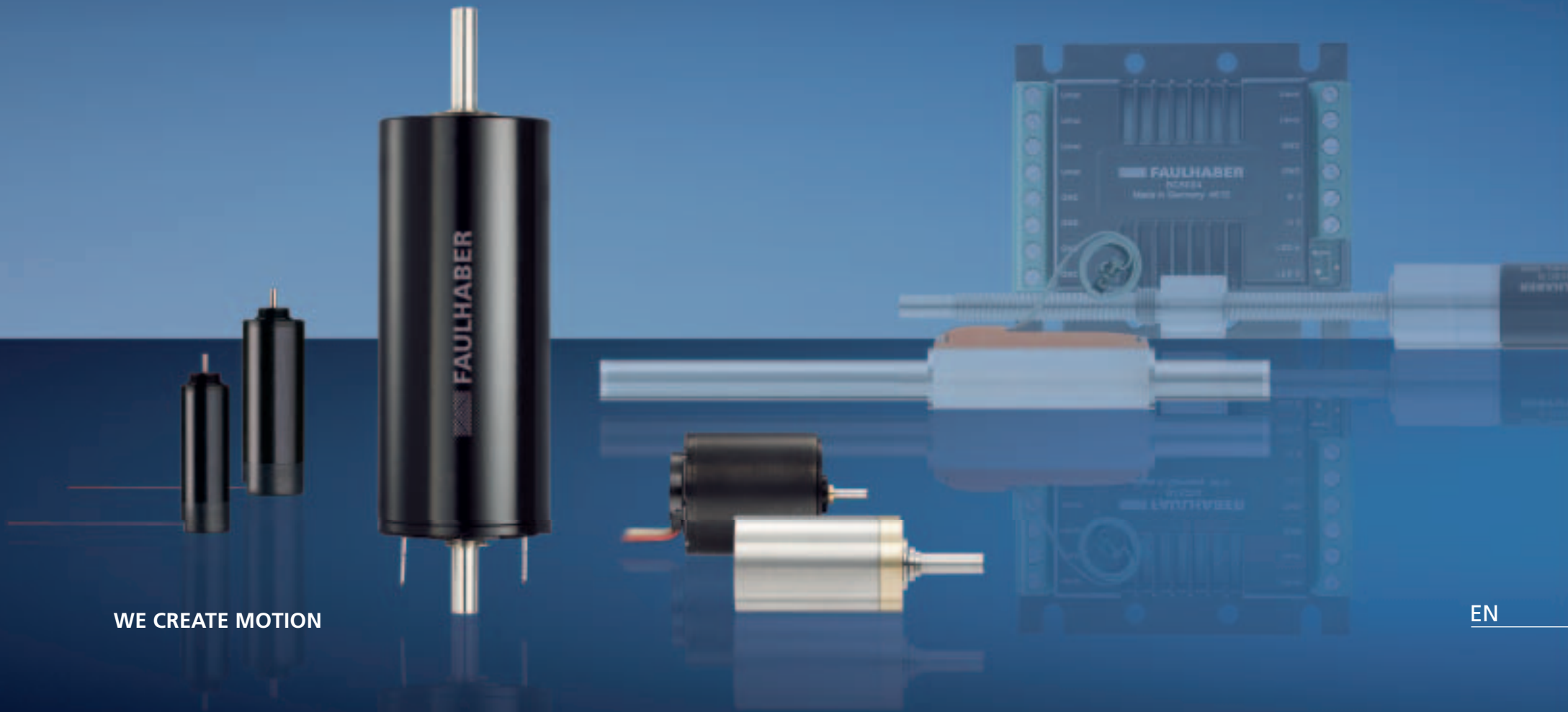


# Miniature Drive Systems



WE CREATE MOTION

Technologies driving the Future

Stepper

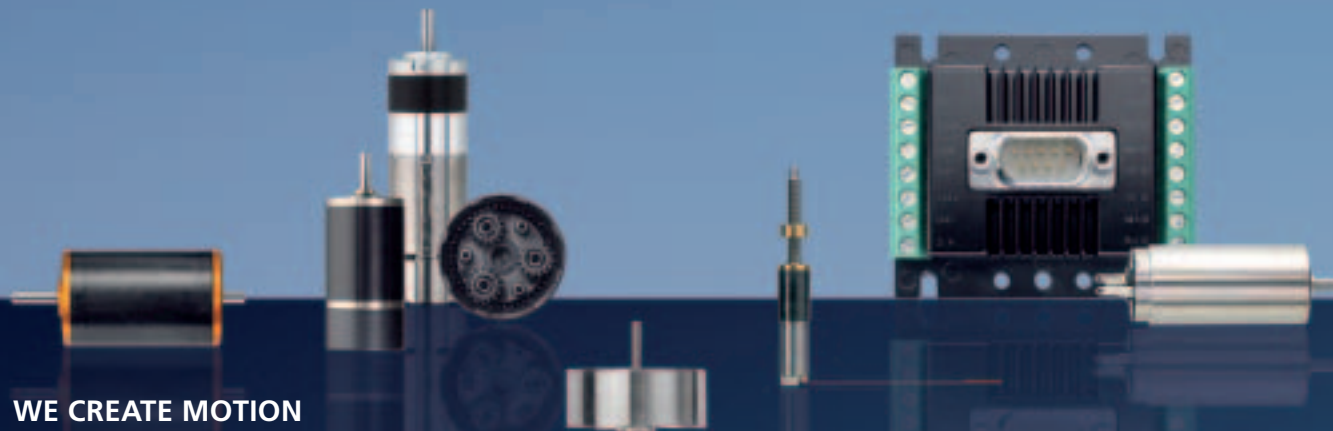
Piezo Motors

Linear DC-Servomotors

Micro Drive Systems

DC-Micromotors

Spur Gearheads



WE CREATE MOTION

Motion Control Systems

Brushless Motors

Planetary Gearheads

Flat DC-Micromotors

Motors

Drive Electronics

The success story of the „FAULHABER“ brand began over 60 years ago with the development of the self-supporting, skew-wound ironless rotor coil by Dr. Fritz Faulhaber. As a symbol of quality the brand is the cornerstone of FAULHABER's pioneering platform of innovative, high precision drive technologies which have unlocked new opportunities for a host of cutting edge applications.

