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Loudspeaker Buyers' GUIDE

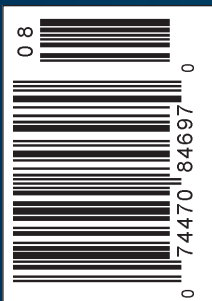
**HOW TO BUY
GEAR ON THE WEB**

**CLEANING UP
AC POWER LINES**

A GUIDE TO BUYING HDTV

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JAZZ SELECTIONS REVIEWED



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How To Buy GEAR on the Web

Online auctions: the good, the bad, and the ugly.

Online auctions have increased access to vintage electronics and components for many of us. There are many auction services online, but my experience has been with eBay. If you have read my restoration articles in *audioXpress*, you have seen many pieces and parts I have bought online. My goal is not to provide you with a step-by-step learning manual, but to provide some guidance on how to do business online, both buying and selling.

I currently have over 1500 transactions on eBay, with a very high positive feedback score, and the experiences and advice I am going to share with you are designed to make your experiences positive. I am going to help you develop a skeptical eye to look at auctions and steps that prevent disappointment and frustration. All of the examples I use are from my actual experiences.

ONLINE COMMERCE

eBay is the largest auction service in the world! If you can't find an item, it probably doesn't exist (well, within reason) or is illegal. They are also one of the most successful dot-coms, and their annual income is very impressive (some might say excessive). They charge fees for everything and also own PayPal, which charges fees to sellers for accepting electronic payments. Combined, these two companies control a large part of online commerce.

A few basics: eBay allows people anywhere in the world to list, buy, and sell items to a worldwide audience. They take *no* responsibility for the accuracy or

truth of any of the listings (this is your first lesson—*buyer beware*). They do have very strict rules about what *cannot* be sold on eBay, and they can be very nasty if you try to sneak around those rules. You can find the basic rules on their site, but like many websites, it is not easy to find answers to questions.

Almost every seller has “terms” for purchasing his/her items, and lesson 2 is to read those terms before you bid. Let me repeat: *Read the terms completely before you bid!* My auctions include the following:

Terms—Please read: by bidding you are agreeing with the following terms:

1. I accept money orders and PayPal only.
2. I will invoice you at the end of the auction. Please be sure to provide a complete address and phone number. If I am shipping via Fed Ex, they require a phone number to accept the package.
3. I expect payment in a reasonable period of time (2-7 days depending on mail or PayPal). Once I receive payment, I usually ship the next day.
4. I leave feedback on a weekly basis. I don't hold you hostage for your feedback. Many sellers won't leave feedback until they receive it, claiming that is to make sure the buyer is satisfied. But beware; these are shiftier sellers. If you look at the few negative feedbacks I have received, you will find they were left by deadbeats in retaliation for filing a complaint with



eBay or PayPal. Many of these people are no longer users of eBay or PayPal. Guess why? They were banned because of consistent bad behavior. I am fair and honest with people, and will treat you that way. However, a problem has arisen with buyers not leaving feedback after they have purchased an item, so, unfortunately, I have instituted a new policy.

If I don't receive feedback from you within 2-3 weeks after the transaction, I will contact you to ask that you provide feedback. If at this point you still don't provide any, I will block you from any of my further auctions. This sounds really nasty, but feedback is important to both sellers and buyers and helps make eBay a safer place.

5. I make every attempt to work out issues with buyers, but you need to be aware that I don't refund money for the following reasons:

- You didn't know what the item was and now don't know what to do with it
- You didn't read the description and didn't realize you weren't buying a moneymaking machine (see above)
- You had no idea what the item was worth and paid a lot more than you should have (see above)

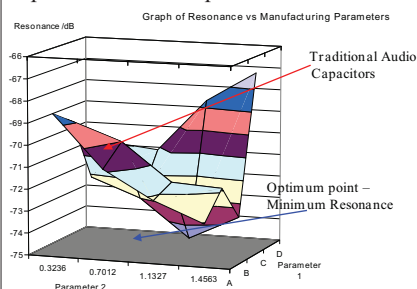
If there is a problem with your purchase, e-mail me or call me and we'll try to seek a resolution. If you look at my



The MR range of capacitors is, we believe, the ultimate audio grade capacitor currently available on the market.

It is the result of a two year research program into the influence an audio capacitor has on overall system sound quality. The research program was conducted in cooperation with the world renowned Acoustics Research Centre at the University of Salford.

No stone was left unturned; the research encompassed all of the materials used in audio capacitors and any existing performance data together with analysis of manufacturing processes and techniques. The crucial factor to emerge was the effect that mechanical resonances within a capacitor have on sound quality and the importance of reducing or controlling a capacitor's sonic output.



The new MR range harnesses all of the knowledge gathered throughout the research program and we believe it offers the market a superior product based upon science and research rather than snake oil.

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2.2 mfd	\$84.00	10.0 mfd	\$188.00
3.1 mfd	\$99.00	12.0 mfd	\$283.00
3.3 mfd	\$102.00	15.0 mfd	\$289.00
3.9 mfd	\$115.00	16.0 mfd	\$292.00
4.1 mfd	\$117.00	18.0 mfd	\$298.00
4.7 mfd	\$119.00	22.0 mfd	\$299.00
5.6 mfd	\$144.00	27.0 mfd	\$311.00
6.2 mfd	\$146.00		

feedback rating—as a buyer and seller—you will see that I am honest and willing to work with people.

REFUNDS

Because I sell restored vintage audio equipment, I have had a couple of issues with what I call “vintage audio evaluators.” These are people who buy a piece of vintage equipment, audition it for a couple of months, and then contact you before the 90-day feedback window expires with a “problem” with the equipment. It usually is some vague complaint, such as hum at low levels, and they want to return the equipment for a refund.

Like most sellers, I go out of my way to work with a customer and will do this, minus the shipping costs. I had this happen twice. One time the amp was perfect (except the buyer kept a very nice preamp tube and substituted a piece of Chinese junk—I assume he didn’t think I would notice); the other involved the buyer actually cutting a ground wire under the chassis. This would never leave my shop this way, because all the equipment I rebuild meets or exceeds original specs and is burned in for several weeks after restoration. Needless to say, I now will only offer a refund within the first 10 days.

LIGHTS, CAMERA, AUCTION!

It is important for you to understand that eBay is just like a real live auction. The auction company takes no responsibility for the object, and they just collect a percentage for listing it and collect a percentage of the selling price. If you bid and win, you own it, and will have to pay for it.

That said, let’s look at the process in more detail. To get started, simply go to www.eBay.com and browse around a bit. You do not need to register or use the “guest” status to just look, only to bid. Once you register and set a screen name and password, the potential addiction begins! The eBay search bar is your gateway to the world.

The way you phrase your search can have a profound effect on the search results. Typing in “tube audio” might bring up several hundred items ranging from single tubes used in audio all the way to complete audio systems using tube components. You are also at the mercy of the

person writing the listing, whether he/she was up front and honest or just trying to get the biggest bang from the ad. (eBay charges you for listing in second categories and provides categories for the items, as well as rules about what you can and can’t say in your listing.) You can’t say, “built like a McIntosh” to get the item listed with vintage McIntosh equipment. This is not to say this doesn’t happen, but it is against the rules and if eBay discovers it, or someone reports it, they will delete the listing and send a warning to the seller.

You will discover many situations like this, and, unfortunately they have millions of auctions at any given moment and can’t police them all. It is your responsibility to use common sense and skepticism online. It is better to be more selective in your searches by using terms such as “Dynaco tube,” “Heathkit tube,” or “tube audio transformers” to narrow the results. Save your search if it returns no results, so you will automatically be notified when an item is listed that matches your description. (No hits is rare, so check the spelling of your search terms before saving it.) It takes time to become really good at search terms and finding what you are looking for.

I set up a search a couple years ago for *Phillips Motion Feedback speakers* and just recently got a hit, and actually ended up buying a pair of them. This three-way system with three amps in the cabinets is pretty rare, made in the 70s. They sense distortion and modify the signal to prevent it. They were quite expensive when they originally sold (about \$1200 each). One requires service on the woofer amp, so I got what I consider to be a very good deal. Of course, this brings up the question: “What am I going to do with them?” I have a house full of audio equipment and have 20 plus pairs of vintage speakers. Remember what I said about addiction to eBay!

SECURITY

Once you sign up for eBay, spam will start flowing to your e-mail account. Some of this will be just your garden variety “improve your sex life” garbage, but some can be very damaging! Never answer any inquiry that comes to your personal e-mail account. Only open ones that you find in “My eBay” account

“messages.” You should log in to your eBay account to get your messages. It is well worth the extra few minutes to protect your password and account.

Spammers (usually outside the US) will send what appears to be an eBay question or inquiry form on eBay letterhead asking you to respond to a question or to dispute an unpaid item alert. When you click on the “respond” button, it will send you to a fake site that will ask you to log in with your eBay screen name and password. When you do, nothing will happen (usually). They will have just stolen your screen name and password, which will allow them to access your eBay personal file and possibly your credit card or bank account information. Do not respond to or open eBay (or PayPal) inquiries without first logging onto their official sites (via your own saved link or using your browser).

Delete any messages you get in regular e-mail. In my e-mail account I average five spoofs, phishes, or Spams per day allegedly from eBay and PayPal, trying to steal my account information. I know people who have set up a new e-mail name and account just for eBay. This can help limit the spam and phishing coming into your normal e-mail account.

My account was recently compromised by a method I had not seen before. The e-mail was titled Auction Cancellation. When I opened it, the text said an auction I was bidding on, with its item number, had been canceled. It didn't ask me to log in. When I clicked on the auction number, an auction page appeared, with a link for the reason the auction was ended. I clicked on the link, logged in, and (stupidly) provided my password.

When nothing happened, I knew I had been “phished” and immediately went to my account to change my password, only to find it had already been accessed and my password didn't work. I immediately contacted eBay and we spent the next four hours securing

my accounts and resetting passwords. The biggest problem was proving to eBay I was the owner of the account. They asked me questions about auctions that occurred over two years ago, and I had no clue about some of them. They were cooperative enough to lock my accounts and auctions down until I could fax them my driver's license to prove my identity.

Just a word to the wise: Keep a folder or notebook with all your transactions by date, so if this happens, you will be able to prove to eBay security that you are the actual account owner. Better yet, follow the rule I violated. Rule 3: “Never answer any inquiry without first logging onto eBay or PayPal directly via your own link.”



SELLING/BUYING

Some sellers put a low starting bid on an item and let it go for whatever the bids hit. Others start low, but have a reserve price, so the item will not sell if the bids don't reach their hidden reserve. Another method includes a high minimum bid, so you know the minimum they will take for an item. And still another method is a combination of these with a “Buy It Now” (BIN) price. The BIN can be a very good deal or a very poor deal, depending on the item and how badly you need it. BINs are temporary and disappear once you bid on the item, so keep in mind that if you don't BIN, it may actually go for more at the end of the auction.

Your success in getting a “good deal” is to know what an item is worth, and what it is worth to you. In almost all cases, I have a price in mind when I am bidding on an item and don't exceed that amount. You can place a bid on eBay, substantially higher than the beginning amount, and if no one else bids, the selling price is the lowest increment of your bid. If someone else bids higher, the selling price will advance incrementally. If this best bid is higher than yours, and exceeds the amount of your maximum, he/she is the high bidder.

This is how a lot of money is spent. You see someone's bid and start taking little cracks at higher amounts, usually at \$10 a bid, until you find out how much he was willing to pay. Pretty soon you are the high bidder, but then you realize that your bid is much higher than you intended and exceeds your maximum. Welcome to online auctions.

There is actually a very simple way to avoid this, as well as keep your bid completely secret until the last seconds of the auction. The system is called eSnipe™ (esnipe.com), an automated bid system. Once you put your eBay bidder name and password into the system (and prepay for

fees—very reasonable), it will bid for you automatically at the very end of the auction. It gets its name from people who will sit up all hours of the night to bid on an item in the last ten seconds of the auction, to try to “snipe” your bid.

Before I tell you more, I must warn you: eBay really hates this program! It can potentially reduce selling prices on auctions, which has the potential to limit their income. The bidding on most auctions really heats up in the last 5-10 minutes, which tends to drive prices up for the buyer. The snipers sit back and don't show any interest in an item until the last ten seconds and then place a bid (or multiple bids, hoping they are larger than your maximum bid).

With eSnipe, you enter your maximum bid and how many seconds before the end of the auction you want your maximum bid placed, and it does the rest. They claim their high-speed servers can place a bid in the last two seconds before an auction ends. I typically have mine set for five seconds, which works very well. If a sniper is sitting at his computer and my bid on eSnipe goes above his, he may still have enough time for one more bid (if he has his bid set and is waiting at the final bid screen). But if he bids and the fast servers at eSnipe see his bid, they increase mine up to the maximum I have specified (as time allows). I really believe their claim about the speed of their servers!

The real beauty of the system is that I can set up my maximum bids at the very beginning of the auction and forget about them until I get a notice that I won or lost the auction. You can set it up to "check" the bid price before the auction ends and alert you if the price has already exceeded your maximum. This is a very cool system that can keep bidding "fever" to a minimum. I have reached the point where I no longer bid on anything without eSnipe.

JARGON OF EBAY

I am going to use some personal examples as well as my interpretation of eBay jargon to help you assess an item's value. My examples (actual auctions) are probably very typical of most buying and selling on eBay. I tend to be a little skeptical after ten years of trading online.

Read the descriptions and terms very carefully! Some sellers are extremely professional (usually with very good feedback ratings 99% or better), and some are just dumpster divers trying to make a quick buck from the less than knowledgeable buyer. Before you bid, read the seller's feedback and rating. I tend not to bid when the seller has less than 97% positive feedback, but not always. To determine the seller's feedback, just click on the feedback number and it will take you directly to the feedback page, which displays the feedback and sums the positive, negative, and neutral responses. It is well worth your time to do this *before you bid!*

Next, you need to read and interpret the actual auction script, which can be

extremely confusing. Some sellers have contradictory statements in the body of the auction and misinformation in other sections. Some sellers list the shipping in the shipping section of the auction and then have a shipping calculator in another section that doesn't give the same amount. Read everything carefully before you bid. Trying to figure out exactly what the seller means can be frustrating. I have established the following dictionary of phrases and terms that may help

you:

A. "As is," "as found," "parts," "for parts," and so on—This is usually pretty self-explanatory. Many of these items are from dumpsters, garages, barns, estate sales, or maybe accumulations of years of collecting (or eBaying). These are usually the bottom of the barrel, but may yield some very nice buys. You really need to know your stuff to bid on these items. If the seller's pictures are clear and

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axial, twin axial and
screw mount up to
550V/600V
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complete, you may have answers to your questions, but if they are blurry, or incomplete, by all means ask the seller questions before you bid. Be very cautious of extremely short descriptions or very long ones that don't really tell you anything.

I recently saw an auction for a McIntosh MR 71 tuner with a very low starting price, but the accompanying picture was a little blurry. The seller had cut and pasted over two pages of specs from Roger Russell's McIntosh site (a very cool site, Roger) and described the tuner as "one of the world's best." The other pictures were much more revealing: The tuner was missing knobs, the front glass was broken, and the very end of the auction description stated "parts missing and operational condition unknown." You are buying it *as is*.

It's a good idea to view the seller's other auctions. When I did this, I found many of the missing items listed in another auction. An operational and cosmetically nice MR 71 will bring a substantial amount of money. You can probably guess what the actual operating condition was before he stripped parts. Many times you will see tube gear selling without tubes, which you will find for sale by checking the other auctions from the same seller. Again, it tells you about the operating condition of the unit. (It also tells you something about the honesty and ethics of the seller.)

I had a similar experience recently with a radio I bought from a seller with some questionable feedback (I know I broke my own rule—and I paid for it). It was a B and O Dynaco Shortwave radio (Dynaco originally sold many B and O products before their focus on kits). I had purchased a very nice unit some time ago and because this was only the second one I had ever seen, I decided to check it out further.

This seller had two whole pages describing his operation, terms, and so on (all in different colors and type sizes and styles—very visually annoying—this may even be a way to discourage people from completely reading the terms). The final sentence

read "as found." His shipping estimate was fairly outrageous (I will discuss shipping later), and the three photos (not very high resolution) showed it to be a little dirty, but complete. His feedback indicated a few negatives and neutrals, but wasn't terrible. He rated the unit as "fine." I won the auction, at a fairly reasonable amount, and paid immediately with PayPal.

When the radio arrived, the condition was, at best, "poor." The bottom 2" of the radio was covered in rust scale, and the battery compartment was pretty much gone. None of the auction pictures showed this part of the radio, so I had no visual clue. If you are familiar with rating systems for coins, watches, guns, or antiques, you know that fine is a fairly high rating, well above good, average, or poor. These designations vary a little bit by system, but the actual definition of the condition terms is very clear in all the systems. By any of the definitions, this radio would be in the poor range.

When I e-mailed him about my disappointment and asked which rating system he used to come up with fine, he was pretty indignant and pointed out that the auction stated "as found," so he really did have me. Just a word to the wise: If a seller makes a claim to a rating, be sure to ask how it was rated and the actual meaning of that rating. It would be wise to ask for more complete pictures and whether there is any visible damage to the item.

B. "Powers up," "tubes light," "works but needs work." "Not functionally tested" is also sometimes included here. As most of you know, powering up vintage tube equipment that has been sitting for a while requires some time and skill to avoid damage. Failure to slowly bring up tube amps not only can result in blowing up electrolytic caps, but can also destroy power and output transformers, especially if there is no load connected—in short, quickly turning a collectible amp into a pile of junk. These terms indicate that the equipment doesn't function, even though the "tubes light." Would you buy a very expensive vintage car on the basis that the "lights work"?

By nature, most people can't resist plugging in tube equipment to see whether it works! So they plug it in, the tubes light, and then the lights dim and a small puff of smoke appears above the unit. Another dead giveaway is the statement "tubes light, no further way of testing." Be very, very leery.

After all, how many people don't have a speaker and an audio source to plug into the amp? How many pawnshops don't have at least some speakers sitting around or an audio test setup station to test all the car stereos before they buy them? Check the seller's other auctions and sometimes you will find the "rest" of the stereo system listed separately: speakers, tuners, and CD players. Sometimes these other auctions will describe the item and say "works great," so they have actually tested the lot, but are not willing to tell the truth. On the other hand, this situation can sometimes work to your advantage.

