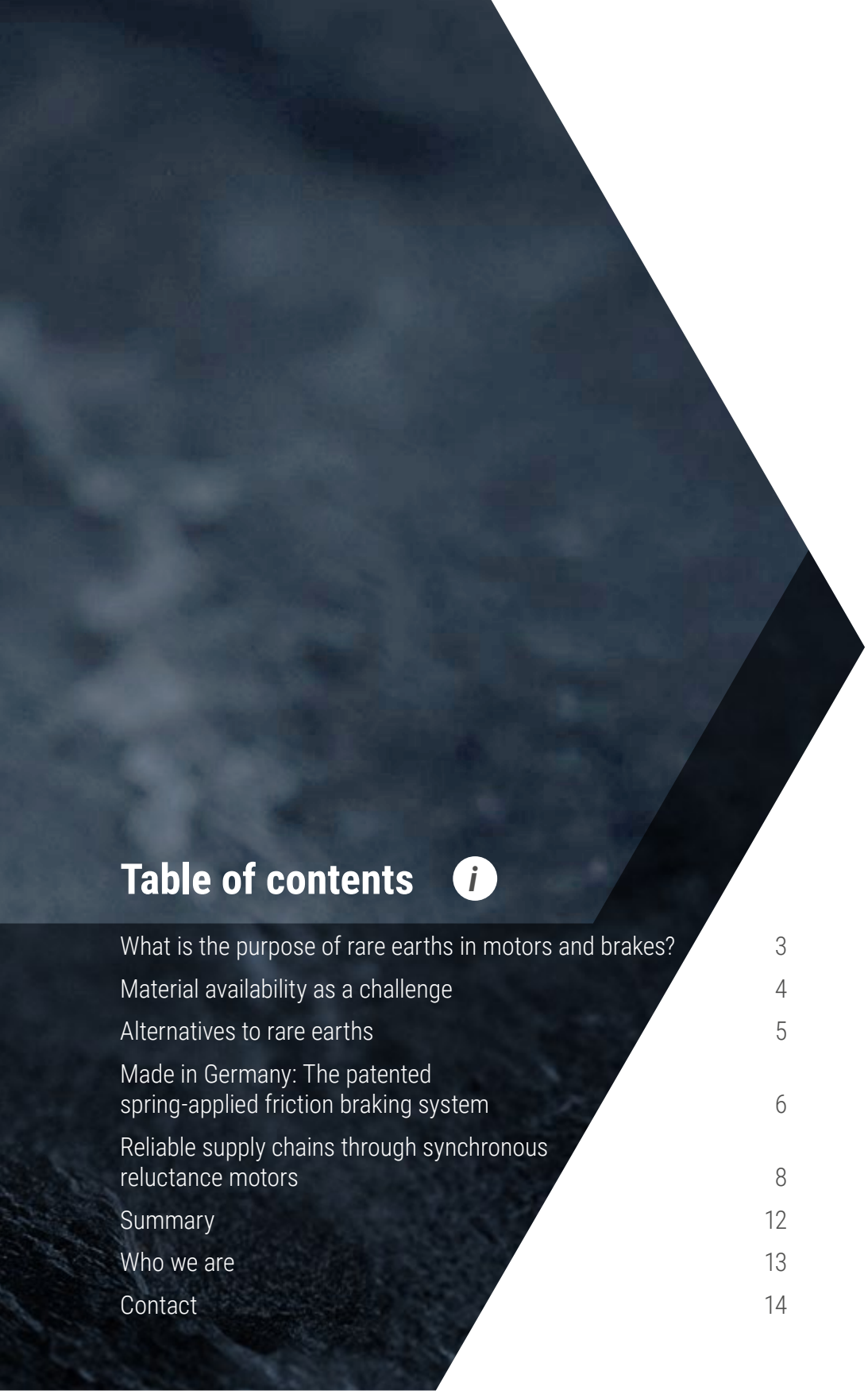
# Brakes and motors
# **WITHOUT RARE EARTHS**

