

Modification of ScanSpeak D2010/8513 tweeter

Disassembling the 8513 tweeter



Fig.1

With a fine-toothed saw the back plate is released from the driver housing. Saw blade should not cut deeper than 2–3 mm all the way round in order not to damage part of the back plate going into the housing. Cut where the back plate is melted to the housing.



Fig.2



Fig.3

Rubber gasket is removed from magnet with a screwdriver. The gasket is not glued and is easily removed. Take care not to damage the wires from the voice coil.

Release the magnet/voice coil assembly by a gentle twist of a screwdriver between magnet and housing. Possibly they will just fall apart.



Fig.4

All driver parts.



Fig.5

Carefully lift off diaphragm/voice coil from magnet gap.



Fig.6

Voice coil gap and diaphragm assembly.

Removing ferrofluid



Fig.7
Remove all ferrofluid with a piece of paper.
Carefully wipe off any ferrofluid from the voice coil.

Adding damping pad to the magnet pole piece



Fig.8
Here in DK you can buy 17 x 3 mm self-adhesive felt pads that fit exactly to the pole piece.
Punch or cut an 8 mm hole at the center of the felt pad and press firmly to the pole piece.



Fig.9
Damped pole piece.

Coating of diaphragm

One layer of DAMAR coating is applied to the diaphragm.
Use a miniature brush and apply DAMAR coating in thin and smooth strokes from edge towards center of the dome.



Fig.10

Do not apply DAMAR coating to the cone suspension!

Leave the coated dome for 1 hour at room temperature and assemble driver.
Coating will be fully dry after approx. 24 hours.

Assemble driver and tighten back plate to housing with silicone glue. Add mild pressure until glue has settled, 6 hours.

Listening tests

The listening sessions were divided in two parts. First the tweeter with no ferrofluid + damped pole piece was compared to the reference tweeter with no modifications.

The V6-HP section was used before drivers and a double switch was attached to the tweeters for quick change between the two. SPL measurements were performed to ensure same listening level.

Tweeters were placed aside on a carpet with no front panels and the average frequency response looked like this:

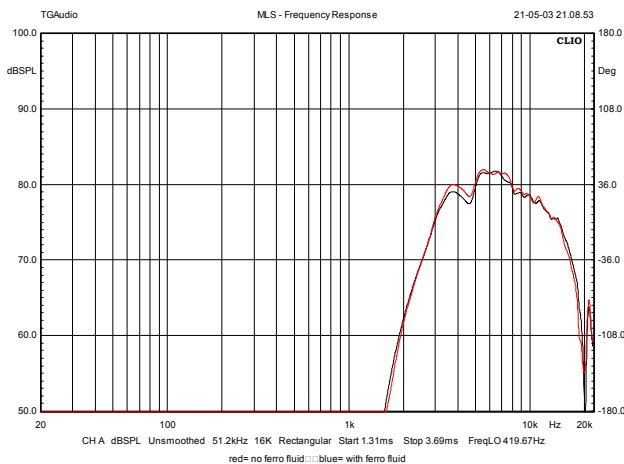


Fig.11

A number of CDs with particularly troublesome sibilance were used for the test.

Listening to a tweeter – solo – above 3.5 kHz at high level is no pleasure for sure. Listening to a brass band crescendo very clearly reveals poor tweeters and improper recordings.

For comparison, tweeters like the SS9000, 9500 and HIQUPHON OWI were included, where response levels were corrected via L-pads.

Ferrofluid

The removal of the ferrofluid and damping of the pole piece did not reveal any significant changes to the modified tweeter. Same sound from both tweeters with a wide range of musical sources.

Coating

When you for the first time are comparing coated vs uncoated it is very clear that you now have two quite different tweeters!

The reference un-modified 8513 compared to the modified and other tweeters appears “flat” and with poor resolution and depth.

Yes, resolution and depth can be heard in a single speaker/mono setup.

The coated 8513 immediately appeared to have a darker sound compared to the uncoated, which was a surprise as frequency response from the two drivers was within 1 dB.

Numerous measurements (SPL, FFT, step response, impulse response, cumulative spectral decay, etc.) have been performed. Tweeter intermods were measured with a 10 and 11 kHz input, where intermods are at 9, 11, 12 and 19 kHz with all intermods down to ≤ 50 dB below 90 dB reference level. Just as good as any other well-designed tweeter.

In no case was there any significant difference between the two tweeters.

And yet the sound is very different.

The nature of this “darker” sound was first fully unfolded after having installed the two drivers in the 2.5 clones with the V6-crossover and 8R2 ohm series resistor to the tweeter giving a smooth response from 300–18000 Hz ± 1.5 dB and $\leq \pm 0.5$ dB between speakers.

This “darker” sound now appears in full scale as an improvement in resolving power, transparency and a more “full-bodied” sound whether being vocal, piano, brass, etc.

And still in mono-mode the coated dome appeared to reduce the midrange “hardness” usually associated with the 8535 driver.

Frequency response of the tested speakers:

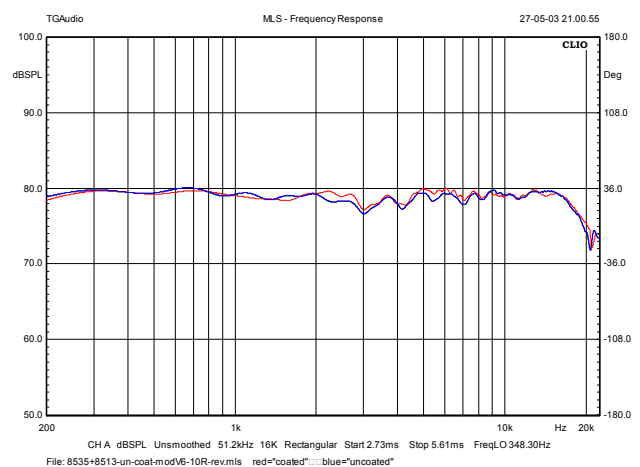


Fig.12. Un-smoothed response.

