Mezzo Proteus

The Mezzo Proteus – The Proteus qualities in a smaller and easier to build package

Originally designed as high-end rear speakers to complete a Home Theatre set-up that consisted of three Proteus speakers for front and centre speakers, they should have the same qualities and a similar sonic signature as the original larger Proteus.

Introduction

A few months ago I was approached by someone looking for a design to complement his existing Proteus Home Theatre system. It would have been nice to have a pair of Proteus speakers for the rear, but size and finance were restricting factors. How about a sort of half-a-Proteus speaker? Furthermore, considering the large amount of positive reactions about the full size Proteus, it would be a nice challenge to see if I could design a speaker with similar acoustic qualities in a more simple to build package. So we are looking at a basic two-way bookshelf monitor with very good musical qualities.

Bird's eye view.

The tweeter

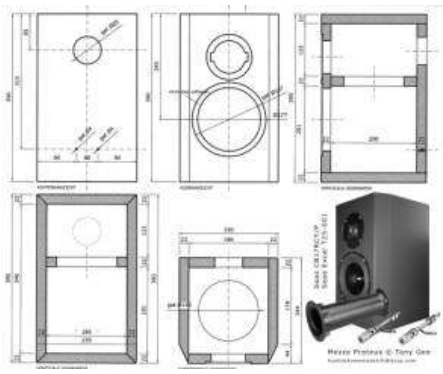
The Seas Excel T25-001. This is what Seas have to say about their product: The T25-001 is a 25mm fabric dome with moderately high efficiency. It is the tweeter of choice for those who want the most precise and realistic reproduction of the high frequency audio range. An optimally shaped diaphragm, which gives well-controlled behaviour through the entire high frequency band. This diaphragm is produced from SONOTEX, a proprietary material developed and manufactured only by SEAS. The SONOTEX process pre-coats the fabric 4 times with a damping/sealing material, resulting in excellent acoustic performance and consistency. Silver voice coil, which improves electrical conductance for greater sensitivity to the fine details in the music signal. Flexible lead-out wires, which ensure a good connection between, voice coil and terminals. This arrangement also helps to prevent lead breakage due to the large excursions encountered when low crossover frequencies are used. Low viscosity magnetic fluid, which provides excellent cooling while maintaining a low resonance frequency. 6 mm solid metal front plate with a slight loading characteristic which ensures linear frequency response, and a stiff and stable connection to the cabinet. A substantial injection-moulded rear chamber, with complex internal shape and reinforcing ribs, which eliminate unwanted chamber resonances and reflections. A double magnet system which increases sensitivity and provides better control of the voice coil. This system also reduces the magnetic stray fields, making the T25-001 an ideal choice in high-end A/V applications. I just think it's a nice smooth sounding tweeter with a decent faceplate to mount it properly.

The mid-woofer

The Seas CB17RCY/P. Nothing new here either, the same as the original Proteus except only one per box instead of two. It has a very lightweight coated paper cone; the moving mass is only 10 grams as compared to 15 grams for the Seas Excel units or even 20 grams for a Scanspeak 18W8545. The magnet is reasonably large and in combination with the lightweight cone it should give a quick reacting driver. A nice detail is that the basket has four more half-depth mounting holes on the rear side. It is therefore easy to drill them through so that the driver can be mounted with eight screws instead of the standard four (see the first image). I believe it is better to divide the pressure as evenly as possible around the frame to give maximum contact between the driver and the cabinet - and it looks rather cool. This unit is also sold by Intertechnik under the name Seas W17PPI.

The cabinet

Simulations suggested that the Seas CB17RCY/P should also work well in the cabinet I had designed for the DD8, so why change a winning team? All panels are made of 22mm MDF. It is a straightforward six-panel box with a single horizontal brace mounted between the woofer and the tweeter. The cabinet is reflex loaded with a ready-made port flared like a trumpet at both ends to minimalism port noise. I used a Monacor BR-45TR port which in combination with the internal volume of 12 litres results in a system tuning frequency of 45Hz with a –3dB point of about 50Hz. Not extremely low but sufficient for most music and plenty for a Home Theatre set-up. Like the original Proteus, the Mezzo-Proteus is optimised for efficiency over bass extension. An active sub-woofer can always supplement the speakers at a later stage if one finds it necessary.

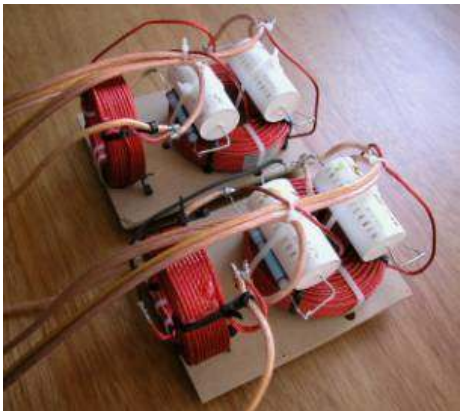


A higher resolution drawing is available on request.

The cabinets without drivers and damping.

All internal walls are covered with 4mm thick bitumen sheets and wedge moulded foam to minimise vibrations and standing waves. Depending on the positioning of the speakers in the room and personal taste you may want to add a little bonded acetate fibre (BAF). It can be rolled up densely or loosely to give a tighter and dryer or a fuller and warmer sounding bass. If you have a small listening room or your speakers have to stand close to a wall then maybe some extra fibre placed in the reflex port will be necessary. For a free stand-mounted position clear from any walls I found that no BAF was needed.

