Application Note
Fuel Cell Emulation

Tektronix® + Elektro-Automatik

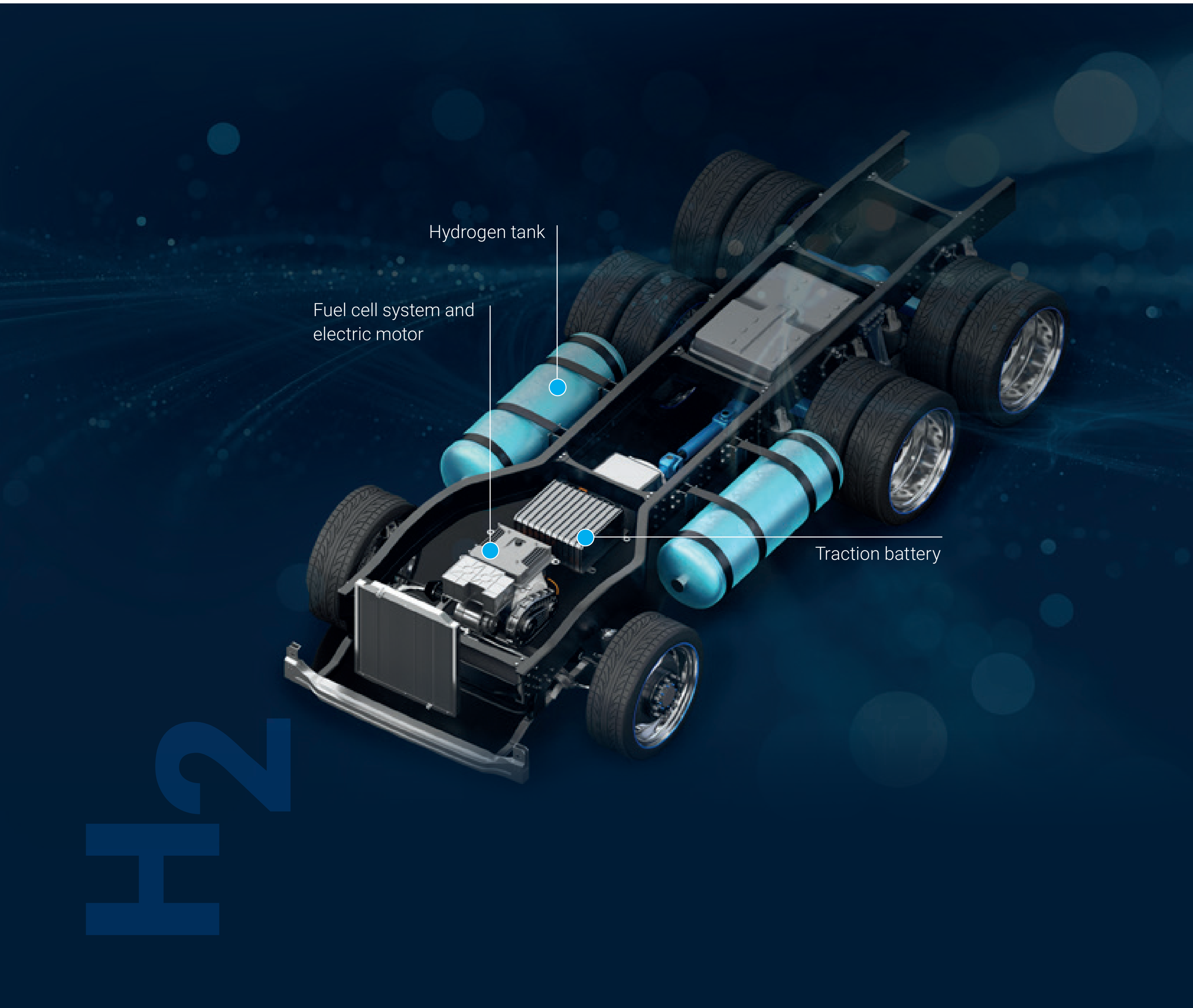
Fuel Cell Technology

A fuel cell is an electrochemical device that converts the chemical energy of a fuel (typically hydrogen) and an oxidizing agent (usually oxygen) directly into electricity. In addition, heat is generated and water is released. Due to their efficiency and environmentally friendly characteristics, fuel cells are used in a variety of applications like transportation, stationary power generation or space exploration.

