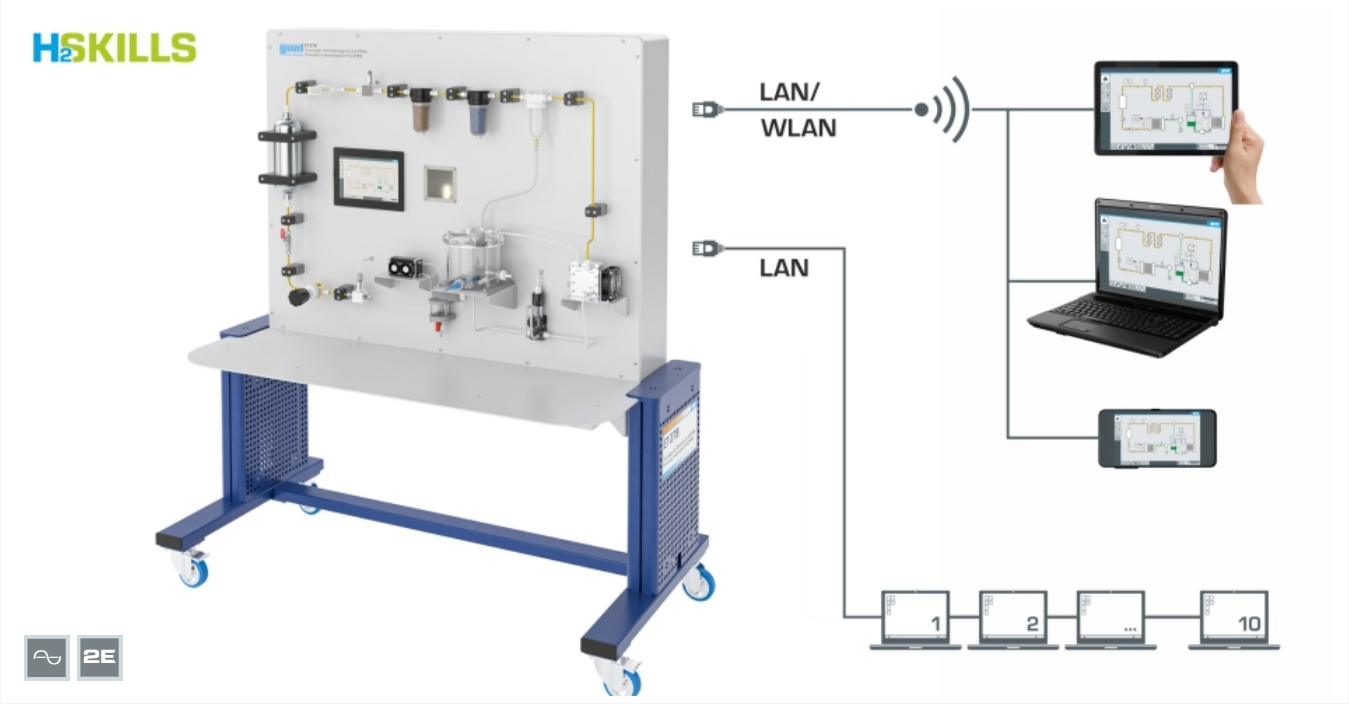
ET 278
Principles of the H2 circuit (PEM)



screen mirroring is possible on up to 10 end devices

Description

- **PEM electrolysis for hydrogen production**
- **simple hydrogen circuit with electrolyser and fuel cell**
- **storage of the hydrogen**
- **system control via integrated PLC with data acquisition**

In networked energy supply systems, surplus electrical energy from renewable sources is temporarily stored as chemical energy in the form of hydrogen. The hydrogen circuit enables hydrogen to be stored and, when needed, converted back into electrical energy. Doing so balances out any deviations between energy supply and demand.

The ET 278 trainer contains all the components needed to study the conversion of electrical energy into hydrogen and the reverse conversion back into electrical energy in a circuit. Hydrogen is produced from purified water in an electrolyser. The proton exchange membrane (PEM) technology is used to break down water (H_2O) into hydrogen (H_2) and oxygen (O_2). The required cell voltage is provided in the electrolyser via a DC voltage source.

The hydrogen produced is temporarily stored in a buffer tank after purification. The stored hydrogen is then converted back into water in a fuel cell using PEM technology, together with oxygen from the ambient air. This produces electrical energy and closes the hydrogen circuit. The electrical energy is used to power a consumer (halogen lamp).

Measured values for hydrogen flow rate and pressure, as well as current and voltage at the electrolyser are monitored. An energy balance can be calculated from the recorded measured values.

The system is controlled via an integrated PLC with touch screen. The experimental plant can alternatively be operated and controlled via a terminal device by means of an integrated router. The user interface can also be displayed on other terminals (screen mirroring). The measured values can be stored internally via the PLC. It is possible to access stored measured values from terminals via WiFi using the integrated router/LAN connection to the customer's own network.

The GUNT Media Center provides free digital multimedia teaching materials.