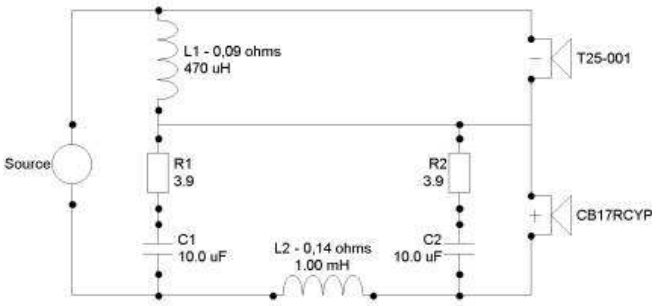
The crossover network



The final hard-wired crossovers.

The Seas CB17RCY/P and the Seas Excel T25-001 are wired together using an a-symmetric series-filter with first order on the tweeter and second order and a Zobel on the woofer giving electrical slopes of 9dB's and 15dB's per octave. Funny coincidence is that the tweeter high-pass capacitor/damping resistor combination is exactly the same as the woofer impedance compensation network! The acoustic slopes are about 12dB per octave centred on 2kHz. This point is lower than the original Proteus but a result of the different crossover topology due to the baffle-step inductor needed (L2). The baffle-step losses are compensated for with the

original Proteus by the second woofer. The inductors are air-core type using thick wire for low Rdc and no saturation and are matched using a LCR meter. All capacitors use metalled polypropylene foil, the capacitor in the Zobel network must also be of the same high quality as the tweeter high-pass cap because some of the information going to the tweeter will also pass through the Zobel. The resistors use metal film with 1-% tolerance. For personal taste you could also try carbon resistors, these are less "grainy" than their metal oxide brothers.



The filter schematic.

Components for the filter:

L1 = 0,47 mH Tritec air-core inductor 3,50 mm wire, R = 0,09 ohms

L2 = 1,00 mH Tritec air-core inductor 3,50 mm wire, R = 0,14 ohms

C1 = 10uF MKP Audyn Cap Plus polypropylene foil capacitor

C2 = 10uF MKP Audyn Cap Plus polypropylene foil capacitor

R1 = 3,9 ohms, 10 watts metal film or carbon resistor

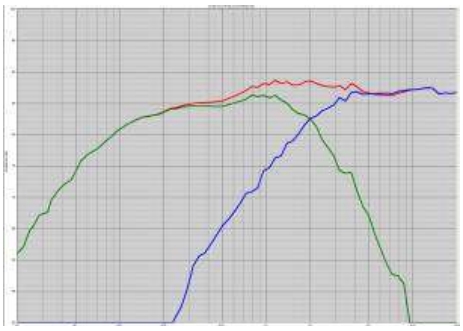
R1 = 3,9 ohms, 10 watts metal film or carbon resistor

Listening impressions and remarks

Well, how do they compare to the larger Grande Proteus? First thing that you notice is the slightly less strong bass, not surprising seeing as we only have one woofer and less than half the cabinet size. The overall sound is open and forward, with sweet highs and a revealing and dynamic mid-range. I prefer the mid-range to that of the Tempo for example in being better separated from the cabinet, with a projection in front of the speakers instead of between the speakers. The Tempo is better in bass, being deeper and stronger at the same time. More warmth can be added to the overall balance by changing L2 to 1,2mH. This lowers the 1-2kHz bump a little but I found this to close things in a little and compress the dynamics a bit. I preferred the 1,0mH inductor. Don't worry, this bump looks worse than it is due to the large horizontal scale of the graph but compared to the rest it is only about 1-1,5dB's. These speakers can play loud but compared to the DD8 with its aluminium cones the Proteus tend to start shouting at an earlier point, but at that point they are beyond pleasant listing levels anyway. I find this to be a common difference between "floppy" paper a "stiff" aluminium cones anyway.

Comparing them with the Tempo.

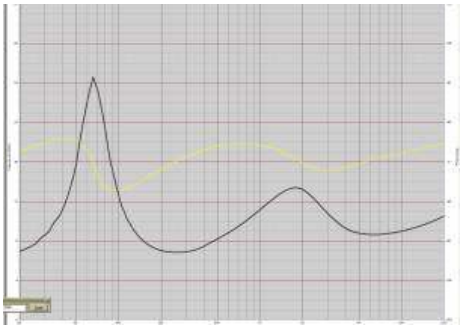
Output level and impedance



The SPL curve.

The output level has a major horizontal scale of 5dB's with sub-divisions of 1dB ranging from 50 to 100dB for 2,83V/1m. Efficiency

is relatively high for a 2-way bookshelf speaker with an average of about 88dB's. Most standard 2-ways are about 2dB less efficient. The drop in the bass is due to the free-field closed box simulation; the real life reflex loaded bass will be at the same level as the rest. I must stress that this graph doesn't take into account the lift of the bass and lower mid-range region when placed near a rear wall. In an average size room with rear wall support the response is very even over the whole spectrum. The crossover point is at moderately low 2000Hz. It has a relatively flat response with +/-2dB over the whole range with a slight emphasis of the mid-range. There seems to be a slight cancellation of the summed response around 7-8kHz due to phase "problems". If the speaker is tilted back slightly this disappears (mount longer spikes in at the front of the speaker compared to the back?).



The impedance curve.

The impedance swings between around 7 and 13,5 ohms except for the port tuning frequency. The graph is for the closed box simulation; the reflex will show two peaks in the bass with a minimum between at the tuning frequency of 45Hz. The electrical phase (the yellow line) is also very nice with +22 degrees and −1,5 degrees over the entire range above the port tuning frequency.

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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