



# STF130N10F3, STF1130N10F3, STH130N10F3-2, STP130N10F3

N-channel 100 V, 7.8 mΩ typ., 120 A S<sup>2</sup>TriP<sup>2</sup>FET™ III Power MOSFET  
in TO-220FP, I<sup>2</sup>PAKFP, H<sup>2</sup>PAK-2 and TO-220 packages

Datasheet — production data

## Features

Order codes	V <sub>DSS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>
STF130N10F3	100 V	9.6 mΩ	46 A
STF1130N10F3			
STH130N10F3-2		9.3 mΩ	120 A
STP130N10F3		9.6 mΩ	

- Ultra low on-resistance
- 100% avalanche tested

## Applications

- High current switching applications

## Description

These devices are N-channel enhancement mode Power MOSFETs produced using STMicroelectronics' S<sup>2</sup>TriP<sup>2</sup>FET™ III technology, which is specifically designed to minimize on-resistance and gate charge to provide superior switching performance.

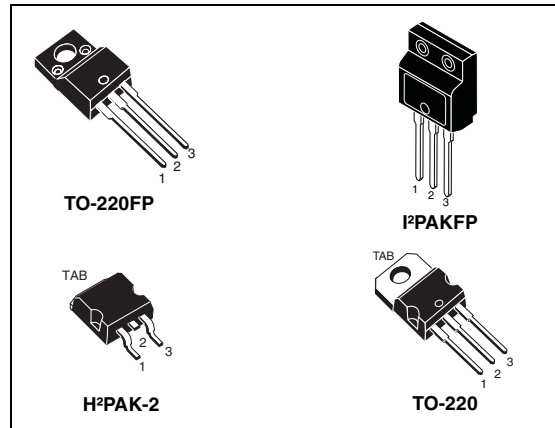


Figure 1. Internal schematic diagram

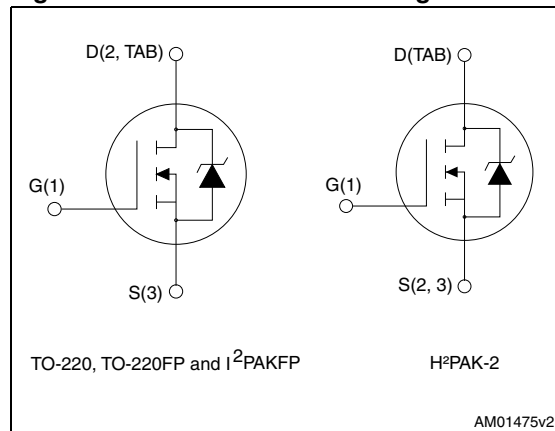


Table 1. Device summary

Order codes	Marking	Package	Packaging
STF130N10F3	130N10F3	TO-220FP	Tube
STF1130N10F3		I <sup>2</sup> PAKFP	Tube
STH130N10F3-2		H <sup>2</sup> PAK-2	Tape and reel
STP130N10F3		TO-220	Tube

## Contents

<b>1</b>	<b>Electrical ratings</b> .....	<b>3</b>
<b>2</b>	<b>Electrical characteristics</b> .....	<b>4</b>
	2.1 Electrical characteristics (curves) .....	6
<b>3</b>	<b>Test circuits</b> .....	<b>10</b>
<b>4</b>	<b>Package mechanical data</b> .....	<b>11</b>
<b>5</b>	<b>Package mechanical data</b> .....	<b>20</b>
<b>6</b>	<b>Revision history</b> .....	<b>22</b>

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value			Unit
		TO-220FP I <sup>2</sup> PAKFP	H <sup>2</sup> PAK-2	TO-220	
V <sub>DS</sub>	Drain-source voltage	100			V
V <sub>GS</sub>	Gate-source voltage	± 20			V
I <sub>D</sub> <sup>(1)</sup>	Drain current (continuous) at T <sub>C</sub> = 25°C	46	120		A
I <sub>D</sub> <sup>(1)</sup>	Drain current (continuous) at T <sub>C</sub> =100°C	29	78		A
I <sub>DM</sub> <sup>(2)</sup>	Drain current (pulsed)	184	450		A
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25°C	35	250		W
dv/dt	Peak diode recovery voltage slope	22			V/ns
V <sub>ISO</sub>	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T <sub>C</sub> = 25 °C)	2500			V
E <sub>AS</sub> <sup>(3)</sup>	Single pulse avalanche energy	125			mJ
T <sub>j</sub> T <sub>stg</sub>	Operating junction temperature storage temperature	- 55 to 175			°C

1. Current limited by package.

2. Pulse width limited by safe operating area.

3. Starting T<sub>j</sub> = 25 °C, I<sub>D</sub> = 50 A, V<sub>DD</sub> = 50 V for TO-220 and H<sup>2</sup>PAK-2; Starting T<sub>j</sub> = 25 °C, I<sub>D</sub> = 29 A, V<sub>DD</sub> = 60 V for I<sup>2</sup>PAKFP and TO-220FP.

**Table 3. Thermal data**

Symbol	Parameter	Value			Unit
		TO-220FP I <sup>2</sup> PAKFP	H <sup>2</sup> PAK-2	TO-220	
R <sub>thj-case</sub>	Thermal resistance junction-case	4.3	0.6	0.6	°C/W
R <sub>thj-a</sub>	Thermal resistance junction-ambient	62.5		62.5	°C/W
R <sub>thj-pcb</sub> <sup>(1)</sup>	Thermal resistance junction-pcb		35		°C/W

1. When mounted on FR-4 board, on 1inch<sup>2</sup>, 2oz Cu.

## 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	$V_{GS} = 0, I_D = 250\text{ }\mu\text{A}$	100	-		V
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0, V_{DS} = 100\text{ V}$ $T_C = 25\text{ °C}$ $T_C = 125\text{ °C}$		-	10 100	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate body leakage current	$V_{DS} = 0, V_{GS} = \pm 20\text{ V}$		-	$\pm 200$	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	2	-	4	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}, I_D = 23\text{ A}$ TO-220FP and I <sup>2</sup> PAKFP		8	9.6	m $\Omega$
		$V_{GS} = 10\text{ V}, I_D = 60\text{ A}$ H <sup>2</sup> PAK TO-220		7.8 8	9.3 9.6	

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{GS} = 0, V_{DS} = 25\text{ V},$ $f = 1\text{ MHz}$	-	3305	-	$\mu\text{F}$
$C_{oss}$	Output capacitance			373		
$C_{rss}$	Reverse transfer capacitance			23		
$Q_g$	Total gate charge	$V_{DD} = 50\text{ V}, I_D = 120\text{ A},$	-	57	-	nC
$Q_{gs}$	Gate-source charge	$V_{GS} = 10\text{ V}$		22		
$Q_{gd}$	Gate-drain charge	(see <a href="#">Figure 20</a> )		17		

