



# STB15N80K5, STF15N80K5, STP15N80K5, STW15N80K5

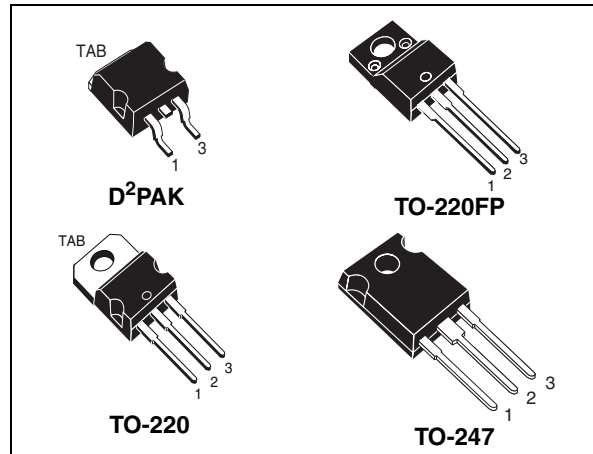
N-channel 800 V, 0.3  $\Omega$  typ., 14 A SuperMESH™ 5 Power MOSFET  
in D<sup>2</sup>PAK, TO-220FP, TO-220 and TO-247 packages

Datasheet – production data

## Features

Type	V <sub>DS</sub>	R <sub>DS(on)</sub> max	I <sub>D</sub>	P <sub>TOT</sub>
STB15N80K5	800 V	< 0.375 $\Omega$	14 A	190 W
STF15N80K5				35 W
STP15N80K5				190 W
STW15N80K5				

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



## Applications

- Switching applications

## Description

These devices are N-channel Zener-protected Power MOSFETs realized in SuperMESH™ 5, a revolutionary avalanche-rugged very high voltage Power MOSFET technology 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

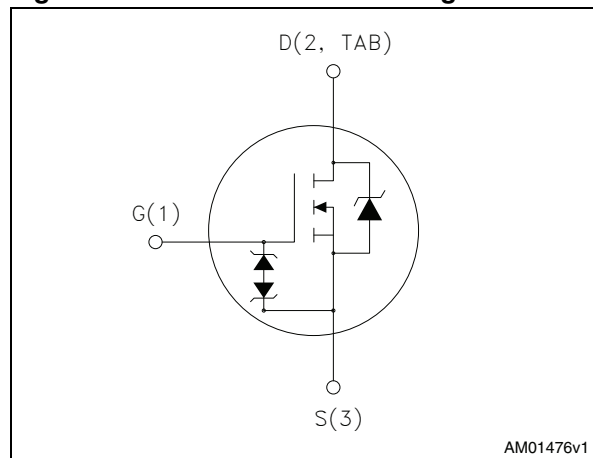


Table 1. Device summary

Order codes	Marking	Package	Packaging
STB15N80K5	15N80K5	D <sup>2</sup> PAK	Tape and reel
STF15N80K5		TO-220FP	Tube
STP15N80K5		TO-220	
STW15N80K5		TO-247	

## Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		D <sup>2</sup> PAK, TO-220, TO-247	TO-220FP	
V <sub>GS</sub>	Gate- source voltage	± 30		V
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 25 °C	14	14 <sup>(1)</sup>	A
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 100 °C	8.8	8.8 <sup>(1)</sup>	A
I <sub>DM</sub> <sup>(2)</sup>	Drain current (pulsed)	56	56 <sup>(1)</sup>	A
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25 °C	190	35	W
I <sub>AR</sub>	Max current during repetitive or single pulse avalanche (pulse width limited by T <sub>jmax</sub> )	4		A
E <sub>AS</sub>	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)	150		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>(3)</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

- Limited by package.
- Pulse width limited by safe operating area.
- I<sub>SD</sub> ≤ 14 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	TO-247	D <sup>2</sup> PAK	TO-220FP	
R <sub>thj-case</sub>	Thermal resistance junction-case max	0.66			3.6	°C/W
R <sub>thj-amb</sub>	Thermal resistance junction-amb max	62.5	50		62.5	
R <sub>thj-pcb</sub> <sup>(1)</sup>	Thermal resistance junction-pcb max			30		

- 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 ( $V_{GS} = 0$ )	$I_D = 1\text{ mA}$	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	$V_{GS} = 10\text{ V}, I_D = 7\text{ A}$		0.3	0.375	$\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit	
$C_{iss}$	Input capacitance			1100		pF	
$C_{oss}$	Output capacitance	$V_{DS} = 100\text{ V}, f = 1\text{ MHz}, V_{GS} = 0$	-	85	-	pF	
$C_{rss}$	Reverse transfer capacitance			1.5			pF
$C_{o(tr)}^{(1)}$	Equivalent capacitance time related	$V_{GS} = 0, V_{DS} = 0\text{ to }640\text{ V}$	-	113	-	pF	
$C_{o(er)}^{(2)}$	Equivalent capacitance energy related			49			pF
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz}, I_D = 0$	-	4.5	-	$\Omega$	
$Q_g$	Total gate charge	$V_{DD} = 640\text{ V}, I_D = 14\text{ A}$ $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 20</a> )	-	32	-	nC	
$Q_{gs}$	Gate-source charge			6			nC
$Q_{gd}$	Gate-drain charge			22			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	$V_{DD} = 400\text{ V}$ , $I_D = 7\text{ A}$ , $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 22</a> )		19		ns
$t_r$	Rise time		-	17.6	-	ns
$t_{d(off)}$	Turn-off delay time				44	ns
$t_f$	Fall time				10	ns

**Table 7. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		14	A
$I_{SDM}$	Source-drain current (pulsed)				56	A
$V_{SD}^{(1)}$	Forward on voltage	$I_{SD} = 14\text{ A}$ , $V_{GS} = 0$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 14\text{ A}$ , $V_{DD} = 60\text{ V}$ $di/dt = 100\text{ A}/\mu\text{s}$ , (see <a href="#">Figure 21</a> )	-	445		ns
$Q_{rr}$	Reverse recovery charge				8.2	$\mu\text{C}$
$I_{RRM}$	Reverse recovery current				37	A
$t_{rr}$	Reverse recovery time	$I_{SD} = 14\text{ A}$ , $V_{DD} = 60\text{ V}$ $di/dt = 100\text{ A}/\mu\text{s}$ , $T_J = 150\text{ }^\circ\text{C}$ (see <a href="#">Figure 21</a> )	-	580		ns
$Q_{rr}$	Reverse recovery charge				10	$\mu\text{C}$
$I_{RRM}$	Reverse recovery current				35	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
$V_{(BR)GSO}$	Gate-source breakdown voltage	$I_{GS} = \pm 1\text{ mA}$ , $I_D = 0$	30	-	-	V

The built-in back-to-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 any voltage transients that may occasionally be applied from gate to source. In this respect, the Zener voltage is appropriate to achieve efficient and cost-effective protection of device integrity. The integrated Zener diodes thus eliminate the need for external components.

