STB13NK60Z - STB13NK60Z-1
STP13NK60Z/FP - STW13NK60Z

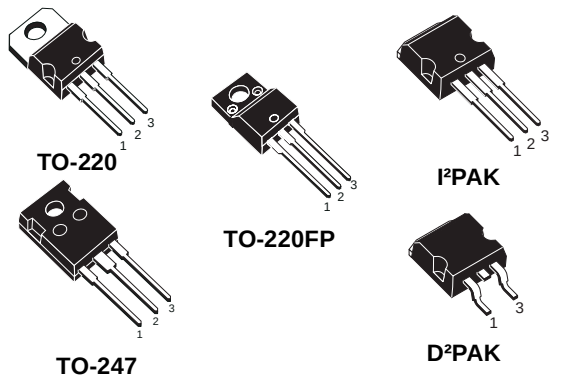
N-CHANNEL 600V - 0.48Ω - 13A - TO-220/FP - D²/I²PAK - TO-247
Zener-Protected SuperMESH™ MOSFET

General features

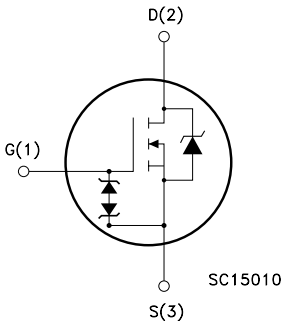
Type	V_{DSS}	$R_{DS(on)}$	I_D	Pw
STB13NK60Z-1	600 V	<0.55 Ω	13 A	150 W
STB13NK60Z	600 V	<0.55 Ω	13 A	150 W
STP13NK60ZFP	600 V	<0.55 Ω	13 A	35 W
STP13NK60Z	600 V	<0.55 Ω	13 A	150 W
STW13NK60Z	600 V	<0.55 Ω	13 A	150 W

- GATE CHARGE MINIMIZED
- VERY LOW INTRINSIC CAPACITANCES
- VERY GOOD MANUFACTURING REPEABILITY

Package



Internal schematic diagram



Description

The SuperMESH™ series is obtained through an extreme optimization of ST's well established strip-based 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.

Applications

- HIGH CURRENT, HIGH SPEED SWITCHING
- SWITCH MODE POWER SUPPLIES
- DC-AC CONVERTERS FOR WELDING, UPS AND MOTOR DRIVE

Order codes

Sales Type	Marking	Package	Packaging
STB13NK60Z-1	B13NK60Z-1	I²PAK	TUBE
STB13NK60ZT4	B13NK60Z	D²PAK	TAPE & REEL
STP13NK60ZFP	P13NK60ZFP	TO-220FP	TUBE
STP13NK60Z	P13NK60Z	TO-220	TUBE
STW13NK60Z	W13NK60Z	TO-247	TUBE

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-220 / TO-247 I²PAK / D²PAK	TO-220FP	
V_{DS}	Drain-Source Voltage (V_{GS} = 0)	600		V
V_{DGR}	Drain-gate Voltage (R_{GS} = 20kΩ)	600		V
V_{GS}	Gate-Source Voltage	± 30		V
I_D	Drain Current (continuous) at T_C = 25°C	13	13 (*Note* 1)	A
I_D	Drain Current (continuous) at T_C = 100°C	8.2	8.2 (*Note* 1)	A
I_{DM} *Note* 2	Drain Current (pulsed)	52	52 (*Note* 1)	A
P_{TOT}	Total Dissipation at T_C = 25°C	150	35	W
	Derating Factor	1.20	0.27	W/°C
Vesd(G-S)	G-S ESD (HBM C=100pF, R=1.5kΩ)	4000		V
dv/dt *Note* 3	Peak Diode Recovery voltage slope	4.5		V/ns
V_{ISO}	Insulation Withstand Volatge (DC)	--	2500	V
T_j T_{stg}	Operating Junction Temperature Storage Temperature	-55 to 150		°C

Table 2. Thermal data

		TO-220 I²PAK / TO-247	D²PAK	TO-220FP	Unit
Rthj-case	Thermal Resistance Junction-case Max	0.83		3.6	°C/W
Rthj-pcb *Note* 7	Thermal Resistance Junction-pcb Max	--	60	--	°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 Tj max)	10	A
E_{AS}	Single Pulse Avalanche Energy (starting Tj=25°C, I_D=I_{AR}, V_{DD}= 50V)	400	mJ

