



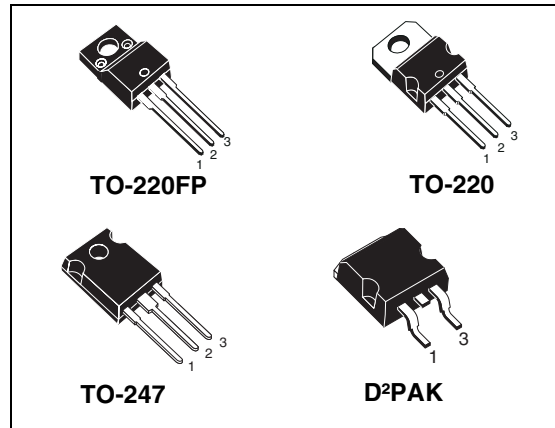
STB23NM50N, STF23NM50N STP23NM50N, STW23NM50N

N-channel 500 V, 0.162 Ω , 17 A TO-220, TO-220FP, TO-247, D²PAK
MDmesh™ II Power MOSFET

Features

Type	V _{DSS} (@T _{jmax})	R _{DS(on)} max	I _D
STB23NM50N	550 V	< 0.19 Ω	17 A
STF23NM50N			
STP23NM50N			
STW23NM50N			

- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance



Application

Switching applications

Description

These devices are made using the second generation of MDmesh™ technology. This revolutionary Power MOSFET associates a new vertical structure to the company's strip layout to yield one of the world's lowest on-resistance and gate charge. It is therefore suitable for the most demanding high efficiency converters.

Figure 1. Internal schematic diagram

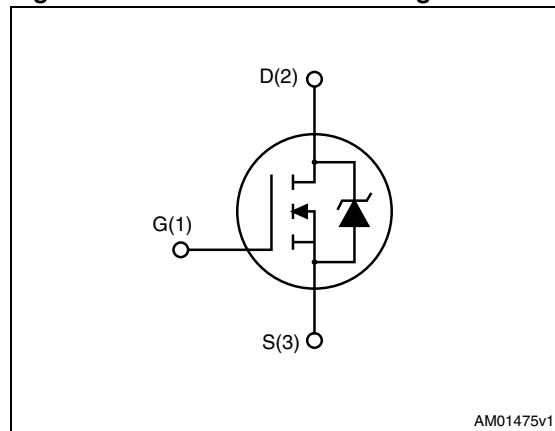


Table 1. Device summary

Order codes	Marking	Package	Packaging
STB23NM50N	23NM50N	D ² PAK	Tape and reel
STF23NM50N		TO-220FP	Tube
STP23NM50N		TO-220	
STW23NM50N		TO-247	

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value			Unit
		TO-220, D ² PAK	TO-247	TO-220FP	
V _{DS}	Drain-source voltage (V _{GS} = 0)	500			V
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	11		11 ⁽¹⁾	A
I _{DM} ⁽²⁾	Drain current (pulsed)	68		68 ⁽¹⁾	A
P _{TOT}	Total dissipation at T _C = 25 °C	125		30	W
V _{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t=1 s; T _C =25 °C)			2500	V
dv/dt ⁽³⁾	Peak diode recovery voltage slope	15			V/ns
T _{stg}	Storage temperature	-55 to 150			°C
T _j	Max. operating junction temperature	150			°C

- Limited only by maximum temperature allowed
- Pulse width limited by safe operating area
- I_{SD} ≤ 8.5 A, di/dt ≤ 400 A/μs, V_{DD} = 80% V_{(BR)DSS}

Table 3. Thermal data

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

- When mounted on 1inch² FR-4 board, 2 oz Cu

Table 4. Avalanche characteristics

Symbol	Parameter	Value	Unit
I _{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T _j Max)	6	A
E _{AS}	Single pulse avalanche energy (starting T _j = 25 °C, I _D = I _{AR} , V _{DD} = 50 V)	470	mJ

2 Electrical characteristics

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

Table 5. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$, $V_{GS} = 0$	500			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = \text{max rating}$ $V_{DS} = \text{max rating}$, @125 °C			1 10	μA μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 20\text{ V}$			0.1	μA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	2	3	4	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{ V}$, $I_D = 8.5\text{ A}$		0.162	0.19	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 50\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$	-	1330	-	pF
C_{oss}	Output capacitance			84		
C_{rss}	Reverse transfer capacitance			4.8		
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{GS} = 0$, $V_{DS} = 0\text{ to }400\text{ V}$	-	210	-	pF
Q_g	Total gate charge	$V_{DD} = 400\text{ V}$, $I_D = 17\text{ A}$, $V_{GS} = 10\text{ V}$, <i>(see Figure 18)</i>	-	45	-	nC
Q_{gs}	Gate-source charge			7		
Q_{gd}	Gate-drain charge			24		
R_g	Gate input resistance	$f=1\text{ MHz}$ Gate DC Bias=0 Test signal level=20 mV open drain	-	4.6	-	Ω

