STP10NK60ZFP

N-CHANNEL 600V-0.65Ω-10A - TO220/FP-D²/I²PAK-TO-247
Zener-Protected SuperMESH™ MOSFET

General features

Type	V_{DSS}	$R_{DS(on)}$	I_D	Pw
STB10NK60Z	600 V	<0.75 Ω	10 A	115
STB10NK60Z-1	600 V	<0.75 Ω	10 A	115
STP10NK60ZFP	600 V	<0.75 Ω	10 A	35
STP10NK60Z	600 V	<0.75 Ω	10 A	115
STW10NK60Z	600 V	<0.75 Ω	10 A	156

- TYPICAL $R_{DS(on)}$ = 0.65 Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- GATE CHARGE MINIMIZED
- VERY LOW INTRINSIC CAPACITANCES
- VERY GOOD MANUFACTURING REPEABILITY

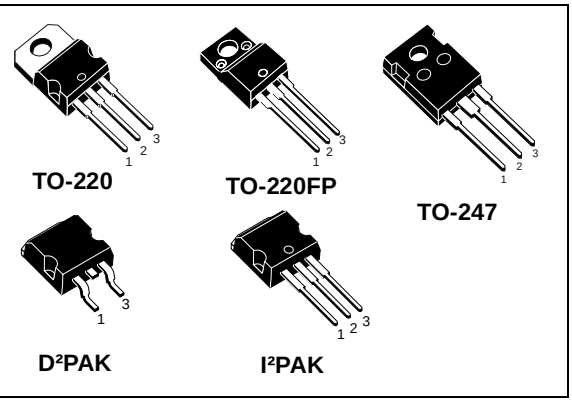
Description

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. Such series complements ST full range of high voltage MOSFETs including revolutionary MDmesh™ products.

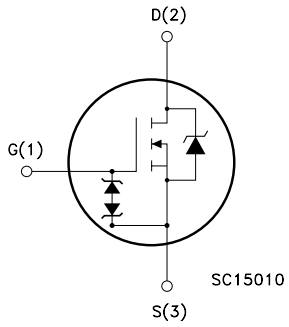
Applications

- HIGH CURRENT, HIGH SPEED SWITCHING
- IDEAL FOR OFF-LINE POWER SUPPLIES, ADAPTOR AND PFC
- LIGHTING

Package



Internal schematic diagram



1 Absolute maximum ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value			Unit
		TO-220/D²/I²PAK	TO-220FP	TO-247	
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	10	10 (*Note* 3)	10	A
I_D	Drain Current (continuous) at T_C = 100°C	5.7	5.7 (*Note* 3)	5.7	A
I_{DM} *Note* 2	Drain Current (pulsed)	36	36 (*Note* 3)	36	A
P_{TOT}	Total Dissipation at T_C = 25°C	115	35	156	W
	Derating Factor	0.92	0.28	1.25	W/°C
Vesd(G-S)	G-S ESD (HBM C=100pF, R=1.5kΩ)	4000			V
dv/dt *Note* 1	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	D²PAK	TO-220FP	TO-247	Unit
Rthj-case	Thermal Resistance Junction-case Max	1.09		3.6	0.8	°C/W
Rthj-pcb	Thermal Resistance Junction-pcb Max (when mounted on minimum Footprint)		60			°C/W
Rthj-amb	Thermal Resistance Junction-amb Max	62.5			50	°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)	9	A
E_{AS}	Single Pulse Avalanche Energy (starting Tj=25°C, I_D=I_{AR}, V_{DD}= 50V)	300	mJ
E_{AR}	Repetitive Avalanche Energy (pulse width limited by Tj max)	3.5	mJ

