

# G5.BatSim

## PC-Software for Battery Simulation

REGATRON's user-friendly battery simulation software G5.BatSim is designed for simulation battery modules and packs with charge and discharge capabilities of a few kW up to the 2000+ kW range. In conjunction with the powerful real-time computing process of the G5 device, even steep changes in charge/discharge currents will be handled with the necessary dynamics and stability. Each battery type reacts in a specific manner to charge and discharge currents in terms of cell voltage, state of charge, ohmic and parametric losses, and polarization effects. These dependencies are considered by specific mathematical models used in the REGATRON G5.BatSim software / firmware. The operator can fine tune the model with several well-defined parameters to adjust the simulation to the user's requirement. Long-term data recording and recall of battery values are available within the G5.BatSim application software.

### Key Features & Functionality

- Fully integrated in REGATRON's G5.BAS and G5.UNV devices
- G5.ESSControl is the user interface software and script environment for the software component G5.BatSim
- Available mathematical battery models: Li-Ion, Lead-Acid, NiMH, NiCd
- Basic or advanced battery model settings: defining a standard battery with just a few clicks or adapting the model to real world measurements
- Adaptation and controlling of the individual configured simulation models possible with simple and powerful scripting language
- Real-time calculation onboard the G5 power supply for time critical processes like internal resistance simulation
- Multi-channel live viewer and data logger with event markers as time stamps and file export in csv format
- Reporting / output-to-file functions during the process are integrated in the scripting language
- Data analysis of different measurements in the time line via a data analyzer component

## Application

Over the past years, engineers began to substitute real bulky, expensive and dangerous batteries by power supplies in order to simulate at least the discharge behaviour of the real battery. By this, one of the most important drawbacks of real batteries could be avoided: In the case of a circuit failure or a short circuit, real batteries are driving nearly unlimited current endangering personnel in the vicinity by fire or splatters of melted metal. Modern power supplies dispose of a fast acting current limit preventing too high current from flowing.

Advanced battery simulation however means not only to reproduce the discharge curve more or less accurate, but rather to cover the full characteristics of electro-chemical storage element during any charge or discharge activity.

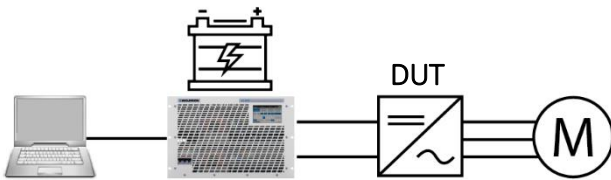


Figure 1: The preset values of the G5 power supply is set by the charging / discharging curve of the G5.BatSim battery model. The DC voltage of the G5 device behaves similar to real battery according the current of the device under test (DUT) and the battery model parameters.

## Control Tab

The control tab represents the main user interface with display of the live data, the DC-on/off button and access to information on warnings, errors, as well as to the saved incident history.



Figure 2: Information on the main operating values, like actual values and controller limits.

- System settings and display: Setting reference and display of actual values like voltage, current, power and internal resistance
- Upper and lower limit for voltage, current and power to protect DUT
- Basic battery configuration: Battery chemistry, number of battery cells in parallel / series, state of charge (SOC), cell cut-off threshold settings, cell nominal voltage and cell nominal capacity
- Simulation control: start, stop and pause a simulation
- Battery state during simulation: Charge / discharge current, battery voltage, effective charge counter and total capacity
- Handling of different G5.BatSim configurations: Load and save of G5.BatSim configuration files

## Advanced Configuration Window

Besides the basic G5.BatSim model parameters for a fast and efficient start, G5.BatSim provides the possibility to fine tune the battery characteristic to match a given battery curve.

Various advanced parameters to fine-tune the battery characteristic to a real measured battery are provided in the advanced configuration window.

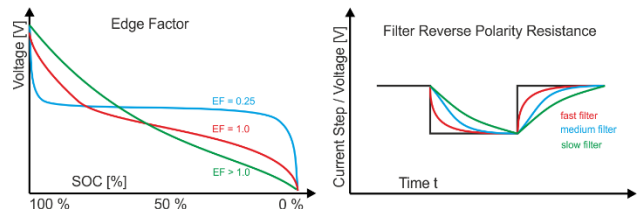


Figure 3: Use the edge factor to shape the discharge curve and adapt the reverse polarity resistance with the filter T (Tau) to adjust the voltage response to current steps.

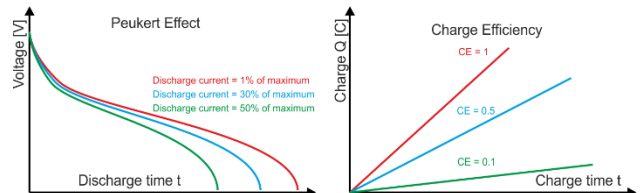


Figure 4: Adapt the peukert exponent to set the battery's reaction to high discharge currents and the battery's charging efficiency.

## Script Editor Tab

Selection of a provided script to be used for testing, or implementing an own custom script is done within the script editor tab.

It provides intelligent coding by means of content assist. The integrated parser displays available commands in a selection box on the fly.

