

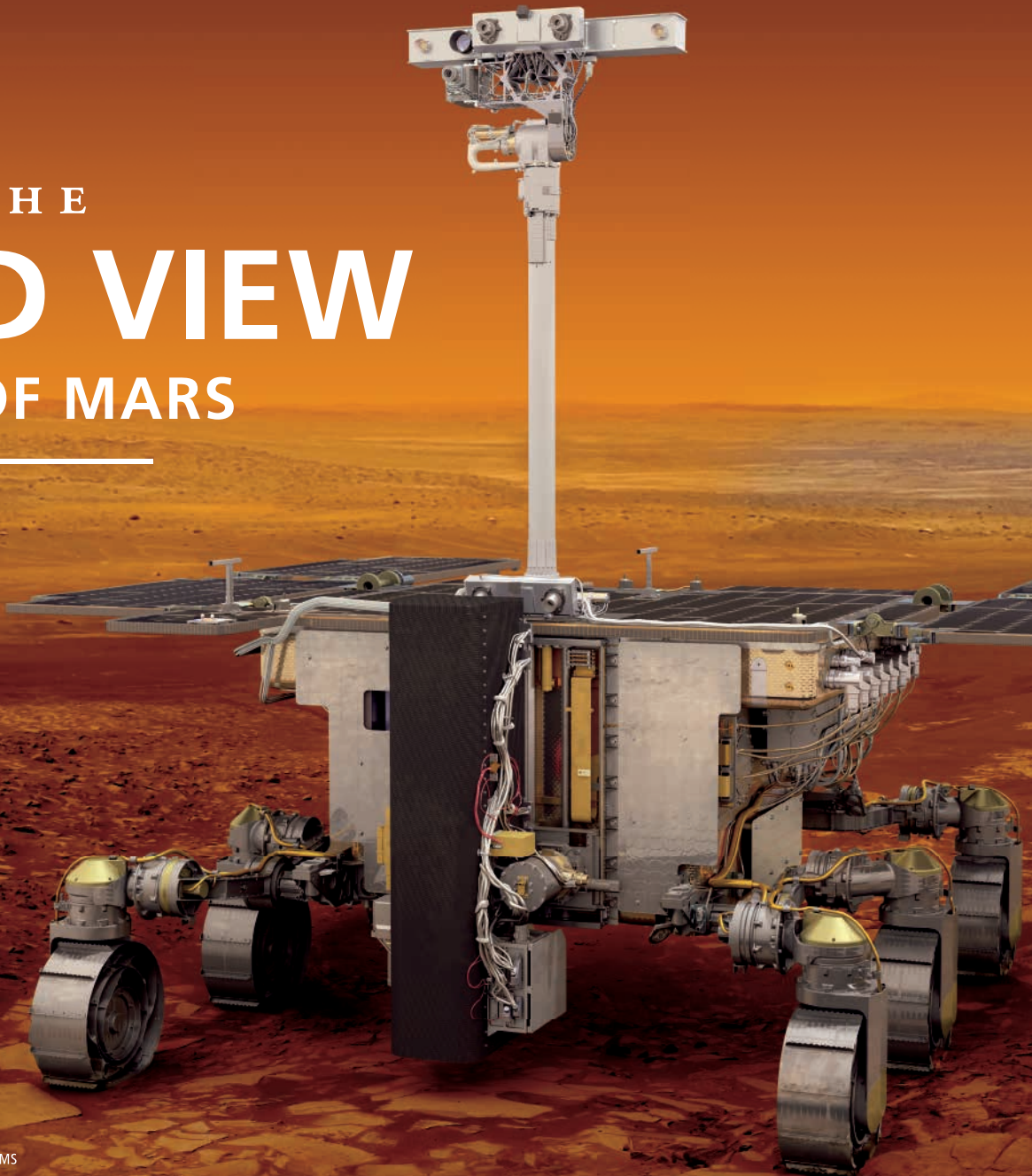
# motion

02.2017

THE MAGAZINE WITH DRIVE

THE  
**3D VIEW**  
OF MARS

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**Dear readers,**

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Apart from the Earth, Mars has been the most intensively researched planet in our universe to date. The first images of the rugged desert surface of the neighbouring red planet were provided back in 1965 by a space probe, whose research has been leading scientists to exciting new discoveries ever since. Another Rover expedition is starting on Mars in 2020. After the landing, drive systems from FAULHABER will help to provide a better picture of the geological structures of the surface.

In the deep sea, on the other hand, an area that has been the subject of much less research, the reliability of FAULHABER drive systems makes reliable and precision handling of organic sediment samples of deep-sea trenches possible under similar extreme conditions. Scientists suspect that the biological and chemical processes taking place here may have an influence on the world climate that is not to be underestimated.

In this edition of FAULHABER motion you can also read about where innovative drive technology is being used in Germany's first ultra-light seaplane, and how FAULHABER is supporting engineering trainees.

I hope you find inspiration while reading!

Sincerely

Gert Frech-Walter  
Managing director

Issue 02.2017

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FAULHABER motion is now available as an app.



[www.faulhaber.com/motion](http://www.faulhaber.com/motion)



## POLITICS MEETS DRIVE TECHNOLOGY



Visit from Chancellor Angela Merkel at the Hanover trade fair

At this year's Hanover trade fair, FAULHABER was able to demonstrate its qualities as a host not only to numerous trade visitors, but also some of the biggest names in politics.

It started with the traditional opening tour by German Chancellor Dr. Angela Merkel. Gert Frech-Walter, member of the FAULHABER GROUP management team and managing director of FAULHABER Germany, and Karl Faulhaber, managing director of FAULHABER Switzerland and managing partner presented the diverse portfolio of small and miniaturized drive systems and the extensive technology know-how of the internationally oriented high-tech company on

the example of selected product highlights and application examples to the German Chancellor, who was accompanied by the Prime Minister of partner country Poland, Beata Szydło. Dr. Merkel was particularly fascinated by the filigree micro drive with an outer diameter of 1.9 mm as the technological cornerstone for minimally invasive heart pumps.

During the days that followed, Economics Minister Dr. Nicole Hoffmeister-Kraut and Prime Minister Winfried Kretschmann also visited the FAULHABER trade fair stand for a glimpse into the world of miniature and microdrive systems.

