

Three channel high side smart solid state relay

Features

Type	Channel	$R_{DS(on)}$	I_{OUT}	V_{CC}
VN450	1 & 2	40 m Ω	10 A	36 V
	3	300 m Ω	2 A	36 V

- Output current (continuous):
10 A (channel 1,2) at $T_C = 25\text{ }^{\circ}\text{C}$
2 A (channel 3) at $T_C = 25\text{ }^{\circ}\text{C}$
- 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

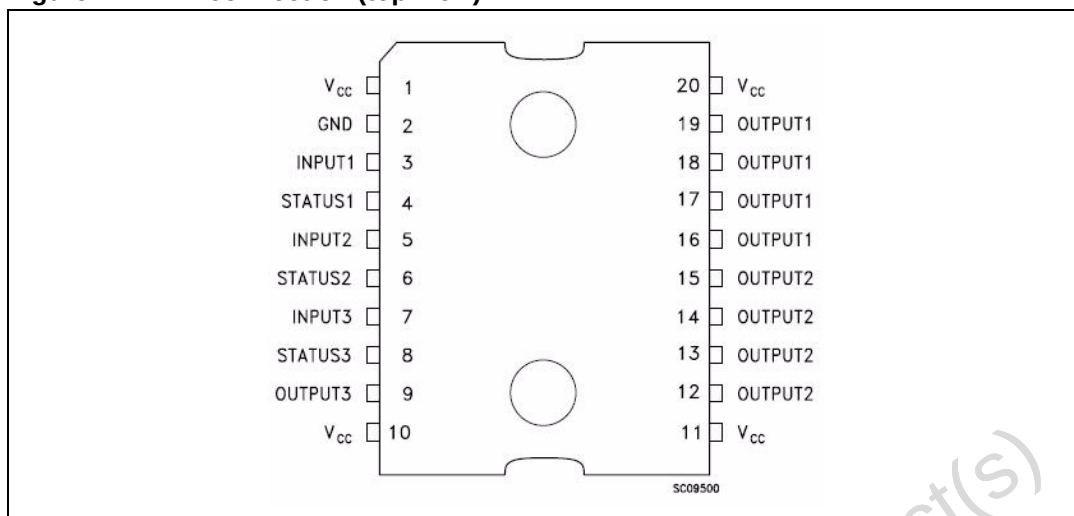
Contents

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

The diagram illustrates the internal architecture of the SC09570 microcontroller. It features a central **LOGIC** block that interfaces with three external inputs (**INPUT1**, **INPUT2**, **INPUT3**) through buffers. The logic also manages three status outputs (**STATUS1**, **STATUS2**, **STATUS3**) and three status inputs (**OVER TEMP. 1**, **OVER TEMP. 2**, **OVER TEMP. 3**). For power management, it includes **OVERVOLTAGE** and **UNDERVOLTAGE** monitoring blocks connected to the **VCC** supply, and three **OPENLOAD** blocks (**OPENLOAD 1**, **OPENLOAD 2**, **OPENLOAD 3**) that monitor the load on each output. The microcontroller controls three output channels, each consisting of a **DRIVER** (DRIVER 1, DRIVER 2, DRIVER 3) and a current-limiting **ILIM** block (ILIM 1, ILIM 2, ILIM 3). Each channel also has a **DEMAG** (de-magnetization) block. The outputs are labeled **OUTPUT1**, **OUTPUT2**, and **OUTPUT3**. The entire device is powered by **VCC** and grounded at **GND**. The part number **SC09570** is indicated at the bottom.

