

Quick Start Guide EMC Filter Synthesis



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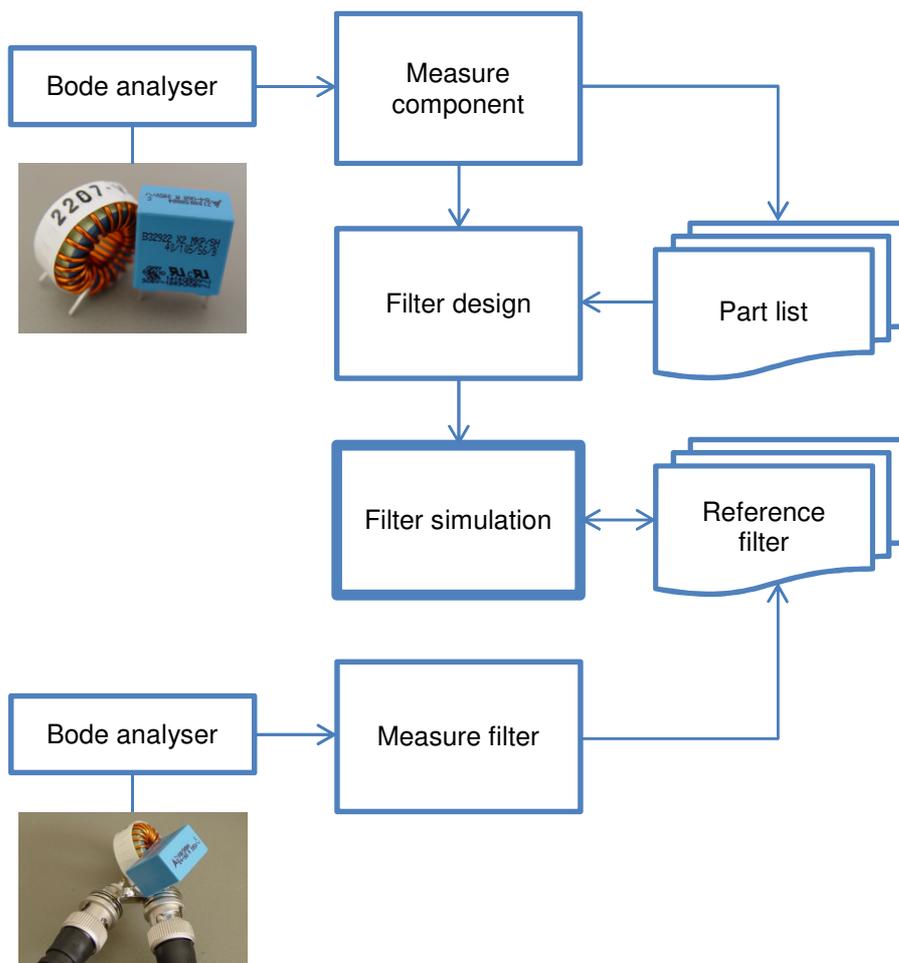
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1. Introduction

EMC Filter Synthesis is a software for simulation and interpretation of realistic and passive filters. The filter synthesis and simulation is based on measured results by individual components. This approach uses the parasitic effects of those parts. No equivalent circuit of the elements needs to be available.

The *EMC Filter Synthesis* is designed with an interface for a Bode 100 vector network analyzer by Omicron Lab. Parts can be measured and immediately used for filter elements. Design of filter schematics with real and measured parts can be realized in one software. An alternative option to import new parts is using the CSV file.

A further possibility is to measure complete filter. The measured filter curve can be imported as a reference curve. Thus, the comparison between simulation and practice is possible.



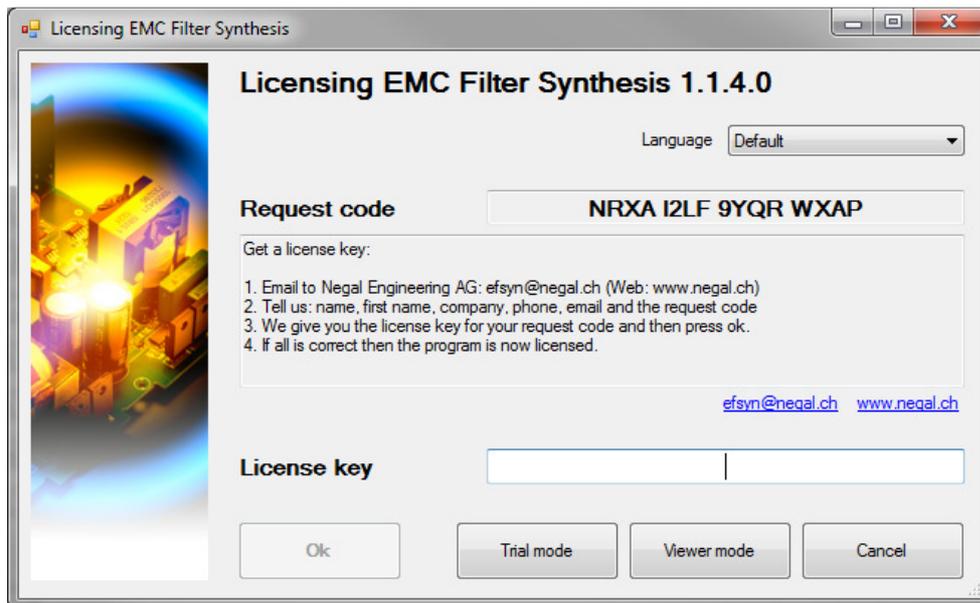
2. Install EMC filter synthesis

2.1. Install software

Download the software from www.negal.ch/efsyn and start the setup-program to install the software.

2.2. Licenses

To use all software features a license key is required which must be confirmed by pressing "Ok".



The license key can be purchased by sending the request code to EFsyn@negal.ch

2.2.1. The Trial mode

The trial mode is 14 days, starting from installation date, available. After expiration a valid license key must be typed in, otherwise only the viewer mode is available.

In the trial mode water marks are shown in the background of the editor and the printouts, for the rest no limitations exist.

2.2.2. Limitations working in viewer mode

- Filters cannot be stored
- Measured filters cannot be stored
- New library parts cannot be created
- Only the demo parts can be selected from part library
- Parts can only be measured with the already existing library parts

3. Bode 100 network analyzer

3.1. EMC Filter Synthesis and Bode 100

To use *EMC Filter Synthesis* in combination with the Bode 100 network analyzer, the installed Bode analyzer software suite (version 2.41 SR1 or higher) is required.

