

G5.BatControl

PC-Software for Battery Testing

The battery testing and cycling software G5.BatControl offers convenient possibilities to test battery modules or packs with charge and discharge capabilities of a few kW up to the 2000+ kW range. G5.BatControl allows selecting and running so-called "BatScripts". These scripts automate the otherwise manually given commands to the G5 power supply. A variety of predefined function blocks with various charge and discharge behaviors are available to easily create a customized test sequence. This allows for defining charge and discharge algorithms, the possibility to run driving cycles or to replay previously recorded discharge / charge data. By this, a given test procedure is set up by a few clicks and may last hours or even days. The PC-Software G5.BatControl has access to time critical measurements like charge and energy counter, which are calculated real-time by the G5 device with highest accuracy, sampling rate and resolution. Long-term measurement data recording and recall are available within the G5.BatControl application software.

Key Features & Functionality

- Fully integrated in REGATRON's G5.UNV and optionally in G5.BT devices
- G5.ESSControl is the user interface software and script environment for the software G5.BatControl
- Predefined charging and discharging blocks like for example CC-CV, CP-CV, or CR-discharge
- Various termination criteria like voltage, current, capacity, or time
- Adaptation and controlling of the individual configured blocks possible with simple and powerful scripting language
- Access to the real-time charge and energy counter in the G5 device
- Record and replay – charge / discharge the battery according to recorded data
- Multi-channel live viewer and data-logger with event markers as time stamps and file export in csv format
- Data analysis of different measurements in the time line via a data analyzer component
- Reporting / output-to-file functions during the process are integrated in the scripting language

Application

With a look to the growing market of e-mobility and the increasing demand for PV energy storage, testing and cycling of real battery systems is of great importance. Real tests are the key to authentic ratings for a given system under given circumstances.

Thus to minimize development costs a drive cycle has to be recorded only once on the test track or in the real city traffic and then can be repeatedly applied with the same quality to different battery configurations.

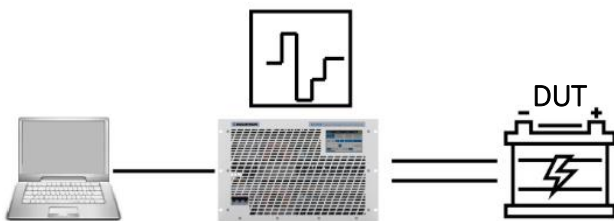


Figure 1: G5 battery tester burdens the battery under test with user defined charge / discharge cycles.

Integration of External Hardware

It is possible to integrate external hardware into G5.BatControl via four analog inputs and control the script behavior accordingly.

Examples:

- Voltage sensors
- Temperature sensors

Predefined Blocks and Features

- CC, CP, CR charge / discharge to a specified end voltage
- CC, CP charge / discharge a specified amount of capacity
- CC-CV charge / discharge to a specified voltage with tapering current
- CC-CV charge / discharge to a specified voltage with stepping down current
- CP-CV charge / discharge to a specified voltage with stepping down current
- Multiple termination criteria like time, voltage, and minimum current possible
- Continuous or stepwise current reduce at U_{max} for optimal charging process
- Several charge and discharge processes may be sequenced using the scripting editor

Use case: IUoU charge

The predefined block "CC_CV_taper_current()" charges the battery to the specified U_0 voltage. While the voltage remains at U_0 , the current is continuously decreasing to the specified minimum current. For lead acid batteries a CV block may be added to hold the battery at the float voltage U_{float} .

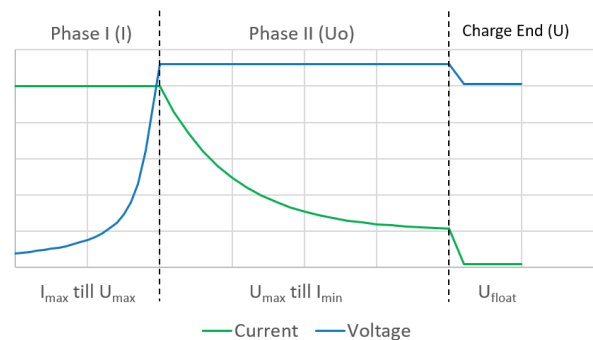


Figure 2: Provided example implements a IUoU charging process with continuous current reduce at U_{max} (U_0) for a lead acid battery.