I recently saw a tuner advertised as "powers up," but no way to test its functions. I e-mailed the seller and asked him to hook a 5' length of wire to the antenna terminals, turn the tuning dial, and tell me whether the meters moved. He replied that both meters moved and the stereo lamp came on. He didn't add that information to his description, and I ended up buying a very nice tuner. It functioned perfectly with a reasonable antenna, and required only some switch and control cleaning and an alignment touchup to meet all factory specs. It ended up being a bargain for me. Sometimes you take a chance, but bid accordingly.

The "needs work" category requires some discussion. Without a schematic, or if you are unable to otherwise service equipment yourself, you will likely spend much more money getting your purchase working. Good tube techs charge \$50-100 per hour. This can turn a good buy into a very questionable one. Even if you have service skills and access to schematics and test equipment, there can be some very interesting challenges.

I recently bought a very cosmetically nice McIntosh 1900 receiver

that was described as “one channel dead and the other one passing a weak signal—needs work.” Imagine my surprise when I opened the case and found that both driver boards were missing! I have no idea how it was able to pass a weak signal without the driver board. Neither did the seller, and we actually worked out a reasonable deal. I now have a very nice “tuner,” until I can find a junker 1900 to get driver boards.

C. “Easy fix,” “probably a bad bulb” (stereo decoder), or “may need a tube” are also suspect descriptions. If it was an “easy fix,” why didn’t the seller fix it? The bad bulb excuse is almost universally wrong when it comes to stereo decoders. With the exception of the Dynaco FM 5, very few tuners ever burn out the stereo decoder lamps alone. Sometimes I’ll read descriptions of equipment that contains lots of cut and paste specs, descriptions of how wonderful and classic a certain piece of equipment is, how rare it is, and how it is probably an easy fix. I’ll then discover the seller is conducting other

auctions selling a complete estate, including clothes and jewelry (and junk) and no other electronic equipment. What makes them experts on repair of vintage electronics?

For some unknown reason, estate sellers and antique store owners seem to think anything with tubes is worth a small fortune, just because they saw a Marantz 8B sell for \$10,000. If it sounds as though I am taking a shot at some sellers—I am. Most sellers are good people, but you must be very careful online!

D. “Works perfectly,” “sounds great,” “guaranteed not DOA”—These descriptions sound pretty good, but they can be misleading. It all depends on your perspective and the knowledge and education of the seller. A tuner that is out of alignment may work “perfectly” even though it is only operating at 20% of its sensitivity. It still may be a bargain, but if you must spend another \$150 to get it professionally aligned, it might not be such a good deal.

A couple of years ago, I bought a

McIntosh MC 30 from a guy selling lots of guitar stuff on eBay. His description said “serviced, re-tubed, sounds great.” It was a little cosmetically challenged, with some extra cooling holes drilled around the output tubes (gee, if McIntosh didn’t think this was necessary, who was the brain surgeon who figured it was a good idea?). It also featured a pair of coke bottle 6L6 new production “red lettered” output tubes as well as some rust on the chassis.

Purists won’t generally bid on “modified” equipment, so I gave it a shot. (I think the MC 30 is one of the best small amps ever built. I have another five of them—this is the addition of eBay.) I bid more than I should have, but because it was “serviced,” I figured I would take a chance.

When it arrived, retubed turned out to be interesting; the phase inverter and driver tubes were used (and weak), the rectifier was the wrong type, and the input tube was a 12AT7 not the 12AU7. The outputs

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were new and looked as though they just got off the boat from China. I put in correct, good tubes and slowly brought it up on the Variac (with a load, input source, and voltmeter connected to it). It didn't make any scary noises, but it really sounded awful and put out about 3W of power before it broke up.

I took it to my friend, Larry, the McIntosh expert. The coupling caps to the grids of the outputs were very leaky, passing lots of DC that disrupted the bias; the phase inverter tube balancing resistors were way off (40%); the power supply decoupling resistors were wrong (probably an attempt to fix the low B+ caused by the wrong rectifier tube); and one of the cathode feedback windings was connected to the wrong pin on the output tube (essentially not functioning as cathode feedback). After replacing coupling caps, balancing resistors, and correcting the wiring error, it sounded like a MAC. I contacted the seller and told him what I discovered, and he swore his tech had given it a clean bill of health and that it sounded great with his guitar.

Back in college I worked on many guitar amps, and I know that rock guitar players like their distortion, but this was way past anything I have seen. Guitar amps generally don't make good hi-fi amps, and vice versa.

When a purchase arrives that isn't right, contact the seller right away to advise him/her of the issue. Then work through the process I will discuss later.

Sometimes, a description will proclaim, "works perfectly, sounds great," but will later indicate, "as with all vintage equipment sold as is" or "because of the age of this equipment no guarantee is offered." Seems like a contradiction in terms, doesn't it? It really is. There is absolutely no reason that any well-serviced, restored, or well-maintained vintage audio equipment shouldn't survive shipping, and function just like it did before shipping (I will discuss packing and shipping at length later). You could always e-mail these sellers and ask specific questions about the

equipment's history, condition, and how long it was operated. This is especially important with estate or dumpster diver sellers, who sometimes interpret lights coming on as working (see B above).

E. **"Rebuilt," "refurbished," or "guaranteed."** These items can be a very good deal, although you should expect to pay more for them than other categories. With these, it is important to be clear on the return terms. Most honest sellers will accept returns, but not refund shipping costs either way, so you need to be sure of terms before you buy.

F. **Parts.** I have bought lots of parts and tubes via eBay, and most were exactly what I expected, but sometimes there are issues. I bought a set of output tubes that were described as NOS and matched. When they arrived they looked very used. The lettering was faded and brown and they were nowhere close to being matched. I contacted the seller and explained my observations and he said he didn't realize that they were used because they were in boxes and rubber-banded together. He actually refunded all my money, including shipping and told me to keep the tubes. Since then I have continued to buy tubes from him, and his expertise and descriptions have improved dramatically.

So, how do you avoid or handle these types of situations with audio gear you buy? First, it is very important to review the auction ad and details. Contact the seller before you do anything else (unlike I did with the MC 30) and politely explain your thoughts, cite the ad, and try to work out a compromise. If this fails, consider other options I will discuss later.

If I have a question on an item, I ask it early in the auction, to allow the seller time to reply. I often get questions on my auction within less than a day before the auction ends, and this sometimes—unfortunately—results in the bidder not getting an answer before the auction ends. Most sellers have real jobs and don't sit by the computer to wait for questions. I have had many sellers never respond to my questions, even if asked very early, and in most cases I don't bid on their auctions. If you don't get an an-

swer to your question, or if it is evasive, don't bid!

SHIPPING

One of the major cost factors with many auctions is shipping. This affects both the buyer and seller, and a complete book could be written about proper packing and shipping of vintage electronics. Most auctions will have a specified shipping cost or a shipping calculator to your zip code (shipping calculators allow the seller to include cost for packing material and "profit"). If neither of these is available, you need to ask about shipping to your location before you bid.

Some sellers also add a "handling and packing fee." I used to think this was just a way of making more money, but it might be to your benefit. Consider you have just bought a \$2500 tube amp and the cost of packing and shipping is \$80 from the coast to the Midwest. This may seem like a lot, but if the seller is buying two boxes, bubble wrap, and packing peanuts, it is probably cheap (a big roll of bubble wrap costs \$53).

Why shouldn't the seller make use of "used" boxes? The major shipping companies will not provide insurance payments for damaged items if the packing materials are not new. Any box with evidence of a previous label or packing tape will invalidate your claim for damage. This is a little-known issue that you will only discover if you have a problem. I routinely reuse packing and boxes, but not on shipments of expensive or delicate items.

I have had very few problems with damage because I am obsessive about packing, but this is not the case with all eBay sellers. It is important to remember that shipping companies can also refuse to pay claims for anything they determine was "inadequately packed." What is inadequately packed?

Last year, I bought three pieces of Dynaco equipment from a young gentleman on the East Coast. It included a PAT 4, an FM 5, and an ST 120. His packing and shipping fee was \$50, which was a little high, but I paid it and asked him to make sure they were packed well, to ship the amp separately, and to insure them. When they arrived, they all were thrown in one box separated by a few sheets of newspaper. The front of the

preamp was destroyed, and the FM 5 had the dial broken and the tuning knob shaft broken off. The 120 had a crimp in the chassis and the cage was dented. His actual shipping cost was \$29 (evidenced by the USPS printed label).

When I called him, he couldn't understand why I was upset and why it was damaged—he blamed the Postal Service. I asked him about filing a claim and then found out he hadn't insured them, even though he charged me for insurance. He explained that because he sold the pieces for less than he had paid for them, he had to recoup his investment somewhere. This is a clear example of someone being pennywise, pound foolish.

To list an item online is pretty inexpensive if you start with a low beginning price. It costs more for a high start price and more for using a "reserve" (eBay's final fee is based on the selling price, and you still get to pay that, but if you are selling an item that will go for big bucks, you can save a few cents by starting it low—always a risk, shows who is cheap). By trying to minimize his expenses, by listing them for less than he paid for them, and writing a bad description, he didn't get very much action, and I should have gotten a pretty good deal. He then tried to make up the difference by inflating shipping costs and not spending money on packing. Unfortunately, by the time we were done, he had lost a bunch more money and I had three parts units to strip. I would have preferred to have the units in good condition for rebuilding rather than for parts.

If you are buying some expensive or very pristine piece of equipment, be willing to pay for expert packing and shipping and *insist* the seller pack them the way you request (be willing to pay for it). There are some sellers who try to use shipping as a profit center. This is not right, and I won't bid on an item with ridiculous shipping charges. You often see this with Chinese or Hong Kong sellers. They sell a new manufactured copy of the Marantz 9 for a reasonable or low price and then charge \$195 for shipping.

I ship items all over the world, and the actual cost for something this size and weight via airmail would be about \$45. Another one is laptop computer batteries. Online sellers in the US get about \$39.95 plus \$12 shipping. Hong Kong

sellers list them at a BIN for \$24.95 with a \$29.95 shipping cost. Where should you spend your money? It might even be better to check with Batteries Plus™, where the same battery sells for \$49.95.

A rough estimate for domestic shipping is about \$1 per pound of final weight. This assumes it is not oversize and does not include the packing materials. I don't usually become too excited about what a seller charges for shipping as long as he/she understands the item must arrive safely! When I pay for an item, I note how I would like the item packed and shipped and offer to pay an additional cost for the service.

How should audio parts be packed to survive? All delicate or heavy items need to be double-boxed. The item should be wrapped very tightly in large bubble wrap and taped securely; you need at least four layers of bubble wrap and a tight fit in the first box, which you could also line with rigid foam board (pink stuff with foil on one side—not white bead board). Place this box in a second box, allowing at least 4" of *tightly* packed

Styrofoam peanuts. *Never* pack any electronic equipment directly in packing peanuts. If you ever spent an hour removing broken and crushed peanuts from all the wiring and crevices in a tube amp, you know exactly what I am talking about.

I purchased a Stereo 400 amp that didn't work, but the knobs and face were pristine and the price was right (it weighed about 50 lbs). I asked the seller to double-box it and charge me for it. He charged me \$50, which was reasonable. When the UPS guy delivered it, the single box was torn open on one end and there were about 12 peanuts still in the box along with some scrap cardboard. The front panel was bent over about 2" on each corner and two of the knobs were missing. The fan was broken off the heatsink and the cage significantly dented.

I was informed that it was inadequately packed (the UPS driver was right) and that I could file a claim, but I wouldn't get anything. I took digital pictures of the box and amp and e-mailed them to the seller. He claimed it was packed well

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and that it was UPS's fault (it wasn't on either count). After a long string of e-mails we came to an agreement, after I told him I would pack it and ship it back to him, but I expected a full refund and shipping both ways.

I really hate these situations, and they certainly aren't the way either party would like them to turn out. It is very important to pack well and to ask that your items be packed well. Be willing to pay for it and you will both be much happier. Shipping companies don't like damaged shipment either and generally will be of great assistance in advising on packing an item to survive.

Having dealt with all the major companies (UPS, DHL, Fed Ex, and USPS), I can't generally find any one better than the other. I use USPS for small items and love Priority Mail with Delivery Confirmation. They also have some flat rate boxes that are ideal for shipping transformers, and the rate is \$9.95 anywhere in the continental US regardless of the weight.

I recently shipped a 22 lb transformer this way. Because of its weight, I bolted it to a piece of plywood and built a box around it, just fitting the box. The buyer e-mailed me that he was extremely pleased with the condition it arrived and was surprised I went to the trouble to pack it the way I did. It took 10 minutes with my tablesaw and drill driver, and saved us both grief.

I tend to use Fed Ex for larger and heavier items because they offer a really nice online shipping system and charge the shipping to my credit card. They also offer a 10-15% discount on all online arranged shipments; this keeps the cost reasonable for both parties.

I recently received a shipment with the best packing I have ever seen! This new system uses expanding foam, with the equipment securely sealed in a heavy plastic bag. This system custom-forms a heavy foam shell around the equipment. Unfortunately, it is pretty expensive to buy and set up, but I would love to have one of these systems!

If the seller isn't interested in packing the item properly, ask him/her to take it to a UPS shipping and packaging center for packing. Be willing to pay extra for this, but the bonus is that if any damage occurs the shipper will pay without

hesitation.

It is also very important to insure the shipment for replacement. If you must file a claim:

1. File a damage report with the shipping company. Take pictures of the packing material, box, and item. Keep the packing materials and box (many times the shipping company will want to inspect it). A polite e-mail to the seller will usually bring a like response. If the shipping company denies the claim, due to poor packing, you can arrange to negotiate via telephone or e-mail.
2. Be prepared with a proposal for the damage in case the seller asks you what you want to do. You should try to work through this so that it is fair to both people. Remember: they probably didn't want this to happen either.
3. You need to work through the claim process fairly quickly because eBay and PayPal have time limits on intervention (60 days for claims).
4. If you fail to come to an agreement, you can file a dispute with eBay, and if you used PayPal to pay for it, the dispute will be filed through them. The eBay dispute process requires you to fill out a form and explain your position and your suggested resolution. It is then forwarded to the other party via eBay, and if they do not respond you can ask eBay to intervene. This may result in a suspension of trading privileges for the seller for 30-90 days or even a permanent suspension if this is his/her third infraction.

I have had only two experiences with this system. I had bought some output transformers from a prominent eBay seller, who informed me after I paid for them that it would be 30 days before I received them because he "hand wound" them. This, by the way, is against eBay policy. After 30 days and no transformers, I contacted him and he said four more weeks. Before the end of 60 days, I filed a claim, eBay contacted him, and I eventually got my transformers. But Larry sent him some McIntosh transformers for rewinding and paid upfront and never received them. He also complained to eBay, as did several others, and the seller was permanently banned from eBay trading (or so they say).

Last year I bought three new Dy-

naco ST 35 clone circuit boards and three sets of output and power transformers, plus a complete amp (obviously a business idea gone awry). The seller said he would accept check, money order, cashier's check, or postal money order, but would hold the shipment for 30 days clearance, except for the postal money order.

This should have made me suspicious, because each of these payments takes about the same time to actually clear (ten days). The seller also listed a starting price (about one-third the actual cost of the items) but no reserve, and I was the only bidder. I sent him a cashier's check via priority mail with delivery confirmation and signature required. I asked him why he was going to hold shipment for 30 days when the bank told me it would clear in 5-7 days. His response was "he could do anything he wanted to do."

After 30 days I e-mailed him to ask for a tracking number for the shipment. He replied that there was no tracking number because he sent them parcel post (this is really stupid, and a great way to lose stuff). At about 45 days the first box came with half the items I had bought. I e-mailed him and asked about the second box—he said to wait a week. When it didn't come and the 60-day limit to file a dispute approached, I filed one with eBay.

He was not happy, and e-mailed me that the second box had come back to him because of damage (probably a lie) and that he was not going to reship it as long as the dispute was open. I did a really stupid thing and closed the dispute (once you close, you can't reopen it—I guess he knew that and I didn't). Needless to say, I never got the rest of my stuff, and he got negative feedback (you can leave feedback up to 90 days after the transaction). I also filed a report with the USPS for mail fraud, but you know how efficient the government can be. Learn from my mistakes!

I prefer to use only PayPal for buying (because of the previously mentioned intervention) and accept PayPal and money orders for items I am selling (I accept personal checks from repeat customers). I never use bank transfers or cash. Even though the seller pays a fee for every electronic transfer via PayPal and they can even be a hassle to work with, they do offer some security for your money.

Just a few weeks ago I sold some books to a buyer, who paid via PayPal. I shipped the books priority mail, with delivery confirmation. The buyer e-mailed me 15 days later claiming he had not received them. I sent him the confirmation number so he could check the delivery. A week later he e-mailed again and demanded to know where the shipment was, so I used USPS link on tracking, got the complete list of where it had gone and when it arrived at his post office. He filed a non-delivery claim with PayPal, which sent me into the resolution center. I was able to attach the shipping and tracking information, as well as the e-mails we had exchanged (he claimed I had never answered any of his e-mails).

Within 24 hours PayPal had closed his claim and e-mailed me that they considered the dispute ended. I permanently banned him from any of my auctions. I have no idea what he was up to, but in this case having all the documentation was the saving grace for me. Because it wasn't very much money I

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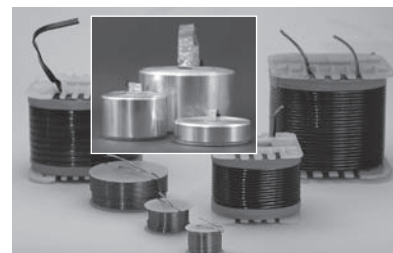


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FEEDBACK

eBay's feedback system allows you to check on buyers' and sellers' previous transactions. Remember Rule #1: You should always check a seller's feedback before you bid on any item. You may choose to reconsider bidding on an item from a seller with a small number of feedbacks or multiple negatives. eBay recently updated its system to allow multiple ratings for communication, packing, shipping, and quality of the item. Reading seller's feedback can give you a pretty good picture of the integrity of the person.

Even negative feedback should be taken with a grain of salt and read carefully. eBay now allows people to respond to, and explain, negative feedback, and sometimes it is very apparent that the negative feedback was retaliation for negative feedback given by the other party. I have had negative feedback—one of these was for leaving negative feedback for nonpayers. The other one was from someone who didn't even con-

tact me about an issue he had with the amp he bought. I have no idea what his problem was. Interestingly enough, I had left him positive feedback.

