



# STU8NC90Z STU8NC90ZI

## N-CHANNEL 900V - 1.1Ω - 7.6A Max220/I-Max220 Zener-Protected PowerMESH™III MOSFET

TYPE	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>
STU8NC90Z	900 V	< 1.38Ω	7 A
STU9NC90ZI	900 V	< 1.38Ω	7 A

- TYPICAL R<sub>DS(on)</sub> = 1.1Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- GATE-TO-SOURCE ZENER DIODES
- 100% AVALANCHE TESTED
- VERY LOW INTRINSIC CAPACITANCES
- GATE CHARGE MINIMIZED

### DESCRIPTION

The third generation of MESH OVERLAY™ Power MOSFETs for very high voltage exhibits unsurpassed on-resistance per unit area while integrating back-to-back Zener diodes between gate and source. Such arrangement gives extra ESD capability with higher ruggedness performance as requested by a large variety of single-switch applications.

### APPLICATIONS

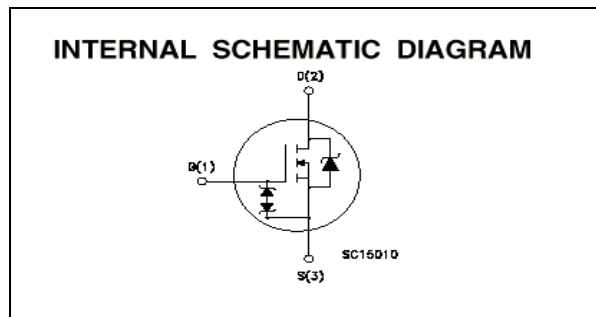
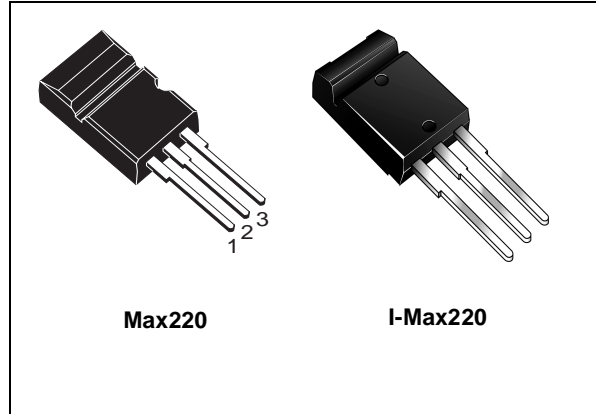
- SINGLE-ENDED SMPS IN MONITORS, COMPUTER AND INDUSTRIAL APPLICATION
- WELDING EQUIPMENT

### ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		STU8NC90Z	STU8NC90ZI	
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	±25		V
I <sub>D</sub>	Drain Current (continuous) at T <sub>C</sub> = 25°C	7	7(*)	A
I <sub>D</sub>	Drain Current (continuous) at T <sub>C</sub> = 100°C	4.4	4.4(*)	A
I <sub>DM</sub> (1)	Drain Current (pulsed)	28	28(*)	A
P <sub>TOT</sub>	Total Dissipation at T <sub>C</sub> = 25°C	160	55	W
	Derating Factor	1.28	0.44	W/°C
I <sub>GS</sub>	Gate-source Current	±50		mA
V <sub>ESD(G-S)</sub>	Gate source ESD(HBM-C=100pF, R=15KΩ)	4		KV
dv/dt(●)	Peak Diode Recovery voltage slope	3		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> ≤ 7A, di/dt ≤ 100A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>j</sub> ≤ T<sub>JMAX</sub>  
(\*)Limited only by maximum temperature allowed



## STU8NC90Z/STU8NC90ZI

### THERMAL DATA

		Max220	I-Max220	
Rthj-case	Thermal Resistance Junction-case Max	0.78	2.27	°C/W
Rthj-amb	Thermal Resistance Junction-ambient Max	30		°C/W
Rthc-sink	Thermal Resistance Case-sink Typ	0.1		°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)	7	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)	430	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	900			V
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	Breakdown Voltage Temp. Coefficient	I <sub>D</sub> = 1 mA, V <sub>GS</sub> = 0		1		V/°C
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

