



# STB20NF06L - STF20NF06L STP20NF06L

N-channel 60V - 0.06Ω - 20A - D<sup>2</sup>PAK/TO-220/TO-220FP  
STripFET™ II Power MOSFET

## General features

Type	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>
STB20NF06L	60V	<0.07Ω	20A
STF20NF06L	60V	<0.07Ω	20A <sup>(1)</sup>
STP20NF06L	60V	<0.07Ω	20A

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

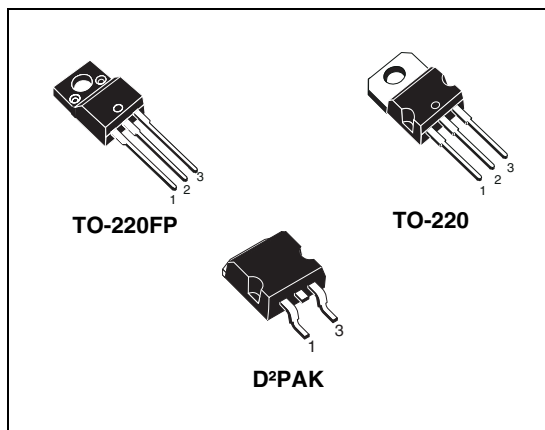
- Avalanche rugged technology
- 100% avalanche tested
- 175°C operating temperature
- High dv/dt capability
- application oriented characterization

## Description

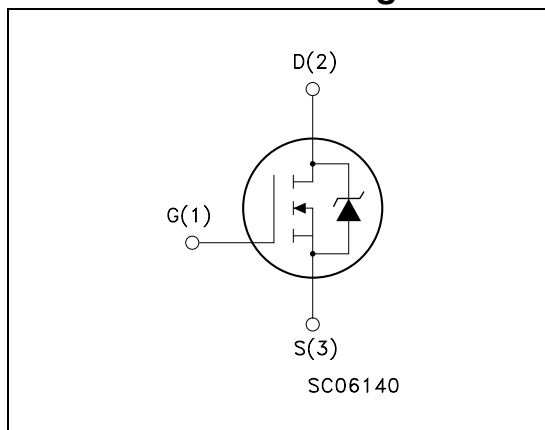
This Power MOSFET is the latest development of STMicroelectronics unique "single feature size"<sup>®</sup> strip-based process. The resulting transistor shows extremely high packing density for low on-resistance, rugged avalanche characteristics and less critical alignment steps therefore a remarkable manufacturing reproducibility.

## Applications

- Switching application



## Internal schematic diagram



## Order codes

Part number	Marking	Package	Packaging
STB20NF06LT4	B20NF06L	D <sup>2</sup> PAK	Tape & reel
STF20NF06L	F20NF06L	TO-220FP	Tube
STP20NF06L	P20NF06L	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	TO-220FP	
$V_{DS}$	Drain-source voltage ( $V_{GS} = 0$ )	60		V
$V_{GS}$	Gate- source voltage	$\pm 18$		V
$I_D$	Drain current (continuous) at $T_C = 25^\circ\text{C}$	20	20 <sup>(1)</sup>	A
$I_D$	Drain current (continuous) at $T_C = 100^\circ\text{C}$	14	14 <sup>(1)</sup>	A
$I_{DM}^{(2)}$	Drain current (pulsed)	80	80 <sup>(1)</sup>	A
$P_{tot}$	Total dissipation at $T_C = 25^\circ\text{C}$	60	28	W
	Derating Factor	0.4	0.18	W/ $^\circ\text{C}$
$dv/dt^{(3)}$	Peak diode recovery voltage slope	9		V/ns
$E_{AS}^{(4)}$	Single pulse avalanche energy	120		mJ
$T_{stg}$	Storage temperature	-55 to 175		$^\circ\text{C}$
$T_j$	Max. operating junction temperature			

1. Refer to SOA for the max allowable current value on FP-type due to  $R_{th}$  value

2. Pulse width limited by safe operating area.

3.  $I_{SD} \leq 20\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  $T_j \leq T_{JMAX}$