2 Electrical characteristics

(T_{CASE} = 25 °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 mA, V_{GS}= 0	600			V
I_{DSS}	Zero Gate Voltage Drain Current (V_{GS} = 0)	V_{DS} = Max Rating, V_{DS} = Max Rating,Tc=125°C			1 50	µA µA
I_{GSS}	Gate Body Leakage Current (V_{DS} = 0)	V_{GS} = ±20 V			±10	µA
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS}= V_{GS}, I_D = 100 µA	3	3.75	4.5	V
$R_{DS(on)}$	Static Drain-Source On Resistance	V_{GS}= 10 V, I_D= 4.5 A		0.48	0.55	Ω

Table 5. Dynamic

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g_{fs} *Note* 4	Forward Transconductance	V_{DS} =8V, I_D = 5 A		11		S
C_{iss} C_{oss} C_{rss}	Input Capacitance Output Capacitance Reverse Transfer Capacitance	V_{DS} =25V, f=1 MHz, V_{GS}=0		2030 210 48		pF pF pF
$C_{oss\ eq.}$ *Note* 5	Equivalent Ouput Capacitance	V_{GS}=0, V_{DS} =0V to 480V		125		pF
Q_g Q_{gs} Q_{gd}	Total Gate Charge Gate-Source Charge Gate-Drain Charge	V_{DD}=480V, I_D = 10A V_{GS} =10V (see Figure 19)		66 11 33	92	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}=300 V, I_D= 5A, R_G=4.7Ω, V_{GS}=10V (see Figure 20)		22 14		ns ns
$t_{d(off)}$ t_f	Turn-off Delay Time Fall Time	V_{DD}=300 V, I_D= 5A, R_G=4.7Ω, V_{GS}=10V (see Figure 20)		61 12		ns ns
$t_{r(Voff)}$ t_f t_c	Off-voltage Rise Time Fall Time Cross-over Time	V_{DD}=480 V, I_D= 10A, R_G=4.7Ω, V_{GS}=10V (see Figure 20)		10 9 20		ns ns ns

Table 7. Gate-source zener diode

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
BV_{GSO} *Note* 6	Gate-Source Breakdown Voltage	Igs=±1mA (Open Drain)	30			V

Table 8. Source drain diode

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{SD} I_{SDM} *Note* 2	Source-drain Current Source-drain Current (pulsed)				10 40	A A
V_{SD} *Note* 4	Forward on Voltage	I_{SD} = 10 A, V_{GS}=0			1.6	V
t_{rr} Q_{rr} I_{RRM}	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	I_{SD}= 10A, di/dt = 100A/µs, V_{DD}=35 V, Tj=150°C		570 4.5 16		ns µC A

(1) Limited only by maximum temperature allowed

(2) Pulse width limited by safe operating area

(3) I_{SD} ≤13A, di/dt ≤200A/µs, $V_{DD} \leq V_{(BR)DSS}$, $T_j \leq T_{JMAX}$

(4) Pulsed: pulse duration = 300µs, 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%

(6) 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 transients that may occasionally be applied from gate to source. In this respect the Zener 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.

