



STP11NC40, STP11NC40FP

N-CHANNEL 400V - 0.44Ω - 9.5A TO-220/TO-220FP

PowerMESH™II Power MOSFET

TYPE	V _{DSS}	R _{DS(on)}	I _D	P _w
STP11NC40	400 V	< 0.55 Ω	9.5 A	120 W
STP11NC40FP	400 V	< 0.55 Ω	9.5 A(*)	30 W

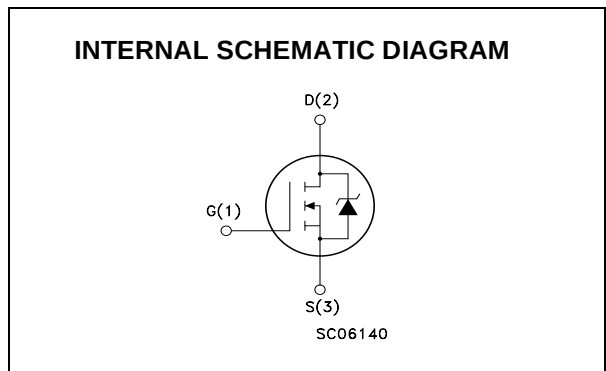
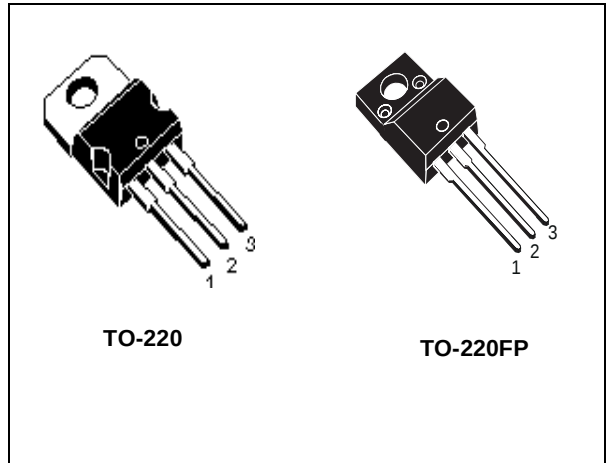
- TYPICAL R_{DS(on)} = 0.44 Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- NEW HIGH VOLTAGE BENCHMARK
- GATE CHARGE MINIMIZED

DESCRIPTION

The PowerMESH™II is the evolution of the first generation of MESH OVERLAY™. The layout refinements introduced greatly improve the Ron*area figure of merit while keeping the device at the leading edge for what concerns switching speed, gate charge and ruggedness.

APPLICATIONS

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



ORDERING INFORMATION

SALES TYPE	MARKING	PACKAGE	PACKAGING
STP11NC40	P11NC40	TO-220	TUBE
STP11NC40FP	P11NC40FP	TO-220FP	TUBE

STP11NC40, STP11NC40FP

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		STP11NC40	STP11NC40FP	
V_{DS}	Drain-source Voltage ($V_{GS} = 0$)	400		V
V_{DGR}	Drain-gate Voltage ($R_{GS} = 20\text{ k}\Omega$)	400		V
V_{GS}	Gate- source Voltage	± 30		V
I_D	Drain Current (continuous) at $T_C = 25^\circ\text{C}$	9.5	9.5 (*)	A
I_D	Drain Current (continuous) at $T_C = 100^\circ\text{C}$	6	6 (*)	A
$I_{DM}(\bullet)$	Drain Current (pulsed)	38	38 (*)	A
P_{TOT}	Total Dissipation at $T_C = 25^\circ\text{C}$	120	30	W
	Derating Factor	0.96	0.24	W/ $^\circ\text{C}$
dv/dt (1)	Peak Diode Recovery voltage slope	3.5		V/ns
V_{ISO}	Insulation Withstand Voltage (DC)	-	2500	V
T_j T_{stg}	Operating Junction Temperature Storage Temperature	-55 to 150 -55 to 150		$^\circ\text{C}$ $^\circ\text{C}$

(●) Pulse width limited by safe operating area

(1) $I_{SD} \leq 9.5\text{A}$, $di/dt \leq 100\text{A}/\mu\text{s}$, $V_{DD} \leq V_{(BR)DSS}$, $T_j \leq T_{JMAX}$.

