



# STP45NF3LL - STP45NF3LLFP STB45NF3LL

N-channel 30V - 0.014Ω - 45A TO-220 - TO-220FP - D<sup>2</sup>PAK  
STripFET II™ power MOSFET

## General features

Type	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>
STB45NF3LL	30V	<0.018Ω	45A
STP45NF3LLFP	30V	<0.018Ω	45A
STP45NF3LL	30V	<0.018Ω	27A

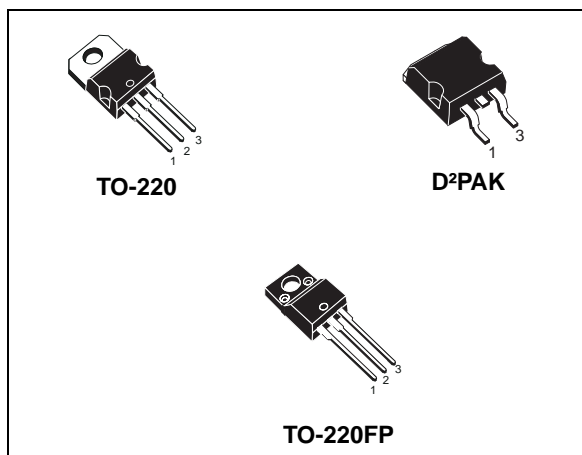
- Optimal R<sub>DS(on)</sub> x Q<sub>g</sub> trade-off @ 4.5V
- Conduction losses reduced
- Switching losses reduced

## Description

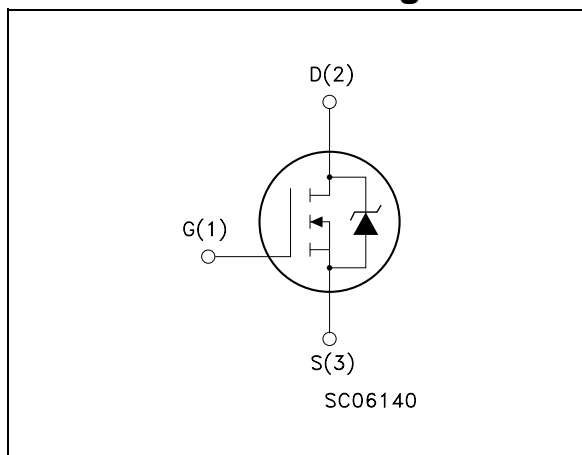
This application specific Power MOSFET is the third generation of STMicroelectronics unique "Single Feature Size™" strip-based process. The resulting transistor shows the best trade-off between on-resistance and gate charge. When used as high and low side in buck regulators, it gives the best performance 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 <sup>2</sup> PAK	Tape & reel
STB11NM60FD-1	B11NM60FD	I <sup>2</sup> PAK	Tube
STP11NM60FD	P11NM60FD	TO-220	Tube

# Contents

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# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		TO-220/ D <sup>2</sup> PAK/I <sup>2</sup> PAK	TO-220FP	
V <sub>DS</sub>	Drain-source voltage (V <sub>GS</sub> = 0)	30		V
V <sub>DGR</sub>	Drain-gate voltage (R <sub>GS</sub> = 20 kΩ)	30		V
V <sub>GS</sub>	Gate- source voltage	±16		V
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 25°C	45	27	A
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 100°C	32	19	A
I <sub>DM</sub> <sup>(1)</sup>	Drain current (pulsed)	180	108	A
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25°C	70	25	W
	Derating factor	0.46	0.167	W/°C
E <sub>AS</sub> <sup>(2)</sup>	Single pulse avalanche energy	241		mj
V <sub>ISO</sub>	Insulation withstand voltage (dc)	--	2500	V
T <sub>stg</sub>	Storage temperature	- 55 to 175		°C
T <sub>j</sub>	Max. operating junction temperature			

1. Pulse width limited by safe operating area

2. Starting T<sub>j</sub> = 25°C, I<sub>D</sub> = 22.5A, V<sub>DD</sub> = 24V

**Table 2. Thermal data**

Symbol	Parameter	Value		Unit
		TO-220 D <sup>2</sup> PAK	TO-220FP	
R <sub>thj-case</sub>	Thermal resistance junction-case Max	2.14	6	°C/W
R <sub>thj-a</sub>	Thermal resistance junction-ambient Max	62.5		°C/W
T <sub>l</sub>	Maximum lead temperature for soldering purpose	300		°C

