

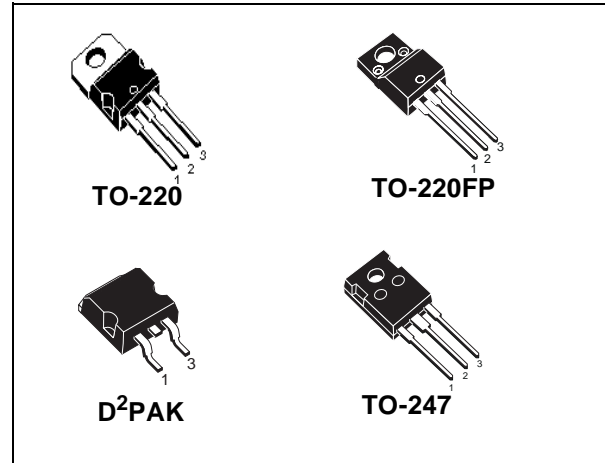


# STP6NK90Z - STP6NK90ZFP STB6NK90Z - STW7NK90Z

N-CHANNEL 900V - 1.56Ω - 5.8A TO-220/FP/D<sup>2</sup>PAK/TO-247  
Zener-Protected SuperMESH™ Power MOSFET

TYPE	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>	P <sub>w</sub>
STP6NK90Z	900 V	< 2 Ω	5.8 A	140 W
STP6NK90ZFP	900 V	< 2 Ω	5.8 A	30 W
STB6NK90Z	900 V	< 2 Ω	5.8 A	140 W
STW7NK90Z	900 V	< 2 Ω	5.8 A	140 W

- TYPICAL R<sub>DS(on)</sub> = 1.56 Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- GATE CHARGE MINIMIZED
- VERY LOW INTRINSIC CAPACITANCES
- VERY GOOD MANUFACTURING REPEATABILITY



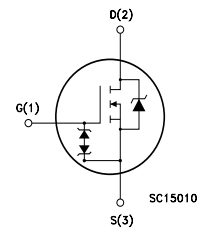
## DESCRIPTION

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

## INTERNAL SCHEMATIC DIAGRAM



## ORDERING INFORMATION

SALES TYPE	MARKING	PACKAGE	PACKAGING
STP6NK90Z	P6NK90Z	TO-220	TUBE
STP6NK90ZFP	P6NK90ZFP	TO-220FP	TUBE
STB6NK90ZT4	B6NK90Z	D <sup>2</sup> PAK	TAPE & REEL
STW7NK90Z	W7NK90Z	TO-247	TUBE

## STP6NK90Z - STP6NK90ZFP - STB6NK90Z - STW7NK90Z

### ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		TO-220/D <sup>2</sup> PAK/TO247	TO220FP	
V <sub>DS</sub>	Drain-source Voltage (V <sub>GS</sub> = 0)	900		V
V <sub>DGR</sub>	Drain-gate Voltage (R <sub>GS</sub> = 20 kΩ)	900		V
V <sub>GS</sub>	Gate- source Voltage	± 30		V
I <sub>D</sub>	Drain Current (continuous) at T <sub>C</sub> = 25°C	5.8	5.8 (*)	A
I <sub>D</sub>	Drain Current (continuous) at T <sub>C</sub> = 100°C	3.65	3.65 (*)	A
I <sub>DM</sub> (•)	Drain Current (pulsed)	23.2	23.2 (*)	A
P <sub>TOT</sub>	Total Dissipation at T <sub>C</sub> = 25°C	140	30	W
	Derating Factor	1.12	0.24	W/°C
V <sub>ESD(G-S)</sub>	Gate source ESD(HBM-C=100pF, R=1.5KΩ)	4000		V
dv/dt (1)	Peak Diode Recovery voltage slope	4.5		V/ns
Viso	Insulation Withstand Voltage (DC)	--	2500	V
T <sub>j</sub> T <sub>stg</sub>	Operating Junction Temperature Storage Temperature	-55 to 150		°C

(•) Pulse width limited by safe operating area

(1) I<sub>SD</sub> ≤ 5.8A, di/dt ≤ 200A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>j</sub> ≤ T<sub>JMAX</sub>.

(\*) Limited only by maximum temperature allowed

### THERMAL DATA

		TO-220	D <sup>2</sup> PAK	TO-220FP	TO-247	Unit
R <sub>thj-case</sub>	Thermal Resistance Junction-case Max	0.89		4.2	0.89	°C/W
R <sub>thj-pcb</sub>	Thermal Resistance Junction-pcb Max (When mounted on minimum Footprint)		60			°C/W
R <sub>thj-amb</sub>	Thermal Resistance Junction-ambient Max	62.5			50	°C/W
T <sub>l</sub>	Maximum Lead Temperature For Soldering Purpose	300				°C

### AVALANCHE CHARACTERISTICS

Symbol	Parameter	Max Value	Unit
I <sub>AR</sub>	Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T <sub>j</sub> max)	5.8	A
E <sub>AS</sub>	Single Pulse Avalanche Energy (starting T <sub>j</sub> = 25 °C, I <sub>D</sub> = I <sub>AR</sub> , V <sub>DD</sub> = 50 V)	300	mJ

### GATE-SOURCE ZENER DIODE

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
BV <sub>GSO</sub>	Gate-Source Breakdown Voltage	I <sub>gs</sub> =± 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.

