



# VN330SP-32-E

## QUAD HIGH SIDE SMART POWER SOLID STATE RELAY

### General Features

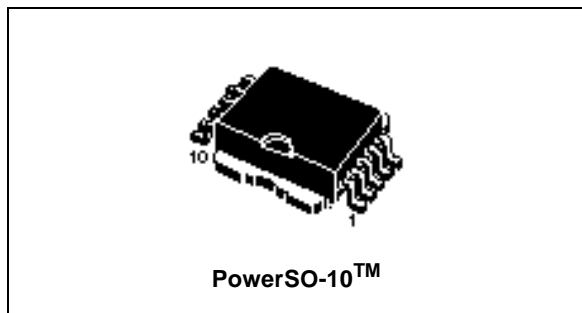
Type	V <sub>demag</sub> (*)	R <sub>DSon</sub> (*)	I <sub>out</sub> (*)	V <sub>CC</sub>
VN330SP-32-E	V <sub>CC</sub> -55V	0.32Ω(**)	1A	36V

(\*)Per channel.

(\*\*)at T<sub>J</sub> = 85 °C

### Features

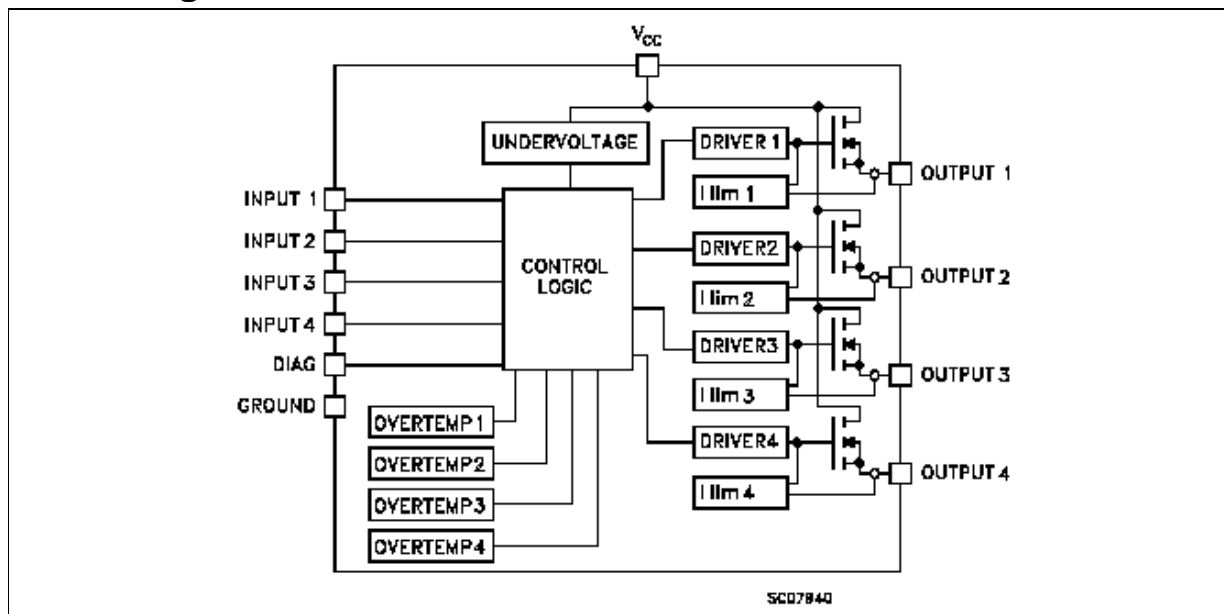
- OUTPUT CURRENT : 1A PER CHANNEL
- DIGITAL INPUT CLAMPED AT 32V MINIMUM VOLTAGE
- SHORTED LOAD AND OVER-TEMPERATURE PROTECTIONS
- BUILT-IN CURRENT LIMITER
- UNDERVOLTAGE SHUT-DOWN
- OPEN DRAIN DIAGNOSTIC OUTPUT
- FAST DEMAGNETIZATION OF INDUCTIVE LOADS



### Description

The VN330SP-32-E is a monolithic device made using STMicroelectronics VIPower Technology, intended for driving four independent 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 over-temperature conditions.

