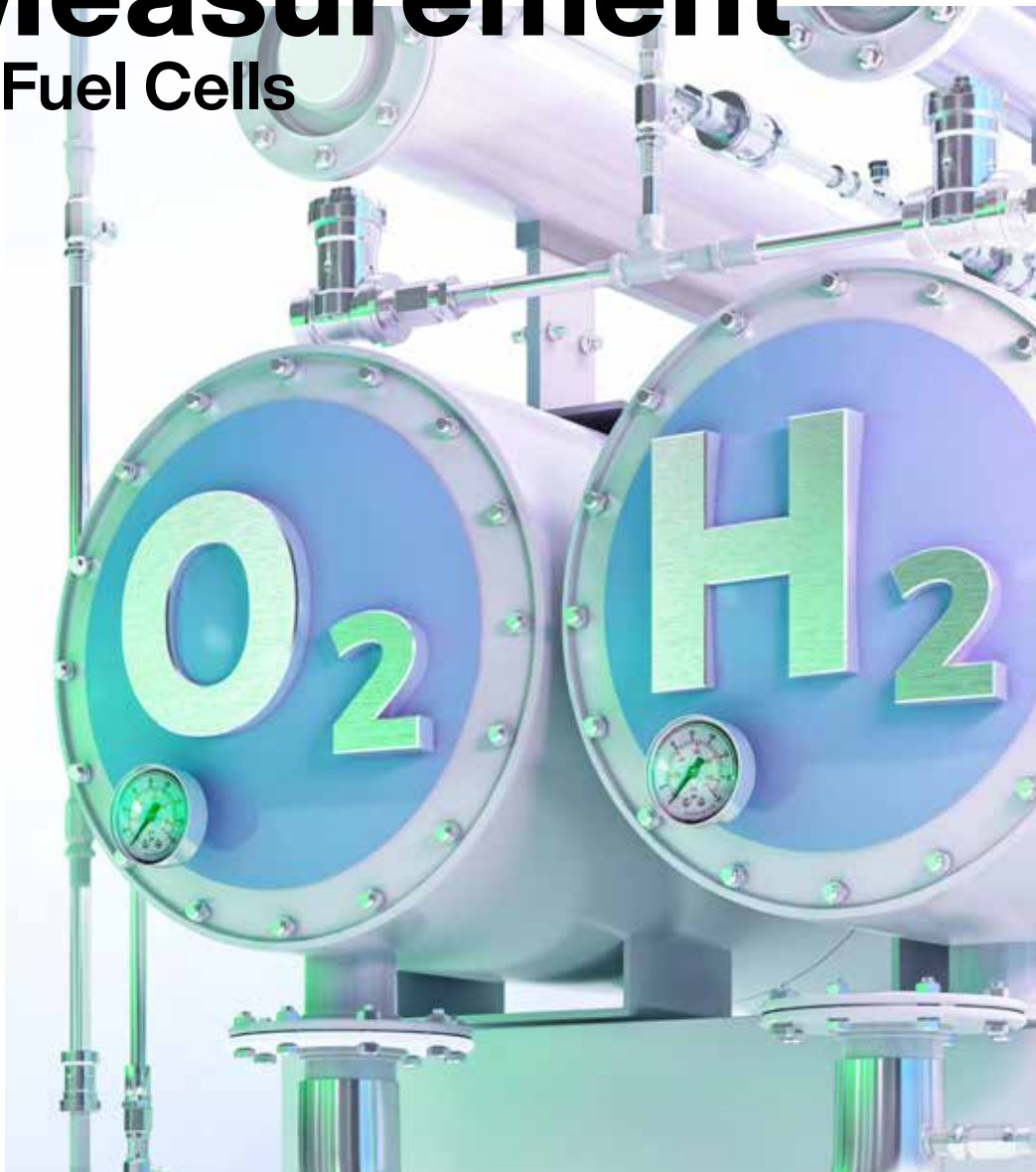


E+E

—
your partner
in sensor
technology.

