



STP45NF3LL - STP45NF3LLFP STB45NF3LL

N-channel 30V - 0.014Ω - 45A TO-220 - TO-220FP - D²PAK
STripFET II™ power MOSFET

General features

Type	V _{DSS}	R _{DS(on)}	I _D
STB45NF3LL	30V	<0.018Ω	45A
STP45NF3LLFP	30V	<0.018Ω	45A
STP45NF3LL	30V	<0.018Ω	27A

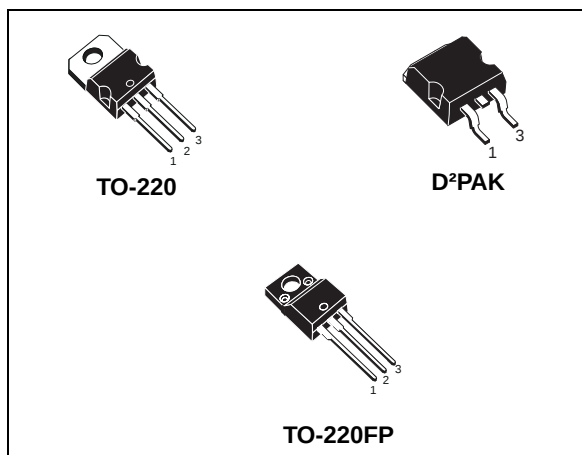
- Optimal R_{DS(on)} × Q_g trade-off @ 4.5V
- Conduction losses reduced
- Switching losses reduced

Description

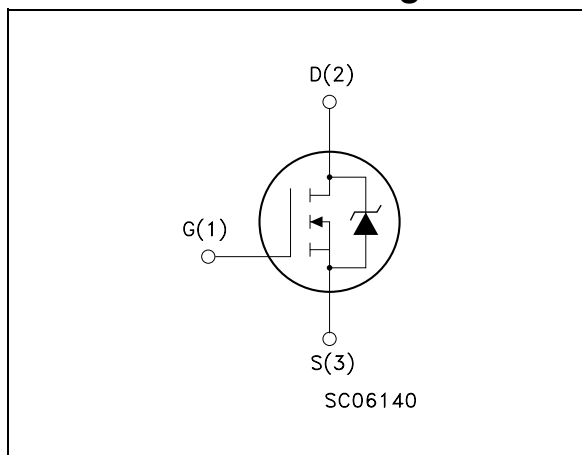
This application specific Power MOSFET is the third generation of STMicroelectronics unique "Single Feature Size™" strip-based process. The resulting transistor shows the best trade-off between on-resistance and gate charge. When used as high and low side in buck regulators, it gives the best performance in terms of both conduction and switching losses. This is extremely important for motherboards where fast switching and high efficiency are of paramount importance.

Applications

- Switching application



Internal schematic diagram



Order codes

Part number	Marking	Package	Packaging
STB11NM60FD	B11NM60FD	D ² PAK	Tape & reel
STB11NM60FD-1	B11NM60FD	I ² PAK	Tube
STP11NM60FD	P11NM60FD	TO-220	Tube

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1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-220/ D ² PAK/I ² PAK	TO-220FP	
V_{DS}	Drain-source voltage ($v_{GS} = 0$)	30		V
V_{DGR}	Drain-gate voltage ($R_{GS} = 20\text{ k}\Omega$)	30		V
V_{GS}	Gate- source voltage	± 16		V
I_D	Drain current (continuous) at $T_C = 25^\circ\text{C}$	45	27	A
I_D	Drain current (continuous) at $T_C = 100^\circ\text{C}$	32	19	A
$I_{DM}^{(1)}$	Drain current (pulsed)	180	108	A
P_{TOT}	Total dissipation at $T_C = 25^\circ\text{C}$	70	25	W
	Derating factor	0.46	0.167	W/ $^\circ\text{C}$
$E_{AS}^{(2)}$	Single pulse avalanche energy	241		mJ
V_{ISO}	Insulation withstand voltage (dc)	--	2500	V
T_{stg}	Storage temperature	– 55 to 175		$^\circ\text{C}$
T_j	Max. operating junction temperature			

