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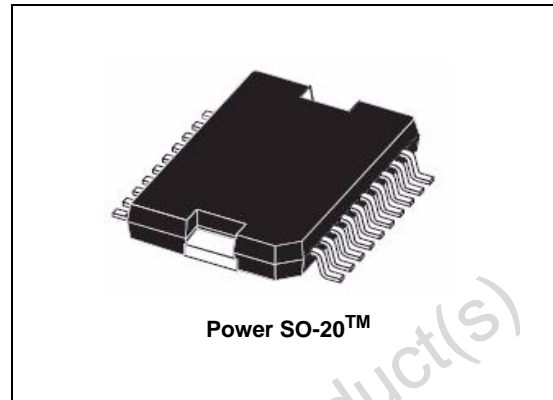
**Three channel high side smart solid state relay**


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**Features**

Type	Channel	R <sub>DS(on)</sub>	I <sub>OUT</sub>	V <sub>CC</sub>
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<sub>C</sub> = 25 °C  
2 A (channel 3) at T<sub>C</sub> = 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

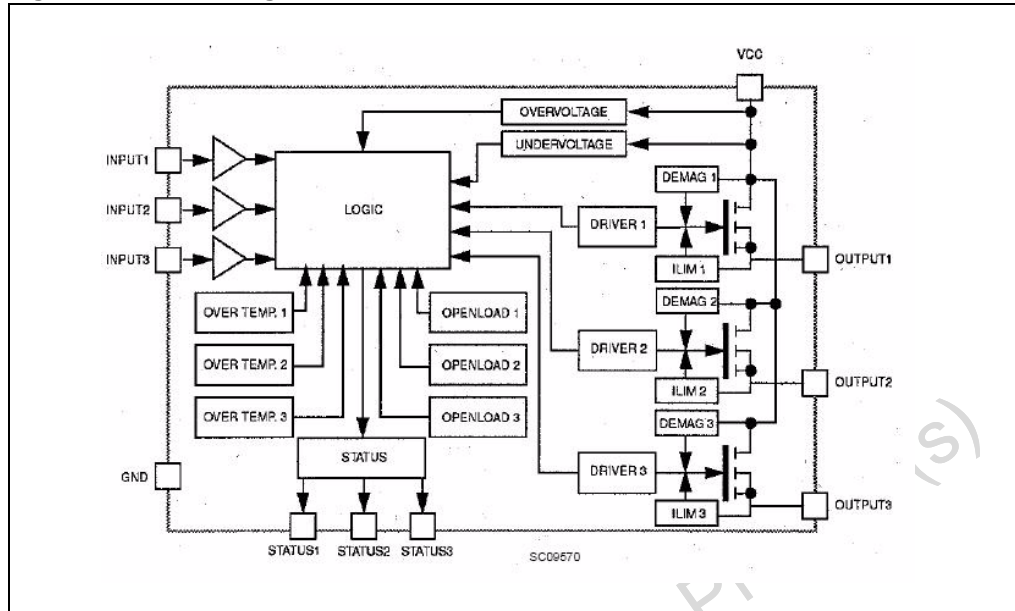
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# 1 Block diagram

