

Excellent Integrated System Limited

Stocking Distributor

Click to view price, real time Inventory, Delivery & Lifecycle Information:

[STMicroelectronics](#)

[STD13NM60ND](#)

For any questions, you can email us directly:

sales@integrated-circuit.com



STD13NM60ND, STF13NM60ND, STP13NM60ND

N-channel 600 V, 0.32 Ω typ., 11 A, FDmesh™ II Power MOSFET
(with fast diode) in DPAK, TO-220FP and TO-220 packages

Datasheet – production data

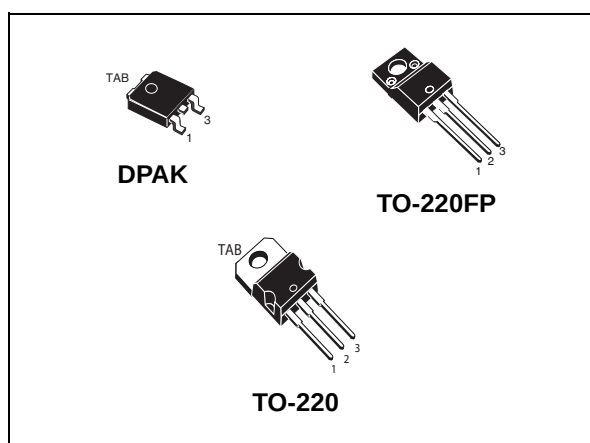
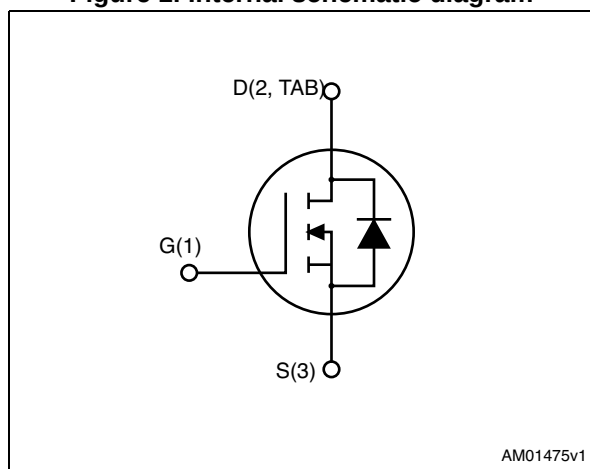


Figure 1. Internal schematic diagram



Features

Order codes	$V_{DS} @ T_{Jmax}$	$R_{DS(on)} max$	I_D
STD13NM60ND	650 V	0.38 Ω	11 A
STF13NM60ND			
STP13NM60ND			

- The worldwide best $R_{DS(on)}$ * area among fast recovery diode devices
- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance
- Extremely high dv/dt and avalanche capabilities

Applications

- Switching applications

Description

These FDmesh™ II Power MOSFETs with intrinsic fast-recovery body diode are produced using the second generation of MDmesh™ technology. Utilizing a new strip-layout vertical structure, these revolutionary devices feature extremely low on-resistance and superior switching performance. They are ideal for bridge topologies and ZVS phase-shift converters.

Table 1. Device summary

Order codes	Marking	Package	Packaging
STD13NM60ND	13NM60ND	DPAK	Tape and reel
STF13NM60ND		TO-220FP	Tube
STP13NM60ND		TO-220	

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	18
6	Revision history	20

STD13NM60ND, STF13NM60ND, STP13NM60ND

Electrical ratings

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		DPAK, TO-220	TO-220FP	
V_{DS}	Drain-source voltage	600		V
V_{GS}	Gate-source voltage	± 25		V
I_D	Drain current (continuous) at $T_C = 25^\circ\text{C}$	11	11 ⁽¹⁾	A
I_D	Drain current (continuous) at $T_C = 100^\circ\text{C}$	6.93	6.93 ⁽¹⁾	A
$I_{DM}^{(2)}$	Drain current (pulsed)	44	44 ⁽¹⁾	A
P_{TOT}	Total dissipation at $T_C = 25^\circ\text{C}$	109	25	W
$dv/dt^{(3)}$	Peak diode recovery voltage slope	40		V/ns
$dv/dt^{(4)}$	MOSFET dv/dt ruggedness	40		V/ns
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink ($t=1\text{s}; T_C=25^\circ\text{C}$)		2500	V
T_{stg}	Storage temperature	-55 to 150		$^\circ\text{C}$
T_j	Max. operating junction temperature	150		$^\circ\text{C}$

- Limited by maximum junction temperature
- Pulse width limited by safe operating area
- $I_{SD} \leq 11\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{DD} = 80\% V_{(BR)DSS}$, $V_{DS(peak)} \leq V_{(BR)DSS}$
- $V_{DS} \leq 480\text{ V}$

Table 3. Thermal data

Symbol	Parameter	Value			Unit
		DPAK	TO-220FP	TO-220	
$R_{thj-case}$	Thermal resistance junction-case max	1.15	5	1.15	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-amb max		62.5		$^\circ\text{C}/\text{W}$
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb max	50			$^\circ\text{C}/\text{W}$

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

Table 4. Avalanche characteristics

Symbol	Parameter	Max value	Unit
I_{AS}	Avalanche current, repetitive or not-repetitive ⁽¹⁾	3	A
E_{AS}	Single pulse avalanche energy ⁽²⁾	162	mJ

- Pulse width limited by T_j max
- starting $T_j = 25^\circ\text{C}$, $I_D = I_{AS}$, $V_{DD} = 50\text{ V}$

Electrical characteristics

STD13NM60ND, STF13NM60ND, STP13NM60ND

2 Electrical characteristics

($T_{CASE} = 25\text{ }^{\circ}\text{C}$ unless otherwise specified)

Table 5. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$, $V_{GS} = 0$	600			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = 600\text{ V}$ $V_{DS} = 600\text{ V}$, $T_C = 125\text{ }^{\circ}\text{C}$			1 100	μA μA
I_{GSS}	Gate body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 20\text{ V}$			± 100	nA
$V_{GS(th)}$	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	$V_{GS} = 10\text{ V}$, $I_D = 5.5\text{ A}$		0.32	0.38	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 50\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$	-	845	-	pF
C_{oss}	Output capacitance		-	47	-	pF
C_{rss}	Reverse transfer capacitance		-	2.5	-	pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{GS} = 0$, $V_{DS} = 0\text{ V to } 480\text{ V}$	-	121	-	pF
R_g	Gate input resistance	$f = 1\text{ MHz}$ Gate DC Bias=0 Test signal level=20 mV open drain	-	4.3	-	Ω
Q_g	Total gate charge	$V_{DD} = 480\text{ V}$, $I_D = 11\text{ A}$ $V_{GS} = 10\text{ V}$ (see Figure 18)	-	24.5	-	nC
Q_{gs}	Gate-source charge		-	4.8	-	nC
Q_{gd}	Gate-drain charge		-	17	-	nC