Economics Minister Dr. Nicole Hoffmeister-Kraut



Prime Minister Winfried Kretschmann



### FURTHER INFORMATION

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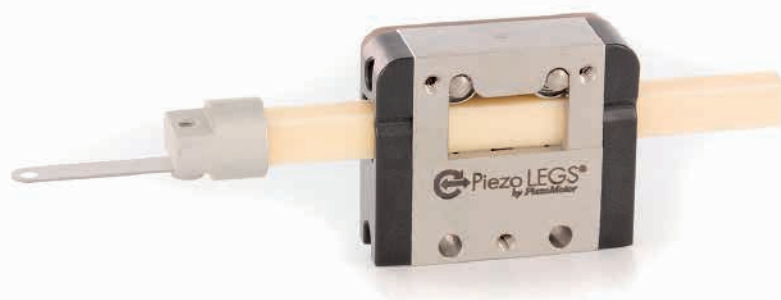
**NEW**

## LINEAR POSITIONING MOVEMENTS IN THE NANOMETRE RANGE

The new linear piezo motor series LL06 has the same piezo-ceramic actuators as the popular classic Piezo LEGS linear 6N LL10, but now has a slimmer basic design and the option of an integrated high-resolution optical encoder.

Motors that are based on Piezo LEGS technology are ideal for positioning applications in which positions have to be moved to and maintained, because the motors are basically extremely rigid and do not

consume energy when they stop in a position. The direct drive principle does not require any gearhead or lead screws, and therefore makes backlash-free movement possible with resolution in the sub-micrometre to nanometre range. This means that the speeds between nanometres per second to millimetres per second can be continuously controlled over the entire dynamic range.



[FURTHER INFORMATION](#)

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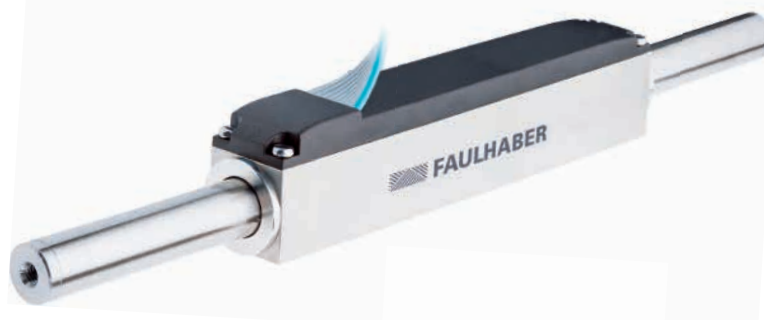
**NEW**

## THE FAMILY OF LINEAR DC-SERVOMOTORS IS GETTING REINFORCEMENTS

The new LM 1483 series. With 6.2 N of continuous force and 18.4 N of peak force, this linear drive combines considerable power with unique dynamics (acceleration up to 220 m/s<sup>2</sup>) and high precision (repeat accuracy of up to 120 µm and down to 40 µm) for extremely small linear movements. The LM 1483 with the dimensions of 14 x 20 x 83 mm and a robust forcer rod made from stainless steel (6 mm diameter) is available in different stro-

ke lengths of 20 to 80 mm. Thanks to the three integrated analogue Hall sensors, the LM 1483 series can be combined with FAULHABER motion controllers without problems, including the new FAULHABER MC 5004 and MC 5005 and the FAULHABER MCLM 300x.

The LM 1483 series is also optionally available in a version with sine/cosine actuation.



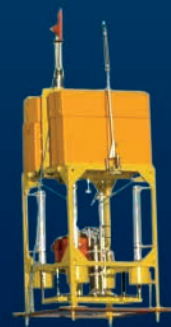
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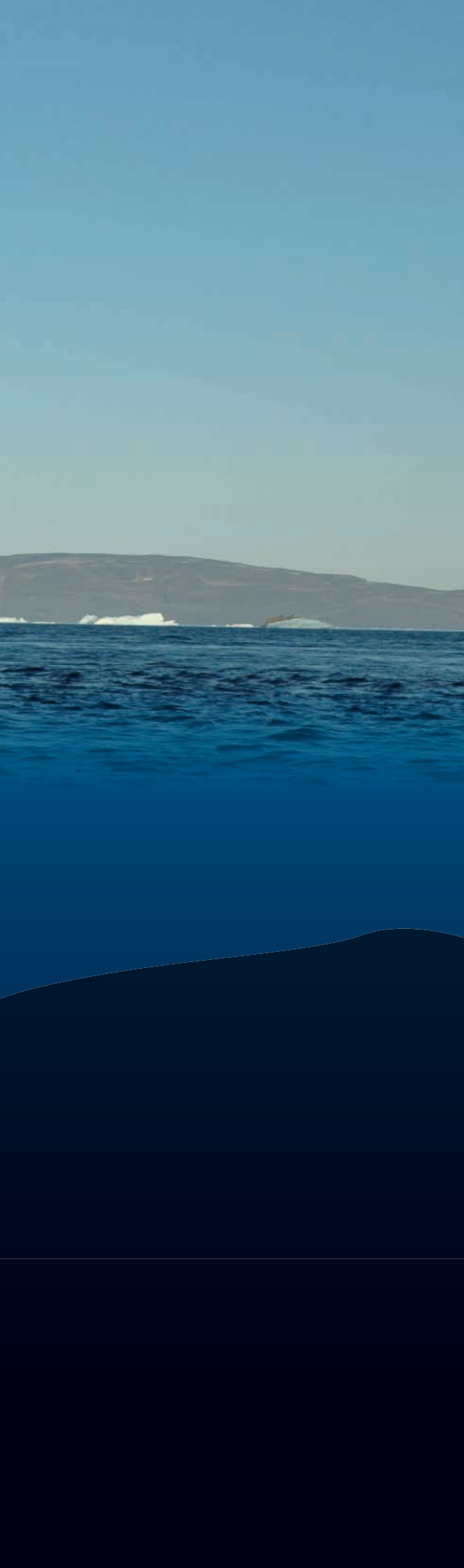


MICROBE RESEARCH

AT A DEPTH OF  
10,000 meters







## ROBOTICS


What influence does hell have on heaven?

