VN330SP-E

Quad high side smart Power solid state relay

Features

Type	V_{demag} (1)	R_{DSon} (1)	I_{out} (1)	V_{CC}
VN330SP-E	V_{CC}-55V	0.32Ω (2)	0.7A	36V

1. Per channel.
2. At T_J = 85°C

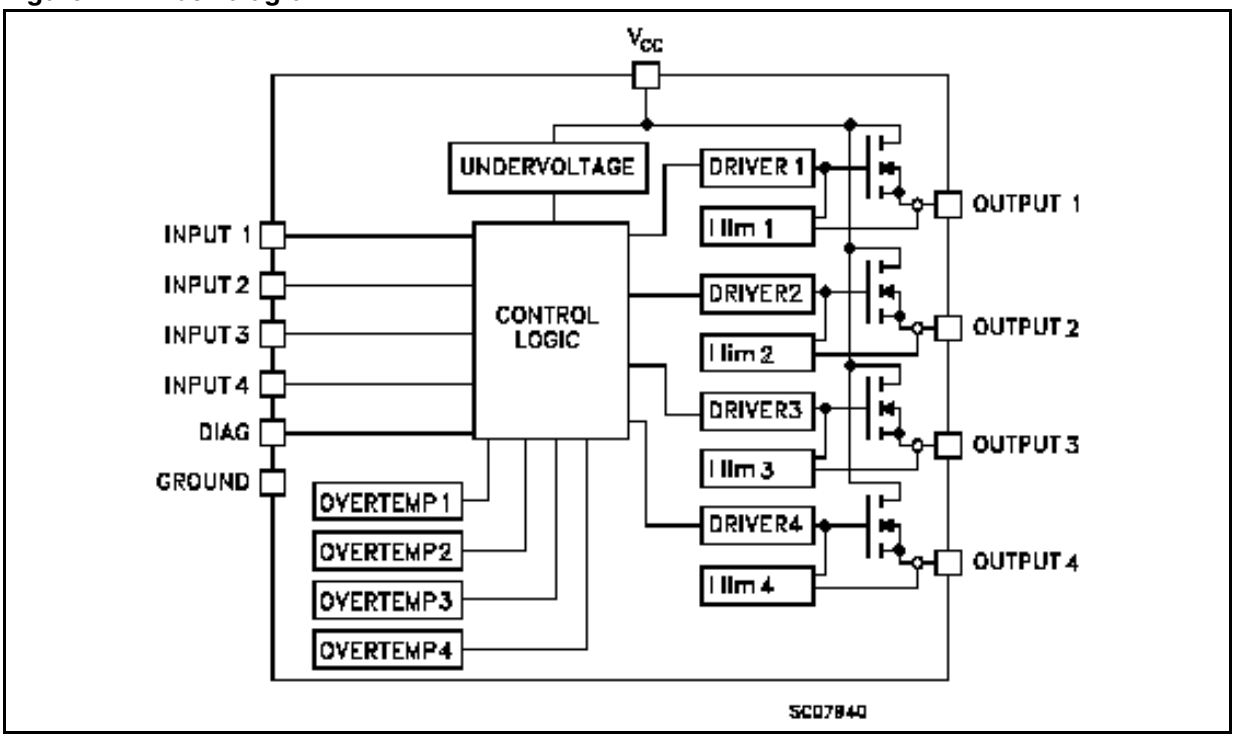
- Output current : 0.7A per channel
- Digital input clamped at 32V minimum voltage
- Shorted load and overtemperature protections
- Built-in current limiter
- Undervoltage shut-down
- Open drain diagnostic output
- Fast demagnetization of inductive loads
- Conforms to IEC 61131-2

PowerSO-10™

Description

The VN330SP-E is a monolithic device made using STMicroelectronics VIPower technology, intended for driving four indipendent resistive or inductive loads, with one side connected to ground. Active current limitation avoids dropping the system power supply in case of shorted load. Built-in thermal shut-down protects the chip from overtemperature and short circuit. The open drain diagnostic output indicates overtemperature conditions.

