SGS-THOMSON MICROELECTRONICS

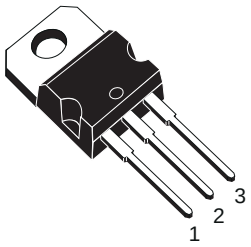
STP38N06

N - CHANNEL ENHANCEMENT MODE "ULTRA HIGH DENSITY" POWER MOS TRANSISTOR

PRELIMINARY DATA

TYPE	V_{DSS}	$R_{DS(on)}$	I_D
STP38N06	60 V	< 0.03 Ω	38 A (*)

- TYPICAL $R_{DS(on)}$ = 0.026 Ω
- AVALANCHE RUGGED TECHNOLOGY
- 100% AVALANCHE TESTED
- REPETITIVE AVALANCHE DATA AT 100°C
- HIGH CURRENT CAPABILITY
- 175°C OPERATING TEMPERATURE
- HIGH dV/dt RUGGEDNESS
- APPLICATION ORIENTED CHARACTERIZATION

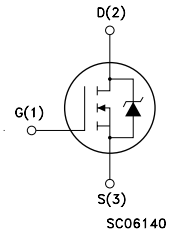


TO-220

APPLICATIONS

- HIGH CURRENT, HIGH SPEED SWITCHING
- POWER MOTOR CONTROL
- DC-DC & DC-AC CONVERTERS
- SYNCRONOUS RECTIFICATION

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source Voltage (V_{GS} = 0)	60	V
V_{DGR}	Drain- gate Voltage (R_{GS} = 20 kΩ)	60	V
V_{GS}	Gate-source Voltage	± 20	V
I_D	Drain Current (continuous) at T_c = 25 °C	38	A
I_D	Drain Current (continuous) at T_c = 100 °C	26	A
I_{DM}(•)	Drain Current (pulsed)	152	A
P_{tot}	Total Dissipation at T_c = 25 °C	90	W
	Derating Factor	0.6	W/°C
dV/dt(1)	Peak Diode Recovery voltage slope	7	V/ns
T_{stg}	Storage Temperature	-65 to 175	°C
T_j	Max. Operating Junction Temperature	175	°C

(•) Pulse width limited by safe operating area

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case	Max	1.66	°C/W
$R_{thj\text{-}amb}$	Thermal Resistance Junction-ambient	Max	62.5	°C/W
$R_{thc\text{-}sink}$	Thermal Resistance Case-sink	Typ	0.5	°C/W
T_l	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, $\delta < 1\%$)	38	A
E_{AS}	Single Pulse Avalanche Energy (starting $T_j = 25\ ^oC$, $I_D = I_{AR}$, $V_{DD} = 25$ V)	300	mJ
E_{AR}	Repetitive Avalanche Energy (pulse width limited by T_j max, $\delta < 1\%$)	75	mJ
I_{AR}	Avalanche Current, Repetitive or Not-Repetitive ($T_c = 100\ ^oC$, pulse width limited by T_j max, $\delta < 1\%$)	26	A

ELECTRICAL CHARACTERISTICS ($T_{case} = 25\ ^oC$ unless otherwise specified)

OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source Breakdown Voltage	$I_D = 250\ \mu A$ $V_{GS} = 0$	60			V
I_{DSS}	Zero Gate Voltage Drain Current ($V_{GS} = 0$)	V_{DS} = Max Rating V_{DS} = Max Rating x 0.8 $T_c = 125\ ^oC$			250 1000	µA µA
I_{GSS}	Gate-body Leakage Current ($V_{DS} = 0$)	$V_{GS} = \pm 20$ V			± 100	nA

ON (*)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$ $I_D = 250\ \mu A$	2	3	4	V
$R_{DS(on)}$	Static Drain-source On Resistance	$V_{GS} = 10$V $I_D = 19$ A $V_{GS} = 10$V $I_D = 19$ A $T_c = 100^oC$		0.026	0.03 0.06	Ω Ω
$I_{D(on)}$	On State Drain Current	$V_{DS} > I_{D(on)} \times R_{DS(on)max}$ $V_{GS} = 10$ V	38			A

