

High side driver

Type	R _{DS(on)}	I _{out}	V _{CC}
VN751S	60 mΩ	2.5 A	36 V

- 
- SO-8

The VN751S is a monolithic device designed in STMicroelectronics VIPower M0-3 technology, intended for driving any kind of load with one side connected to ground. Active V_{CC} pin voltage clamp protects the device against low energy spikes. Active current limitation combined with thermal shutdown and automatic restart protect the device against overload. Device automatically turns off in case of ground pin disconnection. This device is especially suitable for industrial applications in conformity with IEC 61131-2 programmable controllers international standard.

The diagram illustrates a power MOSFET driver circuit. On the left, there are three input terminals: GND, INPUT, and STATUS. The INPUT signal passes through an inverter before entering a central LOGIC block. The STATUS signal also enters the LOGIC block. The LOGIC block is connected to several protection and control blocks: V_{CC} CLAMP, OVERVOLTAGE DETECTION, UNDERVOLTAGE DETECTION, and OVERTEMPERATURE DETECTION. The output of the LOGIC block drives a DRIVER block, which in turn controls a MOSFET. The MOSFET's gate is connected to the DRIVER, its drain is connected to the output terminal (OUTPUT), and its source is connected to a common ground. A Power CLAMP block is connected between the output and ground, and a CURRENT LIMITER block is connected between the driver and the MOSFET gate. The output terminal is also connected to a V_{CC} supply line, which includes a V_{CC} CLAMP block and a series of protection diodes (one in series with the output, and two in parallel with the output to ground).

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1 Maximum ratings

Table 1. Absolute maximum rating

Symbol	Parameter	Value	Unit
V_{CC}	DC supply voltage (overvoltage protected)	45	V
$-V_{CC}$	Reverse DC supply voltage	-0.3	V
$-I_{GND}$	DC reverse ground pin current	-200	mA
I_{OUT}	DC output current	Internally limited	A
$-I_{OUT}$	Reverse DC output current	-5	A
I_{IN}	DC input current	+/- 10	mA
I_{STAT}	DC status current	+/- 10	mA
V_{ESD}	Electrostatic discharge ($R = 1.5\text{ k}\Omega$; $C = 100\text{ pF}$)	5000	V
P_{tot}	Power dissipation $T_C = 25\text{ }^{\circ}\text{C}$	Internally limited	W
T_J	Junction operating temperature	Internally limited	$^{\circ}\text{C}$
T_C	Case operating temperature	- 40 to 150	$^{\circ}\text{C}$
T_{stg}	Storage temperature	- 55 to 150	$^{\circ}\text{C}$
E_{AS}	Single-pulse avalanche energy	0.8	J

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJA}	Thermal resistance junction-ambient Max	93 ⁽¹⁾	$^{\circ}\text{C/W}$
		82 ⁽²⁾	
R_{thJC}	Thermal resistance junction-case Max	15	$^{\circ}\text{C/W}$

1. When mounted on a standard single-sided FR-4 board with 0.5 cm² of Cu (at least 35μm) thick connected to all V_{CC} pins. Horizontal mounting and no artificial air flow.
2. When mounted on a standard single-sided FR-4 board with 2 cm² of Cu (at least 35μm) thick connected to all V_{CC} pins. Horizontal mounting and no artificial air flow.

2 Pin connections

Figure 2. Connection diagram (top view)

