



# STB8N65M5, STD8N65M5, STF8N65M5, STI8N65M5, STP8N65M5, STU8N65M5

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

Datasheet — production data

## Features

Type	V <sub>DSS</sub> @ T <sub>Jmax</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>	P <sub>TOT</sub>
STB8N65M5	710 V	< 0.6 $\Omega$	7 A	70 W
STD8N65M5				70 W
STF8N65M5				25 W
STI8N65M5				70 W
STP8N65M5				70 W
STU8N65M5				70 W

- 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.

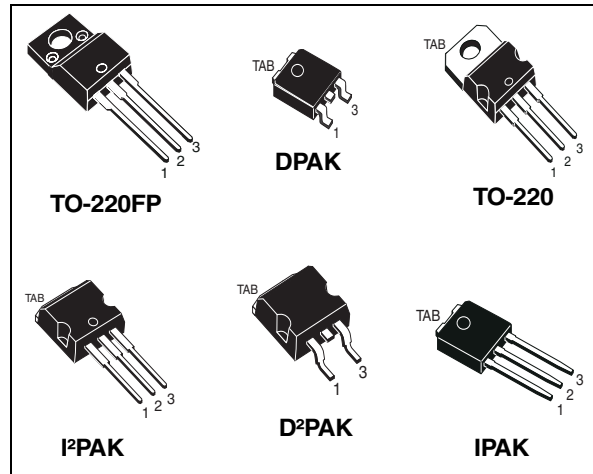


Figure 1. Internal schematic diagram

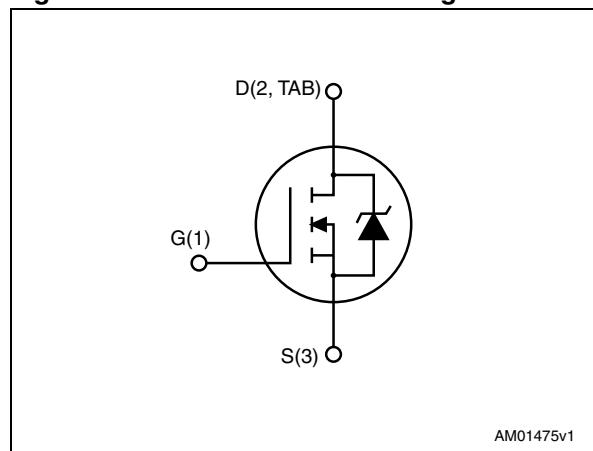


Table 1. Device summary

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

# Contents

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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 by maximum junction temperature

2. Pulse width limited by safe operating area.

3. I<sub>SD</sub> ≤ 7 A, di/dt ≤ 400 A/μs, V<sub>DD</sub> ≤ 400 V, V<sub>DS(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

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 ( $V_{GS} = 0$ )	$V_{DS} = 650\text{ V}$ $V_{DS} = 650\text{ V}$ , $T_C = 125\text{ °C}$			1 100	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 25\text{ V}$			$\pm 100$	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	0.60	$\Omega$

**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	6	$\Omega$
$Q_g$	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		nC
$Q_{gd}$	Gate-drain charge			6		nC

- $C_{o(er)}$  is a constant capacitance value that gives the same stored energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$
- $C_{o(tr)}$  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	$V_{DD} = 400\text{ V}$ , $I_D = 4\text{ A}$ , $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 20</a> ) (see <a href="#">Figure 23</a> )		50		ns
$t_{r(V)}$	Rise time		-	14	-	ns
$t_{c(off)}$	Cross time				20	ns
$t_{f(i)}$	Fall time				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	$I_{SD} = 7\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$ (see <a href="#">Figure 20</a> )	-	200		ns
$Q_{rr}$	Reverse recovery charge			1.6		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current			16		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 7\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$ (see <a href="#">Figure 20</a> )	-	263		ns
$Q_{rr}$	Reverse recovery charge			1.9		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current			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

