



# STB60NF06L STP60NF06L - STP60NF06LFP

N-channel 60V - 0.012Ω - 60A - TO-220/D<sup>2</sup>PAK/TO-220FP  
STripFET™ II Power MOSFET

## General features

Type	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>
STB60NF06L	60V	<0.014Ω	60
STP60NF06L	60V	<0.014Ω	60A
STP60NF06LFP	60V	<0.014Ω	60A <sup>(1)</sup>

1. Refer to SOA for the max allowable current values on FP-type due to R<sub>th</sub> value

- Exceptional dv/dt capability
- 100% avalanche tested
- Application oriented characterization
- 175°C operating range
- Low threshold drive

## Description

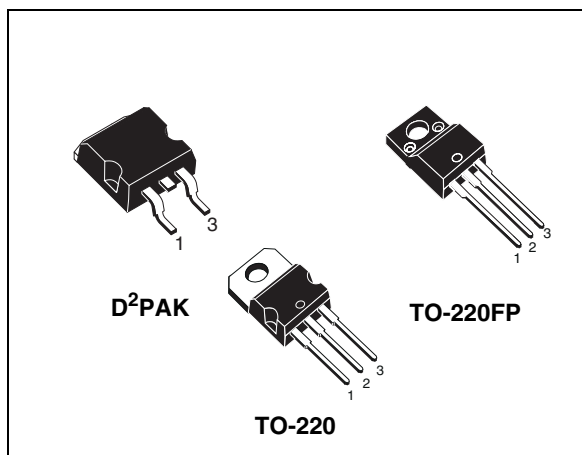
This Power MOSFET series realized with STMicroelectronics unique STripFET process has specifically been designed to minimize input capacitance and gate charge. It is therefore suitable as primary switch in advanced high-efficiency isolated DC-DC converters for Telecom and Computer application. It is also intended for any application with low gate charge drive requirements.

## Applications

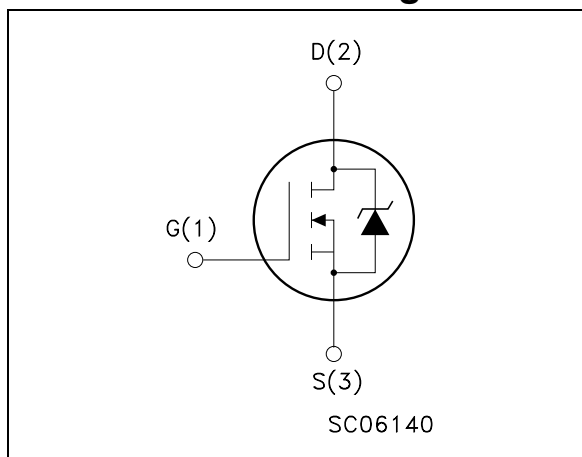
- Switching application

## Order codes

Part number	Marking	Package	Packaging
STB60NF06LT4	B60NF06L	D <sup>2</sup> PAK	Tape & reel
STP60NF06L	P60NF06L	TO-220	Tube
STP60NF06LFP	P60NF06LFP	TO-220FP	Tube



## Internal schematic diagram



# Contents

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# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		D <sup>2</sup> PAK TO-220	TO-220FP	
V <sub>DS</sub>	Drain-source voltage (V <sub>GS</sub> = 0)	60		V
V <sub>DGR</sub>	Drain-gate voltage (R <sub>GS</sub> = 20 kΩ)	60		V
V <sub>GS</sub>	Gate- source voltage	± 15		V
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 25°C	60	60 <sup>(1)</sup>	A
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 100°C	42	42 <sup>(1)</sup>	A
I <sub>DM</sub> <sup>(2)</sup>	Drain current (pulsed)	240	240 <sup>(1)</sup>	A
P <sub>tot</sub>	Total dissipation at T <sub>C</sub> = 25°C	110	30	W
	Derating Factor	0.73	0.2	W/°C
dv/dt <sup>(3)</sup>	Peak diode recovery voltage slope	20		V/ns
E <sub>AS</sub> <sup>(4)</sup>	Single pulse avalanche energy	320		mJ
V <sub>ISO</sub>	Insulation withstand voltage (DC)	--	2000	V
T <sub>stg</sub>	Storage temperature	-65 to 175		°C
T <sub>j</sub>	Max. operating junction temperature			

