First Sensor

Medical

Individual sensor solutions for medical technology

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. With over 800 employees, we are represented at six German locations and also have production and sales sites in the USA, Canada, China, Great Britain, France, Sweden, Denmark and the Netherlands along with a worldwide partner network. Together we identify, meet and solve the challenges of the future with our innovative sensor solutions early on.

„First Sensor is increasing its presence on its target markets through new smart sensors systems that react intelligently to the measurement results and communicate with other systems.“

Dr. Mathias Gollwitzer, Executive Board, First Sensor AG

In the growth market of sensor systems, First Sensor develops and produces customer-specific solutions for the ever-increasing number of applications in the industrial, medical, and mobility target markets. Based on tried-and-tested technology platforms, we develop products such as chips, components, sensors, and entire smart sensor systems. These products give you a real competitive edge. Trends such as Industry 4.0, autonomous driving, and the miniaturization of medical technology will drive our growth extremely rapidly in the future.

Using our detailed understanding of your specific application, we develop solutions whose capabilities go far beyond those of standard components already on the market. By focusing on technology-driven target markets, we are already playing a role in their exceptionally rapid growth. In the future, too, we will benefit from the megatrends that drive these markets. Our goal here is to identify and meet the challenges of the future early on – a goal that is firmly anchored in our corporate culture.

Among the customers of First Sensor are well-known industrial groups and young technology companies that utilize our know-how and many years of expertise to develop their own innovative products. They appreciate the opportunity to make individual adjustments at every stage of the value chain in order to create exceptionally powerful sensors and sensor systems with tailored features. This joint development work frequently forms the basis for long-standing partnerships.

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 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!

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

Triple the experience and innovation

First Sensor is focused on three core markets: Industrial, Medical and Mobility. We support these markets with our international sales as well as uniformly controlled production processes. The development of tailor-made sensor solutions as well as the manufacturing of the products is specifically guided by your 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 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.

In the Industrial market First Sensor 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, smart building 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 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. First Sensor will accompany the automotive industry into this new era with its sensor solutions.

We 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

OEM pressure sensors for

- tank pressure measurement
- fuel delivery
- tank leakage diagnostics
- fank 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 medical technology

For the medical market, responsibility for quality is a central criterion of our work at First Sensor. Our customers have been relying on our powerful technologies and customer-specific branch expertise for over 30 years.

Sensors play an ever more important role in medical technology with the aim of making medical devices even more effective and safer, while simplifying their operation. As a long-standing manufacturer and supplier of sensor system solutions for medical technology, we understand your applications. At First Sensor, you can find not only the standard but also the ideal sensor system solution for your measuring task.

Sensors are crucial components for the quality and reliability of your products and solutions. For this reason, we take great care in our development, production and service activities – working in accordance with certified processes and procedures. With certification according to EN ISO 13485, we comply with the high requirements for medical products. Orientation to the highest quality standards has made us one of the leading providers of sensor solutions for measuring pressure, flow, liquid level, oxygen, light, radiation and acceleration.

We know that medical technology saves lives and are familiar with demanding measuring tasks and challenges. Our highly sensitive ultra-low pressure sensors detect the sudden occurrence of even slight spontaneous breathing and thus help to keep the patient's respiratory effort as minor as possible. Flow sensors from First Sensor measure rapidly, detect the flow direction and are suitable for portable devices. You can measure in a non-contact and hence sterile manner using our flexible capacitive liquid level sensors.

And finally, our large range of photodiodes provides sensitive and rapid measurements of ultraviolet, visible and infrared light as well as ionizing radiation.

We offer tailored solutions, sensors and systems that are developed and manufactured in line with your requirements. This can range from modifying a standard product to developing a completely new special sensor or designing an integrated system with multiple components. Our offer: Talk to our development and sales engineers before you adapt the specifications, design and functionality of your applications to existing standard sensors at considerable time and effort.

The entire value added chain

Supply chain flexibility is becoming increasingly important for you. As a reliable partner, we offer a range of services from tailored solutions – warehousing, replacement part deliveries through 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 medical technology.

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

Breathing and respiration

High-quality sensors in respiratory devices measure smallest flow rates around the zero point of the respiratory flow and also detect flow rates of several hundred l/min. First Sensor develops and manufactures highly reliable sensors and customized sensor systems as a strategic partner to medical product manufacturers in the area of breathing and respiration. Thereby we comply with the high requirements for medical products according to EN ISO 13485.

Respiratory devices

An important feature when controlling (triggering) high-quality respiratory devices is the early detection of the patient's inhalation phase via a flow trigger. Only in this way can the device assist a spontaneous breath with a preset overpressure, while keeping the patient's respiratory effort to a minimum. At the same time, the measurements need to be highly accurate over the entire flow range for many treatments in order to detect the patient's respiratory pattern reliably. In today's respiratory devices, the spontaneous breathing effort and entire respiratory activity of the patient is therefore usually monitored by a highly sensitive thermal mass flow sensor or a highly dynamic differential pressure sensor.

Our sensor solutions for respiratory devices

First Sensor provides highly sensitive and rapid thermal mass flow sensors as well as special versions of its flow-based LDE/LME/LMI differential pressure sensors with resolutions of 0.01 % in the lower pressure range and, at the same time, dynamic measuring ranges greater than 10,000. These special sensors detect smallest flow rates around the zero point of the respiratory flow and also measure flow rates of several hundred l/min. We also develop and manufacture customized multi-sensor modules as a simple plug-and-play solution for respiratory devices. The modules integrate multiple sensors to form fully calibrated and tested systems with signal processing and definite interfaces.