DYNAMIC

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g_{fs} (*)	Forward Transconductance	$V_{DS} > I_{D(on)} \times R_{DS(on)max}$ $I_D = 19$ A	14	19		S
C_{iss} C_{oss} C_{rss}	Input Capacitance Output Capacitance Reverse Transfer Capacitance	$V_{DS} = 25$ V f = 1 MHz $V_{GS} = 0$		2000 350 80	2800 450 120	pF pF pF

ELECTRICAL CHARACTERISTICS (continued)

SWITCHING ON

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ t_r	Turn-on Time Rise Time	V_{DD} = 30 V I_D = 19 A R_G = 50 Ω V_{GS} = 10 V (see test circuit, figure 3)		45 280	65 380	ns ns
$(di/dt)_{on}$	Turn-on Current Slope	V_{DD} = 48 V I_D = 38 A R_G = 50 Ω V_{GS} = 10 V (see test circuit, figure 5)		240		A/µs
Q_g Q_{gs} Q_{gd}	Total Gate Charge Gate-Source Charge Gate-Drain Charge	V_{DD} = 40 V I_D = 38 A V_{GS} = 10 V		60 10 20	80	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} = 48 V I_D = 38 A R_G = 50 Ω V_{GS} = 10 V (see test circuit, figure 5)		65 140 230	85 180 300	ns ns ns

SOURCE DRAIN DIODE

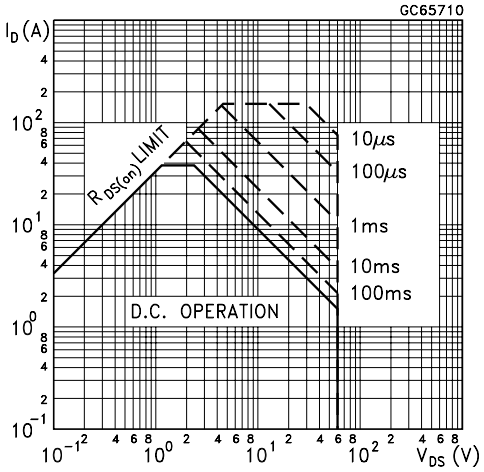
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{SD} I_{SDM}(•)	Source-drain Current Source-drain Current (pulsed)				38 152	A A
V_{SD} (*)	Forward On Voltage	I_{SD} = 38 A V_{GS} = 0			1.5	V
t_{rr} Q_{rr} I_{RRM}	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	I_{SD} = 38 A di/dt = 100 A/µs V_{DD} = 40 V T_j = 150 °C (see test circuit, figure 5)		85 0.3 7		ns µC A

(*) Pulsed: Duration = 300 µs, duty cycle 1.5 %

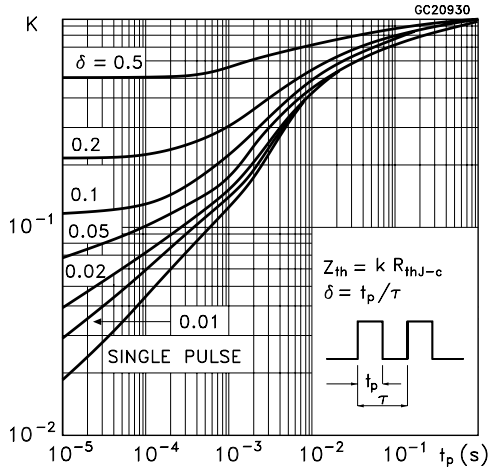
(•) Pulse width limited by safe operating area

(1) $I_{SD} \leq 20$ A, di/dt ≤ 300 A/µs, $V_{DD} \leq V_{(BR)DSS}$, $T_j \leq T_{JMAX}$

