



STD11NM50N STF11NM50N, STP11NM50N

N-channel 500 V, 0.4 Ω 9 A MDmesh™ II Power MOSFET
in DPAK, TO-220FP and TO-220

Features

Type	V _{DSS} @ T _{Jmax}	R _{DS(on)} max	I _D
STD11NM50N STF11NM50N STP11NM50N	550 V	< 0.47 Ω	9 A

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

Application

- Switching applications

Description

This second generation of MDmesh™ technology, applies the benefits of the multiple drain process to STMicroelectronics' well-known PowerMESH™ horizontal layout structure. The resulting product offers improved on-resistance, low gate charge, high dv/dt capability and excellent avalanche characteristics.

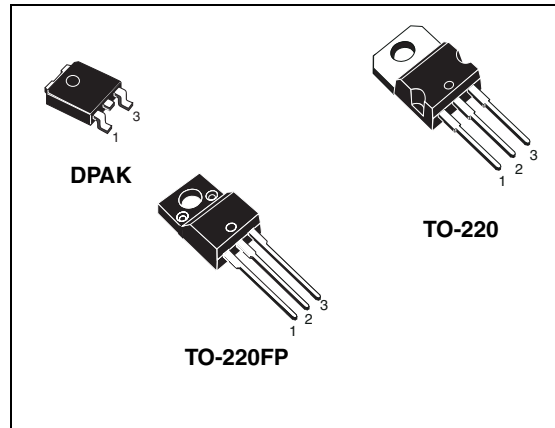


Figure 1. Internal schematic diagram

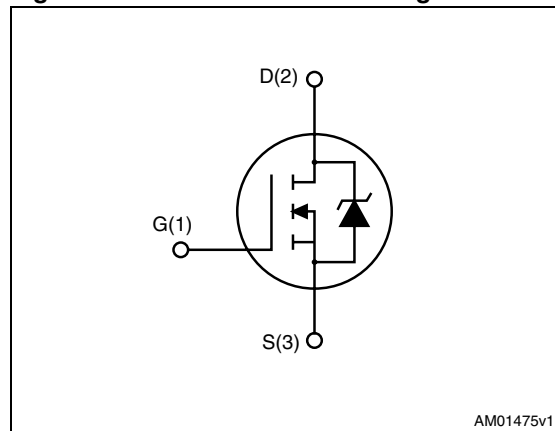


Table 1. Device summary

Order codes	Marking	Package	Packaging
STD11NM50N	11NM50N	DPAK	Tape and reel
STF11NM50N	11NM50N	TO-220FP	Tube
STP11NM50N	11NM50N	TO-220	Tube

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value			Unit
		TO-220	DPAK	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 $T_C = 25\text{ }^\circ\text{C}$	9		9 ⁽¹⁾	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	6		6 ⁽¹⁾	A
$I_{DM}^{(2)}$	Drain current (pulsed)	36		36 ⁽¹⁾	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	70	70	25	W
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max)	3			A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	150			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 ($t = 1\text{ s}$; $T_C = 25\text{ }^\circ\text{C}$)			2500	V
T_{stg}	Storage temperature	- 55 to 150			$^\circ\text{C}$
T_j	Max. operating junction temperature	150			$^\circ\text{C}$

- Limited only by maximum temperature allowed
- Pulse width limited by safe operating area
- $I_{SD} \leq 7.5\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{Peak} < V_{(BR)DSS}$

Table 3. Thermal data

Symbol	Parameter	Value			Unit
		TO-220	DPAK	TO-220FP	
$R_{thj-case}$	Thermal resistance junction-case max	1.79		5	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max	62.5		62.5	$^\circ\text{C}/\text{W}$
$R_{thj-pcb}$	Thermal resistance junction-pcb max ⁽¹⁾		50		$^\circ\text{C}/\text{W}$
T_l	Maximum lead temperature for soldering purpose	300		300	$^\circ\text{C}$

