

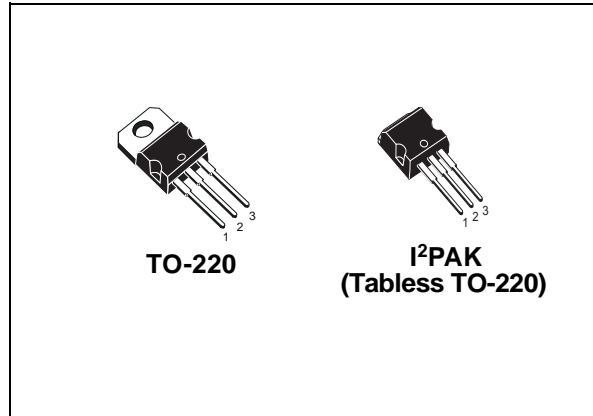


# STP20NM50FD STB20NM50FD-1

N-CHANNEL 500V - 0.22Ω - 20A TO-220/I<sup>2</sup>PAK  
FDmesh™ Power MOSFET (with FAST DIODE)

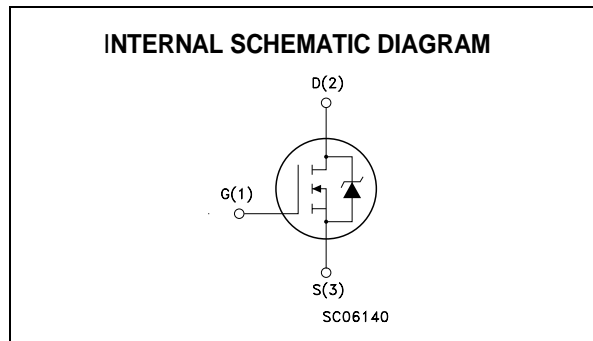
TYPE	V <sub>DSS</sub>	R <sub>DS(on)</sub>	R <sub>ds(on)</sub> *Q <sub>g</sub>	I <sub>D</sub>
STP20NM50FD	500V	<0.25Ω	8.36 Ω*nC	20 A
STB20NM50FD-1	500V	<0.25Ω	8.36 Ω*nC	20 A

- TYPICAL R<sub>DS(on)</sub> = 0.22Ω
- HIGH dv/dt AND AVALANCHE CAPABILITIES
- 100% AVALANCHE TESTED
- LOW INPUT CAPACITANCE AND GATE CHARGE
- LOW GATE INPUT RESISTANCE
- TIGHT PROCESS CONTROL AND HIGH MANUFACTURING YIELDS



## DESCRIPTION

The FDmesh™ associates all advantages of reduced on-resistance and fast switching with an intrinsic fast-recovery body diode. It is therefore strongly recommended for bridge topologies, in particular ZVS phase-shift converters.



## APPLICATIONS

- ZVS PHASE-SHIFT FULL BRIDGE CONVERTERS FOR SMPS AND WELDING EQUIPMENT

## ORDERING INFORMATION

SALES TYPE	MARKING	PACKAGE	PACKAGING
STP20NM50FD	P20NM50FD	TO-220	TUBE
STB20NM50FD-1	B20NM50FD-1	I <sup>2</sup> PAK	TUBE

## STP20NM50FD/STB20NM50FD-1

### ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
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 kΩ)	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	20	A
I <sub>D</sub>	Drain Current (continuous) at T <sub>C</sub> = 100°C	14	A
I <sub>DM</sub> (●)	Drain Current (pulsed)	80	A
P <sub>TOT</sub>	Total Dissipation at T <sub>C</sub> = 25°C	192	W
	Derating Factor	1.2	W/°C
dv/dt (1)	Peak Diode Recovery voltage slope	20	V/ns
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> ≤ 20A, di/dt ≤ 200 A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>j</sub> ≤ T<sub>JMAX</sub>.

