

motion

01.2021

THE MAGAZINE WITH DRIVE



**CELL ANALYSIS
WITH PRECISION**



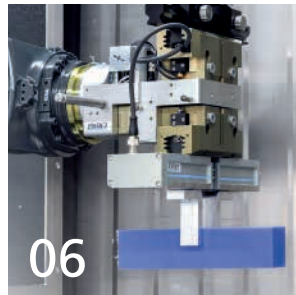
04



10



18



06



14



22

NEWS

04 Home schooling for developers

FAULHABER is starting an exciting series of webinars

NEWS

05 Powerful and extremely miniaturized

Presentation of the new uncased motion controller MC 3001

FACTORY AUTOMATION & ROBOTICS

06 One of a kind in series

How servo-controlled gripper jaws with FAULHABER motors are automating the production of small batch sizes

MEDICAL & LABORATORY EQUIPMENT

10 Cell analysis with precision

Automation of test series in medical research

MEDICAL & LABORATORY EQUIPMENT

14 An idea to support the world's backbone

An exoskeleton motorized by FAULHABER relieves the back during heavy work

FACTORY AUTOMATION & ROBOTICS

18 The mini series takes a taxi

How to variably supply production stations with parts using FAULHABER drive technology

TECHNOLOGY

22 Perfectly Paired for Size & Performance

Dr. Andreas Wagner explains the criteria to select the right motion controller in a drive system



Dear readers,

the pandemic continues, and we are also taking a new approach to staying in touch with our customers and business partners. I am pleased with the excellent response we have received to our new digital event series of FAULHABER webinars. Following the successful start in the spring of this year, we will further expand the topics covered by our online seminars and discuss exciting issues together with you, presented by our FAULHABER employees who are absolute experts in their fields.

Test series with cell cultures are among the most important methods in medical research. With the CYRIS® FLOX automated test systems, work in the laboratories is made much easier. Here, brushless motors from FAULHABER ensure that the cultures are supplied with nutrients and medications for the duration of the trial and the development of the cells is closely monitored – without human intervention. In addition to research, actively combating the pandemic continues to remain in the foreground. FAULHABER is therefore doing everything possible to fulfil our mission as a system-relevant company and to supply the field of medical technology worldwide with reliable drive systems. Of course, we also take care to protect the health of our employees at our locations in the best possible way – recently also with free antigen rapid tests for voluntary self-monitoring.

Small and powerful DC-motors are critical to the development of ever more highly integrated systems. But they only become an application-relevant drive or positioning system when combined with other components, such as gearheads, encoders and motion controllers. Making the right selection is essential for reliable functioning. All components must be compatible with the motor and meet its requirements. In our expert article, we provide you with the best tips for selecting a motion controller that is suitable for your drive system.

Learn more about these and other exciting topics in this issue of FAULHABER motion – our magazine with drive

I hope you enjoy reading this issue!

Sincerely

Gert Frech-Walter
Managing Director

Issue 01.2021

Publisher / Editor:

DR. FRITZ FAULHABER
GMBH & CO. KG
Schönaich · Germany
Phone: +49 (0)70 31/638-0
Fax: +49 (0)70 31/638-100
E-Mail: info@faulhaber.de
www.faulhaber.com

Layout:

Werbeagentur Regelmann
Pforzheim · Germany
www.regelmann.de

Picture credits & copyright:

All rights reserved. The rights for the graphics and pictures used as well as brand names mentioned are held by the respective owner. The copyright for the articles is held by the editor. Reproduction or electronic processing of content, even sections thereof, is only permitted with the explicit written consent of the editor.

Publication frequency & subscription:

FAULHABER motion is published twice a year and is delivered to customers, interested parties and employees of FAULHABER free of charge.

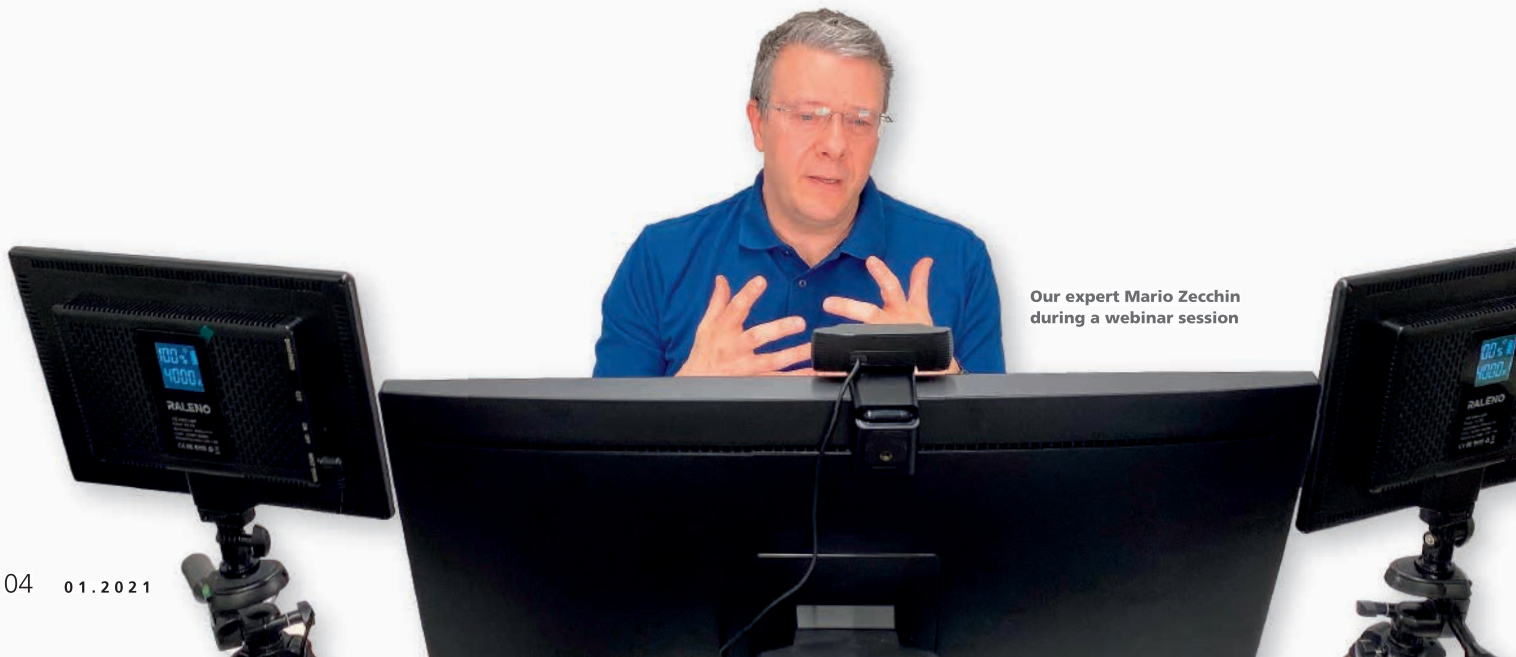
FAULHABER motion is also available in digital format:
www.faulhaber.com/motion



HOME SCHOOLING FOR DEVELOPERS

Learning never stops. Especially in drive technology, it is critical to learn continuously in order to identify and innovate opportunities early on and apply them to the development of applications. FAULHABER started an exciting series of webinars for this purpose. Each webinar examines a specific topic and is professionally moderated by a distinguished expert. Participants

have the opportunity to level with our experts during discussions, where individual questions can also be asked. Modern, mobile, multi-medial: Our webinars are the tool of the hour when it comes to expanding your knowledge – especially also in the home office. Participation is completely free of charge and requires only a one-time registration.



