



# STB8N65M5, STD8N65M5, STF8N65M5 STI8N65M5, STP8N65M5, STU8N65M5

N-channel 650 V, 0.56  $\Omega$ , 7 A MDmesh™ V Power MOSFET  
in D<sup>2</sup>PAK, I<sup>2</sup>PAK, TO-220, TO-220FP, DPAK and IPAK

## Features

Type	V <sub>DSS</sub> @ T <sub>Jmax</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>
STB8N65M5 STD8N65M5 STF8N65M5 STI8N65M5 STP8N65M5 STU8N65M5	710 V	< 0.6 $\Omega$	7 A

- Worldwide best R<sub>DS(on)</sub> \* area
- Higher V<sub>DSS</sub> rating
- High dv/dt capability
- Excellent switching performance
- Easy to drive
- 100% avalanche tested

## Applications

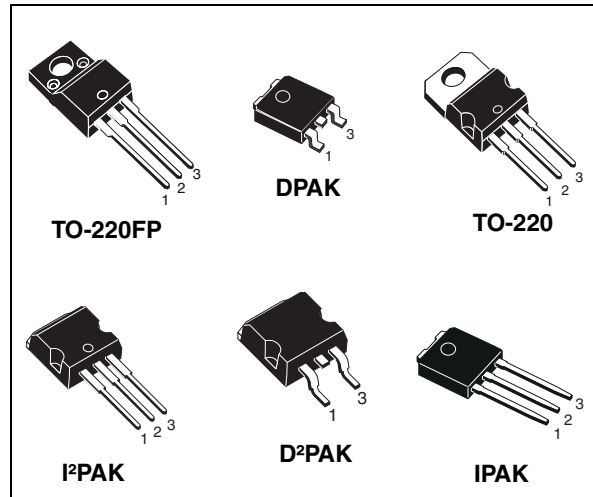
- Switching applications

## Description

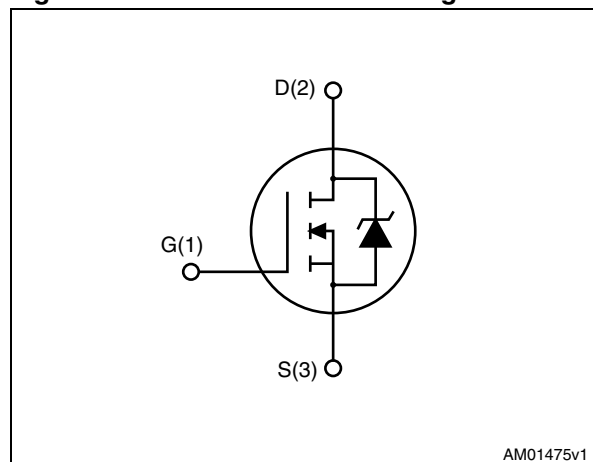
These devices are N-channel MDmesh™ V Power MOSFETs based on an innovative proprietary vertical process technology, which is combined with STMicroelectronics' well-known PowerMESH™ horizontal layout structure. The resulting product has extremely low on-resistance, which is unmatched among silicon-based Power MOSFETs, making it especially suitable for applications which require superior power density and outstanding efficiency.

**Table 1. Device summary**

Order codes	Marking	Package	Packaging
STB8N65M5 STD8N65M5 STF8N65M5 STI8N65M5 STP8N65M5 STU8N65M5	8N65M5	D <sup>2</sup> PAK DPAK TO-220FP I <sup>2</sup> PAK TO-220 IPAK	Tape and reel Tape and reel Tube Tube Tube Tube



**Figure 1. Internal schematic diagram**



AM01475v1

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value			Unit
		TO-220, D <sup>2</sup> PAK I <sup>2</sup> PAK	IPAK DPAK,	TO-220FP	
V <sub>GS</sub>	Gate- source voltage	± 25			V
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 25 °C	7		7 <sup>(1)</sup>	A
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 100 °C	4.4		4.4 <sup>(1)</sup>	A
I <sub>DM</sub> <sup>(2)</sup>	Drain current (pulsed)	28		28 <sup>(1)</sup>	A
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25 °C	70		25	W
I <sub>AR</sub>	Max current during repetitive or single pulse avalanche (pulse width limited by T <sub>JMAX</sub> )	2			A
E <sub>AS</sub>	Single pulse avalanche energy (starting T <sub>j</sub> = 25°C, I <sub>D</sub> = I <sub>AR</sub> , V <sub>DD</sub> = 50V)	120			mJ
dv/dt <sup>(3)</sup>	Peak diode recovery voltage slope	15			V/ns
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
T <sub>stg</sub>	Storage temperature	-55 to 150			°C
T <sub>j</sub>	Max. operating junction temperature	150			°C

1. Limited only by maximum temperature allowed.
2. Pulse width limited by safe operating area.
3. I<sub>SD</sub> ≤ 7A, di/dt ≤ 400 A/μs, V<sub>Peak</sub> < V<sub>(BR)DSS</sub>.

**Table 3. Thermal data**

Symbol	Parameter	Value						Unit
		DPAK	IPAK	TO-220	I <sup>2</sup> PAK	D <sup>2</sup> PAK	TO-220FP	
R <sub>thj-case</sub>	Thermal resistance junction-case max	1.79					5	°C/W
R <sub>thj-amb</sub>	Thermal resistance junction-ambient max		100	62.5			62.5	°C/W
R <sub>thj-pcb</sub> <sup>(1)</sup>	Thermal resistance junction-pcb max	50				30		°C/W
T <sub>l</sub>	Maximum lead temperature for soldering purpose		300				300	°C

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

## 2 Electrical characteristics

( $T_C = 25\text{ °C}$  unless otherwise specified)

**Table 4. On /off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}, V_{GS} = 0$	650			V
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating}, T_C = 125\text{ °C}$			1 100	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 25\text{ V}$			100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{ V}, I_D = 3.5\text{ A}$		0.56	0.6	$\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 100\text{ V}, f = 1\text{ MHz},$ $V_{GS} = 0$	-	690	-	pF
$C_{oss}$	Output capacitance			18		
$C_{rss}$	Reverse transfer capacitance			2		
$C_{o(er)}^{(1)}$	Equivalent output capacitance energy related	$V_{GS} = 0, V_{DS} = 0\text{ to }520\text{ V}$	-	17	-	pF
$C_{o(tr)}^{(2)}$	Equivalent output capacitance time related	$V_{GS} = 0, V_{DS} = 0\text{ to }520\text{ V}$	-	52	-	pF
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz open drain}$	-	2.4	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 520\text{ V}, I_D = 3.5\text{ A},$ $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 19</a> )	-	15	-	nC
$Q_{gs}$	Gate-source charge			3.6		
$Q_{gd}$	Gate-drain charge			6		

- $C_{o(er)}^{(1)}$  is a constant capacitance value that gives the same stored energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$
- $C_{o(tr)}^{(2)}$  is a constant capacitance value that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(off)}$	Turn-off delay time	$V_{DD} = 400\text{ V}$ , $I_D = 4\text{ A}$ ,		50		ns
$t_{r(V)}$	Rise time	$R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$	-	14	-	ns
$t_{c(off)}$	Cross time	(see <a href="#">Figure 20</a> )		20		ns
$t_{f(i)}$	Fall time	(see <a href="#">Figure 23</a> )		11		ns

