



# STP60NE06L-16 STP60NE06L-16FP

N - CHANNEL 60V - 0.014Ω - 60A TO-220/TO-220FP  
STripFET™ POWER MOSFET

TYPE	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>
STP60NE06L-16	60 V	< 0.016 Ω	60 A
STP60NE06L-16FP	60 V	< 0.016 Ω	35 A

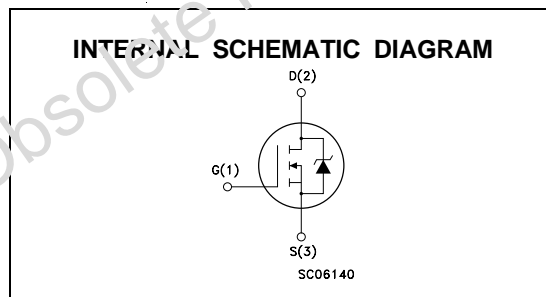
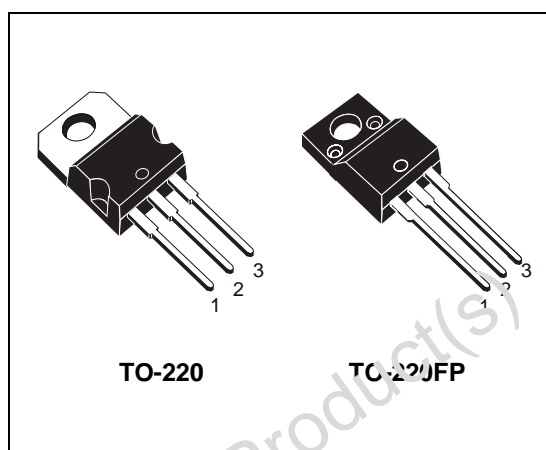
- TYPICAL R<sub>DS(on)</sub> = 0.014 Ω
- AVALANCHE RUGGED TECHNOLOGY
- LOW GATE CHARGE
- HIGH CURRENT CAPABILITY
- 175 °C OPERATING TEMPERATURE
- LOW THRESHOLD DRIVE

## DESCRIPTION

This Power Mosfet is the latest development of STMicroelectronics unique "Single Feature Size™" strip-based process. The resulting transistor shows extremely high packing density for low on-resistance, rugged avalanche characteristics and less critical alignment steps therefore a remarkable manufacturing reproducibility.

## APPLICATIONS

- HIGH CURRENT, HIGH SPEED SWITCHING
- SOLENOID AND RELAY DRIVERS
- DC-DC & DC-AC CONVERTERS
- AUTOMOTIVE ENVIRONMENT



## ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		STP60NE06L-16	STP60NE06L-16FP	
V <sub>DS</sub>	Drain-source Voltage (V <sub>GS</sub> = 0)	60		V
V <sub>DSK</sub>	Drain- gate Voltage (R <sub>GS</sub> = 20 kΩ)	60		V
V <sub>GS</sub>	Gate-source Voltage	± 15		V
I <sub>D</sub>	Drain Current (continuous) at T <sub>c</sub> = 25 °C	60	35	A
I <sub>D</sub>	Drain Current (continuous) at T <sub>c</sub> = 100 °C	42	24	A
I <sub>DM</sub> (•)	Drain Current (pulsed)	240	140	A
P <sub>tot</sub>	Total Dissipation at T <sub>c</sub> = 25 °C	150	45	W
	Derating Factor	1	0.3	W/°C
V <sub>ISO</sub>	Insulation Withstand Voltage (DC)	—	2000	V
dv/dt	Peak Diode Recovery voltage slope	6		V/ns
T <sub>stg</sub>	Storage Temperature	-65 to 175		°C
T <sub>j</sub>	Max. Operating Junction Temperature	175		°C

(•) Pulse width limited by safe operating area

(1) I<sub>SD</sub> ≤ 60 A, di/dt ≤ 300 A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>j</sub> ≤ T<sub>JMAX</sub>

