



# STB20NM50 - STB20NM50-1 STP20NM50 - STP20NM50FP

N-CHANNEL 550V@T<sub>jmax</sub> - 0.20Ω - 20A - TO220/FP-D<sup>2</sup>PAK-I<sup>2</sup>PAK  
Zener-Protected SuperMESH™ MOSFET

## General features

Type	V <sub>DSS</sub> (@T <sub>jmax</sub> )	R <sub>DS(on)</sub>	I <sub>D</sub>
STB20NM50	550 V	<0.25 Ω	20 A
STB20NM50-1	550 V	<0.25 Ω	20 A
STP20NM50	550 V	<0.25 Ω	20 A
STP20NM50FP	550 V	<0.25 Ω	20 A

- HIGH dv/dt AND AVALANCHE CAPABILITIES
- 100% AVALANCHE TESTED
- LOW INPUT CAPACITANCE AND GATE CHARGE
- LOW GATE INPUT RESISTANCE

## Description

The MDmesh™ is a new revolutionary MOSFET technology that associates the Multiple Drain process with the Company's PowerMESH™ horizontal layout. The resulting product has an outstanding low on-resistance, impressively high dv/dt and excellent avalanche characteristics and dynamic performances.

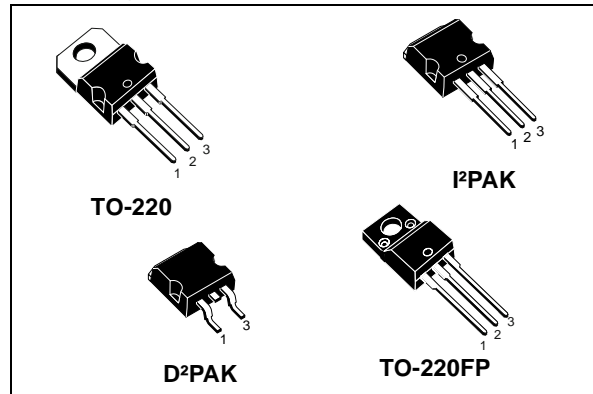
## Applications

The MDmesh™ family is very suitable for increasing power density of high voltage converters allowing system miniaturization and higher efficiencies

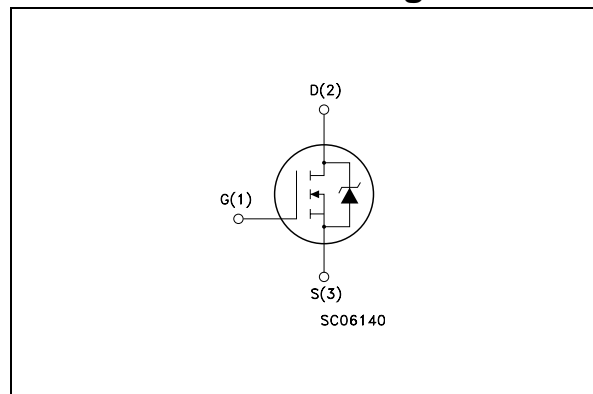
## Order codes

Sales Type	Marking	Package	Packaging
STB20NM50T4	B20NM50	D <sup>2</sup> PAK	TAPE & REEL
STB20NM50-1	B20NM50-1	I <sup>2</sup> PAK	TUBE
STP20NM505	P20NM50	TO-220	TUBE
STP20NM50FP	P20NM50FP	TO-220FP	TUBE

## Package



## Internal schematic diagram



# 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	
$V_{GS}$	Gate-Source Voltage	± 30		V
$I_D$	Drain Current (continuous) at $T_C = 25^\circ\text{C}$	20	20 (Note 3)	A
$I_D$	Drain Current (continuous) at $T_C = 100^\circ\text{C}$	12.6	12.6 (Note 3)	A
$I_{DM}$ Note 2	Drain Current (pulsed)	80	80 (Note 3)	A
$P_{TOT}$	Total Dissipation at $T_C = 25^\circ\text{C}$	192	45	W
	Derating Factor	1.2	0.36	W/°C
dv/dt Note 1	Peak Diode Recovery voltage slope	15		V/ns
$V_{ISO}$	Insulation Withstand Voltage (DC)	--	2000	V
$T_j$ $T_{stg}$	Operating Junction Temperature Storage Temperature	-65 to 150		°C

