



# STD8N80K5, STF8N80K5, STFI8N80K5, STP8N80K5, STU8N80K5

N-channel 800 V, 0.76  $\Omega$  typ., 6 A Zener-protected SuperMESH™ 5 Power MOSFET in a DPAK, TO-220FP, I<sup>2</sup>PAKFP, TO-220 and IPAK

Datasheet — preliminary data

## Features

Order codes	V <sub>DSS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>	P <sub>TOT</sub>
STD8N80K5	800 V	< 0.95 $\Omega$	6 A	110 W
STF8N80K5			6 A <sup>(1)</sup>	25 W
STFI8N80K5			6 A	110 W
STP8N80K5			6 A	110 W
STU8N80K5			6 A	110 W

1. Limited by package.

- Worldwide best FOM (figure of merit)
- Ultra low gate charge
- 100% avalanche tested
- Zener-protected

## Applications

- Switching applications

## Description

These devices are N-channel Power MOSFETs developed using SuperMESH™ 5 technology. This revolutionary, avalanche-rugged, high voltage Power MOSFET technology is based on an innovative proprietary vertical structure. The result is a drastic reduction in on-resistance and ultra low gate charge for applications which require superior power density and high efficiency.

Table 1. Device summary

Order codes	Marking	Package	Packaging
STD8N80K5	8N80K5	DPAK	Tape and reel
STF8N80K5		TO-220FP	Tube
STFI8N80K5		I <sup>2</sup> PAKFP	
STP8N80K5		TO-220	
STU8N80K5		IPAK	

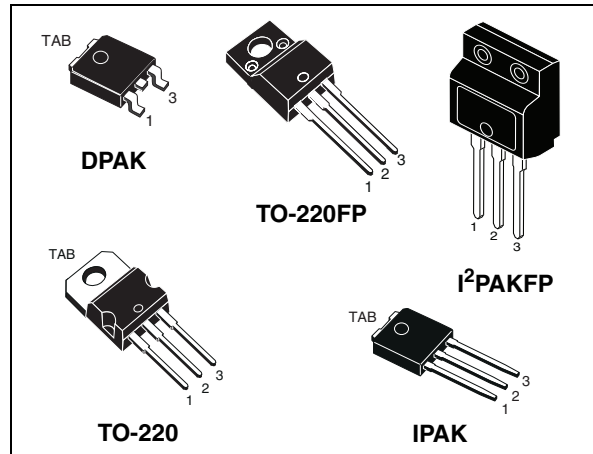
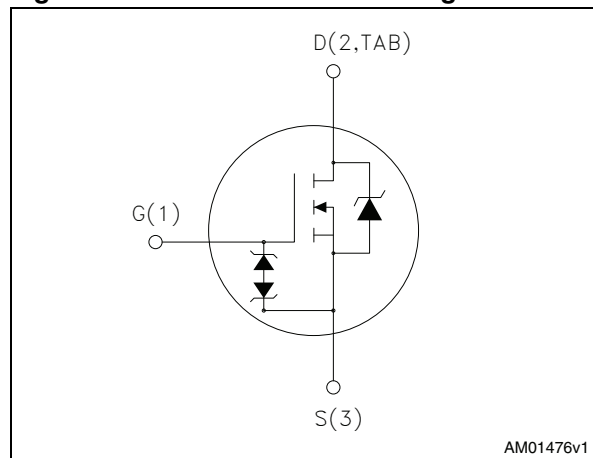


Figure 1. Internal schematic diagram



AM01476v1

# Contents

1	Electrical ratings .....	3
2	Electrical characteristics .....	4
3	Test circuits .....	6
4	Package mechanical data .....	7
5	Packaging mechanical data .....	17
6	Revision history .....	19



# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		DPAK, TO-220, IPAK	I <sup>2</sup> PAKFP TO-220FP	
V <sub>GS</sub>	Gate-source voltage	± 30		V
I <sub>D</sub>	Drain current T <sub>C</sub> = 25 °C	6	6 <sup>(1)</sup>	A
I <sub>D</sub>	Drain current T <sub>C</sub> = 100 °C	4	4 <sup>(1)</sup>	A
I <sub>DM</sub> <sup>(2)</sup>	Drain current (pulsed)	24	24 <sup>(1)</sup>	A
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25 °C	110	25	W
I <sub>AR</sub> <sup>(3)</sup>	Max current during repetitive or single pulse avalanche	TBD		A
E <sub>AS</sub> <sup>(4)</sup>	Single pulse avalanche energy (starting T <sub>J</sub> = 25 °C, I <sub>D</sub> =I <sub>AS</sub> , V <sub>DD</sub> = 50 V)	TBD		mJ
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
dv/dt <sup>(5)</sup>	Peak diode recovery voltage slope	4.5		V/ns
T <sub>j</sub> T <sub>stg</sub>	Operating junction temperature Storage temperature	- 55 to 150		°C

