ReleaseNotes IviumSoft 1.723 (firmware 150)

1. Data reduction: data averaging, or store only data when E/I data changes

When data is captured over extended periods and/or at high sample rates, the large data files produced can become slow and cumbersome to manage. This release of IviumSoft includes two new facilities under Method/Transients which can be used to avoid this problem:

Skipping or Averaging datapoints: Reduce the number of datapoints by entering a number of points to use to compute an average. This is stored as a single value. The new facility in this release enables the user, by ticking the new tick box "No Averaging", to store every n-th value is stored without averaging the intermediate values.

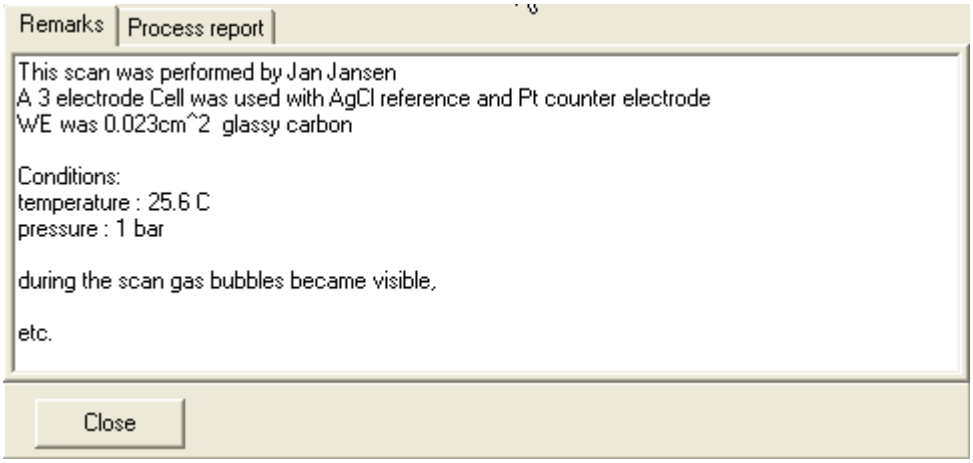
In the existing data reduction option (transient techniques), the number of datapoints can be reduced by setting an averaging number. The intermediate datapoints are averaged to a single stored value. An option is added: When "no averaging" is checked, every n-th value is stored without averaging the intermediate values.

Adaptive sampling enables the user to set a minimum change in the measured parameter (E/I) which will be stored in the data file. Thus, all relevant trends are captured with a minimum of datapoints. The user can define a minimum potential- and/or current-difference which he considers relevant. Datapoints that differ less than the defined delta from the last recorded point, will not be stored. Only datapoints that differ more than the minimal defined delta will be displayed. The exception is the 1st datapoint after each new applied level-change, which will always be stored.
For ChronoAmperometry the instrument will use the "min I delta", and for ChronoPotentiometry the "min I delta" parameter.
For Mixed mode, both parameters will be used: either an E-delta or an I-delta will trigger a sample-recording. In this case, either a single parameter can be effectively disabled by entering a very high value.

