



STP60NS04Z

N-CHANNEL CLAMPED 10mΩ - 60A TO-220 FULLY PROTECTED MESH OVERLAY™ MOSFET

TYPE	V _{DSS}	R _{DS(on)}	I _D
STP60NS04Z	CLAMPED	<0.015 Ω	60 A

- TYPICAL R_{DS(on)} = 0.010 Ω
- 100% AVALANCHE TESTED
- LOW CAPACITANCE AND GATE CHARGE
- 175 °C MAXIMUM JUNCTION TEMPERATURE

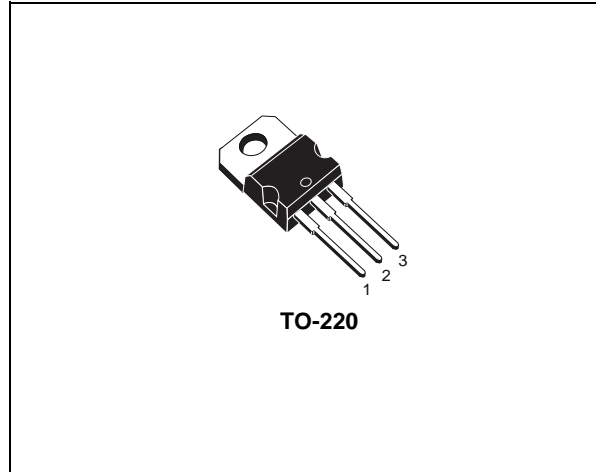
DESCRIPTION

This fully clamped Mosfet is produced by using the latest advanced Company's Mesh Overlay process which is based on a novel strip layout.

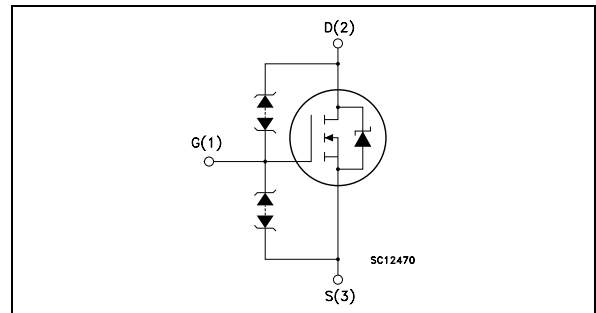
The inherent benefits of the new technology coupled with the extra clamping capabilities make this product particularly suitable for the harshest operation conditions such as those encountered in the automotive environment. Any other application requiring extra ruggedness is also recommended.

APPLICATIONS

- ABS, SOLENOID DRIVERS
- MOTOR CONTROL
- DC-DC CONVERTERS



INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V _{DS}	Drain-source Voltage (V _{GS} = 0)	CLAMPED	V
V _{DG}	Drain-gate Voltage	CLAMPED	V
V _{GS}	Gate- source Voltage	CLAMPED	V
I _D	Drain Current (continuous) at T _C = 25°C	60	A
I _D	Drain Current (continuous) at T _C = 100°C	42	A
I _{DG}	Drain Gate Current (continuous)	± 50	mA
I _{GS}	Gate Source Current (continuous)	± 50	mA
I _{DM} (●)	Drain Current (pulsed)	240	A
P _{tot}	Total Dissipation at T _C = 25°C	140	W
	Derating Factor	0.93	W/°C
V _{ESD(G-S)}	Gate-Source ESD (HBM - C = 100pF, R=1.5 kΩ)	2	kV
V _{ESD(G-D)}	Gate-Drain ESD (HBM - C = 100pF, R=1.5 kΩ)	4	kV
V _{ESD(D-S)}	Drain-source ESD (HBM - C = 100pF, R=1.5 kΩ)	4	kV
T _{stg}	Storage Temperature	-65 to 175	°C
T _j	Max. Operating Junction Temperature	-40 to 175	°C

(●) Pulse width limited by safe operating area.