Figure 1. Block diagram



Contents

1 Maximum ratings

Table 1. Absolute maximum rating

Symbol	Parameter	Value	Unit
V_{CC}	Power supply voltage	45	V
$-V_{CC}$	Reverse supply voltage	-0.3	V
I_{OUT}	Output current (continuos)	Internally limited	A
I_R	Reverse output current (per channel)	-6	A
I_{IN}	Input current (per channel)	± 10	mA
I_{DIAG}	Diag pin current	± 10	mA
V_{ESD}	Electrostatic discharge (R = 1.5KΩ; C = 100pF)	2000	V
E_{AS}	Single pulse avalanche energy per channel not simultaneously *Figure 4.*	400	mJ
P_{tot}	Power dissipation at T_c = 25°C	Internally limited	w
TJ	Junction operating temperature	Internally limited	°C
T_{STG}	Storage temperature	-55 to 150	°C

Table 2. Thermal data

Symbol	Parameter		Max Value	Unit
R_{thJC}	Thermal resistance junction-case (1)	Max	2	°C/W
R_{thJA}	Thermal resistance junction-ambient (2)	Max	50	°C/W

1. Per channel
2. When mounted using minimum recommended pad size on FR-4 board

2 Pin connections

Figure 2. Connection diagram (top view)

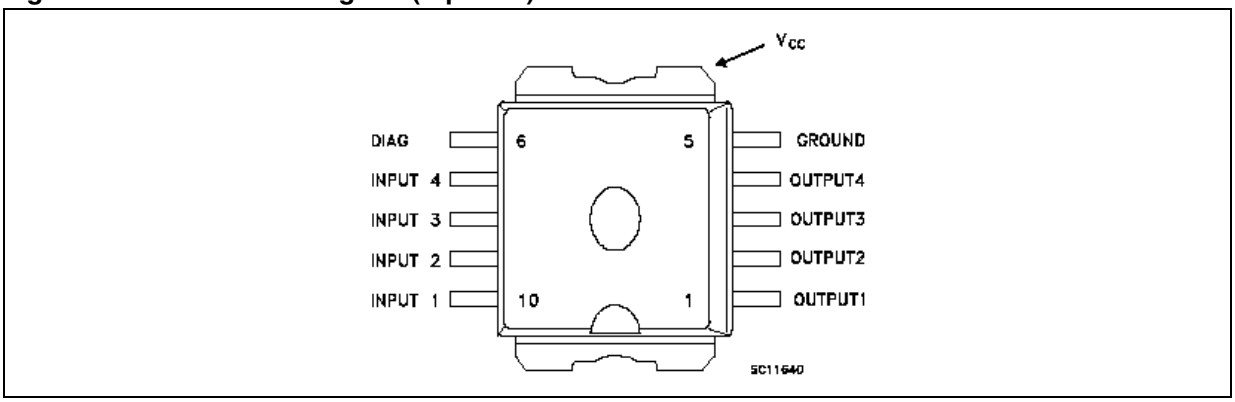
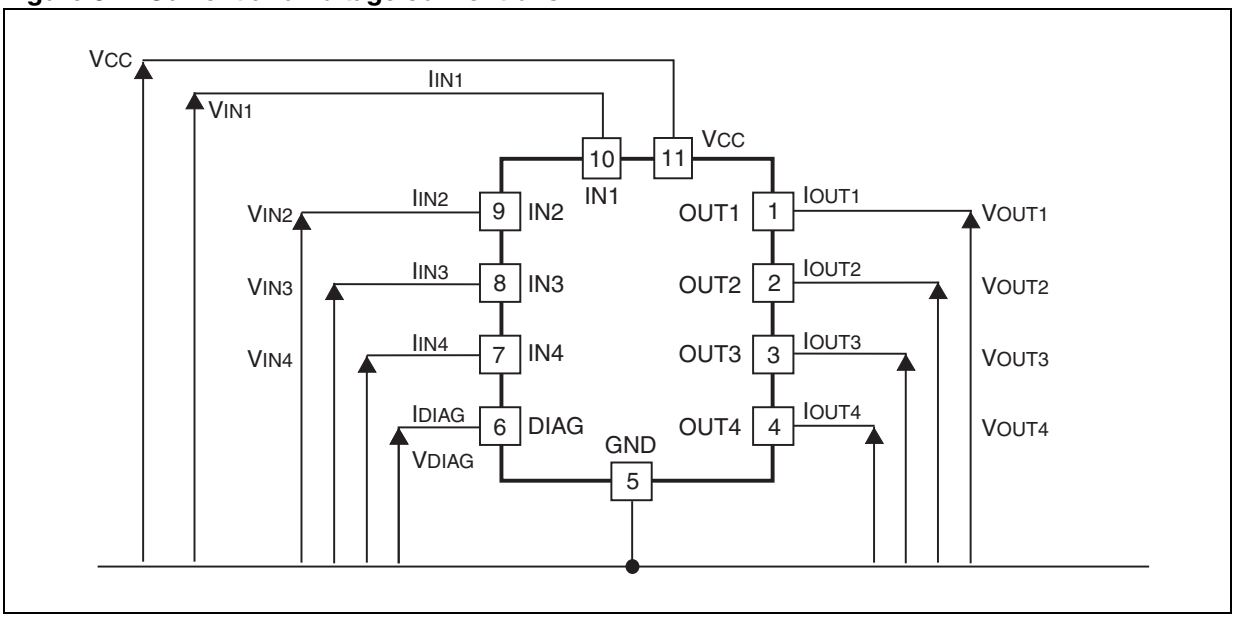


