

Jenzen Accu

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All loudspeaker drivers hold a sonic signature depending on overall construction and components used, not least cone materials. Making a blend of sounds from very different cone materials may not always perform well regardless of how well we implement the crossover. I often had trouble making a good blend of true alu ribbon tweeters and a midrange driver, regardless of the latter's soft or hard cone. Lack of uniform dispersion may be one problem, but the sonic signature of ribbons is special.

In the crossover region we have a blend of sound coming from diaphragms having an e.g. weight ratio of 1:1000, 10 mg to the ribbon and 10,000 mg (10 grams) to the mid, sometimes even more. So, in this range of overlap we have two drivers doing the *same* thing *their way*; not always pleasing to the ear. I don't mind a tweeter having a moving mass of e.g. 500 mg as the treble that counts is mostly in the 1500 Hz to - let's say - 7-8 kHz area. It may prove a lot more pleasing to the ear - that is if the crossover is done well. The crossover is the heart of the speaker and can turn anything into misery if not executed properly.

As discussed before, soft domes may do well with paper and polyprop. Sometime a good alu dome does well too. Planar tweeters, which I like a lot, may do well with polyprop, but not always with paper pulp based on my experiences. Obviously I haven't tried all combinations and generally I don't exclude *any* combination of drivers. It must all be tried before drawing conclusions, or prejudice may exclude us from good times in front of our speakers.

The law of diminishing return goes for high-end speakers as for economics in productivity of consumer goods. We may throw in a diamond tweeter, but we can't be sure the bottleneck is not somewhere else and further investments just doesn't pay off in terms of improved sound.

All of the drivers shown here are pretty much SOTA, state of the art, in their respective areas. This doesn't mean they're the best, because best doesn't exist in speaker drivers. Nor does "world's best speaker" exist although manufacturers love to claim so. Our perception of sound is much too subjective for such statements and one customer's aural nirvana is a another's nightmare.

Dynamic drivers are by all means serious compromises when it comes to reproduce the music we love. Not only can a driver only reproduce a few octaves of the ten some of us can hear, thus we need at least two, preferably three units to cover the entire range.

The inevitable overlap between drivers, the inevitable phase shifts introduced by our crossovers, the lack of uniform dispersion due to varying diameters, the lack of low-end extension, etc., all adds to a particular sound of a system. We could go on about all the imperfections associated with loudspeakers based on dynamic drivers, but at the end of the day we can still manage to put the best together and have an enjoyable hour in front of our "boxes". The key issue before starting a DIY project is that we make perfectly clear to ourselves what our objectives are. What is the size (volume) of my room, how loud do I play, can my amplifier handle the speaker's impedance and sensitivity, etc. Please read [choices](#). The Accuton C173 can't move more air than a Vifa P17, but it may be able to do a couple of things the Vifa cannot.

The Accuton drivers fitted with ceramic cones are considered some of the best transducers around. The rigid cones display piston motion within their operating range, but break up when we reach higher frequencies, e.g. 4-5 kHz for a 6" driver. To dampen the ringing several options are available: Do nothing and filter out the notches, add damping polymers to the cones, punch holes or "ears" in the diaphragm (and seal them again), etc. Whatever we do, the ringing of true hard cones will have an impact on the sound that emanates from the speaker. The trick is to get the resonances as far out of its operating range as possible and to get them some 15-20 dB below output level.

The MLS signal coming from the C173-6-191E drivers during testing suggests well-behaved break-up nodes compared to the ear-shredding peaks from an e.g. pure alu driver. This is no comparison and promise well for the Accutons.

Having a low point of crossover between bass and mid (~200Hz) I wasn't too concerned about compatibility between bass and mid. These are both hard cone drivers and should mate well, and so they did.

Exploring the new Accuton S280-6-282 was an option but 1200+ EUR/ea is a lot of money - and I have the Audio Technology drivers; an argument hard to ignore. The AudioTechnology drivers are 525 EUR/ea. Also the Accutons (11") are a bit too large for the Jenzen cabs, thus 10C77 it is.

Should the Jenzen Accu catch your attention and should you want to replace any of the specified drivers, please DO NOT ask if this or that driver is suitable. I can't tell and I won't speculate on replacements based on driver specs. Thank you!

THE DRIVERS

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Accuton C30-6-024. Click images to view large. Download specs [here](#).

Buying Accuton C30-6-024 tweeters I had other projects in mind, but while working on [Jenzen SEAS](#) speakers, I couldn't help wonder what would become of a Jenzen Accuton set-up. Having received the Accuton tweeters I quickly did some measurements and based on modelling this tweeter appeared an easy implementation in a range of 2- and 3-ways. Thus, the search for an Accuton* midbass driver started.

For the time being (2011) Accuton faces the problem of neodymium prices reaching the skies and their neo drivers have to be redesigned to fully utilise *smaller* neo magnets - or using ceramic magnets. I don't fancy any particular magnet material over another and I don't think anyone ever compared exactly identical drivers with either alnico, ceramic or neodym magnets. Preferences are most likely due to other design features.

*: I was also looking at the Morel [SCM634](#) having heard from Eggleston speakers what they can do, but the more I looked at the C173-6-191E, the more convinced I was that this was the driver to look for in this project. The SCM634 is even more expensive (320 €/ea) than the Accuton.



Accuton C173-6-191E. Click images to view large. Download specs [here](#).

I hope the Accuton C173-6-191E midbass driver will stay consistent in the Accuton program for years to come. Developing a speaker based on drivers that are out of stock next year is no fun! The present C173-6-191E is a development of C173-6-195E. Comparing the two drivers we find Mms to be reduced by 1.7 grams, Qms slightly increased, hence Qt increased from 0.27 to 0.32. Cms has decreased from 1.35 to 1.20 and Sd increased from 130 to 132 cm². Efficiency appears slightly improved as expected from lower mass. That's all. This mostly sounds like a new rubber surround, but there may be changes to rear coating as well, because this cone does have a coating on the rear side.

"E" means it has "anti-resonant cutout fills" to dampen inherent resonances and it makes crossover work easier and the hope is that a simple 2nd order low-pass filter will do. Based on modelling it appears we can get away with a 1st order low-pass filter supplemented by a parallel notch filter smoothing the minor 4 kHz bump. This provides the target 2nd order roll-off.

Listening to music from the C173-6-191E without any crossover doesn't suggest serious cone break-ups or high-Q'd peaks. Quite remarkable from a hard-cone driver.



AudioTechnology 10C77-25-10-KAP sandwich cone. Click images to view large. Go to AT website [here](#).

Audio Technology 10C77-25-10-KAP bass driver has been reported in detail [here](#). Not much to add except that in its category*, this is the best 10" bass driver I've had: Fairly efficient, easy on crossovers, a punchy performer with low-level detail (high Qm) and only bad thing I can think of is weight... In a well constructed enclosure it breaks my back from moving speakers around from its 10 kg added weight.