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 50\text{ V}, I_D = 60\text{ A}$	-	17	-	ns
$t_r$	Rise time	$R_G = 4.7\text{ }\Omega, V_{GS} = 10\text{ V}$		38		
$t_{d(off)}$	Turn-off delay time	(see <a href="#">Figure 19,</a> <a href="#">Figure 24</a> )		52		
$t_f$	Fall time			7.2		

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$ $I_{SDM}^{(1)}$	Source-drain current Source-drain current (pulsed)	For TO-220FP and I <sup>2</sup> PAKFP	-		46 184	A A
$I_{SD}$ $I_{SDM}^{(2)}$	Source-drain current Source-drain current (pulsed)	For TO-220, H <sup>2</sup> PAK-2	-		120 450	A A
$V_{SD}^{(3)}$	Forward on voltage	$I_{SD}=120\text{ A}$ , $V_{GS}=0$ ; for TO-220, H <sup>2</sup> PAK-2 $I_{SD}=46\text{ A}$ , $V_{GS}=0$ ; for TO-220FP and I <sup>2</sup> PAKFP	-		1.5	V
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_{SD}=120\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD}=80\text{ V}$ , $T_j=150\text{ }^\circ\text{C}$ (see <a href="#">Figure 21</a> )	-	68 182 5.4		ns nC A

1. Pulse width limited by safe operating area
2. Pulse width limited by safe operating area
3. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for TO-220FP and I<sup>2</sup>PAKFP

