SGS-THOMSON MICROELECTRONICS

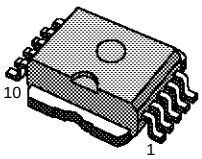
VN370SP

TRIPLE CHANNEL HIGH SIDE SMART POWER SOLID STATE RELAY

TARGET DATA

TYPE	V_{DSS}	$R_{DS(on)}$	I_{OUT}	channel
VN370SP	60V	0.25 Ω	1 A	1
	60V	1.7 Ω	0.3A	2
	60V	1.7 Ω	0.3A	3

- ONE 2.4A (MAX) CHANNEL
- TWO 0.36A (MAX) CHANNELS
- THREE TTL INPUTS
- OVER VOLTAGE SHUTDOWN
- INDEPENDENT THERMAL SHUTDOWN FOR EACH CHANNEL
- CURRENT LIMITER ON EACH CHANNEL
- VERY LOW STAND-BY POWER DISSIPATION



Power SO-10™

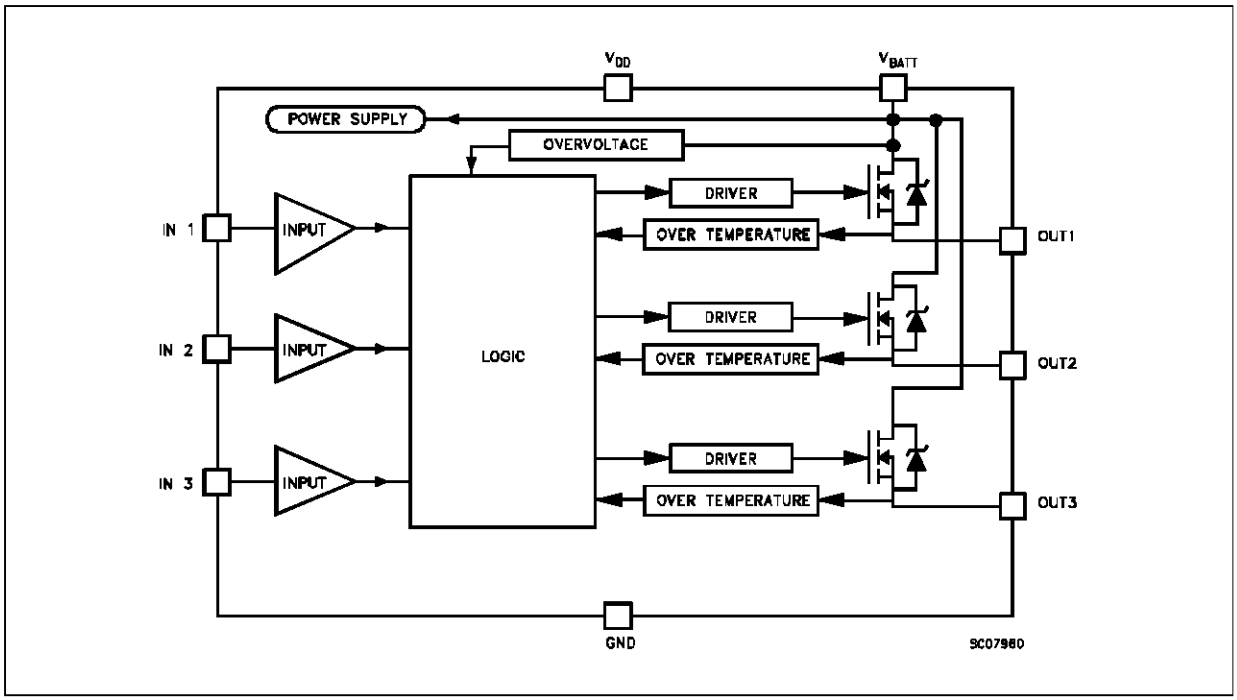
DESCRIPTION

The VN370SP is a monolithic device made using SGS-THOMSON Vertical Intelligent Power Technology, intended for driving three indipedent resistive or inductive loads with one side connected to ground.

