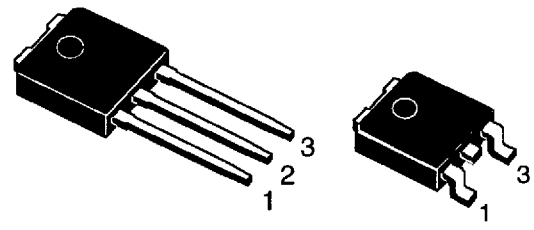
SGS-THOMSON MICROELECTRONICS

STD20N06

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

TYPE	V_{DSS}	$R_{DS(on)}$	I_D
STD20N06	60 V	< 0.03 Ω	20 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
- THROUGH-HOLE IPAK (TO-251) POWER PACKAGE IN TUBE (SUFFIX "-1")
- SURFACE-MOUNTING DPAK (TO-252) POWER PACKAGE IN TAPE & REEL (SUFFIX "T4")



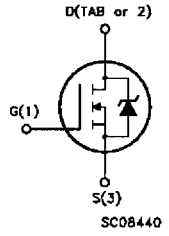
IPAK
TO-251
(Suffix "-1")

DPAK
TO-252
(Suffix "T4")

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	20	A
I_D	Drain Current (continuous) at T_c = 100 °C	14	A
I_{DM}(•)	Drain Current (pulsed)	80	A
P_{tot}	Total Dissipation at T_c = 25 °C	60	W
	Derating Factor	0.4	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	2.5	°C/W
$R_{thj\text{-}amb}$	Thermal Resistance Junction-ambient	Max	100	°C/W
$R_{thc\text{-}sink}$	Thermal Resistance Case-sink	Typ	1.5	°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, $\delta < 1\%$)	20	A
E_{AS}	Single Pulse Avalanche Energy (starting $T_j = 25$ °C, $I_D = I_{AR}$, $V_{DD} = 25$ V)	80	mJ
E_{AR}	Repetitive Avalanche Energy (pulse width limited by T_j max, $\delta < 1\%$)	20	mJ
I_{AR}	Avalanche Current, Repetitive or Not-Repetitive ($T_c = 100$ °C, pulse width limited by T_j max, $\delta < 1\%$)	14	A

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

OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source Breakdown Voltage	$I_D = 250$ µA $V_{GS} = 0$	60			V
I_{DSS}	Zero Gate Voltage Drain Current ($V_{GS} = 0$)	V_{DS} = Max Rating V_{DS} = Max Rating x 0.8 $T_c = 125$ °C			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	$V_{DS} = V_{GS}$ $I_D = 250$ µA	2	3	4	V
$R_{DS(on)}$	Static Drain-source On Resistance	$V_{GS} = 10$V $I_D = 10$ A $V_{GS} = 10$V $I_D = 10$ A $T_c = 100$°C		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	20			A

DYNAMIC

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g_{fs} (*)	Forward Transconductance	$V_{DS} > I_{D(on)} \times R_{DS(on)max}$ $I_D = 10$ A	11	16		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 = 10 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 = 20 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 = 20 A V_{GS} = 10 V		60 10 20	80	nC nC nC

SWITCHING OFF

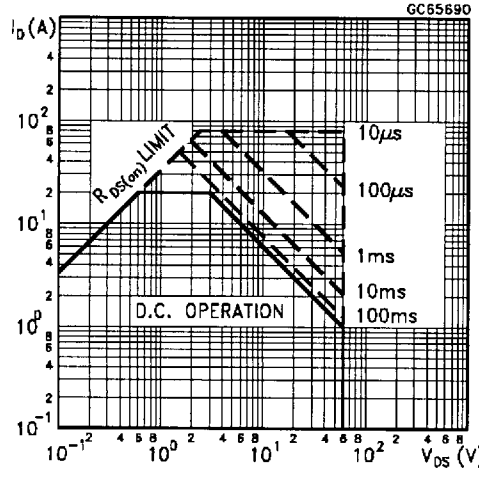
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{r(Voff)}$ t_f t_c	Off-voltage Rise Time Fall Time Cross-over Time	V_{DD} = 48 V I_D = 38 A R_G = 50 Ω V_{GS} = 10 V (see test circuit, figure 5)		55 125 200	75 170 270	ns ns ns