Red = 8535 + 8513 coated

Blue = 8535 + 8513 reference (not modified)

For the sake of good order the bass drivers were swapped and the same tests were repeated with much the same results.

Getting two bass/mid drivers to sound exactly the same is not an easy task. You may fine-tune the crossovers to make the drivers perform within 1 dB and yet they may sound slightly different. Thus the need to swap drivers and repeat tests.



Fig.13. Tweeter test.
(Gaffa tape covering 9500 rebate)

The intriguing thing about the speaker with the coated dome is that it now sounds slightly darker, yet having more presence, which I interpret as a better midrange-tweeter integration.

From the speaker with the uncoated dome, voices sound as coming primarily from the 8535 with some poorly focused highs added from the tweeter, where the speaker with the coated dome seems to “dress” the midrange with the proper overtones and presents a more natural tonal balance.

Going from the “uncoated” to the “coated” removes a curtain, however trivial this expression may be, but it very much describes the transformation that has taken place.

Coating of second tweeter



Fig.14

After drying for 1 hour the tweeter was assembled and reinstalled in the 2.5 enclosures.

Frequency response was measured after 1.5 hours:

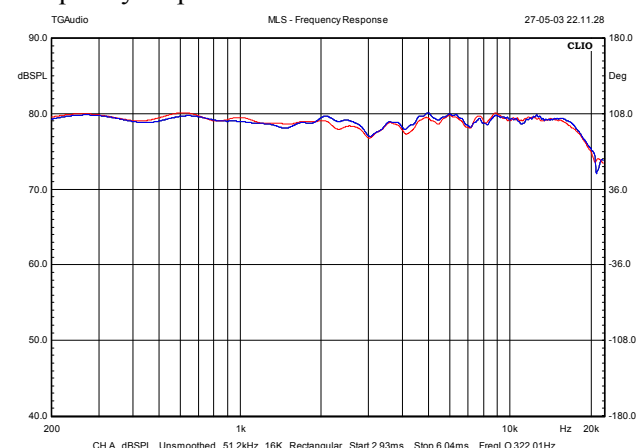


Fig.15. Frequency response, no smoothing.
Red = newly coated dome
Blue = 72 hour coated dome
Very much same performance as seen in Fig.12.
(colours reversed)

The 2.5 clone now bear little resemblance to where it all started with the 2 kHz bump, notch filters, etc.

To summarise the changes:

- Notch filter is omitted by adding a resistor to the LP section capacitor
- 47 ohm resistor in parallel with the 1.8 mH coil is removed
- 8535 drivers have had dust caps 3x coated with DAMAR resin
- Ferrofluid has been removed from tweeter voice coil gap
- Damping material has been applied to tweeter pole piece
- Tweeter dome has been given 1 layer DAMAR coating

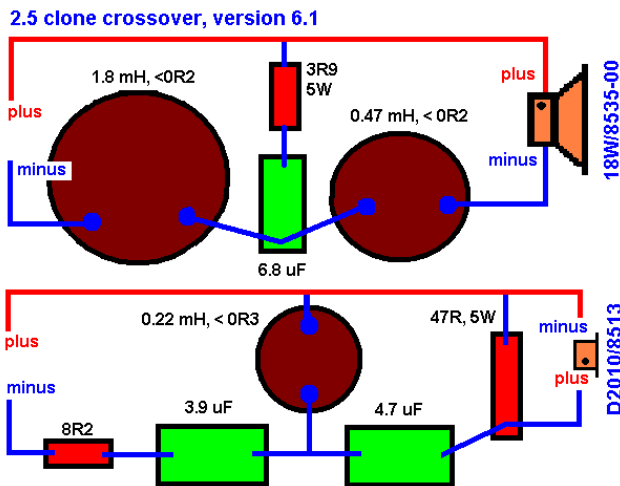


Fig. 16. 2.5 clone crossover, version 6.1.

Listening tests on the 2.5 clones with both tweeters coated:

The speakers fitted with the coated 8513 tweeters now hold some of the same qualities associated with the 8535+9500 setup.

And the 8535+8513 holds qualities different from the 8535+9500 combination.

The 9500 setup is a very good all-rounder that handles almost any choice of music and only rarely leaves the upper midrange behind in making the “perfect speaker”, that is from a modest two-way floor-stander.

The dust-cap coated 8535 + coated 8513 have a slightly more analytical presentation and enhanced depth presentation compared to the 8535+9500 setup.

The midrange is improved even compared to the 8535+9500 setup. I cannot account for this improvement, but it's significant.

I can now enjoy almost all my CDs, even the poorer vocal recordings.

I'll reinstall the 8513 tweeters for good and keep these speakers and thank all the cloners who commented on the performance and suggested changes.

And thanks to JPO for taking in yet another paper. This is the final.

Regards
Troels Gravesen

troels.gravesen@danisco.com

PS. DAMAR coating of the 8535 dust cap:

Apply 3 layers of DAMAR coating to the dust cap with at least two-hour intervals.

And don't apply coating outside the dust cap as it changes the frequency response around 3–4 kHz.



Comments to tweeter modifications

1.

First of all your tweeter mod is excellent, the sibilance has really gone and the sound is much smoother than before.

Zoltan.

2.

