WITTENSTEIN

move

The magazine for customers and partners of WITTENSTEIN SE

Industrial grade optical sensor with sub-nanometer resolution

Sensor of superlatives

move talks to Dr. Dirk Haft and Dr. Martin Zech

April 2017

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Contents

Masthead

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Dear readers,

A single human hair is roughly 0.00005 m or 5 x 10^{-5} m in diameter. When we talk about “splitting hairs” or “hairline cracks”, we are referring to something too small for our minds to gauge accurately. Yet twenty-first century technology is far more precise than this: when sub-nanometer resolution (<10^{-9} m) is specified, the human eye – and even an optical microscope – simply can’t handle it. Until now, this has mainly only been relevant for semiconductor manufacturing and productronics. However, drive technology and precision machines increasingly also demand tighter tolerances and more exact geometries to enable products to be successfully miniaturized and optimized. If the transition from micro to nano scale becomes attainable for industrial companies at a reasonable cost, nano technology and precision engineering will gradually converge – and a milestone will be set. The future potential for competitive, efficient and intelligent production is certainly enormous.

At the Hannover Messe 2017, the WITTENSTEIN Group will unveil an enabling technology for this scalar leap into the nano engineering world under the motto ‘The revolution for high performance engineering: Measurement becomes nanoprecise’: an industrial grade optical sensor of superlatives with sub-nanometer resolution that is extremely easy to integrate. In an interview in this latest issue of our customer magazine Dr. Dirk Haft (Management Board, WITTENSTEIN SE) and Dr. Martin Zech (Management Board, attocube systems AG) describe the evolution and technical USPs of this disruptive, cross-sectional technology for the engineering industry. You can experience our IDS3010 sensor live at our booth in Hall 15 (Stand F10). We look forward to meeting you!

As every year, the Hannover Messe marks a critical dividing line in our twelve-month business agenda – the WITTENSTEIN Group’s new fiscal year 2017/18 begins just a few weeks before the trade fair opens its doors. We have a lot in store for you – and together with you, our customers all over the world: first and foremost, we want to strengthen our market orientation, so that we can advise and serve you even faster, even more comprehensively and in an even more focused way, no matter where you happen to be. A set of reorganization and restructuring measures are currently being implemented to help us achieve this objective.

In addition to standard gearheads, WITTENSTEIN alpha GmbH’s product portfolio now also includes bespoke, special-purpose gearheads and motor-gearhead combinations. The ‘Future Urban Production’ facility in Fellbach will continue to be established as a manufacturing and competence center for gearing components and special-purpose gearheads; parallel to this, WITTENSTEIN bastian GmbH’s sales and development functions will be incorporated into WITTENSTEIN alpha GmbH. Motor and electronics expertise will be pooled within WITTENSTEIN cyber motor GmbH through the integration of WITTENSTEIN electronics GmbH. The future focus of WITTENSTEIN motion control GmbH will lie in the Speciality Technologies segment.

At the same time, we are investing in tomorrow: a cross-functional team of sensor, electronics and software specialists at our newly inaugurated Digitalization Center will convert new, digital technologies into products and business models which are fit for the future. The acquisition of baramundi software AG at the end of March is a further move which will strengthen the Group with strategically important competencies as we tread the digital transformation path. It is our firm conviction that the interplay between Industry 4.0 capable products, secure and intelligent communications between installed products and operators and our ability to generate relevant information and know-how from the available data will equip us optimally to face the challenges of the digital future in high performance engineering.

Dr. Anna-Katharina Wittenstein

Spokeswoman of the Management Board, WITTENSTEIN SE

move talks to:

Dr. Dirk Haft and Dr. Martin Zech

Precision engineering and nanotechnology **converge**

WITTENSTEIN, already an innovation leader in the field of mechatronic drive technology, has recently expanded its expertise with a further competency – nanoprecise measurement systems for high performance engineering – together with Munich-based attocube systems AG. attocube, which for several years now has been a wholly owned subsidiary of the WITTENSTEIN Group, will take advantage of the upcoming Hannover Messe 2017 to unveil the industrial grade IDS3010 sensor with sub-nanometer resolution. Dr. Dirk Haft (Management Board, WITTENSTEIN SE) and Dr. Martin Zech (Management Board, attocube systems AG) explained the background to this innovative development and the technical USPs in an interview with move.

move: Dr. Haft, WITTENSTEIN is a manufacturer of precision drive systems for industry. attocube delivers equipment for world wide research institutes such as nano-accurate positioning drives, cryostats, microscope systems and interferometry. How does all of that fit together?

The bridge between the two companies is our striving for absolute precision. We both produce drives that have to satisfy the most demanding requirements. We differ in terms of the number of decimal places: WITTENSTEIN develops and manufactures micrometer-precise components whereas attocube is at home in the nanometer range. These two worlds are currently converging more and more. Sub-micrometer manufacturing precision is increasingly in demand in a growing number of industries and products. On the sensor side, an easy-to-integrate, ultra-precise measurement system represents an important building block here. Even today, I still find it very remarkable that Dr. Manfred Wittenstein (in the meantime Chairman of the WITTENSTEIN SE Supervisory Board) recognized the need for more precision in mechanical engineering as long ago as 2007 and against this background initiated the cooperation with attocube.

Dr. Zech, what does the name IDS3010 stand for and what exactly does this tiny device do?

IDS stands for 'Industrial Displacement Sensor': it's a contactless interferometric sensor that can measure positions, speeds and acceleration or vibration with extreme precision. The German National Metrology Institute (PTB) has confirmed a measurement uncertainty of 0.0 ppm up to 3 m. This means that our instrument is capable of measuring with practically no deviation from the standard meter. It's a measurement system that theoretically works with infinite accuracy! We measure positions with a resolution of 1 picometer (10^{-12} m) at a frequency of 10 MHz, so that the measurement signal contains absolutely all relevant information on the movement. That's why we prefer to talk about this product as a ‚motion sensor'.
In the engineering industry, on the other hand, people are accustomed to having a separate sensor for every measured variable, for instance a glass scale for the position and an acceleration sensor for vibration. To us physicists, this is all just motion, in other words one measured variable that we determine very precisely and evaluate accordingly.

Dr. Haft, in what application areas does a demand for such a high precision exist today?

We don't need to look far. Very accurate pitches and low tolerances are essential for WITTENSTEIN's compact Galaxie® Drive System. Increasing the accuracy of the pitch is generally a good way to achieve a better distribution of the internal forces acting on the teeth of a precision gearhead. More precise tooth geometries mean lower peak stresses

Dr. Dirk Haft (left) is responsible for innovation on the WITTENSTEIN SE Management Board. On account of his previous position on the Management Board of attocube systems AG, he also bridges the gap between the WITTENSTEIN engineering world and the attocube nano world.

Dr. Martin Zech (right) took over as Managing Director of attocube systems AG after seven years as head of product management and R&D. Together with quantum physicist Professor Khaled Karraï and Dr. Dirk Haft, he was closely involved in the development of the novel interferometric measurement principle to market maturity.

and higher maximum loads. In multi-row roller bearings, too, there is a fundamental correlation between the distribution of internal forces and the smallest possible manufacturing tolerances because these systems are hyperstatic. Precision manufacturing, and hence also the ability to measure with sub-nanometer resolution, is vitally important to enable existing mechanical systems to be developed with even more power density. Furthermore, current technological advances are quite clearly focused on miniaturization and, linked to this, increased product precision. It's now up to the engineering industry to follow suit with its production machinery.

Dr. Zech, could you cite an example of a scenario where the benefits provided by the IDS3010 have made a critical difference to a system's use?

Yes, of course. A manufacturer of hard drives wanted to determine the production-related runout of the motor shafts at operating speed – which, don't forget, is 5400 or 7000 rpm. There was no measurement system in the market that offered the bandwidth and accuracy necessary to do this. It was a simple matter for us, though. The IDS3010 is an optical instrument which allows us to measure the movement of the shaft directly and tell the customer the exact angular position at which the greatest runout occurs. Our sensor is contactless and no forces are exerted. The laser finds its way into even the most confined spaces and is very easy to integrate into production systems. It's an unbeatable combination!

Dr. Zech, what applications is the IDS3010 best suited for?

