

N-channel 80 V, 3.3 mΩ typ., 90 A STripFET™ VII DeepGATE™ Power MOSFET in TO-220FP, H<sup>2</sup>PAK-2 and TO-220 packages

Datasheet - production data

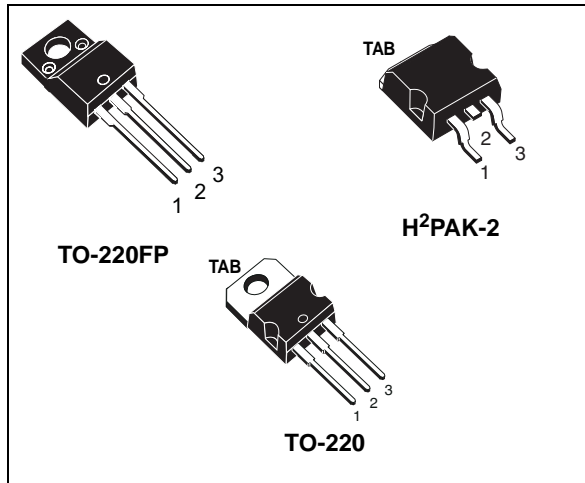
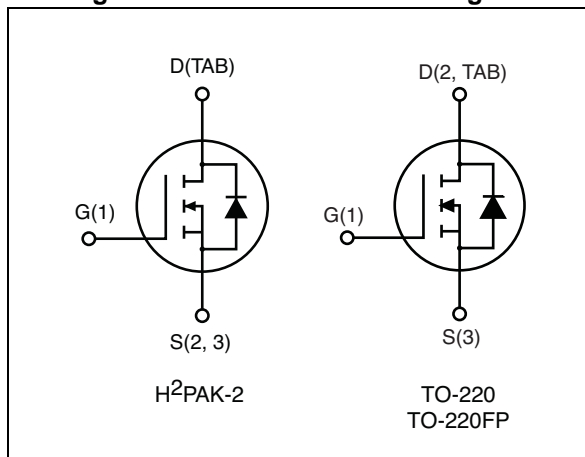


Figure 1. Internal schematic diagram



## Features

Order code	V <sub>DS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>	P <sub>TOT</sub>
STF140N8F7	80 V	4.3 mΩ	64 A	35 W
STH140N8F7-2	80 V	4 mΩ	90 A	200 W
STP140N8F7	80 V	4.3 mΩ	90 A	200 W

- Ultra low on-resistance
- 100% avalanche tested

## Applications

- Switching applications

## Description

These devices are N-channel Power MOSFETs developed using the 7<sup>th</sup> generation of STripFET™ DeepGATE™ technology, with a new gate structure. The resulting Power MOSFETs exhibits the lowest R<sub>DS(on)</sub> in all packages.

Table 1. Device summary

Order code	Marking	Package	Packaging
STF140N8F7	140N8F7	TO-220FP	Tube
STH140N8F7-2		H <sup>2</sup> PAK-2	Tape and reel
STP140N8F7		TO-220	Tube

# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		TO-220 H <sup>2</sup> PAK-2	TO-220FP	
V <sub>DS</sub>	Drain-source voltage	80		V
V <sub>GS</sub>	Gate-source voltage	± 20		
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 25 °C	90 <sup>(1)</sup>	64 <sup>(2)</sup>	A
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 100 °C	90 <sup>(1)</sup>	45 <sup>(2)</sup>	
I <sub>DM</sub> <sup>(3)</sup>	Drain current (pulsed)	360	256	
P <sub>TOT</sub> <sup>(2)</sup>	Total dissipation at T <sub>C</sub> = 25 °C	200	35	W
E <sub>AS</sub> <sup>(4)</sup>	Single pulse avalanche energy	515		mJ
T <sub>j</sub>	Operating junction temperature	- 55 to 175		°C
T <sub>stg</sub>	Storage temperature			

1. Limited by package
2. This value is rated according to R<sub>thj-c</sub>
3. Pulse width is limited by safe operating area
4. Starting T<sub>j</sub> = 25 °C, I<sub>d</sub> = 18.5 A, V<sub>dd</sub> = 50 V

**Table 3. Thermal data**

Symbol	Parameter	Value			Unit
		TO-220FP	TO-220	H <sup>2</sup> PAK-2	
R <sub>thj-pcb</sub> <sup>(1)</sup>	Thermal resistance junction-pcb			35	°C/W
R <sub>thj-case</sub>	Thermal resistance junction-case	4.29	0.75		°C/W
R <sub>thj-amb</sub>	thermal resistance junction-ambient	62.5			°C/W

1. When mounted on FR-4 board of 1inch<sup>2</sup>, 2oz Cu, t < 10 sec

## 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 ( $V_{GS} = 0$ )	$I_D = 250\ \mu A$	80			V
$I_{DSS}$	Zero gate voltage Drain current ( $V_{GS} = 0$ )	$V_{DS} = 80\text{ V}$ $V_{DS} = 80\text{ V}, T_J = 125\text{ °C}$			1 10	$\mu A$
$I_{GSS}$	Gate-source leakage current ( $V_{DS} = 0$ )	$V_{GS} = 20\text{ V}$			100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250\ \mu A$	2.5		4.5	V
$R_{DS(on)}$	Static drain-source on-resistance	For TO-220FP: $V_{GS} = 10\text{ V}, I_D = 32\text{ A}$		3.5	4.3	m $\Omega$
		For H <sup>2</sup> PAK-2: $V_{GS} = 10\text{ V}, I_D = 45\text{ A}$		3.3	4	
		For TO-220: $V_{GS} = 10\text{ V}, I_D = 45\text{ A}$		3.5	4.3	

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 40\text{ V}, f = 1\text{ MHz},$ $V_{GS} = 0$	-	6340	-	pF
$C_{oss}$	Output capacitance			1195		
$C_{rss}$	Reverse transfer capacitance			105		
$Q_g$	Total gate charge	$V_{DD} = 40\text{ V}, I_D = 64\text{ A},$ $V_{GS} = 10\text{ V}$	-	96	-	nC
$Q_{gs}$	Gate-source charge			30		
$Q_{gd}$	Gate-drain charge			26		

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 40\text{ V}, I_D = 45\text{ A}$ $R_G = 4.7\ \Omega, V_{GS} = 10\text{ V}$	-	26	-	ns
$t_r$	Rise time			51		
$t_{d(off)}$	Turn-off-delay time			82		
$t_f$	Fall time			44		

