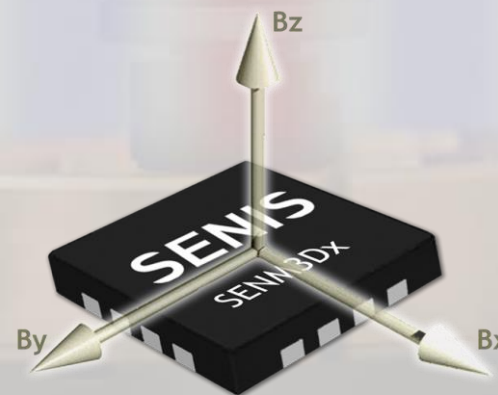


SENIS Advanced Sensors and Instruments for Magnetic Field and Electric Current Measurement

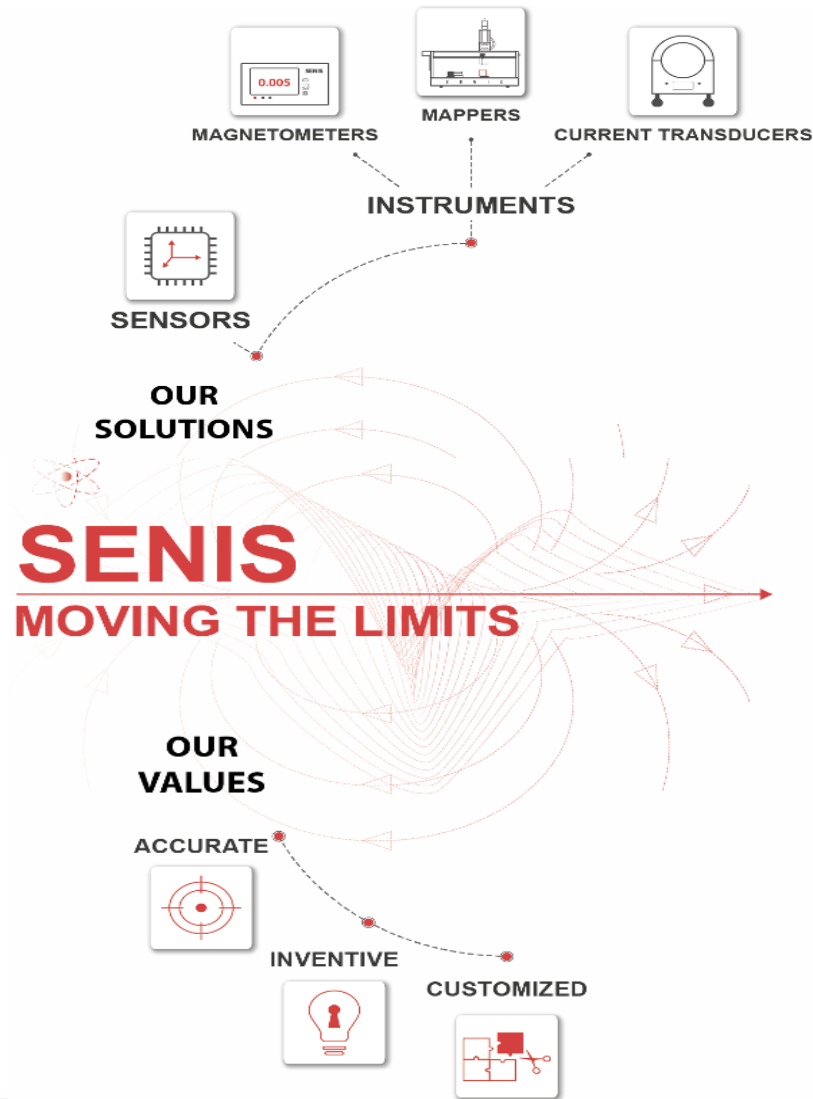
Maciej Urban,
SENIS Group, Switzerland



8.10.2024, Bad Zurzach

FROM CHALLENGES TO SOLUTIONS

Solving customer's needs



CUSTOMERS SEGMENTS



ROBOTICS



AUTOMOTIVE



ENERGY



MEDICAL DEVICES



CONSUMER ELECTRONICS

CUSTOMERS CHALLENGES



CURRENT SENSING



MAPPING & CRACK DETECTION



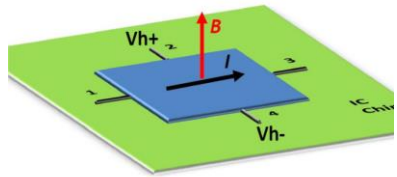
POSITION & SPEED MEASUREMENT



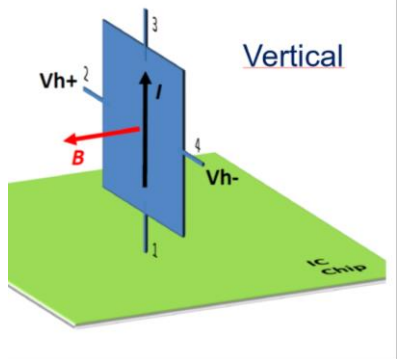
TEST & MEASUREMENT

WORLD'S MOST COMPACT CONTACTLESS SENSING IN THREE DIMENSIONS WITH **SENIS 3DHALL**

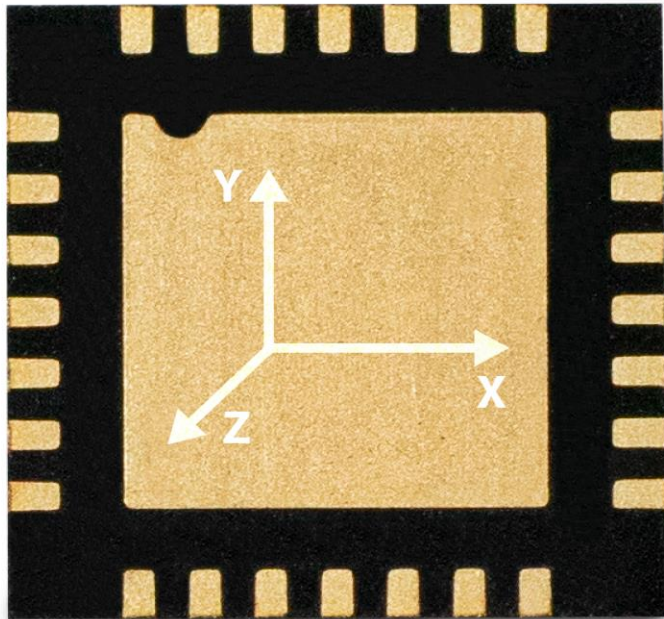
■ includes **PATENTED VERTICAL HALL**
with **highest resolution and smallest size**



Horizontal



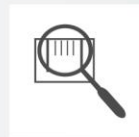
Vertical



UNIQUE VALUES



3D field sensitive spot:
100x100x10 μ m