4. Starting  $T_j = 25^\circ\text{C}$ ,  $I_D = 10\text{A}$ ,  $V_{DD} = 30\text{V}$

**Table 2. Thermal data**

Symbol	Parameter	TO-220/D <sup>2</sup> PAK	TO-220FP	Unit
$R_{thj-case}$	Thermal resistance junction-case max	2.5	5.35	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max	62.5		$^\circ\text{C}/\text{W}$
$T_l$	Maximum lead temperature for soldering purpose (for 10sec. 1.6mm from case)	300		$^\circ\text{C}/\text{W}$

## 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 ( $V_{GS} = 0$ )	$V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating, @ } 125^{\circ}C$			1 10	$\mu A$ $\mu A$
$I_{GSS}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 18V$			$\pm 100$	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250\mu A$	2	3	4	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10V, I_D = 10A$ $V_{GS} = 5V, I_D = 10A$		0.060 0.075	0.070 0.085	$\Omega$ $\Omega$

**Table 4. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 15V, I_D = 8A$		10		S
$C_{iss}$	Input capacitance	$V_{DS} = 25V, f = 1MHz,$ $V_{GS} = 0$		400		pF
$C_{oss}$	Output capacitance			100		pF
$C_{rss}$	Reverse transfer capacitance			40		pF
$Q_g$	Total gate charge	$V_{DD} = 30V, I_D = 20A,$ $V_{GS} = 10V$ (see <a href="#">Figure 16</a> )		7.5		nC
$Q_{gs}$	Gate-source charge			2.5		nC
$Q_{gd}$	Gate-drain charge			4.2		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	$V_{DD} = 30V, I_D = 10A$ $R_G = 4.7\Omega, V_{GS} = 10V$ (see <a href="#">Figure 15</a> )		12		ns
$t_r$	Rise time			30		ns
$t_{d(off)}$	Turn-off delay time			20		ns
$t_f$	Fall time			6		ns

**Table 6. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current				20	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				80	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 20A, V_{GS} = 0$			1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 20A, di/dt = 100A/\mu s,$ $V_{DD} = 20V, T_j = 150^\circ C$ (see <a href="#">Figure 17</a> )		50		ns
$Q_{rr}$	Reverse recovery charge			65		nC
$I_{RRM}$	Reverse recovery current			3		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

