



# STP9NB50 STP9NB50FP

N-CHANNEL 500V - 0.75  $\Omega$  - 8.6 A TO-220/TO-220FP  
 PowerMesh™ MOSFET

TYPE	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>
STP9NB50	500 V	< 0.85 $\Omega$	8.6 A
STP9NB50FP	500 V	< 0.85 $\Omega$	4.9 A

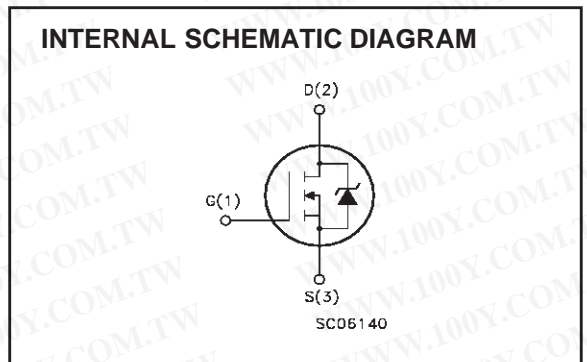
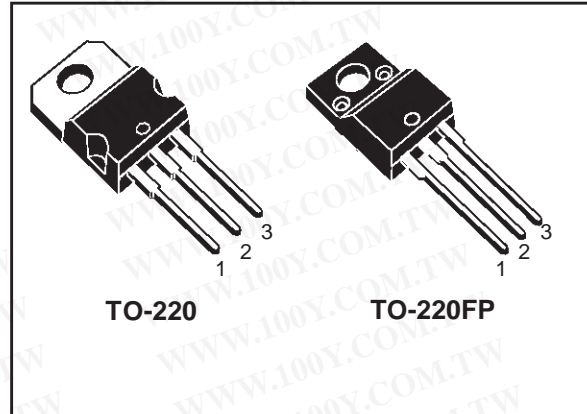
- TYPICAL R<sub>DS(on)</sub> = 0.75  $\Omega$
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- VERY LOW INTRINSIC CAPACITANCES
- GATE CHARGE MINIMIZED

## DESCRIPTION

Using the latest high voltage MESH OVERLAY™ process, STMicroelectronics has designed an advanced family of power MOSFETs with outstanding performances. The new patent pending strip layout coupled with the Company's proprietary edge termination structure, gives the lowest R<sub>DS(on)</sub> per area, exceptional avalanche and dv/dt capabilities and unrivalled gate charge and switching characteristics.

## APPLICATIONS

- HIGH CURRENT, HIGH SPEED SWITCHING
- SWITCH MODE POWER SUPPLIES (SMPS)
- DC-AC CONVERTERS FOR WELDING EQUIPMENT AND UNINTERRUPTIBLE POWER SUPPLIES AND MOTOR DRIVE



## ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		STP9NB50	STP9NB50FP	
V <sub>DS</sub>	Drain-source Voltage (V <sub>GS</sub> = 0)	500		V
V <sub>DGR</sub>	Drain-gate Voltage (R <sub>GS</sub> = 20 k $\Omega$ )	500		V
V <sub>GS</sub>	Gate- source Voltage	±30		V
I <sub>D</sub>	Drain Current (continuous) at T <sub>C</sub> = 25°C	8.6	4.9	A
I <sub>D</sub>	Drain Current (continuous) at T <sub>C</sub> = 100°C	5.4	3.1	A
I <sub>DM</sub> (●)	Drain Current (pulsed)	34.4	34.4	A
P <sub>TOT</sub>	Total Dissipation at T <sub>C</sub> = 25°C	125	40	W
	Derating Factor	1	0.32	W/°C
dv/dt (1)	Peak Diode Recovery voltage slope	4.5	4.5	V/ns
V <sub>ISO</sub>	Insulation Withstand Voltage (DC)	-	2000	V
T <sub>stg</sub>	Storage Temperature	-65 to 150		°C
T <sub>j</sub>	Max. Operating Junction Temperature	150		°C

(●) Pulse width limited by safe operating area

(1) I<sub>SD</sub> < 9A, di/dt < 200A/ $\mu$ s, V<sub>BD</sub> < V<sub>(BR)DSS</sub>, T<sub>J</sub> < T<sub>JMAX</sub>

