



STB21N65M5, STF21N65M5 STI21N65M5, STP21N65M5, STW21N65M5

N-channel 650 V, 0.150 Ω 17 A MDmesh™ V Power MOSFET
D²PAK, TO-220FP, TO-220, I²PAK, TO-247

Features

Order codes	V_{DSS} @ T_{Jmax}	$R_{DS(on)}$ max	I_D	P_W
STB21N65M5	710 V	< 0.179 Ω	17 A	125 W
STF21N65M5			17 A ⁽¹⁾	30 W
STI21N65M5			17 A	
STP21N65M5			17 A	125 W
STW21N65M5				

1. Limited only by maximum temperature allowed

- Worldwide best $R_{DS(on)}$ * area
- Higher V_{DSS} rating
- High dv/dt capability
- Excellent switching performance
- 100% avalanche tested

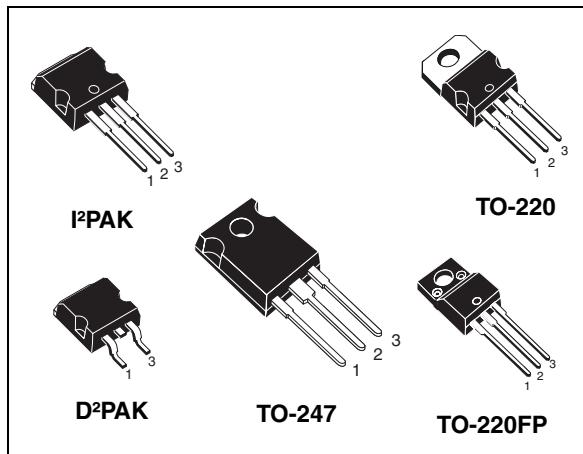
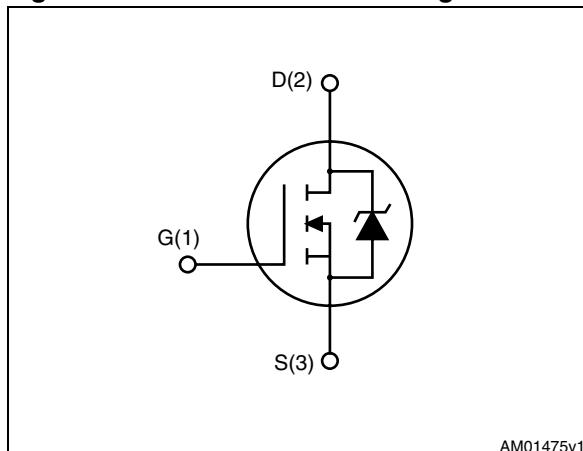


Figure 1. Internal schematic diagram



AM01475v1

Application

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 PowerMESHTM 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
STB21N65M5		D ² PAK	Tape and reel
STF21N65M5		TO-220FP	Tube
STI21N65M5	21N65M5	I ² PAK	Tube
STP21N65M5		TO-220	Tube
STW21N65M5		TO-247	Tube

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-220, I ² PAK, D ² PAK, TO-247	TO-220FP	
V _{GS}	Gate-source voltage	± 25		V
I _D	Drain current (continuous) at T _C = 25 °C	17	17 ⁽¹⁾	A
I _D	Drain current (continuous) at T _C = 100 °C	10.7	10.7 ⁽¹⁾	A
I _{DM} ⁽²⁾	Drain current (pulsed)	68	68 ⁽¹⁾	A
P _{TOT}	Total dissipation at T _C = 25 °C	125	30	W
I _{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T _j max)	5		A
E _{AS}	Single pulse avalanche energy (starting T _j = 25 °C, I _D = I _{AR} , V _{DD} = 50 V)	400		mJ
dv/dt ⁽³⁾	Peak diode recovery voltage slope	15		V/ns
V _{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T _C = 25 °C)	2500		V
T _{stg}	Storage temperature	- 55 to 150		°C
T _j	Max. operating junction temperature	150		°C

1. Limited only by maximum temperature allowed.
2. Pulse width limited by safe operating area.
3. I_{SD} ≤ 17 A, di/dt ≤ 400 A/μs; V_{Peak} < V_{(BR)DSS}, V_{DD} = 400 V.

Table 3. Thermal data

Symbol	Parameter	Value					Unit
		D ² PAK	I ² PAK	TO-220	TO-247	TO-220FP	
R _{thj-case}	Thermal resistance junction-case max	1			4.17	4.17	°C/W
R _{thj-amb}	Thermal resistance junction-ambient max		62.5	50	62.5	62.5	°C/W
R _{thj-pcb}	Thermal resistance junction-pcb max	30					
T _I	Maximum lead temperature for soldering purpose		300			300	°C

2 Electrical characteristics

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

Table 4. On /off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(\text{BR})\text{DSS}}$	Drain-source breakdown voltage	$I_D = 1 \text{ mA}, V_{GS} = 0$	650			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating}, T_C = 125^\circ\text{C}$			1 100	μA μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 25 \text{ V}$			100	nA
$V_{GS(\text{th})}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250 \mu\text{A}$	3	4	5	V
$R_{DS(\text{on})}$	Static drain-source on resistance	$V_{GS} = 10 \text{ V}, I_D = 8.5 \text{ A}$		0.150	0.179	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance					pF
C_{oss}	Output capacitance					pF
C_{rss}	Reverse transfer capacitance	$V_{DS} = 100 \text{ V}, f = 1 \text{ MHz},$ $V_{GS} = 0$	-	1950 46 3	-	pF
$C_{o(\text{tr})}^{(1)}$	Equivalent capacitance time related		-	133	-	pF
$C_{o(\text{er})}^{(2)}$	Equivalent capacitance energy related	$V_{DS} = 0 \text{ to } 520 \text{ V}, V_{GS} = 0$	-	44	-	pF
R_G	Intrinsic gate resistance	$f = 1 \text{ MHz open drain}$	-	2.5	-	Ω
Q_g	Total gate charge	$V_{DD} = 520 \text{ V}, I_D = 8.5 \text{ A},$ $V_{GS} = 10 \text{ V}$		50		nC
Q_{gs}	Gate-source charge		-	13	-	nC
Q_{gd}	Gate-drain charge	(see Figure 20)		23		nC

1. $C_{oss\text{ eq}}$ 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. $C_{oss\text{ eq}}$ 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
$t_d(v)$	Voltage delay time	$V_{DD} = 400 \text{ V}$, $I_D = 11 \text{ A}$,		37		ns
$t_r(v)$	Voltage rise time	$R_G = 4.7 \Omega$, $V_{GS} = 10 \text{ V}$	-	10	-	ns
$t_f(i)$	Current fall time	(see Figure 21)		12	-	ns
$t_c(\text{off})$	Crossing time	(see Figure 24)		24	-	ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		17	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				68	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 17 \text{ A}$, $V_{GS} = 0$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 17 \text{ A}$, $dI/dt = 100 \text{ A}/\mu\text{s}$		294		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 100 \text{ V}$ (see Figure 21)	-	4		μC
I_{RRM}	Reverse recovery current			28		A
t_{rr}	Reverse recovery time	$I_{SD} = 17 \text{ A}$, $dI/dt = 100 \text{ A}/\mu\text{s}$		340		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 100 \text{ V}$, $T_j = 150 \text{ }^\circ\text{C}$	-	5		μC
I_{RRM}	Reverse recovery current	(see Figure 21)		29		A