The input control are TTL compatible. Overvoltage shutdown protect the loads against voltage surges on the supply line.

Three independant current limiters and thermal shutdown protect the chip in over temperature or short circuit conditions.

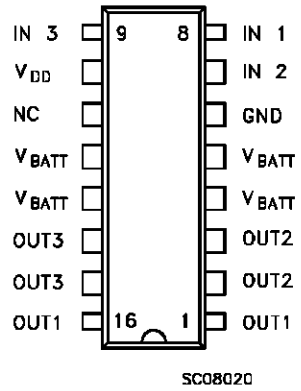
BLOCK DIAGRAM



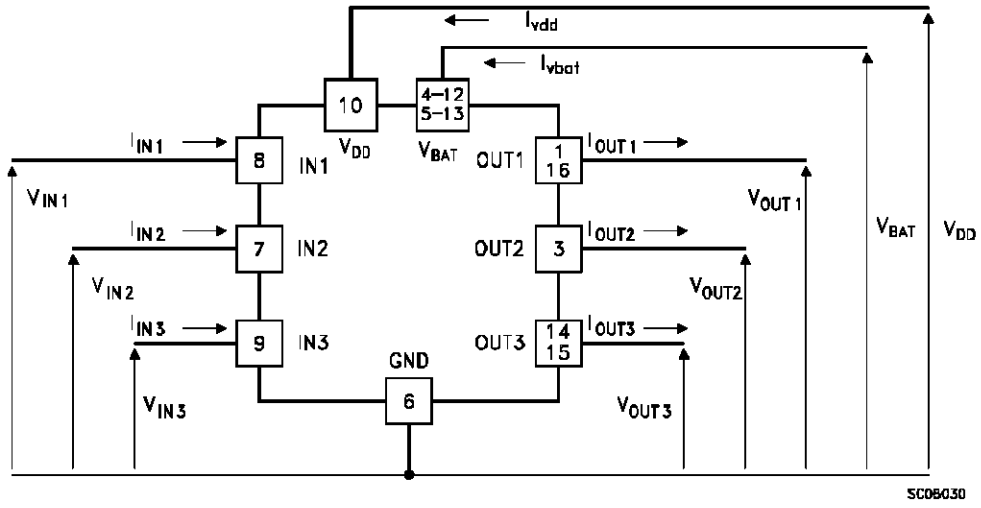
ABSOLUTE MAXIMUM RATING

Symbol	Parameter	Value	Unit
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	60	V
$-V_{CC}$	Reverse Supply Voltage	-4	V
I_L	Maximum DC Load Current	Internally Limited	A
I_R	Reverse Output Current Per Channel	-7	A
I_{IN}	Input Current (INPUTn)	±10	mA
V_{ESD1}	Electrostatic Discharge (1.5 kΩ, 100 pF)	4000	V
P_{tot}	Power Dissipation at $T_c \leq 25\ ^oC$	Internally Limited	W
T_j	Junction Operating Temperature	-40 to 150	^oC
T_{stg}	Storage Temperature	-55 to 150	^oC

CONNECTION DIAGRAM



CURRENT AND VOLTAGE CONVENTIONS



THERMAL DATA

$R_{thj\text{-}case1}$	Thermal Resistance Junction-case (Channel 1)	Max	5	°C/W
$R_{thj\text{-}case2}$	Thermal Resistance Junction-case (Channel 2)	Max	30	°C/W
$R_{thj\text{-}amb}$	Thermal Resistance Junction-ambient (Channel 1) ($)	Max	36	°C/W
$R_{thj\text{-}amb}$	Thermal Resistance Junction-ambient (Channel 2) ($)	Max	60	°C/W

(1) All channels ON
($) When mounted using minimum recommended pad size on FR-4 board

ELECTRICAL CHARACTERISTICS (10V < V_{BAT} < 16V; -40°C < T_{case} < 125°C; 4.75V < V_{DD} < 5.25V; unless otherwise specified)