* I reckon this driver in the family of mid-efficiency bass drivers. A 10 inch high-efficiency bass driver like the Eminence Deltalite II 2510 in a well-constructed horn will - to my ears - outperform the 10C77 with regard to transient response, and low-end extension is only a matter of horn properties. The price to pay is size. If it has to be small the 10C77 is the driver to look for and the price to pay is decent power amps that can handle the current needed.

The Jenzen Accu



Click images to view large.

Prototype front panels. Final front panels will be solid maple with my usual mahogany stripes.
25 kgs to the mid cab and 44 kgs to the bass cab. These speakers are heavy!

The Sound

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Setting up loudspeakers can become boring! Regardless of how the paper pulp or polyprop is used, we may have an idea of how this or that speaker is going to perform - and so they mostly do. Not quite so with these Accuton drivers.

After crossover simulation and a couple of hours' fine-tuning, the first test crossover was up and running - and well, finally something happened that usually doesn't happen: You hear something that sounds radically different from all other speakers. Depending on how the crossover is put together, these drivers will throw a different soundstage. Most noticeable is the reduction of the noise floor, and by this I mean that most other drivers will smear detail to some extent and leave a thin curtain of "noise" that we really don't notice until it's gone. Next we may go through acoustic instrument recordings and every single time start wondering if this is how it *should* sound. Is this driver right and all other drivers wrong? We only have the concert hall for reference so it's hard to compare, but for sure it seems like most instruments have reached a timbre quality few drivers can match.

Getting the midrange and tweeter level right took much longer than anticipated and points of crossover from 1.8-3.0 kHz were tried. Taking the point of crossover really low first of all confirmed the C30 *can* go really low, but on-axis response had to be recessed in the 2-5 kHz range to balance the wide dispersion. This was bit like the [Chario](#) speaker crossing over at 1.5 kHz and voiced to have a recessed on-axis response in the 2-5 kHz range. On paper this may look bad, but in reality provides a good balance between basic notes and overtones. If dispersion in this frequency range is wide we have a lot of energy projected into the room and we may have to attenuate a decibel or two to render a perceived "flat" response. In reality this also depends on room conditions and why some speakers may sound good in an acoustically lively room and in other rooms not. As a speaker designer this is an inevitable compromise to be considered. Most living rooms are less than ideal for sound reproduction and how do we voice a speaker to suit an average of living room acoustics? Not easy.

Eventually 2.3 kHz proved beneficial in not having a too strong upper-mid projection a fairly flat on-axis response. The mid crossover turned out more simple than anticipated and basically we have a 1st order filter on the electrical side with a single notch filter handling the 4 kHz bump. Acoustically this makes a close to perfect LR2 roll-off. The tweeter needed equalisation around 6-7 kHz in order to reduce some tendency to sibilance and an impedance correction circuit is also applied to smooth the high-pass slope and improve power handling.

What pleased me the most in this setup was the lack of attenuation resistors to the midrange. During some of the stages of development I had to attenuate middriver and every time this reduced midrange vitality. These Accutons should be handled with care!

What was also noticed during crossover development was the quality of crossover components. Initially I had a 3 x 33 uF Obbligatos for the mid high-pass section and they're good but changing these for super caps revealed their shortcomings in delivering micro detail.

The soundstage depth these drivers can present is astonishing. I couldn't help thinking of the [Mangers](#) I did in between the Jenzen NEXT and Jenzen Accu. We could make a 2-way from these two Accuton drivers that would forever put the Mangers on the shelf. And by the way: Running the C173 fullrange without high-pass filter suggested a strong and solid bass response even from the progressively stuffed TL mid cab. Material for a small vented two-way monitor some day....

Initially I ran the SEAS 26WFX002 for bass as I had to make new front panels for the 10C77s. The SEAS nextel drivers did well, but 10C77 further improved bass response and made an excellent match to the C173 mids. Over and over again the 10C77 proved a deep and articulate bass response from whatever material I fed them. They do very well with the TL design, firm, "short" and solid.

Getting the point of crossover between bass and mid proved a challenge and speakers had to be set up in different environments to get the best possible compromise, because this will always be a compromise as the acoustic environments these speakers may have to endure will vary greatly. Most people have to place their speakers too close to the front wall and too close to corners and the inevitable room gain starts playing its thing. The bass driver's notch filter is the trick to pull if things turn out too boomy. Leaving it out will increase response around 100 Hz and different resistors can be tried to make the best possible balance.

I can't help pointing to the distortion measurements shown below. This is the lowest distortion levels I have ever measured from a loudspeaker. At 5.6 volts input equivalent to -94-95 dB at 1 meter, the total harmonic distortion is below 0.5% from 1000-20000 Hz and below 1% down to 400 Hz. Amazing! No wonder these drivers deliver an unprecedented level of transparency and resolution.

Every evening during development I went to the workshop to hear another CD from my collection. One day the Getz/Gilberto CD. Although it had been a long time since last hearing, I didn't recall it sounding like this before.



It sounded ruthlessly naked, not as lush and colourful as I remember it. The shortcomings of the recording is clearly audible in terms of inadequate microphone placement and the semi-stereo recording and mixing. Getz' handling of his mouthpiece is clear as ever and the Accutons put you closer to the event than most other speakers will do.

I won't call the Accutons discriminating, nor sterile or "clean", rather neutral and "if this is what you feed me, this is what you'll get". This doesn't mean they're not influenced by the baffle geometry, crossover topology, crossover components' quality, points of crossover chosen and overall dispersion into the room; obviously they are and they appear to be an everlasting challenge in terms of overall voicing in making the best compromise.

I brought CDs that I was sure would fall apart and they didn't. I brought CDs I was sure would sound great and they didn't. These Accutons are a diy'ers dream as you will learn new stuff about all the things going into speaker building. You won't be bored!

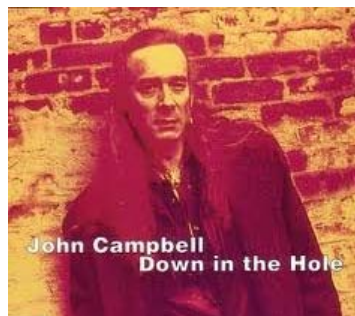


So, what are the limitations of the Jenzen Accu? Considering the overall cost there shouldn't be any shortcomings at all. Well, there are and the bottleneck is size if we play really loud. Playing the Stan Getz *Cafe Montmartre* track two, "I thought about you", at loud level - like sitting 3rd row, the sax solos may become compressed as we approach a sound level exceeding the capability of the midrange driver. Hmm...I took the CD to our living room and played the same track on the DTQWTs with their 8" middrivers and despite a slightly reduced sense of soundstage depth, they reproduce these solos at ear-shredding levels without problems. Size matters. I'm reluctant to put this "on paper" as it may turn off someone who would otherwise be highly satisfied with the design.