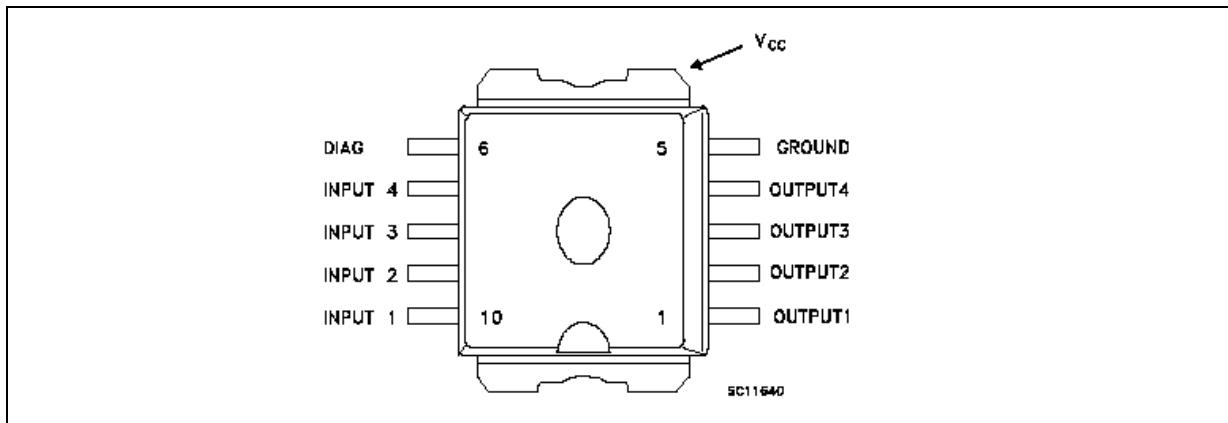
### Block Diagram



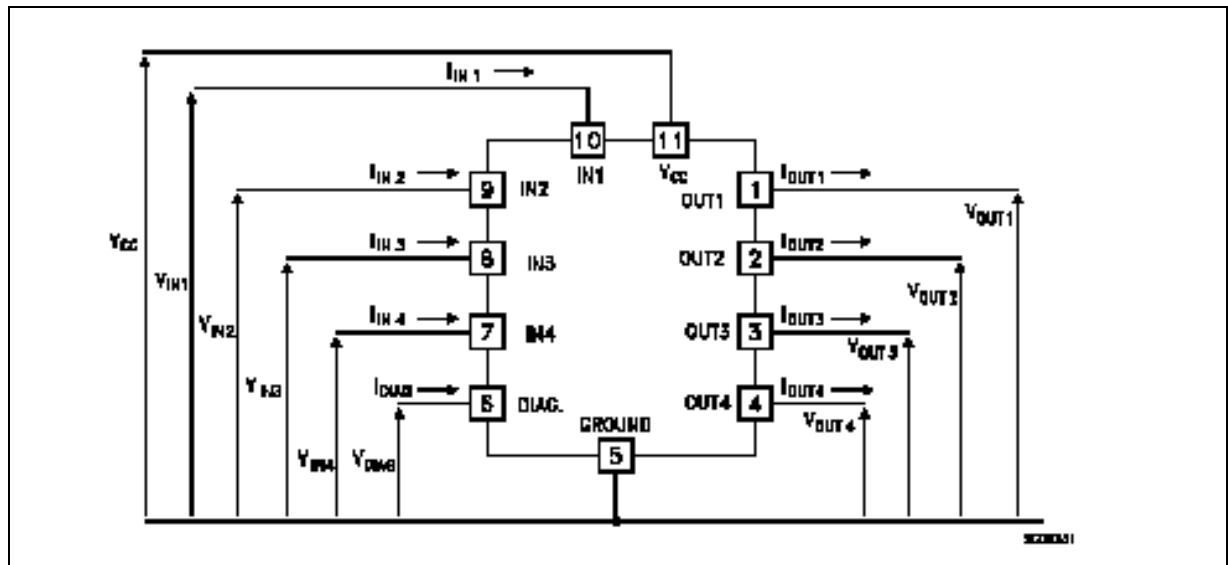
**Table 1. Absolute Maximum Rating**

Symbol	Parameter	Value	Unit
$V_{CC}$	Power supply voltage	45	V
$-V_{CC}$	Reverse supply voltage	-0.3	V
$I_{OUT}$	Output current (continuous)	Internally limited	A
$I_R$	Reverse output current (per channel)	-6	A
$I_{IN}$	Input current (per channel)	$\pm 10$	mA
$I_{DIAG}$	Diag pin current	$\pm 10$	mA
$V_{ESD}$	Electrostatic discharge (R = 1.5k $\Omega$ ; C = 100pF)	2000	V
$E_{AS}$	Single pulse avalanche energy per channel not simultaneously <i>Figure 3.</i>	400	mJ
$P_{tot}$	Power dissipation at $T_c \leq 25^\circ\text{C}$	Internally limited	W
$T_J$	Junction operating temperature	Internally limited	$^\circ\text{C}$
$T_{stg}$	Storage Temperature	-55 to 150	$^\circ\text{C}$

**Figure 1. Connection Diagram (Top View)**



**Figure 2. Current and Voltage Conventions**



**Table 2. Thermal data**

Symbol	Parameter		Max Value	Unit
R <sub>thJC</sub>	Thermal resistance junction-case ( <i>Note:1</i> )	Max	2	°C/W
R <sub>thJA</sub>	Thermal resistance junction-ambient ( <i>Note:2</i> )	Max	50	°C/W

*Note:* 1. Per channel

*Note:* 2. When mounted using minimum recommended pad size on FR-4 board

**Electrical Characteristics** (10V < V<sub>CC</sub> < 36V; -25°C < T<sub>J</sub> < 125°C; unless otherwise specified)

**Table 3. Power Section**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V <sub>CC</sub>	Supply voltage		10		36	V
R <sub>ON</sub>	On state resistance	I <sub>OUT</sub> = 0.5A; T <sub>J</sub> = 125°C I <sub>OUT</sub> = 0.5A; T <sub>J</sub> = 85°C I <sub>OUT</sub> = 0.5A; T <sub>J</sub> = 25°C			0.4 0.32 0.2	Ω Ω Ω
I <sub>S</sub>	Supply current	All channels OFF; V <sub>IN</sub> = 30V; On state; T <sub>J</sub> = 125°C I <sub>OUT1</sub> ...I <sub>OUT4</sub> = 0V			1 10	mA mA
V <sub>demag</sub>	Output voltage at turn-off	I <sub>OUT</sub> = 0.5A; L <sub>LOAD</sub> >= 1mH	V <sub>CC</sub> -65	V <sub>CC</sub> -55	V <sub>CC</sub> -45	V