(*) Limited only by maximum temperature allowed

THERMAL DATA

		TO-220	TO-220FP	
Rthj-case	Thermal Resistance Junction-case Max	1.04	4.1	$^\circ\text{C}/\text{W}$
Rthj-amb	Thermal Resistance Junction-ambient Max	62.5		$^\circ\text{C}/\text{W}$
T_I	Maximum Lead Temperature For Soldering Purpose	300		$^\circ\text{C}$

AVALANCHE CHARACTERISTICS

Symbol	Parameter	Max Value	Unit
I_{AR}	Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T_j max)	9.5	A
E_{AS}	Single Pulse Avalanche Energy (starting $T_j = 25^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	300	mJ

ELECTRICAL CHARACTERISTICS (TCASE = 25 $^\circ\text{C}$ UNLESS OTHERWISE SPECIFIED)

ON/OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source Breakdown Voltage	$I_D = 250\text{ }\mu\text{A}$, $V_{GS} = 0$	400			V
I_{DSS}	Zero Gate Voltage Drain Current ($V_{GS} = 0$)	$V_{DS} = \text{Max Rating}$ $V_{DS} = \text{Max Rating}$, $T_C = 125^\circ\text{C}$			1 50	μA μA
I_{GSS}	Gate-body Leakage Current ($V_{DS} = 0$)	$V_{GS} = \pm 30\text{V}$			± 100	nA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$, $I_D = 250\mu\text{A}$	2	3	4	V
$R_{DS(on)}$	Static Drain-source On Resistance	$V_{GS} = 10\text{V}$, $I_D = 5\text{ A}$		0.44	0.55	Ω

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g_{fs} (1)	Forward Transconductance	$V_{DS} = 15\text{ V}$, $I_D = 5\text{ A}$		8.6		S
C_{iss}	Input Capacitance	$V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$		995		pF
C_{oss}	Output Capacitance			172		pF
C_{rss}	Reverse Transfer Capacitance			25		pF

SWITCHING ON

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on Delay Time	$V_{DD} = 200\text{ V}$, $I_D = 5\text{ A}$ $R_G = 4.7\Omega$, $V_{GS} = 10\text{ V}$ (Resistive Load see, Figure 3)		15		ns
t_r	Rise Time			18		ns
Q_g	Total Gate Charge	$V_{DD} = 320\text{ V}$, $I_D = 10\text{ A}$, $V_{GS} = 10\text{ V}$		32.5	45.5	nC
Q_{gs}	Gate-Source Charge			6		nC
Q_{gd}	Gate-Drain Charge			15		nC

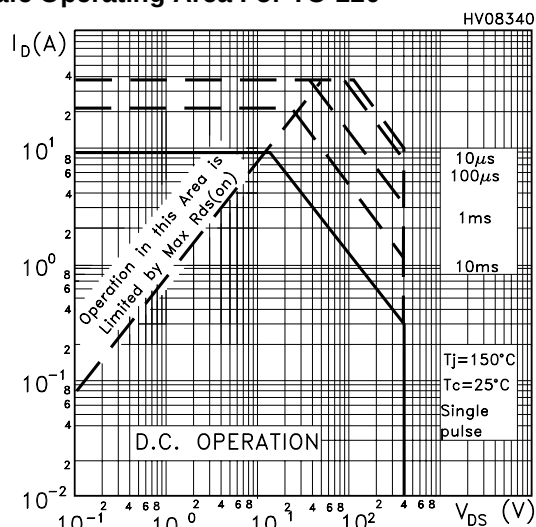
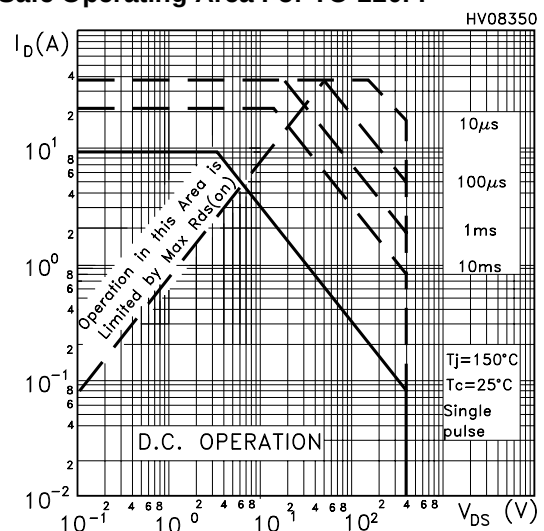
SWITCHING OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(off)}$	Turn-off Delay Time	$V_{DD} = 320\text{ V}$, $I_D = 5\text{ A}$ $R_G = 4.7\Omega$, $V_{GS} = 10\text{ V}$ (Resistive Load see, Figure 3)		43		ns
t_f	Fall Time			15		ns
$t_r(V_{off})$	Off-voltage Rise Time	$V_{DD} = 320\text{ V}$, $I_D = 10\text{ A}$, $R_G = 4.7\Omega$, $V_{GS} = 10\text{ V}$ (Inductive Load see, Figure 5)		7.5		ns
t_f	Fall Time			14		ns
t_c	Cross-over Time			23		ns

