Heliocentris

Possible with integrated HG

New Software with API Interface

Hybrid Energy Lab-System

1.2 kW Fuel Cell and Battery Hybrid System for Laboratory Applications

ACADEMIA OFFERING
RESEARCH SOLUTIONS

A Fuel Cell – Battery Hybrid System that enables users to understand & research individual components and system behavior under various hybrid set-ups. Designed as a lab to support engineering courses focussed on the application of fuel cells, battery technology, hybrid systems, energy management and energy storage. It is critical for today's engineering students to have a deeper understanding of the application of electrical chemical energy conversion & storage. Especially as it relates to fast growing markets of stationary, portable and mobile hybrid power systems.

Ideal for Courses Focused On

- Battery Technology (Modeling)
- Battery Systems & Control
- Applied Fuel Cell Technology
- Battery- Fuel Cell Hybrids
- Electrochemical Energy Storage & Conversion
- Renewable Energy Storage
- Electrical & Hybrid Vehicles (HEV/FCEV)
- Backup Power Systems
- Micro-Grids & Smart Grids

The system provides an experimental platform for advanced training to applied research:

- Fuel Cell – Battery Hybrids
- Battery Charging/Discharging
- Battery & Fuel Cell Model Analysis & Comparison
- Calculation & Evaluation of Electrical Characteristics
- Energy Management
- User Developed Control Algorithms
- Validation of Models Against a Real System
- Hybrid Power System Set-ups:
  UPS, Autonomous Power Supply, Back-up Power System, HEV/FCEV

Hybrid Energy Lab-System

1.2 kW Fuel Cell and Battery Hybrid System for Laboratory Applications

System Overview

The Hybrid Energy Lab-System is a comprehensive learning and research system for hybrid energy systems with a focus on batteries and fuel cells. Designed specifical y for use in universities and colleges, it offers a ide range of theoretical and practical applications for the design criteria of hybrid systems with batteries and fuel cells.

Control and Experimentation PC
- » System Overview
- » Real-Time Display & Data Measurements
- » Execution of experiments

System Overview Module
- » Display for system parameters and controlling

Electronic Load Module
- » Simulation of electrical loads
- » Operating modes: CC, CV, CP, CR
- » Manual or software-supported control

Battery System Module
- » Selection of the battery capacity
- » Connecting external batteries possible

Power Management Module
- » Configuration of the ba tery charging regulation
- » Preparation of regulated DC or AC voltage
- » Inverters with power through circuit
- » Sensor system

Fuel Cell Module
- » Well established Nexa 1200 W fuel cell
- » Unegulated DC Outpout
- » Hydrogen consumption measurement
- » Stack temperature monitoring

H_2 Storage Module
- » Heliocentris Metal Hydride Canister
- » Storage temperature monitoring

Realistic Application of Hybrid Systems

The Hybrid Energy Lab-system enables various hybrid setups for Applied Research of battery and fuel cell / diesel generator systems:

Range Extender

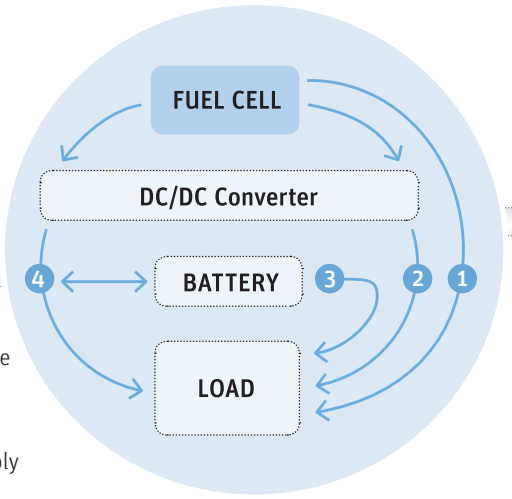
Planning of system switching

Range calculation of the overall system

Autonomous Power Supply

System runs disconnected from the grid so it must be dimensioned to operate autonomously at all times

