



# STF8NK100Z STP8NK100Z

N-CHANNEL 1000V - 1.66Ω - 9A - TO-220 - TO-220FP  
Zener-Protected SuperMESH™ MOSFET

Preliminary data

## General features

Type	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>	P <sub>w</sub>
STF8NK100Z	1000 V	<2 Ω	6.3 A <i>Note 1</i>	40 W
STP8NK100Z	1000 V	<2 Ω	6.3 A	160 W

- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE RATED
- IMPROVED ESD CAPABILITY
- VERY LOW INTRINSIC CAPACITANCE

## Description

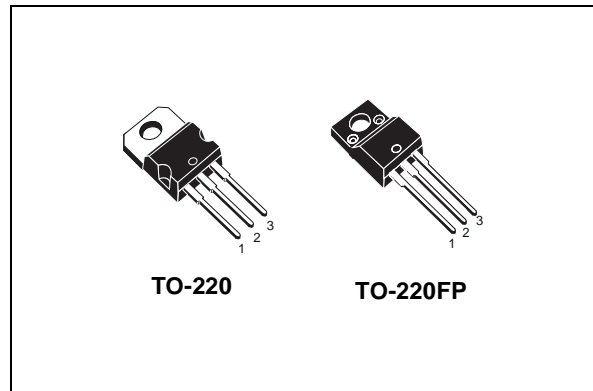
The SuperMESH™ series is obtained through an extreme optimization of ST's well established stripbased PowerMESH™ layout. In addition to pushing on-resistance significantly down, special care is taken to ensure a very good dv/dt capability for the most demanding applications. Such series complements ST full range of high voltage MOSFETs including revolutionary MDmesh™ products.

## Applications

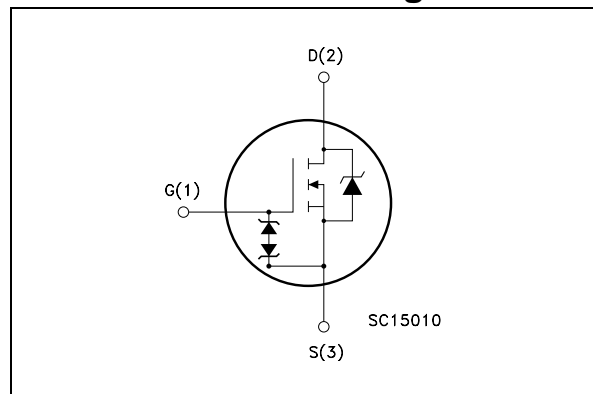
- HIGH CURRENT, SWITCHING APPLICATION
- IDEAL FOR OFF-LINE POWER SUPPLIES

## Order codes

Sales Type	Marking	Package	Packaging
STF8NK100Z	F8NK100Z	TO-220FP	TUBE
STP8NK100Z	P8NK100Z	TO-220	TUBE



## Internal schematic diagram



# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		TO-220	TO-220FP	
$V_{DS}$	Drain-source Voltage ( $V_{GS}=0$ )	1000		V
$V_{DGR}$	Drain-gate Voltage	1000		V
$V_{GS}$	Gate-Source Voltage	$\pm 30$		V
$I_D$ <i>Note 1</i>	Drain Current (continuous) at $T_C = 25^\circ\text{C}$	6.3	6.3	A
$I_D$	Drain Current (continuous) at $T_C = 100^\circ\text{C}$	4.2	4.2	A
$I_{DM}$ <i>Note 2</i>	Drain Current (pulsed)	25.2	25.2	A
$P_{TOT}$	Total Dissipation at $T_C = 25^\circ\text{C}$	160	40	W
	Derating Factor	1.28	0.32	W/ $^\circ\text{C}$
$V_{ESD(G-S)}$	Gate source ESD (HBM-C=100pF, R=1.5K $\Omega$ )	4000		V
dv/dt <i>Note 3</i>	Peak Diode Recovery voltage slope	4.5		V/ns
$V_{ISO}$	Insulation Withstand Voltage (DC)	--	2500	V
$T_j$ $T_{stg}$	Operating Junction Temperature Storage Temperature	-55 to 150		$^\circ\text{C}$

**Table 2. Thermal data**

		TO-220	TO-220FP	
Rthj-case	Thermal Resistance Junction-case Max	0.78	3.1	$^\circ\text{C}/\text{W}$
Rthj-a	Thermal Resistance Junction-ambient Max	62.5		$^\circ\text{C}/\text{W}$
$T_l$	Maximum Lead Temperature For Soldering Purpose	300		$^\circ\text{C}$

