Press Release

Bochum, December 14, 2022

New charging technology enables range of 400 km after 15 minutes charging time

As part of the research project "Direct Superfast charging for the Electric vehicle", the participating cooperation partners developed a new charging technology and a vehicle prototype to store the energy required for a real 400 km range in just 15 minutes.

The aim of the research project "Direct Superfast charging for the Electric vehicle" (abbreviation "D-SEe"), funded by the German Federal Ministry of Economics and Climate Protection, was to reduce the charging time for 400 km of real driving performance to 15 minutes. Within four and a half years of research work, the participating cooperation partners Bochum University of Applied Sciences, hofer powertrain, innolectric, Keysight Technologies, Sensor-Technik Wiedemann (STW), and Voltavision have analyzed and optimized the entire energy flow chain from the power grid to the charging electronics and the charging cable to the vehicle battery. The result is a fast-charging station with 450 kW charging power and a prototype vehicle suitable for reproducibility, which together are able to charge the energy required to drive 400 km into the vehicle battery in just 15 minutes.

State-of-the-art and project objective

For a range of 400 km and the 88 kWh usually required for this, the charging process at charging stations with a power of 50 kW takes more than one and a half hours. Porsche's Taycan 4S is faster, charging at an average of just under 170 kW between 0 and 80% charge. Since a maximum of 150 kW of this power is actually stored in the battery, the Taycan would need at least 35 minutes to charge 88 kWh - if its battery were large enough. "The challenge of the research project was to further optimize this charging power and, to this end, to modify and further develop the electronic components, charging cable technology and vehicle battery that have been common on the market to date," says Prof. Dr.-Ing. Kai André Böhm, professor at Esslingen University of Applied Sciences and project manager of the "D-SEe" research project. Every component used had to meet the high project requirements and was thus subjected to the most exacting tests in terms of efficiency, costs, comfort, and service life. Existing norms and standards also had to be taken into account, such as the standard-compliant implementation of DIN SPEC 70121, which defines the basics of DC fast charging.

Research and development work

Böhm describes the fact that all of the companies have been active in the field of electromobility for years and were able to contribute their in-depth expertise to the research project as a clear advantage. If the components commonly available on the market were not

suitable for project implementation, the project went into in-house product development. For example, the Bochum-based company innolectric developed a new standard-compliant charging communication system, the DC Charging Controller, specifically for the fast charging process.

Keysight Technologies designed new advanced power electronics for the fast-charging process, which enables power of up to 450 kW reliably over longer periods of time due to Silicon Carbide (SiC) technology. As a result of this technology, the prototype vehicle from Bochum University of Applied Sciences can be powered with around 400 kW of power at 460 A and up to 900 V. This would overload a normal vehicle with a common vehicle battery by a factor of four because the power loss in the battery increases by approximately quadratically with the charging current.

The appropriate battery type was developed by hofer powertrain and the University of Bochum. The aim was for the vehicle battery to have an optimum power-to-energy ratio, thus enabling an efficient compromise between heat generation, service life, and range. The various cell formats that made it to the shortlist were tested by the high-voltage test service provider Voltavision. The standardized and automated test procedures were modified again and again during the research project and in some cases newly developed by Voltavision. The final battery prototype now shines with cells with a P/E ratio of 3.5 and an energy density of 210 Wh/kg. The new high power prototype battery with Li-Io technology has a voltage of 645-903 V and can hold around 128 kWh. Various strategies for the actual charging process were also tested by hofer powertrain and employees of the Bochum University of Applied Sciences. The selection of the cells allows a charging process with a constant current of 460 A due to the optimal P/E for the fast charging process. It was possible to dispense with an elaborate cooling concept, as the battery temperature only rises by 26 °C during the fast charging process. The appropriate Battery Management System (BMS), which enables high voltages and maximum charging power, was implemented by the company Sensor-Technik Wiedemann (STW).

Result

"We are pleased that we were ultimately able to exceed our targets during the four and a half years of the project," explained Kai André Böhm at the final presentation of the research project at Voltavision in Bochum, "because with an average discharge power of 70 kW and a discharge energy of 90.3 kWh, we achieve an overall efficiency of 92 %." In addition, all the companies involved benefit from the research and development work carried out as part of the project. The development of new test methods, high-end charging electronics, and a new communication module, in addition to a real 410 km range (WLTP: 564 km) at 88+ kWh and 15 minutes charging time, are definitely interesting project results that will influence the development of eMobility.

"I assume that this fast-charging technology will be found in passenger cars in the future," said Christoph Dörlemann, Section Manager Technology Center of Keysight Technologies, when asked to what extent implementation in series production is conceivable.