Starts from internal energy supply



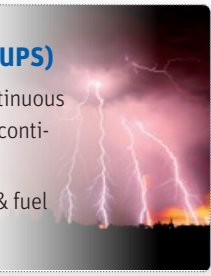
Hybrid Electric Vehicles

The system design allows for the same configurations ound in typical Fuel Cell Hybrid Electric Vehicles (FCEV)

Uninterruptible Power Supply (UPS)

In UPS mode, the system provides continuous power in case of grid failure to ensure continuous power

Automatic switching between battery & fuel cell operation

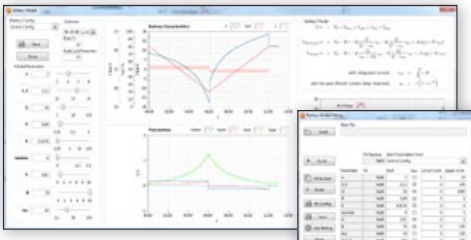


Battery Modeling & Data Fitting

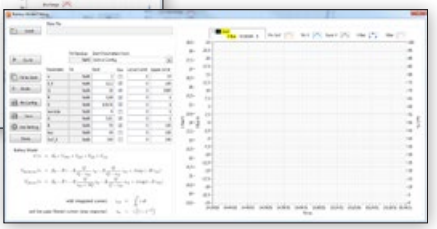
The battery can be further analyzed by fi ting a detailed battery model to the data. The obtained parameters characterize the dynamic behaviour of the battery and give insight into the electrochemical processes.

This analysis task is seamlessly integrated into the Application Software.

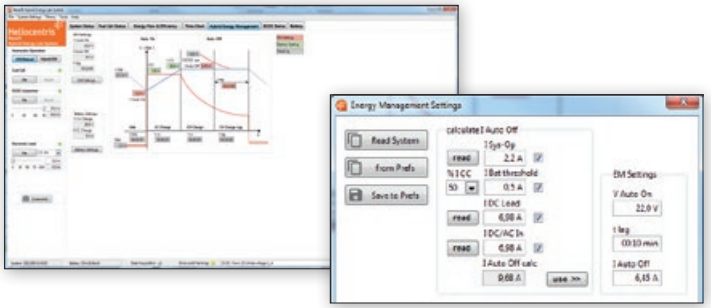
Built-In and user-provided batteries can be analyzed and compared.



Battery Modeling



Battery Data-Fitting



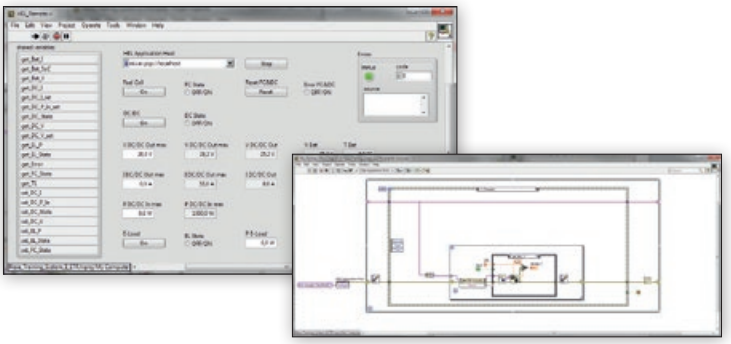
Hybrid Energy Management

The Hybrid Energy Management allows a detailed real life investigation of the hybrid energy management algorithm in different pha es. The connection to different ources and loads are fully configurable and allows a transparent exploration of the process.

Application Programming Interface (API)

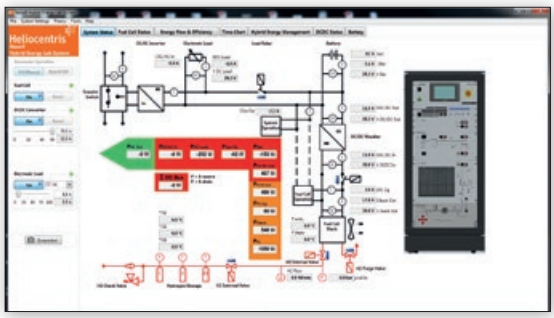
The interface provides a simple and convenient way for the system to control data and to integrate it with other software solutions.