(<http://www.omicron-lab.com>).

Please note that only one program (either the Bode analyzer software suite or the EMC filter synthesis) can access the Bode 100 network analyzer at the same time.

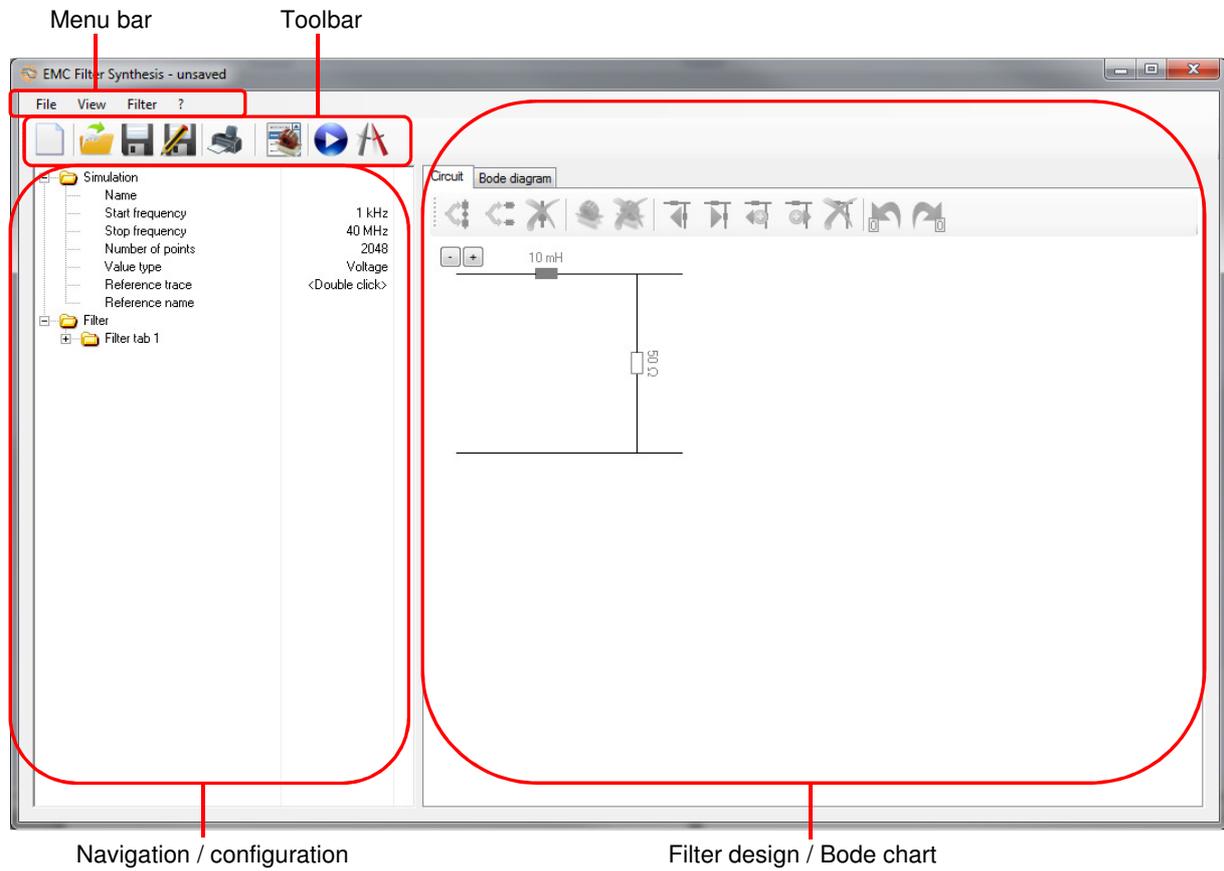
3.2. Connecting Bode 100 to computer

The Bode 100 vector network analyzer is connected with an USB-cable to your computer. For further information about the Bode 100 please visit: (<http://www.omicron-lab.com>).

4. EMC Filter Synthesis

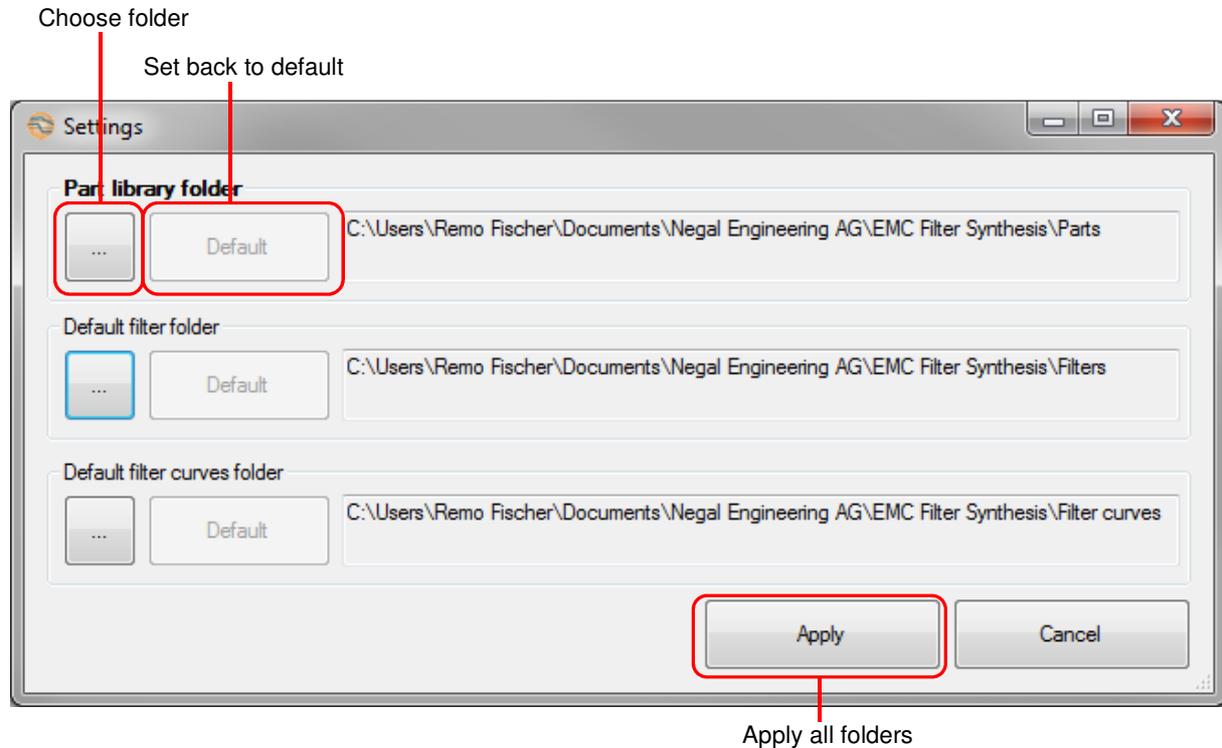
4.1. Navigation

4.1.1. Main window



4.2. Settings

Since program version 1.01.03 a settings windows was added. It can be open by menu “?/Settings...”. The most important part is the folder for the part library, which can be changed now.