SOURCE DRAIN DIODE

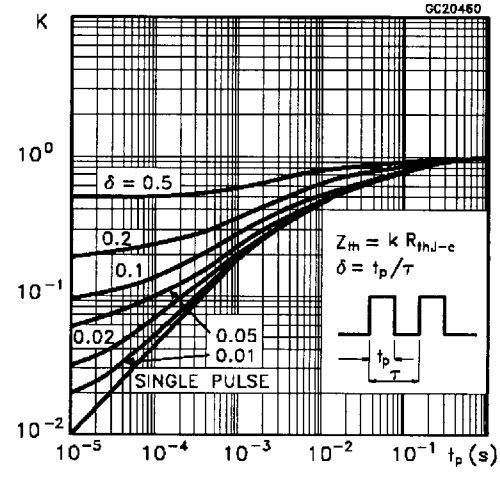
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{SD} I_{SDM}(•)	Source-drain Current Source-drain Current (pulsed)				9 36	A A
V_{SD} (*)	Forward On Voltage	I_{SD} = 20 A V_{GS} = 0			1.5	V
t_{rr} Q_{rr} I_{RRM}	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	I_{SD} = 20 A di/dt = 100 A/µs V_{DD} = 30 V T_j = 150 °C (see test circuit, figure 5)		80 0.3 7		ns µC A

(*) Pulsed: Pulse duration = 300 µs, duty cycle 1.5 %
(•) Pulse width limited by safe operating area
(1) $I_{SD} \le 20$ A, di/dt ≤ 300 A/µs, $V_{DD} \le V_{(BR)DSS}$, $T_j \le T_{JMAX}$