Table 4. Gate-source zener diode

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

2 Electrical characteristics

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

Table 5. On/Off

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	I_D = 250µA, V_{GS}= 0	600			V
I_{DSS}	Zero Gate Voltage Drain Current (V_{GS} = 0)	V_{DS} = Max Rating,			1 50	µA
I_{GSS}	Gate Body Leakage Current (V_{DS} = 0)	V_{GS} = ±15V, V_{DS} = 0			±10	µA
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS}= V_{GS}, I_D = 250 µA	3	3.75	4.5	V
$R_{DS(on)}$	Static Drain-Source On Resistance	V_{GS}= 10 V, I_D= 20 A		0.65	0.75	Ω

Table 6. Dynamic

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g_{fs} *Note* 4	Forward Transconductance	V_{DS} =15V, I_D = 4.5A		7.8		S
C_{iss} C_{oss} C_{rss}	Input Capacitance Output Capacitance Reverse Transfer Capacitance	V_{DS} =25V, f=1 MHz, V_{GS}=0		1370 156 37		pF pF pF
$C_{oss\ eq.}$ *Note* 5	Equivalent Ouput Capacitance	V_{GS}=0, V_{DS} =0V to 480V		90		pF
Q_g Q_{gs} Q_{gd}	Total Gate Charge Gate-Source Charge Gate-Drain Charge	V_{DD}=480V, I_D = 8A V_{GS} =10V (see Figure 19)		50 10 25	70	nC nC nC

Table 7. Switching on/off

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=4A, R_G=4.7Ω, V_{GS}=10V (see Figure 20)		20 20		ns ns
$t_{d(off)}$ t_f	Turn-off Delay Time Fall Time	V_{DD}=300 V, I_D=4A, R_G=4.7Ω, V_{GS}=10V (see Figure 20)		55 30		ns ns
$t_{r(Voff)}$ t_f t_c	Off-voltage Rise Time Fall Time Cross-over Time	V_{DD}=480 V, I_D=8A, R_G=4.7Ω, V_{GS}=10V (see Figure 20)		18 18 36		ns ns ns

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 36	A A
V_{SD} *Note* 4	Forward on Voltage	I_{SD}=10A, V_{GS}=0			1.6	V
t_{rr} Q_{rr} I_{RRM}	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	I_{SD}=8A, di/dt = 100A/µs, V_{DD}=40 V, Tj=150°C		570 4.3 15		ns µC A

(1) I_{SD} ≤10A, di/dt ≤200A/µs, $V_{DD} \leq V_{(BR)DSS}$, $T_j \leq T_{JMAX}$

(2) Pulse width limited by safe operating area

(3) Limited only by maximum temperature allowed

(4) Pulsed: pulse duration = 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%

