

N-channel 100 V, 8 mΩ typ., 120 A, STripFET™ DeepGATE™ Power MOSFETs in D<sup>2</sup>PAK and TO-220 packages

Datasheet – production data

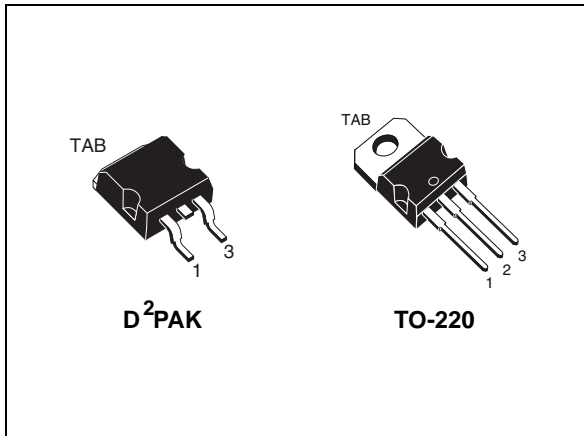
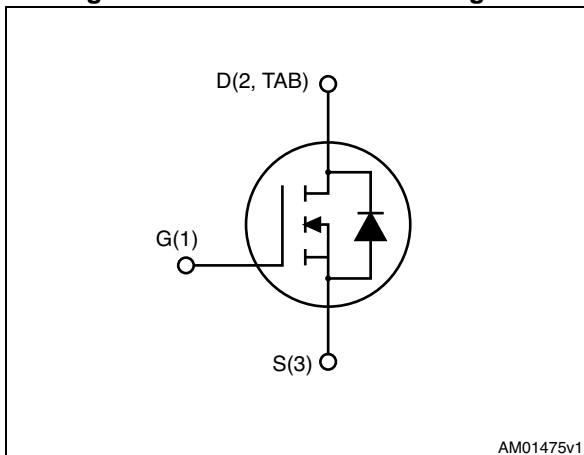


Figure 1. Internal schematic diagram



## Features

Order codes	V <sub>DS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>
STB120N10F4	100 V	10 mΩ	120 A
STP120N10F4			

- N-channel enhancement mode
- Very low on-resistance
- Low gate charge
- 100% avalanche rated

## Applications

- Switching applications

## Description

These devices are N-channel Power MOSFETs developed using ST's STripFET™ DeepGATE™ technology. The devices have a new gate structure and are specially designed to minimize on-state resistance to provide superior switching performance.

Table 1. Device summary

Order codes	Marking	Packages	Packaging
STB120N10F4	120N10F4	D <sup>2</sup> PAK	Tape and reel
STP120N10F4		TO-220	Tube

# Contents

- 1      Electrical ratings ..... 3**
- 2      Electrical characteristics ..... 4**
  - 2.1    Electrical characteristics (curves) ..... 6
- 3      Test circuits ..... 8**
- 4      Package mechanical data ..... 9**
  - 4.1    D2PAK, STB120N10F4 ..... 10
  - 4.2    TO-220, STP120N10F4 ..... 13
- 5      Packaging mechanical data ..... 15**
- 6      Revision history ..... 17**

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage	100	V
$V_{GS}$	Gate-source voltage	$\pm 20$	V
$I_D$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	120	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	85	A
$I_{DM}^{(1)}$	Drain current (pulsed)	390	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	300	W
	Derating factor	2	W/ $^\circ\text{C}$
$E_{AS}^{(2)}$	Single pulse avalanche energy	215	mJ
$T_{stg}$	Storage temperature	- 55 to 175	$^\circ\text{C}$
$T_j$	Max. operating junction temperature		

1. Pulse width limited by safe operating area

2. Starting  $T_j = 25\text{ }^\circ\text{C}$ ,  $I_D = 65\text{ A}$ ,  $V_{DD} = 50\text{ V}$

**Table 3. Thermal data**

Symbol	Parameter	Value		Unit
		D <sup>2</sup> PAK	TO-220	
$R_{thj-case}$	Thermal resistance junction-case max	0.5		$^\circ\text{C/W}$
$R_{thj-pcb}$	Thermal resistance junction-pcb max	35		$^\circ\text{C/W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max		62.5	$^\circ\text{C/W}$