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current	For H <sup>2</sup> PAK-2 and TO-220 For TO-220FP	-		90 64	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)	For H <sup>2</sup> PAK-2 and TO-220 For TO-220FP	-		360 256	
$V_{SD}^{(2)}$	Forward on voltage	For TO-220FP: $I_{SD} = 64\text{ A}$ , $V_{GS} = 0$ For TO-220, H <sup>2</sup> PAK-2: $I_{SD} = 90\text{ A}$ , $V_{GS} = 0$	-		1.2	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 64\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ $T_j = 150\text{ }^\circ\text{C}$	-	58		ns
$Q_{rr}$	Reverse recovery charge		-	92		nC
$I_{RRM}$	Reverse recovery current		-	3.2		A

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

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for TO-220FP

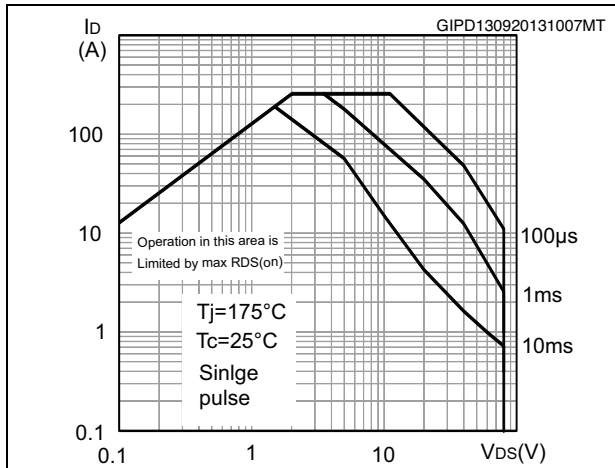


Figure 3. Thermal impedance for TO-220FP

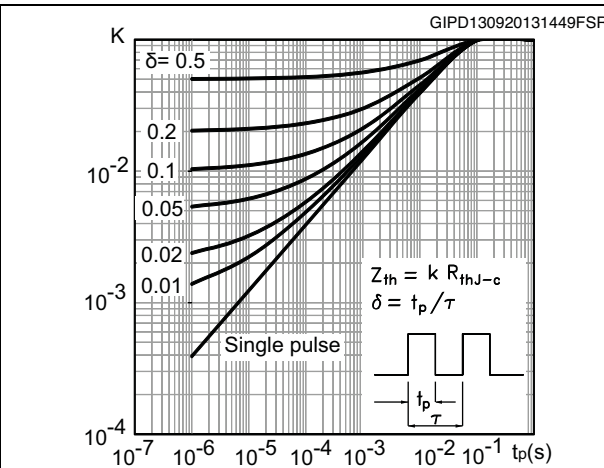


Figure 4. Safe operating area for H<sup>2</sup>PAK-2

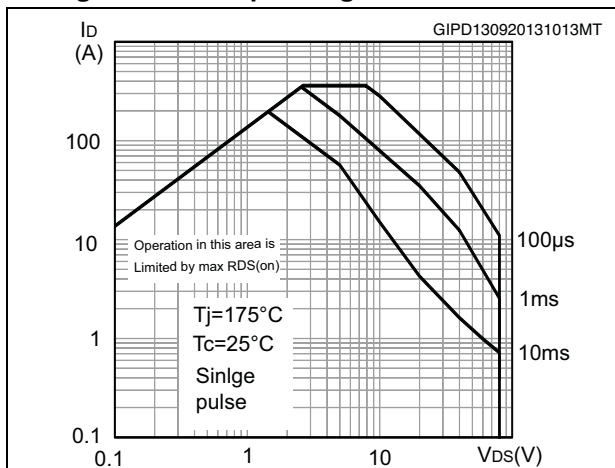


Figure 5. Thermal impedance for H<sup>2</sup>PAK-2

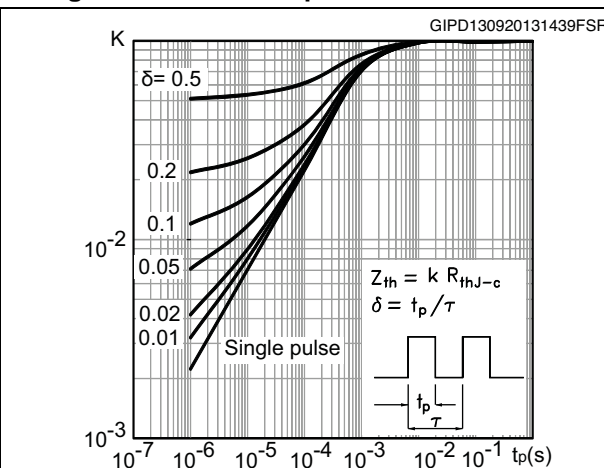


Figure 6. Safe operating area for TO-220

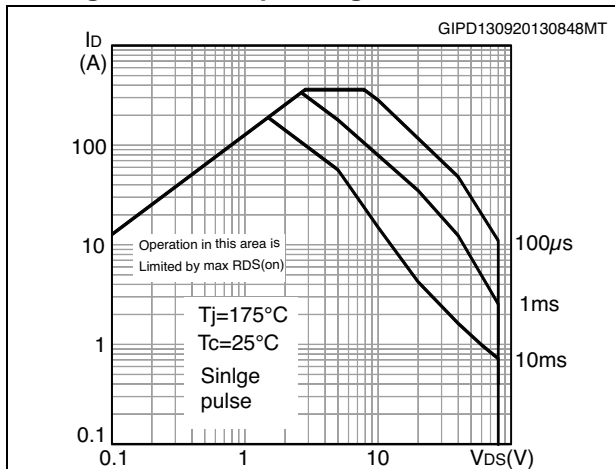


Figure 7. Thermal impedance for TO-220

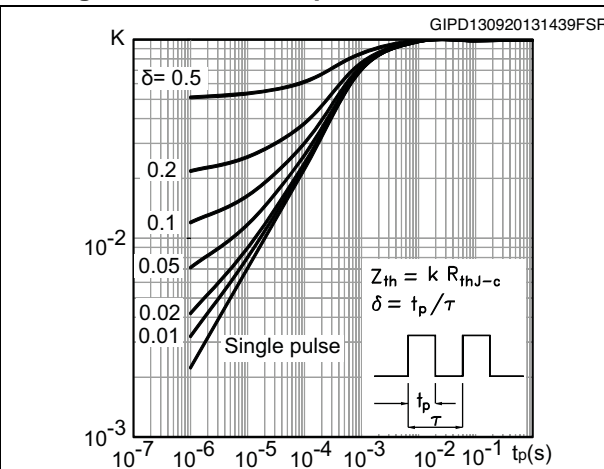


Figure 8. Output characteristics

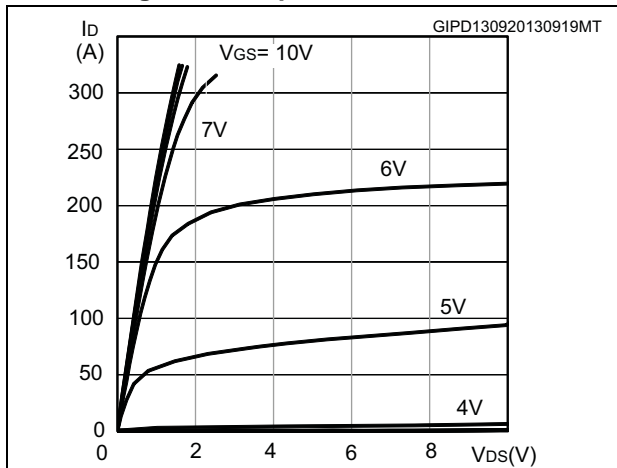


Figure 9. Transfer characteristics

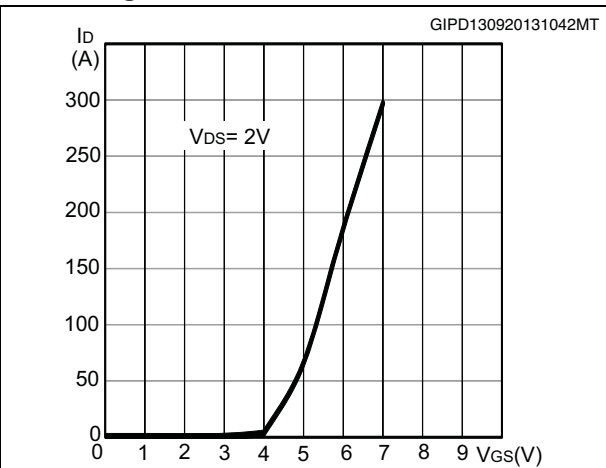


Figure 10. Gate charge vs gate-source voltage

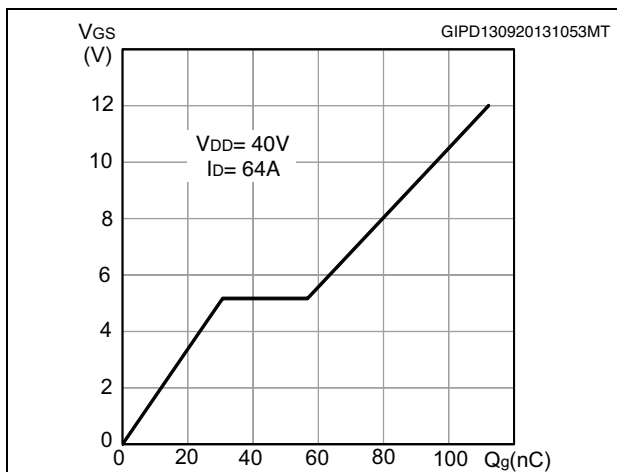


Figure 11. Static drain-source on-resistance for TO-220FP