Alternatives from KEB Automation
for reliable supply chains

#**KEB**white**paper** | EN



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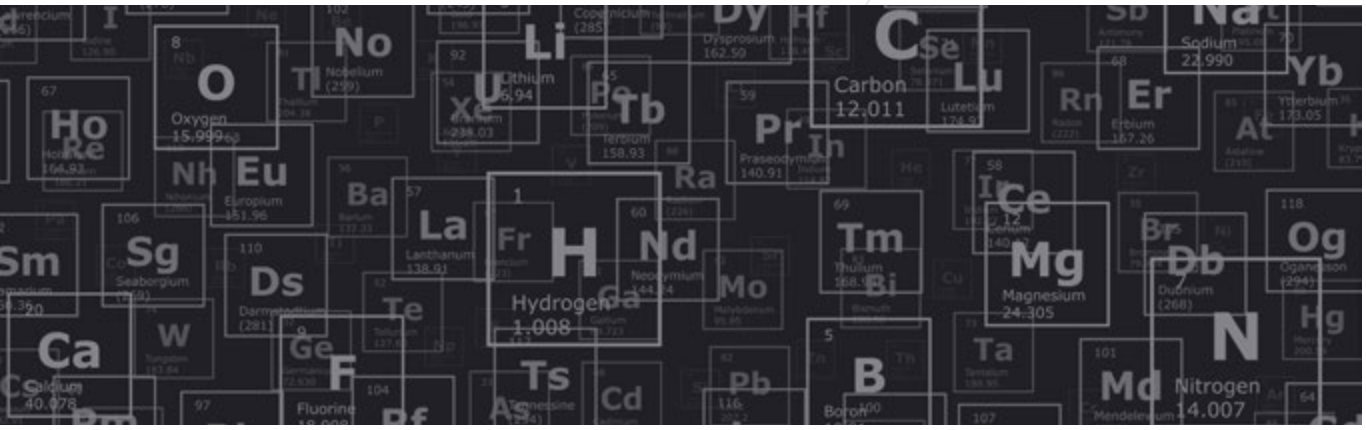
# What is the purpose **of rare earths** in motors and brakes?

**They are called neodymium, samarium or dysprosium: rare earths.** From electronics to energy solutions, they are found in numerous fields of application where they have long been proven due to their unique magnetic properties. Rare earths are also one of the essential materials used in permanent magnet brakes. Permanent magnets made of neodymium-iron-boron, for example, generate a magnetic field that acts on a counterpart such as the brake disc or the armature plate, thereby generating braking force through magnetic attraction. Eddy currents can also be generated. These arise when a conductive material moves through a magnetic field and counteract the momentum of movement.




Due to their magnetic effect, rare earths are also in demand in electric motors. Here, in the form of high-performance permanent magnets, they generate magnetic fields that cause the rotor to rotate and thus have a direct influence on the performance of the motor.

Lower efficiency losses or improved heat resistance of the magnets used can also be reasons for using rare earths in electric motors. Last but not least, motors with rare earths can be built compactly and lightly due to their high magnetisation, as they offer a higher power density.

# Material availability
## as a challenge

In its brake production, for example, KEB Automation relies on a very high level of vertical integration, but individual materials such as rare earths are imported from third countries. Changing geopolitical conditions are also changing access to rare earths. For example, stricter export controls are in place, which affect the availability of materials and result in longer delivery times. The availability of rare earths is also exacerbated by high and rising demand for these raw materials, as they are needed in various future-oriented technologies around the world – from electric mobility to smartphones and computers to wind turbines. Price fluctuations, which can lead to challenges in costing, are another factor that makes it difficult to source rare earths.

Against this backdrop, it is advantageous for KEB customers to communicate their planned requirements for products containing rare earths as early as possible in order to enable the best possible planning. KEB also advises users on the selection of suitable alternative components, which are usually available with shorter delivery times.