**Table 2. Thermal data**

		TO-220/D <sup>2</sup> PAK/I <sup>2</sup> PAK	TO-220FP	Unit
Rthj-case	Thermal Resistance Junction-case Max	0.65	2.8	°C/W
Rthj-amb	Thermal Resistance Junction-amb Max	62.5		°C/W
$T_l$	Maximum Lead Temperature For Soldering Purpose	300		°C

**Table 3. Avalanche characteristics**

Symbol	Parameter	Max Value	Unit
$I_{AR}$	Avalanche Current, repetitive or Not-Repetitive (pulse width limited by $T_j$ max)	10	A
$E_{AS}$	Single Pulse Avalanche Energy (starting $T_j=25^\circ\text{C}$ , $I_D=5\text{A}$ , $V_{DD}=50\text{V}$ )	650	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	$I_D = 250\mu A, V_{GS} = 0$	500			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 10	$\mu A$ $\mu A$
$I_{GSS}$	Gate Body Leakage Current ( $V_{DS} = 0$ )	$V_{GS} = \pm 30V$			$\pm 100$	$\mu A$
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\mu A$	3	4	5	V
$R_{DS(on)}$	Static Drain-Source On Resistance	$V_{GS} = 10V, I_D = 10A$		0.20	0.25	$\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$g_{fs}$ <i>Note 4</i>	Forward Transconductance	$V_{DS} > I_{D(ON)} \times R_{DS(ON)max},$ $I_D = 10A$		10		S
$C_{iss}$ $C_{oss}$ $C_{rss}$	Input Capacitance Output Capacitance Reverse Transfer Capacitance	$V_{DS} = 25V, f = 1\text{ MHz}, V_{GS} = 0$		1480 285 34		pF pF pF
$C_{oss\ eq.}$ <i>Note 5</i>	Equivalent Output Capacitance	$V_{GS} = 0, V_{DS} = 0V\text{ to }400V$		130		pF
$R_g$	Gate Input Resistance	$f = 1\text{ MHz}$ Gate DC Bias = 0 Test Signal Level = 20mV Open Drain		1.6		$\Omega$
$Q_g$ $Q_{gs}$ $Q_{gd}$	Total Gate Charge Gate-Source Charge Gate-Drain Charge	$V_{DD} = 400V, I_D = 20A$ $V_{GS} = 10V$ (see Figure 15)		40 13 19	56	nC nC nC

**Table 6. Switching times**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ $t_r$	Turn-on Delay Time Rise Time	$V_{DD}=250\text{ V}$ , $I_D=10\text{ A}$ , $R_G=4.7\Omega$ , $V_{GS}=10\text{ V}$ (see Figure 16)		24 16		ns ns
$t_{r(Voff)}$ $t_f$ $t_c$	Off-voltage Rise Time Fall Time Cross-over Time	$V_{DD}=400\text{ V}$ , $I_D=20\text{ A}$ , $R_G=4.7\Omega$ , $V_{GS}=10\text{ V}$ (see Figure 16)		9 8.5 23		ns ns ns

**Table 7. Source drain diode**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$I_{SD}$ $I_{SDM}$ <i>Note 2</i>	Source-drain Current Source-drain Current (pulsed)				20 80	A A
$V_{SD}$ <i>Note 4</i>	Forward on Voltage	$I_{SD}=20\text{ A}$ , $V_{GS}=0$			1.5	V
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	$I_{SD}=20\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD}=100\text{ V}$ , $T_j=25^\circ\text{C}$		350 4.6 26		ns $\mu\text{C}$ A
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	$I_{SD}=20\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD}=100\text{ V}$ , $T_j=150^\circ\text{C}$		435 5.9 27		ns $\mu\text{C}$ A

(1)  $I_{SD} \leq 20\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  $T_j \leq T_{JMAX}$

