# Test system for BESS

## For testing the characteristic of battery energy storage systems

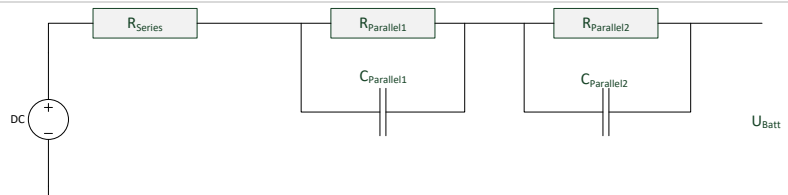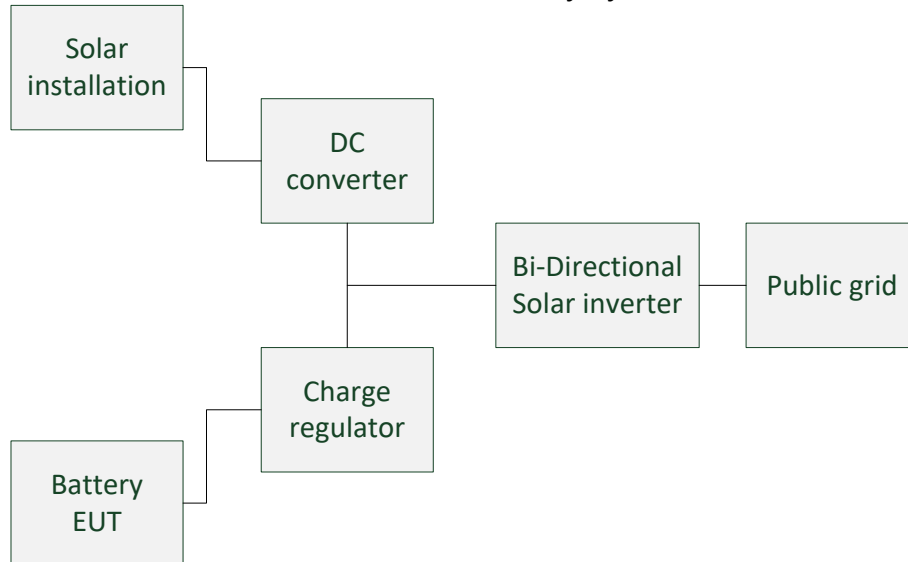*Overall test system for solar inverters extendable to BESS test system*

The test system for BESS is an optional extension of an existing solar inverter test system. The functional principle of the Spitzenberger & Spies BESS test system is based on the battery model of Rincon-Mora.

| *Battery model according to Rincon-Mora:* | |
|---|---|
| |  |

## THE FUNCTIONAL PRINCIPLE OF THE EUT:

*DC connected PV battery systems*

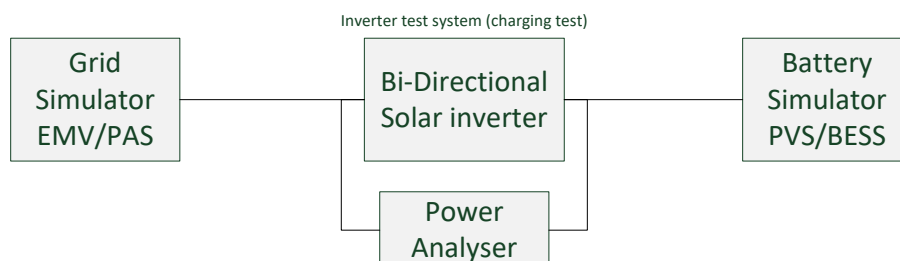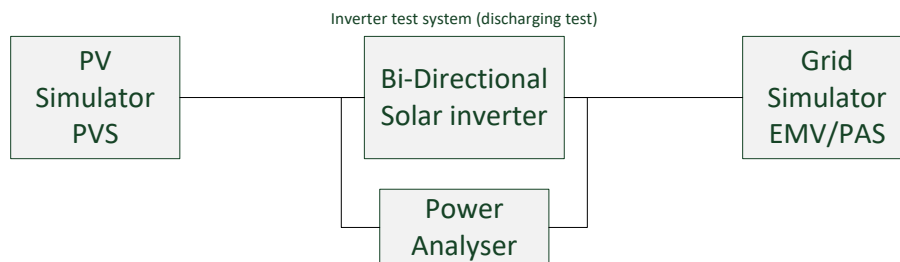Solar installation → DC converter → Bi-Directional Solar inverter → Public grid

Battery EUT → Charge regulator → DC converter

The PV Simulator PVS can operate either as generator / simulator of the PV installation or as battery simulator.

