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OPTIMUM ACCURACY AT EVERY OPERATING POINT

DeepDrive relies on KiTorq torque measuring system from Kistler in electric motor testing



Precision and efficiency throughout the measuring chain: the KiTorq torque sensor from Kistler (not visible in the photograph) also plays its part in testing DeepDrive's electric motors.

DeepDrive, a trailblazing German high-tech company, opts for the KiTorq torque measuring system from Kistler to test electric motors that feature revolutionary motor topology. Kistler's torque sensor – which delivers contact-free measurements – demonstrates its strengths on the test stand to ensure efficient optimization and validation of these high-performance dual-rotor drives.

How can we exploit electric mobility to the full, extend the driving range of electric cars and boost their efficiency? Many developers and observers are still asking themselves these questions – but only a few have come up with answers. DeepDrive, the Munich-based high-tech company, is already one step ahead of the field: founded in 2021, the firm's workforce has already grown to over 70 employees. DeepDrive has raised capital from high-profile backers including BMW i Ventures and Continental's Corporate Venture Capital (CVC) unit, and is involved in development projects at eight out of the world's ten major automobile manufacturers. Thanks to DeepDrive's patented Dual Rotor technology, driving ranges can be extended by as much as 20 percent – and the revolutionary electric motor winding concept cuts the amount of magnet material used by 50 percent.

Maximilian Habersbrunner is the company's Electrical Hardware System Engineer and one of its co-founders. He recalls the early days: "We got to know one another almost a decade ago while we were students at the Technical University of Munich, when we were members of the TUfast Formula Student Racing Team. After having gained around ten years' experience in the automotive industry and large-scale series projects, the time had come for us to pursue our own idea. Munich is an ideal environment for technology start-ups – the networks are great, and there's plenty

of know-how around." DeepDrive definitely sees itself as far more than a mere hardware supplier: it is set to become the category leader in electric motors for the automotive industry and aims to be a fully-fledged technology enterprise with future industrial production on a large scale. Series production of electric vehicle drives is scheduled to begin in 2026, with the first small series set to start in 2025.

Longer range at lower cost with less material

The electric motors are available both for in-wheel integration and as central units – and to test them, DeepDrive relies on the KiTorq torque measuring system from Kistler. The measuring flange system offers measuring ranges of as much as 10,000 Nm and rotational angle resolution of up to 8,192 pulses per revolution. These advantages guarantee the accuracy and performance needed to determine efficiency maps and optimize the performance of the powertrain. Based on the high-resolution encoder output – combined with a torque signal – the speed and efficiency of the device under test can be calculated very precisely. "We were really delighted to get fast support from Kistler in the middle of the pandemic, when many companies were having delivery problems," according to Habersbrunner (who is also responsible for DeepDrive's test stands).

DeepDrive operates a KiTorq torque measuring system with a measuring range of 2,000 Nm to validate the torque output from the motors – for example, on the RM1800 19-inch in-wheel motors with maximum torque of 1,800 Nm. "The key features for us here are the wide measuring range and the ability to deliver accurate measurement values even for small torques – so we really can measure reliably at every operating point. The torque



Seven founders, one goal: the Munich-based company DeepDrive, which has grown to around 70 employees since 2021, is set to give electric mobility a boost with its highly innovative drives.



DeepDrive's revolutionary electric drives are available both for in-wheel integration and as central drive units.

measuring system has been operating since summer 2022, and it's a perfect fit for us. In particular, it gives us the advantages of contact-free measurement without bearings – so it only takes a few minutes to change the DUT (device under test). The signal quality and measurement deviation are also outstanding," Habersbrunner is pleased to report. "On the one occasion when we had a fault, Kistler's service team responded rapidly and the repaired sensor was back with us within a few days."

"To win the trust of the major OEMs, of course, it helps to have measurement technology that is known and proven throughout industry – as is the case with Kistler."

Maximilian Habersbrunner, Electrical Hardware System Engineer, DeepDrive

In the meantime, the tests on DeepDrive's 48-V low-voltage system, using the KiTorq torque measuring system, have been fully completed, and the test phase for the 400-V high-voltage system has begun. Another feature of these very compact high-torque drive units is that they simplify the powertrain as a whole, so less space is needed in the vehicle; even the hydraulic brake systems become superfluous, because everything runs via the motor control. Furthermore, the design of the electric motors means they can be mass-produced with maximum cost effectiveness and resource efficiency. This is achieved by combining an inner and outer rotor with two air gaps, resulting in optimum material utilization and system efficiency levels of over 97 percent. Last but not least, the noise emissions are very low: vehicles powered with the help of DeepDrive technology would be virtually silent on the road.

Best torque measurement technology for high efficiency levels

The next milestone for DeepDrive is a large-scale series order for a renowned automobile manufacturer. "To win the trust of the major OEMs, of course, it helps to have measurement technology that is known and proven throughout industry – as is the case with Kistler. Whenever new requirements come up, we get in contact with Kistler directly. This will be important in the future, when we'll be looking to step up the automation of our test setup on

the test stand, and as soon as we embark on high-volume series production of electric motors – with the help of a partner at the outset," Habersbrunner continues.

In principle, there are no limits to the applications for DeepDrive's Dual Rotor technology: for instance, it could also be deployed in the highly dynamic aircraft market for UAVs (unmanned aerial vehicles), drones, air taxis, and the like. "We intend to become a leading supplier of electric motors not only for the automotive industry, but for other sectors as well. To start with, we're focusing on a vertical approach within the automobile industry – partly because of our automotive experience and the networks we have in place," Habersbrunner explains. As soon as DeepDrive begins series production in 2025, more products and solutions from Kistler's Advanced Manufacturing range may well come into play. Integrated application-specific force sensors, electromechanical joining systems and the matching process monitoring systems are the keys to sustainable optimization of quality, resource efficiency and transparency in industrial production.

Precision, flexibility and process reliability: torque measurement with KiTorq

Kistler's torque measuring flange system, comprising a rotor and a stator, allows highly dynamic torque measurements.



Kistler's KiTorq torque measuring system, comprising a rotor (above) and a stator (below)

Key features:

- Modular combinations of different rotors and stators are possible
- Measuring range from 50 to 10,000 Nm
- High resolution of 8,192 pulses per revolution
- Contact-free signal transmission

Thanks to the integrated CAN bus, users can tare and change measuring ranges remotely so that multi-range efficiency maps can be recorded automatically.

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