

N-channel 80 V, 3.3 mΩ typ., 90 A STripFET™ VII DeepGATE™
Power MOSFET in TO-220FP, H²PAK-2 and TO-220 packages

Datasheet - production data

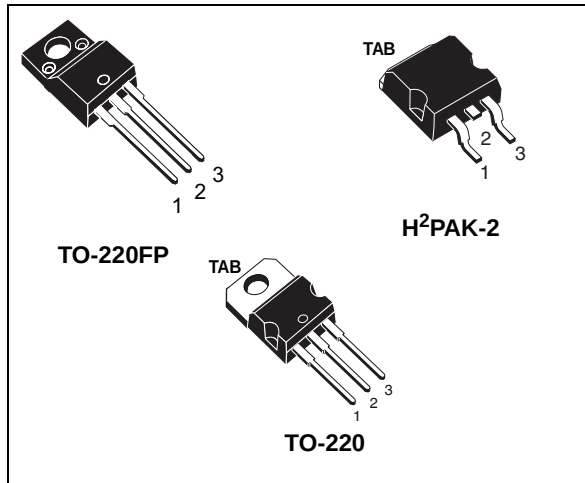
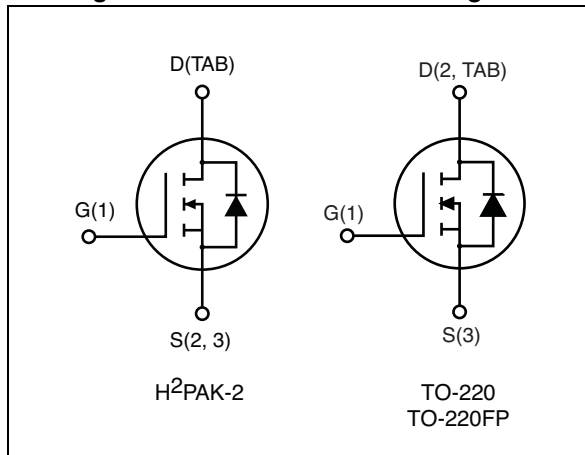


Figure 1. Internal schematic diagram



Features

Order code	V _{DS}	R _{DS(on)} max.	I _D	P _{TOT}
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 7th generation of STripFET™ DeepGATE™ technology, with a new gate structure. The resulting Power MOSFETs exhibits the lowest R_{DS(on)} in all packages.

Table 1. Device summary

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

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1 Electrical ratings

Table 2. Absolute maximum ratings

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

1. Limited by package
2. This value is rated according to R_{thj-c}
3. Pulse width is limited by safe operating area
4. Starting T_J = 25 °C, I_D = 18.5 A, V_{DD} = 50 V

Table 3. Thermal data

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

1. When mounted on FR-4 board of 1inch², 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 ($V_{GS} = 0$)	$I_D = 250\text{ }\mu\text{A}$	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	μA
I_{GSS}	Gate-source leakage current ($V_{DS} = 0$)	$V_{GS} = 20\text{ V}$			100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	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 Ω
		For H ² 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	$V_{DD} = 40\text{ V}, I_D = 45\text{ A}$ $R_G = 4.7\text{ }\Omega, V_{GS} = 10\text{ V}$	-	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 ² PAK-2 and TO-220 For TO-220FP	-		90 64	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)	For H ² 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 ² 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 μs , duty cycle 1.5%

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for TO-220FP

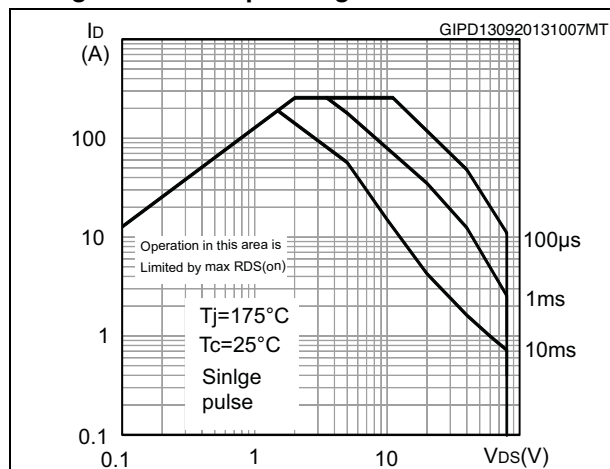


Figure 3. Thermal impedance for TO-220FP

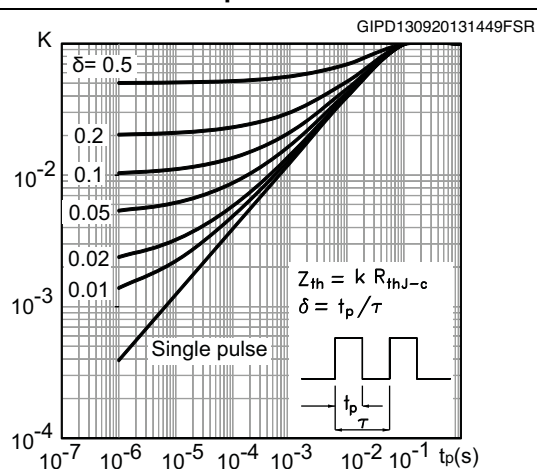
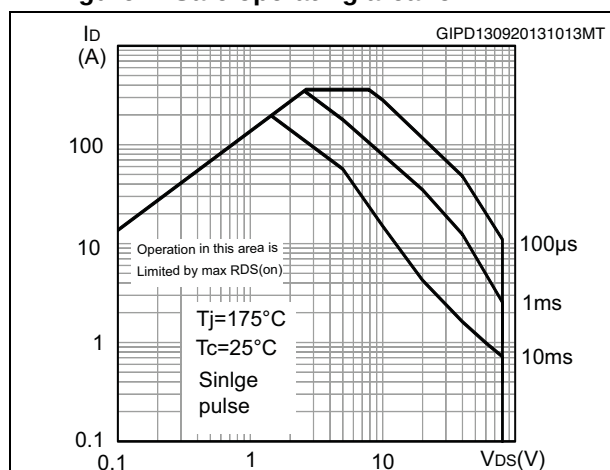
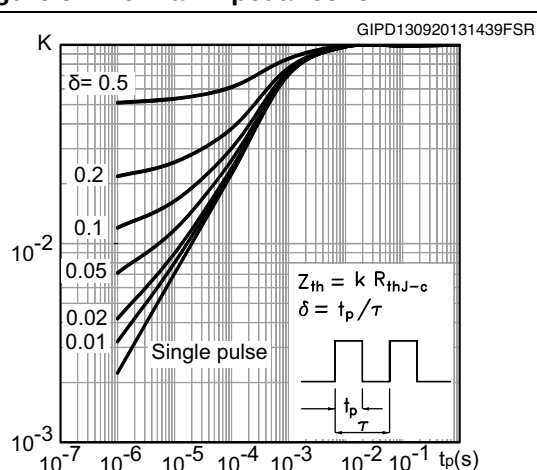
Figure 4. Safe operating area for H²PAK-2Figure 5. Thermal impedance for H²PAK-2

