



# DD8

The DD8 – An all aluminium driver 2-way bookshelf loudspeaker.



## Introduction

About six months ago I was asked by Dedato (the company I work for) to arrange a hifi system for the office. I was given a fixed budget; this meant I could do two things. I could go to a hifi-shop and buy ready made loudspeakers and some equipment to go with them and have everything up and running within a couple of days. But of course I didn't want to do that. I persuaded the company that if they could be patient for a few months I would build the speakers and they would have much better quality for the same price. So I ordered two standard quality CD-players and amplifiers from Marantz and with the budget left I went off to design and build a set of eight loudspeakers in total.

Dedato is a company of designers and architects so matching the looks of the speakers with the architecture of the building was a main issue. The building is very basic in design with lots of concrete, glass and aluminium. For this reason I decided to go for all aluminium drivers. The cabinets were to be mounted on brackets on the walls so the speakers couldn't be too big. The budget determined a 2-way system (better to have a good 2-way than a mediocre 3-way I always say!). The colour of the cabinets was to be the very exciting colour grey.

## The tweeter

The [Seas 27TAF/G \(H883\)](#). A 27mm aluminium/magnesium alloy dome tweeter with a wide, soft fabric surround made from SONOTEX. The dome and surround materials give high consistency and excellent stability against variations in air humidity and temperature according to Seas. The diaphragm is protected by a highly perforated hexagrid carrying an acoustic lens that tailors the high frequency roll off characteristic. The voice coil is wound on an aluminium voice coil former with adequate ventilating holes to eliminate noise from internal airflow. The voice coil is immersed in low viscosity magnetic fluid, for high power handling capacity. A stiff and stable plastic rear chamber with acoustic damping allows 27TAF/G to be used with moderately low crossover frequencies. The chassis is precision moulded from glass fibre reinforced plastic, and its front design offers optimum radiation conditions. I chose this driver because I wanted the same cone material (aluminium) as the mid-woofer.



The drivers. Note the size of the REX magnet.

## The mid-woofer

Seeing as I was going to build 8 speakers in total and the speakers were going to be placed under different acoustic conditions I decided to try two different types of woofers and find out their sonic differences. I chose the 17cm aluminium woofers from Seas, the L17RE/P with a smaller magnet and the L17REX/P. This is exactly the same unit except for the size of the magnet. This would automatically mean two types of crossover but I don't mind, that's part of the fun of designing speakers.

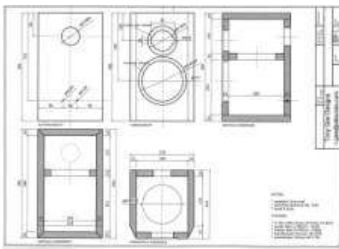
The [Seas L17RE/P \(H1008\)](#) is a 6,5" woofer with an injection moulded metal chassis. The stiff, yet light aluminium cone and the low loss rubber surround show no sign of the familiar 500-1500 Hz cone edge resonance and distortion associated with soft cones. On the other hand, the cone break up modes at higher frequencies call for special attention in the crossover design work. A high

temperature voice coil, with a relatively large diameter, wound on an aluminium voice coil former gives a high power handling capacity. The phase plug reduces compression due to temperature variations in the voice coil, eliminates resonances that would occur in the volume between the dust cap and the pole piece and increases the power handling capacity.

The [Seas L17REX/P \(H1006\)](#) is a 6,5" High Fidelity woofer with an injection moulded metal chassis, intended for bass reflex designs. 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. A high temperature voice coil, with a relatively large diameter, wound on an aluminium voice coil former gives a high power handling capacity. The phase plug reduces compression due to temperature variations in the voice coil, eliminates resonances that would occur in the volume between the dust cap and the pole piece and increases the power handling capacity. The larger magnet system provides higher efficiency and lower Q compared to the L17RE/P.

### The cabinet

For this assignment I was in the comfortable position of being able to have the cabinets made by our carpenter and spray painted to. This would save me a lot of time, which I needed for crossover designing and tweaking. It is a standard type cabinet of 230x390x244mm with an internal volume of 12 litres tuned to 45Hz. All walls are made of 22mm MDF. Just the standard 6 planks plus one extra for an internal brace with a circular cutout of 140mm. No difficult matrix constructions or sandwich walls seeing as they are relatively small and don't forget I had a tight budget to work for. Of course there is nothing to stop you doing this if you want to go all extreme.