No one likes negative feedback—neither the seller nor the buyer—and you should do everything you can to avoid getting or giving it. In my ads I list my personal cell number and encourage any buyer who has questions or concerns to call me before taking any action. I am proud of my very high feedback score and will bend over backwards to keep it that way.

One bothersome practice is performed by sellers who state in their ads that "they will leave feedback after you, the buyer, leave feedback for them." This is holding you hostage. It makes me think that they are trying to make sure they don't get negative feedback. It isn't right; after all, you have won the bid and paid for the item, so you have completed 95% of the transaction. I urge you not to do business with sellers who hold you hostage. This is especially true now since eBay allows you to post a response to negative feedback (you can also ask for arbitration and get negative feedback removed).

Once you have received the item, it is also very important for you to leave feedback. This will help other buyers make the right decision about doing business. Although I leave feedback for everyone who buys from me, only about 60% of them ever leave feedback for me. This is just plain laziness or rudeness.

Over the years I have "met" some very nice people via on-line trading. I correspond with many of these people regularly, and we trade equipment back and forth. Even though I have shared some negative examples with you, I really believe that most of the sellers on eBay are honest. There are many people like me, having some fun and buying and selling some neat stuff. If you follow some of the simple suggestions I have made, you will greatly limit your chance of problems.

Because I live in a relatively remote, underpopulated area (South Dakota), online auctions have been a great benefit to me. I have been able to buy gear I would have never run across in my area, and 95% of the time it has been a very positive and fun experience. *ax*

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CUSTOM WORK

Choosing Cathode Bypass Capacitors

With little practical information in print, it was necessary to derive this simple solution to the problem of triode cathode-bypassing.

When designing a simple cathode-biased triode, voltage-gain stage of the type shown in **Fig. 1**, the designer is usually faced with choosing a cathode bypass capacitor in order to maximize gain. If the cathode resistor is left unbypassed, negative current feedback will limit the available gain of the stage to some minimum value. Usually this is a simple matter of using an arbitrarily large value of capacitance to ensure proper cathode decoupling well below audible frequencies.

Occasionally though, some of you may wish to use a small value of capacitance in order to obtain a treble boost action, because the cathode will be fully bypassed at high frequencies and effectively unbypassed at low frequencies. This might be called “partial bypassing,” and results in the stage operating as a first-order shelving filter. Possible applications include phono stages or pre-amplifiers for musical instruments and microphones, where a bass cut is often

desirable.

Calculating the maximum possible (fully bypassed) gain is easy, and is given by¹:

$$A_{\max} = \frac{\mu \cdot R_a}{R_a + r_a} \quad (1)$$

Likewise, the minimum possible (unbypassed) gain is just as easily found using²:

$$A_{\min} = \frac{\mu \cdot R_a}{R_a + r_a + R_k(\mu + 1)} \quad (2)$$

where, in both cases:

μ = the amplification factor of the valve.

R_a = the anode load resistor.

r_a = the internal anode resistance (plate resistance).

R_k = the cathode bias resistor.

(If the stage is heavily loaded by a following stage, you should substitute R_a for $R_a || R_l$, where R_l is the following loading resistance, which is usually the grid leak resistor.)

LOOKING FOR ANSWERS

But at what point is the transition made from one extreme to the other? And how should you choose the cathode bypass capacitor to give the desired result?

We consulted numerous sources, but none gave satisfactory answers to these questions. The older texts all assume that an audible bass-cut would be undesirable and give this subject almost no treatment at all, while some contemporary texts give incorrect treatment³. *The Radiotron Designer's Handbook* (4th ed.) does give a formula for gain at any frequency, on page 484:

$$\left| \frac{A'}{A_{\max}} \right| = \sqrt{\frac{1 + (\omega R_k C_k)^2}{\left[1 + \frac{R_k(\mu + 1)}{R_a + r_a} \right]^2 + (\omega R_k C_k)^2}}$$

where, all symbols as above, and:

A' = gain at the frequency of interest

$\omega = 2\pi f$

But this is hardly a convenient formula, and even if you solved it for C_k , you must pick an arbitrary level of gain “from the air,” and work from there. Of course, SPICE simulation could solve this problem without trouble, but that could be just as time consuming as solving the above formula. Therefore, we thought it would be more useful to have a universal and simple equation that would allow quick “back of an envelope” choice of the cathode bypass capacitor, or quick analysis of an existing circuit.

A SIMPLE SOLUTION

Normally, filters are defined according to their $\pm 3\text{dB}$ pole/zero frequency. However, this convention is less useful for this type of shelving filter because the difference between $A_{\max}$ and $A_{\min}$ may be much less than 6dB, in which case the pole would be lower in frequency than the zero! In fact, if the difference between $A_{\max}$ and $A_{\min}$ is less than 3dB, then there will be no conventional pole/zero at all! Instead, the best way to define such a filter, which is applicable to all circumstances, is by the point at which gain is halfway between minimum and maximum, which hereafter we call the “half boost point”⁴.

The problem of defining this point is most easily solved using a Nyquist plot of the denominator of equation 2 (**Fig. 2**), first by drawing a vector equal to the instantaneous current through R_a and r_a , and in series with this, current

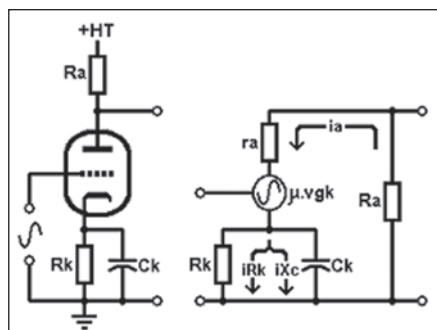


FIGURE 1: Left, a simple triode amplifier stage and its Thévenin equivalent circuit, right.

through $R_k(\mu + 1)$. At zero frequency, no current flows in C_k , and anode current (i_a) is equal to and in phase with current through R_k (iR_k). At maximum gain, C_k is effectively a short circuit, and current through it (iX_c) is also in phase with i_a . At intermediate gain levels, i_a is the vector sum of iR_k and iX_c , the vectors of which describe a semicircular arc, as shown.

At the half boost point, you can determine the total phase shift (θ) in i_a by drawing an arc of radius $R_a + r_a + \frac{1}{2}R_k(\mu + 1)$ as shown. Where this vector is tangential with the arc $\frac{1}{2}R_k(\mu + 1)$, then AB and BC indicate the relative magnitudes of iR_k and iX_c , respectively, while a/b yields the product of R_kC_k in radians per second, so that:

$$a/b = \omega R_k C_k$$

It is then a simple matter of finding a/b , by treating the problem as two geometrical problems as in **Fig. 3**, and solving them simultaneously:

To aid algebraic manipulation, put $(R_a + r_a) = A$ and $\frac{1}{2}R_k(\mu + 1) = B$.

From elementary geometry:

$$a^2 = b(2B - b) \quad (I)$$

and,

$$a^2 = (B - b)(2A + B + b) \quad (II)$$

Equating I and II,

$$2Bb = 2AB + B^2 - 2Ab$$

and collecting terms in b ,

$$b = \frac{B(2A + B)}{2(A + B)} \quad (III)$$

so,

$$b^2 = \frac{B^2(2A + B)^2}{4(A + B)^2} \quad (IV)$$

Substituting III into I and simplifying,

$$\begin{aligned} a^2 &= \frac{4A^2B^2 + 6AB^3 + 2AB^3 + 3B^4}{4(A + B)^2} \\ &= \frac{4B^2(A^2 + 2AB) + 3B^4}{4(A + B)^2} \quad (V) \end{aligned}$$

Putting V over IV and simplifying yields

$$a^2/b^2 = \frac{4A^2 + 8AB + 3B^2}{(2A + B)^2} = \frac{(2A + B) + 2B}{(2A + B)} = 1 + \frac{2B}{(2A + B)}$$

so,

$$a/b = \sqrt{1 + \frac{2B}{(2A + B)}} \quad (VI)$$

the limits of which are 1 and $\sqrt{3}$. Finally, putting $A = R_a + r_a$, and $B = \frac{1}{2}R_k(\mu + 1)$ and $a/b = \omega R_k C_k$,

$$\omega R_k C_k = \sqrt{1 + \frac{R_k(\mu + 1)}{2(R_a + r_a + \frac{1}{2}R_k(\mu + 1))}} \quad (VII)$$

and solving for $f_{(\text{half boost})}$;

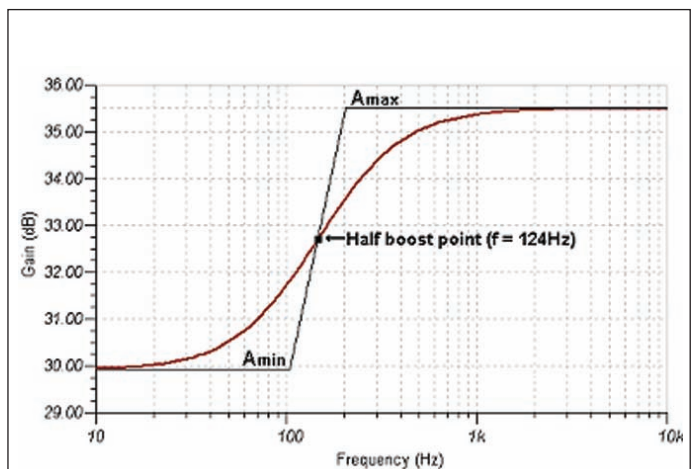
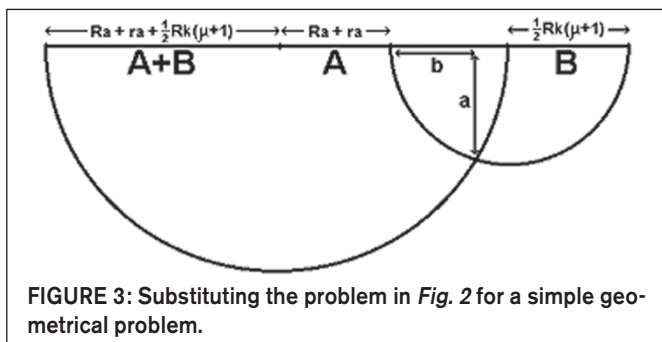
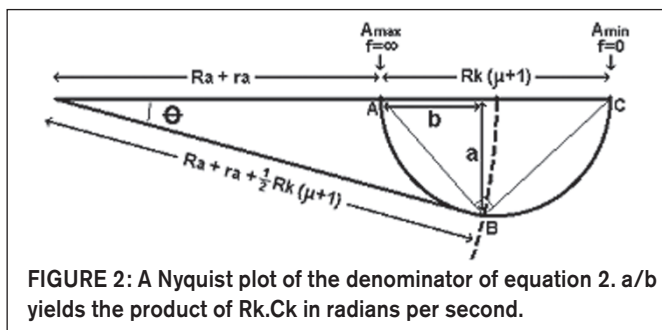
$$f_{(\text{halfboost})} = \frac{\sqrt{1 + \frac{R_k(\mu + 1)}{2(R_a + r_a + \frac{1}{2}R_k(\mu + 1))}}}{2\pi R_k C_k} \quad (VIII)$$

Where all resistances are in Ohms, and all capacitances in Farads.

Figure 4 shows the idealized frequency response of the circuit given in **Fig. 1** using an ECC83 (12AX7), constructed by drawing a first-order (6dB/octave) slope through the half boost point, found with the above equation and converting to decibels. The heavy line shows the response produced by SPICE simulation, showing excellent correlation. In fact, the accuracy of equations 1, 2, and VIII is limited only by the accuracy of the value used for r_a , but this will usually be swamped by the tolerance of the capacitor and triode used. We hope you find this a useful and practical formula to accompany equations 1 and 2 given at the very beginning of this article, when designing triode amplifiers. **aX**

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buyers' GUIDE

MANUFACTURER	Model	Application, Design Principle, Enclosure or System Type	Woofer Diameter, Inches	Midrange Diameter, Inches	Midrange Type	Tweeter Diameter, Inches	Tweeter Type	Separate Level Controls? W= Woofer, M= Midrange, T= Tweeter, C= Super tweeter	Anechoic Frequency Response, Hz to kHz, ±dB	SPL, 1 Watt/1 Meter, dB	Recommended Minimum Amp Power, Watts per Channel	Crossover Frequencies, Hz	Impedance, Ohms: Nominal/Minimum	Dimensions, Inches (To Nearest Inch)	Finish	Grille Color and Material	Weight, Pounds Each	PRICE, \$
ACI	Sapphire XL	4th order	5.25			1	Silk Dome		48-20 ±3	85.5	20		8/6.5	12 X 8.5 X 12.5	Piano Blk, Opt.	Blk.	22	\$1,850.00
	Emerald XL	4th order	4			1	Soft Dome		70-20 ±3	86	20		8/7	10 X 5.875 X 8.25	Piano Blk., Opt.	Blk.	11	\$800.00
	Force XL	Sealed Powered Sub.	10				Yes		20-200 ±3		250 Inc.	35,250		15.75 X 13.75 X 13.75	Piano Blk., Opt.		52	\$900.00
	Titan XL	Sealed Powered Sub.	12				Yes		20-250 ±3		250 Inc.	35,250		20 X 18.875 X 18.875	Piano Blk., Opt.		82	\$1,349.00
	Maestro XL	Sealed Powered Sub.	15				Yes		19-250Hz ±3		500 Inc.	35,250		21.75 X 21.75 X 21.75	Piano Blk.		136	\$2,500.00
ANALYSIS AUDIO	Omicron	Planar Magnetic / Ribbon	325 sq.			40	Ribbon		30-20	86	50	650	4/	44 X 24 X 2.4	Satin blk., gray, cust.	Blk., cust.	68	\$11,800.00
	Epsilon	Planar Magnetic / Ribbon	408 sq.			48	Ribbon		26-20	86	50	650	4/	52 X 24 X 2.4	Satin blk., gray, cust.	Blk., cust.	79	\$14,800.00
	Omega	Planar Magnetic / Ribbon	564 sq.			61	Ribbon		22-20	86	50	650	5/	66 X 24 X 2.4	Satin blk., gray, cust.	Blk., cust.	100	\$19,800.00
	Amphitryon	Planar Magnetic / Ribbon	745 sq.			78	Ribbon		22-20	86	50	650	6/	84 X 28 X 2.8	Satin blk., gray, cust.	Blk., cust.	190	\$26,000.00
	Orion	Planar Magnetic / Ribbon	790 sq.	745 sq.	Planar Mid Bass	78	Ribbon		20-20	86	50 Main Panel/100	650/80 Hz	6/	84 X 28 X 2.8 ea.	Satin blk., gray, cust.	Blk., cust.	360	\$52,000.00
ANGSTROM LOUDSPEAKERS	Obblatio Renaissance	4 Piece active or passive syst																
APERION AUDIO	Bravus 8D	Sealed, Dual Act. Sub.	(2) 8					DSP	35-180Hz		150	Adj., by-pass-150		13.5 X 12 X 12	Gloss Blk., Med. Cherry	Blk.	33	\$499.00
	5DB	Dipole/Bipole	(2) 5.25		Woven Fiber-glass	1	Silk Dome	bipole/dipole switch	100-20	86	50-300		8/	11.75 X 10.6 X 7.5	High Gloss Blk., Med. Cherry	Blk.	17	\$345.00
	5T	Front Ported, 2.5-Way		(2) 5.25"	Woven Fiber-glass	1	Silk Dome		55-20	87	50-150		6/	38 X 6.3 X 8	High Gloss Blk., Med. Cherry	Blk.	36	\$495.00 Each
	6C	Sealed, 3-Way	(2) 6.5	5.25	Woven Fiber-glass	1	Silk Dome		60-20	8	50-300		6/	8.5 X 25 X 11	High Gloss Blk., Med. Cherry	Blk.	39	\$590.00
	5C	Sealed, 3-Way	5.25	4	Woven Fiber-glass	1	Silk Dome		55-20	86	50-150		6/	7.33 X 19.33 X 8	High Gloss Blk., Med. Cherry	Blk.	22	\$350.00
	4C	Sealed, 2-Way		(2) 4	Woven Fiber-glass	1	Silk Dome		80-20	84	25-150		8/	5.33 X 12.8 X 5.5	High Gloss Blk., Med. Cherry	Blk.	8	\$160.00
	6T	Front Ported, 2-Way	6.5	6.5	Woven Fiber-glass	1	Silk Dome		36-20	91	50-300		6/	41.5 X 7.75 X 15.5	High Gloss Blk., Med. Cherry	Blk.	70	\$695.00 Each
	4B	Sealed, 2-way		4	Woven Fiber-glass	1	Silk Dome		120-20	84	25-200		8	8.75 X 5.33 X 5.5	High Gloss Blk., Med. Cherry	Blk.	8	\$120.00
	5B	Ported, 2-way	5.25		Woven Fiber-glass	1	Silk Dome		75-20	84	50-150		8/	12 X 6.75 X 8	High Gloss Blk., Med. Cherry	Blk.	14	\$225.00 Each
	6B	Ported, 2-way	6.5		Woven Fiber-glass	1	Silk Dome		48-20	82	50-200		8/	15 X 8.3 X 12.8	High Gloss Blk., Med. Cherry	Blk.	26	\$345.00 Each