1. Pulse width limited by safe operating area

2. Starting $T_j = 25^\circ\text{C}$, $I_D = 22.5\text{A}$, $V_{DD} = 24\text{V}$

Table 2. Thermal data

Symbol	Parameter	Value		Unit
		TO-220 D ² PAK	TO-220FP	
$R_{thj-case}$	Thermal resistance junction-case Max	2.14	6	$^\circ\text{C/W}$
R_{thj-a}	Thermal resistance junction-ambient Max	62.5		$^\circ\text{C/W}$
T_l	Maximum lead temperature for soldering purpose	300		$^\circ\text{C}$

2 Electrical characteristics

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

Table 3. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source Breakdown voltage	$I_D = 250\ \mu\text{A}$, $V_{GS} = 0$	30			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 10	μA μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 16\text{V}$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\ \mu\text{A}$	1			V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{V}$, $I_D = 22.5\text{A}$ $V_{GS} = 4.5\text{V}$, $I_D = 22.5\text{A}$		0.014 0.016	0.018 0.020	Ω Ω

Table 4. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 15\text{V}$, $I_D = 22.5\text{A}$		20		S
C_{iss}	Input capacitance	$V_{DS} = 25\text{V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$		800		pF
C_{oss}	Output capacitance			250		pF
C_{rss}	Reverse transfer capacitance			60		pF
Q_g	Total gate charge	$V_{DD} = 24\text{V}$, $I_D = 45\text{A}$, $V_{GS} = 5\text{V}$		12.5	17	nC
Q_{gs}	Gate-source charge			4.6		nC
Q_{gd}	Gate-drain charge			5.2		nC

1. Pulsed: Pulse duration = 300 μs , duty cycle 1.5 %

Table 5. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 15\text{V}$, $I_D = 22.5\text{A}$ $R_G = 4.7\ \Omega$, $V_{GS} = 4.5\text{V}$ (see Figure 15)		17		ns
t_r	Rise time			100		ns
$t_{d(off)}$	Turn-off-delay time	$V_{DD} = 15\text{V}$, $I_D = 22.5\text{A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 4.5\text{V}$ (see Figure 15)		20		ns
t_f	Fall time			21		ns

Table 6. Source drain diode

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
I_{SD}	Source-drain current				45	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				180	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 45A, V_{GS} = 0$			1.3	V
t_{rr}	Reverse recovery time	$I_{SD} = 45A, V_{DD} = 15V$ $di/dt = 100A/\mu s$, (see Figure 17)		35		ns
Q_{rr}	Reverse recovery charge			44		nC
I_{RRM}	Reverse recovery current			2.5		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 1. Safe operating area for TO-220/D²PAK