## 2 Electrical characteristics

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

**Table 3. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source Breakdown voltage	$I_D = 250 \mu A, V_{GS} = 0$	30			V
$I_{DSS}$	Zero gate voltage Drain current ( $V_{GS} = 0$ )	$V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating}, T_C = 125^{\circ}C$			1 10	$\mu A$ $\mu A$
$I_{GSS}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 16V$			$\pm 100$	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250 \mu A$	1			V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10V, I_D = 22.5A$ $V_{GS} = 4.5V, I_D = 22.5A$		0.014 0.016	0.018 0.020	$\Omega$ $\Omega$

**Table 4. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 15V, I_D = 22.5A$		20		S
$C_{iss}$	Input capacitance	$V_{DS} = 25V, f = 1 \text{ MHz},$ $V_{GS} = 0$		800		pF
$C_{oss}$	Output capacitance			250		pF
$C_{rss}$	Reverse transfer capacitance			60		pF
$Q_g$	Total gate charge	$V_{DD} = 24V, I_D = 45A,$ $V_{GS} = 5V$		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  $\mu s$ , duty cycle 1.5 %

**Table 5. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 15V, I_D = 22.5A$ $R_G = 4.7\Omega, V_{GS} = 4.5V$ (see Figure 15)		17		ns
$t_r$	Rise time			100		ns
$t_{d(off)}$	Turn-off-delay time	$V_{DD} = 15V, I_D = 22.5A,$ $R_G = 4.7\Omega, V_{GS} = 4.5V$ (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	$I_{SD} = 45A, V_{DD} = 15V$ $di/dt = 100A/\mu s,$ <a href="#">(see Figure 17)</a>		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  $\mu s$ , duty cycle 1.5 %

