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Individual  
sensor solutions for the  
automotive industry

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Our applications and products



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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.

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# 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.

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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.

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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 measurements, building automation, air-conditioning technology, industrial process monitoring and the areas of radiation and safety. 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 the automobile and vehicle industry

As Business Unit Mobility within the First Sensor AG, the reliable partnership with you is the foundation for our high performance products and system solutions.

In the **Mobility Business Unit**, First Sensor develops and manufactures innovative pressure sensors and cameras for the automobile and vehicle industry designed to withstand the toughest conditions: cold, heat or continuous vibrations. We have the technology, capacity and experience to adapt and optimize our sensors to your individual requirements and markets. At First Sensor, the entire production process is implemented as a coherent whole – from processing the sensor chips through to the prefabricated sensor or camera system. By manufacturing all central components

ourselves, we ensure the long availability of all OEM products for series production and the aftermarket. All customized pressure sensors and cameras are developed and manufactured in accordance with the quality management system for the automobile industry ISO/TS 16949.

Our effective CMOS cameras are used in advanced driver assistance systems or agricultural and construction machinery, where they warn against obstructions, help to prevent lane departures and detect speed restrictions. That

means our modular camera concept with various physical interfaces and data formats saves you unnecessary development expenses when it comes to integration into your systems.

Our compact pressure sensors for major series production are available in various pressure ranges from vacuum to high pressure and with customized and electrical or pressure connections for measuring the oil, tank and gasoline pressure as well as detecting leaks. We also offer a wide range of analog and digital interfaces.



## The entire value added chain

WAFER + COMPONENT



SENSOR



SYSTEM



ELECTRONIC ENGINEERING & MANUFACTURING SERVICES



Flexibility in the supply chain is set to 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 a perfect sensor solution from First Sensor for your specific application in automobile and vehicle technology.

**1** State-of-the-art production processes in packaging technology(Photo: GiS pix)

# Advanced driver assistance systems

Advanced driver assistance systems both increase safety and enhance driving comfort – crucial factors when deciding on a vehicle purchase. Thereby highly resilient and reliable cameras and optical sensors are essential for systems such as adaptive cruise control (ACC), reversing aid, traffic sign recognition or lane departure warning.

## Advanced driver assistance systems

Advanced driver assistance systems support the driver with additional information, warn against potential dangers and spare you the effort of dealing with certain tasks. Statutory regulations are increasingly stipulating advanced driver assistance systems as a mandatory component in cars, trucks and buses. Automobile manufacturers throughout the world are currently developing the next generation of advanced driver assistance systems - self-driving cars that can steer, accelerate and brake fully autonomously.

Automobile applications place high demands on the reliability and resilience of the sensors used. Vibrations, dirt, moisture or extreme heat or cold must not change the specifications of the systems used. In addition, it must be possible to integrate the cameras and sensor systems easily and flexibly in advanced driver assistance systems and vehicle electrical systems. Various sensor technologies are also often combined, while camera and LIDAR data is typically consolidated in order to increase the range, accuracy and reliability of the advanced driver assistance systems.

## Our camera solutions for advanced driver assistance systems

First Sensor develops and manufactures robust digital HDR CMOS cameras for advanced driver assistance systems in cars, trucks or agricultural and construction machinery. With their very large dynamic range >100 dB, the cameras are ideally suited to poor light conditions and major differences in brightness. The automobile cameras provide a wide range of digital interfaces such as 2-wire Ethernet (BroadR-Reach), APIX2, Quiet-WIRE Ethernet (MICREL, MARVELL), LVDS or MOST150 and can be supplied with energy via the onboard electrical system. Our cameras can also be equipped with a digital signal processor (DSP) and internal memory capacities. This allows the images to be processed and evaluated directly in the camera system via software algorithms, while the images can also be merged with other sensor signals such as radar or LIDAR data. The camera then has its own „intelligence“ and, instead of transferring any images, only communicates the information obtained from the image analysis, thereby reducing data volumes considerably. All OEM cameras made by First Sensor are subject to the quality management system ISO/TS 16949 for the automobile industry and can be adapted quickly and flexibly to custom requirements. By manufacturing all central components ourselves, we ensure the long availability of all products for series production and the aftermarket.





## Our sensor solutions for LIDAR systems

In LIDAR systems, the surroundings are scanned with a pulsed laser beam and the signal's transit time from the object back to the detector is measured. A three-dimensional image of the surroundings can be calculated in real time from the individual distance points. Modern devices attain very large fields of vision and very high data rates with over a million distance points per second. To measure the light pulses of different intensity in the nanosecond range, First Sensor offers highly sensitive avalanche photodiodes (APD) 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 typically using 8, 16, 5x5 or 8x8 pixels.

