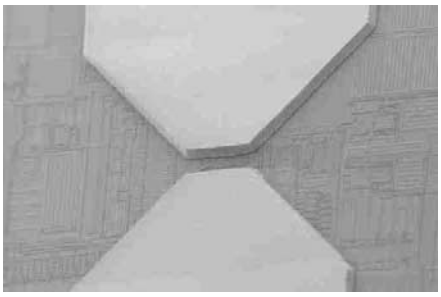
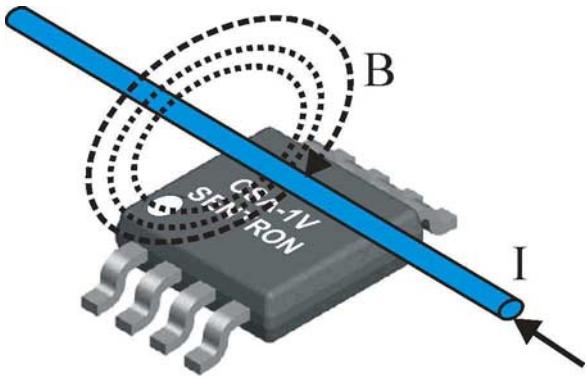
SENTRON

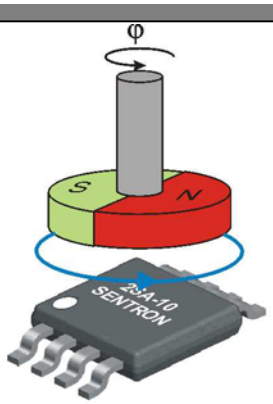
Hall Sensor Catalog - September 2003



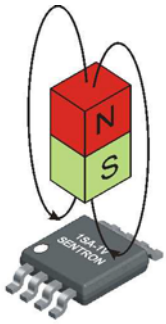
Hall Sensors with Integrated Magnetic Concentrators



Current Sensor CSA-1



Angle Sensor 2SA-10



Analog Sensor and High Sensitivity Switch 1SA-1V

Contents

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GMW P.O. Box 2578, Redwood City, CA 94064, USA. Tel +1 (650) 802-8292. Fax: +1 (650) 802-8298. Email: sales@gmw.com

PROFILE OF SENTRON AG

MISSION: To help SENTRON's clients make distinctive improvements in their products and services: **SENTRON makes it possible through its advanced magnetic sensors, magnetic field measurement instruments, and development of customer-specific components.**

COMPANY: **SENTRON AG** was founded in 1993 as a Swiss corporation ("Aktiengesellschaft" or AG). SENTRON AG is an engineering company specialized in the field of magnetic **SEN**sors and interface elec**TRON**ics. The company is based in Zug, near Zurich, and in Lausanne. The team in Zug is responsible for the development of magnetic sensor systems, production, and sales, whereas the team in Lausanne is specialized in the design of magnetic sensor ASICs. Collaboration with the Swiss Federal Institute of Technology Lausanne (EPFL) helps SENTRON to stay at the leading edge in its field.

PRODUCTS:

SENTRON **Hall Sensors**

Our Hall Sensors respond to a magnetic field parallel with the chip surface and not, as conventional Hall sensors, to a field perpendicular to the device surface. They are also more sensitive then conventional Hall sensors. **From the application point of view, SENTRON Hall sensors are similar to magneto-resistive sensors (MR).** However, they do not have the drawbacks of the MRs, such as non-linearity, hysteresis, flipping, and limited field range. Our Hall sensors are fully integrated CMOS sensor microsystems, including a magnetic flux concentrator, Hall elements, biasing circuit, amplifier, and programming of gain, offset, and temperature coefficient. **Available are single-axis wide bandwidth or low-power and 2-axis Hall sensors.**

SENTRON **Instruments**

Our Hall analog transducers and digital teslameters are used all over the world in particle accelerators, educational and research institutions, manufacturing industry, quality control and wherever magnetic fields have to be reliably measured.