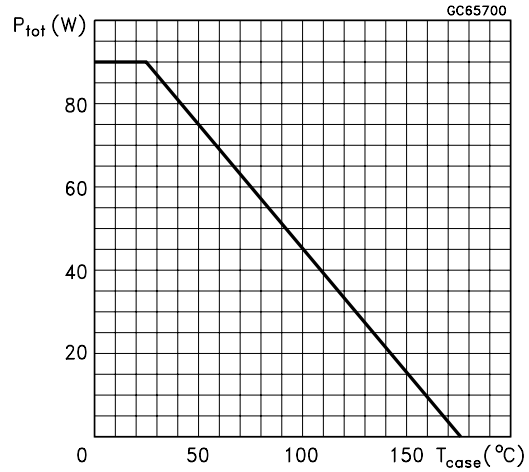
Safe Operating Area



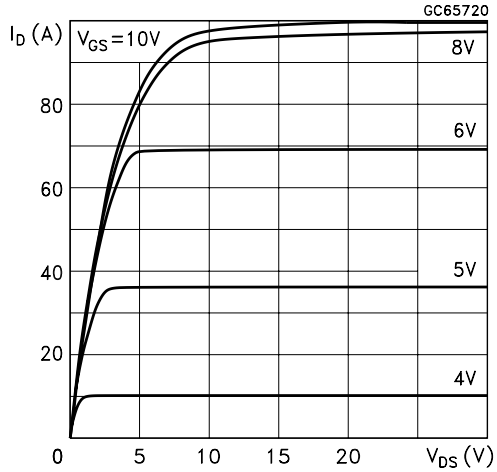
Thermal Impedance



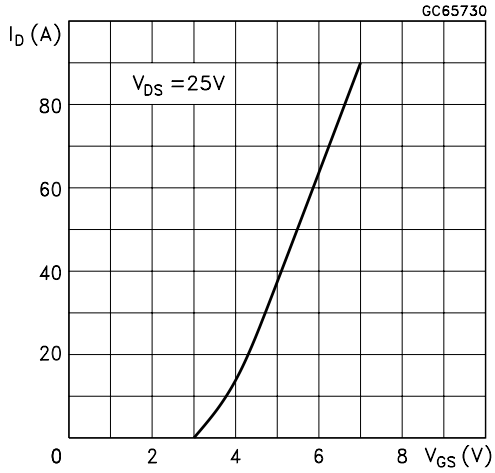
Derating Curve



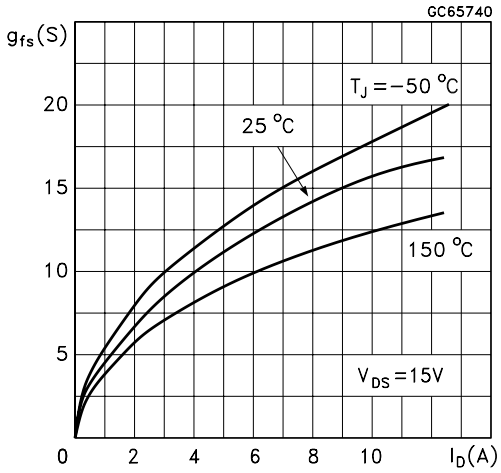
Output Characteristics



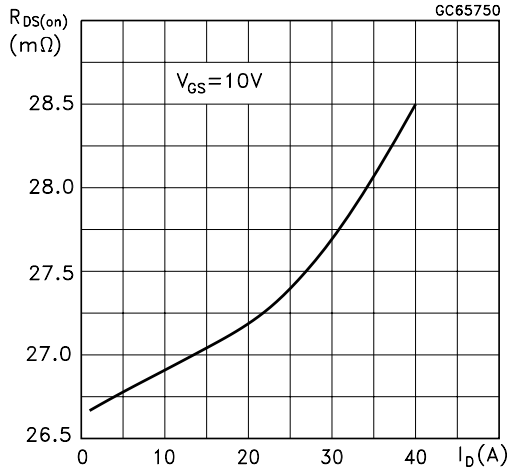
Transfer Characteristics



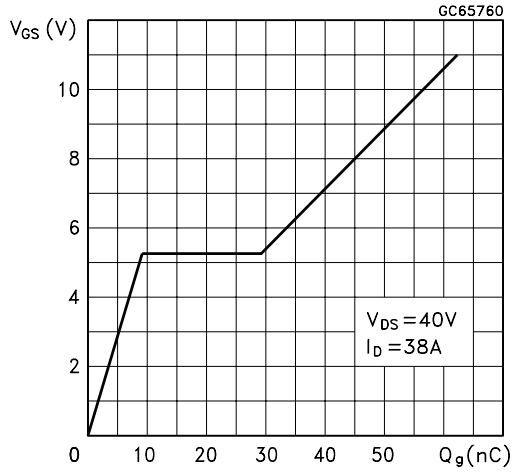