**Table 4. Logical Input**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V <sub>IL</sub>	Input low level voltage				2	V
V <sub>IH</sub>	Input high level voltage .	<i>Note:3</i>	3.5			V
V <sub>I(HYST)</sub>	Input hysteresis voltage			0.5		V
I <sub>IN</sub>	Input current	V <sub>IN</sub> = 0 to 30V V <sub>IN</sub> = 0 to 2V	25		600	μA μA
I <sub>LGND</sub>	Output current in ground disconnection	V <sub>CC</sub> = V <sub>INn</sub> = GND = DIAG = 24V; T <sub>J</sub> = 25°C			25	mA
V <sub>ICL</sub>	Input clamp voltage <i>Note:3</i>	I <sub>IN</sub> = 1mA I <sub>IN</sub> = -1mA	32	36 -0.7		V V

*Note:* 3. The input voltage is internally clamped at 32V minimum, it is possible to connect the input pins to an higher voltage via an external resistor calculate to not exceed 10mA

**Table 5. 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 $< 0.1\mu s$ , $T_J = 25^\circ C$ $T_J = 125^\circ C$		30	40 60	$\mu s$ $\mu s$
$t_r$	Rise time of Output current	$I_{OUT} = 0.5A$ , Resistive Load Input rise time $< 0.1\mu s$ , $T_J = 25^\circ C$ $T_J = 125^\circ C$		50	100 115	$\mu s$ $\mu s$
$t_{d(OFF)}$	Turn-off delay time of Output current	$I_{OUT} = 0.5A$ , Resistive Load Input rise time $< 0.1\mu s$ , $T_J = 25^\circ C$ $T_J = 125^\circ C$		20	30 40	$\mu s$ $\mu s$
$t_f$	Fall time of Output current	$I_{OUT} = 0.5A$ , Resistive Load Input rise time $< 0.1\mu s$ , $T_J = 25^\circ C$ $T_J = 125^\circ C$		8	15 20	$\mu s$ $\mu s$
$(di/dt)_{on}$	Turn-on current slope	$I_{OUT} = 0.5A$ , $I_{OUT} = I_{LIM}$ , $T_J = 25^\circ C$			0.5 2	$A/\mu s$ $A/\mu s$
$(di/dt)_{off}$	Turn-off current slope	$I_{OUT} = 0.5A$ , $I_{OUT} = I_{LIM}$ , $T_J = 25^\circ C$			2 4	$A/\mu s$ $A/\mu s$

**Table 6. Protections**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{DIAG}^*$	Status voltage output low	$I_{DIAG} = 5mA$ ( Fault condition )			1	V
$V_{SCL}^*$	Status clamp voltage	$I_{DIAG} = 1mA$ $I_{DIAG} = -1mA$	32	36 -0.7		V V
$V_{USD}$	Undervoltage shut down		5		8	V
$I_{LIM}$	DC Short circuit current	$V_{CC} = 24V$ ; $R_{LOAD} < 10m\Omega$	1		2.5	A
$I_{OVPK}$	Peak short circuit current	$V_{CC} = 24V$ ; $V_{IN} = 30V$ ; $R_{LOAD} < 10m\Omega$			4	A
$I_{DIAGH}$	Leakage on diag pin in high state	$V_{DIAG} = 24V$			100	$\mu A$
$I_{LOAD}$	Output leakage current	$V_{CC} = 10$ to $36V$ ; $V_{IN} = V_{IL}$ 4 Channels in Parallel			25	$\mu A$
$t_{SC}$	Delay time of current limiter				100	$\mu s$
$T_{TSD}$	Thermal shut down temperature		150	170		$^\circ C$
$T_R$	Thermal reset temperature		135	155		$^\circ C$

(\*)Status determination  $> 100ms$  after the switching edge.