1. $C_{oss\text{ eq.}}$ is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80% V_{DS}

Table 7. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{c(off)}$	Turn-off crossing time	$V_{DD} = 250\text{ V}$, $I_D = 17\text{ A}$ $R_G = 4.7\text{ }\Omega$ $V_{GS} = 10\text{ V}$ <i>(see Figure 17)</i>	-	6.6	-	ns
$t_{r(v)}$	Voltage rise time			19		
$t_{d(off)}$	Turn-off delay time			71		
$t_{f(i)}$	Current fall time			29		

Table 8. 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	$I_{SD} = 17\text{ A}, V_{GS} = 0$	-		1.3	V
t_{rr}	Reverse recovery time	$I_{SD} = 17\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$	-	286		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 60\text{ V}$	-	3700		nC
I_{RRM}	Reverse recovery current	(see Figure 22)	-	26		A
t_{rr}	Reverse recovery time	$I_{SD} = 17\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$	-	350		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 60\text{ V}, T_j = 150\text{ }^\circ\text{C}$	-	4800		nC
I_{RRM}	Reverse recovery current	(see Figure 22)	-	27		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

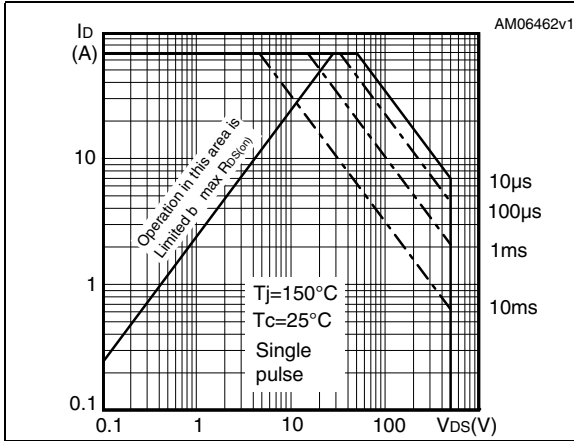


Figure 3. Thermal impedance for TO-220, D²PAK

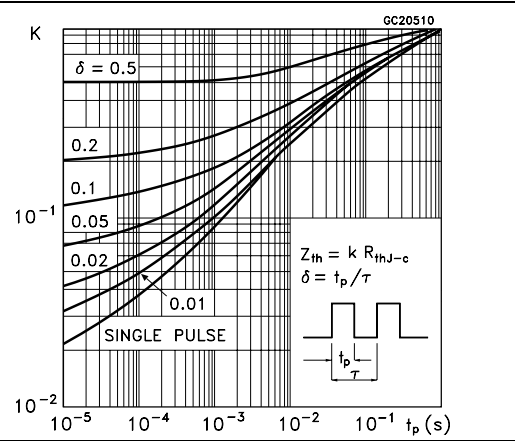


Figure 4. Safe operating area for TO-220FP

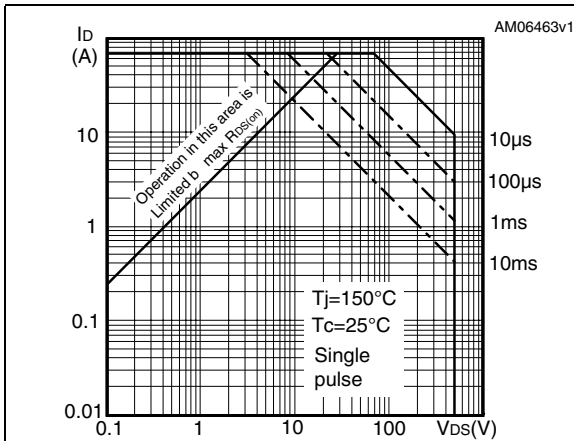


Figure 5. Thermal impedance for TO-220FP

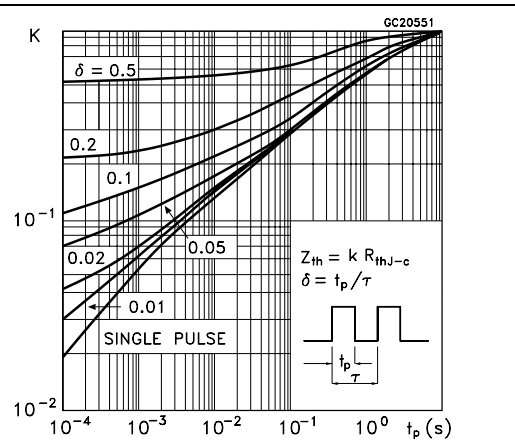


Figure 6. Safe operating area for TO-247

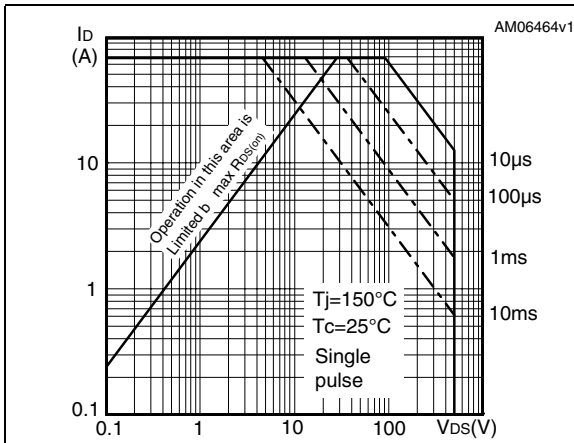


Figure 7. Thermal impedance for TO-247