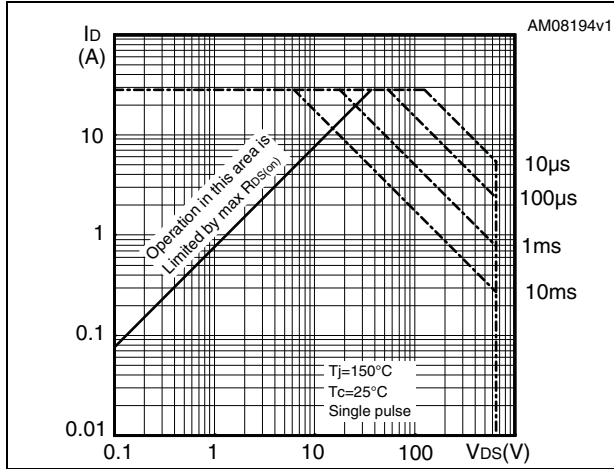
**Table 7. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		7	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		28	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 7\text{ A}$ , $V_{GS} = 0$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 7\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$		200		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 100\text{ V}$	-	1.6		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current	(see <a href="#">Figure 20</a> )		16		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 7\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$		263		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 100\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$	-	1.9		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current	(see <a href="#">Figure 20</a> )		15		A

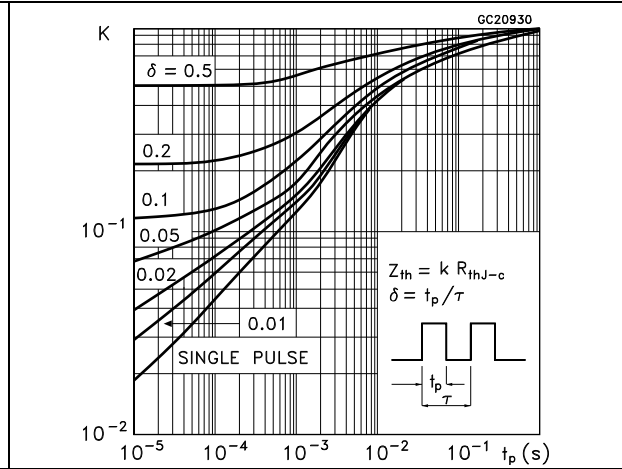
1. Pulse width limited by safe operating area
2. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

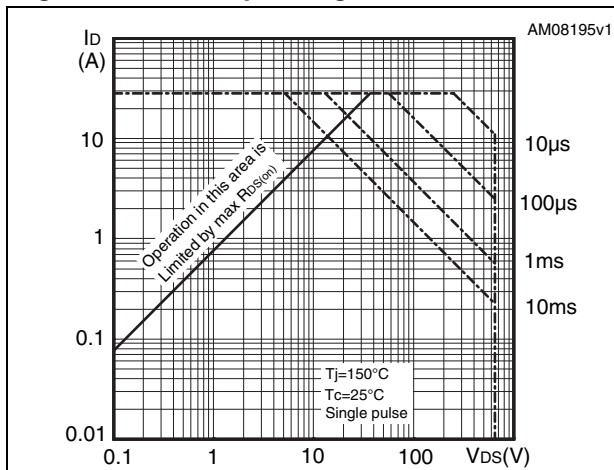
**Figure 2. Safe operating area for TO-220, I<sup>2</sup>PAK, D<sup>2</sup>PAK**



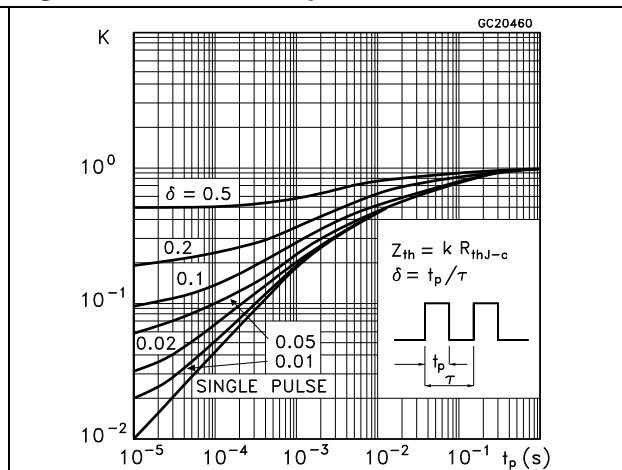
**Figure 3. Thermal impedance for TO-220, I<sup>2</sup>PAK, D<sup>2</sup>PAK**



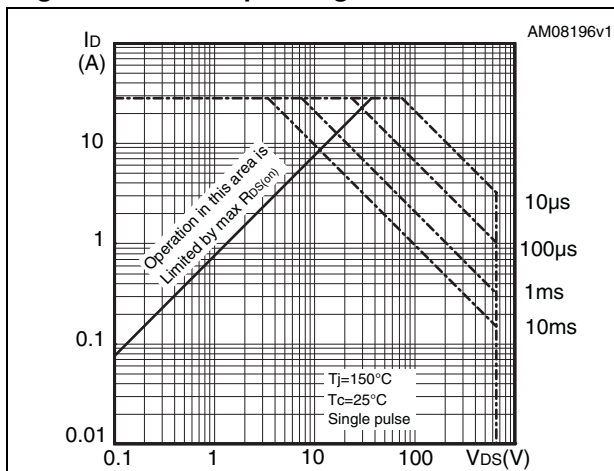
**Figure 4. Safe operating area for DPAK, IPAK**