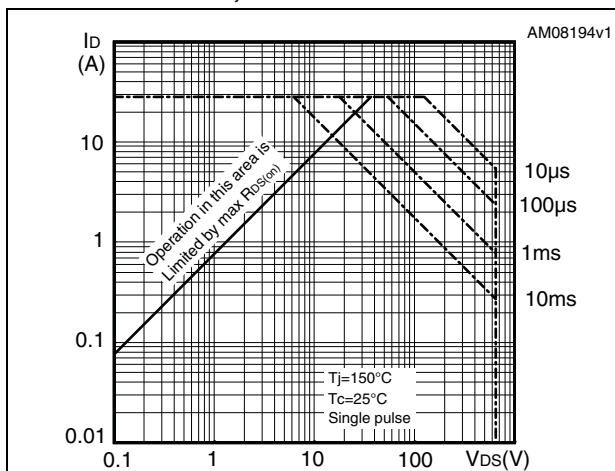


Figure 3. Thermal impedance for TO-220, I<sup>2</sup>PAK, D<sup>2</sup>PAK

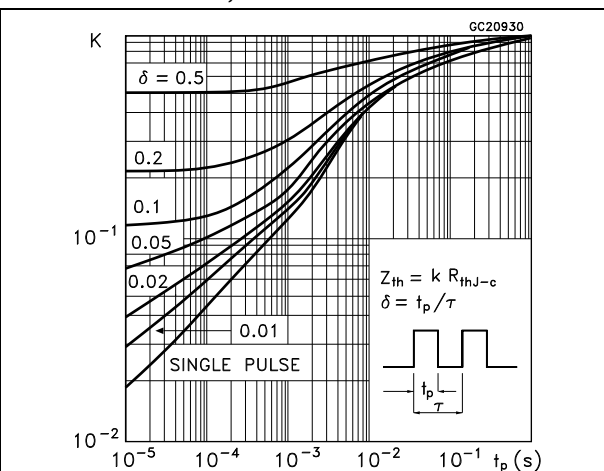


Figure 4. Safe operating area for DPAK, IPAK

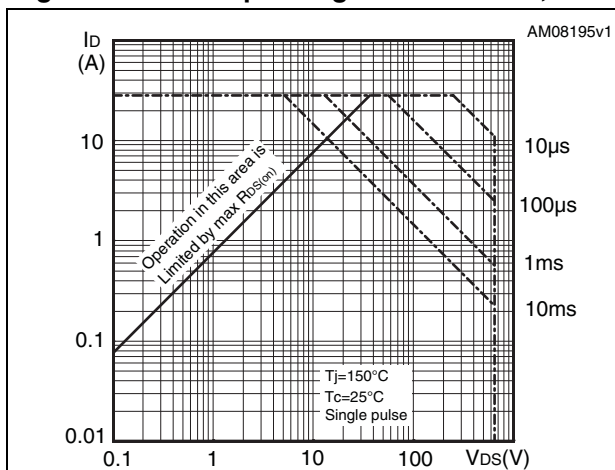


Figure 5. Thermal impedance for DPAK, IPAK

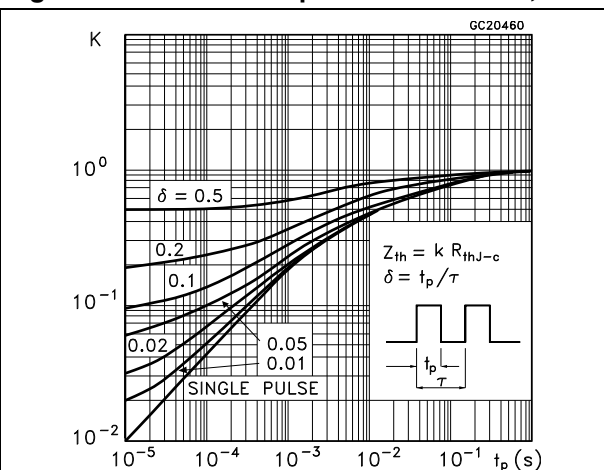


Figure 6. Safe operating area for TO-220FP

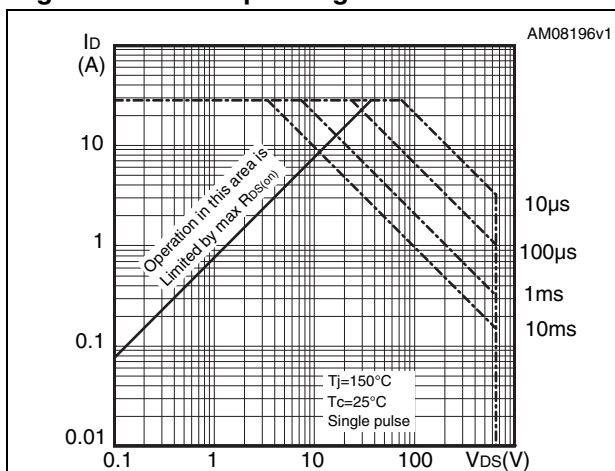


Figure 7. Thermal impedance for TO-220FP

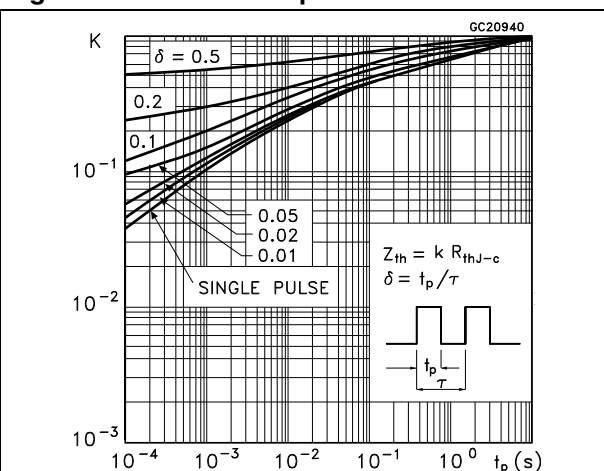


Figure 8. Output characteristics

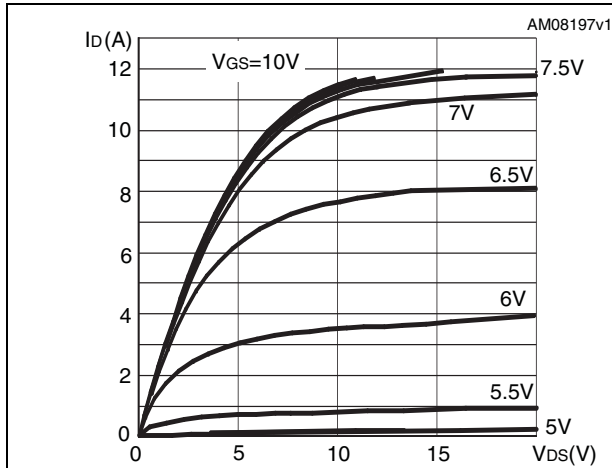


Figure 9. Transfer characteristics

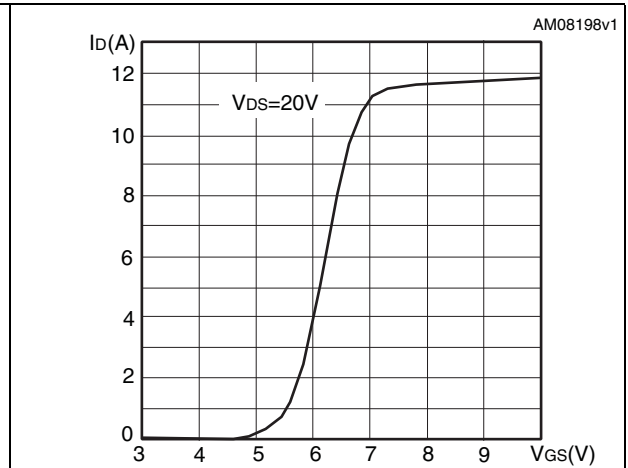


Figure 10. Gate charge vs gate-source voltage Figure 11. Static drain-source on-resistance

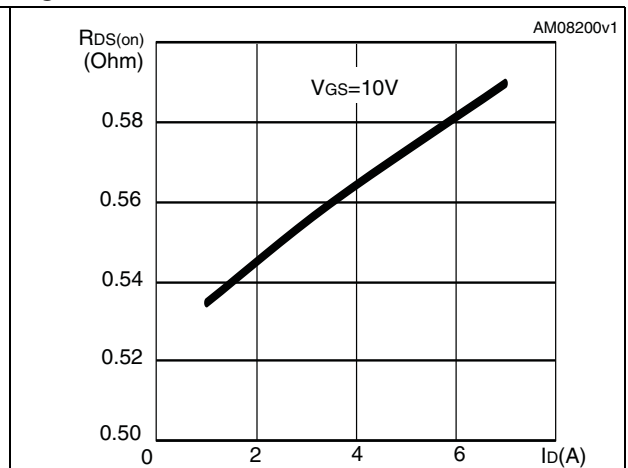
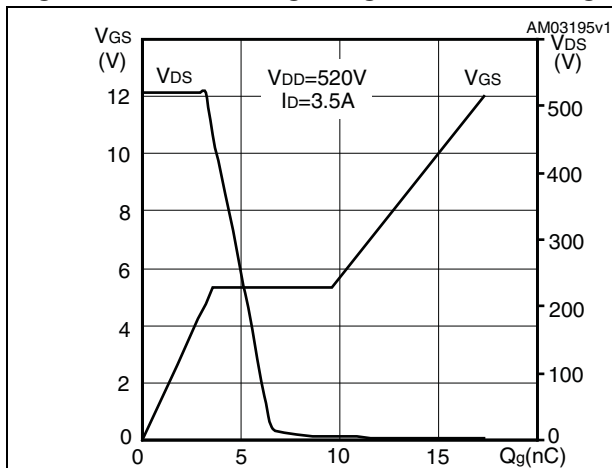