2.1 Typical characteristics

Figure 1. Safe Operating Area for TO-220/D²/I²PAK

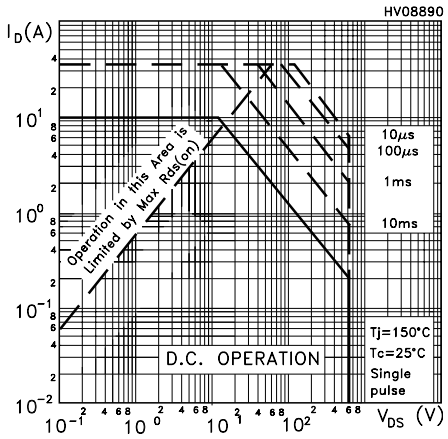


Figure 2. Thermal Impedanc for TO-220/D²/I²PAK

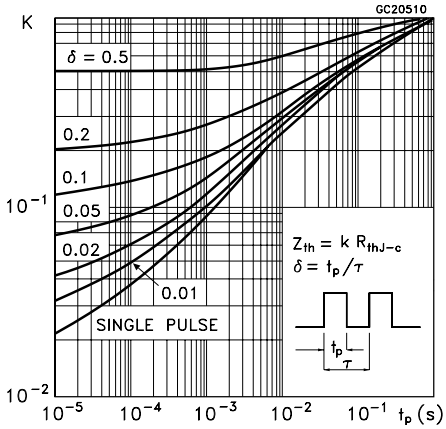


Figure 3. Safe Operating Area for TO-220FP

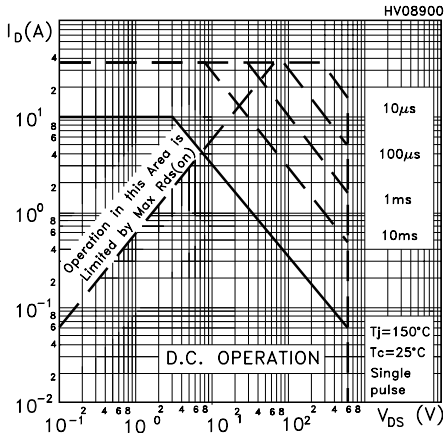


Figure 4. Thermal Impedance for TO-220FP

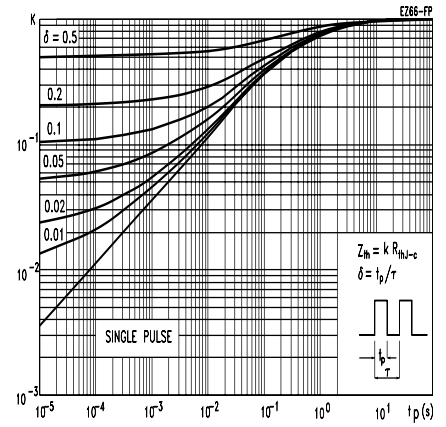


Figure 5. Safe Operating Area for TO-247

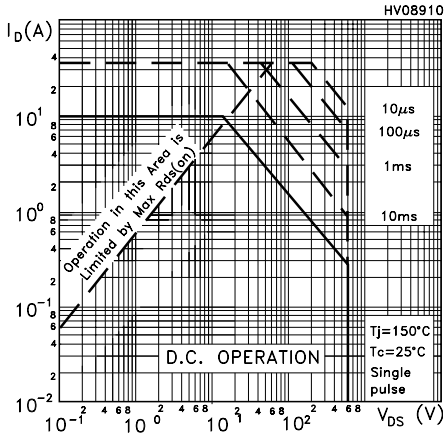