# Alternatives
## to rare earths

In the context of global supply chains and the changes to export regulations outlined above, the question increasingly arises:

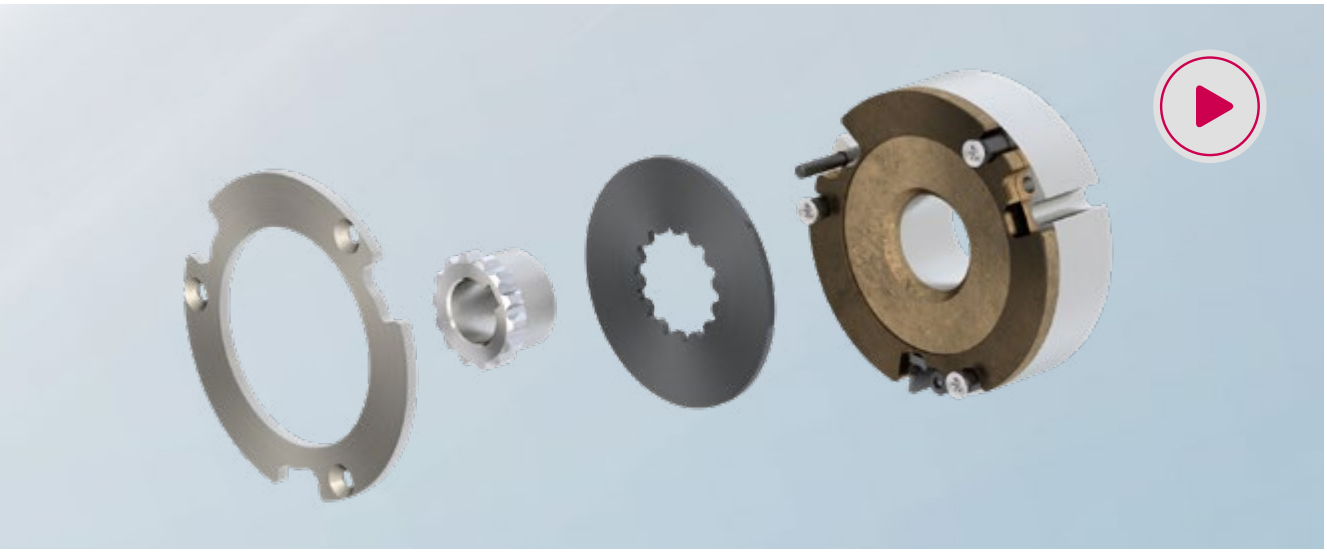
What **alternatives** are there? Are there **brakes** that **do not require rare earths**? How can the **availability** of electric motors be ensured even under **changing conditions**?

Of course, KEB's portfolio also includes permanent magnet brakes that require rare earths – the same applies to electric motors. However, KEB also offers brakes and motors that do not require rare earths, making plant and machine manufacturers completely independent of this material. Below, we present exciting alternatives that combine various aspects: the highest quality and performance with maximum independence from the availability of raw materials, which is difficult to plan for.

# Made in Germany:
## the patented spring-applied brake friction system

With a view to optimal planning and delivery times, brakes that are completely independent of materials such as rare earths are particularly interesting in light of current export regulations. KEB therefore offers an alternative to permanent magnet brakes with a high-performance holding brake, which features a patented friction system.

The big advantage: this is a spring-applied brake that does not require any magnetic materials and yet offers comparable performance to a permanent magnet brake in the same installation space. More torque and more emergency stops are achieved, as well as a high level of safety in the application.



Last but not least, the friction system reduces fine dust pollution to zero and ensures torque stability in the application across all temperature ranges. The friction system is a mechanical system that is used to safely hold the movement of a motor and makes the spring-applied brake a true high-performance holding brake. The principle behind the innovative system is based on the friction generated between the friction disc, armature and flange, whereby the kinetic energy is converted into heat and the movement is slowed down or stopped.

The friction system enables a torque range from 0.5 Nm to 60 Nm and creates ideal conditions for applications with increased safety requirements.

The friction system is 100 percent made in Germany. It was developed and manufactured in Barntrup and is a solution specifically designed for use in servo motors. However, the friction system is also used in automated guided vehicles (AGVs) or in robotics as a customised version. For the development of this spring-applied brake with stable temperature and friction coefficient, KEB has received the seal of approval from the Research Allowance Certification Authority, which certifies the innovative competence of companies.

