First Sensor

Industrial

Individual sensor solutions for the industrial sector

Our applications and products

First Sensor AG is one of the world‘s leading suppliers in the field of sensor systems. Our company develops and manufactures standardized and customized sensor solutions for applications in the Industrial, Medical and Mobility growth markets.

Developing tomorrow‘s products together today

First Sensor AG is one of the world‘s leading suppliers in the field of sensor systems. Our company develops and manufactures standardized and customized sensor solutions for applications in the Industrial, Medical and Mobility growth markets. With over 800 employees, we are represented at six German locations and also have sales and production sites in the USA, Canada, Singapore, China, Great Britain, France, Sweden, Denmark and the Netherlands along with a worldwide partner network.

> Our sensor solutions stand for technical innovation and economic growth. After all, they are a firm basis for the development and use of intelligent technologies.
>
> Dr. Martin U. Schefter, CEO of First Sensor AG

The digitalization pervading practically all areas of life is an integral element not just of industry but also everyone‘s daily routine. Innovative applications such as smart home products and the Internet of Things create new growth markets. Here sensor systems are taking on the role of a key technology. Smart sensor solutions for complex applications are drivers for the future. They record relevant values, process data resulting from this and enable an appropriate response in intelligent systems based on this. Against this background, we aim to retain our leadership in innovation, expand into selected areas and support you as a professional partner in the development of innovative products with genuine unique selling propositions.

A crucial advantage of First Sensor is our ability to handle the entire value added chain in sensor technology, from the wafer to the smart sensor system. We also have the in-house technologies needed to combine the properties of materials and components in innovative ways as part of sophisticated processes. Our specialists are committed to researching all aspects of high-quality sensor systems, allowing them to continually spur innovation and make it a reality.

This acts as an ideal platform on which to realize high-performance projects and thus consolidate our market leadership. By 2019, we shall be among the top 3 suppliers in our core markets.

Our expertise – Your success

We have developed into an integral, internationally oriented technological company over the past few years. Numerous long-standing customer relations with OEMs, system providers and device manufacturers vouch for our professionalism and expertise.

We can advise you what sensor is best suited to your application or whether a custom solution might even attain a better „total cost of ownership." We place great importance in understanding your application so that we can literally „talk the same language." No matter whether specific quality criteria have to be complied with or new developments are to be integrated promptly and seamlessly in the existing technological environments. Our project management expertise ensures that all process steps are oriented to your needs – from development and production to quality testing and logistics.

Innovative products are frequently associated with high investments and quality standards. That makes long-term production and supply certainty all the more important. Our project

1 State-art-the-art production in our own clean rooms

team can therefore accompany you through the entire process while offering advice on all levels.

You will already find the right solution to many applications in our wide and field-tested range of high-performance product platforms: We detect light, radiation, pressure, flow, level and acceleration. Our sensors can also be adapted specifically to your application or even developed individually. This will help you to save time and resources!

Triple the experience and innovation

First Sensor is organized into three Business Units: Industrial, Medical and Mobility. These Business Units are networked with our Competence Centers Research & Development and Production as well as Sales via all levels. This organizational structure enables us to orientate our research and development along with production to your specific performance requirements.

Proximity to markets and customers is for us the key to economic success. The development and production of sensor solutions with you and for you is therefore the central focus of our business model. We see you and your markets from a future-oriented perspective and ask questions like: In what direction are the markets developing? What will be needed in the years ahead? Where can we offer you added value and a competitive advantage? The answer to these and similar questions is custom sensors and sensor system solutions from our company – smart, miniaturized and reliable.

This market- and customer-oriented strategy is reflected in our corporate structure. The **Business Units Industrial, Medical and Mobility** are clearly aligned to the core markets of industrial applications, medical technology as well as automotive and transport. These core markets all share common ground: They combine above-average growth and a technological challenge that can only be mastered by an innovative and professional company like First Sensor.

Our **Business Unit Industrial** has many years of experience and expertise in development and production engineering, allowing it to offer a wide variety of high-quality sensor solutions that can be adapted to your specific requirements. The focus of the applications includes length measurement, radiation and security, building automation and HVAC systems as well as industrial process control. Another complex field of application is aerospace. Here some of the requirements are very high, which in turn calls for our custom solutions.

First Sensor has been manufacturing and supplying sensor solutions for medical technology for over 30 years and has extensive experience in this field. Our specialists in the **Business Unit Medical** are dedicated to not simply providing sensor solutions but also finding and implementing the solution for the relevant measuring task that is the best possible in terms of technology and also affordable. Medical technology is there to save lives, enable patient healing, improve medical treatments and help those affected gain a better quality of life. That means we have to take a special degree of responsibility as a company – a challenge we gladly rise to.

We are about to enter a new era in mobility. Smart mobility has already become an everyday feature in new automobile models: With driver assistance systems from automatic start-stop systems and parking aids to options for semi-autonomous driving. The foreseeable future is set to witness fully autonomous vehicles that can transport their occupants safely and comfortably from A to B. The **Business Unit Mobility** will accompany the automotive industry into this new era with its sensor solutions.

Our Business Units work closely with you in the development of new sensor solutions right from the start. You describe your application, and we contribute the technical standards and our expertise. This means we can jointly configure a perfectly tailored solution. The spectrum ranges from wafers and individual sensor components to conventional sensors and smart sensor systems.

Industrial

Optical and radiation sensors for

- Laser rangefinders
- Laser scanners/LIDAR
- Laser alignment systems
- Encoders
- Spectrometers
- Baggage and container scanners
- Passenger counters

Pressure, flow and level sensors for

- Volumetric flow controllers
- Filter monitoring
- Leak detection
- Level sensing
- Industrial printers
- Cabin air pressure

Inertial sensors for

- Condition monitoring
- Control and navigation systems

Highly accurate inertial sensors for condition monitoring

Medical

Optical and radiation sensors for

- Computer tomographs
- Videoscopes
- Pulse oximeters
- Blood sugar measuring devices
- Gamma probes

Pressure, flow and level sensors for

- Respiratory devices
- Sleep diagnostic devices
- Sleep apnea therapy devices (CPAP)
- Spirometers
- Anesthetic devices
- Dialysis machines
- Infusion pumps
- Oxygen concentrators
- Insufflators

Highly reliable pressure and flow sensors for respiratory devices

Mobility

Cameras and optical sensors for

- Advanced driver assistance systems
  - LIDAR
  - ACC (Adaptive Cruise Control)
  - Collision avoidance systems
  - Traffic sign recognition
  - Blind spot detection
  - Lane departure warning
- Sun and rain sensors

OEM pressure sensors for

- Tank pressure measurement
- Fuel delivery
- Tank leakage diagnostics
- Tank air intake and extraction
- Brake booster systems
- Start-stop systems
- Power-assisted steering
- Engine suspension
- Air-conditioning systems
- Exhaust gas recirculation systems
- Filter monitoring

Camera systems and optical sensors for advanced driver assistance systems

Sensor solutions for industry

Within the First Sensor brand, the Industrial business unit offers innovative sensor solutions backed up by many years of technical manufacturing expertise. We define quality based on our superlative products, which make a reliable and lasting contribution to the continued success of our customers.

Sensors in industrial applications reveal the entire spectrum of parameters covered - light, radiation, pressure, flow, level, or acceleration. In this respect, sensors often form the core element in their products and solutions and have a decisive influence on the quality, economic efficiency, and safety of the application by controlling key process parameters. For this reason, we take great care in our development, production and service activities – working in accordance with certified processes and procedures. From bare sensor elements and media-isolated industrial transmitters to complex systems, we offer innovative sensor solutions and a broad spectrum of technologies across the entire value chain.

First Sensor has the technology, capacity, and experience to adapt and optimize its sensors to your specific applications and markets. In the Industrial business unit, we offer specialized technical expertise, comprehensive consultancy services and customized quality products for the core areas of length measurement, radiation and security, building automation and HVAC systems, industrial process control and aerospace. We are the right partners for customized sensor technology if you do not have sufficient in-house development and production resources, if you want to limit cost and technology risks, or if you simply want to focus on your core activities. Save on time-consuming research - ask our experts about the optimum sensor solution for your industrial application. Our ultra-modern semiconductor production facility with its dedicated clean rooms allows you to plan flexible batch sizes to suit your needs.

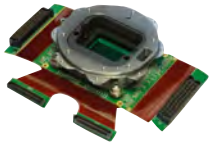
We can give you the edge in terms of technology so that you can manufacture long-lasting measuring devices and machines of very high precision – for use in production and quality assurance, research and development or maintenance and monitoring. The application areas for our high-quality sensors in industry are extremely diverse: They can detect the smallest amounts of light in optical distance measurement. They help screen items of baggage and freight. They monitor air flows in HVAC systems. They recognize levels and pressures in tanks and can detect positions and acceleration when monitoring the condition of buildings.

The entire value added chain

WAFER + COMPONENT

SENSOR

SYSTEM



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ELECTRONIC ENGINEERING & MANUFACTURING SERVICES

Supply chain flexibility will become increasingly important for you. As a reliable partner, we offer a range of services from tailored solutions to integration in your value and supply chain. As a global provider of sensors, we maintain an extensive international presence– with our corporate headquarters in Germany as well as sales and production locations in Europe, America, and Asia. Talk to us – and reap the benefits of the perfect sensor solution from First Sensor for your specific industrial application.

1 State-of-the-art production in our own clean rooms

Length measurement

Industrial optical length measurement delivers swift and reliable measurement results with ultra-high precision over short and long distances. First Sensor develops and manufactures detector solutions for optical distance measuring devices such as laser rangefinders, laser scanners, LIDAR systems, and encoders. We optimize our photodiodes for your special requirements, for example, with reference to sensitivity, amplification, rise time, or Capacitance.