All our instruments are equipped with precisely assembled probe-heads for **single-axis, two axis or three-axis** measurements **ranging from low-cost 1%-accuracy to 0.01% accuracy** in fields **to over 2 tesla**. One unique feature of SENTRON's Hall-Transducer is that it measures **two or three components of a magnetic field at a single spot of about 0.2 mm diameter** with the mutual orthogonality of the components of **better than 0.1°**.

A particular highlight is the 3RT sub-millimeter probe-head, the **world's smallest 3-D Hall-probe** for the characterization of very small magnets.

SENTRON **Custom Made:**

SENTRON welcomes customer R&D projects in the field of magnetic ASICs and magnetic sensor systems. Since its foundation SENTRON has carried out several such projects, providing customers with application-specific magnetic sensor modules for their particular needs. Such modules usually consist of magnetic sensor assemblies, ferromagnetic components and an electronic interface with customer-specific signal treatment and output.

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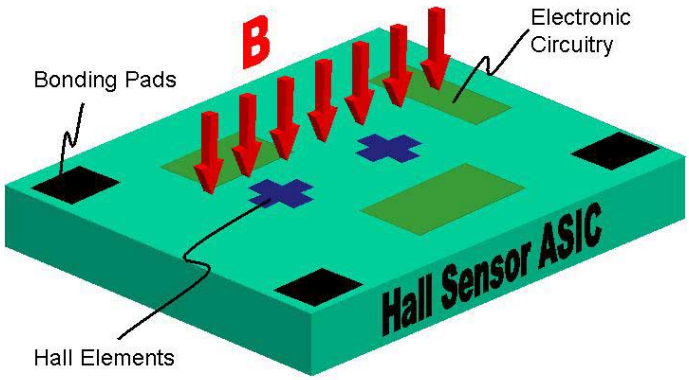
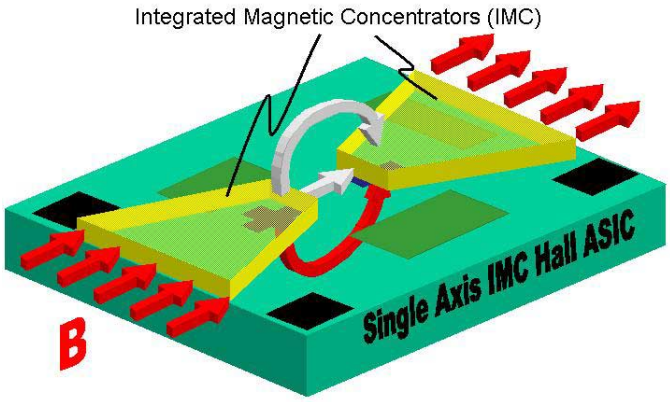
Hall Sensors with Integrated Magnetic Concentrators (IMC-Hall®)

What is IMC-Hall® ?

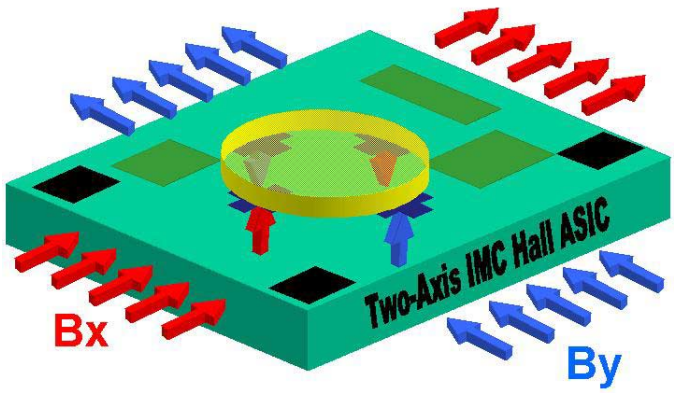
IMC-Hall® is the short-form for a magnetic sensor made of an integrated combination of a Hall elements, electronic circuitry and a ferromagnetic layer. The ferromagnetic layer forms the integrated magnetic concentrator (IMC), which is placed on the CMOS Hall ASIC chip in a batch post process. Whereas a conventional Hall ASIC responds to a magnetic field perpendicular to the chip surface, a Hall ASIC with IMC responds to a magnetic field parallel with the chip surface



