

# SENSOR.KOSMOS.

Issue 32 | September 2024



## Robotics and Automation

The advantages of AI technology

” Growth is not a value in itself,  
but rather the result of  
of other objectives. “

Johannes Nill



A fascinating new milestone is emerging in the ever-evolving landscape of robotics: **The integration of human-like robots in various sectors.** These robots, also known as humanoid robots, have the ability to mimic human movement and interact with their environment in a way that was previously the preserve of science fiction. As this technology develops, there are countless opportunities for companies, including encoder manufacturers, to capitalise on this emerging market.

Humanoid robots are increasingly being used in various industries such as healthcare, retail, hospitality and industrial manufacturing. In healthcare, humanoid robots support patient care, assist the elderly and can even be used for basic medical procedures. In retail, they can act as customer service agents and counsellors, im-

proving the consumer shopping experience. In manufacturing, humanoid robots work alongside humans on the factory floor to streamline production processes and increase efficiency.

A crucial component that enables humanoid robots to function effectively is the use of encoders. Encoders are components that convert movements into electrical signals and provide feedback on the position, speed and acceleration of various mechanical components. In the context of humanoid robots, encoders play a crucial role in ensuring precise and repeatable movements that allow them to navigate their environment with agility, dexterity and safety.

For encoder manufacturers, the advent of humanoid robots presents a unique opportunity to expand their market reach. As humanoid robots be-

come more common in all industries, the demand for high-quality encoders tailored to their specific needs is bound to increase. Encoder manufacturers can capitalise on this opportunity by developing special encoders that meet the unique requirements of humanoid robots, such as compact size, high integrability, and high precision in dynamic environments. In addition, the leading role of Chinese companies in the research and development of human robots should not be underestimated. With significant investments in robotics research and development, Chinese companies are at the forefront of innovation in this field, together with US companies. Close contact with the leading manufacturers is essential for encoder suppliers to understand what characteristics an encoder must have in order to be best suited for use in humanoid robots.

Whereas an industrial robot typically has five to seven joints, a single human robot typically consists of around 50 joints, each of which requires at least two encoders for accurate motion feedback. Therefore, a humanoid robot with 50 joints would require at least 100 encoders to function effectively. This emphasises the significant demand for encoders in the emerging humanoid robot market and offers encoder manufacturers a lucrative opportunity for growth and expansion.

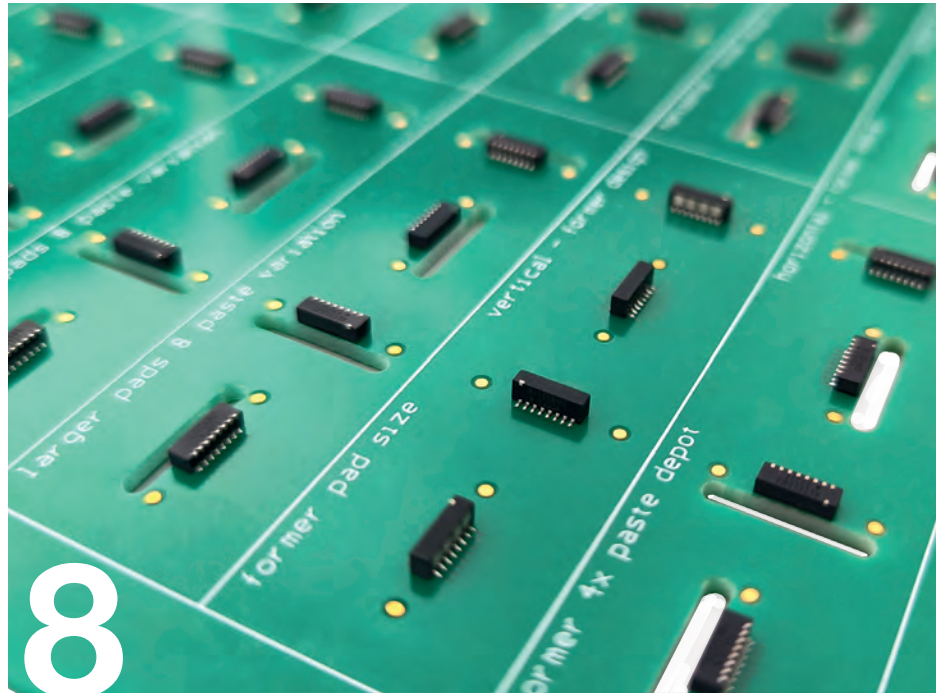
However, with these opportunities come challenges. Humanoid robots present unique technical and design complexities that must be considered to ensure optimal performance and safety. Encoder manufacturers must invest in research and development to develop robust solutions that can withstand the demands of real-world applications while ensuring high levels of accuracy and reliability.