Laser rangefinders

Laser rangefinders have numerous applications and are used, for example, to measure rooms and buildings in the construction sector and for distance measurement in industry. In most cases, the devices use a continuous laser beam with a modulated intensity and measure the phase shift of the laser beam reflected by the object in comparison to the output beam (phase measurement process). Laser rangefinders use sensitive avalanche photodiodes that enable them to cover ranges of up to 200 meters.

Our sensor solutions for laser rangefinders

Avalanche photodiodes (APDs) from First Sensor are optimized for various wavelengths from blue (400 nm) to infrared (1064 nm). Series 8 and 9 have their highest sensitivity at 650 to 850 nm or 905 nm and are used in many laser rangefinders. Series 10 is particularly suitable for all applications using Nd:YAG laser beam sources at 1064 nm. Optimized for the red wavelength range, Series 12 offers extremely fast response times and can be operated with low bias voltages.

1 Sensitive avalanche photodiodes for laser rangefinders

Laser scanners and LIDAR systems

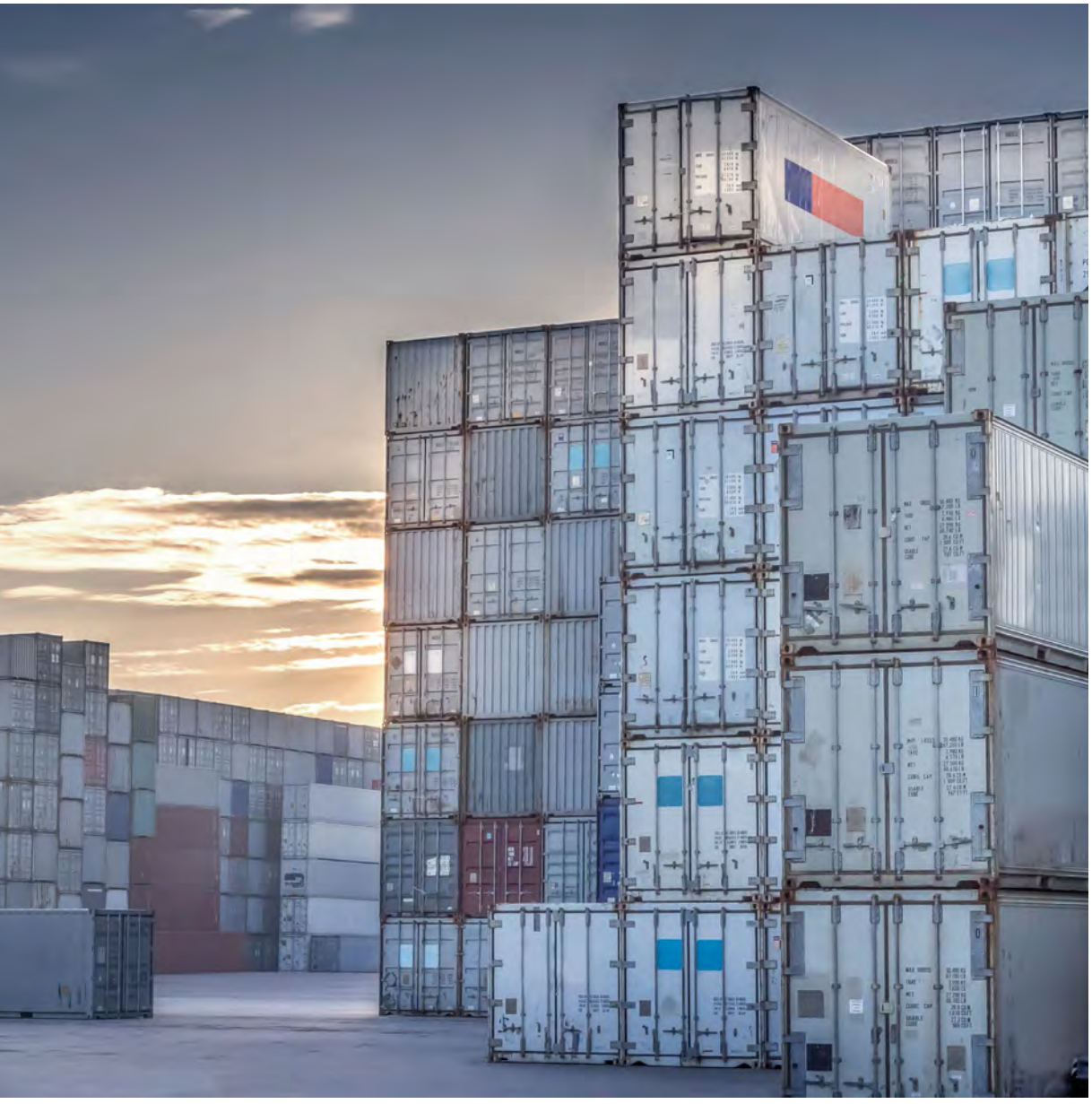
In laser scanners and LIDAR systems, the environment is usually scanned with a pulsed laser beam and the reflection time of the signal from the object back to the detector is measured. The Time-of-Flight (TOF) reflection time measurement can be used over distances ranging from one meter up to several kilometers. To increase the range of the systems, very short laser pulses in the invisible NIR range are used. These enable a higher laser power compared to continuous wave lasers while still complying with eye safety requirements. During the scanning process, the systems gather individual distance points within an aggregate of points, from which three-dimensional images of the environment can be computed. The laser scanners deflect the laser beam using deflecting mirrors, which enables them to achieve very wide fields of vision. Some LIDAR systems also rotate around their own axis and offer 360° all-round visibility. Modern devices achieve very high data rates with over one million distance points per second.

Our sensor solutions for laser scanners and LIDAR systems

For measuring systems based on the reflection time process using light pulses of varying intensity in the nanosecond range, First Sensor offers highly sensitive avalanche photodiodes (APDs) with internal amplification across a wide dynamic range as well as wide bandwidths. To achieve the high spatial resolutions required in optical LIDAR systems, First Sensor develops APD arrays that consist of multiple sensor elements using, for example, 8, 16, 5x5 or 8x8 pixels. For the matrix arrays, development modules that simplify the process of testing the detector are also available.

Radiation and security

Sea ports and airports use inspection and security systems such as container scanners, cargo scanners, and baggage scanners to screen and inspect vehicles, freight, and baggage. First Sensor offers a range of photodiodes and sensor systems for measuring ionizing radiation directly via the absorption in the crystal lattice or indirectly via the measurement of the luminescence radiation of a scintillation crystal.



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Freight inspection systems and baggage scanners

Freight inspection systems such as container scanners and cargo scanners screen and check vehicles and cargo in sea ports, in container terminals and at border crossings. Mobile freight inspection systems can be flexibly deployed at the area of application. Stationary drive-through systems are suitable for higher throughputs at a fixed location. With an output of up to 6 MeV, freight inspection systems can penetrate steel up to 30 cm thick. Airports use freight inspection systems and baggage scanners to carry out X-ray inspection of baggage and freight. In addition, X-ray scanners are used in forwarding agents, warehouses, and logistics companies.

Our sensor solutions for freight inspection systems and baggage scanners

For high-quality X-ray images with highly detailed resolution, precision detectors are essential. Photodiodes from First Sensor with very low dark current and low Capacitance enable low-noise X-ray images with very high contrast.

The X7 PIN photodiodes are optimized for scintillator luminescence radiation in the visible wavelength range and feature an ultra-flat design (chip-scale package). Using the latest flip-chip technology, the chip is mounted on the carrier with its active area and the contacts facing down. The chip is illuminated from the back. This enables a flat chip surface without fragile bond wires, which is ideal for the precision mounting of a scintillation crystal. By means of solder bumps and surface mount technology (SMT), multiple X7 photodiode elements can be assembled to create larger linear or matrix arrays with very high fitting accuracy. First Sensor develops and manufactures custom specific arrays, sensors, and complete systems for OEM manufacturers of freight inspection systems and baggage scanners worldwide.

1 Photodiodes and sensor systems for container and cargo scanners

2 Large detector arrays for X-ray inspection of baggage and freight

Building automation and HVAC systems

Today, modern building automation and HVAC systems intelligently match energy generation, energy distribution, air conditioning, and heat recovery to ensure that energy is used in a manner that saves resources and costs. First Sensor offers high-quality sensor solutions that range from individual sensors to complex customer-specific sensor systems that help to boost the energy efficiency of heating, ventilation, and air-conditioning systems.

HVAC systems

In HVAC systems, the ability to monitor volumetric flow rates and pressures in lines and rooms is decisive when it comes to operating heating, ventilation, and air-conditioning systems efficiently and economically. Pressure sensors are a central element for controlling the systems. To ensure compliance with strict legal requirements and to minimize energy costs, ever-decreasing measuring ranges as well as greater measuring sensitivities, accuracies, and long-term stabilities of the sensors are required. In addition, the pressure sensors must cope with particular requirements in HVAC systems, such as dust-laden air, and must be small and easy to integrate in OEM systems.

Our sensor solutions for HVAC systems

First Sensor offers a range of sensor technologies for measuring lowest differential pressures in volumetric flow controllers, ventilation ducts, rooms and filter monitoring.

Our flow-based LDE differential pressure sensors operate according to the principle of thermal mass flow measurement of air which is conducted through a very small flow channel integrated in the sensor chip. This innovative sensor technology enables highly sensitive measurement of ultra-low pressures from 25 Pa (0.25 mbar) full scale with ultra-high resolution and offset stability. Due to the minimal gas flow, the sensors are highly resistant to dust, humidity, and long connection tubes compared with conventional flow-based pressure sensors.