This is quite a delicate operation! The only thing I found that was not in your instructions was that after the rubber gasket is removed, it is necessary to tap the plastic casing on the side to allow the driver parts to fall free (at least it was in my case). It confused me for a few minutes until I figured it out. Aside from that, everything went well. I did both drivers at the same time and was keen to hear the result, so I've temporarily attached the back plate to the housing with electrical tape - don't worry, it's airtight and I'll redo it properly with silicone tomorrow.

Well, all I can say is that together with the minor crossover mods and extra Damar coating on the 8535, this makes the most significant improvement since your original notch filter. Everything you say in your paper is 100 per cent correct - the tweeter coating really does transform the speaker. The last traces of the original clone's "technicolour" sound are gone, so I guess it's not going to please everybody, but sibilants now sound totally natural, even if they are still a bit more pronounced than in some other designs. The important thing is that they don't "ring" and they don't irritate. I also agree with your description of the treble as "darker", and yet - you're right - at the same time there's more presence to the sound! I think we've been unfair to this tweeter; it had far more potential than we were allowing for. There is now obviously far better integration between the two drivers. It's very strange, but I have to agree with you also that the midrange "hardness" is now much reduced - or at least much less obvious, and it's possible to hear depth layering where it didn't exist before. I have yet to listen to all my "difficult" recordings, but the few I have tried all showed a marked reduction in "listener fatigue". I can enjoy most of them again! I can't say I always find the "carbon-fibre" midrange to my taste, but I can now appreciate it for what it does. The clone truly does now fit the description of a "high-end" speaker. Very impressive.

Darryl.

3.

I have been briefly comparing Troel's modified 8513 tweeter (ferrofluid removed and applied damar coating to cone) and it is very nice. I must modify the woofer crossover to Troel's suggestions before I make any final conclusions but dropped it into the current crossover and it sounds more neutral, less sibilant when CD tracks have too much energy. The same

basic sound character is retained but enough treble zing is shaved off for those who want this, IMO. At this point in time I still prefer the standard unmodified tweeter as there is more of that original Proac lushness, sweetness and detail, but can be sibilant on some tracks, which seems to be the trade-off.

Al.M

4.a

- modifiserte 8513 i går, pluss at jeg satte inn en 10ohms motstand i mitt No1. Filter. Har forresten bestilt deler til No6. filteret i dag.(gleder meg) Resultatet av tweakingen er enorm! Må bare takke!

b.

After many more ours of listening to the clones and the V6 filter, I have come to what will be MY final filter. Sorry, but I was a little too fast to accept the filter for the 8535.

The V6 filter sort of shows the true nature of the 8535, a hard sound.....

But with the V1 filter too the 8535, and the latest (in the link) to the 8513 + the modifications with the tweeter, the sound is the most acceptable ever. I can still hear the 2000Hz bump but then mostly when I listen to TV. The sound on most recordings now is warmer than with the V6 filter. But now I can for the first time totally relax when listen to my favourites.

c.

Dear cloners

I really recommend this modification of the 8513 tweeter. I can promise a sweeter treble. And the metallic sound is totally gone! In fact the whole speaker can be as fantastic as people said, from bottom too the top. I have had big problems accepting the clone's sound until now. This tweak together with the v6 filter and I can call this speaker superior! I agree with Troels that this is the final version!

d.

There is said many strong words about the sound of the clone, but I can't understand how so many people have accepted the sound of the early clones! I can imagine Mr. Steward Tyler having a good laugh more than once! But now He he he.....

Regards from Tor Hauge...Norway

The new coated 8535 drivers from ScanSpeak

As mentioned in my former file on tweeter coating, the new 8535 drivers have a coating on the rear of the cone. This is a deviation from former 8535 drivers and is easily detected on measuring performance.

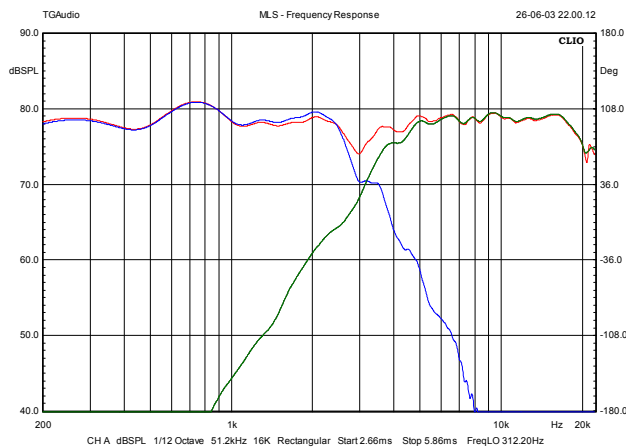


Fig. 1. New coated 8535 and V6.1 crossover.

What can be seen from this graph is a 3-4 dB bump at 600-900 Hz, and due to an earlier roll-off characteristic, a dip at 3 kHz.

Here's the response from the old drivers with modified tweeter, crossover V6.1:

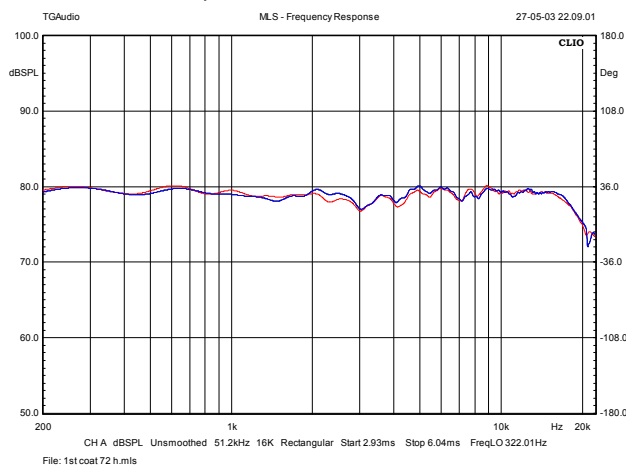


Fig. 2. Old 8535 driver response. Blue and red are various measurements during tweeter coating.