1. Pulse width limited by safe operating area.
2. Pulsed: pulse duration = 300 μs , duty cycle 1.5%

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for TO-220, D²PAK, I²PAK

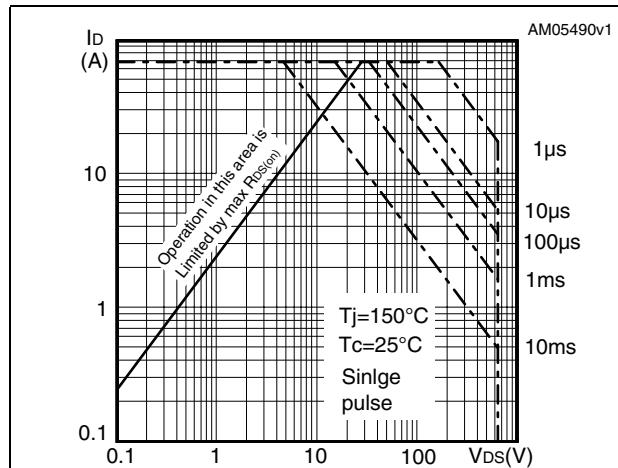


Figure 3. Thermal impedance for TO-220, D²PAK, I²PAK

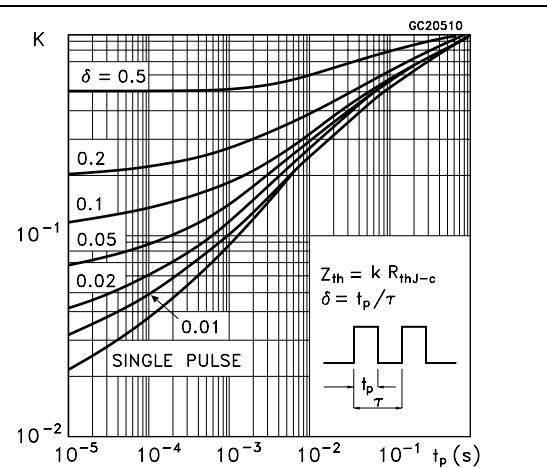


Figure 4. Safe operating area for TO-220FP

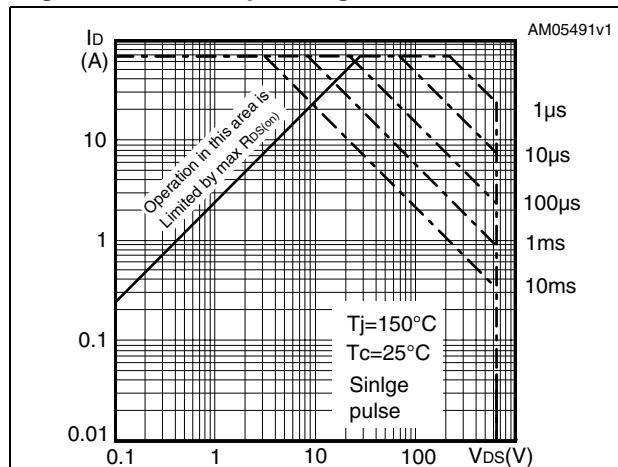


Figure 5. Thermal impedance for TO-220FP

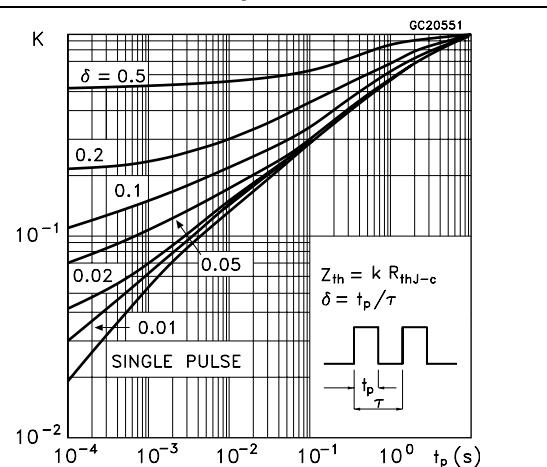


Figure 6. Safe operating area for TO-247

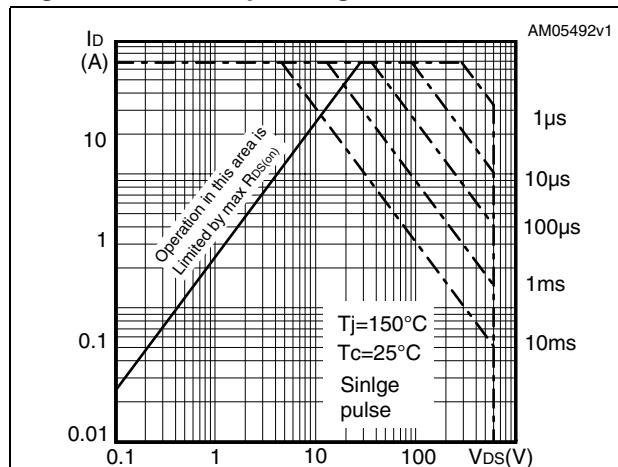


Figure 7. Thermal impedance for TO-247

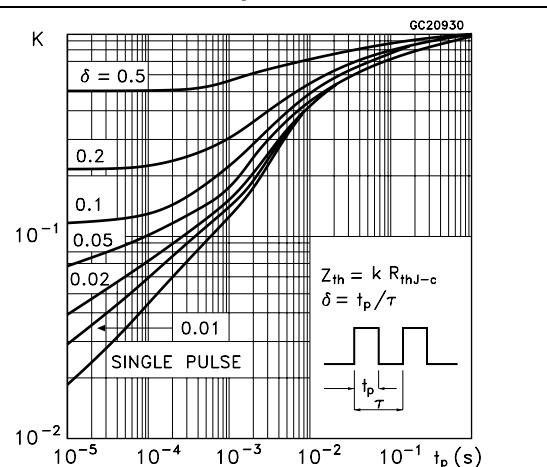


