



STD8NM50N, STP8NM50N, STU8NM50N

N-channel 500 V, 0.73 Ω typ., 5 A MDmesh™II Power MOSFET in DPAK, TO-220 and IPAK packages

Datasheet — production data

Features

Order codes	$V_{DSS}@T_{JMAX}$	$R_{DS(on)max.}$	I_D
STD8NM50N STP8NM50N STU8NM50N	550 V	< 0.79 Ω	5 A

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

Applications

- Switching applications

Description

These devices are N-channel Power MOSFETs 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.

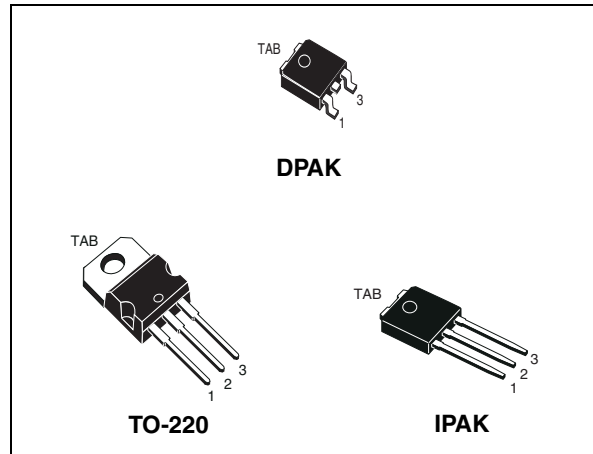


Figure 1. Internal schematic diagram

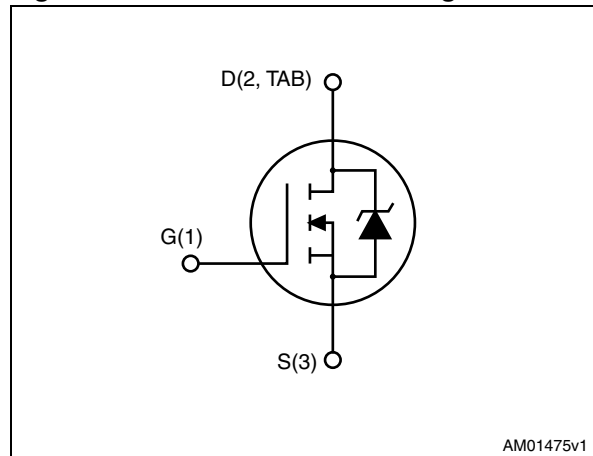


Table 1. Device summary

Order codes	Marking	Packages	Packaging
STD8NM50N	8NM50N	DPAK	Tape and reel
STP8NM50N		TO-220	Tube
STU8NM50N		IPAK	

Contents

1	Electrical ratings	3
2	Electrical characteristics	4
	2.1 Electrical characteristics (curves)	6
3	Test circuits	9
4	Package mechanical data	10
5	Packaging mechanical data	16
6	Revision history	18

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	500	V
V_{GS}	Gate-source voltage	± 25	V
I_D	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	5	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	3	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	45	W
$dv/dt^{(1)}$	Peak diode recovery voltage slope	15	V/ns
T_{stg}	Storage temperature	- 55 to 150	$^\circ\text{C}$
T_j	Max. operating junction temperature	150	$^\circ\text{C}$

1. $I_{SD} \leq 7\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{Peak} < V_{(BR)DSS}$, $V_{DS} = 80\% V_{(BR)DSS}$

Table 3. Thermal data

Symbol	Parameter	Value			Unit
		DPAK	IPAK	TO-220	
$R_{thj-case}$	Thermal resistance junction-case max	2.78			$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max		100	62.5	$^\circ\text{C}/\text{W}$
$R_{thj-pcb}$	Thermal resistance junction-pcb max	50			$^\circ\text{C}/\text{W}$
T_l	Maximum lead temperature for soldering purpose		300		$^\circ\text{C}$

Table 4. 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 $T_j = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	140	mJ

2 Electrical characteristics

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

Table 5. On /off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage ($V_{GS} = 0$)	$I_D = 1\text{ mA}$	500			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = 500\text{ V}$ $V_{DS} = 500\text{ V}, T_C = 125\text{ °C}$			1 100	μA μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 25\text{ V}$			± 100	nA
$V_{GS(th)}$	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	$V_{GS} = 10\text{ V}, I_D = 2.5\text{ A}$		0.73	0.79	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 50\text{ V}, f = 1\text{ MHz},$ $V_{GS} = 0$	-	364	-	pF
C_{oss}	Output capacitance			33		pF
C_{rss}	Reverse transfer capacitance			1.2		pF
$C_{oss(eq)}^{(1)}$	Equivalent output capacitance time related	$V_{DS} = 0\text{ to }50\text{ V}, V_{GS} = 0$	-	147.5	-	pF
R_G	Intrinsic gate resistance	$f = 1\text{ MHz open drain}$	-	5.4	-	Ω
Q_g	Total gate charge	$V_{DD} = 400\text{ V}, I_D = 5\text{ A},$ $V_{GS} = 10\text{ V}$ (see Figure 16)	-	14	-	nC
Q_{gs}	Gate-source charge			3		nC
Q_{gd}	Gate-drain charge			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 7. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit	
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 250\text{ V}$, $I_D = 5\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 15)		7		ns	
t_r	Rise time			4.4		ns	
$t_{d(off)}$	Turn-off-delay time				25		ns
t_f	Fall time				8.8		ns