## 2.1 Electrical characteristics (curves)

Figure 1. Safe operating area for TO-220/D<sup>2</sup>PAK

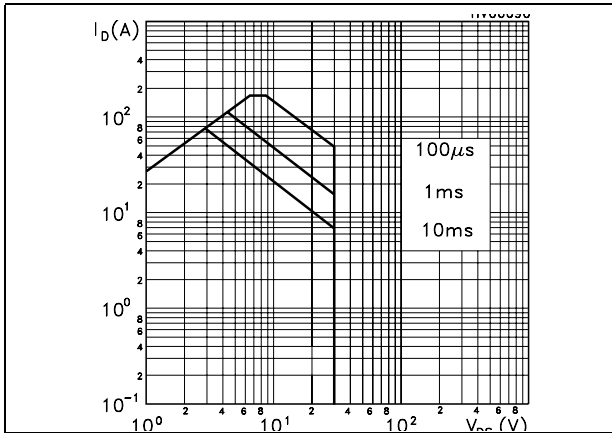


Figure 2. Thermal impedance for TO-220/D<sup>2</sup>PAK

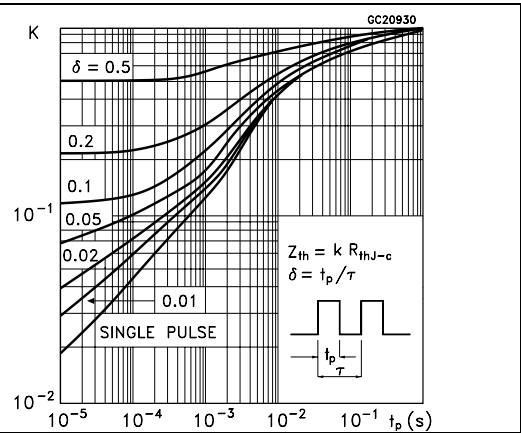


Figure 3. Safe operating area for TO-220FP

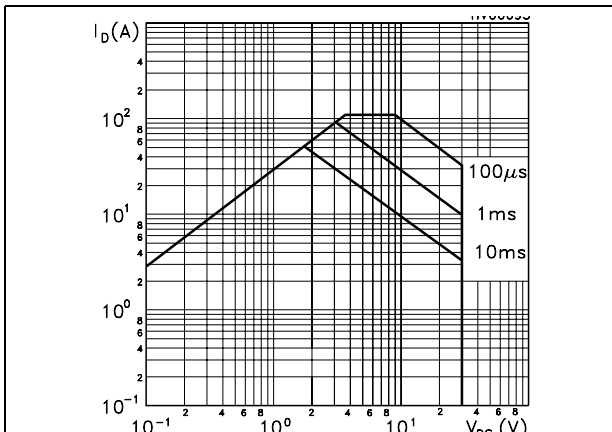


Figure 4. Thermal impedance for TO-220FP

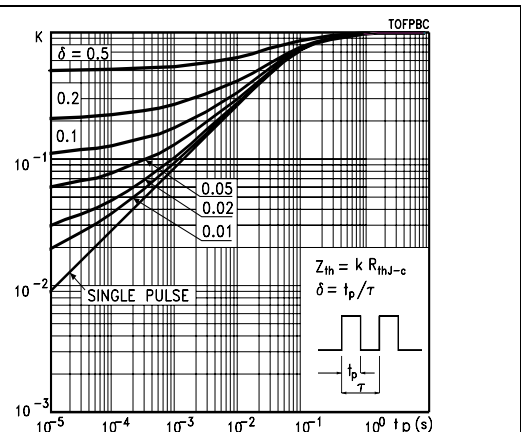


Figure 5. Output characteristics

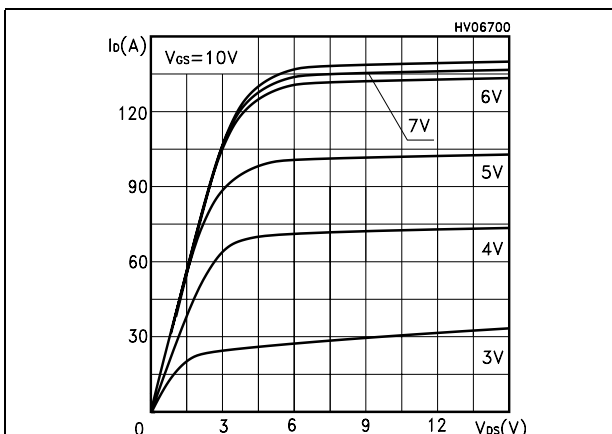


Figure 6. Transfer characteristics

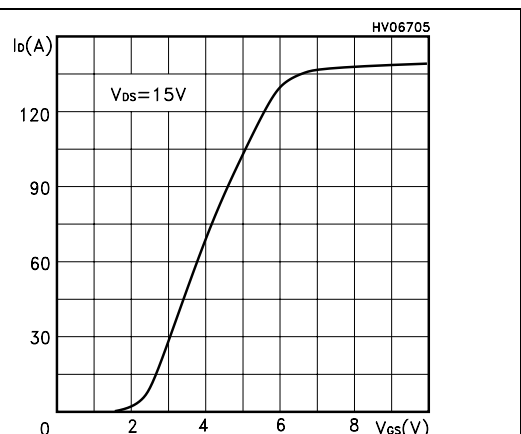