1. Refer to SOA for the max allowable current values on FP-type due to R<sub>th</sub> value
2. Pulse width limited by safe operating area.
3. I<sub>SD</sub> ≤ 60A, di/dt ≤ 600A/μs, V<sub>DD</sub> ≤ 48V, T<sub>j</sub> ≤ T<sub>JMAX</sub>
4. Starting T<sub>j</sub> = 25 °C, I<sub>D</sub> = 30A, V<sub>DD</sub> = 30V

**Table 2. Thermal data**

			D <sup>2</sup> PAK TO-220	TO-220FP	
R <sub>thj-case</sub>	Thermal resistance junction-case	Max	1.36	5.0	°C/W
R <sub>thj-amb</sub>	Thermal resistance junction-ambient	Max	62.5		°C/W
R <sub>thj-pcb</sub>	Thermal resistance junction-pcb <sup>(1)</sup>	Max	35		°C/W
T <sub>l</sub>	Maximum lead temperature for soldering purpose		300		°C

1. Only for SMD, When mounted on 1 inch<sup>2</sup> FR-4 board, 2 oz of Cu.

## 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	$I_D = 250\mu A, V_{GS} = 0$	60			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 ( $V_{DS} = 0$ )	$V_{GS} = \pm 15V$			$\pm 100$	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	$V_{GS} = 5V, I_D = 30A$ $V_{GS} = 10V, I_D = 30A$		0.014 0.012	0.016 0.014	$\Omega$ $\Omega$

**Table 4. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 15V, I_D = 30A$		20		S
$C_{iss}$	Input capacitance	$V_{DS} = 25V, f = 1MHz,$ $V_{GS} = 0$		2000		pF
$C_{oss}$	Output capacitance			360		pF
$C_{rss}$	Reverse transfer capacitance			125		pF
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 30V, I_D = 30A$ $R_G = 4.7\Omega, V_{GS} = 4.5V$ (see <a href="#">Figure 15</a> )		35		ns
$t_r$	Rise time			220		ns
$t_{d(off)}$	Turn-off delay time			55		ns
$t_f$	Fall time			30		ns
$Q_g$	Total gate charge	$V_{DD} = 48V, I_D = 60A,$ $V_{GS} = 4.5V, R_G = 4.7\Omega$ (see <a href="#">Figure 16</a> )		35	66	nC
$Q_{gs}$	Gate-source charge			10		nC
$Q_{gd}$	Gate-drain charge			20		nC

1. Pulsed: Pulse duration = 300  $\mu s$ , duty cycle 1.5 %.

**Table 5. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$ $I_{SDM}^{(1)}$	Source-drain current Source-drain current (pulsed)				60 240	A A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 60A, V_{GS} = 0$			1.3	V
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_{SD} = 60A, di/dt = 100A/\mu s,$ $V_{DD} = 30V, T_j = 150^\circ C$ (see <a href="#">Figure 17</a> )		110 250 4.5		ns nC 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