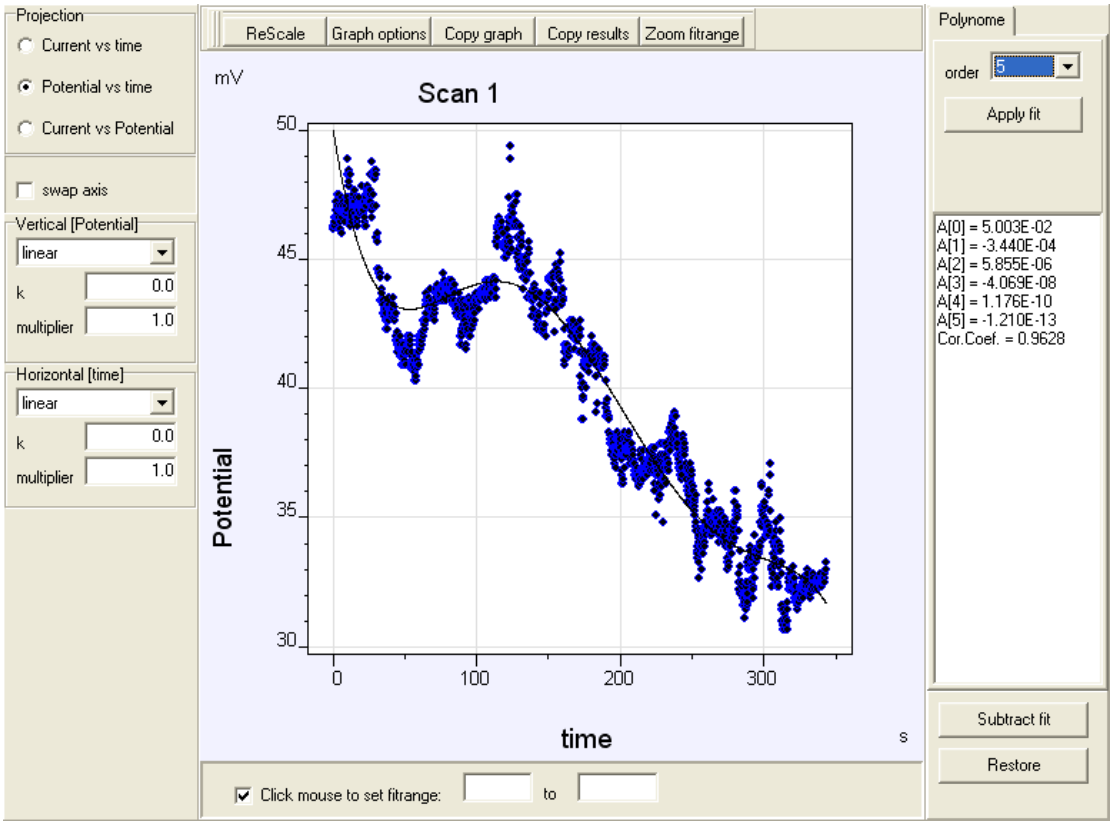
In principle, the averaging approach could be combined with the "minimum delta" method. However, this is not recommended because of the increasing complexity. Therefore, if using the "minimum delta" method, keep the "average every" on 1 point. And for the averaging approach, keep both min-deltas to 0.

2. Data report: add notes to datafiles

A new Method button has been added, called "Report". This allows the operator to include notes and extra information about the experiment in the datafile. When pressing the Report button, a window opens where notes can be typed in the Remarks tabsheet.
Additionally, a Process Report tabsheet is added, that will list all instrument data (see also Figure under item 5. below).



3. Analysis: curve fitting on measured data



Arbitrary polynomials can be fitted on the data, from the Analysis menu.

First select the curve to be analysed, and press Analysis/Curve fit. On the left, the projection can be chosen based on the available variables: potential, current, time, Z1, Z2, frequency, etc. Also both axis can be transformed : linear / log / exp / sqrt / power/ etc.
If desirable, the range that should be fitted can be constricted by clicking the Mouse on the start- and end-points.
On the right, the order of the polynomial can be selected: max 9.

4. EIS: improved frequency resolution

In the previous versions, the applied frequencies were derived from the main 8MHz oscillator: 8MHz/n. This results in reducing frequency resolution at higher frequencies, e.g.. for 100kHz → 1.2%, for 1MHz → 12% etc.
This release includes a more advanced software algorithm which improves the frequency resolution to be better than 0.05% over the whole frequency range.

Note that the frequency resolution is not the same as the applied frequency accuracy. Frequency resolution is defined as the smallest possible separation between 2 applied frequencies whereas frequency accuracy is the accuracy of each frequency point. (For all software versions, with IviumStat/CompactStat, the frequency accuracy is better than 100ppm (0.01%), for –10C to +70C.)