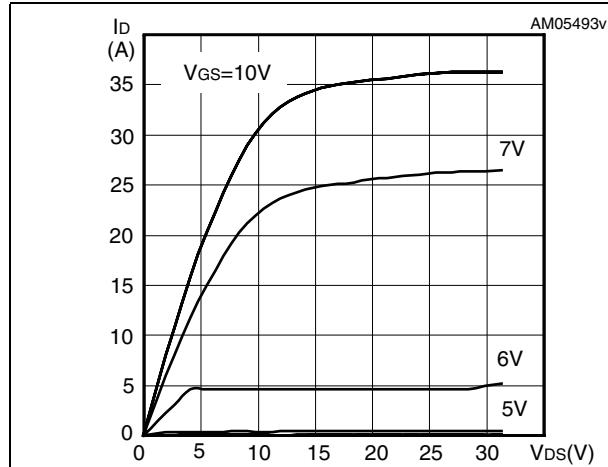
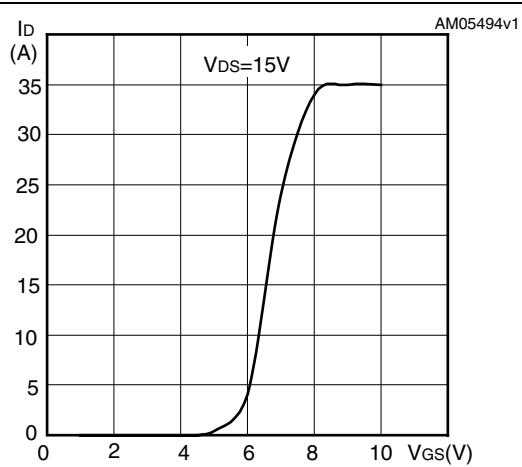
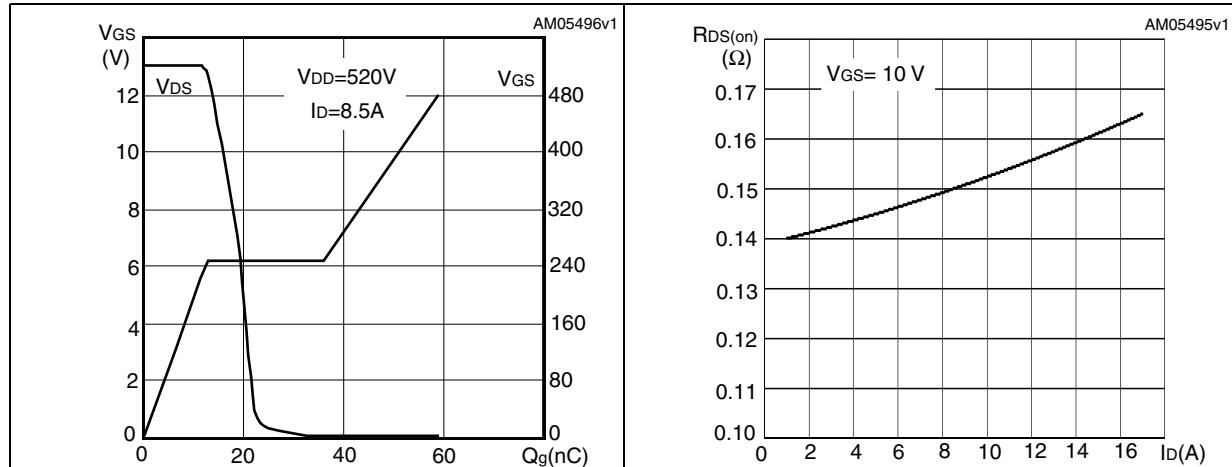
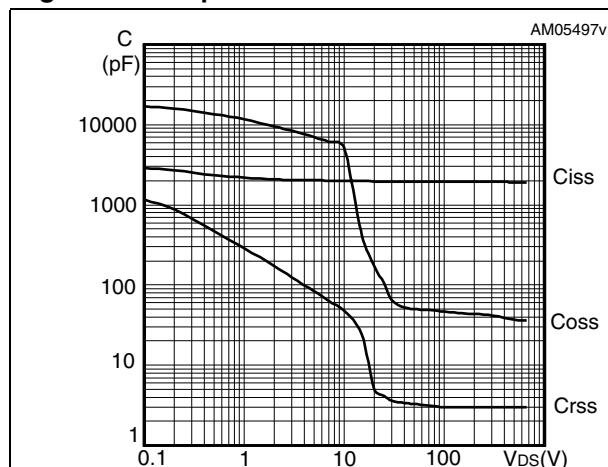
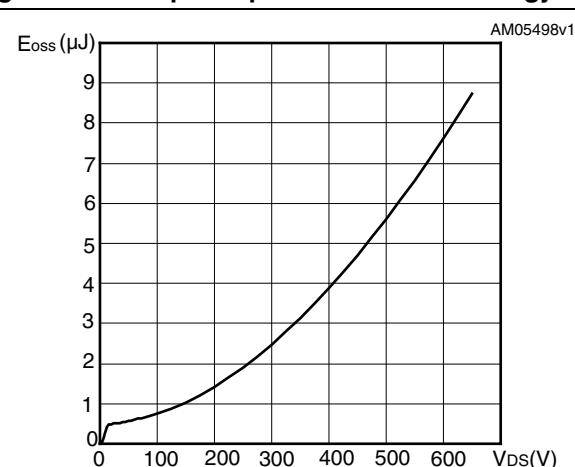
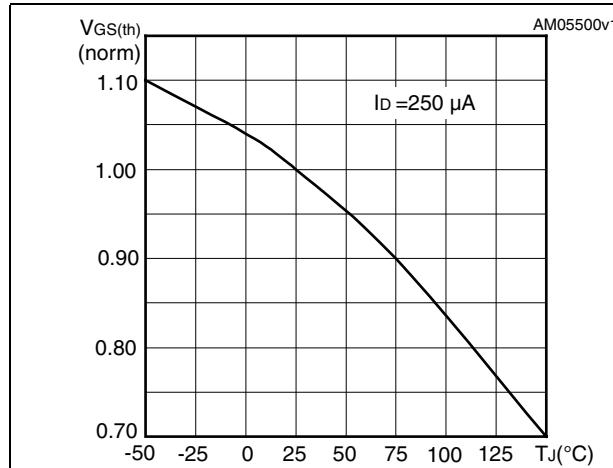
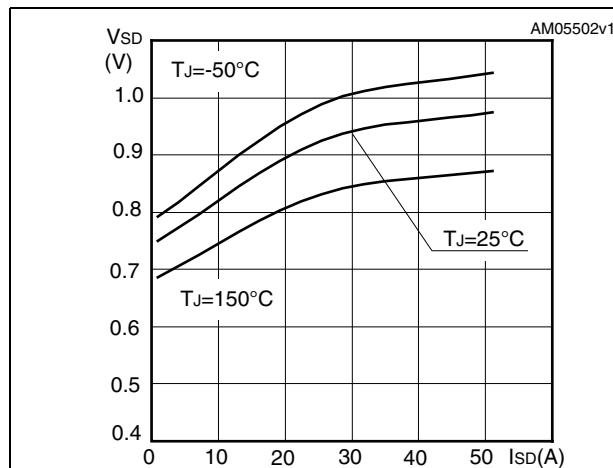
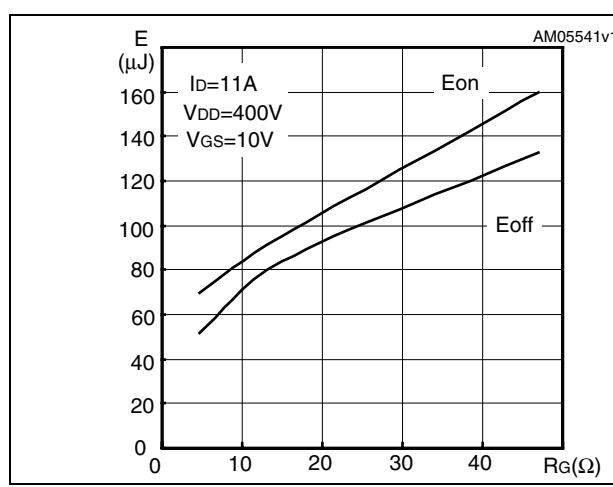
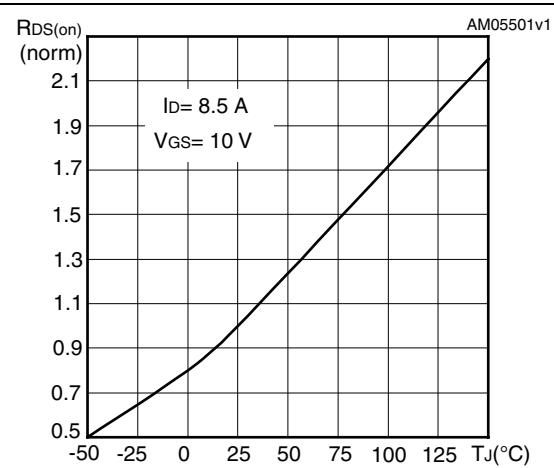
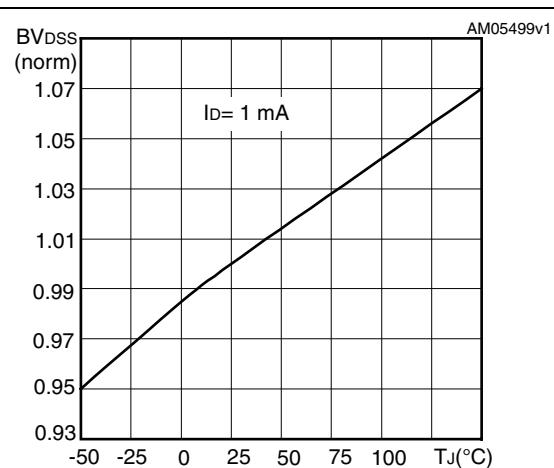
Figure 8. Output characteristics**Figure 9. Transfer characteristics****Figure 10. Gate charge vs gate-source voltage** **Figure 11. Static drain-source on resistance****Figure 12. Capacitance variations****Figure 13. Output capacitance stored energy**