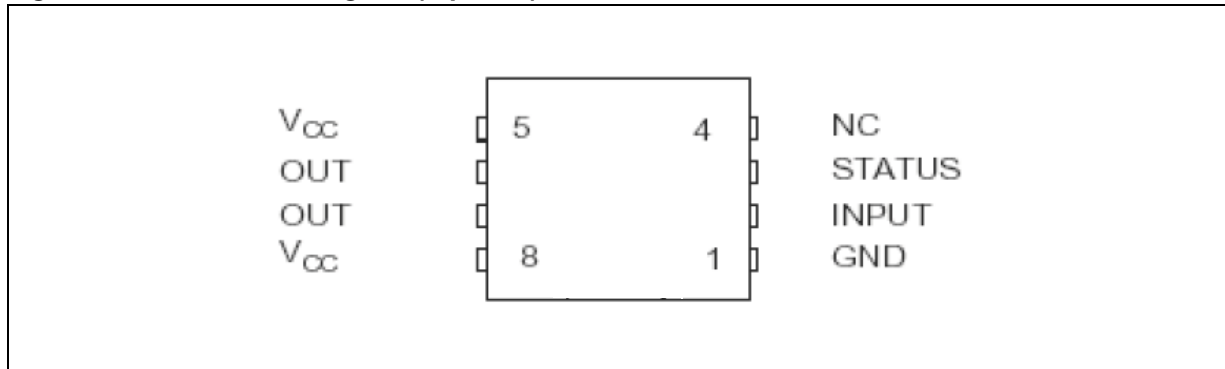
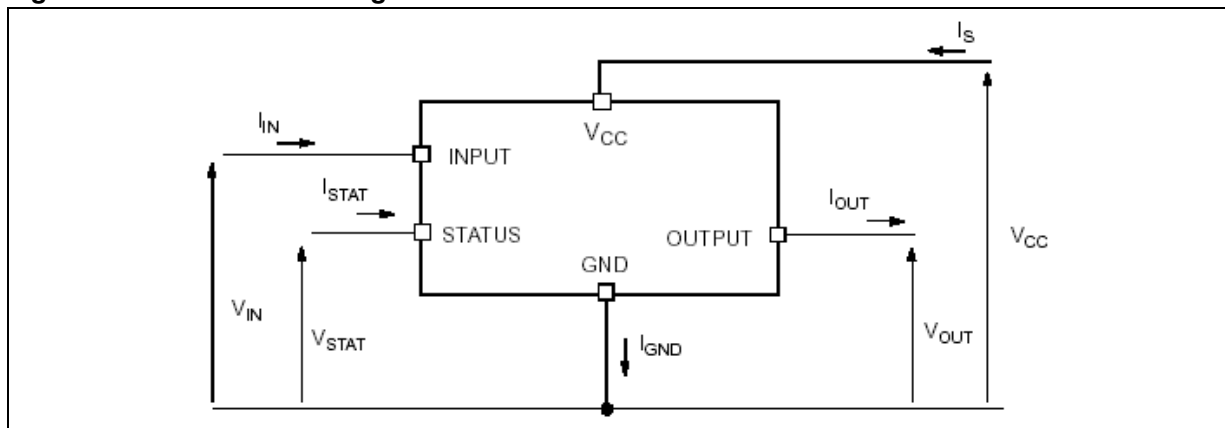


Figure 3. Current and voltage conventions



3 Electrical characteristics

8 V < V_{CC} < 36 V; -40 °C < T_J < 125 °C, unless otherwise specified

Table 3. Power

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
V _{CC}	Operating supply voltage		5.5		36	V
V _{USD}	Undervoltage shut-down		3	4	5.5	V
V _{OV}	Overvoltage shut-down		36			V
R _{ON}	On state resistance	I _{OUT} = 2 A; T _J = 25 °C I _{OUT} = 2 A		60	180	mΩ mΩ
I _S	Supply current	Off state; V _{CC} = 24 V; T _{CASE} = 25 °C On state; V _{CC} = 24 V On state; V _{CC} = 24 V; T _{CASE} = 100 °C		10 1.5	20 1.8	μA mA mA
I _{L(off)}	Off state output current	V _{IN} = V _{OUT} = 0 V	0		10	μA

Table 4. Switching (V_{CC} = 24 V)

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
t _{d(on)}	Turn-on delay time	R _L = 12 Ω from V _{IN} rising edge to V _{OUT} = 2.4 V		12		μs
t _{d(off)}	Turn-off delay time	R _L = 12 Ω from V _{IN} falling edge to V _{OUT} = 21.6 V		35		μs
dV _{OUT} /dt _(on)	Turn -on voltage slope	R _L = 12 Ω from V _{OUT} = 2.4 V to V _{OUT} = 19.2 V		0.80		V/μs
dV _{OUT} /dt _(off)	Turn -off voltage slope	R _L = 12 Ω from V _{OUT} = 21.6 V to V _{OUT} = 2.4 V		0.30		V/μs

Table 5. Input pin

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
V_{IL}	Input low level				1.25	V
I_{IL}	Low level input current	$V_{IN} = 1.25\text{ V}$	1			μA
V_{IH}	Input high level		3.25			V
I_{IH}	High level input current	$V_{IN} = 3.25\text{ V}$			10	μA
V_{hyst}	Input hysteresis voltage		0.5			V
I_{IN}	Input current	$V_{IN} = V_{CC} = 5\text{ V}$			10	μA
V_{ICL}	Input clamp voltage	$I_{IN} = 1\text{ mA}$ $I_{IN} = -1\text{ mA}$	6	6.8 -0.7	8	V V