**Table 3. Avalanche Characteristics**

Symbol	Parameter	Value	Unit
$I_{AR}$	Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by $T_j$ max)	6.3	A
$E_{AS}$	Single Pulse Avalanche Energy (starting $T_j = 25^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{V}$ )	320	mJ

## 2 Electrical characteristics

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

**Table 4. On/off states**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	$I_D = 1\text{ mA}, V_{GS} = 0$	1000			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 50	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate Body Leakage Current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20\text{ V}$			$\pm 10$	$\mu\text{A}$
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 100\ \mu\text{A}$	3	3.75	4.5	V
$R_{DS(on)}$	Static Drain-Source On Resistance	$V_{GS} = 10\ \text{V}, I_D = 3.1\ \text{A}$		1.66	2	$\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$g_{fs}$ <i>Note 6</i>	Forward Transconductance	$V_{DS} = 15\text{ V}, I_D = 3.1\ \text{A}$		7		S
$C_{iss}$	Input Capacitance	$V_{DS} = 25\text{ V}, f = 1\ \text{MHz}, V_{GS} = 0$		2180		pF
$C_{oss}$	Output Capacitance			174		pF
$C_{rss}$	Reverse Transfer Capacitance			36		pF
$C_{oss\ eq.}$ <i>Note 5</i>	Equivalent Output Capacitance	$V_{GS} = 0\text{ V}, V_{DS} = 0\ \text{to}\ 800\text{ V}$		84		pF
$Q_g$	Total Gate Charge	$V_{DD} = 800\text{ V}, I_D = 6.3\text{ A}$		73	102	nC
$Q_{gs}$	Gate-Source Charge	$V_{GS} = 10\text{ V}$		12		nC
$Q_{gd}$	Gate-Drain Charge	(see Figure 17)		40		nC

**Table 6. Switching times**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ $t_r$	Turn-on Delay Time Rise Time	$V_{DD}=500\text{ V}$ , $I_D=3.1\text{ A}$ , $R_G=4.7\Omega$ , $V_{GS}=10\text{ V}$ (see Figure 18)		28 19		ns ns
$t_{d(off)}$ $t_f$	Turn-off Delay Time FallTime	$V_{DD}=500\text{ V}$ , $I_D=3.1\text{ A}$ , $R_G=4.7\Omega$ , $V_{GS}=10\text{ V}$ (see Figure 18)		59 30		ns ns

**Table 7. Source drain diode**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$I_{SD}$ $I_{SDM}$ <i>Note 3</i>	Source-drain Current Source-drain Current (pulsed)				6.3 25.2	A A
$V_{SD}$ <i>Note 2</i>	Forward on Voltage	$I_{SD}=6.3\text{ A}$ , $V_{GS}=0$			1.6	V
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	$I_{SD}=6.3\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD}=50\text{ V}$ , $T_j=25^\circ\text{C}$		620 5.3 17		ns $\mu\text{C}$ A
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	$I_{SD}=6.3\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD}=50\text{ V}$ , $T_j=150^\circ\text{C}$		840 7.5 18		ns $\mu\text{C}$ A

**Table 8. Gate-source zener diode**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$BV_{GSO}$ <i>Note 4</i>	Gate-Source Breakdown Voltage	$I_{gs} = \pm 1\text{ mA}$ (Open Drain)	30			V

(1) Limited only by maximum temperature allowed

(2)  $I_{SD} \leq 6.3\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DS} \leq V_{(BR)DSS}$ ,  $T_j \leq T_{jmax}$

(3) Pulse width limited by safe operating area

(4) The built-in-back-to-back Zener diodes have specifically been designed to enhance not only the device's ESD capability, but also to make them safely absorb possible voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components.

