



STB12N120K5, STFW12N120K5 STP12N120K5, STW12N120K5

N-channel 1200 V, 0.58 Ω , 12 A D²PAK, TO-3PF, TO-220, TO-247
Zener-protected SuperMESH™ 5 Power MOSFET

Preliminary data

Features

Order codes	V _{DSS}	R _{DS(on)} max.	I _D	P _W
STB12N120K5	1200 V	< 0.69 Ω	12 A	250 W
STFW12N120K5				63 W
STP12N120K5				250 W
STW12N120K5				

- Worldwide best R_{DS(on)} in TO-220
- 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.

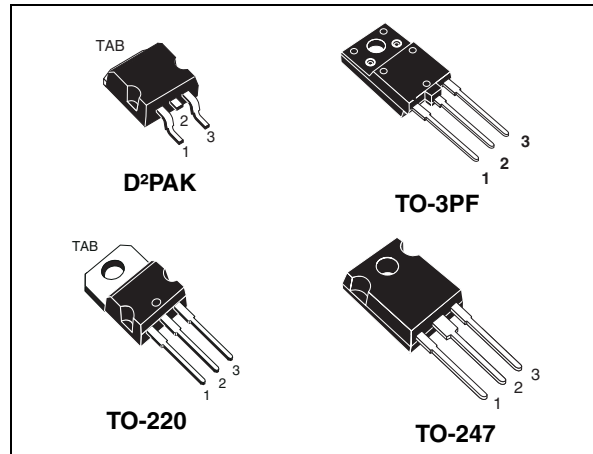


Figure 1. Internal schematic diagram

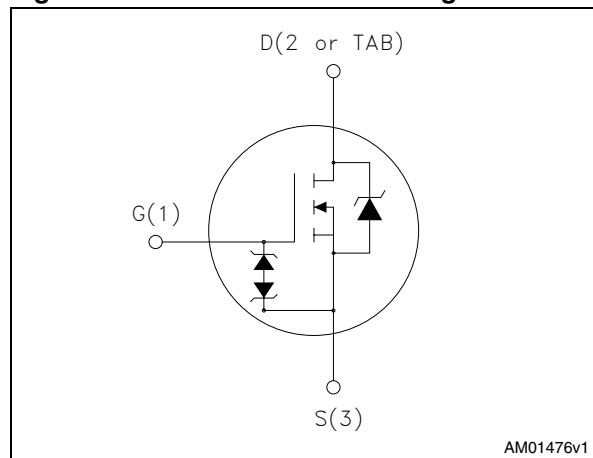


Table 1. Device summary

Order codes	Marking	Package	Packaging
STB12N120K5	12N120K5	D ² PAK	Tape and reel
STFW12N120K5		TO-3PF	Tube
STP12N120K5		TO-220	
STW12N120K5		TO-247	

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value				Unit
		D ² PAK	TO-3PF	TO-220	TO-247	
V _{GS}	Gate-source voltage	30				V
I _D	Drain current (single pulse 10 ms width), T _C = 25 °C	12				A
I _D	Drain current (single pulse 10 ms width), T _C = 100 °C	7.6				A
I _{DM} ⁽¹⁾	Drain current (pulsed)	48				A
P _{TOT}	Total dissipation at T _C = 25 °C	250	63	250		W
I _{AR} ⁽²⁾	Max current during repetitive or single pulse avalanche	TBD				A
E _{AS} ⁽³⁾	Single pulse avalanche energy	TBD				mJ
dv/dt ⁽⁴⁾	Peak diode recovery voltage slope	TBD				V/ns
T _j T _{stg}	Operating junction temperature Storage temperature	- 55 to 150				°C

1. Pulse width limited by safe operating area.
2. Pulse width limited by T_{Jmax}.
3. Starting T_J = 25 °C, I_D=I_{AS}, V_{DD}= 50 V
4. I_{SD} ≤ 12 A, di/dt ≤ 100 A/μs, V_{Peak} ≤ V_{(BR)DSS}

Table 3. Thermal data

Symbol	Parameter	Value				Unit
		D ² PAK	TO-3PF	TO-220	TO-247	
R _{thj-case}	Thermal resistance junction-case max	0.5	1.98	0.5		°C/W
R _{thj-amb}	Thermal resistance junction-amb max		50	62.5	50	°C/W
R _{thj-pcb} ⁽¹⁾	Thermal resistance junction-pcb max	30				°C/W
T _l	Maximum lead temperature for soldering purposes		300			°C

