



WITTENSTEIN

# move

The magazine for customers and friends of WITTENSTEIN AG

WITTENSTEIN AG:

## Investment in the Future

5

September · 2010

## Masthead

**Publisher:**

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**Circulation:**

6.500 copies

**Production:**

WAJS  
Otto-Hahn-Str. 13  
D-97204 Hoechberg / Germany

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Dear readers,

we all feel it in the air – the economic recovery is now having a definite impact on the engineering sector, too. The global economy went through the worst crisis for many decades and it affected all of us. No one knew when the situation would start to pick up again, but one thing was certain: mechanical engineering is and remains key to the success of the majority of industrial sectors, be they active in the fields of environmental technology, resource efficiency, automotive technology, chemicals or feeding the world's population.

So, have we now returned to a state of normality? Far from it!

Markets are stabilising, but nothing is like it was before. Around the world, market shares have shifted, with China in particular having caught up, chasing ambitious growth targets. Globalisation is our fate – but it's also our big opportunity. The range of technologies we have on offer is in demand worldwide. Our potential to solve problems across the globe is just about infinite. Our task here is to develop and manufacture intelligent mechatronic drive technology, servo systems and components. Throughout the crisis period, WITTENSTEIN made not one of its workforce redundant. What's more, we used this time to equip ourselves even better for the future by investing a sum in the double-digit million range in our new production and development location in Switzerland.

Today, now that the economy is picking up again, we are able to support you with undaunted innovative energy and vitality in development. The long-held view that the economy and ecology are contradictory forces has been proven wide of the mark, the two now being seen as two sides of the same coin. Our engineers are implementing this insight in products and services that combine mechanics and electronics. Optimised technology is the key to a longer service life, an aspect to which today's designers pay a great deal of attention. The solution is often to switch from standard to customised, perfectly adapted, high-end drives. Lasting quality and value over the entire service life are pushing out short-sighted price considerations. The result is controllable drive systems that conserve resources. Energy efficiency is a number one priority for all WITTENSTEIN products. This applies to our new rack-and-pinion systems, too, which we will be presenting at MOTEK 2010. Thanks to WITTENSTEIN alpha GmbH's vast sizing expertise, backed up by a similarly extensive portfolio of gearheads, racks and pinions, individual users are sure to find the ideal system for their particular application.

There's one thing we're always fully aware of: our customers are under pressure to consistently increase their productivity. Our drive technology must therefore increase the energy conversion efficiency, availability and reliability of our customers' own drive products and systems. And the trend is shifting to intelligent servo systems. The mechatronic drive facilitates numerous new functions that increase the productivity of modern machines and production units, or some cases makes them viable in the first place. We are accustomed to developing and implementing solutions quickly and flexibly. However, extensive experience in high-end drive solutions is no longer enough to guarantee our future ability to sustain this success. A common understanding of the way complex components and systems are developed, engineered, manufactured and marketed is vital.

Come and talk to us at MOTEK 2010 in Stuttgart!



Karl-Heinz Schwarz

Spokesman of the Board of WITTENSTEIN AG



**move** talks to:

## Dr. Anna-Katharina Wittenstein

### New heights of performance with Swiss precision

The WITTENSTEIN Group is investing around 12 million euros at its Swiss site in Grüşch in the canton of Grisons. The first turf was dug last year. What used to be a small sales centre incorporating a manufacturing facility is now a new production and administrative building for high-quality gear components and sensors. WITTENSTEIN's manufacturing facility for sensor technology "Made in Switzerland" has meanwhile been running successfully for some time and now, in just a few weeks, the new rack manufacturing equipment will commence production. In an interview with MOVE Dr. Anna-Katharina Wittenstein, General Manager of WITTENSTEIN AG in Grüşch, explained the strategic goals for the Swiss site.

**move:** Dr. Wittenstein, in just a few weeks from now WITTENSTEIN will start to manufacture its racks in Switzerland. Industrial "feeling" – in other words, sensor technology – has been established in Grüşch for some time but in future you will be responsible for another business segment as well. Exactly why did you decide to manufacture racks?

**Dr. Anna-Katharina Wittenstein:** We are driving forward our internationalisation strategy in Switzerland and our existing Grüşch site is the base for this. Since the start of the new millennium, we have been using the facilities of the local start-up centre, which is very close to Trumpf Werkzeugmaschinen GmbH & Co. KG, the market leader worldwide for sheet metal processing machines. We manufactured modules for the medical technology and aerospace industries there and we later produced our new torqXis® sensor system. This new rack production division rounds off WITTENSTEIN alpha's range of rack-and-pinion type

WITTENSTEIN AG  
Switzerland's new production  
and logistics centre in Grüşch  
in the canton of Grisons





Dr. Anna-Katharina Wittenstein  
General Manager of  
WITTENSTEIN AG Switzerland

linear drives. We are now able manufacture entire rack-and-pinion systems in house, rather than just developing and designing them.

**move:** What is it that the Swiss site, in particular, offers for this new source of business?

**Dr. Anna-Katharina Wittenstein:** Both Switzerland and Germany have a well-trained and skilled workforce that understands performance and quality. In Grüşch we are able to bring together the best modules and the latest knowledge of the WITTENSTEIN Group's production experts on the proverbial "greenfield" site. Parallel to this, we were able to try out many new ideas here, working with a committed team of employees from Switzerland and company headquarters. We want to use this as a basis for establishing particularly efficient and customer friendly processes.

**move:** What is special about the new, Swiss-made racks?

**Dr. Anna-Katharina Wittenstein:** We made careful comparisons with competitor products and decided to make a product that is unlike the standard. Thanks to the fact that we select the material in conjunction with the hardening process, we have been able to improve the performance of our products significantly: the forces that our new high-performance racks can transfer are up to 60% greater with the same module.

For the customer, this is reflected in more compact drives with less effort involved in handling and transport. In addition to this, we gain enormous logistical advantages from manufacturing in

house: production on the premises gives us greater vertical integration – and with it better control over quality and delivery reliability. Ultimately, we can respond more flexibly to customers' requests for, say, special geometries or particular hole patterns. It can therefore be ensured that clients are always supplied with the ideal racks for their applications.