PRODUCTS

LDE/LME/LMI Series: ultra-low pressure sensors based on flow measurement
HDI/HCE Series: pressure sensors with integrated signal conditioning
Customized sensors, modules and systems

1 Highly reliable flow and pressure sensors for respiratory devices

Sleep apnea therapy devices

In controlled CPAP devices, pressure sensors continuously monitor the therapy pressure, thereby improving the comfort and quality of the treatment. The slight overpressure of a few millibars is generated by a centrifugal blower and supplied to the patient via a tube system and respiratory mask. However, the set therapy pressure of the CPAP device is influenced by the patient's breathing. This leads to increased breathing effort for the patient and to a lower quality of therapy. Higher-quality devices therefore have a precise pressure sensor that continuously compares the actual pressure value with the specified target therapy value. Pressure deviations can then be compensated very quickly by dynamically controlling the blower output. The pressure stability is an essential quality feature and an important comparative parameter of controlled CPAP devices.

Our sensor solutions for sleep apnea therapy devices

Pressure sensors of the HDI and HCE series from First Sensor monitor the pressure value resulting at the device output or in the respiratory mask. Thanks to their very high accuracy and sensitivity, they detect pressure fluctuations in fractions of a millibar. In conjunction with modern control electronics and powerful blowers, the short response time of the sensors in the millisecond range enables pressure deviations to be compensated rapidly.

1

1 Sensors with high resistance to anesthetics

2 Ultra-low pressure sensors measure airflows in spirometers

Anesthetic devices

Anesthetic devices or anesthesia respiratory devices administer a mixture of air, oxygen, nitrous oxide and anesthetic (e.g. isoflurane, sevoflurane or desflurane) to the patient. The volatile anesthetics are added to the respiratory air in precisely defined concentrations via a vaporizer in the anesthetic device. Pressure and flow sensors monitor the line pressures in the anesthetic device along with the inspiratory and expiratory volume flows and ensure that the patient is administered the gas mixtures selected by the anesthetist in the right concentration and with the set pressure and volume.

Our sensor solutions for anesthetic devices

First Sensor provides thermal mass flow sensors or differential pressure sensors to measure inspiratory and expiratory pressure and volume in the respiratory unit of the anesthetic device. For use with anesthetic gases, we have developed special versions of our piezoresistive silicon pressure sensors (for example the HCLA and HCE series) that exhibit a high resistance to anesthetics such as isoflurane, sevoflurane or desflurane.

PRODUCTS

HCL Series:
temperature compensated low pressure sensors
HCLA Series:
low pressure sensors with integrated signal conditioning
Customized sensors, modules and systems

Spirometers

In spirometers special pneumotachographs (e.g. according to Fleisch or Lilly) are used to measure the respiratory flow using differential pressure sensors. The patient's breath flows through a laminar flow element or an orifice with a very small flow resistance. This results in a minimal pressure drop across the element, which is a measure of the respiratory flow rate (respiratory volume per time). These differential pressures can be logged with highly accurate sensors and converted into an electrical signal. So as not to unnecessarily burden the patient's respiration, it is important to keep the flow resistance as low as possible. Where respiratory flows are about 0.1 l/s during spontaneous respiration and approx. 7 l/s with forced expiration, the differential pressures generated via the flow element are therefore very low – in the range from below 100 Pa to several thousand pascals (100 Pa = 1 mbar). To be able to measure low respiratory flows with accuracies of 1 % and, at the same time, ensure measurements over dynamic ranges >10,000, highly sensitive differential pressure sensors are required. In addition, the sensors must fulfill strict specifications regarding the resistance to moisture and dirt.

Our sensor solutions for spirometers

LDE/LME/LMI ultra-low pressure sensors from First Sensor are ideally suited for flow rate measurement using the differential pressure method. The innovative sensor layout with a miniaturized flow channel on the chip level enables highly sensitive measurement of ultra-low pressures from 25 Pa (0.25 mbar) full scale with ultra-high resolution and accuracy.

In addition, the semiconductor technology allows cost effective yet highly stable and compact designs. Due to the minimal air flow through the sensor the LDE/LME/LMI is very insensitive to moisture and dirt. Finally, connecting tubes or filters do not typically have any negative effect on the measuring accuracy.

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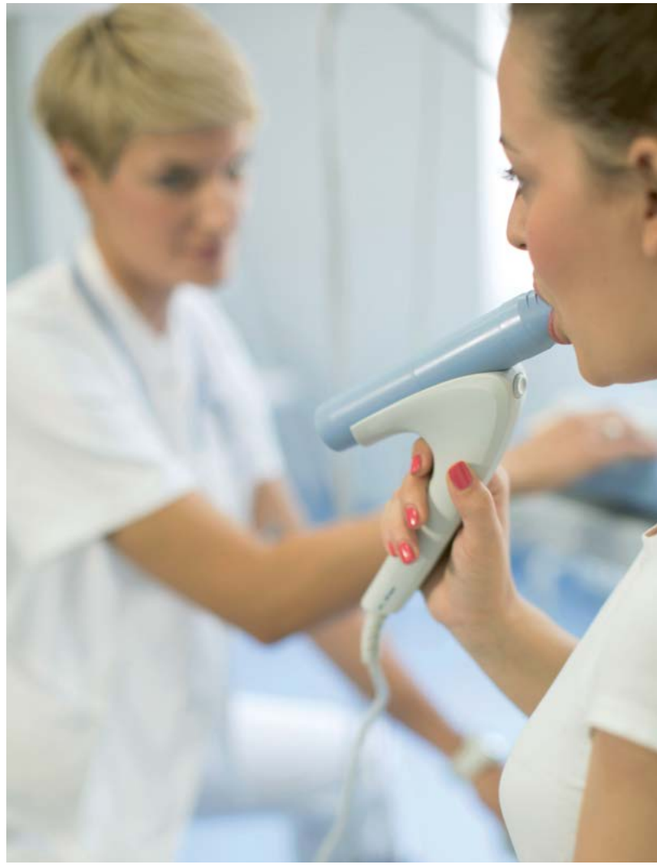


PRODUCTS

LDE/LME/LMI Series: ultra-low pressure sensors based on flow measurement
Customized sensors, modules and systems

Dialysis

Modern dialysis devices for hemodialysis, hemofiltration and hemodiafiltration use a variety of sensors for safety-critical monitoring of pressure, flow and liquid level in the dialysate and blood circulation as well as for detecting leaks and air in the hose system. In particular, the patient‘s blood pressure must be monitored continuously during dialysis.