Table 6. Status pin

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
V_{STAT}	Status low output voltage	$I_{STAT} = 1.6\text{ mA}$			0.5	V
I_{LSTAT}	Status leakage current	Normal operation; $V_{STAT} = 5\text{ V}$			10	μA
C_{STAT}	Status pin input capacitance	Normal operation; $V_{STAT} = 5\text{ V}$			100	pF
V_{SCL}	Status clamp voltage	$I_{STAT} = 1\text{ mA}$; $I_{STAT} = -1\text{ mA}$	6	6.8 -0.7	8	V V

Table 7. Protections

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
T_{TSD}	Shut-down temperature		150	175	200	$^{\circ}\text{C}$
T_R	Reset temperature		135			$^{\circ}\text{C}$
T_{hyst}	Thermal hysteresis		7	20		$^{\circ}\text{C}$
I_{lim}	Current limitation	$V_{CC} = 24\text{ V}$, $R_{LOAD} = 10\text{ m}\Omega$, $t = 0.4\text{ ms}$	2.7		6.0	A
V_{demag}	Turn-off output clamp voltage	$R_L = 12\text{ }\Omega$; $L = 6\text{ mH}$	$V_{CC} - 47$	$V_{CC} - 52$	$V_{CC} - 57$	V

4 Waveforms and truth table

Figure 4. Switching time waveforms

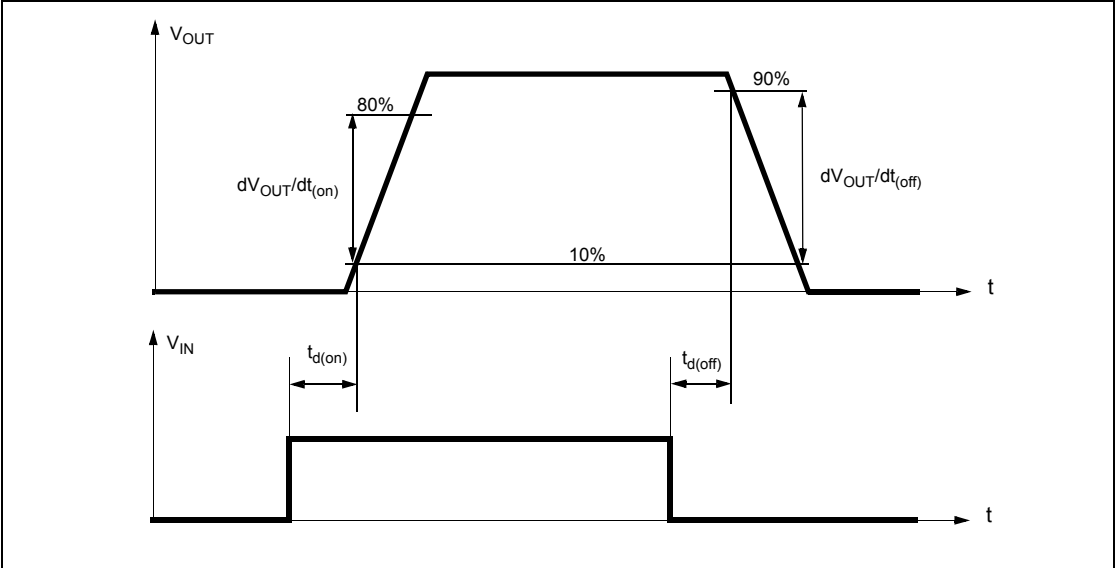
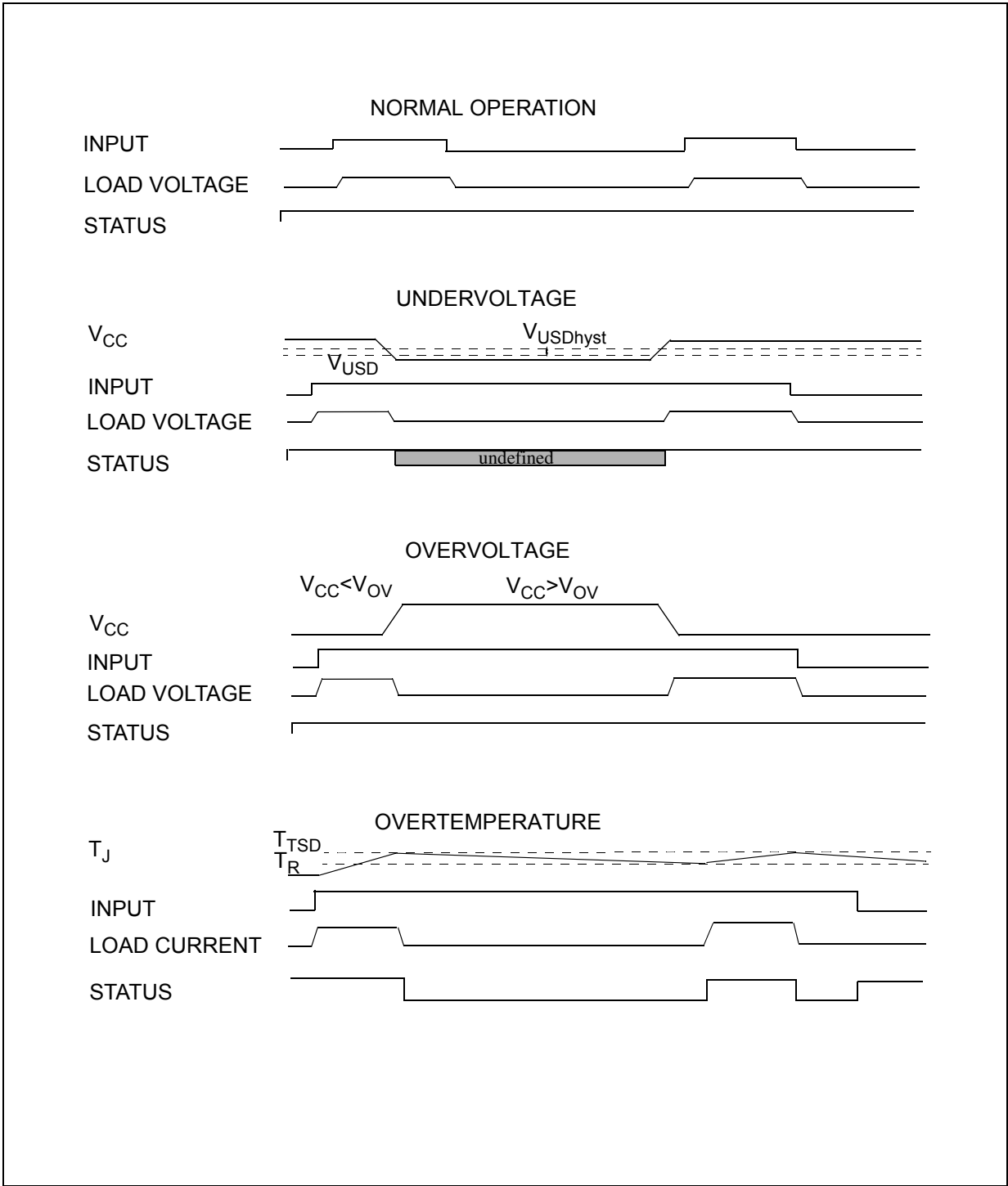


