SGS-THOMSON MICROELECTRONICS

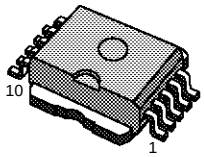
VN121SP

LOW SIDE SMART POWER SOLID STATE RELAY

PRELIMINARY DATA

TYPE	V_{DSS}	$R_{DS(on)}$	I_n(*)	V_{CC}
VN121SP	40 V	0.05 Ω	7 A	26 V

- MAXIMUM CONTINUOUS OUTPUT CURRENT (#): 21 A @ T_c= 85°C
- 5V LOGIC LEVEL COMPATIBLE INPUT
- THERMAL SHUT-DOWN
- UNDER VOLTAGE PROTECTION
- OPEN DRAIN DIAGNOSTIC OUTPUT
- INDUCTIVE LOAD FAST DEMAGNETIZATION
- VERY LOW STAND-BY POWER DISSIPATION

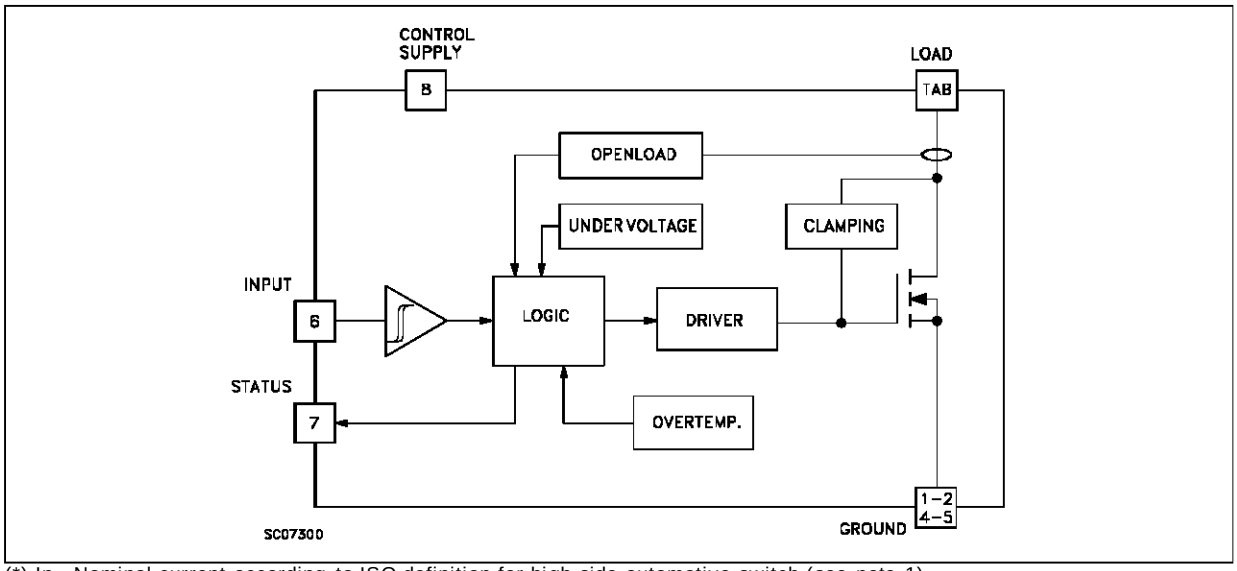


Power SO-10™

DESCRIPTION

The VN121SP is a monolithic device made using SGS-THOMSON Vertical Intelligent Power Technology, intended for driving resistive or inductive loads with one side connected to the supply voltage. Built-in thermal shut-down protects the chip from over temperature and short circuit. The open drain diagnostic output indicates: open load, output shorted to GND and overtemperature. Fast demagnetization of inductive loads is archieved by positive (+45V) load voltage at turn-off.