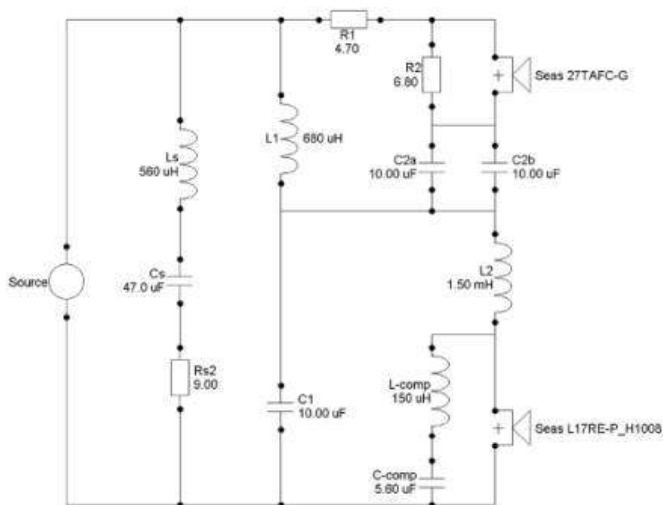


A higher resolution drawing is available on request.

The reflex port is placed in the rear panel and is a standard plastic trumpet shape tube from Monacor, the BR45-TR. The inside of all the walls except the baffle are covered with wedge-moulded foam to minimise standing waves. The reflex port is kept clear. Bonded acetate fibre damping material is rolled up and densely fills the whole enclosure. Depending on the positioning of the speakers in the room and personal taste this fibre can be rolled up densely or loosely to give a tighter and dryer or a fuller and warmer sounding bass. I used Monacor MDM-3 damping pads that consist of 2/3 sheep's wool and 1/3 polyester fibre. The cabinets using the L17RE/P should be more densely filled than the ones with the L17REX/P. The higher Q of the L17RE/P unit will otherwise result in a too warm and thick sounding bass. An alternative would be to use a larger cabinet for the L17RE/P or to tune it to about 38Hz instead of 45Hz. The vertical edges of the front panels are routed with a 22x44mm angle for looks and to remove the sharp edges that would cause baffle diffraction problems.

### The crossover network

No surprises again here: the good old trusty series-filter. New is the use of a notch filter in combination with the series section. This only works in a higher order series filter; in a first order filter the inductor L2 would be left out. The notch filter would then be in the direct signal path of the tweeter which would mess up its response because all a notch filter does is to drop the impedance at the resonance frequency of the notch. When it is connected parallel to a driver the electric energy will choose the path with the lowest resistance and therefore draw away the energy at that point from the driver. But when a notch filter is connected in series with a driver it really messes up its response. The relatively large inductor L2 acts as a sort of protection for the tweeter. Lets say the notch filter makes the impedance drop by 6 ohms at fs (in this case 4500Hz). At this point L2 has a resistance of about 70 ohms so the dip of 6 ohms created by the notch filter is relatively small and therefore won't effect the tweeter.



### Components for the filter with the L17RE/P:

L1 = 0,68 mH air-core inductor 1,4 mm wire, R = 0,26 ohms

L2 = 1,50 mH Ferrobar inductor 1,4 mm wire, R = 0,12 ohms

L-comp = 0,15 mH air-core inductor 0,71 mm wire, R = 0,32 ohms

Ls = 0,56 mH air-core inductor 0,71 mm wire, R = 0,65 ohms

C1 = 10uF MKP polypropylene foil capacitor

C2a = 10uF MKP polypropylene foil capacitor

C2b = 10uF MKP polypropylene foil capacitor

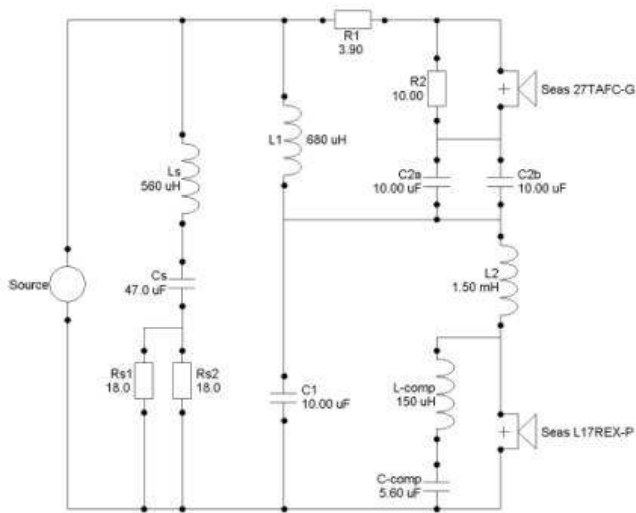
C-comp = 5,6uF MKP polypropylene foil capacitor

