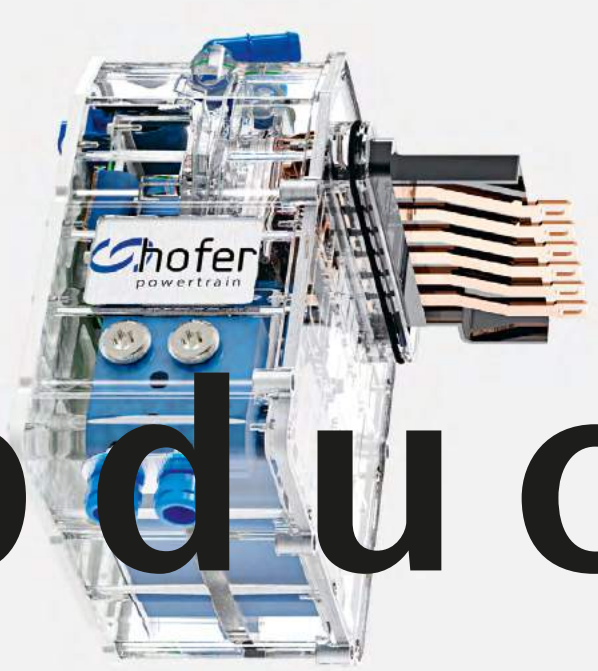
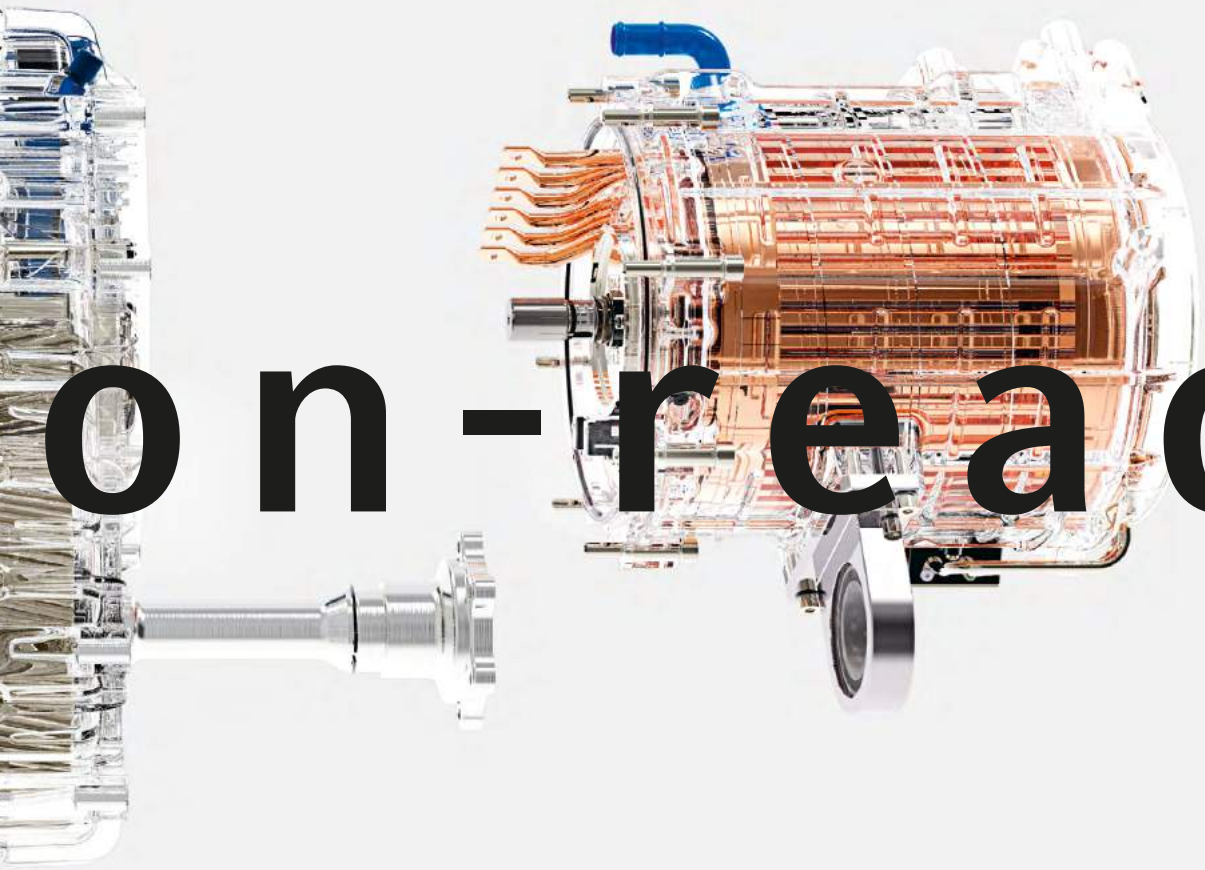