After changing the folder for the part library the program removes all parts from internal list and reloads the parts from the new folder. If the actual filter uses library parts, it could be that some of them in the new folder don't exist. In this case these parts are shown grayed in the editor and the library part in the tree is shown red because it was not found in the new folder! That the parts are found in the new library folder they must be at the same relative location as in the old library folder.

Example:

The old library folder (standard for the user Remo Fischer) is shown in red, the relative path of the part blue/bold:

C:\Users\Remo Fischer\Documents\Negal Engineering AG\EMC Filter Synthesis\Parts\C\Y\C 100nF Y1.csv

The new library folder is shown in red and relative path of the part blue/bold:

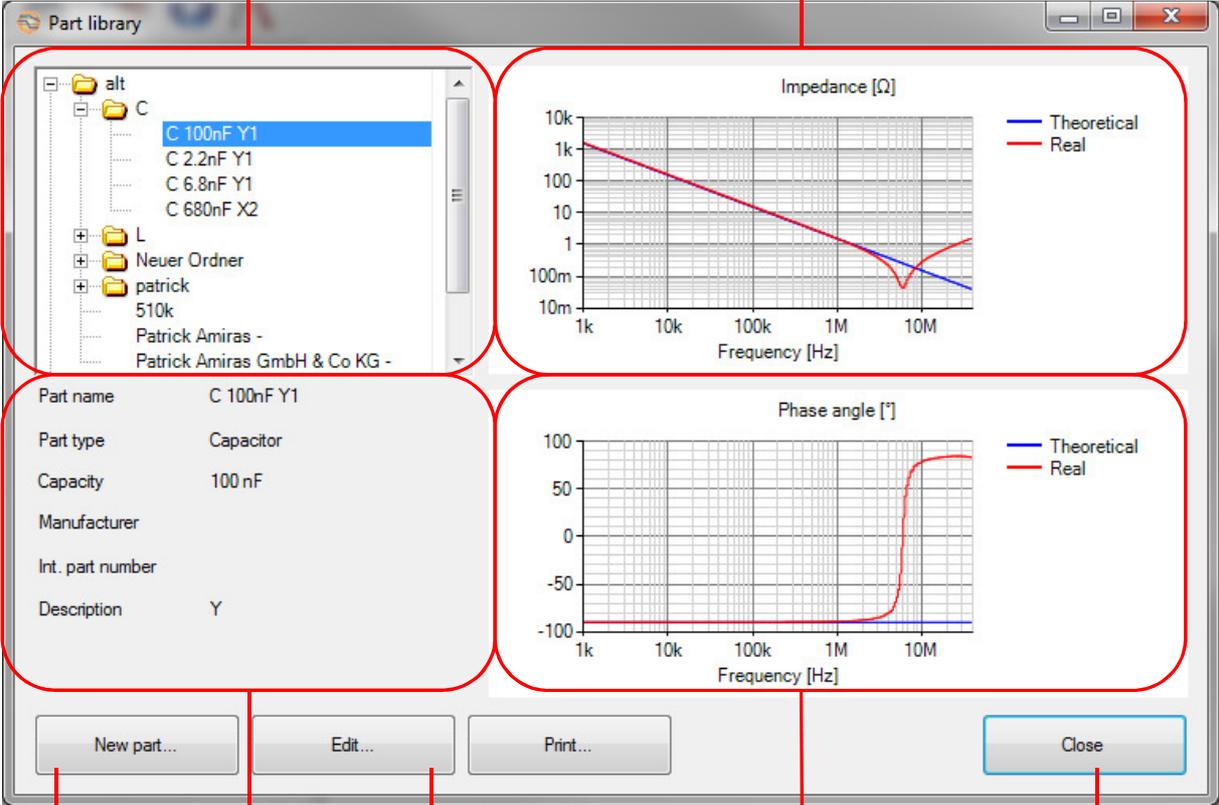
E:\Data\EMC Filter Synthesis\Parts\C\Y\C 100nF Y1.csv

The blue/bold path must be same that the application can find the part in the new library folder.

The default folders for filters and filter curves define only which folders are shown as first in the selection windows.

4.3. Part library

To open the Part library, please click on “View → Part library” in the menu.



The screenshot shows the 'Part library' window with the following components and labels:

- Parts:** A tree view on the left showing folders like 'alt', 'C', 'L', and 'Neuer Ordner'. The 'C' folder is expanded, showing parts like 'C 100nF Y1', 'C 2.2nF Y1', 'C 6.8nF Y1', and 'C 680nF X2'.
- Impedance diagram:** A plot titled 'Impedance [Ω]' showing 'Theoretical' (blue line) and 'Real' (red line) impedance versus 'Frequency [Hz]' on a log-log scale. The real impedance shows a resonance peak around 10M Hz.
- Component specification:** A table for the selected part 'C 100nF Y1':

Part name	C 100nF Y1
Part type	Capacitor
Capacity	100 nF
Manufacturer	
Int. part number	
Description	Y
- Phase angle diagram:** A plot titled 'Phase angle [°]' showing 'Theoretical' (blue line) and 'Real' (red line) phase angle versus 'Frequency [Hz]' on a log-log scale. The real phase angle shows a sharp transition from -90° to +90° around 10M Hz.
- Buttons:** 'New part...', 'Edit...', 'Print...', and 'Close' buttons are located at the bottom.

Imported components are stored in the part library. Measured impedance, phase position and also theoretic results are provided. Also, new components can be added here.