## 2.1 Electrical characteristics (curves)

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

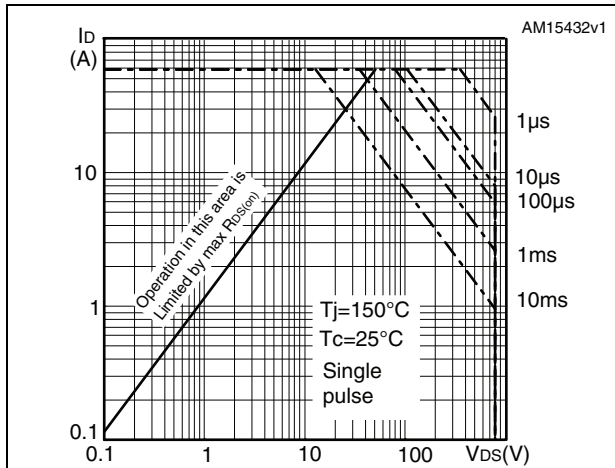


Figure 3. Thermal impedance for D<sup>2</sup>PAK and TO-220

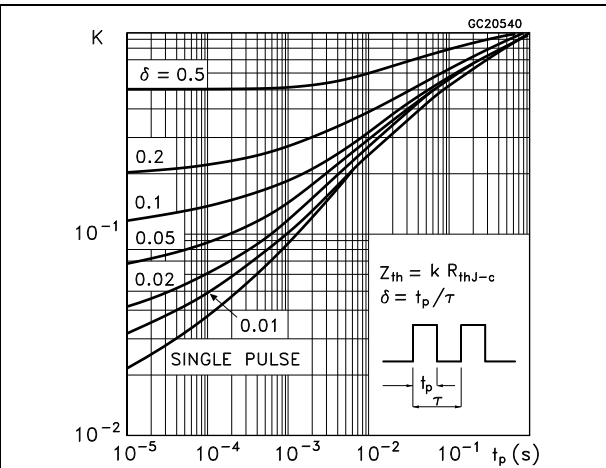


Figure 4. Safe operating area for TO-220FP

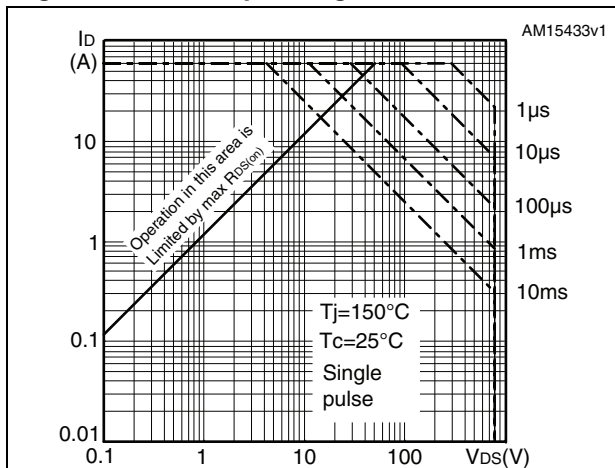


Figure 5. Thermal impedance for TO-220FP

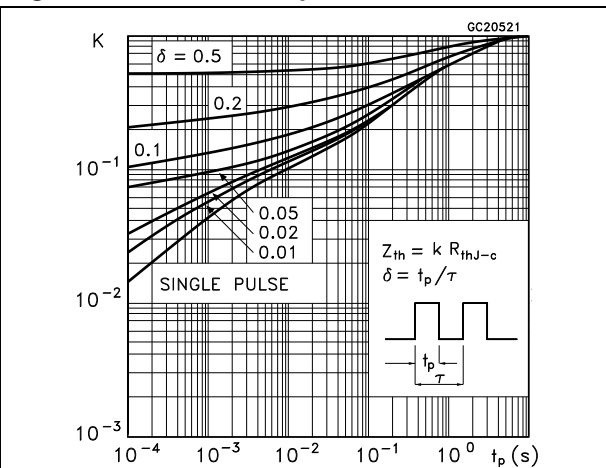


Figure 6. Safe operating area for TO-247

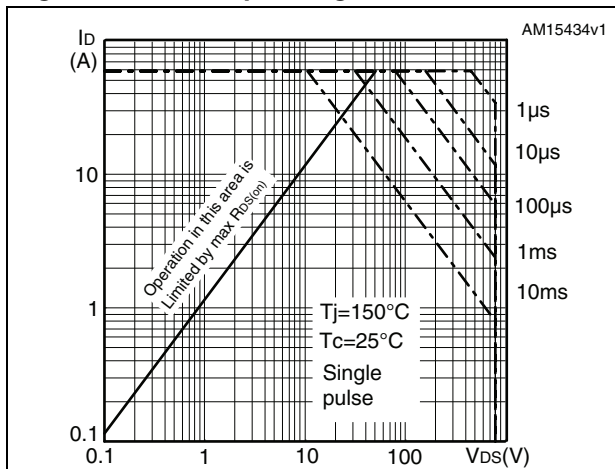


Figure 7. Thermal impedance for TO-247

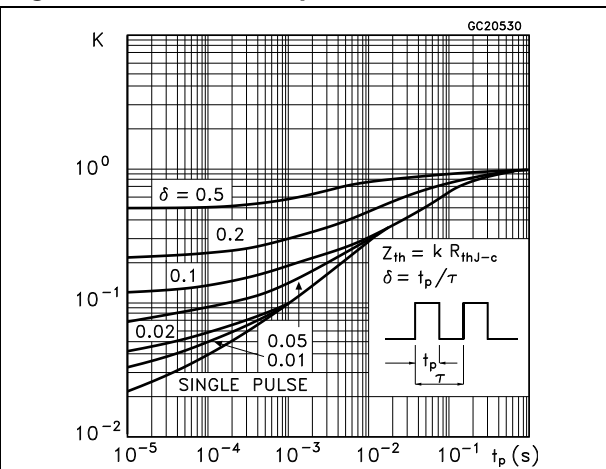


Figure 8. Output characteristics

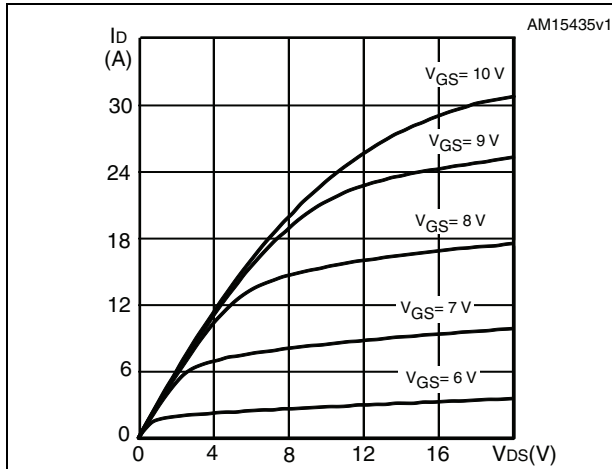


Figure 9. Transfer characteristics

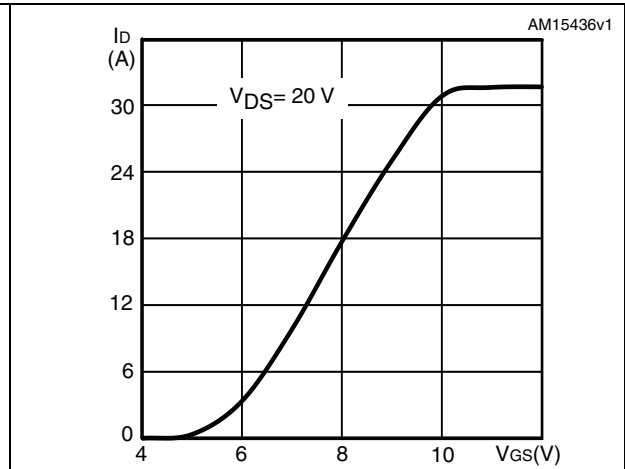


Figure 10. Gate charge vs gate-source voltage Figure 11. Static drain-source on-resistance

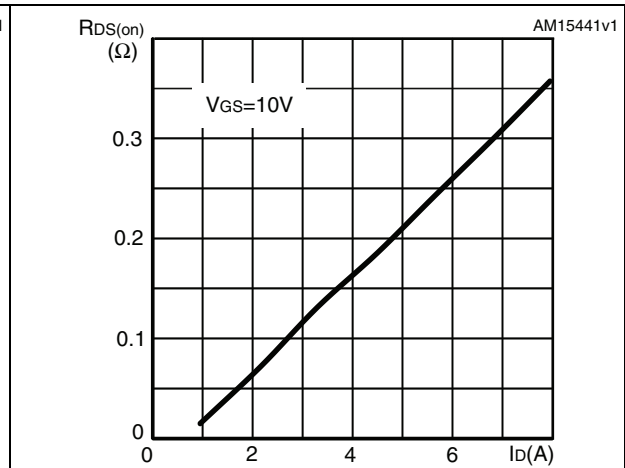
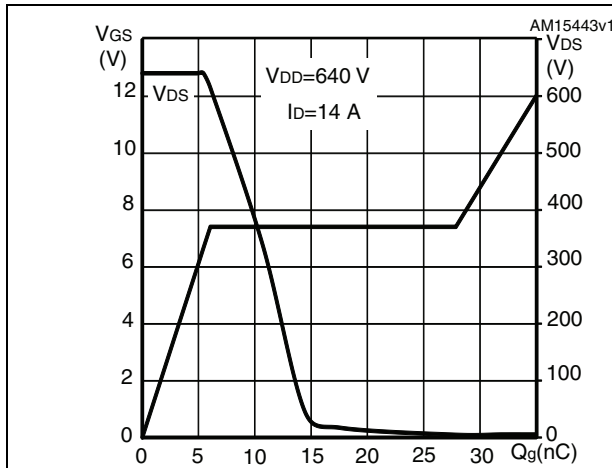


