Boxplot Table of contents

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REGISTRATION

Overview

Box Plot is a Microsoft Windows based program that calculates the frequency response and maximum Sound pressure level for any sealed or vented loudspeaker enclosure. This program can be used by anyone interested in building of modifying high quality loudspeaker enclosures for home or professional use. You should be familiar with the Thiele/Small loudspeaker parameters in order to best utilize this program, but all that is required is a basic understanding of vented loudspeakers and a good data sheet for your drivers.

In addition version 2.0 of **Boxplot** adds passive network design to help with crossover design.
First through fourth order *(non shareware version)* passive crossovers, L-Pad attenuators and impedance compensation networks can be calculated built to complete the speaker system.

This version of **Box Plot** requires Microsoft Windows 3.0 or later to run.   Windows must be running in Standard or Enhanced mode which means that a the computer must have greater than the standard 640kBytes of memory. A math coprocessor is not required but will greatly speed up the frequency response calculations.

History:

Boxplot Version 2.0, Changes from Ver 1.5

Lots of new stuff. Added first through fourth order *(non shareware only)* passive crossover design. Added Icon bar with H and Alpha edit boxes for fast changes. Added Tweeter attenuator calculator, and impedance compensator (Zobel) calculator. Added rectangular box dimension calculator. Added multiple driver configurations. Parallel and Series drivers with Isobaric (constant pressure) options. Added power limit curve to response graph. Updated all dialog boxes to use Windows Common dialog boxes. Fixes up printout for new features. Added real on-line help. Many other internal mods to get ready for next wave of new features.

BoxPlot Version 1.5, Changes form Ver 1.41

Rearranged main menu items to be more CUA/SAA compliant, like other windows programs

Added Page setup dialog box, plus some margin and printing control.

Added Box Dimensions dialog box, to calculate recommended box dimensions.

Added Calculated Qts field to Speaker parameter dialog box.

BoxPlot Version 1.41 Changes From Ver 1.4

Bug fixes to vent dialog box. Vent length was incorrect. Added more value checking on speaker and box parameters.

Box Plot Version 1.4 Changes from 1.3

Adds measurements/tuning sections.

Bug fixes to vent dialog box.

Box Plot Version 1.3 Changes From 1.2

Adds Vent Air Speed Calculations.

Printer Setup now changes the global printer settings instead of forgetting them.

Intro Screen.

Printer output changed to include vent parameters, and re-formated. About Box changed. On screen Plot Dimensions Changed.

Box Plot Version 1.2 Changes from 1.1

Printer Setup dialog box Added. Box Parameters Dialog box reworked. Bug in Comments printout fixed.

Boxplot Version 1.1 Changes From 1.0

Quasi help screen Added. Speaker English/Metric selections added. Bug Fix for SPL scale.

Operation:

To use Boxplot to design a speaker enclosure there are a few simple steps to follow. If you already have a speaker (raw driver) then enter its parameters into the Speaker Parameter dialog box and go on to the Box Parameters dialog box. If you do not have a speaker already then you can enter Speaker parameters for a prospective driver from a data sheet or select one of the speaker files provided with Boxplot. Next enter box parameters into the Box Parameters dialog box. In the Box parameters dialog box is a button labeled *Align*, pressing this will set all of the Box parameters to an optimally tuned enclosure for the specified speaker. A graph will be drawn of the output response, and maximum sound pressure level for this speaker/box combination. If you are satisfied with the results, then all that is left to do is build the box. Below the graph is the actual box volume required for the design and a set of box dimensions are calculated in the Box Dimensions dialog box under the View menu. Comments can be added to the graph, and the results saved and printed out. Of course there are always tradeoffs in speaker design so you may want to experiment with different speakers and box combinations before settling on a final design. Factors such as Low Frequency cutoff, Maximum power handling , sensitivity and box size can all be adjusted to obtain a design that meets your needs.

This Program was designed to allow 'almost' real time update of the response plot as box parameters are changed. This is useful when trying to shoehorn a speaker into a non optimum box, or when the optimum required box volume is the size of a house. Many different combinations of box parameters can be tried in a short period of time. If Auto Plot is turned on, then clicking on the OK button of the Box Parameters dialog box, or changing the H and Alpha parameters will replot the response curves. On computers with a 486 or a 386 with a math coprocesser the update time will be almost instantaneous.