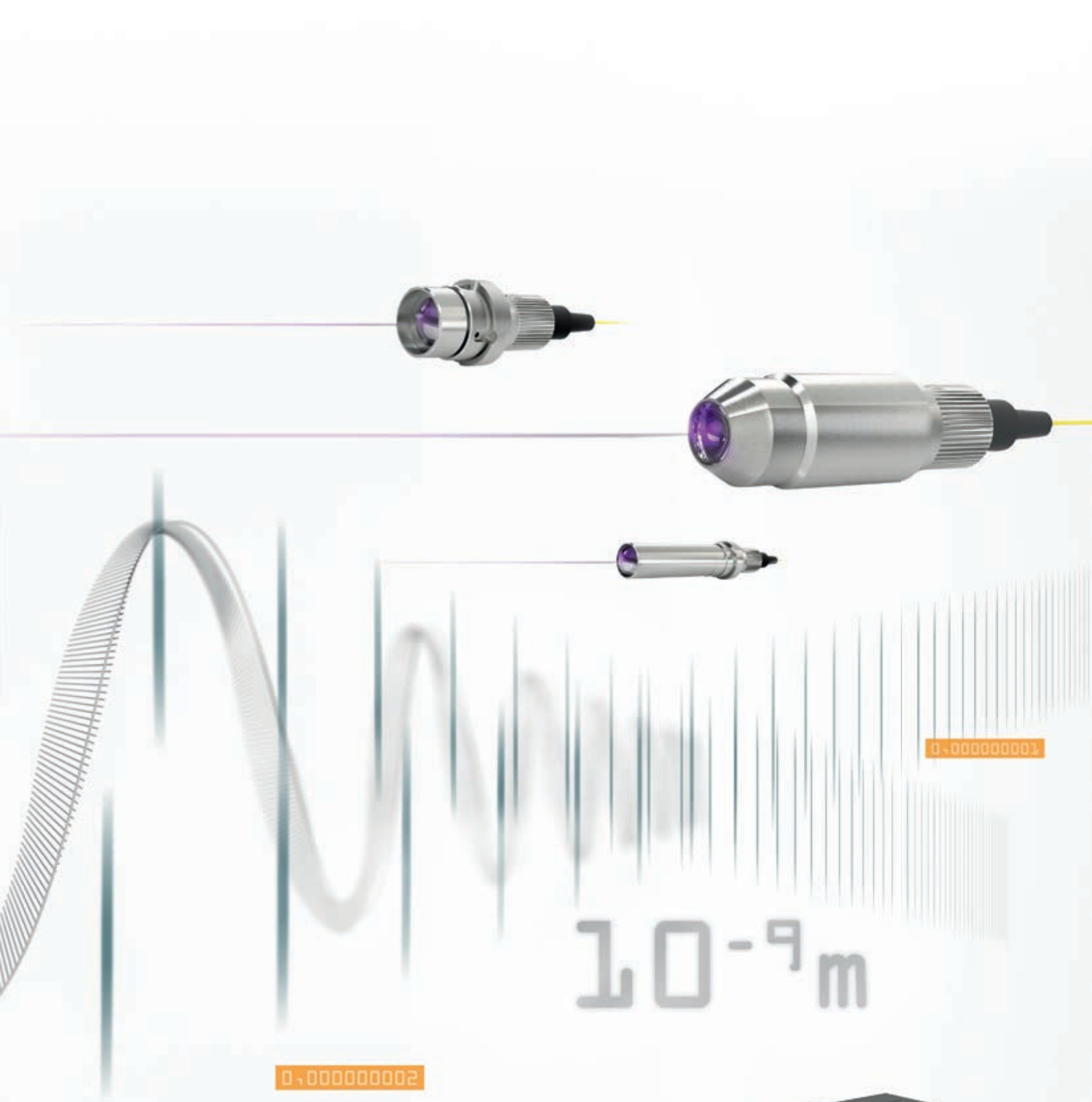
As we see it, interferometry – and specifically the IDS3010 – is the outcome of a cross-sectional technology. As a pure displacement sensing system, the IDS3010 is an attractive alternative for all high precision applications in production machinery, measuring machines, in-process quality inspections, the semiconductor industry or productronics – in other words, in any sector under strong pressure to deliver maximum precision. If the IDS3010 is used as a vibrometer, new opportunities are simultaneously created for measuring vibration – for example, due to imbalances – contactlessly, extremely precisely, easily and fast. The potential is huge.

Dr. Haft, how can you persuade the engineering industry of the advantages of the new technology?

In our experience potential customers are keen to learn more about the new technology upfront and test it at their leisure. We offer a loan service for this reason. More than 70% of all loans result in production use. That's an exceedingly high success rate.

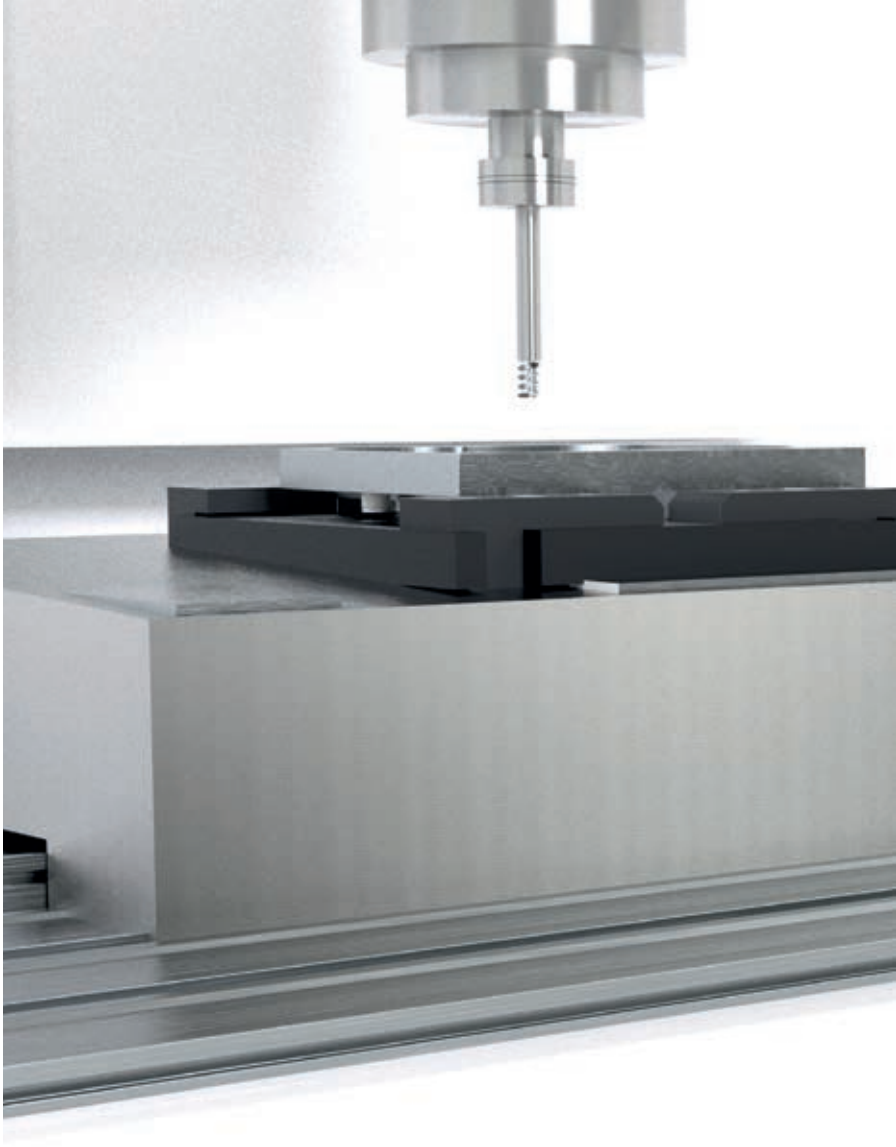
The revolution
for high performance
engineering:

MEASUREMENT BECOMES **NANO PRECISE**



In which machinery and systems
can the IDS3010 Industrial Displacement Sensor be used?
Which functions can the sensor perform there?

The following article contains answers to these and other questions.



Sensor of superlatives
Industrial grade optical sensor with sub-nanometer resolution

Limitations of present-day sensor technologies
Glass scales are currently considered to be the benchmark in industry. When it comes to submicron measurements, however, the manufacturing process means these scales quickly come up against their limits. Their precision cannot be significantly increased. There is also another limiting factor which impacts on the accuracy of today's displacement sensing systems: since they are attached to the machine bed, they are always positioned parallel to the workpiece a certain distance from it. As a result of this, the measured position merely corresponds to the position of the moving sensor head and not to the exact position of the target (workpiece or tool). Systematic errors, like Abbe errors due to guides and bearings, accumulate between the sensor and the workpiece. Variable operational errors such as differences in thermal expansion, deformation of the machine due to process forces, wear or vibration, etc. additionally have to be taken into account. These deviations cannot be determined by ordinary displacement sensing systems with measuring points which are too remote from the ‚action'.

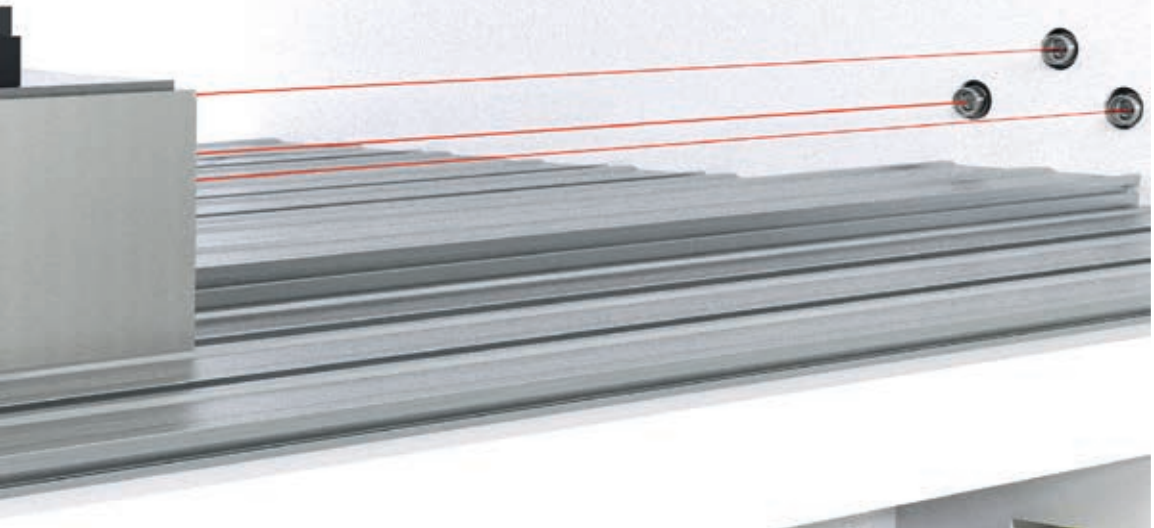
The IDS3010 can be operated with different sensor heads: ultra-compact heads for the most confined spaces or alternative designs where priority is given to easy alignment or to compatibility with a variety of target materials (glass, aluminum, ceramic, etc.).

The attocube solution: measurements directly at the workpiece or tool

The solution to these physical and practical limitations entails a departure from established measurement principles in favor of direct measurements of the workpiece position. attocube's IDS3010 sensor is based on a novel interferometer technology which uses laser to "target" workpieces, shafts and tools or machine slides optically and contact-free. The above-mentioned measurement errors are effectively prevented in this way.
The multi-channel displacement sensor is comprised of two subsystems: the basic unit and the sensor heads, which can be supplied in different versions for a maximum working distance of up to 5000 mm. Up to three sensor heads can be connected to the compact basic unit (19.5 x 5 x 5 cm), enabling simultaneous measurements in up to three axes. These tiny heads contain only passive optical components and are connected to the basic unit via optical fibers.
The 0.0 ppm measurement uncertainty which is achieved between 0 and 3000 mm has been officially confirmed by the German National Metrology Institute (PTB). The sensor can thus be said to work with theoretically infinite accuracy. There is no longer any need to calibrate machines and axes if the sensor is integrated there.
The fiber based design, the very small sensor heads and the fact that the basic unit can be installed in any position mean that

IDS3010

Resolution: 1 picometer (10^{-12}m)
Frequency: 10 MHz



The innovative IDS3010 displacement sensor from attocube systems AG provides a resolution of **1 picometer (10^{-12}m)** – previously unheard of in industrial applications – for working distances from a few millimeters to 5 meters.
Furthermore, the sensor technology supplies the position data of stationary and moving objects at a **frequency of 10 MHz**. No other measuring system has ever succeeded in advancing into these dimensions.