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> = 250μA	3	4	5	V
R <sub>DS(on)</sub>	Static Drain-source On Resistance	V <sub>GS</sub> = 10V, I <sub>D</sub> = 3.8A		1.1	1.38	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	7			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)</sub> max, I <sub>D</sub> = 3.8A		9		S
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 25V, f = 1 MHz, V <sub>GS</sub> = 0		3550		pF
C <sub>oss</sub>	Output Capacitance			205		pF
C <sub>rss</sub>	Reverse Transfer Capacitance			25		pF

## ELECTRICAL CHARACTERISTICS (CONTINUED)

## SWITCHING ON (RESISTIVE LOAD)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on Delay Time	$V_{DD} = 400V, I_D = 4A$ $R_G = 4.7\Omega, V_{GS} = 10V$ (see test circuit, Figure 3)		36		ns
$t_r$	Rise Time			12		ns
$Q_g$	Total Gate Charge	$V_{DD} = 720V, I_D = 8A,$ $V_{GS} = 10V$		73	102	nC
$Q_{gs}$	Gate-Source Charge			18		nC
$Q_{gd}$	Gate-Drain Charge			27		nC

## SWITCHING OFF (INDUCTIVE LOAD)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{r(Voff)}$	Off-voltage Rise Time	$V_{DD} = 720V, I_D = 8A,$ $R_G = 4.7\Omega, V_{GS} = 10V$ (see test circuit, Figure 5)		36		ns
$t_f$	Fall Time			45		ns
$t_c$	Cross-over Time			77		ns

## SOURCE DRAIN DIODE

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain Current				7	A
$I_{SDM(2)}$	Source-drain Current (pulsed)				28	A
$V_{SD(1)}$	Forward On Voltage	$I_{SD} = 7A, V_{GS} = 0$			1.6	V
$t_{rr}$	Reverse Recovery Time	$I_{SD} = 8A, di/dt = 100A/\mu s,$ $V_{DD} = 50V, T_j = 150^\circ C$ (see test circuit, Figure 5)		860		ns
$Q_{rr}$	Reverse Recovery Charge			10		$\mu C$
$I_{RRM}$	Reverse Recovery Current			24		A

## GATE-SOURCE ZENER DIODE

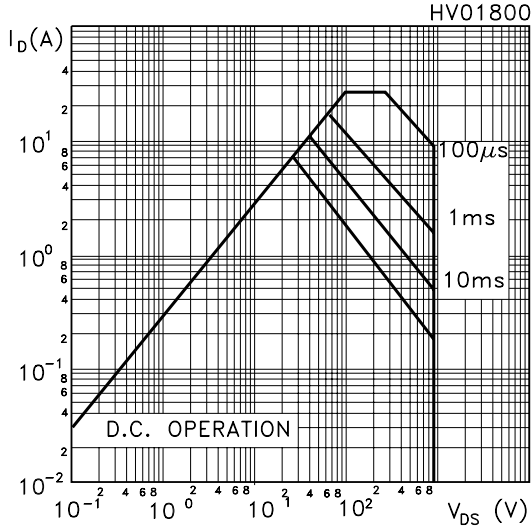
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$BV_{GSO}$	Gate-Source Breakdown Voltage	$I_{GS} = \pm 1mA$ (Open Drain)	25			V
$\alpha_T$	Voltage Thermal Coefficient	$T = 25^\circ C$ Note(3)		1.3		$10^{-4}/^\circ C$
$R_z$	Dynamic Resistance	$I_{GS} = 50mA, V_{GS} = 0$		90		$\Omega$

Note: 1. Pulsed: Pulse duration = 300  $\mu s$ , duty cycle 1.5 %.  
 2. Pulse width limited by safe operating area.  
 3.  $\Delta V_{BV} = \alpha_T (25^\circ - T) BV_{GSO}(25^\circ)$