## 2 Electrical characteristics

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

**Table 4. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source Breakdown voltage	$I_D = 250\ \mu\text{A}$ , $V_{GS} = 0$	100			V
$I_{DSS}$	Zero gate voltage Drain current ( $V_{GS} = 0$ )	$V_{DS} = 100\text{ V}$			1	$\mu\text{A}$
		$V_{DS} = 100\text{ V}$ , $T_C = 125\text{ °C}$			100	$\mu\text{A}$
$I_{GSS}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20\text{ V}$			$\pm 100$	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 250\ \mu\text{A}$	2		4	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$ , $I_D = 60\text{ A}$		8	10	m $\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$	-	7290	-	pF
$C_{oss}$	Output capacitance		-	568	-	pF
$C_{rss}$	Reverse transfer capacitance		-	387	-	pF
$Q_g$	Total gate charge	$V_{DD} = 50\text{ V}$ , $I_D = 120\text{ A}$ , $V_{GS} = 10\text{ V}$ (see Figure 14)	-	131	-	nC
$Q_{gs}$	Gate-source charge		-	40	-	nC
$Q_{gd}$	Gate-drain charge		-	37	-	nC

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 50\text{ V}$ , $I_D = 60\text{ A}$ $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$ (see Figure 13)	-	32	-	ns
$t_r$	Rise time		-	116	-	ns
$t_{d(off)}$	Turn-off-delay time	$V_{DD} = 50\text{ V}$ , $I_D = 60\text{ A}$ , $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$ (see Figure 13)	-	111	-	ns
$t_f$	Fall time		-	79	-	ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		120	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		390	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 60 \text{ A}$ , $V_{GS} = 0$	-		1.2	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 120 \text{ A}$ , $V_{DD} = 80 \text{ V}$ $di/dt = 100 \text{ A}/\mu\text{s}$ , $T_j = 150 \text{ }^\circ\text{C}$ <i>(see Figure 15)</i>	-	72		ns
$Q_{rr}$	Reverse recovery charge		-	215		nC
$I_{RRM}$	Reverse recovery current		-	6		A