*Some of Dr. Faulhaber sen. first models of the self-supporting skew-wound ironless rotor coil*

*Today, the tradition of ironless coil technology leadership is carried on using state-of-the-art development and production technologies*



# Seamless Partnership

## The optimal whole is the sum of unique parts

FAULHABER offers the largest consolidated portfolio of miniature and micro drive technologies available in the world today. This unique basis provides almost limitless possibilities for innovation.

Based on decades of application experience in a myriad of high-tech areas of application, FAULHABER develops new drive systems tailor-made to the ever more challenging needs of our customers. These drive systems find application in industries where high precision, reliability, and miniaturization are essential elements for success.



**WE CREATE MOTION**

*Drive Electronics*

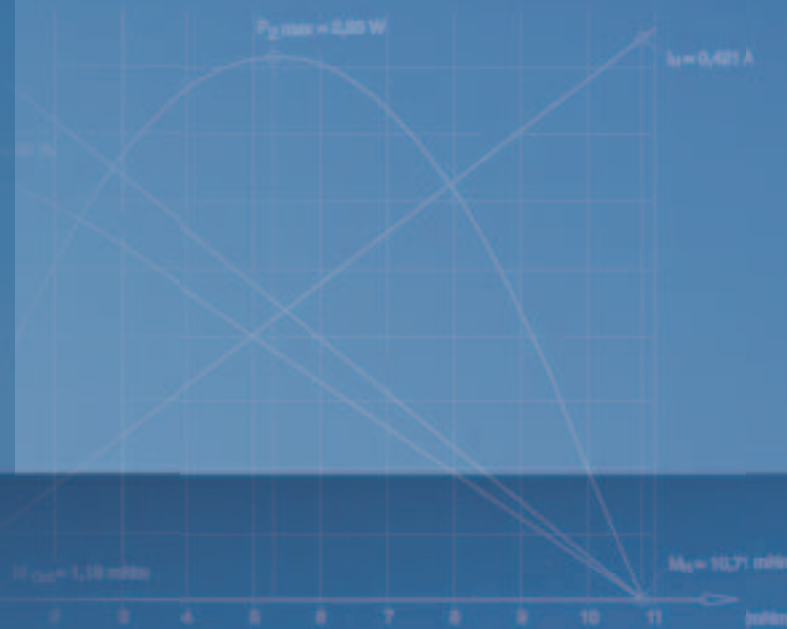


*Motor with integrated Encoder*

*Precision Gearhead*

**Commitment and experience define our mutual success**

The prerequisite for success is the dialog with our customers. Only through a focused exchange of information and ideas can the customer's needs be fully understood and the most efficient solution provided. Our staff is committed to providing their experience and know-how to understand our customer's needs and to help guide them to the best solution for their individual miniature drive system requirements.



# We create Motion

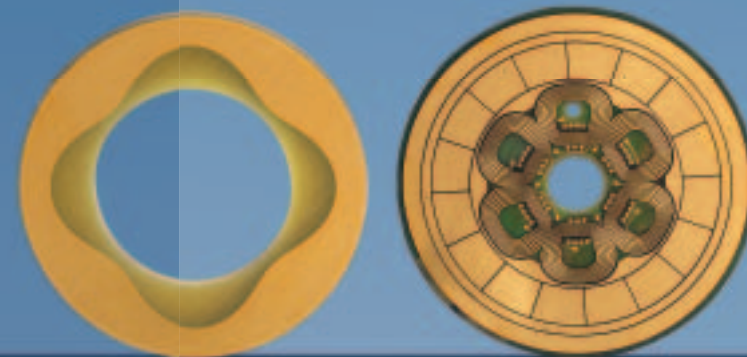
## **Moving in new directions for continuous innovation**

In each of its dedicated research and development departments FAULHABER is hard at work on the future of miniature and micro drive system technologies.

From the idea, to the prototype, and through to the innovative new products that we bring to the market year after year, FAULHABER utilizes state-of-the-art tools and methods to support and enhance its research and development capabilities. Computer aided 3D design, advanced simulation tools, and preventative methods like matrix FMEA's, are par for the course not to mention our uncompromising focus on quality and providing the customer with the most efficient production and logistical solution available.

## **Our philosophy is market driven technology leadership**

For over 60 years the name FAULHABER has been synonymous with inventions and innovations that have written countless chapters in the history of miniature and micro drive technology. The pioneering spirit of Dr. Fritz Faulhaber sen. that drove him to continuously set new standards in the market lives on today in the hearts and minds of our highly motivated and creative engineering team.





*Multiple awards for innovative development and implementation of detailed technical solutions*