The exchange process of data and content between different oftware solutions is possible and a LabView programming example from Helio-centris is also included.



Software Functionality

Our LabVIEW™ based software allows users to control the hardware, system operation & set-up, gather & display data in various formats and perform data fi ting for research and experimentation. Users can validate their models against a real system by using their control algorithms to set system parameters and then run real-time simulations. Acquired data can be exported to external applications such as MATLAB™ & MS Excel and many more.

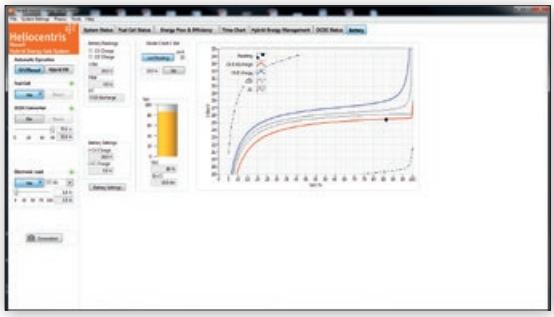


System & Sensor Overview

» Extensive data points for: DC/AC Inverter, E-Load, DC/DC Converter, Fuel Cell, H2 Flow/ Valves/Storage, Batteries, DC/AC Bus

Energy Flow & Efficiency Levels

» Real-Time Sankey diagram of overall system input/ output power & battery charging (SoC)

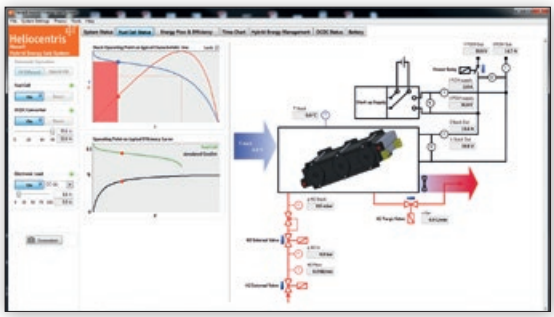


Battery Charging Discharging Behavior

» Real-time display of battery operation based on the battery model (Charge & Discharge Curves), Readings V Bat/I Bat, Settings V CV/CC, SoC

DC/DC Converter

» Real time display of all relevant data: input & output characteristic of the DC/DC (V, I, P), Step-Up/Down, Battery readings (CV, CC, V Bat, I Bat



Fuel Cell & H_2 System

» Real-time display of all relevant fuel cell & H2 data points: Stack Temp. Start-up Supply (I/V), FCM Output (I/V), H_2 Flow & Pressure, Fan

» Built-in capabilities for direct comparison to a simulated back-up diesel generator

Real-Time Graphing

» Plotting of component parameters and measured values

» Measured values are freely configurabl

» Adjustable data acquisition scales

» Simple highlighting of curves by clicking

Instruction and Experimentation Material

Extensive training material assists the teacher in creating a more interactive and specialized classroom experience. Prepared experiments and software-supported exercises simplify the use of the system.

Experimentation manual with:

» Learning goals and content
- Instructions for the execution of experiments
- Topic-specific que tions and sample answers

» Evaluation templates

» Detailed operating manual

Experiments including:

» System design for special applications:
Backup, Emergency power supply (UPS), Autonomous power supply, Boost, range extender

» Examination of the operating behavior of:
Battery module, Fuel cell module, DC converter

» Determination of the efficie y and energy conversion

» Examination of load step changes of up to 1.5 kW

» Generation of characteristic curves

Experiments

Ring binder and CD-ROM

Scope of Delivery of the Hybrid Energy Lab-System

» Fuel cell module
» Power management module
» Electronic load module
» Battery module
» H_2 storage module
» System control module
» Measurement and experimentation software
» All-in-one PC incl. keyboard, mouse
» Instruction and experimentation material

Hybrid Energy Lab-System	Item No. **793***

Accessories for Hydrogen Supply

Solar Hydrogen Trainer

Combine the Hybrid Energy Lab-System with the Solar Hydrogen Trainer to build your own autarkic Power-to-Gas Lab.