Our expert Mario Zecchin during a webinar session



The following webinar topics have already been covered:

- Motion Controller & Speed Controller
- The right technology for your drive solution
- Designing drives with the FAULHABER Drive Selection Tool
- Noise development in drive systems

You can watch them again here:



www.gotostage.com/channel/faulhaber-webinars

Future topics are:

- Best practices when using DC-motors
- Drive systems for space applications
- Motion controller MC 3001 B/P – Commissioning and possible uses
- FAULHABER Speed Controller – Optimal use and customer-specific adaptation

Registration information and all dates:



www.faulhaber.com/webinars

POWERFUL AND EXTREMELY **MINIATURISED**

With an overall height from 2.6 millimeters and a format from 16x27 millimeters, the new unboxed MC3001 motion controllers are extremely miniaturized. They feature very high control dynamics and can be operated with 1.4 amps in continuous operation and with up to 5 amps peak current. In spite of their extremely compact design, the just thumb-sized controllers feature the same functionality as well as the same interfaces (RS232 and CANopen) and encoder interfaces as the other more powerful products of the MC V3.0 generation.

DC-micromotors, linear DC-servomotors, or brushless DC-motors from the FAULHABER product range with 6–30 millimeters are optionally controlled by the integrated output stage with optimized current measurement. They are configured through the FAULHABER Motion Manager software V6 (version 6.8 and higher). The motion controllers are available as MC 3001 B (board-to-board connector) or MC 3001 P (28-pin connector) in 2 variants. The MC 3001 series controllers are the smallest universal drive available today, and are ideal wherever distributed motion control is required, in combination with miniature FAULHABER high performance motors. After basic commissioning via Motion Manager, the controllers can alternatively also be operated at any time in stand-alone mode by means of integrated sequence programs.

As an intelligent driver module, the new motion controllers are especially suitable for installation in customer-specific applications in robotics, automation technology, mechanical engineering as well as medical and laboratory technology. Applications in these areas often have limited space yet call for high control dynamics and high performance. With the new variants, FAULHABER completes the MC V3.0 generation of controllers for smaller motor series.

The advantages at a glance:

- Extremely miniaturized
- Ultra high performance
- High control dynamics



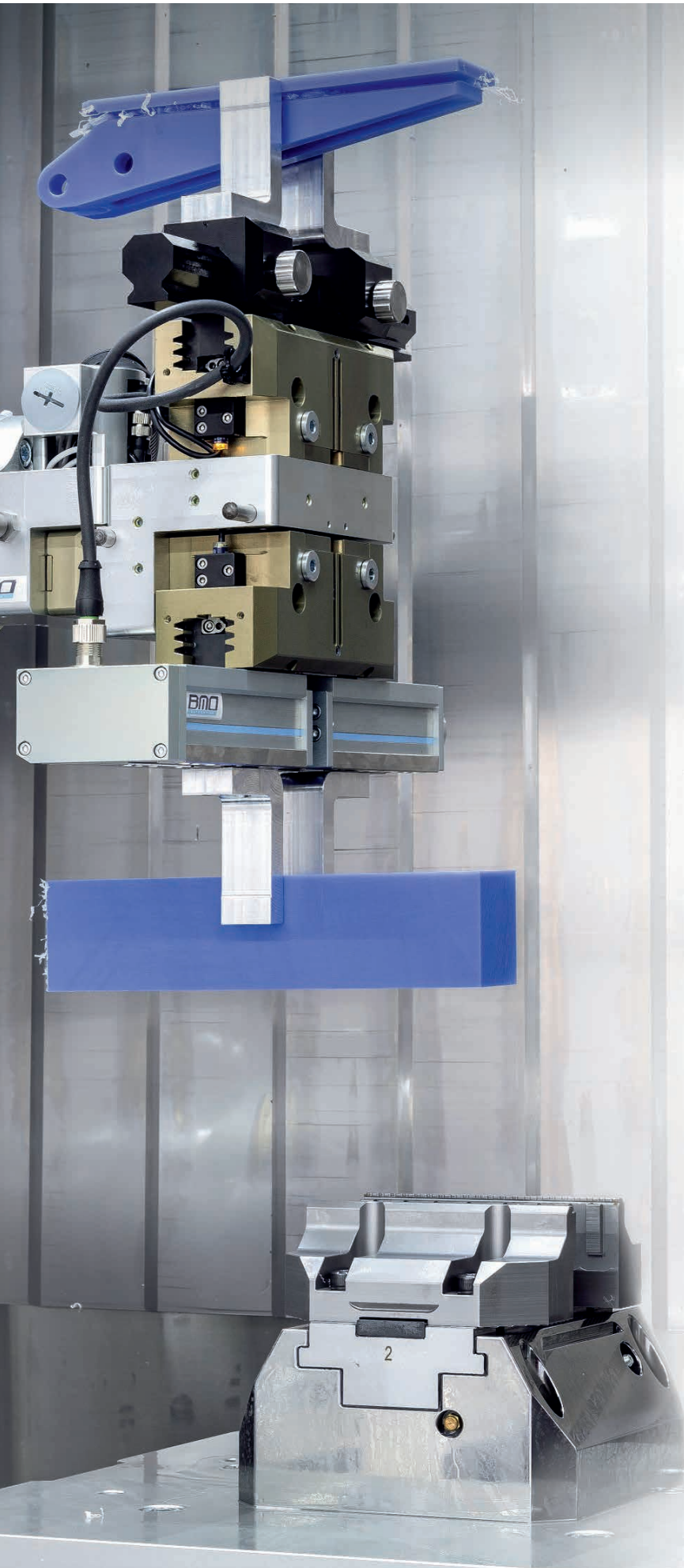
The new MC 3001 at a scale of 1:1



www.faulhaber.com/news

One of a kind in series

Up until now, users in the metal and plastics processing industries often faced a difficult choice: with CNC lathes and milling machines, one opted either for the largest possible variance or for large volumes, i.e., high quantities. An innovative solution from the Netherlands makes both possible and simultaneously lowers the threshold for automation. In the servo-controlled gripper jaws, brushless DC-servomotors with integrated Speed Controller from FAULHABER provide the necessary precision and reliability.