- When mounted on 1inch² FR-4 board, 2 oz 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	$I_D = 1\text{ mA}$, $V_{GS} = 0$	500			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 10	μA μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 25\text{ V}$			100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	2	3	4	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{ V}$, $I_D = 4.5\text{ A}$		0.4	0.47	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 50\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$	-	547	-	pF
C_{oss}	Output capacitance			42		pF
C_{rss}	Reverse transfer capacitance			2		pF
$C_{o(tr)}^{(1)}$	Equivalent capacitance time related	$V_{DS} = 0\text{ to }400\text{ V}$, $V_{GS} = 0$	-	59	-	pF
$C_{o(er)}^{(2)}$	Equivalent capacitance energy related			29		pF
R_G	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	5.8	-	Ω
Q_g	Total gate charge	$V_{DD} = 400\text{ V}$, $I_D = 9\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 18)	-	19	-	nC
Q_{gs}	Gate-source charge			3.7		nC
Q_{gd}	Gate-drain charge			10		nC

- $C_{oss\text{ eq}}$ 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}
- $C_{oss\text{ eq}}$ 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	
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 250\text{ V}$, $I_D = 4.5\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 19)		8		ns	
t_r	Rise time		-	10	-	ns	
$t_{d(off)}$	Turn-off delay time				33		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		-		9	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				36	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 9\text{ A}$, $V_{GS} = 0$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 9\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ (see Figure 22)	-	230		ns
Q_{rr}	Reverse recovery charge			2.1		μC
I_{RRM}	Reverse recovery current			18		A
t_{rr}	Reverse recovery time	$I_{SD} = 9\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 22)	-	275		ns
Q_{rr}	Reverse recovery charge			2.5		μC
I_{RRM}	Reverse recovery current			18		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