1. Limited by package.
2. Pulse width limited by safe operating area.
3. Pulse width limited by T<sub>Jmax</sub>.
4. Starting T<sub>J</sub> = 25 °C, I<sub>D</sub>=I<sub>AS</sub>, V<sub>DD</sub>= 50 V
5. I<sub>SD</sub> ≤ 6 A, di/dt ≤ 100 A/μs, V<sub>Peak</sub> ≤ V<sub>(BR)DSS</sub>

**Table 3. Thermal data**

Symbol	Parameter	Value				Unit
		TO-220	DPAK	IPAK	I <sup>2</sup> PAKFP TO-220FP	
R <sub>thj-case</sub>	Thermal resistance junction-case max.	1.14			5	°C/W
R <sub>thj-amb</sub>	Thermal resistance junction-amb max.	62.5		100	62.5	°C/W
R <sub>thj-pcb</sub> <sup>(1)</sup>	Thermal resistance junction-pcb max.		50			°C/W

1. When mounted on 1inch<sup>2</sup> FR-4 board, 2 oz 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	$I_D = 1\text{ mA}$ , $V_{GS} = 0$	800			V
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = 800\text{ V}$ , $V_{DS} = 800\text{ V}$ , $T_c = 125\text{ °C}$			1 50	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20\text{ V}$			$\pm 10$	$\mu\text{A}$
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 100\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$ , $I_D = 3\text{ A}$		0.76	0.95	$\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance			450		pF
$C_{oss}$	Output capacitance	$V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$	-	30	-	pF
$C_{rss}$	Reverse transfer capacitance			1.6		
$C_{o(tr)}^{(1)}$	Equivalent capacitance time related	$V_{GS} = 0$ , $V_{DS} = 0\text{ to }640\text{ V}$	-	45	-	pF
$C_{o(er)}^{(2)}$	Equivalent capacitance energy related			19		
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	7	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 640\text{ V}$ , $I_D = 6\text{ A}$ $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 3</a> )	-	13	-	nC
$Q_{gs}$	Gate-source charge			3		
$Q_{gd}$	Gate-drain charge			7		

1. Time related is defined as a constant equivalent capacitance giving the same charging time as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DSS}$
2. Energy related is defined as a constant equivalent capacitance giving the same stored energy as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DSS}$

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 400\text{ V}$ , $I_D = 3\text{ A}$ , $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 5</a> )	-	TBD	-	ns
$t_r$	Rise time		-	TBD	-	ns
$t_{d(off)}$	Turn-off delay time		-	TBD	-	ns
$t_f$	Fall time		-	TBD	-	ns

**Table 7. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		6	A
$I_{SDM}$	Source-drain current (pulsed)		24	A		
$V_{SD}^{(1)}$	Forward on voltage	$I_{SD} = 6\text{ A}$ , $V_{GS} = 0$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 6\text{ A}$ , $V_{DD} = 60\text{ V}$ $di/dt = 100\text{ A}/\mu\text{s}$ , (see <a href="#">Figure 4</a> )	-	372		ns
$Q_{rr}$	Reverse recovery charge		4	$\mu\text{C}$		
$I_{RRM}$	Reverse recovery current		22	A		
$t_{rr}$	Reverse recovery time	$I_{SD} = 6\text{ A}$ , $V_{DD} = 60\text{ V}$ $di/dt = 100\text{ A}/\mu\text{s}$ , $T_J = 150\text{ }^\circ\text{C}$ (see <a href="#">Figure 4</a> )	-	522		ns
$Q_{rr}$	Reverse recovery charge		5	$\mu\text{C}$		
$I_{RRM}$	Reverse recovery current		20	A		

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

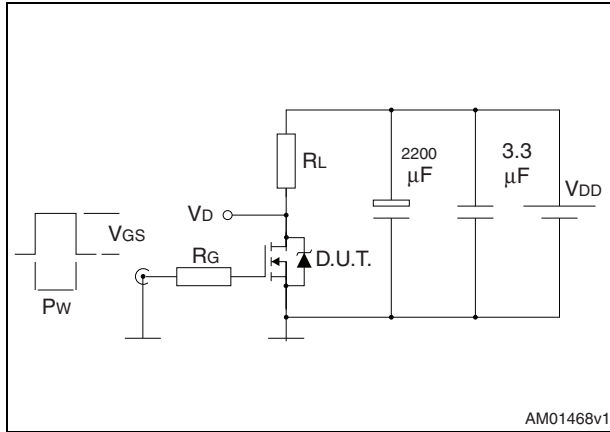
**Table 8. Gate-source Zener diode**

Symbol	Parameter	Test conditions	Min	Typ.	Max.	Unit
$BV_{GSO}$	Gate-source breakdown voltage	$I_{gs} \pm 1\text{ mA}$ , (open drain)	30	-	-	V