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THERMAL DATA

Rthj-case	Thermal Resistance Junction-case	Max	1.07	°C/W
Rthj-case	Thermal Resistance Junction-case	Typ	0.85	°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 _J	Maximum Lead Temperature For Soldering Purpose		300	°C

AVALANCHE CHARACTERISTICS

Symbol	Parameter	Max Value	Unit
I _{AR}	Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T _J max)	60	A
E _{AS}	Single Pulse Avalanche Energy (starting T _J = 25 °C, I _D = I _{AR} , V _{DD} = 30 V)	550	mJ

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V _{(BR)DSS}	Clamped Voltage	I _D = 1 mA, V _{GS} = 0 -40 < T _J < 175 °C	33			V
I _{DSS}	Zero Gate Voltage Drain Current (V _{GS} = 0)	V _{DS} = 16 V T _J = 150 °C V _{DS} = 16 V T _J = 175 °C			50 100	μA μA
I _{GSS}	Gate-body Leakage Current (V _{DS} = 0)	V _{GS} = ± 10 V T _J = 175 °C V _{GS} = ± 16 V T _J = 175 °C			50 150	μA μA
V _{GSS}	Gate-Source Breakdown Voltage	I _{GS} = 100 μA	18			V

ON (*)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V _{GS(th)}	Gate Threshold Voltage	V _{DS} = V _{GS} I _D = 1 mA -40 < T _J < 150 °C	1.7	3	4.2	V
R _{DS(on)}	Static Drain-source On Resistance	V _{GS} = 10 V I _D = 30 A V _{GS} = 16 V I _D = 30 A		11 10	15 14	mΩ mΩ
I _{D(on)}	On State Drain Current	V _{DS} > I _{D(on)} × R _{DS(on)max} , V _{GS} = 10V	60			A

DYNAMIC

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g _{fs} (*)	Forward Transconductance	V _{DS} > I _{D(on)} × R _{DS(on)max} I _D = 30A	20	30		S
C _{iss}	Input Capacitance	V _{DS} = 25V, f = 1 MHz, V _{GS} = 0		2500	3400	pF
C _{oss}	Output Capacitance			800	1100	pF
C _{rss}	Reverse Transfer Capacitance			150	200	pF

ELECTRICAL CHARACTERISTICS (continued)

SWITCHING ON

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Q_g	Total Gate Charge	$V_{DD} = 16\text{ V}$ $I_D = 60\text{ A}$ $V_{GS} = 10\text{ V}$		68	100	nC
Q_{gs}	Gate-Source Charge			15		nC
Q_{gd}	Gate-Drain Charge			19		nC

SWITCHING OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{r(Voff)}$	Off-voltage Rise Time	$V_{clamp} = 30\text{ V}$ $I_D = 60\text{ A}$ $R_G = 4.7\Omega$, $V_{GS} = 10\text{ V}$ (Inductive Load, Figure 5)		85	110	ns
t_f	Fall Time			145	180	ns
t_c	Cross-over Time			90	120	ns

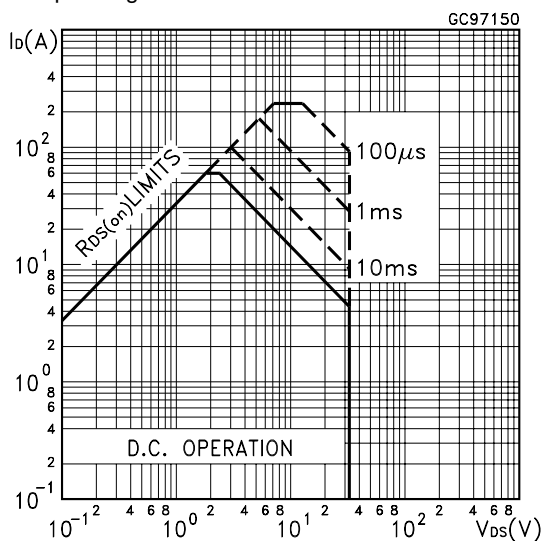
SOURCE DRAIN DIODE

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain Current				60	A
$I_{SDM} (*)$	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	$I_{SD} = 60\text{ A}$ $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 25\text{ V}$ $T_j = 150^\circ\text{C}$ (see test circuit, Figure 5)		65		ns
Q_{rr}	Reverse Recovery Charge			0.15		μC
I_{RRM}	Reverse Recovery Current			4.5		A