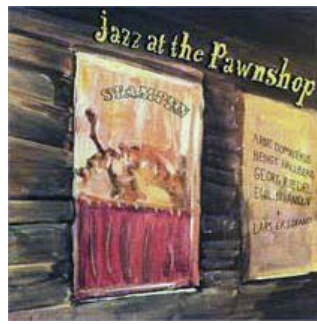
The problem is that when we buy a loudspeaker - or build one - we'd rather not hear about its shortcomings. But every speaker has its shortcomings, let's face it. I had a mail from a guy badly wanting the [PRELUDE](#) and considering the cost I asked him if he was aware of its shortcomings, like how loud a 5" middriver goes? I never heard from him again. We look at gorgeous drivers and fantasize it may be aural nirvana and forget thinking of how much air they can move. I rush to say that the Jenzen Accus were played at levels where most people will leave the room.

You may argue I didn't get the crossover right - or my front gear wasn't up to its task. Maybe so, but so far I have to conclude that the Accutons have their strengths, actually a lot of them - and they have their weaknesses like all other drivers. They can deliver an amazing level of transparency, but they may fall for the "insufficient linear volume displacement capability" like all other drivers. I could take the point of crossover between bass and mid up to 400 Hz and relieve the middriver from some of its duties in upper bass/lower mid, but this takes away the magic of the midrange.

28-04-2012: What was my fear of writing the above has already come true. People are reading reservations like the Devil read the Bible. Again, face it, every speaker has a maximum SPL mostly determined by the size of the drivers.



I often play John Campbell's Down in the Hole as a start for first time DTQWT visitors. Then we're kind of clear on bass performance and ability to play a rough vocal presentation at loud level. From here we can go on exploring more subtle features. So, can the Jenzen Accu do this track at loud level? It can. I'm only adding this example to emphasize that every speaker has its strengths and weaknesses - and to balance the statements made above. The Accuton drivers will time after time make you wonder if what you've heard before is really what it should sound like. Not that the Accutons are right, only a possible reference of neutrality. They will be my reference speakers for evaluating transparency and low distortion.



I know some people are fed up with references to this recording, but it's still an excellent example of spatial information. I can assure the C173/C30 drivers more than ever will make you want to reach out for the beer glass on the bar. I recently bid on mint condition Pawnshop LPs from the Eighties and they went up to 300 USD. I got them and they were worth the price. They clearly tell what happens to LPs when they've been played several hundred times, they lose micro detail and the soundstage depth is reduced.



Above my most likely two desert island LPs. I have a reserve copy of *Still Live* when current pressing gets too worn. Every time I put these LPs on the spinner I discover something new. These are excellent live recordings on par with the Köln concert. Better bring that one too... I enjoyed all LPs thoroughly played on the Jenzen Accu and maybe this is what the (Köln) Bösendorfer piano is supposed to sound like? Usually Keith plays Steinways. The Jenzen Accu has a unique ability to put your power amp on the spot. My power amp stock is limited and I can only refer to the 300B, 6C33 PSE and Jungson JA88D-09 (8, 45 and 80 watts respectively) and the sonic differences are significant. OK, the 8 watt 300B amp really isn't up to the task of driving any of the Jenzen speakers, but it strongly suggests not driving the speakers with even the slightest harsh sounding amps. I tried my old Rotel RB981 power amp and even without any input capacitor this amp sounds really bad. The 6C33 PSE had better grip, but heavy bass transients on a -89 dB speaker is not its favourite dish and it misses the punch of the Jungson. The Jungson drives it very well, only has a slight emphasis on the midband at loud levels despite excellent transparency. I wish I had a pair of really good high-powered valve power amps, maybe the Conrad Johnson LP125M being reviewed in the Dec 2011 *Stereophile* magazine. Or the BAT REX Power to stay with the 6C33 tubes. And by the way: HiFi can easily become an exercise in beautification of reality and the speakers are often the usual suspects if things go wrong. The Accutons may force you to critically review your whole system and try out different cables, coupling caps, etc. But be careful, maybe a piece of harsh sounding music is really supposed to be harsh, only you never heard it before because you've chosen "smooth" sounding caps, "smooth" sounding cables, soft-cone drivers, etc. Go to the nearest symphony hall and listen carefully to the whole string section when all are doing a crescendo. It mostly doesn't sound particularly good - regarded as sound itself. The music may be great, but the sound of a string section is often massive and harsh. I mean, this is what it should sound like in your living room too and not be beatified by a whole range of precautions.



Knud Jörgensen *Jazz Trio* on OPUS3 label. Another example of the magnificent recording from this record label. Intro track *Satin Doll* has some heavy piano chords I often use to test speakers' ability to not smear detail and sound congested. The ceramics are absolutely cool on this material, no problem at all.



Above a few of the classical vinyls enjoyed during Jenzen Accu development. I often play Heinz Holliger to demonstrate speakers' ability to play oboe at realistic levels without distress to the ear. The Decca Benjamin Britten LPs of Brandenburg Concertos were picked up at a local 2nd hand market for nothing. Mint condition vinyls and not CD as shown here. The Sibelius 5th is a reissue and an excellent pressing. Mahler's 5th, Chicago Symph. Orch. is a classic and probably the best recording ever made of this symphony - and it was done in 1958! I have this recording on both LP and CD (JVC sracd).

The original vinyls are worn; never managed to find a mint pressing. By the way: Check out this youtube video of Leonard Bernstein directing the Vienna Philharmonics (4th movement) <http://www.youtube.com/watch?v=pCsnpVYtMg> Maybe an even better vocal presentation by Edith Mathis. Magnificent! Also listen to the 3rd movement; soothing for the soul: <http://www.youtube.com/watch?v=XOuxQmBhXk&feature=related> - quite different from the Chicago recording, which I like the most.



- blue(s) -

OK, I'll stop with these two before it turns into a review of all my music; the remastered Joni Mitchell recording *Blue*. Hearing the track *Case of You* is something on the Accus. I've listened to this tune many times from the Diana Krall *Live in Paris* recording. Here we have the raw, stripped to the bones, version by the artist herself. It sounds like recorded on a two-track tape deck without any editing, added reverb, etc. *Blue* really doesn't sound particularly good - because it shouldn't. Like old Miles Davis recordings, *Blue* has an authenticity, which may be hard to find these days. The Accutons can help you getting there.

And finally the *Café Blue* by Patricia Barber. I recently had this one on vinyl and I'm afraid this will be a desert island LP too. The level of transparency and the dynamics put into the grooves here is remarkable. An outstanding recording and the Jenzen Accu will nail you to your listening chair.