First Sensor‘s membrane-based piezoresistive pressure sensors from the HCL and HCLA series combine very high offset stability with low position sensitivity thanks to a special internal compensation technique. The silicon MEMS sensors achieve especially linear signal/pressure characteristic curves for pressure measuring ranges from 2.5 mbar full scale and offer analog and digital interfaces.

1

1 Sensors for measuring differential pressures in HVAC systems

2 MEMS inertial sensors for condition monitoring

2

Condition monitoring of buildings

A new generation of miniaturized sensor-based monitoring systems uses precision MEMS inertial sensors to monitor structural changes, damage, and critical stress conditions of buildings and structures. In this way, the load exerted on bridges, for example, by usage, aging, and environmental influences such as wind and temperature is recorded and checked by a dense network of sensors at various locations. Micromachining inertial sensors are also suitable for condition monitoring of wind power systems, high-current cables, and pipelines.

Our sensor solutions for condition monitoring of buildings

First Sensor operates an innovative technology platform for manufacturing precision inertial sensors that can be flexibly adapted to your customer-specific requirements. The capacitive inclination and acceleration sensors are based on single crystal silicon sensor elements and the latest micromachining technology. The MEMS sensors achieve a very high signal-to-noise ratio as well as exceptional temperature stability and can detect the smallest changes in position or acceleration. The high aspect ratio microstructures (HARMS) guarantee ultra-low cross axis sensitivities. Furthermore, patented AIM (Air gap Insulated Microstructures) technology minimizes parasitic capacitances by insulating the active areas with an air gap.

Industrial process control

Industrial process control involves monitoring and controlling machinery, systems, and processes across a large number of industries: chemicals, pharmaceutics, biotechnology, energy, water/wastewater, oil, gas, plastic, paper, food, and beverages. Nowadays, industrial preparation, processing, and manufacturing systems are highly automated in order to ensure that raw materials and energy are consumed in a conservative and efficient manner. In this context, the ability to measure pressures, levels, and flow rates reliably and precisely in harsh, humid, and dusty environments and to measure aggressive, corrosive, explosive, and other liquids and gases is essential.

1

Level sensing

Level sensing is one of the most common applications in industrial process control. Key factors influencing the choice of a suitable level sensor include the size, geometry, and material of the vessel, the presence of equipment in the tank such as agitators, and the type of process medium. Level sensors from First Sensor for industrial process control include hydrostatic level sensing as well as optoelectronic level switches and ranges from simple limit value detection to precision continuous level sensing.

Our sensor solutions for hydrostatic level sensing

For level sensing in industrial process control systems, First Sensor supplies hydrostatic OEM submersible sensors and OEM pressure transmitters for the development and construction of plants, measuring systems, and devices. In addition, we can offer you customer-specific solutions and our comprehensive technical development support.

Pressure transmitters and submersible sensors for hydrostatic measurements are sophisticated and largely resistant to corrosive and aggressive substances because the pressure gage and housing for the sensors – depending on the surrounding medium – can be made of ceramic, stainless steel, or plastic.

Our range of pressure transmitters and submersible sensors comprises the compact CTE family with slim housings, the extremely rugged BTE pressure transmitters made of stainless steel, and the KTE family with housings and pressure connections made of plastic for high compatibility with many corrosive and aggressive liquid media. Furthermore, we offer sensors with a flush-mount membrane that prevent the build-up of deposits and are easy to clean. We can adapt all pressure transmitters and submersible sensors quickly and flexibly to your specific requirements, for example, in terms of calibration, mechanical structure, process connection, electrical connection, or output signal.

1 Submersible sensors and pressure transmitters for industrial process control

2 Sensors, electronic circuits, modules, and customized systems for aerospace applications

Aerospace

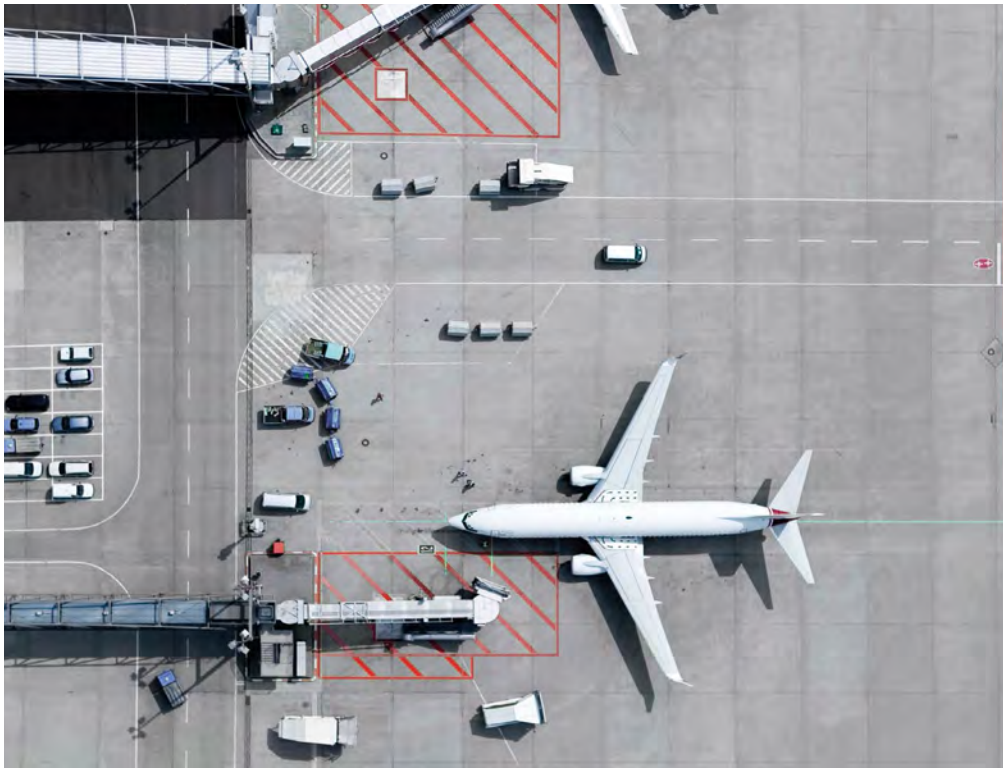
Sensors, electronic circuits, modules, and customized systems have a decisive influence on the quality, economic efficiency and safety of aerospace applications. Extreme environmental conditions such as temperature changes, acceleration, and vibrations place very high demands on the reliability and resilience of the products.

First Sensor Lewicki GmbH, which is owned by First Sensor AG, has over 45 years of application expertise and experience in aerospace technology and operates development, production, and service activities according to processes and procedures certified to EN 9100. To check the reliability of our products, we conduct stress tests (design margin tests) as well as screening and qualification, for example, according to ESA standards. The use of the latest thick-film hybrid technology enables the construction of very small, robust, and ultra-reliable electronic modules and circuits.

Our sensor solutions for aerospace

The NuSTAR X-ray satellite launched in 2012 uses two-dimensional position-sensitive diodes (PSDs) from First Sensor to manage the continuous alignment of the telescope lens relative to the sensor unit.

First Sensor supplies precision inertial sensors for use in control and navigation applications for aircraft, and unmanned spacecraft. The capacitive inclination and acceleration sensors are based on single crystal silicon sensor elements and the latest micromachining technology (HARMS). The innovative technology platform makes it possible to flexibly adjust the inertial sensors to your specific requirements. Our precision piezoresistive silicon pressure sensors monitor and control the cabin air pressure in aircraft. In addition, First Sensor develops and manufactures multi-sensor hes, and micro-controllers to create compact plug-and-play solutions.



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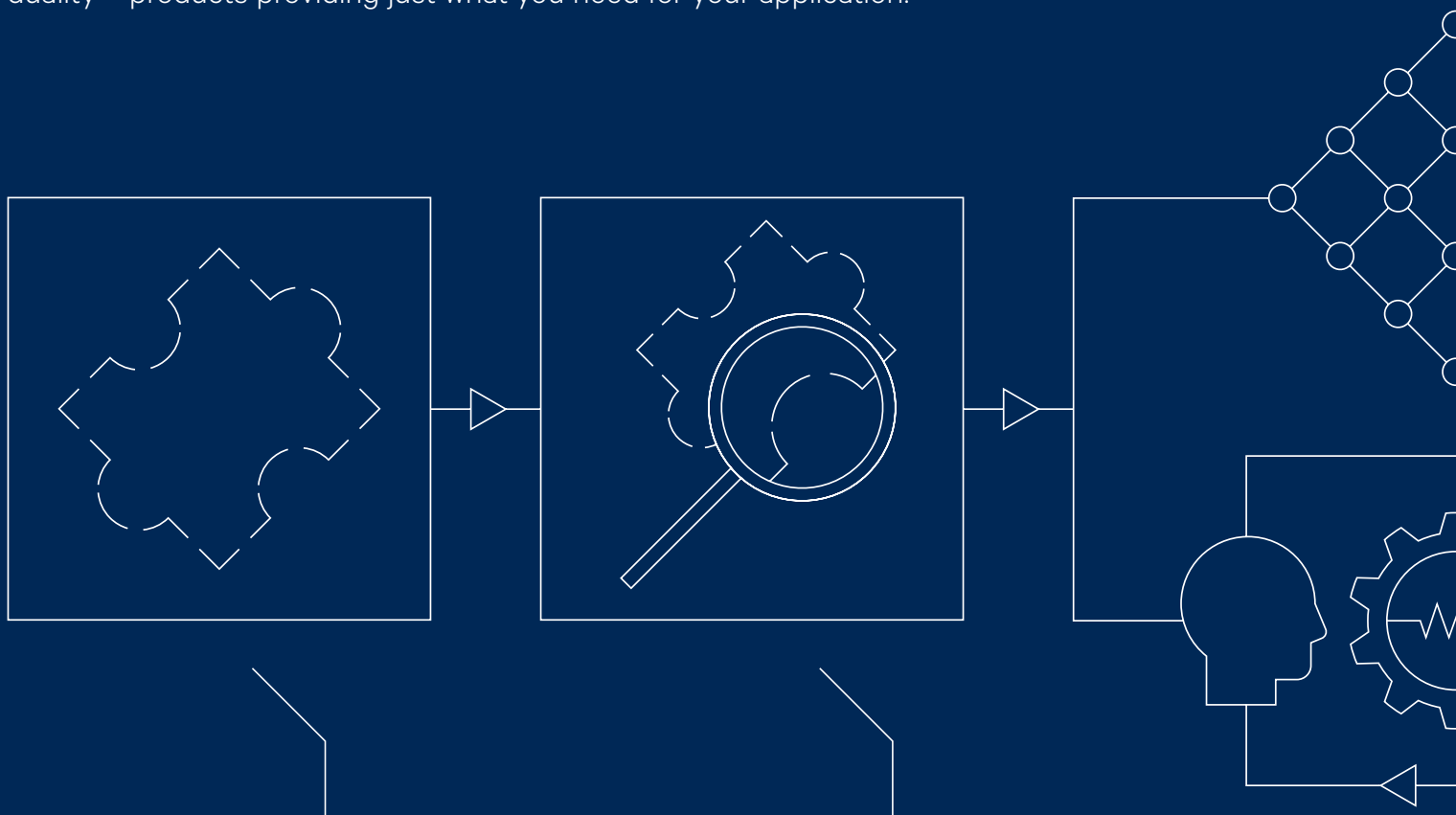
Tailored Technology