**THERMAL DATA**

		TO-220	TO-220FP		
R <sub>thj-case</sub>	Thermal Resistance Junction-case	Max	0.94	2.7	°C/W
R <sub>thj-amb</sub>	Thermal Resistance Junction-ambient	Max	62.5		°C/W
R <sub>thc-sink</sub>	Thermal Resistance Case-sink	Typ	0.5		°C/W
T <sub>I</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)	60	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> = 25V)	400	mJ

**ELECTRICAL CHARACTERISTICS** (T<sub>case</sub> = 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	60			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 10	μA μA
I <sub>GSS</sub>	Gate-body Leakage Current (V <sub>DS</sub> = 0)	V <sub>GS</sub> = ± 15 V			± 100	nA

ON (\*)

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	1	1.6	2.5	V
R <sub>DS(on)</sub>	Static Drain-source On Resistance	V <sub>GS</sub> = 5V I <sub>D</sub> = 30 A V <sub>GS</sub> = 10V I <sub>D</sub> = 30 A		0.014 0.012	0.016 0.014	Ω Ω
I <sub>D(on)</sub>	On State Drain Current	V <sub>DS</sub> > I <sub>D(on)</sub> × R <sub>DS(on)max</sub> V <sub>GS</sub> = 10 V	60			A

**DYNAMIC**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g <sub>fs</sub> (*)	Forward Transconductance	V <sub>DS</sub> > I <sub>D(on)</sub> × R <sub>DS(on)max</sub> I <sub>D</sub> = 30 A		30		S
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 25 V f = 1 MHz V <sub>GS</sub> = 0		4150		pF
C <sub>oss</sub>	Output Capacitance			590		pF
C <sub>rss</sub>	Reverse Transfer Capacitance			150		pF

**ELECTRICAL CHARACTERISTICS** (continued)

**SWITCHING ON**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on Delay Time	$V_{DD} = 30\text{ V}$ $I_D = 30\text{ A}$		50		ns
$t_r$	Rise Time	$R_G = 4.7\ \Omega$ $V_{GS} = 5\text{ V}$ (Resistive Load, see fig. 3)		155		ns
$Q_g$	Total Gate Charge	$V_{DD} = 40\text{ V}$ $I_D = 60\text{ A}$ $V_{GS} = 5\text{ V}$		55	70	nC
$Q_{gs}$	Gate-Source Charge			15		nC
$Q_{gd}$	Gate-Drain Charge			30		nC

**SWITCHING OFF**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(off)}$	Turn-off Delay Time	$V_{DD} = 30\text{ V}$ $I_D = 30\text{ A}$		125		ns
$t_f$	Fall Time	$R_G = 4.7\ \Omega$ $V_{GS} = 5\text{ V}$ (Resistive Load, see fig. 3)		25		ns
$t_{r(Voff)}$	Off-voltage Rise Time	$V_{DD} = 48\text{ V}$ $I_D = 20\text{ A}$		45		ns
$t_f$	Fall Time	$R_G = 4.7\ \Omega$ $V_{GS} = 5\text{ V}$		220		ns
$t_c$	Cross-over Time	(Inductive Load, see fig. 5)		280		ns

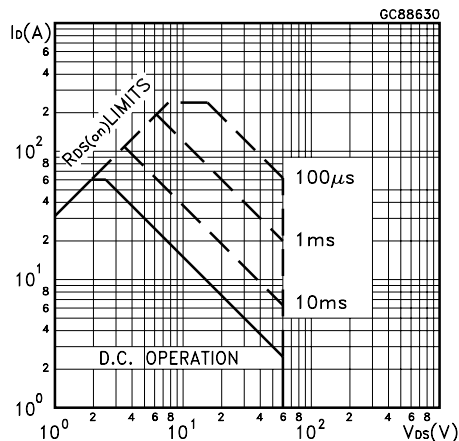
**SOURCE DRAIN DIODE**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain Current				60	A
$I_{SDM}(\bullet)$	Source-drain Current (pulsed)				240	A
$V_{SD} (*)$	Forward On Voltage	$I_{SD} = 60\text{ A}$ $V_{GS} = 0$			1.5	V
$t_{rr}$	Reverse Recovery Time	$I_{SD} = 60\text{ A}$ $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 30\text{ V}$ $T_J = 150\text{ }^\circ\text{C}$ (see test circuit, fig. 5)		85		ns
$Q_{rr}$	Reverse Recovery Charge			300		$\mu\text{C}$
$I_{RRM}$	Reverse Recovery Current			7		A