Figure 12. Capacitance variations

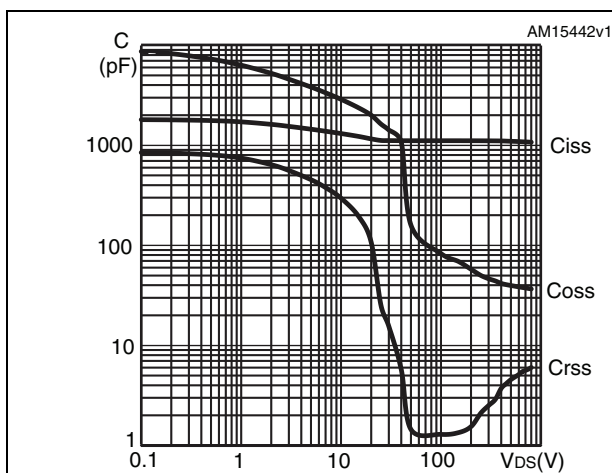


Figure 13. Source-drain diode forward characteristics

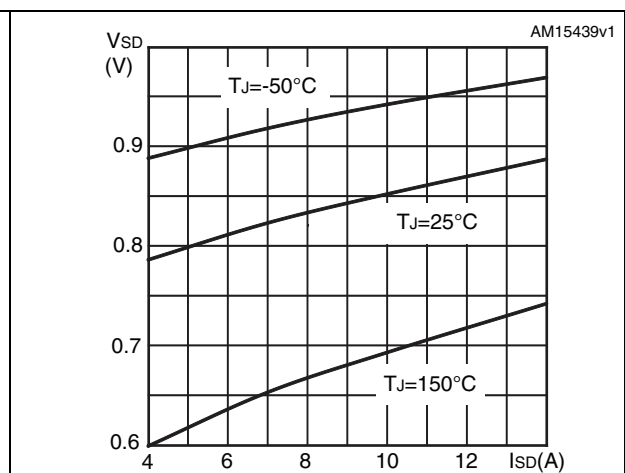


Figure 14. Normalized gate threshold voltage vs temperature

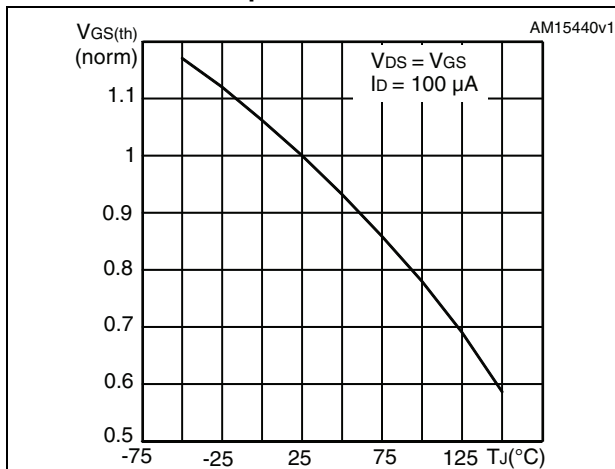


Figure 15. Normalized on-resistance vs temperature

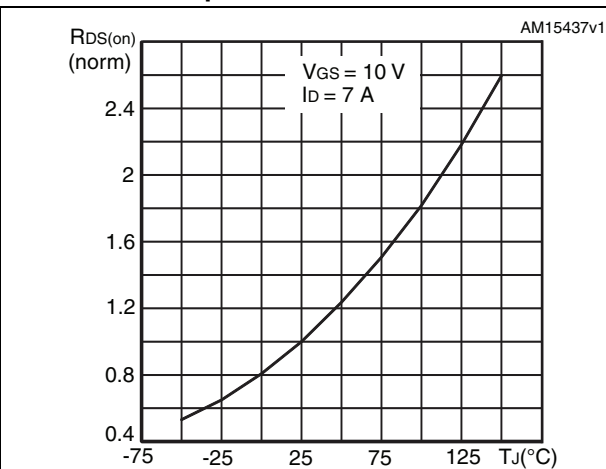


Figure 16. Output capacitance stored energy

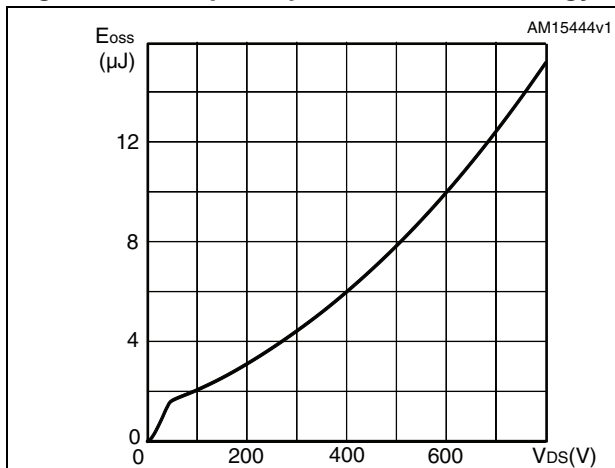


Figure 17. Normalized V<sub>DS</sub> vs temperature

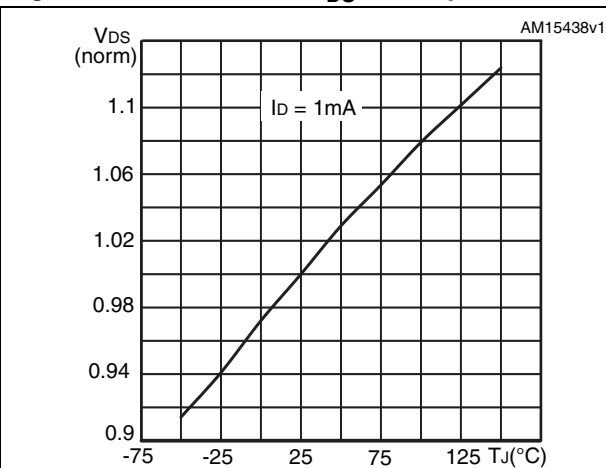
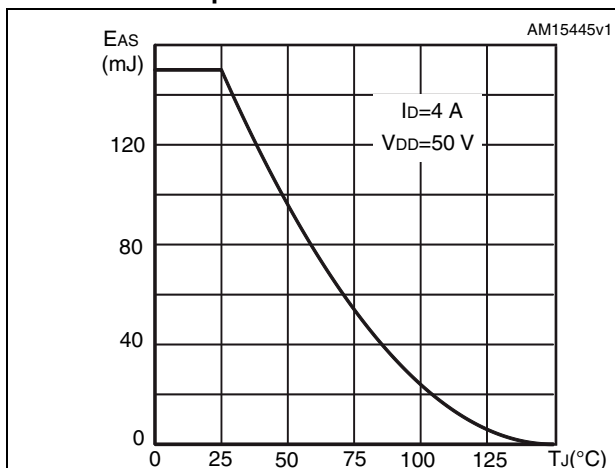


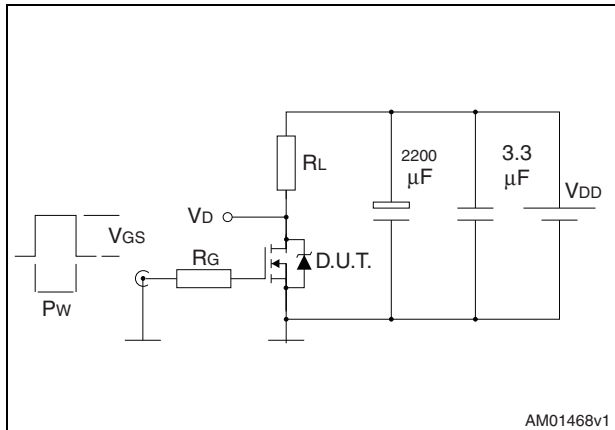
Figure 18. Maximum avalanche energy vs temperature