Transconductance



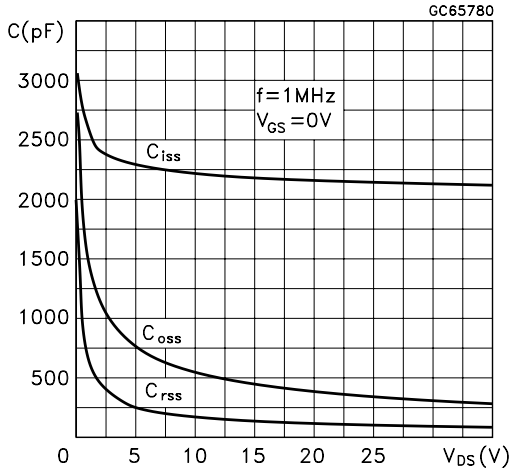
Static Drain-source On Resistance



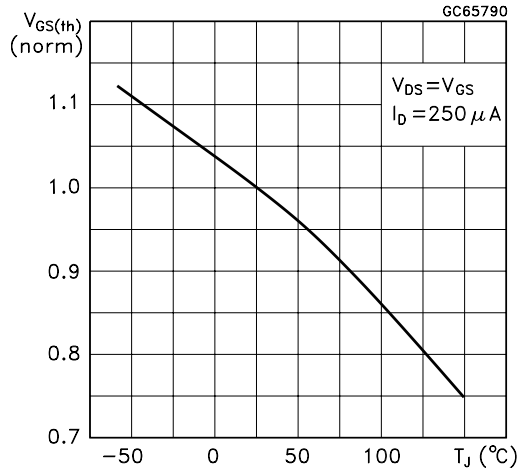
Gate Charge vs Gate-source Voltage



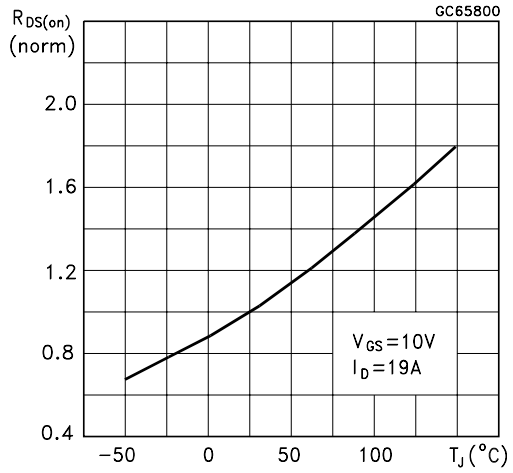
Capacitance Variations



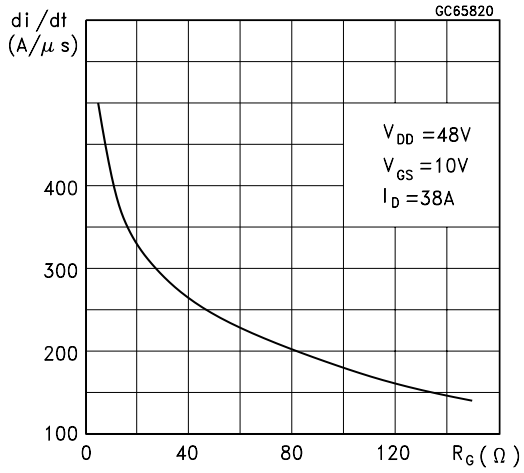
Normalized Gate Threshold Voltage vs Temperature