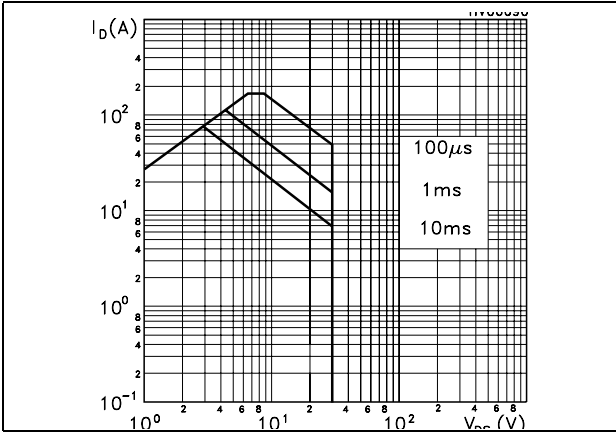


Figure 2. Thermal impedance for TO-220/D²PAK

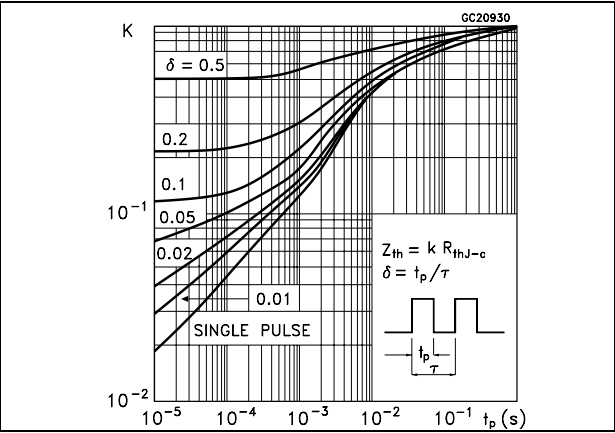


Figure 3. Safe operating area for TO-220FP

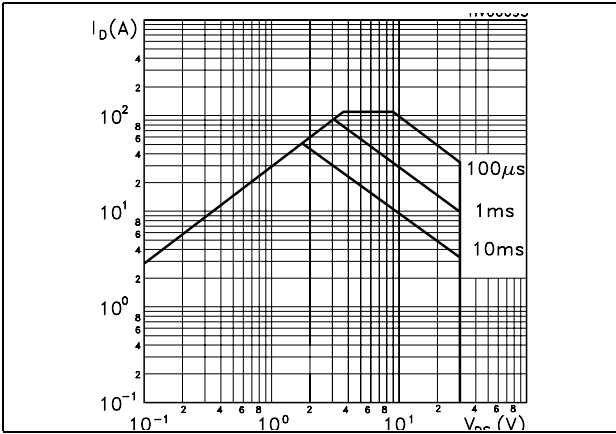


Figure 4. Thermal impedance for TO-220FP

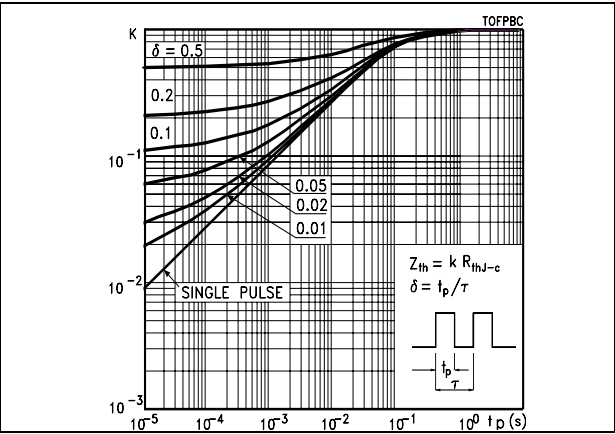


Figure 5. Output characteristics

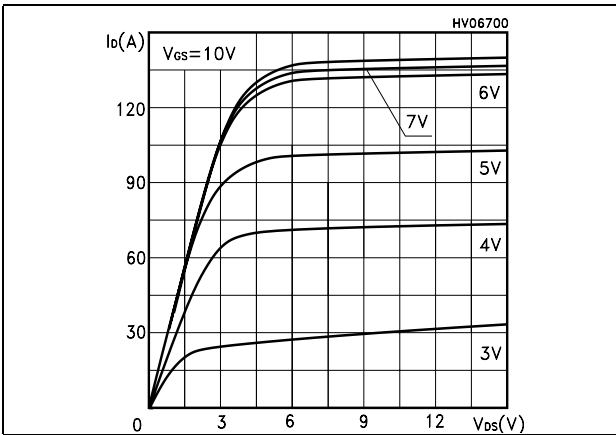