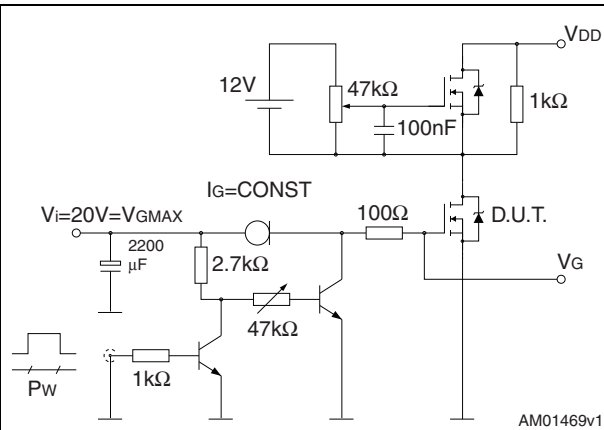
### 3 Test circuits

**Figure 19. Switching times test circuit for resistive load**



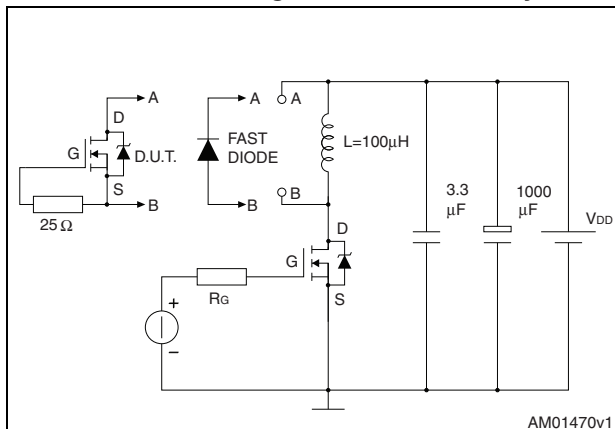
AM01468v1

**Figure 20. Gate charge test circuit**



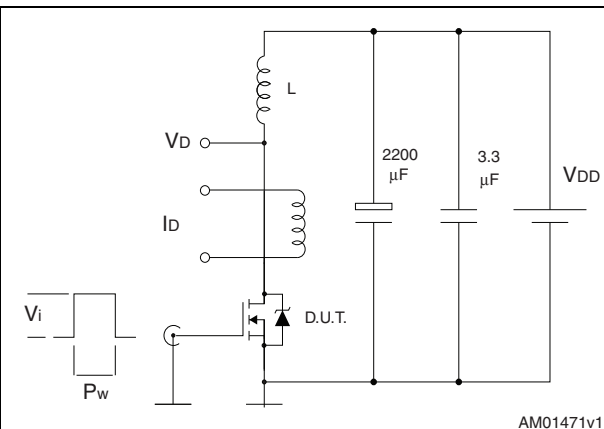
AM01469v1

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



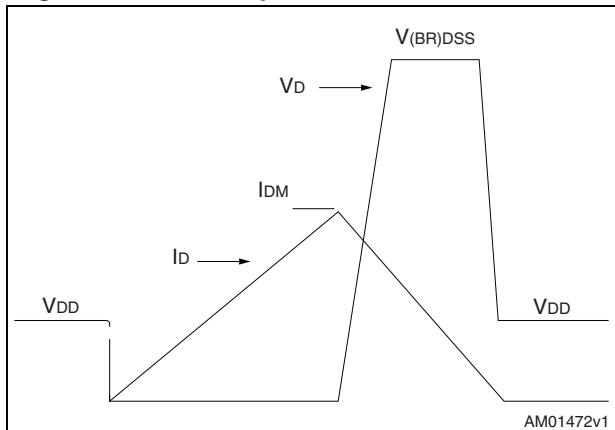
AM01470v1