## STP9NB50/FP

### THERMAL DATA

		TO-220	TO-220FP	
Rthj-case	Thermal Resistance Junction-case Max	1	3.13	°C/W
Rthj-amb	Thermal Resistance Junction-ambient Max	62.5		°C/W
Rthc-sink	Thermal Resistance Case-sink Typ	0.5		°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)	8.6	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)	520	mJ

### ELECTRICAL CHARACTERISTICS (TCASE = 25 °C UNLESS OTHERWISE SPECIFIED) OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V <sub>(BR)DSS</sub>	Drain-source Breakdown Voltage	I <sub>D</sub> = 250 μA, V <sub>GS</sub> = 0	500			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> = ±30V			±100	nA

### ON (1)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	3	4	5	V
R <sub>DS(on)</sub>	Static Drain-source On Resistance	V <sub>GS</sub> = 10V, I <sub>D</sub> = 4.3 A		0.75	0.85	Ω
I <sub>D(on)</sub>	On State Drain Current	V <sub>DS</sub> > I <sub>D(on)</sub> × R <sub>DS(on)</sub> max, V <sub>GS</sub> = 10V	8.6			A

### DYNAMIC

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g <sub>fs</sub> (1)	Forward Transconductance	V <sub>DS</sub> > I <sub>D(on)</sub> × R <sub>DS(on)</sub> max, I <sub>D</sub> = 4.3 A		5.7		S
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 25V, f = 1 MHz, V <sub>GS</sub> = 0		1250		pF
C <sub>oss</sub>	Output Capacitance			175		pF
C <sub>rss</sub>	Reverse Transfer Capacitance			20		pF

ELECTRICAL CHARACTERISTICS (CONTINUED)

SWITCHING ON

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on Delay Time	$V_{DD} = 250\text{ V}$ , $I_D = 4.3\text{ A}$		19		ns
$t_r$	Rise Time	$R_G = 4.7\Omega$ , $V_{GS} = 10\text{ V}$ (see test circuit, Figure 3)		11		ns
$Q_g$	Total Gate Charge	$V_{DD} = 400\text{ V}$ , $I_D = 8.6\text{ A}$ ,		32	45	nC
$Q_{gs}$	Gate-Source Charge	$V_{GS} = 10\text{ V}$		10.6		nC
$Q_{gd}$	Gate-Drain Charge			13.7		nC

SWITCHING OFF

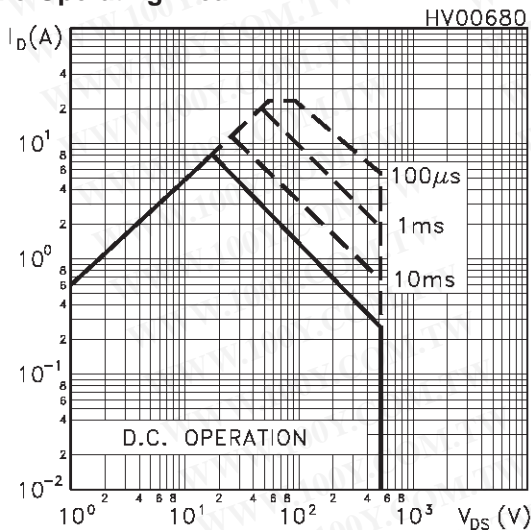
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{r(Voff)}$	Off-voltage Rise Time	$V_{DD} = 400\text{ V}$ , $I_D = 8.6\text{ A}$ ,		11.5		ns
$t_f$	Fall Time	$R_G = 4.7\Omega$ , $V_{GS} = 10\text{ V}$ (see test circuit, Figure 5)		11		ns
$t_c$	Cross-over Time			20		ns