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

Figure 3. Avalance Energy Test Circuit

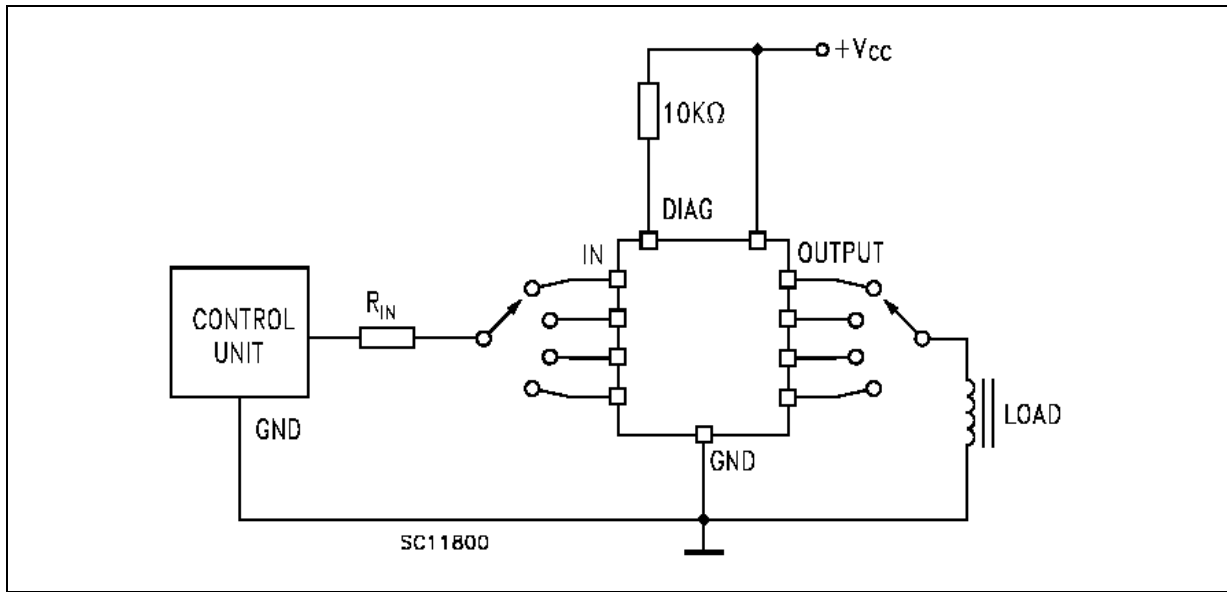
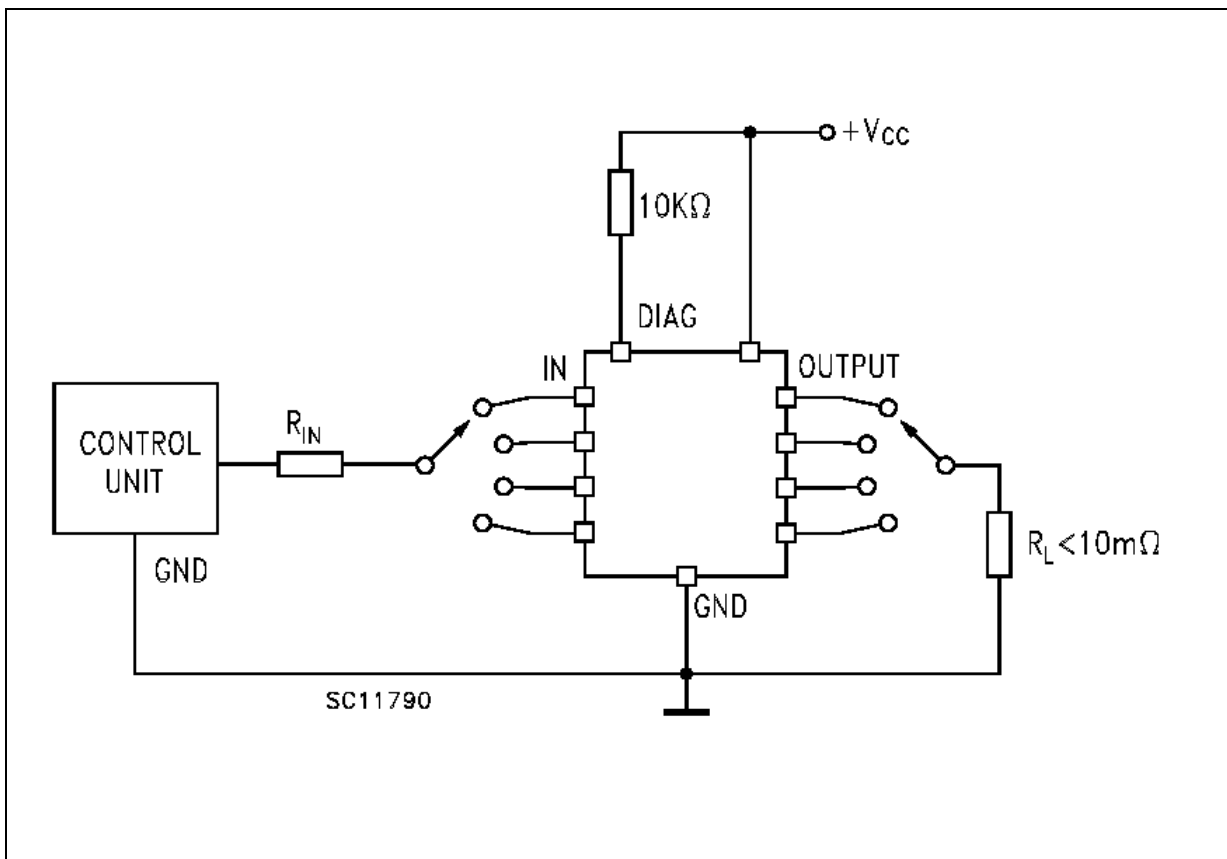