### THERMAL DATA

R <sub>thj-case</sub>	Thermal Resistance Junction-case	Max	0.65	°C/W
R <sub>thj-amb</sub>	Thermal Resistance Junction-ambient	Max	62.5	°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)	10	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> = 35 V)	700	mJ

### ELECTRICAL CHARACTERISTICS (TCASE = 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> = 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 10	μA μA
I <sub>GSS</sub>	Gate-body Leakage Current (V <sub>DS</sub> = 0)	V <sub>GS</sub> = ±30V			±100	nA
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> = 10A		0.22	0.25	Ω

**ELECTRICAL CHARACTERISTICS (CONTINUED)**  
**DYNAMIC**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$g_{fs}$ (1)	Forward Transconductance	$V_{DS} > I_{D(on)} \times R_{DS(on)max}$ , $I_D = 10A$		9		S
$C_{iss}$ $C_{oss}$ $C_{rss}$	Input Capacitance Output Capacitance Reverse Transfer Capacitance	$V_{DS} = 25V$ , $f = 1$ MHz, $V_{GS} = 0$		1380 290 40		pF pF pF
$C_{oss}$ eq. (2)	Equivalent Output Capacitance	$V_{GS} = 0V$ , $V_{DS} = 0V$ to 400V		130		pF
$R_g$	Gate Input Resistance	$f=1$ MHz Gate DC Bias=0 Test Signal Level=20mV Open Drain		2.8		$\Omega$

(1) Pulsed: Pulse duration = 300  $\mu$ s, duty cycle 1.5 %.(2)  $C_{oss}$  eq. is defined as a constant equivalent capacitance giving the same charging time as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DSS}$ .**SWITCHING ON**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ $t_r$	Turn-on Delay Time Rise Time	$V_{DD} = 250V$ , $I_D = 10$ A $R_G = 4.7\Omega$ $V_{GS} = 10V$ (see test circuit, Figure 3)		22 20		ns ns
$Q_g$ $Q_{gs}$ $Q_{gd}$	Total Gate Charge Gate-Source Charge Gate-Drain Charge	$V_{DD} = 400V$ , $I_D = 20A$ , $V_{GS} = 10V$		38 18 10	53	nC nC nC

**SWITCHING OFF**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{r(Voff)}$ $t_f$ $t_c$	Off-voltage Rise Time Fall Time Cross-over Time	$V_{DD} = 400V$ , $I_D = 20$ A, $R_G = 4.7\Omega$ , $V_{GS} = 10V$ (see test circuit, Figure 5)		6 15 30		ns ns ns

**SOURCE DRAIN DIODE**

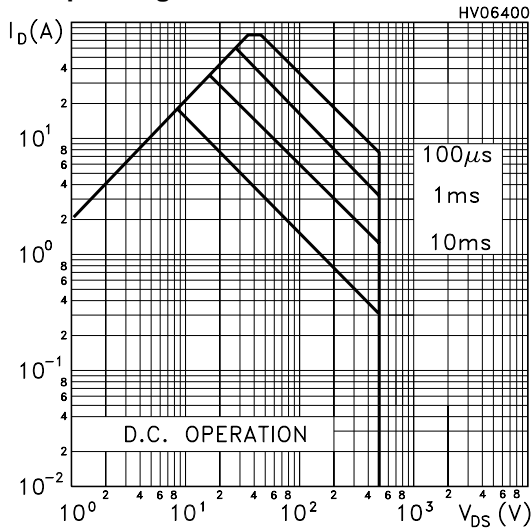
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$I_{SD}$ $I_{SDM}$ (2)	Source-drain Current Source-drain Current (pulsed)				20 80	A A
$V_{SD}$ (1)	Forward On Voltage	$I_{SD} = 20$ A, $V_{GS} = 0$			1.5	V
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	$I_{SD} = 20$ A, $di/dt = 100A/\mu$ s, $V_{DD} = 60V$ , $T_j = 150^\circ$ C (see test circuit, Figure 5)		245 2 16		ns $\mu$ C A

Note: 1. Pulsed: Pulse duration = 300  $\mu$ s, duty cycle 1.5 %.

