



HATT-SE Mk-II

The HATT-SE Mk-II Micro Monitor

It has been more than eight years since the first Humble Homemade Hi-Fi Special Edition mini-monitor was born, time for an update. The compact outer dimensions, 12 centimetre small Seas Excel woofer and the use of a series crossover have been kept. New are the tweeter, the cabinet tuning and of course there have been some changes to the filter design.



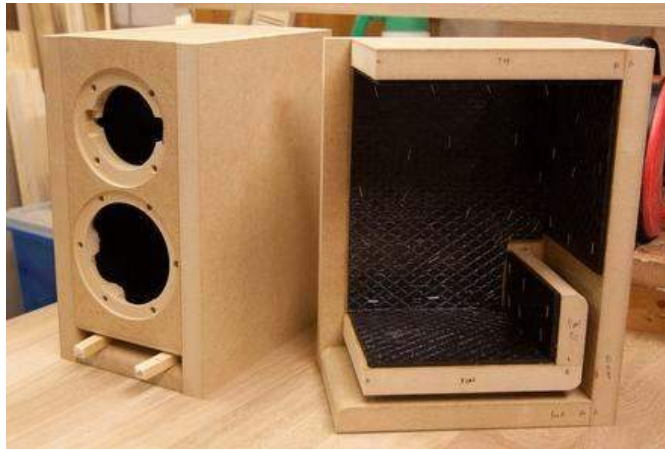
Never change a winner

This concept is, just like in the original version, based around the [Seas Excel W12CY001 / E0021](#) mid-woofer. This little 12cm driver with it's grey magnesium cone has been around for quite some years but can still compete with the best miniature woofers available today. It's cone area is a mere 50cm²! In comparison to other hard cone materials magnesium shows much lower distortion levels, especially the 3rd and 5th harmonic distortion are much lower in level than aluminium for example. This results in a woofer that combines the warmth of paper with the definition of aluminium - an ideal material for making drivers from. The magnesium cone has a natural rubber surround and in it's centre we see a shiny solid copper phase-plug. On the rear there is a large magnet system that produces the driving force for the light-weight cone (Mms = 7,5 grammes). A relatively long voice-coil can take 6mm linear peak-peak excursion and even 9mm peak-peak movement when driven to it's maximum. All the components are held into place by a stiff and light-weight cast basket that is well ventilated front and back. You can even see the voice-coil between the rear suspension and the front pole-piece, so be careful not to let any dust or other particles get in there! Finally the basket has six mounting holes to ensure a secure bonding with the baffle.

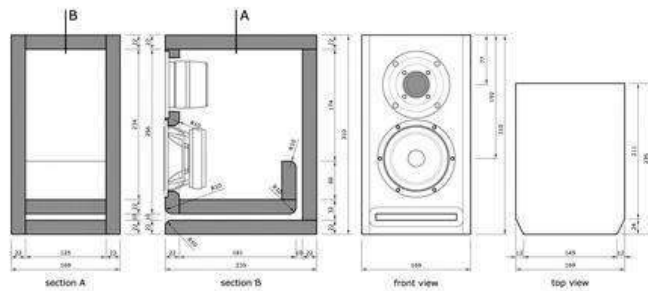
New for the HATT-SE Mk-II is the tweeter. The previous model used the [Seas Prestige 27TAF-C-G / H0883](#) which is still a very nice tweeter, but the new [Seas Prestige 27TBCDGB-DXT / H1499](#) is the same one as used in the Humble Homemade Hi-Fi Nebular Monitor. The goal of this exercise is to see what happens if the same tweeter is used in a totally different way. The Nebular Monitor uses a parallel crossover with steep slopes and correction-networks, the HATT-SE Mk-II uses a more simple series-crossover. If you want to know more about the DXT-tweeter and how it works, please checkout my article about the [Nebular Monitor](#).

The cabinet

The woofer and the cabinet work together in a bass-reflex alignment with a nett volume of 5 litres. At the front of the cabinet there is a slot shaped opening of the port that is tuned to a low 48Hz. In combination with the parameters of the mid-woofer this results in a -3dB-point of about 45Hz. Quite low for such a little woofer. Even though the volume is only 5 litres, the cabinets are made from relatively thick 22mm mdf. Inside we find a rather long reflex port that is also made from the same material. This port also acts as cabinet bracing, so any extra internal panels are not necessary.