(2) Pulse width limited by safe operating area

(3) Limited only by maximum temperature allowed

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

(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%  $V_{DSS}$

## 2.1 Electrical Characteristics (curves)

Figure 1. Safe Operating Area for TO-220/D<sup>2</sup>PAK/I<sup>2</sup>PAK

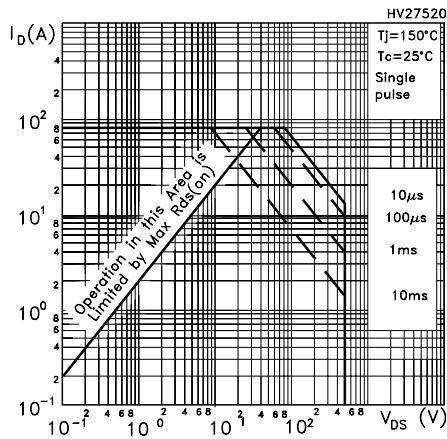


Figure 2. Thermal Impedance for TO-220/D<sup>2</sup>PAK/I<sup>2</sup>PAK

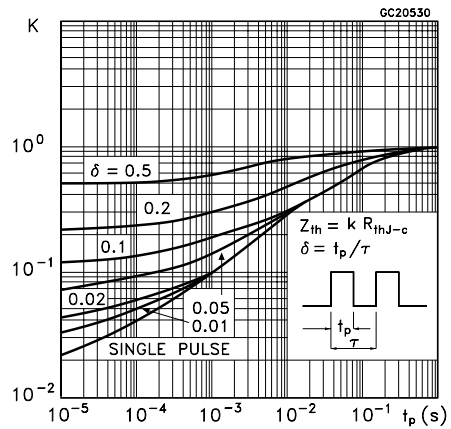


Figure 3. Safe Operating Area for TO-220FP

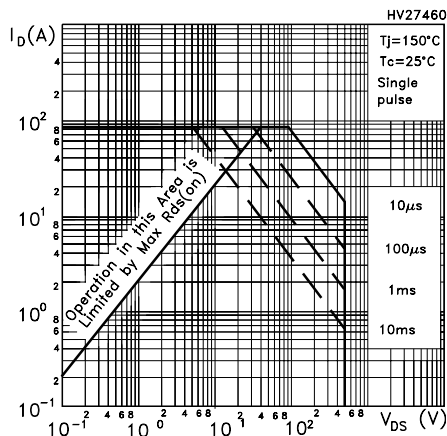


Figure 4. Thermal Impedance for TO-220FP

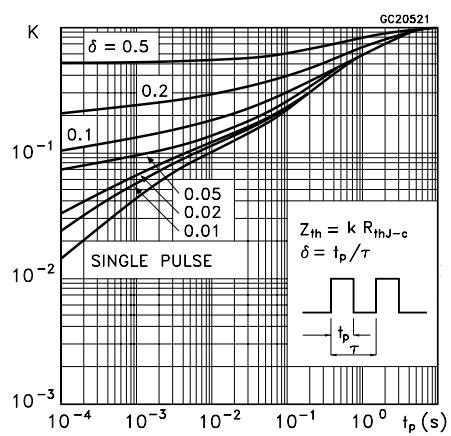