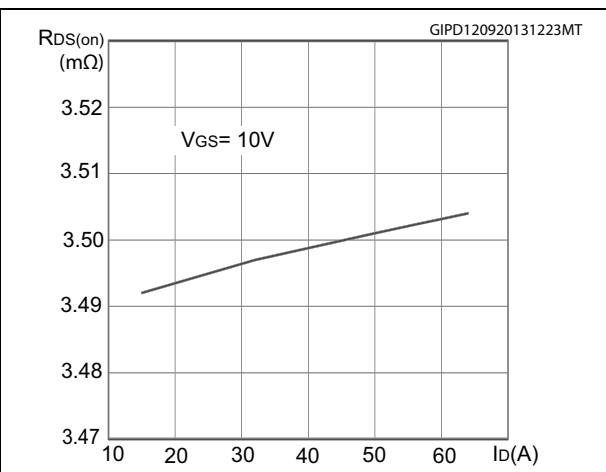


Figure 12. Static drain-source on-resistance for H<sup>2</sup>PAK-2

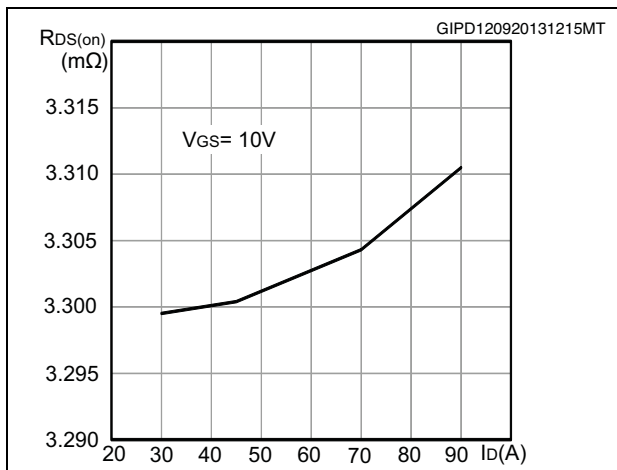


Figure 13. Static drain-source on-resistance for TO-220

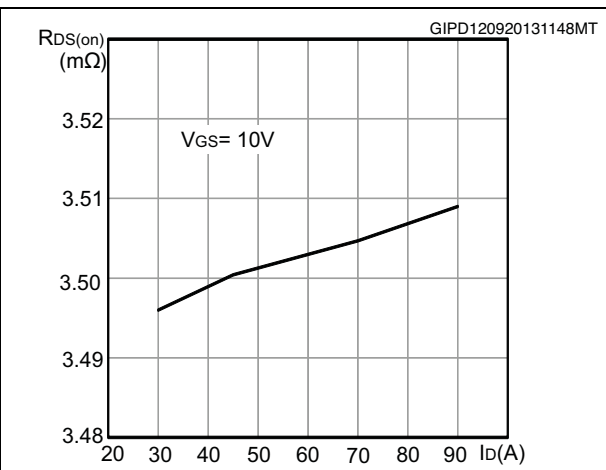


Figure 14. Capacitance variations

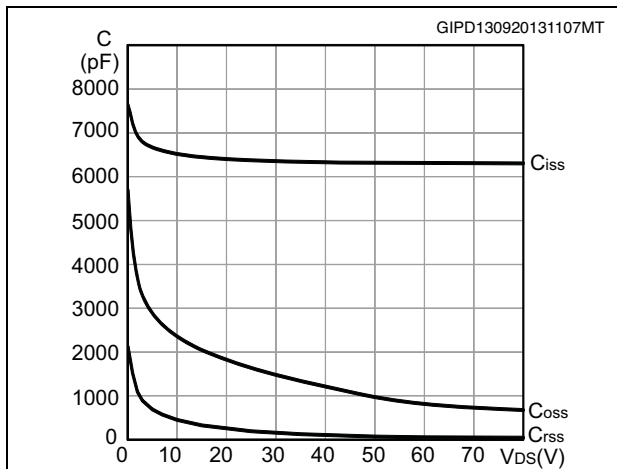


Figure 15. Normalized gate threshold voltage vs temperature

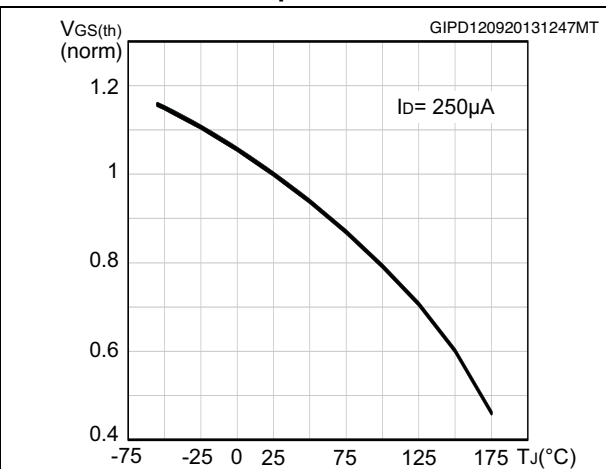


Figure 16. Normalized on-resistance vs temperature

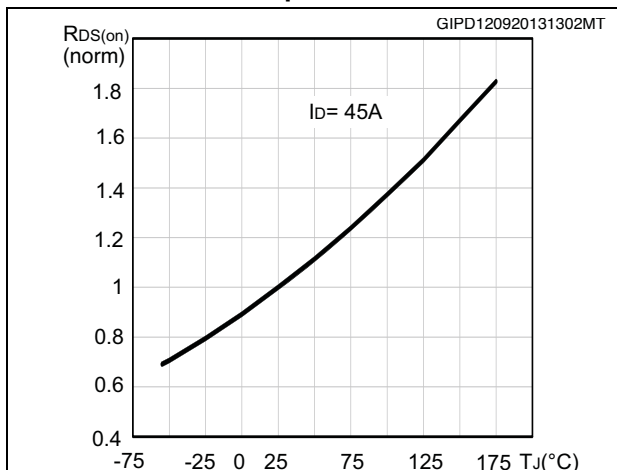


Figure 17. Normalized V(BR)DSS vs temperature

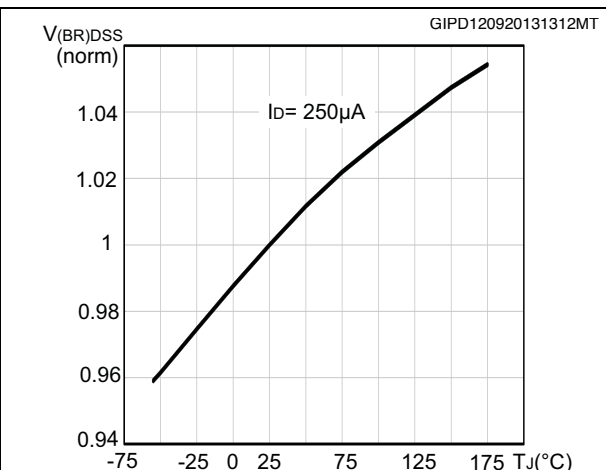


Figure 18. Source-drain diode forward characteristics for H<sup>2</sup>PAK-2 and TO-220

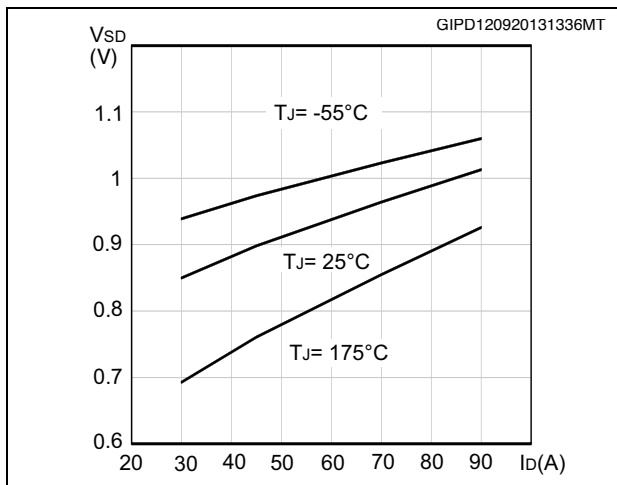
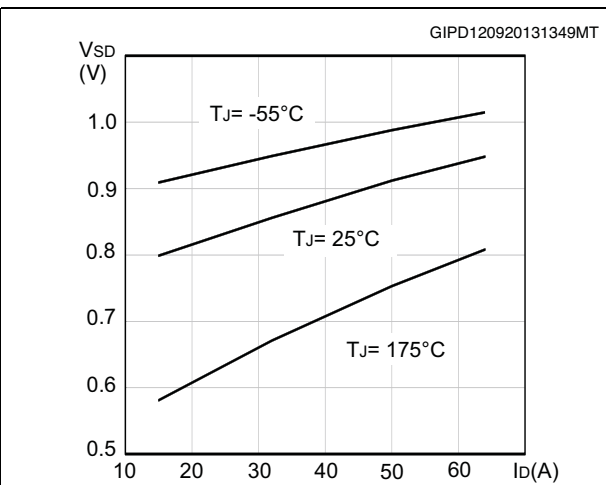


