



STP4NK80Z - STP4NK80ZFP STD4NK80Z - STD4NK80Z-1

N-CHANNEL 800V - 3Ω - 3A TO-220/TO-220FP/DPAK/IPAK

Zener-Protected SuperMESH™ MOSFET

Table 1: General Features

TYPE	V _{DSS}	R _{DS(on)}	I _D	P _w
STP4NK80Z	800 V	< 3.5 Ω	3 A	80 W
STP4NK80ZFP	800 V	< 3.5 Ω	3 A	25 W
STD4NK80Z	800 V	< 3.5 Ω	3 A	80 W
STD4NK80Z-1	800 V	< 3.5 Ω	3 A	80 W

- TYPICAL R_{DS(on)} = 3 Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- GATE CHARGE MINIMIZED
- VERY LOW INTRINSIC CAPACITANCES
- VERY GOOD MANUFACTURING REPEATABILITY

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, ADAPTORS AND PFC
- LIGHTING

Figure 1: Package

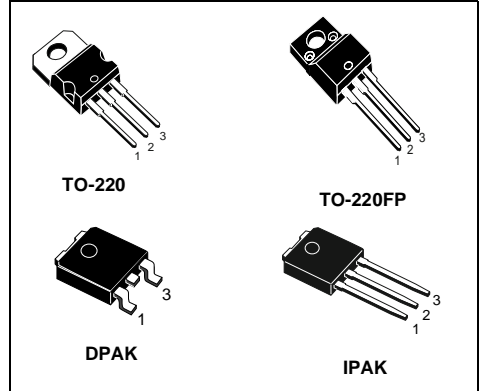


Figure 2: Internal Schematic Diagram

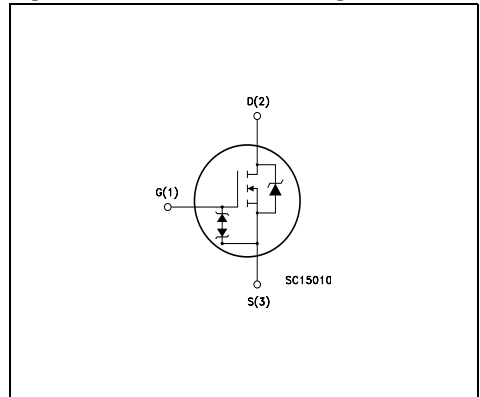


Table 2: Order Codes

SALES TYPE	MARKING	PACKAGE	PACKAGING
STP4NK80Z	P4NK80Z	TO-220	TUBE
STP4NK80ZFP	P4NK80ZFP	TO-220FP	TUBE
STD4NK80ZT4	D4NK80Z	DPAK	TAPE & REEL
STD4NK80Z-1	D4NK80Z	IPAK	TUBE

Table 3: Absolute Maximum ratings

Symbol	Parameter	Value			Unit
		TO-220	TO-220FP	DKPAK/IPAK	
V _{DS}	Drain-source Voltage (V _{GS} = 0)	800			V
V _{DGR}	Drain-gate Voltage (R _{GS} = 20 kΩ)	800			V
V _{GS}	Gate- source Voltage	± 30			V
I _D	Drain Current (continuous) at T _C = 25°C	3	3 (*)	3	A
I _D	Drain Current (continuous) at T _C = 100°C	1.89	1.89 (*)	1.89	A
I _{DM} (*)	Drain Current (pulsed)	12	12 (*)	12	A
P _{TOT}	Total Dissipation at T _C = 25°C	80	25	80	W
	Derating Factor	0.64	0.21	0.64	W/°C
V _{ESD(G-S)}	Gate source ESD(HBM-C=100pF, R=1.5KΩ)	3000			V
dv/dt (1)	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			°C

(●) Pulse width limited by safe operating area

(1) I_{SD} ≤ 4A, di/dt ≤ 200A/μs, V_{DD} ≤ V(BR)DSS, T_j ≤ T_{JMAX}.