BLOCK DIAGRAM

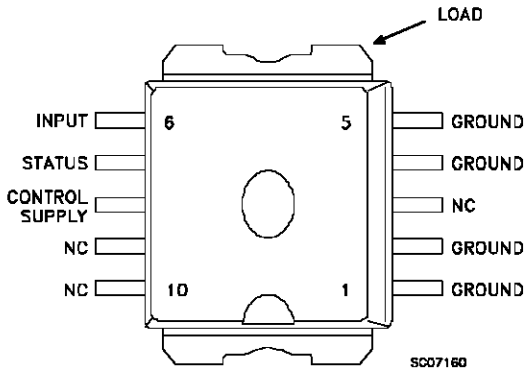


(*) In= Nominal current according to ISO definition for high side automotive switch (see note 1)
(#) The maximum continuous output current is the current at T_c = 85 °C for a battery voltage of 13 V which does not activate self protection

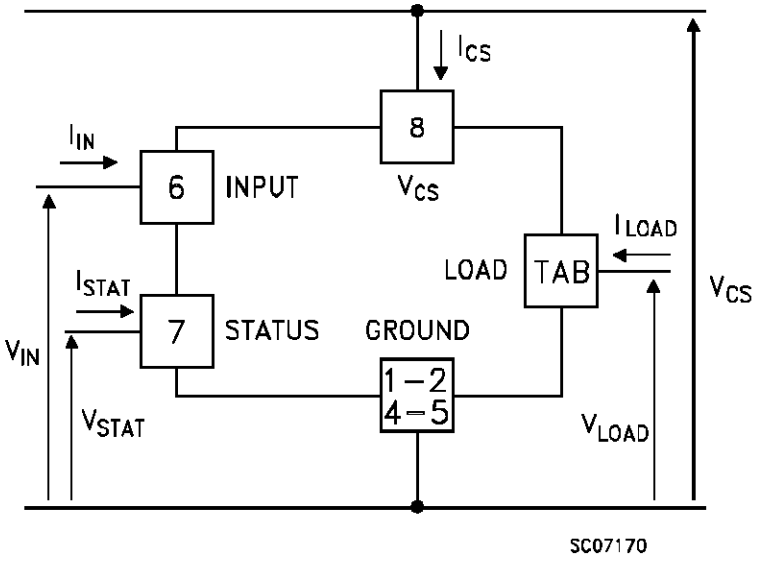
ABSOLUTE MAXIMUM RATING

Symbol	Parameter	Value	Unit
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	40	V
I_{OUT}	Output Current (cont.) at T_c = 85 °C	21	A
I_R	Reverse Output Current at T_c = 85 °C	-21	A
I_{IN}	Input Current	±10	mA
I_{STAT}	Status Current	±10	mA
V_{ESD}	Electrostatic Discharge (1.5 kΩ, 100 pF)	2000	V
P_{tot}	Power Dissipation at T_c = 85 °C	42	W
T_j	Junction Operating Temperature	-40 to 150	°C
T_{stg}	Storage Temperature	-55 to 150	°C

CONNECTION DIAGRAM



CURRENT AND VOLTAGE CONVENTIONS



THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case	Max	1.55	°C/W
$R_{thj\text{-}amb}$	Thermal Resistance Junction-ambient ($)	Max	50	°C/W

($) When mounted using minimum recommended pad size on FR-4 board

ELECTRICAL CHARACTERISTICS ($4.5 < V_{CS} < 16$ V; $-40 \le T_j \le 125$ °C unless otherwise specified)

POWER

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{LS}	Load Supply Voltage				40	V
V_{CS}	Control Supply Voltage		4.5		16	V
In(*)	Nominal Current	$T_c = 85$ °C $V_{DS(on)} \le 0.5$ (note 1)	7			A
R_{on}	On State Resistance	$I_L = 7$ A $T_j = 25$ °C			0.05	Ω
I_S	Supply Current	Off State $T_j \ge 25$ °C		25	50	µA
$V_{DS(MAX)}$	Maximum Voltage Drop	$I_L = 21$ A $T_c = 85$ °C			1.8	V

SWITCHING

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$(^)	Turn-on Delay Time Of Output Current	$I_L = 7$ A Resistive Load Input Rise Time < 0.1 µs		40		µs
t_r(^)	Rise Time Of Output Current	$I_L = 7$ A Resistive Load Input Rise Time < 0.1 µs		45		µs
$t_{d(off)}$(^)	Turn-off Delay Time Of Output Current	$I_L = 7$ A Resistive Load Input Rise Time < 0.1 µs		60		µs
t_f(^)	Fall Time Of Output Current	$I_L = 7$ A Resistive Load Input Rise Time < 0.1 µs		20		µs
$(di/dt)_{on}$	Turn-on Current Slope	$I_L = 7$ A $I_L = I_{OV}$		0.2	0.5 1	A/µs A/µs
$(di/dt)_{off}$	Turn-off Current Slope	$I_L = 7$ A $I_L = I_{OV}$		0.5	3 3	A/µs A/µs
V_{NCV}	Nominal Load Pin Clamping Voltage	$I_L = 7$ A Inductive Load	40.5		55	V
V_{THCV}	Load Pin Clamping Threshold Voltage	$I_{sink} = 70$ mA	40			V

