



VN330SP-32-E

QUAD HIGH SIDE SMART POWER SOLID STATE RELAY

General Features

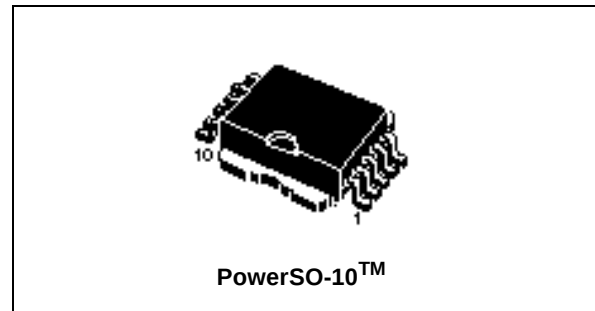
Type	$V_{\text{demag}}^{(*)}$	$R_{\text{DSon}}^{(*)}$	$I_{\text{out}}^{(*)}$	V_{CC}
VN330SP-32-E	$V_{\text{CC}}-55\text{V}$	$0.32\Omega^{(**)}$	1A	36V

(*)Per channel.

(**)at $T_J = 85^\circ\text{C}$

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

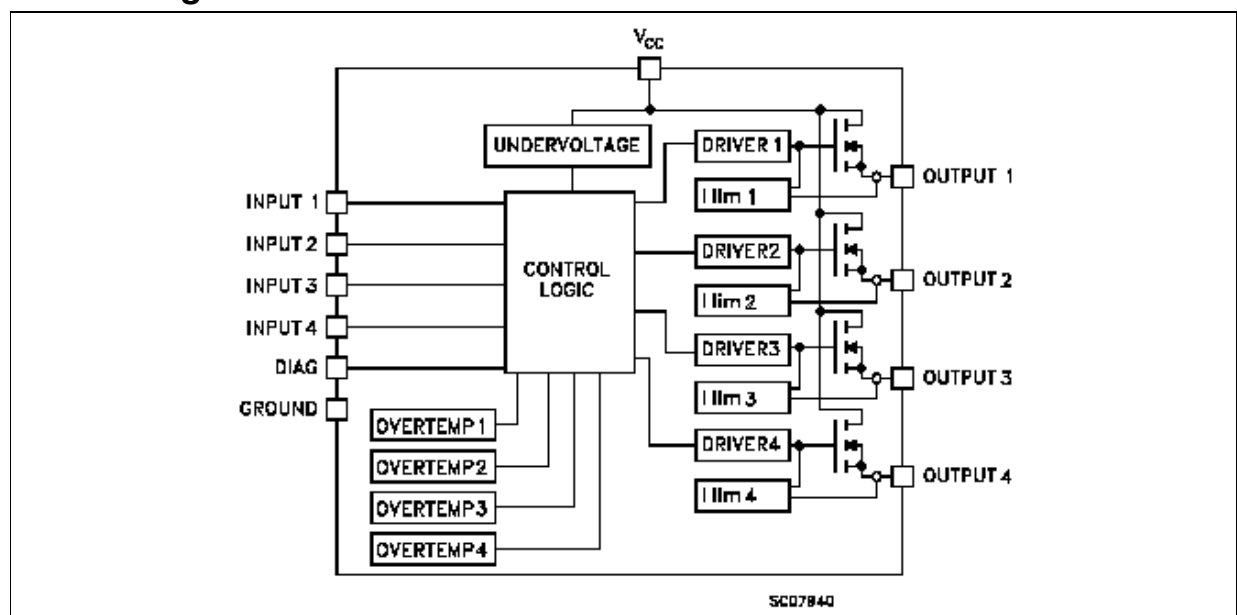


Table 1. Absolute Maximum Rating

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)	± 10	mA
I_{DIAG}	Diag pin current	± 10	mA
V_{ESD}	Electrostatic discharge ($R = 1.5k\Omega$; $C = 100pF$)	2000	V
E_{AS}	Single pulse avalanche energy per channel not simultaneously Figure 3.	400	mJ
P_{tot}	Power dissipation at $T_c \leq 25^\circ C$	Internally limited	W
T_J	Junction operating temperature	Internally limited	$^\circ C$
T_{stg}	Storage Temperature	-55 to 150	$^\circ C$

