



# Humble Homemade Hifi

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## Concerto



The Concerto is a high-grade two-way loudspeaker using two 15cm midwoofers centred above and below a 26mm dome tweeter in a so called MTM-configuration. The crossover-point between the glass-fibre cone midwoofers and the soft-dome tweeter is at a relatively low 1750Hz. The cabinet has an internal volume of 17 litres and is vented on the rear via a large, low-noise, trumpet shaped reflex-port that is tuned to about 50Hz. Inside the enclosure there is also a *Quadratic Residue Diffusor* that is aimed on reducing the intensity of the standing waves inside the cabinet. Especially in the critical midrange where the amount of damping-material needed inside the cabinet can be minimized. The end result being a more dynamic and open sounding image. The Concerto can be built as a compact monitor loudspeaker or as a taller floorstanding version.

The Concerto is available as a high-grade DIY loudspeaker kit. The kit is sold with all components except the cabinet and comes

with the [Scanspeak 15W/8434G00](#) midwoofers, the [Scanspeak D2604/8330](#) tweeter, Supra 5N internal-wiring, gold-plated bindingposts, Intertechnik Damping-10 and Sonofil-S damping material, Intertechnik Jet Set-70 reflex-ports, black mounting screws and a pre-assembled crossover that uses high-grade Mundorf and Jantzen Audio components. In addition, a precisely CNC-milled baffle is available from our [webshop](#). Furthermore WBT-0703-Cu Nextgen binding-posts are available as an option at a small surcharge. On our [download](#) page you will find free CAD-drawings of the stand-mount version, the floorstanding version and a detailed CAD-drawing of the loudspeaker baffle.



### Specifications

Sensitivity	89 dB / 2,83 volts
Impedance	4 ohms nominal
Frequency response	56 - 40.000 Hz (-3dB)
Dimensions (W x H x D)	200 x 500 x 400 mm
Weight (finished product)	18 kg each
Price DIY loudspeaker kit (all parts except wood)	Now the last kits available for only EUR. 329,- each!

## The Concerto in detail

The Concerto is designed to be a good allround loudspeaker regarding size, implementation, cost and ease to build. It is as well at home in a high quality two channel stereo system as it is in a multi-channel home theatre set-up where it's smaller brother, the Concertino, can be implemented for the rear channels. From the outside, the cabinet looks rather standard issue, but inside it is a totally different story. Instead of a standard rectangular box, this loudspeaker uses a unique *Quadratic Residue Diffusor* type of woofer loading. This internal diffusor has several major advantages: first of all it creates an irregular shape that breaks the back wave produced by the woofer. This minimizes the amount of delayed energy that (in more conventional designs) is reflected back off the rear wall and travels through the thin cone of the midwoofer, "smearing" the original clean signal that is fed to the woofer. The second advantage is that the cabinet width and depth vary internally so the strong standing waves that you usually get between two parallel surfaces are broken down into several smaller and therefore less harmful ones. Third item is that the constrained panel layers help reduce panel-borne resonances, flexing and vibrating energy that travel through a panel of constant thickness. Advantage number four: all these extra panels help to make the whole construction "dead" and heavy, again reducing unwanted excess energy radiating from the cabinet. All these advantages together result in a very quiet cabinet that also needs only a minimum of damping material inside and therefore adds to a "live" and dynamic approach to music.



The photo's above show how all the panels and supports are positioned inside the cabinet. It may look a little complicated at first, but all the necessary panels are just cut into straight forward rectangular panels. Also many panels have the same dimensions. I cut the outer cabinet panels full length and made mitred joints, check the high-resolution [CAD-drawings](#) for the exact measurements. Besides the 22mm thick mdf panels there are only two other pieces of wood: a pair of small supports glued horizontally to the inside of the baffle in between the tweeter and the midwoofers. This gives extra strength to the baffle where it is at it's narrowest. The damping material inside these loudspeakers consists of 10mm thick Intertechnik Damping-10 (made from recycled cotton) and Intertechnik Sonofil-S bonded acetate fibre. One sheet of Damping-10 is cut to size and covers the flat internal surface area around the drivers. It also covers the beginning of the outer two diffusor panels. One bag of Sonofil-S (containing two sheets) is cut into 4 equal sized pieces, folded up and placed against the diffusors directly behind each midwoofer. The area around the reflex-port is kept free from any type of dampingmaterial. The photo's below should explain it more.