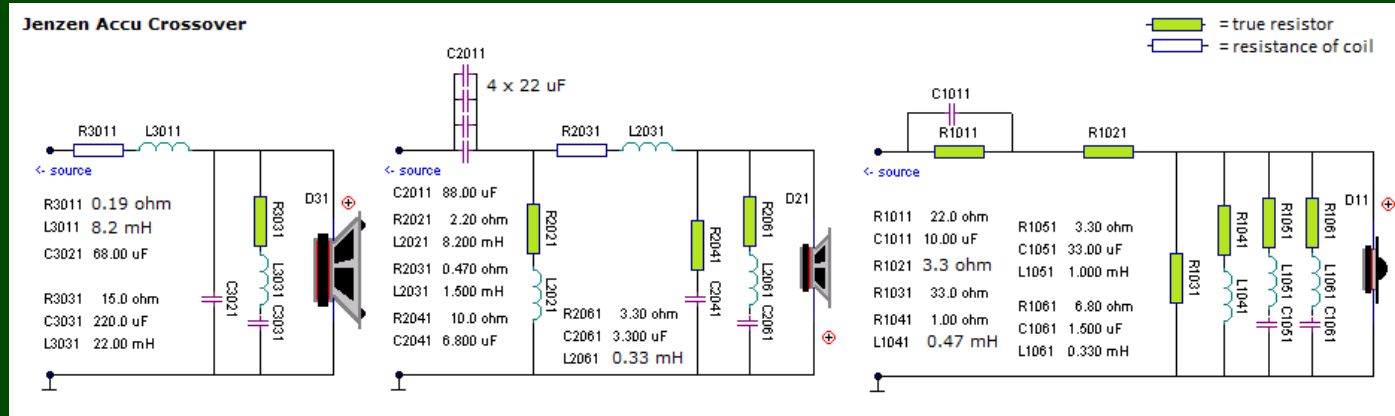
The Accutons may give you another view of your source material, and there's a logic to this. If you have a highly revealing system with low distortion, lesser quality program material will be presented as such, where more "forgiving" speakers may never truly tell you the quality of your recordings. There are bad CDs and there are bad LPs, either due to poor recording* or poor post-processing of master file - and quite often both. By nature vinyl displays higher distortion than CDs and poor LP pressings or poorly mixed recordings may stay on the shelf with the Accutons. The "thing" about these Accuton drivers is that you pretty much get what you feed them. So, can your system - and your ears - "handle the truth?"

*: I always felt the microphones Diana Krall uses for her vocal are really crappy, or she sings too close - or some producer thinks he/she should spice up the sound a bit. Mostly sibilant regardless of speakers I've tried - and they're many.

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Crossover

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The crossover design is as close as possible to a 2nd order [Linkwitz-Riley](#) topology. The tweeter is off-set by 19 mm to render flat amplitude and proper phase integration between mid and tweeter.

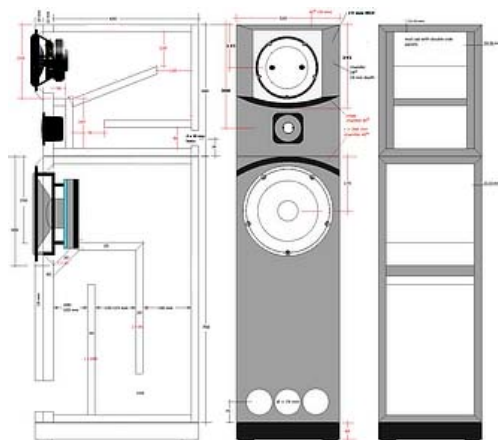
For bass the LCR circuit (R3031, L3031 and C3031) is optional. Due to the low point of crossover the rise in impedance towards lower frequencies alters the behaviour of the low-pass section and by smoothing the bass driver's impedance we get a smoother frequency response. Leaving out the LCR circuit creates a bump in the ~80-120 Hz range. Some may find this adding warmth to the low end response and indeed we have some equalisation options here by altering R3031 and to some extent adjust to room conditions. Placed close to corners the LCR circuit may come handy. Try out 10, 15 and 22 ohms to hear what happens (R3031).

With the Flex unit bass driver, the mid could fortunately do without a series attenuation resistor. Every time I tried reducing mid level with a series resistor as low as 1 ohm, it had a slightly negative impact on mid performance. Included in crossover kit is 0.68 ohm resistor to be inserted before R2031. R2031 and L2021 must be connected right after C2011. I don't think you will find this resistor necessary unless your amp has an unusual presence.

For tweeter, bypassing C1011 with R1011 helps improving phase integration with the midrange driver. LCR circuit 1051 flattens impedance peak and shapes roll-off. LCR 1061 removes a little too much energy around 6-7 kHz (sibilance). Tweeter attenuation is provided by R1021 and R1031. View response graphs below from various R1021 values.

Transmission Line Cabinets

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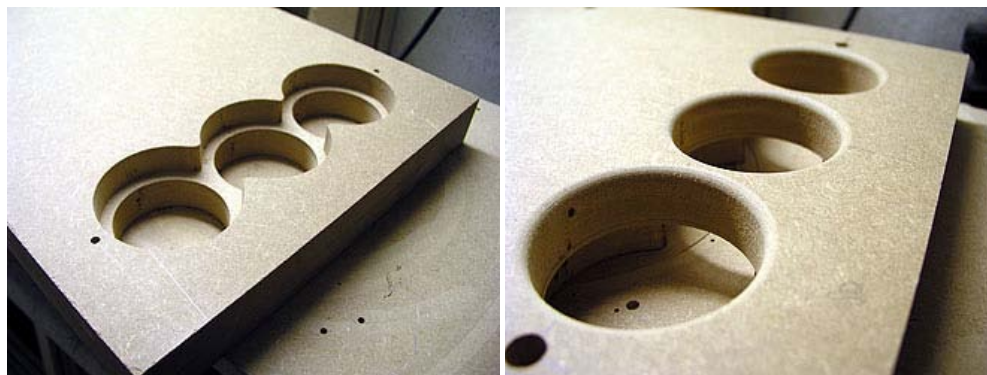
Click image to go view large.

[Go to cabinet construction website.](#)

Pay notice to the different shape of the bass front panel for this Accuton version.



When doing the TL cabs for the SEAS ER version I didn't foresee the size of the 10C77 magnet. This magnet is huge and I had to do the above surgery. Make a 60 x 140 mm cutout as indicated on image and add a small panel on the other side.



Making round holes is easier compared to rectangular, thus 3 holes of 75 mm diameter for the TL vent.

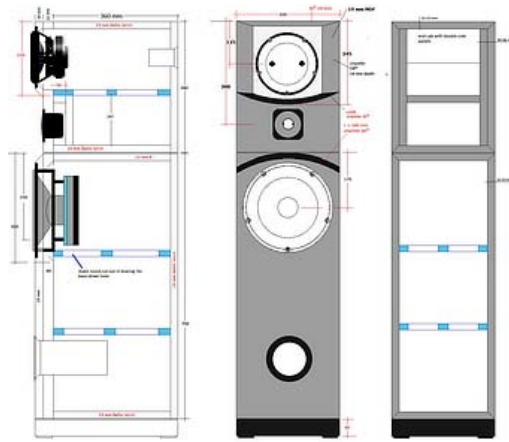
Bass Reflex Cabinets

In case you may want to make a vented version, click image below. If you remove the bass cab transmission line panels you have a net volume of 78 litres. This makes a nice F3 of 35 Hz. Port tuning = 32 Hz. Port = 100 mm (ID) x 155 mm length. If you cut depth to 360 mm (depth without front panel) you get 65 litres and F3 = 38 Hz. Maintain port tuning of 32 Hz and port is now 100 x 197 mm.