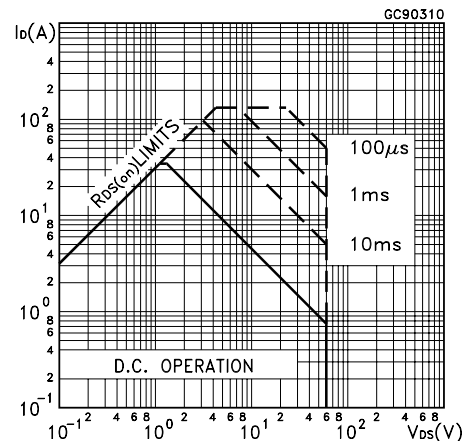
(\*) Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %

( $\bullet$ ) Pulse width limited by safe operating area

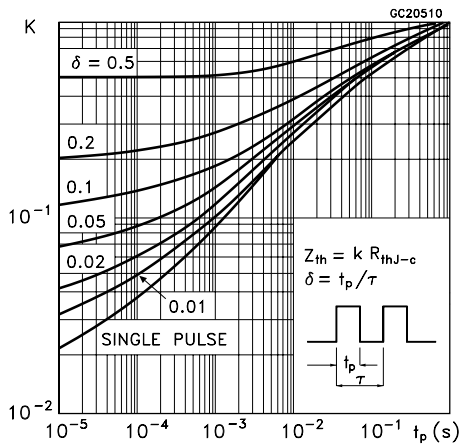
Safe Operating Area for TO-220



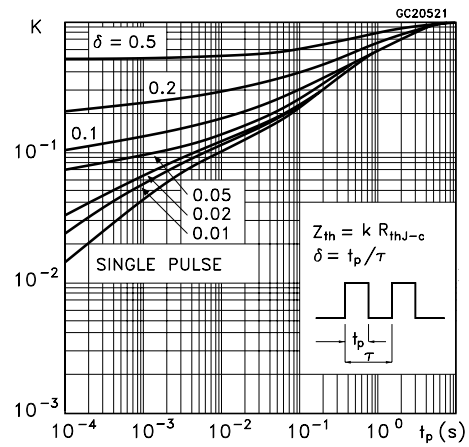
Safe Operating Area for TO-220FP



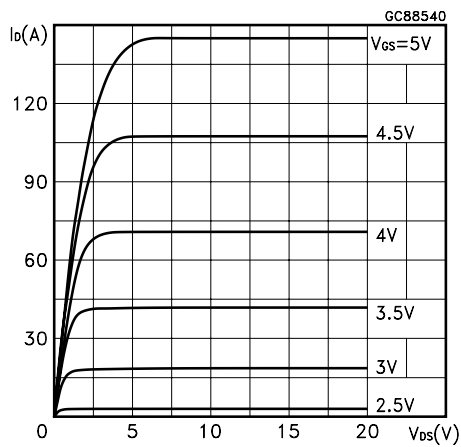
Thermal Impedance for TO-220