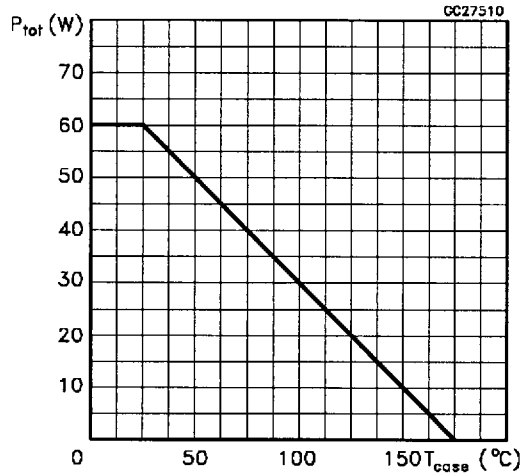
Safe Operating Area



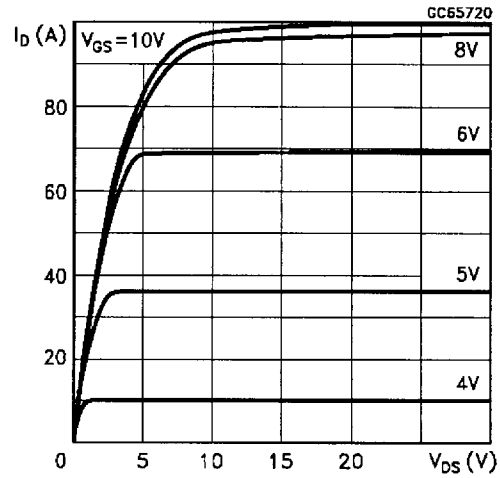
Thermal Impedance



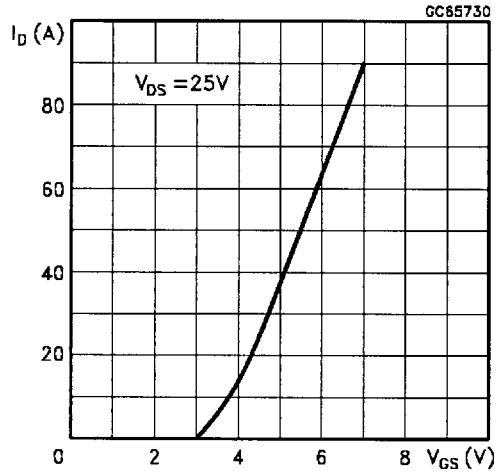
Derating Curve



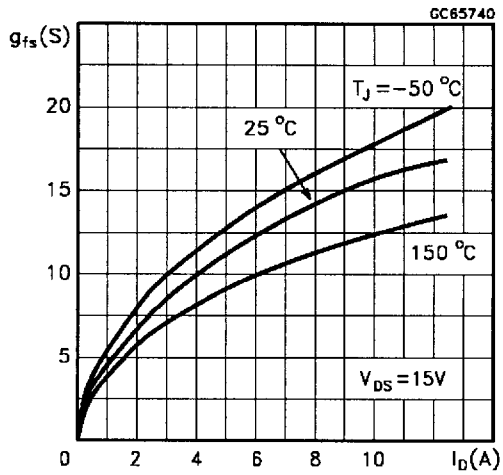
Output Characteristics



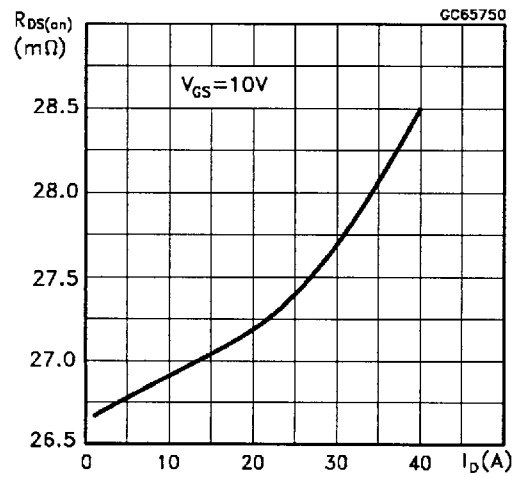
Transfer Characteristics



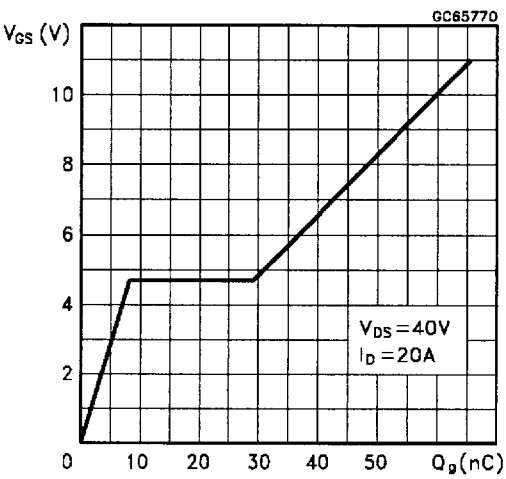