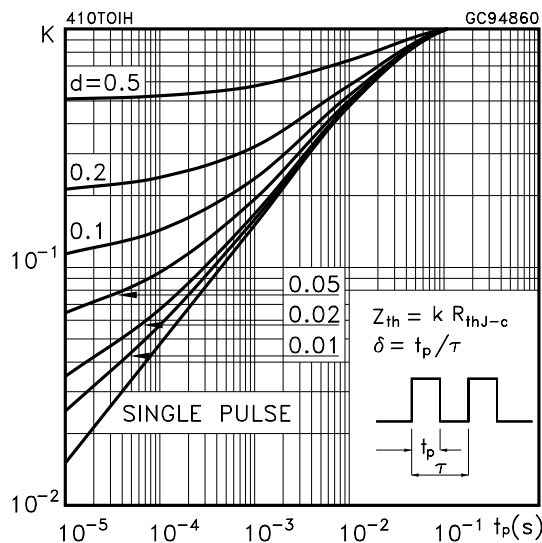
(*) Pulsed: Pulse duration = 300 μs , duty cycle 1.5 %.

(●) Pulse width limited by safe operating area.

Safe Operating Area

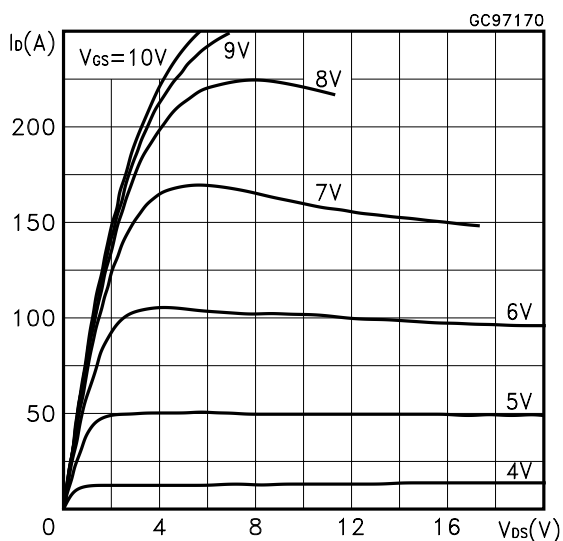


Thermal Impedance

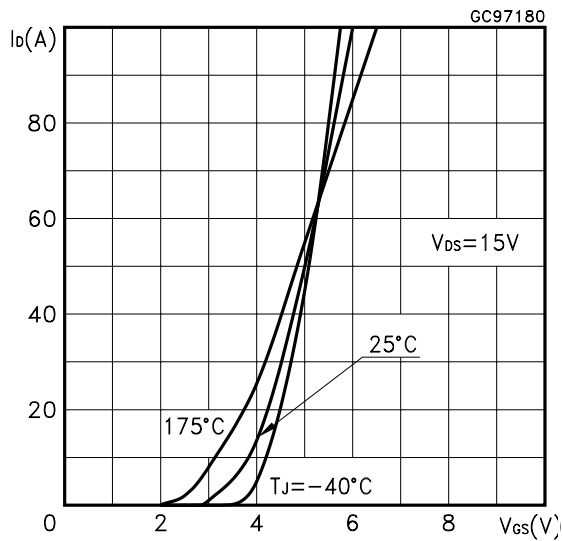


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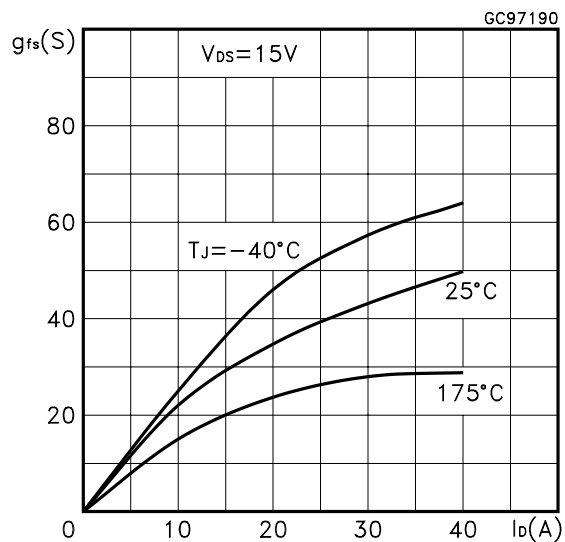
Output Characteristics