The measured components are stored in the following folder in windows

..\[User]\Documents\Negal Engineering AG\EMC Filter Synthesis\Parts

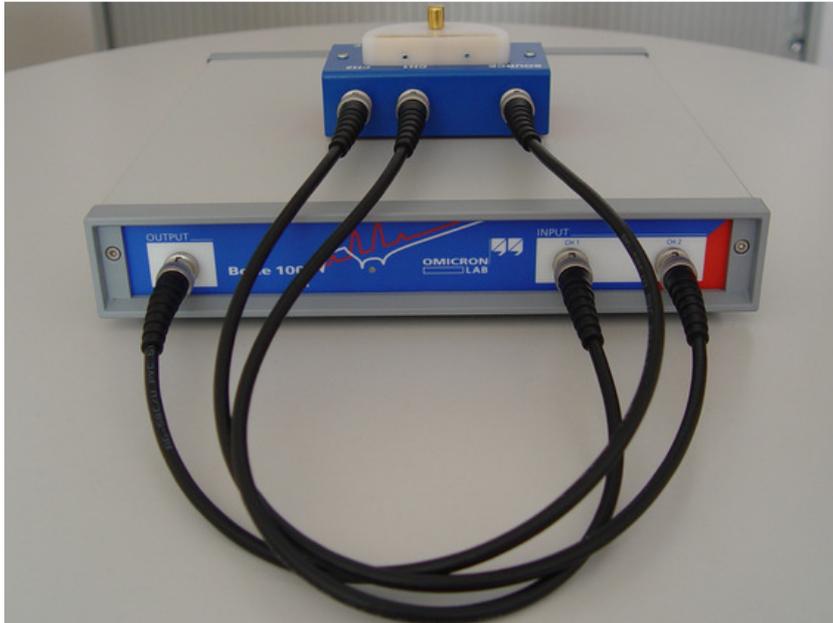
Store separately designed CSV-files as well in this folder. The components in this folder are automatically imported into the software while starting. For further information about the data file please take a look at section 4.3.

Since version 1.01.03 it is possible to change the folder for the library parts in the program settings.

4.3.1. Component measurement

Please follow the instruction to import new components:

1. Connect the test fixture to the Bode 100, as shown below:



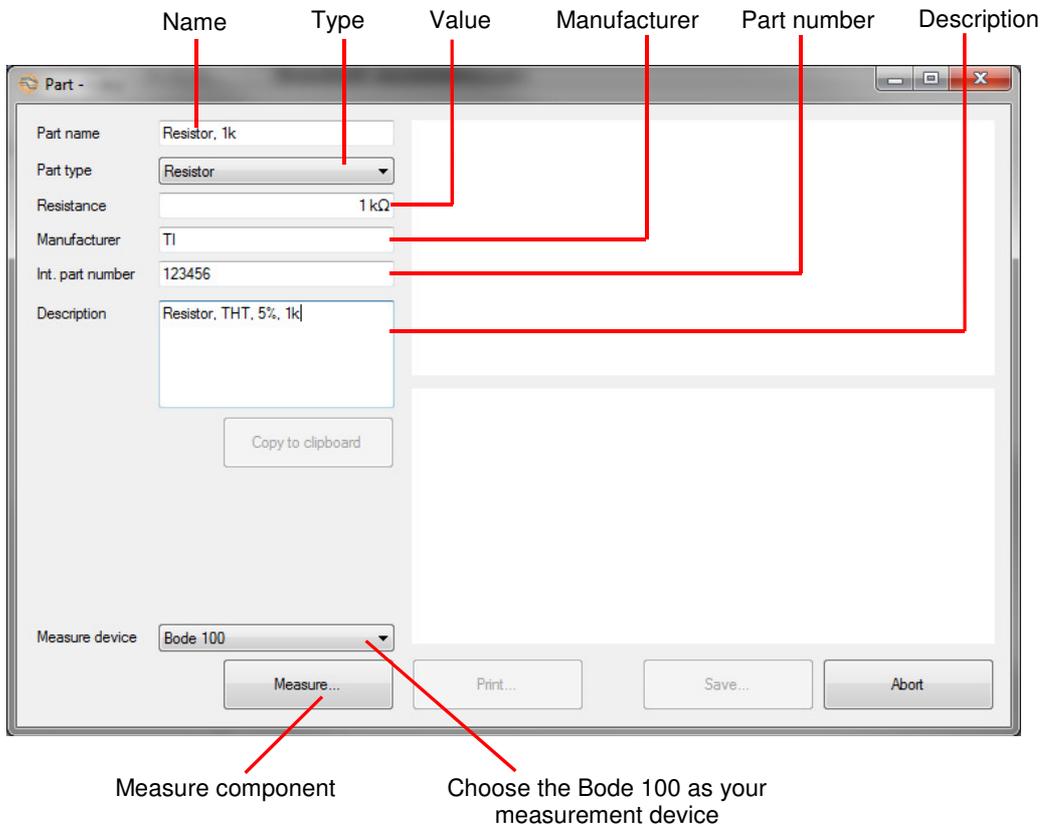
2. Open part list at the menu bar:



3. Click on new part:

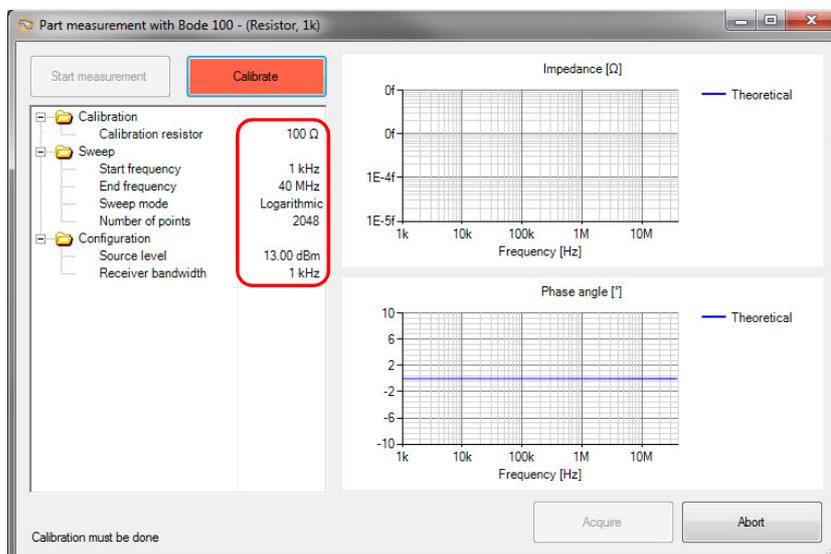


- Enter the component specifications:
Please enter the details of your component into the following fields. After you have entered all the data, please click on “Measure...”.