A central DFB laser diode and the electronic control form the compact basic unit (19.5 x 5 x 5 cm), to which the sensor heads are connected via optical fibers.

measurements can be performed in even the most confined or inaccessible spaces. The contactless measurements directly on the target (workpiece, tool, machine components) and the high bandwidth facilitate completely new applications, for example vibration analyses of machines and processes.

Fiber based sensor heads: added flexibility

Whereas conventional interferometers measure mainly on reflective surfaces, the sensor developed by attocube is also capable of focusing measurements by forming the laser beam and can even measure directly on rough targets with very low reflectivity such as silicon wafers, glass or ceramic.
Measurements on plastic, aluminum, copper or polished steel surfaces are also not a problem. If the surface is not sufficiently reflective, plane mirrors with a diameter of 5 or 9 mm – or the so-called retroreflectors in attocube's range of accessories – can be used.

An integrated **web server** is used to initialize and configure the sensor and to set up data communications. No special knowledge is necessary for this purpose. A broad spectrum of real-time interfaces and protocols allows position data to be transmitted to CNC controllers or RTOS computers. Other standard industrial interfaces such as CANopen, Profinet, Profinet RT or EtherCAT can be provided on request.

Extremely flexible: Three sensor heads can measure three axes perpendicular to one another. Three parallel sensor heads measure the parallelism of surfaces, for example to enable rapid alignment.

Startup with integrated web server

The IDS3010 was specially developed for the industrial market. It ships with a web server, making the sensor compatible with Industry 4.0 applications: data communications, alignment, initialization and configuration can be controlled, adapted and monitored remotely from any location. An integrated, visible pilot laser simplifies the alignment and setup process. The actual signal strength is indicated by a simple bar. After mechanical alignment, the IDS3010 is initialized and instantly displays the distance between the sensor head and the target.

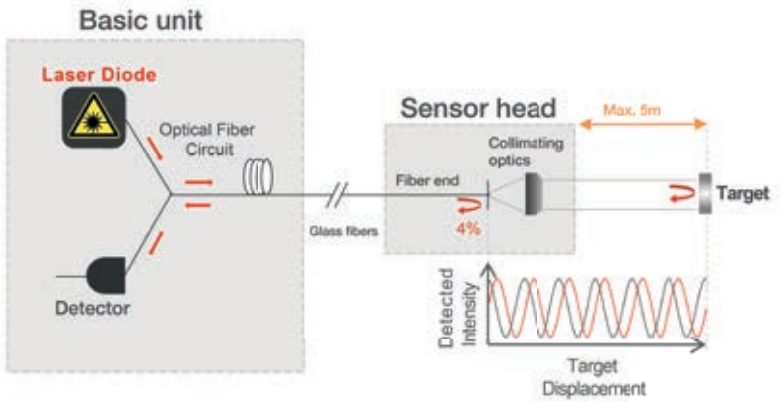
The attocube interferometer – a disruptive, cross-sectional technology for the engineering industry

The ultra-compact dimensions of the basic unit, the tiny sensor heads and the precision of the IDS3010 are so extraordinary that developers and engineers are now compelled to reassess and rethink existing solutions in precision engineering. attocube's IDS3010 is an enabling technology for the quantum into the nano world that is extremely easy to integrate.

Typical applications of the IDS3010:

- **Displacement sensor in quality assurance**
  - For calibrating axes and complete machines
  - In coordinate measuring machines
  - As a universal measuring and testing device in quality assurance (precision measuring rooms)
- **Displacement sensor in production machinery**
  - As an integrated displacement sensing system with up to three axes in high-precision manufacturing equipment (machine tools)
  - As a resolver system for high-precision servo drives (precise trajectories in CNC technology) as well as for axis position control
- **Sensing system in production processes**
  - For in-process workpiece inspections
  - As a workpiece measurement system integrated in the machine, the IDS3010 can even make significantly shorter manufacturing cycle times possible. Thermal drift is also detected.
- **Vibrometer**
  - For process analyses and controls in real time
  - For real-time vibration measurements on machinery and systems in order to detect damage to machines, determine the remaining life of tools or carry out predictive maintenance
  - For detecting imbalances
  - For measuring and actively compensating vibration in real time

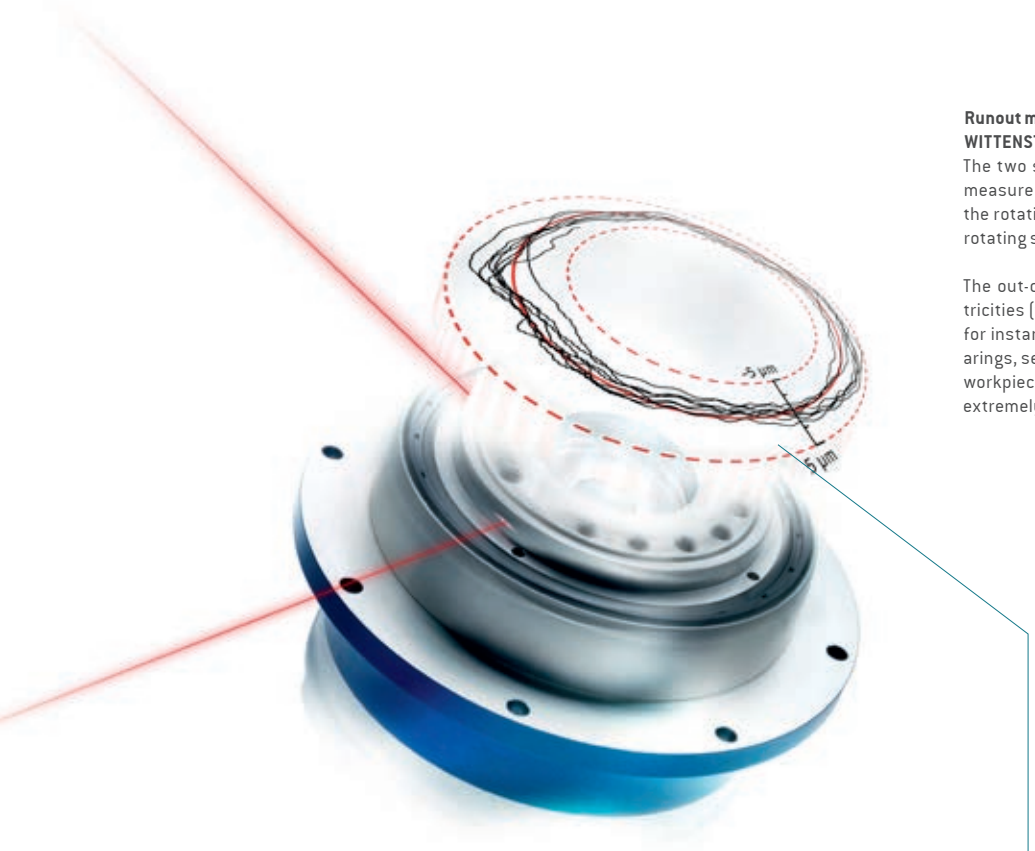
How it works: the IDS3010 optical displacement sensing system



Infrared light is produced in the basic unit of the Industrial Displacement Sensor (IDS) and guided into the sensor head via a glass fiber. Inside the sensor head, part of this light is reflected back into the device through the fibers. The remainder exits from the glass fibers, is reflected by the target – for example the machine component or an applied mirror – and coupled back via the fibers to the basic unit. The two beams which are reflected on the sensor head and the target interfere with each other. The distance between the sensor head and the target can be determined from the total intensity of the interfered light.

»This system lets you measure every single millisecond exactly where the workpiece is positioned, accurately to a billionth of a millimeter, how fast it is moving and how strongly it is vibrating. That adds up to a very wide range of applications for the Industrial Displacement Sensor.«

PROFESSOR KHALED KARRAÏ
INVENTOR OF THE OPTICAL MEASURING SYSTEM AND
SCIENTIFIC DIRECTOR OF ATTOCUBE SYSTEMS AG



Runout measurement on a rotating object, in this case a WITTENSTEIN Galaxie® gearhead:
The two sensor heads of the IDS3010 simultaneously measure the error motion of a shaft perpendicular to the rotating axis. The black lines show the runout of the rotating shaft.

The out-of-roundness (tolerances of form) and eccentricities (tolerances of location) of shafts or shaft stubs, for instance on main or grinding spindles, precision bearings, servo motor shafts, crankshafts and a variety of workpieces, can generally be measured contact-free and extremely accurately.