Figure 4. Peak Short Circuit Test Diagram



**Table 7. Truth Table**

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

**Figure 5. Switching Waveforms**

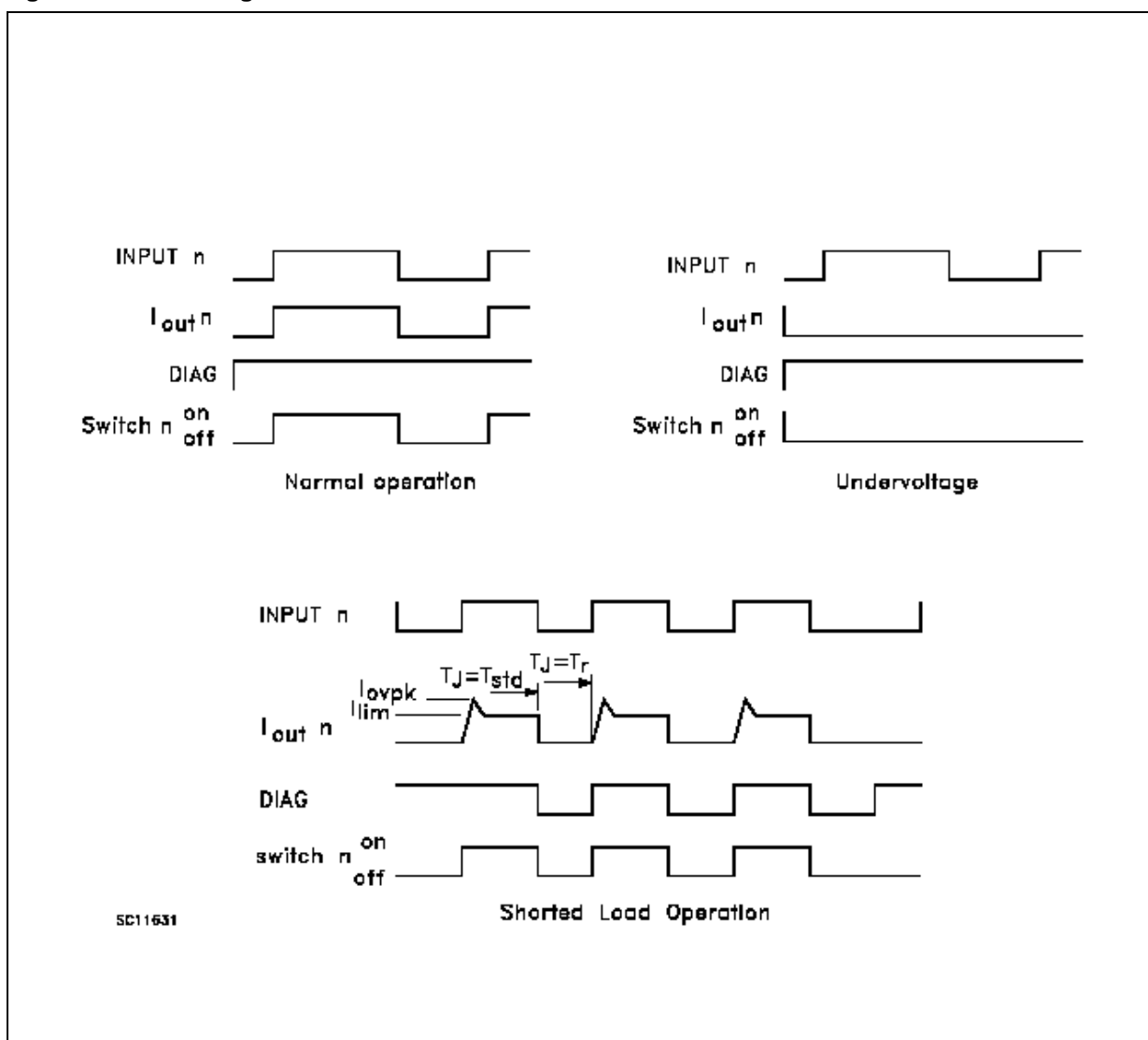


Figure 6. Switching Parameter Test Conditions

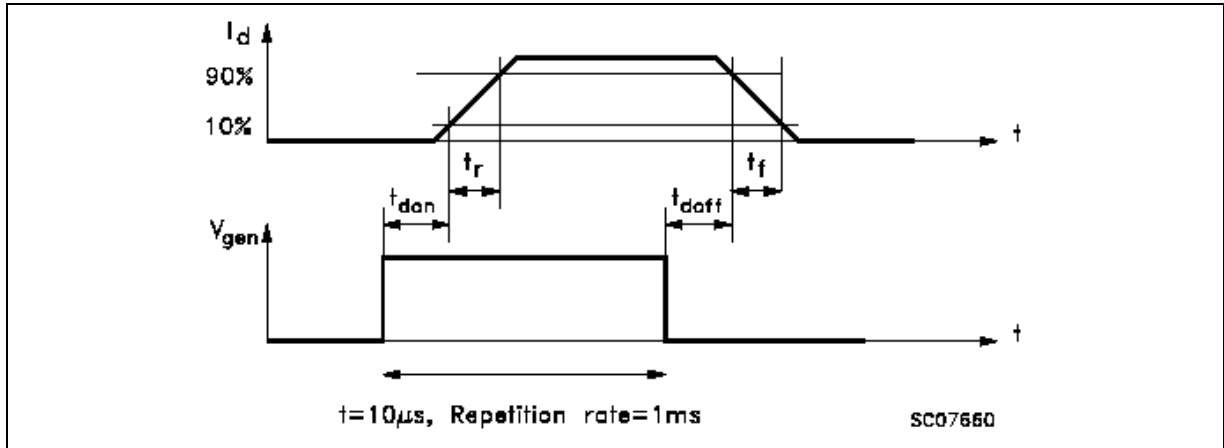
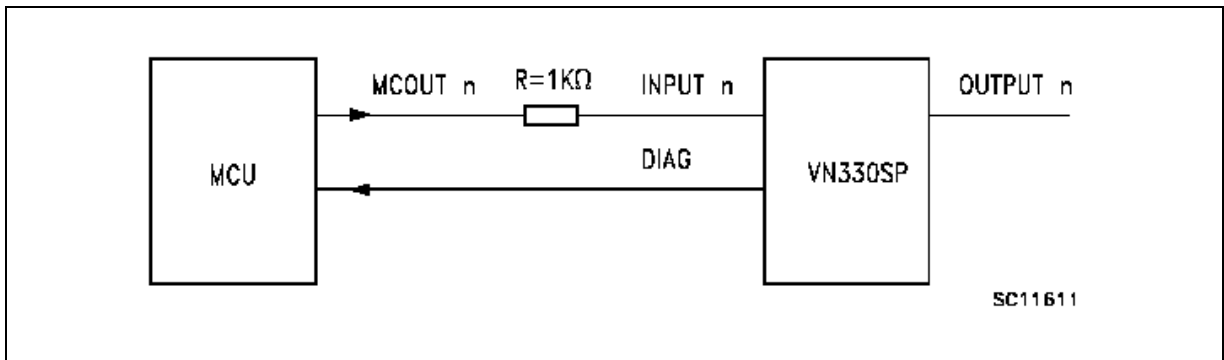