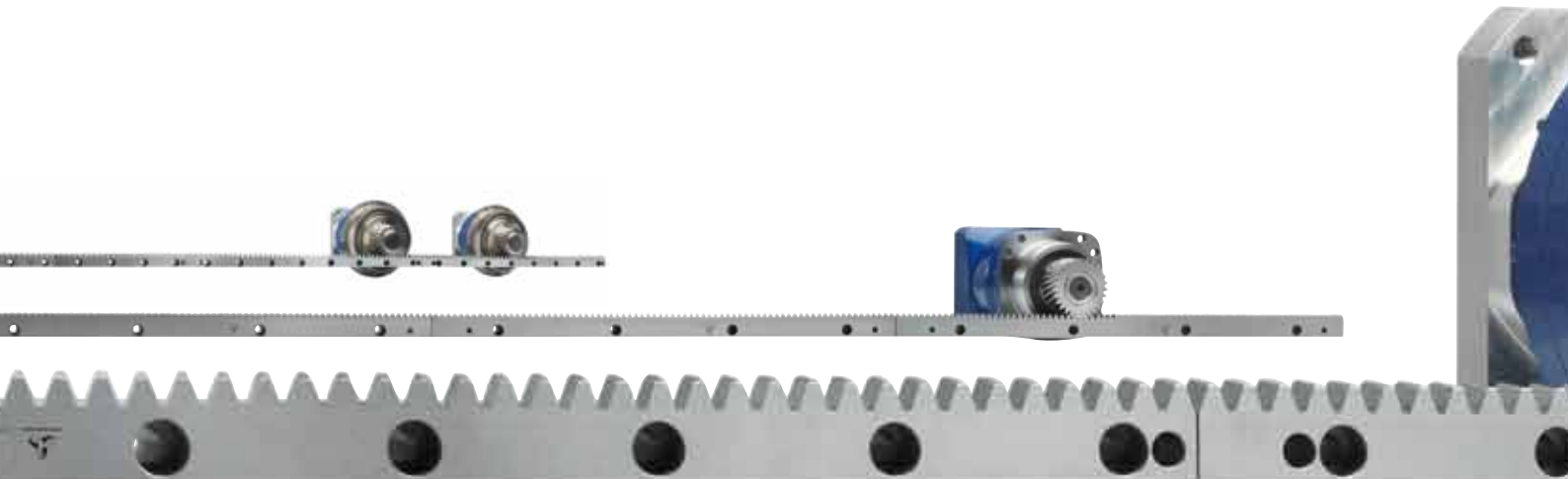
**move:** What product portfolio will you offer in the future? And when will you start to deliver the new Swiss racks to customers?

**Dr. Anna-Katharina Wittenstein:** WITTENSTEIN alpha GmbH's current portfolio of linear drives includes systems made up of low-backlash planetary gearheads, pinions that can be connected in different ways as well as hardened and ground racks. As a system supplier, we are able to configure the ideal combination for each of our customers from our modular components. Here, we not only rely on the 25 years of experience which distinguishes our company: we also use the latest engineering tools. This is why we guarantee the performance and service life of our systems, for instance with our system guarantee.

On the rack side, our delivery programme covers the module 2-8 range with lengths of up to 2000 mm from our Premium, Smart and Value Class lines. The new High Performance rack will be added to this range when it is available for delivery from December. Also, you can be sure that, in future, we will continue to announce interesting innovations in relation to linear drive systems with rack-and-pinion systems.

## New: High Performance rack-and-pinion systems from WITTENSTEIN alpha

Carburisation elevates performance data to a completely new level



**WITTENSTEIN alpha is extending its portfolio of high-precision rack-and-pinion systems with a new generation of carburised racks. These linear systems, which are ideal for applications with high feeding forces, provide compact, dynamic drive solutions.**

The key to the significantly increased strength at the tooth root lies in the production process: the use of a case-hardening steel in conjunction with carburisation has a crucial impact on the rack's ability to withstand stress. Carburisation also facilitates a much higher linear force without altering the geometry. As a result, it is possible to downsize the rack to the next smaller module – or transmit higher forces with the same module – without compromising its performance values. The quantum leap achieved by WITTENSTEIN alpha in rack performance is the outcome of “evolution through interaction” – a strategy for intensive collaboration between designers, developers and process and material specialists. The tight integration of several core competencies within the WITTENSTEIN Group forms the backbone for this high-end innovation that offers unbeatable value for money.

### **The details are embedded in the system**

The carburised rack rounds off WITTENSTEIN alpha's new “Performance System”, meeting customer demands for ever more compact solutions without any loss in quality or performance. WITTENSTEIN alpha delivers precisely this added value with its market-leading gearheads and optimally matched drive systems. As the developer and manufacturer of all system components, WITTENSTEIN alpha possesses all the required expertise in the areas of gearing, engineering, manufacturing and applications to cope with this challenge. We not only understand the synergies of component interaction: even more importantly, we know how to leverage them as efficiently as possible. Our cymex® sizing software guarantees careful selection of the individual components needed for each application. Customers are assured the optimum possible combination of gearhead, pinion and rack for their particular motor. As a total system provider, WITTENSTEIN alpha warrants the functionality and performance characteristics of the designed solution. Together with the high quality standard of every single one of the proven components, this creates a real innovative lead for a comparatively small investment.



### At a glance: the new Performance System

Based on the new rack, WITTENSTEIN alpha has broadened its already wide portfolio with the new Performance System:

- **Performance System** for maximum dynamics and feeding force when only limited space is available for installation
- **Precision System** for exacting dynamics and precision requirements in high-end applications
- **Smart System** for mounting with more degrees of freedom in flexible applications
- **Economy System** for standard linear tasks

The new rack-and-pinion systems from WITTENSTEIN alpha define new benchmarks in terms of precision, dynamics and efficiency under even the most challenging conditions. They impress with their lighter weight, simple handling and transport, high dynamics, convincing energy efficiency and optimal controllability. Don't just take our word for it – see for yourself: the High Performance rack will be released for orders in October 2010 and shipped starting in December.