Figure 5. Output Characteristics

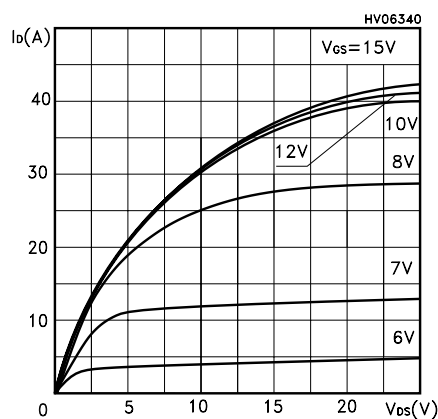


Figure 6. Transfer Characteristics

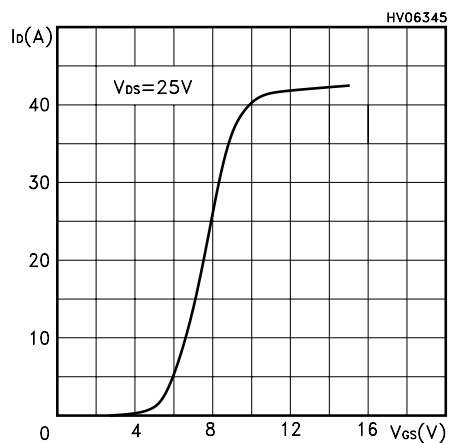


Figure 7. Transconductance

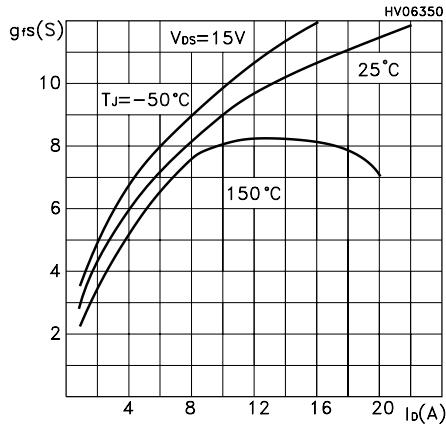


Figure 8. Static Drain-Source on Resistance

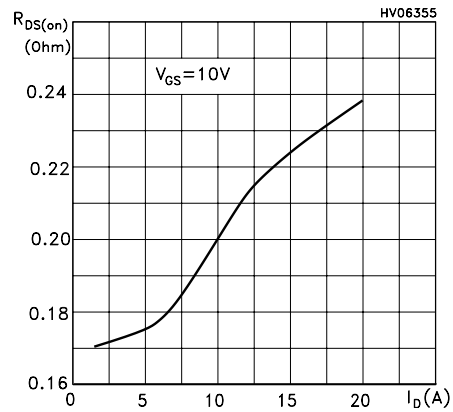


Figure 9. Gate Charge vs Gate -Source Voltage

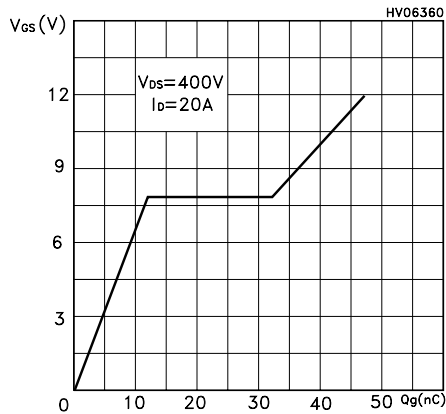


Figure 11. Capacitance Variations

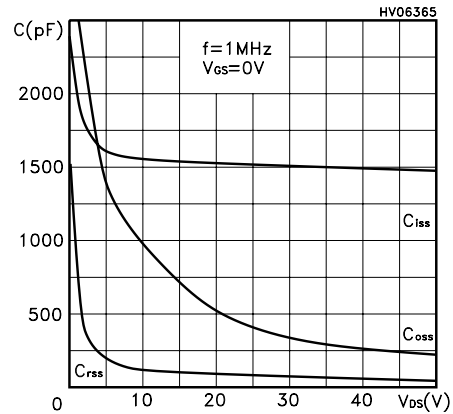


Figure 10. Normalized Gate Threshold Voltage vs Temperature

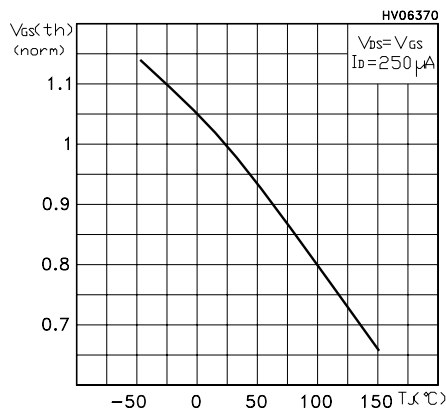
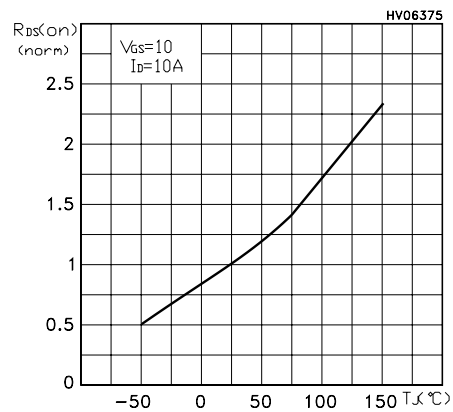
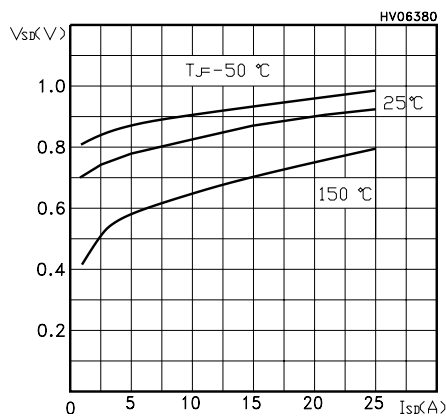