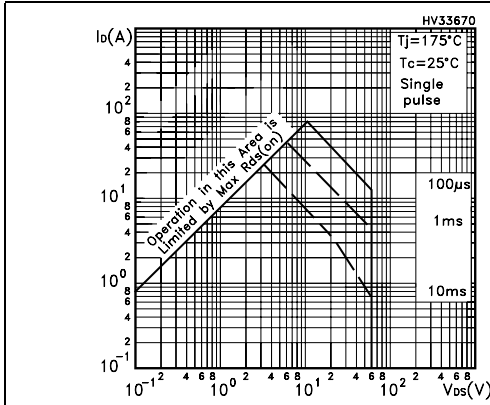


Figure 2. Thermal impedance for TO-220/ D<sup>2</sup>PAK

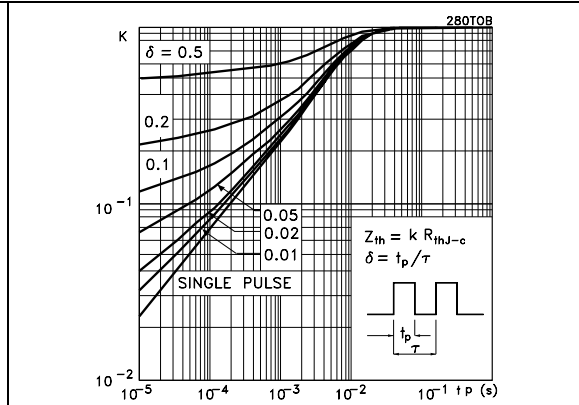


Figure 3. Safe operating area for TO-220FP

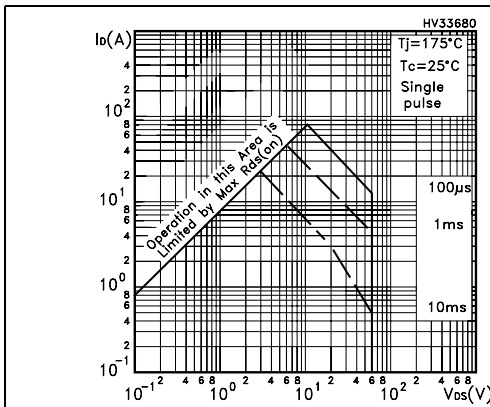


Figure 4. Thermal impedance for TO-220FP

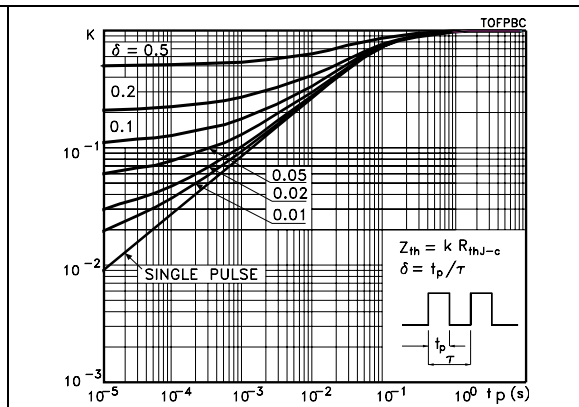


Figure 5. Output characteristics

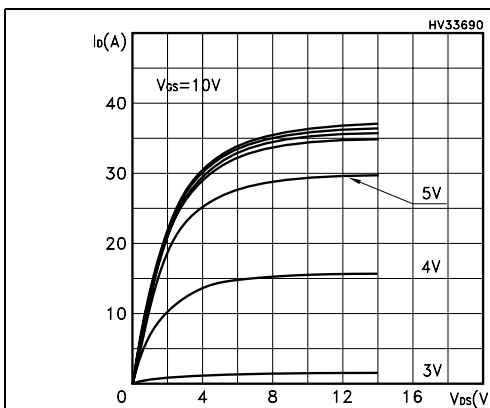