producti

Electromobility is one of the keywords that comes up in any discussion about the future of the automotive industry. Yet many people are not aware of the fact that this technology was actually discovered a long time ago. The first electric car, known as the Trouvé Tricycle, could be found on the streets of Paris way back in 1881. It reached an impressive top speed of 12 km/h and had a range of up to 26 kilometers. Due to the success of the combustion engine, however, this alternative technology remained firmly on the shelf until its renaissance a hundred years later. Vehicles equipped with cutting-edge electric powertrains are enjoyable to drive, and most importantly they come with an extended range – a technological advance that is speeding up the process of transformation in the automotive industry.



on-ready

Effective research and targeted development are paving the way for zero-emissions mobility. They underpin industry efforts to deliver efficient vehicle electrification and transform the entire automotive sector. The task facing companies in this industry is huge, as they not only have to adapt to these changes but must also drive the transformation of their products and processes.

Synergies can be harnessed wherever the whole is greater than the sum of its parts, as Aristotle put it. For this reason, partnerships are an important way of opening up new areas of expertise, combining the respective strengths of individual companies, and expanding the way we look at complex technical relationships. This was exactly the principle that led ElringKlinger to acquire a 27 % stake in hofer powertrain, Nürtingen, Germany, at the beginning of 2017. As a system developer and supplier, hofer powertrain is a highly innovative company that proactively shapes technological developments. It is a global ideas factory, whose expertise ranges from the traditional manual gearbox and modern double-clutch transmissions through to ground-breaking solutions for hybrid and electric vehicles. The company's activities range from the development of electric drive systems combining power management electronics, the transmission, and an electric engine all the way through to system integration. The company set its sights on advanced technologies such as these at an early stage and now supplies customized systems for high-end sports and luxury car applications. "Thanks to our technological edge and the successful field trials that we have already conducted, we believe we are seeing a new dimension of driving pleasure, and we want to integrate this experience as soon as

»Our vision is to deliver future technologies today, all ready for series production – that's what drives us every day.«

Wolfgang Stephan, Chief Technology Officer, hofer powertrain

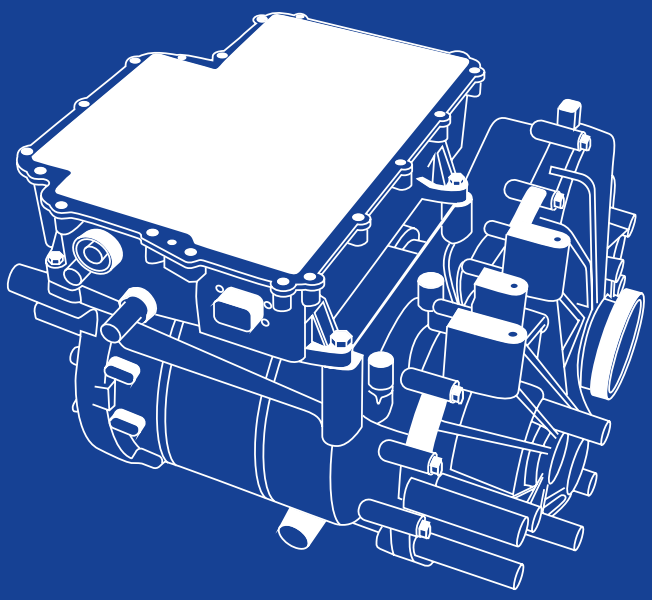
DR. HEINZ SCHÄFER
ELECTRIC DRIVE SYSTEM DEVELOPER

Energy is mass times the speed of light squared. This physics equation is as famous as the person who first wrote it down in 1905 – Albert Einstein. The challenge we work on every day is to put that energy to efficient use on the roads.

4 seconds

To do that, we have already developed a complete system that allows us to accelerate an electrically operated vehicle from 0 to 100 km/h in just four seconds with hardly any noise. The car starts delivering torque immediately with no vibration, no interruption to power delivery, and regardless of rotational speed. In total, four electric motors are built into the vehicle – one for each of the wheels. The vehicle's on-road dynamics are improved by means of short drive shafts. That means all four wheels can be controlled separately in response to the specific driving situation.

To achieve perfection in an electric drive, all the systems must be logically dovetailed. For this reason, we also have the corresponding software technology to provide smart control of power flow.



Mobility of the future – ready for series production. Proven systems expertise. Energetics and dynamics in perfection.

ULRICH SAUTER,
GENERAL MANAGER OF HOFER POWERTRAIN PRODUCTS GMBH (NÜRTINGEN, GERMANY)

hofer powertrain and ElringKlinger bring together demonstrable development expertise and methodological skills, extensive materials know-how, many years of production experience, and a proven track record in multidisciplinary interaction – a perfect match that will help us to successfully navigate the path towards electromobility. Together, we have set ourselves some very ambitious growth targets.