1. $C_{oss\text{ eq.}}$ 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}

STD13NM60ND, STF13NM60ND, STP13NM60ND

Electrical characteristics

Table 7. Switching times

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300\text{ V}$, $I_D = 5.5\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 17)	-	46.5	-	ns
t_r	Rise time		-	10	-	ns
$t_{d(off)}$	Turn-off delay time		-	9.6	-	ns
t_f	Fall time		-	15.4	-	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	$I_{SD} = 11\text{ A}$, $V_{GS}=0$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD}=11\text{ A}$, $di/dt=100\text{ A}/\mu\text{s}$, $V_{DD} = 100\text{ V}$ (see Figure 19)	-	150		ns
Q_{rr}	Reverse recovery charge		-	755		nC
I_{RRM}	Reverse recovery current		-	12		A
t_{rr}	Reverse recovery time	$V_{DD} = 100\text{ V}$ $di/dt=100\text{ A}/\mu\text{s}$, $I_{SD} = 11\text{ A}$ $T_j = 150\text{ }^\circ\text{C}$ (see Figure 19)	-	187		ns
Q_{rr}	Reverse recovery charge		-	1271		nC
I_{RRM}	Reverse recovery current		-	13.6		A

1. Pulse width limited by safe operating area

2. Pulsed: pulse duration = 300 μs , duty cycle 1.5%