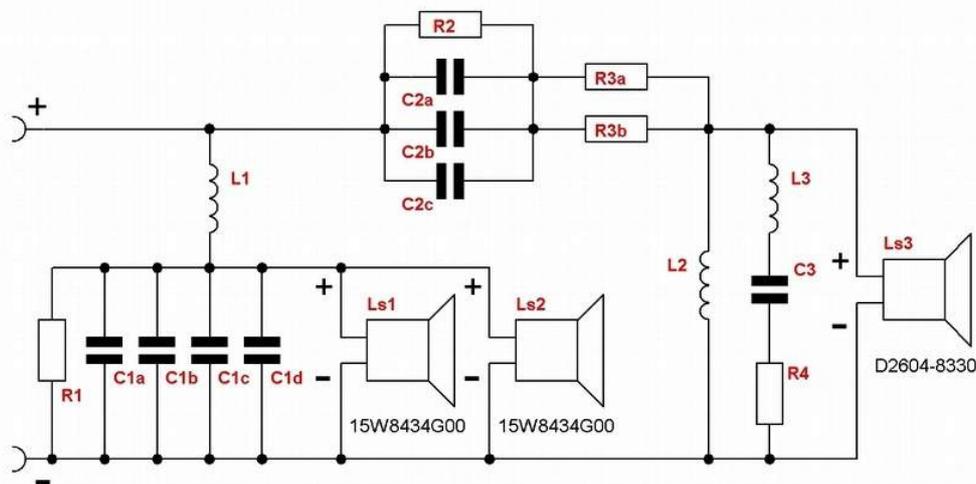
On the centre of the rear of the cabinet there is an Intertechnik Jet Set-70 reflex-port with very large internal and external flares. The port length is such that the supplied inner tube should be cut exactly in half. Each half is then terminated with an internal flare and the larger external flare and then taped together. The ports and the drivers have an air-tight seal to the cabinet by means of self adhesive compression tape (supplied with the kit) that is applied to the rear of the drivers baskets and the rear of the outer port flare. The binding-post terminal-plates come with their own foam backing. For screwing in all the black screws (also supplied with the kit) I use an electric screw-driver for the most part. The final tightening I always do by hand, that way you get a feel of how tight the screws are and you can't over tighten them and cause any damage to the plastic reflex-ports for example. Always work cross-ways, so first one screw nearly all the way in, then the screw opposite and so on.





The drivers, crossovers and terminals should be connected together by the supplied Jantzen Audio 5N stranded wire (made by Supra Cable of Sweden). All the drivers are connected in positive phase. In the monitor version, the crossovers are mounted on the centre of the inside of one of the side panels, keeping them far enough away from the drivers magnets and keeping them out of the way of the reflex-port. The minor change in netto volume won't have any impact on the overall end result. If you find it a little too fiddly working through the woofer cut-outs, you can always mount the crossovers externally or simply build the floorstanding version that has a dedicated crossover compartment.

The crossover schematic might look at little complex at a first glance due to the many parallel components, but basically it is a second-order parallel network. The low-pass function for the two midwoofers is formed by L1 + C1 and the high-pass function for the tweeter is done by C2 + L2. Furthermore the tweeter level is lowered to match that of the woofers by means of resistor R3 and the tweeter also has a notch filter parallel to its terminals that tames a little bump in the output level around 4-6kHz. As you might know, I like to "cook" when designing a crossover. All the crossover components have therefore been chosen not only for their high sonic and build quality but have also been selected for maximum synergy with each other and with the drivers used. Inductor L1 and capacitor C2 have the most impact on the overall sonic performance. For L1 I chose a Mundorf Hepta Strand that are known for their finely detailed, clear and dynamic sound combined with harmonious warmth and near holographic staging. That sounds like a lot from just a simple bit or rolled-up wire, but anyway this type of air-core coil (along with foil types) is among my personal favourites. For the capacitors C2a and C2b I chose Jantzen Audio Superior Z-Caps for their spacious and neutral presentation and their uncompressed, dynamic nature that matches very well with the Mundorf Hepta Strand coil. The remaining components give the final touch by bringing out a fraction more micro-detail and even more natural overtones.