It's my feeling, that these drivers will be best suited with tweeters like ScanSpeak 9300/9500/9700 and a target point of crossover at 2-2.5 kHz, possibly 6-12/18 dB.

Furthermore, a notch filter is needed for the 750 Hz bump.

To my knowledge, this change in performance has not been announced by ScanSpeak and can only be identified by measurements or visual inspection.

I have tried to tweak the V6.1 crossover to adapt to these new drivers:

LP-section:

a. 1.8 mH-(7.8uF+4R7)-0.47 mH

b. LCR notch filter for the 750 Hz bump = 10 mH (2 x 4.7 mH, 0.65 ohm) + 10R + 6.8uF.

HP-section :

No changes.

2.5 clone crossover version 6.2 New coated 8535 drivers

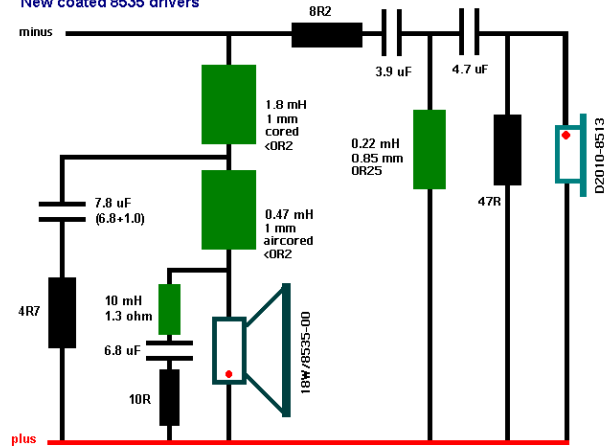


Fig. 3. V6.2

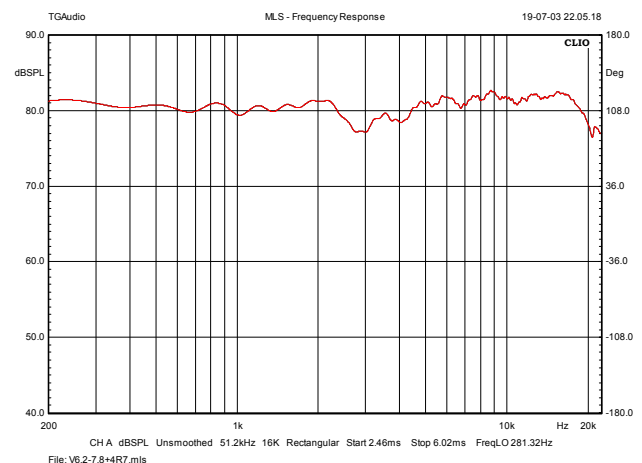


Fig. 4. Frequency response of new crossover.

LCR components:



Fig. 5. mid-LCR.

- And don't spend a fortune on notch filters unless you think this is the speaker of your life!
This shouldn't cost you more than 20 US\$ in all for two.



Fig. 6. "New" coated 8535



Fig. 7. "Old" un-coated 8535

Conclusion

Listening to the V6.1 crossover with the new drivers doesn't sound that awful.

Compared to the old drivers, we have a midrange with some more presence and for sure we are more forgiving to dips (3 kHz) than bumps in the frequency response (remember the series filter?).

With the V6.2 filter, the dip at 3 kHz is slightly reduced and you can add the mid LCR if you think you have too much midrange presence. With this notch filter in place, the midrange is much like the old drivers (and there is not going to be an easy substitute for this tweak).

I don't have two pairs of 2.5 clones to compare, but I would have a hard time pointing out one from the other.

Or did I hear some more background details (talking) in the midrange from the new, coated drivers on the Jazz at the Pawnshop that I haven't heard before????

13.08.03: NEWS on the "new" drivers from Scan-Speak:

Finally there's some explanation from Scan-Speak regarding these drivers:

Alain Letendre, Canada, has received this message from Madisound:

The Scan-Speak 18W/8535-00 has always been coated both front and back, but as it is an air dried cone, its absorbency may differ. We use the same amount of coating glue on each unit so the cone may sometimes absorb all the coating glue (i.e. the coating is hardly visible), and sometimes the cone is saturated after absorbing 80-90% of the glue. The rest of the glue will then form a somewhat shiny surface, leaving the coating visible. I hope this answers your question.

Best regards,

Danish Sound Technology A/S

Carina Sondergaard

Export Assistant

From d-s-t here in Denmark I have received this message (in Danish):

Hej Troels.

De variationer i udseendet, som dine billeder viser er ganske normale. Der er ikke lavet tilsigtede ændringer på denne enhed siden dens "fødsel". 18W/8535-00 er og har altid været coated på både for- og bagside. Ofte er det dog ikke synligt på bagsiden, men der kan opstå skinnende pletter, som dit billede viser.

Membranen er luft-tørret (til forskel fra en kontakt-tørret membran som anvendes på fx 15W). Den lufttørrede membran suger/absorbere coate-limen (som er vand-fortyndet).