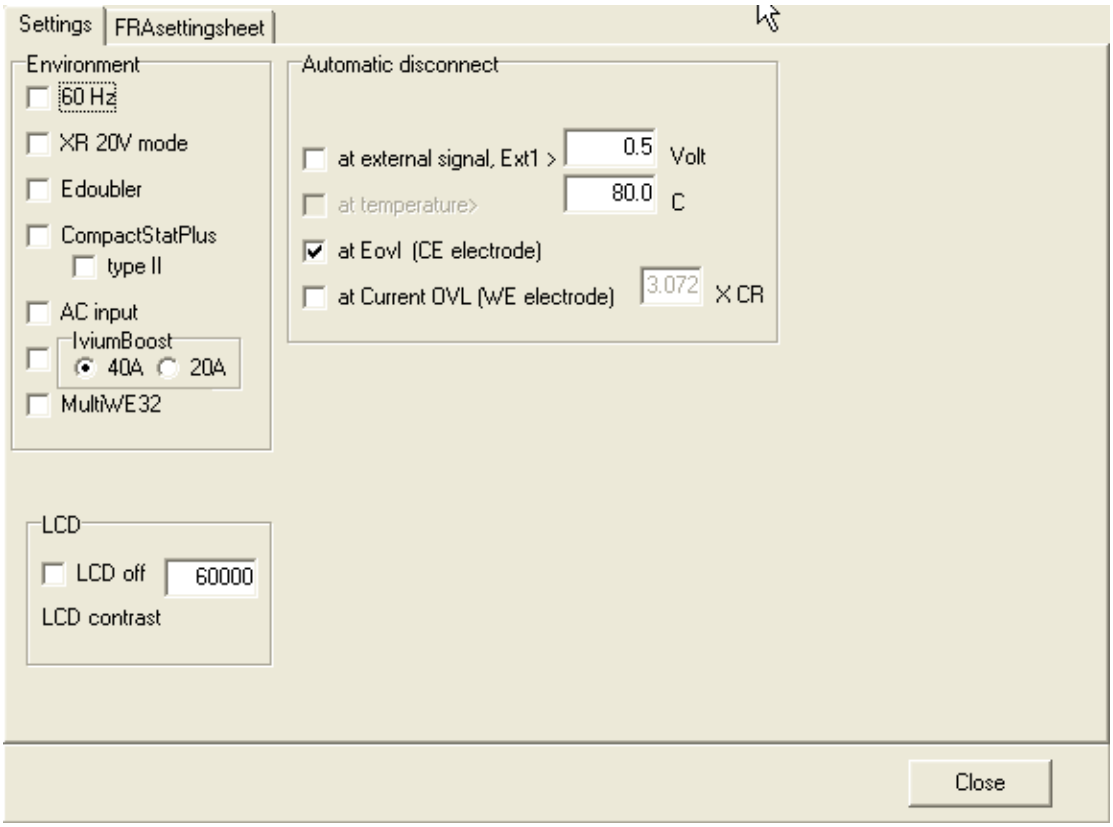
5. Automatic disconnect at defined maximum potential/current/external-input

This is a new facility introduced to provide additional protection against damage to sensitive devices. For example, a loose or intermittent RE or S connection, or simply an operator error, could cause an instrument to overdrive a device.

The current Release incorporates a facility to It is now possible to automatically disconnect power to the electrodes, and abort a measurement underat user-definable conditions. At this time, 3 conditions can be defined:

1. Analog input 1 > "defined voltage value"
2. Potential overload
3. Current overload

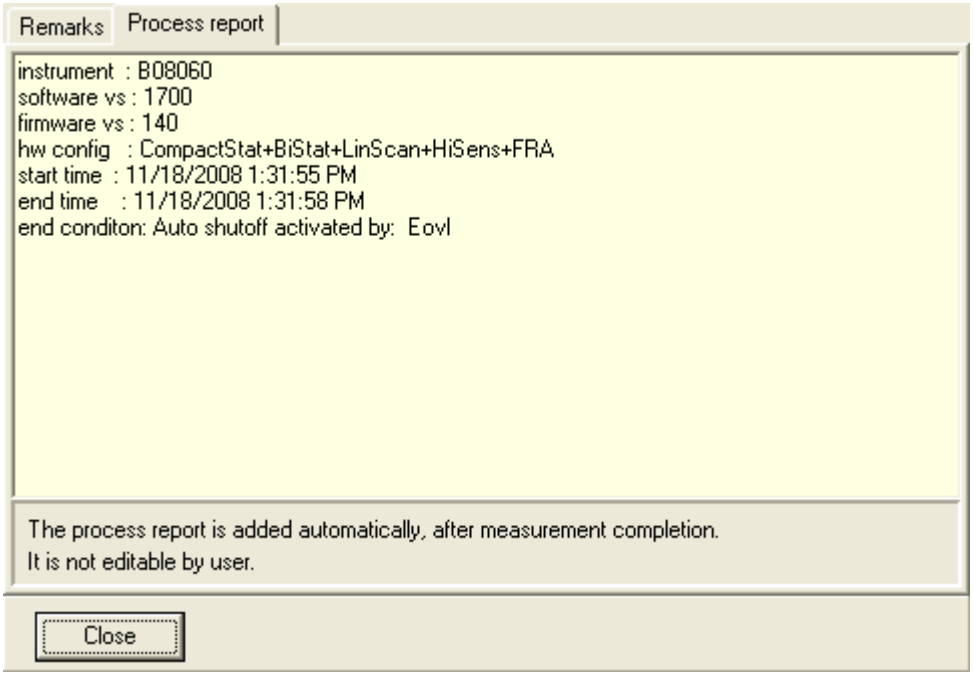
These conditions can be activated in the Options parameters: select menu Options/Options/Settings:



Once activated these will be applied on all subsequent operations. These settings are retained after closing and restarting the software.

If one of the active disconnect conditions is met, the cell will be disconnected automatically, and the method in progress is aborted (most methods). The cell will remain off until the condition is removed and the condition is reset. Resetting can be accomplished by toggling the Cell on/off, or restarting the method.

When a method is aborted by this feature, a message is shown on the bottom Statusbar. Also the condition is logged in the process-report:



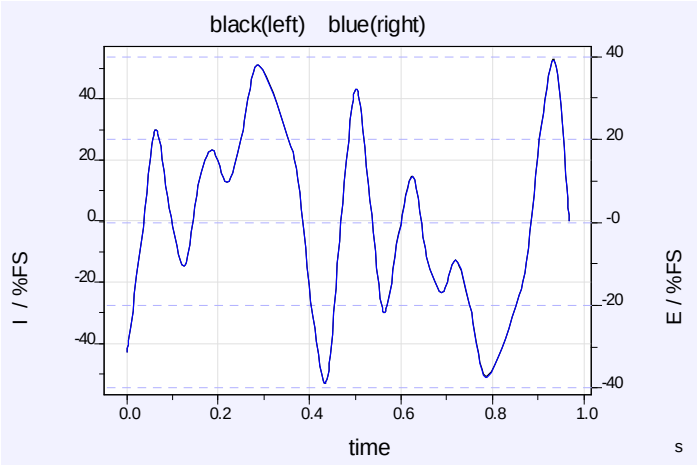
Note that Automatic disconnect is intended as a safety feature. It is directly hardwired in the electronics, therefore it works instantaneous, and does not depend on whatever the software is doing at that time. Even in the event the software has crashed, the electrodes will still be disconnected on the alarm conditions.
The automated disconnect at temperature overload will always be active, and cannot be disabled.

6. Electrolysis report

From the Analysis menu, an Electrolysis report can be generated. It will display the passed charge and current. Also it will report the numerical values for "Total Charge" and "Netto Charge". The "Netto Charge" is defined as the "Total Charge" corrected for the "Baseline Current", which is taken to be equal to the "End current".
Note that this analysis can be used in combination with the Mixed-Mode technique, where in Potentiostatic mode the "Until fraction " parameter can be used to complete electrolysis.

7. EIS: MultiSine

For EIS measurements MultiSine applies multiple sine wave frequencies simultaneously, and the corresponding impedances are collected in a single measurement. For measurements at lower frequencies this can decrease measurement time considerably, and minimize artefacts caused by time-variable impedances.