Transconductance



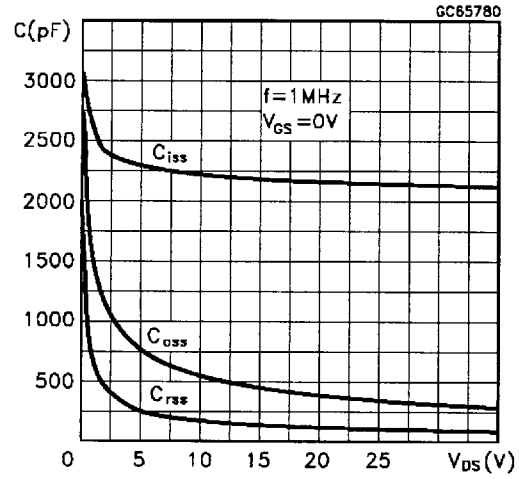
Static Drain-source On Resistance



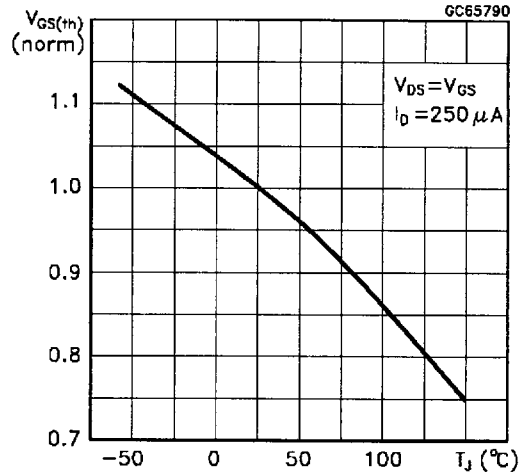
Gate Charge vs Gate-source Voltage



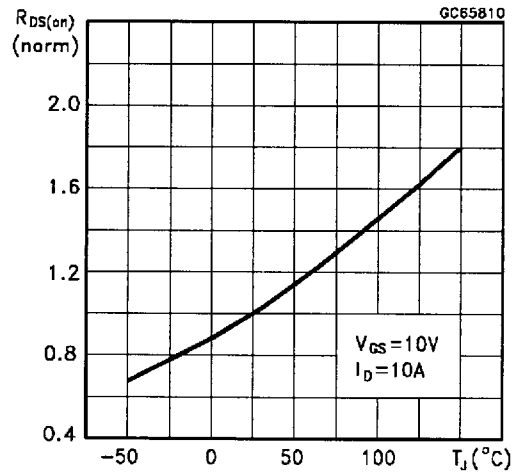
Capacitance Variations



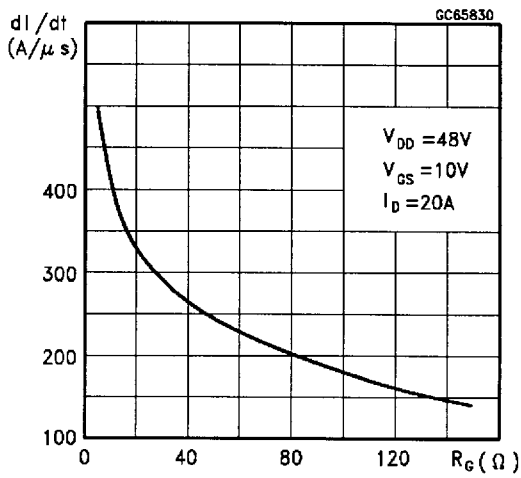
Normalized Gate Threshold Voltage vs Temperature