Together we can plan, develop and guide your entire sensor system project, tailored to your requirements. We offer a wide-ranging and advanced spectrum of standard products optimized to their use or unique solutions tailored to individuality – products providing just what you need for your application!



Step_1
Idea

No matter whether you already have the full specifications for your sensor or merely a rough idea – our Sales department will be pleased to advise you about the right solution in terms of cost and implementation. We know about the underlying conditions associated with production engineering and are familiar with the manufacturing time frames often spanning many years. We would like to utilize our expertise and experience to establish a long-standing and trusting partnership with you.

Let's talk about your ideas.

Step_2
Requirements-oriented analysis

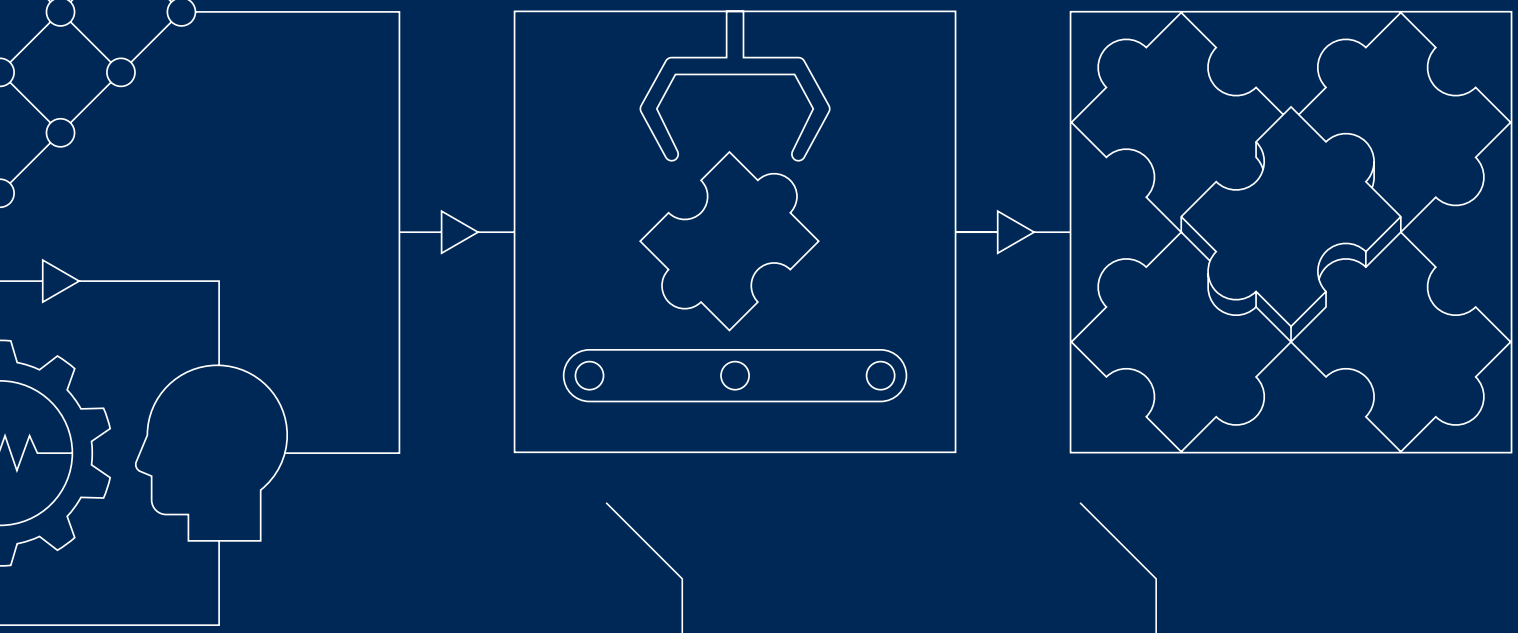
We are specialized in the customized development and production of sensor solutions. Our highly qualified planning and manufacturing expertise enables us to help shape the entire value added chain at in-house production sites – from the chip to up to final calibration. Together with you, we can realize optimum solutions for successful applications with unique selling propositions.

We provide support for your specific application.

Step_3.1
Wide-ranging product portfolio

Our products are renowned for their efficiency and accuracy. Technical excellence, precision and reliability take top priority when transforming your requirements into reality. Our product platforms have been specially developed for the demands of your application and can also be adapted individually as required.

Experience creativity to its fullest extent.



Step_3.2
Individual product development

Our Competence Centers Research & Development and Production are specialized in finding and implementing individual solutions for your requirements. Components, modules and sensor systems are developed in line with a Stage-Gate-Process® coordinated with you.

We offer tailored individuality.

Step_4
Production and quality assurance

Utilize our state-of-the-art production capacity – from rapid prototype manufacture to order-based, cost-efficient series production involving millions of units We carry out our development, validation, qualification and reliability approval work along with production and testing in accordance with the quality standards and certifications specific to your sector. The application-specific measuring system test benches available at our various sites allow us to optimize even the most diverse calibration services.

Customized production

Step_5
Implementation

Our products and processes are individually tailored to your needs, offering long-term availability and a high level of specialization. As a reliable partner oriented to continuity, we are there for you with proven project management. We are always pleased to inspire ideas for your further developments in all stages of the value chain. Come to us for your innovation process!

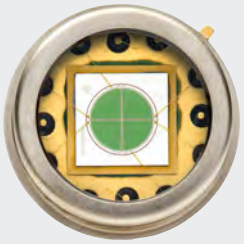
Together, we will have the ideal solution.

Detect more, achieve more – our products

What would you like to find out today? Or what would your product, your customer or a user like to find out? Whether it involves light, radiation, pressure, flow, level, or acceleration – we know which sensor is right for you and will provide you with the precise value.

Our sensor modules and systems immediately convert this value into results and signals that can be used digitally, thereby giving your product eyes, ears, or a sense of touch. Needless to say, we can adapt all our products or develop them specially to fit your application. You will already find the right solution for many applications in our broad and field-tested range of high-performance product platforms. This will help you to save time and resources!

Light



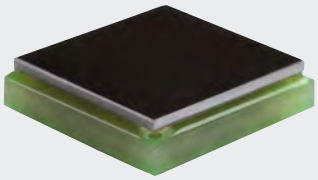
Optical sensors
– PIN photodiodes
– Avalanche photodiodes (APDs)
– Photodiode arrays
– Position-sensitive diodes (PSDs)
– Silicon photomultipliers (SiPMs)

Optoelectronic modules

Emitters
– Laser diodes
– LEDs

HDR CMOS cameras

Radiation



Detectors for ionizing radiation
– with and without scintillator
– Photodiode arrays
– Modules

Pressure

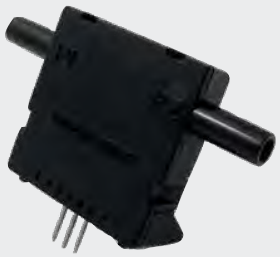
MEMS pressure sensor elements and components

Pressure sensors
– uncompensated
– temperature compensated
– with integrated signal conditioning
– based on flow measurement
– with increased media compatibility
– for corrosive liquids and gases

Pressure transmitters
– for low pressure
– for corrosive liquids and gases

OEM pressure sensors

Flow



Thermal mass flow sensors

Sensors for volumetric flow measurement

Level

Hydrostatic liquid level sensors

Capacitive level sensors

Level switches

Acceleration

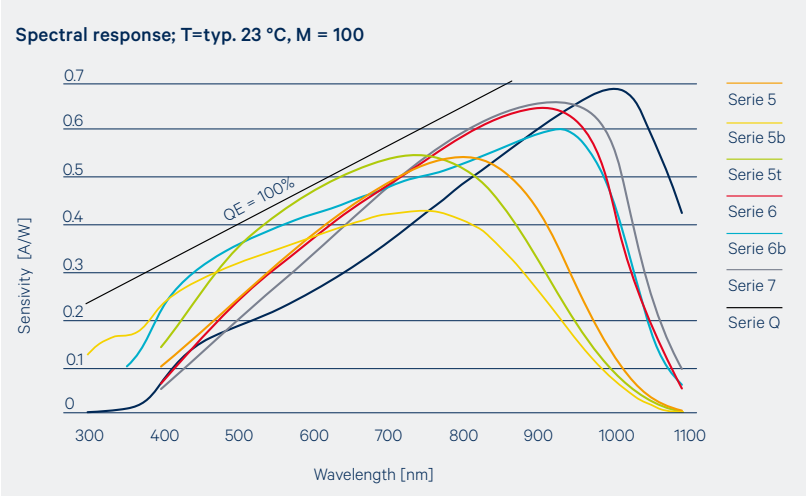
MEMS inertial sensors
- Inclination sensors
- Acceleration sensors

Optical sensors

First Sensor develops and manufactures a large selection of photodetectors with high-sensitivity, high-speed, and low-dark-current which can be adapted to your specific requirements. Our sensors are optimized for ultraviolet, visible, or infrared light as well as ionizing radiation. Package solutions include surface mount (SMD) and through-hole (THD) devices. Further, we provide silicon photomultipliers for the detection of lowest light levels.