(7) When mounted on minimum Footprint

2.1 Electrical characteristics (curves)

Figure 1. Safe Operating Area for TO-220/ D²PAK/ I²PAK

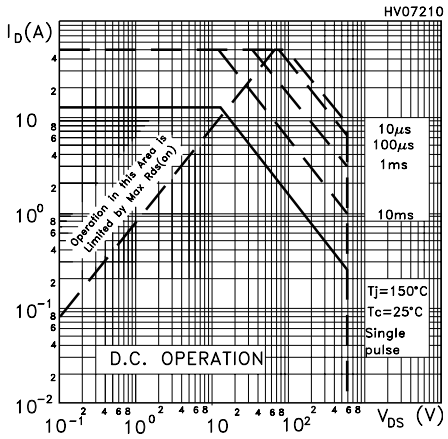


Figure 2. Thermal Impedanc for TO-220/ D²PAK/ I²PAK

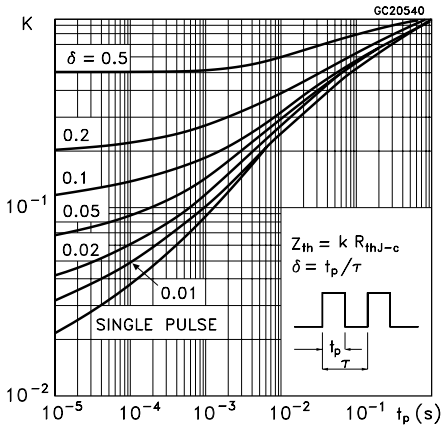


Figure 3. Safe Operating Area for TO-220FP

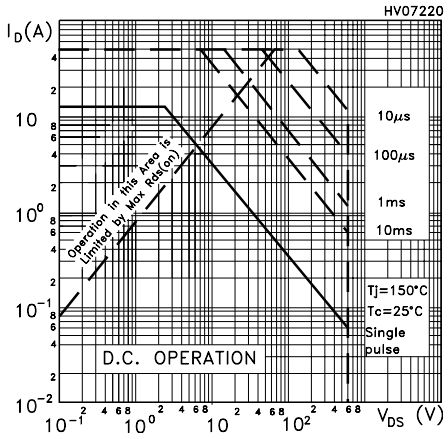


Figure 4. Thermal Impedance for TO-220FP

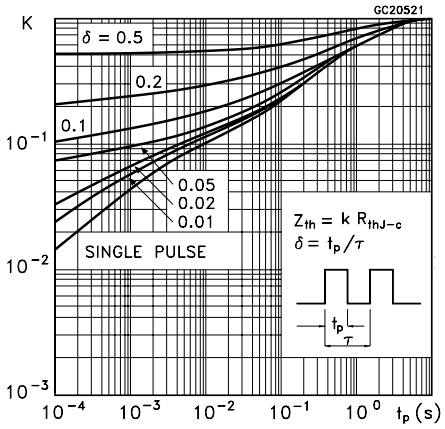


Figure 5. Safe Operating Area for TO-247

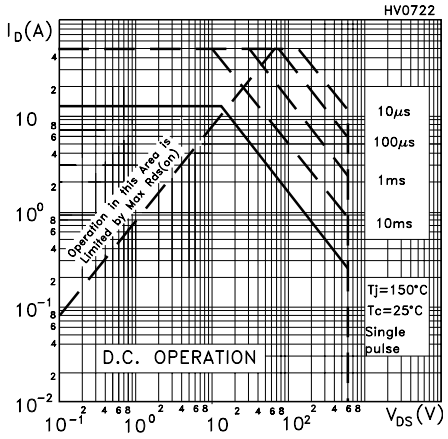


Figure 6. Thermal Impedance for TO-247

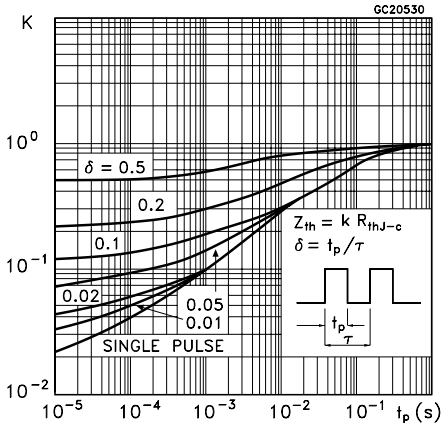