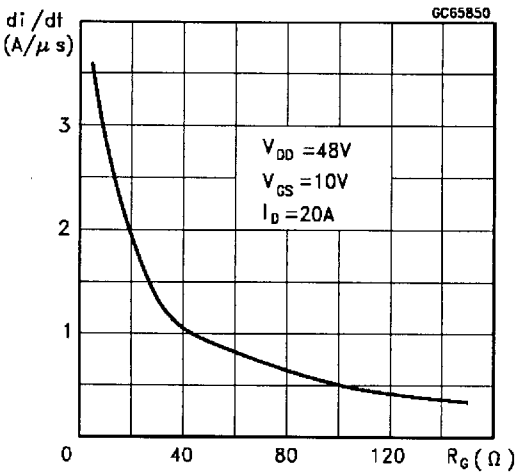
Normalized On Resistance vs Temperature



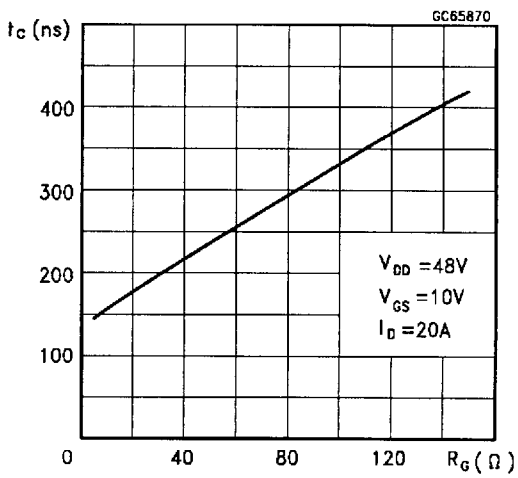
Turn-on Current Slope



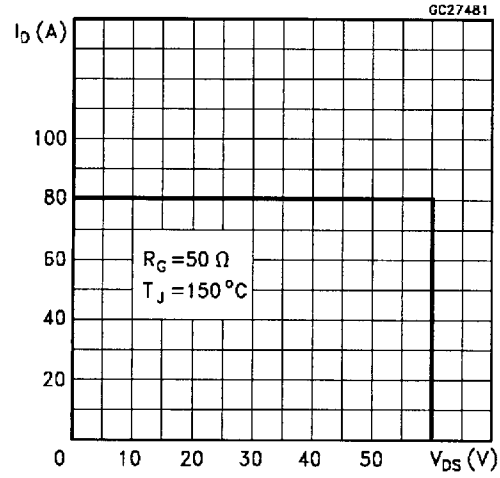
Turn-off Drain-source Voltage Slope



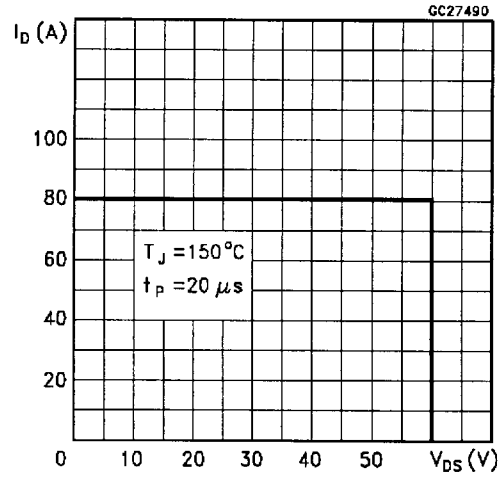
Cross-over Time



Switching Safe Operating Area



Accidental Overload Area



Source-drain Diode Forward Characteristics