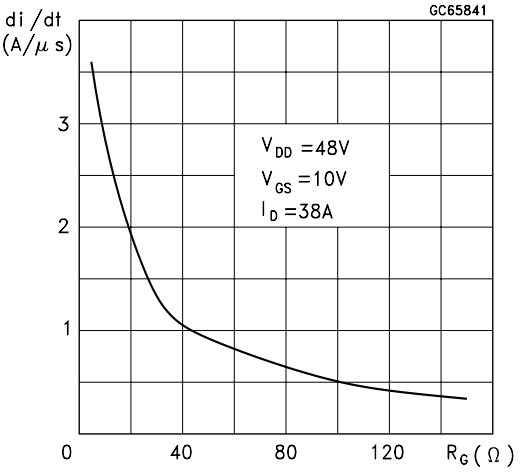
Normalized On Resistance vs Temperature



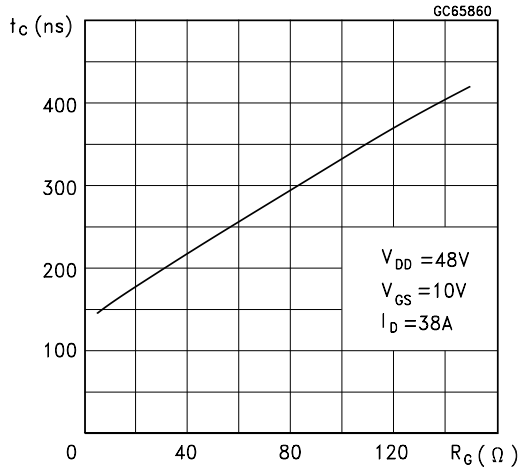
Turn-on Current Slope



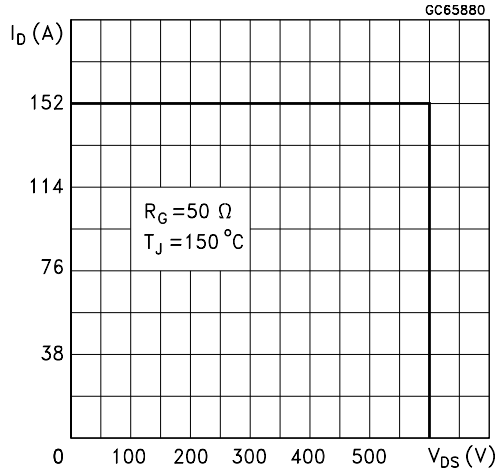
Turn-off Drain-source Voltage Slope



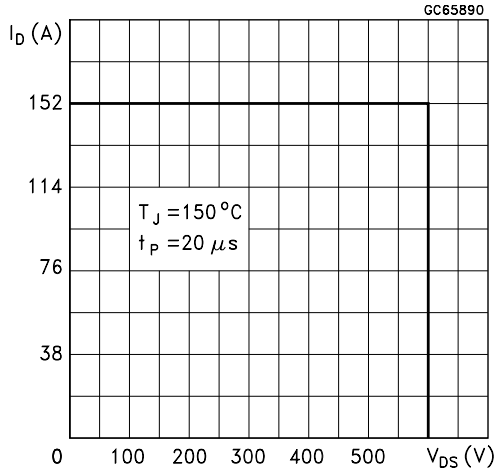
Cross-over Time



Switching Safe Operating Area



Accidental Overload Area



Source-drain Diode Forward Characteristics

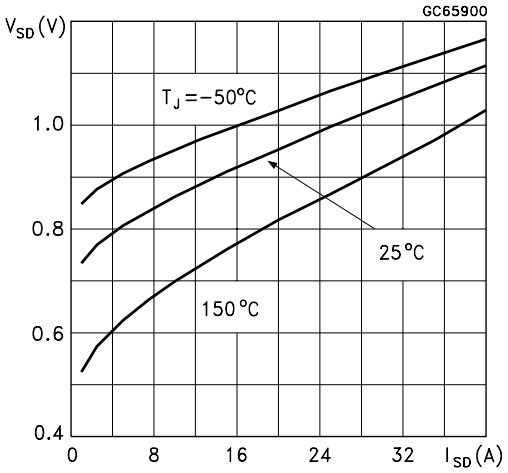


Fig. 1: Unclamped Inductive Load Test Circuit

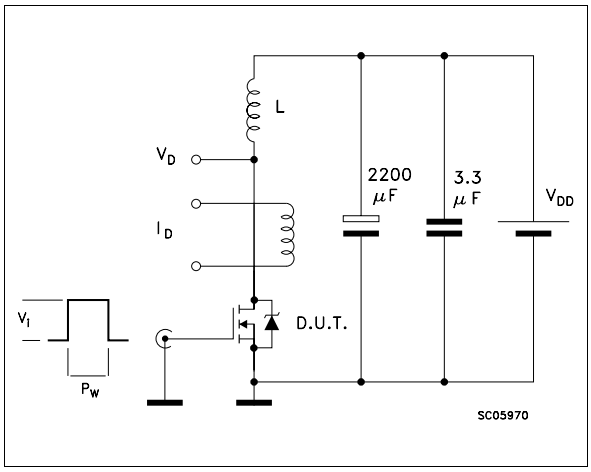


Fig. 2: Unclamped Inductive Waveform

