SGS-THOMSON MICROELECTRONICS

STP40N03L-20

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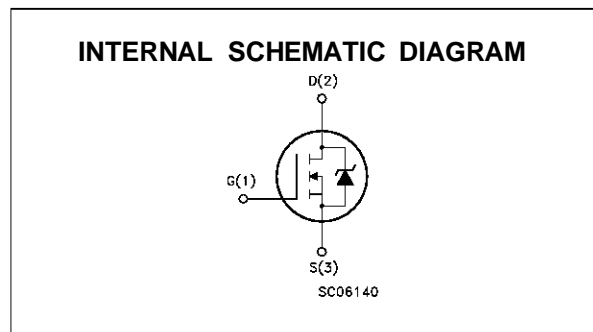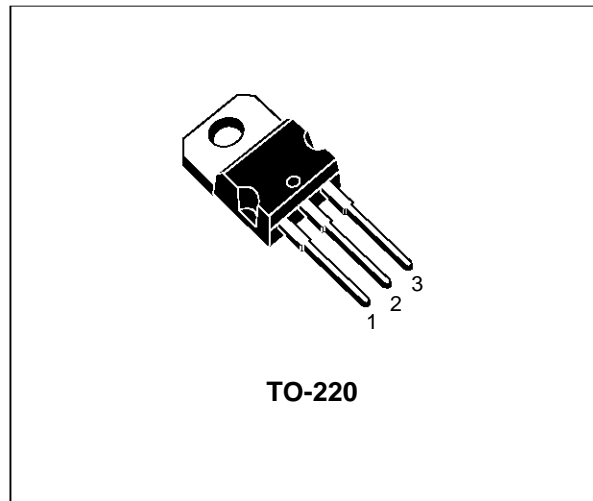## "ULTRA HIGH DENSITY" POWER MOS TRANSISTOR

TYPE	V_{DSS}	$R_{DS(on)}$	I_D
STP40N03L-20	30 V	< 0.02 Ω	40 A

- TYPICAL $R_{DS(on)}$ = 0.016 Ω
- AVALANCHE RUGGED TECHNOLOGY
- 100% AVALANCHE TESTED
- HIGH CURRENT CAPABILITY
- 175°C OPERATING TEMPERATURE
- HIGH dV/dt CAPABILITY
- APPLICATION ORIENTED CHARACTERIZATION

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

TO-220

INTERNAL SCHEMATIC DIAGRAM

D(2)

G(1)

S(3)

SC06140

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source Voltage (V_{GS} = 0)	30	V
V_{DGR}	Drain- gate Voltage (R_{GS} = 20 kΩ)	30	V
V_{GS}	Gate-source Voltage	± 15	V
I_D	Drain Current (continuous) at T_c = 25 ^{o}C	40	A
I_D	Drain Current (continuous) at T_c = 100 ^{o}C	28	A
$I_{DM}(\bullet)$	Drain Current (pulsed)	160	A
P_{tot}	Total Dissipation at T_c = 25 ^{o}C	90	W
	Derating Factor	0.6	W/^{o}C
dV/dt(1)	Peak Diode Recovery voltage slope	6	V/ns
T_{stg}	Storage Temperature	-65 to 175	^{o}C
T_j	Max. Operating Junction Temperature	175	^{o}C

(•) Pulse width limited by safe operating area

THERMAL DATA

$R_{thj-case}$	Thermal Resistance Junction-case	Max	1.66	^{o}C/W
$R_{thj-amb}$	Thermal Resistance Junction-ambient	Max	62.5	^{o}C/W
$R_{thc-sink}$	Thermal Resistance Case-sink	Typ	0.5	^{o}C/W
T_l	Maximum Lead Temperature For Soldering Purpose		300	^{o}C

AVALANCHE CHARACTERISTICS

Symbol	Parameter	Max Value	Unit
I_{AR}	Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T_j max, $\delta < 1\%$)	40	A
E_{AS}	Single Pulse Avalanche Energy (starting $T_j = 25$ ^{o}C, $I_D = I_{AR}$, $V_{DD} = 25$ 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 ($T_c = 100$ ^{o}C, pulse width limited by T_j max, $\delta < 1\%$)	28	A

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

OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source Breakdown Voltage	$I_D = 250$ μA $V_{GS} = 0$	30			V
I_{DSS}	Zero Gate Voltage Drain Current ($V_{GS} = 0$)	V_{DS} = Max Rating V_{DS} = Max Rating x 0.8 $T_c = 125$ ^{o}C			250 1000	μA μA
I_{GSS}	Gate-body Leakage Current ($V_{DS} = 0$)	$V_{GS} = \pm 15$ 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	1	1.6	2	V
$R_{DS(on)}$	Static Drain-source On Resistance	$V_{GS} = 10V$ $I_D = 20$ A $V_{GS} = 10V$ $I_D = 20$ A $T_c = 100$ ^{o}C $V_{GS} = 5V$ $I_D = 20$ A		0.016 0.019	0.02 0.04 0.023	Ω Ω Ω
$I_{D(on)}$	On State Drain Current	$V_{DS} > I_{D(on)}$ x $R_{DS(on)max}$ $V_{GS} = 10$ V	40			A