Table 8. Truth table

Conditions	Input	Output	Status
Normal operation	L	L	H
	H	H	H
Current limitation	L	L	H
	H	X	$(T_J < T_{TSD})$ H
	H	X	$(T_J > T_{TSD})$ L
Overtemperature	L	L	H
	H	L	L
Undervoltage	L	L	X
	H	L	X
Overvoltage	L	L	H
	H	L	H

Figure 5. Waveforms



5 Test circuit

Figure 6. Peak short circuit current test circuit

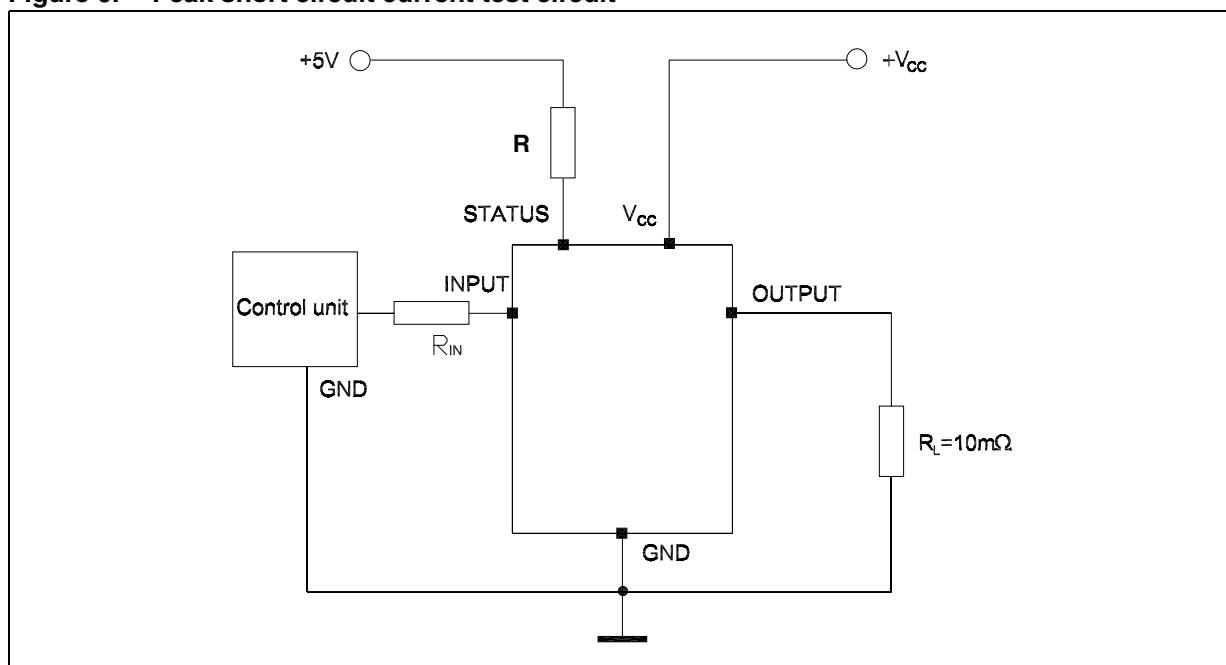
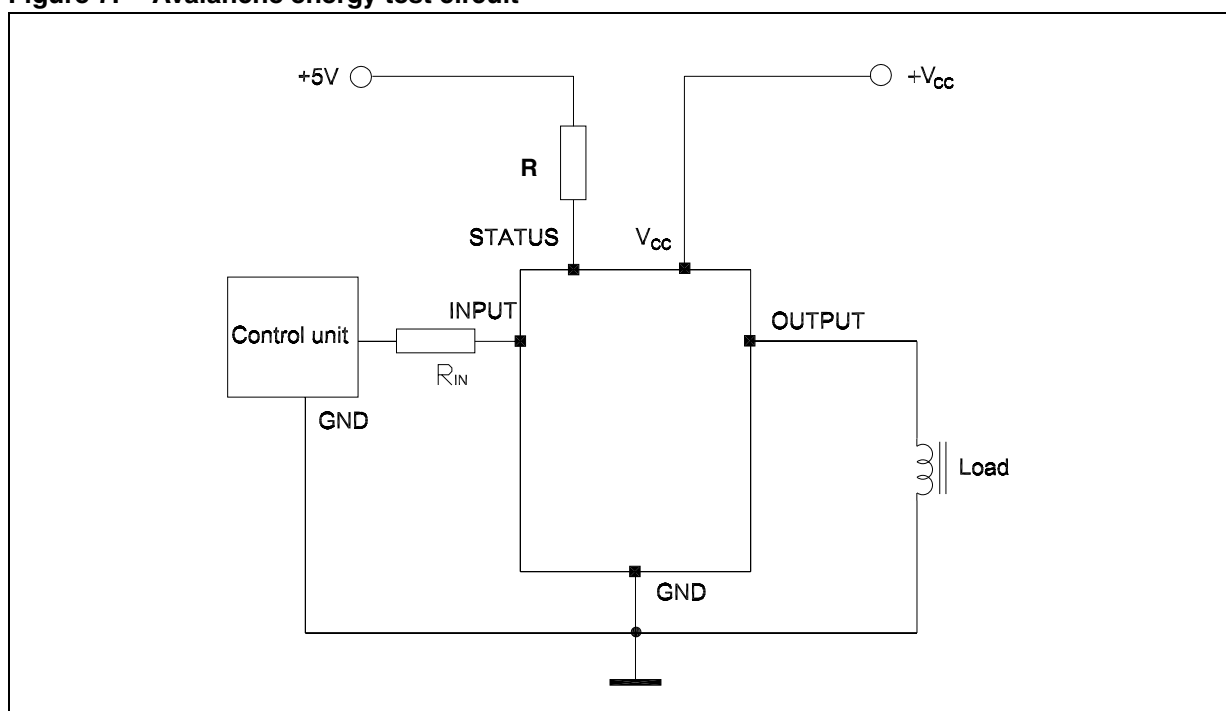
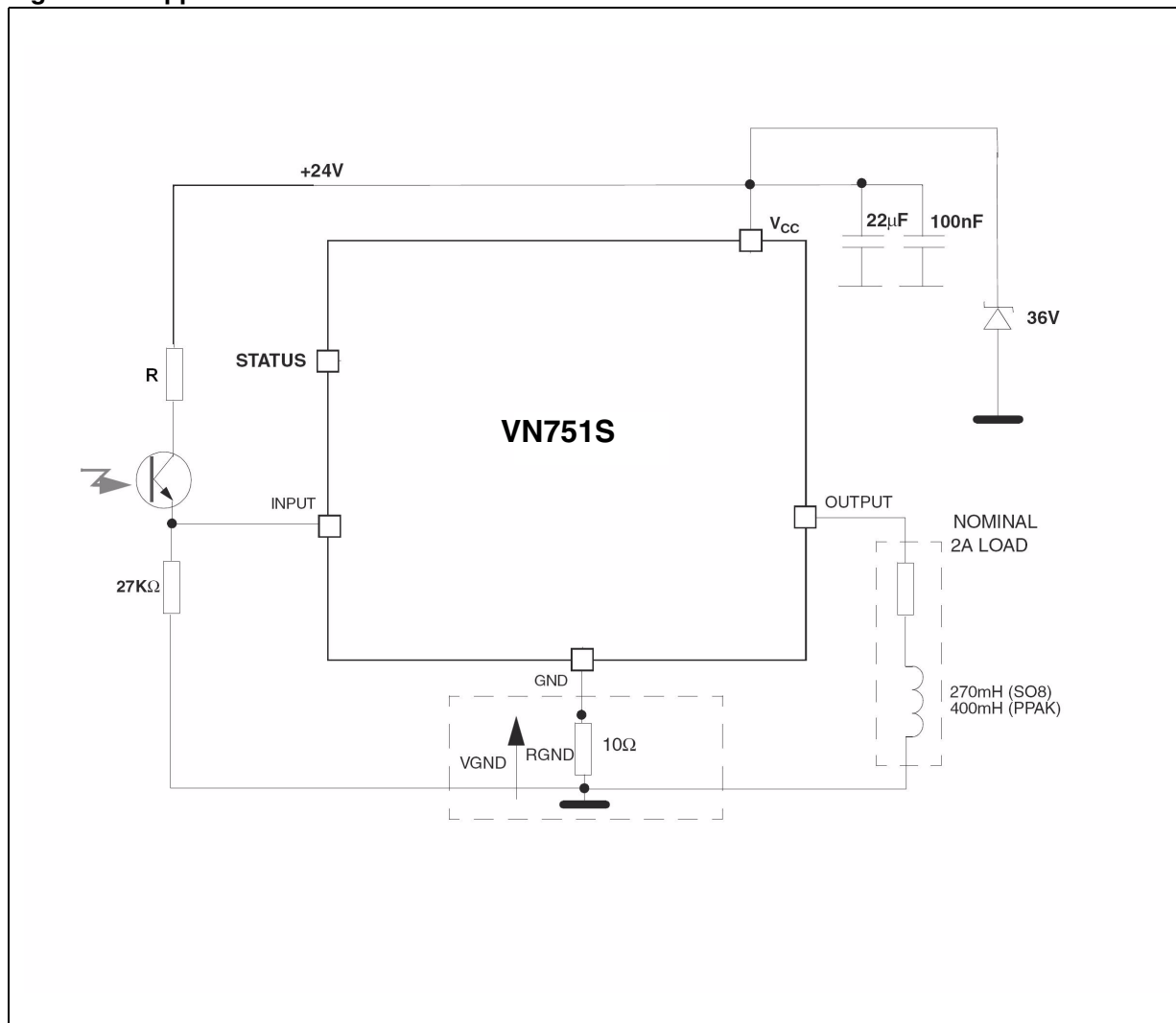