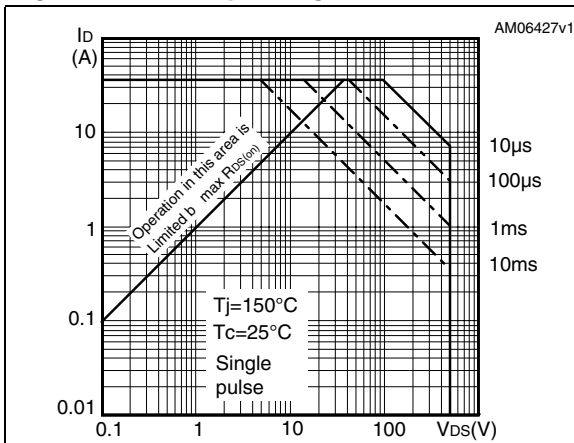


Figure 3. Thermal impedance for TO-220

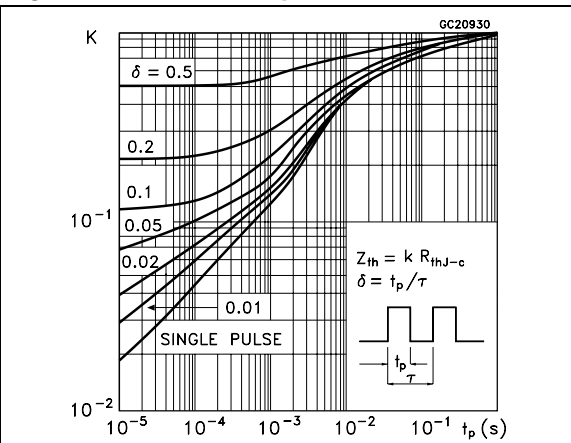


Figure 4. Safe operating area for TO-220FP

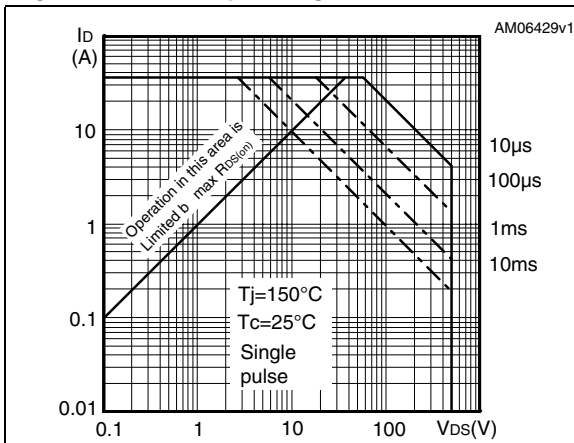


Figure 5. Thermal impedance for TO-220FP

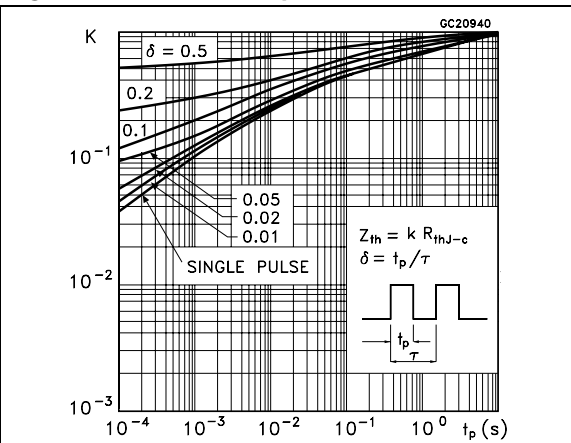


Figure 6. Safe operating area for DPAK

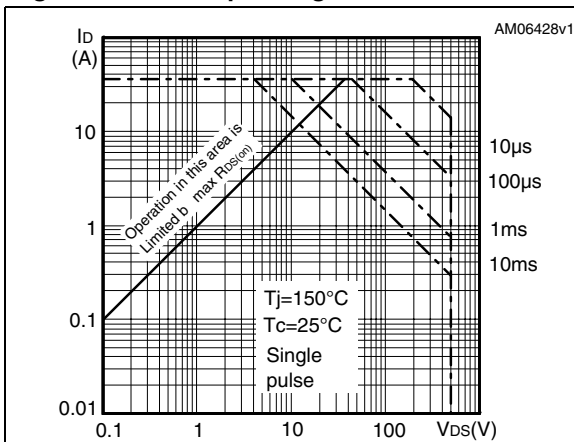


Figure 7. Thermal impedance for DPAK