1. Pulse width limited by safe operating area.

2. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

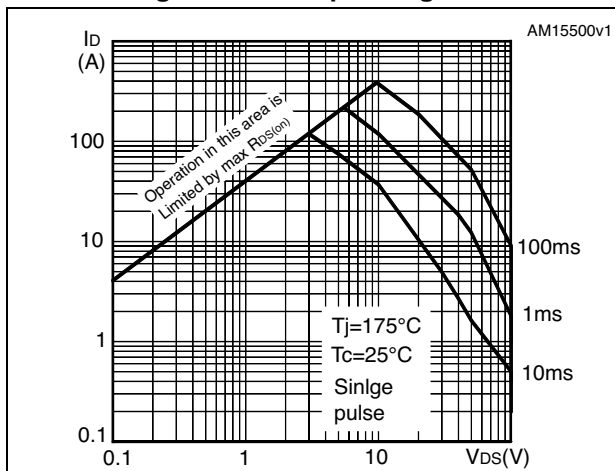


Figure 3. Thermal impedance

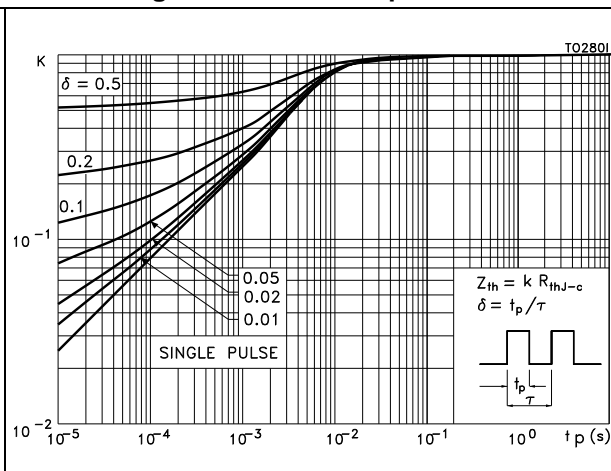


Figure 4. Output characteristics

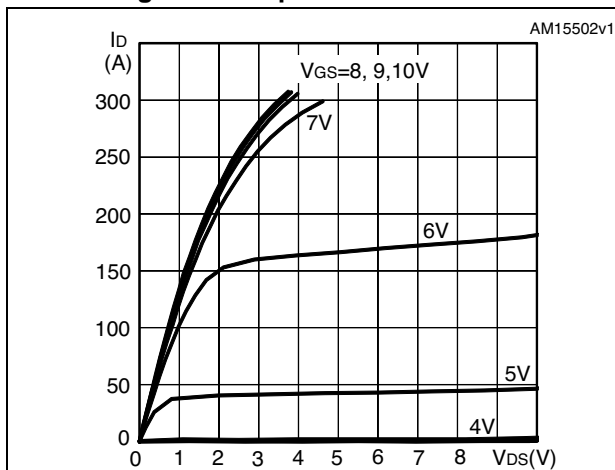


Figure 5. Transfer characteristics

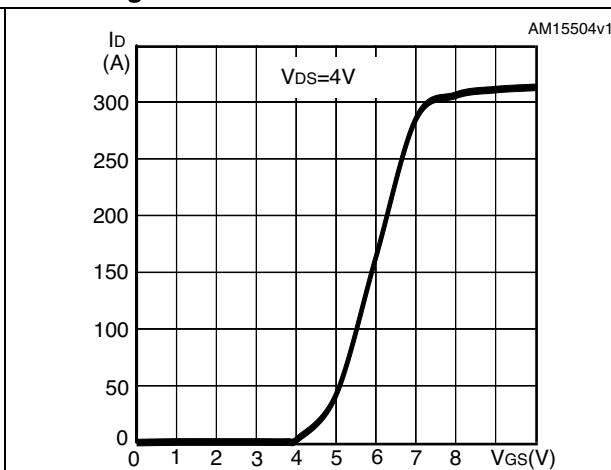


Figure 6. Gate charge vs gate-source voltage

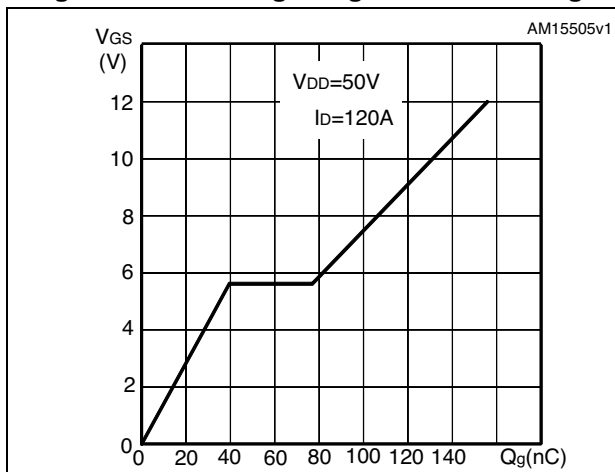