### Precise, dynamic, efficient – the persuasive arguments of the new rack-and-pinion systems

- **High precision:** Linear positioning accuracy of 30 µm even without a direct measuring system (Precision System)
- **High dynamics:** Acceleration up to 4 g and travel speeds of more than 300 m/min
- **High efficiency:** Enormous potential savings in terms of the total cost of ownership – as much as 20 euros per hour of operation for a medium-sized milling centre compared to a linear motor

### Technical specifications

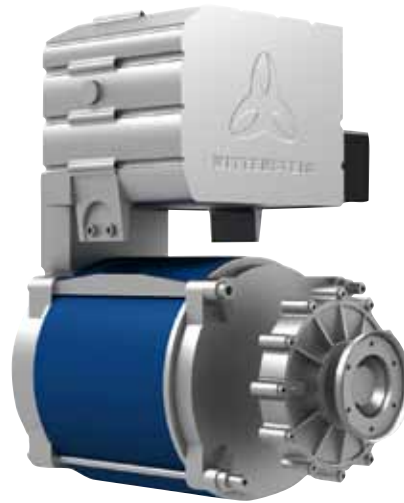
- **Performance System:** Performance Class rack (modules 2 to 6), compact PC+ pinion and low-backlash planetary gearhead in the alpheno®, TP+ or TK+ series for feeding forces up to 76 kN.

- **Precision System:** Premium Class rack (modules 2 to 6), high-precision Premium pinion with the low-backlash SP+ and TP+ planetary gearheads, driven with high concentricity. Machine precision up to 5 µm can be achieved in a master-slave arrangement with TP+ gearheads.
- **Smart System:** Freely and flexibly mountable Smart Class rack (modules 2 to 4) as well as Premium or Standard pinion with freely selectable WITTENSTEIN alpha gearhead.
- **Economy System:** Value Class racks (modules 2 to 6) and Standard pinion for involute output shafts or shafts with a key.

### Typical applications

- Grinding machines
- HSC portal milling machines
- Profile machining centres
- Turning machines
- Boring machines
- Laser machines
- Stamping presses
- Water jet cutters
- Machining centres for wood-plastics compounds
- Plasma cutting machines
- Pipe bending machines
- Automation axes

## Full-speed ahead into the future – electromobility with WITTENSTEIN and the StreetScooter



**Environment friendliness, economy and individuality are the fundamental ideas associated with the topic of eMobility. The increasing scarcity of resources and constantly rising prices are being felt by everyone, as will be the follow-up costs if we don't succeed in reducing environmental pollution such as greenhouse gas emissions. At the same time, the demand for individual mobility is growing, e.g. in mega and other big cities and the urban centres that surround them, in which around 40% of the world's population will live in 2015.**

### **What's so special about a real electric vehicle?**

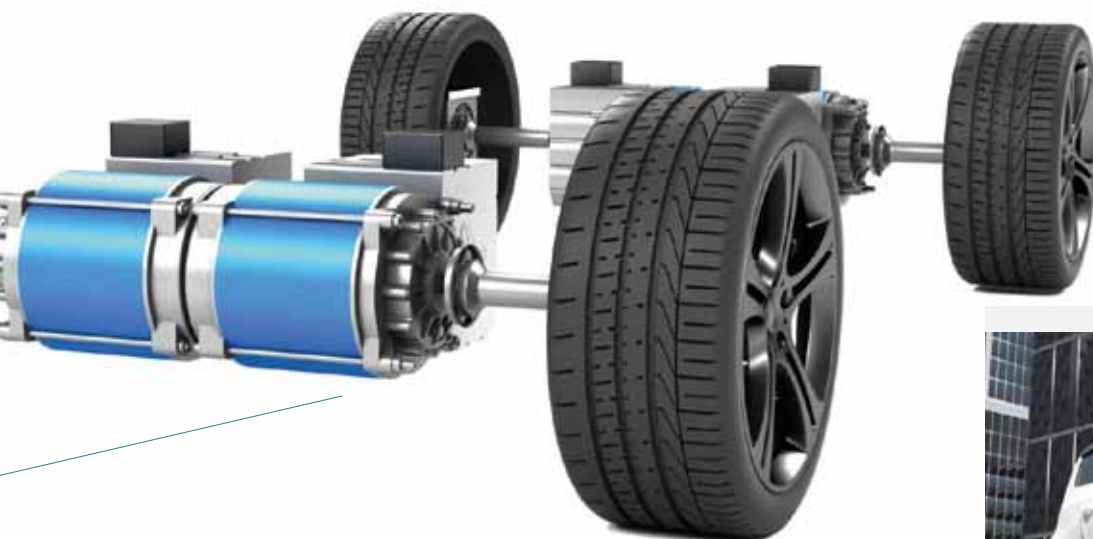
You occasionally see them out on the road, these electric cars that conserve resources, ease the burden on the environment and facilitate individual mobility. But these vehicles certainly won't succeed in turning eMobility into a popular movement, because at present they are simply too expensive for most people to buy. "Today's electric vehicles are essentially nothing more than standard cars with the combustion engine taken out and an electric motor dropped in instead", says Dr. Bernd Schimpf, Head of Generating Process Management at WITTENSTEIN AG. "With respect to space and range, these vehicles are often unsuitable for daily use, and what's more, far too expensive, because they are one-off or mini-series conversions for which both the components and the conversion work are relatively dear." What, then, is so special about a "real" electric vehicle? This is a ques-

tion scientists at RWTH Aachen University have been asking themselves, setting up the StreetScooter project that brings together automotive suppliers and technologies that are key to electromobility. This collaboration is targeted at developing all technologies required for an all-electric city vehicle through to series production. At the same time, the StreetScooter is also to serve as a model for the production of electromobiles, because one of the chief aims of the project is to realise a selling price of approx. € 5,000 plus VAT and battery (or battery leasing). "We're talking not only about product development but about the development of inexpensive production technologies", explains Dr. Schimpf.