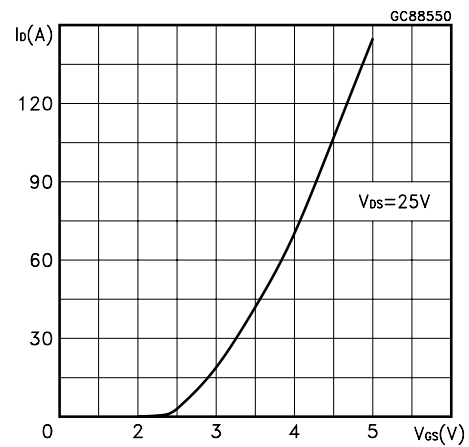
Thermal Impedance for TO-220FP



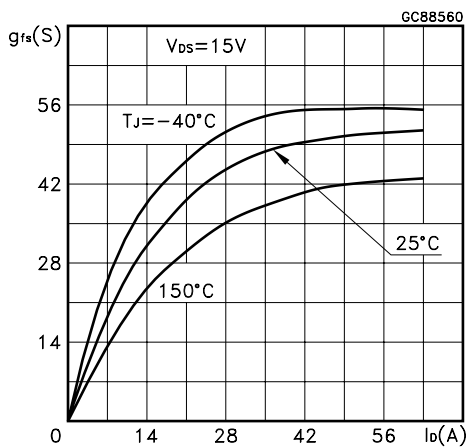
Output Characteristics



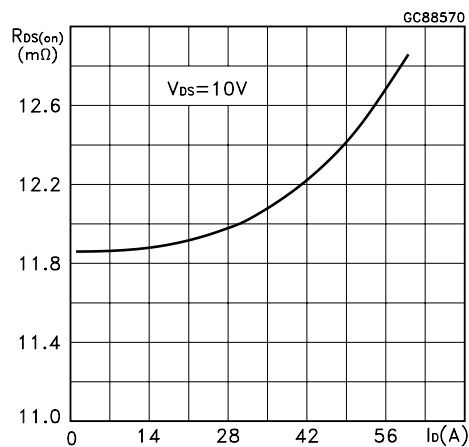
Transfer Characteristics



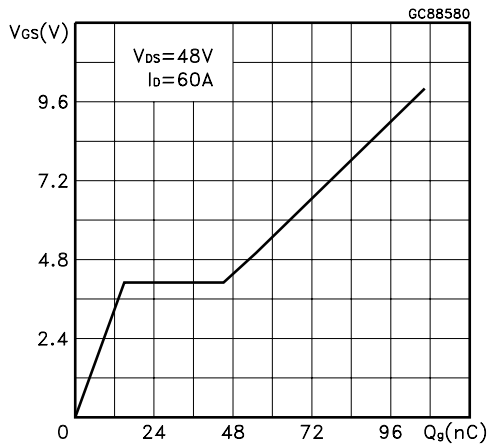
Transconductance



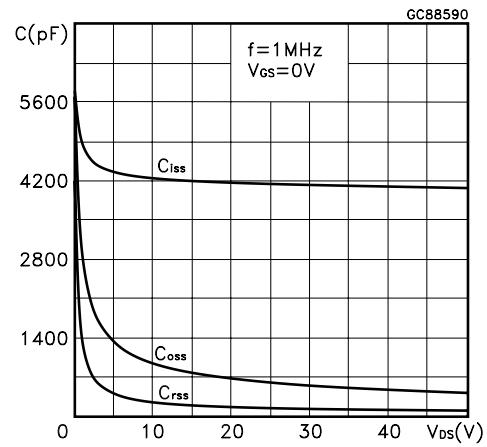
Static Drain-source On Resistance



