CSA-1V

Current Sensor

Features:

- Sensitive to a magnetic field parallel to the chip surface
- Very high sensitivity
- Linear output voltage proportional to a magnetic field
- Wide-band: DC to 100kHz
- Very low offset and offset-drift
- Very low noise
- Isolated from current conductor
- Surface mount SOIC-8 package

Applications:

- AC and/or DC current measurement
- Wide-Band Magnetic Field Measurement
- Battery Chargers
- AC-DC Converters
- Motor Control

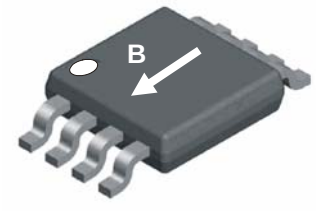
General Description

The CSA-1V is a single-axis integrated magnetic field sensor based on the Hall effect. The circuit is fabricated using a conventional CMOS technology with an additional ferromagnetic layer. The ferromagnetic layer is used as a magnetic flux concentrator providing a high magnetic gain. Therefore, the circuit features very high magnetic sensitivity, low offset, and low noise.
The CSA-1V is packaged in a standard SOIC-8 full plastic package. This package provides:

- highest isolation for applications with the current conductor on the PCB (up to 600V)
- highest sensitivity for applications with the current lead above the chip.

Package: SOIC-8

Pin Out:



1 A_OUT, analog sensor output
2 V_{DD} pos. supply voltage
3 Not connected
4 PV, programming voltage [1)]
5 GND, supply common
6 PD, programming data [1)]
7 PC, programming clock [1)]
8 CO_OUT, common output

Note 1: Used for factory programming

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Absolute Maximum Ratings

Symbol	Parameter	Min.	Typ.	Max.	Unit	Remarks
V_{SUP}	Supply Voltage	0		6	V	
T	Ambient Temperature	-40		+150	°C	

Recommended Operating Conditions

Symbol	Parameter	Min.	Typ.	Max.	Unit	Remarks
V_{SUP}	Supply Voltage	4.5	5	5.5	V	
I_{OUT}	Output Current	-1		1	mA	
C_L	Load Capacitance			1000	pF	

Electrical Characteristics

At T=-40°C to 150°C, V_{SUP}=4.5V to 5.5V if not otherwise specified.

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
I_{SUP}	Supply Current		11	16	mA	
V_{Common}	Common (reference) Output Voltage[2)]	V_{SUP}/2 -20mV	V_{SUP}/2	V_{SUP}/2 +20mV		I_{OUT}=0mA
BW	Bandwidth: DC to		100		kHz	
t_R	Response Time			6	µs	

Note 2: Ratiometric (proportional to V_{SUP})

Characteristics of the Linear Magnetic Field Sensor [3,4)]

With V_{SUP}= 5V and in the temperature range -40°C to 150°C, if not otherwise specified.

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
S	Magnetic Sensitivity [3)]	270	300	330	V/T	B = B_L
ΔS/SΔT	Magn. Sensitivity Temperature Drift	-0.02		0.02	%/°C	I_{OUT}=0mA T=-20°C to 125°C
Voff	Offset Voltage	-15	0	15	mV	B=0T, Iout=0mA, T=20°C
ΔVoff/ΔT	Offset Temperature Drift	-0.2	0	0.2	mV/°C	B=0T, I_{OUT}=0mA, T=-20°C to 125°C
B_{FS}	Full Scale Magnetic Field Range [5)]	-7.5		7.5	mT	
B_L	Linear Magnetic Field Range	-5		5	mT	
NL	Non Linearity		0.1	0.2	%	B = B_L
			0.5	1		B = B_{FS}
ΔBnoise	Input referred magnetic noise spectrum density (RMS)			125	nT/√Hz	f=10Hz to 10kHz

Note 3: Ratiometric (proportional to V_{SUP})
Note 4: When the analog output pin A_OUT is used in differential mode (i.e. Vout=A_OUT-CO_OUT)
Note 5: Device saturates for B>B_{FS}, but is not damaged