Electrical characteristics

STD13NM60ND, STF13NM60ND, STP13NM60ND

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for DPAK

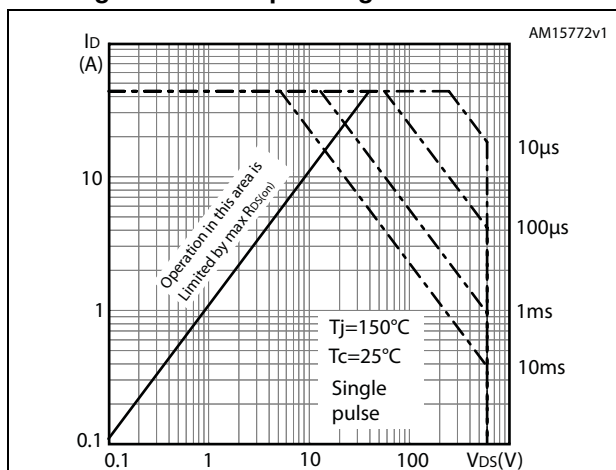


Figure 3. Thermal impedance for DPAK

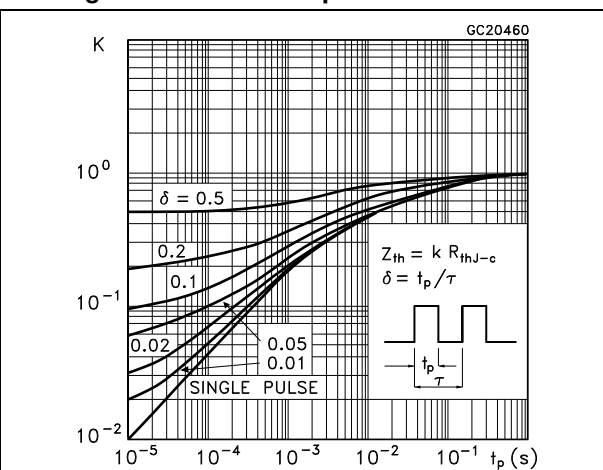


Figure 4. Safe operating area for TO-220FP

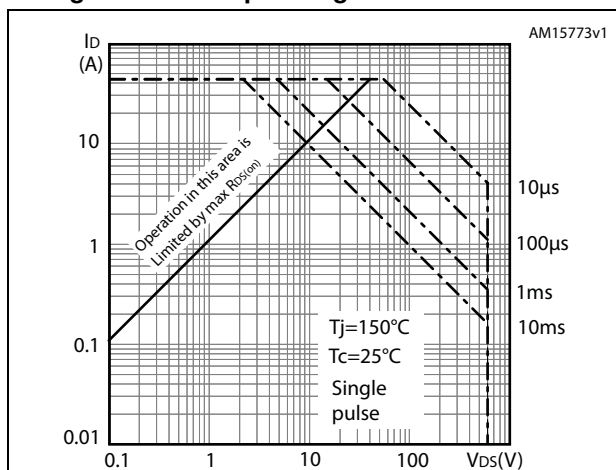


Figure 5. Thermal impedance for TO-220FP

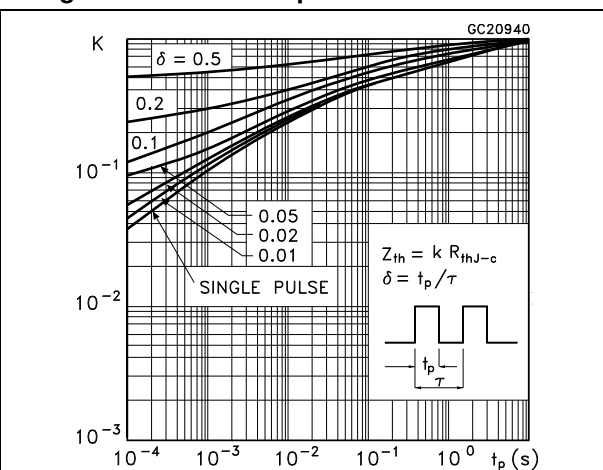


Figure 6. Safe operating area for TO-220

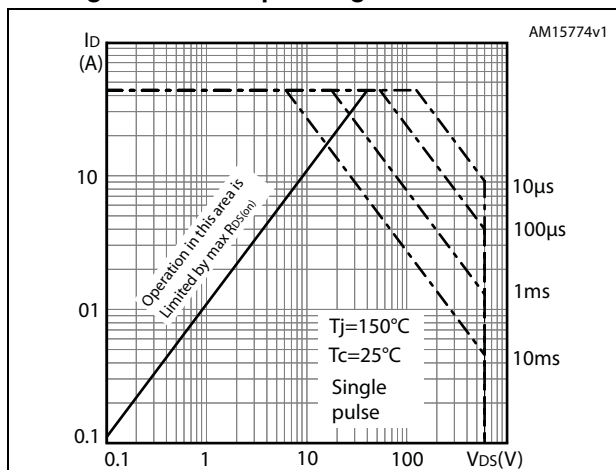
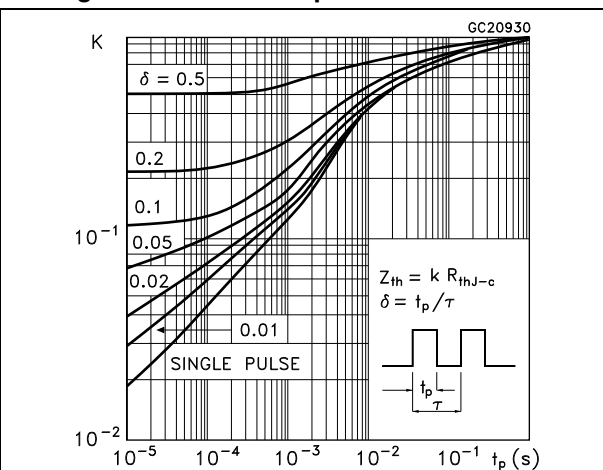


Figure 7. Thermal impedance for TO-220



STD13NM60ND, STF13NM60ND, STP13NM60ND

Electrical characteristics

Figure 8. Output characteristics

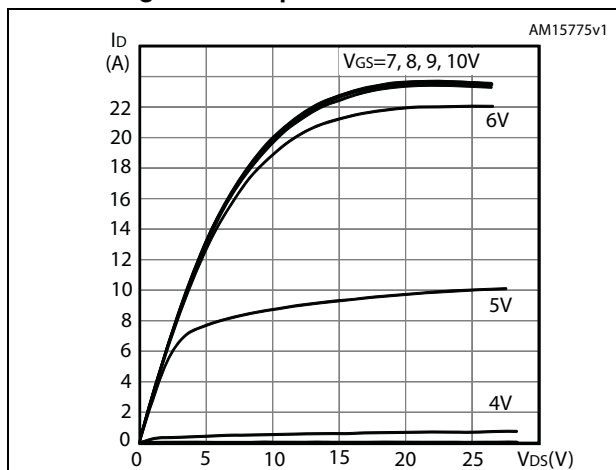


Figure 9. Transfer characteristics

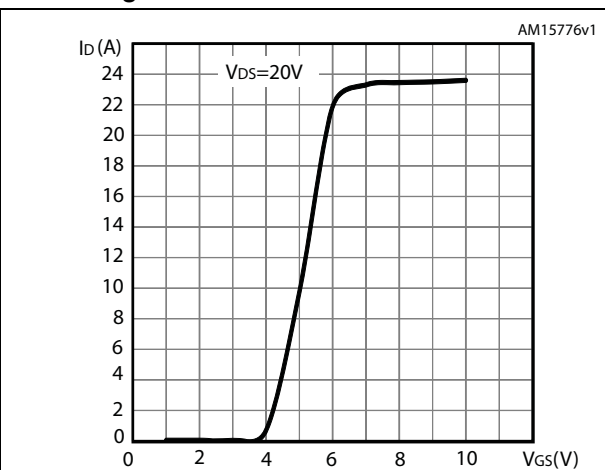


Figure 10. Gate charge vs gate-source voltage

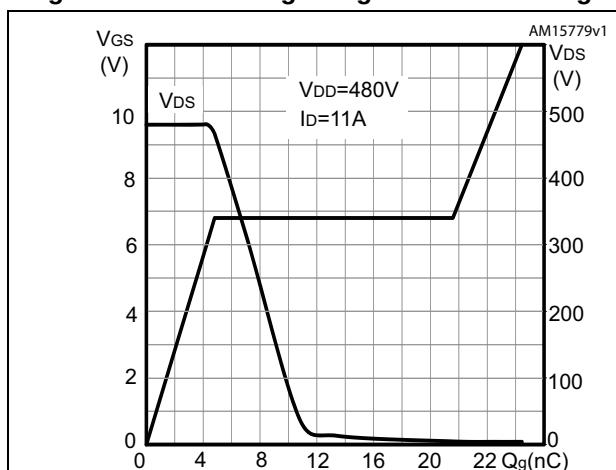


Figure 11. Static drain-source on-resistance

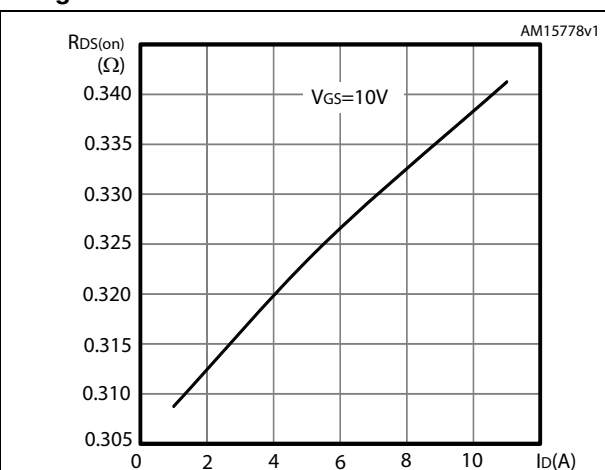


Figure 12. Capacitance variations

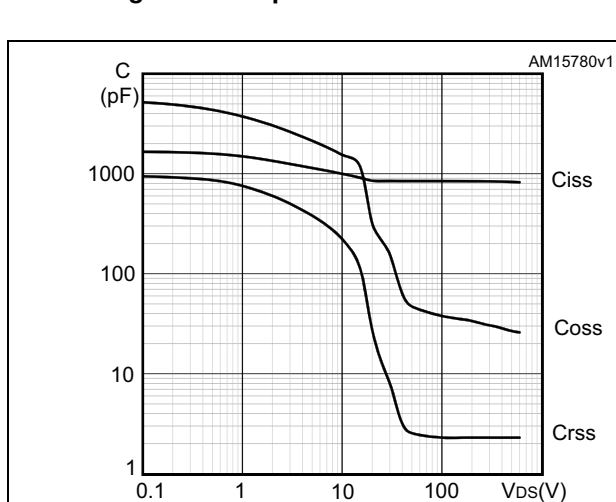
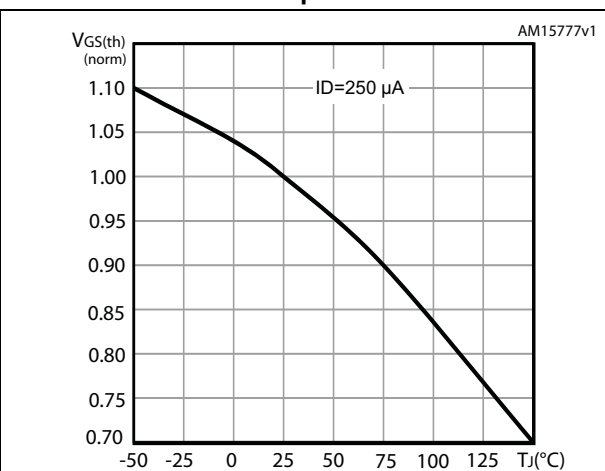