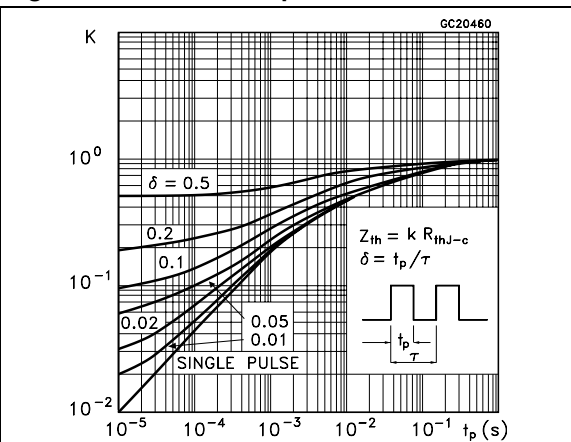


Figure 8. Output characteristics

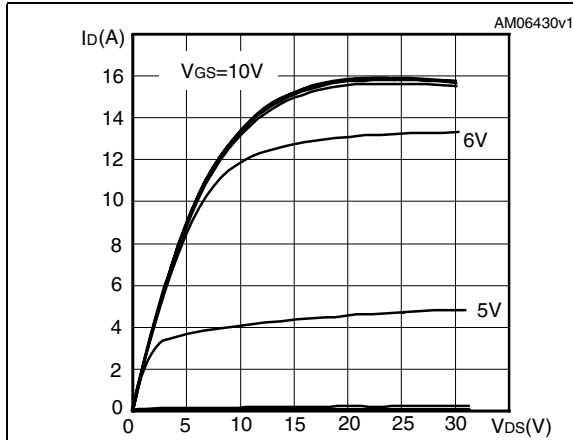


Figure 9. Transfer characteristics

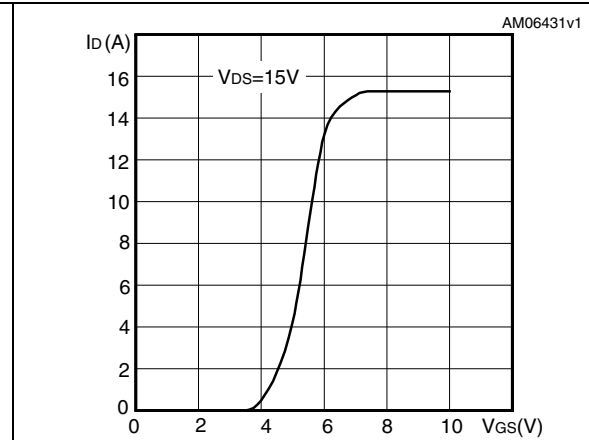


Figure 10. Gate charge vs gate-source voltage

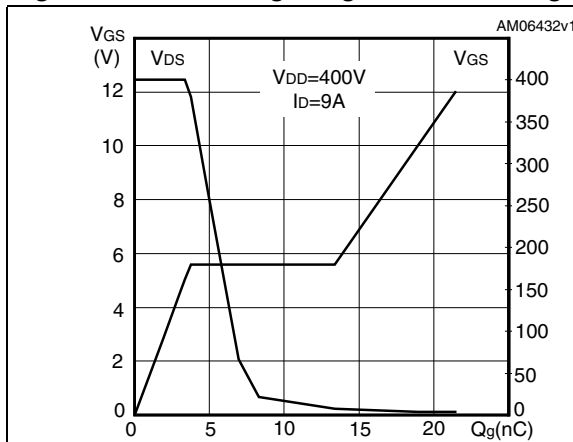


Figure 11. Static drain-source on resistance

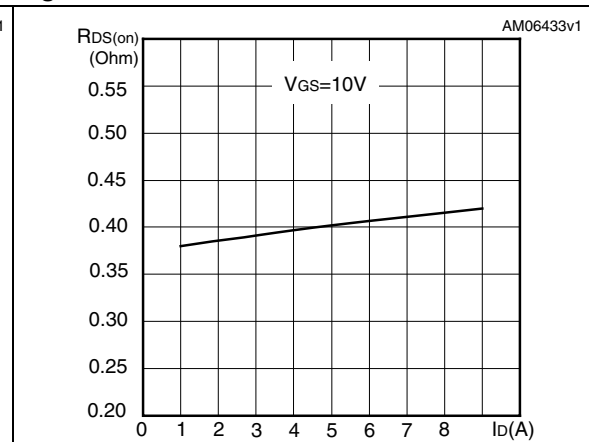