Figure 12. Capacitance variations

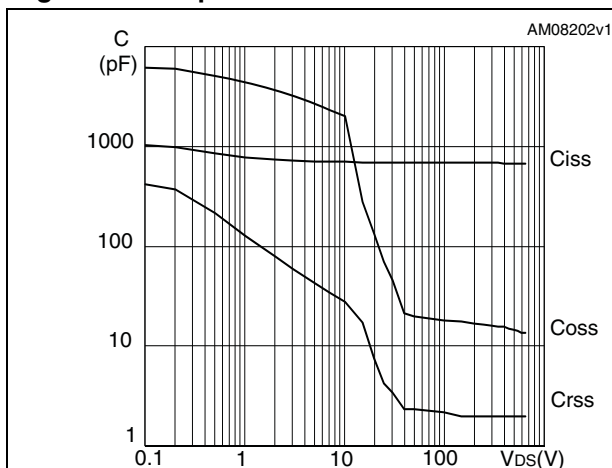


Figure 13. Output capacitance stored energy

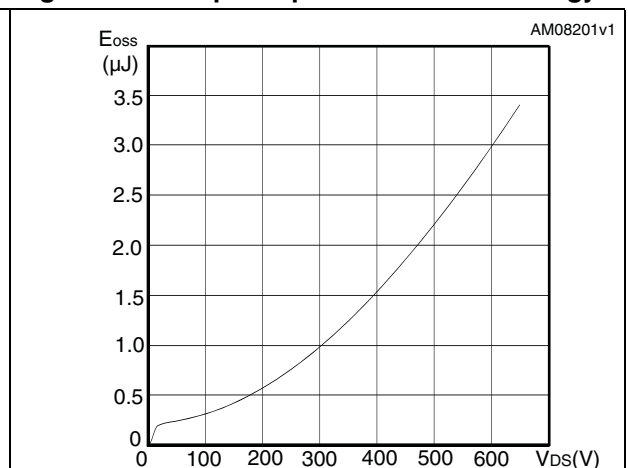


Figure 14. Normalized gate threshold voltage vs temperature

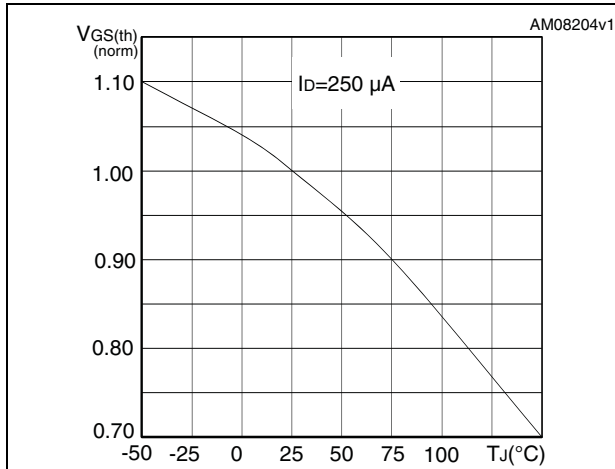


Figure 15. Normalized on-resistance vs temperature

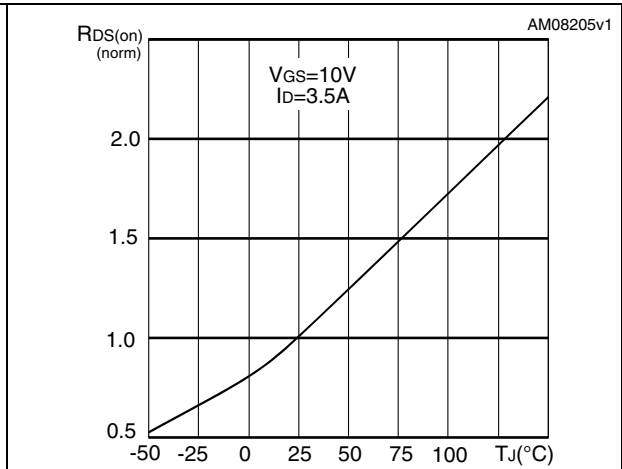


Figure 16. Switching losses vs gate resistance (1)

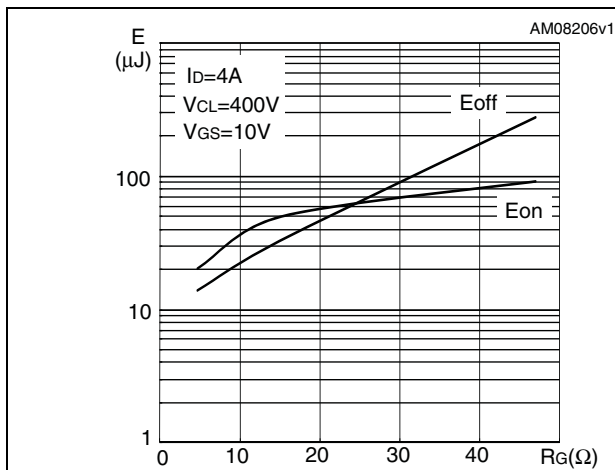
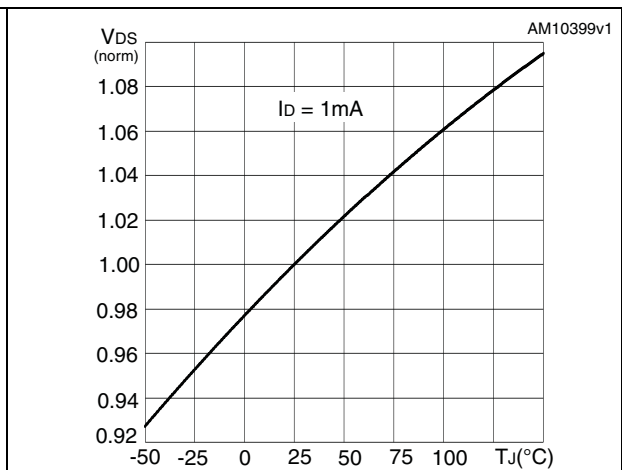