Figure 6. Transfer characteristics

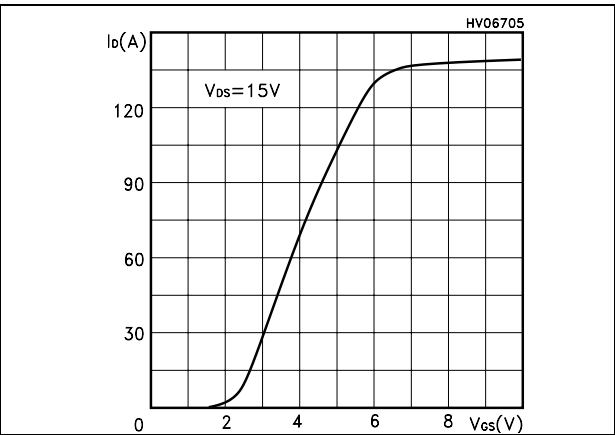


Figure 7. Transconductance

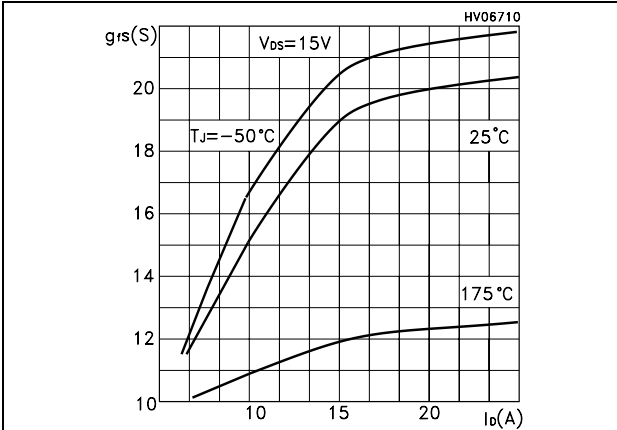


Figure 8. Static drain-source on resistance

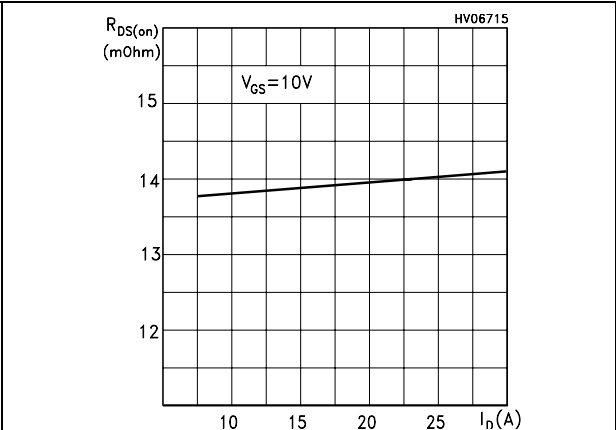


Figure 9. Gate charge vs gate-source voltage

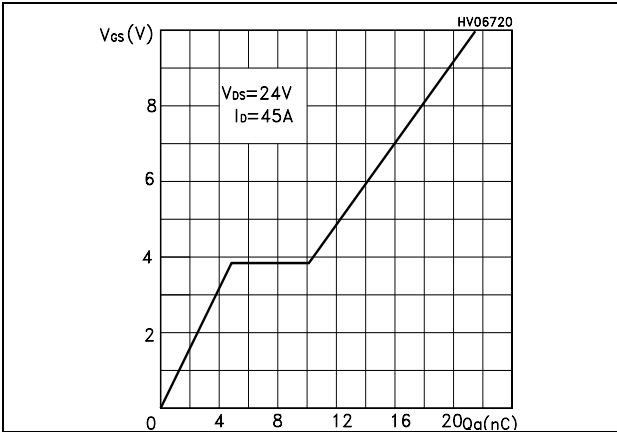


Figure 10. Capacitance variations