Cs = 47uF bipolar electrolytic capacitor

R1 = 4,7 ohms, 10 watts metal film resistor

R2 = 6,8 ohms, 10 watts metal film resistor

Rs = 9,0 ohms (2x18 parallel), 10 watts cemented resistor



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Cs = 47uF bipolar electrolytic capacitor

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

R2 = 10 ohms, 10 watts metal film resistor

Rs = 9,0 ohms (2x18 parallel), 10 watts cemented resistor

It uses a second-order series-filter with a notch filter across the woofer to cut-out the cone break-up at 4500Hz and an impedance correction across the input terminals to flatten the impedance hump at the crossover point. The tweeter is brought down to the level of the woofer with an L-Pad. The inductors are a mixture of iron-core and air core type using reasonably thick wire for low Rdc and are matched within 1/100 of a millihenry using a LCR meter. The capacitors use metallised polypropylene foil except for the in impedance correction and the metal film resistors are also matched for minimum tolerance. Both units are connected with the same polarity.



*The crossovers during assembly.*

### Wiring and connectors

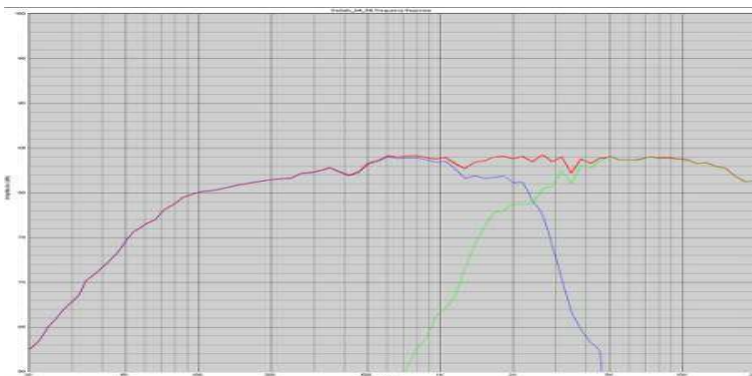
I kept it simple here; after all they were going to hang around an office. So an internal filter and a single pair of gold plated binding posts on the rear, internal wiring is standard 2x 4,0mm OFC. If you want to go all high-end here then there is nothing to stop you using external filters and bi wiring.

### Listening impressions and remarks

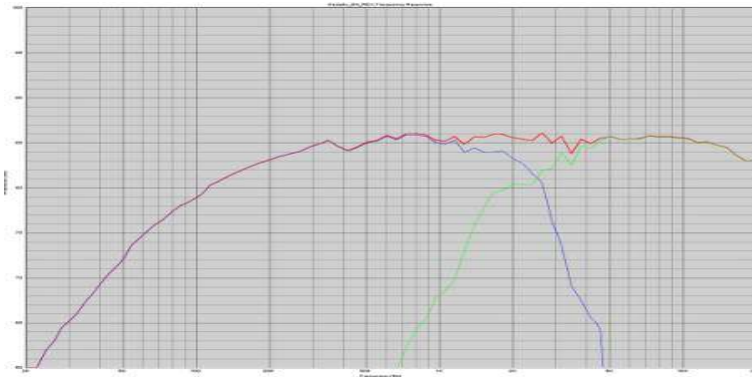
The overall sound is smooth, clear, detailed and revealing without getting harsh. A bit like the HATT but with overall more power and a wider response. It is an all-round speaker with no particular preference for any type of music. Other designs maybe stronger in some areas, for example the Andromeda has more impact and power, the HATT has a slightly more spatial sound, the Proteus is sweeter but the DD8 sort of excels in everything! My initial impression never changed; these are very musical and natural sounding speakers, period. The bass is surprisingly deep for such relatively small loudspeakers. Though the lowest octave (20Hz to 40Hz) is not produced, the DD8's sound much deeper than their 50 Hz bottom suggest. Its bass is tight and punchy, detailed and uncommonly deep; low enough for most music. Even when the loudspeakers are cranked too high levels they don't strain under the heavy load. The DD8's impressed me greatly with their clarity and resolution, particularly in the crucial midrange area. The midrange is open and clear. They have a level of smoothness normally associated with much more expensive high-end loudspeakers. They also possess an even tonal balance, no bloat or exaggeration, and most importantly, no overly warm woolly character that can plague plastic coned loudspeakers. >They are easy-going in the midrange and non-mechanical overall. They have very good retrieval of detail. Their top-end is sweet and amazingly good, very smooth, an excellent balance of detail and sweetness, with a forward and detailed presentation throughout the mid-range. It has two things that it is exceptionally good at: First of all the ability of the image to stay clear and open at any level. If they are playing softly in the background or running flat out, the image doesn't collapse or become narrower and clarity is maintained. The second thing they are better at than most speakers is the amazing depth they produce. The sound stage doesn't only go from left to right and in front of the speakers. There is also this amazing depth behind the speakers! Listening to a live recording of a Mozart opera you can picture the size of the stage the singers are walking about on. They don't only walk from left to right but also from the front of the stage to the back before they disappear behind the curtain at the back. The impedance correction across the input terminals also has a positive and audible effect on the clarity of the image. Not only when tube amps are used but also even on the Marantz PM4200 amp they are running on. It lifts a sort of haze off the image and increases the depth of the sound stage. Comparing the L17RE/P with the L17REX/P I come to the following conclusion: The L17RE/P has the expected deeper and warmer bass. Efficiency doesn't seem to be an issue but the L17REX/P with its larger magnet seems to have more "bite" to its sound. Personally I prefer that. For the rest there is not much in it but that is logical seeing as the crossovers are the same except for the resistors and the tweeters are also identical.