Figure 14. Normalized gate threshold voltage vs temperature**Figure 16. Source-drain diode forward characteristics****Figure 18. Switching losses vs gate resistance (1)**

1. E_{on} including reverse recovery of a SiC diode.

Figure 15. Normalized on resistance vs temperature**Figure 17. Normalized B_{VDSS} vs temperature**

3 Test circuits

Figure 19. Switching times test circuit for resistive load

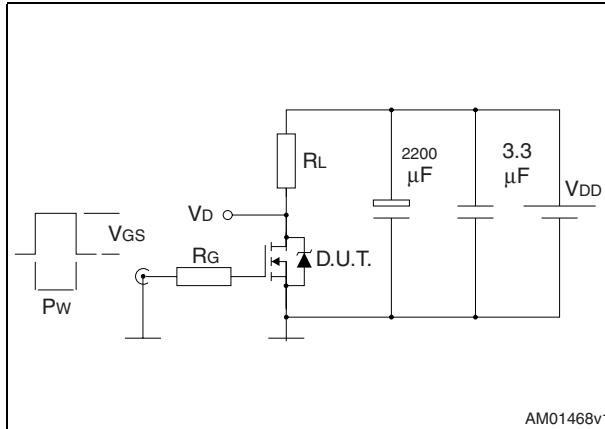


Figure 20. Gate charge test circuit

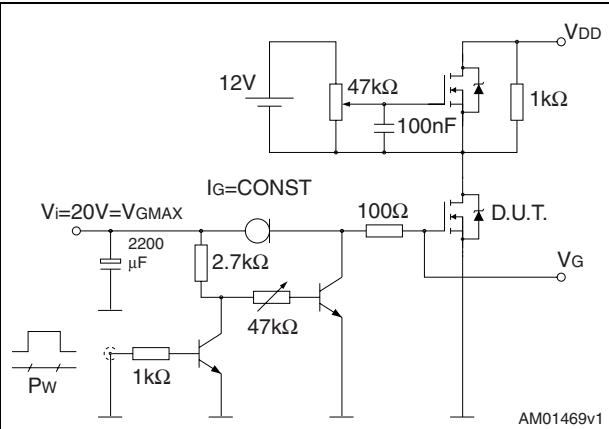


Figure 21. Test circuit for inductive load switching and diode recovery times

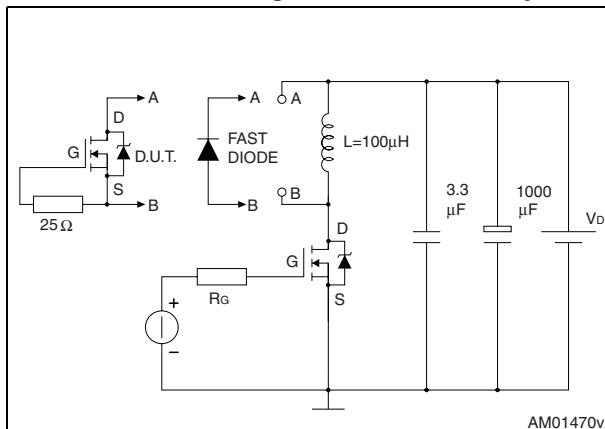


Figure 22. Unclamped inductive load test circuit