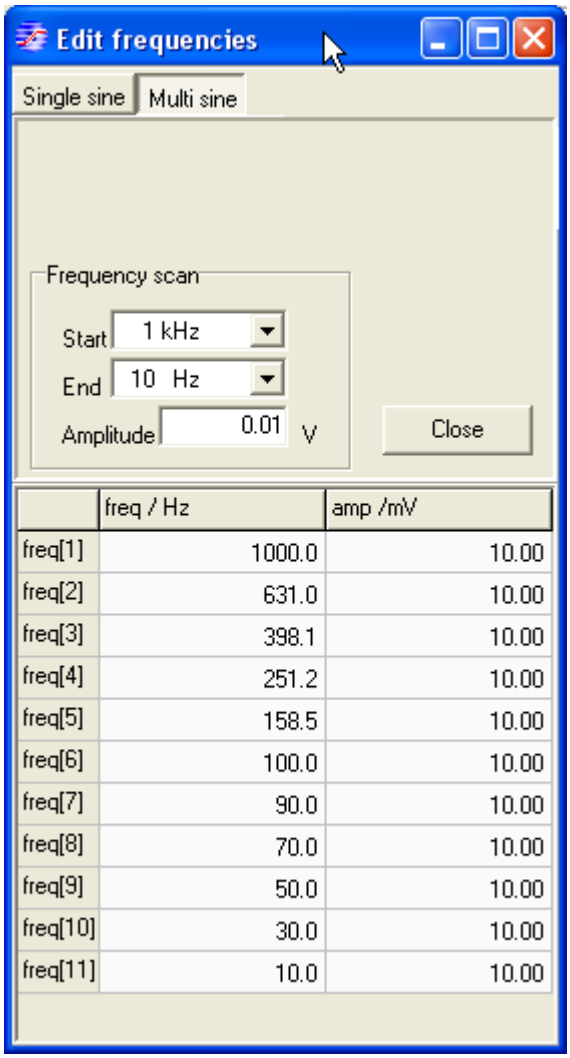


5 simultaneously applied sinewaves of 1,3,5,7 and 9 Hz

In this software version, 5 frequencies within a single decade are combined. By using the odd harmonics: 1:3:5:7:9 Hz., etc. and carefully controlling the relative phase of these frequencies it is possible to minimise the total combined amplitude for a given effect. Thus, the maximum amplitude from the combination of 5 frequencies is less than 2.5 times the individual amplitudes. This minimises the signal degradation which is traditionally inherent in the multi-sine technique whilst still producing fast results.

The MultiSine option can be selected from the top-toolbar in the "Edit frequencies" window. Compared to SingleSine, there are some constraints:

- Start and End frequency must be at decade-boundaries
- Manual override of individual frequencies/amplitudes is not available. The amplitudes are the same for all frequencies.
- Fixed number of frequencies per decade (5)



	freq / Hz	amp /mV
freq[1]	1000.0	10.00
freq[2]	631.0	10.00
freq[3]	398.1	10.00
freq[4]	251.2	10.00
freq[5]	158.5	10.00
freq[6]	100.0	10.00
freq[7]	90.0	10.00
freq[8]	70.0	10.00
freq[9]	50.0	10.00
freq[10]	30.0	10.00
freq[11]	10.0	10.00

Edit frequency window for MultiSine

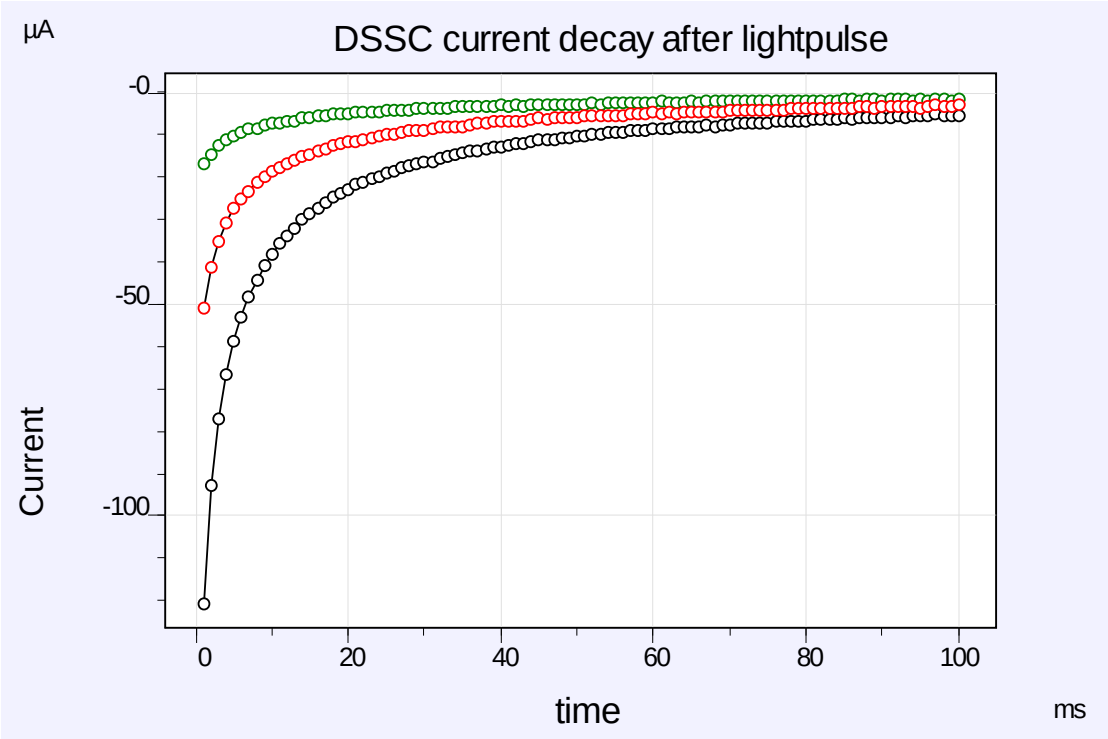
The MultiSine method is applicable for frequencies below 100Hz. However, it is possible to combine the SingleSine method and the MultiSine method in a single frequency scan. In the MultiSine tab simply select the frequency range required and the software will automatically determine which method to use over the frequency range. In the screenshot above, note that the frequencies above 100Hz will use the SingleSine method, while below 100Hz the MultiSine method is applied. Also note the logarithmic frequency distribution for SingleSine, and the odd-harmonic distribution for MultiSine.