Conventional Hall Sensor ASICs consist of a combination of Hall elements and electronic circuitry on a silicon chip. Due to the nature of the Hall elements such sensors are only sensitive to a magnetic field B perpendicular to the chip surface.



A single-axis IMC-Hall® ASIC also consists of Hall elements and electronic circuitry, but additionally it has a thin structured ferromagnetic layer on the surface. A magnetic field B parallel with the chip surface is rotated locally to vertical direction under the edges of the IMC's close to the gap, so that now it can be measured by the Hall elements. Moreover the IMC's also function as passive amplifiers.



By applying a single disk-shape IMC on the chip surface, a two-axis IMC-Hall® sensor is realized. Two Hall elements measure under its edge a magnetic field component Bx (red), and two other Hall elements measured By (blue). This allows to make a real two-axis magnetic field sensor for example for angular position measurement.

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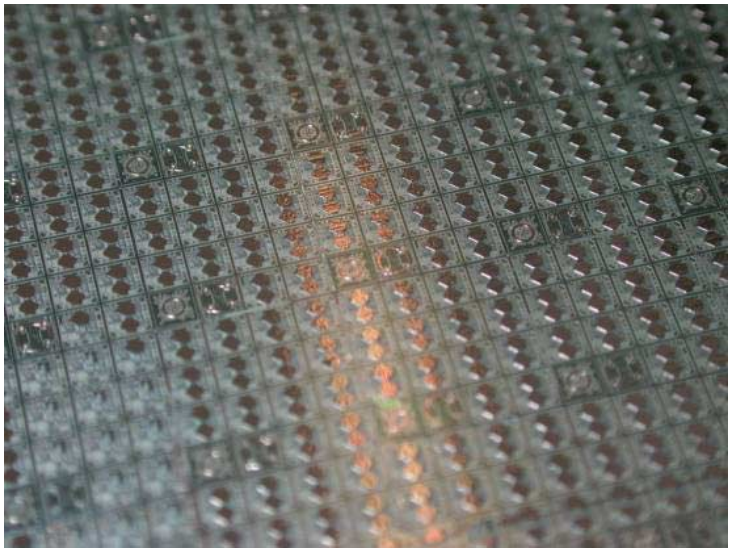
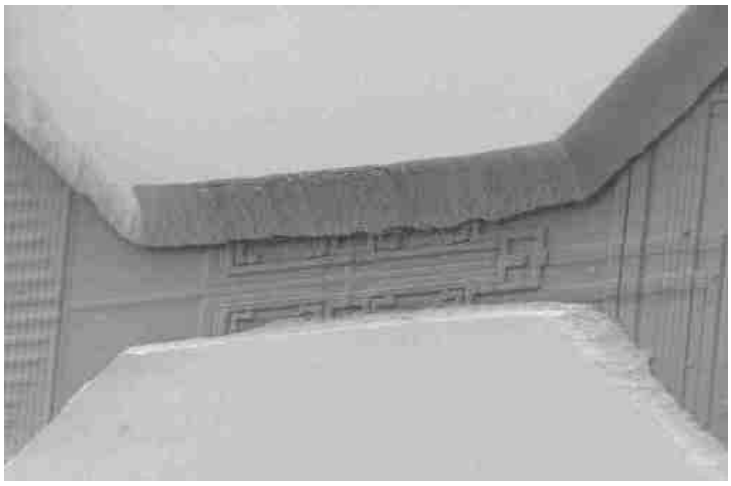
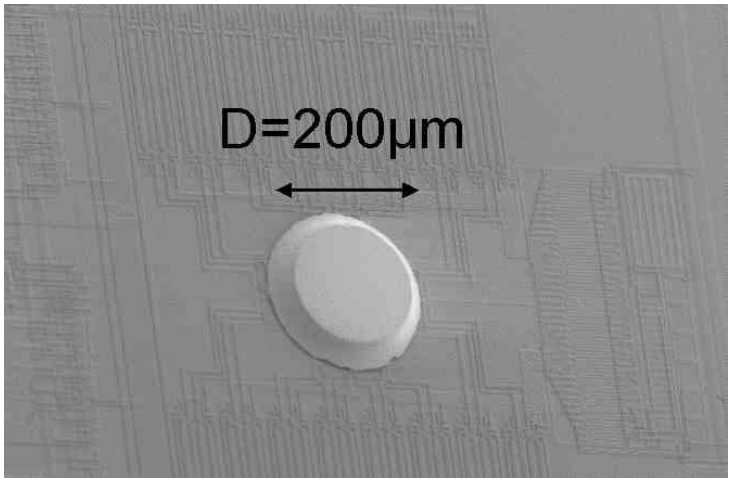
Hall Sensors with Integrated Magnetic Concentrators (IMC-Hall®)