Figure 17. Normalized B<sub>VDSS</sub> vs temperature

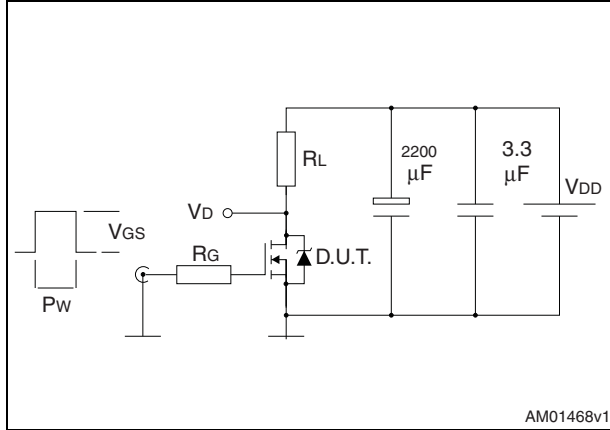


1. Eon including reverse recovery of a SiC diode

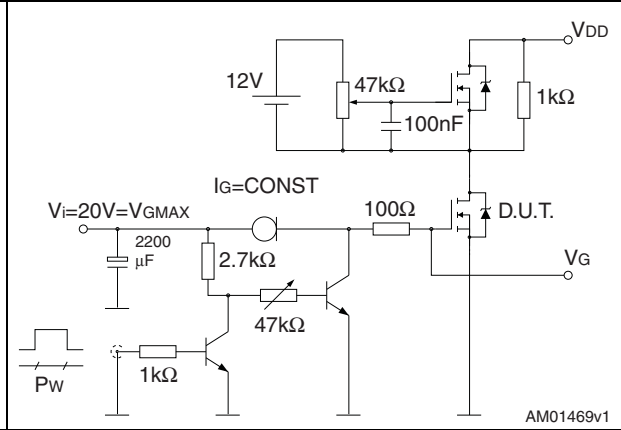


### 3 Test circuits

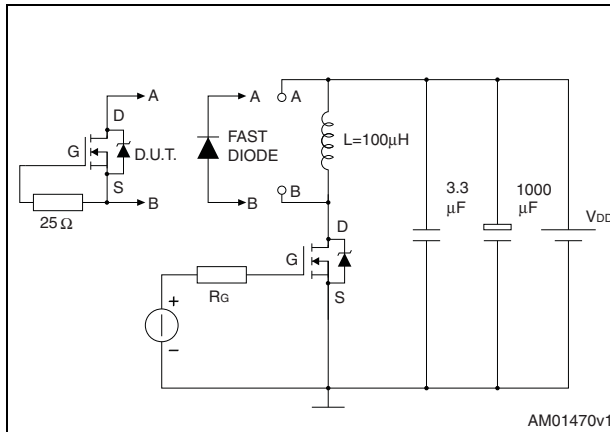
**Figure 18. Switching times test circuit for resistive load**



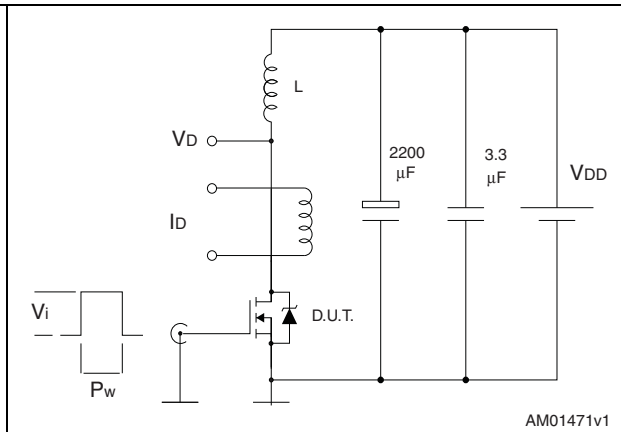
**Figure 19. Gate charge test circuit**



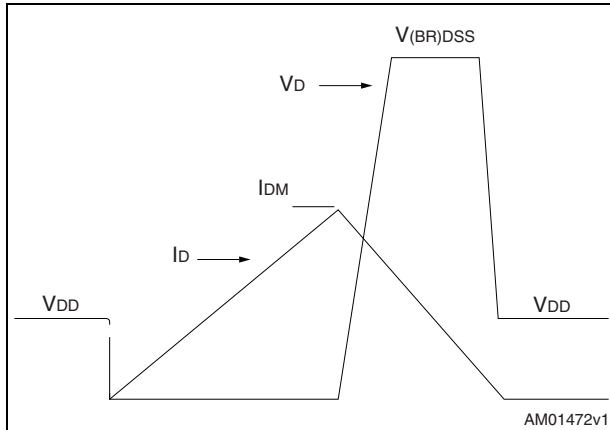
**Figure 20. Test circuit for inductive load switching and diode recovery times**



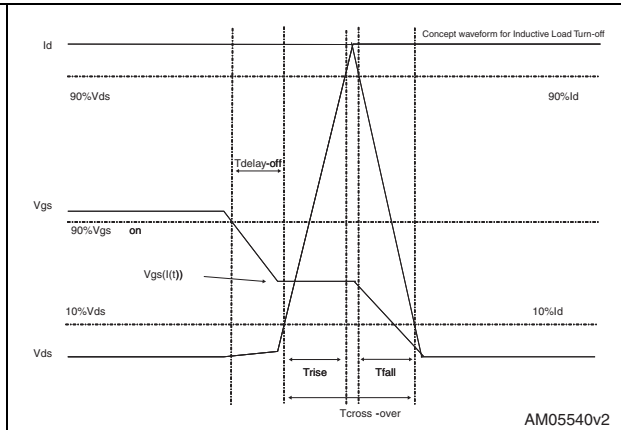
**Figure 21. Unclamped inductive load test circuit**



**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<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 8. 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 24. D<sup>2</sup>PAK (TO-263) drawing

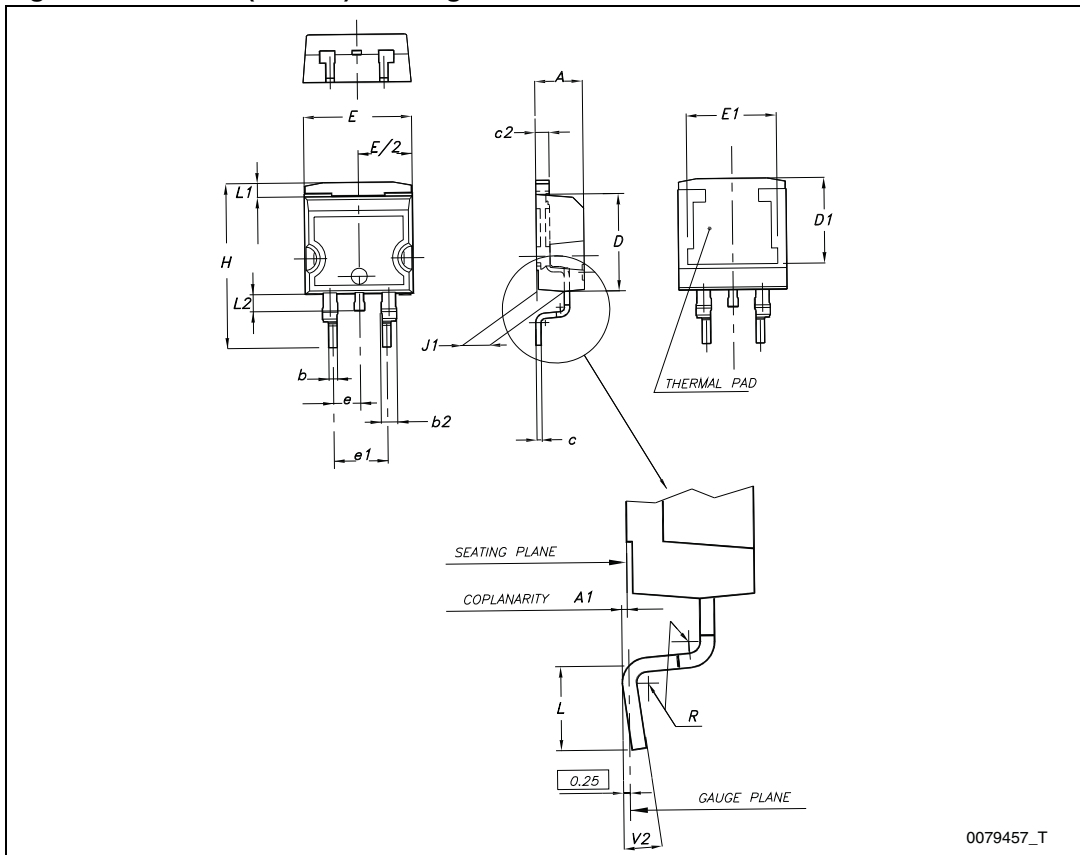
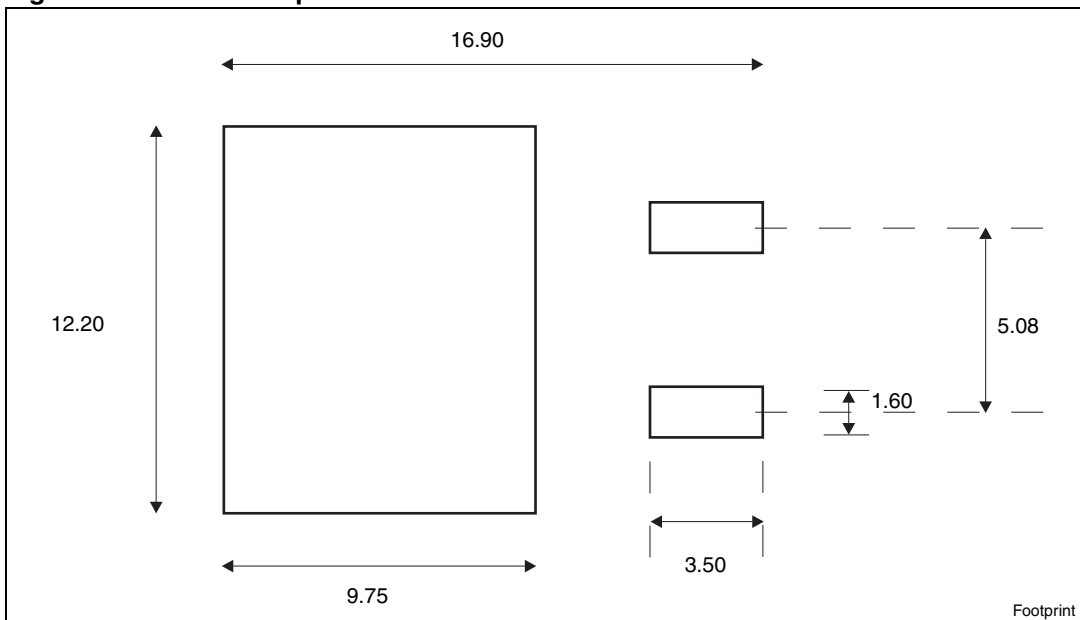