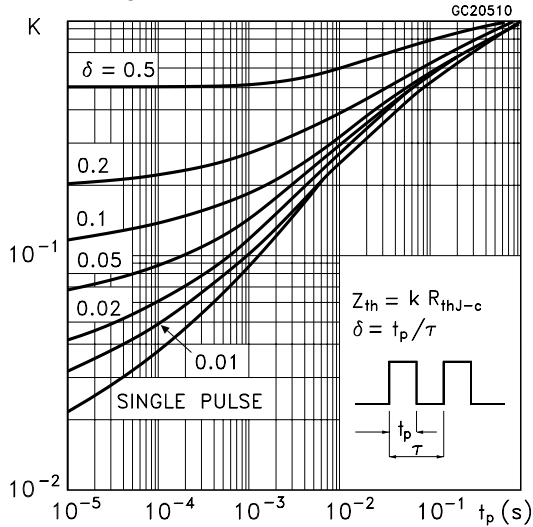
SOURCE DRAIN DIODE

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain Current				9.5	A
I_{SDM} (2)	Source-drain Current (pulsed)				38	A
V_{SD} (1)	Forward On Voltage	$I_{SD} = 9.5\text{ A}$, $V_{GS} = 0$			1.6	V
t_{rr}	Reverse Recovery Time	$I_{SD} = 9.5\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$, $T_j = 150^\circ\text{C}$ (see test circuit, Figure 5)		315		ns
Q_{rr}	Reverse Recovery Charge			2100		nC
I_{RRM}	Reverse Recovery Current			13.6		A

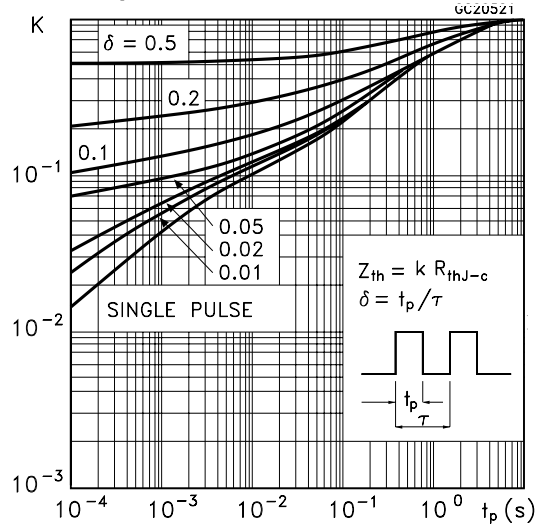
Note: 1. Pulsed: Pulse duration = 300 μs , duty cycle 1.5 %.
 2. Pulse width limited by safe operating area.

