WITTENSTEIN

move

The magazine for customers and partners of WITTENSTEIN AG

DISCOVER **INFINITE POSSIBILITIES**

World first: **Galaxie Drive System**
revolutionizes high performance engineering

April 2015

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Contents

Masthead

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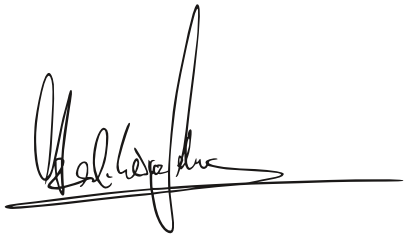
Dear readers,

Examples of visionary personalities abound throughout history – revolutionary inventors like Leonardo da Vinci or James Watt who do things in a different way to anyone else before them. Not only that but they also do them fundamentally better. In the beginning is always what appears to be an impossible objective. To achieve it, existing design strategies must be completely overturned and rebuilt. A "no compromise" approach – or put another way, unlimited power – must be the guiding principle.

For several decades now, WITTENSTEIN has enjoyed a global reputation for innovation and excellence in the field of mechatronic drive technology. Over the last few years, technology pioneers at our family firm have subjected drive concepts to a fundamental, no-compromise reassessment. The outcome: a unique combination of specifications that were hitherto unattainable. The Galaxie Drive System is a genuine world first with a brand new gearhead generation at its innovative core. It is a German invention which fills us with pride and which is set to revolutionize high performance engineering. It will enable automated manufacturing processes to make huge developmental leaps in terms of productivity, quality and energy consumption. The cornucopia of new possibilities is seemingly infinite. Don't just take our word for it – see for yourself at the Hannover Messe 2015! Come along and visit us in Hall 15, Stand F08, and "discover infinite possibilities". This motto will continue to motivate and inspire us long after the exhibition week is over, however. Every single day rapid technological advances, embedded in globalized business flows, leave us – and our customers all over the world – with no option but to question the status quo. Engineering services to facilitate self-optimization and diagnostics are nowadays increasingly important alongside accelerated development processes.

The reason is Industry 4.0: in the factories of the future, intelligent cyber-physical production systems will exchange digital information continuously. They will lay the foundation for services and software to identify weaknesses in a machine before serious problems develop. As with the new Galaxie Drive System, WITTENSTEIN is your innovative partner for tomorrow's world – the world we all inhabit together. With all the opportunities of infinite possibilities.



Karl-Heinz Schwarz
Board of Directors WITTENSTEIN AG

Professor Dieter Spath
Chairman of the Board and CEO WITTENSTEIN AG

Thomas Bayer, Head of Galaxie Drive Systems at WITTENSTEIN AG, explains the revolutionary kinematics behind the Galaxie Drive System with the help of a functional model.

move talks to:

Thomas Bayer

The brand new Galaxie Drive System provides the next machine generation with productivity, precision and dynamics many times greater than has ever been possible in the past. "These are real, verifiable results that have been reported to us by our customers", explains Thomas Bayer, Head of Galaxie Drive Systems at WITTENSTEIN AG. A seasoned engineer and inventor, he takes a look back at the creation process.

»The logarithmic spiral
is a fundamentally new function for
gear teeth that was discovered and developed by us.
It has yet to feature in any textbook.«

Thomas Bayer, Head of Galaxie Drive Systems at WITTENSTEIN AG

move: There are already several very mature precision gearheads based on the hollow shaft principle in the market today. What made you decide to invent and develop a brand new gearhead generation?

WITTENSTEIN specializes in innovations in the gear sector. Our planetary gearheads, in particular, are among the stiffest and the most precise on offer anywhere. Although they still hold potential for optimization, we could see no likelihood of any major developmental leaps. I therefore started wondering what form the gearheads our customers need for the next generation of high performance machines could take. All gear concepts – spur gears, planetary gears, hypoid gears, Harmonic Drive principles, eccentric gearboxes and cycloidal gears – have specific strengths and weaknesses. I couldn't think of one that performs equally well regardless of the application, however. Stiffness, load carrying capacity, zero backlash, precision, a large hollow shaft and so on – we were looking for everything at once and much, much better!

So where did you find the hidden potential you were just waiting to unlock?

The majority of teeth on a gear only rarely engage – they just turn idly. Involute teeth make linear contact, which severely limits the transmissible torques owing to the high Hertzian pressure. Those two basic problems of all gearboxes add up to considerable wasted potential!

How did you solve those problems?

There are two main toothing types in gear design: involute and cycloid plus a few subtypes. The logarithmic spiral is a fundamentally new function for gear teeth that was discovered and developed by us. It has yet to feature in any textbook. Spirals also exist in nature. Many species of plants, the shell of a snail and even galaxies in outer space are "designed" according to the logarithmic spiral principle. That's why "Galaxie" was an obvious choice of name for the new drive system.

What sets the Galaxie Drive System apart from other types of gearhead?

We developed the tooth contact as a true ring gear based on the logarithmic spiral! The gearwheel is segmented into individual teeth, which means that almost all of them can now engage simultaneously. Compared to even the best helical-toothed planetary gearheads the Galaxie Drive System has a 6.5 times larger torque transmission surface! We verified that with FEM. The Galaxie Drive System achieves several times better torsional rigidity and overload capability than other gearhead types without any increase in physical volume. All contacts were developed with low surface pressure in mind. A hydrodynamic lubricating gap forms both in the guide holes of the individual teeth and in the gearing itself. Up to 91 percent efficiency has already been measured for this high-ratio gearbox. At the same time, the drive boasts extreme precision and virtually no backlash.

Do the gearhead's new teeth and kinematics also provide exactly uniform transmission?

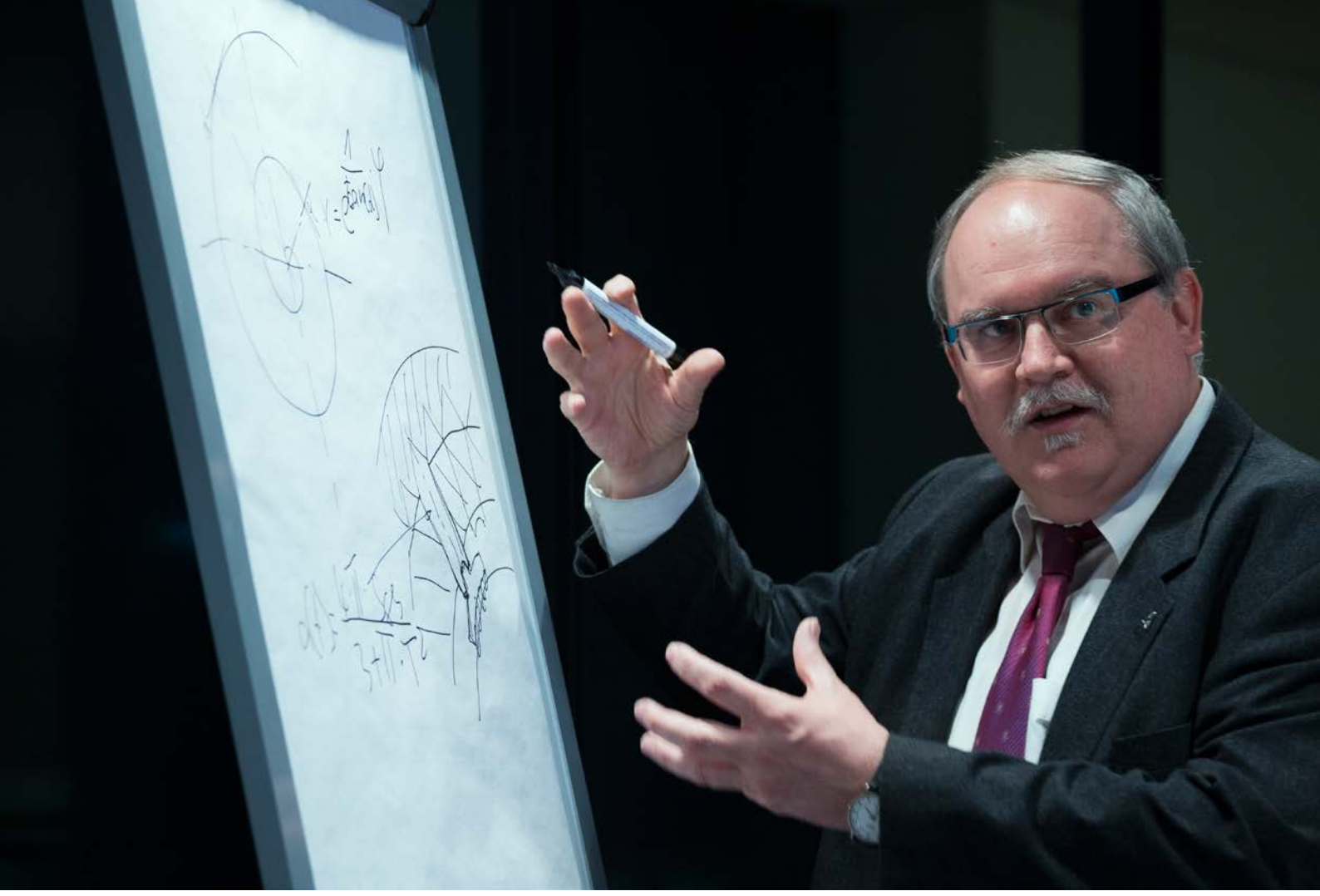
Indeed – perfectly uniform transmission is achieved if the input polygon is designed to ensure a sliding movement of the individual teeth along the ring gear – both following a logarithmic spiral as tooth geometry. A suitable polygon first had to be developed to drive the teeth. A bi- or triangular bearing was therefore needed. That meant we had to invent and develop a rolling contact bearing with a polygonal inner race ring and a segmented outer race ring.