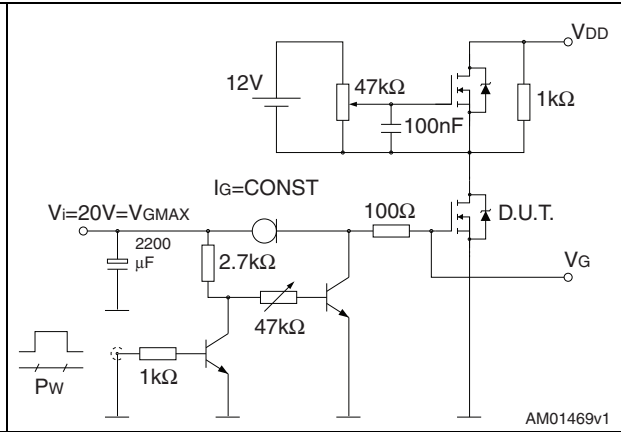
The built-in-back Zener diodes have specifically been designed to enhance not only the device’s ESD capability, but also to make them safely absorb possible voltage transients that may occasionally be applied from gate to source. In this respect the Zener voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device’s integrity. These integrated Zener diodes thus avoid the usage of external components.

### 3 Test circuits

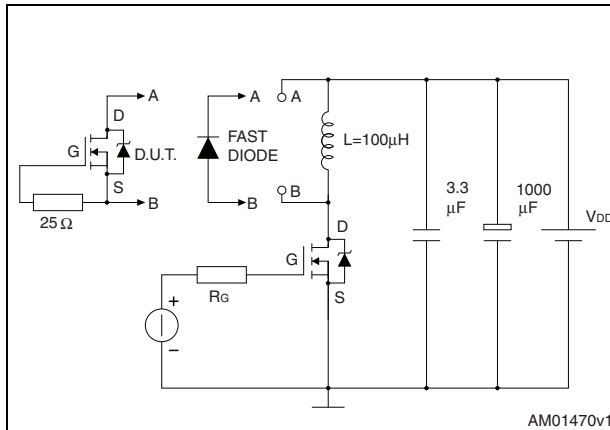
**Figure 2. Switching times test circuit for resistive load**



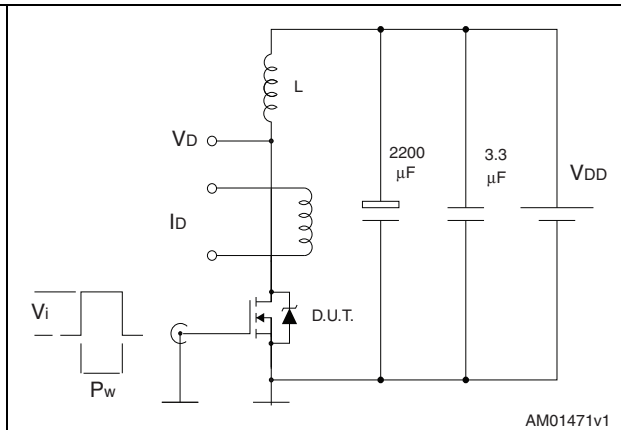
**Figure 3. Gate charge test circuit**



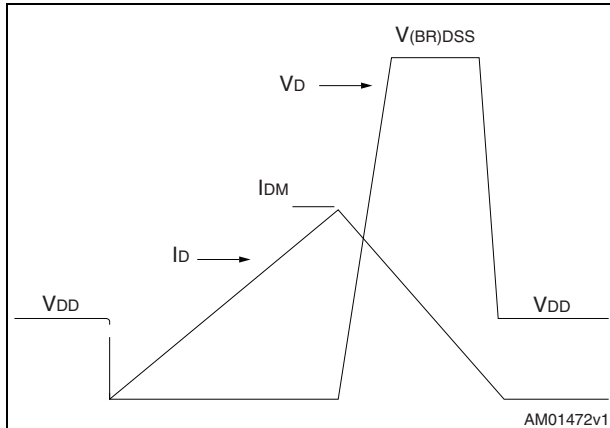
**Figure 4. Test circuit for inductive load switching and diode recovery times**



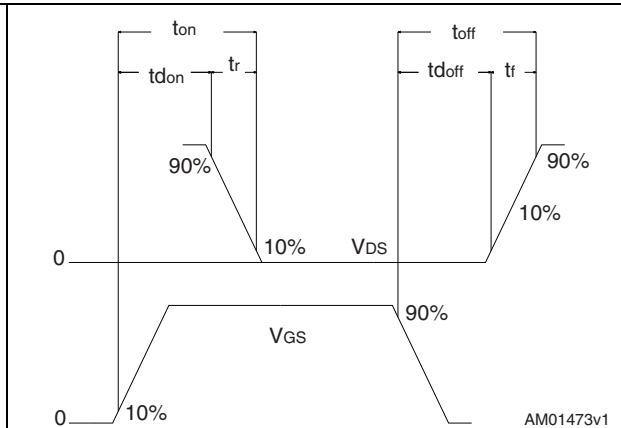
**Figure 5. Unclamped inductive load test circuit**