(*) Limited only by maximum temperature allowed

Table 4: Thermal Data

		TO-220	TO-220FP	DKPAK/IPAK	
R _{thj-case}	Thermal Resistance Junction-case Max	1.56	5	1.56	°C/W
R _{thj-amb}	Thermal Resistance Junction-ambient Max	62.5		100	°C/W
T _I	Maximum Lead Temperature For Soldering Purpose	300			°C

Table 5: Avalanche Characteristics

Symbol	Parameter	Max Value	Unit
I _{AR}	Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T _j max)	3	A
E _{AS}	Single Pulse Avalanche Energy (starting T _j = 25 °C, I _D = I _{AR} , V _{DD} = 50 V)	190	mJ

Table 6: Gate-Source Zener Diode

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

PROTECTION FEATURES OF GATE-TO-SOURCE ZENER DIODES

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.

ELECTRICAL CHARACTERISTICS ($T_{CASE} = 25^{\circ}C$ UNLESS OTHERWISE SPECIFIED)

Table 7: On /Off

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source Breakdown Voltage	$I_D = 1\text{ mA}, V_{GS} = 0$	800			V
I_{DSS}	Zero Gate Voltage Drain Current ($V_{GS} = 0$)	$V_{DS} = \text{Max Rating}$ $V_{DS} = \text{Max Rating}, T_C = 125^{\circ}C$			1 50	μA μA
I_{GSS}	Gate-body Leakage Current ($V_{DS} = 0$)	$V_{GS} = \pm 20V$			± 10	μA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 50\ \mu A$	3	3.75	4.5	V
$R_{DS(on)}$	Static Drain-source On Resistance	$V_{GS} = 10\text{ V}, I_D = 1.5\text{ A}$		3	3.5	Ω

Table 8: Dynamic

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$g_{fs} (1)$	Forward Transconductance	$V_{DS} = 15\text{ V}, I_D = 1.5\text{ A}$		2.9		S
C_{iss} C_{oss} C_{riss}	Input Capacitance Output Capacitance Reverse Transfer Capacitance	$V_{DS} = 25\text{ V}, f = 1\text{ MHz}, V_{GS} = 0$		575 67 13		pF pF pF
$C_{oss\ eq.} (3)$	Equivalent Output Capacitance	$V_{GS} = 0V, V_{DS} = 0V\text{ to }400\text{ V}$		60		pF
$t_{d(on)}$ t_r $t_{d(off)}$ t_f	Turn-on Delay Time Rise Time Turn-off Delay Time Fall Time	$V_{DD} = 400\text{ V}, I_D = 1.5\text{ A}$ $R_G = 4.7\ \Omega, V_{GS} = 10\text{ V}$ (see Figure 19)		13 12 35 32		ns ns ns ns
$t_{r(voff)}$ t_f t_c	Off-voltage Rise Time Fall Time Cross-over Time	$V_{DD} = 640\text{ V}, I_D = 3\text{ A},$ $R_G = 4.7\ \Omega, V_{GS} = 10\text{ V}$ (see Figure 18)		18 7.5 25		ns ns ns
Q_g Q_{gs} Q_{gd}	Total Gate Charge Gate-Source Charge Gate-Drain Charge	$V_{DD} = 640\text{ V}, I_D = 3\text{ A},$ $V_{GS} = 10V$ (see Figure 22)		22.5 4.2 11.3		nC nC nC

Table 9: Source Drain Diode

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{SD} $I_{SDM} (2)$	Source-drain Current Source-drain Current (pulsed)				3 12	A A
$V_{SD} (1)$	Forward On Voltage	$I_{SD} = 3\text{ A}, V_{GS} = 0$			1.6	V
t_{rr} Q_{rr} I_{RRM}	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	$I_{SD} = 3\text{ A}, di/dt = 100\text{ A}/\mu s$ $V_{DD} = 80\text{ V}, T_J = 150^{\circ}C$ (see Figure 20)		400 1520 7.6		ns nC A

Note: 1. Pulsed: Pulse duration = 300 μs , duty cycle 1.5 %.

2. Pulse width limited by safe operating area.

3. $C_{oss\ eq.}$ 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} .