What other advantages does the Galaxie gearhead have for users?

The gearhead is virtually wear-free; even after running 24/7 for two and a half years, it shows no increase whatsoever in backlash. It can even be realized with zero backlash by selecting the parts accordingly – without any reduction in the maximum transmissible torques! Since there is no measurable wear, it remains permanently backlash-free. There's one more defining feature I should mention: the backlash-free version of the gearhead retains its full, incredibly high stiffness at the zero crossing, even with alternating loads. What's more, it combines the largest hollow shaft with a very low noise level that isn't perceived to be a nuisance. And to get the same torques as we do with the Galaxie, we'd have to build any other type of gearhead at least two, if not three, sizes bigger.

Won't the electric motor need to be relatively large in order to exploit the gearhead's full potential?

WITTENSTEIN cyber motor developed an extremely high powered motor for the Galaxie Drive System and tuned it specifically to the



gearhead's characteristics. The motor and gearhead form a mechatronic unit of roughly equal diameter and length. The integrated sensors are designed to fuse this newly developed high performance motor with the gearhead, forming an ultra-compact, hollow-shaft drive system with Industry 4.0 connectivity.

What benefits can engineers realize with the Galaxie Drive System?

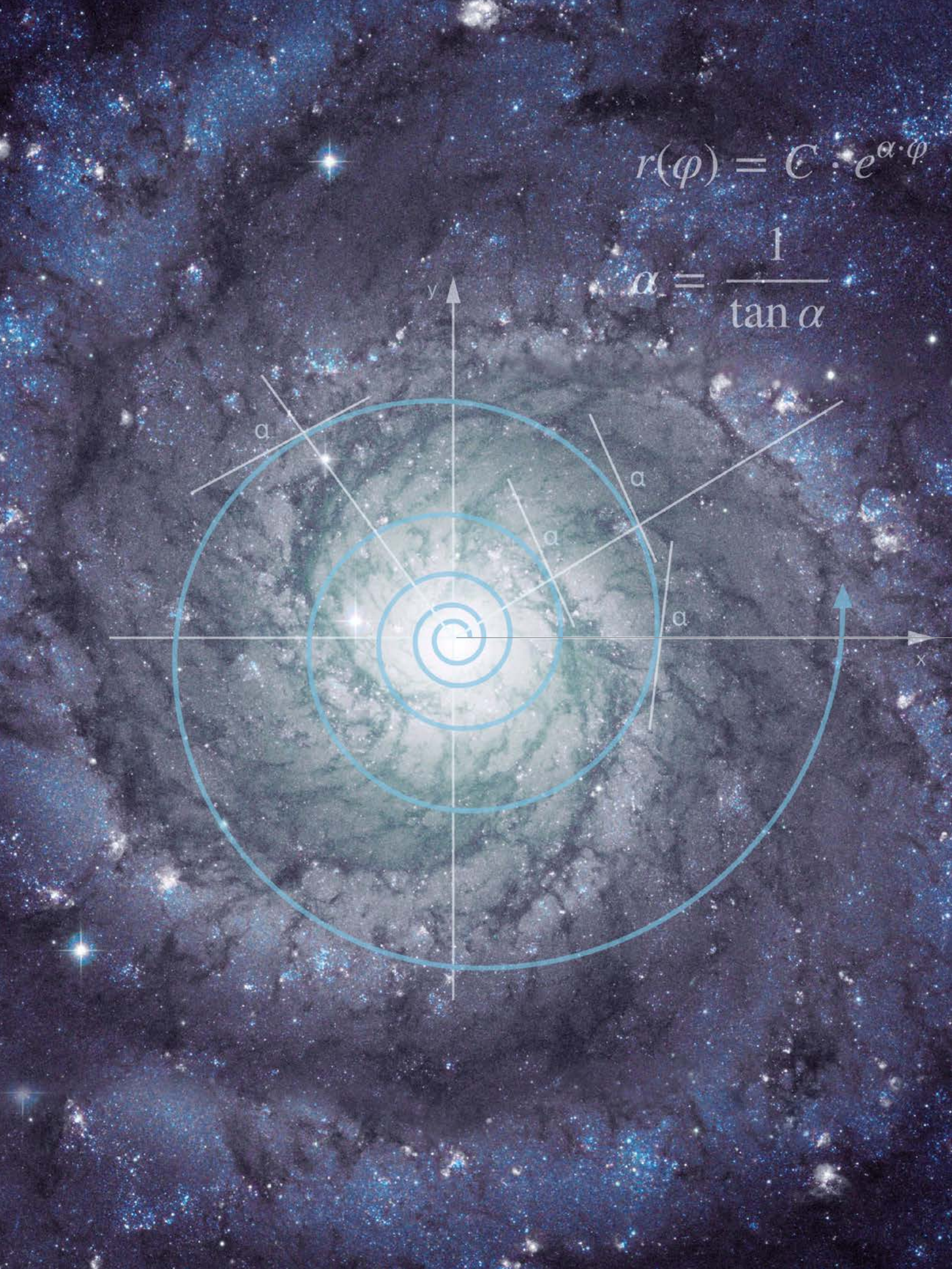
The Galaxie Drive System beats all rival products hands down in all important details. Despite this, it doesn't cannibalize other systems because the production costs are still higher at the moment. However, in the last two years our lead customers have discovered that with up to 580 percent more stiffness and far greater precision in production use, the Galaxie Drive System easily breaks through traditional limits and enhances productivity dramatically. Against this background, the price of the Galaxie Drive System is undoubtedly secondary.

Could you describe a few concrete applications?

The Galaxie Drive System significantly extends the life of machine tools because it unites permanent freedom from backlash with extreme stiffness and precision. Higher cutting speeds and feed rates are possible as a result. There's also a clear improvement in manufacturing quality. The moving cutting heads required for machining are only half the normal size, and even more compact and power dense are no longer a problem. The Galaxie Drive System is particularly ideal for the A, B and C axes of precision machines as well as for wafer handling axes or whenever precise rotational and tong movements and very high forces are essential but space is limited. It also represents a very attractive alternative to expensive direct or tensioned drives because it is permanently backlash-free. It's now up to engineers to completely rethink their existing machine designs and realize developmental leaps that have never been possible in the past.

Why did WITTENSTEIN wait a good two years before going ahead with the official market launch? Wasn't the market ripe enough?