Figure 7. Static drain-source on-resistance

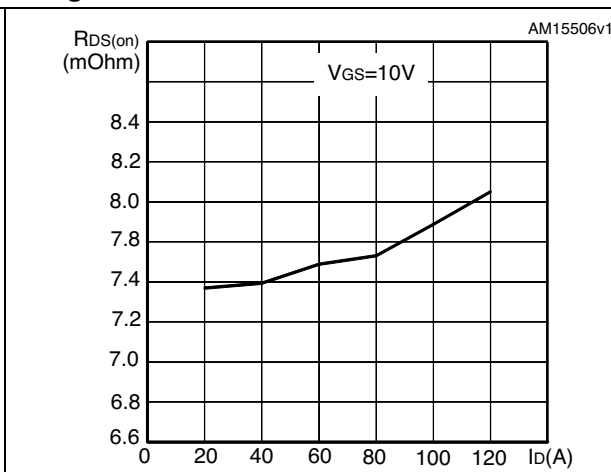


Figure 8. Capacitance variations

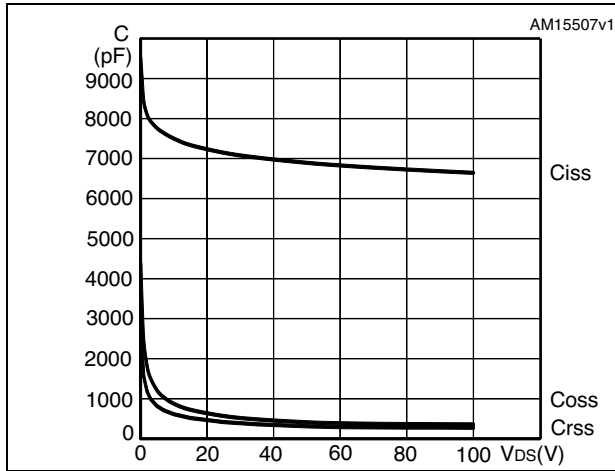


Figure 9. Source-drain diode forward characteristics

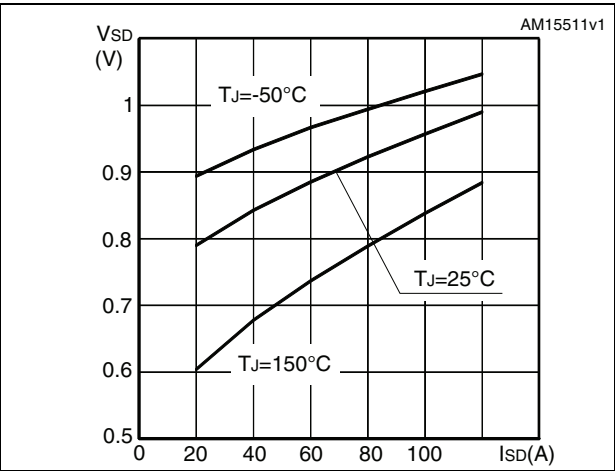


Figure 10. Normalized gate threshold voltage vs temperature

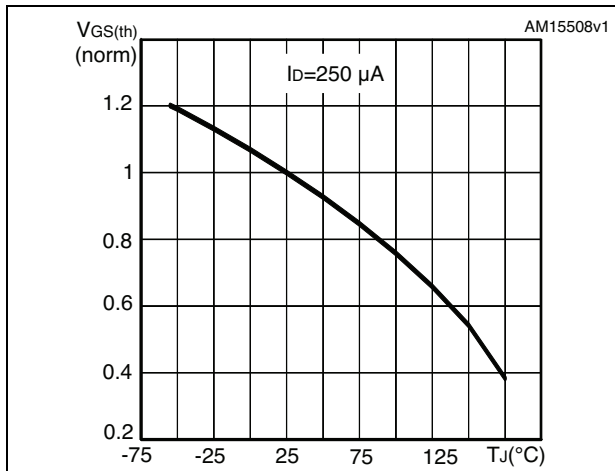


Figure 11. Normalized on-resistance vs temperature

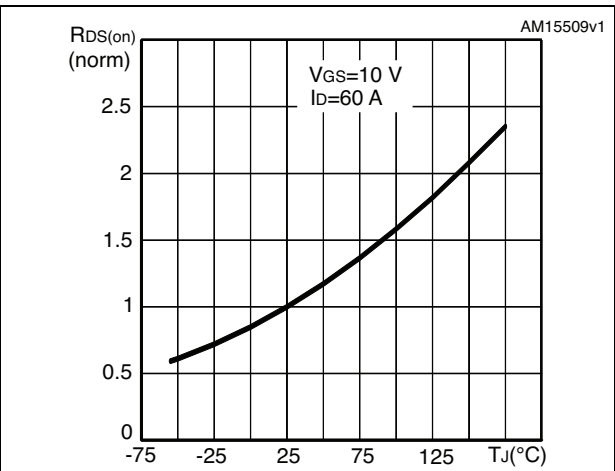
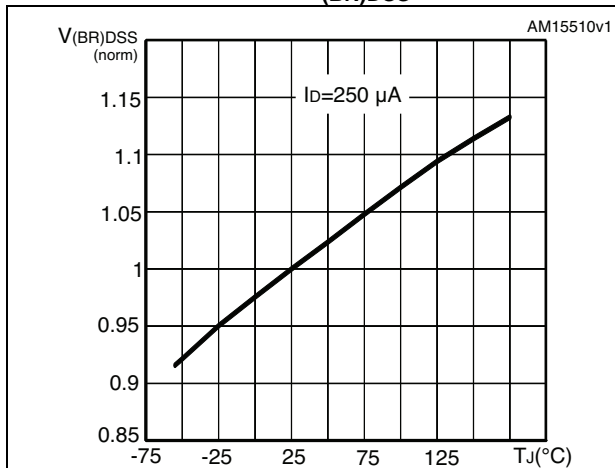