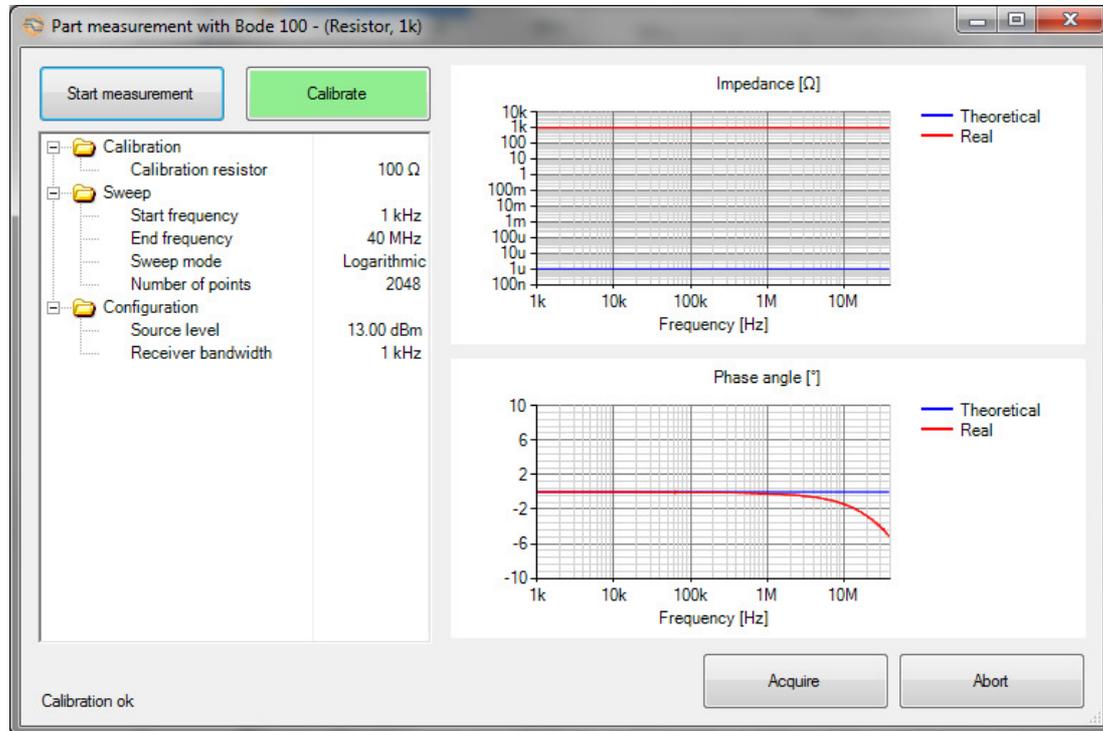
- Calibration:
The Bode 100 needs a calibration if the button “start measure” is disabled and the calibration button is red. In order to do a calibration, please first specify the settings of your measurement (which frequency range, the number of points and the bandwidth (as shown below).

Before the calibration can be started, please take a look at the general data (Frequency range, number of points...) of your measurement in the red field of the picture below and adapt these values to your needs.



Click on the “calibration” button to start the calibration. Please follow the instruction given by the system.

- Put the component on the test fixture and start the measurement.



- Accept the measurement and save the part. Data is saved as a CSV File. The files have to be in the correct folder (all data are saved in the folder below) for use.

...\\[User]\\Documents\\Negal Engineering AG\\EMC Filter Synthesis\\Parts

Since version 1.01.03 it is possible to change the folder of the part library in the program settings.

4.3.2. CSV- file format

All measured components are saved as a CSV file.
The data file must have the following form:

Header	Fileformat-Version	1			
	Part name	731146			
	Part type	Inductor	Value [H]	1.60E-05	
	Manufacturer	Esysco			
	Creation date	28.05.2013			
	Description	L 16u 12A 731146			
	Internal part number;				
Measuring points	Frequency	Impedance	Phase	Impedance theo.	Phase theo.
	Hz	Ohm	°	Ohm	°
	1000	0.105662	85.799	0.100531	90
	1054.412	0.111046	86.106	0.106001	90
	1111.784	0.11733	86.299	0.111769	90
	1172.279	0.123894	86.493	0.11785	90
	1236.065	0.130273	86.502	0.124263	90
	1303.321	0.137638	86.828	0.131024	90
	1374.238	0.145338	86.737	0.138153	90

The maximum of measuring points is 10'000. Externally created CSV files can also be saved in the appropriate directory. When restarting (the program), these components are available with the next program start.
Filter design

4.4. Create a filter circuit

After a successful import of new components into the *EMC Filter Synthesis*, you can start to create new filter circuits.

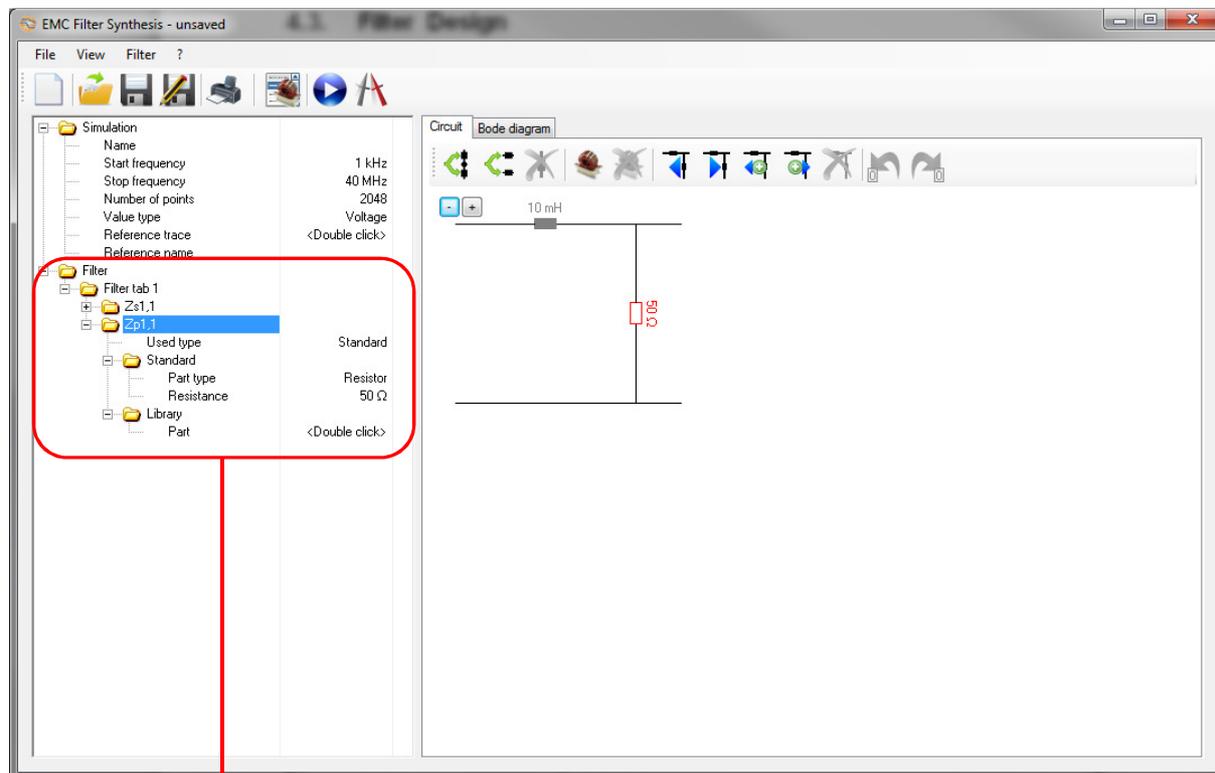
Create a new filter circuit:



4.4.1. Edit components

Edit attributes with a double click on the selected part. The parts can be selected as standard (ideal) and as library. Filter designs can be simulated with ideal and library (and both together) components. Ideal components always shine grey, library components are black. So you always know which model (ideal or library) is currently in use.

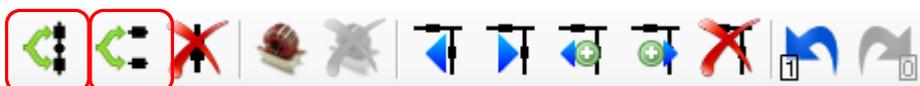
When the ideal model is selected, the component shines grey (grey = ideal component)



Filter structure / Component specification

4.4.2. Add parts

New parts can only be added by splitting existing parts into parallel or serial circuits. Please select the part and then divide it in two new parts (either serial or parallel).

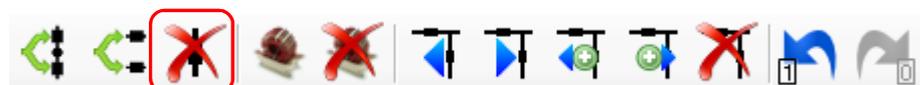


Split to parallel

Split to serial

4.4.3. Remove parts

Every part can be removed until only one part exists on a path of the tab.



Remove part

You can also use the “delete”-Button of your keyboard to delete a part.

4.4.4. Add library part

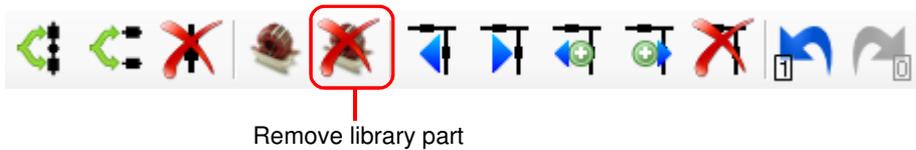
First select the part you want to change. Then add a reference to a library part by pressing the following button.



4.4.5. Remove library part

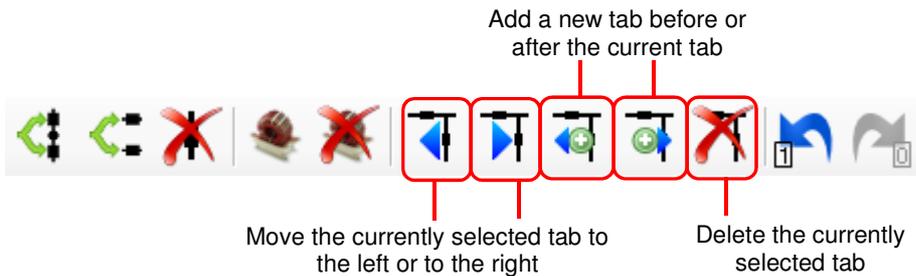
You can remove a library part by clicking the following button. In that case, the program will automatically use the theoretical value.

Remove library part by hitting the following button:



4.4.6. Edit filter tabs

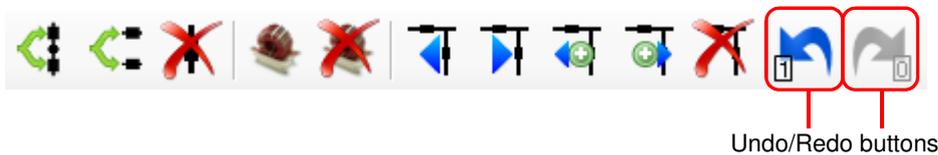
You can add a new filter tab before or after the currently selected filter tab. Also you can move the filter tabs to the left and right. The currently selected filter tab can also be removed.



Filter tabs can be removed as long as more than one tab exists.

4.4.7. Undo/Redo function

Since version 1.01.03 an Undo/Redo function is available. The last 50 changes of the filter can be undone. That does not include the simulation parameters!

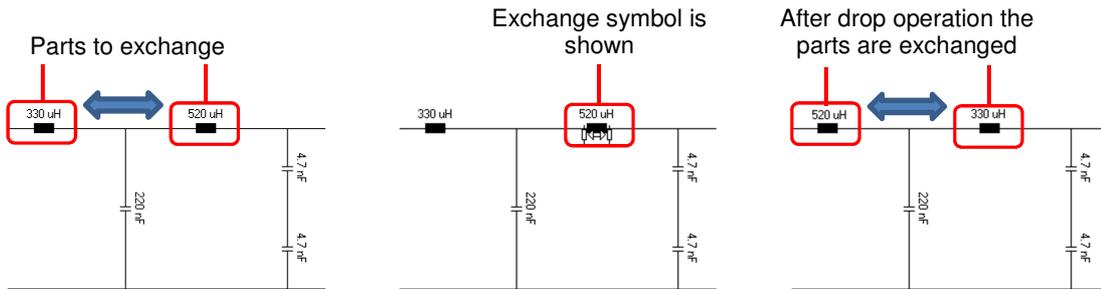


In the small rectangle, on the bottom of the Undo/Redo symbols, is number of steps that can be undone or redone and the tooltip shows the corresponding action.