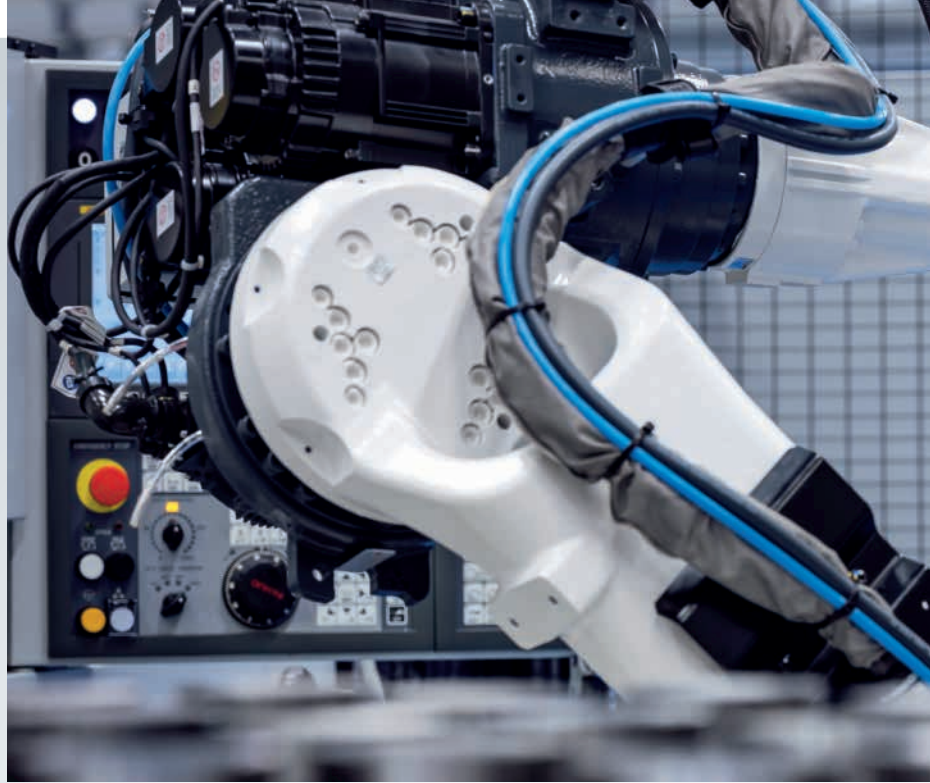
Dutch company BMO Automation started in 2008 with the vision of a significantly more effective loading of CNC lathes and milling machines. Customers, mainly from the metal and plastics processing industries, can make use of modular complete solutions for the machining industry characterized by high-quality, user-friendly and flexible automation solutions. Working in collaboration with FAULHABER, the result was a servo gripper that is connected to a robot arm in the robot cells. These cells are used for the automatic loading and unloading of CNC lathes and milling machines.

Game changer

With their robot cells, BMO Automation from the Dutch town of Nederweert in the province of Limburg enables automated production of widely varying batch sizes with quantities as small as a single unit. "Performance at BMO is defined as flexibility² times productivity. Using the servo gripper developed by us, flexibility is increased significantly and customers can automate for batch sizes as small as 1. This is the future!" stresses Marketing Manager Maarten van Bun. "A simple robot or cobot performs the same job 1000 times. But we believe that the future is more likely to be the automation of smaller product series in a single pass. We call this multi-batch automation. We can also automatically manufacture 1000 parts, but split into multiple series with low volumes. The result is both high mix and high volume."

High mix & high volume

The margins in the manufacturing of small quantities are generally higher than in mass production. At the same time, however, it is more personnel- and cost-intensive if the workpieces need to be manually loaded between individual turning and milling processes. Thus, a solution that achieves both high variances as well as high volumes when using CNC lathes and milling machines in the metal and plastics processing industries is a game changer. For their approach, BMO Automation combines the advantages of pallet automation with the option of also being able to



load individual workpieces fully automatically. From the principle "high mix – low volume" thus becomes "high mix & high volume".

This is made possible by, among other things, servo-controlled gripper jaws whose precision and reliability are guaranteed by FAULHABER drives. In the servo gripper, a FAULHABER motor drives a gear spindle that is part of a linear guide system. The gripper fingers, connected to the guided blocks, thereby move to the desired position for the product that is to be loaded into the CNC machine. The dimensions of the workpiece can change following the turning or milling process. Here, the servo gripper automatically adapts the position of the gripper fingers and does so without changing the loading and unloading cycles. As a result, it is not

necessary to change the gripper.

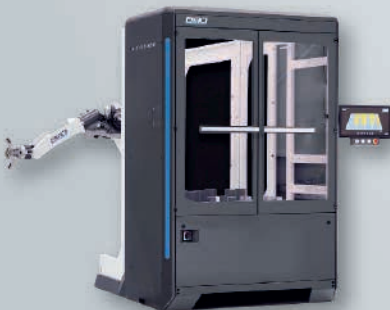
"Harco Hermans, responsible for research and development for us, knew FAULHABER from previous projects, where he had very good experiences with the Motion Control products," explains Maarten van Bun. The appropriate motor was selected using the Drive Selection Tool on the FAULHABER website. At the same time, BMO Automation received support from FAULHABER, for example, in checking the script files for communication with the BMO Intelligent Control Software.

Development lasted approximately one year, including a two-month test phase with reference customers. The biggest challenge was in integrating a reliable solution that is available in the smallest possible dimensions with a low weight and thereby has a minimal impact on

the load capacity of the robot. "Here, FAULHABER offers a very compact and yet high-performance solution in both the mechanical as well as electronic part that convinced us."

Outstandingly innovative

A concentration in the area of CNC automation, many years of experience and good contact with manufacturers of CNC machines enables complete integration of robot automation in machining production. BMO is a leader here in the field of automation and digitization. This is also evidenced by three nominations to the TechniShow Award. The first nomination in 2016 was for an automation solution by means of which individual pieces and series could be manufactured in an ongoing process.





FAULHABER BX4 SC

BRUSHLESS DC-SERVOMOTORS
WITH INTEGRATED SPEED CONTROLLER



www.faulhaber.com/en/markets
www.bmoautomation.nl

This was made possible by the change of clamping means, pallets and products. At the time of the nomination, this was a true first. In 2018, BMO was awarded for the revolutionary Xenon software for Smart Industry 4.0. This is used to collect and link a wide range of data from CNC machines of a machining plant. In 2020, the company was nominated for the third time in a row for its Smart Centric E-Clamp, but did not prevail this time.