Dialysis

Dialysis or renal replacement therapy is a blood purification process that removes toxic or waste substances from the blood of patients with chronic renal failure or chronic renal insufficiency. The exchange of substances here occurs by means of diffusion via a semi-permeable dialysis membrane.

Our sensor solutions for dialysis

First Sensor provides various sensor solutions for dialysis. Our highly accurate piezoresistive silicon pressure sensors of the HDI and HCE series with digital I²C or SPI interfaces are used for indirectly monitoring the blood pressure. Customized pressure measuring ranges in the overpressure and negative pressure (vacuum) area are available for these sensors.

In addition, First Sensor develops and manufactures multi-sensor modules that integrate a variety of components such as sensors, valves, pumps, switches, and microcontrollers to create compact plug-and-play solutions. The use of plastic manifolds allows the precise three-dimensional arrangement of flow channels without the need for cumbersome and fault-prone piping for the individual components. First Sensor‘s manifold modules provide you with cost savings in the development of OEM devices along with competitive advantages thanks to short development cycles.

First Sensor also develops and manufactures customized front-flush pressure transmitters for dialysis devices based on highly precise piezoresistive ceramic or stainless steel pressure measuring cells with long-term stability. Our opto-electronic liquid level switches of the OLP and OLT series are suitable for detecting leaks in the dialysate and blood circulation or for liquid level measurement. A blood leakage through the dialysis membrane into the dialysate is detected by special optical sensors that measure the blood concentration and output a signal if a definite threshold value is exceeded. First Sensor‘s ultrasonic sensors detect air bubbles in various tube lines in a non-contact and hence sterile manner and consequently prevent the air from entering the patient‘s bloodstream.

1

PRODUCTS

HDI/HCE Series: pressure sensors with integrated signal conditioning
OLP/OLT Series: optical liquid level switches
Customized sensors, modules and systems

Diagnostics

In medical diagnostics, new technologies and technical improvements enable ever faster and more accurate measurements and consequently results in better treatment success. Sensors and complex sensor systems from First Sensor offer you extensive options to stand apart from the competition through innovative products – thanks to even more precise, rapid or reliable individual solutions.

Diagnostics

Imaging methods such as endoscopy, computer tomography (CT) and magnetic resonance tomography (MRT) play an important role in medical diagnostics. A further field involves laboratory diagnostics, which utilizes photometric processes for examining blood, for example. Blood sugar measuring devices determine the glucose concentration in the blood of diabetes patients. A generation of devices measures in a non-invasive manner using optical methods. In a similar way, pulse oximeters measure the oxygen concentration in the blood via the different light absorption of the hemoglobin saturated with oxygen.

2

Our sensor solutions for medical diagnostics

First Sensor develops and manufactures customized sensor and micro systems as a strategic partner to medical product manufacturers in the area of medical diagnostics. We utilize state-of-the-art layout and connecting technologies for the assembly and calibration of semiconductor chips and micro-optics under clean room conditions. Our customized optical systems integrate LEDs, laser diodes, photodiodes, filters and lenses into compact units. The elements can be mounted on various substrate materials such as rigid or flexible printed circuit boards, ceramic circuit carriers or metal frames and can be encapsulated hermetically by transfer molding or potting.

We produce large-scale X-ray detector arrays for computer tomography. Ultra-modern flip-chip technology is used to assemble the individual chips on a multilayer LTCC ceramic substrate and underfill them with a special plastic. The individual sensor elements attain the highest fitting accuracies with a tolerance of 10 µm in all three spatial directions, thereby ensuring the smallest dead spaces and a high filling factor. The detector arrays then undergo a complete mechanical and electrical quality check. For flexible video endoscopes, we provide complete optical systems, which integrate the CCD image sensor chip and miniature lens systems into a compact unit.

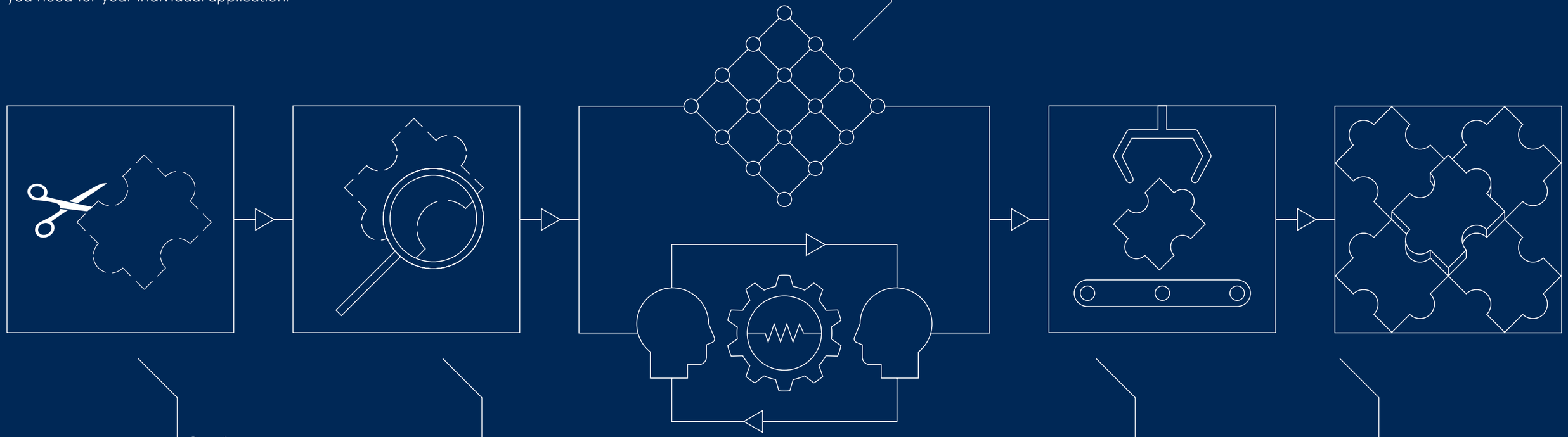
1 Customized sensor solutions for dialysis devices
2 Customized detector arrays for computer tomography