With this new cabinet depth for the mid/tweeter - and by removing internal panels - we have around 25 litres minus volume of tweeter cab and bracings. This fits the C173-6-191E well and I suggest adding a port to the rear of 50 mm (ID) x 75 mm. Stuff the port lightly with damping material to make an aperiodic tuning. The port leaves you the options of vented, aperiodic and closed box (the latter by stuffing the port hard). They don't sound exactly the same and it provides a lot of options for little cost.

Add two braces to the bass cabinet and one brace to the mid cab. Please check other files for how this can be made, e.g [QUATTRO](#) cabs. Regardless of your choice, maintain front panel dimensions, driver layout and front panel chamfering. This is of vital importance of how the crossover performs. The middriver front panel provides an unusual flat response from the drivers tested so far.

Jantzen Audio ports: For bass cab: 2 pcs 100 mm (ID) x 200 mm, item #900029. For mid cab: 2 pcs 50 mm (ID) x 145 mm, item #900023. Cut to required length for mid and for bass if you choose the large vented option.

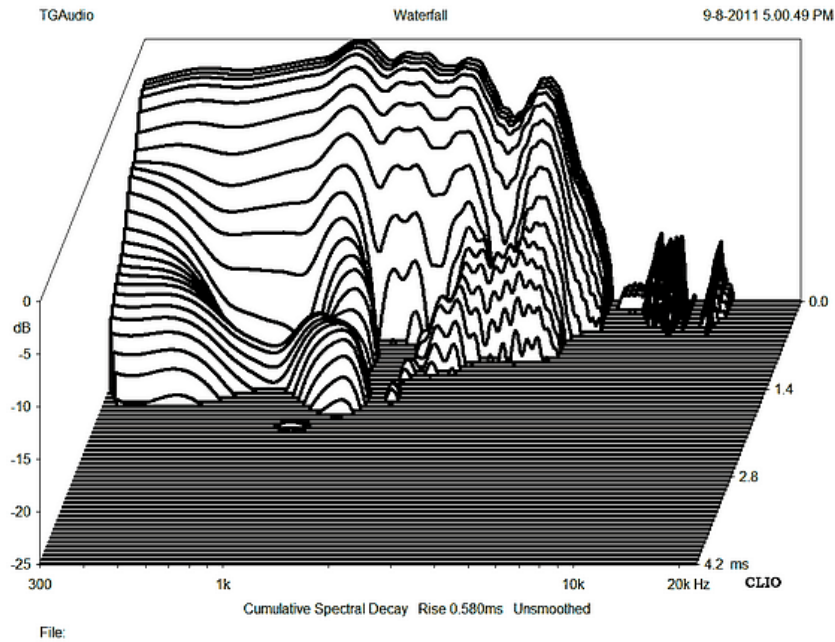


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Measurements

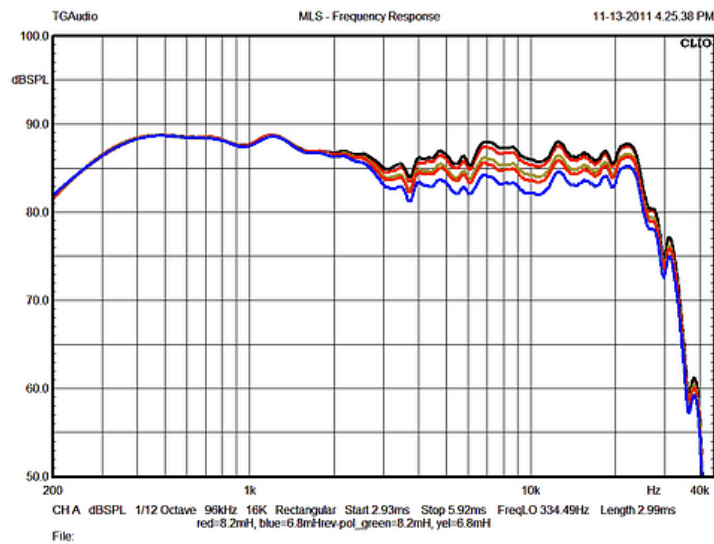
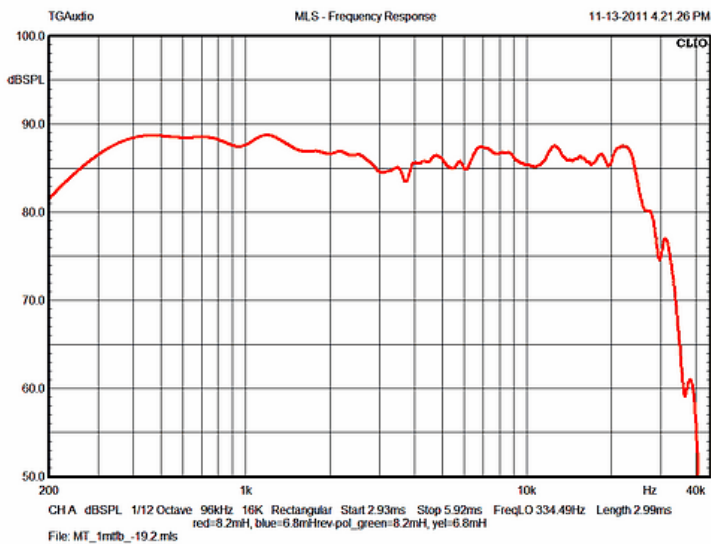
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Generally measurements tell close to nothing about the sound of a speaker system, thus only a few will be shown.