Use case: Drive cycle

A G5 BatScript allows for running a previously recorded drive cycle from a csv file. Replay a cycle in a lab environment under varying conditions help to save testing and development costs.

The provided example implements a simple two parted drive cycle to explain the underlying concept, with easy adaptation to other drive cycles.

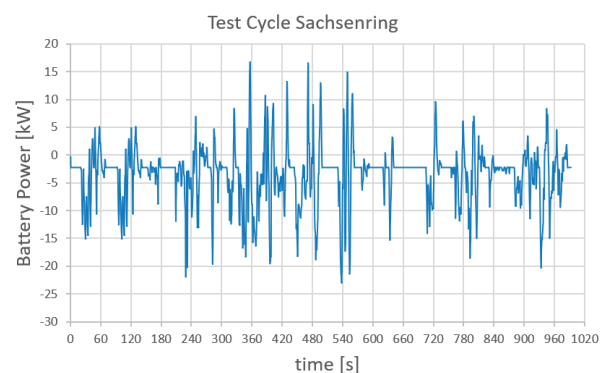


Figure 3: A recorded drive cycle from a test drive on the Sachsenring may be applied identically again and again. Tested with more than 400,000 data points.

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.

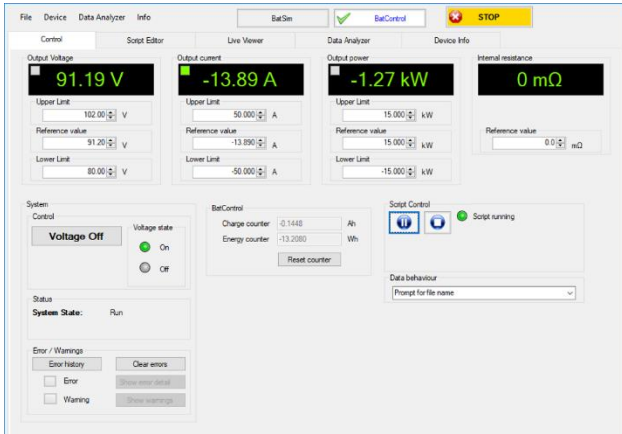


Figure 4: Information on the main operating values, like actual values and controller limits.

- System settings and display: Setting reference and display of actual values as well as indication of controller mode (CV, CC, CP)
- Upper and lower limit for voltage, current and power to protect DUT
- Energy and charge counter display
- Script control: start/stop of programmed test scripts and logging behaviour

Script Editor Tab

Selection of a provided G5 BatScript 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.

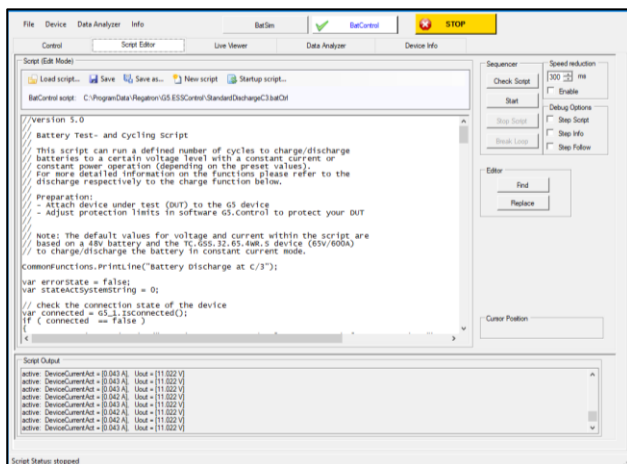


Figure 5: Programming and debugging tab with single step mode and output window.