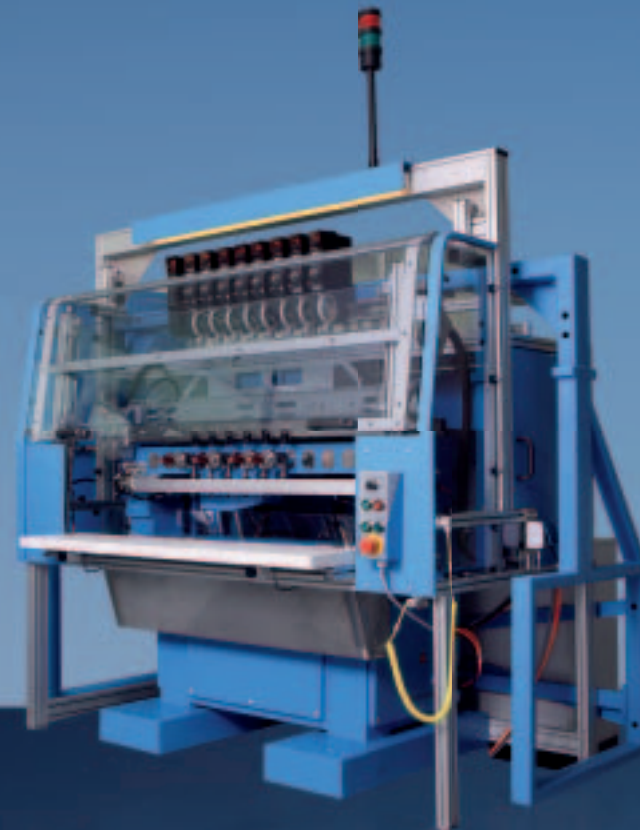
# The Standard is High-tech

## **The highest power in the most compact dimensions**

FAULHABER miniature and micro drive systems are electromechanical masterpieces. In today's high-tech market, miniaturization and an ever increasing need to integrate intelligent features into our systems are common challenges.

Through decades of research and development experience FAULHABER has acquired the high degree of know-how in the various specialized processes, manufacturing, and logistical techniques that are necessary to efficiently produce complex miniature and micro drive systems.

Our globalized network of state-of-the-art production facilities with 1,300 qualified employees provide an integrated, highly competitive, efficient production platform focused on on-time delivery and uncompromising quality.



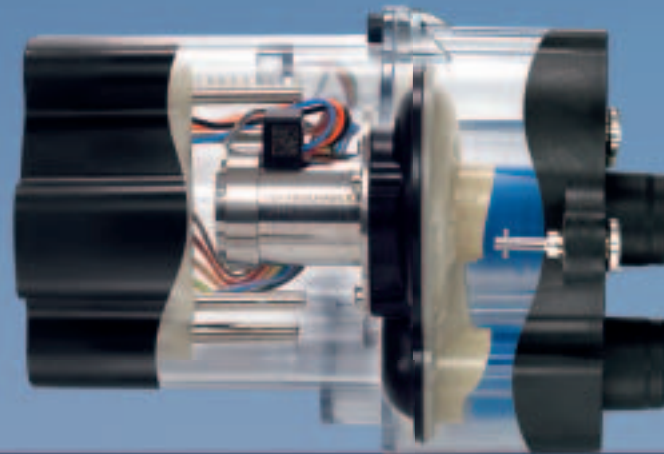
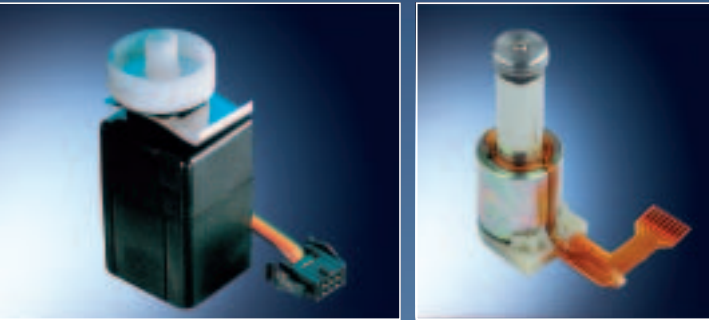




*Efficient and effective  
processes from manual pro-  
duction to highly automated  
production and testing*



# A Vision of Innovation



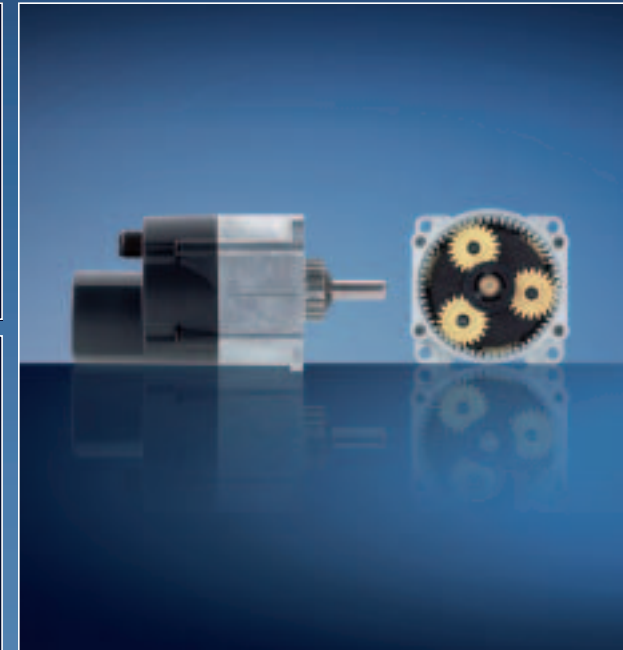
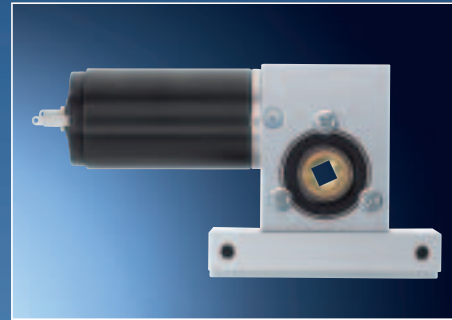
## **Unique applications demand unique solutions**

Decades of drive systems applications know-how and experienced engineers combined with the widest portfolio of high precision drive technologies in the industry, make FAULHABER the ideal partner for a multitude of custom drive system solutions.

## **We provide a strong basis for your success**

FAULHABER's service portfolio ranges from custom design of drive components to the design of complete drive systems based on strategic partnerships with our innovative customers which includes coordinated development and production support.

This close partnership in the creation of custom drive solutions provides our visionary customers the opportunity to focus on their core capabilities in order to assure the future market success of their product.