Photograph showing part of the thousands of IMC's, which are structured on a CMOS silicon wafer that contains the chips with the Hall elements and electronic circuitry.
The deposition of the soft ferromagnetic layer is performed in a low-cost post process, which is now mature for mass production.



Scanning-Electron-Microscope (SEM) photograph of the region around the gap between the two IMC's of a single-axis Sentron Hall Sensor (CSA-1 / 1SA-1). The IMC's are about 20um thick and they cover the underlying Hall elements in a way to obtain maximum magnetic gain and minimum influences from process tolerances.



Close-up SEM photograph of the disk-like IMC used for the two-axis IMC-Hall® Sensor 2SA-10. The disk diameter is very small, so that the sensor has point-like measurement properties. This is very convenient for many applications where the field homogeneity is a critical issue, for example when working with very small magnets.

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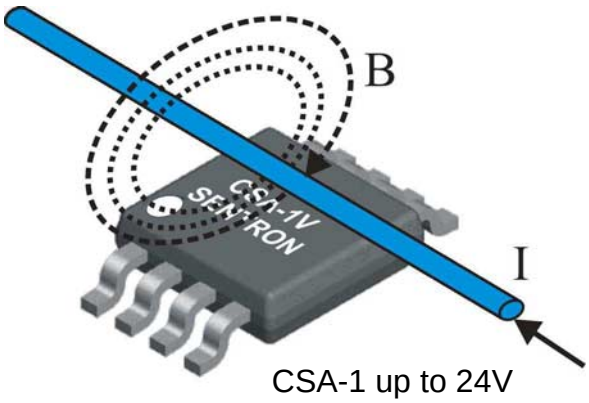
IMC-Hall® Sensor Product Line

Sentron's IMC-Hall® sensor product line consists of three sensor models:

Fast Analog Sensor and Current Sensor CSA-1 and CSA-1V

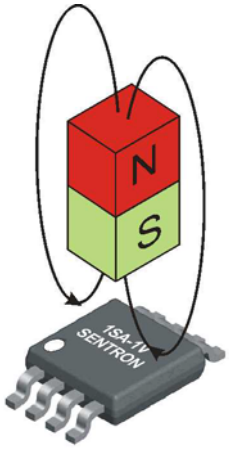


CSA-1 up to 24V
CSA-1V up to 600V

- **Standard SOIC-8 package**
- **5V Power Supply / Ratiometric Output for direct use with standard 5V ADC**
- **Sensitive parallel with Chip Surface**
- **Sensitivity programmable up to 300V/T**
- **6-Bit Sensitivity calibration on chip**
- **Offset < 0.05mT**
- **Resolution < 10mA for Current Measurement on PCB**
- **-3dB Bandwidth 100kHz**
- **0 – 90% Signal response time 6µs**