4.4.8. Drag and drop functions

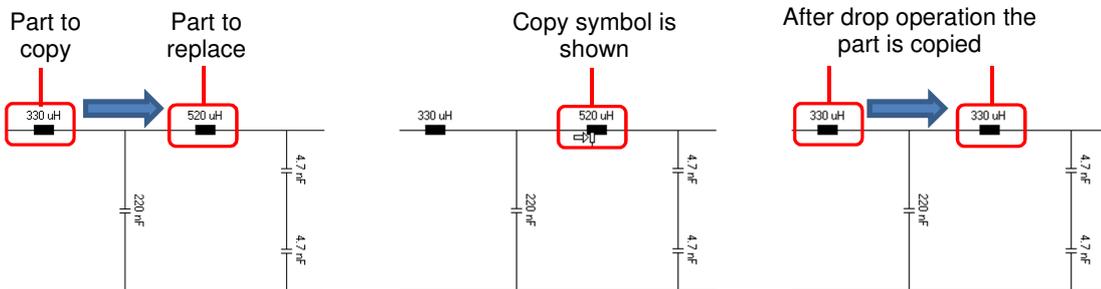
To simplify the handling of parts that are used multiple times in a circuit some drag and drop functionality is available. It is possible to exchange two parts or to copy the part to another location.

1. Exchange of two parts



Press left mouse button over one of the parts you want to exchange. Move the mouse cursor to the second part you want to exchange with and release the mouse button if the exchange symbol is shown.

2. Copy part to another location



Press left mouse button over the part you want to copy while pressing the control key. Move the mouse cursor to the part you want to replace and release the mouse button if the copy symbol is shown, then release the control key too.

4.4.9. Save and open filter

All designed filters can be saved and opened again. The data form of the file is .xflt at the end.

Save filter:



Open filter:

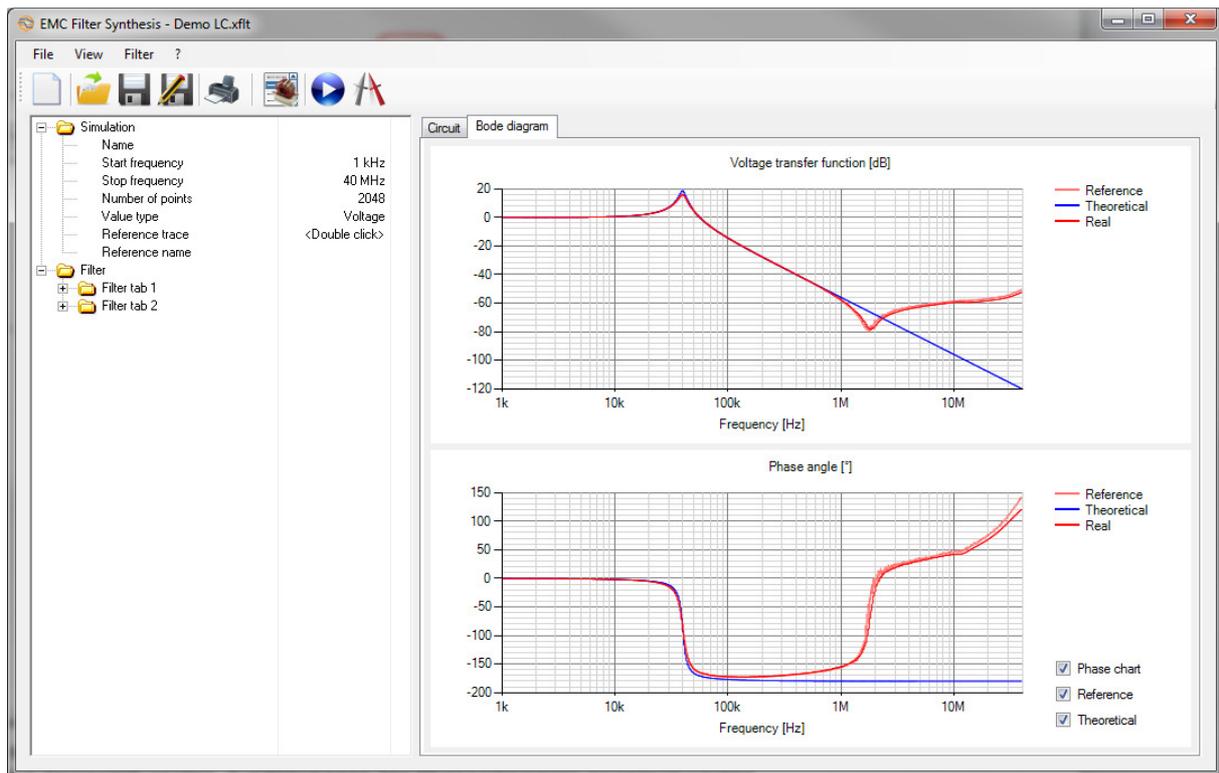


4.5. Filter simulation

4.5.1. Simulation

Simulate your created filter:

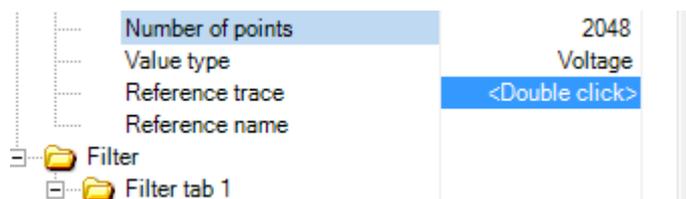
In order to start the simulation, please press the “Calculate Filter” button.



In each diagram two different simulated traces are displayed. The red curve is the simulation based on your library components. The blue curve is based on ideal components. In addition to the attenuation, the phase is displayed in a second diagram.

4.5.2. Reference trace

Reference curves for the calculated curve can be read and displayed. With the EMC filter synthesis program, all filters can be measured and stored (see chapter 0). These measurements can be later read as a reference curve. To add a reference trace, double click on the space next to the reference trace, as shown below.



This will open a popup window and you can select a component or a filter you want to display as reference. Reference curves are also saved as CSV files.

Please see below the CSV formatting of a reference trace.

