



HATT-MkIII-C

The HATT Mk-III-C – The popular mini-monitor taken a level higher

Based on the HATT-MkIII cabinet and woofer, the original Seas tweeter has been replaced by a ceramic version. This resulted in a total revision of the crossover and a new damping material plan but the end result was certainly worth the effort.



The HATT-MkIII-C and to the HATT-MkI.

The tweeter

The [Thiel & Partner C2-12/6](#) is a Ferro fluid filled tweeter with a 25 mm lightweight concave ceramic dome. Designed for 3-way systems or small, low-output 2-way designs. Very high resolution and very good dispersion up to 42 kHz. Low resonance frequency allows first order filtering and a crossover frequency as low as 2 kHz. The ultra hard ceramic dome material moves like a piston well above the audible frequency band and the high internal sound velocity features very low distortion and virtually no coloration.



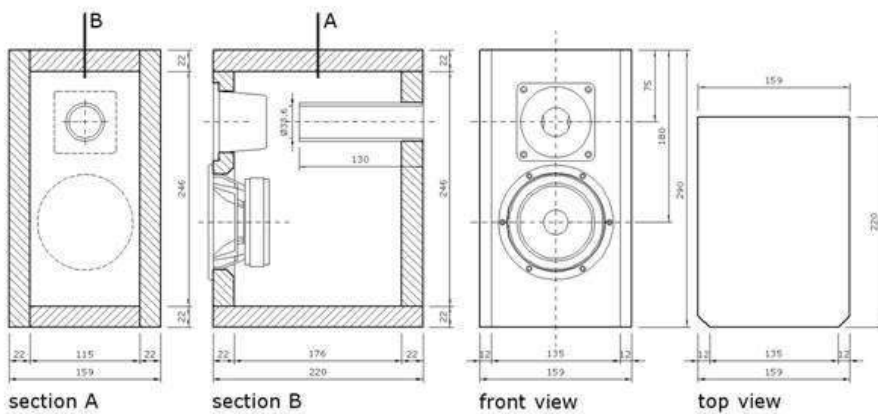
The mid-woofer

The [Seas L12RCYP-H1207](#). It's a 4.5" mini woofer with a stiff and stable injection moulded metal chassis. The stiff, yet light aluminium cone and the low loss rubber surround show no sign of the familiar 500-1500 Hz cone edge resonance and distortion associated with soft cones. On the other hand, the cone break-up modes at higher frequencies call for special attention in the crossover design work. The high temperature voice coil wound on an aluminium voice coil former gives high power handling capacity. A black plastic bullet shaped phase plug reduces compression due to temperature variations in the voice coil, avoids resonance problems which would occur in the volume between the dust cap and the pole piece and increases the long term power handling capacity. An extra large magnet provides high efficiency and low Q. The unit may be used in very small two-way ported systems producing a relatively deep bass and a clean, neutral midrange.



The cabinet

All walls are made of 22mm MDF, just the standard 6 planks. No difficult matrix constructions seeing as they are so small. The cabinets shown on the pictures have additional wooden side-panels for the looks. The edges of the cabinet are routed with 10mm's radius for looks and to remove the sharp edges that would cause baffle diffraction problems – the drawing shows the minimum required: a 45 degree angle on the vertical edges of the front baffle. The reflex port is made from 40mm thick-walled PVC sewer pipe with a length of 130mm.



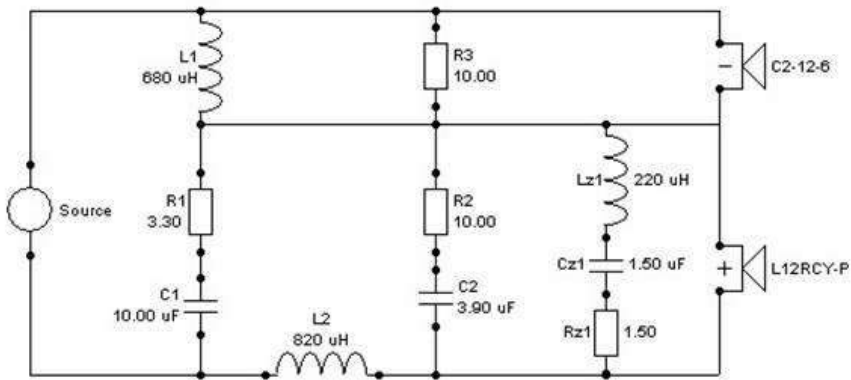
Humble Homemade Hifi - HATT Mk-III-C

Higher resolution drawing is available.

The inside of all the walls except the baffle are covered with lead bitumen sheets and heavy-duty carpet tiles. The carpet tiles have a nice heavy backing that adds mass to the enclosure. No other damping material at all is used. This results in a good bass weight considering the size of the woofer and cabinet with good dynamic capabilities. The internal volume is only 4,5 litres and the bass-reflex port is tuned to 62Hz giving sufficient output down to about 55Hz.

The crossover network

It uses a combination of a first and a second-order series-filter. First order on the tweeter and second order on the woofer due to the extra inductor L2 before the woofer – this compensates the baffle-step. The extra components are the resistors to tame the tweeter and a Zobel network to compensate the inductive rise of the woofers voice-coil. Parallel across the woofer is an LCR-network that cuts out the resonance due to cone break-up and gives a smooth roll-off above the crossover point with the tweeter. The critical inductors are air core type using large gauge copper foil for better imaging and detail compared to standard air-cores. The capacitors use high-grade metallized polypropylene foil and the thick film resistors have minimum tolerance. The tweeter is connected with reversed polarity.