Figure 3. Current and voltage conventions



3 Electrical characteristics

10V < V_{CC} < 36V; -40°C < T_J < 125°C; unless otherwise specified

Table 3. Power section

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
V_{CC}	Supply voltage		10		36	V
R_{ON}	On state resistance	I_{OUT} = 0.5A; T_J = 25°C I_{OUT} = 0.5A; T_J = 85°C I_{OUT} = 0.5A; T_J = 125°C			0.2 0.32 0.4	Ω Ω Ω
I_S	Supply current	All channels OFF On state; V_{IN} = 30V; I_{OUT} = 0V (T_J = 125°C)			1 6	mA mA
V_{demag}	Output voltage at turn-off	I_{OUT} = 0.5A; L_{LOAD} >= 1mH	V_{CC}-65	V_{CC}-55	V_{CC}-45	V

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

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
$t_{d(ON)}$	Turn-on delay time of Output current	I_{OUT} = 0.5A, Resistive Load Input rise time < 0.1µs, T_J = 25°C T_J = 125°C		30	40 60	µs µs
t_r	Rise time of Output current	I_{OUT} = 0.5A, Resistive Load Input rise time < 0.1µs, T_J = 25°C T_J = 125°C		50	100 115	µs µs
$t_{d(OFF)}$	Turn-off delay time of Output current	I_{OUT} = 0.5A, Resistive Load Input rise time < 0.1µs, T_J = 25°C T_J = 125°C		20	30 40	µs µs
t_f	Fall time of Output current	I_{OUT} = 0.5A, Resistive Load Input rise time < 0.1µs, T_J = 25°C T_J = 125°C		8	15 20	µs µs
$(di/dt)_{on}$	Turn-on current slope	I_{OUT} = 0.5A, I_{OUT} = I_{LIM}, T_J = 25°C			0.5 2	A/µs A/µs
$(di/dt)_{off}$	Turn-off current slope	I_{OUT} = 0.5A, I_{OUT} = I_{LIM}, T_J = 25°C			2 4	A/µs A/µs

Table 5. Logical input

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
V_{IL}	Input low level voltage				2	V
V_{IH}	Input high level voltage (1)		3.5			V
$V_{I(HYST)}$	Input hysteresis voltage			0.5		V
I_{IN}	Input current	V_{IN} = 0 to 30V			600	µA
I_{LGND}	Output current in ground disconnection	V_{CC}= V_{INn} = GND = DIAG = 24V; T_J = 25°C			25	mA
V_{ICL}	Input clamp voltage (1)	I_{IN} = 1mA I_{IN} = -1mA	32	36 -0.7		V V

1. The input voltage is internally clamped at 32V minimum, however, it is possible to connect the input pins to an higher voltage via an external resistor that is calculated not to exceed 10mA.

Table 6. Protection and diagnostic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{DIAG} (1)	Status voltage output low	I_{DIAG} = 5mA (Fault condition)			1	V
V_{SCL} (1)	Status clamp voltage	I_{DIAG} = 1mA I_{DIAG} = -1mA	32	36 -0.7		V V
V_{USD}	Undervoltage shut down		5		8	V
V_{OL}	Low state output voltage	V_{IN} = V_{IL}; R_{LOAD} < 10mΩ			1.5	V
I_{LIM}	DC Short circuit current	V_{CC} = 24V; R_{LOAD} < 10mΩ	0.7		2.5	A
I_{OVPK}	Peak Short circuit current	V_{CC} = 24V; V_{IN} = 30; R_{LOAD} < 10mΩ			4	A
I_{DIAGH}	Leakage on DIAG pin in high state	V_{DIAG} = 24V			100	µA
I_{LOAD}	Output leakage current	V_{CC} = 10 to 36V; V_{IN} = V_{IL}			50	µA
t_{SC}	Delay time of current limiter				100	µs
T_{TSD}	Thermal shutdown temperature		150	170		°C
T_R	Thermal reset temperature		135	155		°C

1. Status determination > 100µs after the switching edge.

Note: If INPUT pin is floating the corrisponding channel will automatically switch OFF. If GND pin is disconnected, the channel will switch OFF provided V_{CC} not exceed 36V.