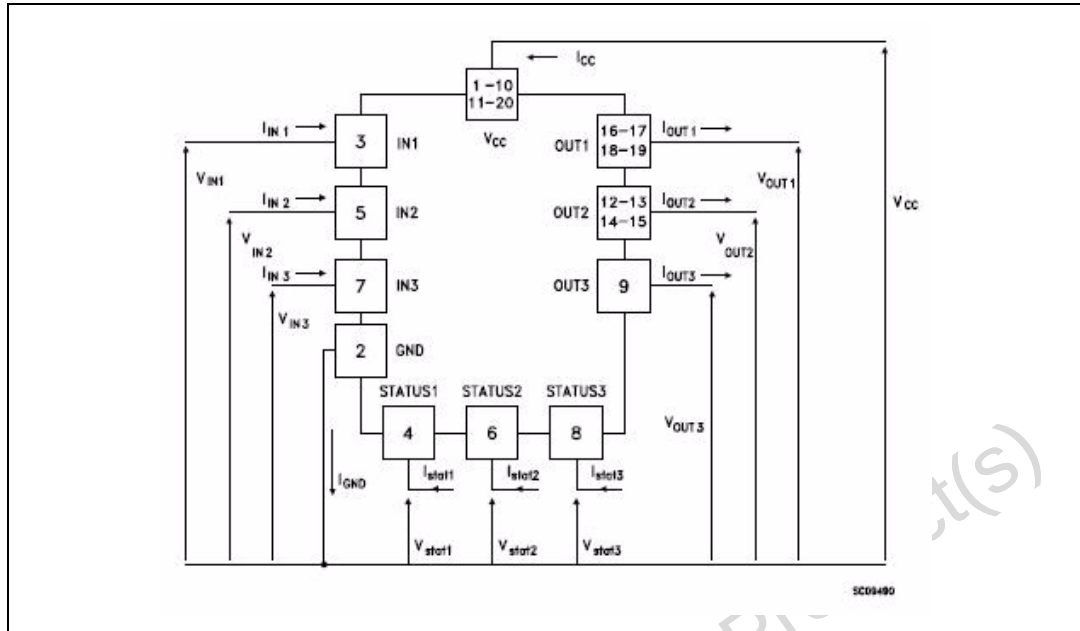
2 Pin description

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				
	I	II	III	IV	Delays and impedance
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)

	Test levels results				
ISO T/R 7637/1 Test pulse	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 $\geq 1 \text{ K}\Omega$ 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	± 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
($V_{CC} = 13\text{ V}$; $-40\text{ }^{\circ}\text{C} < T_j < 125\text{ }^{\circ}\text{C}$ 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	$I_{OUT\ 1,2} = 2\text{ A}$ $T_j = 25\text{ }^{\circ}\text{C}$			40	$\text{m}\Omega$
		$I_{OUT\ 1,2} = 2\text{ A}$			75	$\text{m}\Omega$
		$I_{OUT\ 3} = 0.5\text{ A}$ $T_j = 25\text{ }^{\circ}\text{C}$			300	$\text{m}\Omega$
		$I_{OUT\ 3} = 0.5\text{ A}$			540	$\text{m}\Omega$
I_S	Supply current	Off state $T_{case} = 25\text{ }^{\circ}\text{C}$		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	$V_{IN} = 5\text{ V}$ $T_{case} = 25\text{ }^{\circ}\text{C}$			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
($V_{CC} = 13\text{ V}$; $T_j = 25\text{ }^{\circ}\text{C}$; input rise time $< 0.1\text{ }\mu\text{s}$)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time of output current	$R_1 = 6.5\text{ }\Omega$ Channels 1,2	10	40	140	μs
		$R_1 = 26\text{ }\Omega$ Channel 3	2	20	70	μs
t_r	Rise time of output current	$R_1 = 6.5\text{ }\Omega$ Channels 1,2	32	150	300	μs
		$R_1 = 26\text{ }\Omega$ Channel 3	8	20	60	μs
$t_{d(off)}$	Turn-off delay time of output current	$R_1 = 6.5\text{ }\Omega$ Channels 1,2	120	300	600	μs
		$R_1 = 26\text{ }\Omega$ Channel 3	30	75	150	μs
t_f	Fall time of output current	$R_1 = 6.5\text{ }\Omega$ Channels 1,2	32	80	160	μs
		$R_1 = 26\text{ }\Omega$ Channel 3	8	20	50	μs
$di/dt_{(on)}$	Turn-on current slope	$R_1 = 6.5\text{ }\Omega$ Channels 1,2		0.02	0.05	$\text{A}/\mu\text{s}$
		$R_1 = 26\text{ }\Omega$ Channel 3		0.02	0.05	$\text{A}/\mu\text{s}$
$di/dt_{(off)}$	Turn-off current slope	$R_1 = 6.5\text{ }\Omega$ Channels 1,2		0.02	0.05	$\text{A}/\mu\text{s}$
		$R_1 = 26\text{ }\Omega$ 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 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	$T_{Case} = 85\text{ °C}$		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.