MANUFACTURER	Model	Application, Design Principle, Enclosure or System Type	Woofer Diameter, Inches	Midrange Diameter, Inches	Midrange Type	Tweeter Diameter, Inches	Tweeter Type	Separate Level Controls? W=Woofers, M=Midranges, T=Tweeters, ST=Subwoofer	Anechoic Frequency Response, Hz to kHz, ±dB	SPL, 1 Watt/1Meter, dB	Recommended Minimum Amp Power, Watts per Channel	Crossover Frequencies, Hz	Impedance, Ohms: Nominal/Minimum	Dimensions, Inches (To Nearest Inch)	Finish	Grille Color and Material	Weight, Pounds Each	PRICE, \$
	Bravus 10D	Sealed, Dual Act. Sub.	(2) 10					DSP	30-180Hz		300	Adj., By-pass-150	15 X 13.5 X 13.5	Gloss Blk., Med. Cherry	Blk.	44	\$799.00	
	Bravus 12D	Sealed, Dual Act. Sub.	(2) 12"					DSP	22-180Hz		500	Adj., By-pass-150	17 X 15.5 X 15.5	Gloss Blk., Med. Cherry	Blk.	62	\$1099.00	
	632-1W	In-Wall	6.5		1	Silk Dome	±3dB bass, treble	50-22	88	20-200		8/	9 X 12	Wht.	Alum.	4	\$149.00 Each	
	632-1C	In-Ceiling	6.5		1	Silk Dome	±3dB bass, treble	55-22	88	20-200		8/	9 R	Wht.	Alum.	4	\$149.00 Each	
ASCEND ACOUSTICS INC	Sierra-1	Bamboo Encl., Vented, Ref.	5.25			1	Soft Dome		44-22 ±3dB	86.5	45		8/	14 X 8 X 10	Nat., Piano Blk.	Blk. Knit	21	\$848.00 Pair
	CMT-340 SE	Vented, MTM	(2) 6.5			1	Soft Dome		48-24 ±3dB	90	35		8/	21 X 8 X 10	Blk. Matte	Blk. Knit	26	\$568.00 Pair
	CMT-340 SEC	Vented, Ctr. Speaker	(2) 6.5			1	Soft Dome		48-24 ±3dB	90	35		8/	8 X 21 X 10	Blk. Matte	Blk. Knit	26	\$298.00 Each
	CBM-170 SE	Vented Bkshlf. Monitor	6.5			1	Soft Dome		58-22 ±3dB	89	25		8/	12 X 9 X 10	Blk. Matte	Blk. Knit	14	\$348.00 Pair
	HTM-200 SE	Sealed Bkshlf. Monitor		(2) 4	Cone	1	Soft Dome		74-22 ±3dB	87	25		8/	11 X 6 X 6	Blk. Matte	Blk. Knit	10	\$278.00 Pair
ATE AUDIO TECHNOLOGY ENGINEERING	Transar	Electrostatic Hybrid	6 x 10			63 X 20	Electro-static	DSP	20-25	90	300	200	6/	79 x 22 (4 pcs.)				\$50,000.00
ATLANTIC TECHNOLOGY	8200e LR	Sealed Box, 3-way	(2) 8	(2) 5.25	Cone	1	Dome		60-20, ±3	90		450, 3k	6/	11 X 31 X 12	Gloss blk.	Blk. Knit	53	\$1,660.00 Each
	6200e LR	Sealed Box, 2-way	(2) 6.5			1	Dome		60-20, ±2	90		3k	6/	9 X 23 X 12	Satin blk.	Blk. Knit	26	\$1,150.00 Each
	4200e LR	Sealed Box, 2-way	5.25			1	Dome		80-20, ±3	90		2.5k	8/	8 X 15 X 10	Blk./Gloss Blk.	Blk. Knit	15	\$1,060.00 Pair
AUDIOACCESS	AAS36AW	Indoor/outdoor	6	4	Cone	1	Dome		60-20	90		650, 3k	8/	10 X 5 X 5	Wht.	Wht.	11	\$549.00 Pair
	AAS6	In-wall	6.5			1	Dome		38-20	88		2.5k	8/	7 X 9 X 4	Wht.	Wht. Metal		\$499.00 Pair
	AAS6CS	In-ceiling	6.5		(2) .75		Dome		40-20	88		2.6k	8/	9 R X 4 D	Wht.	Wht. Metal		\$249.00 Each
	AAS8	In-wall	8			1	Dome		30-20	90		2.5k	8/	10 X 13 X 4	Wht.	Wht. Metal		\$599.00 Pair
	AAS55	Horiz./Vert. in-wall	(2) 5			1	Dome		40-20	88		2k	8/	14 X 6 X 4	Wht.	Wht. Metal	6	\$349.00 Pair
	AAS6C	In-ceiling	6.5			1	Dome		40-20	88		2k	8/	9 R X 4 D	Wht.	Wht. Metal		\$449.00 Pair
	AAS88	In-wall sub.	(2) 8			1	Dome		30-100Hz	94		100	8/	12 X 21 X 4	Wht.	Wht. Metal	17	\$499.00 Each
AUDIOKINESIS	Jazz Module	Contr. Patt. Vented	11			10	Wave-guide	T	32-17.5 ±3	92	5		8/7.5	42 X 14 X 18	Walnut		110	\$4,500.00
	Dream Maker	Cont. Patt. Bipole	(2) 11			(2) 10	Wave-guide	T	32-17.5 ±3	92	5		16/14	43 X 26 X 15	Maple		190	\$9,000.00
	The Swarm	4-pc Sub. Set	6.5					W	24-200 ±3		Inc.	30-200		21 X 9 X 15	Oak		30	\$1800.00
AZZOLINA AUDIO	Gran Sfera	Full Range Horn Sys.	15	4	Cone				30-18 ±3	104	1	350	8/	36 X 60 X 30	Gel. Coat, Baltic Birch		100	\$15,000.00
BG RADIA CORP	Radia R-800	In-Wall HT	(2)8	(6)10	Planar-Ribbon	(16) 3	Planar-Ribbon	W, M	20-20 ±3	93	250	20, 250, 1.5k	4/20	82 X 12 X 1	Matte Wht./Blk.	Wht./Blk. Perf.	64	\$19,000.00 Sys.
	Radia R-600	In-Wall HT	(2)8	(4)10	Planar-Ribbon	(12) 3	Planar-Ribbon		50-20 ±3	93	250	50, 250, 1.5k	4/	64 X 12 X 1	Matte Wht./Blk.	Wht./Blk. Perf.	55	\$5,000.00 Each
	Radia R-500	In-Wall HT	(4) 5.25	(2)10	Planar-Ribbon	3	Planar-Ribbon		60-20 ±3	91	150	60, 300, 2.2k	8/	48 X 6 X 1	Matte Wht./Blk.	Wht./Blk. Perf.	29	\$2,500.00 Each
	Radia R-400c	In-Wall HT	(2)8	(4)8	Planar-Ribbon	(2) 3	Planar-Ribbon		50-20 ±3	93	250	50, 300, 1.5k	4/	38 X 12 X 1	Matte Wht./Blk.	Wht./Blk. Perf.	36	\$3,750.00 Each
	Radia R-LCR	In-Wall HT	(2)8	(2)8	Planar-Ribbon	3	Planar-Ribbon		50-25 ±3	88	150	50, 450, 2.4k	4/	32 X 12 X 1	Matte Wht./Blk.	Wht./Blk. Perf.	34	\$2,500.00 Each
	Radia R-320	In-Wall HT	(2)5.25	(2)8	Planar-Ribbon	3	Planar-Ribbon		50-25 ±3	88	125	50, 450, 2.4kk	4/	34 X 6 X 1	Matte Wht./Blk.	Wht./Blk. Perf.	14	\$1,600.00 Each
	Radia R-200	In-Wall HT	(2)5.25			3	Planar-Ribbon		60-20 ±3	88	50	60, 2k	4/	19 X 6 X 1	Matte Wht./Blk.	Wht./Blk. Perf.	7	\$1,000.00 Each
CANTON USA	Vento Reference 1 DC	Bass Reflex, 3-1/2-way	(2) 12	(2) 7	Cone	1	Dome		18-40	89.5		180, 400, 3k	4/8	15 X 56 X 22	Maple, Cherry, Gloss Silvr.	Blk. Knit	194	\$30,000.00 Pair
	Vento 870 DC	Bass Reflex, 2-1/2 way	7	7	Cone	1	Dome		23-40	88		300,3k	4/8	9 X 39 X 12			50	\$3,500.00 Pair
	Karat 730 DC	Compact Bass Reflex, 3-way	8	6	Cone	1	Dome		25-40	86		180,3.1k	200	7 X 15 X 15			25	\$2,000.00 Pair
	Ergo 611 DC		9	7	Cone	1	Dome		20-40	89		300,3.5k	4/8	10 X 45 X 14			71	\$4,000.00 Pair

MANUFACTURER	Model	Application, Design Principle, Enclosure or System Type	Woofer Diameter, Inches	Midrange Diameter, Inches	Midrange Type	Tweeter Diameter, Inches	Tweeter Type	Separate Level Controls? W=woofer, M=midrange, T=tweeter, S=super tweeter	Anechoic Frequency Response, Hz to kHz, ±dB	SPL, 1 Watt/1Meter, dB	Recommended Minimum Amp Power, Watts per Channel	Crossover Frequencies, Hz	Impedance, Ohms: Nominal/Minimum	Dimensions, Inches (To Nearest Inch)	Finish	Grille Color and Material	Weight, Pounds Each	PRICE, \$
	Chrono 509 DC	Bass Reflex, 3-way	7	7	Cone	1	Dome		20-40	88.3		300, 3.5k	4/8	8 X 41 X 11			45	\$2,000.00 Pair
	GLE 403	Compact Bass Reflex, 2-way	7			1	Dome		38-30	89		3k	4/8	8 X 14 X 11			15	\$599.00 Pair
	Vento Reference 9 DC	Compact Bass Reflex, 2-way	7			1	Dome		25-40	87		3k	4/8	9 X 16 X 13			25	\$4,000.00 Pair
COHERENT SPEAKERS	Model 8 hr	Sealed 3-way	12	8					25-26	97	3	50, 2k	16/8	40 X 13 X 12	Exotic Solids/Ven.		95	
COINCIDENT SPEAKER TECHNOLOGY	Triumph Extreme	Vented	7			1	Silk Dome			94	7	3k	8/	16 X 9 X 12	Cherry		30	\$2,699.00
	Partial Eclipse II	Vented	8	5.25		1	Silk Dome		30-30	91	7	150, 3k	8/	37 X 8 X 12	Cherry		55	\$4,499.00
	Super Victory	Vented	12	7		6	Ribbon		22-35	92	7	125, 2.8k	8/	47 X 9 X 17	Cherry		135	\$9,499.00
	Total Victory IV	Vented	(2)12	(2) 7		6	Ribbon		20- 35	94	7	125, 2.8k	10/	52 X 9 X 22	Cherry		165	\$14,999.00
	Pure Reference	Vented	(2) 12	6.5	Ceramic	1.2	Ceramic		20-35	94	7	125, 4k	8/	55 X 9 X 24	Ash		200	\$22,000.00
COX AUDIO SYSTEMS	0506	2-way Vented High Eff.	6.5			1	Silk Dome		80-23	94	10	1.8k	8/6	15 X 9 X 12	Cherry, maple, blk., custom	Blk. Fabric	20	\$1,450.00
	1606	2-way Vented High Eff.	(2) 6.5			1	Silk Dome		60-23	94	15	1.8k	8/5	40 X 9 X 12	Cherry, maple, blk., custom	Blk. Fabric	50	\$3,800.00
	3006	High Eff. Tower	(3) 6.5			1	Silk Dome		45-23	94	20	1.8k	7/4	41 X 10 X 16	Cherry, maple, blk., custom	Cherry, maple, blk., custom		\$6,300.00
	9906	2-way Vented High Eff.	(5) 6.5			1	Silk Dome		25-23	94	25	1.8k	6/3	72 X 15 X 21	Cherry, maple, blk., custom	Blk. Fabric	280	\$18,000.00
CRAFTY LOUDSPEAKERS	Azumi	Mini Trans. Line	4			.75			40-22	85	10	4.2k	6/	31 X 6 X 8	High Gloss Blk./Wht./Blue		22	\$937.00 Pair
	Beluga	Full Range BLH	5.5						53-20	92			8/	39 X 8 X 12	High Gloss: Blk./ Wht./ Blue		30	\$1406.10
DAS AUDIO s.a.	VARIANT-112A	Install Line Array	12 X 1			1 X 2	Neo-dymium		63-18	128	600 RMS			12 X 22 X 15	Blk.	Blk.	77	\$2,700.00
	VARIANT-25A	Install Line Array	5 X 2			1	Neo-dymium		75-17	120	200 RMS			6 X 22 X 9	Blk.	Blk.	27	\$1,761.00
	CA-28A	Line Array	8 X 2			1.5 X 1	Neo-dymium		80-18	450 RMS				10 X 34 X 15	Blk.	Blk.	80	\$3,990.00
	AERO-38A	Line Array	12 X 2	10 X 2	Cone	1.5 X 1	Neo-dymium		60-18	2000 RMS				12 X 55 X 2 3	Blk.	Blk.	176	\$8,265.00
	SM-15A	Stage Monitor	15			1.5			50-17	600 RMS				20 X 17 X 26	Blk.	Blk.	69	\$2,359.00
	ARTEC-28	Install Box	8 X 2			1			64-22	124	300 RMS		8/	25 X 10 X 12	Blk.	Blk.	27	\$778.00
	ARCO-24	Install Box	4 X 2			22 mm	Neo-dymium		65-22	89	100 RMS		8/	17 X 5 X 5	Blk.	Blk.	5	\$153.00
	LX-218	Sub. Sys.	18						28-85Hz	103	2.2k RMS		4	22 X 54 X 2 8	Blk.	Blk.	180	\$4132.00
DAVID WIENER VENTURES (DWV)	Ferrari Art. Engine	Ltd. Ed. Comp Audio Sys	(16) 3		Wide-range, long stroke carbon	1.1	Soft-dome with Neo-dymium motor		40-20 ±3	110	4 X 200	DSP	8/	47 x 16 x 6	Ferrari gloss paint & clear coat	Blk. Alum.	107	\$20,000
DEVORE FIDELITY	gibbon 3	Vented	4.5			.75	Fabric Dome		45-30 ±3	86	18		8/	12 X 6 X 9	Cherry, Ribbon Mahog.	Blk. Knit	12	\$2,000.00 Pair
	gibbon 8	Vented	6.5			.75	Fabric Dome		35-30 ±3	88	8-10		8/	37 X 8 X 12	Cherry, Ribbon Mahog.	Blk. Knit	35	\$3,000.00 Pair
	gibbon Super 8	Vented	6.5			.75	Treated Silk Dome		35-40 ±3	90	8		8/	37 X 8 X 12	Cherry, Waln., Waln./Maple	Blk. Knit	40	\$4,500.00-\$5,000.00 Pair
	gibbon The Nines	Vented	(2)6.5			.75	Treated Silk Dome		29-40 ±3	90	8		8/	38 X 8 X 14	Cherry, Waln.	Blk. Knit	60	\$6,500.00-\$7,500.00 Pair
	Silverback Reference	Vented	(2)9	6.5	Cone	.75	Treated Silk Dome		21-40 ±3	91	8		8/	47 X 11 X 17	Anigre, Tiger Cherry, Waln.	Blk. Knit	95	\$16,800.00 Pair

MANUFACTURER	Model	Application, Design Principle, Enclosure or System Type	Woofer Diameter, Inches	Midrange Diameter, Inches	Midrange Type	Tweeter Diameter, Inches	Tweeter Type	Separate Level Controls? W=woofer, M=Midrange, T=Tweeter, ST=Super tweeter	Anechoic Frequency Response, Hz to kHz, ±dB	SPL, 1 Watt/1Meter, dB	Recommended Minimum Amp Power, Watts per Channel	Crossover Frequencies, Hz	Impedance, Ohms: Nominal/Minimum	Dimensions, Inches (To Nearest Inch)	Finish	Grille Color and Material	Weight, Pounds Each	PRICE, \$
DIAMOND CASE DESIGNS INC	DC-1061LCR	HT	10	6.5	Alum. Cone	1	Silk Dome		30-20		50	100	6/	12 X 19 X 18	Matte Blk.	Blk. Mesh	50	\$699.00
	DC-1061SUB	HT Sub.	10	6.5	Alum. Cone	1	Silk Dome		30-100Hz		50	100	6/	12 X 19 X 18	Matte Blk.	Blk. Mesh	67	\$1,399.00
DYANA AUDIO DESIGN	TAD Reference One	Dynamic 3-way, concentric bery	(2) 10	6.3	Vapor Deposited Beryllium Cone	1.38	Vapor Deposited Beryllium Cone		25-20 ±3	90	50	250	6/	50 X 22 X 27	High Gloss Rare Figured Hardw	Remov. Metal	330	\$60,000.00
E-SPEAKERS.COM	VOLENT VL-2	Vented	7			1	True Ribbon		38-60 ±3	90	100	2.5k	8/	18 X 9 X 14	Glossy Lacq.	Blk. Knit	37	\$5,000.00
	VOLENT VL-3	Vented	7	2	Alum. Cone	.75	True Ribbon		30-100	90	100		6/	40 X 9 X 14	Glossy Lacq.	Blk. Knit	75	\$10,000.00
FARADAY SOUND	Faraday Emperor	Concrete Encl.		7	Cone	1	Inv. Dome		33-22	90.5	30	2k	6	18 X 10 X 11	Matte Blk. Stone		48	\$1995.00
HAWTHORNE AUDIO	Solo	Open Baffle		15	Cone	1	Compression		42-20	96	1.5 RMS	2k	8/	20 X 35 X 10	Oak/Fabric	Blk./Brwn./Gray/Wht.	50	\$850.00 Pair
	Duet	Open Baffle	15	15	Coax. Cone	1	Compression		27-20	96	1.5 RMS	50, 2k	8/	22 X 35 X 12	Oak/Fabric	Blk./Brwn./Gray/Wht.	65	\$1,200.00 Pair
HEMPTONE SPEAKERS	Hemptone 4.5" Full Range	All	4.5						50-17	92	5		8/					\$89.00 Each
HIVI INC	Swans D2.1SE	2-way 4th Order Vented Box Sys		6.8	P.M.K. Integrative Copper 3" VC	1	28mm Ferrite Antimagnetic Low		43-20	85/2.83V/1M	10-120		8/	81 X 119 X 152	Rosewood , Birds Eye	Blk.	24.5	\$1,369.00-\$1,499.00
	Swans M1	2-way 4th Order Vented Box Sys		5	Kevlar/ Paper Cone Composite	1	Die-Cast Faceplate Isodynamic		53-40	86	10-60		8/	83 X 109 X 130	Solid Wood , Pure Leather	Blk.	14.3	\$999.00
	Swans D1080MKII	2-way 4th Order Active Vented		5		1	Dome		59-20	87/2.83V/1M	30	1.7k	4/	72 X 106 X 81	Rosewood	Blk.	13	\$150.00
	Swans M200MKII	2-way 4th Order Active Vented		5	Mid-low	25 mm			56-20	87/2.83V/1M	35	20-20k	22k/	76 X 92 X 154	Walnut Veneer/ Blk. flat	Blk.	17.2	\$260.00
	Swans T200B	2-way 4th order Active Vented	5			1.3	Dome		55-20	83/2.83V/1M	40 RMS		47k	85 X 107 X 127	Black Piano Lacq.	Blk.	17.6	\$575.00
INFINITY SYSTEMS	Cascade Model Nine	Floor St.	(2) 3.4 x 7.75 flat-panel			1	Dome		80-20	87	10	1.5k	8/	47 x 11 x 12	High-Gloss Blk.	Silvr. Cloth	28	\$999.00 Each
	ERS 610	In-ceiling	3.4 x 7.75 flat-panel	(2) 3	Cone	1	Dome	W, T	80-20	85	10	700, 2k	8/	13 R x 6 D	Wht.		8	\$599.00 Each
	Cascade Model Seven	Floor St.	3.4 x 7.75 flat-panel			1	Dome		100-20	85	10	1.8k	8/	47 x 11 x 12	High-Gloss Blk.	Silvr. Cloth	25	\$749.00 Each
	P362	Floor St.	(2) 6.5	4	Cone	.75	Dome		38-20	93	10	350, 3.3k	8/	39 x 8 x 13	Blk.	Silvr. Cloth	49	\$379.00 Each
	P152	Bkshlf.	5.25			.75	Dome		58-20	88	10	3.3k	8/	13 x 7 x 11	Blk.	Silvr. Cloth	14	\$109.00 Each
	C336	Floor St.	(3) 6.5	4	Cone	1	Dome		40-30	91	10	500, 2.8k	8/	49 x 9 x 11	Gloss Blk., Cherry	Blk. Cloth	56	\$899.00 Each
	C205	Bkshlf.	5.25			1	Dome		60-30	88	10	2k	8/	15 x 8 x 9	Gloss Blk., Cherry	Blk. Cloth	11	\$349.00 Each
	CC225	Ctr. Ch.	(2) 5.25			1	Dome		55-30	90		2k	8/	7 x 31 x 5	Gloss Blk., Cherry	Blk. Cloth	16	\$499.00 Each
	C255ES	Surround	(2) 5.25			(2) 1	Dome		60-30	87	10	2.3k	8/	12 x 13 x 7	Gloss Blk., Cherry	Blk. Cloth	9	\$499.00 Each
	PS212W	Wireless Sub.	12					W	25-150Hz		400 Inc.			18 x 14 x 15	Blk.	Silvr. Cloth	45	\$679.00 Each