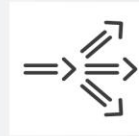
Highest magnetic
resolution: 1 μ T



High f-bandwidth:
DC - 300kHz



Selectable measurement
range: 40mT - 4T



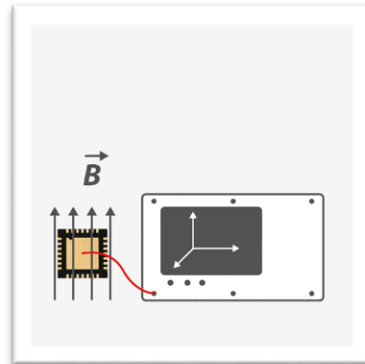
Flexible output:
Analog, SPI, PWM

Professional Sensing and Measurements

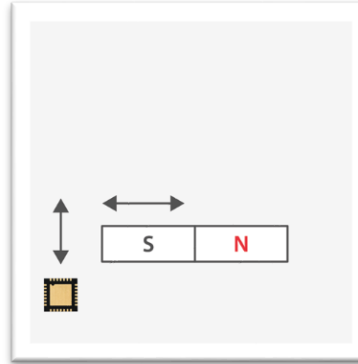
Our solutions are customer driven

TYPICAL APPLICATIONS OF HALL DEVICES

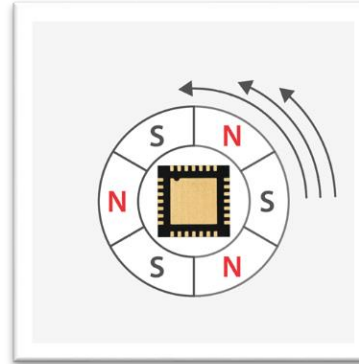
Magnetometry



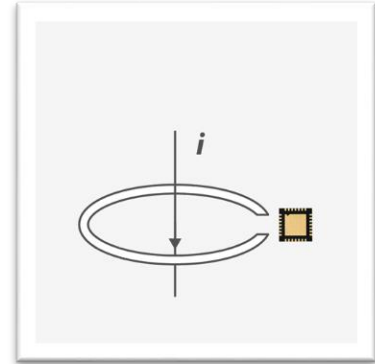
Translation Displacement



Rotary Displacement



Current Measurement



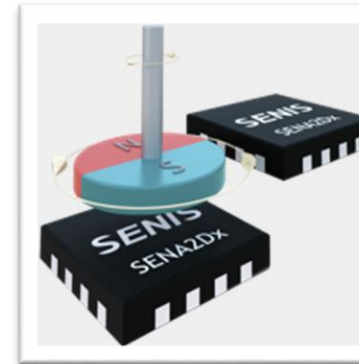
OUR SOLUTIONS TO CUSTOMERS NEEDS



Repeatable, accurate
Sync: position & map



5 x better accuracy
100 x better resolution



Direct angle info
100% faster / 0.08°




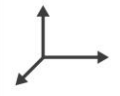
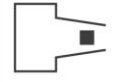

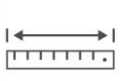
PCB mount, Clamp-on
DC/AC, high currents