SOURCE DRAIN DIODE

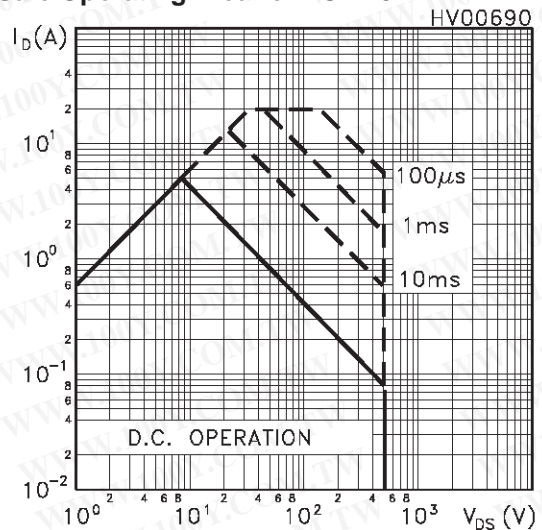
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain Current				8.6	A
$I_{SDM(2)}$	Source-drain Current (pulsed)				34.4	A
$V_{SD(1)}$	Forward On Voltage	$I_{SD} = 8.6\text{ A}$ , $V_{GS} = 0$			1.6	V
$t_{rr}$	Reverse Recovery Time	$I_{SD} = 8.6\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,		420		ns
$Q_{rr}$	Reverse Recovery Charge	$V_{DD} = 100\text{ V}$ , $T_j = 150^\circ\text{C}$ (see test circuit, Figure 5)		3.5		$\mu\text{C}$
$I_{RRM}$	Reverse Recovery Current			16.5		A

Note: 1. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.  
 2. Pulse width limited by safe operating area.

Safe Operating Area

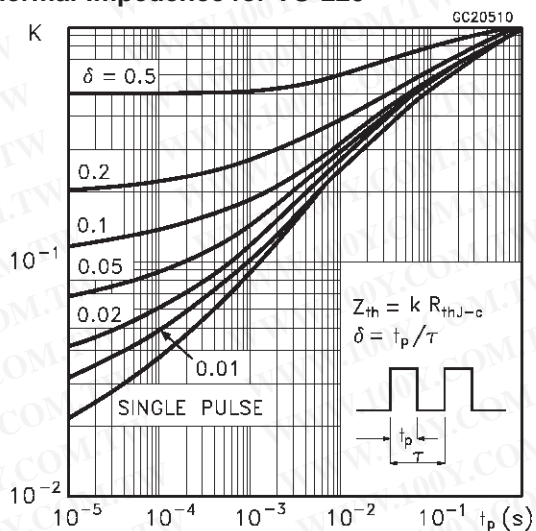


Safe Operating Area for TO-220FP

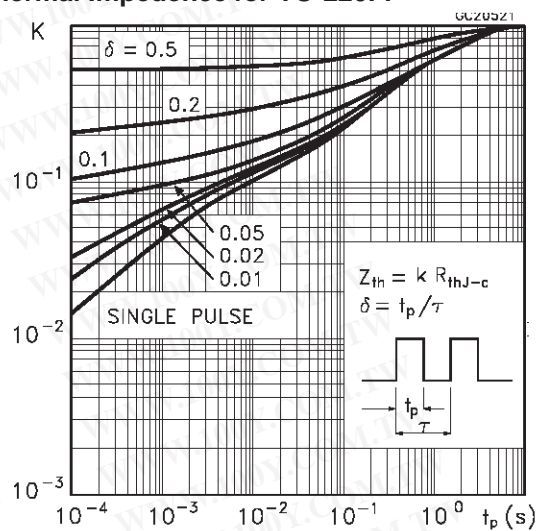


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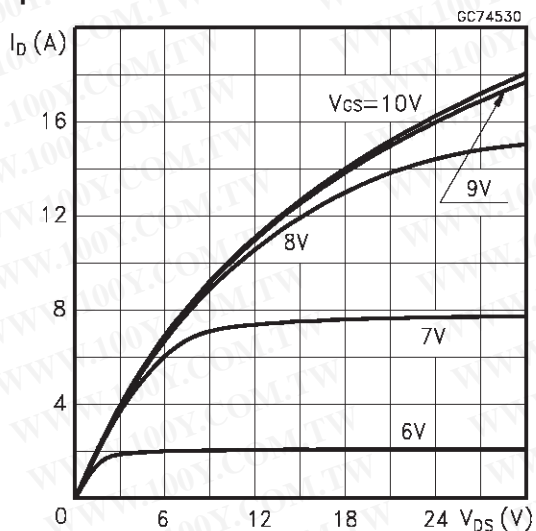
Thermal Impedance for TO-220