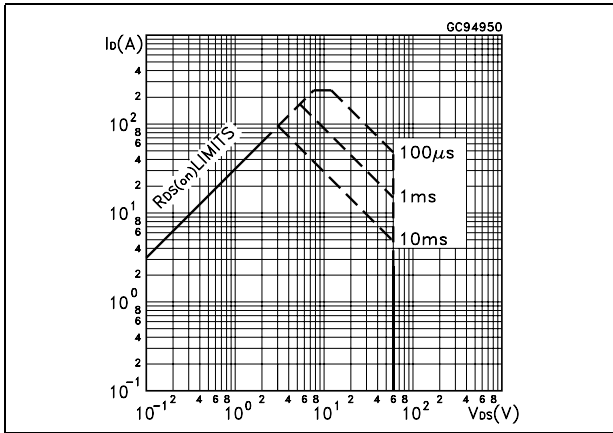


Figure 2. Thermal impedance

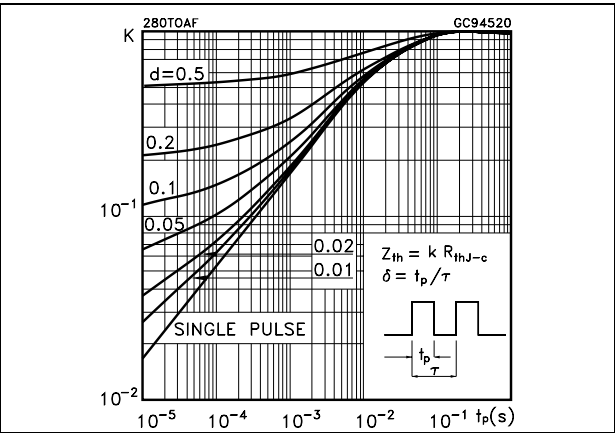


Figure 3. Safe operating area for TO-220FP

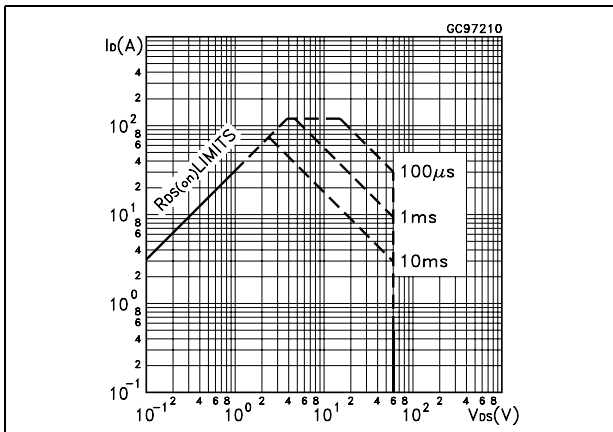


Figure 4. Thermal impedance for TO-220FP

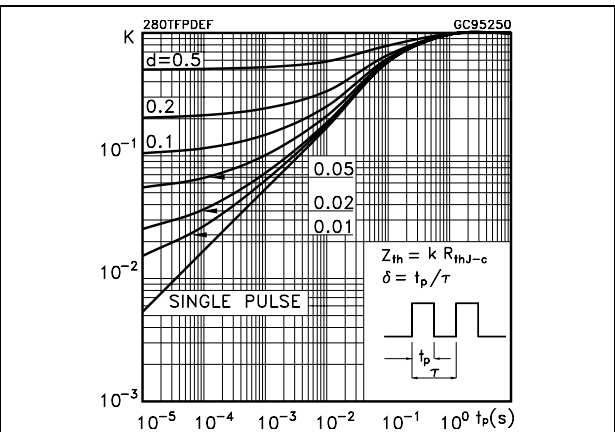


Figure 5. Output characteristics

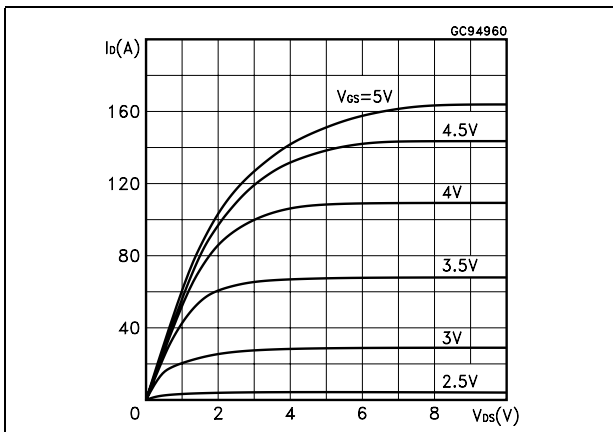


Figure 6. Transfer characteristics