## STP6NK90Z - STP6NK90ZFP - STB6NK90Z - STW7NK90Z

### ELECTRICAL CHARACTERISTICS (T<sub>CASE</sub> = 25°C UNLESS OTHERWISE SPECIFIED) ON/OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V <sub>(BR)DSS</sub>	Drain-source Breakdown Voltage	I <sub>D</sub> = 1mA, V <sub>GS</sub> = 0	900			V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current (V <sub>GS</sub> = 0)	V <sub>DS</sub> = Max Rating V <sub>DS</sub> = Max Rating, T <sub>C</sub> = 125 °C			1 50	μA μA
I <sub>GSS</sub>	Gate-body Leakage Current (V <sub>DS</sub> = 0)	V <sub>GS</sub> = ± 20V			±10	μA
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 100μA	3	3.75	4.5	V
R <sub>DS(on)</sub>	Static Drain-source On Resistance	V <sub>GS</sub> = 10V, I <sub>D</sub> = 2.9 A		1.56	2	Ω

### DYNAMIC

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g <sub>fs</sub> (1)	Forward Transconductance	V <sub>DS</sub> = 15V, I <sub>D</sub> = 2.9 A		5		S
C <sub>iss</sub> C <sub>oss</sub> C <sub>rss</sub>	Input Capacitance Output Capacitance Reverse Transfer Capacitance	V <sub>DS</sub> = 25V, f = 1 MHz, V <sub>GS</sub> = 0		1350 130 26		pF pF pF
C <sub>oss eq.</sub> (3)	Equivalent Output Capacitance	V <sub>GS</sub> = 0V, V <sub>DS</sub> = 0V to 720V		70		pF

### SWITCHING ON

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t <sub>d(on)</sub> t <sub>r</sub>	Turn-on Delay Time Rise Time	V <sub>DD</sub> = 450 V, I <sub>D</sub> = 3 A R <sub>G</sub> = 4.7Ω, V <sub>GS</sub> = 10 V (Resistive Load see, Figure 3)		17 20		ns ns
Q <sub>g</sub> Q <sub>gs</sub> Q <sub>gd</sub>	Total Gate Charge Gate-Source Charge Gate-Drain Charge	V <sub>DD</sub> = 720 V, I <sub>D</sub> = 5.8 A, V <sub>GS</sub> = 10V		46.5 8.5 25	60.5	nC nC nC

### SWITCHING OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t <sub>d(off)</sub> t <sub>f</sub>	Turn-off Delay Time Fall Time	V <sub>DD</sub> = 450 V, I <sub>D</sub> = 3 A R <sub>G</sub> = 4.7Ω, V <sub>GS</sub> = 10 V (Resistive Load see, Figure 3)		45 20		ns ns
t <sub>r(Voff)</sub> t <sub>f</sub> t <sub>c</sub>	Off-voltage Rise Time Fall Time Cross-over Time	V <sub>DD</sub> = 720V, I <sub>D</sub> = 5.8 A, R <sub>G</sub> = 4.7Ω, V <sub>GS</sub> = 10V (Inductive Load see, Figure 5)		11 12 20		ns ns ns

### SOURCE DRAIN DIODE

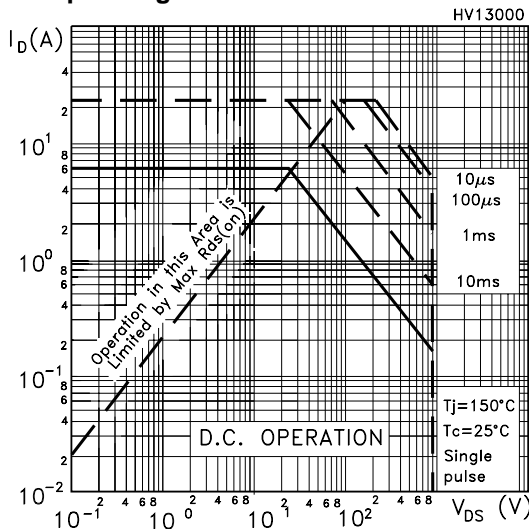
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I <sub>SD</sub> I <sub>SDM</sub> (2)	Source-drain Current Source-drain Current (pulsed)				5.8 23.2	A A
V <sub>SD</sub> (1)	Forward On Voltage	I <sub>SD</sub> = 5.8 A, V <sub>GS</sub> = 0			1.6	V
t <sub>rr</sub> Q <sub>rr</sub> I <sub>RRM</sub>	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	I <sub>SD</sub> = 5.8 A, di/dt = 100A/μs V <sub>DD</sub> = 36V, T <sub>J</sub> = 150°C (see test circuit, Figure 5)		840 5880 14		ns nC A

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

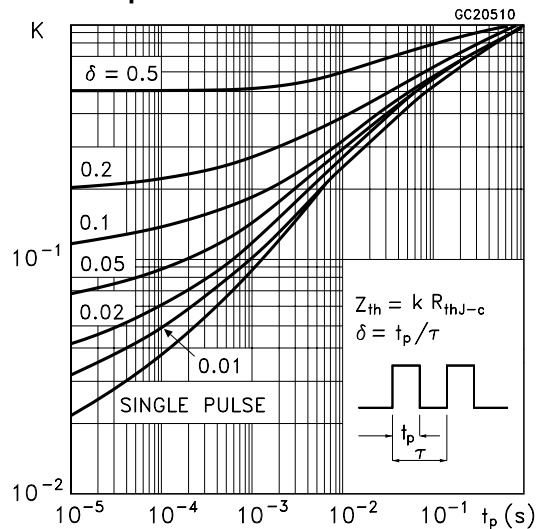
2. Pulse width limited by safe operating area.