4 Test circuits

Figure 4. Avalance energy test circuit

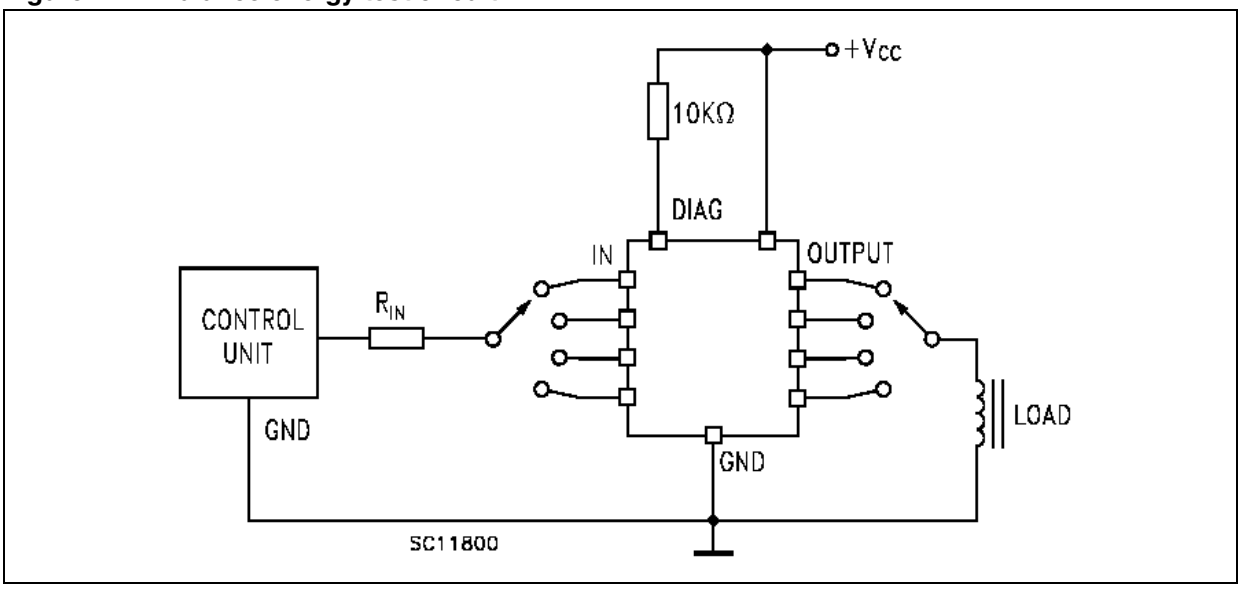
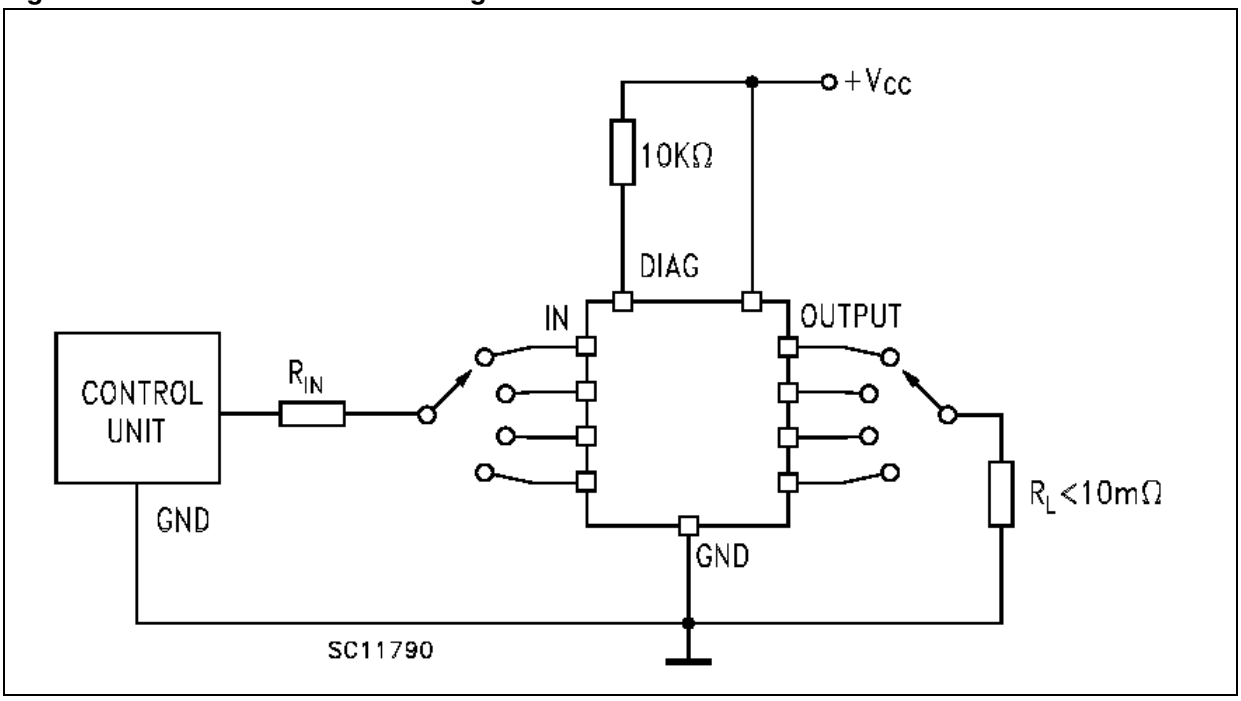


