

PRELUDE

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Audio Technology 10C77-25-10-KAP + AT 15H52-06-13-SDKAM + ScanSpeak Revelator D2905/9900

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Bass: Audio Technology 10C77-25-10 KAP. **Mid:** Audio Technology 15H52-06-13-SDKAM. **Tweeter:** ScanSpeak D2905/9900.
The middriver comes with new rubber surround, optimised for better air-flow and termination of cone energy, underhung voice coil, 6 mm windings in a 13 mm gap.
Download driver specs: **10C77 - 15H52 - SS 9900**
The actual 15H52 varies from the one shown on the PD in having an underhung voice coil.
The correct type used here is **15H52-06-13-SDKAM**, Re = 5.5 ohms.
(SDKAM: SD = symmetric drive. KA = basic kapton voice coil former reinforced with aluminium. M = middriver (special rubber surround))

Why?

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This may be an odd place to start, but why another speaker? The world is full of speakers and don't we have enough? From mails coming in, the appetite for new speakers in the diy community is endless. Curiosity and the passion for making something better than last time is the main driver. This must have been going on ever since we sat around the fire carving bows and arrows. How do I make this arrow fly faster, with more precision, with better penetration? If only.... then I would only have to go hunting half day and the afternoon could be spent sitting in the shadow of the trees playing my bone flute - until I get bored and start thinking: "What if..?" Anyway, this isn't about arrows or bone flutes, rather sophisticated loudspeaker drivers that may enable us to get a little closer to the music, reveal more detail and provide an overall more truthful sonic image of what was going on behind the microphones capturing an acoustic event.

The construction shown here will offer you an opportunity to reach into serious high-end, that is: If you make rock solid cabinets, if you damp them well, if you offer serious money on drivers and crossover components - and if you have a good amps and source material, the latter not least important. All of this doesn't come cheap and we're into the area of diminishing return from our investment. What we *should* get from expensive drivers is the ability to play louder with less distortion compared to el-cheapo drivers and here you get it. Some people question the value of expensive crossover components like super caps, etc. My response to this is that if you can't hear the difference between a standard cap and a super cap, your amps, your CD player or turntable cartridge simply isn't good enough.

During construction and crossover optimisation, the Morel CAT-308 was the tweeter in place and did a damned good job. However, modelling a large number of tweeters, it was found that the venerable ScanSpeak D2905/9900 not only allowed better phase integration, simpler crossover, better sound, thus the 9900 it's going to be. The slightly concave face plate adds distance to the dome and impulse response could be further improved. The low Fs allowed a simple 2nd order LR to be established with as few components as possible. I like that! Ideally the CAT-308 would require a single cap and two notch filters to shape the 2nd LR roll-off although a single LCR circuit did well for the listening test. With SS 9900 in place a perfect 2nd order LR roll-off could be had from a RL circuit to ground. The 9900's impedance peak at 500 Hz needs flattening from a LCR circuit. Serious listening test were performed w/wo this notch filter and it was impossible to hear any difference, but for the benefit of the doubt it stayed in place. View schematics below and read comments on crossover development.

The PRELUDE will offer you a rock solid bass playing high or low, a fully integrated midrange and treble with some of the best treble I've had due to driver quality and the low-order filters employed. The PRELUDE will handle anything from classical guitar, vocals and trio-jazz to heavy metal. Give it some of the best 100 watts you can afford and you may even throw a Saturday evening party.