Safe Operating Area For TO-220**Safe Operating Area For TO-220FP**

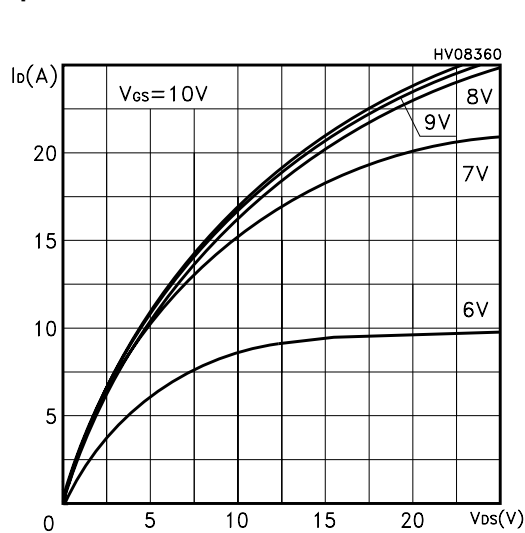
Thermal Impedance For TO-220



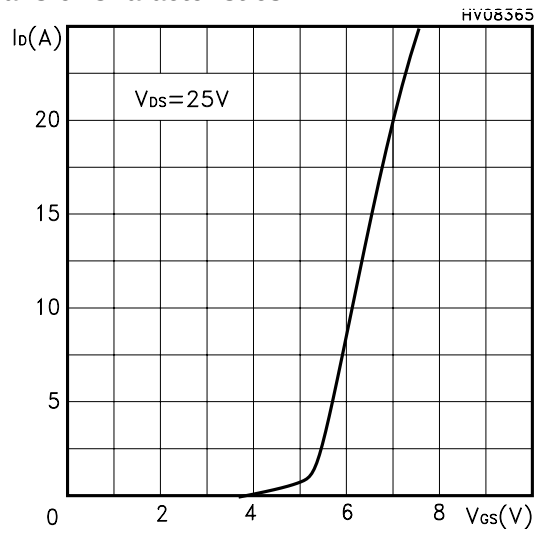
Thermal Impedance For TO-220FP



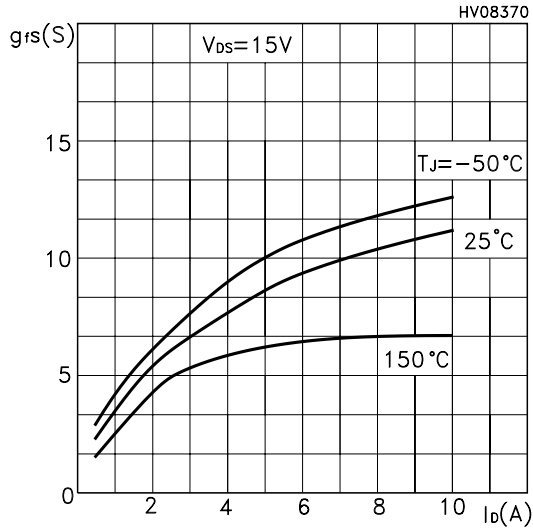
Output Characteristics



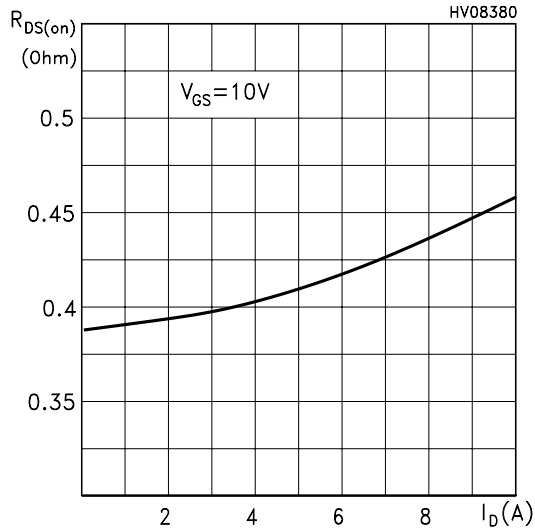
Transfer Characteristics