Figure 12. Capacitance variations

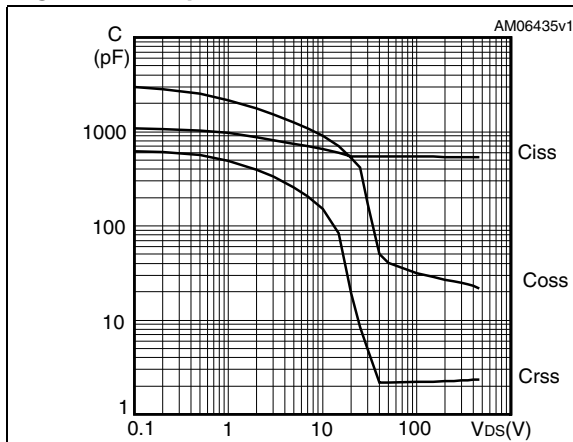


Figure 13. Output capacitance stored energy

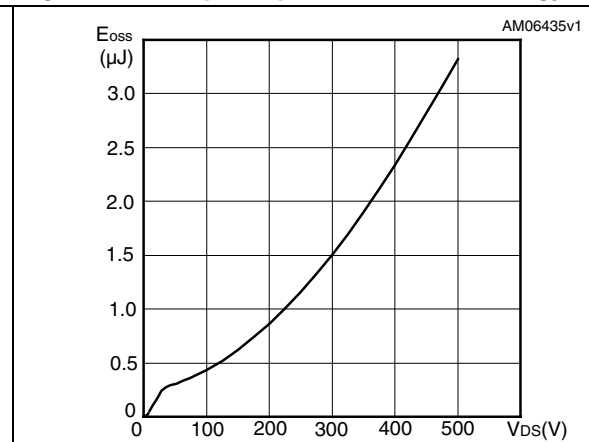


Figure 14. Normalized gate threshold voltage vs temperature

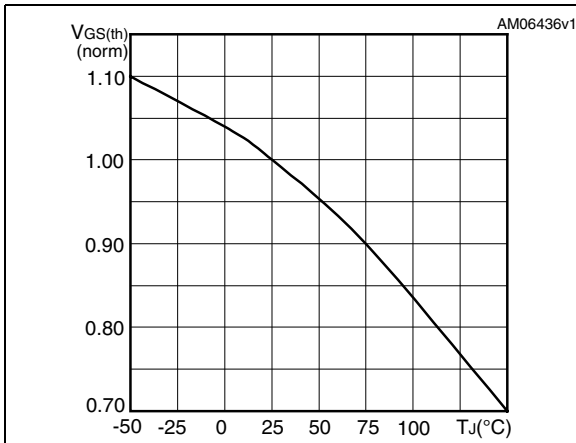


Figure 15. Normalized on resistance vs temperature

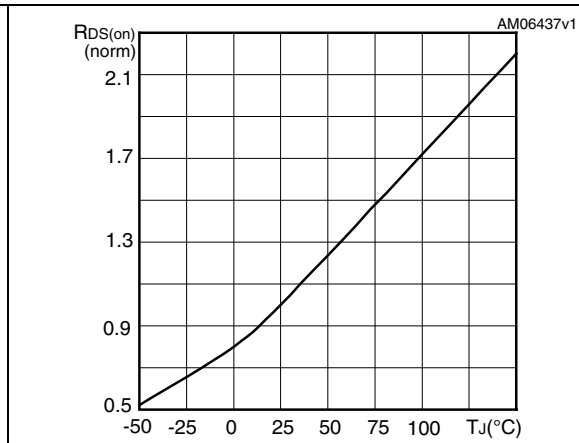
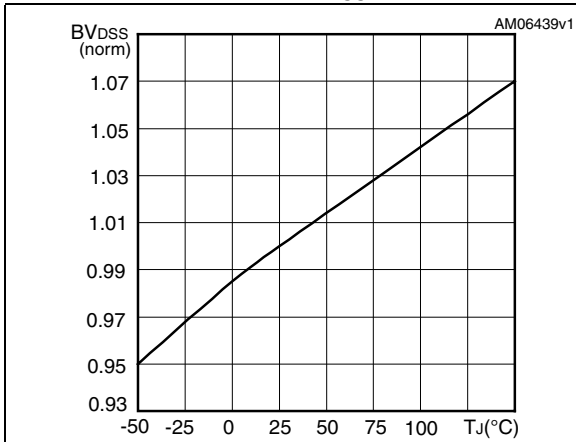