Frequency	Mag(Gain)	Phase(Gain)
Hz	#	°
1000	0.31178151	-65.1386023
1005.19009	0.31192641	-65.4953212
1010.40711	0.31105255	-65.6486053
1015.65121	0.31004597	-65.7745463
1020.92253	0.30896595	-65.8865873
1026.22121	0.30784866	-65.9931012
1031.54739	0.30672503	-66.0938479

4.6. Measure filter

It is possible to measure a complete filter with *EMC Filter Synthesis*. You can use the data as a reference trace for your simulation.

Follow the description to measure and import a filter:

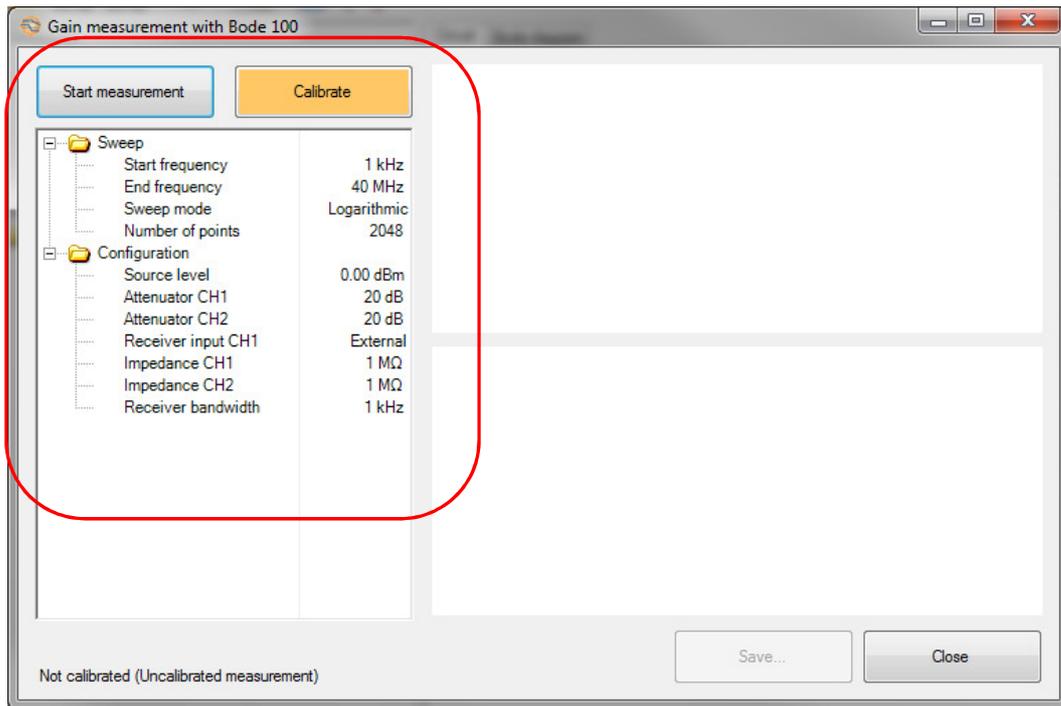
1. Click in the toolbar on “Measure filter...” or select in the menu “Filter/Measure...”.



2. Calibration:

The Bode 100 doesn't need a calibration, but it is better to use it for better results. The calibration is already done if the “Calibrate” button's background is green. To start the calibration, please press the “Calibrate” button. Please use the BNC-through connector for the calibration process. Before the calibration and measurement, please adapt the settings, such as the frequency, etc... as shown in the picture below.

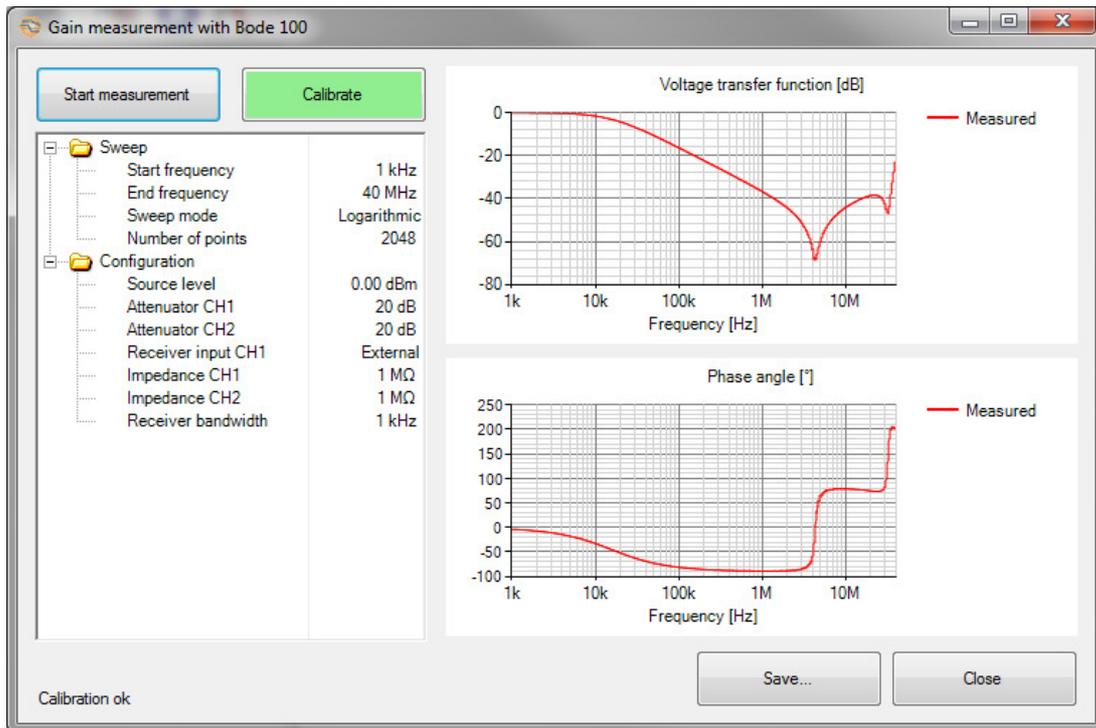




3. Connect the filter (instead of the BNC-through-connector) with the Bode 100



4. Start the Measurement and click on “save” afterwards.



Measurements are saved as CSV-file. Only CSV-files are used to import data into *EMC Filter Synthesis*. The results can be used as reference trace.

4.7. Simulation and reality

The simulation and the measured filter can now be compared. Add the reference trace easily with a double click. With this feature, a perfect synthesis between reality and theory is guaranteed.



5. Support

5.1. Address

Support-request:

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