Figure 3: Safe Operating Area for TO-220/ DPAK/IPAK

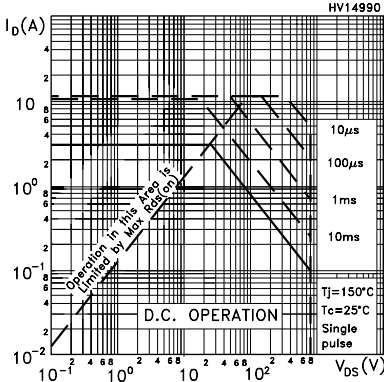


Figure 4: Safe Operating Area for TO-220FP

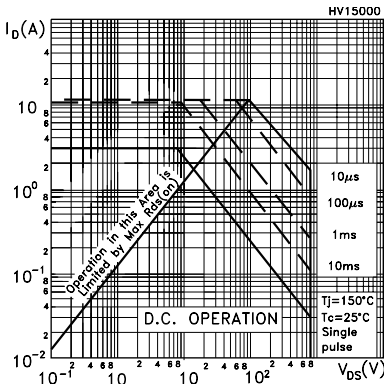


Figure 5: Output Characteristics

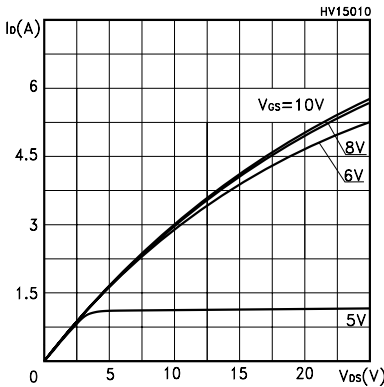


Figure 6: Thermal Impedance for TO-220/ DPAK/IPAK

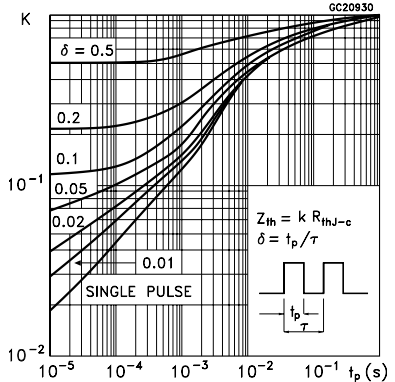


Figure 7: Thermal Impedance for TO-220FP

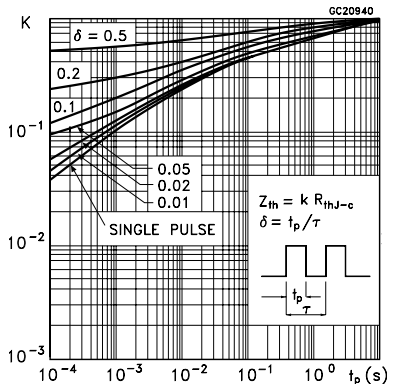


Figure 8: Transfer Characteristics

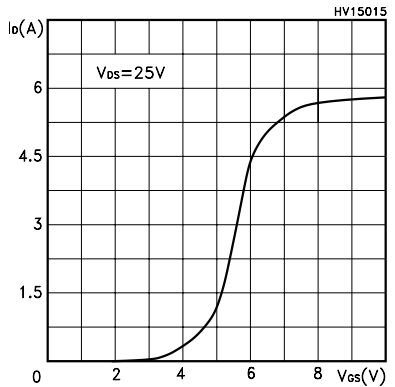


Figure 9: Transconductance

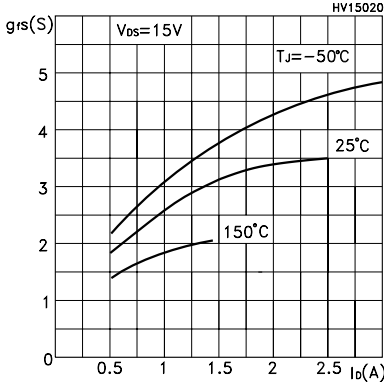