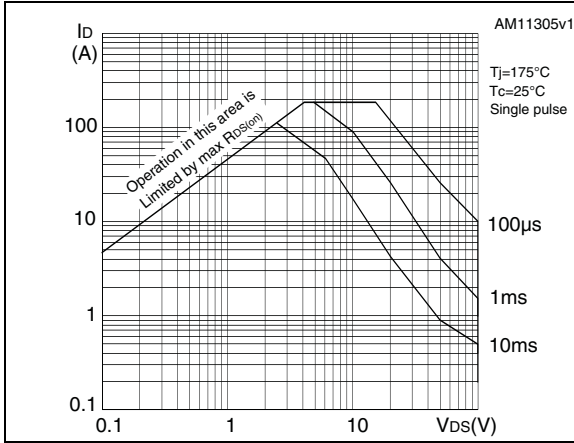


Figure 3. Thermal impedance for TO-220FP and I<sup>2</sup>PAKFP

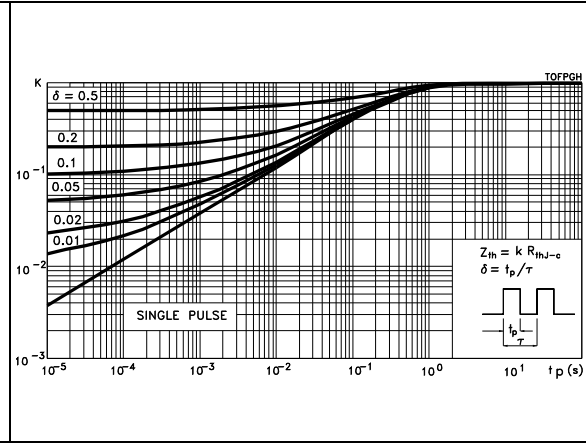


Figure 4. Safe operating area for H<sup>2</sup>PAK-2 and TO-220

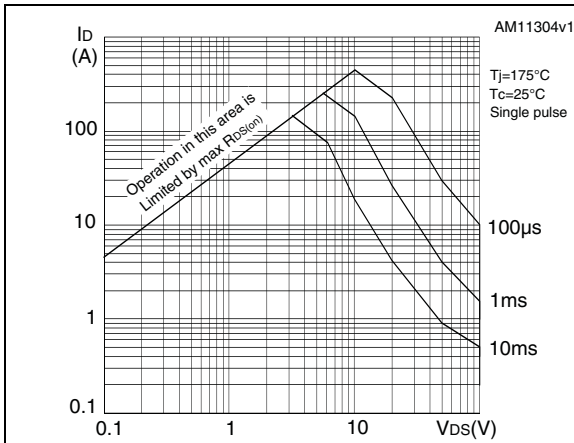


Figure 5. Thermal impedance for H<sup>2</sup>PAK-2 and TO-220

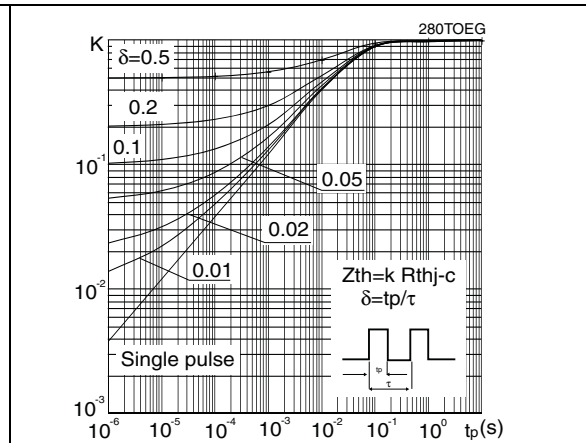


Figure 6. Output characteristics

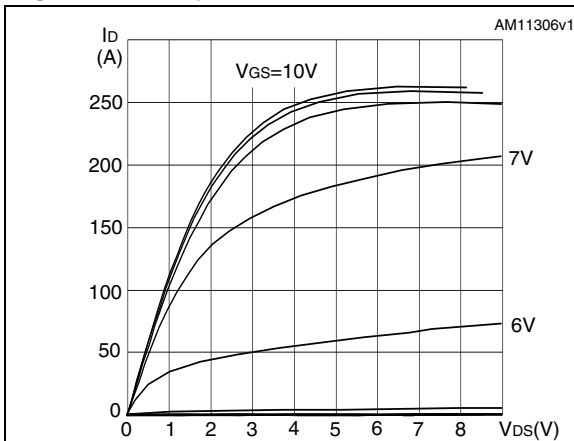


Figure 7. Transfer characteristics

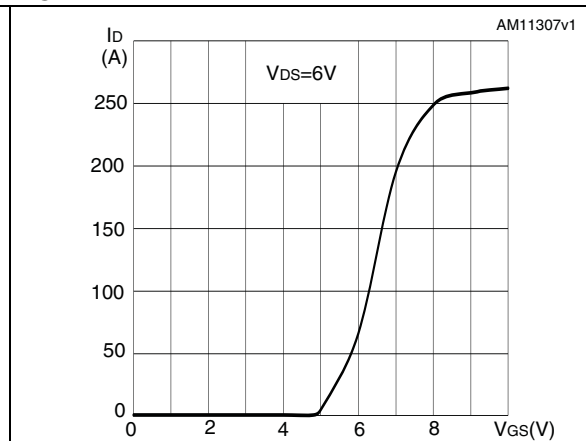


Figure 8. Static drain-source on-resistance for TO-220FP and I<sup>2</sup>PAKFP

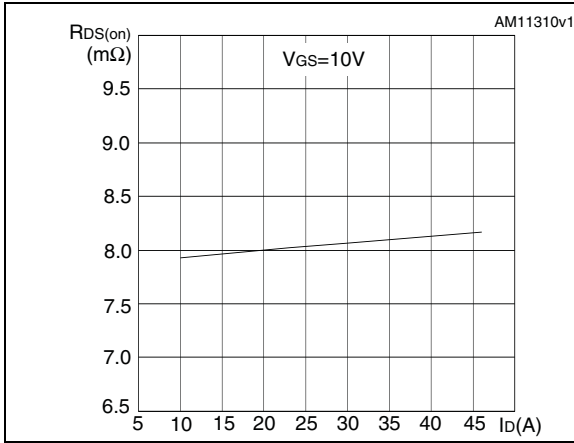


Figure 9. Static drain-source on-resistance for H<sup>2</sup>PAK-2

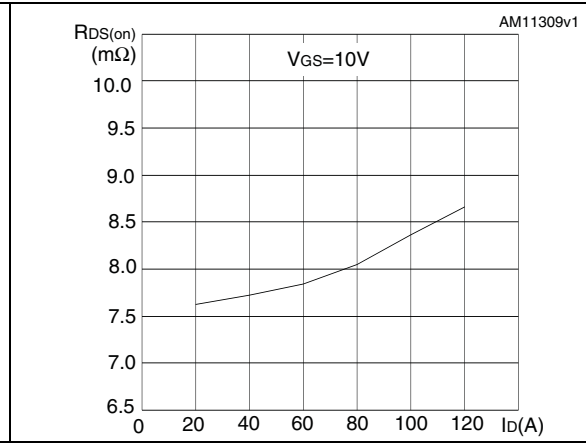


Figure 10. Static drain-source on-resistance for TO-220

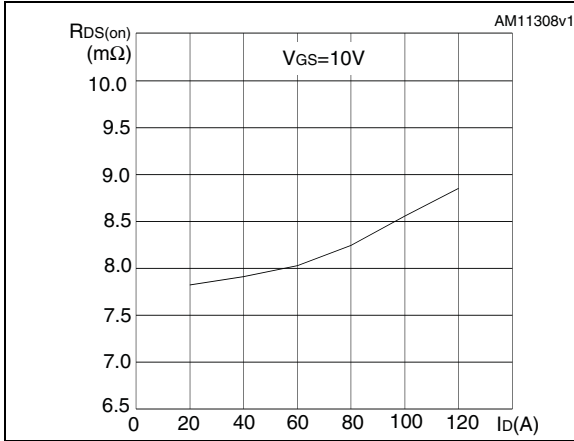


Figure 11. Normalized B<sub>V</sub>DSS vs temperature

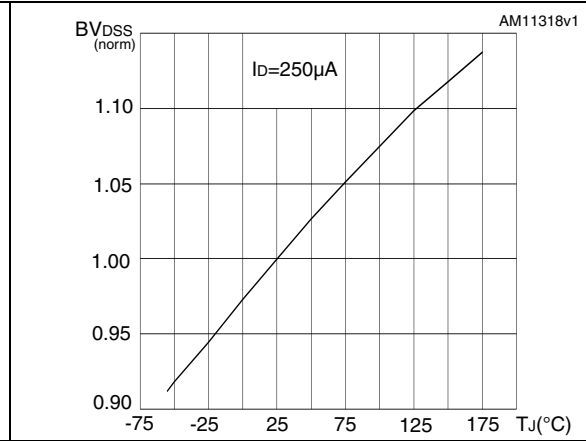


Figure 12. Gate charge vs gate-source voltage

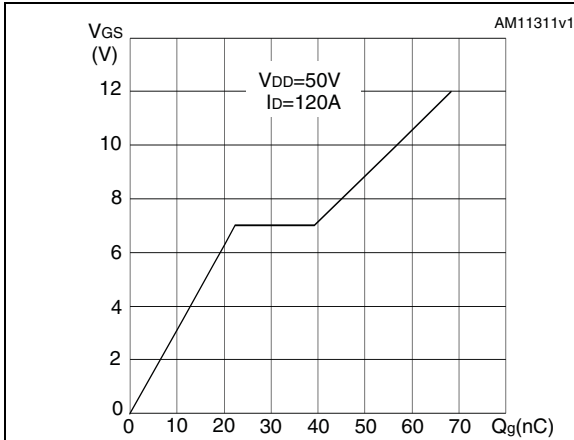


Figure 13. Capacitance variations

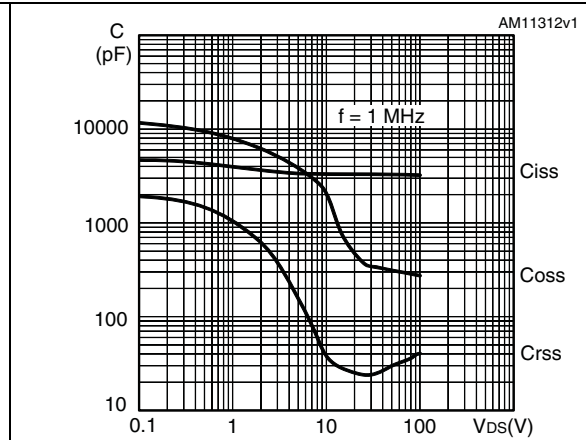


Figure 14. Normalized gate threshold voltage vs temperature

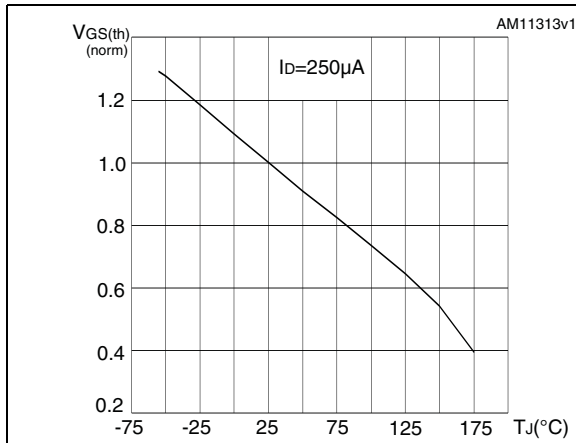


Figure 15. Normalized on-resistance vs temperature for TO-220FP and I<sup>2</sup>PAKFP