Filter components:

L1 = 0,68 mH Copper Foil 12-AWG air-core inductor, R = 0,15 ohms (tolerance max 2%)

L2 = 0,82 mH Copper Foil 12-AWG air-core inductor, R = 0,17 ohms (tolerance max 2%)

Lz1 = 0,22 mH air-core inductor - 0,71mm wire baked varnish, R = 0,39 ohms (tolerance max 2%)

C1 = 10uF MKP polypropylene foil capacitor - Clarity Cap SA or better (tolerance max 2%)

C2 = 3,9uF MKP polypropylene foil capacitor - Clarity Cap SA or equivalent (tolerance max 2%)

Cz1 = 1,5uF MKP polypropylene foil capacitor - Clarity Cap SA or equivalent (tolerance max 2%)

R1 = 3,3 ohms (3x 10 ohms parallel), Caddock MP930 thick film resistor (tolerance 1%)

R2 = 10 ohms, Caddock MP930 thick film resistor (tolerance 1%)

R3 = 10 ohms, Caddock MP930 thick film resistor (tolerance 1%)

R4 = 1,5 ohms, 5 watts MOX (tolerance 5%)

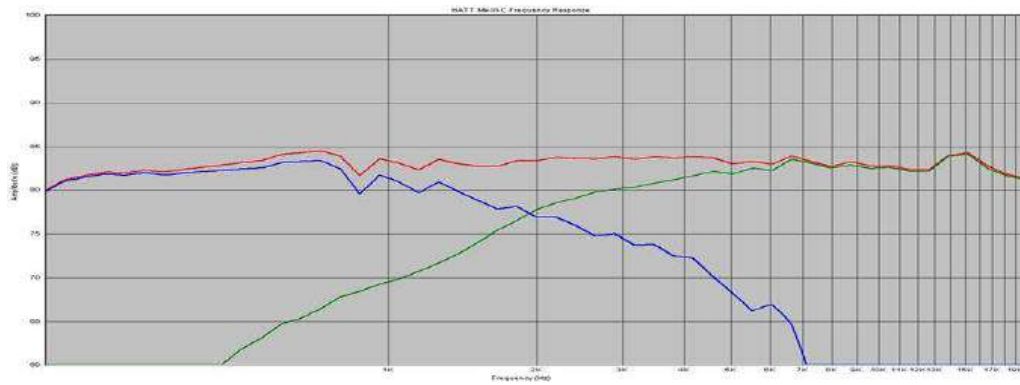
* Bypass all capacitors with a 0,01uF Styroflex or Vishay MKP1837 capacitor

** The Caddock MP930 should be mounted on a heat-sink for maximum power handling.

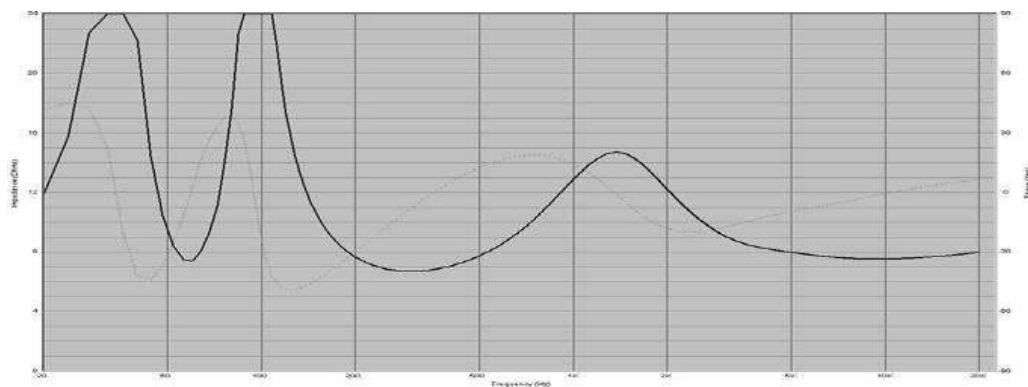


The external crossover.

Measurements



Output level 200-20.000Hz – horizontal division 5dB. Good linearity within +/- 1,5dB, the drop towards the lower end is due to the measurement being done in free-air (so no boundary re-enforcement) – typical in room response is down to about 60Hz. Crossover point at 2 kHz.



Impedance plot 20-20.000Hz, horizontal division 1 ohms, and range 0-24 ohms. Note the port tuning frequency just above 60Hz. The impedance peak just below the crossover point can be compensated with an LCR-network parallel across the input terminals. The values should be 1,5mH / 11uF / 18 ohms.

Sound

Straight out of the box, these hard-cone drivers sound cold, closed-in and lack bass and dynamics. Give them at least about four to six weeks of normal listening before they open up. The burn-in period can be shortened by feeding them decent levels of pink noise or FM radio inter-station noise. After this burn-in period The HATT-MkIII-C can best be described as a very coherent, clean and smooth sounding loudspeaker. The bass is light-weight and "quick", varying the distance to a rear-wall can be used to balance the bass-weight to personal taste. Completely free-standing they can be a little lean but I found the best results with them about 30cm from the rear-wall. The midrange is clear and flows seamless into the dear and clam treble. Micro-detailing is very good as is spatial information. The Accuton tweeter costs more than the Seas tweeter from the HATT-MkIII but in my ears, is really worth the extra investment. The high-grade crossover components bring out the quality of this little speaker very nicely.





NOTE: This design is strictly for the home DIY enthusiast and not to be used professionally without my permission!

Tony Gee, The Netherlands

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