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Block Diagram

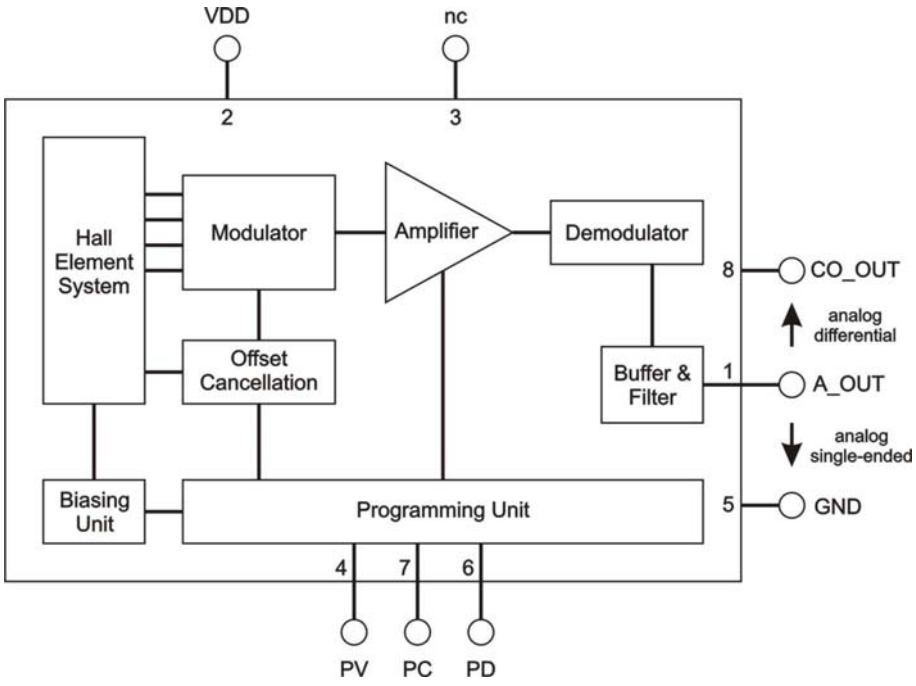
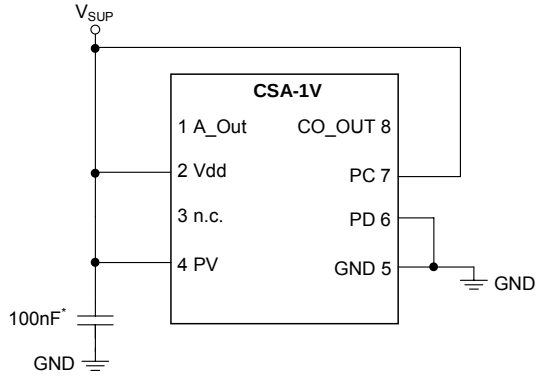


Fig. 1 Block diagram of CSA-1V

IMPORTANT For reliable operation within the specifications the sensor must be connected as follows:

Connect Pin 6 (PD) to Pin 5 (GND)
Connect Pin 7 (PC) to Pin 2 (Vdd)
Connect Pin 4 (PV) to Pin 2 (Vdd)
Put a 100nF capacitor close to the chip between Pin 2 (Vdd) and Pin 5 (GND)



* If the supply voltage is disturbed by EMI it can be useful to place a second capacitor (100pF, ceramic) parallel to the 100nF capacitor.