Figure 6. Thermal Impedance for TO-247

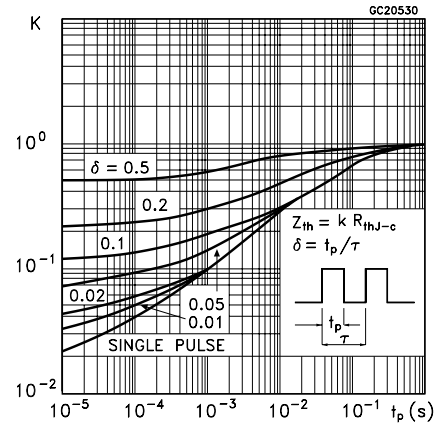


Figure 7. Output Characteristics

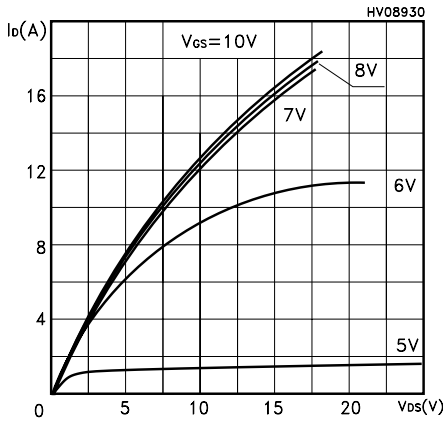


Figure 8. Transfer Characteristics

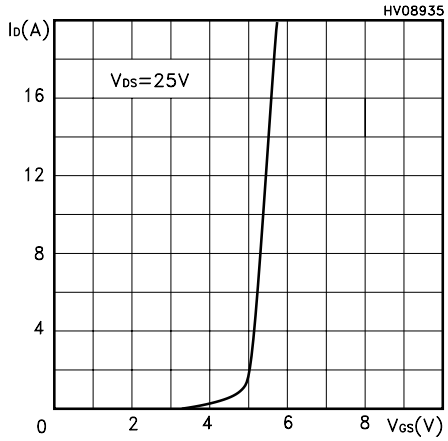


Figure 9. Transconductance

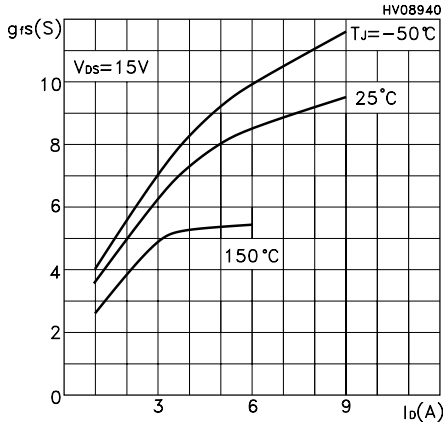


Figure 10. Static Drain-Source on Resistance

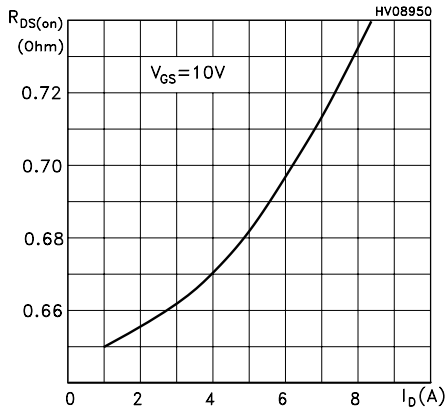


Figure 11. Gate Charge vs Gate -Source Voltage

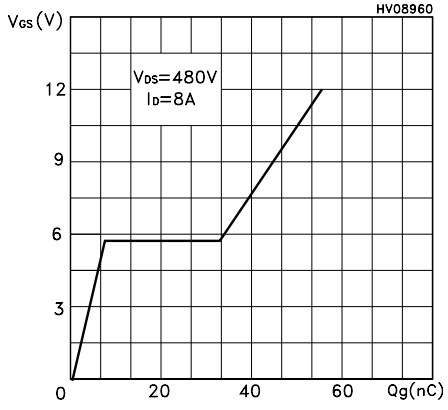


