SGS-THOMSON
MICROELECTRONICS

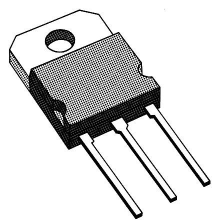
VNH100N04

"OMNIFET": FULLY AUTOPROTECTED POWER MOSFET

TARGET DATA

TYPE	V_{clamp}	$R_{DS(on)}$	I_{lim}
VNH100N04	42 V	0.012 Ω	100 A

- LINEAR CURRENT LIMITATION
- THERMAL SHUT DOWN
- SHORT CIRCUIT PROTECTION
- INTEGRATED CLAMP
- LOW CURRENT DRAWN FROM INPUT PIN
- DIAGNOSTIC FEEDBACK THROUGH INPUT PIN
- ESD PROTECTION
- DIRECT ACCESS TO THE GATE OF THE POWER MOSFET (ANALOG DRIVING)
- COMPATIBLE WITH STANDARD POWER MOSFET
- STANDARD TO-218 PACKAGE



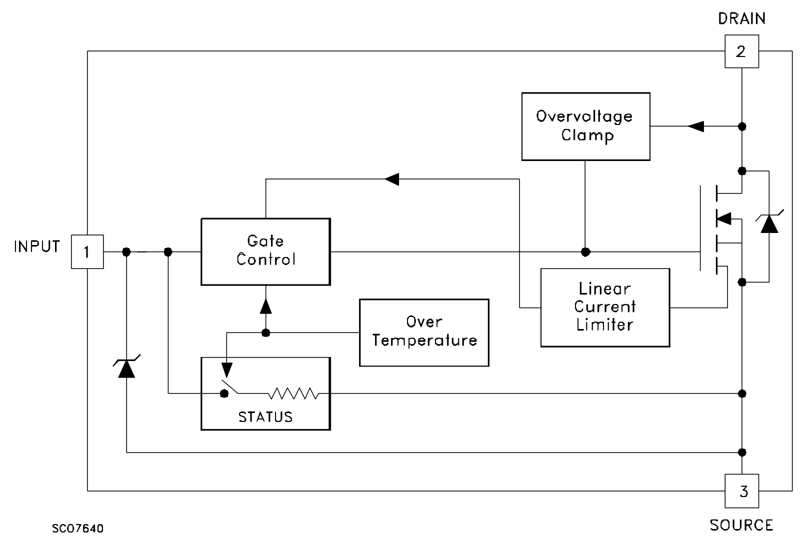
TO-218

DESCRIPTION

The VNH100N04 is a monolithic device made using SGS-THOMSON Vertical Intelligent Power M0 Technology, intended for replacement of standard power MOSFETS in DC to 50 KHz applications. Buit-in thermal shut-down, linear current limitation and overvoltage clamp protect the chip in harsh enviroments.

Fault feedback can be detected by monitoring the voltage at the input pin.

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATING

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source Voltage (V_{in} = 0)	Internally Clamped	V
V_{in}	Input Voltage	18	V
I_D	Drain Current	Internally Limited	A
I_R	Reverse DC Output Current	-50	A
V_{esd}	Electrostatic Discharge (C= 100 pF, R=1.5 KΩ)	2000	V
P_{tot}	Total Dissipation at T_c = 25 ^oC	208	W
T_j	Operating Junction Temperature	Internally Limited	^oC
T_c	Case Operating Temperature	Internally Limited	^oC
T_{stg}	Storage Temperature	-55 to 150	^oC

THERMAL DATA

$R_{thj-case}$ $R_{thj-amb}$	Thermal Resistance Junction-case Max Thermal Resistance Junction-ambient Max	0.6 30	$^oC/W$ $^oC/W$