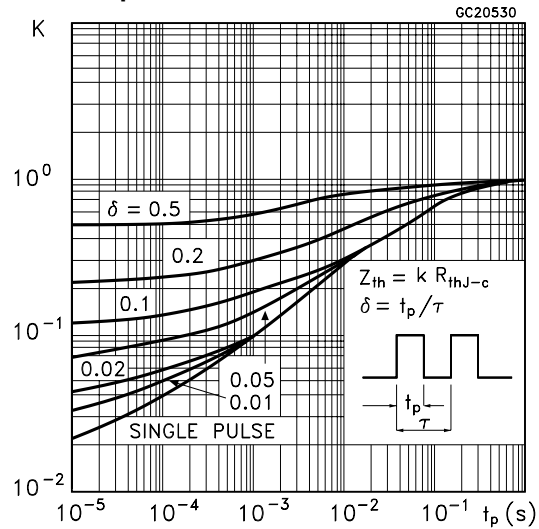
2. Pulse width limited by safe operating area.

# STP20NM50FD/STB20NM50FD-1

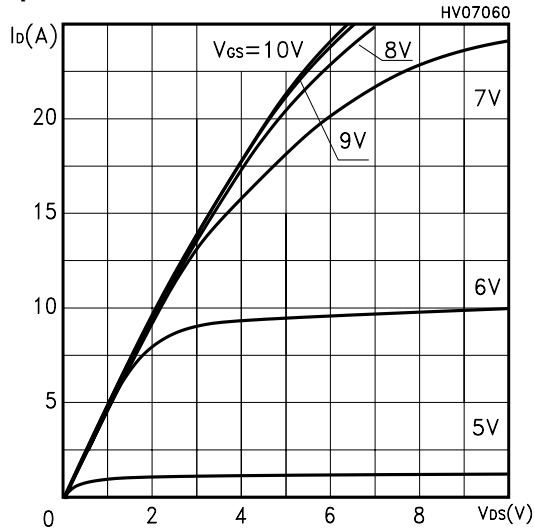
## Safe Operating Area For TO-220 / I<sup>2</sup>PAK



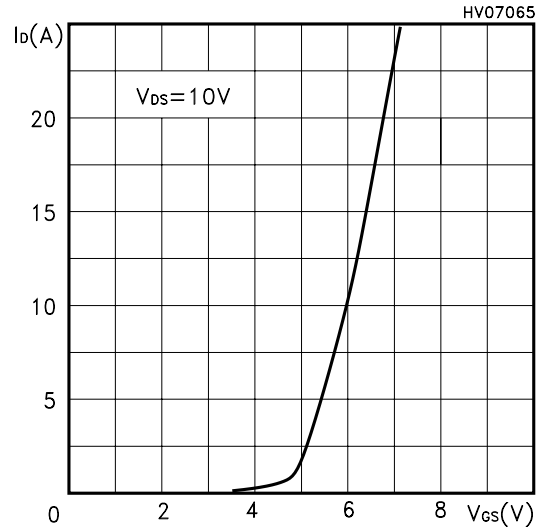
## Thermal Impedance For TO-220 / I<sup>2</sup>PAK