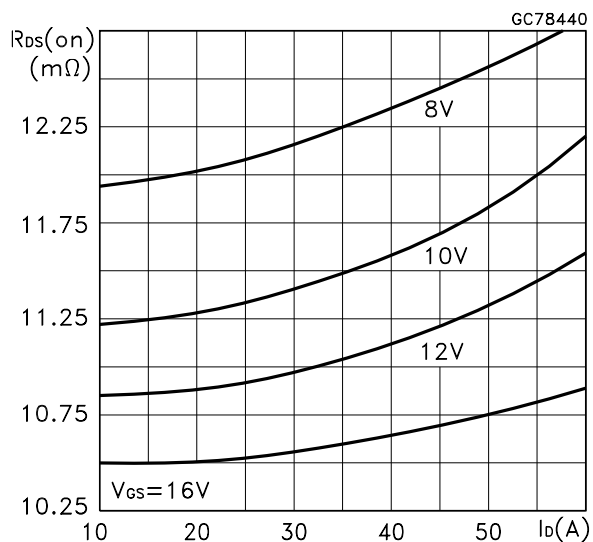
Transfer Characteristics



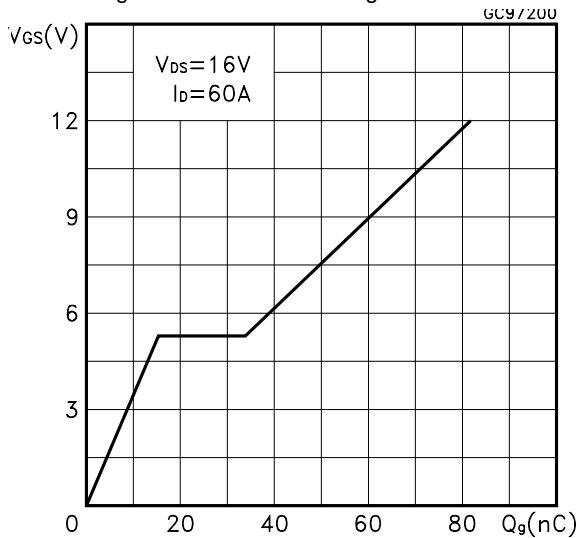
Transconductance



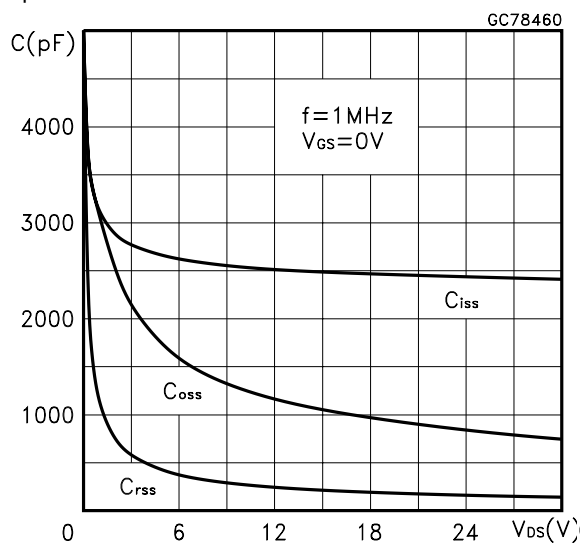
Static Drain-source On Resistance



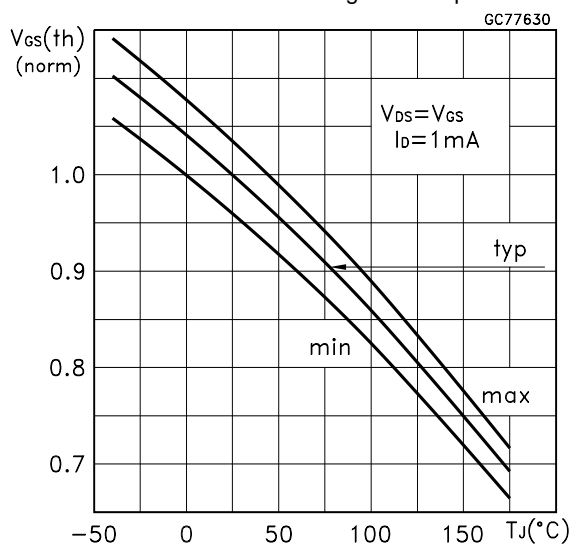
Gate Charge vs Gate-source Voltage



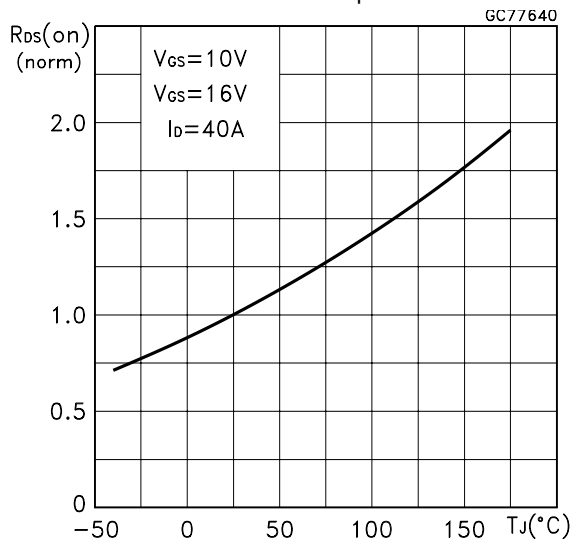
Capacitance Variations



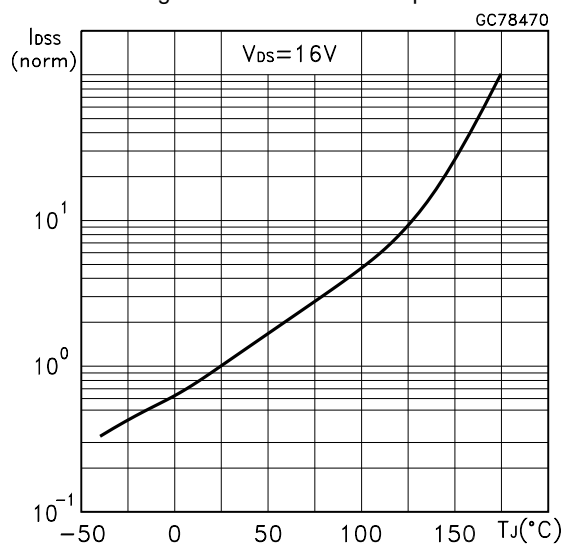