Further features of the script editor tab:

- Possibility to customize the factory test scripts: Add data channels to the data collector for the live scoping and the data analyzer
- Load, save and reset to factory G5 BatScript
- 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
- Allows for arbitrary command sequences and automatic test cycles
- Programming with editor support of a parser
- Saving of data being recorded during execution of a script to file, importing data from file to be processed in a script
- Easy adaption and expansion of standard G5 BatScript with predefined block functions
- Selecting folders that contain G5 BatScripts
- Immediately starting a functional G5 BatScript

Example of a G5 BatScript:

```
// Sequence your blocks here according definitions above START ---
// Example for a discharge with 4 Amps down to 10.5 Volts
// for a max time 200 minutes
CCU(-4,10.5,200);

// Example for a pause block for 1 minute
// while still recording values
waitandviewMin(1);

// Example for a charge with 12.5 Amps to max 14.8 Volts,
// cutoff current 1.25 Amps for a max time of (time_limit_factor)
// - theoretical time according to set C-Rate (time set to 0)
CC_CV_taper_current(12.5,14.8,1.25,0);
```

Figure 6: Example of a discharge / charge sequence.

- Discharges battery to 10.5 V with 4 A for max. 200 minutes
- Wait 1 minute while still logging data
- Charge the battery with 12.5 A to max. 14.8 V then reduce current continuously down to 1.25 A for max. time according to set C-rate.

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.

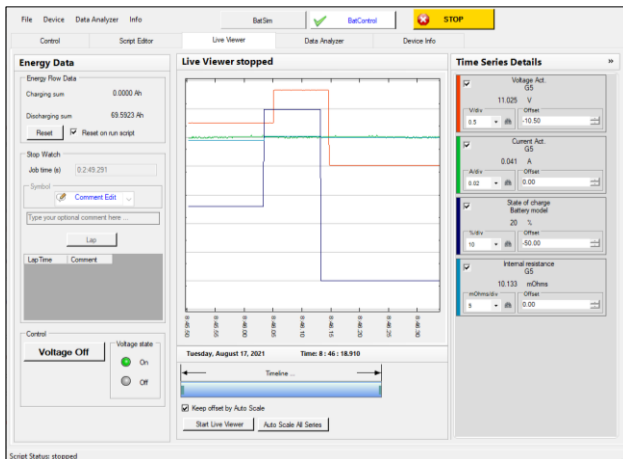


Figure 7: Rolling output information on the live viewer tab.

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.

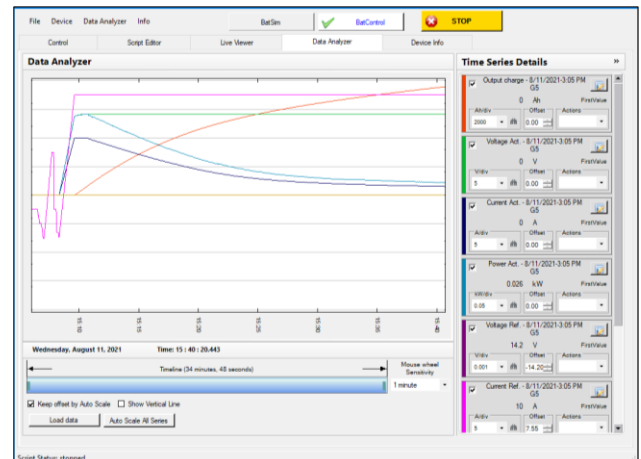


Figure 8: Evaluation of data from a test sequence on the data analyzer tab.

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.BatControl on G5 Devices

G5.BatControl comes in combination with a G5.UNV, optionally G5.BT device, and includes access to the real-time charge and energy counter as well as the data logging functionality.

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 your local sales partner.



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All product specifications and information herein are subject to change without notice.

Filename: PD_G5.BatControl_EN_220830

Class: Public