Solar Hydrogen Trainer with HG72	**Art.-Nr. 812**

H_2 Connection Kit

Pressure reducer for 200 bar standard compressed gas cylinders for the refil ing of the metal hydride canister.

15 bar H_2 Connection Kit	**Art.-Nr. 736**

Hydrogen Generator

Produce high-purity hydrogen for the direct operation of the Fuel Cell Trainer or for refilling the metal hydride canisters.

Product Options	
HG72 - HG198	**Art. no. 1303-04**
Optional remote control software	**Art. no. 1307**

Hydrogen Detector

The portable hydrogen warning device (0 – 100 ppm) for monitoring of the workplace in combination with a leak detection liquid assure safety when working with hydrogen.

H_2-Detector	**Art.-Nr. 731**

* Only available in combination with a hydrogen supply from Heliocentris.

Technical Data

Hybrid Energy Lab-System	
Dimensions (B × H × T)	520 × 1330 × 600 mm
Weight approx.	200 kg
Permissible environmental temperature during	+5 ... +35 °C
Connection standards	DIN, CGA, BS
Mains connection	230 V_{AC} (50 Hz), 115 V_{AC} (60Hz)
Communication interface	Ethernet
Fuel Cell Module	
Fuel Cell System	
Rated output	1200 W @ 5 ... 25 °C
Rated current	60 A_{DC} max.
Operating voltage	18 ... 36 V_{DC}
Maximum hydrogen consumption	15 Nl/min
Hydrogen purity for operation	min. 4.0
Permissible H_2 inlet pressure	1 ... 15 bar
H_2 Flow Meter	
Measuring range	0.83 ... 25 Nl/min
Measuring accuracy	± 1.5 % from the end value
H_2 Sensor	
Sensor standard range	0.00 ... 1.00 Vol. % H_2
Power-Management-Modul	
DC Converter with Integrated Load Regulator	
Max. output power	1500 W
Max. output current	55 A_{DC}
Rated output voltage	24 V_{DC}
Output voltage range	21 ... 30 V_{DC}
Max. input current	60 A_{DC}
Input voltage range	18 ... 36 V_{DC}
Efficiency	96 %

Inverter	
Continuous output power	1500 W_{AC}
Inlet voltage	21 ... 30 V_{DC}
Output voltage	230 V_{AC} (50 Hz), 115 V_{AC} (60Hz)
Output signal form pure	Reiner Sinus (THD < 3 %)
Efficiency	91/93 % (110/230 V)
Electronic Load Module	
Max. continuous power	1200 W
DC load current	0 ... 85 A_{DC}
DC load voltage	0 ... 80 V_{DC}
Load resistance	0.08...30 ΩC
Battery Module	
Battery set 1	lead-acid, 24 V, (2 x 12 V), 7,2 Ah
Battery set 2	lead-acid, 24 V, (2 x 12 V), 18 Ah
Safety elements	30 A, 80 A
H_2 Storage Module	
Hydrogen manometer	0 ... 25 bar
Safety elements	3 x temperature sensors, pressure relief valve, hydrogen safety switch, manometer
Metal Hydride Canisters	
Storage capacity	3x 600 Nl @ 15 bar, 20°C
All-in-one PC and System Control Module	
All-in-one PC, keyboard, mouse and user software	
System control with touchscreen for measured value indication and adjustment	

Nexa® Integration System

From theory to applied application. Easy integration into various systems:

1200W Fuel Cell Module	**Item No. 1911**

Nexa® DC1200 Converter

DC1200 DC converter 24/48 V	**Item No. 1610/1611**

Heliocentris

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