LOGIC INPUT

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{IL}	Input Low Level Voltage				0.8	V
V_{IH}	Input High Level Voltage		2		(•)	V
$V_{I(hyst.)}$	Input Hysteresis Voltage			0.5		V
I_{IN}	Input Current	$V_{IN} = 5$ V $T_j = 25$ °C	100	300	500	µA
V_{ICL}	Input Clamp Voltage	$I_{IN} = 10$ mA $I_{IN} = -10$ mA		6 -0.7		V V

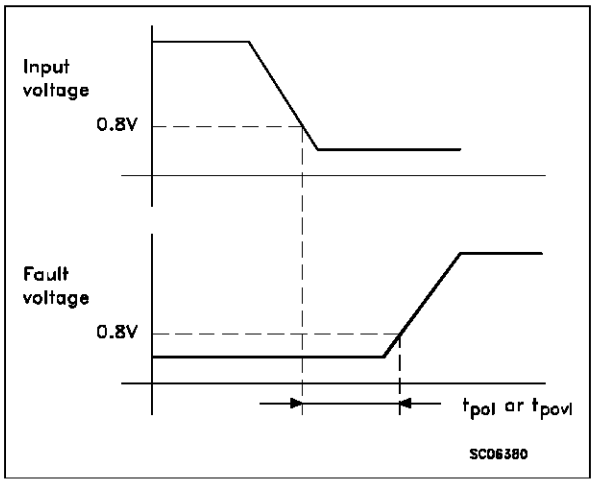
ELECTRICAL CHARACTERISTICS (continued)

PROTECTION AND DIAGNOSTICS (continued)

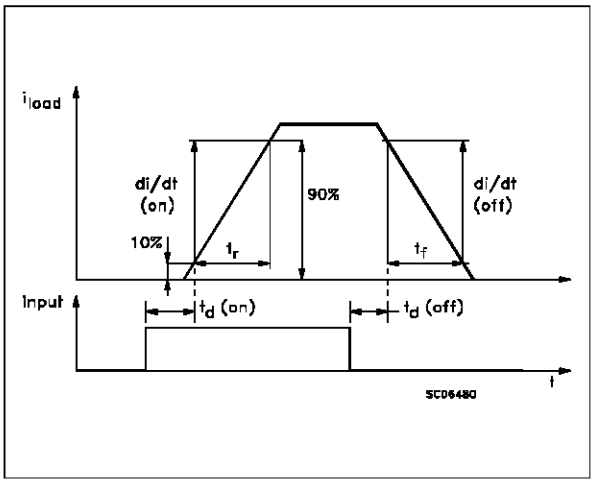
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{STAT}	Status Voltage Output Low	I_{STAT} = 1.6 mA T_j = 25 °C			0.4	V
V_{USD}	Under Voltage Shut Down				4.5	V
V_{SCL}	Status Clamp Voltage	I_{STAT} = 10 mA I_{STAT} = -10 mA V_{LOAD} = 13V		6 -0.7		V V
I_{OV}	Over Current	V_{LS} = 13V	40			A
I_{OL}	Open Load Current Level	ON STATE	5	300	700	mA
T_{TSD}	Thermal Shut-down Temperature		140	160	180	°C
T_R	Reset Temperature		125			°C
$t_{1(on)}$	Open Load Filtering Time	(note 3)	1	5	10	ms
$t_{1(off)}$	Open Load Filtering Time	(note 3)	1	5	10	ms
$t_{2(off)}$	Open Load Filtering Time	(note 3)	1	5	10	ms
t_{povl}	Status Delay	(note 2)		5		µs
t_{pol}	Status Delay	(note 2)	50	1000		µs