Figure 12. Normalized  $V_{(BR)DSS}$  vs temperature



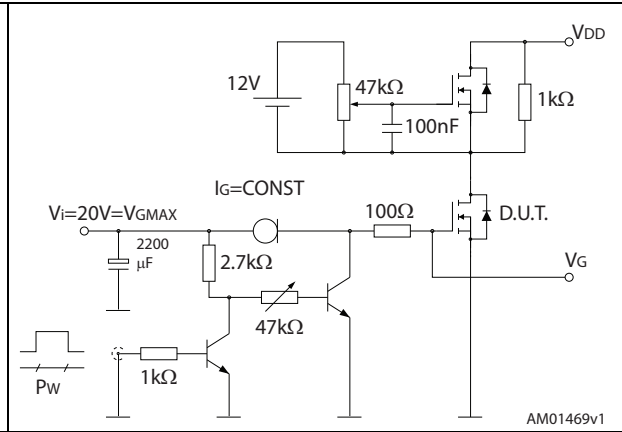
### 3 Test circuits

Figure 13. Switching times test circuit for resistive load



AM01468v1

Figure 14. Gate charge test circuit



AM01469v1

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



AM01470v1

Figure 16. Unclamped inductive load test circuit



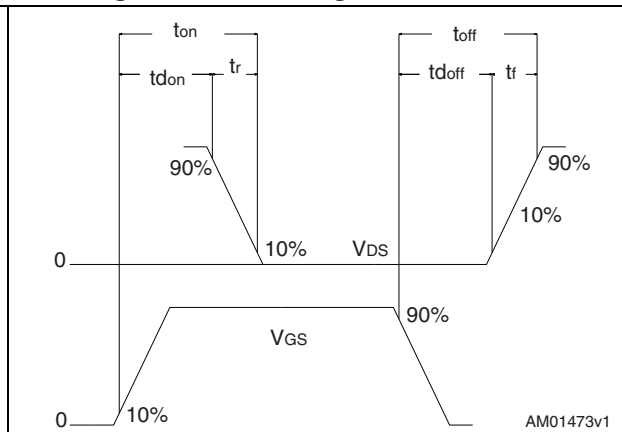
AM01471v1

Figure 17. Unclamped inductive waveform



AM01472v1

Figure 18. Switching time waveform



AM01473v1



## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

### 4.1 D<sup>2</sup>PAK, STB120N10F4

Figure 19. D<sup>2</sup>PAK (TO-263) drawing

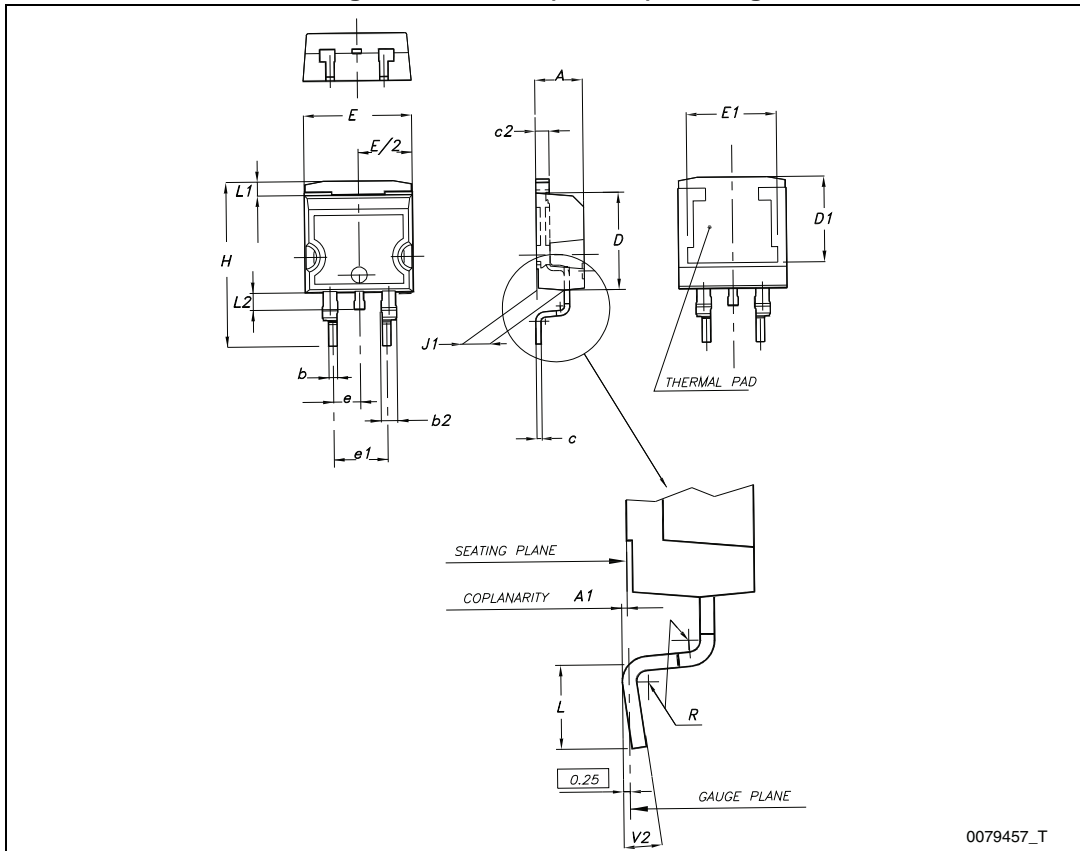
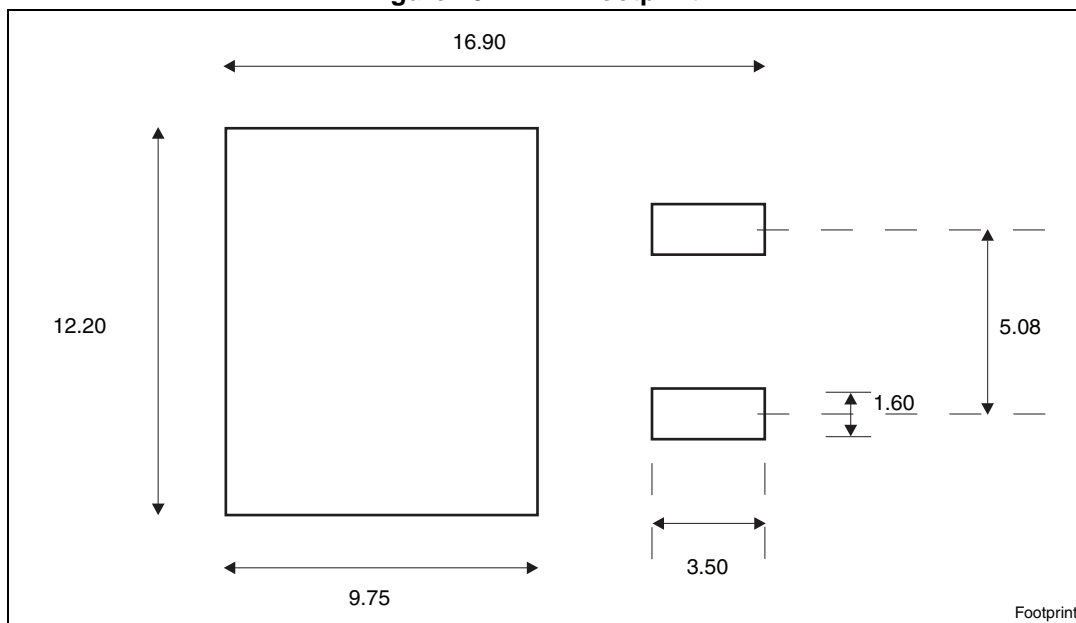