For more information, see
www.wittenstein.de/measurement

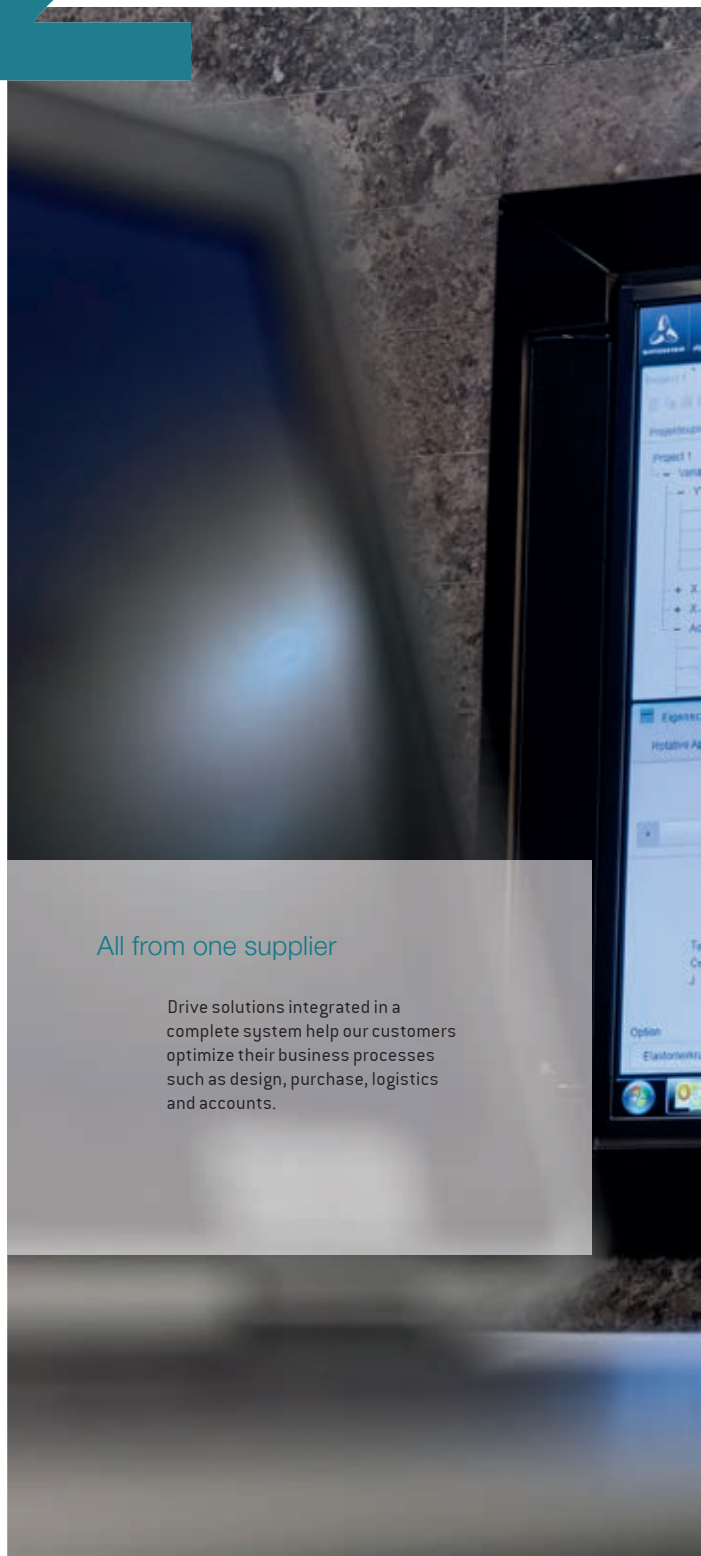
Drive sizing software portfolio:

2 paths to one goal

Gearheads made by WITTENSTEIN alpha stand for the highest levels of technical excellence. They demonstrate this in countless applications. If you look over the shoulder of the designers and product managers responsible for electric drives, you'll notice that gearheads and drive trains are often designed and sized based on different sets of requirements and criteria.

"You often only need a small amount of information to design a gearhead", explains Timo Markert, Product Manager at WITTENSTEIN alpha. "Other, more complex design tasks, for example involving shaft and bearing calculations or electrically preloaded drives, require more detailed calculations of the kinematics or the load requirements." Whereas some people want to arrive at the optimum gearhead in a matter of seconds, others insist on a drive design that has been well thought-out from A to Z. "Each user group can choose the software solution that best meets their needs from our portfolio of sizing tools", Timo Markert adds.

The **SIZING ASSISTANT** and **cymex® 5** cater for totally different drive design requirements and procedures – which is why we provide two separate tools. It is therefore only logical that WITTENSTEIN alpha should continuously maintain and expand both the portfolio itself and the individual tools: the next release of cymex® 5, for example, is due out this summer. In addition to the existing databases for racks and pinions, it will also include WITTENSTEIN alpha's new 'preferred linear systems' in all performance classes.



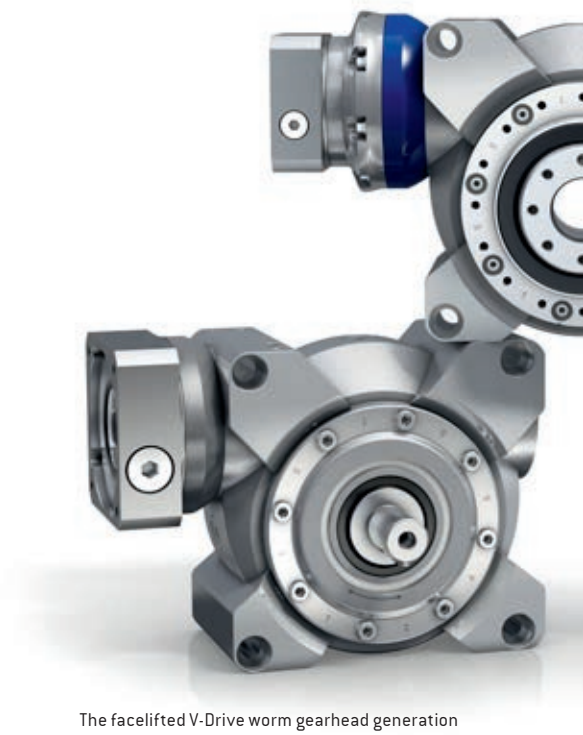
All from one supplier

Drive solutions integrated in a complete system help our customers optimize their business processes such as design, purchase, logistics and accounts.

Quick and easy selection or complex kinematic systems precisely designed down to the last detail: The SIZING ASSISTANT and cymex® 5 from WITTENSTEIN alpha provide two software paths to one goal – efficient drive sizing in all axes.

SIZING ASSISTANT

Efficient sizing, excellent driving



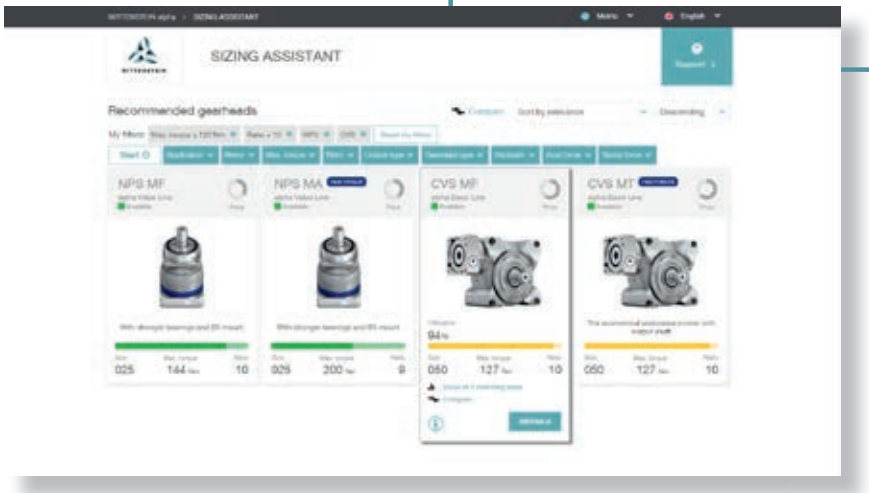
The facelifted V-Drive worm gearhead generation including V-Drive Basic – the newest family member – is also part of the cymex® 5 release.

Reducing the time required for sizing without compromising the application's reliability – this was WITTENSTEIN alpha's objective when developing the web based, multilingual SIZING ASSISTANT.

Users can get started via either the motor or the application. In both cases only a few parameters are needed, for example the manufacturer, motor type and ratio – or maybe the motion profile, duty cycle, maximum torques and ratio. A short click, a quick glance – and the user has an overview of the smallest, most powerful and most energy efficient gearhead that can be realized. It is also possible to vary the different criteria and generate a list of alternatives including the technical and commercial efficiency latitudes. "It's conceivable that similar applications could be implemented with an identical gearhead variant, so that there are fewer product types", says Timo Markert. "Or that a gearhead in the list of suggestions already exists in the bill of material and doesn't need to be created again."

SIZING ASSISTANT
YOUR GEARHEAD WITHIN SECONDS

- Efficient selection of the optimum gearhead
- Online sizing in a matter of seconds
- No login required
- Get started via the motor or the application
- Only a few relevant input parameters needed
- Information on the price and delivery time
- Quick documentation in the form of a product data sheet and CAD data
- Quotation can be requested directly after selecting the product



Predetermined motor or defined application –
In both cases, a few clicks are all it takes for the SIZING ASSISTANT to show you the optimal gearhead in terms of energy efficiency, performance and size.

cymex® 5

The flagship drive sizing software

cymex® 5 is the flagship software application for sizing complete, complex drive trains.

»SIZING ASSISTANT
or cymex® 5 – guaranteed convenience, reliability and time savings regardless of the design scenario.«

TIMO MARKERT
PRODUCT MANAGER AT WITTENSTEIN ALPHA

"That's even more true now that we've integrated a huge database of metal bellows and elastomer couplings as well as torque limiters in the new Release 2.3 for the first time", explains Benedikt Berberich, Product Manager at WITTENSTEIN alpha. "The real revolution is that thanks to cymex® 5 it's now possible to design a coupling, gearhead and motor integrally in one train and document them transparently. That's something no other software in this category can do." cymex® 5 features an easy-to-use quick sizing tool that is a great help in selecting the ideal coupling solution. Taking the diameter of the gearhead shaft, for instance, or the maximum torque which is present on the output side as the basis for the sizing calculation, it identifies the most compact version of the coupling that best meets the requirements. When it comes to detailed sizing tasks – like main axes involving shaft and bearing calculations, the simultaneous definition of any number of axes in one project, an examination of electrically preloaded drives or the optimization of design spaces – WITTENSTEIN alpha's multifunctional cymex® 5 sizing software is the perfect tool. "Optimizer" and "Master-Slave" functions can be built in as options; the user interface is customizable and the software is available as a free download.

cymex®5
CALCULATE ON THE BEST

- Detailed calculation of entire drive trains and sizing of the complete machine
- Precise simulation of the machine's motions and loads
- Basic version of the software can be downloaded free of charge
- Integral design without technology or media gaps
- Product data sheet, CAD data and full calculation documentation
- "Master-Slave" and "Optimizer" options as Premium functions on request

Torque multiplier 4.0

WITTENSTEIN designs a heavy-duty engine with smart electronics

The harshest possible surroundings and the most severe stresses imaginable – like here on a wind turbine where bolts with M160 threads or larger typically have to be tightened to as much as 200 kNm – are the norm in the characteristic operating environments for alkitronic's heavy-duty torque multipliers.