DYNAMIC

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g_{fs} (∗)	Forward Transconductance	$V_{DS} > I_{D(on)}$ x $R_{DS(on)max}$ $I_D = 20$ A	15	22		S
C_{iss} C_{oss} C_{rss}	Input Capacitance Output Capacitance Reverse Transfer Capacitance	$V_{DS} = 25$ V f = 1 MHz $V_{GS} = 0$		1800 450 180	2300 580 230	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} = 15 V I_D = 10 A R_G = 4.7 Ω V_{GS} = 5 V (see test circuit, figure 3)		20 80	30 100	ns ns
$(di/dt)_{on}$	Turn-on Current Slope	V_{DD} = 24 V I_D = 20 A R_G = 50 Ω V_{GS} = 5 V (see test circuit, figure 5)		200		A/µs
Q_g Q_{gs} Q_{gd}	Total Gate Charge Gate-Source Charge Gate-Drain Charge	V_{DD} = 24 V I_D = 20 A V_{GS} = 5 V		40 10 20	60	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} = 24 V I_D = 20 A R_G = 4.7 Ω V_{GS} = 5 V (see test circuit, figure 5)		42 45 76	55 60 100	ns ns ns

SOURCE DRAIN DIODE

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{SD} $I_{SDM}(\bullet)$	Source-drain Current Source-drain Current (pulsed)				40 160	A A
V_{SD} (∗)	Forward On Voltage	I_{SD} = 40 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} = 24 V T_j = 150 °C (see test circuit, figure 5)		65 0.12 4		ns µC A

(∗) Pulsed: Pulse duration = 300 µs, duty cycle 1.5 %
(●) Pulse width limited by safe operating area
(1) $I_{SD} \leq$ 40 A, di/dt $\leq$ 300 A/µs, $V_{DD} \leq V_{(BR)DSS}$, $T_j \leq T_{JMAX}$

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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	$K\Omega$

DIODE DRAIN GATE (Depletion Capacitance)

Symbol	Parameter	Value	Unit
CJO	Zero Bias p-n Capacitance	2.7	nF
VJ	p-n Potential	0.35	V
M	p-n Grading Coefficient	0.55	

DIODE DRAIN SOURCE

Symbol	Parameter	Value	Unit
CJO	Zero Bias p-n Capacitance	10	nF
VJ	p-n Potential	0.35	V
M	p-n Grading Coefficient	0.55	
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	15	Amp/V^2

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

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PSPICE NETLIST OF THE SUBCIRCUIT

.SUBCKT STP40N03L-20 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
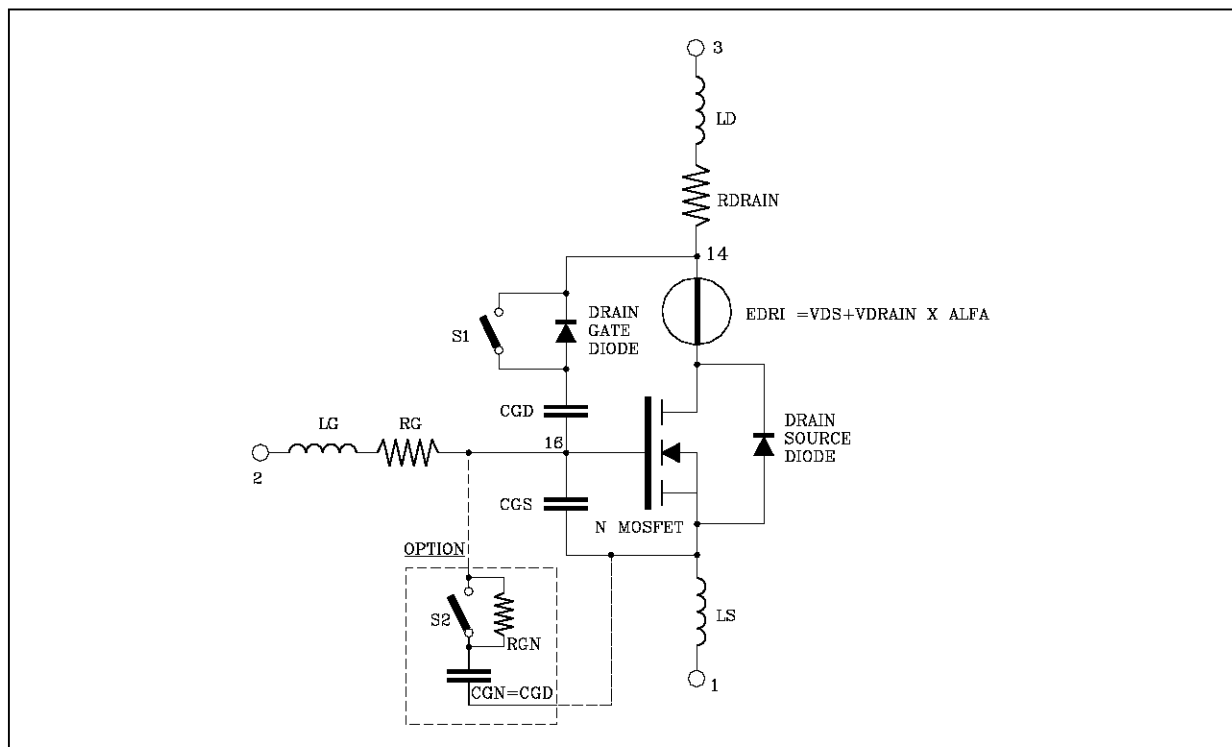*RGN 51 16 10k

*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

P011C

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