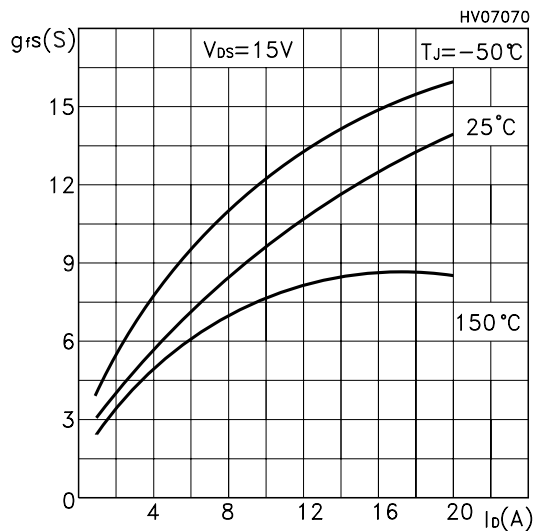
## Output Characteristics



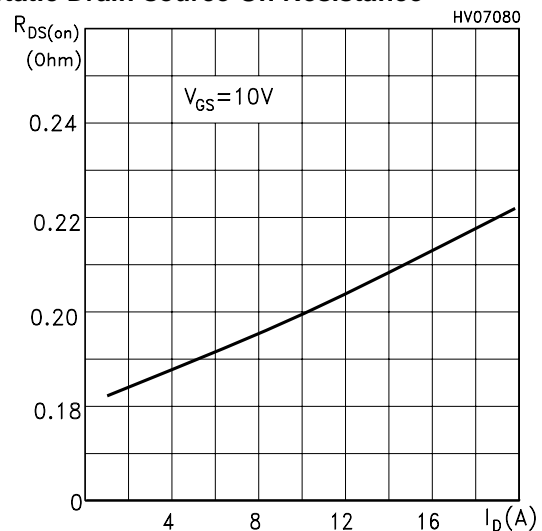
## Transfer Characteristics



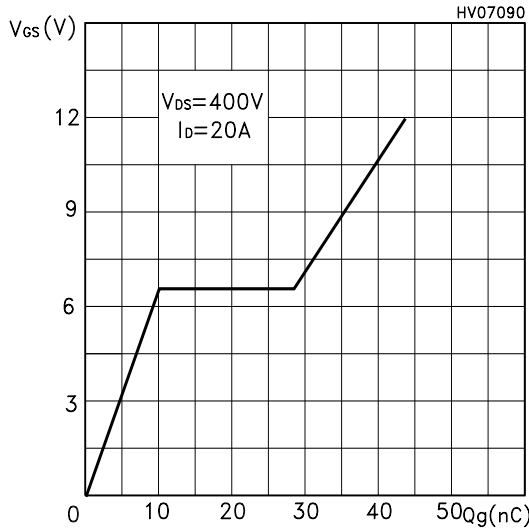
## Transconductance



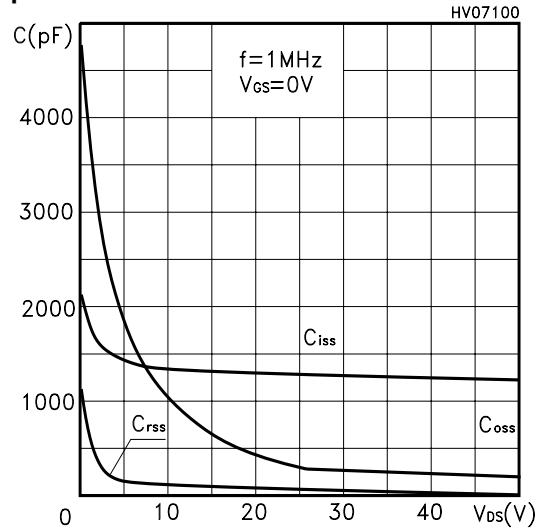
## Static Drain-source On Resistance



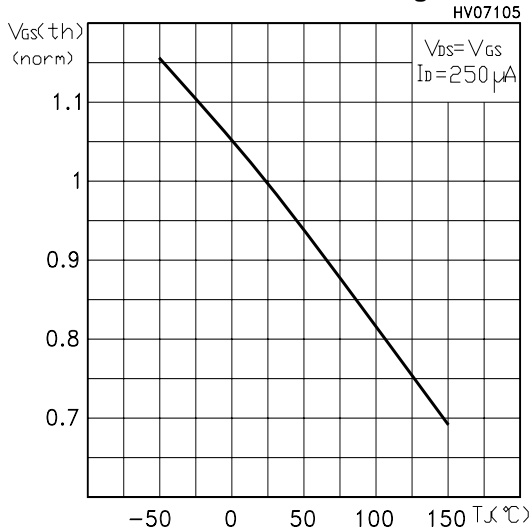