Automatically an advantage

"CNC automation increases productivity, reduces processing time and offers a way to avoid issues associated with the shortage of specialists," states Maarten von Bun. The advantage of an automated robotics solution also proved itself

during the Covid-19 pandemic. "Corona had a large impact on the metal industry. At the start, customers were more conservative with investments. The segment quickly changed, however, as it became clear that CNC automation is not only a solution for the future but also for today. A robot does not fall ill and, even with limited working hours, a human operator can maintain the production level together with a BMO robotics solution."

Automated manufacturing also makes production possible on-site, thereby eliminating the disadvantages of outsourced production, such as closed borders, restrictions on travel and the movement of goods, longer border and customs inspections and local lockdowns, as have been experienced during the pandemic.

"If you would like to automate, it is important that a precise process be created that constantly guarantees a high level of safety. This precision and, in particular, the repeatability are important; because everything happens fully automatically, the error rates are low and our automation solutions function without an employee needing to be present. A reliable process is, therefore, extremely important. The products from Faulhaber guarantee us quality, safety and nothing that we need to worry about. We know that it's good and trust the products that FAULHABER offers us," summarize Maarten van Bun.





CELL ANALYSIS WITH PRECISION

The limit of viability

Rescue lives, cure diseases, alleviate symptoms – that is what modern medications do a million times over, day after day. But we are far from having a medicine for every complaint. Moreover, corona has made us keenly aware that new illnesses are constantly joining those which are already known. New medications are, thus, constantly needed, and development work on them is ongoing. These medicines should, of course, be both effective as well as safe – ideally even before they are tested on humans. This last phase – the clinical trial phase – is essential. However, a great deal about the effect of a pharmaceutical product can also be determined already in the lab. Because this effect unfolds largely in the cells of the human

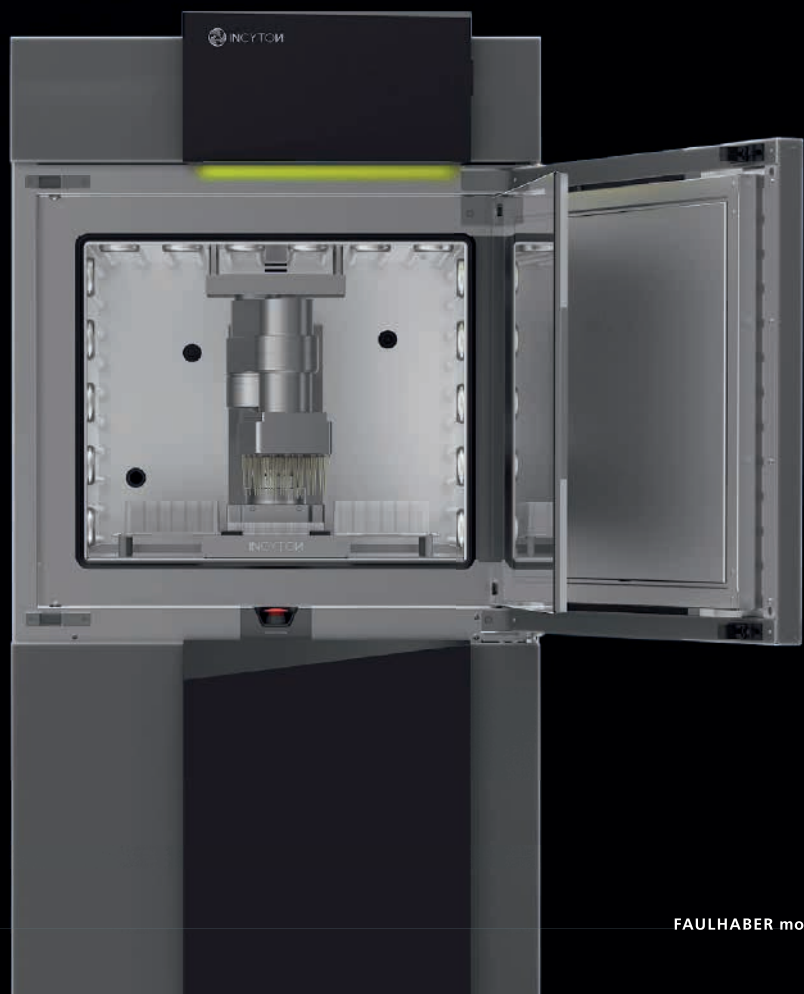
body. As a result, a cell culture can serve as a substitute for "trying out" the medication.

"We can, for example, determine the limit value above which a substance becomes toxic to the cells," explains Márton Nagy, biotechnology developer at the Munich-based company INCYTON®. "This applies not only for medications, by the way, but also for, e.g., potential environmental toxins. We place a certain quantity of the substance in the nutrient solution that contains the culture and observe how the cells respond. The quantity is then increased incrementally. Based on certain measurement data and the optical monitoring with a microscope, we can identify the point at which it



Which medication can defeat cancer? What dosage achieves the desired result without side effects? Above what limit does the beneficial medication turn toxic? Today, such questions are answered in test series with cell cultures. They are among the most important methods in medical research. With the CYRIS®FLOX automated test system, work in the laboratories is made much easier. Here, motors from FAULHABER ensure that the cultures are supplied with nutrients and medications for the duration of the trial and the development of the cells is closely monitored – without human intervention.

becomes critical for the cells. This value can be converted to the body weight of a person. In practice, the permissible limit value for a dose is then generally defined as a fraction of this critical value." In pharmaceutical research, many tests are performed using cancer cells. With these cells, however, the tables are turned: here, the objective is to determine which medication, and in what quantity inhibits their reproduction or completely destroys them. The observation of the cells is a multilayer and, above all, relatively time-consuming process. A single trial takes an average of approximately three days. During this period, numerous individual measurements are performed, and the cells are repeatedly photographed in short intervals. The image sequences can be merged together to create a time-lapse film that shows the course of the cell growth. Three physical quantities are examined for the measurements: oxygen content, pH value and electrical resistance of the cell layer.





Physical quantities provide information

Up until now, such test series required a great deal of manual work. The various steps could only be partially automated. With CYRIS® FLOX, INCYTOI® has created a fully automatic device that can perform the multi-day test run without human intervention and can also fully document the results.

At the heart of the test setup is a microtitre plate made of transparent material that has 24 wells, or test chambers. These hold the cell samples like miniature Petri dishes. 24 pipettes on a robot arm supply the small cultures with nutrient solution and feed in the substances that are to be tested. In doing so, a different composition of the solution can be selected for each pipette. Each test chamber is equipped with sensors for oxygen content, pH value and electrical resistance. The individual test chambers are photographed from below at regular intervals through a microscope lens.