### **Two-seater or pickup: the modular system determines the vehicle type**

With respect to vehicle assembly, the experts at RWTH Aachen have developed a totally new production concept for the StreetScooter. The vehicle is divided into a number of vertical modules, i.e. the front end and front section of the passenger compartment, the rear section of the passenger compartment and the rear-end module. The classic mode of final assembly in the automobile industry is being replaced by a concept in which pretested modules, which can come from different suppliers, are joined together. It's the modules that then determine the diversity of vehicle models available, from two-seaters through convertibles to pickups. Differentiation and personalisation of vehicles in line with customer tastes





WITTENSTEIN heads up the eMobility drive technology side of the StreetScooter project: the highly compact, electric drive system (see photo) first exhibited at the Hanover Fair 2010 delivers the basis technology.



Thanks to the know-how and affordable technology from WITTENSTEIN, the StreetScooter is en route to success.  
Source: RWTH Aachen University

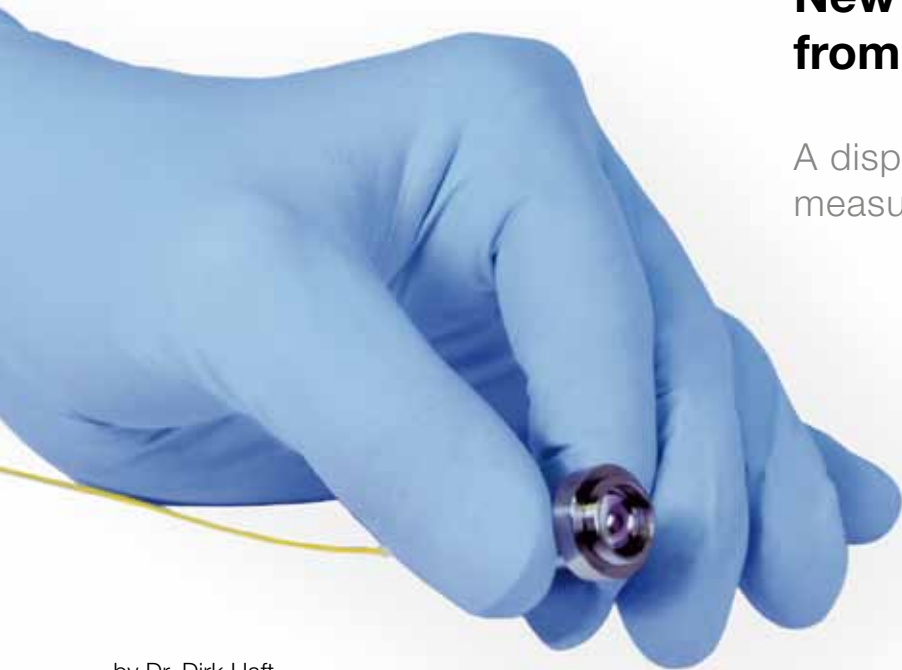
will then no longer take place at the factory; instead external, StreetScooter-certified customisers will kit out each StreetScooter with precisely what the orderer wants, e.g. a leather interior, sat-nav system or sound system.

#### **WITTENSTEIN heads up the drive technology side of eMobility**

What sounds so simple, namely to design an electric vehicle segment by segment and compile the different model variants by piecing together the modules, requires a huge amount of development and coordination work and the right technology partners. To this end, a total of nine LEGs (Lead Engineering Groups), each responsible for a different technology, e.g. bodywork, safety or memory systems, were set up for the StreetScooter project. One of these LEGs goes by the name of “Electric Drive” and is led by WITTENSTEIN. “How important the results produced by this LEG in particular really are becomes very apparent as soon as one realises that 30% of the production costs for a StreetScooter are accounted for by the drive system”, explains Dr. Schimpf. “As a drives specialist, we therefore bear a huge share of the responsibility when it comes to the success or failure of the StreetScooter project, which is why we are investing our entire experience with compact and even miniaturised drive system solutions – with maximised efficiency and power / weight ratio – from other industries, such as aerospace and medical engineering.”

#### **Economically viable manufacturability of WITTENSTEIN drives**

WITTENSTEIN's contribution on the drive side of eMobile concepts speaks for itself. In collaboration with a well-known automotive manufacturer, WITTENSTEIN presented a very compact and rugged drive system at the last Hanover Fair, a system that integrates the motor, electronics and gearhead and offers acceleration that rivals that of Formula One cars while being totally emission-free. Of great importance to the StreetScooter project is that the motor, gearhead and electronics in the drive modules are optimally harmonised to achieve maximum efficiency and therefore the maximum possible range. Moreover, the drives conform to the strictest imaginable operating, safety and reliability requirements. “All components are made by WITTENSTEIN and optimally matched”, says Dr. Schimpf. “What's more, we will be rolling out various systems one after the other – in line with the modular concept. This means we can configure drives for different performance classes and in different quantities while still exploiting the cost benefits of high-volume production for the individual components. And by realising economically viable manufacturability of the drives, we are making a massive contribution toward achieving the € 5,000 target price for the StreetScooter.”



## New “attoFPSensor” from attocube systems AG

A displacement sensor that could even measure the thickness of an atom

by Dr. Dirk Haft,  
CEO of attocube systems AG

attoFPSensor – a displacement sensor with atomic sensitivity

**attocube systems’ Metrology division has developed a glass-fibre based displacement sensor that closes the technology gap when it comes to measuring distances and displacements with ultra-high precision in extreme environments and confined spaces. While virtually no competition exists in this market niche, there are numerous applications available.**

The science of metrology dates back to the ancient Greek world, in which measures of length were based on the size of body parts such as “foot” or “finger segment”. Over thousands of years, metrology has been honed in exact accordance with evolving technology, allowing modern engineers and scientists to trace back time, length, weight and other measures to international standards with unprecedented accuracy. Although length and displacement measurement systems with accuracies in the 10 parts-per-billion (ppb) range are offered on a commercial scale, there has been a technology gap in the availability of highly compact, ultra-sensitive displacement sensors for use in extreme environments. attocube systems has recognised – and closed – this gap by developing a new product family around a single-fibre based interferometer. The “attoFPSensor” is capable of operation in harsh environments such as ultra-high-vacuum (UHV) or ultra-low temperature, while providing traceable displacement measurements with sub-nanometre sensitivity.

