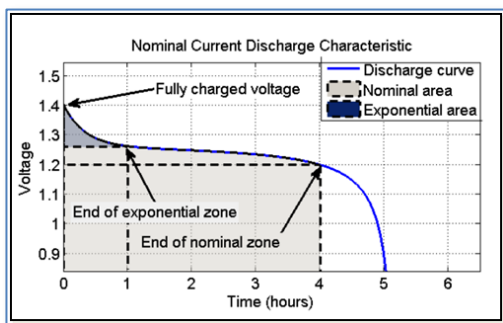


## Key Features & Functionality

BatSim provides a convenient Windows interface for simulating secondary battery stacks. It is used in combination with the bidirectional TC.GSS modules, ResAct or ReGen systems. The software is based on the comprehensive Tremblay/Dessaint model (2009). It enables the user to define and vary a wide range of electrical characteristics:

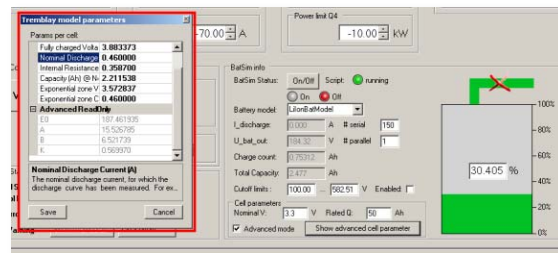
- Selection of model according to battery chemistry: Li-ion, Lead Acid, Ni-MH and Ni-Cd (others on request)
- Number of cells along with rated capacities, series/parallel configuration of cells
- Optional cut-off voltage limits to simulate invalid battery states (overcharge / deep discharge state)
- Exponential capacity and voltage levels
- Influence of charging loss (using TopCon R<sub>i</sub>)
- Adaptation and implementation of own battery models possible with simple, yet powerful scripting language
- Multi-channel logger with output to file (CSV, timestamps)
- Reporting / output-to-file capabilities from within the scripting language during process
- Data analysis (e.g. comparison) of data of different measurements in data analyzer component



Overview of the battery model

The user is not tied to existing models or chemistries. Experimental or non-standard cells can be simulated. The multi-channel data logger provides live reporting and output to file (CSV) with timestamps. Previously recorded data can be reviewed and compared in the analyser mode. BatSim is a valuable tool for the test and development engineer who is engaged in:

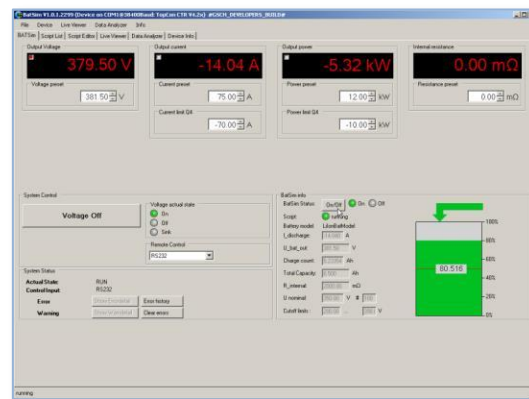
- Testing of battery chargers, generators, inverters and alternators
- Behaviour and stability tests of on-board power systems and DC subsystems
- Profiling of powertrains for HEVs and EVs
  - Comparative studies on the influence of: charge/discharge current, nominal voltage, cell scheme and optionally battery temperature



Comprehensive user adjustable cell configuration

## Main Screen of BATSim:

- Display of live and preset values for current and power limits along with the voltage and internal resistance being simulated
- Selection of battery chemistry, cell characteristics and pack configuration
- Control of the the system: Power ON/OFF, connect mode, error handling
- Charge counter in Ah
- SOC visualisation showing the charge/discharge process

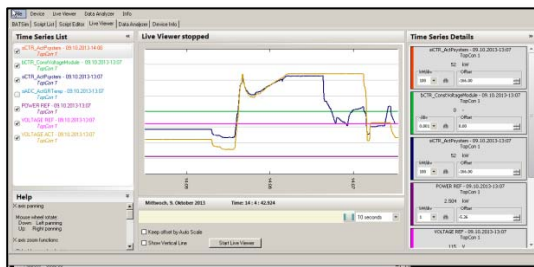


Main screen of BatSim application (status: charging at approx. 80% SOC)