Figure 6. Safe operating area for TO-220

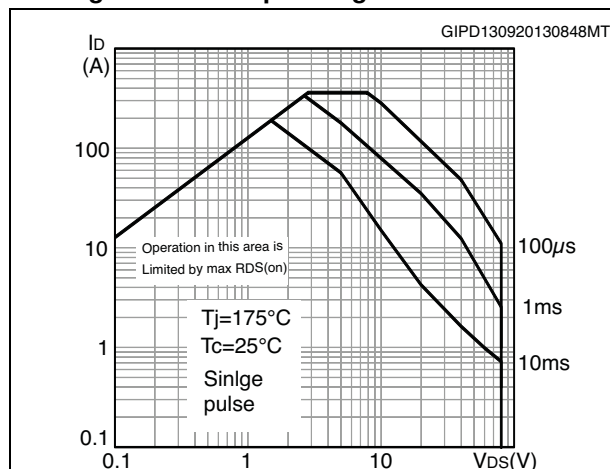


Figure 7. Thermal impedance for TO-220

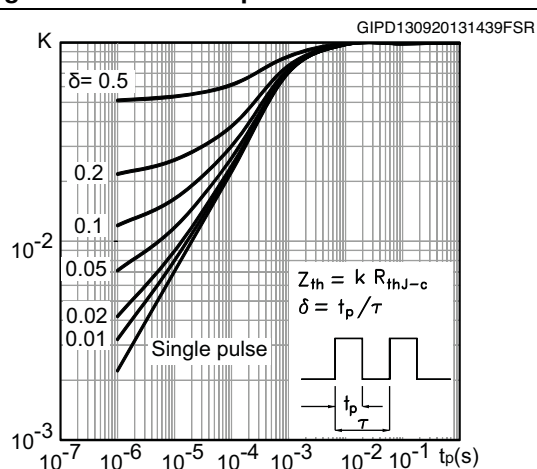


Figure 8. Output characteristics

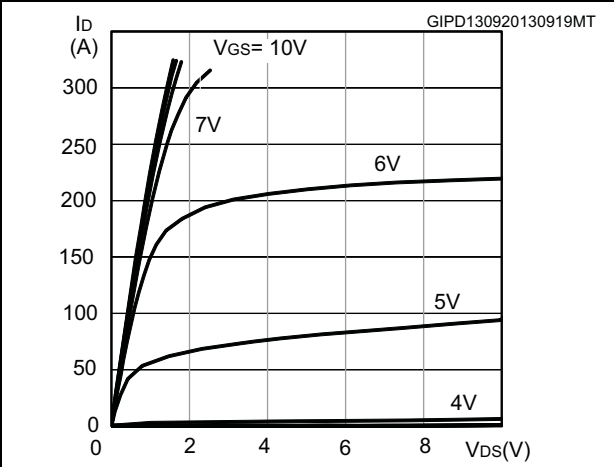


Figure 9. Transfer characteristics

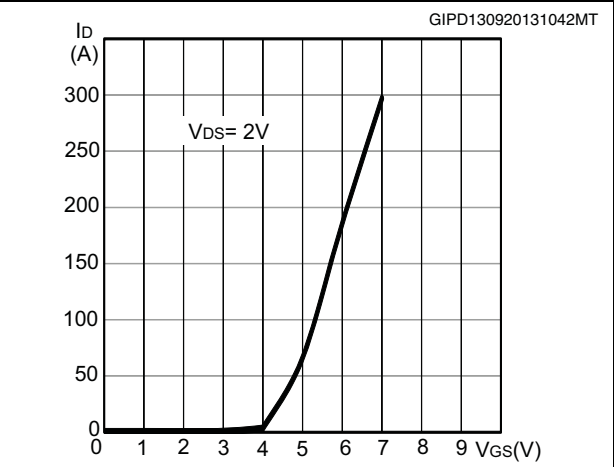


Figure 10. Gate charge vs gate-source voltage

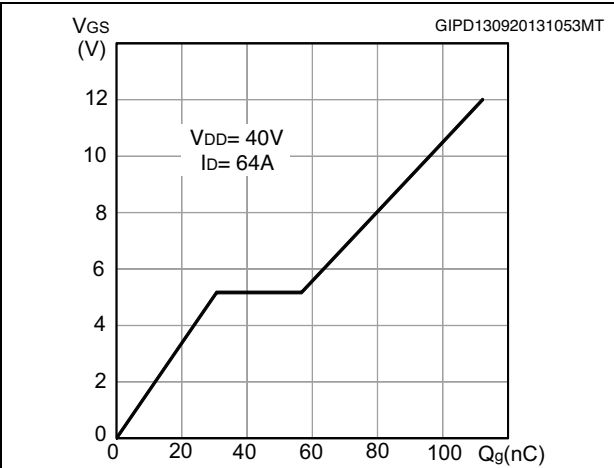


Figure 11. Static drain-source on-resistance for TO-220FP

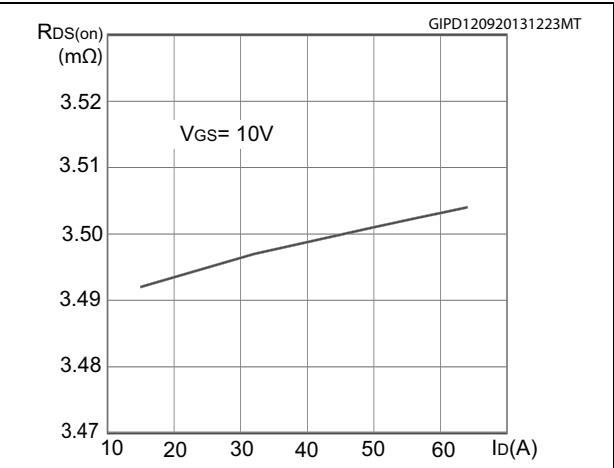


Figure 12. Static drain-source on-resistance for H²PAK-2

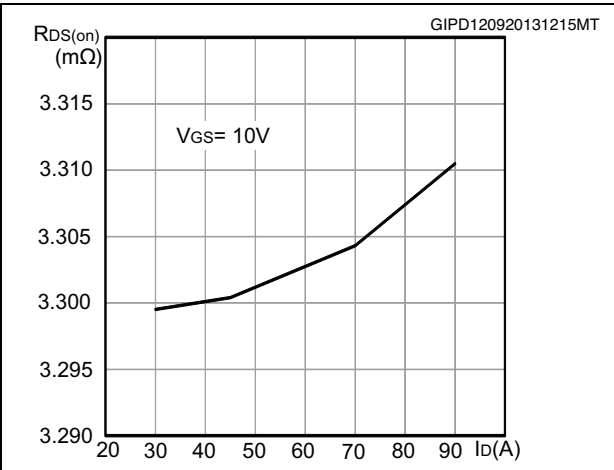