WORLD'S MOST PRECISE TESLAMETER

Magnetometers for Professionals



UNIQUE VALUES

-  High accuracy:
better than 100ppm
-  3-Axis Hall probes:
8.0x4.0x0.9mm
-  Field sensitive spot:
100x100x10µm
-  Highest magnetic
resolution: 1µT
-  High measurement
range: 100mT - 20T

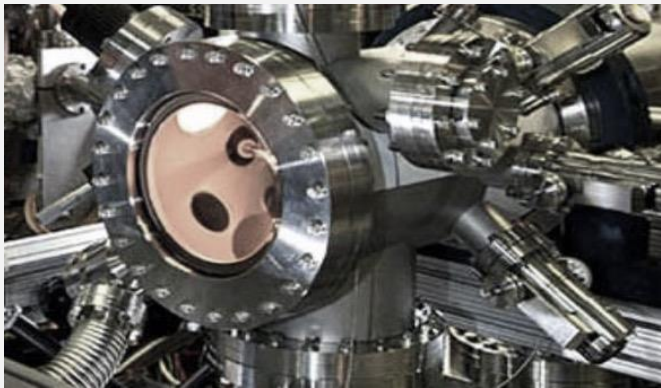
TECHNOLOGY MEETS HEALTH

From research to application

Free electron lasers: lowest noise

Local measurement, accurate positioning

Proton therapy: Radiation hard sensors



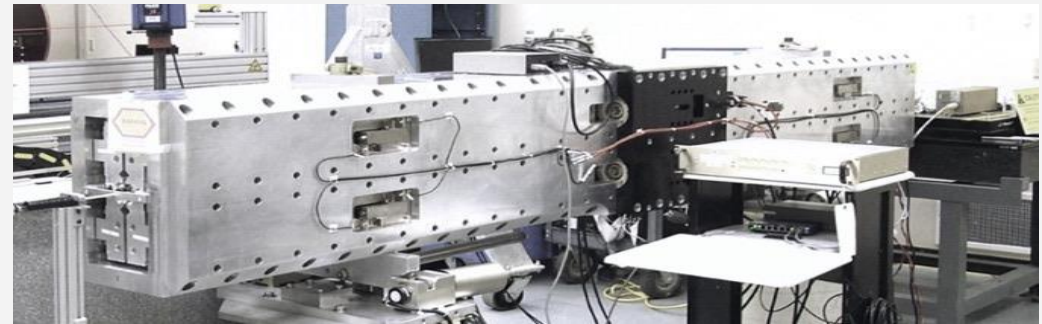
BROOKHAVEN
NATIONAL LABORATORY



MAX IV

“Our system relies on a 3D SENIS Hall probe transducer, which provides high accuracy, linearity and low noise that enabled very precise and accurate tuning of our Insertion Device.”