**The huge market potential for this type of sensor is explained by the following two application examples:**

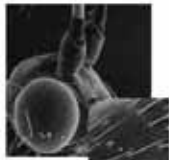
For a new, linear electron accelerator in Geneva, up to 4,000 quadrupole electromagnets need to be actively aligned and adjusted with respect to a reference mass with an accuracy of better than 1 nm root mean square (rms). Although the technology for meeting this requirement already exists in the form of commercially available seismometers or geophones, their signal-to-noise ratio is insufficient for the envisaged particle accelerator. What further complicates the matter is that geophones intrinsically only measure velocity rather than displacement, creating a need to mathematically integrate the measurement signals over defined time periods. This data integration process results in additional signal noise and worsens the overall performance of the system. attocube systems’ new “attoFPSensor” represents a genuine solution to this problem – to which no commercial-scale answer has existed in the past. The “attoFPSensor” easily measures the

Part of the WITTENSTEIN Group since 2008:  
**attocube systems AG (Munich)**

attocube systems AG, established in 2001 as a spin-off of the Center for NanoScience (CeNS) at Ludwig-Maximilians University in Munich, is an extremely successful developer of servo motors for nano-precise positioning. Thanks to its patented principles, applications can for the first time be taken to the limits of what is physically and technically possible in environments characterised by ultra-low temperature (minus 270 degrees Celsius), ultra-high vacuum or very high magnetic fields. The precision and stability of this intelligent, interdisciplinary technology will steer the drives –and hence complete microscope systems – to market leadership in the competitive global arena.



1 mm = 0.001 m



1  $\mu$ m = 0.000 001 m



1 nm = 0.000 000 001 m

Servo motors from attocube systems travel in just one second to within one nanometre of a destination point along a displacement path several centimetres long. This feat could be compared with a golf ball that is driven from Munich to Paris – some 600 miles away – where it lands in a hole just four inches wide.

required absolute displacement between the sensor head and the reference mass, leading to an improvement in signal quality of around 500 percent compared to the best geophones currently available in the market. In contrast to other “classic” interferometer systems, the “attoFPSensor” excels with its vacuum compatibility, compactness and fibre-based design, which presently make it the only possible solution to this problem. As a further advantage, the “attoFPSensor” allows up to 10 sensor heads to be operated with a single laser source, massively cutting the capital costs compared to competitor products. This is of particular importance when several thousand sensors are necessary for operation, as is the case with this large-scale research facility.

The second example is taken from the semiconductor industry. To further increase the density of transistors in integrated circuits, the industry is investing huge sums into the development of extreme UV lithography technology (EUVL). EUVL is scheduled to be ready for use and commercially available by the end of 2012, by which time it will allow the creation of integrated circuits with a feature size for the smallest chips of just 10 nm by taking advantage of a 13.5 nm light source

in the lithography process. However, due to the extremely high energy of the light beam, all lithography processes will have to be conducted in ultra-high vacuum to avoid absorption and ionisation of the impurities present in air. One of the main issues to be solved in the development of EUVL is the alignment between the UV optics and the photomask, providing the upscaled image of the pattern to be written on the wafer. Commercial interferometer sensors have not been suitable for this task, as none of them are compatible with the ultra-high vacuum conditions that prevail in the revolutionary lithographic apparatus. The “attoFPSensor”, on the other hand, can cope remarkably well with the challenge of such an extreme environment and furthermore allows the distance between the photomask and the objective to be measured with 1 nm sensitivity, as required by the system manufacturer for this process. Positioning bulky, heavy objects such as the EUV objective with nanometre precision is like “putting a man on the moon” – and the “attoFPSensor” might well turn out to be one of the crucial components for this task.

# Doing our bit towards disaster relief

Turbine spur gears from WITTENSTEIN bastian drive emergency generating sets

by Claus Stoll, Sales Manager at WITTENSTEIN bastian GmbH

Electricity is usually in short supply in disaster areas. Thanks to a remarkable technological development from Austria, disaster relief can now be provided considerably more efficiently than previously with the aid of emergency generating sets. WITTENSTEIN bastian has supplied the innovative gearing technology to make it happen.

Jakadofsky GmbH, based in Kottlingbrunn, Austria, develops and manufactures special gas turbines with an integral gearhead that are used to drive emergency generating sets. Conventional emergency generating sets operate with piston engines and weigh up to 200 kg, whereas turbines with an integral gearhead cut the weight of the set to around just 25 kg. In emergency situations, lighter-weight generating sets enjoy a clear advantage: relief services, such as the fire brigade, rescue and supply teams, can get the units to where they are needed and get them running much faster.

### The challenge

Owing to the high structural and tribological stresses on the toothing in the gearhead, the task of sizing and machining the gearing components was a welcome challenge for the development engineers at WITTENSTEIN bastian. In view of the high number of cycles that need to be withstood, it is essential that the gearing be designed and sized to guarantee excellent fatigue strength in respect of pitting and tooth root fatigue fracture. Through the choice of tooth geometry, the engineers were able to positively influence the gearing's resistance to wear and scuffing load capacity. Owing to the high operating temperatures and expected, deficient lubrication conditions, special attention was paid to the choice of materials and a suitable form of heat treatment for the turbine spur gears.



Drive of emergency generating sets for disaster relief: the 14 HP turboshaft from Jakadofsky with integral WITTENSTEIN bastian gearing.  
Source: Jakadofsky GmbH

### The technology

The roughly 10.5 kW of power to be transmitted is output with a steady-state torque of 1 Nm and at an input speed of 100,000 rpm at the turbine shaft. The ambient temperatures of the gear wheels lie between -20°C and +130°C. Two different versions of the turbine are built: in the case of the lower-cost version, the toothing is lubricated with a nebulised oil-and-fuel mixture. By contrast, the teeth of the industrial version are supplied with lubricant by a recirculating oil lubrication system. The length of service life demanded for the spur gears corresponds to 6,000,000,000 load changes in the drive stage.

### The outcome

Following production of the prototype by WITTENSTEIN bastian and several successful test runs, CEO Peter Jakadofsky confirmed that the WITTENSTEIN gearing satisfies all requirements with regard to longevity. And that's not all: expectations as regards low noise levels were clearly exceeded.