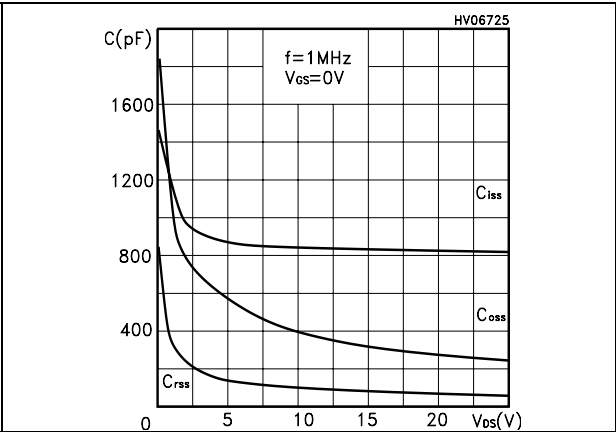


Figure 11. Normalized gate threshold voltage vs temperature

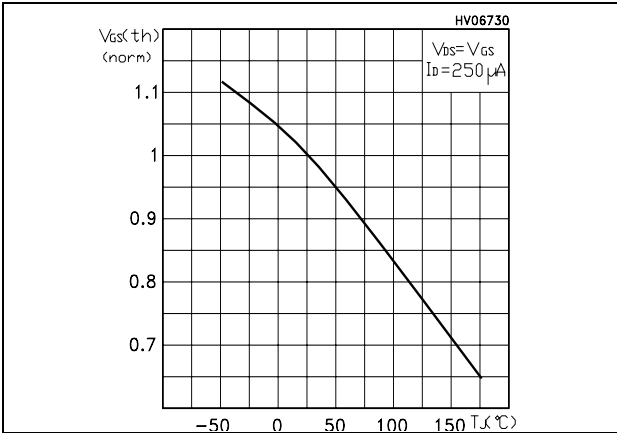


Figure 12. Normalized on resistance vs temperature

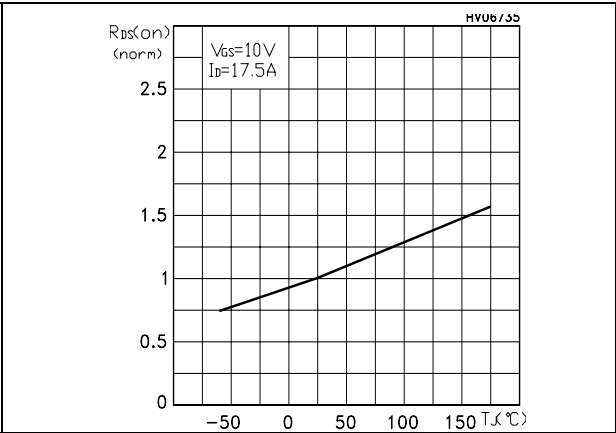


Figure 13. Source-drain diode forward characteristics

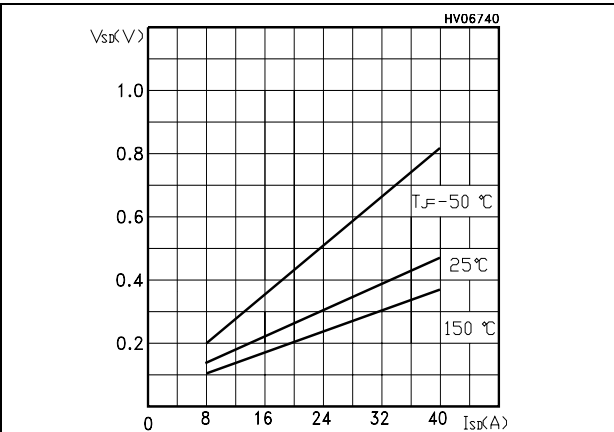
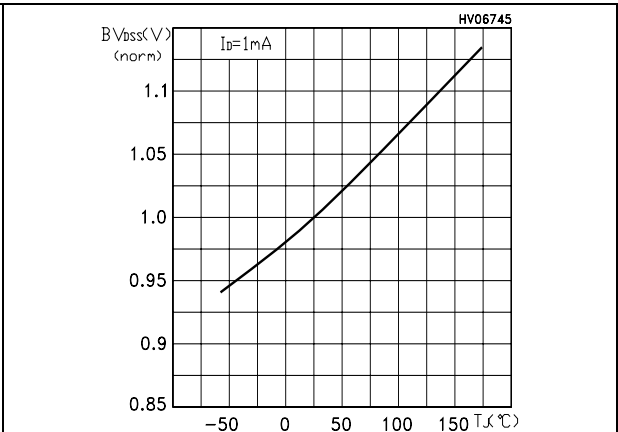