Fig. 2 Connection diagram of CSA-1V

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Package Information SOIC-8

B: Magnetic sensitive direction

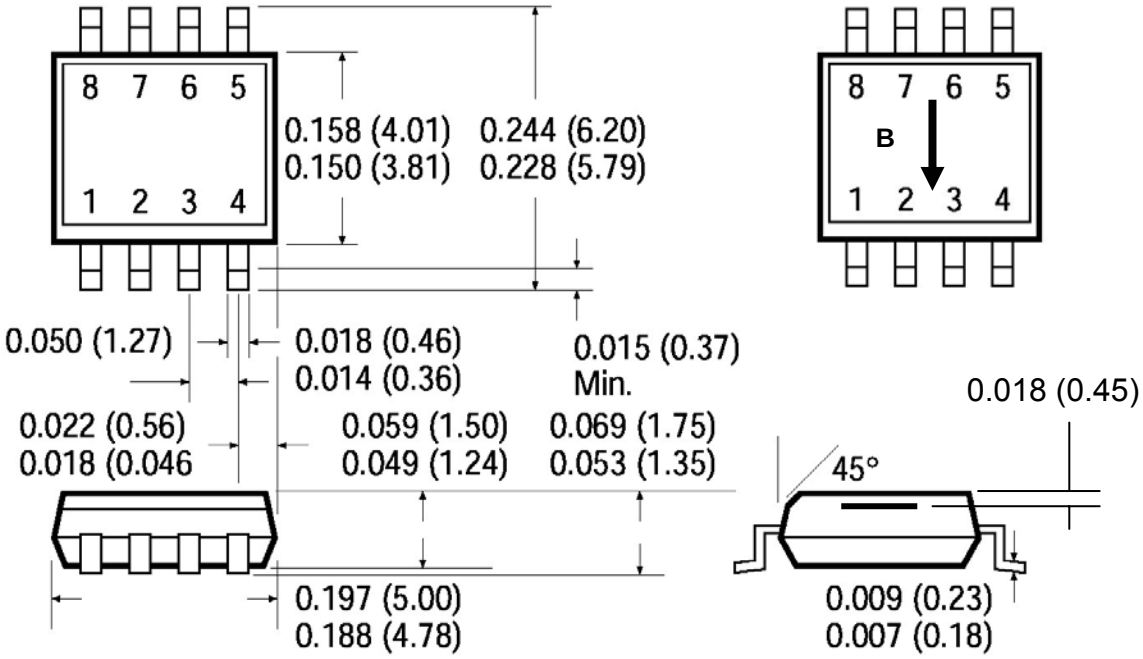

Fig. 3 Package information and magnetic sensitive direction

Dimension and Pads CSA-1V in dice form

(all dimensions in µm)

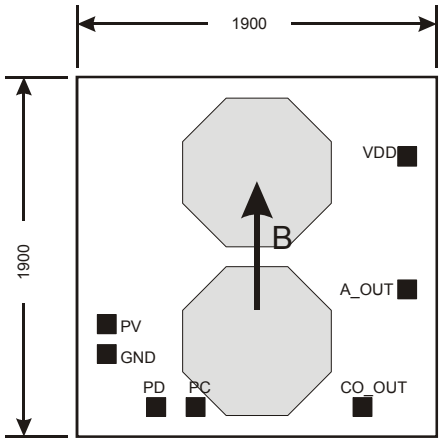

Fig. 4 Dimensions of dice

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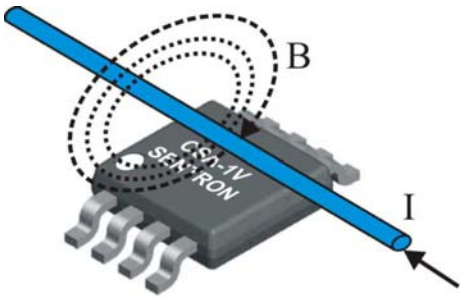
Typical Applications

Current Measurement A

The current conductor is situated above the chip.



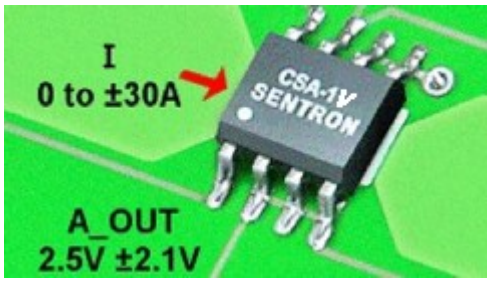
A current conductor is placed at a certain distance above or beyond the chip. The magnetic field around a long current wire is described by H=I/2πr. The flux density at the place of the sensor depends upon the current in the wire I and the distance between sensor and wire r:
$B = \mu_0 * I / 2\pi r$.

All examples for S=300V/T

Max current [A]	Distance sensor to wire [mm]	Sensitivity [mV/A]	Approx. Resolution (raw) [A]	Approx. Resolution (t_{INT}=1ms) [A]	Linearity Error [%]
10	0.2	120	0.1	0.01	<0.1
50	2	25	0.5	0.05	
100	4	12	1	0.1	
500	20	3	3.5	0.35	
1000	40	1.5	7	0.7	

Current Measurement B

The current conductor is situated below the chip (on PCB).



The CSA-1V current sensor is placed on a PCB directly over the current track. The current track can consist of one or several loops, depending on the maximum current to be measured. The sensor measures the magnetic field emanating from the current flowing through the tracks.

Typically obtained values for for this type of application are (width of PCB current track 2.5mm):

Max current(*) [A] DC / pulsed	No of tracks under sensor	Sensitivity [mV/A]	Resolution (raw) [mA]	Resolution t_{INT}=1ms [mA]	Linearity Error [%]
2 / 10	4	140	70	7	<0.1
10 / 50	1	35	280	28	

(*) max current depends on PCB properties/thermal budget

Please contact us for documentation such as application notes, technical papers and others.

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