Figure 13. Static drain-source on-resistance for TO-220

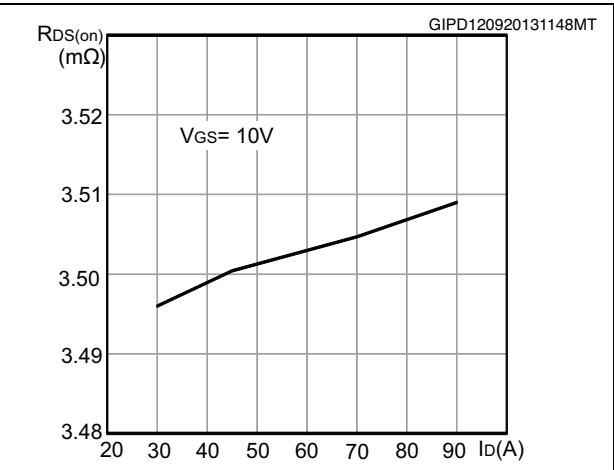


Figure 14. Capacitance variations

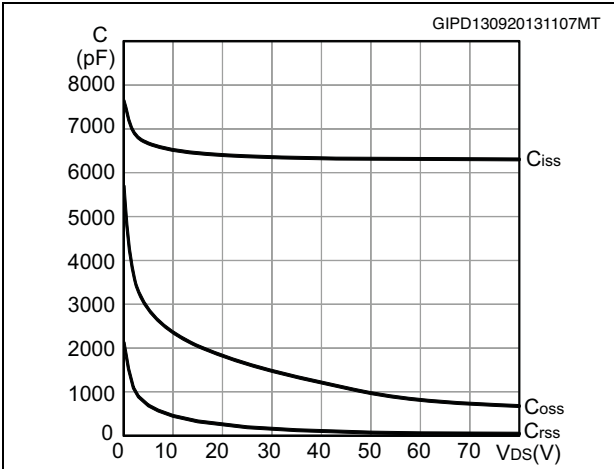


Figure 15. Normalized gate threshold voltage vs temperature

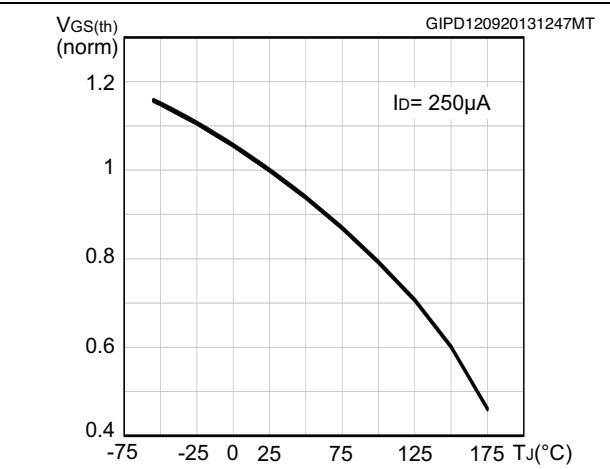


Figure 16. Normalized on-resistance vs temperature

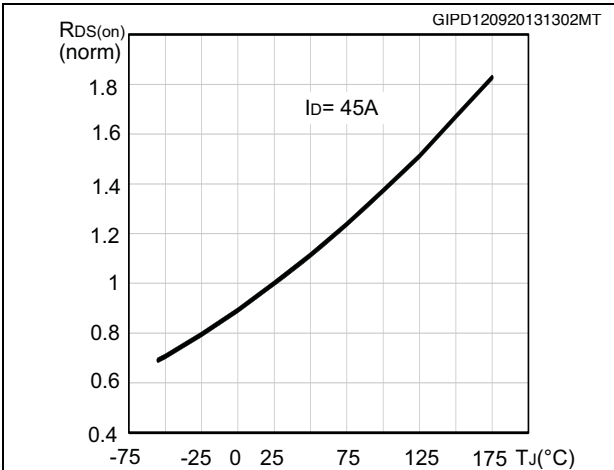


Figure 17. Normalized V(BR)DSS vs temperature

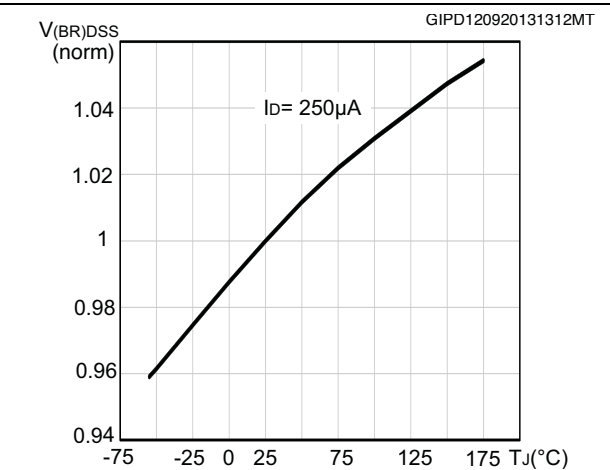


Figure 18. Source-drain diode forward characteristics for H²PAK-2 and TO-220

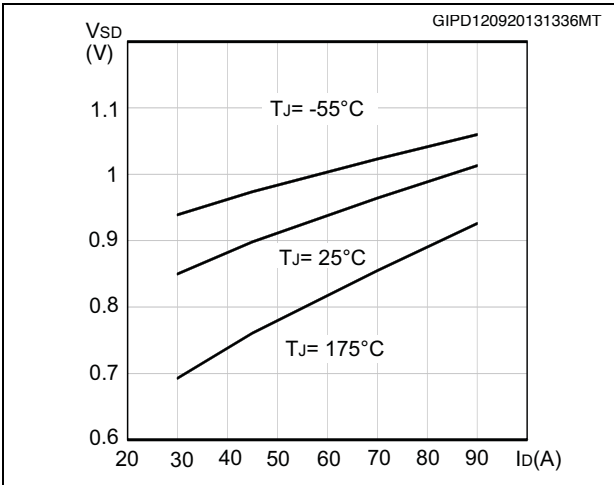
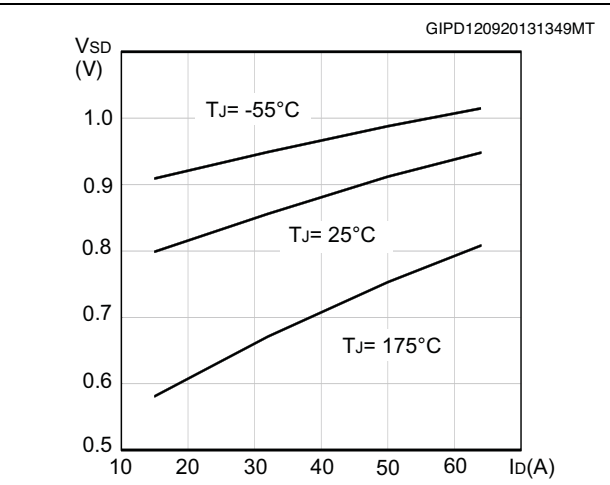