PIN photodiodes

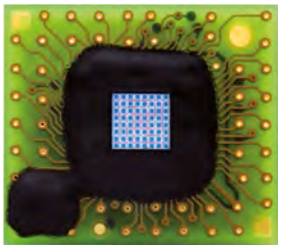
Silicon features unique properties for light detection. Silicon PIN photodiodes are used to convert photonic energy into electrical current and achieve very fast rise times. First Sensor develops and manufactures PIN photodiodes in standard product lines optimized for specific wavelength ranges as well as customized detectors adapted to your specific requirements. Additionally, we offer quadrant PIN photodiodes with four optically active areas.

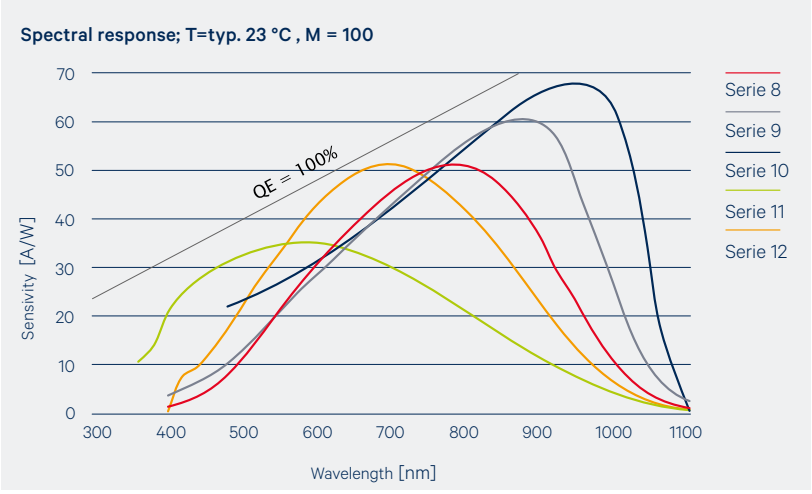


PIN series	Optimized for	Special features
SERIES 6b	**350...650 nm**	**Blue/green enhanced**
SERIES 5b	**350...650 nm**	**High-speed blue-enhanced Epitaxy PIN-diode**
SERIES 5t	**500...900 nm**	**High-speed red-enhanced Epitaxy PIN-diode**
SERIES 5	**500...900 nm**	**High-speed NIR-enhanced Epitaxy PIN-diode**
SERIES 6	**700...1000 nm**	**General purpose, low dark current, fast response**
SERIES 7	**700...1000 nm**	**Low Capacitance, full depletable design available**
SERIES Q	**900...1100 nm**	**Enhanced NIR sensitivity, low voltage, fully depletable, low Capacitance**
SERIES i	**900...1700 nm**	**InGaAs photodiode, high IR sensitivity, low dark current**

Avalanche photodiodes (APDs)

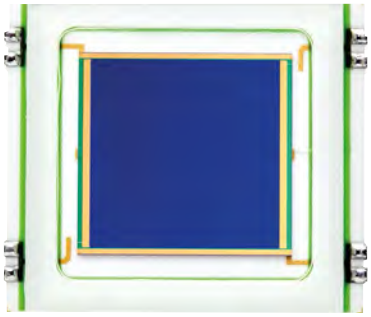
Silicon avalanche photodiodes (APDs) are optical detectors with an internal gain mechanism capable of a high gain bandwidth product. Due to their very high sensitivity avalanche photodiodes are ideally suited for measurements of very low light levels. First Sensor provides single element APDs as well as linear and matrix APD arrays with multiple active areas e.g. with 8, 16, 5x5 or 8x8 pixels.





APD series	Optimized for	Special features
SERIES 11	**350...550 nm**	**Blue enhanced, high speed**
SERIES 12	**550...780 nm**	**Ultra-low temp. coefficient, flat frequency response up to 3 GHz**
SERIES 8	**630...850 nm**	**High speed, low temperature coefficient, high gain, high gain bandwidth product**
SERIES 9	**800...905 nm**	**Lower rise time at higher NIR sensitivity, low temperature coefficient, high gain**
SERIES 10	**900...1064 nm**	**Sensitivity at 1064 nm is close to physical limits**

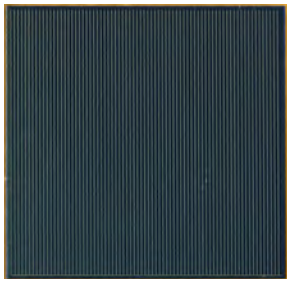
Optical sensors



Position-sensitive diodes (PSDs)

Position-sensitive diodes monitor relative changes in the position of a light spot on the detector. These silicon PIN photodiodes utilize the effect of the lateral division of the generated photocurrent between the electrical contacts. First Sensor offers one and two dimensional PSDs with high sensitivity in the red and infrared spectral range and very high linearity and spatial resolution.

PIN series	Optimized for	Special features
SERIE 6	**700...1000 nm**	**General purpose, low dark current, fast response**
SERIE 7	**700...1000 nm**	**Low Capacitance, full depletable design available**



Silicon photomultipliers (SiPMs)

Silicon photomultipliers from First Sensor enable the detection of ultra-low light levels down to single photons. The peak sensitivity of our SiPMs is in the blue wavelength range. Further, the silicon photomultipliers feature low noise, a large range of stable operation and an extremely low temperature coefficient of the gain.

Our development modules connect the optical sensor with the amplification and electronics required for signal processing and, if required, with an ultra-stable voltage supply. This allows the sensor to be tested under laboratory conditions and simplifies the integration into your application.

Hybrids

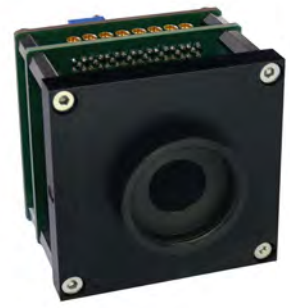
First Sensor offers compact integration of photodiodes and amplifiers. The amplifier is matched to the specific features of the detector. Contact us to find your specific sensor solution.

Development modules

First Sensor manufactures APD modules and development boards as well as modules for quadrant photodiodes, position- and wavelength sensitive photodiodes. They enable test runs in the research lab and easy integration into your system.

Evaluation kits

Our product portfolio also features complete evaluation kits including temperature compensated high voltage sources and amplification to make the evaluation of your APDs as simple as possible. Ask us for your specific evaluation kit.

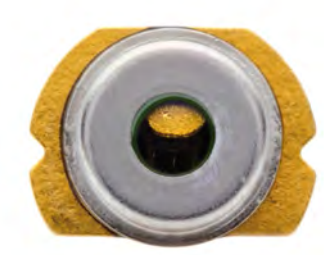


High voltage sources

High voltage sources from First Sensor are optimized for use with PIN photodiodes and APDs and feature minimal voltage noise and compact designs.

Emitters

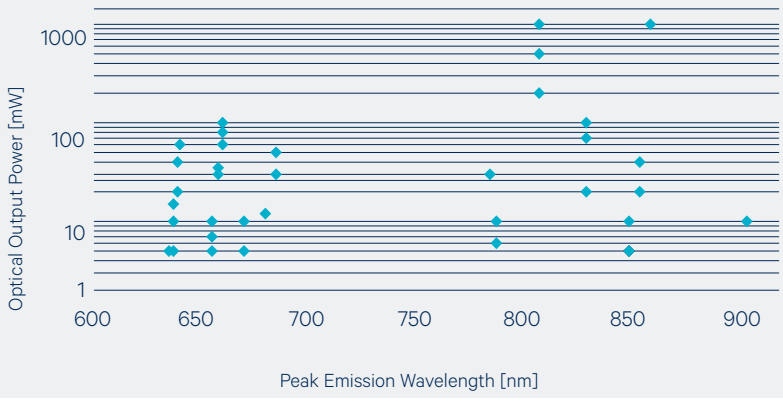
First Sensor provides you with the ideal emitter for their range of optical sensors. We offer laser diodes for the visible and infrared wavelength range. Further, optimized light-emitting diodes (LEDs) are available for high volume applications.



Red laser diodes and IR laser diodes

Laser diodes are available in the wavelength range from 635 nm to 905 nm. The large selection covers lasers with up to 100 mW single-mode CW operation as well as high-power multi-mode lasers.