Over 90 per cent of brakes and clutches are manufactured in-house at KEB. Thanks to this high level of vertical integration, KEB has access to every step of the manufacturing process and can make changes or adjustments quickly and easily. This ensures that the result meets the customer's wishes and technical requirements in the long term.

# Are ferrite magnets an alternative to rare earths?

Due to the limited availability of rare earths, the question arises as to whether alternative materials such as ferrite magnets can be used. In principle, these are conceivable in certain applications and can replace neodymium or samarium cobalt, for example.

However, there are some limitations in practice. Although ferrite magnets tend to be less expensive and more readily available, they have lower magnetic energy in comparison and are brittle and mechanically sensitive due to their nature. In addition, they require more installation space for the same magnetic force. This is an argument against the use of ferrite magnets, as compact design is particularly important in plant and mechanical engineering, and there are also high demands in terms of precise control. Against this background, the use of compact holding brakes with the performance of permanent magnet brakes is recommended as an alternative to rare earths.

# Brakes without rare earths?

## Our Head of Sales Kevin Zysk explains how this works


WHAT ELSE YOU SHOULD KNOW ABOUT THE INNOVATIVE FRICTION SYSTEM

- Plug&Play ensures quick installation
- Lower torque loss at 120 °C due to stable and high torque
- More emergency stops with higher energy ensure a longer service life
- Lower operating risks thanks to fail-safe
- No organic coating and less brake dust pollution

# Reliable supply chains through synchronous reluctance motors

Rare earths play an important role not only in the field of brakes. They are also found in many electric motors, as they enable permanent magnets, which in turn are relevant for the respective performance and efficiency of the motor. Lower efficiency losses or improved heat resistance of the magnets used can also be reasons for using rare earths in motors.

For optimum planning reliability and dependable supply chains, it is worth considering an alternative that does not require rare earths: the synchronous reluctance motor. Its simple mechanical design, easy maintenance and robustness are arguments that save time, material, costs and nerves in everyday practice. The motors deliver their best performance when used in combination with COMBIVERT F6 drive controllers from KEB. This is reflected in improved energy efficiency and particularly precise torque control in partial load ranges.

The reason why synchronous reluctance motors do not require rare earths lies in the design of the motor. This is essentially similar to the design of asynchronous motors. However, there are differences in the construction of the rotor. It has identical sectors with several different slots of varying dimensions and shapes and is not symmetrically distributed. The physical properties vary along the different directions within the rotor. The differences in magnetic conductivity – the reluctance torque – are exploited in a targeted manner. The reluctance is largely determined by the air-filled areas on the rotor sheet, which form a kind of magnetic barrier. This creates areas through which the magnetic flux flows preferentially.

## Kerim Demirtas explains the advantages of the synchronous reluctance motor

# **The synchronous reluctance motor –** integrated in system solutions from KEB

As a system provider, KEB offers complete solutions for plant and machine engineering based on the synchronous reluctance motor. The motors are always operated with an inverter, which is why the use of the **COMBIVERT F6 Drive Controller** is ideal. This creates a finely tuned drive system in which control, motor parameters and application-specific aspects interact. In the system, users benefit from sensorless safety technology *i* (e.g. Safely-Limited Speed), high efficiency and performance, and the option of supplementing the drive with control technology, brakes or IIoT solutions.