- **Mohammed Ebbeni**,
Research engineer at MAX IV Laboratory



SLAC NATIONAL
ACCELERATOR
LABORATORY

SENIS® F3B 3-AXIS ANALOG MAGNETIC TRANSDUCER

Application at customer side: Inline Inspection

New: industrialized to ramp up quickly

- 3-axis
- smallest FSV
- FSV to object 0.1mm



HITRIplus - Heavy Ion Therapy Research Integration



CNAO

BEVATECH

cea

CERN European Organisation for Nuclear Research

Laboratorio Nacional de Fusión Ciemat

COSYLAB

GSII
GSI Helmholtzzentrum für Schwerionenforschung

INFN Istituto Nazionale di Fisica Nucleare

MedAustron

PAUL SCHERRER INSTITUT PSI

1862 RIGA TECHNICAL UNIVERSITY

SEE IST South East European International Institute for Sustainable Technologies

UKGM UNIVERSITÄTSKLINIKUM GIESSEN UND MARIENBURG

UNIVERSITÄTSKLINIKUM HEIDELBERG

L-Università ta' Malta

Philipps Universität Marburg

UPPSALA UNIVERSITY SWEDEN

wigner

KLINIČKI CENTAR Črna Goră

Jožef Stefan Institute

SENIS magnetic & current measurement

UPPSALA UNIVERSITET

UPPSALA UNIVERSITY SWEDEN

HITRI
Heavy Ion Therapy Research Integration

Cyrl and Methodius University in Skopje

www.hitriplus.eu



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101008548

SENIS
magnetic & current measurement

SENIS Magnetic Field Mapping Systems family



M3D-2A-PORT



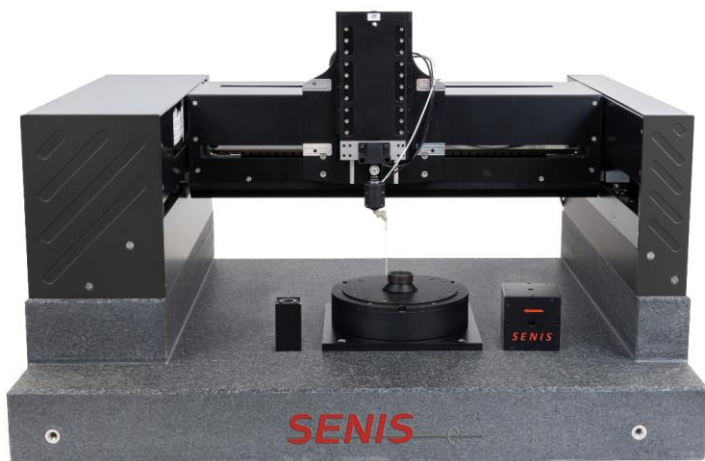
MMS-2A-ROT



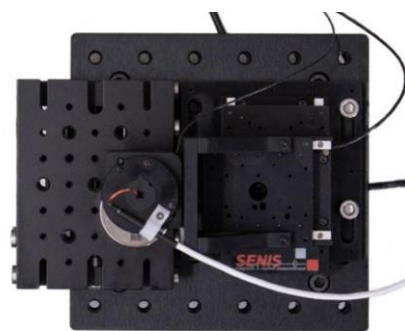
MMS-1A-RS



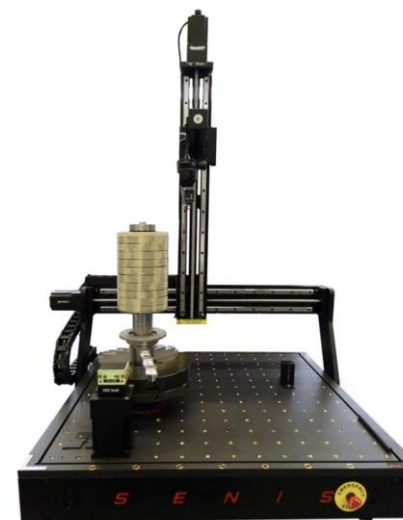
MMS-1X-RS



MMS-1G-RS



Special Mapper Solutions



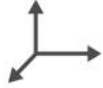

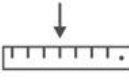
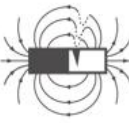

TRUE 3D Magnetic Field Mapping with SENIS 3D Mapper

“We are happy to have found a measuring System, which gives us the opportunity to make a statement about the quality of our rotors as well as to develop certain performance aspects and increase development potential.”

Mr. Christian Kienzler, Quality Engineer
Elektric/Hybridsystem Formel E, **Porsche AG**



UNIQUE VALUES

-  3-Axis Hall probes:
only 0.5mm thick
-  Accurate mapping:
better than 0.1%
-  Position repeatability:
 $\pm 5.0\mu\text{m}$ / ± 0.025
-  Highest flexibility:
crack detection,
advanced analysis
-  Measurement range:
100mT - 2T / 1mT

SENIS 3D Magnetic Field Mapping System for Beam Lines application



“We are very satisfied with the SENIS mapper and we especially appreciate the ease-of-use of the tool. Yet, the tool returns precise magnetic field data. We like that the software is very much visive, i.e. it shows 'almost real-time' measurements allowing a first order evaluation of the gradient of our quadrupoles”

Grazia Laricchiuta, PhD,
Accelerator Physicist – Particle Accelerator Department,
LinearBeam S.r.l., Italy