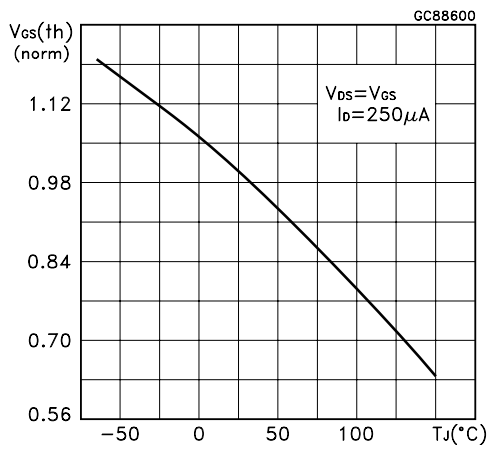
Gate Charge vs Gate-source Voltage



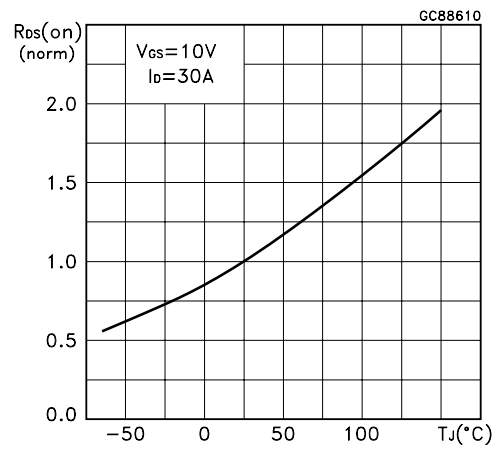
Capacitance Variations



Normalized Gate Threshold Voltage vs Temperature



Normalized On Resistance vs Temperature



Source-drain Diode Forward Characteristics

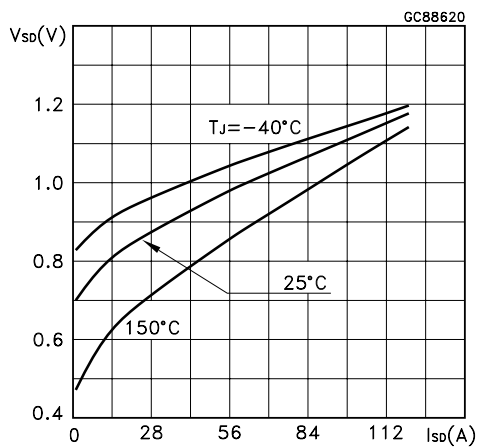


Fig. 1: Unclamped Inductive Load Test Circuit