3. C<sub>oss eq.</sub> is defined as a constant equivalent capacitance giving the same charging time as C<sub>oss</sub> when V<sub>DS</sub> increases from 0 to 80% V<sub>DSS</sub>.

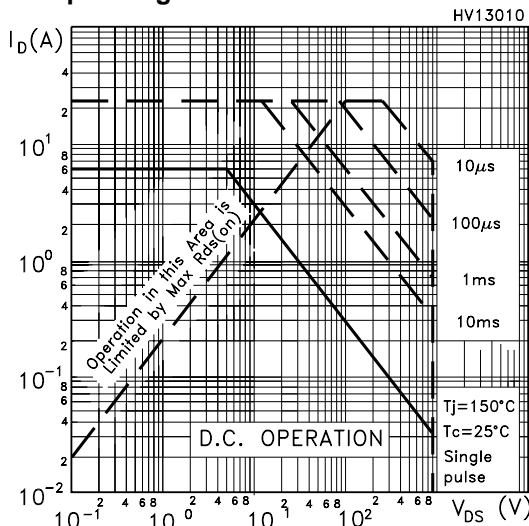
Safe Operating Area For TO-220/D2PAK



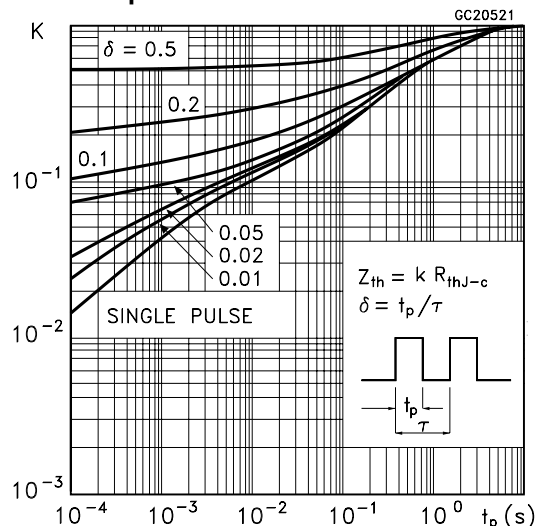
Thermal Impedance For TO-220/D2PAK



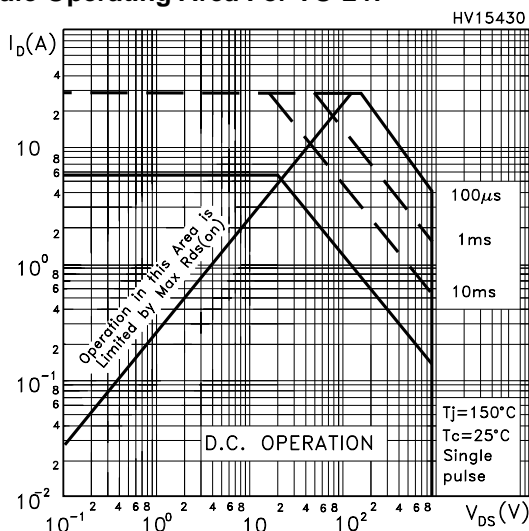
Safe Operating Area For TO-220FP



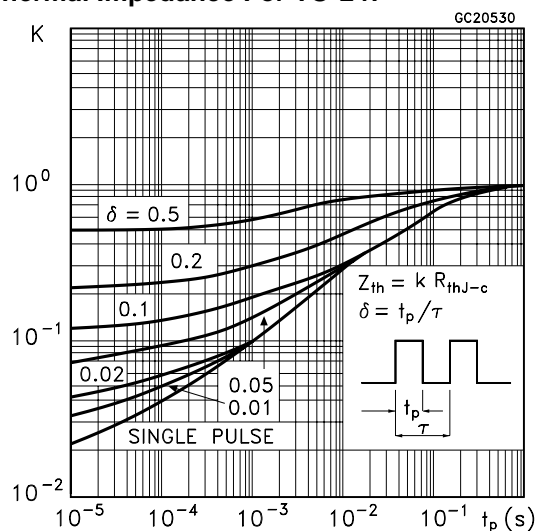