Figure 12. Capacitance Variations

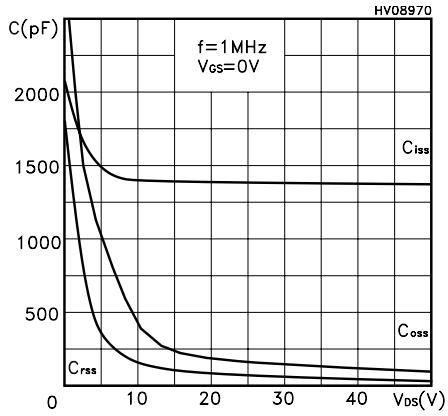


Figure 13. Normalized Gate Threshold Voltage vs Temperatute

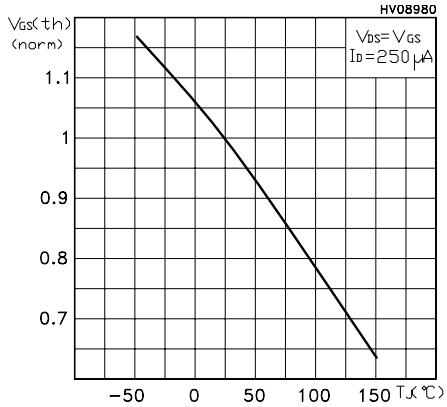


Figure 14. Normalized on Resistance vs Temperature

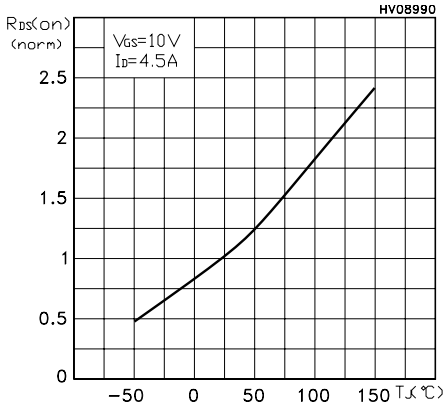


Figure 15. Source-drain Diode Forward Characteristics

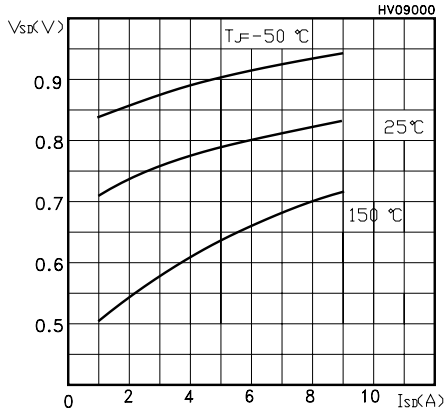


Figure 16. Normalized BVDSS vs Temperature

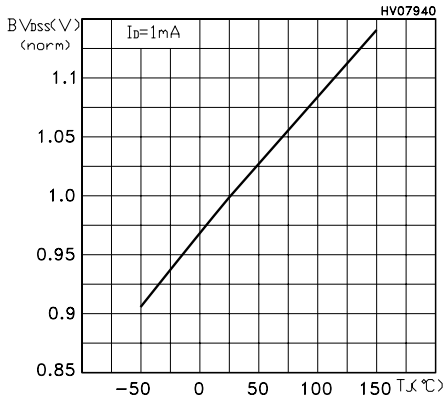
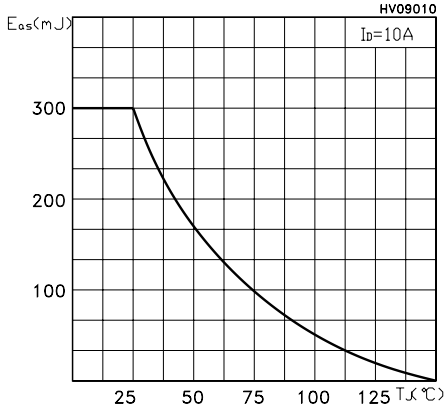