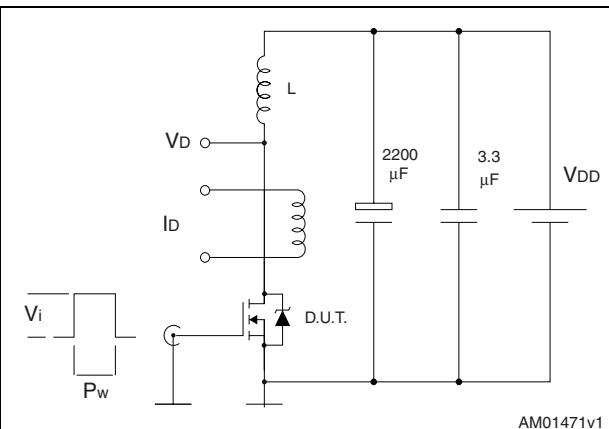


Figure 23. Unclamped inductive waveform

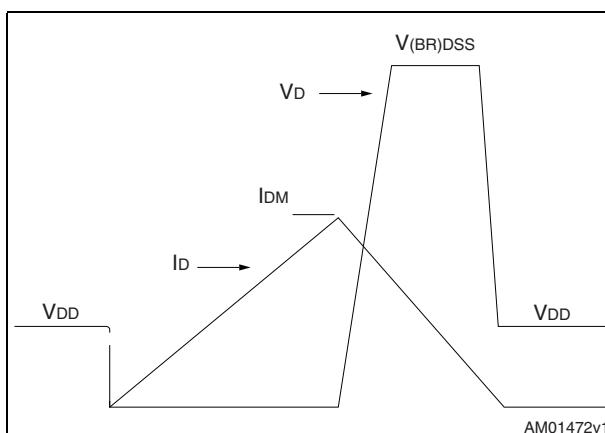
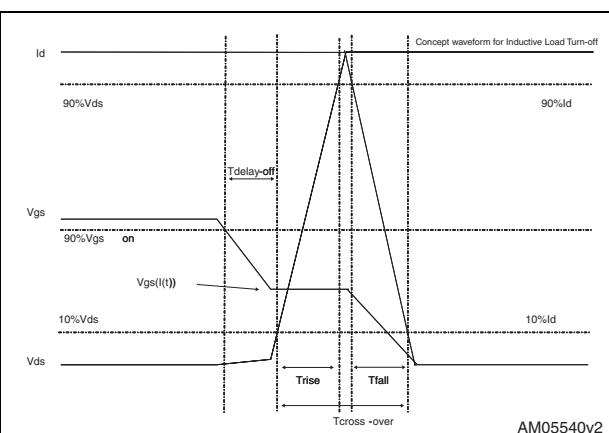


Figure 24. Switching time waveform



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 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 25. TO-220FP drawing mechanical data

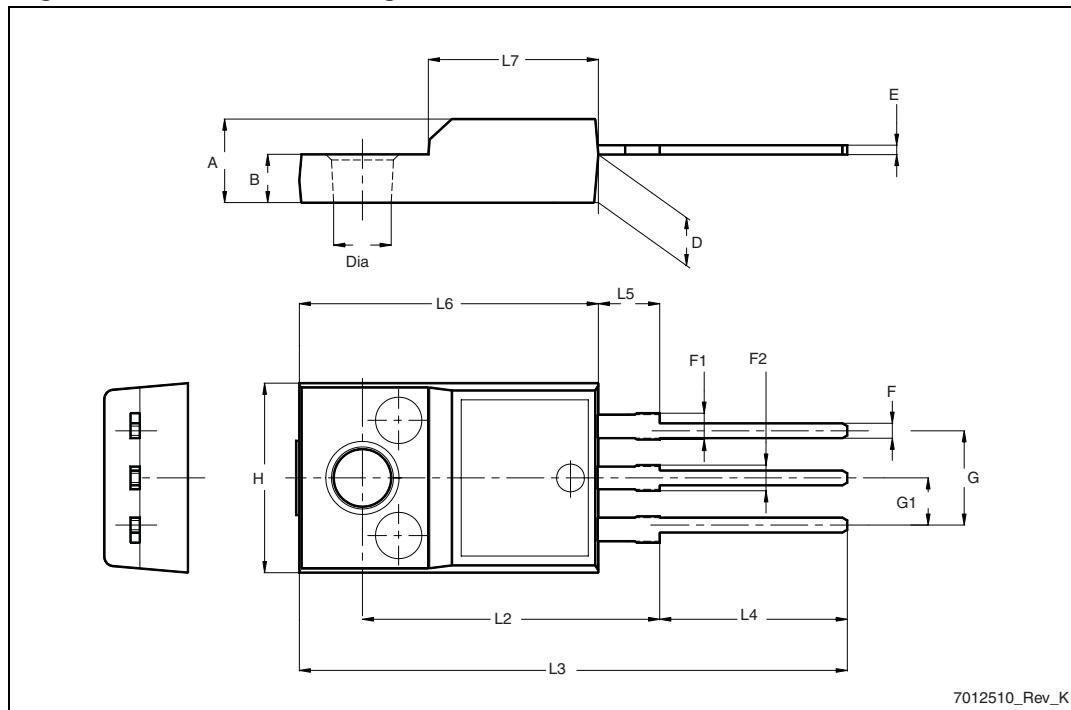


Table 9. I²PAK (TO-262) mechanical data

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

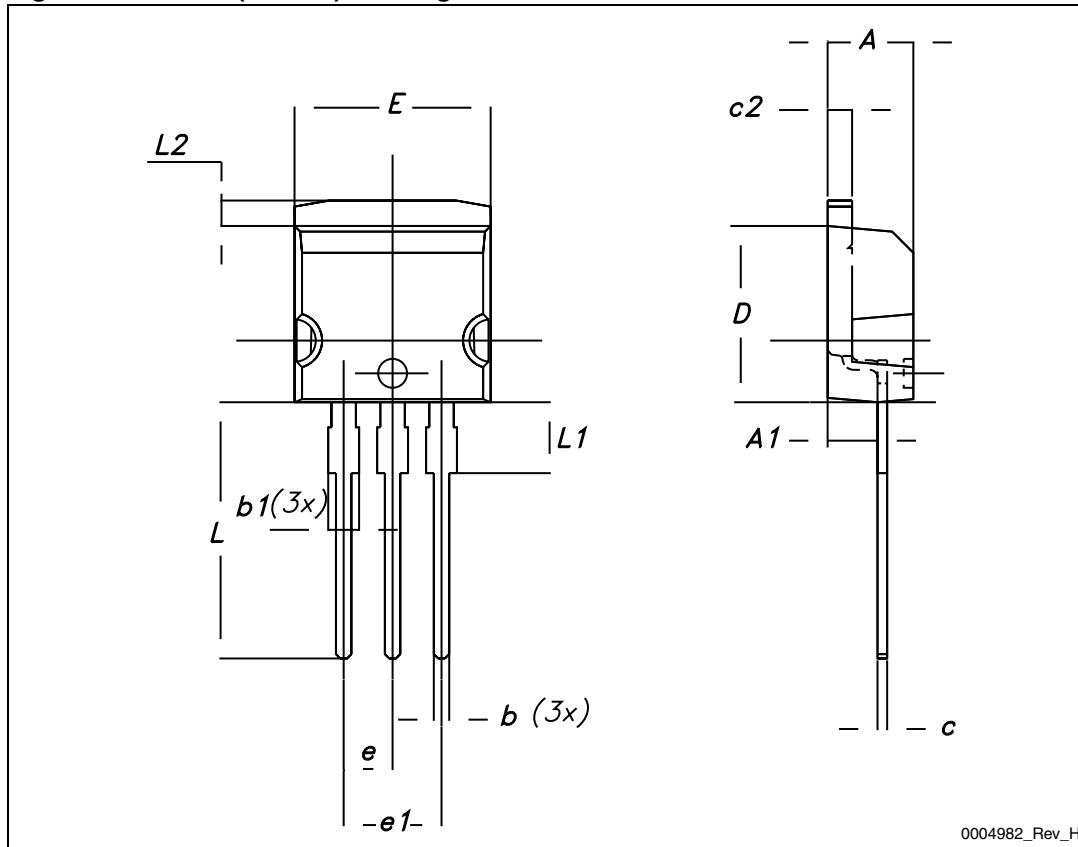
Figure 26. I²PAK (TO-262) drawing

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	
$\emptyset P$	3.75		3.85
Q	2.65		2.95