PRODUCTS

Customized sensors, modules and systems

Sensor solutions

Together we can plan, develop and guide your entire sensor system project, tailored to your requirements. We offer a wide range of application-optimized standard products or customized solutions - products providing exactly what you need for your individual 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 implementation and cost. 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 up to final qualification. Together with you, we can realize optimum solutions for your successful applications with unique selling propositions.

We support 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.

Find everything you need.

Step_3.2
Individual product development

Our Research & Development and our production sites are specialized in finding and implementing individual solutions for your requirements. Components, modules and sensor systems are developed in close cooperation with you in a Stage-Gate-Process®.

We offer tailored individuality.

Step_4
Production and quality assurance

Utilize our flexible production capacity – from rapid prototype manufacture via medium-sized quantities to order-based, cost-efficient series production involving millions of units. We carry out our development, validation, qualification and reliability approval work along wi dards and certifications specific to your sector. At our different production sites we offer application-specific measurement technologies and master various calibration methods.

We customize our 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 realize your solution.

Detect more, achieve more – our products

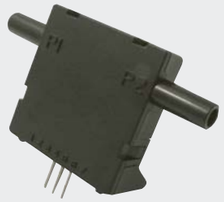
What would you like to find out today? Or what would your product, your customer or a user like to find out? Whether it involves pressure, flow, radiation, light, level or acceleration– we know which sensor is right for you and will provide you with the precise value.

Our sensors and sensing 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!

Pressure

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

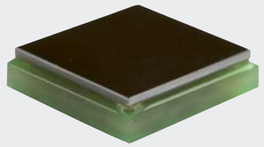
Flow



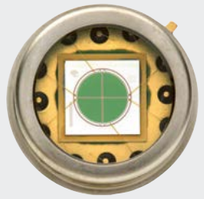
Thermal mass flow sensors

Sensors for volumetric flow measurement

Radiation / Light



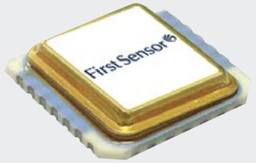
Detectors for ionizing radiation
– with and without scintillator
– photodiode arrays



Optical sensors
– PIN photodiodes
– avalanche photodiodes (APDs)
– quadrant photodiodes (QP)

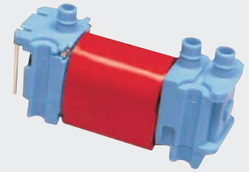
Level / Acceleration

Liquid level switches



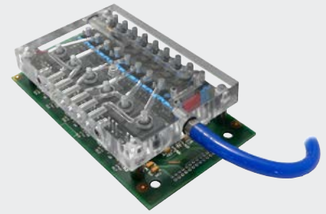
MEMS inertial sensors
– inclination sensors
– acceleration sensors

Valves



Miniature solenoid valves
– switching solenoid valves
– proportional solenoid valves

Systems



Customized sensors and sensing systems
– multi-sensor modules
– manifolds
– plug-and-play solutions

Pressure sensors

First Sensor develops and manufactures a large selection of highly accurate and reliable pressure sensors for air, gas and liquids. The sensors either provide basic mV signals or fully signal conditioned analog or digital outputs. Our flow-based differential pressure sensors use a new and innovative MEMS technology for ultra-low pressure measurement from 0.25 mbar (25 Pa).

Uncompensated pressure sensors: piezoresistive basic 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.

	HDU	HMU
Pressure range	100 mbar to 5 bar	100 mbar to 10 bar
Pressure type	Absolute, gage, differential	Absolute, gage, differential
Output signal (span)	typ. 60...100 mV	typ. 50...100 mV
Thermal effects		
- Offset	typ. ±0.02 %FSS/°C	typ. ±0.02 %FSS/°C
- Span	typ. -0.2 %FSS/°C	typ. -0.19 %FSS/°C
- Bridge resistance	typ. 0.26 %/°C	typ. 0.26 %/°C
Operating temperature range	-40...85 °C	-40...85 °C

Temperature compensated pressure sensors: calibrated and temperature compensated

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.

	HCL	HDO	HRO
Pressure range	5 to 75 mbar	10 mbar to 5 bar	10 mbar to 10 bar
Pressure type	Gage, differential	Absolute, gage, differential	Gage, differential
Output signal (span)	typ. 10...20 mV	typ. 20...90 mV	typ. 13...100 mV
Accuracy (non-linearity, hysteresis)	typ. ±0.05 %FSO	typ. ±0.1 %FSO (P-Grade) typ. ±0.2 %FSO (H-Grade)	typ. ±0.25 %FSS
Temperature range			
- compensated	0...50/70 °C	0...50 °C	0...50/70 °C
- operating	-25...85 °C	-40...85 °C	-25...85 °C

Applications:
Respiratory devices
Anesthetic devices
Sleep apnea therapy devices
Spirometers
Dialysis machines
Insufflators
Oxygen concentrators

Pressure sensors with integrated signal conditioning: amplified output signal

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.

