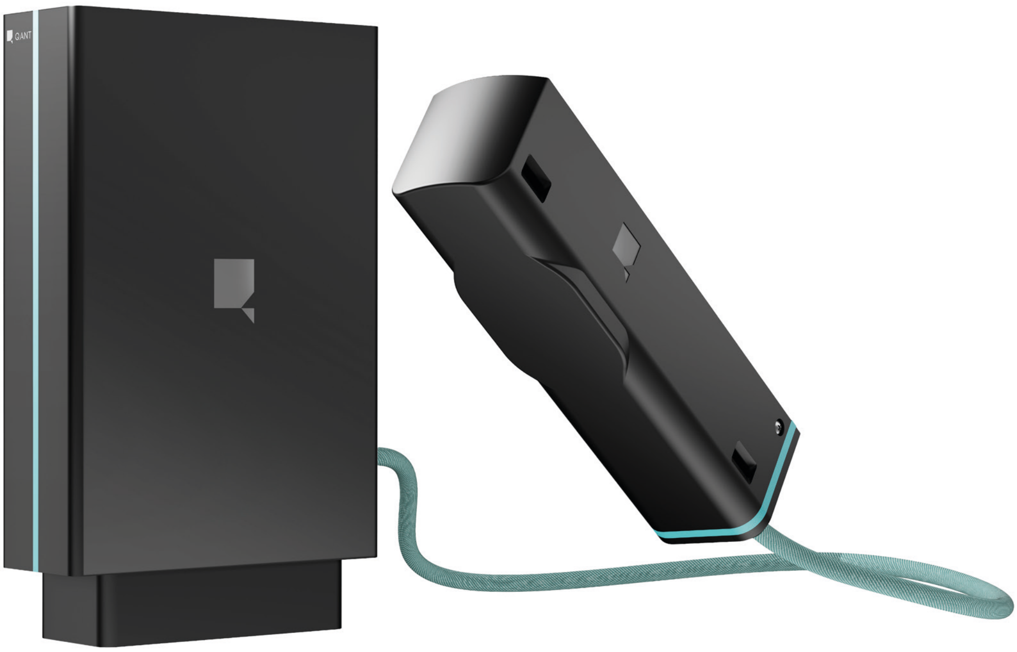
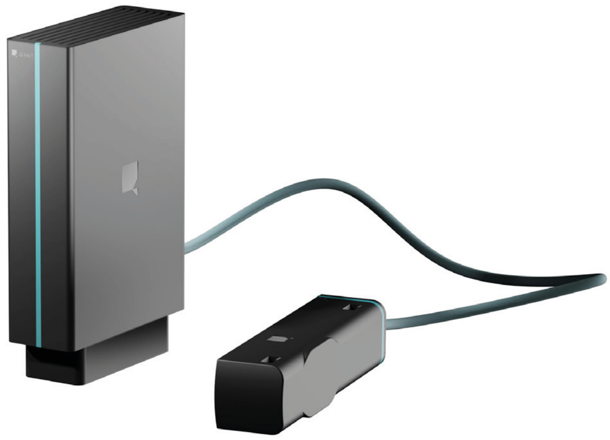


Quantum magnetometer:
New Definition of Magnetic Field Sensing

Highest sensitivity, room temperature operation
and compact design for medical and industrial appications

20 pT/√Hz: Quantum technology opens up new dimensions in magnetic field measurements

High-sensitivity magnetic field measurements previously required bulky equipment and special laboratory conditions. The Q.ANT magnetometer works under everyday conditions. High-precision magnetic field measurements can thus be rethought. The system consists of electronic components and fibre-coupled sensor heads, which are placed at the actual measuring point. This significantly simplifies integration into applications, and makes the sensor robust and mobile enough to be used and applied in everyday situations.
The sensor system is taking the sensitivity to the next level with the gradiometric approach. It allows for effective compensation of surrounding stray fields just as in noise cancellation headphones by using an additional sensor picking up only surrounding stray fields.