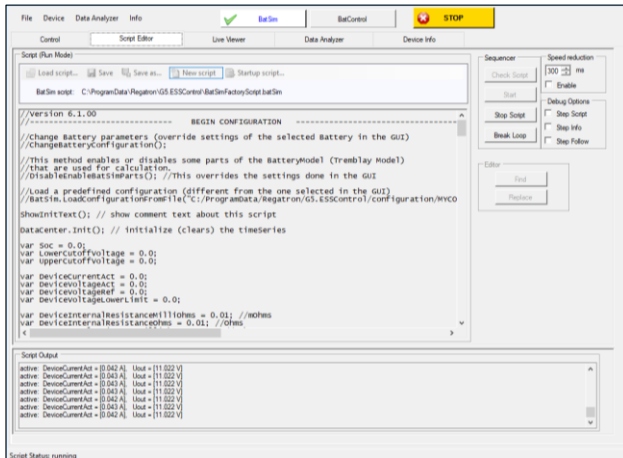


Figure 5: Programming and debugging tab with single step mode and output window.

### Further features of the script editor tab:

- Possibility to customize the factory model script by adding data channels to the data collector for the live scoping and the data analyzer
- Load, save and reset to factory script
- Run, stop and pause of a script
- Script debugging via “step mode”, grain syntax script checking, single step mode, slow motion, and interactive loop break
- Write and test a script with highlighting of search strings
- Ready-to-use G5.BatSim script which may be modified by the user
- Saving of data being recorded during execution
- Selecting folders that contain G5.BatSim-scripts
- Check and preview the selected script
- Immediately starting a functional script

## Live Viewer Tab

The live viewer is a long-term data logger with immediate observation and virtually unrestricted data recording. Start/stop of the live viewer and the selection of commonly used signals is done within a programming script.

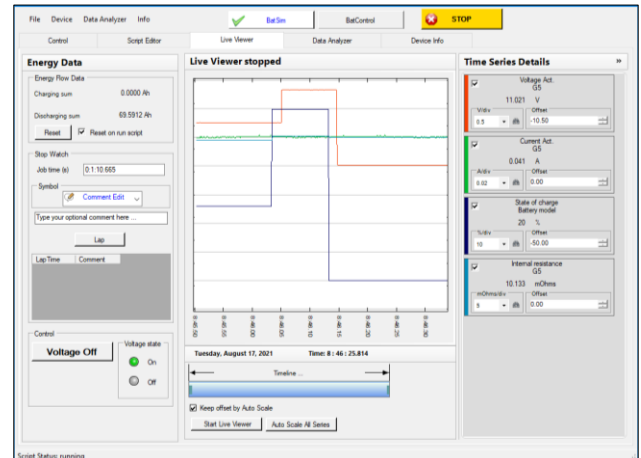


Figure 6: Rolling output information on the live viewer tab.

### Further features of the live viewer tab:

- The channels are selectable in the time series details group
- Event marker setting as time stamps for the data analyzer tab
- Scope over the total time line with zoom-window functionality
- Conjoint collection of data from different data sources
- Arbitrary selection from a set of possible signals to be recorded from G5 device
- Recording with real-time stamp
- Start/stop programmable by software command

## Data Analyzer Tab

With the data analyzer various data streams recorded by the live viewer or imported from a csv file can be analyzed and compared. Using the time shift feature allows a direct overlay of different records for comparison.

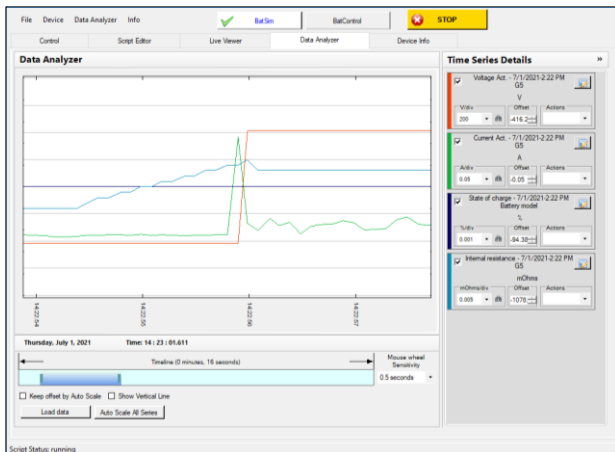


Figure 7: Evaluation of data from a test sequence on the data analyzer tab.

### Further features of the data analyzer tab:

- Comparing of two sessions that have been recorded at different time
- Setting time markers
- Shifting signals to the time marker position
- Display of event markers that are set in the live viewer tab
- Load recorded data from files and save session in a new file

## Device Info Tab

The device info tab shows information about the connected G5 system such as device identification, software versions, multi-device configuration, installed software options and overall system values.

## G5.BatSim on G5 Devices

G5.BatSim comes in combination with a G5.BAS or G5.UNV device and includes the mathematical models of the battery characteristics.

## Connectivity

A connection is established via Ethernet or USB using the connection manager of the G5.ESSControl software, which offers further functions such as auto connect for pre-configured connections and a communication watchdog.

## System Requirements

- Windows 10 (32bit and 64bit)
- 4 GB RAM
- 5 GB disk space
- Recommended screen resolution 1280 x 720 or higher

This product is developed, produced and tested according to ISO 9001 by REGATRON.

For detailed technical information, contact REGATRON or your local sales partner.

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