Figure 6. Transfer characteristics

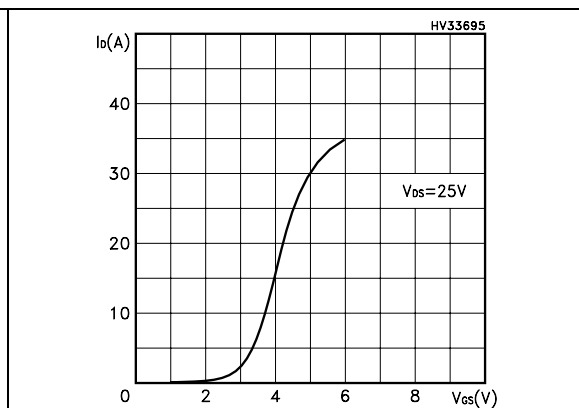


Figure 7. Transconductance

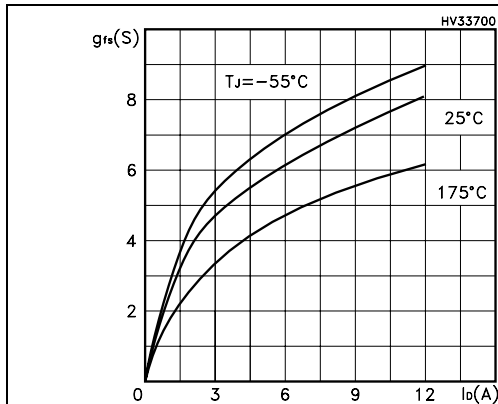


Figure 8. Static drain-source on resistance

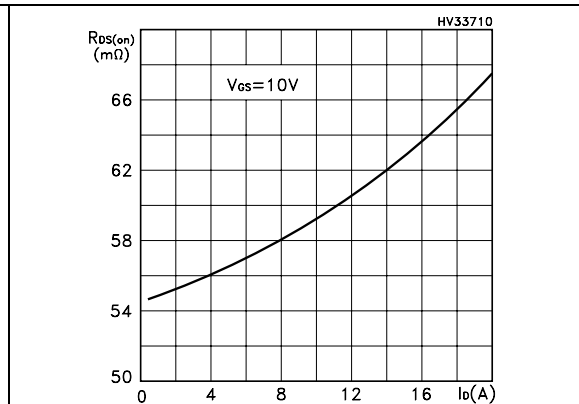


Figure 9. Gate charge vs gate-source voltage Figure 10. Capacitance variations

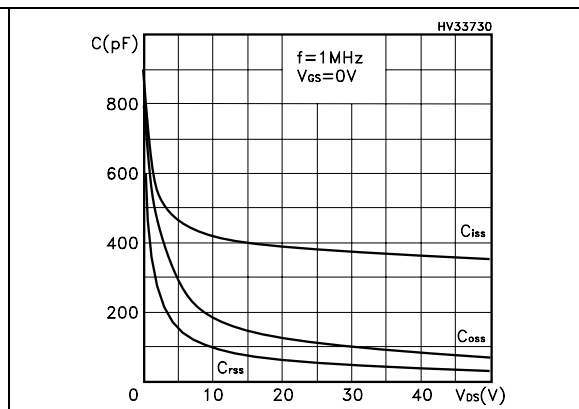
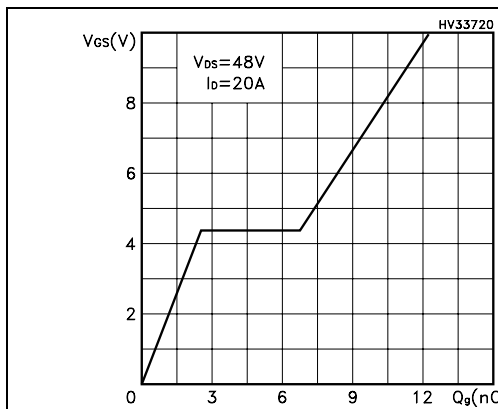