Figure 19. Source-drain diode forward characteristics for TO-220FP



3 Test circuits

Figure 20. Switching times test circuit for resistive load

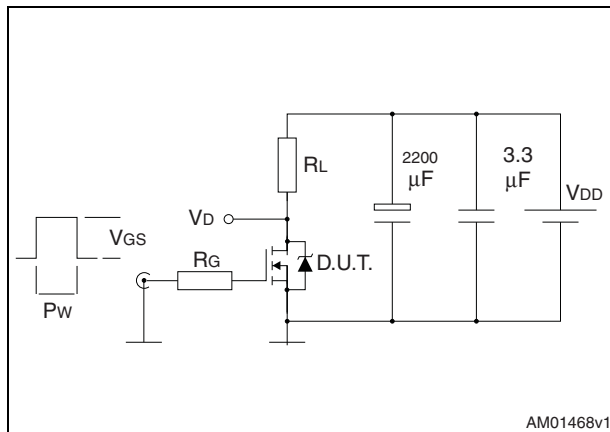


Figure 21. Gate charge test circuit

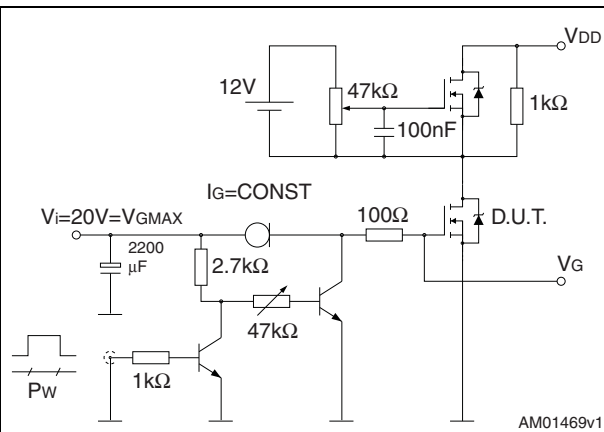


Figure 22. Test circuit for inductive load switching and diode recovery times

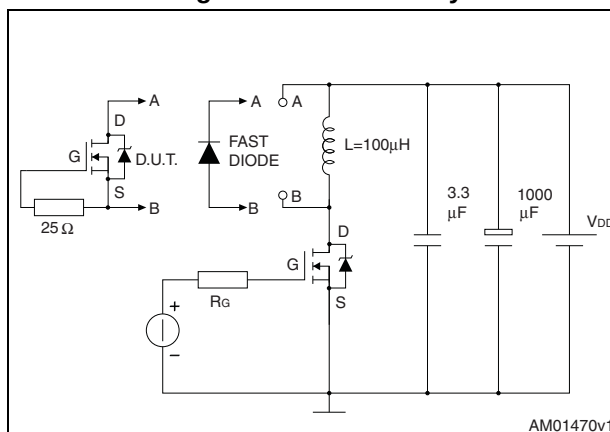


Figure 23. Unclamped inductive load test circuit

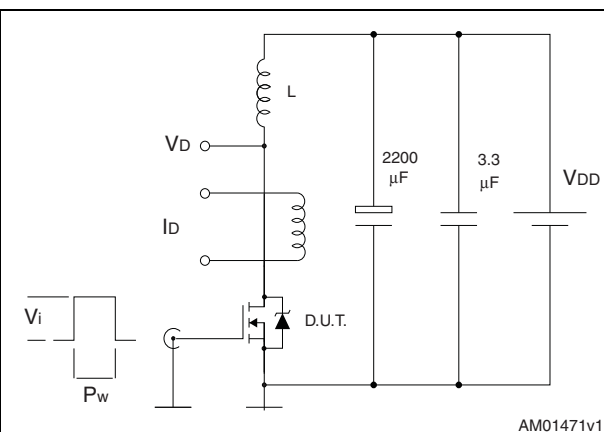


Figure 24. Unclamped inductive waveform

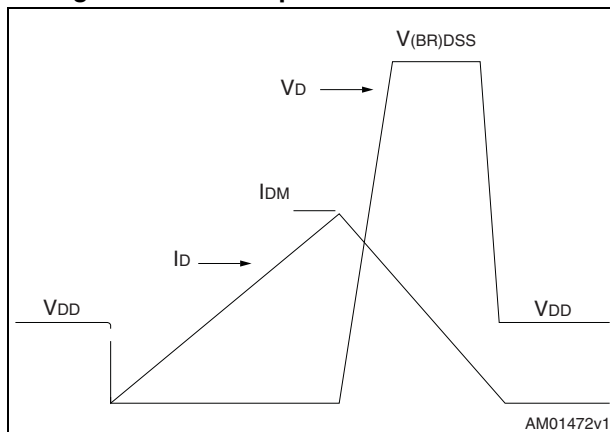
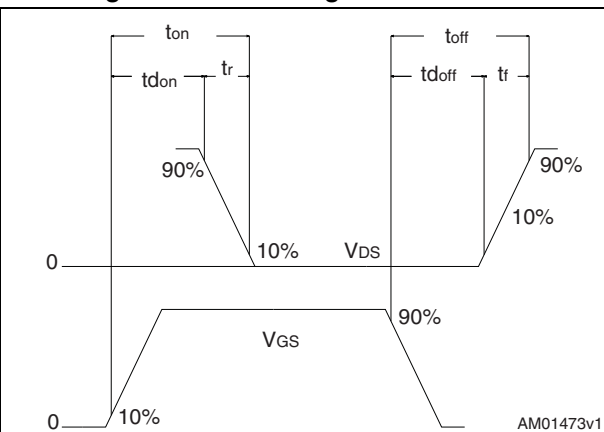


Figure 25. Switching time waveform



4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK[®] 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 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