Figure 19. Source-drain diode forward characteristics for TO-220FP





### 3 Test circuits

Figure 20. Switching times test circuit for resistive load

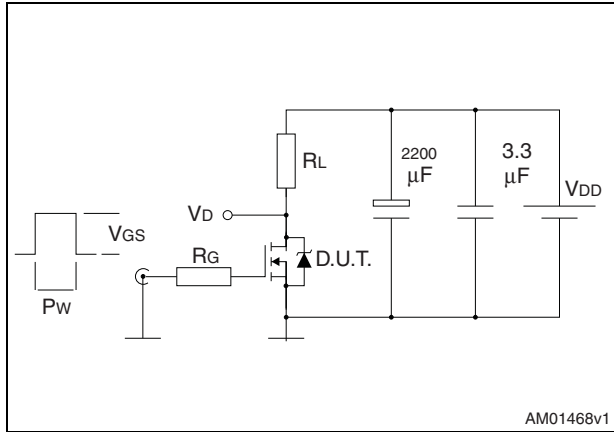


Figure 21. Gate charge test circuit

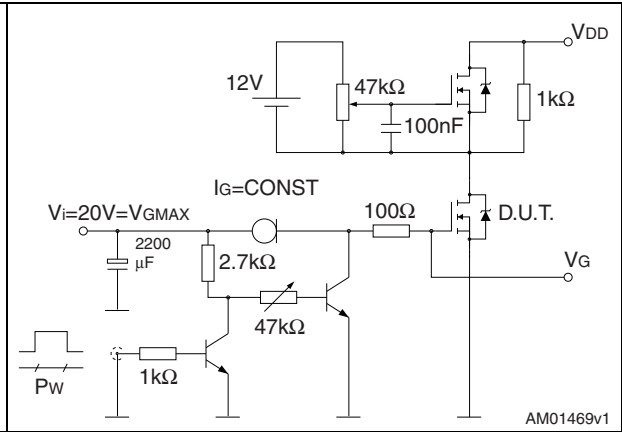


Figure 22. Test circuit for inductive load switching and diode recovery times

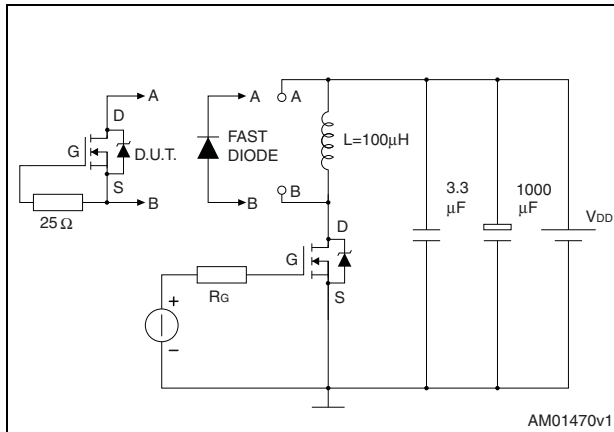


Figure 23. Unclamped inductive load test circuit

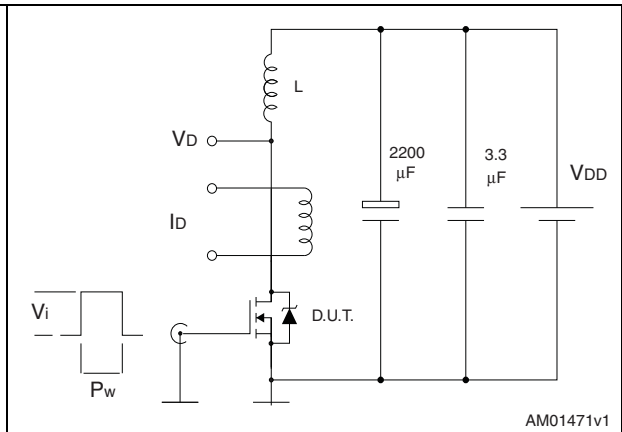


Figure 24. Unclamped inductive waveform



Figure 25. Switching time waveform