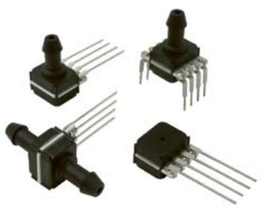
	HCLA	HCE	HDI
Pressure range	2.5 to 75 mbar	10 mbar to 5 bar, barometric pressure ranges	10 mbar to 5 bar, barometric pressure ranges
Pressure type	Gage, differential	Absolute, gage, differential	Absolute, gage, differential
Output signal	Analog and I²C-Bus	Analog and SPI-Bus	Analog and I²C-Bus
Accuracy			
- Non-linearity, hysteresis - Total accuracy (0...85 °C)	typ. ±0.05 %FSS	max. ±0.5 %FSS	max. ±0.5 %FSS
Operating temperature range	-25...85 °C	-25...85 °C	-20...85 °C

Pressure sensors based on flow measurement: ultra-low pressure

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.

	LDE	LME	LMI
Pressure range	25 to 500 Pa	25 to 500 Pa	25 to 500 Pa
Pressure type	Gage, differential	Gage, differential	Gage, differential
Output signal	Analog and SPI bus	Analog and SPI bus	I²C bus
Offset stability	max. 0.1 % p.a. (ab 50 Pa)	max. 0.1 % p.a. (ab 50 Pa)	typ. 0.02 % p.a. (ab 50 Pa)
Total accuracy	typ. ±0.5 %FS	typ. ±0.5 %FS	typ. ±0.5 %FS
Temperature range			
- compensated	0...70 °C	0...70 °C	-20...85 °C
- Operating	-20...80 °C	-20...80 °C	-40...85 °C

Pressure sensors



Pressure sensors for corrosive liquids and gases: amplified output and digital interface

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.

	HMA	HMI	HME
Pressure range	100 mbar to 10 bar	100 mbar to 10 bar	100 mbar to 10 bar
Pressure type	Gage, differential	Gage, differential	Gage, differential
Output signal	Analog	I²C bus	SPI bus
Accuracy			
- Non-linearity, hysteresis	max. ±0.25 %FSS	max. ±0.25 %FSS	max. ±0.25 %FSS
- Total accuracy (-20...85 °C)	max. ±1.5 %FSS	max. ±1.5 %FSS	max. ±1.5 %FSS
Operating temperature range	-20...85 °C	-20...85 °C	-20...85 °C

Pressure sensors for corrosive liquids and gases: fully welded, stainless steel

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.

	SSO	SSI
Pressure range	200 mbar to 35 bar	200 mbar to 35 bar
Pressure type	Absolute, gage	Absolute, gage
Output signal	typ. 45...130 mV (span)	Analog and I²C bus
Accuracy		
- Non-linearity	typ. ±0.1 %FSO	
- Total accuracy (-20...85 °C)		max. ±1.5 %FSS
Temperature range		
- compensated	0...50 °C	-20...85 °C
- operating	-40...125 °C	-40...120 °C

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: fast, energy efficient

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.

	WBI	WBA	WTA
Flow ranges	200 ml/min to 1 l/min	200 ml/min to 1 l/min	2 to 50 l/min
Output signal	I²C bus	1...5 V	0.5...4.5 V
Accuracy (hysteresis, repeatability)	max. ±0.25 % of reading	max. ±0.25 % of reading	typ. ±0.25 % of reading
Temperature range			
- compensated	0...50 °C	-25...85 °C	0...50 °C
- operating	-25...80 °C	-25...85 °C	-25...85 °C

Differential pressure sensors: for volumetric flow measurement

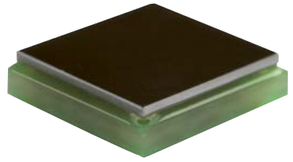
Differential pressure sensors and rugged differential pressure transmitters for volumetric flow measurement from First Sensor detect the pressure drop across a flow element. Our flow-based ultra-low differential pressure sensors from 0.25 mbar (25 Pa) feature high sensitivity and offset stability as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

	LDE/LME/LMI	HCLA	BTE5000
Pressure range	25 to 500 Pa	2,5 to 75 mbar	1 mbar to 10 bar
Pressure type	Gage, differential	Gage, differential	Gage, differential
Output signal	Analog and SPI bus, I²C bus	Analog and I²C bus	1...6 V, 4...20 mA
Housing	SMT, SIL	SMT, SIL	Transmitter (aluminum)

Applications:
Respiratory devices
Anesthetic devices
Sleep apnea therapy devices
Spirometers
Insufflators
Oxygen concentrators

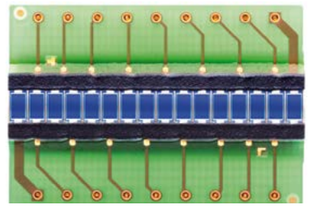
Detectors for ionizing radiation

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.

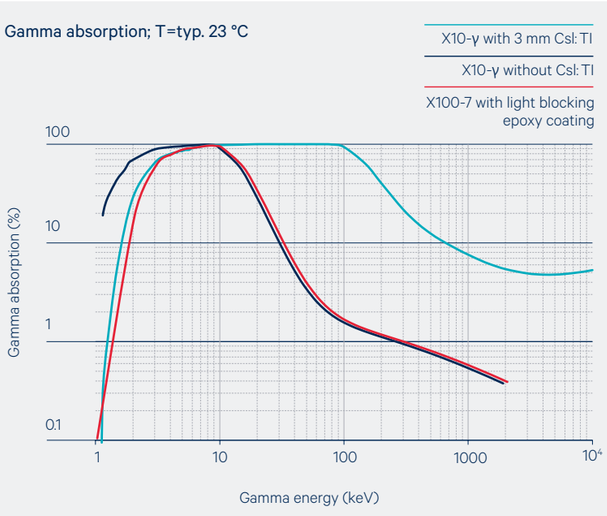


Radiation sensor with or without scintillator

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.