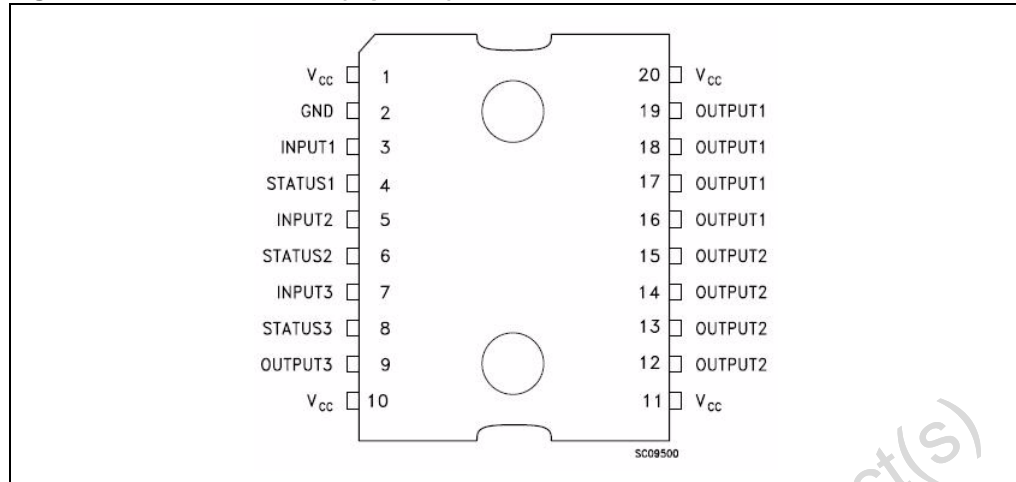
Figure 1. Block diagram



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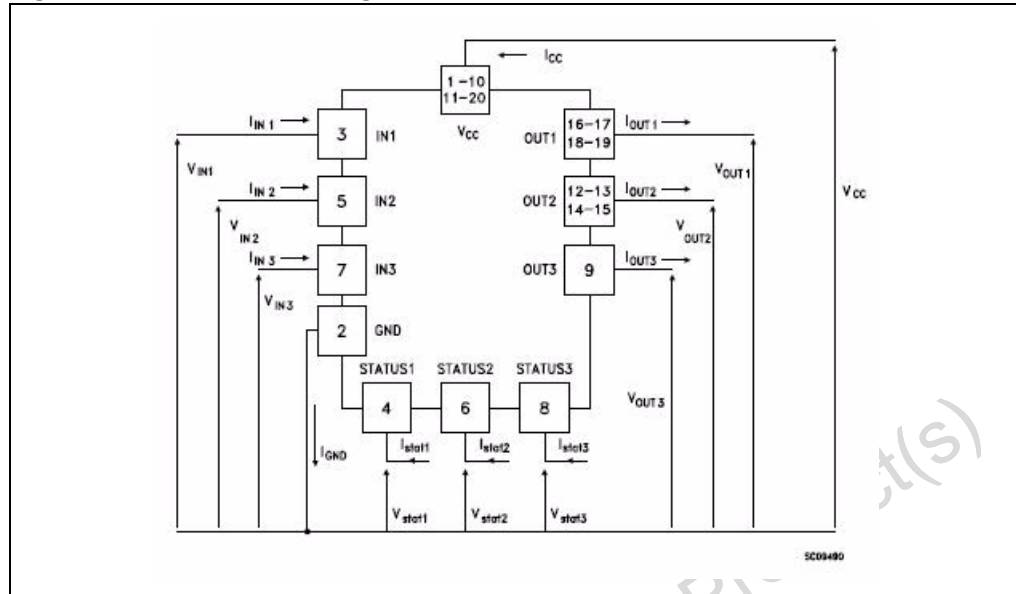
## 2 Pin description

Figure 2. Pin connection (top view)



### 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 $\Omega$
2	+25 V	+50 V	+750 V	+100 V	0.2 ms, 10 $\Omega$
3a	-25 V	-50 V	-100 V	-150 V	0.1 $\mu$ s, 50 $\Omega$
3b	+25 V	+50 V	+75 V	+100 V	0.1 $\mu$ s, 50 $\Omega$
4	-4 V	-5 V	-6 V	-7 V	100 ms, 0.01 $\Omega$
5	+26.5 V	+46.5 V	+66.5 V	+86.5 V	400 ms, 2 $\Omega$

**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  $\geq 1$  K $\Omega$  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	$\pm 10$	mA
$I_{STAT\ 1,2,3}$	Status output current	$\pm 10$	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	$m\Omega$
		$I_{OUT\ 1,2} = 2\text{ A}$			75	$m\Omega$
		$I_{OUT\ 3} = 0.5\text{ A}$ $T_j = 25\text{ °C}$			300	$m\Omega$
		$I_{OUT\ 3} = 0.5\text{ A}$			540	$m\Omega$
$I_S$	Supply current	Off state $T_{case} = 25\text{ °C}$		30	60	$\mu\text{A}$
		On state		4.2	10	$\text{mA}$

**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	$\mu\text{A}$
$V_{ICL}$	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	$\mu\text{s}$
		$R_1 = 26\ \Omega$ Channel 3	2	20	70	$\mu\text{s}$
$t_r$	Rise time of output current	$R_1 = 6.5\ \Omega$ Channels 1,2	32	150	300	$\mu\text{s}$
		$R_1 = 26\ \Omega$ Channel 3	8	20	60	$\mu\text{s}$
$t_{d(off)}$	Turn-off delay time of output current	$R_1 = 6.5\ \Omega$ Channels 1,2	120	300	600	$\mu\text{s}$
		$R_1 = 26\ \Omega$ Channel 3	30	75	150	$\mu\text{s}$
$t_f$	Fall time of output current	$R_1 = 6.5\ \Omega$ Channels 1,2	32	80	160	$\mu\text{s}$
		$R_1 = 26\ \Omega$ Channel 3	8	20	50	$\mu\text{s}$
$di/dt_{(on)}$	Turn-on current slope	$R_1 = 6.5\ \Omega$ Channels 1,2		0.02	0.05	$\text{A}/\mu\text{s}$
		$R_1 = 26\ \Omega$ Channel 3		0.02	0.05	$\text{A}/\mu\text{s}$
$di/dt_{(off)}$	Turn-off current slope	$R_1 = 6.5\ \Omega$ Channels 1,2		0.02	0.05	$\text{A}/\mu\text{s}$
		$R_1 = 26\ \Omega$ Channel 3		0.02	0.05	$\text{A}/\mu\text{s}$