+
**Humidity
Measurement
in Fuel Cells**



+ Condition Monitoring to Increase the Efficiency of Fuel Cells

Resource-saving, environmentally friendly energy production is the buzzword of our time. The fuel cell is a highly efficient and, in particular, emission-free alternative to conventional methods of electricity generation. Fuel cells convert chemical energy directly and without combustion into electrical energy and heat. The efficiency of a fuel cell essentially depends on the balance of water and temperature within the cell. This makes it all the more important to reliably monitor these factors over the long term. Not an easy task. The demanding environment and the long service life require highly sensitive measuring devices that can withstand permanent stress. With the EE33 humidity and temperature sensor and the HTE501 digital humidity and temperature sensing element, E+E Elektronik provides the ideal solution.

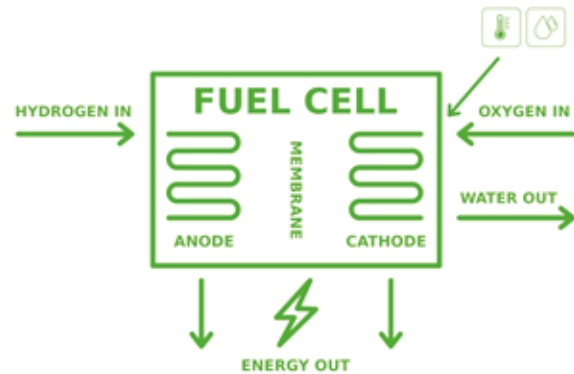
The functional principle of fuel cells is based on the conversion of the chemical reaction energy of a continuously supplied fuel (H_2) and an oxidant (O_2) into electrical energy. One of the most common types of fuel cell is the polymer electrolyte membrane (PEM) fuel cell. In a PEM, the supplied hydrogen reacts with the help of a catalyst at an anode and forms electrons and hydrogen nuclei (protons). The protons are transported via a correspondingly permeable membrane to the cathode, where they react with the oxygen supplied there to form water. The electrons are discharged via an external circuit and thus form the electric current.

Fuel cells have a wide range of applications. In addition to stationary versions for decentralised energy generation, the vehicle industry in particular is one of the key sectors.

Increased efficiency

The efficiency of a fuel cell is limited by various factors. Some of the key mechanisms influencing these factors depend on the environmental conditions within the cell. If the temperature and humidity levels are not controlled accordingly, the catalyst

and membrane will age more quickly. The cell loses power and may even be destroyed.



Functional principle of a fuel cell with measuring position

The proton conductivity of the membrane and thus the performance and service life of a fuel cell increases proportionally with the water content of the polymer membrane. Therefore, this must be kept humid at all times. This is usually achieved by humidifying the reaction gases hydrogen and oxygen via a precise water pump. With the help of the humidity measurement in the fuel flow, this process can be continuously monitored and adjusted if necessary.



Areas of application for fuel cells

High demands on measurement technology

The biggest challenge for the measuring devices is the high humidity environment (>85% relative humidity). Condensation on the sensor affects the relia-

bility and stability of the measurement and leads to deviating measurement results in the longer term.

The solution:

The EE33 and the HTE501 from E+E Elektronik

E+E Elektronik has a wealth of experience in measuring humidity and temperature in fuel cells. With the EE33 humidity and temperature sensor for test benches and the HTE501 humidity and temperature sensing element for customised solutions, it is possible to perform highly accurate measurements with long-term stability even under harsh conditions.

This is due in particular to the controlled heating of the sensing elements which, despite a highly humid environment, allows for precise measurement results. The sensor is used directly downstream the humidifier in the air or oxygen supply. This ensures that the membrane is continuously humidified sufficiently.

In addition, E+E Elektronik offers customised solutions for customer-specific applications. With the HTE501 as a sensing element, it is possible to develop and produce individual modules.



EE33



HTE501

The Challenge.