Wherever bridges are built, wind turbines erected, aircraft maintained, industrial facilities constructed or heavy machinery and heavy-duty engines installed, heavy-duty torque multipliers from the Ingolstadt firm of alkitronic are a familiar sight. A new torque multiplier has just been added to the portfolio – it is equipped with a sensorless sleeve valve engine as well as smart electronics with Industry 4.0 connectivity from WITTENSTEIN cyber motor.

alkitronic has been developing and producing pneumatic, hydraulic and electric screwing tools for professional use in various industrial fields ever since the early eighties.

"They're used to bolt threads with up to 200 kNm of torque", explains Alexander Kipfelsberger, Managing Director of alkitronic. Yet bolting alone will no longer be sufficient in the future. "Users are longing to realize even more complex bolting processes with new operating modes; they come to us wanting to know how monitoring and documentation of these processes can be streamlined, for example", he replies when asked where the market's priorities lie. The idea for the smart torque multiplier was born. "It was obvious that we'd have to tread completely new paths as regards the engine technology and the electronics", Alexander Kipfelsberger recalls. The question was 'Who with?'.

"WITTENSTEIN cyber motor GmbH convinced us with their business model – customized motor and electronics development that also permits an efficient transfer to series production", he continues. Following a successful feasibility study, an ultra-compact drive module came into being at WITTENSTEIN in a bespoke development process.

Inside view: The electronics of alkitronic's new electric torque multipliers are based on a modular platform from WITTENSTEIN cyber motor, which enables customer and application-specific requirements – both technical and commercial – to be satisfied very efficiently.

Compact drive system: motor and electronics in MINI design

Miniaturization, Innovation, Networking and Intelligence – WITTENSTEIN's MINI strategy is clearly reflected in the requirements for the new drive system. This consists firstly of a sensorless synchronous motor in a cylindrical frame which is easy to integrate and service – a design that permits simple and uncomplicated mounting above the operating handle. The completely redesigned drive system electronics are likewise packed into the limited space available in the torque multiplier housing. "They're based on our modular electronics platform, which enables customer and application-specific requirements – both technical and commercial – to be satisfied very efficiently", explains Patrick Rommel, a sales engineer at WITTENSTEIN cyber motor. "Thanks to the innovative processor technology, the new torque multipliers are now digitally controlled for the first time. As a result of this, alkitronic has been able to integrate up to seven operating modes plus a series of protection and monitoring functions", he adds. The significantly improved control characteristics also pave the way for much higher repeatability. "That's a crucial argument, especially in applications where several torque multipliers have to be operated simultaneously and exactly in sync", Alexander Kipfelsberger emphasizes.

Future-proof system on board

The electronics for the new torque multiplier have a memory unit, which acts as a data logger for recording and storing the bolting torques. There is also a wireless Bluetooth module on board. The multiplier load data which is measured for each bolting process can be read out directly on the construction site using a smartphone or tablet, for example, and then documented transparently later on at a central location.

The fully integrated graphical user interface with display and keyboard control is likewise new; together with the Bluetooth functionality, it opens up an array of customizing options – for instance to make servicing and maintenance far smarter than ever before. "In the future, our traders around the world will normally be able to repair, replace and program defective bolting systems out there in the field courtesy of the plug & play design", says Alexander Kipfelsberger.

"Torque multiplier 4.0" becomes a reality

Data logging and wireless transmission do not simply enable intelligent and flexible applications; they also fit the torque multipliers for Industry 4.0.

A hundred axes
from one supplier

WITTENSTEIN in all axes: view of the WITTENSTEIN alpha drives for the two servo mechanisms which flip over the wooden panels near the cover layer feeding station

Lisocore® – the new, patented lightweight material based on natural fibers from Lightweight Solutions GmbH – is up to 70 percent lighter than conventional composite wood panels. The company has trod new ground with it in many respects in the market for lightweight systems and succeeded in arousing the interest of numerous potential customers: its special properties create exciting opportunities in furniture production and interiors, exhibition and display systems, interior fittings for motorhomes, ships and yachts, stage and set construction, transport packaging and logistics.

The right partner to implement the engineering

The main challenge was to manufacture the lightweight panels in a technically and commercially efficient way – a project which was actively supported by the German Ministry of the Environment with funding from its Environmental Innovation Program. Unfortunately though, boards aren't made with money alone. "We soon realized that no suitable machines or standards for our special manufacturing requirements existed in the market, nor was there any extensive experience we could draw on", remembers Michael Schäpers, Managing Director of Lightweight Solutions and inventor of Lisocore®. The Bavarian firm therefore decided to design the necessary production line with automated handling system itself. "It wasn't an easy undertaking because many of the requirements, like the servo drive technology for handling the panels, only became clear gradually and they've also changed a number of times since."

Luckily, lws maschinenbau GmbH – a subsidiary of Lightweight Solutions – was able to put its trust in a competent partner. Michael Schäpers was thoroughly impressed by the consulting expertise he encountered while going over the drive design with WITTENSTEIN's engineers: "The fact that WITTENSTEIN alpha provided us with

Partners and pioneers – Lightweight Solutions GmbH and WITTENSTEIN alpha GmbH came up with a completely new production line for Lisocore®, the lightweight material. About 100 hypoid and planetary gearheads fine-tuned to performance needs as well as linear rack-and-pinion systems reliably control even complex motion profiles for handling the ultra-light and highly stable composite wood panels.

»WITTENSTEIN alpha was a professional partner throughout for all questions linked to the drives and gearheads.«

MICHAEL SCHÄPERS
MANAGING DIRECTOR OF LIGHTWEIGHT SOLUTIONS GMBH

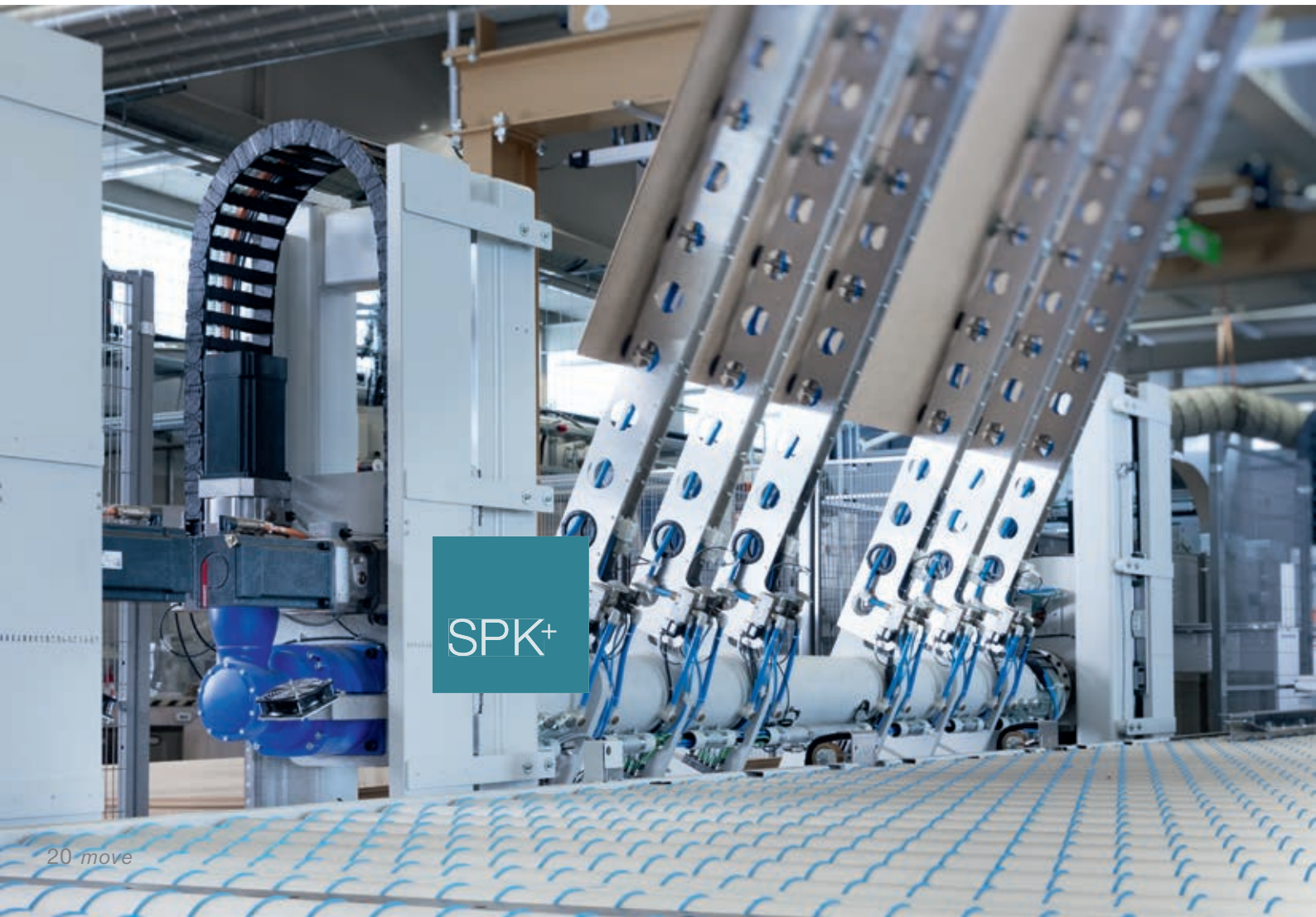
broad and prompt support throughout the project life in the form of large-scale simulations and detailed sizing calculations was crucial to our ability to control the handling kinematics safely and reliably".

Cleverly calculated kinematics – WITTENSTEIN in all axes

The Lisocore® production line has a footprint measuring around 500 square meters and a capacity for two million square meters of the lightweight material per year. "The line drills cover layers made from different materials, either with or without a decorative coating, applies the adhesive fully automatically and then combines these layers with the 3D core", explains Marcus Wehner, Manager Sales / Research & Development at Lightweight Solutions. All kinematics relevant for performance were simulated and optimized by WITTENSTEIN during the project phase with the help of the cymex® 5 sizing software. "This proved to be a particular challenge when it came to the pivoting unit of the servo mechanism for flipping over the cover panels because rotary and linear motions are superimposed there simultaneously", adds application engineer Daniel Meißner of WITTENSTEIN alpha GmbH's Sales Office South-East. From this first station via the diverse handling units at the automatic drilling and gluing stations and the flat press all the way to the final palletizing machine, the motto is 'WITTENSTEIN in all axes': size 240 SPK+ right-angle gearheads with an integral output stage, planetary gearheads belonging to the RP+ series, CP series gearheads in functionally optimized sizes and XP+ and TP+ gearheads – some of them designed as rack-and-pinion systems. "The line has about 100 axes altogether, each of which is equipped with one of our servo gearheads", comments Sven Sanitz, the Regional Sales Manager responsible.