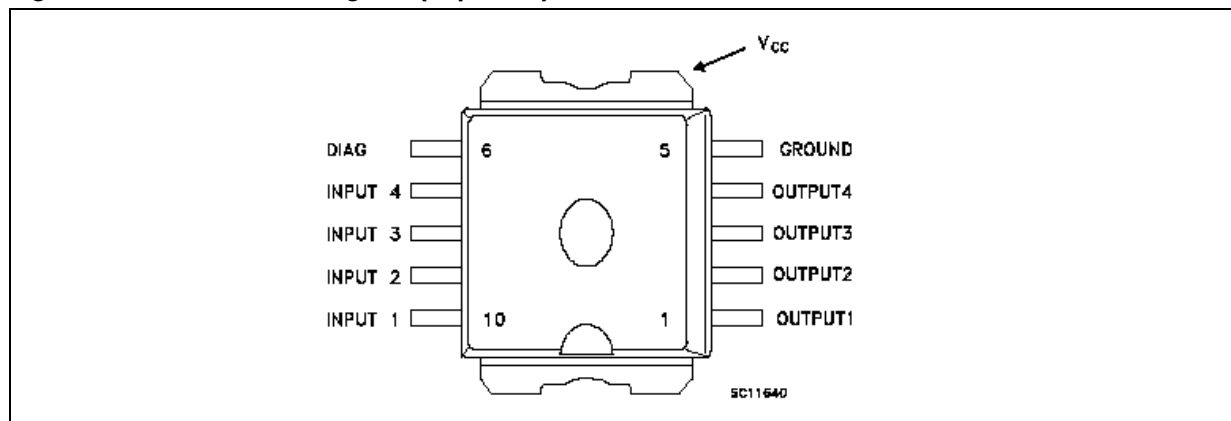
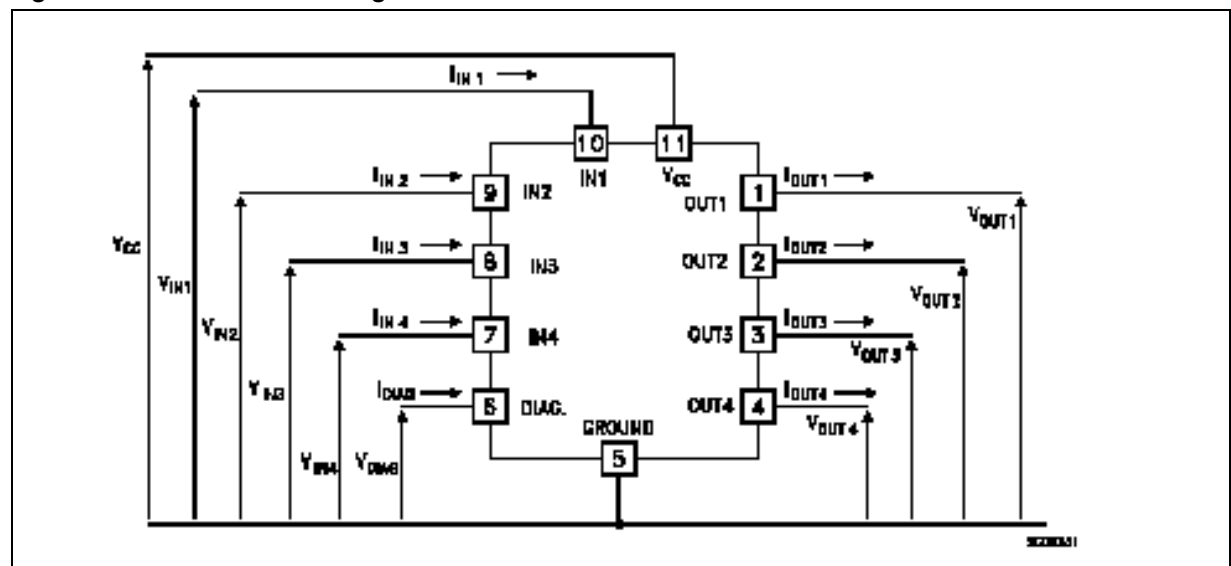
Figure 1. Connection Diagram (Top View)**Figure 2. Current and Voltage Conventions**

Table 2. Thermal data

Symbol	Parameter		Max Value	Unit
R_{thJC}	Thermal resistance junction-case (<i>Note:1</i>)	Max	2	°C/W
R_{thJA}	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_{CC} < 36V; -25°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	$I_{OUT} = 0.5A$; $T_J = 125^\circ C$ $I_{OUT} = 0.5A$; $T_J = 85^\circ C$ $I_{OUT} = 0.5A$; $T_J = 25^\circ C$			0.4 0.32 0.2	Ω Ω Ω
I_S	Supply current	All channels OFF; $V_{IN} = 30V$; On state; $T_J = 125^\circ C$ $I_{OUT1}...I_{OUT4} = 0V$			1 10	mA mA
V_{dema}	Output voltage at turn-off	$I_{OUT} = 0.5A$; $L_{LOAD} \geq 1mH$	$V_{CC}-65$	$V_{CC}-55$	$V_{CC}-45$	V