### The relative output level

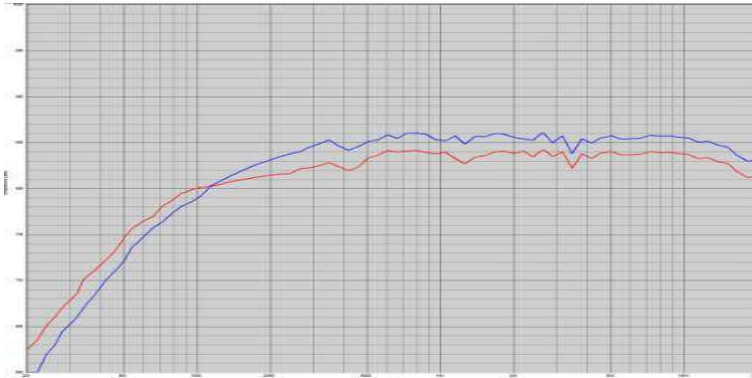
The major horizontal scale is 5dB's ranging from 60 to 100dB for 2,83V/1m. It has a relatively flat response with +/-1dB! over the whole range with a gradual roll-off towards the top. This top end roll-off suggests a non-aggressive sounding tweeter even though it has a metal dome - cone break-up doesn't happen until about 27kHz. 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 standard 2500Hz.



*SPL curves with the L17RE/P. The main horizontal division is 5 dB's with sub divisions of 1 dB.*



SPL curves with the L17REX/P. The main horizontal division is 5 dB's with sub divisions of 1 dB.

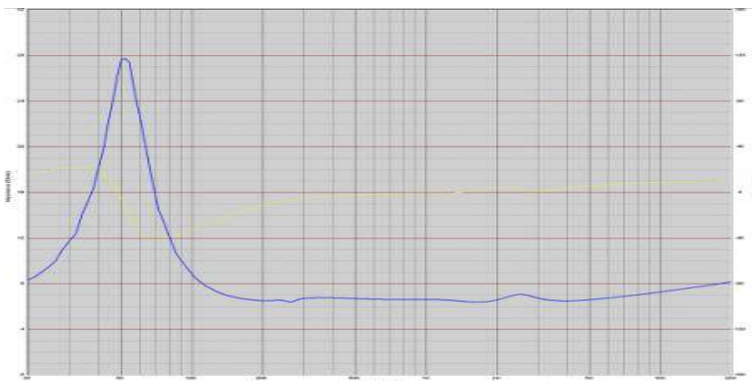


The SPL curves of the two variations compared. The main horizontal division is 5 dB's with sub divisions of 1 dB.

Interesting to see the difference between the two types of speakers. Due to the smaller magnet the L17RE/P (red line) delivers deeper bass at the cost of about 2dB's in efficiency.

### The impedance

The impedance varies around 6,5 ohms. It should be a very easy load for most amplifiers with no extreme swings except for at 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. Due to the nearly flat impedance the electrical phase (the yellow line) is also nearly perfect within +/- 10 degrees from 200-20.00Hz.



The impedance of both types is the same. The main horizontal division is 4 ohms with sub divisions of 1 ohms.

### A few pictures of the final set-up



*Music while you work!*

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

Tony Gee, The Netherlands

June 2002