>> download CSA-1 Datasheet / CSA-1V Datasheet

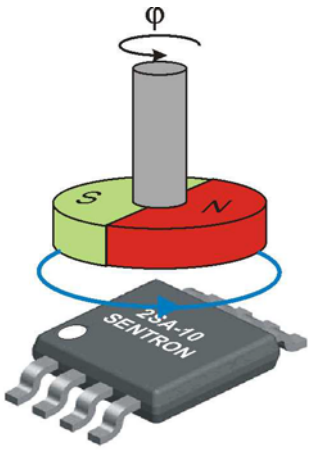
Analog Hall Sensor and Hall Effect Switch 1SA-1V



- **Standard SOIC-8 package**
- **5V Power Supply / Ratiometric Output for direct use with standard 5V ADC**
- **Sensitive parallel with Chip Surface**
- **Sensitivity programmable up to 300V/T**
- **Bipolar Switch with 0.25mT Threshold**
- **Offset < 0.05mT**
- **Pulsed Operation for Low Power Consumption possible**

>> download 1SA-1V Datasheet

Two-Axis Hall Sensor and Magnetic Angle Sensor 2SA-10



- **Standard SOIC-8 package**
- **5V Power Supply / Ratiometric Output for direct use with standard 5V ADC**
- **Sensitive parallel with Chip Surface**
- **Analog Output Sin and Cos Signals**
- **Sensitivity programmable up to 100V/T**
- **Angular Accuracy/Resolution better 0.5°/0.1°**
- **3-Phase Analog Output available**

>> download 2SA-10 Datasheet

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IMC-Hall® vs. other Hall sensors and MR sensors

In the following, some characteristics relating our IMC-Hall® sensors to existing solutions like other Hall sensors and magneto-resistive (MR) sensors are discussed. For a more detailed description of the comparison please send an email to info@sentron.ch with "compare" in the subject line. We encourage you to also indicate your experience.

How do IMC-Hall® Sensors compare to other Hall Sensors ?

Sensitivity	IMC-Hall® sensors are considerably more sensitive than other Hall sensors
Direction of Sensitivity	IMC technology allows for the measurement of two orthogonal magnetic field components by a single sensor.
Resolution	Sentron's IMC-Hall® sensors have a resolution about 10 times higher than other Hall sensors.
Output Signal Level	Sentron's IMC-Hall® sensors feature a ratiometric, amplified differential output of 2.5V ± 2V or single ended output 0.5V .. 4.5V.
Bandwidth	Sentron's IMC-Hall® sensors feature high sensitivity, low offset and low offset drift without having to compromise on speed.
Switching Level	Sentron's IMC-Hall® sensor 1SA-1 switches already at 0.2mT
Hysteresis	In Sentron IMC-Hall® sensors hysteresis effects are virtually inexistent.
Cost	Sentron's IMC-Hall® sensors are manufactured by standard high-volume CMOS processes and are therefore low-cost devices.

How does Sentron's 2SA-10 compare to magnetoresistive Sensors for angle measurement applications ?

Axial Tolerances	Sentron's 2SA-10 angle sensor can be mounted with larger axial tolerances than MR angle sensors.
Distance Tolerances	Sentron's 2SA-10 angle sensor can be mounted further away from the rotating magnet with larger distance tolerances than MR angle sensors
Hysteresis	Hysteresis effects with Sentron's 2SA-10 are virtually inexistent.
Output Signal Level	Sentron's 2SA-10 yields standard 0.5 – 4.5V analog output voltage.
Programming	In Sentron's 2SA-10 several parameters can be one-time programmed
EMI	Sentron's 2SA-10 angle sensor is much less sensitive to EMI than MR sensors
Magnetic Robustness	Sentron's 2SA-10 angle sensor does not need any resetting and cannot be destroyed by a strong magnetic field
Electrical Robustness	Sentron's 2SA-10 angle sensor is manufactured using high-volume standard CMOS processes
Cost	Sentron's 2SA-10 angle sensor you reduces overall system cost significantly.