Figure 13. Normalized gate threshold voltage vs. temperature



Electrical characteristics

STD13NM60ND, STF13NM60ND, STP13NM60ND

Figure 14. Normalized on-resistance vs temperature

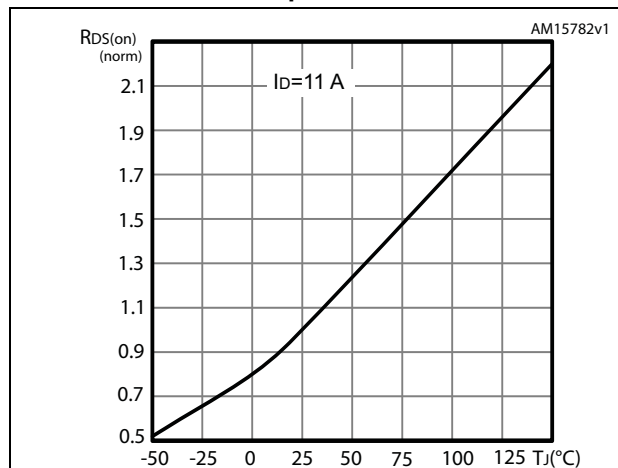


Figure 15. Source-drain diode forward characteristics

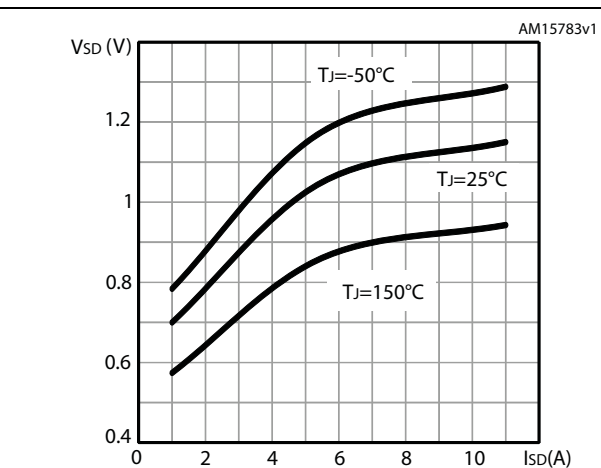
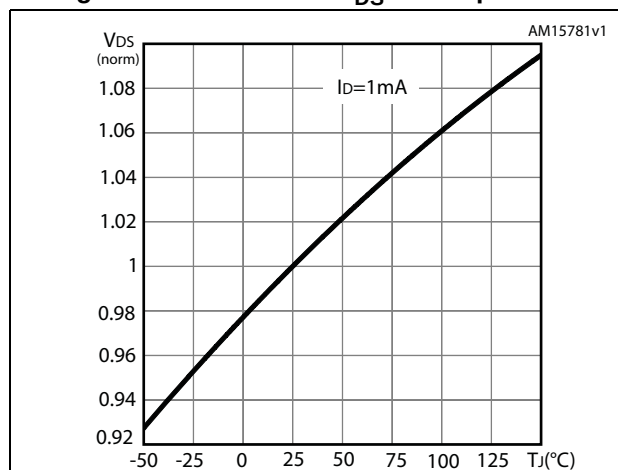