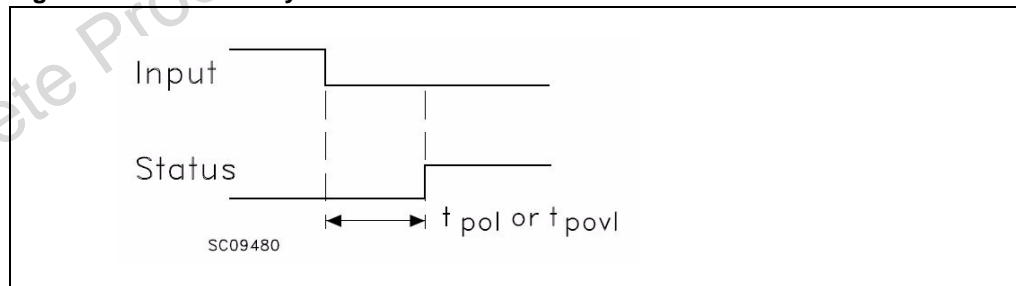


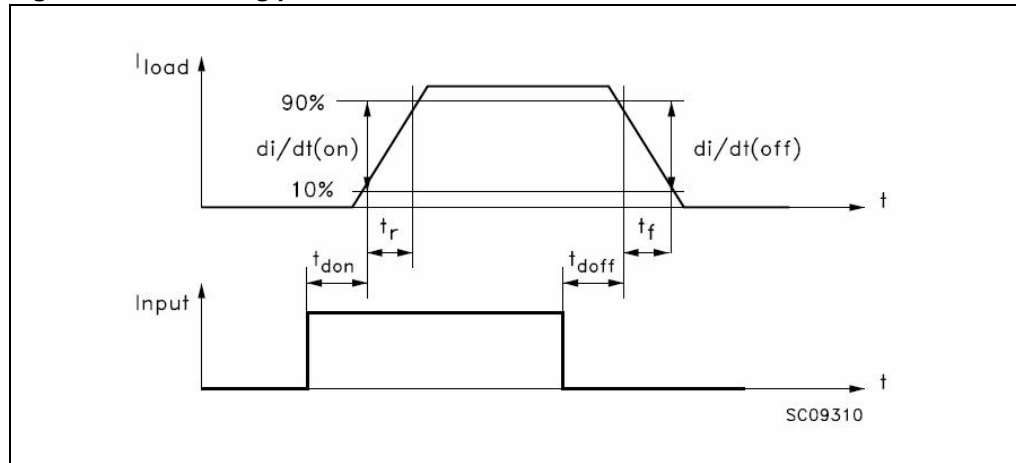
**Table 10. Electrical characteristics: protection and diagnostics**

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	$8\text{ V} \leq V_{CC} \leq 36\text{ V}$	100	450	800	mA
		Channel 3	$8\text{ V} \leq V_{CC} \leq 36\text{ V}$	5	50	100	mA
$I_{OV}$	Over current	$R_1 \leq 10\text{ m}\Omega$	Channels 1,2	10	18		A
		$R_1 \leq 10\text{ m}\Omega$	Channel 3	2	3.5		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		A
					2		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	7	V
					-0.7		V
$t_{POL}$	Status delay	<sup>(1)</sup> (see <a href="#">Figure 4.</a> )		50	300	950	$\mu\text{s}$
$t_{POVL}$	Status delay	<sup>(2)</sup> (see <a href="#">Figure 4.</a> )				10	$\mu\text{s}$
$V_{DEMAG}$	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.