Figure 27. TO-220 type A drawing

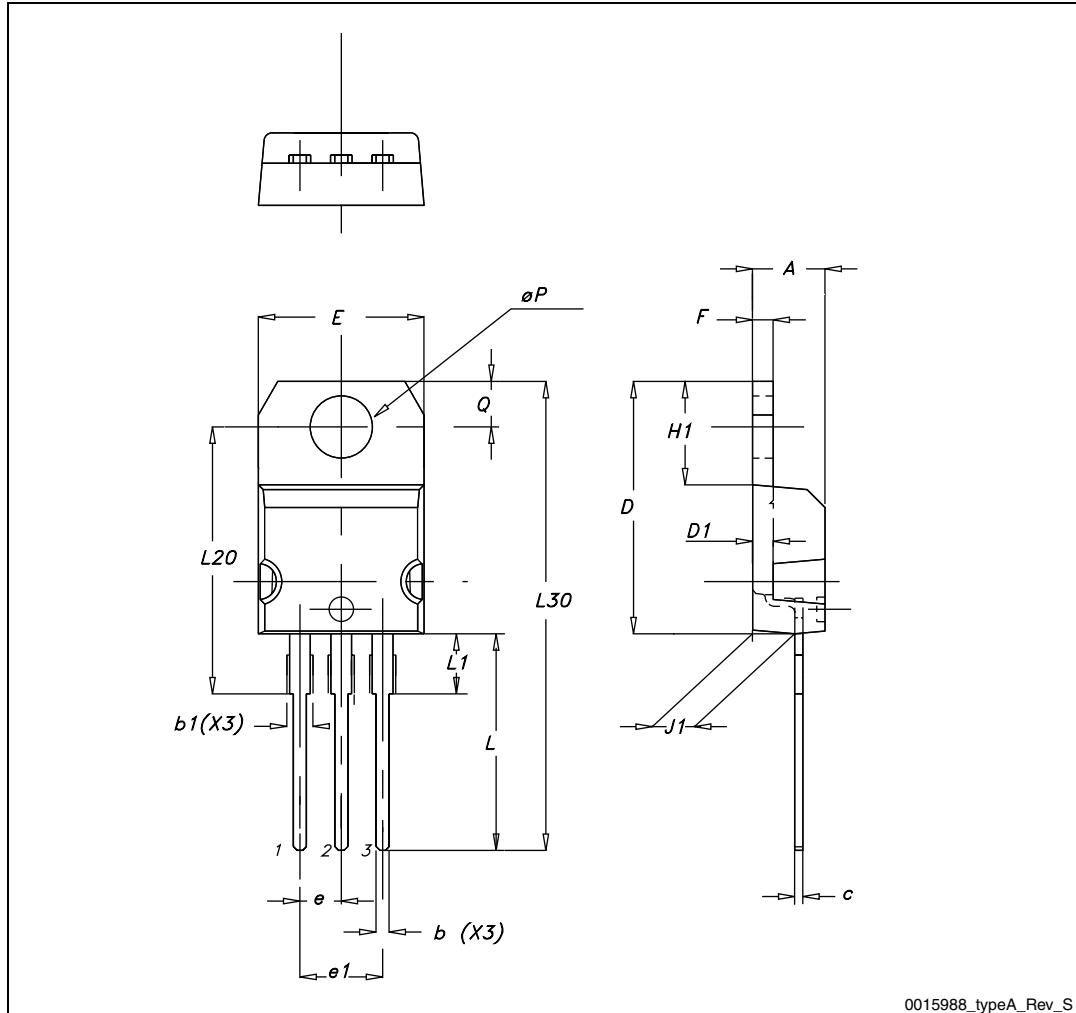


Table 11. TO-247 mechanical data