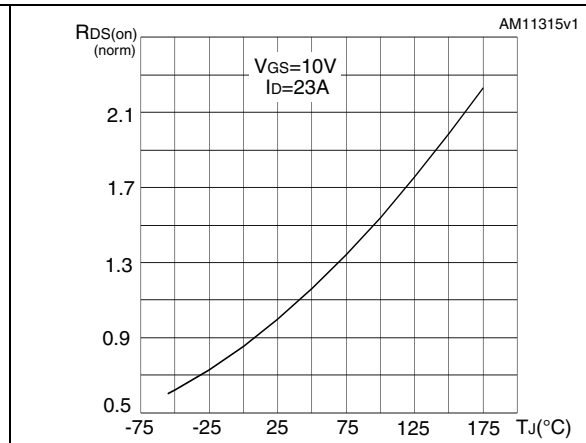


Figure 16. Normalized on resistance vs temperature for H<sup>2</sup>PAK-2 and TO-220

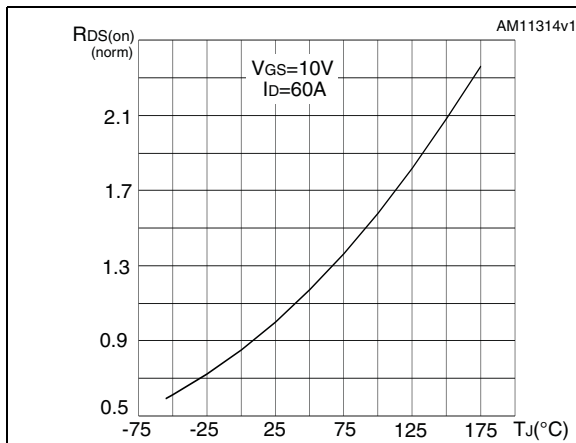


Figure 17. Source-drain diode forward characteristics for TO-220FP and I<sup>2</sup>PAKFP

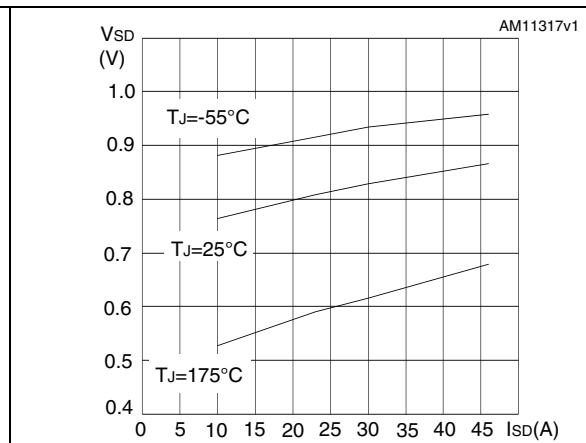
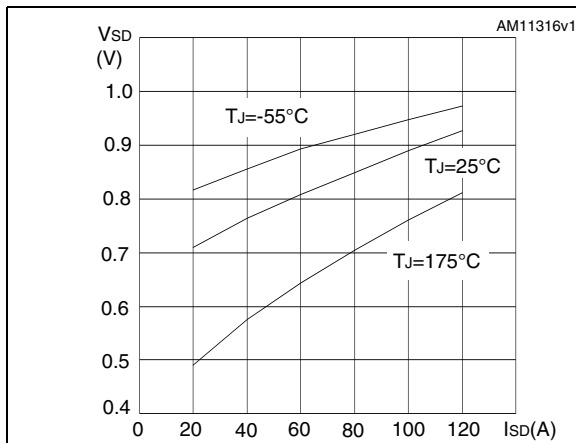




Figure 18. Source-drain diode forward characteristics for H<sup>2</sup>PAK-2 and TO-220