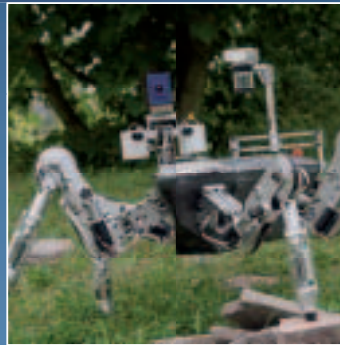
*FAULHABER completes  
the drive system with  
custom designed electronics,  
software and sensor  
components*

# Applications driving the Future



## Optical, Audio and Video

- Camera lens adjustments
- CCTV
- Concert lighting
- Film winders
- Microfilm readers
- Microscopes
- Movie & photo cameras
- Photographic aerial applications
- TV studio equipment
- Video recorders



## Factory Automation and Robotics

- Handling equipment
- Screwdrivers
- Remote inspection devices
- PCB automated handling
- Robots, educational robots
- SMD, SMT



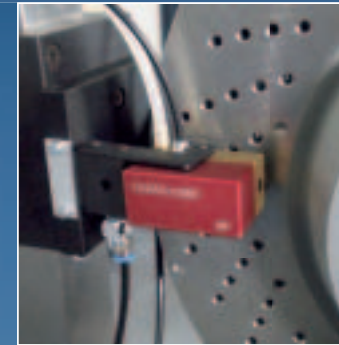
## Medical and Laboratory Equipment

- Analysis & dialysis equipment
- Arthroscopic tools
- Artificial limbs
- Blood extraction pumps
- Chemotherapy pumps
- Dental equipment
- EGG & EEG recorders
- Hearing aids
- Mammographs
- Ophthalmic tools
- Orthopaedic equipment
- Peristaltic pumps
- Respiratory aids
- Safety equipment
- Syringe drivers
- X-Ray equipment



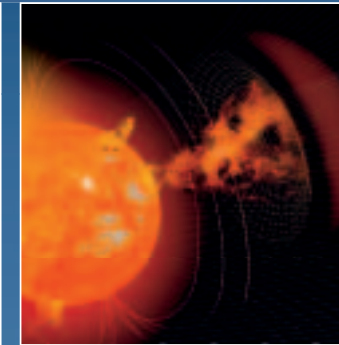
## Industrial Machinery and Equipment

- Automatic weighting systems
- CD production machines
- Industrial sawing machines
- Laser cutting systems
- Laser marker machines
- Paper industry
- Positioning devices
- Battery operated devices
- Power nailers
- Printing industry
- Surface roughness scanners
- Textile machines
- Tool changers
- Welding equipment
- Winding machines



## Instrumentation

- Balances, scales
- Densitometers
- Display boards
- Fibre optics splicers
- Geotechnical measurements
- Laser levelling devices
- Laser measuring equipment
- Measuring equipment
- Micrometers
- Valves
- Potentiometers
- Plotters
- Scanners
- Solar displays
- Photo spectrometers
- Surface roughness meters
- Thermoprinters



## Aerospace & Aviation

- Aircraft instrumentation
- Flap controls
- Flight recorders
- Flight simulators
- Gyros
- High altitude cameras
- Infrared pyrometers
- Radar
- Range finders
- Thermal imagers

Innovation in products and processes and a consistently high level of expertise are the driving force behind the success of FAULHABER in highly demanding fields of application.



### Environmental and Safety

- Air sampling monitors
- Emissions supervision devices
- Forced air gasmasks



### Office, Security and Communications

- Access systems
- Card readers
- Copiers & Printers
- Data processing equipment
- Data storage equipment
- Voice recorders
- Labelling & franking machines
- Personal emergency senders
- Locking systems
- Paper cutters
- Pagers
- Payphones
- Ticket printers & dispensers
- Vending devices

# Total Quality Commitment



**We believe that the commitment to total quality is the responsibility of each and every employee**

For FAULHABER, quality assurance is not just a technical certification but also an employee philosophy. An atmosphere of solution oriented cooperation and dialog contribute to the total quality consciousness that is embodied by each and every employee in our Group.

A clearly defined quality system supports our employees from the first contact with a customer through to delivery and after sales service and contributes to the uncompromising quality and high performance of our products and services.



Periodical ISO audits guarantee that we fulfill the accepted international standards and we profit from an external view of our management processes and procedures. The will for continuous improvement and the implementation of state-of-the-art test procedures enhances the value of our products and services for our customers.



*FAULHABER drive systems are considered components according to the EG rules for CE compliance. They are intended for use by our customers, who are considered experts in their individual fields of application, as an integrated part of an application and thereby do not require the CE mark*



# Naturally efficient

## The basis for a responsible use of resources

The reduction of CO<sub>2</sub> emissions and the responsible use of energy play a key roll in protecting our environment in all its natural beauty for future generations.

FAULHABER is doing its part through the conscientious development of highly energy and resource efficient drive systems which help to lower overall energy use in a myriad of high-tech applications.

FAULHABER maintains a high standard of environmental consciousness in each aspect of its organization. This transparent commitment to a responsible relationship to the environment is confirmed by our certification according to the ISO 14001 standard.

In practice for FAULHABER this means energy efficient production, disciplined recycling, and a commitment to energy efficient infrastructure and facilities worldwide.







*The most recent addition to the FAULHABER facility in Schönaich, Germany, was constructed with a conscious focus on energy and resource efficiency*



# DC-Micromotors

## DC-Micromotors

FAULHABER DC-Micromotors differ from conventional iron core DC motors in that the rotor consists of a self-supporting, skew wound copper coil.

Among the inherent properties of this pioneering design are an extremely low rotor inertia and zero cogging or preferred rotor position. These factors help to define the uniquely high, power to volume ratio of the motors as well as their extremely dynamic performance characteristics.

Due to low brush contact resistance the use of precious metals in the commutation system has proven very effective for power sensitive applications. Graphite brush systems achieve high operational lifetimes in areas of application where high power density and durability are required.