Overview of available output powers and wavelengths; T=typ. 23 °C

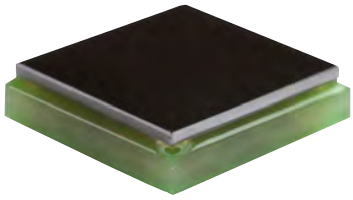


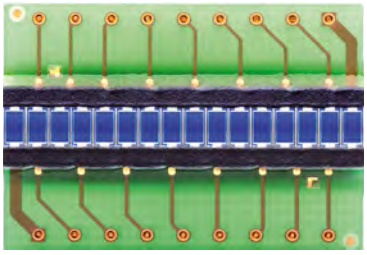
Detectors for ionizing radiation

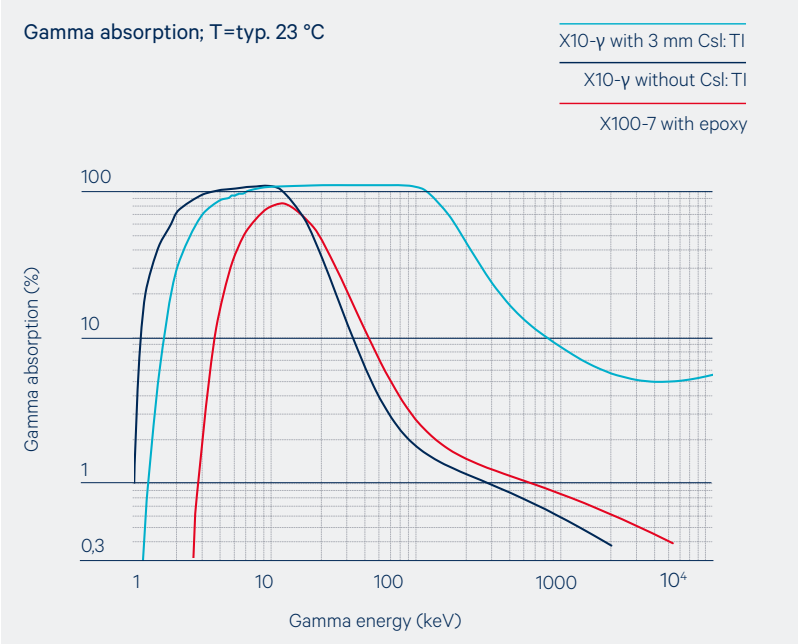
Alpha, beta, gamma, and X-ray radiation can be detected with silicon PIN photodiodes either directly via the absorption in the crystal lattice or indirectly via the measurement of the luminescence radiation of a scintillation crystal. First Sensor develops and manufactures customized photodiodes, detector arrays, and complete systems adapted to your specific requirements.

Radiation sensor with or without scintillator

The Series X from First Sensor features optimized silicon PIN photodiodes, which form wide, fully depleted space-charge regions even at low reverse voltages in order to guarantee the maximum absorption of radiation. For high-energy radiation we offer detectors with a CsI:Tl scintillation crystal. Scintillators convert the ionizing radiation into visible light, which is then measured by highly sensitive photodiodes. Our flat surface mount devices can be assembled to create larger custom detector arrays with very high fitting accuracy.







HDR CMOS cameras

Our rugged and compact cameras withstand the toughest conditions: cold, heat or permanent vibrations to name only a few. At First Sensor the complete assembly process is under one roof – from the processing of the sensor chip to the finishing of the camera system. At the same time we save you unnecessary development effort during the integration into your systems due to our modular camera design with different interfaces and data formats. All cameras can be adapted quickly and flexibly to your specific requirements.

Blue Raven Cameras

Stand-alone HDR CMOS Cameras

The stand-alone HDR CMOS cameras feature a powerful microcontroller and internal memory, which enables the evaluation of the images inside the camera system through complex software algorithms. In that case, the camera does not forward images but only the obtained information to reduce the amount of data. Further, the HDR CMOS cameras allow the fusion of the images with other sensor signals such as radar.

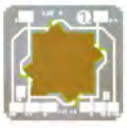
Parameter	Special features
Memory	**4 GB DDR3-RAM, 4 GB NAND flash**
Input voltage	**PoE, 12/24 V_{DC}**
Current consumption by 12 V_{DC} /30 fps	**200-230 mA**
Data interface	**Ethernet**
Operating temperature	**-40 ... 85 °C**

MEMS pressure sensor elements and components

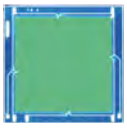
Piezoresistive silicon pressure sensors for absolute, relative and differential measurement in the range from 3 kPa (30 mbar) to 60 MPa (600 bar).

Pressure sensor elements

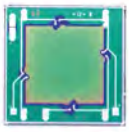
Pressure sensor elements from First Sensor utilize the „Sensor Technology for Advanced Resistors“ (STARe). This technology is based on the development of suitable materials, layouts and electrical shielding and enables pressure measurement with highest accuracy and stability. We offer product lines for highest precision (High Stability Line) as well as for aggressive media and fluids (Harsh Environmental Line).



Standard Line STARe
Absolute, relative and differential pressure
1 bar to 30 bar



High Stability Line STARe
Absolute, relative and differential pressure
30 mbar to 400 bar



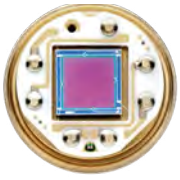
Industrial Line STARe
Absolute, relative and differential pressure
100 mbar to 600 bar

Harsh Environmental Line
Absolute pressure
2 bar to 16 bar

Pressure sensor components

K-Series STARe pressure sensor components from First Sensor are pressure sensor elements of the High Stability Line STARe mounted on a TO-8 header whose coefficient of thermal expansion is adapted to the sensor element. Further, the devices include a high-precision PTC temperature sensor and ceramic components to reduce the dead volume. This construction enables precision measurements within the 0.04 % accuracy class. The K-Series STARe is supplied with a plastic housing for transport protection and pressure measurements up to 10 bar.

K-Serie STARe A/G
Absolute and relative pressure
60 mbar to 400 bar



K-Series STARe D
Differential pressure
30 mbar to 10 bar

Pressure Sensors

First Sensor develops and manufactures a large selection of highly accurate and reliable pressure sensors and pressure transmitters for air, gas and liquids. The sensors either provide basic mV signals or fully signal conditioned analog or digital outputs. Our rugged industrial pressure transmitters use ceramic or stainless steel pressure sensor elements to achieve high media compatibility for corrosive liquids and gases.

Uncompensated pressure sensors

Our cost-effective piezoresistive pressure sensors for air and gases offer pressure ranges up to 10 bar. The uncalibrated and uncompensated basic sensors feature analog mV output signals and almost unlimited resolution. They offer very small housings with pressure ports for tubing or manifold connection and custom pressure ranges.

Series	Pressure ranges
HDU	**100 mbar to 5 bar**
HMU	**100 mbar to 10 bar**

Temperature compensated pressure sensors

High-precision miniature piezoresistive pressure sensors for air and gases from First Sensor feature full scale pressure ranges from 5 mbar. The sensors provide calibrated and temperature-compensated analog mV output signals and almost unlimited resolution. They are available in many different housing options and with custom pressure ranges.

Series	Pressure ranges
HCL	**5 to 75 mbar**
HDO	**10 mbar to 5 bar**
HRO	**10 mbar to 10 bar**

Pressure sensors with integrated signal conditioning

Digital piezoresistive miniature pressure sensors with amplified output signals for air and gases from First Sensor feature full scale pressure ranges from 2.5 mbar, a broad range of housing options and custom pressure ranges. High-resolution digital signal conditioning provides for a very high level of overall accuracy within large operating temperature ranges.

Series	Pressure ranges
HCLA	**2,5 to 75 mbar**
HCE	**10 mbar to 5 bar**
HDI	**10 mbar to 5 bar**

Pressure sensors based on flow measurement

Our ultra-low differential pressure sensors from 0.25 mbar (25 Pa) are based on thermal mass flow measurement. The extremely low air flow through a micro-flow channel integrated within the sensor chip ensures high immunity to dust contamination and condensation. The sensors feature high sensitivity and offset stability.

Series	Pressure ranges
LDE/LBA	**25 to 500 Pa (0,25 to 5 mbar)**

Pressure sensors with increased media compatibility

Our miniature piezoresistive pressure sensors with digital signal conditioning provide measurement ranges up to 10 bar and increased media compatibility for gases and liquids. We offer various housing options with a selection of pressure ports and custom pressure ranges.

Series	Pressure ranges
HMU	**100 mbar to 10 bar**
HMA	**100 mbar to 10 bar**
HMI/HME	**100 mbar to 10 bar**

Pressure sensors for corrosive liquids and gases

Our fully welded, media isolated stainless steel pressure sensors allow for high media compatibility with corrosive liquids and gases. These sensors stand out through their excellent price/performance ratio as well as very good stability and repeatability.

Series	Pressure ranges
SSO/SSI	**200 mbar to 35 bar**

Low pressure transmitters

Low pressure transmitters for air and gases from First Sensor offer full scale pressure ranges from 1 mbar. Options include a broad range of pressure and electrical connections as well as fast and flexible customization to specific requirements.

Series	Pressure ranges
CTE7000	**10 mbar to 5 bar**
BTE5000	**1 mbar to 10 bar**

Pressure transmitters for corrosive liquids and gases

Our pressure transmitters for corrosive liquids and gases use ceramic or stainless steel pressure sensor elements to ensure high media compatibility. The transmitters are available with a choice of different pressure and electrical connections and as custom versions.

Series	Pressure ranges
CTE8000	**250 mbar to 100 bar**
CTE9000	**100 mbar to 35 bar**
KTE6000	**250 mbar to 400 bar**

OEM pressure sensors

First Sensor develops and manufactures innovative and reliable pressure sensors for OEM applications that are adapted to your specific requirements with the help of our vast application experience. Due to our in-house production of all main sensor components we are able to ensure long product availability for your serial production.