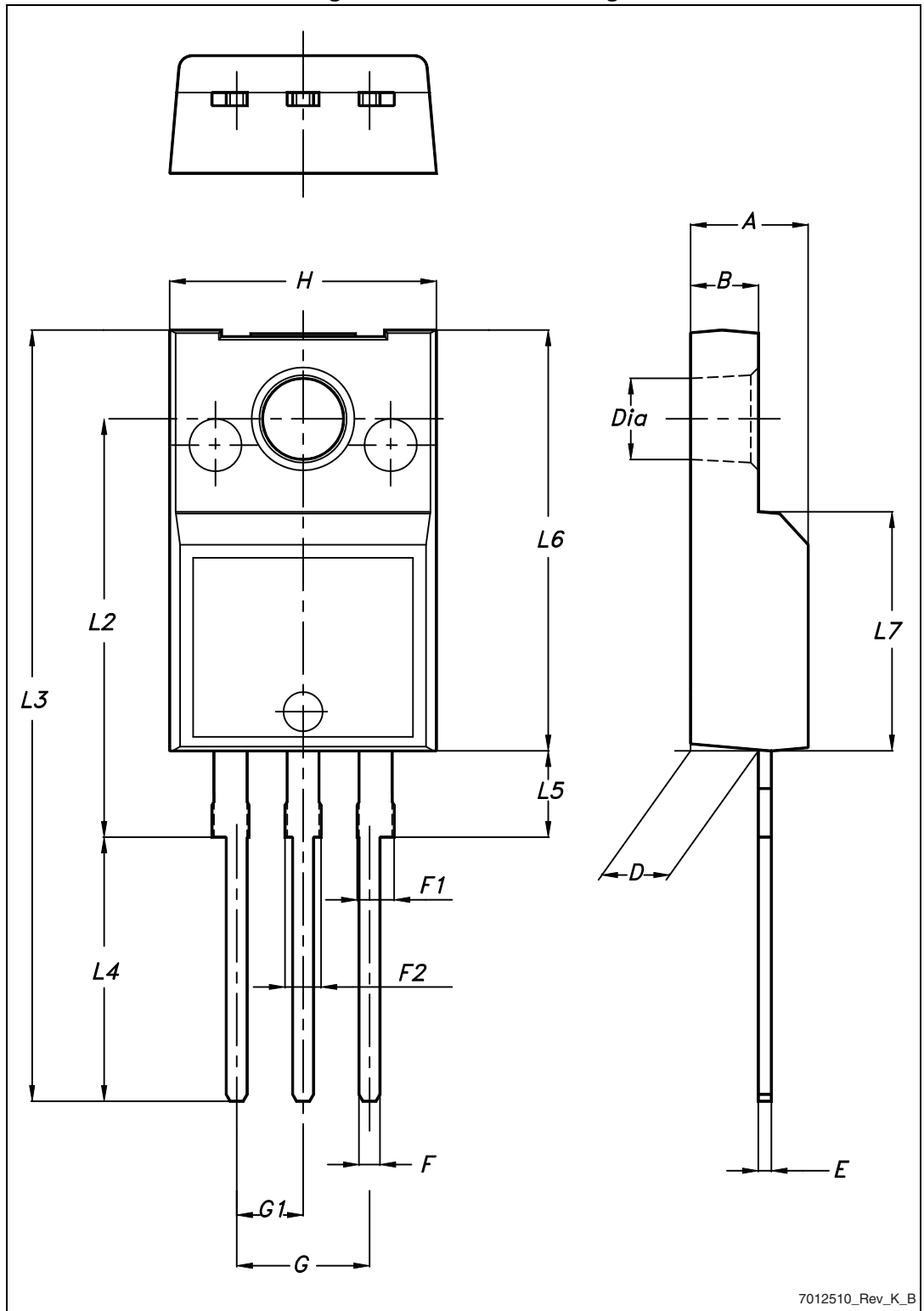
## 4 Package mechanical data

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<sup>®</sup> is an ST trademark.

**Table 8. TO-220FP mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.60
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	2.40		2.7
H	10		14
L2		16	10.4
L3	28.6		
L4	9.8		30.6
L5	2.9		10.6
L6	15.9		3.6
L7	9		16.4
Dia	3		3.2

Figure 26. TO-220FP drawing



7012510\_Rev\_K\_B

Table 9. 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

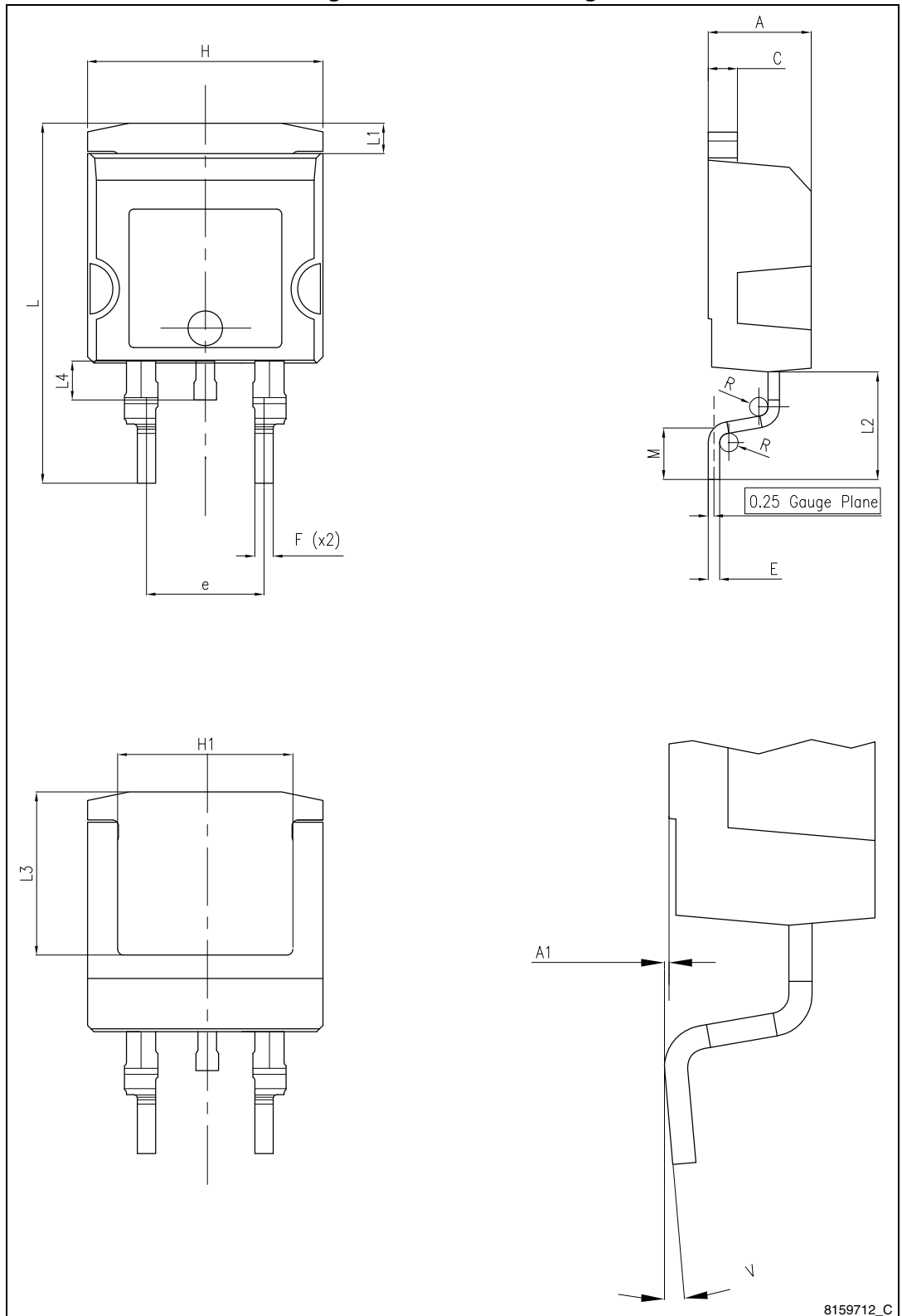
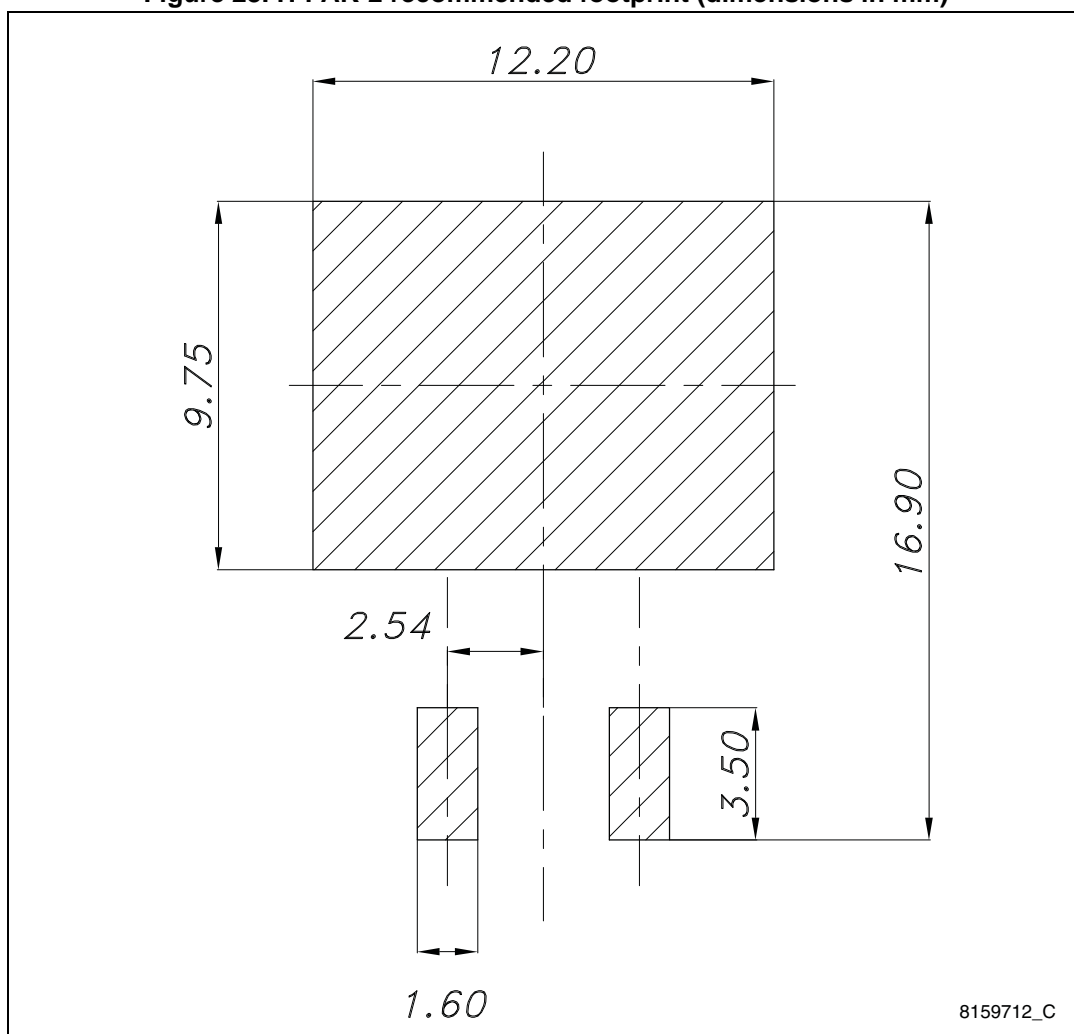


