ZMAN Quick Start Manual

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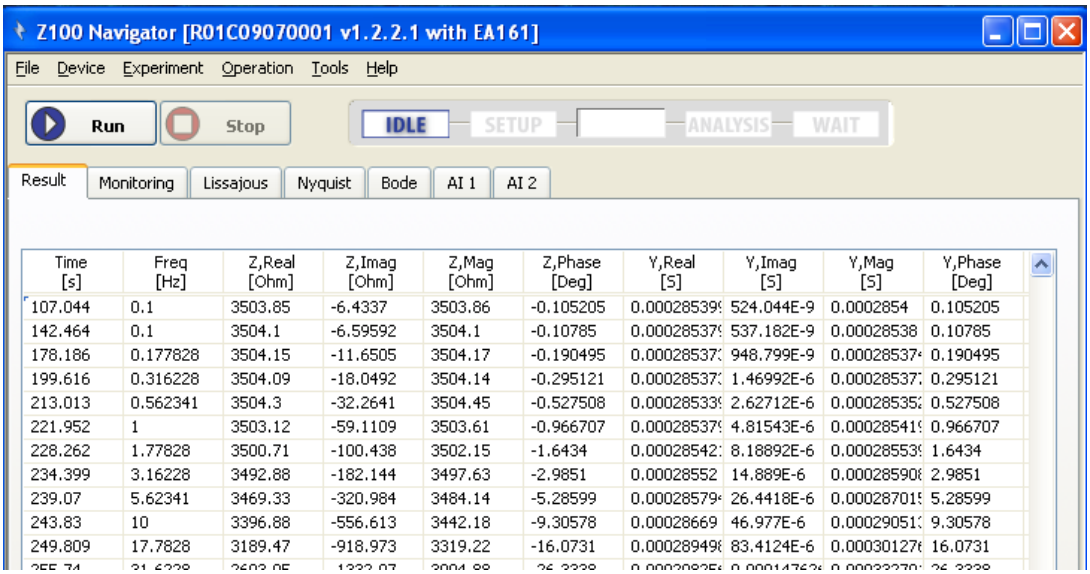
This document will demonstrate the operation of the ZMAN analysis and modeling application based on a simple RC model using the Test Network provided with the system. In this case the model tested is a 500 Ohm resistor in series with a 1uF capacitor shunted by a 3000 Ohm resistor- a simplified version of a super capacitor.

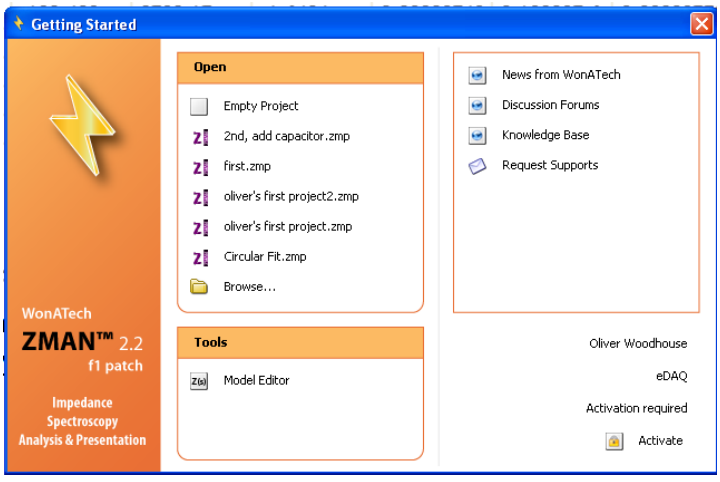
Run the experiment using **Z100 Navigator**, using appropriate settings:



Time [s]	Freq [Hz]	Z,Real [Ohm]	Z,Imag [Ohm]	Z,Mag [Ohm]	Z,Phase [Deg]	Y,Real [S]	Y,Imag [S]	Y,Mag [S]	Y,Phase [Deg]
107.044	0.1	3503.85	-6.4337	3503.86	-0.105205	0.00028539	524.044E-9	0.0002854	0.105205
142.464	0.1	3504.1	-6.59592	3504.1	-0.10785	0.00028537	537.182E-9	0.00028538	0.10785
178.186	0.177828	3504.15	-11.6505	3504.17	-0.190495	0.00028537	948.799E-9	0.00028537	0.190495
199.616	0.316228	3504.09	-18.0492	3504.14	-0.295121	0.00028537	1.46992E-6	0.00028537	0.295121
213.013	0.562341	3504.3	-32.2641	3504.45	-0.527508	0.00028533	2.62712E-6	0.00028535	0.527508
221.952	1	3503.12	-59.1109	3503.61	-0.966707	0.00028537	4.81543E-6	0.00028541	0.966707
228.262	1.77828	3500.71	-100.438	3502.15	-1.6434	0.00028542	8.18892E-6	0.00028553	1.6434
234.399	3.16228	3492.88	-182.144	3497.63	-2.9851	0.00028552	14.889E-6	0.00028590	2.9851
239.07	5.62341	3469.33	-320.984	3484.14	-5.28599	0.00028579	26.4418E-6	0.00028701	5.28599
243.83	10	3396.88	-556.613	3442.18	-9.30578	0.00028669	46.977E-6	0.00029051	9.30578
249.809	17.7828	3189.47	-918.973	3319.22	-16.0731	0.00028949	83.4124E-6	0.00030127	16.0731

Choose **File > Save As Binary Format** to save the file in an appropriate (or automatic) location, in this case it was a PEI experiment and was saved in folder PEI/2011-01-20 as RCNetwork.wis. The file is then available for analysis by ZMAN.

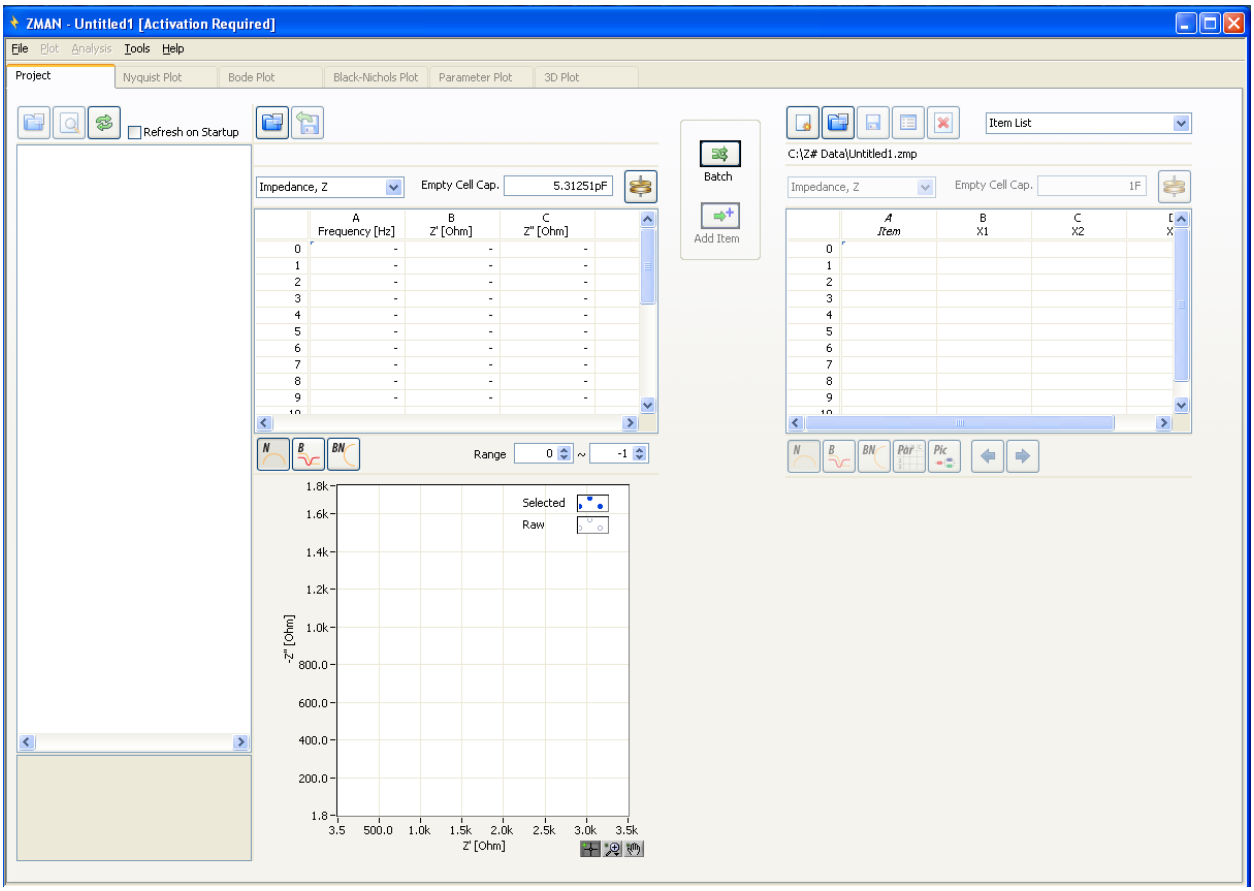
Open **ZMAN** and choose **Empty Project** from the **Open menu**



