

VN20ANSP

HIGH SIDE SMART POWER SOLID STATE RELAY

PRELIMINARY DATA

TYPE	VDSS	R _{DS(on)}	Ιουτ	Vcc
VN20ANSP	60 V	0.05 Ω	33 A	36 V

- OUTPUT CURRENT (CONTINUOUS): 33A @ T_c=25°C
- LOGIC LEVEL 5V COMPATIBLE INPUT
- THERMAL SHUT-DOWN
- UNDER VOLTAGE PROTECTION
- OPEN DRAIN DIAGNOSTIC OUTPUT
- FAST DEMAGNETIZATION OF INDUCTIVE LOAD

DESCRIPTION

The VN20ANSP is a monolithic device made using SGS-THOMSON Vertical Intelligent Power Technology, intended for driving resistive or inductive loads with one side grounded.

Built-in thermal shut-down protects the chip from over temperature and short circuit. The diagnostic output indicates an over temperature status.

Fast turn-off of inductive load is achieved by negative (-18V) load voltage at turn-off.



BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATING

Symbol	Parameter	Value	Unit
V _{(BR)DSS}	Drain-Source Breakdown Voltage	60	V
Ιουτ	Output Current (cont.)	33	A
I _R	Reverse Output current	-33	A
l _{IN}	Input Current	±10	mA
-Vcc	Reverse Supply Voltage	-4	V
I _{STAT}	Status Current (sink)	±10	mA
Vesd	Electrostatic discharge (1.5 kΩ, 100 pF)	2000	V
P _{tot}	Power Dissipation at $T_c \le 25$ °C	100	W
Tj	Junction Operating Temperature	-40 to 150	°C
T _{stg}	Storage Temperature	-55 to 150	°C

CONNECTION DIAGRAM



CURRENT AND VOLTAGE CONVENTIONS





THERMAL DATA

R _{thj-case}	Thermal	Resistance	Junction-case	Max	1.25	°C/W
R _{thj-amb}	Thermal	Resistance	Junction-ambient (\$)	Max	50	°C/W
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(\$) When mounted using minimum recommended pad size on FR-4 board

ELECTRICAL CHARACTERISTICS (V_{CC} = 9 to 36 V; $T_{case} = 25$ °C unless otherwise specified) POWER

Symbol	Parameter	Test Conditions		Тур.	Max.	Unit
V _{CC} *	Supply Voltage	-40 °C < T _j < 125 °C	7		36	V
Ron	On State Resistance	$ I_{OUT} = 14 \text{ A} \\ I_{OUT} = 2 \text{ A} V_{CC} = 30 \text{ V} T_j = 125 ^{\circ}\text{C} $		0.04	0.05 0.09	Ω Ω
Is	Supply Current	Off State V _{CC} = 30 V On State V _{CC} = 30 V On State V _{CC} = 30 V T _j = 125 $^{\circ}$ C			1 9 7	mA mA mA

SWITCHING

Symbol	Parameter	Test Conditions	Min.	Тур.	Max.	Unit
t _{d(on)}	Turn-on Delay Time Of Output Current	I _{OUT} = 14 A Resistive Load Input Rise Time < 0.1 μs		30		μs
tr	Rise Time Of Output Current	I _{OUT} = 14 A Resistive Load Input Rise Time < 0.1 μs		65		μs
t _{d(off)}	Turn-off Delay Time Of Output Current	I _{OUT} = 14 A Resistive Load Input Rise Time < 0.1 μs		65		μs
t _f	Fall Time Of Output Current	I _{OUT} = 14 A Resistive Load Input Rise Time < 0.1 μs		25		μs
(di/dt) _{on}	Turn-on Current Slope	$ \begin{array}{ll} I_{OUT} = 14 \ A & 25 \ ^{\circ}C \ < \ T_{j} \ < \ 125 \ ^{\circ}C \\ I_{OUT} = I_{OV} & 25 \ ^{\circ}C \ < \ T_{j} \ < \ 125 \ ^{\circ}C \\ \end{array} $			0.5 1	A/μs A/μs
(di/dt) _{off}	Turn-off Current Slope	$ \begin{array}{ll} I_{OUT} = 14 \ A & 25 \ ^{\circ}C \ < \ T_{j} \ < \ 125 \ ^{\circ}C \\ I_{OUT} = I_{OV} & 25 \ ^{\circ}C \ < \ T_{j} \ < \ 125 \ ^{\circ}C \\ \end{array} $			1.5 4	A/μs A/μs
V _{demag}	Inductive Load Clamp Voltage	$I_{OUT} = 14 \text{ A}$ -40 °C < $T_j < 125 $ °C	-24	-18	-14	V

LOGIC INPUT (-40 $^{\circ}C \le T_j \le 125 ^{\circ}C$ unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Тур.	Max.	Unit
VIL	Input Low Level Voltage				0.8	V
VIH	Input High Level Voltage		2		(*)	V
V _{I(hyst.)}	Input Hysteresis Voltage			0.5		<
l _{in}	Input Current	$V_{IN} = 5 V$ $V_{IN} = 2 V$ $V_{IN} = 0.8 V$	25	250	600 300	μΑ μΑ μΑ
VICL	Input Clamp Voltage	I _{IN} = 10 mA I _{IN} = -10 mA	5.5	6 -0.7	-0.3	V V