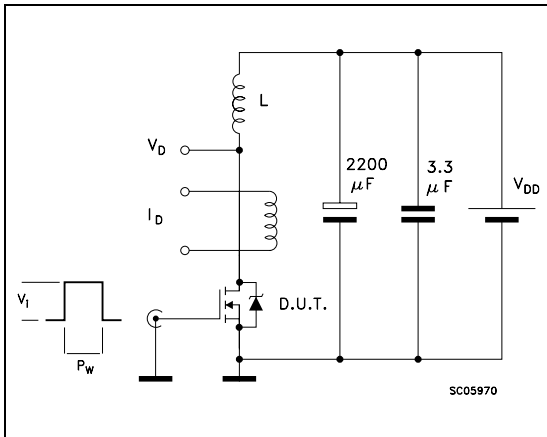


Fig. 2: Unclamped Inductive Waveform

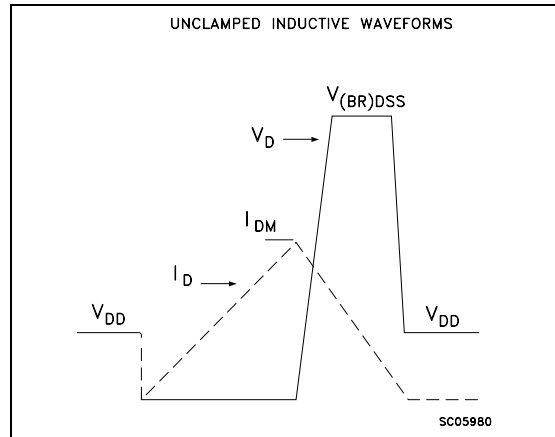


Fig. 3: Switching Times Test Circuits For Resistive Load

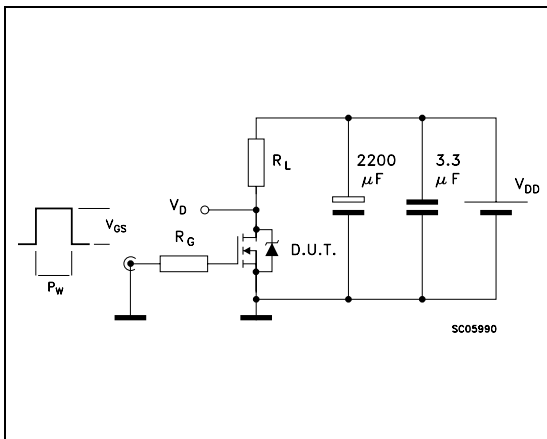


Fig. 4: Gate Charge test Circuit

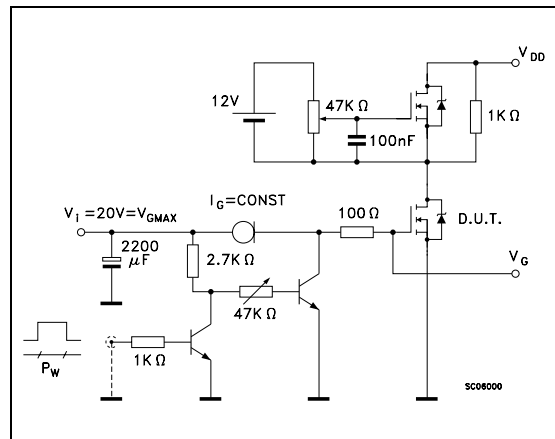
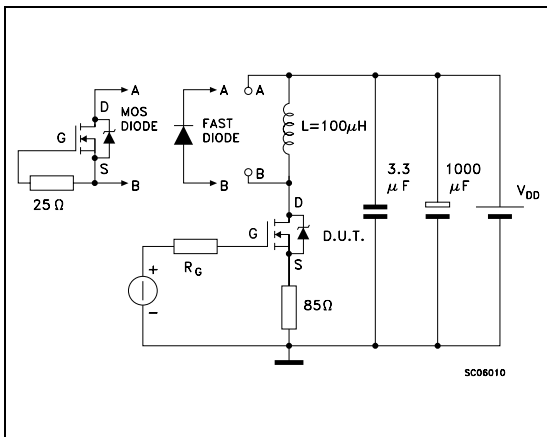
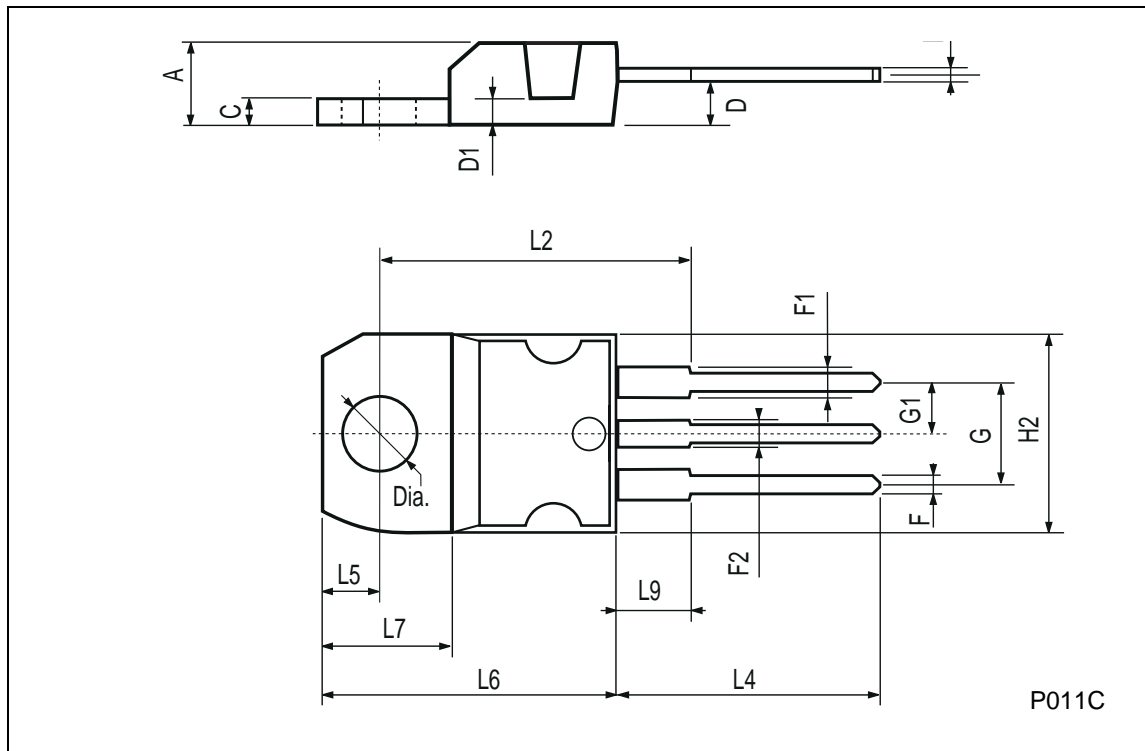