ZMAN Main screen: Note activation is only required if 3rd party data is to be analysed. Data recorded on the EDAQ Z100 (*.wis) does not require activation.

The center column will display data about to be submitted for analysis. Once the user is satisfied the contents of the file it can be moved to ZMAN for analysis. Transfer of files to ZMAN can either be performed one at the time by using the **Add Item** icon or as a batch of files related to an experiment with changing parameters by using the **Batch** icon.

In this example a single file will be transferred for analysis.

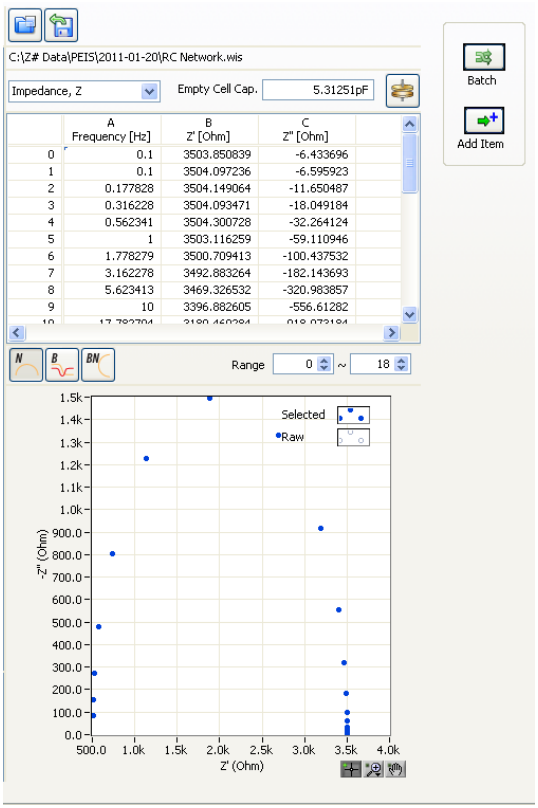


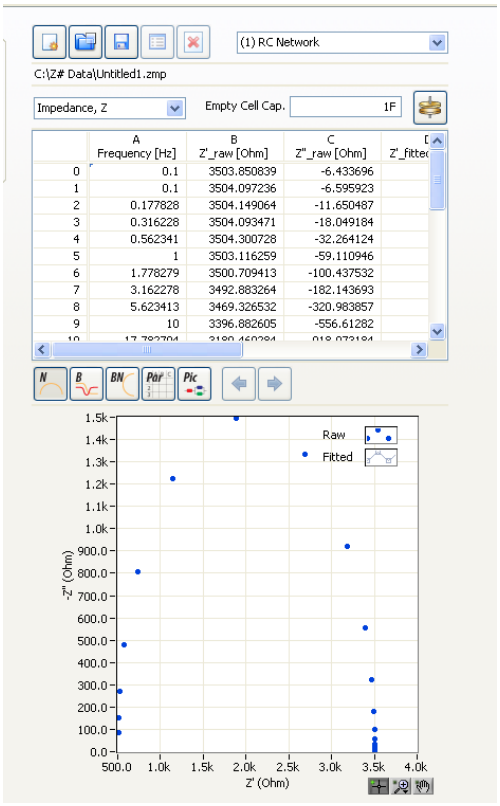
Click the "**Open File**" icon, and navigate to the file you saved in Z100 navigator. In this case the target data was stored in Z# Data/PEIS/2011-01020/RCNetwork.wis

The data will be displayed in the two panels in the middle column.

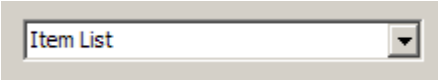
The top Panel displays the numerical values and the bottom panel provides a graphical view of the same data either as a Nyquist or Bode plot.

Click "**Add Item**" to add the selected file to the data to be analysed/fitted. The data will now appear in the list on the right hand side of the screen.