Figure 10: Gate Charge vs Gate-source Voltage

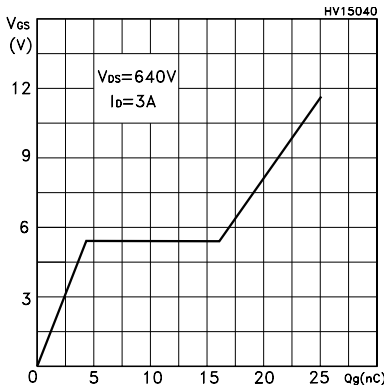


Figure 11: Source-Drain Diode Forward Characteristics

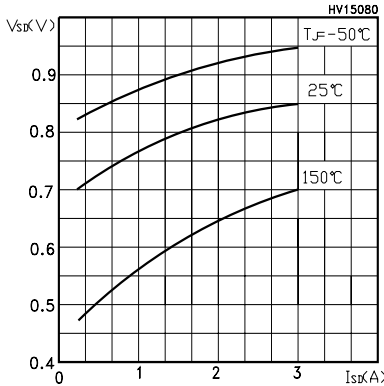


Figure 12: Static Drain-source On Resistance

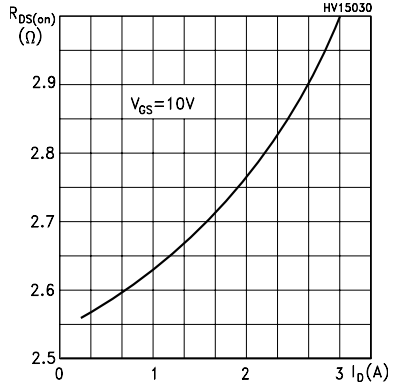


Figure 13: Capacitance Variations

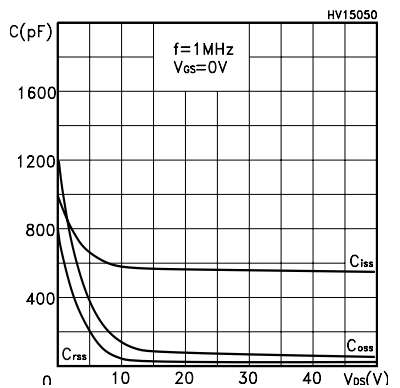


Figure 14: Normalized BV_{DSS} vs Temperature

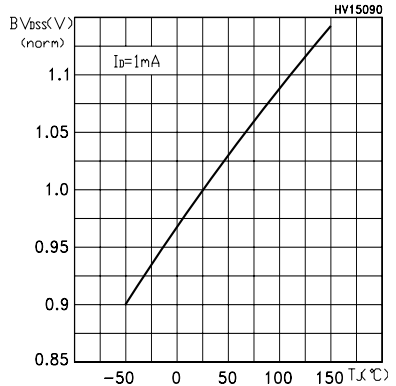


Figure 15: Normalized Gate Threshold Voltage vs Temperature

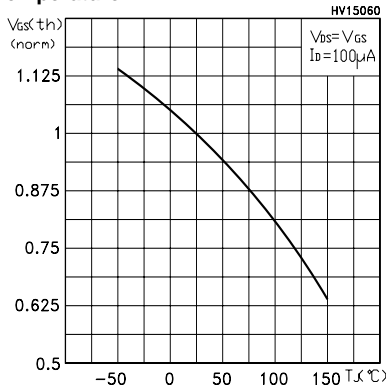


Figure 17: Avalanche Energy vs Temperature