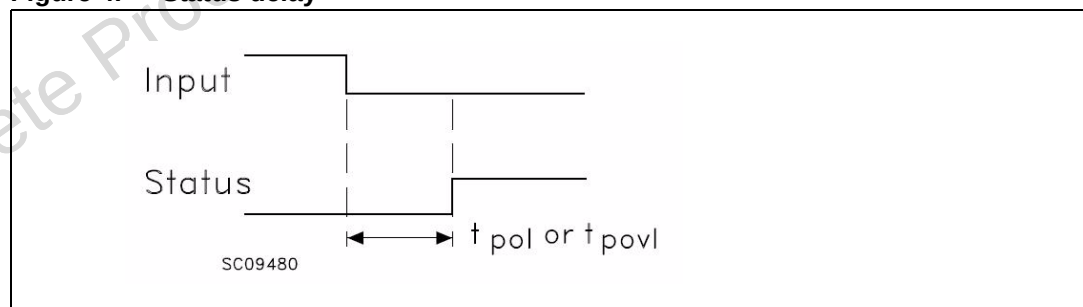
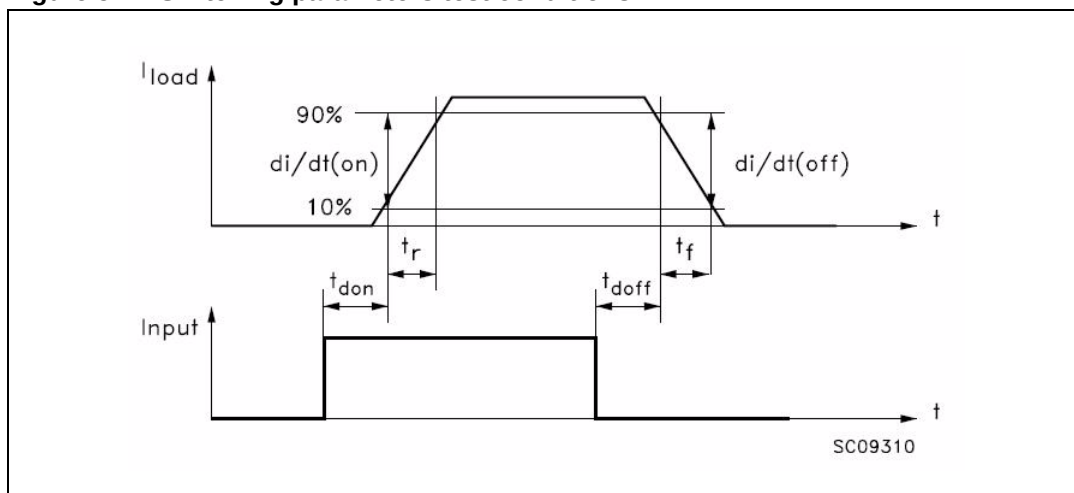
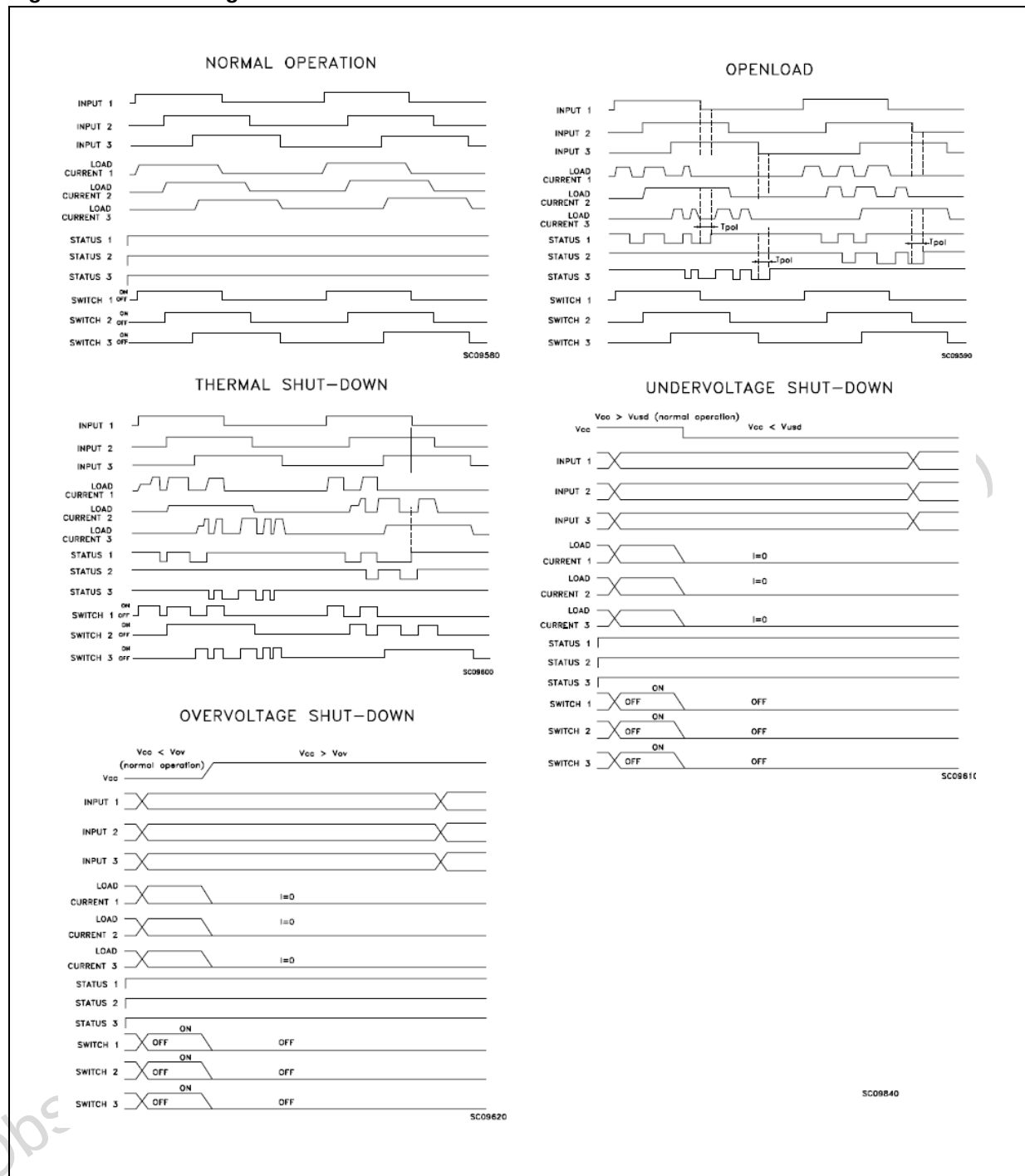
Figure 4. Status delay