Figure 7. Avalanche energy test circuit



6 Application schematic

Figure 8. Application schematic



7 Reverse polarity protection

A schematic solution to protect the IC against a reverse polarity condition is proposed.

This schematic is effective with any type of load connected to the outputs of the IC.

The R_{GND} resistor value can be selected according to the following conditions to be met:

1. $R_{GND} \leq 600 \text{ mV} / (I_S \text{ in ON state max})$.
2. $R_{GND} \geq (-V_{CC}) / (-I_{GND})$

where $-I_{GND}$ is the DC reverse ground pin current and can be found in the absolute maximum rating section of the device datasheet.

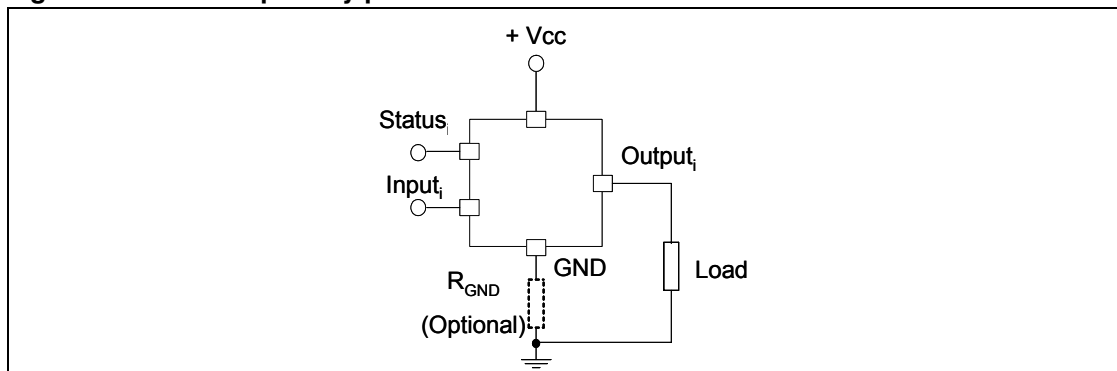
The power dissipation associated to R_{GND} during reverse polarity condition is:

$$PD = (-V_{CC})^2 / R_{GND}$$

This resistor can be shared by several different ICs. In such case I_S value on formula (1) is the sum of the maximum ON-state currents of the different devices.

Please note that if the microprocessor ground and the device ground are separated then the voltage drop across the R_{GND} (given by $I_S \text{ in ON state max} * R_{GND}$) produce a difference between the generated input level and the IC input signal level. This voltage drop will vary depending on how many devices are ON in the case of several high side switches sharing the same R_{GND} .

Figure 9. Reverse polarity protection



8 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect . The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com

Table 9. SO-8 mechanical data

Dim.	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A			1.75			0.068
a1	0.1		0.25	0.003		0.009
a2			1.65			0.064
a3	0.65		0.85	0.025		0.033
b	0.35		0.48	0.013		0.018
b1	0.19		0.25	0.007		0.010
C	0.25		0.5	0.010		0.019
c1	45 (typ.)					
D	4.8		5.0	0.188		0.196
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		3.81			0.150	
F	3.8		4.0	0.14		0.157
L	0.4		1.27	0.015		0.050
M			0.6			0.023
S	8° (max.)					

Figure 10. Package dimensions

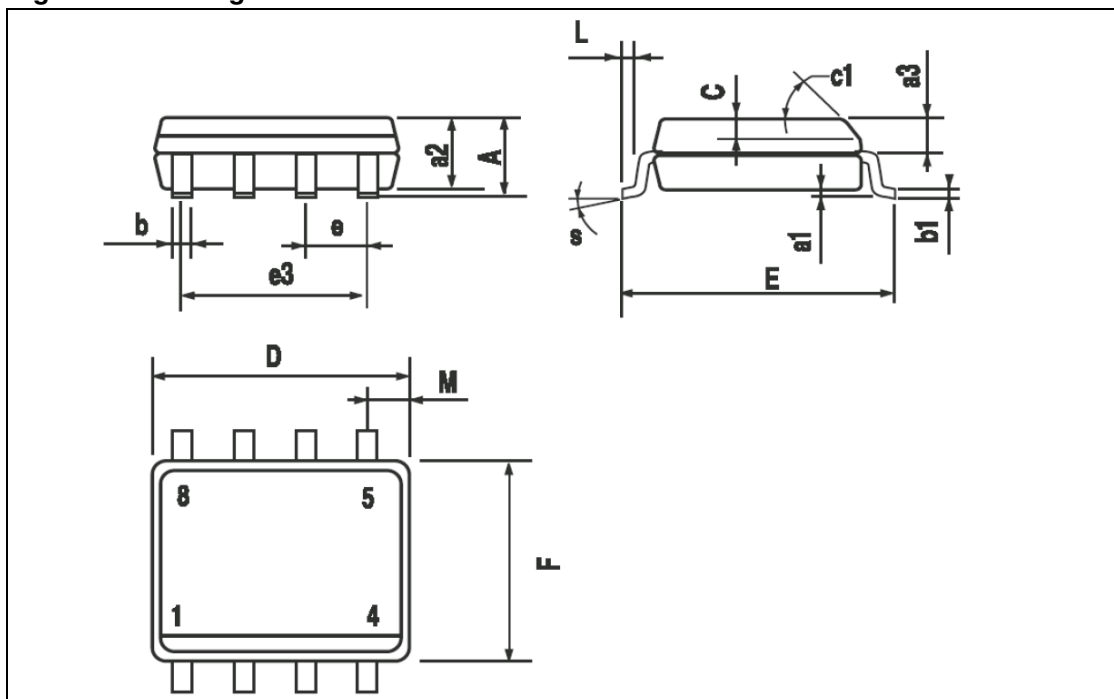
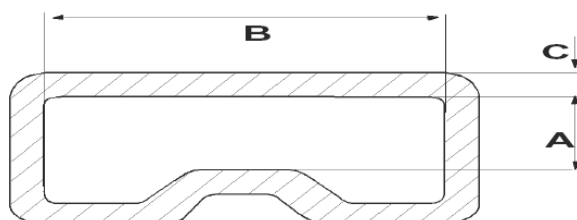
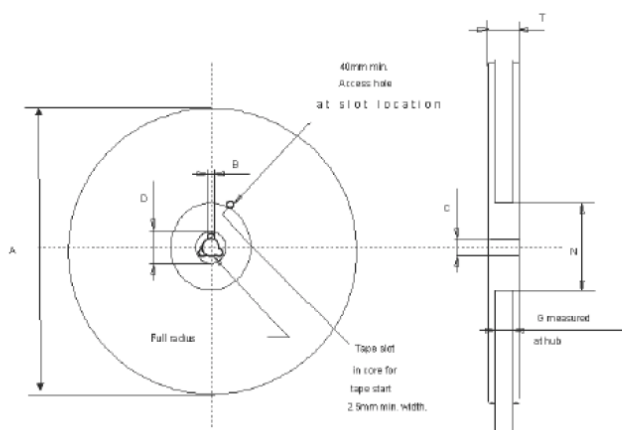