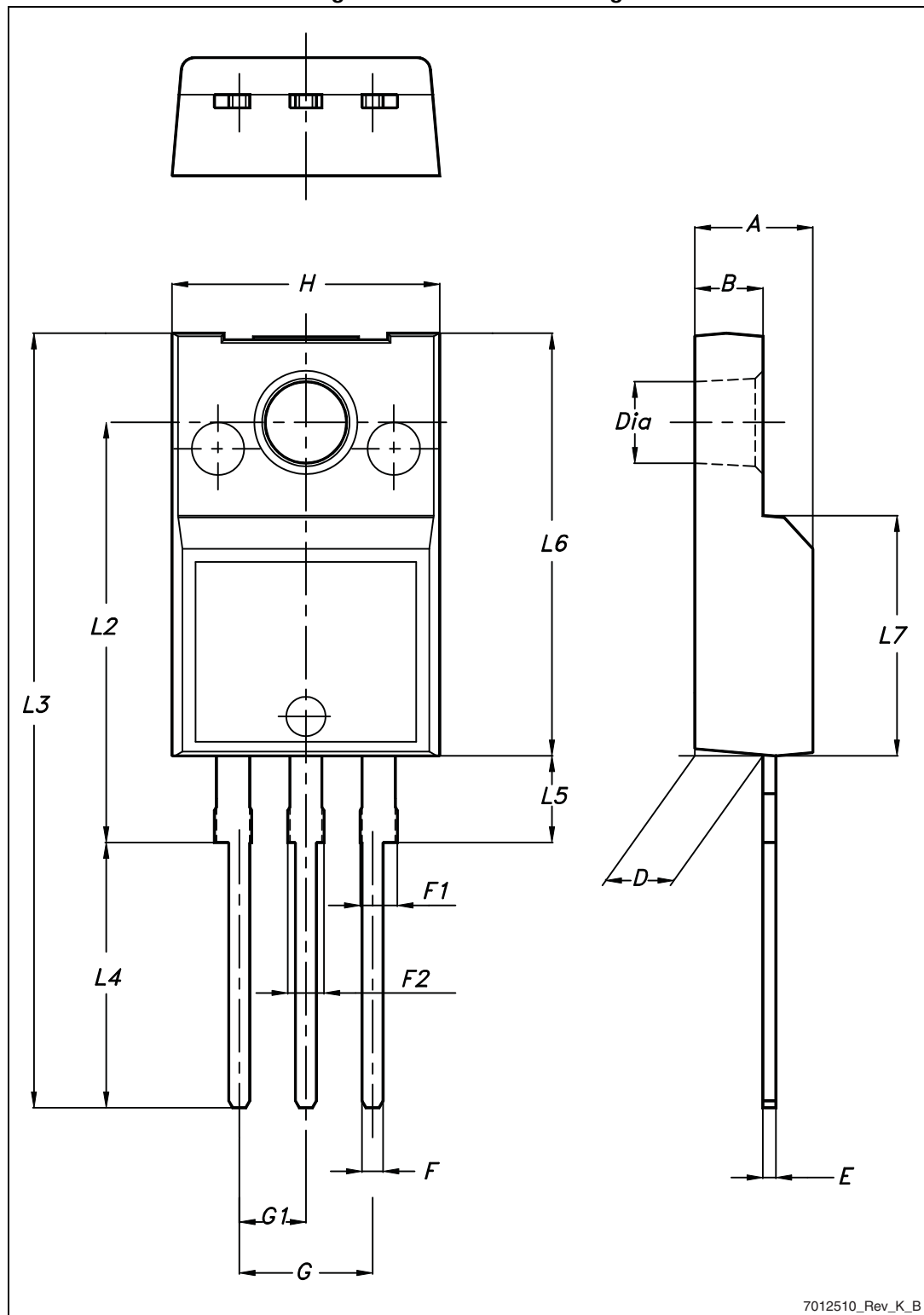


Table 9. H²PAK-2 mechanical data

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