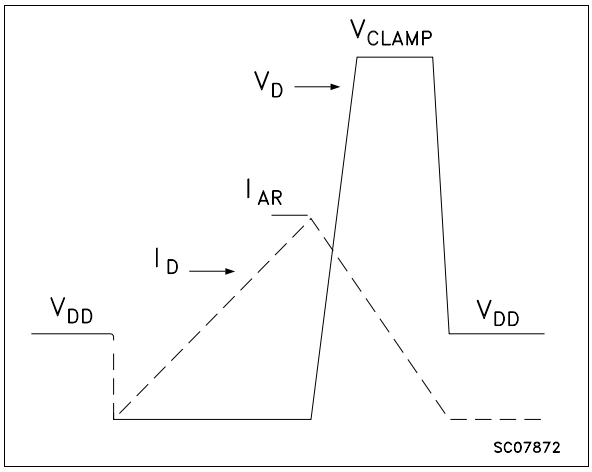


Fig. 3: Switching Times Test Circuits For Resistive Load

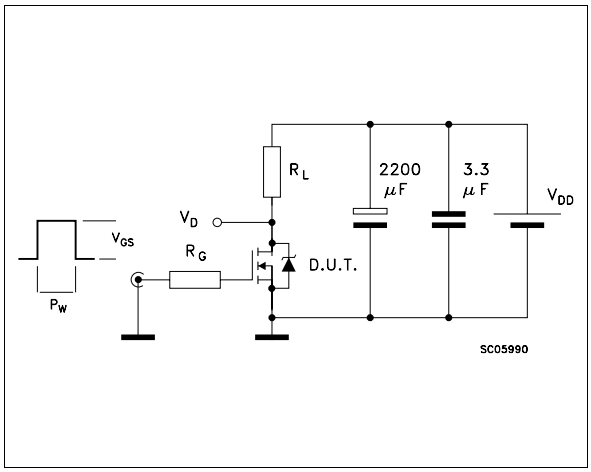


Fig. 4: Gate Charge test Circuit

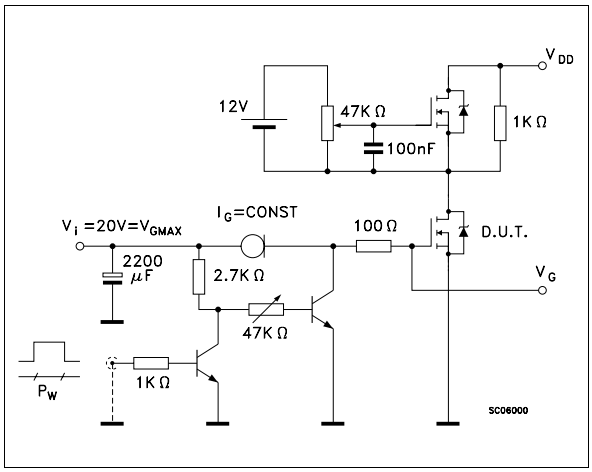
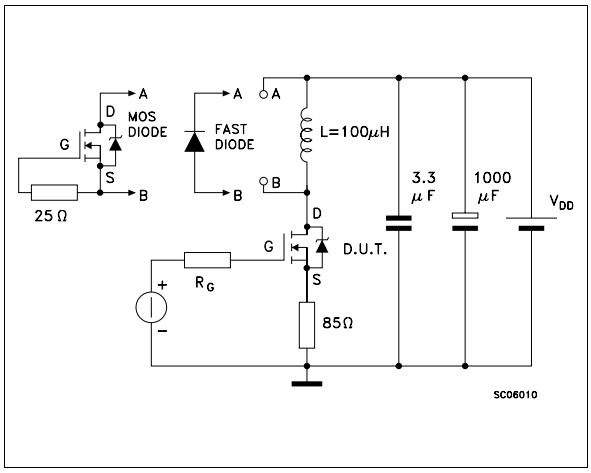


Fig. 5: Test Circuit For Inductive Load Switching And DIode Recovery Times



PSPICE PARAMETERS

SUBCIRCUIT COMPONENTS

Symbol	Parameter	Value	Unit
S1	(V14_16<0) (See Power Mosfet Model Subcircuit)	ON	
S2	(V16_11<0) (See Power Mosfet Model Subcircuit)	ON	
LD	Drain Inductance	8	nH
LG	Gate Inductance	10	nH
LS	Source Inductance	10	nH
RDRAIN	Drain Resistance	$1.9E^{-2}$	Ω
RGATE	Gate Resistance	1	Ω
CGD	Gate Drain Capacitance	3.92	nF
CGS	Gate Source Capacitance	1.9	nF
ALFA	Drift Coeficient	$1E^{-3}$	V^{-1}
RGN	Negative Bias Resistance	10	KΩ

DIODE DRAIN GATE (Depletion Capacitance)

Symbol	Parameter	Value	Unit
CJO	Zero Bias p-n Capacitance	2.6	nF
VJ	p-n Potential	0.1	V
M	p-n Grading Coefficient	0.6	

DIODE DRAIN SOURCE

Symbol	Parameter	Value	Unit
CJO	Zero Bias p-n Capacitance	7.8	nF
VJ	p-n Potential	0.1	V
M	p-n Grading Coefficient	0.6	
TT	Transit Time	20	nsec