To complete your design, Passive crossover networks can be designed using the crossover dialog box.. The crossover frequency must be entered and the *calculate* button pressed in order to update the crossover parameters. The display shows the crossover schematic diagram with the necessary component designations. Crossovers are necessary when constructing a multiple speaker system, to eliminate unwanted low frequencies from tweeters as well as high frequencies from woofers. The crossovers are two-way designs (which means only a woofer and a tweeter), but can be extended to three or four way systems.

Menus

The following shows the main menu items and each ones pull down menu.

File

- New
- Open
- Save
- Save as
- Print
- Page setup
- Exit
- About

Edit

- Speaker Parameters
- Box Parameters
- Comments

View

- Box Dimensions
- Vent Design

Crossover

- Passive Crossovers
- Attenuators

Plot

- Plot Response
- AutoPlot

Help

Help Menu

Brings up this Boxplot On-line help. This uses the standard Windows help system, which your are now using. There is help on help available in the Help menu.

Registered Users will have access to the Speaker building tutorial included in the help file. This tutorial provides additional information on the best way to use Boxplot and tips on successfully building speaker enclosures.

Speaker Parameters:

Speaker parameters are entered by bringing up the **Speaker Parameters** dialog box, from the **Edit** menu. When you are satisfied with your changes, click on the ***OK*** button to save the parameters. The parameter names are the Thiele/Small parameters specified on most good data sheets. Parameters can be entered in either metric or English units. Selecting the metric or English checkbox will change the units for the entire program, not just the speaker parameters.

Also note that changing units will use the values currently saved from the last time the OK button was pressed. This means that the speaker units should be changed *before* changing other values.

Fs

Free air resonance of the speaker.

Vas

Volume of air equivalent to the speakers compliance.

Qms

Mechanical Q of the speaker.

Qes

Electrical Q of the speaker.

Qts

Total Q of the speaker (calculated field) *

Xmax

Maximum linear cone displacement.

Pd

Maximum power dissipation (in watts).

Re

Dc resistance of the voice coil.

Diam

Effective piston diameter of speaker.

Le

(used only for Zobel design)

Voice coil inductance in millihenries.

Sensitivity

(used only for attenuator design)

Speaker Sensitivity in dB, measured with 1 Watt of input power at 1 Meter. Notice that even when using English units the sensitivity is still measured at 1 Meter.

* **Qts** is calculated and displayed from the Qes and Qms values. This is not an edit box so you can not change the calculated value directly. This calculated Qts should be close to the manufacturers specified value. Qts is only updated after the Ok button is pressed.

Box Parameters:

Box Parameters are entered in a dialog box. To bring up the dialog box select **Box Parameters** under **EDIT** the menu. After parameters are entered click on the **OK** button. When the OK button is clicked, all of the parameters are entered and range checked and the new response is calculated. If autoplot is on, the screen will be updated with the new response. The **Align** button will reset all of the box parameter to an optimally tuned box for the specified speaker. The particular alignment used is the QB3-B4-C4 series of responses based on the work of R.H. Small and others. This alignment is optimized for a flat frequency response with a good low frequency cutoff. Some significant optimizations can be made by adjusting the H and Alpha parameters to get a lower cutoff or different box size. Use the Iconbar's H and Alpha scroll buttons to adjust these parameters without bringing up the Box Parameter dialog box.

Box Type

Selects either a Sealed or Vented enclosure to use for all box calculations.

EQ Type

This selection controls the type of external ACTIVE equalizer than is used with the system. An external equalizer may be used with the speaker system but is not necessary.

Number of Drivers:

This selects the number drivers (woofers) in the system. Most systems use a single driver, but any number of drivers can be installed in the system. For multiple driver systems certain parameters must be scaled so the proper box dimensions can be found. Checking 2-drivers will enable the Driver configuration box an perform the appropriate parameter scaling.

Driver configuration:

If two or more drivers are installed in the system then they can be in a number of different physical as well as electrical configurations. Electrically they can be wired in series or parallel and in phase or out of phase. Physically they can be mounted both facing forward, one can be facing forward and one mounted with the magnet facing out (Push-Pull) or in an Isobaric configuration.
NOTE: The shareware version of Boxplot can only calculate a normal driver configuration.

Box Parameters:

Alpha: System Compliance ratio.

Alpha determines how big to make the box.
Alpha is the ratio of box volume (Vb) to speaker Vas. Alpha = Vas / Vb

H: System tuning ratio.