. H²PAK-2 drawing

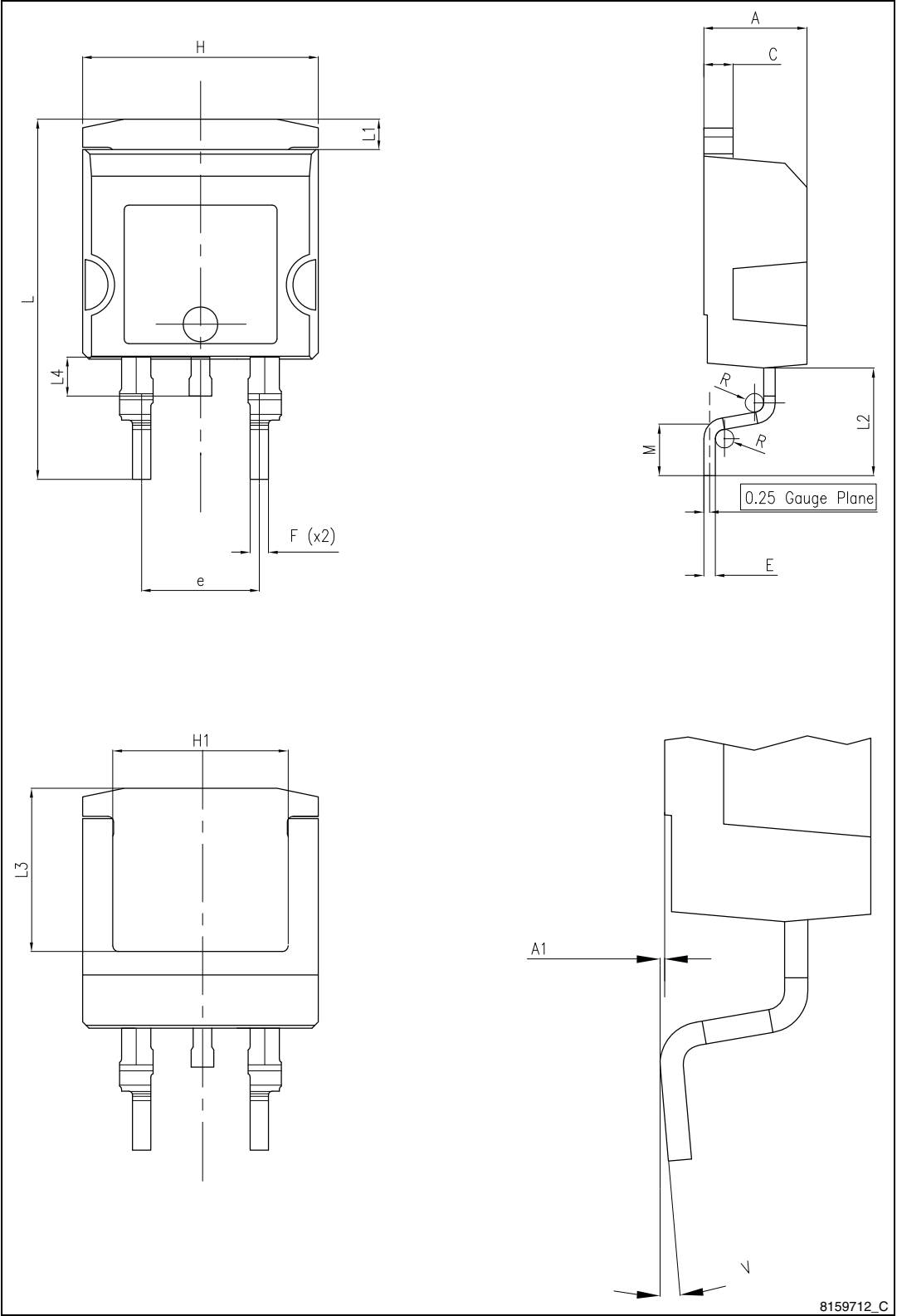


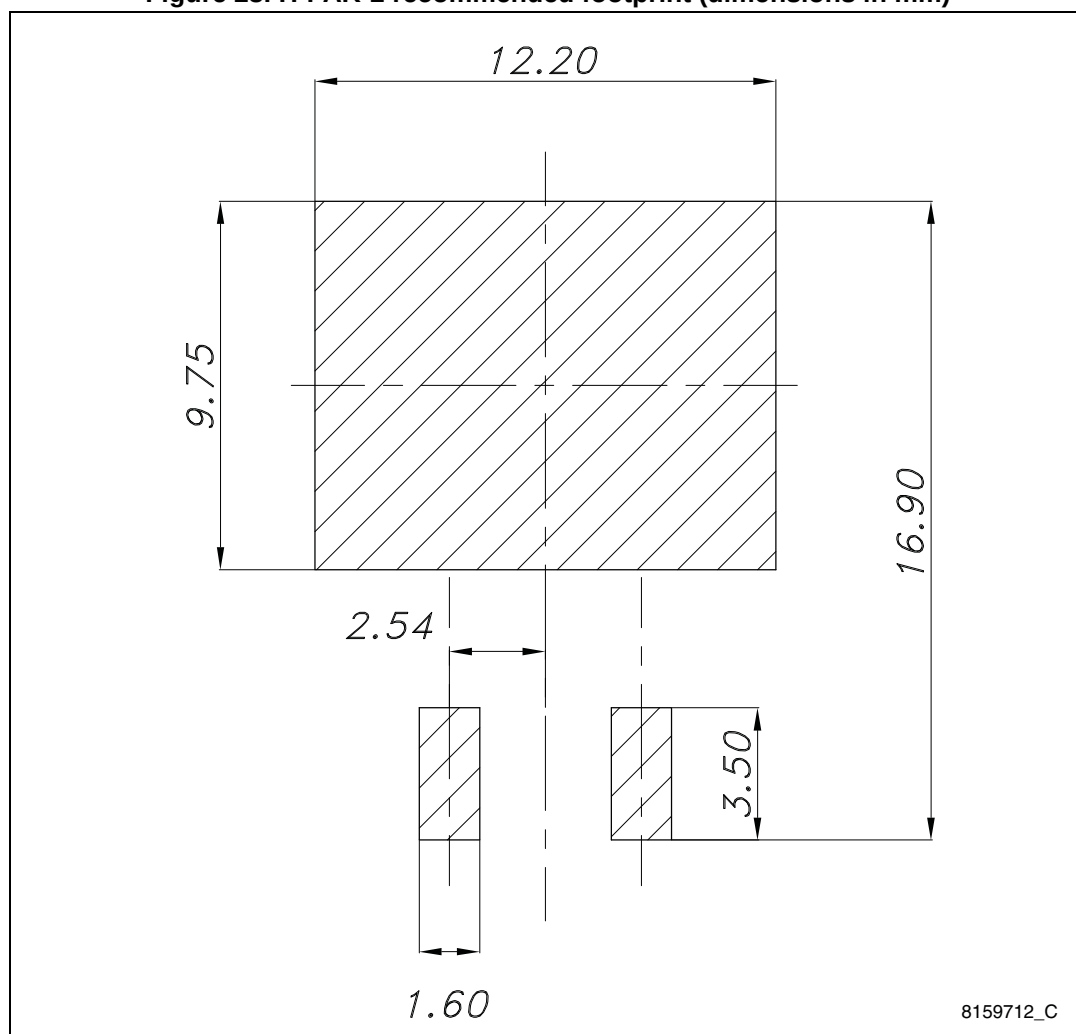