Hvorfor så forskellene? Som følge af fremstillings-processen forekommer der variationer i den lufttørrede membrans indre struktur, mens vægten er let at holde (det er den, der er specificeret med tolerancer). Det er lufttørringen, som giver det specielle udseende på forsiden. Nogle gange vil membranen være lidt mere kompakt end andre gange, og det påvirker suge-evnen. Mængden af påført coate-lim altid er den samme (vi kontrollerer desuden viskositet). Den er doseret til næsten at mætte membranen. Derfor vil membranen nogle gange absorbere al limen, så den ikke synligt er coated på bagsiden (som trænet er det let at se, at enheden på dit første billede ER coated på bagsiden. Det ville du også kunne se, hvis du havde en u-coated membran). Andre gange vil membranen i områder lige nå at blive mættet, før al coate-limen er påført. Den resterende mængde coate-lim vil derfor lægge sig uden på membranen. Jeg håber, det har kastet lidt lys over sagen. Mvh. Ulrik Schmidt, udviklings-ingeniør

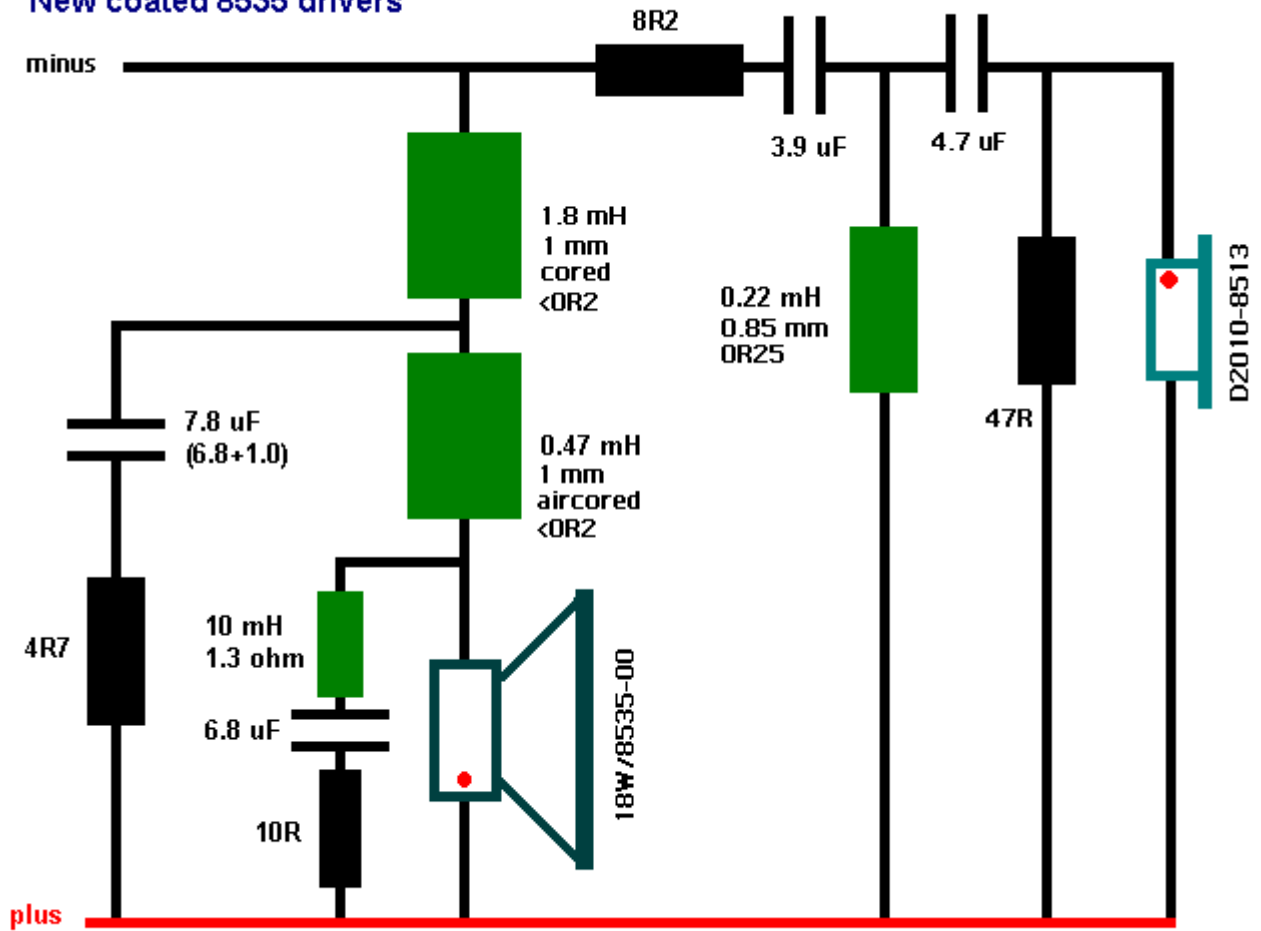
This message says much the same thing as the message from Madisound.

So, this is production variations and my only comment to this is:

BEST OF LUCK CLONERS!

Your will probably not be able to determine what type of crossover will be best suited for your drivers without measuring equipment.

2.5 clone crossover version 6.2
New coated 8535 drivers



New project to come:

“The Point75”: 8535 bass + SEAS W15CY001 di-pole midrange + ribbon tweeter.