**Figure 6. Unclamped inductive waveform**



**Figure 7. 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 9. DPAK (TO-252) mechanical data

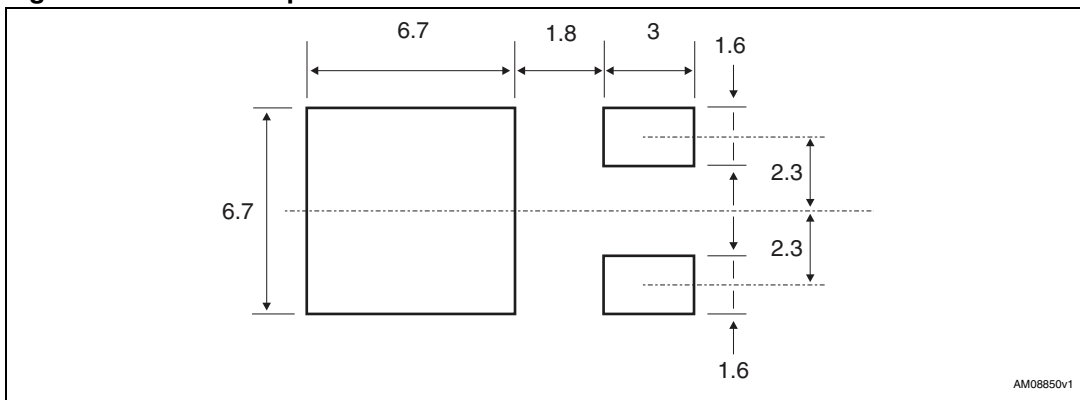
Dim.	mm		
	Min.	Typ.	Max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1		5.10	
E	6.40		6.60
E1		4.70	
e		2.28	
e1	4.40		4.60
H	9.35		10.10
L	1		
L1		2.80	
L2		0.80	
L4	0.60		1
R		0.20	
V2	0°		8°