1. When mounted on 1 inch² 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 ($V_{GS} = 0$)	$I_D = 1\text{ mA}$	1200			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = 1200\text{ V}$, $V_{DS} = 1200\text{ V}$, $T_C = 125\text{ °C}$			1 50	μA μA
I_{GSS}	Gate body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 20\text{ V}$			± 10	μA
$V_{GS(th)}$	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	$V_{GS} = 10\text{ V}$, $I_D = 6\text{ A}$		0.58	0.69	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance			1700		pF
C_{oss}	Output capacitance	$V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$	-	110	-	pF
C_{rss}	Reverse transfer capacitance			2		
$C_{o(tr)}^{(1)}$	Equivalent capacitance, time-related	$V_{GS} = 0$, $V_{DS} = 0\text{ to }960\text{ V}$	-	TBD	-	pF
$C_{o(er)}^{(2)}$	Equivalent capacitance, energy-related			TBD		
R_G	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	TBD	-	Ω
Q_g	Total gate charge	$V_{DD} = 960\text{ V}$, $I_D = 6\text{ A}$		49		nC
Q_{gs}	Gate-source charge	$V_{GS} = 10\text{ V}$	-	TBD	-	nC
Q_{gd}	Gate-drain charge	(see Figure 3)		TBD		nC

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	$V_{DD} = 600\text{ V}$, $I_D = 6\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 5)	-	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		-		12	A
I_{SDM}	Source-drain current (pulsed)				48	A
$V_{SD}^{(1)}$	Forward on voltage	$I_{SD} = 12\text{ A}$, $V_{GS} = 0$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 12\text{ A}$, $V_{DD} = 60\text{ V}$ $di/dt = 100\text{ A}/\mu\text{s}$, (see Figure 4)	-	TBD		ns
Q_{rr}	Reverse recovery charge			TBD		μC
I_{RRM}	Reverse recovery current			TBD		A
t_{rr}	Reverse recovery time	$I_{SD} = 12\text{ A}$, $V_{DD} = 60\text{ V}$ $di/dt = 100\text{ A}/\mu\text{s}$, $T_J = 150\text{ }^\circ\text{C}$ (see Figure 4)	-	TBD		ns
Q_{rr}	Reverse recovery charge			TBD		μC
I_{RRM}	Reverse recovery current			TBD		A

1. Pulsed: pulse duration = 300 μs , 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 been specifically designed to enhance not only the device's ESD capability, but also to make them capable of safely absorbing possible voltage transients that may occasionally be applied from gate to source. In this respect, the Zener voltage helps to achieve efficient and cost-effective protection of device integrity. These integrated Zener diodes thus reduce the necessity for external components.