Table 8. 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	$I_{SD} = 5\text{ A}$, $V_{GS} = 0$			1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 5\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ (see Figure 20)		187		ns
Q_{rr}	Reverse recovery charge			1.3		μC
I_{RRM}	Reverse recovery current				14	A
t_{rr}	Reverse recovery time	$I_{SD} = 5\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$ (see Figure 20)		224		ns
Q_{rr}	Reverse recovery charge			1.5		μC
I_{RRM}	Reverse recovery current				13	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 2. Safe operating area for DPAK and IPAК

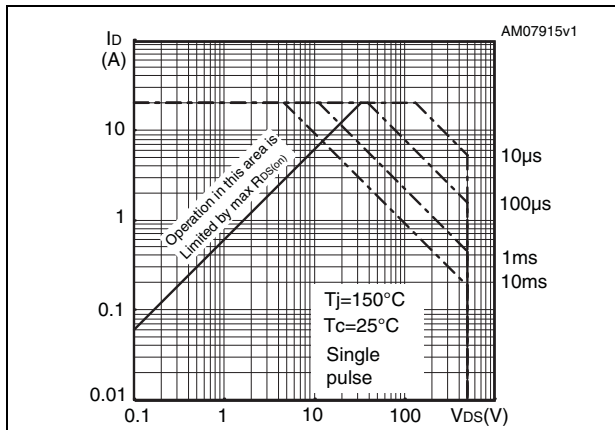


Figure 3. Thermal impedance for DPAK and IPAК

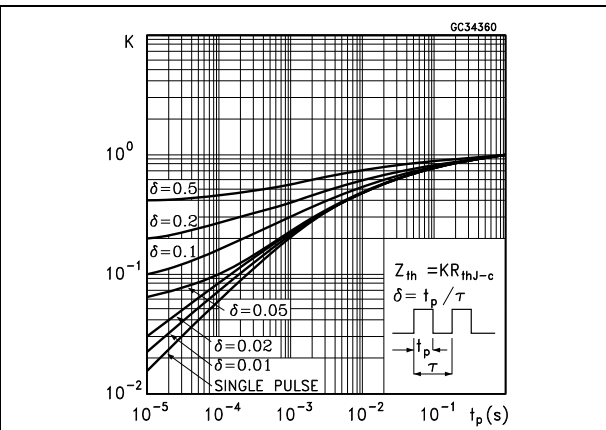


Figure 4. Safe operating area for TO-220

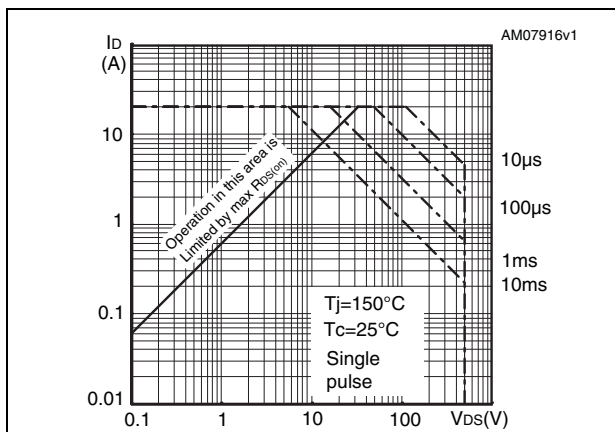