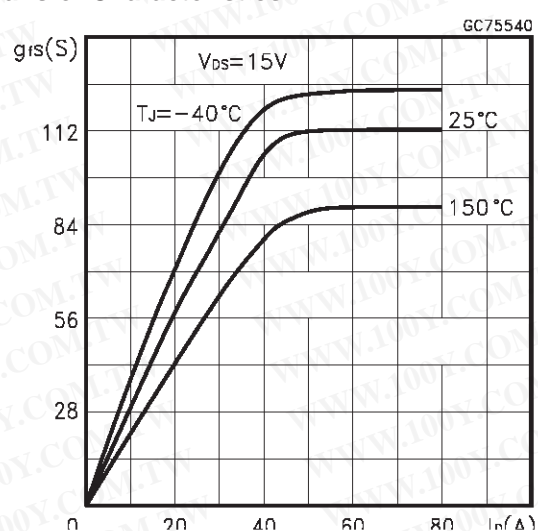
Thermal Impedance for TO-220FP



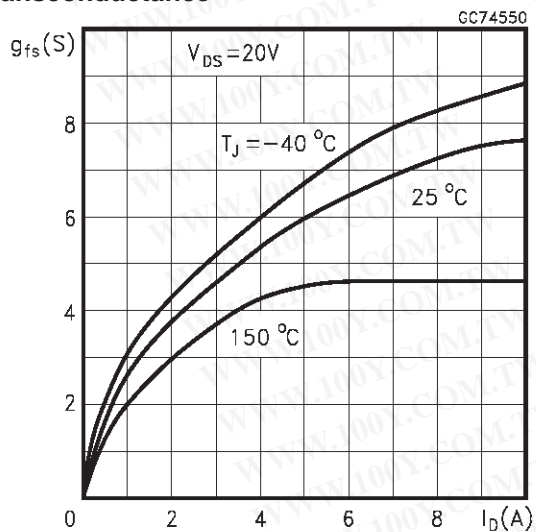
Output Characteristics



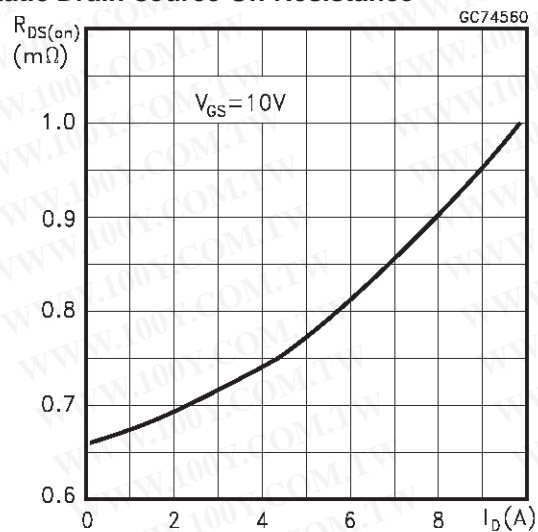
Transfer Characteristics



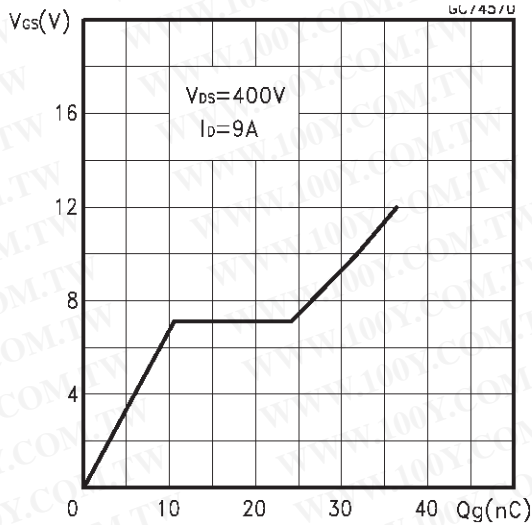
Transconductance