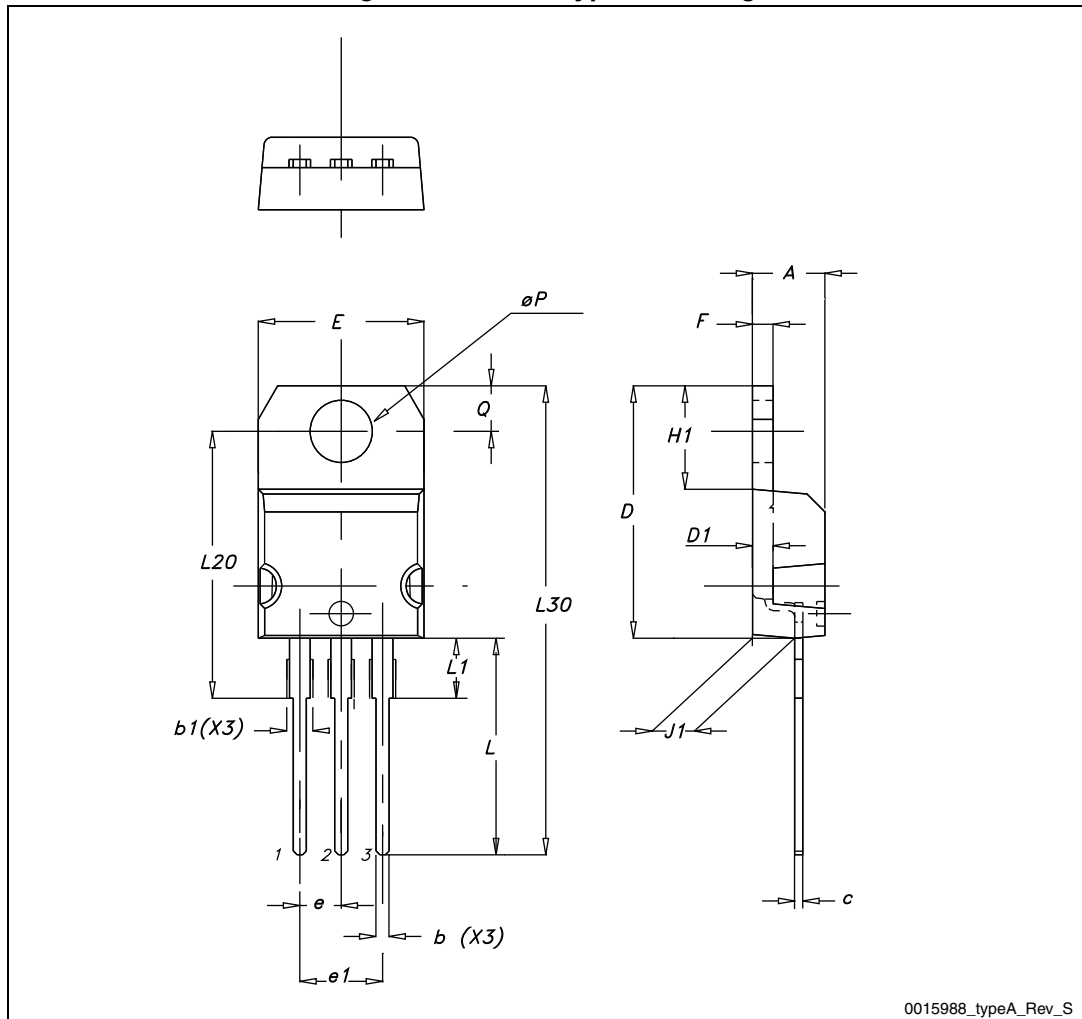
Figure 28. H²PAK-2 recommended footprint (dimensions in mm)