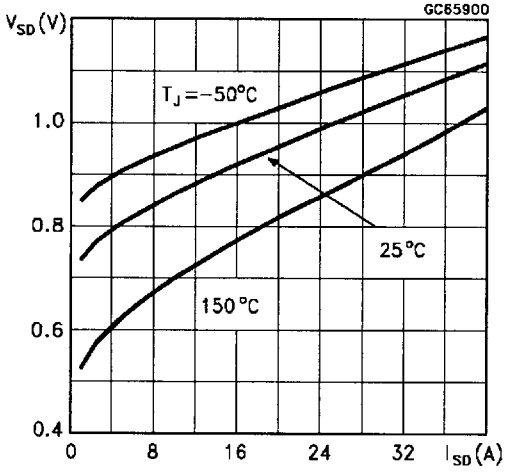


Fig. 1: Unclamped Inductive Load Test Circuit

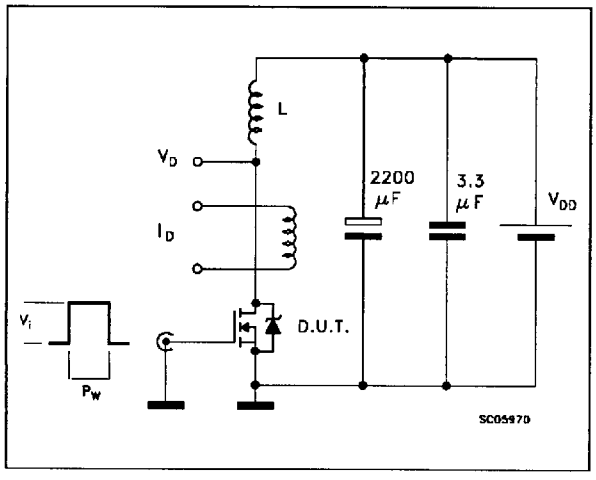


Fig. 2: Unclamped Inductive Waveform

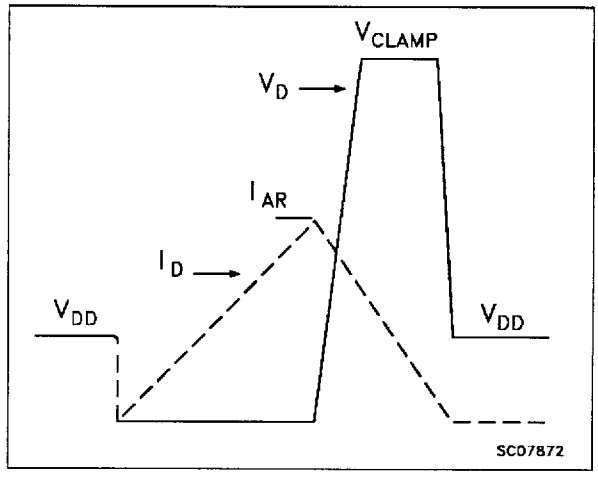


Fig. 3: Switching Times Test Circuits For Resistive Load

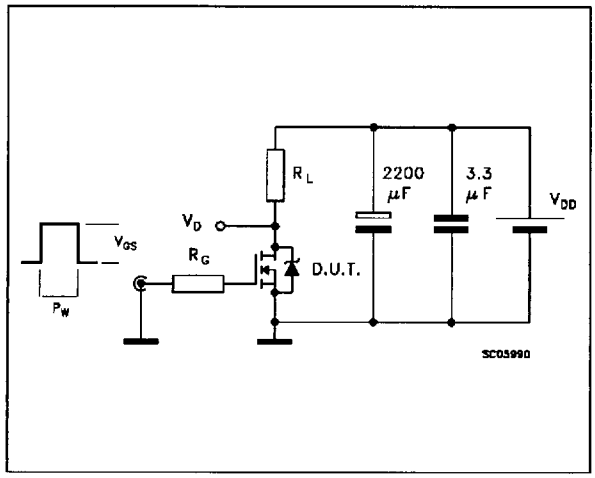


Fig. 4: Gate Charge test Circuit

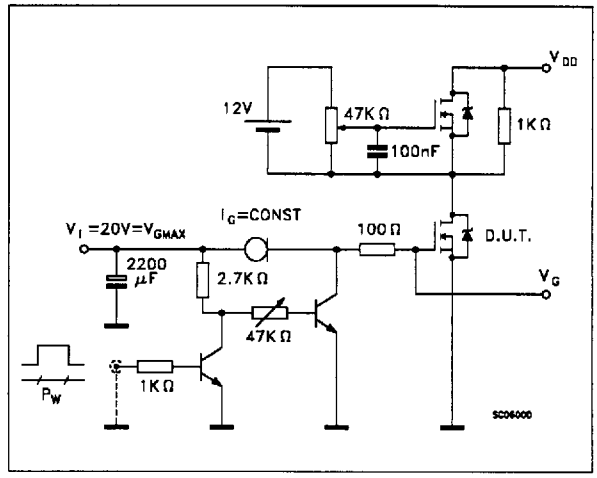
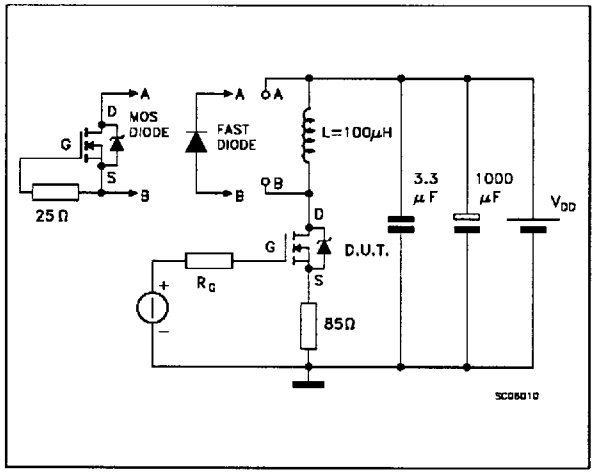