**Figure 5. Thermal impedance for DPAK, IPAK**



**Figure 6. Safe operating area for TO-220FP**



**Figure 7. Thermal impedance for TO-220FP**

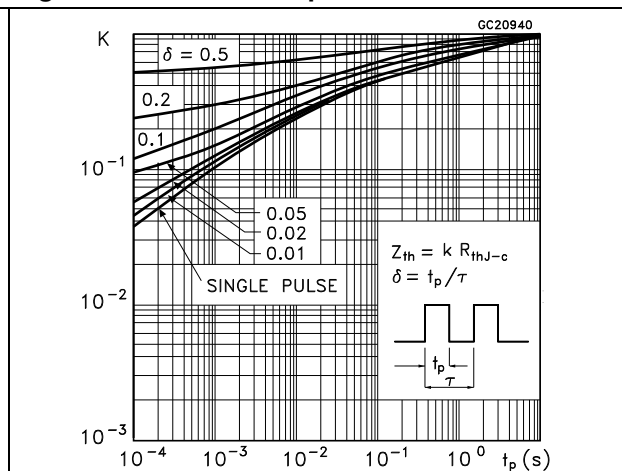


Figure 8. Output characteristics

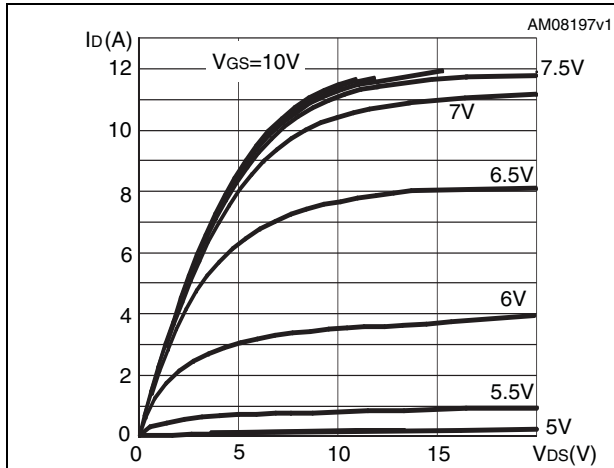


Figure 9. Transfer characteristics

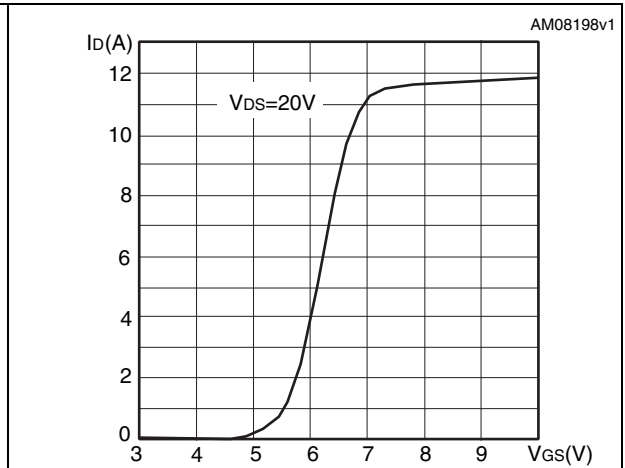


Figure 10. Gate charge vs gate-source voltage Figure 11. Static drain-source on resistance

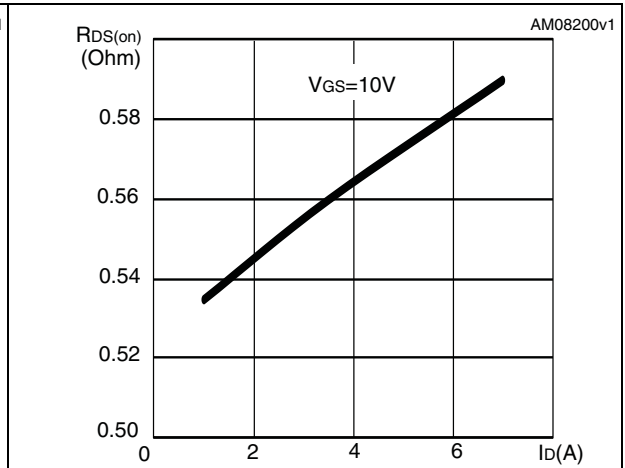
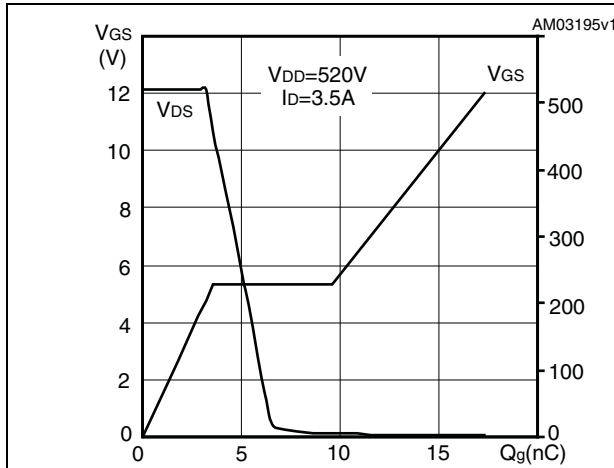


Figure 12. Capacitance variations

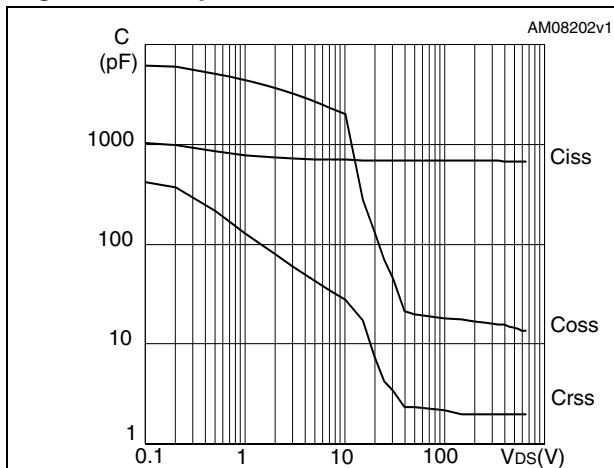


Figure 13. Output capacitance stored energy

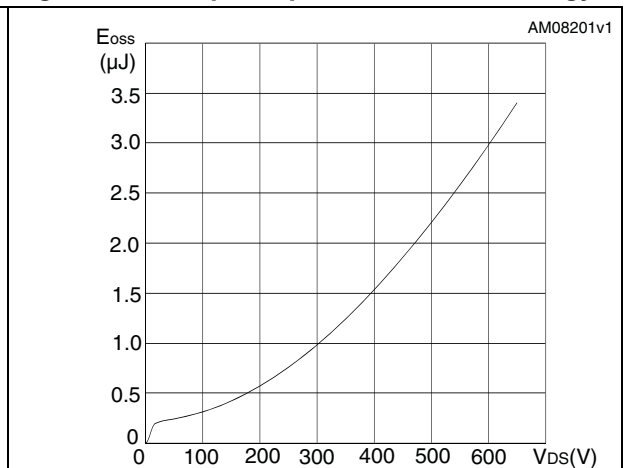


Figure 14. Normalized gate threshold voltage vs temperature

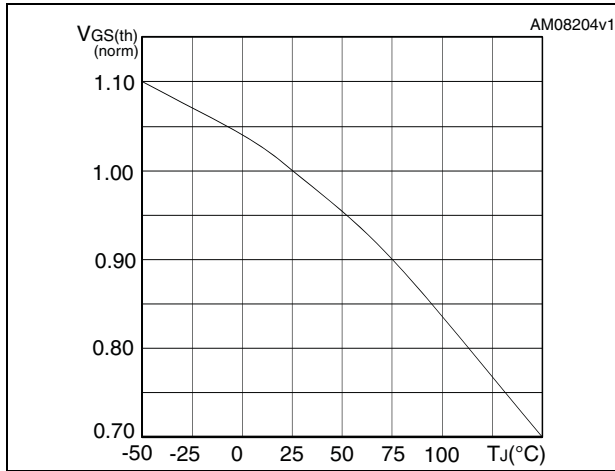


Figure 15. Normalized on resistance vs temperature

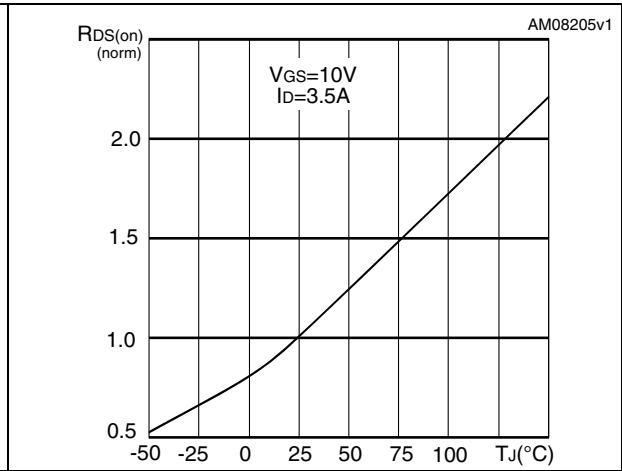


Figure 16. Switching losses vs gate resistance (1)