### 3 Test circuits

Figure 19. Switching times test circuit for resistive load

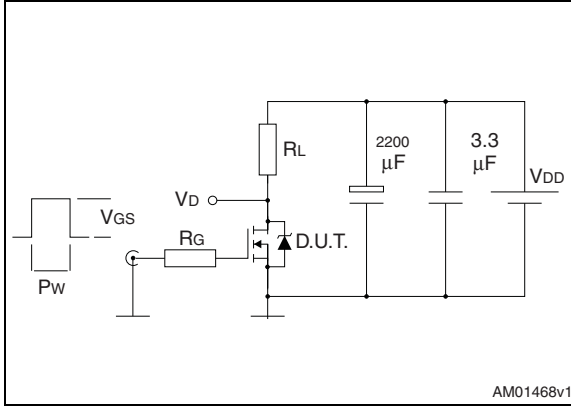


Figure 20. Gate charge test circuit

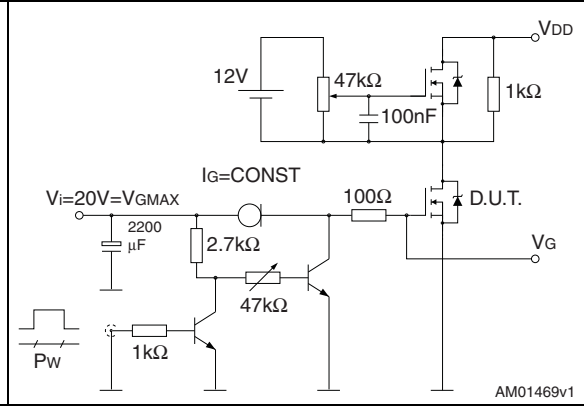


Figure 21. Test circuit for inductive load switching and diode recovery times

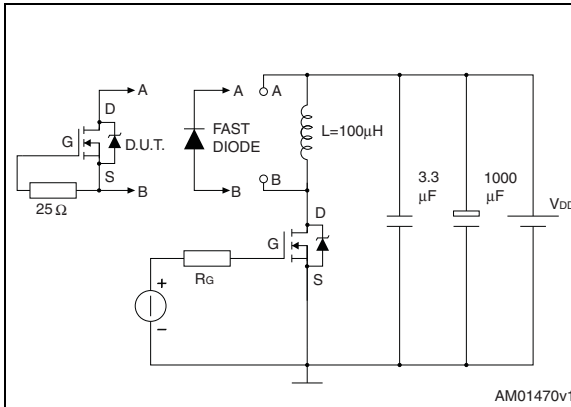


Figure 22. Unclamped inductive load test circuit

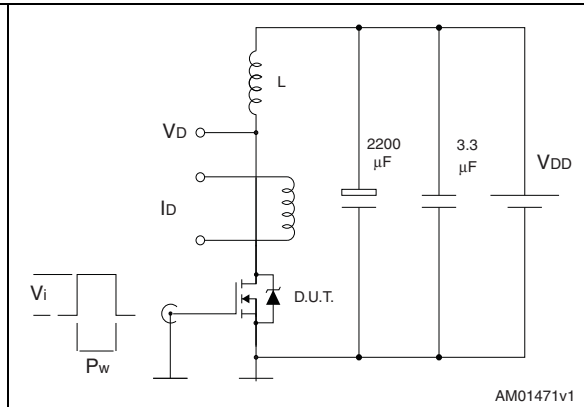


Figure 23. Unclamped inductive waveform

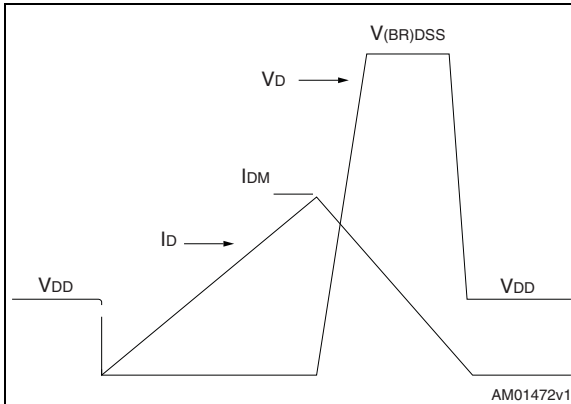
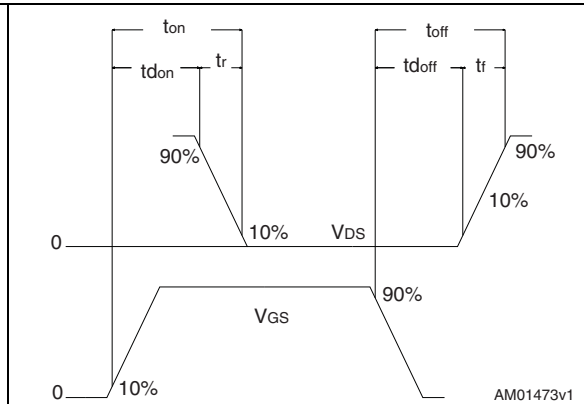


Figure 24. Switching time waveform



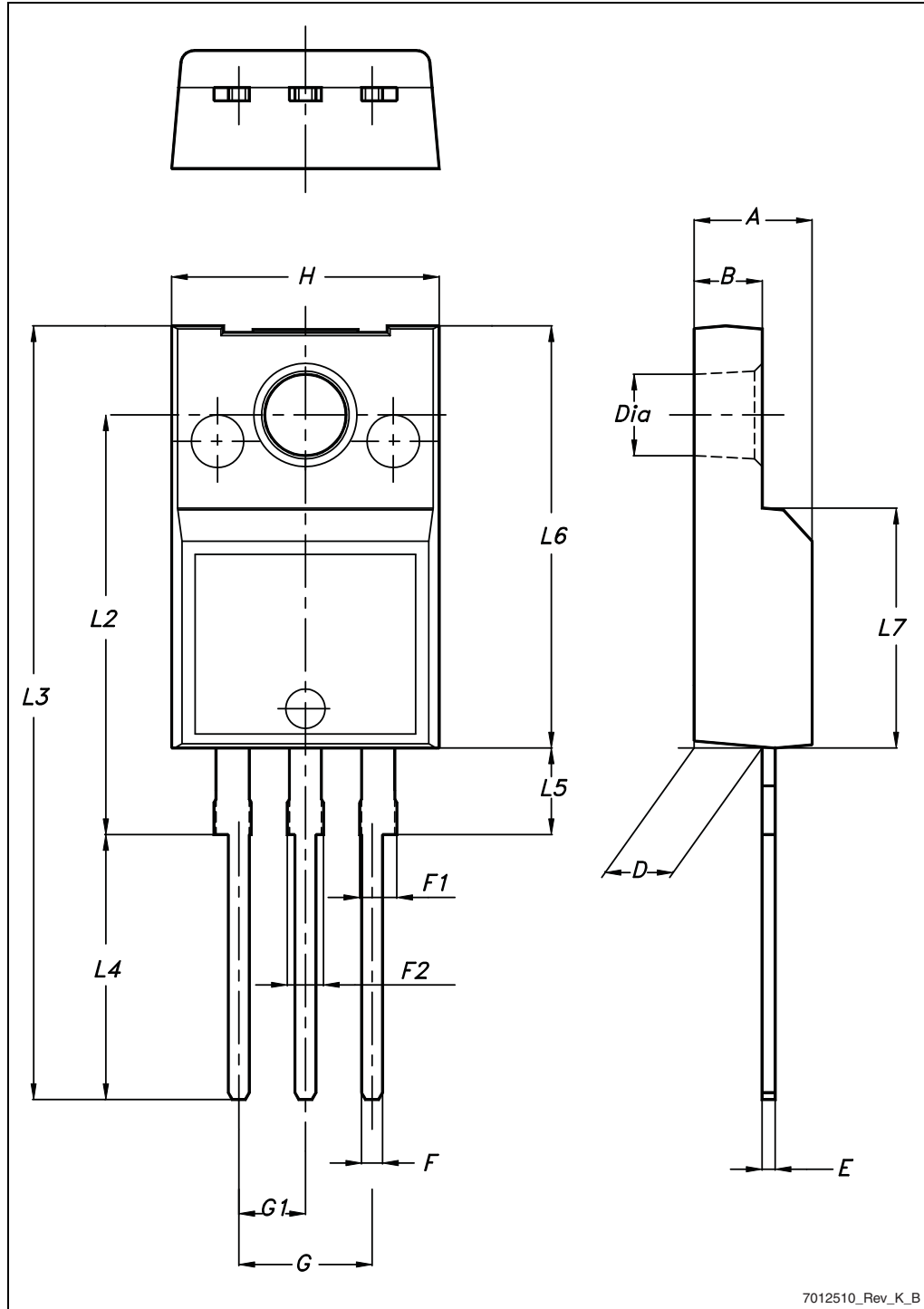
## 4 Package mechanical data

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 is an ST trademark.