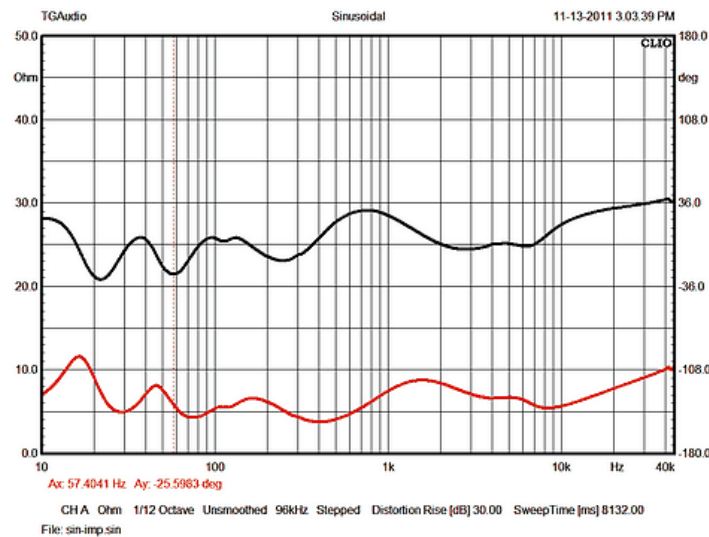
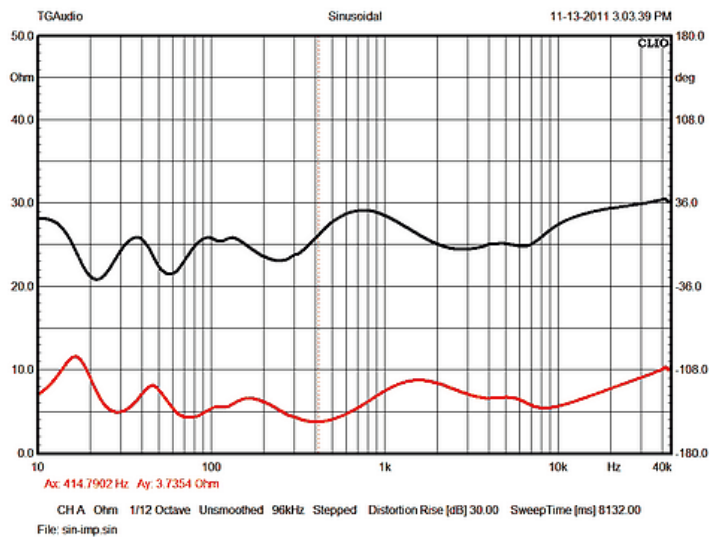


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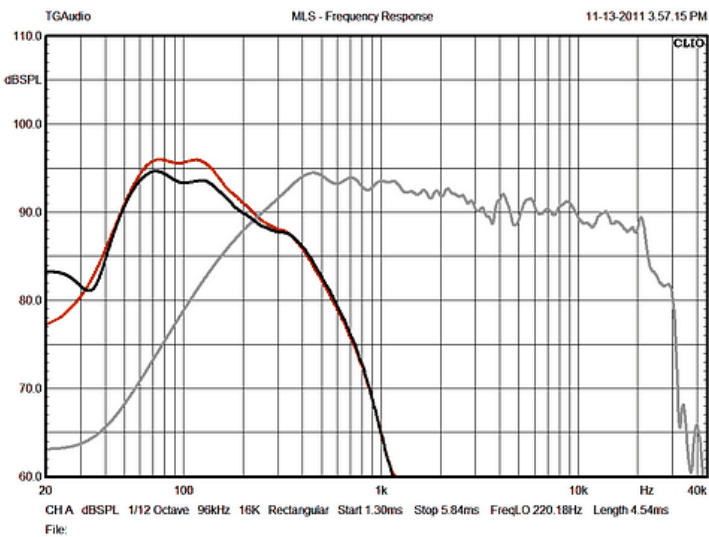
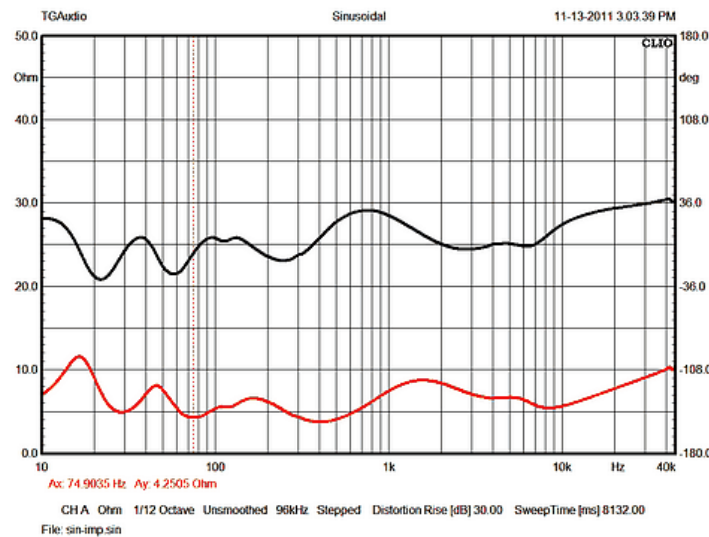
I'll start with this cumulative spectral decay plot showing the C173-6-191E as-is. No crossover attached. This is better than many soft-cone drivers can manage and tells why we can listen to the driver fullrange without ear protection.



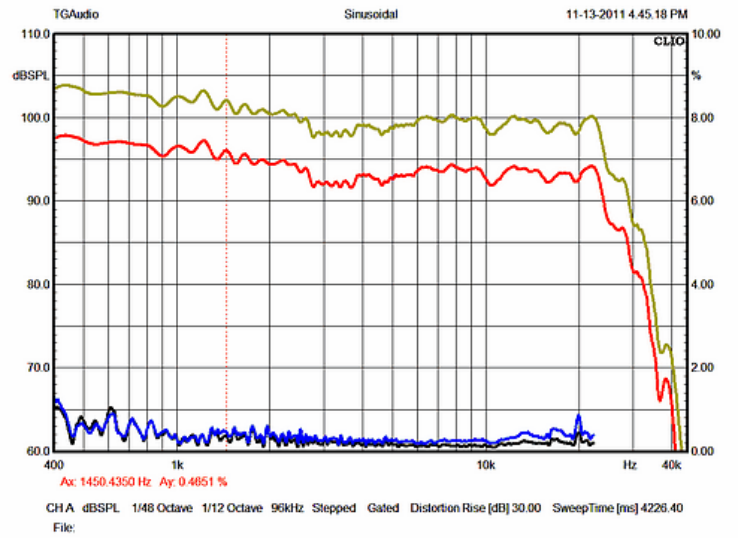
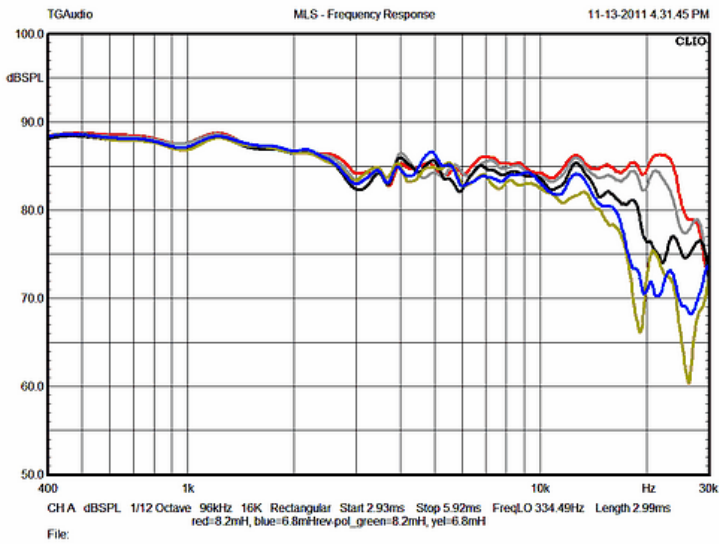
Left: MT section at 1 meter/2.8 volts. Tweeter attenuation resistor (R1021) 2.7 ohms. Right: Tweeter level at R1021 = 2.2, 2.7, 3.3, 3.9 and 4.7 ohms. You may think 2R2 is the way to go, but considering the unusual wide dispersion of the C30 dome, this will project way too much treble into the room. I use 3R9. If you don't listen very loud, a 3R3 may be suitable, it does deliver loads of detail. The bigger the listening distance the lower attenuation you may favour.