POWER

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{CC}	Supply Voltage		7	13	24	V
R_{on1}	On State Resistance (Channel 1)	I_{OUT1} = 1 A I_{OUT}1 = 1A T_j = 25 °C		 0.2	0.5 0.25	Ω Ω
R_{on2}	On State Resistance (Channel 2)	I_{OUT2} = 0.3 A I_{OUT2} = 0.3 A T_j = 25 °C		 1.4	3.3 1.7	Ω Ω
R_{on3}	On State Resistance (Channel 3)	I_{OUT3} = 0.3 A I_{OUT3} = 0.3 A T_j = 25 °C		 1.4	3.3 1.7	Ω Ω
I_{bs}	Supply Current from V_{bat} pin	Off State $T_j \geq 25$ °C On State $I_{out1} = I_{out2} = I_{out3} = 0$			50 50	µA mA
I_{ds}	Supply Current from V_{DD} pin				5	mA
I_{ls}	Output Leakage Current	$V_{SW1} = V_{SW2} = V_{SW3}$ = 0V, current measured between OUT1 or OUT2 or OUT3 and GND	-50		50	µA
V_{dem1}	Channel 1 Output Demagnetization Voltage	I_{out1} = 1 A L_{LOAD} = 1 mH T_c = 25 °C	-24	-20	-16	V
V_{dem2}	Channel 2 and Channel 3 Output Demagnetization Voltage	I_{out2} or I_{out2} = 0.3 A L_{LOAD} = 1 mH T_c = 25 °C	-24	-20	-16	V

SWITCHING

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on Delay Time (Chan. 1, 2, 3)	$I_{OUT} = I_n$, Resistive Load Input Rise Time < 0.1 µs T_j = 25 °C			50	µs
t_r	Rise Time Of Output Current (Chan. 1, 2, 3)	$I_{OUT} = I_n$, Resistive Load Input Rise Time < 0.1 µs T_j = 25 °C			50	µs
$t_{d(off)}$	Turn-off Delay Time (Chan. 1, 2, 3)	$I_{OUT} = I_n$, Resistive Load Input Rise Time < 0.1 µs T_j = 25 °C			100	µs
t_f	Fall Time Of Output Current (Chan. 1, 2, 3)	$I_{OUT} = I_n$, Resistive Load Input Rise Time < 0.1 µs T_j = 25 °C			50	µs

ELECTRICAL CHARACTERISTICS (continued)

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	$V_{IN(X)}$ = 5.5 V V_{BAT} = 14 V	-10		10	µA
V_{ICL}	Input Clamp Voltage	$I_{IN(X)}$ = 10 mA $I_{IN(X)}$ = -10 mA	8	9.5 -0.7	11	V V

PROTECTION AND DIAGNOSTICS

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{ov}	Over Voltage Shut-down	(see fig. 1)	24	27	30	V
I_{LIM1}	Current Limit (Channel 1)	R_{L1} = 500 mΩ	2.3		4.4	A
I_{LIM2}	Current Limit (Channel 2 and Channel 3)	$R_{L2,3}$ = 500 mΩ	0.36		0.72	A
I_{BLG}	Leakage Current From V_{BAT} When GND pin is Open	R_{L1} = 16 Ω R_{L2} = 53 Ω R_{L3} = 80 Ω GND pin is open	-10		10	mA
T_{TSD1}	Thermal Shut-down Temperature (Chan. 1)		150	170	190	°C
T_{R1}	Thermal Reset Temperature (Chan. 1)		120			°C
T_{TSD2}	Thermal Shut-down Temperature (Chan. 2 and 3)		140	160	180	°C
T_{R2}	Thermal Reset Temperature (Chan. 2 and 3)		130			°C

(*) The V_{IH} is internally clamped at 9.5V about. It is possible to connect the input pins to an higher voltage via an external resistor calculated to not exceed 10 mA at the input pin.
(•) Status determination > 100 µs after the switching edge.