Normalized Gate Threshold Voltage vs Temperature



Normalized on Resistance vs Temperature



Zero Gate Voltage Drain Current vs Temperature



Source-drain Diode Forward Characteristics.

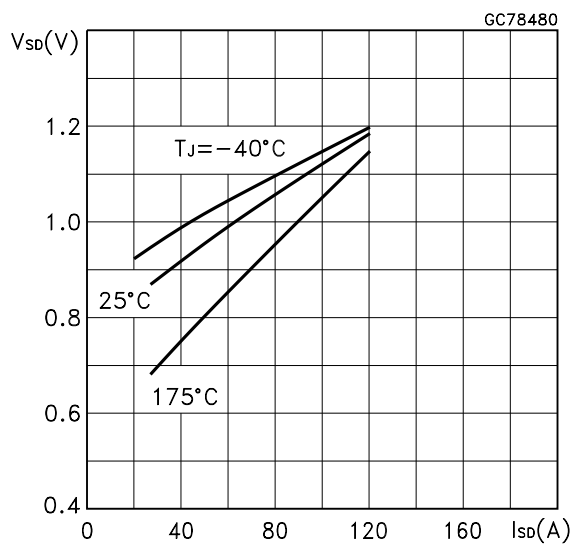


Fig. 1: Unclamped Inductive Load Test Circuit



Fig. 2: Unclamped Inductive Waveform



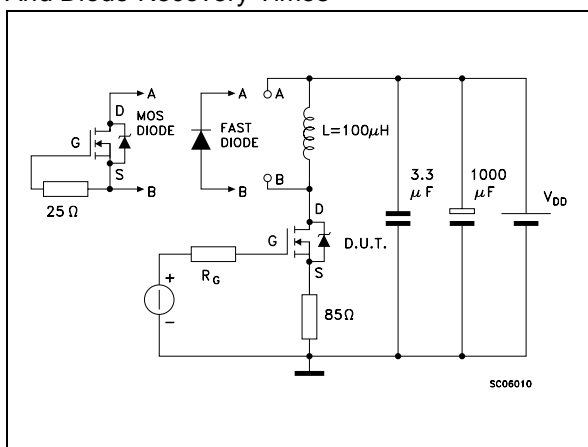
Fig. 3: Switching Times Test Circuits For Resistive Load