Table 8. D<sup>2</sup>PAK (TO-263) mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50		
E	10		10.40
E1	8.50		
e		2.54	
e1	4.88		5.28
H	15		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.4	
V2	0°		8°

Figure 20. D<sup>2</sup>PAK footprint<sup>(a)</sup>



a. All dimension are in millimeters

### 4.2 TO-220, STP120N10F4

Figure 21. TO-220 type A drawing

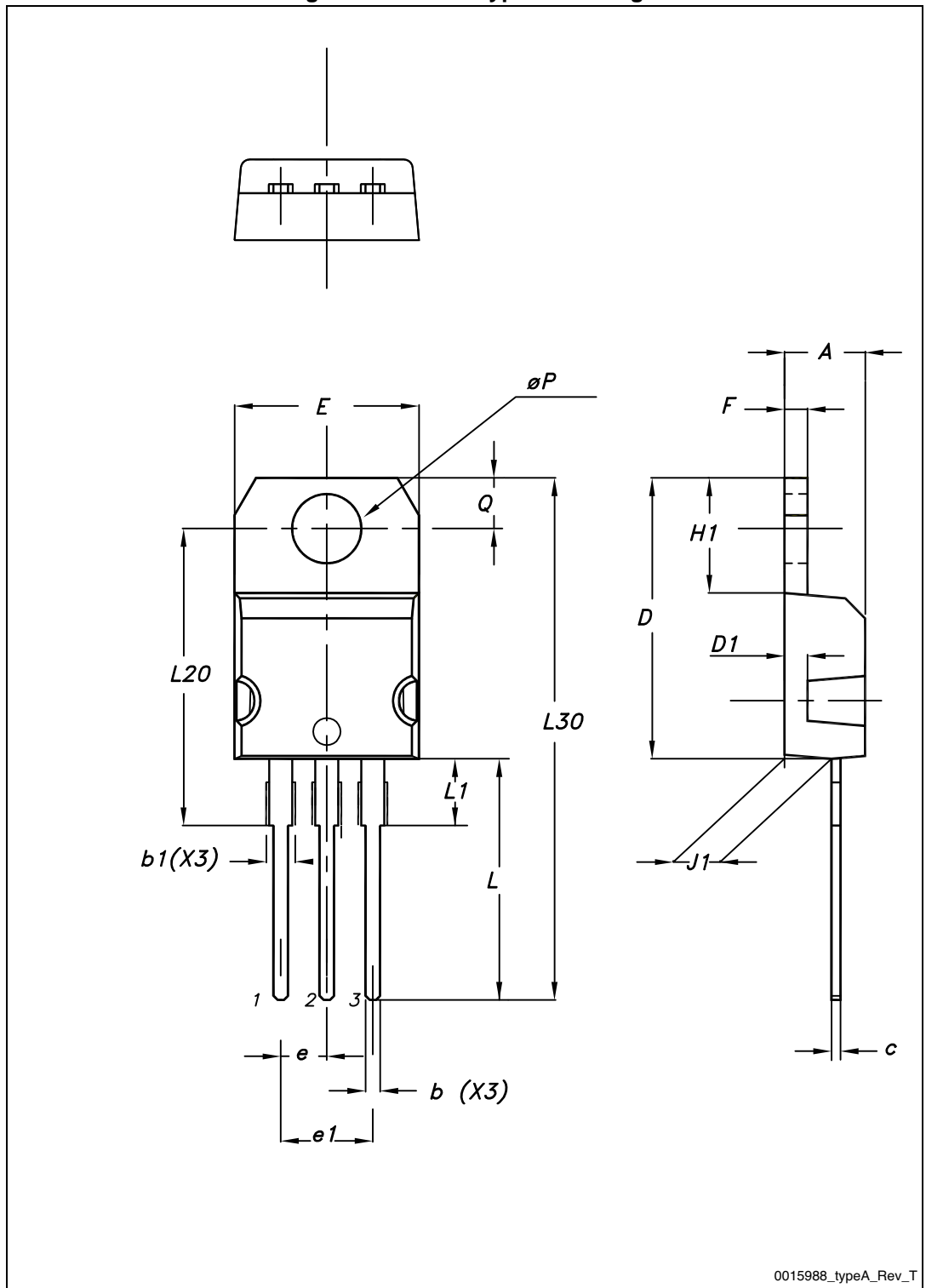


Table 9. TO-220 type A mechanical data

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	
$\overline{AEP}$	3.75		3.85
Q	2.65		2.95