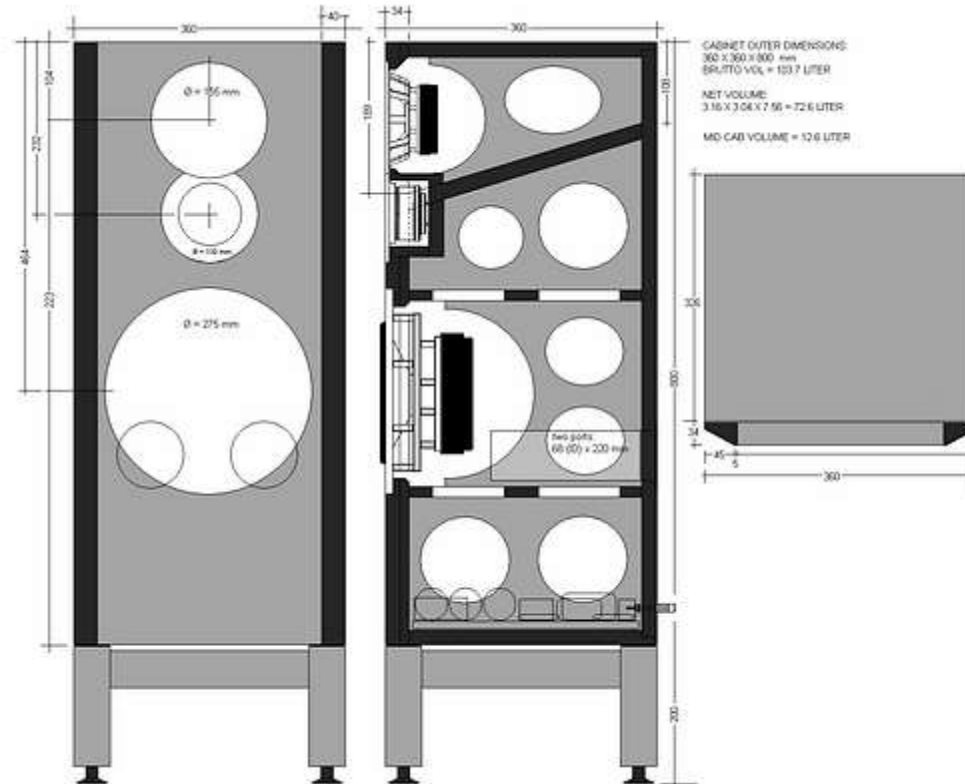


Click image to view large

Finished speakers. Very classic indeed and not to everyone's taste. From visitors I know that some find oak veneer just beautiful and others just plain ugly! This speaker is so heavy I left out the spikes and settled for some felt pads on the stools, which were made from solid elm.

The Box

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Click image to view large.

The aim of this cabinet construction is to make a rock solid enclosure for the AT drivers, so be generous with bracing. Next I wanted the midrange at ear height, thus a small stool to lift the speaker to an overall height of 1 meter. The stool is 16 cm high and some spikes or whatever adds to the final 20 cm base height. Finally I wanted a cabinet where most diy'ers can follow in terms of overall complexity. No curved panels or fancy forms that only CNC machines - or talented diy'ers - can cope with. No, this is not a skinny runt of 18 cm width, rather a 36 cm (14") wide baffle providing acoustic support for the drivers and enabling simplicity of crossover.

Regarding box size and tuning: Please read here: <http://www.troelsgravesen.dk/10C77.htm>