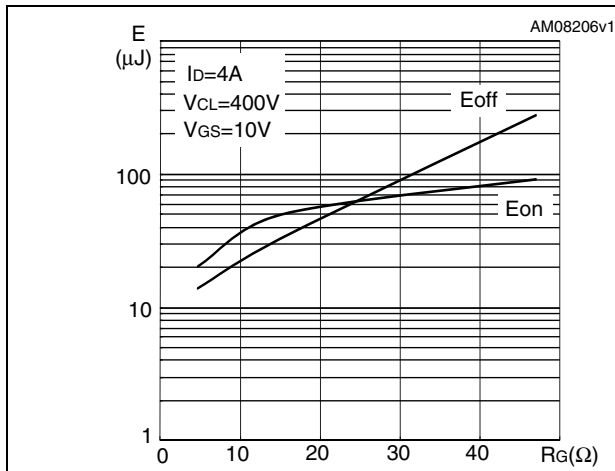
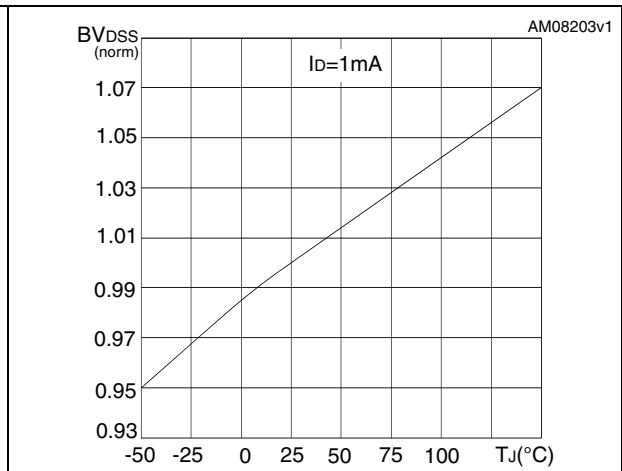


Figure 17. Normalized B<sub>V</sub>DSS vs temperature



1. Eon including reverse recovery of a SiC diode

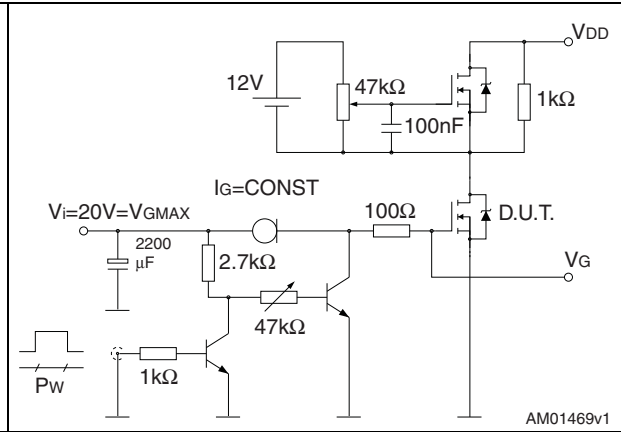


### 3 Test circuits

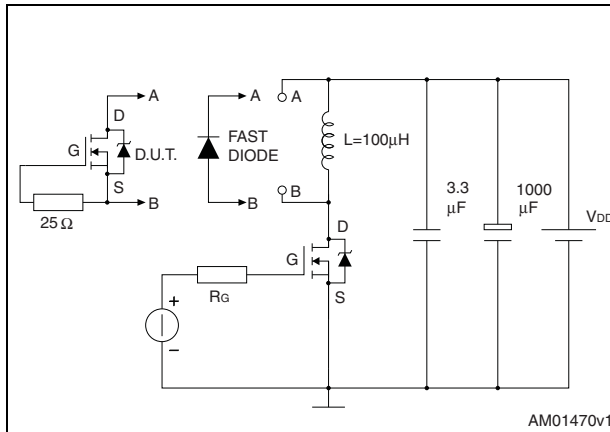
**Figure 18. Switching times test circuit for resistive load**



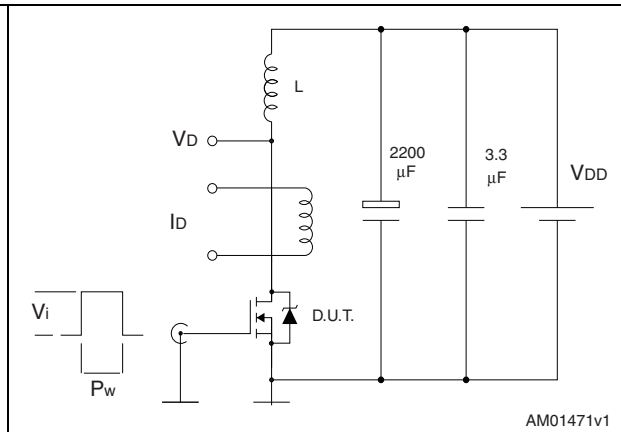
**Figure 19. Gate charge test circuit**



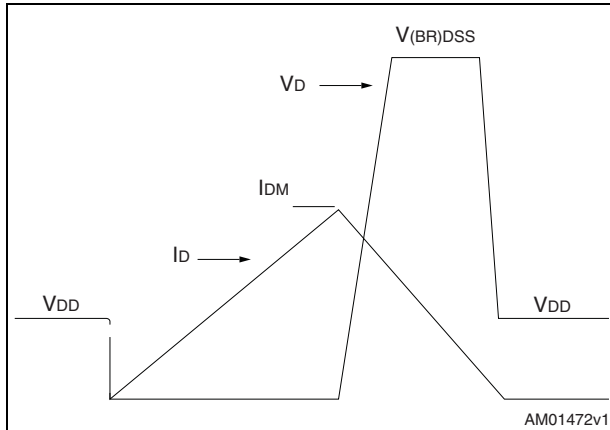
**Figure 20. Test circuit for inductive load switching and diode recovery times**



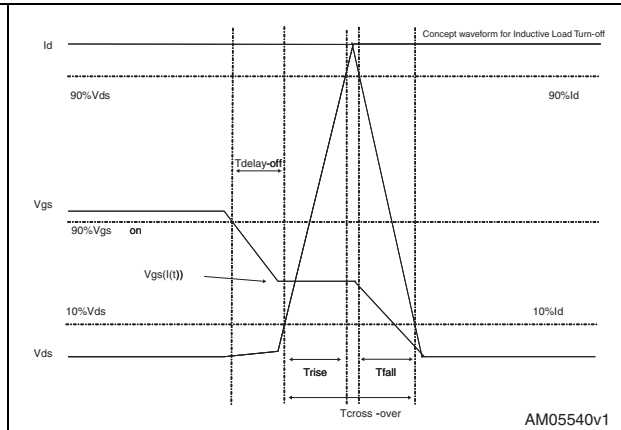
**Figure 21. Unclamped inductive load test circuit**



**Figure 22. Unclamped inductive waveform**



**Figure 23. 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](http://www.st.com). ECOPACK is an ST trademark.

Table 8. 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 24. TO-220FP drawing mechanical data

