

Three channel high side smart solid state relay

Features

Type	Channel	R _{DS(on)}	I _{OUT}	V _{CC}
VN450	1 & 2	40 mΩ	10 A	36 V
	3	300 mΩ	2 A	36 V

- Output current (continuous):
10 A (channel 1,2) at T_C = 25 °C
2 A (channel 3) at T_C = 25 °C
- 5 V logic level compatible inputs
- Under voltage shut-down
- Over voltage shut-down
- Thermal shut-down
- Open drain diagnostic outputs
- Very low stand-by power dissipation



Description

The VN450 is a monolithic device made using STMicroelectronics vertical intelligent power technology, intended for driving resistive or inductive loads with one side connected to ground. This device has three independent channels and three diagnostics.

Built-in thermal shut-down protects the chip from over temperature and short circuit.

The control inputs are 5 V CMOS logic level compatible.

The open drain diagnostic outputs indicate shortcircuit (no load) and over temperature status.

Table 1. Device summary

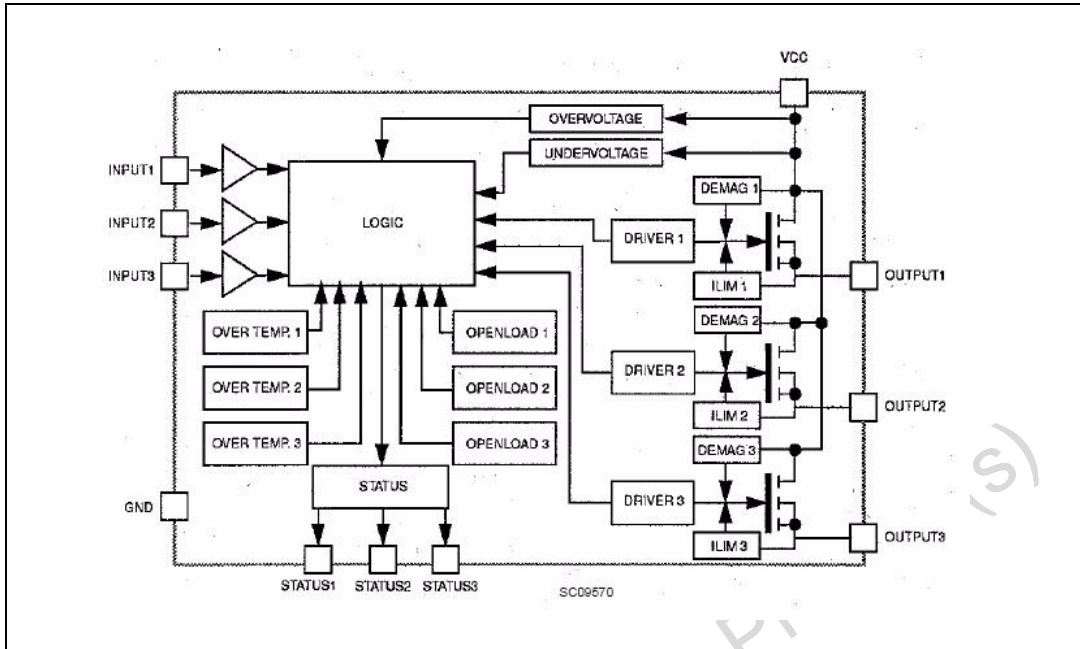
Order code	Package	Packing
VN450	Power SO-20	Tube

Contents

1	Block diagram	3
2	Pin description	4
3	Electrical specification	5
3.1	Electrical transients requirements	5
3.2	Absolute maximum ratings	6
3.3	Thermal data	7
3.4	Electrical characteristics	7
4	Package information	11
5	Revision history	12