Figure 16. Normalized B_VDSS vs temperature



3 Test circuits

Figure 17. Switching times test circuit for resistive load

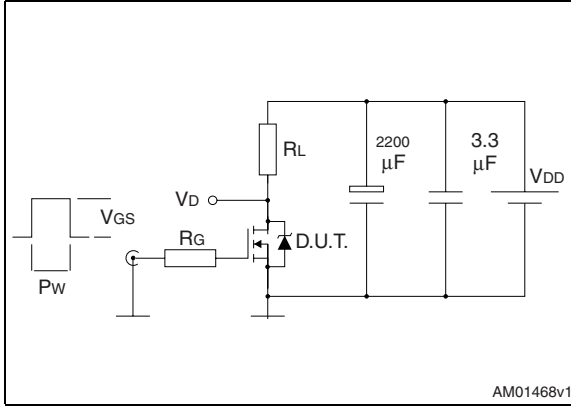


Figure 18. Gate charge test circuit

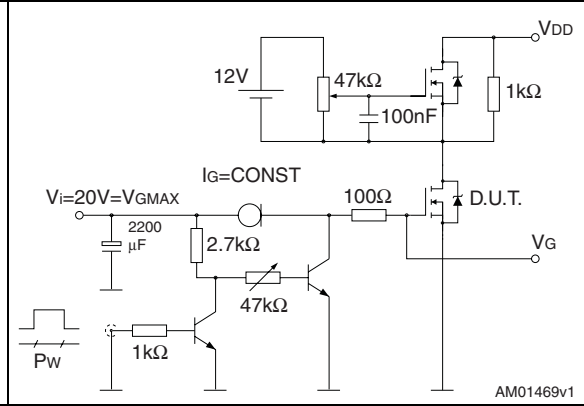


Figure 19. Test circuit for inductive load switching and diode recovery times

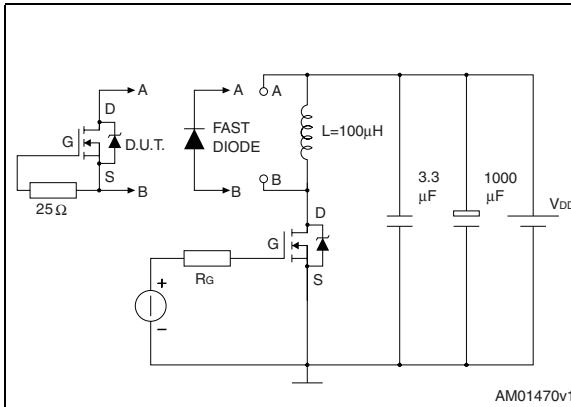


Figure 20. Unclamped inductive load test circuit

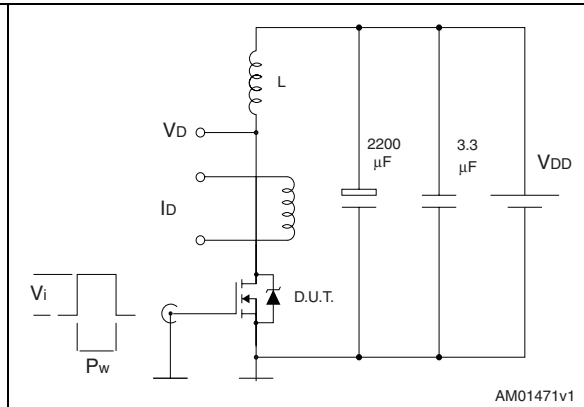


Figure 21. Unclamped inductive waveform

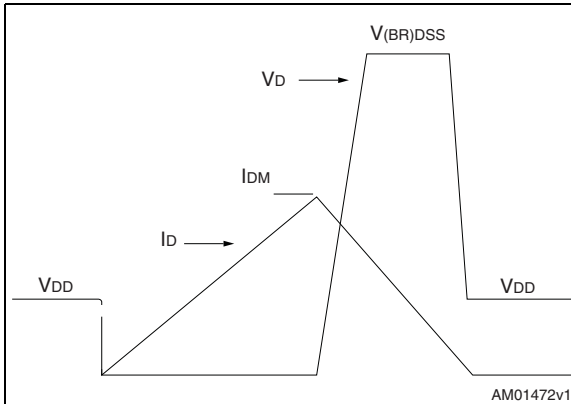
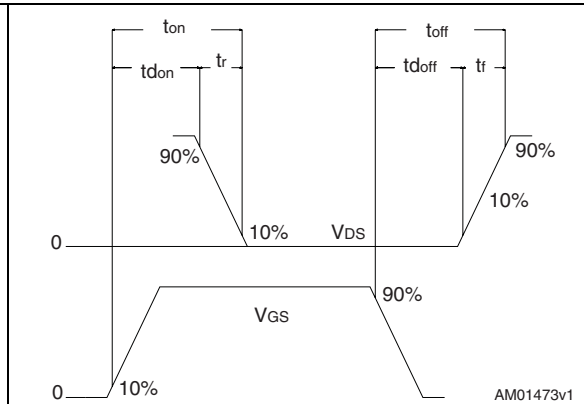