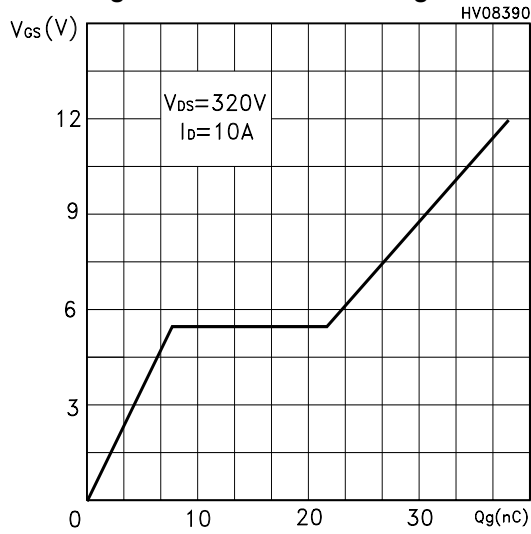
Transconductance



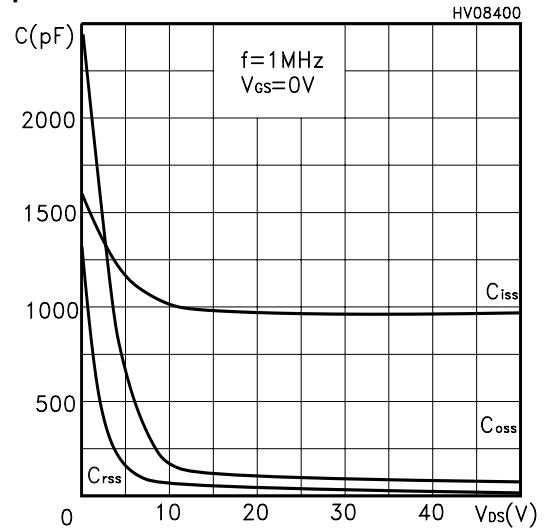
Static Drain-source On Resistance



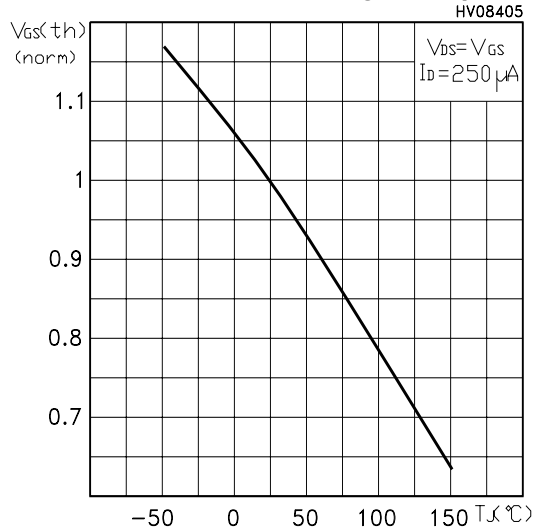
Gate Charge vs Gate-source Voltage



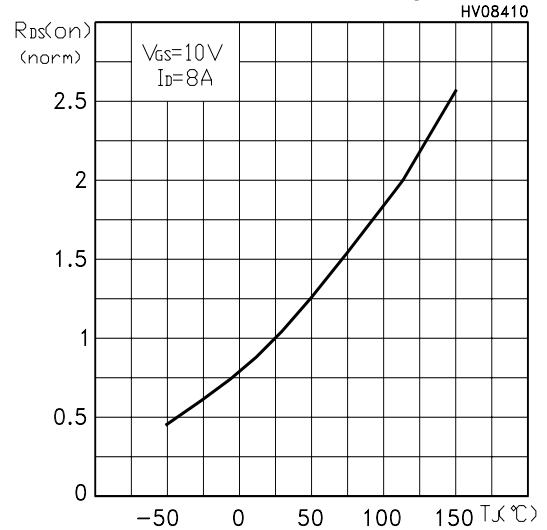
Capacitance Variations



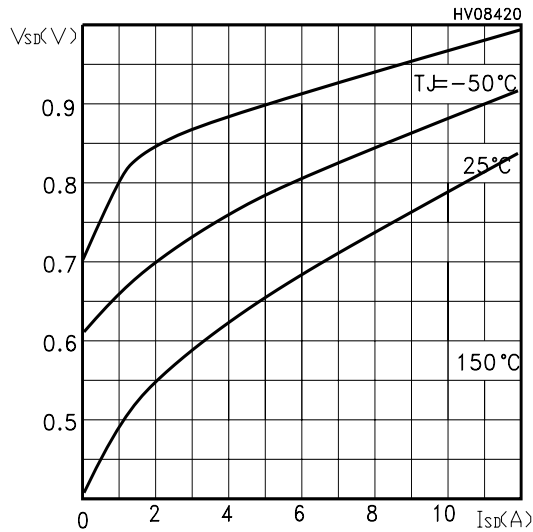
Normalized Gate Threshold Voltage vs Temperature