Figure 11. Normalized gate threshold voltage vs temperature

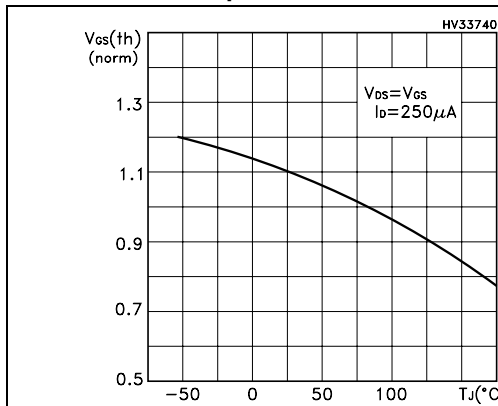


Figure 12. Normalized on resistance vs temperature

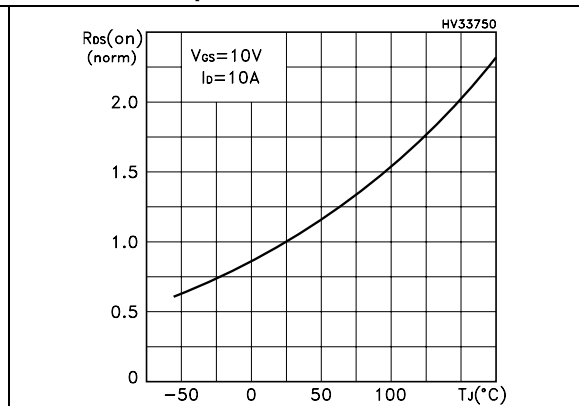


Figure 13. Source-drain diode forward characteristics

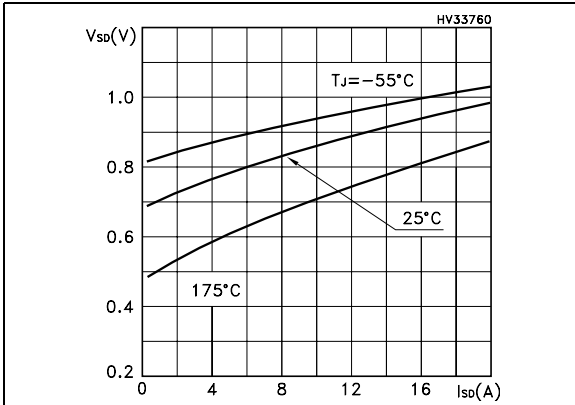
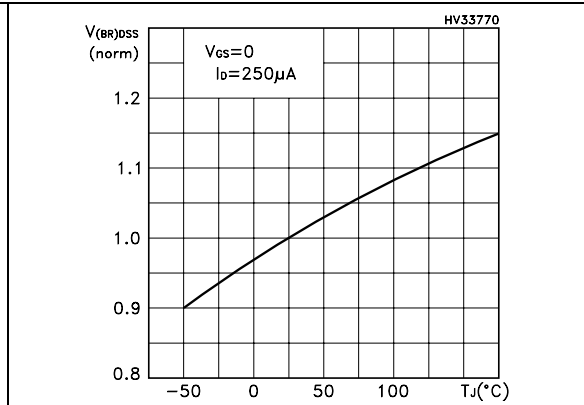