1 Resilient cameras and optical sensors for advanced driver assistance systems

# OEM pressure sensors

First Sensor develops and manufactures innovative and reliable OEM pressure sensors for integration in motor vehicles and machines, which can be adapted to your individual customer requirements with a high level of application expertise. By manufacturing all central components ourselves, we ensure the long availability of all products for series production and the aftermarket.



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## OEM pressure sensors

The number of sensors in modern vehicles is continually increasing. Sensors supply the measuring values for the electronic control units and are therefore an essential component for the safe, comfortable and economic operation of cars, trucks and buses. The extreme conditions in automobile applications such as heat, cold or continuous vibrations place high demands on the reliability and resilience of sensors. At the same time, the sensors need to be small, energy saving and cost effective.

Our sensors are available in various pressure ranges from vacuum to high pressure and with customized and electrical or pressure connections. We also offer a wide range of analog and digital interfaces, for example ratiometric signals, SENT, LIN, PWM and I<sup>2</sup>C. All custom OEM pressure sensors are developed and manufactured in accordance with the quality management system for the automobile industry ISO/TS 16949.

## Our sensor solutions for fuel applications

Our OEM pressure sensors for fuel applications are used for tank pressure measurement, tank leakage diagnostics and fuel delivery and optionally come with an integrated temperature sensor. The sensors are installed on the tank wall or directly in the tank, where they are completely enclosed by fuel or fuel vapors. For measurement in the tank, we offer patented

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- 1 OEM pressure sensors for the safe, comfortable and economic operation of cars
- 2 High pressure sensors for hydraulic applications

technologies and processes that enable space-saving, maintenance-friendly and cost-effective sensor solutions. The sensor can be mounted on a component of the fuel tank such as a tank flange or the fuel delivery module for this. Our highly accurate low-pressure sensors are used for leakage measurement, as they are able to detect minimal pressure changes in the fuel tank. To regulate the tank air intake and extraction, pressure sensors from First Sensor monitor negative pressures and overpressures in the fuel tank.

### Further sensor solutions for the vehicle industry

In brake booster systems, our vacuum pressure sensors measure the negative pressure for controlling the vacuum pump and thus ensure optimal support for the braking action. For electrohydraulic power-assisted steering, we offer high-pressure sensors with measuring ranges up to 400 bar and multiple pressure connections for measuring different pressures and temperatures. To set the damping of the engine suspension First Sensor develops and manufactures pressure sensor solutions with very fast signal processing and high accuracy by using application-specific integrated

circuits. In automobile air-conditioning systems, our sensors measure pressure and optionally also temperature of refrigerants such as R134a, R1234yf and carbon dioxide (R744). For the highly sensitive measurement of ultra-low differential pressures in vehicles and machines, we provide an innovative flow-based sensor technology with measuring ranges from 25 Pa (0.25 mbar) as well as highest resolution and offset stability.

# Together for the Best Product

Every second raw material producer utilizes innovative radar solutions from the Aachen-based sensor system manufacturer indurad. As part of an interesting cooperation model, indurad and First Sensor have together developed a camera system that is as robust as it is technically innovative.



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- 1 Safety systems for mining machinery use robust cameras
- 2 Erik Busse, head of development, First Sensor Mobility
- 3 Modular camera system – configurable and diverse

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Here we have not simply commissioned the development and production of a modular camera system – instead, we have jointly developed a configurable product for highly diverse applications.

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Dr. Reik Winkel, Managing Director of indurad GmbH — and customer of First Sensor Mobility

Very large, very heavy and with extremely poor visibility conditions for the driver – practically all vehicles in mining have these difficulties in common. indurad has specialized in developing safety systems for excavators, trucks and other special vehicles in mines that warn against collisions and typically help drivers to keep to the road on a berm.

The previous solution was to be combined with visual sensors because drivers need to recognize what kind of obstacle they are actually encountering. Are stones in the way or is a person still lingering in the hazard zone? The standard camera systems available on the market are only suitable to a limited extent for the conditions prevailing in the mining industry.

The temperatures typically occurring in Australian or Brazilian iron ore mines along with

vibrations, moisture and dirt mean the optics and electronics are subject to extremely high requirements.

Thanks to a high level of independence among suppliers and long-standing experience in the development of industrial sensor systems, First Sensor was able to implement the requirements set by indurad.