2 Production facilities

To achieve this, we have established a very close partnership based on trust. Our first step will be to prepare our current assembly line in Germany, which so far has only handled small-scale orders, so that it can deal with larger production volumes. We are also setting up a production facility in the UK. The second step will be to penetrate the Chinese and North American markets. At the same time, drawing on the ElringKlinger Group's manufacturing strength, we plan to keep expanding the division's vertical range of manufacture and harness additional synergies.

Effective research and targeted development are paving the way for zero-emissions mobility. They underpin industry efforts to deliver efficient vehicle electrification and transform the entire automotive sector. The task facing companies in this industry is huge, as they not only have to adapt to these changes but must also drive the transformation of their products and processes.

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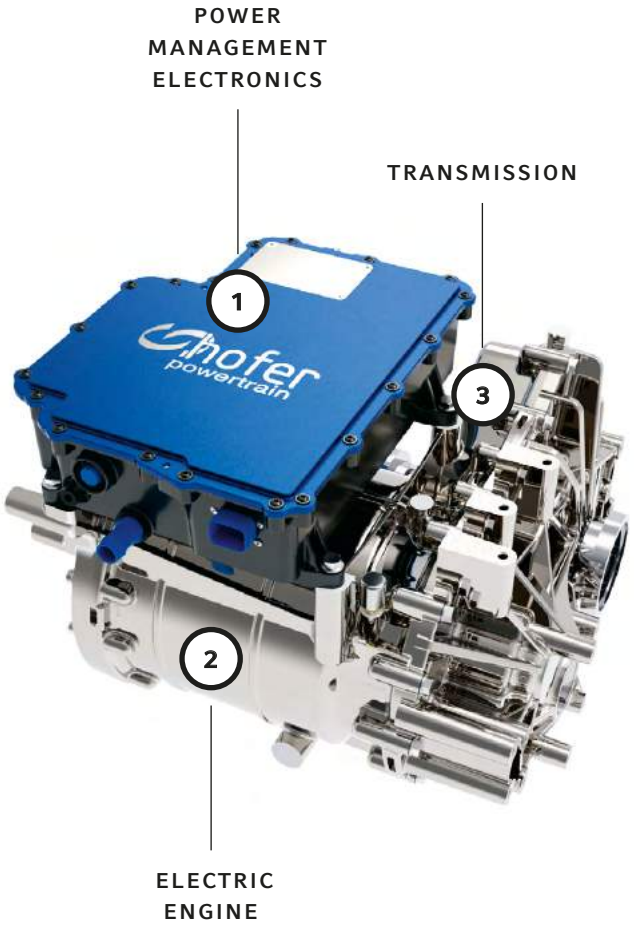

ELECTRIC DRIVE UNIT

hofer powertrain already supplies production-ready electric drive units. That includes customized solutions for high-end sports and luxury car applications. The electric drive unit includes (1) the power management electronics, which provide overall drive control and convert the direct current in the high-performance battery into three-phase AC power. (2) The electric engine then converts this electrical energy into mechanical energy. The job of transferring the torque to the wheels is performed by the (3) transmission.

»By combining know-how with development and production expertise, we are evolving together as a provider of complete e-mobility solutions.«

Armin Diez, Vice President New Business Areas, ElringKlinger AG

possible into other models of vehicles," explains Wolfgang Stephan, Chief Technology Officer at hofer powertrain.

In the past, due to the relatively modest volumes of the orders involved, the company relied on a relatively small manufacturing workshop to translate its development ideas into products. However, hofer powertrain's expertise and success have placed increased demands on operations. At series production level, you need greater standardization and automation, and there are new technical demands. As development cycles become shorter and shorter, the success of an order depends crucially on being ready for series production when the customer needs your product. For this reason, the overall time frame has to be planned systematically in advance. The organizational framework and main processes are specified in a multi-project plan. The early involvement of industrialization experts from the production subsidiary hofer powertrain products GmbH is crucial, as they are responsible for process development and for creating the infrastructure needed to optimize series production from a cost perspective. By way of example, a modular development structure is a critical advantage. The more an overall system can be structured in the form of modules, the more its assembly processes can be standardized and existing production facilities used for other projects. "Working together, we were able to lay the main organizational foundations within both companies in a very short time – even before the market for purely electric vehicles grew to any significant size," explains Armin Diez, who heads up ElringKlinger's New Business Areas unit. "That means there are no longer any obstacles to our working together on complex orders."

ULRICH SAUTER, GENERAL MANAGER OF HOFER POWERTRAIN PRODUCTS GMBH (NÜRTINGEN, GERMANY)

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