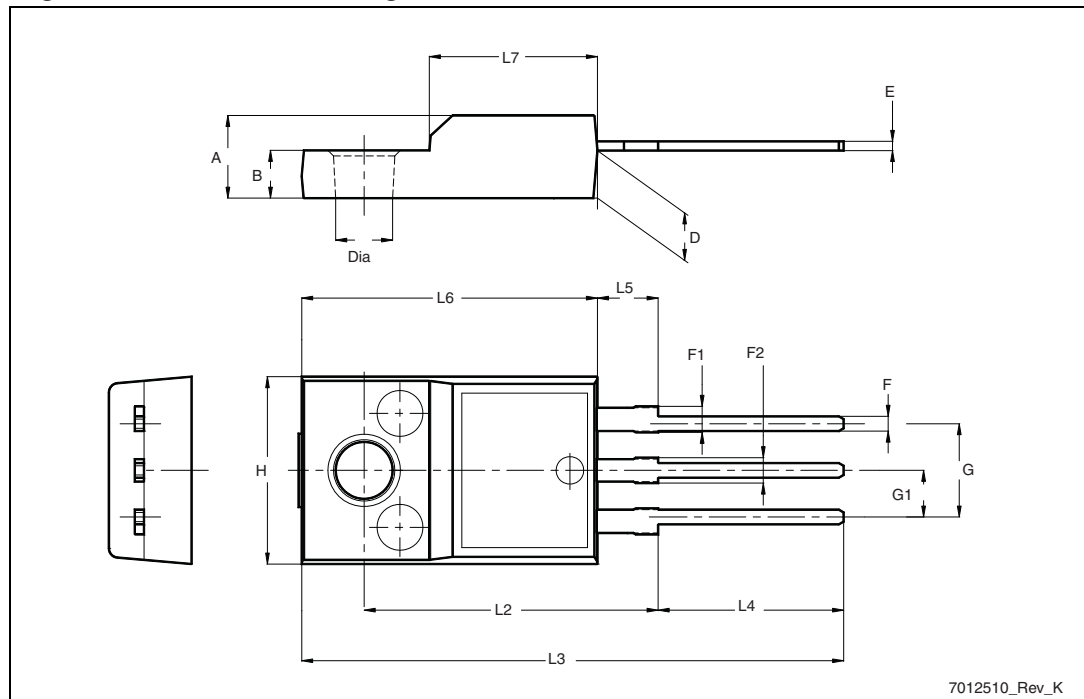


Table 9. D<sup>2</sup>PAK (TO-263) mechanical data

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

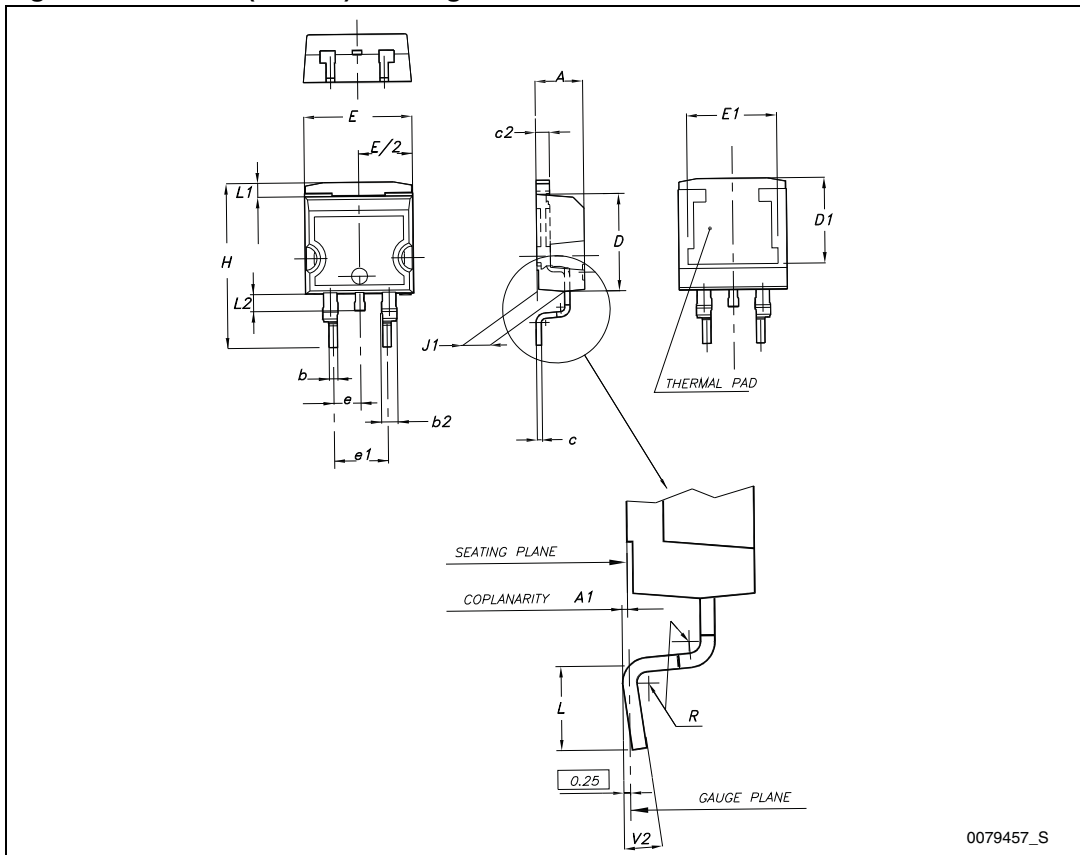
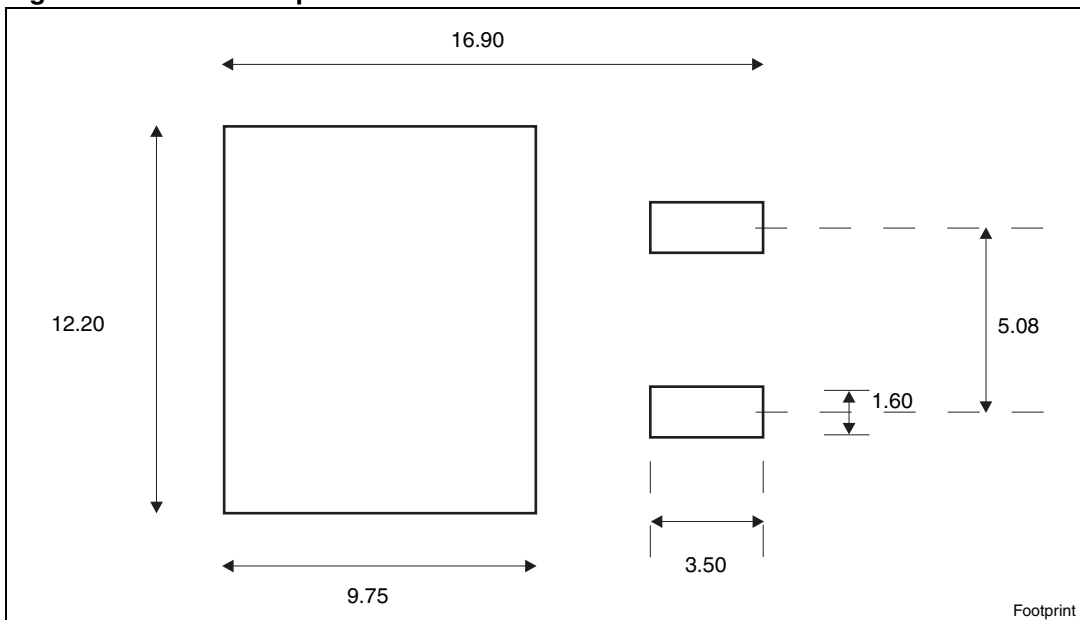