The photo shows how the cabinet is built and also shows a few small but important details. The driver frames are counter sunk and the woofer's cut-out is chamfered on the inside of the baffle so that the woofer can "breathe" freely at the back. If the baffle is not chamfered on the inside, the air will create turbulence and reflection problems in close proximity to the cone. Furthermore both ends of the port are rounded-off with a 10mm radius, also to minimize turbulence problems. It's best to make all these details before the cabinets are assembled. The inside of the cabinet walls is lined with a self-adhesive anti-resonance material constructed from bitumen foil with a thickness of 4mm. This material covers all the inside panels except for the baffle and the inside of the port. I used [Intertechnik Bitumex FG4](#) and put in a few staples to ensure a perfect bonding of the material with the mdf. The cancel flutter echo's the cabinets are loosely filled with Bonded Acetate Fibre damping wool. A higher resolution drawing is available on request.

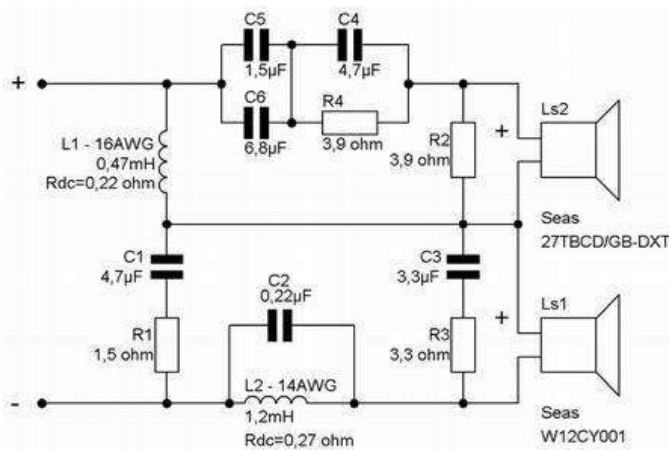


Humble Homemade Hifi - HATT Special Edition Mk-II © 2010

- * cabinet 22mm mdf
- * all measurements in millimeters
- * Vbox=5 liter netto $f_0=48\text{Hz}$ $f_3=45\text{Hz}$
- * woofer: Seas Excel W12CY-001 - E0021
- * tweeter: Seas 27TBCD/GB-DXT - H1499-06

The crossover

The basis of this filter is a modified second-order series crossover. First of all the low-pass function is formed by inductor L1 that lets low frequencies pass by the tweeter and directs them via woofer and L2 back to the amp. High frequencies like to go through group C5 / C6 and via the tweeter to C1, then back to the minus side of the amp. The tweeter level is damped by the series resistors R1 / R4 and the parallel resistor R2 where bypass capacitor C4 lets the highest frequencies pass by resistor R4 creating more "air" and transparency. The woofers cone break-up at high frequencies is cut by capacitor C2 that forms a "black hole" circuit together with L2. The woofer has a Zobel-network parallel so that L2 does it's properly, it compensates the impedance rise at higher frequencies due to the voice-coil inductance of the woofer. All capacitors must be good quality MKP's and the two inductors must be low Rdc air-core types.



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L1 = 0,47mH / 16AWG copper-foil / Rdc = 0,22 ohms