H determines what frequency the system will be tuned to, and therefore how to design the vent.
H is the ratio of the speaker free air resonance to the system tuning frequency (Fsb).
H = Fs/Fsb

Ql or Q7: Q from box leakage losses.

This is a measure of how airtight a box is. Even vented boxes MUST be airtight (except for the vent hole of course).
This is the enclosure Q at Fb from leakage loss. (better sealed boxes have higher Q's)
This parameter must be measured after the enclosure is built. Start with 7 as a good estimate. A Ql of 3 or less is unacceptable and must be improved, a Ql of 15 or higher is very good.

Fe/Fs:

This is the ratio of the Equalizer resonant frequency to the box frequency.

D

This is the equalizer Damping coefficient. D = 1/Q

Box Types

There are 6 basic box types that can be modeled with Box Plot. These types are controlled with the Box Type and EQ type radio buttons. The box can be either sealed or vented. A sealed box is a simple closed box with no opening other than the speaker. A vented box is a box with a speaker and a port. A port can consist of a length of tubing of the appropriate diameter and length or a simple hole cut in the box (not recommended). Each box type can have one or two drivers. Two driver systems can be configured in either normal, Push-Pull or an Isobaric configuration.

The following is a list of the basic box types supported by Boxplot

Closed Box:

A Simple sealed Enclosure with no port.

Closed Box with first order equalizer:

A sealed box with a first order hi pass filter. The first order filter usually provides subsonic attenuation to prevent unwanted cone motion.

Closed Box with second order filter:

A sealed box with a second order hi pass filter. The filter is usually an active filter placed before the power amp. Adjusting the Q of this filter modifies the low end response f the system. This is usually used to extend the lower 3dB point.

Vented Box:

A box with a tuned port. This is the most common type of enclosure.

Vented Box with first order eq:

A vented box with an external equalizer. A first order Eq is more useful here than in a sealed box. At low frequencies the port ceases to function causing a loss of loading on the speaker. This makes it susceptible to damage caused by excessive cone motion at subsonic frequencies. The external filter can be used as a hi-pass filter to stop subsonic frequencies from reaching the speaker.

Vented Box with second order eq:

A vented box with a second order active filter before the power amp. This is used much the same way as in a sealed box.

Isobaric

An Isobaric (constant pressure) configuration is where two drivers are mounted such that they share a common air chamber between them, and this chamber is not open to the outside or inside of the enclosure. The air pressure between the two drivers does not change (isobaric) because both drivers move coincidentally. This configuration cuts the speakers Vas in half, but because there are two drivers the equivalent Vas it that of a single driver. This configuration reduces the box volume required by 1/2 of a normal 2-driver configuration.

Push Pull Driver Configuration

The Push-Pull configuration is when two drivers are mounted such that the cones move in opposite directions

when responding to the same signal. This requires that one driver be mounted with its rear (magnet) facing out and the other driver facing in (the normal way). In addition the drivers must be wired out of phase so the cone motion is correct.

The advantage of this configuration is that if two identical drivers are used, the opposite cone motion will cancel distortion due to nonlinear excursions of the cone on positive or negative cycles.

Comments:

The comments field is a text string, 255 chars long that can be used to annotate the graph. The comment text is displayed under the graph and may not be visible if the window is not large enough. The comments are printed either above or below the graph, depending on the page setup.

New:

This will reset all program parameters to pre-defined settings. The settings are not based on any particular speaker or box. The file name will be cleared and one must be provided when saving the file.

Open:

Read a file from the disk. The default file extension is .SPK. If you do not include it as the extension it will be included automatically.
The speaker files should be stored in a separate subdirectory, This will help to keep things organized as the number of files grows. The program does not require that the files are stored in any particular directory.

Save: Save as:

This will save the speaker, box, and comments in the specified file. The name in brackets are subdirectory names. these can be used to move around in the directory structure. The **[..]** name will move you up one directory level.

Print:

This will bring up the print selection box. This allows printing of the speaker response and comments, crossover design, attenuator design and Zobel design, along with the Printer Setup.

Printer Setup will bring up the active printer setup dialog box. Any changes made in the setup box will be saved as the current printers setup. (Note that this will change the settings for other windows applications as well).