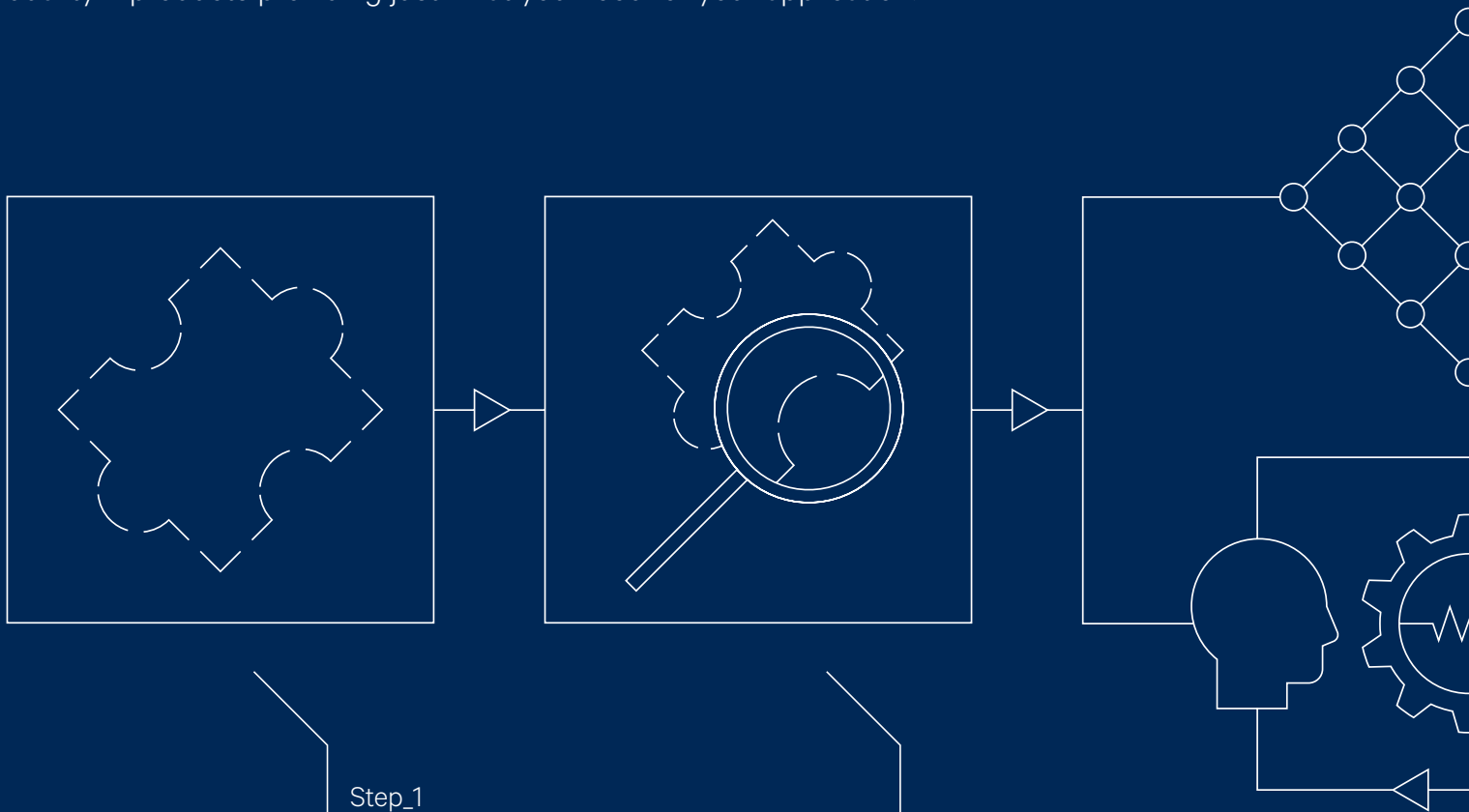
However, use of the solution jointly developed by the sensor system specialists is not limited to mining applications. Although coming together in development, indurad and First Sensor address separate sectors in marketing, with the aim of making the solution more widespread in application while establishing further cost benefits.

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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

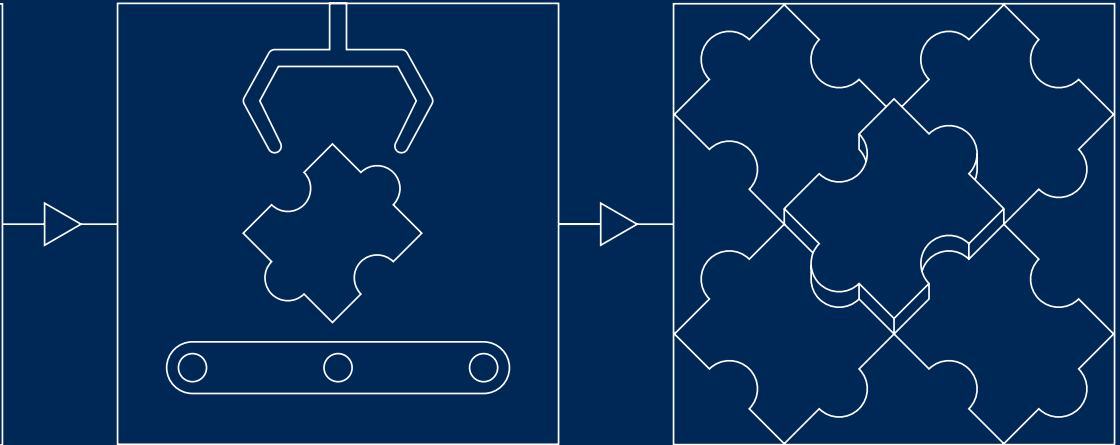
We are specialized in the customized development and production of sensor solutions. Our highly qualified planning and manufacturing expertise enables us to help shape the entire value added chain at in-house production sites – from the chip over calibration up to final testing. Together with you, we 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, pressure or flow – we know which sensor is right for you and will provide you with the precise value.