Gamma absorption; T=typ. 23 °C



Applications:
Radiation detectors
Scintillator luminescence detection
Photometry
Dosimeter
X-ray fluorescence spectrometers

Serie X: modular, sensitive / detectors for ionizing radiation

Order #	Chip	Package	Active area Size (mm) / Area (mm²)	Dark current (nA)	Capacitance (pF)	Gamma-energy (KeV)	Scintillator CsI (Tl)	window
50190301	X5-γ	TO8S	Ø 2.52 / 5	0.01	2.5	>1	no	Ø 6 mm
501559	X7-F	CSP	2.8 x 2.8 / 6.2	0.015	12	-	no	-
50190401	X10-γ	TO8Siγ	Ø 3.75 / 10	0.02	4.5	>1	no	Ø 6 mm
50190001	X10-γ	TO8S Sc	Ø 3.75 / 10	0.02	4.5	2...>1000	yes	Ø 6 mm
501907	X10-6	TO39	Ø 3.57 / 10	0.5	18	>5	no	epoxy dome
501401	X100-7	LCC10	10 x 10 / 100	3	80	>5	no	black epoxy
501400	X100-7	CerPin	10 x 10 / 100	3	80	>5	no	black epoxy
50147702	X100-7	CerPin	10 x 10 / 100	5	80	5,,>1000	4 mm	white coating
50147701	X100-7	CerPin	10 x 10 / 100	5	80	5,,>1000	8 mm	white coating

Photodiode arrays: modular, sensitive

Our linear PIN photodiode arrays are optimized for CsI:Tl scintillator luminescence detection and designed for linear multi-device assembly.

Order #	Chip	Package	Elements	Pitch (mm)	Active area Size (mm) / Area (mm²)	Dark current at10 mV (pA)	Capacitance at 0 V (pF)	Scintillator
50146101	16XA1.9-B	DIL18 full	16	1.275	0.9 x 2.15 / 1.94	5	250	optional
50146102	16XA1.9-B	DIL18 slim	16	1.275	0.9 x 2.15 / 1.94	5	250	optional
50146201	16XA2.6-A	DIL18 full	16	1.575	1.2 x 2.15 / 2.58	5	135	optional
50146202	16XA2.6-A	DIL18 slim	16	1.575	1.2 x 2.15 / 2.58	5	135	optional
50146301	16XA5.2-A	DIL18 full	16	2.525	2.15 x 2.4 / 5.16	7,5	240	optional
50146302	16XA5.2-A	DIL18 slim	16	2.525	2.15 x 2.4 / 5.16	7,5	240	optional

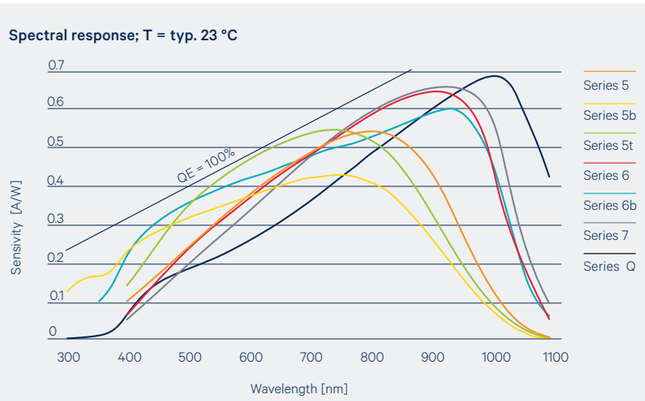
Optical sensors

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, and 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 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 for detecting the position of laser beams.

Spectral response; T = typ. 23 °C

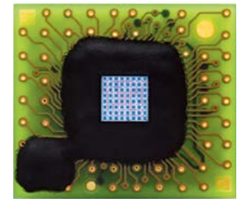


PIN series	Optimized for	Special features
Series 6b	**350...650 nm**	**Blue/green enhanced**
Series 5b	**350...650 nm**	**High speed blue-enhanced Epitaxy PIN-diode**
Series 5t	**500...900 nm**	**High speed red-enhanced Epitaxy PIN-diode**
Series 5	**500...900 nm**	**High speed NIR-enhanced Epitaxy PIN-diode**
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**

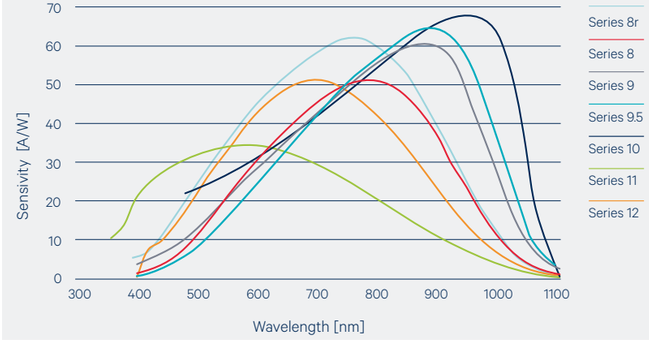
Applications:
Laser alignment
Scintillator luminescence detection,
Photometry
Fluorescence detection

Avalanche photodiodes (APDs)

Silicon avalanche photodiodes 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, 5 x 5 or 8 x 8 pixels.



Spectral response; T=typ. 23 °C , M = 100



APD series	Optimized for	Special features
Series 11	**350...550 nm**	**Blue enhanced, high speed**
Series 12	**550...750 nm**	**Ultra-low temperature coefficient, flat frequency response up to 3 GHz**
Series 8r	**620...750 nm**	**Optimized for 650 nm, fast rise time, low capacitance, flat gain curve**
Series 8	**750...820 nm**	**High speed, low temperature coefficient, high gain bandwidth product**
Series 9	**750...930 nm**	**Fast rise time at higher NIR sensitivity, high gain**
Series 9.5	**800...950 nm**	**Excellent responsivity in 950 nm range, fast rise time, low dark current**
Series 10	**900...1100 nm**	**Sensitivity at 1064 nm close to physical limits**

Optical sensors

Silicon photomultipliers (SiPMs)

Silicon photomultipliers from First Sensor enable the detection of ultra-low light levels down to single photons. The detectors are optimized for near ultraviolet (NUV) or red, green and blue light with peak sensitivities at 420 nm or 550 nm. Compared to conventional photomultiplier tubes, our SiPMs offer significant advantages such as low operating voltage, excellent temperature stability, immunity to magnetic fields and a much smaller size for easy system integration.