This is not an issue of theology: marine scientists refer to the deepest depths of the oceans as the "hadal" zone, named after the shadow empire of the ancient Greeks. They do, however, suspect that a great deal more life exists there than in the mythical Hades. The deep-sea trenches may even influence the world's climate. Motors from FAULHABER are helping to find answers.



Mars is many million kilometres away from Earth. And yet its surface is better studied than the floors of the deep-sea trenches, which lie only eight to eleven kilometres below the sea surface. The biological and chemical processes that transpire there are, in fact, still largely unknown. A research project, appropriately named "Hades-ERC", is aiming to change this and supply completely new insights into the depths of the oceans. It was initiated by Professor Ronnie Glud from the University of South Denmark in Odense.

"In marine biology, there is actually a simple basic rule", he says. "The deeper you go, the less life one finds." Because with increasing depth, it becomes colder and darker. Less of the food produced in near-surface water reach the great depths. Moreover, the water pressure increases by 1 bar every ten metres. At a depth of 10,000 metres, the pressure of approximately 1000 bar is a thousand times higher than on the ocean shore. "But gravity exerts its effects even in this environment. A portion of the organic material that sinks to the deep ocean floor ultimately lands in the trenches, where it collects."



The drive unit in the plastic cylinder is protected from the enormous pressure in the depths by a membrane filled with an inert liquid.

### Collection basin for organic material

Thus, it was no surprise to Professor Glud as he found highly active microbial communities at a depth of nearly eleven kilometres in 2013. At that time, he had descended the instruments into the Mariana Trench in the Western Pacific. "We found more organic matter at depths below 10,000 metres than at 6,000 metres", the marine researcher explains. "We therefore assume that the trenches have a disproportionately high influence on the nitrogen and carbon balance of the seas. Although they account for only two percent of the ocean area, they could have a disproportionately high effect on the carbon footprint and climatic occurrences."

The Hades-ERC project aims to – literally – get to the bottom of such questions and enable better understanding of the processes in the trenches. It is financed by the European Research Council, which belongs to the EU. A so-called Advanced Grant totaling 2.5 million euro allows the scientists to conduct long-term, open-ended basic research. In addition to Glud's department in Odense, marine biologists at the University of Copenhagen as well as marine research institutes from Germany, Japan and Scotland are involved. The sophisticated instrumentation is developed as a joint venture between the team in Odense and a German team headed by Dr Frank Wenzhoefer that is based at the Max Planck Institute in Bremen.

The project is scheduled to last five years. The studies will be conducted beginning this autumn in three Pacific trenches – the Japan Trench, the Atacama Trench and the Kermadec Trench – at depths between 8,100 and 10,900 metres. These formations were selected because the organic load in the waters above them is much different. They therefore offer their microbial inhabitants widely varying conditions.

### Robots instead of submarines

While manned dives have already taken place to such depths, the use of submarines would not be practical for extensive research of bottom sediment. The project team therefore developed robots that independently descend to the sea floor and then carry out preprogrammed studies. They are equipped with sensors which, among other things, can measure the oxygen intake of the bacteria – a value from which one can make deductions on the quantity of the processed organic material.

Other sensors help answer the question of whether deep-sea microbes breathe oxygen, nitrate or sulphate. "To survive under the extreme conditions of the deep sea, the bacteria must be much different than their relatives in shallower waters", Professor Glud says. "For example, their membranes and enzymes must function in a completely different way. How exactly, that's what we want to learn."

It is a special challenge to study the microbes themselves. Because they have adapted to an environment with enormous water pressure, they cannot simply be brought to the surface. They would turn into a "soup" on the way up, as the Danish researcher illustratively describes. The Hades-ERC robots are, therefore, provided with equipment that can inject a fixing agent into the sediment, which keeps the microorganisms intact during recovery.





The robot during a test run, here in shallow water in Japanese Sagami Bay

### Prerequisite: pressure resistance

While the microbes need to be protected from the decreasing pressure as they are brought to the surface, special precautions must be taken for the equipment in the robots to protect them from the extreme pressure in the trenches. The sensors as well as the tools for handling the sediment are specially equipped for this environment and can withstand the pressure. To perform their work, they do, however, need to come into contact with the sediment and must be moved into various positions. Responsible for this movement are DC-micromotors of series 2342...CR from FAULHABER, provided with encoder and the appropriate planetary gearheads.

While some components are housed in a pressure stable titanium cylinder, some devices like the motors and gearboxes can only perform their work when in contact with the surroundings that are to be studied. "We therefore inserted these components into another cylinder in a small flexible membrane which is filled with an inert fluid," Professor Glud explains. "The membrane ensures that the water pressure effects the enclosed components without a pressure difference occurring. Because this would crush the motors."

In an earlier version of the robot, various motors were still used for the different tasks. In practical tests, the team has come to the conclusion that it makes more sense to work with just a single, especially robust motor type. "The robot remains at its operation site for many hours before returning to the surface with the samples. During this time, it operates

completely autonomously", Professor Glud explains. "Our success is dependent on – among other things – the flawless function of the devices during this time. Thus, the motor needs to be extremely reliable, compact and strong. The model from FAULHABER has proven outstanding in the depths and is ideally suited for use under these extreme conditions."

#### DC-MICROMOTOR

Series 2342...CR  
 Ø 23 mm, length 42 mm  
 Output torque 19 mNm



#### FURTHER INFORMATION

UNIVERSITY OF SOUTHERN DENMARK  
[www.sdu.dk](http://www.sdu.dk)

FAULHABER  
[www.faulhaber.com](http://www.faulhaber.com)

## A PUMP

# THAT SIMPLIFIES LIFE WITH DIABETES

Diabetes is among the most common diseases in today's societies. If the disease is not treated in time or if treated incorrectly, important organs, such as heart, eyes and kidneys, could suffer serious damage. Chronically ill patients can optimally control their treatment with an insulin pump – supported by micromotors from FAULHABER.



### **Diabetes, a widespread disease.**

Diabetes mellitus, commonly referred to as diabetes, is a chronic metabolic disorder in which the body's supply of the hormone insulin is disrupted. Shortly after eating, the blood sugar level of healthy people rises because the glucose from the food enters the blood. The insulin causes sugar to be absorbed from the blood into the somatic cells. This lowers the blood sugar level again. By means of the body's control mechanism, the insulin constantly keeps the blood sugar within narrow limits. People who produce no or insufficient insulin or who cannot utilise it suffer from diabetes.