Figure 8. DPAK (TO-252) drawing



Figure 9. DPAK footprint<sup>(a)</sup>



a. All dimensions are in millimeters

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

Figure 10. TO-220FP drawing

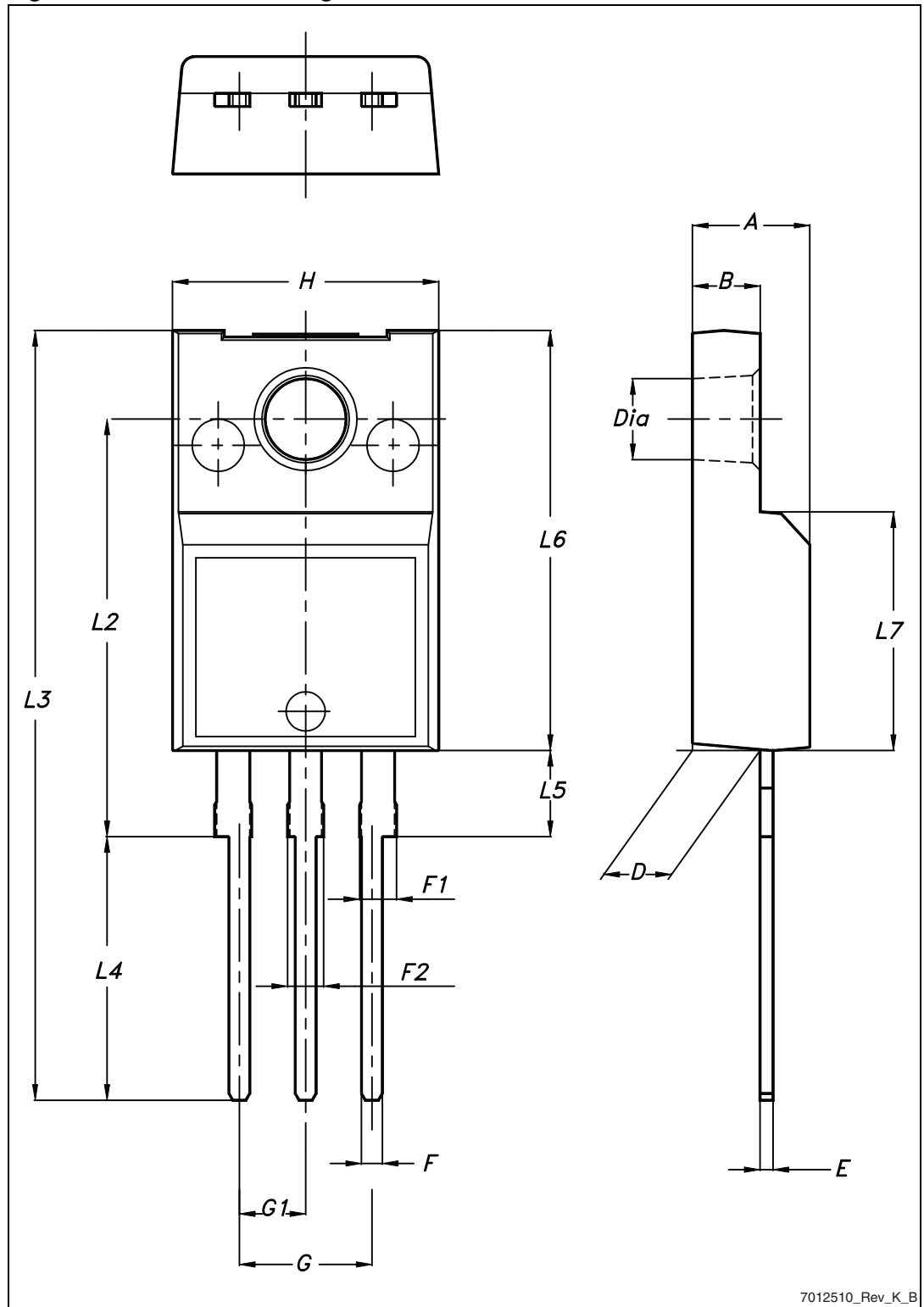


Table 11. I<sup>2</sup>PAKFP mechanical data

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 11. I<sup>2</sup>PAKFP drawing