Table 4. Logical Input

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{IL}	Input low level voltage				2	V
V_{IH}	Input high level voltage .	<i>Note:3</i>	3.5			V
$V_{I(HYST)}$	Input hysteresis voltage			0.5		V
I_{IN}	Input current	$V_{IN} = 0$ to 30V $V_{IN} = 0$ to 2V	25		600	μA μA
I_{LGND}	Output current in ground disconnection	$V_{CC} = V_{INn} = GND = DIAG = 24V$; $T_J = 25^\circ C$			25	mA
V_{ICL}	Input clamp voltage <i>Note:3</i>	$I_{IN} = 1mA$ $I_{IN} = -1mA$	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	μs μs
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	μs μs
$t_{d(OFF)}$	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	μs μs
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	μs μs
$(di/dt)_{on}$	Turn-on current slope	$I_{OUT} = 0.5A$, $I_{OUT} = I_{LIM}$, $T_J = 25^\circ C$			0.5 2	A/ μs A/ μs
$(di/dt)_{off}$	Turn-off current slope	$I_{OUT} = 0.5A$, $I_{OUT} = I_{LIM}$, $T_J = 25^\circ C$			2 4	A/ μs A/ μs

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	μA
I_{LOAD}	Output leakage current	$V_{CC} = 10$ to $36V$; $V_{IN} = V_{IL}$ 4 Channels in Parallel			25	μA
t_{SC}	Delay time of current limiter				100	μs
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. Avalanche Energy Test Circuit