Figure 7. Transconductance

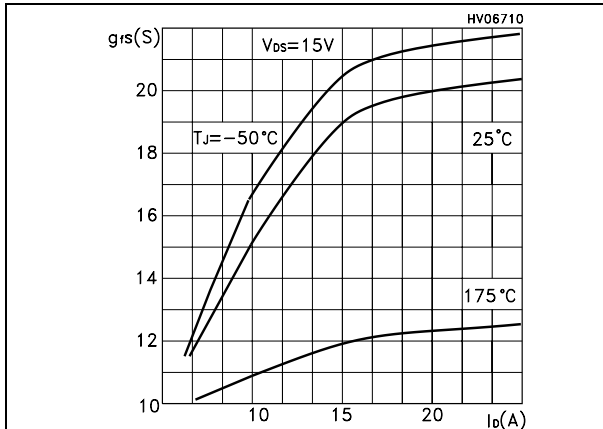


Figure 8. Static drain-source on resistance

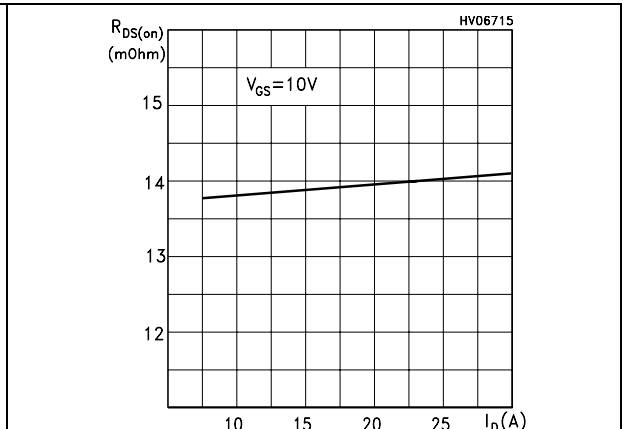


Figure 9. Gate charge vs gate-source voltage

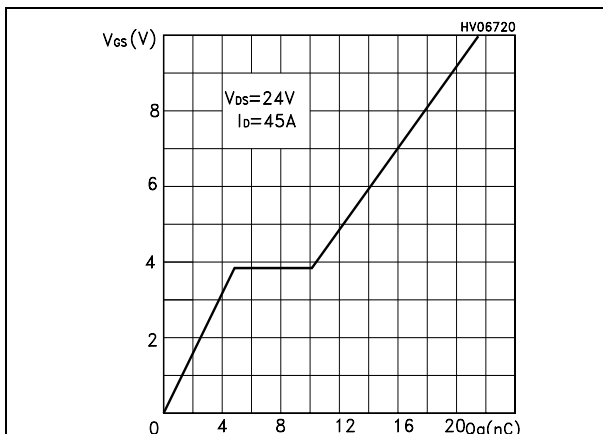


Figure 10. Capacitance variations

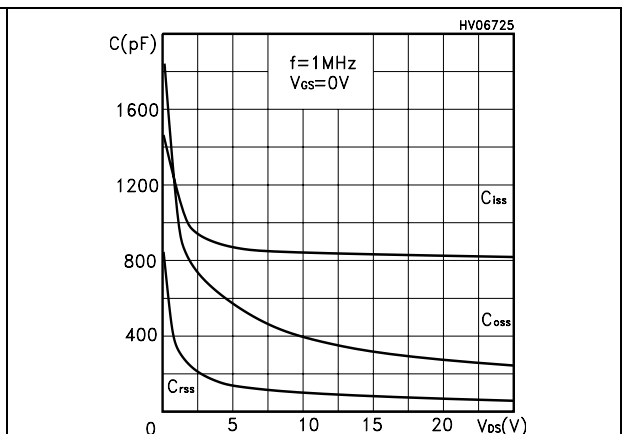


Figure 11. Normalized gate threshold voltage vs temperature

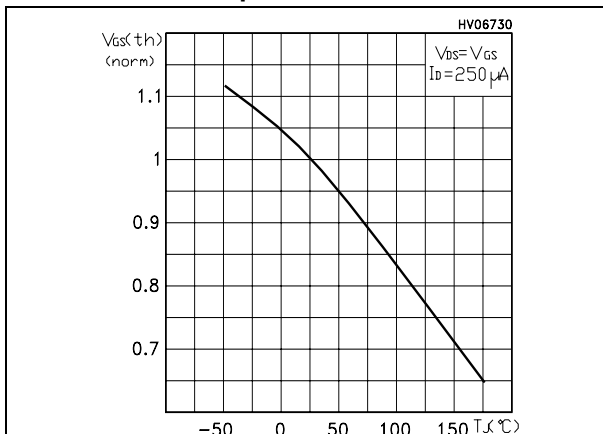


Figure 12. Normalized on resistance vs temperature

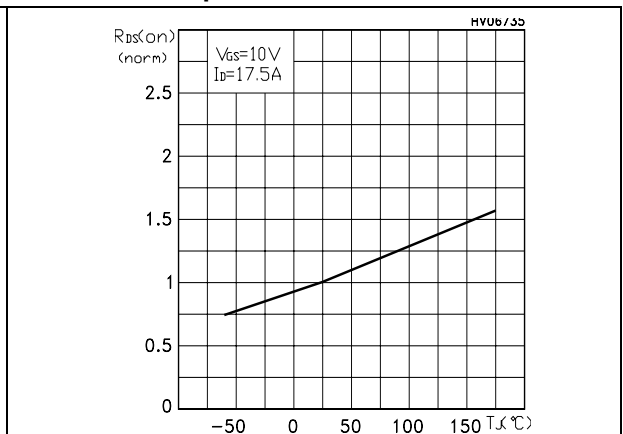


Figure 13. Source-drain diode forward characteristics

