Sound Practices

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Summer 1992 Contents

Voices from the Fringe?

Audio today consists of a much wider range of practice than you'll find reported in the glossy mags. Some of the most interesting activity in the hobby takes place outside the borders that commercial producers of contemporary equipment accept as their playing field. There are vintage gear enthusiasts, modifiers of old and new gear, and people who build things that the manufacturers are wise to avoid - products with limited popular appeal or which are not economically viable to manufacture. Except for Audio Amateur/Glass Audio, there's no dedicated forum for do-it-yourself audio, one of the most rewarding facets of our hobby. Only a few decades ago DIY was an important part of the hobby for people as committed to it as we are. What happened?

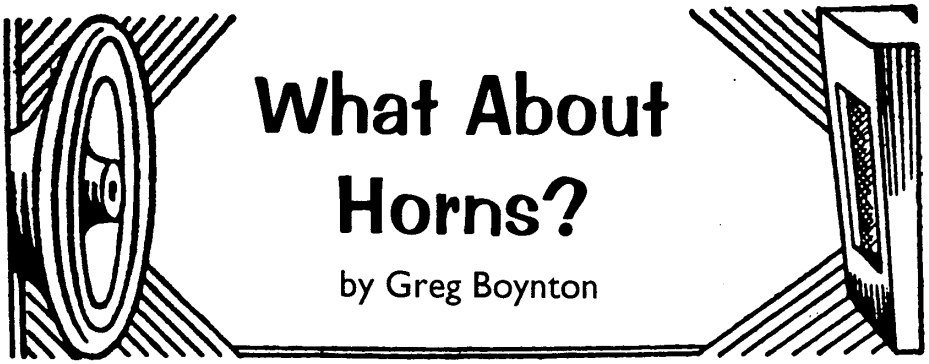
Since most magazines focus on the latest gear and currently fashionable technologies, any sense of the development of audio over the decades is lost. I consider the absence of historical perspective in the literature a very major failing. The development of the technology over the 80 years since the first useable tubes came along is a fascinating and important story which is too seldom told. And we would have a clearer understanding of present trends in audio (and other technology) if we study the past accomplishments of the ancestors and evaluate our practice in light of the technical and institutional factors which give it its present shape. Besides, some obsolete (and otherwise unfashionable) technologies can produce superb 1992 sound! Witness the current triode "revival".

My academic training is in anthropology not engineering. One of the main tenets of anthro is "relativism", the idea that one should keep an open mind about different ways of being. First you must consider what people themselves think they're doing, from *their* insider perspective, if you want to understand their actions. If you enter the worlds of sound engineers of the 1930's, Japanese horn speaker listeners, or contemporary high end designers you will meet some very smart people. The tools, technologies, and values are different, but there is a timelessness in the wisdom (and sometimes foolishness) of all sound practices.

Everyone who contributed to this issue is writing on a subject they get excited about. To get Sound Practices rolling, I wrote an article on one of my favorites, the single 300B amp. Then, I approached a few passionate, perceptive, and particularly adventurous audiophiles and asked them to write about what *they* believe needed to be said. I think you'll agree that there is an atypical group indeed gathered in the pages of our premiere issue. You would never read this stuff in *The Sensible Sound.* Voices from the fringe? Perhaps, but they say it with heart.

Lunatic fringe, DIYers, historians, and experimenters.There is a group of us looking beyond what is available in the glossy magazines. We know who we are and, as the old Spanish *aforismo* puts it, "We are not many but we know how to find each other." Maybe Sound Practices will be a place where we can meet and enjoy the benefits of the gathering.

Joe Roberts



What About Horns?

by Greg Boynton

Over the last 5 years, I have had the pleasure of exploring a branch of home speaker design that has been all but forgotten by the audio mainstream. The title of this article should give you a hint. Yep, that's right, HORNS! Oh my God you say, what is this person babbling about. Obsolete technology. Honky and distorted, right?

Wrong. I once held the opinion that horns were a kind of bad joke. People who used horns for speakers were either deaf or had a major case of tin ear. I now find myself in the somewhat awkward position of being a horn advocate. While bad horn systems are indeed unspeakably bad, a great one can be truly great.

Horn speakers fall into that category of products that includes vacuum tube amplifiers, vinyl records, and analogue tape recorders. These technologies were discarded primarily for reasons of convenience and profit margin. For the serious audiophile, the analogue record-tube electronics-horn speaker combination offers performance that leaves many CD -solid state amp - cone speaker systems in the dust.

Horn systems take up a lot of space but doing it right will also require time. To really get horns set up correctly will require a fair amount of thought and experimentation. You absolutely must get amplifiers which are compatible with the speakers. Biamplification (separate amps for high and low frequency drivers) is necessary to explore their full potential. It will require some effort on the part of the builder to acquire all necessary parts for the system. Finally, most horn system components (even the classy pro stuff) just don't cut it. You will have to choose your parts wisely.

But when you get a horn system set up right, the sound quality is amazing. The most obvious advantage is in the dynamic range and transient response of the horns. For me, the emotional impact of recorded music is in the dynamics. Most speakers just do not produce realistic dynamic contrasts. Horns do, and they do so with ease. They also excel in low distortion. The sound seems unusually clean even at high levels. Imaging quality ranges from adequate to outstanding, depending on the shape of the high frequency horn and the frequency extension of the driver. When I listen to my horn system, I find myself getting lost in the music, rather than in critiques of sound quality and technical arguments. That's the whole point.

SELECTING A HORN SYSTEM

Now that I've talked up horns, let me say that I'm not suggesting that you run out and buy one of the "classic" hi-fi speakers from the 1950's. Most of them make horrible compromises in design and are not worth the trouble. Particularly bad sounding horn speakers for the money include: any Klipsch product, RCA, EV Patricians, Georgians, etc., JBL Hartsfields (HA!), Altec 604s, any folded horn design, and any design in which time alignment of the drivers is impossible.

If you want a horn system, the best bet is to start with industrial equipment made by Altec, JBL, or Western Electric. Altec gear is the easiest to find and to work with. Aside from being reasonably common, Altec components are available at reasonable prices - a great system should cost less than $1000, much less if you're lucky. Also they made about the only workable low frequency cabinet for hi-fi use.

A two-way system is the easiest to build and set up. Also some of the best speaker components ever built were designed specifically for use in two-way systems. My favorites are the components designed by Jim Lansing (of JBL and Altec-Lansing fame) for Altec's famous "Voice of the Theater" systems. All of the VOT systems use similar cabinet designs but the size varies dramatically. Some of these babies weigh thousands of pounds. All VOT systems used the same drivers in various combinations. Typically they use 15" woofers and 1" or 1.4" high frequency compression drivers. The crossover point is typically in the 500 cycle range, giving each driver approximately 5 octaves to reproduce. The high frequency driver is fully horn loaded. The woofer is partially horn loaded with lower frequencies handled by a ported enclosure. The best known examples of this kind of speaker are the venerable Altec A5 and A7 VOT systems.

THE HIGH FREQUENCY HORN

Horn selection is probably the single most important challenge in constructing a high-fidelity horn system. Nearly all of the horns that were available from the major manufacturers sound dreadful. In putting together my system I listened to 12 different pairs of Altec horns, as well as some Electrovoice and JBL pieces. All of the horns were rated for use with a 500 cycle crossover. I can only conclude that sound quality just was not as important a design consideration as small size and dispersion control. Almost all of these horns exhibited large amounts of distortion at the crossover point and significant high frequency rolloff.

Most horns designed for theaters and auditoriums are meant to spread sound over a large area. Wide dispersion is not something which comes easily to horn speakers. Most designs rectify the directivity problem by sacrificing performance in other parameters. Such horns include multicellular, diffraction, and sectoral designs. All of them (well, most of them...) perform as designed. But, when the goal is ultimate fidelity, avoid them. Their sins are too numerous to list.

Instead, look for a horn with the following characteristics: First, you should be able to look straight into the mouth of the horn/driver combination and directly see the phase plug of the driver with no obstructions whatsoever. From the driver, the horn walls should follow a smooth curve as the horn opens out. Straight walls should be avoided if possible. Avoid radical changes in the cross-sectional shape of the horn. From

the driver through the throat, it should smoothly assume the shape of the horn mouth. The shape of the mouth is probably best kept close to a square or circle. Rectangular mouths with radial aspect ratios have the characteristics of diffraction horns and should be avoided.

In order for the horn to sound good through the crossover point it must be very long compared to most commercial designs. I would suggest at least 3 1/2 feet long for a 12 dB per octave crossover at 500 cycles. A somewhat shorter horn will work with an 18 dB or 24 dB per octave crossover. Shorter horns will tend to have severe intermodulation distortion and impedance problems around the crossover region.

Avoid any horns built of non-rigid materials like cardboard (no joke!). If the horn is constructed of a resonant material like cast aluminum or sheet steel, use some sort of deadening material like Mortite or lead sheet to control the resonance. Bolting the horn to a secure mount also helps. That's right, take all of those piles of old stereo magazines out from under it and bolt it down.

THE HIGH FREQUENCY DRIVER

There are several factors to consider in choosing a high frequency driver. The diaphragm material is important if wide frequency response is a goal. Aluminum, beryllium, and titanium are good. Only metal diaphragms are worthy of serious consideration. Phenolic diaphragms are best used in airport paging systems. Apologies to fans of old EV and RCA stuff but they just don't do it for me.

The phase plug is also important. The best system was used in the Western Electric, Altec, and JBL drivers. These units use concentric exponential flared slots through which the sound passes from the diaphragm to the throat. Again, avoid older EV drivers - now that the patent has run out EV uses the Lansing phase plug.

The magnetic system is also significant in its effects on both frequency response and driver distortion. heavy drivers generally sound better than light ones. This is because a large amount of iron is needed to carry the powerful magnetic fields which energize the voice coil gap. Try to get drivers with Alnico V magnets. These have inherently lower distortion than the ferrite crap they make nowadays. Pre WWII drivers often used

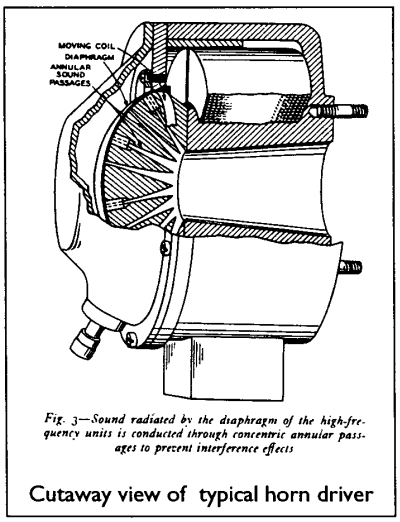


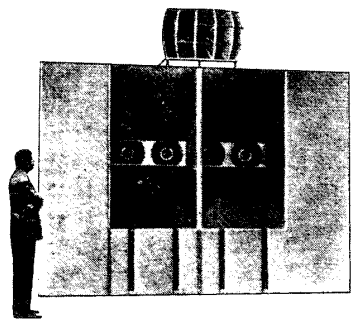
Fig. 3—Sound radiated by the diaphragm of the high-frequency units is conducted through concentric annular passages to prevent interference effects

Cutaway view of typical horn driver

powerful electromagnets and are worth checking out if you can find them.

THE LOW FREQUENCY ENCLOSURE

Low frequency horns require lots of space. To actually get even 50 cycle tones out of a horn it must be *huge*. In some installations people have built straight exponential bass horns. A system of this size would take up my whole house. The best compromise is to partially horn load the bass. This requires an enclosure which is both a short horn and a tuned port. The short horn is not compression driven like the high frequency section. It's really more of a directional baffle. It serves two purposes: the woofer cone is recessed into the enclosure facilitating the alignment of high and low frequency drivers and the dispersion of the woofer at the middle frequencies is narrowed making a more natural transition to the narrow dispersion high frequency horn. Altec used this system almost exclusively in "Voice of the Theater" installations.



The Altec A-2: A large VOT system

For most people, buying the cabinet is a smarter move than building one. Construction of the wooden horn parts is best left to those with serious woodworking experience. I built Altec A7 type cabinets and it was no fun at all. An interesting and convenient alternative is to buy one of the modern public address cabinets. Community Light and Sound makes a cool thing called a VB790 which is a fiberglass version of the Altec vented horn type enclosure. To build it you buy the fiberglass horn from CLS and construct a nice rectangular box. The flare bolts in with no hassle. But, I imagine most of you are hung up on having the original kind of thing. In that case, buy the Altec 3/4" or 5/8" plywood cabinets that were part of the A5 or A7 systems.

The A5 and A7 cabinets are fairly common since they were the mainstays of the VOT line. If you have the space, one of the larger VOT cabinets would provide better low frequency performance. For most of us, practical considerations dictate a smaller system

LOW FREQUENCY DRIVERS

There are a lot of good choices for a low frequency loudspeaker. I have listened to units from Altec, Electrovoice, JBL, Jensen, and Stephens. The quality of bass note tracing some of these units can produce when properly horn loaded is amazing. Woofer design has not really improved for quite a while. Many of the older units are unsurpassed in performance.

Most modern woofers offer reduced efficiency and greater power handling capability. I have seen this trend quite clearly in the sound industry. JBL now makes 15" woofers that handle 800 watts. Compared to the 15" units made even 30 years ago these monsters don't sound as good. Power handling means heat dissipation, which means more weight. The voice coil gets heavier, the coil former gets heavier. The suspension of the driver has to be strengthened to withstand those 800 watt excursions. If you want to know how this makes a speaker sound, just tape a big rock to the cone of your favorite speaker (or listen to some of the leading planar speakers).

When looking for a woofer, try to find one with a big Alnico magnet. Alnico has efficiency and distortion advantages over ferrite and ceramic magnets. Another desirable feature is an edgewound voice coil. This geometry gets more wire into the gap, promoting high efficiency. The voice coil

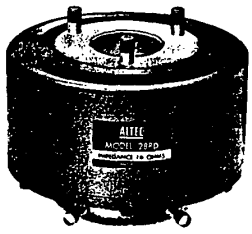
Recommended ALTEC Components

HORNS

Finding a good horn is the key to building a great system. Unfortunately, the good horns are few. Some horns require "throats" or adaptors to mate with your driver. Try to get these when you get your horn if you need them. They can be expensive or hard to find as spare parts. A crossover no lower than 500 cycles is recommended with these nominally 300 cycle horns.

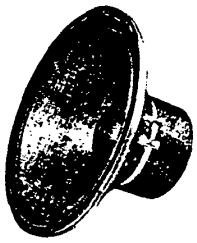
Here are a few horns that worked for me. These are subjective impressions and somewhat surprising in light of Altec's intended applications. Among common and reasonably proportioned Altec units, the 311-60 and the 311-90 are your best bet. Surprisingly good sounding despite their rather cheapo cast construction - apply damping to exterior. A 288 bolts right on. The sheet metal 203 is a nice long two cell horn which avoids many of the problems presented by shorter horns with more cells in the home listening context. Intended as a "long throw" horn but sounds good short range. The Altec horn that works best in my system is the large cast aluminum 329A. It is rather unhandy to install but it sure sounds good.

Perhaps the best option is to build the right kind of horn from scratch. Simple equations for horn design can be found in *Audio* magazine articles fron the '50s and a number of textbooks. Use of Altec hardware and throats can facilitate the mechanical interface with your driver. I'm working on this project myself - results forthcoming in a future installment.



288 Driver

Power	40 Watts (above 500 cycles)
Frequency	500-16,000 cps
SPL	115 dB at 1 W / 131 dB at 40 W
Impedance	16 Ohms
Weight	20 pounds



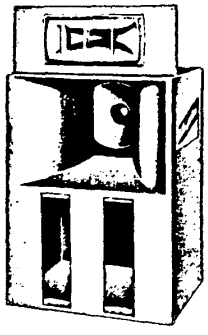
515 Loudspeaker

Power	35 Watts (50 W. Peak)
Impedance	16 Ohms
Diameter	15 3/16"
Mounting hole	13 1/4"
Weight	26 pounds

LOW FREQUENCY HORNS

These enclosures are direct radiating exponential horns using a modified bass reflex principle and are the proper enclosure for the 515 or 803A loudspeaker in full range two-way public address systems.

	HEIGHT	WIDTH with wings	WIDTH without wings	DEPTH	NET WEIGHT
110 with stand	87"	73¼"	50"	35½"	400 lbs.
210	84"	80½"	32½"	39½"	560 lbs.
410	84"	103"	65"	39½"	890 lbs.
610	84"	135½"	97½"	39½"	1220 lbs.
825	42"		30"	24"	100 lbs.



825 Cabinet

formers on the better speakers are paper. A heavy aluminum former just reduces the quality of the sound. Besides, we're only going to be running maybe 50 watts max on the system, so who cares about 800 watt power handling?

As far as cone material is concerned, paper is *it*. The combination of a light paper cone and a big magnet is difficult to beat. Harder stock usually provides more detailed reproduction through the midbass. The shape of the cone can be important. Straight wall cones have better tone and detail through the mid bass and curved wall cones have better top end extension. With a 500 cycle X-over, straight wall cones are preferable.

Woofer suspensions also have a great effect on sound quality. In high efficiency speakers there is little coil overhang in the gap. The coil must be returned to the exact center of its travel. If this doesn't happen, the sound is muddied because of asymmetry in the magnetic field. I like the old Lansing spiders which are made of Bakelite. They hold the cone in a rigid grip and provide for controlled excursion. In a proper enclosure, total cone travel is only a small fraction of an inch so excursion limiting is no problem.

The most common really great old woofer is the Altec 515 or 515A. It was in production for about 40 years beginning in the mid-40s. The older ones used bakelite spiders and a straight walled cone of hard stock with a half-rolled paper surround. This is how speakers should be built. The later 515 is the B model. During the 1980's this speaker was made with a ferrrite magnet which is clearly inferior to the awesome Alnico magnet of its forebearers.

Other woofers worth checking out are the Altec 416 and 803. The 416 is a late 803 with a different part number. The 803 is similar to the 515 but designed for use with an 800 cycle crossover. The 803 woofer with the 825 cabinet, the 803 compression driver, and the 811 horn made up Altec's A7. This was the "baby" VOT.

CROSSOVERS

As is the case with horns, most crossover designs of the early days are not really that good for hi-fi use. One of the biggest problems can be solved by using very long horns. The reason that horn length can affect crossover performance so dramatically is

(continued on p. 21)

HORNS (continued from p.4)

because crossovers are directly affected by impedance changes in the drivers. If a horn is too short for a given frequency to be reproduced the speaker will present a far different load to the crossover than its nominal 16 or whatever ohms. Crossover networks require a flat impedance curve for the high and low frequency drivers to sum properly. Impedance changes result in phase and amplitude anomalies.

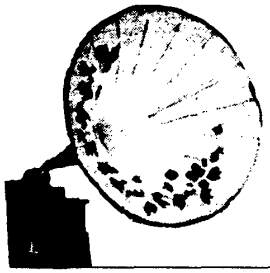
Be sure to take pains to phase your speakers correctly. You will have to experiment because drivers are not all phased the same electrically. Go for the connection which produces the most output at the crossover point. Get a friend to switch the connections while you listen. Make sure the drivers are aligned such that the ear-speaker distance is the same for each driver.

Because of the complicated nature of crossover design, I am inclined to gloss over it in this introductory article. In a follow-up piece, I will provide tips for bringing old crossovers in line with modern practice and a design for a high quality line level crossover for a biamp application that will really get those old drivers working. Stay tuned.

One of the major challenges in setting up a horn system is finding an amplifier which will work with the horns. High power solid state amplifiers sound best when mated to inefficient speakers. With horn speakers they tend to sound really awful. The efficiency of horns is so high that your average big hog solid state amp never really gets turned on. Likewise, big tube amps using banks of 6550s just don't sound that clean when operated in the milliwatt power range. Horns work best with *low power* tube amps.

I hope this introductory survey will help some experimenters avoid a few of the most tempting wrong turns. Most of the information you really need to know will not be found in any books. Good "pro" sound practice differs from the best strategy for hi-fi horns in the home. Some suggestions you read here would be a mistake in the theater context. But recognize that what excels in the auditorium won't necessarily soar in your listening room and you're on your way.

Greg Boynton is proprietor of Rapid Sound, provider of audiophile quality sound reinforcement and audio consulting for the Grand Rapids, MI area.



Mono Mia !

by Vinny Gallo

I was born in the tragic slums of tragic Buffalo NY in 1961. I grew up there in an Italian-Black-Puerto Rican neighborhood. The Disco Superstar Rick James was my neighbor and is still good friends with my Uncle John or John "The Bull" Fantazzo, as he's known on the block. My family moved next door into my Grandmother's house when I was two, one month after my father was sent to jail. Don't ask. Anyway, he got out when I was 15 and threw me out of the house a year later on my 16th birthday. Don't ask.

I remember my Grandma's house. It was small and it had a smell, not a good smell or a bad smell just a certain smell. There was no TV, no radio - just this old wind up 78 machine with this big metal horn that had flowers painted on it. Underneath in a shelf, she had 9 records: three by Domenico Modugno- you know, the guy who wrote *Volare*, four Caruso records, and her two favorites - one by Dean Martin and one by my father singing "Fools Rush In". Before my Pops went to prison, he was a nite club singer. He got to record one single. If I think back, other than the fact that I hated her records, Grandma's windup machine sounded astoundingly good.

In the neighborhood, my Best Friend was this guy named Butchy, Butchy Megadino. His Pops was the biggest bigshot on the block. He was the biggest in the neighborhood, which to me seemed like the whole world. His name was Stefano Megadino. I say *was*, cause he was gunned down in front of Ray's Pizza Parlor in 1978 - 13 days after he joined Audiomart. He was the 13th guy to subscribe. Poor guy, he was so excited.

Mr. Megadino was tough and he worked hard to stay on top. But he would also spend a lot of time fooling with Hi-Fi. Mr. Megadino loved Modernization. He loved being the first to buy a new gadget and he always got his new Caddy first, or else! And he had the first and only Color TV in the neighborhood. I remember me and my Mother going over the Megadino's to watch Super Bowl III on COLOR TV. What a shock, COLOR TV! Everybody loved the Jets and that modern slickster, Broadway Joe. Everybody, except me. My hero was the simple conservative Johnny Unitas and the good-old-fashioned Colts. I cried when the Colts lost.

Mr. Megadino's biggest obsession was his Hi-Fi gear or *stereo equipment*, as it was called. And since I was like a son to him, I got to witness first hand the buying and selling of a lot of gear. I helped unload the first SAE 50 watt amp, the first GAS Ampzilla, the first Mark Levinson preamp. I loaded up Dahlquists, Magneplanars, Quads, KEF 103s, all of it.

Man, it was great - he was on top of the world. He had all the latest technology in the palm of his "black hand". Plus everytime he got something new, I could make a few bucks hooking it up for him. He refused to fix or connect anything. The guy would pay me to change the batteries in a flashlight. I still don't know if he *wouldn't* or *couldn't* do things like that. Anyway, his son Butchy was the same way. So they both needed me.

Mr. Megadino would always use one of his four copies of Tony Bennett's *Cloud 7* on Columbia featuring Chuck Wayne on guitar to show off any new gear. He had good taste. I was Hi-Fi HOOKED. Obsessed and in love with the stuff. Also during this time my hippy cousin, Asti Bunza, who was 18, was turning me on to all kinds of music. He had 24 LPs, the most of any kid in the neighborhood. He had every Beatles LP.

I was also spending a lot of time just going to stereo and record stores just staring and dreaming. Buffalo was a tough place for a kid to make a buck, especially in the early 70s. I had to really hustle. I had a bunch of contracts mowing lawns in rich neighborhoods and in the winter I would shovel a lot of driveways for a buck a driveway. I beat up this kid once who was stealing my customers with his gas engine snow plow. I also got 25 cents a day for lunch money, so right there I could save $1.25 a week, even though I was always starving. And I saved ever penny I made.

My friend Butchy was the opposite. He spent but he refused to work. He had a lot of habits to support - pinball, ice cream, candy, comic books, pot, and cigarettes plus a six pack every Saturday night. He was also a King Farouk with the girls. So he needed a lot of money. his father was generous to him but it wasn't enough. So Butchy became a thief, a BIG thief, a big FAT thief. It was OK with me because he stopped trying to borrow money.

One snowy Sunday morning after church, I went to Butchy's house and within 5 minutes he talked me into robbing the corner bar. It was called the Jolly Jug. Five days earlier, the owner bought some hi-fi gear hot, *very* hot, from a local junkie named Elmo Wright. Our plan was to get the hi-fi stuff and all the liquor we could carry out, so we used Vito Padulla's newspaper wagon for the job. Everything went smooth. The hardest part was divvying up with Butchy. We argued for an hour splitting up the booze. When we got to the hi-fi, neither of us would budge. We cut the stereo system in half. I kept one Dynaco MK IV amp and Butchy got the other one. I got the PAS 2 preamp and Butchy took the FM-1 tuner. We each got one A-25 speaker. The AR turntable fell out of the wagon and broke during our getaway so we left it behind in the snow.

In my Grandma's house, I slept on the couch in the living room. I didn't have my own room, so when I got home with my stuff I set it up in the basement. I already sold my share of the liquor to Frankie Bones at the Social Club at 220 Connecticut Av. He gave me two 20s, 40 Bucks. Forgeta 'bout it, I was rich! So the next morning I skipped school and went straight to my favorite stereo store. I needed a turntable to listen to my new system. I shopped all day checking out the latest and greatest and finally settled on a $75 Technics SL-20 with a $15 Grado P-mount cartridge. Total cost 90 bucks- the guy said if I paid cash no tax.

OK, now I had the 40 from the booze heist but that left me 50 short. I would have to spend 50 from my hard earned lawn mowing & snow shovelling money. Twenty five lawns and twenty five driveways - that was a lot of grass and a lot of snow. But I

couldn't get that SL-20 out of my mind. Those Japanese were geniuses at selling us pork eating Americans shitty good looking stereo stuff and between beef jerkys and bags of chips we were trading in our great old mono tube stuff to pay for it. Even the Italians did it. I was only 13 years old, how could I know? What's *your* excuse? The real funny thing is that old Technics and Pioneer stuff doesn't even look good anymore. It didn't hold up.

But that day I was thrilled and I rushed home and hooked up my half stereo system. One problem left- the Technics didn't have 78 speed and I had no records of my own. I had to use a 78 on 45 speed. I chose my fathers single and played it on 45. At 78 RPM, Pops was an OK song stylist, but in 45... MAN, he was singin' the *blues!* My pops just became a great Black blues legend in 45! But after a couple plays I was bored. Plus the Grado wasn't tracking 78s too good. I *needed* records.

Suddenly I got a flash, My cousin Asti Bunza the hippy got drafted and was getting ready to go in the Army. I heard he was selling his record, poster, and bong collection so I rushed over to make him a deal on the records. We settled on $11 and two joints that I found at the school playground about two years earlier. Besides, I had no need for that kind of stuff. I got all 24 LPs. He was a hippy and I was a happy. I went home and blasted all four sides of the Beatles' White Album. WOW! It was brilliant, trust me.

That was my first system and it was great and it was only one speaker and one amp. Unfortunately, that would be the last time I would be completely happy with my hi-fi system for years to come. What happened was I put the White Album away and ran over to Butchy's to try to try to buy the other amp and speaker from him. Unfortunately, Mr. Megadino wanted to buy my half. He was getting hooked on tubes again. Dynaco was his first setup and he was a sentimental guy. And besides his Ampzilla had blown up one too many times. I couldn't refuse the "Boss of Bosses" so I sold him my share of the stereo. But the guy did pay me very well.

Anyway that started a long period of buying and selling audio gear. I've owned it all- old stuff, new stuff , Levinson to Fairchild to Krell to Audio Research, back to old Marantz, then to Western Electric. Every amp, every speaker. All of it and for what? What did I get? A pain in the AASSSS. That's what. And why? Was it the equipment? My room? My records? *Me*? Forgeta 'bout it! I was OK, my records were the best, my room was beau-ti-ful, and some of the gear was good, especially the old triode amps. So what was the problem? Huh?

Think about it. Are mechanical and electrical reproducers supposed to take the place of live music? NO, they're not. They are what they are. They are their own thing. They have their own place in our lives and they shouldn't even be compared to live music. I really believe that great hi-fi should sound like the best radio you ever heard. Great hi-fi affects your ears and emotions in its own way, reminding you of sounds and sound impressions. For example take a photo of a chick that you love. It is not an actual reproduction - you can't touch or smell her. But you can get a strong emotional reaction from the stimulus of the photo. Some chicks even look better in photos and sometimes a simple black and white photo can be the most beautiful. Hi-fi works the same way.

Great Hi-Fi should sound like the best radio you ever heard.

Hi-fi is its own beautiful thing and for me the more simple it is the better. Mono, that's right, MONO. Ya heard me, MONOphonic. For years people listened to it and loved it. But some hustlers told us stereo was better while they were selling us two of everything. Well, it's not. Trust me. It might be more but it's not better.

Fortunately, one time I was stuck with only one amp and one speaker that I really wanted to wire up and listen to. Happens all the time when you try to put together classic vintage systems. Anyway, I tested them out and I was shocked. It sounded great! The gear was good but I realized that a big part of it was that it was mono. So pure, so simple, so beautiful. I never went back. It was like the first time I saw "Raging Bull", suddenly Black and White was hip again.

No more breaking my back to find two of everything, no more taking the whole room apart to fit in two of everything. Plus systems are half the price. And all the gear and many of the records I like were meant to be listened to in mono. Just try to get those big multicell horns to sound good in an average sized room in stereo, Not a chance. No longer did I have to sit in one narrow spot exactly between two speakers to enjoy the music.

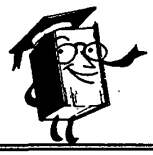
Another great thing about mono is that it sounds right no matter where you are in the room. My system sounds great even from the next room or outside. My neighbors are always yelling up from the street, "Hey Vinny! That sounds Beautiful".

Mono, Mono, that's right, MONO MIA! Thank God. Less gear to fix, less wires. Stereo is a SCAM. How does dividing a recording in two make any sense anyway? What if you have a five piece band? What side does the fifth guy come out of? To me, the mono sound is perfect - coherent and whole. Stereo sounds like a special effect. Listening to stereo is like having to wear 3-D glasses every time you go to see a movie.

Many of the best records are mono anyway. There's so much great music recorded before stereo took over. And there are a lot of BAD stereo records around. Most of the time, they don't even get the special effect right. Good mono beats bad stereo everytime - just like good records sound better than bad CDs.

Stereo is like having to wear 3-D glasses everytime you go to see a movie.

I say most of you stereo equipment nuts hardly have time to listen to your gear because you're too busy shopping for special interconnects. Try this instead, set yourself up a simple mono system and listen to the music. Then you can share a pair of those special interconnects with your best friend. Keep it simple and have fun! If you shoot for the simple thing, you got a better chance of success. You might be surprised. Chew the fat, shoot the breeze, mull it over, think about it and give mono a try. Love, Vinny.



from the archives

Passive Crossover Networks for Bi-Amplifier Systems

by Blaine B. Kuist

This article first appeared in AUDIO, November 1969. With *yet another* resurgence of interest in multi-amp systems, let's take a rearward look. . .

Electronic crossovers are getting the spot-light in a resurgence of interest in bi- and tri-amplification (high, intermediate, and low frequencies split ahead of the power amplifiers).

A lot of hi-fi buffs might be interested in an alternative that is simpler to build (2 hours), not too costly ($50 for two channels with one crossover point), high in reliability with few components and top performance.

The alternative is the old work-horse—passive L-C filter networks.

An article about Electronic Crossovers[1] intrigued me with the potential of improved sound with bi-amplification. My hi-fi fever set in last spring after looking for a starter outfit with my teenage son. Casual looking and listening led to growing interest.

I wondered why a treble speaker like the Altec-Lansing 802-D driver and 511-B horn couldn't be teamed with a good 15-in. speaker, thus covering the whole audio range with just one crossover. By now I had eagerly waded through some of the good handbooks for hi-fi hobbyists, such as "Speaker Enclosures," by A. Badmaieff and Don Davis,[2] and "Hi-Fi Projects for Hobbyists," by Leonard Feldman.[3]

From current literature from manufacturers like Sony, Bozak, C/M Labs, and Pioneer, a tailored design (for a selected crossover frequency and cutoff slope) of an electronic crossover appeared to be a tough project for a beginner to tackle. Fortunately, I talked to a professional audio engineer about my interests. His reaction was, "Why not use high- and low-pass filters?"

The key idea was to feed the filters from the pre-amplifier, matching the 600-ohm output impedance of the pre-amplifier with a 600-ohm input impedance of the filter. The 600-ohm output impedance of the filter was also matched and terminated by a 600-ohm resistor (in parallel with the 100-k ohm input impedance of the power amplifier). Thus the filter was matched at the input and output with 600-ohm constant impedances.

SETTLING ON FILTERS

This sounded simple enough—until I tried to find the filters. A search of electronic catalogs, stores, and magazines indicated filters were readily available with 18 dB/octave cutoff slope of the constant-*k* type but would have to be special-ordered for the 12-dB slope which was desired. Perhaps these are available from some professional audio equipment suppliers but my hurried searches failed to turn them up.

So it was back to the "do-it-yourself" method which didn't disappoint me, really. *Audio's* articles on "Professional Audio Controls"[4] had a reference to Howard Tremaine's comprehensive handbook on *Passive Audio Network Design*.[5] This had the practicalities of filter design and construction spelled out.

Again with simplicity in mind, I focused on parallel high- and low-pass L-C filters involving the familiar networks of conventional speaker crossovers except being designed for 600 ohms instead of the usual 4, 8, or 16-ohm speaker voice-coil circuits.

Fig.1— Schematic of the passive filter networks used with the bi-amplification system described by the author. Two networks are required for stereo.

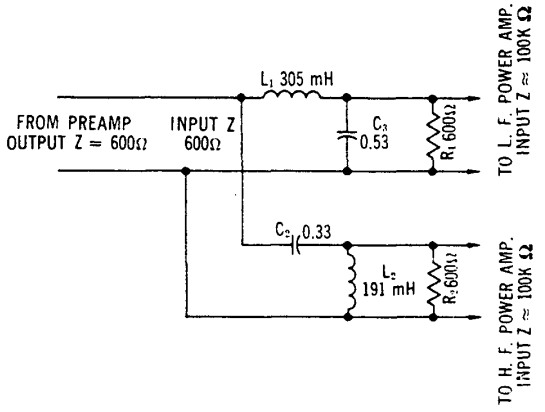
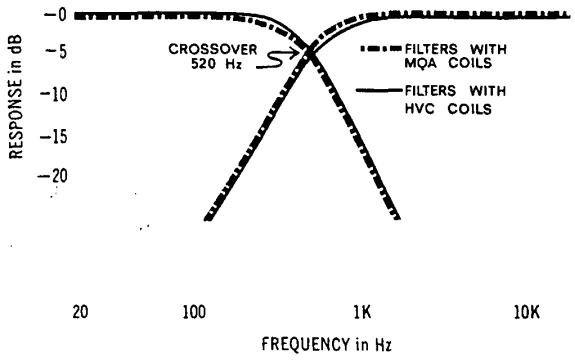


Fig.2— Frequency response curves for the author's passive networks.



	PASSIVE (before amplifier)	ELECTRONIC	CONVENTIONAL (after amplifier)
Bass damping and transient response	Permits performance to full damping ability of amps	Same as passive	Reduces woofer response by resistance and reactive impedance between amp and speakers
Amplifier performance	IM distortion minimized by separate amps for high and low frequencies	Same as passive	IM distortion due to high and low going through same amp. Dynamic range linited because power peaks for high and low are additive
Speaker distortion	Minimized— None due to crossover frequencies shifting	Same as passive	Crossover frequency and phase of highs and lows shift with impedance variations of speaker
Insertion loss or gain	-3.5 dB	0 to +3dB typical Some types, -6DB	Depends on quality (high Q) of particular coils used. -0.1 to -2dB typical

TABLE I: Comparison of Crossover Alternatives

The filter networks selected and built are described as follows:
Parallel, *m*-derived
m = 0.6 for constant impedance over 85% of transmission band
Impedance in and out: 600 Ohms
Crossover frequency: 500 Hz
Attenuation at crossover: 3dB
Slope of attenuation: 12 dB/octave

The component values are derived from these formulas:

$$L_1 = (1 + m)\frac{Ro}{2\pi fc} \text{ Henry}$$

$$L_2 = \frac{Ro}{2\pi fc} \text{ Henry}$$

$$C_2 = \left(\frac{1}{1+m}\right)\frac{1}{2\pi fcRo} \text{ Farad}$$

$$C_3 = \frac{1}{2\pi fcRo} \text{ Farad}$$

Where R_o = filter characteristic impedance
fc = crossover frequency

In rounding up material to build the filters, we found the capacitors were readily available but the inductances were another matter. With values of 191 and 305 mH needed, air-core coils were out of the question because of large size and hence large resistance. Little usable information seems to be available for constructing iron-core inductors so it was back to the catalogs. Coils with desired characteristics were rarely listed and hard to find. However, the United Transformer Company catalogs listed coils that covered the audio-frequency range with Q's of the order of 10 to 30 at the 500 Hz crossover point.

For the first pair of coils, the HVC Variductors were tried because they were adjustable and available at a nearby electronic store. The coils were finally set reasonably close to the desired values but they were sensitive to set, although once set, they held their settings and worked well.

For the second pair of coils, the MQA fixed inductances were chosen. These high "Q" toroids with inductances of +/- 1 per cent, the numbers closest to those desired without a special order. This compromise on inductance from the desired 191 and 305 mH was not significant.

A description of the coils used follows:

	mH	DC mA	DCR
Filter A			
HVC-4 Variductors	30-300	30	8.6 ohms
HVC-5 Variductors	70-700	20	22
Filter B			
MQA-8 Hi-Q Toroids	200	50	16
MQA-9 Hi-Q Toroids	300	40	25

Typical "Q" curves for the metal core coils rise to a peak then fall off after the saturation point of metal cores is reached. The peak Q (about 160) for the MQA coils occurs at about 5 kHz. At the crossover of 500 Hz the Q is about 40. At 20 kHz, Q is about 25 and at 20 Hz it is in the range of only 1 to 2.

The HVC coils being adjustable, the peak Q falls somewhere in the lower half of the audio range depending on the setting. At 500 Hz the Q is in the range from 5-15.

Although the MQA coil had in general the higher Q characteristics, there was no audible difference in performance.

FILTERS ASSEMBLED

With the coils in hand, the remaining parts were readily available and assembly went fast. All the parts were mounted on a plastic board fastened to the cover of a 4" X 5" X 3" steel box. Steel was used for shielding although this was later found to be unessential.

Response vs. frequency curves were run with an audio generator and a VTVM with the results shown in Fig. 2. The 520 Hz crossover point was close enough to the 500 Hz goal.

The crossover point was down 3.5 dB from the bass plateau and 4.0 from the treble, vs. the goal of 3.0. Theoretically, the total sound pressure level should then suffer a bit of a drop in the crossover region. Practically, this slight dip could not be measured in the total output from the speakers (audio generator input and microphone

pickup) and certainly could not be detected by ear. The insertion loss was 3.6 to 3.2 dB (20 Hz and 20 kHz respectively).

As the text books state, distortion for the passive filter network should be practically nil. This was checked through the courtesy of a manufacturer's amplifier clinic and proved to be so. The filters were used between a Dynakit PAT-4 preamplifier and two Dynakit 120 amplifiers. The THD was measured at 2 volts output, which would fully load the amplifiers when feeding 16 ohm speakers. No difference could be read in the THD with and without the filters in the output.

In my setup, the amplifiers were fed into the Altec-Lansing treble horns mentioned earlier and Klipschhorn bass corner horns. The defenders of the conventional crossover have pointed out that the electronic crossover (or filter) ahead of the amplifiers adds little or nothing to the damping of the bass speaker which is horn loaded like the Klipsch. Theoretically, this might be right. I have not had the opportunity yet to check this with A/B tests of conventional crossovers vs. filters with the horn loaded speakers. probably the differences are less prominent than with direct-radiating speakers. All I can say at this point is that the sound from the horns with the filters ahead of the amplifiers is superb.

If you have been following the interesting articles and letters to the editor in *Audio* Magazine for the last year and a half on this subject, you are pretty well posted on the pros and cons of electronic crossovers vs. conventional crossovers after the amplifiers.

This article presents another alternative, passive filter networks ahead of the amplifiers. Comparing filters with electronic crossovers, it appears that there is a lot to be said for the filters, especially for the audiophile who wants to build the device himself with minimum time and cost. Advantages and disadvantages of the three alternatives are listed in Table 1.

The debates continue on whether the sound is significantly better (and worth the cost) with the crossover ahead of the amplifiers. To anyone who has listened to an A/B test with direct radiating speakers, there is no doubt about the result being audibly better with crossovers ahead of the amplifiers. And for the audio buff who is determined to get the best in sound, an easy, economical, and reliable way to do it is with passive filters.

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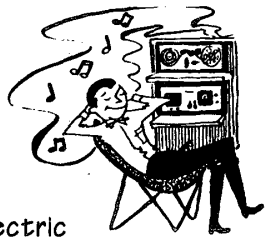
Casual Reactions



by Herb Reichert, Eddy Electric

ULTRA FI HORN SYSTEMS

The vast majority of American audiophiles that I meet are unfamiliar with the sound that a good horn system provides. In fact, most seem to believe that *there is no such thing* as a *good* horn. Most have heard only damaged, overdriven, and poorly installed P.A. horns at the stadium or disco. A few remember hearing vintage Electro-Voice systems or Klipschorns driven by early transistor or aging, out of spec tube amps. We have all had bad horn experiences and nothing is as painful as a really awful horn system. If you have only heard nasty horns, you might find it hard to believe that a good horn system can be the best speaker PERIOD.

Only a small handful of American enthusiasts have heard the kind of carefully engineered and lovingly installed triode-powered horn systems that the French and Japanese have been listening to. I have been lucky; my French and Japanese friends have helped me to develop a system of this kind. Building it was one of my most rewarding audio projects ever.

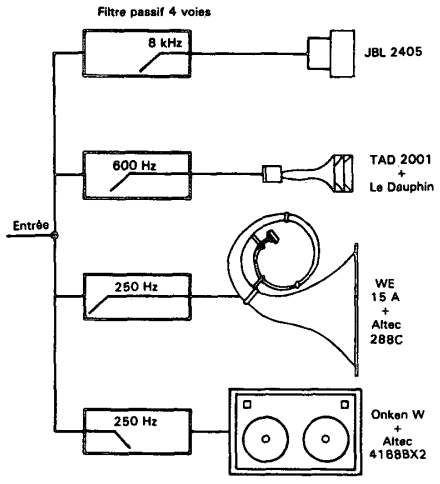
Although there is a lot of room for the individual touch in design of horn systems, a few classic components have achieved worldwide recognition. A typical Asian or European horn system consists of either an Onken or Altec V.O.T. bass cabinet with Altec 515, 416, or 414 drivers. These two low frequency systems are of such quality that they provide the foundation for nearly all the "ultra-fi" horn systems in Asia and France.

The "Petite Onken" enclosure for the Altec 414 12-incher is very popular in smaller European homes. At 40 Hz, Jean Hiraga measures .8% THD @ 100 dB/1m with this combination. It measures only 34"h x 18"d x 25"w. A larger Onken box for 15" woofers is also very popular in Europe and Japan.

The V.O.T. based systems have less bass extension but play with more veracity and power in the 100-500 Hz band and are therefore most favored by lovers of large orchestral works.

There is a much wider range of choices for quality midrange. The Altec 511/811 horns with appropriate compression drivers or Altec multicellular horns with 288 drivers are universally popular entry level midranges. Everybody has their favorite tweaks for these old stand-bys. Well financed triode maniacs in France favor the Onken SC-500 sand-filled wood horn or its look-alike, "Le Dauphin". These are used with the TAD 2001 or Onken OS-500 compression drivers. In Japan, the TAD wood horns or home-made equivalents are commonly used with a wide variety of TAD, Altec, WE, or JBL drivers. Here again, the best systems tend towards wood horns with compression drivers.

Système Onken/Western/TAD/JBL



Triodemania '93 hosted by *La Maison de L'Audiophile* in Paris—Onken W enclosure for 2 Altec fifteens, Western Electric 15A wooden "ram's horn" with Altec 288C compression-drivers for the midbass, and a Onken-style wooden horn for the midrange. *Incroyable!*

Audiophile horn systems are usually three-way setups. Above 5000 Hz, the rich guys use the renowned Onken OS-5000 and everybody else does the best they can. The French prefer the JBL 2405 "slot" tweeter and Japanese like tweeters by Fostex and Gauss.

The Europeans prefer passive crossovers and one pair of "Legend" 300B amps or other fine triode amps, while the Japanese universally favor bi- or tri-amplification.

None of this equipment is compact or inexpensive. An all-Onken system could easily cost $10,000! But the build quality and durability are of the highest standard and the level of sonic refinement such systems provide is impossible to achieve otherwise.

It takes love, patience, and cash to build one of these exotic "ultra-fi" systems. Unless you've heard one, you are going to have to trust me when I tell you that these systems do not sound like ANY horns most Americans have heard. In my experience, these combinations can be more vivid, more detailed, far more dynamic, and less easily confused than the typical U.S. high-end setups. This is the type of system for which the Edgar midrange horns are designed.

Bruce Edgar's 250 Hz tractrix horn for the Dynaudio D-54 driver.
Measures only 11" H X 21" W X 13" L

THE E-HORN

When I drank, I couldn't keep a secret at all. Now, after eight years without a drop, I can only keep a secret if it is totally boring. So, I have to tell you that a scientist from Torrance, CA has made some break-through discoveries that could radically change the reputation of the horn in American "high-end" audio -- at least for those of us fortunate enough to live in something larger than an Airstream trailer or a NYC "studio" apartment.

Bruce Edgar is a contributing editor for *Speaker Builder* and a space scientist by day. He has been working on refined horn designs for a number of years. His current portfolio includes five midrange horns that take the horn out of pro-sound, past hi-fi, and on to the world of "ultra-fi." They are cone-driven horns made from wood which are based on a Tractrix expansion, the only flare which provides a spherical wavefront.

Each of the five horns was designed around a specific, commonly available cone or dome driver from companies like Dynaudio, Focal and Polydax. The driver is fastened onto the back of the wood horn. The complete units have sensitivities in the 100-105 dB/watt/meter range. They are four octave devices, covering the 400-5000 Hz band. They are remarkably small for their LF cutoff rating. One 300 Hz horn I have on hand is only 18" wide and 11" deep.

Dr. Edgar's philosophy is "Ultra-fi for the people." He is a supporter of home construction and a hobby builder himself. Aside from writing for Speaker Builder, he is often involved with DIY speaker contests and the like. The Edgarhorn is meant as a DIY project, although Bruce does sell some horns he makes in his garage wood shop at very reasonable prices.

With people like Bruce Edgar supporting creative home audio, the real state of the art is in the domain of the experimenter and not in a color ad in an audio magazine.

The sound from these wood horns is so smooth, detailed, and undistorted that when a friend and I first listened we thought something was wrong. We both kept looking at each other saying, "This is very strange." However, as the piano player rolled back and forth past middle-C we looked at each other and froze. It was startling—and right!

At this point we both realized it was not the Edgar horn that was strange, but every other speaker we had heard to date. Our initial reaction was that this was RIGHT and we both knew it. The distortion we have come to accept from loudspeakers has been reduced in the Edgarhorn to such low levels that, after experiencing music through them, other audiophile and professional speakers sound fuzzy, grainy, and opaque in comparison.

The two most outstanding traits of this driver are its complete lack of artificial character and its grainless, dynamic presentation. These are rare qualities, found only in the very best loudspeakers. Additionally, these speakers require only a few tube watts to play ANY type of music at extremely high SPLs. What more do you ask?

Compared to the IRS-Vs, the Divas, and several Euro-style ultra-fi systems I got to hear around New York, the Edgarhorn presents music in a smoother, more relaxed, and "cleaner" fashion. With the Edgarhorn and a pair of homemade Onken or recycled Altec V.O.T. bass modules and a JBL 2405 or Polydax PR-120 tweeter, create a world class loudspeaker system at a small fraction of the usual cost. A clever music lover who is handy with a saw and screwdriver could conceivably build a IRS-V beater and hang out with the Ultra-fi horn crowd for under $2000 !

Where's the caveat? My only disappointment is that the Rolling Stones sounded a lot more 'rough and ready' on my Altec 1005/288Cs. All the little peaks and ringing in these horns add some excitement to live rock recordings that the Edgar wood horns do not. But that's a special case., In general, the Edgars throw a gentle, even light on the performance that just makes you want to keep on listening. It appears that a cone driven horn may have advantages over a compression driver for small room systems. Listener fatigue is simply not an issue.

So for now, I tell you these horns are wonderful, perhaps as good as it gets, but you can't just substitute them for your present midrange in most systems. My early experiments have shown that because they are horns, because they are sensitive (efficient), and because they are very low distortion, creating a complete system or integrating them into an existing system can be challenging. In short, it's hard to find a low end that is good enough in the ways that the Edgarhorn is good.

Finding six more octaves of this quality is what I hope to do myself. Dr. Edgar's low frequency horn designs, the "Monolith" 40-400 Hz horn and the 50 Hz "Show" horn, might be the ticket. Stay tuned for a detailed report on the "Show" horn and a bi-amped Onken/Edgarhorn system I'm building.

If I have succeeded in developing a "high fever" in some of my readers, I am sure you will be writing Dr. Edgar and experimenting without waiting for me—here are a few tips worthy of consideration.

First, if you choose a direct radiator or Onken bass enclosure: BI-AMP. Padding the mid-horn down 6-9 dB to match the efficiency of these bass units makes the speaker sound dull and lifeless. The same amount of padding makes compression type drivers sound bright, grainy and harsh.

If you use a passive filter, use only a first-order device. The mechanical rolloff of the horn on the low end will give you a steeper effective slope on the bottom and cone mass induced roll off will take care of low pass on the top end. A high quality series capacitor is all the crossover you should need with the Edgar mid. Use another series cap for the tweeter and you're in business.

If you don't want to bi-amp, use a horn below 500 Hz. One of Dr. Edgar's other designs might be perfect. I'm using an Altec 825 (A-7 low end) with 515s in combination with the Edgar-horn in my system.

One last note; don't just pile this stuff up. If you want to experience the tremendous focus and detail of this driver you must tie them down and damp them. I recommend separate, sand-filled enclosures for the mid and high units. I then recommend mounting the mid and high units on separate spiked and sand-filled stands. This creates a three-piece full range speaker with exceptional mechanical isolation that the truly fevered can arrange and "time-align" to taste.

If you're traveling along the path outlined in this article, please write me care of *SP* and share your discoveries.

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Contact: Bruce Edgar, PO Box 1515, Redondo Beach, CA 90278

ed. note - It's true. The Edgarhorn is indeed special. After a few weeks listening to a pair of custom E-horns designed to work with my favorite 8" cones—Altec 755As and Lowther PM-6s, what was left of my Altec and WE theater gear collection went up for sale. Sure the Edgarhorns require care in set up but something like an Altec horn system is *much* more challenging to get right in a smallish room. At least, I personally never got a compression driver system with metal horns tweaked to the point where I was 100% happy. With the Onken/416A LF system and a Gauss pro tweeter, I had *la musique* after only two days of playing around with the E-horn—with no machine work or heavy lifting required.

The Edgarhorn doesn't sound like a speaker at all—at least not like any other speaker I ever heard. The E-horn is destined to become the reference standard for midrange purity. Although I don't have much patience for whining Audiophile criticism, I must admit that it is unsettling to listen to a midrange that doesn't provide anything to complain about.

I am really glad that I tried Edgar's midrange horn. The only problem is that now I strongly desire horn loading down to at least 100 Hz. Hey, Bruce. . . where's my *mid-bass* horn?

CLASSIC DESIGNS

THE ONKEN ENCLOSURE

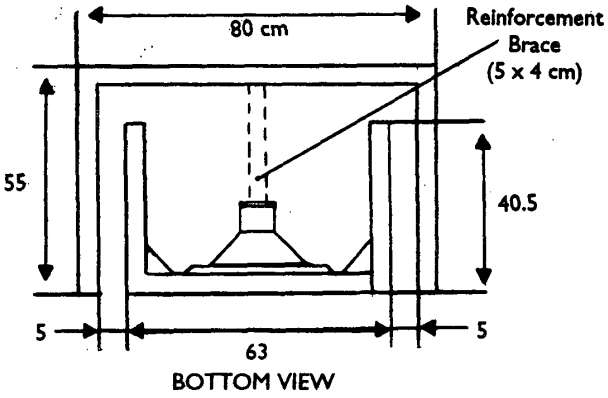
"Onken" is not exactly a household name among Western audiophiles. But for those in the know it represents one of the ultimate refinements in modern audio. Despite their rarity and great expense, the Onken transducers are among the few modern speakers that have achieved cult status worldwide.

Founder Eijiro Koïzumi brought the finely crafted Onken transducers onto the market in Japan in the early Seventies. The Onken drivers and speaker enclosures, designed in consultation with an acoustics professor from Tokyo University, received wide critical acclaim among advanced Japanese audiomaniacs. Unlike the many Japanese super-mania creations which go completely unrecognized outside the local audio community, Onken was to enjoy an international destiny.

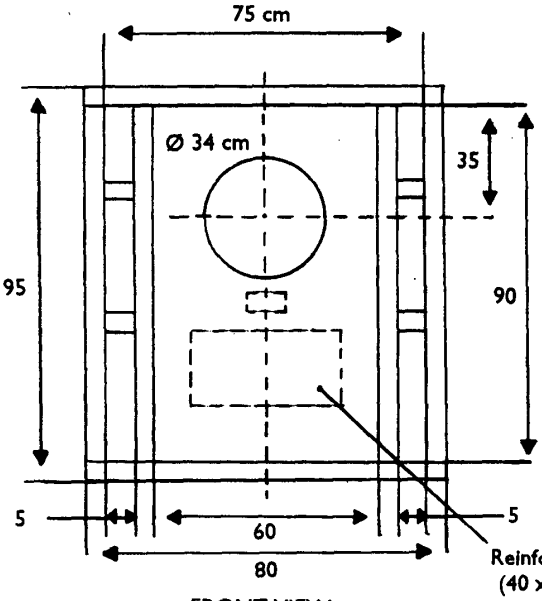
The man responsible for the wide diffusion of the Onken system was Jean Hiraga, a Franco-Japanese engineer and journalist who wrote for *Revue du Son* and edited the pioneering journal *L'Audiophile* from its inception in 1977.

Hiraga lived and worked in Japan as a correspondent for *Revue du Son* during the era of the ascent of the Onken. His role was to act as a broker between the Japanese and French audio cultures. He was the first and most influential contemporary spokesman for triode amplifiers and horn speakers in the Western Hemisphere.

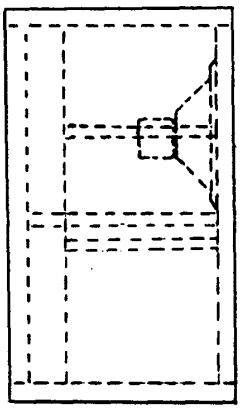
In one of the premiere issues, *L'Audiophile* promoted the Onken bass enclosure, a design derived from a Jensen design of 1938, as an answer to the difficult question of what to use for a low end with high resolution horn midrange speakers.



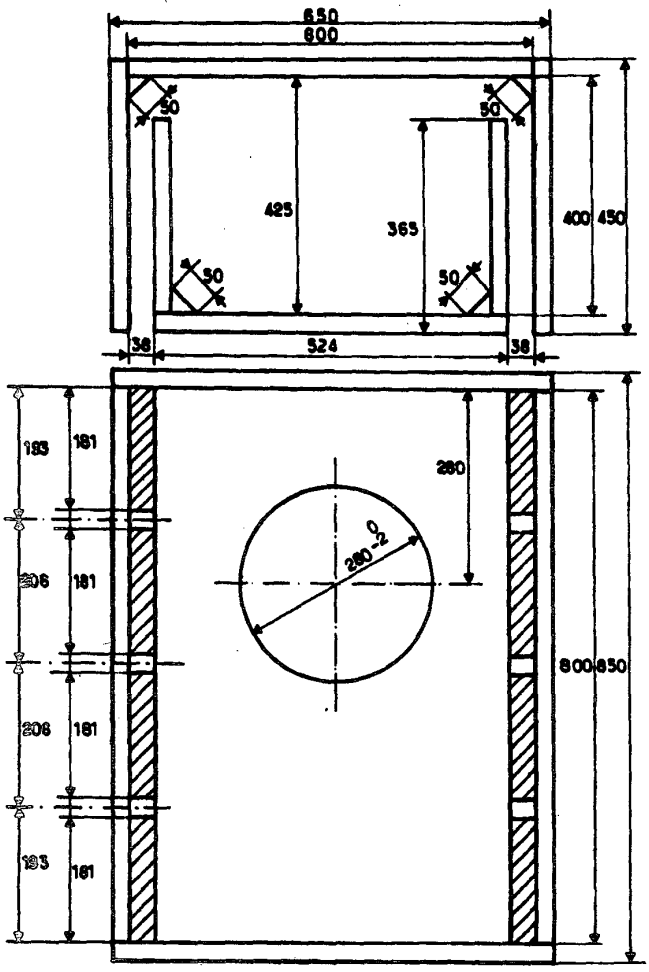
BOTTOM VIEW



FRONT VIEW


SIDE VIEW

The classic ONKEN enclosure for the Altec 416-8B



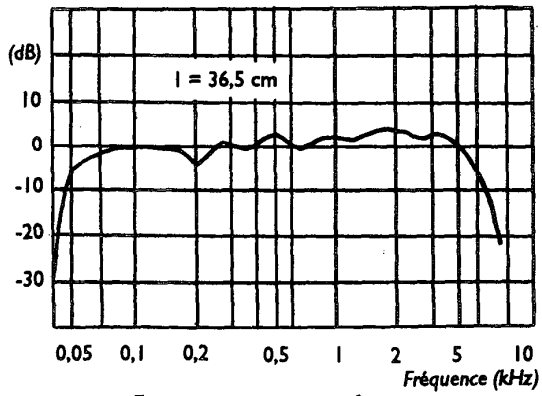
The "Petite Onken" for the Altec 414-8B.
A front-to-back brace should be
added as in the 15" enclosure

Finding a quality low end for your horn system can be a real challenge, as many independent experimenters have discovered and Hiraga had one solution. Based on listening tests, *L'Audiophile* suggested the Altec 416-8B as a suitable replacement for the scarce and expensive Onken woofer in the original 15" bass cabinet.

In September 1982, L'Audiophile published the plans for a smaller Onken enclosure designed by Koïzumi in 1976. It became very popular in Europe, as it had in Japan, due to its reduced size and for its ease of setup and tuning relative to its big brother. This smaller Onken box is known as the "Petite Onken" in France and by its original name "IP Ultra-Bass" in Japan. The 12 inch Altec 414-8B was used in this cabinet. Subjective and measured performance is generally on par with the larger Onken.

During the Eighties, the French loudspeaker manufacturer Focal recommended Onken-derived enclosures for several of their LF drivers, including the 10C01. The "Onken-Mahul" Focal bass system differed from the classic Onken in that it had ports on all four sides of the box, rather than only on the sides. The unique Focal plaster "Egg" two-way system was utilized as an HF system with the Onken-Mahul box.

Thanks to construction plans published in *L'Audiophile*, the Onken designs were and are widely reproduced by advanced hobbyists and craftsmen who cater to the audiophile elite. As always, selection of materials is a critical aspect of the art of audio design and in this regard there is no equivalent to the original Onken. The Japanese version used exotic pressure treated one-inch plywood and carefully selected long-fiber wool for damping. The *L'Audiophile* articles recommend one inch (2.5 cm) marine-grade plywood and argue that wool stuffing is indeed the best choice.



Frequency response of
Petite Onken/Altec 414-8B

If you choose to recreate the Onken box, the finishing touches are up to you. However, between the French and the Japanese, all likely variations have been tried. *L'Audiophile* suggests building these designs "*sans aucune modification*"— probably well founded advice. By all means, rear mount the driver; do not blindly follow conventional audiophile wisdom and attach the driver from the front!!

The Onken enclosure is renowned for its natural, articulate, and detailed low end. Although there are bass systems which have greater extension and bass horns with more "slam", the Onken ranks high in terms of subtlety and finesse. In terms of pedigree and mystique, Onken is in a class of its own among modern loudspeaker systems.

ALTEC "Voice Of The Theater" Speakers For Hi-Fi

by Jeff Markwart and John Tucker

Several years ago, while auditioning components for an overall system upgrade, Bill Fisher of Friendswood, Texas, suggested that I consider horn loaded speakers. The following weekend, he gave me a demo of his classic Altec Lansing A7-500W-1 Magnificents. The Magnificents are a furniture cabinet version of the A7 small "Voice of the Theater" system with a 500 Hz horn.

It was immediately apparent that these imposing boxes did a number of things very well compared to the majority of speakers I had been evaluating. Positive characteristics included:

- huge, effortless dynamics
- fast, controlled midrange transient response
- dramatic presence
- midrange clarity
- natural, open sounding bass
- high efficiency

I was hooked. Before long there was a pair of A7-500 Utilities in my front room running on a pair of 6B4-G push-pull triode monos I built. John Tucker stopped by for a listen and soon Altecs appeared at his house also. Over time, however, John and I became aware of a number of shortcomings inherent in the stock A7. These included:

- midrange and treble distortion on program peaks
- treble ringing
- lack of soundstage/imaging
- lack of clean bass
- lack of deep bass
- lack of system balance at lower SPLs
- crossover region colorations
- requirement for a low system noise level

The following paragraphs suggest some practical remedies for these limitations. We were impressed with the results of our experiments but we feel they only approach the limit of potential improvement. Some of these recommendations will not be appropriate or cost effective in commercial applications. Many of these recommendations apply to other Altec systems. Our goal was to optimize the A7 for full range, hi-fidelity use in relatively small, quiet, environmentally controlled spaces.

NOISE, NOISE, NOISE!

A7s are extremely efficient. The typical A7 has a pressure sensitivity of 105 dB SPL (1W/1M). You may discover your system noise floor is clearly audible through this speaker. Hum must be 1-2 mV or less for woofer inaudibility; even less if there is any non-sinusoidal component. The compression driver can reproduce thermal noise in its bandpass quite readily, and this may have to be reduced so as not to be intrusive in a quiet room (40-45 dBA). The following steps may be useful in achieving an acceptably low system noise level:

- use main amplifiers that have less than 1-2 mV of hum at their output with the input grounded
- eliminate system ground loops
- eliminate unneeded gain stages
- use stepped attenuators
- for unbalanced terminations, employ interconnects that use a shield as a drain
- upgrade stock speaker wiring, crossover wiring, and connectors
- upgrade stock internal wires between the compression driver binding posts and the diaphragm voice coil terminations
- clean all signal connection mating surfaces

These steps should result in greater usable dynamic range, lower harmonic distortion, an increase in low level program information, and better imaging. You promised to do this years ago, anyway, right?

WHICH WAY IS UP?

The speaker can either be configured "inverted", with the H.F. horn mounted in the cabinet reflex port and the short bass horn closest to the floor, (Magnificent, A7-W, some Utilities - Fig.2), or "upright", with the H.F. horn on top of the cabinet and the reflex port closest to the floor (Fig.1). If the

ALTEC A7 Systems

PERFORMANCE SPECIFICATIONS:		A7 SYSTEM	A7-500 SYSTEM
Power Rating:		30 watts	30 watts
Impedance:		16 ohms	16 ohms
Horizontal Distribution:		90 Degrees	90 Degrees
Vertical Distribution:		40 Degrees	40 Degrees
Frequency Response:		35-22,000 cps	35-22,000 cps
Pressure Sensitivity:		109.2 db (w/1 watt input at 4')*	109.2 db (w/1 watt input at 4')*
		124 db (w/30 watts input at 4')	124 db (w/30 watts input at 4')
Crossover:		800 cps**	500 cps***
Dimensions:	42" H, 30" W, 24" D } LF Horn Only	52 ¼" H 30" W 24" D	54 ¼" H 30" W 24" D
Finish:		Theatre Gray	Theatre Gray
Weight:	100 lbs. (Cabinet)	135 lbs.	142 lbs.

* 109.2 db measured 4' from mouth of horn over warble frequency range 500-2,500 cps. (Ref: .0002 dynes/cm² for 1 watt input.)

** N-800D furnished; Adjustable in 4 steps of 1db *** N-500D furnished; Adjustable in four steps of 1.5 db

H.F. horn is removed from the port for upright mounting, the reflex port area must be reduced from approximately 375 to 220 square inches. The upright configuration is superior for bass projection and tightness, overall imaging, and a seamless blending of the drivers.

CAUTION: DIPS AHEAD

Each speaker requires crossover phase alignment of its two drivers for lowest distortion and best imaging. Altec recommends locating this point by: 1) positioning the driver voice coils in basic vertical alignment and then, 2) adjusting the H.F. driver/horn position (connected electrically out of phase from the woofer) to achieve the greatest observed dip at crossover on a real-time analyzer measuring speaker reproduced pink noise. A dip of 6-8 dB should be attainable. Reverse the H.F. connections when you finish securing the horn and the drivers will be in-phase at crossover.

ACOUSTIC MUD & OTHER FINDS

The stock bass cabinet contributes significant amounts of unwanted acoustic energy to program material. Reduce these vibrations by stiffening the box with external veneers or laminates and adding internal panel bracing of 2X2s or 2X4s glued and screwed on edge. Dampen the internal flare of the short horn with contractor's epoxy, tar, insulating foam, or other suitable material. Install braces between the short horn flares and the sides of the box. Brace the port boards with diagonal hardwood 1X2 glued and screwed on edge. These actions will eliminate the muddying distortions caused by cabinet radiations in the mid and upper bass.

Altec cast aluminum horns ring like the Liberty Bell. They need to have damping material applied to their exteriors until a knuckle rap produces only a "thunk". Use tar, Soundcoat, layers of latex paint over sand, lead, sand filled enclosures, or other suitable material. This will eliminate the treble ringing of the H.F. horn that is a major source of listener fatigue.

All air leaks in the box should be sealed. A common problem seen in many older boxes is a gap that appears along the bottom edge of the short bass horn flares.

SO MANY CHOICES, So Little Time

There are two basic families of compression drivers applicable to the A7 — the small 1" throat type and the larger 1.4" variety. The one inch family includes the 802, 804, 806, 807, 808, 902, 908, and 909. The one and a quarter inch type can be either a 288, 291, or a 299. There have been many cosmetic and performance changes over the years in both families.

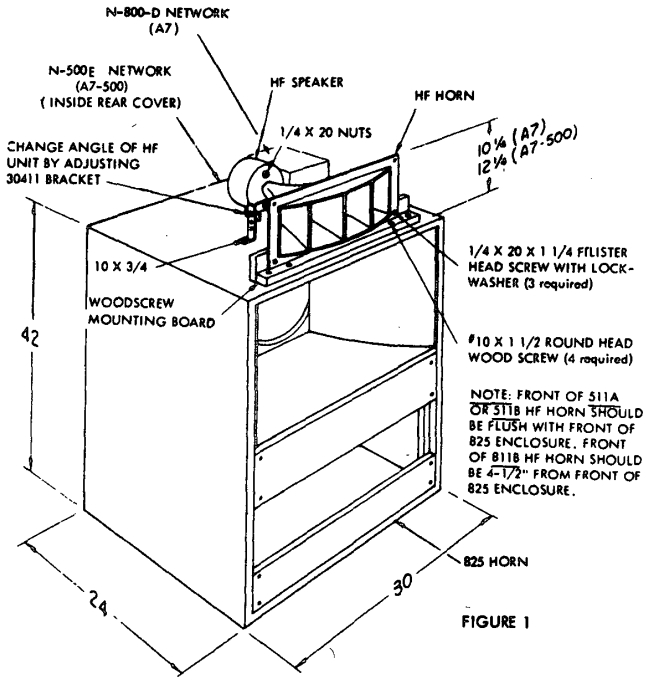


FIGURE 1

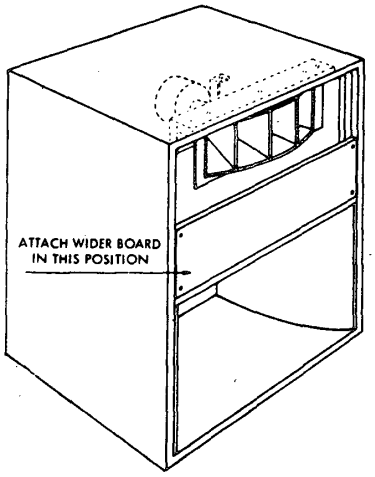


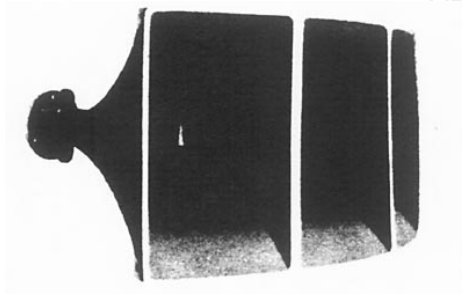
FIGURE 2

UPRIGHT AND INVERTED A7 CONFIGURATION

Generalities:

- Older units (pre 1980) use Alnico magnets ; later units use ferrite
- Older units (pre 1977-79) use a machined metal phasing plug; later units use the plastic "Tangerine" phasing plug
- Older units have a bronze throat screen attached to their mounting gasket; later units have a bronze or stainless screen sandwiched between the phasing plug and throat
- The 1 inch drivers bolt to the 511 or 811 sectoral horn directly; an adaptor is required to connect 1 inch drivers to larger sectoral, multicellular, or constant directivity horns designed for 1.4 inch drivers

ALTEC 311-60 AND 311-90 SECTORAL HORNS



The Altec 311-60 and 311-90 are the newest sectoral horns in the Altec line. They are designed for use in sound systems where a low cutoff and uniform control of the projection angle are required. These horns are treated with "Aquaplas", a patented sound deadening material, to assure freedom from resonance and ring. They are designed to operate with an Altec 288C, 290E or 730C Driver Loudspeaker through the proper receiver attachment. Use of an Altec N-500C Network or 15045A 70-volt matching transformer will provide driver protection. Both horns feature a 300-cycle cutoff frequency, and the sound pattern, controlled by the sectoral expansion, is 60-degrees horizontally for the 311-60, and 90-degrees for the 311-90. Vertical distribution for both horns is 40 degrees.

Many experimenters prefer longer, lower cutoff horns over the stock 511/811

- 1.4 inch drivers bolt directly to the large sectoral horns and to various throats of the multicells or CDs

Three types of diaphragms exist for Altec compression drivers:

1. Aluminum: low power handling; best transient and high frequency response (288, 802/902, 804/806)

2. Pascalite: high power handling; transient and high frequency response slightly less than aluminum. (299, 909)

3. Symbiotik: high power handling; poorest transient and high frequency response of the three. (291, 807, 808/908)

There are two basic families of woofers applicable to the A7 — the large magnet 515 series and the less efficient 803/416 variety. There have been many cosmetic and performance changes over the years in both families.

- Early units (515, 803A) use light, stiff cones with 40-45 Hz resonant frequencies and 16 to 20 ohm voice coil impedances
- Later units (515B and later, 803B/416A and later) use heavier cones with 25 Hz resonance and 8 or 16 ohm impedances
- Older units use Alnico magnets; later units use ferrite

DETAILS, DETAILS

Whether you choose small or large format compression drivers, eliminate the throat screens. These screens prevent bugs and other debris from entering the compression drivers in unattended or hostile commercial environments. Although light and thin, their construction has a polarizing effect on visible light. Remove them from the gaskets on older models; on later units cut an "x" across them with an Exacto knife, then grasp and remove them with a hemostat or large pair of tweezers. These "bug" screens are responsible for the bulk of midrange and treble distortions on program peaks, softening of treble leading edges, midrange colorations, H.F. signal attenuation, and phasey images that are hard to localize. Altec compression drivers sound excellent with these throat restrictions removed.

Whether you choose small or large format compression drivers, use aluminum diaphragms for best home sound. They are available in 8 or 16 ohms impedance for the 1" units; 8, 16, 24, or 32 ohms for the 1.4" types. Their only performance limitation is power handling, but this should be of little concern for Hi-Fi use unless you plan on producing constant, ear-shattering output levels. If you do, use the Pascalites.

Whether you use passive or active crossovers, stay at 500 Hz and employ a relatively long horn with a low cutoff frequency for best performance and sound. The 1" drivers will fit the larger sectorals, multicells, and CDs via throat adapters from Altec. A long horn with a low cutoff will provide more effective throat loading in the crossover region than the stock 511 horn. Consider 311s or 329As. The 329A resembles the 311 pictured above but with reinforcing bars instead of sectors.

Altec 500 Hz crossovers are excellent sounding units. Most are straightforward 12 dB/oct, parallel L/C, Butterworth types that were designed for 8 or 16 ohm loads. A few models (e.g. N500C and E) had their component values set for 12 ohms. Replace the stock wiring and capacitors in these units with your favorites to improve their sound. We measured the stock capacitors in several Altec crossovers and found that some had drifted in value considerably.

Still higher performance can be obtained by bi-amping the A7. I've listened through various solid state and tube crossovers employing 12, 18, and 24 dB/oct slopes and feel they all offer performance advantages over the single amp/crossover per speaker configuration. My favorite is the 24 dB/oct Linkwitz/Riley.

If you like to hear information above 10-12 kHz, opt for the 1" drivers over the 1.4" units. No contest here - tics on 802s sound like pops on 288s; leading edge attacks are razor sharp on 802s, softened on 288s. The 21216 adapter is a current Altec part which will allow the use of 1" drivers on horns designed for 1.4" drivers. Jobber price is around $75/pr.

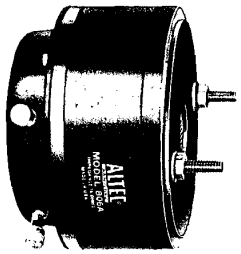
The midrange sounds cleaner on drivers that use the machined metal phasing plug. Distortion that is noticeable through a Tangerine plug on steady tones or program material is not present on the metal units.

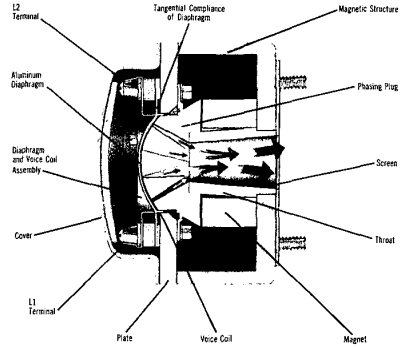
We prefer 416 type woofers in the A7 for the best overall performance in a Hi-Fi application. Use the 515 for low frequency augmentation.

(Continued on page 31)

802D & 806A Driver Loudspeakers

802D
806A





Features:

- 500-22,000 Cycle Response
- Smooth, Peak-Free Response
- Extremely High Efficiency
- Low Distortion
- Faithful Reproduction
- Aluminum Diaphragm with Tangential Compliance
- Edge-Wound Voice Coil
- 30-Watt Capacity
- Compact — Easily Installed
- Field Replaceable Diaphragm & Voice Coil Assembly

PROFESSIONAL 'PLAYBACK' SOUND SYSTEMS
BROADCAST & RECORDING STUDIOS • BALL ROOMS
AUDITORIUMS • SCHOOL & CHURCH MUSIC ROOMS
MUSIC HALLS • THEATRES • NIGHT CLUBS
DANCE STUDIOS • WIDE RANGE MUSIC SYSTEMS

The Altec 802D and 806A High Frequency Driver Loudspeakers are designed for all professional **PLAYBACK** applications requiring outstanding reproduction of sound over an extremely wide frequency range at substantial power levels. Such conditions are readily fulfilled with unusually high efficiency and exceptionally uniform response from 500/800 (dependent on the dividing network and horn employed) to over 22,000 cycles.

When used in conjunction with the Altec 511A, 511B (500 cycle) or 811B (800 cycle) sectoral horn,-the N-500D (500 cycle) or N-800D (800 cycle) network, and the 414, 515, or 803 low frequency loudspeaker, the 802D and 806A furnish the realistic reproduction demanded by all major broadcasting stations, recording studios, theatres, auditoriums and music halls.

Both the 802D and 806A transducers utilize a voice coil of notably large diameter (1¾") edge wound with aluminum ribbon and coupled to a large 2¼" aluminum diaphragm having tangential compliance. A mechanical phasing plug (i.e., pole piece), having two exponential acoustic slots, is utilized to provide the proper phase relationship between the sound emanating from the center and outer edges of the diaphragm and voice coil assembly, thus insuring maximum high frequency reproduction while maintaining a smooth overall response. Either driver is capable of uniform, peak-free reproduction to a point far above the range of human hearing. The entire diaphragm and voice coil assembly of the 802D and 806A is field replaceable; no special tools or skills are required.

For full range systems utilizing low frequency loudspeakers of relatively low efficiency, located in non-reverbrant areas having moderate ambient noise levels, the Altec 806A driver proves a perfect match. (Such conditions would be analgous to the average listening room or smaller broadcast and recording studio).

In instances wherein relatively high ambience is present, and where maximum efficiency of both vocal speech and music must be reproduced with greatest clarity, the heavier magnet weight and greater flux density of the 802D are preferred. The 802D represents one of the finest high frequency transducers manufactured by Altec; the 2 db greater efficiency (over the 806A), coupled with the same precision accuracy of minute production tolerances, make the 802D the industry standard for laboratory and professional usage alike.

These factors, together with the all-important Altec criterion of engineering experience, combine to produce the 802D and 806A high frequency loudspeakers of virtually matchless quality and limitless application.

ALTEC LANSING

RECORDING & BROADCASTING EQUIPMENT

From 1966 Altec Specifications for Engineers and Architects

ALTEC 802D 806A

SPECIFICATIONS

	802D	806A
Power:	30 watts (with N-500D or N-800D Network)	30 watts (with N-500D or N-800D Network)
Frequency Response:	500-22,000 cycles	500-22,000 cycles
Pressure Sensitivity:	111.7db* at 1 watt; 126.4db at 30 watts	109.5db* at 1 watt; 124.2db at 30 watts
Impedance:	16 ohms	16 ohms
Voice Coil Diameter:	1.75"	1.75"
Application:	HF Driver unit for wide-range, two-way studio 'Playback' Systems	HF Driver for wide-range, two-way, studio 'Playback' Systems
Protection:	N-500D Network and 511A or 511B horn for 500 cycle crossover	N-500D Network and 511A or 511B horn for 500 cycle crossover
	N-800D Network and 811B horn for 800 cycle crossover	N-800D Network and 811B horn for 800 cycle crossover
Magnet Weight:	1.2 lbs.	13 oz.
Flux:	15,250 Gauss	13,000 Gauss
Dimensions:	Diameter: 4½" Depth: 3 1/16"	Diameter: 4½" Depth: 3¼"
Weight:	7 lbs.	5 lbs., 11 oz.
Finish:	Altec Green	Altec Green
Accessories:	511A, 511B, 811B Sectoral Horns; N-500D, N-800D Dividing Networks; 70.7v transformers	511A, 511B, 811B Sectoral Horns; N-500D, N-800D Dividing Networks; 70.7v transformers

*(Ref: .0002 dynes/cm² measured with warble frequency 500 - 2,500 cycles, 4' from mouth of 30" trumpet)

Note: For Multicellular Horns use Altec drivers 730, 288 and 290 types.

ARCHITECTS' & ENGINEERS' SPECIFICATIONS

(FOR ALTEC 802D):

The high frequency driver loudspeaker shall utilize a 2¼" diameter aluminum diaphragm having tangential compliance, coupled to a voice coil of edge wound aluminum ribbon having a diameter of 1¾". The voice coil gap shall have a flux density of at least 15,250 Gauss, produced by a magnet having a weight of 1.2 pounds. A machined phasing plug, which also serves as the pole piece, having two exponential acoustic slots shall be utilized to provide the proper phase relationship between the sound emanating from the center and edges of the diaphragm and voice coil assembly, thus insuring maximum high frequency reproduction while maintaining a smooth overall response. The entire diaphragm and voice coil assembly shall be field replaceable without requiring special tools or skills; this shall be interpreted to mean that the speaker shall incorporate self-centering dowels to insure proper spacing and alignment of the diaphragm and voice coil assembly.

The HF driver loudspeaker shall produce a sound pressure level of at least 111.7 db with 1 watt input and 126.4 db with 30 watts input at a distance of 4 feet from the mouth of a 30" trumpet when a warble band of 500 to 2,500 cycles is used. Single frequency measurements shall not be acceptable under this specification. The frequency response of the HF driver shall be uniform over the range of (SPECIFY):

500 to 22,000 cycles, when used with the Altec 511A or 511B sectoral horn and N-500D dividing network.
800 to 22,000 cycles, when used with the Altec 811B sectoral horn and N-800D dividing network.

Any high frequency driver loudspeaker not meeting all of the foregoing requirements shall not be acceptable under this specification.

The high frequency driver loudspeaker shall be Altec Lansing Model 802D.

(FOR ALTEC 806A):

The high frequency driver loudspeaker shall utilize a 2¼" diameter aluminum diaphragm having tangential compliance, coupled to a voice coil of edge wound aluminum ribbon having a diameter of 1¾". The voice coil gap shall have a flux density of at least 13,000 Gauss, produced by a magnet having a weight of 13 ounces. A machined phasing plug, which also serves as the pole piece, having two exponential acoustic slots, shall be utilized to provide the proper phase relationship between the sound emanating from the center and edges of the diaphragm and voice coil assembly, thus insuring maximum high frequency reproduction while maintaining a smooth overall response. The entire diaphragm and voice coil assembly shall be field replaceable without requiring special tools or skills; this shall be interpreted to mean that the speaker shall incorporate self-centering dowels to insure proper spacing and alignment of the diaphragm and voice coil assembly.

The HF driver loudspeaker shall produce a sound pressure level of at least 109.5 db with 1 watt input and 124.2 db with 30 watts input at a distance of 4 feet from the mouth of a 30" trumpet when a warble band of 500 to 2,500 cycles is used. Single frequency measurements shall not be acceptable under this specification. The frequency response of the HF driver shall be uniform over the range of (SPECIFY):

500 to 22,000 cycles with the Altec 511A, 511B sectoral horn and N-500D dividing network.
800 to 22,000 cycles with the Altec 811B sectoral horn and N-800D dividing network.

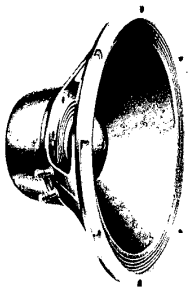
Any high frequency driver loudspeaker not meeting all of the foregoing requirements shall not be acceptable under this specification.

The high frequency driver loudspeaker shall be Altec Lansing Model 806A.

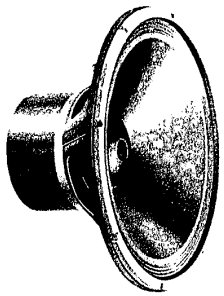
414A, 416A, 515B L. F. Loudspeakers

414A
416A
515B

414A



416A



515B

Features

Heavy Alnico V magnet
Edge-wound voice coil
Rugged construction
Smooth response
High efficiency
Low cone resonance
Low distortion
High power capacity
High linearity

LOW FREQUENCY SPEAKERS FOR WIDE-RANGE, TWO-WAY SOUND REINFORCEMENT SYSTEMS • OUTSTANDING AUDIO REPRODUCTION FOR THE LARGEST CONCERT HALL, THEATRE, AND AUDITORIUM SYSTEMS • PROFESSIONAL 'PLAYBACK' SYSTEMS • BROADCAST AND RECORDING STUDIO MONITORING

Altec low frequency loudspeakers are designed for use in the finest recording and broadcast studio 'Playback' systems as well as providing outstanding reproduction of the lower audio spectrum when used in two-way systems for the largest theatres and auditoriums. Utilizing heavy Alnico V permanent magnets, rugged, die-cast frames, edge-wound copper ribbon voice coils of the largest practical diameter, and exceptionally compliant cone suspension, these LF transducers combine the advantages of long-term operation with unparalleled response throughout the entire audible bass frequency range.

The smooth response and exceptional linearity of each loudspeaker is achieved by means of strict adherence to precision design and manufacturing tolerances. The axial retention of the voice coil, in a magnetic field uniform over the full excursion, assures the clarity of bass reproduction at high power levels. The low cone resonance, when coupled to a properly designed Altec enclosure, eliminates virtually all 'doubling' or self-generation of unwanted harmonic components.

The Altec 414A, with a range exceeding 30 to 4,000 cycles, is an outstanding 12-inch LF transducer — ideal for use in institutional and entertainment systems of moderate size and coverage area. The power rating of 25 watts makes the 414A, singly or in multiples, an excellent choice in two-way systems utilizing Altec high frequency drivers and sectoral horns.

The Altec 416A is a 15-inch low frequency loudspeaker of professional quality, chosen to complement the finest broadcast and recording studio monitor systems (such as the Altec A7 and A7-500) in addition to providing the critical listener with superb bass reproduction for all wide-range public address, sound reinforcement and theatre or auditorium systems.

The Altec 515B, with its exceptional low frequency response, high efficiency and ability to faithfully reproduce the lowest audio frequencies at unusually high power levels remains the unchallenged leader in the largest and finest two-way systems throughout the world. When used in conjunction with the Altec 288C HF driver, N-500C dividing network and multicellular horn of the desired size and coverage angle, the 515B becomes an integral part of the identical Altec 'Voice of the Theatre' loudspeaker systems currently employed by the majority of the largest and finest theatres, auditoriums and concert areas.

ALTEC LANSING

ALTEC 414A, 416A, 515B

SPECIFICATIONS

	414A	416A	515B
Power Rating (Continuous):	25 watts	30 watts	35 watts (50 watts peak)
Frequency Response:	30-4,000 cycles	20-1,600 cycles	20-1,000 cycles
Pressure Sensitivity:	99 db (SPL at 4' from 1 watt*) 113 db (SPL at 4' from full 25 watts)	99 db (SPL at 4' from 1 watt*) 114 db (SPL at 4' from full 30 watts)	103 db (SPL at 4' from 1 watt*) 118.5 db (SPL at 4' from full 35 watts)
Impedance:	16 ohms	16 ohms	16 ohms
Cone Resonance:	30 cycles	25 cycles	25 cycles
Voice Coil Diameter:	3"	3"	3"
Magnetic Assembly:			
Magnet Weight:	1.8 lbs.	2.4 lbs.	4.4 lbs.
Magnet Type:	Alnico V	Alnico V	Alnico V
Flux Density:	10,000 Gauss	12,000 Gauss	14,750 Gauss
Construction:			
Frame (Basket):	Structurally-reinforced cast aluminum	Structurally-reinforced cast aluminum	Structurally-reinforced cast aluminum
Cone:	Molded Fibre	Molded Fibre	Molded Fibre
Cone Suspension:	High-compliance cloth surround with mechanical resistance	High-compliance cloth surround with mechanical resistance	High-compliance cloth surround with mechanical resistance
Voice Coil:	Edge-wound copper ribbon	Edge-wound copper ribbon	Edge-wound copper ribbon
Diameter:	12¼"	15⅝"	15⅝"
Weight:	15 lbs.	17½ lbs.	26 lbs.
Mounting:			
Mounting Hole Diameter:	10¼"	13¼"	13¼"
Mounting Bolt Centers:	4 holes, equally spaced, on 11⅜" centers	4 holes, equally spaced, on 14⅜" centers	4 holes, equally spaced, on 14⅜" centers
Loudspeaker Depth:	5⅝"	7"	7¾"

The Altec 414A, 416A, and 515B low frequency speakers may be used to greatest advantage in wide range, two-way systems with the addition of the following Altec components:

HF Drivers & Horns: 802D & 806A (with 511A/B or 811B Sectoral Horns)
288C & 290D (with Altec multicellular horn having proper cutoff frequency and distribution pattern)

Dividing Networks: N-800D (800 cycle crossover)
N-500C (500 cycle crossover)
N-500D (500 cycle crossover; for use with Altec 802D & 806A HF Drivers)

Accessories:
Altec Loudspeaker Enclosures: For 414A: 612B, 614B, 618B, 622B, 855A, 858A, 859A.
For 416A & 515B: 612B, 614B, 825A, 855A, 856A, 857A, 858A, 859A, 210, 410.