SiPM-NUV: near ultraviolet (NUV) SiPMs

Order #	Package	Active area (mm)	Pixel size (µm)	Pixel	Fill factor	Dark count rate (kHz/mm²)	Photon detection efficiency (%)	Gain
50162801	SMD	1x1	40x40	625	60	<50 @ 2 V OV <100 @ 6 V OV	43	3.6x106
50162802	SMD	Ø 1.2	40x40	673	60	<50 @ 2 V OV <100 @ 6 V OV	43	3.6x106
50162803	SMD	3x3	40x40	5520	60	<50 @ 2 V OV <100 @ 6 V OV	43	3.6x106
50162804	SMD	4x4	40x40	9340	60	<50 @ 2 V OV <100 @ 6 V OV	43	3.6x106

SiPM-RGB: red, green, blue (RGB) SiPMs

Order #	Package	Active area (mm)	Pixel size (µm)	Pixel	Fill factor	Dark count rate (kHz/mm²)	Photon detection efficiency (%)	Gain
50162901	SMD	1x1	40x40	625	60	<100 @ 2 V OV <200 @ 4 V OV	32.5	2.7x106
50162902	SMD	Ø 1.2	40x40	673	60	<100 @ 2 V OV <200 @ 4 V OV	32.5	2.7x106
50162903	SMD	3x3	40x40	5520	60	<100 @ 2 V OV <200 @ 4 V OV	32.5	2.7x106
50162904	SMD	4x4	40x40	9340	60	<100 @ 2 V OV <200 @ 4 V OV	32.5	2.7x106

Applications:
Medical imaging
Nuclear medicine
Analytical instruments

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 optical liquid level switches which register the level using limit values.

Optical liquid level switches: small and cost-effective

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.

	OLP/OLT	OLM
Output	100 mA, 1 A	10 mA, 800 mA
Operating temperature range	-25...80 °C, -40...125 °C	-25...80 °C, -40...125 °C

MEMS inertial sensors

Our capacitive inclinometers and accelerometers are based on single crystal silicon sensor elements and utilize state-of-the-art micromachining technology. The MEMS sensors allow for flexible customization to fit your individual application requirements.

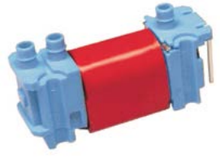
Inclinometers and accelerometers: innovative and highly precise

The inertial sensors achieve large signal-to-noise ratios and excellent stability over temperature. High aspect ratio microstructures (HARMS) allow for ultra-low cross axis sensitivities. Further, the patented highly flexible AIM (Air gap Insulated Microstructures) technology minimizes parasitic capacitances.

	Inclinometer	Accelerometer		
	SI-11.S1.C-30	SA-12.S1.C-3	SA-13.S1.C-8	SA-14.S1.C-15
Measurement range	±30 °	±3 g	±8 g	±15 g
Resolution at 10 Hz	< 0,0015 °	< 40 µg	< 65 µg	< 95 µg
Noise density	< 0,0004 °/√Hz	< 12 µg/√Hz	< 20 µg/√Hz	< 30 µg/√Hz

Miniature solenoid valves

To complement the extensive range of sensors, we supply high precision valves to control air and gas flows. The miniature solenoid valves save space, energy and have optimised flow characteristics which lend them to being ideally suited as switching and proportional valves.



Switching solenoid valves: small, reliable

	X-Valve	MX-Valve	MX-Valve
Type	2- or 3-way NO, NC or distributor	2-way, latching Universal	2- or 3-way NO, NC or distributor
Operating pressure	6, 30, 100 psi	6, 15 psi	6, 30 psi
Flow rate	9 slpm air @ 100 psi	11 slpm air @ 15 psi	48 slpm air @ 30 psi
Orifice size	0.020, 0.030, 0,045 inch	0.045 inch	0.075 inch

Proportional solenoid valves: closed loop control, precise

	VSO	VSO MAX HP	VSO LowPro
Type	2-way, NC	2-way, NC	2-way, NC
Operating pressure	50, 75, 100, 150 psi, -27 inHg	120 psi	30, 50 psi, -27 inHg
Flow rate	60 slpm air @ 100 psi	290 slpm air @ 120 psi	50 slpm air @ 50 psi
Orifice size	0.010, 0.020, 0.030, 0.040, 0.050, 0.065 inch	0.116 inch	0.040, 0.050, 0.080 inch

Applications:
Respiratory devices
Anesthetic devices
Oxygen concentrators
Patient monitors
Pressure and flow control
Negative pressure wound therapy
Insufflators

Customized sensors and sensor systems

Customized multi-sensor modules, manifolds, and plug-and-play solutions from First Sensor allow you as a medical device manufacturer to shorten your design cycle, save development costs and achieve competitive advantages as well as fast innovations to the market. As a development service provider, we utilize state-of-the-art packaging technologies for the assembly and calibration of semiconductor chips and micro-optics under clean room conditions as well as long-standing technological experience.

Multi-sensor modules and manifolds

We develop and manufacture multi-sensor modules and manifolds which integrate components such as sensors, valves, pumps, microcontrollers, etc. to form compact OEM subsystems. The use of plastic manifolds enables the three-dimensional configuration of flow channels thus eliminating time consuming and error-prone piping procedures.