The feedback from Lightweight Solutions has been equally positive and Michael Schäpers is full of praise: "WITTENSTEIN alpha has helped the project to flourish and successfully assessed and incorporated several essential changes to the design – often with repercussions for the line as a whole. What's more, receiving engineering support from a single supplier saved us a lot of time and minimized the risk of errors."

The foundation has thus been laid for more Lisocore® production lines and sustainable cooperation.



Delighted with the results achieved together:
Daniel Meißner, an application engineer at WITTENSTEIN alpha (right), and Michael Schäpers, Managing Director of Lightweight Solutions and inventor of Lisocore® (left).

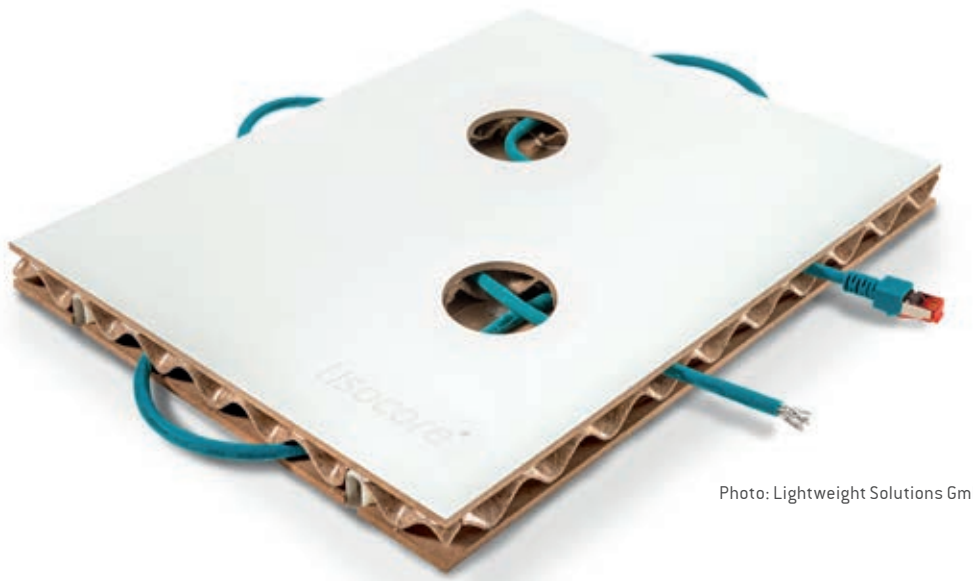


Photo: Lightweight Solutions GmbH

Lisocore®: More than simply light

Lisocore® is an extremely efficient, lightweight construction material made from renewable resources. Its outstanding properties are the outcome of a unique design: at least two thin cover layers are locked firmly in place by a three-dimensional core structure. Lisocore® consequently requires between 50 and 70 percent less material, and is correspondingly lighter, than conventional composite wood panels.

The customer selected size 240 SPK+ right-angle gearheads with an integral output stage for the pivoting arm because their high performance and torsional rigidity is conducive to precise and dynamic handling of the cover layers.

Six months on, **back on his feet again**

Ben Harrow has got back his independence. He can now take a walk again without anyone to help him.

May 15, 2012 was a turning point in the life of Ben Harrow, a Captain in the United States Army. He was so badly wounded in action in Afghanistan that he lost both legs. A father and a keen sportsman, his next battle in life was against the wheelchair that threatened to be his permanent fate: today, thanks to two prostheses, he can walk again and play with his children. He owes his new, independent and autonomous existence to FITBONE®, the intramedullary lengthening nail.

Ben Harrow spent about two months in hospital as a result of his injuries before he was fit enough to start his rehabilitation. It was during this period that he made up his mind he would “walk again one day”. While fighting his uphill battle against the wheelchair he became an expert in limb lengthening techniques: “I hit on the subject while surfing the net. It was something I’d never heard of before”, he explains, looking back. “Nevertheless, I knew straight away that a FITBONE® operation would literally put me back on my feet again.”

Pros and cons weighed up in numerous consultations

The chief outcome of his research was that artificial lower limbs can only be individually fitted if the femur has a certain minimum length. That wasn’t the case with Ben Harrow – the amputation had left his right femur too short for a prosthetic leg. He therefore sought advice from various physicians – including a limb lengthening consultant in Baltimore who specializes in treatment using external fixators. “He told me the treatment would last eight to ten months and that

FITBONE®

Extremity correction with FITBONE®

The FITBONE® intramedullary lengthening nail from WITTENSTEIN intens is a fully implantable limb lengthening system, for example for compensating leg length discrepancies or one-sided abnormal or impaired growth. The operation by specially trained surgeons is a minimally invasive procedure which gives perfect cosmetic results with no scarring or side-effects. Only twenty-four hours later, the leg has recovered sufficiently to bear at least part of the FITBONE® patient's weight again and the first steps can be attempted with crutches.

They can be discharged from hospital within a few days and subsequently control the distraction process themselves in the comfort of their own home. They are provided with a handy transmitter for this purpose, which activates the FITBONE® motor and carefully lengthens the nail. In contrast to external fixators, FITBONE® unites high wearing and treatment comfort for the patient with significantly reduced pain throughout the distraction phase. Another advantage is that rather than being confined to their bed, the patient can to a large extent lead a normal life again during the treatment period.

I'd have to take antibiotics the whole time to rule out the risk of infection", Ben Harrow continues. Yet he refused to resign himself to this less-than-satisfactory solution and carried on searching until he stumbled on Dr. Mark Dahl. "He belongs to the specially trained network of surgeons at the Centers of Excellence, whose members benefit from the regular instruction and qualification measures we provide in connection with FITBONE®, adds Stefanie Michel, Product Manager WITTENSTEIN intens. The physicians participating in this network are all experts in the intramedullary lengthening nail who have helped several thousand patients achieve new mobility over the past few years. "Definitely the most important aspect for me was that the FITBONE® could be fitted to my very short right femur", Ben Harrow points out.

The wheelchair is banished for good

The FITBONE® procedure was a huge success – as was the treatment process. "Dr. Dahl reckoned on longitudinal growth of about five to seven centimeters to begin with, but eleven months on we measured an amazing fifteen centimeters – just perfect for fitting the prosthesis", Ben Harrow recalls.

Six months later, he's finally made it: Ben Harrow is out and about again on two legs without anyone to help him. Not surprisingly, he has no reservations in recommending the FITBONE® treatment to others. It's a story that's propelled him to stardom on American TV shows and YouTube.

For more information, see
www.wittenstein-intens.com

Helicopter performance retrofit

Active parallel flight control by
WITTENSTEIN aerospace & simulation

From rod and pulley system to software control: Whereas next-generation helicopters have electronic fly-by-wire control, many older models that have gone into service over the last few decades are still equipped with electromechanical flight control systems.
The active parallel actuator system developed by WITTENSTEIN aerospace & simulation as a retrofit for these helicopters achieves a dramatic improvement in performance while significantly reducing the outlay for repairs and maintenance.

Experts have estimated that several thousand electromechanically controlled helicopters worldwide would benefit from a retrofit with the active parallel system. “These machines were developed, built and taken into service long before the technology was ripe for electronic flight control”, explains Christoph Heine, Managing Director of WITTENSTEIN aerospace & simulation GmbH. “The pilot enters flight commands using throttles, center sticks or pedals, for example. Their movements are transferred to the rotors by rods and hydraulic systems.

Less maintenance, degrees of freedom safely controlled

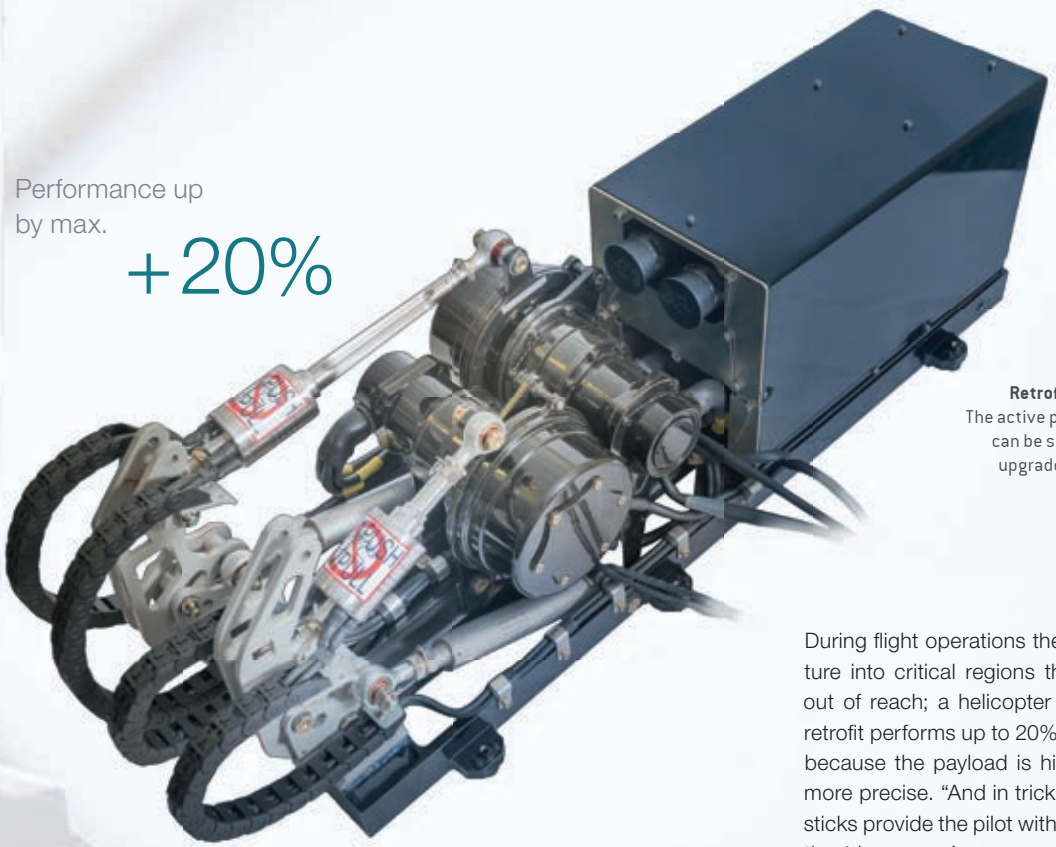
Like any electromechanical system which has to meet very strict loading and safety requirements, the complete actuator technology needs a great deal of maintenance. Added to this is the safety aspect. A helicopter has four degrees of freedom in flight – vertical, pitch, roll and yaw; in the absence of fly-by-wire, their respective critical regions can generally only be determined by test pilots and only coordinated with one another to a limited extent. “This presents risks, for instance if the pilot yaws too much in forward flight”, Christoph Heine adds. The latest state of the art puts an end to these drawbacks. Thanks to the active parallel solution developed by WITTENSTEIN aerospace & simulation, the pilot’s mechanical control movement is now executed electronically. Less maintenance is necessary and the critical regions of the four degrees of freedom in flight can be programmed and optimally correlated in the software.