The advantages

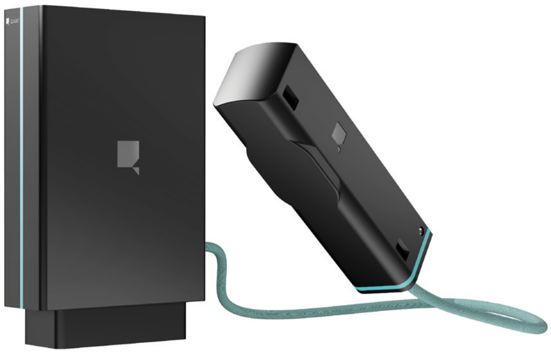
- Extremely high sensitivity under everyday conditions
- Wide dynamic range: Detects very small magnetic field changes even with strong background fields
- High spatial resolution
- Detection of magnetic field direction: Allows e.g. conclusions about the location of the magnetic field source
- Elimination of interfering signals

The physical principle behind the system

Based on the principles of quantum physics, nitrogen vacancies (NV) in diamonds can be used to high-precisely measure physical quantities such as magnetic fields. The NV magnetometer of Q.ANT allows the measurement of very small magnetic fields in the range of 20 picotesla at room temperature in a compact size.

Until now, this sensitivity range was only achieved by cooling sensor systems to an absolute zero at -273 °C or by heating up to 150 °C. As an outlook, under laboratory conditions, sensitivities in the sub-picotesla range have already been achieved.

Performance data of the technology demonstrator

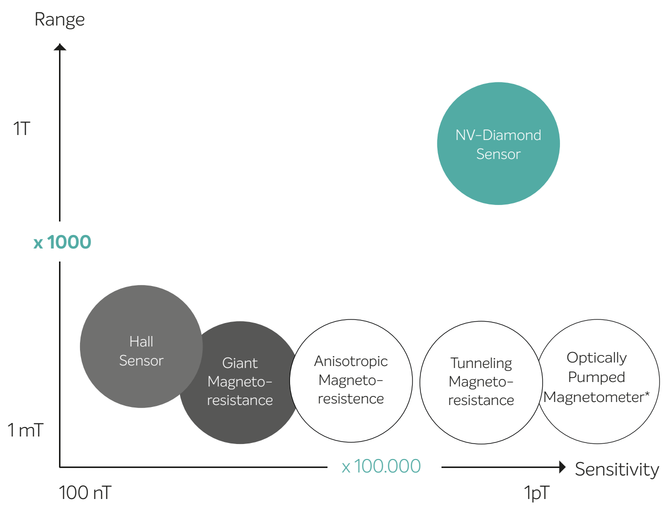


Size electronics	160 x 100 x 50 mm
Size sensor head	60 x 40 x 100 mm
Weight	600 gr
Energy consumption	10 W
Interface	Ethernet
Resolution	20 pT/√Hz
Sensor size	0.5 x 0.5 x 0.5 mm
Dynamic range	2.7 µT (optional: resonance locking)
Laser wavelenght	520 nm
Frequency bandwidth	3kHz

An Outlook on the future of magnetometry

2023 PORTABLE MAGNETOMETER	**2024** INTEGRATED GRADIOMETER	**2025** UNSHIELDED INTEGRATED GRADIOMETER	**2026** PORTABLE GRADIOMETER	**2027** PORTABLE GRADIOMETER
Dimension <1000 ccm	Dimension 1000 ccm	Dimension <500 ccm	Dimension <300 ccm	Dimension <100 ccm
Sensitivity Performance 100 pT/√Hz	Sensitivity Performance 20 pT/√Hz	Sensitivity Performance 20 pT/sqrtHz	Sensitivity Performance 10 pT/sqrtHz	Sensitivity Performance < 10 pT/sqrtHz

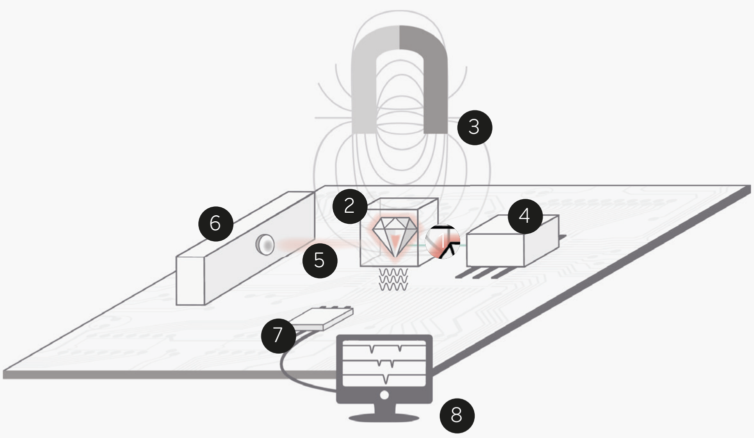
Advantages of diamond magnetometers over state-of-the-art magnetometers