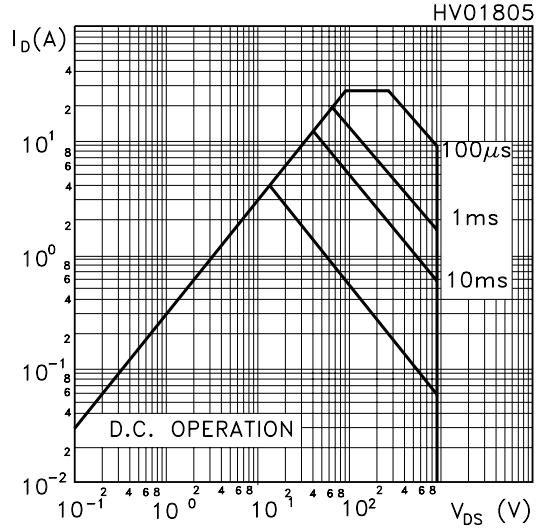
## PROTECTION FEATURES OF GATE-TO-SOURCE ZENER DIODES

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 25V 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.

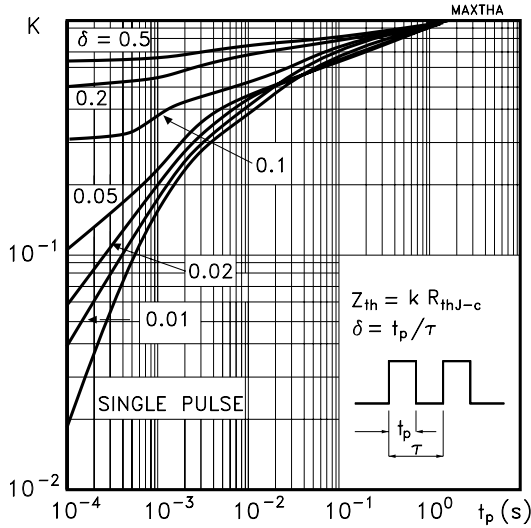
Safe Operating Area For Max220



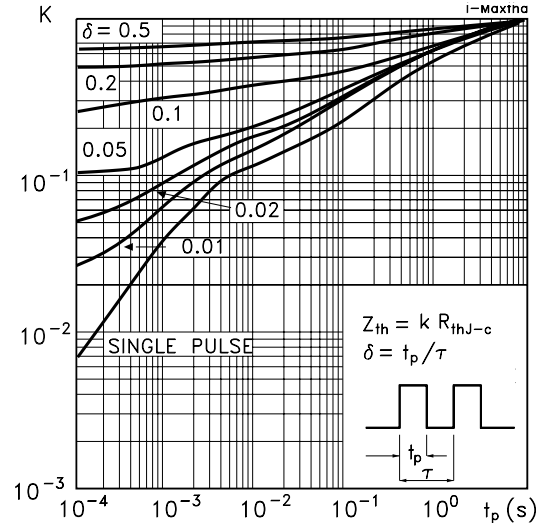
Safe Operating Area For I-Max220