## Our technologies for your gearing problems:



### Bevel gears

Tooth type: Gleason arc  
Module: 0.8 – 8, up to ø 275 mm  
Quality (max.): DIN 1

### Spur gears

Tooth type: Straight, helical, conical  
Module: 0.3 – 9, up to ø 400 mm  
Quality (max.): DIN 3

### Internal gears

Tooth type: Straight, helical, conical  
Module: 0.4 – 6, up to ø 400 mm  
Quality (max.): DIN 6

## No sharp angles or edges



New series: stainless-steel actuators for use in germ-free environments

**The new “axenia” stainless-steel actuators from WITTENSTEIN motion control GmbH are put to use wherever hygiene has top priority, aggressive cleaning materials are used and systems have to be driven with utmost precision. The most demanding requirements are set, for example, by the pharmaceuticals packaging and food processing industries. The name “axenia” is derived from the adjective axenic meaning germ-free.**

The first actuator in this series to successfully come through the field trials is the axenia-CPM 080, the tests being conducted in a sausage machine. The drive rotates a twin tube onto which the sausage skins are pushed prior to being filled with sausage meat. The axenia-CPM 080 comprises a two-stage gearhead in the alphira® 080 series with a maximum acceleration torque of 80 Nm and an MSS1 064 synchronous servo motor with a maximum acceleration torque of 4.3 Nm, and – with the exception of the output shaft – satisfies degree of protection IP 69K. This is important because it guarantees total ingress protection against foreign bodies such as dust or water during high-pressure or steam-jet cleaning.

Thanks to an innovative sealing system, the output shaft achieves IP 67 protection (dust-tight and protection against temporary immersion). Machines in the food processing industry are cleaned several times a day, that is to say they are covered with lather and then sprayed down with a high-pressure jet. By employing 1.4301 stainless steel, the degree of corrosion resistance to these alkaline or acidic cleaning agents and disinfectants is increased, making the actuator particularly well suited to use in food applications. Such innovative industrial design means there is no need to use excessive quantities of cleaning agents, because the stainless

steel axenia-CPM actuator was developed and designed in accordance with hygienic guidelines: with no sharp edges, beads or exterior screw heads. As such, WITTENSTEIN motion control has set a new benchmark in industrial design and hygienic suitability, because so far there are no comparable products on the market. Other versions with a TP gearhead (a planetary gearhead with high torsional rigidity) are already in the pipeline as the axenia-TPM.

Processes and workflows in the food industry are still primarily carried out by hand – the level of automation in this industry is merely 20%. This explains why there is such high potential for the deployment of axenia actuators, particularly in the automation of food processing. Even if large sums of money have to be invested in hygiene standards during the planning and implementation of new plant and systems, it still makes good economic sense over the entire length of the equipment’s service life. After all, there’s no denying that insufficiently hygienic machinery leads to immense damage and losses for the user.

Every actuator is designed and sized in line with the individual customer’s requirements because operating and environmental conditions differ greatly.

- For further information, please contact Siegfried Wallauer, Product Manager Rotary Drive Systems at WITTENSTEIN motion control GmbH, e-mail: [E-Mail: siegfried.wallauer@wittenstein.de](mailto:siegfried.wallauer@wittenstein.de).

# al[pha] + pheno[menal] = alpheno<sup>®</sup>

A new dimension in perfection



**The perfectionists at WITTENSTEIN alpha have put their heads together again. The outcome: alpheno<sup>®</sup> – a high-performance gearhead that sets new benchmarks**

For more than 25 years now, WITTENSTEIN alpha has been the market and innovation leader when it comes to high-precision planetary gearheads. Back in 1983, Dr. Manfred Wittenstein achieved a new milestone in servo technology when he introduced the first low-backlash planetary gearhead. The product range has been regularly extended and optimised ever since. The further development of the SP<sup>+</sup> and TP<sup>+</sup> series in 2009 marked an important highlight in the “alpha gearhead’s” ongoing success story.

#### **Perfect is never perfect enough for us!**

The performance of planetary gearheads is taken to an entirely new level with alpheno<sup>®</sup>. While many market competitors are still reflecting on ways to improve precision and operating noise, WITTENSTEIN alpha is already one step ahead. For several years, alpheno<sup>®</sup> has been the model of choice in

highly challenging applications where individual requirements exceed the performance capabilities of the standard product range. The power density of alpheno<sup>®</sup> has been increased by up to 130% compared to the SP<sup>+</sup> – exceeding all current standards in the market.

#### **No matter how exacting your specification, we can meet it!**

Like the SP<sup>+</sup> shaft gearhead, alpheno<sup>®</sup> is also available in a HIGH SPEED<sup>®</sup> version and with a hollow shaft at the output. A variant with optimised mass inertia guarantees maximum energy efficiency. In combination with the WITTENSTEIN alpha rack-and-pinion portfolio, alpheno<sup>®</sup> represents an unbeatable drive solution in the field of linear motion.

- **Have we aroused your curiosity?**

**If so, contact us at the following address for individual consulting: [info-alpha@wittenstein.de](mailto:info-alpha@wittenstein.de)**



The new MINI-IQ-Drives® from WITTENSTEIN electronics

2 x 1 kW in business card format



## 1 kW in business card format

The new MINI-IQ-Drives® from WITTENSTEIN electronics

**From individually tailored system solutions to practice-proven standard products, these miniaturised, intelligent software and electronic drive components from WITTENSTEIN electronics are additionally designed to work absolutely reliably in extreme environments, for example at very high or low temperatures, at the bottom of the sea or up in space.**

The new “MINI-IQ-Drives®” electronic servo amplifier series from WITTENSTEIN electronics provides up to 1 kW of power while occupying a surface area of only 50 x 80 mm – no bigger than a standard business card! The exceptionally compact and robust controller is powered from an input of 10 to 60 V DC and supplies phase current output of up to 21 A. The miniaturised drive controller is suitable for use in extreme ambient temperature environments from -40 to +85°C. It is thus well suited for distributed automation solutions that require a fast and precise response to application-oriented events.