How does Sentron's CSA-1 current sensor compare to magnetoresistive Sensors for current measurement applications ?

Sensitivity	Sentron's CSA-1 current sensor shows the same sensitivity as MR sensors.
Magnetic robustness	Sentron's CSA-1 current sensor does not need any resetting and cannot be destroyed by a strong magnetic field.
Hysteresis	Hysteresis for Sentron's CSA-1 current sensor is virtually inexistent.
Output Signal Level	Sentron's CSA-1 current sensor outputs standard 0.5V – 4.5V analog voltage
Programming	Sentron's CSA-1 current sensor can be used for complete in-situ system calibration.
EMI	Sentron's CSA-1 current sensor is much less sensitive to EMI than MR sensors
Electrical Robustness	Sentron CSA-1 current sensor is manufactured using high-volume standard CMOS processes.
Cost	Sentron's CSA-1 current sensor reduces overall system cost significantly.

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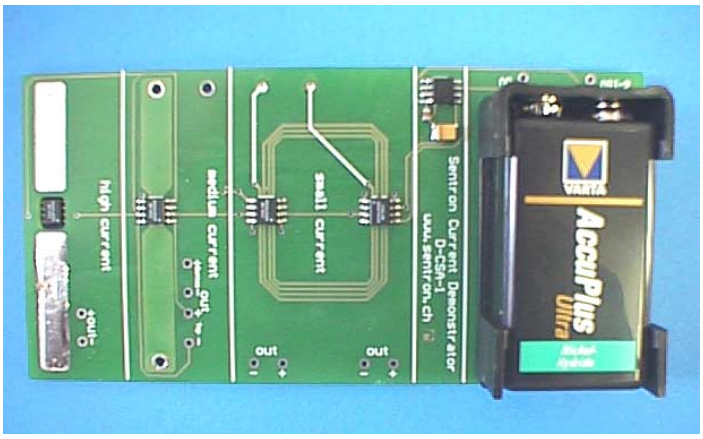
Application Evaluation Kits

The following application evaluation kits shall support you to quickly evaluate our Hall sensors for your application. They are conceived in a way to plug-and-play to let you “feel” what IMC-Hall is about.

Current-Sensor Application Evaluation Kit: D-CSA1

Our **Current Sensor Application Evaluation Kit D-CSA1** allows you to rapidly test your ideas about Sentron’s novel integrated Hall magnetic sensor CSA-1.
For example, with the aid of this kit, you may easily measure AC and DC currents in the range of 0.1 .. 100 Amperes and DC .. 100kHz. You may also use it for the detection of current spikes down to a few µs.



The Current-Sensor-demonstrator kit consists of a PCB with current tracks for three different current ranges. A 9V Battery is connected to the PCB in order to supply the CSA-1 sensors with a regulated 5V voltage. Five CSA-1 sensors are included in the kit, three of them are assembled on the PCB.

The characteristics of current measurement with the three different current ranges are:

	Unit	Low current	Medium current	High current
No of tracks used for measurement	-	4	1	1 (using copper bar which is included)
max DC current	A	2	10	50
Output at Max Current	mV	400	700	2000
Sensitivity	mV/A	200	70	40
Resolution	mA	5	25	40
Linearity	%	> 99	> 99	> 99