Those interested in the topic can register for the webinar "D-SEe research project: new charging technology enables 400 km range after 15 min charging time" via the following link. The speaker is Prof. Dr.-Ing. Kai André Böhm, professor at Esslingen University of Applied

Sciences. Participation is free of charge. More information about the project can be found at www.dsee-project.com.

Project Partner

Hochschule Bochum
Institut für Elektromobilität

About Hochschule Bochum

Electromobility is a research focus of Bochum University of Applied Sciences. Through the Institute for Electromobility, the university has positioned itself as a competent contact for research and development on the topic of electromobility. Our activities focus on the development, construction, and testing of electric vehicles and components as well as sustainable, digital, and networked mobility and energy solutions.

The vehicles designed and manufactured at the institute in research and industrial projects serve a wide range of vehicle classes and application scenarios. For example, in addition to solar-powered racing vehicles (SolarCar project), an electric quad (Karo), a small electric transporter with wheel hub drive (BOmobil) and an electric trailer for inner-city freight transport (ZemiSec) have already been developed. The focus of development is on the design and construction of the electric drive train and component development.

hofer powertrain

About hofer powertrain

hofer powertrain is a system supplier, engineering, and technology partner for efficient powertrain solutions covering all classes of electrified vehicles. The company's primary goal is to increase the efficiency of e-mobility with future-oriented solutions. This goal is achieved through a unique, in-depth knowledge of the complete powertrain system, including software, functions, and vehicle integration from pre-development to SOP and beyond. This holistic powertrain expertise is represented worldwide by expert teams in Europe, Asia, and the United States.

About innolectric

Started as a spin-off of a leading developer of test systems for electric drives, innolectric combines the dynamics of a young company with the expertise of an experienced player in electromobility. The core competence comprises the development and production of components along the electric power train. Power electronics and charging communication are the focal points of the portfolio. In addition, innolectric offers engineering services for issues related to electromobility. A deep understanding of electromobility, personal enthusiasm, and a high sense of responsibility are the basis on which innolectric brings its projects to life.

About Keysight Technologies

Keysight delivers advanced design and validation solutions that help accelerate innovation to connect and secure the world. Keysight's dedication to speed and precision extends to software-driven insights and analytics that bring tomorrow's technology products to market faster across the development lifecycle, in design simulation, prototype validation, automated software testing, manufacturing analysis, and network performance optimization and visibility in enterprise, service provider and cloud environments. Our customers span the worldwide communications and industrial ecosystems, aerospace and defense, automotive, energy, semiconductor, and general electronics markets. Keysight generated revenues of $5.4B in fiscal year 2022. For more information about Keysight Technologies (NYSE: KEYS), visit us at www.keysight.com.

About Sensor-Technik Wiedemann

As a medium-sized and internationally operating company, Sensor-Technik Wiedemann (STW) is a leading supplier of electronic products, systems, and solutions for mobile machines. STW specializes in the automation and digitalization of machines and their work processes. The compatible STW modular system enables the custom-fit and user-friendly solution for the markets and applications of the future. In partnership, STW supports customers in the development and integration of their innovative applications.

About Voltavision

Voltavision is an independent development and test center for power electronics and energy storage. With our services, we support manufacturers, developers, and suppliers of automotive and industrial applications in the development and validation of their products. Together with our customers, we develop strategies for efficient and meaningful testing of battery systems and power electronics. For this purpose, our highly motivated team operates state-of-the-art test benches with voltages of 0...1000 V, currents of ±3.6 kA, and powers of up to ± 1.2 MW at three locations throughout Germany. Complex lifetime and performance tests for mobile and stationary applications are carried out in climatic and temperature chambers of up to 30 m³. With our business units Testing, Product and Consulting, we want to move our customers forward so that the technology change proceeds as quickly as possible.

Image Material

On the website https://www.dsee-project.com/press-information/ you can download the high-resolution images listed below.

Figure 1: The BOmobil was specially equipped for the "D-SEe" research project with a new and powerful battery to enable fast charging of 15 minutes for a 400 km range.

Photo: Voltavision GmbH

Figure 2: The BOmobil stands in front of the container that contains the charging electronics for the fast charging process.

Photo: Voltavision GmbH

Figure 3: The BOmobil was charged "live" as part of the final presentation of the research project. The exact measured values of the charging process can be read on the monitor.

Photo: Voltavision GmbH

Figure 4: Prof. Dr.-Ing. Kai André Böhm talking to the trade press about the D-SEe research project.

Photo: Voltavision GmbH