USB

The Universal Speaker Box

The USB is an extremely versatile, small-sized, magnetically shielded, two-way loudspeaker designed for stereo or multichannel music and video home entertainment systems. It performs equally well as an excellent full-range stereo pair, surround-sound pair, and high performance centre-channel speaker. Its excellent fidelity makes it as comfortable playing demanding music as it is playing your favourite movie soundtracks.The coaxially mounted drivers allow it to be oriented vertically or horizontally without compromising accurate time response. As a result, the speaker delivers full-range performance regardless of speaker or listener position since the listener is always exactly the same distance from each driver.

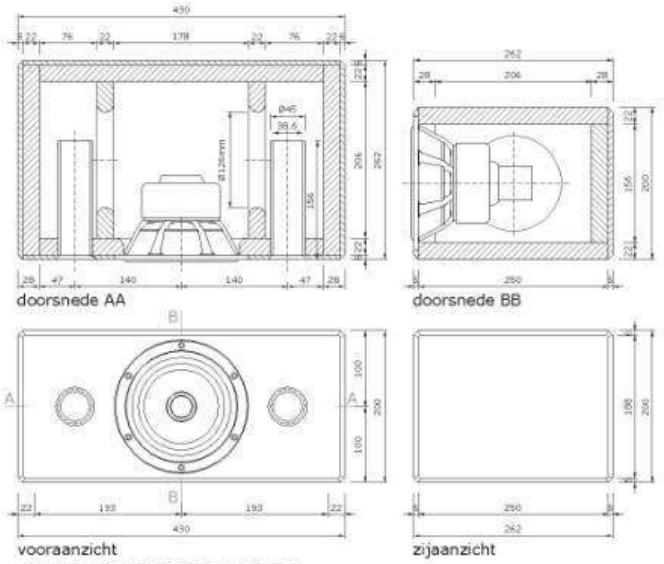
The driver

The Seas T18RE COAX-TVFC-H1144 is a coaxial arrangement of a 6.5" woofer with an XP cone and a precoated fabric dome high frequency unit, with a low resonance frequency. The cone of the woofer acts as a horn loading for the tweeter, and the chassis of the dome unit represents the throat of this horn. Unlike most traditional coaxial loudspeakers, this arrangement has two advantages: The two drive units have (nearly) identical acoustic centres, and their directivities in the crossover frequency region are practically identical. Thus, it is possible to build a full range Hi Fi system with a symmetrical and stable radiation pattern combined with a smooth energy response. A compensation magnet and a shielding cup is mounted on the woofer magnet system to eliminate magnetic stray fields, hence the unit can be used very close to CRT`s in audio/video applications (according to Seas). The T18RE COAX-TVFCuses the new 18cm chassis with 6 mounting holes and large windows in the basket both above and below the spider reduce sound reflection, air flow noise and cavity resonance to a minimum. Also it has a decent sized rim for mounting with a large contact area to the cabinet.

The driver: Seas T18RE COAX-TVFC H1144.

The cabinet

All walls and the two internal partitions are made of 22mm MDF. The outside of the cabinet is furthermore covered with 6mm mdf bringing the total thickness to 28mm. The extra layer has two advantages: first of all the varying density works better in keeping the cabinet calm than a single layer of the same total thickness. Secondly it makes finishing the cabinet easier, all the butted joints are covered by this 6mm layer and the edges of the cabinet are routed with a 6mm/45 degree angle. So later on there will be no visible lines of hair-cracks in the paintwork. With the realized version of this speaker the top layer is 12mm instead of 6mm making an even sturdier and heavier cabinet. The symmetrically front placed reflex ports are made from 40mm diameter thick-walled PVC sewer pipe.



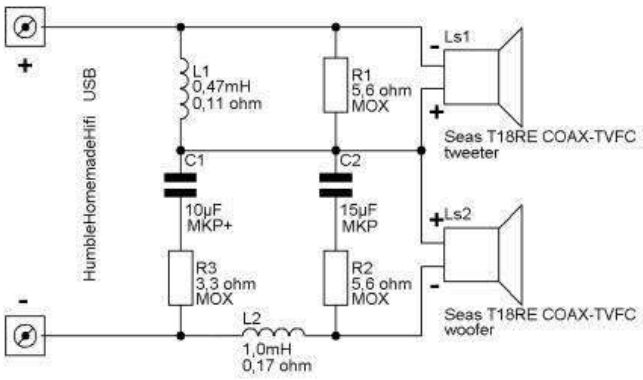
A higher resolution drawing is available on request.