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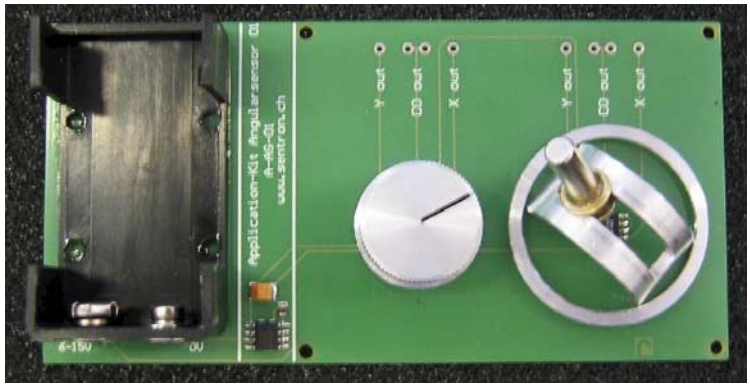
Angle-Sensor Application Evaluation Kit: A-AS01

The angle sensor application kit A-AS01 allows you to rapidly test your ideas using Sentron's novel integrated 2-Axis Hall magnetic sensor 2SA-10.
For example, with the aid of this kit, you may easily set-up and test a simple contact-less potentiometer or a joystick.

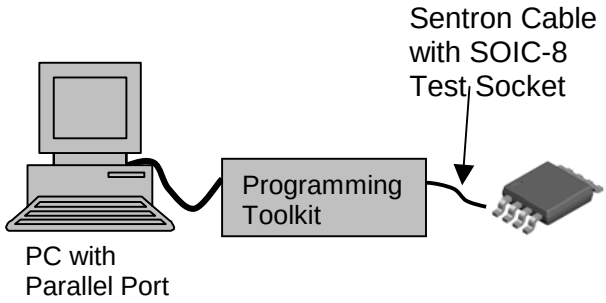


The angle sensor application kit A-AS01 consists of a PCB with the mechanical set-up for a contactless angular sensor and for a joystick. A 9V Battery is connected to the PCB in order to supply the 2SA-10 sensors with a regulated 5V voltage. Five 2SA-10 sensors are included in the kit, two of them are assembled on PCB.

Contactless angular sensor	Contactless joystick
 A 360° rotation of the magnet in the contactless potentiometer generates twohigh level analog output voltages, oneproportional to the sine and the other tothe cosine of the rotation angle.The output voltages can either bemeasured differentially 2.5 V +/- 2 V orsingle-ended with reference to supply ground between about 0.5V and 4.5V (allvoltages+/-20%)	 The X and Y outputs from the 2SA-10 are proportional to the projection of the magnetic field vector into the sensor plane. Therefore the output signals are proportional to the inclination angle with about 2.5 +/- 0.8 V. (+/-20%)

Sensor Programming Toolkit

The **Sentron Sensor Programming Toolkit** is used to test/program the sensors CSA-1 / 1SA-1 / 2SA-10.
The Toolkit contains all necessary parts like AC power connector / cables / programming board / software. It can be easily configured to program different sensors by using the corresponding Sentron Configuration Connector.



Programming procedure

You will succeed in programming your sensors by following a step-to-step programming procedure:

1. Connect the sensor
2. Turn power on
3. Select RUN mode
4. Modify Bits and test the setting by selecting TEST. You can TEST several times until you have the correct setting.
5. PROGRAM the sensor
6. Check correct programming by performing RUN
7. Turn power off
8. Disconnect sensor

The Programming Toolkit features three different modes of operation:

- **RUN mode**
  This mode just supplies power to the sensor. It is the normal operation mode of the sensor. The sensor uses the data, which is stocked in its PROM memory.
- **TEST mode**
  This mode allows you to operate the sensor with various programming settings without really programming the sensor. You may vary parameters like sensitivity, offset, temperature coefficient etc several times until you reach the best combination for your application.
- **PROGRAMming mode**
  This mode finalizes the sensor programming by physically writing the programming bits on the sensor. Programming can only be performed once, therefore it is preferable to determine the parameters before using TEST mode.

Please contact sales@sentron.ch for a quotation for this product

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