Fuel cells are advantageous because they produce electricity with high efficiency and no emissions, compared to conventional combustion-based power sources. This makes them an attractive option for sustainable energy solutions and helps in contributing to the reduction of greenhouse gas emissions and dependence on fossil fuels.

Fuel cell System

A powertrain using fuel cell technology typically consists of several key components that work together to convert hydrogen fuel into electrical energy, which then powers an electric motor. The fuel cell stack is the heart of the system and will be supplied with hydrogen, which is fed from a hydrogen storage tank. Power electronic components are connected to the fuel cell to manage the flow of electricity between the fuel cell stack and the electric motor. These include DC-DC converter, inverter, junction boxes and control systems that optimize performance and efficiency. In addition, a battery is typically also installed to store excess energy generated by the fuel cell for later use, especially during peak demand or acceleration.



Advantages of fuel cell emulation

Fuel cell emulation is a simulation of the real fuel cell behavior. The electrical characteristics and the performance of a real fuel cell can be imitated to test and analyze various aspects of fuel cell systems without needing a physical fuel cell. Emulators of a fuel cell provide a safe and controlled environment as it avoids the handling and hazards of hydrogen during testing. Hydrogen is highly flammable and can ignite easily. It is the lightest gas and disperses quickly into the atmosphere and is also often stored under high pressure, which can pose an explosion hazard. By using a real fuel cell for testing, explosion protection requirements like ATEX must be considered to minimize the risk of explosions and to ensure the safety of both equipment and personnel in potentially hazardous environments. Furthermore, the infrastructure and a reliable supply of hydrogen is necessary. With fuel cell emulation, these challenges can be eliminated during testing as no hydrogen is necessary for it. This reduces infrastructure costs significantly and ensures a safer test environment.