*Further restrictions of OPMs: Low bandwidth of 200 Hz, Operation temperature 120 °C

- Room temperature operation
- High sensitivity (pT/sqrt(Hz))
- Large bandwidth (dc – kHz)
- Large dynamic range (up to several T)
- Contactless measurement
- Vector-magnetometry integratable
- Miniaturizable
- Biocompatible

NV Magnetometry: How the Q.ANT magnetometer works



1. Diamond: located at the heart of the sensor, the diamond becomes magnetic field sensitive by inserting an atomic lattice vacancy and a nitrogen atom, a so-called NV doping

2. Microwaves: bring the NV dopants into a magnetic field sensitive state

3. External magnetic field: has an effect on the sensor

4. Green laser: radiates onto the NV diamond and makes the NV dopants fluoresce with red light

5. Red fluorescent light: changes when external magnetic field changes

6. Photodetector: detects the fluorescent light

7. Control unit: processing of photodetector data

8. Monitor: user-friendly display of the signal

High precision magnetic field measurement for industry and science

NV magnetometers have been researched in science for many years. Under laboratory conditions, the suitability of the NV sensors for measuring the smallest magnetic fields down to below 1 pT could be demonstrated. This corresponds to magnetic fields that are 50,000,000 times smaller than the earth‘s magnetic field. Physical quantities such as temperature, current flow and pressure can also be resolved with the sensors. Q.ANT has set itself the goal of translating this technology into reliable sensors suitable for industrial use. Concrete scenarios are currently emerging in these areas:

Prosthetics

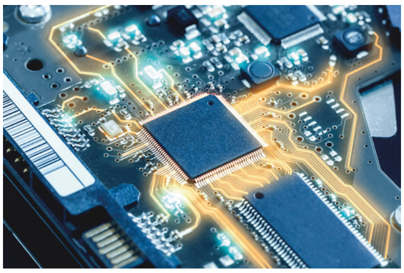
Locally resolved measurement of muscle signals for the control of prostheses and exosceletons enabling a new kind of Human-Machine-Interface

Medical Technology

Early detection of brain diseases and localized measurement and detection of muscular signals, heart and patient monitoring

Automotive and Mobility

Applications in localization, navigation, identification and communication

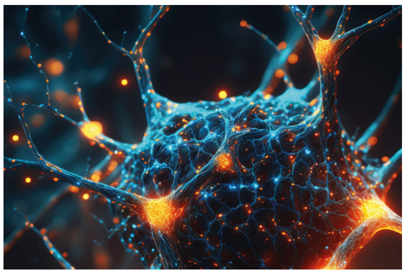


Electronic and Material Control

Quality control or failure analysis for electrical and electronic components, e.g. circuit carriers or hard disks; detection of fault currents in power chips or batteries. Identification of defects in the material structure of components

Geophysics

Exploration of magnetic fields in the Earth‘s interior for the investigation of plate tectonics and mineral deposits



Materials Science and Nanotechnology

Characterization of magnetic materials and nanoparticles. Investigation of biological processes and nanoscale magnetic phenomena in biophysics and nanotechnology

Q.ANT

Everywhere where finest currents have to be measured, the quantum magnetometer opens up new possibilities. This technology enables a wide range of future-oriented applications in industry, research and medical technology, all the way to human-machine interaction.
The control of prostheses by muscle signals with the quantum magnetometer is a realistic scenario.

Michael Förtsch, Founder and CEO, Q.ANT

Q.ANT makes quantum technology applicable for numerous industries and use cases. Founded in 2018 in Stuttgart, the company develops quantum sensors and photonic quantum computing chips in four product lines. Photonic Quantum Computing, Particle Metrology, Atomic Gyroscopes, and Magnetic Field Sensors.

Q.ANT GmbH
Handwerkstraße 29
70565 Stuttgart, Germany
+49 711 45969613
info@qant.de

www.qant.com/magnetometer