3 Test circuits

Figure 2. Switching time test circuit for resistive load

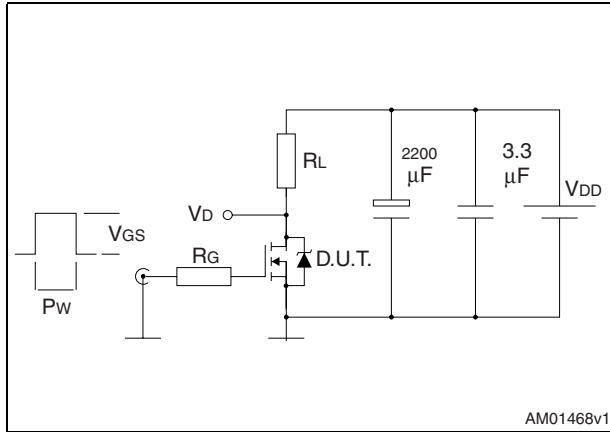


Figure 3. Gate charge test circuit

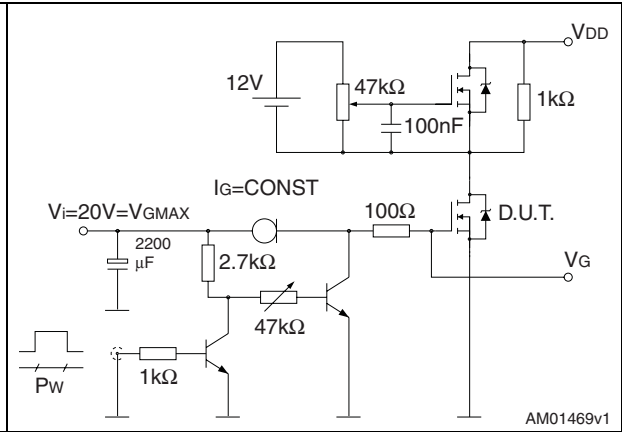


Figure 4. Test circuit for inductive load switching and diode recovery times

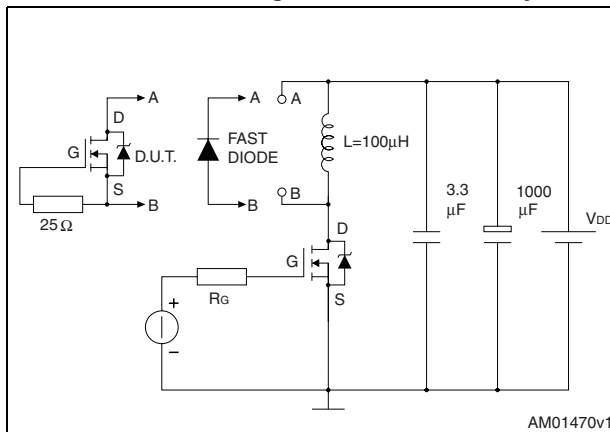


Figure 5. Unclamped inductive load test circuit

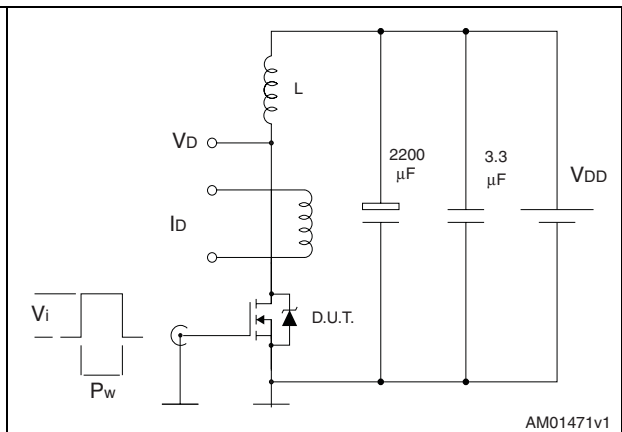


Figure 6. Unclamped inductive waveform

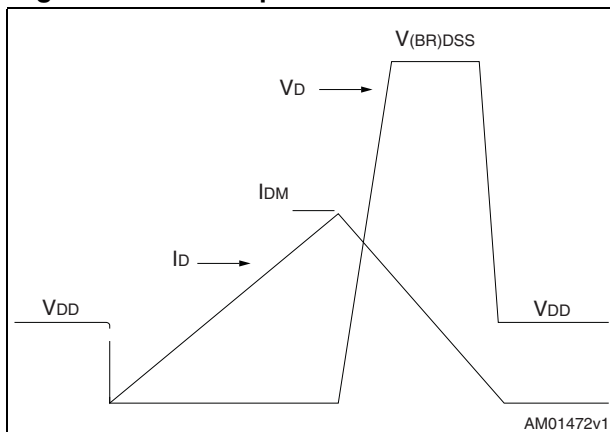
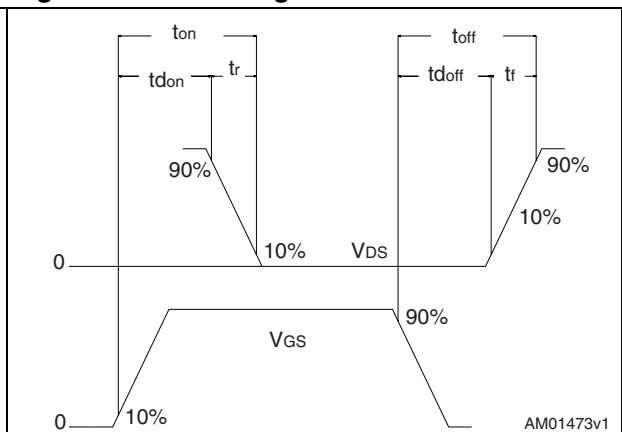


Figure 7. Switching time waveform



4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK[®] 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 9. D²PAK (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 8. D²PAK (TO-263) drawing