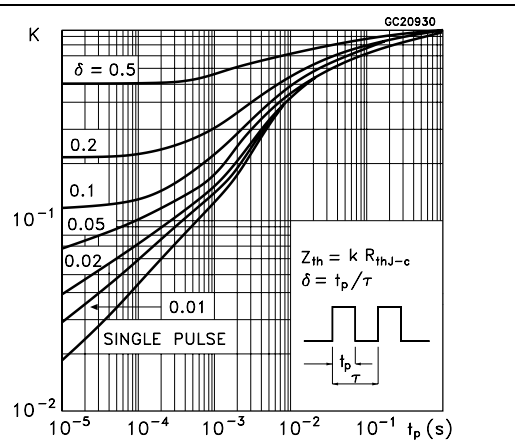


Figure 8. Output characteristics

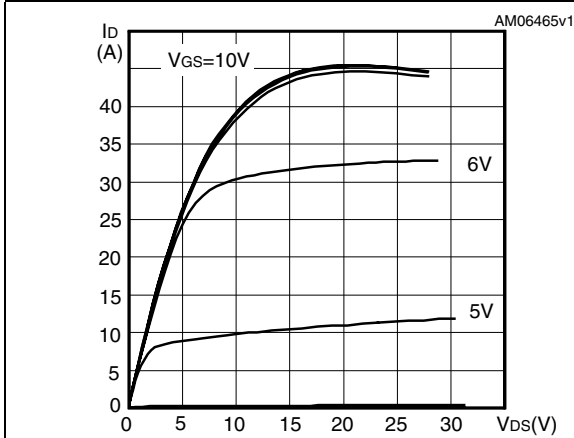


Figure 9. Transfer characteristics

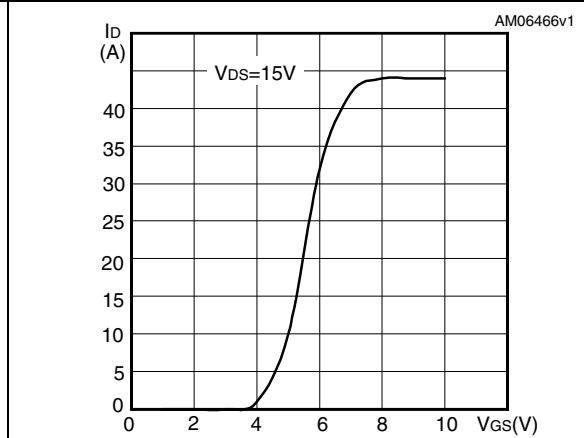


Figure 10. Gate charge vs gate-source voltage

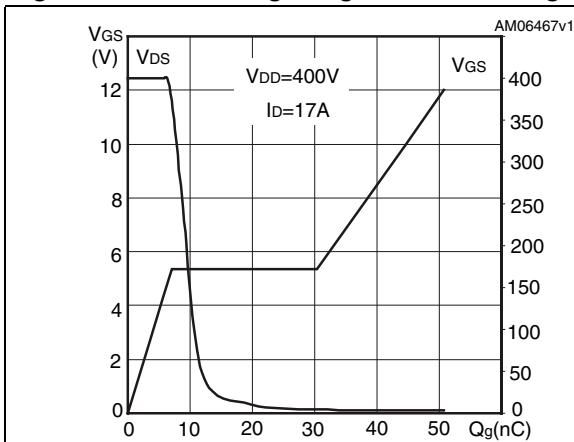


Figure 11. Static drain-source on resistance

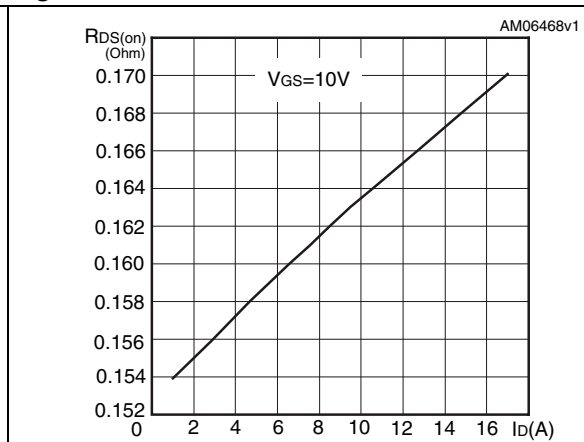


Figure 12. Capacitance variations

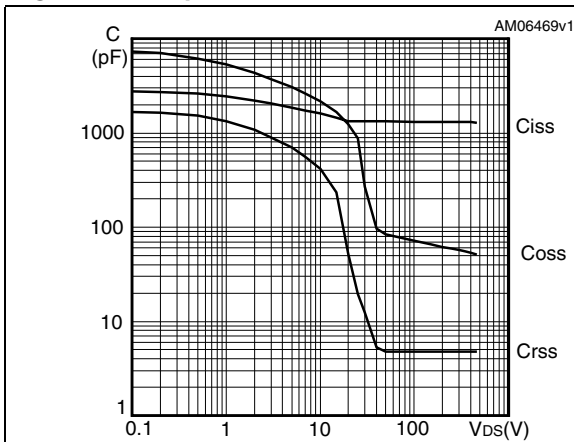


Figure 13. Output capacitance stored energy

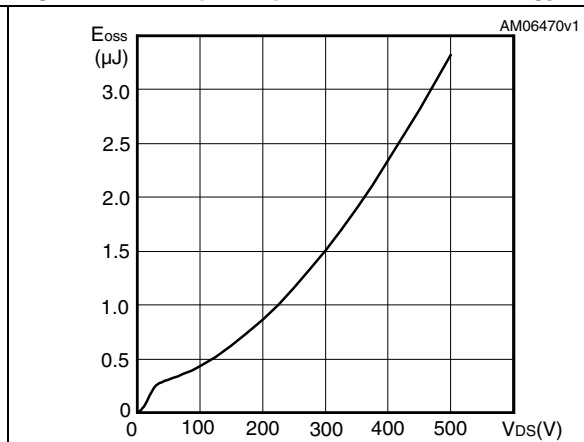


Figure 14. Normalized gate threshold voltage vs temperature

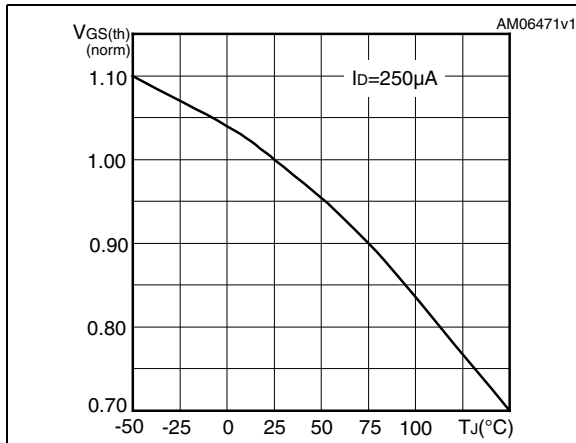


Figure 15. Normalized on resistance vs temperature

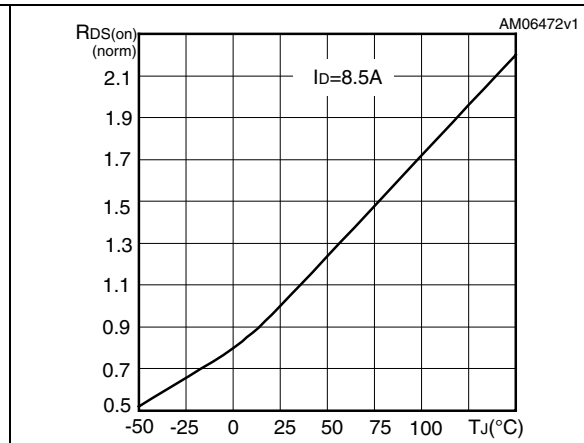
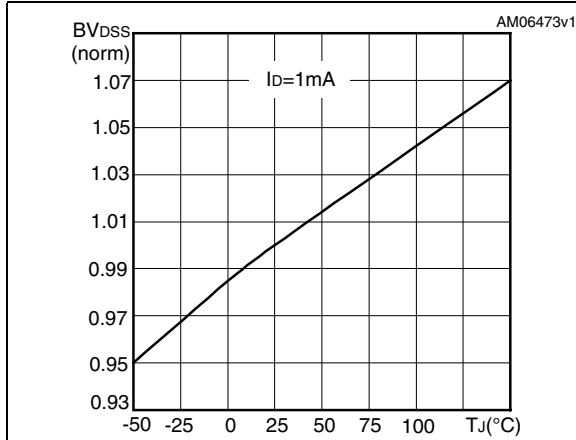