1 Block diagram

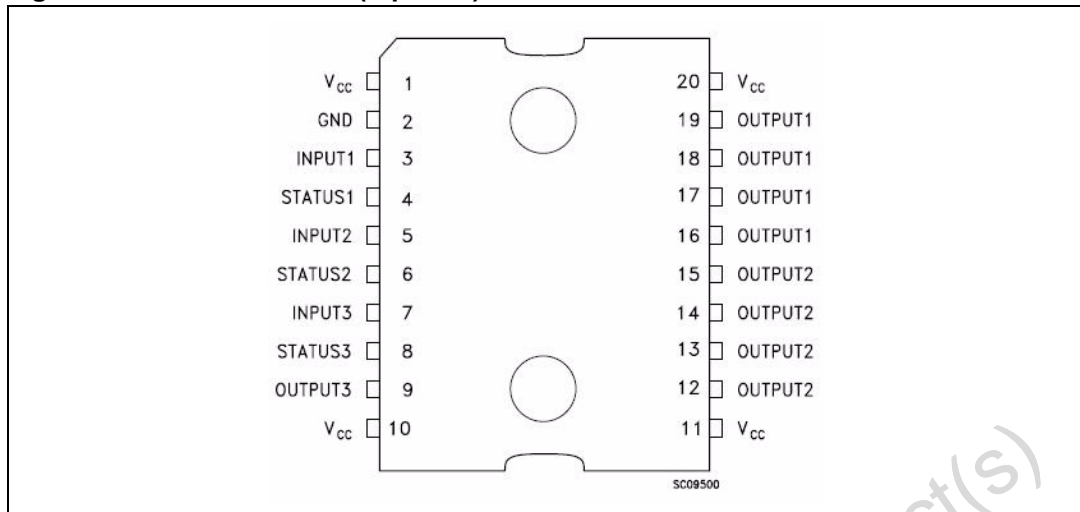
Figure 1. Block diagram



Obsolete Product(s) - Obsolete Product(s)

2 Pin description

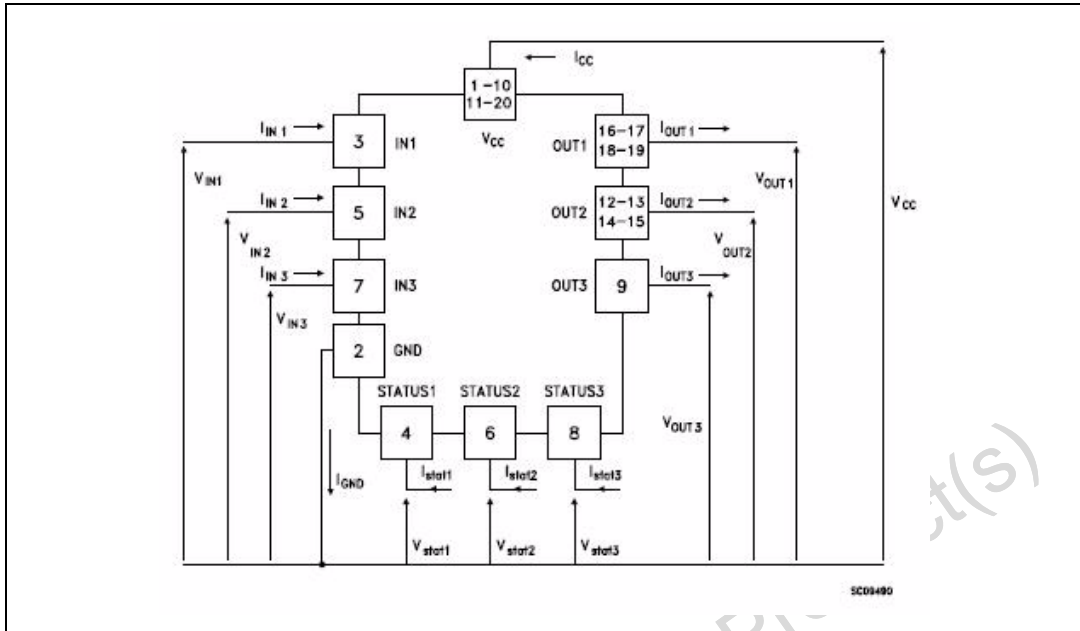
Figure 2. Pin connection (top view)



Obsolete Product(s) - Obsolete Product(s)

3 Electrical specification

Figure 3. Current and voltage conventions



3.1 Electrical transients requirements

Table 2. Electrical transients requirements (part 1)

ISO T/R 7637/1 Test pulse	Test levels				Delays and impedance
	I	II	III	IV	
1	-25 V	-50 V	-75 V	-100 V	2 ms, 10 Ω
2	+25 V	+50 V	+75 V	+100 V	0.2 ms, 10 Ω
3a	-25 V	-50 V	-100 V	-150 V	0.1 μ s, 50 Ω
3b	+25 V	+50 V	+75 V	+100 V	0.1 μ s, 50 Ω
4	-4 V	-5 V	-6 V	-7 V	100 ms, 0.01 Ω
5	+26.5 V	+46.5 V	+66.5 V	+86.5 V	400 ms, 2 Ω

Table 3. Electrical transients requirements (part 2)

ISO T/R 7637/1 Test pulse	Test levels results				
	I	II	III	IV	
1	C	C	C	C	
2	C	C	C	C	
3a	C	C	C	C	
3b	C	C	C	C	
4	C	C	C	C	
5	C	E	E	E	

With a series resistor ≥ 1 K Ω in input and status pins.