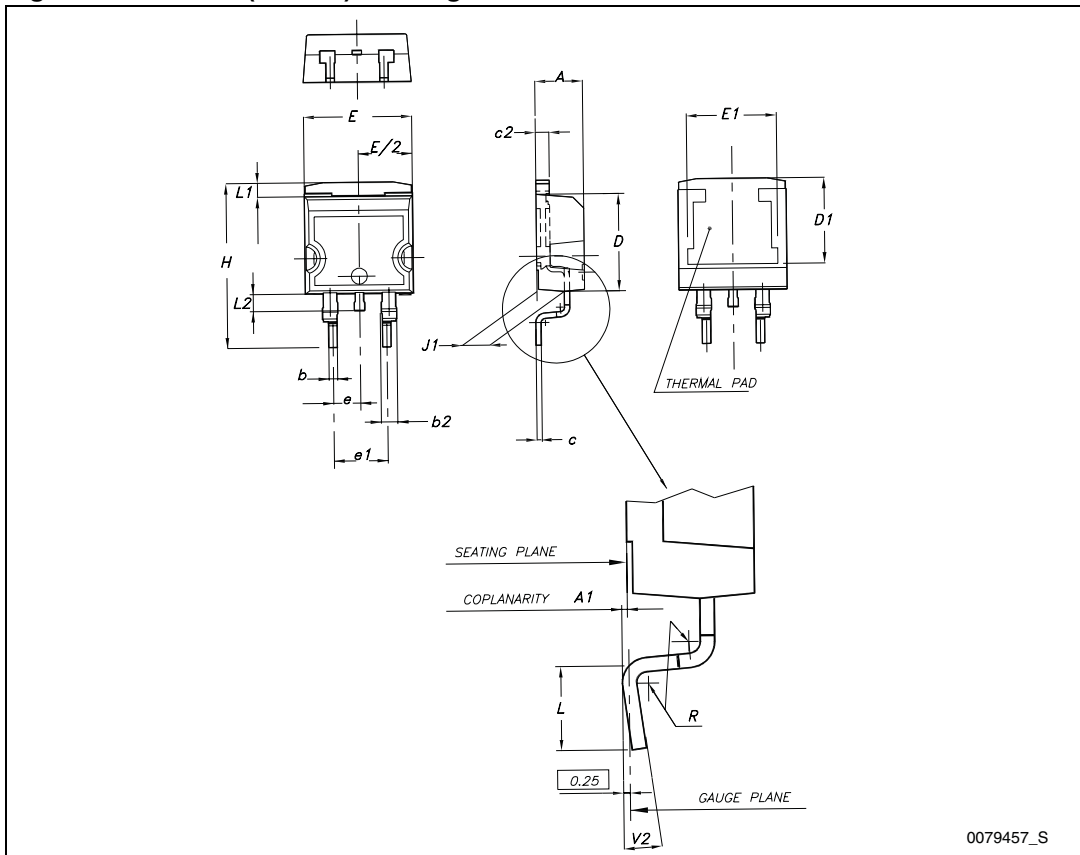
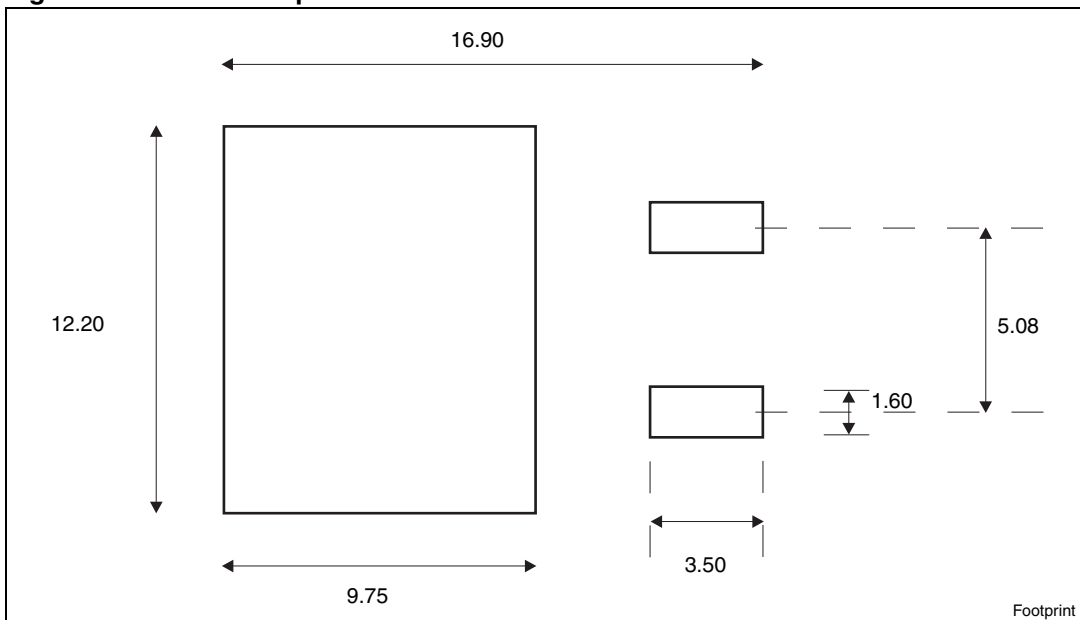