Figure 5. Peak short circuit test diagram



5 Switching time waveforms and truth table

Table 7. Truth table

	INPUTn	OUTPUTn	Diagnostic
Normal operation	L H	L H	H H
Overtemperature	L H	L L	H L
Undervoltage	L H	L L	H H
Shorted load (Current limitation)	L H	L H	H H

Figure 6. Switching waveforms

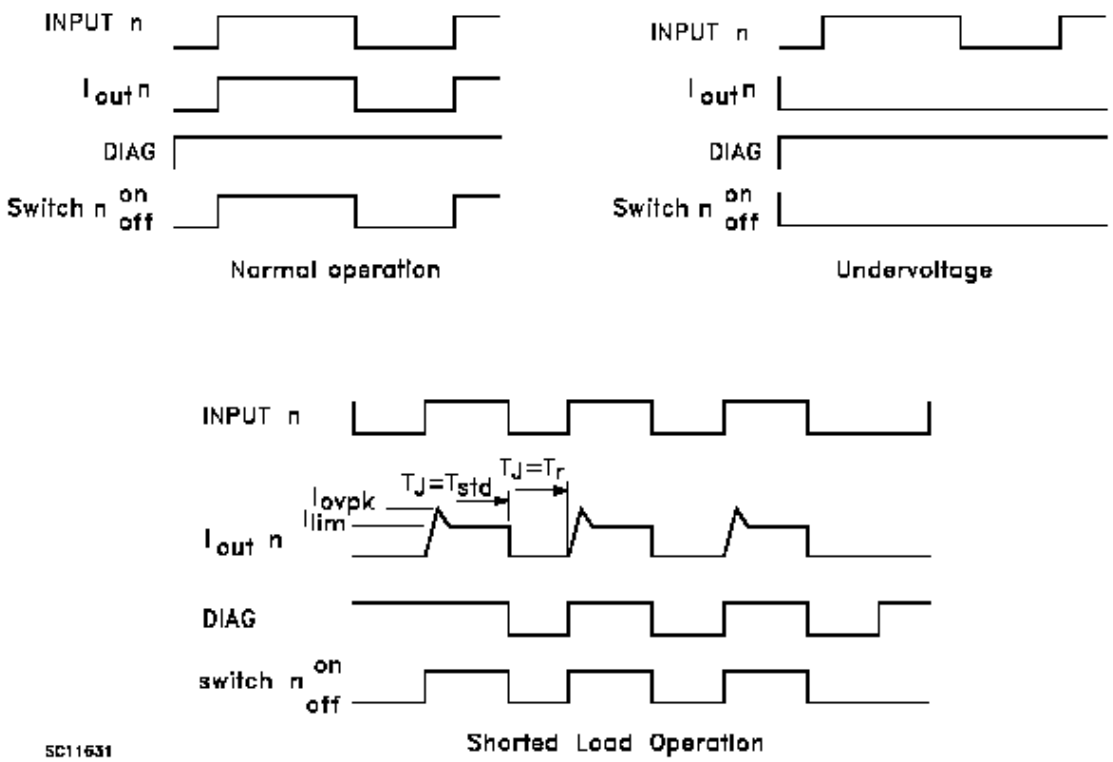


Figure 7. Switching parameter test conditions

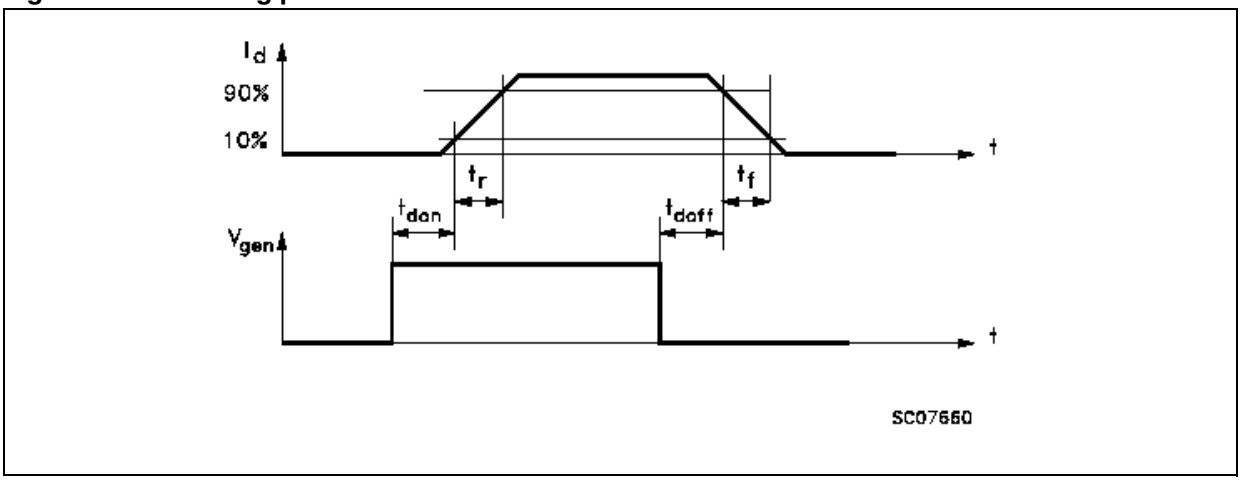
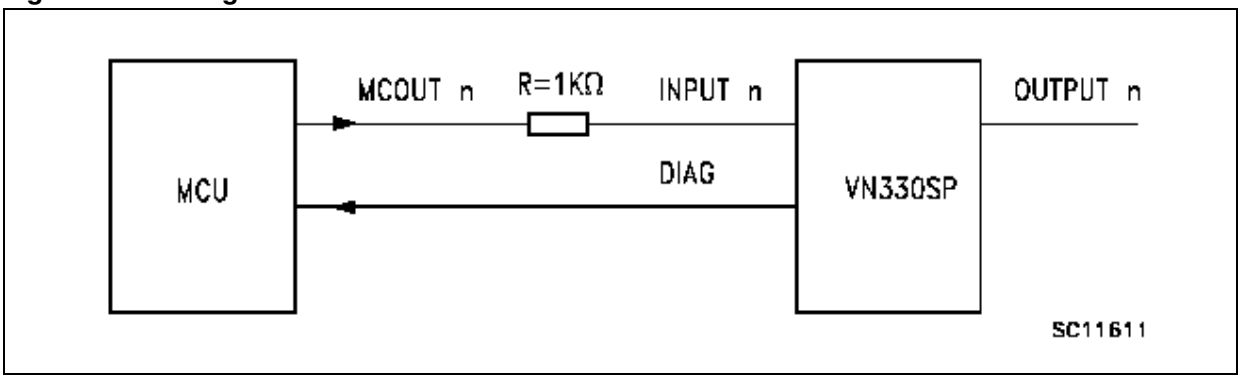


Figure 8. Driving circuit



6 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 8. PowerSO-10 Mechanical data