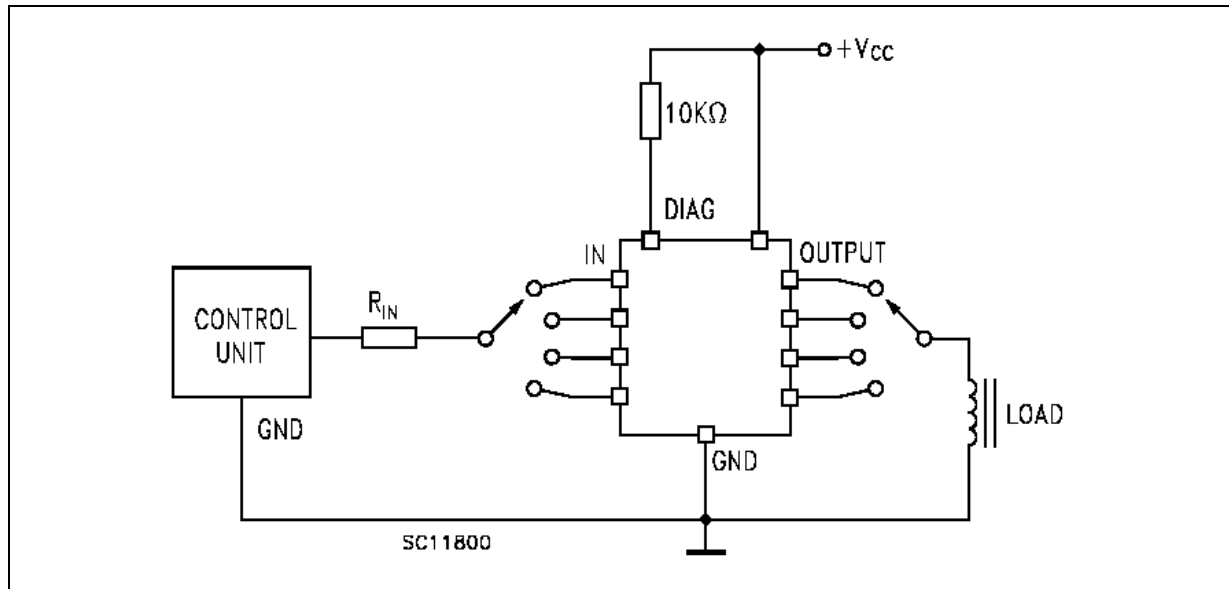


Figure 4. Peak Short Circuit Test Diagram

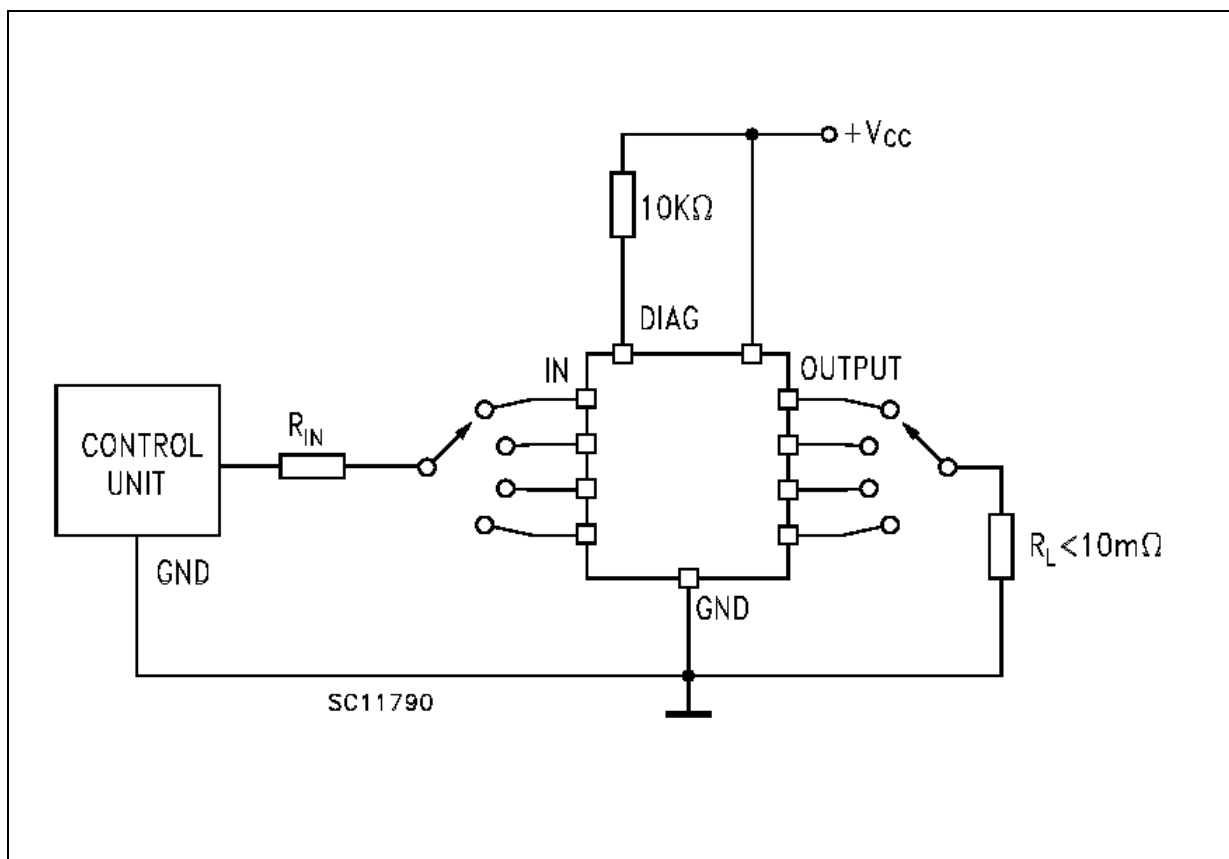


Table 7. Truth Table

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