Figure 7. Output Characteristics

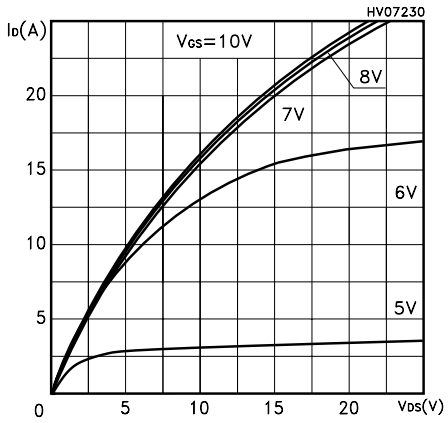


Figure 8. Transfer Characteristics

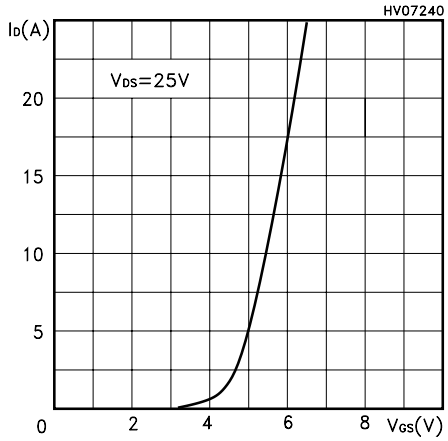


Figure 9. Transconductance

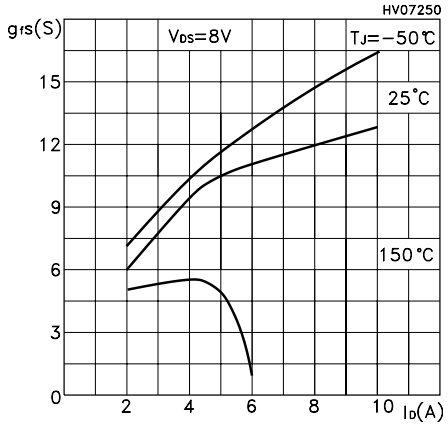


Figure 10. Static Drain-Source on Resistance

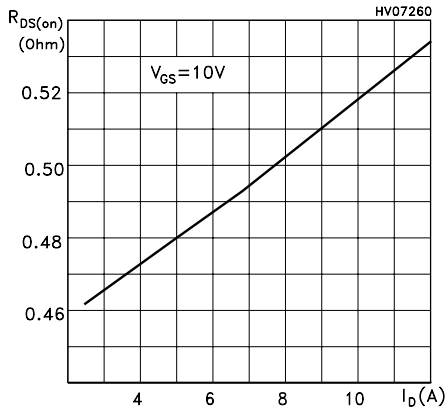


Figure 11. Gate Charge vs Gate -Source Voltage

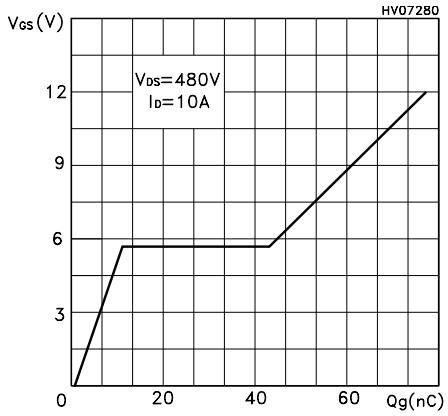


Figure 12. Capacitance Variations

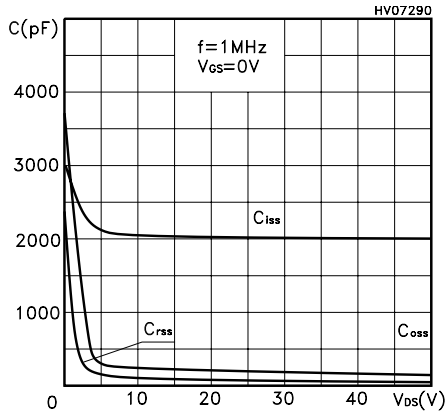


Figure 13. Normalized Gate Threshold Voltage vs Temperatute

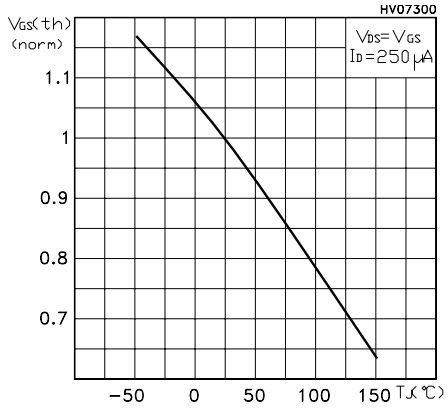