(5)  $C_{oss,eq}$  is defined as a constant equivalent capacitance giving the same charging time as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DSS}$

(6) Pulsed: pulse duration = 300 $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

Figure 1. Safe Operating Area for TO-220

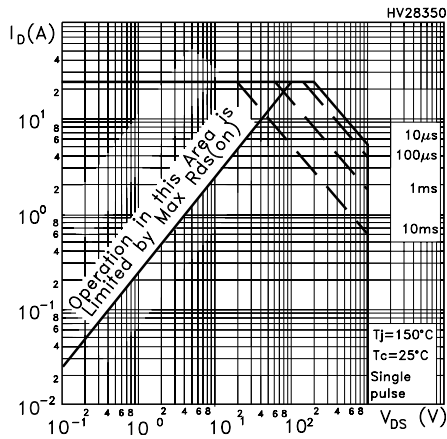


Figure 2. Thermal Impedance for TO-220

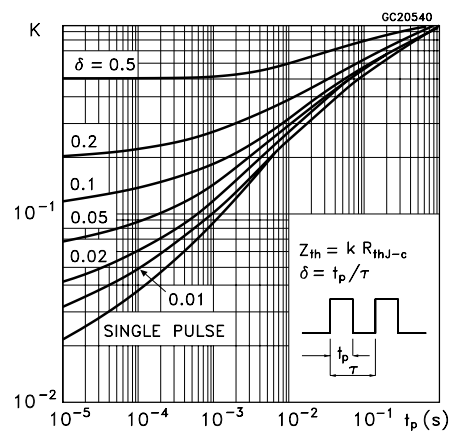


Figure 3. Safe Operating Area for TO-220FP

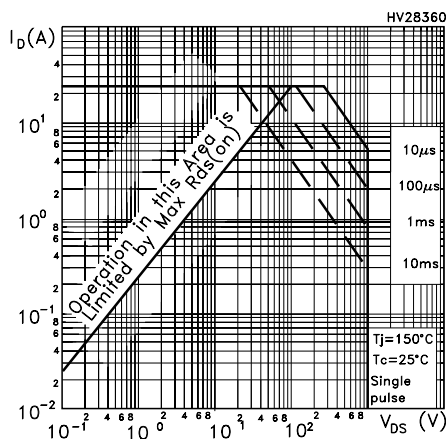


Figure 4. Thermal Impedance for TO-220FP