Custom OEM pressure sensors

We design, develop and manufacture compact pressure sensors for integration into high-volume OEM applications. Our sensors are available in different pressure ranges from vacuum to high pressure and with customer-specific electrical connectors and pressure ports. Further, we offer a range of analog and digital interfaces such as ratiometric voltage output, SENT, LIN, PWM and I²C.

Parameter	Special features
Pressure range	**-1...2000 bar**
Pressure mode	**Absolute, gage, differential**
Output signal	**Ratiometric, SENT, LIN, PWM, I²C**
Temperature range	**-40 ... 135 (150) °C**
Protection class	**IP6K9K**

Flow sensors

Our thermal mass flow sensors record even smallest flows fast and with high precision. Within a modular technology platform First Sensor provides complete packaging technologies so as to realize complex custom specific solutions from individual chip elements. Further, our differential pressure sensors detect ultra-low pressure drops in volumetric flow measurement applications.

Thermal mass flow sensors

Our mass flow sensors for air and gases utilize a highly sensitive thermal measuring principle to detect even smallest flows. The sensors are based on highly stable MEMS silicon chip technology and feature fast response times, low power consumption and bidirectional sensing capabilities.

Differential pressure sensors for volumetric flow measurement

Differential pressure sensors and rugged differential pressure transmitters for volumetric flow measurement from First Sensor detect the pressure drop across a flow element. Our flow-based ultra-low differential pressure sensors from 0.25 mbar (25 Pa) feature high sensitivity and offset stability as well as high immunity to dust contamination and condensation.

Level sensors

Fluid level control sounds quite easy but can turn into a demanding sensor application problem if movement, foaming, or media and container issues come into play. To reliably monitor the liquid level in tanks or containers, First Sensor offers a range of different sensor technologies. Depending on the application, they can register the level continuously or using limit values.

Hydrostatic liquid level sensors

Submersible hydrostatic liquid level sensors with amplified output signals from First Sensor use ceramic or stainless steel pressure sensor elements to achieve high media compatibilities. For these sensors we offer fast and flexible modifications based on your specific requirements.

Series	Measuring range
CTE9000...CS	**1 to 50 mH_2O**
CTE8000...CS	**2,5 to 50 mH_2O**
KTE8000...CS	**2,5 to 50 mH_2O**

Capacitive liquid level sensors

Our capacitive liquid level sensors are based on a new contact-free sensor technology. The sensors measure continuously or as limit value switches and can be quickly and flexibly adapted to different application conditions.

Series	Measuring range
CLC	**0...100 mm**
CLW	**limit**

Optical liquid level switches

Optical liquid level switches from First Sensor use solid state technology with no moving parts and reliably distinguish between liquid and gas. The sensors are suitable for simple, space-saving installation in tanks, containers and pipes.

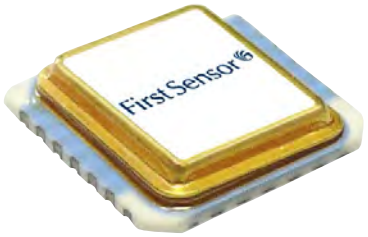
Series	Measuring range
OLP, OLT, OLM	**limit**

MEMS inertial sensors

First Sensor features a highly innovative technology platform for manufacturing high-precision inertial sensors for geoengineering, condition monitoring or navigation applications. The MEMS sensors allow for flexible customization to fit your individual application requirements.

Inclinometers and accelerometers

Our capacitive inclinometers and accelerometers are based on single crystal silicon sensor elements and utilize state-of-the-art micromachining technology to achieve large signal-to noise ratios and excellent stability over temperature. Therefore, they are able to detect extremely small changes in inclination or acceleration. Due to high aspect ratio microstructures (HARMS) the sensors feature ultra-low cross axis sensitivities. Further, the patented highly flexible AIM (Air gap Insulated Microstructures) technology minimizes parasitic capacitances.

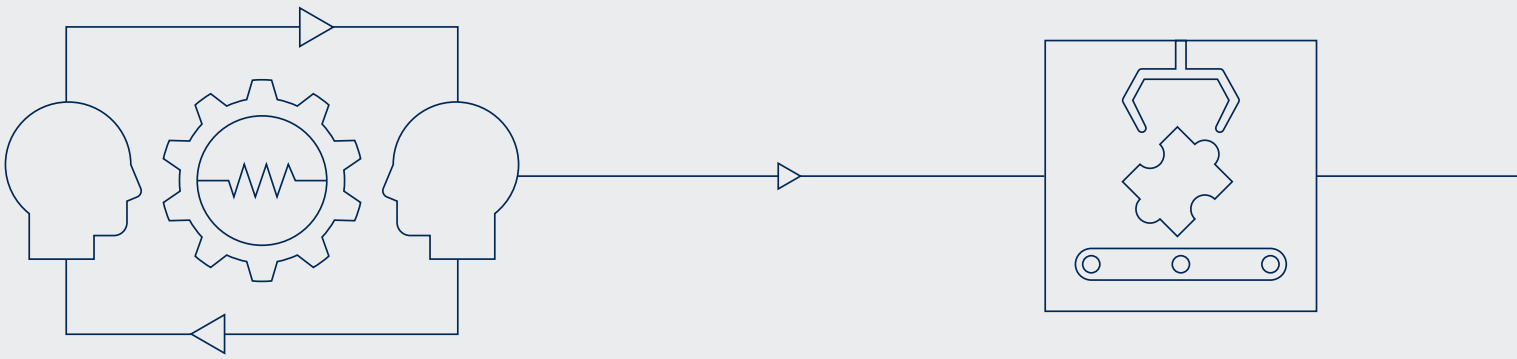


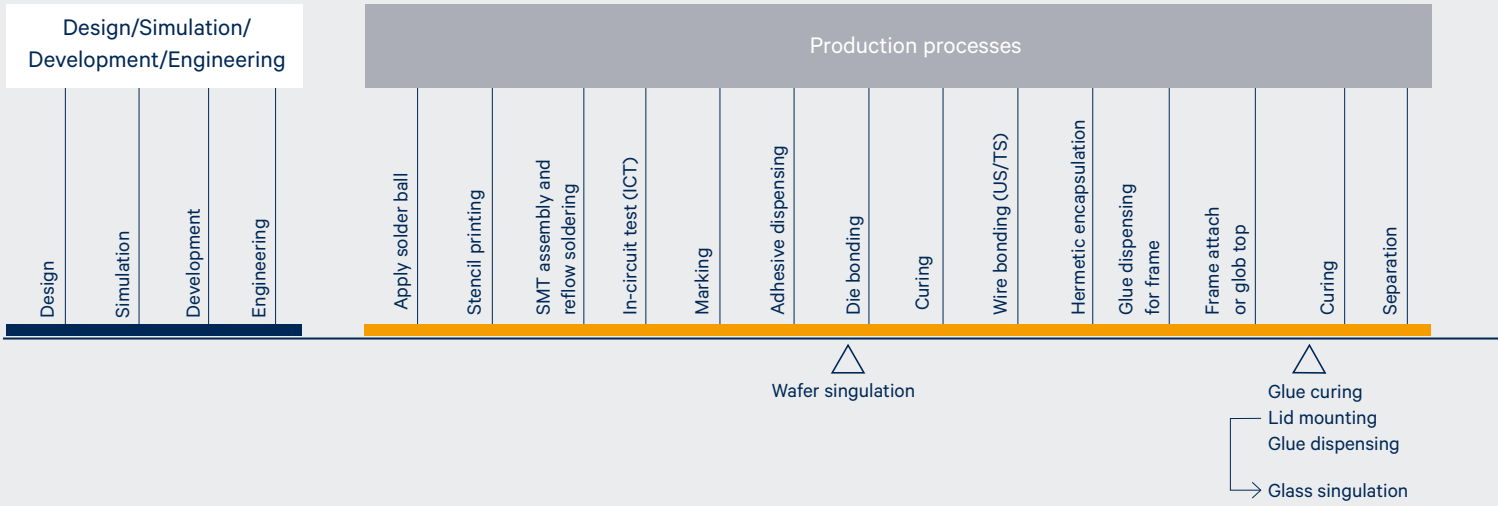
	Inclinometer			Accelerometer		
Parameter	SI-11.S1.C-30	SI-11.P3.C-30	Unit	SA-13.S1.C-8	SA-14.S1.C-15	Unit
Measurement range	±30	±30	°	±8	±15	g
Resolution at 10 Hz	< 0,0015	< 0,0040	°	< 65	< 95	µg
Scale factor (repeatability)	±35	±50	ppm	±35	±35	ppm
Scale factor (temperature coefficient)	±50	±50	ppm/K	±50	±50	ppm/K
Bias (repeatability)	±0,0030	±0,0045	°	±260	±470	µg
Bias (temperature coefficient)	±0,0025	±0,0030	°/K	±105	±175	µg/K
Noise density	< 0,0004	< 0,0015	°/√Hz	< 20	< 30	µg/√Hz
Measuring frequency	400	800	Hz	400	400	Hz
Digital interface	SPI	SPI/I²C		SPI	SPI	
Operating temperature	-40 ... 85	-40 ... 120	°C	-40 ... 85	-40 ... 85	°C

Development and production services

As a manufacturer of sophisticated systems, are you always facing new challenges because of global competition, increasing process requirements and new customer requests? Are you looking for ways to distinguish yourself and your products? You can do this with even more precise and faster measurements, more efficient, reliability, cost-reducing integration, application-specific combinations of measurement procedures, special form factors of sensor systems and/or greater reliability.