Figure 14. Normalized on Resistance vs Temperature

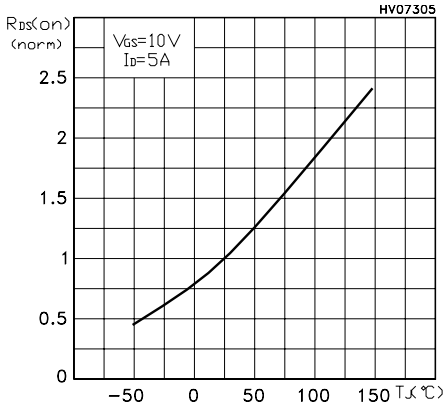


Figure 15. Source-drain Diode Forward Characteristics

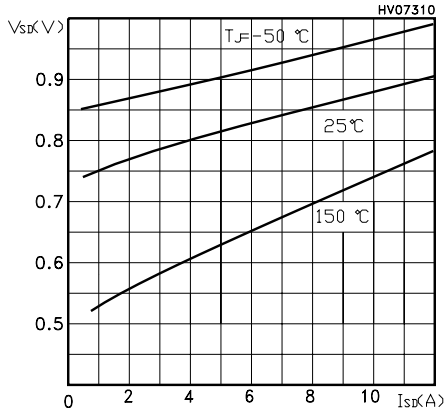


Figure 16. Normalized BVDSS vs Temperature

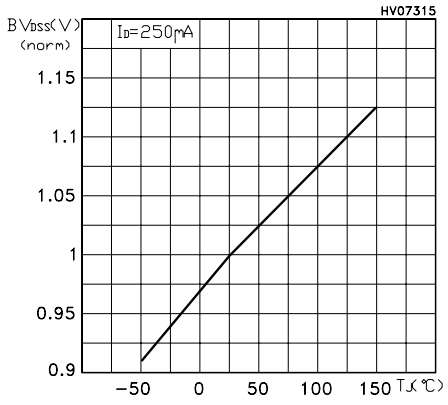
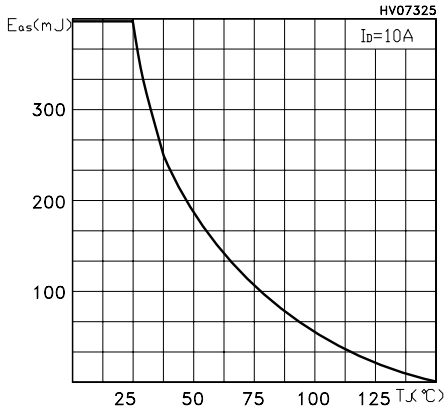


Figure 17. Maximum Avalanche Energy vs Temperature



3 Test circuits

Figure 18. Switching Times Test Circuit For Resistive Load

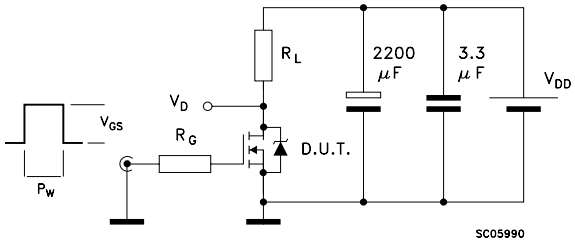


Figure 19. Gate Charge Test Circuit

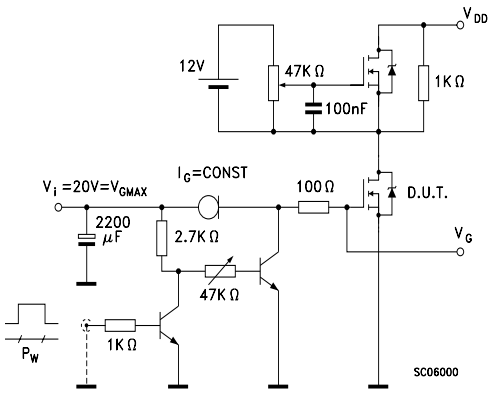
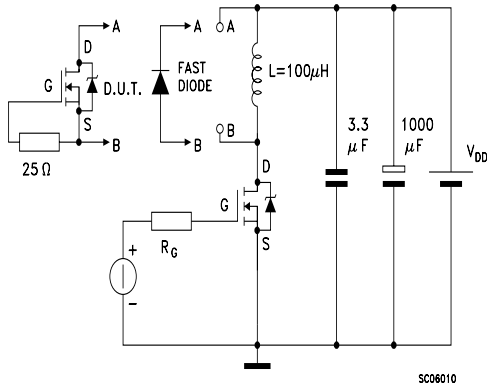