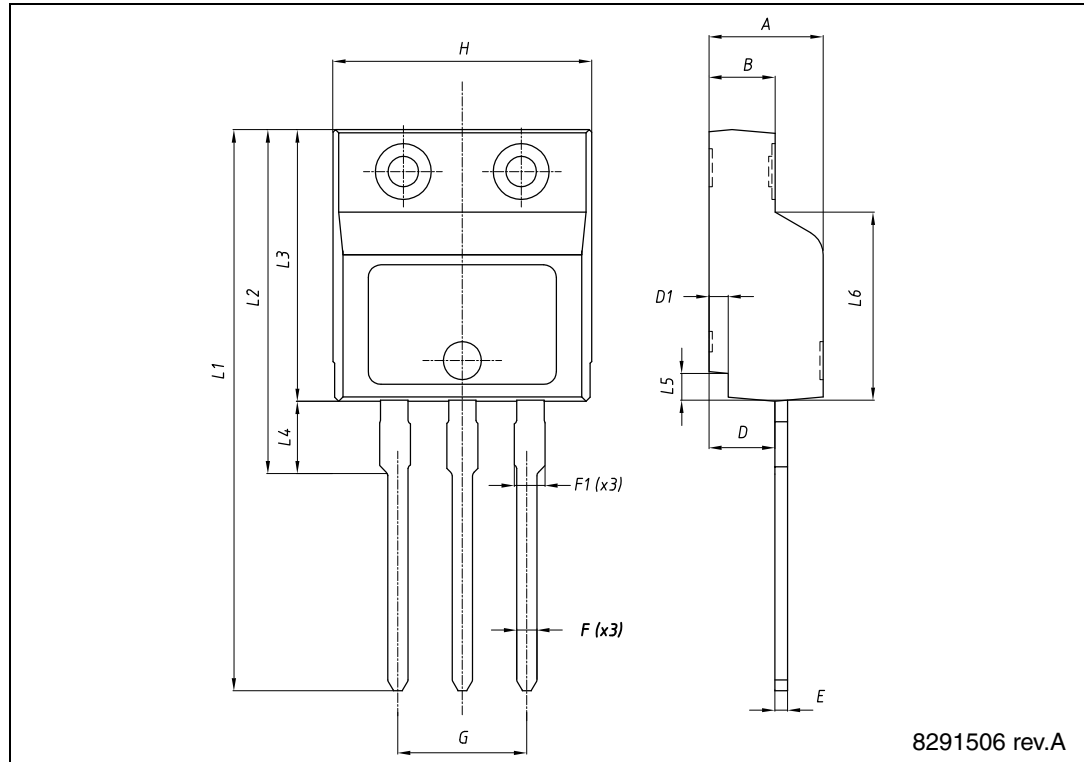


Table 12. TO-220 type A mechanical data

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 