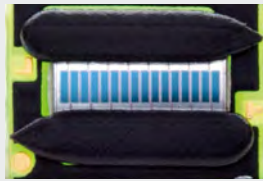
Our sensor modules and systems immediately convert this value into results and signals that can be used digitally, thereby giving your product eyes, ears, or a sense of touch. Needless to say, we can adapt all our products- or develop them specially to fit your application. You will already find the 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

## Pressure



**HDR CMOS cameras**



### **Optical sensors**

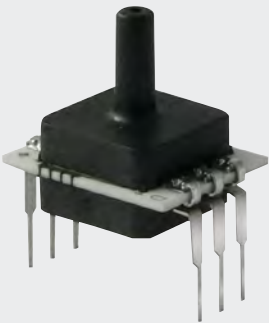
- Avalanche photodiodes (APDs)
- Photodiode arrays



**OEM pressure sensors**

## Flow

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**Pressure sensors for air and gases**  
– based on flow measurement  
– piezoresistive



**Thermal mass flow sensors**



**Sensors for volumetric flow measurement**

## Rugged HDR OEM cameras

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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 customer-specific requirements.



### Programmable VGA CMOS Cameras

These analog cameras with a screw thread are especially designed for mobile video surveillance applications. A programmable interface allows individual settings of brightness adaptation and mirror functions. In addition, the rugged housings protect the cameras against the ingress of water and dust.

Parameter	Special features
Memory	8 KB flash
Input voltage	12/24 V <sub>DC</sub>
Current consumption at 12 V <sub>DC</sub> /30 fps	55 mA
Data interface	Analog (PAL/NTSC)
Operating temperature	-40 ... 105 °C

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## Blue Eagle Cameras

### Digital HDR CMOS cameras

With their extremely large dynamic ranges >100 dB the digital megapixel cameras are ideal for high brightness differences and low light conditions. The cameras offer a wide range of digital data interfaces for easy and flexible integration into automotive on-board networks and driver assistance systems. In addition, the rugged housings protect the cameras against the ingress of water and dust.



Parameter	Special features
Memory	512 KB flash
Input voltage	PoE, Clamp15
Current consumption at 12 V <sub>DC</sub> /30 fps	80-110 mA
Data interface	Ethernet, LVDS, APIX, MOST150
Operating temperature	-40 ... 85 °C / -40 ... 95 °C / -40 ... 105 °C

## 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.

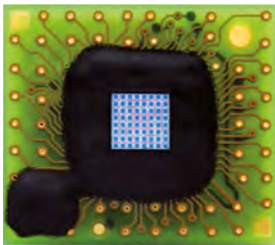


Parameter	Special features
Memory	4 GB DDR3-RAM, 4 GB NAND flash
Input voltage	PoE, 12/24 V <sub>DC</sub>
Current consumption at 12 V <sub>DC</sub> /30 fps	200-230 mA
Data interface	Ethernet
Operating temperature	-40 ... 85 °C

## Optical sensors

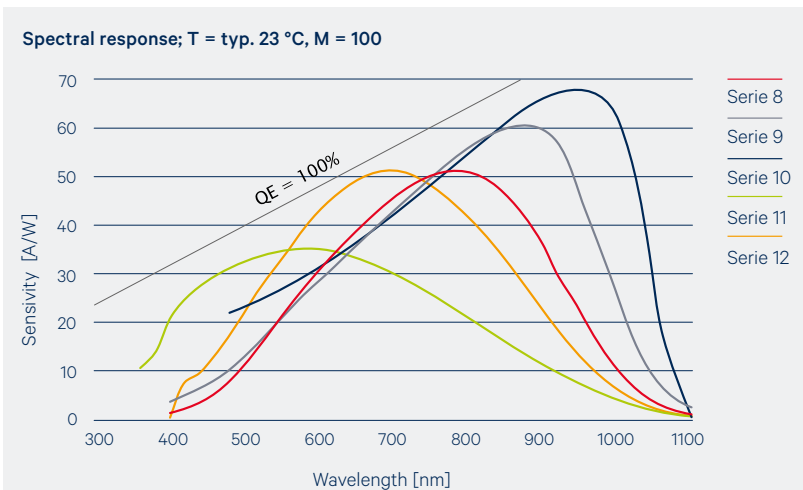
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First Sensor develops and manufactures a large selection of photodetectors with high-sensitivity, high-speed, and low-dark-current which can be adapted to your specific requirements. Our sensors are optimized for ultraviolet, visible, and infra-red light. Package solutions include surface mount (SMD) and through-hole (THD) devices.