Left: Impedance of final system. Minimum 3.7 ohms @ 415 Hz. Right: Impedance showing phase angle of -26° at 57 Hz. Generally a very easy load on amplifier.



Left: Impedance showing minimum impedance of 4.3 ohms at 75 Hz. Right: Nearfield response of bass and mid-tweeter. Point of crossover ~230 Hz. Black = bass LCR circuit connected, R3031 = 15 ohms.



Left: Horizontal dispersion at 0°, 10°, 20°, 30°, 40°.
 The C30 tweeter display and unusual wide dispersion characteristic, hence my default tweeter attenuation resistor is 3.9 ohms.
 Right: Distortion (THD in percent) measured at 0.5 m distance, 1/48 octave intervals, 2.8 and 5.6 volts input, equivalent to ~88 dB and ~94 dB, 1 meter.
 This is the lowest distortion levels I have ever measured from a loudspeaker.

Crossover Kit

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Jenzen Accu kit-calc						
Coils:						dim. mm
Coil No.	Wire Ø mm	AWG	mH	Ohm	Ø x h x Ø	pcs
C-coil	1.20		8.2	0.19	70 x 25	2
5079	1.00		22	0.96	46 x 55	2
5033	0.80		8.2	0.80	45 x 35	2
WAX		16	1.50	0.47	81	2
WAX		16	0.47	0.23	59	2
WAX		16	0.33	0.19	55	2
1835	0.80		0.33	0.39	15 x 30	2
2235	0.80		1.00	0.33	30 x 24	2
Caps						mm, Ø x L
	type	volt	µF			
STANDARD Z-CAP	MKP	400	68		48 x 62	2
Electrolytic	alu	100	220		16 x 38	2
Superior Z-cap	MKP	800	22		52x70	8
Superior Z-cap	MKP	800	6.8		36x65	2
Superior Z-cap	MKP	800	3.3		30x45	2
Silver Z-cap	MKP	800	10.0		46x70	2
Superior Z-cap	MKP	800	1.50		22x45	2
STANDARD Z-CAP	MKP	400	33.00		33 x 60	2
resistors						dim. mm
		watt	ohm			
MOX		10	15		8 x 53	2
Superes	non-inductive	10	0.68	mid att. optional	8 x 53	2
MOX		10	2.2		8 x 53	2
Superes	non-inductive	10	10		8 x 53	2
Superes	non-inductive	10	3.3		8 x 53	4
Superes	non-inductive	10	22		8 x 53	2
Superes	non-inductive	10	2.7	tweeter att.	8 x 53	2
Superes	non-inductive	10	3.3	tweeter att.	8 x 53	2
Superes	non-inductive	10	33		8 x 53	2
Superes	non-inductive	10	1.00		8 x 53	2
Superes	non-inductive	10	6.8		8 x 53	2
						62
Miscellaneous						item #
terminals	satin nickel			pairs		4
wire	Jantzen Supra			black	meters	3
wire	silver plated copper in teflon			red	meters	10
wire	silver plated copper in teflon			black	meters	10
solder tag strips	gold plated					2
felt material, 13 mm	square meters					2.0
polyester damping, 30 mm	square meters					1.5
egg crate foam	square meters					1.0
drivers						
Accuton	C30-6-024	not supplied by Jantzen Audio				2
Accuton	C173-6-191E	not supplied by Jantzen Audio				2
Audio Technology	10C77-25/10-KAP	not supplied by Jantzen Audio				2

For price quotation incl. shipping, please contact Jantzen Audio at: contact@jantzen-audio.com

Download [Jenzen Accu Kit Presentation](#)

I strongly suggest including the damping materials in your purchase as this is of vital importance for making the transmission lines work properly. Builders send me images of damping materials and based on photos I cannot tell if these materials work properly.

Include 2 pcs 100 mm (ID) x 200 mm, item #900029 and 2 pcs 50 mm (ID) x 145 mm, item #900023 if you go for a vented solution.

I bought my Accuton drivers here: <http://www.hifisound.de/> There a quite a few dealers on Accuton so take a look around. For US citizens, Madisound seems the place to go: <http://www.madisound.com/>

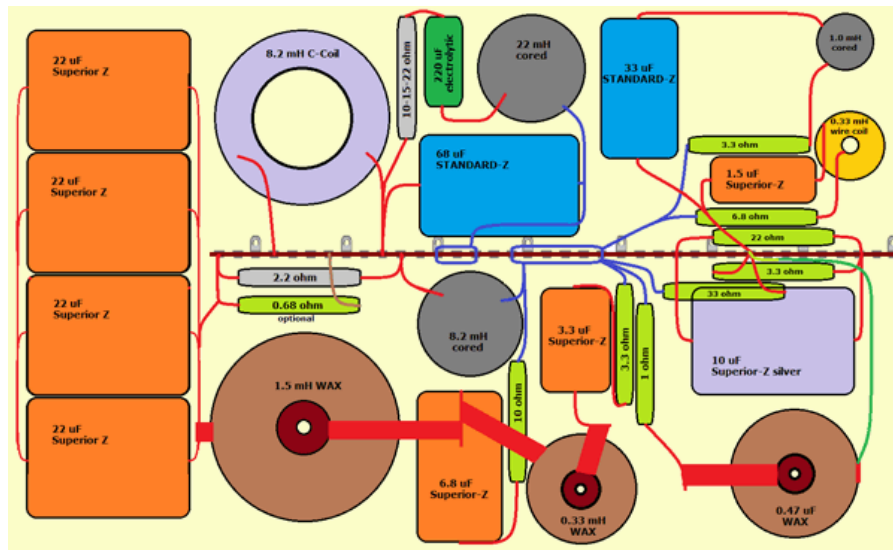
Audio Technology drivers available directly from the factory: <http://www.audiotechnology.dk>

Asia from where I live is "Far East" and I honestly don't know where you guys buy your speaker parts. I know Korea has diy shops like [SOUNDFORUM](http://www.soundforum.com), but that's about it. They trade both Accuton and Audio Technology.