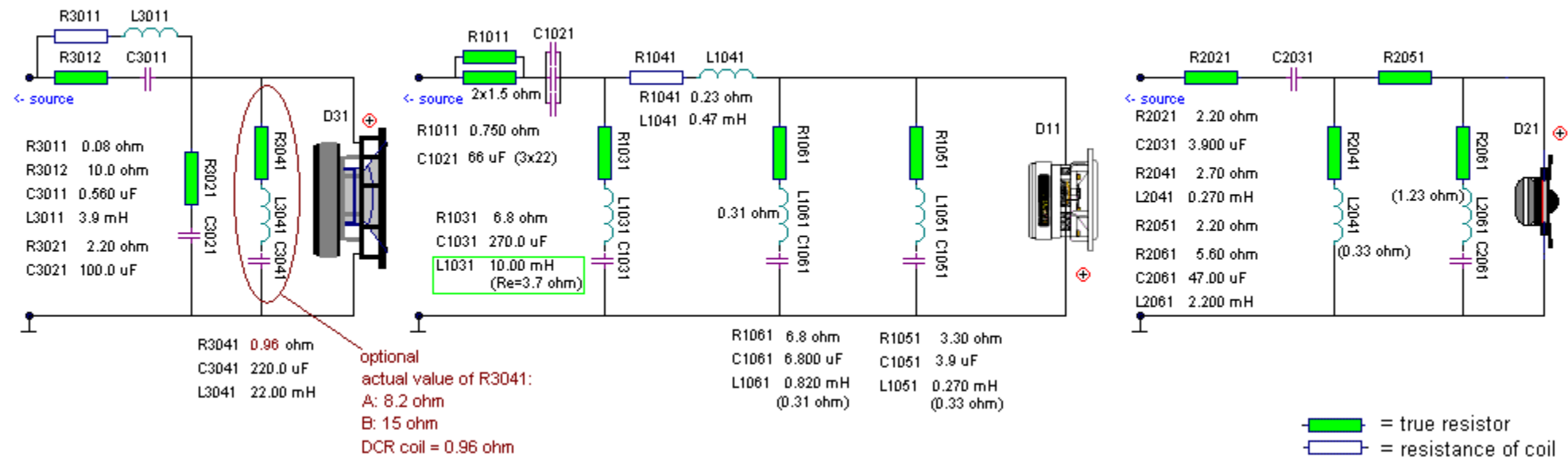
Final box shown here is around 55 liters net volume (for bass driver alone) depending on use of bitumen pads, amount of bracing, volume taken by crossover, etc. I recommend a port tuning of 30-33 Hz. Use 2 x vents @ 68 mm diameter and 220 mm length. Download excel file to calc. vent length [here](#). Note excel file is set for

one port. When you use two ports, double vent length.

The Crossover

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Audio Technology 10C77-25-10-KAP + AT 15H52-06-13-SDKAM + ScanSpeak D2905/9900, version 2



Work on this crossover has been ongoing for 4-5 months, much longer than any other speaker I've made and eventually produced "**Siri's Killer Note**". The reason for this is not that the drivers are particularly difficult, and going the standard route of 2nd/3rd order filters, the crossover was in place in a few hours. But these drivers are not any drivers and upper mid and treble presentation suggested more work to be done, thus a whole range of crossovers were simulated and tested for the mid-tweeter section going from 3rd LR to 2nd LR to 1st order filters and eventually a combination of LR2 and 1st order Butterworth did what I was after. In reality true 1st order filters for all drivers cannot be realised and the acoustic roll-off is indeed often something between a true 1st order Butterworth and 2nd order LR and depends on how far above or below point of crossover we want the slope to follow target response.

What often happens during crossover development is that you reach a certain point where the sound is very good, but measurements suggest more to be done and slowly you improve measured performance - and decrease sonics. Reaching crossover version 7 mkII, everything looked great - but magic had gone. Now bass and mid integration was pretty much in place but what happens here will also have an impact on upper registers and in reality I had reached a rather perfect LR2 topology for both mid and tweeter. The close-to-first-order mid-tweeter filter of previous versions was gone - and so was the magic. Hmm... Back to LspCAD and some more late night hours' simulation and crossover soldering. When the final middrivers were at hand, another round of crossover fine-tuning had too be done, but nothing serious compared to the temporary 15H52-15-06 SD I had used for initial experiments.

LR2 between bass and mid was run for a long time, but having the mid on top, driver integration wasn't perfect, thus the 1st order high-pass to the mid was tried and an LCR circuit takes care of the mid's impedance bump at 80 Hz. The mid cabinet has a 40 mm vent and $F_b = 47$ Hz, but eventually the vent was stuffed lightly with damping material and the impedance flattening circuit introduced. This works. Actually the LCR circuit also works very well with the vent not stuffed, so take your pick. The sound is slightly different and I strongly recommend adding the vent for experimentation with closed, aperiodic and vented mid cab. With a second order low-pass section to the bass driver and true 1st order high-pass to the mid, good driver integration could be achieved with regard to amplitude and phase. This step also included lowering point of crossover between bass and mid some 100 Hz, now close to 320 Hz. Not only did it measure well, it also sounded great.

The final crossover is asymmetric, providing LR2 slopes to bass and tweeter and 1st order to the middriver. Thus proper phase integration is achieved with enhanced impulse response. In a commercial add this would account for perfect transient response, time-aligned, zero time and phase distortion and bla bla bla.... But let's be honest and agree only e.g. QUAD ESL speakers come close to these virtues. Dynamic drivers can do a lot of things electrostatics can't, and as always there is room for improvements.