### **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 temperature 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

## OEM-Pressure sensors

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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 as well as the aftermarket.

### Custom OEM pressure sensors

We design, develop and manufacture compact pressure sensors for integration into high-volume automotive and machine 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 I<sup>2</sup>C. All custom OEM pressure sensors are developed and manufactured in line with the quality management standard for the automotive industry ISO/TS 16949.



**Fuel supply pressure and temperature sensor**



**Vacuum pressure sensor for brake boosters**

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Parameter	Specification
Pressure range	-1...400 (2000) bar
Pressure mode	Absolute, gage, differential
Output signal	Ratiometric, SENT, LIN, PWM, I <sup>2</sup> C
Temperature range	-40 ... 135 (150) °C
Protection class	IP6K9K



Tank pressure and temperature sensor for inside mounting



High-pressure sensor up to 2000 bar

## Pressure Sensors for air and gases

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First Sensor offers different sensor technologies to detect smallest differential pressures in the automotive industry - differential pressure sensors based on flow technology and membran-based piezoresistive silicon pressure sensors which are not flowed through by air.



### 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.



### 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.



## Flow sensors

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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.



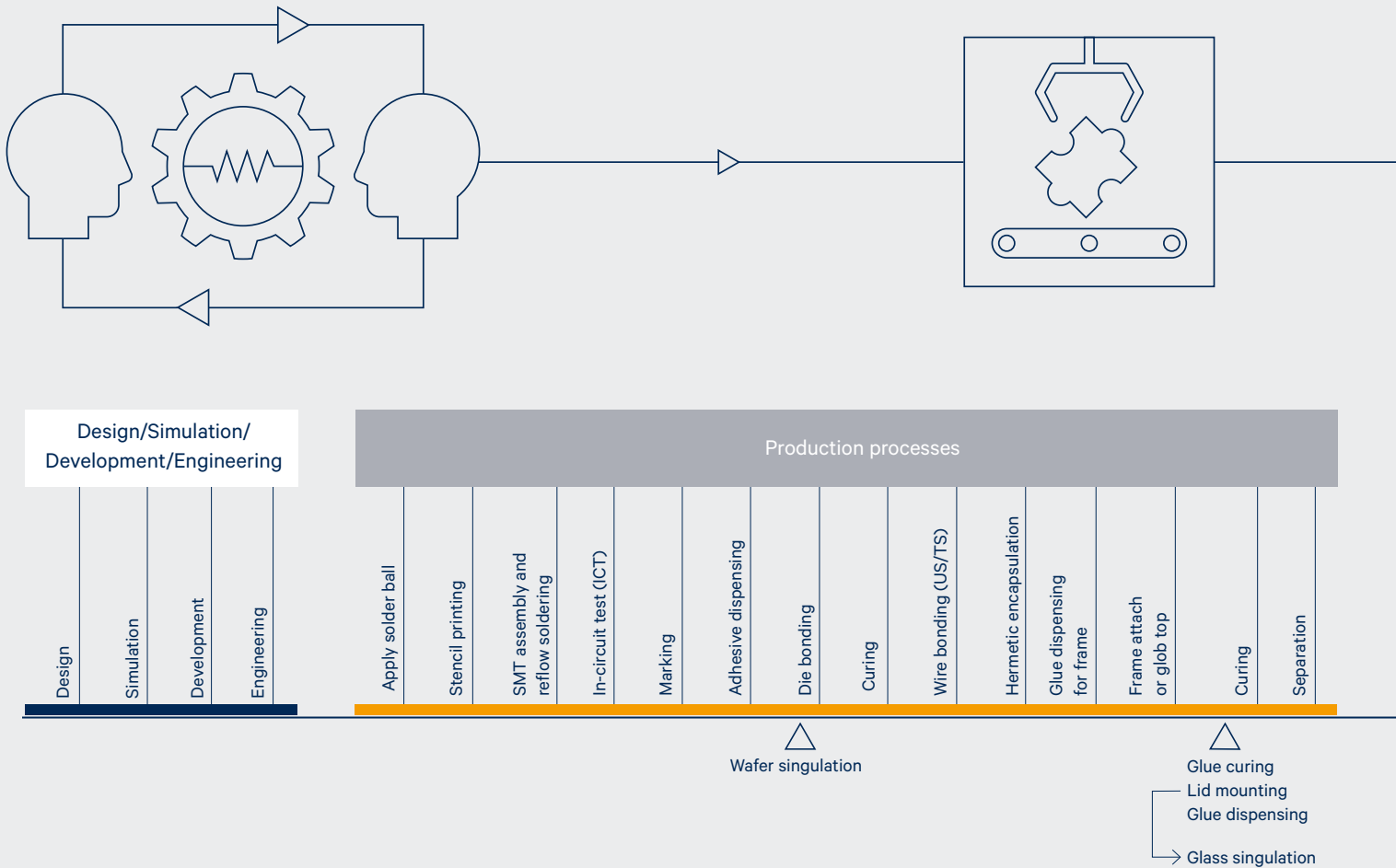
## Development and production services

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 measu-

rement 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.