Figure 16. Normalized V_{DS} vs temperature



STD13NM60ND, STF13NM60ND, STP13NM60ND

Test circuits

3 Test circuits

Figure 17. Switching times test circuit for resistive load

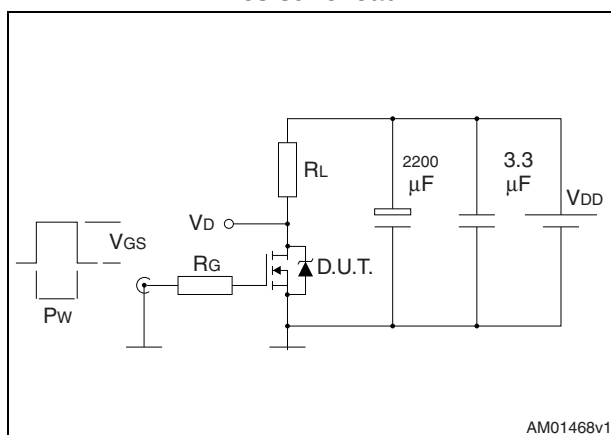


Figure 18. Gate charge test circuit

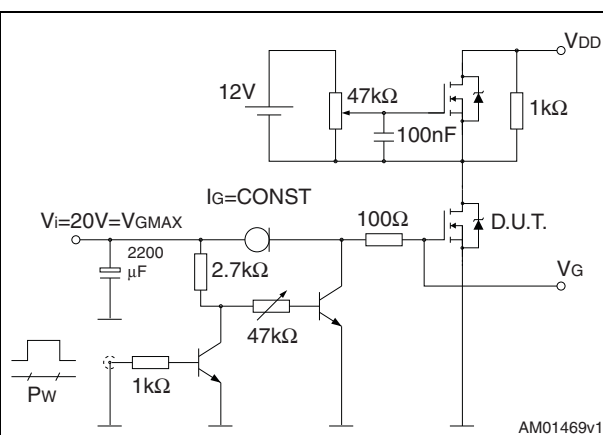


Figure 19. Test circuit for inductive load switching and diode recovery times

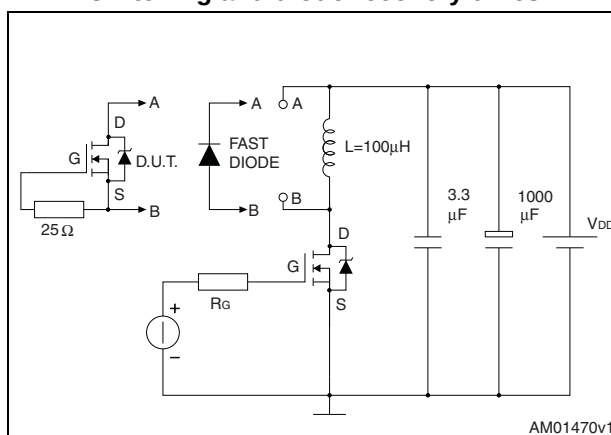


Figure 20. Unclamped inductive load test circuit

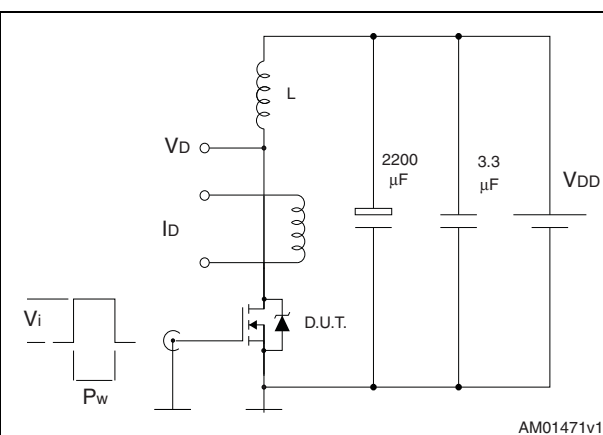


Figure 21. Unclamped inductive waveform

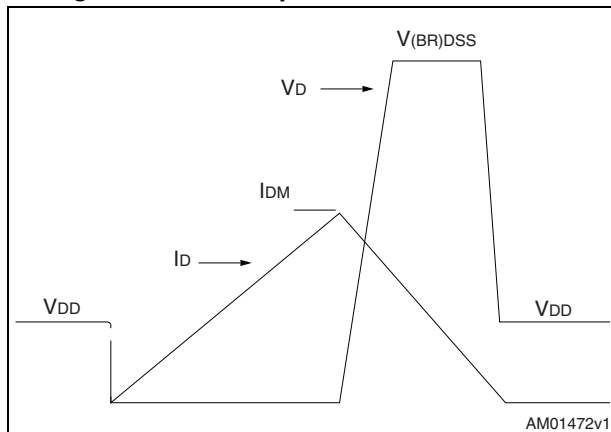
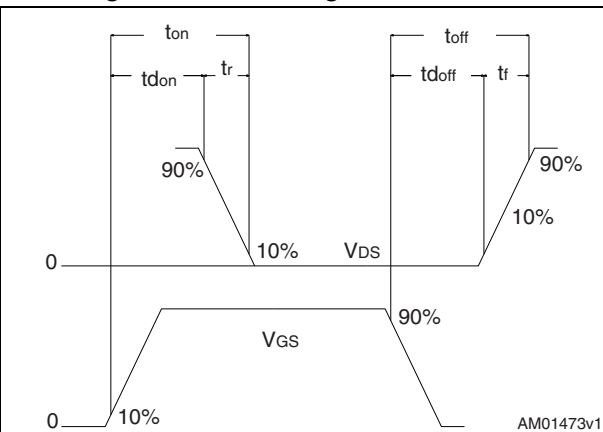


Figure 22. Switching time waveform



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.

STD13NM60ND, STF13NM60ND, STP13NM60ND

Package mechanical data

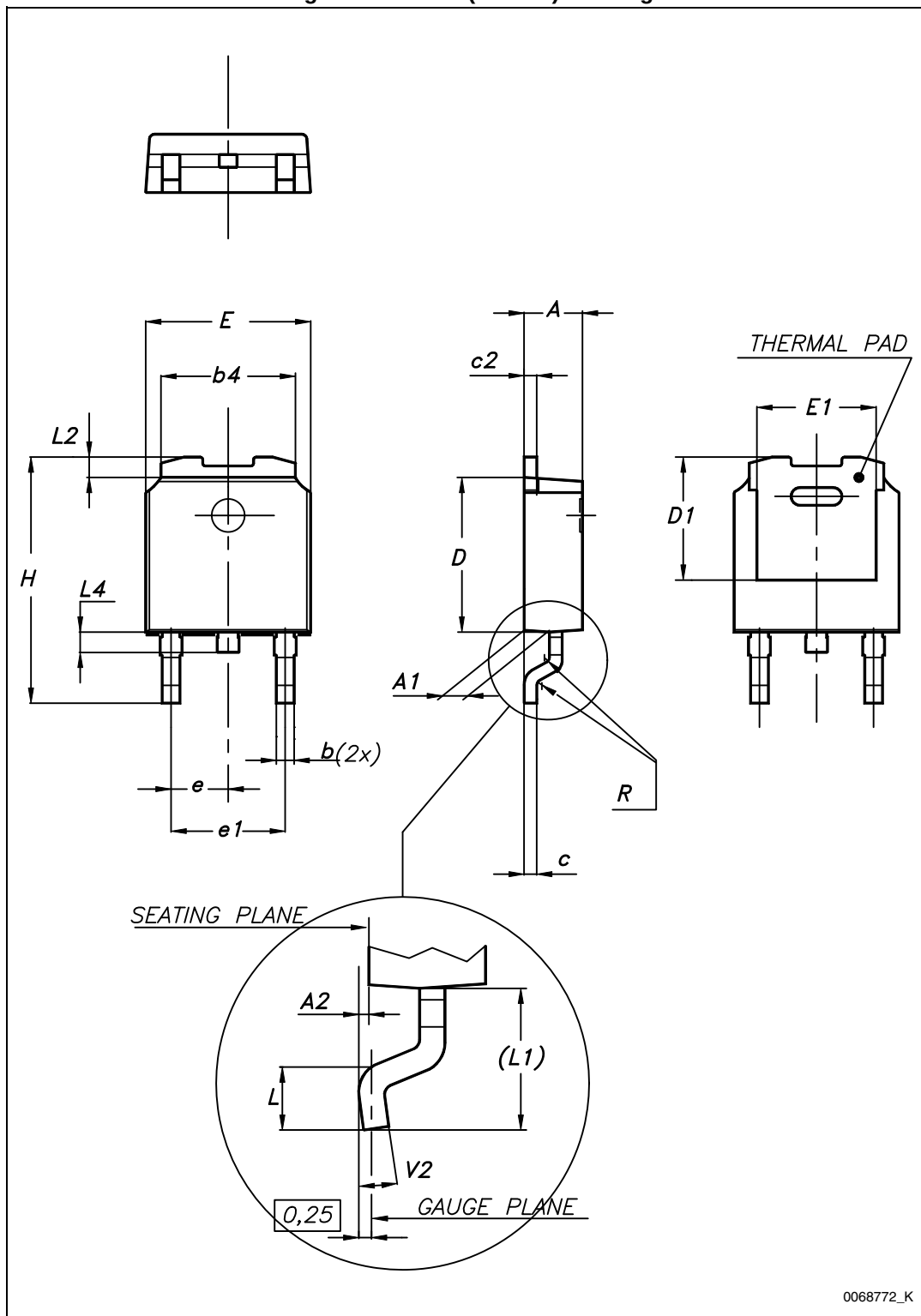
Table 9. DPAK (TO-252) mechanical data

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	1.00		1.50
(L1)		2.80	
L2		0.80	
L4	0.60		1.00
R		0.20	
V2	0°		8°