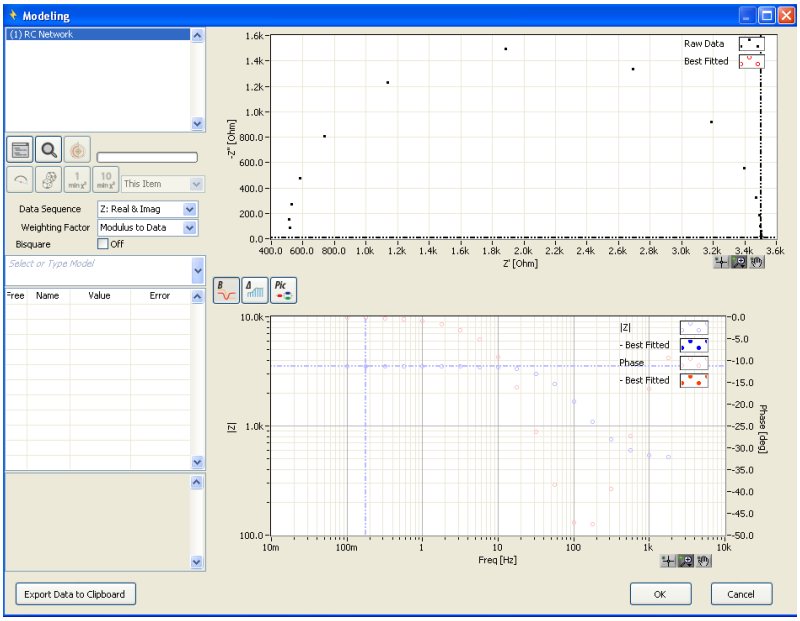




Click on the **Item List** menu and choose the file you just imported. The data will now be displayed in the bottom-right part of the screen in a variety of user selectable formats.



The file is now ready for analysis and modeling. Go to the **Analysis** menu and choose **Modeling**. This displays the Modeling screen



If you know what model you wish to apply to your data, click the **Select Model…** button. This provides the means to chose a model from the large repertoire of model categories and models within each category.

In this case we have good information about the model to be fitted and we can select **Battery and Supercapacitor** from the **Category** drop down menu and the **Rs-R/C** model and then

The initial model parameters presented are arbitrary values and in order to obtain the calculated estimates select either of **Circular Fit** or **Genetic Algorithm icons.**

This will produce model parameters based on the data set. Choosing Circular Fit or Genetic Algorithm will produce slightly different answers due to the different fitting techniques used.

The modeling screen shows the values obtained for the model.