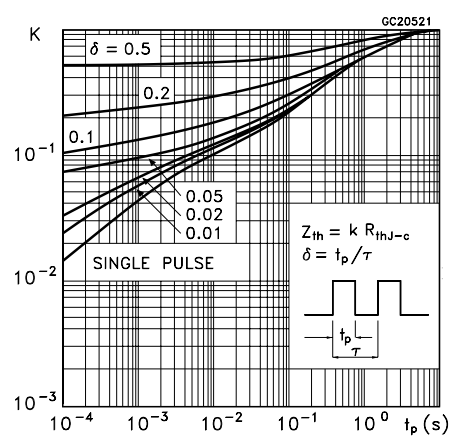


Figure 5. Output Characteristics

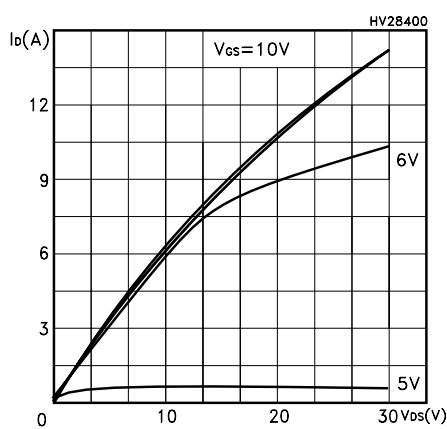


Figure 6. Transfer Characteristics

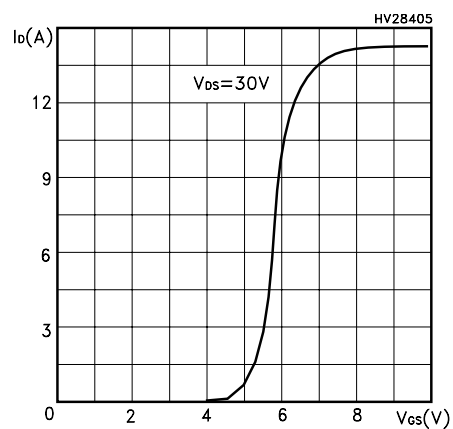


Figure 7. Transconductance

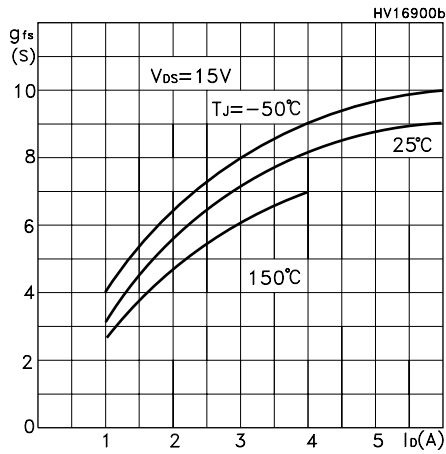


Figure 8. Static Drain-source on Resistance

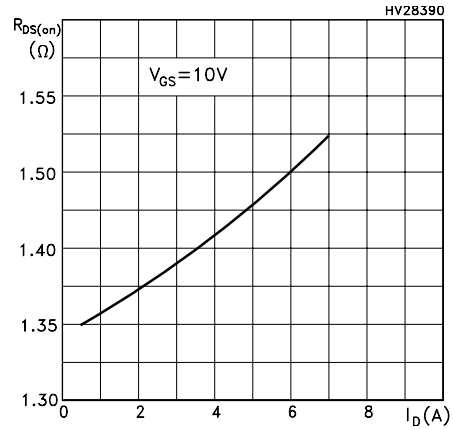


Figure 9. Gate Charge vs Gate-source Voltage Figure 10. Capacitance Variations

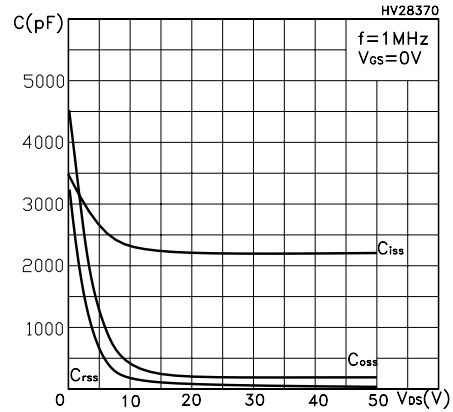
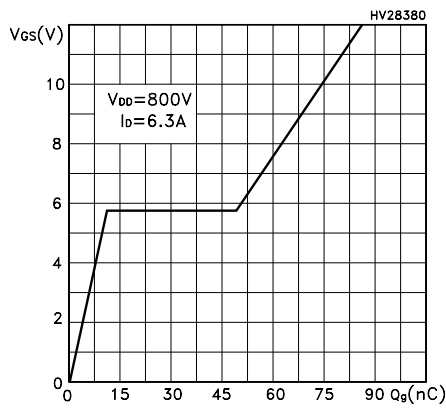