MANUFACTURER	Model	Application, Design Principle, Enclosure or System Type	Woofer Diameter, Inches	Midrange Diameter, Inches	Midrange Type	Tweeter Diameter, Inches	Tweeter Type	Separate Level Controls? W=woofer, M=Midrange, T=tweeter, ST=Subwoofer	Anechoic Frequency Response, Hz to kHz, ±dB	SPL, 1 Watt/1 Meter, dB	Recommended Minimum Amp Power, Watts per Channel	Crossover Frequencies, Hz	Impedance, Ohms: Nominal/Minimum	Dimensions, Inches (to Nearest Inch)	Finish	Grille Color and Material	Weight, Pounds Each	PRICE, \$
JANSZEN LOUDSPEAKER	Model J1P	2 Ch. Audio; Sealed ESL hybrid	(2)8	(6) 2 x 15 (rectangular)	Electro-static	(3) 1 x 15 (rectangular)	Electro-static	M/T	35-20 ±3	85 (1 kHz, single speaker)	100	250 Hz, 650 Hz	12/8	75H x 20W x 10D	mixed wood, metal, paint	nat		
JBL	ES90	Floor St.	(2) 8	4		(2) .75	Dome		36-20	91	10	500, 3k, 12k	8/	43 X 10 X 15	Blk./Char., Cherry/Char.	Blk. Cloth	53	\$599.00 Each
	880 Array	Ctr. Ch.	(2) 8			(2) 3, 1	Compression		70-40	90	10	1k, 8k	8/	12 X 29 X 11	Blk./Mahog. Lacq. Wood	Blk. Cloth	46	\$3,500.00 Each
	ES10	Wall-Mntbl. Surr./Sat.	4			(2) .75	Dome		65-40	86	10	3k, 9k	8/	8 X 12 X 6	Blk./Char., Cherry/Char.	Blk. Cloth	9	\$349.00 Pair
	ES25C	Ctr. Ch.	(2) 5			(2) .75	Dome		80-40	90	10	3k 12k	8/	7 X 19 X 10	Blk./Char., Cherry/Char.	Blk. Cloth	17	\$349.00 Each
	ES250P	Powered Sub.	12					W	25-150Hz					20 X 16 X 17	Blk./Char., Cherry/Char.	Blk. Cloth	43	\$599.00 Each
	L890	Floor St.	(2) 8	4		(2) 1, .75	Dome		28-40	91	10	700, 5k, 20k	8/	42 X 10 X 15	Blk. Ash, Cherry, Beech	Blk. Cloth	60	\$799.00 Each
	L820	Wall-Mntbl. Sat./Bkshf.	6	4	Cone	(2) 1, .75	Dome		55-40	90	10	600, 3.5k 20k	8/	12 X 16 X 5	Blk. Ash, Cherry, Beech	Blk. Cloth	19	\$750.00 Pair
	L8400P	Powered Sub.	12					W				50-150 contin. adj.		17 X 16 X 16	Blk. Ash, Cherry, Beech	Blk. Cloth	58	\$1,099.00 Each
	LS360C	In-ceiling	7.75 x 3.38	(2) 3	Cone	(2) 1	Dome	W, T	80-30	85	10	700, 2k	8/	13 R X 6 D	Wht.	Wht. Metal	8	\$599.00 Each
	1400 Array	Floor St.	14			(2) 3, 1	Compression		32-40	89	10	750, 8k	8/	47 X 16 X 19	Blk./Mahog. Lacq. Wood	Blk. Cloth	115	\$5,500.00 Each
JRM AUDIO	Reference System	Vented, Sealed, Horn	(2)18 (8)8	(2)4	Horn	(2) 1.75	Horn	W,M, T, ST	18-21	97	1,000 Inc.	125,650,7k	8, 3, 16, 8 / 3	44 X 25 X 17, 74 X 15 X 9	Opt.	Opt.	425	\$22,500.00
	Monitor II	Vented, Sealed, Horn	(2)18 (2)10	(2)4	Horn	(2) 1.75	Horn	W,M, T, ST	21-21	97	800 Inc.	120,700, 6.8k	8, 8, 16, 8 / 6	74 X 28 X 17	Opt.	Opt.	280	\$12,500.00
	Monitor VLA	Vented, Sealed, Horn	(4)10 (6)6.5	(12) 4.5	Cone	(2) 1.75	Horn	W,M, T, ST	22-19	95	800 Inc.	120,800,5k	4, 3, 3, 8 / 2	73 X 21 X 17	Opt.	Opt.	225	\$10,500.00
KINETIC AUDIO INTERNATIONAL LTD	Priority	TATL-Labyrinth	(2) 12	(2) 6.5 (1)	Cone, MT Dome	1	Dome	M,MT,T	8-22 ±2	91	75	Selectable	Selectable	72 X 18 X 22	Opt. Exotic Ven.	Blk. Knit	395	\$65,000.00 Mtch. Pair
	Identity	TATL w/ Varivent	12	6.5	Cone	1.125	Dome	M, T	20-22 ±3	91	60	90, 3.5k	Selectable	26 X 15 X 15	Opt. Exotic Ven.	Blk./Brwn. Knit	160	\$15,000.00 Mtch. Pair
	Stat	TATL	6.5			1.125	Dome	T	28-22 ±3	90	60	2.5k	2/4/8	15 X 9 X 9	Opt. Exotic Ven.	Blk./Brwn. Knit	55	\$9,000.00 Mtch. Pair
	Nonpareil	TATL-Labyrinth	12	(2) 6.5, 2	Cone, Dome	1	Dome	M, MT, T	8-22 ±2	90	100	Selectable	Selectable	60 X 15 X 22	Opt. Exotic Ven.	Blk. Knit	335	\$55,000.00 Mtch. Pair
	Standard	TATL- Labyrinth	(2) 12	(2) 6.5, 2	Cone, Dome	1	Dome	M, MT, T	12-22 ±2.5	91	75	Selectable	Selectable	60 X 18 X 22	Opt. Exotic Ven.	Blk.Knit	365	\$45,000.00 Mtch. Pair
	Trapezium	TATL- Labyrinth	12	(2) 6.5, 2	Cone, Dome	1	Dome	M, MT, T	10-22 ±2.5	90	75	Selectable	Selectable	60 X 16 X 20	Opt. Exotic Ven.	Blk. Knit	285	\$40,000.00 Mtch. Pair
	Ethereal	TATL- Labyrinth	12	(2) 6.5, 2	Cone, Dome	1	Dome	M, MT, T	16-22 ±2.5	90	75	Selectable	Selectable	54 X 15 X 20	Opt. Exotic Ven.	Blk. Knit	200	\$40,000.00 Mtch. Pair
	Refined	TATL- Labyrinth	12	(2) 6.5, 2	Cone, Dome	1	Dome	M, MT, T	16-22 ±2.5	90	75	Selectable	Selectable	48 X 15 X 16	Opt. Exotic Ven.	Blk. Knit	170	\$35,000.00 Mtch. Pair
	Labyrinth	TATL- Labyrinth	12	(2) 6.5, 2	Cone, Dome	1	Dome	M, MT, T	14-22 ±2.5	90	75	Selectable	Selectable	48 X 16 X 18	Opt. Exotic Ven.	Blk./Brwn. Knit	200	\$30,000.00 Mtch. Pair
	Trapezoid	TATL w/ Varivent	12	(2) 6.5, 2	Cone, Dome	1	Dome	M, MT, T	18-22 ±3	91	60	90, 750, 6k	2/4/8	40 X 15 X 15	Opt. Exotic Ven.	Blk./Brwn. Knit	180	\$20,000.00 Mtch. Pair
KLEIN + HUMMEL	O 110	Pro. Act. Studio Mon.	5.5			1	Tit./Fab. Dome	W, M	56-24k ±3	107.7	80,50 (Bi-Amped)	2.5 k	14/	10.5 X 6.7 X 7.5	Anthracite	Fixed Metal	11	\$899.00

MANUFACTURER	Model	Application, Design Principle, Enclosure or System Type	Woofer Diameter, Inches	Midrange Diameter, Inches	Midrange Type	Tweeter Diameter, Inches	Tweeter Type	Separate Level Controls? W=woofer, M=midrange, T=tweeter, SP=super tweeter	Anechoic Frequency Response, Hz to kHz, ±dB	SPL, 1 Watt/1 Meter, dB	Recommended Minimum Amp Power, Watts per Channel	Crossover Frequencies, Hz	Impedance, Ohms: Nominal/Minimum	Dimensions, Inches (To Nearest Inch)	Finish	Grille Color and Material	Weight, Pounds Each	PRICE, \$
	O 300	Pro. Act. Studio Mon.	8	3	Fab. Dome	1	Tit./Fab. Dome	W, M, T	35-24k ±3	112.8	150, 65 (Continuous)	650, 3.3 k	14 /	10 X 15.1 X 11.4	Anthracite	Opt. Metal	30.8	\$3,158.00
	O 410	Pro. Act. Studio Mon.	10	3	Fab. Dome	1	Tit./Fab. Dome	W, M, T	30-24k ±3	120	340, 160, 180 (Continuous)	600, 2k		25.375 X 1 X 17.5	Anthracite	Opt. Metal	79.4	\$6,998.00
MARTIN LOGAN	Fresco i	Hybrid ATF, Front/Ctr./Surr.	(2) 4	1.5 X 6	ATF	1.5 X 2.25	ATF		75-20 ±3	90	150	500, 3.2k	5	8 X 24 X 5	Elite Blk. Face, Grey Cab.	Blk. Cloth	16	\$995.00
	Motif	Hybrid Electrostatic, Ctr. Ch.	2 X 5.25		Electrostatic	1	Neodymium Soft Dome		73-20 ±3	89	150	450, 4k	6/4	10 X 30 X 9	Dk. Cherry, Blk.	Blk. Perf. Metal	25	\$1,695.00
	Helos 100	In-Ceiling, Front./Ctr./Surr.	8	8	Cone	1	Neodymium Soft Dome	M	37-20 ±3	92	100	2k	4/	12 X 12 X 6.5	Paintable Wht.	Paintable Wht. Perf. Metal	8.5	\$499.00
	Matinee	Hybrid Electrostatic, Ctr. Ch.	2 X 5.25		Electrostatic	1	Neodymium Soft Dome		73-20 ±3	89	150	450, 4k	6/4	8 X 30 X 9	Blk.	Blk. Cloth	25	\$1,395.00
	Helos 20	In-Ceiling, Front./Ctr./Surr.	6.5	6.5	Cone	(2) 0.75	Neodymium Soft Dome		47-20 ±3	89	100 / 50 X 50	2.6k	4/8 x 8	9.5 X 9.5 X 5	Paintable Wht.	Paintable Wht. Perf. Metal	4.5	\$399.00
	Spire	Hybrid Electrostatic Floorst.	10		Electrostatic		Electrostatic	W	29-23 ±3	91	200	320	4/0.8	59 X 13 X 18	Cust. Opt.	Blk. Perf. Metal	58	\$8,495.00
	Depth i	Subwoofer	(3) 8					W	20-120Hz ±3			30, 35, 45, 55, 65, 80		18 X 17 X 17	Custom Opt.	Blk. Perf. Metal	70	\$1,995.00
	CLX	Electrostatic, Floorst.			Electrostatic		Electrostatic		56-23 ±3	90	225	360	6/0.7	70 X 26 X 15	Cust. Opt.	Blk. Perf. Metal	110	\$19,995.00
	Grotto i	Subwoofer	10					W	22-120Hz ±3			30, 35, 45, 55, 65, 80		19 X 15 X 14	Blk. Ash	Blk. Perf. Metal	51	\$1,395.00
	Vantage	Hybrid Electrostatic Floorst.	8		Electrostatic		Electrostatic	W	34-23 ±3	92	250	400	4/1	57 X 11 X 16	Cust. Opt.	Blk. Perf. Metal	52	\$5,295.00
	Descent i	Subwoofer	(3) 10					W	18-120Hz ±3			30, 35, 45, 55, 65, 80		21 X 21 X 20	Custom Opt.	Blk. Perf. Metal	105	\$2,995.00
	Vista	Hybrid Electrostatic Floorst.	8		Electrostatic		Electrostatic		43-23 ±3	90	200	450	4/1.2	57 X 11 X 17	Cust. Opt.	Blk. Perf. Metal	54	\$3,995.00
	Abyss	Subwoofer	12						23-120Hz ±3			30-80		16 X 14 X 15	Blk.	Blk. Cloth	40	\$999.00
	Purity	Fully Powered Hybrid Electrost	2 X 6.5		Electrostatic		Electrostatic	W	41-23 ±3	93/95	200	450	4000, 14000	52 X 10 X 15	Dk. Cherry, Blk.	Blk. Cloth	51	\$2,995.00
	Dynamo	Subwoofer	10						25-120Hz ±3			30-80		14 X 12 X 13	Blk.	Blk. Cloth	28.5	\$599.00
	Source	Hybrid Electrostatic Floorst.	8		Electrostatic		Electrostatic		42-22 ±3	90	200	470	5/1.6	51 X 10 X 15	Dk. Cherry, Blk.	Blk. Cloth	47	\$1,995.00
	Voyage	In-Wall, Front/Ctr./Surr.	(2) 8	(2) 1.5x6	ATF	1.5 x 2.25	ATF		40-20 ±3	91	200	350, 3k	5/	36 X 11 X 6	Wht., Blk., Silver, Paintable	Cloth	25.5	\$1,995.00
	Preface	Hybrid ATF Floorst.	3 X 6.5	6.5	Cone	1.5 X 2.25	ATF		35-20 ±3	92	200	2.2k	4	40 X 9 X 17	Dk. Cherry, Blk.	Blk. Perf. Metal	46	\$1,495.00
	Passage	In-Wall, Front/Ctr./Surr.	(2) 6.5	6.5	Cone	1.5 x 2.25	ATF		45-20 ±3	90	150	2.2k	6/	25 X 9 X 5	Wht., Blk., Silver, Paintable	Cloth, Perf. Metal	16	\$799.00
	Stage	Hybrid Electrostatic, Ctr. Ch.	2 X 6.5		Electrostatic	1	Neodymium Soft Dome		69-22 ±3	90	250	450, 2.7k	4/2.9	9 X 35 X 10	Cust. Opt.	Blk. Perf. Metal	39	\$2,995.00
	Ticket	In-Wall, Front/Ctr./Surr.	(2) 4	4	Cone	1	Neo-dymium		75-20 ±3	88	150	2.9k	8/	16 X 8 X 5	Wht., Blk., Silver	Cloth, Perf. Metal	5	\$399.00
	Vignette	Hybrid ATF, Front/Ctr./Surr.	(2) 4	4	Cone	1.5 X 2.25	ATF		78-20 ±3	89	125	2.2k	6	7 X 20 X 5	Grey Cabinet	Blk. & Silvr. Cloth	14	\$699.00
MCINTOSH LABORATORY INC	Helos 10	In-Ceiling, Front/Ctr./Surr.		6.5	Cone	1	Neodymium Soft Dome		47-20 ±3	89	100	2.8k	4/	9.5 X 9.5 X 5	Paintable Wht.	Paintable Wht. Perf.	5	\$299.00
	XRT2K	Line Array, Sealed	(6) 12	(64) 2	Inverted Dome	(40) .75	Dome		16-45 ±3	86	200-2k	250, 1.5k	8/4	84 X 19 X 18	Gloss Blk.	Blk. Knit	452	\$50,000.00 Each
	XCS350	Bessel (L,C,R) (In/On Wall)	(2) 8	6.5	Cone	(5) 1	Dome		45-43 ±6	82	50-400	250, 1.5k	8/4	10 X 34 X 6	Matte Blk.	Blk. Knit	49	\$3,500.00 Each
	XCS2K	Line Array (L,C,R.)	(3) 12	(32) 2	Inverted dome	(20) .75	Dome		16-45 ±3	83	200-2k	250, 1.5k	8/4	23 X 42 X 27	Gloss Blk.	Blk. Knit	294	\$35,000.00 Each