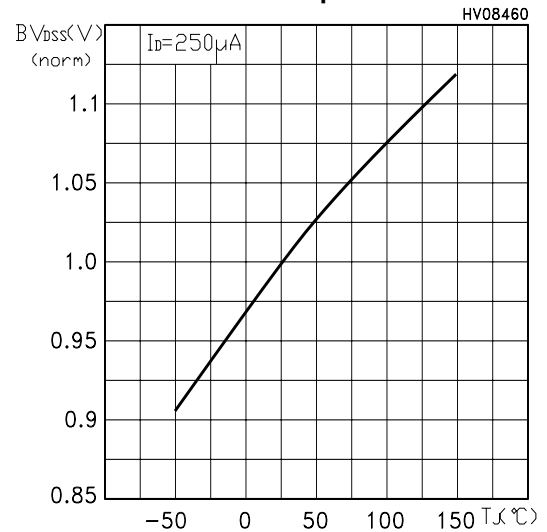
Normalized On Resistance vs Temperature



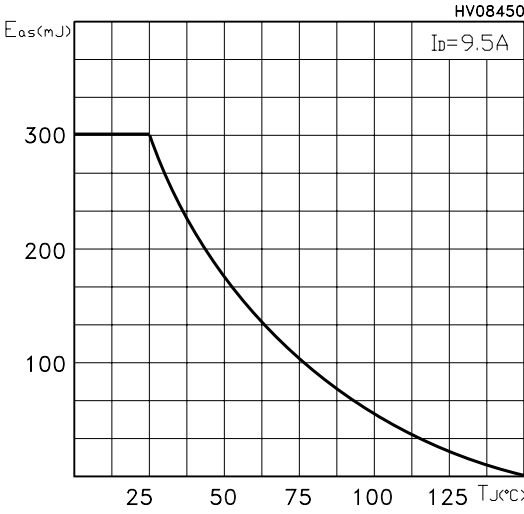
Source-drain Diode Forward Characteristics