## Technical data

Outer diameter	6 ... 38 mm
Length	15 ... 90 mm
Nominal voltage	1.5 ... 48 V
Rated speed	10 000 rpm
Continuous output torque	0.11 ... 224 mNm



### Flat DC-Micromotors & DC-Gearmotors

FAULHABER flat DC-Micromotors are based on a unique, axial airgap, self-supporting, ironless rotor winding which provides all the advantages of a motor with an ironless rotor but in a very thin profile.

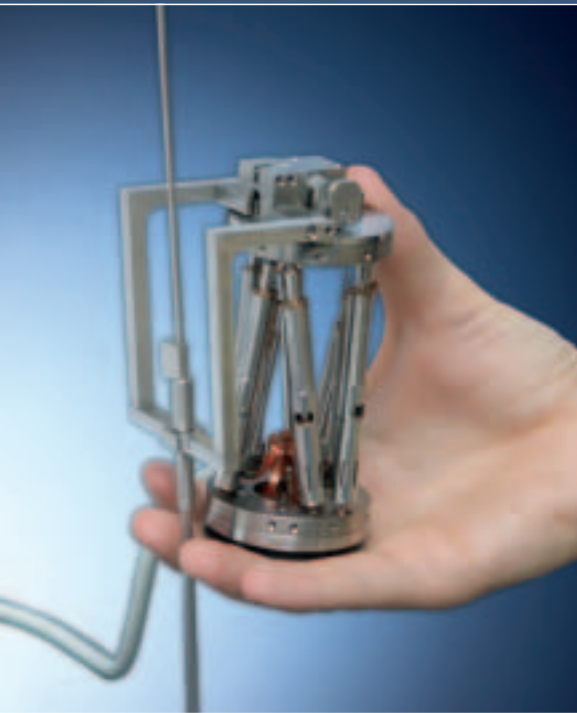
Advantages include an extremely low rotor inertia, zero cogging or preferred rotor position, low starting voltage and very low current. These factors in combination with their size and weight make these motors particularly suitable for portable battery operated devices.



Technical data	
Outer diameter	15 ... 26 mm
Length	5.5 ... 21.5 mm
Nominal voltage	3 ... 24 V
Rated speed	3 000 rpm
Continuous output torque	0.4 ... 100 mNm



# Brushless DC-Motors



## Brushless DC-Micromotors

With its light and compact design, the brushless smoovy® DC-Micromotor series has been specially developed for microtechnology applications.

As a standard for use in many applications the smoovy® platform includes versions with a micro planetary gearhead and a linear actuator version with an integrated lead screw and matching nut.

## Technical data

Outer diameter	3 ... 5 mm
Length	8.4 ... 14.6 mm
Nominal voltage	3 ... 6 V
Speed	up to 84 000 rpm
Continuous output torque	0.023 ... 0.2 mNm

### Brushless DC-Servomotors

FAULHABER Brushless DC-Servomotors are designed for demanding drive applications under extreme operating conditions. Aside from the standard motors with digital Hall sensors, they are available with a wide variety of standard executions including versions with analog Hall sensors or autoclavable motors.

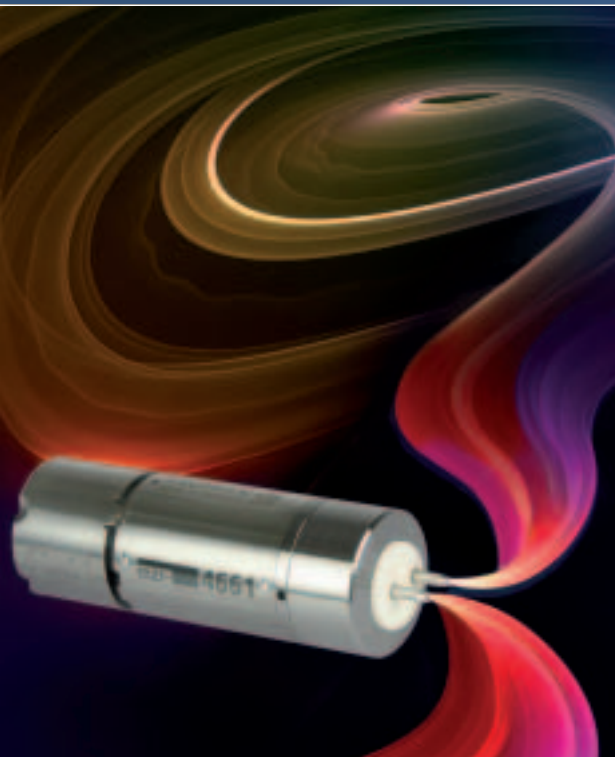
For highly demanding speed control or precise positioning applications, FAULHABER provides the most compact, fully-functional, integrated single axis position controller in the industry today. Standard communication buses include serial RS-232 or a CAN interface.

#### Technical data

Outer diameter	6 ... 44 mm
Length	18 ... 90 mm
Nominal voltage	6 ... 48 V
Speed	up to 100 000 rpm
Continuous output torque	0.36 ... 202 mNm



# Brushless DC-Motors



## Brushless DC-Servomotors, 4 Pole Technology

FAULHABER BX4 series motors are characterized by their innovative design and very high power density. Very few parts and robust construction provide for efficient production processes. Despite their compact size, the BX4 series delivers higher torque for a given size than conventional motors. This is due to their high torque 4 pole rotor design.

Thanks to electronic commutation the operational lifetime of the motors is many times higher than traditional brush commutated motors and they have a more smooth and quiet performance.

In addition to the standard motor, the BX4 series includes a full range of servo components such as combinations with integrated encoders, integrated speed controllers, gear-heads, and much more.