Figure 26. D<sup>2</sup>PAK footprint<sup>(a)</sup>

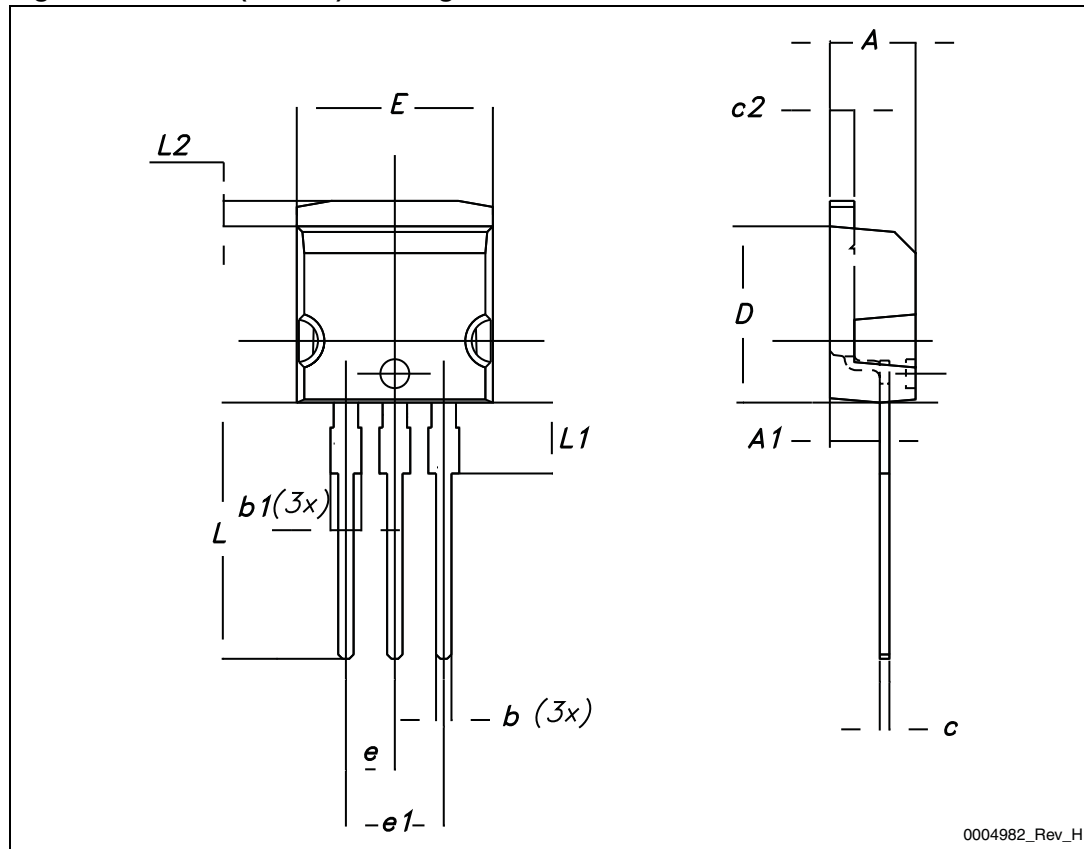


a. All dimension are in millimeters

Table 10. I<sup>2</sup>PAK (TO-262) mechanical data

DIM.	mm.		
	min.	typ	max.
A	4.40		4.60
A1	2.40		2.72
b	0.61		0.88
b1	1.14		1.70
c	0.49		0.70
c2	1.23		1.32
D	8.95		9.35
e	2.40		2.70
e1	4.95		5.15
E	10		10.40
L	13		14
L1	3.50		3.93
L2	1.27		1.40

Figure 27. I<sup>2</sup>PAK (TO-262) drawing



0004982\_Rev\_H

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 28. TO-220 type A drawing

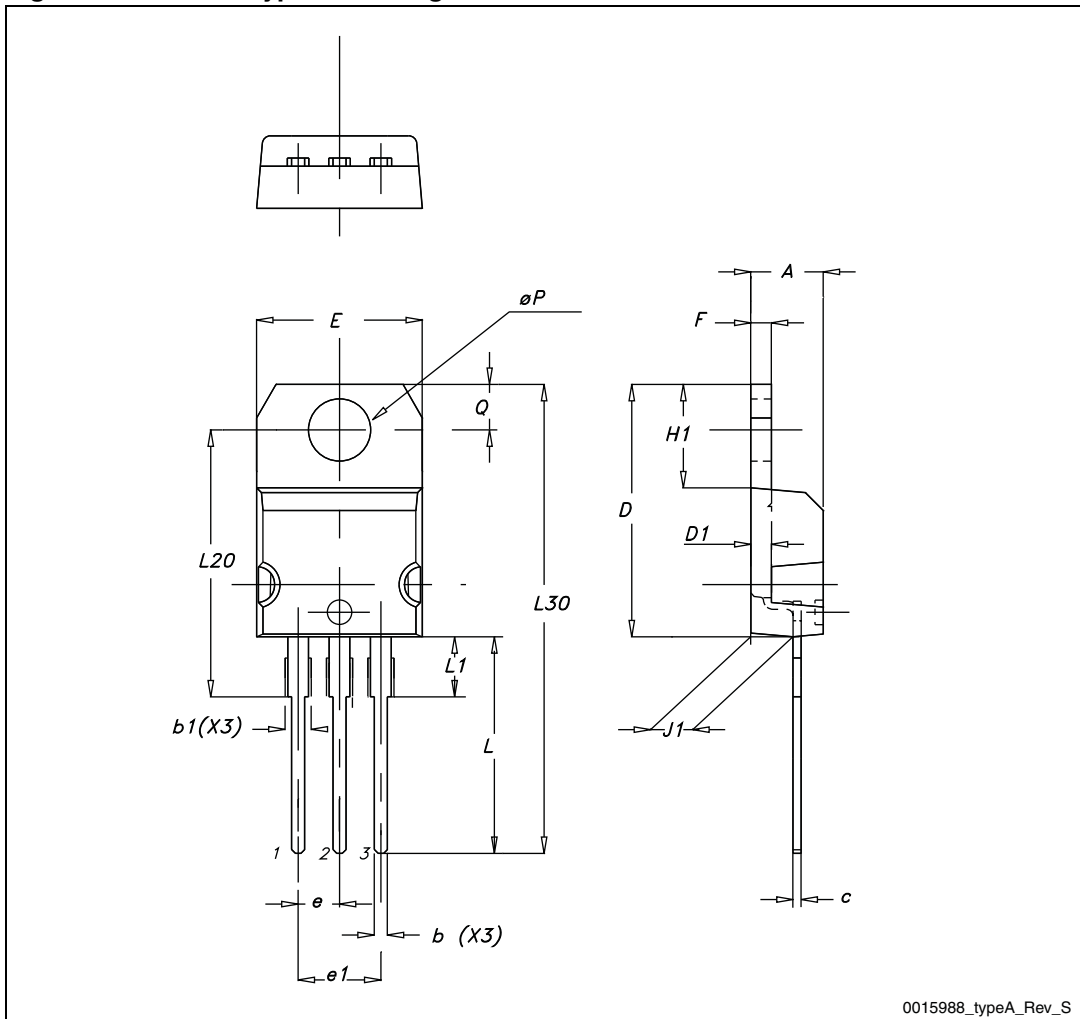




Table 12. DPAK (TO-252) mechanical data

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		1.50
L1		2.80	
L2		0.80	
L4	0.60		1
R		0.20	
V2	0°		8°