*414A = EIA rating of 52db at 30 ft. from 1 milliwatt
416A = EIA rating of 52db at 30 ft. from 1 milliwatt
515B = EIA rating of 56db at 30 ft. from 1 milliwatt

ARCHITECTS AND ENGINEERS SPECIFICATIONS

414A

The low-frequency speaker shall be 12" in diameter and shall have a minimum pressure sensitivity of 99 db (spl at 4 ft. from 1 watt) measured on axis. The voice coil shall be approximately 3" in diameter and shall be of edge-wound copper ribbon operating in a magnetic field of at least 10,000 gauss derived from an Alnico V magnet weighing 1.8 pounds minimum. Speakers with smaller voice coils or round wire windings are not acceptable under this specification. The free-air resonance of the speaker shall not be greater than 30 cycles and it shall have a continuous power rating of at least 25 watts. Frequency response of the speaker shall range from 30 to 4,000 cycles. Any low-frequency speaker not meeting all of these requirements shall be deemed unacceptable under this specification.

The speaker shall be Altec Lansing Model 414A.

416A

The low-frequency speaker shall be 15" in diameter and shall have a minimum pressure sensitivity of 99 db (spl at 4 ft. from 1 watt) measured on axis. The voice coil shall be approximately 3" in diameter and shall be of edge-wound copper ribbon operating in a magnetic field of at least 12,000 gauss derived from an Alnico V magnet weighing 2.4 pounds minimum. Speakers with smaller voice coils or round wire windings are not acceptable under this specification. The free-air resonance of the speaker shall not be greater than 25 cycles. The speaker shall have a continuous power rating of at least 30 watts and shall have a frequency response from 20 to 1,600 cycles. Any low frequency speaker not meeting all of these requirements shall be deemed unacceptable under this specification.

The speaker shall be Altec Lansing Model 416A.

515B

The low-frequency speaker shall be 15" in diameter and shall have a minimum pressure sensitivity of 103 db (spl at 4 ft. from 1 watt) measured on axis. The voice coil shall be at least 3" in diameter, of edge-wound copper ribbon, operating in a magnetic field of at least 14,750 gauss derived from an Alnico V magnet weighing 4.4 pounds minimum. Speakers with smaller voice coils or round wire windings are not acceptable under this specification. The free-air resonance of the speaker shall not exceed 25 cycles. The speaker shall have a continuous power rating of at least 35 watts and a peak power rating of at least 50 watts. Frequency response shall be uniform from 20 to 1000 cycles. Any low-frequency speaker not meeting all of these requirements shall be deemed unacceptable under this specification.

The speaker shall be Altec Lansing Model 515B.

WHO STOLE THE DEEP BASS?

Nobody. The stock A7 cabinet cannot efficiently produce deep bass due to the relatively high box resonance created by its low port area to internal volume ratio. If you increase the ratio (hopefully by decreasing the port area - not enlarging the box!) the rise in electrical impedance will degrade the bass smoothness, efficiency, and transient response that the A7 is famous for. The solution to this dilemma is to find a subwoofer that can be blended seamlessly with the A7 "sound". We couldn't find any.

We became interested in adapting the Karlson Enclosure to this task after Bill Fisher related an anecdote about the ability of this mid-50s design to produce significant low frequency output from a relatively small volume. The story went something like this: A mysterious source of energy was shaking things off the wall in the juke box repair shop. It was eventually traced to infrasonic turntable rumble being reproduced by the shop's Karlson test speaker!

The Karlson is a folded pipe configuration that drives its bass output through a tapered, exponential slot with both front cone radiation and a chamber driven reflex port. A pair of K-15s were soon acquired for experimentation. While John applied his professional level of carpentry skills to the modifying and refinishing tasks, I busied myself with tuning, impedance and response testing, and bandpass filter design.

Specific modifications applied to the Karlson Enclosure for 15" drivers included:

- Altec 416 or 515 woofer with 25 Hz resonant cone installed
- Stock reflex port replaced with two 3", 90 (degree) PVC elbows.
- Enclosure tuned to 30 Hz
- Active bandpass filter implemented; centered at 30 Hz with -3 dB points at 19 and 45 Hz; 12 dB/oct skirts. (Requires 12 to 15 dB of boost above line level at 30 Hz for good subjective blending with A7s)
- Carpet piercing spikes attached to cabinet

The Karlson adaptation adds seamless balance to A7 based systems when reproducing music and movie soundtracks containing deep bass. The Karlson, like the A7, is easy to drive — a Mac 40 works well.

FINAL MIX

The performance that results from carefully optimizing the small Altec VOT speaker for Hi-Fi can be truly stunning. The remedies that we have suggested here can be applied to the thousands produced since 1947, including the current production A7-8G system. If you don't think a speaker can have explosive dynamics, wall-to-wall imaging, a seamless midrange that just won't quit, incredibly low distortion, a sweet, airy, top end, and do all this *without a hint of strain*, you haven't driven a good horn system lately!

Footnotes:

[1] Ted Uzzle, "Polarity and Phase", Application Note AN-9, Altec Lansing Corp., 1986.

RESOURCES

Factory reconing service is available for most Altec woofers. Your local reconing service might be competent to replace cones but Altec has equipment to remagnetize drivers, a procedure often required after 15 or 20 years of service to restore full performance. Contact Altec Service Dept. for more information.

Altec Lansing Corporation
P.O. Box 26105
Oklahoma City, OK 73126-0105
405-324-5311

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About the Authors

Jeff Markwart and John Tucker work for Aerospace firms supplying Space Shuttle and Space Station engineering services to NASA at the Johnson Space Center in Houston, Texas. Their terrestial pursuits include design, construction, and modification of sound equipment for use in musical sound reinforcement and hi-fidelity audio.

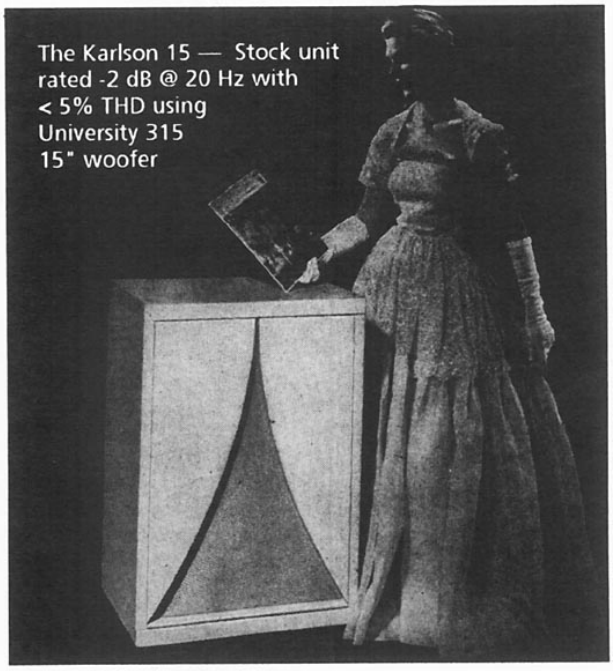


Photo from 1956 advertisement

One comment that Herb made was closely the same as what we have found, that AC signals are electromagnetic "shockwaves". I think that there is more to that than most audio engineers realize. To give you an example, when I started looking at capacitors in 1979, we devised the following test:

Connect a capacitor over the output terminals of a stable power amplifier, then connect a frequency generator to the input, and set the volume level at about 1/4 to 1/2 volume. Then run a frequency sweep from 0-20/khz into the amplifier. All the plastic capacitors that I've tried sounded like small (very small) loudspeakers, the paper caps were almost silent. We employed sensitive listening devices like medical stethoscopes for these tests. The frequency at which a capacitor resonates under these conditions closely matches the colouration it introduces into the sound of the amplifier when used in the signal path.

This is not a finite, conclusive test by any means, but a good and quick way of disqualifying most contenders. On the subject of feedback, the electromechanical "shockwave" theory may also have some mileage; when I have time over the next few months I shall run some tests and formulate some thoughts on this subject.

Peter Qvortrup
Audio Note UK

KLIPSCH

Dear SP:

I just received the most recent issues of your magazine. I think they are wonderful and contain very interesting articles, ones we all have been looking for these days.

One thing I don't understand, however, are the negative references and reviews of Klipsch products, such as in Greg Boynton's "What About Horns?" in *SP #1*.

Department of Corrections

Changes to Issue #3

6BX7 TRIODE AMPLIFIER (p. 11)
The 6.3 filament is shown grounded in two places in the schematic diagram. Choose ONE grounding arrangement.

READER'S FORUM:
Reply to O'Connell-san (p. 34)
The Silver Night is a *push-pull* amplifier (called *super-linear* by the designer) and not a parallel single ended amplifier as reported. This mental slip provides strong evidence for O'Connell-san's argument that Roberts-san has single ended triodes on the brain.

Mr. Paul W. Klipsch has been involved in the audio-industry for a very long time and has witnessed the evolution of sound reproduction from its beginning.

The Klipschorn has been in uninterrupted production since the 1940s and it is still recognized worldwide for its design and sound qualities. It is also the most copied loudspeaker in the world.

While the audio community kept pushing for change, and witnessed the introduction of the transistor, the direct radiator speaker, electrostatic and planar speakers, and so on, Mr. Klipsch continued to promote the horn-loudspeaker, making sure that horns were not forgotten.

So before selling it all to the Japanese, as happened with Marantz, McIntosh, etc., you should better appreciate your American heritage. We in Europe do.

I get very good results with the Klipsch La Belle, a 1975 model, which I use in combination with the L'Audiophile 300B Legend mono-blocks.

These French triode-tube kits are from the Maison de L'Audiophile, in Paris, and were designed by the famous Jean Hiraga. They use an original Western Electric 300B triode and the Partridge TK4519 output transformer, filter choke and power transformer.

As a pre-amplifier I use the McIntosh C 28, because it also has an independent center-channel output, for 3-speaker stereo. For your information, Mr. Klipsch has mentioned and favoured a 3-speaker-array in his "audio papers."

This can be done with 3 electrical true independent channels, as introduced by Bell Telephone Labs in 1934, or as a 2-track, 3 channel by means of a phantom circuit, where the center channel speaker is an acoustic mix of the left and right channels.

Enclosed is a Reference Listing from a German audio magazine, where you will find the Klipschorn ranked in the top category.

Henk B. De Ruiter,
Giekerk, Holland

Dear Mr. De Ruiter:

Of all the correspondence we receive, some of the more passionate mail has to do with Klipsch. Many serious and experienced listeners swear by Klipsch speakers, particularly the Klipschorn.

Well, a group of us recently listened to a pair of Klipsch La Scalas powered by some small triode amps as part of a high efficiency speaker survey for SP #5. We thought

they were really good. And, yes, we were somewhat surprised. Pleasantly surprised.

I came up with several untested theories on why the big Klipsches aren't favored by typical American tweak audiophiles.

—They never heard them (at least not with an appropriate low power tube amp)
—They are hopeless snobs and Klipsch speakers aren't fashionable in certain elitist audiophile circles.
—Klipsch are viewed as "old" designs and, in our culture, there is a tendency to break with the past and subscribe wholeheartedly to the illusion of "progress."

Of course, there are probably some who gave Klipsch speakers a serious evaluation and simply didn't like them as much as something else. To each his own. But, as you suggest, if more high-end types gave Klipsch speakers an honest chance surely many would find that they like them quite a bit.

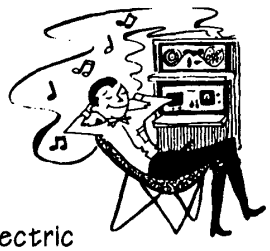
Contrary to the stereotype you mention above, there are *many* in the US who value our classic products. Greg Boynton is certainly one—he studied every paper Klipsch ever wrote. He has the greatest respect for Klipsch's work but he wants to time-align drivers 1993 style. He values solid contemporary practice as well as the classics. A good healthy attitude, I think.

Of course, the number of "historians" is small compared with the total US audio buying public—not to mention the total population. How many Europeans really care about classic audio gear, regardless of where it came from? There are individuals everywhere who recognize quality and it's certainly true here in the States.

As for the Japanese, I congratulate them for recognizing quality and getting a good deal on the purchase. There's still plenty left for the rest of us who know what is good. Sure, prices are higher thanks to Japanese interest—but that's life in a free market world. Looking on the bright side, North American and European enthusiasts can occasionally unearth a real bargain. Recently, I found a few nice Western Electric speakers for $5 each. That would *never* happen in Tokyo!

COMING IN SP #5. . .
SINGLE ENDED TRANSISTOR AMP
RETURN OF THE "POOR MAN'S ONGAKU". .. *AT LAST!!!*

Casual Reactions



by Herb Reichert, Eddy Electric

CAN'T STOP RUNNING WATER: The Edgar Horns and The Blue Island System

The horn skeptics are dropping like toddlers in a marathon. The phone lines are abuzz. The Edgar Horn System is opening musical doors and turning on perceptual lights for open-minded audiophiles across the United States and overseas. Here in NYC the High Fever boys are working their jig saws and keeping their irons ON. Based on our continuing auditions, the triode-amped Edgar horn is beginning to look like the greatest audio discovery since the LP.

I fully expect that the mainstream manufacturer/press coalition will soon discover what tens of thousands of Asian and European music lovers have known for almost two decades: that carefully engineered triode/horn systems will play the hell out of your records in a way that makes "recommended" audio systems seem sterile and emotionally distant.

We are so enthused that we have begun to collaborate on an all-out *Blue Island System* (BLue ISland System = BLISS) here in the old Staten Island Firehouse. The purpose of this system is to create triode magic that will take us to places we have never been before. Because of lower distortion and elevated dynamics, music recreated by the triode-horn combination follows a direct conduit to our nervous systems, hearts, and minds.

Triode maniacs take enormous, detailed soundstages and scary resolution for granted. This is Class A, no-negative feedback, triode turf. The real breakthrough is the EHS. Never before have the virtues of low power directly heated triode amplifiers been revealed without the serious dynamic compression of conventional cone/dome systems or the peaky resonances of theater horn systems. These wooden, cone driven horns showcase the beauty of musical presentations without asking us to overlook the ringing and serious colorations which come stock with most other horn transducers.

These observations are based on three very different systems which all have the Edgar midrange horn in common:

- A tri-amped setup with MOSFET-powered transmission line bass, a 4" throat mid-horn with a Focal 7V, and a Polydax PR-120-il tweeter.
- A system consisting of a single-ended 6B4-G PP amp, a Petit Onken bass cab, a 4" throat horn with an Altec 755C, and the glorious Onken OS-5000 tweet.
- My system, which currently employs Altec 515As in a VOT cabinet with a 1 1/4" inch stone top and no crossover and 2 1/2" throat mid horns with Dynaudio D-54 drivers in spiked, sand-filled cabinets. I use series 48 mF oil caps to cross over to the D-54 and a series 4 mF cap on the PR-120.

Any of the these systems will give you more goosebumps than ANY store bought system, but this is only the beginning. Beyond all the above lies the *Blue Island System!*

WHY BOTHER?

Before I describe the "soon to be completed" BLISS, I would like to remind our readers why I think any of this is important and why I think one should go to the considerable effort to "create" a system of this nature.

When we experience the beauty of art (painting, poetry, music, etc.), we very often consciously acknowledge our recognition of this beauty by saying something (i.e. Wow!) or doing something (i.e. pausing for further study). The simple experience of acknowledgment has great significance to our personal development. The mechanism of recognition must come from within. In other words, we must "comprehend" beauty.

Our ability to recognize or comprehend the sublime in art is probably founded in our experience of the sublime in nature of which we are an integral part. The beauty we recognize on the "outside" is DIRECTLY RELATED to the beauty we recognize on the "inside". The inner experience of beauty enhances the possibility of the outer experience and vice versa. Our efforts to seek beauty directly relate to our experience of "quality" in life. All of this is a sort of barometer of who we are now and what we aspire to be.

Man, I believe, endeavors to create and understand "sublime architectures" like those he perceives in nature. A Ferrari, the Sistine Chapel, Van Gogh's Irises, Mozart's *Don Giovanni*, the electromagnetic spectrum — these are all sublime architectures. High quality music reproduction can be a channel to an almost infinite variety of these architectures. To this end it behooves us to establish a type of audio engineering which is capable of illuminating these artistic structures in recorded music. If we can enhance our systems' "communicative skills," if we can design a system that showcases more "artistic intent," we can open doors to understanding ourselves, nature, and the hearts and minds of the composers whose music we choose to play.

We perceive the sublime in art through contrasts; big-little, hard-soft; near-far; light-dark; warm-cool, etc. You will have to trust me on this, but to my aging senses, the type of system we are undertaking here preserves the nuance and drama of these contrasts better than anything else available.

I believe that a fine music reproducing system, listened to in the privacy of our homes allows us two critical enhancements not available in commercial live-music venues. First, and most important, is the ability to choose the great performance we feel like hearing NOW! Not the second rate Beethoven we paid six months in advance for. Second, we can, dance, cry, scream, shake, or tear the roof off this place at will. Do not underestimate the power of these freedoms. I often enjoy radical changes of program too. Going from Laurie Anderson to Junior Wells, to Sun Ra, to Wagner, and

finishing with "Love in Vain" and "You can't always get what you want" might just be what I need to get my creative juices flowing. Our BLISS is intended to let us exalt in these kinds of indulgences. In this issue I would like to give you some engineering architectures to work with.

©AN'T TAME A CRAB: What to do about Crossovers

One of my biggest regrets is the amount of time I spent tweaking passive speaker crossovers. I began to spend equal amounts of time devising strategies to avoid using any crossover. Every time I successfully eliminated a choke or a cap from the amp load the music became more vivid, detailed and alive. Setting driver levels can also be a nightmare.

There is one solution which solves all your crossover problems at once. . . at the expense of a few extra amplifiers. If you want to go beyond the mundane in audio, I believe there is no easier way than to provide high quality loudspeakers with separate bandwidth-limited amplifiers for each driver. With this method, the drivers are connected directly to their own amplifier's output terminals and there are no additional parts, gain stages, or buffers.

Additionally, the amplifier can be specifically designed to meet the electrical, mechanical, and sonic needs of the driver. Going beyond simple interstage filters the drivers response can be adjusted by clever use of multiple time constants inherent in every amplifier design. Fortunately for us, the Edgar horns seem to require none of this type of skullduggery. *On to the BLISS. . .*

FINER THAN FROG'S HAIR: Speakers With Bowties

One reason horns became dinosaurs was the nastier aspect of "horn sound". Another drawback is that horns do not fit in well with most peoples' ideas of home decor. Taming horn resonances and making them "handsome" is still tricky as ever. We are trying to create a home speaker system that exceeds Wamm and has a touch of WAF. Okay I admit it: WAF is well down on the list of priorities for the BLISS. However, with the proper veneers, grill cloths, and marble colors it can be made quite attractive — see Raul Gil's setup for inspiration.

Figure #1 shows our steel spike, sand-filled horn, stone arrangement. No one will guess you have load bearing joist supports in the basement! This system is a bit heavy but it sings like Pavarotti.

BLUE ISLAND SYSTEM: Electronic Architectures

Figure #2 shows the schematic for the bass amp I have chosen to power the Altec 414s in the Petit Onken enclosures. A solid state amp could provide better bass transients and lower octave transparency but the low input impedance would require that I use an active filter with a buffered output to interface with my preamp which has a slightly high output impedance.

Fixed bias on the 2A3s would also reduce any subjective effect of softness in bass regions, but I prefer the overload characteristics of cathode bias. This 10 watt push-pull amp represents a compromise in some areas of bass performance but I think this amp will redeem itself in the smooth tonal transition at the 100 Hz turnover point.

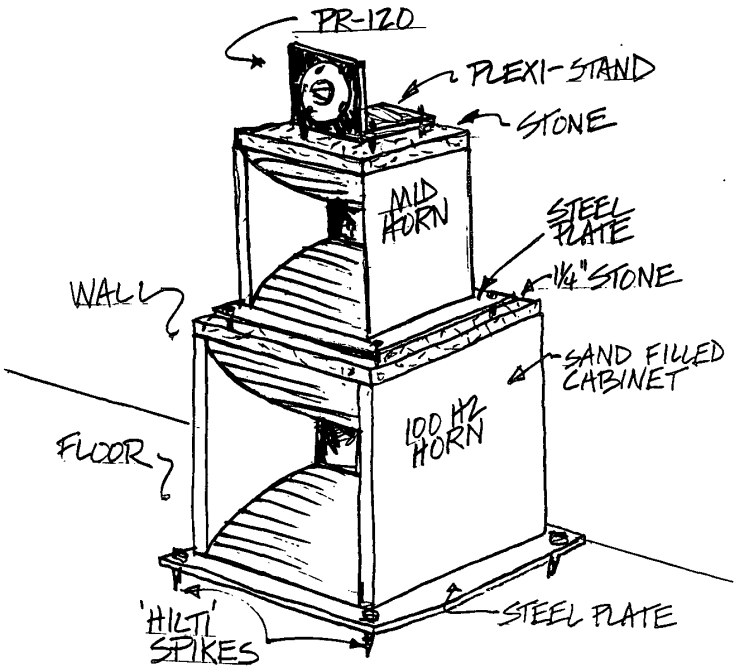


Figure 1 — Visualization of Blue Island System

Figure #3 shows my 300B Single amp with the 100 Hz-500 Hz bandpass filter installed. I really love the speed and vivid textures of the 300B single throughout the midband. This amp will power the soon to arrive Edgar 100 Hz horn. Bruce tells me his horn comes in at 110 dB/watt/meter!

The Edgar 100 Hz horns are approximately two feet on each side, designed to be used against a wall but away from the corners. The beauty here is the potential freedom from room boundary effects in a region typically sabotaged by cancellations and doubling just below middle C.

Having a dedicated amp makes bringing the level down to the 98 dB of the Onken easy and minutely adjustable. At 500 Hz, 1 dB level mismatches are certain to skew tonal balance. Precision stepped attenuators at the inputs of each amp will allow the BLISS to be tweaked to +/- 0.5 dB through the critical lower midrange.

Any amplifier with a direct coupled and a R-C coupled stage can be configured as a bandpass amp using a R-C network between the direct coupled stages for low pass and a coupling cap in the R-C stage chosen to yield the desired LF roloff point.

Electronic Architectures: Blue Island System

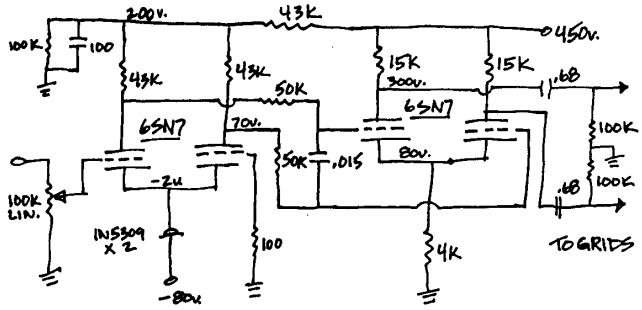


Fig. 1 - 2A3 Push-Pull Bass Amp
100 Hz low pass

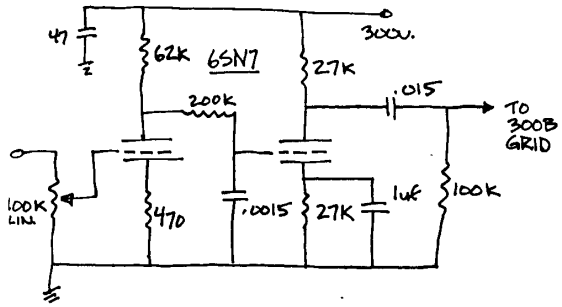


Fig. 2 - 300B Single 100 Hz Horn Amp
100 - 500 Hz Bandpass

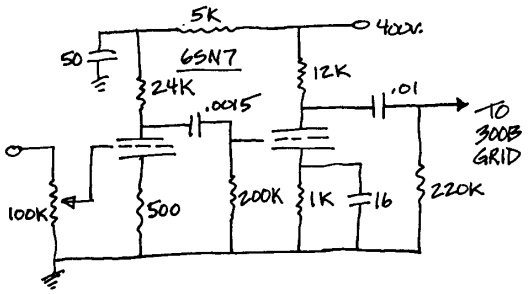


Fig. 3 - 300B Single 500 Hz
Midrange Horn Amp

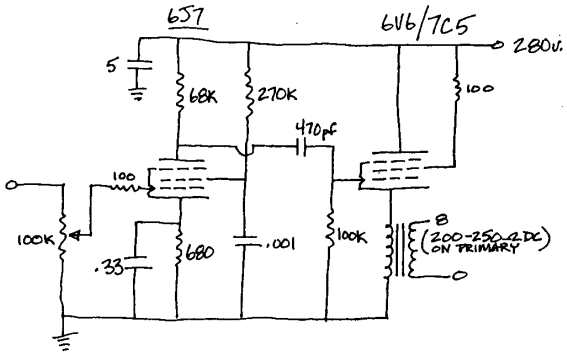
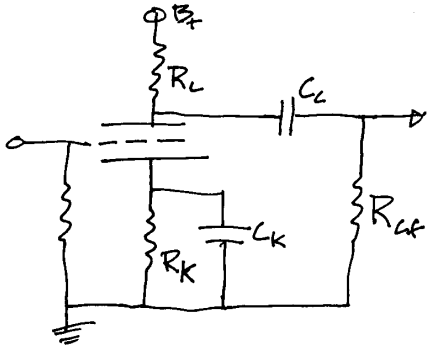


Fig. 4 - PR-120 Tweeter Amp



$$f_1 = \frac{1}{2\pi RC}$$

$$C_L = \frac{1.6 \times 10^6}{f_1 R_{CF}}$$

$$C_K = \frac{1.6 \times 10^6}{f_1 R_K}$$

f_1 = low frequency limit

Adjusting time constants for passive high-pass interstage filter networks

Reader Raul Gil and family perched on Raul's handcrafted full range Edgar horn system.

This creation is finished in rich maroon lacquer and birds-eye maple veneer, combining Deco Movie Palace style visual appeal with horn loading down to 40 Hz ! For constructional details on Edgar's *Monolith* bass horn, see *Speaker Builder, 1993:6.*

Figure #4 is the schematic for the amp I presently use with the Edgar mid-horn. It has only a 500 Hz high-pass filter. The D-54 is very well behaved outside its horn-loaded passband.

Figure #5 is a suggested schematic for a PR-120 tweeter amp. This design uses the 6J7 for low input capacitance and good RFI rejection. Tweeter resonances can have a very serious effect on midrange clarity. They can sabotage voice articulation and upper midrange tonal balance. This design uses three staggered poles to get the amp as far down by 2000 Hz as possible without severe phase shift or ringing. This is an untested design which, if implemented, should be examined on the scope looking closely for transient and phase anomalies outside the 5000-20,000 Hz passband.

BIRDS OF A FEATHER: THE PR-120

Dr. Edgar spent twelve years developing these horns and then he "casually" recommends the inexpensive Polydax PR-120 tweeter ($50) for use with them. Last issue, I was recommending the JBL 2405 as the best choice at a reasonable cost. Well, I take that back! Further listening has shown that this tweet is way out! I can't believe how good it really is. I have been listening to the new version, the PR-120i1, in the tri-amped system mentioned earlier and you can buy this unit with no reservations. Only the Sequerra Ribbon, the Plazma and the Onken OS-5000 have sounded better in my experience. Thank you, Dr. Edgar for your great taste. You can contact Bruce Edgar at POB 1515, Redondo Beach, CA 90278.

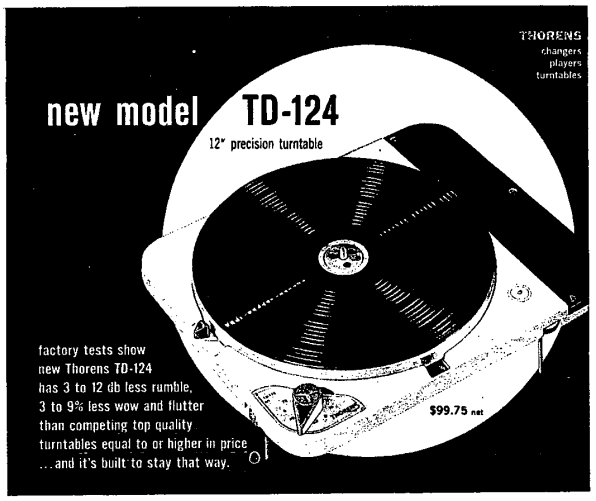
In my next installment I will go into the details of system setup, measuring, and wiring. In the spirit of shared discovery, I hope you will continue to do your own research on the edge of audio art. Remember, the High Fever boys still believe that there are AT LEAST 144 perfect ways to do anything.

THE MUSIC GOES ROUND AND COMES OUT HERE: The Thorens TD-124

Part of my "research" involves going around to NYC audio salons and harrassing the proprietors to let me "study" their systems. My purpose is to figure out "how it works". I do this to lonely audiophiles with original type systems too. The only thing I can say for sure I have learned is: when comparing the best to the best, analog front ends provide INSTANT goosebumps and visceral access to musical contrasts while digital sources seem to even everything out by generalizing on textural and coloristic details. The sensation of "something special and beautiful" or the effect of "tough and gritty", or the notion of "hard" in rock — these aspects seem to get lost in digital and show up in spades on analog. The serene, the nasty, the heroic, the hesitant, the shy, all come out very clearly in analog. These are some of the qualities we are designing the BLISS to elucidate.

I have always admired the audiophile who had the means and good taste to assemble a perfectly set up turntable/tonearm/cartridge combination. This is where the truly sophisticated music lover shows his character. He can assume the role of connoisseur and art collector by his selection, setup and maintenance of these components. This, to me, is where the "high end" was to be found. Unfortunately, entry level costs for front end connoisseurship are kinda steep for my blood. Undaunted, I have spent much of my adult life seeking high-end analog on a mid-fi budget.

After my cheapo late-70's Garrard with the free cartridge, I stepped up to a Dual 1219 with an ADC cartridge. Then came the Kenwood KD-600 which I loved for about 12 years. Then IVOR! He made me save my money for a LP-12, but when the time came to plunk down my cash, I wavered and swooned and bought an all out SOTA at the last minute.



Here's a new hi-fi turntable that works on an absolutely new principle—The Thorens "Roto-Drive," actually two turntables in one — *to give the lowest flutter, wow and rumble of any 12" turntable with equal or less moment of inertia*... Performance far exceeds broadcast standards for wow, flutter and rumble... exceeds that of turntables with hysteresis synchronous motors. What's more, the TD-124 gives you a truly outstanding combination of features. Check them!

* Continuously running, heavy 10-lb. rim-concentrated cast-iron lower table or fly wheel that—
  1. Provides high inertia (3 times as heavy as aluminum; outweighs 16" aluminum turntables).
  2. Completely shields pickup from strong hum fields.
* Light aluminum cover table with attractive mat that—
  1. Forms precision rotating surface.
  2. Allows fast starts and stops (⅓ rev. max.)
  3. Prevents attraction of pickup magnet to flywheel.
* Exclusive Thorens clutch instantly joins heavy and light tables, makes starts fast, makes cuing easy. Saves records; you can start turntable *after* you've placed stylus.
* Four speeds 16⅔, 33⅓, 45, 78.
* Built-in illuminated strobe disc for all speeds.
* Plus or minus 3% speed adjustment for all speeds.
* Built-in turntable level for easy leveling.
* Built-in knurled leveling screws accessible from top of unit.
* Easily detached, standard 12" arm mounting board. (16" board available as accessory.) You can change arms without leaving unsightly marks.
* Shock-mounted "Roto Drive" motor is completely vibration isolated by limp, extremely compliant belt drive, plus large idler.
* Easy to mount, only 2¾" clearance required below mounting board. Top surface requires 15 ¾" x 12 ¾" with 12" arm mounting board; 18" x 12 ¾" with 16" board. (NOTE: These are minimum dimensions; arms with rear overhang may require slight additional space allowance.)
* Comes with power line cord, shielded pickup cable and solder plate.
* May be used on 50 or 60 cycle alternating current. 100-120, 125-150, and 200-250 volts. Easy to change over.

HI-FI COMPONENTS • LIGHTERS • SPRING-POWERED SHAVERS • MUSIC BOXES THORENS SWISS MADE PRODUCTS NEW HYDE PARK, NEW YORK

Thorens TD-124 ad from 1959

For about a year it was my favorite possession, then I noticed that I spent most of my listening time looking for albums that "sounded good." I used to just play what I felt like listening to with no forethought about sonics.

Once I realized what I was doing, this search for sonics became even more of an obsession — one that excluded whole record labels and their artists from my listening repertoire. No more Columbia, Deutsche Gramophone, or Phillips! I knew this was bad, but I didn't know how to stop.

At first I thought the cheap MMT arm must be "dead". I bought a FT-3 looking for "life". Very little improved. So what the hell maybe it's my choice of cartridge. . . so I tried a few others. Still, the system seemed "off" and "sour" and "even". Adventure returned quickly, however, when a friend turned me on to the Thorens TD-124. We compared it to his Well-Tempered/Van Den Hul set up and it was no contest. I sold my SOTA instantly and started listening to ALL my records again.

The Thorens excelled at presenting weight, body and rhythm. These are qualities that I treasure and were lost in the SOTA and the Well-Tempered, but should I have bought a Linn in the first place? We know it is a rhythm master, but would it let me play records with no sonic forethought? Would it make me stop wondering if I was missing something? The Thorens is so old and clunky looking I always wonder if the NEW high end rigs would outclass it like the new preamps outclass the 7-C and SP-6. Then came John Atkinson and Corey Greenberg singing about the Linn and extolling the "good ol' soul" of the LP-12-Lingo-Cirkus. HOO HAW!!! MAN!!! HAHA-HAHAHA!!! MAN O MAN!!!

That was it! I begged and borrowed and got a Linn Valhalla and set it up exactly like the TD-124: identical Fletcher MDC-800 arms, identical Kimber KCAG Silver arm cables, Shure V-15-V, Adcom Crosscoil, and Stanton C-100 and 981LZS cartridges. I even made two mahogany arm boards to eliminate another variable.

Guess what? The Linn showed me why I have never heard a bad system with an LP-12 playing the records. The Linn is very, very transparent. It is transparent in a way that makes recorded performances seem extra holographic and pristine. This transparency takes over your listening space and impresses your friends. Its tempo keeping ability will also give you weeks of delight. But! But! I think the emperor is not fully dressed! Alas, he forgot his pants! The weight, body, and drive that gives a performance momentum and keeps the rhythm going is missing.

So what about the 124? It seems equal to the Linn in every area except noise floor and transparency. Plus it has a bit of "weight" that the Linn lacks. Now I was really getting frustrated. Even if I had lots of money I still didn't know what I wanted. Remember, I am a body-freak. One super rare quality that my big horn system with Thorens TD-124 has is that at very low SPLs it will still vibrate my chest and rumble my chair. Even at low levels you still can feel the bang of the kick-drum on your body! Try *that* on your system. With the Linn, most of this quality was missing. But, I love that transparency. The Thorens was thick and opaque by comparison.

This state of affairs gave me a high fever. I started changing and tinkering and trial and erroring till I made the Thorens transparent. I think I have excavated maybe 90% of the Linn's transparency out of the venerable old clunker. Try this: remove the aluminum platter cover and mat from the 124. Scrape off the rubber spacers from the platter itself. Next, replace these rubber spacers with dots of 'Blue-tac' and unfasten the three screws that hold the rubber mat on the platter cover. As you replace the cover on the platter, press firmly, making sure the cover is level and parallel to the heavy rotating platter. Add a gray felt Discwasher mat and reset your VTA and stylus pressure. That is all there is to it. All we are doing is changing the record/table interface. Isolating the platter cover reduced the noise floor and the felt mat imitates the Linn record platter interface which I maintain is a substantial part of the Linn sound.

While the LP-12 gives "high-Q" bass, the low bass performance of the TD-124 is a bit on the soft and wooly side — even after modification. Hence, the punchy bass of the Linn does not seem to be a result of the felt mat. In any case, the 124 with a felt mat seemed to subjectively lose a few Hz at the very bottom, but the leading edge of bass transients is clearly improved.

All in all, the Thorens shows itself to be a true contender for wannabe high end connoisseur types on a budget. I truly expect that with the addition of a high quality power supply and line voltage filtering this table could perform at the highest level. The 124 deserves the attention of some creative minds with musical souls.

Desperately Seeking an Efficient Speaker

by Mike LaFevre and Peter Stillwell

Now that we have these great low powered single triode amplifiers, what the heck do we do for speakers?

After *Sound Practices* #1 hit the streets, the MagneQuest hotline got lots of phone calls from people interested in using our transformers in the single ended 300B "91" circuit. Most of them wanted to know whether the relatively inefficient speakers they had would work well with this "hunk of an amplifier." Will eight watts drive my LS3-5As (or my Celestion 600s, or my JPWs, or my Vandersteens, etc.)?

The sad fact is that most of these adventurous souls have speakies that are just *terribly* inefficient by single triode standards. The majority of modern speaker systems need big horsepower to really come to life. This is not a problem if you are looking at the hundreds of medium to high powered amplifiers out there. It is only since the new wave of interest in low powered amplification arose that the scarcity of highly sensitive speakers became such a hot issue.

Although many of these inquiring souls would be pleasantly surprised at what eight watts can do, I usually recommended that they acquire a set of reasonably efficient speakers before building the fabled "91" if they want to achieve the best results. The hard part was to make an honest recommendation to them. Basically, the speaker market is way behind the times in terms of what the rapidly expanding base of triode listeners need.

Of course, I could have recommended some of the vintage drivers that were revered for overall performance capabilities and their suitability with the smaller single-ended amps and sent callers to the used market. But there were a lot more callers than there are old Altec 604s or whatever. Also, vintage speaker systems are usually anything but plug and play. You often have to build a proper cabinet to house the drivers and you may have to do some experimentation and modification to get those classics to do what you want them to do.

Many people understandably don't want to hassle with the recycled audio scene, objecting to buying raw drivers or complete speaker systems that they had never seen or heard from someone they don't know. They just want to go out and buy a new, finished pair of speakers. Nothing wrong with that.

Based on a perceived public need, I suggested to the editor that we try to assemble a small number of highly efficient speakers that are currently in production for the purposes of seeing if there is anything out there will run on, say, an amplifier with under ten watts output.

Years ago, efficient speakers ruled the roost. Amps were too low powered to allow speaker manufacturers to disregard the efficiency of their products. Then we got to the fork in the road that Herb Reichert so eloquently described in *SP#1*. The speakers shrank in size (and efficiency), and power became less and less expensive.

Then new tubes like the KT-88 and 6550 increased the power output of pentode amplifiers by 50%. The amplifier horsepower race was on and power handling displaced high sensitivity as the prime engineering challenge in loudspeaker design.

Now, we may have passed the peak of the horsepower race in amplifier design as some audiophiles are beginning to realize that less is more. Unfortunately, the result of decades of the bigger-amp-is-better mentality is that there are no contenders in the home speaker market that produce modern rivals of the beloved efficient speakers of yore: 604, 755, VOT, Paragon, Metregon, etc.

Actually, it should be possible to produce something just as efficient and much better than the aforementioned classics for audiophile applications in the average listening room. There are some very promising modern materials out there — horn tweeters and midranges with neodymium magnets, anyone? The art of speaker cabinetry has certainly come a long way since big Altec and JBL systems ruled the Earth.

I'm now a bit bemused that single-ended amplifiers are in the process of being "mainstreamed" by the high audio priests. The confessional booths at the audio temples are now jam packed. Editors and writers proclaim that they have seen the sin of their ways. Don't forget that just a fortnight ago, these same gurus held forth with utter disdain and disbelief that some kooky Japanese audiophiles might love three watt amplifiers with "antique" speakers. But the high end has gone full circle before.

In the meantime, there are a lot of disheartened ex-audiophiles out there sipping a Bud in front of their 52" color screens and groovin' to the hi-fi stereosonics of Top Gun. Who can blame them? There is no shortage of hype in this business and some of it has led in counterproductive directions.

For instance, the local tweak hi-fi industry has for decades completely ignored most of America's premier loudspeaker manufacturers. Companies like JBL, Gauss, Electro-voice, Altec, Jensen, Stephens and a few others that I've missed. All are or were manufacturers of solid, honest high grade equipment, much of which is very popular among overseas audiophiles. These companies, if they survived, flourished in markets other than hi fi, such as the pro-sound or sound-reinforcement fields. Thank God for all the gymnasiums.

There were survivors in other parts of the world: Lowther and Vitavox in England, TAD (a division of Pioneer...oops! not high end, sorry) from Japan. Additionally, there are some small companies and individuals in the U.S. and elsewhere that are committed to high-quality, high-efficiency drivers and speakers. In the U.S., Dr. Bruce Edgar is believed by many to really be at the cutting edge. Too bad he has been totally ignored by the high priests for so many years. Another fellow in Japan handbuilds really cool field coil speakers, at a reported cost of $2,500 each. This guy must be the ultimate craftsman — kudos!

Where does this leave us 40 years after the horsepower race began? Are there any speakers left in the marketplace that are efficient and worthy of consideration? To get our audition rolling, we secured four different sets of loudspeakers, all of which were appropriate for use with itsy-bitsy power amps.

The rules governing selection were simple: the speakers had to be currently manufactured in finished form (no kits this time around, folks); cost less than $2,000 a pair; and have good prospects for being favorably reviewed. It would also be a plus if two of us together could lift the speaker.

The field was narrowed from a list of 40+ speakers with efficiencies of 95 dB or higher, as identified through *Audio's* Annual Equipment Directory, to the following four products:

1 - **Audio Note AN-E:** A high-efficiency two way box speaker with an 8" paper cone woofer and a soft dome tweeter in a ported enclosure. Used by the manufacturer to demonstrate amps costing more than some small aircraft, so we figured it was worth a listen. We got the copper wired version, not the upscale silver-wired version.

2 - **pipe dream:** A Focal 7-incher in a tapered pipe enclosure, conceived by J.C. Morrison, noted Downtown guerrilla audio designer. Available from Fi in NYC as a custom-order product.

3 - **Klipsch Heresy** & 4 - **Klipsch La Scala** They might not be popular with snooty audio journalists but Klipsch never abandoned the quest for high efficiency. Let's give credit where it is due.

Our esteemed panel included a small core group of three or four people plus whoever else we could round up for a listen or two. The luminaries included my audio soulmate Jimmy Dobbs, who really hates "toy amps" and efficient speakers; Scott Stillwell, renowned speaker archeologist; his brother, Petey, who grooves on Porsches and Guzzi racing machines; Johnny Z, an accomplished luthier; Dr. Krause, a passionate audio explorer; and Jim Novak, crazed audiophile and amp builder. We were even blessed with the presence of the elusive editor of this publication at our first speaker-feast. And speaking of feasts, many thanks to Scott and Rosemary for the refreshments and warm environs in which to do our work.

We thought it was important to include a few highly experienced audiophiles with little or no direct experience of low-powered amps for balance and a touch of objectivity.

This "audition" was not set up as an official quasi-scientific review. We didn't even have a control system. Instead, we listened to a wide range of amplifiers and preamps always trying to keep things equal. For instance, when we played Mark Lyons' homespun 300B single ended, we made sure that we played it on all the speakers. What we were after was not an absolutely definitive in-depth analysis complete with a listing of all the sources and associated equipment employed. Rather, we wanted to gather impressions about the speakers that we might be able to pass on to the reader interested in the general issue of low-power applications. For additional insight, participants were encouraged to take a pair of speakers home with them to audition more carefully with equipment they knew well.

Klipsch La Scala

So let's let the cat out of the bag. After our first "group" meeting, I asked everyone which of the speakers they enjoyed the most. Which would you like to take home with you? The unanimous favorite was the Klipsch *La Scala.*

Frankly, we were all surprised. We too had fallen victim to the folklore and false stereotyping that the big Klipsches would suffer from driver-to-driver discontinuity and "horniness" (also referred to as "honkiness"). After nearly seven hours of auditions on the first day, the *La Scalas* were everyone's first choice. And each time — every time — after that, at all our meetings, no matter the size, no matter who participated, the consensus remained: the *La Scalas* brought home the gold.

The *La Scalas* played with a sense of ease, composure, and grandeur that had two local *TAS*-subscribing audiophile club members picking their jaws up from the floor. Just put Mercury's CD of "Also Sprach Zarathustra" on the smallest amp in the house (in this case, a two-watt, type 45, direct-coupled single ended designed and built by Gordon Rankin) and help your dearest friends through their ecstatic recovery. The *La Scalas* played this demanding piece with the utmost grace, control, and verve. Ever hear a two watter slam on a *La Scala?*

I'm sure you're all thinking that Mikey has finally gone off the deep end, so this would be a good time to call on another member of our elite group of auditioners to report our findings.

Again, we can't claim that these are scientific results derived under perfectly controlled circumstances. But they are accurate, at least to our ears. With that behind us, let me pass the gauntlet to Peter Stillwell, who was organized enough to take notes while the rest of us were busy munching on snacks and catching smokes out on the patio...

Listing at almost $2,000 a pair, the Klipsch *La Scalas* are the most expensive, beefiest (at 123 lbs. apiece) and efficient (at 104 dB) entries in our survey. Excellently finished in black, the *LS* are reasonably grand in physical proportions, measuring 35½"H X 23¾"W X 24½"D.

A three-way, horn-loaded system, the *La Scala* employs a 15" woofer and mid and high horns with all wiring easily accessed via the open crossover. The cabinet is somewhat resonant due to the large surface, despite overall high build quality with most joints being glued and screwed. They are highly placement-sensitive. We settled on placing them as "near cornerhorns", which gave "rock-solid imaging anywhere in the room" and softened a slight forwardness in the horns.

Everyone agreed that the *La Scalas* sound "large, open and effortless" and deliver a "movie theater-like recreation." Detailing and imaging are, with proper placement, extremely accurate, making the *LS* evocative of actually "being there". We had some concerns about time alignment of the tweeter and potential megaphonesque "horn honkiness" which turned out to be totally unfounded.

La Scala!

The *La Scala* worked with a variety of material, ranging from Bach to rock. The bass response is the only area of some controversy. Scott thought that the bass was open, akin to an Altec VOT sound, whereas John Z and Jimmy Dobbs preferred the more controlled, "tighter" bass of the Heresy. This likely stems from the larger, more resonant cabinet of the big Klipsch. Scott opined that, of all the speakers, "The big Klipsch are the most livable." Mike said, "These *La Scalas* free you from the power monkey. You could take a walkman with fresh batteries and run 'em!" These speakers allow you to pick an amplifier based on its inherent sonic beauty, without regard for power specifications.

Klipsch Heresy

Klipsch *Heresy*, at a retail of $800 the pair, give the most bang for your buck. They are 96 dB efficient. "Not efficient enough for the pee-wee single ended amps, you really need 100 plus dB efficiency for the two- to five-watt amps," according to Mike. But there's plenty of oomph on the 300B based amps for all but the most cavernous listening rooms. The *Heresy* drivers, 12" woofer, mid and high horns, are packed tightly into attractive, oak-finished cabinets with wedge shaped stands. The factory stands are inadequate and, based on our experiments, not high enough. The horns really need to be at ear level. Placed about two feet from each wall in a corner on tall spiked stands, they provide detailed and room-filling sound.

John Z preferred the *Heresy*: "Bass response is more slamming, the detail on the upper end is good, maybe even better than the *La Scala*." We agreed that they didn't sound as open, refined, or airy as the *La Scala*, but opinions varied regarding the top end. I found the Heresy to be a little too hot, "in my face" and a little ragged in the midrange. Damping the horns might have a civilizing effect but we didn't want to go wild with loaned speakers.

These same "rough" qualities, however, made them the best rock 'n' roll speakers of the bunch. For example, they seemed totally "at home" on well-produced Clapton material. Indeed, the *Heresies* are very involving. Like dating a very sexy, aggressive and cerebral college woman: exciting, but in need of a little maturational claying and crossover work.

Audio Note

The Audio Note *AN-E*, built in Great Britain, list for $1,500 per pair and are 93 dB efficient. They are "traditional" in appearance with oak finish and black grill cloth. A nice, simple two-way speaker, the *AN* crossover is very good. The smoothness of transition from the 1" dome tweeter to the 8" woofer is impressive. One listener noted that "you pick up some notes throughout the range that are represented more truly" than with the horns. The bass is rich but undifferentiated, lacking distinct reproduction of various notes on some jazz material.

Imaging and detailing are accurate and natural sounding, but the *AN-E* sound stage, although deep, lacks the big presentation of the *La Scala*. This "smooth, creamy, nice" sound would doubtless appeal to many but left our panel of inebriated hedonists feeling "emotionally uninvolved."

We found the *AN-E* to be very sensitive to placement relative to the floor and walls and somewhat picky about amps and cables. We also found that the *AN-E* worked much better with an eight watt 300B SE than with the flea-power single 45 amp. Overall, it is a speaker that will benefit from the kind of careful system matching and setup that we were unable to furnish in the context of our auditioning session.

The *AN-E* provides a quietly satisfying, natural, and cerebral sound one can live with. But in the end, it's the sort of sound that leaves you longing for a weekend tryst with the brazen *Heresy*.

Morrison Pipe Dream

The *pipe dream* is a tapered pipe using a single Focal 7V313 per side. J.C. designed these as *midrange* speakers to be used from 100 Hz to 10 KHz in conjunction with a woofer and tweeter. A number of independent-minded listeners have taken to listening to them as stand-alone full range transducers. Don Garber at *Fi* loves them and he uses them as stand-alones in his home system with a 2A3 SE amp. A few of our contacts in the NY area recommended them highly so we got a pair in for the listening session.

The *pipe dream* resides in 7"W X 12"D X 44"H cabinets superbly crafted in relatively thin Baltic birch plywood. The speaker is mounted at the top of the tower-like cabinet, giving the whole assembly a high center of gravity. A "zobel network" tames the powerful 7" Focal driver — probably the most expensive raw driver tested here. They are visually engaging and cost $1,200 a pair.

These single-driver speakers are descended from a proud tradition: many purists single cone full range speakers such as Lowther, Hartley, and WE 755. Comparisons with the legendary WE 755 are expected, but both drivers suffer many of the same flaws. That doesn't mean that they are unlovable, just that it takes someone special to overlook the lack of top and bottom end in full range service in appreciation of other satisfying sonic qualities.

In fairness, it should be mentioned that neither the Audio Notes nor the *pipe dream* are the kind of speakers that will wow a roomful of well-fed audiophiles after they have been blasting Klipsch *La Scalas* for a couple of hours. The *pipe dream* is a subtle, intimate kind of speaker that excels in smoothness, coherence, and other "low profile" performance criteria. This is true also of the *AN-E*. They are both competent at what they set out to do, but they ain't horns and they don't have the kind of "slam and dazzle" that goes over big for a crowd of rowdy audiophiles primed to rock and roll.

Conclusion

Our little band of speaker reviewers listened intently to four pairs of loudspeakers during several sessions over several months' time. In the end and with this parting breath, I turn to my philosophical training. Want to call this a speaker review? Sure, go ahead. But we don't pretend to dictate purchasing policy here.

The best speaker to use with your single ended? We're still looking. Keep your ears open and your preconceived notions (probably acquired in hand-me-down fashion) under tight rein.

Could there be other modern-day treasures out there? Of course, two great classics are still available. First there are the famous Klipschorns at about $4,000 a pair. A quick thought experiment: how much higher in price would the Klipschorns be if they were made by some yuppie-driven "high-end" company? If you like them, get them while they're still available at this great price. And don't forget that Altec still offers the VOT in assembled form for a mere $4,300. Audition these: the new 515s are reputed to be better than their vintage counterparts by many. Don't get sucked into the religion of pure nostalgia practiced by some antiqueophiles. Use your ears and your own aesthetic judgment and share your thoughts, impressions, and findings with us through *Sound Practices.*

Some 40 years ago, Paul Klipsch argued that what the world needed was a good five-watt amp. Nowadays, my sense is that what the world needs are more great speakers to choose from optimized for the current generation of single ended amps. In the meantime, we advise you to test drive some high-efficiency speakers for yourself.

Editor's note: "Mike, this article makes it sound like you think the *La Scala*s are the best speakers in the world."

"Well, they're way better than we thought they would be and it could be one of the best $2000 speakers in the world — for single-endeds, anyway. If some yuppie high end company was making these they would cost $10,000 a pair."

Mike, ever the man of the people, owner of a two watt single 45 amp, adopted a pair of *La Scalas* for his home system. He reports good results with unauthorized tweaks like plasticlay damping on the midrange and tweeter horns and removing the protective circuitry, no longer needed with his three watt amplifier. Mike heard that a major improvement can be had by locating the crossover in an outboard box and filling the cavity holding the midrange and tweeter with sand. He thinks the Klipsch has great untapped tweak potential.

Although the *La Scala* did sound surprisingly good, part of that may have been the weight of old stereotypes falling. Even a horn lover like me didn't expect a middle of the line *Klipsch* to sound so convincing. As for their performance, with solid state gear or anything besides small triode amps, who knows? Maybe there are good sonic reasons after all as to why Klipsch speakers fell from grace sometime back in the Seventies. A pair of *La Scalas* on a GAS Son Of Ampzilla *might* provide the most painful experience you ever had.

Aside from the fact that the most popular speaker in this modest survey was a decades old design that is wrongly maligned by audiophile snobs, what struck me most about this project is how few contenders there are out there. I'd like to see a dozen competitors for the *La Scala* in terms of price *and* performance.

I can't understand why ambitious speaker designers aren't rushing to market with new and exciting high-efficiency designs. After all, business in triode amps is reported to be quite healthy and the resulting unmet demand for efficient speakers holds great opportunities for fast-moving, forward thinking loudspeaker manufacturers. Even in the experimenter underground, where manufacturing economics and practicality aren't the main drivers, progress in speakers lags developments in electronics by a large margin. Let's get on the stick and come up with some speakers!

Manufacturers' Comments

pipe dream

Fairly accurate review. I never did care much for Canal Street boom and sizzle anyway. However, I did get an irate late-night call from a usually friendly neighbor not long ago threatening to call the police. Bach organ music — it's not called the *pipe dream* for nothing — powered by the above mentioned 2A3. There are a couple of changes from the review model though. The Zobel filter is out. And there's considerably less stuffing — just enough to contain the back wave bounce. I was thinking to myself that that it was sounding a bit proper with the mods and then a certain party dubbed them the "Christian Temperance Monitors." Now they're back to their original state. George Jones sounds like there's sour mash in his veins and the opening shots of Beethoven's 7th are right there in my living room.

Don Garber, *Fi*

Klipsch

Over the better part of the last two decades, I've had the opportunity to listen to a multitude of hi fi systems, a lot of them using Klipsch loudspeakers, including my own. People are funny about Klipsch. It seems everyone has strong opinions about Klipsch. Why is this?

Over the years, I've developed some highly unscientific but usually repeatable conclusions about who likes Klipsch and who doesn't. If we rank people from 1 through 10 based on their knowledge, love, and interest in music and hi fi equipment, Klipsch does very vell with the ones through sevens, poorly with the eights and nines, and then great with the tens. Let me explain.

Ones through Sevens: These are the folks who are not highly schooled in the art and science of audio equipment. They might be normal people who only listen to AM radio in the car or they might be world class musicians. All they know is what they hear and Klipsch sounds good to them. They are not educated in the black arts of hi fi. They don't know the jargon associated with our stuff and they neither know nor care what soundstaging, depth of image, detail, or the big A, Accuracy, are. They just know that a guitar sounds like a guitar, or a piano sounds like a piano. It just simply sounds right.

Eights and Nines: These guys (I'm not being sexist, most of the eights and nines *are* males) are the troublemakers for Klipsch. We should all remember the fable of the Emperor's New Clothes. This is the one where the head guy was sold a bill of goods by his tailor, who led the Emperor to believe that he had those really hip new set of "threads," when in reality he was sportin' nothin but his own base level equipment. It took a purely honest voice (a child) to point out the truth and the Emperor became the laughing stock of the Empire.

This fable reminds me of this group of hi fi devotees that I refer to as "audio lemmings." They know just enough to be dangerous. Most of them read the audio periodicals, some of them work at audio stores. The trouble happens when they begin to read (and believe) advertising or, even worse yet, reviews of products. They go on to discuss the merits of particular products among themselves, often hever having heard the product in question. This hearsay evidence has killed many fine audio products in our lifetimes. Klipsch is often a victim of these sometimes accidentally ruthless characters.

Tens: Once again, Klipsch falls back in favor with these folks, who tend to be truly educated individuals. Engineers, designers, and others with a true appreciation and often passion for the concepts encoded in Klipsch design philosophy. They may or may not personally like the sound put forth by a Klipsch speaker (which doesn't really matter, by the way) but they respect the product for attempting to attain a stated reputable design goal, based on and designed to work within the laws of physics.

In summary, my opinion on evaluating speaker systems or any other component is very simple: *Listen to it*, preferably in your system, in your listening room. a.) If it sounds good to YOU, that means it is good for you and your system. It means nothing else; b.) If it does not sound good to YOU, don't put it in your system. It means nothing else.

This may seem overly simple and maybe it is, but I think this attitude toward "evaluating" audio components is much more sound than investing in a piece of equipment based on someone else's ears, system, room, and subjective opinions.

Mike Dyer,
Klipsch and Associates

Audio Note
Thank you for this interesting listening survey. I am pleased to note that your listeners found that the *AN-E* had a very "true" sound within certain ranges. The main design goal of the *AN-E* was to provide a quality high efficiency speaker at a reasonable price. It is our experience that they certainly do benefit from careful system matching and setup, but this is true of many, perhaps most, loudspeakers.

I am not surprised that your panel found the horns more *impressive*. A good horn system can give any dynamic speaker a difficult mark to beat in certain areas. What is needed here is a discussion of technology, manufacturing economics, and current trends in the loudspeaker market. I feel that we are at a crossroads right now with many interesting prospects for the future. I propose to write an essay of several thousand words on the subject. Is there time and space?

Peter Qvortrup
Audio Note,UK

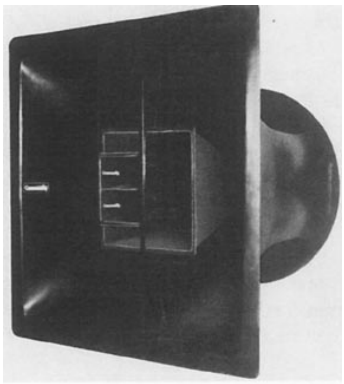
ed.— Whoa! I know this is your favorite topic but the essay will have to wait for #6. Anyway, we're just getting started with this discussion.

Contemporary Pro Horn Systems — interesting, huh?

One theme which frequently emerges in discussions of high efficiency speakers is professional audio. Back when relatively small amps were the way it was in hi-fi, there was considerable overlap between the professional market and the top end of home audio loudspeaker markets. The same JBL, EV, and Altec components used in furniture cabinets were installed in utility cabinets for commercial installations. A good speaker back then was a good speaker — for home, theater, *or* gymnasium use.

Somewhere along the line, audiophiles and audiophile loudspeaker manufacturers decided that they were doing something different from, loftier than, and totally incompatible with the pro sound market. Pros think audiophile gear is wimpy while many audiophiles consider pro gear to be durable but unrefined. In some cases, these assertions are true but solid build, reliability, and the "professional" label do not necessarily exclude audiophile-grade performance.

COMMUNITY LEVIATHAN II



Imagine. . . an enormous listening room with a built in loading dock. . . a trailer backs up and a union crew offloads the amazing *Leviathan II* from Community Light and Sound, Inc. WOW! A pair of these six-foot square triaxes powered by a couple pairs of nice 300B amps, wouldn't that be special? At 108 dB 1m/1W, low power is not an issue!

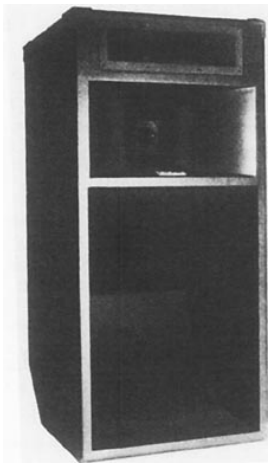
The low end of this modest horn system consists of six 15-inch low frequency drivers coupled to a colossal sandwich-core fiberglass horn. The mouth of the LF horn is 72" by 72" with a flare rate of 32 Hz. A Community M4 driver works into a PC1452M horn between 250-1200 Hz and a pair of Community's newly developed MH 2.8 carbon fiber diaphragm HF drivers coupled to a PC464 horn handle the top end.

Overall, the unit measures 84" deep. The sensitivity of the system is 108 dB 1W/1M and it is rated for a maximum continuous level of 136 dB! Power handling capability is 1200 W continuous/ 2400 W program, so you won't blow them out with your 300B amps. Price TBA, but figure on spending all of the change you saved up for that Wilson WATT/Puppy system!

Sure, a lot of pro electronics is deservedly suspect from the viewpoint of the kind of listener who would have a small tube amp in the rack. However, many serious audiophiles in the US and abroad use pro loudspeakers in their home systems. You just wouldn't know about it from reading *Stereophile*. In Japan and Europe, quality pro speakers from makers like TAD, Gauss, Vitavox and, yes, Altec and JBL, are highly popular among top audiomaniacs. One reason you don't see more is that this stuff ain't cheap. You could get a very decent pair of small speakers for the price of a pair of TAD tweeters. Even for upper rank audiophile speakers, the costs of using some of the better pro parts would be prohibitive.

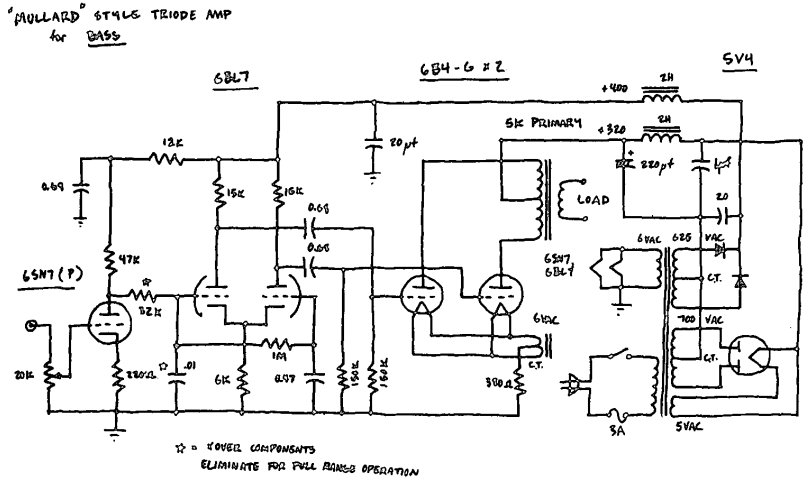
With the current resurgence of interest in horn loudspeakers for home use maybe it would be worthwhile to raid the contemporary professional market for good parts, useful insights, and inspiration. Let's look beyond the old classics like the Altec VOTs (which are far from perfect for hi-fi in stock configuration) and discover what progress has been made in pro speakers over the last few decades. No doubt there are some very worthy contenders out there among high end 'working' speakers. Here are a few to ponder.

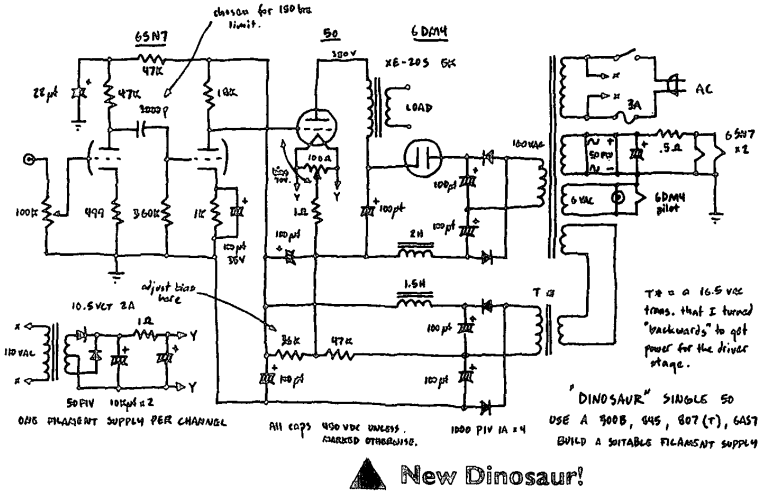
EASTERN ACOUSTICS WORKS CF-350



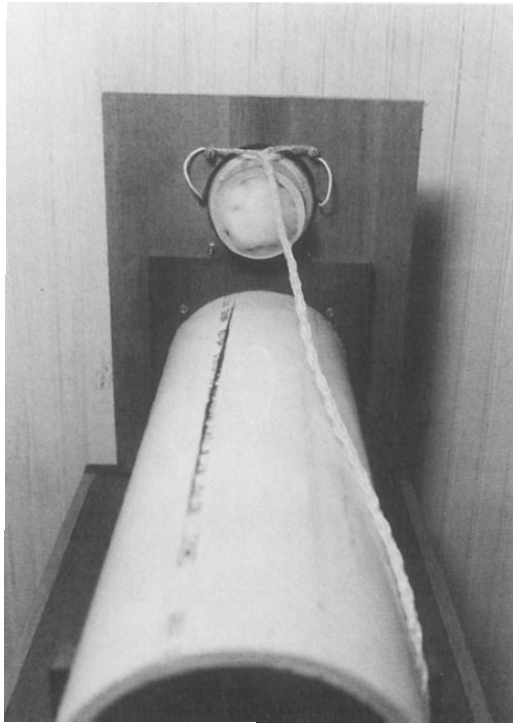
This classic three way horn system is still available on special order from Eastern Acoustics Works in Framingham, MA. It uses a 15" cone in a wooden bent bass horn, a cone-driven mid horn outfitted with a phase plug from 350-3500 Hz, and a N481 1" compression driver tweeter on a constant horizontal horn. Sensitivity is rated at the promising figure of 105 dB/ 1W@1m and it is capable of 130 dB max output. Measuring a manageable 22.5 W X 48.5 H X 23.75 D, the CF-350 will easily fit in the space vacated by your IRS V.

Our pro sound guru says "Very natural mids, sweet extended highs, and tight moderately extended bass. Worth checking out." Costs less than a pair of B&W 801s or current production Quad ESLs with the advantage that you can rent them out for weekend sound reinforcement jobs!





New Dinosaur!



Voigt's formula for a tuned pipe:

$$L_{pipe} = \frac{13548}{4f} - 1.7R$$

where R equals the radius of the pipe and *f* is approximately equal to the resonant frequency of the driver. "Approximately" is where the tweaking comes in.

Be sure to read Weems' 2/87 *Speaker Builder* article if you're interested in pipes.

The crossover inverts phase so I hooked up the bass driver "backwards". A 1 mh choke rolls off the midrange and I use a 4.6 mF cap to bring in the tweeter at around 3K.

	Bass	Mid	Tweeter
	Focal 12V	Focal 7V313	Focal T122Ti
xover freq.	150 Hz LP	1200 Hz LP	3000 Hz HP
tuned freq	28 Hz	100 Hz	600 Hz
pipe length	120"	22"	3"
pipe diameter	13 x 13"	6" i.d. PVC	3" alum pipe
stuffing	wool 30 oz.	wool	wool
port	7 x 10.5"		
cabinet	13 x 34 x 22"		

Tuned In (con't)

I became interested in transmission lines primarily out of frustration with reflex boxes. In my experience, there is a "boing" or "echo" associated with bass reflex that is nearly impossible to get rid of. We all know the lengths some have gone in order to stop transient ringing in vented boxes, "matrix bracing" and the like. I decided to give up instead. Sealed boxes don't ring like that but they have other exaggerated resonances and are generally compressed sounding as well. I looked around at older technology for alternatives. A two-way open baffle sounded great but had limited bass. Later, labyrinth speakers interested me, just as they had caught the interest of many way back in the day.

Lines and pipes are basically loading systems which either dissipate or null the back wave of a speaker driver while providing the high acoustic impedance that cone drivers like to work out of. The advantage of dissipating rather than trying to tune the backwave is simplicity. The driver gets the extra damping and restoring force it needs at the resonant frequency but with less potential for interaction than a resonant box. An additional bonus is that lines and pipes also lower the frequency of those resonances. The mere fact that the box is open makes for a more open and dynamic sound. All told, the most important benefits can be listed as similar to the best vented boxes, but the result is smoother and the problems are more innocuous.

My present speaker system is a three-way transmission line. The drivers I use are made by Focal and are widely available. The basic idea is to use a single-ended amplifier to drive the mid and treble and a push-pull amp on the bass.

The tweeter is a Focal T-122-Ti, an un-chambered version of the T-130 with an oxidized 1" titanium dome. The efficiency is 95 dB/1W@1m. The pole-piece comes drilled with three holes through it so that the unit has as much output from the back as it does from the front. The line is made from 3" o.d. aluminum pipe and it is tuned for 600 Hz, i.e. 3" long. Dimensions are calculated according to Voigt's classic formula given above. A hamburger sized wad of long haired wool is stuffed in the line.

The midrange is a 7" polyglass coated paper cone, the Focal 7V313. It draws heavily on the Lowther PM-2 and the JBL LE5 for its technical heritage. The super light stiff cone, huge magnet, short underhung voice coil, and lossy coated foam surround moves a lot of air and provides shocking transient performance. Its nominal efficiency is 95 dB/1W@1m. I have given up on small midrange drivers. They *all* sound anemic and lifeless to me, no matter how pretty they may be. The other advantage of a 7 or 8 inch mid is that it can usually cover the entire vocal range + harmonics. This means *no crossover between 150 Hz and 3 kHz*, a strangely uncommon practice that can only make for better music. I'd prefer one driver that works from 100 to 10,000, an old QUAD that actually moved air at 100 dB SPL. If only. . .

The midrange works into a 6" i.d. PVC pipe 22 inches long. The line frequency is 100 Hz and it is loosely filled with wool. Like the JBL and Lowther drivers, the Focal has one nagging quirk— a rising output with frequency characteristic that makes for that old bright and in yo' face "West Coast Sound." More on this later.

The woofer is a monster: the Focal 12V. Nominal efficiency is 96 dB/1W@1m. Same "polyglass" coated paper cone as the midrange, which makes for a seamless match. The 3" voice coil is vented through the rear of the driver. A coated linen accordion surround damps the cone. As with the 7V midrange, a huge magnet and a short underhung voice coil provide wild dynamic shifts if they come up. The 12V works into a 10 ft. line folded into a box 13 X 32 X 22" with 30 oz. of wool distributed through the line.

The midrange and tweeter are crossed over with a first order xover, the only kind I use anymore. The trick with the 7V is to cross it over early (1200 Hz in this case) to minimize the effects of the rising amplitude characteristic. The tweeter needs to be cut at least two octaves above resonance (3000 Hz) to really work well with a first order crossover. I actually spread it a little to get a small "Advent dip" in the presence region.

The bass amps are standard Mullard type circuits with self-biased 6B4-Gs in a push-pull no feedback configuration. I parallel a 6SN7 and directly couple the plate to a 6BL7 long tailed pair. There are no sneaky tricks, just a low impedance driver stage and the tactic of burning the tubes at 17W dissipation (272 V X .126A = 17.13 W). I use an RC filter between the direct coupled stages to roll off the highs above 500 Hz, well out of band of my intended 150 Hz crossover.

The active crossover is a single 71A triode gain stage with an RC filter tuned for 150 Hz. Without the RC network, this unit makes a great line stage project for those of you who must own a CD player. It may almost sound like music after a trip through a 71A. Other little triodes that lend themselves to this type of circuit are 12-As and 26s. These little tubes with solid nickel plates are super detailed and hyper beautiful.

The "Dinosaur" has been changed several more times since the last article and I am even happier with it. It now dispenses with the FET and the cathode follower, although I must confess a growing interest in FETs (cool sound). I had three directly coupled tube stages, but now I use a small cap between the first and second stage to limit the bandwidth to 150 Hz high pass.

The cables are all Kimber Silver, which should be a controlled substance. The phono preamp is a stealth device I worked on with Art Loesch. The attenuator is an Eltus, an expensive Japanese 'L' pad, 250K with 47K Holcos paralleled to the I/O. The turntable is a 301 with a Fidelity Research FR-64 arm and a new model Denon DL-103 moving coil. I have to make new arm cables as the ones I'm using are shot.

I also use a heavily modified Thorens TD-124 with a Sumiko FT-3K arm and a Stanton 981LZS low impedance moving magnet. If you are looking for a cartridge, please check this one out. Not only is the general presentation big and present, the subtle stuff around and behind the music is there in delightful proportion. I am shocked at how stupid good this cartridge sounds. I think it is impossible to get more phono music for the money.

All this stuff *plays* my records and I've been having big fun with the bass, which goes all the way down. Splitting the work up between top and bottom simplifies matters dramatically. There is a myth that one amp is somehow more "zen" or something. Unless you are driving one speaker, this is absolute crap. Two drivers and a passive crossover with one amp, especially if it is a multi-pole crossover, is more of a liability than using two amps. Single ended technology doesn't make much power and will cramp the style of many modern speakers. This can be heavily compensated for by limiting the work an amp has to do. Given the efficiency of any speaker, 66% of the power needed for audio occurs below 150 Hz. The increasing availability of drivers in the 90-96 dB range means that integrating these low power amps is not beyond anyone's reach. Make your own and bi-amp!

CONEHEAD

La Fevre and Stillwell's article "Desperately Seeking an Efficient Speaker" in *SP* 2:1 struck a chord. Over the past few years, I have been conducting a discreet investigation into why 90% of all commercial loudspeakers have an efficiency rating of around 86 dB/W.

Basically it is down to two things: Thiele and Small and the popularity of 'bookshelf' loudspeaker enclosures. All of the theories associated with these and other 'hand calculator' methods rely on small/medium magnet to cone mass rating, i.e. medium to high Q ratings. Loudspeaker chassis with very strong magnets and light cones, the Lowther PM series being examples - Q about 1, do not work with Thiele and Small.

Thiele and Small rely on the trapped (or trapped and tuned for a ported enclosure) air predictably controlling the movement of the cone. With a large magnet the air cannot load the cone as well, especially when the cone is under 9" in diameter. The magnet is just too bossy. This is a bit of a simplistic statement, but submitting a 30 page epic would be the best way to explain it.

So, for a 5" cone, 84-85dB/W, 10" 90-95 dB/W, 12" 91-96 dB/W, and 15" 93-100 dB/W — all dictated by small enclosures and Thiele and Small parameters.

The strongest loudspeaker magnet I have come across is the Lowther PM4A motor. With its 18 lb. Ticonal G magnet and cobalt pole pieces, this beast packs a gap flux of 24,000 Gauss. Total flux is 385,000 Maxwells. There is only one possible use for such a driver and that is to horn load it.

Quarter-wave loading, large multiple unit systems, and horn loading are the only ways to increase sensitivity beyond the magic 100dB/W mark.

As 90% of all HiFi customers are spending less than £300 on a pair of speakers (in the UK anyway), there ain't no way the majors are gonna bother trying to increase the efficiency. An LS3/5A with a 96 dB/W rating will never happen. You canna change the laws o' physics, Captain.

I foresee a renaissance for quarter-wave loading, a Voigt patent. Castle Acoustics has three models already available and selling like hot cakes, despite a dome tweeter (and a metal one at that). [Note:. The Castle Acoustics speakers are not ultra high efficiency units . All less than 90 dB/W- ed.]

Personal pet hates are crossovers, dome tweeters - especially metal ones, super tweeters, Mr. direct/reflect himself Dr. Bose, computer designed boxes complete with 'bumps' in the bass. Even QUAD electrostatics can now have bumpy bass. Just add a Gradient or a REL subwoofer to raise the subsonics to a level way beyond what it should be. They'll love it at audio shows.

Some people like the phasey ting of a dome tweeter. They love the engineered bump in the bass. It is gonna take a long time for this single speaker quarter-wave loaded pipe dream to become a popular reality.

As Voigt himself once said, it is the midrange where we live, the rest is not as important.

The informed readers of Sound Practices can just relax and be ahead of the crowd.

Haden Boardman
Audio Classics UK

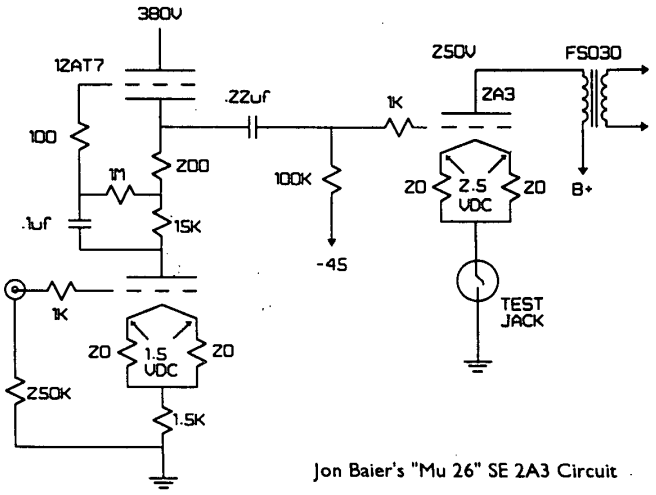
REPORT FROM THE TRENCHES

I got some ideas from the Garrard 301 article. Removed the magnetic brake from my TD 124. Used a small variac to control the speed. The table is quieter. All along I thought I had bearing chatter but it must have been the brake rattling. The problem with the variac trick is that you have to lower voltage so much that the strobe light goes out. I ended up removing the motor pulley and machining it down to 1.032 dia on a lathe. It was 1.075 originally.

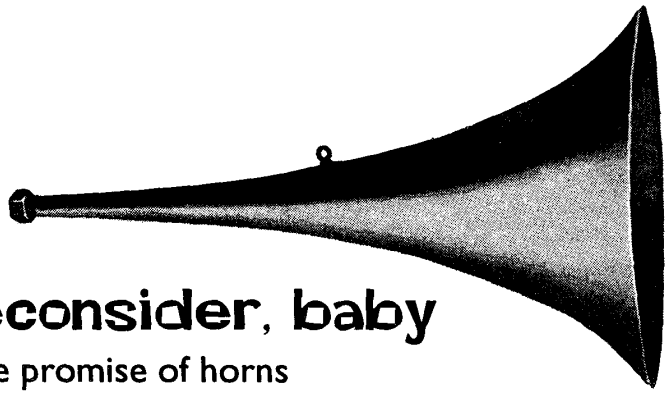
The table now runs at proper speed on 117 VAC. I keep the variac in line for minor speed adjustments. One nice thing about the smaller pulley is some increase in torque. The speed seems more constant judging from the strobe. Does it sound better? Who the hell knows? Doesn't sound worse.

I tried just about all the popular output tubes — 300B, 275, 6A3, 45, Chinese, etc. I love the 2A3 double plate. It matches the 604s best. All single plate tubes (of these, I like the single plate 2A3 best) sound lighter and more analytical. The 2A3 bi is GREAT. Others have listened and all prefer 2A3 biplate on my system. Based on my theory that high current, low voltage filaments sound better, I used a #26 for the front end. The amp is much more open and dynamic with the #26 than with any indirectly heated triode I have tried. Also sweeter. It sounds faster than a speeding bullet. Enclosed is a schematic for chuckles. Keep up the good work.

Jon Baier
Schenectady, NY



Jon Baier's "Mu 26" SE 2A3 Circuit



reconsider, baby

The promise of horns in the contemporary situation

by Joe Roberts

For being a totally out of the blue concept, single-ended triode amplifiers enjoyed a relatively easy ride to respectability. The stuff is cool, no doubt about it, and that doesn't hurt a bit. In fact there are lots of people who are big fans of triode amps who never heard them — they got whipped up into a frenzy just thinking about it. Many others who viewed these fleapower amps with suspicion were won over by the *experience* of good triode amps.

Triodes do all the things the mainstream audio institutions say good audio amps have to do extremely well. You want imaging, soundstaging, back wall, yak yak yak? Look no further. The triode is your best friend if 3-D is your illusion of choice. But the lesson in triode amps for the "high-end" is that there are a few things that the general run of audio amplifiers does not do, things that we don't even have words for yet. The way good triodes play music leaves many jaded audiophiles speechless when they hear it.

Then the project of building a system around one of these fabulous amps runs you right into the question "What do I use for speakers?" Good question, one of the eternal questions in audio regardless of whether you're running two watts or two thousand. It gets a bit trickier when you leave behind the established power and sensitivity norms of the industry and enter the domain of "experimentation." With five watts, you're on your own looking for speaks, homes — at least as far as the high end speaker world is concerned.

Believe me, eight watts from a 300B will play many available speakers to at least *medium* listening levels. People are more or less happily running ProAcs, Ensemble Reference 3As, Spica TC-60s, etc. After all, all of these people running around raving about SE amps are listening to them on *something*, no? As reported by CG in *Stereophile*, my two watt 45 amp played loud and proud on a pair of ProAc Studio 100s .

The *subjective* sense of power that a triode amp can deliver far exceeds expectations. It is not unusual to hear reports that this or that >10W amp sounds louder, fuller, and weightier than this or that 100W transistor amp or p-p pentode amp. Whether a particular speaker will work on a particular amp is a question for empirical research. A high and flat impedance and >90 dB sensitivity helps.

From *my* listening chair, I say power ain't nuthin but a number as far as musical and emotional impact are concerned. But my chair is in front of a huge pair of high-efficiency speakers: 15" Altec woofers, Edgar midrange horns, Gauss compression tweeter. The listener with 8 watts and an 88dB speaker will encounter limits. How constraining these limits are depends on your needs. If you really like to crank up your stereo now and again or large scale orchestral music is your passion, the speakers you already have probably won't really shake the rope on three watts.[1]

Triode amps sound great turned up to realistic SPLs, which makes the whole situation even more tragic.

Enter Horns

Thanks to the collective search for good high efficiency loudspeakers to use with low-powered amplifiers there's a lot of curiosity afoot about horn loudspeakers, probably the most unfashionable topic known to the modern high-end. Even 8 track gets more (and better) press than horn speakers in the US specialist mags.

Once upon a time, in the post WWII era, the earliest balls out hi-fi systems were constructed from recycled theater gear. Through the 50s and into the 60s, swanky top-of-the-line home hi-fi speakers featured arrays of horn-loaded squawkers and tweeters. A lot of this plastic horn and phenolic diaphragm stuff is a bit rough on the modern audiophile ear, but it sure was cool to be a "horn man" back then. Ain't that way now.

The need for high sensitivity dwindled as transistor power multiplied. Designers focused on ribbons, electrostats, and miscellaneous cones in sealed boxes intended to be driven by banks of steaming transistors or big hog parallel 6550 amps. The pioneers of the "high-end" as we know it had a different listening program and horns didn't fit. Quite a switch from the McIntosh and JBL 1950's upper crust hi-fi mentality. The horn ceased to exist in the mind of the modern US audiophile, except as a bad joke.

This is where triode amps and horns differ: single-ended amps are something totally new in the Western audiophile cosmos, horns have been tried and rejected. Nothing does more damage to music than a bad horn system and everybody knows it.

You can get a lot of music out of a good triode amp and a *good* horn. But, of course, it's not that easy. One minor problem is that *good* horns are extremely uncommon. Most horns are *totally unlistenable* in a serious music listening context. In my opinion, the bad reputation horns have endured among latter-day audiophiles is largely deserved. Most horns are junk.

But it is obvious that the kind of sensitivity a horn can provide would sure come in handy when you've got three watts and some change to burn. Plus the kind of crazy romantic audio nuts adventurous enough try

1— One obvious solution to the power challenge is to BI-AMP, preferably with crossovers before the amps. Use that SE triode amp on the mids and/or highs and use your Jadis, ARC, VAC, Aragon, or whatever on the low end. I resisted the concept of multiamp systems for years because I thought it was too complicated to work. I was dead wrong. Using different kinds of amps in roles where they'll perform best makes sense to me and it gets around the low power issue entirely.

a single-ended amplifier just to see what it can do are just the type who would gamble on horns too. So, here we are giving triodes and horns, the cutting edge technology of the thirties, a try in the Pentium age.

RISK OF TRIVIALIZING THE ISSUE

Because most horns are awful beyond description, if the goal is to pick up a few tricks which will lead us toward more perfect reproduction systems, we must be very selective. Most horns will be a total waste of time. If it looks like a cheap piece of junk, it is. Any horn made out of thin cheap plastic or cast metal that rings like a bell is going to be a problem. After all, how many cheap thin plastic or cast aluminum musical instruments can you name?

Our forebears figured out that most of those bottom of the line Jensen and EV $6.98 horn tweets were junk back in the fifties. We don't need to go through that discovery procedure again. Because horns vary so wildly in quality and performance, there is a real risk in thinking a "horn is a horn" and leaving it at that. While an "average" triode amp still sounds pretty decent, an "average" horn will DESTROY MUSIC.

Only the top 10% of the horn population is worthy of consideration for serious music listening. A few lesser horns are okay to play with for fun and may do some really interesting things, but they will have at least one dire failing which will have them in the garage after a few weeks playing time. Leave the junk in the airport paging systems where it belongs.

In recent attempts at covering the "Horn and Triode Scene," whatever that is, one big reviewer hooked up some cheap and junky squawk boxes with popularly priced SE amps and, in essence, reported that "Wow, this is better than I thought it would be but it's not that great, *really*." The writer was obviously having a good time, which is fine by me, but I don't think that he exhausted the possibilities of the horn genre with that experiment.

Screwing around with some funky cheap speakers is great recreation — I do it every chance I get— but it will not provide a lasting contribution to the goal of achieving real magic in the listening room.

What is needed is a *profoundly deviant* mindset. We have to search for something *way better* than what we've got to get where we need to be. Our sights must be elevated. Listening to junk and finding that it is slightly better than expected does little to shake the pillars of mundane audio practice.