The market was certainly ripe. However, the functional principles – like the hydrodynamic tooth contact over the full surface and the Galaxie Drive System's kinematics – are so fundamentally new and the results for all important parameters so enormously improved that we didn't want to be accused of simply blowing our own trumpet. We believed that testimonials from the first real customers would carry more weight. After more than two years in production use, the time has now come.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y
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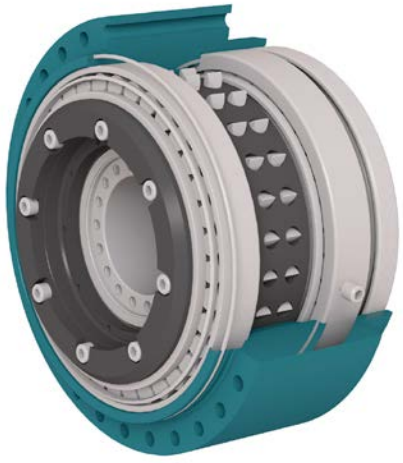
It's the kind of innovation that only happens once every fifty years, a masterstroke of engineering, a brand new gearhead generation – WITTENSTEIN's new Galaxie Drive System has already been showered with praise by users. "The innovative core is formed by the completely redesigned gearhead kinematics, where each tooth is an independent and dynamic entity, and the hydrodynamic tooth contact over the full surface", reports Thomas Bayer, Galaxie's inventor and Head of Galaxie Drive Systems at WITTENSTEIN AG. The decision to dispense with the gearwheel as the gearhead's key component and the innovative tooth geometry mean Galaxie can unleash forces that no-one ever imagined were possible before.

Galaxie Drive System revolutionizes the state of the art



Discover infinite possibilities

- 6.5 times larger tooth contact surface than with a planetary gearhead
- Up to 5.8 times more torsional rigidity than any gearhead of comparable design currently available in the market
- Three times better overload capability than cycloid gearheads
- Extremely high stiffness at the zero crossing in the backlash-free version
- Excellent dynamic positioning accuracy as a result
- No measurable wear = no increase in backlash
- Best efficiency in its class
- Exceptionally quiet operation even at maximum loads

All performance features upgraded – "no compromise" approach

"Galaxie's kinematics represent a paradigm shift with far-reaching consequences for electric drive technology", says Volker Sprenger, Head of Sales Galaxie Drive Systems, WITTENSTEIN AG. For the first time, it isn't just one or two performance features such as load carrying capacity, torsional stiffness or dynamic positioning accuracy that are upgraded by a new gearhead but all features simultaneously.

And the improvement is not just a few percentage points but several times over. It's been several decades since new doors were last opened so wide. Engineers and designers are now all set to develop the next generation of high performance machines and launch into a totally new universe with Galaxie.

Innovative core:
Gearhead kinematics reinvented

Galaxie is the key to a revolutionary new way of thinking in drive engineering. For the first time ever, a gearhead dispenses completely with a gear wheel – instead, each of the 24 teeth involved in torque conversion is an independent and dynamic entity, which is supported by a needle roller bearing, grouped around a non-circular input polygon and guided along the teeth of a ring gear. As a result of this principle, almost all teeth now engage simultaneously and participate in the torque transmission process, contributing to the torsional rigidity. "No standard gearhead types in the market today do it that way: normally, only a few of the teeth engage at once while the rest just turn without actually doing anything", explains Thomas Bayer. Another fundamental difference is that the novel tooth geometry corresponds to a logarithmic spiral. In contrast to conventional technologies, the tooth contact is no longer a line but a surface.

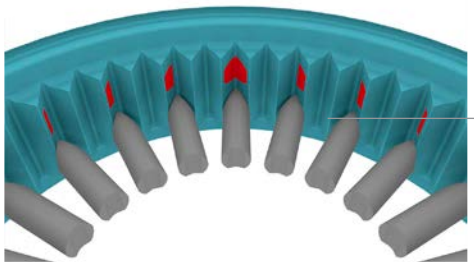
Benchmark calculations with a helical-toothed planetary gearhead show that the new Galaxie kinematics give a tooth contact surface which is more than six times larger for the same hollow shaft diameter. In addition, a hydrodynamic lubrication film is built up by the teeth in contact – even at low speeds and up to very high torque loads.

The sum of these features – Galaxie's multiple teeth, surface contact and hydrodynamic lubrication – leads to a unique combination of specifications that were hitherto unattainable.

Record breaking in every discipline

Thanks to its revolutionary new kinematics, the Galaxie Drive System is light years ahead of all rival gear principles today, regardless of the drive engineering discipline. The tooth contact surface is extremely large and the hydrodynamic lubrication film guarantees a constant pressure distribution with neither friction nor wear; the teeth which engage are hardly deformed at all and the automatic alignment results in an optimal transverse load distribution. Owing to the design principle, the Galaxie Drive System allows very large hollow shaft diameters. It is thus extremely compact even when high torques are specified – opening up enormous downsizing potential for designers.

"All this will make Galaxie the enabler for the next generation in high performance engineering", Volker Sprenger predicts. His optimism is not entirely unfounded; after all, the first customer projects in the metalworking, robotics, handling technology and machine tools sectors are already offering impressive confirmation – for instance, with up to double the usual productivity.



The new Galaxie kinematics give a tooth contact surface which is about 6.5 times larger than with a helical-toothed planetary gearhead.

Benefits for industry...

The Galaxie Drive System is a technological innovation that was developed explicitly for industrial applications. Its stiffness and its permanent freedom from backlash, for example, permit machine tools with a longer life, higher cutting speeds, more dynamic feed rates and highly precise motion control, especially at reversal points. All of this results in higher productivity and lower unit production costs. Thanks to Galaxie's high power density, it is now possible to design more compact machines and optimize the weight of robot structures or other handling actuators. More economically efficient machine concepts – as well as major productivity and quality improvements – can be achieved by using Galaxie as an alternative to expensive direct drives.

Learn more about the Galaxie Drive System

The Galaxie Drive System fuses a brand new gearhead generation with a newly developed high performance motor, forming an ultra-compact hollow-shaft drive system with integrated Industry 4.0 connectivity.

the environment and...

True innovations are also characterized by the attention that is paid to environmental compatibility and the benefits for society. The high efficiency which is built into the Galaxie Drive System also means less energy consumption. A compact design can be accommodated in a smaller space – and the smaller the drive system, the lower the material usage, CO_2 emissions and environmental impact when the machine is manufactured. Better process and product quality automatically implies fewer tool failures and less scrap – and hence less wastage of valuable resources.

...society

Sustainability arguments are a very effective way to make sure an innovation like Galaxie gains rapid social acceptance. Energy efficiency through reduced power consumption is one important aspect. An overload-proof design for the drives used in wind turbines, leading to a long service life with low costs for maintenance, is another. In the medtech sector, the Galaxie Drive System's extremely high torque density and overload capability pave the way for new exoskeletons for the elderly and disabled. The combination of very high power density and very small size is also an advantage in space travel – as long ago as 2012, a total of four Galaxie Drive Systems were on board the SHEFEX II sounding rocket launched by the German Aerospace Center (DLR). Their mission in this exciting development project for a future space transporter was to drive the craft in such a way that active position control and vibration damping would be possible on its re-entry into the Earth's atmosphere. The Galaxie Drive System won the contract because it was the only candidate that met the requirements for size, weight and robustness in every respect.

Technological highlight at Hannover Messe 2015

After almost three years of continuous operation in selected industries and applications, WITTENSTEIN will officially unveil the Galaxie Drive System at the Hannover Messe 2015. It will then be up to designers and engineers to realign their existing machine concepts to the Galaxie Drive System and make real developmental leaps in terms of productivity, quality and energy consumption. Traditional markets and applications will undoubtedly be joined by many new ones, for which a power dense drive system like Galaxie has so far been lacking.

When it comes to packaging consumer goods, no compromises are allowed – speed, precision and optimal availability are vital. That's why the designers at sema Systemtechnik of Hüllhorst (Germany) put their trust in gearhead technology made by WITTENSTEIN alpha.

Precision and performance

for 34,000 yoghurt cups per hour

The packaging machinery specialist has an easy task convincing customers like Yeo Valley of the advantages of worm, bevel and planetary gearheads made in Igersheim. sema recently built a high speed carton sleever for this British manufacturer of dairy products, which is rated for a throughput of 34,000 cups per hour, twenty-four hours a day and seven days a week.