Figure 7. Driving Circuit



PowerSO-10™ Thermal Data

Figure 8. PowerSO-10™ PC Board

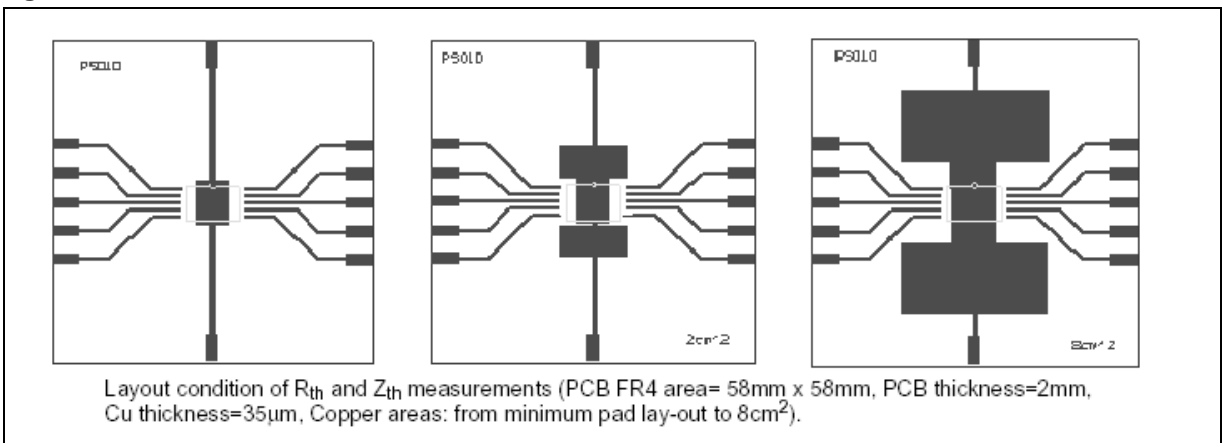
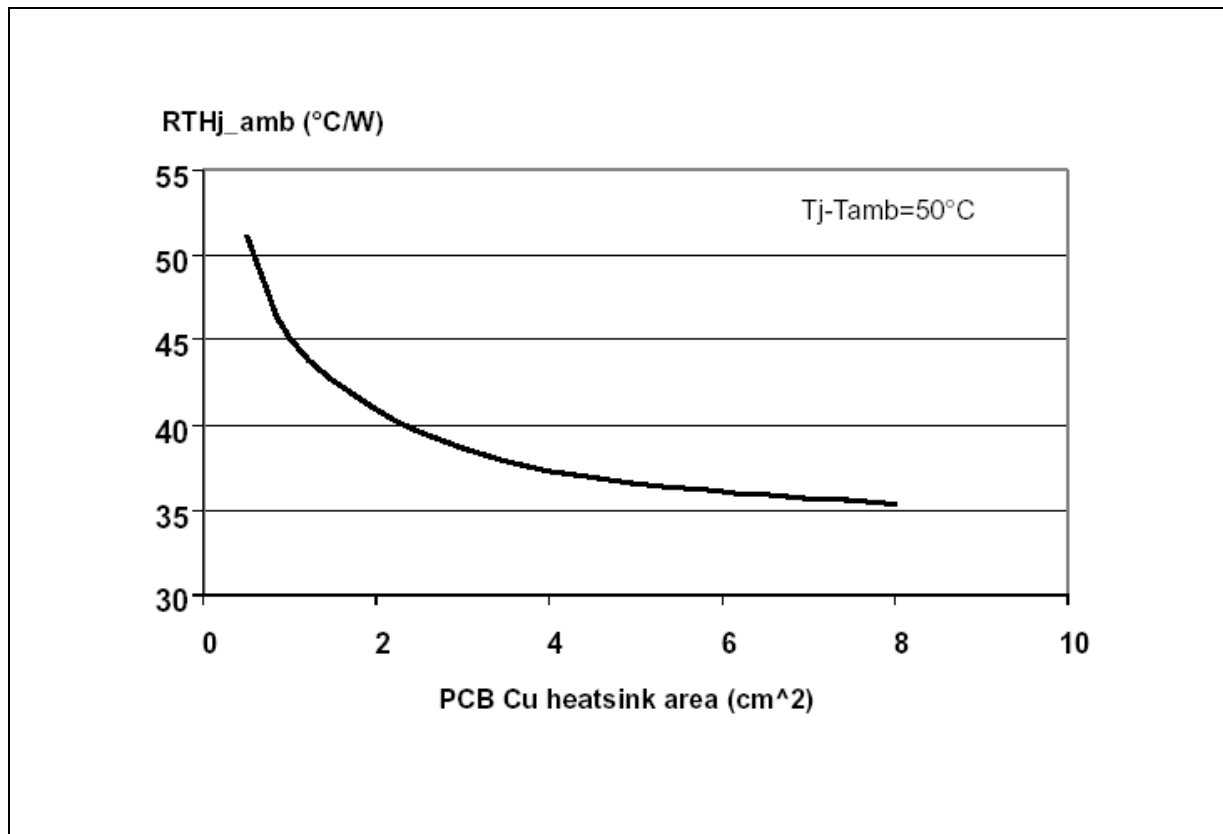