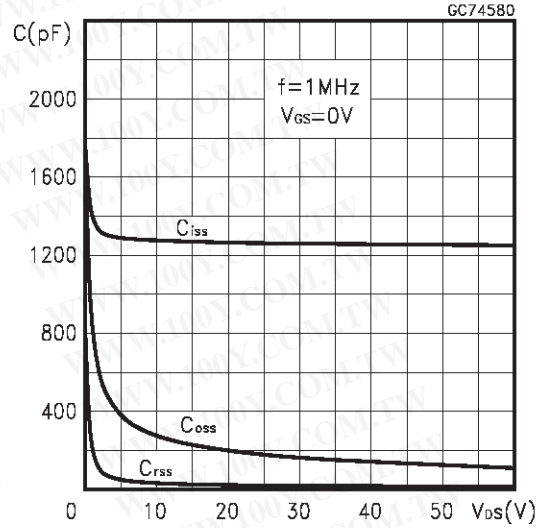
Static Drain-source On Resistance



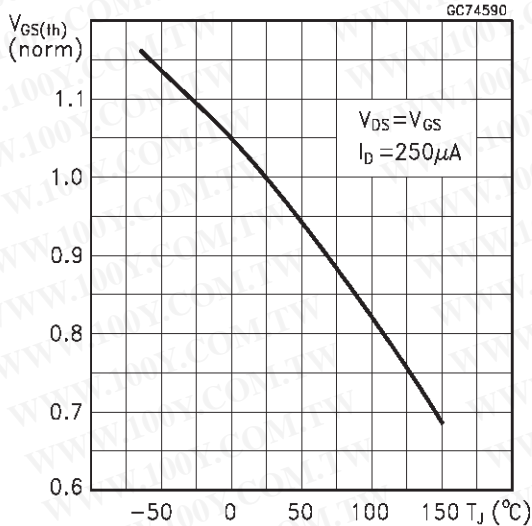
Gate Charge vs Gate-source Voltage



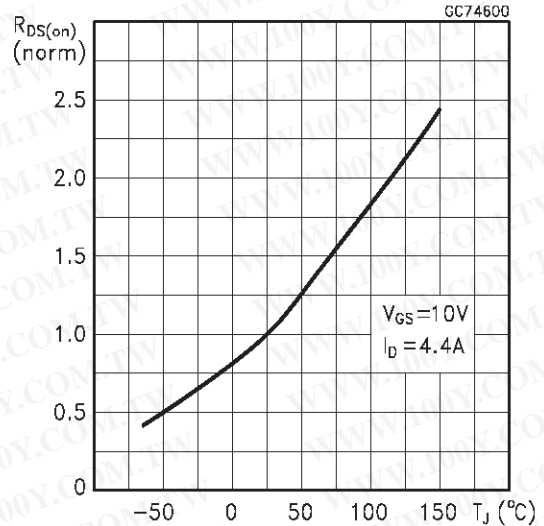
Capacitance Variations



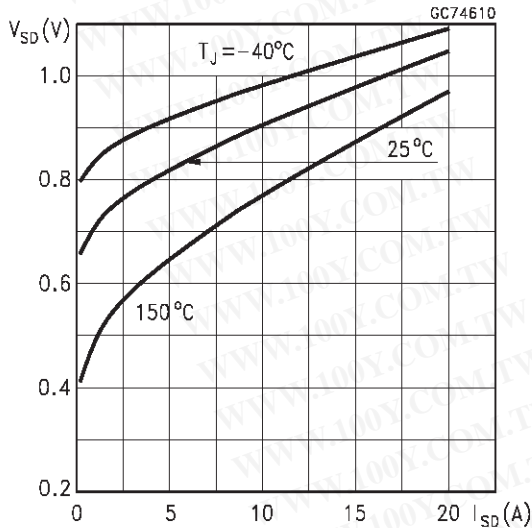
Normalized Gate Threshold Voltage vs Temp.