### Technical data

Outer diameter	22 ... 32 mm
Length	33.8 ... 85.4 mm
Nominal voltage	12 ... 24 V
Speed	up to 34 000 rpm
Continuous output torque	10 ... 97 mNm



### Brushless DC-Motors

In FAULHABER Brushless DC-Motors, the self-supporting, skew wound coil becomes a component of the stator. The mechanical commutation system is replaced by integrated speed control electronics.

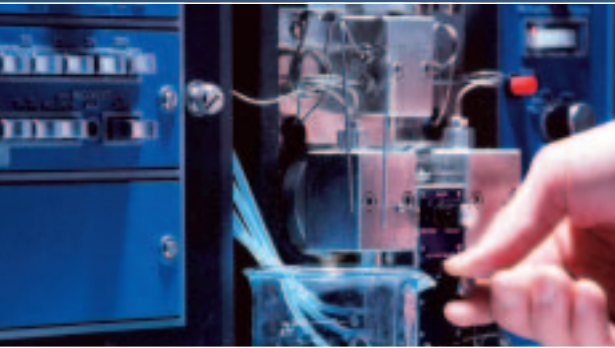
FAULHABER Brushless DC-Motors are highly reliable and are particularly suitable for continuous duty applications such as miniature pumps.

#### Technical data

Outer diameter	15 ... 31 mm
Length	25 ... 53 mm
Nominal voltage	6 ... 24 V
Speed	up to 16 000 rpm
Continuous output torque	1.8 ... 28 mNm



# Brushless DC-Motors



## Brushless Flat DC-Micromotors & DC-Gearmotors

Based on a flat ironless rotor these products are characterized by zero cogging, smooth performance and extremely small dimensions.

Thanks to electronic commutation these drives are particularly suitable for continuous duty operations in pumps and fans, high precision optical filters, choppers or scanning devices. The brushless flat DC Micromotors are also available as gearmotor version and optionally with integrated Speed Controller.



### Technical data

Outer diameter	3 ... 26 mm
Length	2 ... 22 mm
Nominal voltage	6 ... 12 V
Speed	up to 40 000 rpm
Continuous output torque	0.16 ... 100 mNm



# Motion Control Systems

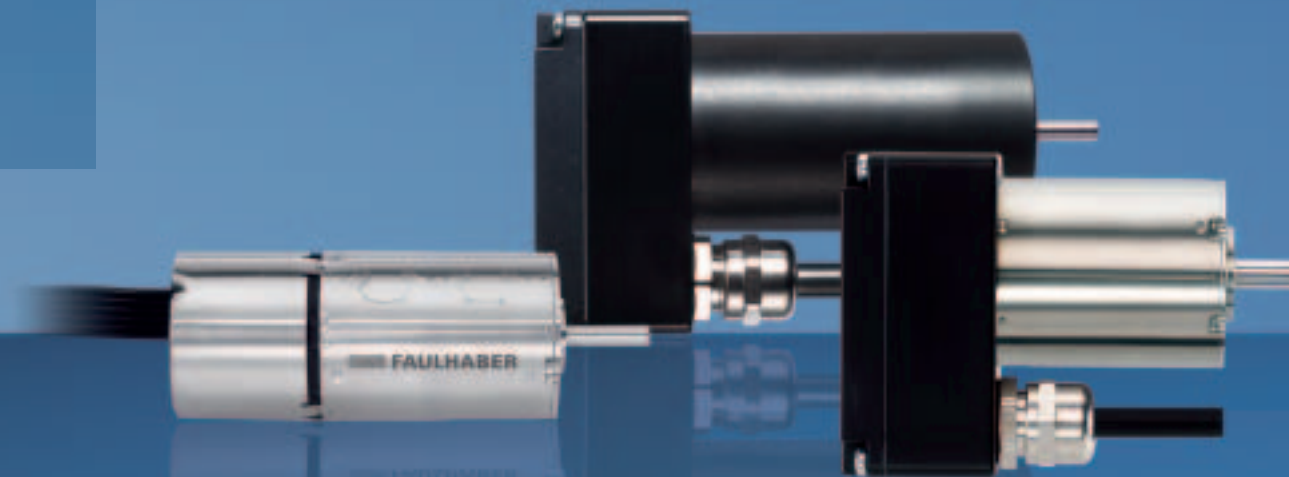
## Motion Control Systems

FAULHABER Motion Control Systems unit a powerful brushless DC-Servomotor, a high-resolution encoder and a programmable position and speed regulator.

As well as the familiar RS232 interface, the system is available with a CAN interface and CANopen protocol. The powerful motion controller, together with the valuator, permits a whole host of positioning tasks. The use of the latest DSP technology enables very high regular sensing rates and PWM frequencies that make the dynamic power pack score extremely well in terms of regulation and effectiveness.

### Technical data

Outer diameter	22 ... 35 mm
Length	49.6 ... 89.8 mm
Nominal voltage	24 V
Speed	5 ... 8 000 rpm
Continuous output torque	18 ... 96 mNm



# Stepper Motors

## Stepper Motors

PRECiStep® Two phase stepper motors offer high torque in compact dimensions. With sizes ranging from 6 mm in diameter they are the industry's most compact high precision stepper motor available today.

Robust assembly, high speed range, and exceptional performance in even the harshest environments make PRECiStep® drive systems the perfect solution for demanding positioning applications. They are available with a wide variety of modular servo components like encoders, zero backlash gearheads, integrated lead screws and much more.



## Technical data

Outer diameter	6 ... 22 mm
Length	9.6 ... 30.9 mm
Number of steps per revolution	20 / 24
Holding torque (boost)	0.2 (0.28) ... 22.0 (37.0) mNm



# Linear DC-Servomotors

## Linear DC-Servomotors

QUICKSHAFT® Linear DC-Servomotors bring linear motion to new dimensions. These high performance, miniature, linear motors consist of a solid stator housing and coil assembly and a multi-pole magneticforcer rod. High power magnets help the motor achieve its excellent force and dynamic speed performance.