Figure 12. Normalized on Resistance vs Temperature



**Figure 13. Source-drain Diode Forward Characteristics**



### 3 Test circuits

Figure 14. Switching Times Test Circuit For Resistive Load

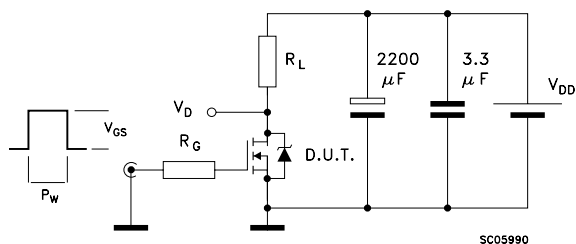


Figure 15. Gate Charge Test Circuit

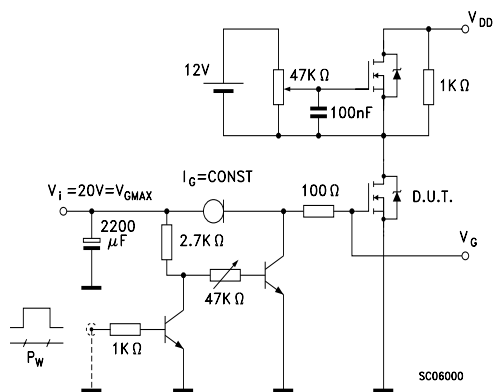


Figure 16. Test Circuit For Inductive Load Switching and Diode Recovery Times

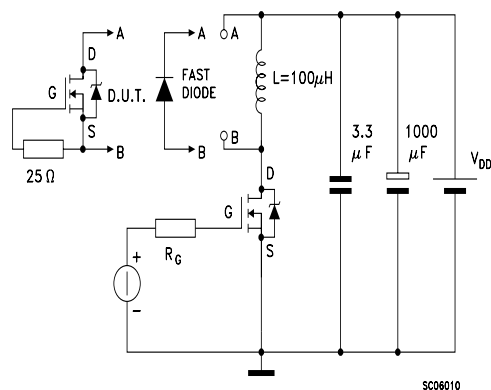


Figure 18. Unclamped Inductive Load Test Circuit

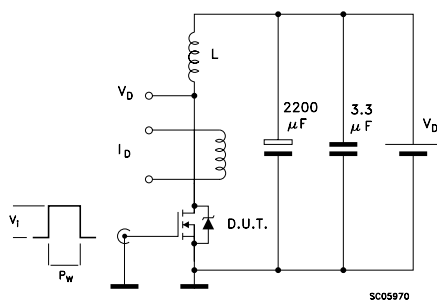
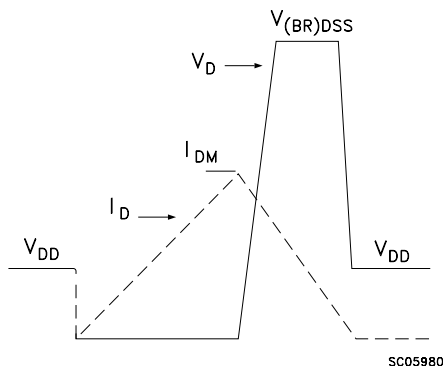