## Two different types.

Medicine distinguishes between type 1 and type 2 diabetes. The onset of type 1 diabetes generally occurs during childhood or adolescence. These patients produce no insulin in their body. Type 2 diabetes, on the other hand, is caused by a poor diet, overweight and lack of physical activity. Diabetics require insulin regularly to regulate their blood sugar level. Patients who suffer from type 2 diabetes generally only need to take tablets. With serious type 2 cases as well as for type 1 patients, insulin must be injected. In Germany, injection is often performed with the aid of a pen, an injection device that is similar to a fountain pen. In addition to the intake of insulin, the patients must regularly check their blood sugar and learn to estimate the carbohydrate content of their meals in order to calculate the required amount of insulin.

## Relief through technology.

There is, in fact, a relatively recent technological development that should considerably simplify life for diabetes patients: the insulin pump. The patient wears this directly on the body. It constantly delivers a small quantity of insulin to the blood; the additional insulin required at mealtimes can be controlled by pressing a button. It does not eliminate the need for patients to estimate their carbohydrate intake, but it is a huge relief for most users in daily life. It is even already in use by small children and can be remotely controlled by parents.

## Insulin pumps with micromotor.

Though available from various manufacturers, the design of insulin pumps is always similar: an ampoule contains the insulin, which enters the body as needed by means of the battery-operated pump via a catheter and a cannula. A small motor pushes the plug of the insulin ampoule forward via the threaded rod, causing insulin to be released. Extremely high demands are made of the motor: In order to keep down the weight of the wearable device the motor must be compact, and as a rule the diameter must be no more than about 10 millimetres. The motor must be reliable and precise, since too little or too much insulin is harmful to the patient. A human life may even depend on the reliability of the motor that is used. Since the insulin has to be injected into the body every few minutes, the motor must start and

stop at regular intervals. In addition, the motor must operate in a very efficient manner due to its battery operation.

## Drive system from Schönaich.

In order to fulfil all of these high demands, insulin pump manufacturers rely on the micromotors from Schönaich. Various motors produced by FAULHABER are used here: Motors with precious-metal brushes, brushless motors with 2-pole technology and stepper motors. The 0816...SR series is an example of micromotors with precious metal commutation. The brushless DC-servomotors of series 0620...B and 0824...B have an extremely long service life. Precision dosing control is possible here using the analogue Hall sensor. Some manufacturers rely on the stepper motors of series AM 0820 or AM 1020.

## Future perspectives.

The insulin pump is primarily used by diabetes patients as a wearable medical pump, but other application areas are emerging. Because patients with other chronic illnesses such as Parkinson's disease or immunodeficiency are also reliant on regular injections. FAULHABER stepper motors of the AM 0820 series are already in use here.

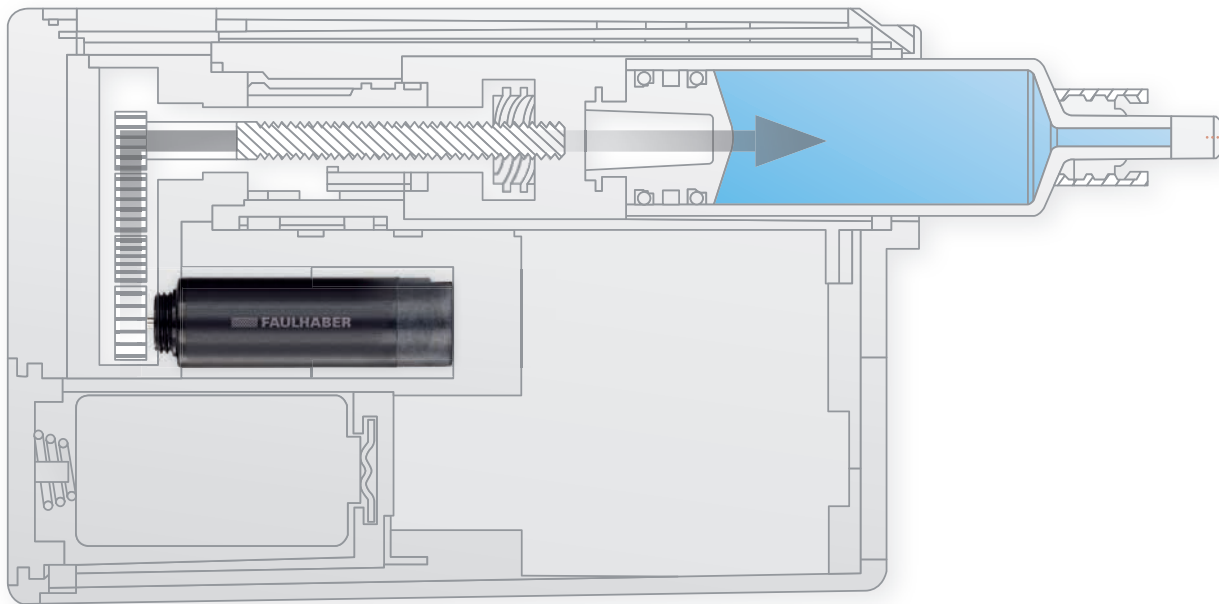
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### FURTHER INFORMATION

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FAULHABER  
[www.faulhaber.com](http://www.faulhaber.com)

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TO KEEP THE  
DEVICE LIGHTWEIGHT,  
THE MOTOR MUST  
BE COMPACT



# ULTRA-STRONG

AND ULTRA-LIGHT







Images: © Peter Wolters

## AEROSPACE & AVIATION

Be it on land, on water or in the air, the Flywhale moves safely and reliably in all three elements. And more than that: It is a special aeronautical pleasure with which to explore the world from above in this amphibious aircraft made from super-light fibre composite material. Innovative drive technology from FAULHABER is also put inside these fascinating seaplanes, which are manufactured in North Germany.