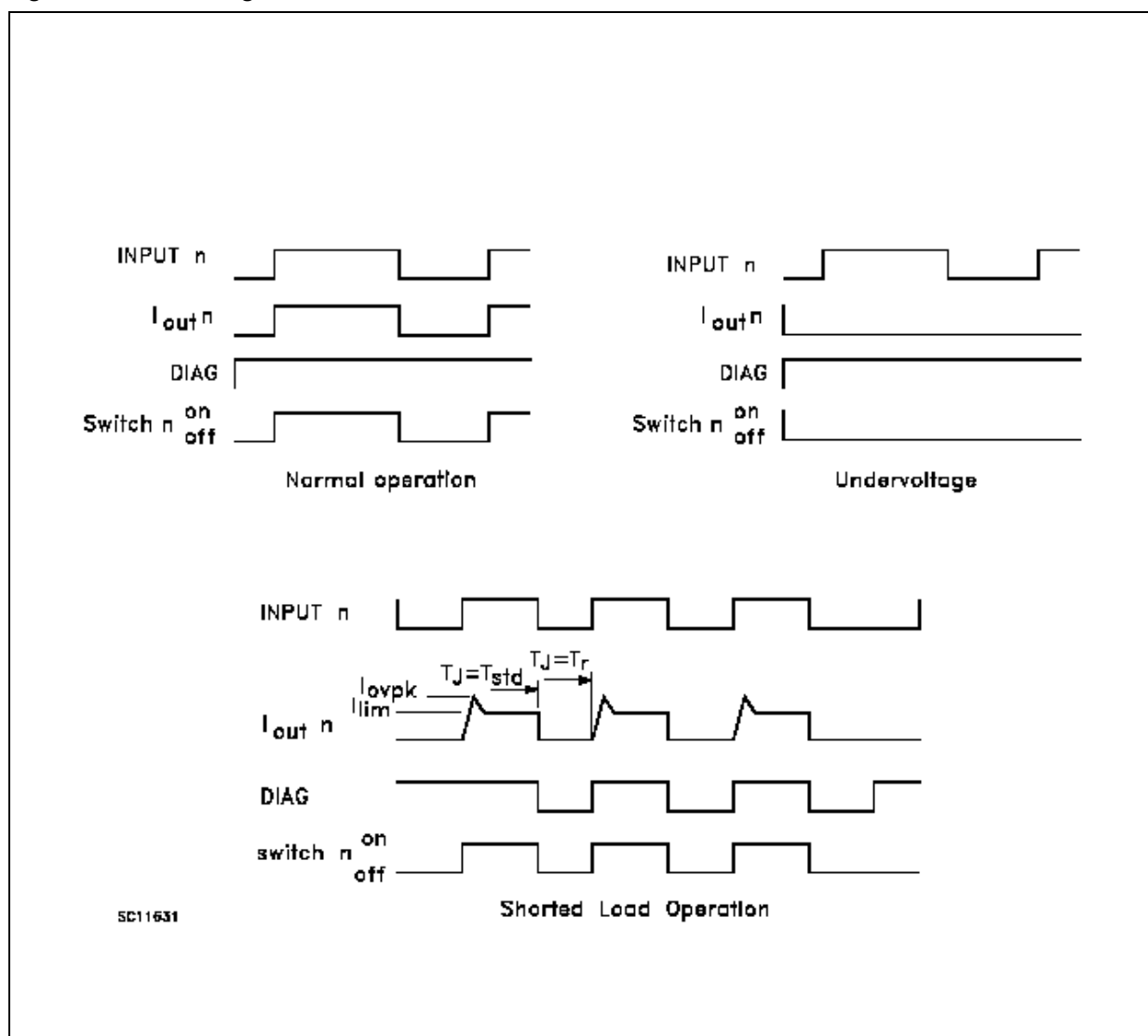


Figure 6. Switching Parameter Test Conditions

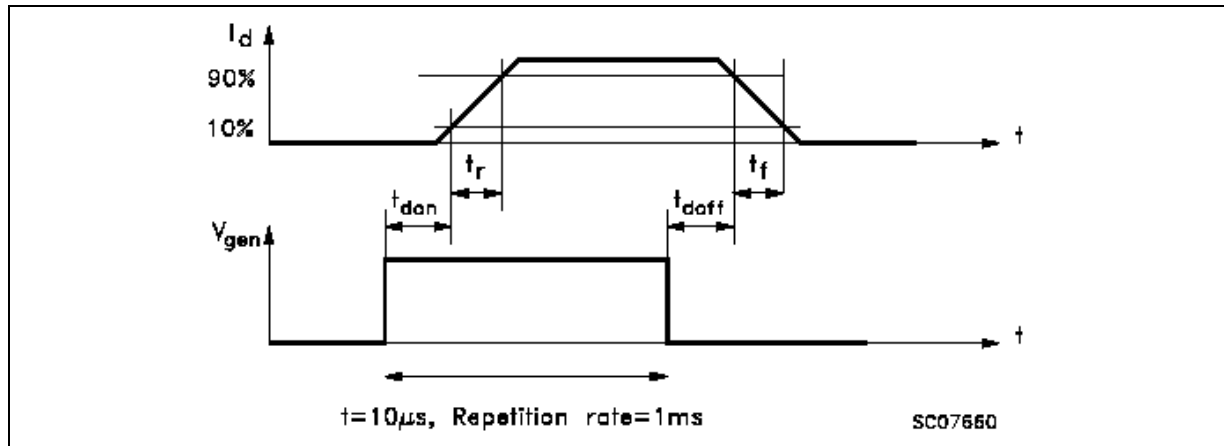
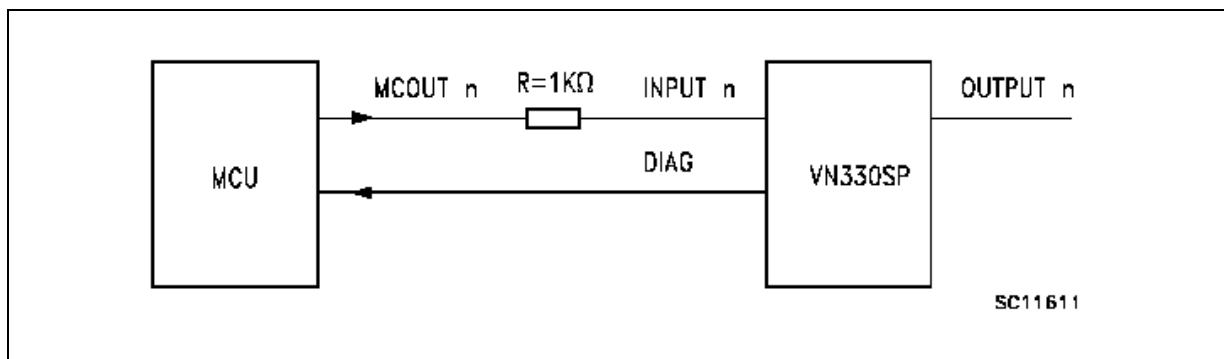