Thermal Impedance For TO-220FP



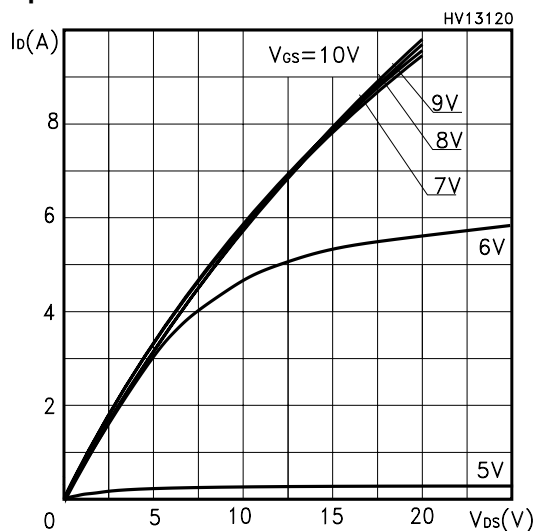
Safe Operating Area For TO-247



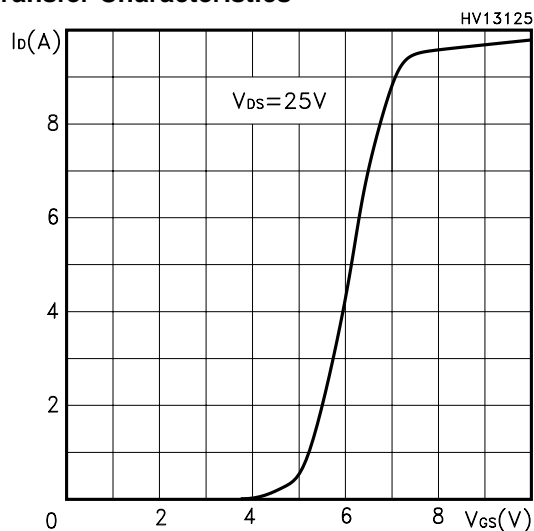
Thermal Impedance For TO-247



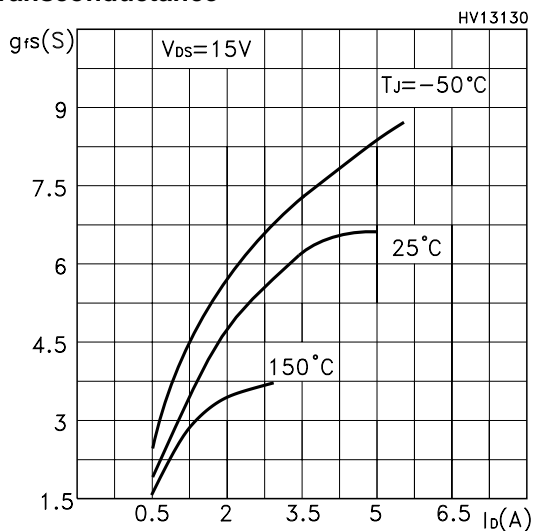
**Output Characteristics**



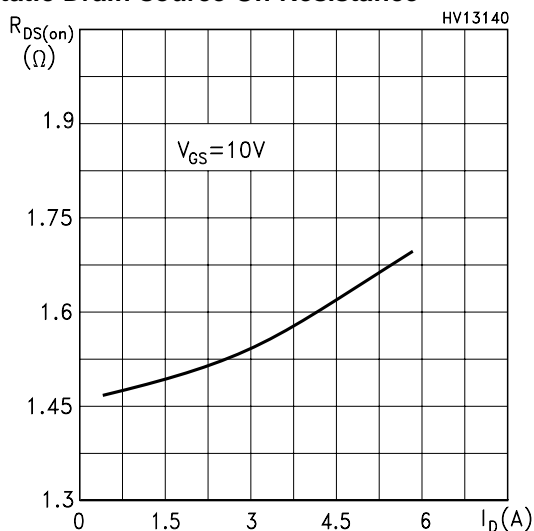
**Transfer Characteristics**



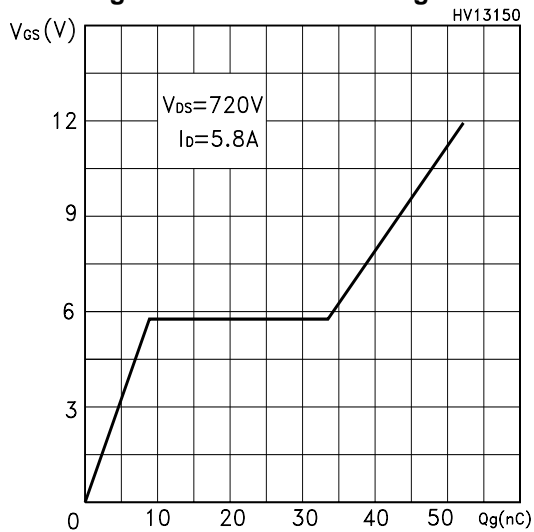
**Transconductance**



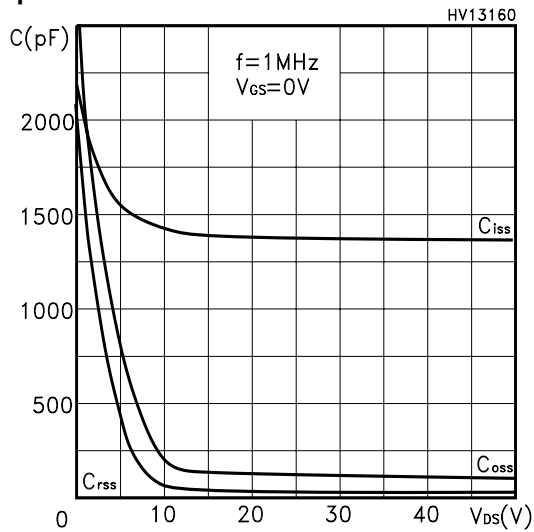