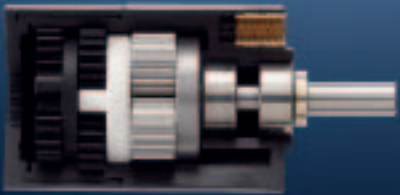
The motors are equipped with analog Hall sensors for position and speed control. FAULHABER completes the system with available electronics for high precision speed and position control.

### Technical data

Outer diameter	8 ... 20 mm
Length	33 ... 74 mm
Stroke length	15 ... 120 mm
Speed	1.8 ... 3.2 m/s
Continuous force	1.03 ... 9.2 N



# Precision Gearheads



FAULHABER develops high performance modular gearheads to complement each of its motor technologies.

From high torque planetary technology in a variety materials, to zero backlash spur gears, FAULHABER has the right solution.

## Technical data

Outer diameter	6 ... 44 mm
Reduction ratio	from 4:1 up to 983 447:1
Continuous output torque	0.015 ... 16 Nm



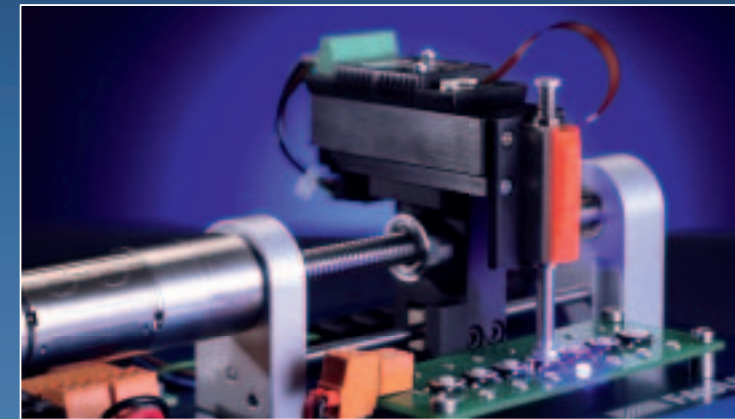
# Linear Components

## Ball Screws

Thanks to their high-precision mechanical design, FAULHABER ball screws are ideally suited for positioning tasks requiring a high degree of accuracy. Combinations with DC-Micromotors with high-resolution encoders, integrated Motion Controllers or Stepper Motors represent a superior system solution for the most demanding applications in optical systems, special machine construction, automation or medical technology.

### Technical data

Diameter	22 ... 32 mm
Stroke, standard	94 ... 130 mm
Continuous axial load, max.	105 ... 176 N
Linear speed, max.	125 ... 166 mm/s



# Encoders



## Encoders

The incremental shaft encoders in combination with the DC-Micromotors and Brushless DC-Servomotors are designed for both indication and control of both shaft velocity and direction of rotation as well as for positioning.

At the encoder outputs, two 90° phase-shifted rectangular signals are available with up to 1.024 impulses and an index impulse per motor revolution (3 channel version).

In the AES version (absolute encoder), absolute position information is provided per revolution.

Custom modifications including custom resolution, index position and index pulse width are possible.

## Technical data

Principle	optical, magnetic, Single Chip
Channels	2 ... 3 / absolute
Lines per revolution	16 ... 1 024 / 4 096 steps absolute
Frequency range	7 ... 430 kHz



# Drive Electronics

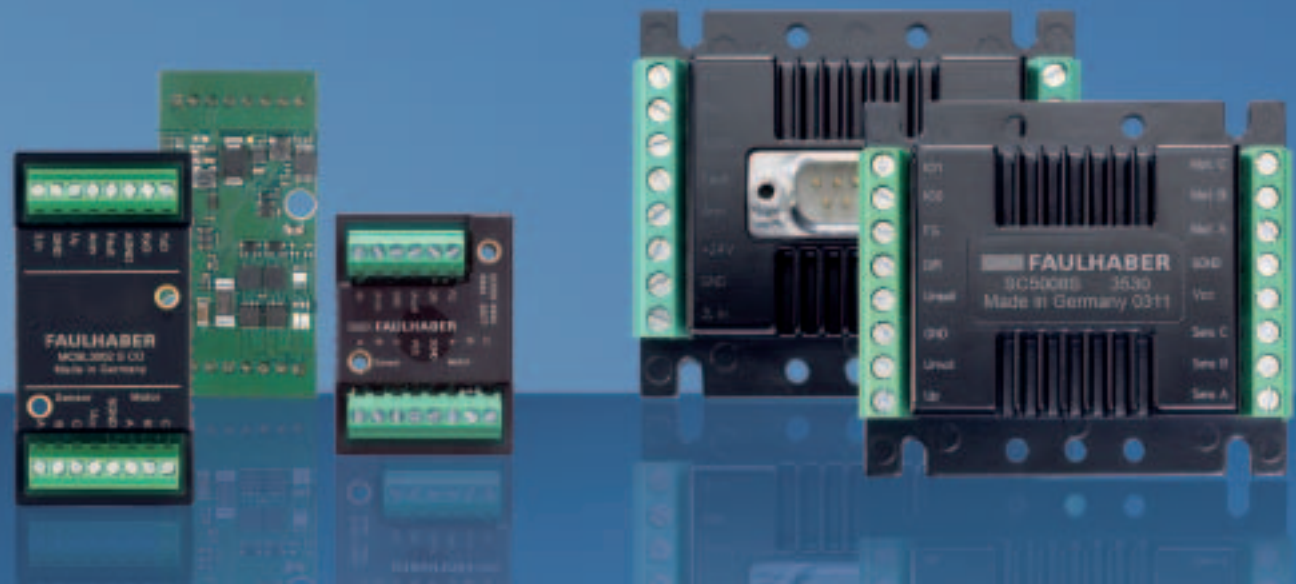
## Drive Electronics

Ranging from high precision positioning controllers and high resolution encoders to programmable speed controllers, the FAULHABER product range includes a large selection of high performance motion control electronics and servo components.