Dötlingen in Lower Saxony is the headquarters of Flywhale Aircraft GmbH & Co KG, which was founded by Elke and Helmut Rind in 2012. "Our goal was to develop and market an ultra-light seaplane", explains Helmut Rind. The team tinkered with the implementation of the Flywhale Adventure iS Sport for many months. This was followed by many tests. The result is an ultra-light amphibious aircraft which can take off and land on both water and land, and impresses with the high quality of its aerodynamics. Flywhale Aircraft GmbH is Germany's only manufacturer of ultra-light seaplanes.

### For adventurers and lifesaver

"Our Flywhale is a modern flying boat with the latest engine technology and several special technical features", elaborates Rind. "It provides plenty of room – and above all there is a high fun factor. It was created for adventurers who want to be independent." However, the target groups are not just aviators with a passion for water, but also the coast-guard and rescue services. The seaplane reaches a top speed of up to 200 kilometres per hour. The annual production that the company is endeavouring to achieve is 20 aircraft, and about eight aircraft are currently being manufactured per year.



## Components from FAULHABER

"The latest technology is used for the construction of our Flywhales, and we use the best materials", says Helmut Rind. Components from FAULHABER play an important part in lowering and raising the landing gear. One drive for the main landing gear and one drive for the nose gear are realised using FAULHABER products. The nose gear is moved by a spindle mechanism. The drive solution from FAULHABER ensures that the required rotation of the lead screw takes place. A drive unit is used which consists of a graphite-commutated series 3257 ... CR DC motor, including an IE3-1024 Encoder and a type 32/35 Planetary Gearhead. A type MCDC 3006 S RS controller completes the intelligent system.

## No additional sensor systems required

"The end positions for the status of the raised and lowered landing gear are determined by the encoder and controller, and are displayed in the cockpit as a signal using a blue and green control LED", explains Michael Schütte, Area Sales Manager at FAULHABER. "This means that we were almost able to dispense with an additional sensor system for end position detection altogether." The nose gear is also equipped with a spring element which ensures that outstanding suspension comfort is provided. The two main

### DC-MICROMOTOR

3257 ... CR series  
 Ø 32 mm, length 57 mm  
 Output torque 73 mNm



Nose gear drive with FAULHABER motor gearhead encoder unit as well as spur gearheads with lead screws

landing gears are raised and lowered using a worm gear drive. The same FAULHABER drive as the one used for the nose gear is used at both sides. A screw which moves the landing gear via a gear segment is driven by the FAULHABER gearhead type 32/35 via the gearbox output shaft. Similarly to the nose gear, the end positions are detected accordingly via the encoder and the controller and displayed in the cockpit.

## Special challenges

"The drives must provide a high level of drive power for a short time and be as light as possible. Also, the landing gear movement must be able to take place both in the water and in the air", elaborates Michael Schütte. The system must therefore be extremely reliable. Because of their light weight, high power density and compact size, the FAULHABER components are just the job for this.

## Professional service

As far as the people responsible for the Flywhale are concerned, it is not only technical reliability but also professional service that speaks in favour of FAULHABER motors. "We are delighted to collaborate with FAULHABER", emphasises Helmut Rind. "The thing that FAULHABER and Flywhale have in common is that we are only satisfied with the best result."

### FURTHER INFORMATION

FLYWHALE AIRCRAFT GMBH & CO. KG  
[www.flywhale.de](http://www.flywhale.de)

FAULHABER  
[www.faulhaber.com](http://www.faulhaber.com)





EMPTY WEIGHT: 342,5 KG

MAX. TAKE-OFF WEIGHT: 517,5 KG  
(495 KG + 22,5 KG RESCUE SYSTEM)