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

OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{CLAMP}	Drain-source Clamp Voltage	I_D = 30 A V_{in} = 0	36	42	48	V
V_{CLTH}	Drain-source Clamp Threshold Voltage	I_D = 2 mA V_{in} = 0	35			V
V_{INCL}	Input-Source Reverse Clamp Voltage	I_{in} = -1 mA	-1		-0.3	V
I_{DSS}	Zero Input Voltage Drain Current (V_{in} = 0)	V_{DS} = 13 V V_{DS} = 25 V			50 200	μA μA
I_{ISS}	Supply Current from Input Pin	V_{DS} = 0 V V_{in} = 10 V		250	500	μA

ON (∗)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{IS(th)}$	Input Threshold Voltage	V_{DS} = V_{in} I_D = 1 mA	0.8		3	V
$R_{DS(on)}$	Static Drain-source On Resistance	V_{in} = 10 V I_D = 30 A V_{in} = 5 V I_D = 30 A			0.012 0.015	Ω Ω

DYNAMIC

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g_{fs} (∗)	Forward Transconductance	V_{DS} = 13 V I_D = 30 A		40		S
C_{oss}	Output Capacitance	V_{DS} = 13 V f = 1 MHz V_{in} = 0		1800	3000	pF

ELECTRICAL CHARACTERISTICS (continued)

SWITCHING

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ t_r $t_{d(off)}$ t_f	Turn-on Delay Time Rise Time Turn-off Delay Time Fall Time	V_{DD} = 15 V I_d = 30 A V_{gen} = 10 V R_{gen} = 10 Ω (see figure 3)		100 400 900 400	TBD TBD TBD TBD	ns ns ns ns
$t_{d(on)}$ t_r $t_{d(off)}$ t_f	Turn-on Delay Time Rise Time Turn-off Delay Time Fall Time	V_{DD} = 15 V I_d = 30 A V_{gen} = 10 V R_{gen} = 10 Ω T_j = 125 °C (see figure 3)			TBD TBD TBD TBD	ns ns ns ns
$t_{d(on)}$ t_r $t_{d(off)}$ t_f	Turn-on Delay Time Rise Time Turn-off Delay Time Fall Time	V_{DD} = 15 V I_d = 30 A V_{gen} = 10 V R_{gen} = 1000 Ω (see figure 3)			TBD TBD TBD TBD	µs µs µs µs
$(di/dt)_{on}$	Turn-on Current Slope	V_{DD} = 15 V I_D = 30 A V_{in} = 10 V		TBD		A/µs
Q_g	Total Gate Charge	V_{DD} = 12 V I_D = 30 A V_{in} = 10 V		TBD		nC

SOURCE DRAIN DIODE

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{SD} (∗)	Forward On Voltage	I_{SD} = 30 A V_{in} = 0			TBD	V
t_{rr} Q_{rr} I_{RRM}	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	I_{SD} = 30 A di/dt = 100 A/µs V_{DD} = V T_j = 150 °C (see test circuit, figure 5)		TBD TBD TBD		ns µC A

PROTECTION

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{lim}	Drain Current Limit	V_{in} = 10 V V_{DS} = 13 V	70	100	140	A
t_{dlim}	Step Response Current Limit	V_{in} = 10 V V_{DS} = 13V			TBD	µs
T_{jsh}	Overtemperature Shutdown		150	170	190	°C
T_{jrs}	Overtemperature Reset		135			°C
I_{gf}	Fault Sink Current	V_{in} = 10 V V_{DS} = 13 V		50		mA
E_{as}	Single Pulse Avalanche Energy	starting T_j = 25 °C V_{DD} = 20 V V_{in} = 10 V R_{gen} = 1 KΩ L = mH	TBD			J

(∗) Pulsed: Pulse duration = 300 µs, duty cycle 1.5 %

PROTECTION FEATURES

During normal operation, the Input pin is electrically connected to the gate of the internal power MOSFET. The device then behaves like a standard power MOSFET and can be used as a switch from DC to 50 KHz. The only difference from the user's standpoint is that a small DC current (I_{iss}) flows into the Input pin in order to supply the internal circuitry.