Carton sleever transforms individual cups into sales friendly multi-packs

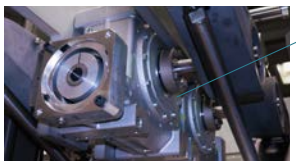
The carton sleever designed for Yeo Valley's dairy products transforms the individual yoghurt cups entering the machine into transport and sales friendly multi-packs. The sleever is loaded in three different ways: with the filled and sealed cups, with blank sleeves from a magazine and with pre-folded trays supplied by an upstream sema tray former. Screw conveyors inside the machine separate and position the cups precisely in four lines. Dual-axis robot modules each pick up four double cups and insert them into the blank sleeves, which are cycled into the machine in four lanes. The sleeves are then glued to the flaps with hot melt adhesive in the sealer – a process that calls for similarly precise handling. Finally, sixteen containers per cycle, each with 2x2 stacked cups, are placed in four pre-positioned trays by another robot module and conveyed to the next step. Wolfgang Beckmann, Manager Packaging Solution Design at sema, is visibly proud of the machine's performance: "The carton sleever delivers up to 17,000 single-layer multi-packs an hour in this way with a cycle time of 3.4 seconds".

Extreme precision, extreme reliability – experience pays

He and his team realized all servo applications in the carton sleever with gearhead solutions from WITTENSTEIN alpha. Beckmann is particularly admiring of the V-Drive⁺ series of servo worm gearheads – and that isn't just because of their food grade lubrication: "Throughout my fifteen years in the engineering profession, this gearhead type has consistently proved to be absolutely dependable. It also convinces me with its efficiency, excellent performance data, high overload protection and very low operating noise." All in all, about a dozen of these V-Drive⁺ gearheads are installed in the Yeo Valley line: at the main drive and for feeding the sleeves, gripping the cups, gluing the sleeves or placing the multi-packs in the trays. "When dynamic positioning is called for, the high precision they allow in all these functions is quite awesome", Beckmann confirms.

V-Drive⁺

All in all, about a dozen servo worm gearheads in the V-Drive⁺ series are installed in the carton sleever's various freely programmable robot units.



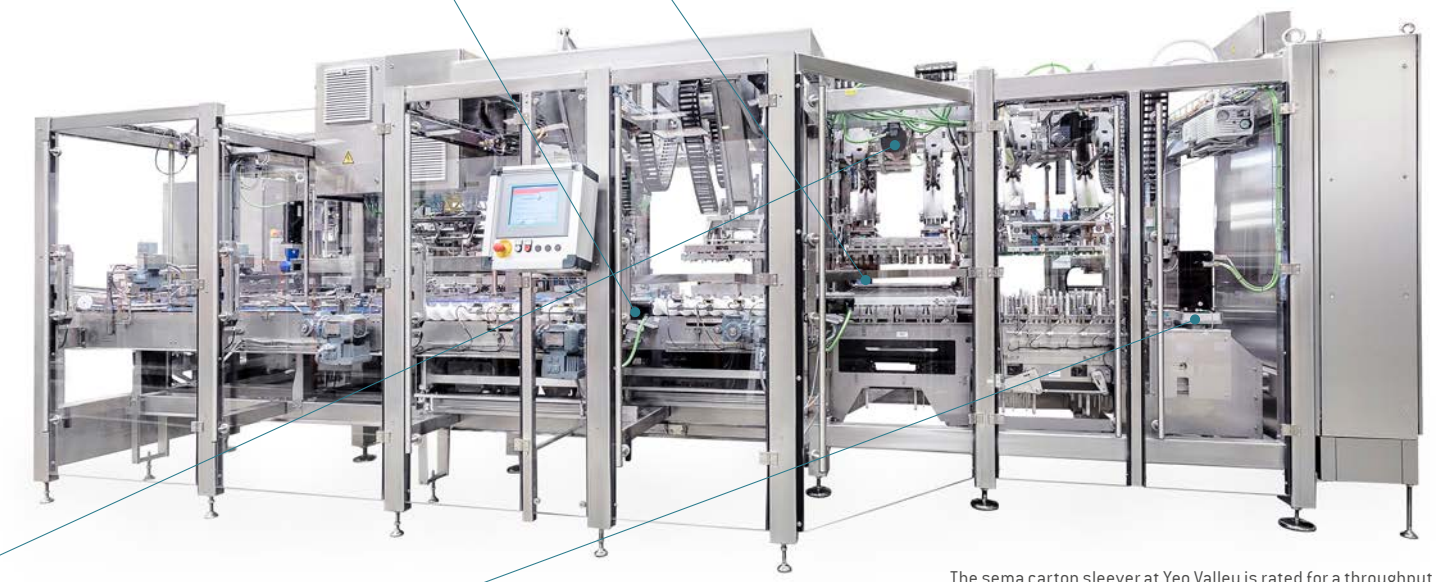
LPBK+

LPBK+ right-angle gearheads on a special separating system make sure the trays are accurately positioned and spaced before the sleeved products are placed in them.

LPB+ Generation 3

LPB+ Generation 3 planetary gearheads help position the sealed cups exactly on screw conveyors.

The special tooth geometry of the V-Drive+ gearheads assures the constant, lifelong accuracy that is vital in high-precision servo applications such as this. "Owing to their hollow-flank teeth, the increase in torsional backlash that is normally accepted over time is virtually zero", explains Karl Schmitt, Product Manager at WITTENSTEIN alpha GmbH in Igersheim. "This geometry also permits higher efficiency and there is no tendency to slip back, which could be detrimental to the precision of the motions. As a result, the V-Drive+ gearheads achieve constant, high positioning accuracy."



The sema carton sleever at Yeo Valley is rated for a throughput of 34,000 cups per hour, twenty-four hours a day.

Specialist for secondary and tertiary packaging solutions

sema Systemtechnik GmbH & Co. KG
sema Systemtechnik – at home in Hüllhorst, twenty miles north of Bielefeld in North-Rhine Westphalia (Germany) – has been in the packaging technology business for about four years now. The firm develops and distributes clean design systems for packaging, transporting, palletizing, erecting and re-packing primary packaged products in cups, jars, cans or dishes. Tray formers, top loaders, case packers, re-packers and carton sleevers are in great demand in the dairy and food processing industries.

All gearhead technology from a single supplier
In addition to the servo worm gearheads, sema also trusts in WITTENSTEIN gearhead technology elsewhere throughout the machine: right-angle gearheads in the HG+ series for handling the blanks in the sleeve magazine and LPB+ Generation 3 low-backlash planetary gearheads on the screw conveyors to position the cups before they are gripped by the robot modules. Innovative, technically reliable and economical – these are the hallmarks of the WITTENSTEIN alpha gearheads installed in sema Systemtechnik's packaging machines.

"Master movers"
drive automated guided vehicles

Intralogistics is their domain:
Automated guided vehicles – or AGV for short – glide around the factory as if by magic; they dodge obstacles, stop off at docking stations and are capable of driving forwards, backwards and sometimes even sideways. The vehicle masses moved in this way, either with or without a load, can be anything from a few hundred kilos to ten tons or more. AGVs are powered by electric drives. DS AUTOMOTION has realized a flexible transport solution for engine assembly on behalf of John Deere, Germany's biggest manufacturer of agricultural machinery, based on **TAS, the innovative traction drive system from WITTENSTEIN motion control**.

Until recently, vehicle manufacturers tended to put their drive systems together themselves using standard components. However, designing and sizing your own drive takes time and compact, energy efficient solutions offering high power density are rare. Moreover, important features such as speed sensors, service brakes or integrated safety technology are frequently missing. Thanks to TAS, the innovative traction drive system, all these limitations are now a thing of the past. WITTENSTEIN motion control's "master movers" have already impressed early adopters with their operational performance.

Four performance classes in plug-and-play design
Install it, switch it on and go – TAS is a traction drive system that lets manufacturers of automated guided vehicles (AGV) purchase a complete drive unit as an easy-to-integrate module. Per vehicle axle this module comprises two servo actuators belonging to the TPM+ family and distributed servo amplifiers in the simco drive series. "We supply TAS as an integrated motor-gearhead unit in four different performance classes and sizes", explains Elena Eberhardt, a sales engineer in WITTENSTEIN motion control's Industrial Systems Business Division. "At the same time, the drive systems are designed to adapt very easily to a wide range of AGV solutions." Regardless of the version, the TAS doesn't simply drive the vehicle; as a differential drive, it is also capable of steering it. Steering and turning are controlled according to the speed difference between the two drives on the vehicle axle.