The measurement data format will be the same as for SingleSine, each frequency will be stored individually as before. Also the data analysis is conducted in the same manner.

Note that MultiSine offers faster measurement, however this is at the expense of measurement accuracy. If measurement duration is not an overriding issue, it is strongly recommended to use the standard SingleSine method.

8. Analog pulse/level at measurement start

This is a facility to generate an external output pulse or variable voltage level just before the measurement starts. With this option, another measurement device can be triggered to start simultaneously, or a generator can be controlled to perform at the selected analog level. For example the intensity of a light-source can be varied to study photoelectric phenomena. It is both possible to apply a pulse of defined duration before the measurement starts, and apply a continuous voltage level at Analog Output 2 from the peripheral port.



Chronoamperometry at 0V for a Dye Sensitized Solar Cell, after variable intensity light pulses of 20ms

The pulse level can be defined at 16bits resolution. The pulse duration can be programmed from 0.05ms to 500 ms, at 10us resolution. The pulse is applied just before measurement sampling starts. In the HiSpeed techniques, the first recorded measurement sample follows within 0.05ms after the pulse/level-change.

For all techniques, in Advanced mode, the methodparameter "Anout2" can optionally be selected. When checked, 2 parameters appear:

- Level : the voltage to be applied to Analog output 2
- Pulse period : the duration of the pulse (0.05 to 500 ms), or 0

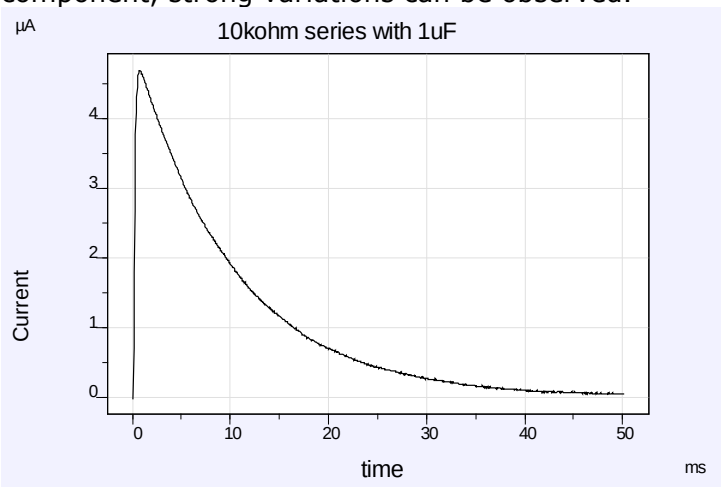
If a Pulse period of 0 ms is set, the level will be applied continuous. The value will be applied during the whole measurement, and thereafter. In such case, the analog output maintains its setting, and must be reset in manual control or by the next executed scan.