The damping material inside is reduced to an absolute minimum to maintain maximum output from the ports. A piece of Bonded Acetate Fibre damping material is rolled up and fills the centre of the enclosure, that's all! I used Monacor MDM-3 damping pad that consists of 2/3 sheep's wool and 1/3 polyester fibre. The internal volume is a compact 10 litres and the bass-reflex port is tuned to 47Hz.The cabinets are finished in RAL 9006 metallic aluminium colour to match the TV they are placed under.


Note the internal partition with its circular cutout.

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 before the woofer (this acts as the baffle-step compensation). The whole filter is nice and simple using only three active components for two drivers but still giving a crossover with electrical slopes of nearly 15dB per octave for the woofer and 9dB per octave for the tweeter. The only extra components are the resistors to tame the tweeter and a Zobel network to compensate the inductive rise of the woofers voice-coil. The inductors are air core type using thick wire for low Rdc and are matched within 1/100 of a millihenry using a LCR meter. The capacitors use metalled polypropylene foil and the film resistors are also matched for minimum tolerance. The tweeter is connected with reversed polarity.



The simple crossover.

Filter components:

L1 = 0,47 mH air-core inductor 2,00 mm wire, R = 0,11 ohms

L2 = 1,0 mH air-core inductor 2,00 mm wire, R = 0,17 ohms

C1 = 10uF MKP polypropylene foil capacitor – quality and taste count here, so treat yourself to something nice here

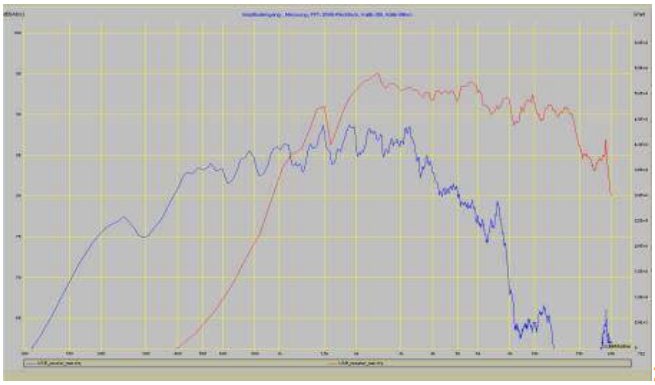
C2 = 15uF MKP polypropylene foil capacitor – Intertechnik Audyn Cap, LeClanché or Mundorf Mcap

R1 = 5,6 ohms, 10 watts MOX resistor

R2 = 5,6 ohms, 10 watts MOX resistor

R3 = 3,3 ohms, 10 watts MOX resistor – for a slightly brighter overall sound change to 3,0 or 2,7 ohms

Measurements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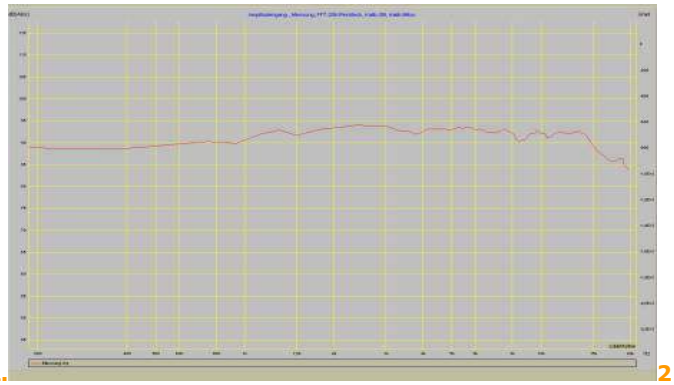
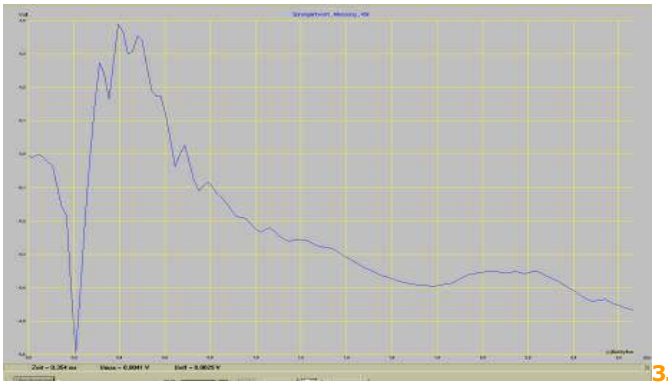

2.