Figure 17. Unclamped Inductive Waveform

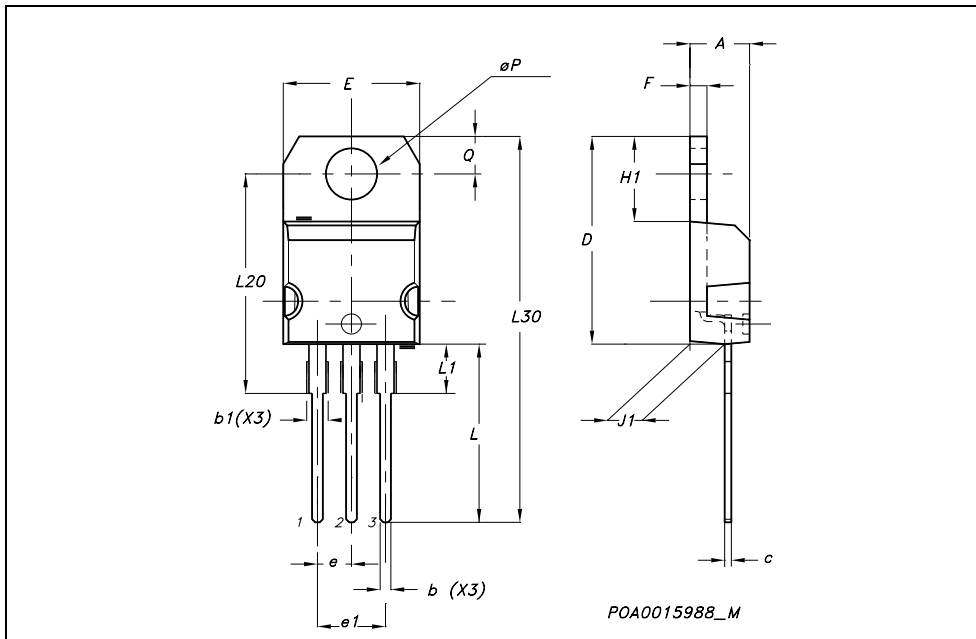


## 4 Package mechanical data

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)