The device integrates:

– OVERVOLTAGE CLAMP PROTECTION: internally set at 42V, along with the rugged avalanche characteristics of the Power MOSFET stage give this device unrivalled ruggedness and energy handling capability. This feature is mainly important when driving inductive loads.

– LINEAR CURRENT LIMITER CIRCUIT: limits the drain current Id to Ilim whatever the Input pin voltage. When the current limiter is active, the device operates in the linear region, so power dissipation may exceed the capability of the heatsink. Both case and junction temperatures increase, and if this phase lasts long enough, junction temperature may reach the overtemperature threshold T_{jsh}.

– OVERTEMPERATURE AND SHORT CIRCUIT PROTECTION: these are based on sensing the chip temperature and are not dependent on the input voltage. The location of the sensing element on the chip in the power stage area ensures fast, accurate detection of the junction temperature. Overtemperature cutout occurs in the range 150 to 190^{o}C, a typical value being 170^{o}C. The device is automatically restarted when the chip temperature falls below 135^{o}C.

– STATUS FEEDBACK: In the case of an overtemperature fault condition, a Status Feedback is provided through the Input pin. The internal protection circuit disconnects the input from the gate and connects it instead to ground via an equivalent resistance of 200 Ω. The failure can be detected by monitoring the voltage at the Input pin, which will be close to ground potential.

Additional features of this device are ESD protection according to the Human Body model and the ability to be driven from a TTL Logic circuit (with a small increase in $R_{DS(on)}$).