The drive electronics are available with a CAN bus interface. The connection to the outside world takes place over an optional connector board. Without the connector board, the automatic controller can also be integrated directly. Aided by

an efficient signal processor, the automatic controller with its scanning rate of 32 kHz supports three modes of operation: position, speed and torque control. The drive can provide speed and torque controlled operation either with a motor feedback encoder or without one (i.e. “sensorless”).

### Modular and flexible

Assembly-friendly output stage modules of surface mount design save time and costs in the production process and assure high product quality and reliability. The product line combines extremely high quality with a broad application scope for drive solutions in the food processing, handling, packaging, printing, paper, plastics, semiconductor and textile industries. The hardware and software can be customised on request.

MINI-IQ-Drives® can be used to drive precision AC servo actuators made by WITTENSTEIN cyber motor directly. These miniaturised drive systems offer the highest power density, dynamics and precision available in the brushless servo motor industry today. The components have been validated together and are already operating successfully in a variety of demanding applications.

### Technical specifications:

- Power supply 12 to 60 V DC
- Nominal continuous current up to 10 A<sub>rms</sub>
- Sine wave commutation for quiet operation and maximum power density
- Operating modes:
  - Speed control
  - Torque control
  - Position control
  - Sensorless control (EMF based)
- Fieldbus: CANopen protocol with device profile (DS402) and communication profile (DS301)
- PC Interface: USB 2.0
- Extended temperature range (-40 bis +85°C)
- 16 kHz PWM frequency
- 32 kHz controller frequency

# Aspiring to new heights

Control loading systems for flight simulators manufactured by WITTENSTEIN aerospace & simulation have successfully cleared the hurdle of certification by the authorities

by Christoph Heine, Managing Director  
WITTENSTEIN aerospace & simulation GmbH



Boeing E-3 Sentry ("AWACS")  
Source: NAEW&CF E-3A component



A flight simulator – only the experts can see it is not a genuine cockpit.  
Source: CAE Elektronik GmbH

**Anyone who is interested in technology and is also an aerospace enthusiast has at least seen a photo of the flight simulators used by major airlines such as Lufthansa, mounted on a hydraulic hexapod with full motion and affording all-round visibility.**

These simulators give trainee pilots a realistic impression of a simulated flight. Not only do they learn to fly economically but they can also simulate difficult conditions and system failures and discover how to respond to them properly without being exposed to any danger – something that would be almost impossible in a real aircraft. However, the market for simulators is much larger.

Firstly, there are simulators for different aircraft such as passenger aircraft, helicopters, military jets and transport planes. Simulators are even used to train pilots of light aircraft. Also, there are what are termed procedure trainers, which are a kind of very simplified simulator. These are used to teach tasks like the various switching procedures or how to handle faults. Mission trainers are used for pilot deployment, where

the exercise is less about piloting skills and more about simulating dogfights. Centrifuge trainers simulate the g-forces of flight manoeuvres realistically, allowing the pilot to deal with this particular stress factor.

Training equipment used in the aerospace sector is subject to legal requirements imposed by national and international air safety authorities, just as the real aircraft are. This is the German Civil Aviation Authority (LBA) in Germany. In Europe this used to be governed by the JAA (Joint Aviation Authorities) until EASA (European Aviation Safety Agency) took over responsibility a few years ago. In view of its record of several successfully implemented orders, WITTENSTEIN aerospace & simulation qualified as a supplier of certified systems in the last few months.





**What are “control loading systems” (force feedback systems)?**

This is a term used to describe technical systems which give the pilot using the simulator the most realistic feedback possible of the forces at the controls – for example on joysticks, pedals and thrust levers. So that the parameters can be designed for programming and dynamic use, this equipment is not spring mounted but is instead supported by actuators.

In addition to such actuators, WITTENSTEIN aerospace & simulation GmbH, as experts in this area, supply complete modules (with original-type handles, if requested by the customer) as well as peripheral devices and the system software.

**The technical challenges involved in development and implementation lie in the man-machine interface and the classical problems linked to this:** Feeling is something subjective and cannot really be covered by technical parameters. The statement “It feels right” is a very soft criterion and cannot be accurately expressed in specifications. WITTENSTEIN’s control loading systems can therefore be parameterised in many ways. After technical commissioning, the systems are fine-tuned for human factors in a tuning session with experienced pilots.

As an additional service, WITTENSTEIN aerospace & simulation GmbH offers the measurement of force characteristics in the original aircraft so that these can be reproduced in the simulator, making it possible to deliver a full system solution from one source.



Modern flight simulator at a training establishment  
Source: CAE Elektronik GmbH

Reconfigurable pedal assembly from WITTENSTEIN aerospace & simulation

Active cyclical joystick for use in a helicopter simulator, manufactured by WITTENSTEIN aerospace & simulation

Just a few examples:

**Civil aviation**

For CAE Elektronik GmbH, a subsidiary of CAE Inc. of Canada, WITTENSTEIN aerospace & simulation developed and supplied a control loading system for the prototype EC-135 helicopter to comply with the standard JAR-FSTD H FTD Level 3. The first customer and operator is a Polish air rescue company, which organises emergency transport for seriously ill persons and the transportation of medical teams or organs.

**Military aviation**

One of the most interesting projects over the last few months was the development of a control loading system for a Boeing 707 E-3A Sentry – also known as an AWACS or a “flying radar station”. Although the prototype 707 aircraft went into service as far back as the end of the 1950s, many AWACS planes are still in use. So that the pilots of these aircraft can continue to

be trained properly, NATO has ordered a new simulator (flight training device) and, again, CAE will be the manufacturer. The challenge for WITTENSTEIN aerospace & simulation here was to integrate a modern control loading system into the new flight training device. It is planned that this system (which complies with JAA Level-2 FTD, JAR-STD-2A) will go into service in 2011 at the NATO air base in Geilenkirchen.

**General aviation**

Working in cooperation with the customer Diamond Simulation GmbH in Trebur near Frankfurt, WITTENSTEIN aerospace & simulation has developed a control loading system to be used on flight simulators for the DA40/42 light aircraft, which has been certified to JAR FSTD-A FTD Levels 5 and 6. A particular customer requirement for this project was to plan suitable modular technical solutions for two different certification altitudes.