If we start dredging up all the trash horns that have been justifiably scorned for years and reverifying what we already know, i.e. cheap horns flat-out suck, we run the risk of trivializing the issue. A serious dialogue on horns, centering on open-minded evaluation of the finest of the species and reevaluation of our present-day goals and achievements, might get us to new and exciting places.

Horns and Mainstream Aesthetics

One day I was discussing the marketplace realities of horns with Peter Qvortrup of Audio Note UK. He evaluated the situation thusly: "There is so much suspicion about horns in the marketplace that listeners will be against the product before they even hear it. If you go out on the market with a product that doesn't do what they want and *expect*, you'll get destroyed".

Come to think of it, there *is* a bit of a party line regarding what constitutes "good" in the audio mainstream, a standardized aesthetic program. So what if horns do some musically relevant things better than cone and planar "high-end" speakers? Even the very best horns I have heard do not do some things on the 1994 Official Audiophile Speaker Criteria List.

Peter's findings were that horns do not give you "hall sound" and he predicts that reviewers will freak out if there is no "hall sound" regardless of how right the speaker is otherwise. Minus this critical performance factor, there could be PR problems ahead for our old friend the horn speaker.

I personally think "hall sound" is a cool illusion. Hall sound, as I understand it, is a recreation of the original acoustic space in which a recorded performance took place. This is, of course, partly a matter of the quality of a stereo recording, but a reproduction system has to be tuned in the right way to furnish an illusion of the original recording space. It's become a given that good systems do all this "hall sound" stuff right and a lot of contemporary audiophiles like this phenomenon. Most, I am sure, never questioned the issue since it sounds so good on paper.

Granted that hall sound is a neat illusion, isn't it strange that when we are supposedly trying to get to the sound of live music, we evaluate what we hear in terms of "soundstaging" and "imaging"? These concepts are strictly audio geek notions, totally irrelevant to the experience of live music. The language some people use to talk about reproduced sound suggests they are more concerned with questions of architectural acoustics of the hall than the music on the stage.

Dionomite!

At $25,000, Be Yamamura's full-range, single driver, multi-horn *Dionisio* is unlikely to show up at your local high end saloon, or in my system, for that matter. But after listening to a cone-driven Edgar mid horn for a few years, I am a champion of this concept. At a range of ten feet, metal midrange drivers can blast a hole in the wall behind your listening position. A horn loaded cone can really sing close in.

The *Dionisio* uses a modified Lowther PM-4 to drive this 2.3 m tall cork covered fiberglass sculpture between 27 Hz to 16kHz with better than 100dB efficiency. Said to play on two watts.

Yamamura has various smaller and larger versions of the *Dionisio* in the works, some priced down in the economy car range. Crazy price aside, paper cones, cork, and no crossovers sounds like a reasonable recipe to me.

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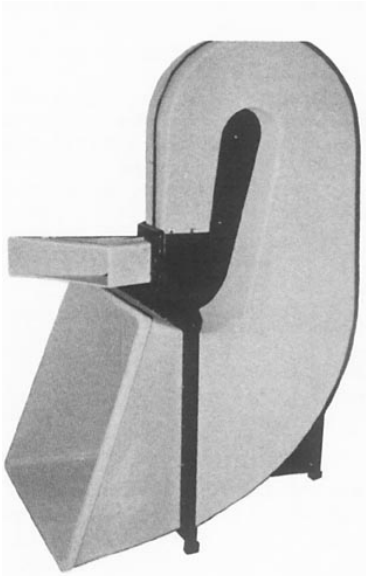


Dionisio

Once Heard, Never Forgotten —
so goes the motto for the Turbosound line of top-shelf pro sound speakers.

Next time you want to hear Dark Side of the Moon, wheel in a pair of Turbosound monitors and put the LS3/5As in the closet. If they're good enough for Pink Floyd concert performances, maybe they're good enough for our home systems.

Turbosound TCS-612

The TCS-612 system pictured above is set up for bi-amping with an electronic crossover. LF sensitivity is 98 dB @ 1m/1W and HF sensitivity is 103 dB @ 1m/1W. Response +/- 4dB 60-20000 Hz.Nice comfortable 16 ohm load. Size is manageable: approx. 23H X 14.5 W X 14.75D. Midrange uses a horn loaded 6.5" paper cone with concentrically mounted titanium compression driver tweeter. The 12" bass is reflex loaded. Turbosound also makes some mighty impressive high power systems with modular components in the 106-108 dB sensitivity range.

I haven't talked with anybody who evaluated this stuff with triode amps in a home listenihg situation but it sure looks promising in theory. Can audio nirvana be found in the pages of *Mix* magazine?

While it is nice to sit in a great hall and hear some unamplified acoustic music, it is unnatural to focus on the hall sound while you are there. You came to hear the music, right? Nobody talks about music that way and, as far as I can tell, live music doesn't even do most of the 3-D stuff that audiophiles insist on from their systems.

Furthermore, the effect of imaging is contrived and fake even when done well. I loved my Spica TC-50s but there wasn't any way they could reproduce any music except solo mandolin with a realistic sense of scale. Would you accept what passes for good hall sound in your speakers as good sound in an actual hall? No way, Jose.

Far from being an *absolute* part of listening to music, all this a soundstage jazz is an acquired taste and a rather obscure one at that. I like it quite a bit myself, but it took me a lot of magazine reading back in the Seventies and Eighties to even figure out what the writers were talking about.
Concepts like "dial in the soundstage with some Shun Mook ebony root pods from Mother Africa" are not intuitive. Ever notice how your non-audiophile friends never volunteer that your imaging is superb or remark, "Wow, I never heard the back wall on that recording before."

If you have to *learn how to hear* this stuff and *learn* that it is important, this suggests to me that hi-fi is not directly realistic despite the claims of the orthodox ideology. What we consider "real" is a matter of agreement rather than anything "absolute". There are codes and styles in reproduced sound just as there are in "realistic" visual art.

They are HERE

Contrary to popular folklore, horns *can* project three dimensional images. They are still "better" images than you get live. Big weighty images that grab you with presence and impact, just like real music, rather than relying on unnatural levels of hot top end "detail" . 3-D is no problem for good horns.

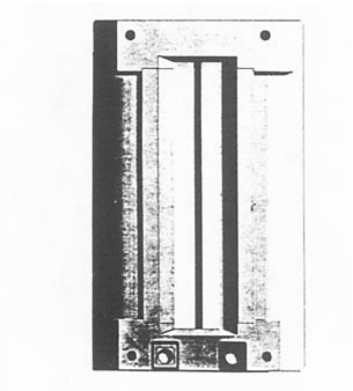
Horns have a very forward presentation. Back in the Seventies, "too forward" was a common criticism of speakers. What people were looking for was that backward sound, I guess.

The illusion horns provide is a "they are here" sound rather than the old "you are there" illusion. That is, the sound is so dynamic and alive that it sounds like the music is going on IN YOUR ROOM. True, the "soundstage" illusion of reproducing the original hall sound is skipped over as a consequence. After a few years of listening to horns, I strongly prefer the "right here in the room" sound of horns to the "looking into the room from a hole in the wall" sound I used to get with mini-monitors.

My real complaint about most soundstage projecting speakers, and I haven't heard them all, is that they can't rock out. Sometimes I just gotta listen to some old Funkadelic and whatnot. Stage boundaries are irrelevant in this context.

Maybe there is some grand cosmic tradeoff between dynamics and soundstaging. I think a lot of the hall sound master speakers

STAGE ACCOMPANY SA 8535 COMPACT DRIVER



Nominal Impedance	12 ohms flat
Frequency range	1-30 kHz
Peak power	1000 W peak /60 W cont.
Sensitivity	125.5 dB @1m/2.83V (127.2 dB @1m/1W)

The Compact Driver is a ribbon driver with a neodymium magnet. Unlike the plumbing fixture pro horns of yore, this unit would be a civilized addition to your listening room decor. The driver only weighs about 9 pounds. The optional wave guide horn is less than 11 inches square.

You might be inclined to think of this ribbon driver in terms of super tweaked up Deccas and Kelly Ribbons. But these hot rods are in a different class entirely. Fitted with the optional horn, they can reach down to 1K, handle 1200W peaks and can produce 125 SPLs continuously. Try THAT with a pair of Decca Londons! I wouldn't stand where you could be hit with shrapnel while attempting it. If you're a *real* headbanger, a cooled version is available that can handle 4000 Watt peaks and crank out 131.5 dB continuous.

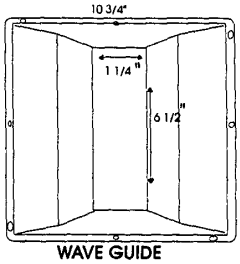
The sensitivity of this driver is so high that the question of compatibility with low powered triode amps and the like is settled in advance. Two watts was enough to blow me out of my listening chair. Funny that they work so well with ancient 45 type tubes when they were designed to withstand the total output of racks of steaming Crown amps.

The 12 ohm resistive load these drivers present to your amps will make your SE triodes smile.

Stage Accompany makes a full line of complete systems incorporating the Compact Driver. Most are 2-way designs with one or two 12" woofers. Not many horn-based loudspeakers can give you such wide bandwidth from a two way setup. Life is complicated enough without a three way horn system in your living room.

At roughly $1300 a pair, the Compact Driver is a bit pricey as an OEM part for high end manufacturers. But if you think you'll find this level of performance for $12.95 from a catalog featuring VCR belts and Pyle Drivers, think again.

US distribution:
Stage Accompany USA
4106 Fox Run Trail 6
Cincinnati, OH 45255
513-528-4035
513-528-4037 fax



WAVE GUIDE

create that unitary soundspace illusion by flattening out the dynamics somewhat and confining the presentation to a small listening window.

How can a 6" cone and a dome tweeter produce a powerful and spatially grandiose recreation of an orchestra? Most of the instruments you are trying to reproduce are way bigger than these dinky boxes. How can you expect "real" sized piano presence or the visceral growl of a bowed cello in front of a 6" plastic cone? Forget it. Getting the dynamics right and a larger sense of scale creates a stronger illusion of reality for me than fake soundstage information, even on well-miked acoustic music.

In Search Of The Perfect Jukebox

Horn lover and audio philosopher Dennis Fraker nailed it down in a recent phone chat: "What audiophiles want is a really good jukebox, except they don't know that's what they want because they never been exposed to it and people are telling them that they want something else. But when they hear it, they know that's what they really want. You know, the right jukebox in the right bar can be magic. . ."

Whew, that phone call went off on a wild tangent, but he had a point there. Back when I was a snobby, sweater-wearing "high-end" salesman I often used the word *jukebox* as a term of derision, as in "the IRS ain't nothin' but a rich man's *jukebox*." Years in the hobby later, I realize that the perfect jukebox is perhaps the loftiest goal a music listener can aspire to attain. And perhaps the most challenging and difficult goal as well. The perfect jukebox, think about it.

If you're looking for buying advice, I can't give you a turnkey horn package purchase recommendation yet. At this stage of my explorations, I have enjoyed glorious results with my enormous 3-way Edgarhorn based system and I found a few "parts" that demonstrate real promise for music listening. The Stage Accompany Compact Driver is one such intriguing "part" (*see sidebar*).

After unpacking a loaner pair of Compact Drivers, I popped them on top of my Altec 416/Onken bass cabs, connected a 10 mF Hovland MusiCap speaker cap in series to roll off the driver around 1 K, stuck a coil in the woofer line, and turned on some music. Nice! LOUD! CLEAN! That was easy. 10 minutes down and we were rocking.

You know how well done live amplified music has that immediate sound that you can't get in your home reproduction even though both are products of amps and speakers? Well, the Stage Accompany sounds like a great sound reinforcement speaker. It's the kind of speaker you hope the jazz club has when you go down to hear Betty Carter and it can bring Betty into your home for your listening pleasure.

Reminds me of a discussion I read on the Internet one time. One sage hobbyist wrote something to the effect that "of course, blues music sounds great on paper cone speakers and tube amps — it was produced on paper cone speakers and tube amps!"

Conversely, if your thing is music that went though a microphone or pickup at the live venue, maybe something like the Compact Driver is what you need. It is musically satisfying and fun to listen to a speaker that can slice through ether the way a Hammond B-3 played through a Leslie cabinet does. Leslies don't "image" and "localize", they energize the whole room.

The ultra clean sound of the Compact driver really helped out acoustic music too. Listening to Ralph Stanley transported me right back to old Virginia. The banjo notes sprayed out like ice and the fiddle breathed and moaned. "Natural" is a good word to use to describe the sound of this ribbon speaker and I'm not using this word in the metaphorical audiophile sense here.

My experiments with the compact driver really showed me some new possibilities in sound. What more could you ask from a component than a glimpse of the beyond? It may be years before you can go out and buy a "high-end" approved horn system. Might never happen. In the meantime, listen and grow.

WHY THIS CULT IS DESTINED FOR MASS SUICIDE

Shopping for speakers for a 7 watt amp with Seth Goldwin

Ya wanna know what's wrong with this magazine? I'll tell ya what's wrong with this magazine, speakers, that's what's wrong with this magazine; that's what's wrong with this whole damned single ended cult trend thing if you ask me.

I got hooked into SE amps by a really great demo of a tiny 3 watt 2A3 amp at the now, sadly, defunct Fi retail store. I then built my own 7 watt AudioNote Kit One amp and have been thrilled by the sounds I'm able to get out of it. But when I started trying to make a stereo system, that is amp AND speakers, based around the AudioNote that I could sit down and listen to day after day I started running into trouble.

I have a pair of NHT SuperZeros that are cheap, tiny, accurate, are an easy load for an amplifier to drive, sound great and even look pretty good. But the maximum cruising volume I can get out of them from my 300B amp is about 90dB. To get more volume, I gotta get more efficient speakers.

To get an equivalent range of frequency response from a cool, modern, miniaturized horn, like those from Dr. Edgar, I would need a four way, Frigidaire sized system. And that *is* the mini version. An even cooler retrochic WE VOT setup would require a Manhattan living room for each speaker. No wonder Vinny "Retro Boy" Gallo decided mono was the key to the future.

So I started looking for speakers that you can actually go to a store and buy, that might fit into a human's house, that cost less than a car and that can be driven to ecstasy by a 7 watt, 300B amplifier. I scoured the *Audio* Equipment Directory. Out of five billion speakers listed there, about a dozen have claimed efficiencies of greater than 95dB.

I have listened to tons of the less than 90dB efficient speakers most people buy, the stuff that clogs up most of the pages of the Oct. *Audio* directory issue. I know how rare a good speaker is *regardless* of how big your amp is. Trying to find the gems is like playing the percentages with women. If you hit on every damn female that ever crosses your path, eventually one might come across. On the other hand, nothing in the laws of nature says that one absolutely *will* come across, but it might make you feel better that you've put in the effort.

A much better method is to get introduced by mutual friends who *might* help to filter out some of the psycho sludge that seems to be my primary date material (not you, sweetie, you're special), not to mention the class of speakers I end up living with.

So I tried to be smart. I asked around a lot to find out what people are using with their 300B amps. Boy, did that get me nowhere. People are using EVERYTHING! Linaeums rewired with silver, new and old QUADs, Radio Shack shitboxes, ProAcs, AudioNote's "I am not a Snell" lookalikes, Klipsch (of *course*), and many, many, many homemade bastardizations of time honored horn systems.

But nobody I know of is 100% thrilled with their rig. Everyone's constantly diddling. Personally, I dig diddling. To a point. Then I want to sit down and listen to MUSIC, know what I mean?

The two speakers I listened to in the last couple of months were not specifically designed for use with watt wimps like the AudioNote. The Klipsches discussed below were designed for megawatt home theater installations. Those down cats in Hope, Arkansas probably haven't seen a functioning tube amp since the 60s. The Swans were designed for wimpy amps, but not quite as wimpy as the ones *I* like, expecting to see something more like 20 to 100 watts. Nonetheless, both speakers fit all my other criteria for availability, size and cost and at least *offer* the possibility of delivering the sonic goods from a tiny SE amp.

KLIPSCH EPIC: HIGH END HORNS!

When I read that Klipsch was introducing a new, audiophile oriented speaker line I got all excited. And every SE cultist I spoke to about it also got excited. Then I flexed the reviewer muscle and got a pair of the Klipsch Epic CF-3s trucked to my apartment. Now I was *really* excited!

The new Epic series is Klipsch's attack on the high end audio/video speaker market. The series are all pretty alike, varying mainly in woofer and cabinet size. They are two-way bass reflex designs, set up in a

D'Appolito fashion with identical woofers receiving an identical signal from the crossover, surrounding a plastic tractrix horn tweeter.

The Epic line starts with 6 1/2" woofs and tops out at 12". The one I got is the CF-3, second from the top, sporting twin 10" woofers and at the bottom, two front facing bass ports. The CF-1's, with the 6-1/2" woofers claim 96dB efficiency. The ones I got claim 100dB! Cool! ROCK 'N' ROLL!

Klipsch designed these speakers for actual living rooms, unlike some of their older designs which seem happier in more, uh, exotic settings like, for instance, someone *else's* living room. While still pretty big for the modern home at 41" X 17" X 17", the review pair came finished in a very nice light oak veneer and actually was a lot less overwhelming in the room than I expected a box of this size to be. The front of the speaker is a black inset with beveled edges to reduce diffraction. Covering this is an easily removable (and replaceable) cloth grill cover. I felt the covers ever so slightly muffled the sound and left them off most of the time.

A lot of technology has gone into these speakers and the designers have spent a lot of time playing off the lobing characteristics of the cone woofers and the horn tweeter to achieve a more tightly focused spray of sound than you usually get out of a horn system, the net result of which is supposed to be imaging and soundstaging, two areas high efficiency horn speakers have traditionally sucked at. Did they succeed? Have I mentioned the 100dB efficiency?

YOU CAN'T ALWAYS GET WHAT YOU WANT

I was warned by Mike Dyer at Klipsch to break these babies in for at least 20 hours before listening to them. I was so excited to get them though I ignored his warning and fired them up the minute I had pried them out of their boxes. BOY, was he right. Completely dreadful, ragged, peaky highs and WAY boomy bass. I resolved to always pay attention when Mike tells me something.

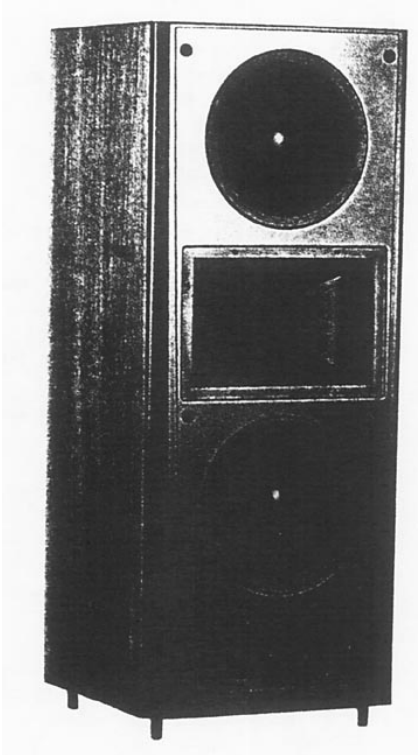
To break the speakers in I pushed them together face to face so they were firing into each other, reversed the phase on *one* of the speakers and threw a blanket over both of them. This arrangement very substantially cut the volume of the sound crud leaking out of the speakers so I could then safely blast track 8 off the XLO test disc on infinite repeat all day while I went off to my job. The XLO break in disc sounds like broadband pink noise with a frequency sweep over it and seemed to work pretty good but I would think that setting your tuner between FM stations would be just as effective. Or playing Maceo Parker's *Life On Planet Groove* over and over until your cats are ready to knife you the minute ya' git home.

When Mike warned me about the break-in, he also told me to take off the rear set of spikes so the speakers would have that ever-cool pulling-a-wheely look and to make sure that the listening seat was 1.33 times the distance between the speakers. I played around with all sorts of setup options, finally arriving at something sorta like what Mike suggested.

To begin with, I was too close to the speakers and they were too close to each other. Unlike the NHTs, the image these throw is strictly limited to between the speakers. Supposedly because of the Controlled Focus technology, the Klipsches don't seem to mind being close to the sidewalls, a situation that usually results in smeared imaging. At any rate, the imaging never got better as I squished them closer together. In order to get more distance between the speakers while still maintaining the 1.33 to 1 listener/speaker ratio I had to disassemble and redo my whole room. This additional space between me and the speakers paid off and I didn't feel quite as assaulted by these kinda upfront speakers.

Finally, I got them into what I thought was the best sounding position in my room, about 28" from the center of the speaker to each side wall and 65" from the wall behind them, with each speaker toed in so that from the center of my sofa I couldn't see either side of either speaker, only the front. In other words, they were aimed right at me. This put about 9' between the speakers and me 11' from a point midway between them.

How'd they sound, you might ask? On the plus side, the Klipsches will go just about as loud as I could want them to offa' seven



KLIPSCH *epic* CF-3

Bandwidth: 35-20 kHz ± 3 dB

Sensitivity: 100 dB SPL @ 1 Watt/Meter

Nominal Impedance: 8 Ohms

Power Handling: 250 Watts

Enclosure Type: Bass reflex 2-way

Drive Components:
1-2" (5.08 cm) Tractrix horn tweeter
Aluminum diaphragm
2-10" (25.4 cm) woofers

Crossover Frequency: 1500 Hz

Price: $ 2000

Corporate Offices & Customer Service:

Klipsch and Associates
8900 Keystone Crossing
Suite 1220
Indianapolis, IN 46240

Tel. 1-800-KLIPSCH
Fax (317) 581-3199

measly watts and even at lower SPLs they have wads of dynamics, which my acoustic suspension speakers driven by the same low power amp can't touch for all the tea in China plus a free pass to the new speaker strip-joint down the mall. I did not find them to have the honky sound a lot of people accuse horns of having (although I *am* the horny honky a lot of people accuse *me* of being), nor was there any evidence of the uncontrolled cabinet resonances that others have reported hearing from a lot of horns in big plywood bass reflex cabinets.

In short, the CF-3 seemed like a reasonably flat, reasonably accurate reporter of the frequencies and dynamics recorded on the CD. There was a touch too much upper bass energy which gave a full, exciting sound on some cuts, like Nirvana's "Teen Spirit" and Metallica's "Enter Sandman", but made other stuff, like Hamiet Bluiett's alto sax on the World Saxophone Quartet's *Breath of Life* sound mushy where it should have been crisp.

Not despite, but *because* of this excess bass warmth coupled with truly swinging dynamics, I found a lot of material I could really enjoy on the CF-3s. Loud, punchy rock 'n' roll played with the volume UP sounded great. The more people who were over at the time it was being played, the better it sounded. *Exile On Main Street*, early Joe Cocker, Creedence Clearwater Revival, nasty electric blues like the Red Devils *King King* played at 100dB just kicked out the jams.

What appealed about these gritty songs played loud was that the Klipsches gave an approximation of the sound of funky electric blues played live in a small club through a PA system. It had the feel of live electric music. I put on "Commanche" off the *Pulp Fiction* Soundtrack which has got drums and bass recorded into the right channel and gee-tar in the left and not a hell of a lot in between. My friend Ron, who was over at the time, said "It sounds just like my band in high school sounded when we played at this shitty little club in Providence. Guitar over *there*. Bass and drums over *here*. I LIKE IT!"

On the negative side, and this tuned out to be a biggie for me, the Klipsch CF-3s just wouldn't know a soundstage from a hole in the ground. As a gross generalization, I've never particularly taken to the horn systems I've heard because of how they fall down on the job when asked to decode the sound of instruments in a room. In my experience horns can do a fabulous job describing the sound of a particular instrument, but they ain't so hot when it comes to describing the complex sonic event of a group of instruments playing together in a space. Or even not playing together in a non-space, like most of the panpotted, close-miked rock 'n' roll I usually listen to. Despite the recording method, most of these discs still have a definite sense of space even if it's a totally concocted one. In all fairness, the Epic was better than other horns I've heard at creating a stereo image. BUT, it didn't even come close to the cheap and li'l NHT SuperZero's I happily use as my usual speakers while I search for the ultimate.

The Klipsches' image usually spread between the speakers, but it was consistently flat, dimensionless, and the horns did about the worst job of presenting soundstage information of any speaker I've auditioned in my room. While I occasionally had a limited sense of depth behind the musicians, I never felt the soundstage come forward and envelop me. And I *never* felt the speakers just disappear. Both of these are regular experiences with the SuperZeros and with the Swans I talk about later.

On music that depended on volume and dynamics to communicate its message the Klipsches delivered the goods. When the message depended on an interplay of musicians in a space, the Klipsch didn't do the job. But even though rock tends more to the former, lots of rockin' CDs I dig the mostest just don't play good on the Klipsches. For instance, Henry Threadgill's *Too Much Sugar For A Dime*. Ostensibly this is a jazz album, as only a band featuring *two* tuba players could be, but with enough rhythmic drive and dynamic contrast to at least appeal to most rockers, myself included. It should be heaven on the Klipsches, but there's such a dense interplay of musicians that you really need a space decoder like the Swans just to figure out what's going on.

Even on simpler material, like Liz Phair's *Exile In Guyville*, sounds which regularly spread across the room and to the back wall with the SuperZeros got flattened into a two foot thick slab anchored exactly by the front, back and outer edges of the Klipsches.

Call me a fussy, picky pain-in-the-butt, but what I'd really like is both volume and space. When I put on an excerpt from Massanet's "Le Cid" ballet from a Klavier sampler disc, it clearly demonstrated both the pluses and minuses of these speakers. This cut is a dialog between the woodwinds and the brass, with a quiet pooty-flooty section answered by a thunderous response from the whole rest of the orchestra. I've found this to be a great test cut 'cause a) it's fun to listen to, b) the thunderous response bit is a great test of bass power and dynamics, c) the quiet parts are a fine test of imaging capabilities and d) there's a castanet that cuts through the orchestra, clearly from far in the back of a big room. If the speaker you're listening to does NOT represent that, it doesn't do soundstaging. Period. The Klipsch didn't do that. Instead, it was just a clacking sound coming from the right speaker. On the other hand, it just rocked the house when the whole orchestra kicked in.

The clincher for me was one night when I had to work 'til 11:00 PM at my real job and came home tense, tired and none too pleased with the world. As I opened the door to my apartment, the thought flashed through my mind "I wish the NHTs were set up so I could just listen to some music." I guess I just didn't want that nostalgic "go to a club, get shitfaced, and wake up in a puddle of your own vomit" feeling that the Klipsches were so good at delivering.

THE SWANS BATONS

The Swans Baton is a regular old floorstanding box speaker, with a slightly better than normal efficiency of 90dB, that gets talked about as being usable with way low power SE amps. So we called Prince Edward Island in Canada and schmoozed it up with Frank Hale, the speaker's designer, and his extremely well organized wife, Margie, who handles calls from pesky reviewers, and got them to send a pair of them for inclusion in this review.

These are damn nice looking speakers. Mine came in a truly gorgeous rosewood with the finest book matched veneer work I've ever seen on a commercial speaker. They are about 40" tall on spikes, 9" wide and 11" deep. They really look good in a room. Too good looking for my taste, but those with more sense than hifiitis, like your wife, will dig 'em for sure. Beneath the veneer is inch thick MDF, heavily internally braced holding a 7" Focal woofer and a 1" Morel tweeter. In other words, standard 2 ways.

YOU JUST MIGHT FIND,
YOU GET WHAT YOU NEEE-EEE-EEED

Right out of the box, these guys sounded good. Not killer good, not sell-the-kids-I'm-never-coming-back good, but good nonetheless. Civilized, correct and pleasing. Definitely, *not* additive. They threw an exquisitely focused center image and they were absolutely no slouch at projecting soundstage info both front and back. In addition the upper end was nice and sparkly.

Basically the Batons did just great on everything that the Klipsches threw up on. Then I started putting on the things the Klipsches did great on. And the Swans didn't do bad with it either. Could have been more dynamic and definitely could have gone louder. But, these are really nice speakers in the ProAc Response 2 class. Grown up, mature, reasonably priced for the quality of workmanship and materials, terrific little speakers.

Given that they're two-ways, based around a 7" woofer with a lotta cabinet, you wouldn't really expect them to go that low and they don't. While they can pump out something from the Stereophile Test CD 2 even down to 25Hz, it ain't a lot and it ain't very pretty. The worst thing about these speakers was a slightly unpleasant quality to the bass information around the region where it stopped being able to produce the fundamentals. It had a slightly sharp, truncated bass sound on some lower down material such as Jimmy Smith's organ bass pedals on *Organ Grinder Swing*. I was able to effect significant changes in the bass by playing around with the distance from the rear wall. Clearly the best, fullest and most pleasing bass sound was with the speakers much closer to the rear wall, like 24" away, than I usually like my speakers. While the bass was pretty good, this position compromised the Batons' stellar soundstaging ability.

So what's a gal to do? Being the possessor of just enough info to feel dangerous I made up a pair of cheap 1 cap/1 resistor, 1st order high pass filters to drain off any low frequencies under say 80Hz and switched those over to my NHT SW2P subwoofer. This allowed me to pull the speakers back out into the room, giving them room to breathe and develop the sense of performers in a room that I really enjoy. Now, I don't know if you'll find this as helpful as I did, but to me it was a big revelation to find out how totally EASY it is figure out the necessary elements in a cheap n' cheerful high pass filter like this.

I had learned how to make filters like this from Corey Greenberg's review of the SuperZeros in the January 1994 issue of *Stereophile*. In the review there's a cryptic footnote from the editor that supposedly tells you how to derive your own resistor and cap values, but it left out crucial information for the electronics novice, such as myself, like a) how to find out the input impedance of your amp and b) how to calculate the combined resistance of the amp and your chosen resistor.

Well, I got the information, and I got it from Corey who was nice enough to help a recent immigrant from buy-it-at-the-store land. He explained it in a totally clear, highly useful way and I pass the info on to you.

First, find the input impedance of your amp. Turn off the amp, plug an interconnect into it and measure the ohms at the other end with your multimeter (put the black lead on the outside barrel of the RCA plug and the red lead onto the pin). Then figure out the values of the resistor and cap to use by doing the following calculations. Its way easier to do this with a spreadsheet than on paper, because you need to substitute different R and C values to get to the corner frequency you want. The corner frequency, by the way, is the frequency at which the sound will be -3dB and then continue dropping at 6dB an octave after that.

Usually, the process is made easier because you might have some caps lying around and that limits the number of calculations you have to make to get where you want to go.

Lets call the amp's input impedance R1 and the value of the resistor you want to use R2. Then figure out the combined resistance of the amplifier and the resistor with this formula: (R1 * R2) / (R1 + R2).

Since the AN impedance measured out at 475 kOhms and I wanted to use a 33K resistor the calculation (475,000 * 33,000) /

SWANS BATON

Bandwidth: 48-18.5 +/- 3 dB

Sensitivity: 90 dB 1W@1M

Nominal Impedance: 5 ohms

Max Power: 200W

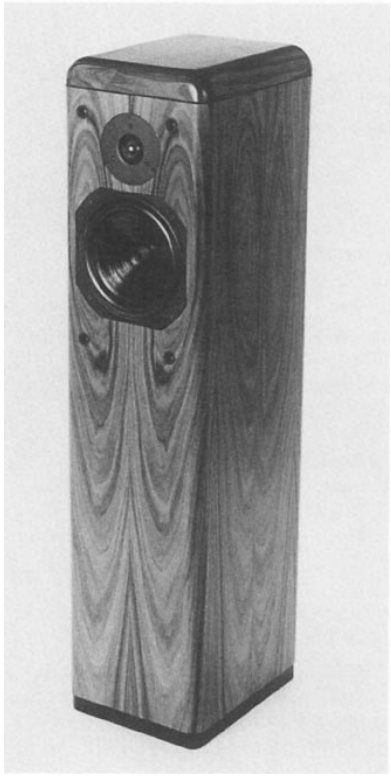
Min Power: 11W

Driver complement:
7" cone
1" soft dome

Price: $2075 oak
Cosmetic and biwire options available at additional cost.

Swans Speaker Systems
RR #1 Mason Rd.
Charlottetown P.E.I.
Canada C1A 7J6

Tel. 902-569-5520
Fax 902-569-5123



(475,000 + 33,000) yielded a result of 30.856 kOhms, which we'll now call R.

Then plug the result into the following formula: 1 / (0.628 * R * C) where C is the capacitance of the capacitor you want to use expressed in Farads, so if the cap says .1uF then the number you use is .00001.

Personally, I have a hard time getting the zeros right, so I just add zeros until the resulting frequency looks right. Since I had some .068uf MIT multi-caps in the house, these were what I used. The calculation 1 / (.628 * 30,856 * .00000068) equaled 75.9, just about the Hz number I wanted to get to. The actual filters themselves are easy to make as pie, if, like me, you do all your baking with a soldering iron. For info, I refer you to Corey's original article.

With the Swans set up in this way, I'd come home from 16 hours on the job, exhaustedly plop down into my sofa, listen for an hour or so to unwind, go to sleep, then do exactly the same thing the next day. So it didn't hit me for a while how much I was actually enjoying these speakers. Without a lot of fanfare they were delivering what I needed them to deliver, the music I like to listen to whatever that might be at any given moment, be it Schubert or Sonny Sharrock. They weren't hopping around the room going Oh, look at me, I'm the best speaker you ever did see, Oh, Oh, please look at me, they just sat there doing the job.

The Batons offer first rate imaging and soundstaging, smooth response, detail and clarity without any specific performance characteristic demanding your attention. But, as my friend Patty said one day, "These aren't good speakers for having company over, 'cause they make you want to pay attention to the music." Sounds like as good a distinction between high-end and mid-fi as I've yet heard.

So why aren't I peeling huge wads of dollars off my bulging roll to run out and buy a pair for myself? Whelll, ish like dish: after all is said and done they just don't go loud enough off of seven watts to either fulfill my stringent review criteria or to make me want to buy them. Its no big deal, its not that they don't do what they were designed to do, its not Frank Hale's fault or anything. They just need another 3 to 5 dBs of efficiency more than the 90dB they deliver.

I called Frank and asked him about this and not surprisingly he wasn't surprised. From my chat with him its clear that he thinks the single-enders are onto something and that something is sitting down with your stereo at the end of a hard day or the beginning of an easy one and just enjoying your music. That's what he had in mind for the Batons, and in my opinion that's more or less what he delivers.

Yeah, I had to play with them and use a subwoofer to get the best possible sound in my living room, but even without the sub they deliver the musical goods except on the most way down material. But, they don't go loud enough and Swans knows about it. Frank is designing two new speakers, which will get their introduction at the Winter CES in Las Vegas, designed to eke a few more dBs out of standard cones. Based on my pleasing, but too quiet, experience with the Batons I'll look forward to hearing them.

THE EVIL TWIN SYNDROME

After having the Batons as my main speakers for about five weeks, I put the Klipsches back up while I finished the review. It's just two different worlds. The Klipsch has got all the volume and dynamics you could want but it literally flattens every disc. The Batons don't play loud enough and don't have half the dynamic swing of the Kippers but paint a really full blown, wall-2-wall 3D sonic picture. It's the evil twin syndrome. If I was forced at gunpoint to choose one of these two speakers, I'd have to pick the Swans because they play more of my music but the Klipsches were definitely a lot of fun on certain material. What I'd really like is to force the Klipsch and Swans to mate so's I could buy the bastard children. Except with my luck, recessive genes from nowhere would land me with a squalling baby Bose AM-5!

AES SE-1 AMP KIT UPDATE

After last issue's love gush on the AudioNote Kit One, I started thinking about the ol' unloved AES SE-1. How could I improve it?

Joe Roberts had some good (and CHEAP) ideas so I tried them[1]. I unsoldered the 10K metal resistors going from pin 3 of the power tube socket to the terminal strip above it, and replaced 'em with 15 cents of Radio Shack 1K carbon resistors. And I removed the poly bypass caps around the big 'lytic cap on the left (when the amp is upside down). I was rewarded with an increase in transient response, but now it was harsh, baby, harsh. I took one of the Vitamin Q caps I had been only too grateful to remove just weeks before and used it as a bypass on the big cap. Now I was getting somewhere! This combo gave me the increased snap I was looking for but without the grating harshness I wasn't looking for.

But still I didn't prefer the SE-1 to any of the other amps I had. I pestered Joe to send me some 2A3 tubes. (*You better lay off my stash, punk—ed.*) He finally dug up a pair of used GE babies that he said tested good. I geared myself up for a major redo of the amps internals to fit this new tube. I sat down to plan my strategy and came up with the following: throw the tubes in and readjust the bias to 100ma. That's it. That's the extent of the mods needed to try the 2A3.

And, man, did it pay off! Finally, a setup on this amp I could actually enjoy. Less power, even lower volume, but smooth, integrated, loads of detail and no obvious weaknesses at either frequency extreme. The amp even looks better, more correctly proportioned, with 2A3s in it.

So why does the SE-1 do so good with 2A3s and not do so good with 300Bs? Could it be that the 337V B+ supplied to the tubes is just about perfect for a 2A3 type tube, but a little skimpy for a 300B which really wants more like the 420V supplied by the AudioNote? But if it's perfect for a 2A3 tube, why is the SE-1 sold as a 300B amp? Beats the hell out of me, that's for sure. I just wish I had some great sounding high efficiency speakers so I could really hear those 3 watts.

MANUFACTURERS' COMMENTS

SWANS

Thank you for the colourful and positive review of the Baton. We are honoured to be in the pages of what I consider a vanguard magazine. Although there are many that still consider single ended amplifiers to be a fad, we look at them with the same interest as the introduction of the CD. They are definitely here to stay. Now if we only had a

1— Some experimenters advise changing both 4.7K resistors in the 6SL7 circuit to 2.2K and bypassig the bias supply with a 47 mF/250 V cap between the bias adj. pot and the 220K grid resistor. Try it.

decent selection of speakers for these babies...

There is hope. While most high-end manufacturers are pursuing the audio-video market, Swans has decided to dedicate all of its R&D efforts to designing speakers that work well on low, as well as high, wattage power amps. All of our new speakers including those at the WCES will be at least 90 dB efficient.

Seth, your analogy between finding the perfect date, or "the Speaker from Heaven," rings a familiar bell. Unfortunately many get led astray by purchasing equipment based on what they have read rather than by what they hear. After a while one learns that life is filled with compromises, no matter HOOOWWW much you spend or look. Anyone who says differently is a liar.

As an audiophile I have constantly been frustrated auditioning two way designs that would be fine if they just had a little more bass. Finding an efficient speaker that does this narrows the field significantly. The Baton is not audio nirvana incarnated, but it does deliver a full and satisfying sound that is not analytical or hard. With the right amp it delivers emotion in aces and spades. In my wife's (and business partner) words when she heard the Baton for the first time, "It's like being wrapped in a warm blanket." In Seth's (if I may anticipate), "But sweetie, it's better with tubes."

Frank Hale
Swans Speaker Systems

KLIPSCH

Mr. Goldwin's review once again reminds me of the importance of individual *point of reference* regarding audio reproduction. All of our opinions and responses to whatever stimuli are cumulative effects of what we have experienced in the past. As we all know, there is no such thing as "the perfect sound reproduction system". Horns sound different than direct radiators, transistors different than tubes and so on and so on. Any system that we as designers and builders or as consumers and listeners put together will be a series of compromises, maximized to match the priorities of the individual. What is right for one person may or may not be the best choice for another. I refer to this as *point of reference.*

When I worked in a hi-fi store, customers often would come in and ask, "Which speaker is the *best?*" My usual response was "Compared to what?" If the individual expounded on the virtues of this or that hi-fi system, than I led them to a product with wonderful "soundstaging and imaging" and ever important ACCURACY. If, on the other hand, they were musicians or heavy concertgoers, I moved in the direction of products that were strong in dynamics, transient response and "feel". Different smokes for different folks.

During the development of the epic series of products at Klipsch, our goal was to bridge the gap between these two camps. Imaging with punch, soundstaging with dynamics. Finesse at 102 dB sensitivity!

Have we achieved Nirvana? Nah. But we are convinced that the Epic products offer the strongest case to date for a product that can hold its own on any subjective or objective criteria.

Mr. Goldwin's wish that he could have multiple systems available at any given time is not unusual. I know I wish I could have a specific system maximized for each piece of music in my collection. I would also like to own a city house, a country house, a ski chalet, a place on the ocean and one in Hope, Arkansas (to cut travel time and stay out of the Holiday Inn, but that's another story. . .) but I can't afford those either. My point is that all systems make compromises and if a mini-monitor that "disappears" is preferred by an individual, that's OK, but it doesn't indicate superiority over a product that sounds *live* (there I go using those subjective terms again).

Klipsch is a company that continues to develop the state of the art in horn type loudspeakers. As the Klipschorn set the standard for horn type loudspeaker design 50 years ago, so does the epic series today. As the Klipschorn has evolved and improved over the years, so will the epic products. Klipsch is a company that is never complacently satisfied with its products. Our chief design engineer, Roy Delgado, will surely continue to look for ways to improve the epic series, which we believe to be the finest imaging horn system produced by Klipsch to date.

Mike Dyer
Klipsch

Factors Determining Tube Life

by Prof. A.V.J. Martin

Reduced service life is often due to high voltages

SOME of the tubes used in modern electronic circuits are exceptionally hard-working components, especially in television receivers. It is a well-known fact that some of them have a relatively short service life, mainly because of the operating conditions (high power, pulse operation, etc.).

However, there are several common factors which influence the average life of all tubes, namely, excessive heater voltage and excessive plate dissipation.

The effect of heater overvoltage is shown in Fig.1A for a 6.3-volt tube. It does not take into account the probability of the heater opening up but only the exhaustion of the oxide film which constitutes the cathode. The life of the tube at the nominal voltage of 6.3 is taken as 100%.

More frequently, the overvoltage fluctuates around an average value. An unstable heater voltage is extremely detrimental to tube life, as seen in Fig. 1B where curve 2 refers to a tube which is alternately normally and excessively heated. For comparision, curve 1 refers to a tube having a constant heater voltage equal to the average value of the irregular voltage of curve 2.

Fig. 1C shows the effect of plate overload which is evidently less detrimental since an overload of 50% reduces tube life by only 25%.

The conclusion is evident. The best way to insure maximum tube life is to operate all tubes well within their design ratings.

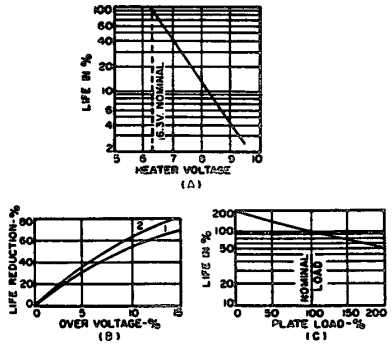
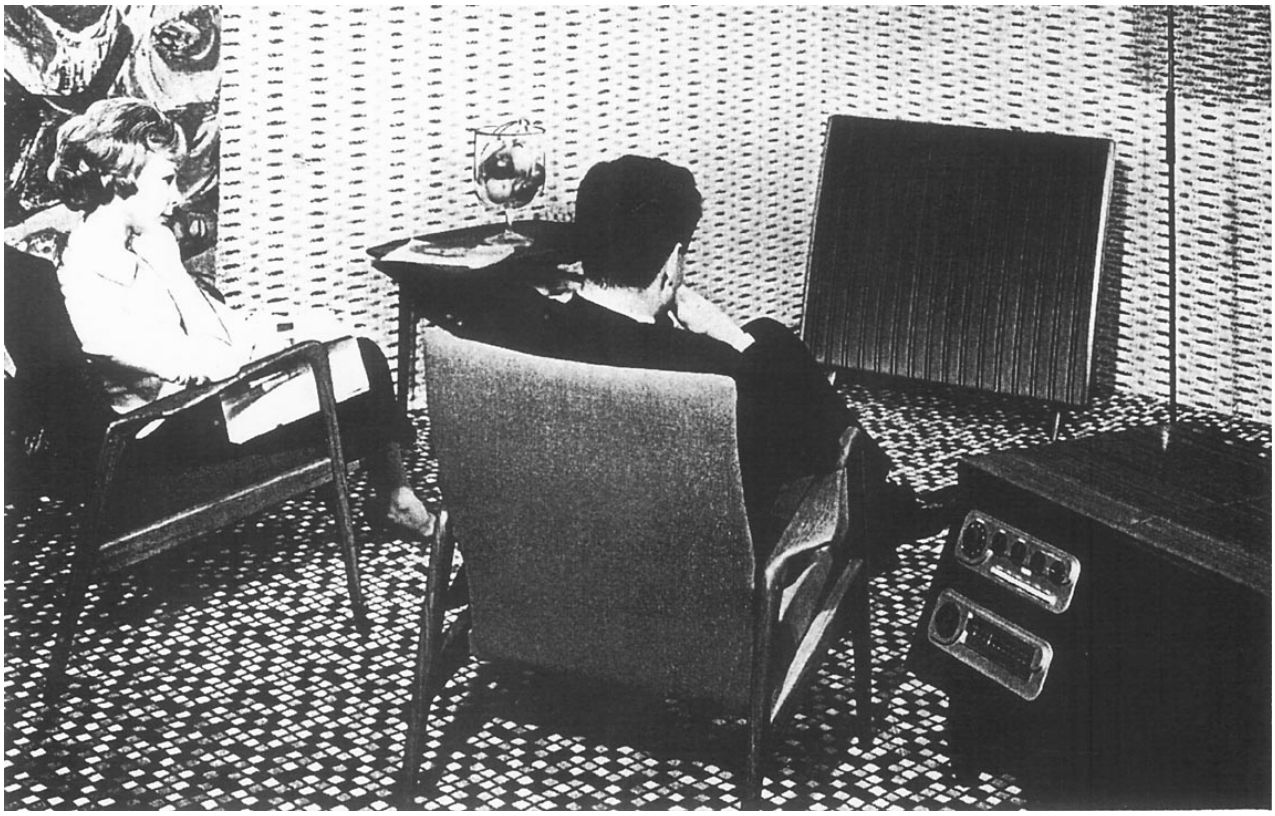


Fig. 1. (A) Effect of high heater voltage on tube life. (B) How fluctuating voltage shortens the life of tube. (C) The effect of plate overload on tube longevity.



THE QUAD ELECTROSTATIC LOUDSPEAKER

by
Haden
Boardman

Mellotone
Acoustics

A good electrostatic has something special, a magic spell that weaves itself over you. Critics (of which there are few) moan on about "won't play rock" or "only for string quartets". Ask these plaintiffs what system they have, or what kind of speakers, and the usual response is some old west coast monster.

Electrostatic speakers generally consist of four main parts: a *power supply*, to provide the necessary electrostatic charge; a *rigid plate* (or plates) to hold the charge; a *flexible plate* to act as diaphragm (only 2.5μm thick in the QUADs) which makes the music, driven by a *step up transformer* to multiply the voltage output from your amplifier to a level high enough to move the flexible plate.

It's a difficult thing. The fixed plate has to let the sound pass through it, and so is usually perforated. The flexible plate has to have near zero mass to be moved by the output from the amplifier. It's amazing the whole thing works at all.

It's funny that while in studios condenser microphones are the bees knees, the electrostatic loudspeaker has never enjoyed a similar level of "professional" attention, and therefore suffered a relative lack of development.

Although electrostatic speakers have been known to exist from the nineteenth century, the first *commercially* made speakers were fitted to a few picture houses in Chicago in the late 1920s. Nothing is known about these early devices, if anyone has any information about these I would be delighted to know.

Peter Walker was the first in 1956 to offer to the public a High Fidelity electrostatic loudspeaker. Others have followed: Acoustats, Audiostatics, Dayton Wrights, Martin Logans, etc. But QUAD were first. QUAD still manufacture an electrostatic, of course. 1980 saw the introduction of the ESL 63, so called because that was the year that Walker & Co. started work on a replacement for the original. In a lot of people's perspectives, mine included, the new design did not quite match the earlier speakers' performance in some areas, for others the new model was a revelation.

The original's cookie '50s look amuses me something rotten. The expanded metal grille, the stubby little feet are all pure 1950's Britain. Most were fitted with "bronze" grilles and with classic teak end caps. Later production had severe (and very boring) black grilles along with rosewood end caps. There were variations — I recently picked up a pair of late 1959 items with black end caps and baby sick green grilles. I will be parading these things about next year at shows, be warned!

There are few, if any loudspeakers that raise as many passions as the QUAD electrostatics. Like the DECCA cartridges, Linn LP12, Tim de Paravicini, LS3/5a and other quirky Brits a relationship with a pair of QUADs is either pure love or pure hate relationship.

Let's get the hate bit out of the way right now. If you head bang, please turn to The Gallo's article (in SP #6) right now, waste no more time, do not pass go, do not collect $200. Maximum SPLs are about 100dB for a pair, in an average British living room, less I would imagine at yer average Texan ranch. Stacking a pair can of course give you far more headroom, if less house room, but more on that later. Subwoofers and other low life can also add a few extra SPLs thanks to the reducing burden on the ESL. But basically ESLs will never make your ears bleed.

The biggest total hate (on my part) is the directivity of the thing. These speakers are *so* directional it hurts. For those inexperienced in the ways of the ESL, these things make a pair of ALTEC 604s sound like an omnidirectional design.

Forget using ESLs if using some super amplifier or super budget amplifier. Powerwise, pair of ESLs need 15 watts per channel, a stacked pair double. Any more and you risk of destructive lightning within your speakers' panels. Due to the varying impedance (1.8 ohm at 20 kHz, to over 60 ohm at 150 Hz.) and highly capacitive load, ESLs are not suitable for any amp that is not totally stable into any load.

I once saw the remains of a little Rotel RA 820BX that some bafoon wired up to a pair of ESLs, the innards resembled a scaled down model of downtown Hiroshima, circa 1946. Craters where transistors once sat, melted resistors and capacitors everywhere. Single ended triodes are fine, in fact more than fine, they're great with the ESL, as long as you do not mind mushy bass.

QUADs have bass, and anyone who wants to argue the toss is either a wimp or tone deaf, so there.

Final fly in the ointment is the build quality. QUAD has a reputation for making the best built kit here in Blighty, and I do not want to chink the armour but it has to be said some of the production techniques used to assemble the originals is a bit dire, if limited by fifties technology. This manifests itself mainly in dust cover rattles. Yes folks, ESLs can rattle, pop, buzz and fart.

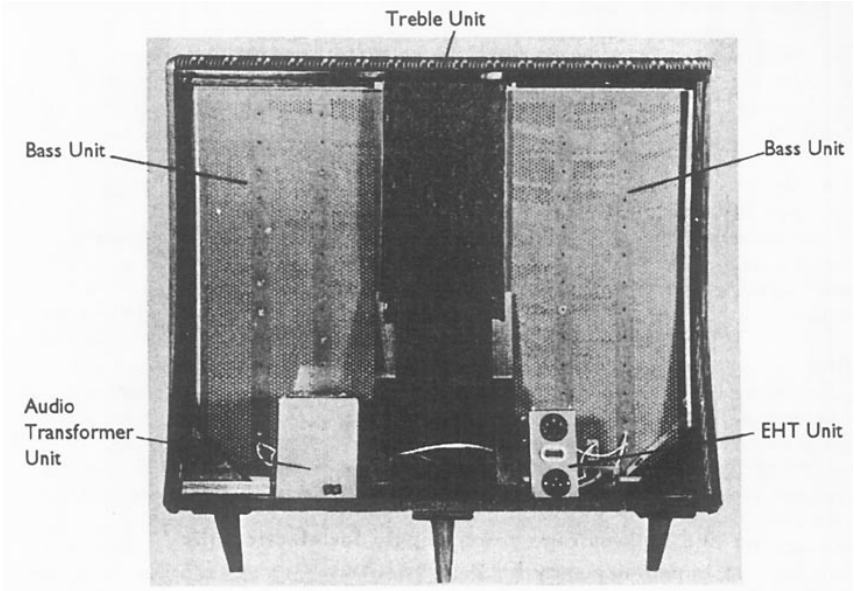
Enough of this negative vibe, what about the plus side? Well, thankfully to say it is a much longer list. For spec. freaks, these babies are a dream.

Frequency response? 40 Hz to well past 20 kHz. Distortion? Compared to any moving coil unit, it's non existent. Impulse test? Quicker than the measuring microphone. Fine, but how does this mumbo jumbo manifest itself in the sound quality?

I do not want to mislead subjectives into hating this speaker on the "measure fine, must sound like dog shit" knee jerk reaction — although they *would* be right with some QUAD crap like the 405 family. This speaker was extremely well regarded from the outset. It earned the nickname of "Walker's Wonder" very quickly. Both Harold Leak and Gilbert Briggs went into blind panic on first audition in the '50s. Leak quickly set to work on his own ESL (although nothing other than a couple of *Wireless World* articles ever came of it). Briggs answered with the not totally unsuccessful Wharfdale sand filled baffle three. Logic being if you can do it with static 'lectric you can bloody well do it with big magnet speakers. Even Goodmans (Mr. E. Jordan, one of my heroes) developed one.

A pair of electrostatics can sing. They add no spice to the sound. They play it as the electrical signal on their input terminals tell them. They add nothing and take very little away. The truth, the whole truth and nothing but the truth. If your system is bogus, on the end of a pair of ESLs it will sound "line me up and shoot me" bad. If your system really sings, and does not need speaker coloration to give it bass, check out a pair or, even better, a *stacked* pair.

The most common criticism against them is the lack of bass. This is total bullshit. Yes, the bass will not play loud enough to annoy the neighbours. Yes, it's free from the usual boxy boom most makers engineer into their crappy little box speakers. What bass there is, is clean fast and unbelievably cool. I get totally pissed off with all these "boom" box subwoofers. Most of them have resonances about 30 Hz, adds a Technicolor bass bloom. Christ, even QUAD themselves are at it now. When is a dipole subwoofer not a dipole subwoofer, when its a Gradient of course! As for these over amplified boom boxed which seem to have gathered street cred in the last couple of years, most of 'em are ripoffs of Audio Pro. QUADs have bass, and anyone who wants to argue the toss is either a wimp or tone deaf, so there.



Internal workings of QUAD ESL

At the other frequency extreme it's just as delightful. So clean and free of sibilance. No spit. No sizzle. Nothing added, very little taken away. Some do complain the ESL rolls the top off, and I suppose it does a bit, but then so do half of the single ended amps on the market at the moment. The bit in-between also rates as "jolly". The midrange is ever so natural and unrushed. You could never accuse the ESL of forcing the sound onto you. You walk "into it" rather than it walking over you. I can think of no other speaker that handles the midrange as well as the original ESL, *period.*

By now, you either want a pair or have already turned over to a different article. Two very important words to remember when chasing QUADs: *caveat emptor* or if you skipped on Latin lessons at school, let the buyer beware. And boy, does the buyer have a lot to watch.

Budget on at least £500 minimum for a pair when refurbished, if it costs you any less, you have been very lucky. If buying condition unknown, never pay more than £100 for a pair. Serious. In time everything can and will go wrong with an Electrostatic speaker. Budget on a complete set of new panels, (there are three in each speaker, two bass and a treble panel) plus a new EHT unit. These items cover 99% of Electrostatic ailments.

The treble panel is usually the first to have problems. Solid state amps tend to clip quite hard into an electrostatic speaker (due to the difficult load and falling impedance at higher frequencies). This tends to cause arcing, which burns holes right through the centre diaphragm and removes the electro-conductive paint off the fixed plates. This reduces the efficiency and power handling as well as causing strange popping noises from the panel. Bass panels suffer similar problems, over excursion causing a similar effect, although the symptoms can be more tricky to spot, it usually manifests as lower efficiency.

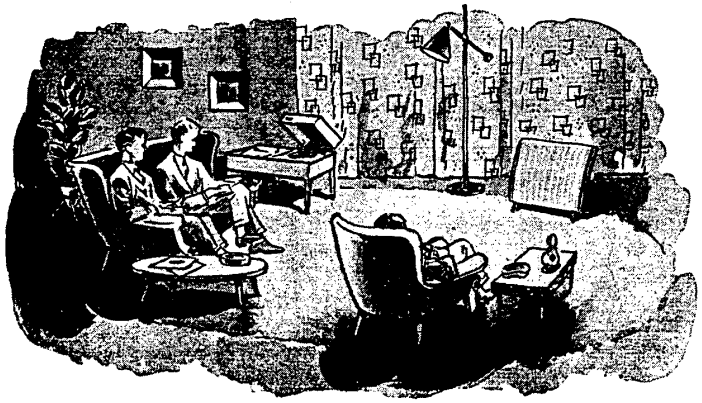
EHT units tend to die with age. Either no output or so low you cannot hear it are the fault. The rest of the electronics are pretty reliable. I have seen both audio transformers and mains transformers dead, and they are most certainly not cheap to source. QUAD automatically fit a protection circuit ("clamp") on the ESL these days, which does its best against abuse. It's not 100% perfect, so watch yourselves.

Anyone thinking about doing DIY work on QUAD ESLs should plan to be extremely careful. Disconnect the mains, leave for a minimum of six hours and disconnect the amplifier. This last bit is very important. The audio transformer steps up the AC signal (sound) to a very high level, if by accident music is playing into an unenergized QUAD and you happen to touch the wrong wire, YOU ARE DEAD. It's far more potent than the ESLs' power supply, due to the low source impedance of the audio transformer.

An engineer for whom I once had very little respect told me in the case of most home brew audio gear said Destroy It Yourself would be more appropriate. Well, an ESL bites back, Destroy Yourself, if you are not sensible, please be careful. Take no chances, electricity takes no prisoners.

Servicing the ESLs is fairly easy. Unscrew the back panel, the wooden end cheeks. Carefully tease out the staples from the metal grill and remove them. If you have no cats, dogs, or rug rats, and don't object to staring at naked QUADs, use 'em like this. The expanded metal grille does a big fat zero for the sound quality, if everything for the looks.

Carefully unsolder the connections from the back of the panels (make a sketch to show where each wire came from). There are 5 wires on the treble panel and 3 on the bass panels. Be very careful when moving the units. They have a thin "cling film" protective dust cover over the entire frame. Watch for dropping "solder blobs" which will drop straight through the panel. Inspect yours closely. Any tears, rips or holes should be rectified with some new dust covers.



Most covers sag periodically, the cure being a heat gun or hair dryer. On the lowest motor speed setting and maximum heat, carefully move around the diaphragm with the heat, and most of the wrinkles will disappear. Sonically, loose grilles equal buzzes, rattles and farts. It is impossible to completely mitigate, you will always have a bit of a buzz. Dust covers are always replaced when replacing a faulty panel.

Damp is the biggest threat to the longevity of the panels. If you put your ear close to the speaker and detect a slight rustling noise, trapped humidity is eating away the conductive paint on your panels. This is the main reason why the panels lose efficiency for no apparent reason. I suppose this is going to be a bigger problem to me than most reading *Sound Practices*. Manchester does have a bit of a reputation as far as damp is concerned.

All of the electronics are screwed to the base of the cabinet. Audio transformer with crossover components soldered underneath to the left, EHT power supply (6000 volts for the bass and 1500 volts for the treble) and mains transformer to the right. On the whole, these are fairly robust. As earlier mentioned, the older EHT units have just about run out of steam, making necessary their replacement. I have seen unserviceable audio transformers, but not many. Their failure is usually due to the speaker being connected to some 4000 watt monster of an amplifier that did not like the difficult load and decided it would eat it instead.

Tweaks and mods are all now pretty well established. For the unacquainted, here's the HTB guide to QUAD tuning:

1) If using a single, use a rigid stand, ideally about 18" to two feet tall. I have seen several different stands for these beasties now, some of which clamp the sides, some of which screw into the sides where the wooden end cheeks are. Most seem pretty competent. Best solution was by a good friend of mine, who built a mini brick wall underneath them.

2) Positioning. Never put an ESL flat against the wall, or running parallel with a wall. Don't forget, as much energy comes out of the rear as comes out of the front. It's wrong to say ESLs are only for large rooms, I've found they work better in small rooms. The most ridiculous was an 7 x 8 foot room. They sounded really great. If you are lucky, and have a bloody big room, best idea is as much space behind them as in front. Keep the beasts a minimum of a metre away from the side walls. On 18 inch stands like this, they really sing.

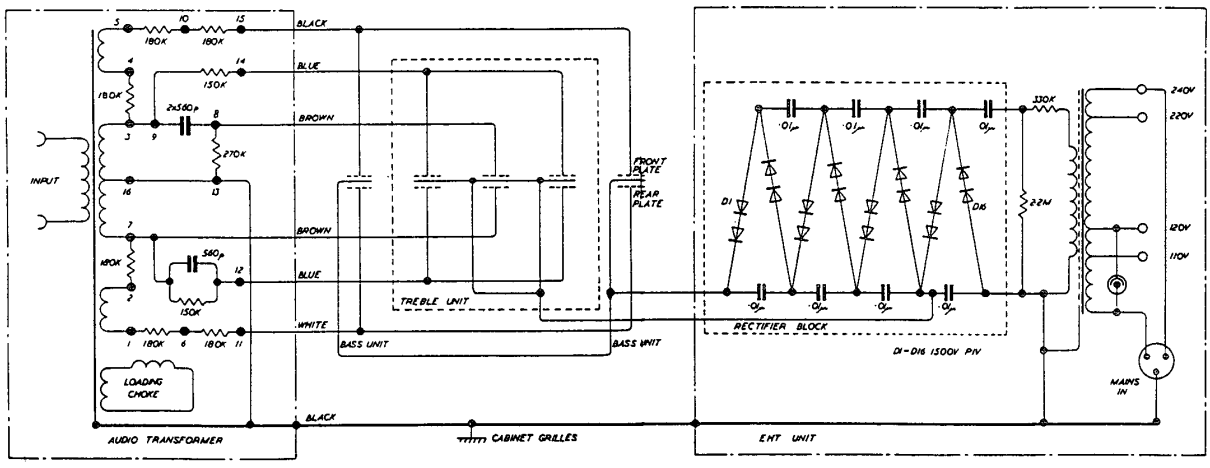
3) Lurking behind the panels are a couple of furry devices designed to stop the sound reflecting back from the wall behind the speaker. With the aforementioned positioning, all our furry little friends do is make the speaker sound dirty. Remove 'em. The items over the bass units resemble sack cloth!

4) Grille removal. Dodgey one this. Not only does it expose the naked panels to the outside world, risking the film dust cover's life, it exposes 4000V to your room, risking some bugger else's life. Like everything else in audio they sound really good naked, but it ain't for the party man or the family man. Tread carefully. Easy to do, see above.

5) New frame. The original frame has a slightly contoured shape. When the panels are securely mounted, they take on this slightly bananas profile. Although this aids dispersion, it does not help the rattles. A new, more rigid frame helps quite a lot. I have built several now, and have taken the opportunity to position the electronics at the bottom in a plinth, with the frame and panel up in the air. Drive units flat.

6) Which leads us nicely to the ultimate QUAD mod, STACKING. Extra efficiency, higher SPLs and deeper bass. Twice the height also equals twice the W.A.F. (sorry Joyce). If you just want to stack an original framed pair, it's quite easy. If you want to be a real smart ass, build complete new frames for both, so you can locate the panels as close as you can together, awesome. Most just stick to the original QUAD recommendations.

7) For those who like to hang upside down, only like the dark, and get miffed if there is not much output past 20 kHz, DECCA ribbons have been used to complement the higher registers. A buddy of mine has horn bass (under the house!) electrostatic mid



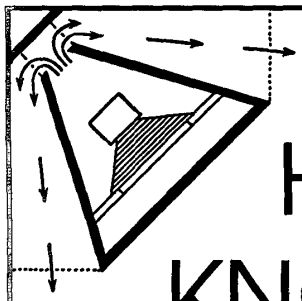
Electronic diagram of QUAD ESL

and ribbon tops, all home made, being driven via single ended transistor. Anyone who thinks this can't work, should think again—it does, really well.

For my ears, the ultimate QUAD setup is a stacked pair in solid frame. One of the best sets I've heard belongs to "Mr. Hard-wired" himself, Glen Croft. Lover of OTLs, No. 1 fan of Julius Futterman (I think Glen has a Futterman shrine buried somewhere in his Erdington workshop), Glen has produced the best sound I have heard out of a quartet of QUADs.

Running without the film dust covers is a very silly idea, this screws the beasts up in a matter of months. Even if it does sound cool.

No, the first commercially produced ESL has a lot going for it. Just watch the reliability. When they were discontinued around 1985, after a production run spanning back to 1956 over 60,000 pairs have been made. The price then was £700 a pair, roughly 60% the cost of the inferior ESL63. Today's price for the '63 is near enough £3000. A rough calculation makes an original ESL worth around £1800. Second-hand, you get laughed at if you ask any more than about £600 for a mint pair. I reckon they are worth triple that.



HOW TO KNOCK YOUR SOCKS OFF WITH 5 WATTS

Some general observations by The Baroda Bard and Ray

My friend Ray knows a lot about speakers. He designed them professionally for about 25 years and probably would do it again under the appropriate circumstances. The other day, I went over to Ray's house on the St. Joe River for lunch. After we chatted about close friends, poetry, pipe organs, music for same, fine food and wine, we talked about speaker efficiency, a favorite subject for both of us.

This article isn't about amps, at least not directly. The title screams that, I guess. But inherent in any discussion about single-ended triode amps, there is the nagging question of what speakers to use. What follows are notes that we put together as our discussion on speaker efficiency continued on for a few weeks.

Yes, I know there are some answers — ranging from classics like Western Electric and Altec "Voice of the Theatre" cinema sound systems, vintage home hi-fi systems, still available "vintage" designs like Klipsch La Scalas and K-horns, to contemporary "pro sound" gear, and home-brew designs of various sorts.

But how does one sort through this strange menu? How can you know which direction to go? While I'm convinced that the way to go is the speaker that "plays the most of your records" in an emotionally connecting way, I'm also inclined to get to this fine place via some grounded rationale. (Help, if you will).

Cut to the chase, you say. And don't bore or confuse me. OK! It's probably not far off to say that most contemporary "high-end" audio consumers are purchasing power amps ranging from 100 to 300 watts per channel. This is a difference in power that, all else being equal, produces a difference in sound pressure level (SPL) of 4.8 decibels (dB). 4.8 dB is a rather *modest* difference.

The above-described power range of 4.8 dB has sort of evolved to "work out" with a range in loudspeaker sensitivities (SPL developed with a 1-watt input at a distance of 1 meter) of something like 81 to 91 dB. This is a 10 dB difference, just over *twice* that of the power amps. A 10 dB difference in SPL is a difference of the genuine knocks-your-socks-off variety.

The 4.8 dB amp difference is able to deal with the 10 dB speaker difference due to variations in type of music listened to, the degree to which the listener wants to duplicate the SPLs of live music, the tolerance and closeness of the neighbors, size of pocketbook, size of room, etc.

Now, enter the single-ended triode amp! Not 100 watts! Not even 50 watts ('cept the Cary 805 monoblocks). More like 10 or 12 watts. Or the 2A3-powered AES SE-1 kit on my credit card—five (hot) watts. And me wanting to try that 2A3 amp I read about that does about 2.5 watts.

In short, with SE triodes on the scene, the contemporary status quo of speaker sensitivities no longer cuts it. Specifically, 2.5 watts is *16 dB down* from 100 watts, a LOT more than the 5 and 10 dB differences noted above. This article is about guidelines for building loudspeaker systems which can really knock your socks off with lower powered amplifiers by making up for the power shortfall with greater speaker efficiency.

The following comments are relatively brief and could build into several more detailed, longer articles—some more obvious than others. Making a speaker one of the ways described doesn't say it will necessarily sound good or be a perfect partner for your new flea-powered SE-triode amp, but the physical laws behind the examples might help select or design a speaker system that doesn't wimp out when powered the way you like it.

SPL Increase	Amp Power Increase	Subjective Reaction (You)
1 dB	1.3 times	Can just hear, if you're paying close attention.
3 dB	2.0 times	Pretty obvious, but not if the increase is at all gradual (not A-B).
6 dB	4.0 times	Can get your attention, even if you're not listening for it.
10 dB	10 times	Knocks your socks off. Twice as loud.

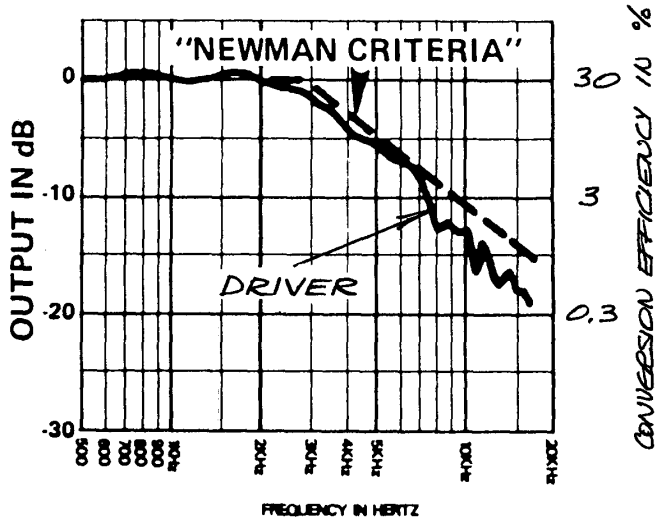


Figure 1—The "Newman Criteria" for Compression Drivers Compared to a Typical High-Quality Example (basically no exceptions)

High-Frequency Compression Drivers

Compression drivers can theoretically be about 50 percent efficient, that is, convert 50 percent of the electrical power input into the acoustic power we hear.

Physical realities, like air squeezing through small slots and friction in diaphragm suspensions, conspire against this happy result, to produce a real-world maximum of around 30 percent. (This is just over 2 dB down from the 50-percent maximum.) And that maximum only holds up to about 3 kHz, beyond which additional gremlins produce a treble roll-off of about 6 dB per octave. That means that at 6 kHz the efficiency drops to 7.5 percent. At 12 kHz, efficiency is just under 2 percent! And this is for a very well designed driver.

Around the world, I've spoken about this more-or-less ignored (except to those who make a living designing compression drivers) characteristic, and dubbed it the "Newman Criteria," after my friend Ray, who first explained it to me over 20 years ago. The Newman Criteria and the performance of a typical high-quality compression driver are illustrated in Figure 1.

The reality of the Newman Criteria means that if you just slap a good compression driver on a horn and sit back to listen, it's going to, by definition, sound dull, unless:

1. The designer has depressed its mid-band efficiency to produce a sound with "more highs." Or—

2. The driver has been placed on a horn whose coverage angle decreases with frequency in a way that compensates (or partially compensates) for the driver's inherent high-frequency roll-off. Straightforward exponential horns and the closely related radial horns (e.g., Altec 511B and 311-90) display this characteristic. It amounts to a sort of "acoustic equalization" that applies only to the guy listening on the horn axis. Off-axis listeners will end up being short changed.

In my experience, the most respected "professional" compression drivers hew close to the Newman Criteria: Altec 288, TAD 4001, JBL 375, 2441, 2445, 2446, and EV DH1 and DH1A. I suspect it also applies to the Western Electric originals. But many drivers don't come close. Meeting the criteria is expensive.

And the criteria also applies to tweeters, e.g., JBL "bullets" or the EV ST350, except that they join the Newman Criteria on its downward slope above 3 kHz, since their diaphragms and horns are too small to go down in frequency to the 30-percent efficiency range.

What About Woofers?

Ray says that horn-loaded woofers never seem to quite reach the 30-percent figure, for reasons he has never seen explained, topping out at about 20 percent. That's about 2 dB down from 30 percent. Horn-vented "combination" low ends such as the Altec Voice of the Theatre approach the 20-percent figure only in the upper octave or so of their overall operating range (about 50 to 500 Hz), because their relatively small, straight horns are insufficiently large to act as horns in the lower octaves—they turn into vented direct radiators in this range (see next paragraph).

Very-high-efficiency direct-radiator woofers are about 5-percent efficient in an acoustic half-space (where the output is restricted by a large baffle to one-half of a sphere). These speakers pack all or most of the voice coil in the gap, and include 1950's JBL, Altec, Stephens and EV hi-fi designs, among others; and whose currently available descendants are still used by guitar players, (e.g., EV EVMs and the JBL E series). 5-percent efficiency is down almost 8 dB from the compression driver's 30 percent!

And if - 3dB low-frequency limits in the 32- to 40-Hz range are sought, efficiency offerings in the 2- to 3-percent range result in enclosures much less like refrigerators. I like the 32 Hz, which Ray once described to me as a "magic" number because it encompasses a 16-foot, 32 Hz organ stop.

Picking the 2.5-percent middle of the range, that's nearly 11 dB down from the 30-percent-efficient compression driver! And for those of us who remember when Ed Villchur (Acoustic Research) invented the acoustic suspension bookshelf speaker system, c.1956: its half-space efficiency was about 0.5 percent, nearly 18 dB below all those WE compression drivers that first appeared in movie theaters. If 5 watts works for a good ol' WE driver, digging up 18 dB of efficiency reduction jumps the power requirement to over 300 watts. Ouch!

Table 1 summarizes these efficiencies, the related 1W@1m sensitivities, dB SPL losses that result as efficiency is reduced from the 30 percent top, amp power implications, and the net internal box volume required to realize low-frequency 3-dB-down points (f_3's) of 40 Hz. (Double all the box volumes for 32-Hz f_3's).

I added one particularly interesting system type to the chart, the multiple direct radiator. Up to the 300 to 500 Hz range, using multiple drivers increases efficiency, and four direct radiators essentially match the efficiency of a fully horn-loaded device—with a box one-half to one-quarter the size. Think about that!

RAY'S DISCUSSION of TABLE I

In the table, a number of low-frequency systems with varying efficiencies are noted with dB SPL losses that result as efficiency is reduced from the 30-percent top limit. Also noted are the internal box volumes required when a - 3 dB low-frequency limit of 40 Hz is desired. The various systems shown are nearly optimum designs for the efficiency levels shown.

Several interesting things are revealed by the table:

1. Relatively high efficiencies (5 percent and above) imply relatively large boxes, less deep bass, or both.

2. As efficiency requirements are lowered, box volume reduces proportionately for a fixed low-frequency limit (40 Hz here).

3. Multiple direct radiators can compete with bass-horn efficiency and have smaller boxes.

   [Not in the chart but note: reducing the acoustic environment from the specified half space to that of a corner, an acoustic eighth space, changes the game enough to, for example, reduce the horn volume by roughly a *factor of four*, to 20 ft^3! Paul Klipsch's classic corner horn is one approximate example.]

4. While loudspeaker "sensitivity" and "efficiency" are often spoken of as the same thing (which does well enough for the rough approximation), these are two different concepts related by the directional properties of the loudspeaker.

   For example, while 10 and 15 inch loudspeakers may radiate the same amount of acoustic power from a given electrical power input (and thus have the same *efficiency*, i.e. output power divided by input power and expressed as a percentage), the larger

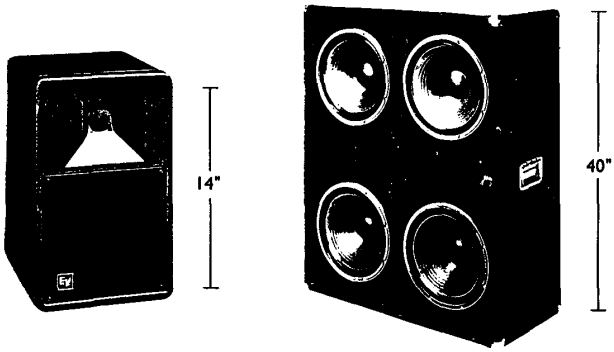
Table I —Fundamental Efficiency, Sensitivity, Amp-Power and Size Facts for Selected Low-Frequency Loudspeaker System Types with Low-Frequency 3-dB-Down Points of 40 Hz

System Type	Half-Space Conversion Efficiency	dB Down from Compression Driver Efficiency of 30%[1]	Factor of Amplifier Power Increase to Make Up for the Difference	Probable Sensitivity (1 W/1 m)[2]	Net Internal Box Volume[3]
Fully horn loaded (mouth large enough for a half-space environment)	15-20%	1.8-3 dB	2.0-3.1 times	108 dB[4]	80 ft^3
High-efficiency direct radiator (single woofer)	5%	8 dB	6.3 times	99 dB	7.2 ft^3
Medium-high-efficiency direct radiator (single woofer)	2.5%	11 dB	13 times	96 dB	3.6 ft^3
Low-efficiency direct radiator (single woofer)	0.5%	18 dB	63 times	88 dB[5]	0.72 ft^3
Multiple high-efficiency direct radiators (four woofers)	18%	2 dB	1.6 times	107 dB	26 ft^3

1. 10 $\log_{10}$ (efficiency X%/30%) rounded to the nearest dB.
2. 100-800 Hz. The horn and multiple-direct-radiator sensitivities are from commercial examples available in the last decade. The high-efficiency direct radiator example is actual performance of a 15-inch system currently available. The other direct-radiator examples are calculated from the efficiency differences relative to the 5% direct radiator. For the direct radiators, actual results could vary slightly due to directivity differences. Also, the horn is more sensitive relative to the 5% direct radiator (108 dB - 99 dB = 9 dB) than the efficiency difference alone would indicate ($10\log_{10}$ (5%/20%) = 6 dB) because the radiating area of the horn mouth is significantly larger than that of even a 15-inch cone.
3. Direct radiators are in vented enclosures producing "maximally flat" response.
4. 20 percent efficient.
5. Not by any means the lowest sensitivity rating typically encountered for high-end loudspeaker systems.

Four high-efficiency direct radiators can provide the efficiency of a horn — 19 dB more sensitive than a typical small monitor.

That difference would turn five SE watts into 397 watts!



loudspeaker has a narrower coverage angle above the low-bass range and will therefore have a higher *sensitivity* —producing a higher on-axis SPL at mid and high frequencies for a given power input. This is because squeezing the same amount of acoustic power into a smaller angular zone results in higher sound pressure on axis. This concept is intuitive, I think.

System Interrelationship Equation

The points illustrated by the table are not arbitrary. They follow a scheme that is dictated by something we have come to call the "system interrelationship equation." This equation allows you to interrelate certain important performance and size matters to the hardware required in pulling it off. This equation is:

$$E = CV(f_3)^3K$$

where "E" is efficiency, "C" is a constant fixed by the environment being radiated into and the numerical system being used, "V" is the box's internal volume, "f_3" is the low-frequency 3-dB-down point (notice that it is *cubed* in the equation) and "K" is another constant, the system constant, related to the type of system you have (sealed, vented, horn, etc.).

As you might expect, the loudspeaker itself (unmounted) needs to be appropriately designed for the equation to hold true. Two good-guys named Thiele and Small go into this in detail—I will try to avoid that but bear with me because the equation is a neat piece of mathematics.

This equation holds for the low- to mid-frequency range, from whatever you're willing to settle for at low frequencies to something like 500 Hz (give or take an octave). It's also what's called a "small-signal" equation so it doesn't tell you much about cone excursion.

The system constant, K, typically varies from something like 0.5 to 4 in a certain measurement system. Well-designed sealed systems can approach a K value of 2, vented systems can approach 4 and very good horns appear to be between 1 and 2 although the results aren't completely in on them.

And now, my final (gasp) remarks:

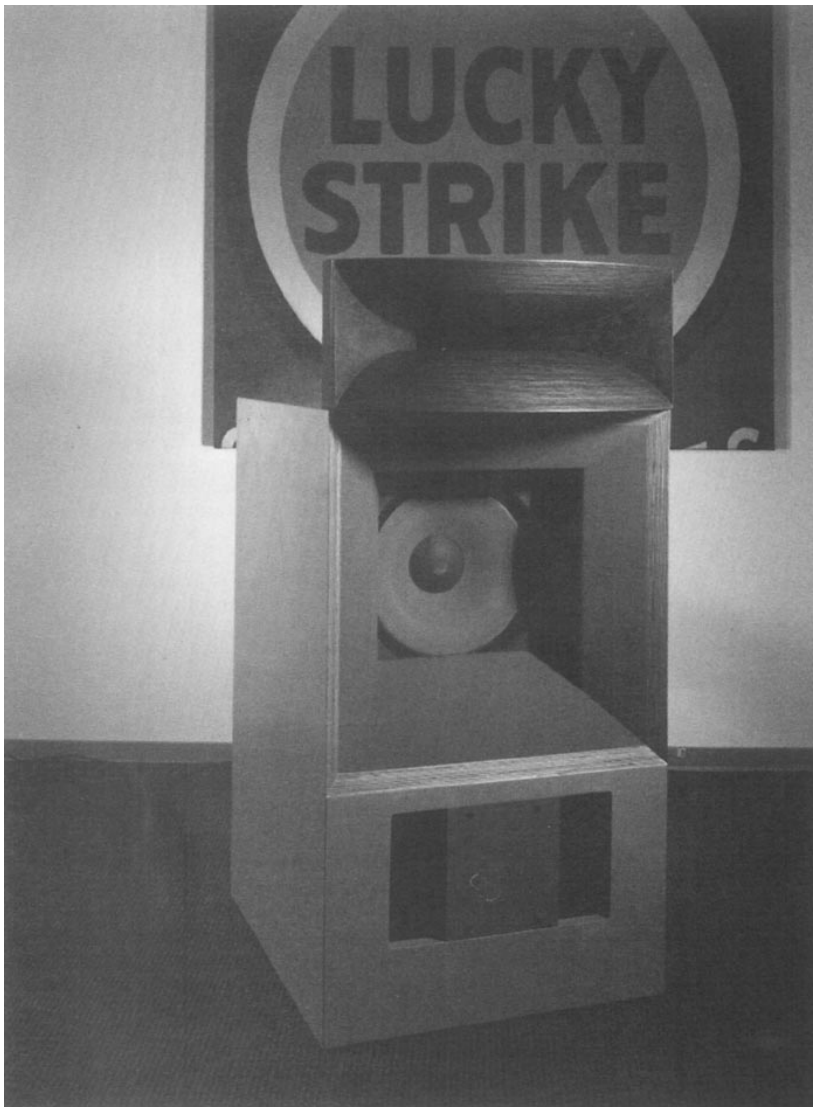
1. Because f_3 is *cubed*, the thing can really turn on you when you want more bass. One more octave down (i.e., one-half) means one-eighth the efficiency (a 9 dB loss). To hold the same efficiency, *eight times* the box volume is required.

2. When you shrink box volume something has to give (efficiency or f_3) unless you can up K somehow.

3. A larger K helps everywhere and (with certain restrictions) can allow direct radiators to have very high efficiencies in smaller boxes (or lower f_3's) than horns.

4. The constant "C" gets larger as you restrict the angular zone radiated into at low frequencies. Corners, an acoustic eighth space (as noted earlier), are most helpful (but often not the most available) and hanging in space (an acoustic whole space) the least.

The really great thing about the system interrelationship equation is that it reveals a lot about what you can and can't do. Here's to the Bard's 2A3 five watts!



BLUE THUNDER

by Christian Rintelen and R. Luigi Andreoli

It all started with commercially available 94dB/W/m speakers and a custom-built triode amplifier. The virtues of this combination were evident — but so were its flaws. As always, different component swaps confirmed that the speakers were the weak link in the chain.

We looked and listened around for a speaker that would enhance the strengths and tone down the weaknesses of that configuration. But no commercially available speaker met all our requirements: they were either too big or too ugly or colored too much or did not match the amp or . . .

In short, we decided to start from scratch and build a speaker exactly to our taste.

Building a speaker always means dealing with compromises. The no-compromise speaker does not exist, despite all claims by manufacturers. Satisfaction has a lot to do with defining goals and being fully aware of compromises. There will still be a lot of surprises to handle during the process, but it's better to start with fixed goals. Otherwise, it's a never-ending story.

We defined our ideal speaker as follows:

- It should be a true full-range speaker with drivers that handle as much bandwidth as possible, preferably two-way.
- It should be of high efficiency (SPL over 100 dB @1W/1m).
- It should be easy to drive for triode amplifiers (loads, resonances).
- Its sound should be powerful and dynamic — yet natural, detailed and as uncolored as possible.
- It should not only please the ears, but also the eyes.
- It should work well in medium-sized (i.e. 30 m^2) rooms.
- It should not require a listening distance of more than 4 meters.

We couldn't use the room corners for various reasons, so we had to forget about corner horns like certain Klipsch or Lowther designs.

Which way to go? Our goals were lofty and the restrictions clear. We thus decided from the very start that we were willing to invest in the best available components.

The demand for high efficiency and pleasing esthetics narrowed the choice down to reflex port bass and horn-loaded upper bass systems or Onken-like cabinets. Going two-way all the way, on the other hand, required a driver that could manage all frequencies above 500 Hz. Furthermore, such a driver should be horn-loaded to assure homogeneity with the presumably horn-loaded bass.

There are not many high-efficiency drivers that fulfill these requirements. But an evaluation of the different possibilities showed that one driver was perfectly up to the task—the TAD 4001 compression driver. This 2 inch unit with a beryllium diaphragm has a flat frequency response from 600 Hz to well above 20 kHz and a 12 ohm impedance at the crossover frequency range.

Efficiency is around 110 dB/W/m, due to the 2 kilograms of Alnico magnets. The compression driver weighs a hefty 13 kilograms.

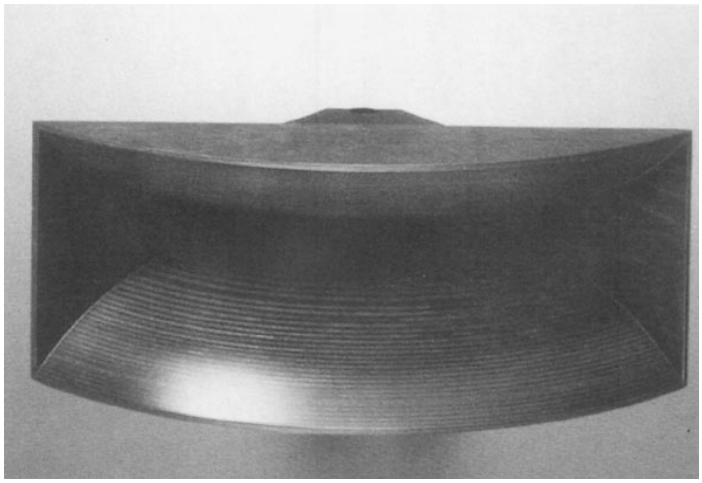
Designing a horn that covers such a wide frequency range with uniform sound dispersion and without high frequency rolloff is a tricky job. We thought about building our own horn using a Hypex or Tractrix expansion. Doing so would require a lot of work and money without guaranteed satisfaction. TAD, on the other hand, offers a horn especially designed for the 4001 compression driver. We decided to go for that option, assuming that the guys at TAD surely know how to tweak the best out of their drivers. After all, their driver/horn combination is considered hot stuff in recording studios all over the world. [*and well received in global audiophile circles, except in the US market where a decades-old divide between pro and high-end gear has prevailed. Of course, the price of the top professional compnents like TAD is somewhat restrictive but Class A high-end speaks ain't cheap either —ed.*]

The TAD horn width is 61 centimeters — a measurement of some significance since we didn't want the speaker to look like a haphazard stack of boxes. The original Onken design is some 80 centimeters wide. Putting the TAD horn on top of it would have been an eyesore. In short, the cabinet of the bass speaker should also be 61 centimeters wide.