Figure 14. Normalized breakdown voltage temperature





### 3 Test circuit

Figure 15. Switching times test circuit for resistive load

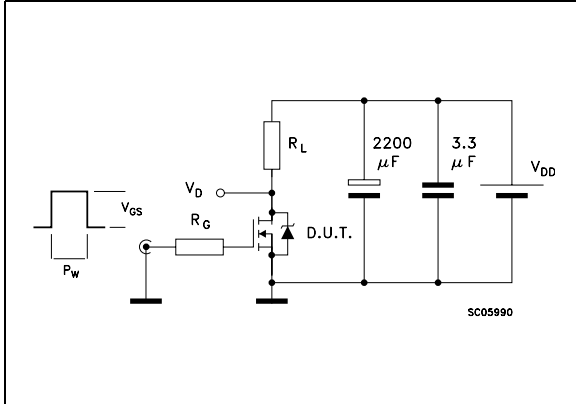


Figure 16. Gate charge test circuit

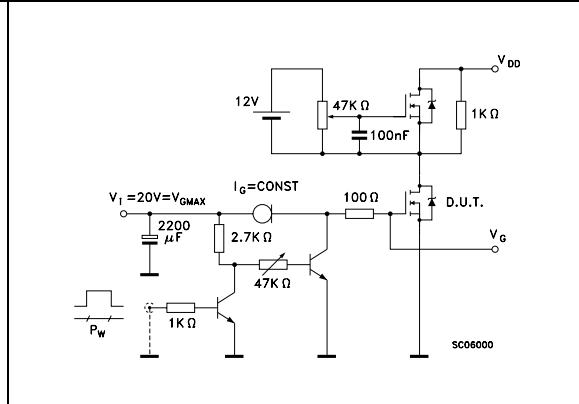


Figure 17. Test circuit for inductive load switching and diode recovery times

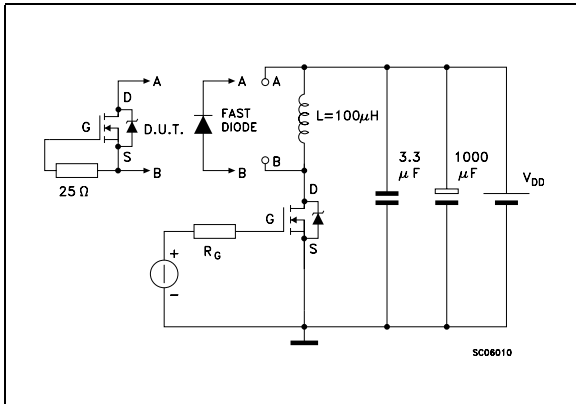


Figure 18. Unclamped Inductive load test circuit

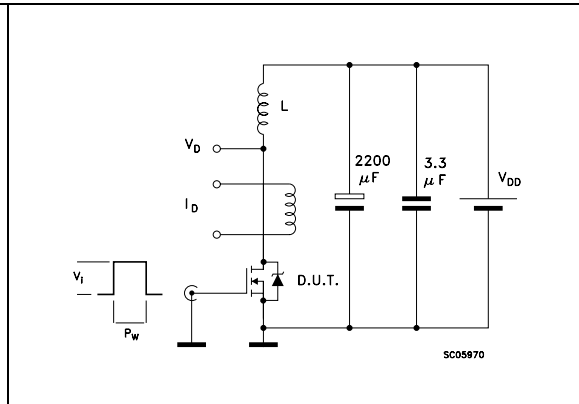


Figure 19. Unclamped inductive waveform

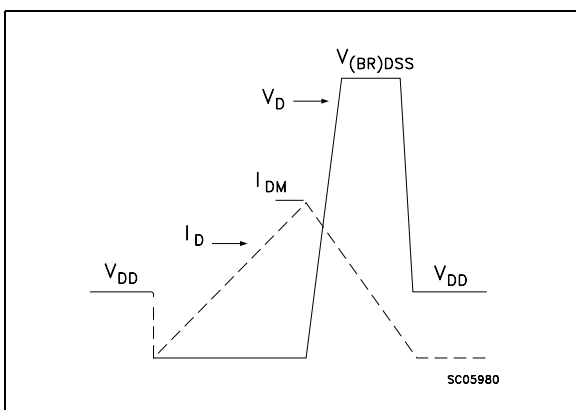
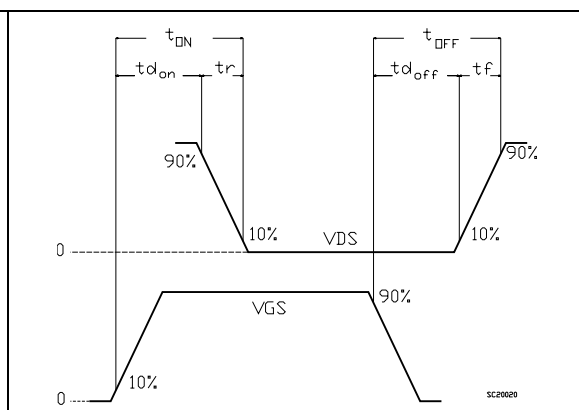


Figure 20. Switching time waveform

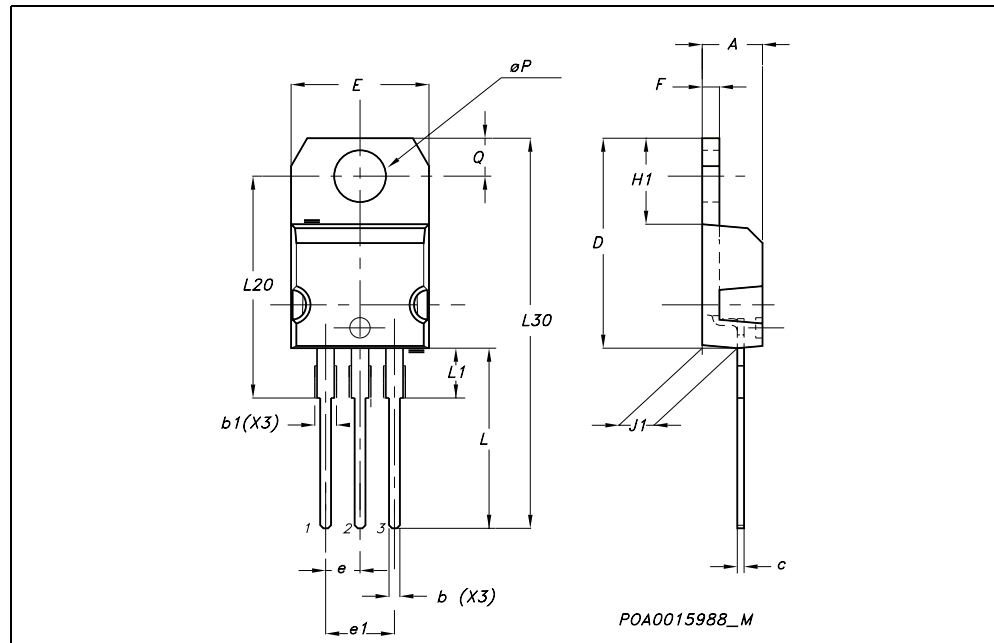


## 4 Package mechanical data

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)