**Figure 22. Unclamped inductive load test circuit**



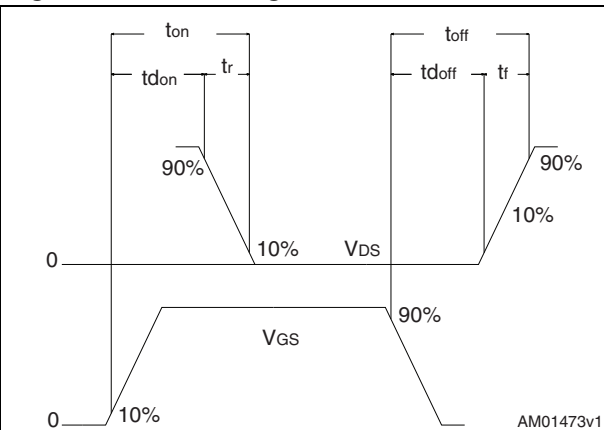
AM01471v1

**Figure 23. Unclamped inductive waveform**



AM01472v1

**Figure 24. Switching time waveform**



AM01473v1

## 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. D<sup>2</sup>PAK (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 25. D<sup>2</sup>PAK (TO-263) drawing

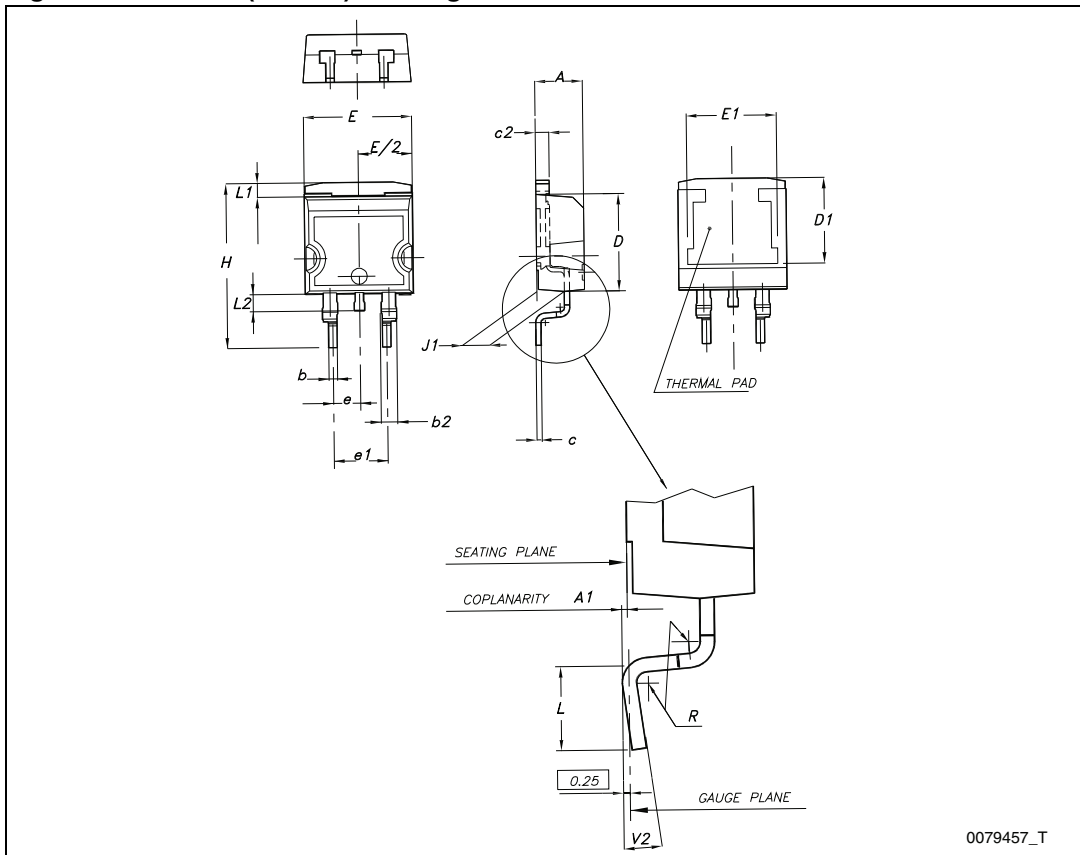
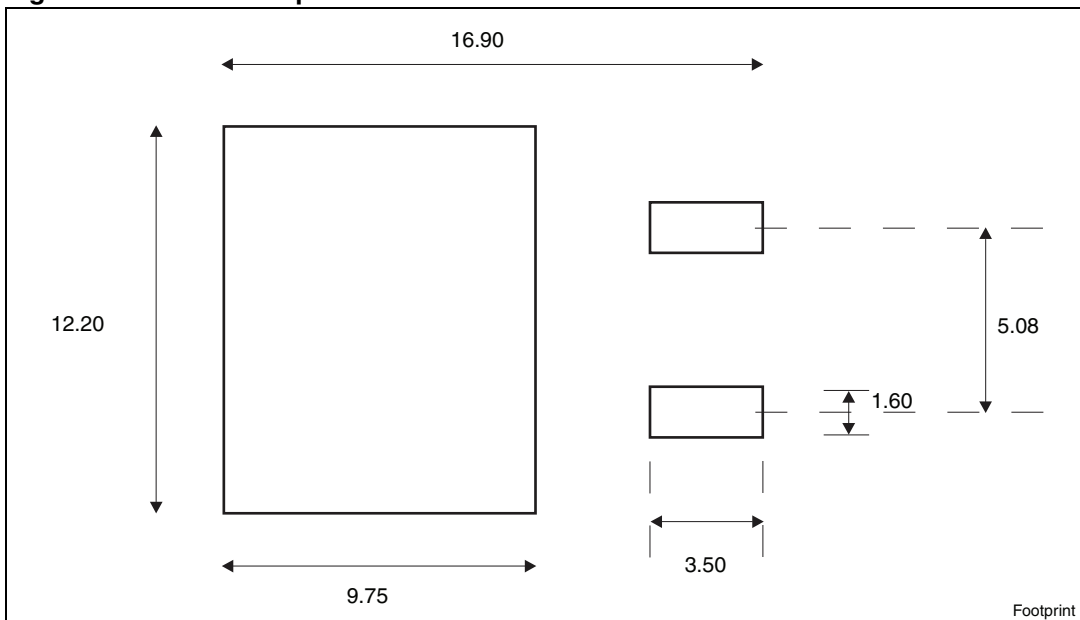