Table 8. 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

Figure 25. TO-220FP drawing



7012510\_Rev\_K\_B

Table 9. I<sup>2</sup>PAKFP (TO-281) mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40	-	4.60
B	2.50		2.70
D	2.50		2.75
D1	0.65		0.85
E	0.45		0.70
F	0.75		1.00
F1			1.20
G	4.95		5.20
H	10.00		10.40
L1	21.00		23.00
L2	13.20		14.10
L3	10.55		10.85
L4	2.70		3.20
L5	0.85		1.25
L6	7.30		7.50

Figure 26. I<sup>2</sup>PAKFP (TO-281) drawing

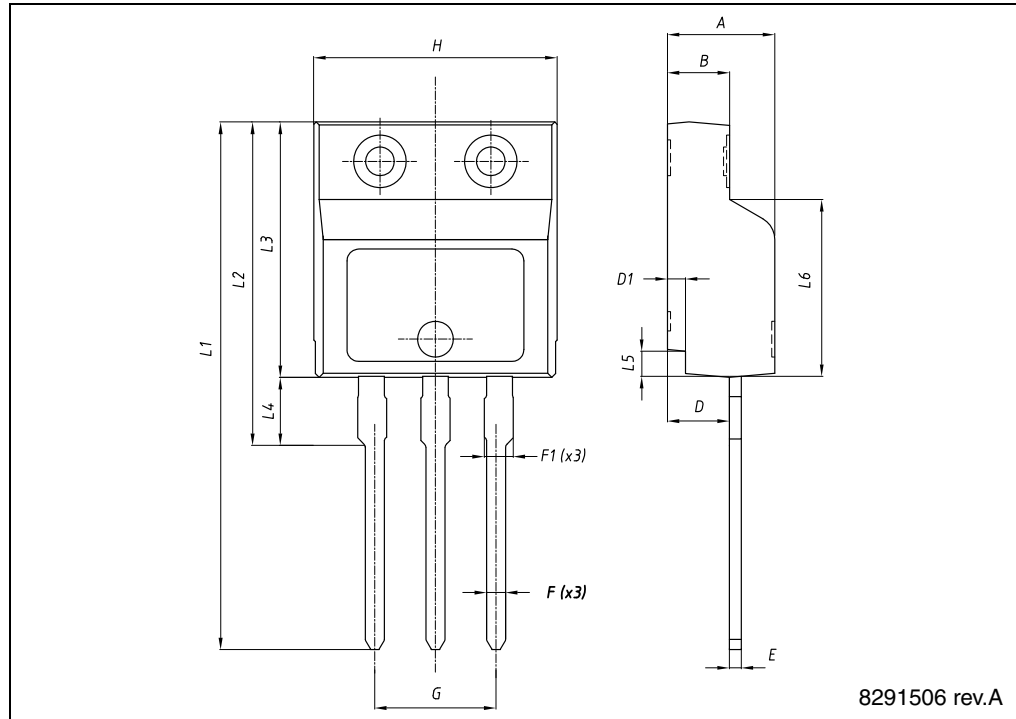


Table 10. H<sup>2</sup>PAK-2 mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.30		4.80
A1	0.03		0.20
C	1.17		1.37
e	4.98		5.18
E	0.50		0.90
F	0.78		0.85
H	10.00		10.40
H1	7.40		7.80
L	15.30		15.80
L1	1.27		1.40
L2	4.93		5.23
L3	6.85		7.25
L4	1.5		1.7
M	2.6		2.9
R	0.20		0.60
V	0°		8°