This ruled out any Onken-style cabinets with 15 inch woofers, since the area of the reflex openings on that design is equivalent to the driver surface. The Onken bass enclosure was originally designed to be used with transistor amps (even the models with the reduced vents are reported to have a slightly lumpy bass with tube amps compared to transistor designs). It would also have needed a large lower midrange horn to offset the decreasing sound pressure of the direct radiating woofer, so we decided against it.

Comparing the different driver options for the woofer, we went for the Focal Audiom 15 VX II instead of the Altec 416, since the latter needs a 30% larger enclosure volume for the same bottom end. Horn loading all the way down was out of question, since the opening required for 25 Hz would be $4m^2$!

So we settled for a vented cabinet with horn loading down to approximately 120 Hz, similar to the Voice of the Theatre. Tractrix or exponential? The Tractrix curve horns sound good in the 150 to 500 Hz



TD-4001 High-Frequency Driver

The TD-4001 successfully achieves all the design objectives we set forth — very high efficiency, wide and perfectly flat response from 600Hz to 20kHz, and low distortion.

DIAPHRAGM. The TD-4001 employs a pure beryllium diaphragm 3-15/16 inches (100mm) across. Beryllium is a light but very rigid material that features very high-speed sound propagation. The weight of the dome section has been reduced to a mere 1g, contributing to the very high efficiency (110dB/W) of this driver.

VOICE COIL. The TD-4001 employs an aluminum ribbon voice coil, insulated by alumite film and wound edgewise on the bobbin. The voice coil has a small mass yet offers a high conversion efficiency. The bobbin is formed of polyimide film, displaying excellent heat resistance to temperatures as high as 752°F (400°C).

MAGNETIC CIRCUIT. Total magnetic flux is 228,000Mx, with flux density of 20,000G, thanks to the use of a very heavy (6 lbs. 10 oz./3kg) alnico 5DG magnet. An oxygen-free copper shorting ring prevents impedance rise, resulting in low distortion.

DESIGN. The TD-4001 is of the rear compression design, which eliminates the resonance and phase distortion produced by a surround. It also eliminates cavity resonance interference, achieving very flat frequency response, extremely natural sound and superb definition. A phasing plug helps smooth the response of extra high frequencies.

CROSSOVER. We recommend the use of a crossover frequency of 600Hz or higher, and a cutoff slope of 12dB/oct. or sharper.

TD-4001 SPECIFICATIONS

Voice coil impedance: 16 ohms **Voice coil diameter:** 4 inches/101mm **Equalizing system:** 5-slit type **Frequency range:** 600 — 20,000Hz **Maximum input power:** 60 watts (600Hz, – 12dB/oct.) **Sound pressure level:** 110dB/W (1m) **Crossover frequency:** over 600Hz (– 12dB/oct.) **Total magnetic flux:** 228,000 maxwells **Magnetic flux density:** 20,000 gauss **Hole size for throat connection:** 1-15/16 inches/49.4mm **Mounting dimensions:** 4 inches/101.6mm (4 holes) **Weight:** 29 lbs. 12 oz./13.5kg **Outer dimensions (diameter × depth):** 7 × 6-1/8 inches/178 × 155.5mm

TH-4001 Stabilized Dispersion Horn

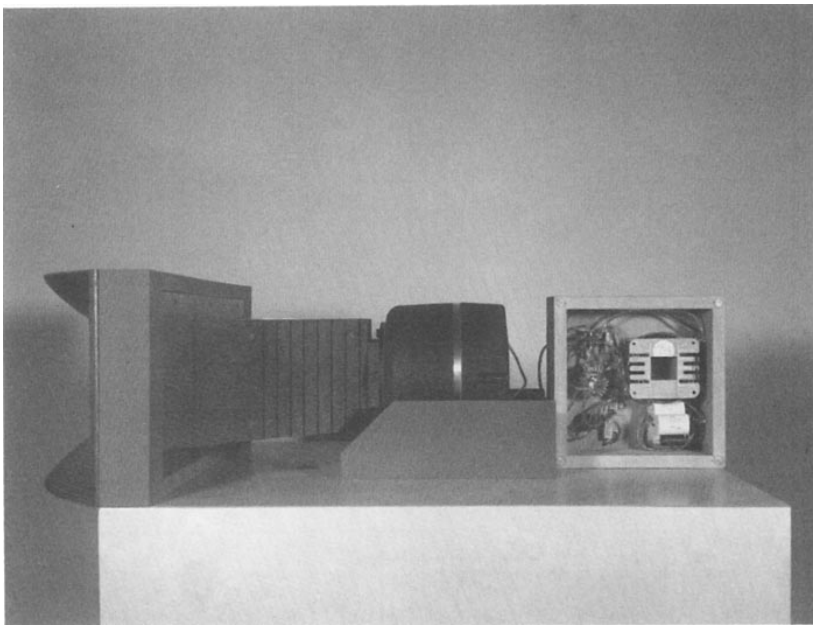
The TAD TH-4001 is a stabilized dispersion horn designed specifically for use with the TD-4001 high-frequency driver. It allows you to exploit the wide frequency response of this unit, providing excellent dispersion of all frequencies, including high frequencies above 10kHz, a feat rarely achieved by large horns. The dispersion pattern is optimized, based on our measurements of actual room acoustics. As a result, the entire output of the TD-4001 is uniformly distributed over a large area. High resolution is another result of our acoustic engineering. The horn is made of genuine maple, for clean, rich, natural sound.

TH-4001 SPECIFICATIONS

Type: Stabilized dispersion horn **Cut-off frequency:** 320Hz **Flare type:** Hyperbolic curve **Radiation angle:** 90° (horizontal)/40° (vertical) **Throat diameter:** 1-31/32 inches/50mm (suitable driver throat diameter: 1-15/16 inches/49.2mm — 2 inches/50.8mm) **Driver mounting system:** P.C.D. 4 inches/101.6mm L90° 4 bolt mounting **Weight:** 24 lbs. 11 oz./11.2kg **Outer dimensions (W × H × D):** 24-1/8 × 9-7/16 × 16-1/8 inches/612 × 239 × 410mm **Accessories:** Horn mounting hardware pieces × 6, Washers × 6, Bolts with hexagonal heads × 6

US office for TAD Professional Components: Pioneer Electronics Service, Inc., PO Box 1750, Long Beach, CA 90801 Voice 800-872-4159 FAX 310-952-2821

Catalog Descriptions of Technical Audio Devices Horn and Driver



Highpass filter with 0.2 dB per step attenuator, 1.2 mH/0.13 Ohm DCR coil, and five PP caps bypassed with a tinfoil cap shown mounted behind the TAD horn

Interior view of bass cabinet.

The interior of the cabinet is lined with black acoustic foam. No further stuffing was used.

Birch plywood "sounds" very nice and is ideally suited for this kind of speaker, but it is a real pain to work with.

Note the two hefty (10 kg each!) 0.27 mH 0.17 Ohm DCR coils made of 5 mm^2 wire used in the symmetrical low pass filter.

range. In addition to this, a Tractrix curve would allow a nice visual effect because the 45 degree angle of the cabinet walls blends perfectly with the miter joints we intended to use for the cabinets. According to Dinsdale's and Lambert's work, the true cutoff in a Tractrix horn occurs at the 70% to 80% point of the mouth area — the cabinet walls precisely made up for this percentage.

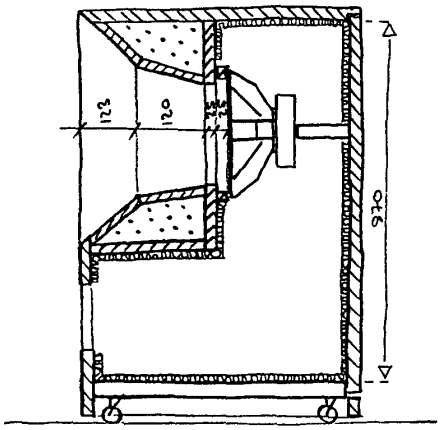
The Audiom driver needs a volume of about 220 liters (0.22 m^3) in a vented cabinet to produce bass down to 40 Hz. Add that to the volume of the horn plus the massive plywood, and you get a fairly big cabinet. With the front being relatively narrow, the speaker looks impressive but neither intimidating nor overly conspicuous. The finished speaker is 61 cm wide, 125 cm high, and 70 cm deep (including midrange horn). It weighs approximately 150 kilograms. The finish is clear lacquer for the enclosure and dove-blue Nextel for the Tractrix horn and the crossover box.

The speaker was intended to be used in bi-amp setup using two stereo amps with 6336 dual triodes in the output stage. The amp allows one to drive the twin power triodes either P-P or SE, since phase-splitting is done in the pre-amp and the four channels of the power amps are each connected with two coaxial leads carrying the 0 and 180 phase signal. For push-pull, both input signals are connected and both sections of the 6336 are driven. Conversion to SE can be done in two seconds by disconnecting the phase inverted input signal, so only one section of the twin power triode is driven. We use P-P for the bass and SE for the midrange.

The crossover frequency is 560Hz with a 12dB design using two huge coils in the bass to minimize DC resistance. We chose a symmetrical configuration since the output transformer of the amp is not grounded. This allows the woofer to be driven equally on both leads. The crossover for the TAD can either be used in a conventional configuration for single amp operation with a stepped attenuator providing 0.2 dB steps or with the attenuator bypassed for bi-amping. The choice of excellent drivers allows simpler crossover designs since you don't need extensive filtering to fix any inherent glitches and flaws.

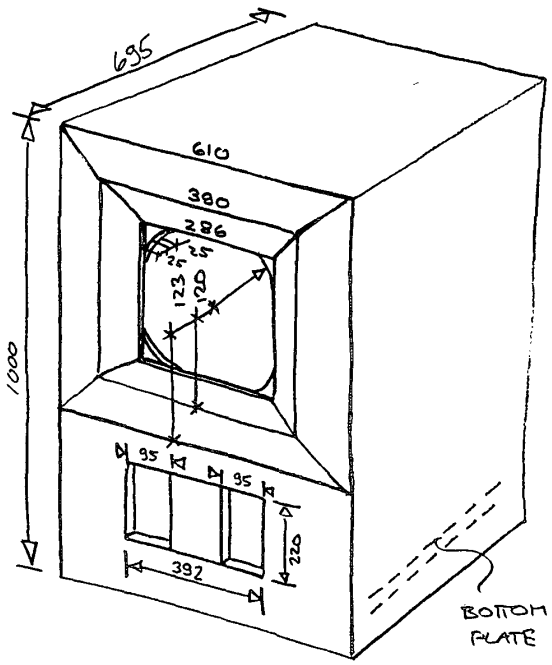
The Audiom woofers were "burned in" for three days with different frequencies before mounting. Despite our best efforts at initial break in, the bass reproduction continued to improve significantly for half a year!

Simplified Version of Tractrix Upper Bass Horn



	Birch plywood	30mm
	MDF	25mm
	Birch plywood	40mm
	Glass blast powder density	2,86

Speaker cabinet: 30mm high density birch ply
Horn: 25mm MDF
Bottom Plate: 40mm birch plywood



We selected 30 millimeter birch plywood for the cabinet in order to raise cabinet resonance to a point well above the radiated frequencies. The Tractrix horn was made of 25mm MDF — a wise choice considering the many odd angles of the Tractrix horn. The cavity between Tractrix horn and cabinet was filled with sandblast-grade glass beads.

Like everybody, we wanted a speaker capable of credibly reproducing all kinds of recorded music. To us, this "credibility" includes (among other criteria):

- Convincing micro- and macro-dynamics
- Timbral correctness
- No disturbing coloration in any frequency range
- Credible reproduction of sound stage depth and width
- Authority (i.e. the necessary body and air real music has).

Just a brief description of what we ended up with — as unbiased as possible: the speaker produces a big, emotionally involving, but nevertheless precise and thus credible reproduction of the recorded event. It does not turn a lousy recording into gold, but even mediocre recordings and pressings really shine.

The bottom end has tremendous energy and authority. It is fast, colorful, tight and controlled without audible cabinet resonances. It really moves air when kick-drums are kicked. The far left of a piano has the necessary attack and speed to be considered "almost real." Plucked bass is reproduced sonorously with plenty of snap and color.

The midrange is seamless and very homogeneous, despite the crossover in the critical 500 Hz range. Harmonics of bass instruments really "sing." Forget any prejudice about horn speakers not being suited for voices — the TAD sure is. The highs are neutral, extended and sweet. Hot or bright recordings can be tamed by the very fine increments of the attenuator. What is especially pleasing with this two-horn speaker: you don't have to move 6 meters away to get homogeneity and a seamless blend of the two horns — 3 meters is enough.

We are happy with the result. Of course, the speaker is big. But it integrates well into rooms that measure 30 m^2 or more. The money spent on excellent component quality was well invested. Our recommendation to all DIYers: Don't build a big speaker with little money — build a small one with the best components you can afford. It certainly pays off!

The perfect speaker does not exist! A fully horn-loaded bass, for instance, would speed up the bass even more. A super-tweeter above 15 kHz would probably add some extra air and reduce the directionality of high frequencies. And who knows how much more magic a SE 2A3 amp with built in passive crossover would add to the TAD drivers? But that's another story.

The authors:
Christian Rintelen is a free-lance writer and spends his spare time editing *HiFi Scene*, a Swiss nonprofit underground magazine. Luigi "Blue" Andreoli studied architecture and design. After completing his first houses, he decided that hi-fi is more fun. He hand crafts everything from MC cartridges and amps to speakers of any size. Christian and Blue live in Zürich, Switzerland.

ed.- Hi-Fi Scene is one of those mags like *MJ* from Japan and *Costruire Hi-Fi* from Italy that makes a poor monoglot like me wish that Esperanto was the world language. Every *progressiver* audiomaniac would enjoy the vision this *"von Kennern für Kenner"* German-language magazine offers. Write Christian for more info on this *inspirierte Zeitschrift.*

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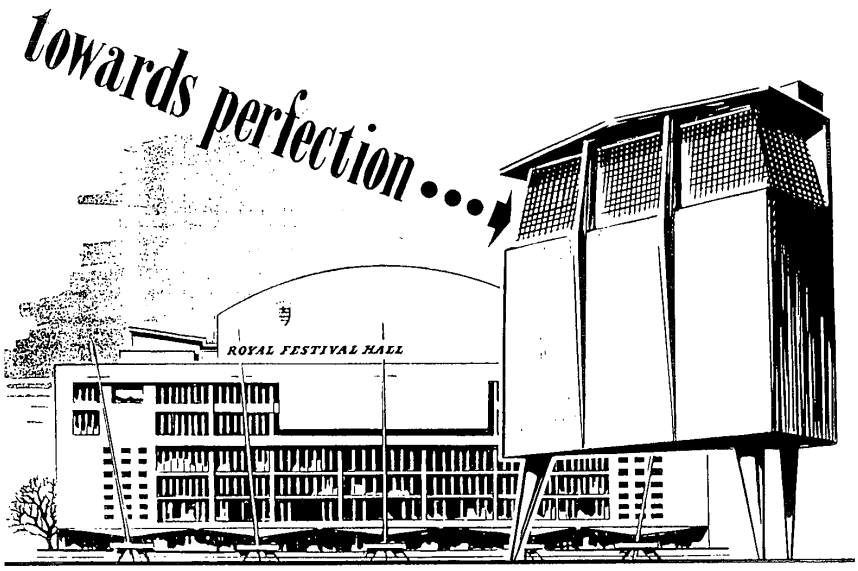


THE LOWTHER-VOIGT LEGACY

Haden Boardman, Mellotone Acoustics

Getting hot under the collar? Cannot find that 100dB/watt speaker to use with yer flea powered single-ended tube amp? Fed up with power sapping crossovers, misaligned phase fouling multiway speakers? Tired of that metal dome tweeter ting and over Q'd bass? Well, read on.

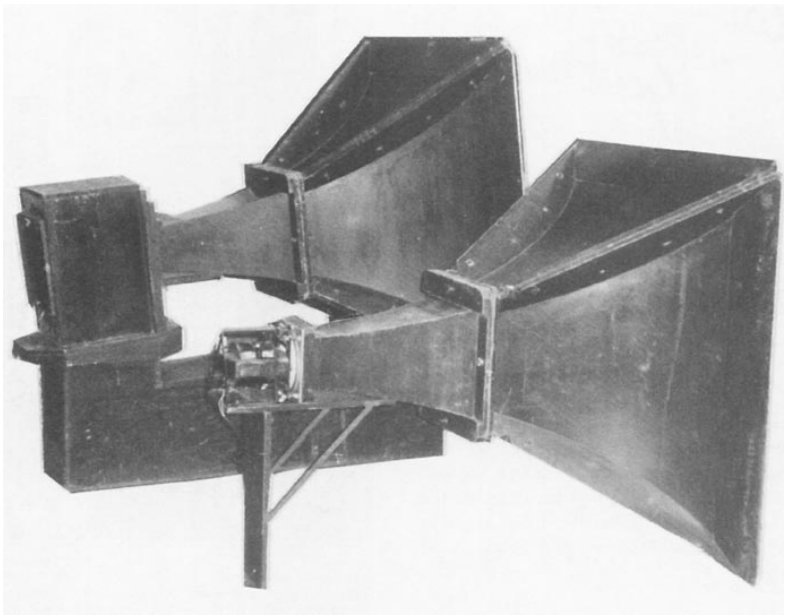
Most multiway speakers suck—period. 99% have crossovers in the 500-5000 Hz range, the area that your hearing and brain are most sensitive to.

Worse still, most makers add a "phasey" dome tweeter (any dome tweet, not just metal 'uns) to the act. The idea of the dome is to disperse the sound as far as possible. The problem is the sound "bounces" off the tweeter's face plate, the loudspeaker cabinet and nearby furniture. This gives the travelling sound wave a small amount of delay, which permanently "masks" the original fine imaging details of the recording, resulting in only LEFT - CENTRE - RIGHT imaging with no, or at least very little, depth of image. Stereo is supposed to be "3D", you do not need surround sound or quadraphonics to fill your room with "3D" sound.

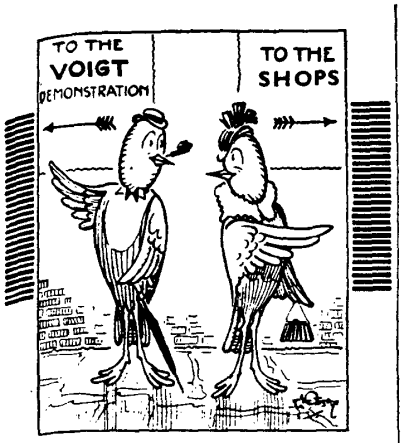
The final problem with "domes" is the fact that most of the dome stays still, most of the sound comes off the edge of the voice coil rather than the mass of the dome. Imagine for a moment, you have a 16mm diameter voice coil dome tweet. 16mm is the full wave length of a 20,625 Hz wave form. Or more importantly, half a 10,312.5 Hz wave form. So if you sit at an odd axis, the sound from the edge furthest away could be out of phase with the edge closest to you. The result is partial cancellation. In practice this is a bit simplistic, but most seem to have ignored the facts, otherwise I am very sure the devilish things would not be so popular.

If you want good imaging, speakers SHOULD be directional, only then can they convey the original imaging data encoded in the original stereophonic signal.

Take the LS3/5a and Spica TC50s. Both speakers go out of their way to mask the diffraction and create a controlled dispersion pattern that at least tries to be in phase with itself. Both speakers have a good reputation as far as imaging is concerned. One has to wonder how much better these loudspeakers could have been if the designers had used a cone tweeter instead — presuming that any of the "big boys" in the loudspeaker chassis OEM market made any decent ones.



Original Voigt wooden tractrix cinema horns from the 1930s

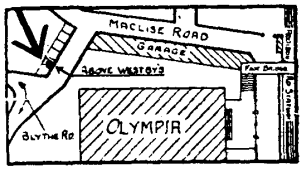


"Good-bye, my dear. I'm off to talk shop with the technical staff at Voigt's demonstration rooms."

We look forward to meeting Mr. Tit and our many other friends again at

2, BEACONSFIELD TERRACE ROAD

(Just opposite the Main Goods Entrance at back of Olympia)



11 a.m. to 1, and 3 to 10.30 p.m. (i.e., ½ hour after Olympia closes)

Come and refresh your ears!

VOIGT

VOIGT HOLDINGS LTD

The Courts, Silverdale, London, S.E.26

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1939 Voigt Patents Ad

The Voigt Legacy

Back to the thread, there is one speaker that is not hard to construct, is efficient, has output past 20 Khz, with no bloody treble ting or bass boom. It is based on the work initially of one gentleman, Mr. P. G. A. H. Voigt.

Back in the 1920s Voigt worked on the design of the moving coil loudspeaker, while unknown to him at the time, Rice & Kellogg were working on a very similar design, both using a medium sized 6 1/2 inch cone. R & K beat Voigt to the patent, thus denying Paul Voigt whatever fame and fortune was involved.

At this time, Voigt was working for a small English company, J.E. Hough, Ltd. (which later became Edison Bell), manufacturing radios and records. It was here that Voigt patented an early condenser microphone and all electric recording cutting system, instead of the purely acoustic method.

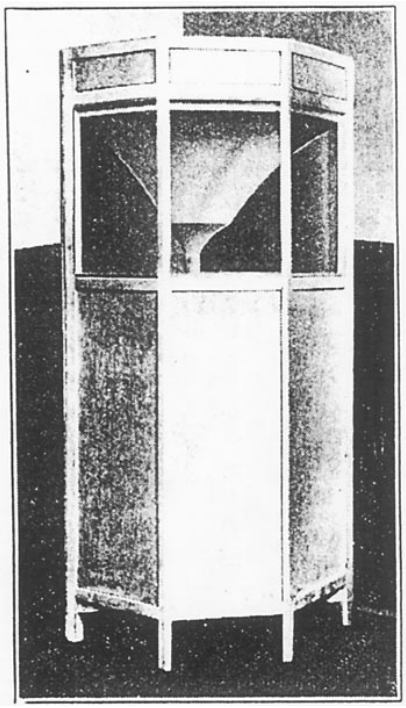
Voigt then left this outfit and set up his own company, Voigts Patents Ltd, after Edison Bell crashed in the Great Slump of 1933. It was now that he began to produce the famous Voigt Corner Horn, which had a mains energised (200 volt, 42 watt) field coil, a single six inch cone, front mounted tractrix horn for the mids and highs and a quarter wave "bass chamber".

A few years later, Voigt patented the "twin cone" cone. If the guy had earned a penny for every twin cone loudspeaker produced after his patent lapsed, he would easily have been a millionaire several times over. This was added to the Corner Horn, with another clever idea — a double wound voice coil. This must be a pain in the ass to make. The only way I can see it being done is to wind the first coil onto a "forming" rod, wrap the voice coil card over it and then wrap the second coil over the whole lot, presumably adding lots of glue as you go. Incidentally, the voice coil is wound with aluminum wire.

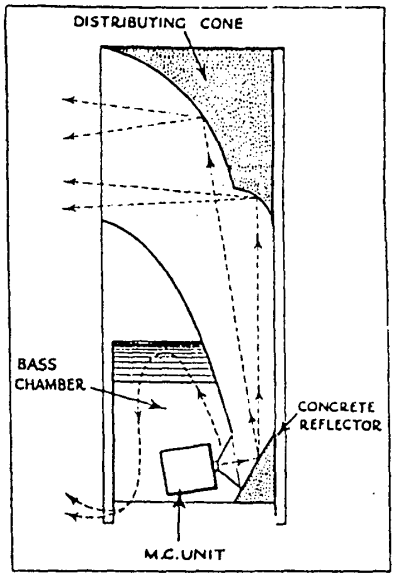
The cone itself is folded from a flat piece of trimmed-to-shape paper, the whole thing held together by glues, lacquers and varnish. Operation of the Voigt Voice Coil spider is very impressive. The cone was terminated in a soft roll surround.

At the same time in the 1930s, another small company was prospering with its "high quality" wireless and gramophone equipment. This company was called "Lowther", run by a Mr. Peter Lowther. The two names were eventually tied up in a marriage that has lasted until the present day.

I often wondered what was the point in making "high quality" equipment, when you



Designed to fit into a corner of the room the latest Voigt domestic speaker has similar characteristics to those of a 4ft.-mouth horn.



The Voigt Corner Horn of the 1930s used reflectors to tame the directionality of the driver and spread out the sound, making a single speaker sound like a whole band. Perhaps this idea was 100% right for mono but it's 100% wrong for stereo, where the strong directionality of an "unreflected" Lowther driver assists stereo imaging and dimensionality.

played your records with a pick up that lacked any finesse, and was lucky to play anything past 5 kHz. It would have been lucky if the records contained information much higher than this anyway. No FM remember, only AM. Why did Voigt make such joy that his speaker had good output past 13,000? What *was* the point?

It is easy to forget that AM radio is capable of a very high quality of sound reproduction. These days, with stations limited to an 8 kHz bandwidth and crammed on your radio's dial like sardines in a tin, AM is not even lo-fi , it's no-fi.

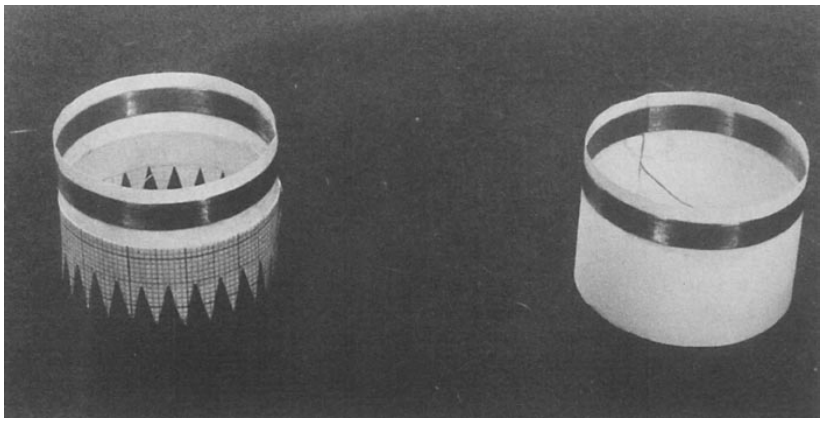
Sixty years ago the waves were not as crowded. A radio station could take up as much bandwidth as it was capable of. Microphones of quality were around, as were electronics capable of decent bandwidth. Imagine our illustrious radio listener circa 1935. He could tune into one of the BBC's live concerts, free from any kind of processing (practically none existed), straight to the transmitter, and onto an empty radio band, virtually free from interference.

In the home, genuine "radiophiles" would have nothing other than a "straight set" (or TRF, if you prefer). These receivers had massive bandwidth giving good frequency response, and no superheterodyne whistle to hide. Sensitivity was down to the amount of aerial you had up. The most complicated straight sets consist of two stages of R.F. amplification and "diode" to remove the sound wave from the RF carrier wave. Amplification via a couple of PX4 triodes, push pull class A, all driving the Corner Horn. I can imagine the whole thing being quite awesome.

I once built (sort of as a joke) a wide bandwidth AM tuner (TRF of course) and matching transmitter. I was amazed at how good the medium actually was. Perhaps we all took to FM a little too early. At any rate, the early quest for great radio sound was where what later came to be known as Hi-Fi has its roots.

Lowther through the Hi-Fi Years

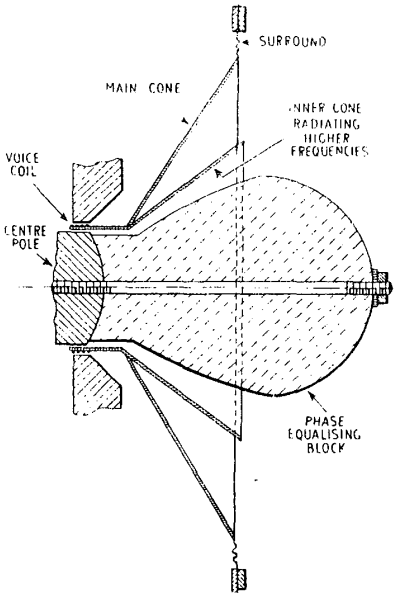
Voigt left England soon after the end of WWII hostilities, bad health meant he had to go to the warmer climate of the North Americas. His designs were left in the capable hands of Lowther, and particularly Mr. Donald Chave, although Mr. Mordant, later of Mordant Loudspeakers, also played a very important role.



Dual wound voice coil - Aluminum for low weight

The original Voigt Corner Horn was carried back into production virtually unchanged after the war. Voigt and Chave, working independently, introduced the first *permanent magnet* drive units in the late 1940s.

Chave's PM-1 unit brought about a small improvement in gap flux, and dispensed with the need for 200 volts DC. The PM2 followed, and around the same time Voigt's original spider disappeared, to be replaced with a more modern type. This switch allowed Chave to fit a "phase plug" in the centre of the voice coil, to prevent the very high frequencies from cancelling themselves out in the apex of the cone, thereby extending the frequency response from the previous 13,000 to past 18,000 Hz.



Cross-section of Lowther-Voigt driver

The PM3 was the next drive unit to be offered. This was a custom drive unit for the TP1 enclosure, which offered a front mounted Tractrix horn on the front of the units and an exponential horn for the bass. As with the early corner horns, the TP1 must be used in a corner.

An update of the Voigt Corner Horn, the PW2 followed. It was fitted with the new "baby" PM6 unit, which despite its magnet's physical size, had an in-gap flux higher than the PM1 it effectively replaced. The PW2 was not as good as the original Voight Corner Horn but it was far cheaper.

Later drive units are the PM2 mkII (Lowther's biggest magnet), PM2 mkIII (essentially a mkI with a different mounting bracket), PM4 (a PM2mkII with cobalt pole pieces) and last of the line, the PM7, which despite its smaller size I think is a better unit than the bigger PM2, and much easier to use.

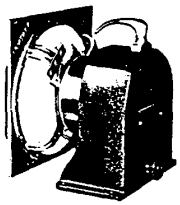
All these units share the same basic cone/chassis. PM2s and the PM4 have a magnet support frame, the original chassis cannot support the full weight of the magnet. The PM3 looks like it is mounted in a saucepan!

There are two options on phase plugs, one is a small beastie that is used in cabinets where the front of the unit is not coupled to a horn, the larger item is for a unit coupled via a horn.

LOWTHER *Drive Units*

PM 2 Mk. 1.
Gap flux 21,000 gauss. Total flux 281,000 maxwells. Frequency range 20-22,000 Hz. Impedence 15 ohms. Capacity 6 watts. Weight 6 kilos.

PM 5
Size and details as PM2 Mk. 1 BUT with 23,200 gap flux.

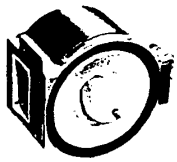


PM 2 Mk. II
Gap flux 23,000 gauss Total flux 350,000 maxwells. Frequency range 20-22,000 Hz. Impedence 15 ohms. Capacity 6 watts. Weight 8 kilos.

PM 6
Gap flux 17,500 gauss. Total flux 196,000 maxwells. Frequency range 20-22,000 Hz. Impedence 15 ohms. Capacity 6 watts. Weight 3 kilos.

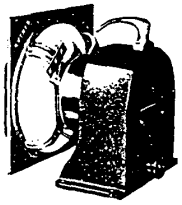
The special design of the PM 6 drive unit preserves the fundamental to harmonic relationship throughout the entire audio range, thereby ensuring smooth, natural sound. Designed especially to meet the requirements of horn-loaded operation, the PM 6 should never be used as a conventional direct radiator.

PM 6 Mk. I is a PM 6 magnet assembly with a new diaphragm assembly: LOWTHER SPECIAL SILVER speech coil, roll surround and back centering providing an improved performance.



PM 3 (Not available as a separate unit from TP 1 enclosure.)
Gap flux 21,000 gauss.
Total flux 281,000 maxwells.
Frequency range 20-22,000 Hz.
Impedence 15 ohms.
Capacity 6 watts.
Weight 10 kilos.

PM 3/5
This improved PM 3 unit has a gap flux of 23,200 gauss.



PM 4
Gap flux 24,000 gauss.
Total flux 385,000 maxwells.
Frequency range 20-24,000 Hz.
Impedence 15 ohms.
Capacity 6 watts.
Weight 8 kilos.
PM 4 drivers are fitted with special cobalt alloy pole pieces.

PM 7
Gap flux 19,650 gauss.
Total flux 250,000 maxwells.
Frequency range 20-20,000 Hz.
Impedence 15 ohms.
Capacity 6 watts
Weight 4 kilos.

Representative Lowther lineup from late '60s through early '70s

Lowther's mainstay cabinet range during the 1960s was called the Acousta line. Originally in two forms, an odd looking corner thing, that fired the unit into the room's corner, and a much better model, with the unit and mouth of the horn pointing at you. Most Lowther cabinets were now fitted with constant width rear horn, the exceptions being TP1, Audiovector and the L.I.B. (Lowther Ideal Baffle, which used a "drone cone").

Chave constantly updated the designs. The small Corner Acousta became the Dual Position Acousta, and the standard Acousta was updated to suit the PM6 and PM7 units.

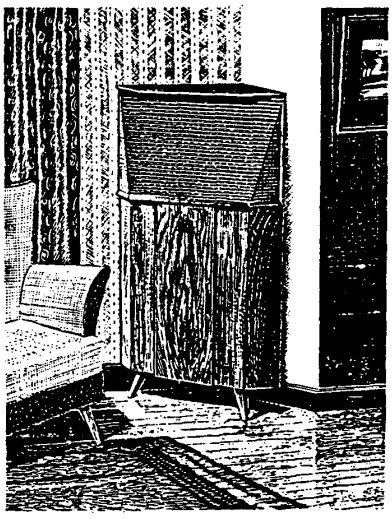
Throughout the 1970s countless different variations on the Acousta theme appeared. Mini Acoustas, Super Acoustas, Twin Acoustas — you get the picture. Cabinet material changed from ply to MDF. In my humble opinion, this was a BIG mistake. Chave should have listened to Voigt's then thirty year old ideas.

Lowther Today

Later in the early '80s, Lowther were the last to switch over to ceramic magnets from the alnico/ticonal they had previously used, although thankfully they still manufacture the original superior units. The current owners of Lowther are convinced ceramics are much better than the alnicos. You can guess what I think.

The current line includes several models using the "BICOR" principle, wherein two different sized horns are fitted to one cabinet. I make no bones about not liking one bit of these designs, although others swear by them.

In recent times, the design of the basket has been improved to some extent. Over the years, there were four generations of Lowther-Voigt drive units: early mains energized electromagnetic units, the mainstay of the '50s through the early '70s one piece alloy cast chassis, to the latest "black" chassis. During the '70s some production was fitted with a plastic basket.



Corner housing Type P.W.2, Walnut Finish.

Build the 1964 Acoustas

The design we are presenting here in *Sound Practices* is the 1964 version of the full size Acousta. This model will work happily with PM6A, PM7A, or if you are on a tight budget, the PM6C. It is a pretty self explanatory blueprint, an' I am no great woodworker, but I would offer these few tips:

Always build a folded horn from the best grade of ply you can afford. NEVER use MDF. When assembling the cabinet make sure you sand all of the internal joints so they are s-m-o-o-t-h, this is especially important near the "neck" of the horn. If you have rough patches, the bass horn loses its efficiency. Worse still, if it is rough near the neck, soundwaves reflect back through the cone and give the sound a "dirty" complexion.

PM6 ceramics have three problems not associated with their Alnico brothers. First the large ceramic puck reflects sound from the rear of the cone back towards it, the alnico version has carefully shaped magnets to avoid this problem. Unfortunately, it would be impossible to duplicate it in ceramic.

Due to this magnet shape, to use the ceramic speaker you must make a "gasket" of 1/4" ply, because there ain't no way that big ceramic baby is gonna fit in the li'l magnet box given in the 1964 plans.

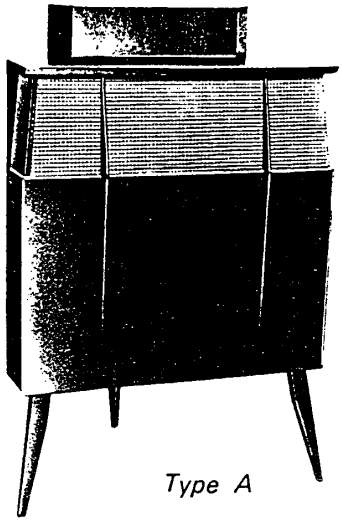
Final problem with the PM6C is more serious and a touch bizarre. For some strange and unexplained reason, Lowther fit a cone to the ceramics which is embossed with an annular pattern. I call this cone the "ribbed for extra sensation", I suppose it is whatever takes your fancy. I can see what they are trying to do, they are trying to stop "bell mode" cone breakup. Problem is, it does not help the other cone breakup mode, the "concentric" mode. The originals have a much better idea. "Diagonal" patterns are deeply embossed into the paper cone. This helps stop both "concentric" and "bell" modes of cone breakup from occurring.

At the end of the day I must conclude that unless you are totally and utterly strapped for cash, go for a pair of PM6 or PM7 alnicos. 'Tis the best, no doubt.

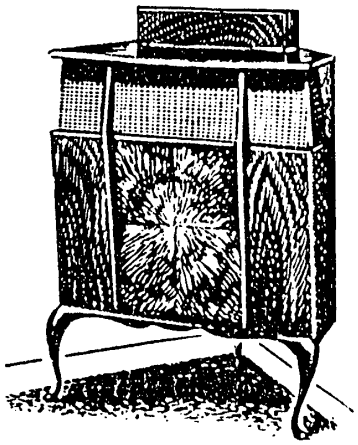
Sound wise all three magnet options kick ass. Even the "ribbed for extra sensation" PM6C sounds good. I use a pair of carefully made Acousta fitted with PM7A drivers.

LOWTHER

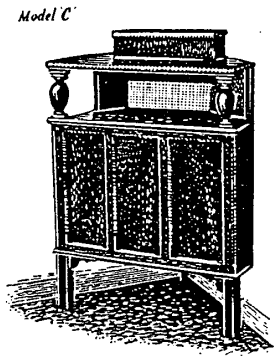
CORNER REPRODUCERS MODEL T.P.1

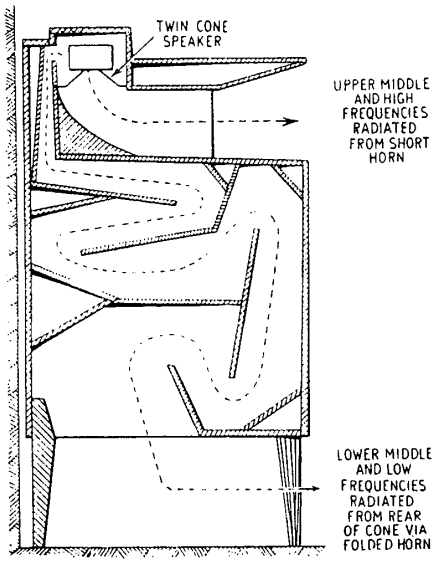


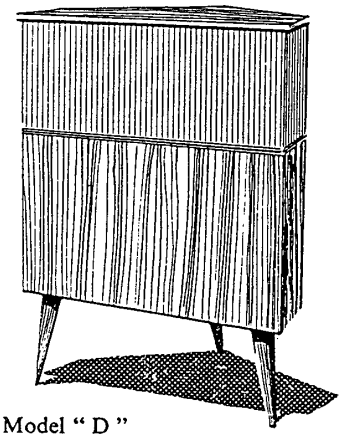
Type A



TYPE B







Model " D "

MODERN LOWTHER DRIVERS

ABRIDGED SPECIFICATIONS Specifications abregées Kurz Spezifikationen	PM6A	PM7A	PM2A	PM5	PM4
Overall Diameter Diamètre hors tout Gesamt – Ø	23.2cm	23.2cm	23.2cm	23.2cm	23.2cm
Overall depth Epaisseur hors tout Gesamttiefe	10.5cm	11.0cm	13.0cm	13.0cm	16.5cm
PCD Mounting Centres Ø de cercle primitif de centres de montage Teilkeis–Ø D.Befestigungspunkte	20.8cm	20.8cm	20.8cm	20.8cm	20.8cm
Baffle hole cut-out Ouverture du baffle Schallwandöffungs – Ø	19cm	19cm	19cm	19cm	19cm
Voice coil diameter Diamètre de la bobine mobile Schwingspulen-Ø	3.9cm	3.9cm	3.9cm	3.9cm	3.9cm
Voice coil impedance (nominal) Impédance de la bobine mobile Schwingspulenimpedanz	8or15ohm	8or15ohm	8or15ohm	8or15ohm	8or15ohm
Air gap width Entrefer Luftspalt	1mm	1mm	1mm	1mm	1mm
Magnet type Type d'aimant Magnettype	Alcomax2	Alcomax3	Alcomax3	Alcomax3	Alcomax3
Flux Density (1 Tesla = 10,000 Gauss) Densité du flux Kraftliniendichte	1.75Tesla	1.95Tesla	2.1 Tesla	2.3Tesla	2.4Tesla
Diaphragm Diaphragme Membran	Twin-paper Double/papier Doppelmembran/pappe				
Frequency response Réponse de fréquence Übertragungsbereich	30Hz-20kHz	30Hz-20kHz	30Hz-22kHz	30Hz-22kHz	30Hz-22kHz
Nominal air resonance Résonance nominal à l'air libre Nennresonazwert in freier Luft	36Hz	36Hz	36Hz	36Hz	36Hz
Sensitivity at 1m/1kHz/1Watt Sensibilité 0.2MN/m^2 Ansprechempfindlichkeit 0.2MN/m^2	96db	96db	97db	98db	98db
Maximum voice coil travel Déplacement de la bobine mobile Schwinspulenweg	±1mm	±1mm	±1mm	±1mm	±1mm
Shipping weight Poids d'expédition Versandgewicht	4.0kg	4.0kg	6.0kg	6.5kg	10.0kg

ABRIDGED SPECIFICATIONS Specifications abregées Kurz Spezifikationen	45C	55C	PM6C	PM7C	PM2C
Overall Diameter Diamètre hors tout Gesamt – Ø	17.4 cm	17.4cm	23.2cm	23.2cm	23.2cm
Overall depth Epaisseur hors tout Gesamttiefe	5.6cm	5.8cm	7.6cm	7.6cm	7.8cm
PCD Mounting Centres Ø de cercle primitif de centres de montage Teilkeis–Ø D.Befestigungspunkte	15.6cm	15.6cm	20.8cm	20.8cm	20.8cm
Baffle hole cut-out Ouverture du baffle Schallwandöffungs – Ø	14cm	14cm	19cm	19cm	19cm
Voice coil diameter Diamètre de la bobine mobile Schwingspulen-Ø	3.9cm	3.9cm	3.9cm	3.9cm	3.9cm
Voice coil impedance (nominal) Impédance de la bobine mobile Schwingspulenimpedanz	8ohm	8ohm	8ohm	8ohm	8ohm
Air gap width Entrefer Luftspalt	1mm	1mm	1mm	1mm	1mm
Magnet type Type d'aimant Magnettype	Feroba 2	Feroba 2	Feroba 2	Feroba 2	Feroba 2
Flux Density (1 Tesla = 10,000 Gauss) Densité du flux Kraftliniendichte	1.75Tesla	1.98Tesla	1.75Tesla	1.98Tesla	2.1 Tesla
Diaphragm Diaphragme Membran	Twin-paper Double/papier Doppelmembran/pappe				
Frequency response Réponse de fréquence Übertragungsbereich	80Hz-20kHz	80Hz-22kHz	30Hz-20kHz	30Hz-20kHz	30Hz-20kHz
Nominal air resonance Résonance nominal à l'air libre Nennresonazwert in freier Luft	60Hz	80Hz	36Hz	36Hz	36Hz
Sensitivity at 1m/1kHz/1Watt Sensibilité 0.2MN/m^2 Ansprechempfindlichkeit 0.2MN/m^2	93db	94db	95db	96db	97db
Maximum voice coil travel Déplacement de la bobine mobile Schwinspulenweg	±1mm	±1mm	±1mm	±1mm	±1mm
Shipping weight Poids d'expédition Versandgewicht	2.5kg	3.0kg	3.0kg	3.5kg	4.0kg

They are totally compelling. The stronger the magnet, the more high frequencies you get. The '6C has a pleasant, almost "soft" sound compared to the more expensive Alnico versions. If you are having hum problems with your setup, the '6C might be the one to go for due to its lower (97 dB) sensitivity. Overall, the '6C is very easy on the ear.

By way of improvement, the Alnico PM6A gives an extra 3 dB sensitivity and a "cleaner" presentation. With the Cs you are aware you are listening to Hi-Fi, but the '6As just disappear, leaving only the music behind. The music seems to come from nowhere.

The PM7s go all the way. It is amazing how much extra detail these babies can pull out of the signal. The PM7 is even higher sensitivity (102 dB/1W), cleaner, sharper, and more focused. If these drive units were cameras, the 6C would be a Leica miniature, the 6A a Bronica, and the 7A without doubt a Hasselblad.

If you have carefully constructed the cabinet, you should have very little coloration,

Acousta cabinet fitted with PM7A

and by the time you have "tuned in" (this process usually takes five minutes) you will not notice any.

At first audition, the Acoustas will seem odd. The bass will appear thin, the treble will lack sparkle, but the sound will grab your attention. All of a sudden, a real bass note will come along—BANG you are blown out of your chair by a pair of 6" woofers. A cymbal is brushed and then tapped, at last you can hear the difference. No more phasey ting or engineered bass bloom, everything very natural.

I guarantee you have not experienced anything as dynamic and true to life as this speaker, regardless of your choice of drive units. A 1 watt per channel amp will make your ears bleed (unless you are in a very large room, and then you may have to insist on at least a 2A3 SE).

The Acoustas are so "correct" you will find everything else "odd". If you try to switch back to your TING-BOOM speakers, you now will hear real coloration, and you won't like it.

Be careful to sit on axis with the Acoustas, off axis the sound takes on a woody coloration. The HF is very directional. Sometimes moving your head an inch can cause the highs to do a disappearing act.

My fave Lowther design is the classic TP-1. This speaker is the best. There is a school of thought in audio that if something is buttugly, it must work well. The TP-1 is the most odd looking piece of woodwork I have ever clapped eyes on. Whoever decided to fit this thing with Regency style Queen Anne legs must have had a sense of humor. The damn thing looks alive in the corner of the room, almost like some strange robot from a B movie.

But the sound . . . the front horn gives them more presence and less "spotlight" treble than the smaller Acoustas. The bass is just awesome. Even heavy rock fans will love the TP-1.

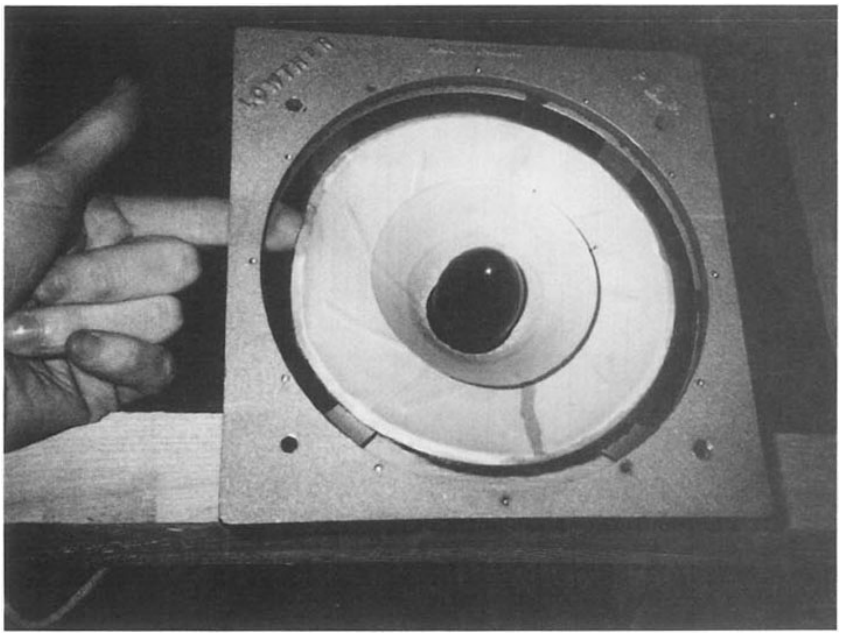
Given the choice of either a pair of Tannoy 15" silvers/Lancaster cabinets or Quad ESLs against the Acoustas or TP-1s, Lowther wins hands down. It is far more natural, more lifelike, more "you are there", less from a box, less from a pile o' tubes, capacitors and resistors.

If sourcing drive units second hand, be careful. Lowther were one of the first to go to foam surrounds, which have usually rotted by now. Lowther-Voigt in the UK will repair them, but at a high price. NEVER use a Lowther with any transistor amp that comes on with a thud! Any amount of DC through the coil will see the inner voice coil fall off the former, with disastrous and expensive results.

The gap between pole pieces in the Lowther drivers is very small compared with most designs. This helps to saturate the voice coil in magnetism. The PM4A is the only speaker made that has a totally saturated voice coil gap. 24,000 gauss! Nothing comes close.

Even a lowly PM6C has a good magnet to cone mass ratio. It has to in order to get the high frequencies. If a PM4 were a car, it would have a power to weight ratio of 1,000,000 BHP per ton!

It is interesting to note that mechanically the units cross over twice. Very high frequencies come directly off the edge of the inner voice coil (hence the need for a phase plug), the next frequencies down are handled by the "whizzer" cone, and finally the 6" cone.



When buying vintage Lowther drivers, watch that foam!

Nothing is ever perfect, on a swept frequency response the Lowthers do themselves no favours (especially the PM6A, which has a curious peak at 11 kHz, adding a bit of false presence). But on a pulse test, they are in the electrostatic class.

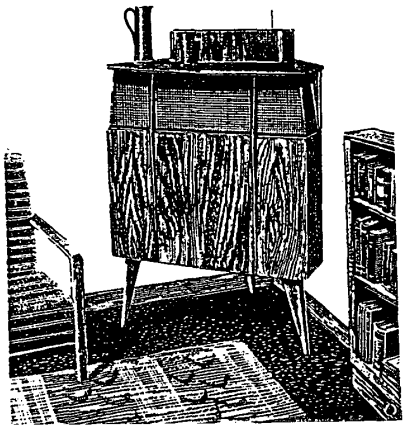
If you overload them they damage very quickly, a small SE or small PP amp is *de rigeur*. When forced to handle 15 watts, you can make the voice coil fry. Just remember that 15 watts in a Lowther is in excess of 111dB! That is painful. Most owners will NEVER use any more than 1,000 milliwatts of power.

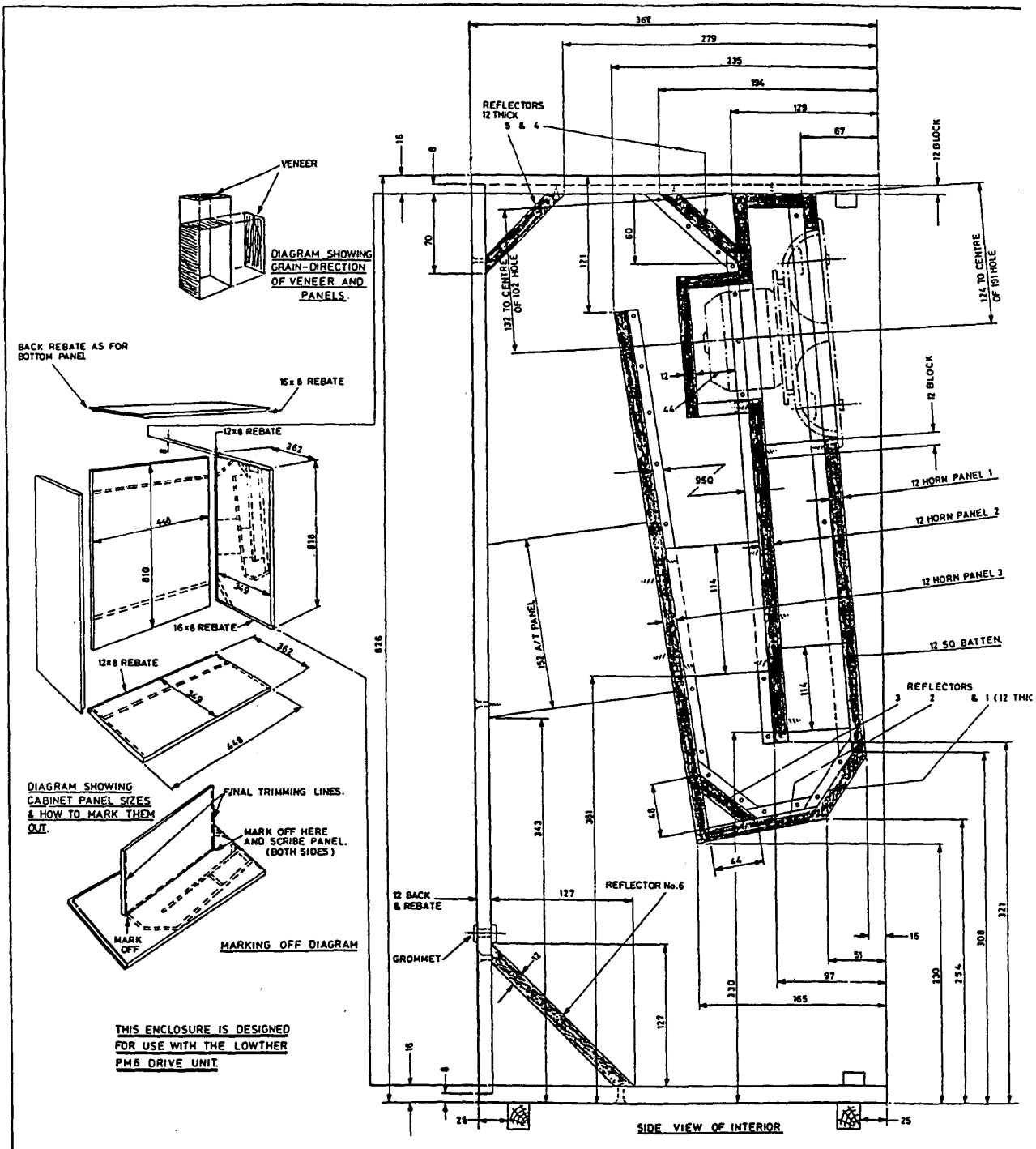
Prices of Lowther drive units vary from £250 for PM6C up to £900 for a pair of PM4A. Second-hand prices vary wildly from country to country—just watch that foam on vintage units.

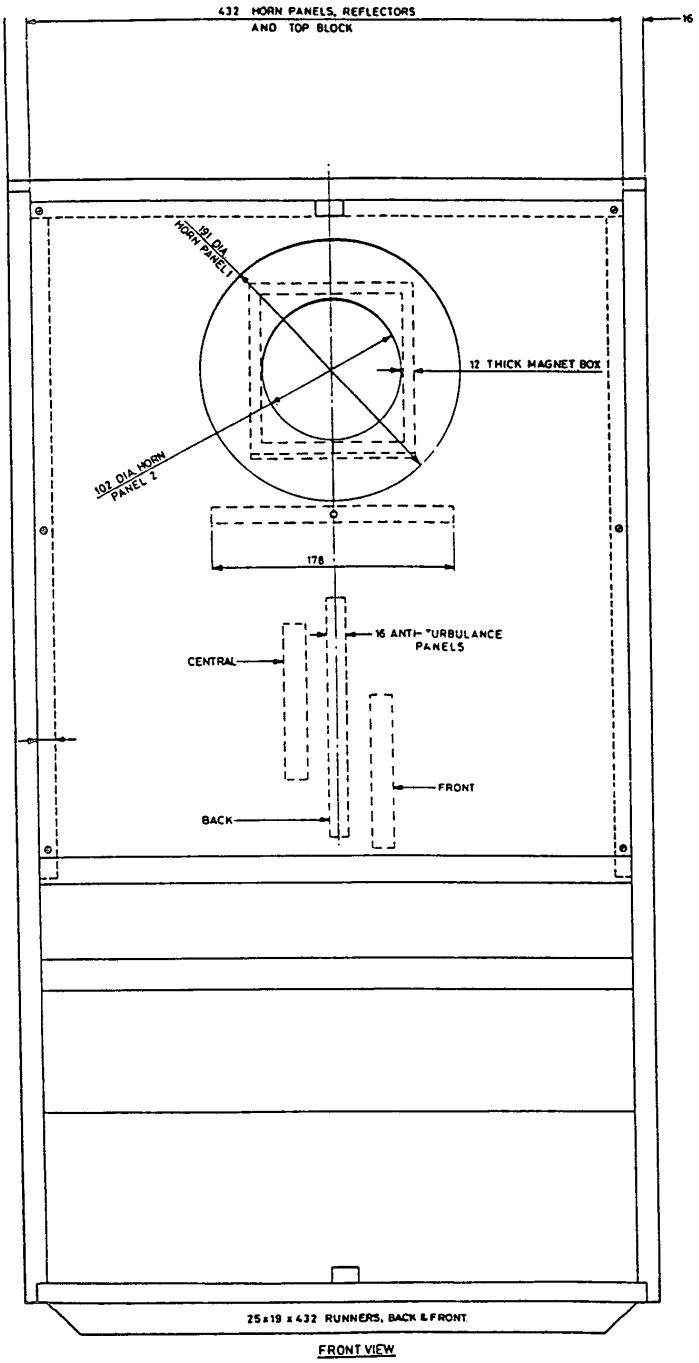
TP1 and Audiovector cabinets fetch very high prices, justifiably so. In my estimation, Lowther can offer no new complete loudspeaker to match these underrated classics.

I get the feeling that the factory considers the old top of the line cabinets somewhat old fashioned and dumb, but they sound as good today as they ever did. The TP-1 is certainly not an amateur woodworking project but if you have the skill and the plans, go for it. If you happen to have the plans for the original TP-1, *pleeeze* send me a copy care of SP, so I can get myself a pair.

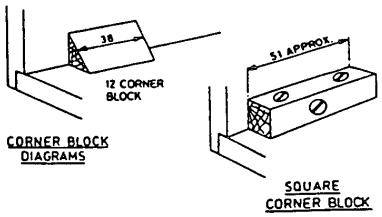
Perhaps price has something to do with it. In 1962, a Tannoy 15" dual concentric cost £37 10s, while a Lowther PM4 cost £48! The price of TP-1A was just under £200 a pair. For what you're getting for your money, I consider the present selling price of Lowther drivers to be far too cheap. Buy yours now before they realize and shove the price up!




VENEER
DIAGRAM SHOWING GRAIN-DIRECTION OF VENEER AND PANELS.
BACK REBATE AS FOR BOTTOM PANEL
16 x 8 REBATE
12x8 REBATE
362
446
810
818
349
16x8 REBATE
12x8 REBATE
382
349
446
DIAGRAM SHOWING CABINET PANEL SIZES & HOW TO MARK THEM OUT.
FINAL TRIMMING LINES.
MARK OFF HERE AND SCRIBE PANEL. (BOTH SIDES)
MARK OFF
MARKING OFF DIAGRAM
THIS ENCLOSURE IS DESIGNED FOR USE WITH THE LOWTHER PM6 DRIVE UNIT
368
279
235
194
129
67
REFLECTORS 12 THICK 5 & 4
12 BLOCK
16
8
70
60
121
132 TO CENTRE OF 102 HOLE
124 TO CENTRE OF 191 HOLE
12
44
12 BLOCK
95Q
12 HORN PANEL 1
12 HORN PANEL 2
12 HORN PANEL 3
12 SQ BATTEN
152 A/T PANEL
114
114
REFLECTORS 3 2 & 1 (12 THIC
826
343
381
48
44
12 BACK & REBATE
127
REFLECTOR No.6
GROMMET
12
16
51
97
165
330
230
254
308
321
127
16
8
25
25
SIDE VIEW OF INTERIOR



FRONT VIEW



CORNER BLOCK DIAGRAMS

SQUARE CORNER BLOCK

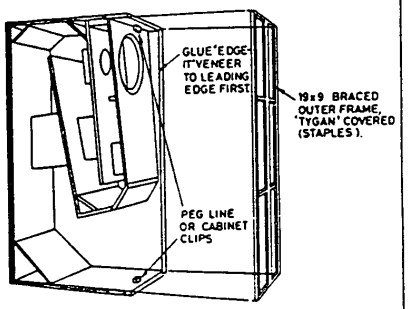


DIAGRAM OF INTERIOR

CUTTING LIST

DESCRIPTION	SIZE	No OFF	DESCRIPTION	SIZE	No OFF
16 BLOCKBOARD *			REFLECTOR 1	86 x 432	1
SIDE PANELS	826 x 362	2	" 2	98 x 432	1
TOP PANEL	464 x 362	1	" 3	67 x 432	1
BOTTOM PANEL	451 x 362	1	" 4	95 x 432	1
			" 5	98 x 432	1
12 BLOCKBOARD			" 6	178 x 432	1
BACK PANEL	821 x 451	1	BATTENS	1250x495	2
HORN PANEL 3	478 x 432	1	"	950x432	2
HORN PANEL 2	491 x 432	1	"	950x407	2
HORN PANEL 1	503 x 432	1	"	950x 73	2
			"	950x 70	2
MAGNET BOX	127 x 127	1	"	950x 60	2
" "	127 x 51	2	"	950x 70	2
" "	102 x 51	2			
HORN PANEL SPACERS	56 x 432	1	RUNNERS	25 x 19 x 432	2
"	52 x 178	1	BRACED FRAME	19 x 9 x 4108	1
A/T PANEL	152 x 165	1			
" "	114 x 90	1			
" "	114 54	1			

*OR GOOD QUALITY CHIPBOARD.

ALL DIMENSIONS IN MILLIMETRES.

ISSUE	DATE	MODIFICATION
4	5.6.79	REDRAWN DRAWING ORIGINALLY QUARTER FULL SIZE NOW HALF SCALE AND DRAWING CONVERTED TO MILLIMETRE DIMENSIONS.

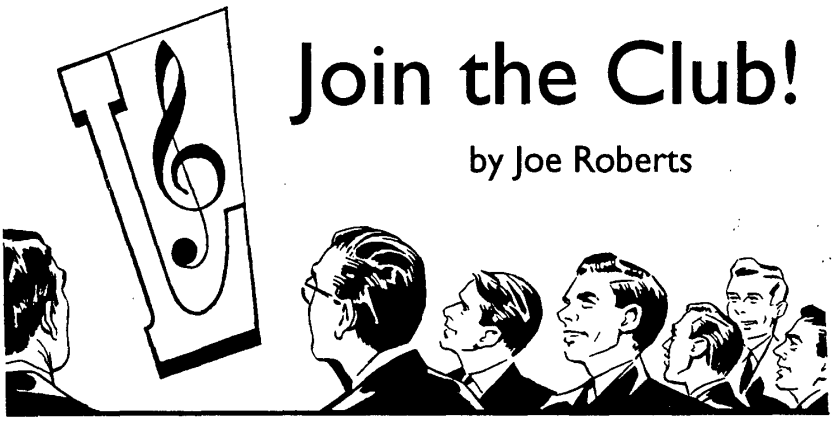
ITEM No.	DESCRIPTION	No OFF	DRG. No.	MATERIAL	REMARKS
	THE LOWTHER ACOUSTA 115 ENCLOSURE				

LOWTHER ONLIFE DEVELOPMENT LTD. BROMLEY, KENT, ENGLAND

DRN	CHKD	APPD	SCALE	DRG No.
O.D.P.	O.D.P.		AS SPECIFIED	651 SHT.1

Join the Club!

by Joe Roberts



Like all 20th Century American youth, I was brought up to believe in the inevitability of progress. Over time, I realized that some very worthy concepts and tools disappeared in the marketplace scramble over the decades. You can find good stuff under all those Kraco 8 track players, LED wristwatches, IBM Selectric typewriters, blown out Phase Linear amplifiers, 6 V tube car radios, and Commodore 64 computers down at the town dump. Might even unearth a few directly heated triodes if you dig deep enough.

Some observers call the current interest in vacuum tube technology *retro* audio, as if to say "aha, *nostalgia* buffs". True that some of us are history students, but most are just looking for some good tunes in 1995, don't know anything about all that old junk, and often couldn't care less. People who are listening to triode amps proudly consider themselves to be *futurists* not retro geeks. Triode listeners are not living in the past.

And why should they want to? There is a lot going on in the audio universe right here in 1995. In particular, the tube scene is healthier than it has been for decades, maybe since the rise of the transistor. There is no longer any need to be an antique hound if you're into hollow state. You can build an amp out of triodes and fancy output transformers that came out only this year if you really want to be *au courant* and whatnot.

After fifteen years of push-pull parallel 6550 amps, audio was certainly ready to take the next step. I admit that reproducing music is an astoundingly difficult feat, but we weren't even getting *close* with most of the fake rackmount tube amps of the high-end era. Who's fooling who?

Okay, so maybe we haven't come *that* far since 1992, but at least there's real excitement in the air for a change. People who have been in audio all their lives feel like they're really getting somewhere bringing music home, often just when they were on the verge of giving up the quest, selling the Gold Lion KT-88s in the safe deposit box, and investing the proceeds in a remote control home theater setup.

Perhaps after all the hype and love at first sight about triode amplifiers evaporates and we have a chance to absorb what we're hearing, maybe it will turn out that we really *are* learning something important about music reproduction in the flux and confusion of the present moment. Maybe in a few years we'll really learn how to use tubes to play music. Hope springs eternal.

What people are calling *retro*, I call refusing to let a good idea die. A good idea is one we can still learn something from, regardless of vintage. We sure can't go home to the Thirties after twenty years of reading *TAS* and *Stereophile*. Just because you use a few classic parts and techniques out of Lee de Forest's attic doesn't mean you're a time traveler. We're headed into the future on a one way track. Ain't no going back.

Yesterday's brilliant solutions become quaint curiosities when they no longer answer the questions that are being asked. New goals and changing technological contexts leave two year old hi-tech wunder products sitting by the curb on trash night. Obsolescence often doesn't have anything to do with user satisfaction or what a user would consider quality. It's usually a business decision, based on cold numbers alone.

Freedom of choice for the mass consumer ultimately boils down to freedom to choose from whatever they're trying to sell you at any given point in time. You can only eat what is on the menu — unless, of course, you're willing to cook for yourself.

Today we're experiencing a refreshing initiative among audio people to create our own idiosyncratic niche of electronics, based on the best of the past, present, and future. We're moving beyond obsolescence, nostalgia, and the tunnel vision of the mainstream. The synthesis of hindsight and forward thinking we're seeing today is a sign of maturity, experience, and an emergent late 20th c. pragmatism toward our past audio achievements and future audio goals. This surely isn't retro, it never happened before.

ALIVE AND KICKING

The Lowther-Voigt story is one of the great sagas of 20th century audio technology. Their mainstay product, Paul Voigt's twin cone full-range loudspeaker, has been in continuous production, with refinements and changes, for almost *fifty* years. Today's high tech doesn't last fifty weeks.

No doubt Lowther ran into hard times during the transistor muscle amp era when an ultra high efficiency, limited power handling dainty thing like a Lowther was considered a peculiar prehistoric artifact. Who needs 100 dB efficiency with half kilowatt amps? The merest touch of DC offset on the output of your Ampzilla and your dual-wound Lowther voice coils transform into a puff of expensive grey smoke. Down at the audiophile society, the whizzer cone alone is enough to provoke fits of laughter.

But those who understood the product weren't laughing. Lowther has always enjoyed a very dedicated following and many stayed with the company through the dark ages of the high-powered high-end. This core of Lowther devotees together with determined management kept the company going over the past few dry decades.

Apparently, sales have been on the upswing in recent years with the resurgence of general interest in tube amplification and low power tubes in particular. Lowther currently has a tube amplifier and matching preamp in the works. They are actively expanding their world distribution network. Business is good in the Asian audiomania market, where locals have taken a liking to Lowthers. Like I was saying, it's hard to keep a good idea down. For Lowther, maybe it was just a question of sticking around until the world caught up with them again.

ONE WAY OUT

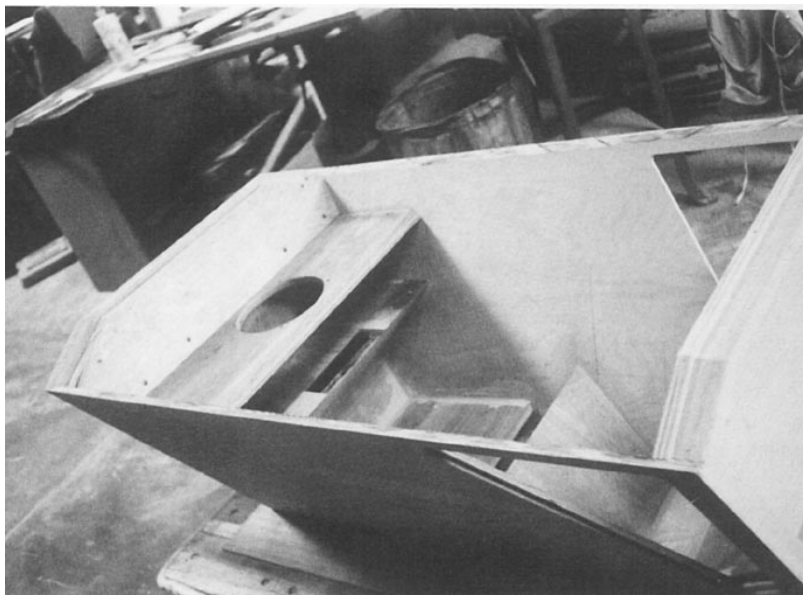
The appeal of an uncompromising one-way speaker like the Lowther is obvious. No other approach maintains the fundamental wholeness of the signal. *All* crossovers segment the analog continuum. In the minds of some holistic purists, this is an unnatural thing to be avoided. It's like having one instrument playing the fundamental and another playing the harmonics.

A similar line of argument is often levied at digital. Why take something apart that is whole to begin with and needs to be whole at the output? Can we really take it apart expertly enough to put it back together again properly? It is a strange idea to break up music into constituent parts with electronics then reassemble it, but we do it all the time without thinking about it.

The glaring drawback with full-range cones is that in most instances they are not *really* full range according to industry standards. Typically a big chunk of the low end is missing and anything above 13-15K is gone. There is no reason to accept that kind of bandwidth limitation in even the most unambitious systems if you're willing to use more than one driver. A $3 tweeter can get you out to 22 kHz. On the other hand, getting a single driver to play 40-20K full range is a wildly ambitious engineering effort. What? Much more work? Way higher cost? Same specs? Pass the tweeters.

The challenge and art of the traditional full-range cone, or any kind of speaker, is balance. In short, if you don't have an extended low end, you can't have an extended top end or the sound will be thin. The LF and HF rolloffs must be complementary. If you put a tweeter or woofer on a full range cone, or use loading tricks to extend bandwidth on the low end, you can ruin it. Limited range can sound very satisfying but it has to be limited at the right points. A mini monitor that only goes down to 70 Hz with the wind blowing in the right direction should be bandwidth limited up top also. 70-30K doesn't work as well as 70-13K.

The Lowther drivers escape this conundrum, since they are *truly full range* devices when appropriately installed. Given that they are intended to be rear horn loaded for the low end, yielding a bass efficiency boost, the high end output is adjusted accordingly. For this reason, you can't just put a Lowther in a bass reflex or on a flat baffle. The price you pay for Lowther-style full-range one way sound is complexity in box design and a hefty bill from your cabinetmaker.



Homespun Opus One cabinet in progress in Lowther enthusiast Frank Reps' workshop. Frank says that since he's been into triode amps, the QUAD ESL-63s live in the closet and the TP-1s are in the listening room making sweet music with his Audio Note Ongaku doing the honors.

It sure would be nice if mechanical simplicity came along with the conceptual simplicity of the single full-range driver, but that's not the way the universe works. Achieving the bandwidth which the Lowther speakers provide in a one-way design takes heavy engineering and careful execution.

The Lowther magnets are incredible, especially on the upstream models. Enthusiast Frank Reps took an old PM6A he was restoring over to a super high tech magnetizing laboratory out in California and they couldn't re-magnetize the unit to factory specs. This feat requires very special and precise Lowther factory procedures. All that magnetic flux is provided to move the cone through a total excursion of 1 mm!

The Lowther drivers have always been hand made and the end result of that fine British craftsmanship comes out looking like a dainty flower with a huge chunk of magnet where the stem should be. At first glance you know that there is nothing else like a Lowther. And it sounds like it looks.

Living with Lowthers is an adventure that benefits from a thoughtful appreciation of and a close personal relationship with the technology at hand. Hartmut said it all in a message on the Internet:

> "If anything ever is or was the Bugatti of something then the Lowther drivers are the Bugattis of speakers. In all respects, mind you . . . and not disregarding the Bugatti Owner's Manual suggestion for starting a Bugatti on what the Bugatti might consider a cold day — nothing complicated, just tap off all the oil and heat it gently on a stove to some recommended temperature . . . and then follow all the other simple instructions and in the end your Bugatti will start if it feels like it."

If you go around asking about Lowthers you'll hear tales like this, but the thing is that usually they come from the lips of people who LOVE Lowthers and wouldn't listen to anything else. Lowther owners enjoy telling war stories but look at where their hearts are. Basically the Lowthers are instruments requiring intelligence and care in use. They'll last for many years if treated well but they're not bulletproof by any stretch.

With such a hyper-strong magnet and a ultra-slim magnetic gap, the danger of some sliver of ferrous junk getting in there and interfering with voice coil movement is something to worry about. Best to work with the naked drivers in a clean environment, not on a dirty garage floor or junk-strewn workbench. Keep the drivers in plastic bags when not safely installed in a cabinet. Old timers suggest protecting the front of the driver by stretching a nylon stocking across the cone after installation as a dust cover.

Might also want to slip off your automatic Rolex before handling your PM4s and keep a strong grip on the screwdriver during installation. The magnets on Lowthers are wickedly powerful and recone kits ain't free.

Lowther was the first manufacturer to use foam surrounds. The dreadful foam on most of the early foamed speakers is crunchy brown dust by now. The new foam is much more durable and long lasting but the ancient jokes about Lowther foam persist. You can still get cone kits, so any disaster short of theft is repairable.

Some Lowther aficionados insist that the cones take a few *years* to break in, and the older they are the better they sound. The paper Lowther cone is indeed almost a living thing. I listen to a pair of PM6As in my Edgarhorns off and on and I know what they mean about sensitive. Changes in humidity trigger sonic changes. Nothing sounds better on a rainy day than a Lowther, not a problem in England, I'm sure.

Beyond the routine care and feeding issues involved in keeping a British hotrod like the Lowther on the road, a bottomless tradition of tweakery grew up around them over the years. Every substance known to man has been smeared on a Lowther cone at some point in time. Start cataloging some of the crazy cabinets designs that Lowther fans have been spinning since the 1930s and you'll realize that you struck one of the main veins of hi-fi tweakery. Five whole issues of SP dedicated entirely to Lowther wouldn't even scratch the surface.

In short, the Lowther is a pure enthusiast's speaker. If you want something you can take to the beach, buy a Bose Wave Machine. For people willing to invest some thought and care in planning and operation, maybe this is it. Lowthers are not for everybody but they are for some of us. You know who you are!

THE CLUB SCENE

Lowther-Voigt developed an interesting sort of distribution system specially tuned to the needs of the hobbyist. On the one hand, Lowther offers a line of finished cabinets for the global retail market, with the 15K$ Opus One at the top of the heap. On the other hand, Lowther services the hobbyist and experimenter market through a network of Lowther "clubs"— enthusiast-run organizations providing drivers, cabinet plans, service, technical assistance, and other forms of emotional and practical support.

The club scene is a parallel channel of availability distinct from the "official distributor" network. The clubs are run by and for Lowther fans who are in it for the love of the product. I consider myself a fan of Lowther drivers but I gotta say that these club guys are heavy-duty, big league Lowther-Voigt nuts. A few weeks ago, I wrote Andreas Mau of Lowther Club Deutschland just to introduce myself and say hello. Andreas was so excited about the opportunity to spread the gospel that he sent me 26 faxes so far and several hundred pages of related info, including a cabinet design article he wrote back in the mid-eighties called "Lowther for Life!!!" and pictures of what appears to be a religious shrine with a Voigt theme. His faxes come signed "Lowther is the answer!!!, Andreas" — hard core, indeed!

The German and Danish Clubs work together closely to promote and support the proliferation of the speaker with the white cone. Hundreds of people belong to the European Lowther Clubs and it seems like they have a real nice thing going on, sharing information, circulating new cabinet plans, and generally having a good time.

LOWTHER CLUB OF AMERICA

Unfortunately for us Yanks, Lowther hasn't had a US distributor for many years. During the '50s, Lowther cabinets were produced here by Brociner under license. In the early '60s, Stuart Hegeman designed a loudspeaker for Harmon Kardon called the "Citation X" featuring the outrageous-looking special version Lowther (pictured on the cover of this issue) mounted in an up-firing position. Hegeman also designed at least one top of the line cabinet for Lowther for the British domestic market, the stately Lowther-Hegeman Corner Reproducer.

Although there was a powerful Lowther cabal among top ranking Stateside hi-fi operatives during the '50s and '60s, it was an extremist fringe scene. After the new generation came in and tubes went out, Lowther vanished from the US market. The way I see it, Lowther, old chaps, you didn't miss any action not being in this market while we were all lusting after Vandersteens and Apogees to go with our Adcom 555s and Krells.

But nowadays with all this triode stuff going on, Lowthers make sense again. With the A series you can get 100 dB sensitivity in a reasonably proportioned box and NFB SE friendly 16 ohm voice coils as a bonus. There ain't nothing like a Lowther but a Lowther, so check out a Lowther if that's what you're after.

Andreas Mau of Lowther Club Deutschland with his prized Opus One corner horns.

That the time is once again ripe for Lowthers was not lost on Mr. Tony Glynn. Tony is a longtime Lowther enthusiast and Oregon Triode Society member who somehow got suckered into selling his prized Acoustas during a move in the early '80s, one of those deals that makes sense at the time but leads to eternal regret and dismay, kind of like that time I "lent" Vinny Gallo one of my Altec 755As for a "few days" three years ago.

The story goes something like this: Tony contacted the factory with the idea of purchasing a pair of drivers to get back with the one way scene and, a year later, he's forming the Lowther Club of America! Alright! I'm joining. I want to be the second US member, after Tony Glynn of course.

The major point of debate among Lowther freaks is over which cabinets to go with. Like all worthwhile audio questions, there is probably no correct answer to this one. For example, some people who have owned various old cabinets prefer certain new cabinets, while others stick with the old 50s and 60s designs, decrying the new stuff as a sign of the decline of Western Civilization.

There are lots of plans out there for Lowther cabinets. The 1964 Acousta design so heartily recommended by Haden above is a reasonably easy to build, high-performance box. Other cabinets range in complexity from later Acoustas with a flat front for simpler carpentry, to mind-boggling projects like the old TP-1 and the modern Opus One corner horn (60 precision-cut parts per side!). Since I never saw or even heard of most Lowther cabinet designs, don't ask me! Find yourself an "expert". Join the club. If you come up with something really good, be sure to let us all know. I like to think that the "best" Lowther cabinet has yet to be built. Gentlemen, start your table saws!

The way I see it, a good old answer to an even older question is always worth a listen. Since Lowther traces its heritage to one of the very first moving coil speakers ever, it's a very old answer indeed. The fact that Voigt's genius loudspeaker is still alive and well more than fifty years after its conception suggests that a lot of people over the ages thought it was a very *good* answer too.

You can't accuse me of nostalgia for old British technology, even though I do think some of it is pretty cool. I'm from Philly and I grew up playing stickball not cricket. I'm just looking for a good speaker to use with my tube amps like everybody else. My plan for a better audio future in my living room doesn't rule out giving the classic solutions another shot in a new context. Scholars say that each generation writes its own history, weighing past deeds in light of where they are and what they aspire to accomplish. In my picture of 20th c. audio, Voigt is a giant and whizzer cones aren't always a joke.

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Many thanks to Tony Glynn, Andreas Mau, Peter Qvortrup, John "Count 8-Track" Peterson, Tom Hodgson, Frank Reps, and Bruce Edgar for contributing pictures, information, and opinions for the Lowther articles in this issue.

WORDS OF LOUDSPEAKER WISDOM (the BIG ten)

by Ray Newman

0. If left alone, solutions to acoustic problems will eventually be resolved by a creeping Darwinian process. Better solutions will occur with increasing frequency under conditions of use, until they eventually become the norm. Applying keen intelligence gets you there faster and with more pizzazz.

1. Loudspeaker design is a technologically based art form.

2. Perceptions mean a lot--especially *visual* perceptions.

3. Get to know continuums from catastrophes. Most matters of acoustics respond gradually and forgivingly to small changes and won't crash. Just don't miss drilling the loudspeaker bolt-circle diameter by more than 1%!

4. Know how to relate dBs to subjective experience.

5. The louder system *always* sounds better in a direct comparison.

6. Understand the concept of using the volume of space allocated to a loudspeaker system in the most efficient manner possible, even if you must make compromises later.

7. Watch out for the implications of the small and large-signal relationships once you find out what they are.

8. Learn to separate first-order technological matters from second-order ones, much less third-order ones.

9. Send the acoustic message in the right direction as much as you can. Loudspeaker directional characteristics count.

10. Beware of the "Laws of Physics"--people who use this term often don't know what they are talking about.

This document was passed around in a loudspeaker engineering lab as a "philosophical" offering some years ago where it pretty much got lost in a black hole. Here's a copy for posterity.

Raven Ribbon Tweeters

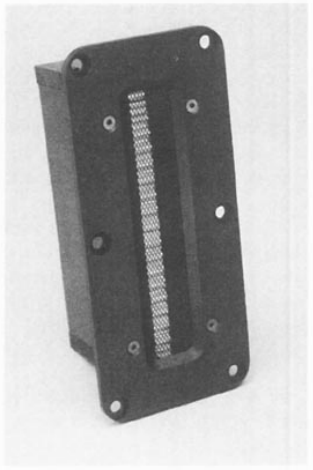
Recognizing the swelling popular demand for top quality high sensitivity drive units, ORCA is now importing the French-made Raven ribbon tweeters. Historically, ribbon drivers have been good-sounding but inefficient devices. Today's new neodymium alloy magnet materials permit ribbon transducers with very high sensitivity ratings. The spec sheet on the Ravens warns that if the magnets of two drivers are allowed to come into contact, it may be impossible to separate them! Furthermore, the super-light ribbon element of the Raven is pure conductive material (no metalized film) with 1/30th the mass of a dome tweeter!

R1 specifications

Sensitivity	95 dB/W/m
Frequency Response	2kHz - 45kHz
Impedance	6 and 12 ohm taps
Size	92mm H x 80mm W
Weight 1.14kg	Price $196

R2 specifications

Sensitivity	98 dB/W/m
Frequency Response	2kHz - 46kHz
Impedance	6 and 12 ohm taps
Size	92mm H X 80mm W
Weight 2.22kg	Price $340



Raven R2 Tweeter

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Agoura, CA 91301
818-707-1629 voice
818-991-3072 fax

Marchand Vacuum Tube Crossover

The XM26 Tube Electronic Crossover is a fourth-order constant voltage crossover design that provides both low-pass and high-pass outputs. The slope of each output is 24 dB/octave. Because of the fourth-order design, the high-pass and low-pass outputs of the crossover are always in phase with each other.

The XM26 uses four 12AX7 tubes in each of the two channels. It has a solid state regulated power supply for both plate and filament voltages. The power supply employs automatic sequencing to protect the tubes from turn-on surges and to insure long tube life.

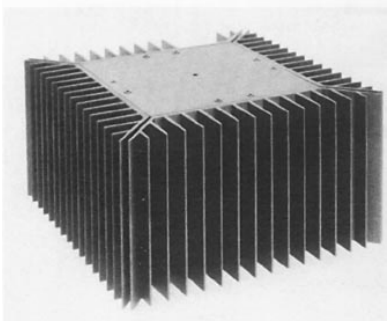
The crossover frequency of the XM26 can be set by replacing frequency modules. Crossover frequencies are available from 20 Hz to 5000 Hz. Normal slope is 24/dB constant voltage (Linkwitz-Riley) but modules for first, second, and third order slopes are also available.

The front panel features four calibrated level controls, one for each low pass and high pass and for left and right channels. A summing switch allows the low pass channels to be summed for use with a common subwoofer. A two year warranty covers everything, including the tubes. Priced at $599 each. Frequency modules (4 required) are $9.95 each.

Marchand Electronics
PO Box 473
Webster, NY 14580
716-872-1960 voice
716-872-1960 fax
phil@marchandelec.com
http://www.marchandelec.com

New Developments in Silicon SE

Following on the heels of the well-received Aleph 0 power amplifier, Pass Laboratories — undisputed leader in transistor SE amplifier design — recently announced October availability of the new 30 watt Aleph 3 stereo unit. With the Aleph 3, Pass hopes to make high quality single-ended transistor performance accessible to the average mainstream enthusiast. Suggested retail price is $2000.



Pass Aleph 3

Each channel features two gain stages: one input mosfet and an output stage consisting of paralleled power mosfets with a current source. Along with some of his comrades in the tube camp, designer Nelson Pass advocates simplicity and purity in the gain path as a recipe for pure sound. Like all Class A amplifiers, the Aleph 3 runs a bit on the warm side. Generous heatsinking is provided to prevent injury and assure long component life.

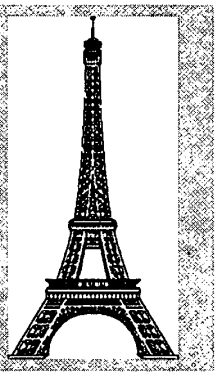
Pass Laboratories
21555 Limestone Way
Foresthill, CA 95631
916-367-3690 voice
916-367-2193 fax

Yo, where's the WE 300Bs???

Westrex Corporation recently announced that the long-awaited release of the new production Western Electric 300B is currently scheduled for mid-November. The proposed breakup of AT&T into three separate companies will have only a minor impact on the tube and production work at Western Electric Kansas City Works is making significant progress, according to Charles Whitener at Westrex.

The reintroduced WE 300B will be manufactured in the USA at AT&T facilities using original tooling and the same materials, engineering specifications, and manufacturing processes of the original units. Existing WECO warehouse stock of NOS materials, such as a proprietary filament alloy derived from a 1963 melt, will be utilized in the new tubes. Bernard Magers, senior engineer of vacuum tube production at WE since the 1950s, provided valuable input on the tube and he will remain with the project to help ensure the highest quality standards.

MONSIEUR RANKIN's EURO SELECTION



by Gordon Rankin, Wavelength Audio

Yet more pro bono work from the explorateur at Wavelength.

Aside from the obvious requirement for reasonable sensitivity, speakers that work well with low power triodes usually have a well tempered (untemperamental) impedance curve. It really helps if the x-over uses a simple first order network so that power is going to drive the speaker not the network.