Figure 5. Thermal impedance for TO-220

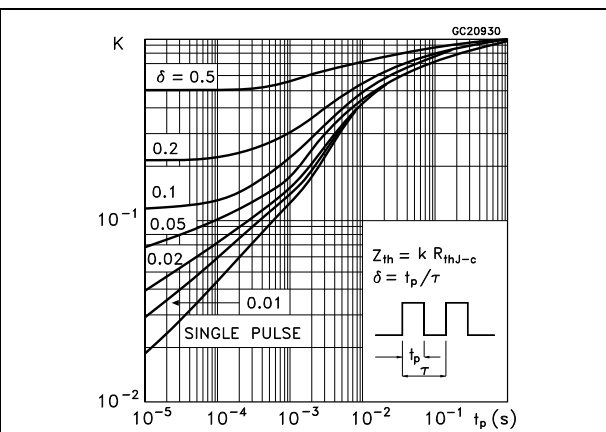


Figure 6. Output characteristics

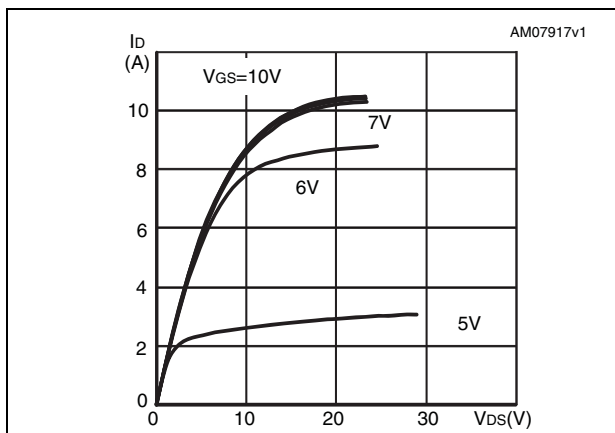


Figure 7. Transfer characteristics

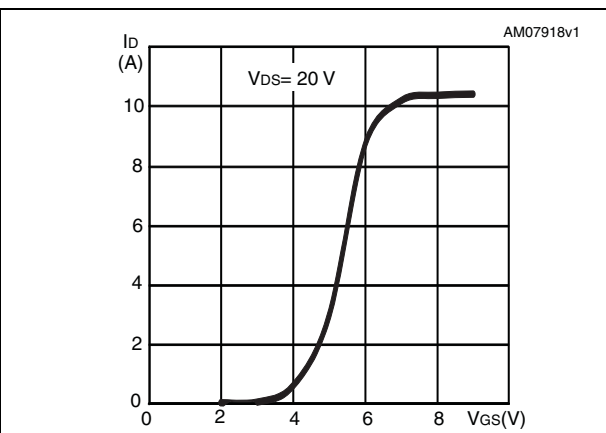


Figure 8. Static drain-source on resistance

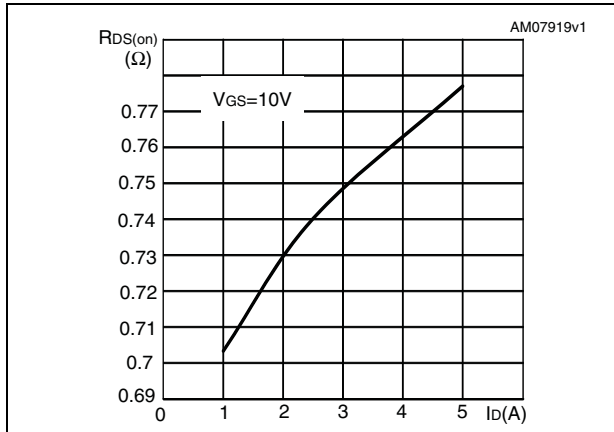


Figure 9. Gate charge vs gate-source voltage

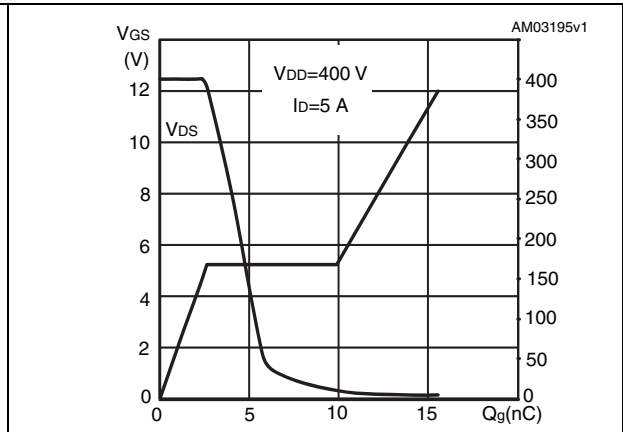


Figure 10. Capacitance variations

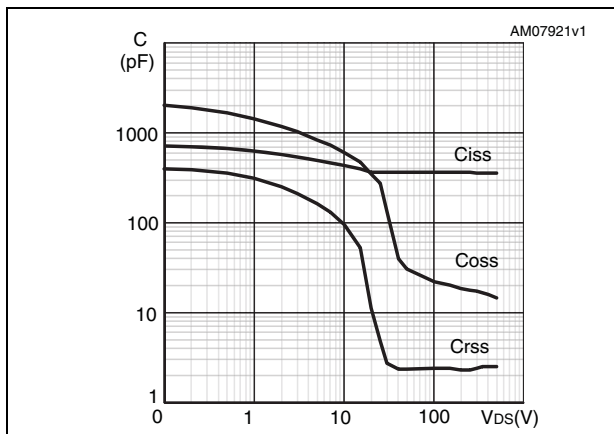


Figure 11. Output capacitance stored energy

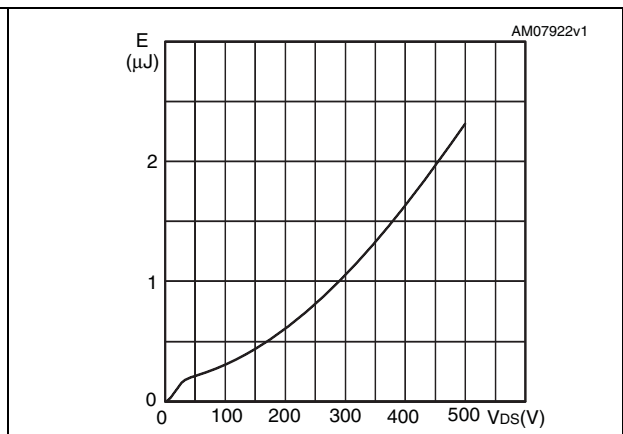


Figure 12. Normalized gate threshold voltage vs temperature

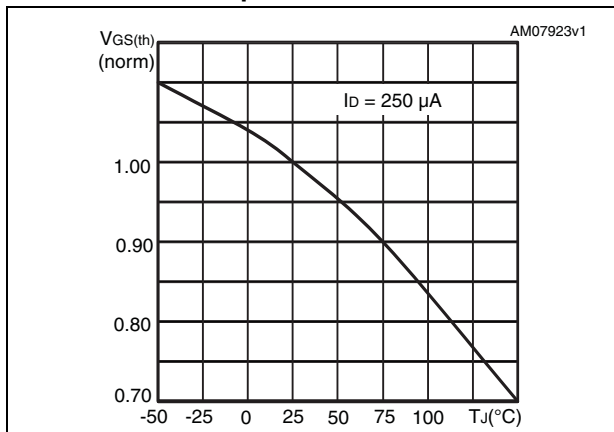


Figure 13. Normalized on resistance vs temperature

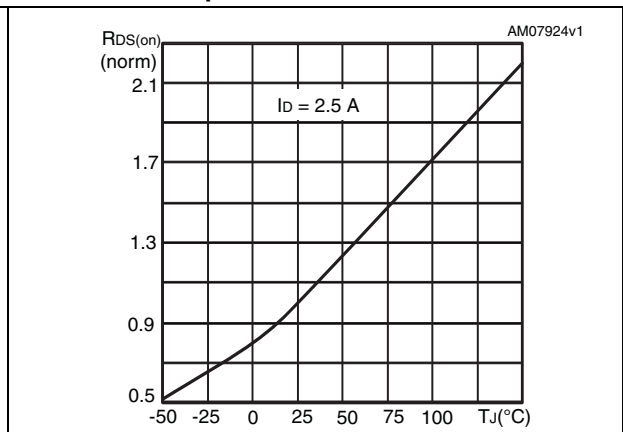
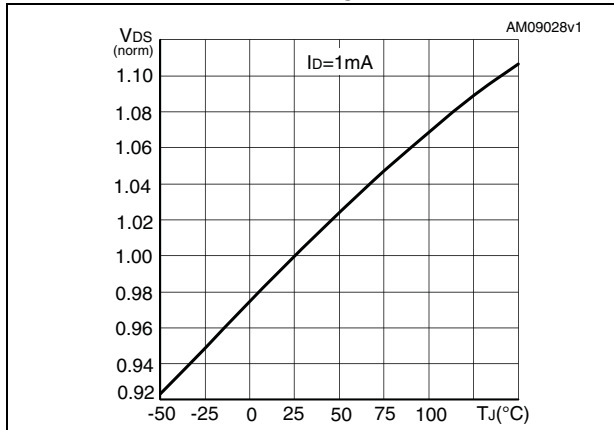