Table 4. Electrical transients requirements (part 3)

Class	Contents
C	All function of the device are performed as designed after exposure to disturbance.
E	One or more functions of the device is not performed as designed after exposure and cannot be returned to proper operation without replacing the device.

3.2 Absolute maximum ratings

Table 5. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage (continuous)	45	V
$-V_{CC}$	Reverse supply voltage (continuous)	-0.3	V
$-I_{gnd}$	Reverse ground current	-200	mA
$I_{OUT\ 1,2}$	Output current (continuous), channels 1, 2	10	A
$I_{OUT\ 3}$	Output current (continuous), channels 3	2.5	A
$I_{R\ 1,2}$	Reverse output current (continuous) channels 1, 2	-10	A
$I_{R\ 3}$	Reverse output current (continuous) channels 3	-2.5	A
$I_{N\ 1,2,3}$	Input current	± 10	mA
$I_{STAT\ 1,2,3}$	Status output current	± 10	mA
V_{ESD}	Electrostatic discharge ($R = 1.5\ k\Omega$, $C = 100\ pF$)	2000	V
P_{tot}	Power dissipation at $T_c \leq 25\ ^\circ C$	95	W
T_j	Junction operating temperature	-40 to 150	$^\circ C$
T_{stg}	Storage temperature	-55 to 150	$^\circ C$

3.3 Thermal data

Table 6. Thermal data

Symbol	Parameter	Value	Unit
$R_{th\ j-case}$	Thermal resistance junction-case	Max. 1.3	$^\circ C/W$
$R_{th\ j-amb}$	Thermal resistance junction-ambient	Max. 50	$^\circ C/W$

3.4 Electrical characteristics

Table 7. Electrical characteristics: power
($V_{CC} = 13\text{ V}$; $-40\text{ °C} < T_j < 125\text{ °C}$ unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{CC}	Operating supply voltage		5.5	13	36	V
V_{USD}	Under voltage shut-down		3	4	5.5	V
V_{OV}	Overvoltage shut-down		36	39	45	V
R_{on}	On state resistance	$I_{OUT\ 1,2} = 2\text{ A}$ $T_j = 25\text{ °C}$			40	m Ω
		$I_{OUT\ 1,2} = 2\text{ A}$			75	m Ω
		$I_{OUT\ 3} = 0.5\text{ A}$ $T_j = 25\text{ °C}$			300	m Ω
		$I_{OUT\ 3} = 0.5\text{ A}$			540	m Ω
I_S	Supply current	Off state $T_{case} = 25\text{ °C}$		30	60	μA
		On state		4.2	10	mA

Table 8. Electrical characteristics: logic input (channels 1,2,3)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{IL}	Input low level voltage	(1)			1.5	V
V_{IH}	Input high level voltage	(1)	3.5			V
$V_{I(hist.)}$	Input hysteresis voltage		0.2	0.85	1.5	V
I_{oIN}	Input current	$V_{IN} = 5\text{ V}$ $T_{case} = 25\text{ °C}$			100	μA
V_{ICL}	Input clamp voltage	$I_{IN} = 10\text{ mA}$	5	6	7	V
		$I_{IN} = -10\text{ mA}$		-0.7		V

1. The input voltage is internally clamped at 6 V about. It is possible to connect this pin to an higher voltage via an external resistor provided the input current does not exceed 10 mA.

Table 9. Electrical characteristics: switching
($V_{CC} = 13\text{ V}$; $T_j = 25\text{ °C}$; input rise time $< 0.1\ \mu\text{s}$)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time of output current	$R_1 = 6.5\ \Omega$ Channels 1,2	10	40	140	μs
		$R_1 = 26\ \Omega$ Channel 3	2	20	70	μs
t_r	Rise time of output current	$R_1 = 6.5\ \Omega$ Channels 1,2	32	150	300	μs
		$R_1 = 26\ \Omega$ Channel 3	8	20	60	μs
$t_{d(off)}$	Turn-off delay time of output current	$R_1 = 6.5\ \Omega$ Channels 1,2	120	300	600	μs
		$R_1 = 26\ \Omega$ Channel 3	30	75	150	μs
t_f	Fall time of output current	$R_1 = 6.5\ \Omega$ Channels 1,2	32	80	160	μs
		$R_1 = 26\ \Omega$ Channel 3	8	20	50	μs
$di/dt_{(on)}$	Turn-on current slope	$R_1 = 6.5\ \Omega$ Channels 1,2		0.02	0.05	A/ μs
		$R_1 = 26\ \Omega$ Channel 3		0.02	0.05	A/ μs
$di/dt_{(off)}$	Turn-off current slope	$R_1 = 6.5\ \Omega$ Channels 1,2		0.02	0.05	A/ μs
		$R_1 = 26\ \Omega$ Channel 3		0.02	0.05	A/ μs