Figure 11. Normalized Gate Threshold Voltage vs. Temperature

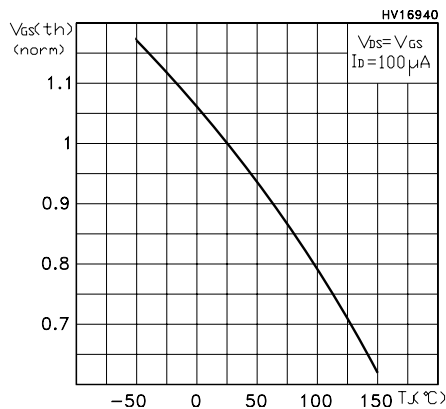


Figure 12. Normalized On Resistance vs. Temperature

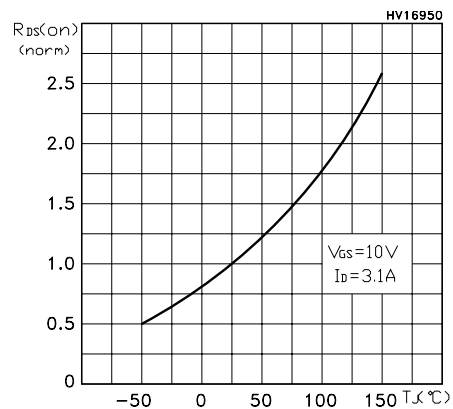


Figure 13. Source-drain Diode Forward Characteristics

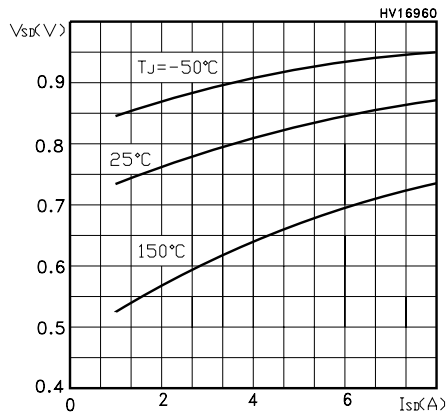


Figure 14. Normalized BVDSS vs Temperature

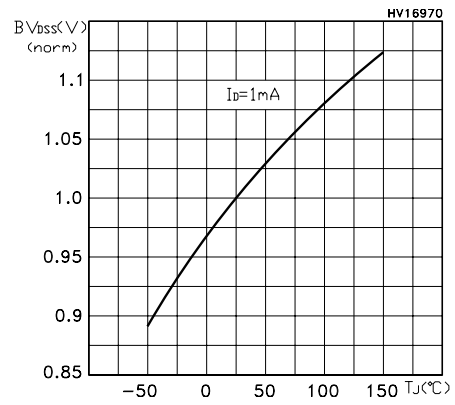
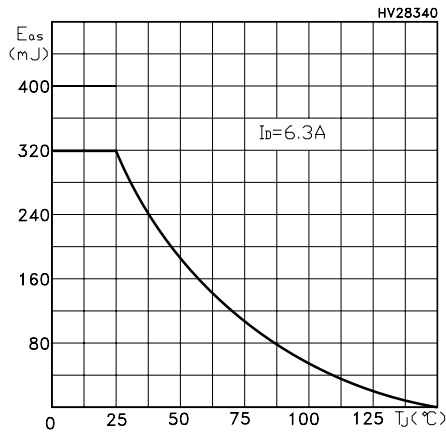


Figure 15. Maximum Avalanche Energy vs Temperature



### 3 Test circuits

Figure 16. Switching Times Test Circuit For Resistive Load

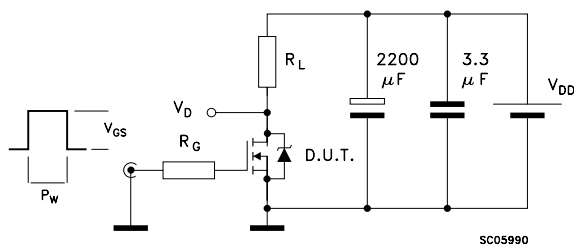


Figure 17. Gate Charge Test Circuit

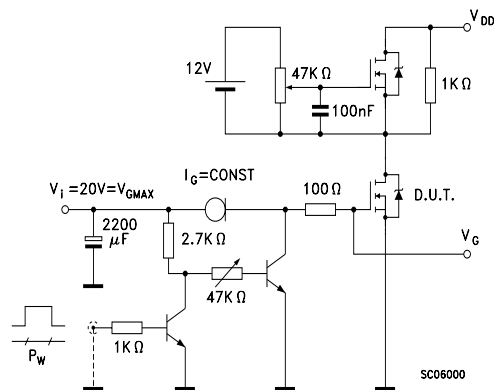


Figure 18. Test Circuit For Inductive Load Switching and Diode Recovery Times

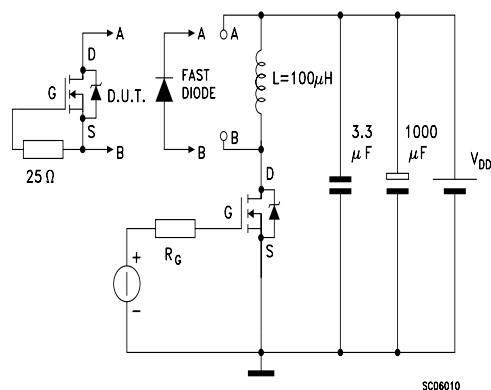


Figure 20. Unclamped Inductive Load Test Circuit

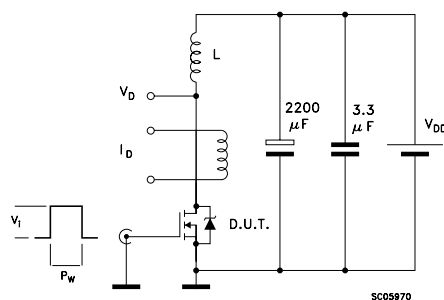
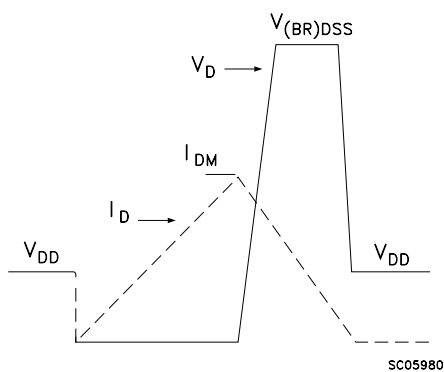