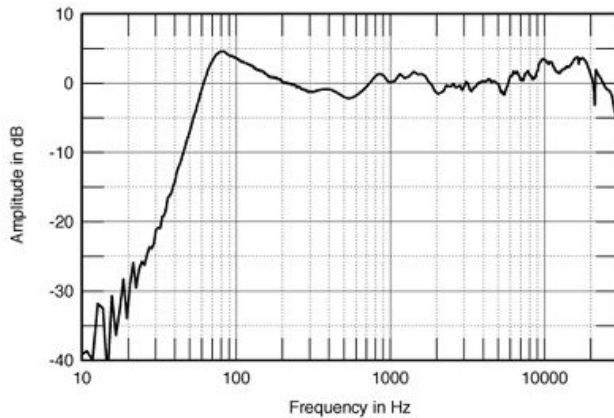


Regards

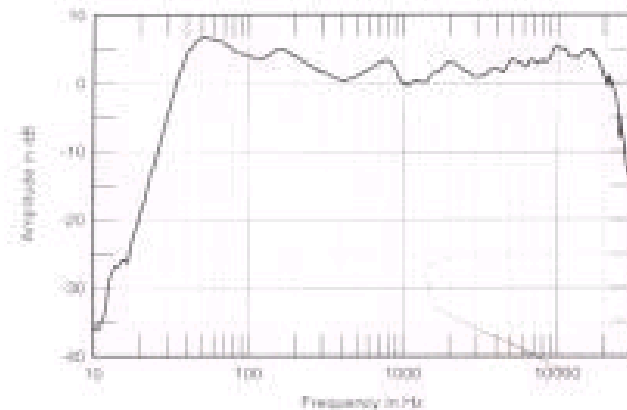
troels.gravesen@danisco.com

Notes on the ProAc sound:

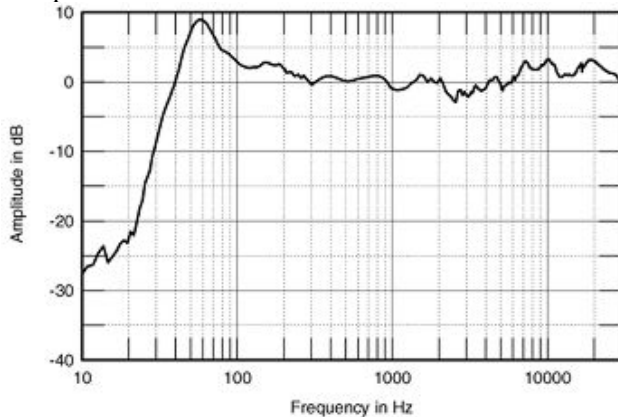
Much has been said on the ProAc sound, and this can be found in all the reviews seen in HIFI magazines, etc. If we take a look at the frequency response curves from a number of ProAc Response designs, this is what we see:



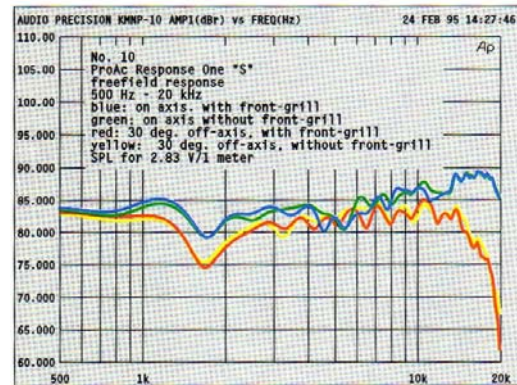
Response 1SC



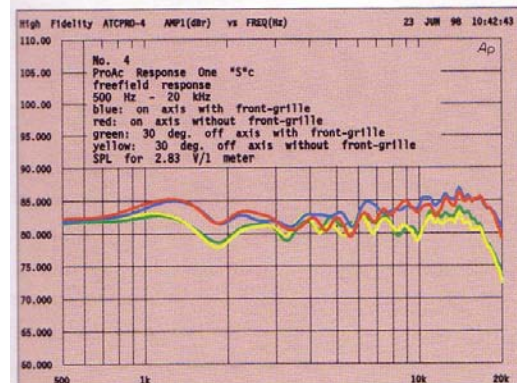
Response 2.5



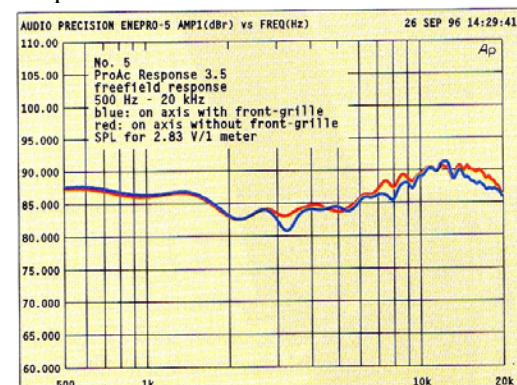
Response 3.8



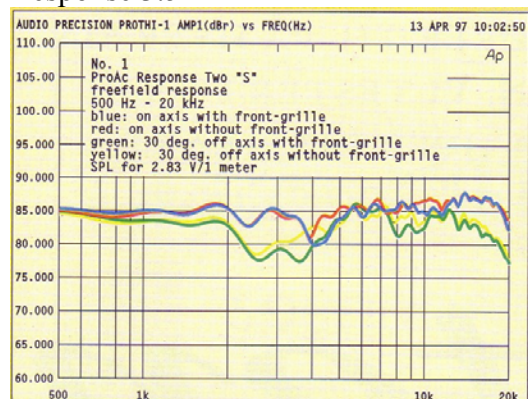
Response 1S



Response 1SE



Response 3.5



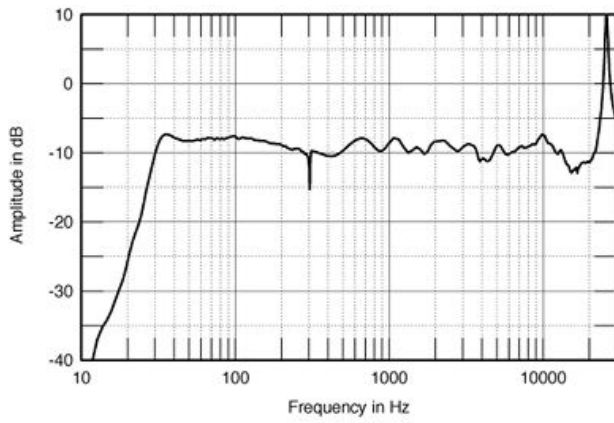
Response 2S

The Response 2S is an exception from this profile and the Response 3.5 is the worst of them all. Worst??