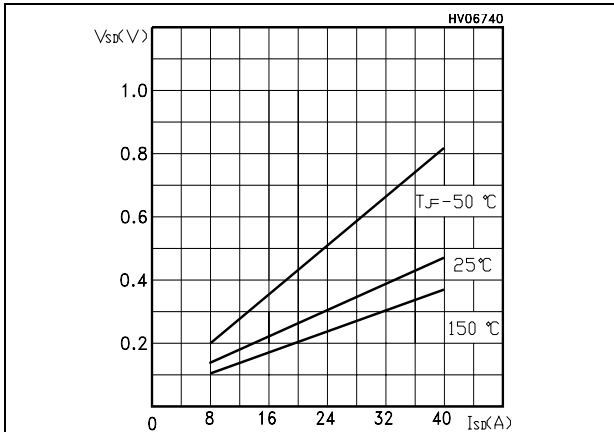
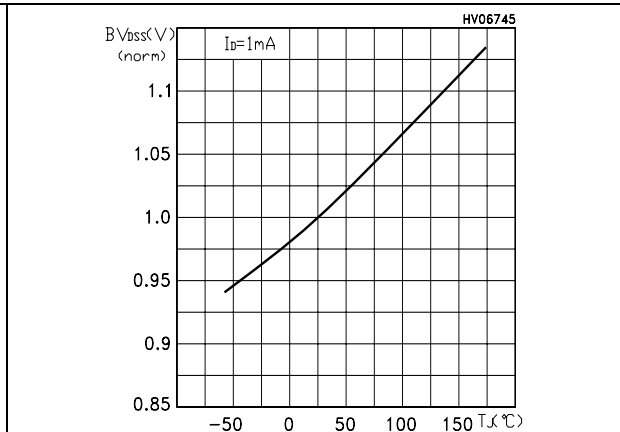


Figure 14. Normalized breakdown voltage vs  $t_j$





### 3 Test circuit

Figure 15. Switching times test circuit for resistive load

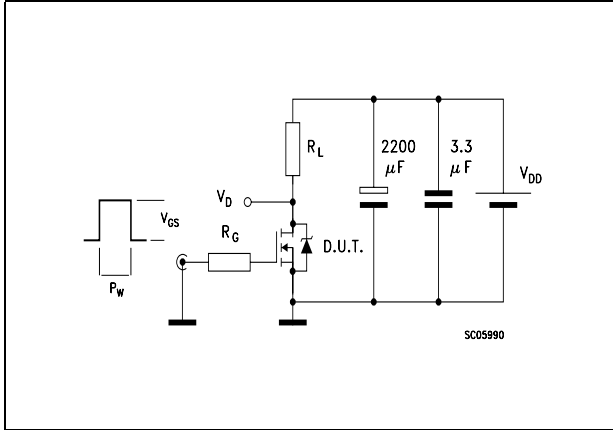


Figure 16. Gate charge test circuit

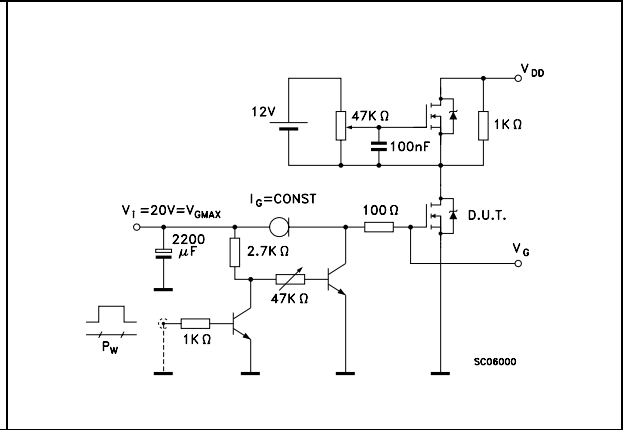


Figure 17. Test circuit for inductive load switching and diode recovery times



Figure 18. Unclamped Inductive load test circuit

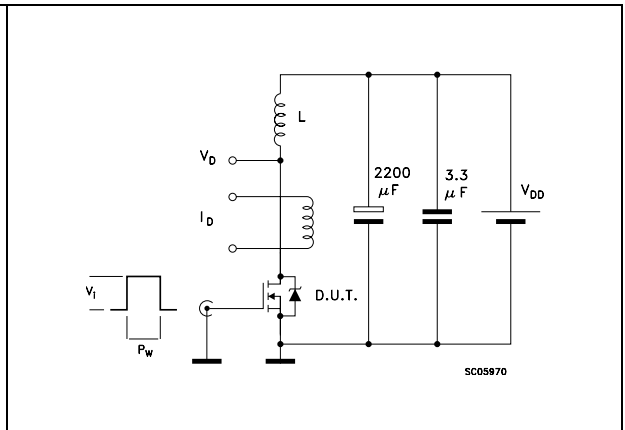
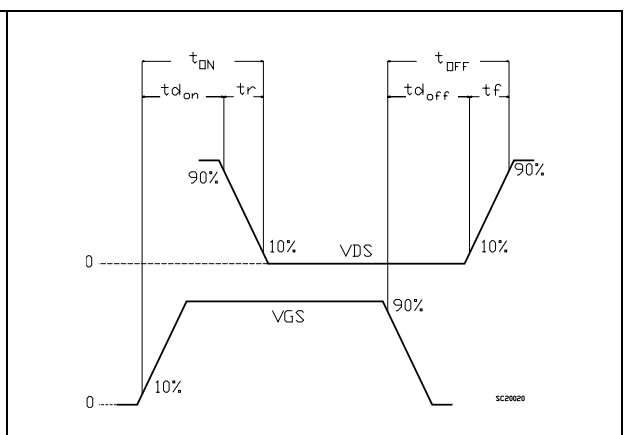