Table 10. Electrical characteristics: protection and diagnostics

Symbol	Parameter	Test conditions		Min.	Typ.	Max.	Unit
T_{TSD}	Thermal shut-down temperature			150	170	190	°C
T_{TR}	Thermal reset temperature			135			°C
T_{RSD} (HYST)	Thermal hysteresis			5	15	30	°C
V_{ENOL}	Output voltage authorizing openload detection	$8\text{ V} \leq V_{CC} \leq 36\text{ V}$		5.2	6.6	8	V
I_{OL}	Open load current level	Channels 1,2 Channel 3	$8\text{ V} \leq V_{CC} \leq 36\text{ V}$ $8\text{ V} \leq V_{CC} \leq 36\text{ V}$	100 5	450 50	800 100	mA mA
I_{OV}	Over current	$R_1 \leq 10\text{ m}\Omega$ $R_1 \leq 10\text{ m}\Omega$	Channels 1,2 Channel 3	10 2	18 3.5		A A
I_{AV}	Average current in short circuit	$R_1 \leq 10\text{ m}\Omega$ Channels 1,2 Channel 3	$T_{Case} = 85\text{ }^\circ\text{C}$		3.4 2		A A
$V_{STAT1,2,3}$	Status output voltage	$I_{STAT} = 1.6\text{ mA}$ (Fault condition)				0.4	V
$V_{SCL1,2,3}$	Status clamp voltage	$I_{STAT} = 10\text{ mA}$ $I_{STAT} = -10\text{ mA}$		5.5	6 -0.7	7	V V
t_{POL}	Status delay	⁽¹⁾ (see Figure 4.)		50	300	950	μs
t_{POVL}	Status delay	⁽²⁾ (see Figure 4.)				10	μs
V_{DEMAG}	Turn-off output clamp voltage			$V_{CC}-45$	$V_{CC}-50$	$V_{CC}-55$	V