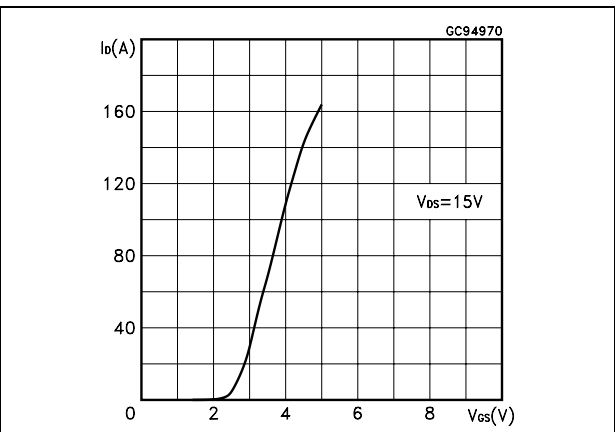


Figure 7. Transconductance

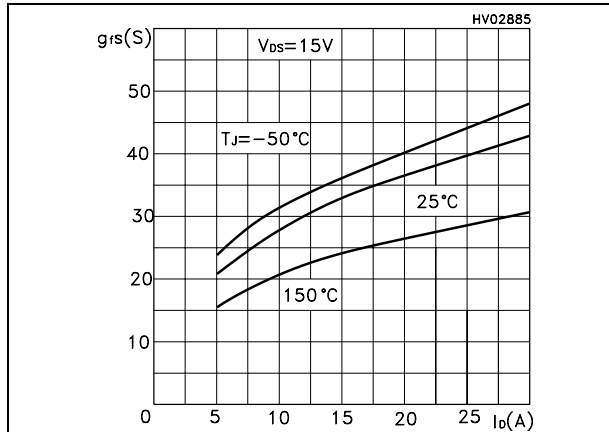


Figure 8. Static drain-source on resistance

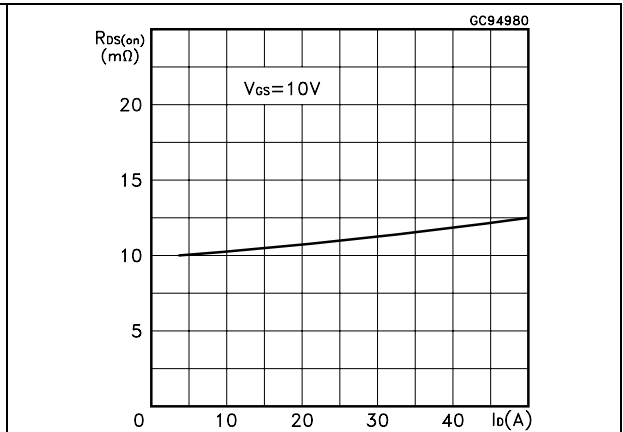


Figure 9. Gate charge vs gate-source voltage Figure 10. Capacitance variations

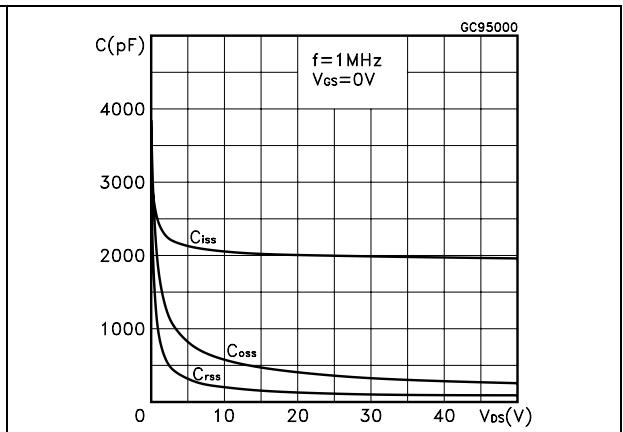
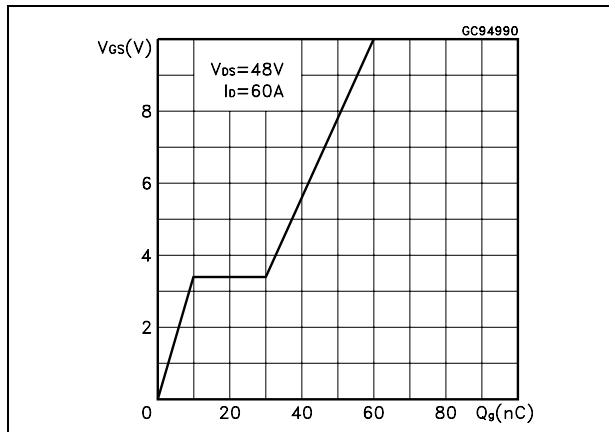