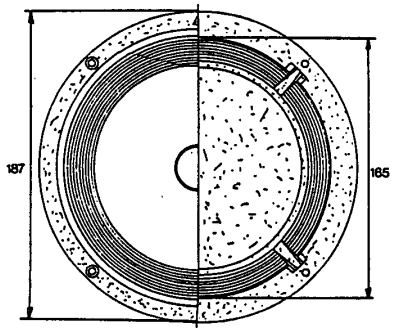
Perhaps it is because most American designers opt for higher order networks that I find I usually prefer some European models which present an easier load to a tube amplifier. On a few occasions I worked with series x-over networks and I found that they worked better than the standard parallel networks, though they were harder to develop.

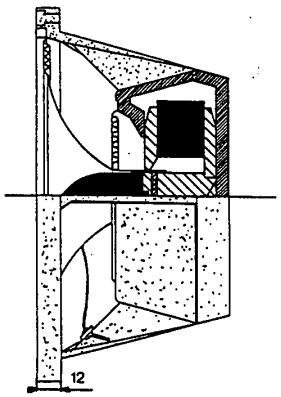
My current favorite commercial speakers are the Swiss-made Reference 3A Royal Master Control (US importer Fanfare Int'l 212-734-1041). They are two way systems featuring an 8" driver and a partially horn loaded tweeter. The 3A uses no crossover on the bass/mid driver and two resistors and one Hovland cap on the tweeter. Wiring is Siltech silver 22/2 (appprox. 15 ga.). They are rated at 93 dB with an impedance that doesn't dip below 7.8 ohms and they sound great with my 300B amps. Aside from the Reference 3As, I suggest that owners of my 300B amps be sure to have a listen to Spendor 71 and QUAD ESL II (both from QS&D 800-659-3711) and also the ProAc Response 1 & 2 (US importer Richard Gerberg 410-486-5975).

The only vintage speaker I have had good luck with is the WE/Altec 755A, maybe because this full range cone driver requires less tweaking than multi-way systems. I used a 1.8 cu ft cabinet with the 755A with two Scan Speak Variovents to extend the LF a touch. Although these ancient, impossible-to-find speakers are great in the mids, they lack bass and high end. Other vintage components may have potential but I get frustrated with all the work necessary to get them right.

Diameter 107mm
Power max 40 W
Efficiency 94 dB/W/m
Resonant frequency 49 Hz
Nominal Impedance 12 ohms
Min. Impedance 10.2 ohms @ 300 Hz

TRIANGLE T17FLV 608





For a DIY project I recommend making speakers that are foolproof. Keep it simple, like a two-way with an 8" and a 1" dome tweeter. There are a few interesting Cabasse drivers that look good on paper, specifically the DOM4 tweeter at 96 dB and the 21M18 Woofer at 93 dB sensitivity. The woofer is good out to 5 or 6 K. Zalytron offers some kits using these drivers. Unfortunately the crossovers are hogs, but you can buy the drive units and cabinets and work on the x-over yourself. I personally don't like the sound of D'Appolito configurations or multiple driver arrays. Like I said, keep it simple.

LS 0/65 Single Driver Single Ended Partner

Looking over all of the drivers on the market for the last few years, I was discouraged since most require elaborate cabinets or complex correction circuitry. I began hearing good things about the Triangle T17FLV 608 paper cone 5 inch full-range drivers so I faxed France and bought a pair. The T17FLV 608 is rated at 94 dB with a range of 50-18 kHz. so it appeared to be an excellent candidate for a triode amp partner. What's more, this unit works real well in a simple to tune and construct slotted or ported design.

The Triangle drivers are now distributed in the US market by ORCA, which is a good thing because they can provide the basis for a reasonably priced, non-time consuming, near-foolproof efficient speaker project.

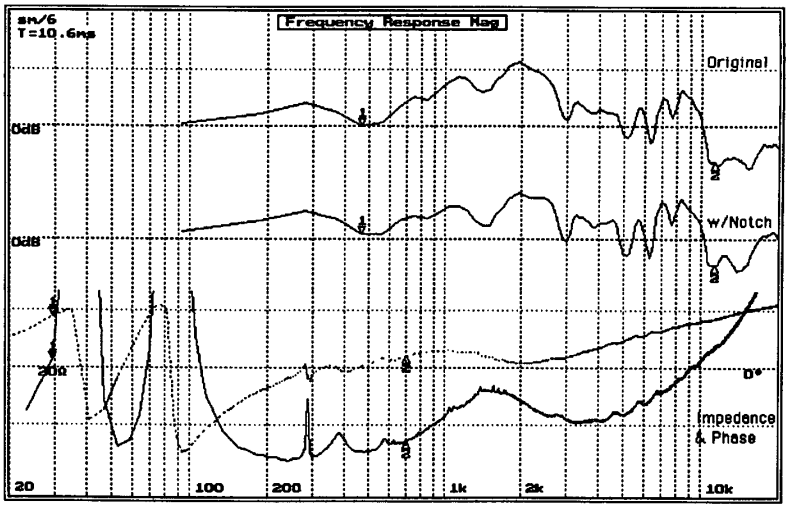
I built speakers for years back in the early 80s when I had access to great test equipment in college. I even designed a test fixture for the DEC VAX 11/760 for my senior project. After school, I got bummed out with speaker projects because testing can take forever. Luckily there are some great PC and Mac packages to help steer us modern speaker craftsmen through our explorations. I used the new Audiosuite software from Liberty Instruments, mainly because it was cheap, it does the job, and Bill Waslo lives here in town.

I also downloaded some programs from the Madisound BBS to calculate the cabinet sizes. The T17 FLV has a resonance of 49 Hz, nominal impedance of 12 ohms, and it is 94 dB efficient. With a Qt of 0.41, the volume of a ported enclosure needed to be 1.8 cu. ft. I used the Woodstyle WS123 cabinets for my 755A experiments and I remembered that these were just the size I needed. For this project, I used the new slim line (12" W X 13.75" D X 24" H o.d.) version.

With a 1.8 cu. ft. cabinet and a box resonance of 52 Hz (-3 dB point), I came up with a port size of 4" round and 4.5" long. Using the Audiosuite setup, I was able to adjust the port equal to the resonance frequency empirically. The optimal port size determined by measurement wound up very close to the calculated results at 4.375". There was a slight rise in the output of the driver at 2 kHz that was up around 5 dB higher than the mean of the response curve. I wrote a program in "C" on my PC to determine the appropriate notch filter for that frequency. I came up with 20 uF in parallel with a 6 ohm resistor and a 0.5 mH inductor.

Using the frequency response plotter in Audiosuite, I tuned the filter by varying the resistance and capacitance. The EQ sounded and measured best with a 5 ohm instead of 6 ohm resistor and with a paralleled 0.22 uF Hovland across the SCR 20 uF capacitor. As you can see from the impedance plot, the notch filter centered around 1.75k instead of 2k. I think it sounds better with the filter because the main irregularities in the response shift down to the less offensive <2k region, aside from having a flatter response overall. The minimum impedance of the system is 11.9 ohms at 240 Hz with a mean sensitivity of 94 dB. Perfect for your SE amplifiers.

This speaker plays realistic bass down to about -3 dB @ 50 Hz. The highs are a bit attenuated but what's there sounds very good. Overall, the sound quality of the LS 0/65 in on a level with many of the high quality commercial speakers I have heard. The nicest thing about the speaker is the midband speed of the crossoverless driver. Also, this design avoids x-over distortion problems that usually accentuate driver mismatch in the upper midrange.



Measured response and impedance plots of author's LS/065 SE Partner. Note smoother overall response with EQ filter installed (lower curve).

Construction is easy. Buy the following components:

SCR 20 uF / 630 V caps
Hovland 0.22 uF / 600V Musicaps
Sidewinder 0.5 mH inductors
5 ohm Mills MRB12 or Lynk 20 W resistors
Triangle T17 TLV 608 drivers
Woodstyle WS123 narrow cabinets
Spectra Dynamics Deflex pads (4 total)
Silicone (100%) sealant
Your favorite cable

Cut and route the driver holes and the duct. Install Deflex pads directly behind the driver and at the top of the cabinet above the driver. This will help clear up any cabinet resonances. Install the driver 8" from the top of the cabinet to driver center and install the port 8" from the bottom to center.

I think you will be very pleased with the performance of this simple, low resource drain project. After listening to these one-ways, I have a better appreciation of why audio purists have always searched for the perfect single driver loudspeaker. A single cone and a nice triode amp can yield some fine musical enjoyment.

Vendors

Madisound Speaker Corporation
PO Box 44283
Madison, WI 53744
608-831-3433 Phone
608-831-3771 Fax
608-836-9473 BBS 8/N/1

Zalytron Industries Corp.
469 Jericho Turnpike
Mineola, NY 11501
516-747-2515 Phone
516-294-1943 Fax

ORCA Design and Manufacturing Corp.
(Triangle importer)
1531 Lookout Drive
Agoura, CA 91301
818-707-1629 Phone
818-991-3072 Fax

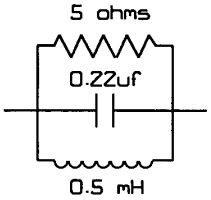
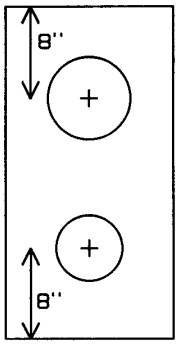


Diagram of notch filter/EQ network. Mount in series with the positive speaker lead.

Usual set-up configuration is with driver on top and port on bottom. However, if using high stands, try inverting the cabinet to get the driver down to ear level for your listening position. Experiment with placement for best balance.



SPEAKing OUT for SE

by Scott Nixon, Anodyne

Love American Style

First off, support American products, or as close as you can get, when it comes to the purchase of your store bought fancy dude speakers. Most of the small time imported European fare costs double or more what it should, with half your money covering shipping, weak dollars, and high importer markups. Readers in the ECM should do the inverse, or import more American goods while the dollar is down.

As will be shown below there are incredible values available from manufacturers in the US that offer much more for your real dollar. It is also time to be slightly wary of efforts to squeeze your juke-box-money with sham products that promise to be 'SE Ready'. Not long ago it was 'Digital Ready' speaker hype we had to put up with. So, look out for dumpy 15" 2 way jobs with fake EV 8HD horns or towers of thousand dollar '98db' hype. Sensitivity isn't everything. Caveat Emptor Rules.

New Designs — Real Finds, No Fluff!!!

KRK You got a modest sized room? How about a pair of 7" 2 way compact monitors that will fit on 20-24 inch stands and are 92 dB sensitive. As an audiophile you expect to spend what . . . $3900? . . . too much? Well take back $3451 and spend $449 for a pair of K-RoK monitors from KRK. These come in a gray speckled finish and would look great in both Fred and Barney's groovy sound dens. Wilma and Betty will love the size and it matches all their furniture too. K-RoKs were designed for nearfield home studio monitoring and are quite revealing little guys and certainly not mid-sucked mindless robots. If these were built by an audiophile producer, they would be gloss black and two thousand dollars. Find these at pro sound dealers that handle recording equipment. Think of these as a low cost fast and bulbous 'BBC type monitor' for the hungry SE masses.

METAPHOR A new model speaker, Metaphor 5 offers an 8" 3way floor standing, small foot print design that is 93 db sensitive. The current retail is $3450 but these also feature unique and beautifully crafted enclosures. They do dip to 4 ohms in the bass region, but ain't dat what th' dadburn 4 ohm taps 'fer? These offer a lot of value and better sound than most smaller, lesser performing imported products. The SE user is exposed to mostly full range, almost e-stat sound, that is virtually wartless.

The Metaphor 5s kind of remind me of an upscale sonic DNA crossing of an (please excuse the comparison) Avalon, B&W and Quad, but overall better, and they are drivable with most good SE amps. The Metaphors will definitely show up weaknesses in amplifiers of slack too. Overall, I'm pretty impressed.

Both of the designs above barely meet *my* minimum sensitivity criteria for a 7-8 watt 300B based amp. Both should work very well in modest rooms (12x15 to 14x18) if you can live with moderate playback levels. Speakers with 90 and below sensitivity should be home auditioned in big time audio party mode before plunking down cash. Play some solo female vocal, solo piano, small Gothic choral groups, and big sound symphonic pieces. If you don't clip the stew out of your amp on this music you're more than likely okay. It's mostly the sustained complex harmonics that clip your amp into the low sens. speakers. A lot of OTLs have similar limitations.

But there is a way out, and it won't hurt for very long. Think of the next speakers as a modified 12 step program to de-program your stereophule mindset. Bubba, you been remanded to Sensitivity Training . . .

K-Rok Personal Monitors

Two way mini-monitor designed for home recording studio use.

Response	57Hz-19 kHz +/- 3 dB
Sensitivity	92 dB 1w/1m
Impedance	8 ohms nominal
Crossover	2.5 kHz
Size	14" x 12" x 9.75" HWD
Finish	Grey texture
Price	$449/pr.

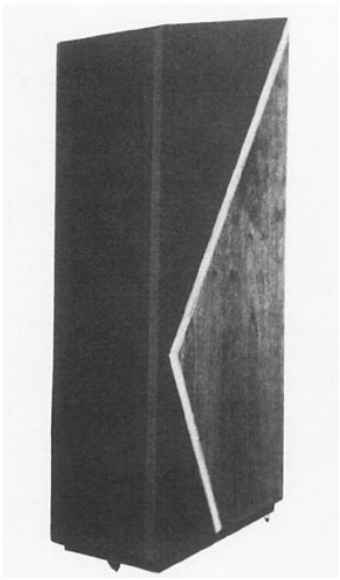
KRK Monitoring Systems
16462 Gothard St., Unit D
Huntington Beach, CA 92647
714-841-1600 voice
714-375-6496 fax

Metaphor 5

Three way system with each driver mounted in a separate tuned enclosure within a rigidly braced cabinet.

Amplitude response	35Hz-22kHz
Sensitivity	93 dB/2,83V@1m
Impedance	4 ohms nominal
Size	39" x 11" x 15 1/4" HWD
Finish	Natural cherry/black grille
Price	$3450/pr. (standard finish)

Contact info:
Metaphor Acoustic Designs
15390 Twin Creeks Court
Centreville, VA 22020
703-815-0082 voice
703-815-2939 fax



HERESY For too long Klipsch speakers have mostly gotten a bad rap. The whole line has been castigated as a rowdy boy's white trash party sound. The Heresy and Forte II are 97 and 99 dB and with 7 watts these will blast. If you have heard either of these with any amp other than a high quality SE thang (including PP tube amps), forgetaboutit.

Simply put, these two relatively affordable models are the 'Vandersteen' equivalent for the SE toting crowd, with a most decent benchmark sound and the appropriate SPL factor. At $400-800 used these will clearly outperform a lot of the Johnny-come-lately big SPL sham boxes that are begging for your attention. Instead of the juicy sucked out midrange death of a lot of audiophile-approved designs, certain Klipsch models really dance and sing, even with a few tiny watts.

Admittedly, Heresys are not the highest resolution design in the world, but they can get you started using SE without power limit angst. Be creative with setup of Klipsch and avoid the dreaded dead-on-axis position. Heresys are spazmatic to set up. Here are a few things to try: You can use the built-in plinths if you converge the center axis 3 to 4 feet in front of or behind your butt and, in a big room, the stage occurs at normal height. A favorite setup at the Anodyne megaplex has been 16" stands and flat up against the wall pointing straight out, a la Linn Sara. The boundary effect is great for the bass and you won't get the wallpaper soundstage effect. Fortes need 10 or 12 inches of elevation. Try a couple concrete blocks. Fire them straight out and keep away from boundaries.

One option worth serious consideration if you like the Heresy concept but you are looking for something a step ahead comes from Gillum Loudspeaker Systems in Ridgedale, Missouri.

People who have heard them insist that Gary Gillum's g3 speaker is a much better sounding design than the Heresy and based on these reports, I consider them to be a must audition. These carefully handcrafted units are NOT a copy of the K design but an affordable (under $1500) speaker that is in a similar format — 12" + mid and tweet horns — using better drivers and horns than the current issue Heresy.

As with all of store-bought Plug 'n' Play speakers mentioned above, it's totally your personal choice. Remember just because you read about something in a good-looking slick magazine, does not make what is said true and does not make that product the best, or the worst compared to anything else.

This is a hobby, it's about illusion, and the reality is, for most publishers, only about advertising revenue, not your sound, not your music.

DIY Roll your own 8" 2 ways are pretty easy to do and you can find 92-94 dB Focal and Davis drivers that will roll off on their own. Then you add in a tweeter at 6 to 8 kHz. Simple, easy to drive, but hit or miss without some way to test them.

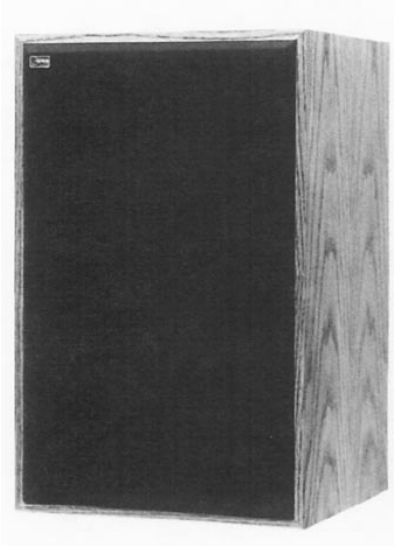
Fortunately, testing has never been simpler. New software to turn your PC with 16 bit Soundblaster card into a powerful FFT jammin' Spectrum analyzer can be had for 50 to 200 American dollars. But even so, unless you do your own woodwork, to buy drivers/enclosures, etc. you land around $350 for something that might be great or might really reek. All DIY projects are a gamble, none have much resale, and you could buy KRK or used Klipsch for a few dollars more and have a known entity. That said, *you* decide how you want to proceed.

Gillum G3 Loudspeaker

Horn loaded compression driver midrange and tweeter with a direct radiating 12" woofer, featuring high efficiency and high output power.

Bandwidth	50-Hz-17.5 kHz +/- 4 dB
Sensitivity	97 dB 1W/1m
Impedance	8 ohms nominal
Crossover	750 Hz and 6.5 kHz
Size	23 1/4 " x 14 1/4 x 13 5/8 HWD
Price	$1100/pr.

Contact Gary Gillum at
Gillum Loudspeaker Systems
PO Box 123
Ridgedale, MO 65739-0123
417-334-7428



Now you have some tunes while you expend efforts to build your ultimate Big Dog system. You will find the whole process much more enjoyable with decent SE sounds to entertain you, while you quest for more fire. Ugh, big sticks = more fire!

Big Dog Horn Rigs

Now we think about Edgar midhorns and biamping and big bass thangs and start breaking the normal audiophile code of conduct. With horns try to always use higher than first order filters, second order and up will lower out of band distortions and squelch diaphragm resonances, especially in bullet tweeters. First order is too easy, it works for direct radiator designs, but it is a cop-out, offering many problems when used with horns.

There are projects from the early 80s in *L'Audiophile* that combine Onken boxes with time aligned Audax 7" and Fostex tweeters that are direct radiating 100db designs that are quite good. This would be a raw parts cost thousand+ dollar project, and most big designs will be at this price level or even much higher.

Pro Sound Most of the offerings from most manufacturers are great for your typical lounge lizards or rockin teenage combos but are boom and sizzle audio death boxes for your home hi fi. High sensitivity and lumpy response curves are the norm and most come carpet covered/expando grilled/plastic cornered. Except for the high sensitivity, this is not your home hi fi dream speaker, more like a hi fi nightmare.

There are some pro candidates showing potential for home-based listening. Used UREI coaxial studio monitors have mid-90s sens. and do sound fine, but even the smallest used pair will go for over a grand. You may have heard of BagEnd ELF subwoofers in some of the recent audio press, they are quite good also. Most hobbyists probably have not heard of their full range designs. The Bag End TA12 is a time aligned 12" 2 way that is 100 dB sensitive,housed in a fairly small enclosure, and good to 70 Hz.

Use an SE amp on the TA12 full range, bypass the electronic xover, and use a single mono ELF woofer (models from a single 10" to 2x18"). With the least expensive ($798) ELF processor and a decent SS amp, you would be looking at a $3-4000 system. You can substitute a pair of new Gillum g3 and use a single 10" ELF woofer and the xover/integrator and get a huge flat to 20 Hz full range sound for a total of about 3K bills, plus your SE amp and some SolidState dog for woofer duty. Pun intended.

Other finds for old pro prospects are obvious. Ain't got no money? I have seen old road-worn Altec A7s with 416/511/802 with blown diaphragms for as low as $250 a pair. *(No lie—the last time I visited the author in High Point, we spotted a pair of junked A7 cabs out in the street over by the railroad tracks! That ol' boy didn't act too excited, but I'm sure he went back for a pick-up the minute I peeled out of town. - ed.)*

Bondo the corners, apply paint, new diaphragms and for $450 you can get started into big scale horn sound, not perfect but it's a start. Later add Edgarmids and biamp then you're closer to the big thang you're after. There are also lesser known bass 'bins' which may work better with Edgarmids than the A7. The JBL 4560 is a shorter front loaded bass horn. At 36" tall it has a tighter sounding bottom end and goes a smidgen lower. Road dogs of these can go for 50 to 100 bucks each.

Altec makes a short half-height front loaded horn enclosure, the 816. Same basic flare as the A7 with a tighter bottom end but slightly higher low cut off.

I heard a setup with 816s, D54 Edgarmids, Fostex slot tweeters, and all passive networks sound mighty fine, and it did not visually dominate the listening room. With most road dog rescued PA boxes, it's best to have your sound pad hidden from view, unless you're a true refinish-wiz.

All of the above has been heard either in the multi-tens-of-dollars Anodyne listening lounge or in rooms of dealers and friends of da'dyne in one form or another. By no means is this information the last word or anything of the sort, but a cryptic report on what has been seen and heard hereabouts. Important to remember is that this is all just equipment/toys and it is meant to be placed into action. Get off the phone, out of the cyberjunk wasteland, chain yourself to your work bench, then enjoy the musical fruits of your labor.

For more info on Anodyne products:

Anodyne
PO Box 6227
High Point, NC 27262
910-884-7394 voice
910-884-1072 fax

CONFESSIONS OF A JUNKYARD DAWG!

by Steve Melkisethian, Angela Instruments

Our underground hit squad
MADE the sucker speak out!

When somebody comes to me looking to buy a single-ended amp, I usually ask what sort of music they listen to, how loud they like it, the size of their listening room, and what sort of speakers they now own. I've found that people who mainly listen to loud rock will probably not find the low powered SE experience very satisfactory no matter how efficient their speakers are. Remember, rock concert PA systems consist of super-efficient speakers (still mainly *horns*) driven by banks of very powerful solid state amps. Not surprisingly, many headbangers consider this sort of arena rock PA rig to be *ideal* for reproducing their notion of the true sound of live music in the home. Who am I to stand in the way of their pleasure?

Another group of listeners better served by higher power amplification includes lovers of large orchestral works who like their music played at "realistic" volume levels in medium to large rooms. Generally, when someone mentions the importance of large dynamic contrasts, presentation of "scale", high sound pressure levels, and a preference for digital source material, I try to steer them away from buying a seven or eight watt amplifier since no speaker known to man, whatever the efficiency specs, will deliver the wallop they crave.

Yet another group of potentially SE incompatible audionuts I frequently encounter are "the men who are married to their speakers". They want to know if these "little amps I've been reading about are any good?" I always try to explain that going SE calls for complete openmindedness in prospective speaker choices. No matter to this bunch of blindered cheap bums! The fact that they got "such a great deal" on some "*Stereophile Class B*" ranked Danish modern room dividers means that they are hitched to the damn things *for life*, or at least until their little pride n' joys are dropped from the Recommended Components List. To the dealer of SE triode amps, this means that your lovely little amplifiers will have to fit the Procrustean bed these audio cheapskates have made for 'em, or else!

My experience with SE triode amps over the past few years has brought into bold relief the realization that no one type of amplification known to man at this point is the most "absolute" in the presentation of sonic truth. All designs are flawed. They all have their strengths and faults. Which set of virtues and vices do you find most livable?

If you're willing to make some real compromises in the presentation of dynamics, low bass impact, scale, and you don't go nuts when your amp clips, then SE triodes with the right speakers will deliver a sense of presence and immediacy (you-are-thereness) that I have never heard from any other form of amplification. All good SE triode amps seem to share a unique ability to convey the emotional soul of great music through any kind of reasonable speaker. When you experience this presentation, it is unmistakable and almost scary!

Is it any surprise that the established amp manufacturers were the most aggressive opponents of SE triodes back in the '80s when most American audiophiles hadn't heard of such amplifiers? This war of disinformation was waged in the audiophile mags for some years, continuing in somewhat attenuated form even today. We were repeatedly told that none of the puny little amplifiers favored by Japanese audio 'cultists' could possible drive big, bulging American speakers to satisfying volume levels in the average American home. After all the propaganda, local audiophiles are usually shocked when they finally get to hear this stuff and find out how loud it can actually go.

Could it be that the High End establishment was scared that American audiophiles would become infatuated with a product that *they* didn't make and promote? Even more subversive is the notion that some of the best amplifiers are built at home by hobbyists, unguided by the audio experts at the mags or by "professional audio consultants" in the High End salons. Accordingly, the homebrew/DIY zone was "ghettoized" by the High-End press, considered fit turf only for bottom fishin' Dyna-scum and other lowballers.

As far as the old establishment was concerned, High End audio electronics was a *tricky* business. Only a trained engineer/artiste could achieve the proper balance of brute technical mastery and 80s sensitive guy shit required to design and manufacture such 'necessarily complex' circuits.

As I see it, the "problem" of speaker efficiency has been grossly overstated and it serves as the last line of defense for those in the High End community who wish the whole single-ended triode amplifier movement would just go away. If you have the guts to just throw the numbers out the window and listen without preconceived notions, you'll probably be shocked and delighted at the number of "illegal" (but good sounding) modern and vintage speakers that work with SE triode amps.

The only speaker kit I am aware of that was designed specifically for low power tube

amps is offered by *Hi-Fi World* mag in England. I haven't heard these but they appear to be well-designed and fairly priced (FAX 011 441 71 289 5620). I think it's likely that Audio Note UK will offer a kit version of their superb speakers within a year's time. I'm hopeful that other speaker manufacturers will see the opportunity here and jump into the fray as well.

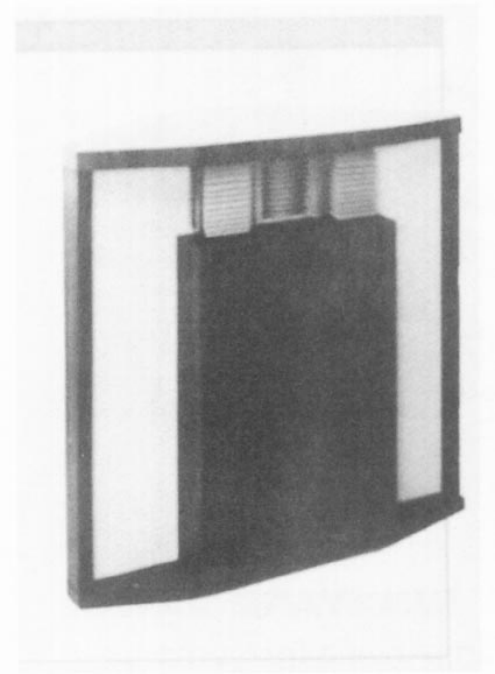
Twenty five years ago I used to build ported, 'bass reflex' stage monitors for rock bands. I'd load my jammin' homebuilt boxes with 12"-15" Eminence ceramic magnet woofers and cheap, ringy aluminum horn tweeters on the top. At the time, these sounded better to us than anything you could buy at most music stores, so we loved 'em, especially since we couldn't afford to even dream of owning JBLs and other 'real' speakers. This efficient, primitive but venerable speaker system design lives on in dozens of commercial versions you'll find at your local 'combo' music store by Peavey, Fender, Sunn, CLS and countless others.

Recently, this design has even reappeared in the low end of the High End, targeted at single-ended bugeteers. Could this be the most popular design of all time? If you'd like to try building your own (its easy!) for under $400, call Image Communications at 1-800-552-1639 for their very informative brochure/price list of RAW speaker components (woofers, horns, drivers, replacement diaphragms, crossovers, mo'...) by Eminence, McCauley, EV and others. Hey, if you don't dig the way YOUR homebuilt babies do "hi-fi", you could always start a band!

MY fave: ProAc Response IIs

As a subscriber to the Japanese audio hobbyist mag *MJ* ($245/year HA! HA!), I have seen a lot of ads for interesting high efficiency speaker components lately, including some horns, drivers, woofers, and some alnico coaxial designs! It might be worth checking out some of this stuff if you're undaunted by the potential hassles of cross-cultural mail order! Speaking of KOOL stuff from Japan, Pioneer still offers some of the wonderful TAD pro speaker components for sale, including Alnico high-frequency drivers and 15" woofers. Wide bandwidth, high efficiency, high dollar, top quality.

My current fave speakers remain the Pro Ac Response II boxes with massive Target stands that I've used for the past four years. I agree that they put a bit of a police spotlight on the treble but the overall balance is so much more realistic and *pleasurable* than anything else I've ever heard that I don't think I could ever cut 'em loose. Yes, they are *only* 86 dB efficient. So What? Seriously, I'd love to hear a version of this design with efficiency in the low 90s, Alnico magnets, and maybe some silver wire in there somewhere. I wrote the designer, Stuart Tyler, a couple of times about coming up with a more efficient speaker design for small tube amps but NO REPLY has been forthcoming. US Representative for ProAc— Modern Audio (410) 486-5975 / FAX (410) 560-6901



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Following are some speakers I found to sound good with low powered tube amps. Check them out for yourselves! By the way, I don't sell any of these except on occasion a few of the vintage units mentioned. You'll have to take your chances in *Audiomart*, your local hi-fi shop, wherever.

1. Almost any Spendor model except the LS3/5A (too dinky sounding and too inefficient for my taste at 82 dB). The folks, including many sound biz professionals, who buy these tend to keep them for a long, long time. The old BC-1 is a true classic and sounds wonderful with small tube amps.

2. The current line up of Audio Note speakers are unique in that they are the only High End designs I know of that were developed specifically to work with SE triode amps. Sure, I'm prejudiced, but anyone shopping for speakers in this price range owes it to themselves to check these out. I plan to buy a pair of the large Model 3s for my home system later this year.

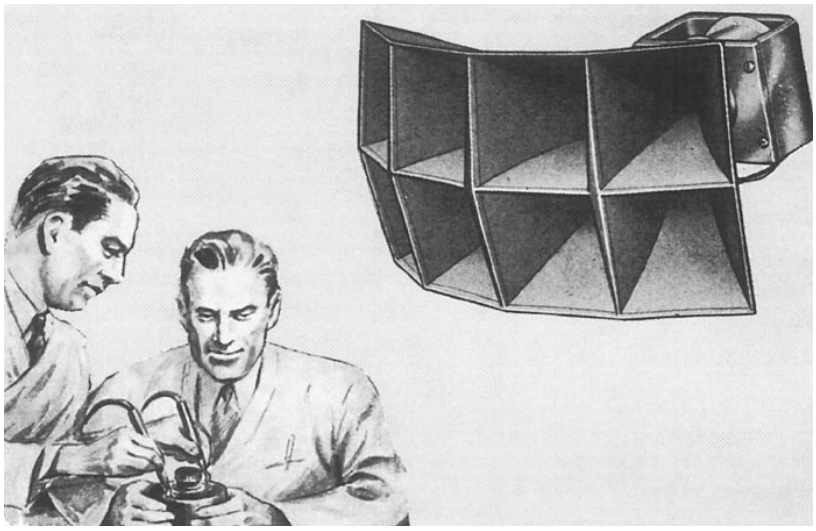
3. I heard the Royal Masturbators or whatever the @#!$ they are called in the Jadis room at CES/Vegas. [*That's Royal Master Control Reference 3A, boss. Sheesh, I can tell you ain't French —ed.*] What a beautiful sound! They were driving them with the Jadis Defy when I stopped by but I bet these speakers would sound fine with any good SE triode amp. Fanfare Int'l (212) 734-1041.

4. On several occasions, I got to hear Classic Audio Reproductions Hartsfield repro speakers driven by Atmasphere OTL electronics and I liked them very much. I have never been a big fan of the old JBL "singing furniture" approach (Paragon? Ugh! Metragon? Forget it!) but this version by JBL nuts John Wolff and Mark Weiss seems to keep the resonances down to a manageable level.

5. Over the years, I must have turned on dozens of tube amp fans on a budget to the Celestion 3 ($289/pr.) and 5 ($399) speakers. I like the earlier, non-ported versions better than the current higher efficiency models, but I still think they're a safe bet and they play much louder than the specs say they do! Like most budget speakers, these will benefit from upgraded crossover parts, cabinet panel damping, rewiring with Kimber wire, and all the usual tweakhead tricks. You'll only get the best out of these if you put 'em on MASSIVE stands (hint: make your own out of old truck crankshafts and other junkyard metal).

6. The little Acoustic Research Holographic Imaging M1 is another decent budget ($270 a pair!) choice. Once again, tweaks and stands are mandatory.

7. The Sequerra MET 7 ($750/pr.) is another popular long-term choice among lovers of all kinds of low-to-medium power vintage and contemporary tube gear. Despite drivers that look like something you'd find in the doors of a '76 AMC Gremlin, the smooth tonal balance and imaging capabilities of these speakers on good stands is most seductive.



Do yourself a favor . . . forgetabout vintage theater horns

8. Numerous customers who've bought either the Angela Model 91 amps or the Audio Note Kit One from us report good results with a bewildering array of pricey (Acoustic Energy, Sonus Faber, etc.) and Econ-O-Mojo modern mini-monitor loudspeakers. I list here only those examples that I have checked out myself but consider my "thumbs up" to be, uh, qualified since I only heard some of these boxes 'on the fly'. Still, they're worth checking out if you're doing low powered tubes on a tight budget: Wharfedale Diamond ($300/pr.), NHT Super Zero ($280/pr.) and Model 1.1s ($380/pr.), and the Dana Audio Model 1 ($199/pr.).

Doubtless there are dozens and dozens of these little boxes to try out. The results can range from dire (any LS3/5A) to delightful. In general, stick with two way box speakers, avoid the exotics (anything with a ribbon, electrostatics, and other Science Fair projects). Also, avoid anything with a LOW specified impedance and high parts count/ complex crossovers.

I suggest that you tote your tube amps down to your local hi-fi discount barn on a SLOW day and ask 'em if you can check out some speakers. Most of the folks I know who've tried this number were pretty damn shocked. There are some real sleepers out there and a whole bunch of doggies, depending on your personal tastes. It's my contention that, given the sheer volume of product out there, any determined person in any area of this great land can turn up listenable/affordable speakers if they try enough stuff. Happy hunting! Let me know what you dig up.

9. Tannoy still offers a number of very efficient (95-99 dB) 12" and 15" *Alnico* dual concentric driver designs for both the home and recording studio in several formats. Included in the line up is an OUTRAGEOUS 99 dB efficient, $30 K horn-loaded behemoth called "The Westminster" targeted at the Japanese market. Tannoy aficionados swear that the earlier models sound better. I agree but the quality of even their new stuff would put most other speaker brands to shame.

Do avoid the smaller Tannoy enclosures made from particle board; they sound *TERRIBLE!* Remount the excellent drivers in custom-made robustly constructed solid hardwood boxes, well-braced and damped. Write to Tannoy in England for plans. The US distributor is actually located in Ontario, Canada—TGI North America (519) 745-1158 / 745-2364 fax.

POSTSCRIPT: On the Sunday I was finishing this article, I took a break and hit a local flea market. I found a clean, original pair of '50s 12" Tannoy "reds" for $70! Who says that efficient vintage speakers are hard to find and expensive? Not me!

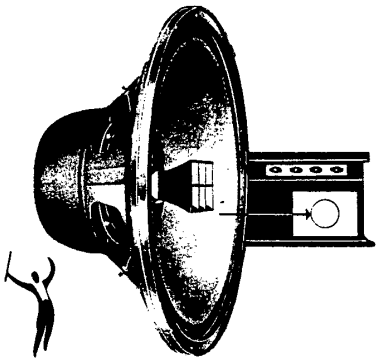
10. Technical Audio Devices offers a range of super high quality studio monitors reminiscent of older JBL Alnico designs. TAD systems employ heavy, SOLID WOOD high frequency horns and they are built to a level

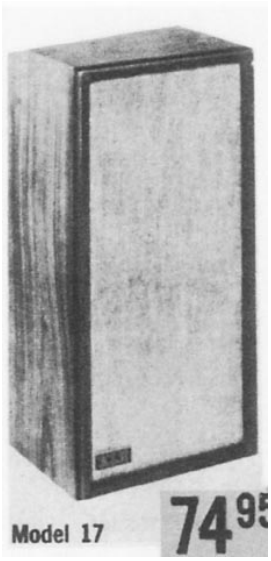
of quality that is rarely achieved in today's so-called "High End" loudspeakers. Over the years, quite a few were shifted in the pro recording studio market. Maybe you should place a "Wanted" ad in *Mix* magazine classifieds. Be prepared to part with at least $5K-$7K to score these babies!! Call Barry Smith at the TAD division of Pioneer (310) 952-2387 for details on current offerings.

11. Unless you're filthy rich and can afford to outbid the elite collectors in Asia and Europe, do yourself a favor and forgetabout vintage horns. Cliched but true, if you have to ask the price for the best Western Electric and Altec gear, you probably can't afford it. Don't waste your time and energy lusting after an obscure object of desire you'll never even see a picture of, let alone own. It's maddening to American collectors but the fact remains that even if you have deep pockets full of money doesn't mean that you'll be able to buy this gear! The folks who're holding the best examples of these old speakers can afford to be damn choosy about who they sell to. Trust, honor, manners, sincerity in personal relations and other obsolete concepts count as much as money in this rarefied world.

"I don't get it Steve! I paid $6000 for these speakers and they *SUCK!*" Even if you can score some good ones, grooving to the exciting sound of horns may not work for you. To those raised on modern "neutral" audiophile speakers, the colorations that seem to be inherent in horns may be intolerable at first listen, perhaps overshadowing their unique virtues. As with other acquired tastes, persistence and the passage of time can change bewilderment into appreciation. Or maybe not . . .

12. Altec 604/B/C Duplex speaker with coaxially mounted horn tweeter (any original Alnico iteration) '40s-'70s. Popular U.S. 15" two-way recording industry stalwart.





KLH Model 17. . . bring your hand saw!

These don't do 'fast', nor some other things that seem to be important to mod audiophiles but they are efficient and lively sounding. These are highly considered by a number of single-ended amp enthusiasts. Junk the original ugly Altec boxes: it shouldn't be hard to build something mo' betta. 604s routinely change hands for $200-$500 each but you may be able to find 'em in the pro sound/recording market for less (try the OLDEST recording studios in your area). Sounds best with the also defunct Mastering Labs crossover: you can probably find these through *Audiomart* in the $250-$400 range.

13. Dyna A-25, common two-way ported box speaker, late '60s-'70s. A favorite among budget audiophiles in its day, these had pretty nice quality Seas drivers. One day, just for kicks, I hooked up a pair of these to an Audio Note Kit One and boy was I surprised at how loud 'n clean they went! If you want to check these out you shouldn't have much trouble finding 'em CHEAP from used hi-fi dealers. By the way, avoid the '90s 'reissue' of this model; it SUCKS.

14. Flat broke? Loser? Can't even afford a pair of used Dynaco A-25s? Boy, have I got a speaker for you! Meet the KLH Model Seventeen! These are so common in the thrift stores in my area that I've seen 'em used, *nailed together*, as semi-permanent structural elements in the book and record shelving! Although an old-fashioned acoustic suspension design with not so great efficiency specs, they seem to work OK with all of the low (7-35W) powered tube amps I tried 'em with. The El Cheapo paper cone drivers sound, not surprisingly, a bit 'cardboardy' but not bad either. Just for a goof, I used a pair of these at home for about a year with an ST70. You can certainly spend a lot more and do worse! Here's a tweak for you: remove (and discard!) the speaker grills. Then take a handsaw and cut the front edges of the boxes flush with the driver boards.

15. ***Steve's Top Four ONE-WAY speakers!*** Some of the best sound I've ever heard from small tube amps has been through what I call "ONE-WAY" vintage cone speakers. These old (40s-70s) full range speakers are an especially appealing match with low powered SE triodes and they share some of the same positive attributes: unparalleled midband realism and a powerful sense of presence and immediacy. True 'single point source' drivers offer some important inherent advantages over 'multi way' designs. Time alignment and phasing problems disappear. Also, you can forget about crossover colorations, cause there isn't one! Further, many of these speakers were designed with efficiency in mind since they're mainly from the pre-solid-state hi-fi era.

On the downside, power handling can be quite limited and bandwidth, even in the full range models, is somewhat less than what many modern hi-fi nuts would find satisfying. Still, some of you might discover that these relics from the past offer just the sort of listening experience you've been looking for. Interested in trying some of these? Try *Audiomart* ads but beware of sharks. Insist on original cones only! As with other vintage gear, it is usually better to obtain it from a fellow hobbyist than most of the dealers I know of. Experimentation with different cabinet designs (ported, acoustic suspension, T-line, etc.) might pay off big time!!!

1) Western Electric/Altec 755A 8" speaker. First brought to my attention in Bender and Werth's groundbreaking 80's article on vintage gear in *TAS #59*. Rated 70-13K, the "8 watts power handling" limit makes this one a natural for 300B amps! Very efficient and as fast as lightning!

2) Goodmans AXIOM 80 full range 9 1/2 inch speaker. Made in England, 50s-early 60s. The maker claimed 20-20K from this one, and that's not too far from what I've heard. With a power handling capacity of just 6 watts, the Axiom 80 certainly challenges our definition of SE triode amps as low powered! Seriously, if you're lucky enough to score a pair of these babies, be careful with that volume control since there

Western Electric 755A ad from 1948

are NO replacement cones available. The other types of speakers (coaxials, triaxials, woofers, etc.) crafted by Goodmans during this period are also efficient and excellent sounding. BARGAIN HUNTERS ALERT: Goodmans sold lots of fine speakers here in the 50s-60s under the "Lafayette" brand name. (*Yeah, but watch out. Lafayette also sold a lot of early Pana-sonic imports.—ed.*)

3) Barker Duode 12" full-range speaker. 50s England. One of the strangest looking cone speakers I've ever seen! The cone appears to be made out of yellowed, parchment-like material! The sound is anything but antique, though. This one is pretty much fullrange (30-15K) and probably the fastest 12" speaker you'll ever hear! The "high flux magnet system" gives "high sensitivity and control, especially when Duode systems are used with low power amplifiers."

4) Wharfedale Super 12/CS/AL 12" full range speaker. England 50s-60s. I found one of these in a junk shop about four years ago. Picked it up because it looked a bit like the British guitar speakers (Alnico Celestion, Goodmans, etc.) I'm familiar with. Since it was Sunday, I took it home and hooked it up to my tube hi-fi rig for a quick test. When the music came on my jaw hit the floor! This was no funky guitar speaker—this thing cranked! Even with no baffle, there was decent bass! Rated at 12 Watts power handling from 30-18K, this one's a natural for single-ended tube amps! In my experience, these sound best in a REAL BIG BOX.

Other listeners report good vibes from vintage one-ways by Baker, Hartley, G.E.C., various Western Electric models and even ancient field-coil type full range cone speakers by Jensen and others. We're probably on the threshold of a revival of this type of speaker, as others will report in this issue of *SP*. Hopefully, these "new" one-ways will unite the superior materials (alnico, W.E. style complex cones, etc.) found in the best of the vintage units with the tight manufacturing tolerances and computer/laser testing methods available today. Some of these vintage or "second-wave" one-ways might turn out to provide just the sound *you* were searching for, or maybe not. In any event, this is certainly another interesting avenue for sonic exploration.

By the way, that's my point exactly! There's a big, wild, varied universe of valid listening experiences out there and no one approach is going to do for everyone.

Loudspeaker Matching with Single Ended Amplifiers

by Graham Tricker, GT Audio

I normally consider loudspeakers to fall into two categories. These are horn and direct radiator designs. From a commercial point of view 8 watts is very limiting unless you have a market consisting of efficient loudspeaker designs like horns. I have a collection of vintage hi-fi which includes a matching pair of Voigt corner horns. In my opinion these are one of the finest sounding classic horns ever to have been made. On the whole, however, people using horns are few and far between in the UK and Europe. I guess this is due to the imposing physical dimensions needed to achieve realistic results.

Eight watts does not sound much to the average audiophile, especially when most familiar well-reviewed valve amplifiers had power outputs greater than 60 watts. Such high powered amplifiers are required to drive inefficient and power hungry loudspeakers like the panel, electrostatic and ribbon designs that have been popular these past decades.

Surprisingly, eight watts can be quite adequate with conventional loudspeakers providing the listener does not want to listen at loud levels; the chosen music is of the simple acoustic variety and not a full symphony or even worse rock music; the listening room is not too large; and lastly, the 8 watt amplifier truly measures 8 watts. Many so-called 8 watt 300B designs which run in self-bias configuration in fact only deliver 5.5 to 6.5 watts of power on the test bench.

Generally speaking, to meet all listening requirements with conventional loudspeakers, 12 to 25 watts is a minimum requirement. To achieve this output level, a single-ended design has to connect more than one valve in parallel, i.e. parallel single-ended or (my preferred option) use a single high voltage triode like the 211 or 845. In order to permit wide application, our GT Audio "TRON" range of valve amplifiers focuses on single ended Class A designs in the 12-25 watt range.

In choosing a loudspeaker to match an eight watt amplifier there are two things to consider (this also holds true for matching all loudspeakers to amplifiers):

Rule #1 is that there is no such thing as a perfect loudspeaker. Every design is a series of compromises.

Rule #2 is that one has to accept that there will be compromises and decide on a design which reduces these compromises the most for the size of loudspeaker and the type of music you will be listening to.

Horn Designs (Vintage and Current)

The principles of a horn loudspeaker (i.e. high efficiency) dictate that it is most suitable for low-powered single-ended designs. There are a number of different interpretations of horn designs, like the famous Tractrix Horn from the legendary Paul Voigt and designs like Tannoy, Lowther and Klipschorn, etc.

All of these loudspeakers have a broadly similar way of conveying a musical performance. Generally the sound is very realistic, very fast with excellent dynamics and it is often difficult to believe that a real instrument or voice rather than a recorded one is not actually in the room.

Horns were originally designed in the days of mono where a speaker had to throw as much sound as possible into a room or hall from a limited power output. This meant that they were generally placed in the corner of the room (hence the name "corner horn") and used the walls and floor as an extension of the horn.

When two horn loudspeakers are connected in stereo a big wide sound stage is achieved. However, horns are very room dependent and poor specimens can sound nasal, coloured and offer very little depth to the sound stage as well as producing large unrealistic images of voices and instruments. Some of the early Lowther and Tannoy designs can sound quite forward in the midrange often causing fatigue during listening sessions.

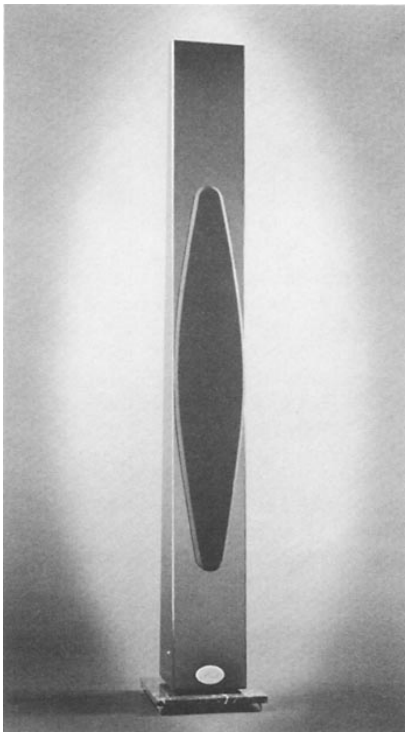
The best modern horn design which I have heard is the Great British Horn made by Nottingham Analogue. Based on the Klipschorn it uses very expensive drive units—see enclosed picture behind one of our TRON 300B prototypes.

Direct Radiator Designs

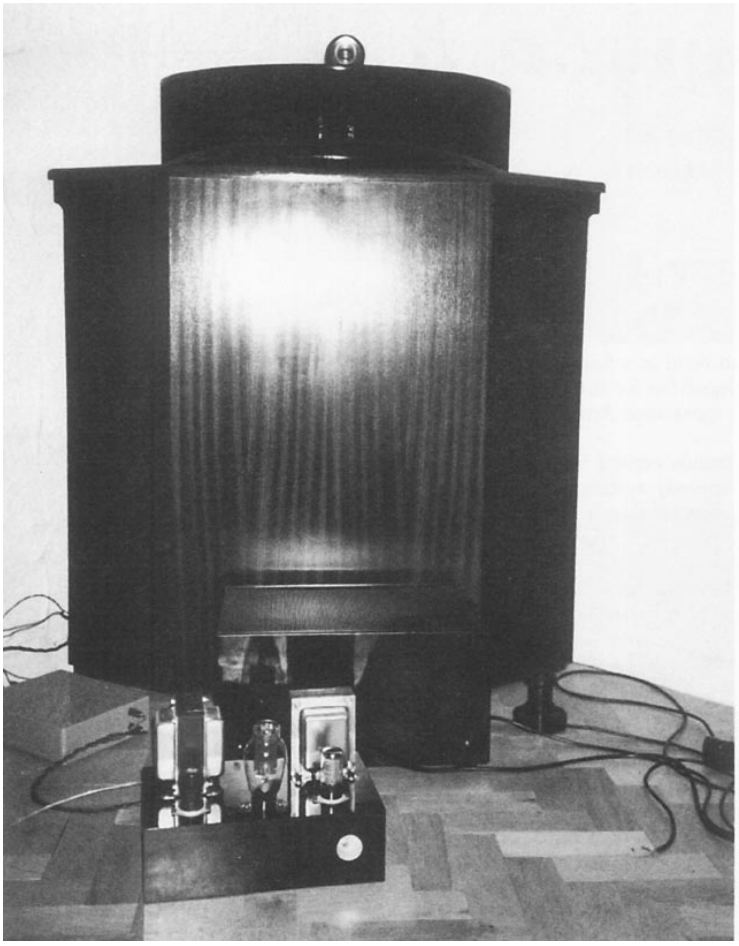
There exists a large variety of designs, e.g. bass reflex, sealed box, open baffle, etc. These designs generally give better bass extension, greater depth to the sound stage and better image placement but lack the dynamics and presence of horn loudspeakers.

Loudspeakers that we have found work particularly well and can be used with low powered amps are the Snell designs from America, Audio Note designs from the UK, the Cadence ES from India and the Horning and Posselt Albatross from Denmark.

The Cadence ES is an unusual design as it uses a bass reflex cabinet with an electrostatic mid range and treble unit mounted on top of the cabinet. Surprisingly this hybrid has an efficiency of 91 dB and nominal 8 ohm impedance.



Posselt Albatross



Great British Horn by Nottingham Analogue

The Posselt Albatross designed by Jens Posselt from Denmark took seven years to develop. They are a 91 dB 6 foot high floor standing design, giving excellent focus and imaging. The size is very important as it determines the correct position of voices and instruments as if the performance was being performed in front of you. We chose the Albatross as a reference for developing our forthcoming range of amplifiers. They are probably the least compromised loudspeakers we have ever heard. Posselt can be reached via fax @ +45 98 29 47 32.

Selecting an Amp for Your Speaker

Our experience when building single ended amplifiers is that the majority of audiophiles use conventional direct radiating designs and therefore the following questions have to be asked to discover whether their speaker will match an eight watt amplifier or not.

1. What is the sensitivity of the speaker?
2. What is the nominal impedance of the speaker and does it have a wild impedance curve?
3. What type of music do you listen to, e.g. chamber, symphony, folk or rock?
4. How loud do you listen to music?
5. How big is your listening room?

From these questions one can establish in a few seconds whether an 8 watt single ended amplifier will be suitable.

Here is a useful chart that can aid in the decision. Tick each question next to the appropriate column (either A or B) that suits your criteria. When complete count the ticks for each column. If there are more ticks in column A then you will need more power than 8 watts. If on the other hand you have more ticks in column B then an 8 watt amplifier may be suitable.

In determining whether a horn loudspeaker will fit the bill or whether a conventional loudspeaker is more suitable to your requirements, physical size may well be the deciding factor.

However, the question should be asked- what is the listening criteria? i.e. is it live in the room stuff or a much more relaxed sound with pinpoint imagery. If the latter criteria is more important then a reasonably efficient direct radiating design will give better results than a horn design.

My own personal preference for SE amps is the high voltage triode design like the 211 or 845 as these drive conventional loudspeakers and horns very well. Eight watts in certain domestic situations simply does not give enough power unless horns are used. Eight watts can drive a conventional loudspeaker on simple music but a full symphony orchestra on full chat will run the amp dry.

GT Audio
5 Upper Road,
Higher Denham, Bucks, UB9 5EJ UK
tel/fax 01895 833099

Question	Column A	Tick for A	Column B	Tick for B
Speaker sensitivity	< 90dB		> 90dB	
Nominal speaker impedance	< 4 Ohms		> 4 Ohms	
Type of Music	Rock music, large Orchestral		Chamber, folk, simple acoustic music	
Listening Level	normal to Loud		normal level	
Cubic room size	< 1152 cubic ft		> 1152 cubic ft	

DEGREES OF COMMITMENT

Musings on the topic of loudspeaker selection

by Don Garber, Fi

Fo, Fum. . .

If you're listening to music you want to listen to, a plastic boombox is fine. But, yes there is something better. And it does make a difference. Is there a contradiction here? I don't think so. But I don't consider myself to be an "audiophile". I suppose the major difference between myself and most audiophiles is that I hate talking about it. I can't think of anywhere I'd rather not be than a CES. With this as a preface, I'll try to respond to the editor's request for "Speaker Tips from the Amp Makers".

First who I am. I run a one-man operation, by choice. I make a number of variations on a direct-coupled single-ended 2A3 amp. I recently finished the production prototype of a single-ended 300B amp. It's now in production. I have been promising a preamp "next month" for unconscionably too long but I recently discovered a new twist that I may incorporate and which may set things back a bit. I also do custom work to order. I love designing and building things and I try to make them as simply and as elegantly as I can. I also try to get orders out as quickly as possible, sooner than promised if I can. This doesn't leave much time for speakers.

I have little experience as a speaker designer. Most of it has been pure experimentation so I'm not sure how helpful I can be. There are a lot of books and references available, but nothing beats the empirical approach.

Tip #1— If you are seized with the desire to strap a pair of 15" drivers directly on to your ears, do it. If an attempt isn't any good, you will usually know it immediately. The books are more often than not right, but nothing beats direct knowledge.

I have four different speaker systems in my home and shop. The living room system consists of Focal T120T102T, 7V313, and 10C01 mounted on a very heavy 16" X 38" board with a very minimal crossover. Completely open on the back. If I ever get the time to build in a finished form, it will be very elegant but for now it is a little less than that in appearance. Artist's rendition below.

This creation evolved from a pipe-loaded 7" Focal one-way system J.C. Morrison built for the Fi retail shop. It's 95 dB efficient and very good with a 2A3 amp (plays 95% of what I listen to), but with 3 watts it won't play everything. With the new 300B amp it's making me revise my statements about the 2A3 being the better tube. It's very live and very good. It will go a little deeper with a pipe, but at a great cost in immediacy. *Tip #2 — There's always a tradeoff.*

The second system, the Pipedream, is a case in point. With a good single driver system one can get clarity and imaging unachievable by anything else. I don't intend to slight this system but enough has been said about it elsewhere.

The third system is a modified Altec A5: 805 horns, 288C compression drivers, 515 woofers in 828 cabinets with an occasionally-added tweeter. The crossover is my own; it's much simpler than the Altec, but then I'm not using it in a movie theater either. Everything the audiophiles say about this setup is true. On the other hand, it has more immediacy, more startling reality than anything else I've ever heard. I want that. It's also HUGE and it doesn't go down very low. *Tip #3 — If you want the ultimate, you'll have to pay for it in space, money, real estate, and no doubt, other terms.*

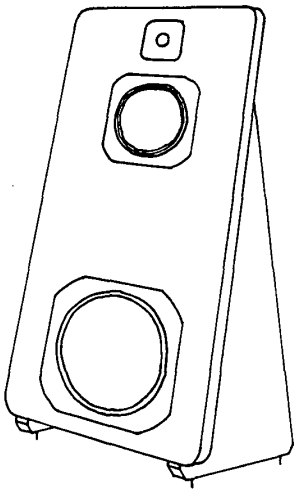
I have in mind a Japanese gentleman who lives somewhere in the mountains. Photographs published a few years back in *MJ* show two equally-sized houses on a mountainside. The one on the left has two projections out the back going uphill to a pair of sheds. He and his family live in the other one. The two projections are low frequency horns (the sheds contain the drivers) leading to the end wall where they open into eight foot a side horn mouths inside the room. He is pictured smiling in front of them. Yes, there are varying degrees of commitment.

The last system, if you can call it that, is a pair of little KLH speakers (Model 24) that I picked up off the sidewalk on 37th Street. These are high on a shelf in my studio/shop, driven by a pair of slightly minimalized Heath W3s through 50 ft. of thin Canal Street "speaker wire". It plays far better than many highendmegabuck systems that I've heard. *Tip #4— Define it yourself.*

I wouldn't feel terribly limited if I were confined to any one of these systems. They all play a lot of music well. But then, I'm not an audiophile. I don't listen to Mussorgsky or Respighi. When I do sit down to listen to music, its more often than not string quartets or Northern Indian classical music, Jazz, or a few other arcane things I wont bother to mention. You can extrapolate from here to what qualities are important in my system. But then, I occasionally listen to Mahler. There is only one way to play Mahler.

The perfect system designer is probably a Talmudic scholar: ". . . but then, on the other hand". If I should ever have the time to do some serious work on speakers, it'll no doubt start with horn loading. That presence and immediacy is like nothing else. The efficiency in itself, though welcome, is secondary. And who knows, maybe coffin bass— remember that. Komuro's new 845s are amazing on the bottom and the new preamp doesn't have multiple outputs for nothing.

Oh yes, I forgot to mention that there's a plastic boombox in the darkroom. But then, I'm not an audiophile.

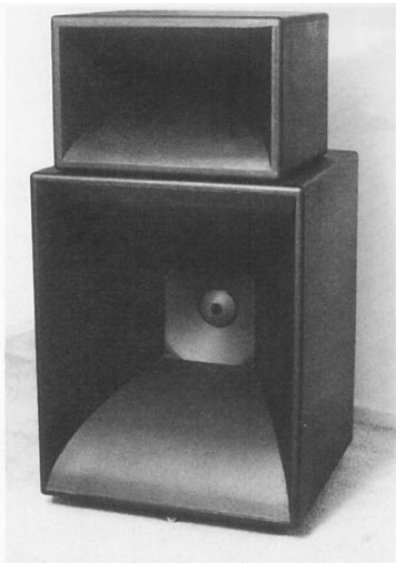


Experimental three-way Focal system mounted on open baffle

— HORNS REVISITED —

THE EXEMPLAR PROJECT

Jeff Markwart and John Tucker
Triode Support Systems, Houston



***Almost* Heaven**

When we finished tweaking our Altec Voice of the Theater systems as described in *Sound Practices #4* we were happy campers. A mere triode half-watt or so into those babies produced big smiles and lots of foot tapping; movie soundtracks that sounded so right; speed, dynamics! Life was good!

Unfortunately, VOT life was not perfect. There are a few major drawbacks that come with the territory when the home music listener adopts a classic Altec auditorium design. To list a few—

Size - A pair of A7s on spikes carrying 311-90 horns on top visually dominates any normal size listening room. The decor aspect of a VOT is best described as "Early Industrial Strength" or "West Coast Monolithic".

Bass - Not much below 40-50 Hz. A subwoofer or two is needed. This sure doesn't help the size issue any.

Horn Integration - The aluminum exponential and the plywood radius short horn just don't sound the same.

After many experiments, we recognized that we stiffened, damped, and tweaked the basic VOT technology well into the region of diminishing returns. To successfully overcome the remaining drawbacks meant *major* changes, a rethinking of the basic system design to the point where the result probably wouldn't look or sound much like an A7 when finished.

We needed a smaller cabinet along with a lower system tuning point to address size and bass issues. It turned out that Altec had been building such a cabinet for many years, the Model 816. The 816 is basically an A7 horn with a much smaller internal reflex volume.

Well, we built a pair of 816 cabinets (ash veneer - still in the shop somewhere) following Altec's plans, and stuffed them with ALNICO 515Bs. Next came a matching pair of boxes to house the 811 horns, with provision for filling the interiors with sand. We filled the exterior horn concavities with patching concrete and mounted a pair of 806-A ALNICO compression drivers on the resulting 811 module.

Nice looking system; small footprint, tuned at 40 Hz, crossover at 800 Hz, 16 Ohm impedance. It sounded good in most respects but the midrange was not as articulate as the A7.

The reason turned out to be standing waves created between the parallel non-flared sides of the 816 horn. With the sides at 16.125 inches the fundamental resonance was at 419 Hz. Altec avoided this standing wave problem in the A7 bass horn with non-parallel surfaces for the short horn sides. An additional effect of the parallel sides in the

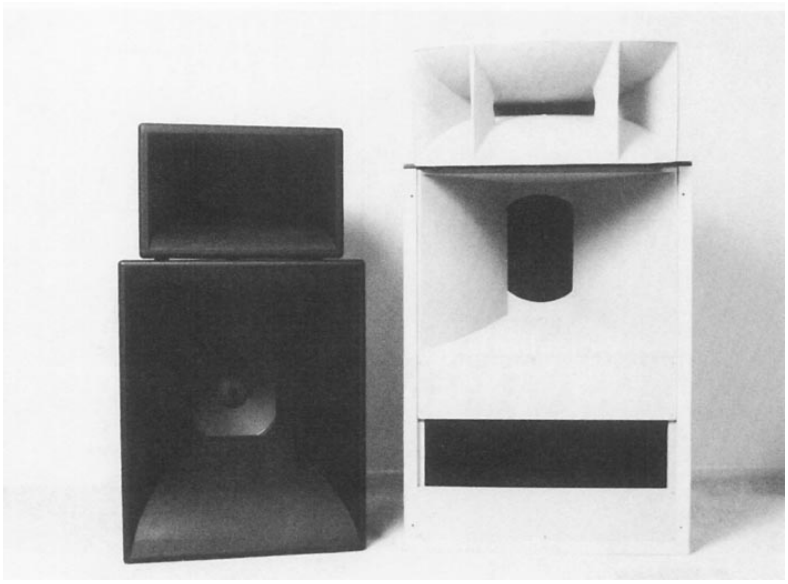


Fig 1 — Exemplar system shown with camo white A7 for comparison

816 was a higher horn cutoff due to a smaller mouth area compared to the A7, 177 Hz versus 160 Hz for the A7. These problems made a smooth transition out of horn loading more difficult.

Although our faith in the Altec drivers and horn technology was high, we slowly realized that we would have to create a system tailored to our goals to realize the full potential of horns in a home listening situation. We wanted the entire system to have a footprint smaller than an A7, offer a seamless blending of the horns, and play deep, loud, and clear on a measly triode watt or two.

Enter the Tractrix

It was during this period that we heard a full range speaker system employing tractrix horn flares for the midrange and bass drivers. The tractrix flare, although not new, has seen a resurgence of interest in the last few years thanks to the efforts of Dr. Bruce Edgar.

The tractrix expansion is unique in that it is the only horn flare whose mouth terminates at 90 degrees to its central axis. It is also the only flare that can produce a spherical waveform and it offers very low mouth impedance reflections compared to other horns. The effect of this flare is a horn that does not sound like a horn. The music is clean, clear and natural without the characteristic *horn* signature. What a difference!

We started to wonder:

- Would high efficiency, professional quality drivers excel in tractrix horns?
- Would compression drivers be suitable for use with tractrix horns?
- Would a simple two-way design be feasible and adequate?
- Would our favorite vintage drivers be suitable for retrofit?
- Could bass reflex be effectively integrated with tractrix?

We decided that working out positive solutions to these questions would bring us closer to our goal of overcoming the A7's drawbacks and improving the overall listening quality of our Altec-based horn systems.

Bass Horn Module

We started off on our design quest with bass cabinet design. In designing the bass horn we had to juggle a bewildering number of interrelated factors. The going was slow as we wrestled to produce the optimum blend of aesthetics, performance, and size using spreadsheets and CAD tools.

A few of the major factors we dealt with were:

a. Horn shape - round, square or rectangular
b. Mouth area/cutoff frequency/aspect ratio
c. Overall height to allow acceptable compression driver horn mounting height
d. Driver mounting depth to allow ease of compression driver time domain alignment
e. Optimum internal reflex volume versus aspect ratio
f. Materials and construction techniques
g. Tuning

What finally emerged from our brainstorming and number crunching activity was a freestanding, wooden, rectangular tractrix bass horn with a mouth cutoff of 135 Hz., and four 6 inch diameter rear-firing ducted ports. In order to meet our design goal of a relatively compact two-way system with extended bass response, and also utilize free standing tractrix horns to the maximum extent feasible, we decided to handle the bass below a predetermined point without horn loading. Overall dimensions of the finished product are 33" tall, 26" wide, and 25" deep and the visual aspect is far more domestic than the old A7 bass cabinet (**Figure 1**).

Since direct radiation would be important in the region where it blends with reflex energy, the bass driver would have to perform from the deep bass through the upper midrange—a span of 6 to 7 octaves. We also needed high efficiency and a reasonable reflex volume requirement.

Our initial modeling efforts concentrated on finding a woofer that met these requirements. Plot after plot of Theile-Small parameters yielded few contenders. Our favorite vintage Altecs, 416s and 515Bs were knocked out fairly early in the process due to their low mass rolloff frequencies and large reflex volume requirements.

What we needed was a driver with a huge motor, a very light and stiff cone assembly, and Fs/Qes/Vas values that allowed the best tradeoff of box tuning and mass rolloff. In a nutshell, we needed a driver designed for horn loading. Our search finally led to the current production 515-8G from Altec.

Reflex modeling for the 515-8G looked good but we were concerned about mass rolloff. Altec Applications Engineering assured us that with the light, stiff cone and large motor assembly on the 515-8G, the Fs/Qes ratio didn't tell the whole story. Altec assured us that we could expect flat magnitude response to at least 1 kHz in our application.

While we were thinking about what to do for a midrange horn, we set up a few prototype systems using the new bass module with Altec 511Bs. The unit was set up to allow flush front mounting the 511B horn with compression driver time domain alignment, and a vertical central axis height of 39 to 41 in. The 511B horns and Altec 902-8B compression drivers were installed in sand-filled boxes for mechanical damping.

We set up this prototype system for listening evaluation in four venues over several months. We tried both a stacked D'Appolito arrangement with Altec 511s (**Figure 2**) and more conventional single bass module per side with 511 compression driver horns. Listeners usually mentioned the bass modules' low distortion, high articulation, and natural transients. In smaller rooms, we got a fundamental bass response down to 20 Hz. The low end of this system got consistent praise from listeners.

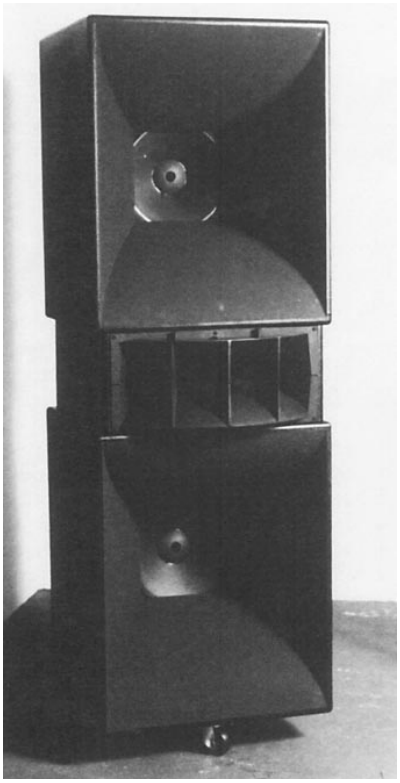


Fig 2— Experimental d'Appolito configuration using bass horn prototypes with sand-damped Altec 511B HF horns

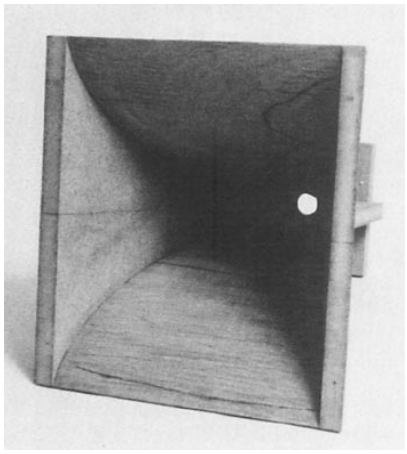


Fig 3 — Early prototype 333 Hz 35° tractrix HF horn.

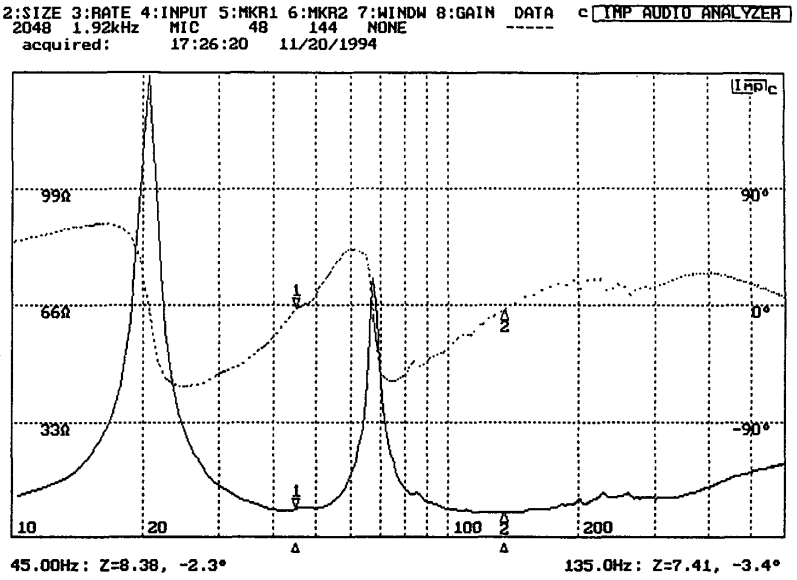
Unfortunately, comments regarding our superdamped 511B horns and 902 compression drivers were also consistent — they were way above average for 511Bs due to the sand damping but they didn't really click. Nobody could put their finger on it, but something wasn't quite right. These findings sure kept us motivated to continue our HF tractrix horn development program!

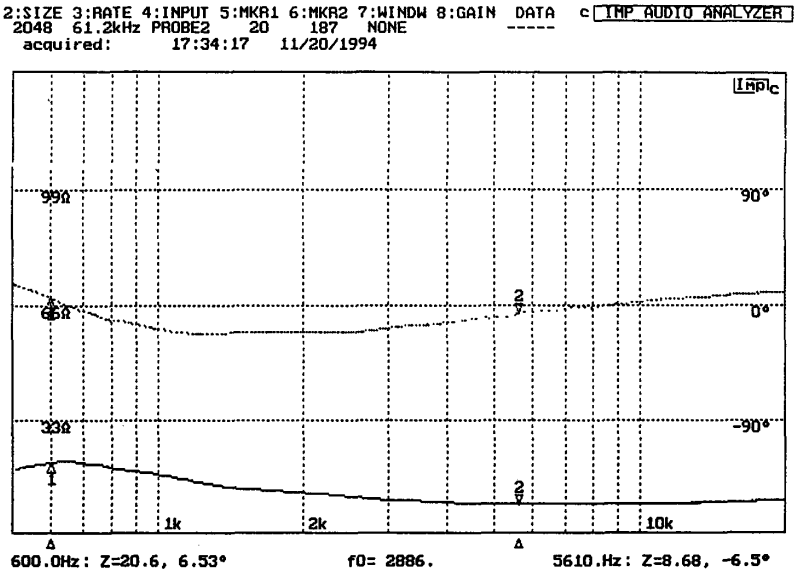
One of the big lessons we learned during this period was how different the horn profiles actually sounded from each other. And when different types were mixed, such as a VOT bass with a tractrix treble, or a tractrix bass with an exponential treble, their unique signatures were very apparent, and didn't sound well integrated. When we switched to a tractrix horn curve for compression driver loading that problem went away and the LF and HF sounded as one. The Exemplar *system* had been born.

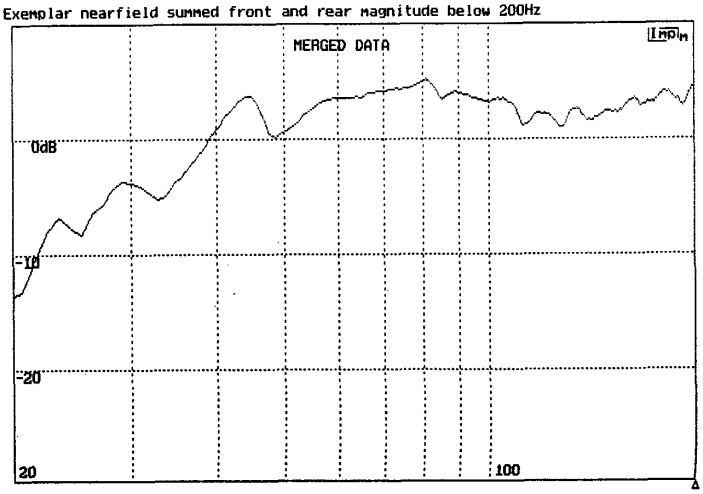
Tractrix Compression Driver Horn

The prototype tractrix compression driver horn was also fashioned from wood, covered a narrow 35 degrees in the horizontal, and had a mouth cutoff of 333 Hz. **See Figure 3.** It was obvious from the first note that it shared the high articulation and low distortion characteristics of the bass module.

Working prototypes were then produced with a wider 70 degree horizontal dispersion, which more closely matched the bass modules in coverage angle and sensitivity. The larger mouth area produced a cutoff frequency of 232 Hz. We adopted this horn







Top to Bottom

Fig. 4
Fig. 5
Fig. 6

profile for the final design as pictured throughout this article.

An interesting thing happened about this time that at first seemed to be a disaster, but eventually proved to be significantly beneficial. We contacted Altec to order some 8 Ohm aluminum diaphragms and were told they were going to be discontinued—the aluminum alloy Pascalite would effectively replace them when all stocks were exhausted. This was distressing. I had compared the two diaphragms on 802-Ds and felt the aluminum had superior extension/transient response.

Gary Jones at Altec listened patiently but was confident that the Pascalite would be superior on the 902. The major difference between the 802 and 902, aside from the magnet material, was the phase plug. The newer Tangerine phase plug (802-8G and later) was designed for more output above 10 kHz, and the even newer Pascalite diaphragm took full advantage of it. We tested and listened to the 902-8As (effectively transforming them into 909-8As). Gary was right.

System Integration

Initial testing showed few surprises. The bass module impedance and phase curves (**Figure 4**) revealed standing wave effects in the 200-250 Hertz region created by the internal dimensions utilized. The enclosure was stiffened and additional damping material was incorporated to minimize any effects. The tuning point is at cursor 1, 45 Hz., and the minimum system impedance at cursor 2, 7.41 Ohms at 135 Hz.

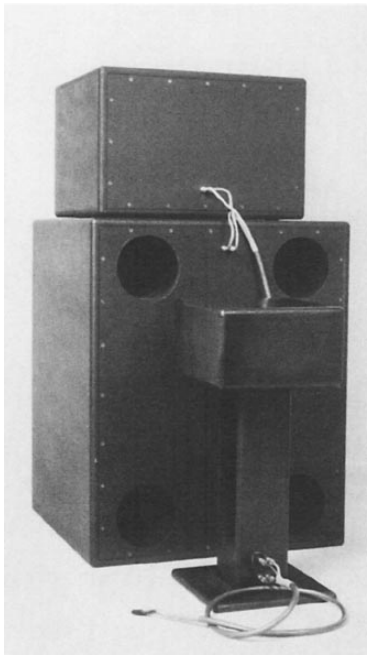
Figure 5 for the compression driver shows the passive crossover at 750 Hz, a benign phase response, and a minimum impedance of 8.68 Ohms at 5610 Hz.

A composite magnitude plot of front horn/cone and rear port radiation for the bass module is shown in **Figure 6.**

The quasi-anechoic magnitude response curve for the compression driver (**Figure 7**) reveals the basic characteristics they all share; peaks centered around 2 and 4.5 kHz and falling high frequency response. Interestingly, the tractrix did better in the extreme top end than either exponential or constant directivity horns, which were typically down by 10 dB and 20dB respectively at 20 kHz.

This peaked and rolled unequalized response is what gives compression drivers their presence and speech intelligibility and it also explains why a simple shelving control will not produce adequate results in Hi-Fi applications. If you shelve down the upper midrange to match the woofer the high frequencies are lost; if you crank up the high frequencies the upper midrange drives you over the edge.

Figure 8 indicates what we accomplished with passive equalization - same test setup, same driver. An additional benefit to this equalization was that the compression driver sensitivity could be matched to the woofer



A separate sand-filled enclosure houses the Exemplar crossover

and thus eliminate the need for series padding resistance in the high-pass circuit. The resulting system sensitivity is 103 dB/SPL @ 1W/1m.

A Better Crossover

The vast majority of two and three-way speakers are designed with passive

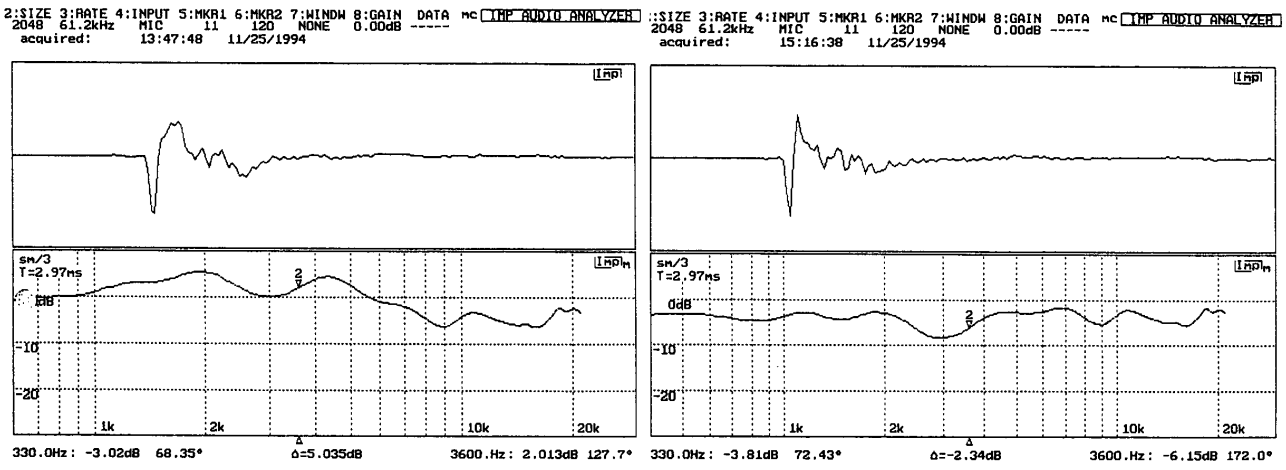
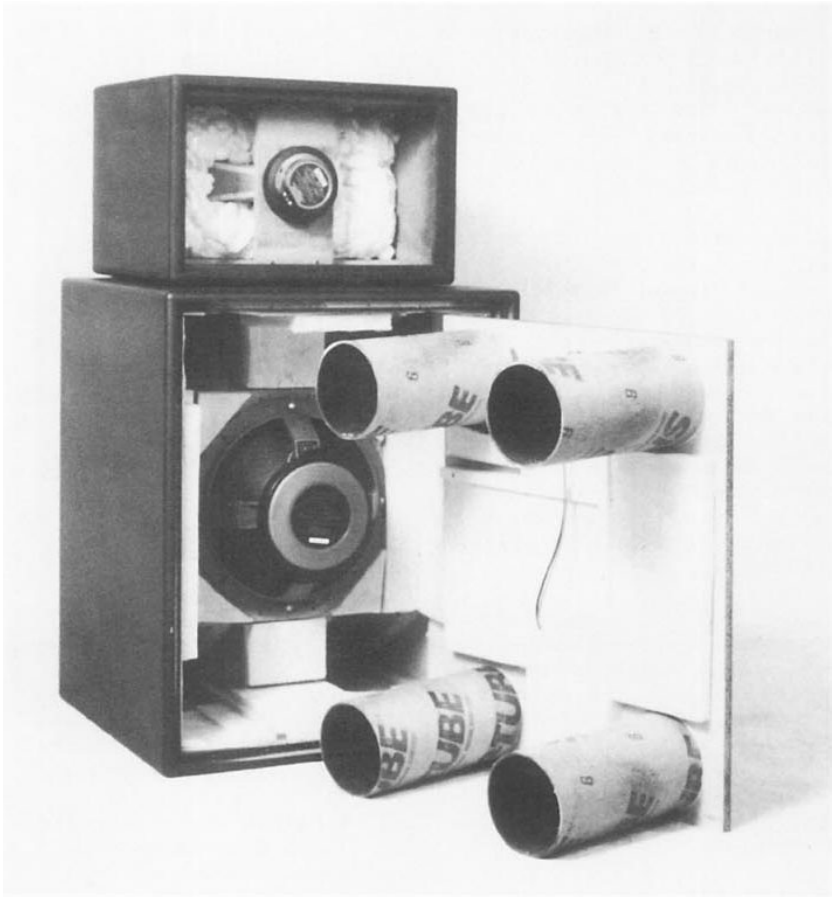


Fig. 7— Unequalized system response

Fig.8 — System response with passive EQ



Interior aspect of Exemplar cabinets showing ducted port construction

crossovers. They are relatively simple to implement for the manufacturer and hold down cost and complexity for the user. You just plug in an amplifier and play!

Unfortunately few commercial crossovers use premium parts and bi-wiring. Even fewer can be easily bypassed to allow direct access to the drivers and not many are contained in separate outboard enclosures to eliminate the acoustic and magnetic effects of a hard working woofer nearby.

The Exemplar passive crossover was designed with all of these concerns in mind. Housed in a separate, sand-filled enclosure, it is completely bi-wired from the supplied speaker cable right up to the individual drivers. Reactive signal path components were chosen for their sonic merit — Solo CFAC inductors and Sidereal capacitors.

For cable and point-to-point wiring we selected long crystal copper developed for the Japanese super-conducting magnet program. The crossover point and slope are 750Hz and 12dB per octave, the filter type is Linkwitz-Riley. Internal enclosure wiring is also super conducting magnet type, 12 AWG to the woofer and 18 AWG to the compression driver.

Drivers

Why do we use premium drivers anyway? After all, the Altecs cost many times more than the typical drivers found in most high-end speakers. Wouldn't less expensive drivers have been just as good? Frankly, *no*.

The Altecs have a lineage that traces directly back to the Western Electric theater systems introduced in the 1930s. They deliver linearity, high efficiency, and long life. We are continually impressed by old Western Electric/Altec drivers that perform flawlessly and continue to sound excellent after 30, 40, and 50+ year "break-in" periods.
The newer magnet materials used in the Exemplar drivers aren't sensitive to temperature and mechanical shock like the older Alnico Altec motors and they aren't as susceptible to overpower problems like the old Alnicos. In short, the quality plus proven performance and longevity of professional quality Altec drivers should easily offset their higher cost. They should outlast their owners!

But how well do they work? — the inevitable bottom line, and a good question. This project didn't start out as an exercise in blending engineering and art for its own sake, although there is powerful satisfaction in turning a concept into a physical reality through innovation and creativity.

Our basic goal from the start was to fashion improvements in looks as well as sound, to better satisfy aesthetic sensibilities and to enhance emotional responses to music. It needed to work on visual and sonic levels.

Looks

The matching, complimentary, horn flares terminate at 90 degrees and then continue to quickly curve away, and at the same time into each other, via the rounded cabinet edges. Flat cabinet frontal area is simply nonexistent, the horn is dedicated to producing direct sound from the drivers. The curves lead the eye inward as well along the junction of the surfaces, and give visual form to the concept of the tractrix.

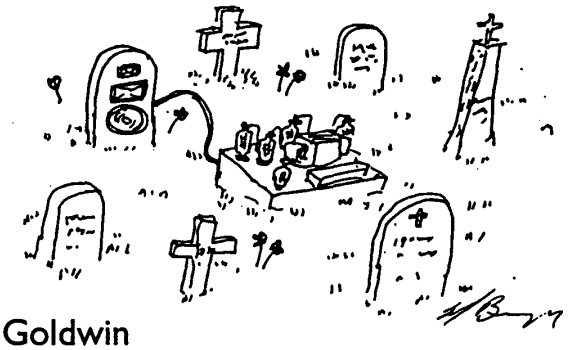
Sound

At times the speakers utterly disappear in an acoustic sense, like articles of furniture sitting mute amid sonic figures arrayed on the soundstage. They can seem totally out of place. . . we have found ourselves wondering "who parked these objects in the center of all this musical activity?"

So, after eight years of modifying, redesigning, substituting, measuring, and countless hours of listening, we finally managed to create a horn based system that does all the things we were told horns aren't supposed to be able to do. Things like deep and wide soundstaging from virtually any listening position in front of the speakers; flat, extended treble response from a compression driver, transparency; and emotional impact.

Obviously, we are very pleased with the results of our efforts. We are also pleased to be part of the resurgence of horns and triodes for home listening. By the way, some of the motivational credit has to go to the "theys" who said it couldn't be done!

WHY THIS REVIEWER IS DESTINED FOR MASS SUICIDE



by Seth Goldwin

Ain't no free lunch, pal . . .

Since building my single ended kit amps last summer I've been on a more or less full time search for a pair of speakers for them. I've heard a decent variety of low to medium cost speakers that sound good with 30 plus watt amps, but when you get into the sub 10 watt arena you *really* need an efficient design and, so far, most the speakers I've heard that claim to work with watt-wimp amps just didn't cut it when I installed them in my living room and gave a serious cranked up listen.

This time out I wanted to get serious and find something, *anything*, that really rocked my world. Furthermore, I wanted to compare whatever I found to a real fine, fine, super fine solid state amp/acoustic suspension setup. I guess the idea was to compare the fringe world of single ended amps to the mainstream cult of solid state amps, and settle for myself whether one kicked the ass of the other or what.

To do this I rigged my homebrew buffered passive preamp to have two switch controlled amp outputs. With minimal effort (two switch flicks and a volume adjustment) I'd be able to A/B the two major thrusts in audiophilia today and give you, the curious public, my report.

Well, do this I did. Despite every piece of evidence that he was committing review suicide by letting me have a pair—since the magazine I write for *loves* SE amps driving efficient speakers, and "hates" solid state amps driving acoustic suspension speakers—Ken Kantor, master of NHT and all he surveys, demonstrated the ample faith he has in his ability to design a world-class speaker and sent a pair of his flagship speakers, the 3.3s.