Figure 20. Test Circuit For Inductive Load Switching and Diode Recovery Times

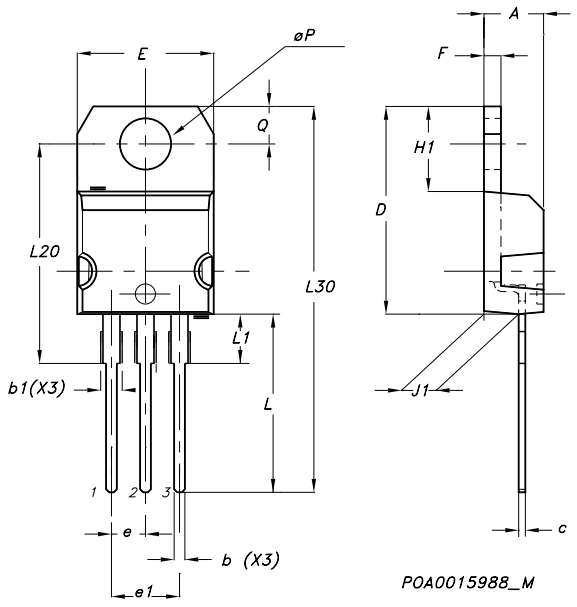


4 Package mechanical data

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

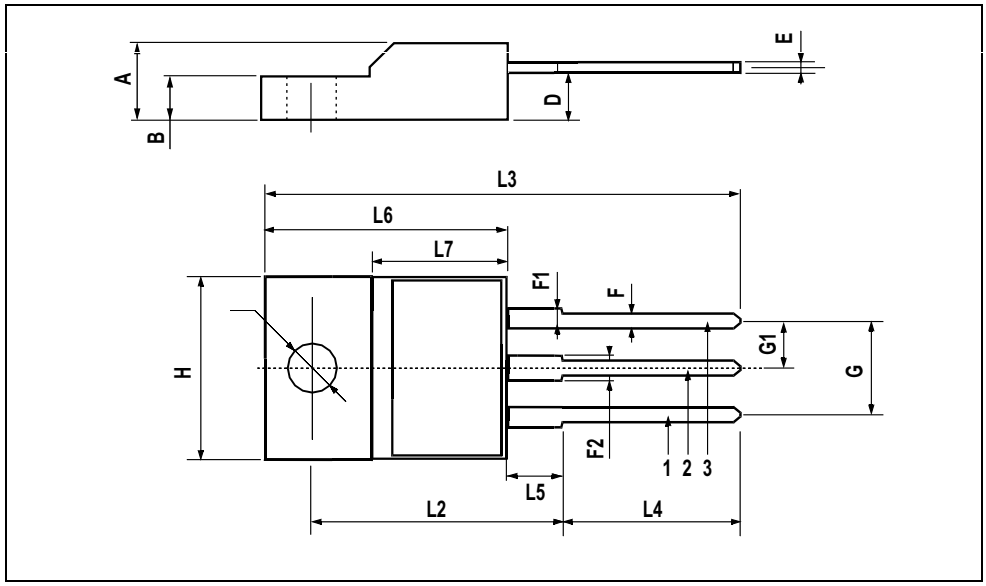
TO-220 MECHANICAL DATA

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



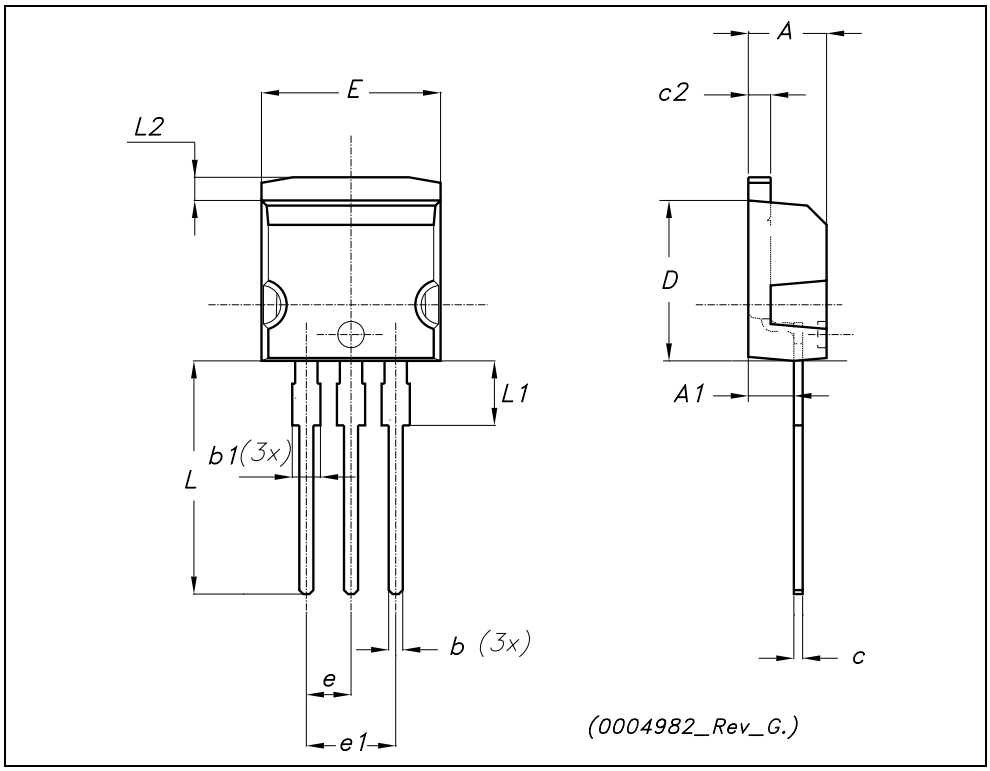
TO-220FP MECHANICAL DATA

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



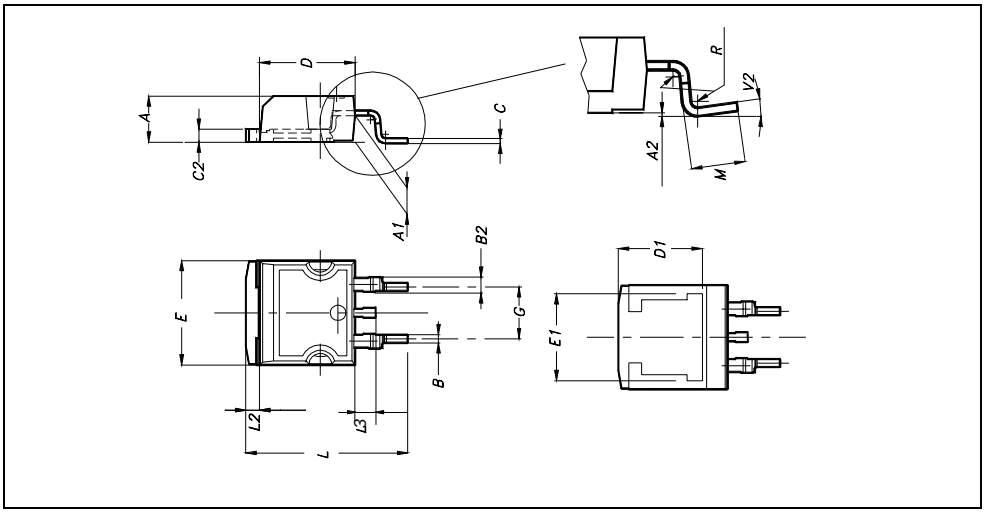
TO-262 (I^2PAK) MECHANICAL DATA