Due to different types of solar inverters the PVS/BESS series has five voltage ranges:
- 400V / 500V / 600V / 800V / 950V

Inverter test system (discharging test)

PV Simulator PVS → Bi-Directional Solar inverter → Grid Simulator EMV/PAS

Bi-Directional Solar inverter → Power Analyser

Inverter test system (charging test)

Grid Simulator EMV/PAS → Bi-Directional Solar inverter → Battery Simulator PVS/BESS

Bi-Directional Solar inverter → Power Analyser

THE PURPOSE OF BATTERY SIMULATION:

With a battery simulation system all possible combinations of solar inverters and storage systems can be tested and simulated.

The solar energy industry focus is now on storing the harvested solar energy for later use in decentralized storage systems. This can be small systems for private house solar installations as well as larger systems for industrial and public solar installations.

In future installations there will be bi-directional solar inverters included which are able to convert the harvested and stored energy into AC and to supply the public grid as well as to convert the AC grid power into DC and store it into the local storage system.

This local storage of public energy would give much flexibility in storing cheaper energy (depending on the accounting conditions of the public power distributors) for later use.

In existing solar installations with a unidirectional inverter it is possible to upgrade the installation both with a local storage system as well as with a second unidirectional inverter for storing public energy into the local storage system.

The most important technical point to test, simulate and to measure is the overall efficiency of such an installation and to optimize the characteristic of the solar inverter.

With a battery simulation system solar inverters can be tested in many possible environment conditions and with many different types of storage batteries without having these storage batteries or without investing lots of money for having these battery systems available.

Not to be forgotten shall be the advantage to reproduce the charging and discharging characteristic of the different storage systems at every time.

The Spitzenberger & Spies BESS test system is also available as an upgrade of existing Spitzenberger & Spies solar inverter test systems to a BESS test system.