To summarise, the emergence of human robots represents a transformative change in the robotics landscape and opens up new opportunities for companies in various industries. Encoder manufacturers in particular will benefit from this trend by developing specialised measurement solutions tailored to the specific needs of humanoid robots.

*Eike Guthörl - Head of Development*

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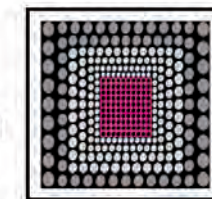
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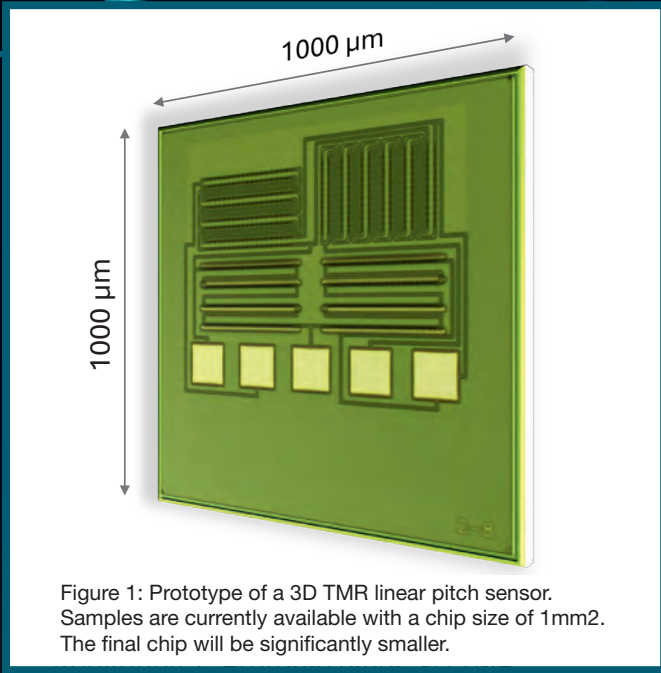
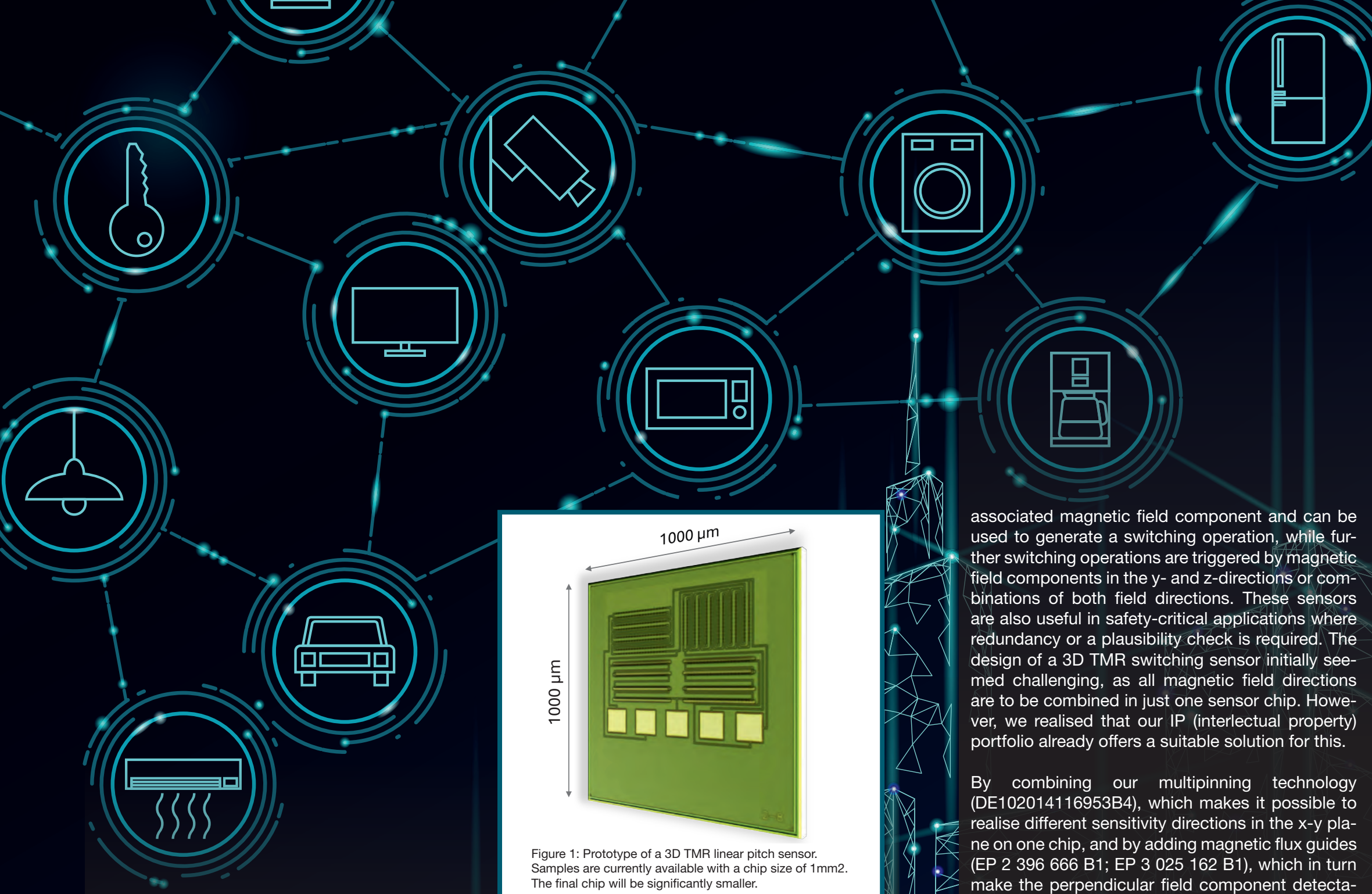