Figure 25. D<sup>2</sup>PAK footprint<sup>(a)</sup>



a. All dimension are in millimeters

**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 26. DPAK (TO-252) drawing

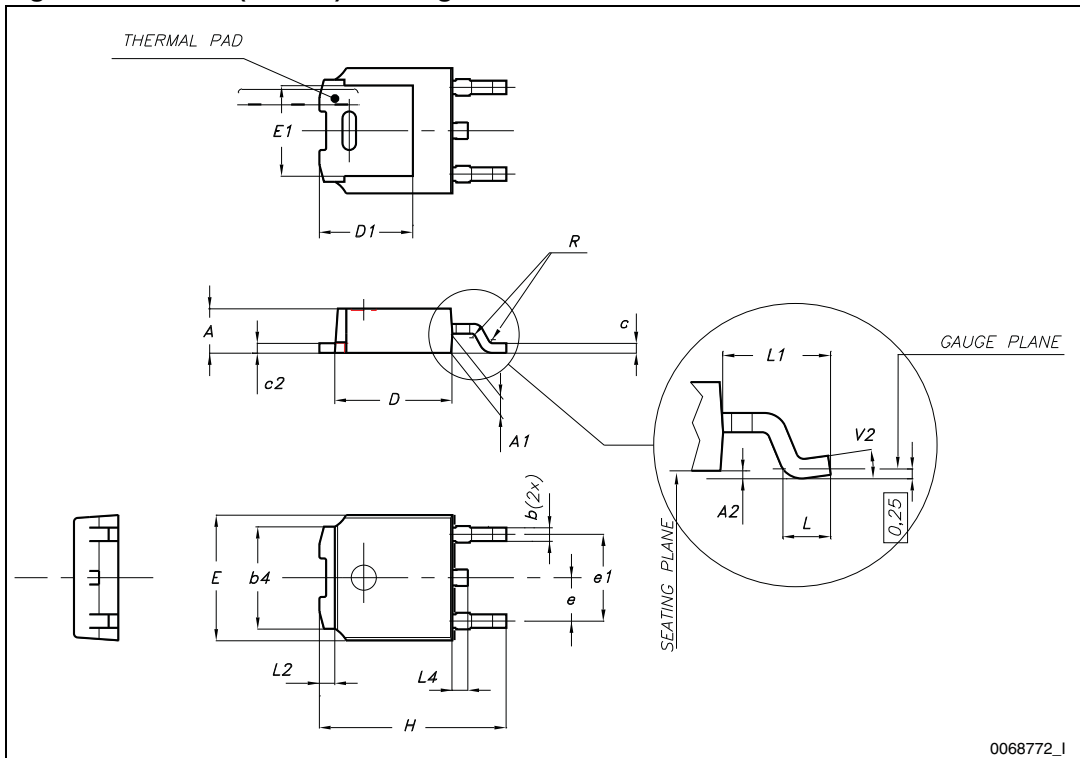
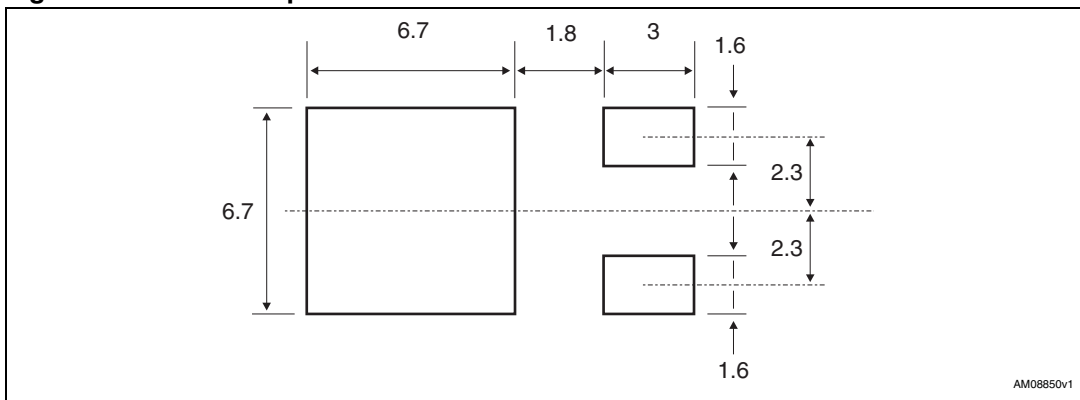