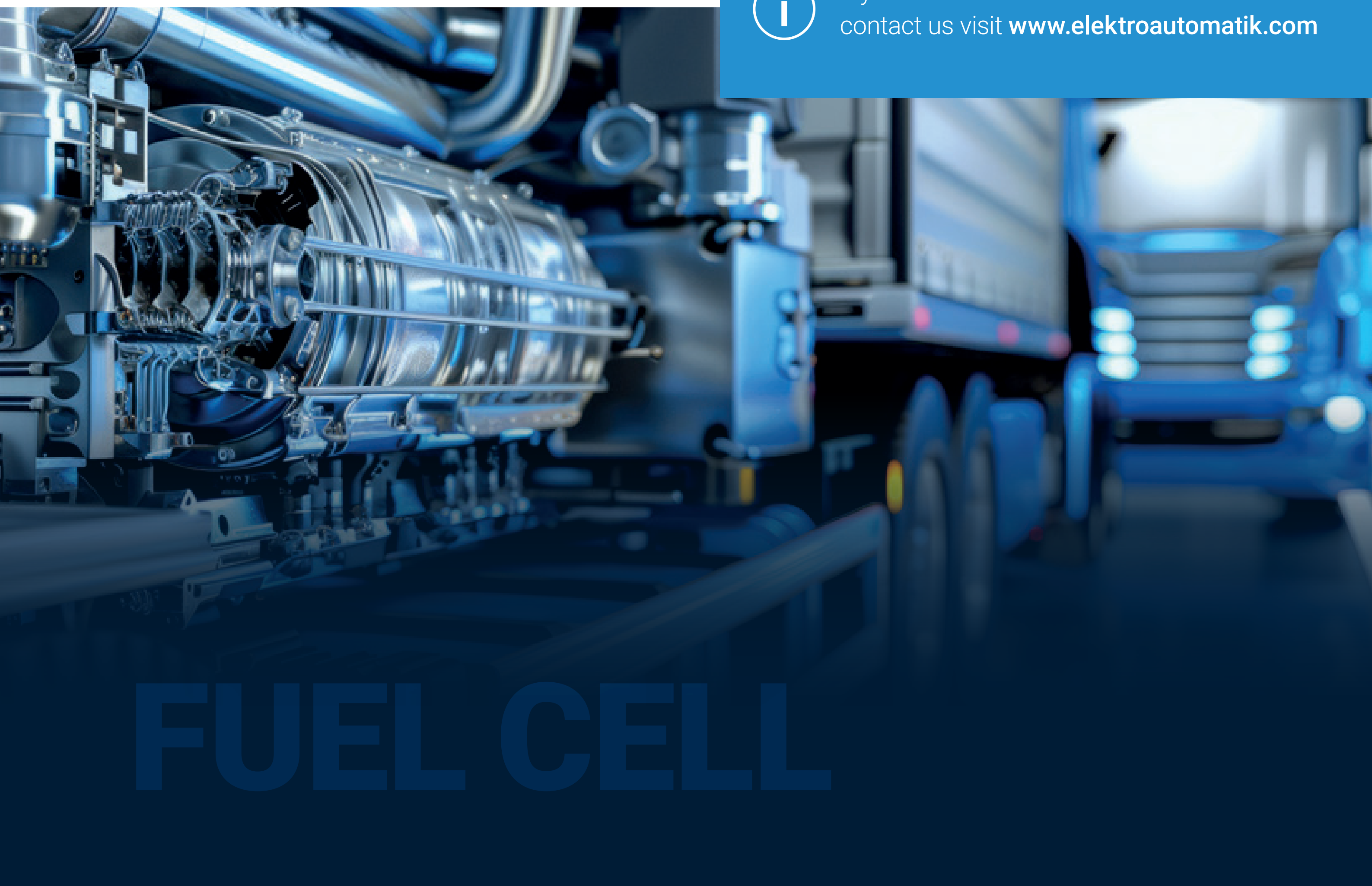
With an emulator it is possible to test how fuel cells will interact with other systems, such as drive trains of vehicles, power management systems and energy storage systems. The needed operating points of the emulated fuel cell can be easy set up and quick switches between different conditions of a real fuel cell is possible. In this way, testing can be carried out faster and more efficiently, which shortens development times and increases quality helping to optimize the overall system design. Fuel cell emulation is a valuable tool in advancing fuel cell technology and its applications.

Efficient high-performance applications up to 3.84 MW

In order to test the systems connected to a fuel cell like drive trains for heavy duty transport vehicles, a power supply is required that can emulate the electrical behavior of the fuel cell. To emulate a fuel cell an I-V curve must be created based on the available data and an corresponding instrument that can operate along the I-V curve of the fuel cell is needed which has sufficient capacity to provide the needed maximum power of the fuel cell.

The devices in the EA 10000 series and the EA-10000 Industrial series impress with their high degree of efficiency. Functions such as genuine autoranging optimize the test sequence. Parallel operation is possible with all devices in all power classes of the 10000 series. As high-performance systems can be assembled with just a few devices, less rack space is required. For example, 42 U of the EA-10000 Industrial series in a 19" rack creates a system with 300 kW on a footprint of just 0.6 m². For high-performance applications up to 3.84 MW, a unit consisting of 13 racks with 64 devices, each with 60 kW, can be configured. The high power density reduces operating costs. This means that emulations of fuel cells can be carried out cost-effectively.

If you need further information or want to contact us visit **www.elektroautomatik.com**



Service for you worldwide

At EA Elektro-Automatik 450 qualified associates, in a facility of 19000m², research, develop, manufacture and market high-tech equipment for laboratory power supply, high power mains adaptors and electronic loads with or without power feedback. The sales and service network includes branches in China, Singapore and USA, offices in Spain and Korea as well as an extensive partner network. Since 2024 EA Elektro-Automatik has been part of the Tektronix Group, which has increased sales and service coverage globally.

TM