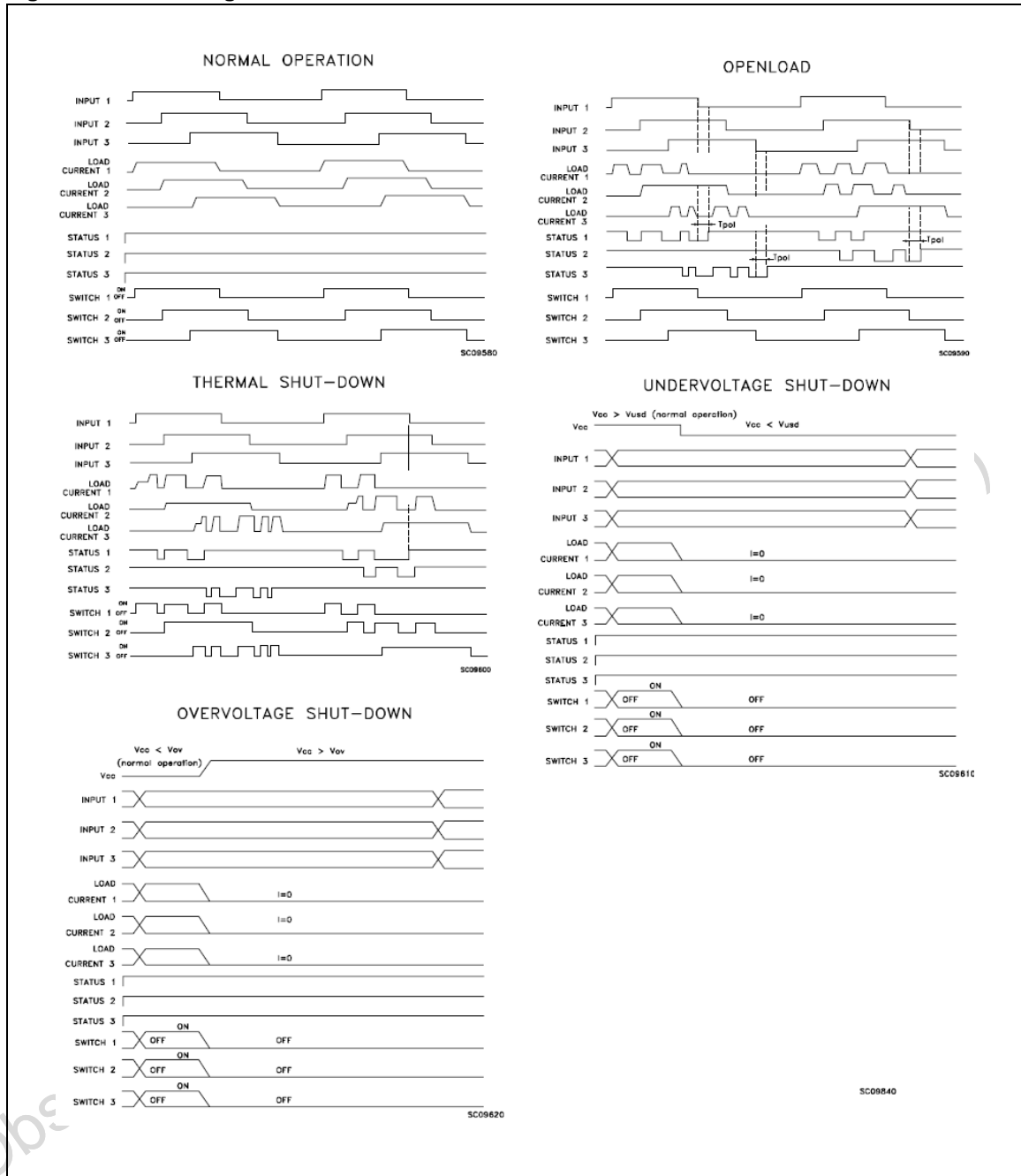
**Figure 4. Status delay**

**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

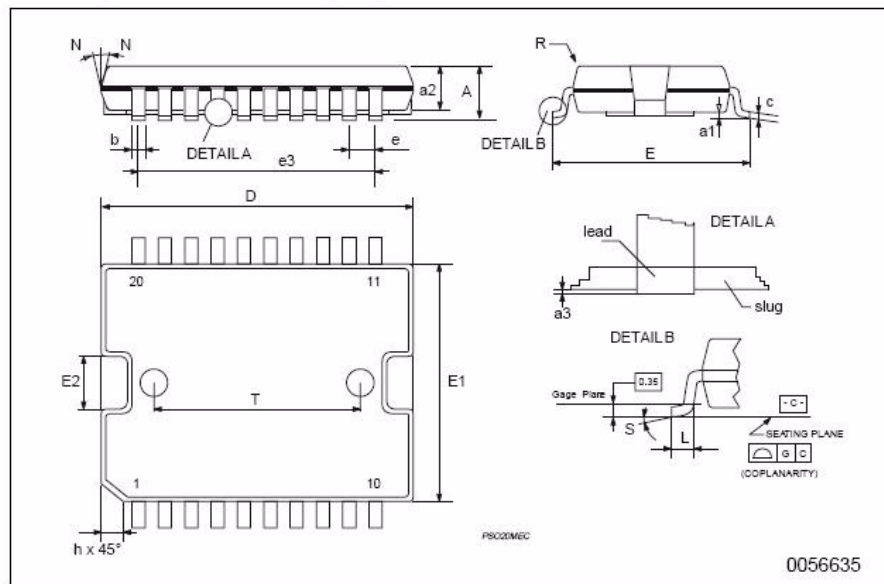
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**Figure 7. Power SO-20 mechanical data and package dimensions**

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 <a href="#">Table 1: Device summary on page 1</a> . Updated <a href="#">Section 4: Package information on page 12</a> .

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