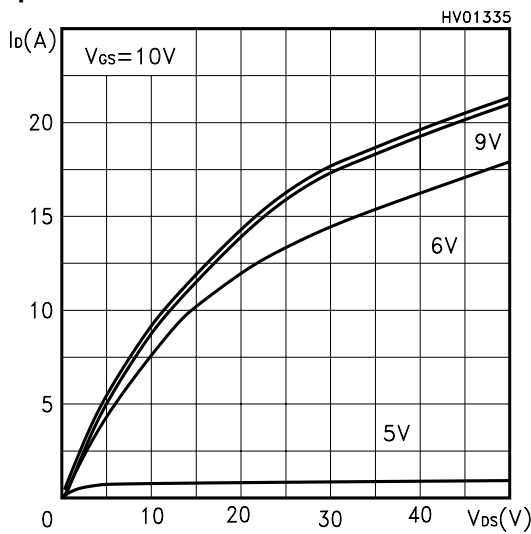
Thermal Impedance For Max220



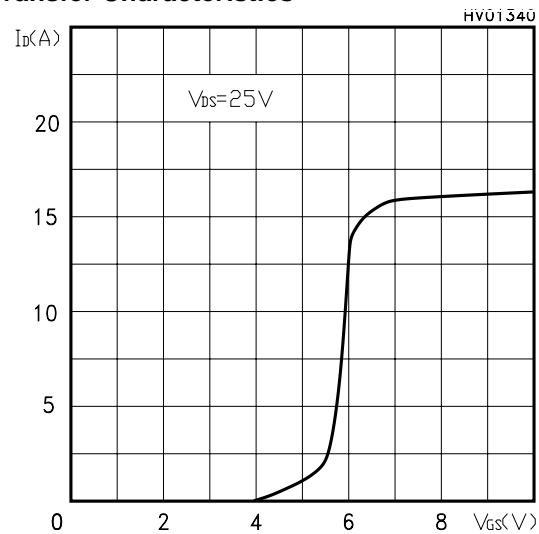
Thermal Impedance For I-Max220



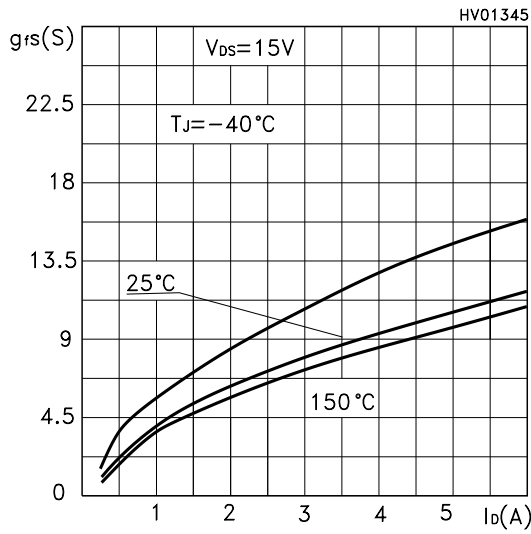
Output Characteristics



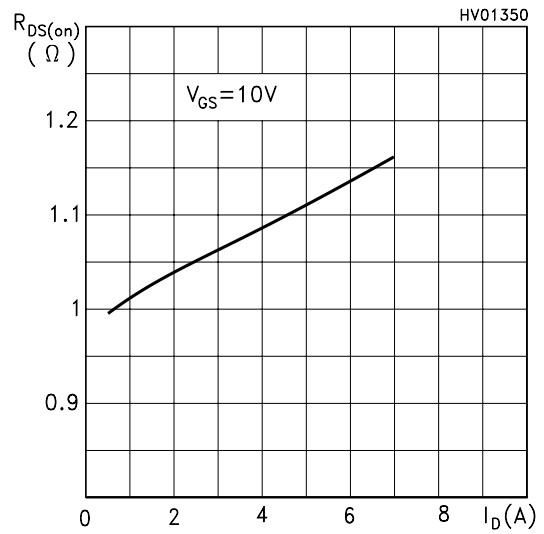
Transfer Characteristics



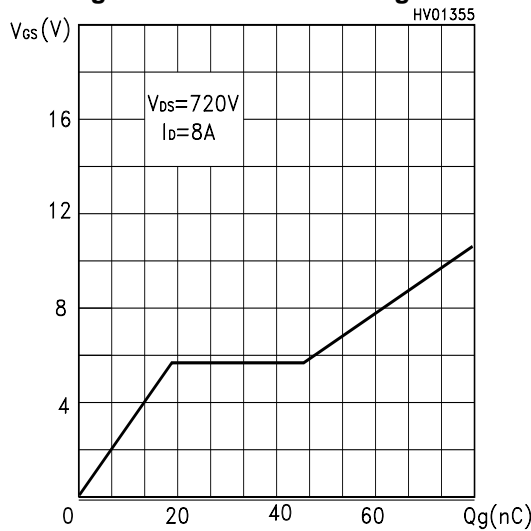