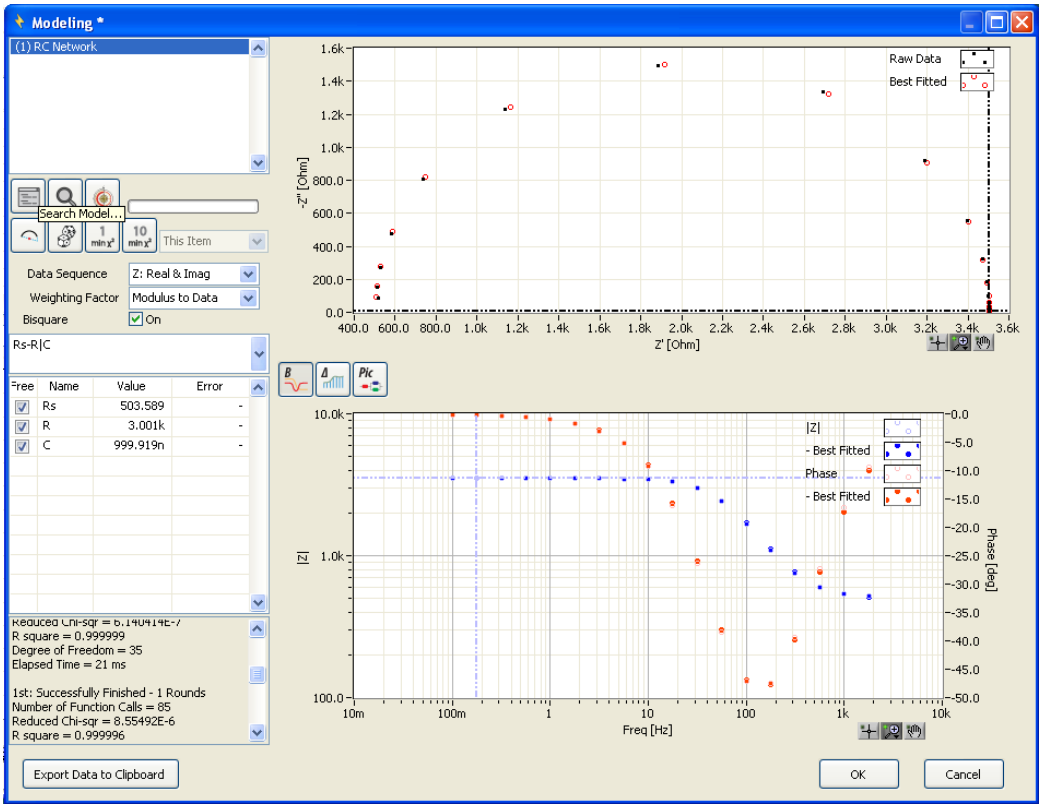
Modeling can be applied to different data sequences selected by the **Data Sequence** drop down menu.

Selecting **Bisquare** results in a more accurate estimate of model parameters but will take longer on complex modelsl. These two algorithms will produce results with no errors unless

Nyquist plot is always displayed and the lower graph can display Bode, Error or a pictorial view of the selected model and its elements.

The χ^2 operation fits the model to the actual data points with the errors displayed.

As the results obtained below with this simple example accurately represent the known values of the model elements.



Global Model Searches

However if you are unsure of the model details you can let the system search for an appropriate model that best fits the experimental data.