I powered these with the solid state Acurus 3X200 amp I usually use in my home theater rig. The other camp was represented by my hand (and home) built Audio Note Kit One 300B single ended amp and sometimes my fairly well-tweaked AES kit amp, now modified to use 2A3 tubes to pump out a bullet-stopping 3.5 watts.

The sources were a Pioneer PD-65 CD player used as a CD transport, an unimproved Theta Basic D/A converter (the official current version of this product is III, but I'm still digging the I) and a really cool, very cheap, Sumiko Project One turntable and a terrific $800 phono stage from Golden Aero Tubes. Almost all the wire is Kimber Kable, PBJ interconnect between everything and 8TC from the Acurus to the NHTs. Speaker wire from the Audio Note amp is. . . Audio Note. Just to be different.

NHT 3.3 These speakers have been near ecstatically reviewed by a lot of people who ordinarily would rather be accused of sleeping with goats than of agreeing with each other: Corey Greenberg, Peter Aczel, Mike Fremer, D.B. Keele and some guy from *$ensible Sound* to name a few. Well, I'm here to tell you they're all wrong, maaaaaan! No, actually, just kidding. These speakers are so good and provide such a pleasing and easy access to just about the highest level of reproduction of recorded music that I would have no problem recommending their purchase to *anyone* who could afford them.

The 3.3s are unusual in design. They stand 41" tall, are 31" deep (!), but only 7" wide. The fronts of the speakers are angled and contain three drivers, each in its own enclosure within the larger cabinet. A butyl foam strip runs along the outside edge of the tweeter and midrange drivers, to catch image smearing first reflections before they happen. The fourth driver, a big 12" woofer, is on the inside edge of each cabinet near the back. The whole thing is veneered in a durable, cool-looking black. There's some disagreement I guess about the looks of these speakers but I like 'em a lot and so has everyone who's come over since I got them.

Since the whole arrangement is so tall and thin, and therefore unstable, two metal stabilizer bars are screwed to the bottom of each cabinet to extend the surface touching the floor by another 3" on each side so the massive 123 pound *each* cabinets don't fall over and crush your cats while you're sleeping.

Every single unusual aspect in the physical design of these speaker is extremely deliberate, based on science, and part of a very explicit set of design goals. These goals being: extremely flat, full range frequency response in *your* room, very high volume capability and correct stereo performance. The idea of the speakers is to *exactly* follow the manufacturer's instructions for room placement and, except in rare cases, hear exactly what the speaker's designer intended you to hear.

The instructions are to put them as close to the rear wall as possible, preferably about 3" away, then to align them to be exactly parallel with both each other and the side walls. Sit at roughly the same distance from the speakers as they are from each other (i.e., make an equilateral triangle) and you're there, dude. I actually ended up sitting a lot farther away than that, and surprisingly, this had the effect of opening up the soundstage even more while not yielding the image focus an iota.

Placed this way, the speaker's woofers are firing into a 3 surface "corner" made up by your room's floor and back wall, and the slab of the speaker's cabinet. By enforcing this, the speaker was designed with the designer knowing what kind of acoustic environment the woofer would be firing into. Compare this with speakers designed to go *anywhere* and you can see the advantage. While the woofers are firing away into their virtual corners, the three way design on the angled front of the cabinet is pushed 31" away from

the back wall, angled in by 21 degrees, and stray reflections are scooped up by the foam strip. In other words, this part of the speaker is designed to both minimize room reflections and to put the listener in the right place for best channel separation and minimal interaural crosstalk.

As I understand the design, its purpose is to work *with* your room, to minimize the effects of the particular room on the sound of the speaker. That is, what you hear out of *your* 3.3s is likely to be what I hear out of *my* 3.3s, which is likely to be real close to what Ken hears outa *his* 3.3s.

Traditionally, you get a speaker and spend the next three months driving yourself and all around you crazy making infinitesimally small adjustments of the speaker placement until it sounds least bad to you. The 3.3s on the other hand were pretty optimally set up within a week. This may not be a positive selling point to those of us who have made a life commitment to the geekier edge of audiophilia, but it's a godsend for those who want to hear their music as it was recorded.

When I first put these speakers in a couple of months ago, I was astounded by their unparalleled bass performance and complete precision of focus. But I was less than blown away by their rendering of acoustic space. In fact, I thought I preferred the *el cheapo* SuperZeros. Why? I wondered. This actually lead me to one of the very few insights I've ever had about music reproduction.

Where I'd placed the SZs was almost exactly half the distance between the listening sofa and the back wall. I'd arrived at that placement by the time-tested method of moving the suckers around 'til they sounded "right." What that position does is provide a falsified illusion of depth and palpability, that is not necessarily the depth recorded. Only after listening to a good chunk of my CD collection over a period of several weeks did I fully come to trust what I was hearing from the 3.3s. On some discs, the soundstage was completely flat, while on others it would stretch to Cincinnati. With my SuperZeros I got a bigger picture, but much less variety.

The point is, that once I got used to it, I realized that these speakers tell you what's been recorded. Not everything always sounded pretty, but that's because not everything *is* pretty. Man, I can't tell you how *liberating* it then became to start listening to my records knowing that what was *on* the record was what I was hearing. Finally, I had speakers I could trust! The actual meaning of reference gear became clear to me for the first time. And I'm telling you, all other speakers with the temerity to enter my listening room are gonna have a tough time.

NHT 3.3

Perennial high-end favorite
big rig loudspeaker system

In-room response	23 Hz-26 kHz +/- 2 dB
Sensitivity	87 dB SPL@2.83V
Impedance	6 ohm nom, 4.3 ohm min.
Recommended Amp power	30-300W
Size	42" x 7" x 31" HWD
Weight	123 lbs. each

NHT
535 Getty Court, Suite A
Benecia, CA 94510
1-800-NHT-9993 voice
1-707-747-1252 fax

The bass on these speakers is mindblowingly good. I've never heard better in my room. It was precise and tight, yet fully capable of grunting like a tortured demon. This is bass so damned good you don't even notice it. Know what I mean? Usually on speakers with "great" bass, like the B&W 801s you're all sitting around being *pummeled* by waves of low frequency energy going "Hey, man, isn't this great??" while secretly hoping the apocalypse will happen *now* and the electricity will go out and you'll be free, oh, free, free at last, so help me God!

Not the 3.3s. Instead, all you hear is the bass energy that was recorded, in correct proportion and weight to the rest of the music. I threw all my bass-heavy shit at these speakers, and even went out and bought more. Art Zoyd, Melvins, Metallica, the killer new PJ Harvey: all went down like honey. Angry, scary honey, perhaps, but still sweet to my ears.

Another outstanding, but somewhat confusing, feature of the 3.3s is the laser-locked focus these guys provide. Why confusing? Because they don't image in the way I've heard some other focus-monsters do. For instance, the Wilson Watts seem to not only paint the picture of the instrument being played, they draw a black line around the picture like a child's coloring book so none of the color leaks out. While this can be a cool effect, to me it seems to be another lie, another way that audiophiles demand a little more out of reproduced music than they do out of live music, or for that matter the music that has actually been recorded.

With the 3.3s it is abundantly clear where and what is being played. However, those sensations are not then hyped up to a carnival level presentation of imaging fakery, like you'd get out of say, the Avalon Ascents.

Incidentally, forget about tubes with these. I tried powering them straight, and biamped, with my big gun (ex-big gun. I sold it.) 30 watt Lectron amp and my little gun AN amp and they both sucked. Bass went all to hell when trying to power the whole deal, and even biamped with the Acurus on the bottom, the tube amps, especially the AN, were just too weak to deliver the goods in other than a compressed, over-driven and distorted fashion.

When I first biamped with the AN I thought I loved it, but then the weekend came around and I turned the volume up a little and found out what it really sounded like. Just do like all right thinking Americans do and use a big solid state amp.

Overall, the 3.3s produced music in a wholly neutral and transparent way. After my initial concerns, it became clear that on disc after disc what I was hearing was what was recorded. If I didn't like the sound, it wasn't

Stage Accompany PS 44

Upscale home speakers from a Dutch leader in pro sound gear

Response	40 Hz-32 kHz +/- 3dB
Coverage angle	HxV 110° x 40°
Nominal Impedance	8 ohms
Sensitivity	93 dB, 2.83V@1m
SPL dB Program/Peak@ 1m	115/121
Size	22.6" x 14.6" x 14.4" HWD
Standard Finish	Anthracite coating

Stage Accompany USA
6573 Wyndwatch Dr.
Cincinnati, OH 45230
513-624-9977 voice
513-232-8709 fax

the fault of the speakers, it was the fault of the recording. This is a big deal not so much because I want some of my records to sound bad, but because it's important to me to hear my records as they actually are even if they do occasionally sound bad.

STAGE ACCOMPANY PERSONAL

After Joe Roberts went wild about how cool the Stage Accompany ribbon tweeter sounded with his Onken box bass cabinets in issue #7, the company was moved by his impassioned prose to call him up and offer the chance to listen to their packaged speaker, the Personal. Joe showed greater generosity than *I* ever would've and got them sent to *me* for inclusion in this review.

And for that, I lick the ground just before where his boot steps might fall so that no dust shall ever impede his path because *finally* I've found a great sounding speaker that can be happily powered by weensy-teensy watt-wimps. After many happy weeks auditioning these babies, they have only two real drawbacks: they cost $4,300 and they're *red*. The Personals offer a silky smooth, super detailed high end, a charming midrange, and a powerful, articulate bottom end on almost no power!

They're reasonably sized, about 23" high, 15" across and 14" deep. They are a very simple two way, front ported design mating a 12" paper cone woofer with a version of the totally excellent Stage Accompany ribbon tweeter and have a rated frequency range of 35Hz to 30 kHz.

Revealing Stage Accompany's Dutch roots in international pro audio, the Personal uses the completely consumer-alien SpeakOn connector. While the SpeakOn connector is convenient, easy to use and guarantees a solid connection at both ends, it's completely useless unless you've got SpeakOn connectors AT BOTH ENDS!! Which, of course, I don't. So I had to jerry-rig SpeakOn connectors on the speaker end and then solder regular old speaker cable (the green Audio Note stuff I had) to the naked ends. If it sounded bad you could question my setup, but since it sounded GREAT I guess the issue is moot.

The Personals are housed in a thick and heavily braced MDF cabinet, and as I said, mine were finished in an actually kind of cool, but *definitely* noticeable Ferrari red lacquer. I've been assured, however, that you can get other, more restrained, colors upon request. [*They probably send the red ones to reviewers to make sure they send them back — ed.*]

Before I got the specs on these I guesstimated sensitivity at 96dB. As it turns out, they are only 93 dB but man they sounded clear and loud even with my smallest amp. While raw efficiency obviously counts, there's clearly more to it than just that: for instance, a smooth, highish impedance curve.

The best sound I got them was with my 2A3 powered AES amp and that's what I did most of my listening with, though I also tried the AN amp and the Acurus. I was able to drive both of the li'l amps into clipping before reaching actually painful volume levels, but was able to hit and sustain more than reasonable volumes, even with the tiny 2A3 amp. With the 200 watt Acurus I was able to wake the dead and then kill them again. These suckers play *LOUD!* Again, even with the 3 watt 2A3 amp, I got really good sounding, powerful and tuneful bass. Not quite in the 3.3 league, but then again virtually nothing is.

As usual, I spent a lot of time moving them around in my room looking for the ideal spot but these just weren't that position sensitive. The first day I had them, they sat on the floor and boomed bass willy nilly. I immediately put them on 16" stands and like that, boom, the bass tamed itself. Once on stands, no matter where I put these in my room I got at least real good sound. The best setup was in the traditional hifi location about a third of the way into the room and approximately 30" from the side walls. I toed them in, feeling I got best imaging that way.

Overall, the SA Personals fared well in comparison to the 3.3s, suffering only in quality and extension of the lower bass. They also gave up a little of the extraordinary image focus of the bigger, badder 3.3s. What they offer in recompense is a smoother, more grainless treble. And volume. The Personals were completely satisfying playing off my littlest amp. I couldn't even *hear* the 3.3s when I tried to play them off 3 watts.

Given the paragraphs of spume I spew on speakers I don't really like, I got relatively little to say on these. They're just real damn good speakers and do nearly everything well. Great tonal balance, good dynamics, terrific bass and midrange, outstanding treble range, better than good imaging and soundstaging. I could be real happy owning these speakers, and would expect that satisfaction to last for a good long time.

While I had the Personals and the 3.3s set up for the wall to wall A/B comparison I had a fair number of friends come by and hear the two. Much to my surprise, the consensus of opinion as to which was better correlated almost exactly with the degree of audiomania: those with more liked the Personals, those with less liked the 3.3s. Interesting, huh?

SHOOTOUT CONCLUSION

The NHT 3.3s win. I'm buying them. Best, most pleasing, most music-like reproduction I've ever had in my apartment. While still being the most expensive thing I own, the $4,200 price tag strikes me as a bargain for the level of sound quality that they deliver.

The Stage Accompany Personals come surprisingly close, giving up the edge only in bass extension and clarity and in imaging focus, but beating the 3.3s in treble smoothness and air.

As mentioned above, the big deal for me in this review was to finally put a topnotch efficient speaker up against a really good "mainstream" speaker. I got real good, rockin' sound out of both the 3.3 and the Personal, both of which were sound statements I could be happy living with.

But, in the final analysis I decided to purchase the big NHTs because they gave me the most perfect insight into the actual recorded musical event I've heard in my living room, single ended or not.

So, I'm glad that I finally found a cool sounding efficient speaker in the Stage Accompany Personal. But, you know what? I'M STILL PISSED OFF. And I'll tell you why. After listening to really quite a few speakers these are the first ones I've found that I *really* want to own to use partnered with my single ended amps. So, that's a good thing, right? Yeah, sure, of course it is but these cost more than $4K!!! Well, so what, I hear you saying, the NHT 3.3s cost more than $4K too!

But here's my point: without really suffering *that* much I could be happy listening to my old Dynaco and a pair of $230 SuperZeros plus a $600 SW2P subwoofer. But if I *had* to slot in a sub 10 watt amp I would not be happy with *any* of the speakers I've seriously auditioned in the last year given my listening habits except for the Stage Accompany Personals.

Sure, they're a *lot* better than my lowest level of acceptability, but why isn't there *anything* in the $0 to $4,000 price range? See what I'm saying? You can get a really pretty cool sounding stereo rig together for about $3,000 but NOT if you go single ended. Then you gotta pony up and PAY THE PRICE.

In other words the single ended pursuit, like high-fi generally, is a completely fringe pursuit open only to two types: A) those with wad after wad of long green to cast into the stereo rack, and B) the simultaneously unemployed and technically talented with the time and skill to build their own.

Since we all know that food tastes better when you kil't it 'urself the single ended pursuit of perfection really belongs, morally, to those in group B, and group A should move on to sailboats which are more efficient at sucking up money.

Given that, I think the reviews I've been writing, essentially trying to bring an off-the-shelf product focus to what at this stage of market development is properly an experimenter/DIY pursuit, are bogus. Build more, buy less, have more fun. That's what I say.

Casual Reactions:

The Search for Audio Tranquility

by Herb Reichert, Audio Note NYC

Get the tweak monkey off your back

Audiophiles who have never abused drugs or alcohol should consider themselves very lucky. Can you imagine an audio fiend on crack? He would be down the toilet to Trollsville in 48 hours. Once the audio obsession hits most music lovers are finished, never to enjoy music again. Did you ever see one of these wino-trolls walking down the street talking to himself. . . swatting flies that are not there, turning around in circles, or arranging broken bottles in perfect order? This guy is listening to voices in his head. There is a little committee up there in the control room of his skull and this crazy committee can't agree on anything. The Troll drinks and drugs to turn off these voices — or at least to turn the volume down.

From where I am sitting, it looks like most audiophiles also have voices in the head . . . "Sammy Davis says Tango is the best, but he uses 2.5K with 300B." "I thought that they used REAL *Tang* with the vodka, now you are telling me. . . Keith Richards says expensive winos must always parallel output tubes and never use oil caps." "Herb told me the Quad ESL was a wonderful speaker." "That's funny, cause he told me it was slow and incorrect." Reggie says, "Always bypass." Ricky says, "Lucy knows best about tone character." This is not funny, I get calls like this every day! An evil virus infects the mind of the restless audio consumer. People become addicted to the hi-fi 'good sound' fix. They don't realize it is not good sound but *good music* they are after. A few minutes of musical pleasure here, some tight bass there, soundstage everywhere — always trying to capture and hold on to some memory of audio bliss where it all comes together.

Winos call the first drink of the day "getting connected". Audiophiles think good connectors get them closer to the music. The guys selling audio magazines know that audio is a drug. So do the manufacturers. The minute you stop concentrating on the music and the little voice in your head says, "Maybe the bass is soft. . . maybe the string tone is wrong. . . too strident, maybe I should move my speakers," you might as well be out on the street selling your bod to get bucks for crack. You are G-O-N-E.

I know what I am talking about because I keep getting this same disease. The uncertainty, the confusion, the lack of clear *facts* all make audio difficult but it is the voices in the head, fueled by the voices in the audio press and the words of the audio salesmen that send us to Trollsville.

Crazy Facts and Twisted Lives

Reckon me this: The 1994 *Audio Directory* lists at least 2600 (!) different audiophile speakers. Five years ago, the same directory listed a *different* 2600 speakers. All but ten or so of these 1989 speakers are no longer manufactured. Worse still, how many cents on the dollar do you think you can get trying to sell one of these five year old speakers? It is important to grasp the absurdity of this dynamic.

Try calling up the manufacturer of your preamp and telling him your system sounds bad and you think his preamp is the cause. My guess is you will learn that the man who designed your amp is a wife-beater, the manufacturer of your cables is a fraud, and the store that sold you the system is misanthropic. If you think your system could sound better than it presently does, please believe me it is not your fault. The only thing you are guilty of is not telling your wife how much you spent to get it to sound this bad.

Let's just say I want to 'quit' the audio hobby and just listen to music. I decide I hate building, selling, and writing about audio. I have been doing this a long time, but let's just say I surrender—I am *burned out*. I still haven't figured out how to 'get it right', I am more confused than ever and all I want to do is stop copping audio fixes and sit peacefully listening to some piano music. What do I do? It is like kicking drugs. I may never be happy again. I can't buy a rack system or a wave radio - I am too jaded for that. I am also too jaded to think that just one more big infusion of cash will set my system up right for a long time. All I now want is simple audio peace. I want the voices of the audiophile committee in my head to stop so I can listen to everything ever recorded by Franz Liszt. If you know an easy solution, a patch for my arm or something, please call me now. If you are in this hobby and you have not burned out at least once yet, you will. The fever keeps rising.

Each of us requires a different 'medicine' to bring the fever down and some of us will need quite a large truck to haul away the audio wreckage we created while in the delirium. I spent nearly five years trying to make 4-way horn systems 'work' in my room. These were multi-amp systems with multiple power supplies and exotic tubes and parts. I fell to my knees and begged for help. This is why I stopped with the Edgar Horns —I couldn't do it. . . I broke down intellectually, physically, and emotionally. My wife said, "Don't you listen to music any more? All I ever hear is test tones." Her words were my catalyst. I *knew* she was right. Hell, I was walking down the street and laying in bed scheming system changes. If by accident you are getting like I was, here are a few suggestions and a few observations.

Too many choices

The hardest thing for most audiophiles to grasp is that the loudspeaker plays the room and the room plays the whole hi-fi. The relationship between the listener, the system and the room is the most important relationship in audio. Steve Guttenberg, Chesky's balance engineer, always reminds me: "Don't expect a Steinway grand piano to sound any better on your hi-fi than it would playing live in your room." This rule applies to a full rock or jazz drum kit or a full orchestra. You can't overload the room and expect natural timbre and clarity. All we can hope for is an intimate, naturally proportioned, realistically balanced *miniature* of the recorded performance. Therefore the size of the room, the size and radiation pattern of the speaker, the

decoration of the room and where we sit are very important considerations.

I want you to imagine your listening room with just three or four small, simple pieces of audio equipment sitting on beautiful, low, hardwood altars. Tiny pin-spots illuminate the faceplates and the rest of the room is shadowed with a Rembrandt-like glow. You have created a chamber, a retreat, a place to visit to renew yourself. I believe that if we can create the simplest most elegant system in the simplest, most serene room we can make the voices stop.

The single biggest mistake that audiophiles make is picking the wrong speaker. You can't blame the audiophile too much because there are thousands of really bad speakers to choose from. Unfortunately, once you pick a speaker that goes to war with the room, the hope of audio peace is over. If the speaker is big and ugly, the hope of simplicity and elegance is also lost. So let's start the quest for peace and beauty with small and simple.

Pick a *classic* new or used speaker that has proven its' worth through the test of time. These are easy to spot. A classic speaker is one that has been in production, largely unchanged, for more than ten years AND has retained its original value or risen in price. A one year old Avalon Accent that originally sold for $16K and is now worth only $6K is NOT a classic. A Quad 'ESL' that was in continuous production for over thirty years IS. In 1978 the ESL sold for $535. Today you can expect to pay $600 - $1200 for a nice pair. The JBL 'Paragon' and the Altec A-7 are worth ten times what they cost used in 1978! They are too big for our purposes here.

I recommend a small speaker in a small room - this minimizes the amount of obsession required to place the speakers optimally. The original Quad, the Rogers/Spendor LS3/5A, the Spendor BC-1, the Western Electric 755, the Lowthers, and for those of you who do not have a small room, I recommend my favorite speakers of all time: the Snell A2 and A3.

All of these speakers will retain their investment value, in fact they should all go up in value while you are listening to them. Will your currentspeaker do this? More importantly, all of these speakers are happy with 20 watts or less. Isn't it funny how all the classics (don't forget the Klipschorn) are speakers that work well with low powered amps? A case in point: the original Advent and the Dahlquist DQ-10 were very popular, decent sounding speakers. Tens of thousands were sold. Today you can barely give them away to an audiophile—too power hungry, not enough (any) quality high-powered amps. Can you name a 100-watt amp that has gone *up* in value?

If you are not a speaker designer, admit it to yourself. Chances are, you never will be. I sometimes like to think I am since I have been trying for 30 years—but I have never even come close to beating any of the above-listed speakers. Sorry, but what I am telling you is that the voice in your head that says, "you can do better" is lying. That is the same voice that told the designers of those 50,000 discontinued speakers, "you can do it - and cheaper too." Yeah, right!

We must stop the war between the speaker and the room. Most systems that sound bad do so because the speakers integrate poorly with the room acoustic. Play a 440 Hz tone and walk around the room. In some places you can barely hear it and in others it will be twice as loud. When I listen to most peoples' systems I become stressed because I feel the conflict between the system and the room. Quality music reproduction is simply a matter of proportion. When the basic tone and dynamic capabilities of a system are in order, in balance if you will, when reproduction has a sturdy, unshifting dynamic balance, then even poorly recorded records seem very listenable. Why? Because great musical art communicates its own proportions and when the mind can recognize these proportions during playback, the music sounds good. All we really need to enjoy our records and CDs is to preserve the basic proportions of the performance.

If you want to find peace with audio, start by TURNING THE VOLUME DOWN! You must learn to listen on a modest scale. The speakers I recommend here will minimize your placement and room coloration problems only if you learn to listen at lower than live volumes. Audio systems actually have greater resolving power at lower volume levels. Playing music quietly shows that you are sophisticated, that you have been around the audio block, and that you have recovered from audio burn out.

More than half way to green pastures

If you have a modest speaker in a modest room and your are sitting in a very nice chair listening at connoisseur levels to some PJ Harvy or some Elly Ameling, you are almost home, but the next step is VERY HARD. Almost no one gets this one: You must figure out what really matters to you most in music reproduction. Choosing one of my recommended speakers has already limited your low frequency response, some of your high frequency response, and, in the case of the Quad, your dynamic expression. In order to create a satisfying system you will have to find a CD and/or a LP source and some amplification that will not limit you any further. You must have gear that will paint with a full palette of tone color, keep extraordinary tempo, and wring the last bit of expression out of your music software.

This is tough, but it does not have to be expensive. I think many of you are already on the right track because most *Sound Practices* readers already know that a small parts count goes a long way towards creating quality electronics. More important though, is compatibility. The amp, speaker, cable combination is the motor that drives the heart. This combo pressurizes the room and gives the reproduction its sense of life. If the voice in your head says, "you must build your own audio" then build your own amp. It is possible to learn from the classic amps and build something in the basement that will not sidetrack you from your quest for audio serenity.

The *classic* amps, the ones people keep playing music with for decades, have a few things in common. First, they are usually simple tube amplifiers and secondly, more often than not, they have tube rectifiers. The most lovable preamps have tube rectifiers also. There is a beguiling sense of continuity, like a river flowing, that makes these tube rectified electronics subliminally appealing.

There is a similar effect with "split-load" inverters in push-pull amps. The popularity of single-ended amps is based on this feel ing of continuity. Single-ended is the purest expression of continuity. The best SE amps also have tube rectifiers. The full wave bridge tube rectifier is rare but the best at evoking this effect. The Mac, Marantz, WE, Fisher, Scott and Dynaco gear mostly had tube rectifiers. They also used Allen-Bradley resistors and some of the most musical of these classic amps and preamps used choke filters. A choke, a tube rectifier, and a simple design are almost a lock when it comes to classic status. Reliability does not hurt either. So what do I recommend?

Lets start with the Quad ESL. This speaker should only be used in small dedicated listening rooms. Its bass performance is near perfect in rooms of less than 5000 cubic feet and rarely 'goes to war' with the room it is

playing in. This speaker's only problems are famous: it beams very badly and it is dynamic expression is quite limited. The amp choices are simple; forget the OTLs that were the rave and stick with the Quad II. Get the amp, preamp, and tuner and enjoy your music while you watch the value of your whole system go up. The Dyna ST-70 and Citation II amps are fine also. This system will make your friends feel bad when they go home and turn on theirs. Single-ended can work here, but you must have around 18-watts with at least 20 volts swing at the output. Remember what the expensive wino said. . .

The LS3/5A will be around a long time after the Sonus Fabers are gone. These tiny boxes are the definition of what I have been talking about - let's call them an 'antidote' loudspeaker. I like the Quicksilver Monos (8417), the Dynaco ST-70, the 300B single-ended amp and the 2A3 push-pull with this speaker. Don't laugh, I honestly think the Dyna ST-70 is one of the most satisfying of all the vintage amps. Try not to modify it too much. . . leave it alone and enjoy the music. This speaker can be a fine start towards elevating your internal reference for balanced reproduction.

The Lowthers and the WE 755A are both established classics. Their character is 'fast' and chameleon-like. NOT dynamically challenged. They will play any kind of music. If you don't agree, the voices are talking wild in your head or you are not ready to surrender to audio peace. Two other possibilities; you haven't heard them with a no-feedback triode amp or you are playing them too loud and loading the room in a bad way. Speakers like these are what we climb the mountain to talk to the master about. The Holy One does not use crossovers. With no crossover you hear the cone, sorry! You also see the light.

With either of these classic full range drivers, use the BEST amp you can build or buy. The ST-70 will not do here — I recommend the Audio Note Gaku-Ons ($252,100.00). The discontinued Snell A2/A3 should still be in production. This speaker has little competition for the rank of most musically satisfying ever! Which amp? 20 - 100 watts directly-heated triode is perfect.

Next you must have a preamp, but recommending preamps is tough for me. There are only a few I can personally say will bring audio peace. Most preamps lack naturalness and ease and therefore will turn up the volume of the audio committee in your head.

From a home builder's standpoint I say build the RIAA and the line stage from any RCA tube manual and get a step-up transformer for your MC cartridge. The Marantz 7-C has become a high-prop collector's item that is fundamentally charming and engaging but not simple enough for audio peace. I hate to say it but I like the Dyna PAS II. This preamp is weak on information recovery but simple and honest. Again, don't modify it too much.

Remember, our goal here is to create a simple system that will impress ourselves and our friends with its ability to draw us in and make music enjoyable. Some other possible choices are the Audio Research SP-6B, the Vendetta phono stage, and maybe the Super-It. If you get this far towards audio peace maybe you can tell me which preamp works.

I am still too front-end crazy myself to make any firm recommendations regarding software playback. The Linn LP-12 and the Rega tables are a good place to start. After these, the investment aspect gets shaky. CD? You-pick-em! Trying to buy a separate transport, cable and DAC from three different manufacturers seems unmanageable and a sure-fire formula for turning up the voices.

I must say that my heart is truly with the music lover. Buying a satisfying music playback system from a high-end audio salon is nearly impossible. Audio magazine reviews only make the confusion and the fever rise. Building your own is a formula for years of lost sleep. Where does that leave us? I think the builder or the buyer can both enjoy the process of acquiring and listening to a good hi-fi if they just remember to limit their aspirations. Don't tax the room; choose a small simple speaker. Don't tax your budget; choose components that retain their resale value. Don't tax your mind; choose components that have *proven* their worth and musical prowess over time.

Most important of all—work slowly and trust your own feelings.

The new Edgar Lineup

For example, **AES/CARY** just introduced a SV811-3 mono amp called the *SE-811*. This 12 Watter features a beefy "screen-driven" 5881 driver and it sounded like they were driving this tube right into a pair of lead-lined Focal-based prototype loudspeakers. According to Dennis Had, the *SE-811* might ultimately be available in kit form, so be on the lookout.

Those hometown Vegas transformer-winders from **ELECTRA-PRINT** had several sharp-looking SV-811 based amps. The 50 Watt *Vershina* really showcases the brilliant white glow of those thoriated tungsten SV-811 filaments with four parallel SE power tubes per side. This $10k a pair, 85 pound monoblock is class all the way, down to the gen-u-ine 24K plate on the transformer end bells. Of particular interest to the DIY community, E-P serves up full and partial kit versions of two of their SE amplifiers, the $4300 eighteen-watt stereo *218EP* VV30B amp and the $3200 stereo *210EP* SV811-3 ten-watter. Being crazed experimenters themselves, Jack Elliano and Cy Brenneman love to work with fellow DIYers looking for a worthwhile project. Aside from the considerable therapeutic and educational value of building a kit, you can save over half the cost of the assembled versions by soldering your own connections. Gold plate optional.

Several new species of **EDGARHORN** were on hand at the show. Photo shows three Edgars, the *System 50*, the *System 80* and *Bruce* himself. The second-biggest Edgar is the $10K two-way that Bruce engineered as an answer to all the "fancy European stuff" that's coming out these days. The circular wood-horned compression driver HF was big and smooth on vocals. Wood is definitely the ticket. Forget those amusical cast aluminum airport paging horns. Low end is handled by a 50 Hz wood horn of substantial proportions.

The System 80 is a 42"x 19"x 18" integrated horn setup with a 5 foot long folded tractrix 80 Hz horn, a 5" JBL mid on a 400 Hz tractrix mid, and a tractrix horn tweeter. Designed for against the wall placement for bass reinforcement, incidentally making it an ideal horn solution for installations where floor space is at a premium. Whopping two watts recommended minimum power at 103 dB 1W/1m system sensitivity. Popularly priced at $1200/pr. Watch out, *La Scala!*

CLASSIC AUDIO REPRODUCTIONS added a new horn rig to their collection of fine furniture neo-classic horn loudspeakers. The *Studio Standard* is a three-way system based on the design principles of the legendary *Hartsfield*, featuring a 15" woofer crossed over to a JBL titanium diaphragm compression driver fitted with an acoustic lens topped off with a wide dispersion HF unit. The smaller, more rectangular footprint of this system is an advantage over the Hartsfield in some setups. Sensitivity of this $6350 system is a roaring 103 dB 1W/1m.

These diehard JBL nuts were also demonstrating a killer "bookshelf horn" with a JBL mid/high horn and a pair of fancy imported 6 1/2" inch woofs. Called the *Cinema Music Channel*, these 96 dB 1W/1m, 8 ohm speakers are being presented as a home theater accessory, but they sure sounded powerful and hearty playing rockin tunes on 8 watts from a *Cary SE-1*. Suggested list on these sleepers is $2030/pr. He might not remember the conversation but after a couple beers at the *Fi* party, John Wolff offered to extend a very special introductory deal to *SP* readers to get 'em started on horns. I'm your witness . . . operators are standing by. . .

Classic Audio Reproductions
515 Red Fox
Brighton, MI 48116
810-229-5191/810-229-5969 FAX

In five pages, I can only explore the tip of the thermionic volcano that was CES '96. Also worthy of note were the **BEL CANTO** 845 amps, **VAIC VALVE AGs** corral of luxury SE amps, the **N.E.W.** battery operated preamp, the French **AUDIO SCULPTURE BY AUDIO MATIERE** amps that run single 845s with a triode-wired 813 that kicks in when extra power is needed, the **MPR** SV811 amps from that hotbed of tube experimentation, Italia, and on and on. Consumer Electronics Shows are always full of new products. What made this year different for me is that with all the fresh spirited action that went down this year, I'm actually looking forward to Vegas '97! Unbelievable.

Classic Audio Reproductions' stable of horn speakers

MAUHORN

by Andreas Mau
Lowther Club Deutschland
World's greatest Lowther fan

My *Type IV* 3.5m horn uses 22mm boards for the outer case with the following dimensions:

2 each 102.5 cm x 82.5 cm
2 each 25.6 cm x 82.5 cm
1 each 25.6 cm x 98.1 cm

The best way to put the enclosures together is to place a large side panel on the floor or table and glue the parts of the horn onto it. The final step is to glue the other side panel on like a cover.

Lowther for Life!

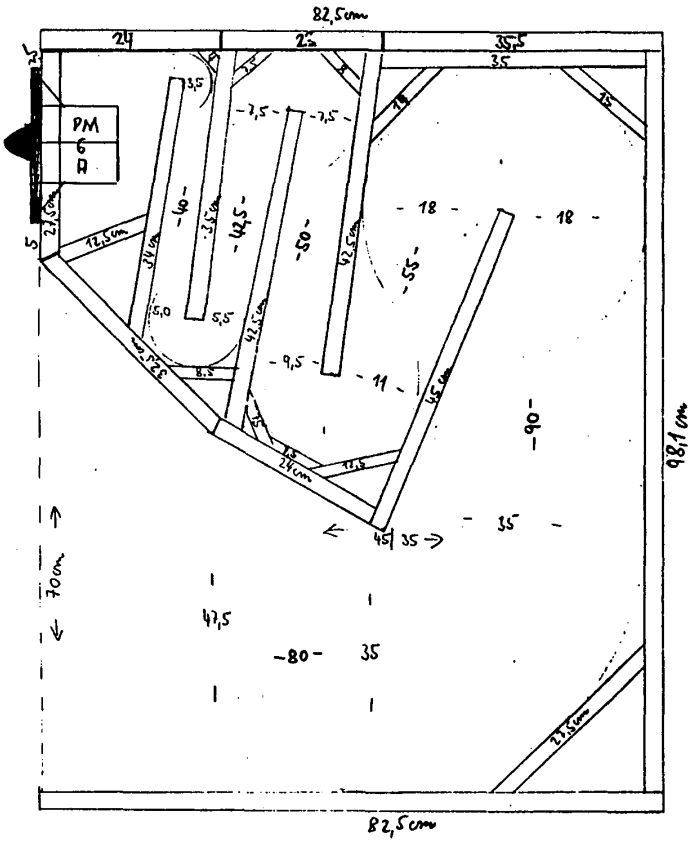
The beginning of it all for me was a demonstration of the Lowther Classic 400 by a friend of mine. I was surprised how clear and natural the sound was. I built the *Acousta 124* and the *Delphic 500*. I thought the very best solution would be a one drive unit direct-radiator with a large bass horn.

I tried the old *Acousta 115* but the wood in the panels was too thin. The wood for a bass horn must have 19mm strength. The sound of the *Acousta 115* with a PM6A was fine and very clear but the bass was very thin. So I planned a larger bass horn with a little magnet chamber.

I did my research on these cabinets in 1985 and 1986 and published the results in the German loudspeaker journal *Klang & Ton* in November 1991.

My first horn with a 3.5m length was fitted with a PM7A driver. I was totally blown away with the dynamic bass response. Live sound! I closed my eyes and I was absolutely delighted. Such a clear sound I never heard before. I was a speaker builder for many years and I tested many constructions, including big transmission line cabinets fitted with KEF and Celestion drivers. They all sounded poor and unnatural compared with Lowthers on a long bass horn.

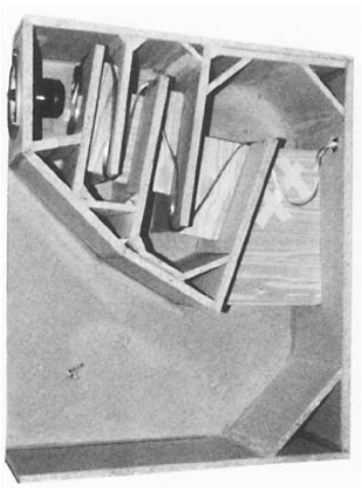
Both of my cabinets feature a small magnet chamber. One horn is 3.5m long and one is 4.5m long. Both are 25.6cm wide inside width. I used 22mm shipping boards for the outer walls of the cabinet so the outside width of the cabinet is 30cm. A combination of 19mm and 16mm boards were used for the reflectors.



MALHORN Type IV

Outside Dimensions
Depth = 82.5 cm
Height = 102.5 cm
Width = 30 cm (26 cm inside)

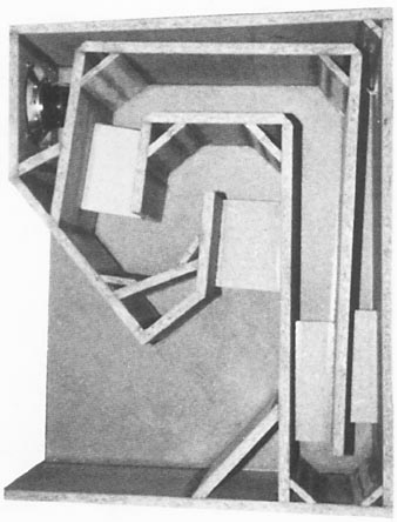
Volume = 254 liters
Bass horn length = 3.5 m

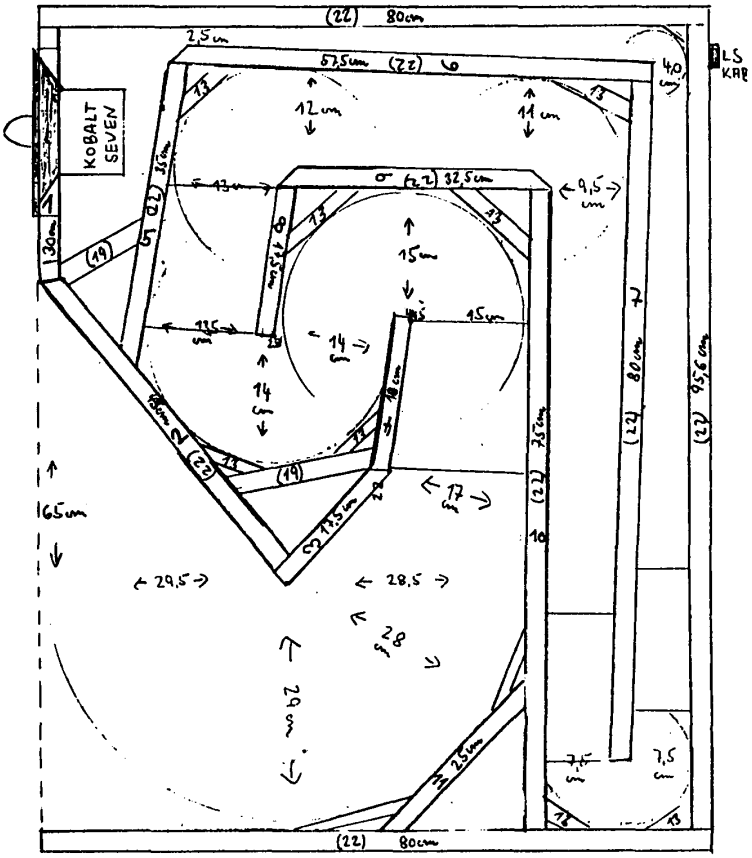


MALHORN Type V

Outside Dimensions
Depth = 80 cm
Height = 100 cm
Width = 30 cm (26 cm inside)

Volume = 240 liters
Bass horn length = 4.5 m





After I built the outer cabinet I installed an extra 22mm panel on each side for reinforcement. So now each cabinet weighs 80 kg and requires 6 rollers!

I initially designed these cabinets for myself, so the sketches provided below are the only drawings I have.

This cabinet is relatively small and it can be located near the side walls in the corners of the room. The cabinet can also be mounted on a wooden frame with the driver and horn mouth facing down, for use as a subwoofer. Another idea is to position the cabinets with the drivers facing the rear wall and then use a forward-facing small cabinet or midrange horn for the high frequencies.

The *Type IV* 3.5m horn is intended for use with the PM7A, 2A, and 5A drivers. The *Type V* 4.5 m horn is for PM6A and 7A drivers because of the little back chamber. I designed these cabinets as modules, thinking that more cabinets can be put together if I ever wanted to move more air.

The sound quality of both horns is fantastic. The shorter horn offers a more pressurized, high energy bass response while the longer horn sounds more inconspicuous, but extremely clear and with deeper bass extension. Standing in the corner, the wall serves to enlarge the mouth of the bass horn.

The large panels on the horn should definitely be stabilized by additional panels. There is no need for any damping material such as wool, coatings, or anything else. Note that the chamber is very small and the pressure inside is very high. I think it is a high-performance racing motor of a sports car, an old design driver in a high-pressure cabinet! This is what I did not find before in any of the factory *Acousta* and *Bicor* cabinets. To reproduce 40 Hz bass the cabinet must have a certain size. The large bass horn is the best solution. You will only need a 2 or 3 watts per channel amplifier to play music in natural live atmosphere sound.

As Paul Voigt was a son of German parents, I feel that I have to work for his name. Why do so few people know of Lowther and Voigt? As so many people are now interested in Lowther there is no need for more words. You will see what happens when great loudspeaker fans hear Lowthers for the first time. They will throw all other speakers out of the window!

The top-end Lowther cabinets are the great corner horns like the *Voigt Domestic Horns*, *TP-1*, and *Opus 1*, but if you are looking for a mid-size, easy to build construction, please hear my horns. Never will you forget!

Andreas Mau
Lowther Club Deutschland
Postfach 12 46
24584 Nortorf
Germany
FAX 0049/4392/ 8168

BUILDING THE MAUHORN TYPE IV

by
Jérôme Phaneuf
Experiences Sonores

The story began when my father read the articles by Haden Boardman and Joe Roberts about Lowther in *SP*. He was impressed that they were so enthusiastic and he soon wanted to know more about the product. He called Frank Reps, a longtime votary of Lowther and after the long praises of Lowther Frank sang to him, he began to look at his *3A Master Controls* differently. Mr. Reps was apparently living an audio experience that my Dad couldn't even think possible. He sent the plan for the *Acousta* to my Dad: "Try them Christian!" Dad had a pair made by one of his friends and the reign of the 3As began to fade.

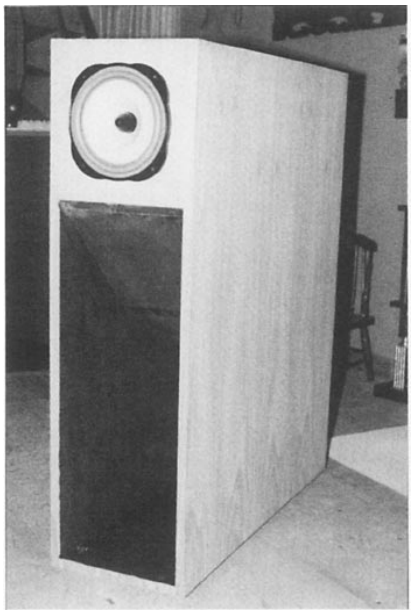
Then he wrote to Andreas Mau to ask for plans of another good Lowther enclosure. Dad wanted something simple to build, like the late model *Acousta*, since we don't have a lot of woodworking tools. Mr. Mau kindly sent him the plan of the *Fidelio* along with comments and pictures of different types of Lowther enclosures. But there was something else in the envelope. . .

It was the plan of a tremendously long horn (3.5m), featuring a very narrow baffle and a small driver chamber. The box itself is about 83 cm deep, 1 m high, and exactly 25.6 cm wide inside the horn. A big enclosure but since it is very narrow, it can fit in a medium-sized listening room quite well. Be sure that the floor is strong enough to hold them, because each of these superboxes weighs over 100 pounds! Dad was intrigued by the idea of a very long horn in a not-so-big box. And, after all, since Mr. Mau sent the plan, it was certainly a product of that world-renowned German engineering. "Son, can you build that?"

We decided to use 3/4 thick Russian veneer which is made of 15 layers of white, good smelling, and very dense birch wood. This plywood is the best quality available here. I suppose we could have used MDF, but Dad is a no-compromise kind of guy and I hate to work with MDF. It is always crumbling. Have you ever seen a violin made of MDF? Anyway. . .

The plan was a little hard to follow since my German is not very good. The major challenge was to adapt the plan so I could use plywood of the same thickness throughout the enclosure. Mr. Mau uses boards of different thicknesses in his horn so I had to recalculate to ensure that internal dimensions remained the same.

I filled all the cavities with insulating foam to avoid box resonances (when the box is closed, it's too late, pal!). I also ran the speaker cable (silver) in the upper panel of the enclosure because I was afraid it would vibrate when the music played if I ran it through the labyrinth. This measure also reduces the length of wire required, a good thing economically (for us garage sale cheapskates) and sonically.

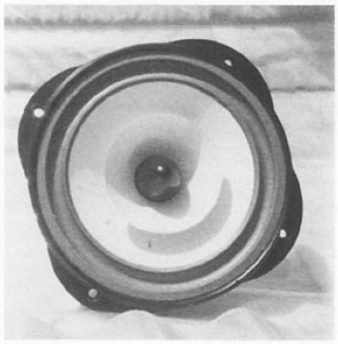


Finally, following wise advice from Frank Reps, I made extra sure that all of the seams in the driver chamber were perfectly smooth. We carefully filled and sanded the edges all over the length of the horn. I'm not sure that this does any good but it can't hurt. In any event, Dad and I wanted to be sure that we maximized our efforts before the enclosure was sealed. Months of weekend work later, The Day Came.

I fitted those babies with my father's new pair of PM7A "Hi-Ferric" units. At this time, Dad was very anxious. He was choosing some CDs to make the test—Dave Grusin's *The Gershwin Connection*, MJQ and friends, some Sheffield (including Drum Test Record), etc. Oh god almighty! This was good sound! I never thought those delicate Lowther drivers could have so much bass. Clean, true, clear bass, I mean. Not that kind of fat, artificial boomy bass we hear so often. It was a good idea on the part of Mr. Mau to design the box very narrow. While improving imaging, this design make the horn stiffer so it won't vibrate a lot at low frequencies to make what I call the "box sound."

Before we listened to the **MAUHORN** or any Lowther at all, Dad's good friend Frank Reps told him that the Lowther experience was like removing heavy blankets that were hung in front of your speakers. I was a bit skeptical. How could a homemade enclosure sound better than the 3A Master Control driven by an excellent 300B amplifier? I have not heard thousands of speakers like you audio fanatics, but I've heard a certain number of very fine systems and nothing (according to my personal tastes, naturally) even approached the natural sound of the 3As.

I will tell you the truth—the 3A Master Control never played again in the house after we hooked up the **MAUHORN**. Frank was right: the blankets were removed and it was time to listen to some unmuffled music. The sound was so limpid, image so good, fine details we never noticed before began to appear—the illusion of being there with the musician was striking. The **MAUHORN** is indeed an excellent design that Andreas Mau must be proud of. Trust him! Make yourself a pair. You will have no regrets when you sell your other speakers to somebody else.



BETTER THAN OKTOBERFEST?

I just finished reading through all the issues *SP* published yet and would like to congratulate you on its fascinating contents. It sure is a shame none of my friends urged me to read *SP* earlier. Since I am more into speakers than amps, I would like to pass on my thoughts on what I read on horns while the others cherish the lasses at the beer festival.

i) Altec upper range: I found the 288C the best driver overall, if you want a finished product. Faster and more dynamic, though, is the old alnico 290 driver sans xformer and with an 288 alu dome glued to it. My own pair also has a very thin (~2μm) layer of silver applied to the poles (idea taken from JBL LE 85/2420) for even better HF performance by lowering coil inductance; it goes up to 18k @-6dB, which puts the question of sacrificing homogeneity by going 3-way to rest forever. That is, if you can live without an 8 to 15 cell horn for broad dispersion duties. Try 311-90 or 203 instead; 311-60 has some 3 to 4 dB lift on axis at 1 to 3 kHz, depending on driver/diaphragm used, but is OK otherwise. For low cutoff, try 290 or 288 with resin diaphragm on 1503 or 203 horn using steep (I mean steep) active x/o at 240 Hz.

ii) Altec phase plugs: I do not agree with the somewhat generalized view held by some of your correspondents, namely that on 1" drivers the WE-type phase plug is better than the tangerine; the best Altec 1" I know of is a 808B alnico + tangerine with 891318 ass'y (nearest equivalent is an off-the-shelf 802G driver). Although Altec's literature of the day claimed extended "high-end response while significantly reducing distortion", the midrange through a WE-type phase plug is indeed slightly clearer, the first claim nevertheless holding true. Contrary to what has been implied, an aluminium 1" works best into 511, not 311 horns, the latter sounding rather slow and restrained (overdamped?); also, the 802G top end is not better than that of a 1.4" driver modified as described above, if you ask me. I suspect some standard 288C samples might even beat a 1" driver on a 311 or 329 horn @10k, the result largely depending on the sample variations among the 1.4" driver's diaphragms. I haven't tried 1.4" tangerines yet, but comparisons might be misleading, as Altec has changed phase plug and magnet structure more or less simultaneously as opposed to the late 70s transitional time span employed on 1" units.

iii) Tractrix upper range (in the US named after a guy who seemingly likes 4 extra chars in front of his name): First put into broad use by P.G.A.H. Voigt (nine extra) of Lowther fame pre WW2, they offer the most neutral performance I have heard. Since the impedance varies more than with some other types of horn, I'm not sure whether it's a good idea to x/.1st order?!? As far as I know, they were first used with D54 in the 70s in a speaker past IRS price range by a company based in Duisburg now trading as A Capella. Their mid-horns are circular and employ perfectly curved surfaces in glossy white lacquer...a dream! Apparently a guy in Berlin called Martion started doing similar things at about the same time. I tried a like-looking lampshade with Yamaha NS 1000 and 2000 beryllium domes, but as all parts of 'em domes move in unison instead of warping and disengaging their central bits like your D54 does, you really need a phase plug to get output beyond 3k. Back to i), then. Maybe, though, one secret to classic joy of the law is having horns circular, as the Japanese GOTO horns (pure exponential flare laws) are circular as well and absolutely gorgeous at that!

iv) If you have the necessary spare change or are lucky to get hold of one at a giveaway price, try a Pioneer/TAD driver, especially the Alnico/beryllium-domed 4001 2-incher. Said to be the last word.

Ralph Gibbemeyer
Munich, Germany

TWEAKING TOWARD JERUSALEM

I just received issue 9 of *SP*. Speaking out! You know, the Aquarian Age for music started in 1968 and now Armageddon is not too far away anymore. Like Yasser Arafat said himself in Bethlehem; he's only 3 miles away from Jerusalem...

The best music rolls off a genuine-silver-throughout Ongaku. The global domination of tyrannical monsters can begin. Can the Ongaku stop them? Will New Age music ease your mind? Is Mr. Reichert of Audio Note NYC frustrated because of this?

The big oil companies are indeed suppressing the 300 miles per gallon carburetor. Now listen, around 1990 there was this German engineer who made a turbodiesel engine of 1.5 liter, 4 cylinder, 100 HP din, more or less. He mounted this engine in place of the Mercedes 2.5 liter turbodiesel of 90 HP din. Guess what? His 190 reached a top speed of 180km/h, that's 120 miles/h fast, and at an

La Voice of the Theater Chez Nous

Taming the ALTEC A5 Classic for Domestic Use

by John Stronczer
Bel Canto Design

When I had the opportunity to hear Jean Hiraga's A5 system in the *Nouvelle Revue du Son* listening room with our *Orfeo 30*, 845 SE amp, I *instantly* knew that I had heard the system that could replace the Spendor SP-1s that have been doing the job in our living room for over 13 years.

Actually, the Spendors officially belong to my wife. She always had a suspicion, totally unjustified of course, that I would go out and sell the old reliable SP-1s in an audio frenzy.

I confess that it was love at first listen with the A5s. I mean I listened to a single bar and I *knew*. When I chose the Spendors it took me about 10 minutes of listening. It doesn't take me much listening to recognize a speaker I can really live with.

In any event, the decision to explore a large scale horn system has proven itself to be a positive step. Music has injected itself totally into our lives through these devices, they are, indeed, the other half of the wonderful music creating possibility of the SE triode amplifier.

No, they aren't perfect, although I am not yet certain if any weaknesses are a result of other system components or the recording or the speakers. These speakers make music completely engaging, without any 'High End' audiophile pretensions in the traditional sense.

Sure they aren't perfect (what is?), but they are so much better than any alternatives, and they play music so convincingly that I just don't really notice or care about weaknesses.

A properly set-up A5 system can make one forget about the little audiophile worries and just listen, becoming engaged with the music, whether Hendrix, Gould, Bizet (opera comes positively alive), Brel, Evans, Miles, Nina Simone, the Beatles, you get the idea, every artist communicates their musical potential through a system like this. The source can be CD, LP, radio or even an old cassette, you will still hear more of the music and the musician(s) than you ever have before.

I am not an audio reviewer, so I won't take apart the performance. Let's just say that they can do everything very well, some things better than any other system I have laid ears on. Overall, they are good enough to make other familiar systems seem Dead End. Instead they incite you to dance or laugh or sing or just shake your head in wonder at the musicianship of a performance.

Actually, after living with our customized version of the classic A5 Voice of the Theater system we have concluded that it would be just about impossible to go back to a more 'normal' type of loudspeaker.

Jean Hiraga's System

How do they do what they do? As an engineer this is the first question that comes to mind when I experience something unexpected. This was what led me to the 845 triode and SE amplifiers some 10 years ago and it is happening again with these loudspeakers. I will describe the system that I heard in Paris and continue by describing what I have managed to assemble, looking at the parts before trying to home in on the whole.

M. Hiraga uses the 828 style bass/midbass cabinet with a Westrex (Westrex was the export arm of Western Electric/ALTEC) sourced 515B type 16" bass/mid driver below 500 Hz, a Westrex 2080 1.4" compression driver (Altec 288 C) comes in at 500 Hz and drives a 1505B, 15 segment exponential horn, and for large spaces he brings a JBL ring type tweeter in above 15 kHz.

The crossover/EQ design generously shared by M. Hiraga was essential for getting a loudspeaker which was originally designed to fill a large theater to make music in a reasonably sized home.

The third octave sweep from the system in France and the crossover circuit from M. Hiraga are shown below. It looks somewhat complex but is really quite a simple and elegant solution to the challenge at hand.

The crossover marries these two drivers very well, yielding a response that is remarkably flat in room from about 40 Hz to around 16-17 kHz. I did not use a ring tweeter, agreeing with M. Hiraga that it is not necessary in smaller spaces.

The 828 cabinet is a hybrid design using a short horn loading the 515 above 150 Hz. Below this it behaves as a reflex cabinet, using both the front and back waves plus room augmentation to get enough efficiency to match the short horn midrange. The result is about 100 dB/W/m down to around 40 Hz. This is very high sensitivity for domestic use, enough to get tons of sound out of a 3 watt amp.

Despite the high sensitivity of the A5 system, Hiraga prefers high power SE amps such as the 30 or 60 watt *Orfeo 845* amps, meaning he gets lower overall distortion, better bass and still has plenty of headroom for dynamics in his large listening room. He brings in the HF horn at 500 Hz with some EQ in the crossover to extend the upper end response to around 16-17 kHz and bring the overall efficiency in line with the bass cabinet.

The 1505B is mounted above the bass cabinet, phase aligned and directed down towards a listener about 12-15 ft away from the speakers. The Altec horn has a fixture which allows the vertical angle of the horn to be changed, permitting you to aim the horn at the listening height and blend it with the bass driver. The horn is not rigidly mounted to the bass cabinet, you can move it to align for best phase response with the bass.

The JBL super tweeter is placed well back on the external rear top of the bass cabinet, also phase aligned and firing at a 45 degree angle into the listening area. This fills the room with the high harmonics and reduces the directionality of the system.

Thanks to the extensive EQ in the crossover, a passive unit designed for use with one amplifier, the sound is very balanced. M. Hiraga changed the port opening on the bass cabinet to better align the reflex cabinet and he uses side mounted bass 'wings' to restore the low bass efficiency for use away from room boundaries. There is some strategically placed damping putty on the mid horn and there is a large thick felt blanket in front of the JBL to prevent reflections off of the cabinet top.

I find the whole assembly attractive in a purposeful industrial design, no nonsense kind of way. My wife has been convinced to live with ours, especially after hearing what they do for music, and a promise from me to clean up the finish a bit. It does take up space, to be sure, but it makes more and better music than any other system I have heard.

Despite the size, it won't go down to 20 Hz, that will have to wait for some kind of serious subwoofer system in the future. The rest of the spectrum reveals how uninvolving and uncommunicative most 'High-End' systems are. Not even taking SE triodes into the equation, this kind of speaker will get the most out of whatever goes in front of it. This is the direction that we need to go.

The Logic of A5 Systems

So, what can we learn from Hiraga's A5 based system?

1) Use high performance, intrinsically linear (i.e. low distortion), high efficiency, drivers and cabinets.

2) Avoid overly extended or resonant cabinet alignments.

3) Use as wide a midrange bandwidth as possible, avoiding crossovers in the 1000 to 3000Hz region. The special qualities of this loudspeaker are in part due to the use of only two drivers for full range response.

4) Phase align and focus the driver alignment.

5) Pay attention to response smoothness over absolute maximum efficiency, 96-100 dB will be enough for virtually any domestic situation even with only a few watts.

6) Make sure the upper harmonic energy is there and can get around the room.

7) Don't worry too much about the lowest octave, especially at the expense of the upper and mid bass performance. The low bass is where the mud starts. And above all, keep it simple.

I will now detail the speaker by addressing each of the above points and discussing specifics of my implementation:

Driver Quality is where everything starts...

The 515 bass driver and 825/828 style cabinet are remarkable for their efficiency, bandwidth and low distortion. I used a 16 ohm 515E driver. This is the ceramic version of the 515B, the legendary Alnico driver.

The 515B and 515E apparently have less midrange output than the new 515G version. This is probably a good thing as there is about a 5 dB step from around 150 Hz up shown in the 515G documentation. This is great when projecting sound in a theater, through a screen, but it definitely needs taming for domestic use.

I personally have no problem with the ceramic version of this driver, the moving

1— According to Altec expert Gary Jones, the early versions of the A5/A7 bass cabinet were called 825, which was replaced by the 828 when the 515 switched from a 15" frame to a 16" frame in the mid-70s. The later woofers will fit in the 825 cabs because the mounting holes are slotted. The early woofers will not fit in the 828.

elements are the same as the 515B version and assuming the gap linearity and flux density is high enough I won't ever have to agonize about whether the Alnico needs to be remagnetized as they sometimes do after time or after a mechanical blow or overload. The 515s are great drivers in any version.

515s have enormous magnets and the 3 inch edge wound aluminum ribbon voice coils are underhung, which greatly increases the driver linearity. The 16 ohm version has a BL factor, which is a measure of the magnetic flux density times the number of turns of wire in the gap, of about 22 for the 515E. Contrast this with a good 8 inch High End woofer BL factor of around 5-8. This is remarkable for any driver and especially impressive in combination with the underhung design mentioned above. This gives an idea of the acceleration potential and the control that this motor system can provide.

The cone is a beautiful paper construction with a very stiff spider. You can push on the edge of the 15 inch cone and there is no rocking, just a linear movement of the whole cone.

The dust cap has a 1 inch hole in the center to avoid compression distortion and dust cap coloration and the damped, pleated suspension avoids the low level hysteresis loss typical of rubber surrounds.

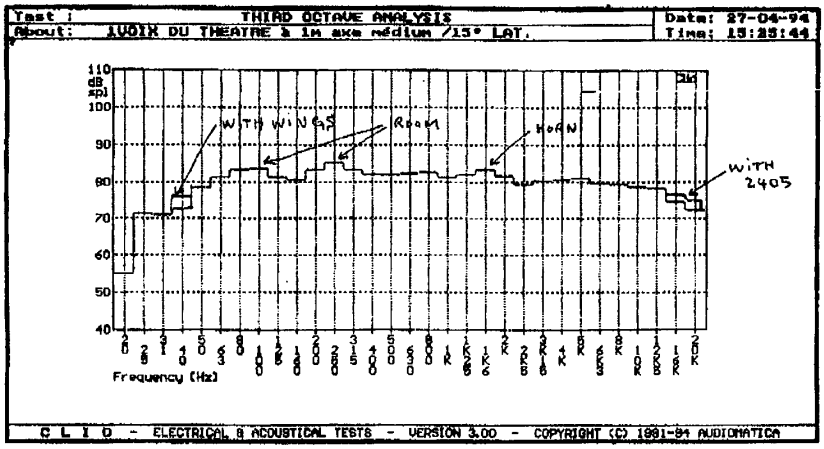
The frame is a masterpiece, with a 1 inch thick edge and massive support beam construction with little area to constrict the back wave flow. The 515E weighs in at a cool 30 pounds. There is really no other way to get the low distortion, high efficiency and impact that the 515 provides.

Altec 515s are not mongo PA speakers like many massive pro drivers. Rather, they are delicate instruments which can knock your socks off while they tantalize your subtler senses. They are true high fidelity devices and are rated to handle only about 75 watts of power, no power at all in today's pro speaker universe.

The upper half of the acoustic spectrum is handled by a wonderful driver and horn, the 288K-16 1.4" throat compression driver and the 1505B horn. The version of the 288 that I am using is a newer ceramic magnet 16 ohm unit with the Tangerine precision cast metal phase plug. It goes even higher and cleaner than the older Alnico drivers, making the JBL super tweeter even less necessary.

Above: the A5 system that changed my mind. Jean Hiraga's reference loudspeakers at *La Nouvelle Revue du Son* in Paris

Below: Third octave sweep of frequency response showing contribution of extension "wings" and JBL tweeter.



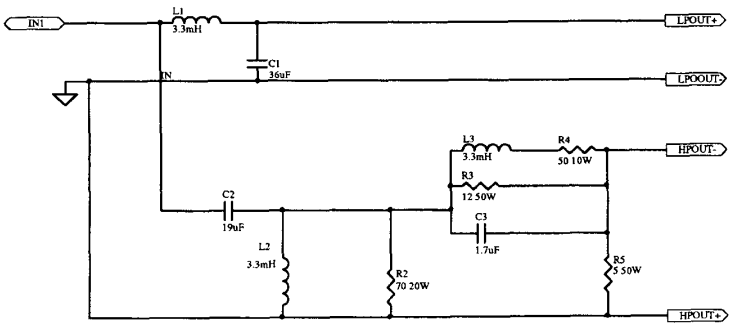
The 288K uses a 2.8 inch diameter concave aluminum alloy dome with integral tangential suspension and edge wound aluminum ribbon voice coil. This "tweeter" weighs 30 pounds giving an idea of the construction quality and magnet size! It has 20,500 gauss flux density in the gap (as much as a Lowther).

The 288K's maximum excursion capability of only 0.035 inches indicates that it is designed to operate without any diaphragm breakup throughout the frequency band and up to very high levels.

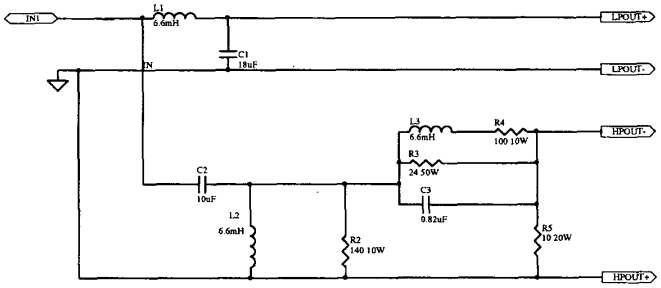
When coupled with a horn like the 1505B it has 112 dB/W/m sensitivity in the 1-5 kHz band! The response drops above this to about 103 dB at 16-17 kHz.

Be sure to pry out the bug screen that these drivers have to protect them in pro use. On the other hand, if you are buying some used you may want to be sure the screens are there if they have been used professionally.

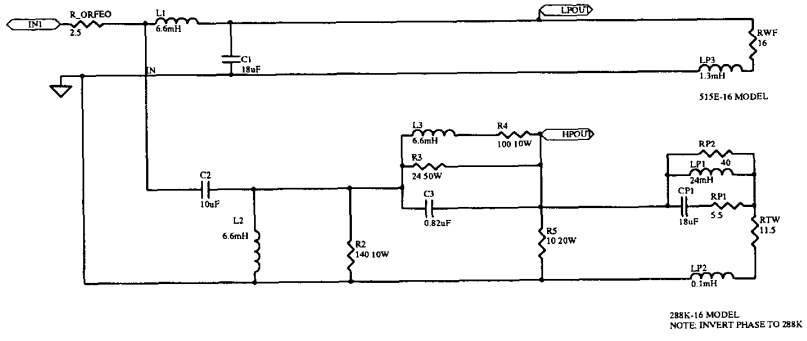
Altec still supplies diaphragms for most of these compression drivers and they can repair, recone and remagnetize most old



Jean Hiraga's crossover for 8 ohm drivers



Crossover component values scaled for 16 ohm drivers from Hiraga's original design



SPICE simulation schematic, including models of 288HF driver, 515 woofer, and simulated output impedance of Orfeo SE 845 amp

cone drivers. The record shows that these puppies can last for over 40 years in auditorium and theater use with virtually no service.

The 288 driver and horn is designed to play at peak levels up to 128-130 dB although its continuous power handling is only around 15 watts. Like the 515 it inhabits a different world from typical "hi-fi" drivers.

Both the low and high frequency horns have controlled directivity with 120 degree horizontal for the high frequency and 90 degree for the low. Both horns have 40 degree vertical dispersion. These dispersion figures mean that they can nicely fill a room but they won't tend to interact as a direct radiator but more like a panel speaker for ceiling and floor reflections.

The very wide dispersion of the 15 cell exponential high frequency horn removes any tendency to beam high frequency energy and cut off your head as many horns can.

The 1505B deserves more description. It is a very large and impressive looking device made from 15 individual exponential horns which come together in a complex assembly having over 3 square feet of radiating area. They are specified for use in theaters with over 400 seats! In my 450 square foot listening room they are barely breathing.

These exponential horns are designed assuming a planar wave launch from the compression driver. It is the job of the phase plug to align the acoustic phase off of the concave diaphragm to approximate a planar wave launch into the driver throat.

The horn really begins with the phase plug. The "Tangerine" plug used in the 288K is a beautifully formed metal piece and allows much of the diaphragm to remain visible through the center of the horn. It appears that the 288 uses about a 2:1 compression ratio through the phase plug. This helps to keep distortion low at high levels and the clear acoustic path helps high frequency extension and clarity.

The 1505B uses long cells to get good low frequency extension with 15 cells in three rows of 5 and a small mouth opening on each cell to get good high frequency extension and dispersion.

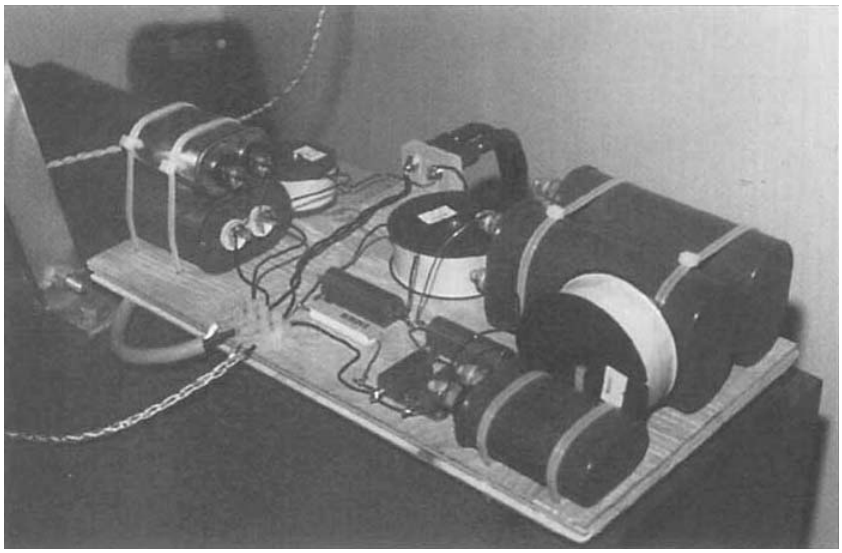
Each individual cell is a hand made aluminum construction with some sort of material like car undercoating used to

dampen any high Q resonances. This is a very effective method and I have had no desire to further dampen this horn.

I hate to think of how much these horns would cost to produce today. They are the only part of this system which cannot be bought off the shelf. If you find some extras, let me know...

I suspect that the enormous mass difference between the moving elements of the 288K and the stationary parts of the 30 pound driver and 30+ pound horn make it doubtful that much energy from the diaphragm goes into resonating these structures. The ability of this combination to reveal natural detailing of harmonic structures and dynamic inflection argues in that direction.

This pair also has the sweetest high frequencies, much like a Maggie ribbon but with much greater impact and dynamic potential.



Constructional Details of Crossover

Make the right tradeoffs in the bass...

The 515 is designed expressly to work in a horn enclosure like the 825/828 cabinet. M. Hiraga has mentioned the golden number ratio when talking about the proportions of this cabinet. These proportions may be why it sounds good even unmodified, with little of the 'boxy' sound that many bass cabinets have. It loads the 515 perfectly, newer ones have the correct volume and port area to allow optimum bass extension and efficiency.

Older ones will need to have the area behind the short horns closed off and the port area reduced by up to 50%. The cabinets that I bought allow some adjustment of the port area and I have set these to the minimum of 25 1/2 by 8 1/4 inches. This port arrangement is near ideal in that the depth of the port is only 5/8", the thickness of the panel. The usual port turbulence and airflow noise is eliminated.

Taken together with the mid-bass short horn and the 1505B HF horn there is about 8.5 square feet of radiating area in each A5. They image and energize a room much like a panel speaker but they have lower distortion, much better efficiency and dynamic capability. There is no troublesome back wave to contend with.

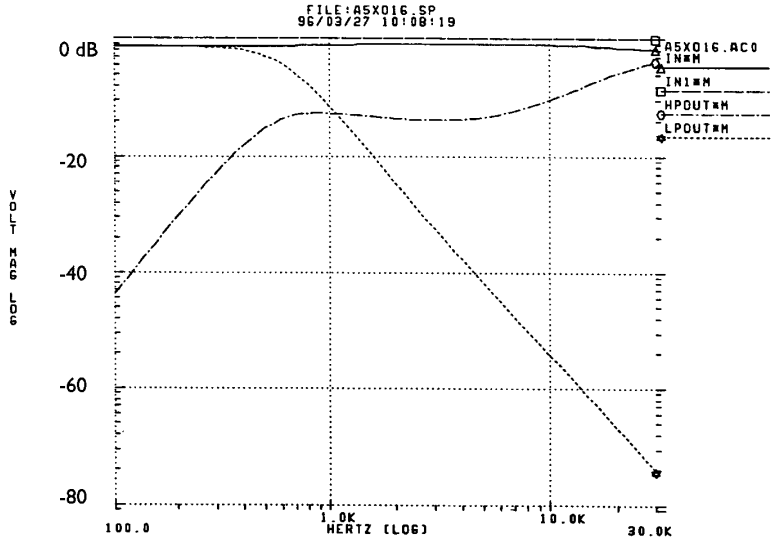
My recent vintage 828 cabinet is well constructed, although it is made of 5/8 inch compressed board. I will be augmenting this with 1/2 or 5/8 inch thick Apple ply, a high quality plywood with thick hardwood ply material. I am going to do this for cosmetic and acoustic reasons.

It has been suggested to inject the area behind the short horn flares with polyurethane insulation material. This sounds like a good idea and should stiffen and dampen the short horn. Although I haven't tried this yet, I don't find much to complain about in the performance that I am getting with the stock boxes.

Make sure that you have a thick bat of fiberglass or other acoustic material on the inside back wall of the enclosure to absorb the back wave at midrange frequencies, the driver is quite close to the back of the enclosure. Don't go overboard here as the low frequencies need to get out of the cabinet or the low frequency extension will be compromised.

If you are looking at older plywood cabinets beware of delamination of the plys as this can be impossible to rectify. Like ceramic magnets, compressed board may not be as sexy but it may be a better overall solution!

I have measured average levels at the listening seat of 100-103 dB when listening



Response of LF, equalized HF driver, and summed response

STANDARD "VOICE OF THE THEATRE" COMPONENT CHART

Model	Amplifier Power (Watts)	Distribution V° H°	L.F. Drivers	H.F. Drivers	H.F. Horn	Throat	Network	L.F. Cabinet	Overall Size – Inches H W D	Approx. Shipping Wt. Lbs.
A1X	200	60 x 125 60 x 105 40 x 100	(6) 515B	(4) 288C	1804B or 1504B or 1004B	(2) 30170 (2) 30170 (2) 30170	N500C	610	113 x 152 x 39½ 113 x 152 x 39½ 105 x 152 x 39½	1530 1500 1475
A1	100	60 x 105 40 x 100	(6) 515B	(2) 288C	1505B or 1005B	(1) 30172 (1) 30170	N500C	610	108½ x 152 x 39½ 102½ x 152 x 39½	1410 1390
A2X	150	60 x 105 40 x 100	(4) 515B	(4) 288C	1504B or 1004B	(2) 30170 (2) 30170	N500C	410	113 x 113 x 39½ 105 x 113 x 39½	1400 1334
A2	80	60 x 105 40 x 100	(4) 515B	(2) 288C	1505B or 1005B	(1) 30172 (1) 30170	N500C	410	108½ x 113 x 39½ 102½ x 113 x 39½	1263 1250
A4X	60	60 x 105 40 x 100	(2) 515B	(2) 288C	1505B or 1005B	(1) 30172 (1) 30170	N500C	210	108½ x 80½ x 39½ 102½ x 80½ x 39½	788 775
A4	40	60 x 105 40 x 100 40 x 80	(2) 515B	(1) 288C	1505B or 1005B or 805B	(1) 30166 (1) 30210 (1) 30162	N500C	210	108½ x 80½ x 39½ 102½ x 80½ x 39½ 102½ x 80½ x 39½	763 750 745
A5X	35	60 x 105 40 x 100 40 x 80	(1) 515B	(1) 288C	1505B or 1005B or 805B	(1) 30166 (1) 30210 (1) 30162	N500C	825B	64 x 30½ x 30 59 x 30 x 27 59 x 30 x 27	393 280 275
A7-8	50	40 x 90	(1) 416-8A	(1) 807-8A	811B	None	N801-8A	825B	52½ x 30 x 24	154
A7-500-8	50	40 x 90	(1) 416-8A	(1) 808-8A	511B	None	N501-8A	825B	54½ x 30 x 24	160
A8	30	60 x 90	(1) 416A	(1) 806A	30623	None	N800D	39624	42 x 30 x 12	112

to some recent Clapton (he sounds like he's fronting a great bar band...). At this level, with plenty of drum and bass energy and peaks of 110 to 115 dB, the 515 drivers are barely moving! This is a direct indication of the low distortion level that this system has under even extreme conditions. Most woofers would be moving up to 1/2 inch at these kinds of levels. This system is not even moving 1/8 inch peak to peak – well within the linear range of the driver.

Like the 1505B, the short horn in the 825/828 enclosure is inherently pleasing to look at and I would recommend leaving it open to the world. I suspect that a clear finish on light birch ply would complement the neutral gray of later 828 cabinets. I am going to make a simple hardwood foot assembly to support the 1505B and the 288 driver assembly. Typically they are mounted with 4 inch long L brackets and the adjustable rear support leg to a piece of 'vulgar' painted plywood, as my wife calls it. A more elegant T shaped construction with three cones for support would bring the 1505 somewhat lower and also provide some worthwhile mechanical isolation from bass cabinet energy.

The crossover brings the system together...

If I did not have M. Hiraga's valuable input into the crossover design I would have been much more concerned about the outcome of this experiment. As it happens, his 10-20 years of experience with this type of system and his insight into how to knit the system together nearly guaranteed some level of success.

His original network shown above is for 8 ohm drivers. I scaled the values for the 16 ohm versions and added R5 to match levels. The complete crossover schematic is shown on p. 8.

I simulated the schematic using SPICE, a program that I use for Integrated Circuit (IC) design. It uses complex matrix equations to solve the nodal values for the circuit and is quite accurate if your model is accurate. The complete simulation schematic is provided on p. 8, including models I developed to simulate the non-linear impedances of the loaded drivers and I have added a 2.5 ohm resistor to simulate the output impedance of a typical SE triode amp driving this network.

L1 and C1 make up a 2nd order butterworth low pass network at 500 Hz for the 515 driver. It is quite simple and classic. For now I have a 500 watt rated ferrite core inductor with less than 0.5 ohm DCR and I used high power 660VAC rated oil filled polypropylene and paper capacitors for the low pass section (GE type 97F41XX). The idea is to be sure that the crossover components are stressed as little as the drivers in typical use.

The high frequency section is more complex with a basic high pass 2nd order section consisting of L2 and C2. I used an air core coil and 10 kHz rated low inductance, high power, oil filled caps for this section (GE type 97F85XX). R2 controls the maximum Q of the inductor and dampens transient overshoot energy, having little effect on the steady state frequency response. L3, and C3 along with R3, R4 and R5 make up a resonant trap with controlled Q and attenuation to equalize the 112 dB midband response of the 288 driver down to 100 dB and to allow it to go to 16 kHz with little attenuation.

The resulting response of this network into the simulated driver impedances is shown on page 9 above. Note that there is about 12 dB (over 4X voltage or 10X power) attenuation from 1-5 kHz with the response above and below this region allowed to rise as the natural rolloffs of the driver/horn take over. Again, L3 is an air core coil and C3 is a 19 kHz rated oil filled cap which are totally unstressed in this application.

The off the shelf cost of these components is more than a manufacturer would put in an entire $1500 pair of speakers, let alone a crossover network. I probably will replace L1 in the woofer circuit with a copper ribbon or some other exotic inductor as it is likely the limiting element in the implementation. All resistors are 50 watt rated wire wound aluminum cased units. You could give some range to R5 for a treble level control. I would suggest a 5 to 20 ohm range, this would give you several dB of adjustment without affecting the crossover frequencies. Use a good quality 20 watt single turn wire wound rheostat with a fixed resistor in series for an adjustable R5.

It is very instructive to listen to each driver alone through the crossover. Each frequency section sounds so very different that you wonder how the mushy low end and tinny high end can come together to make music. I believe that the 500 Hz crossover point is an ideal place for a crossover, as the Fletcher Munson curves show that the ear's operation changes at this point, acting differently above and below this frequency band. It seems a natural point to divide the spectrum. Listening tests bear this out.

Phase align the Bass and Mid drivers...

The separate 1505B horn allows you to move the upper frequency driver to align it with the bass and focus the energy toward your listening area. This is similar to what Wilson does with his larger systems and gives great flexibility in system setup and optimization.

I am using the speakers only about 8 inches from the back wall with the cabinets toed in so that the center is around 10-11 inches from the back and about 55 inches from the side walls. They image fine in this position and the Bestplace software available off the net from RDL Acoustics shows about 6-8 dB of room gain at 40 Hz. If used in a larger room, farther from room boundaries, you will need to add the wings to extend the last octave or so to get 40 Hz response. Putting them nearer to the back wall is great because it reduces the physical impact relative to smaller free standing speakers and the controlled directivity above 150 Hz means that imaging does not suffer at all. If they are too close to the back wall there will be too much mid bass energy.

I found that moving them only a few inches can make a real difference in how they load the room. My room is probably about as small as you would want to go with these and it is about 19 x 23 x 8 1/2 feet. This lets me put them 11 feet apart with a listening position 13-15 feet away. In this setup they have a remarkable ability to disappear acoustically and images can occur between, behind, and beyond them, as the recorded material allows.

When I align the HF horn I use a flashlight to make sure that I can see the diaphragm through the center horn from the listening chair. Then I move the horn forward and back relative to the bass driver while listening to a good female vocal to get the smoothest response through the crossover region. Movements as small as 1/8 inch can be audible.

Why doesn't the stock crossover work in this type of speaker?

That is really quite simple. For theater use the crossover is designed to be as lossless as possible, efficiency is everything when trying to fill a large space with intelligible speech and music.

	515	515B	515C	515E	515-8LF	515-8LFE	515-8G	515-16G	515-8GH
Power	35W	75W	75W	75W	125W	125W	75W	75W	200W
Response*	55-1000Hz	55-1000	55-1000	45-1000	45-1500	45-1000	50-4000	55-4000	60-4000
X-over	500	500	500	500	500	500	2,500	2,500	2,500
Sens.**		105 dB	105 dB	105 dB	105 dB	105 dB	105 dB	106 dB	106.5 dB
Z	16 Ohms	16 Ohms	16 Ohms	16 Ohms	8 Ohms	8 Ohms	8 Ohms	16 Ohms	8 Ohms
Fs	25Hz	25Hz	25Hz	25Hz	25Hz	25Hz	37Hz	37Hz	37Hz
Magnet	Alnico	Alnico	Alnico	Ferrite	Alnico	Ferrite	Ferrite	Ferrite	Ferrite
Flux		1.4750 T	1.4750 T	1.3T	1.4750 T	1.3T	1.5T	1.5T	1.5T
Frame	15"	15"***	16"	16"	16"	16"	16"	16"	16"

Notes: *Frequency response corrected to indicate 3dB down points for all models
**Sensitivity measurements corrected to 1W/1M rating
***515B manufactured after July 1977 had 16" frames

Altec 515 LF Driver Revision History

In a small room for music listening you need at least 12 dB of HF attenuation and you can let the higher harmonics come in better. These horns sound remarkably sweet in the upper frequencies and can even seem overly soft until some real HF energy comes in and startles you with its presence and detail. When EQed correctly, they have a very natural bloom and energy with very low distortion giving a sweet yet detailed sound.

Distortion of this speaker above 100 Hz at 100 dB out will be typically less than 0.05%! This level of distortion is even less than that provided by the 30 watt *Orfeo* amp which is around 0.07% at 1 watt out. I would guess that most people have never heard a loudspeaker with as low distortion as these. This contributes greatly to the naturally detailed sound and dynamics that approach those of live music.

Upper frequency energy is very important to living, breathing music.

Most (virtually all) dome tweeters are totally anemic in presenting upper frequency energy. They lack the bloom and subjective power that is needed to fill out the harmonic structures in music. They also tend to pinch the sound and lack dynamic headroom. The 288/1505B combination allows these frequencies to fill the room with ambiance and harmonic detail that otherwise I have only heard live.

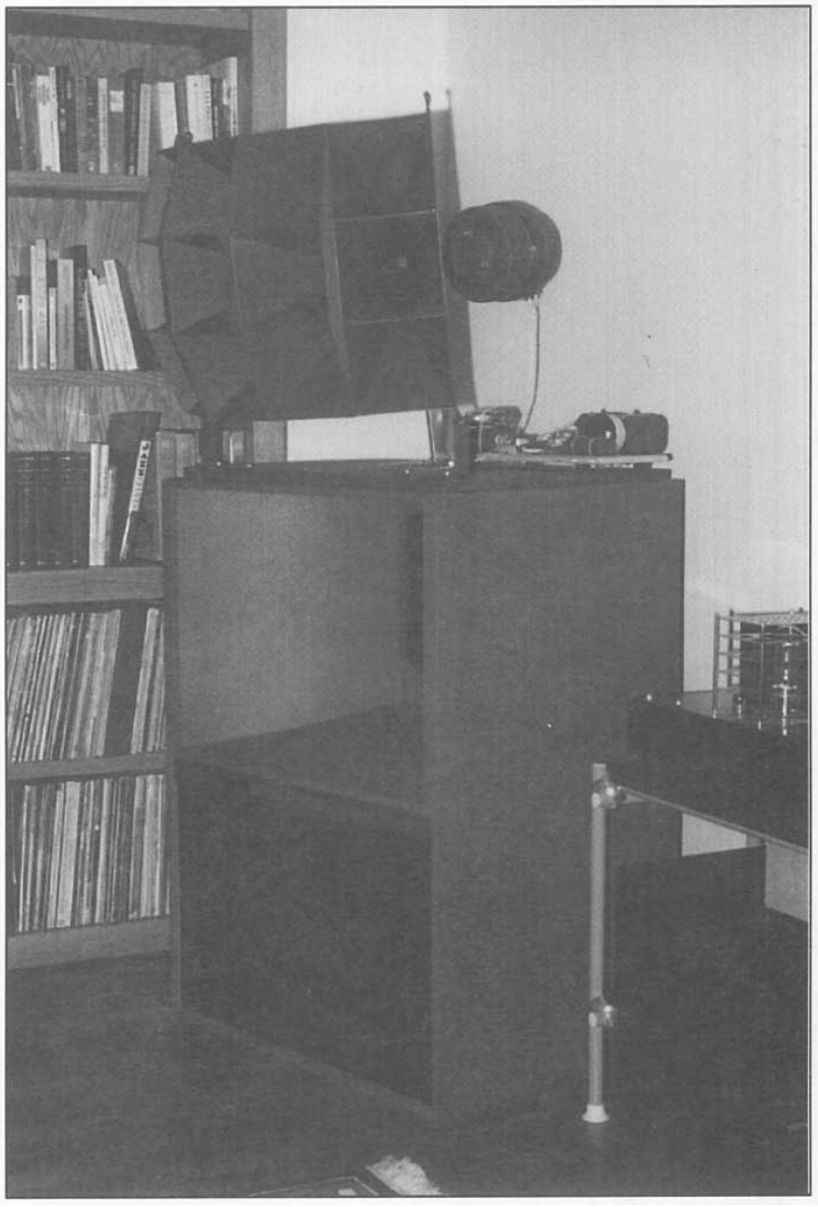
These speakers will not impress your friends with ultra low frequency energy and sensaround experiences.

They will play a cello, timpani and string bass better than you have heard them before with tremendous midbass presence from the short horn and excellent, resonance free bass. If this can't impress your friends, get new ones! I hope that you can hear what a system like this can do. It's worth it.