**Static Drain-source On Resistance**



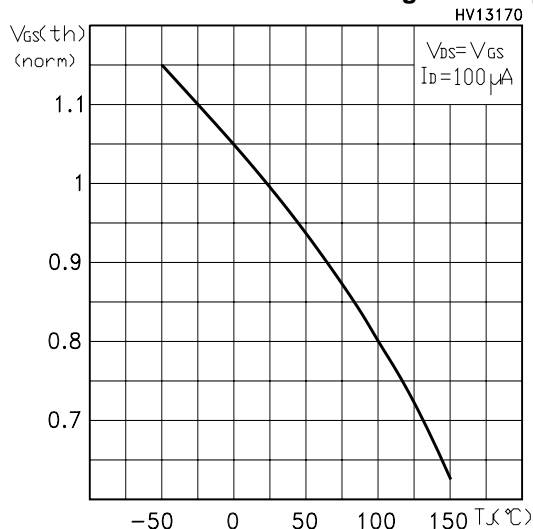
**Gate Charge vs Gate-source Voltage**



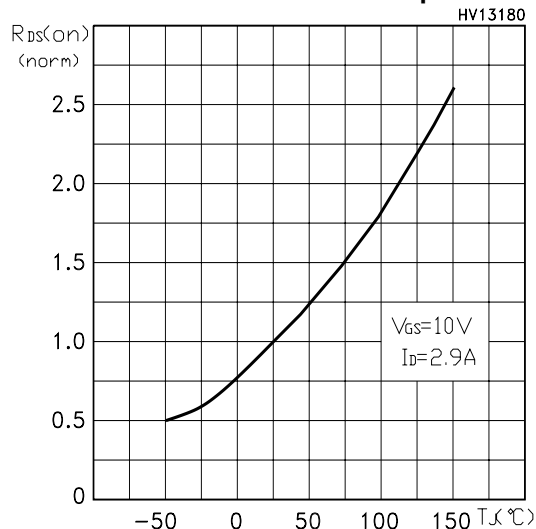
**Capacitance Variations**



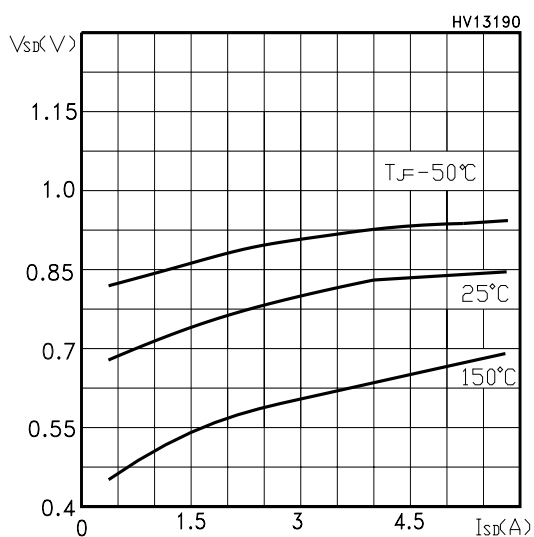
Normalized Gate Threshold Voltage vs Temp.



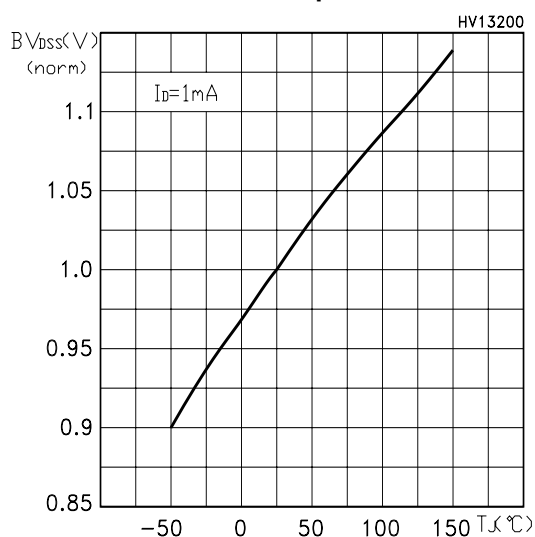
Normalized On Resistance vs Temperature



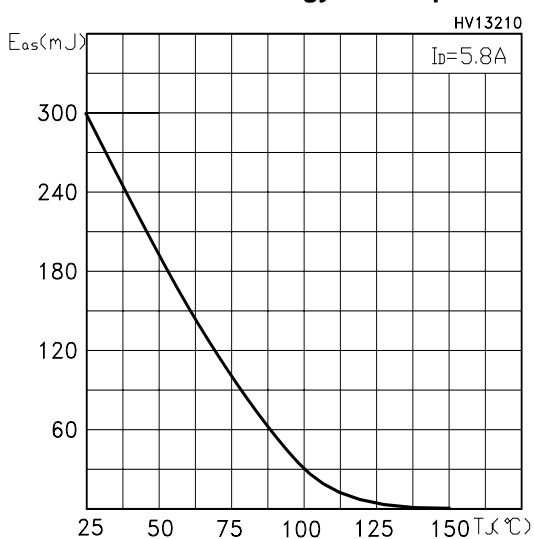
Source-drain Diode Forward Characteristics