The easy to use PC based controlling software allows to specify lots of charging / discharging characteristics of battery storage systems and to store and retrieve these values for later use.
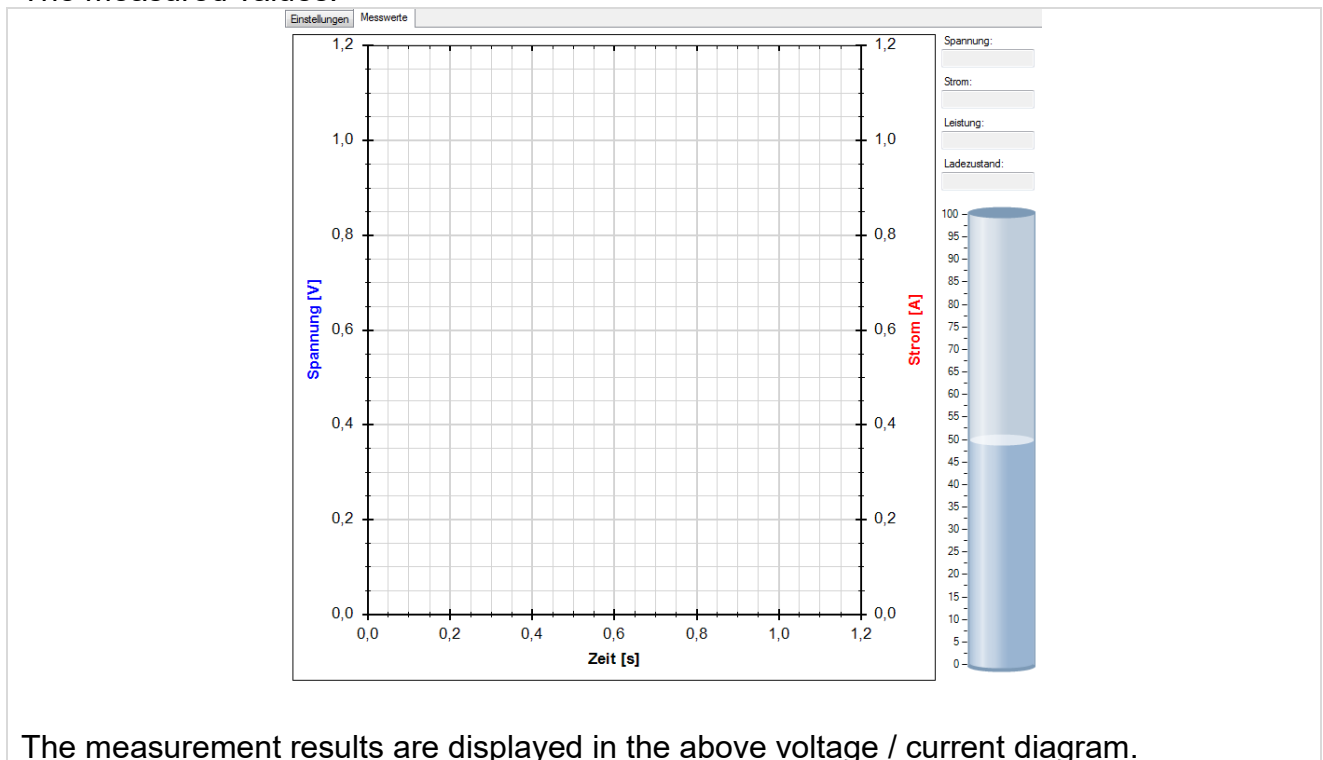
Model parameters of the software:
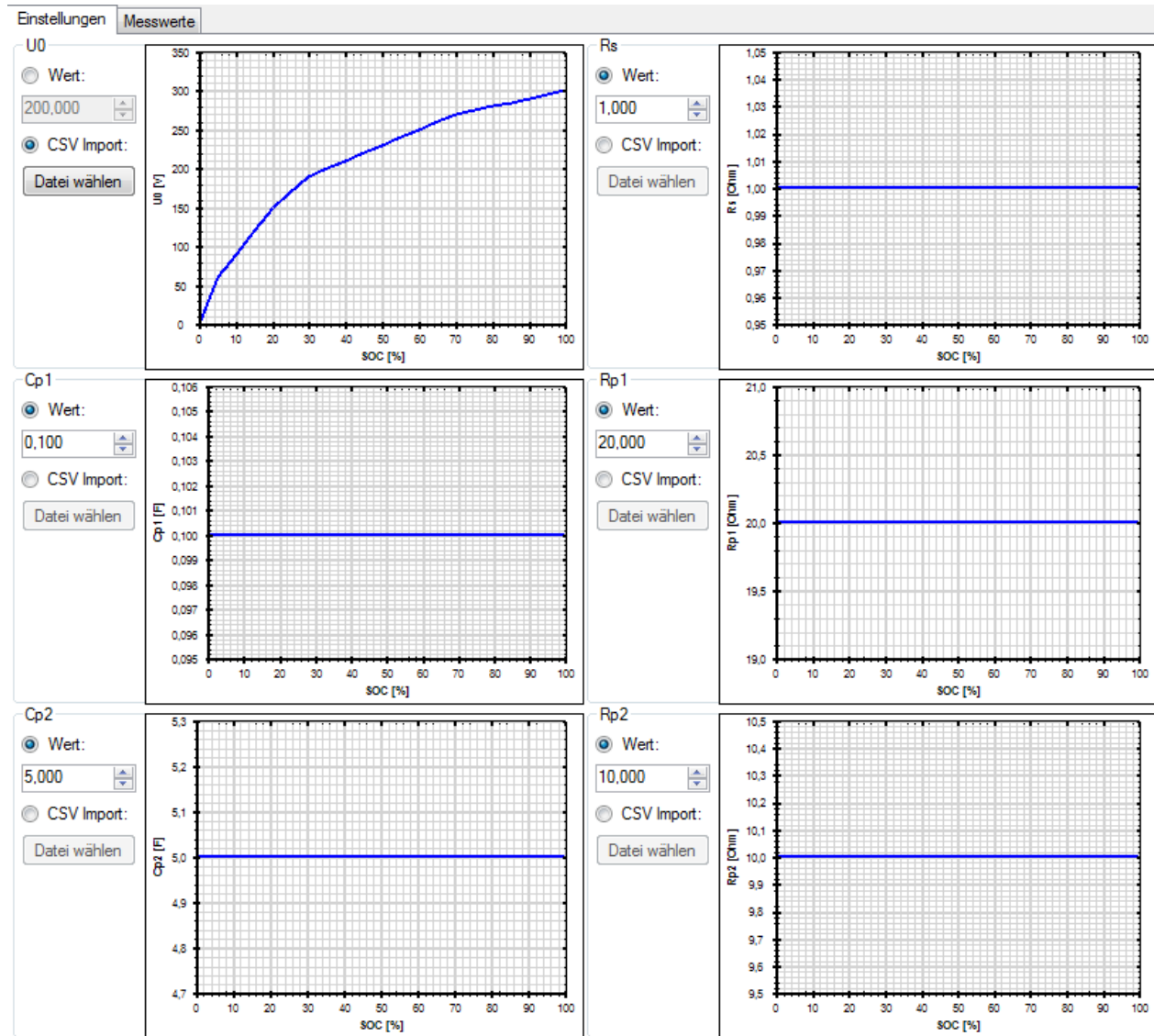


The input parameters of the battery characteristic in relation to the state of charge:

- $U_0$: the battery voltage
- $R_S$: the serial impedance
- $R_1$: the parallel impedance 1
- $C_1$: the parallel capacitance 1
- $R_2$: the parallel impedance 2
- $C_2$: the parallel capacitance 2

## The battery test software solution:

The input values for the battery characteristic are:

- *Capacity (Ah)*
- *State of charge at system startup (%)*
- *Maximum current capability (A)*
- *Maximum voltage capability (V)*

## The measured values:

The measurement results are displayed in the above voltage / current diagram.

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