TRUTH TABLE

	IN1	OUT1	IN2	OUT2	IN3	OUT3
Normal Operation	L H	L H	L H	L H	L H	L H
Over-Voltage	L H	L L	L H	L L	L H	L L
Thermal Shutdown Channel 1	L H	L L	L H	L L	L H	L L
Thermal Shutdown Channel 2	L H	L H	L H	L L	L H	L H
Thermal Shutdown Channel 3	L H	L H	L H	L H	L H	L L

FUNCTIONAL DESCRIPTION

The device integrates one high current channel (1A nominal current) and two identical low current channels (0.3A). Each of these three channels is independently controlled by TTL compatible input pin IN1 to IN3 and drives a resistive or inductive load in high side configuration.

When any channel switches off an unclamped inductive load, the relevant output voltage is clamped to typically -20V.

The device is powered both from a battery input therminal V_{BAT} and from a supply input therminal V_{DD}.

V_{DD} terminal should be connected to a 5V ±5% supply while V_{BAT} terminal is connected to the car battery line through a (L=40mH, C=4000µF) filter. An antiparallel diode ahead of the LC filter clamps the negative voltage on V_{BAT} terminal to -0.8V typ for channel 1 and 0.5A typ. for channel 2 and channel 3.

When channel 2 or channel 3 is overloaded, so that the relevant power output junction temperature reaches 160 ^{o}C typ, the overladed output shuts down and restarts automatically when the power output temperature has cooled down to 130 ^{o}C. The other channels remain unaffected.

If channel 1 is overloaded, so that power output 1 junction temperature reaches 170 ^{o}C typ, the three channels shut down and restart automatically when the power output1 temperature has cooled down to 120 ^{o}C.

if VBAT terminal voltage ingrases abobe 27V typ, all outputs shut down and restart again when VBAT voltage has decreased below 27V.

If GND terminal is opened, all outputs shut down whatever the state of IN1, IN2 and IN3 provided no pin voltage exceed 16 V with respect to the loads negative terminal.