Page Setup:

This allows some limited printer setup. The printer margins are adjustable, as well as the position of the comments. By default the comments are printed under the graph, but this can be changed to above the graph by checking the appropriate box. The reset button will reset all of the page setup parameters The default values are 0.5" for all margins, and the comment box below the graph. When the OK button is selected the page settings are saved and will remain in effect for all speakers.

About:

This is the standard About box that seems to be on all windows programs. It shows whatever program revision number you have as well as copyright info.

Exit

Exit the program. This will exit Boxplot and close any open files. The page settings are saved in an INI file.

Box Dimensions:

This dialog box will show the inside dimensions for a rectangular box based on the golden rectangle. The volume for the box is calculated from the currently defined speaker and box combination. This is not a very intelligent calculation. It will warn you if the width of the box is smaller than the speaker diameter, but makes no attempt at calculating another box. Also it does not check it the specified vent is longer than the depth of the box.

This also provides a simple box dimension calculator for a rectangular box. New values for Height , width and Depth are entered the new box volume and Alpha re calculated automatically. Be sure to include extra volume for bracing and enclosure tuning. Usually 15 to 20% extra volume is plenty.

If an invalid character or negative number is typed in as a dimension, the volume will show the word "Error". Box dimensions cannot be saved with an error in this field.

Vent Design:

This dialog box will show the vent length based on the present box/ speaker combination. Enter the diameter of the vent you intend to use. Note that the equations used assume a vent that is a tube flush mounted to the cabinet front, extending into the enclosure. This is the normal type of vent usually seen. If the vent length is equal to the cabinet thickness, then just cut a hole in the cabinet. Make sure you cut the vent tube about 20% longer than calculated so it can be shortened when tuning the enclosure.

The Vent Air Speed Mach Number is the speed of the air in the vent relative to the speed of sound. A Mach number of 1 means the vent air speed is equal to the speed of sound. The mach number should be kept below .2 in order to avoid audible whistling and wind noise from the vent.

Plot:

Selecting plot will cause the graph to be recalculated and redrawn based on the current speaker/Box combination.

Auto Plot:

When the Auto Plot menu item is checked, anytime a speaker or box parameter is changed, the graph will be regenerated. This keeps the graph up to date with the latest parameters. This also may be annoying on slower machines so it can be turned off.

Theil/Small Parameters:

Most of the credit for taking the black magic out of speaker design belongs to A. N. Thiele and R. H. Small, whose work on modeling a vented enclosure has made predictable speaker enclosure design possible. By modeling a speaker and its enclosure as an electrical circuit (hi pass filters) and using network analysis, a set of equations were produced. From these equations, they developed a set of procedures that make designing excellent sounding enclosure more science than art. The model takes in to account all of the significant factors that influence the overall performance of a vented loudspeaker enclosure. Their work resulted in what they called *alignments*. An alignment is a combination of loudspeaker and enclosure parameters that result in a particular frequency response. Thiele and Small developed tables of alignments that narrow down the literally unlimited combinations of loudspeaker and box parameters to a few easily managed combinations.

IconBar

The IconBar is used to speed access to some of the most frequently used functions in Boxplot. The buttons on the Icon bar access the same functions as the menu items do. The only difference is the ease of access.

The following lists the Icon bar functions from left to right:

| | | | | | | Box Alpha edit box
| | | | | | Box H edit box
| | | | | Re-Plot frequency response graph
| | | | Box dimensions dialog box
| | | Vent design dialog box
| | Speaker parameters dialog box
| Box Parameters dialog box
Save the current file

Crossovers

The crossover dialog box allows the design of passive crossovers and other networks useful for the speaker builder.   A Passive crossover is used to limit the frequencies going to each driver in a two or three way speaker system to their designed range. Crossovers are necessary in any speaker system with more than one driver. Crossovers networks can be either passive or active. Boxplot only allows the design of passive crossovers in this release of the software. Active networks are planned for the next release.

Building a crossover network involves first designing the network for the drivers that are in the system. Each driver has a specified frequency ranges in which it is designed to operate. For example a tweeter in a two way system might have a crossover that limits the tweeter to all frequencies *above* 2000Hz. The crossover would also limit a woofer in such a system all frequencies *below* 2000Hz.   This crossover is said to have a corner or crossover frequency of 2000Hz. The actual crossover frequency must be determined by examination of the frequency response graphs of the individual drivers and the manufactures recommended crossover frequencies.