Figure 26. D<sup>2</sup>PAK footprint<sup>(a)</sup>



a. All dimension are in millimeters

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 27. TO-220 type A drawing

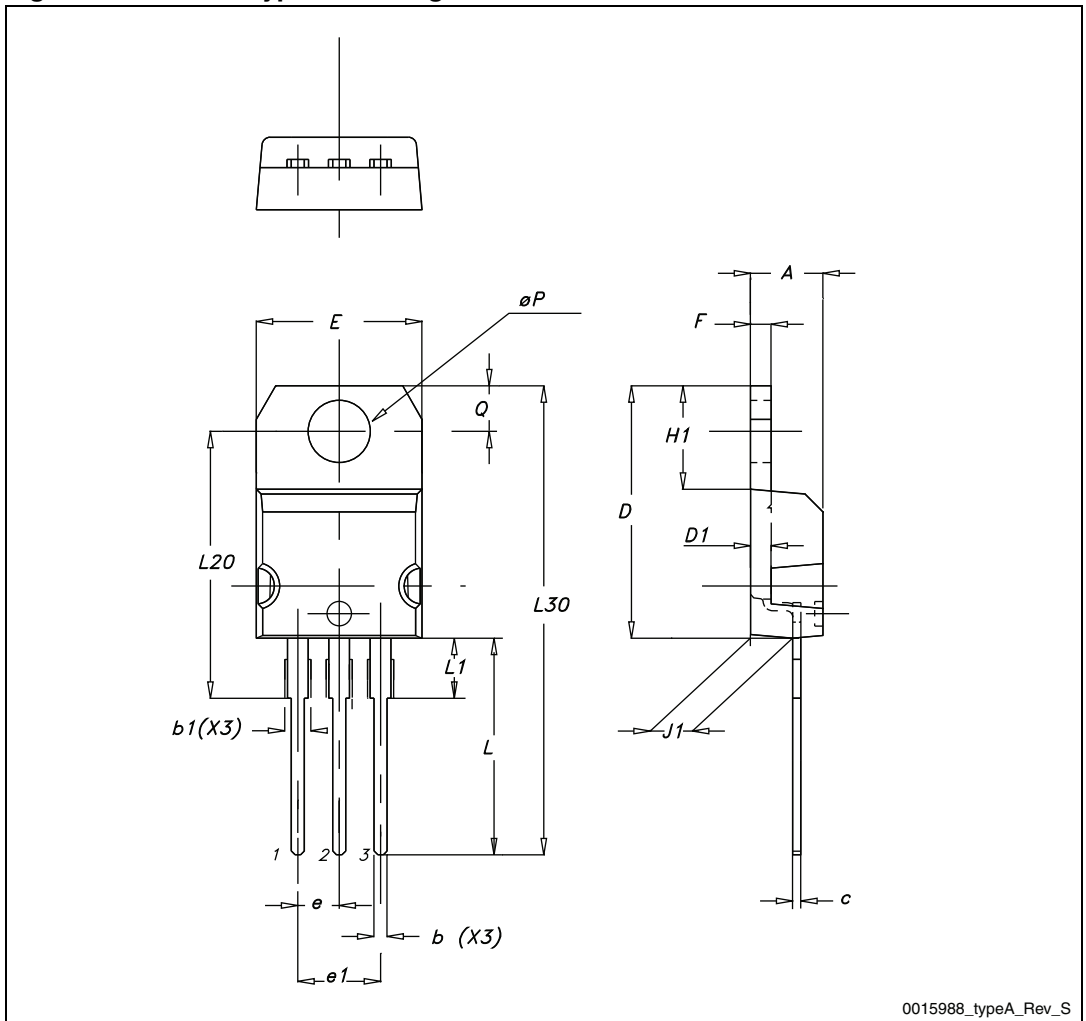
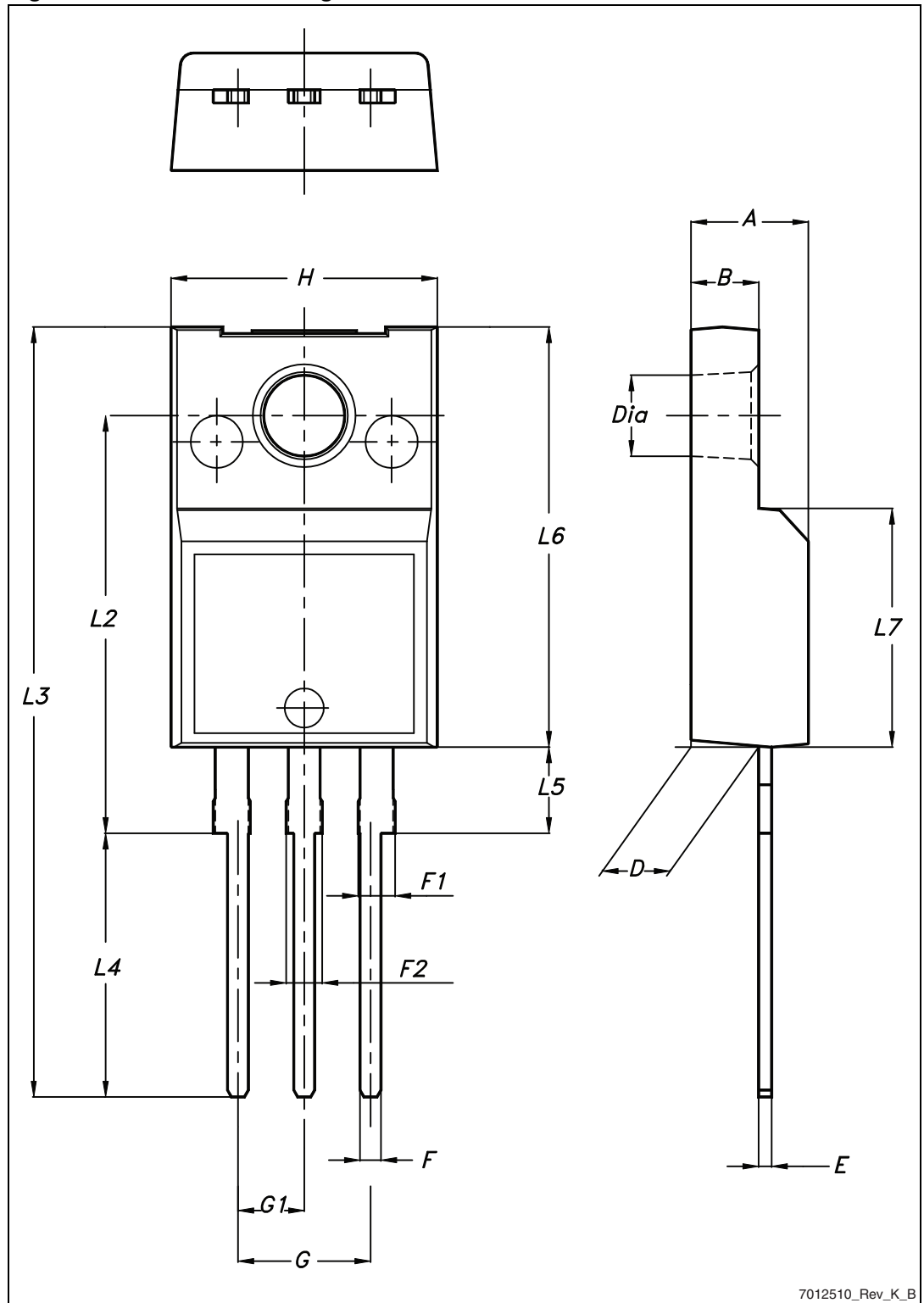