R1 = 1,5 ohms / 10 watts MOX resistor

L2 = 1,20mH / 14AWG copper-foil / Rdc = 0,27 ohms

R2 = 3,9 ohms / 10 watts MOX resistor

C1 = 4,7uF Clarity Cap SA 630VDC

R3 = 3,3 ohms / 10 watts MOX resistor

C2 = 0,22uF Clarity Cap SA 630VDC

R4 = 3,9 ohms / 10 watts MOX resistor

C3 = 3,3uF Clarity Cap SA 630VDC

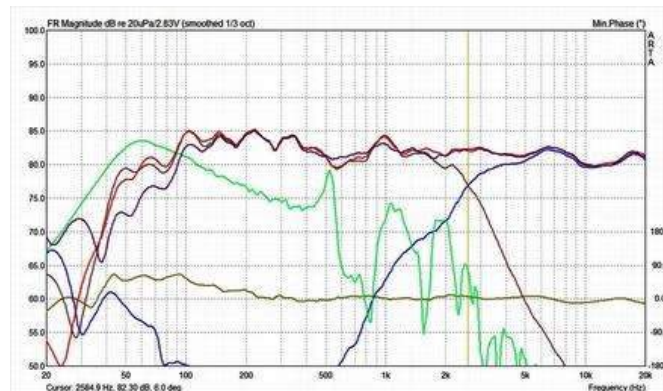
C4 = 4,7uF Clarity Cap SA 630VDC

C5 = 1,5uF Jantzen Audio Superior Z-Cap

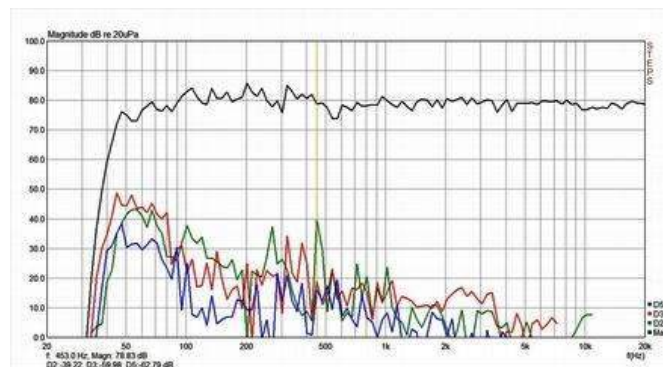
C6 = 6,8uF Clarity Cap SA 630VDC

Measuring and listening

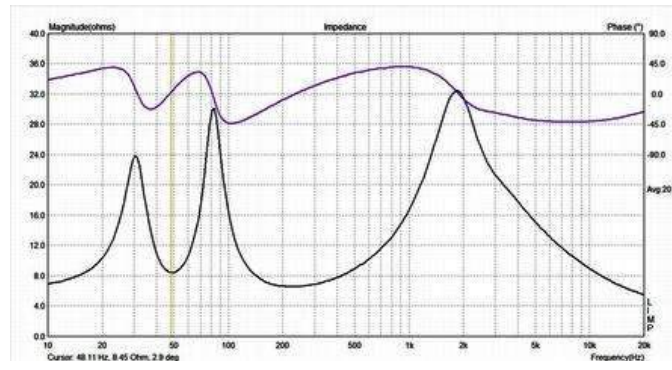
These little fellows need a few weeks of normal use to burn-in. During this process the bass will become deeper and gain definition, the image will become more spatial and the treble will gain fine detail and refinement. The speakers should be placed on some sturdy stands with the tweeter at ear-height. These speakers produce quite some bass considering the very small woofer used. It is relatively deep, has definition and could be described as on the warm side of neutral rather than on the dry side. Going seamlessly up the frequency spectrum, the treble is transparent and precise but never harsh or over-etched. Things like the ping of a cymbal or the wiping of brushes on the snare-drum come across quite realistic. Instruments and voices are placed well separated in space with good front to back imaging. The HATT-SE Mk-II is a good all-round speaker for small listening rooms that produces everything in a neutral manner.



The frequency measurements show a relatively smooth response (red curve) without any large peaks or dips. Only the output from the port (green curve) has a few irregularities in the upper region but these blend in with the rest when listening further away than the standard 1 meter measurement. The peak at 1kHz and the dip at 550Hz in the overall response are actually caused by woofer / port interaction - this is quite normal and can be found in nearly any ported two-way system. If the port is dosed (purple curve) these irregularities disappear resulting in a ruler flat midrange, ideal should you decide to use these speakers in combination with a sub-woofer. The port does have a text-book response around it's tuning frequency, very smooth and quite symmetrical. The overall efficiency is low as to be expected from a very small speaker: about 82 to 84dB's for 2,83 volt input level.



The distortion levels are rather low considering the size of these little speakers. The second harmonic shows a couple of peaks in the midrange caused by the port but seeing as our hearing doesn't find 2nd harmonic unpleasant, I wouldn't worry about it.



The impedance plot finally shows the port tuning frequency centred at 48Hz and the overall impedance never drops below 6,5 ohms. This should make life a little easier for your amplifier, it doesn't need to deliver heaps of current.



Tony Gee, The Netherlands, January 2011

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