Figure 22. Switching time waveform



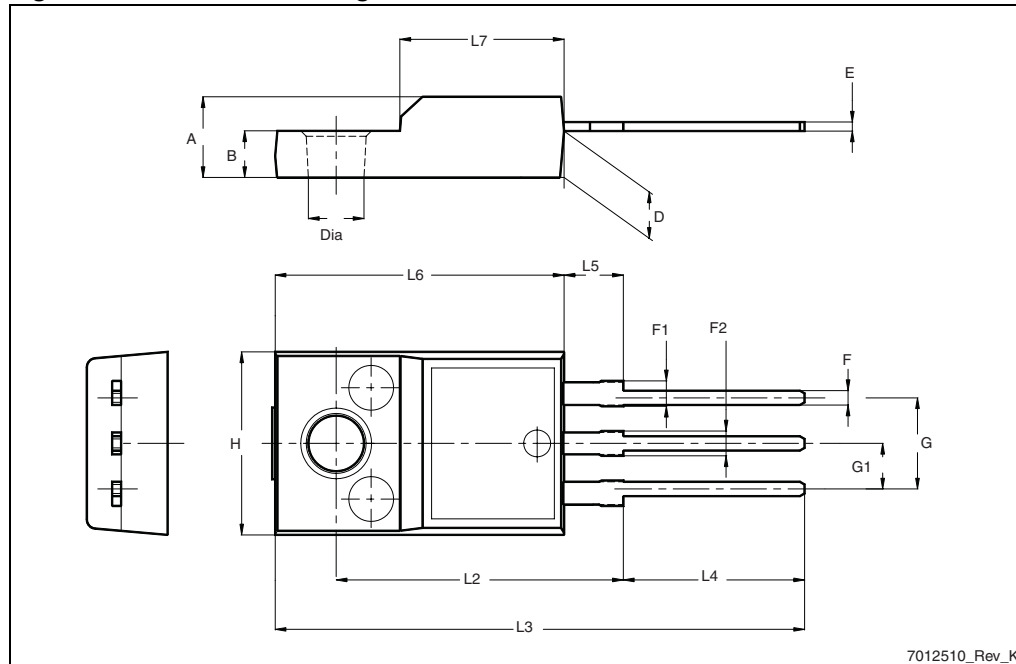
4 Package mechanical data

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 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

