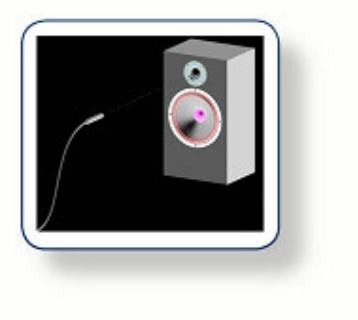
FINE X-over™



X-over Design

Reference Manual

LOUDSOFT
www.loudsoft.com

Chapter 1. Wizard

When starting a new file, you will get the Wizard (Figure 1), which will guide you to design the best possible x-over for your system.

1.1 Wizard Start

In the wizard start window, you should input the 'Nominal system impedance' and 'How many sections'. Normally, the nominal system impedance is 4 or 8 ohms (mostly determined by the woofer), but even 1 ohm or 0.5 ohm is possible. The nominal impedance is used for initial x-over calculations and for minimum impedance calculation.

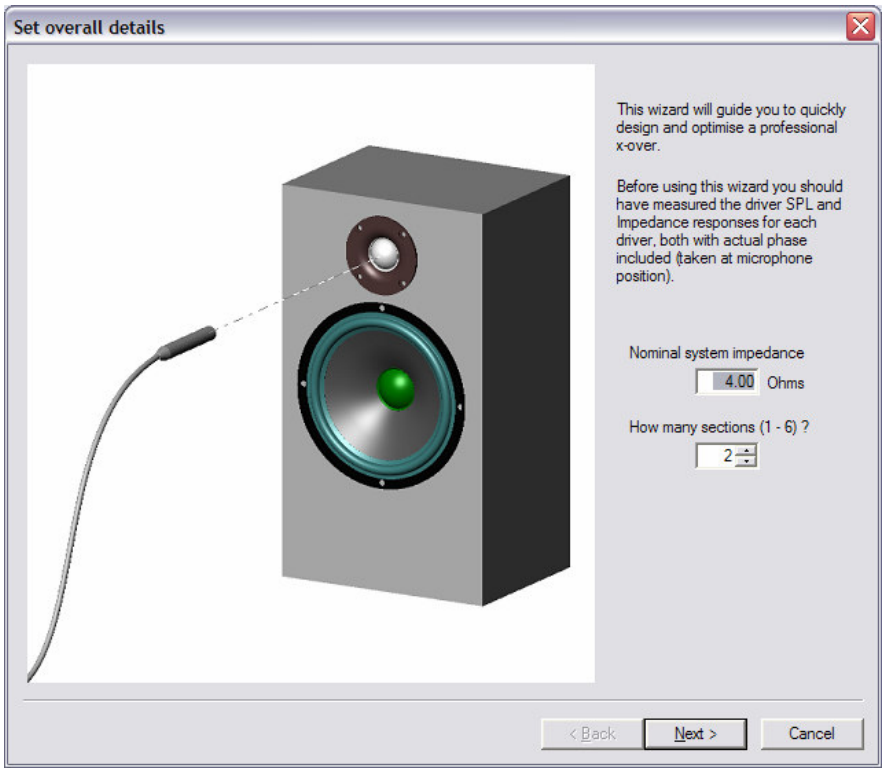


Figure 1. Wizard Start

1.2 Import SPL and impedance files

You have the option to import measured files from a number of systems like MLSSA, LMS, CALSOD, Sound-check etc. Here you use MLSSA files as *.FRQ and *.TXT.

The drivers are measured in the cabinet as shown on the sketch. You should place the microphone in the listening position (usually in line with the tweeter), and in the preferred 2-3 m distance, if you have a very large room. If the drivers are close together you may use 1 m or closer. Do not move the microphone, but measure all drivers in the same position. Finally you measure the impedance from 20-20kHz for both drivers.

Press Next. Open SPL to load the file you had previously measured, and Open Imp. to load the impedance file, see Figure 2. You can click the file to preview and check that you have selected the correct curve (Fig. 3).

You can also import up to six ‘SPL off-axis data files’, using the below ‘Open’ button. *Note! It is important for high quality speaker system design to measure and optimise both the on-axis as well as the off-axis responses.*

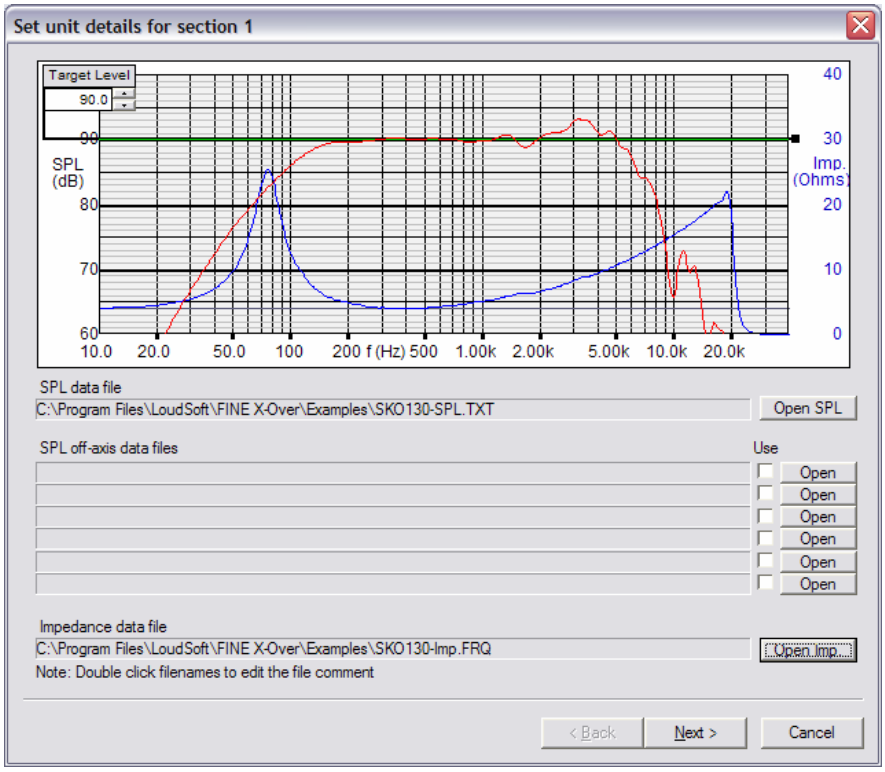


Figure 2. File load

Note the horizontal line —— Target level (figure 2). This is the level we want to optimise the system to. You can drag the line up/down by the left mouse button, or overwrite the number (e.g. 90.3 dB in figure 2). We have chosen the flat level above 200Hz for the woofer, because this is close to the maximum level we expect to get out of the total system.