Package mechanical data

STD13NM60ND, STF13NM60ND, STP13NM60ND

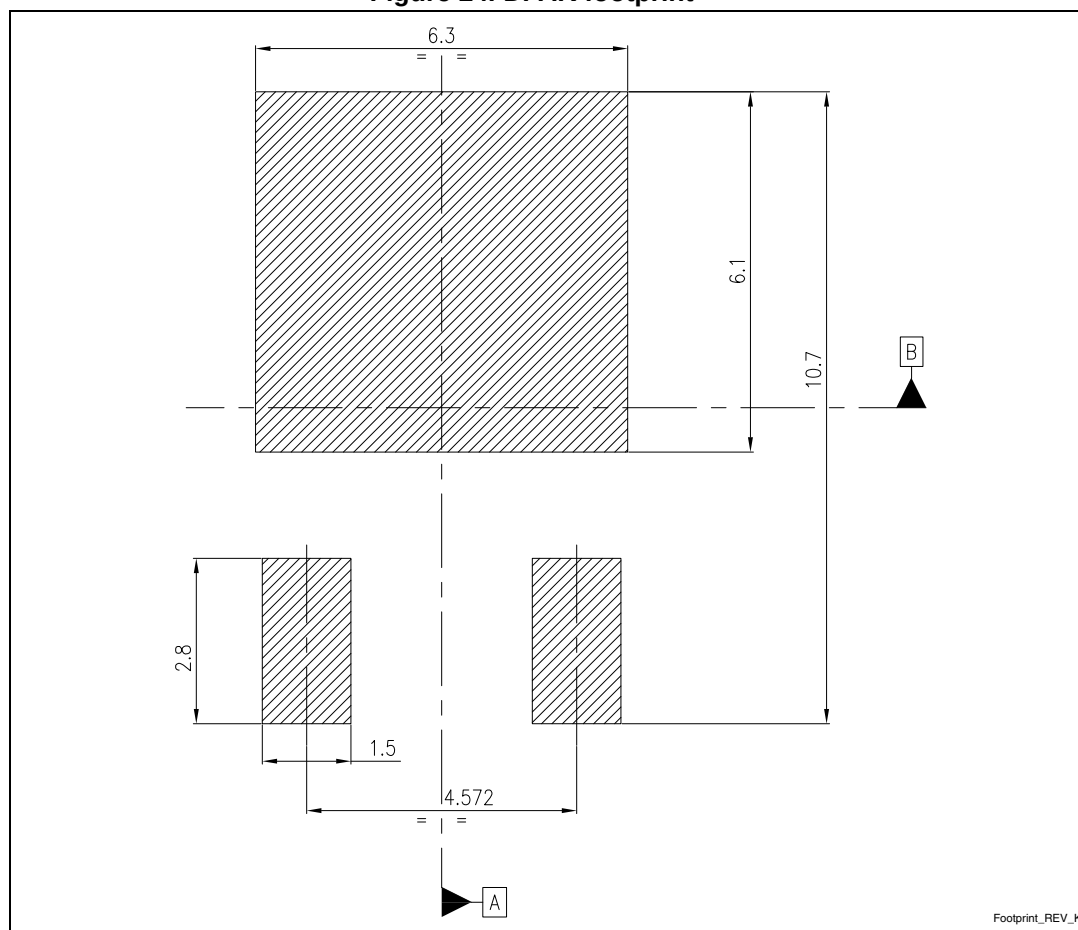
Figure 23. DPAK (TO-252) drawing



STD13NM60ND, STF13NM60ND, STP13NM60ND

Package mechanical data

Figure 24. DPAK footprint (a)



a. All dimensions are in millimeters

Package mechanical data

STD13NM60ND, STF13NM60ND, STP13NM60ND

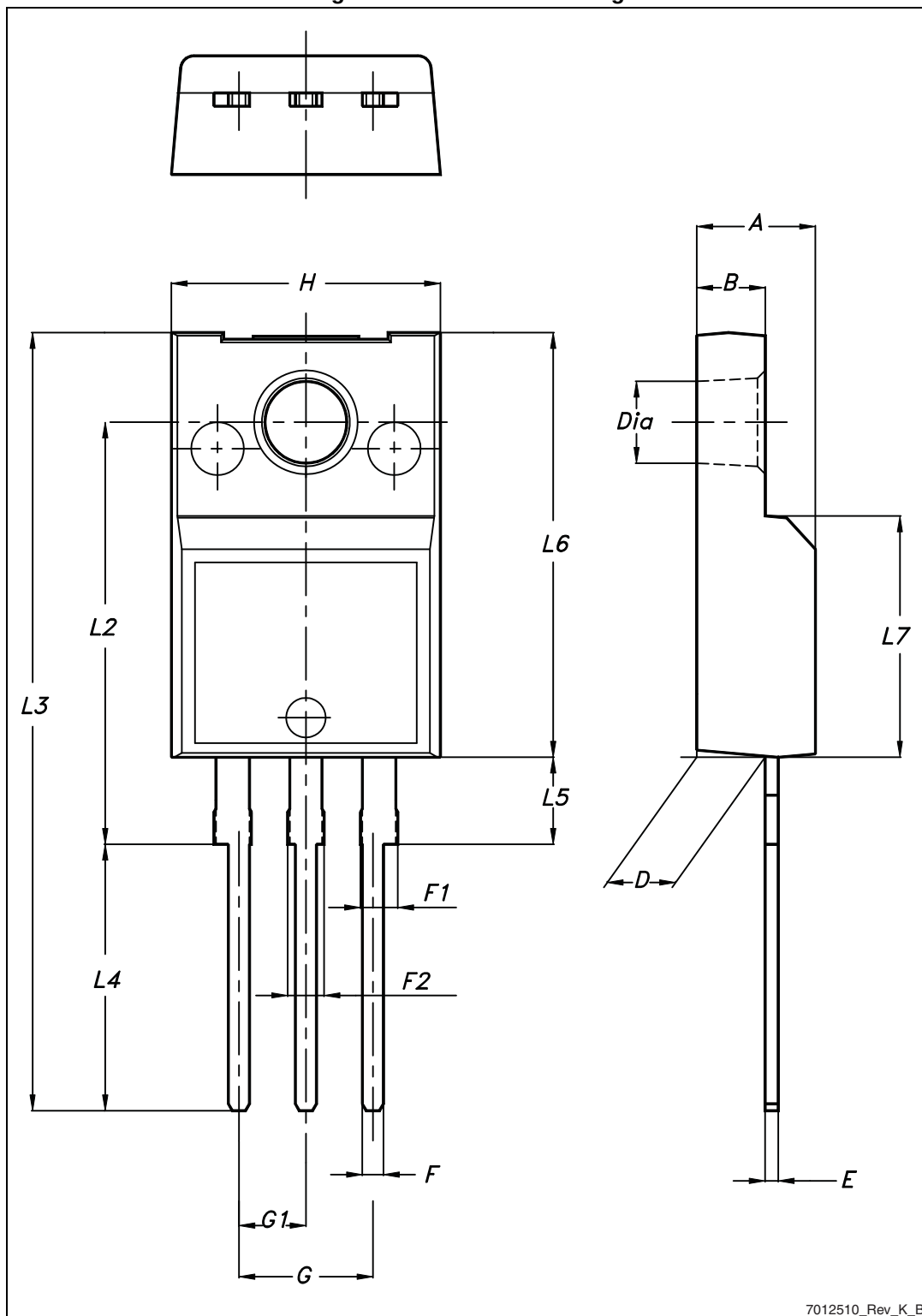
Table 10. TO-220FP mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2