Figure 1: Prototype of a 3D TMR linear pitch sensor. Samples are currently available with a chip size of 1mm<sup>2</sup>. The final chip will be significantly smaller.

## SWITCHING APPLICATIONS RETHOUGHT

### 3D SENSORS WITH LINEAR CHARACTERISTIC CURVE AND LOW CURRENT CONSUMPTION

The 1D magnetic field sensors TF954 and the switching sensors of the KTM1300 series from Sensitec, which have been available for some time, are characterised by their linear measuring range of  $\pm 10$  mT and particularly low power consumption. The sensors are based on a typical internal resistance of approx. 6 MOhm - this means that with an applied voltage of 1 volt, the sensor chip only requires 166nA current. This makes these products ideal for low-power applications, especially in battery operation. In addition to the sensor chip, the KTM1300 sensors also contain an evaluation ASIC,

which ensures a defined, digital switching point at the output. In response to various customer enquiries, we have now developed a prototype for a 3D TMR switching sensor that also provides the two other field components in the y and z directions in a linear, electrical output signal.

Such sensors can be used in a more flexible and versatile way, for example in the consumer sector, where several switching operations or switching points are to be detected by just one sensor. A magnetic movement in the x-direction causes an

associated magnetic field component and can be used to generate a switching operation, while further switching operations are triggered by magnetic field components in the y- and z-directions or combinations of both field directions. These sensors are also useful in safety-critical applications where redundancy or a plausibility check is required. The design of a 3D TMR switching sensor initially seemed challenging, as all magnetic field directions are to be combined in just one sensor chip. However, we realised that our IP (interlectual property) portfolio already offers a suitable solution for this.

By combining our multipinning technology (DE102014116953B4), which makes it possible to realise different sensitivity directions in the x-y plane on one chip, and by adding magnetic flux guides (EP 2 396 666 B1; EP 3 025 162 B1), which in turn make the perpendicular field component detectable by deflecting it into the sensitive plane, we have succeeded in detecting all three spatial field components (H<sub>x</sub>, H<sub>y</sub> and H<sub>z</sub>) independently and separately on one TMR chip. The design of the 3D TMR prototype chip consists of three half-bridges connected in parallel, which are monolithically integrated on a chip substrate with 5 connection boards (see Figure 1).

Each half-bridge therefore represents a different sensitivity direction in a single-ended output signal. The measuring range is designed for  $\pm 10$  mT with a sensitivity of approx. 4 mV/V/mT per half bridge. Figure 2 shows the typical characteristics of the 3D TMR chip. It should be noted that x- and y- sensitivities are almost identical, while the sensitivity in the z-direction can have a maximum deviation of 10 % - this must be taken into account when

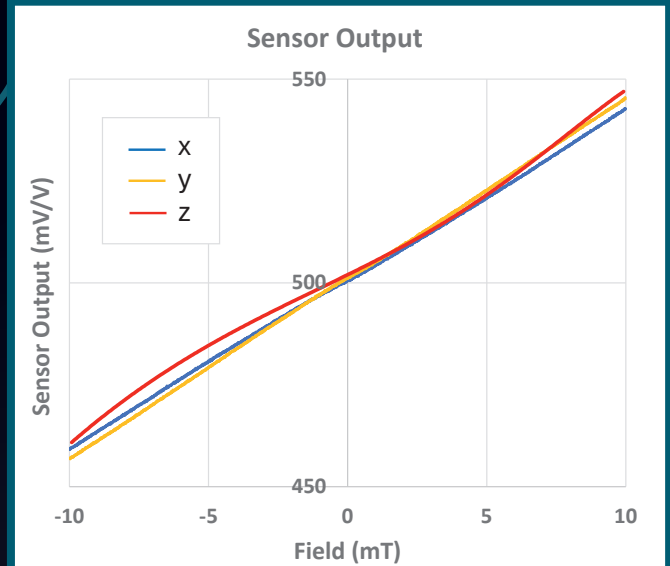


Figure 2: Characteristic curves of the sensor. When a field is applied in the x, y and z directions, the output signal changes linearly with the applied field.

calibrating the sensor. The total resistance of the sensor is typically 1.5 MOhm, even though the sensitive area of the chip is only 0.35 mm<sup>2</sup>.

Now that the technology has been successfully evaluated using the prototype, the product design phase begins. In addition to the 3D TMR switching sensors, 2D TMR switching sensors can be easily derived by omitting the z-direction. Furthermore, full-bridge designs in the x, y or z direction are also possible. This makes the chip more robust against alternating fields and induction effects and doubles the sensitivity - the expected offset is almost 0mV/V.

Further customer-specific adaptations, such as changes to the resistance, the linear range or the pad layout, can also be realised.

Delivery at wafer level is planned as the main delivery form for the sensor chip. Alternatively, the chip can also be integrated into standard housings to enable simple assembly in the SMD process on printed circuit boards.