Figure 29. DPAK (TO-252) drawing

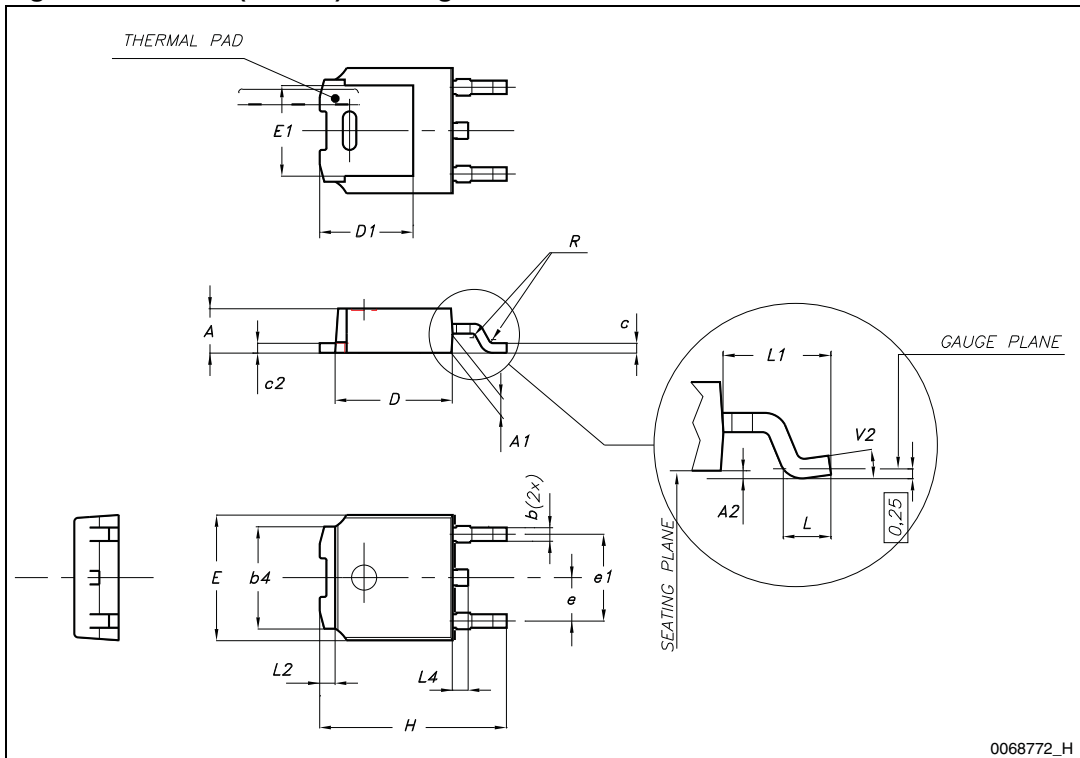
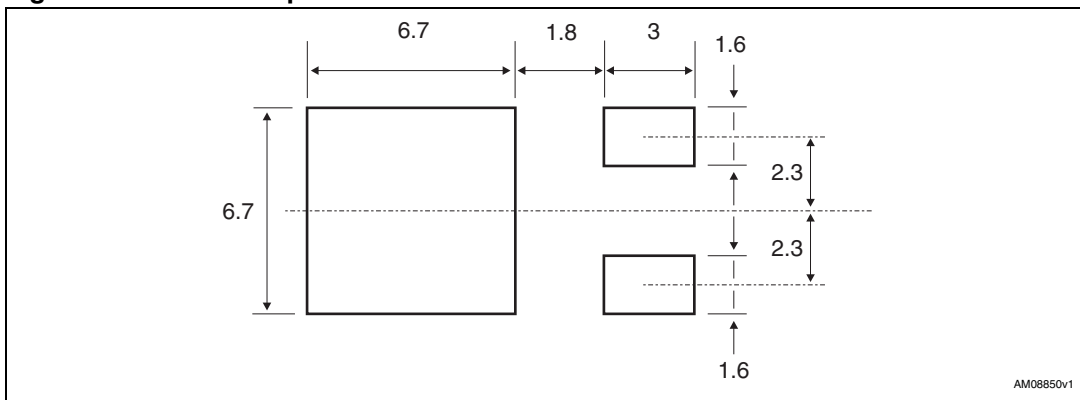


Figure 30. DPAK footprint<sup>(b)</sup>

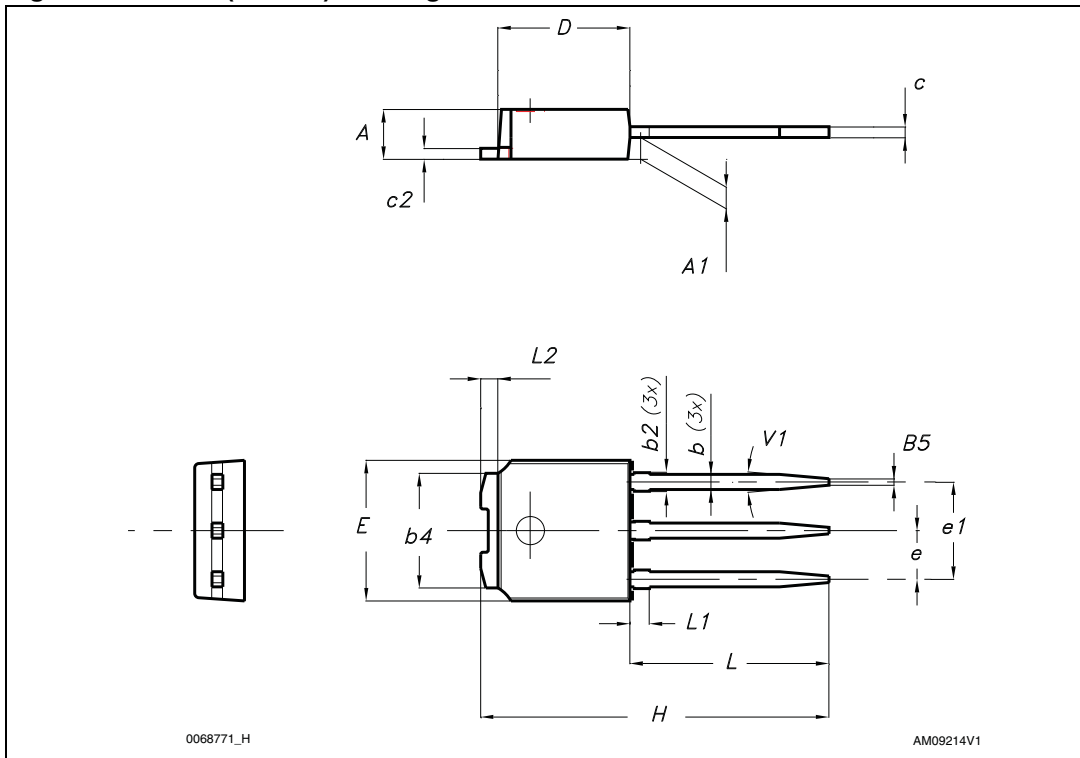


b. All dimension are in millimeters

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		0.3	
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 31. IPAK (TO-251) drawing