## LiveViewer:

The multi-channel logger allows for long term data acquisition. Values are graphically displayed in real time

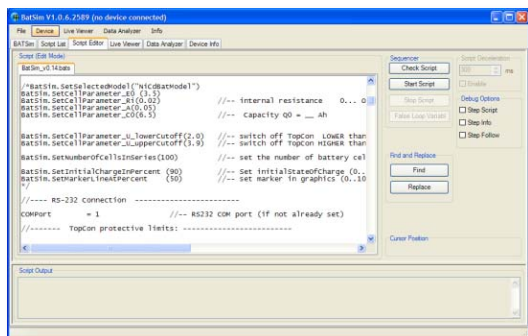
- Live data logging with realtime stamp
- Almost unrestricted signal recording directly to PC
- Collection of data from multiple sources
- Comprehensive selection of recording signals
- Start/Stop intervals programmable by software commands
- Export to CSV for further processing and analysis of recorded data
- User defined realtime annotation of data



Data Live Viewer (battery discharge 100-0%)

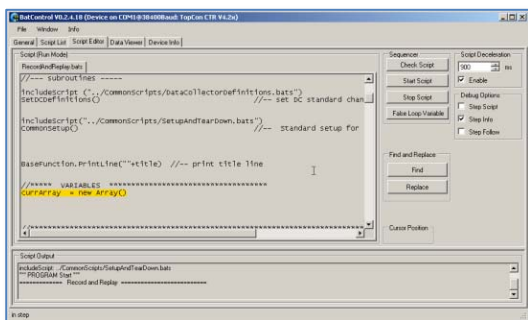
### Script Editor (free option, advanced user):

Along with the graphical interface, script based editing software is provided within BatSim. Commands are written in an easy to learn programming language similar to JavaScript. A BatScript with explanatory comments is provided for reference. It is in an open format to allow user modification. The script editor is a powerful tool for the setting, adaptation and implementation of user specific battery models. It offers a wide variety of options to the advanced user.



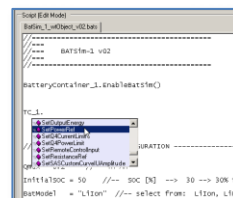
BatScript example

- Programming Mode: create command sequences and automated test cycles
- Edit mode: modify and test a BatScript file
- Execution mode: run a BatScript file
  - Extended debugging capabilities: single step mode, slow motion, interactive loop break



Script editor in execution mode (current line is lit)

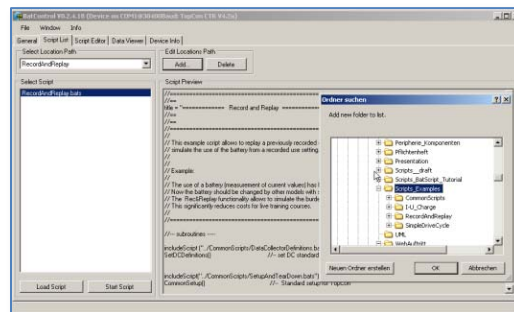
- View and record data during the execution of a BatScript file
- Import data from an existing file to be converted into BatScript
- Intelligent editor support with contextual command suggestions:



### Script Selection List (free option, advanced user):

Main entry point for execution of proprietary functional programs (BatScript)

- Easy selection of standard supervisor script for normal BatSim operation; shipped as default script (open format, modifiable)
- Selecting folders that contain BatScripts
- Check and preview the selected script
- Immediately starting a functional script
- Scripts are editable with built-in script editor



Script list window with script selector

### Scope of delivery

- Latest version of TopCon firmware including all functionality that is needed by BatSim.
- Installer package for PC including:
  - BatSim user interface and middleware functionality; BatSim script / object with user modification points
  - Various function libraries (basic and enhanced communications + .NET support)
  - Handbook (operations, programming)