ELECTRICAL CHARACTERISTICS (continued)

PROTECTION AND DIAGNOSTICS (-40 $^{\circ}C \le T_{i} \le 125 ^{\circ}C$ unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Тур.	Max.	Unit
Vstat	Status Voltage Output Low	I _{STAT} = 1.6 mA			0.4	V
ISTAT	Status Leakage Current	V _{STAT} = 5 V			10	μA
V _{USD}	Under Voltage Shut Down		3.5	6	7	V
VSCL	Status Clamp Voltage	I _{STAT} = 10 mA I _{STAT} = -10 mA	5.5	6 -0.7	-0.3	V V
lov	Over Current	$R_{LOAD} < 10 m\Omega$		80		А
l _{av}	Average Current In Short Circuit	$R_{LOAD} < 10 \text{ m}\Omega$ $T_c = 85 ^{\circ}\text{C}$		2.5		A
IDOFF	Leakage Current	$V_{CC} = 30 V$			1	mA
T _{TSD}	Thermal Shut-down Temperature		140			°C
T _R	Reset Temperature		125			°C

(*) The Vih is internally clamped at about 6V. It is possible to connect this pin to a higher voltagevia an external resistor calculated to not exceed 10 mA at the input pin.

TRUTH TABLE

	INPUT	DIAGNOSTIC	OUTPUT
Normal Operation	L H	н	L H
Over-temperature	Н	L	L
Under-voltage	Х	Н	L

WAVEFORMS





FUNCTIONAL DESCRIPTION

The device has a diagnistic output which indicates over temperature conditions.

The truth table shows input, diagnostic output status and output voltage level in normal operation and fault conditions. The output signals are processed by internal logic.

To protect the device against short circuit and over current conditions, the thermal protection turns the integrated Power MOS off at a minimum junction temperature of 140 $^{\circ}$ C. When the temperature returns to 125 $^{\circ}$ C the switch is automatically turned on again. To ensure the protection in all V_{CC} conditions and in all the junction temperature range it is necessary to limit the voltage drop across Drain and Source (pin 3 and 5) at 28V accordinf to:

 $V_{ds} = V_{CC} - I_{OV} * (R_i + R_w + R_l)$ where:

R_i = internal resistence of Power Supply

R_w = Wires resistance

R_I = Short Circuit resistance

Driving inductive loads, an internal function of the device ensures the fast demagnetization with typical voltage (V_{demag}) of -18V.

This function allows the reduction of the power dissipation according to the formula:

 $P_{dem} = 0.5 * L_{load} * (I_{load})^2 * [(V_{CC} + V_{dem})/V_{dem}] * f$

where f = Switcning Frequency

Based on this formula it is possible to know the value of inductance and/or current to avoid a thermal shut-down.

PROTECTING THE DEVICE AGAINST REVER-SE BATTERY

The simpliest way to protect the device against a continuous reverse battery voltage (-36V) is to insert a Schottky diode between pin 1 (GND) and ground, as shown in the typical application circuit (Fig. 3). The consequences of the voltage drop across this diode are as follows:

If the input is pulled to power GND, a negative voltage of $-V_f$ is seen by the device. (V_{il}, V_{ih} thresholds and Vstat are increased by V_f with respect to power GND).

The undervoltage shut-down level is increased by $\mathsf{V}_{\mathsf{f}}.$

If there is no need for the control unit to handle external analog signals referred to the power GND, the best approach is to connect the reference potential of the control unit to node [1] (see application circuit in fig. 4), which becomes the common signal GND for the whole control board avoiding shift of V_{ih} , V_{il} and V_{stat} . This solution allows the use of a standard diode.



Over Current Test Circuit



VN20ANSP



Typical Application Circuit With A Schottky Diode For Reverse Supply Protection

Typical Application Circuit With Separate Signal Ground







R_{DS(on)} vs Junction Temperature

R_{DS(on)} vs Supply Voltage



RDS(on) vs Output Current



Output Current Derating



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MICROELECTRONICS





Power SO-10 MECHANICAL DATA

DIM		mm			inch			
Divi.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.		
A	3.45	3.5	3.55	0.135	0.137	0.140		
В		1.28	1.30		0.050	0.051		
С			0.15			0.006		
D	9.40	9.50	9.60	0.370	0.374	0.378		
E	4.98	5.08	5.48	0.196	0.200	0.216		
E1	0.40	0.45	0.60	0.016	0.018	0.024		
E2	1.17	1.27	1.37	0.046	0.050	0.054		
F	9.30	9.40	9.50	0.366	0.370	0.374		
F1	7.95	8.00	8.15	0.313	0.315	0.321		
G	7.40	7.50	7.60	0.291	0.295	0.299		
Н	6.80	6.90	7.00	0.267	0.417	0.421		
Ι		0.10			0.004			
к	13.80	14.10	14.40	0.543	0.555	0.567		
L		0.40	0.50		0.016	0.020		
М	1.60	1.67	1.80	0.063	0.066	0.071		
N	0.60	0.08	1.00	0.024	0.031	0.039		





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