MANUFACTURER	Model	Application, Design Principle, Enclosure or System Type	Woofer Diameter, Inches	Midrange Diameter, Inches	Midrange Type	Tweeter Diameter, Inches	Tweeter Type	Separate Level Controls? W=100mm, 1" Midrange, T=Twoers, CT=Super Tweeter	Anechoic Frequency Response, Hz to kHz, ±dB	SPL, 1 Watt/1 Meter, dB	Recommended Minimum Amp Power, Watts per Channel	Crossover Frequencies, Hz	Impedance, Ohms: Nominal/Minimum	Dimensions, Inches (To Nearest Inch)	Finish	Grille Color and Material	Weight, Pounds Each	PRICE, \$
	XRT1K	Line Array, Ported	(2) 10	(44) 2	Inverted Dome	(28) .75	Dome		16-45 ±3	85	50-12k	50, 2k	8/4	80 X 15 X 16	Gloss Blk.	Blk. Knit	168	\$17,500.00 Each
	XCS1K	Line Array (L,C,R)	(2) 10	(32) 2	Inverted Dome	(20) .75	Dome		16-45 ±3	83	50-12k	250, 1.5k	8/4	17 X 39 X 22	Gloss Blk.	Blk. Knit	133	\$17,500.00 Each
	XRT28	Line Array	(2) 10	(20) 4	Cone	(16) 1	Dome		16-20 ±3	85	200-12k	300, 2k	4/3	76 X 16 X 16	Matte Blk.	Blk. Knit	124	\$11,000.00 Each
	XR27	Bessel Array (L,C,R)	(4) 8	6.5	Cone	(5) 1	Dome		80 - 20	86	200-12k	275, 2.8k	4/3	13 X 47 X 6	Matte Blk.	Blk. Knit	84	\$6,000.00 Each
	XLS360	Bessel Array	(2) 10	6.5	Cone	(5) 1	Dome		34-34 ±6	82	50-600	250, 1.5k	8/4	51 X 18 X 13	Matte Blk.	Blk. Knit	107	\$5,000.00 Each
	XLS340	Bessel Array (In/ On Wall)	(2) 8	6.5	Cone	(5) 1	Dome		38-34 ±6	82	50-400	250, 1.5k	8/4	44 X 15 X 12	Matte Blk.	Blk. Knit	69	\$4,000.00 Each
	XLS320	Bessel (In/On wall)	6.5			(5) 1	Dome		50-34 ±6	82	50-250	1.5k	8/4	15 X 11 X 5	Matte Blk.	Blk. Knit	24	\$2,500.00 Each
MIDGARD AUDIO	Gaia	Controlled Dispersion	(4) 15	(2) 8, (2) 4, (2) 2	Dome & Cone	(2) 3/4	Soft & Alum. Dome	DSP	15-25	130	Integr. 3600 RMS	130, 380, 1.5k, 6k		80 X 33 X 26	Cust. Opt.	Cust. Opt.	695	\$120,000.00
MOREL AMERICA	Octave Signature Bookshelf	Vented	5.25			1.1	Soft Dome Acuflex (tm) Coated		20-30	86	50	2.2k /12dB Octave	6/	7 X 12.5 X 12.75	Blk., Wht., Red Piano Finish	Blk.	15.4	\$1,999.00 Pair
	Octave Signature Center	Vented	5.25	5.25	1 Pc. Integrated Hybrid Motor	1.1	Soft Dome Acuflex (tm) Coated		20-30	88	50	2k /12dB Octave	4/	21.75 X 9.75 X 12.75	Blk., Wht., Red Piano Finish	Blk.	36	\$1,499.00 Each
	Octave Signature Floor-standing	Vented	5.25			1.1	Soft Dome Acuflex (tm) Coated		20-30	86	50	2.2k/12dB Octave	6/	7 X 39.5 X 12.75	Blk., Wht., Red Piano Finish	Blk.	52.8	\$3,998.00 Pair
OUTLAW AUDIO	BLS	Sealed Box, 2-way	5.25			1	Dome		54-22 ±3	87	50		6/	12 X 11 X 7	Blk./Cherry	Blk. Knit	16.5	\$999.00 Pair
PARTS EXPRESS INTERNATIONAL	Usher 701 KIT	D'Appolito	7			1.05	Soft Dome		100 -20 ±1.7	86.5/ 2.83V/ 1M	10		4/	17 X 10 X 12.5	Cherry, Piano Blk.,Rich Mahog.	Blk.	43	\$279.00
PASS LABORATORIES	SR1 Loudspeaker	4-way Floorst. Sys.	(2)10, 8	7	Nextel-Coated Cones	1.1	Soft-Dome						6/4			Blk.		\$25,000.00
PI SPEAKERS	12Pi basshorn subwoofer	Sub.	(2) 12						30-200Hz ±3	108/ 2.83V/ 1M			4/	45 X 28 X 45	Blk.			\$2,500.00
	3Pi Sub-woofer	Bass Reflex	12						22-200Hz +1/-3	92/ 2.83V/ 1M	10		4/	20 X 20 X 20	Ash, Birch, Maple, Waln.			
	4Pi-18 Sub-woofer	Bass Reflex	18						30-200Hz +1/-3	95/ 2.83V/ 1M			8/	32 X 40 X 20	Ash, Birch, Maple, Waln.			
	One Pi	Bass Reflex (Cone/ Dome Bkshl.)	8			1	Dome		60- 20 +1/-3	95dB/ 2.83V/ 1M	No minimum	2.5kHz	8 ohms	18 x 12 x 8	Ash, Birch, maple, walnut			
	Two Pi	Bass Reflex (Cone/ Dome Bkshl.)	10			1	Dome		55-20 +1/-3	95dB/ 2.83V/ 1M	No minimum	2.5kHz	8 ohms	22 x 15 x 10	Ash, Birch, maple, walnut			
	Two Pi Tower	Bass Reflex (Cone/ Dome Tower)	10			1	Dome		38-20 +1/-3	95dB/ 2.83V/ 1M	No minimum	2.5kHz	8 ohms	46 x 16 x 13	Ash, Birch, maple, walnut			
	Three Pi	DI-Matched 2-way (Const. Dir.)	12			2 Di-aphr. 1 Throat	Wave-guide/ Horn Loaded Compr.		50-18 +1/-3	95/ 2.83V/ 1M		1.3k	8/	30 X 20 X 14	Ash, Birch, Maple, Waln.			
	Four Pi	DI-matched 2-way (Const. Dir.)	15			2 Di-aphr. 1 Throat	Wave-guide/ Horn Loaded Compr.		50-18 +1/-3	97/ 2.83V/ 1M		1.3k	8/	26 X 18 X 14	Ash, Birch, Maple, Waln.			
	Six Pi	Const. Dir. Cornerhorn	12	10	Wave-guide/ Horn Loaded Cone	2 Di-aphr. 1 Throat	Wave-guide/ Horn Loaded Compr.		50-18 +1/-3	98/ 2.83V/ 1M		200, 1.3k	8/	56 X 18 X 30	Ash, Birch, Maple, Waln.			

MANUFACTURER	Model	Application, Design Principle, Enclosure or System Type	Woofer Diameter, Inches	Midrange Diameter, Inches	Midrange Type	Tweeter Diameter, Inches	Tweeter Type	Separate Level Controls? W=woofer, M=Midrange, T=Tweeter, ST=Super Tweeter	Anechoic Frequency Response, Hz to kHz, ±dB	SPL, 1 Watt/1Meter, dB	Recommended Minimum Amp Power, Watts per Channel	Crossover Frequencies, Hz	Impedance, Ohms: Nominal/Minimum	Dimensions, Inches (To Nearest Inch)	Finish	Grille Color and Material	Weight, Pounds Each	PRICE, \$
	Seven Pi	Const. Dir. Cornerhorn	15	10	Wave-guide/ Horn Loaded Cone	2 Di-aphr. 1 Throat	Wave-guide/ Horn Loaded Compr.		50-18 +1/-3	100/ 2.83V/ 1M		200, 1.3k	8/	54 X 18 X 30	Ash, Birch, Maple, Waln.			
	Eight Pi	Const. Dir 2-way	10		Wave-guide/ Horn Loaded Cone	2 Di-aphr. 1 Throat	Wave-guide/ Horn Loaded Compr.		38-18 +1/-3	95/ 2.83V/ 1M		1.3k	8/	40 X 26 X 17	Ash, Birch, Maple, Waln.			
	one Pi	Bass Reflex	8			1	Dome		60-20 ±3	95/ 2.83V/ 1M		2.5	8/	18 X 12 X 8			St. at \$350.00 Each	
PSB SPEAKERS	Alpha LR1	Bkshlf./Surr.	3.5			.75	Alum. Dome		100-21 ±3	87	15	3k	6/4	5 X 7 X 6	Blk. Ash, Wht. Textured	Blk./Wht. Alum.	3.3	\$199.00 Pair
	HD10	750W Sub.	(1)10 (2)10				W		30-150Hz ±3			50, 150		12 X 12 X 12	Satin Blk.	Blk. Steel	38	\$1,499.00 Each
	Alpha CLR1	Ctr./Bkshlf./Surr.	(2)3.5			.75	Alum. Dome		90-21 ±3	88	15	3k	8/6	10 X 4 X 6	Blk. Ash, Wht. Textured	Blk./Wht. Alum.	4.8	\$169.00 Each
	Alpha B1	Bkshlf./Surr.	5.25			.75	Alum. Dome		65-21 ±3	91	10	3k	6/4	7 X 12 X 9	Blk. Ash, Sienna	Blk. Alum.	8.8	\$279.00 Pair
	Alpha T1	Tower	(2)5.25			.75	Alum. Dome		55-21 ±3	91	15	3k	8/6	7 X 36 X 12	Blk. Ash, Sienna	Blk. Alum.	29	\$599.00 Pair
	Alpha C1	Ctr./Bkshlf./Surr.	(2)5.25			.75	Alum. Dome		62-21 ±3	92	10	3k	8/6	18 X 7 X 9	Blk. Ash, Sienna	Blk. Alum.	16	\$229.00 Each
	SubSeries 1	110W Sub.	8				W		36-150Hz ±3			50, 150		10 X 13 X 14	Blk. Ash, Sienna	Blk. Alum.	23	\$399.00 Each
	SubSeries 5i	150W Sub.	10				W		30-150Hz ±3			50, 150		12 X 17 X 15	Blk. Ash, Sienna	Blk. Cloth	31	\$549.00 Each
	SubSeries 6i	225W Sub.	12				W		29-150Hz ±3			50, 150		15 X 20 X 20	Blk. Ash	Blk. Cloth	41	\$749.00 Each
	HD8	500W Sub.	(1)8 (2)8				W		35-150Hz ±3			50, 150		10 X 10 X 10	Satin Blk.	Blk. Steel	25	\$999.00 Each
RADIAN AUDIO ENGINEERING	Apex 1500	Floor Wedge	15 Coax w/ 4 VC			2		Passive/ Bi-Amp Switch	45-18	102	500 RMS		8/16	14.75 X 17.5 X 22.75	Blk. /Dur-Radian	Blk./Wht. 13 Gauge	66	\$ 2,295.00
	Apex 1200	Stage Monitor	12 w/ 4 VC			2		Passive/ Bi-Amp Switch	55-18	99	500 RMS		8/16	12.5 X 14.5 X 21.5	Blk./Wht. Duradian	Blk./Wht. 13 Gauge	56	\$ 2,095.00
	RCH 1594	Two-Way Arrayable Speaker	15 w/ 4 VC			2 w/ 90 X 40 or 90 X 60 Horn		Passive /Bi Amp Switch	55-20	135	1200 RMS		8/16	29.5 X 18 X 16.5	Blk./Wht.	Blk./Wht.	78	\$ 2,099.00
	RCX-108 P	Two-Way	8 Coax			1		No	70-20	96	200 RMS		8/	19.25 X 12.6 X 13	Blk. /Wht.	Blk./Wht.	32	\$ 699.00
RBH SOUND	T-30LSE	3-way Sealed and Bass Reflex	(2) 10	(4) 6.5	Alum. Cone	(3) 1.1	Ref. Silk Dome		18-20 ±3	91/ 2.83V/ 1M	150	80, 2.2k	4/	15.25 X 60.5 X 18	Custom Veneer Opt.	Blk. Cloth	160	\$15,000.00 Pair
	1266-SE/R	Sig. Ref. Series Tower	12	(2) 6.5	Ref. Alum.	1.1	Ref. Silk Dome		27-20 ±3	88/ 2.83V/ 1M	100	100, 2.7k	4/	8.75 X 48 X 16.5	Blk. Oak Wood Grain	Blk. Cloth	79.5	\$4,729.00 Pair
	T-1/R	Sig. Ref. Series Mod.	(4) 6.5		Ref. Alum.	(3) 1.1	Silk Dome		45-20 ±3	91/ 2.83V/ 1M	100	2.5k	4/	13.25 X 30 X 18	Blk. Oak Wood Grain	Blk. Cloth	75	\$3,679.00 Each
	T-2/R	Sig. Ref. Series Mod.	(2) 10	(4) 6.5	Ref. Alum.	(3) 1.1	Ref. Silk Dome		20-20 ±3	91/ 2.83V/ 1M	300	2.5k	4/	13.25 X 61.25 X 18	Blk. Oak Wood Grain	Blk. Cloth	156	\$10,959.00 Pair
	T-3/R	Sig. Ref. Series Mod.	(4) 10	(4) 6.5	Ref. Alum.	(3)	Ref. Silk Dome		20-20 ±3	91/ 2.83V/ 1M	500	2.5k	4/	13.25 X 91.75 X 18	Blk. Oak Wood Grain	Blk. Cloth	237	\$14,169.00 Pair
	1010-SEN/R	Sig. Series Non-Powered Sub.	(2)10		Ref. Alum.				18-180Hz ±3	90/ 2.83V/ 1M	200		4/	13.25 X 30 X 18	30 Cust. Real Hardwood Opt	Blk. Cloth	89	\$1,999.00 Each

MANUFACTURER	Model	Application, Design Principle, Enclosure or System Type	Woofer Diameter, Inches	Midrange Diameter, Inches	Midrange Type	Tweeter Diameter, Inches	Tweeter Type	Separate Level Controls? W=woofer, M=midrange, T=tweeter, SP=super tweeter	Anechoic Frequency Response, Hz to kHz, ±dB	SPL, 1 Watt/1Meter, dB	Recommended Minimum Amp Power, Watts per Channel	Crossover Frequencies, Hz	Impedance, Ohms: Nominal/Minimum	Dimensions, Inches (To Nearest Inch)	Finish	Grille Color and Material	Weight, Pounds Each	PRICE, \$
	61-SE/R	Sig. Ref. Series Bkshlf.	6.5		Ref. Alum.	1	Ref. Silk Dome		50-20 ±3	87/2.83V/1M	75	2.7k	8/	8.75 X 14.5 X 11.5	Blk. Oak Wood Grain	Blk. Cloth	22.5	\$1,799.00 Pair
	66-SE/R	Sig. Ref. Series On-	(2) 6.5		Ref. Alum.	(2) 1	Ref. Silk Dome		60-20 ±3	90/2.83V/1M	75	3k	4/	16 X 14 X 8.5	Blk. Oak Wood Grain	Blk. Cloth	29	\$2,519.00 Pair
	661-SE/R	Sig. Ref. Series Ctr.	(2) 6.5		Ref. Alum.	1	Ref. Silk Dome		50-20 ±3	90/2.83V/1M	75	2.7k	6/	8.75 X 22 X 11.5	Blk. Oak Wood Grain	Blk. Cloth	34.5	\$1,329.00 Each
	6100-SE/R	Sig. Ref. Series Ctr.	(4) 6.5		Ref. Alum.	(3) 1	Ref. Silk Dome		45-20 ±3	92/2.83V/1M	100	2.5k	4/	8.75 X 48 X 16.5	Blk. Oak Wood Grain	Blk. Cloth	85.5	\$4,199.00 Each
RENAISSANCE AUDIO GROUP	Duet	Semi-Trans. Line	6.5			4 .375	Soft Dome		42-21 ±3	89	20	2.1k	6/	15 X 12 X 8	Semi Gloss Blk.	Blk.	26	\$1,295.00 Pair
	Prelude	Trans. Line	6.5			4.375	Soft Dome		36-22	91	20	3.3k	6/	39 X 12 X 9	Blk. Oak	Blk. Knit	52	\$2,295.00 Pair
	MLP-403.5	Sealed	8.75	5.5	Soft Dome	3.75	Soft Dome		38-22	89	25	800, 4.2k	8/	22 X 12.5 X 11	Waln., Blk.	Blk.	35	\$1,090.00 Pair
	MLP-202.3	Sealed	6.5			3.75	Soft Dome		46-22	89	20	2k	6/	13 X 9.5 X 8	Waln., Blk.	Blk.	16	\$750.00 Pair
	Cello	Ctr. Channel HT	(2) 6.5			4.375	Soft Dome		44-20	89	20	2.25k	5/	8.75 X 25.70 X 13	Blk.	Blk.	32	\$895.00
	Phantom, Sub.	Passive Sys.	12 Active, 15 Passive						16.5-150 Hz					18 X 15 X 22	Blk.	Blk.	68	\$1,595.00
SONG AUDIO LTD	Type II Silk DM Speaker	3rd Order Vented Box	6.5		Kevlar Cone	1				90/2.83V/M	4		8/	16 X 8.5 x 12	Piano Blk. Gloss	Cloth	23	\$2,900.00
	Loth-X BS-1 Speaker	Truncated Trans. Line	6	6	Paper Cone	1	Soft Dome		70 (-3) Bass Response	94/2.83V/M	4		8/	16 X 8.5 X 12	Cherry Wood Veneer	Blk. Cloth	18	\$790.00
	Loth-X Amaze	Truncated Trans. Line	6						70 (-3) Bass Response	96/2.83V/M	4		8/	16 X 8 X 12	Cherry Wood Veneer	Blk. Cloth	13	\$990.00
	Loth-X Troubadour	Back Loaded Horn	8						55 (-3) Bass Response	104/2.83V/M	4		8/	48 X 11 X 17	Bubinga	Blk. Cloth	85	\$7900.00
	LOTH-X Ion Aura	Folded Back Horn	6						60-20 ±3	98	4		8/	41 X 10 X 16	Cherry Wood Veneer	Blk. Cloth		\$2,900.00
SONIST LOUD-SPEAKERS	Concerto 2	Vented	8			2.25	Ribbon		40-40 ±3	95	2	2k	8/6	18 X 11.5 X 13.5	Cherry	Blk. Knit	40	\$2,495.00 Pair
	Concerto 3	Vented	8		Cone	2.25	Ribbon		30-40	95	2	2k	8/6	40 X 11.5 X 14	Cherry	Blk. Knit	60	\$3,495.00 Pair
SOUND LAB INC	Majestic 945	Full-R. Electrostatic	Sngl. Membr.					W, M, T	24-20 ±3	88	50		8/	104 X 40 X 9	Oak, Opt. Wood	Blk Knit, Opt.	216	\$32,470.00 Pair
	M	Electrostatic/Dyn. Hybrid	6.5			(2) 5 X 5	Electrostatic	T	60-20 ±3	92	15	950	8/	20 X 9 X 12	Oak, Opt. Wood	Blk Knit, Opt.	32	\$2,970.00 Pair
	MiniStat	Electrostatic/Dyn. Hybrid	6.6			50 sq.	Electrostatic	T	60-20 ±3	92	15	950	8/	20 X 9 X 12	Oak, Opt. Wood	Blk Knit, Opt.	32	\$2,970.00 Pair
	Majestic 845	Full-R. Electrostatic	Sngl. Membr.					W, M, T	26-20 ±3	88	50		8/	94 x 40 x 9	Oak, Opt. Wood	Blk Knit, Opt.	198	\$28,370.00 Pair
	Ultimate-1PX	Full-R. Electrostatic	Sngl. Membr.					W, M, T	26-20 ±3	88	50		8/	82 X 38 X 10	Blk. Matte, Opt. Color	Blk Knit, Opt.	210	\$36,470.00 Pair
	Audiophile-1PX	Full-R. Electrostatic	Sngl. Membr.					W, M, T	28-20 ±3	88	50		8/	81 X 40 X 10	Oak, Opt. Wood	Blk Knit, Opt.	185	\$26,870.00 Pair
	Audiophile-3PX	Full-R. Electrostatic	Sngl. Membr.					W, M, T	30-20 ±3	88	50		8/	75 X 35 X 9	Oak, Opt. Wood	Blk Knit, Opt.	145	\$19,970.00 Pair
	Millennium-1PX	Full-R. Electrostatic	Sngl. Membr.					W, M, T	28-20 ±3	88	50		8/	80 X 40 X 10	Oak, Opt. Wood	Blk Knit, Opt.	176	\$23,970.00 Pair
	Millennium-2PX	Full-R. Electrostatic	Sngl. Membr.					W, M, T	30-20 ±3	88	50		8/	74 X 35 X 8	Oak, Opt. Wood	Blk Knit, Opt.	135	\$17,270.00 Pair
	DynaStat	Electrostatic/Dyn. Hybrid	10			176 sq.	Electrostatic	T	28-20 ±3	90	25	250	8/	72 X 19 X 4 (woofer 20 deep)	Oak, Opt. Wood	Blk Knit, Opt.	113	\$7,270.00 Pair
SPEAKER ART	Marquee	Electrostatic/Dyn. Hybrid	(2) 6.5			75 sq.	Electrostatic	T	45-20 ±3	92	15	950	4/	9 X 35 X 12	Oak, Opt. Wood	Blk Knit, Opt.	48	\$2,770.00 Each
	Super Clef	Terminated Vent	8			1	Soft Dome		30-22 ±3dB	88	150 RMS	18k	8/6	21 X 13 X 10	Oak, Cherry, Blk.	Blk.	52	\$1,995.00 Pair