Figure 17. Maximum Avalanche Energy vs Temperature



3 Test circuits

Figure 18. Switching Times Test Circuit For Resistive Load

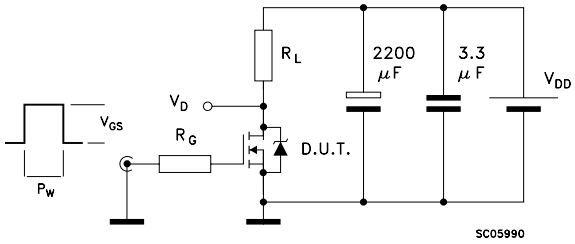


Figure 19. Gate Charge Test Circuit

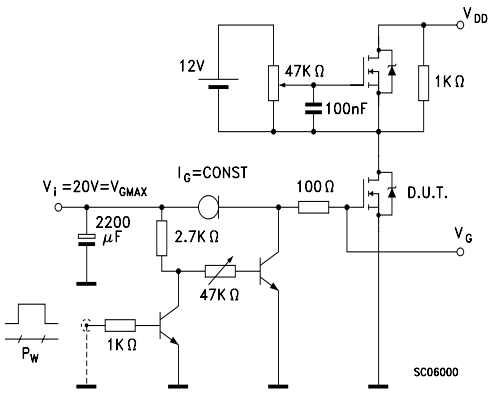
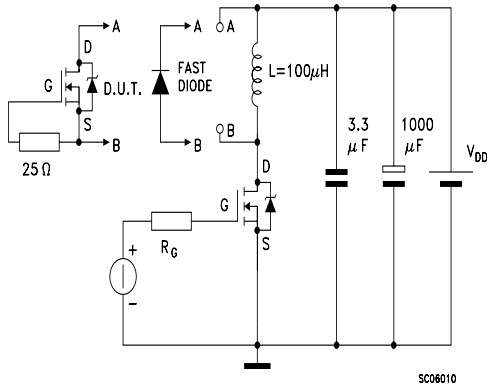
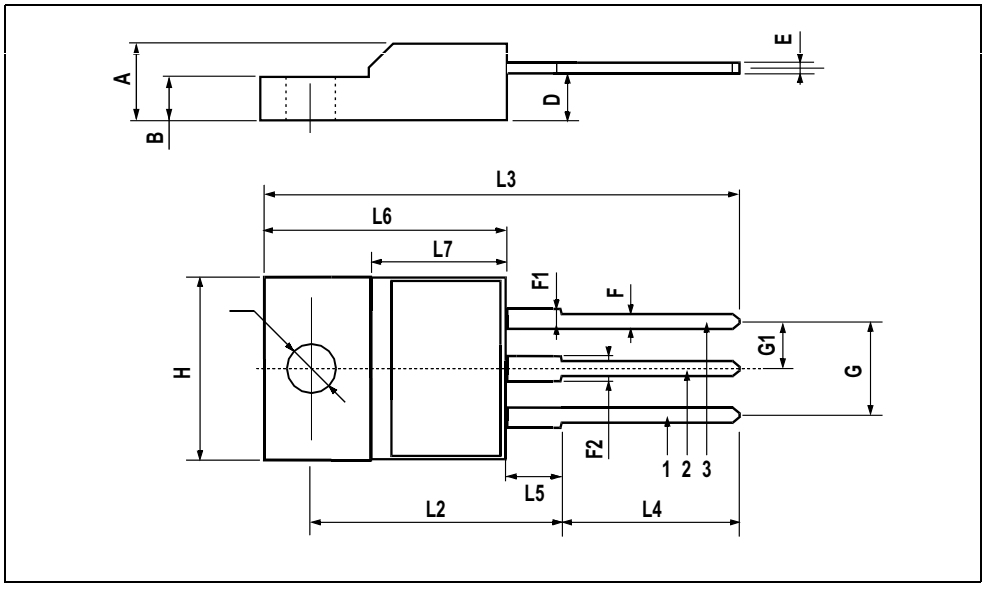