(^) See Switchig Time Waveforms
(•) The V_{IH} is internally clamped at 6V about. It is possible to connect this pin to an higher voltage via an external resistor calculated to not exceed 10 mA at the input pin.
note 1: The Nominal Current is the current at T_c = 85 °C for battery voltage of 13V which produces a voltage drop of 0.5 V
note 2: t_{povl} t_{pol}: ISO definition (see figure)
note 3: $t_{1(on)}$: minimum open load duration which acctivates the status output
$t_{1(off)}$: minimum load recovery time which desactivates the status output
$t_{2(off)}$: minimum on time after thermal shut down which desactivates status output

Note 2 Relevant Figure



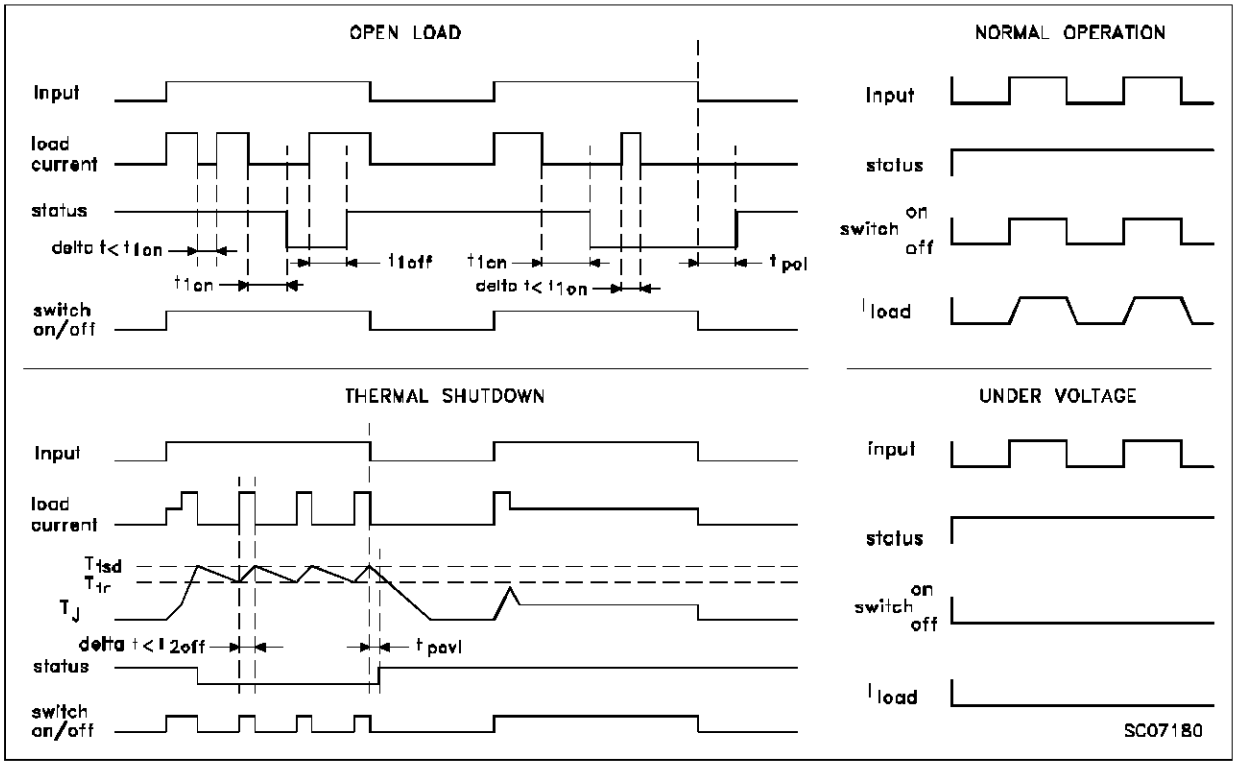
Note 3 Relevant Figure



TRUTH TABLE

	INPUT	LOAD	DIAGNOSTIC
Normal Operation	L H	H L	H H
Over-temperature	H	H	L
Under-voltage	X	H	H
Open Circuit (no load)	H	L	L

Figure 1: Waveforms



Power SO-10 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	3.45	3.5	3.55	0.135	0.137	0.140
B		1.28	1.30		0.050	0.051
C			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
H	6.80	6.90	7.00	0.267	0.417	0.421
I		0.10			0.004	
K	13.80	14.10	14.40	0.543	0.555	0.567
L		0.40	0.50		0.016	0.020
M	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