Figure 19. Unclamped inductive waveform



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](http://www.st.com)

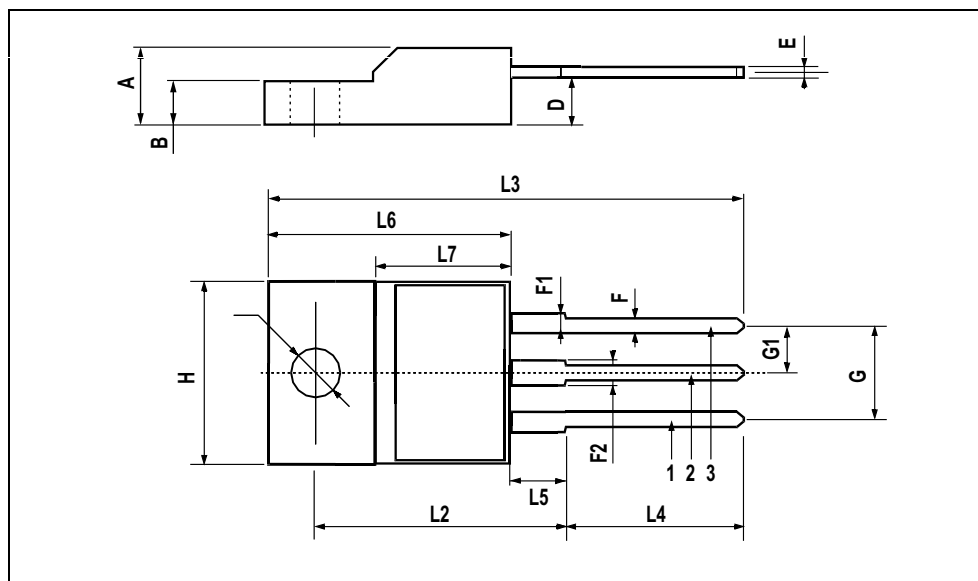
**TO-220 MECHANICAL DATA**

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



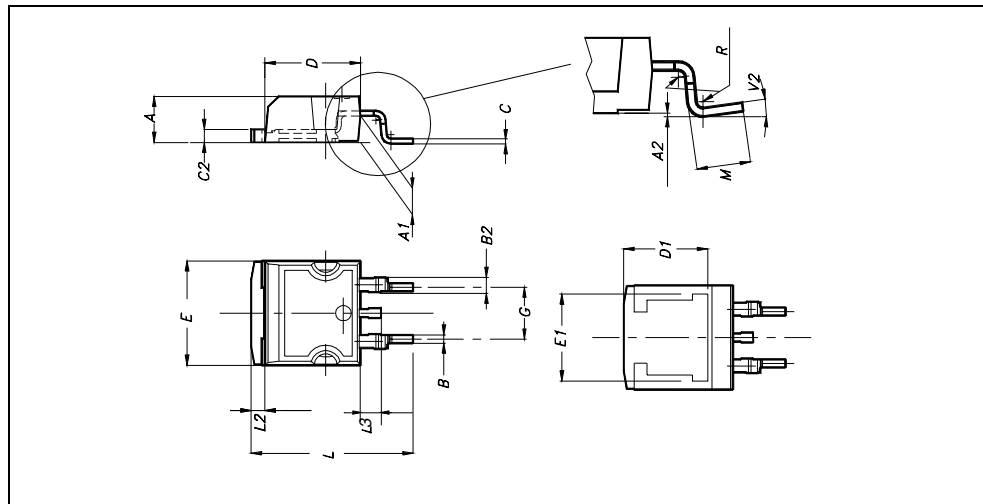
**TO-220FP MECHANICAL DATA**

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



D<sup>2</sup>PAK 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

## D<sup>2</sup>PAK 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

\* 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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