**Transconductance**



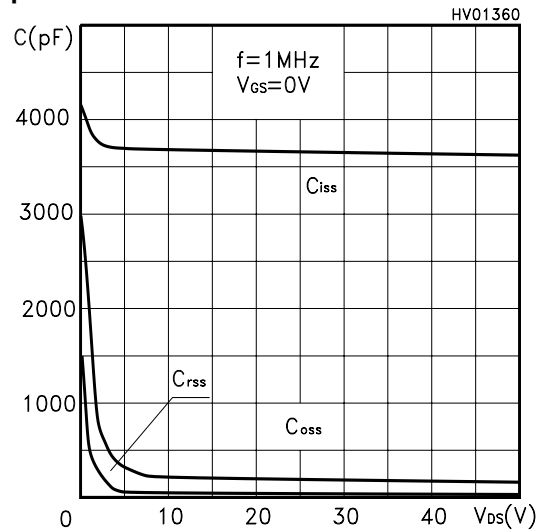
**Static Drain-source On Resistance**



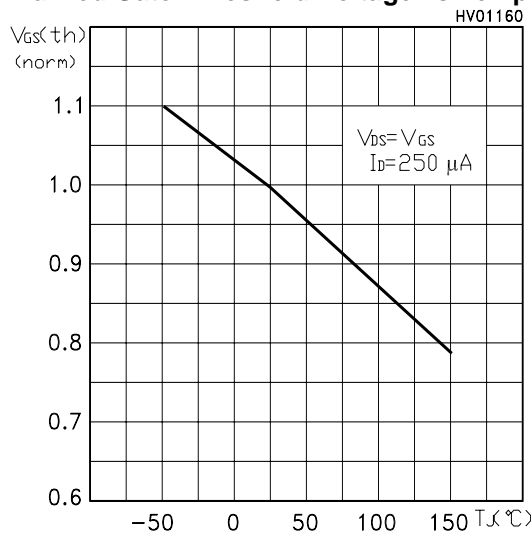
**Gate Charge vs Gate-source Voltage**



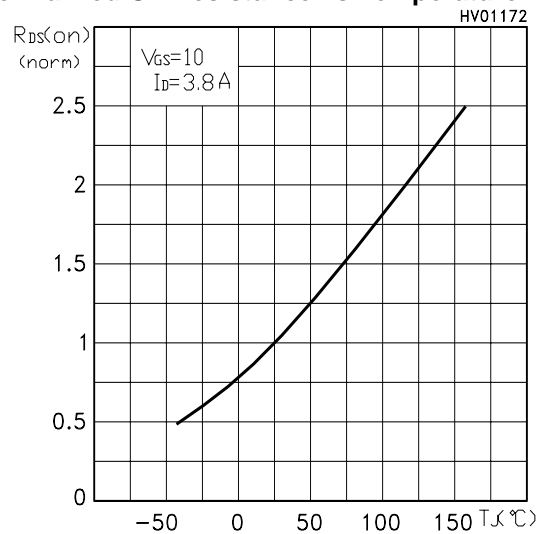
**Capacitance Variations**



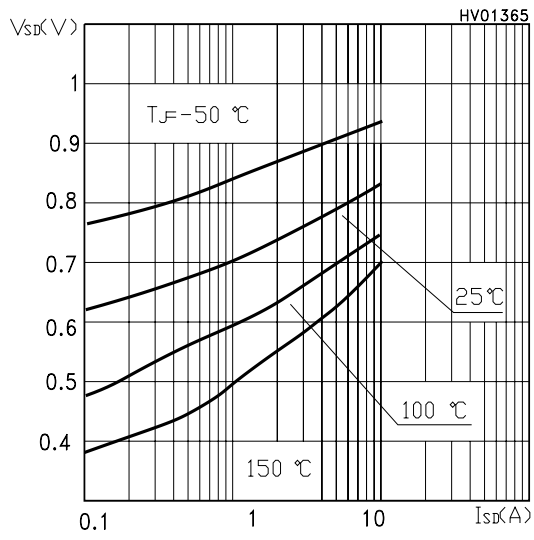
**Normalized Gate Threshold Voltage vs Temp.**