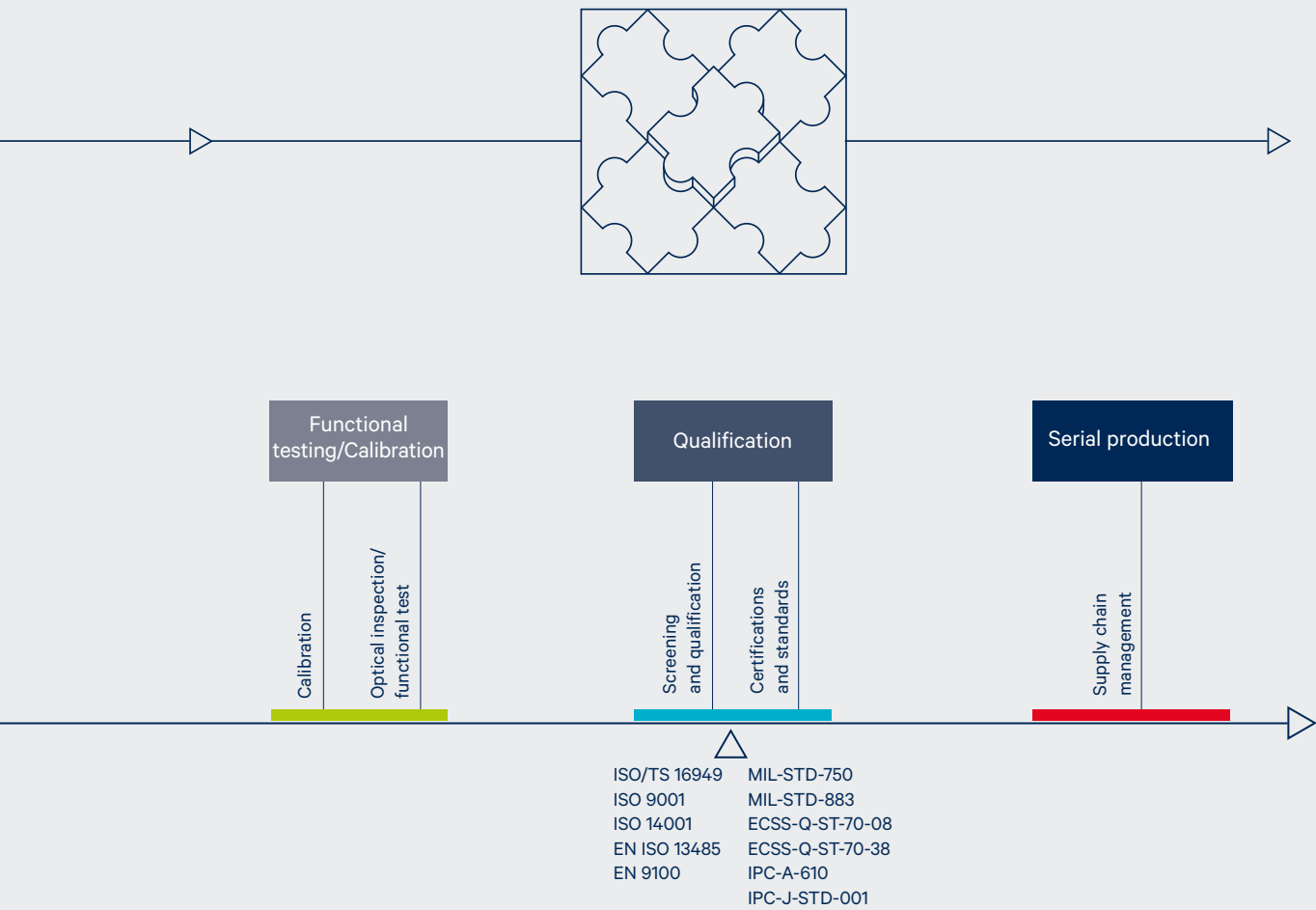


The reasons for this are manifold:

- 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

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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 capacity 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)



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

- 1 State-of-the-art production processes according to ISO/TS 16949 (Photo: GiS pix)
- 2 Packaging technologies according to certified processes