Fig. 4: Gate Charge test Circuit

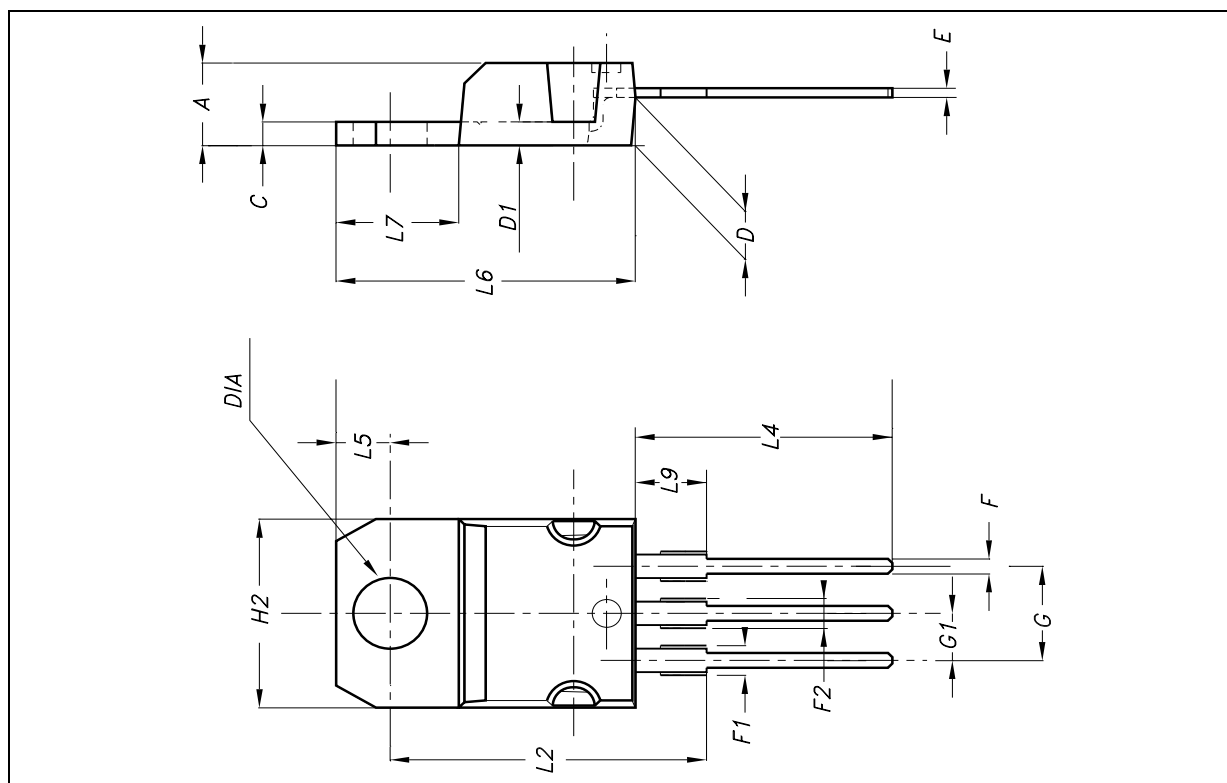


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



TO-220 MECHANICAL DATA

DIM.	mm.			inch.		
	MIN.	TYP.	MAX.	MIN.	TYP.	TYP.
A	4.4		4.6	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	2.40		2.70	0.094		0.106
H2	10		10.40	0.393		0.409
L2	16.10	16.40	16.73	0.633	0.645	0.658
L4	13		14	0.511		0.551
L5	2.65		2.95	0.104		0.116
L6	15.25		15.75	0.600		0.620
L7	6.20		6.60	0.244		0.260
L9	3.50		3.93	0.137		0.154
DIA	3.75		3.85	0.147		0.151



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