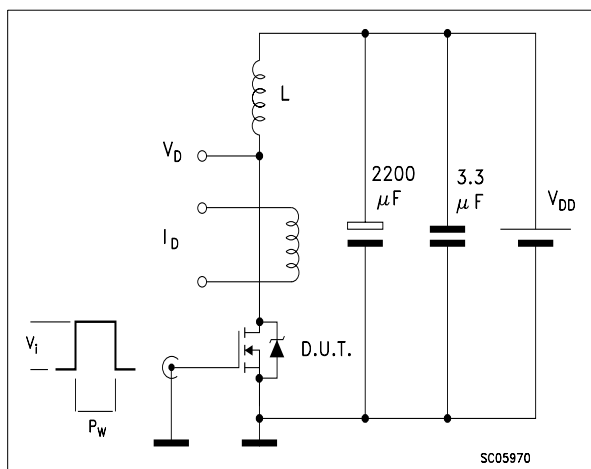
Normalized BVDSS vs Temperature



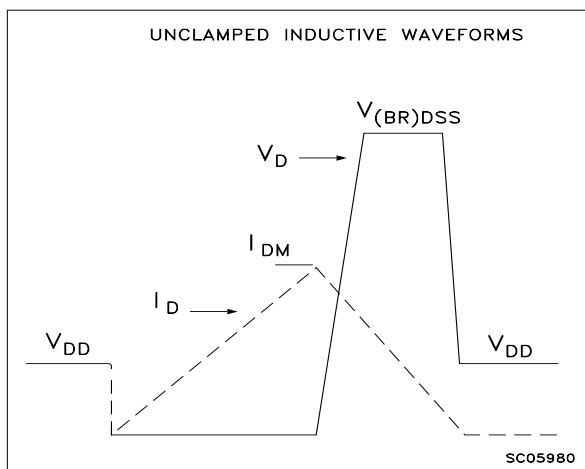
Maximum Avalanche Energy vs Temperature



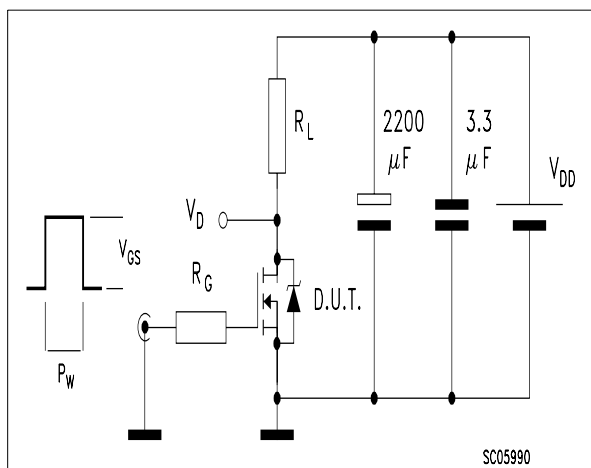
**Fig. 1: Unclamped Inductive Load Test Circuit**



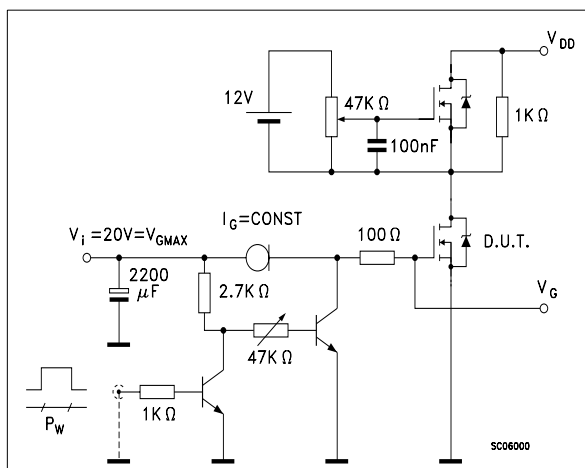
**Fig. 2: Unclamped Inductive Waveform**



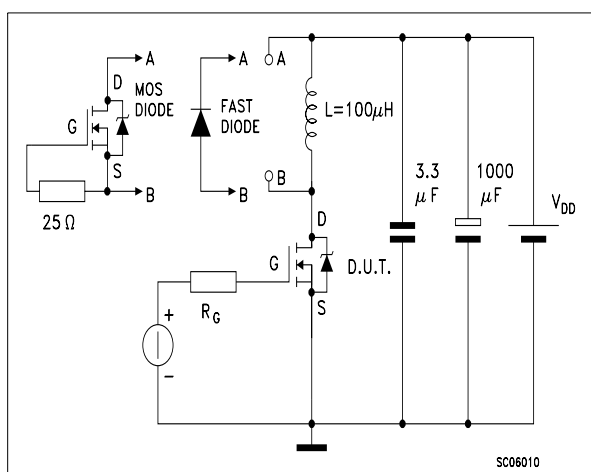
**Fig. 3: Switching Times Test Circuit For Resistive Load**