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 28. TO-247 drawing

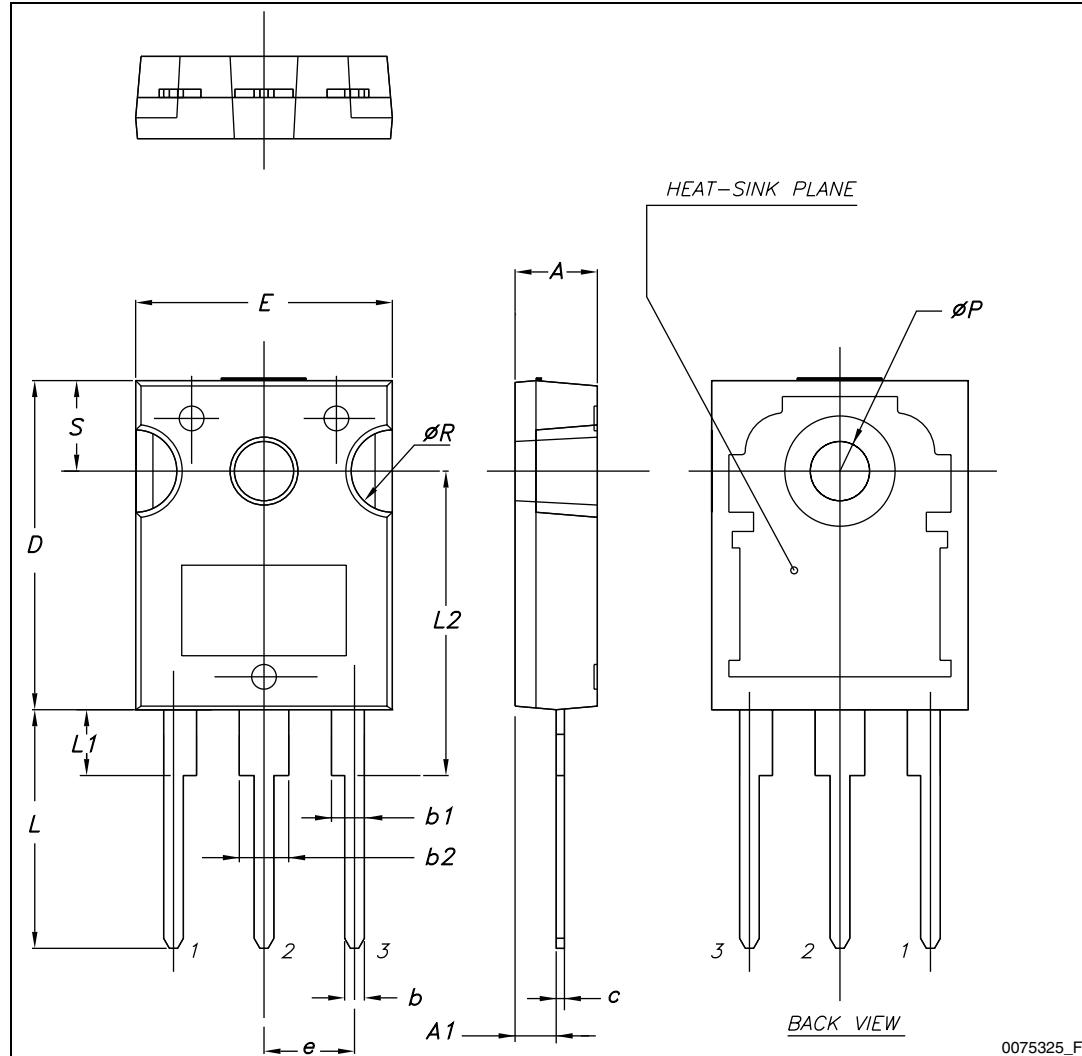
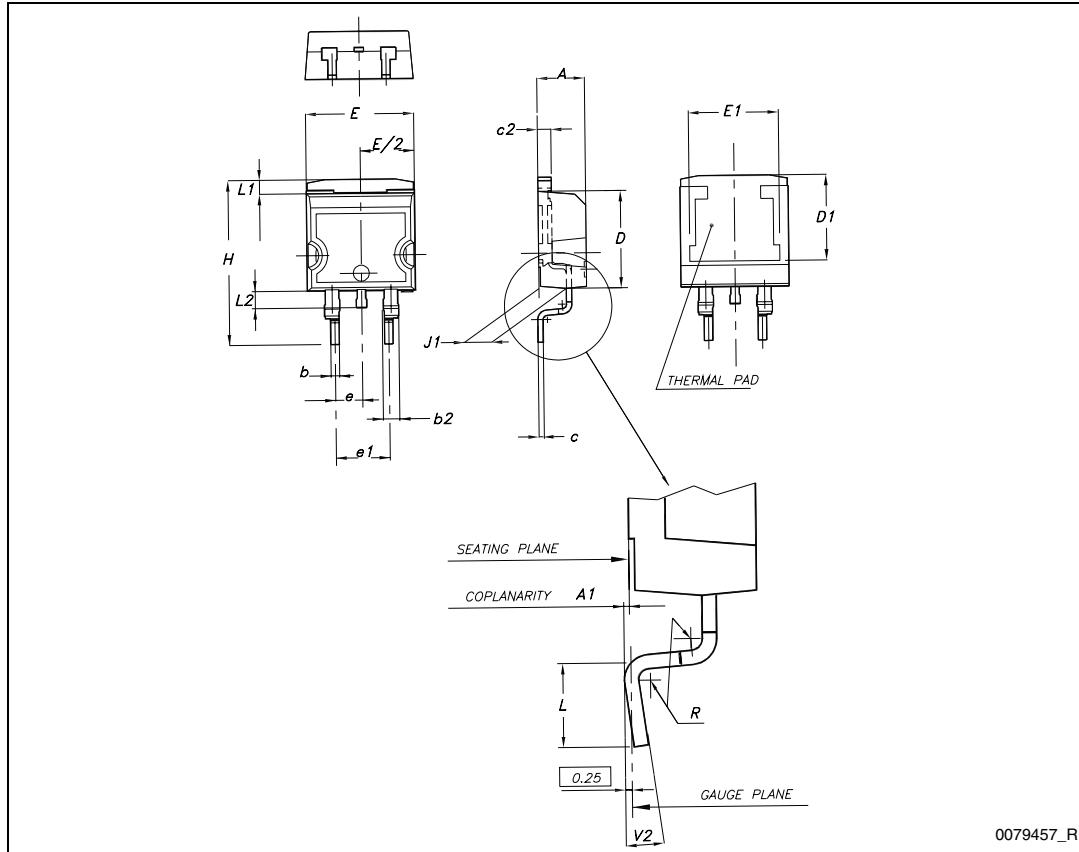