Ingenious, energy efficient design
A TAS features a whole series of technical highlights that are essential for AGV applications. The gearheads are integrated directly in

WITTENSTEIN traction drive systems (TAS) are used at John Deere in Mannheim in automated guided vehicles for the flow assembly line.

the driving wheels, for instance, so that on the one hand, no valuable space is wasted in the warehouse and on the other, each TAS is exceptionally compact and slim. "Amongst other things, this is a particular advantage for hospital logistics, where the vehicles often have to drive underneath the load in order to pick it up", says Wolfgang Hillinger, Business Unit Manager Customized Solutions at DS AUTOMOTION in Linz (Austria), one of the leading manufacturers of automated guided vehicle systems. The low energy consumption of these integrated drive units is a further highlight: the less electricity they consume, the longer the driving cycles and the charging intervals, in other words the higher the availability of the vehicle.

John Deere engines assembled using TAS

DS AUTOMOTION has realized a flexible, high availability transport solution for the agricultural engine assembly line at John Deere's Mannheim plant. A **three-minute video clip on YouTube** shows how the AGVs there – powered by TAS – transport heavy loads from one assembly station to the next. The traction drive systems installed in the vehicles are almost invisible yet utterly convincing with their quiet running, low energy consumption and high reliability and availability. The TAS concept meets all the requirements for tomorrow's AGV drive solutions – as confirmed by the large number of visitors it regularly attracts at international exhibitions like LogiMAT.

Global supplier of dispensing systems
for processing reactive resins

bdtronic GmbH is one of the world's leading manufacturers of machinery, equipment and complete processing solutions for dispensing, impregnation, hot riveting, low and atmospheric pressure plasma treatment and related automation tasks. Its customer base includes numerous big names in the automotive and automotive supplies industries, the electric and hybrid drives sectors, electric, electronic and solar products as well as filters and medical technology. Approximately 200 staff have helped write the company's success story at the main plant in Weikersheim (Germany) and at various sales and service offices in Belgium, Italy, the U.K., the U.S. and China. To date, bdtronic has shipped more than 3000 units to customers all over the world.

Single and two-component reactive resins such as polyurethanes, silicones, epoxy resins and thermal conductive pastes are processed in the dispensing machine with high precision and reliability.

Getting the mixture exactly right is vital – not only when dispensing medicines or baking a cake but also in mechatronic drive technology. bdtronic dispensing machines for processing reactive resins are a good example of what this actually means in practice. This world market leader from south-west Germany is excellently prepared to meet ever higher customer expectations – such as increased positioning and dispensing accuracy or optimal machine productivity – whenever necessary thanks to a comprehensive drive solution developed by WITTENSTEIN cyber motor.

Reactive resins – and what they're for

Polyurethanes, silicones, epoxy resins and thermal conductive pastes are all typical single and multi-component reactive resins. They are employed in all kinds of industrial processes – encapsulating cable penetrations and sensors, sealing casings, bonding vehicle door handles, spraying protective coatings onto PCBs and electronic components or applying foamed gaskets to windows and filters. "Every material has different dispensing properties and even substances with the same name but from different manufacturers – whose properties

The performance of the simco drive servo amplifiers is perfectly matched to the performance potential of the cyber dynamic 40 servo motor with its fast current control and high current resolution.

Precise dispensing –
with precisely dosed driving power

should theoretically be identical – frequently react in different ways in real processes. The quality of the processed material must conform to the specification in spite of this, in other words it must have the right mixing ratio and it must be homogeneous and fluid with no air bubbles, to ensure an optimal output rate and dispensing results", replies Markus Rieger, Sales Manager Germany at bdtronic, when prompted to describe the challenges facing fully automated dispensing machines.

Premium performance from a brushless DC motor

Yet finding a reliable way to control such heterogeneous influencing factors is not the sole objective. "The market is demanding increasingly high levels of dispensing precision and repeatability", Rieger continues. One technological approach favoured by bdtronic for mastering these challenges is the so-called Performance package, which is comprised of a simco drive servo amplifier and matching brushless DC motor in WITTENSTEIN's cyber dynamic line family. "The cyber dynamic 40 servo motors have an integrated planetary gearhead. When they drive our progressive cavity pumps, even tiny quantities of no more than a few microlitres can be dispensed extremely precisely", he explains, adding: "The simco drive servo amplifier controls everything so accurately that we can regulate each dispensing flow rate individually, reduce our tolerances to a minimum, achieve repeatable results and ensure optimal process control".

Comprehensive solution for optimized performance

The cyber dynamic 40 servo actuator and the simco drive servo amplifier chosen by bdtronic interact optimally with one another in a mechatronic package – and are the ideal drive solution. The cylindrical design of the servo motor matches the dispensing systems perfectly. With a length of just 81 mm and a maximum torque of 12 Nm depending on the mounted gearhead, the motor also provides high torque density – while weighing no more than 700 or 900 grams. The dispensing systems are often integrated in moving gantry axes, and these require much less kinetic energy than with comparable servo motors. "The brushless DC motors also reduce the need for the complex mechanical adapter parts between the motor and the dispensing pump that are normally mandatory for integrating non-WITTENSTEIN motors which are bigger in size", Rieger comments. The simco drive servo amplifier combines very high-resolution current control in measuring applications with fast current sensing. "These features enable even the smallest quantities to be pumped exceptionally precisely, even if the travel speeds of the gantry axes vary", he confirms.

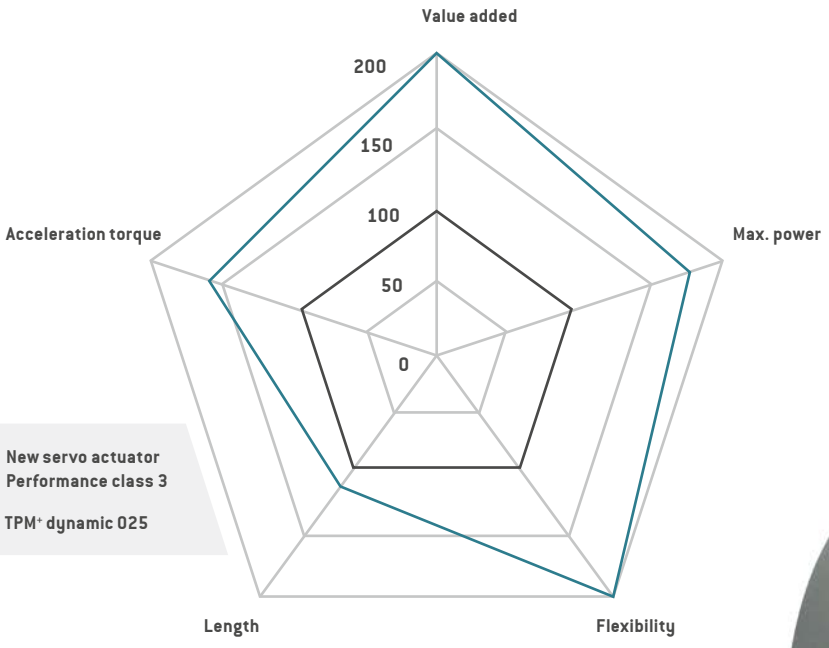
The optimized performance of the brushless DC motor system is not simply a product of chance: the unique demands of the application were analyzed in close cooperation between bdtronic and WITTENSTEIN. This dialogue between engineers and technicians at the two companies resulted in a perfectly matched solution that meets the specific requirements of the dispensing machines reliably.