N MOSFET

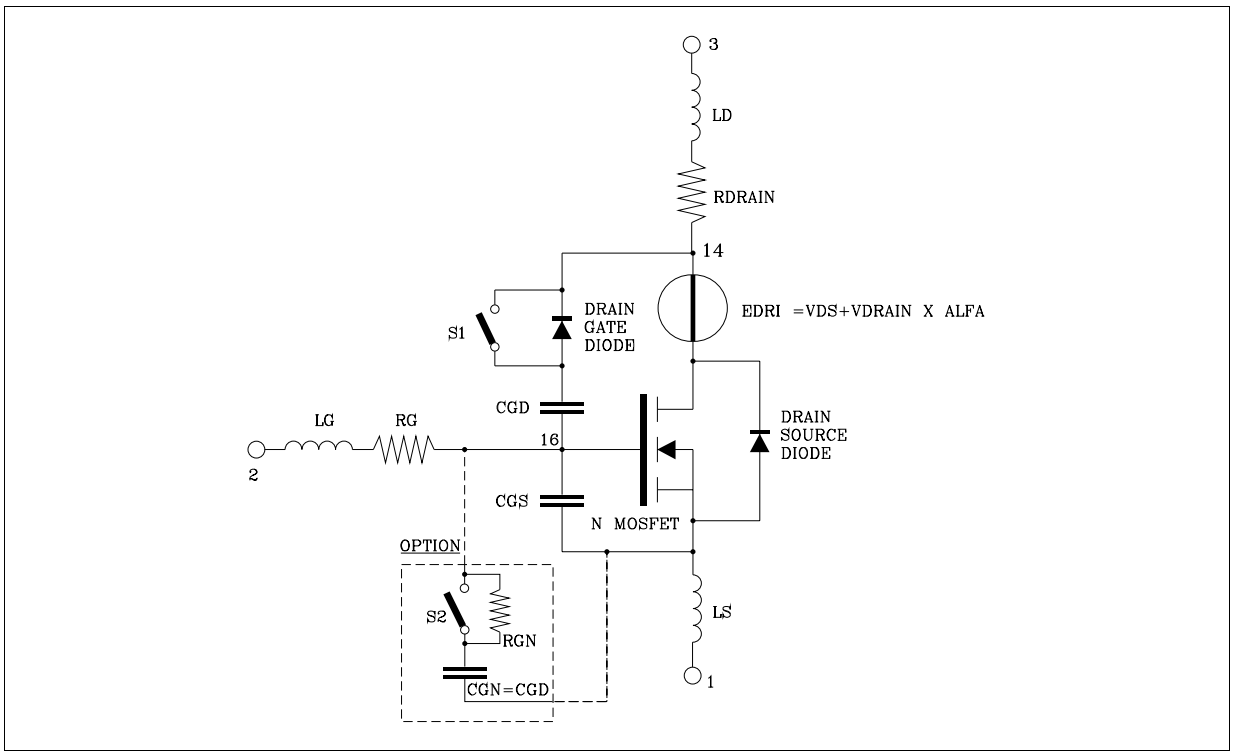
Symbol	Parameter	Value	Unit
L	Channel Length	1	µMeter
W	Channel Width	1	µMeter
LEVEL	Model Index	3	
TOX	Oxide Thickness	1	Meter
VTO	Zero Bias Threshold Voltage	3.25	V
U0	Surface Mobility	600	cm^2/VS
THETA	Mobility Modulation	0.005	V^{-1}
Vmax	Maximum Drift Velocity	0	Meter/sec
KP	Trans Conductance Coefficient	28	Amp/V^2

For Transient Simulation Applicate U.I.C. (Use Initial Condition) Option

PSPICE NETLIST OF THE SUBCIRCUIT

```
.SUBCKT STP38N06 1 2 3
*VALUE OF THE PACKAGE INDUCTANCES
LS 1 11 10n
LG 2 12 10n
LD 3 13 7n

*RESISTANCE OF THE GATE
POLYSILICON
RG 12 16 1

*EPY AND DRIFT RESISTANCES
RD 13 14 1.9e-02
EDRI 14 15 POLY(2) (13 14) (13 11) 0 0 0 0
1e-3

*CAPACITANCE GATE SOURCE
CGS 16 11 1.90n

*OPTIONAL FOR NEGATIVE GATE BIAS
*S2 51 11 11 16 SWITCH
*CGN 51 16 3.92n
*RGN 51 16 10k

*MILLER CAPACITANCE
CGD 16 17 3.92n

* DEPLETION CAPACITANCE
DGD 17 14 DGD
S1 17 14 16 14 SWITCH
.MODEL DGD D +IS=
+CJO=2.6n
+Vj=.1
+M=.6

.MODEL SWITCH VSWITCH
+RON=1m
+ROFF=1MEG
+VON=0.1

* OUTPUT CAPACITANCE AND BODY DRAIN DIODE
DBD 11 14 DBD
.MODEL DBD D
+TT=20n
+CJO=7.8n
+VJ=.1
+M=.6

* MODEL OF THE MOSFET
MMAIN 15 16 11 11 MMAIN L=1u W=1u
.MODEL MMAIN NMOS
+LEVEL=3
+TOX=1
+VTO=3.25
+uo=600
+THETA=0.005
+VMAX=5e7
+KP=28
.ENDS
```

Power Mosfet Model Subcircuit



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