In addition to the corner frequency, the slope of the crossover is an additional concern. The slope determines how sharply the unwanted frequencies are attenuated. For example a 6dB/octave slope means that if a crossover's hi-pass section (the one connected to the tweeter) has a corner frequency of 2000Hz, a signal at 1000Hz would be attenuated by 6dB. Likewise a woofer with a 2000Hz lo-pass filter would have a signal at 4000Hz attenuated by 6dB.   A 6dB crossover is considered to be only marginally effective at limiting the spectrum sent to each driver. Each driver must have a very large bandwidth to make 6dB/Octave crossovers a viable design.   A two way speaker system should use at least a 12dB/Octave and preferably higher order crossovers in order to cause a minimum overlap of the drivers output and protect the tweeter from low frequencies. The tradeoff in using higher order crossovers is complexity and expense of construction.

To access the Crossover design box, choose *Crossover* from the main menu, then choose Passive Crossovers.

Passive Networks

A passive network or crossover is one that does not require any external power sources to operate. A passive network is usually made up of only capacitors, inductors and resistors. Most crossovers built into speaker system are passive networks.

Active networks

An active network is any electronic circuit that requires an external power source. An active crossover network is usually inserted between the pre-amp and the power amps in an audio system. Active crossovers require a separate amplifier for each band (frequency range). Active crossovers are usually made of op-amps, resistors and capacitors.
(Active crossover design will be part of the next release of Boxplot)

Crossover Dialog Box

The Crossover dialog box shows a schematic diagram of the crossover network along with its component designators and a listing of their values. Entry fields for all of the required parameters are initially filled in with default values derived from the woofer parameters.

Crossover Circuit diagram:

The circuit diagram shows the components and connections required to construct a crossover. The designators are shown for each component, which their values listed in the box to the right of the circuit diagram. This diagram will be changed whenever a different crossover slope is chosen.

Crossover Frequency

The crossover frequency specifies where the crossover point will be. The user is required to type in a value that is suitable for the particular woofer and tweeter chosen.

Crossover Slope

This Specifies the slope or Order of the crossover network.
1st Order has a 6dB per octave slope

NOTE: 2nd thru fourth ofder crossovers are avaiable in the Non-Shareware version of Boxplot sent
to all registered users. Please Register!!

Crossover Type

This selects the type of frequency response the crossover will exhibit at the crossover frequency. The only selection for a first order crossover is All Pass, higher order crossovers can have varying amplitude and power response at the crossover frequency.
NOTE: The non-shareware version of Boxplot contains All-pass, Constant power and Compound crossover types.

All Pass

An *All Pass* response means that the amplitude response of the combined woofer and tweeter speaker outputs will be flat. This means that all frequencies are passed with the amplitude unchanged. The phase response is not flat. The All pass crossovers obey the following equation:
|Vwoof + Vtweet| = |Vin|

Woofer   resistance

This entry specifies the DC resistance OR the nominal impedance of the woofer. This value is should be the impedance that the crossover will see at the crossover frequency.

Tweeter   resistance

This entry specifies the DC resistance OR the nominal impedance of the woofer. This value is should be the impedance that the crossover will see at the crossover frequency.

PLEASE REGISTER

This is an unregistered copy of Boxplot. Boxplot is shareware, it is not a free program. You may evaluate Boxplot for 10 days free of charge after which, you must register it.

To register the registration form and $25.00 in U.S. funds to:

Rick Carlson

62 Fox Trail Rd.

Sparta, NJ 07871

Compuserve 71041,3015

You can also register thru Compuserve's Shareware registration service.

Please specify 3 1/5" or 5 1/4" floppy disks.

Send your name and address and where you obtained you shareware version of Boxplot. (to help in distributing new versions).

Registered users will get the latest version of Boxplot which includes more features such as more Box types (Isobaric, Bandpass), more crossover types (1st thru 4th order), more speaker files, more on-line help and a Printed tutorial on speaker building. Plus notification of upgrades and bug fixes as they are available.

Registration Form

PLEASE REGISTER

Registered users will get the latest version of Boxplot which includes many more features such as more Box types (Isobaric, Bandpass), more crossover types (1st thru 4th order), Zobels and other networks, Box tuning section, more speaker files, on-line help and a Printed tutorial on speaker building. Plus notification of upgrades and bug fixes as they are available.

To register please fill in the form and send $25.00 in U.S. funds to:

Rick Carlson

62 Fox Trail Rd.

Sparta, NJ 07871

Compuserve 71041,3015

You can also register thru Compuserve's Shareware registration service.