Figure 16. Normalized B_VDSS vs temperature



3 Test circuits

Figure 17. Switching times test circuit for resistive load

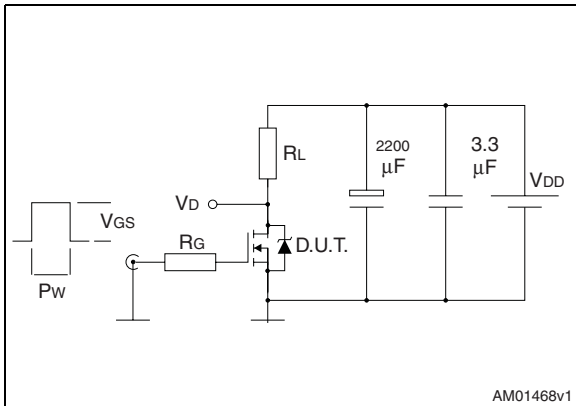


Figure 18. Gate charge test circuit

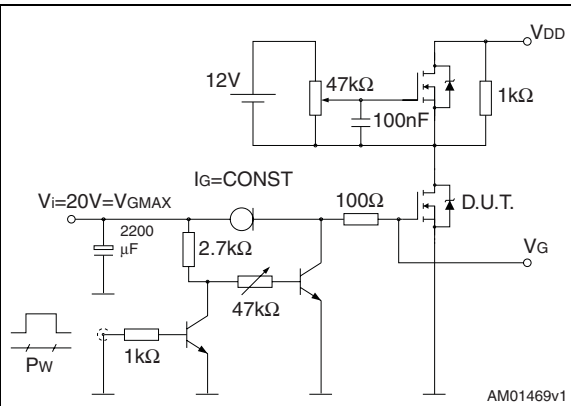


Figure 19. Test circuit for inductive load switching and diode recovery times

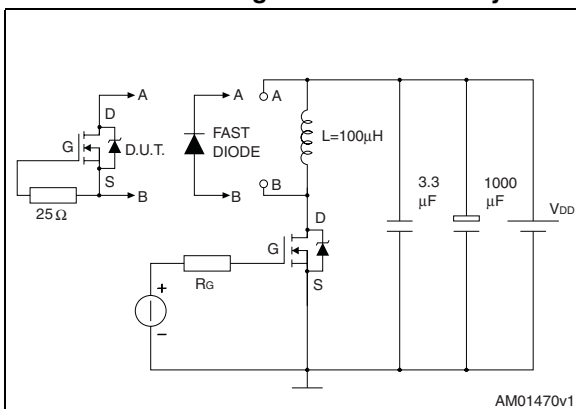


Figure 20. Unclamped inductive load test circuit

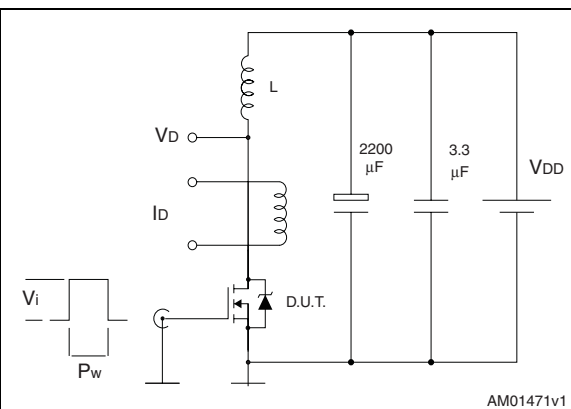


Figure 21. Unclamped inductive waveform

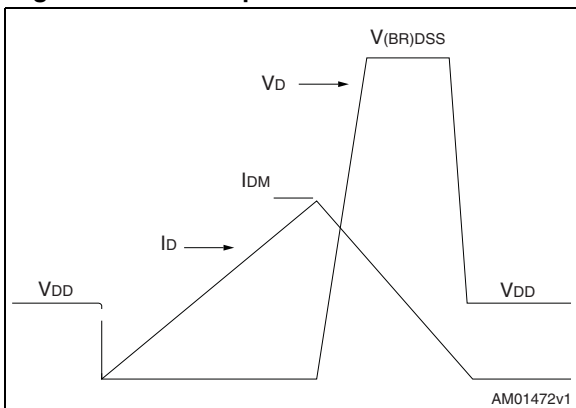
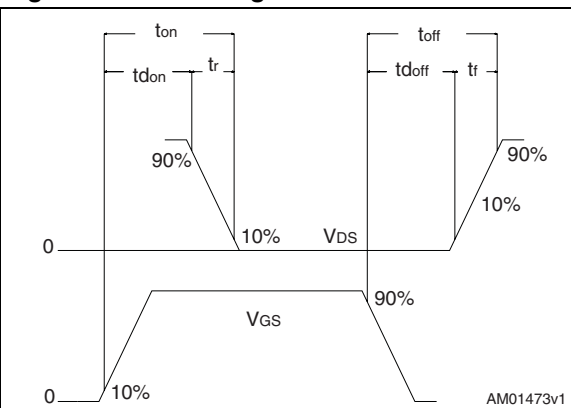