SWITCHING PARAMETERS TEST CONDITIONS

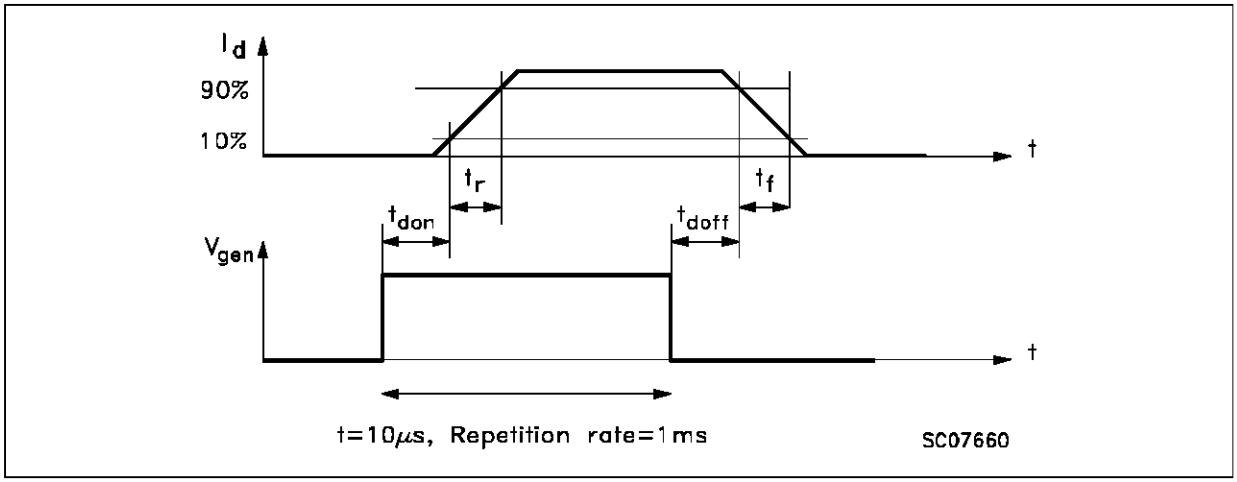
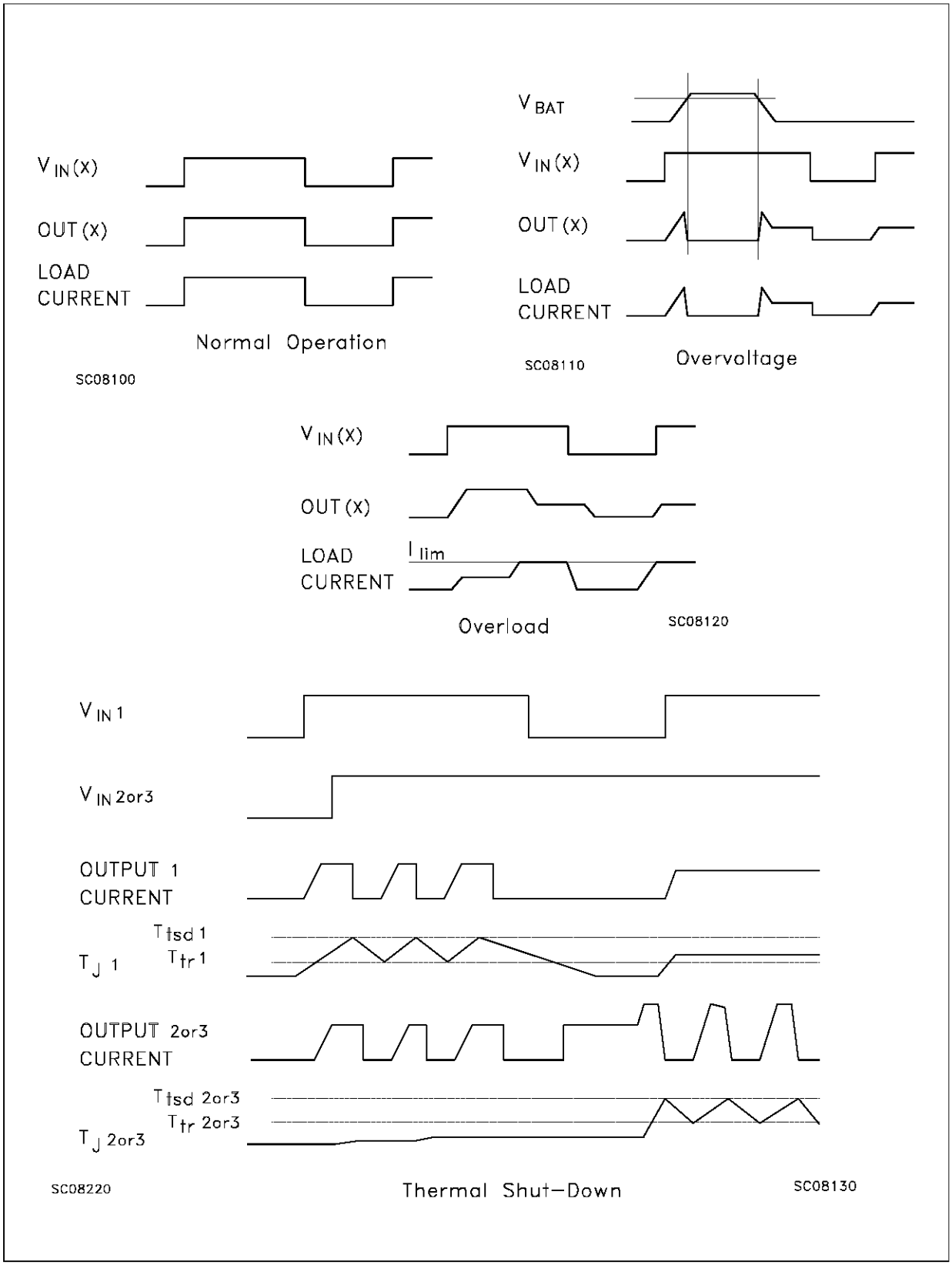


Figure 1: Waveforms



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