All technical questions at: troels.gravesen@hotmail.com

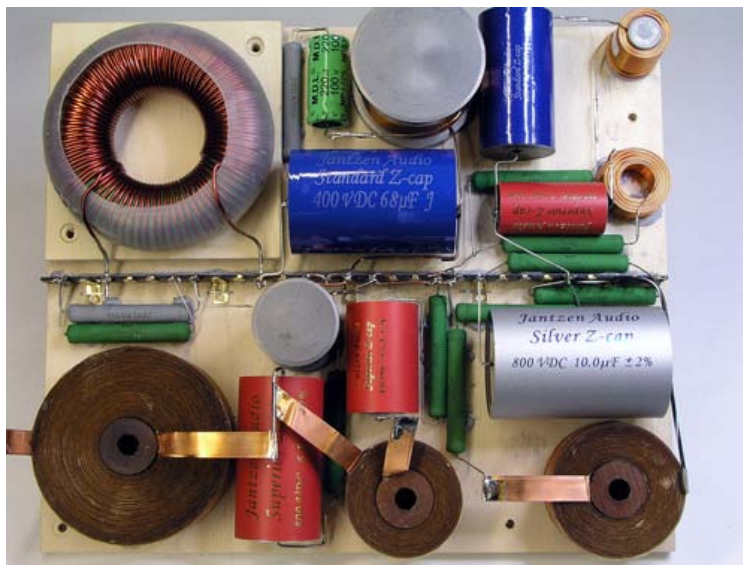
Crossover Layout

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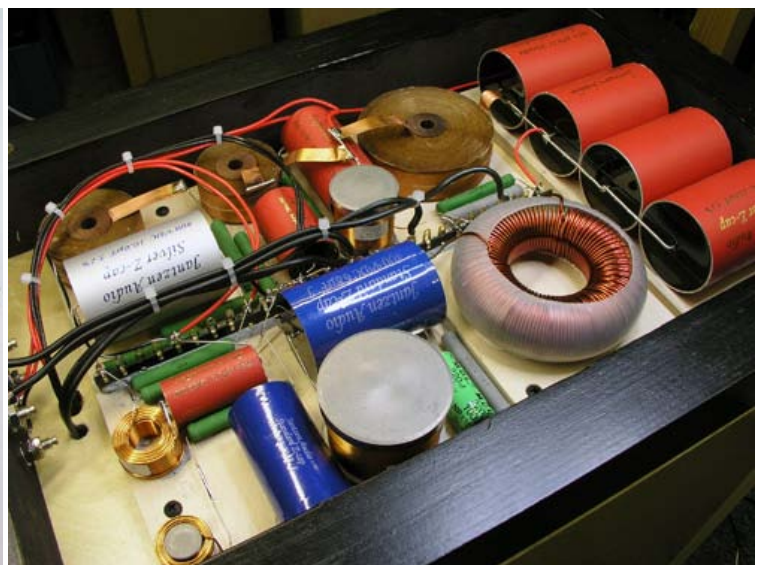
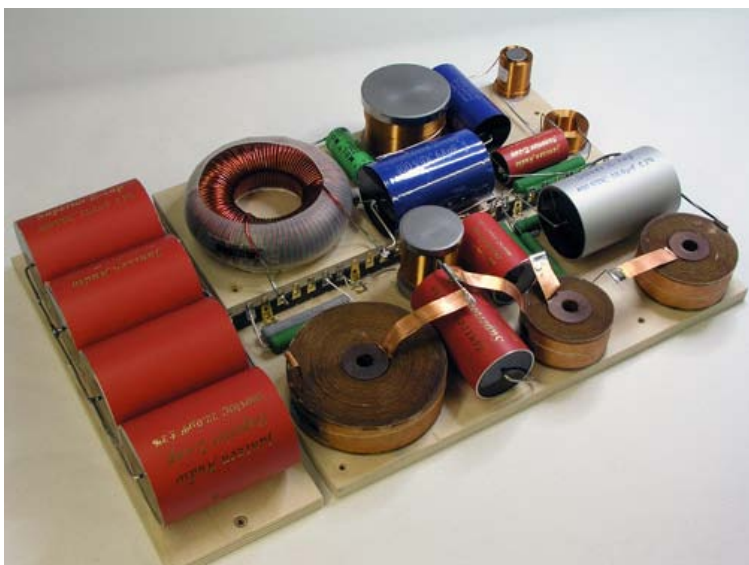


Click image to view large.

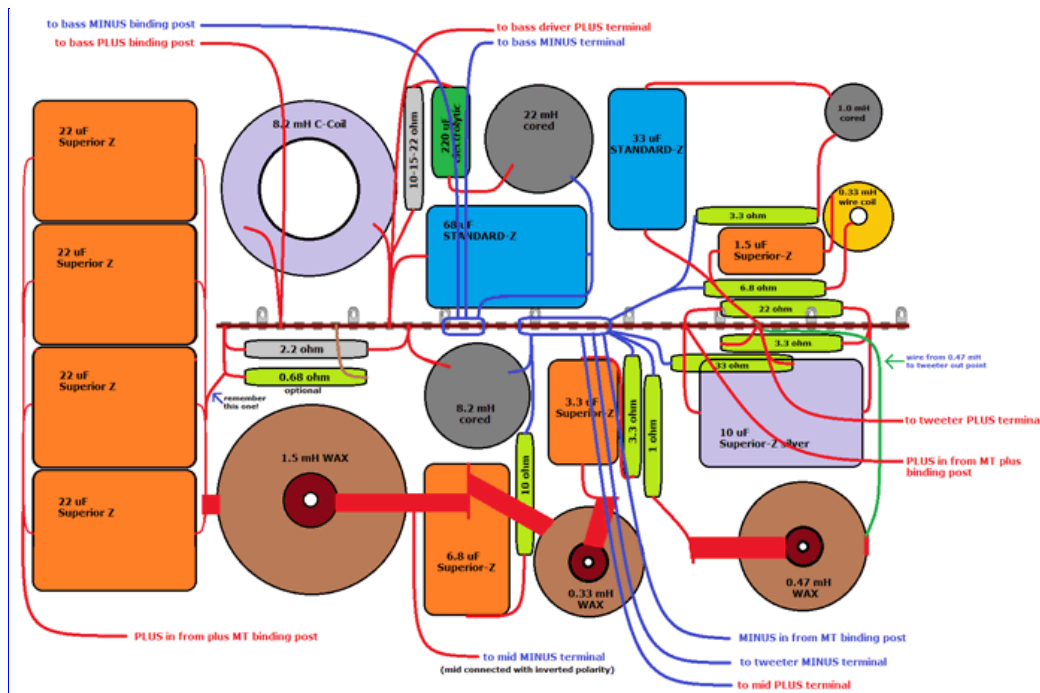
In case you want to attenuate mid level, download wiring instruction [here](#).



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Connecting drivers and binding posts. Click image to view large.



Prototype front panels had a quick splash of black paint for the photoshoot.