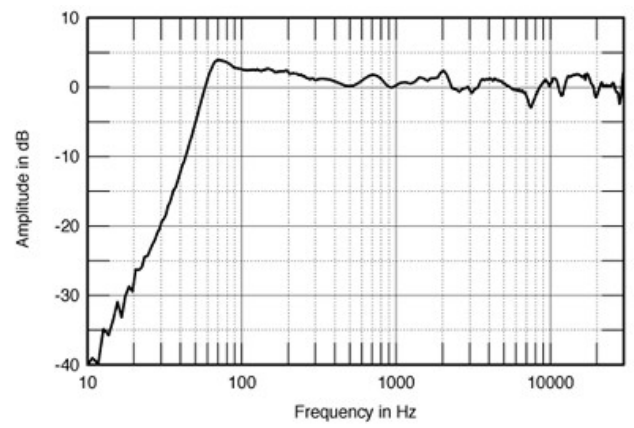
Well, first let's take a look at 10 randomly picked designs from the Stereophile files:

(A few speakers with very peculiar response profiles have not been considered)

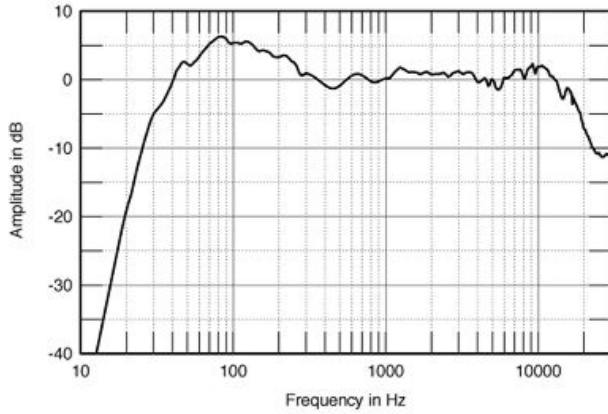
The Danish magazine High Fidelity confirms the response curves seen from the ProAc 1S and 1SC.