Figure 27. DPAK footprint<sup>(b)</sup>

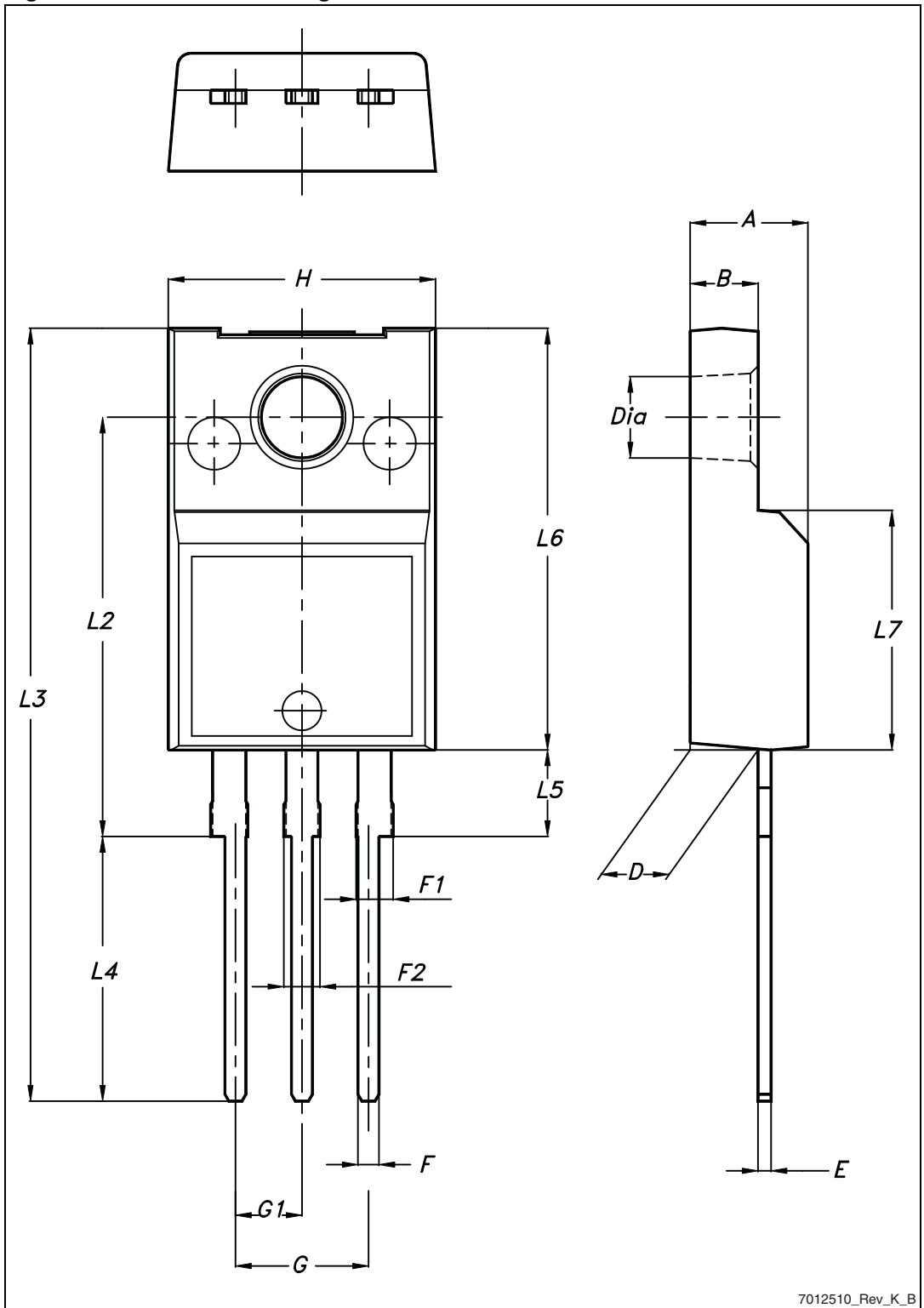


b. All dimensions are in millimeters.