**Gate Charge vs Gate-source Voltage**



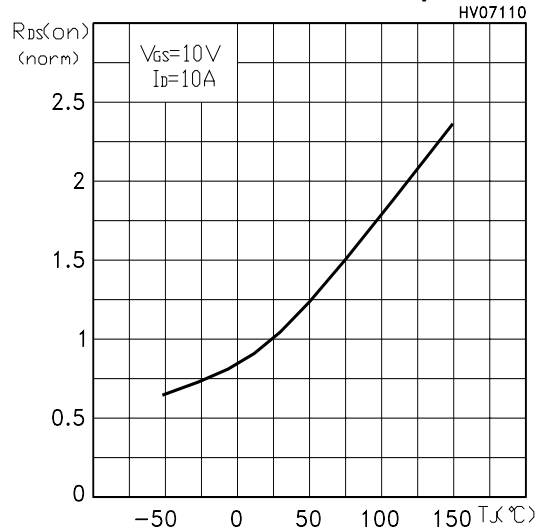
**Capacitance Variations**



**Normalized Gate Threshold Voltage vs Temp.**



**Normalized On Resistance vs Temperature**



**Source-drain Diode Forward Characteristics**

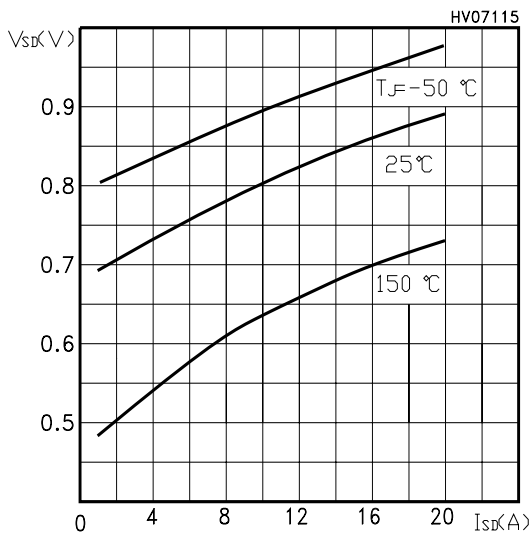


Fig. 1: Unclamped Inductive Load Test Circuit

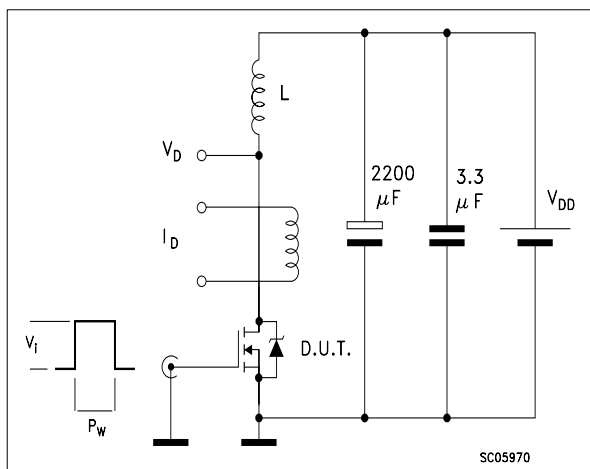