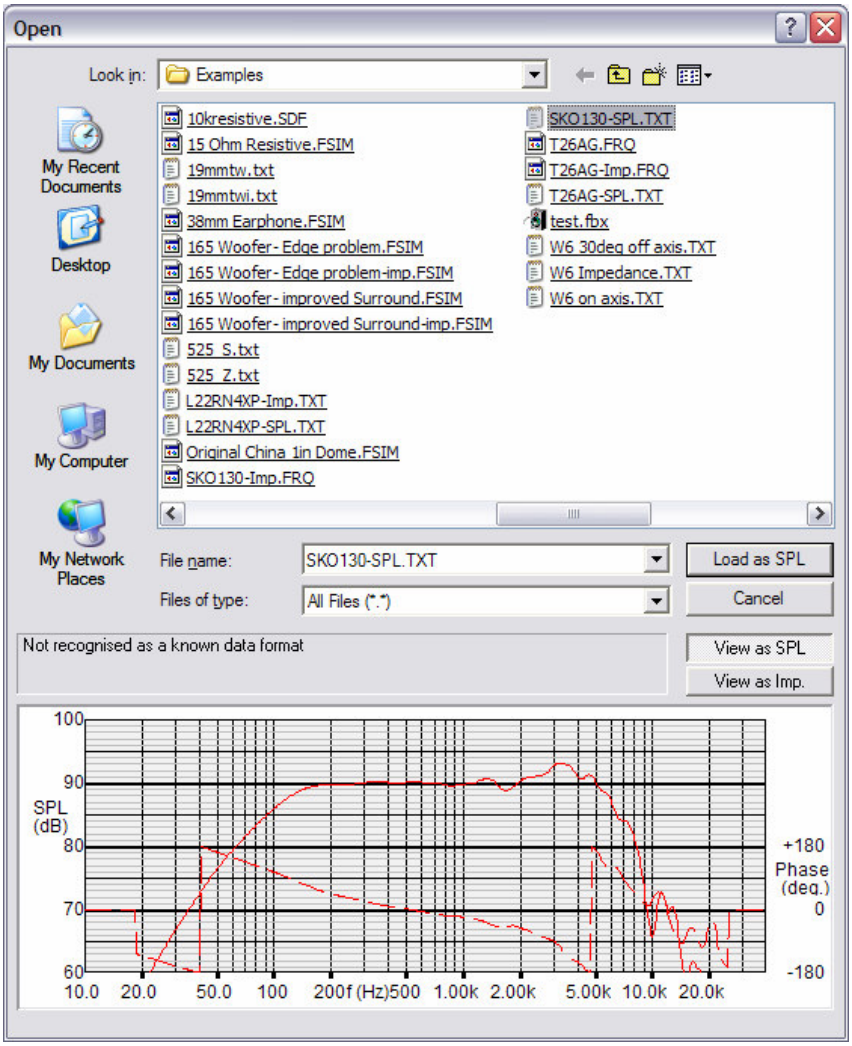


Figure 3. File Preview

1.3 Selecting the x-over type and Target frequency response

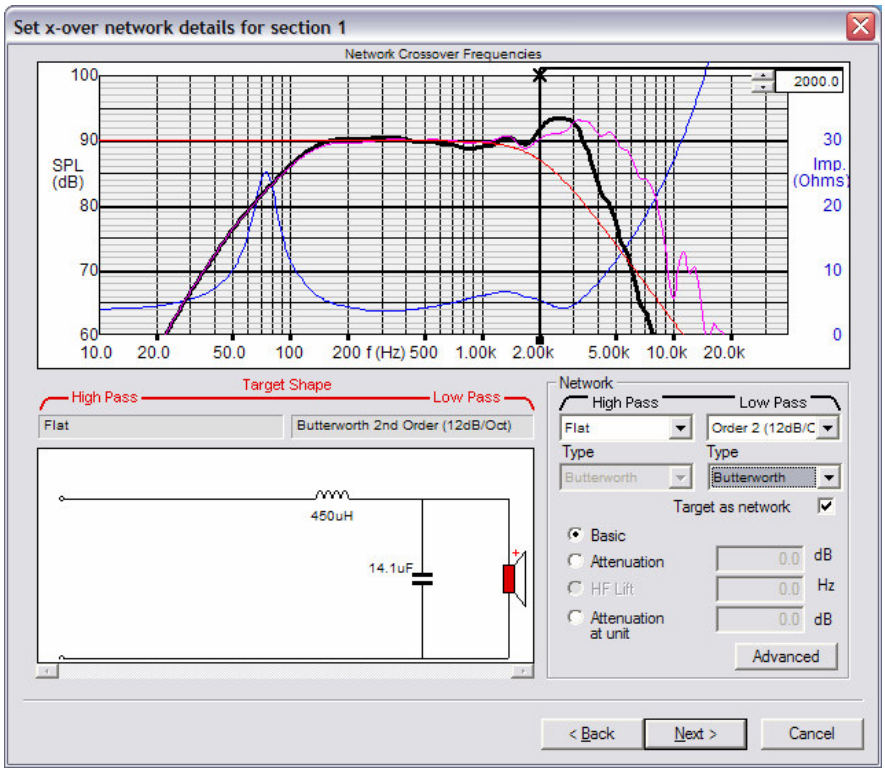


Figure 4. X-over type and target response

To select the x-over type and Target frequency response, you may chose Butterworth (or Linkwitz-Riley, Chebyshev and Bessel) and from 1st Order (6dB/Oct) up to 4th Order (24dB/Oct) slope. The black vertical x-line shows the chosen x-over frequency. You can drag the X-line by the left mouse button, while observing the filtered section response change (figure 4).