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. H²PAK-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

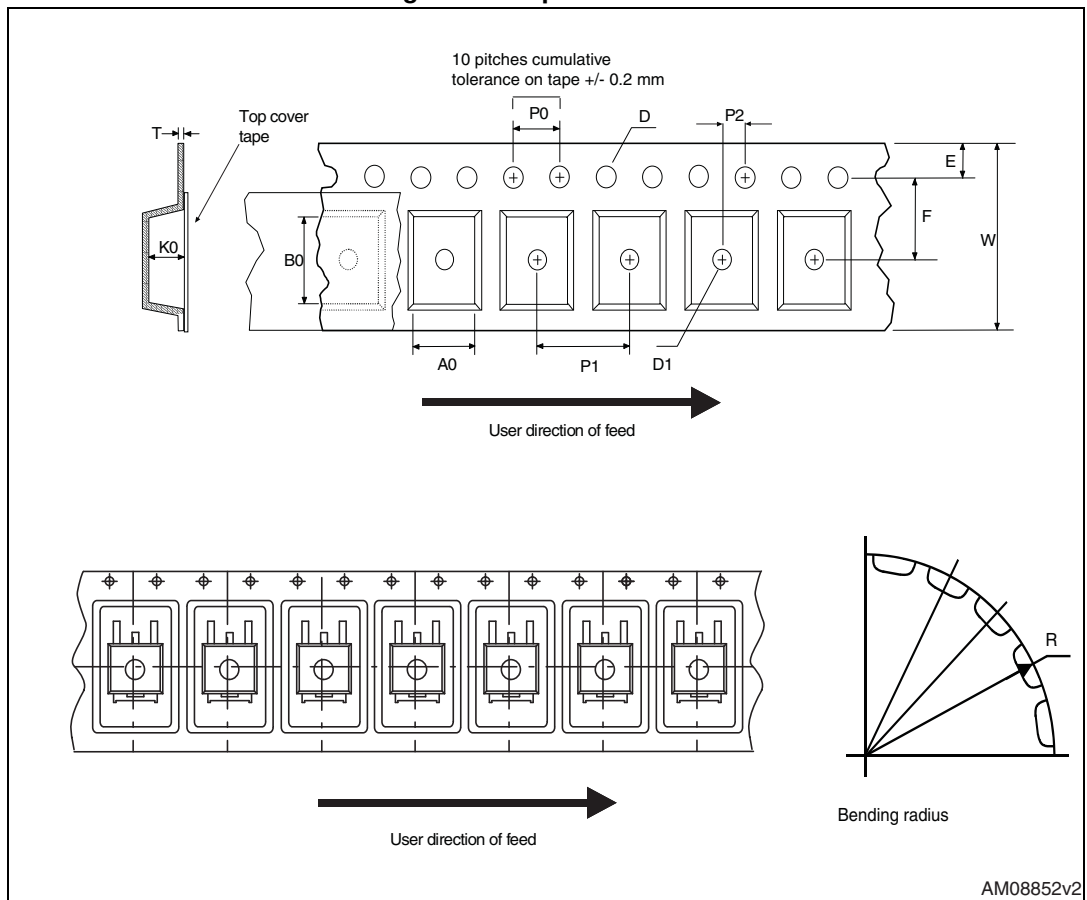
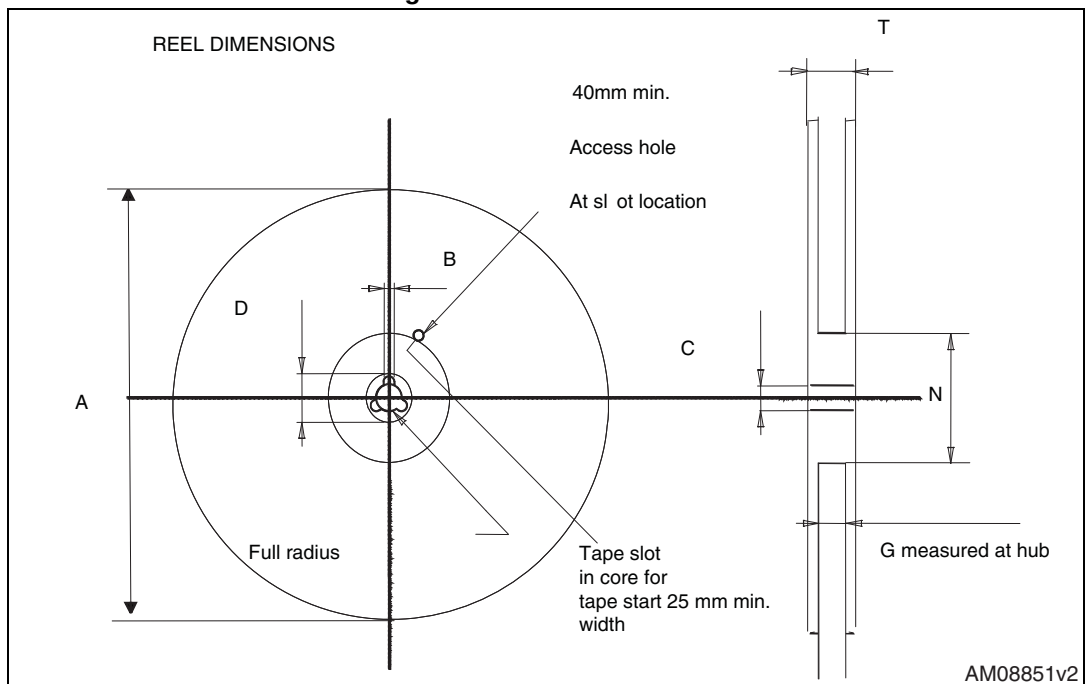


Figure 31. Reel dimension



6 Revision history

Table 12. Document revision history

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

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