

Hybrid Fuel Cell - Battery Research System

Using the Hybrid Energy Lab System (HEL)

The NTS gives users the opportunity to research & understand battery & fuel cell behaviour under various conditions.

Examine and control system functionality during charge and discharge cycles, and experiment with various types of hybridization set-ups while performing extensive data acquisition, analysis and visualization.

Includes set-ups for uninterruptible power supply, autonomous power supply, back-up power systems and hybrid electric vehicles.

Training & Research Topics

Battery Charging/Discharging

- Data acquisition of battery operating behavior while charging & discharging
- Charging & discharging profiles: e.g. Constant current (CC), constant voltage (CV), programmable user profiles.
- Charging via DC/DC Converter and Discharging via Electronic Load

Battery Model Analysis & Comparison

- Data fitting of model parameters
- State of Charge (SoC) vs. Battery Voltage
- Evaluation of user generated equivalent circuit models

Calculation & Evaluation of Electrical Characteristics

- Data acquisition of Internal Resistance & Temperature,
- Calculation of State of Charge (SoC), Capacity (Ah) & State of Health (SoH)
- Peukert Coefficients
- Storage efficiency (energy balance of charging and discharging)

Fuel Cell – Battery Hybrids

- Applications Set-ups: Backup, Uninterrupted Power Supply, Autonomous Power Supply, Supply for Power Burst, Recuperated Power
- Calculation of system efficiency & plotting of characteristic curves

Energy Management

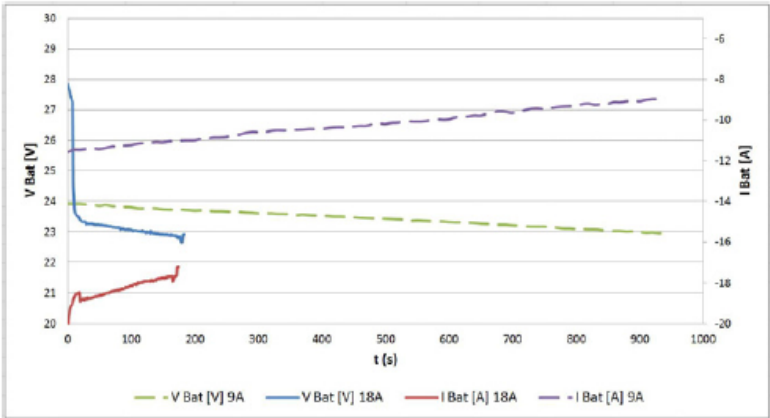
- Control of fuel cell operation as related to battery voltage levels – e.g. start fuel cell when battery voltage equals 25% of charge
- Management & control of overall system efficiency
- Calculation of system losses & overall efficiency



Battery Charging & Discharging

Each battery has its own unique charge and discharge characteristics based on its chemistry, the load and the temperature used. The NTS allows for the control of these parameters while collecting the data over time.

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

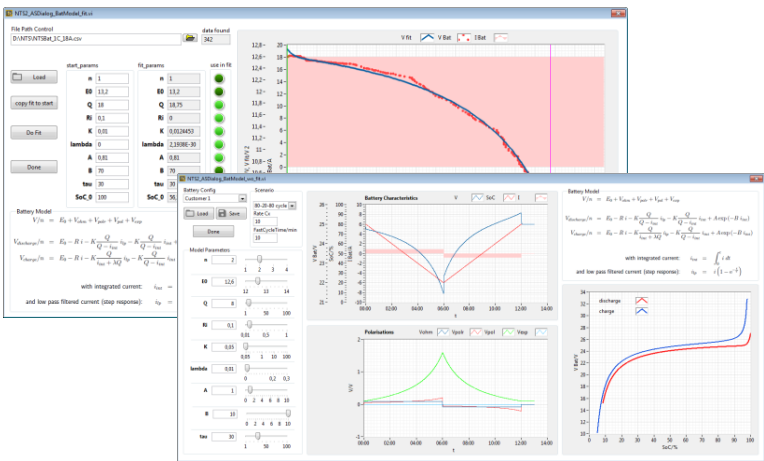


NTS: Battery discharge behavior displayed in relation to the current

Battery Models

The battery can be further analyzed by fitting 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.



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