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



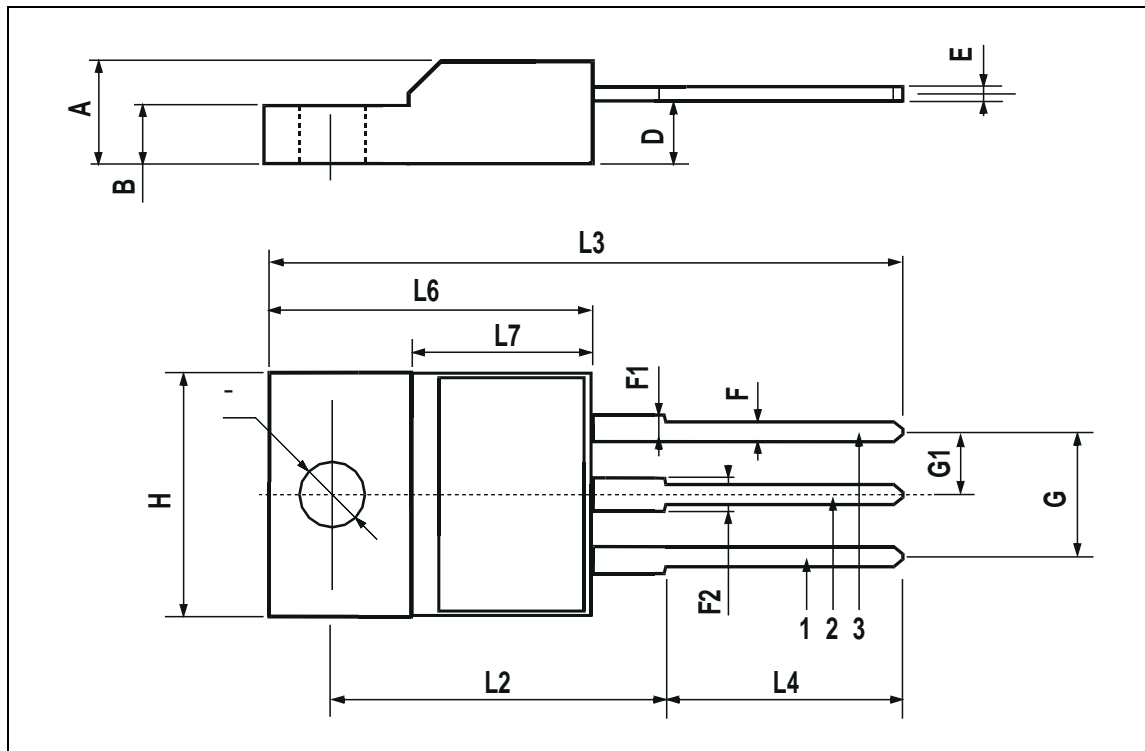
## TO-220 MECHANICAL DATA

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





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