# 5 Packaging mechanical data

Figure 22. Tape

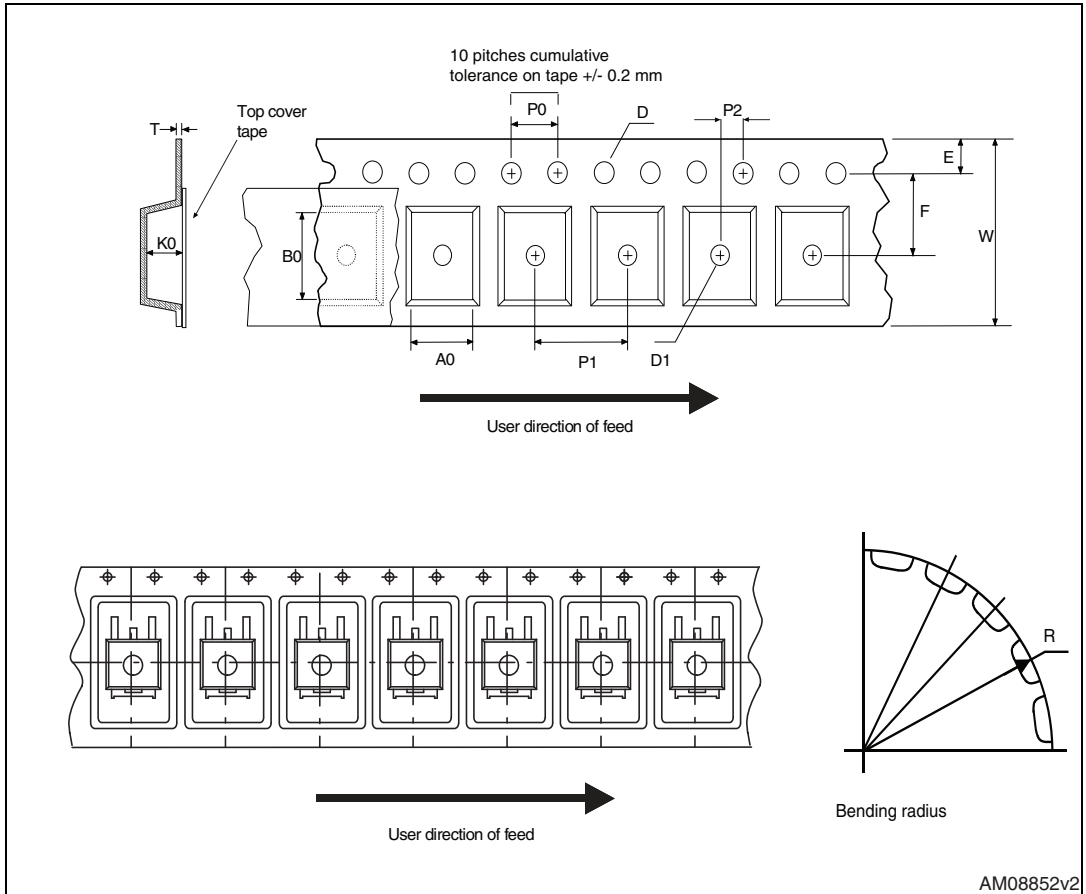


Figure 23. Reel

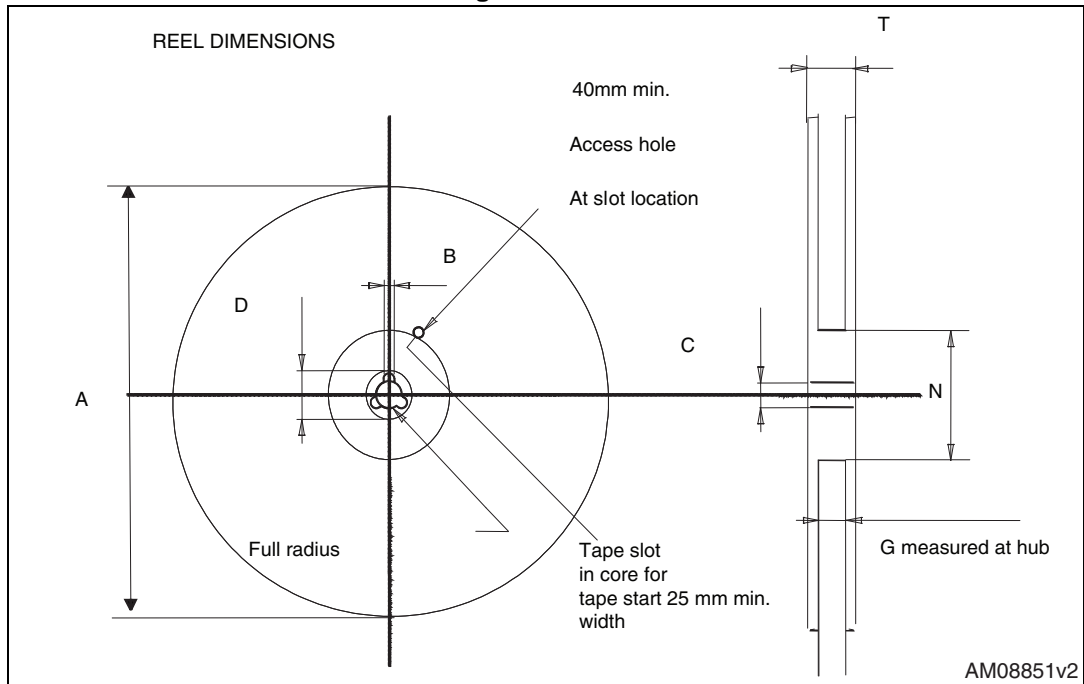


Table 10. D<sup>2</sup>PAK (TO-263) tape and reel mechanical data

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	10.5	10.7	A		330
B0	15.7	15.9	B	1.5	
D	1.5	1.6	C	12.8	13.2
D1	1.59	1.61	D	20.2	
E	1.65	1.85	G	24.4	26.4
F	11.4	11.6	N	100	
K0	4.8	5.0	T		30.4
P0	3.9	4.1			
P1	11.9	12.1	Base qty		1000
P2	1.9	2.1	Bulk qty		1000
R	50				
T	0.25	0.35			
W	23.7	24.3			



## 6 Revision history

Table 11. Document revision history

Date	Revision	Changes
02-Apr-2014	1	First release.

**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 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.

© 2014 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](http://www.st.com)