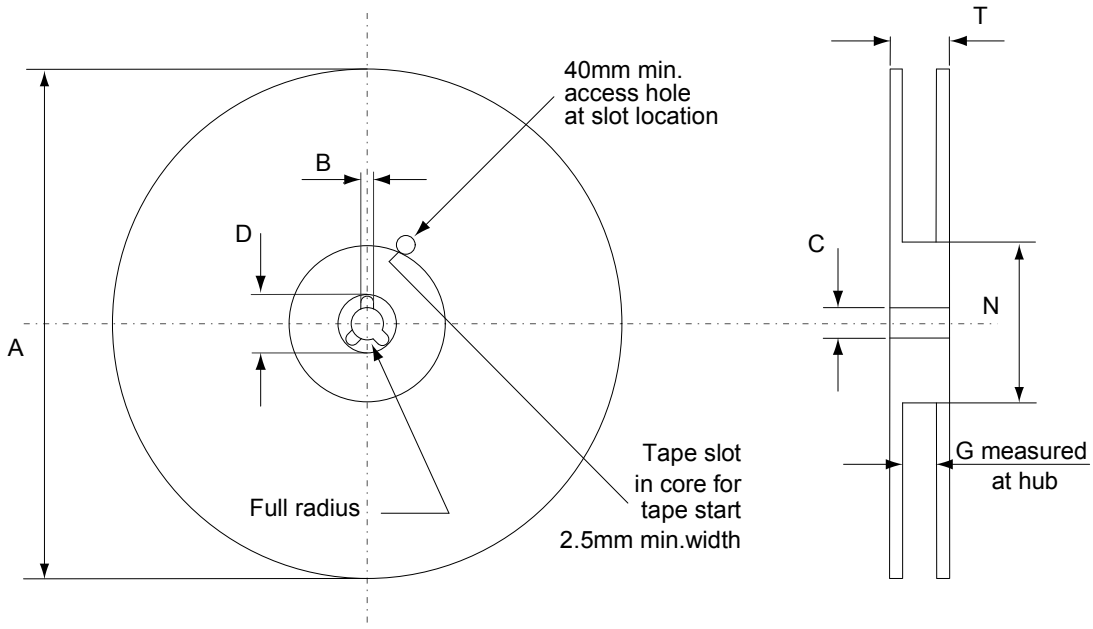

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Table 10. **DPAK (TO-252) tape and reel mechanical data**

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
21-Jun-2012	1	First release.
12-Dec-2013	2	– Modified: title, Features and *Table 1* in cover page – Modified: *Figure 15*, *16*, *17* and *18* – Updated: *Table 10* and *Figure 23*, *24* – Minor text changes
07-Nov-2018	3	Removed maturity status indication from cover page. The document status is production data. Modified *Table 4. On/off states.* Updated *Section 4 Package information.* Minor text changes.
25-Sep-2023	4	The part number STB7ANM60N have been moved to a separate datasheet and the document has been updated accordingly. Updated Section 4 Package information. Minor text changes.

Contents