The FAULHABER „Motion Manager 5“ software provides an easy to use interface for anything from adjusting motor parameters to programming custom motion profiles and positioning sequences.

### Technical data

Power supply	4 ... 50 V
Continuous output current	up to 8 A
Interfaces	RS232 / CANopen



# Micro Precision Systems

## **mps Micromechanical Systems**

The mps range of micromechanical systems includes high-precision 4-point contact and linear ball bearings as well as ballscrews.

mps, with its roots in the Swiss watch and fine mechanics industry of the 1930's, is recognized as a global benchmark when it comes to the production of miniaturized components. It is renowned in particular for its expertise in centerless machining, which produces a degree of precision in circularity and concentricity that would be impossible to achieve with conventional methods.

This makes mps an experienced specialist in the development and production of high-precision miniature systems that are both complex and increasingly diminutive in size.



**WE CREATE MOTION**



# Piezo Motors

## Piezo LEGS®

Multiple bimorph piezo actuators form a single component with movable legs of ceramic “muscles”. Using direct drive, which makes gears or mechanical transmission unnecessary, the Piezo LEGS® is a motor technology for high accuracy positioning. The motion can be controlled down to the nanometer range. Durable materials ensure long service life with virtually no wear.

Piezo LEGS® is offered in linear or rotational versions and can be adapted to fit numerous customer specific applications.

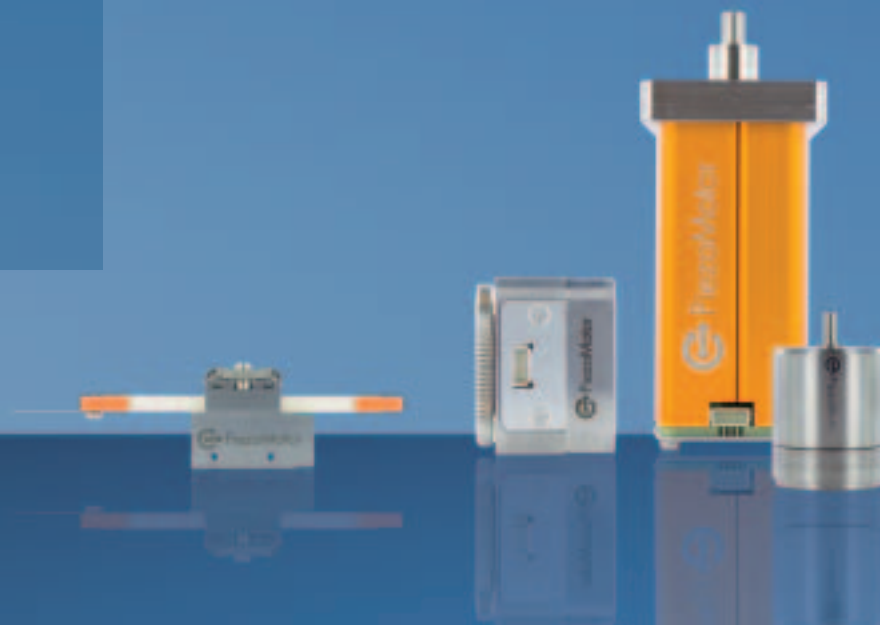
### Technical data

#### Linear piezo motors

Force	0.1 ... 450 N
Resolution	< 1 nm
Speed	nm/s ... mm/s

#### Rotary piezo motors

Torque	0.1 ... 80 mNm
Resolution	< 1 µrad
Speed	µrad/s ... rad/s



# FAULHABER worldwide

## HEAD OFFICES

**DR. FRITZ FAULHABER  
GMBH & CO. KG**  
Daimlerstraße 23/25  
71101 Schönaich · Germany  
Tel.: +49 (0) 7031 638 0  
Fax: +49 (0) 7031 638 100  
info@faulhaber.de

**FAULHABER MINIMOTOR SA**  
6980 Croglio · Switzerland  
Tel.: +41 (0)91 611 31 00  
Fax: +41 (0)91 611 31 10  
info@minimotor.ch

**MICROMO**  
14881 Evergreen Avenue  
Clearwater, FL 33762-3008  
Tel.: +1 (727) 572 0131  
Toll-Free: 800 807 9166



**WE CREATE MOTION**

## SUBSIDIARIES/PARTNERSHIPS



### SALES AND MARKETING

- **FAULHABER Singapore Pte Ltd**  
Singapore
- **FAULHABER France SAS**  
France
- **FAULHABER Drive System Technology  
(Taicang) Co., Ltd.**  
China
- **MINIMOTOR Benelux bvba**  
Belgium



### DEVELOPMENT AND PRODUCTION

- **FAULHABER Motors  
Hungaria Kft**
- **FAULHABER Motors  
Romania S.R.L.**
- **FAULHABER PRECISTEP SA**  
Switzerland
- **Rolla Microgear AG**  
Switzerland
- **Rolla Décolletage**  
Switzerland
- **PFM Automatismi SA**  
Switzerland
- **PiezoMotor Uppsala AB**  
Sweden

### MICRO PRECISION SYSTEMS

- **MPS Micro Precision Systems AG**  
Switzerland
- **MPS Décolletage SA**  
Switzerland





Representatives in more than 30 countries worldwide.

**DR. FRITZ FAULHABER  
GMBH & CO. KG**

Daimlerstraße 23/25  
71101 Schönaich · Germany  
Tel.: +49 (0) 7031 638 0  
Fax: +49 (0) 7031 638 100  
info@faulhaber.de

**FAULHABER MINIMOTOR SA**

6980 Croglio · Switzerland  
Tel.: +41 (0)91 611 31 00  
Fax: +41 (0)91 611 31 10  
info@minimotor.ch

**MICROMO**

14881 Evergreen Avenue  
Clearwater · FL 33762-3008 · USA  
Tel.: +1 (727) 572 0131  
Toll-Free: 800 807 9166

Your local contact