Figure 14. Normalized V_{DS} vs temperature



3 Test circuits

Figure 15. Switching times test circuit for resistive load



Figure 16. Gate charge test circuit

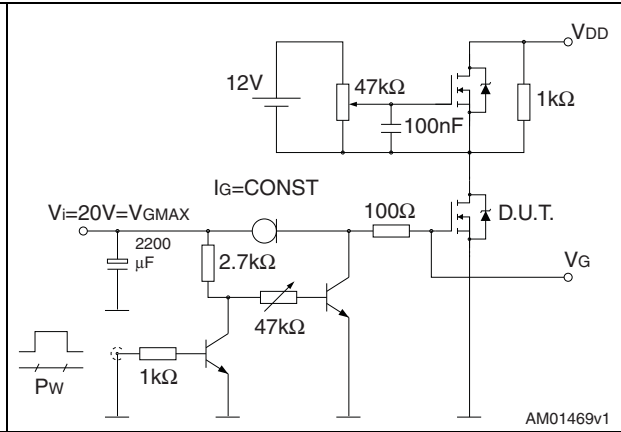


Figure 17. Test circuit for inductive load switching and diode recovery times

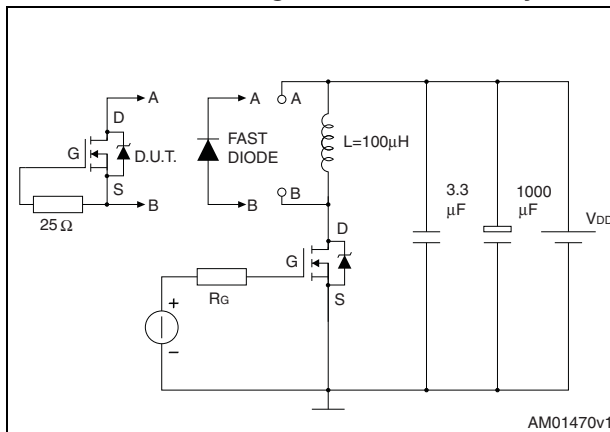


Figure 18. Unclamped inductive load test circuit

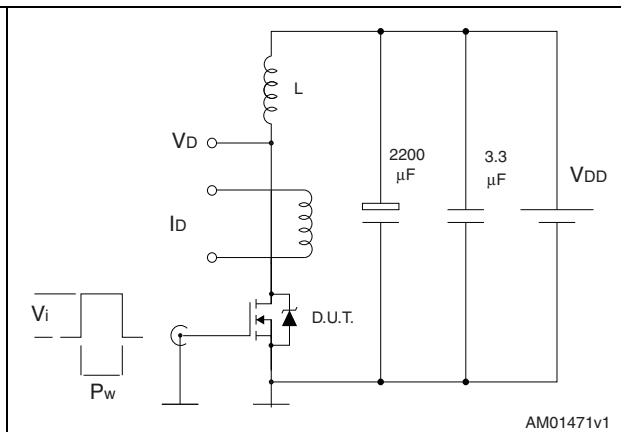


Figure 19. Unclamped inductive waveform