Optical systems

Our customized optical systems integrate LEDs, laser diodes, photodiodes, filters and lenses into compact units. The elements can be mounted on various substrate materials such as rigid or flexible printed circuit boards, ceramic circuit carriers or metal frames and can be encapsulated hermetically by transfer molding or potting. For flexible video endoscopes, we provide complete optical systems, which integrate the CCD image sensor chip and miniature lens systems into a compact unit.

Detector arrays

First Sensor produces large-scale X-ray detector arrays for computer tomography. Ultra-modern flip-chip technology is used to assemble the individual chips on a multilayer LTCC ceramic substrate and underfill them with a special plastic. The individual sensor elements attain the highest fitting accuracies with a tolerance of 10 µm in all three spatial directions, thereby ensuring the smallest dead spaces and a high filling factor.

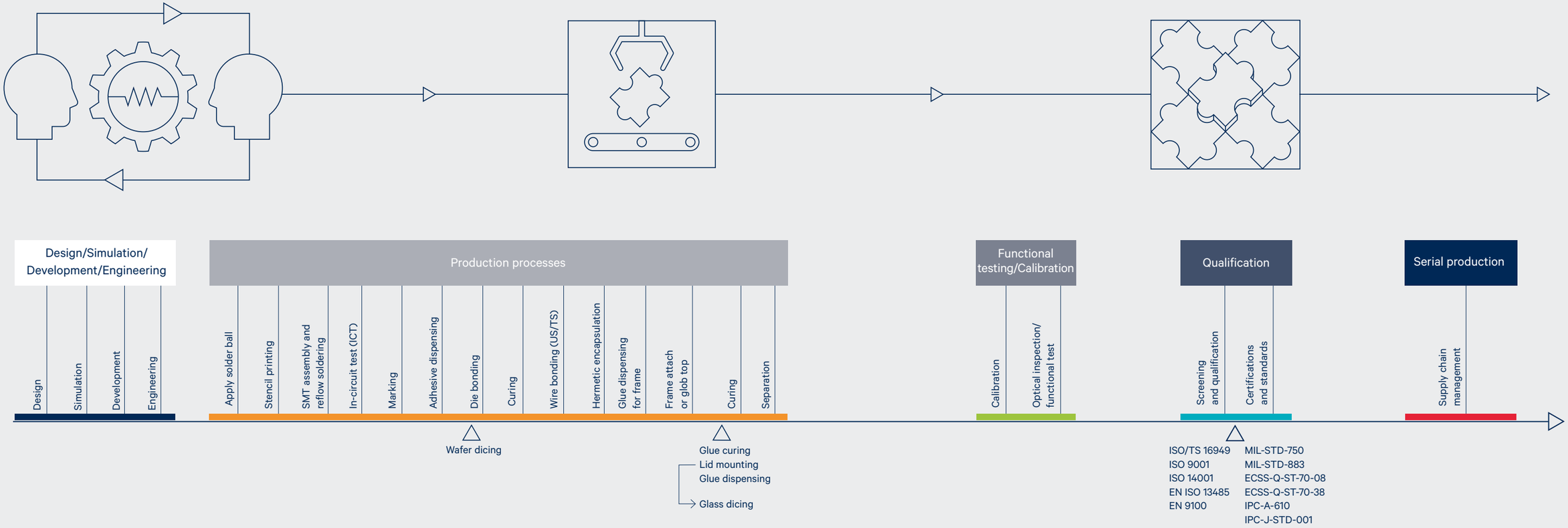
Development and production services

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 and 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 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).

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.

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

LOCATIONS

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, China, UK, France, Denmark, Sweden and the Netherlands as well as a global network of partners.

Australia
- Sydney

Belgium
- Zaventem

China
- Hangzhou
- Shanghai

Denmark
- Copenhagen

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

Spain
- Madrid

France
- Paris
- Lisses

United Kingdom
- Shepshed

India
- Faridabad

Israel
- Rishon Le-Zion
- Tel Aviv

Italy
- Aicurzio
- Rome

Japan
- Tokio

Canada
- Montreal

Korea
- Cheonan-si

Netherlands
- Eindhoven
- Dwingeloo
- Valkenswaard

Sweden
- Kungens Kurva
- Uppsala

USA
- Lexington
- Mansfield
- Westlake Village

Headquarters

First Sensor AG
Peter-Behrens-Str. 15
12459 Berlin
Germany
T +49 30 6399 2399
F +49 30 6399 2333
contact@first-sensor.com

Sales offices

Germany
First Sensor AG
Boschstr. 10
82178 Puchheim
T +49 89 80083-0
F +49 89 80083-33
fsm@first-sensor.com

United Kingdom
First Sensor Technics Ltd.
Unit B3, First Floor, Illuma Park
Gelders Hall Road, Gelders Hall Ind Est
Shepshed, Leicestershire
LE12 9NH
T +44 1509 503451
F +44 1509 506064
uk@first-sensor.com

USA
First Sensor, Inc.
5700 Corsa Ave #105
Westlake Village, CA 91362
T +1 818 706-3400
F +1 818 889-7053
us@first-sensor.com

USA
First Sensor, Inc.
905 South Main Street, Suite 201
Mansfield, MA 02048
T +1 508 339-2955
F +1 508 339-2991
us@first-sensor.com

Sweden
First Sensor Scandinavia AB
Jägerhorns vg 10
141 75 Kungens Kurva
T +46 8 4495642
F +46 8 4495649
sweden@first-sensor.com

Denmark
First Sensor Scandinavia AB
T +45 45561377
F +45 45566477
denmark@first-sensor.com

Netherlands
First Sensor Benelux
T +31 40 2011546
F +31 40 2013105
benelux@first-sensor.com

China
First Sensor China
T +86 21-6875 8536 ext 1648
F +86 21-6875 8573 ext 5648
china@first-sensor.com

France
First Sensor France SAS
T +33 1 8695 0233
france@first-sensor.com

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www.first-sensor.com