Development for automation

INCYTOI® is a start-up with academic roots. The founders of the company worked previously in university research. There, they used motors from other manufacturers for the initial prototypes of their device. These did not prove to be suitable and were later replaced by models from FAULHABER. They convinced with their compact

design and the reliability of the components. When it came to the further development of the system to prepare for series production, there was, thus, no need to find a drive supplier. New goals were, however, defined for this area: "We wanted to work with as few different motor types as possible," says Matthias Moll, head of development, describing the initial situation. "We also wanted a simpler arrangement for the wiring. We were looking for a drive in which the electronics are already integrated. Up until then, they were housed in a control element of the robot arm, which meant that many cable connections were necessary in a moving element." In addition, the motors should be able to report errors, for example, if overheating causes or threatens to cause a mechanical blockage.

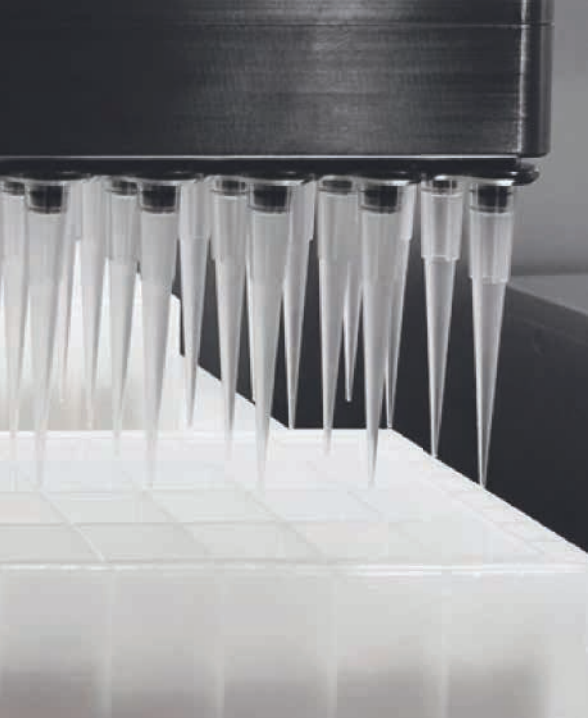
In combination with an integrated Motion Controller of the CxD series, the 2232...BX4 brushless servomotor satisfies these new requirements of the technicians from INCYTOI® – as well as all others, such as high performance in an extremely compact design, low weight and volume as well as compatibility for laboratory use. Six motors are built into the CYRIS® FLOX analysis device. Three of these move the pipetting head in the robot arm on three axes. They are responsible for moving the pipettes precisely over the microtitre test chambers and for moving into position just

above the chambers for discharging the solution. A fourth motor drives 24 suction pistons, which transport up to 200 µl of culture medium in sterile pipette tips. Two motors move the microscope on an XY table below the cell samples. The photos of the individual test chambers are taken from below through the transparent material of the microtitre plates.

Precision and reliability in continuous operation

"In order to track the development of individual cells in the time lapse later on, the lens must always be at the exact same point under the test chamber," says Matthias Moll as he explains the challenge in this step. "With the help of the FAULHABER motors, we can precisely position the table to within two micrometres." For comparison: A human hair has a thickness of between 50 and 70 micrometres. The motor that drives the pistons of the pipette head must also operate very precisely. Only if the quantity of liquid corresponds exactly to the specifications can valid test results be produced.

In CYRIS® FLOX systems, precision is a continuous task. The maxim for the motor applications is, therefore, repeatability. The exact movement must be performed repeatedly for the days of the test in short intervals without deviation. "We expect the highest possible level of reliability

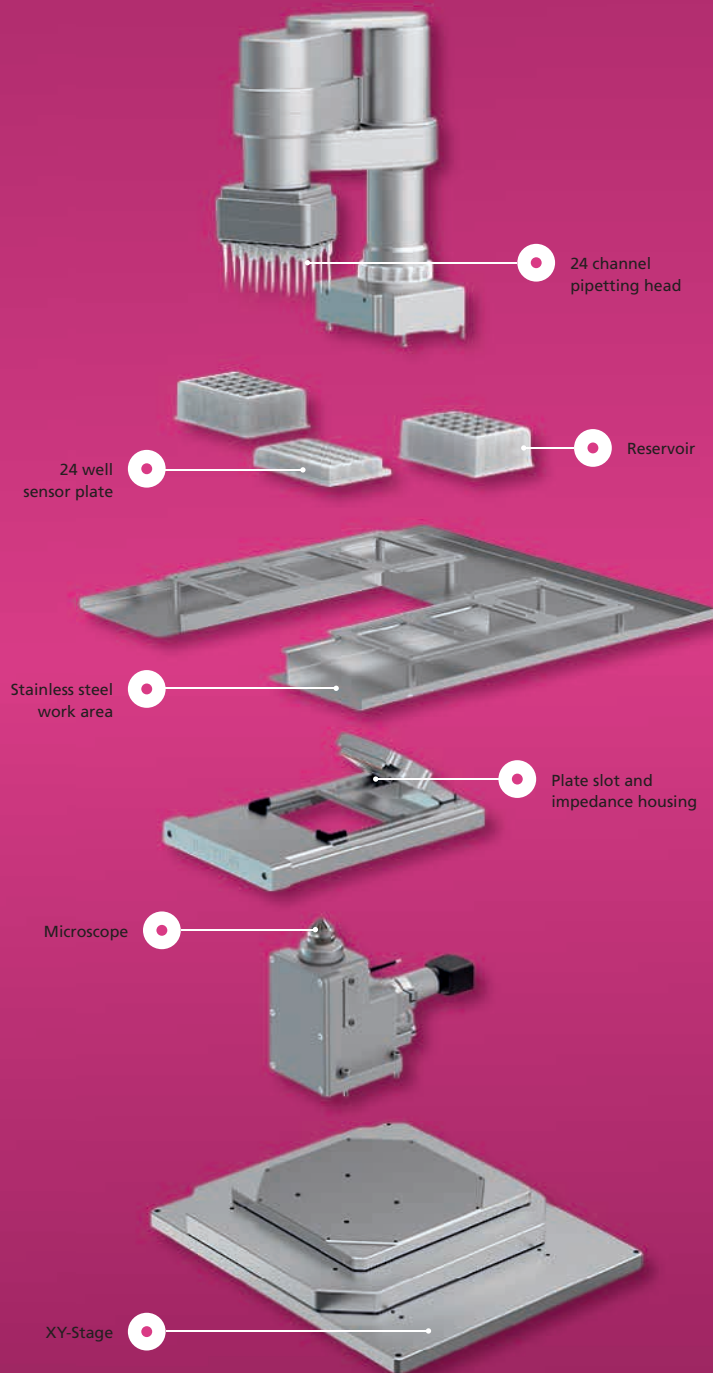


from the drives in continuous operation," emphasises the head of development. "Only then do we create the conditions for a long 'walk-away time'." In the world of laboratory automation, this is what one calls the time during which a test can operate without human intervention. "With CYRIS® FLOX, this time can be extended from a few minutes to hours or days. The highly qualified scientists and laboratory technicians can perform other work in the meantime. The efficiency of the laboratory operations increases, the running costs decrease, and the device quickly pays for itself."