SEATS

CABIN WIDTH: 1,20M

LENGTH: 7,0M

HEIGHT: 2,49M

SPAN WIDTH: 9,0M



CRUISING SPEED:  
200 KM/H

VNE: 250 KM/H

STALL SPEED:  
65 KM/H



STORAGE SPACE:  
50 L

FUEL QUANTITY: 90 L

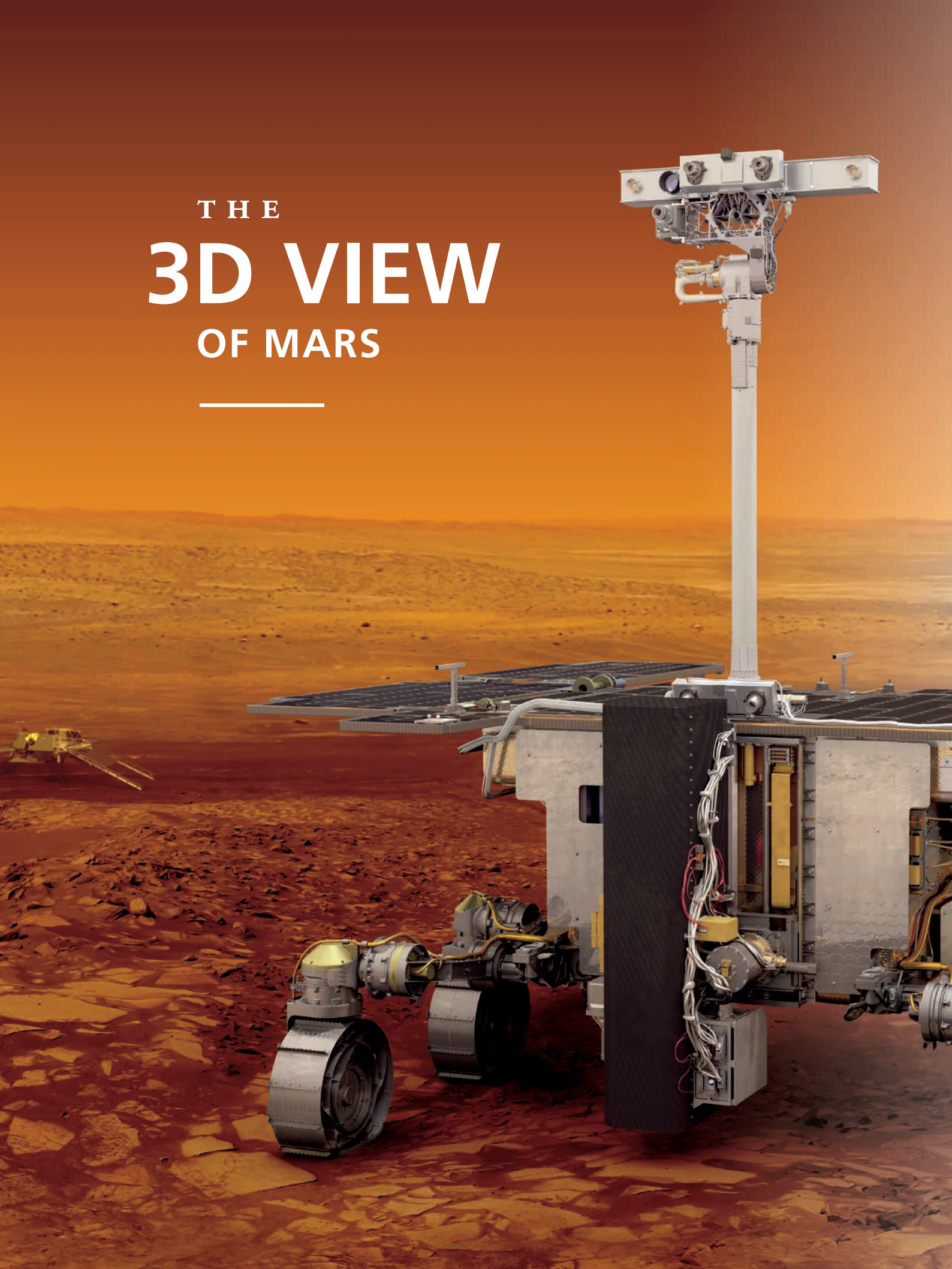
RANGE: 7H





THE  
**3D VIEW**  
OF MARS

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2020 is the year of the next Rover mission to Mars. The main payload of the Russian Proton rocket: the ExoMars Rover, developed by the European and Russian Space Agencies (ESA & Roskosmos). The plan is for the vehicle to be equipped with nine measuring instruments. Including one that will be mounted on a two-meter mast on the rover.

"The Panoramic Camera", which was developed by Mullard Space Science Laboratory (MSSL-UCL) in collaboration with OHB (Munich), DLR (Berlin) and TAS-CH (Zurich), will take stereo images of the planet. The so-called PanCam features two rotating filter wheels which are mounted in front of its wide-angle cameras (WAC; manufactured by Thales Alenia, Zurich) to enable it to take three-dimensional images of panoramic landscapes. A high resolution camera (HRC; manufactured by OHB/DLR) provides detailed images of landscapes, geological structures, and soil samples. Three stepper motors from FAULHABER drive the rotation shaft for the filter change system as well as the focus of the high-resolution camera.



The mission is clear, as is each individual task. Needless to say, the requirements for equipment planned for use on Mars are so stringent that nothing quite compares to them. And if the mission for 2020 goes according to plan, the Rover built by ESA will start searching the surface of Mars for past or present biological activity as soon as it lands. This will require not only obtaining soil samples with a core drill, but also performing analyses with an extensive science package. Meanwhile, the ExoMars Trace Gas Orbiter will stay in orbit in order to help the rover phone home and ensure that the data and measurement results it collects can make it back home.

### Improved images and protection from dust

The ambient conditions on Mars require for every single piece of equipment to deliver unrivalled performance. For starters, the Rover will be working under an atmospheric pressure of 0.00636 bar, which is equivalent to the pressure found at an altitude of 35 kilometres on Earth. And to go even further, the planet is characterized by temperature fluctuations that go from just under +20 °C to -120 °C. In addition to this, the dust kicked up by the Rover is expected to have a negative effect on the operational reliability of its high-precision measuring and analysis instrumentation, which is one of the reasons why the Panoramic Camera will be suspended two meters above the ground on its mast. "This will of course protect the lenses, but there's another important advantage in that kind of elevated position, and that's the fact that we'll be able to get significantly better panoramic images," explains Jonathan Jones, a mechanical and thermal engineer at the Mullard Space Science Laboratory south of London.

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# PERFECTLY SUITED FOR THE HARSH CONDITIONS IN SPACE

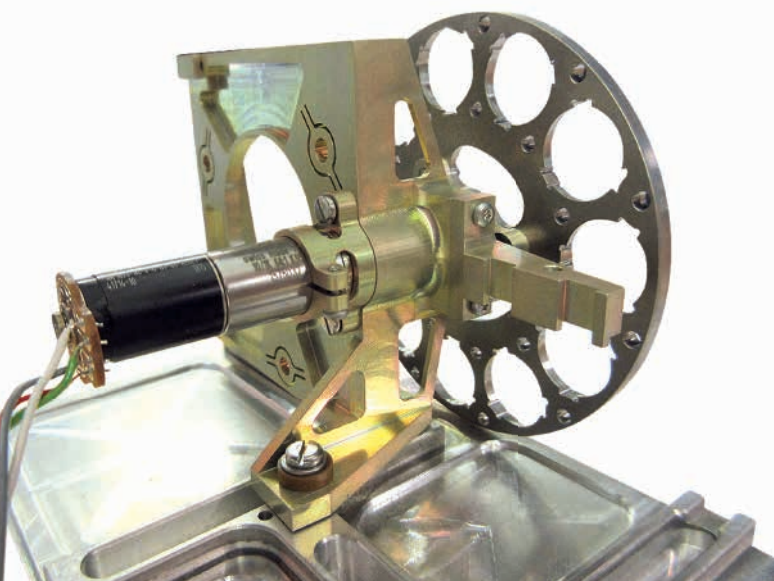


With the filters in front of Wide Angle Cameras, MSSL has created a system that will be able to take pictures at various wavelengths during the mission scheduled for 2020 and use them to generate images with varying content. "The plan is to send ten images to Earth every day," Jones says. Sure, it may sound like nothing at first, but a closer look reveals that this is actually quite an ambitious target. First, the camera generates three pictures for a single image. These are then sent to Earth and superimposed on top of each other to create the actual image. And then there are the limitations imposed by the low data bandwidth available with radio communications between the two planets, which simply makes it impossible to send more than ten images per day.