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



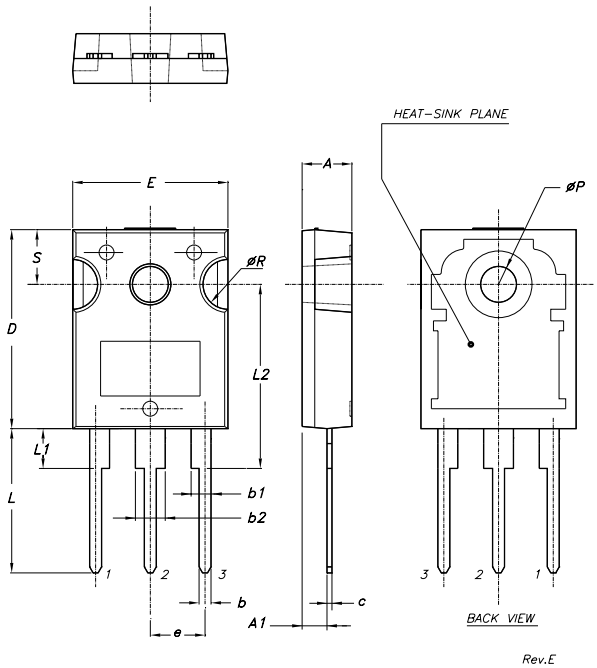
D²PAK MECHANICAL DATA

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	0º		4º			



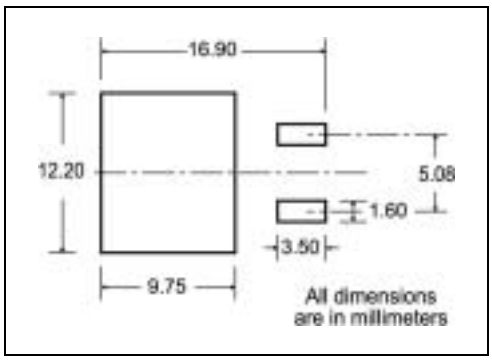
TO-247 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.85		5.15	0.19		0.20
A1	2.20		2.60	0.086		0.102
b	1.0		1.40	0.039		0.055
b1	2.0		2.40	0.079		0.094
b2	3.0		3.40	0.118		0.134
c	0.40		0.80	0.015		0.03
D	19.85		20.15	0.781		0.793
E	15.45		15.75	0.608		0.620
e		5.45			0.214	
L	14.20		14.80	0.560		0.582