1). Output level of the individual unfiltered drivers 100-20.000Hz – horizontal division 5dB. The drop towards the lower end is due to the measurement being done in free-air (so no boundary re-enforcement) and the baffle step. The roll-off above 15kHz is the upper limit of my measuring equipment and not the speaker. Note the lower-end lift of the tweeter output due to the horn loading of the woofer cone.

2). Output level on-axis of the final speaker 200-20.000Hz – horizontal division 5dB. Smooth response within +/-2dB.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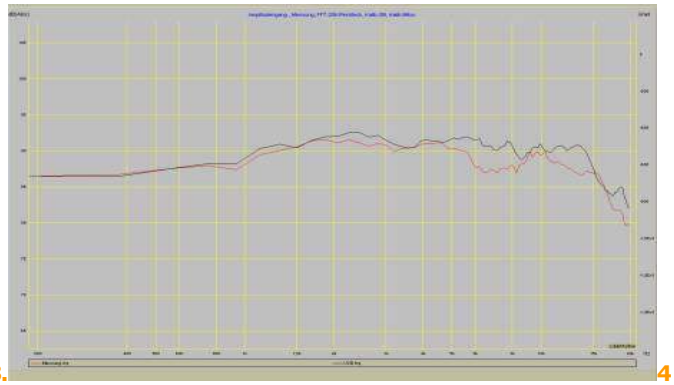
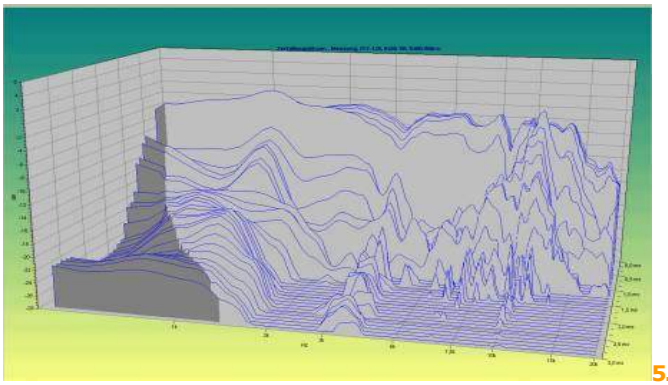

4.

3). Step response – time window 3,0ms. As can be seen from this plot, the tweeter has a fast rise within 0,2ms and is connected out of phase; the in-phase woofer follows very quickly at about 0,4ms.

4). Output level on-axis of the final speaker 200-20.000Hz (black curve) and 30 degrees off-axis (red curve) – horizontal division 5dB.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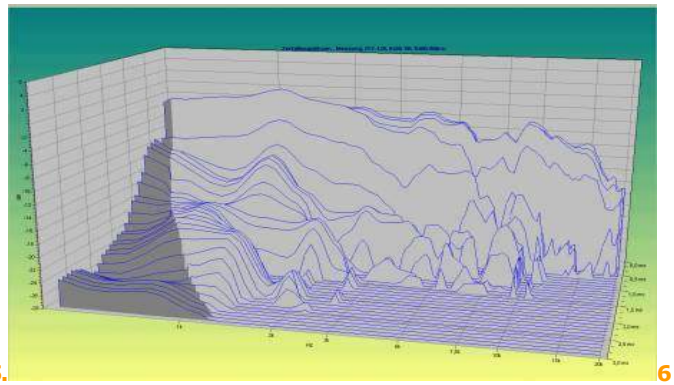
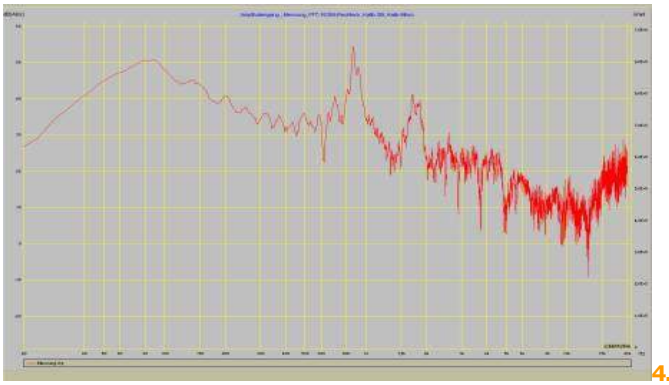

6.