ACCURATE



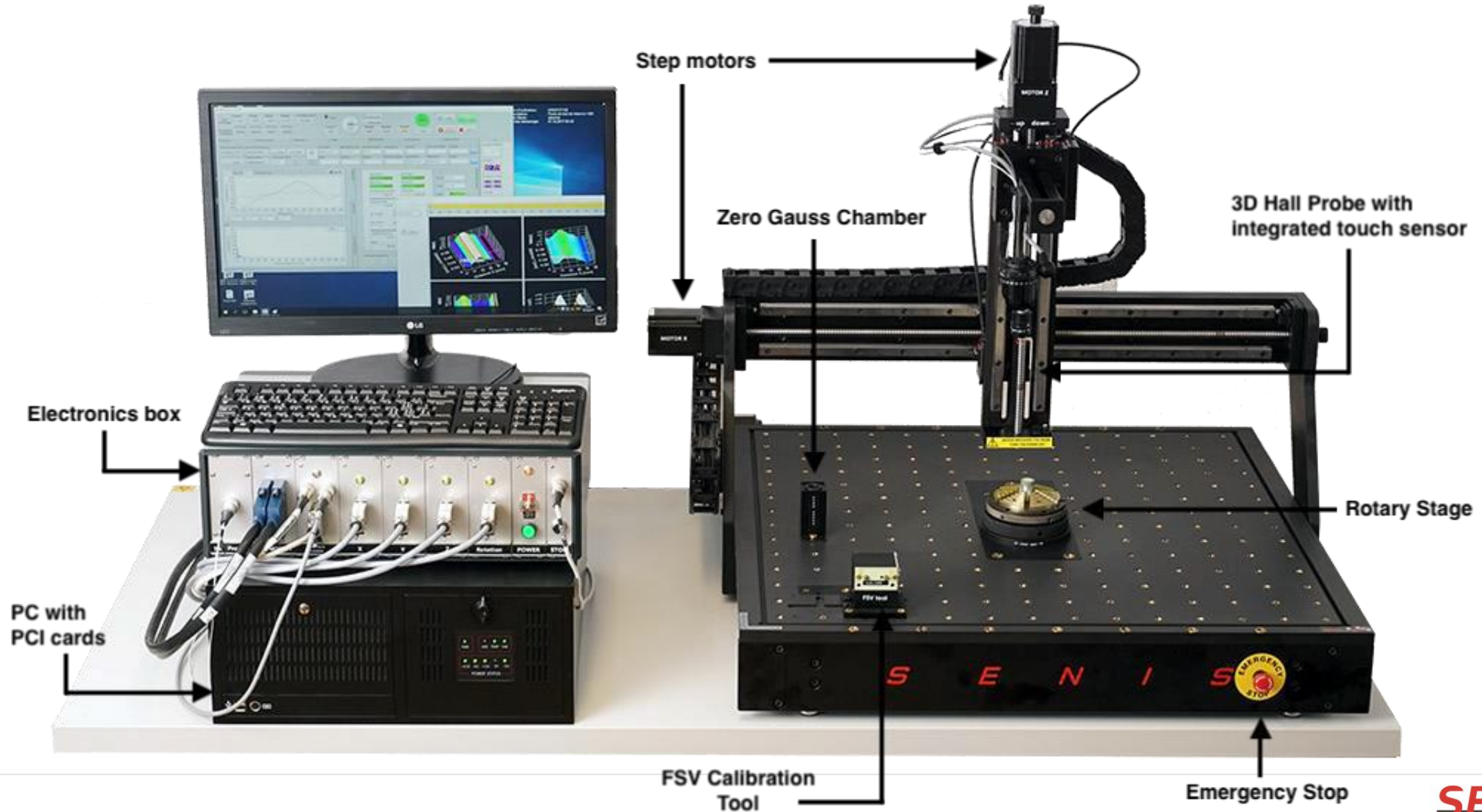
INVENTIVE



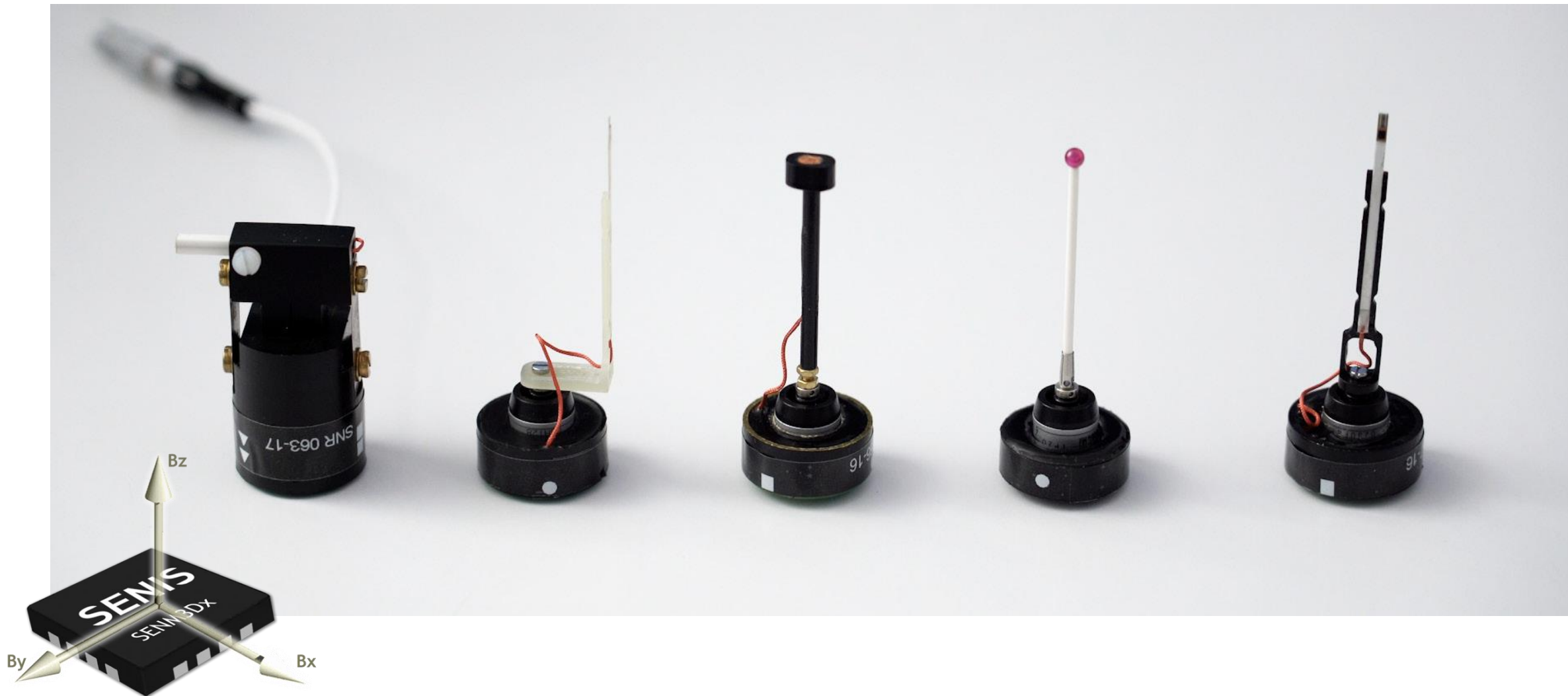
CUSTOMIZED



TRUE 3D Magnetic Field Mapping with SENIS 3D Mapper



SENIS 3D Magnetic Field Mapper Probes

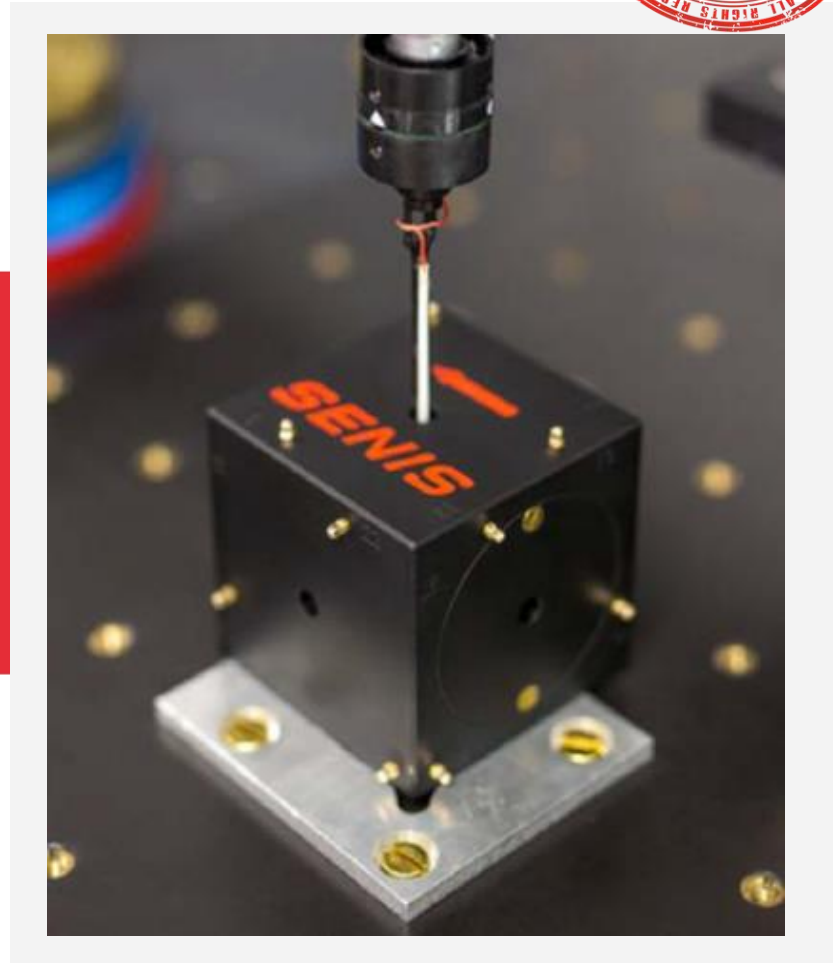


Calibration