Normalized BVDSS vs Temperature



Maximum Avalanche Energy vs Temperature



I_d vs Temperature

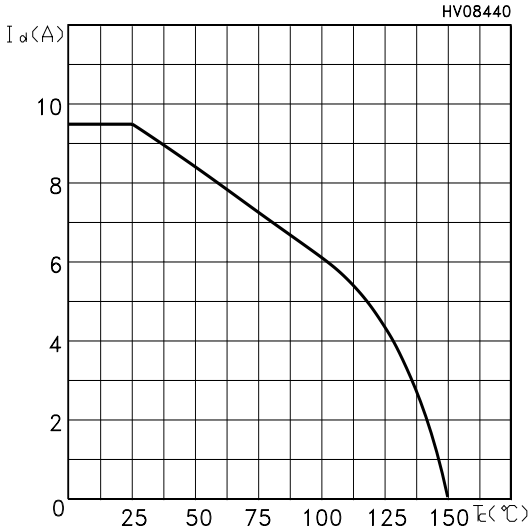


Fig. 1: Unclamped Inductive Load Test Circuit

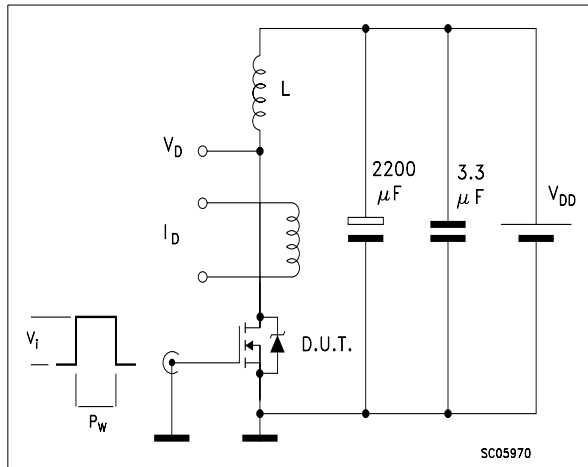


Fig. 2: Unclamped Inductive Waveform

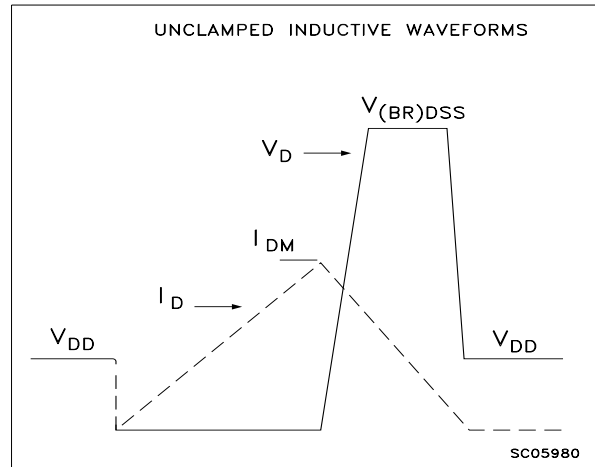


Fig. 3: Switching Times Test Circuit For Resistive Load

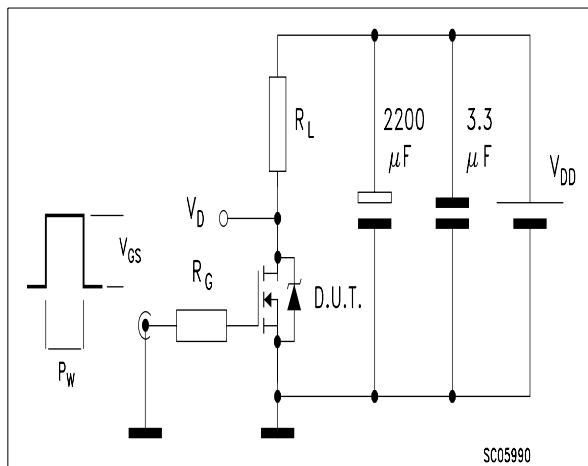


Fig. 4: Gate Charge test Circuit

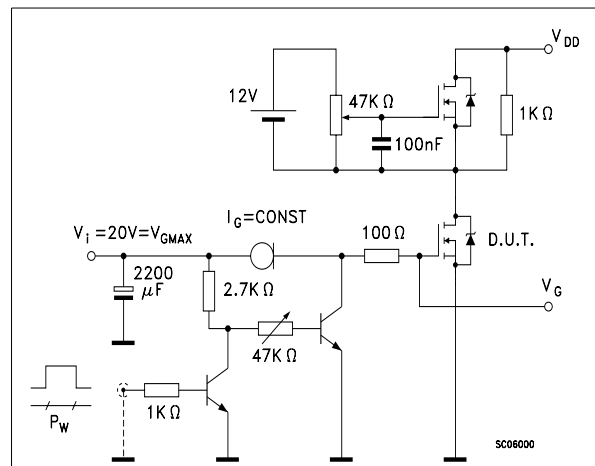
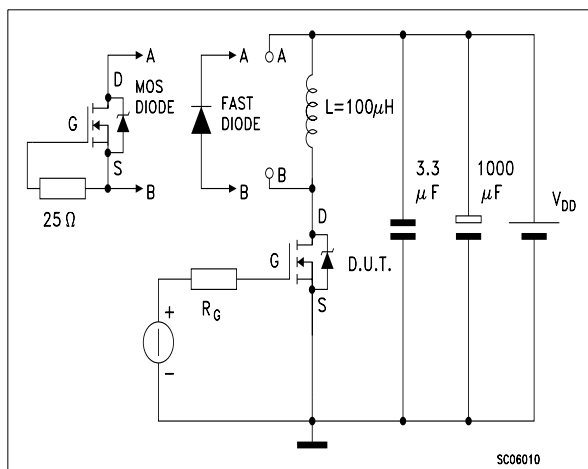
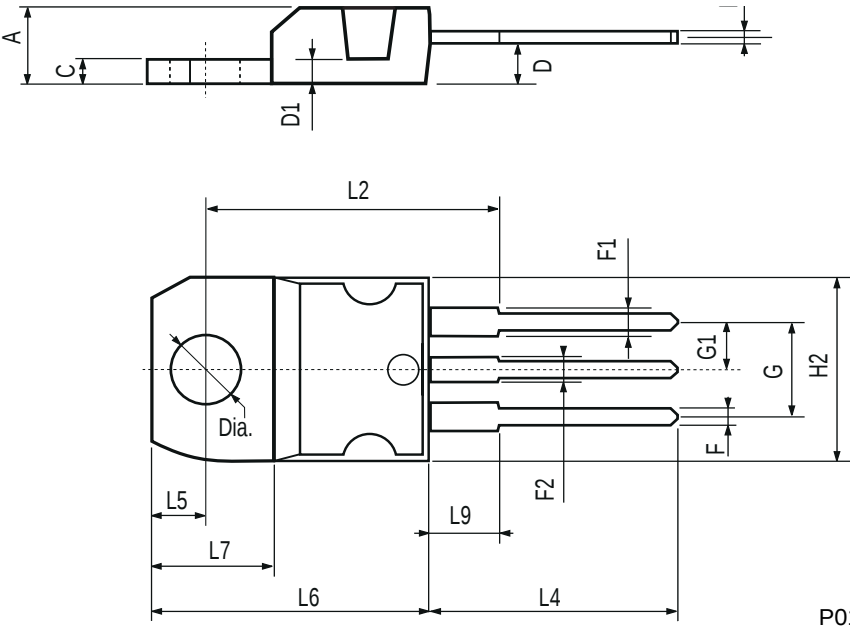