L1	3.70		4.30	0.14		0.17
L2		18.50			0.728	
øP	3.55		3.65	0.140		0.143
øR	4.50		5.50	0.177		0.216
S		5.50			0.216	

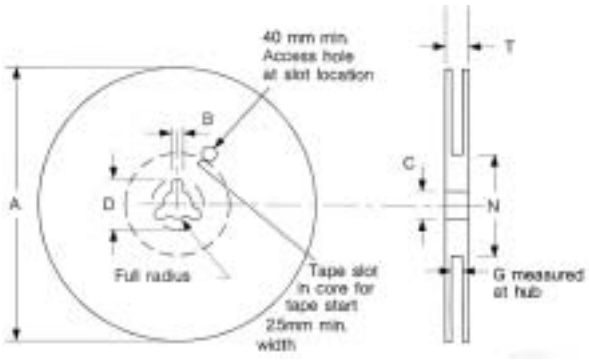


5 Packing mechanical data

D²PAK FOOTPRINT



TAPE AND REEL SHIPMENT



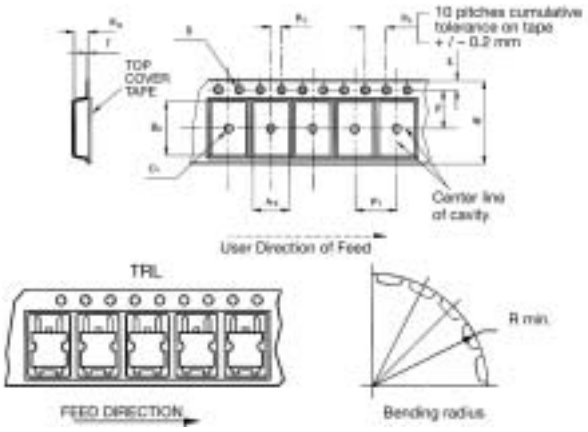
REEL MECHANICAL DATA

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		0795	
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



* on sales type

6 Revision History

Date	Revision	Changes
12-Sep-2005	2	Inserted ecopack indication