Figure 9. D²PAK footprint^(a)

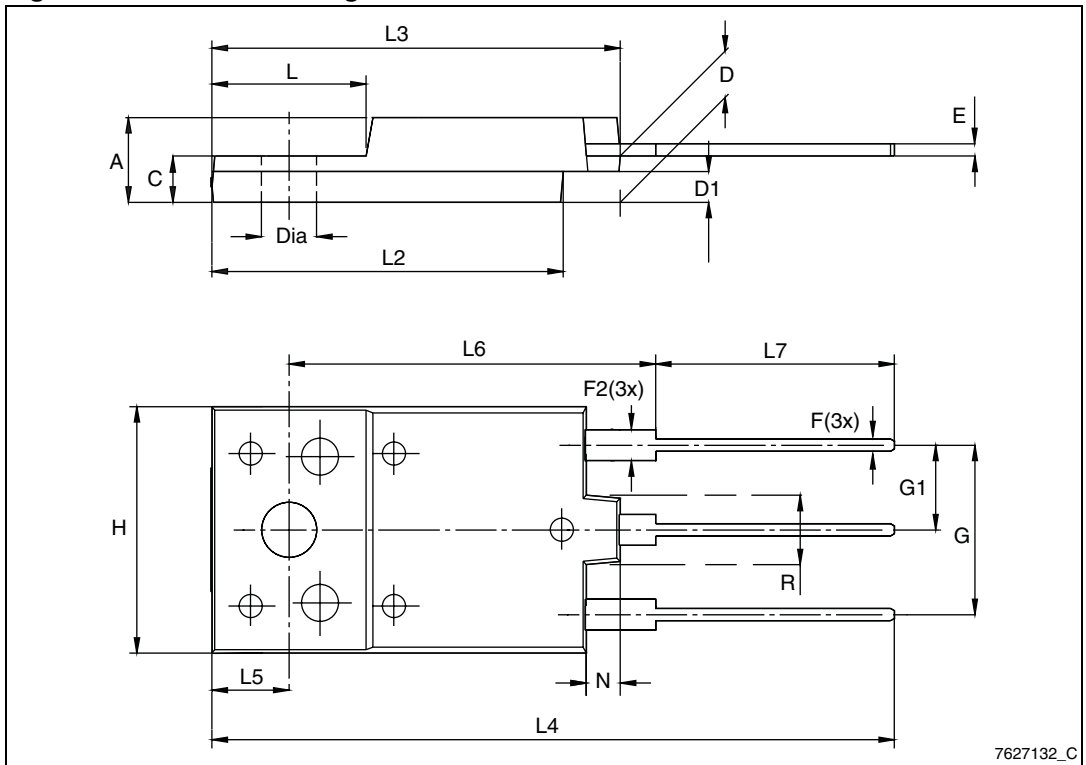


a. All dimensions are in millimeters

Table 10. TO-3PF mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	5.30		5.70
C	2.80		3.20
D	3.10		3.50
D1	1.80		2.20
E	0.80		1.10
F	0.65		0.95
F2	1.80		2.20
G	10.30		11.50
G1		5.45	
H	15.30		15.70
L	9.80	10	10.20
L2	22.80		23.20
L3	26.30		26.70
L4	43.20		44.40
L5	4.30		4.70
L6	24.30		24.70
L7	14.60		15
N	1.80		2.20
R	3.80		4.20
Dia	3.40		3.80