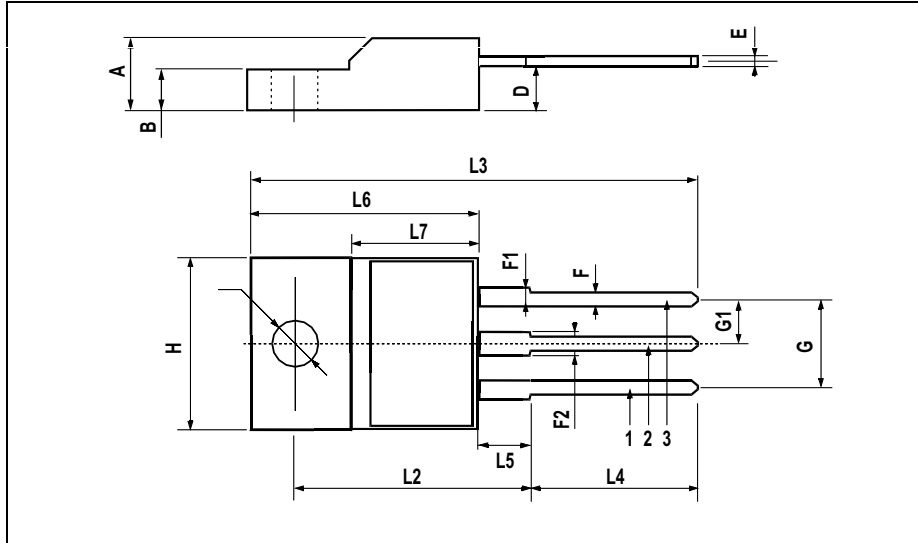
## TO-220 MECHANICAL DATA

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



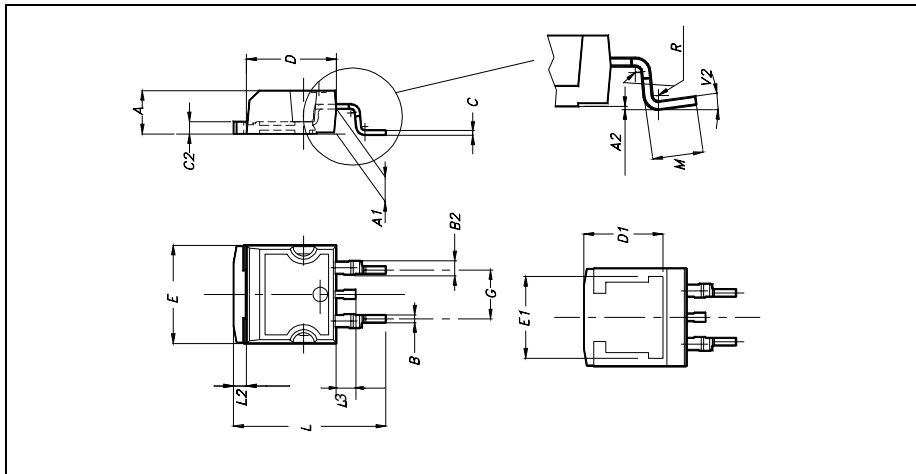
**TO-220FP MECHANICAL DATA**

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



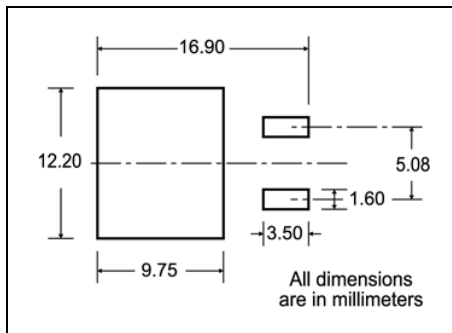
D<sup>2</sup>PAK MECHANICAL DATA

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 Packing mechanical data

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

G measured at hub

#### 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

#### 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

10 pitches cumulative tolerance on tape + / - 0.2 mm

Center line of cavity

User Direction of Feed

R min.

Bending radius

FEED DIRECTION

TRL

\* on sales type

## 6 Revision history

Table 7. Revision history

Date	Revision	Changes
09-Dec-2004	1	First release
27-Jul-2006	2	New template, inserted D <sup>2</sup> PAK

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