Fig. 5: Test Circuit For Inductive Load Switching And Dlode Recovery Times



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

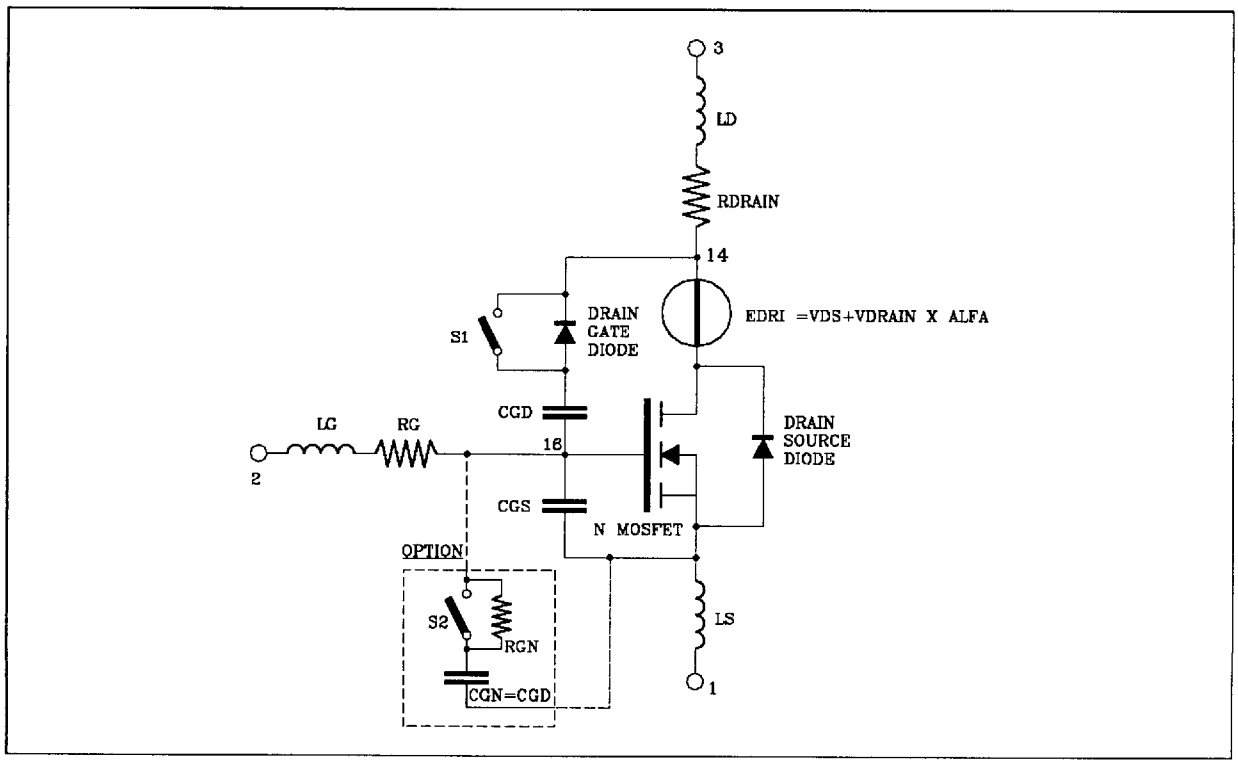
Symbol	Parameter	Value	Unit
L	Channel Length	1	µMeter
W	Channel Width	1	µMeter
LEVEL	Model Index	3	
TOX	Oxide Thickness	1	Meter
VTO	Zero Bias Threshold Voltage	3.25	V
U0	Surface Mobility	600	cm^2/VS
THETA	Mobility Modulation	0.005	V^{-1}
Vmax	Maximum Drift Velocity	0	Meter/sec
KP	Trans Conductance Coefficient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