1. ISO definition: T_{POL} = Status delay in case of open load conditions.

2. ISO definition: T_{POVL} = Status delay in case of over load conditions.

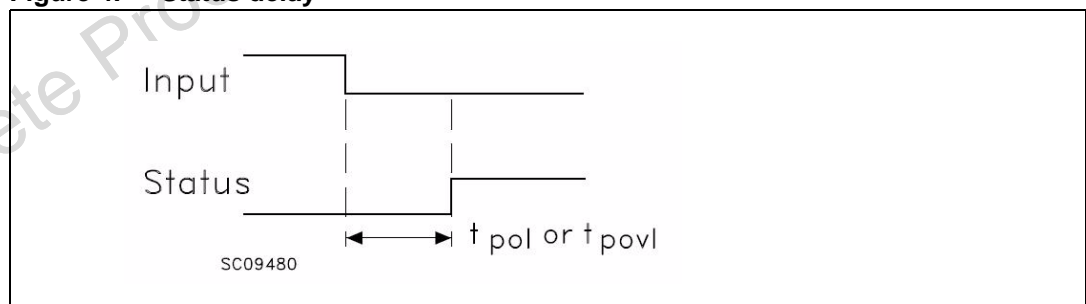
Figure 4. Status delay

Figure 5. Switching parameters test conditions

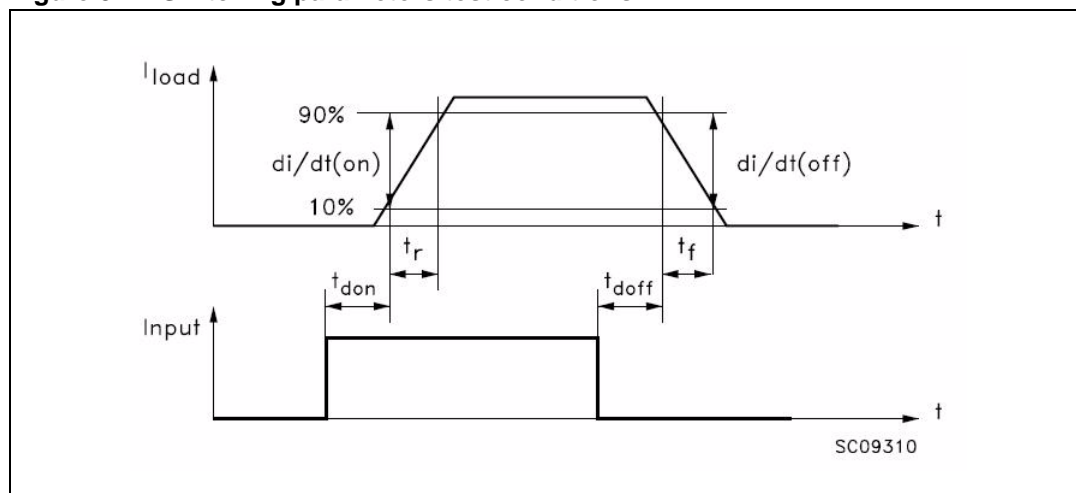
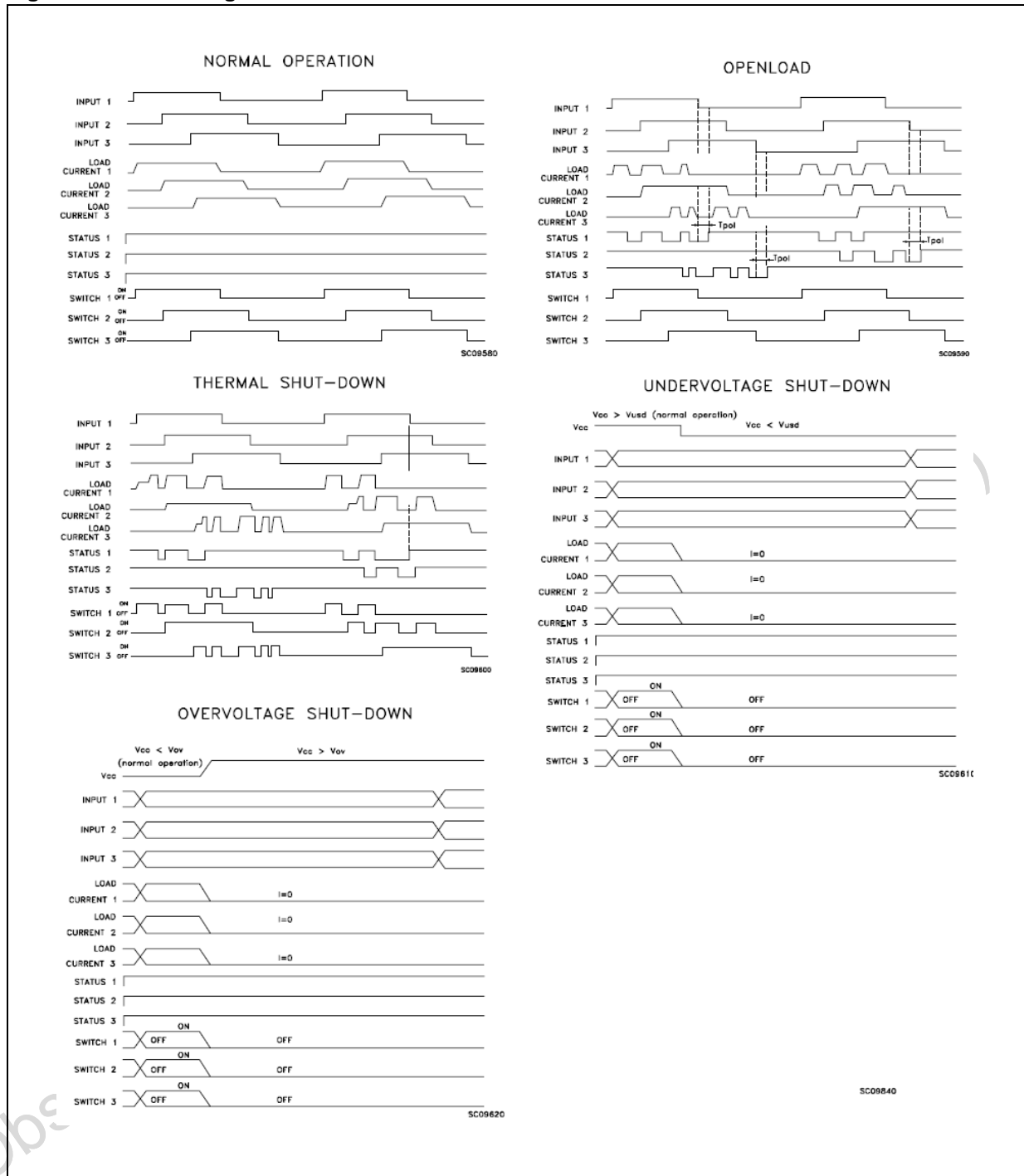