Dim	Mm			Inch		
	Min	Typ	Max	Min	Typ	Max
A	3.35		3.65	0.132		0.144
A1	0.00		0.10	0.000		0.004
B	0.40		0.60	0.016		0.024
c	0.23		0.32	0.009		0.012
D	9.40		9.60	0.370		0.378
D1	7.40		7.60	0.291		0.300
E	9.30		9.50	0.366		0.374
E1	7.20		7.40	0.283		0.291
E2	7.20		7.60	0.283		0.300
E3	6.10		6.35	0.240		0.250
E4	5.90		6.10	0.232		0.240
e		1.27			0.050	
F	1.25		1.35	0.049		0.053
H	13.80		14.40	0.543		0.567
h		0.50			0.002	
L	1.20		1.80	0.047		0.071
q		1.70			0.067	
a	0°		8°			

Figure 9. Package dimension

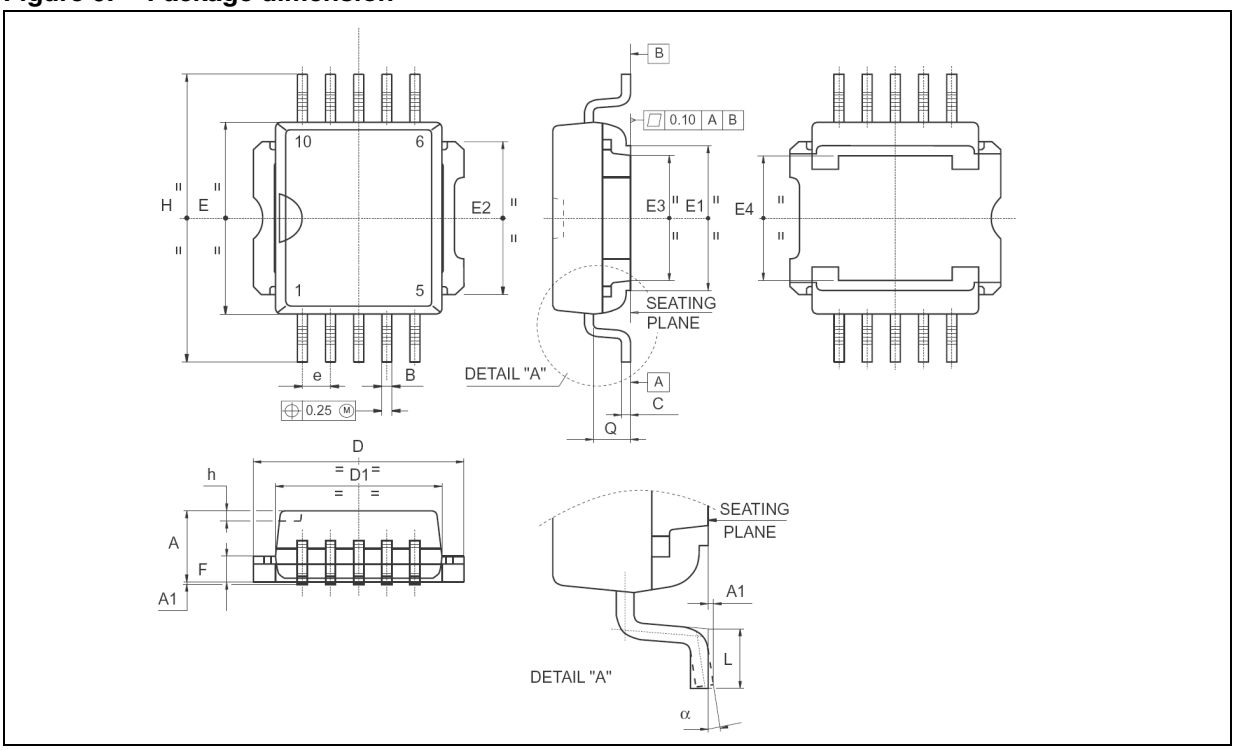
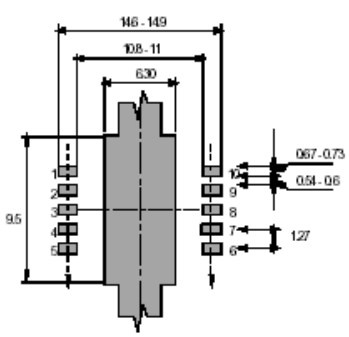
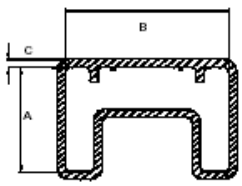
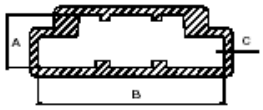