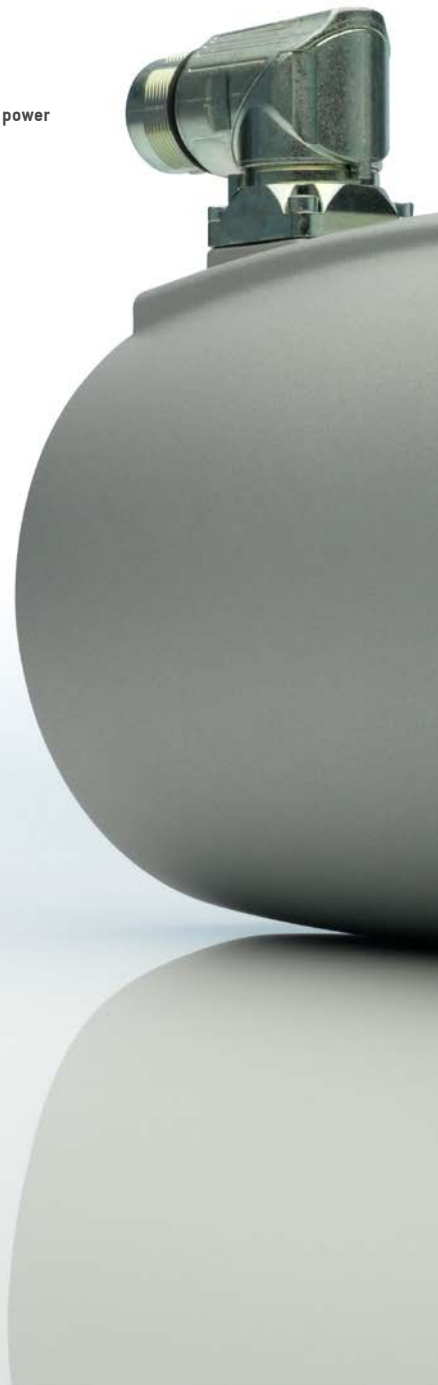
The cyber dynamic line family of brushless DC motors is offered in four sizes with a 17 mm, 22 mm, 32 mm or 40 mm diameter and is suitable for all performance ranges from 25 to 335 watts.

With their incredible power density, outstanding flexibility and high energy efficiency, WITTENSTEIN motion control's new servo actuators represent a genuine innovation in mechatronic drive technology. The stylish, functional housing underlines the futuristic concept by emphasizing the technological aesthetics of each performance class in this product family. Thanks to the interfaces for Endat 2.2, DRIVE-CLiQ and one-cable HIPERFACE® DSL, these servo actuators are optimally equipped to face the challenges of the digital future.

Mechatronics in an innovative new look

The latest generation of servo actuators from WITTENSTEIN motion control





First impressions

"Futuristic" is often the first word that springs to mind the first time people set eyes on the new servo actuators. The surface gives the impression of having been designed in a wind tunnel – it is absolutely smooth with no dead spaces and no visible screwing elements. "It wasn't the lowest possible drag coefficient we were aiming for as in automotive development, however, but a hygienic design that prevents fouling or residues from adhering to the surfaces, for instance if the new servo actuators are used in filling or packaging machines for food products", explains Siegfried Wallauer, Product Manager at WITTENSTEIN motion control GmbH. The mechatronic drive units are a real eye-catcher that also make a stunning impression in the open-type machines that are frequently preferred today to simplify cleaning.

Genuine amazement

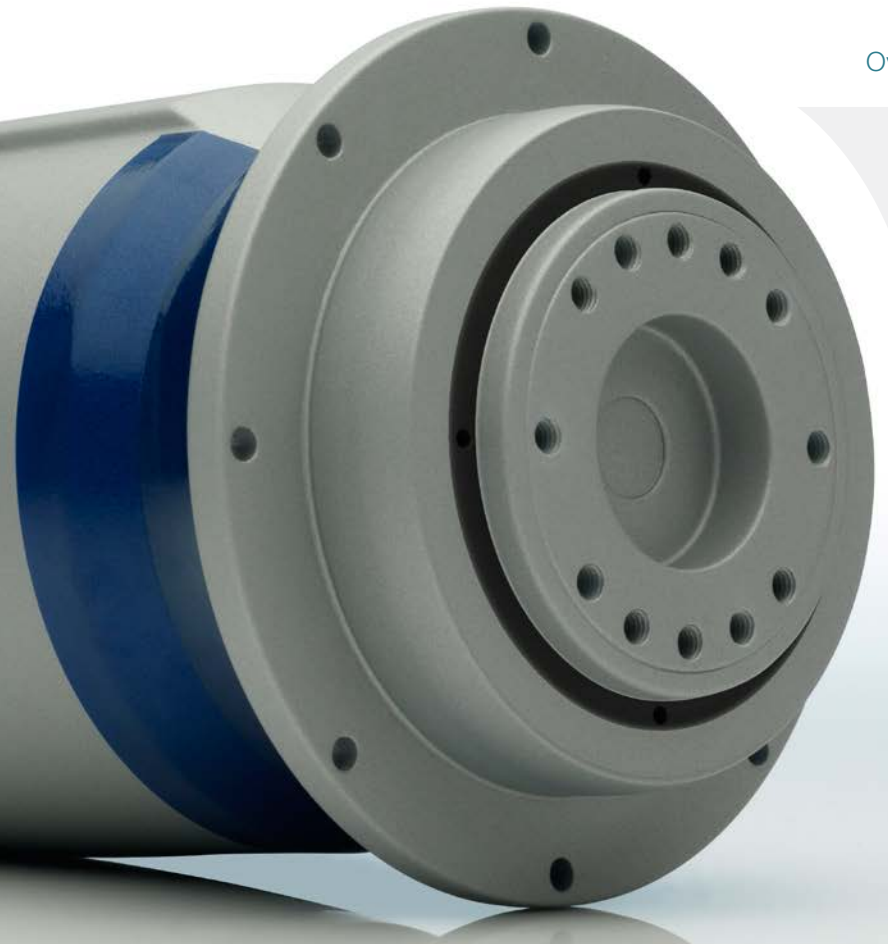
The new servo actuators are equally pleasing to look at in each of the first three sizes, which cover all torques from 55 Nm to 380 Nm. A wide range of reduction ratios are also offered, the most popular so far being i=10 and i=100. Despite this, only minimal space is required to install the new servo actuators, especially compared to their performance – in practice, they deliver up to 80 percent more power from the same physical volume.

Lower costs

It's a similar story when it comes to energy efficiency: up to 60 percent more torque with virtually no increase in current consumption represents another new benchmark. "These values help the new servo actuators push back traditional power density boundaries", says Wallauer. The version with digital, one-cable HIPERFACE® DSL technology also offers the advantage of fewer connectors, space-saving wiring arrangements in cable carriers or bushings and reduced weight – and hence less kinetic energy – when installed on the vertical and handling axes.

More flexibility

The new servo actuators are surprisingly flexible, giving mechanical and electrical designers unprecedented degrees of freedom. The interface to the machine is freely designable with several possible variants, while the interface to the servo controller provides almost unlimited connectivity due to the maximum voltage range of 750 V and the wide choice of analogue and digital encoders.



It isn't just the impressive performance features that make the new servo actuators such a decisive innovation in mechatronic drive technology but also the futuristic, functional design.