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.

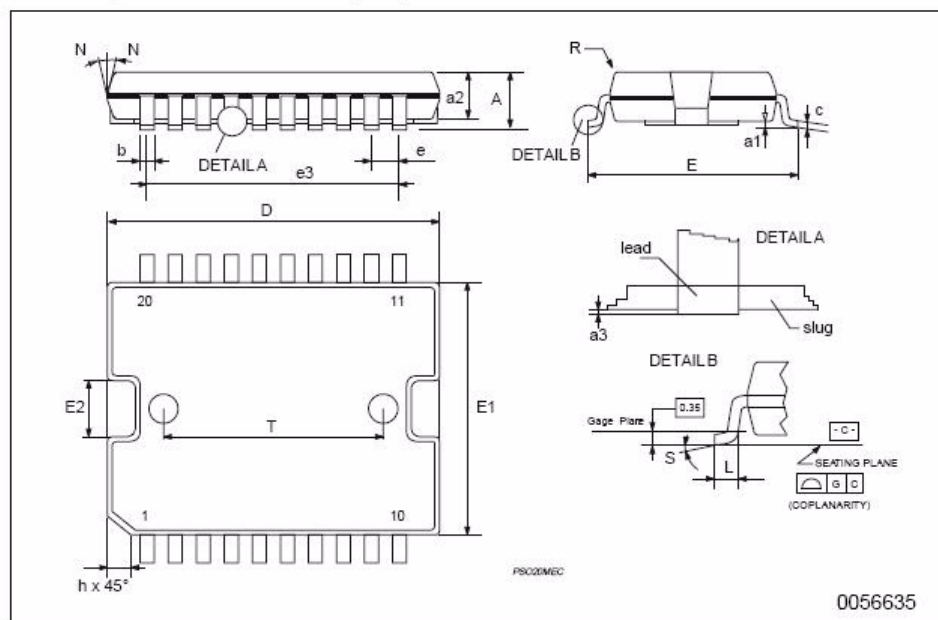
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Figure 7. Power SO-20 mechanical data and package dimensions

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 Table 1: Device summary on page 1 . Updated Section 4: Package information on page 12 .

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