Figure 20. Test Circuit For Indictive Load Switching and Diode Recovery Times



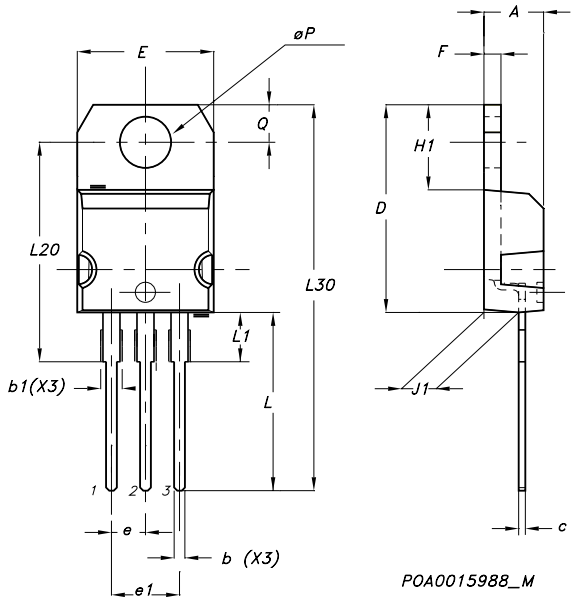
TO-220FP MECHANICAL DATA

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



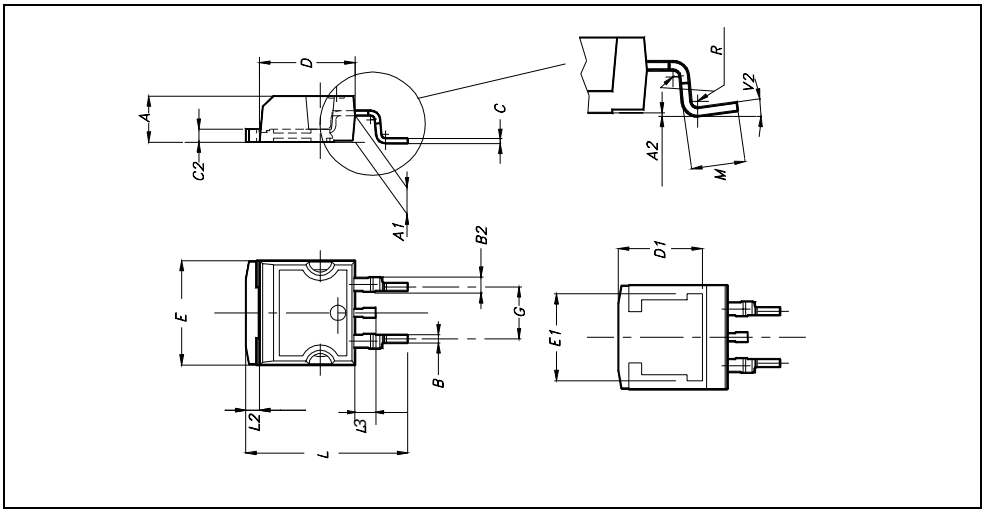
TO-220 MECHANICAL DATA

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



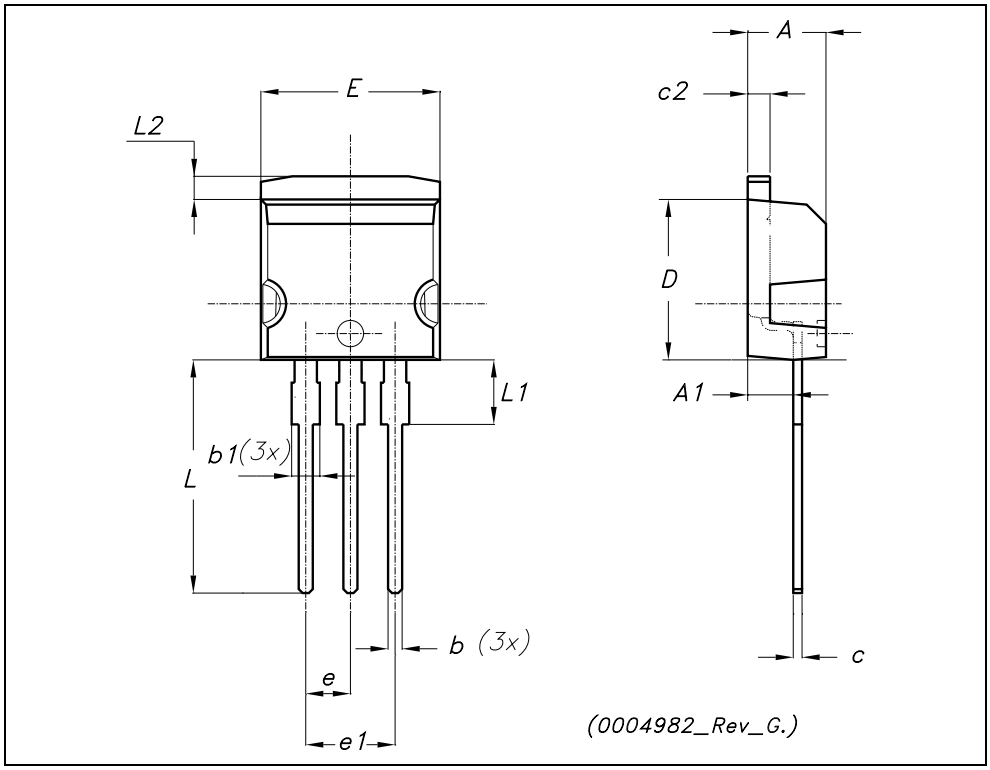
D^2PAK MECHANICAL DATA

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			