Learning objectives/experiments

- H_2 circuit: conversion of electrical energy into chemical energy (hydrogen) and back into electrical energy
- generation of H_2 by means of PEM electrolyser
- generation of electrical energy by means of PEM fuel cell for direct H_2 consumption
- relationships between operating parameters of the electrolyser
- calculation of relevant parameters
- determination of the energy balance

- screen mirroring: mirroring of the user interface on up to 10 end devices
  - ▸ menu navigation independent of the user interface shown on the touch screen
  - ▸ different user levels available on the end device: for observing the experiments or for operation and control

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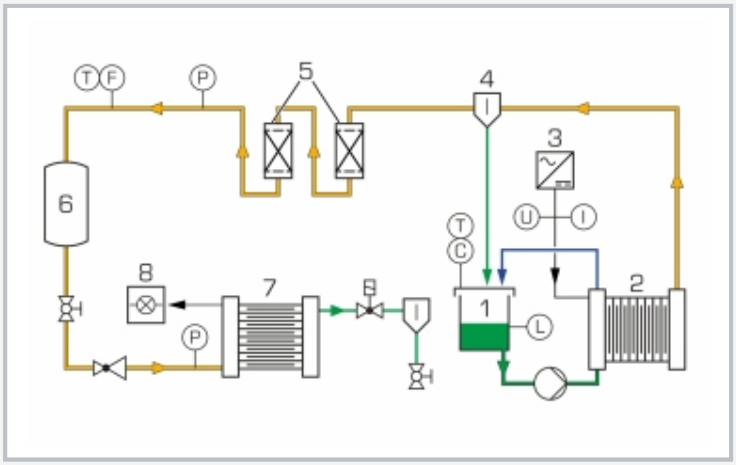
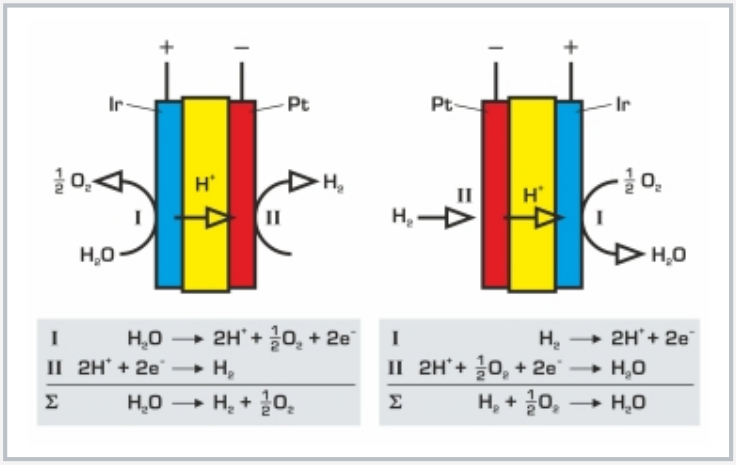
1 halogen lamp as electrical consumer, 2 buffer tank for H_2, 3 touch screen, 4 PEM fuel cell, 5 diaphragm pump, 6 PEM electrolyser, 7 water tank, 8 water separator, 9 drying units



Hydrogen circuit: 1 water tank, 2 PEM electrolyser, 3 DC voltage source, 4 water separator, 5 drying units, 6 buffer tank for H_2, 7 PEM fuel cell, 8 electrical consumer; P pressure, F flow, T temperature, L level, C conductivity, U voltage, I current, orange: H_2, blue: O_2, green: H_2O



left: how PEM electrolysis works
right: how the PEM fuel cell works
blue: anode, red: cathode, yellow: proton exchange membrane

Specification

[1] complete H_2 circuit with electrolyser and fuel cell: conversion of electrical energy into chemical energy and back into electrical energy
[2] water tank for purified water with monitoring of temperature, conductivity and fill level
[3] H_2 generation in the PEM electrolyser
[4] H_2 purification: water separator and drying units
[5] intermediate storage of the H_2
[6] PEM fuel cell generates electrical energy
[7] halogen lamp as electrical consumer
[8] recording of H_2 flow rate and pressure, current, voltage at the electrolyser
[9] data acquisition via PLC on internal USB memory, access to stored measured values via WLAN/LAN with integrated router/LAN connection to customer's own network or direct LAN connection without customer network
[10] screen mirroring: possible to mirror the user interface on up to 10 end devices
[11] multimedia instructional materials online in GUNT Media Center

Technical data

PLC: Weintek cMT3108XP

Electrolyser (PEM technology)
- hydrogen production: 300mL/min
- oxygen production: 150mL/min
- water quality: 10 ppm TDS (Total Dissolved Solids), conductivity: max. 15,6 µS/cm
- water consumption: 17mL/h
- max. pressure: 10bar

Fuel cell (PEM technology)
- rated output: 30W
- hydrogen pressure: 0,5bar
- hydrogen consumption: 350mL/min
- hydrogen purity: min. 99,95%

Diaphragm pump
- flow rate: 0,6L/min
- head: 10mmWC

Measuring ranges
- current: 0...25A
- voltage: 0...24V
- conductivity: 0,1...5000µS/cm
- flow rate: 0...300mL/min
- pressure: 0...10bar

230V, 50Hz, 1 phase; 230V, 60Hz, 1 phase
LxWxH: 1520x790x1760mm, Weight: approx. 180kg

Required for operation

2 litres water: 10 ppm TDS (Total Dissolved Solids)

Scope of delivery

electrolyser, fuel cell, online access to the GUNT Media Center, set of instructional material