Figure 14. Normalized breakdown voltage vs t_j



3 Test circuit

Figure 15. Switching times test circuit for resistive load

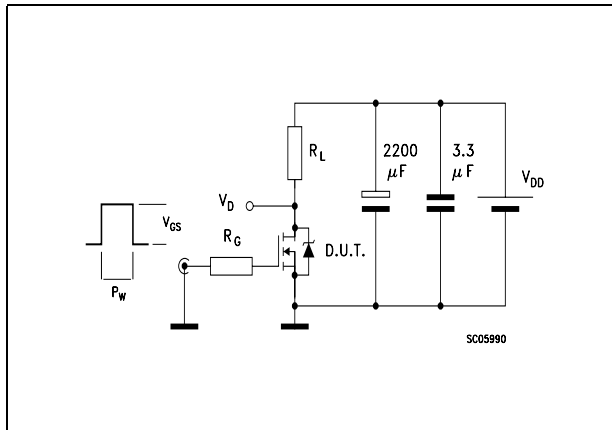


Figure 16. Gate charge test circuit

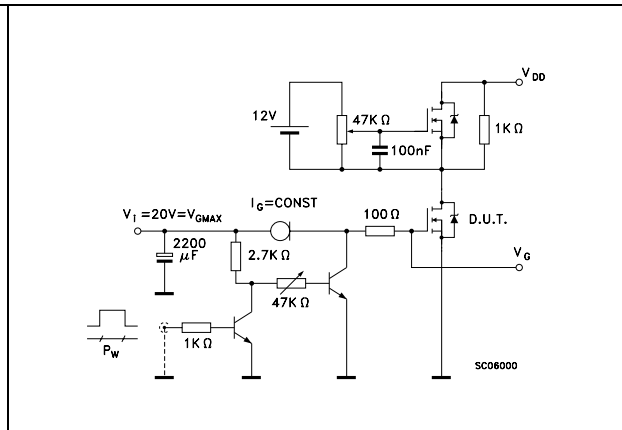


Figure 17. Test circuit for inductive load switching and diode recovery times

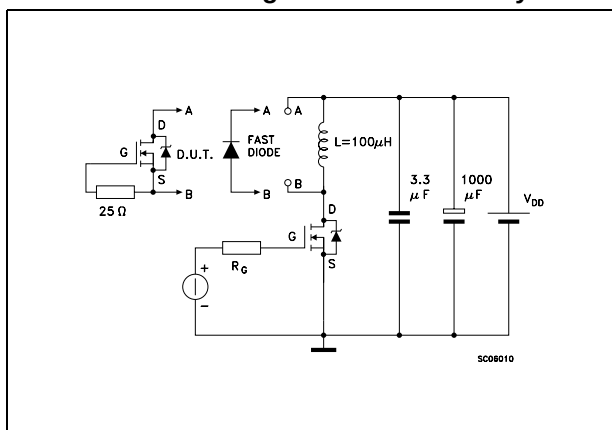


Figure 18. Unclamped Inductive load test circuit

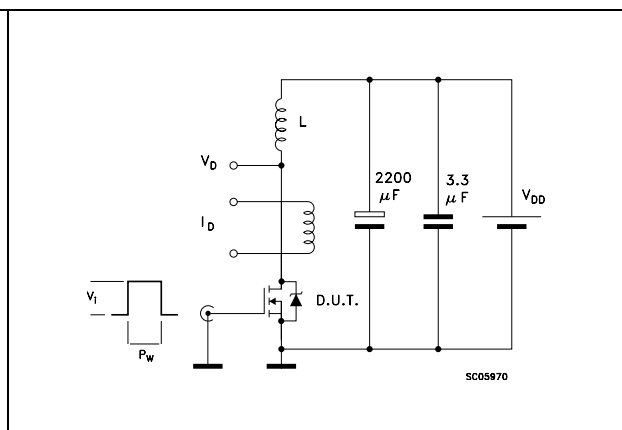


Figure 19. Unclamped inductive waveform

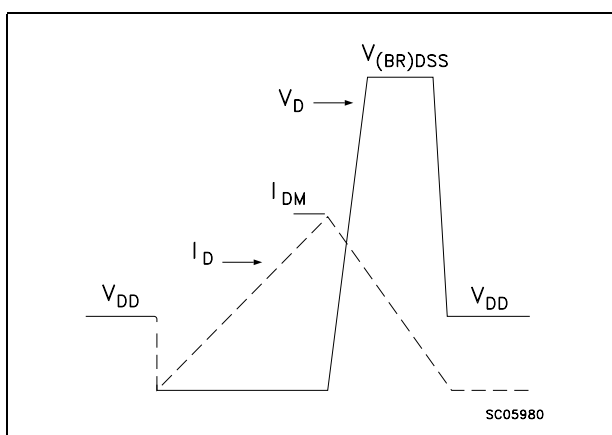
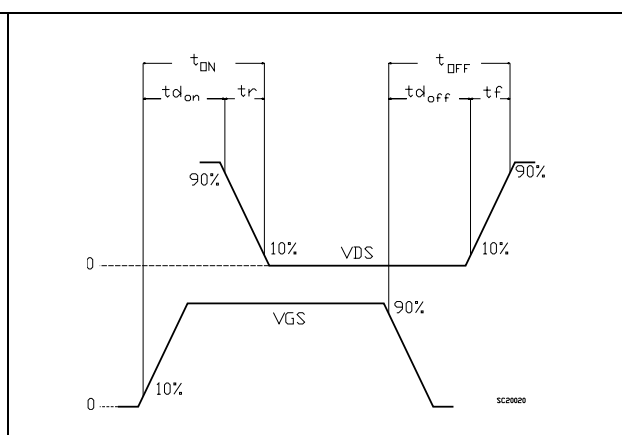