Figure 7. Driving Circuit



PowerSO-10™ Thermal Data

Figure 8. PowerSO-10™ PC Board

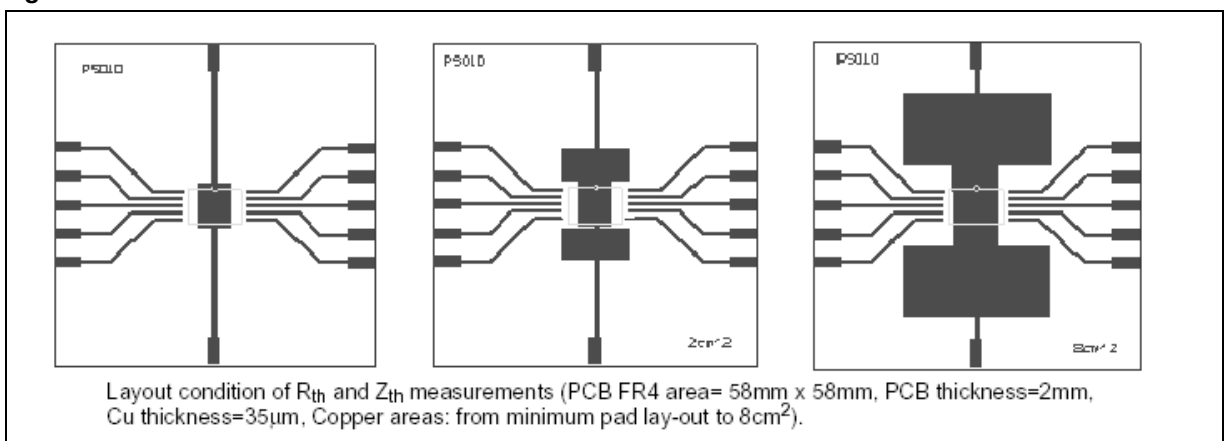
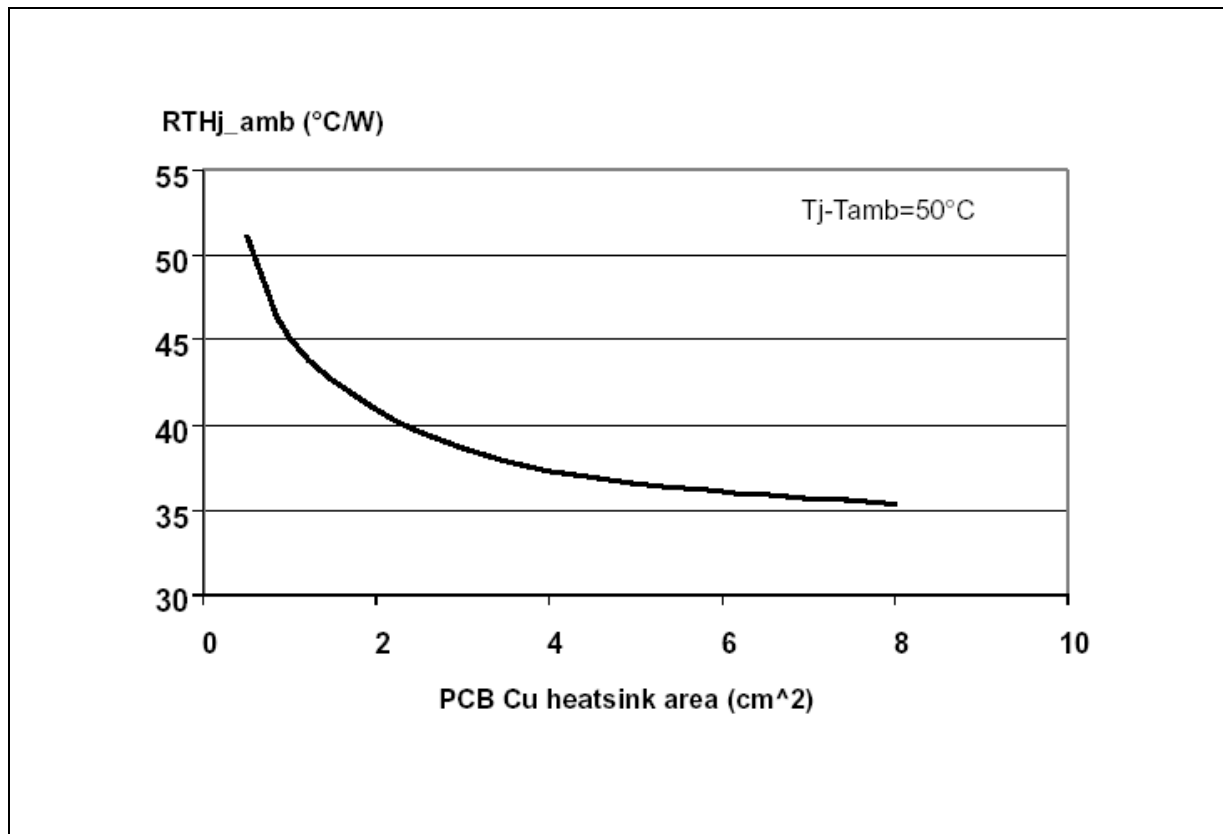