**Fig. 4: Gate Charge test Circuit**

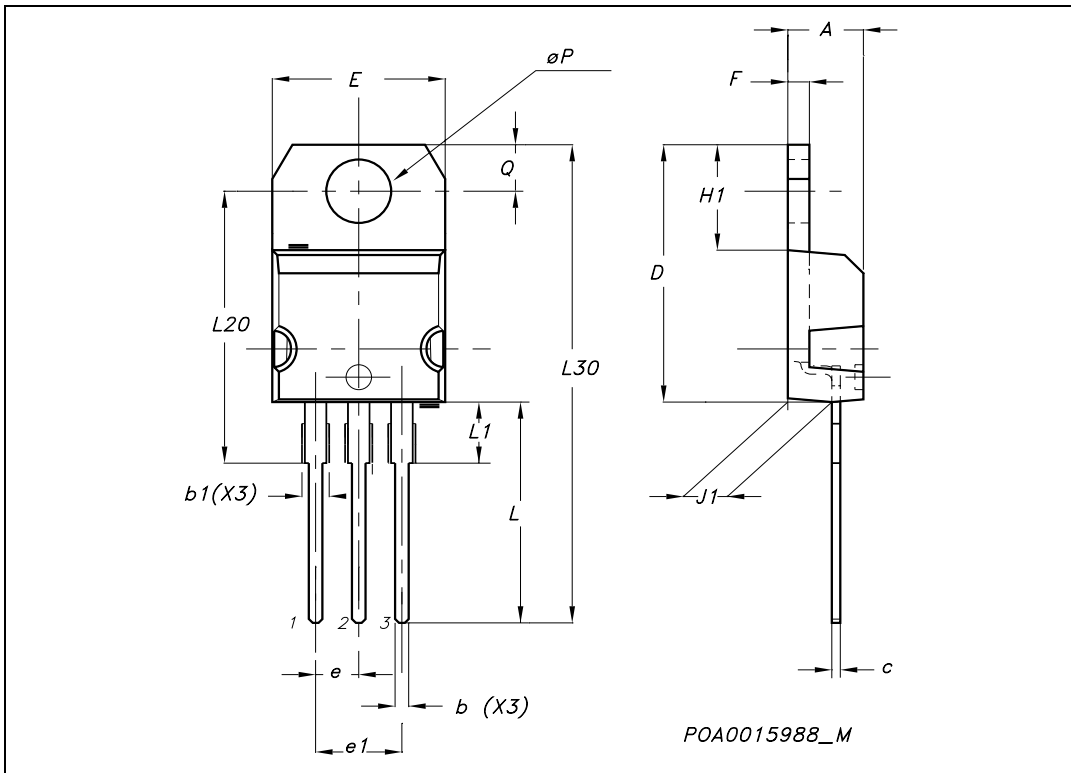


**Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times**



**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





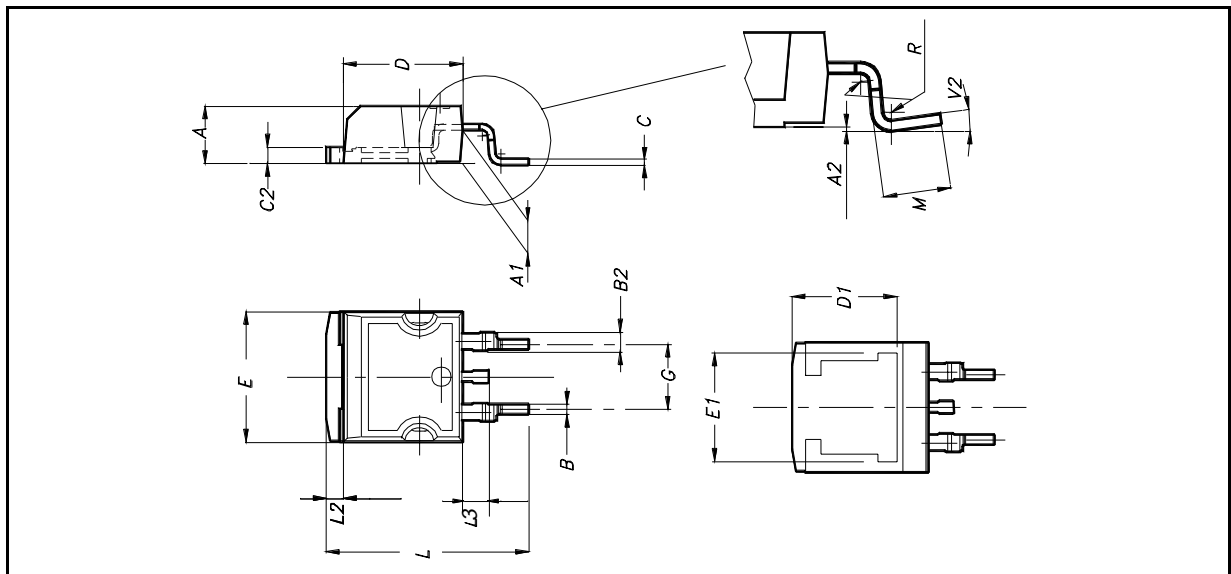
**TO-220FP MECHANICAL DATA**

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		1.5	0.045		0.067
F2	1.15		1.5	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

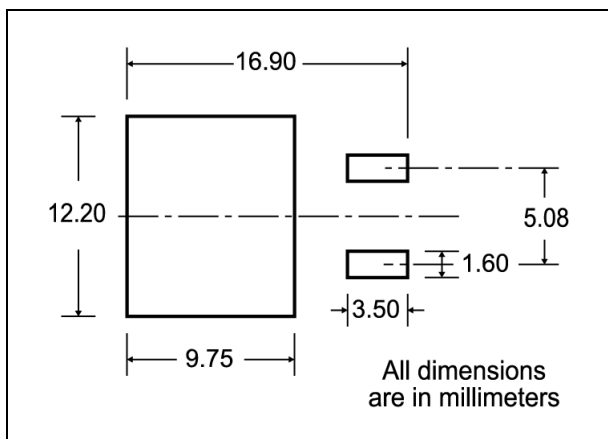


**D<sup>2</sup>PAK MECHANICAL DATA**

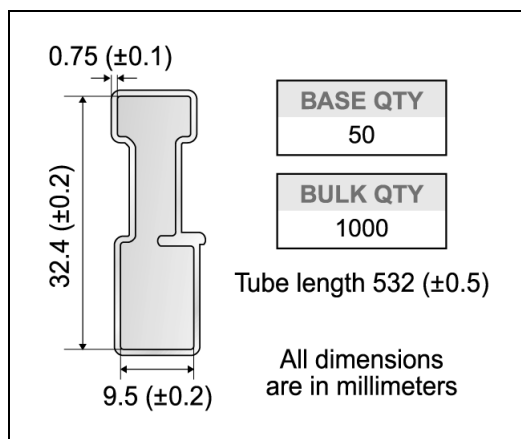
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
A1	2.49		2.69	0.098		0.106
A2	0.03		0.23	0.001		0.009
B	0.7		0.93	0.027		0.036
B2	1.14		1.7	0.044		0.067
C	0.45		0.6	0.017		0.023
C2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1		8			0.315	
E	10		10.4	0.393		
E1		8.5			0.334	
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°			