## NEW SENSOR PACKAGE FOR FLEXIBLE DESIGN OPTIONS

The **AL700 sensor family** requires the sensor chip to be aligned perpendicular to the scale surface on incremental measuring scales. This often results in a carrier circuit board that is also arranged perpendicular to the magnetic scale, which has a negative effect on axial scanning of pole rings, for example, and often prevents a compact design. To overcome this design limitation, Sensitec is now offering the **AL700 sensor family** in the new **SIL8 package**, which can be soldered horizontally or vertically onto a carrier PCB.

This allows the carrier PCB to be arranged parallel or orthogonal to the scale or pole ring surface without sacrificing the vertical orientation of the sensor chip. This enables compact integration of the sensors at the measuring point.

The **SIL8 package** measures 6x2x1.5mm and offers the same pin-out for all sensors of the **AL700 family** thanks to a new innovative design technology. This means that the AL796, AL797, AL798 and AL780 models can be used in the same pin-compatible design. In order to avoid subsequent rotation of the components during assembly, the **AL700 sensors in the SIL8 package** are available in two belt variants, in which the components are already orientated horizontally or vertically.

Further details on the new **SIL8 package** can be found in the corresponding data sheets for the **AL700 sensors**.

# PURCHASING DEPARTMENT

## Purchasing transformation: What matters in the future!

One of the most important challenges in times of recession in Europe is to react appropriately to the market.

Purchasing is at the interface with suppliers, and this close cooperation with partners is changing the role of purchasing as a cost optimiser in the long term. 'We will transform from operational to strategic purchasing so that we can continue to assert ourselves on the market,' says Head of Purchasing Tim Leukel.

Initial preparations have already begun in 2023 and our goal is to complete the transformation by 2024/2025.

In the first step, the responsibilities of the buyers for the article portfolio were defined according to a categorisation. This portfolio will now be followed by a defined product group strategy.

In the second step, we will review and reduce the number of suppliers and enter into strategic partnerships with selected suppliers. A higher weighting of suppliers will be sought and better conditions will be negotiated.

Following the supply bottlenecks that began in 2021, when stocks were significantly increased, and the subsequent fall in demand at the end of the pandemic, we now need to reduce our inventories and adjust our purchasing levels in line with the size of the company.

We are optimistic that these measures will get us through this period well and are looking to the future with confidence.

Jasmin Hahn - Marketing



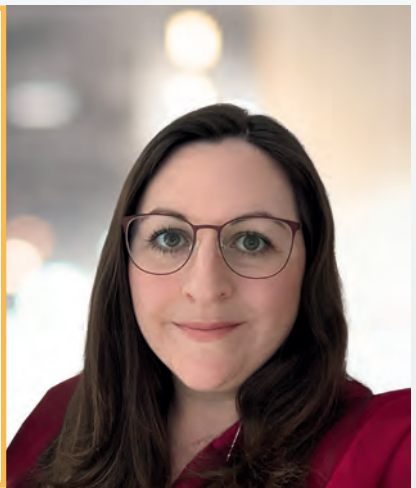
**Vanessa Schulz** (33) has been with the company since March 2015. She completed her training as an industrial clerk at LTi / Keba. She is Deputy Purchasing Manager at Sensitec and is responsible for strategic purchasing.

Vanessa Schulz would like to see closer ties with suppliers in the future in order to counteract international competitive pressure. The topic of digitalisation should be tackled more intensively in order to streamline processes. She would also like to see closer collaboration with other departments both inside and outside the company - 'Because teamwork makes the dream work.'



**Jennifer Heiser** (35) started at Sensitec in Mainz in October 2018 as a chemical laboratory technician in Chemical Support and moved to the Purchasing department in June 2023. As a trained chemical laboratory technician, she was previously responsible for chemical support and ordering chemicals.