Table 11. TO-220FP mechanical data

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 28. TO-220FP drawing



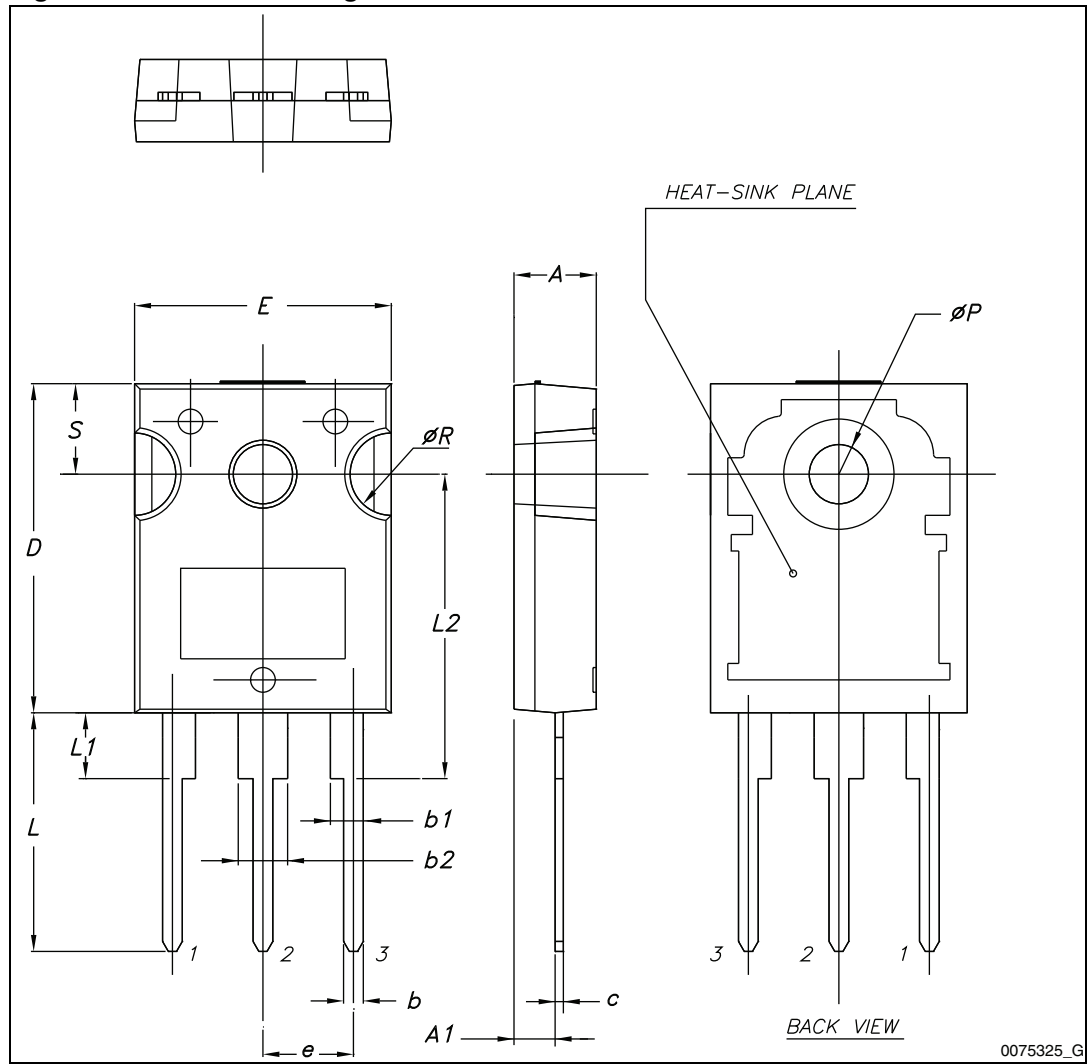
7012510\_Rev\_K\_B



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	5.30	5.45	5.60
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
ØP	3.55		3.65
ØR	4.50		5.50
S	5.30	5.50	5.70