**D<sup>2</sup>PAK FOOTPRINT**



**TUBE SHIPMENT (no suffix)\***



**TAPE AND REEL SHIPMENT (suffix "T4")\***

Diagram showing the tape mechanical data. The tape width is A. The distance from the center to the edge of the mounting tabs is B. The distance between the centers of the mounting tabs is C. The distance from the center to the edge of the mounting tabs is D. The distance from the center to the edge of the mounting tabs is E. The distance from the center to the edge of the mounting tabs is F. The distance from the center to the edge of the mounting tabs is G. The distance from the center to the edge of the mounting tabs is T. The distance from the center to the edge of the mounting tabs is N. The distance from the center to the edge of the mounting tabs is G measured at hub. The distance from the center to the edge of the mounting tabs is 40 mm min. Access hole at slot location. The distance from the center to the edge of the mounting tabs is 2.5mm min. width. The distance from the center to the edge of the mounting tabs is Full radius. The distance from the center to the edge of the mounting tabs is Tape slot in core for tape start.

**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

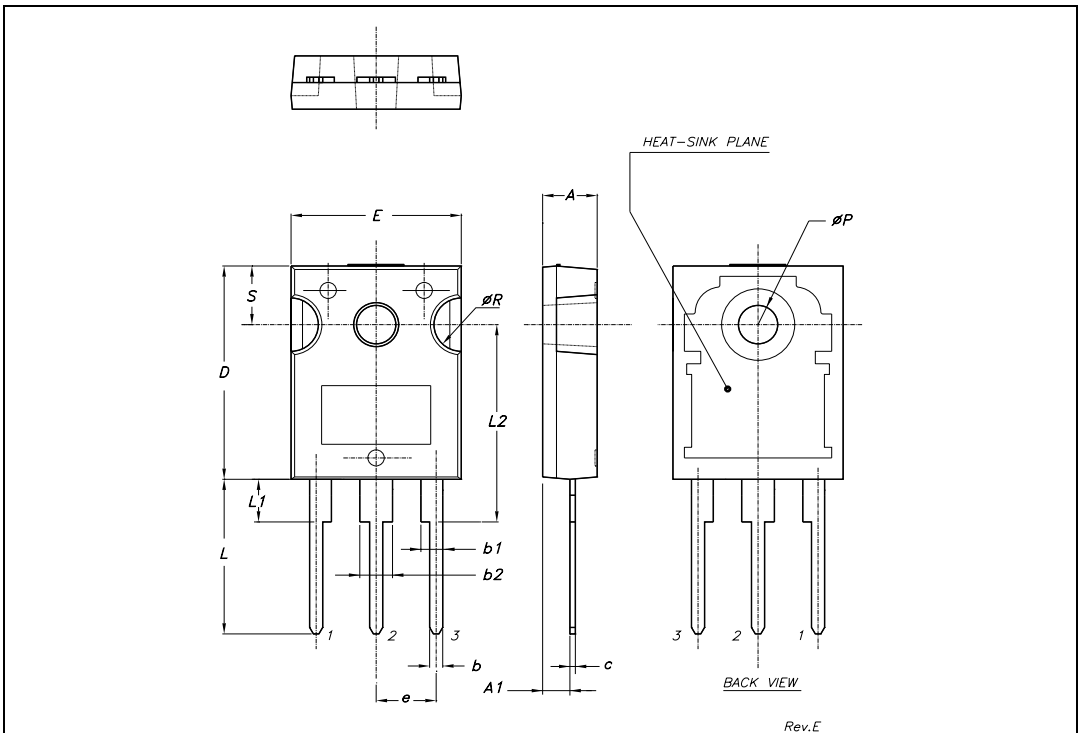
Diagram showing the reel mechanical data. The distance from the center to the edge of the mounting tabs is K<sub>0</sub>. The distance from the center to the edge of the mounting tabs is T. The distance from the center to the edge of the mounting tabs is D. The distance from the center to the edge of the mounting tabs is P<sub>2</sub>. The distance from the center to the edge of the mounting tabs is P<sub>0</sub>. The distance from the center to the edge of the mounting tabs is E. The distance from the center to the edge of the mounting tabs is F. The distance from the center to the edge of the mounting tabs is W. The distance from the center to the edge of the mounting tabs is B<sub>0</sub>. The distance from the center to the edge of the mounting tabs is D<sub>1</sub>. The distance from the center to the edge of the mounting tabs is A<sub>0</sub>. The distance from the center to the edge of the mounting tabs is P<sub>1</sub>. The distance from the center to the edge of the mounting tabs is Center line of cavity. The distance from the center to the edge of the mounting tabs is 10 pitches cumulative tolerance on tape + / - 0.2 mm. The distance from the center to the edge of the mounting tabs is User Direction of Feed. The distance from the center to the edge of the mounting tabs is Bending radius R min. The distance from the center to the edge of the mounting tabs is FEED DIRECTION. The distance from the center to the edge of the mounting tabs is TRL.

\* on sales type



**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	
∅P	3.55		3.65	0.140		0.143
∅R	4.50		5.50	0.177		0.216
S		5.50			0.216	



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