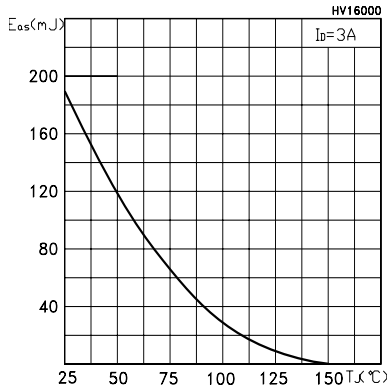


Figure 16: Normalized on Resistance vs Temperature

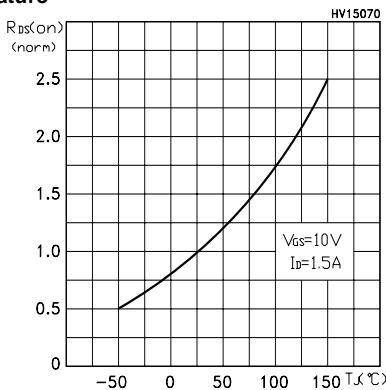


Figure 18: Unclamped Inductive Load Test Circuit

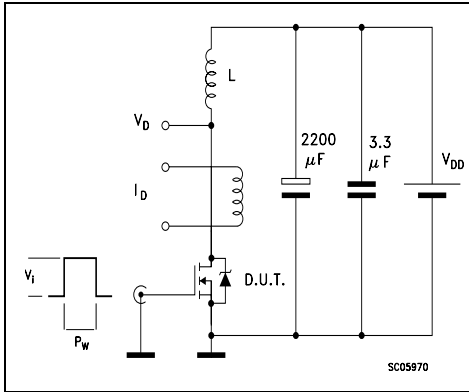


Figure 19: Switching Times Test Circuit For Resistive Load

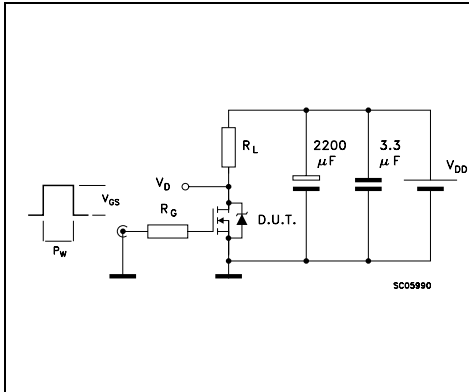


Figure 20: Test Circuit For Inductive Load Switching and Diode Recovery Times

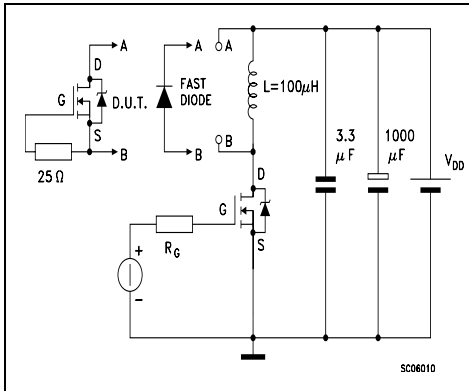


Figure 21: Unclamped Inductive Waeform

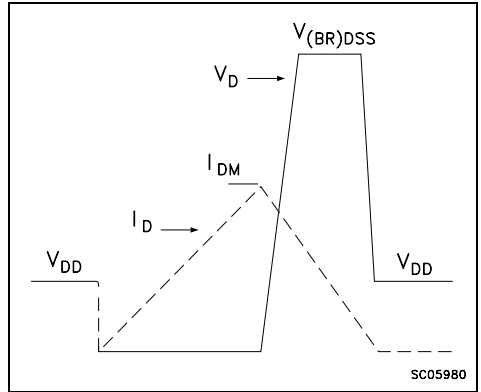
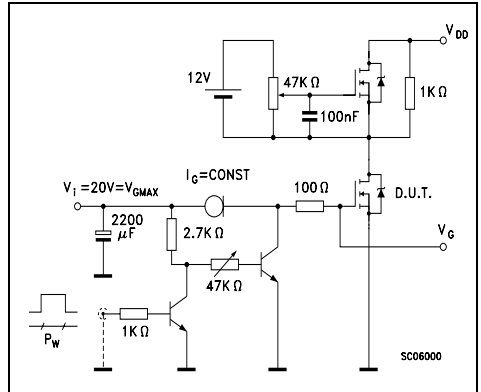
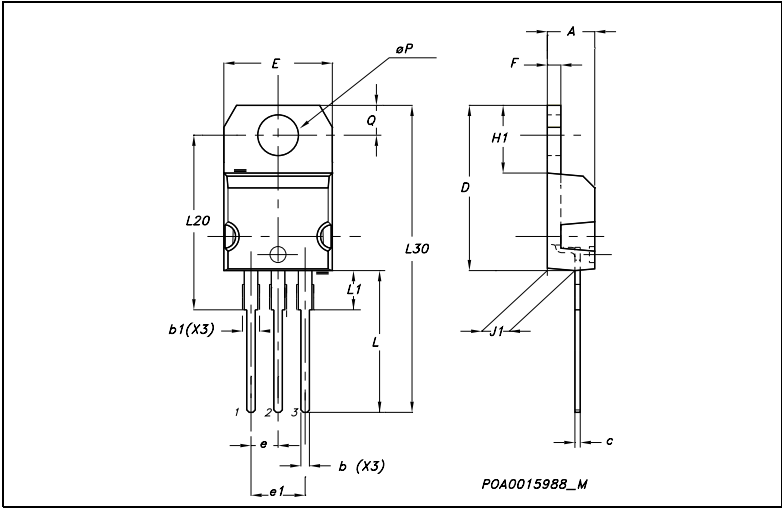