## WITTENSTEIN Italy

### The art of paper converting

The Italian province of Lucca is a major centre for the paper industry. One of the companies based there is MTC, which employs around fifty people producing, among other things, interfolders for the manufacture of facial tissues, paper napkins and paper handkerchiefs. MTC uses WITTENSTEIN alpha series SP<sup>+</sup>, HG<sup>+</sup> and TP<sup>+</sup> planetary gearheads. Up to 14 gearheads are installed in one single machine.

Feather-light paper napkins, facial tissues and paper handkerchiefs are produced from one paper roll weighing 2,000 kg – all at extremely high processing speeds. This is why it is crucial which mechanical components are used. The extremely quiet running and precision ( $\leq 1$  arcmin) of WITTENSTEIN alpha's SP<sup>+</sup> planetary gearheads with optimised helical toothing impressed the Italian design engineers. Irrespective of where they are installed, they always require the same amount of lubrication and are available in seven sizes with ratios from  $i = 3$  to  $i = 100$ , with acceleration torques of up to 4,500 Nm and maximum input speeds of up to 6,000 rpm. The HG<sup>+</sup> right-angle gearhead with hollow output shaft is known for its precision and torsional rigidity. This

positions the drive train of the entire interfolder, which works at speeds of up to 50,000 cycles per hour and extremely accurately. At ratios from  $i = 3$  to  $i = 100$ , acceleration torques of up to 640 Nm and input speeds of 4,000 to 6,000 rpm are achieved – with a minimum circumferential backlash of  $< 4$  arcmin over the entire service life of the gearhead.

Reliability and productivity are absolutely fundamental requirements for the interfolders because they work three shifts. Massimo Gabrielli, MTC's Technical Director says: "We use components from leading manufacturers, such as gearheads from WITTENSTEIN alpha, to ensure that our machines work reliably". The decisive criterion when using precision gears is their service life. This is increased to a maximum, thanks to the quality and optimum design of the gearing and all the components used. "All our products are individually tested. Random samples are not good enough for us", says Renato Zampogna, Area & Engineering Manager at WITTENSTEIN S.P.A, WITTENSTEIN alpha's Italian subsidiary. MTC invests in its machines and they are built using excellent individual components: "It always pays off in the long run", claims Massimo Gabrielli.



Source: MTC

**How paper towels are produced:** The roll of paper is positioned on the machine and the sheet is fed in via the reelstand. The individual stages then follow – bonding, bordering, printing and embossing. The layers of paper are finally fed into the folding head and folded and cut according to the dimensions specified by the customer.



**Application with a special status:** MTC and WITTENSTEIN engineers have found a new and unusual application for the SP<sup>+</sup> 180 planetary gearhead as a differential gear. The SP<sup>+</sup> gearhead is fitted "the other way round", i.e. what is used is its reduction ratio. The great advantage is that, when setting the axis, the gearhead can be utilised in such a way that it is extremely versatile and free from structural specifications. The main axis is set by an external electric motor, which cuts in if required.

## Prize competition

We are aiming to make our customer magazine move even more interesting for our readers. Please help us by answering the following questions and sending in your reply by fax or e-mail:

1. Which article in the current issue interested you most?
2. Which article was least relevant for you? Why?
3. Which topics would you like to see covered (e.g. mechatronics, applications, technical details)?
4. How would you rate the magazine in terms of design, clarity and content?

Design:  Very good  Good  Average  Not very good

Clarity:  Very good  Good  Average  Not very good

Content:  Helpful  Interesting  Informative  Uninteresting

5. What needs to be improved? What is lacking?

6. Other comments, criticisms or suggestions:

Please send in your reply, either by e-mail to [move@wittenstein.de](mailto:move@wittenstein.de) or by fax to +49 (0)7931/493-10301, by October 15, 2010 at the latest, stating your full name and address.

All participants will be entered in a draw, in which ten lucky winners will receive a copy of the book "Geschäftsmodell Deutschland. Warum die Globalisierung gut für uns ist" by Dr. Manfred Wittenstein. The book will be premiered in October 2010 at the Frankfurt Book Fair.



Please complete:

I am a  Customer  Supplier  Other: \_\_\_\_\_

My company's current size:  < 500  > 500

Postal address: \_\_\_\_\_

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## FAIRS AND EXHIBITIONS 2010/2011 (selection)



**BIMU**, Milan (Italy)  
 International Trade Fair for Machine Tools,  
 Robots and Automation  
 WITTENSTEIN S.P.A.  
**October 5 - 9, 2010**



**Forum Maschinenbau**, Bad Salzufflen (Germany)  
 Trade Fair for Suppliers in the Machinery Manufacturing Industry,  
 WITTENSTEIN alpha GmbH  
**November 3 - 5, 2010**



**PTC Asia**, Shanghai (China)  
 International Exhibition for Electrical  
 and Mechanical Power Transmission,  
 Transformers, Hydraulics, Technologies  
 and Machine Parts  
 WITTENSTEIN (Hangzhou) Co. Ltd.  
**October 25 - 28, 2010**



**SPS/IPC/DRIVES**, Nuremberg (Germany)  
 Electric Automation, Systems and  
 Components, Exhibition & Conference  
 WITTENSTEIN alpha GmbH, WITTENSTEIN  
 motion control GmbH, WITTENSTEIN cyber  
 motor GmbH, WITTENSTEIN electronics GmbH  
**November 23 - 25, 2010**



**Scanautomatic**, Gothenburg (Sweden)  
 International Fair for Hydraulics, Pneumatics,  
 Electronics, Transmission and  
 Measuring, Control & Regulating Instruments  
 WITTENSTEIN AB  
**October 26 - 28, 2010**



**Intec**, Leipzig (Germany)  
 Trade Fair for Manufacturing, Tool and Special-  
 Purpose  
 Machine Construction  
 WITTENSTEIN alpha GmbH  
**March 1 - 4, 2011**



**Pack Expo**, Chicago (USA)  
 International Trade Fair and Conference  
 for Packaging Technology  
 WITTENSTEIN Inc.  
**October 31 - November 2, 2010**



**Hanover Fair**, Hanover (Germany)  
 The World's Leading Showcase for Industrial  
 Technology  
 WITTENSTEIN Group  
**April 4 - 8, 2011**