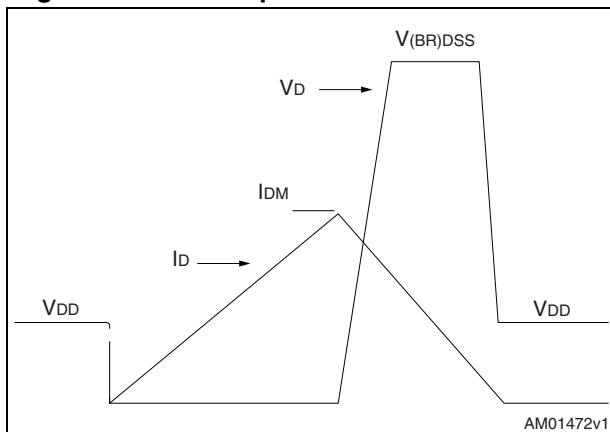
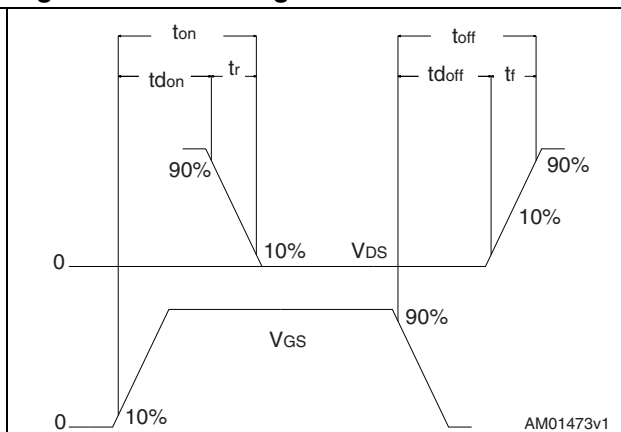


Figure 20. Switching time waveform



4 Package mechanical data

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.

Table 9. DPAK (TO-252) 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		
L1		2.80	
L2		0.80	
L4	0.60		1
R		0.20	
V2	0°		8°

Figure 21. DPAK (TO-252) drawing

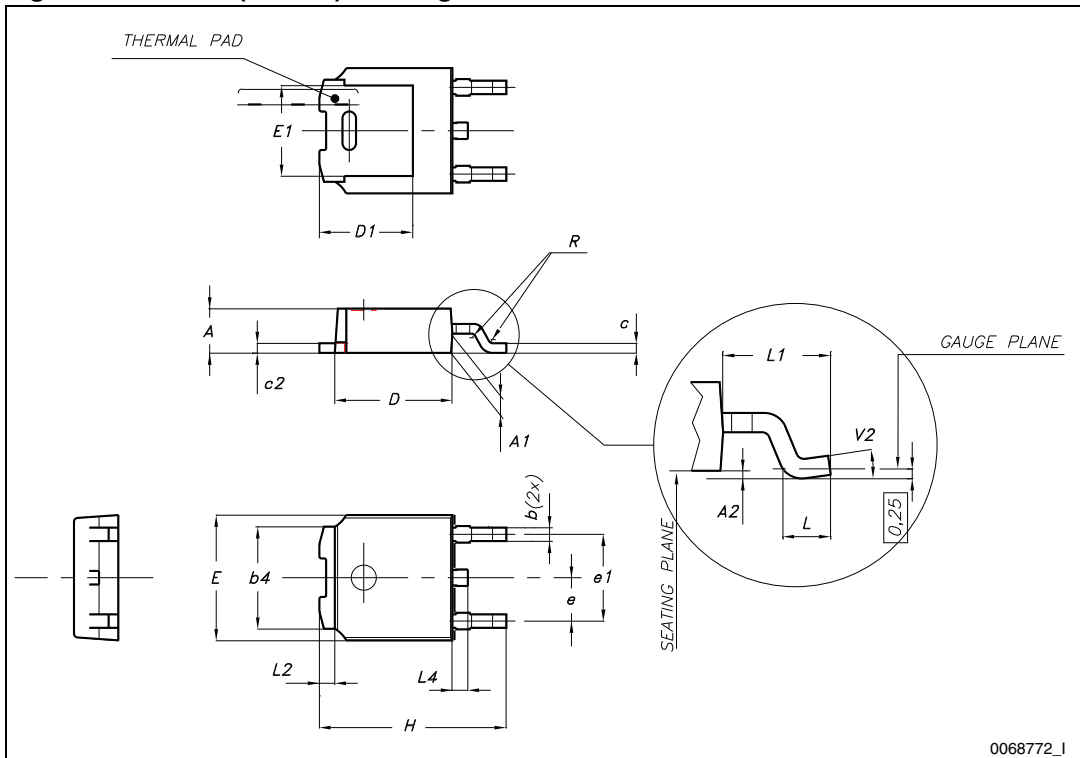
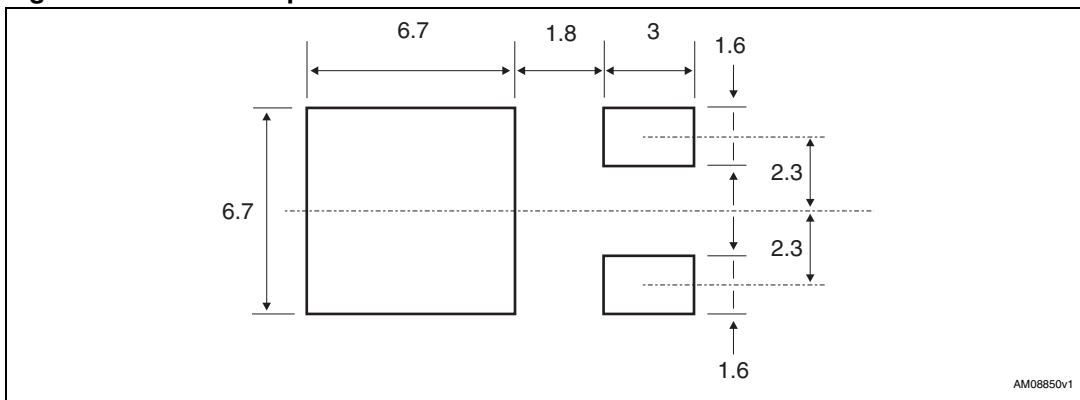