Fig. 1: Unclamped Inductive Load Test Circuits

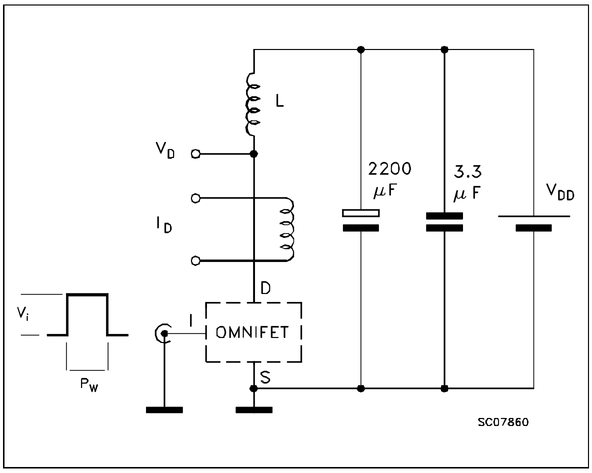


Fig. 2: Unclamped Inductive Waveforms

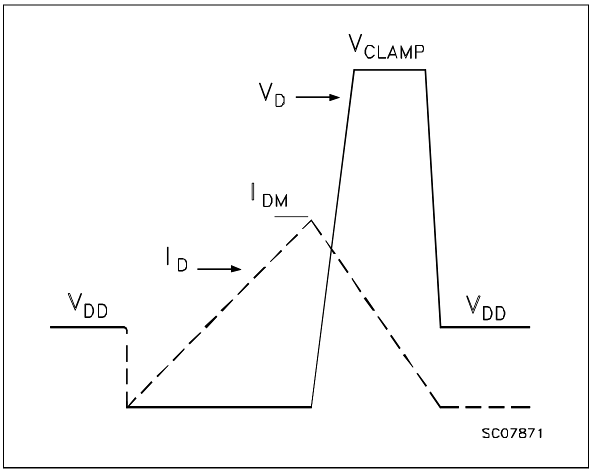


Fig. 3: Switching Times Test Circuits For Resistive Load

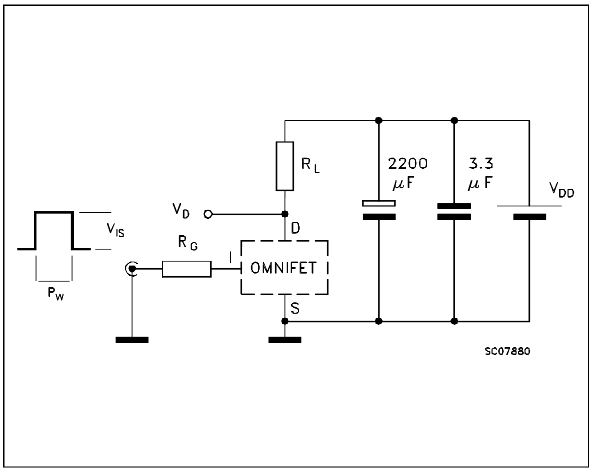


Fig. 4: Input Charge Test Circuit

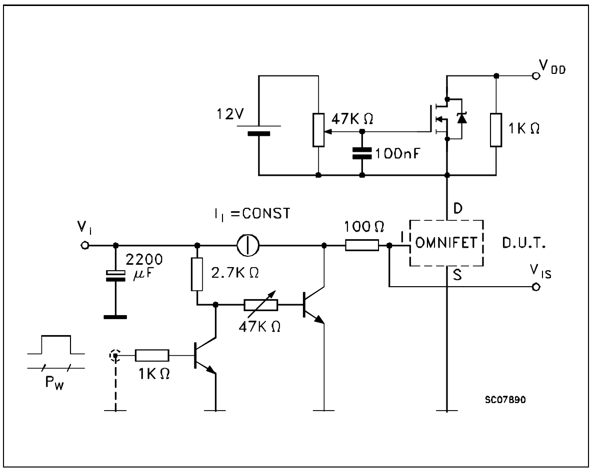


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times

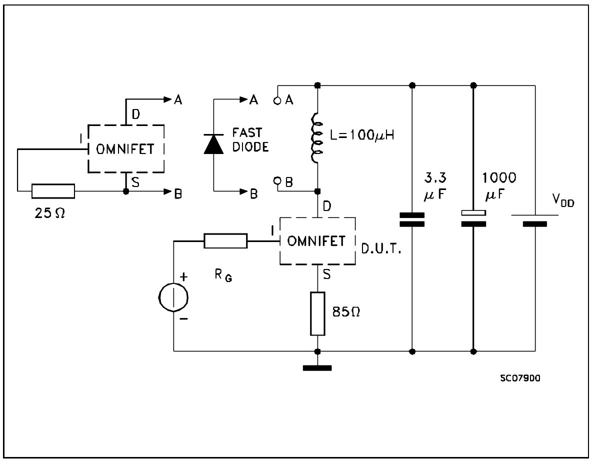
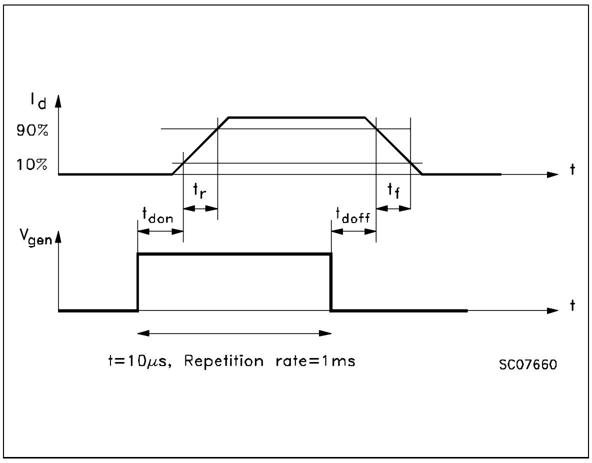


Fig. 6: Waveforms



TO-218 (SOT-93) MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.7		4.9	0.185		0.193
C	1.17		1.37	0.046		0.054
D		2.5			0.098	
E	0.5		0.78	0.019		0.030
F	1.1		1.3	0.043		0.051
G	10.8		11.1	0.425		0.437
H	14.7		15.2	0.578		0.598
L2	–		16.2	–		0.637
L3		18			0.708	
L5	3.95		4.15	0.155		0.163
L6		31			1.220	
R	–		12.2	–		0.480
Ø	4		4.1	0.157		0.161