Figure 9.  $R_{thJA}$  Vs. PCB copper area in open box free air condition



## Mechanical Data

In order to meet environmental requirements, ST offers these devices in ECOPACK<sup>®</sup> 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](http://www.st.com)

Table 8. PowerSO-10™ Mechanical Data

Symbol	millimeters		
	Min	Typ	Max
A	3.35		3.65
A (*)	3.4		3.6
A1	0.00		0.10
B	0.40		0.60
B (*)	0.37		0.53
C	0.35		0.55
C (*)	0.23		0.32
D	9.40		9.60
D1	7.40		7.60
E	9.30		9.50
E2	7.20		7.60
E2 (*)	7.30		7.50
E4	5.90		6.10
E4 (*)	5.90		6.30
e		1.27	
F	1.25		1.35
F (*)	1.20		1.40
H	13.80		14.40
H (*)	13.85		14.35
h		0.50	
L	1.20		1.80
L (*)	0.80		1.10
a	0°		8°
α (*)	2°		8°

Note: (\*) Muar only POA P013P

Figure 10. PowerSO-10™ Package Dimensions

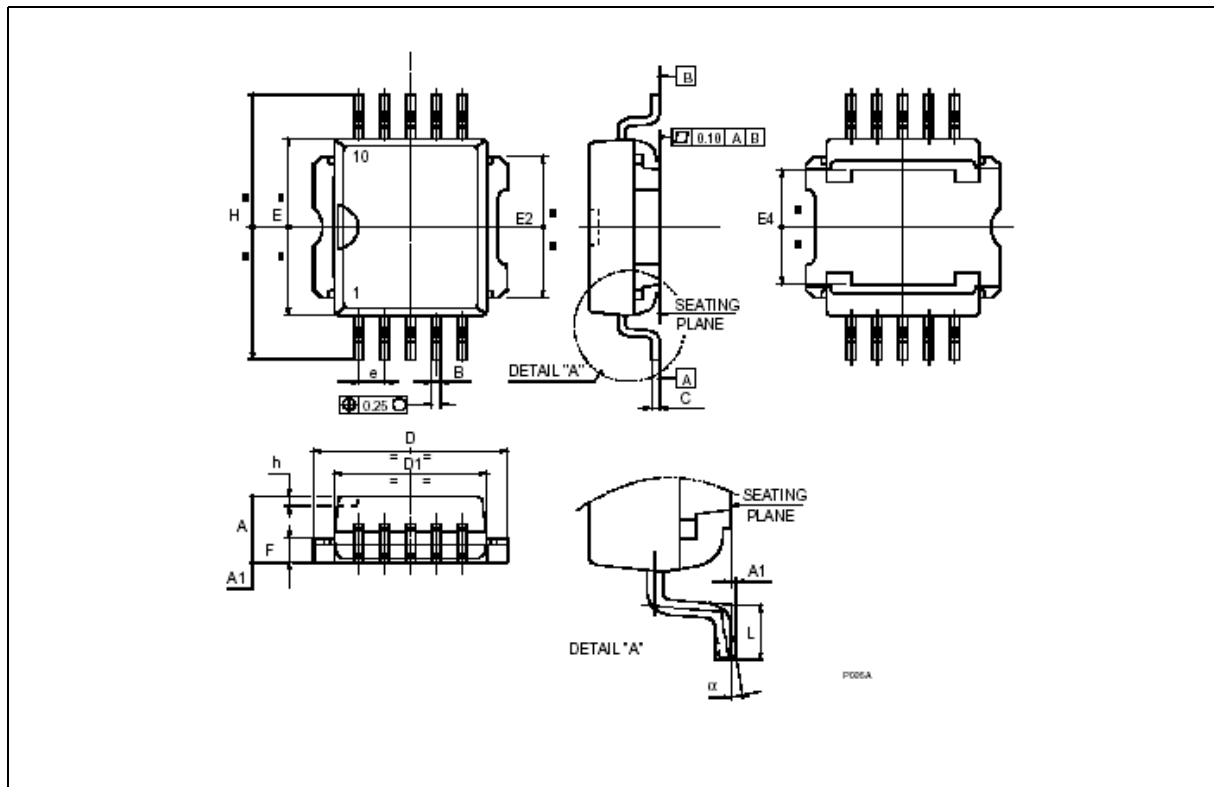


Figure 11. PowerSO-10™ Suggested Pad and Tube Shipment (No Suffix)