- SENIS' calibration laboratory is ISO 17025 accredited
- SENIS has a patented solution for orthogonality calibration

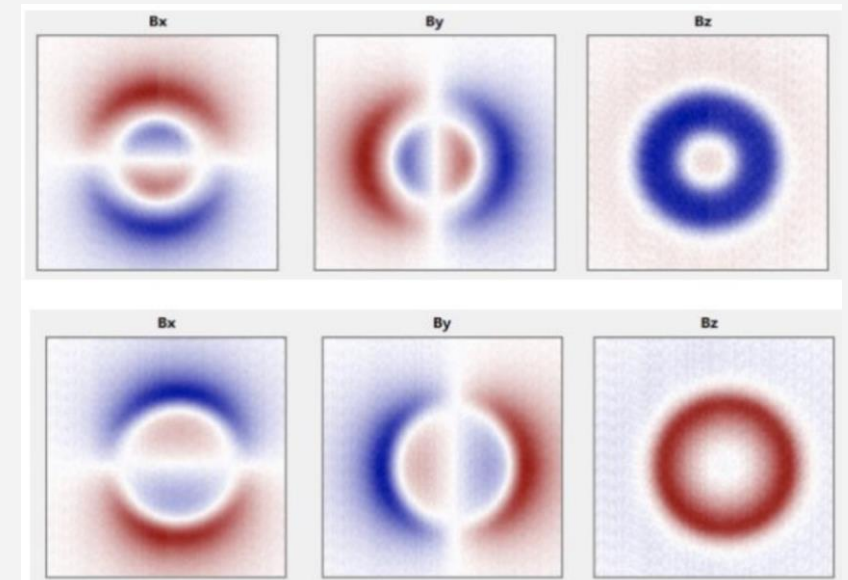


- ▶ Accredited calibration lab: ISO 17025:2017
- ▶ Quality system: ISO 9001:2015
- ▶ Business continuity: ISO 22301:2019