Humble Homemade Hifi - Concerto © 2012

#### Inductors

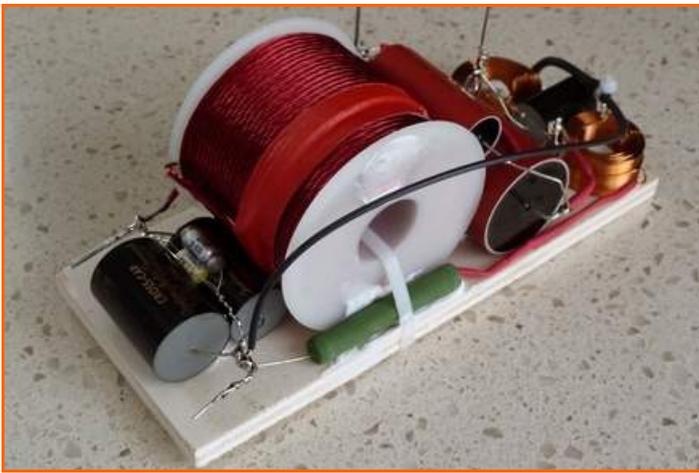
L1 = Mundorf M-Coil Hepta Strand LL60 baked varnish wire  
 L2 = Jantzen Audio baked varnish air-core / 0,70mm wire  
 L3 = Jantzen Audio baked varnish air-core / 0,70mm wire

#### Resistors

R1 = carbonfilm resistor / 0,25 watts  
 R2 = carbonfilm resistor / 0,25 watts  
 R3a = Mundorf M-Resist Supreme / 20 watts  
 R3b = carbonfilm resistor / 0,25 watts  
 R4 = Jantzen Audio SuperRes Non-Inductive / 10 watts

#### Capacitors

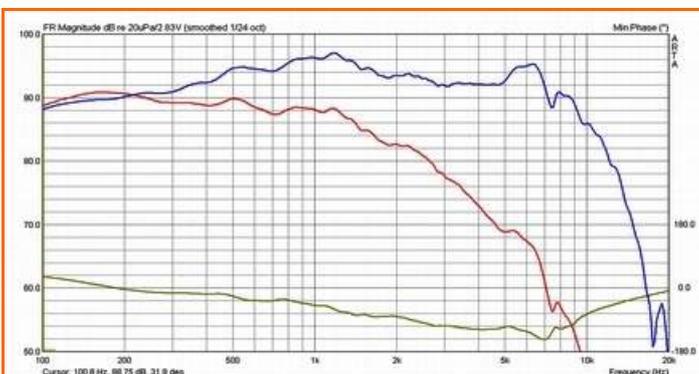
C1a = Jantzen Audio Cross Cap / 400VDC  
 C1b = Jantzen Audio Cross Cap / 400VDC  
 C1c = Vishay MKP1839 / 400VDC  
 C1d = Styroflex / 160VDC  
 C2a = Jantzen Audio Superior Z-Cap / 800VDC  
 C2b = Jantzen Audio Superior Z-Cap / 800VDC  
 C2c = Vishay MKP1839 / 400VDC  
 C3 = Jantzen Audio Cross-Cap / 400VDC



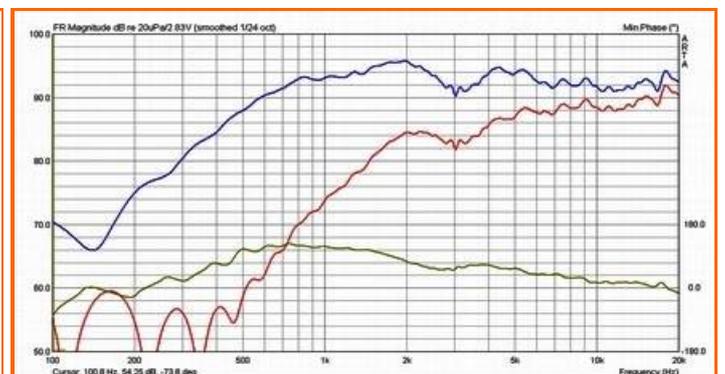
## Concerto - listening and measurements