**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 28. TO-220FP drawing



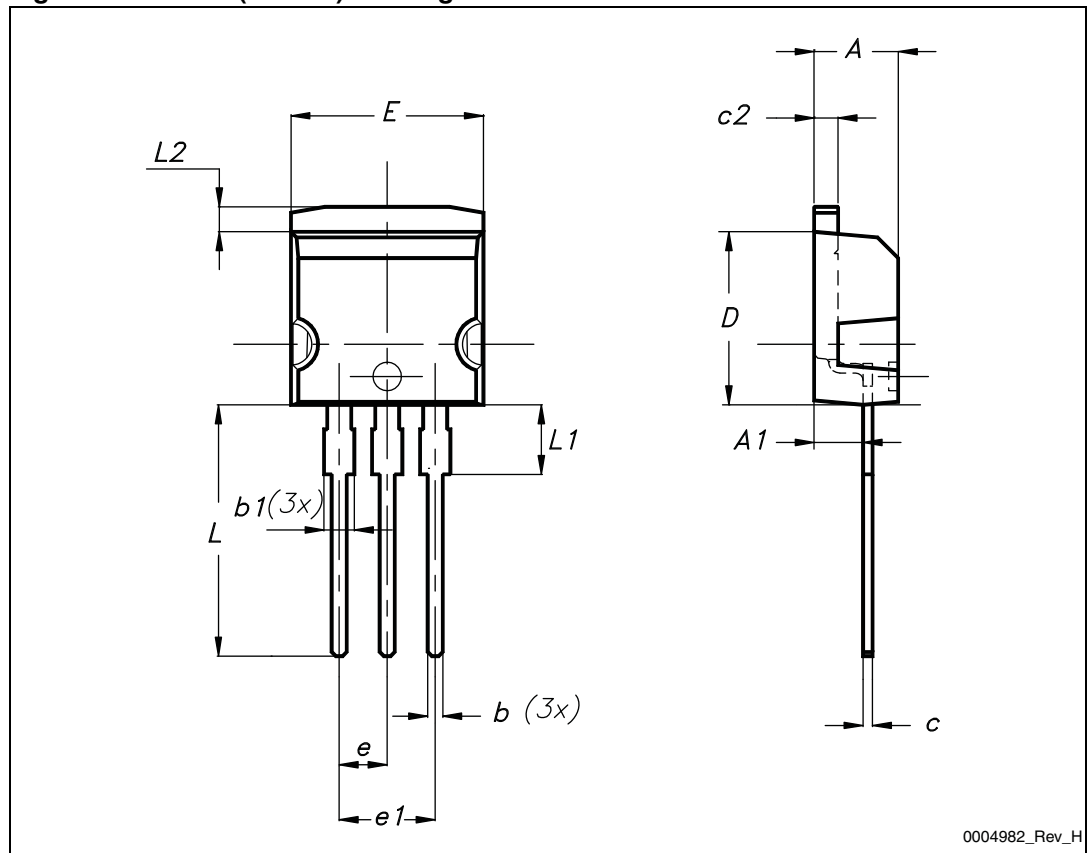
7012510\_Rev\_K\_B



**Table 11. 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

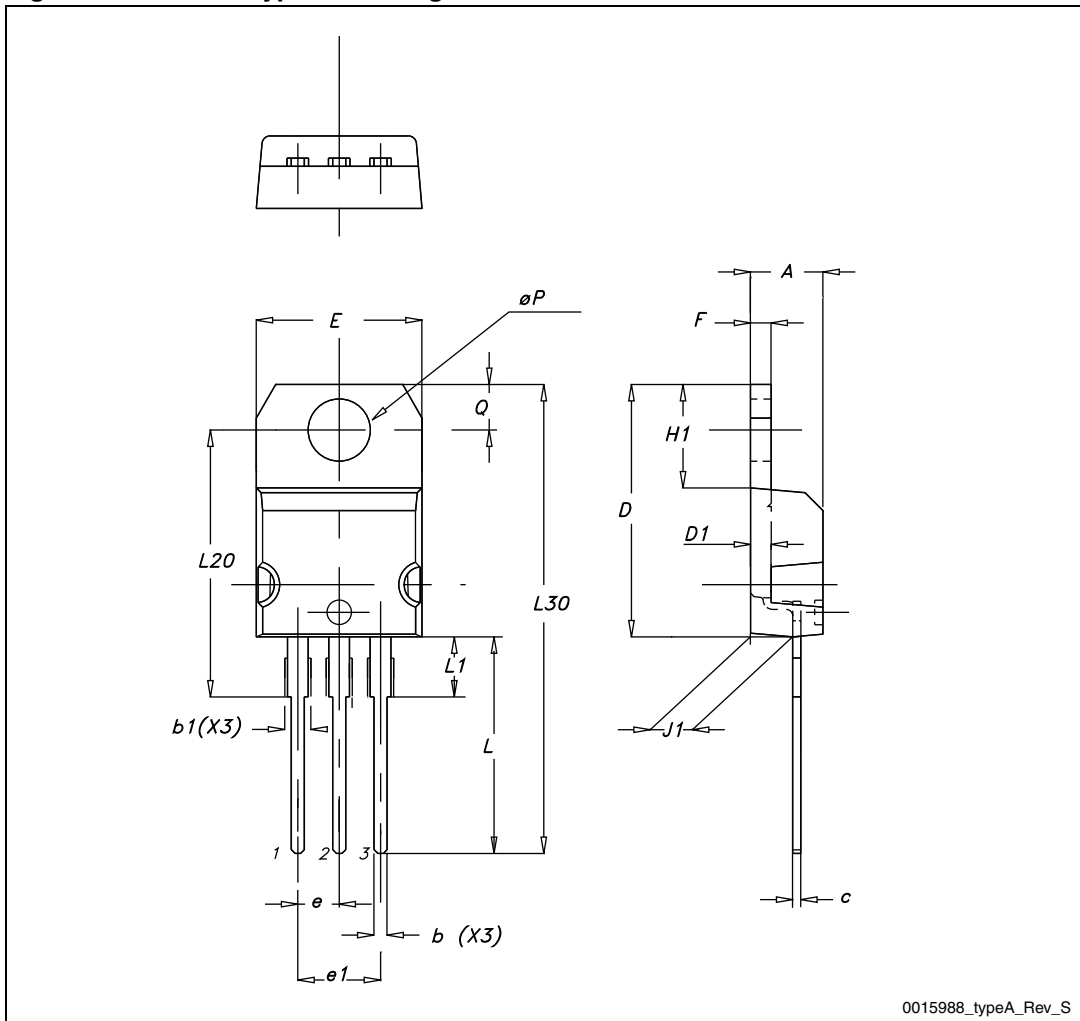
**Figure 29. I<sup>2</sup>PAK (TO-262) drawing**