Figure 22. Switching time waveform



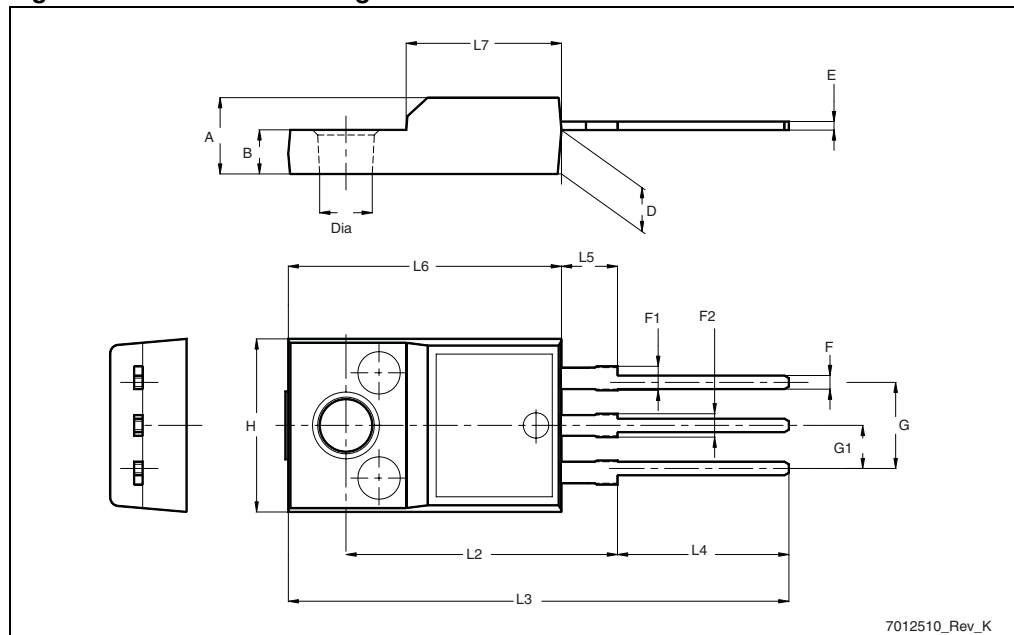
4 Package mechanical data

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. TO-220FP mechanical data

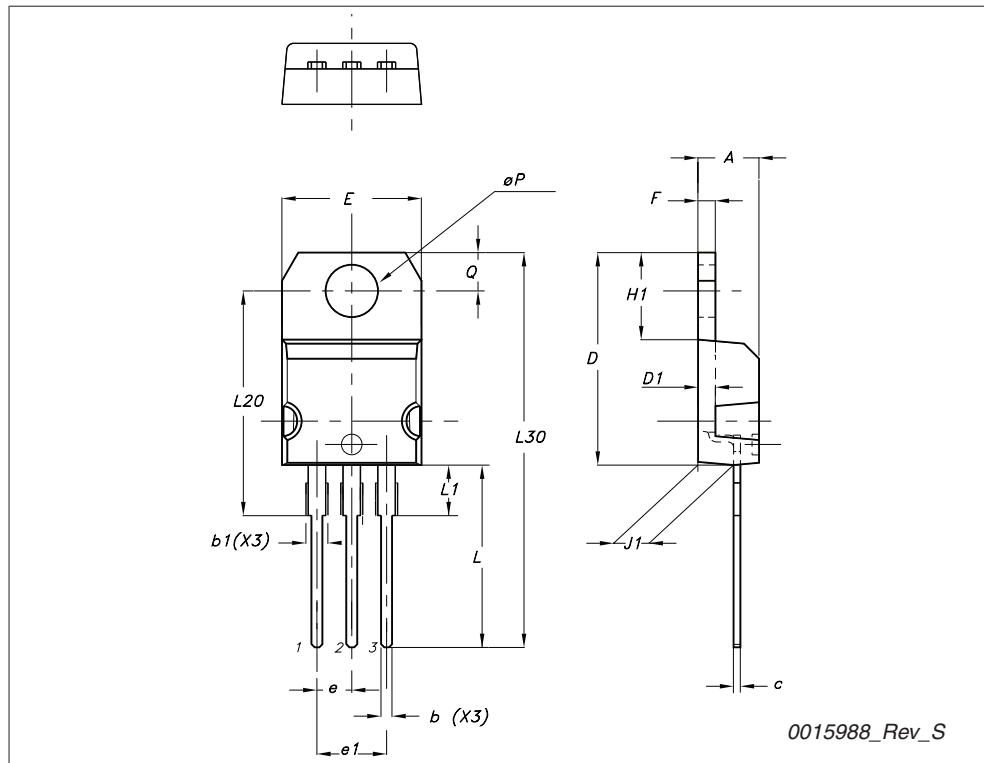
Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2

Figure 23. TO-220FP drawing



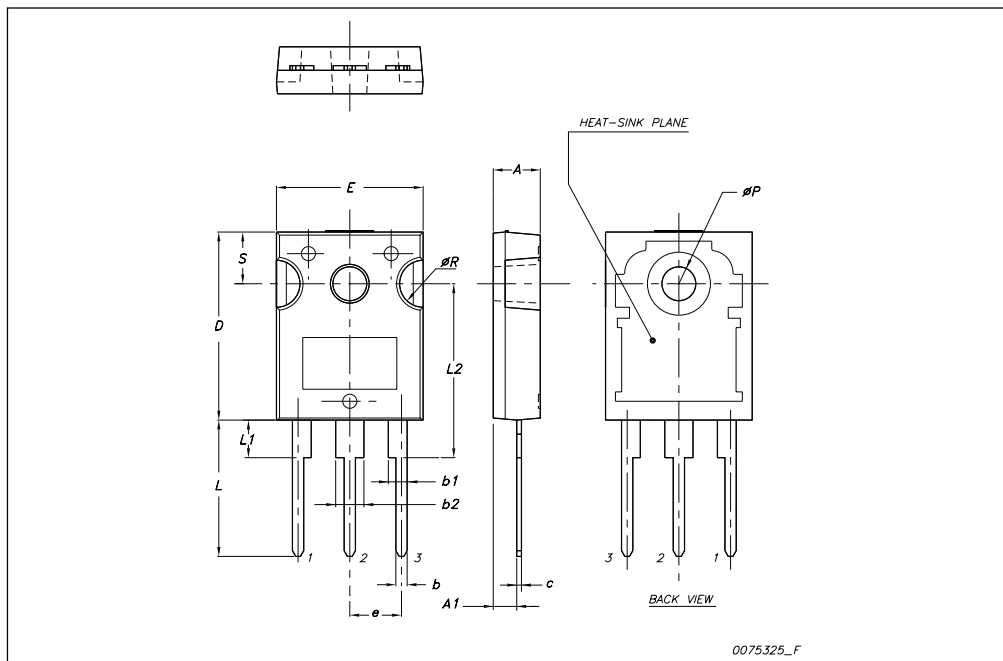
TO-220 type A mechanical data

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	
∅P	3.75		3.85
Q	2.65		2.95