Figure 11. Normalized gate threshold voltage vs temperature

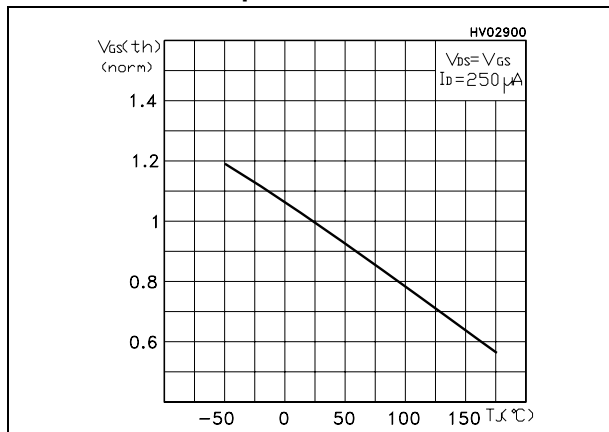


Figure 12. Normalized on resistance vs temperature

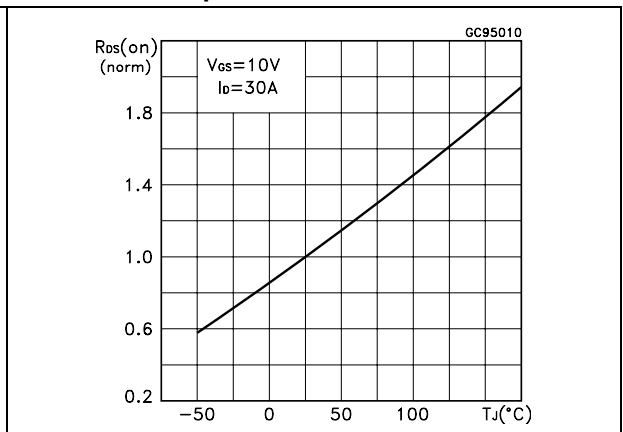


Figure 13. Source-drain diode forward characteristics

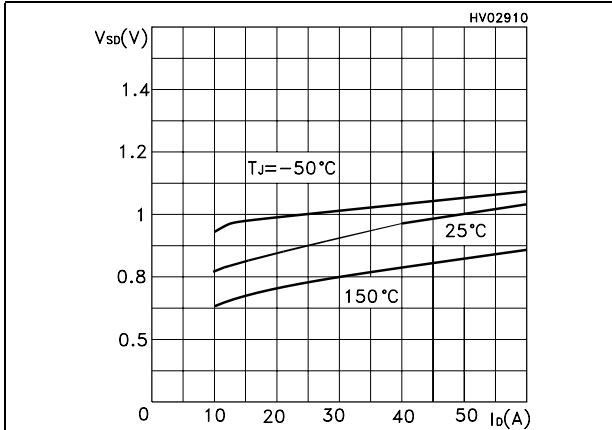
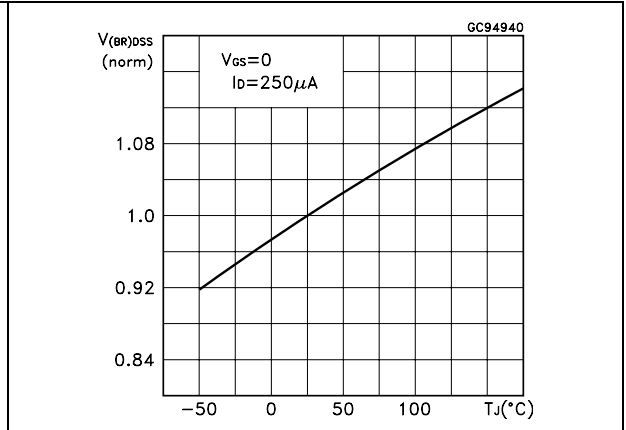