5). Waterfall plot 400-20.000Hz on-axis, time window 3,0ms. Resonances around 3,5kHz and 7-10kHz probably due to the tweeter being mounted deep in the woofer cone.

6). Waterfall plot 400-20.000Hz 30 degrees off-axis, time window 3,0ms. Smoother response than on-axis, this confirms my

assumption of the tweeter mounting.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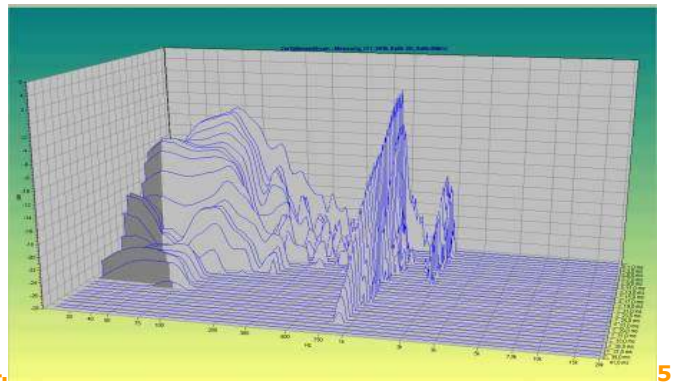
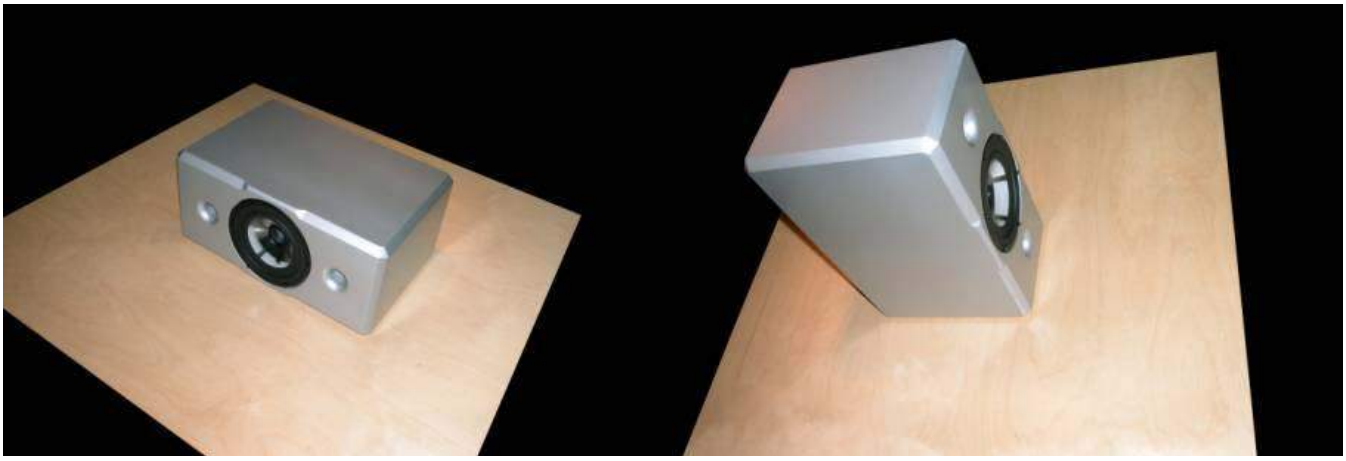

5.

4). Near field output level of the reflex-port 20-20.000Hz – horizontal division 5dB. Maximum output centred around 80Hz, the ports are tuned to 47Hz so I don't know if this is the actual output level of the ports or the limitations of my measuring equipment are starting to show. It is followed by a nice drop of 20dB and then a rise to strong port resonances at just under 900Hz and an octave higher around 1800Hz. That's the downside of hardly any stuffing in the box.

5). Corresponding waterfall plot 20-20.000Hz, time window 41,0ms. Port tuning works well but the main port resonance takes even longer to decay than the actual fundamental! Now you can see why I prefer closed boxes when possible! More stuffing in the box would have shortened the decay time but would have also killed bass.

Sound

The character of this speaker can best be described as neutral, smooth and easy listening. Bass is strong and relatively deep considering the size of the cabinet, the mids are neutral and the top end is polite. The coaxial mounting of the drivers gives a very nice coherent spatiality; the character of the speaker is maintained at any listening angles. The XP-cone material reminds me of the signature of poly-cones without the sluggishness some polycone designs can have.



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