Safe use in the critical regions adds up to more performance

The actuator system retrofit allows all assemblies with a major influence on flight performance to be electronically controlled: the main rotor for vertical movements, the rotor swashplate for helicopter roll and pitch and the tail rotor for yaw about the helicopter’s own axis. “All of these different types of movement together form a kind of 4D coordinate system – we refer to it as an envelope – within which the pilot can control the aircraft”, Christoph Heine continues. “In contrast to a mechanical flight control system, this envelope is protected by the software and the active parallel actuators.”

Performance up by max.

+20%



Retrofit boosts performance: The active parallel actuator system can be supplied as a retrofit and upgrade package for numerous helicopter models.

During flight operations the pilot can thus venture into critical regions that were previously out of reach; a helicopter equipped with this retrofit performs up to 20% better, for example because the payload is higher or maneuvers more precise. “And in tricky situations, the joysticks provide the pilot with tactile feedback on the ‘dangerous’ maneuver”, Christoph Heine concludes.

Linear actuators with screw

New addition to the cyber dynamic line family

They're something a lot of engineering companies have been yearning for: industrial grade small servo motors with an integrated screw. They're the ideal solution for highly dynamic positioning axes or for installation in a confined space. When combined with the servo regulators in the simco drive series, they can even be configured as complete small servo axes.

They can be integrated in the appropriate automation environment via suitable fieldbus interfaces. This new series makes a perfect complement to WITTENSTEIN cyber motor's portfolio of rotary servo motors and servo actuators in the cyber dynamic line product family.

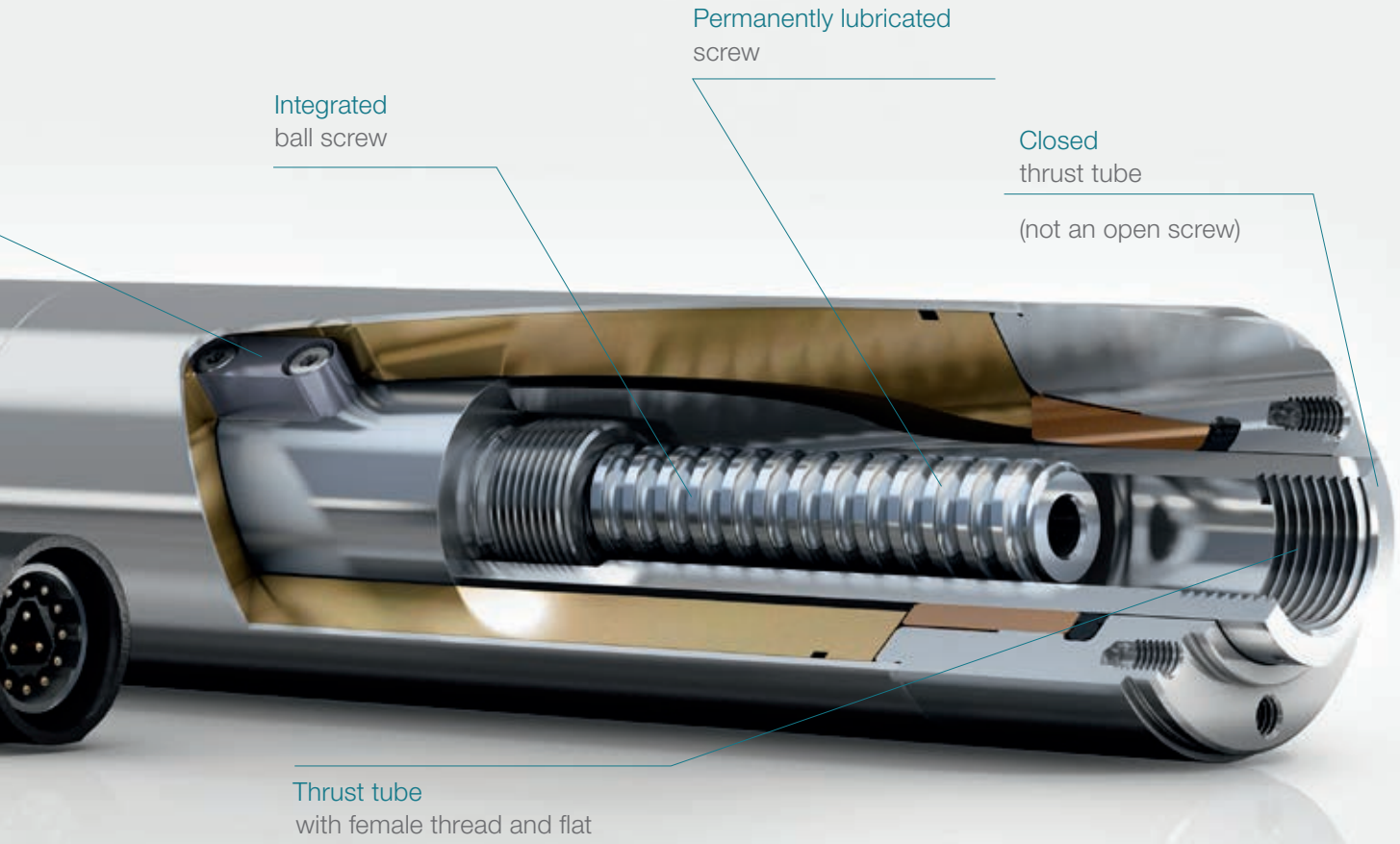
High power density in an industry grade design

With their high power density and dynamics, the new small servo motors with integrated screw are particularly impressive in action. Each of the four available sizes achieves excellent acceleration values, cycle rates and machine throughputs in a very small space. "This is due to the compact design, which results in much lower mass inertia than is possible, for instance, if the screw is simply attached to the servo motor", explains Carolin Ank, Product Manager at WITTENSTEIN cyber motor. The strictly industry grade design was another top priority. The complete actuator is accommodated in a robust stainless steel housing with IP54 protection and can be mounted in any position. The screw itself is maintenance-free with an anti-rotation mechanism and fits inside a closed thrust tube. The spindle drive and reinforced bearings allow both a tensile and a compressive force to be applied. An absolute single-turn encoder system can be supplied for all sizes. "If the 32 or 40 size is installed, the functionalities of our own, integrated multiturn encoder – probably the smallest currently on offer in the market – can additionally be implemented as an option", Carolin Ank continues. All sizes are moreover designed using EMC shielded single-cable technology which is suitable for cable carriers. "Thanks to these innovative features, the actuators are perfect for industrial applications", the Product Manager adds.

Open to comprehensive solutions with special connectivity

The new small servo motors with integrated screw can be configured with simco drive servo regulators to form high-performance small servo axes. They can be integrated in a higher-level controller via CanOpen, EtherCAT, Profinet RT/IRT or EtherNet/IP. At the same time, this single-source system solution entails absolutely no interface risks and has an electronic identification plate that reduces the time for commissioning. As another software feature to simplify start-up, two special homing modes are provided: they enable the end positions to be determined easily, safely and reliably and prevent the actuator's mechanical stops from being approached dynamically.

In short: These maintenance-free small servo motors with an integrated screw in the cyber dynamic line series are ideal whenever a strictly industry grade design, high compactness and dynamics, wide-ranging connectivity and optimal energy efficiency are called for.



More reliable and more energy efficient:
servo technology takes the place of pneumatics

Unlike pneumatic cylinders, these linear actuators with an integrated screw permit precise, flexible and stepless position control regardless of the application – without any retooling on the machine. They thus have a clear advantage in applications where frequent format changes are likely. The servo technology offers better controllability by design; together with the easy connection to a higher-level controller, this facilitates reproducible processes. A linear actuator – and indeed the entire servo drive technology – eliminates the risk of leakage at the compressed air line. It is also more energy efficient – after all, compressed air is not only expensive to produce but a significant share of it is lost. Finally, servo technology is virtually maintenance-free and also quieter – two further benefits compared to pneumatics.

All-rounders
for the engineering industry

These maintenance-free small servo motors with an integrated screw open up a range of exciting solutions. They are used, for instance, for positioning, joining, bending, gripping and dispensing in reshaping and handling applications, the semiconductor industry, packaging machinery or assembly automation. The 100% stainless steel design with IP65 protection also creates numerous interesting applications for the new, integrated linear actuator in food and beverage plants, such as in filling valves for highly precise bottling lines.

Top (from right to left): Dr. Felix Szabo with Dionisie Dezsi and trainee Cret Alin in the production plant at WITTENSTEIN Romania.

Bottom: WITTENSTEIN supports the vocational training college at its Romanian manufacturing location: Managing Director Markus Rothenfels (on the left in the photo) and Head of Production Dr. Felix Szabo (2nd from right) recently donated new laptops for IT training to Ardelean Dan (right), Deputy Head of Independenta Sibiu vocational training college. The WITTENSTEIN trainees were naturally also present when the donation was officially handed over.

»We want to ensure the same high quality elsewhere in the world as we have in Germany.«

DR. KATHRIN HECKNER
MANAGER TRAINING AT WITTENSTEIN SE

Training **“made in Germany”**

Highly qualified specialists are a rarity in many countries. The German dual model of vocational training is the object of worldwide envy and admiration because it guarantees a high standard of training for young people that is geared to actual needs. At its international manufacturing locations, WITTENSTEIN sets great store by a training concept based on the German idea of theory and practice closely interwoven: the first young industrial mechanics, toolmakers and mechatronics fitters in the U.S. and Romania will soon be completing their apprenticeships.