Addendum

I have just read a recent article in the *Journal of the Audio Engineering Society* (Vol. 44, No. 1/2, 1996 January/February) which throws some light on why the 1505B sounds so much better than other mid horns in my experience. This article titled 'The Sound of Midrange Horns for Studio Monitors' should be required reading. It describes a very well constructed test to compare the sound of midrange horns from 1kHz to 4kHz with several references. These references are the old QUAD electrostatic which is a long time reference for subjective midrange quality, an Audax (Polydax) 6 1/2 inch pro quality cone driver and two horn coupled mids including a large sectoral Fostex and a Tannoy. These references are compared to 14 different horn mids and a couple of cone control drivers. This article could be a model for scientifically valid subjective testing. Care was taken to choose test material and test methodology to avoid listener fatigue and stress and to insure valid results which correlate to listening to music. The authors' approach is much more sophisticated than the ABX method which some have tried to force on the industry.

Anyway, the results showed that there is a horn 'sound' with most mid horns. There were, however, two horns which were never identified as being horns in the blind testing. One is a prototype short horn with a medium mouth opening and a length of only 230mm. The other horn is an old ALTEC 806C 8 cell multicell which is a smaller version of the 1505B with the same basic construction and fewer individual cells.



There are two keys to these horns' performance. The short horn length on the one means that any mouth reflections occur in a short time span and are subjectively innocuous. On the long ALTEC horn the mouth area is large enough, compared to the cutoff frequency, that the mouth reflections are a small fraction of a dB.

The second key to the subjective sound quality is that these horns are designed to have no abrupt flare rate changes along their lengths from the phase plug to the mouth opening. Any flare rate discontinuity causes high frequency reflections which cause spectral colorations and problems in the upper mids and high frequencies. Neither of these horns have flare rate discontinuities when used with the right compression drivers.

Indeed, the ALTEC multicell horn was thought to sound most like the QUAD electrostat. It was not identified as a horn speaker by any of the listeners, including a 'Golden Eared' pro who was among the test subjects. It seems that this old design was very well thought out when it was done originally for cinema use in the 30s and 40s.

I also suggest that you seek out Harry F. Olson's 1947 book *Elements of Acoustical Engineering*. Page 106, section 5.24 has an excellent discussion of the mouth reflection effects of a horn and shows clearly why a large mouthed long horn will sound better, avoiding the 'horn' sound problem that shows up with many small midrange horns. The solution to mid horn sound problems was clearly known back then, they knew more than we have forgotten.

Special thanks to Jean Hiraga for sharing his research with the audio community.

Thanks also to Jim Long and Gary Jones of the Mark IV Audio North America pro sound team.

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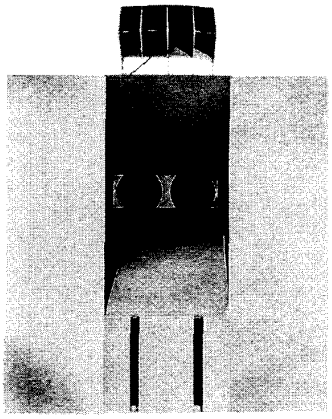
Low Frequency Horns

L-F HORNS



210 Horn with speakers installed

Features

Direct Radiating

Rugged Construction

Authentic Bass Reproduction

Exponential Expansion

Wide Distribution

Exceptional Air Coupling

Uniform Response

Variety of Sizes

Efficient Bass Projection

For High Quality, Two-Way Sound Systems In . . .
Theatres • Auditoriums • Arenas • Churches
Concert Halls • Audition Rooms

Altec "Voice Of The Theatre" speaker systems are used in more than 12,000 motion picture theatres, auditoriums, arenas and other sound reinforcement installations throughout the world. An important component of each such system is an Altec Low Frequency Horn.

These large low frequency horns ensure proper loading which effects excellent air coupling and enhances the performance of the low frequency loudspeakers. Exponential expansion, properly spatial phased with the high frequency horn, assists the projection of the important mid-range frequencies.

Front loaded in design, Altec Low Frequency Horns have no folds or bends to introduce 'holes' or 'hot spots' in the sound coverage. The elimination of any irregularities assures a uniform response across the dispersion angle of the horn, a factor essential in the calculation of sound systems. The combination bass reflex/front loaded design prevents the boom and false accentuation often associated with public address systems which use other types of enclosures, reduces the amplitude of cone movement at resonant frequencies, and allows higher power input without distortion. The efficient use of the lower end of the sound spectrum contributes to the illusion of loudness and presence required to distinguish the outstanding Altec "Voice Of The Theatre" system from ordinary loudspeaker systems. For installations where the 210 and 410 horns are used on the floor, the use of wings will further improve the bass projection.

Altec Low Frequency Horns are carefully constructed with heavy materials and braced where acoustically required to exclude unwanted vibrations. The sturdiness of these horns permit them to be mounted in walls and ceilings of auditoriums, or to be suspended overhead in large areas. All horns are finished with a flat finish, dark grey, instrument lacquer. Where the horns are to be used in outdoor installations, a weatherproof coating of resin may be applied without impairment of their performance.

These horns are designed for use with either the Altec 416A or 515B Low Frequency loudspeakers. They should be used in conjunction with high frequency horns (multicellular or sectoral) and high frequency drivers for a full range, two-way system (see Table II).

ALTEC LANSING

A Division of LTV Ling Altec, Inc.

1515 S. Manchester Ave., Anaheim, Calif.
New York

1966 ALTEC Engineering Specifications

ALTEC L-F HORNS

TABLE I: SPECIFICATIONS

Horn Model Number (A)	Number of Low Frequency Speakers Per Horn (B)	DIMENSIONS (C)				Weight (Without Wings) (D)
		Height	Width		Depth	
			With Wings	Without Wings		
210	2	84"	80½"	32½"	39½"	560 lbs.
211*	2	32½"	(Not Used)	84"	39½"	560 lbs.
410	4	84"	103"	65"	39½"	890 lbs.
825	1	42"	(Not Used)	30"	24"	100 lbs.

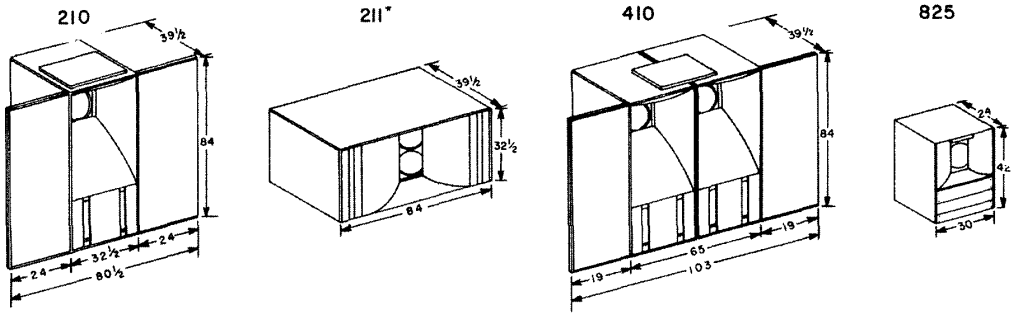


FIGURE 1: Dimensional Drawings of Altec Low Frequency Horns
*Available on special order only

TABLE II: Recommended Components for Complete Systems

LF Horn	Power (Watts)	HF Drivers	LF Drivers	HF Horn No.	Distribution	Throat	Network (16 ohm)	Overall Size H W D	Approx. Shipping Weight
410	150	4 — 288C	4 — 515B	1804B, 1504B, 1004B	60° x 125° 60° x 105° 40° x 100°	2-30170 2-30170 2-30170	N500C	113" x 120" x 39½" 113" x 120" x 39½" 105" x 120" x 39½"	1400
410	80	2 — 288C	4 — 515B	1505B, 1005B	60° x 105° 40° x 100°	1-30172 1-30170	N500C	108½" x 120" x 39½" 102½" x 120" x 39½"	1250
210	60	2 — 288C	2 — 515B	1505B, 1005B	60° x 105° 40° x 100°	1-30172 1-30170	N500C	108½" x 80½" x 39½" 102½" x 80½" x 39½"	775
210	40	1 — 288C	2 — 515B	1505B, 1005B, 805B	60° x 105° 40° x 100° 40° x 80°	1-30166 1-30210 1-30162	N500C	108½" x 80½" x 39½" 102½" x 80½" x 39½" 102½" x 80½" x 39½"	750
825	35	1 — 288C	1 — 515B	1505B, 1005B, 805B	60° x 105° 40° x 100° 40° x 80°	1-30166 1-30210 1-30162	N500C	64" x 30½" x 30" 59" x 30" x 27" 59" x 30" x 27"	275
825	30	1 — 806A	1 — 416A	811B	40° x 90°	None	N800D	54" x 30" x 24"	200
825	30	1 — 806A	1 — 416A	511B	40° x 90°	None	N500E	54" x 30" x 24"	200

NOTICE

We recommend that you obtain your Altec products from factory trained authorized Altec Sound Contractors and Distributors. This will assure you of proper installation, continuing source of knowledgeable advice, service, and quick warranty protection.

ARCHITECTS AND ENGINEERS SPECIFICATIONS

The low frequency horn shall be of the direct radiating type with an enclosure of combined bass reflex/front loaded type. It shall consist of a short exponential horn designed to match the phasing of the high frequency horn specified elsewhere. Horns which employ folds or bends will not be acceptable under this specification because of their tendency toward frequency concellation.

The horn shall measure (C) and weigh approximately (D). It shall be of heavy plywood and shall be fully braced with 2" x 3", and 2" x 4" frames. It shall be designed to mount and properly load (B) low frequency speakers of the type specified elsewhere.

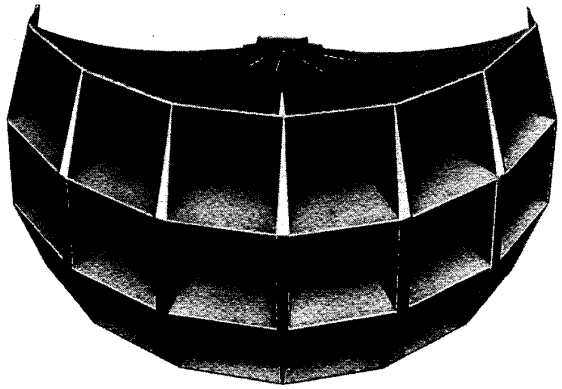
Any low frequency horn not meeting these requirements shall not be acceptable under this specification.

The low frequency horn shall be Altec Lansing Model (A).

Litho in USA C/P 3/66

AL-1435-3

Multicellular Horns



AUDITORIUMS • STADIUMS • ARENAS • THEATRES • AIRPORT TERMINALS
OUTDOOR VOICE WARNING SYSTEMS • INDUSTRIAL AND COMMERCIAL INSTALLATIONS

The exponential multicellular horn is the most efficient of all projectors for delivering top quality sound uniformly over a defined listening area. The unique excellence of the multicellular horn results from its distinctive design:

(a) The multicellular horn consists of a number of individual horns assembled in various configurations to provide controlled angles of vertical and horizontal distribution for best sound coverage of any listening area.

(b) Each horn or cell of the multicellular horn is a straight exponential trumpet through which sound can pass unimpeded. This is a distinct advantage over horns of the re-entrant or reflex type which severely attenuate the high frequencies and cause distortion due to sharp folds or bends in the sound passage.

(c) The column speaker exercises control of sound only in the vertical plane, whereas the multicellular horn controls sound in both the vertical and horizontal planes thus providing the added advantage of restricting sound projection into reverberant side walls.

(d) The re-entrant or reflex horn and the column speaker are handicapped by the fact that the beam width becomes steadily narrower as frequency increases, to a point where sound coverage in the critical high frequency range between 2,000 and 10,000 cycles shrinks to a narrow pencil of sound, in some cases only 15° to 30° wide.
In contrast, the beam width of the multicellular horn above the cross-over region and in the important mid- and high-frequency regions to 12,000 cycles and beyond, is independent of frequency. This entire portion of the frequency spectrum is uniformly distributed throughout the full angle of the horn.

(e) The multicellular horn with its great undistorted power handling capacity (up to 400 watts) is unequaled by any other commercially available sound projector for distribution of highest quality sound over large outdoor areas.

Altec multicellular horns will accommodate as many as four drivers of the 288C type for indoor use, or 730B and 290D type for outdoor use. The latter drivers and the 30546 angle adaptor in combination with a multicell horn constitutes a complete All-Weather system.

The multicellular horn was developed by the Bell Telephone Laboratories of a necessity to insure the success of early talking pictures. Ordinary horns proved incapable of providing good quality coverage to every seat in large theatres, most of which were far from ideal acoustically. The folded horn was discarded in theatre work in 1934 and since that time the multicellular horn has remained the standard of excellence.

The 300 cycle cutoff multicellular horn is often used as a "one-way" speaker where voice only is to be reproduced, or where maximum intelligibility is required to penetrate high ambient noise levels, or for projection over long outdoor distances. The 500 cycle multicellular horn with a 500 cycle crossover network and low frequency speakers, Altec 416A or 515B, are generally used for full range "two-way" loudspeaker systems such as Altec "Voice of the Theatre" systems for the reproduction of high quality voice and music.

PERFORMANCE AND SPECIFICATION DATA ON BACK PAGE

ALTEC LANSING

A Division of LTV Ling Altec, Inc.

1515 S. Manchester Ave., Anaheim, Calif.
New York

MULTICELLULAR HORN PERFORMANCE CHART

Horn Model Number* (a)	Quantity of Drivers Used per Horn (b)	Driver Model Number (c)	Sound Pressure Level Full Power Each Driver** Measured at 30 feet (d)	Measured at 100 feet (d)	Distribution Pattern (e)	Cutoff Frequency (f)	Cell Configuration	Throat Code Number ***
203B	1	288C	118 db	108 db	20° x 40°	300 cps	1 x 2	(not required)
		290D	121 db	111 db				
		730B	114 db	104 db				
803B	1	288C	115 db	105 db	35° x 70°	300 cps	2 x 4	30162
		290D	118 db	108 db				
		730B	111 db	101 db				
804B	2	288C	118 db	108 db	35° x 70°	400 cps	2 x 4	30172
		290D	121 db	111 db				
		730B	114 db	104 db				
805B	1	288C	113 db	103 db	40° x 80°	500 cps	2 x 4	30162
		290D	116 db	106 db				
		730B	109 db	99 db				
1003B	1	288C	113 db	103 db	35° x 90°	300 cps	2 x 5	30210
		290D	116 db	106 db				
		730B	109 db	99 db				
1003B	2	288C	116 db	106 db	35° x 90°	300 cps	2 x 5	30170
		290D	119 db	109 db				
		730B	112 db	102 db				
1004B	4	288C	119 db	109 db	40° x 100°	400 cps	2 x 5	(2) 30170****
		290D	122 db	112 db				
		730B	115 db	105 db				
1005B	1	288C	112 db	102 db	40° x 100°	500 cps	2 x 5	30210
		290D	115 db	105 db				
		730B	108 db	98 db				
1005B	2	288C	115 db	105 db	40° x 100°	500 cps	2 x 5	30170
		290D	118 db	108 db				
		730B	111 db	101 db				
1504B	4	288C	118 db	108 db	60° x 105°	400 cps	3 x 5	(2) 30170****
		290D	121 db	111 db				
		730B	114 db	104 db				
1505B	1	288C	110 db	100 db	60° x 105°	500 cps	3 x 5	30166
		290D	113 db	103 db				
		730B	106 db	96 db				
1505B	2	288C	113 db	103 db	60° x 105°	500 cps	3 x 5	30172
		290D	116 db	106 db				
		730B	109 db	99 db				
1803B	1	288C	110 db	100 db	53° x 105°	300 cps	3 x 6	30166
		290D	113 db	103 db				
		703B	106 db	96 db				
1803B	2	288C	113 db	103 db	53° x 105°	300 cps	3 x 6	30172
		290D	116 db	106 db				
		730B	109 db	99 db				
1804B	4	288C	116 db	106 db	60° x 125°	400 cps	3 x 6	(2) 30170****
		290D	119 db	109 db				
		730B	112 db	102 db				

* Model code denotes number of cells and horn cutoff frequency. Example: 1504B = a 15 cell horn (3 rows of 5 cells per row) with cutoff frequency of 400 cps.

** Sound Pressure Level (SPL) as shown in column (d) above is based or measured at 30 and 100 feet with full rated power applied to each driver as shown in column (b) and averaged uniformly over 600 to 2,400 cps. (see note 1.)

*** One 30474 Adapter required in addition to indicated throat for each 730B Driver used.

**** If only two drivers are desired on the 400-cycle horn, use two 30210 single throats in place of two 30170 double throats.

NOTE 1. Full power rating on
288C is 40 watts
290D is 100 watts
730B is 60 watts

NOTE 2. Driver units should be protected against low frequency by use of N500C Altec Network, or the 15045A Line Transformer.

NOTE 3. It is recommended that 30546 45-degree angle adapters be added to each driver for added weather protection in all outdoor installations.

NOTE 4. Sound Pressure Level Conversion Table

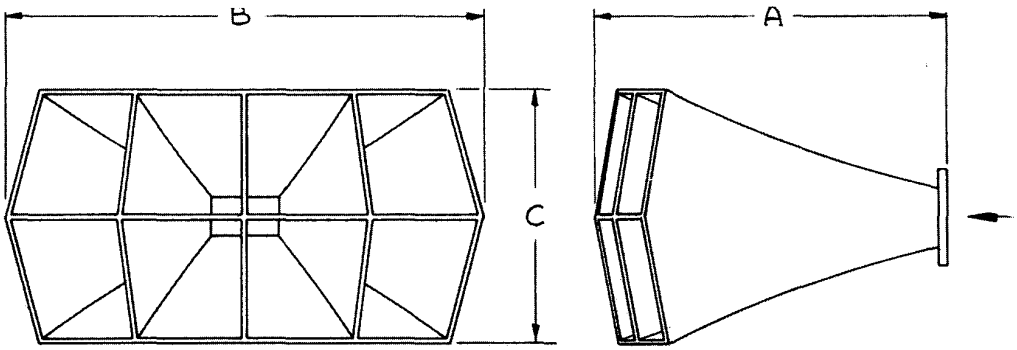
I) To increase SPL 3 db double the input power; to increase 6 db, quadruple the input power.

II) Each time distance of horn projection is doubled substract 6 db SPL.

ARCHITECTS AND ENGINEERS SPECIFICATIONS

The high-frequency horn shall be of the multicellular type, equipped with proper throat and adapters and (b) (c) compression driver or transducer. As specified elsewhere, it shall produce a uniform sound pressure field of (d) db at a distance of (select from d) feet with (Note 1) watts input power applied to each driver over a field of distribution of (e) uniformly averaged over the band of 600 to 2,400 cps. Single frequency measurements will not be acceptable under this specification. The low-frequency cutoff shall be (f) cps.

The horn shall be constructed of individual weatherproofed metal cells with a special damping material coating the external surfaces of each cell. The cells shall all be straight with an exponential expansion. Folded or re-entrant horns or horns fabricated of wood or other fiberous materials will not be acceptable. The horn shall be equipped with mounting brackets or facilities both on the front or mouth and on the appropriate cast throat. Multicellular horn shall be Altec Lansing Model (a).
(Note: Fill in proper values and numbers from Horn Performance Chart.)



Multicellular Horns

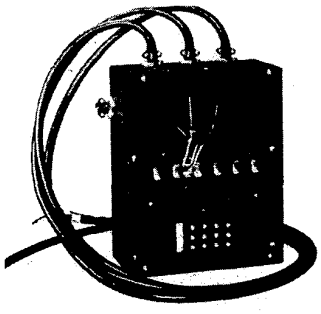
HOW TO SELECT THE CORRECT MULTICELLULAR HORN FOR SPECIFIC AREA COVERAGE

Multicellular projectors are available in several configurations. The sound distribution pattern (angle) is determined by the cell arrangement. Each cell of a 500 cycle horn projects sound over an area of 20° square, or 400 square degrees per cell; a 400 cycle horn distributes sound over an area of 19° square per cell and a 300 cycle horn over an area of 17-1/2° square per cell (2038 horn - 20° square per cell). The sound distribution pattern, both horizontal and vertical, of a horn, is established by the total number of cells assembled in each plane.

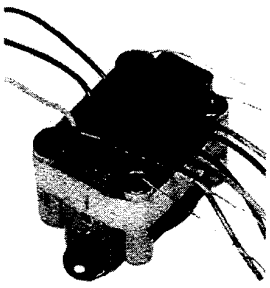
Determine the area to be covered and, by reference to the chart on page 4 of this bulletin, select the horn having a distribution pattern which will most closely cover this area. To obtain full advantage of controlled distribution, no greater area of sound coverage should be provided than can be effectively used. Multicellular horns are composed of a group or stack of individual horns so that each small horn becomes a component part of the large horn assembly. All cells are fed from a common throat.

The partial spherical front achieved by grouping the cells allows each cell to contribute to the whole without overlap or confusion. In installations where speech only is to be projected, the projection ability of a 300 cycle horn can be increased by sharply cutting off the low frequency energy fed the horn an octave above the rated cutoff of the horn by use of an Altec N-500C network or the 15045A 70-volt line transformer. In this manner, the horn has an effective length considerably greater than its physical length. By selection of the proper cell configuration, the projected sound is fully controlled in both the vertical and horizontal plane and this feature proves useful in combating high reverberation and in minimizing or eliminating acoustic feedback. A 300 cycle horn in combination with a 500 cycle crossover network, will greatly aid in overcoming objectionable reverberation by giving the horn greater projection ability by restricting the radiation of the low frequencies, which are often undesirable in the masking of sound and contribute little or nothing to speech intelligibility.

Accessories



N-500C Dividing Network Set



15045A 70-Volt Line Transformer

30546 45° weatherproof throat adapter

30162 horn throat (single unit)

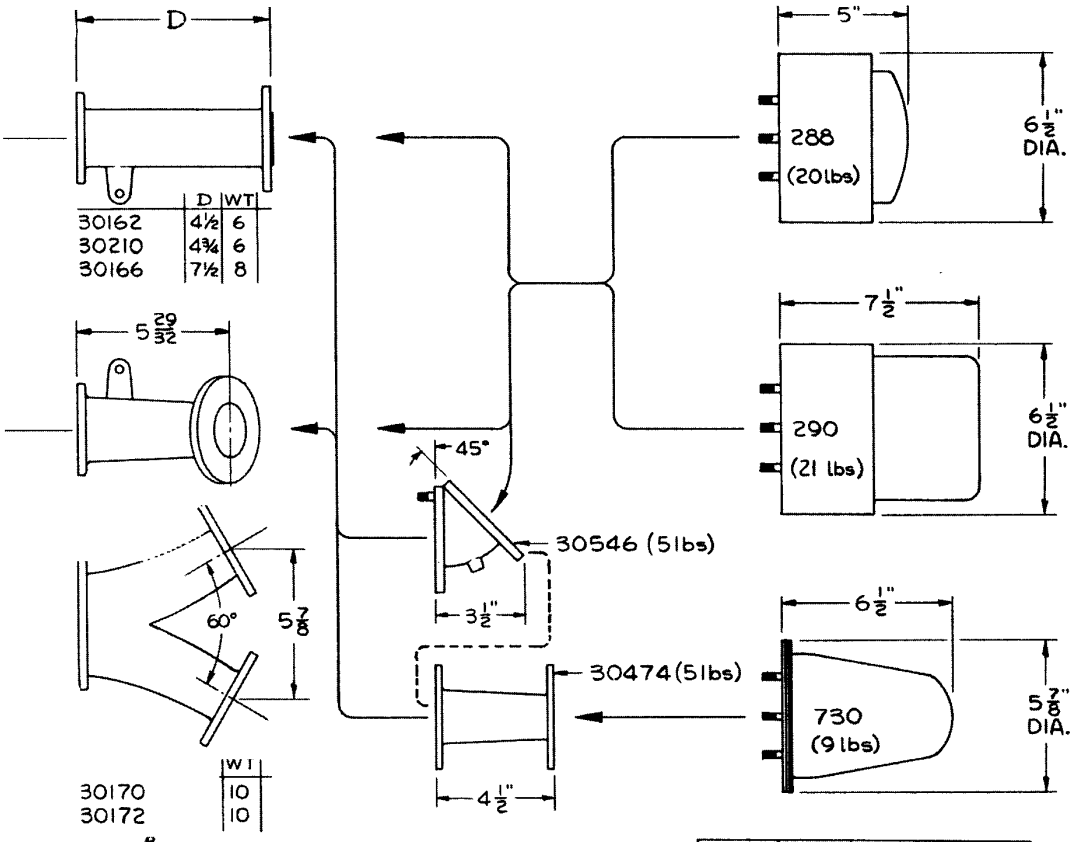
30210 horn throat (single unit)

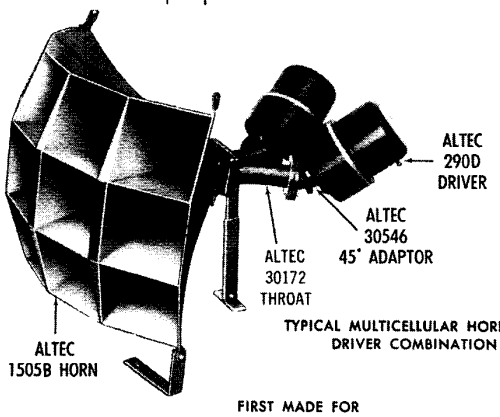
30166 horn throat (single unit)

30170 horn throat (double unit)

30172 horn throat (double unit)

30474 adapter





TYPICAL MULTICELLULAR HORN AND DRIVER COMBINATION

HORN	A	B	C	WT.
203B	31	32	17	22
803B	26 1/2	32	16 1/4	27
804B	23 1/2	32	16 1/4	25
805B	17 1/2	24 1/2	13	17
1003B	25 1/2	38	16 1/8	32
1004B	*20 1/2	38 1/2	16 1/4	30
1005B	17 1/4	30	13	20
1504B	*21	38 3/4	24	48
1505B	16 3/4	30 1/2	18 1/2	22
1803B	27 1/2	44	24	60
1804B	*23 1/2	44	24	58

*(Add 4" for throat adapter)
(Furnished)

FIRST MADE FOR

TOLERANCES EXCEPT AS NOTED: FRACT. ± 1/64" DEC. ± .005" HOLE SIZES 0 TO 1/2" ± .001 OVER 1/2" ± .005 ANGULAR ± 1/2°

ISSUE	APPR'D	DATE	CHANGE

ALTEC® LANSING
ANAHEIM, CALIFORNIA

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ALC 53

NOTICE

We recommend that you obtain your Altec products from factory trained authorized Altec Sound Contractors and Distributors. This will assure you of proper installation, a continuing source of knowledgeable advice, service, and quick warranty protection.

Ennemoser

The bone doctor of musical sound

by Joe Roberts

Over the last ten or so years, the audio world recognized the vital role of materials in musical reproduction. There's a lot of concern with resonance control and tuning. Audio metallurgists and jewelers tout the advantages of .9999 OFC copper and soft annealed silver. There's plenty of discussion about Teflon™, Delrin™, and other lab-born brand name materials but how often do you read about human bone and tissue, the business end of every audio system, in the pages of the glossy audio magazines? Music as we experience it is, after all, a sensation of shaking bone and flesh at the most basic level.

Ennemoser is the first person I met who truly appreciates the fundamental notion that our hearing apparatus is made of bone and the whole thing is mounted in a skull that is also made of bone. Ennemoser said it took a long time to recognize this powerful truth because laziness of thought and language makes us stupid about some very important things.

Even after 20 years of working with these concepts, Ennemoser complains that he often feels silly talking about bones given all the scary monster movie connotations we attach to this most natural substance. Everybody who hears about Ennemoser's works feels obliged to throw in a few Frankenstein jokes to lighten up the conversation. Ennemoser himself jokes about it.

Because he constantly struggles against old habits of language, Ennemoser is concerned about being cast as one of those audio guys who invent colorful theories and then elaborate on them using verbal logic and poetry. Real science builds theory from experience, not the other way around, he rightfully insists.

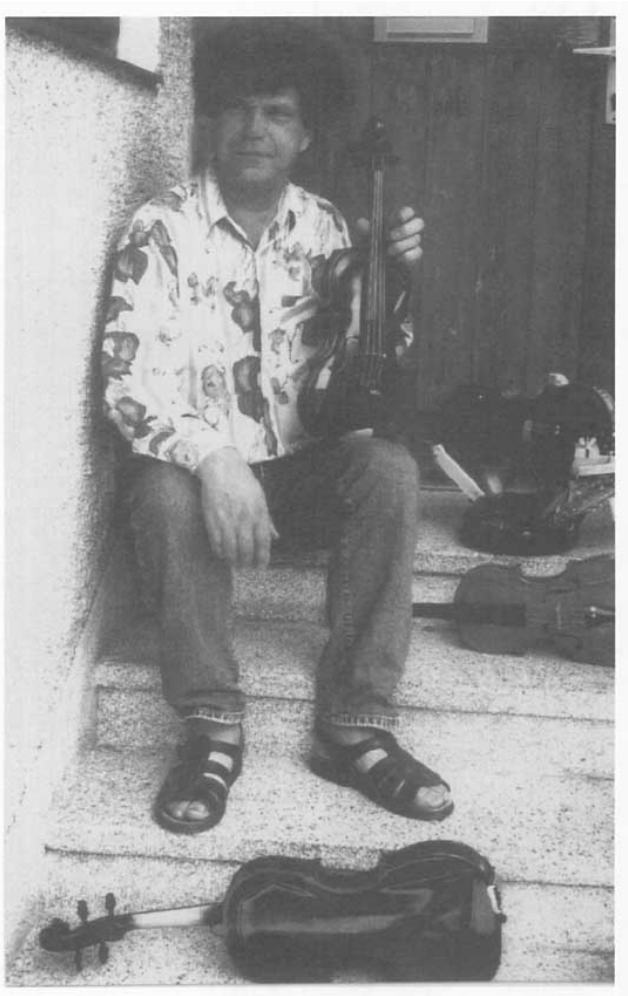
That kind of thinking is what got me interested in Ennemoser's ideas when I am usually inclined to let wacky tweaks and overly creative reinterpretations of audio physics pass me by. When I first heard about Dieter Ennemoser, I thought he was just another flaky smokescreen artist.

After I talked to him and read his stuff, he impressed me as being down to earth, almost too down to earth for the average Joe to get a handle on. Ennemoser definitely seems more interested in digging deeper into what is right in front of his nose rather than inventing wild new stuff. The irony is that people like that often come up with the most radical inventions and freshest insights.

The other thing that impressed me about Dieter Ennemoser is that the man builds violins. Can't do that with theory and thought experiments. Even Stateside resonance gurus Michael Green and Shun Mook can't build violins. Demonstrated success in this craft is a strong credential in the practical black arts of vibration, resonance, and musical sound. The nature of materials and their behavior is all that matters. Musical capabilities are paramount. Violin makers get paid for sonic results. Call me a hick, but I'm impressed – Ennemoser is not just another unemployed TV repairman trying to break into the luctrative tweak accessory market.

Ennemoser started out as a student of mechanical engineering but he doesn't like to talk about it much. He claims it took 20 years to unlearn the mindset imposed on him by the books. He found that much of what he needed to know to produce instruments was completely outside the usual domain of mathematical physics and the usual measurements had little to do with the art of the violin and the life of music.

As Ennemoser developed his talents as an apprentice, the learning curve he had to follow to perfect his craft steered him off the trail of routine scientific engineering and usual violin making practice. The ear is the ultimate lab instrument for the violin maker and nothing else could tell Ennemoser what he knew in his bones.



Ennemoser followed his ears to a point that got him into trouble with the authorities. Based on his acoustic research, he developed some innovative violin designs outside the tradition of the official instrument makers' guild. They tried to force him to stop making unauthorized instruments. He tried to claim an official "artist" legal status as a creative violin smith, but the Austrian authorities didn't buy it and they threw his butt in jail for his guerrilla violin making activities. This was back in 1989.

I can understand why the conservative violin makers' mafia didn't appreciate Ennemoser's instruments. They feature inset angular depressions designed to enhance radiation of "C37" frequencies, lending a very non-traditional almost "punk" look to instruments from the atelier of Ennemoser.

Even worse in terms of traditional requirements, Ennemoser's instruments are tinted in unexpected colors. He prefers the sound of blue violins, but says that pink and wine red are also good sounding colors. In short, body colors, "meat" colors, are what sound good.

In order for violins to enter competition, they must be tinted orange using a specific aniline synthetic dye, Ennemoser complains. "Orange is the worst possible color for a musical instrument because it is the opposite of blue." This is insanity, according to Ennemoser.

On the question of the sound of colors, Ennemoser claims psychic kinship with the great von Karajan. The maestro customarily required his players to wear sky blue shirts or wine red jackets, although he also liked bright vibrant red. Maybe most people are moving too fast to pick up on subtle energies like the sound of color. I'm willing to concede that sensitive individuals can tune into dimensions of perception that I miss entirely.

However, it is difficult to discuss even the slightest possibility of color sounds because we are conditioned to think that such a relationship is a totally crazy concept. With that kind of an attitude, how can we ever learn?

While in the slammer, Ennemoser wrote the essay which was later published in Switzerland and excerpted below. He says that until he went to prison, he was unable to gain much sympathy for his cause because he was fighting a well-entrenched lobby with no fame or money behind his cause. As a political prisoner, a status that attracted attention, Ennemoser's voice was heard.

Ennemoser stuck with the case and, after his story was told, he ultimately won out. It was a long five year battle but the government is now one of his great supporters and also one of his customers. For examle, the *Tiroler Landesmuseum* recently purchased a blue string quartet for its permanent collection of local arts.

Looking back on his tangle with the system, Ennemoser has no hard feelings. It was a learning experience for everyone involved.

Ennemoser's Practical C37 System

On the surface, Ennemoser's C37 theories might come across as just another abstract and flaky explanation thrown together to account for an ethereal sonic phenomenon. Actually, the C37 scheme is grounded in the earthiest, least ethereal substances there is. C37—Carbon at 37 degrees C. Carbon at body temperature. Warm bone.

Fearing the worst, the first thing I asked Ennemoser is whether his stuff has bone in it. I flashed on the romantic image of Dieter in his workshop drilling cartridge mounting holes in a tonearm made from the shinbone of an antediluvian ox chipped out of the glacial Alpine icepack up in the mountains.

Dieter said "no bone in my stuff" but I'm pretty sure he liked the idea. He joked about how many of his friends are now using pieces of actual bone in their projects, inspired by his ideas on the special resonance character of bone.

Right Blue violin from Ennemoser's Tirolian workshop exhibiting special angles designed to enhance C37 patterns.

Left 18 C 37 technology 3000 Hz LF driver with angled diaphragm and laquered cone

Below Detail drawing from Ennemoser's patent for transducer with "discontinuous variation of the aperture angle" designed to produce decay behavior similiar to the human auditory organ. Specific angles of 163, 157, 140, 114, 98, 82, or 66 degrees are employed. (European Patent # EP 0 491 139 B1)

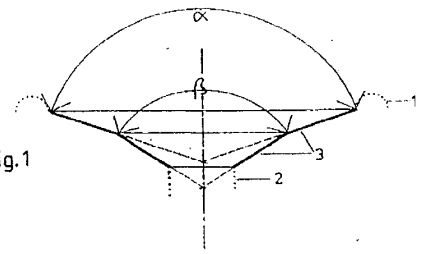


Fig.1

Basically, what Ennemoser is excited about is the *sound of bone* at body temperature when struck. He believes that the "dry" sound of bones is a very special illusion that occurs because our auditory apparatus is itself made out of bone. Our hearing bones filter frequencies in a particular way and then feed them to a brain which evolved over millions of years of processing sound stimuli transmitted through warm bone. Bone is a privileged material because we are made of it.

The interplay of music and the mind is a dance of the bone vibrations inside our bodies and instruments which vibrate in a manner relevant to our carbon-based perception setup.

What Ennemoser is working to identify and manipulate is the C37 sound pattern that bone produces. For a quick sample of C37 pattern, you can tap your skull right behind your ear using your fingertip. You will hear a satisfying thunk that is controlled yet rich, not a bad material for speaker cabinets, huh? The point is that you're always doing this C37 test while listening, whether you realize it or not. All of the interconnects in our ears are bone.

So, that's how Ennemoser does most of his research. He taps on stuff, *plays it* as it were, and listens for the sound. Like I said he's super down to earth. He is a tuner, not a storyteller. Indeed, Ennemoser claims that his biggest challenge was trying to learn to think without using language. The logic of violins and music is not linguistic.

Ennemoser's C37 system builds on a set of practical tools and techniques. He found that certain angles enhance production of C37 frequencies and he uses these angles in his violins and in his speaker cones. The speakers use a patented multi-angle cone optimized for C37 signal processing.

Another novel idea of Ennemoser's is the notion that physical dimensions of electronic circuits are important determinants of sound. Changing the size of a printed circuit board, for example, can impact sonics and this can be tuned in accordance with C37 principles.

On the level of materials, Ennemoser uses a special C37 lacquer that you can paint on your favorite musical objects to benefit C37 patterns. Since the resonances are temperature related, the lacquer is formulated for use within a particular temperature range, e.g. there is 20°C lacquer for room temperature applications and a different formula to use inside heat generating electronics.

(continued on p. 37)

According to Stein Hi-Fi, the C37 *Speziallack* (lacquer) does wonderous things for CD players–two coats on the component side and mechanical parts of transport (watch the lens!). C37 *Lack* is also good on interconnects, they say. Recently, a German mag painted a Rickie Lee Jones CD with C37 and in a blind panel test, all 20 of the auditors preferred the smoother, more liquid sound of the C37ed version. It is also alleged to be great for painting circuit boards, parts and all. 1001 uses in the listening room.

Ennemoser sent me a sample 10 ml bottle of C37 *Speziallack 20*°C and a bottle of C37 *Spezialverdünnung* (thinner). Once I had these blue vials of bug juice, I had to try them out and I started looking around the room for stuff to lacquer up. A 10 ml vial is enough to do one 15" paper cone, two 8 inchers, one CD player, or other small scale job. Coverage depends on the surface.

The first thing I did was unscrew the cap and take a good deep whiff ...aaah, smells just like an old world workshop. My eye rested on the white cones of my Lowther PM-6As. I resisted the thought. No, I like them just the way they are. My mind raced on. I couldn't help it. Huffing lacquer will do that to you.

C37 *Speziallack* is a new concept in resonance tuning but its far less strange than some of the things people are doing out there. I drew faith from Ennemoser's comment about how C37 tuning produces "a more lively, open, and warmer sound and turns sharpness into brilliance." I really like that image and that was what I was hoping that the C37 would do for me. Even though I know Ennemoser is anti-linguistic, language is a difficult habit to shake.

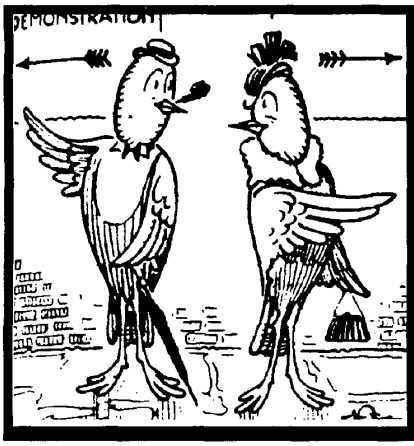
So, the deed is done. The verdict won't be in in time for this issue however. C37 *Speziallack* takes *months* to dry completely on absorbent paper cones (much faster on non-porous surfaces). So forget quick A-B comparisons — fine by me since I'm not into 5 minute clinical psych lab experiments anyway. I like to take the time to make evaluations in the real context of my normal musical listening activity.

Nor am I into the tweak neurosis that I saw coming if I sat here for a couple months listening to the C37 *Lack* dry, so I decided to put the Lowthers away for a time and get on with my life while it cures. Started to sound interesting before I wheeled them out to storage, two weeks after the C37 aplication.

I wasn't out looking for Lowther mods since I think they're very good as is but I figured that in order to give the C37 lacquer its best shot, I should put it on something fine to start with instead of wasting it on a $50 CD player in hopes that it would magically transform into a Wadia. Nobody said it was magic, especially not Mr. Ennemoser.

Bone Doctor (continued from p.35)

Ennemoser is the first person I know to argue the point that temperature is a critical element in resonance tuning. For example, he says that glass sounds like C37 in the 70°-72°C range and at another point in the 180° range. Most preamp tubes run cooler than this and power tubes run too hot. You can experiment with concentrating the heat around your preamp tubes with a cardboard hat to get up to the 70°C range and try it for yourself.



Lowther, another opinion.

by Marc S. Wauters

More fuel for the inner fire

I've been following the almost euphoric acceptance of Lowther loudspeakers into the hearts and homes of American Audiophiles over the last few years with great interest, and some concern.

With the popularization of the single ended vacuum tube amplifier and the resultant quest for high efficiency speakers it was only a matter of time before Lowther drivers would be recognized as a viable contender.

Having spoken with many "new" Lowther enthusiasts during the past few years I realized that there are quite a few misconceptions floating around in regard to both Lowther as a company and Lowther drivers. I hope that anyone considering the purchase of new or used drivers may benefit from the information provided here.

IMPORTANT! *Be aware that while the following text contains many facts, much of it is also based on MY personal opinions developed through MY experiences. Opinions are like noses, everybody's got one and everyone's is different. Have an appropriate amount of salt handy.*

If you've been reading the articles in *Sound Practices* and maybe surfed over to one of the Lowther Club web sites, then you have a pretty good idea of what these drivers are all about.

High efficiency drive units that can cover the entire audio frequency range at deafening volume levels with only a few single ended watts of power. The purists dream come true ...well, almost.

Now not all of what you are going to read here is necessarily positive. But to dispel any suspicions to the contrary, I would like to say, capitals Mr. Printer please and in bold if you can:

I AM ABSOLUTELY A GREAT LOWTHER FAN !!! ("Worlds *greatest* fan" was already taken.) However, I am also painfully aware of the following facts:

#1: Separating Lowther "Cult Lore" from real-world usable information can be difficult, but it is possible. And as I have come to learn the Lowther factory is not always a good source of information unless you can get hold of the chief designer, Mr. Roy Hopps, but that can be difficult.

#2: In spite of being called "The World's Finest Drive Units", Lowthers are not perfect and you must accept their flaws in order to enjoy their strengths. False expectations based on wrong information (sometimes put out by Lowther themselves) poor product quality and plain old misuse of these drivers has caused quite a bit of frustration for some Lowther enthusiasts. This has to some degree already been pointed out in other articles.

#3: Unlike roses, "A Lowther, is not a Lowther, is not a Lowther" (thanks Harvey...and Gertrude). Or to put it another way: Not all Lowthers are, or were created equal. It is important to know at least some of the technical details of what makes a Lowther sing when considering a purchase. Especially older used ones which may have made it to U.S. shores over the last 20 years must be scrutinized carefully.

#4: Dealing with Lowther directly in regards to product purchase can be extremely unrewarding. While I know a few people who have ordered drivers and actually received them in this lifetime, this is the exception! Many stories are in circulation suggesting that common Lowther procedure is payment in full up front for the merchandise and wait to see what happens. Maybe you'll get it, maybe you won't.

Quite some time ago a friend of mine ordered a pair of PM-4As for which he paid in full up front. After a year and a half of lame excuses from Lowther he was talked into taking a bunch of Feroba drivers instead. Unhappily he accepted because his money was gone and it was quite apparent that he wasn't going to get what he had ordered.

In other words you should get your Lowthers or spare parts from a knowledgable dealer, representation available in most parts of the world nowadays. Your chances of getting a good specimen of Lowther product go up dramatically when someone with a little knowledge and love for these speakers has inspected them!

I'm sure all of the above may sound a little confusing. But if you read on, I assure you it will all fall into place.

My personal Lowther history:

Most of my early years were spent in Europe, Germany to be specific, where Lowther has always enjoyed some varying level of popularity. I first became aware of Lowther sometime in the late 1970s when they were really quite the rage. Kind of what's going on in this country right now. WARNING!

Design and production quality were almost at their best during the late-70s. It should be pointed out that much of Lowther's good reputation was based on products from that time period. The design of the drivers was practically perfect around 1975 and there have been NO REALLY SIGNIFICANT IMPROVEMENTS to the product since then.

I watched Lowther go from extreme popularity during the late 1970s to a low somewhere in the early to mid 1980s. Dealer after dealer tossed in the towel and gave up the line. Few were able to handle the constant changes made to the drive units, changes which never improved the sound. Production quality was more variable than the weather in Germany, going from reasonably good to lousy and back within weeks.

Lowther took some pretty big hits back in the 1980s and it was really all their own fault. Unfortunately, some production and quality control problems persist to this day, which is to say that a knowledgeable and quality-oriented Lowther dealer is definitely worth seeking out.

Through thick and thin, there were some people who've always kept the faith, maybe because they fondly remembered the good old stuff. And eventually I met one of them and he really helped me out a lot. More on that below.

By the time I was ready to purchase my first set of Lowthers, the only places you could still buy them were large mail order houses. Most of the dealers with auditioning rooms had stopped carrying the product. In late 1981, I finally bought a pair of "C" series PM 6 Mk1s, the ones with the "Special Silver Speech Coil". I had been warned by several people not to get the silver voice coil option because the silver voice coils were said to be unreliable, having a tendency to come undone.

Of course, this is exactly what eventually happened, but I *had* to have silver. I think all the stuff I read in *Hi-Fi Exclusiv* about Audio Note of Japan and their "Silver Philosophy" back in the early 1980s had something to do with it.

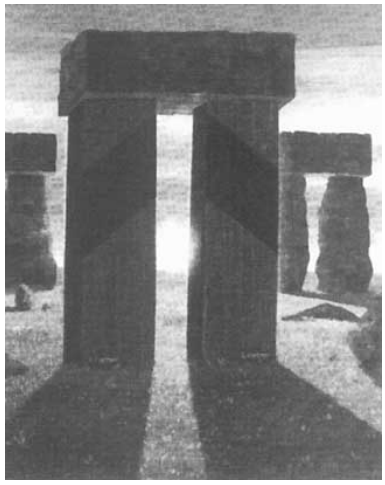
I never did get to use these drivers while I was still living in Germany because in early 1982 I moved back to Los Angeles. My Lowthers, my vinyl, and some select audio gear followed about 6 months later. Not long after I had put my drivers into some experimental cabinets, one of them started to "scratch". So I took them both apart and found that, as predicted, the inner winding of the voice coil had come off the former and was now flopping around in the air gap.

To my great dismay, I also found that the voice coils of the two drivers were of completely different lengths. One was 6 mm long whereas the one on the broken driver was 9mm long!!! Remember what I said about constant changes? Well, these were *supposed* to be identical drivers. I was able to find out from a friend in Europe who had a sort of "Hot Wire" to Lowther at the time that they decided to change the voice coil length of that model from one week to the next. Of course, there was no change in model designation and I just happened to get an "old one" and a "new one" ...hey, thanks a lot, folks.

Replacing the defective cone-voice coil unit was not possible at the time so the still good driver went into the closet and I went on to listening to something else. But I couldn't quite forget the brief experience of listening to those drivers. Although far from perfect the way I had them running, there was something special about the "Inner Fire" (a German expression) , intensity and fine dynamics these speakers displayed even at very low listening levels.

Sometime in 1984, I found out about someone who was selling complete Lowther speakers in Canada and I was able to secure the last pair of Accolade 2s they had for myself. This was the "New Generation" of Lowthers. This speaker consisted of a PM 6 C and a C45 driver in a very small enclosure. Although it was claimed to be a folded horn, it was actually something like a multi-vented reflex enclosure of some kind.

Upon inspecting the drivers I found that they were not very much like the Lowthers I had seen in the past. The color of the cone was now bright white instead of pale yellow and the new paper didn't seem to have the density of the old stuff. The whizzer cone was shorter and the suspension was rock hard compared to the very compliant suspension Lowthers usually had.



These speakers did sound like Lowthers, but real bad ones. A little experimenting soon showed that the C45 unit was a complete joke and that they sounded better with it simply disconnected. But that was not a complete cure. I took out the PM 6s, retired the boxes to shelf ends in the garage and I used the C45s as paper weights.

Later a friend built me a pair of "new" Acousta 115s for use with my salvaged PM 6s. These were not the same Acoustas shown in a previous issue of *Sound Practices* but were a slightly smaller version designed for the "C" series drivers with Feroba magnets. Results were a little better in some ways than with Accolade enclosures but not what I had expected. Four weeks of experimenting with everything rational and irrational yielded no benefit

Then one day a key event took place. The friend who built the Acoustas and I were listening to the speakers when I decided to dig that old PM 6 Mk1 out of the closet and put it into one of the Acoustas just for kicks.

Friends and Lowther Fans, the difference was remarkable! And I was not even sitting in front of the speaker, I was sitting next to it after installing the driver when my friend turned up the tunes. It was not like night and day but the old driver with the pale yellow cone and soft suspension was better sounding in every way. Clearer, more fine dynamics, better tonal balance and less aggressive. This was clearly much more of what I thought and remembered a good Lowther should sound like. The problem was, I only had one driver and mono was not my bag, sorry Vinny.

I was disappointed and confused over the driver issue and knew Lowther themselves would be of no help, so I put the Acoustas in the garage for a while and again searched for something else to listen to.

Quite some time later I decided to give the Lowthers another try, partially because I had just sold my regular speakers. Upon getting them into my listening room I found that the aggressive *"smelL. A."* (I can say that because I was born there) air had taken its toll on the foam surround.

Curiously the older PM 6 Mk1s suspension was still in good shape.

I tried calling the German distributor for Lowther in Berlin in order to get some replacement cones only to find out that they too had thrown in the towel. For reasons of my own more or less outlined in fact # 4, I refused to even attempt dealing directly with Lowther. More phone calls to friends in Germany revealed that a company by the name of Audio Technik in Bad Salzuflen had taken over the German distributorship, so I got their number and gave them a call.

This marked the second key event in my Lowther history.

I spoke to the owner, Mr. Dieter Kirchhoff, and ordered some replacement cones. In the ensuing conversation which lasted about an hour, I learned more about Lowther drivers than in all the previous years from all sources combined. In the

meantime I've spent at least the cost of a pair of PM 4s on overseas calls gathering all the information I could.

I learned that if there is one person who could potentially write the definitive book on Lowther drivers, it is Dieter Kirchhoff. Having been a Lowther enthusiast for almost a quarter of a century, long before he became the German distributor, he has pretty much seen and heard it all. He personally knew Donald Chave, principal designer of all drive units for many years, whom he visited in England on several occasions.

I knew from the experiences outlined above and from talking to other Lowther enthusiasts in Europe that there were quite a few variables associated with Lowther drivers. Dieter was able to explain to me what they were. He taught me all about voice coils, cone types, frames, magnets and driver break-in.as discussed below in the "Techno Stuff" section.

Audio Technik sells two types of Lowther drivers, the standard current production units as they arrive from England (within reason, of course) and what they call the "A.T. Special " line.

A.T. Specials are slightly different than standard-issue Lowther drivers. Mr. Roy Hopps and Dieter put together a list of 26 items which differentiate an A.T. Special from standard Lowther production units. A.T. Specials have the best cones, voice coils, least amount of glue, best magnets, they're aligned perfectly, and they have NO Hi Ferric applied. You can't do any better! But you'll have to pay a little more.

Needless to say the cones I received from Audio Technik were sonically a lot closer to what I expected from a Lowther driver. My faith had been restored.

TECHNO STUFF

"C" type Magnets

The Feroba type magnets are fairly consistent in actual magnet power i.e. relatively close to rated gauss specs. Ideally the magnets center piece should be flush with the outer edge of the air gap. Depending on production run, this has varied by up to 2mm plus or minus making voice coil height adjustment a little difficult because the top edge of the voice coil should be flush with the outer part of the air gap.

"A" type Magnets

The smaller Alcomax type magnets like those on the PM 6 A are not as consistent in gauss ratings, sometimes several Kgauss down from spec. On Alcomax types, the very edge of the inner voice coil should be flush with the edge of the magnets' assembly center piece, i.e. it should just be visible when looking "into" the driver. Having a longer voice coil former than Feroba units, some Alcomax units, such as the PM 2A have the pole piece chamfered so that the phase plug fits properly with respect to voice coil height (see photo). There do exist older units without the chamfering. A replacement cone for this type of magnet will have to be adjusted appropriately in height.

Voice Coils

As you probably know Lowthers have a "balanced" voice coil that is wound on the inside as well as the outside of the parchment paper type voice coil former. The whole voice coil assembly forms a mechanical filter described in "Driver Break In" below.

Much experimentation has gone into finding the optimum voice coil length. Donald Chave believed it to be somewhere between 5 mm and 6 mm. Longer voice coils make the drivers sound a bit "Slow". All A.T. Specials have a voice coil length of 4.5 mm which is what Dieter determined to be optimum. I think most standard Lowthers are currently made with 4.5 mm voice coils also.

For about three years now Lowther has been coating their voice coils with a magnetic paste they call "Hi-Ferric". It's supposed to keep the voice coils centered and increase efficiency.

I'm not so sure it really does much for the voice coil centering. In fact, it will ruin the centering if not evenly applied. It does increase efficiency, but only in a small upper mid-frequency range. And let's face it Lowther fans, the last thing a Lowther needs is more output in the mid-range!!! Worse yet the stuff doesn't seem to stay on for very long. It flakes off and gets stuck in the air gap of the magnet where it causes problems. This requires dissassembly of the driver and a good cleaning of the air gap with cellophane tape. For these reasons, A.T. Specials do NOT have coated voice coils. Draw your own conclusions about the stuff...

Here's the scoop on voice coil material: Aluminum is the traditional material, silver being offered as an expensive alternative. Donald Chave told Dieter that the only reason silver was ever used as voice coil material was for use in the Acousta 124 enclosure, also called the "Super Acousta". This folded horn was essentially an Acousta 115 with two drivers. One of the drivers was fitted with a silver voice coil, not for any special magic sonic benefit, but because of its higher mass specifically to *slow the driver down!* This reduced interference between the two drivers at higher frequencies. So again, draw your own conclusions.

The voice coils on Feroba and Alcomax units differ as follows. The distance from the top edge of the voice coil to the edge of the cone assembly is almost twice as long on Alcomax units, i.e.. the voice coil carrier on Alcomax units is much longer (see photo).

To (hopefully) clarify this a bit, an Alcomax type cone could potentially be used on a Feroba magnet if installed with spacers but a Feroba type cone CANNOT be used on an Alcomax magnet because it would not reach into the air gap.

Power handling

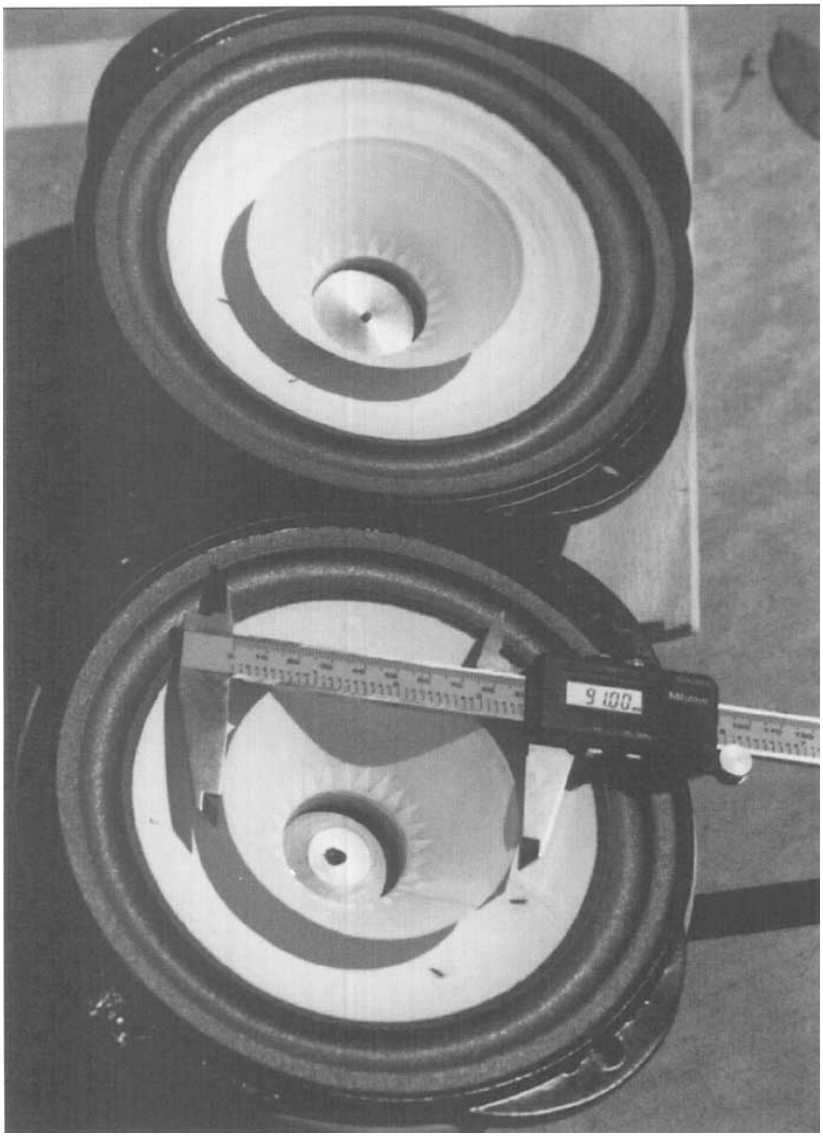
100 Watts?!?!?!? Well maybe for a milli second or so. Let's face it. A voice coil made to be light enough to reach far into the treble range simply cannot be made with a wire gauge able to handle 100 Watts for any length of time. Typical Lowther misinformation. Dieter says in his humorous way that: "At 100 watts the life expectancy of a Lowther is reduced from 10 to 20 years to about 5 seconds."

Driver Break-in

The voice coil former consists of a type of parchment paper chosen by Donald Chave specifically for its thinness of about 0.05 mm and for the following effect, according to his theory —As the drivers are used this parchment paper and the lacquer they are coated with literally "softens", allowing the voice coil itself to move more independently from the cone assembly at higher frequencies. It is this effect, above all others, that is responsible for the difference in sound quality of a Lowther that is broken-in and one that is not.

The cone assembly itself also experiences some softening. You can actually run your thumb nail along the voice coil of a new (non Hi Ferric) Lowther and depending on how crisp a sound you get, which is proportional to the amount of lacquer on it, you can tell if the driver will require a longer or shorter break-in time.

A fully decoupled voice coil produces two sonic effects that are not necessarily supported by measurements. First of all the drivers sound better, faster more extended and less aggressive, often described as



PM-2A (bottom) and PM6C with phase plugs removed. Note the voice coil former is almost twice as long as on the PM-2A. Notice also the chamfering on the PM-2A's center pole. 91mm is the proper size for the whizzer cones.

"silkier" in the treble range. And secondly the extreme directivity at high frequencies is somewhat reduced.

Suspension

Over the years there have been two types of suspension used on Lowthers. The proper "soft" type and the ridiculous "hard" type that was around for a good part of the 1980s. It is doubtful that any of the drivers with this hard type of suspension are still intact because it had a life expectancy of about 1/3 that of the soft type suspension.

Thanks to Dieter's efforts, the early 90s saw the return of the soft suspension and a few other things. If you find some used drivers with the hard suspension, buy them cheap for the magnets and get some new cones. The cones on hard suspension units were all wrong anyhow.

Frames

Frames have always been made out of aluminum. For a very short period sometime in the early 1970s the drivers used plastic frames. These were sonically better in some ways but just not strong enough.

About 5 or 6 years ago, Lowther switched from older style brushed aluminum frames to the stronger black painted version. This is the only change in about the last 20 years that has been generally accepted as an improvement. Some older enclosures will not readily accept the newer frame without modification, so be aware when trying to mix and match.

Cones

More than any other single element, the Lowther's cone is the predominant factor in sound quality and can make or break the drivers as to their usefulness in high quality audio. At the same time, no other part of these drivers has seen more experimentation by hobbyists and the Lowther factory.

The low point in driver quality was reached during the 1980s when the following three elements were combined to produce the worst drivers Lowther ever made, causing much dismay among enthusiasts.

1. The previously mentioned hard suspension was used causing the drivers to suffer especially in regard to resolution of fine-dynamics.

2. The cones were no longer made using the pre-1980 pale yellow paper (about the color of a manila folder) but instead were then made with a white paper that did not have the same high inner density. This 1980s white paper did not have the ability to control certain cone resonances very well and those cones sounded noticeably more aggressive.

I realize that this may alarm some people who recently bought Lowthers with "white" cones. In regard to that let me say this: to the best of my knowledge, Lowther today uses the good paper on all of the A series units However, some C series drivers have reportedly been shipped with the less desirable white paper in recent memory. It varies with the production run, as do so many other things. All AT Specials, whether A or C type use the better paper or else Dieter wouldn't sell them. Again, it is not the color that matters but the "weight" of the paper. Again, find yourself a knowledgeable dealer...

3. The whizzer cone had been shortened by a whopping 8mm!!! I think Lowther did this in response to recommendations by various publications (one no less by the prestigious *L'Audiophile*) that recommended various forms of "butchery" to the whizzer cone to achieve better measured

frequency response and to attempt to tame a resonance that occurs at about 2.5 kHz. Overall, these attempts failed in subjective listening tests when compared to mid-1970s drivers.

Dieter related an interesting story to me about some friends who tried, during weeks of eager experimentation, every possible modification known to man to the whizzer cone. They tried lengthening it, shortening it, cutting triangular patterns into it, you name it. When they brought the "optimized" drivers to Audio Technik, Dieter quickly pointed out that they had rediscovered the 91 mm whizzer cone of the mid-1970s.

According to Donald Chave there is only one correct set of parameters in regard to cone geometry that works optimally. So whether old or fresh off the line, make sure your whizzers are as close to 91 mm outer diameter as possible (see photo).

When Audio Technik was offered the German distributorship of Lowther products in 1989, Dieter asked for samples of current production units. Upon inspecting the current "State of the Art" he respectfully declined unless Lowther were willing to supply him with drivers based on the design of the 1970s, especially in regard to the cones. So after some research and the sacrifice of some older good drivers, Dieter forwarded the design information to Lowther.

Through the concerted efforts of Dieter and especially Mr. Roy Hopps, chief designer at Lowther (credit where it is due), the year 1990 saw the introduction of Lowther drive units by Audio Technik with the suffix "A.T Special" which are very similar to 1975 units. Many of the findings of this research were also incorporated into standard production models, much to the benefit of the product line.

Early 1970s cones had the very outer edge of the cone bent downward and the surround was attached to this lip instead of the cone directly. This kept the cone nice and round and offered a little more strength. Unfortunately it's been impossible to persuade Lowther to use that method again, apparently because it is rather difficult to manufacture.

As to the patterns impressed into the cones, the older diagonal is preferred. All the Alcomax drivers have the original pattern. Only the "C" series has the newer ring pattern and only on the low frequency cone. The whizzer on "Cs" still has the original pattern.

Cone trivia: Sometime in the early 80s Lowther was experimenting with PLASTIC CONES! I have photos to prove it.

The Feroba Models

The only Feroba driver recommendable is the PM 6. All the others have the large magnet problem in which sound is reflected off the magnet back through the cone. A PM 6C/A.T. Special sounds almost identical to a PM 6A/A.T. Special, the C type sounding a little bit brighter because of the shorter mechanical filter described earlier. Don't even consider the C 45 or the C 55!

The PM 7C and the PM 2C tend to sound a bit shrill and aggressive, partially due to the shorter mechanical filter, than their A type counterparts. Don't be fooled into mistaking brightness for clarity.

The Alcomax Models

The Alcomax series consists of 3 different magnets combined with various "soft" and "hard" iron pole pieces and end plates to produce the different magnet assemblies. The hard iron pole pieces concentrate more energy in the air gap for a given physical size but the soft iron pole piece, in my opinion, produce a more "linear" magnetic field.

PM 6A: Has the smallest magnet and pole piece.

PM 7A: Has the PM 6 type small magnet but has a hard iron pole piece that is able to concentrate more energy in the air gap.

PM 2A: Has a medium size magnet with PM 2 soft iron pole piece.

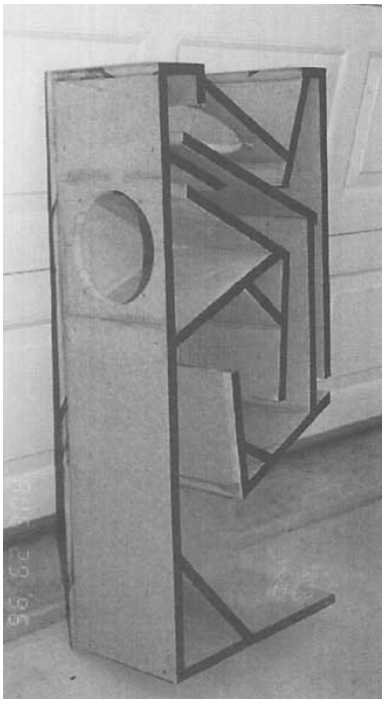
PM 2 MK2: This driver is no longer available. It had the same magnet as the PM 4 A with a soft iron pole piece.

PM 3A: This is a PM 2A with an attached enclosure purpose built for the TP 1 type enclosures.

PM 3/5A: This is a PM 5A with the above mentioned enclosure.

PM 4A: Has the PM 4 magnet with the biggest hard iron pole piece available. This driver was designed to be used as an indirectly radiating speaker in the Audiovector type enclosure which is why it has that "light bulb" like diffuser instead of the standard phase plug. It was never intended to be used as a direct radiator like all the other models.

PM 5A: Has the same magnet as the PM 2 A but has the hard iron pole piece of the PM 4A.

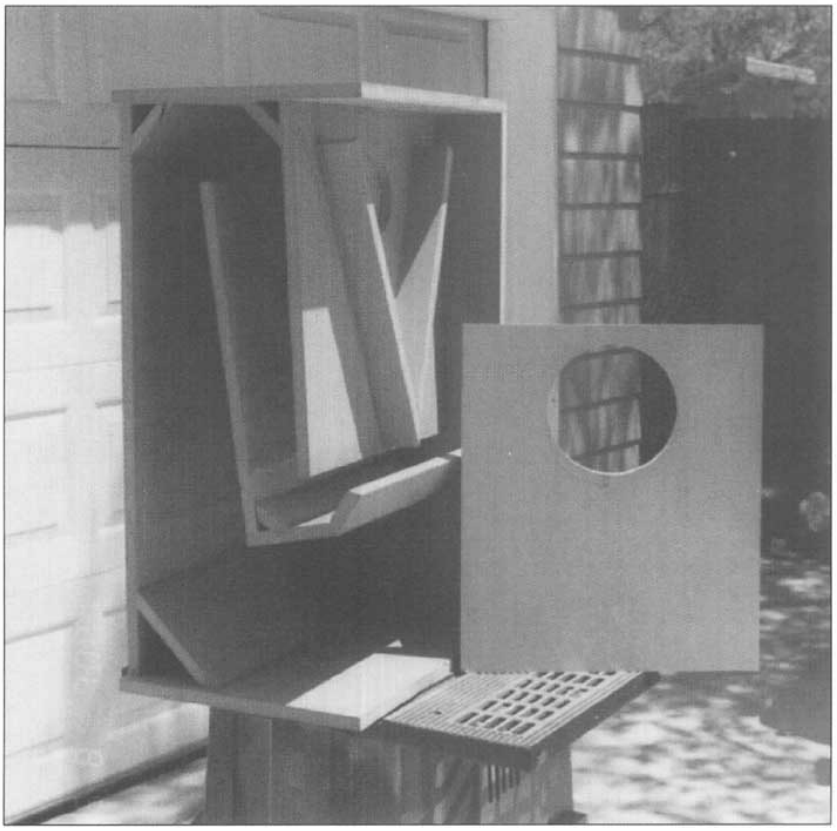


An Academy in the works.

The PM 7A currently enjoys great popularity that I don't quite understand. Dieter points out that the PM 7A is a PM 6A with a different pole piece allowing a little more of the PM 6A type magnets' energy to reach the air gap. Notice the identical weight specification for the PM 6A and PM 7A. Recent spec sheets indicate that the PM 6A has an Alcomax 2 magnet and the PM 7A has an Alcomax 3 magnet? No comment.

If you're considering buying a pair of PM 7s, you may want to invest a few more dollars and get the PM 2A. It's a much better deal. As magnet power increases so do things like high frequency extension, dynamics, voice coil control, and unfortunately a tendency of the speaker to sound aggressive and unbalanced. The PM 2A seems to strike the best compromise in this respect partially, I believe, because it has a soft iron pole piece. Time and time again, I have seen this model chosen by many enthusiasts as the best driver for direct radiating applications because it sounds the most "harmonious."

Note: The use of silver voice coils now available on all units may reduce the aggressive tendencies of some of the more powerful drivers. But this is probably due to the weight factor as pointed out earlier.



A modified Acousta cabinet in progress

It seems wiser to me to put your money into a better magnet assembly versus a "slower" voice coil to achieve this desirable effect.

What to buy used

Of the Feroba type, only the PM 6C and PM 6C MK1

Anything and everything of the Alcomax line you can find cheap but be aware that if it's from the 80s, you're buying it for the magnets. What is cheap? That's hard to say. If you have some used drivers lined up you should check to see what a replacement cone would cost for that particular unit versus the complete unit new. The rest is obvious. Stunning logic, huh?

The good thing about functional used drivers is that they're probably already broken in!

What to buy new

This, of course, depends on the intended application. Get the appropriate driver for the enclosure you plan to build.

As you can tell from what I said earlier I personally would recommend the PM 6C if you're on a budget. If it's Alcomax you want and you can afford it, get the PM 2A, my personal favorite. Other people have different opinions, what can I say?

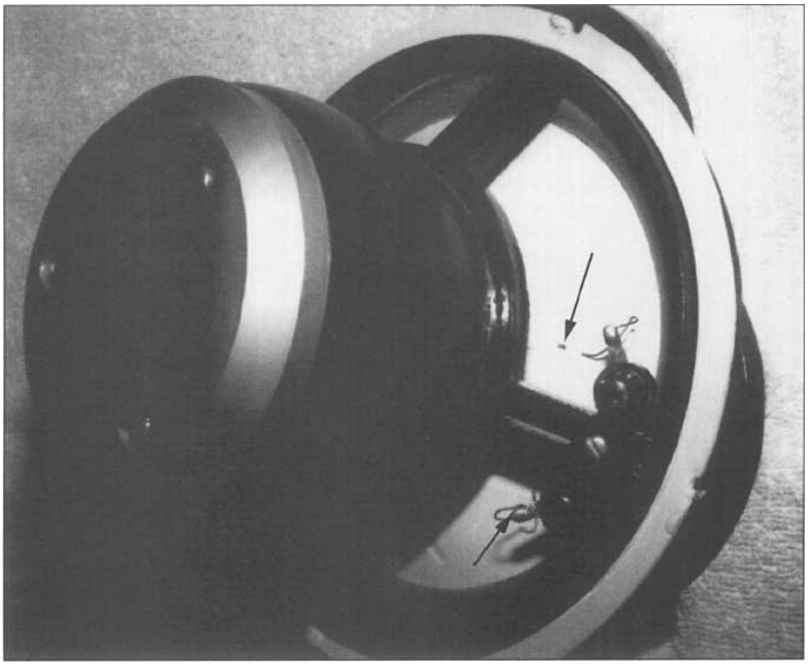
Important: If you are not in a position to hear a set of Lowthers of any type before you buy and don't want to take it on faith, I strongly recommend that you get a pair of PM 6Cs. I am personally absolutely convinced that if you do not like the basic sonic signature and character of Lowther drivers, it won't matter what model driver or what enclosure it is, you ain't gonna like it!!! So if you have to find out through a purchase it may as well be cheap. I assure you the PM 6C has all the qualities that will let you know if Lowther is for you at a reasonable cost.

If you find that you like Lowthers, you can then consider upgrading to one of the Alcomax models. Furthermore, if you want to experiment with one of the dual driver type enclosures, you can get an Alcomax for the front and use your PM 6 Cs for the back.

FIRST AID

The following applies mainly to used drivers, of course. But if you get your drivers directly from Lowther, you should give them a thorough check up, especially with regard to voice coil centering. Lowther is really bad about that.

First check the voice coil with an Ohm



Voice coils often break at these points. This is a repairable condition.

meter. If it reads open,the coil is either fried or the unit has the following typical Lowther problem: When Lowther attaches the aluminum voice coil wire to the litz wire going to the binding posts, they often put too much tension on the coil wire. Eventually this causes the wire to break at that point. Especially if the drivers are stored in a place with varying temperatures, like a garage. I know this because its happened to me. Although very tricky this is repairable (Dieter does it all the time). First you must find out where the wire is broken and then you will have to use a special solder for the repair. It is best regarded as a job for your Lowther dealer or someone who's done it before.

A case in point: A friend of mine in France had 8 new drivers stored for 8 years. When he unpacked them recently to complete the "temporarily" shelved project ALL EIGHT drivers' coils measured open. Yes he was extremely bummed!!!

As I said earlier any thing from the 80s which has the hard suspension and/or the short whizzer, and/or the white paper cones, the cones should be replaced. If the drivers are functional, certainly you can go ahead and use them, just know this is not how it was intended to be.

If you found some drivers that appear to be in O.K. shape, and not from the crap vintage, inspect the whizzer cone for any evidence of butchery which unfortunately is quite common. It should have a measured outer diameter of about 91 mm (see Photo).

Next check to see that the voice coil is centered properly. Press down carefully and evenly onto the whizzer cone with thumb and index finger of both hands. Listen and feel for any resistance or scratching. If any resistance or scratching is present, proceed as follows. Loosen the bolts attaching the frame assembly to the magnet just enough so you can move the frame independently from the magnet. If you have a function generator set it to 20 Hz and give it enough voltage to get the cone to move a few mm. If you get a lot of scratching, use common sense and back off!

Carefully move the frame relative to the magnet until you can turn the generator voltage up far enough to get a good 2 to 3mm of excursion in either direction without any interference to the voice coil. But this is only a starting point. If left here, there is a good chance that the voice coil may be very close to a side of the air gap. When the driver is installed the weight of the magnet can produce enough distortion of the frame to again cause interference.

The careful pushing on the cone method introduces enough "slop" to reduce the chance of this happening. So now go back and do the pushing test again. If the voice coil scratches, do the re-adjust again and check by hand until it runs free. This takes time and practice. Re-tighten the bolts carefully and evenly.

If you can't get the voice coil to run free after several attempts, there's probably something in the air gap that will have to be removed. This is especially likely if you have a Hi Ferric driver.

In this case the frame/cone assembly will have to be removed and the air gap cleaned with tape. As always, use extreme caution during this procedure. Completely remove all bolts before carefully lifting the frame from the magnet.

Should you decide you need a new cone for any reason, it would be wise to remove it from the driver and measure the distance from the edge of the voice coil to the cone assembly. This information may help you or your dealer in getting the best possible replacement unit. If you can't get an exact duplicate, at least you'll know if shimming for proper voice coil alignment is an option. This, by the way, is a common practice.

Repairing minor foam surround damage is possible. I like window silicone the best because I can paint it on very thin with a small paint brush and it has very little effect on the suspension's compliance. Of course, you have to thinly coat the complete surround and spider on both sides. The spider on Lowthers is also made of foam and siliconing it properly will require disassembly of the driver.

Is it really worth fixing an old driver? Well yes, if it's one from the 70s. And furthermore its going to be about as broken in as it will ever get! Besides what have you got to lose?

ENCLOSURES AND WHAT TO EXPECT

This chapter really requires a separate article because there's so much that could be said. But here are a few brief thoughts. The powerful magnets needed to overcome inertia for high frequency reproduction tend to reduce low frequency response. It is also necessary to keep cone excursion down as low as possible to prevent doppler distortion. For these reasons, Lowthers are generally fitted to some type of rear loading bass horn that augments the frequencies below 300 Hz or so.

In my opinion, these horns are a blessing as much as they are a curse. I've been doing quite a bit of work on alternate horn designs for Lowthers as well a some non-horn designs. Assuming there is any interest and I don't get shot by some "Lowther Cultist" for saying some of the things I have so far, I might publish some of my findings in a future issue of *Sound Practices. [Heck, send in the manuscript even if you do get shot. We'll do posthumous articles--ed.]*

I separate the enclosures into 3 basic types:

1) The *Acousta-type* free-standing horns. These are front-firing and are somewhat less critical in room placement than the Bicor type. These are the Mini Acousta 109, the standard Acousta 115 the "new" Acousta 115 and the Super Acousta 124 which uses 2 drivers.

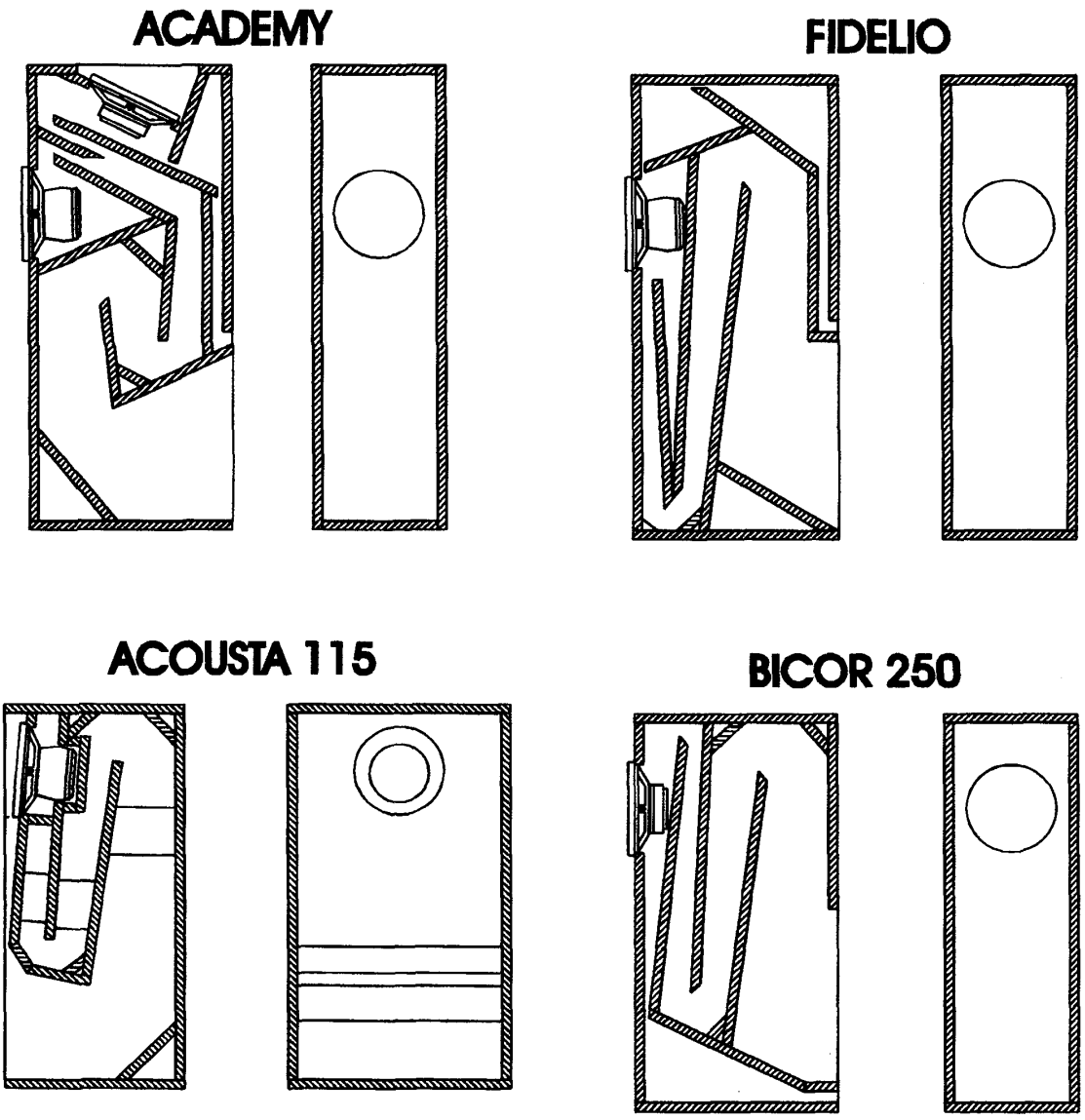
2) The *Bicor-type* enclosures which are rear firing and must be placed to some degree close to the back wall of the listening room. This family of enclosures includes the Bicor 200, the Bicor 250, the Fidelio, and the Belcanto. The models that use 2 drivers are the Bicor 2000, the Academy, the Delphic and the Delphic 500. (The Delphic 500 is not really a bicor, since it does not have a "bicor column.")

3) The *large corner horns* like the Opus I and the TP1 which don't always sound as well as may be expected. Let's stuff Ricky Lee Jones tightly into a corner and see what she sounds like, shall we?

And then there's the Audiovector, Dieter's favorite, which is sort of in a category of its own. This is a VERY large semi free standing horn that uses the PM 4A driver firing upward onto a reflector. Some versions (there are 4 types) also use a PM 2A firing directly. There are probably a lot more enclosures than those mentioned above, but these I know and have the plans for.

So lets have a look at the beloved Acousta 115. This is truly the classic Lowther folded horn. And its got that "Vintage Appeal". The interesting thing is that this enclosure according to Donald Chave is not one of their originals at all!!! Lowther at some time back in the dark ages took the plans from some other speaker and adapted them for use with the PM 6 driver.

There are two things that support this theory. First of all the throat area of this horn



Acousta 115 shown with some newer Lowther "Bicor" designs. Note the narrower baffle width on the new designs

is about 110 cm^2. Just about all other Lowther designs I have seen provide the driver with about 50 to 60 cm^2 of throat area. Which is more appropriate for a driver of this size. In fact if you take a close look at the throat area you can see that it really looks like a hack job with a very uneven transition from compression chamber to throat. This is not Lowthers' style because in spite of many of their faults Lowther does an incredible job of folding their horns. The Super Acousta 124 with two drivers in the same horn provides a better loading.

Secondly, there's that funky magnet box. Look at any other Lowther horn, including the Mini Acousta 109 and you'll see that they generally do a much better job of accommodating the driver's magnet than with a magnet box!

The Acoustas I just built for myself eliminate both problems. They have no magnet box and the throat is 20 cm longer and tapers down to an area of 60 cm^2 (see photo). This horn was built to accommodate the PM 2A/A.T. Specials that I have. Not having an original for comparison I can't say whether it works any better though.

The Acousta's major drawback is its large baffle size. There are a lot of reflections and secondary radiation coming off the baffle that cause some problems and because of this it sounds best at a listening distance of 4 meters or more. Notice that almost all current Lowther speakers have cabinet widths not much greater than the driver itself. The Acousta's big plus is that with minor adjustments to the magnet box it will take any of the Alcomax drivers up to a PM 2A.

The Bicor line are very narrow enclosures. This eliminates many of the problems associated with the large baffle of the

Acousta. They consist of a small folded horn that fires out toward the back. There is also a second "air column" basically in parallel with the horn that terminates in a small vent next to the horn mouth. Lowther claims it eliminates standing waves. Most of the Bicor horns will only take Feroba-type drivers which they were designed for. The single driver Fidelio will take a PM 2A and the two driver Academy will take a PM 2A in the front position and a PM 6C in the rear.

Dieter says that with this driver combination, the Academy is one of the best sounding cabinets going and he sells a lot of them. He also says that where the Acousta has a tendency to "scream" at you the Academy will "sing" to you.

In spite of being a little suspect of the twin driver concept, I built a pair of Academys with a PM 2A/A.T. Special up front and a PM 6C/A.T. Special as the rear driver and compared them to my Acoustas. In my opinion there is NO comparison. The improvements offered by the Academy in every respect, including far better bass in my listening room, are so staggering that thoughts I had of correcting some of the Acousta's shortcomings no longer seem that interesting.

The Fidelio is more or less the single driver version of the Academy and I would build this enclosure before I build another Acousta. It is very popular in Europe right now.

Of the large horns, Dieter considers the Audiovector to be the sonic flagship. It uses the PM 4A rear-loaded into a long bass horn and front-loaded into a midrange horn which fires up against a reflector. This virtually eliminates the unpleasant effects normally associated with the extreme directivity of Lowthers. It can use an additional PM 2A firing directly forward. This driver is attenuated quite a bit in relationship to the PM 4A and it should be run from a separate amplifier with proper attenuation.

I think the large horns should not be considered by Lowther neophytes. They're very ambitious and expensive projects that are difficult to build. It would be wise to start small and graduate to something like an Audiovector.

Unless you're going to get a super high grade (and super expensive) plywood like the Europeans like to use, such as Finland Birch or Multiplex, I would generally recommend MDF for cabinet construction.

Audiovector

There's no substitute for mass. Think about it, if you build an Acousta from some of that super strong and light alloy stuff they recovered from the Roswell U.F.O. crash and it weighed only 5 lbs what would it sound like?[*That Roswell stuff is good for tonearms too- ed.*] Standard plywood may have reasonable strength, but it doesn't have enough mass.

Contrary to what you may have heard the compression chambers of ALL cabinets should have some damping material in them to absorb higher frequencies so they don't reflect back through the cone. Hold a piece of Manila folder (similar to Lowther cones) tightly up to your speakers and see how much sound makes it through. Enough said.

As to the sound you can expect, let me quote my friend Peter Clark who stopped by while I was writing this article to hear my altered Acoustas with the PM 2A/A.T. Specials. After a few minutes of Rare Silk, on vinyl of course, he said:

"They really don't have a lot of bass but man that's the fastest darn thing I've ever heard"!!! And he hasn't even heard my Academys yet!

And fast they are indeed, extremely so. The response to the attack as well as the decay of transient information is absolutely phenomenal. In my opinion, this is Lowthers' greatest strength. These drivers produce a level of midrange clarity, detail, dynamic contrast and liveliness that is just incredible.

The PM 6C does sound a bit rolled off but not enough to be bothersome to me. Years of riding loud motorcycles has reduced my ears "top end response" to about 14.7 KHz. On the other hand the PM 2A plays with a clarity in the top registers that makes any thought of a super tweeter fade quickly. At the same time the sound can take on a somewhat aggressive quality depending on the specific driver and enclosure used and the listening distance. This is due partially to the 2.5 kHz cone resonance described earlier and the extreme beaming at higher frequencies. But you will find that you don't need to turn Lowthers up as far to get the message. All the fine dynamics and detail are there even at relatively low listening levels.

Lowthers can play LOUD. One slip of the volume control and your ear drums will meet in the center of your head!!! And they'll do it with just a few single ended watts.

In his must read book, *The Tube Preamp Cookbook*, Allen Wright makes a statement that I find profound and agree with wholeheartedly. He says, "The ability to accurately reproduce low level information in the presence of other stronger signals is one of, if not *the* most vital property of really good audio gear!" And Lowthers do this sooo well.

So what about the bass you ask? Well J. C. Morrison wrote in one of his articles that no amplifier plays perfectly over 10 octaves. And Lowthers don't either. Lowthers are undoubtedly bass challenged regardless of driver model or enclosure type. The bass they have is bone dry, swift and punchy. But there's just not very much of it and it really doesn't go all that low. Things really start slacking off in the lower mid-bass area and if you're used to the grunt of 15" cobalt powered Tannoys like me, its the only thing you're going to miss.