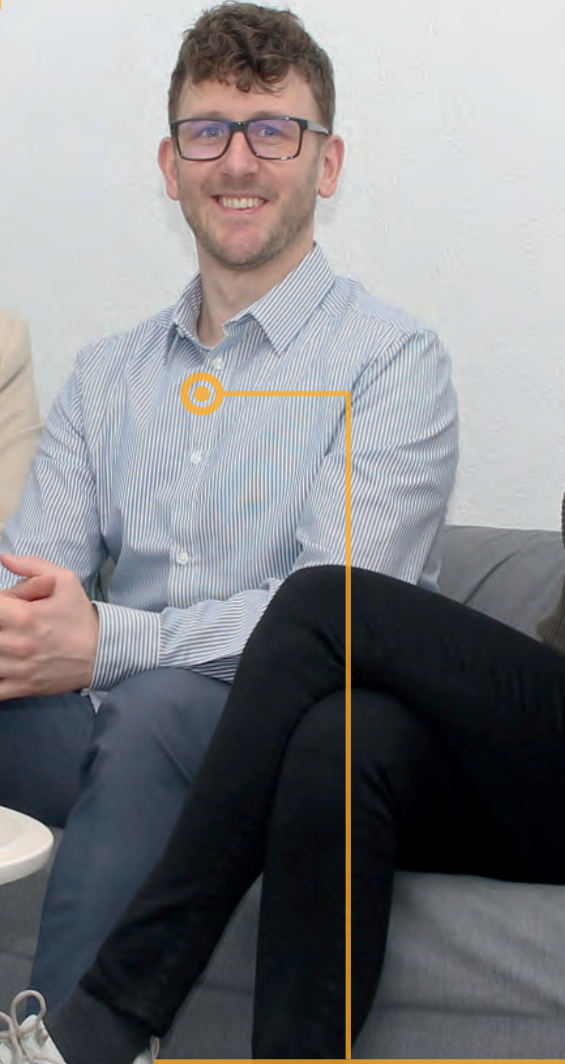
As an operational purchaser, she now takes care of all orders relating to the Mainz site. Starting with the creation and ending with the receipt of goods. The precise coordination of deliveries of production-relevant materials is one of her main areas of responsibility.



**Tim Leukel** (37) has been responsible for purchasing management in Wetzlar and Mainz at Sensitec GmbH since October 2022. He is responsible for the restructuring from operational to strategic-operational purchasing and integrated supply chain management.

He graduated as an industrial clerk in 2011 and gained many years of professional experience as Senior Director Supply Chain & Procurement for the GEA business unit. He also completed an additional qualification as 'Manager Strategic Purchasing'.

Tim Leukel hopes that the team can realise his professional and personal goals within the framework of the company's objectives so that we are well prepared for the future and its challenges.



**Gerold Sinkel** (40) has been supporting the purchasing team since April 2023. He has many years of professional experience in order preparation/processing, purchasing and in a managerial role, as well as management experience in the logistics industry.

Gerold Sinkel is responsible for setting up and managing Sensitec's own product groups and suppliers, as well as the transition from operational to strategic purchasing. The department has already achieved a number of targets, but he is also facing challenges due to the overall economic situation.

He is looking forward to future, exciting and varied projects, such as internal process optimisation, as the entire team is motivated and this gives him courage for the future.



**Christine Roth** (58) completed her training as an industrial clerk after graduating from high school and has been supporting the company since 2004. Over the years, she has continued her education with various customs training courses.

When she joined the company 20 years ago, there was only one employee in Purchasing and Order Processing. Christine Roth started in Purchasing as a deputy and has remained loyal to it ever since.

# EXPANDED PRODUCT FAMILY: NEW TMR-BASED ENCODERS FOR PRECISE ROBOTICS APPLICATIONS

In 2024, Sensitec will expand its axial encoder product family with the **PAM7943**, **PAM7951** and **PAM7953** models in collaboration with colleagues from China. These new absolute magnetic angle encoders are based on the proven **TMR technology** and are the perfect solution for use in robotics and other precision applications. All encoders in this series utilise a pseudo-random bit code that enables immediate position determination after switch-on. In addition, multi-turn detection is possible, which is also secured in the event of a failure thanks to an integrated battery memory.