Figure 9. R_{thJA} Vs. PBC copper area in open box free air condition



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

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

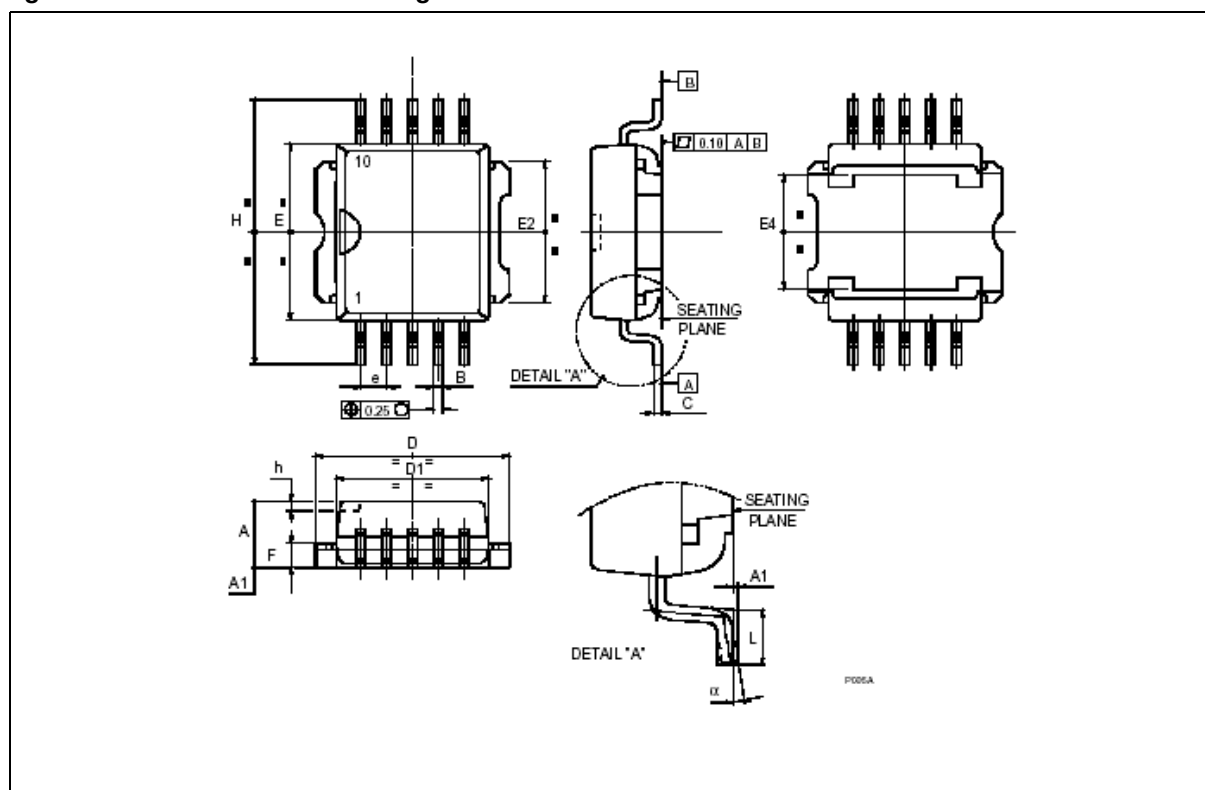


Figure 11. PowerSO-10™ Suggested Pad and Tube Shipment (No Suffix)