The loudspeakers should best be placed free-standing with the tweeters at ear-height, toed-in enough that the inner sides of the cabinets are just visible. Playing with the amount of toe-in lets you find the right balance between top-end brightness and image size. The distance between the rear of the cabinets and a wall should be at least 30cm's, preferably a little more. By varying this distance you can adjust bass-weight to your personal situation.

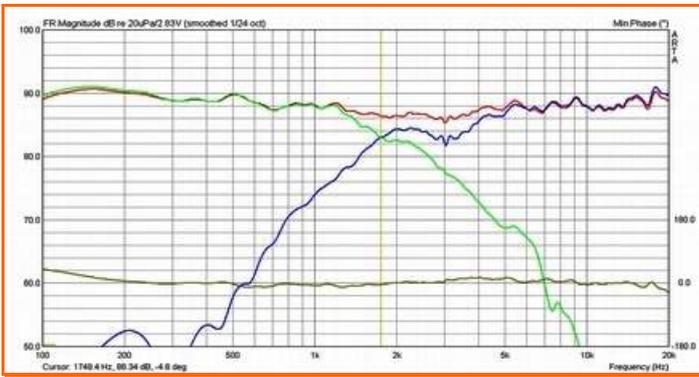
After you have finished building these loudspeakers give them a few weeks of normal use to settle in. When first connected they will sound a bit on the bright and lean side and the image will tend to stick to the loudspeakers. This is quite normal and is the case with any new loudspeaker. After a while the sound will grow, become warmer, more spacious and will extend at both frequency extremes. Once fully burnt-in you will be rewarded with an open and spacious sounding loudspeaker, the image being projected on a large stage that extends far around and in front of the loudspeakers. The tonal balance is seamless from top to bottom. The bass is surprisingly deep considering the relatively small woofers and has a hint of warmth, making the loudspeakers seem larger than they physically are. The midrange is very neutral with good vocal rendition and has a nice dynamic snap to it. The top end is clear with lots of detail but never gets harsh or over-etched. I found these loudspeakers to perform well with a large variety of source equipment and amplification, they just seem to grow as the quality of the equipment grows with them. And last but not least, below you will find the corresponding measurements of these loudspeakers.



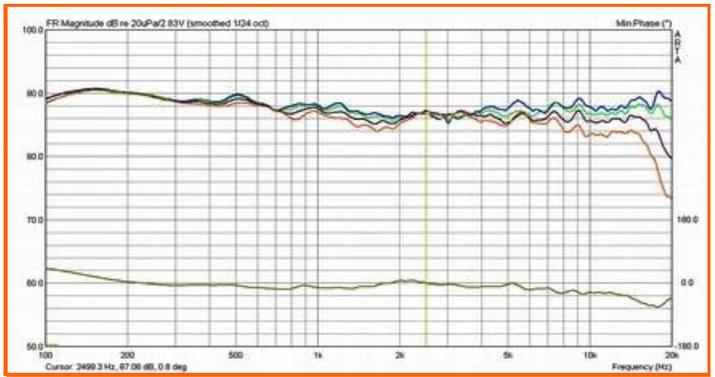
Above left: frequency curves of the midwoofer without crossover (blue) and with crossover (red) with corresponding acoustic minimum phase; frequency range 100Hz - 20kHz; vertical range 50dB - 100dB, subdivision 2dB's.