## 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

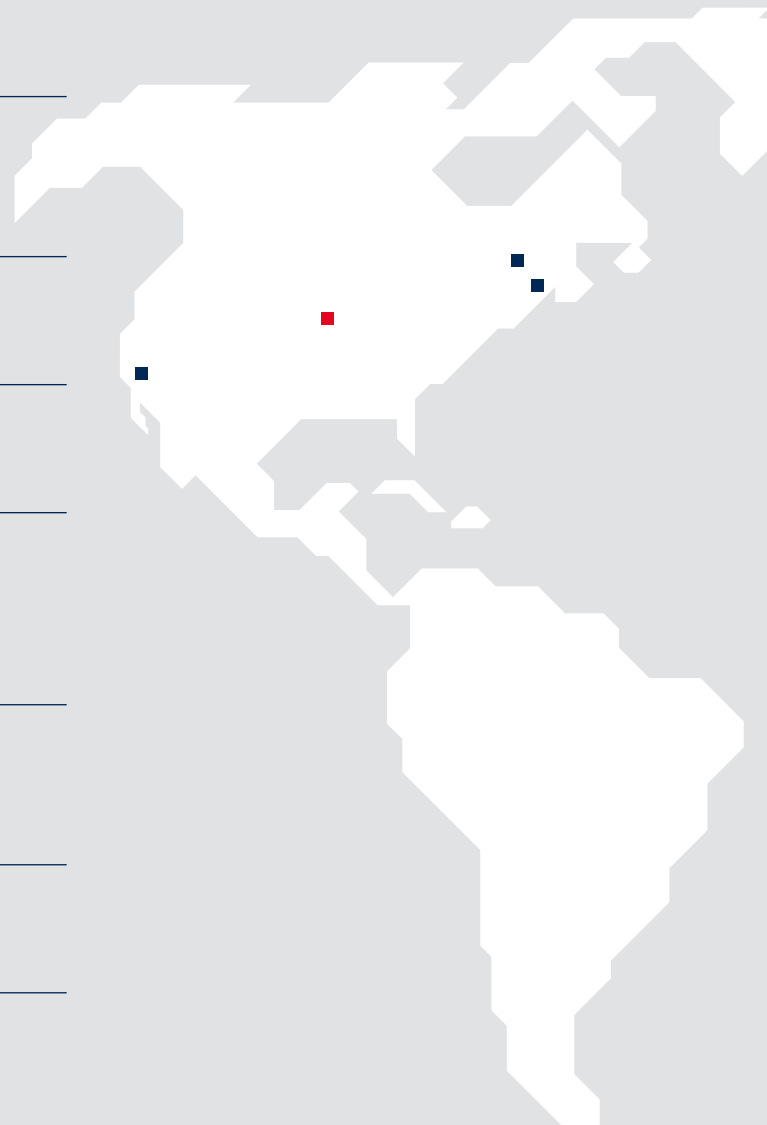
- Kungens Kurva
- Uppsala

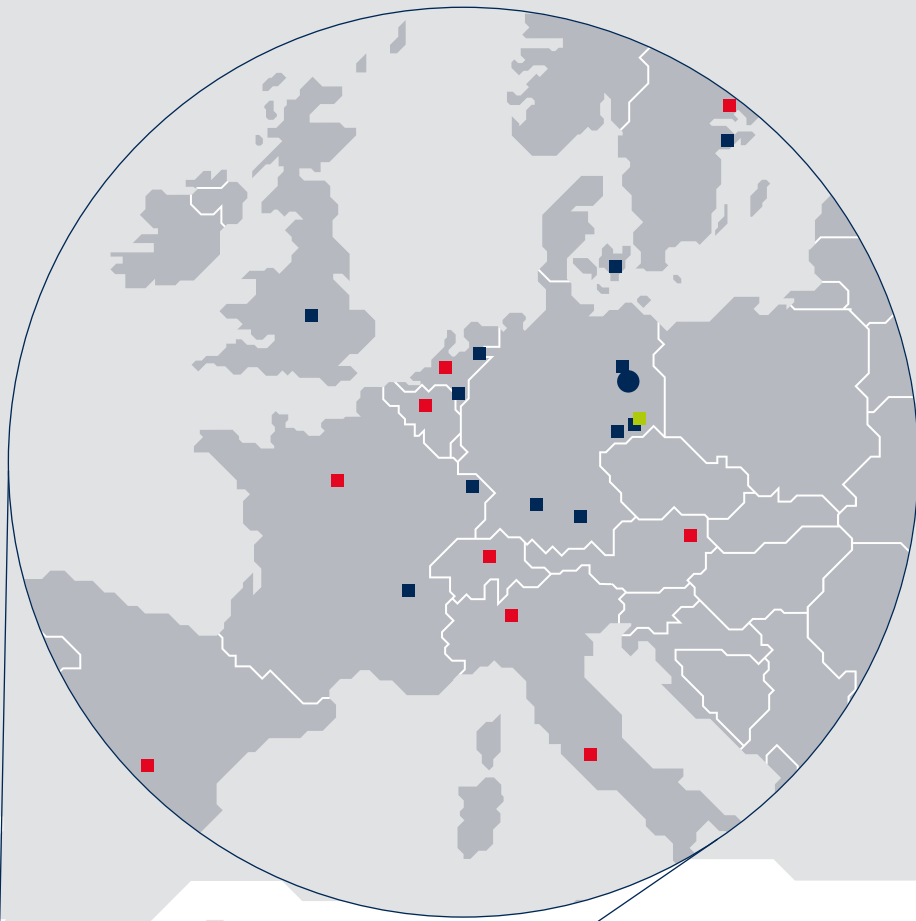
### Singapore

- Singapore