Figure 22: Gate Charge Test Circuit



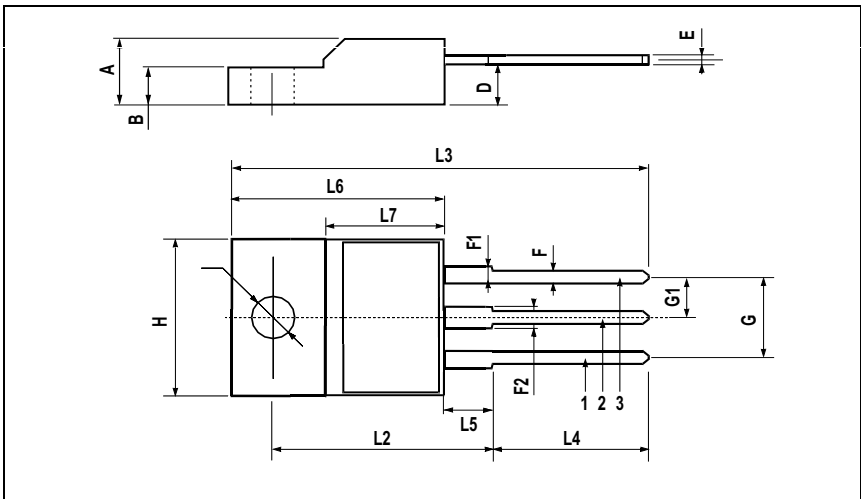
TO-220 MECHANICAL DATA

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



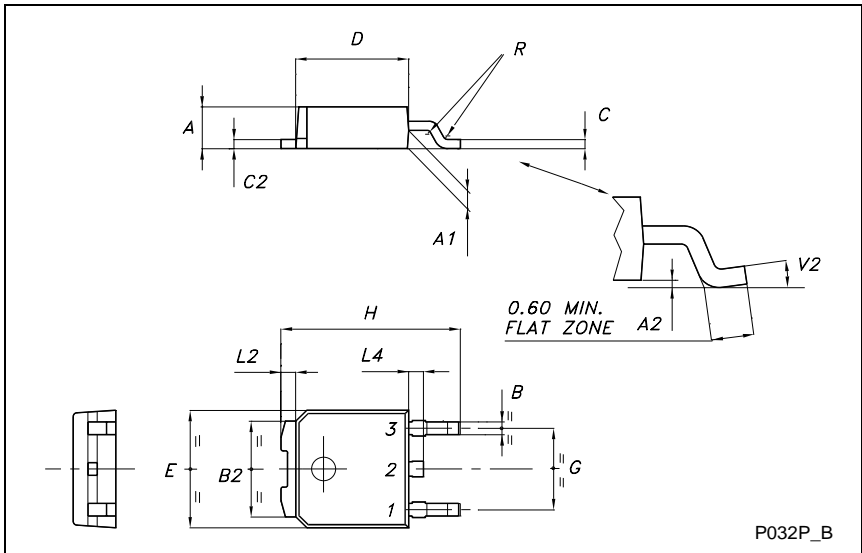
TO-220FP MECHANICAL DATA

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



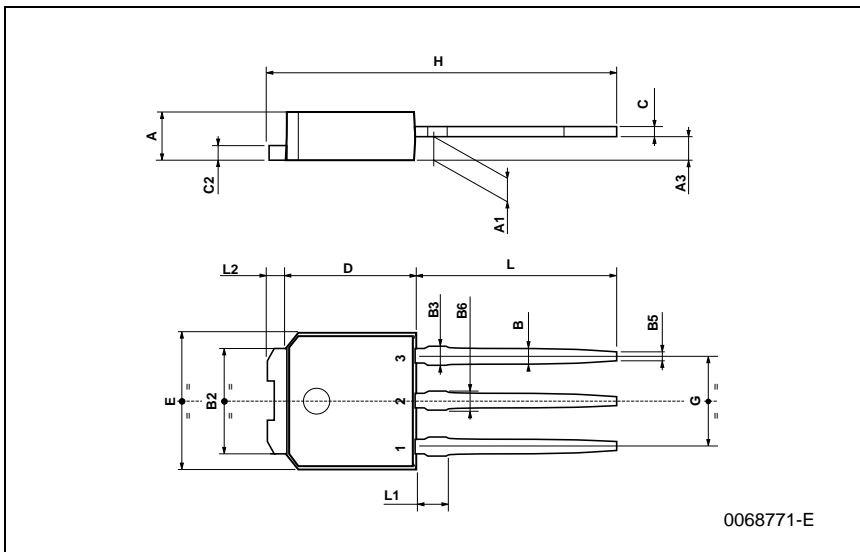
TO-252 (DPAK) MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.20		2.40	0.087		0.094
A1	0.90		1.10	0.035		0.043
A2	0.03		0.23	0.001		0.009
B	0.64		0.90	0.025		0.035
B2	5.20		5.40	0.204		0.213
C	0.45		0.60	0.018		0.024
C2	0.48		0.60	0.019		0.024
D	6.00		6.20	0.236		0.244
E	6.40		6.60	0.252		0.260
G	4.40		4.60	0.173		0.181
H	9.35		10.10	0.368		0.398
L2		0.8			0.031	
L4	0.60		1.00	0.024		0.039
V2	0°		8°	0°		0°

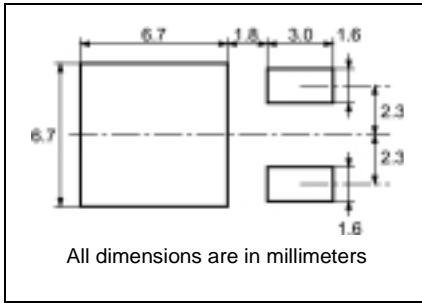


TO-251 (IPAK) MECHANICAL DATA

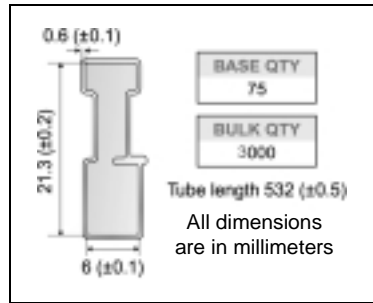
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.2		2.4	0.086		0.094
A1	0.9		1.1	0.035		0.043
A3	0.7		1.3	0.027		0.051
B	0.64		0.9	0.025		0.031
B2	5.2		5.4	0.204		0.212