MANUFACTURER	Model	Application, Design Principle, Enclosure or System Type	Woofer Diameter, Inches	Midrange Diameter, Inches	Midrange Type	Tweeter Diameter, Inches	Tweeter Type	Separate Level Controls? W=Woofers, M=Midrange, T=Tweeter, ST=Super Tweeter	Anechoic Frequency Response, Hz to kHz, ±dB	SPL, 1 Watt/1Meter, dB	Recommended Minimum Amp Power, Watts per Channel	Crossover Frequencies, Hz	Impedance, Ohms: Nominal/Minimum	Dimensions, Inches (To Nearest Inch)	Finish	Grille Color and Material	Weight, Pounds Each	PRICE, \$
	Super Clef TL	1/8th Wave Trans. Line	8			1	Soft Dome		22-22 ±2dB	88	150 RMS	18k	8/6	38 X 15 X 10	Nat. Cherry	Blk.	70	\$6,995.00 Pair
	Ceramic TL	1/8th Wave Trans. Line	8.75 Ceramic			1	Ceramic		25-22 ±2dB	89	150 RMS	16k	8/6	37 X 15 X 10	Lt. Maple	Blk.	72	\$10,000.00
	Clef	Terminated Vent	8			1	Soft Dome		30-21 ±3dB	88	150 RMS	18k	6/8	21 X 13 X 10	Oak, Cherry	Blk.	50	\$1,499.00
TERESONIC	Ingenium	Trans. Line		8	Full Range				30-22 ±3	101.5	2		8	73 x 10 x 20	Rosewood/Blk. Gloss	Blk. Knit	42	\$9,975.00
	Integrum	Trans. Line		8	Full Range				30-22 ±3	101.5	2		8	47 x 10 x 20	Rosewood/Blk. Gloss	Blk. Knit	35	\$7,950.00
	Integrum JL	Trans. Line		8	Full Range				30-22 ±3	101.5	2		8	47 x 10 x 20	Rosewood/Blk. Gloss	Blk. Knit	35	\$10,950.00
	Magus	Compact Monitor		5	Full Range				55-22 ±3	98	3		8	15 x 12 x 8	Rosewood/Blk.	Blk. Knit	12	\$3,985.00
THE LOTUS GROUP	Feastrex D5nf	Bass Reflex, Horn, Open Baffle		5					120-20 ±3	92	8		16/		Blk.		10	\$1,995.00 Each
	D9e Type III	Bass Reflex, Horn, Open Baffle		9					60-20 ±3	95	2		16/		Blk.		23	Inq.
	D9e Type II	Bass Reflex, Horn, Open Baffle		9					60-20 ±3	95	2		16/		Blk.		23	Inq.
	Feastrex D5nf-G	Bass Reflex, Horn, Open Baffle		5					120-20 ±3	92	8		16/		Gold		10	\$2,450.00 Each
	D5-MA Monster	Bass Reflex, Horn, Open Baffle		5					120-20 ±3	92	8		16/		Blk./Silvr.		15	\$3,950.00
	D5e Type I	Bass Reflex, Horn, Open Baffle		5					120-20 ±3	92	8		16/		Blk.		16	\$5,950.00 Each
	D5e Type II	Bass Reflex, Horn, Open Baffle		5					120-20 ±3	92	8		16/		Blk.		16	Inq.
	D5e Type III	Bass Reflex, Horn, Open Baffle		5					120-20 ±3	92	8		16/		Blk.		16	Inq.
	D9nf	Bass Reflex, Horn, Open Baffle		9					60-20 ±3	95	2		16/		Blk.		19	\$3,950.00 Each
	D9-MA Monster	Bass Reflex, Horn, Open Baffle		9					60-20 ±3	95	2		16/		Blk./Silvr.		28	\$9,500.00 Each
D9e Type I	Bass Reflex, Horn, Open Baffle		9					60-20 ±3	95	2		16/		Blk.		23	\$8,000.00 Each	
THIEL LOUDSPEAKERS	CS3.7	Floor St., Bass Reflex	10	4.5	Wave-Shaped Alum. Dia-phragm	1	Alum. Dome		33-26 ±2 dB	90	100		4/2.8	12.5 X 21 X 45	Opt. Wood Ven.	Blk. Knit	90	\$12,900.00 Pair
	CS2.4	Floor St., Bass Reflex	8	3.5	Alum. Cone	1	Alum. Dome		36-25 ±2 dB	87	100		4/3	11 X 14 X 42	Opt. Wood Ven.	Blk. Knit	70	\$4,950.00 Pair
	CS1.6	Floor St., Bass Reflex	6.5			1	Dome		50-20 ±2 dB	90	50		4/3	9 X 12 X 36	Opt. Wood Ven.	Blk. Knit	38	\$2,490.00 Pair
	MCS1	Bkshlf., Bass Reflex	(2) 6.5	3.5	Alum. Cone	1	Alum. Dome		50-20 ±2 dB	90	50		4/3	10 X 13 X 29	Opt. Wood Ven.	Blk. Knit	61	\$2,200.00 Each
	SCS4	Bkshlf., Bass Reflex	6.5			1	Alum. Dome		48-20 ±2 dB	87	30		4/3	9 X 12 X 18	Nat. Cherry, Dk. Cherry	Blk. Perf. Steel	25	\$990.00 Each
VELODYNE ACOUSTICS																		
	MiniVee 10	HT Bass Repro.	10						23-120 ±3			40-120		12.8 X 12.4 X 14.5	Char. Pica	Blk. Cloth	35	\$1,249.00
	MicroVee	HT Bass Repro.	6.5						38-120 ±3			50-200		9 X 9 X 9.6	Anod. Blk. / White	Blk. Cloth	20	\$999.00
	DD-18	HT Bass Repro.	18						14-120 ±3			15-199		23 X 21.3 X 19.3	Blk. Gloss, Cherry, Maple	Blk. Cloth	120	\$4,999.00
	DD-1812	HT Bass Repro.	18						14-120 ±3			15-199		40 X 25.5 X 18.5	Blk. Gloss, Cherry, Maple	Blk. Cloth	450	\$15,000.00
	DLS-3500R	HT Bass Repro.	8						34-140 ±3			40-120		15.3 X 12 X 16.4	Blk. Gloss	Blk. Cloth	44	\$499.00
	DD-15	HT Bass Repro.	15						15-120 ±3			15-199		20 X 18 X 17.8	Blk. Gloss, Cherry, Maple	Blk. Cloth	100	\$3,999.00
	DLS-3750R	HT Bass Repro.	10						28-120 ±3			40-120		16 X 15 X 18.3	Blk. Gloss	Blk. Cloth	55	\$599.00
	DLS-4000R	HT Bass Repro.	12						25-120 ±3			40-120		18 X 15 X 19.5	Blk. Gloss	Blk. Cloth	61	\$699.00
	DLS-5000R	HT Bass Repro.	15						23-120 ±3			40-120		21 X 18.4 X 20.8	Blk. Gloss	Blk. Cloth	75	\$999.00

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WESTLAKE AUDIO	MiniVee	HT Bass Repro.	8						28-120 ±3		40-120		10 X 10.4 X 12.8	Char. Pica	Blk. Cloth	35	\$899.00	
	DD-10	HT Bass Repro.	10						18-120 ±3		15-199		11.8 X 11.8 X 13.5	Blk. Gloss, Cherry, Maple	Blk. Cloth	57	\$2,499.00	
	DD-12	HT Bass Repro.	12						17-120 ±3		15-199			Blk. Gloss, Cherry, Maple	Blk. Cloth	67	\$2,999.00	
	SPL-800R	HT Bass Repro.	8						28-120 ±3		40-20		10.1 X 10.4 X 12.8	Blk. Gloss, Cherry	Blk. Cloth	33	\$1,249.00	
	SPL-1000R	HT Bass Repro.	10						24-120 ±3		40-120			Blk. Gloss, Cherry	Blk. Cloth	46	\$1,649.00	
	SPL-1200R	HT Bass Repro.	12						22-120 ±3		40-120		14 X 14.4 X 16.5	Blk. Gloss, Cherry	Blk. Cloth	53	\$1,899.00	
	SC-1W	HT Bass Repro.	10						22-120 ±3				28.75 X 14 X 3.4	Blk. Pica	Blk. Cloth	43	\$999.00	
	SPL-1500	HT Bass Repro.	15						20-120 ±3		40-120		18.4 X 18 X 17.4	Blk. Pica, Cherry	Blk. Cloth	65	\$2,099.00	
	VX-10	HT Bass Repro.	10						36-120 ±3		50-200		15 X 12 X 17	Gray Pica Vinyl	Blk. Cloth	35	\$299.00	
	LC6.75F	HT/Bkshif.	5			.75	Dome		60-20	88	80	4k	7/5	16 X 8 X 10	Waln./Blk.	Blk. Knit	22	\$3,595.00 Pair
WESTLAKE AUDIO	LC3w12VF	HT/Bkshif.	12	6.5	Cone	1	Dome		40-20	91	100	160, 4.5k	5/7	30 X 15 X 15	Waln./Blk.	Blk. Knit	102	\$9,500.00 Pair
	BBSM-12VNF	HT/Floor St.	(2)12	6.5	Cone	1.25	Dome		38-20	96	145	500, 3.5k	2/4	48 X 17 X 22	Waln./Blk.	Blk. Knit	230	\$19,850.00 Pair
	Tower 6	HT/Floor St.	(2)6.5	4	Cone	1	Dome		38-20	91	125		2/4	43 X 12 X 15	Waln./Blk.	Blk. Knit	128	\$16,250.00 Pair
	HR-1VF	HT	(2)15	(2)10, 2	Horn	1			34-20	99	200	1k, 4.5k	2/4	48 X 34 X 21	Waln./Blk.	Blk. Knit	375	\$79,850.00 Pair
	L8.1F	HT/Bkshif.	6.5			.75	Dome		55-20	90.5	85	3.6k	5-7	18 X 10 X 12	Waln./Blk.	Blk. Knit	31	\$4,295.00 Pair
	BBSM-10F	HT/Bkshif.	(2)10	6.5	Cone	1.25	Dome		45-20	94	115	600, 4k	4/2	16 X 30 X 20	Waln./Blk.	Blk. Knit	150	\$14,993.00 Pair

New Silver Gold Z-cap



More resolution.
More sound stage.
More life in the mid tone.
 (outstanding for piano music and more)
Delivering lots of dynamics.
Human voice is reproduced very natural and lifelike.
Outstanding natural sound.
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2-3 times higher sound quality level compared to the market.

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Jantzen Audio Z - Primus Silver Cap
 Is a phenomenon: it has as a sonic base all the good characteristics of the Z - Superior Cap, but with some fantastic additional benefits - it sounds absolutely natural, nearly without audible coloration to the music signal, delivering an authentic soundstage. Besides, it is super smooth, without any harsh additions to the sound and the tonal balance is absolutely neutral. Sonically, it behaves more like a fine piece of wire than a capacitor.
 A truly outstanding audio part!
One of the best capacitors currently available in the world.



Jantzen Audio Z - Superior Caps
 Are absolutely high-end components, delivering a natural, almost holographic soundstage. Even the finest nuances can be heard.
 The sound never gets over-edged, really superb naturalness .
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 Are fast, smooth, detailed and less grainy compared to similar competitor Caps on the world market.

JANTZEN AUDIO DENMARK

MANUFACTURER	Model	Application, Design Principle, Enclosure or System Type	Woofer Diameter, Inches	Midrange Diameter, Inches	Midrange Type	Tweeter Diameter, Inches	Tweeter Type	Separate Level Controls? W=Horn, M=Midrange, T=Tweeter, S=Super tweeter	Anechoic Frequency Response, Hz to kHz, ±dB	SPL, 1 Watt/1Meter, dB	Recommended Minimum Amp Power, Watts per Channel	Crossover Frequencies, Hz	Impedance, Ohms: Nominal/Minimum	Dimensions, Inches (To Nearest Inch)	Finish	Grille Color and Material	Weight, Pounds Each	PRICE, \$
	Tower 12	HT/Floor St.	(2)12		Cone	2	Horn		38-20	97	145	1.2k	2.6/4	56 X 28 X 24	Waln./Blk.	Blk. Knit	350	\$38,980.00 Pair
	SM-1VF	HT	(2)15	(2)12, 2	Horn	(2)1, .5	Horn		20-20	101	400	200, 800 (3.2k/10k)	2/4	57 X 42 X 28	Waln./Blk.	Blk. Knit	875	\$125,650.00 Pair
	LC265.1VF	HT/Floor St.	(2)6.5	5	Cone	1	Dome		48-20	91	125	180, 4k	3-5	28 X 10 X 12	Waln./Blk.	Blk. Knit	60	\$7,995.00 Pair
	BBSM-10SWP	HT/Sub.	18						26-55	96.5	200	55k	3/2	30 X 29 X 24	Waln./Blk.	Blk. Knit	275	\$23,890.00 Pair
	Tower HR7	HT/Floor St.	(2)12	10	Cone	1	Horn		32-20	96	200	400 (1.8k/8.5k)	2/4	60 X 27 X 25	Waln./Blk.	Blk. Knit	385	\$59,990.00 Pair
	BBSM-15F	HT/Floor St.	(2)15	10	Cone	1	Horn		38-20	98	200	350/1.6k	2/4	28 X 41 X 25	Waln./Blk.	Blk. Knit	345	\$33,596.00 Pair
	Tower SM-1	HT/Floor St.	(2)18	(2)12, 2	Cone	(2)1, 1.5	Horn		20-20	101	400	200, 400 (3.2k/10k)	2/4	75 X 40 X 30	Waln./Blk.	Blk. Knit	975	\$154,000.00 Pair
	LC3w10VF	HT/Bkshlf.	10	5	Cone	.75	Dome		42-20	88	100	150/4.5k	3/5	25 X 12 X 14	Waln./Blk.	Blk. Knit	71	\$7,595.00 Pair
	BBSM-10VNF	HT/Floor St.	(2)10	6.5	Cone	1.25	Dome		40-20	95	115	550/4k	2/4	46 X 15 X 20	Waln./Blk.	Blk. Knit	165	\$15,995.00 Pair
	BBSM-15VNF	HT/Floor St.	(2)15	10	Cone	1	Horn		36-20	99	200	350/1.6k	2/4	60 X 21 X 26	Waln./Blk.	Blk. Knit	520	\$38,500.00 Pair
	TM-3VF	HT	(2)18	2	Horn	1	Horn		34-20	99	200	800/4.5k	2/4	44 X 34 X 21	Waln./Blk.	Blk. Knit	370	\$59,450.00 Pair
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	415	HT Sngl. Encl.	4	(3) 3.25	Cone			W,T	45-20 ±3			150		31.5 X 5.5 X 5	Blk. Gloss	Blk. Metal	14	\$499.99
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An On-Peak Power Supply, Pt. 1

Welcome to the first of a five-part series on AC power methods.

One of the improvements to early radio was the introduction of the AC power supply. The very first amplified radios were powered by batteries—at least two. The “A” battery, used to light the filaments, was 6V, and similar to the batteries used in automobiles of the time. Although in batteries built specifically for radio use, the plates were designed for lower current over a longer time.

The second, “B” battery powered the plate circuit. That is why even today the high voltage rail is referred to as “B+.” At the dawn of radio the voltage required was about 45V, so often two 22-24V batteries were needed to achieve the B+ voltage. A third battery (“C”) was sometimes used to provide bias. The happy high-end radio owner of the day would often have his batteries charged at the local automotive service station.