Table 11. Truth table (channels 1,2,3)

Conditions	Input	Output	Status
Normal operation	L	L	H
	H	H	H
Over-voltage	X	L	H
Under-voltage	X	L	H
Thermal shut-down	H	L	L
Open load	H	H	L

H = high level; L = low level; X = unspecified.

Figure 6. Switching waveforms



4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com.

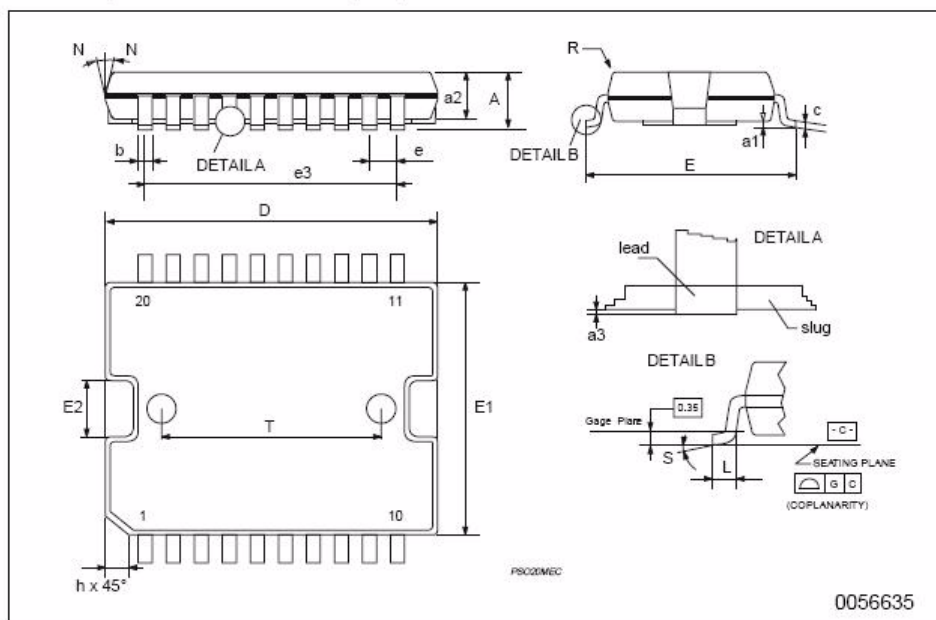
ECOPACK® is an ST trademark.

Figure 7. Power SO-20 mechanical data and package dimensions

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			3.60			0.1417
a1	0.10		0.30	0.0039		0.0118
a2			3.30			0.1299
a3	0		0.10	0		0.0039
b	0.40		0.53	0.0157		0.0209
c	0.23		0.32	0.009		0.0126
D (1)	15.80		16.00	0.6220		0.6299
E	13.90		14.50	0.5472		0.570
e		1.27			0.050	
e3		11.43			0.450	
E1 (1)	10.90		11.10	0.4291		0.437
E2			2.90			0.1141
G	0		0.10	0		0.0039
h			1.10			0.0433
L	0.80		1.10	0.0314		0.0433
N	10° (max.)					
S	8° (max.)					
T		10.0			0.3937	

(1) *D and E1* do not include mold flash or protrusions

- Mold flash or protrusions shall not exceed 0.15mm (0.006")



5 Revision history

Table 12. Document revision history

Date	Revision	Changes
10-Feb-1998	1	Initial release.
04-Mar-2009	2	Document reformatted. Added Table 1: Device summary on page 1 . Updated Section 4: Package information on page 12 .

Obsolete Product(s) - Obsolete Product(s)

Please Read Carefully:

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

UNLESS EXPRESSLY APPROVED IN WRITING BY AN AUTHORIZED ST REPRESENTATIVE, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2009 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

www.st.com