**Normalized On Resistance vs Temperature**



Source-drain Diode Forward Characteristics



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



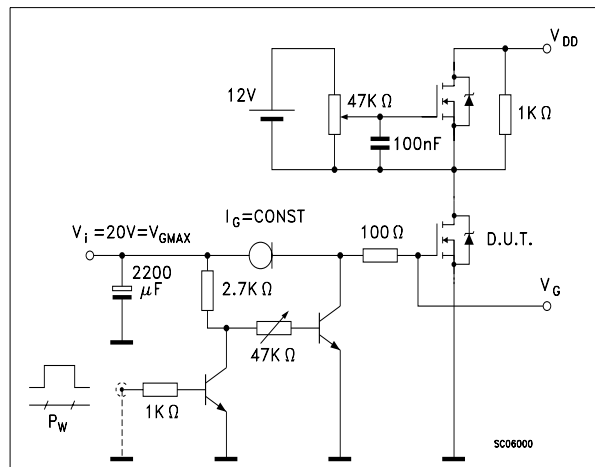
**Fig. 2: Unclamped Inductive Waveform**



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



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

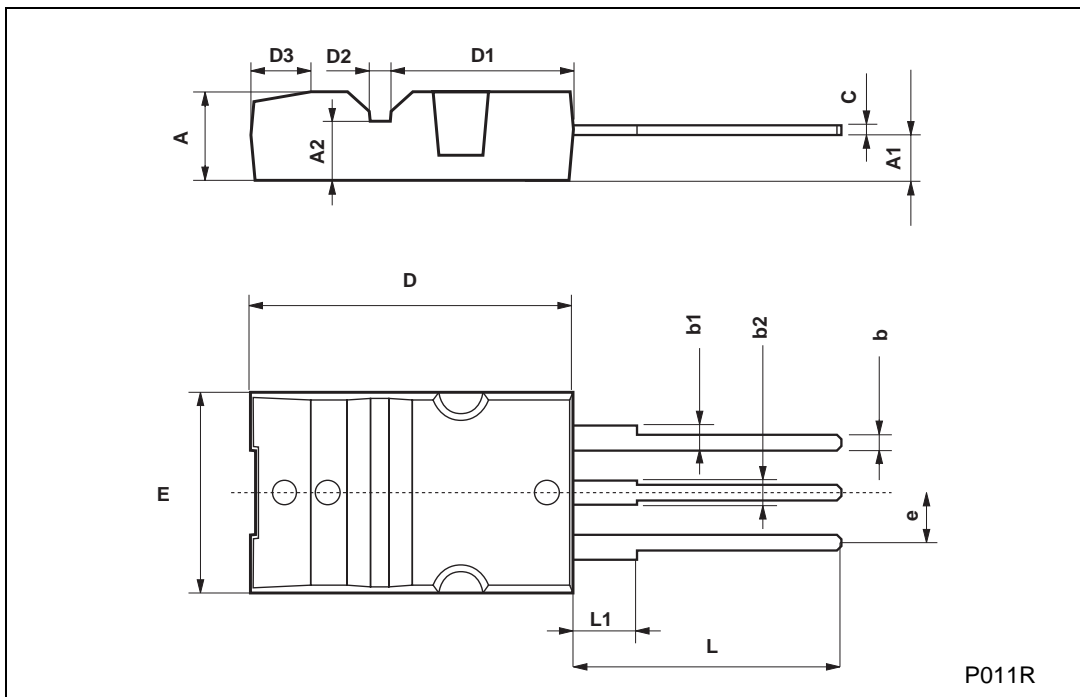


**Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times**



**Max220 MECHANICAL DATA**

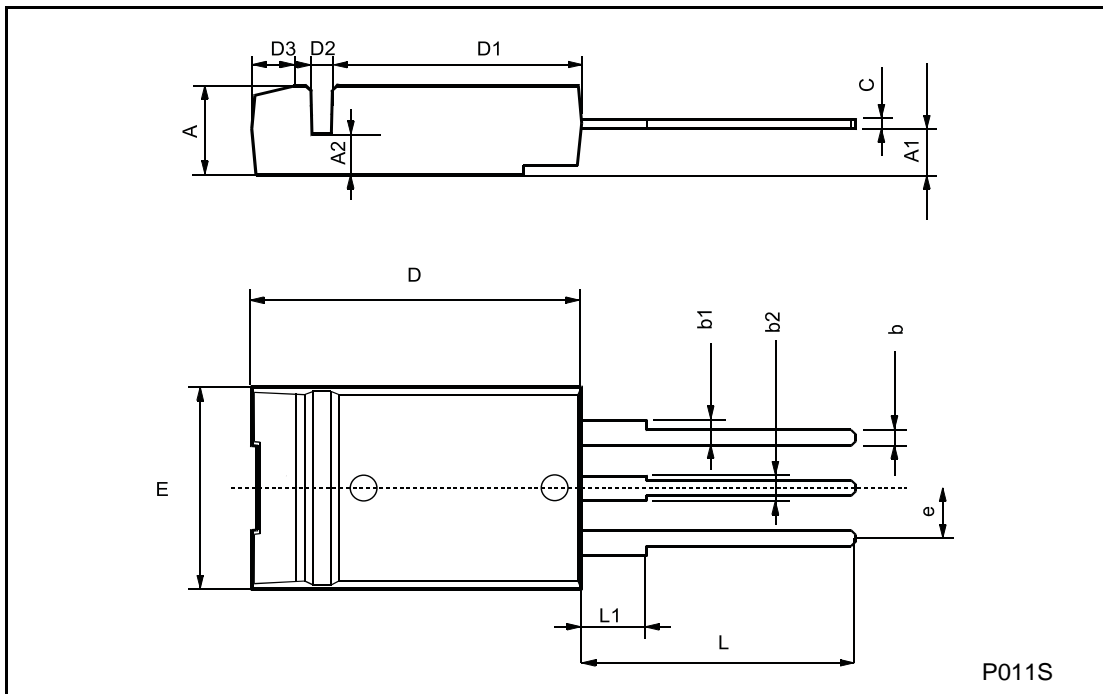
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.3		4.6	0.169		0.181
A1	2.2		2.4	0.087		0.094
A2	2.9		3.1	0.114		0.122
b	0.7		0.93	0.027		0.036
b1	1.25		1.4	0.049		0.055
b2	1.2		1.38	0.047		0.054
c	0.45		0.6		0.18	0.023
D	15.9		16.3		0.626	0.641
D1	9		9.35	0.354		0.368
D2	0.8		1.2	0.031		0.047
D3	2.8		3.2	0.110		0.126
e	2.44		2.64	0.096		0.104
E	10.05		10.35	0.396		0.407
L	13.2		13.6	0.520		0.535
L1	3		3.4	0.118		0.133





I-Max220 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.3		4.6	0.169		0.181
A1	2.6		2.75	0.102		0.108
A2	1.95		2.15	0.077		0.084
b	0.7		0.93	0.027		0.036
b1	1.25		1.4	0.049		0.055
b2	1.2		1.38	0.047		0.054
c	0.45		0.6	0.017		0.023
D	15.9		16.3	0.626		0.641
D1	12.5		12.9	0.492		0.508
D2	0.6		1	0.023		0.039
D3	1.75		2.15	0.069		0.084
e	2.44		2.64	0.096		0.104
E	10.05		10.35	0.396		0.407
L	13.2		13.6	0.520		0.535
L1	3		3.4	0.118		0.133



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