FAULHABER BX4 CXD
BRUSHLESS DC-SERVMOTORS
WITH INTEGRATED MOTION CONTROLLER


COMPONENTS CYRIS® FLOX



www.faulhaber.com/en/markets/medical-laboratory-equipment
www.incyton.com

AN IDEA STRENGTHENS THE BACK OF THE WORLD





It is neither fatal nor infectious but very difficult to manage and extremely expensive to society: the widespread medical disorder of chronic back pain. A motorised exoskeleton can provide relief to the especially vulnerable lumbar spine. French manufacturer Japet relies on FAULHABER, as its product demands the highest quality and every ounce counts.

Back pain accounts for one of every ten sick leaves and 13 percent of early retirements. 80% of people have experienced the disorder themselves and the pain is chronic for 10 to 20 percent of the total population. These numbers come from France, where the annual follow-up costs to the economy and health system are estimated at 20 billion euros. Similar values can be found in all industrial countries.

Adverse strain and continuous overloading of the spine are by far the most common causes for chronic back pains. The improper strain can actually easily be avoided by observing one simple rule: always lift loads with the knees and while keeping the upper body upright. In daily life and with many jobs, this rule can, however, often be difficult to follow. Helping a patient out of bed, lifting a postal package out of the car, handling heavy parts in a production process or working with heavy, portable machines on a construction

site can make it extremely difficult to keep back strain in the ergonomically correct range. The lifted weight then unavoidably presses on a flexed spine.

Negative leverage effect aggravates the problem

The leverage effect is extremely negative here: depending on the degree of bending, a 10 kilogram package can press an equivalent force of up to 50 kilograms on the lumbar discs of the lower spine. While these natural shock absorbers made of fibrocartilage are exceptionally tough and resilient, they age over time, and, when constantly subjected to improper strain, can wear prematurely: they shrink, the damping effect subsides and the adjacent bone tissue also changes, often with painful consequences. In the case of a slipped disc, the intervertebral disc actually ruptures, the core slips out and presses extremely painfully against the surrounding nerves. "If the improper strain

cannot be consistently avoided, measures that provide relief must be considered," says

Antoine Noel. In 2015, the robotics engineer, together with Amelie Blondeaux and Damien Bratic, founded the company Japet in Lille. "Our objective was to develop an active support corset for the lumbar spine. Undesirable strain should be compensated for by motor power, thereby protecting the intervertebral discs."

Relief through actuators

The result of their work is the Japet.W exoskeleton. It consists essentially of two belts that are connected to one another by four actuators – two on each side of the body. The upper belt supports the back, the lower belt is seated on the hips. The actuators are referred to as series-elastic actuators, (SEA). They "feel" a force that is acting upon them and use their own motor power to counter it.

Their most important elements are a motor, a lead screw and a spring. A potentiometer measures the applied force, for example, if the wearer of the exoskeleton bends forward and picks up a weight. This measurement signal puts the motor, which is coupled to the drive lead screw by a gearhead, into operation. The turning of the lead screw transfers the motor power to the



spring. It presses from the lower belt on the upper belt, supports the upper body and relieves the lumbar spine. With respect to the level of relief provided by the exoskeleton, the wearer can select from four levels. The controller and the battery of the device are integrated in the double belt.

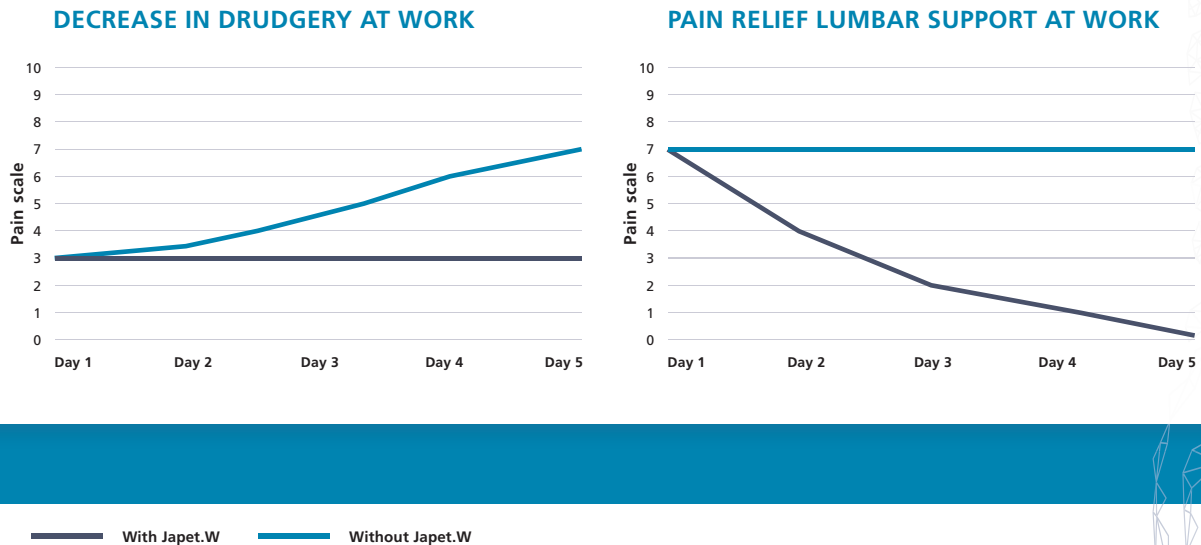
"The hips experience only a slight additional strain as a result of the added pressure; they are, in any case, able to withstand even heavier weights without problem," explains Antoine Noel. "The force that acts on the lumbar spine is, on the other hand, greatly reduced. It is, above all, the excessive strain on the intervertebral discs while in a bent position that is thereby significantly reduced or avoided completely. At the same time, the position of the upper body is also improved."

Micromotors lift four cars

The founders of Japet first met FAULHABER at a trade show. At that time, their company was still a technical testing lab in a side room of a clinic in northern France. The first sale was still in the distant future. In their first test devices, the three young entrepreneurs had installed inexpensive and noisy motors that could be controlled only poorly. The experts from FAULHABER took a liking to the ideas of the young engineers. They supported them with intensive consulting and prototypes of high-quality motors that could meet the needs of the demanding application. "That played a big part in making our product ready for series production," emphasises Antoine Noel.