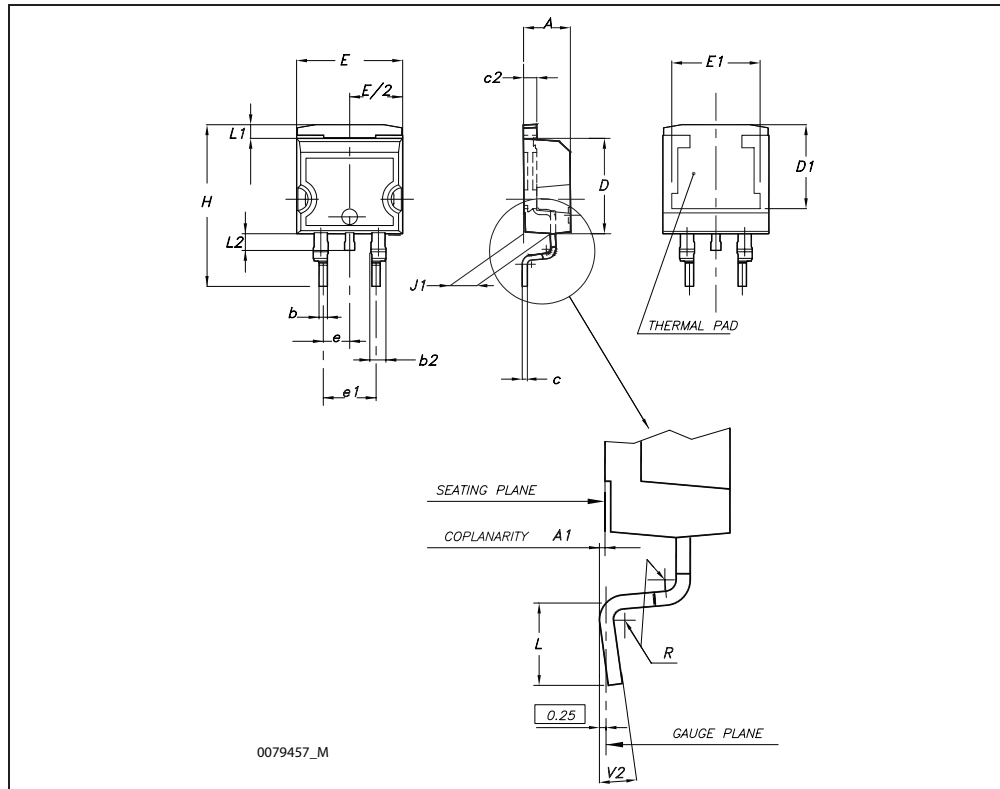
TO-247 mechanical data

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	



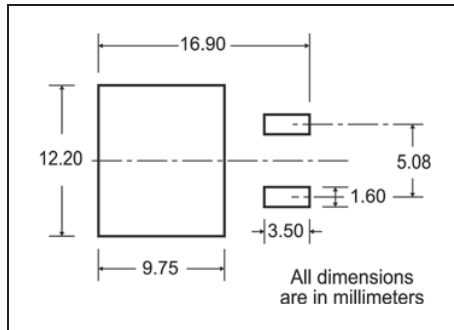
D²PAK (TO-263) mechanical data

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
A1	0.03		0.23	0.001		0.009
b	0.70		0.93	0.027		0.037
b2	1.14		1.70	0.045		0.067
c	0.45		0.60	0.017		0.024
c2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1	7.50			0.295		
E	10		10.40	0.394		0.409
E1	8.50			0.334		
e		2.54			0.1	
e1	4.88		5.28	0.192		0.208
H	15		15.85	0.590		0.624
J1	2.49		2.69	0.099		0.106
L	2.29		2.79	0.090		0.110
L1	1.27		1.40	0.05		0.055
L2	1.30		1.75	0.051		0.069
R		0.4			0.016	
V2	0°		8°	0°		8°



5 Package mechanical data

D²PAK FOOTPRINT



TAPE AND REEL SHIPMENT

TAPE MECHANICAL DATA

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A0	10.5	10.7	0.413	0.421
B0	15.7	15.9	0.618	0.626
D	1.5	1.6	0.059	0.063
D1	1.59	1.61	0.062	0.063
E	1.65	1.85	0.065	0.073
F	11.4	11.6	0.449	0.456
K0	4.8	5.0	0.189	0.197
P0	3.9	4.1	0.153	0.161
P1	11.9	12.1	0.468	0.476
P2	1.9	2.1	0.075	0.082
R	50		1.574	
T	0.25	0.35	0.0098	0.0137
W	23.7	24.3	0.933	0.956

REEL MECHANICAL DATA

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A		330		12.992
B	1.5		0.059	
C	12.8	13.2	0.504	0.520
D	20.2		0.795	
G	24.4	26.4	0.960	1.039
N	100		3.937	
T		30.4		1.197

BASE QTY	BULK QTY
1000	1000

6 Revision history

Table 10. Document revision history

Date	Revision	Changes
11-Dec-2009	1	First release.
26-May-2010	2	Document status promoted from preliminary data to datasheet.
16-Sep-2010	3	Added new value in Figure 14 , Figure 15 and Figure 16 .

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