Figure 27. H<sup>2</sup>PAK-2 drawing

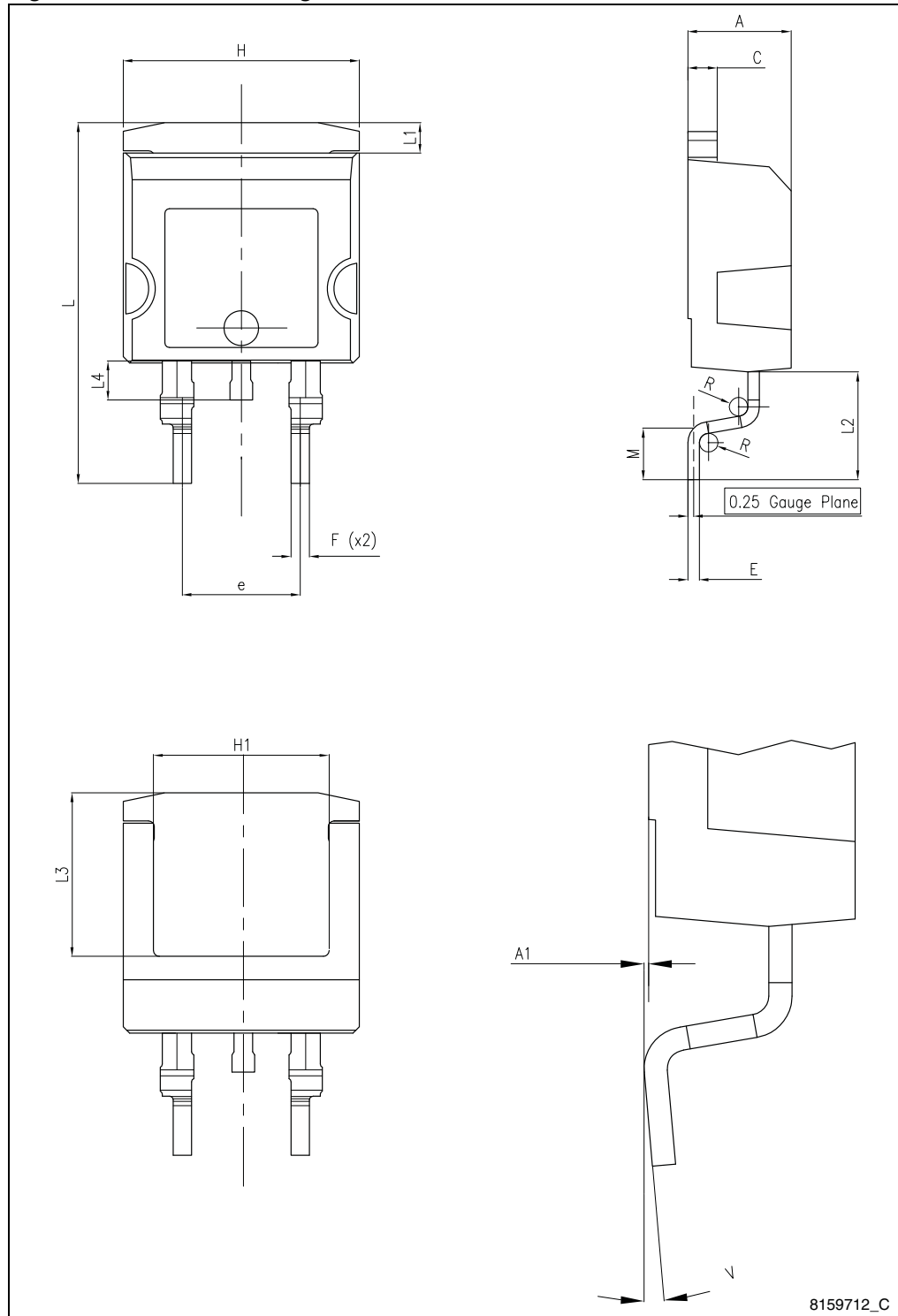




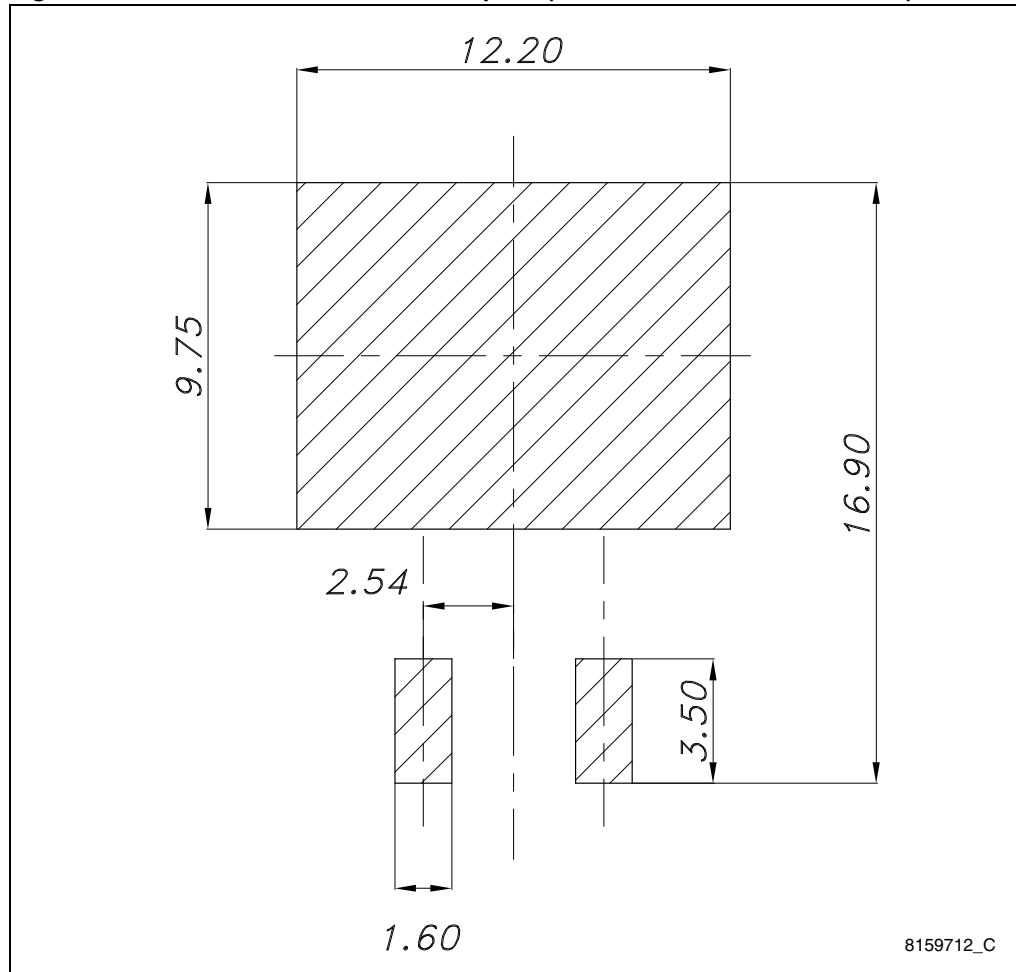
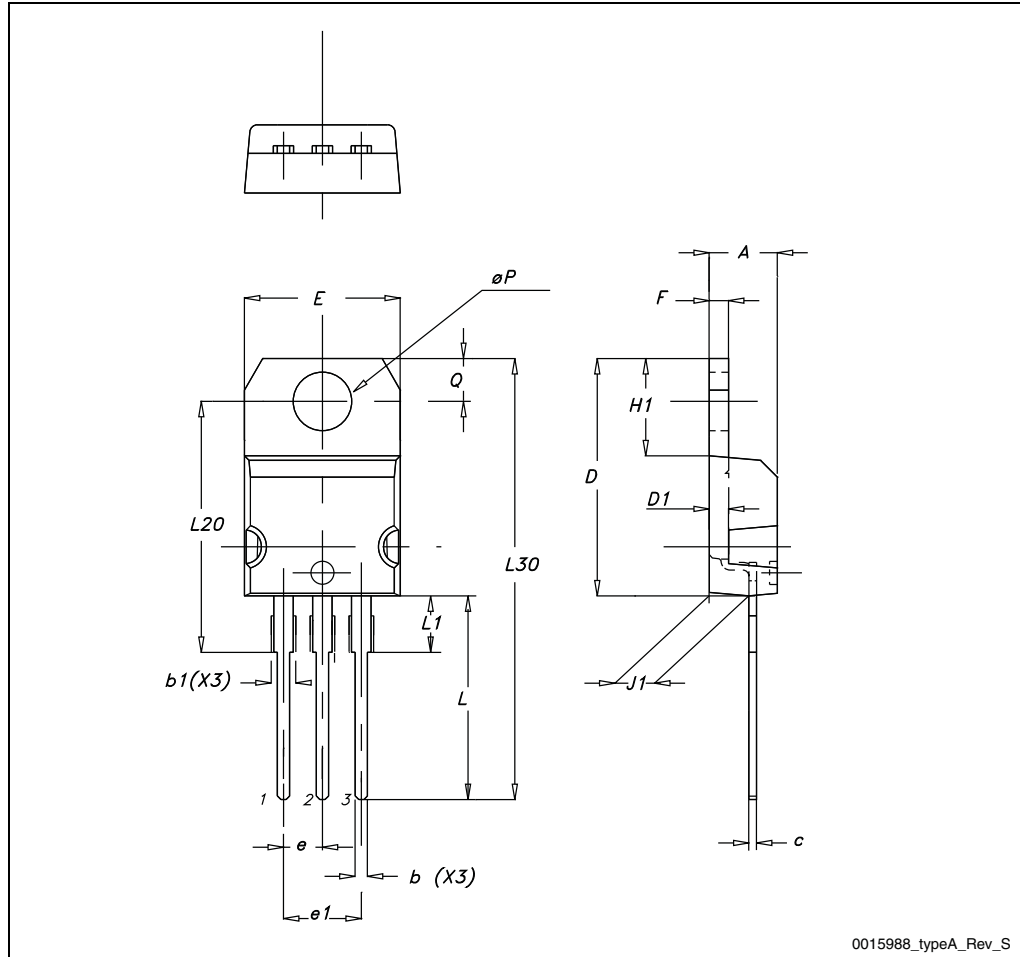
Figure 28. H<sup>2</sup>PAK-2 recommended footprint (dimensions are in millimeters)