Overview of performance features

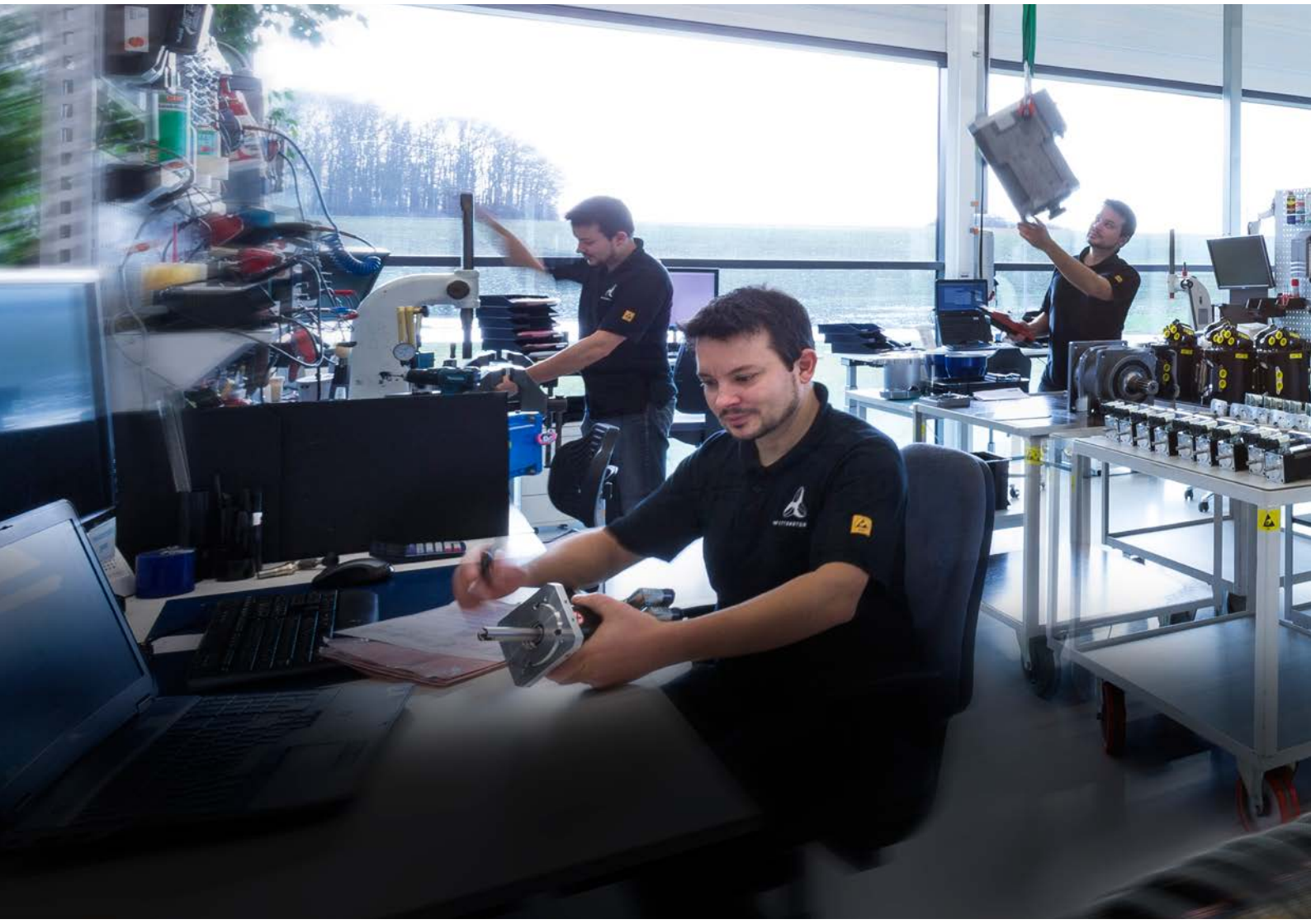
Performance class	Max. power [kW]	Acceleration torque [Nm]	Length [mm]
1	**1.55**	**55**	**From 155**
2	**2.50**	**143**	**From 185**
3	**8.50**	**380**	**From 221**

Excitement with safety features

A compact, modular design, significantly improved performance and energy efficiency and fully prepared for innovative digital encoder technologies – the new servo actuators have already excited considerable enthusiasm among users. Safety, security and reliability aspects are also optimally integrated. The significantly higher holding torque and the digital encoders – which meet all the requirements of relevant international standards for functional safety, opening up numerous safety applications for the new servo actuators – are just two examples. Customers profit from double added value: the sum of these technical characteristics and the economic benefits.

Services

as a crucial competitive factor



They're a valuable unique selling point for some and an economic benefit and competitive advantage for others – engineering services are equally important for OEMs and machine operators. With its comprehensive service portfolio, WITTENSTEIN is excellently positioned in the mechatronic drives sector as more than simply a supplier of quality products. "Each customer can put together an optimal, no-hassle package from the wide range of services on offer and ensure maximum uptime with appropriate, efficiently planned maintenance measures", explains Volker Metzger, Manager Customer Service at WITTENSTEIN.

Maintenance and repairs: an often underestimated efficiency potential

There cannot be many technical products that manage completely without spare parts: a certain degree of wear is inevitable after running for several years or due to heavy duty, overloading or insufficient –

Regardless of whether a new standard drive needs to be assembled within just a few hours or a faulty unit has to be expertly repaired in an emergency – if you're desperate for assistance, our Customer Support department guarantees prompt support.

WITTENSTEIN's service portfolio is at least as innovative as our mechatronic drive technology.

Our range of services is regularly extended and optimized in response to new customer needs.

or incorrect – maintenance. It is therefore a great advantage if a component supplier like WITTENSTEIN can provide its customers not only with high quality products but also with the services necessary to safeguard this high quality in the long term. According to estimates by experts, about forty percent of a company's total costs can be influenced by maintenance and technical services. This is a significant proportion when you consider that the personnel and material costs which are directly related to maintenance amount to something in the order of 250 billion euros a year in Germany, with another 750 billion annually in additional, indirect costs for machine downtime, shortfalls, drops in quality, warehousing and spares. Maintenance and other technical services are investments that promise a fast return – and a crucial competitive factor for any engineering manufacturer.

»Technology considerations mean the future belongs to condition monitoring. The reason is Industry 4.0.«

Volker Metzger, Manager Customer Service at WITTENSTEIN AG

Maintenance strategies for more availability

All maintenance activities share the same basic objective, namely to make sure a drive (or any other item of equipment) remains fully functional. Yet what is the best time for them? How many hours should the equipment run for before maintenance action is recommended? Not every maintenance routine is the outcome of a well-thought-out strategy – in practice, reactive maintenance is closer to repair. "It's in this kind of situation that our customers particularly value our 24-hour service hotline and our speedline® service, which makes a commitment to deliver spare parts for all WITTENSTEIN alpha's standard series very promptly", Metzger continues. Preventive maintenance is several steps ahead of this. It involves carrying out proactive maintenance work at regular inspection times between scheduled stoppages. "Even if vulnerable parts are not actually worn, they are nevertheless replaced proactively – especially if they're unlikely to last until the next scheduled maintenance stoppage", Metzger adds. To extend the life of a machine's parts and components still further, it is necessary to resort to condition monitoring. Metzger sums up the challenge: "The trick is getting hold of precise information on the condition of a machine's components and then predicting the best time to carry out maintenance before expensive downtime becomes unavoidable".

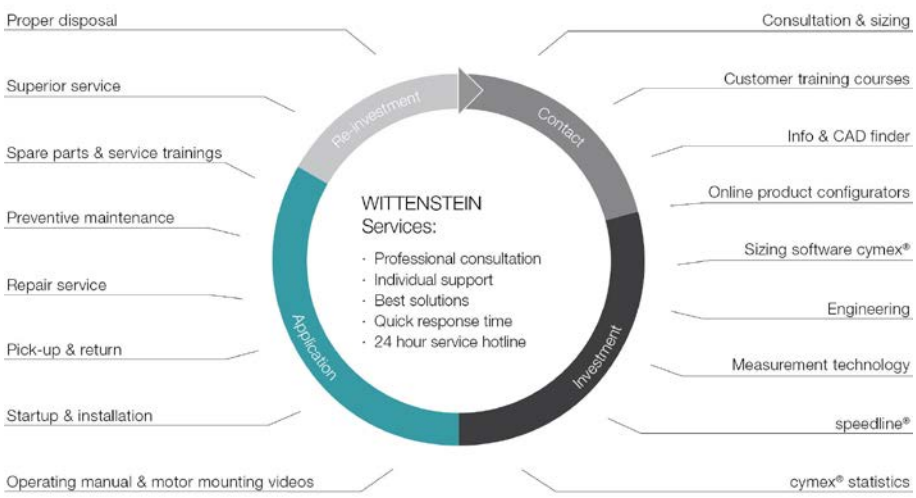
Intelligent maintenance with Industry 4.0

Technology considerations mean the future belongs to condition monitoring. The reason is Industry 4.0. In the factories of the future, intelligent cyber-physical production systems will exchange digital information continuously – not simply in order to optimize production processes and make them more flexible but to facilitate self-optimization and diagnostics.

Julia Lanig, Service Engineer at WITTENSTEIN AG, outlines the future scenario: "They will lay the foundation for services and software to identify weaknesses in a machine before serious problems develop. By collecting and storing machine data in this way, it will be possible to analyze wear at an early stage and predict at any time exactly how it will advance. Faults can be detected before it gets too late and appropriate measures taken to correct them – and at the same time, optimum use can be made of the means of production."