9. Variation of "alpha" for staircase sweeps

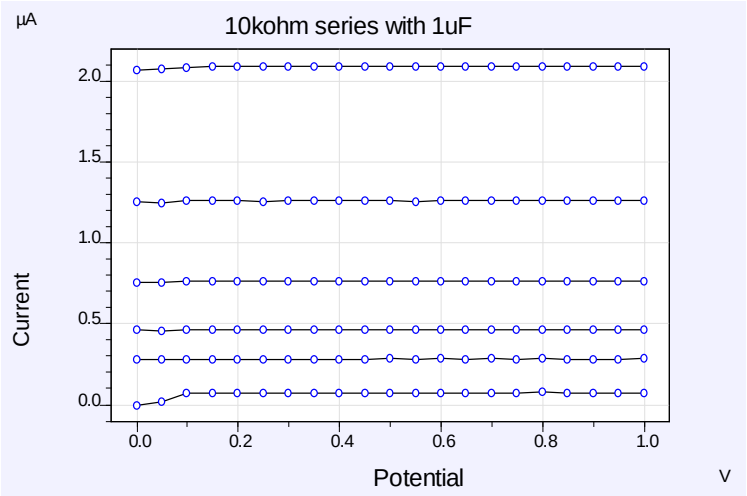
During digitally produced sweeps, e.g. in LSV and CV, the potential/current-ramp is generated in step-increments in a staircase shape. This compares with the smooth analog shape of a True Linear sweep.

The standard practice for staircase sweeps is to sample the measured variable (current for chrono-amperometry: potential for chrono-potentiometry) at the end of each step increment. However in some cases, a different sampling point is required for the measurement. Hence the parameter "alpha" is used to indicate the fraction of the step at which sampling occurs. For example, "alpha"=1 (the default setting) means sampling at the end of each step whereas alpha = 0.5 is halfway along, and so on.

In practice, the effect of "alpha" depends on the object under test. For a pure resistor, "alpha" variations have no effect, but for systems with a capacitive component, strong variations can be observed.



Current response on an RC-cell: 50mV step on a 10kohm+1uF circuit



LSV 1V/s, Estep=50mV, with alpha from top to bottom: 0.2/0.3/0.4/0.5/0.6/1.0

In the two figures above, the effect of "alpha" is demonstrated. The staircase scan is made from 50mV steps that are applied every 50ms. In the first figure is shown how the current decays after each step. The 2nd figure shows the

corresponding decrease of the LSV current with increasing "alpha". Note that alpha=0.2 corresponds with 2ms, etc.

For the staircase techniques of LSV and CV in Advanced mode at Standard speed, the parameter "Alpha" can be activated. When checked, a value from 0.125 to 0.625 can be entered. The resolution for alpha is 0.04ms.
If the "Alpha" parameter remains unchecked, the value reverts to 1 (default).

10. Record data during Equilibrium stage

Previously the measured data during an Equilibrium stage was not recorded. In this software release, this is changed.
The measured current (Estat) or potential (Istat) is appended to the pre-treatment data. The results will be shown in the pre-treatment plot, and stored in the datafile.

If the actual method description already contains pre-treatment data, the equilibrium-data is appended as it where an additional pre-treatment stage.

Note that for the Impedance-Potentialscan/Currentscan techniques, the equilibrium stage is repeated at each dc-potential/current, before each frequency-scan starts. However the pre-treatment stage is only executed before the first frequency-scan.

11. EIS: export of fit-results

The calculated parameters for the equivalent circuit can be exported from the "Equivalent circuit calculator". From the Edit menu, choose "Copy fit parameters". This will place the results in the clipboard, to be exported to other applications.

On the Data tabsheet of the "Equivalent circuit calculator", several new buttons are added:

- "Phi |Z| model" : will display the modelled numerical phase/impedance data
- "Z' Z'' model" : will display the modelled numerical complex impedance data
- "Copy data" : will copy the currently displayed data in the clipboard.

12. Automatic range setting potential measurements

Previously in direct mode, the potential measurements were always done on the widest range. Therefore the resolution for measured potential was limited: 0.125mV for CompactStat, 0.333mV for IviumStat, etc.
In this release, the instrument will automatically choose a more sensitive range if possible. This will increase resolution below 1uV.
This feature may optionally be disabled, by unchecking the "Automatic E ranging" checkbox on the Direct control tabsheet.