- Preventing the membrane from drying out over the entire service life of the product (many years and up to many thousands of operating hours)
- High demands on the robustness and long-term stability of the sensors due to the constantly high air humidity
- Dealing with demanding applications and changing environmental conditions

The Solution.

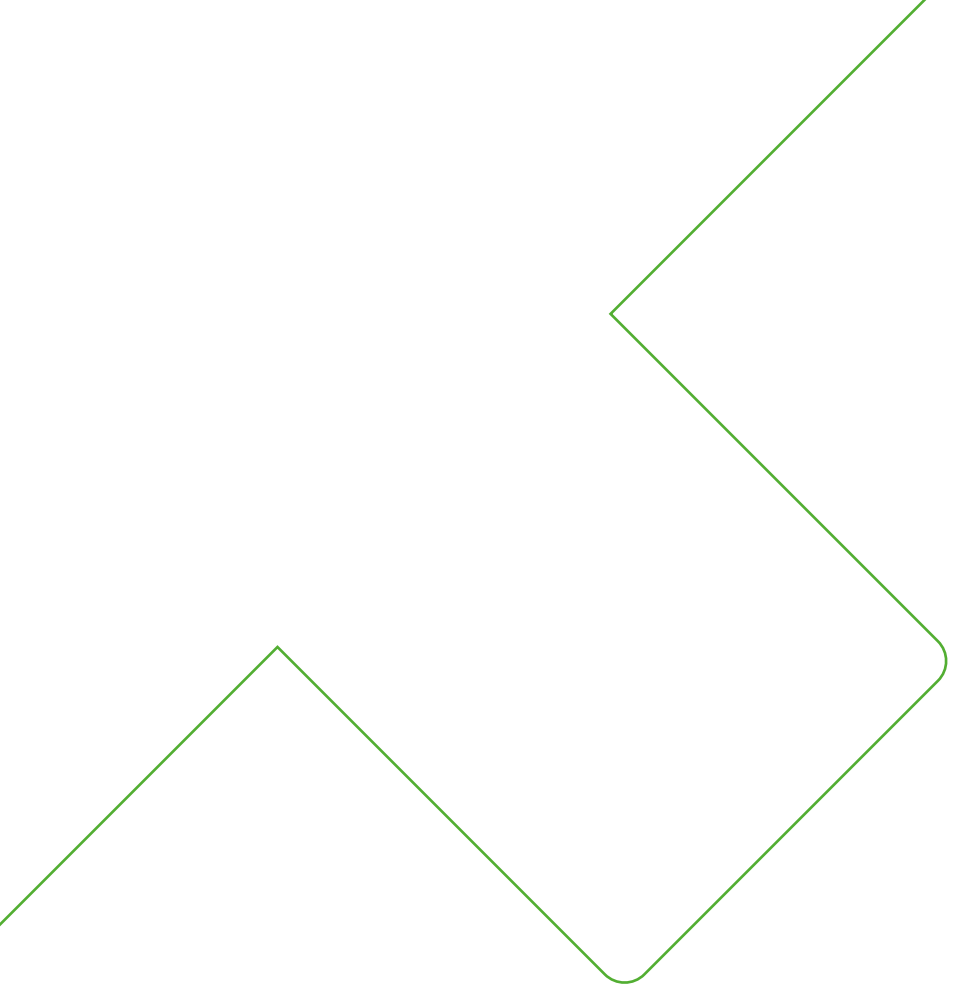
- EE33 for test benches
- HTE501 for customised applications
- Controlled heating of the sensing element
- Output of relative humidity, temperature and dew point

Product Benefits.

- Long-term stability and highly accurate measurement
- Fast recovery after dew formation
- Robust and insensitive to dirt
- Heating modes for temporary condensation, permanent high humidity and chemical exposure
- E+E proprietary sensor coating
- Reputation on the market
- Sensor self check

Overall Value.

- Extended service life of the membrane
- Longer maintenance intervals
- Optimum performance of the system



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