Figure 20. Switching time waveform



4 Package mechanical data

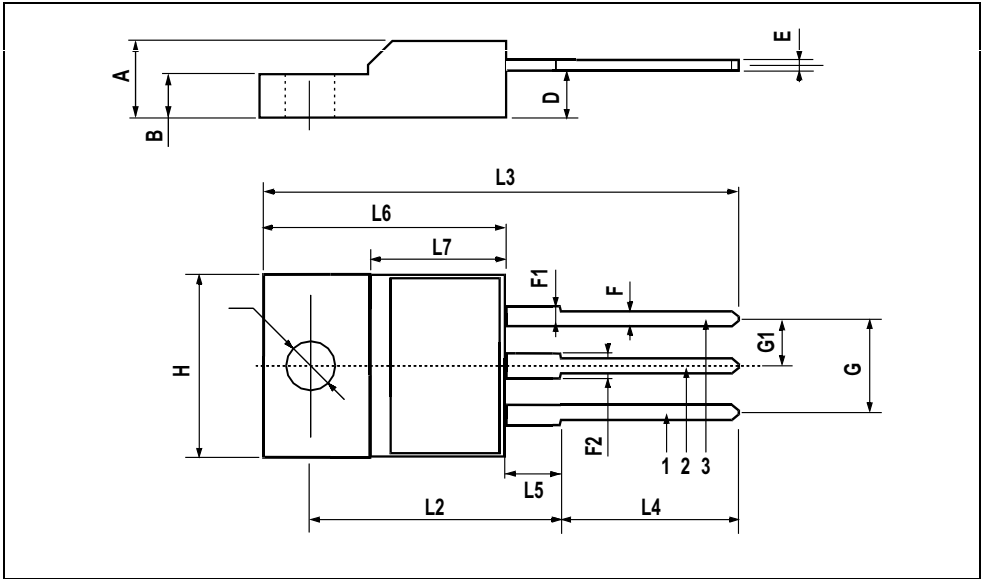
In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect . The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at : www.st.com

TO-220 MECHANICAL DATA						
DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
b	0.61		0.88	0.024		0.034
b1	1.15		1.70	0.045		0.066
c	0.49		0.70	0.019		0.027
D	15.25		15.75	0.60		0.620
E	10		10.40	0.393		0.409
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
F	1.23		1.32	0.048		0.052
H1	6.20		6.60	0.244		0.256
J1	2.40		2.72	0.094		0.107
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L20		16.40			0.645	
L30		28.90			1.137	
øP	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



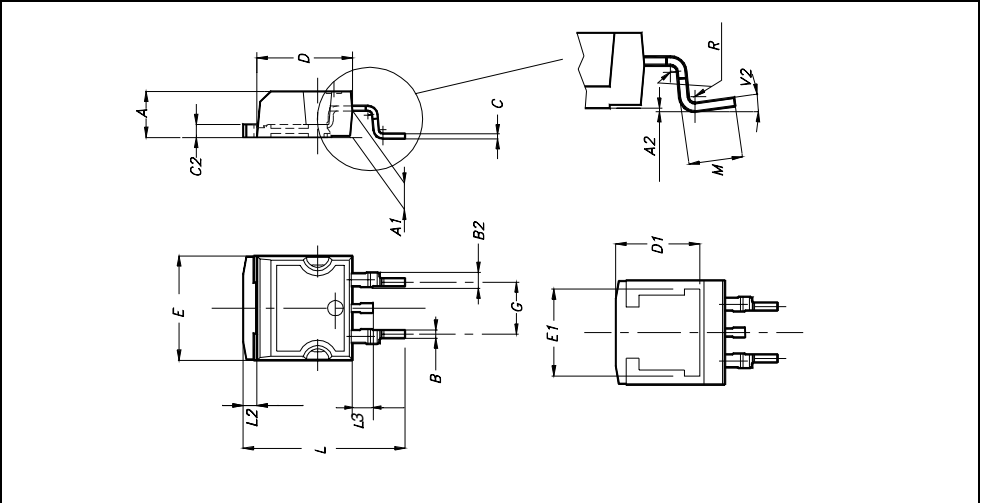
TO-220FP MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
B	2.5		2.7	0.098		0.106
D	2.5		2.75	0.098		0.108
E	0.45		0.7	0.017		0.027
F	0.75		1	0.030		0.039
F1	1.15		1.7	0.045		0.067
F2	1.15		1.7	0.045		0.067
G	4.95		5.2	0.195		0.204
G1	2.4		2.7	0.094		0.106
H	10		10.4	0.393		0.409
L2		16			0.630	
L3	28.6		30.6	1.126		1.204
L4	9.8		10.6	.0385		0.417
L5	2.9		3.6	0.114		0.141
L6	15.9		16.4	0.626		0.645
L7	9		9.3	0.354		0.366
Ø	3		3.2	0.118		0.126