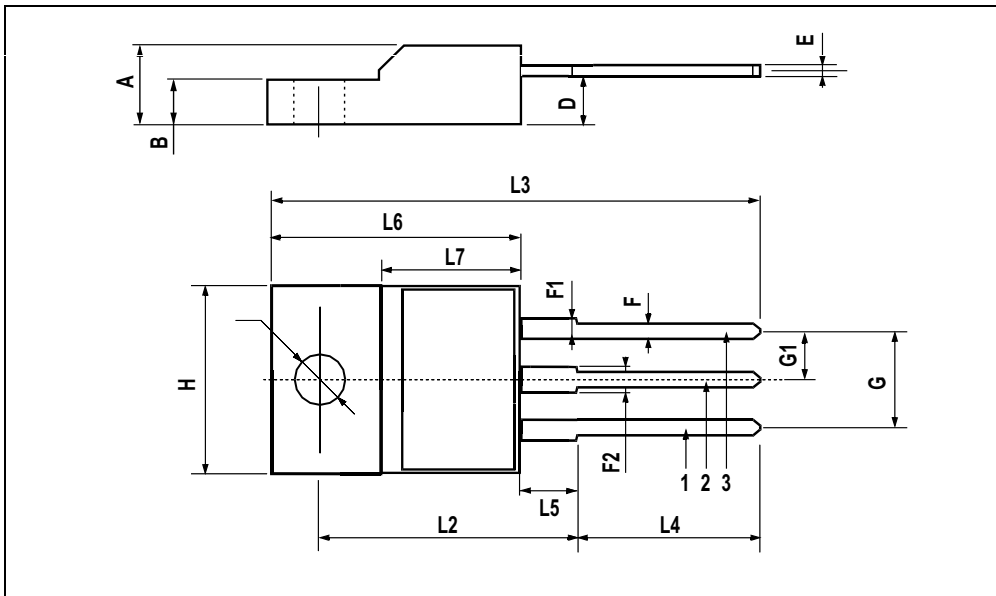
**TO-220 MECHANICAL DATA**

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



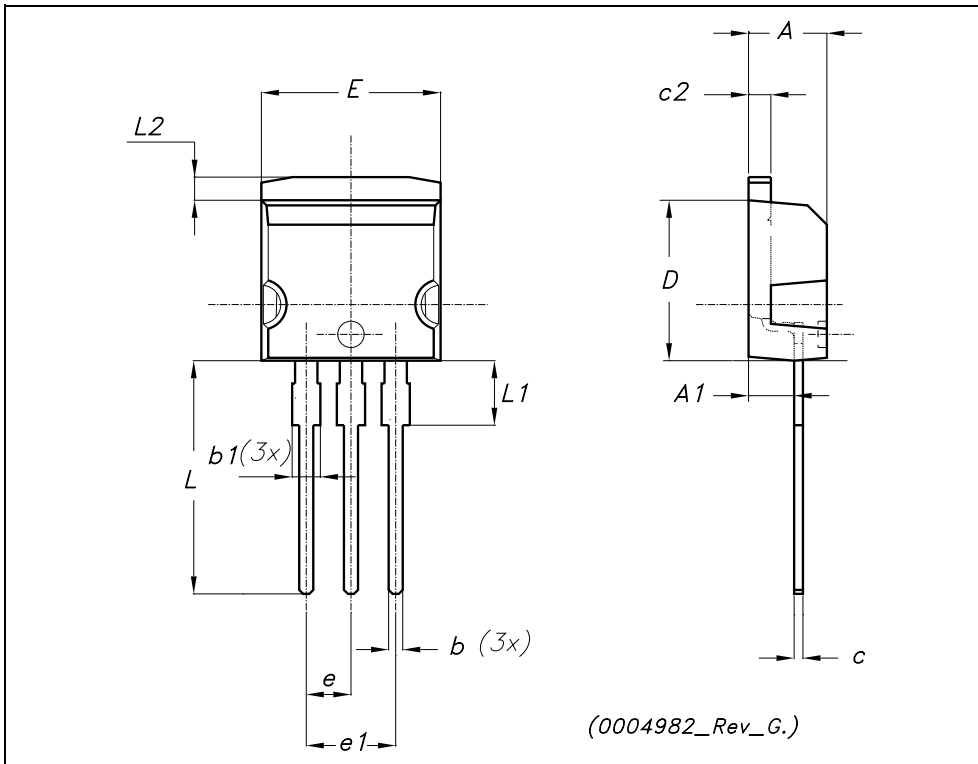
**TO-220FP MECHANICAL DATA**

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
∅	3		3.2	0.118		0.126



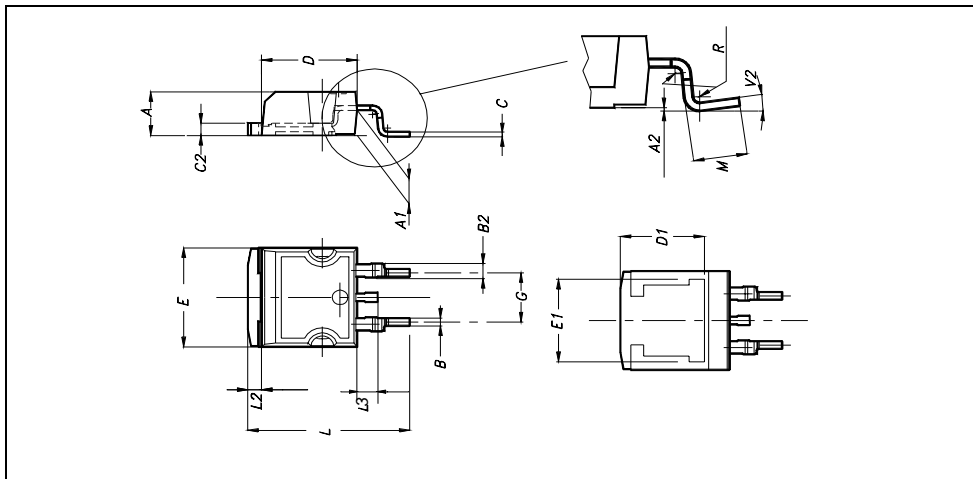
**TO-262 (I<sup>2</sup>PAK) MECHANICAL DATA**

DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
A1	2.40		2.72	0.094		0.107
b	0.61		0.88	0.024		0.034
b1	1.14		1.70	0.044		0.066
c	0.49		0.70	0.019		0.027
c2	1.23		1.32	0.048		0.052
D	8.95		9.35	0.352		0.368
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
E	10		10.40	0.393		0.410
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L2	1.27		1.40	0.050		0.055



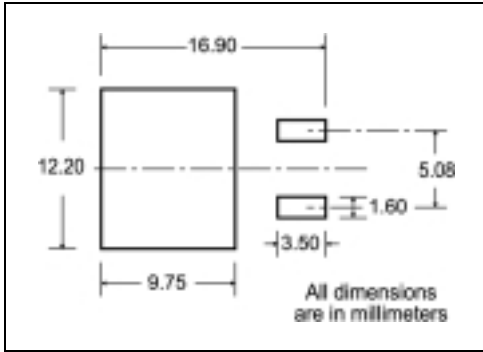
**D<sup>2</sup>PAK MECHANICAL DATA**

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

**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

Date	Revision	Changes
05-Sep-2005	2	Inserted Ecopack indication

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