The following options are available:

- Target as network.

With this option, the target curve will change with the network; otherwise, you can select an individual target curve.

- Basic.

This means basic settings without any extra network.

- Attenuation.

If the sensitivity of the unit is higher than needed, this option can be used to attenuate the sensitivity of this section in dB.

- HF lift.

Will lift up the response at high frequencies starting from a given frequency, by reducing the attenuation at HF.

- Attenuation at unit.

Here the attenuation components are placed close to the unit.

By pressing the ‘Advanced’ button, the advanced settings show up as shown in figure 5, where F means frequency, and R is resistance.

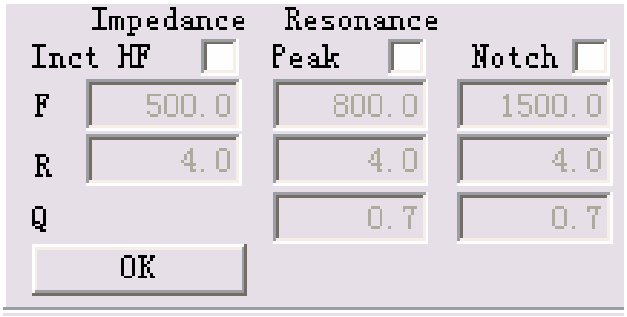


Figure 5. Advanced setting

- Inct HF.

A RC series branch is added in parallel with the unit to compensate for the rising impedance curve.

- Peak.

A LCR series branch is inserted in parallel with the unit to compensate for a peak in the response. F, R and Q value can be adjusted manually. This can be used to flatten the impedance peak at resonance Fs.

- Notch.

A LCR series branch is inserted as before. This may be used to remove a peak in the SPL response.

1.4 Section Optimisation

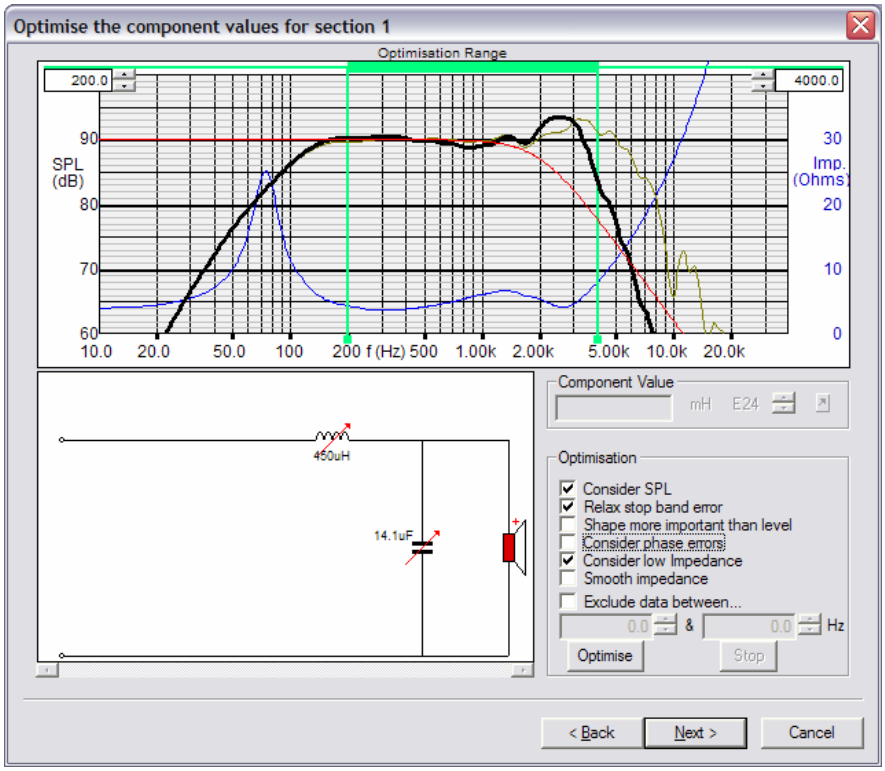


Figure 6. Section Optimisation

Figure 6 shows the section optimisation window. The red curve is the target, to which we will optimise the x-over components. The chosen optimising range is shown between the two green lines, which can be dragged as usual. Before we press the 'Optimise' button, we should choose some of the optimisation settings:

- Consider SPL (Default).
- Relax stop band errors (Default). Helps to avoid out of band problems to disturb optimisation.
- Shape more important than level. Focuses on the response shape, not SPL level.
- Consider phase errors. Includes phase errors.
- Consider low impedance. Use this setting to avoid getting lower than minimum impedance, which is 20% lower than the nominal impedance (according to the IEC 60268-5 standard).
- Smooth impedance.
- Exclude data between….Use this feature for example to exclude a known peak from disturbing optimisation.

Press “Optimise” to see the optimised response in a few seconds.

Next, the wizard will step through all the sections in the same way.