In the Japet.W exoskeleton, four DC-motors with precious metal commu-

Impact on lumbar pain in real working conditions



tation of the 1524...SR series supply the supporting force for relieving the spinal column. Responsible for the load transmission are planetary gearheads of the 15A series. Because the device is, of course, worn on the body to which it is to provide relief, every gramme matters here – at 18 g per motor, the drives account for just a fraction of the total weight. Nevertheless, they are strong enough to relieve the intervertebral discs the weight of three to four medium-sized cars over the course of a workday. In addition to the ratio between volume and force, quality and reliability are among the key decisive criteria for Japet: "The exoskeleton is a certified medical product," explains Antoine Noel. "The highest standards apply here. Moreover, the device must support its wearer in continuous operation, over a long period of time and,

ideally, with no maintenance. This is made possible with the drives from FAULHABER."

The Japet.W has now been on the market for over a year. It is already used in numerous industries, including the railway industry, in construction and in medical care. Its use serves to counter the possible development of chronic back pain. It is, however, also used by people who have already developed this syndrome and are searching for a way to continue to work. "75% of all wearers who had previously developed back pain while working report from an effective reduction in pain," emphasises Antoine Noel. "That is a noteworthy value from a medical perspective, especially as chronic back pains are a very persistent and difficult to treat condition. Because we all tend to work longer and because the know-how of the

older employees is becoming increasingly more valuable, the exoskeleton has great potential from an economic vantage point as well."



FAULHABER SR
DC-MICROMOTORS WITH
PRECIOUS METAL COMMUTATION



www.faulhaber.com/en/markets/medical-laboratory-equipment
www.japet.eu

FACTORY AUTOMATION & ROBOTICS

THE MINI TAKES A



SERIES TAXI

The Internet of Things makes it possible to produce individualized products automatically – in batches as small as a single product. The path of the component through the assembly process thereby takes on an entirely new meaning. In the Adaptive Machine Platform Prolynk, manufacturing machinery and assembly stations can be configured and combined with total flexibility. The parts move individually from station to station, in a mini-taxi so to speak. FAULHABER supplies the drive technology for the small AGVs.

When Henry Ford installed the first "moving assembly line" in 1913, he increased the production of his cars eightfold – a quantum leap in production efficiency. This allowed him not only to drastically reduce the price of his Model-T but also to increase his workers' wages. It's no surprise that this success was soon copied. Even today, countless products are produced according to the assembly line principle.

It is, however, less suited for small series and not at all for individualized, automatic production. But this is one of the goals of Industry 4.0 and the Industrial Internet of Things (IIoT): individual products should be designed and equipped according to customer requirements – with the highest possible level of automation. This requires flexibility in the processes that is not very compatible with the permanently installed path of a conveyor belt.

Components take a taxi

With the Prolynk technology, the configuration of the "assembly line" can be freely adapted or reconfigured, following changing requirements. The components no longer travel on a predetermined path, but instead take a taxi in the form of a small driverless transport unit (automated guided vehicle, AGV): "The part to be processed is thereby reliably transported to all required stations," explains Antonio Sanchez, Chief Commercial Officer of Prolynk. "The processing steps,

whether performed manually or by robots, can occur completely individually. Yet, the sequence is still automated."

A platform made of standardised table-shaped modules serves as the physical basis of the system. It consists of standardised plates and can be designed freely with respect to size and shape. Simple metal plates form the base unit and serve as movement surface. A variant of the base plate is equipped with fastening indexing units. For production steps that require high precision or for which a larger application of force needs to be compensated, they hold the vehicle and component in position. Here, the plate element also has an opening in the middle. This can be used to perform processing from below as well, as it corresponds exactly to the shape of the opening in the AGV.

Arbitrary sequence of the assembly stations

The Prolynk AGV is available in two sizes (325x230 and 450x350 millimeters); the maximum load is between 5 and 35 kilograms depending on the model. The component to be processed is secured for travel to the individual assembly stations via the opening in the middle. These stations can be freely attached, including manual jobs as well as tasks performed automatically by machines or robots, e.g., laser



engraving, soldering, tightening of screws or performing test routines. If there is a quality problem, the vehicle can be sent to a specific station where this problem can be rectified.

"The central controller knows each AGV and its load," explains Antonio Sanchez. "It knows which processing steps must be performed on a given part. Individual products can thereby be created in an automated process. While communicating with the Prolynk system, the PLC remains in control of all processes." If the processing steps do not need to be performed in a certain order, there is an additional gain in efficiency: in this case, the AGV moves to a station that is currently free. There is less waiting time,

utilization increases. Another advantage of the system can be in the form of relief to the employees. Components no longer need to be moved between stations with muscle power. Constant lifting and setting down – movements with especially high risk of causing back pain – can be eliminated.

The Prolynk AGV is driven by two wheels, each of which is located in the middle of the long sides. The corners of the vehicle are supported by passive rollers. If the wheels move in opposite directions, the vehicle turns in place. This usually occurs in a 90-degree angle. It can thereby turn toward a station with a one quarter rotation or change back and forth between the

parallel "lanes" on the table with two rotary movements. It should be noted that these lanes exist only virtually: The AGV remains in its lane as does a car even when there are no markings on the road.

High power and precise orientation

The vehicle receives its route guidance and driving instructions from the central controller via WLAN. It specifies the routes as well as the stations and decides which vehicle has the right of way in cases where the lanes intersect. The part taxis need only report their precise position in order for this traffic

rule to function. The motion controllers of type MC 5004 P and encoders of the IE3-1024 series from FAULHABER play an important role here. They detect the rotation of the brushless motors of the BX4 series, which is used by the Prolynk electronic motherboard to do the odometry, calculate AGV position and manage motion control. The motor's force is transferred to the drive belts of the wheels by planetary gearheads of the 32/3 design.

"If a company decides on the Prolynk solution, the small AGVs become the heart of a production process. They must, thus, function completely reliably and with a very low level of maintenance, over as long a time as possible, securing a low total cost of ownership" says Antonio Sanchez, explaining the priorities for selecting the AGV components. "With the drive unit, the quality of the products had top priority for us. FAULHABER can guarantee us not only the required quality, but the motors also offer additional advantages that

are essential for our application. There is very little space in the vehicle. Even so, a great deal of motor power is needed to move what are often heavy parts at the required speed. With respect to the ratio between volume and torque, the BX4 series is a leader on the global market. This power density is a key factor in allowing us to offer our customers a solution that is as reliable as it is flexible."

The combination of reliability and flexibility gives users of the Prolynk solution maximum flexibility in designing their production processes. They can theoretically get started with a small platform consisting of just a few plates and a single mini-AGV. The system can be freely expanded or reorganised, with high flexibility and machine adaptability. Smart functions are available and the Prolynk technology is easy

to integrate into the PLC architecture. New products, new processes and technologies can also be easily integrated; the existing modules can be rearranged depending on circumstances. "There are no limits to the system's adaptability," emphasises Antonio Sanchez. "The production capacity follows directly from the order situation."

