

# Battery Testing System for Student Education

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## Project Funding

### Showcase Regions for Electric Mobility



- In April 2012, the German Government selected four regions in the country to act as „Showcase Regions for Electric Mobility“.
- Based on a decision by the German Bundestag, research and development into alternative drive systems is to take place across each of these regions.
- The Federal Government is providing a total of €180 million in funding for these large scale demonstration and pilot projects.
- The aim is to test electric mobility within the overlapping systems of energy, vehicle, and transport.

### Showcase Electric Mobility Bavaria/Saxony



As part of the Federal Government's Showcase Regions for Electric Mobility, the Federal Ministry of Education and Research is providing 3.4 Million Euro in funding for the project „Akad. Bildungsinitiative zur Elektromobilität Bayern/Sachsen“ („Academic Education Initiative for Electric Mobility Bavaria/Saxony“) – one of 40 projects taking place in Bavaria and Saxony.

## Programme Development

### Institute of Executive Education



- Executive and advanced training has become an important field at the University of Technology Ingolstadt.
- The IAW offers the possibility to study next to a fulltime job.

### Academic Education Initiative for Electric Mobility Bavaria/Saxony

As a part of the project „Academic Education Initiative for Electric Mobility Bavaria/Saxony“ new courses in the field of electric mobility are developed in cooperation with the University of Applied Sciences Zwickau.

- The Aim is to qualify students in courses like
  - Circuit-Design and -Simulation, PCB design
  - Automotive Electronics
  - Electrical Power Drive Systems
  - Electromagnetic Compatibility
  - Electrochemical Energy Storages
  - Electric and Hybrid Vehicles
- The target group are technicians and electrical engineers.
- To ensure that the programs meet the needs of the industry, interviews to experts in companies are kept.



## Experiments for Practical Courses

As part of the project „Akad. Bildungsinitiative zur Elektromobilität Bayern/Sachsen“ a new battery test system for the education of students is developed. Emphasis is placed on the integration of special needs concerning a didactic concept for part-time students.

### Experiments for Practical Courses (Bachelor/Master Electric Mobility)

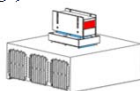
- Charging/Discharging (cycling) battery cells of various kinds
- Parameter measurement (rated voltage, charge characteristics, discharge characteristics, capacity, internal resistance)
- Behavior of cells under load, in driving cycles, measurement of energy efficiency
- Development of/learning about SoC/SoH determination algorithms
- Impedance spectroscopy
- Calorimetric temperature measurement
- Experiments with temperature dependence, e.g. cold start-up behavior
- Experiments on electrochemical cells (Operating as potentiostat, galvanostat)
- Connection with overall vehicle simulation (Battery in the loop)



## Requirements & Targets

### Requirements on the device that is to be developed

- Scaling the electric vehicle battery system to a smaller scale (one cell only) → Safety during the practical course (no high voltages) / Cost savings (material / support effort increases with high voltage technology) / Size suitable for laboratory working table space
- Built-in safety shut-off, monitoring module → Safety is provided by the equipment during the practical courses for students and equipment → lower support costs
- Device should be simple: Reduce costs per unit → More devices in practical operation → Smaller groups → Better individual understanding
- Modular Design → Extensibility in the future / Cost and time savings during development
- High measurement accuracy / High accuracy of parameters (current (I), voltage (U), temperature) → Accurate test results → Better understanding
- Intuitive user interface of the control software → Focusing on the essential, the experiment
- Thermostat for accumulators → Temperature-dependent experiments are possible
- Calorimeter



## Technical Specification

### Device Interface

- Using a serial port protocol (USB-RS232 or Bluetooth SPP)
- New developed experiment-software for students
- Connection to vehicle simulation (e.g. CarMaker) for Battery in the Loop simulation thinkable



### Current-/Voltage-Source

- Experiments regarding accumulator cells (e.g. Lithium-Ion-Cells 250mAh, 30C)
  - max. charge-/discharge current: ±6 A (measuring accuracy 1mA to 10mA)
  - max. charge-/discharge voltage: ±6 V
- Experiments regarding electrochemical cells
  - max. charge-/discharge current: ±20 mA (measuring accuracy 250 nA)
  - max. charge-/discharge voltage: ±10 V (if applicable ±30 V)

### Thermostat for accumulators

- Cell temperature: -30 °C to 80 °C (measuring accuracy ± 1 K)

### Calorimeter

- Cell temperature: measuring accuracy 0.1 K

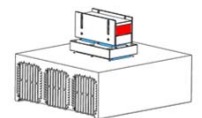
### Impedance Spectroscopy

- Frequency range: up to -1 kHz (if possible 10 kHz)

### Safety shut-off, monitoring module

- Brakes the accumulator-circuit to prevent danger situations and damaging the accumulator
- Temperature monitoring adjustable to ± 80 °C
- Voltage monitoring adjustable to ± 30 V
- Current monitoring adjustable to ± 15 A

## Project



### 2013:

- Design of Thermostat, currently: parts for the first development stage are ordered
- Thermostat for cells, first stage of development, one device
- Battery test system, first stage of development, one device
- Depending on the results of the tests with the first version, unchanged or improved/modified parts for other versions can be procured.
- Thermostat for cells, the second stage of development, one device
- Preparation for two battery test systems (housing, power supplies) for 2014/2015

### 2014:

- Battery test system, second development stage two devices
- Calorimeter first stage of development, one device
- Thermostat for cells, third development stage two devices
- Calorimeter, second stage of development, one device

### 2015:

- Battery test system (first version), > 10 devices (funding from university)
- Development of student education course

## Contact

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