Figure 22. DPAK footprint^(a)



a. All dimension are in millimeters

Table 10. TO-220 type A mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
ØP	3.75		3.85
Q	2.65		2.95

Figure 23. TO-220 type A drawing

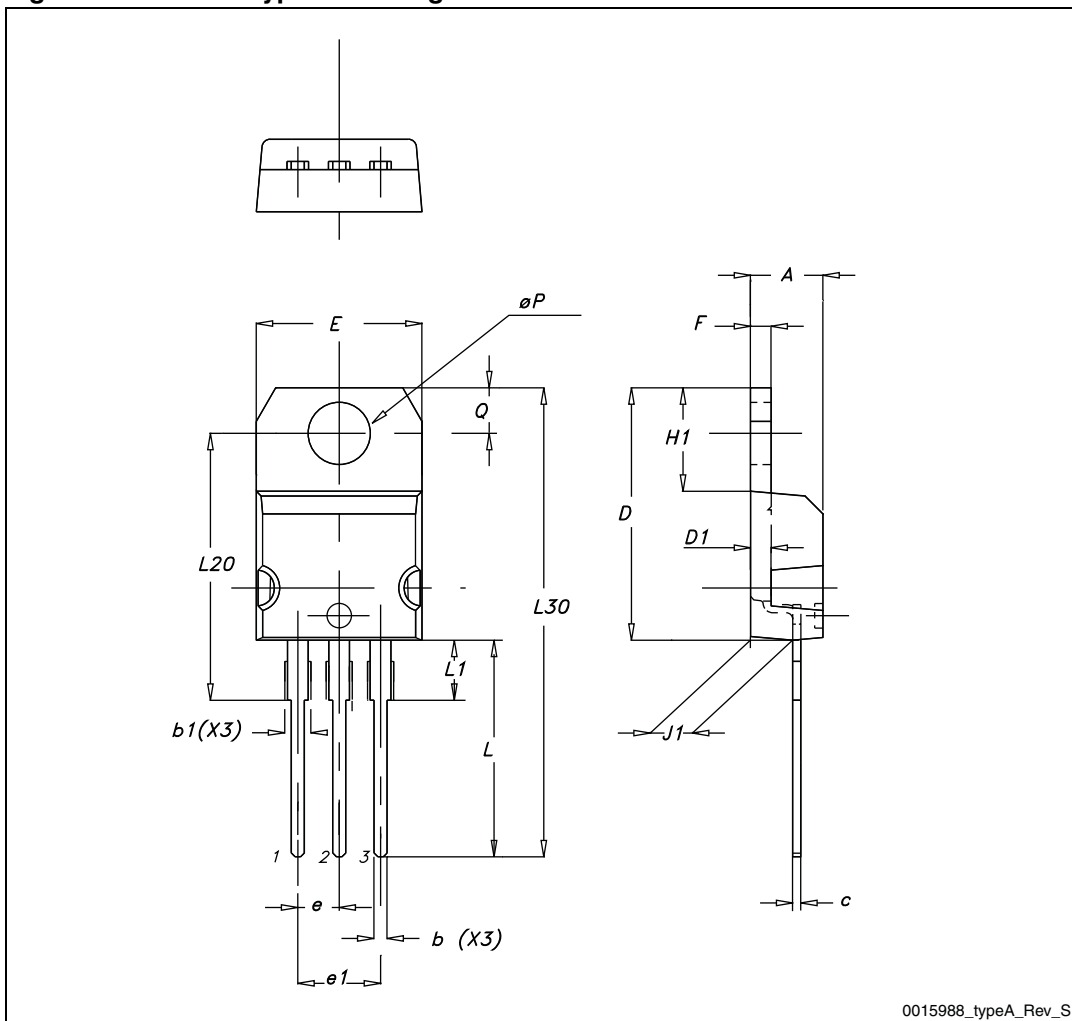
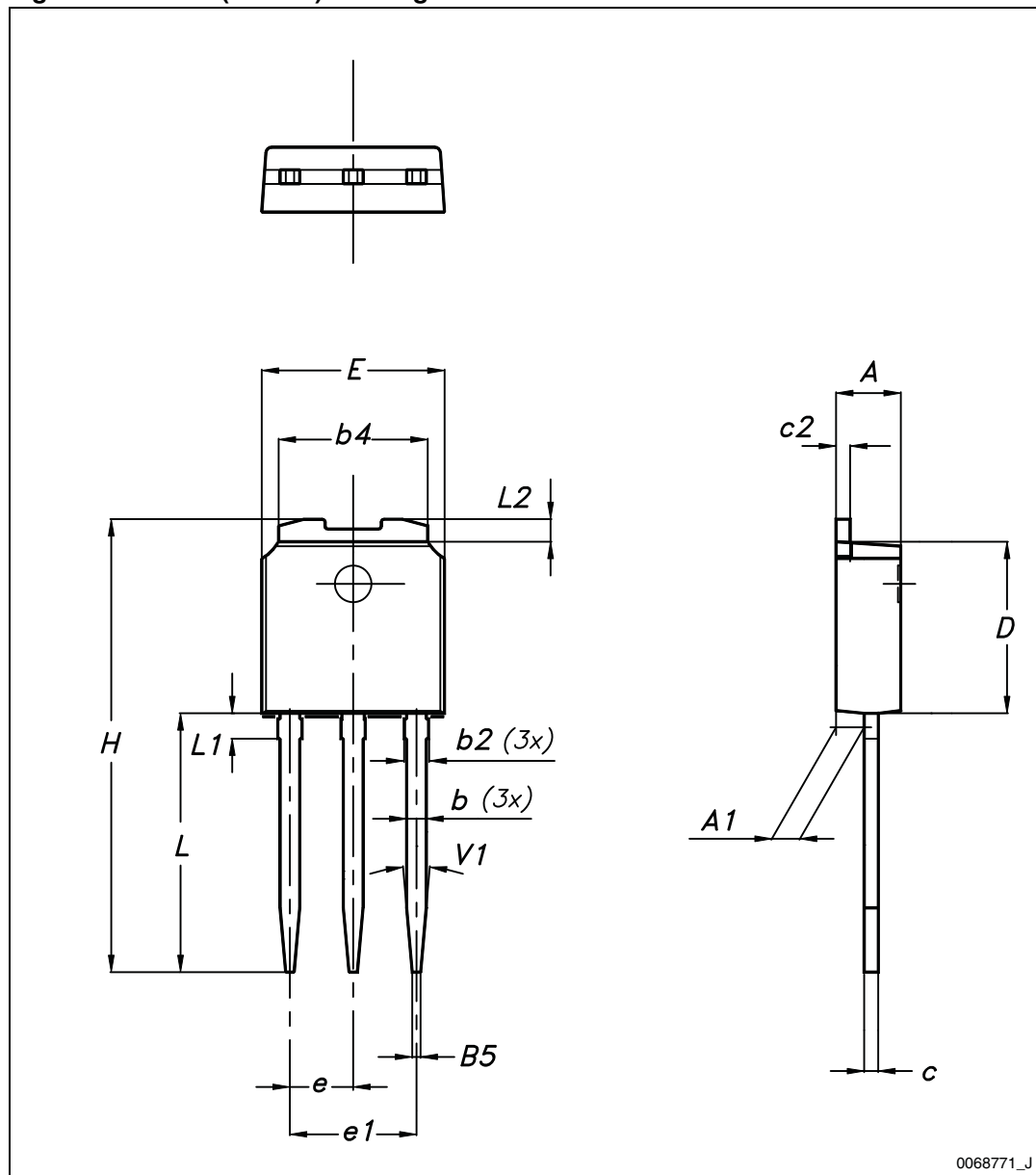