Figure 14. Normalized breakdown voltage temperature





### 3 Test circuit

Figure 15. Switching times test circuit for resistive load

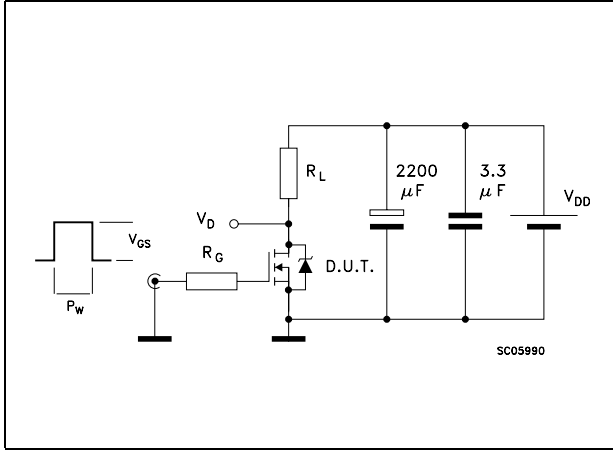


Figure 16. Gate charge test circuit

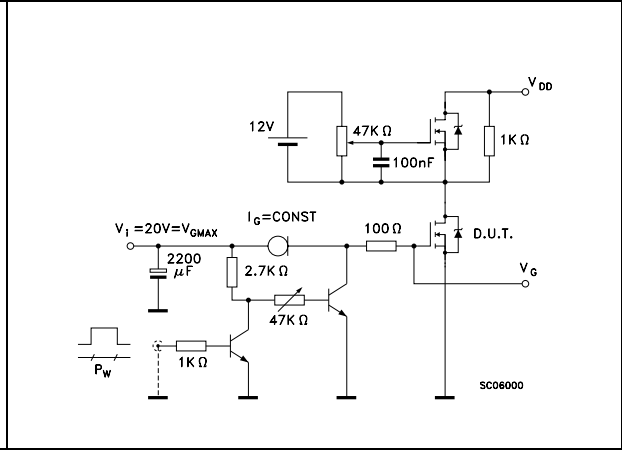


Figure 17. Test circuit for inductive load switching and diode recovery times



Figure 18. Unclamped Inductive load test circuit

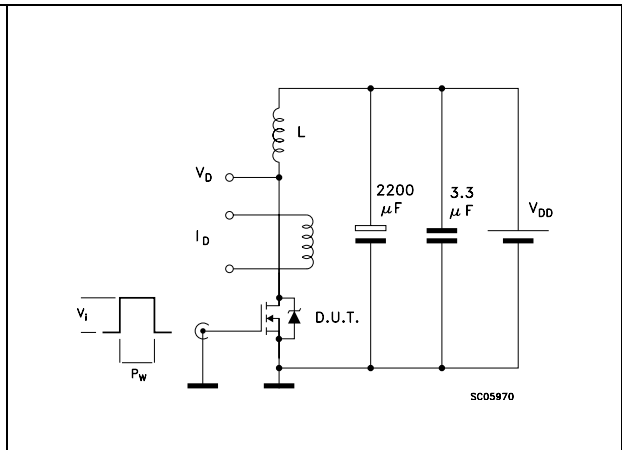


Figure 19. Unclamped inductive waveform

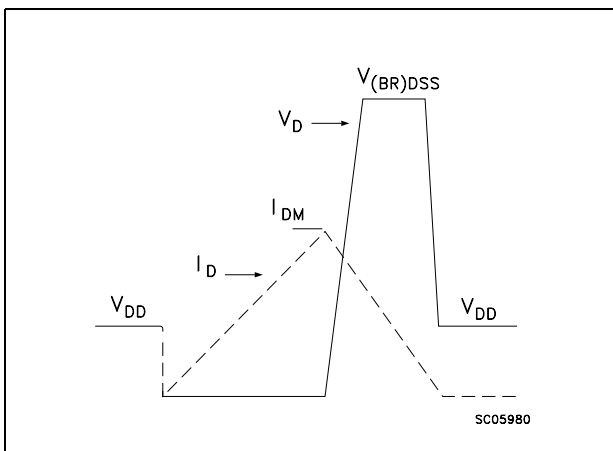
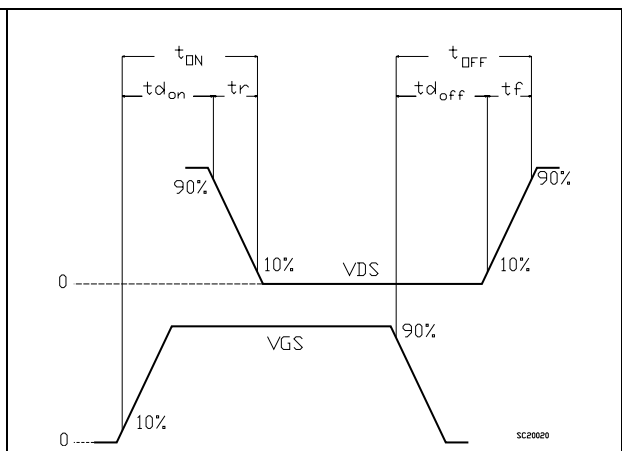