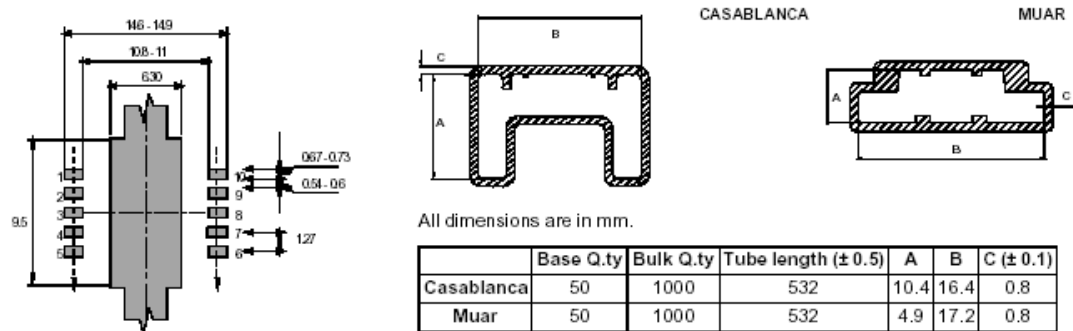


Figure 12. Tape and Reel Shipment (Suffix “TR”)

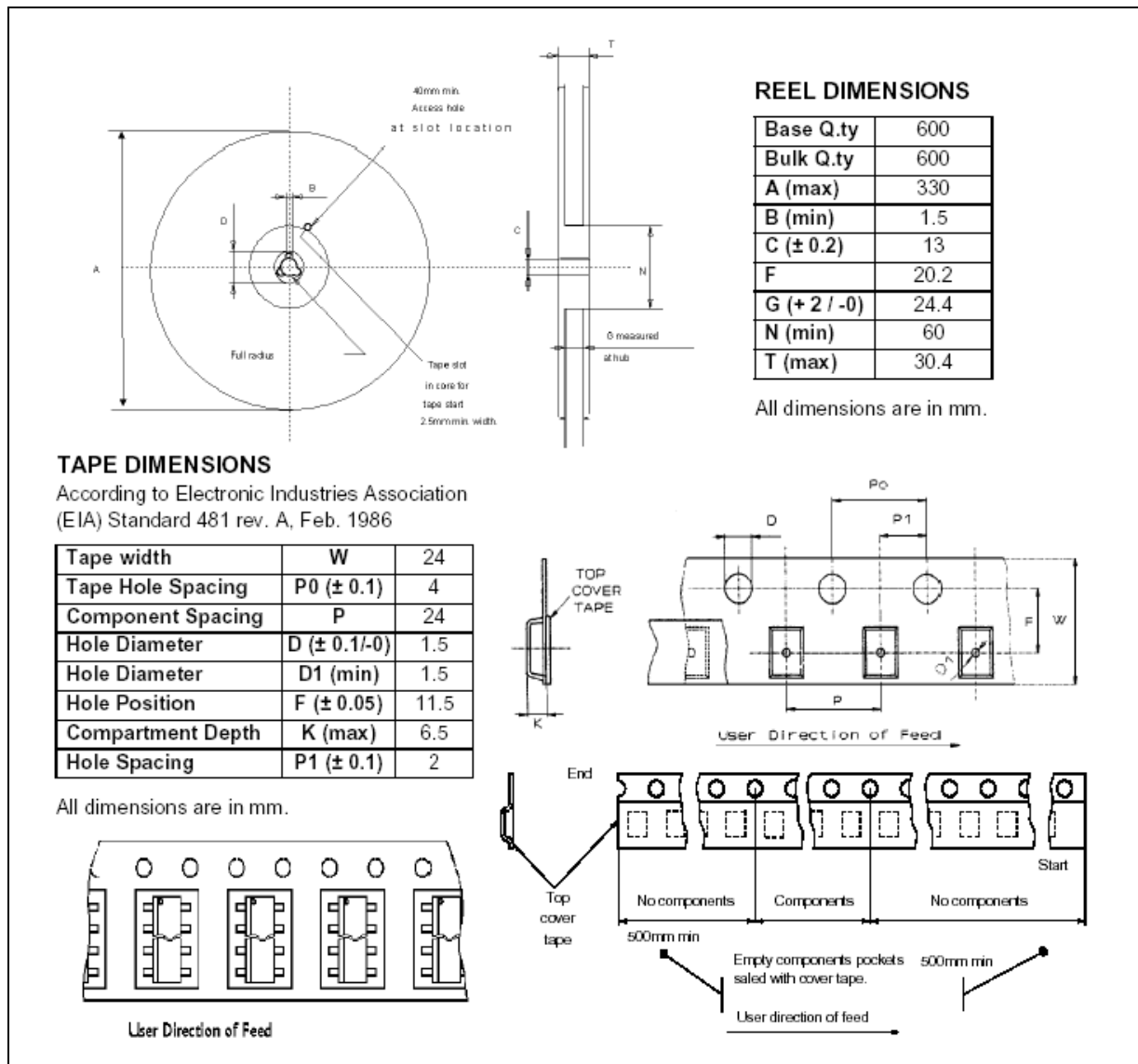


Table 9. Order Codes

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

Table 10. Revision History

Date	Revision	Changes
5-Sep-2005	3	Final release

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