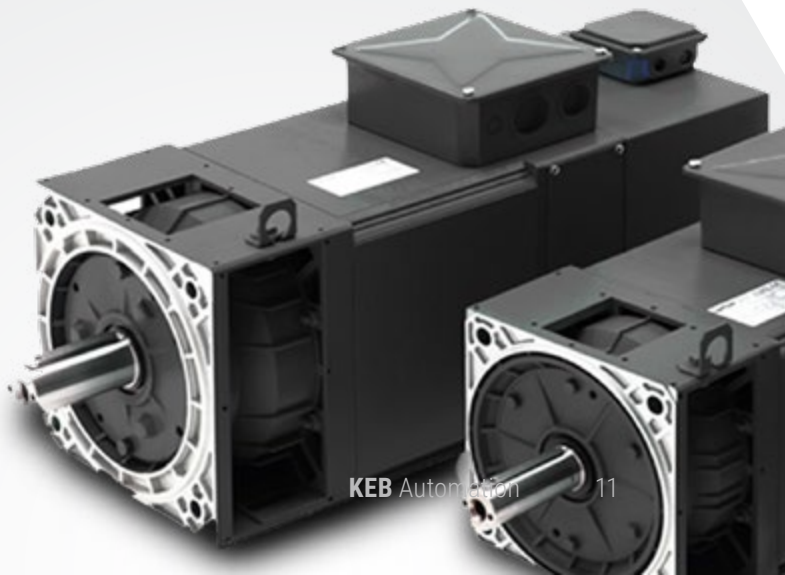
Another advantage: *i* thanks to its simple mechanical design, the synchronous reluctance motor has no rotor with magnets and, unlike the asynchronous motor, rotor losses are much lower. This results in significantly lower maintenance costs and maintenance can usually be carried out on site by the machine manufacturer.

## Where are KEB synchronous reluctance motors used?

The combination of the synchronous reluctance motor and other components from the KEB portfolio (COMBIVERT F6 drive controller or the open **NOA automation platform**) opens up efficient drive options for numerous applications. These include, for example, extruders in the field of plastics technology, packaging systems and wire and sheet metal processing. Woodworking machines, speed-controlled pumps, paper and cardboard production lines, machine tools and recycling plants are further possible applications for the motor. Depending on the requirements of the application, both converters and motors are available in different power classes and are individually tailored.

# Where are KEB synchronous reluctance motors used?

- Forced (internal) ventilation or water-cooled in the power range up to 500 kW
- Available in six speeds and seven sizes
- Very high efficiency (IE4)
- Perfect interaction with F6 drives from KEB
- Customised adaptations
- Vibration sensors and other sensors for condition monitoring solutions with NOA, F6 and the KEB software team
- Thanks to improved thermal behaviour, a longer service life for the bearings can be expected with lower maintenance requirements
- No special tools required to replace the rotor, unlike synchronous motors with magnets on the rotor