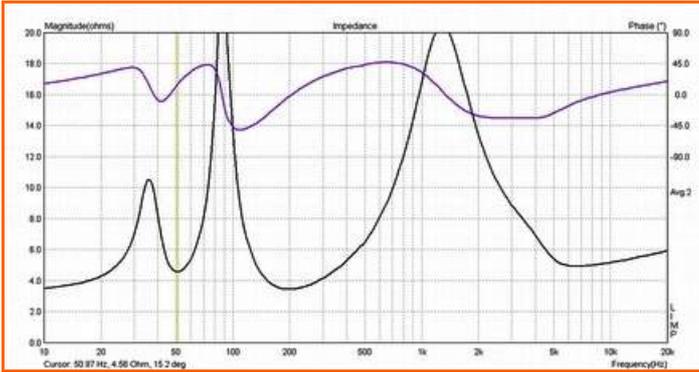
Above right: frequency curves of the tweeter without crossover (blue) and with crossover (red) with corresponding acoustic minimum phase; frequency range 100Hz - 20kHz; vertical range 50dB - 100dB, subdivision 2dB's.



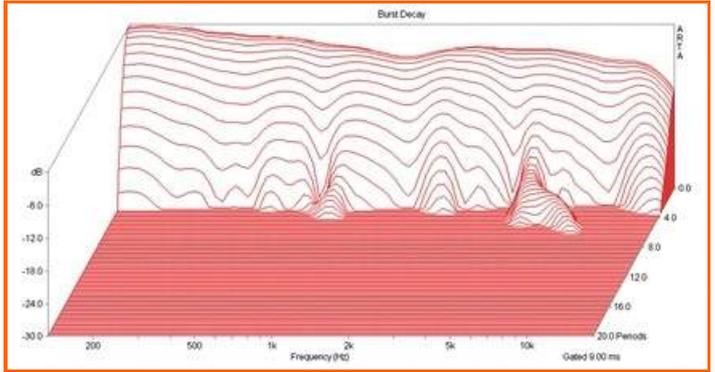
Above left: individual frequency curves of the midwoofer (green) and tweeter (blue) and the summed response of the finished system (red) with corresponding acoustic minimum phase; frequency range 100Hz - 20kHz; vertical range 50dB - 100dB, subdivision 2dB's.



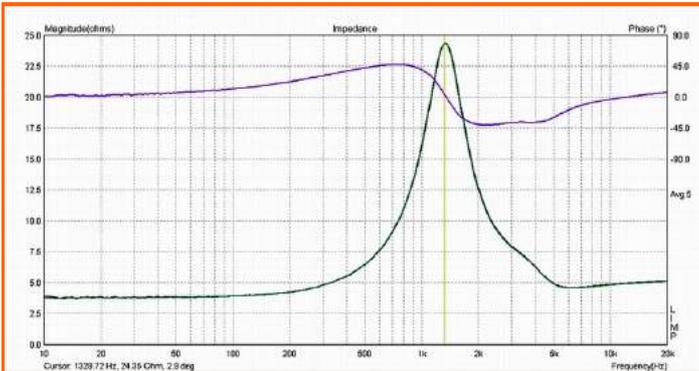
Above right: on axis and off-axis frequency curves of the summed system response: on-axis (blue); 15 degrees off-axis (green); 30 degrees off-axis (purple); 45 degrees off-axis (brown); frequency range 100Hz - 20kHz; vertical range 50dB - 100dB, subdivision 2dB's.



Above left: impedance curve of the finished system (black) with corresponding electrical phase (purple); frequency range 10Hz - 20kHz; vertical range 20 ohms, subdivision 2 ohms.



Above right: burst decay of the finished system; frequency range 100Hz - 20kHz; vertical range -30dB, subdivision 6dB's, time window 20 periods.



Final measurement check for each crossover and then matching them using a 3,3 ohm dummy load for the tweeter and the woofers: two impedance curves of a pair of finished and matched crossovers (black + green) with corresponding electrical phase (purple); frequency range 10Hz - 20kHz; vertical range 25 ohms, subdivision 2,5 ohms. As you can see: they are identical!

Concerto - built by others



Concerto Extended by Cors from The Netherlands

*"Wow, these sound great! It is a rediscovery of various CD's that I have. Even with my non-high-end surround amplifier there is space in the picture, good placement of voices and instruments and with voices it sounds as if there is "air" around them. I do not know how to explain it exactly, but it is certainly nice. During burn-in the frequency range expanded and also the stage grew bigger. I also have CDs where the soundstage is wider than the speakers are apart. And that my simple amplifier. Top Class!"*



Concerto MK-II coming soon!



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