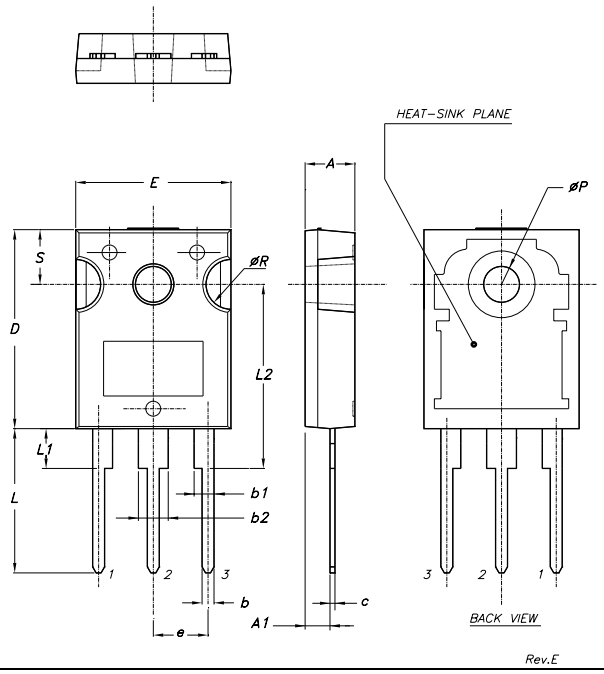
TO-262 (I^2PAK) MECHANICAL DATA

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



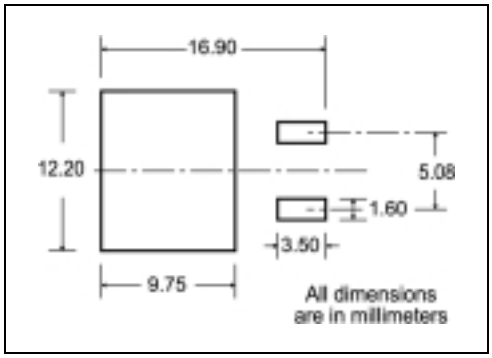
TO-247 MECHANICAL DATA

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	

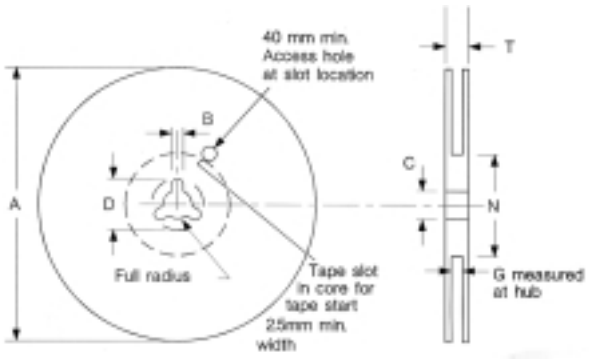


5 Packing mechanical data

D²PAK FOOTPRINT



TAPE AND REEL SHIPMENT



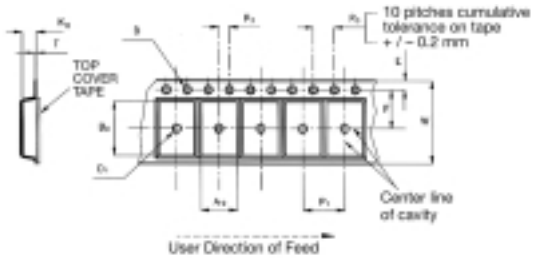
REEL MECHANICAL DATA

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