Our services at a glance

Individual consulting and services in all phases of interaction



Customer Service

WITTENSTEIN's pick-up and return service coordinates the collection of faulty drives and their subsequent return to the customer – including all shipping formalities.

Maintenance Meetings generate great interest

On-site consulting, extensive inspections, maintenance recommendations, a 24-hour service hotline, speedline® spare parts deliveries – WITTENSTEIN customers can take advantage of a broad portfolio of services. The special service seminars offered to customers and the regular Maintenance Meetings are also very popular. "Amongst other things, participants learn the proper way to mount the motor to the gearhead or replace wearing parts and gear assemblies in a mixture of theory and practice", Lanig reports proudly. "Our tips and tricks are designed to help customers assess damage cases more reliably in future and optimize their operational processes."

The feedback from the events held so far has been overwhelmingly positive – and the first enrolments have already been received for the next Maintenance Meeting in the autumn. Please contact **service@wittenstein.de** if you are interested in attending.

To (literally) give a voice to youth and enable talented young opera singers to be discovered and showcased – the mission of DEBUT, the European Opera Singing Competition is certainly an admirable one.

7th European Opera Singing Competition
DEBUT 2014

Winners of DEBUT 2014:
Adriana Ferfecka, winner of the Golden Victoria 2014 (centre), Maria Chabounia, Silver Victoria (right) and Jakub Józef Orlinski, Bronze Victoria (left).

When the very first DEBUT was staged back in 2002, Dr. Manfred Wittenstein, already a successful entrepreneur, finally realized his vision of bringing together industry, technology and culture as three particularly innovative and creative forces in society. This singing competition in the beautiful Tauber Valley has long become an internationally celebrated event. Once again, the General Managers of several major opera houses and leading representatives of the theatre and cultural management scene took advantage last autumn of this unique chance to discover and hire fledgling performers. 247 young singers from 44 different countries originally applied to enter. In the end, six talented newcomers remained. In the grand finale they faced the critical verdict of the jury and the acclaim of an enthusiastic audience. As in previous years, this glittering opera gala at the Bad Mergentheim Wandelhalle was hosted by Jan Hofer, Senior Newsreader on ARD's television news, who presided over the event in his familiar charming style. "Singing people are happy people – because singing is both heart-warming and heart-opening", said Dr. Wittenstein, Chairman of the WITTENSTEIN AG Supervisory Board, in an interview with Hofer. Christa Ludwig, Kammersängerin and DEBUT patron, was suitably impressed by the outstanding renditions given by the participants. She summed up her commitment to the event as follows: "The

> »Singing people are happy people«
>
> Dr. Manfred Wittenstein, Chairman of the Supervisory Board of WITTENSTEIN AG

Exceptionally talented and only 17 years old: Yurii Yushkevich of St. Petersburg

DEBUT 2014 began with the qualifying rounds at Weikersheim Castle Music Academy and ended with the traditional gala concert in Bad Mergentheim.
The best of the best: Polish soprano Adriana Ferfecka (Golden Victoria), Maria Chabounia from Belarus (Silver Victoria) and Polish counter-tenor Jakub Józef Orlinski (Bronze Victoria). The competition was endowed with prizes worth more than 30,000 euros. Professor Christa Ludwig (Kammersängerin) and BDI President Ulrich Grillo acted as joint patrons.

The DEBUT competition (www.debut.de) has forged a novel link between industry, technology and culture. It manages without any form of public sponsorship and as such is completely independent.
It was initiated by Dr. Manfred Wittenstein, Chairman of the Supervisory Board of WITTENSTEIN AG. Jeunesses Musicales Germany (JMD) has been a DEBUT partner since 2010.

Video report
on DEBUT 2014

Dr. Manfred Wittenstein, Chairman of the Supervisory Board of WITTENSTEIN AG and initiator of the European Opera Singing Competition DEBUT (left), in conversation with Jan Hofer (right)

Adriana Ferfecka, the Polish soprano and winner of DEBUT 2014, delivers her winning performance at the Wandelhalle in Bad Mergentheim

biggest challenge for any vocalist is to express a thought or an emotion that has been set to music in such a way that every single note is inspired. When I accept this invitation to lend support and encouragement talented newcomers, my role as I see it is to communicate this essential aspect, which is not actually visible in the notes themselves." Adriana Ferfecka, the Polish soprano, was presented with the Golden Victoria and 10,000 euros in cash. She was equally convincing in all four categories: vocal quality, technique, repertoire and artistic interpretation.

Trade fair calendar
2015

Hannover Messe
Hanover (Germany)
Flagship Trade Fair for Motion, Drive & Automation
WITTENSTEIN Group
Hall 15, Stand F08
April 13 to 17, 2015

Sino Corrugated
Shanghai (China)
The World's Leading Corrugated Manufacturing Show
WITTENSTEIN (Hangzhou) Co. Ltd
April 14 to 17, 2015

CIMT
Beijing (China)
International Machine Tool Show
WITTENSTEIN (Hangzhou) Co. Ltd
April 20 to 25, 2015

OTC
Houston, Texas (USA)
International Offshore Technology Conference
WITTENSTEIN motion control GmbH
May 4 to 7, 2015

Indumation
Kortrijk (Belgium)
National Trade Fair for Factory, Process and Infrastructure Automation
WITTENSTEIN bvba
May 6 to 8, 2015

SPS IPC Drives
Parma (Italy)
Europe's Leading Exhibition for Electric Automation
WITTENSTEIN S.P.A.
May 12 to 14, 2015

FEIMAFE
São Paulo (Brazil)
International Machine Tools and Integrated Manufacturing Systems Trade Fair
WITTENSTEIN do Brasil
May 18 to 23, 2015

IPACK-IMA
Milan (Italy)
International Exhibition of Technology and Materials for Processing and Packaging
WITTENSTEIN S.P.A.
May 19 to 23, 2015

SMART
Linz (Austria)
Trade Fair for Industrial Automation
WITTENSTEIN GmbH
May 19 to 21, 2015

Metalloobrabotka
Moscow (Russia)
International Exhibition for Materials Processing Technologies, Machines and Tools
WITTENSTEIN alpha GmbH
May 25 to 29, 2015

all about Automation
Friedrichshafen (Germany)
Regional Exhibition for Industrial Automation Technology
Stand 209
WITTENSTEIN alpha GmbH
June 9 to 10, 2015

Paris Air Show
Le Bourget (France)
Salon International de l'Aéronautique et de l'Espace
Hall 2c, Stand B354
WITTENSTEIN aerospace & simulation GmbH
June 15 to 21, 2015

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

Essen Welding & Cutting
Shanghai (China)
International Trade Fair for Joining, Cutting and Surfacing
WITTENSTEIN (Hangzhou) Co. Ltd
June 16 to 19, 2015

automation & electronics
Lausanne (Switzerland)
Switzerland's Trade Fair for Industry and Science
WITTENSTEIN AG
June 17 to 18, 2015

automation & electronics
Zürich (Switzerland)
Switzerland's Trade Fair for Industry and Science
WITTENSTEIN AG
June 24 to 25, 2015

CIROS
Shanghai (China)
China International Robot Show
WITTENSTEIN (Hangzhou) Co. Ltd
July 8 to 11, 2015

Taipei International Industrial Automation Exhibition
Taipei City (Taiwan)
International Automation Industry Exhibition
WITTENSTEIN Co., Ltd.
August 26 to 29, 2015

SPE Offshore Europe
Aberdeen (UK)
Oil & Gas Conference & Exhibition
WITTENSTEIN motion control GmbH
September 8 to 11, 2015

Pack Expo
Las Vegas, Nevada (USA)
Advanced Processing and Packaging
WITTENSTEIN Inc.
September 28 to 30, 2015

Motek
Stuttgart (Germany)
International Trade Fair for Assembly and Handling Technology
WITTENSTEIN Group
October 5 to 8, 2015

EMO
Milan (Italy)
The World's Premier Trade Fair for Metalworking Technology
WITTENSTEIN S.P.A.
October 5 to 10, 2015

Current trade fair calendar