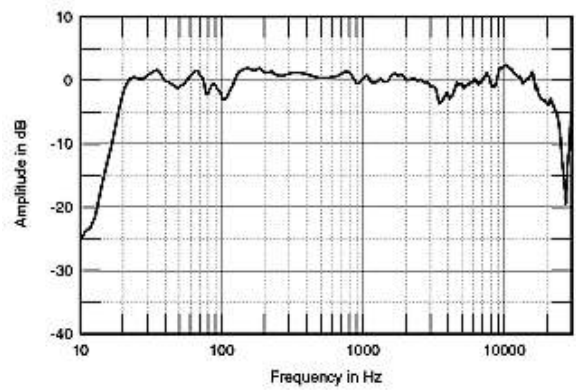
Totem Acoustic Mani2



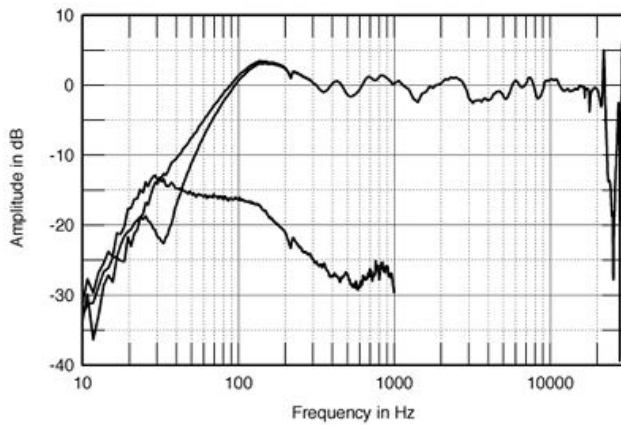
KEF RDM



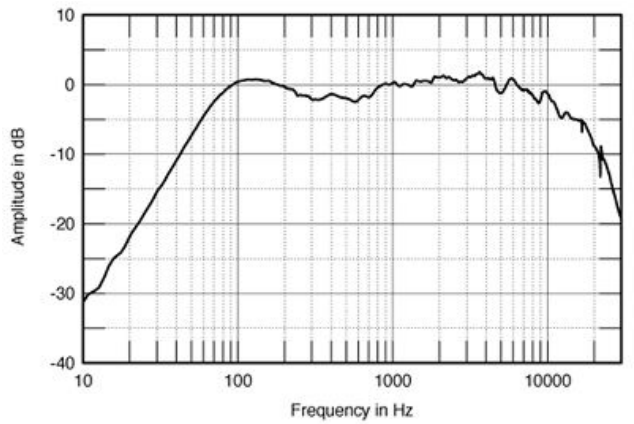
Dynaudio Confidence C4



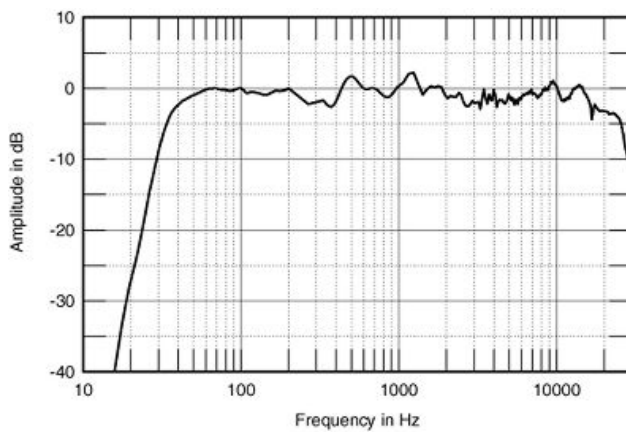
Revel Salon



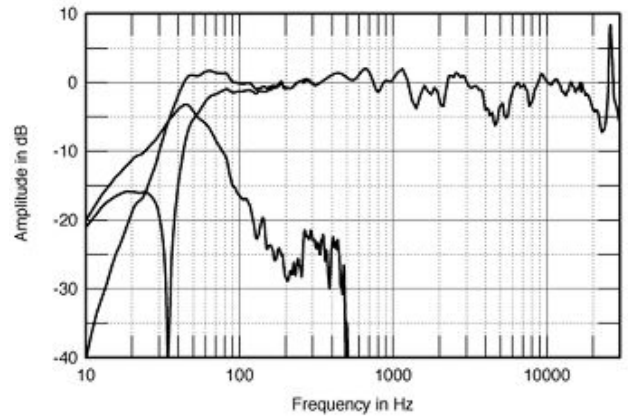
JMLab, Chorus 706



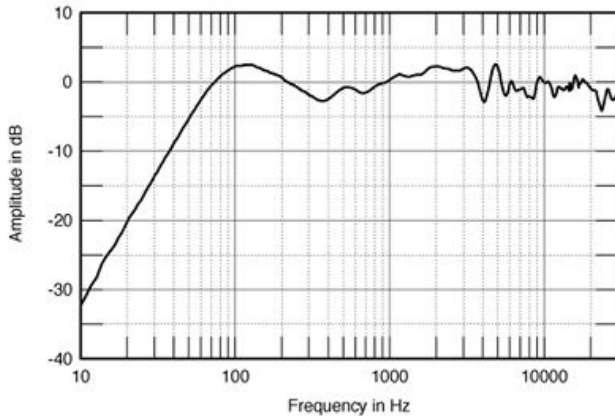
Spendor S3-5se



Joseph RM 33si



Vandensteen 2ce



KEF Reference 207

The speakers chosen here are from small monitors to large floorstanders.

Try to zoom out on our PDF reader and watch the two pages simultaneously.

Few of these nine speakers have some or a slightly elevated bass response, but none of these have the persistent increase in bass and treble response as seen from the ProAc speakers, combined with a generally recessed midrange. Even the Response 2.5, where we can see the 2 kHz midrange bump following an 800 Hz bump.

It is apparent, that the Response series was created with the intention of maintaining a specific response profile, thus giving the “ProAc” sound to them all, where the main differences are bass performance, logically derived from the size of the cabinet and bass drivers.

This is in no way a new approach and can be heard from a number of other manufacturers, where the main differences in “sound”, relates to bass extension.

The Response 2.5 800 Hz bump, by the way, could be the explanation for the acceptance of the 2 kHz bump in the original design.

The “sum” of these two bumps may kind of even out the overall perceived balance.

(Actually we can now get both of these bumps with the new coated drivers from SS. Leave out (or reduce) the series resistor in the LP section, and leave out the LCR notch filter for removing the 800 Hz bump + reduce tweeter series resistor to 5 ohm!

How about that? Finally we can recreate the original ProAc Response 2.5 sound/profile with all the bumps).

In the history of HIFI, response curves displaying excessive bass and treble at the expense of a recessed midrange, was the trademark of the so called “West Coast” sound. Lots of bass and lots of treble. Excellent for “Surfin’ USA” by The Beach Boys.

I remember JBL having a 14” bass driver (LE14) married to a small paper cone tweeter. This was a “tizz and boom” speaker!

If you have to make a living of producing loudspeakers, you have to catch the attention of your

audience, and the easiest way to do this, is pushing the “loudness” button = “west-coast-sound”.

“Cheap-trick-low-fi”, that’s what it is.

Thus the need to re-evaluate the crossover design if you want to listen to acoustic instruments and voices and have a more natural presentation of an acoustic event.

The ProAc Response designs are nowhere near the old “tizz-and boom”/”west-coast-sound”/”boom and tweet” sound, but displays a specific profile, aimed at creating an “engaging” sound. The objective of neutrality appears to be somewhat compromised.

Quote, Martin Colloms:

Subjective effects of first-order errors

“Slight errors in channel balance, either in specific frequency ranges or in overall level, can subtly disturb one's opinion of the sharpness of stereo focus. Statistically well-controlled testing has not only confirmed the audibility of absolute phase/polarity but also that of level differences as little as 0.2dB. These differences may be of octave or several-octave bandwidth, with a sensitivity of a similar magnitude. The subjective responses to variations in amplitude/frequency response are pretty well documented; the careful reviewer bears these constantly in mind. For example, less than 0.5dB—5%—of treble lift in the 3-10kHz range can give rise to a mildly increased sense of immediacy, transparency, and liveliness without necessarily being directly obvious as treble lift. A similar degree of loss in the 150Hz-400Hz range can make a vocalist appear lightweight and lacking in power in the fundamental range, lending a crisper quality to the sound. This might be preferred on one recording but disliked on another”.

With the variation in specification of drivers and crossover components + cabinet construction and damping, not to mention the front-end consisting of amps and players, it’s no wonder we get different reports on sonic performance of the 2.5 clone.

It’s my feeling, that if you choose to target the original response profile, you’re in for some serious tweaking on amps, cables, CD players, etc., to get it right.

If you’re in for the more British school of loudspeakers, represented by names like Rogers, Harbeth, KEF, Spendor, etc., and target a more flat response profile, you will have a speaker, that will tolerate a larger range of amplifiers and CD players. And to my ears be more “high-fidelity” compared to the more immediately appealing ProAc sound.

On the various schools of speaker designs, please read: <http://www.aloha-audio.com/library/speaker-design1.html>