**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 30. TO-220 type A drawing

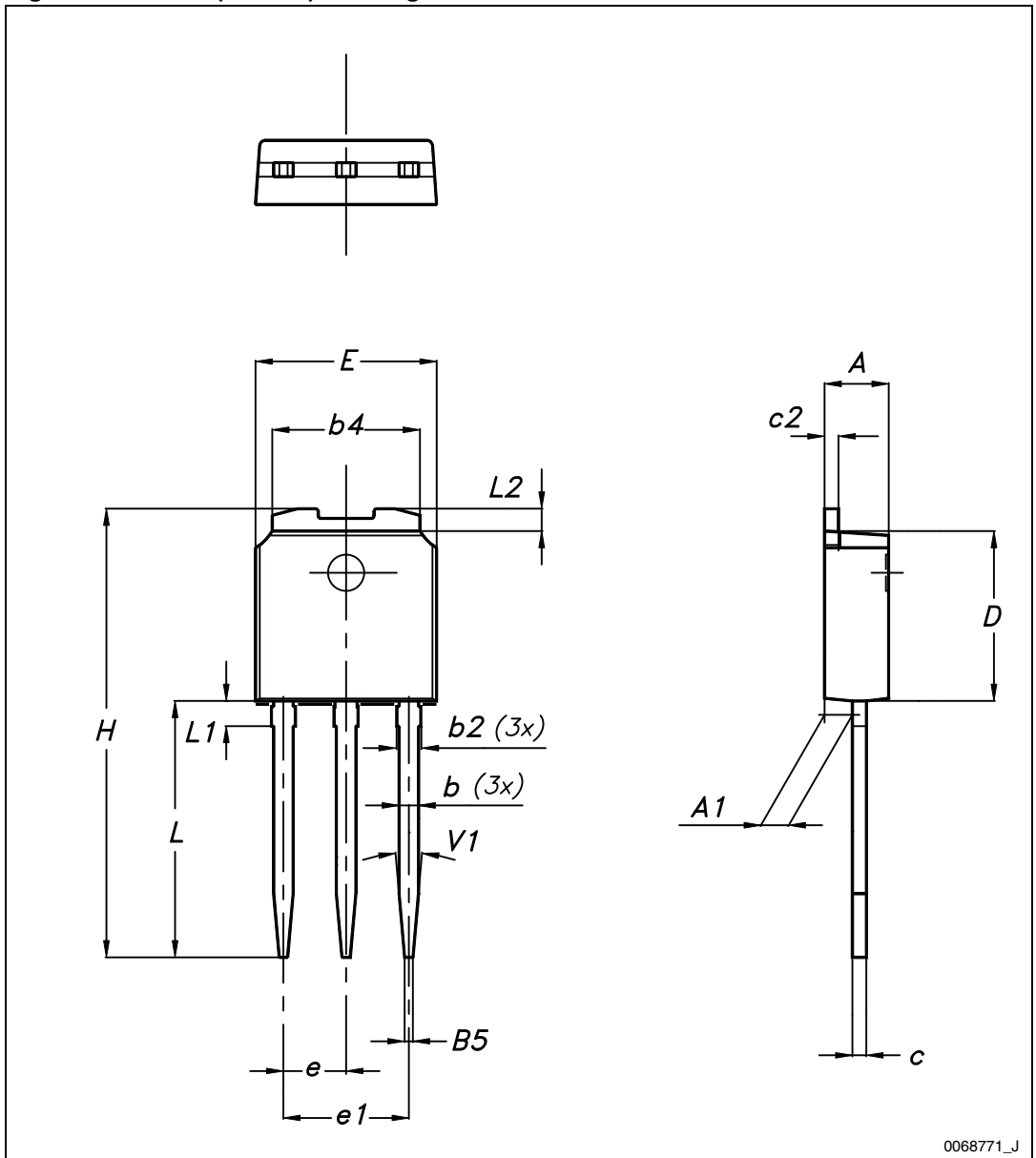


0015988\_typeA\_Rev\_S

**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 31. IPAK (TO-251) drawing



## 5 Packaging mechanical data

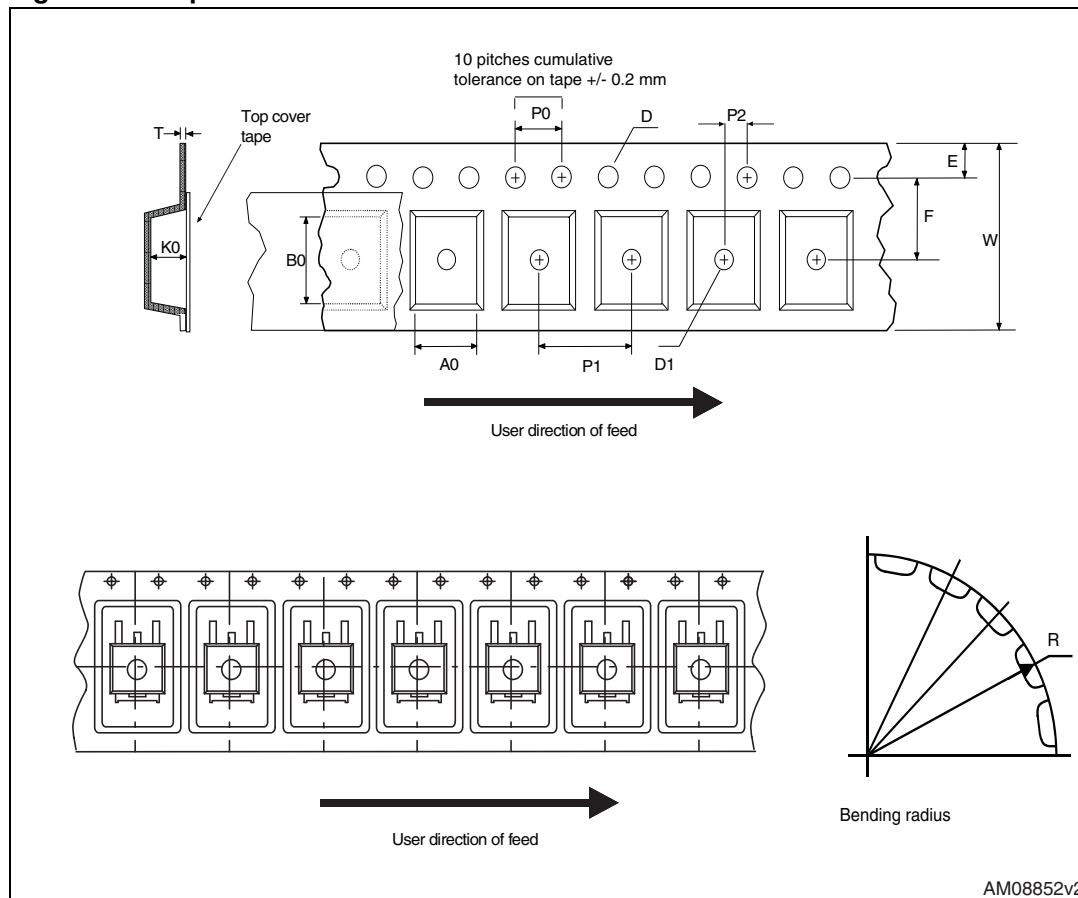
Table 14. D<sup>2</sup>PAK (TO-263) tape and reel mechanical data

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

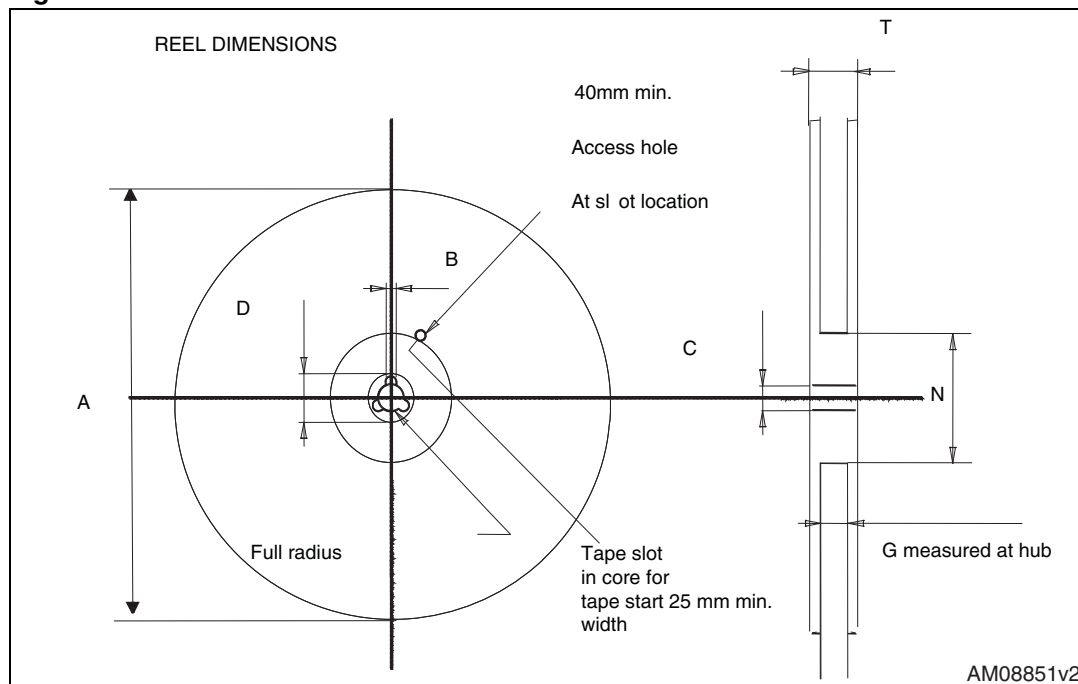
Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	6.8	7	A		330
B0	10.4	10.6	B	1.5	
B1		12.1	C	12.8	13.2
D	1.5	1.6	D	20.2	
D1	1.5		G	16.4	18.4
E	1.65	1.85	N	50	
F	7.4	7.6	T		22.4
K0	2.55	2.75			
P0	3.9	4.1	Base qty.		2500
P1	7.9	8.1	Bulk qty.		2500
P2	1.9	2.1			
R	40				
T	0.25	0.35			
W	15.7	16.3			

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.
04-Oct-2012	4	<ul style="list-style-type: none"><li>– Updated: <a href="#">Figure 1</a>, <a href="#">10</a>, <a href="#">14</a> and <a href="#">17</a>.</li><li>– Updated: <a href="#">note 1</a> and <a href="#">3</a> below the <a href="#">Table 2</a></li><li>– Updated the entire <a href="#">Section 4: Package mechanical data</a>.</li><li>– Updated title and description on the cover page.</li></ul>
29-Oct-2012	5	– Updated $R_G$ values in <a href="#">Table 5</a> .

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