Chapter 2. The FINE X-over Main Window

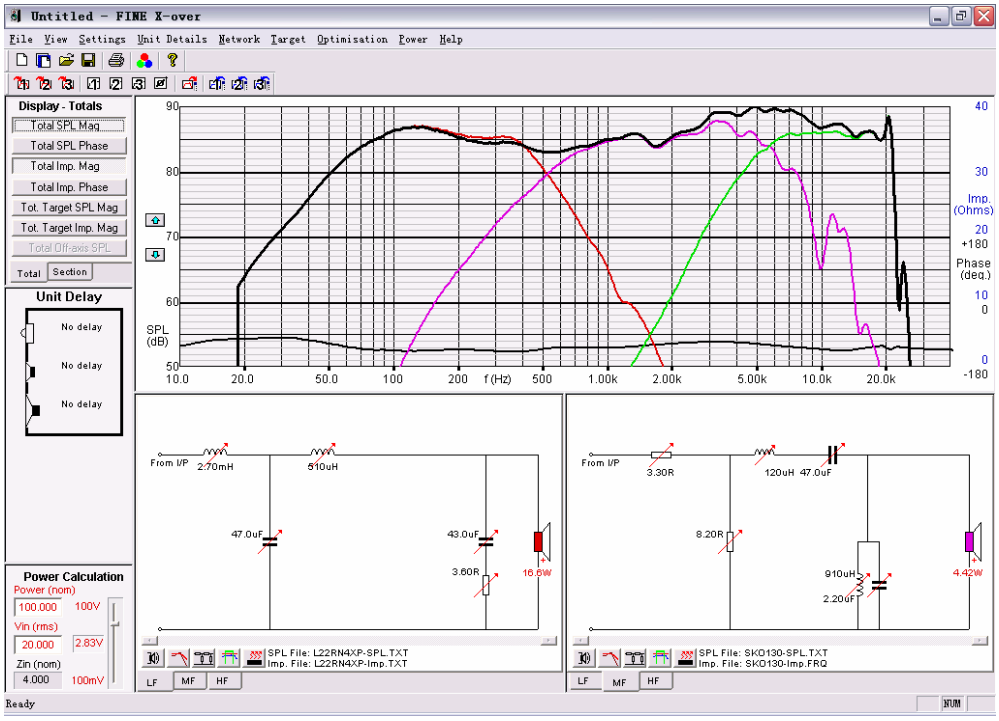


Figure 7. FINE X-over Start Window

The complete start menu is based on the default parameters and the menu contains the following part windows:

- Upper left. The **Display Totals** and **Display Sections window**
- Middle left. The **Unit Delay window (or Driver Delay window)**
- Lower left. The **Power Calculation Window**
- Upper middle. The **Main Graphic Window**
- Lower middle. The **Network Window**
- Top. The **Dropdown-Line** and a **Toolbar**

2.1 The Display Totals and Display Sections window

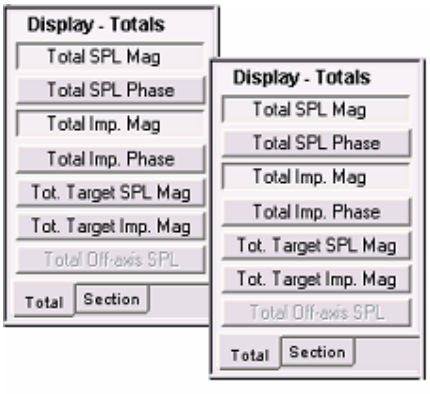


Figure 8. Display – Total and Display - Section

Figure 8 shows the Display – Totals including settings as below:

- Total SPL mag : Shows the total response magnitude.
- Total SPL Phase: Shows the total response phase.
- Total Imp. Mag: Shows the total impedance magnitude.
- Total Imp. Phase: Shows the total impedance phase.
- Tot. Target SPL Mag: Shows the total target response magnitude.
- Tot. Target Imp.l Mag: Shows the total target impedance magnitude.
- Total Off-axis SPL: Shows the off-axis response.

And the Display – Sections including some settings as below:

- SPL mag: Shows the response magnitude in each section.
- SPL Phase: Shows the response phase in each section.
- Imp. Mag: Shows the impedance magnitude in each section.
- Imp. Phase: Shows the impedance phase in each section.
- Driver Only SPL Mag: Shows the driver response magnitude without x-over.
- Driver Only Imp. Mag: Shows the driver impedance magnitude without x-over.
- Target Mag: Shows the target response magnitude in each section.

2.2 The Unit Delay window

You can simulate changes to the driver positions by introducing delay, Fig. 9. By clicking and rolling with the mouse wheel the user can simulate +/- movements of the driver recessed in or protruding from the baffle. You can find the movement distances and also the delay time of the unit.

It is possible to find the best position by observing the acoustical phase of the individual drivers in the Main Graphic window.

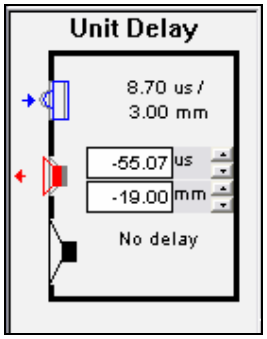


Figure 9. Unit Delay

2.3 The Power Calculation Window

The input power can be specified in the power calculation window. Or the input voltage (rms) can be specified in the middle column, Vin (rms). The voltage is also shown in the right slide bar, and can be adjusted with the mouse. The normal impedance, Zin (nom), is shown in the lower column as set in the wizard, and it cannot be changed here. The upper column shows the calculated power (nom) based on the input voltage and the normal impedance.

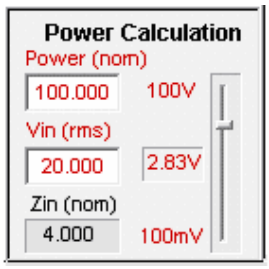


Figure 10. Power Calculation

2.4 The Main Graphics Window

The curves are shown in the main graphic window, see fig. 11. The scale on the left is the sound pressure level in dB, while scales on the right show the impedance in ohms and phase in degrees, separately.

Clicking on the blue arrow buttons on the left will move the responses up and down in 10 dB steps.

The settings, to hide or display curves was discussed in the introduction of *The Display Totals and Display Sections window*.

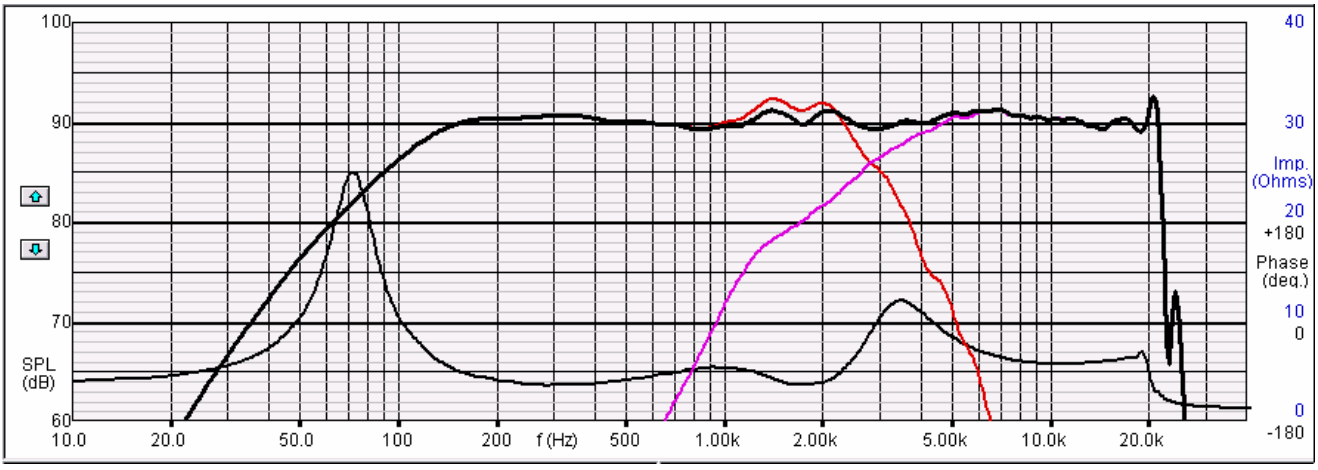


Figure 11. The main graphic window

2.5 The Network Window

The network window shows the network for each section, see figure 12.

2.5.1 Section options

The buttons on the bottom of the network window is used to switch between the sections. Six buttons, LF1, LF2, MF1, MF2, HF1, and HF2, are shown in figure 12, for a design of up to six-way cross-overs. The number of active buttons could be from one up to six following the number of the sections.

2.5.2 Fast access

The sections buttons,  , provide fast access to:

1. Response Input
2. Target
3. Network
4. Optimise
5. Power

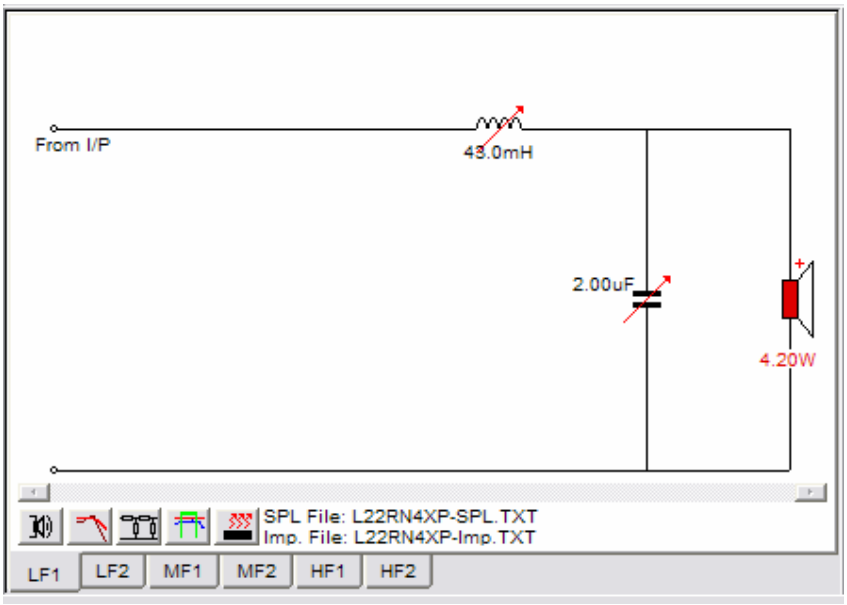


Figure 12. The network window

2.5.2.1 Response Input

The details of response input can be found in Chapter 1.2.

2.5.2.2 Target

The target setting is described in Chapter 1.2.

2.5.2.3 Network

The details of network design, is illustrated in Chapter 1.3.

2.5.2.4 Optimise

The description of Optimise is shown in Chapter 1.4.

2.5.2.5 Power

Pressing the button  will display the power in all the components and the drivers in every x-over section. In figure 13, the real power calculated for the resistive components and the driver is shown for section 2 (Midrange) of a 3-way x-over. The input is 200W (RMS) in nominal 4 ohms, with a power spectrum per IEC 60268-1, to simulate “normal” music.

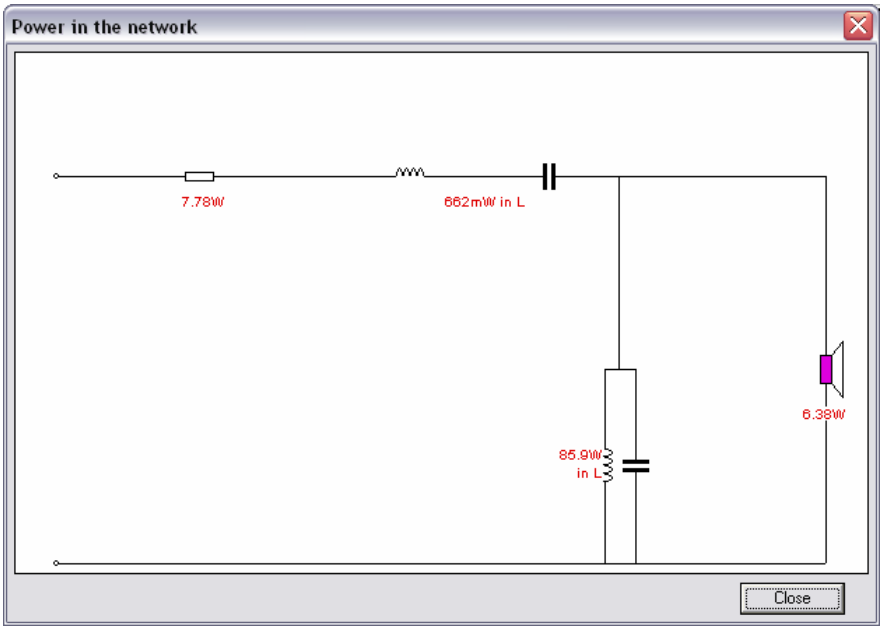


Figure 13. Real Power in 3-way section 2 (Midrange)

2.5.3 Value setting for the components

In the section window, you can left click on one component, and change the value in the submenu, shown in figure 14. You may input the wanted value directly, or roll the middle button of the mouse to choose by a value from the standard E24 series. A red arrow means that this component is included in the optimization. By clicking on the small red arrow right to the value column, you can switch it into a black arrow, which means that this component is not taken into account in the optimization.

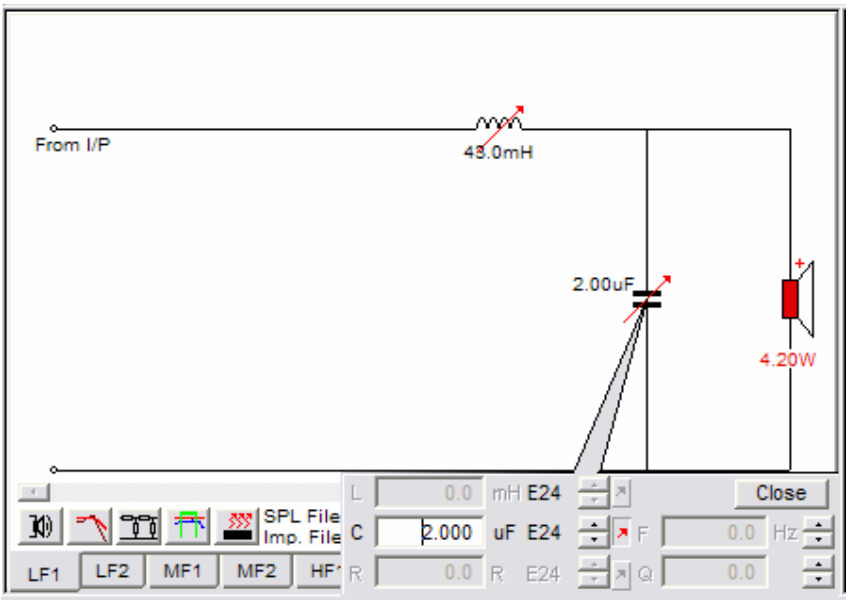


Figure 14. Value changing of the components

By right clicking on a branch, figure 15 shows up. Here, the branch type can be changed. The active tick mark activates this branch or not. The tick mark of “Can be optimised” setting is the same as the red arrow setting mentioned in the upper paragraph.

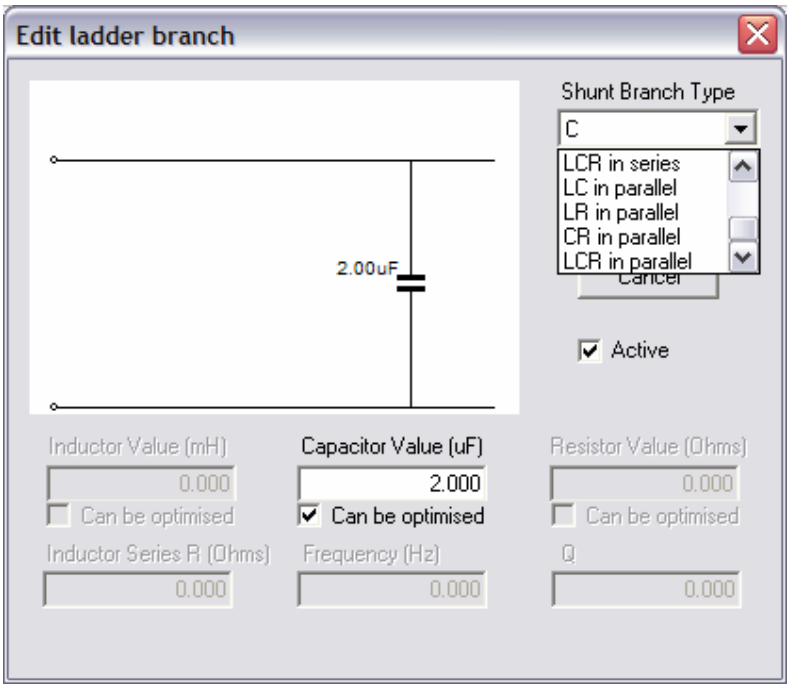


Figure 15. Edit ladder branch

By either left or right clicking on the left terminal of a section, where the signal input is connected, you can open a connection-setting window, see figure 16. Different input connections can be chosen here. This is very useful for designing for example 2.5 way x-overs by tapping the second woofer section input from the first woofer terminals.

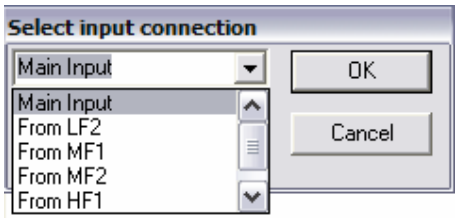


Figure 16. Select input connection

You can also invert or leave out the driver by clicking it and choose tick marks in the shown window. See figure 17.

Figure 17. Output of a section

2.6 The Toolbars

There are two tool bars in FINE X-over.

2.6.1 Standard tool bar

This is the standard tool bar, shown below.

The seven buttons from the left to the right are start a new file, start a new file based on an existing model, open file, save file, print, colour setting, and help, separately. The first button starts the wizard, which has been mentioned in chapter 1; the second button also starts a wizard, which is based on the current x-over; the third button is to open a file as usual; the fourth button is for saving the current design; the fifth button will print; the sixth button is the options shown in figure 18 and the seventh button shows the current version of FINE X-over.

When you press the sixth button the option dialog shows up. There are three columns in this dialog, General (figure 18), Component Adjustment (figure 19) and Power Calculation (figure 20).

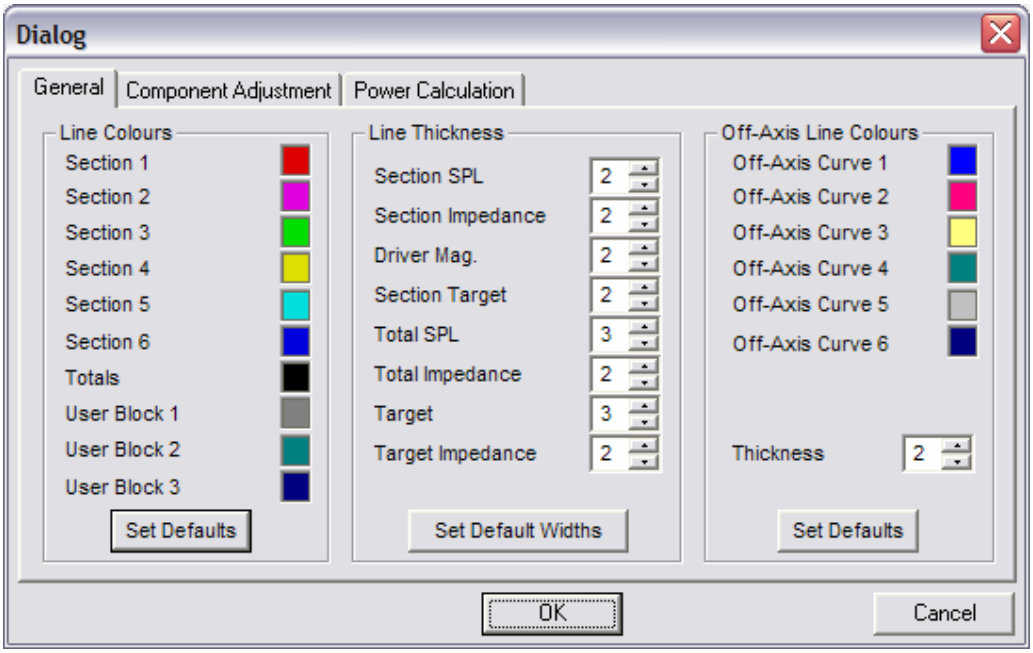


Figure 18 General

In the General tab, settings of line colours, line thickness and off-axis line colours can be set, see figure 18.

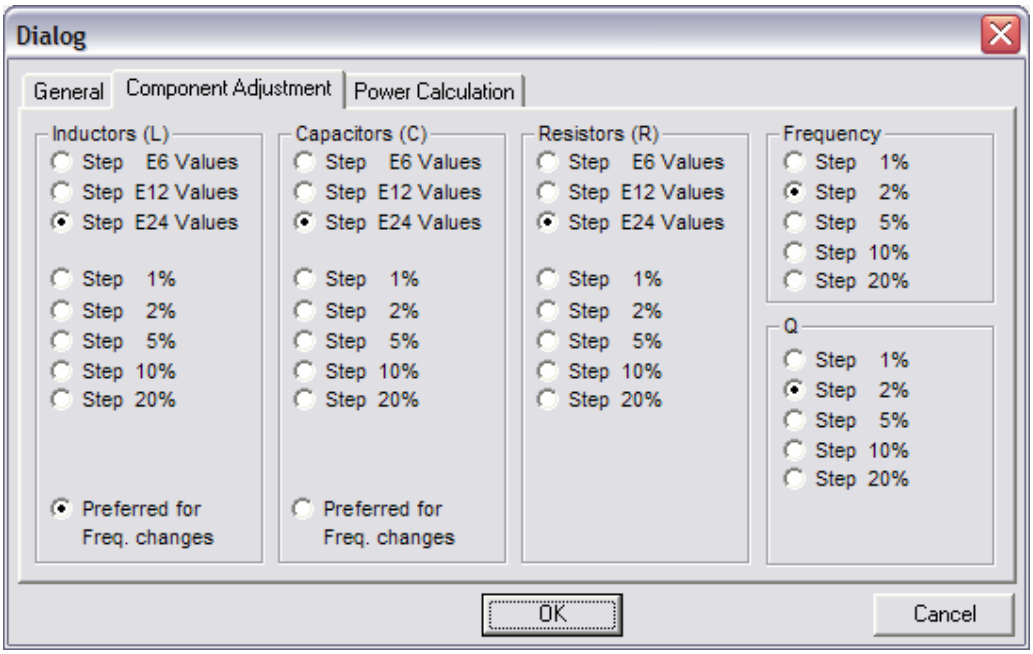


Figure 19 Component Adjustment

In the Component Adjustment tab, you can choose the range of standard components, which is indicated in figure 19.

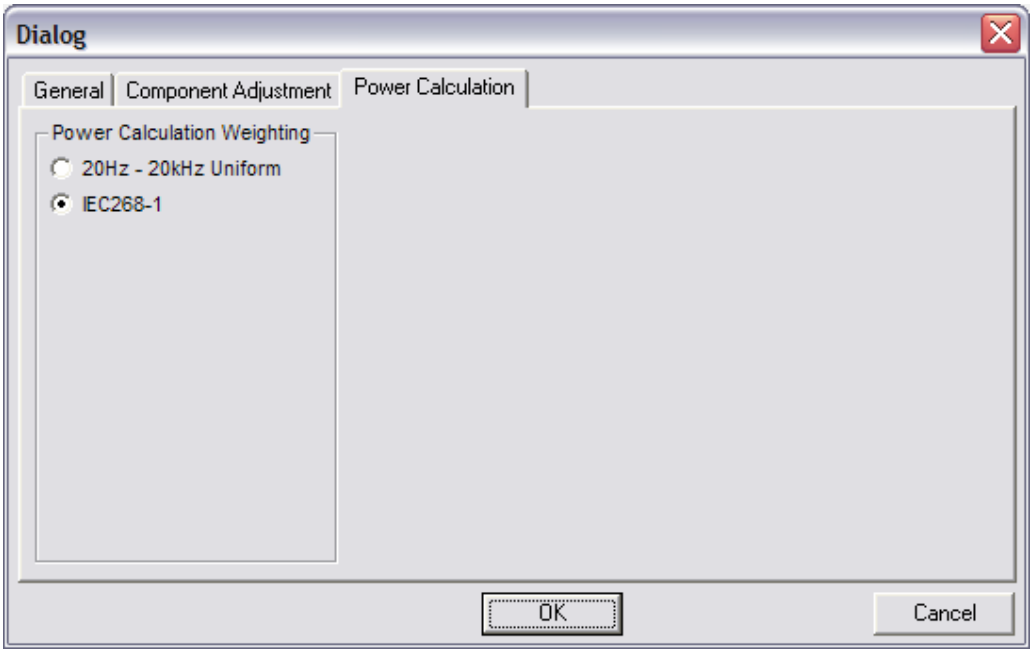


Figure 20 Power Calculation

In the Power Calculation tab, power calculation weighting is either 20Hz – 20kHz uniform or per IEC268-1, see figure 20.

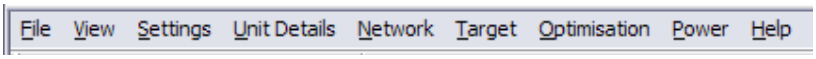
2.6.2 Tool bar of the curves

The tool bar for the curves is shown below.

The first three buttons are used to save the current frequency response as user curves No. 1, No. 2, and No. 3, separately. The next three buttons are used to display the user curves No. 1, No. 2, and No. 3, separately. Button  is to show the phase of the displayed user curves; button  is to save current frequency response to a file; the last three buttons are used to load curves from files and set them as user curves No. 1, No.2, and No. 3, separately.

2.7 The Drop-down menus

The drop-down menus have the standard functions of the normal windows software and some special functions of FINE X-over.



Drop-down menu - File

All the functions in the drop-down menu – file are shown in the previous chapter 2.6 where we illustrate the buttons.

Drop-down menu - View

Here, you can set or hide the tool bars and the station bar, and show the user curves No. 1, No. 2, and No. 3, as we introduced in chapter 2.6.2.

Drop-down menu - Settings

This is the same as button , illustrated in chapter 2.6.1.

Drop-down menu – Unit Details

Here you can change the loaded SPL and impedance curve for each section, which is also illustrated in chapter 1.2.

Drop-down menu – Network

This is to set the network of each section, which is also illustraed in chapter 1.3.

Drop-down menu – Target

This sets the crossover section targets and whole system target. A standard system target curve is shown in chapter 1.2. In the following, a more advanced system target curve is illustrated.

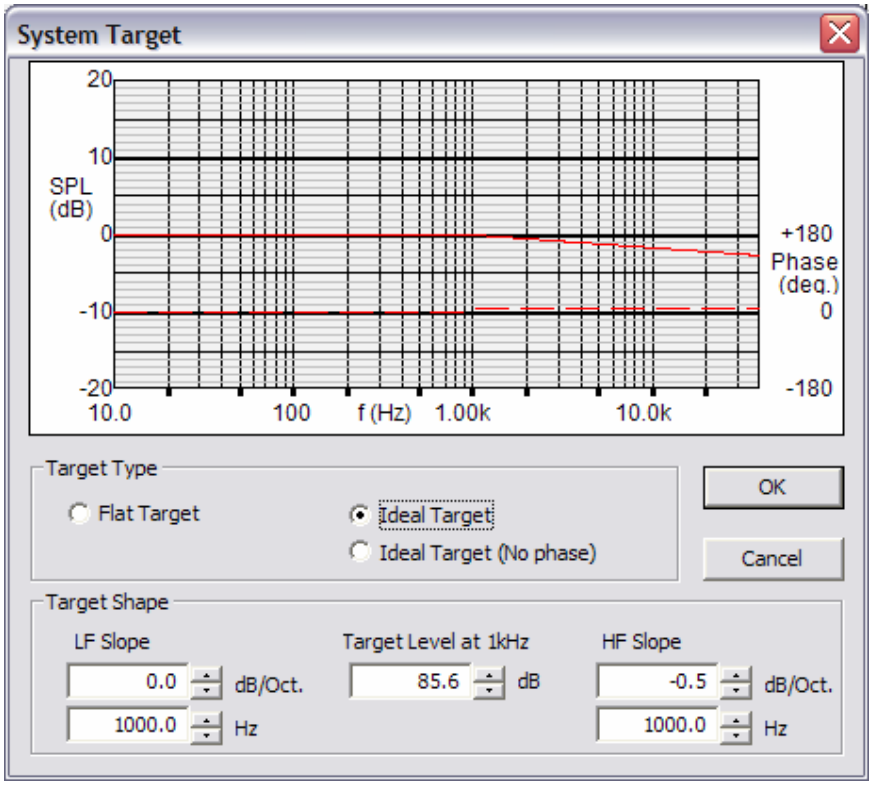


Figure 21 System target

An ideal target is possible, shown in figure 21. Either the LF slope or the HF slope can be set at certain frequencies with a given slope in dB/Oct.

Drop-down menu – Optimization

You can do the section optimization like in chapter 1.4, and also do the system optimization, shown in figure 22.

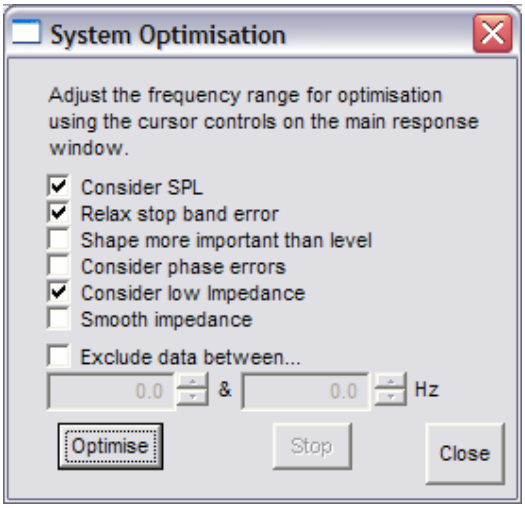


Figure 22 System Optimisation.

Drop-down menu – Power

This is to show the power of each component in each section.

Drop-down menu – Help

The current version of FINE X-over is shown here.

Spark Yu Luan