Fig. 2: Unclamped Inductive Waveform

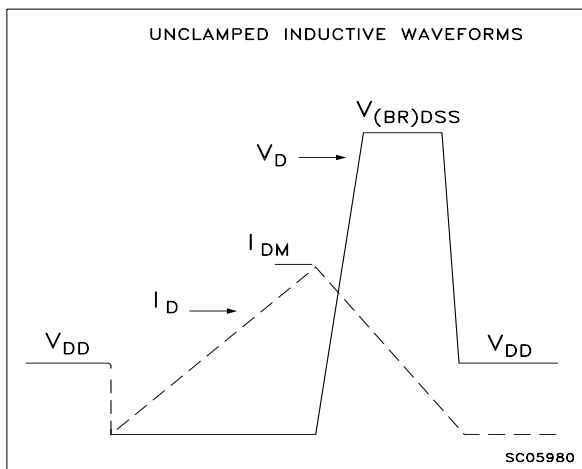


Fig. 3: Switching Times Test Circuit For Resistive Load

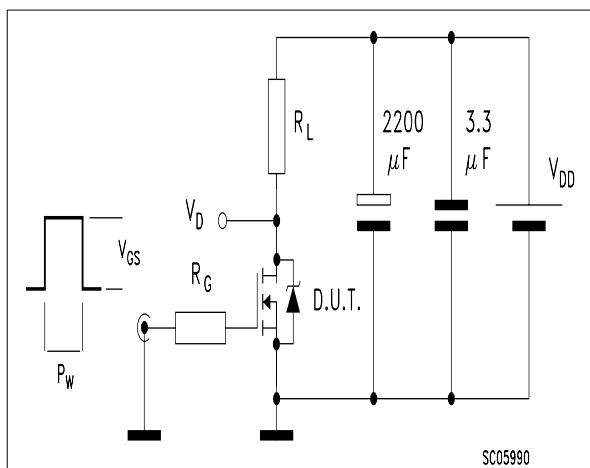


Fig. 4: Gate Charge test Circuit

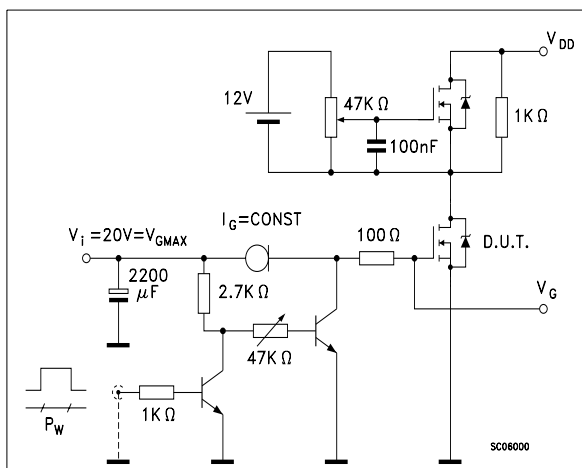
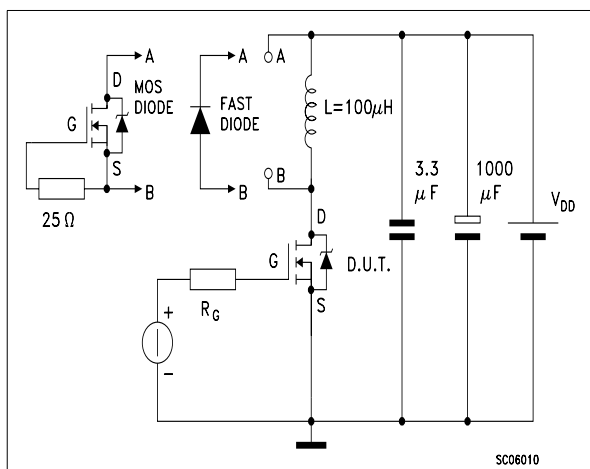
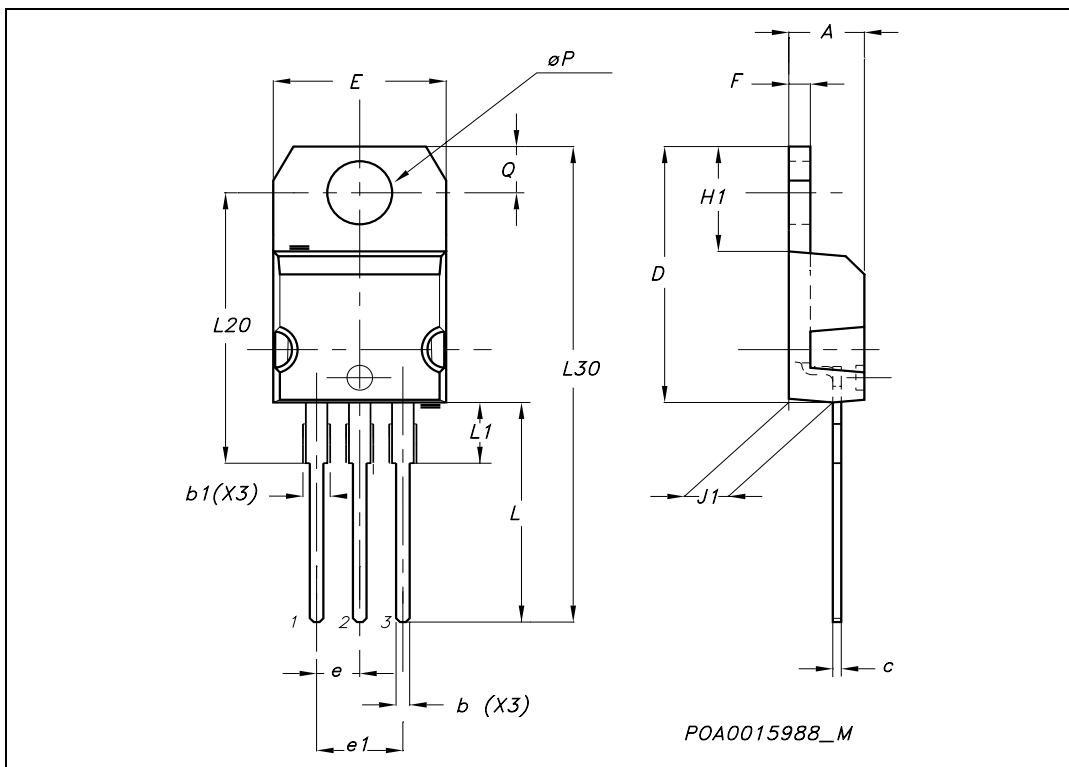