Looking at the step response below, we're close to a perfect time alignment between mid and tweeter and this truly pays off in terms of transient response and enhanced overall transparency. Adding an all-pass section to the tweeter to render same polarity for mid and tweeter was tried and didn't pay off. Serious listening tests were performed but I'm really not sure that same polarity pays off as long as proper phase integration is accomplished. It may be a give-and-take situation where the added series components detract from any possible benefits of same driver polarity.

The crossover seen below may seem a bit complex to some people and here are my comments, click [here](#).

I've already had the question on the differences between the middrivers tested and I had three identical pairs except for voice coil former material, alu, kapton and kapton/alu. The voice coil former material has a significant impact on performance, particularly on upper mid and treble range and what works the best may depend on choice of tweeter and crossover topology. The impact on sound is very subtle and the choice was hard. The mids with alu formers had the best (smoothest) frequency response but eventually the kapton/alu was chosen based on sonics and please do not ask how they differ, because if I put in onto paper it would be black and white - and it isn't. The choice of voice coil former material will depend on the actual application, and we can't simply conclude one material is better than the other. Read here at Audio Technology website about voice coil former materials: [**What is the difference between Kapton and aluminum**](#), question 3.

Crossover Parts

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PRELUDE								
Coils:								
Coil No.	Wire Ø mm	AWG	mH	Ohm	dim. mm ø x h x Ø	core	discs	pcs
C-Coil	1.60		3.90	0.08	82 x 28	30		2
1248	0.70		10.0	3.70	25 x 30 x 49	0	0	2
wax coil		16	0.47	0.23	59 x 20	0	0	2
1828	0.80		0.27	0.33	10 x 35	0	0	4
2231	0.80		0.82	0.31	30 x 23	14530	0	2
1564	0.80		2.20	1.23	30 x 41	0	0	2
5079	1.00		22.0	0.96	46 x 55	24635	5507	2
Caps								
	type	volt	uF		mm, Ø x L	id		
CROSS CAP	MKP	400	100		57 x 62			2
CROSS CAP	MKP	400	270		62 x 110			2
CROSS CAP	MKP	400	47		44 x 56			2
CROSS CAP	MKP	400	220		54 x 108			2
Superior Z-cap	MKP	800	0.56		16x43			2
Superior Z-cap	MKP	800	22		51x70			6
Superior Z-cap	MKP	800	6.80		35x65			2
Superior Z-cap	MKP	800	3.90		30x56			4
Resistors, all 10 W								
			ohm	id	mm, 10 W			
Superes			10		8 x 53			2
Superes			2.2		8 x 53			6
Superes			1.5		8 x 53			4
Superes			3.3		8 x 53			4
Superes			3.9		8 x 53			2
Superes			2.7		8 x 53			2
Superes			5.6		8 x 53			2
Superes			6.8	R1031	8 x 53			4
MOX			8.2	R1041	8 x 53			2
MOX			15	R1041	8 x 53			2
Miscellaneous								
	item #							
PORT, JA	900018				68 x 220			4
PORT, JA	900030				42.7 x 123			2
terminals, pairs	satin nickel				pairs			4
wire	2.5 mm ² , Supra black				meters	for bass		2
wire	silver plated cobber in teflon				red	for mid+tw		5
wire	silver plated cobber in teflon				black	for mid+tw		5
solder tag strips								4
DRIVERS								
	item #							
Audio Technology	10C77-25-10-KAP	not supplied by Jantzen Audio, mail AudioTechnology at mail@audiotechnology.dk						2
Audio Technology	15H52-06-13-SDKAM	not supplied by Jantzen Audio, mail AudioTechnology at mail@audiotechnology.dk						2
ScanSpeak	D2905/9900	not supplied by Jantzen Audio, mail AudioTechnology at mail@audiotechnology.dk						2

Complete kit only available from Jantzen Audio, contact@jantzen-audio.com

Kit can be bought with /without tweeter