Figure 19. Unclamped Inductive Waveform



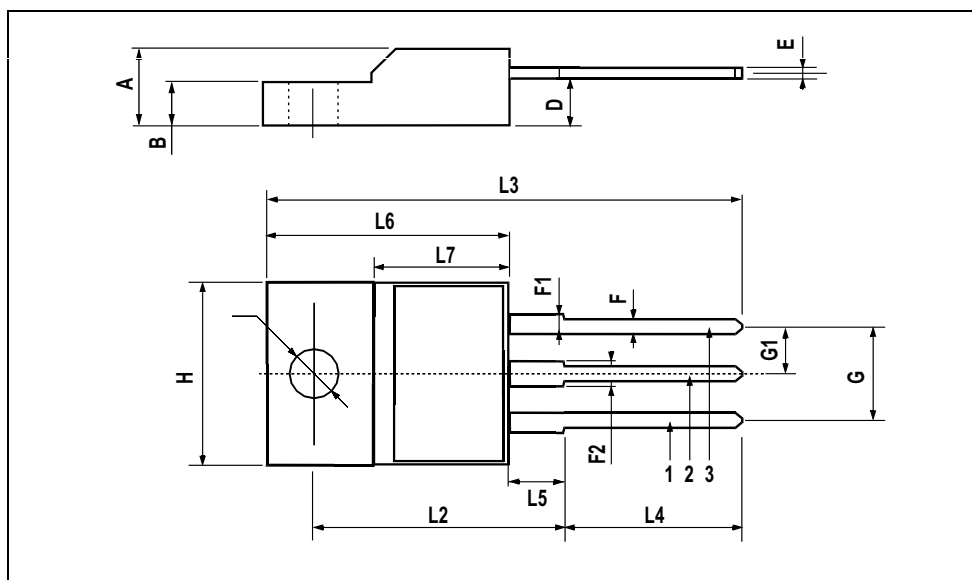


## 4 Package mechanical data

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)

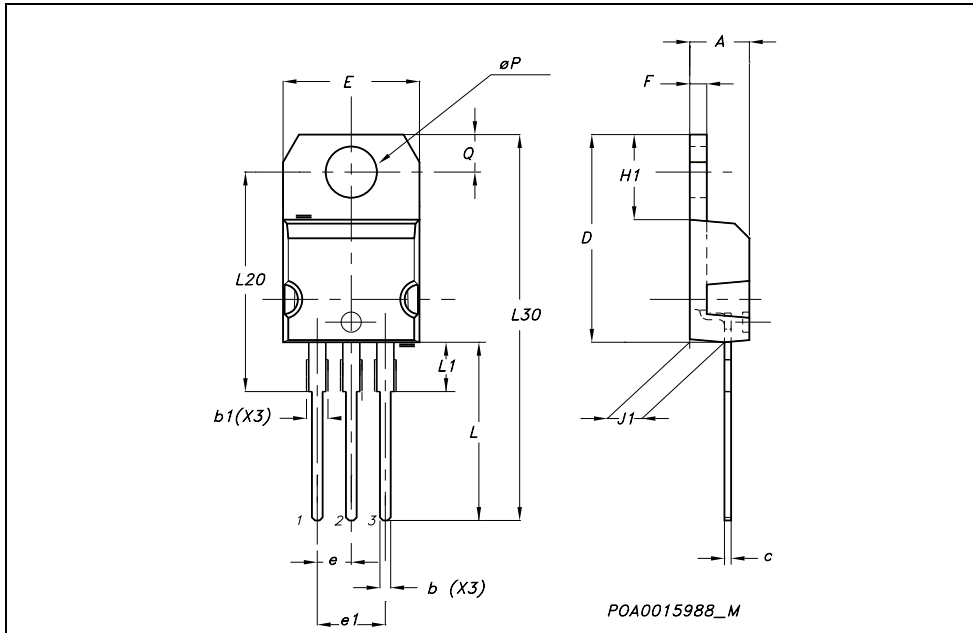
**TO-220FP MECHANICAL DATA**

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
∅	3		3.2	0.118		0.126



**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



## 5 Revision History

Date	Revision	Changes
24-Oct-2005	1	First release

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