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



TO-220 MECHANICAL DATA

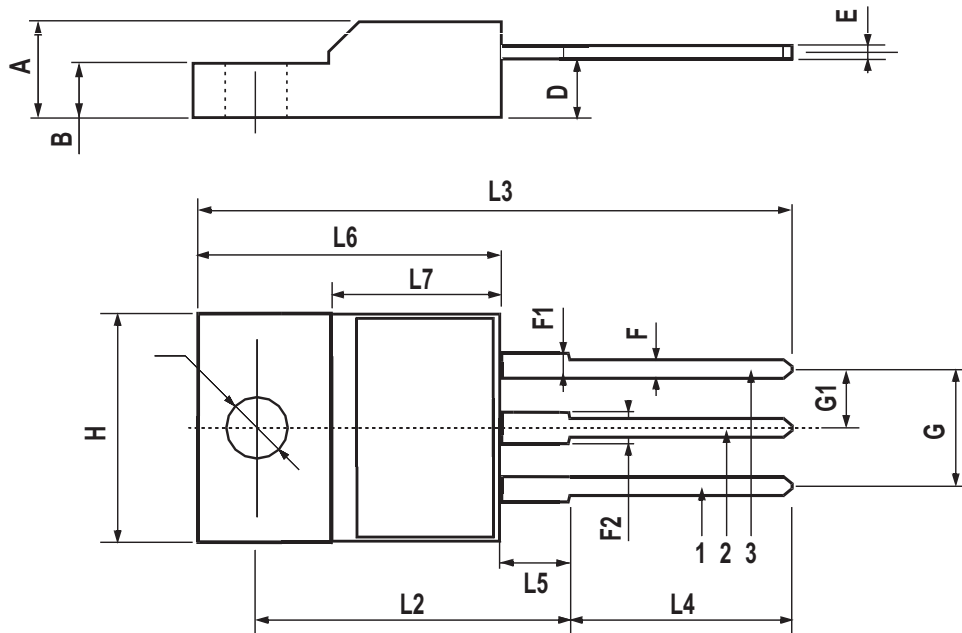
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
C	1.23		1.32	0.048		0.051
D	2.40		2.72	0.094		0.107
D1		1.27			0.050	
E	0.49		0.70	0.019		0.027
F	0.61		0.88	0.024		0.034
F1	1.14		1.70	0.044		0.067
F2	1.14		1.70	0.044		0.067
G	4.95		5.15	0.194		0.203
G1	2.4		2.7	0.094		0.106
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



P011C

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	.0385		0.417
L5	2.9		3.6	0.114		0.141
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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