Figure 28. H<sup>2</sup>PAK-2 recommended footprint (dimensions in mm)

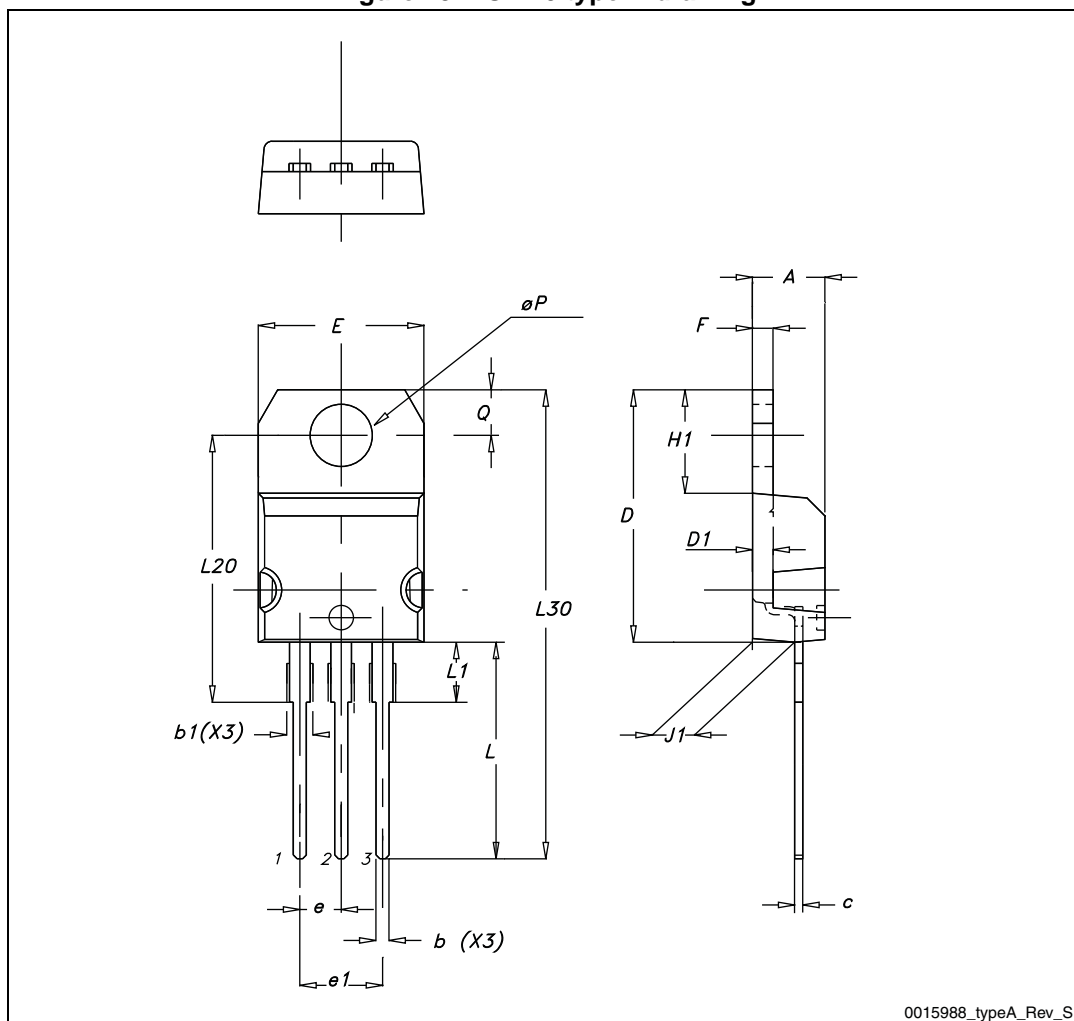


8159712\_C

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 29. TO-220 type A drawing





## 5 Packaging mechanical data

Table 11. 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 dimension