STD13NM60ND, STF13NM60ND, STP13NM60ND

Package mechanical data

Figure 25. TO-220FP drawing



Package mechanical data

STD13NM60ND, STF13NM60ND, STP13NM60ND

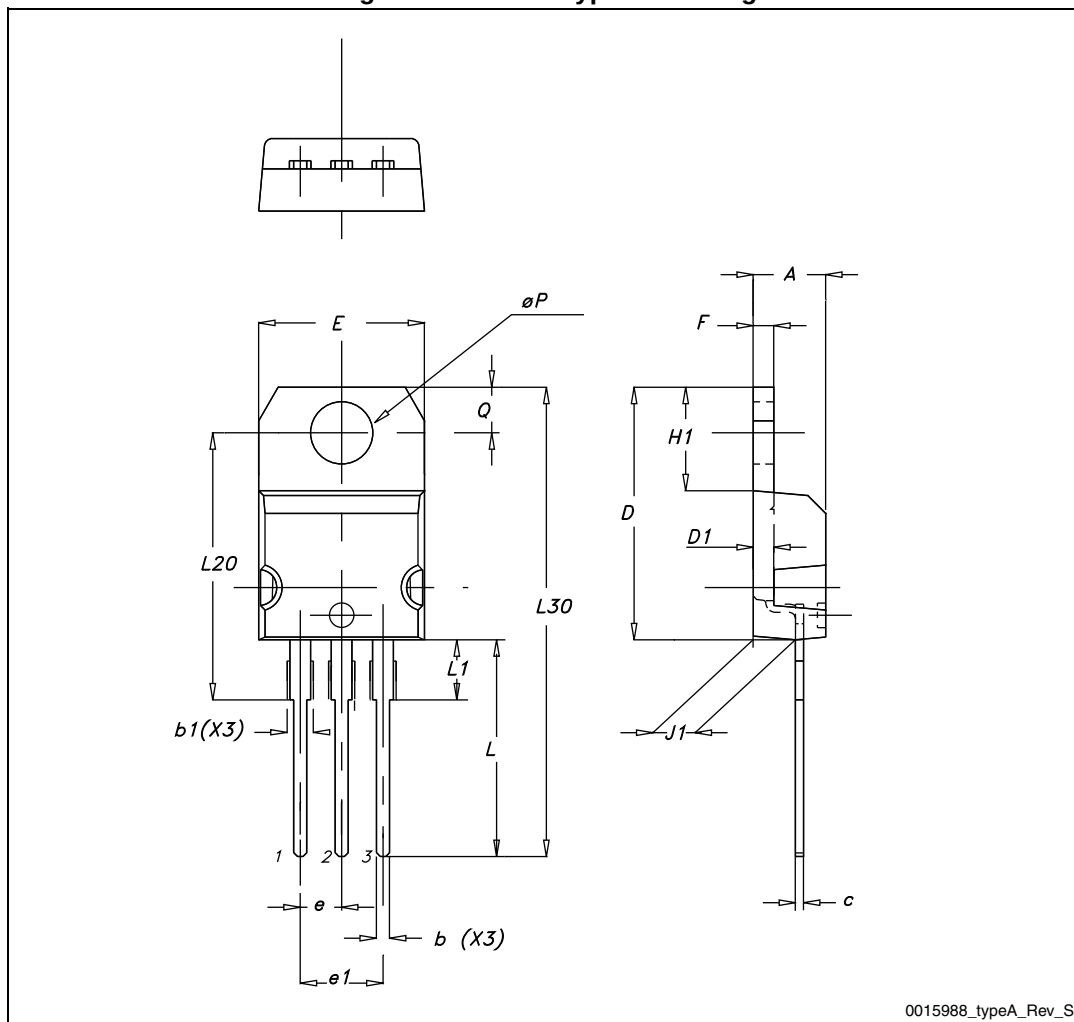
Table 11. TO-220 type A mechanical data

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

STD13NM60ND, STF13NM60ND, STP13NM60ND

Package mechanical data

Figure 26. TO-220 type A drawing



Packaging mechanical data

STD13NM60ND, STF13NM60ND, STP13NM60ND

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			

STD13NM60ND, STF13NM60ND, STP13NM60ND

Packaging mechanical data

Figure 27. Tape for DPAK (TO-252)