If a company decides on the Prolynk solution, the small vehicles become the heart of a production process.

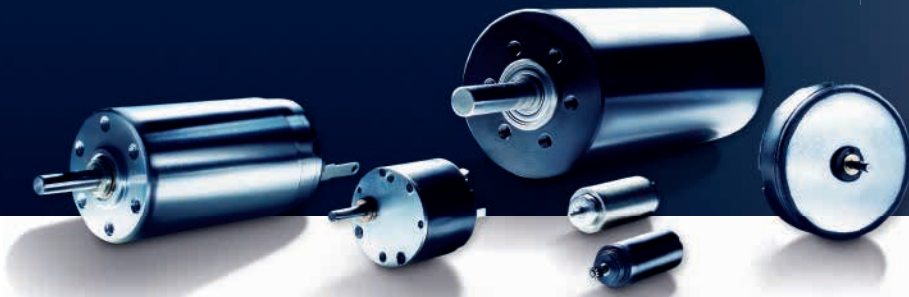


FAULHABER BX4
BRUSHLESS DC-SERVOMOTORS
4 POLE TECHNOLOGY



www.faulhaber.com/en/markets/factory-automation-robotics
www.prolynk.eu

Perfectly Paired for Size & Performance



Small and powerful DC-motors are critical to the development of ever more highly integrated systems. These motors are driving technology in many different sectors, from medical and laboratory technology to aerospace, robotics, optics and photonics, as well as industrial machinery and equipment in general. But the small motors only mature to an application-relevant drive or positioning system when combined with other components, such as gearheads, encoders and motion controllers. Making the right choice is fundamental for reliable operation. All components must be compatible with the motor and meet its requirements. In the worst case, selecting the wrong controller could destroy a motor in no time.

When selecting a suitable motion controller for a drive system, it is important to answer a few questions first. For example, the movements that are to be carried out must be established, and it must be defined what this means in terms of motor control requirements. Is the drive working continuously

or in start-stop mode? Is precise positioning required? What type of load will the drive be moving? What are the load cycles? Is a gearhead required? Which motor is best suited for the application? The motion controller is then selected based on the answers. And it may get interesting, because not every motion controller suits every motor. DC-micromotors in particular have unique requirements due to their design.

Risk of overheating

At the heart of the DC miniature- and micromotors from FAULHABER is the patented, self-supporting, coreless rotor coil with skew-wound design and brush commutation, which rotates around a fixed magnet.

No cogging torque forms due to the symmetrical air gap, which enables precise positioning and excellent speed control. Triple continuous torque in overload mode is quite common and easily possible for servo applications, as long as the temperature of the motor winding is monitored. But motors with a dia-

meter of only 22 mm or less don't have an integrated temperature sensor. There simply isn't enough space. So if just any controller is connected to a microdrive, in the worst case the coil may be completely burnt up before any heat is even noticed on the outside.

Problems like these can be avoided with motion controllers from FAULHABER, which were developed for the requirements of mini and micro drives and tested under real operating conditions. They 'estimate' the winding temperature for the respective motor type using models of varying complexity. This means that the full dynamic range of the motor can be exploited, for example for fast positioning processes. The current is also reduced before the winding overheats. The parameters required are conveniently transmitted to the drive controller with the "Motor selection dialogue" of the FAULHABER Motion Manager.

Additional information about thermal integration in the application can be used in the models that are stored in the controllers for further improvement. How well is the



motor cooled? Is it necessary to limit performance due to high ambient temperatures? Is a gearhead and encoder used? With additional information like this, maximum motor power can also be used with, e.g. a drive that works cyclically in a climatic chamber, in that the motor controller keeps track of the ambient temperature parameters from the climatic chamber control within the models stored. The same applies if the load cycles are known. The motor can then often be smaller in design, which is an advantage especially when used in mobile devices. Due to the low electrical time constant, which benefits dynamic processes, additional losses may occur due to the pulse width modulation (PWM) that is common in drive controllers. The typical electrical time constants of FAULHABER coreless motors are about 10 μ s. For PWM frequencies below 50 kHz, the continuous torque specified in the data sheet is no longer achievable in many cases, or the motor may overheat. That is why it is important that the PWM frequency is sufficiently high when selecting a motor controller. For FAULHABER motion

controllers, this is between 78–100 kHz, depending on the type. Due to the type of modulation, up to 200 kHz act on the motor, which suits the requirements of the small motors.

Powerful and extremely miniaturized

The motion controllers of the MC V3.0 family, which have been tried and tested for years, have limited usability for the micromotors from FAULHABER due to their size and the resolution of the integrated motor current measurement. This is where the new MC 3001 B/P comes in: The

M 1:1



16 mm

first motion controller that is perfectly suited to smaller servo drives, both in terms of its size and the resolution of the current measurement. With a maximum supply voltage of 30 V, the motion controller sized 16 x 27 x 2.6 mm (W x L x H) achieves a continuous current of 1 A and a peak current of 5 A. At lower supply voltages, such as in 12 V systems, continuous currents of up to 2 A can also be easily achieved. At the same time, they do not compromise on function compared with their large family members. The I/O options and encoder interface are the same as the rest of the product family. USB, RS232, and CANopen are available as communication interfaces. A compact EtherCAT interface can then also be provided via a customer-specific carrier board (motherboard).

The controllers are available in two variants: The model with flat board-to-board connectors (MC 3001 B) is ideal when several drive controllers are combined on one carrier card. The MC 3001 P variant features a plug connector with a 2.54-mm grid over three sides. It is easy to integrate into your own configuration, e.g. for multi-axis applications in laboratory automation. Now, there are finally powerful motion controllers for even the smallest DC drives from FAULHABER, perfectly matched to the motors both in terms of size and function.



Dr. Andreas Wagener
Head of System
Engineering at
FAULHABER

NAVIGATE AUTONOMOUSLY WITH MILLIMETER PRECISION



In concepts such as Industry 4.0 or the Internet of Things (IoT), intralogistics play a decisive role. The main focus: autonomous mobile robot platforms that enable flexible material transport. For these to find their way in warehouses and production halls, extremely precise navigation is essential. The scalable mobile transport systems from Evocortex perform this task with unusual means. Their creative, technical concept could only be realized with FAULHABER motors as these provide the required power density yet use very little space.



Ident-Nr. 000.9122.21

Further information:

[faulhaber.com](https://www.faulhaber.com)[faulhaber.com/facebook](https://www.faulhaber.com/facebook)[faulhaber.com/youtubeEN](https://www.faulhaber.com/youtubeEN)[faulhaber.com/linkedin](https://www.faulhaber.com/linkedin)[faulhaber.com/instagram](https://www.faulhaber.com/instagram)

FAULHABER motion is also
available in digital format:

