

Boxsim

OB Manual

Version 20.05.2011

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1. Introduction

1.1 Boxsim is a loudspeaker simulation program, which is originally dedicated to drivers of the German manufacturer VISATON. Boxsim will find the relevant driver data of almost any Visaton driver in the “Chassis” folder, which is generated with the installation of Boxsim.

It is possible to load all relevant data of non-Visaton drivers into Boxsim projects, but they can only be saved within that project (or its copies). It is **not** possible to save Boxsim driver data of non-Visaton drivers as .BCH files in the “Chassis” database.

Simulating open baffles in Boxsim is a workaround. Simply speaking it simulates a vented enclosure and opens the BR port to the size of the baffle. The depth (and volume) of the vented “enclosure” behind the baffle is reduced to zero.

Boxsim assumes the radiation to the rear of the baffle to be the same as to the front. While this is obviously wrong, leading to a severe limitation of the simulation accuracy, it is – best to my knowledge – common practice of all other OB simulation programs too.

2. Preliminaries

2.1 Installation

You get the Boxsim installation file from www.boxsim.de. Download www.boxsim.de/download/Boxsim120en.zip to an appropriate folder, perhaps named Boxsim. Copy all files and folders from the .zip file into the folder. That’s all – no special installation procedure. You will need to install the Boxsim shortcut icon on the desktop yourself.

2.2 Changing Default.BPJ

Boxsim always starts with a “Default” project, which is deposited in the “Projekte” folder. You can delete the Default.BPJ file from that folder, but will get some error messages when starting Boxsim. It would be a good idea to make your own basic OB default project and file it as “Default.BPJ” in the “Projekte” folder.

2.3 Concept

Boxsim does all simulations for a listener in infinite distance. That means: there is no crossing of driver axis’ at any point – they are always parallel. Consequently you can’t choose any simulation distance or height. SPL levels are calculated for 1 m distance though.

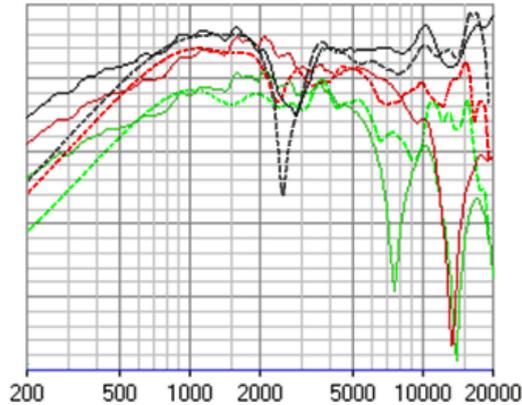
The simulation is based on measured sound pressure, phase and impedance values. Measurements may be taken on infinite baffle, on a DIN/ISO standard baffle or on the OB under construction. If you don’t have any measurement data, the TSP alone will suffice for a basic simulation.

2.4 Limitations

Boxsim will only simulate flat rectangular baffles in free air. No wings or frames of any sort. But (in an advanced step) you can place baffles of different dimensions freely in space.

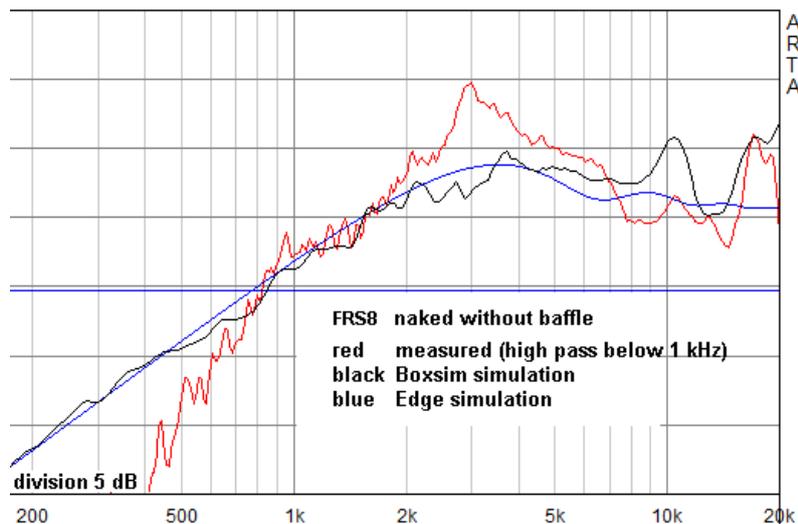
As mentioned above, the OB simulation does not account for any response deviations caused by the basket and magnet on the back of a driver. The edge diffraction simulation of Boxsim is based on a rather simple algorithm afaik. Based on a multitude of off-axis measurements correction factors have been added. They seem to work really well for box designs, but not for open baffles (which were not under

consideration when Boxsim was developed). My own OB measurements show that Boxsim will continuously calculate the 30° response at a lower SPL than in reality. 60° sims are more in line with reality again. On-axis-response notches, which result from highly symmetrical OB constructions, are really much deeper than simulated by Boxsim, and they reach into the 30° curve more fiercely than shown by Boxsim:



Above: Visaton FRS8 centered in a square OB of 22x22 cm. Measurements (with a high pass filter below 500 Hz) are dotted lines, Boxsim simulation continuous lines. 0° black, 30° red, 60° green.

Below: Dynamic drivers typically develop an additional response peak near the first dipole peak due to basket cavities behaving as resonators. This – and other anomalies induced by the rear radiation at higher frequencies – doesn't show in the simulations.



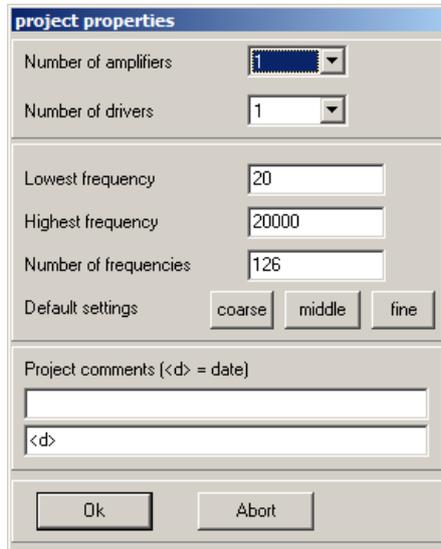
Last not least the off-axis sims are not derived from measured off-axis data of the individual driver, but from a generalized simulation model. Drivers which change their radiating surface with frequency, like most fullrange drivers, can't be expected to show their true off-axis response at higher frequencies in Boxsim.

3. Menus

The use of Boxsim will not be explained in a "doing my first project" way, but almost exclusively as a reference. There may be "how to do" inserts for special applications.

3.1 File

3.1.1 New project



This should be self explaining for the most part. You can change all properties any time into the project, but reducing the number of amplifiers or drivers will probably delete some work previously done.

"Number of frequencies" will change the frequency resolution of the calculations. Try "coarse", "middle" and "fine" and how much time they each need on your PC.

3.1.2 Load project file / Save project file

Self explaining

3.1.3 Export results ...

To be done later

3.1.4 Project properties

Same as 3.1.1 New project

3.1.2 Quit program

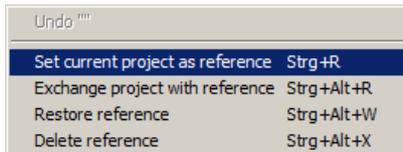
Self explaining. You will be asked to save a project, if changes have not been saved before.

3.2 Edit

3.2.1 Undo

Self explaining. You can “undo” consecutively more than one step (don’t know how many), but you can’t “redo”.

3.2.2 Reference



This is a nice tool for comparing your development steps. The “referenced” step will show in dashed lines behind the new step.

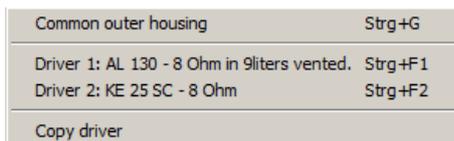
Reference data will show in the tabs “Frequency response”, “Phase response”, “Max. SPL”, “Directivity”, “Driver” and “Frequency response electr..”

“Exchange project with reference” will toggle between both steps.

A referenced project will even stay if you load a new project file.

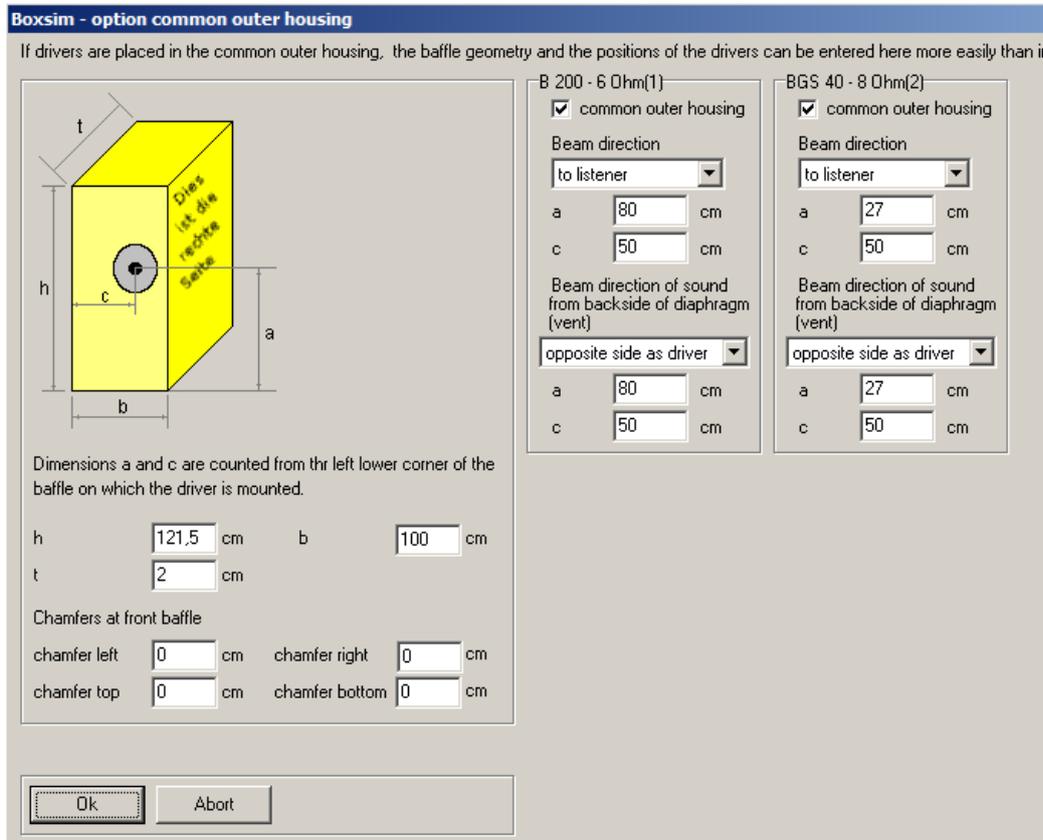
3.3 Drivers & Enclosures

This is the most important menu, if you start a new Boxsim project from scratch. Everything else is peanuts in comparison. So hold on ... in the end it is more intuitive than it looks at the start.



3.3.1 Common outer housing

This is the main (and only) baffle if you place all drivers on a single OB:



This example shows the Visaton NoBox baffle

<http://www.visaton.de/en/bauvorschlaege/breitband/noboxbb/index.html>

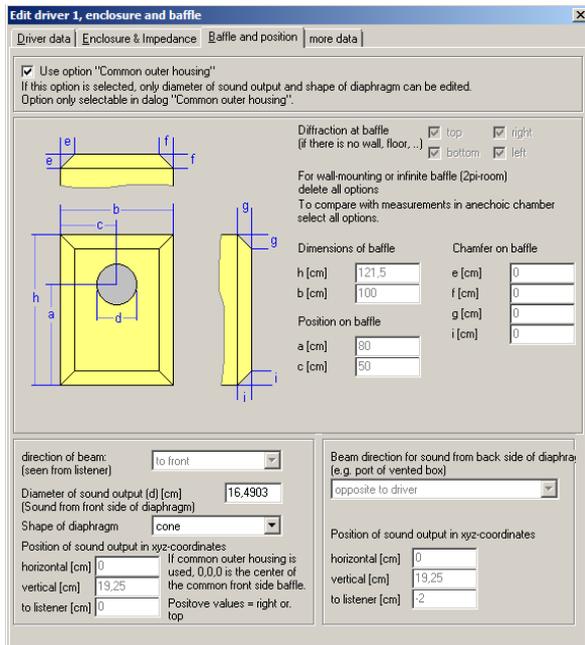
I have added the average depth of the wings on both sides to the baffle width – resulting in 100 cm width overall.

On the left side you see the baffle dimensions h (height), b (width) and t (depth). Sorry for the strange letters, they stand for the German Höhe x Breite x Tiefe. For the curious: Chamfers are 45° and they are subtracted from the baffle size – not added.

On the right side you place the drivers on the baffle. Remember that the rear radiation is a workaround from a vented box. Its position has to be exactly opposite from the frontal beam direction. The value of “a” is the same for both front and rear. The “c” for the backside is **not** the same as for the front – it has to be the baffle width minus the frontal “c”! Both values will only be identical for drivers placed on the vertical mid-axis of the baffle.

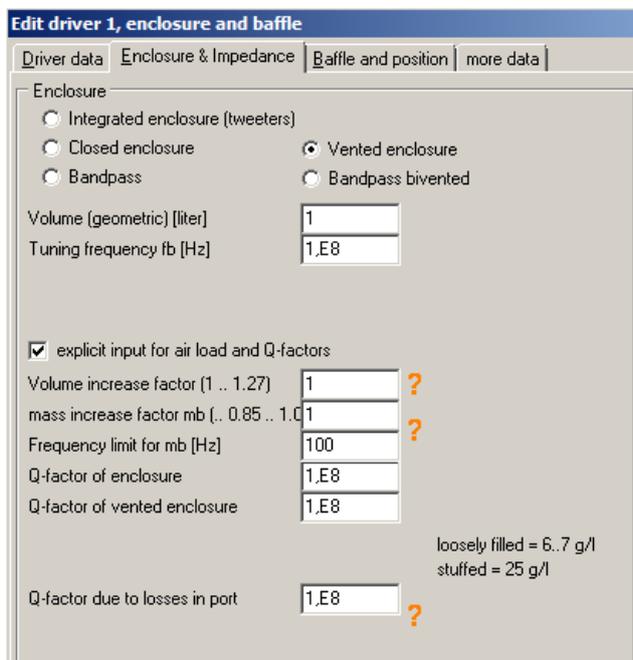
3.3.2 Driver 1 ...

When opening “Driver ...”, the “Baffle and position” tab will open first. After choosing the driver(s) and dimensioning the “common outer housing” the “Baffle and position” tab will look like this:



You don't need to change anything in this tab. Same for the tab “more data”, which is really a collection of informative data only which don't become part of any calculation.

Essential for OB use is the tab “Enclosure and Impedance”:



Make sure that for all dipole drivers with rearward radiation all selections and entries are made like in the example above. This is the heart of the dipole workaround.

Last tab is “Driver data”. If you have already loaded a project file, the tab will show all data of the chosen driver:

Driver data | Enclosure & Impedance | Baffle and position | more data

Driver data

Denomination: B 200 - 6 Ohm [Load driver from file ...]

Comment: VISATON LAUTSPRECHER GmbH & Co. KG (39/09)

Resonance frequency fs [Hz]	40	Linear excursion per side [mm]	2
Electrical Q-faktor Qes	0,83	DC resistance Rdc [ohm]	5
Mechanical Q-factor Qms	8,39	Inductance of voice coil Le [mH]	0,07391
equivalent volume Vas [liter]	102	substitution resistor Re2 [ohm]	6,50335
Effective piston area [cm2]	214	substitution inductance Le2 [mH]	0,11669
P max [W]	70	substitution resistor Re3 [ohm]	0,67967
Nominal impedance [ohm]	6	substitution inductance Le3 [mH]	0,23988

Internal enclosure (e.g. dome tweeters) [Calculate Re.. and Le.. From impedance response]

Use frequency response use acoustic phase resp.

... starting around 2*fc

Measurement of frequency response took place: 3. VISATON test enclosure small side

f [Hz]	A [dB]	f [Hz]	Phase [°]
20	71,9401	20	-132,18
20,5626	72,1515	20,5626	-134,93
21,141	72,5594	21,141	-138,09
21,7357	73,0393	21,7357	-141,43
22,3472	73,495	22,3472	-144,71

position of point of sound origin (SEO) to which phase response corresponds: 42 mm (>0 = behind baffle)

use impedance response. use electric phase resp.
Measured impedance is only considered at frequencies above 3 * fc, except for enclosure type "integrated enclosure"

f [Hz]	Imp. [ohm]	f [Hz]	Phase [°]
20	6,1039	20	34,914
20,5626	6,166	20,5626	35,732
21,141	6,2686	21,141	36,357
21,7357	6,3955	21,7357	37,276
22,3472	6,5126	22,3472	38,162

There is no reason to tamper with any of those data – except you want to load a new driver.

If you haven't loaded a driver yet, the upper part will look like this:

Edit driver 1, enclosure and baffle

Driver data | Enclosure & Impedance | Baffle and position | more data

Driver data

Denomination: [] [Load driver from file ...]

Comment: []

Resonance frequency fs [Hz]	0	Linear excursion per side [mm]	0
Electrical Q-faktor Qes	0	DC resistance Rdc [ohm]	0
Mechanical Q-factor Qms	0	Inductance of voice coil Le [mH]	0
equivalent volume Vas [liter]	0	substitution resistor Re2 [ohm]	0,001
Effective piston area [cm2]	0	substitution inductance Le2 [mH]	0,001
P max [W]	0	substitution resistor Re3 [ohm]	0,001
Nominal impedance [ohm]	0	substitution inductance Le3 [mH]	0,001

Press the “Load driver from file ...” button and choose the appropriate Visaton driver from the pre-selected “Chassis” folder. All entries in the “Driver data” tab will fill automatically.

Don't forget to confirm your selection by pushing the “OK” button at the bottom of the window. Otherwise your driver selection will not become part of the project.

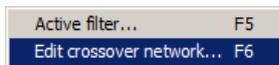
Including your own non-Visaton driver data into this window will be explained in a future version of this manual.

3.3.3 Copy driver

This feature will be explained in a future version of this manual.

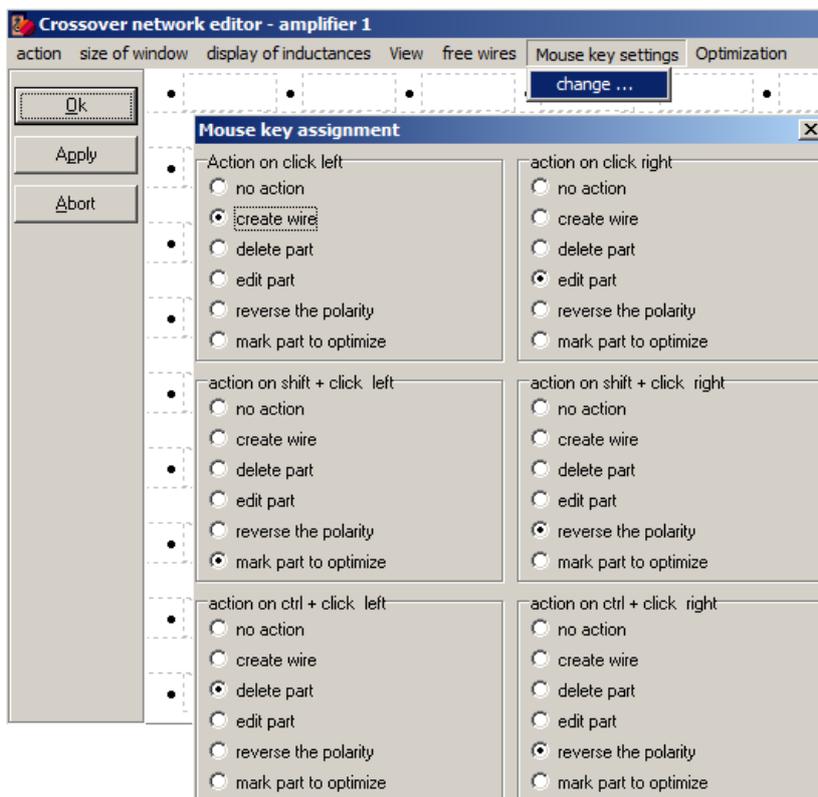
3.4 Amplifier 1

This is not so much about the amplifiers, but about filters and crossovers. You can choose between active and passive and indeed mix both, if you want so.



3.4.1 Edit crossover network ...

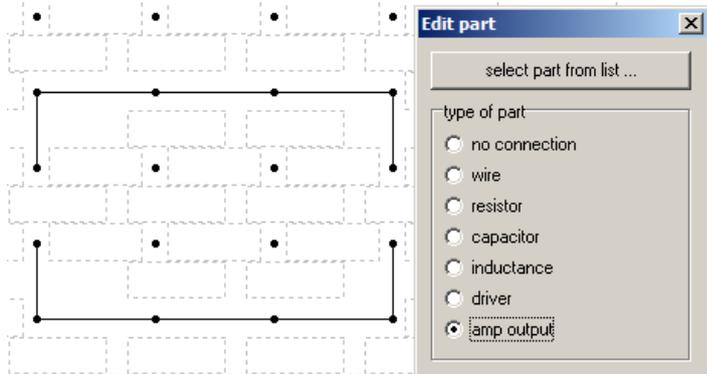
Before generating or editing any passive filter or network, please get acquainted with the mouse key actions:



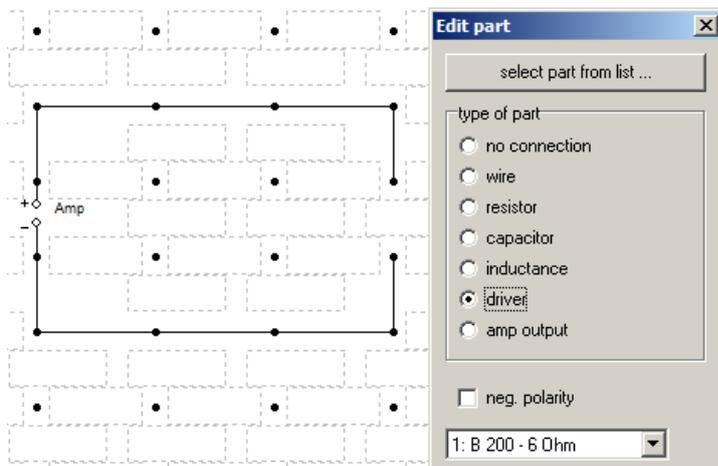
The Crossover network editor shows a grid of nodes (black dots). You can create a wire or a component horizontally or vertically between two adjacent nodes by placing the mouse cursor between those nodes. Press the left mouse key for placing a wire. Press the right mouse key for placing/selecting any other part. Press "ctrl" and the left mouse key to delete any part or wire under the mouse key.

It is not possible to **move** any parts or wires.

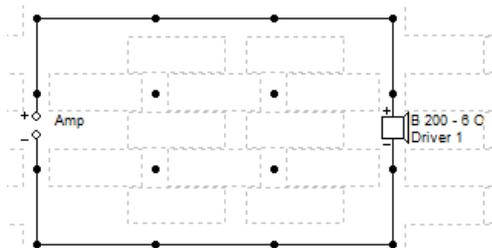
You will at least need an amp output ...



... and a driver:



This is the minimum network configuration to start with:

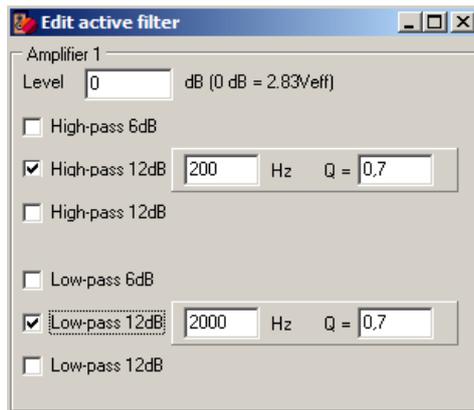


Changes in the Crossover network editor will only become effective after pressing the “Apply” or “Ok” button in the window.

There are some more options in the editor. Some are self explaining, others – like “Optimization” – *will be explained in a future version of this manual.*

3.4.2 Active filter ...

You will have to create a minimum network configuration (amp and driver – see above) for every active filter you want to apply.



Choose an amplification or attenuation level, and apply high- and low-pass filters as required. You can combine two or three filters to achieve higher filter orders. Q of a Butterworth filter is 0,707, Bessel is 0,577, Linkwitz-Riley is 0,5, Chebycheff is 1.

... to be continued

The explanations above should help you to get started. I will extend this manual step by step, but wanted to publish it as soon as it is of any help.

You will find the newest version at www.dipolplus.de/downloads/boxsim_manual.pdf