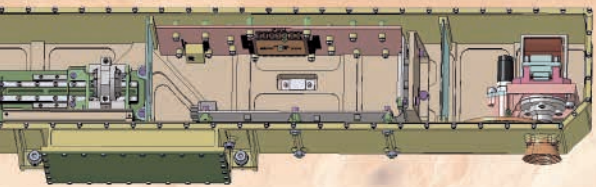
## Stepper motors position lens filters

With eleven filters per wheel, it is possible for the Pancam WACs to take a wide variety of pictures under various light conditions. These filter wheels rotate in front of the two WACs, and must be brought exactly into position in order to obtain sharp images. For driving the rotating filter system, MSSL makes use of two stepper motors from the FAULHABER PRECI-step portfolio. These two units have been passing the endurance tests currently being conducted on them with flying colours.

During the development process for the Panoramic Camera, the MSSL engineers looked for motors that would not only be able to deliver reliable and precise positioning performance, but that would also be extremely compact. Stepper motors were the natural choice given these requirements, as they are







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not only able to precisely position objects with a resolution of 1280 steps per revolution without the need for a separate feedback system, but are also much sturdier and easier to use than conventional servomotors. The focussing mechanism of the high-resolution camera is driven by a FAULHABER PRECISTEP stepper motor. This motor is able to exactly follow an externally applied field without requiring time-consuming and complex adjustments. "It is the perfect solution for optical application as the motors can hold the lens position even without current thanks to their residual torque. Moreover, the control in open loop allows to get rid of jittering effects and therefore obtain very sharp and clear images," explains Sébastien Vaneberg, who works as a Sales Manager at FAULHABER PRECISTEP SA. The Swiss company, which is part of the FAULHABER Group, specializes in miniature stepper motors. "In short, it is a simple and robust drive with outstanding capabilities, ideal for the harsh space conditions."

### Miniature motors approved for use on Mars

In each camera of the PanCam, each drive has a diameter of just 10 millimetres. The stepper motor counts 20 steps per revolution, and is combined with a precision gearhead of the same diameter with a gear ratio of 64:1. On top of this, FAULHABER worked closely together with MSSL in order to further customize the engineering behind its two drives so that they would meet the required specification posed by its use on Mars surface. The resulting changes include, for instance, a dry lubricant and custom sintered bearings. "To put it simply, the motors need to be able to survive on Mars," Jonathan Jones says when

#### STEPPER MOTORS

Series AM1020  
Ø 10 mm, length 15,9 mm  
Output torque 1,6 mNm



succinctly summarizing the requirements that the FAULHABER drives need to meet.

And in order to ensure that nothing will be left to chance after the landing, the Mullard Space Science Laboratory is currently testing the components in the Panoramic Camera in a testing environment. The test conditions are even harsher than those on Mars. The positioning drives must complete 5,000 positioning cycles - with temperatures oscillating between -130 degrees Celsius and 50 degrees Celsius, of course. "The test is still ongoing, but the motors are really showing what they're made of," Jonathan Jones happily reports. During the development of the drives, there was nothing else on the market that could come even close to the FAULHABER units. Not to mention the fact that FAULHABER is already a go-to partner for the European Space Agency (ESA), which, together with the Russian Roscosmos space agency, is responsible for getting the ExoMars project to its launch pad by 2020.

#### FURTHER INFORMATION

MULLARD SPACE SCIENCE LABORATORY  
UNIVERSITY COLLEGE LONDON  
[www.ucl.ac.uk/mssl/current-projects](http://www.ucl.ac.uk/mssl/current-projects)

FAULHABER  
[www.faulhaber.com](http://www.faulhaber.com)

# PRECISION **IS A SWISS** **SPECIALITY**

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When satellites revolve around the sun, drive specialists and mechanical engineers inevitably think of planetary gearheads – the units with which speed-torque conversion can be performed with utmost precision. Within the FAULHABER Group, Swiss workmanship is a key component in the production of all geared parts. Rolla Microgear AG produces gears, output shafts, intermediate drives and sprockets made of various materials at their facilities in Grenchen. The region around Lake Biel is known as “Precision Valley” for good reason. It is the centre for watches and precision engineering in Switzerland.





Rolla Microgear has belonged to the FAULHABER Group since 2007 and, with more than 50 years of experience, is considered an expert in all matters related to gearing. "On the one hand, we supply precision parts for FAULHABER gearheads and, on the other, are a partner for other customers. For example, in this area we manufacture gears for our customers which make the connection between the motors and their application", explains Michaël Raymond, COO and plant manager at Rolla Microgear.

Normal practice often involves ordering gear motors that are appropriately designed for the application, which FAULHABER then delivers ready-for-installation. "Many customers must themselves, however, still procure the sprocket as the interface to the machine/application and then install it on the shaft", Raymond reports from experience. "In this regard, we would like to be able to recommend ourselves in the future even more as a complete supplier and actually deliver the complete drive train – including mechanical interface – together with FAULHABER."



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**MICHAËL RAYMOND**

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COO and plant manager  
Rolla Microgear

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Rolla Microgear is ideally equipped for these custom adaptations to gears and sprockets. The Swiss firm produces more than ten million components for FAULHABER gearheads alone. Typical gear series are produced in quantities of between 1000 and one million pieces, with diameters between one and 15 millimetres. The Rolla Microgear machine park is always state-of-the-art, forming the basis for the manufacture of small components made of brass, hardened steel or even stainless steel with maximum precision and repeatability. "Microgears are a Swiss speciality", Michaël Raymond proudly remarks. The associated expectations extend further, from production to testing. In the "Precision Valley", the 100% FAULHABER subsidiary monitors the products not only optically, but also with measurement methods that are much more precise, such as the dual flank test.

Even during the selection of materials for the high-precision geared parts, Rolla Microgear leaves nothing to chance. The blanks, which are transformed into their final gear shape in the gear cutting

machines, likewise have their origin in the FAULHABER Group and are produced from metal bars using long automatic lathes. "So-called Swiss lathes."

After turning the blank and subsequent milling the gear geometry in Grenchen near Lake Biel, the parts are far from ready for installation in a FAULHABER gearhead. The range of services provided by Rolla Microgear also includes heat treatment of the components and surface coating procedures. The parts do not reach the shipping department until the profiles are within the strict tolerance standards. "FAULHABER's demands are high", says the COO, who would therefore like to further incorporate his company's know-how in additional markets. "Everyone asks how they can best connect the gear motors to their machine. As system partner, we have the right answer."