Figure 20. Switching time waveform

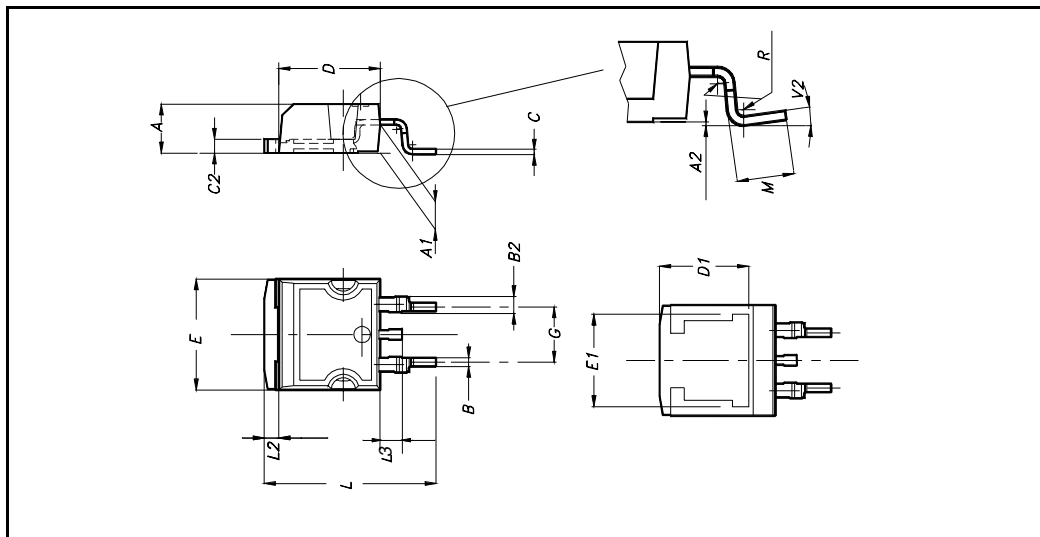


## 4 Package mechanical data

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)