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

Figure 29. TO-220 type A drawing



## 5 Package mechanical data

Table 12. H<sup>2</sup>PAK-2 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			

Figure 30. Tape

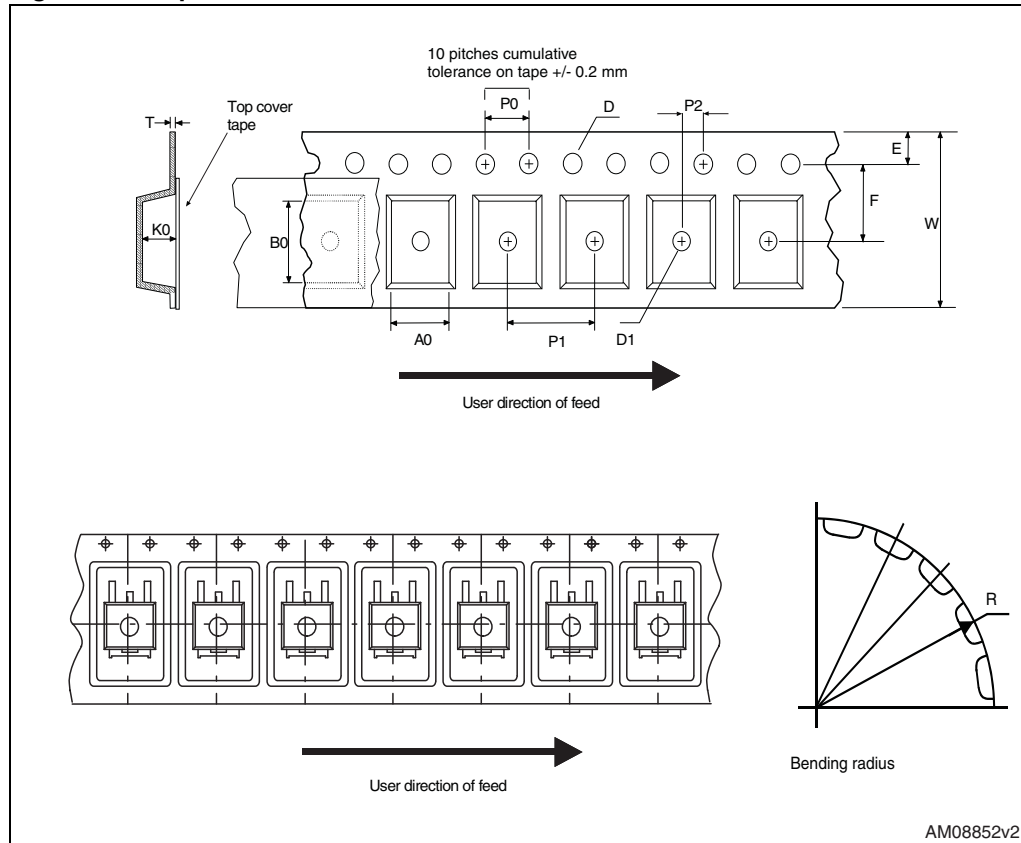
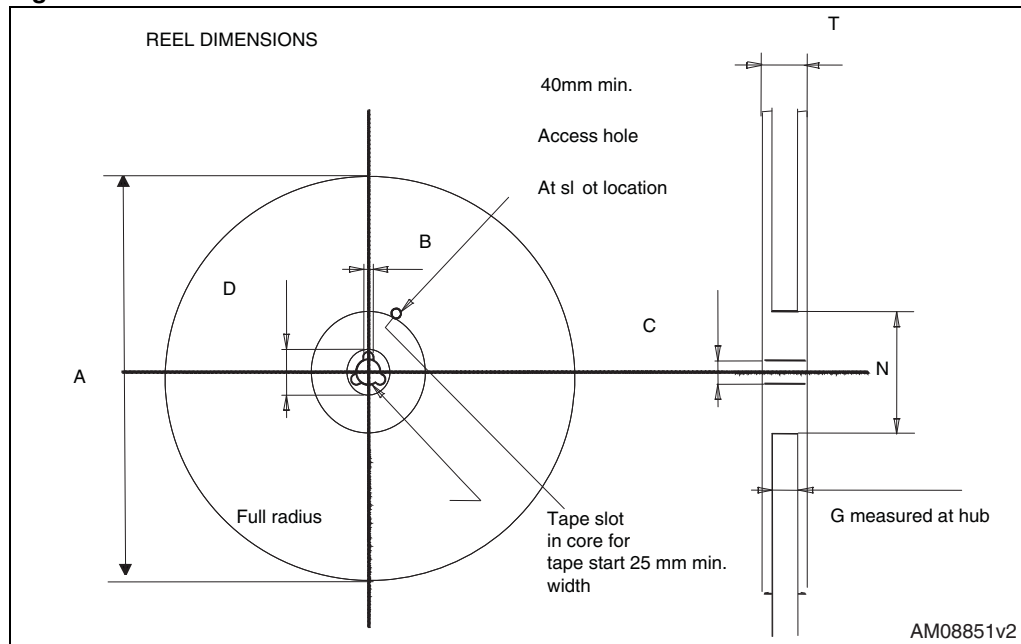


Figure 31. Reel



## 6 Revision history

Table 13. Document revision history

Date	Revision	Changes
24-Feb-2011	1	First version.
07-May-2012	2	Added <a href="#">Section 2.1: Electrical characteristics (curves)</a> . Minor text changes.
07-Nov-2012	3	Added new device in I <sup>2</sup> PAKFP and updated the document accordingly. Updated <a href="#">Section 4: Package mechanical data</a> .

**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](http://www.st.com)