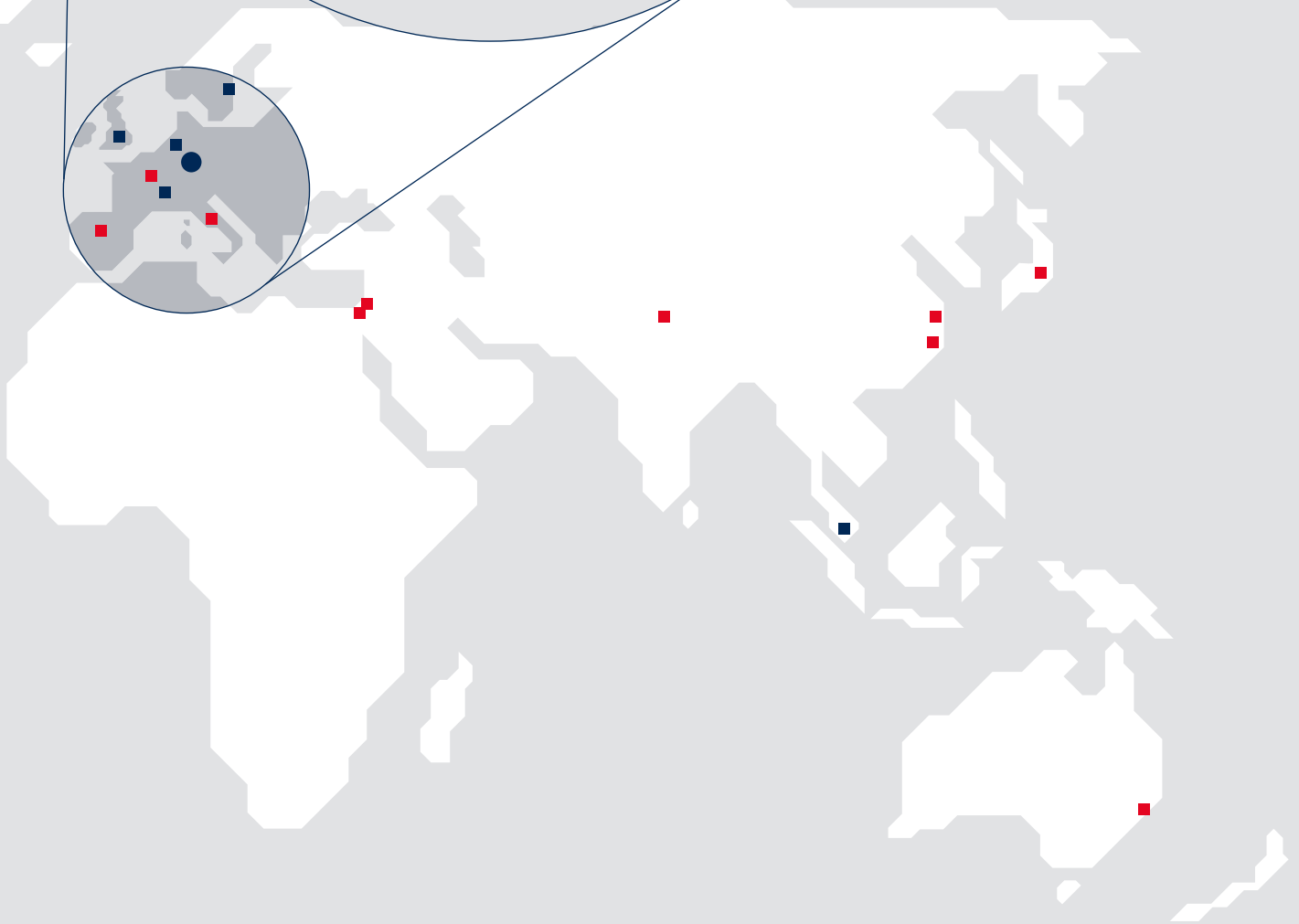
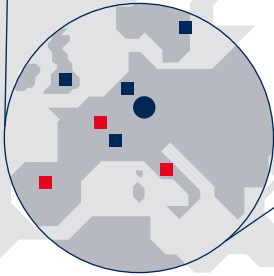
### USA

- Lexington
- Mansfield
- Westlake Village





- headquarters
- location
- partner



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