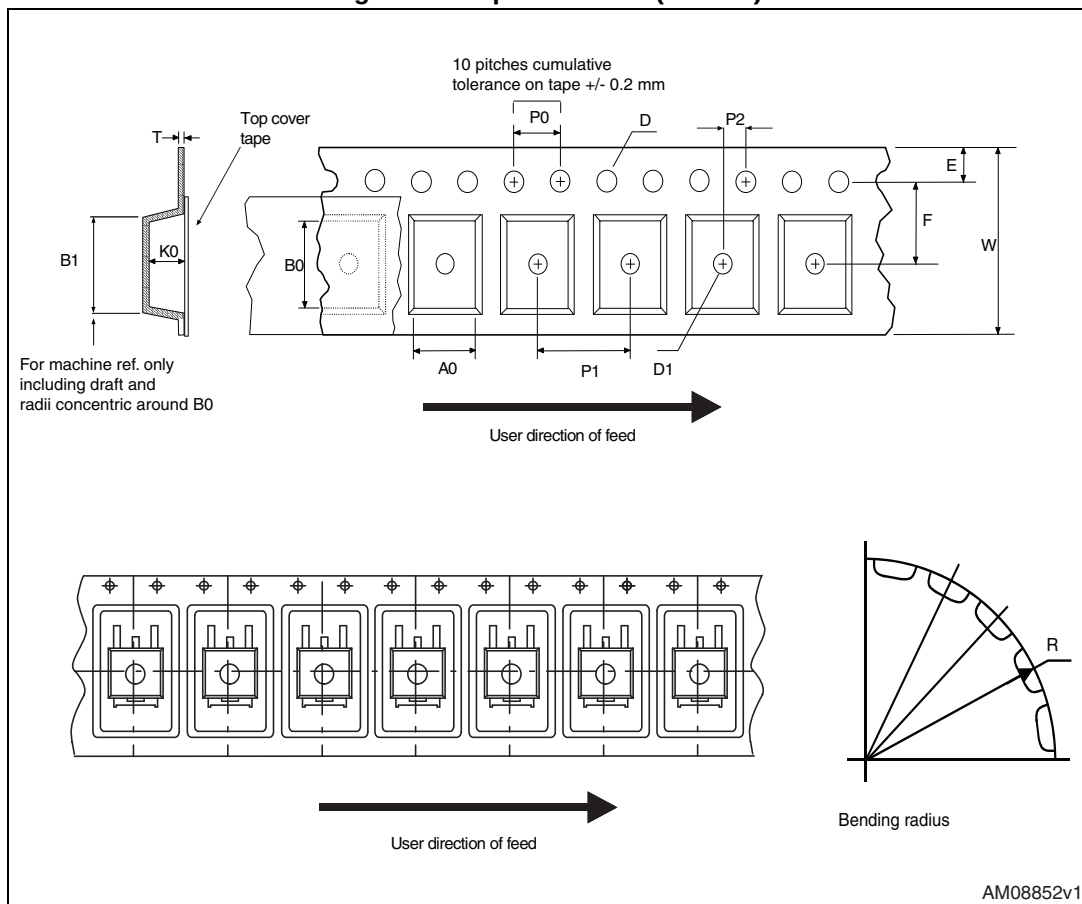
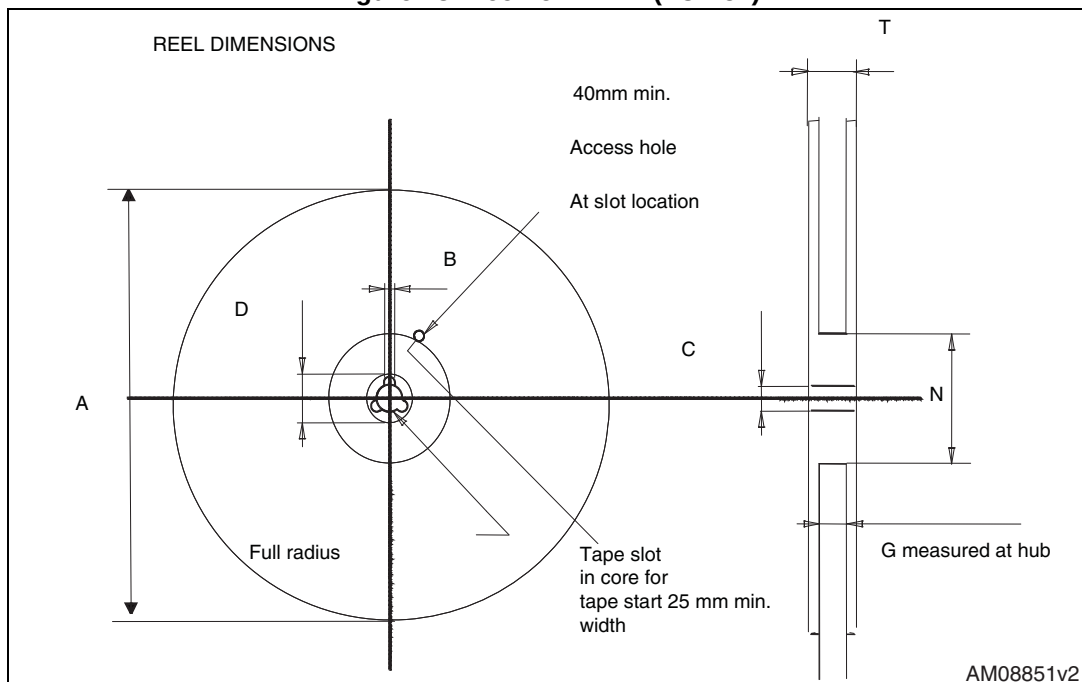


Figure 28. Reel for DPAK (TO-252)



Revision history

STD13NM60ND, STF13NM60ND, STP13NM60ND

6 Revision history

Table 13. Document revision history

Date	Revision	Changes
15-May-2013	1	First release.

STD13NM60ND, STF13NM60ND, STP13NM60ND

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.

ST PRODUCTS ARE NOT AUTHORIZED FOR USE IN WEAPONS. NOR ARE ST PRODUCTS DESIGNED OR AUTHORIZED FOR USE IN: (A) SAFETY CRITICAL APPLICATIONS SUCH AS LIFE SUPPORTING, ACTIVE IMPLANTED DEVICES OR SYSTEMS WITH PRODUCT FUNCTIONAL SAFETY REQUIREMENTS; (B) AERONAUTIC APPLICATIONS; (C) AUTOMOTIVE APPLICATIONS OR ENVIRONMENTS, AND/OR (D) AEROSPACE APPLICATIONS OR ENVIRONMENTS. WHERE ST PRODUCTS ARE NOT DESIGNED FOR SUCH USE, THE PURCHASER SHALL USE PRODUCTS AT PURCHASER'S SOLE RISK, EVEN IF ST HAS BEEN INFORMED IN WRITING OF SUCH USAGE, UNLESS A PRODUCT IS EXPRESSLY DESIGNATED BY ST AS BEING INTENDED FOR "AUTOMOTIVE, AUTOMOTIVE SAFETY OR MEDICAL" INDUSTRY DOMAINS ACCORDING TO ST PRODUCT DESIGN SPECIFICATIONS. PRODUCTS FORMALLY ESCC, QML OR JAN QUALIFIED ARE DEEMED SUITABLE FOR USE IN AEROSPACE BY THE CORRESPONDING GOVERNMENTAL AGENCY.

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.

© 2013 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