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

PSPICE NETLIST OF THE SUBCIRCUIT

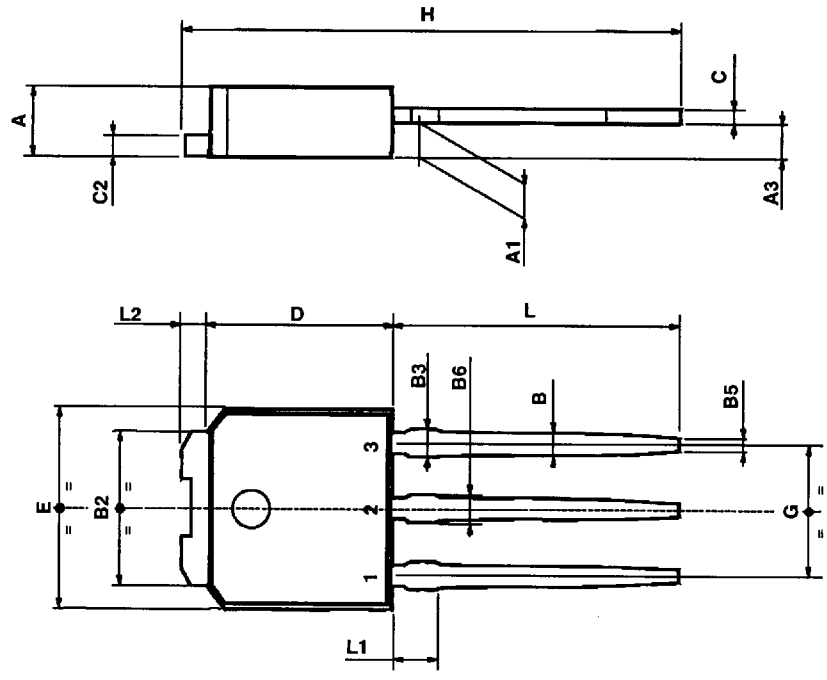
```
.SUBCKT STD20N06 1 2 3
*VALUE OF THE PACKAGE INDUCTANCES
LS 1 11 10n
LG 2 12 10n
LD 3 13 7n

*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-251 (IPAK) MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.2		2.4	0.086		0.094
A1	0.9		1.1	0.035		0.043
A3	0.7		1.3	0.027		0.051
B	0.64		0.9	0.025		0.031
B2	5.2		5.4	0.204		0.212
B3			0.85			0.033
B5		0.3			0.012	
B6			0.95			0.037
C	0.45		0.6	0.017		0.023
C2	0.48		0.6	0.019		0.023
D	6		6.2	0.236		0.244
E	6.4		6.6	0.252		0.260
G	4.4		4.6	0.173		0.181
H	15.9		16.3	0.626		0.641
L	9		9.4	0.354		0.370
L1	0.8		1.2	0.031		0.047
L2		0.8	1		0.031	0.039



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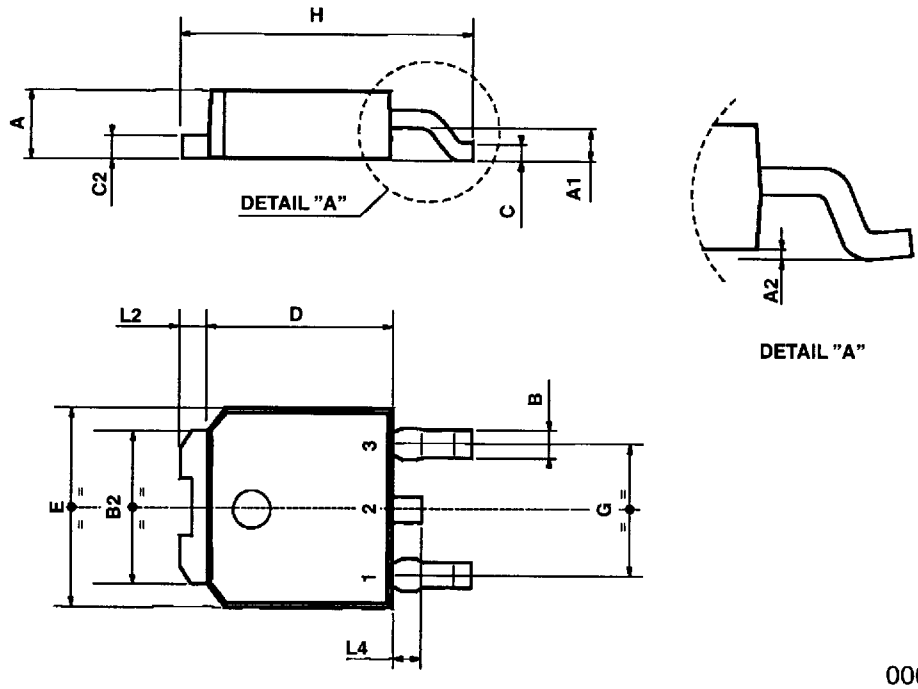
TO-252 (DPAK) MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.2		2.4	0.086		0.094
A1	0.9		1.1	0.035		0.043
A2	0.03		0.23	0.001		0.009
B	0.64		0.9	0.025		0.035
B2	5.2		5.4	0.204		0.212
C	0.45		0.6	0.017		0.023
C2	0.48		0.6	0.019		0.023
D	6		6.2	0.236		0.244
E	6.4		6.6	0.252		0.260
G	4.4		4.6	0.173		0.181
H	9.35		10.1	0.368		0.397
L2		0.8			0.031	
L4	0.6		1	0.023		0.039



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