Standard sensors are often no longer enough to distinguish yourself from the competition. Sustainable application, quality and cost advantages can only be achieved and guaranteed with customized sensor systems. The development of application-specific sensor systems therefore presents you with a make-or-buy decision. Even if the sensor technology is an extremely important system component of your targeted solution, you are often unwilling or unable to allocate the development resources and expertise required for such developments.

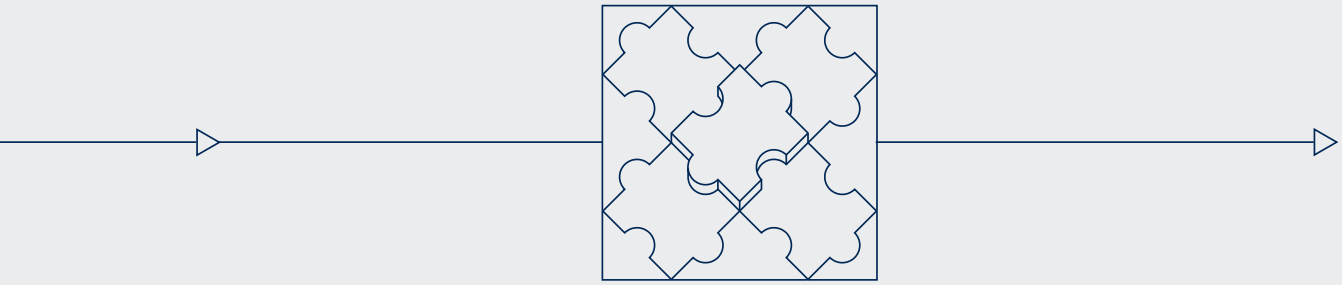


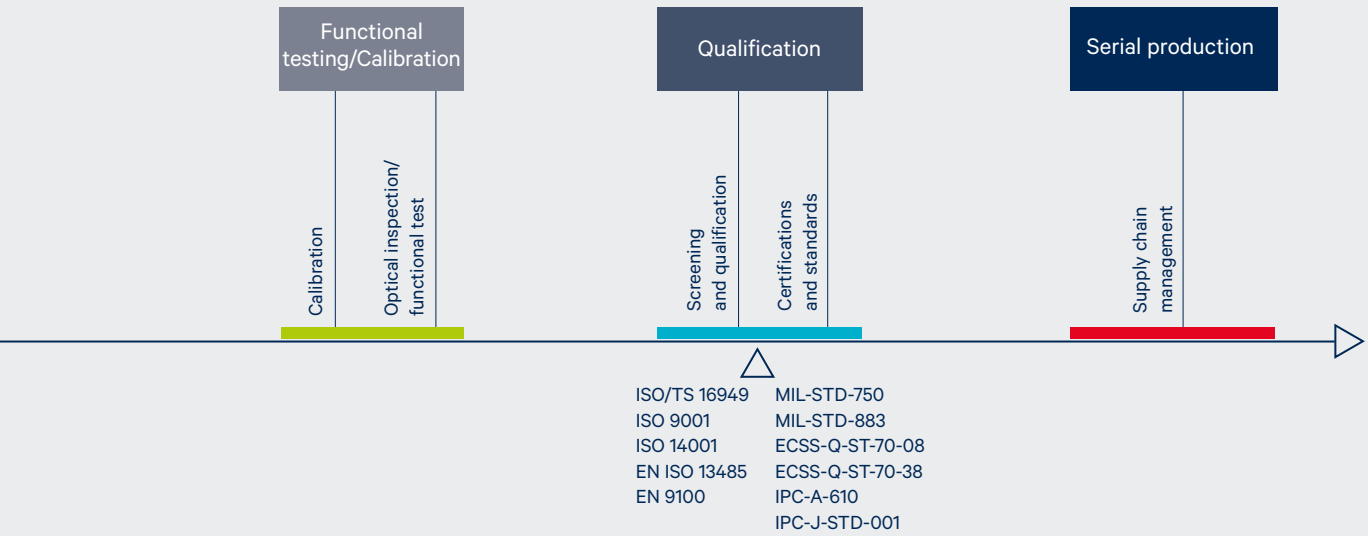


The reasons for this are manifold:

- Capacity bottlenecks: internal development teams are tied up in other projects.
- Specific expertise: you do not have the metrological know-how to develop and produce specific sensor systems reliably and efficiently or to integrate new sensor technology.
- Outsourcing strategy: sensor technology is part of your own applications but is not considered a core competence.
- Risk and cost management: you want to speed up development projects significantly, limit cost and technology risks or achieve a predictable ROI via external development projects at fixed prices.

First Sensor is your first port of call if you are looking for a competent, reliable partner with many years' experience for the development and production of high-performance, customerspecific sensor systems.





Strategic partner for development and production of customized products

As a specialist in the development and production of sensor systems, we have been enabling long-term differentiation from the competition for many years. We provide all the expertise, technology and capacity this requires:

- Complete development services ranging from the solution concept and initial proof-of-concept to prototypes and serial production maturity; from hardware to software and integration; microsystems technology from the ASIC and the module to the end product
- Design and implementation of technologies that enable many sensor functions and applications in the first place
- State-of-the-art production Capacitance for a broad range of volumes – from rapid prototype production to order-based, cost-efficient serial production of millions of units
- Support for development by metrology specialists from various disciplines and the use of application-specific metrological test stations and calibration services
- Development, validation, qualification and reliability certification, production and testing according to industry-specific quality standards and certifications (e.g. EN ISO 13485 for medical devices and ISO/TS 16949 for the automotive industry)

1 State-of-the-art production in our own clean rooms

Tried-and-tested approach for maximum efficiency and minimum risks

We offer you not only metrological know-how, but also seasoned project management that allows highly efficient as well as low-risk developments.

First Sensor worldwide

First Sensor is headquartered in Berlin and represented at six locations in Germany and also operates sales and production sites in the USA, Canada, Singapore, China, UK, France, Denmark, Sweden and the Netherlands as well as a global network of partners.

Australia
- Sydney

Belgium
- Zaventem

China
- Hangzhou
- Shanghai

Denmark
- Kopenhagen

Germany
- Berlin-Oberschöneweide
- Berlin-Weißensee
- Dresden-Klotzsche
- Dresden-Albertstadt
- Munich (Puchheim)
- Ulm (Oberdischingen)

Spain
- Madrid

France
- Charbonnières
- Forbach
- Lisses

Great Britain
- Rugby

India
- Faridabad

Israel
- Rishon Le-Zion
- Tel Aviv

Italy
- Aicurzio
- Rom

Japan
- Tokio

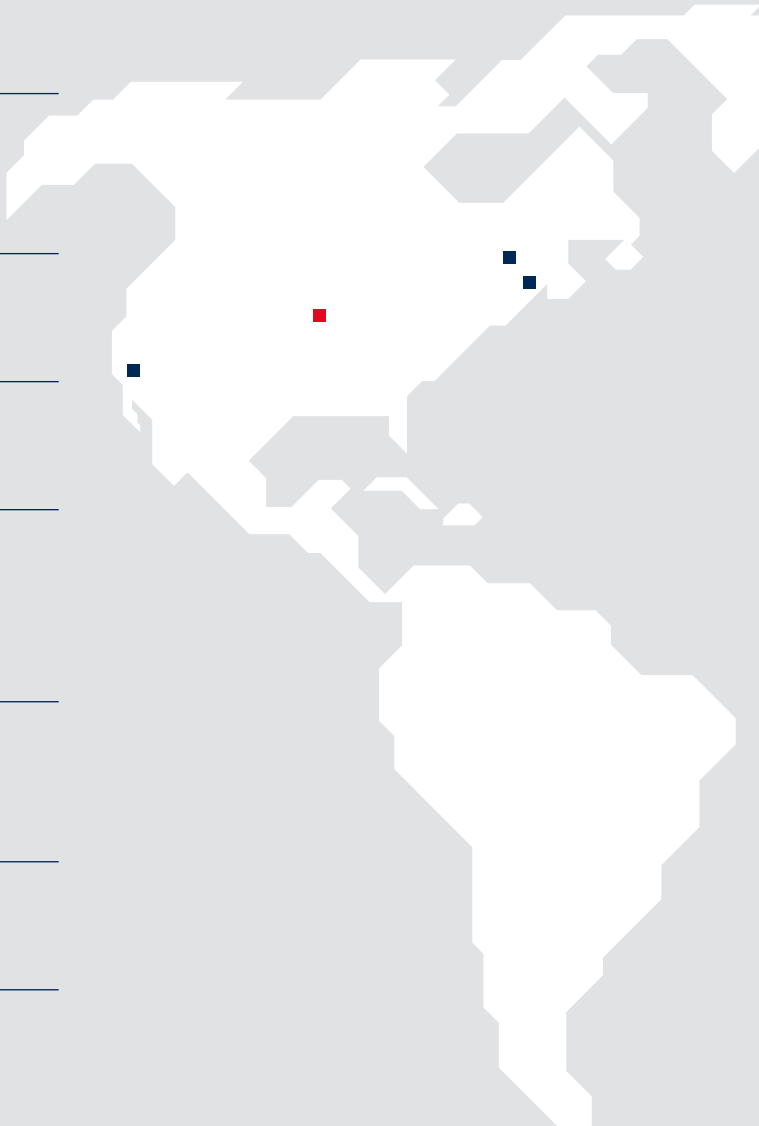
Canada
- Montreal

Netherlands
- Eindhoven
- Dwingeloo
- Valkenswaard

Sweden
- Kungens Kurva
- Uppsala

Singapore
- Singapore

USA
- Lexington
- Mansfield
- Westlake Village




headquarters
location
partner

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