(Search for Boxplt2.zip)

Name:____

Street:____

City:__________________________________ State:_________________

Zip Code:_____________________________ Country:_________________

Phone: (Optional) ____

Please specify 3 1/5" or 5 1/4" floppy disks. Disk Type: 3.5" [ ] 5.25" [ ]

Where did you obtain Boxplot:______________________________________

What other features would you like to see included in the next release of Boxplot:

____

____

Tutorial

Registered users will receive a tutorial on speaker constructions with hints and tips for successful speaker building. Please register today.

Zobels

A Zobel is an impedance equalizer used for making the speaker input impedance look like a constant resistance to the crossover. A zobel will compensate for the woofer inductance at higher frequencies making the woofer more closely simulate a constant resistance. Since most passive crossovers are designed assuming that the woofer is a resistive load, a complex impedance will alter crossover frequency response. The amount of variation mostly depends on the inductance of the woofer at higher frequencies. Zobels are most effective when the crossover point is far away from the tuning frequency of a vented box. Zobels should not be connected to the speaker when tuning a vented box. Zobels should NOT be used on any system that has a active or low level crossovers. Any speaker that is directly connected to an amplifier should NOT use a Zobel network.
Use the crossover menu to access the Zobel Dialog box.

Zobel Design Dialog Box

The Zobel design dialog box consists of a schematic diagram of the impedance compensator network with component designators and the calculated values. The users is required to enter the woofer inductance and resistance values in order to calculate a Zobel.

Schematic diagram:

The schematic diagrams shows the capacitor and resistor configuration and component designators for the attenuator. The Zobel network is places across the terminals of the woofer.

Component Values

This box lists the component values for R1 and C1. The Calculate button must be pressed to update the component values. The resistor must be a 5-10W resistor. The capacitor must be a non-polar capacitor of sufficient voltage. The voltage rating can be determined by the following formula:
Vc = sqrt(Pamp * Zwoof) * 1.414
where Vc is AC voltage rating of the capacitor, Pamp = power amp output power and Zwoof is the woofer impedance

Woofer

DC Resistance:

This is the actual DC resistance of the woofer. Enter the DC resistance stated on the data sheet or measure it at the speaker terminals with an ohmmeter.

Inductance:

This is the specified voice coil inductance of the woofer. The inductance is usually specified on a data sheet.

Calculate

This button recalculates the component values for R1 and C1 with the current Woofer values.

Attenuators

Tweeter Attenuators are used for reducing the output level of a midrange or tweeter in a multidriver speaker system. Typically a tweeter will have a higher sensitivity than a woofer, and therefore need attenuation in order to have its output balanced with that of the woofer. The amount of attenuation if based on the relative sensitivity of the tweeter and woofer. A tweeter with a sensitivity of 96dB and a woofer with a sensitivity of 92dB will need an attenuator of 4dB on the tweeter to play at equal volume levels. The exact amount of attenuation may be adjusted to the builders taste of course. The attenuators designed by Boxplot are fixed and are not meant to be changed after the system is built. An L-pad can be used instead if variable attenuation is needed.
An attenuator consists of two resistors which must be of the proper wattage rating to handle the power levels required. Ten Watt resistors are usually sufficient for most reasonably powered systems.
Use the Crossover menu to access the Attenuator Dialog box.

Attenuator Dialog box

The attenuator dialog box consists of a schematic diagram of the attenuator network with component designators and the calculated values. The users is required to enter the tweeter and woofer sensitivity and impedance values in order to calculate attenuator values.

Schematic diagram:

The schematic diagrams shows the resistor configuration and component designators for the attenuator. The Attenuator must be placed between the crossover network and the tweeter.

Component Values

This box lists the component values for R1 and R2. The Calculate button must be pressed to update the component values.

Woofer and Tweeter

Resistance:

This is the actual impedance of the woofer or tweeter. Enter the DC resistance or the actual impedance of the speaker near the crossover frequency.

Sensitivity:

This is the rated sensitivity of the woofer or tweeter. Sensitivity is measured in dB per Watt at a distance of one meter. Sometimes manufactures will changes the way sensitivity is measured or will use peak values for this number. It is best to have a graph of the speaker output vs frequency to ensure that the stated numbers are correct.

Calculate

This button recalculates the component values for R1 and R2 with the current Woofer and tweeter values.