Figure 10. TO-3PF drawing



7627132_C

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 11. TO-220 type A drawing

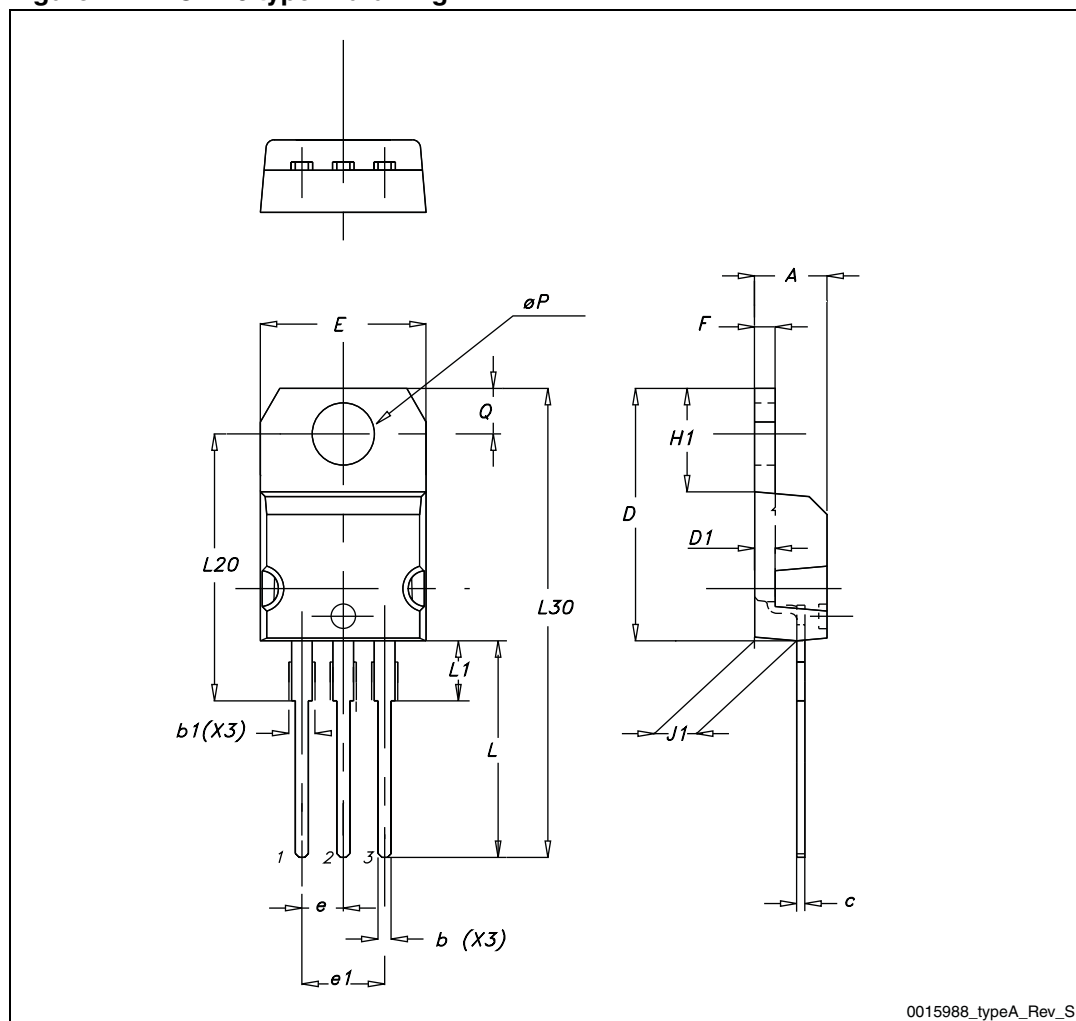
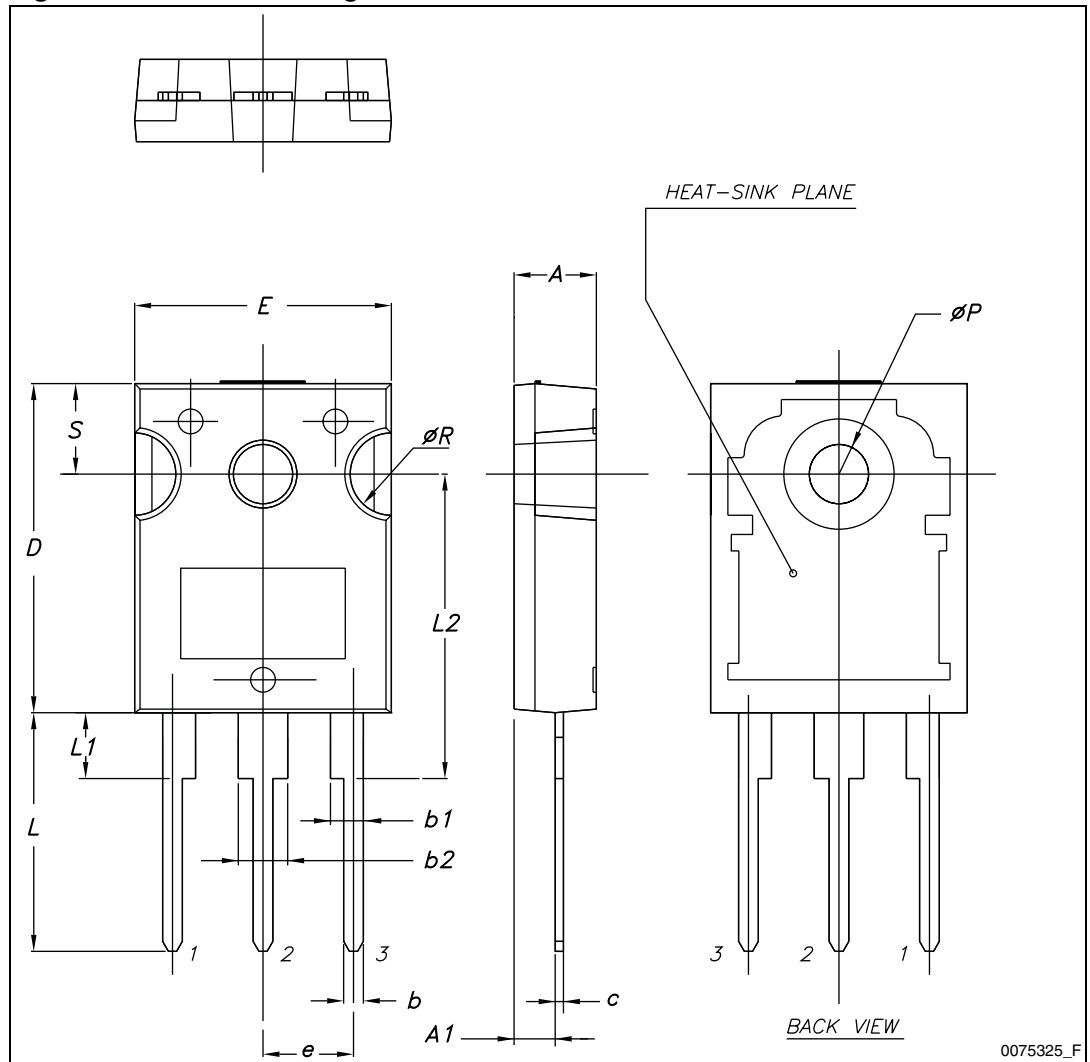