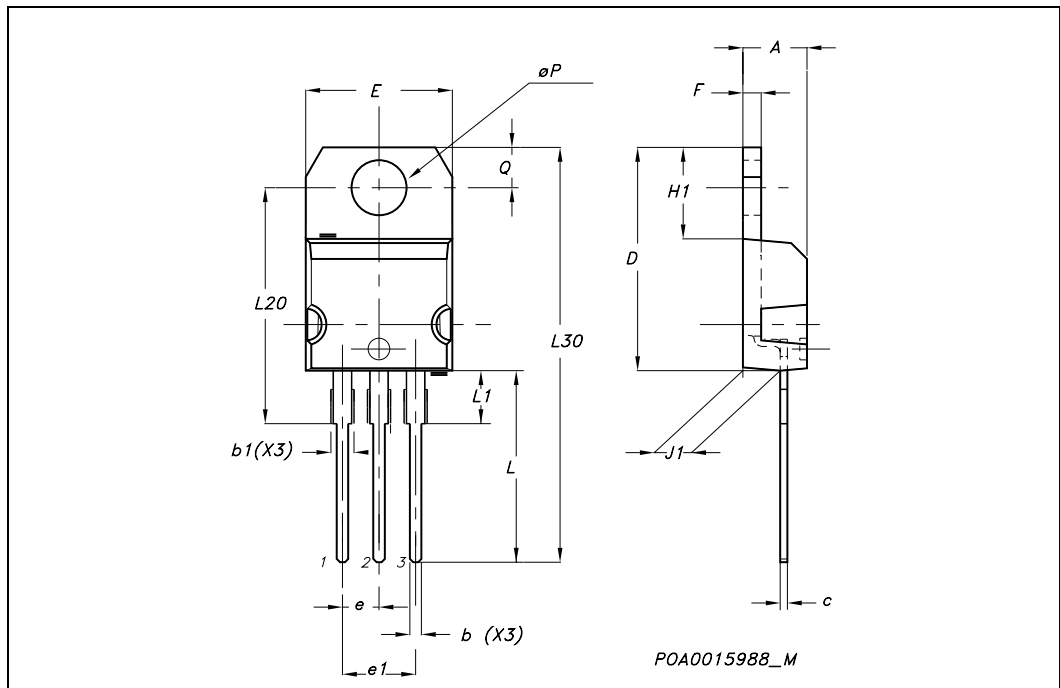
D<sup>2</sup>PAK MECHANICAL DATA

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°			



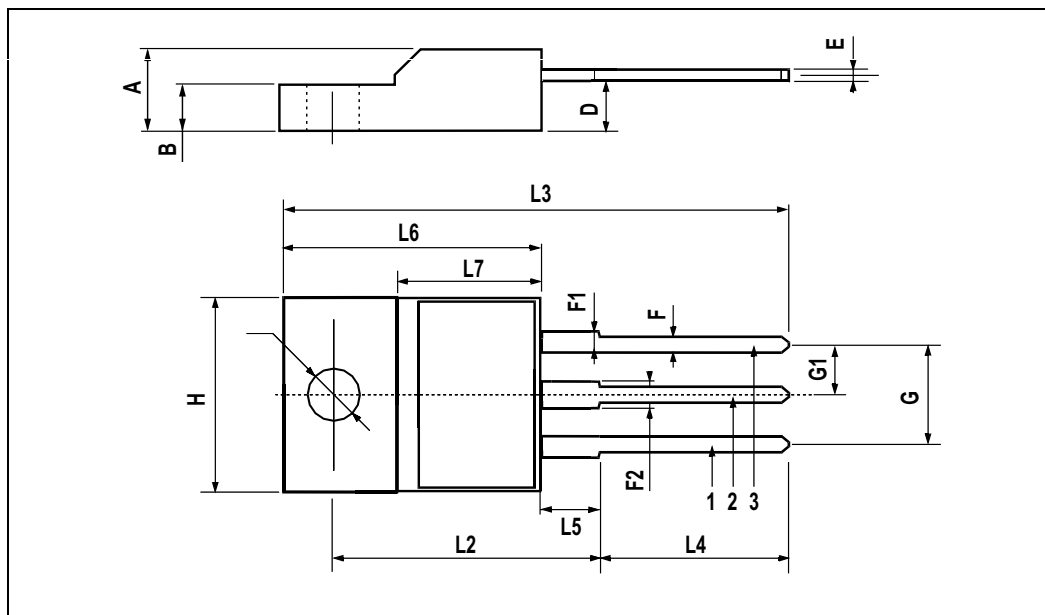
**TO-220 MECHANICAL DATA**

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



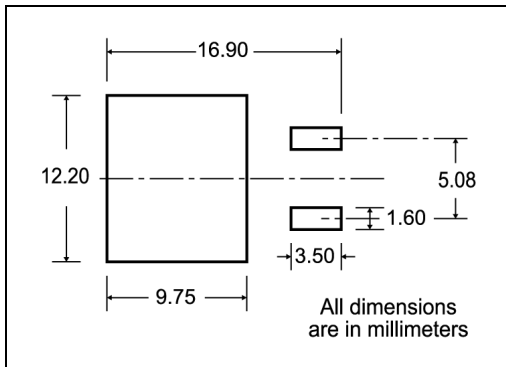
## TO-220FP MECHANICAL DATA

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



# 5 Packing 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

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

Feeding radius

\* on sales type

## 6 Revision history

**Table 6. Revision history**

<b>Date</b>	<b>Revision</b>	<b>Changes</b>
21-Jun-2004	2	Complete version
26-Jun-2006	3	New template, no content change

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