Normalized On Resistance vs Temperature



Source-drain Diode Forward Characteristics



STP9NB50/FP

Fig. 1: Unclamped Inductive Load Test Circuit

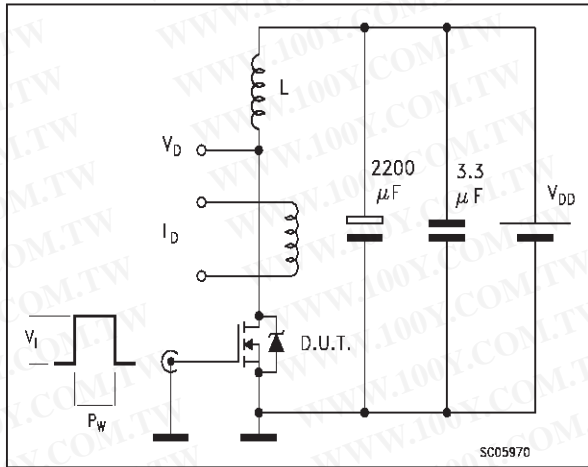


Fig. 2: Unclamped Inductive Waveform

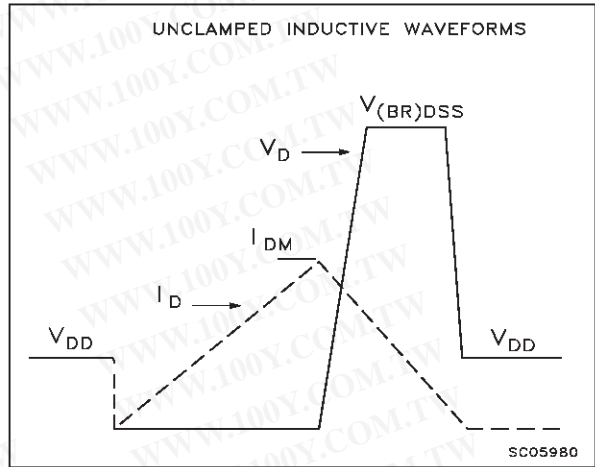


Fig. 3: Switching Times Test Circuit For Resistive Load

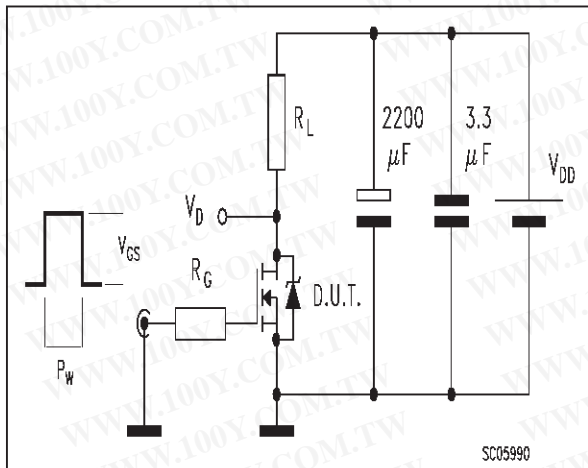


Fig. 4: Gate Charge test Circuit

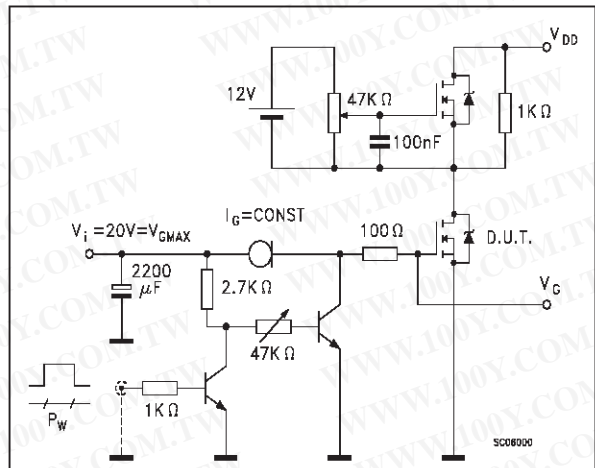
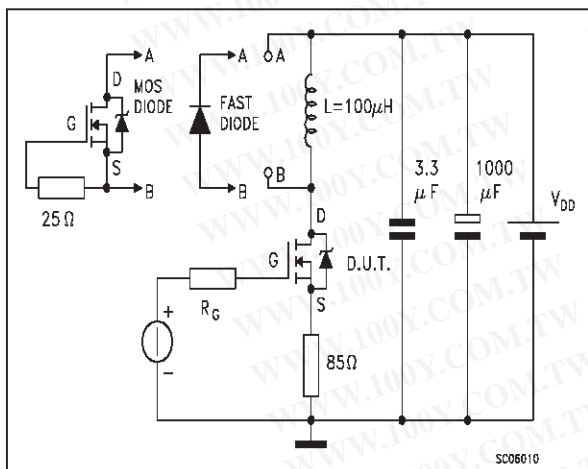
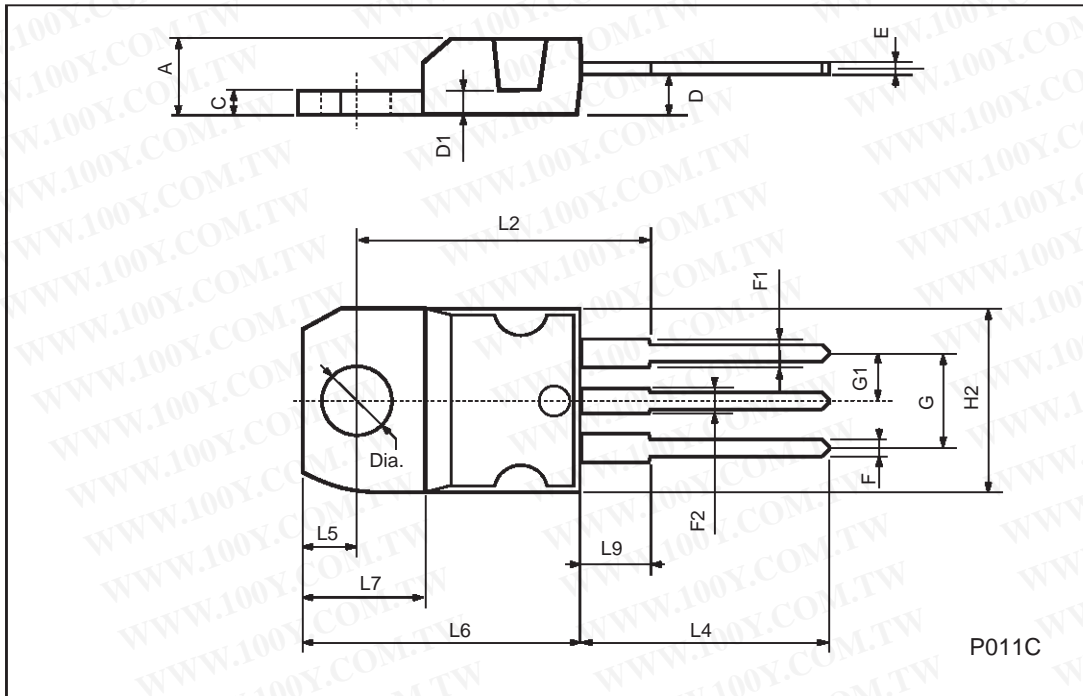


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



TO-220 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
C	1.23		1.32	0.048		0.051
D	2.40		2.72	0.094		0.107
D1		1.27			0.050	
E	0.49		0.70	0.019		0.027
F	0.61		0.88	0.024		0.034
F1	1.14		1.70	0.044		0.067
F2	1.14		1.70	0.044		0.067
G	4.95		5.15	0.194		0.203
G1	2.4		2.7	0.094		0.106
H2	10.0		10.40	0.393		0.409
L2		16.4			0.645	
L4	13.0		14.0	0.511		0.551
L5	2.65		2.95	0.104		0.116
L6	15.25		15.75	0.600		0.620
L7	6.2		6.6	0.244		0.260
L9	3.5		3.93	0.137		0.154
DIA.	3.75		3.85	0.147		0.151



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	0.385		0.417
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