In contrast to the previous **PAM7941**, the **PAM7943** is mounted on bearings, which enables direct installation without additional calibration. The sensors are also located on a full-ring PCB, which can be customised to meet specific customer requirements. With a resolution of 24 bits and an accuracy of 15 angular seconds, the **PAM7943** is the perfect solution for applications that require maximum precision.

At trade fairs in 2024, the **PAM7943** met with great interest and first customers report positive experiences, especially in robotics, where the encoder impresses with its robustness against environmental and interference influences.

The new **PAM7951** combines two **PAM7943**

encoders in a single device - one on the drive side and one on the output side.

This 2-in-1 solution enables precise synchronisation of both sides and thus offers decisive advantages in many industrial applications. The **PAM7951** is available in different diameters, ensuring flexibility for a wide range of applications.

The **PAM7953**, on the other hand, combines two encoders on a single board and achieves an extremely low overall height of just 15 mm. This encoder is also available with bearings and in different diameters, making it the ideal choice for applications where space is at a premium.

With these new products, Sensitec is setting new standards in **TMR technology**, offering customised solutions for precise absolute position measurement in robotics and beyond. Continuous development and positive feedback from the field show that Sensitec is ideally equipped to meet the requirements of the robotics industry and set new standards.

*Felix Steinbach - Produktmanagement*



## ENCODER VARIANTS FOR SPINDLE APPLICATIONS

Encoders play a crucial role in the precise control and monitoring of spindles in various industrial applications. In order to fulfil this task, encoders must meet a large number of stringent requirements. In addition to precision and accuracy, robustness, reliability, a compact design, dynamic behaviour and resistance to interference factors are particularly important.

Encoder variants for spindle applications

As a developer of MR sensor solutions, Sensitec can rely on two different measurement methods to fulfil these requirements. In passive measurements with GMR sensors, a ferromagnetic gear wheel mounted on the shaft of the spindle is scanned. Gear wheels can be manufactured with very low imbalance and in any size. They can be turned at very high speeds and are tried and tested components in the industrial environment of a spindle. The tooth structure of the gear deforms the magnetic field of a support magnet, which is integrated in the encoder. Our GMR sensors detect these magnetic field changes and thus enable position and speed measurement of the gear wheel.

Pole rings are used as measuring scales for active measurements. North and south poles are alternately applied to the magnetic material. With **TMR and AMR** sensors, the magnetic field emanating from the pole ring can be scanned and position and speed measurements can be carried out in this way. As support magnets are obsolete with active measurement, active measurement allows significantly greater installation tolerances than with passive measurement. Until now, conventional pole rings were not designed for the high speeds of a high-speed spindle.

Our portfolio includes three different encoders that we offer for spindle measurements. All encoders are housed in a metal housing that protects the sensors from electromagnetic interference fields and external influences such as oil and dust. Each encoder consists of two sensors that simultaneously scan an incremental and reference track, enabling absolute measurement.

Thanks to its magnet arrangement and design, the **EBR7811** passive encoder is particularly impressive due to its compact dimensions and is ideal for small spindles and confined installation environments.

The **EBR7831 passive encoder** has the standard industrial dimensions and features a newly developed magnet arrangement, which offers more flexibility in installation and better performance with varying working distances. This eliminates the need for recalibration during installation.

With the **EBR7915**, we are offering an active encoder for high-speed spindles for the first time. The pole wheel mentioned in SENSOR.KOSMOS issue 31, developed with Miba AG, allows active measurement with AMR and TMR sensors at very high rotational speeds.

The steel ring with a sputtered samarium-cobalt magnetic layer can be used at



EBR7915



# NEUE MITARBEITER



**Markus Wilhelm**

**Kimberly Hegen**

**Felix Steinbach**

**Markus Wilhelm** (27) has been working in sales at Sensitec since 15 January this year. After successfully completing his training as an industrial mechanic, he has already gained experience in purchasing management and service technology.