Figure 10. PowerSO-10™ Suggested Pad and Tube Shipment (No Suffix)





CASABLANCA

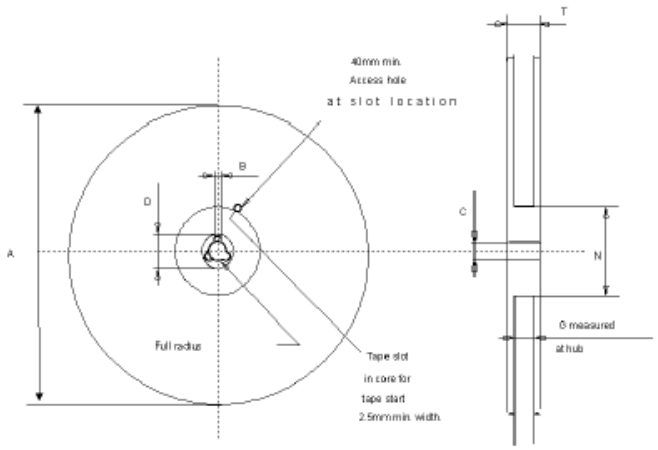


MUAR

All dimensions are in mm.

	Base Q.ty	Bulk Q.ty	Tube length (± 0.5)	A	B	C (± 0.1)
Casablanca	50	1000	532	10.4	16.4	0.8
Muar	50	1000	532	4.9	17.2	0.8

Figure 11. Tape and Reel Shipment (Suffix "TR")



REEL DIMENSIONS

Base Q.ty	600
Bulk Q.ty	600
A (max)	330
B (min)	1.5
C (± 0.2)	13
F	20.2
G (+ 2 / -0)	24.4
N (min)	60
T (max)	30.4

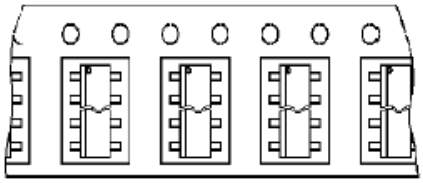
All dimensions are in mm.

TAPE DIMENSIONS

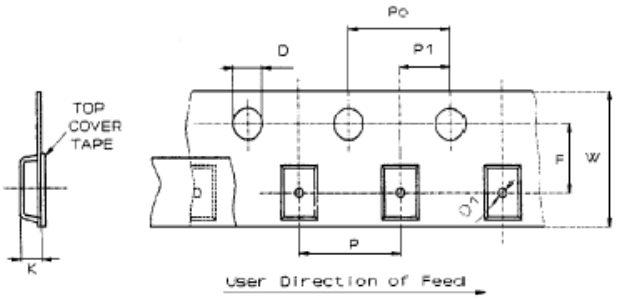
According to Electronic Industries Association (EIA) Standard 481 rev. A, Feb. 1986

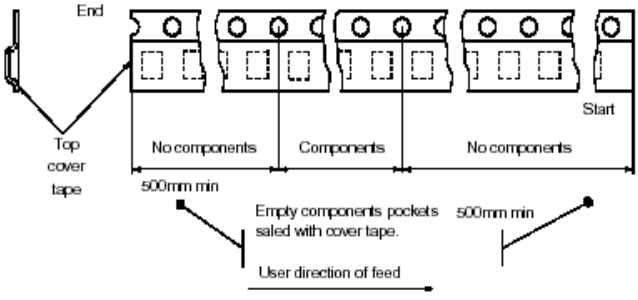
Tape width	W	24
Tape Hole Spacing	P0 (± 0.1)	4
Component Spacing	P	24
Hole Diameter	D (± 0.1/-0)	1.5
Hole Diameter	D1 (min)	1.5
Hole Position	F (± 0.05)	11.5
Compartment Depth	K (max)	6.5
Hole Spacing	P1 (± 0.1)	2

All dimensions are in mm.



User Direction of Feed





7 Order code

Table 9. Order code

Part number	Package	Packaging
VN330SP-E	PowerSO-10™	Tube
VN330SPTR-E	PowerSO-10™	Tape and reel

8 Revision history

Table 10. Revision history

Date	Revision	Changes
6-Sep-2005	1	Initial release
31-Oct-2006	2	Typo in Electrical characteristics temperature conditions updated *on page 5*
27-Mar-2007	3	Document reformatted, typo in *Note 1 on page 6*

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