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



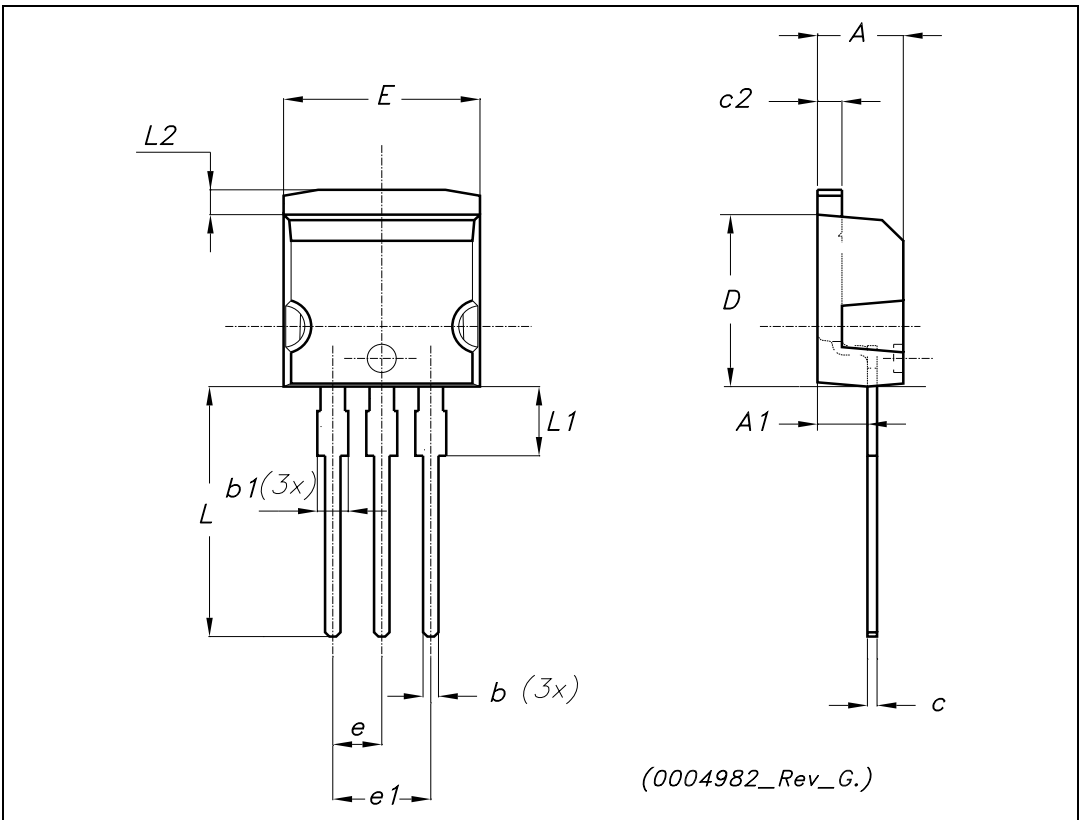
**TO-220 MECHANICAL DATA**

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-262 (I<sup>2</sup>PAK) MECHANICAL DATA**

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
A1	2.40		2.72	0.094		0.107
b	0.61		0.88	0.024		0.034
b1	1.14		1.70	0.044		0.066
c	0.49		0.70	0.019		0.027
c2	1.23		1.32	0.048		0.052
D	8.95		9.35	0.352		0.368
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
E	10		10.40	0.393		0.410
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L2	1.27		1.40	0.050		0.055





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