B3			0.85			0.033
B5		0.3			0.012	
B6			0.95			0.037
C	0.45		0.6	0.017		0.023
C2	0.48		0.6	0.019		0.023
D	6		6.2	0.236		0.244
E	6.4		6.6	0.252		0.260
G	4.4		4.6	0.173		0.181
H	15.9		16.3	0.626		0.641
L	9		9.4	0.354		0.370
L1	0.8		1.2	0.031		0.047
L2		0.8	1		0.031	0.039



DPAK FOOTPRINT



TUBE SHIPMENT (no suffix)*



TAPE AND REEL SHIPMENT (suffix "T4")*

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	16.4	18.4	0.645	0.724
N	50		1.968	
T		22.4		0.881

TAPE MECHANICAL DATA

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A0	6.8	7	0.267	0.275
B0	10.4	10.6	0.409	0.417
B1		12.1		0.476
D	1.5	1.6	0.059	0.063
D1	1.5		0.059	
E	1.65	1.85	0.065	0.073
F	7.4	7.6	0.291	0.299
K0	2.55	2.75	0.100	0.108
P0	3.9	4.1	0.153	0.161
P1	7.9	8.1	0.311	0.319
P2	1.9	2.1	0.075	0.082
R	40		1.574	
W	15.7	16.3	0.618	0.641

BASE QTY 2500 **BULK QTY** 2500

* on sales type

Table 10: Revision History

Date	Revision	Description of Changes
24-Mar-2005	2	Final version

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