Figure 11. SO-8 tape and reel information



Base Q.ty	100
Bulk Q.ty	2000
Tube Length(± 0.5)	532
A	3.2
B	6
C(± 0.1)	0.6



Reel Dimension

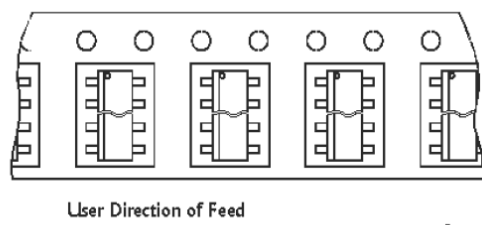
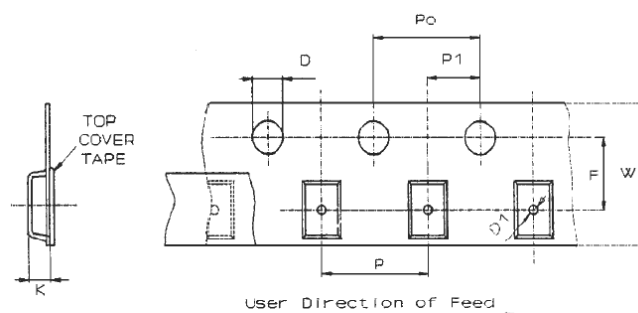
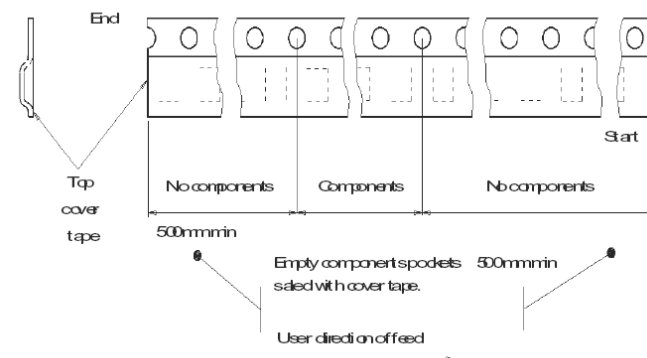
Base Q.ty	2500
Bulk Q.ty	2500
A(Max)	330
B(Min)	1.5
C(± 0.2)	13
F	20.2
G($+2/-0$)	12.4
N(Min)	60
T(Max)	18.4

Tape Dimension

According to Electronic Industries Association(EIA)
Standard 481 rev. A, Feb 1986

Tape Width	W	12
Tape Hole Spacing	P0(± 0.1)	4
Component Spacing	P	8
Hole Diameter	D($\pm 0.2/-0$)	1.5
Hole Diameter	D1(Min)	1.5
Hole Position	F(± 0.05)	5.5
Compartment Depth	K(Max)	4.5
Hole Spacing	P1(± 0.1)	2

All dimension are in mm.



9 Order code

Table 10. Order codes

Order codes	Package	Packaging
VN751S	SO-8	Tube
VN751STR	SO-8	tape and reel

10 Revision history

Table 11. Document revision history

Date	Revision	Changes
18-Sep-2006	1	Initial release
12-Mar-2007	2	Document reformatted, typo in Section Table 3.: Power on page 5 , updated P_{tot} value Table 2 .
15-May-2007	3	Typo in Table 1 on page 3 V_{ESD}
18-Sep-2007	4	Added I_{STAT} value in Table 1 on page 3
11-Oct-2007	5	Updated Table 2 on page 3
08-Jul-2008	6	Added Section 7 on page 11

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