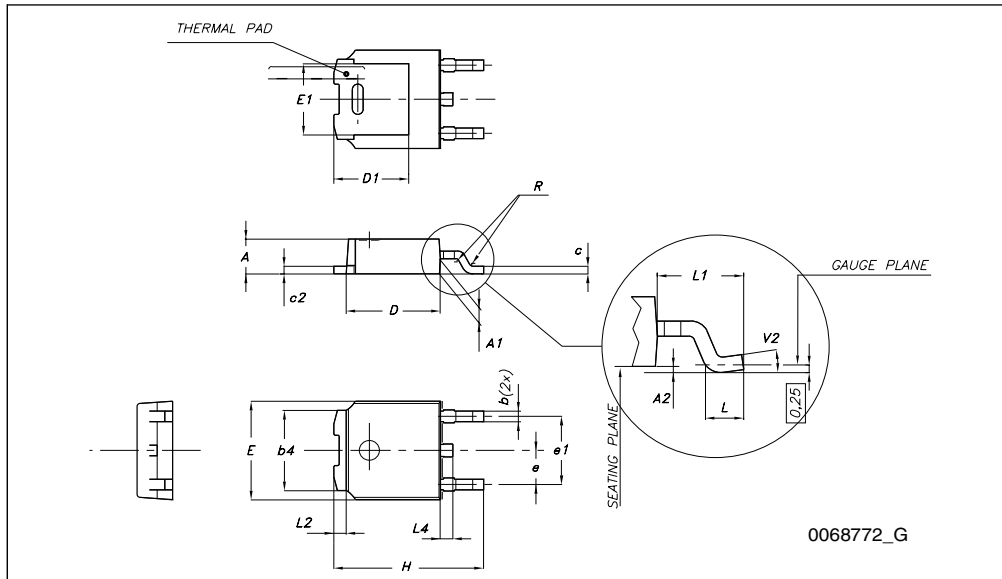
Figure 23. TO-220FP drawing



7012510_Rev_K

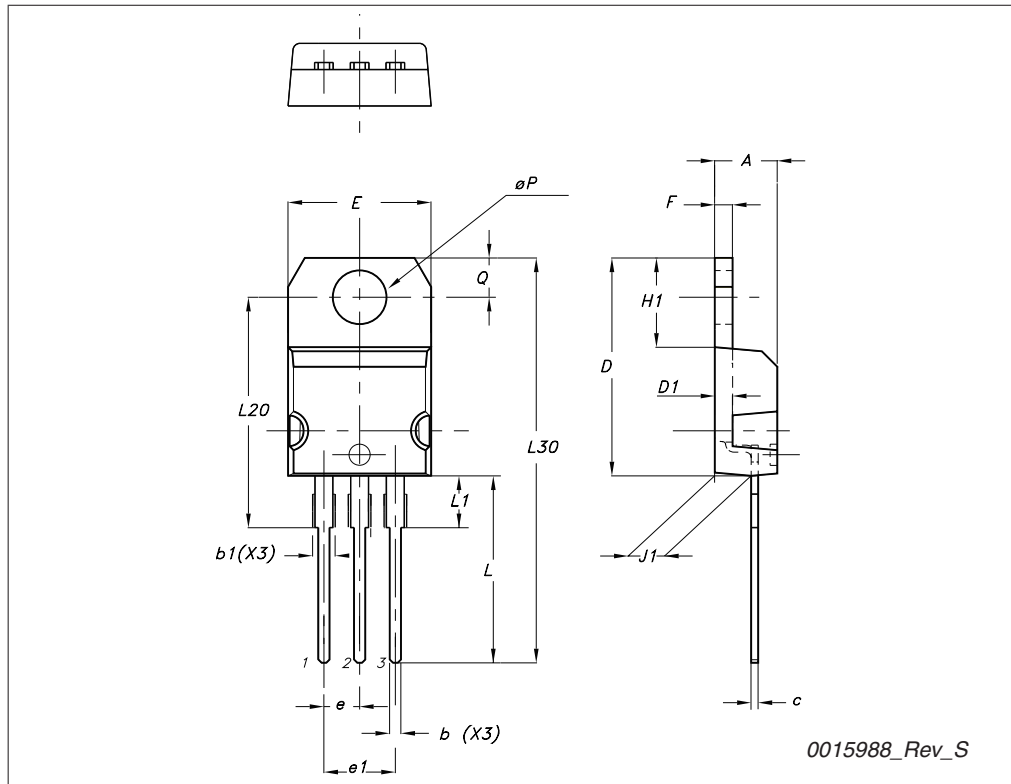
TO-252 (DPAK) mechanical data

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°



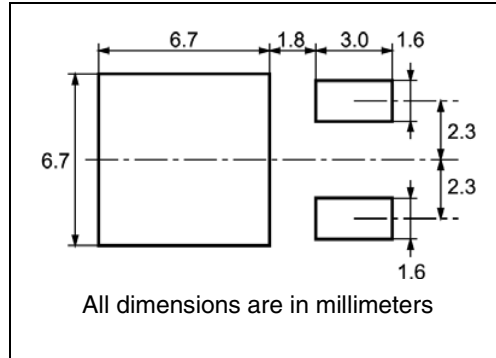
TO-220 type A mechanical data

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



5 Packaging mechanical data

DPAK FOOTPRINT



TAPE AND REEL SHIPMENT

40 mm min. Access hole at slot location

Full radius

Tape slot in core for tape start 2.5mm min. width

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	16.4	18.4	0.645	0.724
N	50		1.968	
T		22.4		0.881

BASE QTY	BULK QTY
2500	2500

TAPE MECHANICAL DATA

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A0	6.8	7	0.267	0.275
B0	10.4	10.6	0.409	0.417
B1		12.1		0.476
D	1.5	1.6	0.059	0.063
D1	1.5		0.059	
E	1.65	1.85	0.065	0.073
F	7.4	7.6	0.291	0.299
K0	2.55	2.75	0.100	0.108
P0	3.9	4.1	0.153	0.161
P1	7.9	8.1	0.311	0.319
P2	1.9	2.1	0.075	0.082
R	40		1.574	
W	15.7	16.3	0.618	0.641

10 pitches cumulative tolerance on tape +/- 0.2 mm

For machine ref. only including draft and radii concentric around B0

User Direction of Feed

FEED DIRECTION

Bending radius R min.

6 Revision history

Table 9. Document revision history

Date	Revision	Changes
22-Feb-2010	1	First release.
26-Apr-2010	2	Updated Table 7: Source drain diode .

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