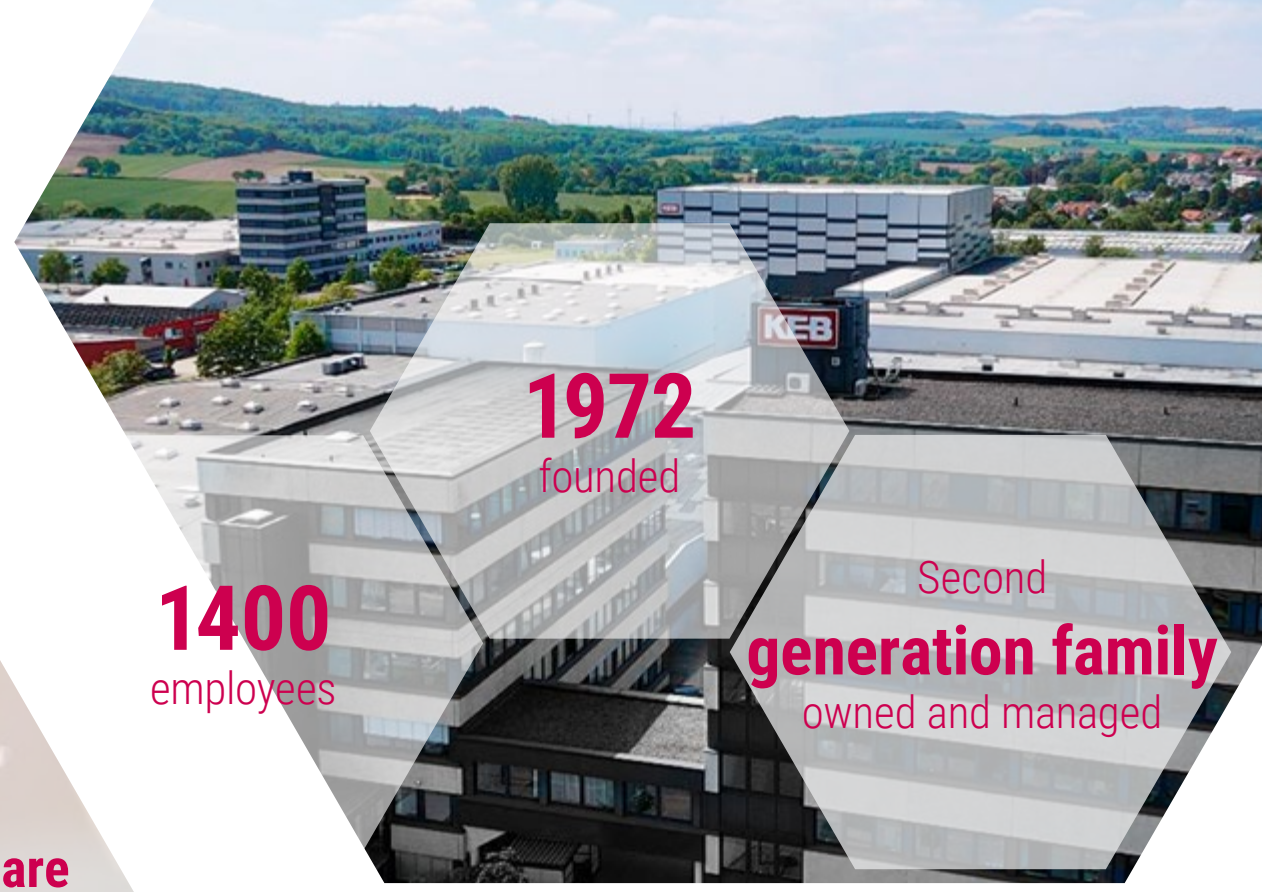


# **At a glance**
# Summary

Rare earths are often used in brakes and electric motors. The reason for this is the special magnetic properties of the material. Geopolitical changes are also affecting the availability of neodymium, dysprosium and other rare earths. Tighter export controls are impacting supply chains and thus delivery times.

In many cases, brakes and motors that incorporate rare earths can be replaced by products that are completely independent of this material. This improves delivery conditions and makes planning much easier for suppliers and users. In the field of brakes, spring-applied brakes offer a genuine alternative to permanent magnet brakes. The brake has a patented friction system and offers comparable performance to permanent magnet brakes in the same installation space. The result is more torque, more emergency stops, a high degree of safety in application and independence from rare earths.

Synchronous reluctance motors also create independence. They are an exciting alternative to electric motors in which rare earth permanent magnets are used. The design of the synchronous reluctance motor does not require these materials, and the motor itself impresses with its simple mechanical design, easy maintenance and robustness. The motors deliver their best performance in combination with COMBIVERT F6 drive controllers from KEB.




## Who we are

# KEB Automation

KEB Automation is a supplier of drive technology and stands for tailor-made automation. Plastics machinery, wood processing, process technology and intralogistics, as well as wind energy and e-mobility, are just some of the areas of application in which KEB's products and applications are in demand.

KEB offers complete solutions tailored to individual needs – from IIoT to hardware and software in the field of control and automation to reliable drive controllers, powerful motors and gearboxes, and high-quality brakes and clutches.

Karl-Ernst Brinkmann – KEB for short – founded the company in 1972 to develop, produce and distribute electromagnetic clutches and brakes. Drive technology was added in the 1980s, followed by a factory for gear motors in 1993 and control technology in the 2000s. In 2017, Karl E. Brinkmann GmbH became KEB Automation.

The addition of "Automation" to the company name underlines its active focus as a system supplier for mechanical and plant engineering.
KEB attaches great importance to research and development. The company participates in various research projects and is one of 27 core companies in the leading-edge cluster it's OWL – Intelligent Technical Systems East Westphalia-Lippe.

Starting with six employees, the company has developed into a globally active medium-sized enterprise with twelve subsidiaries and more than 50 partners worldwide. Around 1,400 employees – including around 850 at the headquarters in Barntrup (North Rhine-Westphalia) – now work at KEB. The company is owner-managed in the second generation of the family.

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