Of course it depends very much on the listening room. None of the enclosures couple well to a large room. Measurements of a well placed Acousta indicate response down to 50 Hz. Subjectively speaking, I feel that things start getting a bit thin at about 100 Hz or so. The Lowthers bass shyness has sparked many designs in which these drivers were liberated from frequencies below 200 Hz to 300 Hz or so by using a 12" or 15" woofer for the low end. One design as I recall even suggested a Karlson coupler!

I know Lowther fans don't want to hear this but if you want bass extension to complement the Lowthers' spectacular midrange and top, there's simply no getting around using some kind of subwoofer. The problem is finding one that can match the speed of a Lowther. In applications where a subwoofer is desired, Dieter uses nothing less than a Klipschorn actively coupled at 70 Hz. He thinks that it is the only bass speaker that can keep up with Lowthers' speed.

So there you have it. I could have said twice as much and still not have finished my say but all things must come to an end.

Lowthers (good ones) have a unique quality which is entirely their own. They don't appeal to everyone but after reading this you may be closer to knowing if they're for you. If you've been contemplating using Lowthers in your system I hope that you'll now be a little better equipped to make the best choice for yourself. If you get good examples of these drivers, break them in, and use them properly I'm sure you'll derive a great amount of listening pleasure out of them just as I have.

For questions, comments (I have a feeling I'll get a lot of those) corrections or just basic exchange of ideas I can be reached at E-mail : darmah@ goodnet.com Phone: 520-776-5996 Arizona time please! Fax : 520-776-5994

If you want to talk to real Lowther expert, Mr. Dieter Kirchhoff at Audio Technik in Germany, can be reached at 011-49-5222-3096 (voice phone) Make appropriate allowances for local time difference.

Editors note:

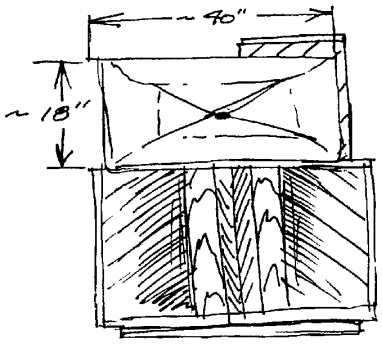
When I first got hip to Lowthers some years ago, I thought that something like a PM6A in an Acousta box would be a great sensible system for tube lovers. And my PM6As in Medallion-style Acoustas are just that for me. Natural sound, simple, reasonable size, medium cost, play loud on low power, intriguing whizzer cone design, I'm quite satisfied with the PM6A Medallion combo. Even though it doesn't have the presence and scale of a 300 lb. horn system, it's no slouch for the size and price.

Little did I appreciate early on that Lowther attracts a wildly diverse, ultra-hardcore crowd beyond anything else in audio. Five articles like Mark's fine essay above would only scratch the surface of what has been done and could be done with Voigt's twin-cone loudspeaker design.

One thing to mention counter to much cult lore about Lowthers is that these things work great with big tube amps too. They seem to come alive with the added power. Somehow it got implanted in many minds that you *have to use a small amp* with Lowthers because they are so efficient. I say try 'em with a pair of 6550s.

Feedback amps really help control the low end, although they *will* play on flea-powered NFB amps. I did find that some otherwise fine amps, like my 45 SE 2 watter, just didn't cut it on the Lowthers. You got to try it out to know for sure, as usual.

From the Backwoods



Yet another way to play strings (and kick butt) with a few watts

by The Baroda Bard

Pressing toward musical ecstasy with a two-way and a woofer

I've been playing with horns in the world of pro audio since my employer, Electro-Voice, got into the business circa 1974, later to become a major player beyond all the grand originals (Western Electric, Altec, JBL, Stephens, et.al.). I've hooked up and voiced more two, three, and four-way horn systems (sometimes mixed in with direct radiators) than I can shake a stick at. In auditoriums, trade show demo rooms, hotel rooms, mono, stereo. . .

I've never had much trouble making them sound enough like music to want to bring one home to my stereo someday. Someday. Right now I'm listening to a system at home that I've been working on since November 1994. See the pictures and the system diagram below. We are having a blast and the emotional chills are abundant.

My buddy Will calls the system "nouveau retro hi-fi." It doesn't look anything like Lowther cones, Altec multicells, A7s or A5s, Tannoys, Klipschorns, EV Patricians, or WE goodies, or the modern Eurythmies and Edgarhorns. All of the above are relatively mainstream now. What I've been listening to with so much pleasure and excitement is the way of only me and Ray and Takane-san in Tokyo. Essentially discovered beyond my living room, perhaps never to be discovered, which is OK.

The system is multiamped, horn-loaded from 80 Hz on up, and is easily powered by a few watts– and not just for Haydn string quartets. To give an idea of the territory we're working in, we have closed out late-night parties with the 80 rank Sanfilippo Wurlitzer, 32 foot stops and all, at the same 108 dB broadband maximum long-term average level I measured in the hall.

Or how about Hank Williams, Jr. doin' "Ain't Nobody's Business" at 112 dB? And the system isn't even topped out yet. As for the string quartets, *they* top out at 79 dB maximum average level experienced in the sixth row.

I got into the SE 2A3 thing because I didn't want to pay the 300B price, but come on with 45s, 300Bs, or any old PP thang you found in Grandma's attic. I have a few 20 to 30 W push-pulls that I put to good use and they work fine, aside from being total overkill in the watts out department.

I like an occasional, very robust pipe organ with my cognac, so there's a high-efficiency (97 dB 1m/1W) vented direct-radiator covering 25 to 80 Hz. This is an EV DL15W 15" woofer in a 3.2 cubic foot box tuned to 28 Hz, a so-called B_6 alignment that requires an underdamped (Q=2) high-pass filter at 28 Hz to flatten the overall system frequency response. You can get the same response without EQ if you double the box size and maintain the same tuning frequency.

Basically, it is a Thiele-Small on the computer style design, which takes a lot of power relative to horns. I use an old pair of Mac MC40s on loan as low bass amps.

So, here's my current recipe for approaching musical ecstasy with horns in stereo, using only a few watts.

1— Keep it basic, cinema-style

Two-way configuration, 500 Hz crossover. Compression driver and horn above 500 Hz. Fully horn loaded cone driver under 500 Hz.

The big bass horns are a creation of my late very best friend Ray Newman, who died suddenly in February of 1996. Total surprise to me and I wasn't prepared to learn how much I depended on "talkin' to Ray" and slipping his latest LF horn design into the old system. This prototype pair of horns develops a whomping 106 dB 1W/1m and is solid from 80-500 Hz using EV DL10X 10 inchers.

See John Stronczer's article in Issue 11, *Voice of the Theatre Chez Nous*, for an excellent treatment of horns and woofers that sound like music. It was very much a pleasure to see some real speaker basics outlined. Bottle heads interested in getting into speakers should take heed!

2— Select a big, dead-stiff HF horn that loads the driver pretty much like an old-fashioned, straightforward exponential horn but with constant dispersion over its operating range of 500-20,000 Hz.

Horns with this characteristic are called "constant directivity"(CD) horns. These devices have a bad name in some audiophile quarters. John Stronczer, for one, rightfully warns against modern CD horns with abrupt flare rate changes and non-optimally sized mouths, including too small.

Indeed, constant directivity is not a natural thing for a speaker to do, even though horns can be designed to produce this characteristic. Often in the world of pro sound, driver loading performance is compromised to achieve the desired directional results, with associated detrimental sonic effects.

I believe that given the realities of typical listening room acoustics, controlling the angle of radiation with stability across the frequency range – say over angles of 90° x 40° or 120° x 60° –creates an "open" or "transparent" quality that is very revealing of a stereo recording's inherent character.

A side benefit is being able to step out of the magic listening position, say to finish dinner in the kitchen alcove, and still being able to hear most of what you hear in the magic spot.

Electro-Voice developed the first CD horns in the early 1970s, which otherwise behaved like the best classic exponentials before them. The EV HR9040 and

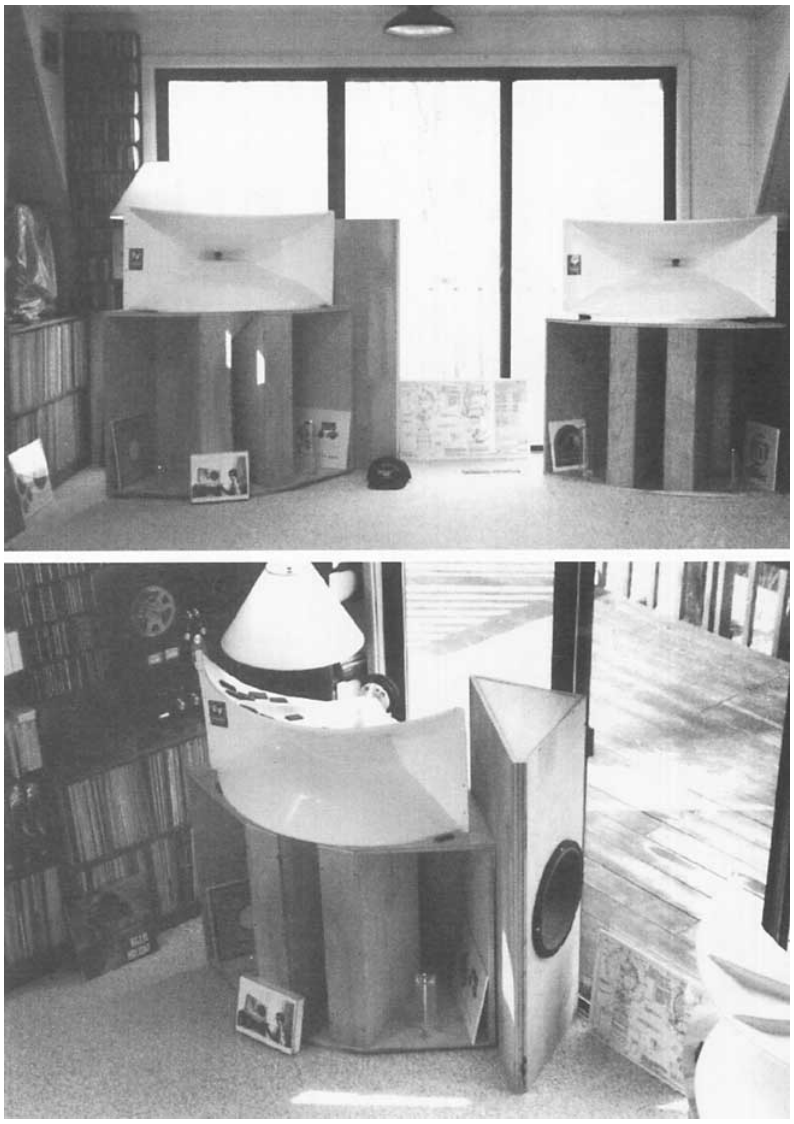
HR9040A (c.1974-85) offered extraordinarily constant 90° x 40° dispersion across the bandwidth without messing up the driver load.

Technical proof is in the very uniform impedance vs. frequency response, suggesting a lack of bad-sounding mouth reflections. The sine wave response curve was also very smooth, without the up and down nasties that most advertising departments like to keep hidden in the closet.

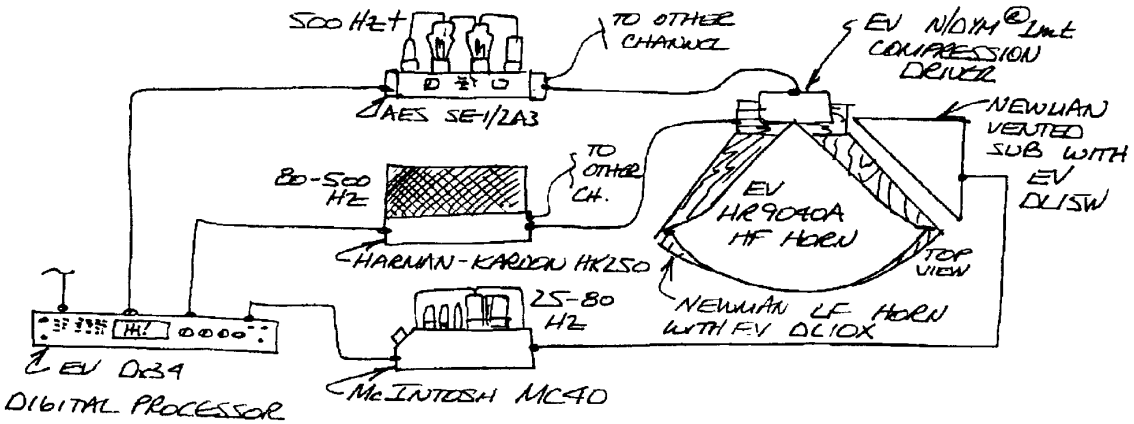
Executed in brilliant white fiberglass, the smoothly sculpted shape of the HR9040A is a sight to behold from the listening position. Its physical presence is even more substantial than the 1505B multicell—overall dimensions of 17" x 40" x 23" hwd for a huge mouth area of nearly five square feet!

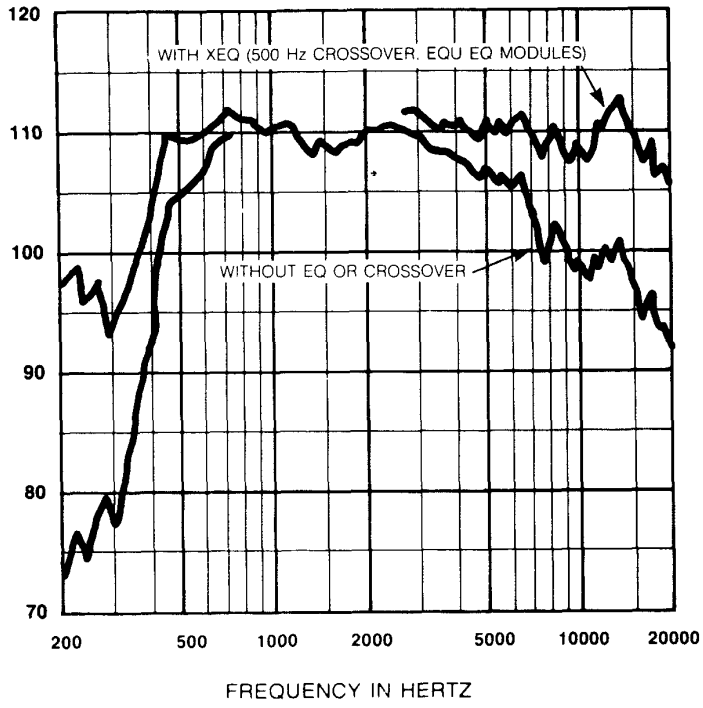
One benefit of the large mouth is the horn's ability to maintain its rated 90° horizontal coverage angle down to the crossover frequency of 500 Hz. A horn needs to be at least 27 inches wide to do this. Smaller horns can be 90° at higher frequencies, but at some point way above 500 Hz, they will "balloon out" and approach omnidirectional (360°) response as frequency decreases.

The HR9040(A) throat size is 1.3 inches and the flange has holes for EV 1.3 inch drivers and Altec 288s, 299s, etc. The



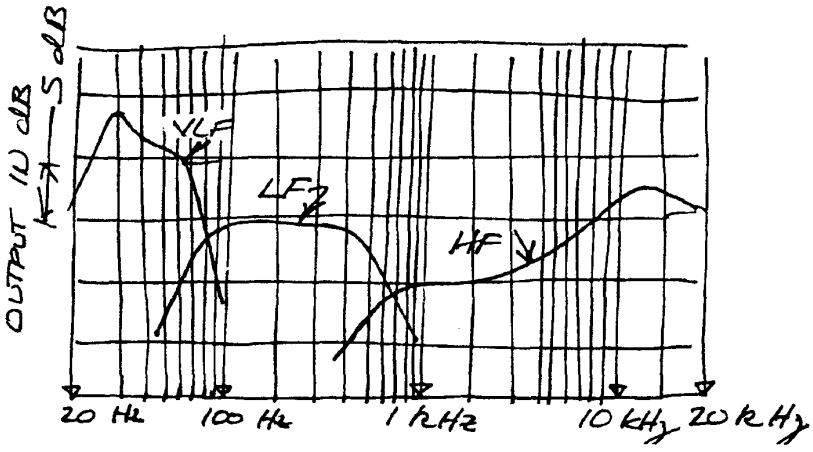
The Bard's "mostly" horn-loaded backwoods ecstasy system. Bass below 80 Hz is handled by a direct radiator 15" EV woofer.



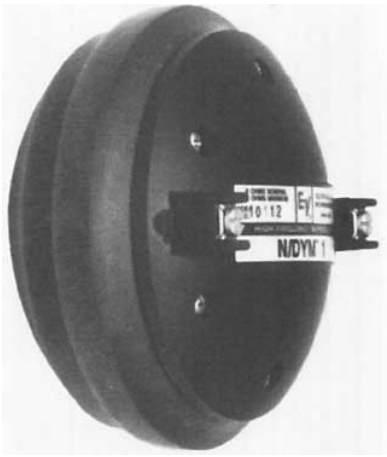


Unequalized axial frequency response of N/DYM-1 high-frequency driver mounted on an EV HP9040 constant directivity horn demonstrates a uniform 6 dB rolloff above 3000 Hz or so, close to the theoretical maximum.

Active or passive EQ can be used to obtain an essentially flat frequency response out to 20 kHz. Not being one to miss out on a good shortcut to musical ecstasy, the Bard uses the latest tool of pro sound, the digital signal processor.



Approximate digital EQ transfer function for a flat in-room response with The Bard's Backwoods Two-Way + woofer



Electro-Voice N/DYM-1mt High-Frequency Reproducer

Neodymium alloy magnet system, titanium diaphragm with edge-wound aluminum voice coil.

Available in 8 and 16 ohm versions..

Minimum crossover frequency 500 Hz

Throat diameter 1.3 inches

Sensitivity 111 dB@1m/1W(500-5000 Hz on HR9040A horn)

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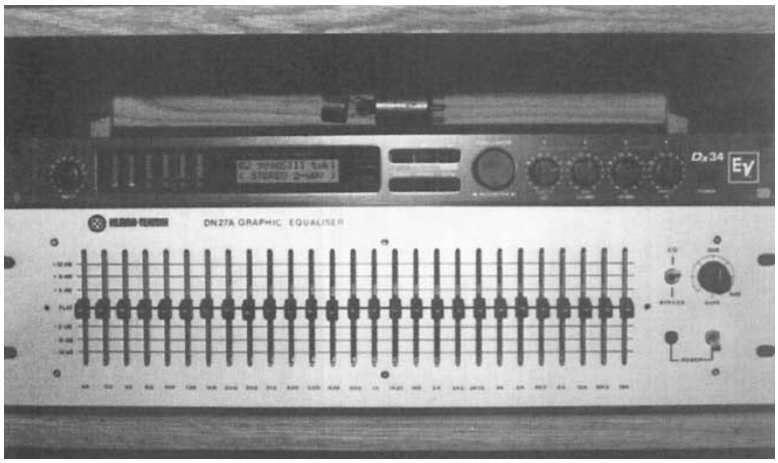
slightly different exit diameter of the Altecs (1.4 inches) is of no acoustic consequence.

I started out with a later-generation EV "small format" CD horn that I liked for pro applications and the Klipsch K-400 midrange horn. The small CD horn just didn't sound right, although the dispersion was great. The K-400 sounded very good but beamed like mad– a characteristic that, in the end, made me want to go back to my old speakers which didn't beam.

When I tried the big HR9040A, there was no contest. It was like removing a barrier in the room between me and the performer. Immediate, open, and right there.

The HR9040 and HR9040A are the same basic design but the "A" traded a vertical front stiffener for radial stiffeners and used a simpler-to-produce throat detail that had the side benefit of smoothing response a bit above 10 kHz. The story of the EV HR horns is contained in Don Keele's 1975 Audio Engineering Society preprint, "What's So Sacred about Exponential Horns?" Write The Bard c/o SP for a copy or e-mail me direct @ jlong2@compuserve.com.



The Bard's latest system uses two EV Dx34 digital signal processors for crossovers, parametric and shelving EQ, and signal delay for shaping loudspeaker response. The defunct de Forest Audion from the Bard's dad sits atop a single Dx34. The Klark Teknik DN27A one-third octave EQ was formerly used for the job.

3— Use a compression driver with performance close to the Newman criteria in acoustic power output vs. frequency.

One of the frustrating realities of all compression drivers is that the efficiency of a well-designed driver falls off at about 6 dB per octave as the frequency increases beyond 3 kHz. In short, there is no way around this phenomenon which is caused by physical realities like air squeezing through small slots and friction in the diaphragm suspensions (see Bard and Ray, *SP #7*). The best you can do with a real world speaker is 30% efficiency in the mid-band, dropping off with increasing frequency, and the rest of the power turns into heat.

The top drivers from companies like Altec, JBL, EV, TAD and so on perform at a level approaching this theoretical maximum. In order to get a flat acoustic response, you can use a horn, such as the Klipsch K-400, employing a geometry which results in a decreasing coverage angle with frequency. This gives a sort of "acoustic equalization" for a lucky on-axis listener, but listeners off to the side of the horn don't get the highs. And the music can seem oddly "closed in" to me. Not my idea of cool! What to do?

The other way to get a flat response where you're listening is to use EQ. With a CD horn, obviously, it's the *only* way.

4— Use one of the latest tools of pro audio—a digital signal processor—to EQ for the Newman Criteria and artfully integrate the woofer and tweeter in a biamp configuration.

To make the system sound right to me, I hook it up the way I would at work. Ten years ago, we had 1/3 octave EQs and active crossovers. Today, it's digital processors with adjustable crossover, parametric EQ, shelving, and signal delay to get the drivers in step without having to have equal path lengths to the listener.

The way I see it, life is too short *not* to use the most effective tools at my disposal to tune up a horn system. Essential tools in my arsenal include a good flat lab mic and a spectrum analyzer, plus extensive EQ and active crossover facilities.

I know what you are all thinking: "How could he listen to that evil digital processor?" How could I cut up my nice analog signal and try to piece it back together before I send it to a neat little SE triode amp? What you really mean is how could I listen to it and get anything like musical ecstasy out of the deal?

Well, all ya gotta do is come over to my house some night for dinner and hear Dinah Shore and Andre Previn doing "It Had to be You" followed by Les Brown and his big band at concert level, and you might get hooked—Capitol's late-1950s recording style in the tower at Hollywood and Vine might have something to do with it. We do country, rock, and Carl Orff too.

Sure, it would be possible to do the compensation with analog electronics, resonant

Get back, Jack! The Bardmobile out prowling the woods for more lumber.

circuits using caps and coils, but there's a lot to be said for the ease of dialing it right in with the processor. Here's a brief rundown of the setup procedure I use:

1– Start by EQing the in room response of each speaker/amp combo operating alone for a flat response 6 dB down at the crossover point. A pink noise source and one-third octave spectrum analyser are what I use, although software is available to adapt your computer to this worthy purpose. I also like to roll off the lowest woofer below its bandpass to keep infrasonic junk the speaker can't reproduce from muddying up the sound.

2– EQ the HF horn for a flat response above 500 Hz measured on-axis with the mic about three feet away (to minimize room effects). The curve may vary a bit in a more distant listening position, but the direct field will be essentially flat and the ear/brain combo keys in on this.

3– EQ the bass horn and sub and adjust the LF/HF balance *at the listening position.* Efficient bass speakers "put a big handle on the room" and, thus, the room– walls, floor, and all– puts a big handle on them. Deal with that at the listening position.

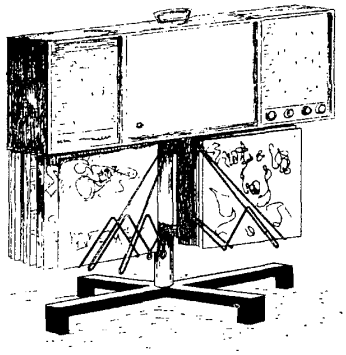
Of course, it is possible to go too far with compensation. If you try to EQ out every little bump in the response, you can squash the music out of it. Plus, if you can cancel out all the narrowband variations in one position, when you move the mic a bit you'll just have another set of small variations to contend with. In my system, a gradual broadband HF boost does the trick.

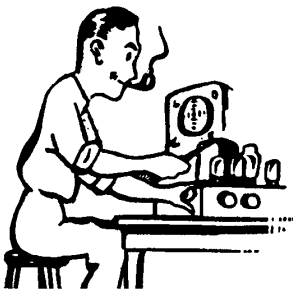
4– Adjust for path-length differences from the speakers to the listening position with the signal delay feature of the Dx34. Delay is adjustable in 20 microsecond increments, equivalent to a distance of about 0.3 of an inch. Close enough for me.

Looking at the system from the listening position, the subs are nearest, meaning their signal arrives first. The HF drivers are about 24 inches farther away, and the drivers in the folded LF horns are about another two feet away.

To adjust delay, I set the SPL of each speaker operating alone to be equal at the crossover frequency using a signal generator. Next, I turn them both on, inverting the polarity of one driver and advance the delay until the sound level at the listening position begins to drop then increase again. At the null, the signals are exactly 180° out of phase, causing a cancellation of the output. Restore the correct polarity of the inverted device and there you have it, perfect, instep summing at the crossover point.

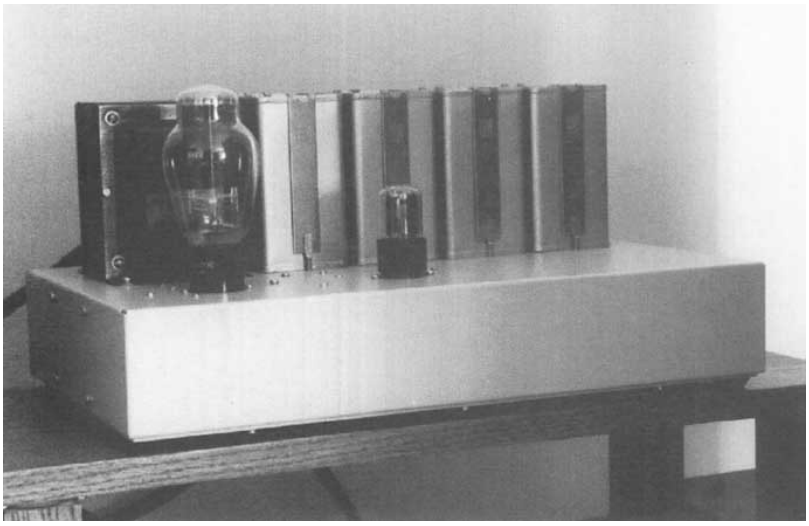
It took a few years to get everything lined up the way I have it now, but almost every night, we sit down to enter another world—MUSIC. We don't hear horns or crossovers, even with the big speaker rigs only eight feet away. And we've had enough friends over to know that our great happiness is transferable. Musical ecstasy? Go for it– I think we've got it!





Homebrewer of the month

Bruce Berman of Long Island, NY



Bruce's homebrew 300B SE mono amplifier audio chassis

One look at Bruce Berman's carefully hand crafted triode and horn music listening system is all the evidence we need to recognize Bruce as a Tube Man of the first order. Hey, good job!

What better evidence of dedication and commitment to the craft can there be than this monument to the gods of music, not to mention the gods of the homebrew art?

A system like this is one man's audio dream made real through hard work, so naturally Bruce has a great deal of pride in his audio setup—as well he should, because he turned a pile of old cast off junk and raw materials into a custom high-performance music system unlike anything you can buy anywhere. There's only one way to get a system like this—if you want one, you've got to build it for yourself.

As far as circuits go, Bruce swears by time-tested, carefully engineered, simple circuits with the best parts that he can buy, scavenge, or recycle, selected for sonics, not fashion. Although he does seem to have a certain fondness for old US-made industrial and broadcast parts, if the new stuff sounds better, the cool old parts don't make the final cut.

He experiments with circuits using breadboards to perfect the operating points and evaluate component sonics. After he knows exactly what is going in, then he does an exacting mechanical layout with calipers and graph paper. The clean look of Bruce's equipment owes a lot to his "measure twice and cut once" philosophy.

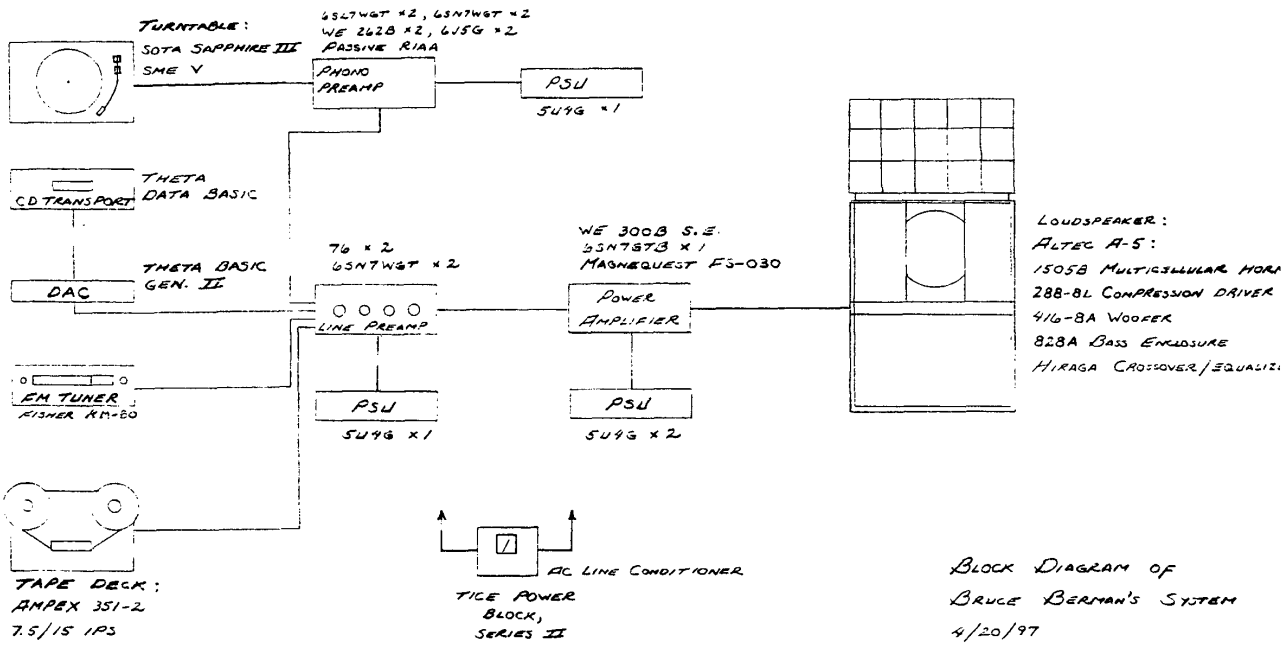
It's obvious that a lot of hours and hard work went into putting this system together. yet Bruce is super-content these days because he feels he's arrived at a lifetime system. Indeed, aside from tubes, most of this simple and solid equipment could easily last several lifetimes.

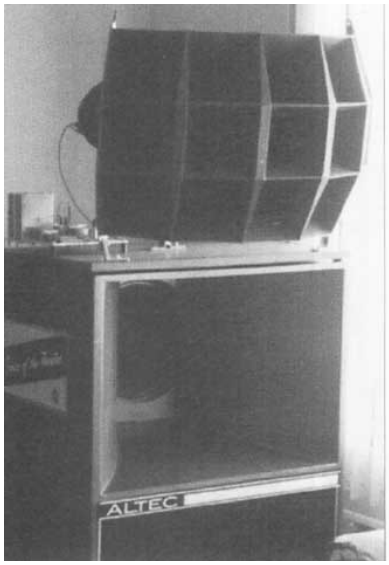
A system like this is an investment in the future but it draws heavily on the past for lessons and inspiration. It is obvious from the way this gear is put together that Bruce has a real appreciation for the classic American industrial electronics tradition.

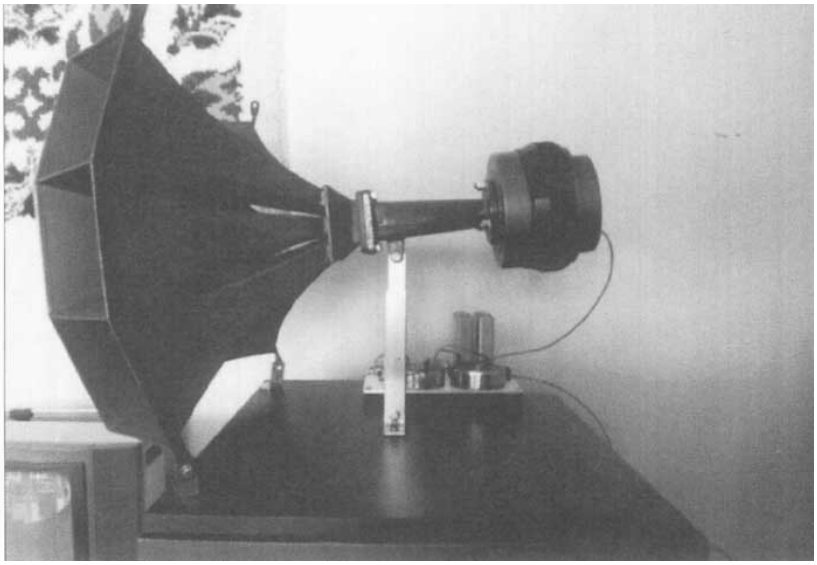
They don't build them like that anymore, and perhaps they haven't since World War II, but Bruce is still doing it. Keep the faith, brother!

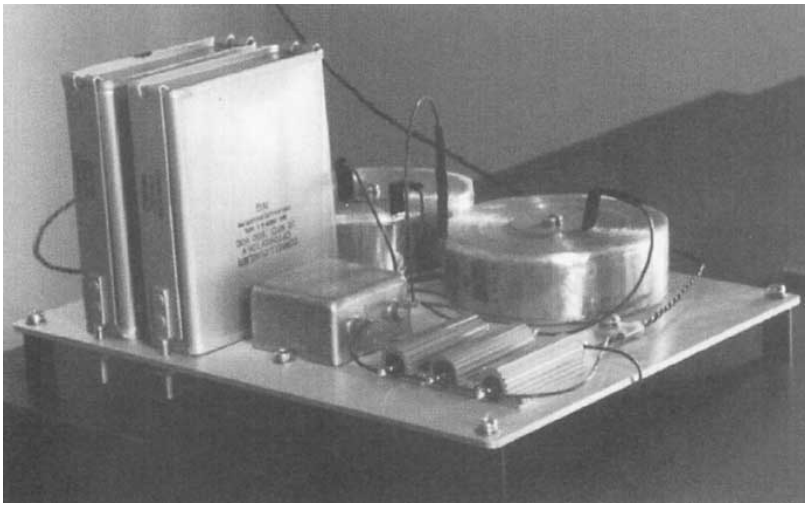
Tube rectified , choke input power supply for one 300B mono amplifier. Bruce believes that the power supply should always be much heavier than the audio chassis—in this case, the PS for each channel weighs a chunky 75 pounds!


ALTEC


TURNTABLE:
SOTA SAPPHIRE III
SME V
6SL7WGT ×2, 6SN7WGT ×2
WE 262B ×2, 6U5G ×2
PASSIVE RIAA
PHONO PREAMP
PSU
5U4G ×1
THETA DATA BASIC
CD TRANSPORT
THETA BASIC GEN. II
DAC
76 ×2
6SN7WGT ×2
LINE PREAMP
WE 300B S.E.
6SN7GTB ×1
MAGNEQUEST FS-030
POWER AMPLIFIER
PSU
5U4G ×1
PSU
5U4G ×2
LOUDSPEAKER:
ALTEC A-5:
15058 MULTICELLULAR HORN
288-8L COMPRESSION DRIVER
416-8A WOOFER
828A BASS ENCLOSURE
HIRAGA CROSSOVER/EQUALIZ
FM TUNER
FISHER RM-80
TAPE DECK:
AMPEX 351-2
7.5/15 IPS
AC LINE CONDITIONER
TICE POWER BLOCK, SERIES II
BLOCK DIAGRAM OF
BRUCE BERMAN'S SYSTEM
4/20/97





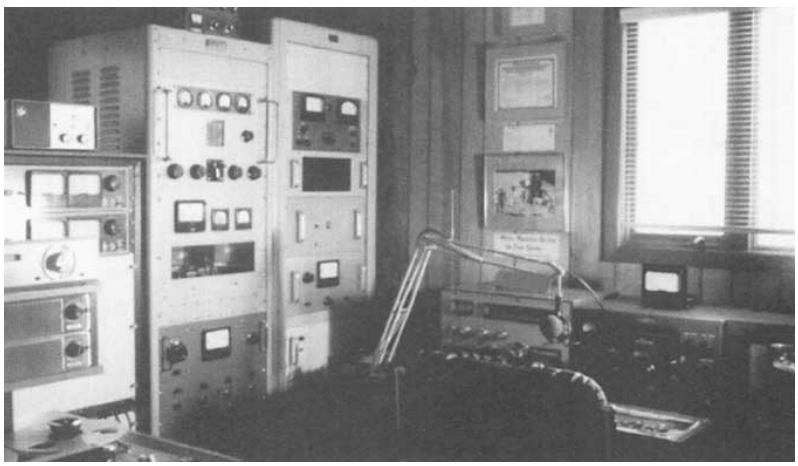


Fine attention to detail in layout, construction and parts selection is evident in Bruce's Hiraga-style EQ crossovers (see Stronczer, SP #11) for his Altec A5 "Voice of the Theater" loudspeaker systems.

Vintage Cornell Dubilier oil caps, Solo CFAC foil inductors, and Dale non-inductive, aluminum-cased, power resistors definitely looks like it ought to sound good. Bruce highly recommends the EQ crossover to VOT users, saying that the speakers really "clicked in" for home music listening with the new x-overs.

Being the consumate tube man that he is, Bruce is not content to limit himself to the 20 Hz-20 kHz frequency range. Pictured at right is his all "hollow state" amateur radio station, featuring a homebrew AM transmitter using a 4-400A modulated by a pair of 833A (behind the glass window in the center rack), capable of 1 kilowatt of broadcast-quality Class B audio. The speech amplifer driving the modulator is a Dyna ST-70.

Bruce definitely knows how to keep warm during those long New York winters! If this guy turned on all of his tube gear at once, the line voltage would sag all over the neighborhood!



The 210 Split

Domesticating the Giant Altec 210 Bass Cabinet

by
Michael Frye

If you can domesticate the 210, you're pretty good at that kind of work

The Altec VOT A5 and later A7 system using the 825 and 828 enclosures have been featured in a number of excellent articles in the pages of *Sound Practices*. A few of the modification suggestions to the enclosures have been straightforward and have enabled me to get much more from the upgraded boxes.

Changing woofers has also made some difference. The 803A with its thin straight wall cone and higher (40-50 Hz) resonance offered improvement in the lower mids while the 515 with its lower cone resonance and larger magnet seemed to improve the mid-bass output and snap somewhat.

I speculated that better bass extension, improved bass and midrange clarity, and the elusive quality of articulation and detail might be more easily realized using a full bass horn design. It seemed to me that a longer bass horn with its lower horn cut off would be a choice worthy of exploration.

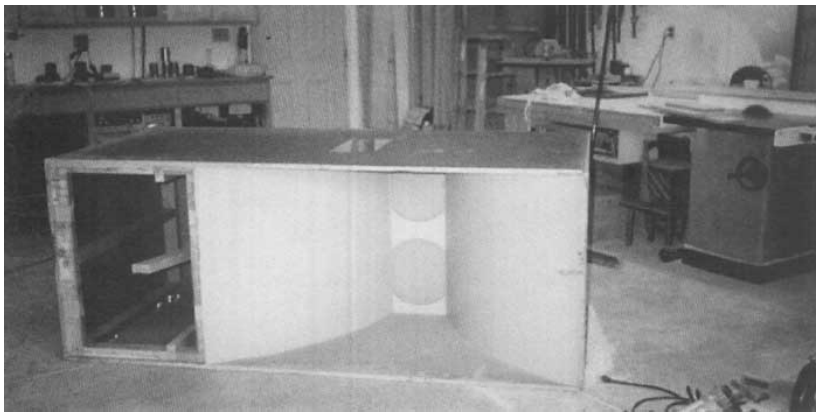
Fortunately, I had access to a large number of Altec's big 210 bass horn enclosures and more than enough Minneapolis cold weather shut-in time to experiment.

ALTEC 210 HORN DESCRIPTION

The 210 bass cabinet is clearly built for the auditorium. Its physical dimensions measure 84 H x 34 W x 39.5 D. These dimensions are so unruly for home use that about the only door through which it can be maneuvered is a wide front door or a large patio door. Most interior doorways are 30 or 32 inches, so unless one has a very large foyer that serves as a listening room, this behemoth is not going to work.

However, the Altec 210 has the potential to produce better articulation and a deeper, smoother, more continuous response than its smaller sibling, the A5 bass enclosure. In part, this is due to the bass horn's nominally lower free air cut off frequency (70 Hz versus 180 Hz). This free air response is going to be quite a bit lower in a listening room because among other things coupling the enclosure to the floor in the right places within a room may give perhaps another octave (35 Hz) of range. I later found out that usable bass output in my room extends even lower.

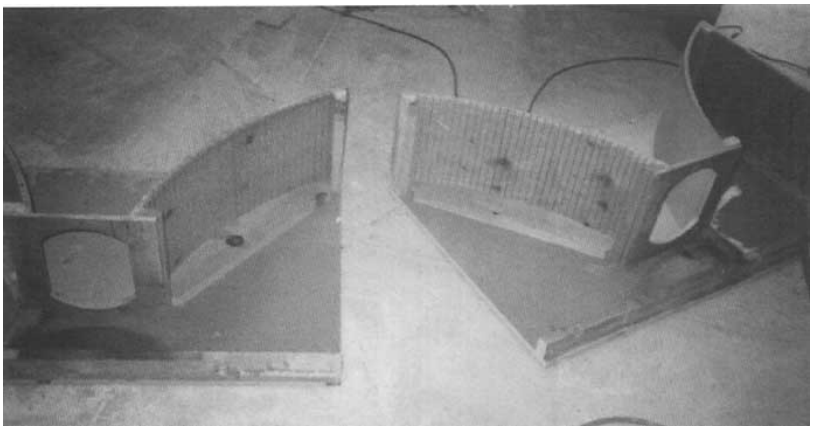
The stock cabinet takes two 15 inch woofers per side. Loaded with a pair of Altec 515 woofers, it should produce about 110 db/1 watt/1meter given Altec's 104 dB rating for a single 515 without horn loading. Like the 825/828 cabinet the 210 has an approximately 2 foot high port area



Above—Even without "wings," the 210 cabinet is a giant at 84" tall

Right—210 bass horn bisected on the workshop floor.

In particular, bracing and damping suggestions improved the VOT system's definition in the lower mids and upper bass and make an otherwise excellent loudspeaker better. Any change to tame the stock crossover has to be an improvement and several suggestions (issues #2 and #11) are worthy of consideration.



beneath the bass horn. In contrast with the 825/828 horn, the non flared sides of the 210 horn are parallel. (The two non-flared sides of the very early 825 cabinets were parallel.) These sides in the 210 are 5 feet in length at the mouth of the horn. All in all, this is one impressive looking horn!

DOMESTICATING THE 210

The kernel of the idea to tame this giant for use in a home listening room derived in part from the design of the JBL 4550 cabinet. The JBL is a dual woofer design along the lines of the 210, but it is a full horn load and is claimed to have usable response to 50 Hz in JBL's literature. Compared with the 210, the 4550's dimensions seem almost manageable at 60" H x 36" W x 32.5"D. Although the 4550 doesn't pass the doorway test either, it is physically smaller because it lacks the two foot port section found on the 210.

My solution for the 210 was to cut off the two foot port a la the JBL 4450 and, since the saw would already be out, cut the enclosure in a vertical line, right down the center.

In the process of creating an enclosure that met the doorway test, cutting the enclosure halved the number of woofers one would need for a stereo pair. After the cuts were made, new plywood was cut, glued, and screwed to create new bottoms and sides.

The result is visually quite stunning (at least to a horn aficionado). With its 17.75" x 39.5" footprint it occupies slightly less floor area the standard A7/A5 and is just 18 inches taller. The surgery had reduced the footprint by half but also reduced the total volume to less than 37% of its original size, while maintaining the original horn geometry.

The clean, sweeping curves of the horn flares and the slim frontal aspect makes for a modern, elegant looking enclosure. Looking into that 5 foot vertical horn mouth made me want to load it up real fast and see what this beauty could do.

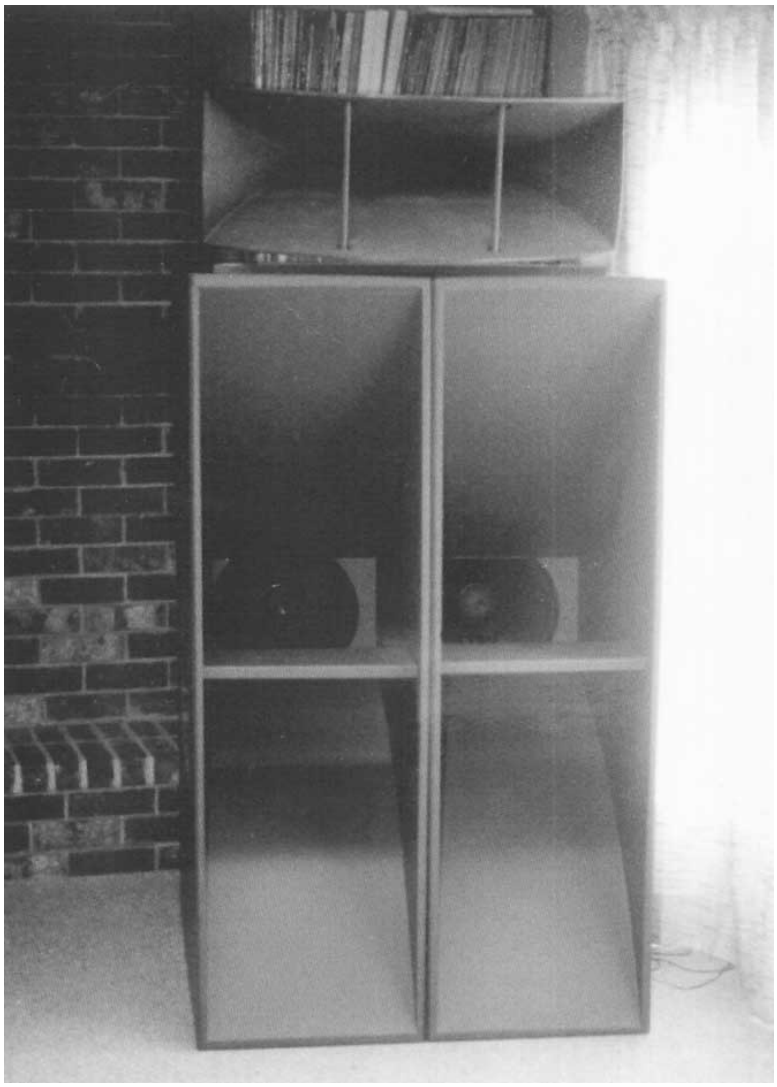
LISTENING AND ADJUSTMENTS

After loading the modified cabinets with my favorite woofers and adding high frequency horns, drivers, and crossovers, it was clear that this rig had great potential. One of the first adjustments I made was to add a strut across the mouth of the bass horn. The large, unsupported area of plywood on the 5 foot sides resonated and rattled at certain frequencies causing some bass muddiness.

Since the horn mouth was essentially unchanged from the original Altec design except for halving the distance from side to side, I wondered why Altec or JBL, for that matter, did not address the matter of cabinet resonance caused by these large unsupported panels. Earlier RCA bass bins from the 1940s had horizontal and vertical struts across the mouth to eliminate the resonances that naturally results from large unsupported panels. Two more struts added internally further cut cabinet resonances.

Originally, the split 210 cabinet was intended to be a fully horn loaded bass enclosure just like JBL's 4550. While changing woofers, I left the center section of the three part back off. The effect of this "accidental" rear port was to increase the range of bass response. In addition, there seemed to be no sacrifice in the upper bass clarity with the reflex port in the rear of the cabinet as there was with a front reflex port. I found that I enjoyed the noticeably lower bottom end with the accidental port and decided to stick with a reflex port contrary to my original plan to have a full horn load.

I cut different-sized center board sections according to whether I would be using a Jensen, Altec, JBL, or EV woofer. The calculated effective interior volume of these modified bass horns was found to be 12



Right—"Double" modified 210 configuration with Altec 329A HF horn plus a 288 driver

cubic feet. At this volume, there is supposed to be no advantage in using a reflex port. However, after a good deal of experimentation, I found that a rear port of approximately 64 square inches seemed slightly preferable to a full horn loading in my listening room.

Now that the enclosure was about right, I tried two bass cabinets per side in both the upright position and then one stacked upon another in the horizontal position. Though not particularly practical for my narrow listening room, the horizontally placed double cabinets per side certainly sounded great. The two vertically placed cabinets per side with a nice 329A high frequency horn resting on top looked as cool as they sounded.

Cool as they looked to me, the females of the family opined that a single enclosure per side sounded every bit as good and had a nice, slim, minimalist look that was quite appealing. You judge for yourself from the photos.

SP readers wishing to share their experiences can write to me at 18435 5th Ave. N., Minneapolis, MN 55447. By the way, I might still have access to some 210 cabinets if anyone is interested...

Right—Single 15" modified 210 with early wood 808 horn/802 driver

Homebrewer of the Month

Joseph Esmilla of Suburban Maryland

Simple circuits and quality parts
yield top musical satisfaction

Enclosed are pictures of my present system which has evolved over the past six years inspired by reading Sound Practices as well as Japanese publications like MJ and Stereo Sound. My circuits are pretty straightforward and conventional, nothing radical or innovative. I am a violinist not an electronic engineer… I just paid close attention to using tubes that I am familiar with sonically, preferring Art Deco era preamp, input, and driver triodes for voltage amp applications in a given circuit topology based on years of listening and experimentation.

I used parts that sound good to my ears. Carbon resistors (Allen-Bradley, Riken, or carbon film types from MCM) for plate load and cathode bias. Paper in oil or copper foil caps by Jensen, Icar or Facon for coupling. Cerafine, LCR or Solen caps for PS filtration, Black Gates for cathode by-pass and Kimber TCSS or AGSS for wiring in the signal path. Lately I've gotten good results using 19 gauge solid core 99.99% silver wire with Teflon sleeving, much more affordable than AGSS.

I did all the metal work using Greenlee chassis punches with lots of WD40 to cut through 1/8" thick aluminum plates. Except for the custom maple wood bases on the 300B monoblocks, the rest of the woodwork was also done by me using pre-cut lumber and a $10 miter saw box from Sears.

I am not much of a writer but I will try to describe the pictures and throw in a few comments.

My phono front end is a Garrard 301 "grease bearing" mounted on a homemade plinth using 7 layers of 3/4" thick, 22 x 20" birch ply. I used the 301 template to cut out the first 3 layers to accommodate the turntable assembly, the remaining 4 layers are solid except for tonearm mounting provisions. After all the necessary holes were cut,I used animal glue (used by violin makers) which is very thin in consistency and does not settle quickly so that I could align every layer before clamping them to dry overnight.

For tonearms I use a Fidelity Research FR64fx and an Audio-Technica ATP12T. My cartridges are an Ortofon SPU Classic GME and a Denon 103R in an Orsonic headshell. Both cartridges are fed through Mogami microphone cables to Tamura TKS 83 MC step-up transformers.

The SPU GTE is a very musical cartridge, very lush and delicate sounding. I listen to it to enjoy music by candlelight while sipping a glass of cognac. On some recordings, it can sound rather veiled and this is when I switch over to the 103R which is perfect for playing recordings that sound rather "slow" since it is an "accurate" sounding cartridge.

The FR64 and SPU are gifts from buddies in Manila who formed a club called SETUP (Single-Ended Triode Users of the Philippines) whom I have influenced to dabble with DIY and subscribe to Sound Practices because of their frustration with "high-end."

Initially, I thought I cured the 'impulse' upgrade syndrome (from WATT/Puppies to GRAND SLAMMS, SME V to Air-Tangent, etc.) that plagued my buddies—however, now that they've seen the light, I am constantly bombarded and hounded by e-mails discussing the merits of Amorphous core F5002, Permalloy NY15s, 10429s and Kanno OPTs. They've even built a transformer-coupled line level preamp using Tango NP216N iron. I'm sure this keeps Yokota-san of Sound Shop Big busy and happy, but I'm afraid their wives and girlfriends might not talk to me the next time I visit Manila!

My phono stage is based on the RCA tube manual phono circuit, using 5691s and battery bias. The line-stage is similar to the Berman featured in SP #15, with a 76 DC coupled to a 6SN7 cathode follower. I bypassed the cathode resistor on the 76 with a 100uf/10V cap since this gave a warmer and airier sound. To minimize microphonics on the 76s, I mounted the 5-pin sockets on rubber isolation spacers I found in a local hardware store that look very similar to those used in the Marantz 7.

The outboard power supply (barely visible in the picture below beside the left 300B monoblock) is a choke input type using a 5AR4/GZ34 rectifier producing about

Joseph and his DIY audio system in his 12 x 15 x 7.5' listening room

Globe 245 amp: Circuit is an SRPP 5691 with 2.2k,1W AB resistors,Facon .22uf paper in oil, 245 and a Tamura F475,5k OPTs. Kimber TCSS wire throughout.

275V for the line-stage and around 250V for the phono stage and a rectified DC filament line.

I only like SRPP with hi mu, lo gm tubes, finding the 6SL7/5691 best for the job. I tried SRPP 5687 and 6SN7 and understand why other people don't like SRPP.

I use AC filament supplies on all my power amps. In spite of the lower noise floor afforded by DC heated filaments on DHTs, I cannot find myself liking the "leaner"tonal balance.

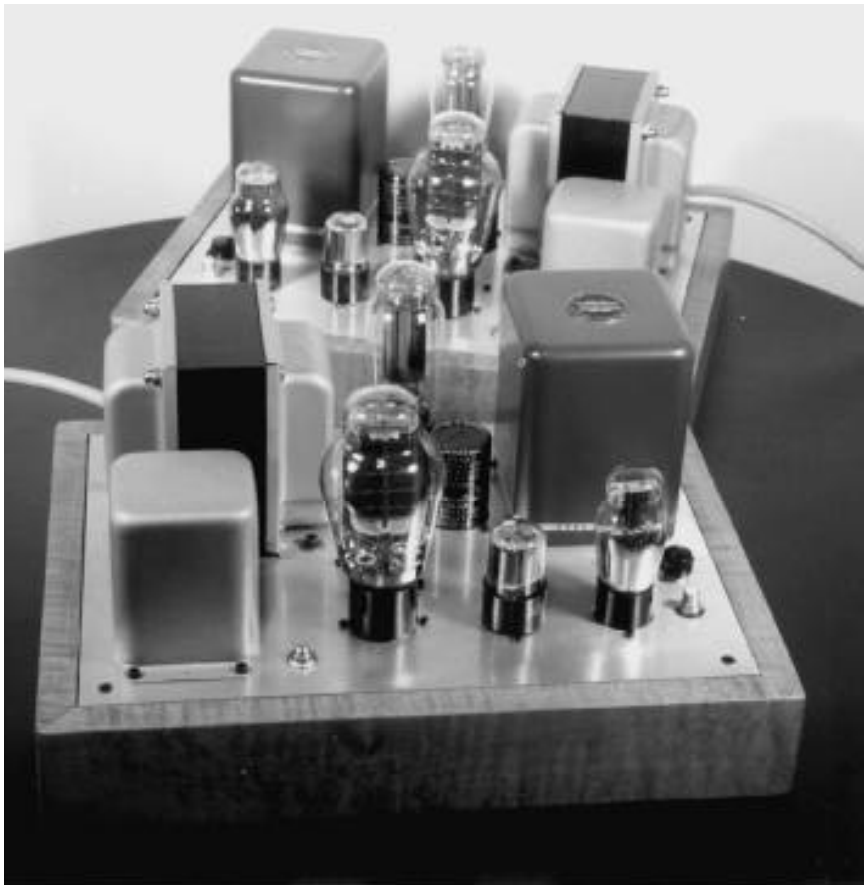
At the moment, I have five SE DHT amps at my disposal, this includes a Stereo 245 with Tamura F475s, Stereo 10/VT25A/801A with Tango FW20-7S, Stereo 300B with XE60-3.5s, a pair of monoblock 300Bs with Tamura F7002s and a Stereo 2A3 with U808s hooked to my TV/VCR hi-fi set-up in the bedroom driving "cheap 'n cheerful" (11 bucks a pop from MCM or Parts Express) paper coned 4 1/2" Pioneer full-range units in a homemade TQWT cabinet.

Except for the 245 amp, all my power amps share the same basic input/driver topology - DC coupled two stage circuit using low-to-medium mu triodes. My first attempt in building an SE amp used both sections of a 6SN7. I tried RC coupling between stages but prefer the added texture and dynamic nuances afforded by DC coupling.

Later on, I investigated using 56, 76 and 27 since they are claimed to possess greater linearity than the 6SN7. After several prototypes and listening sessions I kept the 6SN7GTB at the driver stage preceded by a 76 or 56. Using a 76 as a driver tube just does not cut it for me; it sounds too lean. I also found that I like the airiness and warmth afforded by operating the driver tube around 6 or 7ma.At close to max. current (~10ma.), the sound becomes dry and analytical for my taste. For the input stage I shoot for about 3 or 4 ma. of current.

My latest 300B monoblocks use Cunningham 327 "mesh plates" (pulled out of an old Atwater-Kent radio I found at a flea market) at the input stage, DC coupled to 1/2 6SN7GTB. This combination is very transparent across the frequency band— less midbass crud and better definition, an almost 245 or WE205D-like vividness in the mids with delicacy and airiness in the highs!

The WE300B re-issues are indeed better than any version of the Chinese clones, but to me, the mesh-plate 327 probably contributed more improvement. I am talking about subtle differences here and the best way to describe it is that, once I take away the 327/WE300B combo, I know I'll miss



300B monoblocks: Circuit is a 76-DC-1/2 6SN7GTB-RC-300B-Tamura F7002, 3.5k permalloy OPTs. CLCLC power supply with a GZ37 rectifier and Cerafine caps. When he finds the time, he wants to try Cunningham "mesh plate" 327s pulled out of an old radio in place of the 76s.

ABOVE: Tamura TKS83 MC step-up transformers feature selectable impedance between 3 and 40 ohms and a provision for switching two inputs.

LEFT : Garrard 301 (early version) in a base made from laminated sheets of plywood

not having them!

Both the 10 and 245 amps possess a degree of refinement and finesse I could never quite capture with 2A3s (yes, even monoplates!) or 300Bs. I use the 245 amp mostly for solo vocals accompanied by a small ensemble or piano and the 10 for jazz quartet or trio instrumental combinations. Both amps are excellent for string quartets and my choice is really dependent on my mood.

Found some Globe 280s over the summer and changed the rectifier from 5U4Gs—didn't hear a difference in sound, but looks much nicer.

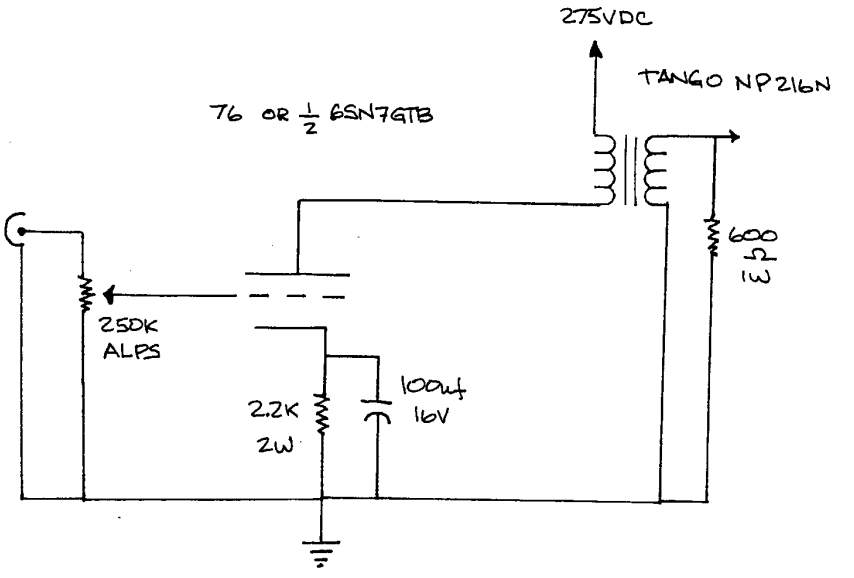
VT25/10 amp - 76-RC-76-RC-10/VT25-Tango FW20-7S. CLC PS using a 5R4GY rectifier.

Stereo SE 300B/2A3 amp using the same front-end and a similar CLC type power supply as the 300B monoblocks, but with Tango XE60-3.5s. Presently configured for SE300B operation, so that I can compare the sound of permalloy over regular "cut core"—my ears tell me that permalloy does have the edge in terms of midrange transparency but this is only obvious upon direct comparison.

Lately though, I'm realizing that there are Tango and Tamura "signature sounds", the Tango tending to be leaner and analytical whereas the Tamura is "juicier." Regardless of core material, both brands produce high quality sound and I would not want to open another debate as to which is better, but my taste tends to favor the Tamura.

For the past two weeks I've been listening and testing a pair of WE205Ds that are en route to Manila for my friends in SETUP. Since my power transformer (the Angela Universal) has dual HV secondaries, I soldered the 640VCT winding, changed the cathode bias resistor to a 1k, 20W and then "mismatched"the secondaries by using the 4 ohm tap to reflect a pri. Z of 7k when loaded with an 8 ohm nominally rated speaker. Actually, with 755As, it defeats the purpose since they are 4 ohms. Over the weekend I was over at my friend's house in NYC and we listened to it through his 8 ohm 604-8Gs. Using either speakers, the sound of the WE205Ds has the midrange quality of a 245 with the dynamics and slam of WE300Bs. They also go much louder than the 1.5W I measured—very nice!!!

My main speakers are Altec 755As on open baffles. I based this contraption on plans published in Stereo Sound "special issue"Vol. 3, 1996.The original plan called for a composite wooden material that is similar to



TRANFORMER COUPLED LINE STAGE USED/DEVELOPED BY MY "BUDDIES" IN "SETUP".

that used for chopping boards, but thinner, roughly 3/4". Since 3/4" birch ply is relatively inexpensive, I converted the dimensions to inches and found these baffles to work really well. For almost a year I've been using a pair of 755Cs until recently, when I found a nice pair of Altec 755As.

A friend gave me 2 cu. ft. boxes, considered by many to be de rigeur for 755As, for comparison. After living with them for a few weeks, however, I still prefer the open-baffle for either 755A or 755Cs.

755Cs go about half an octave lower in the bass with less high-frequency extension compared to the 755A—could this be psycho-acoustic? In the midrange, the 755A wins, no contest. To me, however, the 755C is still a sonic bargain since it probably does 85-90% of what the 755A can in the midrange, that's why I'm keeping mine as a spare.

The sound is very reminiscent of original Quads I had ten years ago. In terms of usable frequency range, they are equals. Just like Quads, there are no "boxy" colorations, an open and airy sound typical of dipoles, very life-like midrange, BUT much better rendition of dynamic contrasts and musical nuances when driven by single-ended DHT amps.

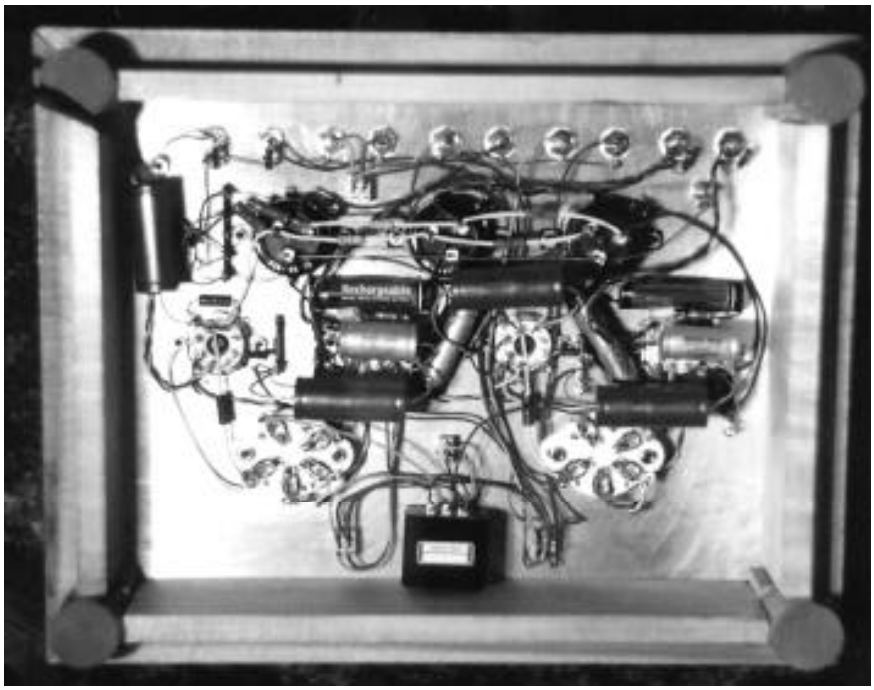
With a 300B or 2A3 amp, I can listen to Mahler symphonies on this system in my average sized room. The 10/VT25 and 45/245 being more suitable for the rather intimate setting of chamber music. Setting them up can be fiddly depending on your room. I used the same basic principles in finding the best placement for Quad ESLs.

I've shared this open-baffle plan with a couple of friends who were startled to find such a simple device to work so well. In fact, my friend Ding in NYC mounted a pair of 604-8Gs to enjoy his SE45 amp.

I hope others will give this setup a try. I spent about $75 for 3/4" thick birch plywood cut to size and shape by a local lumber yard and about a half day's work putting it all together.

Other candidates for drivers I tried and heard include Altec 403A, 409B, Stephens FR80, Norelco 9710M and Diatone PM610Bs. Here's a summary of my initial impressions:

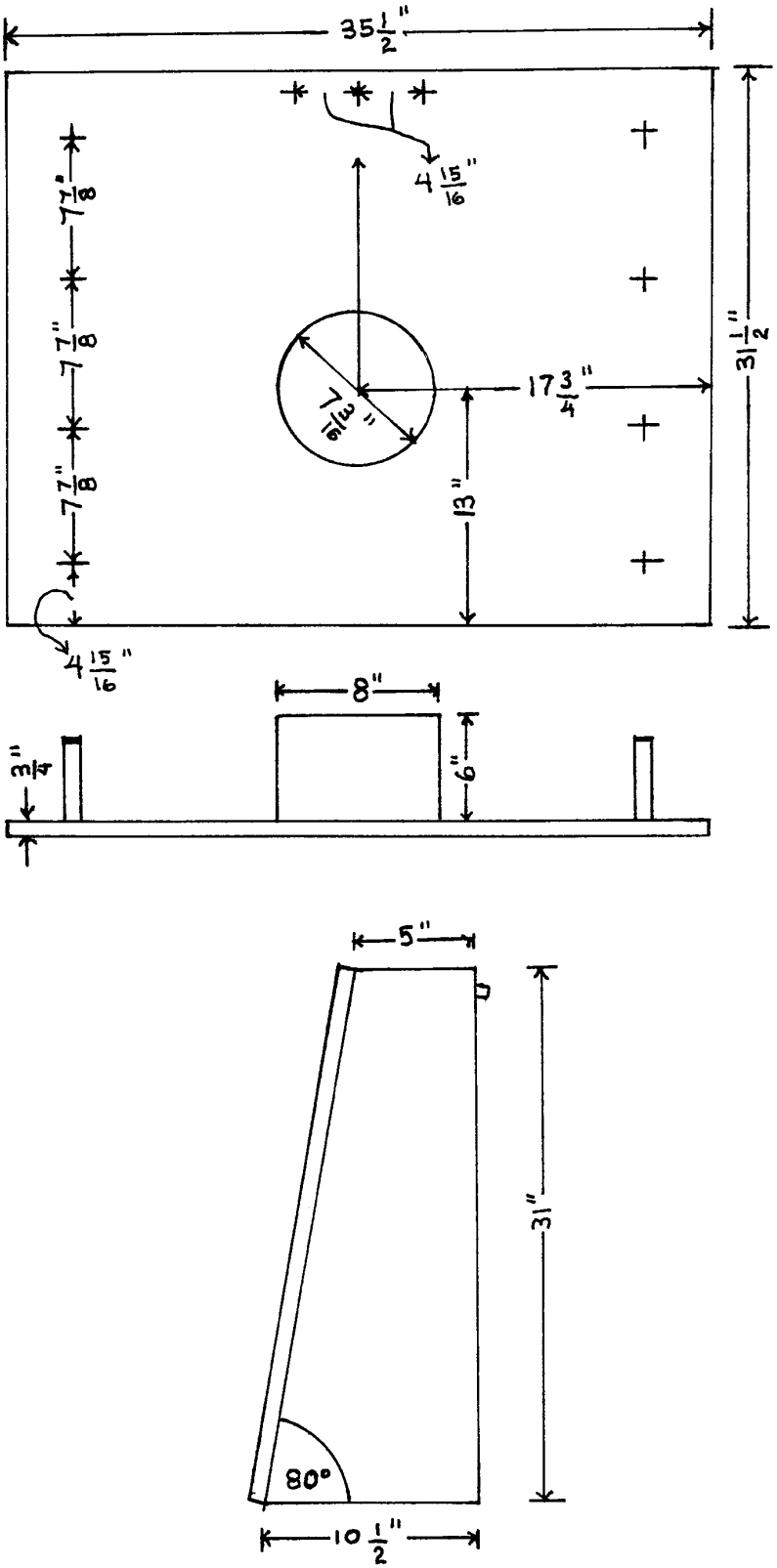
Diatone PM610Bs - I'm sure quite a few readers are familiar with these drivers. I acquired these in the original bass reflex box and didn't really like it too much, so I kept the drivers. The cabinet is overly resonant — colored mids, and boomy bass.



However on the open baffle, it started to sing. The midrange was warm and lucid but did not sound as "big" as the others in this group (smaller cone diameter???) and the tendency for the bass to boom was still slightly evident (too much compliance in the suspension??). Best performance with this driver is probably realized in a well braced bass-reflex cabinet or TQWT (quarter-wave pipe).

Stephens FR80 - The useable frequency range seem at par with a 755A, smooth and refined. However I found the sound rather dry and "closed-in", as if it cannot quite open up and boogie.

Altec 409B - Very efficient but also very dark sound, it surprised me that in spite of



the co-ax design, it had the least amount of treble output from this group. Maybe it will appeal to those who like BASS…or perhaps, I just had a pair of duds!

Altec 403A - this is a pretty decent sounding unit but unfortunately I only have one unit and had to listen in mono. The treble sounds more extended compared to a 755C. As nice as the tonal balance actually was, the midrange did not possess the "snap" of either 755s.

Norelco 9710M - Found this single NOS driver at a radio swapmeet over the summer. Again I had to listen to this in mono. There seem to be a lot of potential with this driver. It gives a totally different presentation compared to a 755A; with more bite and snap. Very dynamic and involving, however it can be argued that it is not as refined. Anyone willing to help me find a mate to this one?

Although I listen primarily to LPs, other sources include a Tascam DAP1 DAT player which I use for recording live performances (recitals and chamber music) with Shure SM81 mics, Sony TCD5M and Marantz PMD430 portable cassette decks, a Tandberg 3500X reel to reel, Scott LT110B FM tuner and a Philips CD921 with a DITB. Except for phono, cables are Kimber KCAG, PBJ and 4TC.

After several years of being involved in this hobby, I have determined that there is no such thing as the best component. A satisfying audio system entirely depends on synergy and voicing, best learned through DIY.

I like to view audio components in a similar manner as violins are evaluated by professionals. Guarneri del Gesus and Stradivariuses are established workhorses for world-class caliber violin virtuosos. Heifetz used a del Gesu throughout almost his entire career, whereas Milstein and

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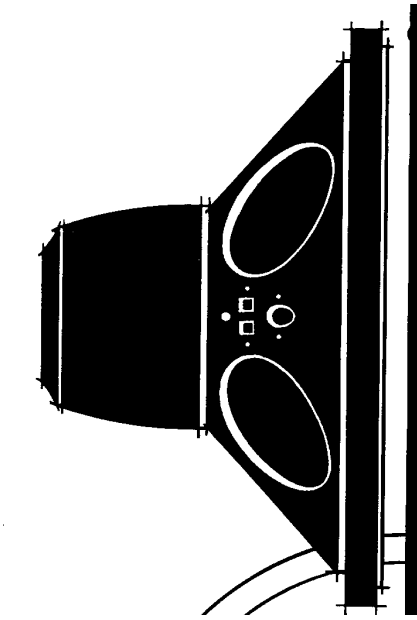
Building tips for the Open Baffle:

1.I used No. 8 - 2 1/2" "decking" screws to put the whole thing together.

2. Make sure you drill pilot holes for mounting the 'feet' and the top plate (clamps help make this task more convenient). Those 3/4" birch plys are tough!

Even with pilot holes,I had to give my hand-held electric drill a rest every now and then during assembly to prevent it from overheating.



A Homebrew HORN for TANNOY Dual Concentric Loudspeakers

by ROY HILSLEY

Reviving a 1960s classic…

I consider myself to be very lucky. My father introduced me to hi-fi when I was a teenager. That was over forty years ago! In those days audio electronics and hi-fi was very much an experimenter's hobby and my father loved to put electronic components together to make all manner of things. He built our amps, tuner and speakers—first for mono and then stereo. He even built our first TV set!

The early hi-fi shows in England were held at the Hotel Russell in London and we would visit to look, see and hear the latest audio innovations. My father was a music lover and could play the piano. He knew what sounded natural. At one of the shows he was so impressed with the sound made by one particular manufacturer that he ordered a pair of the speakers at the show. They were Lowther Acoustas (with PM6A magnets). These little gems were fast and very dynamic and we lived with them for several years but Dad always complained that they lacked really deep bass.

We fired them up with a Beam Echo pre-amp and a home brew Mullard 5-10 amp. This was a push pull EL84 ultra linear design. Great sounding design (based on the Leak Stereo 20) which he used with these speakers for several years until the Lowther surrounds deteriorated and he got fed up with adjusting the magnet to prevent periodic voice coil interference.

He was by then firmly committed to the sound of horns and he decided to try another approach using Tannoy dual concentric drive units. These very novel speakers have a horn loaded HF unit concentrically mounted within a large bass driver. They were made in three frame sizes: ten inch (called III LZ), twelve inch and a mighty fifteen inch unit and were supplied with a separate crossover. Tannoy units could be mounted in horn loaded or reflex cabinets and plans were available from Tannoy. My father bought two III LZ drivers for a horn loaded speaker project. Unfortunately, he never got 'round to building those speakers.

Many years passed and when I cleared out the old house, I came across these drivers and they captured my imagination. Those old units looked like new and yet were over 35 years old, but somehow the design looked right with the pepper pot drillings at the throat of the HF horn and the substantial cast frame.

I was at the start of the trail of audio simplicity and rebirth. I had owned typical hi-end British made transistor based hi-fi for many years and was listening to inefficient milti-driver speakers. They were, however, lifeless and had no

dynamics. Yes, I am sorry to say that I had become a victim of the press hype.

Dad had managed to collect all sorts of audio "junk" over the years and during the course of trading this at a vintage audio store in the UK I discovered that the industry was being revolutionized by the experimental amateurs again. Valves were back. Minimalist SE designs were advocated. Horns were being rediscovered. I discovered Sound Practices.

I started using a modern push pull valve amp for a while and then decided to build a pair of SE amps to my own design, 417A, 6J5GT transformer coupled to a VAIC 300B. Next came a home brew phono pre-amp (similar to the Siren Song) and what joy. The transition from high feedback transistor designs to no feedback valve designs revitalized my record collection and gave me so much more music and much more pleasure. The fun I had making changes then listening and making changes again.

After a while I became satisfied with the amps and I decided to try horn speakers. I started by trying a vintage pair of Lowther Acoustas. I loved the speed and life but soon became dissatisfied with the bass.

I decided to take up the project which my father had not managed to complete. I studied plans for the Acousta published in SP and I looked at the cross sectional plans of the well-respected Tannoy GRF enclosure published in old copies of Hi-Fi News. These designs gave me some ideas.

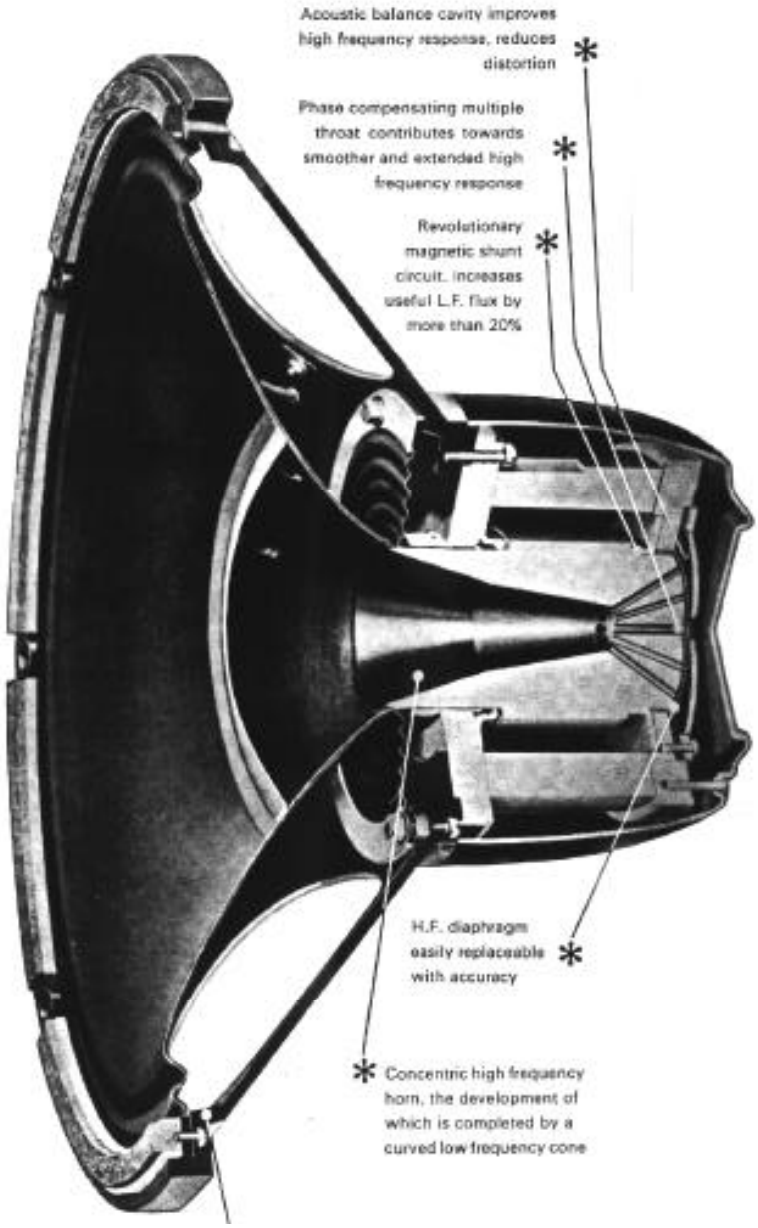
I wanted the efficiency and projection of horn loading, but with deeper bass, but I also wanted the cabinets to be dimensionally acceptable and wife friendly! The ideas crystallized into the cabinet shown in the photograph and illustrated in the sketch plans. The design is not theoretically founded on a particular horn flare. I adopted an empirical approach. I listened to, studied and measured other horns and based my design on what might look right and work. The plans are given as a basis for you to try a simple-to-build horn enclosure for Tannoy dual concentric units. You are free to experiment and improve or modify.

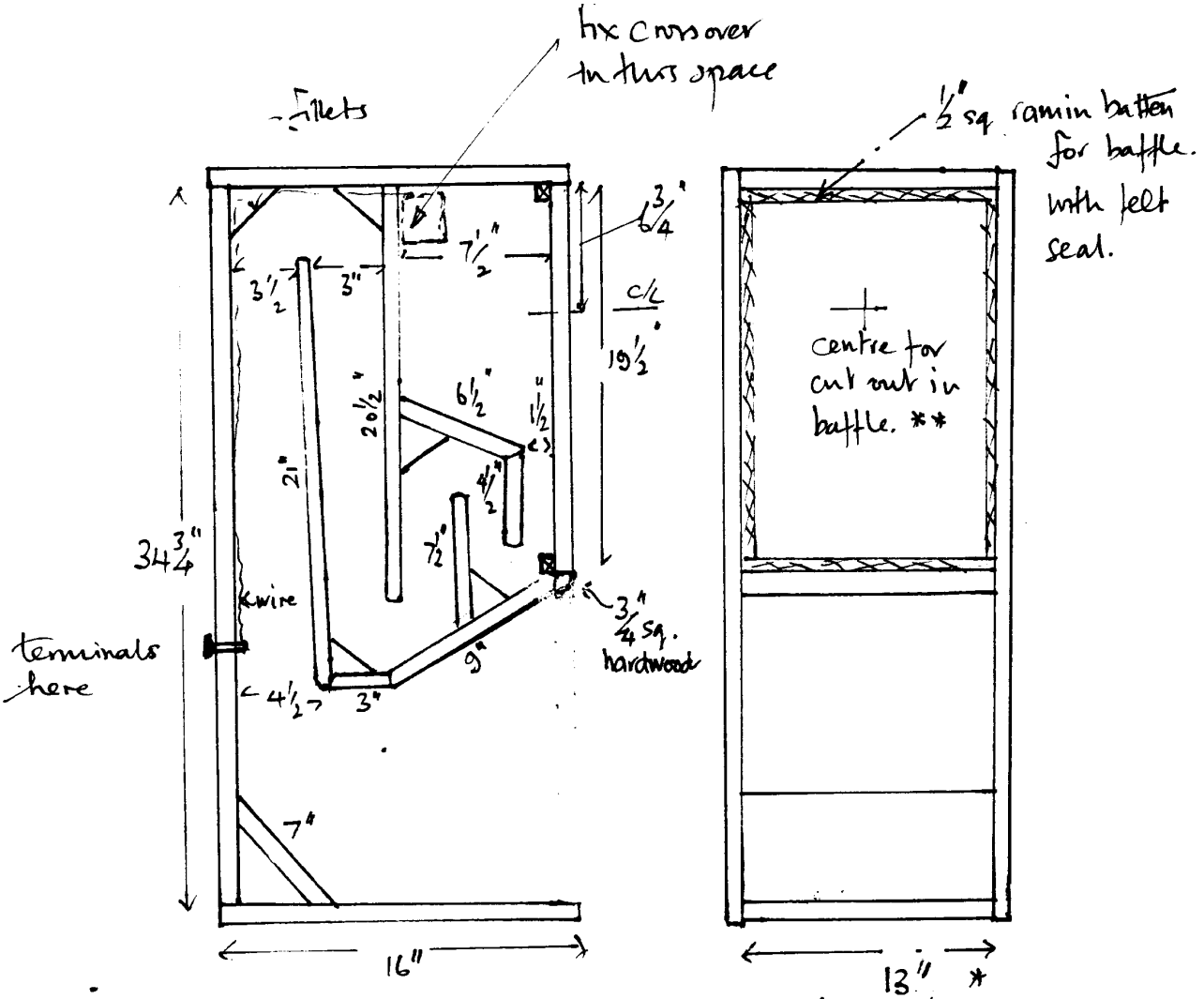
Cut the wood to the sizes shown. I used veneered plywood. There are two cabinet widths possible. One for the ten inch units and another for the twelve inch units. Assemble the top, bottom, rear and inner panels to a side panel. I used a "filler" type of fast-setting mastic glue. Do not glue the front baffle and remember to run internal speaker wires.

Make sure that the horn is airtight. Make the bass horn throat about half of the area of the bass cone. Glue liberally and smooth internal folds with glass paper (sand paper)as well as you can before you fix the second side panel. Make the front panel baffle airtight by using a gasket made of thin felt glued to the internal batten. Screw the baffle to the internal batten with about eight brass countersunk wood screws. Fit the crossover in the space shown on the plan. When construction is complete, sand down all external surfaces, oil and polish to suit.

When the glue is set and the polishing done fire them up—you will not be disappointed! You should be listening to deep tuneful bass with a solid image and good projection. The Tannoy HF horn will give you a clean midrange and top end projection. These speakers are efficient so you can drive them with your 10 watt or so valve amps.

In comparison to the Acoustas, you will hear deeper bass without the characteristic mild "honk" which I think the Lowther cabinets have. These Tannoy horn speakers have less of a "hot seat" stage as an added benefit. They are not particularly sensitive in respect of placement and I turn them in just a little and use them about a foot from the wall for best effect in my room.





Materials

side panels = 18 mm

top, bottom, baffle = 14mm

internal = 12 mm.

all fillets = 4 mm.

Plan for Homebrew Horn for Tannoy Dual Concentric Speakers

RWH Sept '98

Tannoy "Monitor Gold" Specifications

	"FIFTEEN"	"TWELVE"	"III LZ"
Frequency response	23—20,000 Hz.	25—20,000 Hz.	27—20,000 Hz
Polar Distribution for 60° inc. Angle	–4dB at 10,000 Hz.	–3dB at 10,000 Hz.	–2dB at 10,000 H.
Power Handling Capacity	50 watts*	30 watts*	15 watts*
Impedance Via Crossover Network	8 ohms (5 ohms min.)	8 ohms (5 ohms min.)	8 ohms (5 ohms min)
Flux Density L.F. Gap	13,500 gauss	11,500 gauss	10,000 gauss
Flux Density H.F. Gap	18,000 gauss	15,000 gauss	15,000 gauss
H.F. Voice Coil Diameter	2″	2″	2″
L.F. Voice Coil Diameter	2″	2″	2½″
Intermodulation Products	less than 2%	less than 2%	less than 2%
Bass Resonance	26 Hz.	28 Hz.	30 Hz.
Magnet Assembly Weight	13 lb.	7½ lb.	6¼ lb.
Magnet Material	Ticonal G	Ticonal G	Ticonal G
Crossover Frequency	1,000 Hz.	1,000 Hz.	1,200 Hz.
Overall Diameter of Frame	15¼″	12⅜″	12 1/32″
Overall Depth	9″	7½″	6½″
Fixing Holes P.C.D.	14½″	11¾″	11″
Weight: (Crossover network & Switch panel as separate units)	21 lb. 13 ozs. (crossover 4 lb.)	12 lb. (crossover 4 lb.)	10 lb. 4 oz. (crossover 3¼ lb.)
Finish: Cover	High impact plastic	High impact plastic	High impact plastic
Frame	Stove enamel	Stove enamel	Stove enamel
Magnet Assembly Parts	Cadmium plate	Cadmium plate	Cadmium plate