SENCAM – Pure 3D Magnetic Field Camera

World's first Magnetic Field Camera that truly measures in 3D



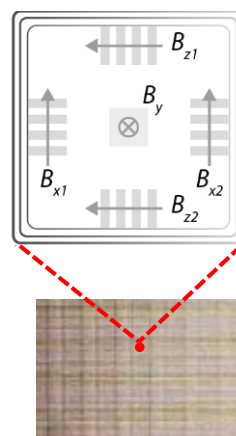
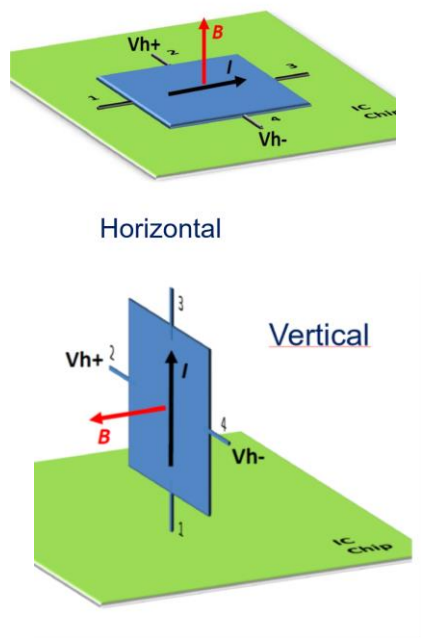
3-AXIS HALL

Measuring the same point in all directions

THE INNOVATIVE SOLUTION: ALL-IN-ONE INTEGRATION ON SILICON-CHIPS

3D sensor = 1 pixel in the magnetic camera
PURE 3D Hall sensors enable instant measurement of the B_x , B_y , B_z components in the World's smallest sensor FSV

ROBUST, COMPACT,
ACCURATE & STABLE
PURE 3D Magnetic Camera:
128x128 pure 3D Hall sensors = 16'000 pixels



The **smallest** sensitive volume of each pixel!
High mutual **orthogonality of the sensitivity axes!**
Equal performance for Horizontal and Vertical Hall sensors integrated in PURE 3D HALL technology!
SENIS is the World's leader in 3D Hall technology!

SENCAM – Pure 3D Magnetic Field Camera



World's first true 3D Magnetic Field Camera

- Measuring all three magnetic field components (B_x , B_y , B_z) in every pixel
- 16,000+ pixels.

50x smaller FSV than any competing technology

- Spatial resolution 100 μm
- Tiny FSV 27 μm x 9 μm x 4 μm in each pixel

7x faster than the competition

- Up to **seven** images per second!

Unique, Innovative Solution

3D Magnetic Camera combined with Optical Camera (SENCAM-OPT)



Optical Camera

Magnetic Camera in a mechanical holder

Industrial Computer compatible with industrial standards and protocols

Optical Image matched with Magnetic Image

Optical Image

Precise measurement of object's geometry and magnetic field distribution

- within the same coordinate system
- combined with optical camera and innovative packaging

Seamless integration into your existing setup and professional vision software for manufacturing

- gives access to ready-to-use routines and machine learning

K3A: Cryogenic Low Noise Magnetic Field Transducer

Magnetic Measurement at Cryogenic Temperatures with Ultra-High Resolution and Accuracy



KEY FEATURES & VALUES

- Measures 3D (B_x , B_y , B_z) magnetic fields at cryogenic temperatures down to about 1 K
- Highly compact sensor head:
4.5 x 4.5 x 9 mm
- World's smallest field sensitive volume
of less than 0.6 mm³
- Stable, low noise, ultra-high resolution
and low drift electronics
- Accurate calibration of 0.25 % at fixed
temperature down to 5 K available as option
- High field calibration
up to ± 9 T available as option

K3A Cryogenic Low Noise Magnetic Field Transducer Probe Options

External dimensions of the probe are 9.0 x 4.5 x 4.5 mm.

With the three Hall sensors arranged in a cube, this probe also features the world's smallest 3D (Bx, By, Bz) magnetic field sensitive volume of <math>< 0.6 \text{ mm}^3</math>.