12. TO-220 type A drawing

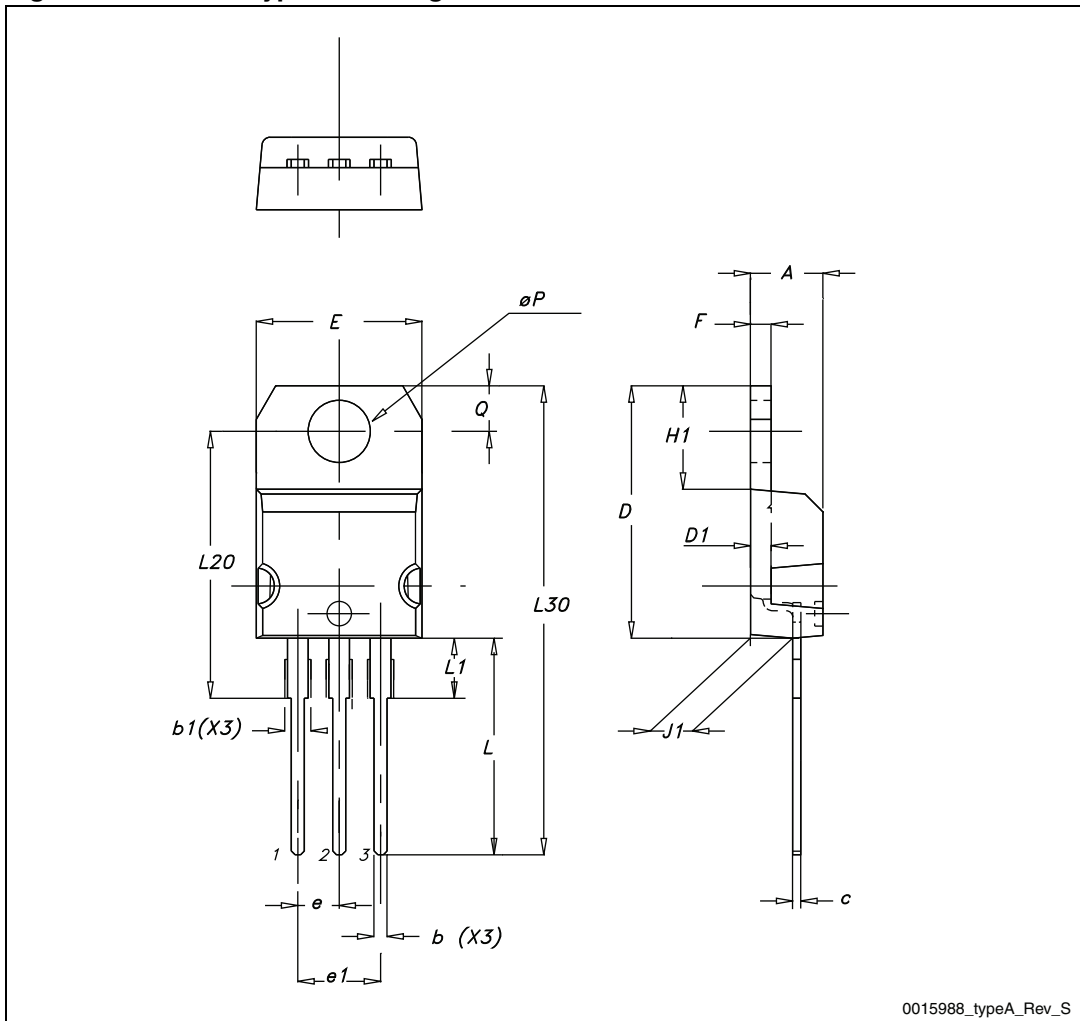
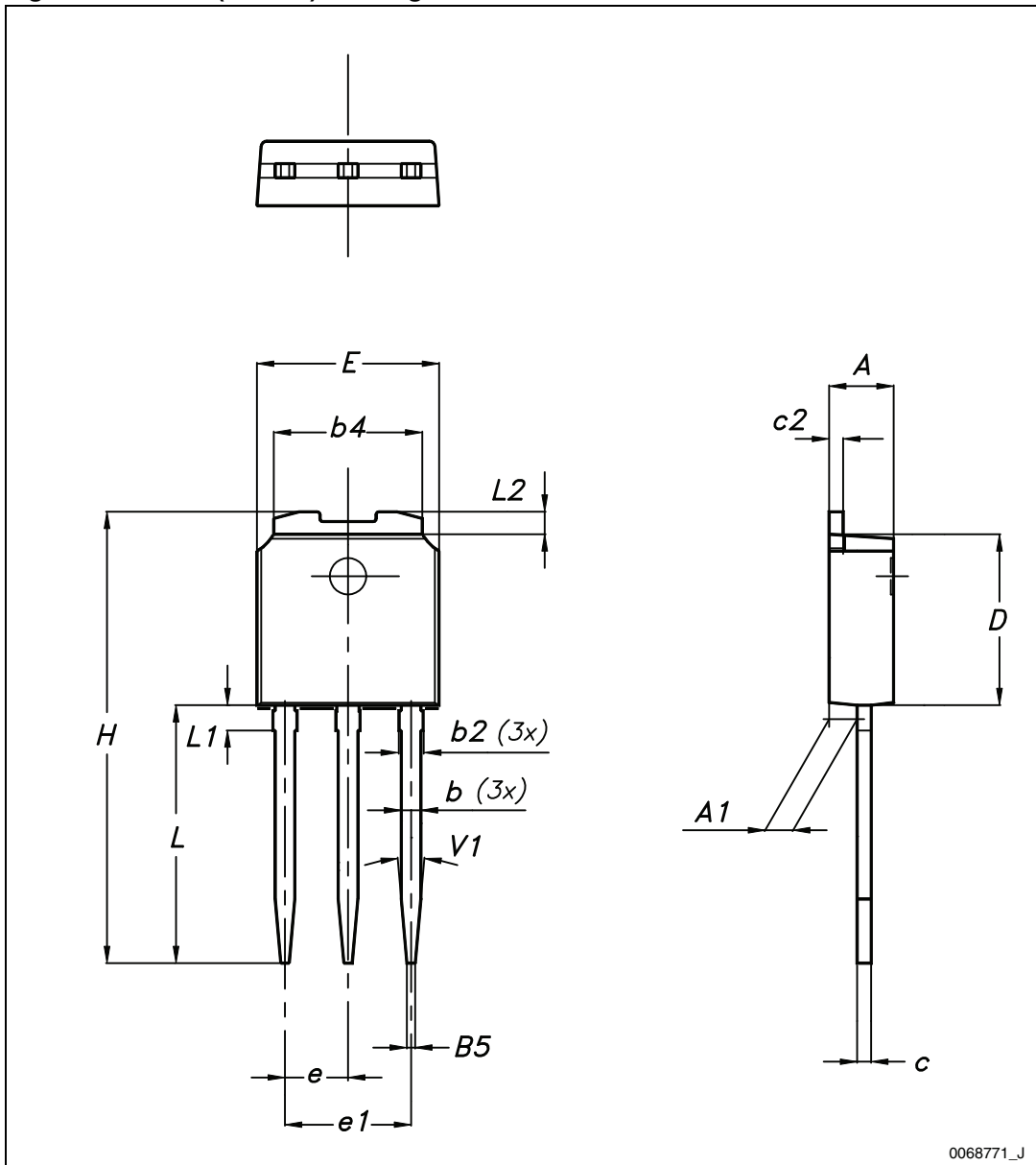