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#### FURTHER INFORMATION

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Rolla Microgear AG  
[www.microgear.ch](http://www.microgear.ch)

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FAULHABER GROUP  
[www.faulhaber-group.com](http://www.faulhaber-group.com)

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## Rolla Microgear - Part of the FAULHABER GROUP

The FAULHABER GROUP is a leading technology and system solution partner for sophisticated mechatronic applications. With 19 companies and investments worldwide, the group has a global, high-performance know-how and production network with a total of over 1,900 employees. The portfolio of the group is divided into four business areas:

### Drive Systems

From powerful DC motors with 200 mNm of continuous torque to filigree micro drives with an outer diameter of 1.9 mm – the drive systems division has the most extensive range of technology for innovative small and micro drive solutions which is available worldwide from a single source under the FAULHABER brand.

### Micro Precision Systems

The MPS business area develops and produces micro-mechanical solutions for applications which require high-precision movements. The core competences of the division that can be found in different locations in Switzerland are based on eighty years of experience in the areas of miniature bearings and ball screws.

### Precision Components

The companies in this division are specialists in machining technology. Their focus is on the manufacture of miniaturised, high precision turned and stamped parts. Decades of experience and a modern machine park with high manufacturing depth make this business area a respected solutions partner for many different areas of industry.

### North American Operations Center

The North American competence centre of the FAULHABER GROUP concentrates on transforming customer needs into products with maximum added value with regard to their mechanical and electronic requirements. It works hand-in-hand with the customer's development teams, supported by the group's global network.



# DRIVERLESS RACING CARS

Driverless driving is a topic which is currently attracting a great deal of attention from experts and media alike. Driverless racing cars have now competed against each other for the first time in "Formula Student Driverless" in August 2017 in the "Formula Student Germany" competition at the Hockenheimring (Baden-Württemberg). These vehicles were built by teams of students. FAULHABER supported two of these teams: one from Stuttgart and one from Munich. Both teams received important technical components for their vehicles from FAULHABER.



## 9th place for the Munich team

Around 120 students from the University of Munich from a wide range of different degree courses such as vehicle technology, mechanical engineering, industrial engineering, computer engineering, design and business administration worked together under the name of munichMotorsport. The Formula Student Racing Team was founded in order to put the theory from lectures into practice. FAULHABER provided the munichMotorsport team with two motors including



the appropriate accessories for a driverless vehicle that took part in the "Formula Student Driverless" competition.

"The main focus of our team during the competition was on showing that we can build a driverless racing car", says team member Maximilian Steiner. The team succeeded in doing this, even though they were somewhat unlucky during the competition: They "only" managed 9th place in the event because of a cable break in one of the sensor systems. However, munichMotorsport team wants to compete with a driverless vehicle again in the coming season.

## 4th place for the Stuttgart team

25 students from different technical degree courses at the University of Stuttgart combined to form GreenTeam Uni Stuttgart. The team has been building racing cars for more than 50 years. Now they were faced with the task of converting their Formula Student racing car for highly-automated, i.e. driverless, driving round a circuit for the first time.

"We chose the FAULHABER 3274 ... BP4 brushless DC-Servomotor as the actuator for the steering. We installed this parallel to the steering column. It operates directly on the steering column using the planetary gearhead 38A (60:1) from FAULHABER and a spur gear stage that we developed ourselves", says Paul Melzer from the GreenTeam, explaining the technical details. The driverless racing car from the Stuttgart team achieved a respectable 4th place in the competition.

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### FURTHER INFORMATION

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FORMULA STUDENT GERMANY E.V.  
[www.formulastudent.de](http://www.formulastudent.de)

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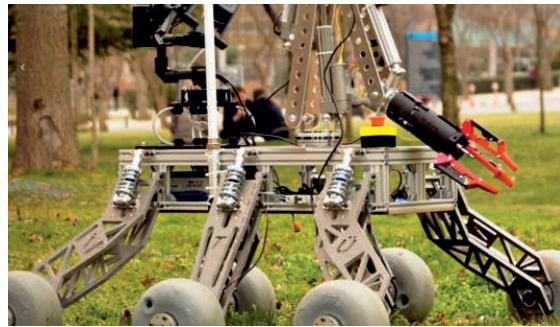


# VEHICLES

## FOR THE

### red planet

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Students at Istanbul Technical University (ITU) have developed the prototype for a Mars rover in which components from FAULHABER look after important functions. The ITU team successfully took part in the “University Rover Challenge” (URC) in the USA with this vehicle.

Specifically, the ITU team used six DC-micromotors with graphite commutation from series 3272...CR and the relevant gearhead to drive the six wheels, plus an additional unit for rotating the gripper. The sponsorship by FAULHABER was thanks to Turkish company ALTINAY, which has been a FAULHABER customer for many years. ALTINAY, which has been on the market since the early 1990's, is a pioneering company in the industrial robotics in Turkey, and is now one of the country's leading suppliers.

The student team from ITU took part in the “University Rover Challenge” (URC) in the USA with their “ALTINAY Mars Explorer” in June 2017 - and achieved a great result. Although they were the first Turkish team to ever take part in the competition, they achieved 4th place against 82 teams from 13 countries.



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#### FURTHER INFORMATION

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[URC.MARSSOCIETY.ORG/HOME](http://URC.MARSSOCIETY.ORG/HOME)  
[www.altinay.com](http://www.altinay.com)

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# BEACON LIGHTS OF THE MODERN AGE



There are 1 600 fixed beacon lights on the coast of Germany alone – and their glow extends far across the sea. The light must be visible from 23 nautical miles, i.e. approximately 40 kilometres. The distinctive lighthouses with buoys, satellite navigation and radar are part of a quartet that gives skippers the necessary orientation. The structures may appear old and dignified, but the technology inside is modern and robust. And anyone who has a look inside a lantern room along the French coast has a good chance of experiencing drive technology from FAULHABER. Find out more about this in the next issue of FAULHABER motion.



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#### Further information:



[faulhaber.com](http://faulhaber.com)



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



[faulhaber.com/youtubeEN](https://www.youtube.com/faulhaber)



[faulhaber.com/linkedin](https://www.linkedin.com/company/faulhaber)



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



**FAULHABER motion is now also available as an app.**

You can get the free download with this QR code.