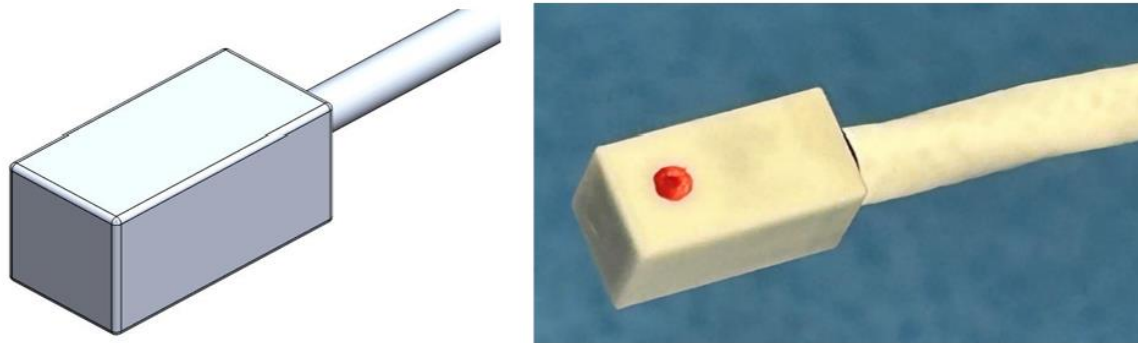


Figure 1: Standard SENIS prismatic-shaped 3D cryogenic Hall probe. Red point denotes the upper surface of the probe.

The newest SENIS cylindrical-shaped probe (OD <math>< 3 \text{ mm}</math>, length 10 mm) is the world's smallest compact 3-axis cryogenic Hall probe that is specially designed for measuring the magnetic fields inside the apertures which cross-sections are $\geq 3 \text{ mm}$. With the three Hall sensors arranged along its longitudinal (Z) axis, this probe also features the world's smallest 3D magnetic field sensitive volume of <math>< 0.4 \text{ mm}^3</math>.

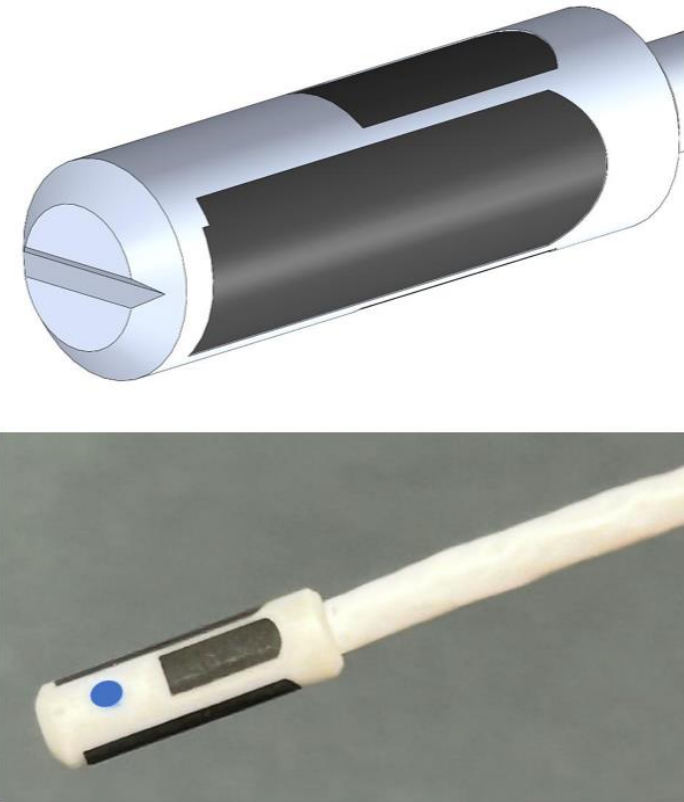


Figure 1: 3D cylindrical-shaped Hall probe type for K3A Cryogenic magnetic field transducers

SENIS Current Sensors

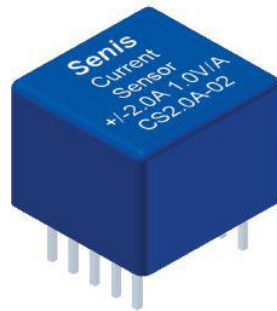
BBM-03 series



CTH Series



CS-03 Series



Clamp-On Open-Loop DC MicroAmmeter & Insulation Fault Detector

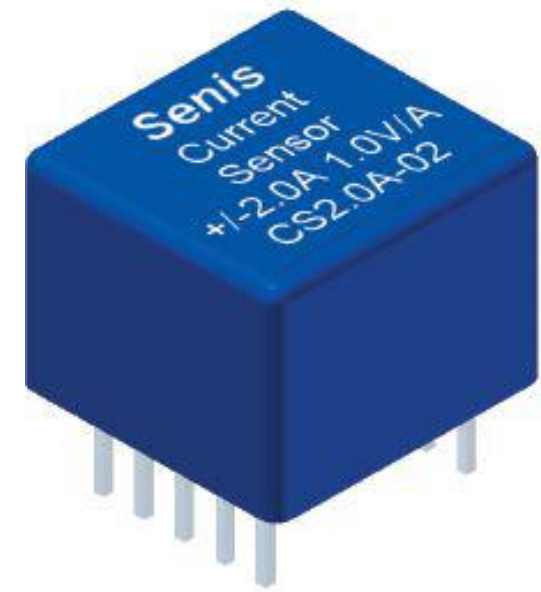


SENIS Current Sensors in CERN Application



“A first prototype of the new boards with the SENIS component has been successfully tested and a full production is about to be launched for installation end of 2024.”

Sune Jakobsen, CERN



■ THANK YOU!

SENIS
magnetic & current measurement
www.senis.swiss