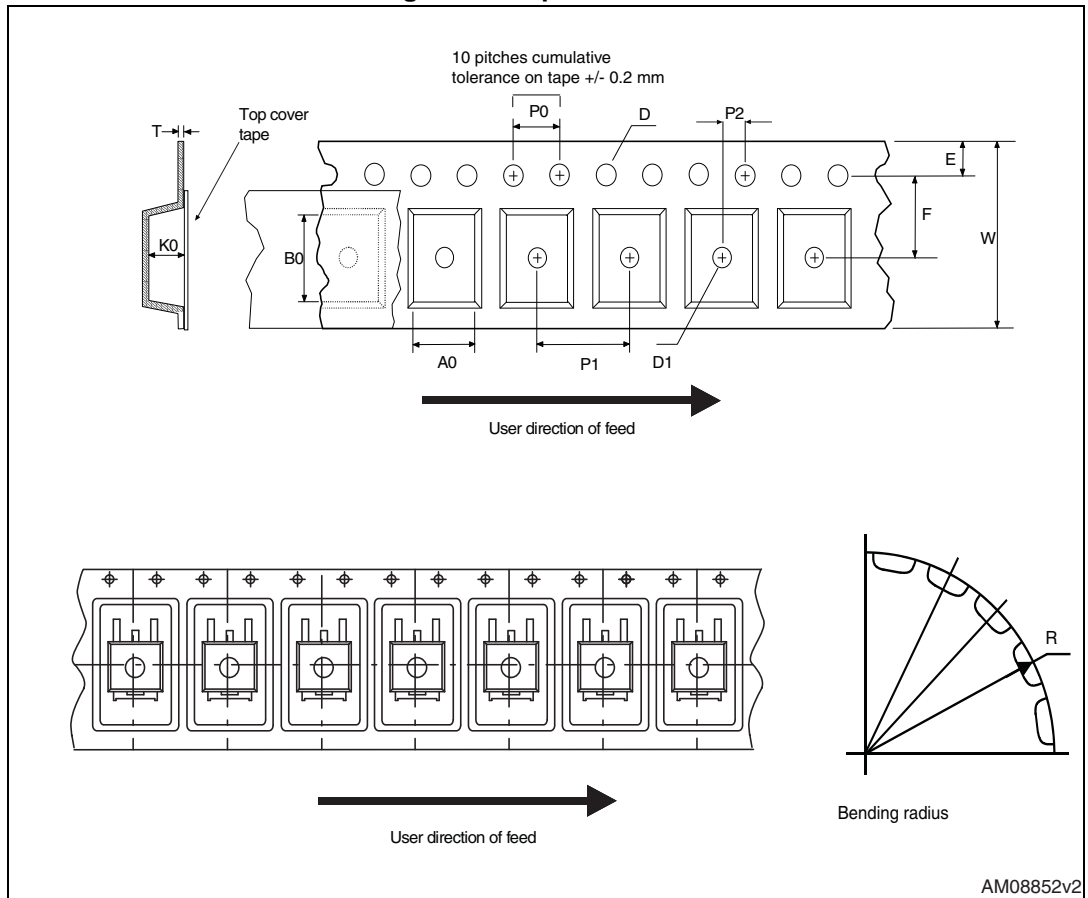
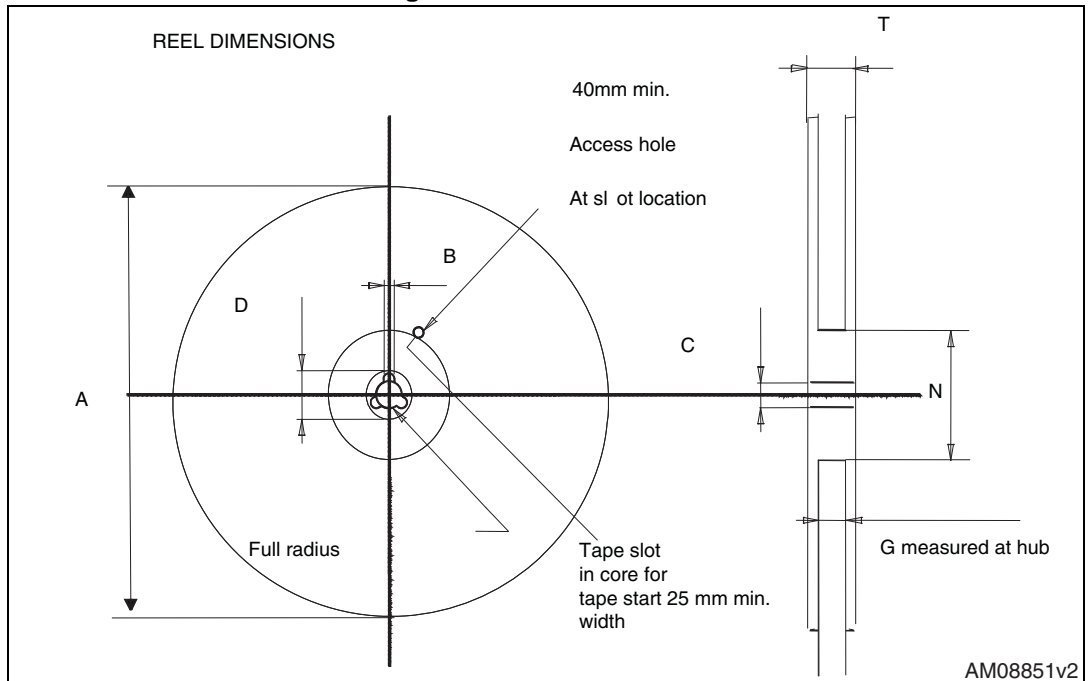


Figure 31. Reel dimension



## 6 Revision history

Table 12. Document revision history

Date	Revision	Changes
18-Sep-2013	1	First release.

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