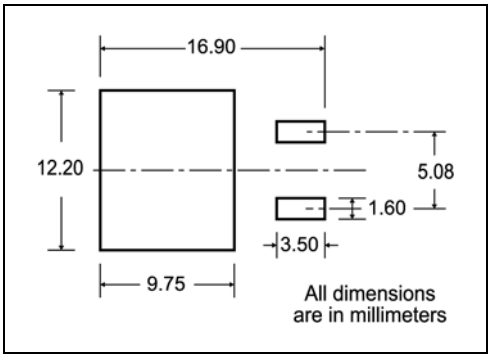
D²PAK MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
A1	2.49		2.69	0.098		0.106
A2	0.03		0.23	0.001		0.009
B	0.7		0.93	0.027		0.036
B2	1.14		1.7	0.044		0.067
C	0.45		0.6	0.017		0.023
C2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1		8			0.315	
E	10		10.4	0.393		
E1		8.5			0.334	
G	4.88		5.28	0.192		0.208
L	15		15.85	0.590		0.625
L2	1.27		1.4	0.050		0.055
L3	1.4		1.75	0.055		0.068
M	2.4		3.2	0.094		0.126
R		0.4			0.015	
V2	0°		4°			

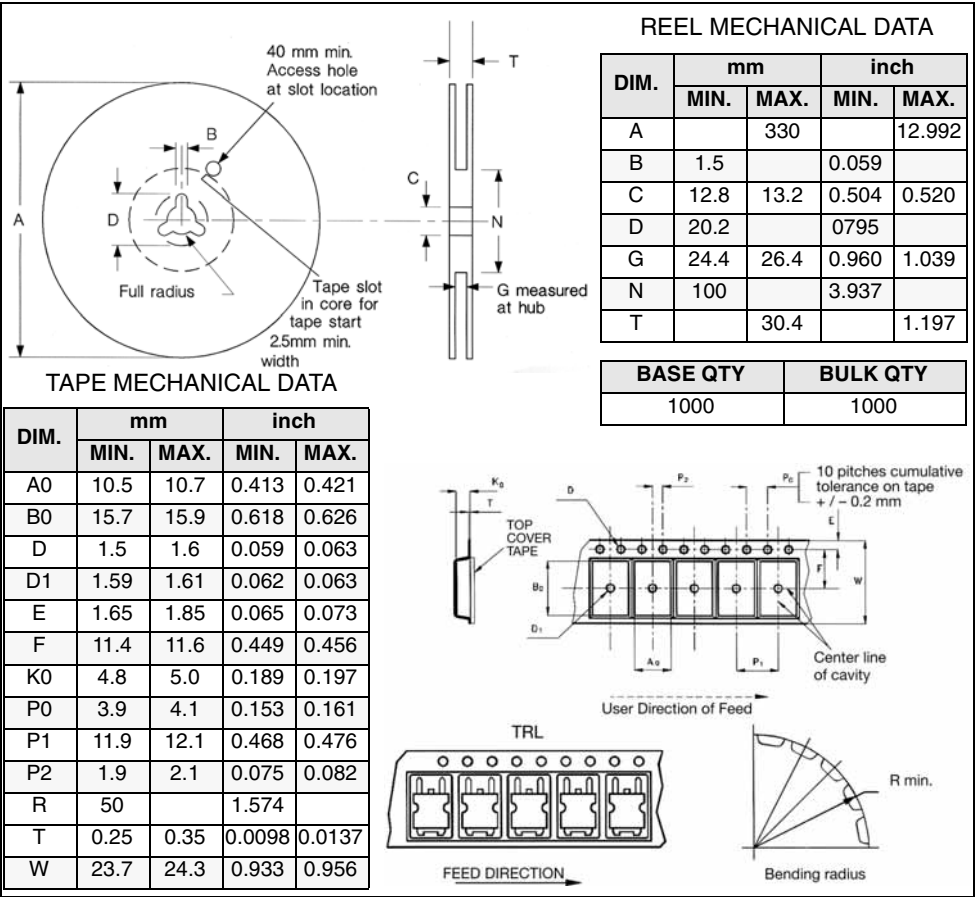


5 Packaging mechanical data

D²PAK FOOTPRINT



TAPE AND REEL SHIPMENT



* on sales type

6 Revision history

Table 7. Revision history

Date	Revision	Changes
09-Sep-2004	3	Complete document
09-Aug-2006	4	New template, no content change

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