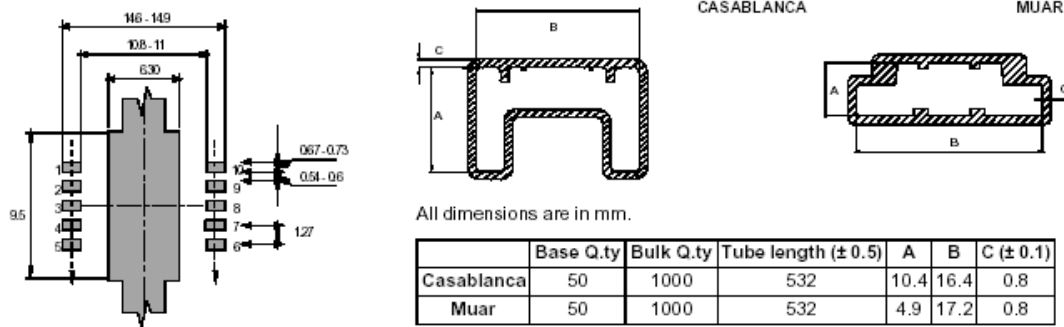
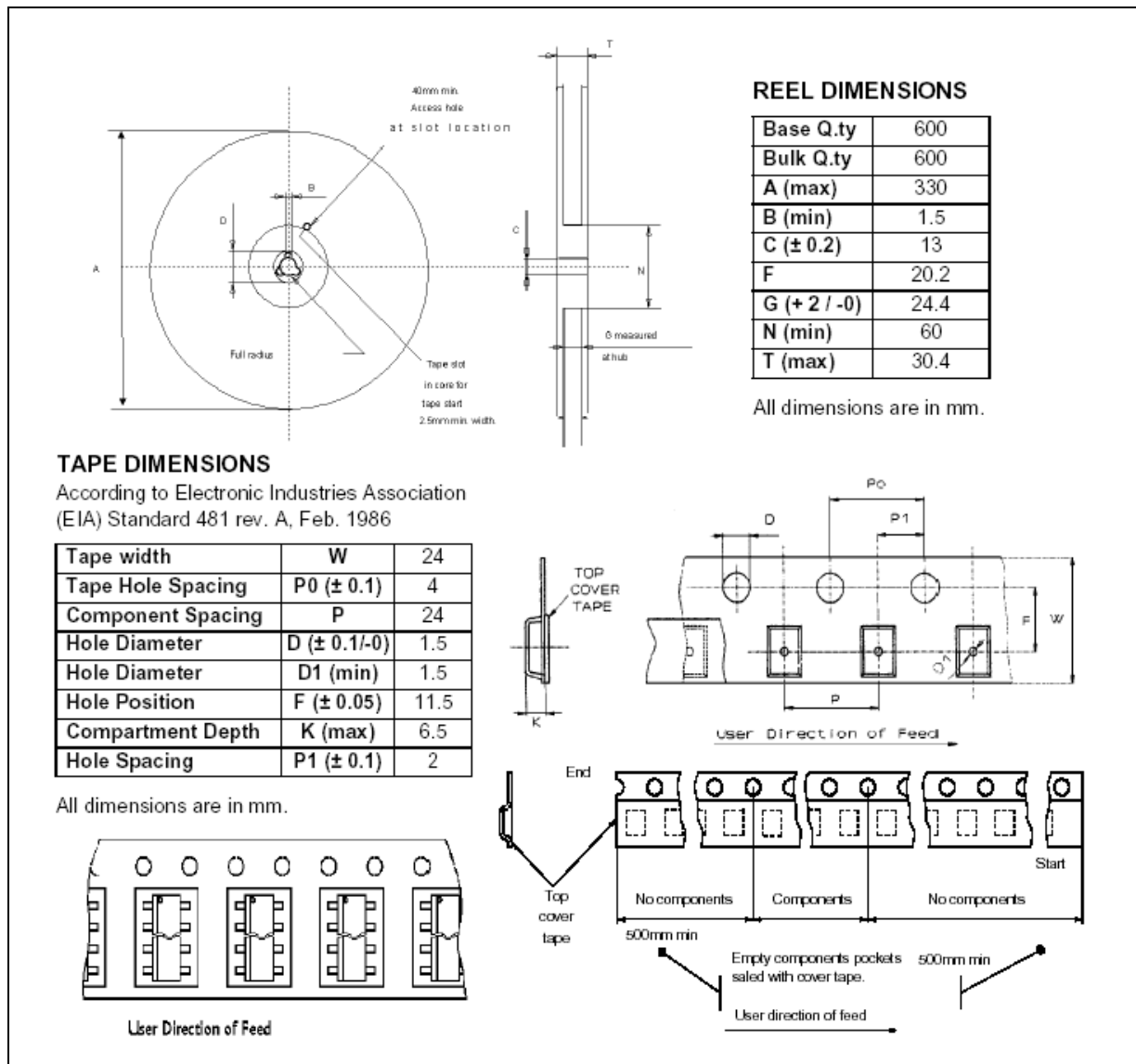


Figure 12. Tape and Reel Shipment (Suffix “TR”)



**Table 9. Order Codes**

Package	Tube	Tape and Reel
PowerSO-10™	VN330SP-32-E	VN330SPTR-32-E

Table 10. Revision History

Date	Revision	Changes
5-Sep-2005	3	Final release

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