WITTENSTEIN SRL has been producing in Sura Mica, not far from Sibiu (Romania) since 2008. A total of 57 people meanwhile work at the plant there. “It wasn’t easy finding qualified staff to begin with”, recollects Markus Rothenfels, Managing Director of WITTENSTEIN SRL in Romania. “Traineeships in industry still don’t enjoy a very good reputation among the population, not least because the state-run educational institutions are poorly equipped and many Romanian companies really do give the impression of being relics from another age.” It was soon clear to both him and Dr. Felix Szabo, his Head of Production, that in the long term it would not be possible to meet the demand for specialists without actively providing training locally.

Building bridges together

An important role when exporting education is played by any training establishments which already exist as well as by other German companies in the country concerned or – where applicable – the German Chamber of Commerce. “We are co-initiator of a new, three-year ICATT program (Industry Consortium for Advanced Technical Training) by AHK USA (German-American Chamber of Commerce)”, says Peter Riehle, President and CEO of the WITTENSTEIN holding, Corp. in Bartlett / Chicago. AHK Chicago, the State of Illinois, German SMEs and U.S. firms have set up this program to enable young people to train as an industrial mechanic. In addition to the school based part, apprentices also receive practical training from their respective employers. Today, Manager Training Jürgen Limbrunner looks after three aspiring industrial mechanics at the WITTENSTEIN Training Workshop.

Laptop donation to vocational training college

Adapting German training standards to country-specific realities – this step-by-step strategy is being pursued with a considerable measure of success in Romania. Three WITTENSTEIN trainees in their first year and four more in both the second and third years are already benefiting from specialist instruction in CNC machine operation and mechatronics at ‘Independenta Sibiu’ vocational training college. The project was initiated by Sibiu’s German-Romanian Dual Training Association, of which WITTENSTEIN Head of Production Dr. Felix Szabo is Vice President. WITTENSTEIN regularly assists with renovation work and college equipment through donations in cash and kind – for example with 20 new laptops for

Alexis Ojeda is WITTENSTEIN North America's first ICATT trainee. The young people who complete this three-year combined company-and-college program end up with a qualification as an industrial mechanic.

IT training. In the meantime, the subsidiary's own in-house training has been brought into line with the WITTENSTEIN standard: there are specific curriculae and a typical WITTENSTEIN training island – an electrical workbench including turning and box-column drilling machines.

Same standards worldwide

"We want to ensure the same high quality elsewhere in the world as we have in Germany" – this is what Dr. Kathrin Heckner, Manager Training at WITTENSTEIN SE, is aiming for. That also includes training the next generation of specialized staff ourselves. "It's the only way we can meet our own technical and commercial requirements. And in addition to training qualified specialists, we also want to fulfil our social responsibility in each country where we operate. Integrating apprentices and vocational training into the everyday life of the company simultaneously creates added value for our corporate professional development culture in general – if we can succeed in communicating the necessary technical and process expertise to young trainees, we'll be just as good and efficient in that respect when it comes to our future employees."

Pioneering work in Romania and the U.S.

Markus Rothenfels knows that untiring perseverance is a must: "By investing in training both at educational institutions and in-house at companies, we gradually make gaining qualifications in this kind of profession more attractive for the local population. This is not something that will happen overnight and we can't afford to take it for granted. Here in Transylvania, for instance, we organize careers caravans at schools to put young people directly in touch with potential employers.

The project initiated by Peter Riehle and his fellow-entrepreneurs in Chicago is likewise reaching a growing number of people: the German-American Chamber of Commerce is currently extending its training program to Wisconsin, Michigan and Indiana. And the ICATT standards have also been taken up in equivalent programs in Atlanta and New York. Training "made in Germany" is a genuine export hit.

»Qualified specialists are scarce in the U.S., which is why we're actively involved in the ICATT program in Chicago. The dual training format doesn't only work for German companies in the States – there's also a huge interest on the part of American firms.«

PETER RIEHLE
CEO WITTENSTEIN NORTH AMERICA

iStock.com/tronniechua

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Close to the customer, prompt service in Northern Europe

20 years of WITTENSTEIN Sweden / Denmark

The WITTENSTEIN Group's Scandinavian subsidiary recently celebrated its 20th anniversary in Malmö (Sweden). Ever since it was first established in 1996, customers in Sweden and Denmark have profited from a broad array of competencies, products and system solutions.

Managing Director Johan Sjölin (2nd from right in first row) and his team provide support to numerous Scandinavian customers in the automation sector.

Employees as the key to success

There is no doubt in the mind of Björn Proschinger, Head of Sales Europe, WITTENSTEIN alpha GmbH: "Our customers value the expertise and the absolute customer focus of the entire WITTENSTEIN team in Sweden and Denmark very highly. That's one reason why such close and enduring relationships have been built up with their key contacts over many years."

Eight staff testify to the Scandinavian subsidiary's remarkable growth since the original "alpha drives" was founded. In the last 20 years only two people have left the team headed by Managing Director Johan Sjölin. He sees trust, continuity and cohesion – not just among the employees – as the key drivers of steady and sustainable growth: "It's important in sales to maintain a local presence and be close to where your customers are. That's especially true if you're selling technical products whose success depends on designs and concepts tailored to individual needs. The closer we are to our customers, the less time it takes us to optimize their mechatronic solutions and improve the performance of their machines".

Cross-border growth

The merger with the Danish sales office in 2012 laid the foundation for expanding WITTENSTEIN's share of the Scandinavian market to more than 60%. The high level of automation expertise and the ability to implement the most diverse customer requirements rapidly were crucial here. "We respond to inquiries immediately. It goes without saying that we endeavor to keep delivery times to a minimum. That strengthens our position in the market and helps us generate new leads", Johan Sjölin explains. It's no wonder that Scandinavia's number one manufacturer in the food and beverages industry names WITTENSTEIN Sweden / Denmark as their preferred supplier.

Extra space to ensure the future

Johan Sjölin and his dedicated team are looking forward to the challenges and the projects that lie ahead, and will in future have extra space available to handle them. It was with this in mind that WITTENSTEIN Sweden / Denmark moved to a new location in March 2017 – for the fourth time in the company's history. The new premises are better aligned to the needs of both customers and staff. The Scandinavian subsidiary HQ has remained true to its roots in southern Sweden. After all, continuity and closeness to the customer are attributes worth preserving.

Visit us at
www.wittenstein.se
www.wittenstein.dk

Trade fair calendar 2017

WITTENSTEIN is represented at numerous trade fairs and exhibitions worldwide.
We look forward to meeting you!

Hannover Messe
Hanover (Germany)
WITTENSTEIN Group
April 24 to 28, 2017

OTC
Houston / Texas (USA)
WITTENSTEIN motion control GmbH
May 1 to 4, 2017

Expomafe
São Paulo (Brazil)
WITTENSTEIN do Brasil
May 9 to 13, 2017

Metalloobrabotka
Moscow (Russia)
WITTENSTEIN alpha GmbH
May 15 to 19, 2017

SMART
Linz (Austria)
WITTENSTEIN GmbH
May 16 to 18, 2017

SPS IPC Drives Italia
Parma (Italy)
WITTENSTEIN S.P.A.
May 23 to 25, 2017

BUTECH
Busan (Korea)
Fatec Co. Ltd.
May 24 to 27, 2017

automation & electronics
Zurich (Switzerland)
WITTENSTEIN AG
June 7 to 8, 2017

FOOMA Japan
Tokyo (Japan)
WITTENSTEIN Ltd.
June 13 to 16, 2017

Paris Air Show
Paris (France)
WITTENSTEIN aerospace & simulation GmbH
June 19 to 25, 2017

Fispal
São Paulo (Brazil)
WITTENSTEIN do Brasil
June 27 to 30, 2017

CIROS
Shanghai (China)
WITTENSTEIN (Hangzhou) Co., Ltd.
July 5 to 8, 2017

SEMICON WEST
San Francisco (CA) (USA)
WITTENSTEIN holding, Corp.
July 11 to 13, 2017

ProPack
Shanghai (China)
WITTENSTEIN (Hangzhou) Co., Ltd.
July 12 to 14, 2017

Taichung Plastics and Rubber Show
Taichung (Taiwan)
WITTENSTEIN Co., Ltd.
July 13 to 17, 2017

SPE Offshore Europe
Aberdeen (UK)
WITTENSTEIN Inc.
September 5 to 8, 2017

AMTS
Shanghai (China)
WITTENSTEIN (Hangzhou) Co., Ltd.
September 5 to 8, 2017

Taipei International Automation Industry Exhibition
Taipei City (Taiwan)
WITTENSTEIN Co., Ltd.
September 6 to 9, 2017

EMO
Hanover (Germany)
WITTENSTEIN SE
September 18 to 23, 2017

Pack Expo
Las Vegas (NV) (USA)
WITTENSTEIN holding, Corp.
September 25 to 27, 2017

PPMA Show
Birmingham (UK)
WITTENSTEIN Ltd.
September 26 to 28, 2017

HI
Herning (Denmark)
WITTENSTEIN AB
October 3 to 5, 2017

M & MT
Milan (Italy)
WITTENSTEIN S.P.A.
October 4 to 6, 2017

M-Tech
Osaka (Japan)
WITTENSTEIN Ltd.
October 4 to 6, 2017

KOMAF
Ilsan (Korea)
Fatec Co. Ltd.
October 24 to 27, 2017

CeMAT Asia
Shanghai (China)
WITTENSTEIN (Hangzhou) Co., Ltd.
October 31 to November 3, 2017

CIIF
Shanghai (China)
WITTENSTEIN (Hangzhou) Co., Ltd
November 7 to 11, 2017

Forum Maschinenbau
Bad Salzuflen (Germany)
WITTENSTEIN SE
November 8 to 10, 2017

Elmia Subcontractor
Jönköping (Sweden)
WITTENSTEIN AB
November 14 to 17, 2017

Automation Fair
Houston / Texas (USA)
WITTENSTEIN holding, Corp.
November 15 to 16, 2017

SPS IPC Drives
Nuremberg (Germany)
WITTENSTEIN SE
November 28 to 30, 2017