Figure 29. TO-247 drawing



0075325\_G

## 5 Packaging information

Table 13. D<sup>2</sup>PAK (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 30. Tape

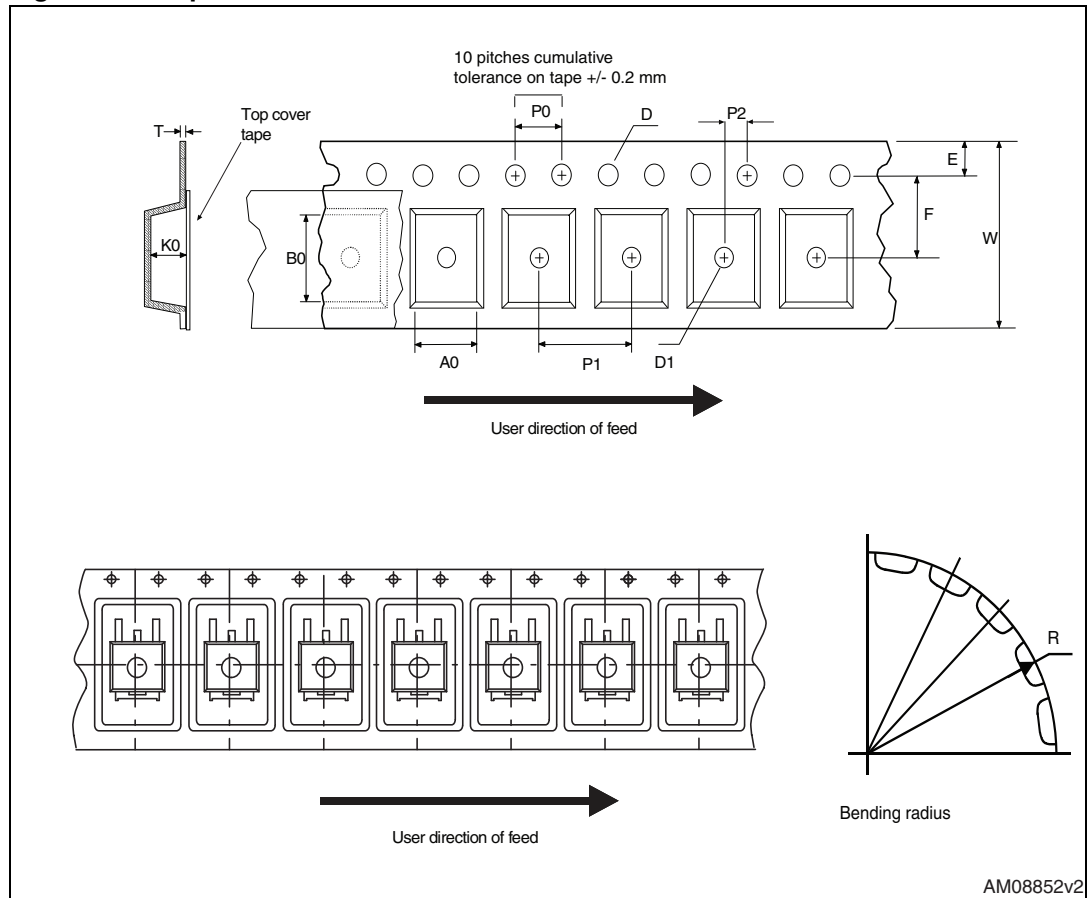
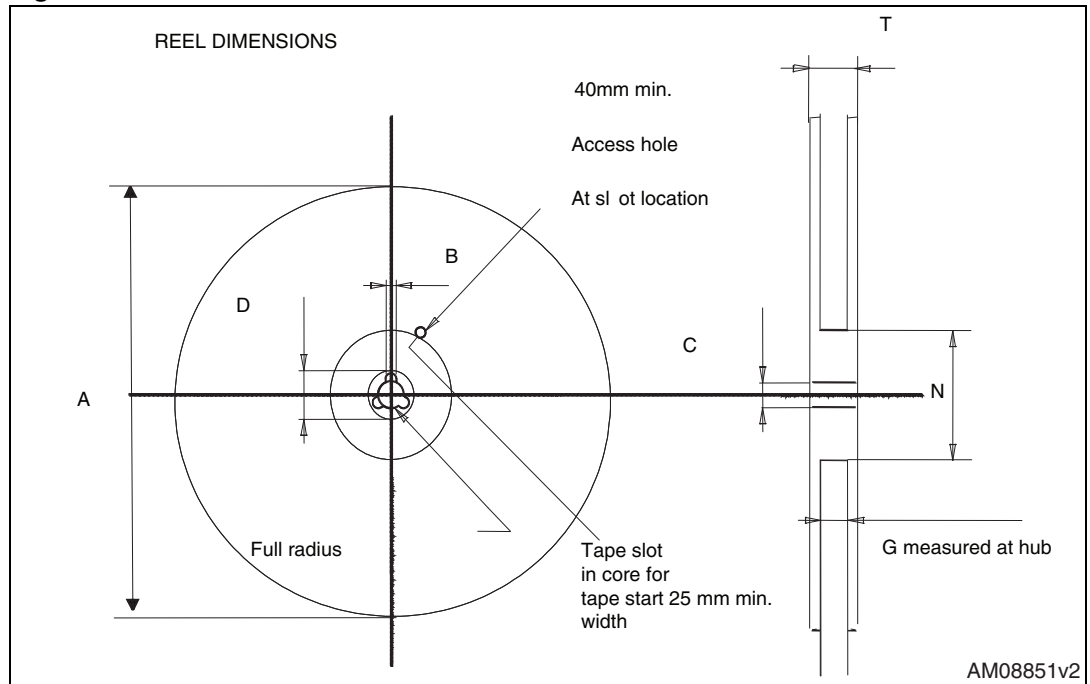


Figure 31. Reel



## 6 Revision history

Table 14. Document revision history

Date	Revision	Changes
18-Jul-2012	1	First release.
31-Oct-2012	2	<ul style="list-style-type: none"><li>– Inserted: <math>I_{AR}</math>, <math>E_{AS}</math> and <math>dv/dt</math> values in <a href="#">Table 2</a></li><li>– Inserted: <a href="#">Table 5</a>, <a href="#">6</a> and <a href="#">7</a> typical values</li><li>– Inserted: <a href="#">Section 2.1: Electrical characteristics (curves)</a></li><li>– Minor text changes</li></ul>

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