At Sensitec, he is responsible for internal technical sales. In the future, Markus Wilhelm is aiming for more intensive cooperation with other departments, the simplification of processes and a stronger focus on value-adding activities. He also plans to continue his professional and technical training in order to provide optimum support for sales.

**Kimberly Hegen** (23) has been supporting sales at Sensitec since 1 June 2023.

After training as an office management assistant, she completed her vocational baccalaureate in business and administration. In her role as sales assistant, Kimberly Hegen is responsible for order processing, quotation preparation, sample delivery and trade fair follow-up, among other things.

For her future work in the company, she would like to work more closely with other departments and actively contribute to achieving the company's goals.

**Felix Steinbach** (32) has been part of the product management team at Sensitec since 1 March 2024.

After studying physics at the Technical University of Berlin, he worked as a research assistant at the Max Born Institute from 2020, where he researched the interaction of ultrashort laser pulses with magnetic systems. At Sensitec, he works in the Positioning Systems division and acts as an interface between the various departments.

He is particularly looking forward to working with his colleagues and developing new technological products. With the new Axial encoders, he sees great potential for entering the growing robotics market and successfully acquiring customers there.

# 25 YEARS



# SENSITEC

MAGNETORESISTIVE SENSORS



## A quarter of a century of innovation and precision

Sensitec GmbH is celebrating its **25th anniversary** this year. Since its foundation in 1999, the company has developed into one of the most innovative providers in the sensor industry and achieved numerous technological milestones.

From humble beginnings to our current position as a technology leader, our journey has been characterised by innovation, passion and commitment. Our products have significantly influenced the development of sensor technology and helped to provide intelligent solutions to complex challenges, says Peter Radde, Managing Director of Sen-

sitec GmbH. Sensitec is proud to be able to look back on an impressive success story.

With a large number of patents and innovations, the company has established itself as a pioneer in the field of magnetic sensor systems. The products are used in the automotive industry, medical technology, renewable energies and many other areas.

A significant milestone in the company's history was the acquisition by the Chinese company Sinomags Electronic Technology Co., Ltd. based in Ningbo, China, in September 2021.

This step strengthened Sensitec's international presence and gave it access to new markets. The partnership with Sinomags has not only helped Sensitec to intensify its research and development activities, but also to bring innovative products to market more quickly.

This strategic partnership has made a significant contribution to further expanding the company's position as a technology leader. Three months after closing the deal with Sinomags, Sensitec took over the full portfolio of Sinomags current sensors in Europe.

Over the past 25 years, Sensitec has not only set

new standards in technology development, but has also received numerous awards for its innovative solutions. 'We are proud of what we have achieved over the last 25 years,' says René Buß, CTO & Head of Product Management/Marketing at Sensitec GmbH. 'The acquisition by Sinomags was a turning point that opened up new opportunities for us.'

We look forward to continuing to be at the forefront of technological innovation together with our partners and customers. We would like to take this opportunity to thank our customers, partners and employees for their support and trust in Sensitec. Without your co-operation, this success would not have been possible.'

*Claudia Ulbricht - Marketing & PR*

# NEWS

## 17. XMR-SYMPOSIUM 2025

The next **'Magnetoresistive Sensors and Magnetic Systems' symposium** is planned for 12 - 13 March 2025 in Wetzlar. Systems' is planned in Wetzlar. 20 highly interesting presentations on new results, applications and trends in XMR sensor technology have already been confirmed.

The conference programme is expected to be published on the website in November 2024. Online registration will be activated in December → **Information will follow**. If you would like to receive a personal invitation, please send us your e-mail address to [christiane.eckhardt@sensitec.com](mailto:christiane.eckhardt@sensitec.com)



## TRADE FAIR

We will be at **SPS Smart Productions Solutions** in Nuremberg from 12 to 14 November 2024 and at **electronica** in Munich from 12 to 15 November 2024.

We look forward to welcoming you again in person!

SPS Hall 4A | 626

electronica Hall B3 | 415

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