## 5 Packaging mechanical data

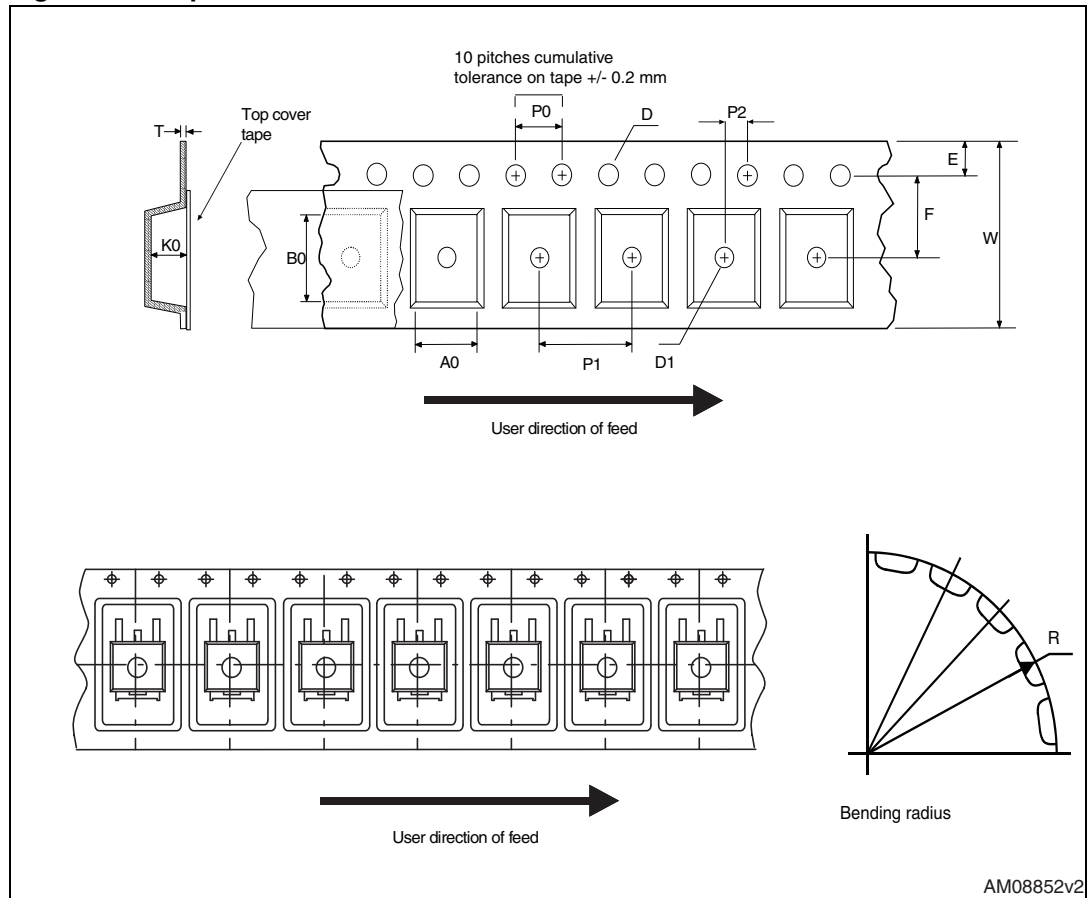
Table 14. D<sup>2</sup>PAK (TO-263) tape and reel mechanical data

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			

Table 15. DPAK (TO-252) tape and reel mechanical data

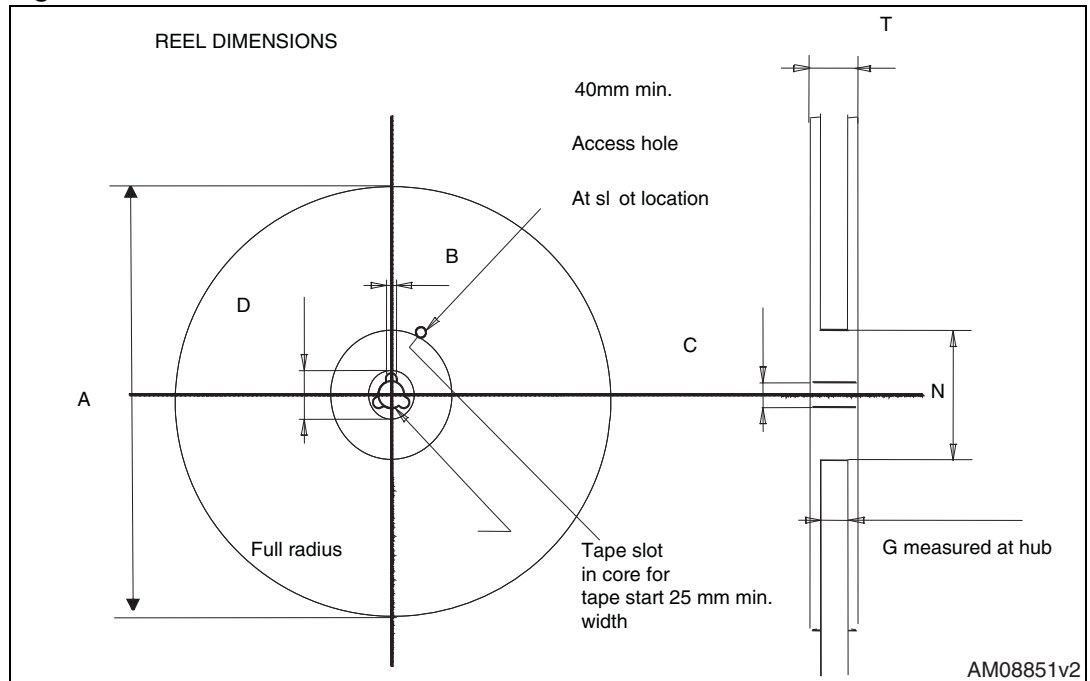
Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	6.8	7	A		330
B0	10.4	10.6	B	1.5	
B1		12.1	C	12.8	13.2
D	1.5	1.6	D	20.2	
D1	1.5		G	16.4	18.4
E	1.65	1.85	N	50	
F	7.4	7.6	T		22.4
K0	2.55	2.75			
P0	3.9	4.1	Base qty.		2500
P1	7.9	8.1	Bulk qty.		2500
P2	1.9	2.1			
R	40				
T	0.25	0.35			
W	15.7	16.3			

Figure 32. Tape for DPAK and D<sup>2</sup>PAK



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Figure 33. Reel for DPAK and D<sup>2</sup>PAK



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## 6 Revision history

**Table 16. Document revision history**

Date	Revision	Changes
23-Oct-2009	1	First release
14-Oct-2010	2	Document status promoted from preliminary data to datasheet.
05-Jul-2011	3	<a href="#">Table 7: Source drain diode</a> has been updated.



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