Table 12. TO-247 mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e		5.45	
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
ØP	3.55		3.65
ØR	4.50		5.50
S		5.50	

Figure 12. TO-247 drawing



0075325_F

5 Packaging mechanical data

Table 13. D²PAK (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			

Figure 13. Tape

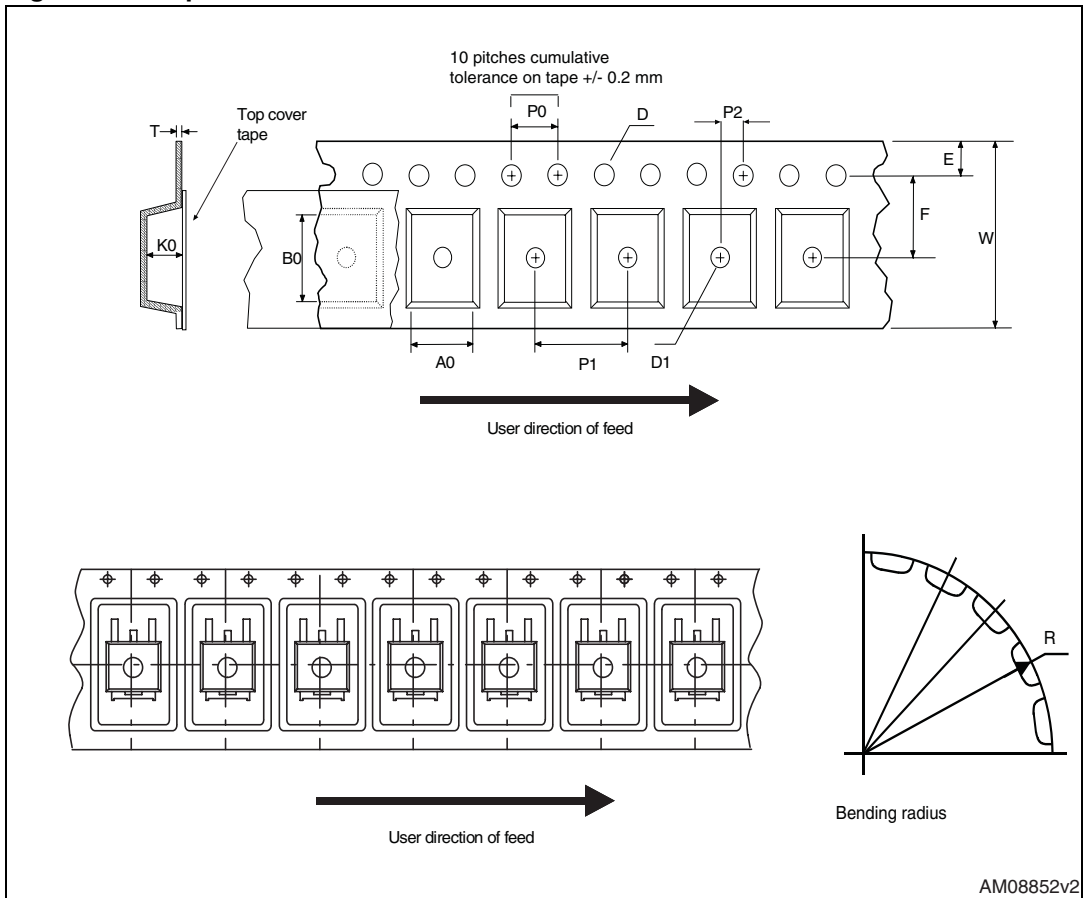
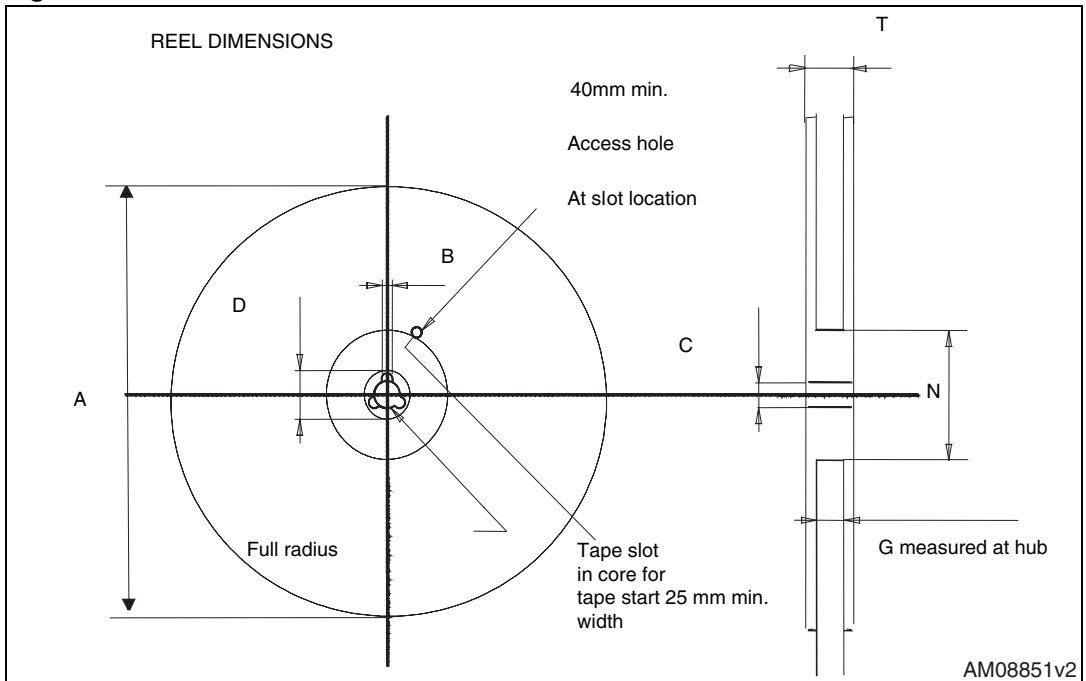


Figure 14. Reel



6 Revision history

Table 14. Document revision history

Date	Revision	Changes
23-Aug-2011	1	First release.

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