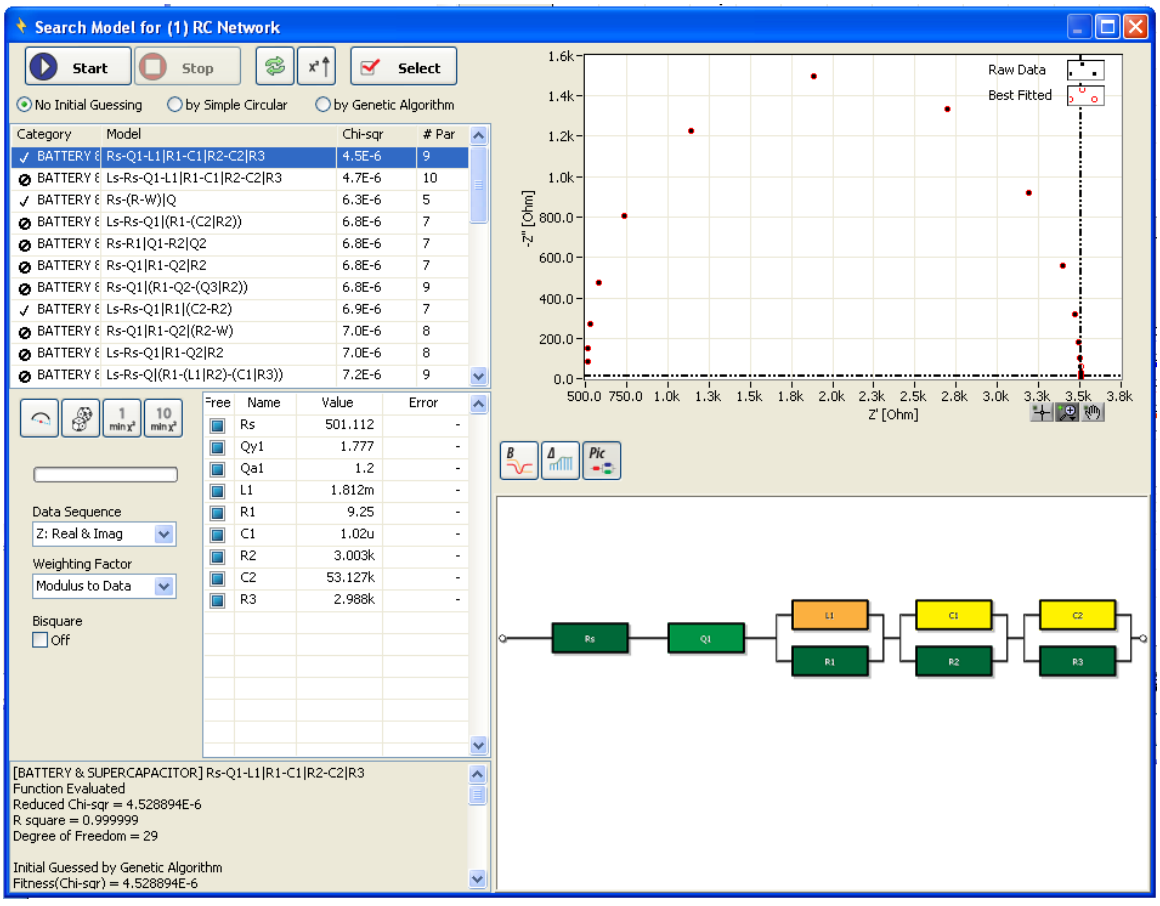
This is performed by clicking the **Search Model…** button to have ZMAN attempt to find the best model for data.

Search Model… 

If you choose **Search Model**, it is advisable to limit the search by selecting the categories of models that applies to your system, for example in the above case select **Battery and Superconductor** and click **yes**.

Wait patiently while ZMAN tries all the models against your data. When done, it will present a list (best to worst χ^2). The system has no knowledge of the internal details of your model so it will attempt to fit the model as closely as possible to the experimental data even if it has to add some very small or large value components to achieve this result. These small errors could be due to real parasitic elements or they could also be caused by small measurement errors.

In the example above the system determined that the best model has 9 elements but the 3 element model has only a slightly higher χ^2 error. This result highlights the need for the researcher to review the model carefully and determine what elements can be eliminated.



The system provides the means to fine tune models by locking elements to specific known values.

If all has gone well, you have now got a good fit to your data, and have determined the values of the components in the equivalent circuit!

It is highly recommended that initial experiments be performed on the Z100 test network or other RC network combinations until a certain proficiency is obtained on the system and more complicated “wet” models are analyzed.