Table 12. D²PAK (TO-263) mechanical data

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°

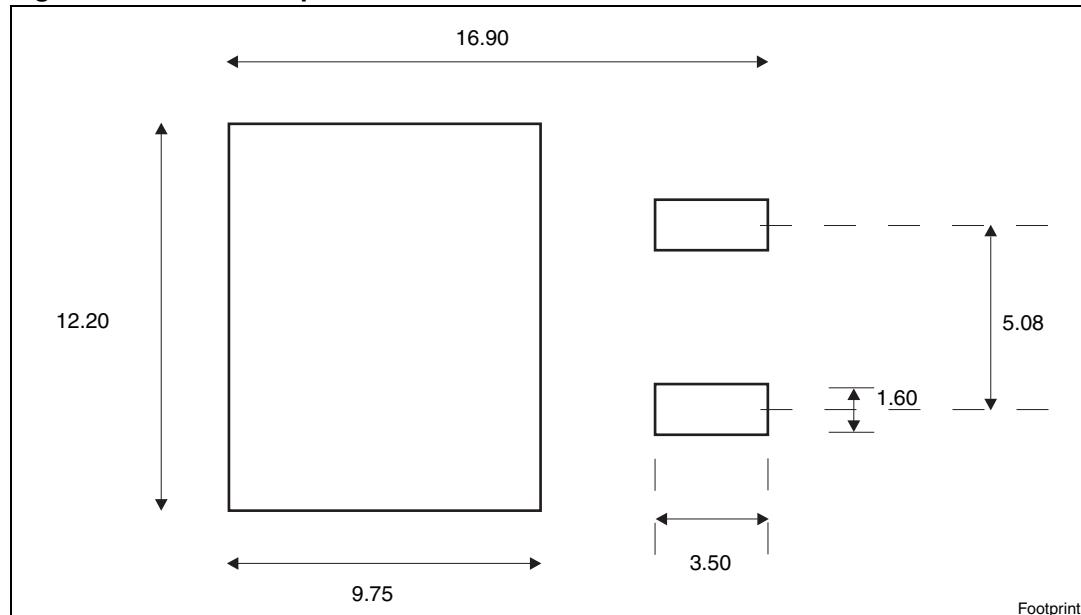
Figure 29. D²PAK (TO-263) drawing

5 Packaging mechanical data

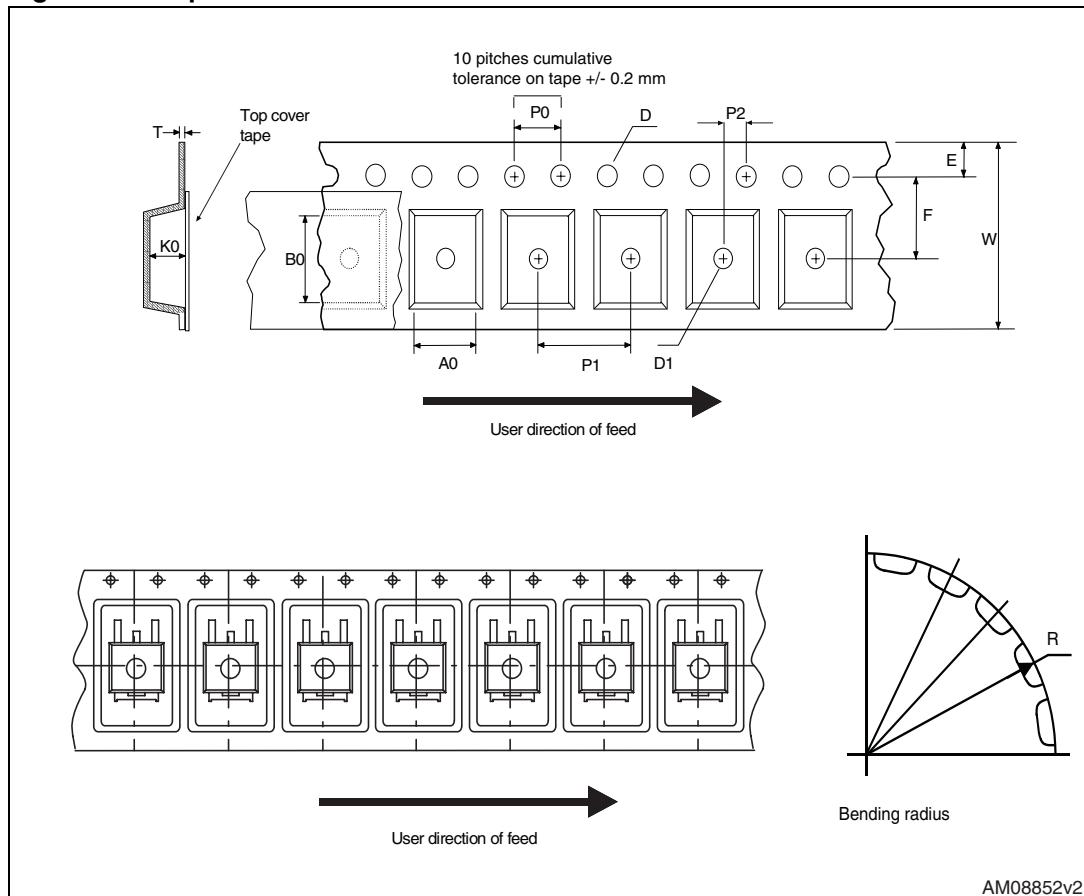
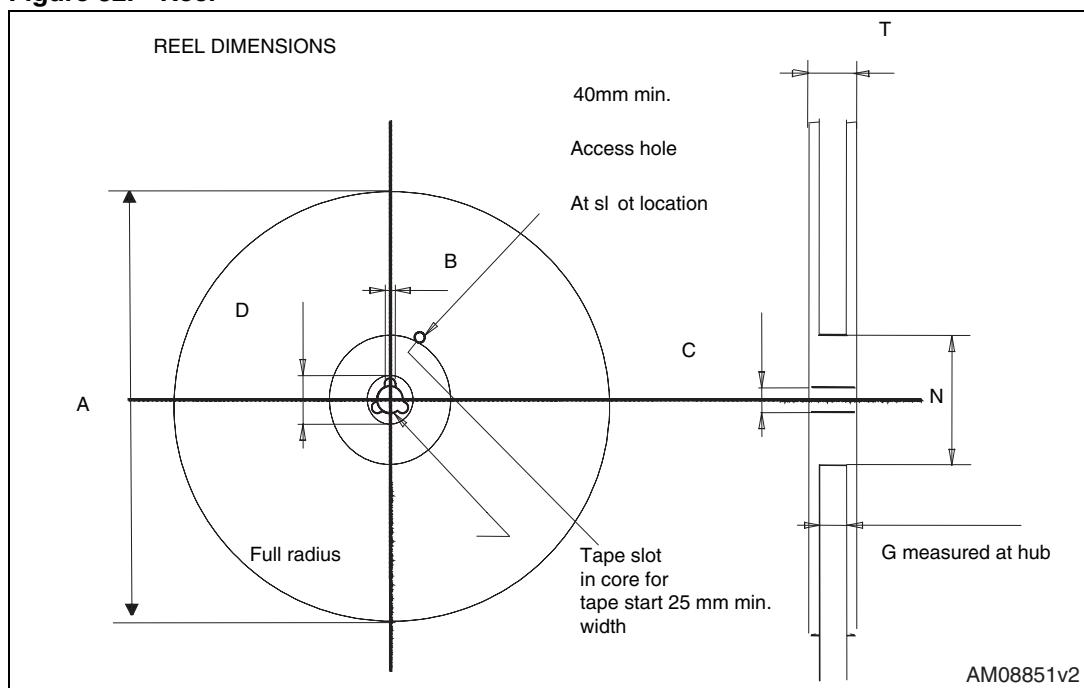
Table 13. D²PAK (TO-263) tape and reel mechanical data

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 30. D²PAK footprint^(a)



a. All dimension are in millimeters

Figure 31. Tape**Figure 32. Reel**

6 Revision history

Table 14. Document revision history

Date	Revision	Changes
24-Feb-2009	1	First release
27-Feb-2009	2	Corrected package information on first page.
11-Nov-2009	3	Document status promoted from preliminary data to datasheet.
11-May-2011	4	$R_{DS(on)}$ values have been updated (see <i>Table 4: On/off states</i> and <i>Figure 11: Static drain-source on resistance</i>).

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Собственная эффективная логистика и склад в обеспечивает надежную поставку продукции в точно указанные сроки по всей России.

Мы осуществляем техническую поддержку нашим клиентам и предпродажную проверку качества продукции. На все поставляемые продукты мы предоставляем гарантию .

Осуществляем поставки продукции под контролем ВП МО РФ на предприятия военно-промышленного комплекса России , а также работаем в рамках 275 ФЗ с открытием отдельных счетов в уполномоченном банке. Система менеджмента качества компании соответствует требованиям ГОСТ ISO 9001.

Минимальные сроки поставки, гибкие цены, неограниченный ассортимент и индивидуальный подход к клиентам являются основой для выстраивания долгосрочного и эффективного сотрудничества с предприятиями радиоэлектронной промышленности, предприятиями ВПК и научно-исследовательскими институтами России.

С нами вы становитесь еще успешнее!

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