Table 11. IPAK (TO-251) mechanical data

DIM	mm.		
	min.	typ.	max.
A	2.20		2.40
A1	0.90		1.10
b	0.64		0.90
b2			0.95
b4	5.20		5.40
B5		0.30	
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
E	6.40		6.60
e		2.28	
e1	4.40		4.60
H		16.10	
L	9.00		9.40
L1	0.80		1.20
L2		0.80	1.00
V1		10°	

Figure 24. IPAK (TO-251) drawing



0068771_J

5 Packaging mechanical data

Table 12. 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			

Figure 25. Tape for DPAK (TO-252)

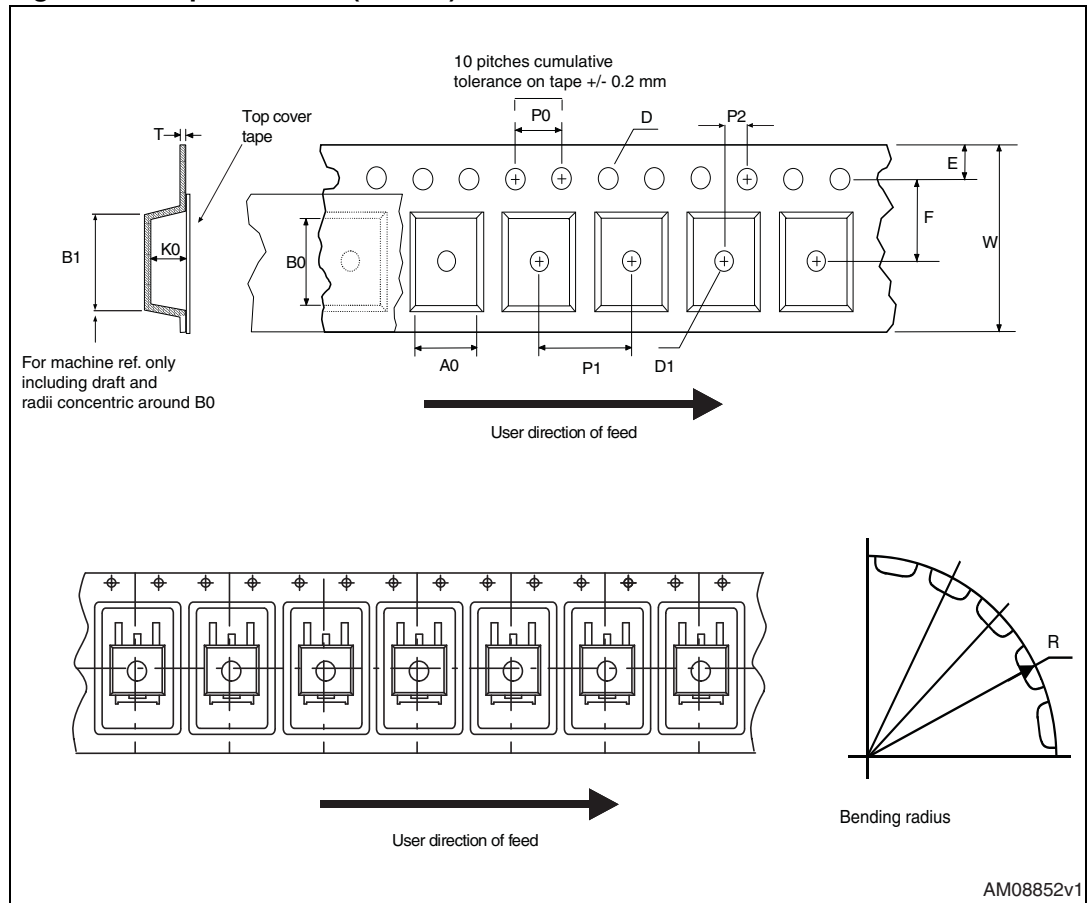
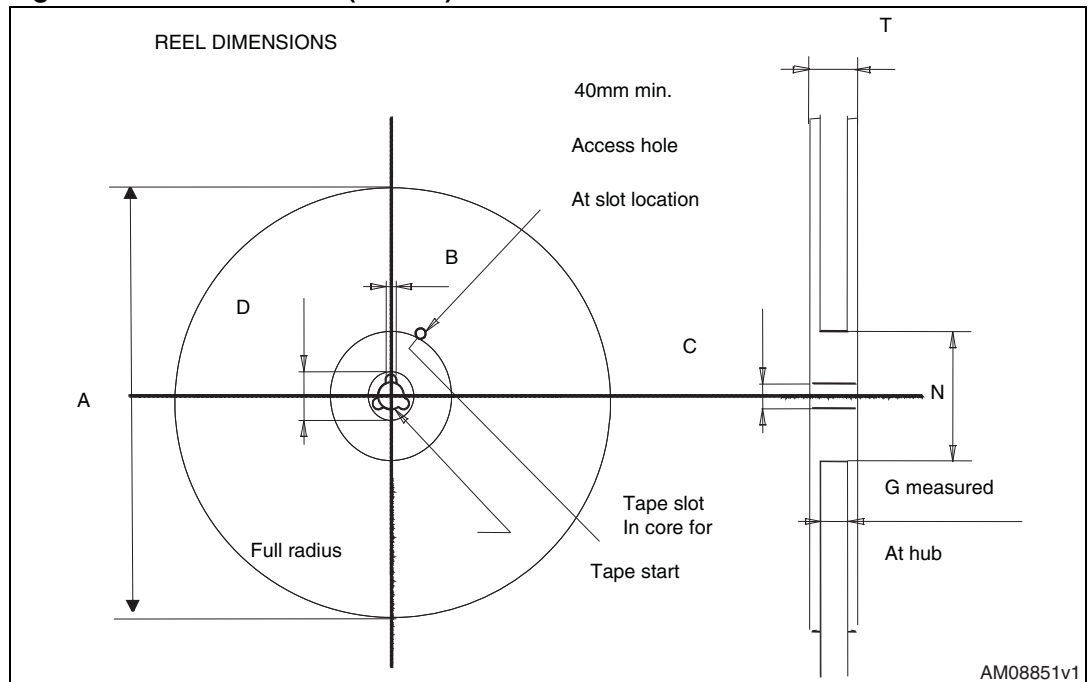


Figure 26. Reel for DPAK (TO-252)



6 Revision history

Table 13. Document revision history

Date	Revision	Changes
20-Apr-2010	1	First release.
03-Sep-2010	2	Document status promoted from preliminary data to datasheet. Inserted Section 2.1: Electrical characteristics (curves) . Corrected $R_{DS(on)}$ max value in: Features .
03-Feb-2011	3	Modified: Figure 4 . Modified: note 1 . Modified: Table 5 .
21-Oct-2011	4	Updated V_{DSS} (@Tjmax) in cover page. Updated Section 4: Package mechanical data . Minor text changes.
15-Nov-2011	5	The part number STF8NM50N has been moved to a separate datasheet.
13-Sep-2012	6	Figure 2 and Figure 4 have been modified. Section 4: Package mechanical data has been updated.

Please Read Carefully:

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

UNLESS EXPRESSLY APPROVED IN WRITING BY TWO AUTHORIZED ST REPRESENTATIVES, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2012 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

www.st.com