Table 13. IPAK (TO-251) mechanical data

DIM	mm.		
	min.	typ.	max.
A	2.20		2.40
A1	0.90		1.10
b	0.64		0.90
b2			0.95
b4	5.20		5.40
B5		0.30	
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
E	6.40		6.60
e		2.28	
e1	4.40		4.60
H		16.10	
L	9.00		9.40
L1	0.80		1.20
L2		0.80	1.00
V1		10°	

Figure 13. IPAK (TO-251) drawing



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## 5 Packaging mechanical data

Table 14. 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			

Figure 14. Tape for DPAK (TO-252)

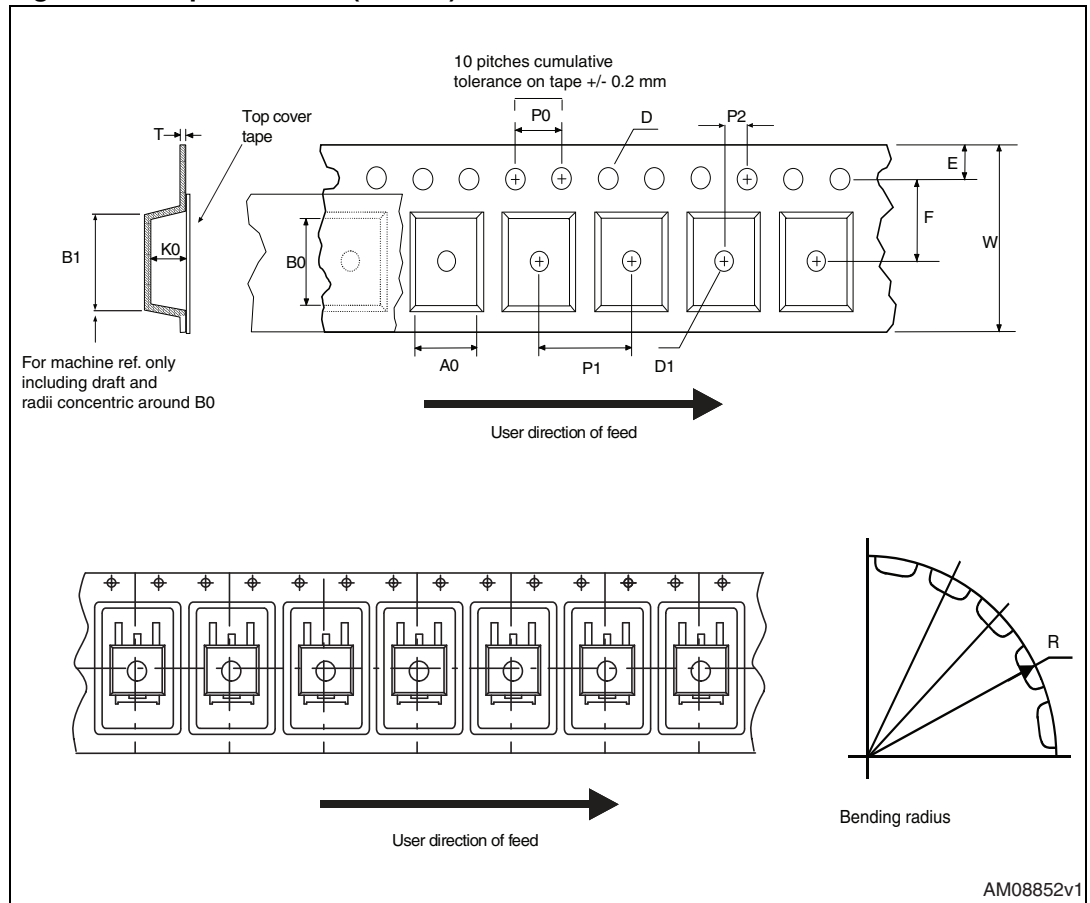
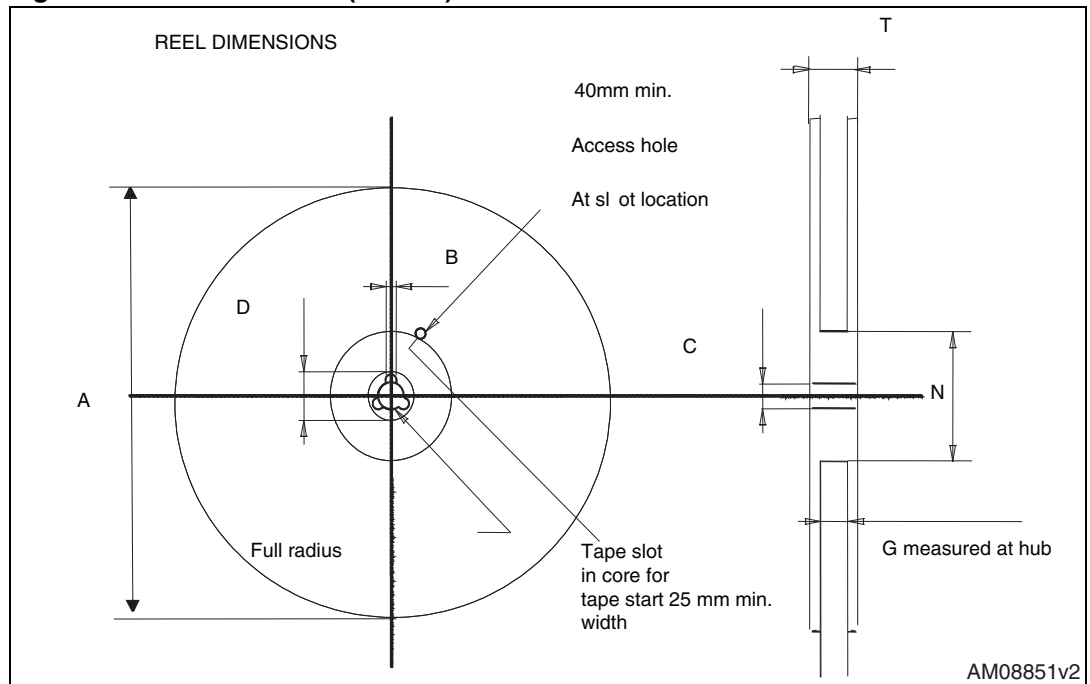


Figure 15. Reel for DPAK (TO-252)



## 6 Revision history

Table 15. Document revision history

Date	Revision	Changes
06-Aug-2012	1	First release.
16-Oct-2012	2	<ul style="list-style-type: none"><li>– Minor text changes in cover page</li><li>– Updated: PTOT value for DPAK, TO-220 and IPAK in <a href="#">Table 2</a>, <math>R_{thj-case}</math> value for DPAK in <a href="#">Table 3</a>, VSD value in <a href="#">Table 7</a></li><li>– Deleted <math>T_1</math> in <a href="#">Table 3</a></li><li>– Updated <a href="#">Section 4: Package mechanical data</a> for DPAK and IPAK</li></ul>

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