FILL IN THE BLANKS

Looking at **Fig. 1** (a typical radio circuit of the day), you may wonder how such a circuit could work. It appears that the antenna is coupled to a tunable inductor that feeds an amplifier tube. There is no capacitor to form a resonant filter circuit. The output of the amplifier tube, which you would assume is all radio frequency (RF) energy, goes directly into the headphones. That is because this schematic is for construction purposes.

If you wish to analyze the circuit, first pencil in a capacitor across the tuning inductor. This is the self-capacitance that is inherent in

all components. In the inductors used for this type of radio, the capacitance was large enough to allow the inductor coil to resonate as low as 500 kilocycles. (Today it would be 500kHz.)

The second missing factor is that the tube is not biased properly. Pencil in a resistor to show the leakage resistance across the input capacitor—this will serve as a bias resistor. It will vary a bit with temperature and humidity, but it is always there. Some versions of the radio circuit did not even use this capacitor. The inductor was connected directly to the grid, so that it also functioned as the bias resistor.

This improper (by today’s methods) bias causes the tube amplifier to work in class “C,” which is a label that wasn’t around then. Class “C” amps are very nonlinear because they conduct for only part of a cycle. This works great for this circuit because it acts as both amplifier

and as a partial rectifier!

Now you can pencil in a series inductor that is built into the headphones’ coils. These act as the RF choke to keep the tubes’ gain high at RF frequencies and also as a low-pass filter to smooth the distorted (rectified or pulse-width modulated!) amplitude modulated (AM) signal into audio!

The headphones of the day did not use a moving voice coil. The design of choice was based upon another major invention—the telegraph. The moving part was a steel disk or armature, held in place at the center by a “U” shaped magnet, the edge of which was supported by the case a little further out than the magnet. This caused the disk to bow in slightly at the center.

Two coils were wound around the magnet. The current through the headphone’s coils would cause the magnetic field to vary, moving the steel disc. The moving coil loudspeaker we know today was not well described in the literature until Rice and Kellogg wrote their paper in 1925.

The batteries, of course, pretty much act as just a power source. The internal resistance inductance and capacitance don’t really contribute much; everything need not be complicated.

Even today, most sound systems are still operated by batteries. The ones you may prefer to play with require more power than is conveniently supplied by batteries.

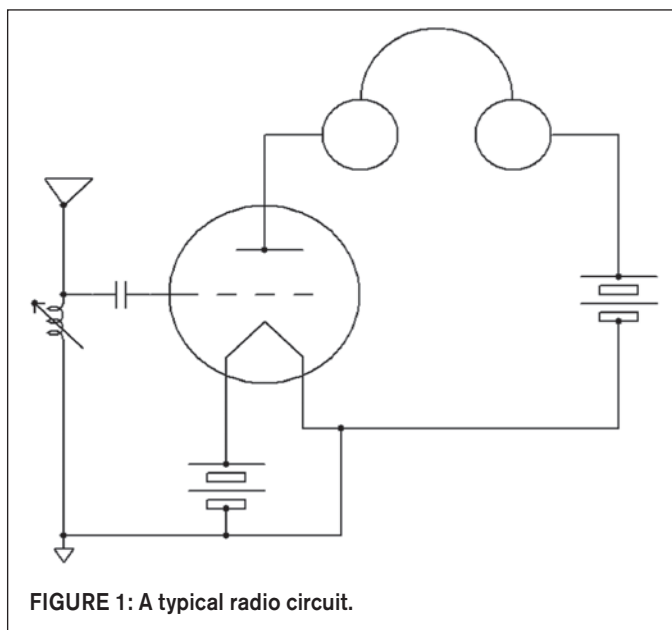


FIGURE 1: A typical radio circuit.

SLOW PROGRESS

The introduction of the

AC (alternating current) line-operated power supply in the 20s was a great convenience. A high voltage supply could be made from the household electrical service using a tube rectifier. Although of low current by today's standards, these were a great step forward at the time.

The filaments' power supply required more current than was practical with the then available rectifier, so it was powered by a low AC voltage. This introduced hum into the audio with a directly heated cathode, so the indirect cathode heater became popular. With a well-designed radio this hum could be kept to a minimum.

Most of the electricity used in the household first was devoted to incandescent lighting. As time progressed, the motor in the refrigerator and even one in the furnace added to the household load. Electric motors became the second killer "App" for the new electric service. Industry quickly caught on to the usefulness of these remotely locatable motors.

The motors had different current draw characteristics than light bulbs. In a light bulb load the current draw follows the voltage level as the sine wave voltage goes up and down. In a motor the current draw was determined to follow or lag the voltage. This was due to the inductive component of the motor's load. This was a new problem that was not present when the only power choice was direct current.

To make matters worse, the lag would vary depending on the actual load placed on the motor. This required rethinking how power use was calculated. The idea of power factor came into use. Power factor looks at the actual power consumed and compares it to the power that would be used if the peak current draw occurred at the same time as the peak of the AC waveform voltage. True power is the voltage times the current times a

correction for the phase angle between the peak current and voltage.

Today, refrigerators are more efficient, and people use fewer incandescent lamps. Many of the loads you place on electric service are electronic in nature. These often require direct current (DC) sources of electricity. There is a power supply inside to produce the voltage and current actually needed. Some of the power supplies provide regulated voltages; others do not. Some supplies use switching regulators because they often are more efficient. Others use linear power supplies, which are simpler and cost less.

CIRCUIT OPERATION

All of the DC power supplies have one thing in common: They take the AC current, rectify it, and filter it, often with a capacitor or sometimes with an inductor. **Figure 2**, a typical AC rectifier and capacitor power supply, uses a transformer to change the line voltage. Not all power supplies use transformers; the input to a switching supply is usually straight from the wall. The DC voltage measured from this supply is shown in **Fig. 3**.

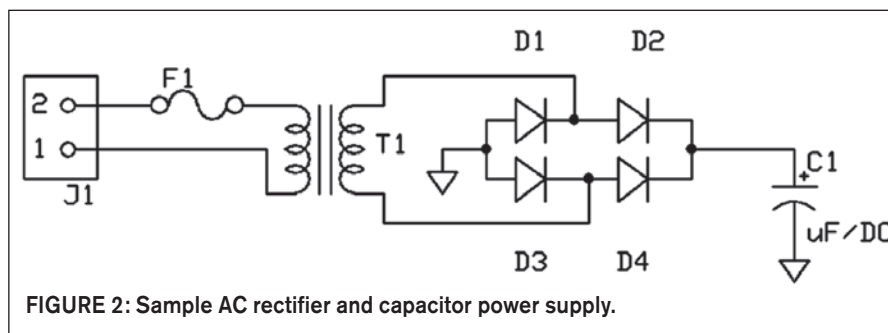


FIGURE 2: Sample AC rectifier and capacitor power supply.

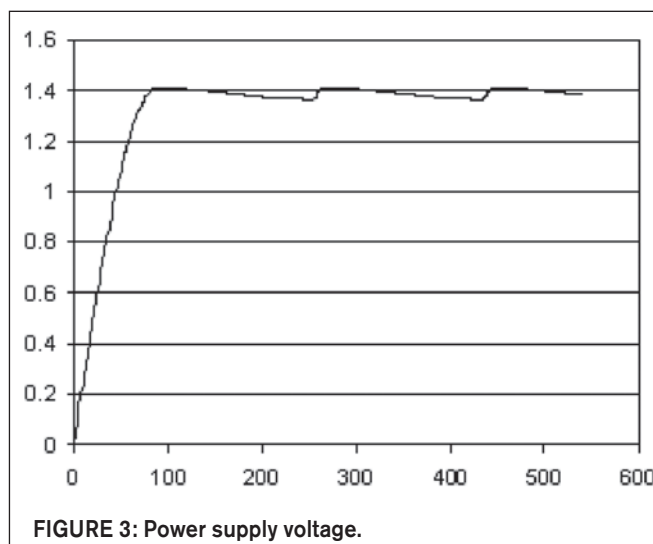


FIGURE 3: Power supply voltage.

The diodes in the circuit act as a one-way valve. The electrons that make up the current can flow only one way. (Electron flow is actually from negative to positive, but when the idea of current flow was developed by looking at how sparks jumped, scientists concluded that current flows from the positive to the negative terminals.) By arranging the diodes properly in this manner (called a bridge), the capacitor is charged positively from both the positive and the negative excursions of the AC line. The noise that is caused by the diodes' rectification action has been well covered before, so I will not go into that noise source.

The output of the supply first charges as the line voltage rises. The capacitor stores this energy to make it available at the output of the power supply. When the line voltage falls (thus the current is called alternating), the capacitor provides energy to the load. The voltage drops as the capacitor delivers current; there is less energy stored. That is the nature of a capacitor.

The capacitor will replace this energy only when the voltage into it is greater than the stored charge. That is why there is a downward slope at the top of the waveform's crest. If the capacitor is charged to 140V at the peak, and the capacitor is big enough or the load small enough,

it may discharge only about 5% or 7V. As a result, the capacitor will not recharge until the supply voltage goes back above 133V. It will continue charging until the line reaches the maximum of 140V again. The line voltage will drop to zero, but again the capacitor will hold charge and keep the output above 133V.

I call this a 140V supply with 7V of ripple. Others would call it a 133V supply with 7V of ripple.

It should be clear that if this power supply were putting out

1mA at 140V, it should take in about the same total power. The problem is that it puts the current out continuously but recharges only for a small fraction of that time.

To get 140mW ($140V \times 1mA = 140mW$) into the power supply, you have only a fraction of the time available. With 7V of ripple you would have only 18° of the 180° cycle from when the voltage rises above 133V until it reaches 140V. That means that if the charging current were supplied uniformly during this time, it would need to be almost 10mA.

A transformer has some hidden attributes. When the AC line voltage reaches a peak, the diode should have topped off the capacitor's charge. Actually, as the load is reduced on the transformer, its voltage rises so that it has the ability to spread out in time when the energy is delivered. There is also the hidden inductance in the transformer. As the secondary is unloaded, the inductance will cause the output voltage to rise until the energy stored in the inductance can be discharged. There is also some hidden capacitance in the windings that has energy stored, but to a lesser extent.

All of these characteristics help to reduce the harmonic content returned to the AC power lines.

The spectrum in Fig. 4 is of the current drawn from the AC line by a simple diode bridge power supply. 110m corresponds to one amp of current. Here you can see that the second harmonic is suppressed a bit by the balanced nature of a bridge. The third harmonic is almost the same amplitude as the first! The bandwidth limitations of the transformer reduce the higher harmonics.

NOISE SOURCES

Now you must consider another unseen component. The power lines from the power station to your home have some resistance. In order to be efficient, this resistance is made as low as is cost effective! Some loss is tolerated because the cost for no loss would become excessive.

As you may know, Georg Simon Ohm (1789-1854) applied mathematics to electricity and current flow, resulting in his law first published in 1827. It states that the current times the resistance is equal to the voltage. To make this con-

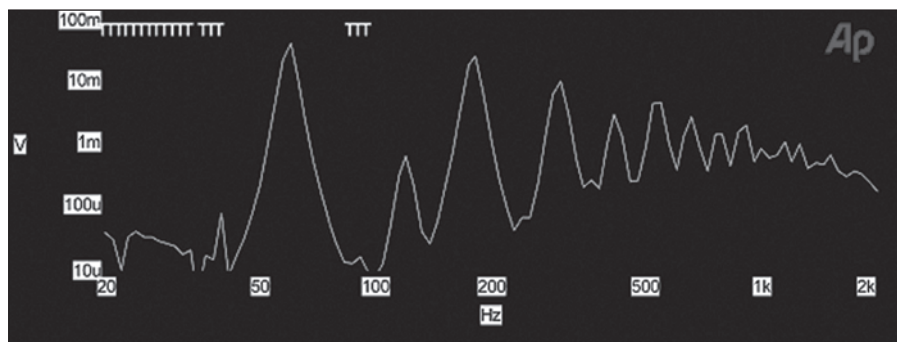


FIGURE 4: Spectrum of the current drawn from the AC line by a simple diode bridge power supply.

fusing, the symbol "I" represents current measured in amperes (or amps), or, in this case, because I am talking about alternating current and not direct current, I use the lowercase "i."

Resistance is measured in ohms, so you use the letter "R" to stand for it. Of course, when you talk about the AC value, you use "Z." Many people use the letter "V" or "v" to stand for voltage measured in volts, so, of course, I use the traditional "E," which stands for electromotive force. The classic equation for direct current is $I \times R = E$, and

for alternating current it's $i \times z = e$. To completely confuse the non-initiated, you use j, not i, for the square root of negative one!

For the second problem, consider that all the power supplies for everything from lights to computers are drawing current just at the voltage peaks, greatly increasing the current draw on the utility lines at that time (or for a limited phase angle). I could do some very fancy math to calculate the current draw over the time integral for the Fourier series that represents the power, but you can get

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close enough just using Ohm's law. The peak current times the equivalent line resistance is equal to the voltage sag.

Figure 5 is the actual current drawn from an AC line. As you can see, almost all the current draw is entirely at the peak of the AC voltage. The current draw does not smoothly follow the voltage.

This is a nonlinear load, which causes a flattening of the voltage and is a form of harmonic distortion. This is why the load generates additional energy at multiples of the 60Hz fundamental. Professional engineers who design power systems aim for less than 5% distortion in the AC voltage waveform from this cause. It may be just coincidence, but many power distribution transformers have 5% adjustment taps to get the final voltage very close to what is required.

METER MEASUREMENTS

When you measure the AC line, you must understand what you are measuring. My simplest meters use a diode to rectify the AC to DC, a resistor to change the voltage to a current, and a meter to show what the current actually is. The scale is then calibrated to show the root mean squared (RMS) voltage level for a clean sine wave. The RMS value of the AC line is the measurement of preference for determining the heating ability of an AC source when compared to a DC source. Ten volts RMS AC will provide the same heat (or total energy) from a given load resistance as 10V DC.

Some meters—true RMS meters—actually do the math on the AC waveform to determine the real RMS value. Others—such as my simple meters—assume a clean sine wave and are called “Peak Reading RMS Indicating” (PRRI). If your meter does not proclaim loudly it is a “true RMS” meter, it is almost certainly a PRRI meter.

On my distorted AC power line the RMS meter will read 120V, while the simpler meter will read 118V. Both are

right! The power is there for a heater or motor, but the peak voltage is clipped.

An amp that is rated for 100W at 8 Ω should have DC rails inside of at least 40V. If the amp was intended to operate from an AC line voltage of 120V and you have 120V RMS with 5% flattening of the peak or top of the AC waveform, then the amp rails could actually drop to 38V. This would reduce your output power to 90W!

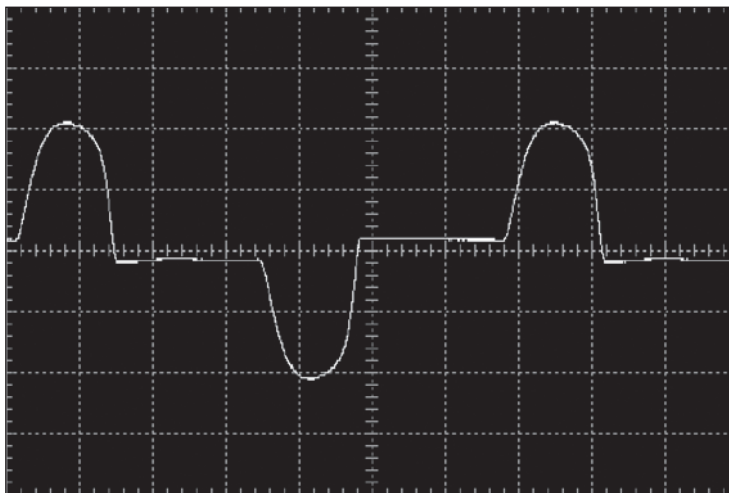


FIGURE 5: Actual current drawn from an AC line.

A third source of noise occurs when a load is switched on or off the line. This causes a dip or spike in the voltage. Although this is momentary, a large load switching off in combination with the inductance of the line and load can cause a voltage spike large enough to damage other equipment connected to the line. The current or energy that was flowing through the inductor must find a place to go. The voltage across the inductor will continue to rise until the energy finds a new home.

If the current and inductance are large and the only load on the line is your brand new Wowsa Mark Seven amplifier, there is no contest. Start shopping for a price on a new Mark Eight!

This problem also occurs on a smaller scale—a universal motor will put noise on the power line. Watch for the sparks on the commutator of a router or other power tool in use, indicating a noise source, which can put out energy in to the tens or even hundreds of megahertz range!

Sometimes you may deliberately put noise on your own power lines, with a number of devices from intercoms

to light switches that use the domestic power system to carry radio signals for short-range purposes. Of course, there are also radio, television, and other transmitters that will send some of their signals into power lines. If you are close to a 50kW transmitter, how much energy do you pick up? Do you really think all the energy from your microwave oven stays in the box?

Lightning strikes also cause spikes, and they behave differently depending on your power company! My power company places one of the “hot” AC lines on the top of the wire run; others use the “neutral,” which is intended to be grounded at the building point of entrance so that any lightning surges should be reduced or removed. Great idea, but if the building ground is defective, the protection you were counting on is now a defector to the side of Thor’s flash and boom. When the hot

lead is on top, sometimes you will see a lightning strike destroy some gear and leave others untouched. This could be a mystery if we didn’t know the reason.

PROTECTION

The energy in a lightning strike is tremendous. If one hits your power wiring, severe damage will occur. If the lightning only strikes close to you or your power lines, then protection will help.

One of my bits of engineering philosophy is that an engineer takes a vaguely defined problem, first defines it, researches, redefines it, and finally comes up with the solution(s). A technician can take a well-defined problem and build a gizmo.

Now that you have a handle on what we get from our AC supply and perhaps some idea of what you want, you have solved the first step in the engineering problem.

The simple goal is to look at how to reduce enough of the noise to remove any consequential concerns (another vaguely defined problem!) and return the peak voltage back to what it should be.

The most dangerous noise is, of course, the abrupt voltage spike caused by a load being removed from the line or part of a lightning strike. So you need a spike eliminator or surge suppressor. The first step a prudent designer takes is to look at what is already made for this purpose! Digi-Key's catalog lists about 60 pages of circuit protection components. So now you need to narrow that down to a few good choices.

I know from the national electrical code that the maximum voltage drop for an outlet should be 10% from all sources. I estimate that an average good outlet, then, will be 5%. For a 20A outlet at 120V, that is 6V at 20A or 300m Ω of wiring resistance. You probably have never noticed this drop because it is rare to actually have a 20A load in household use. (Note: If your amplifier is true class A, then the voltage drop is constant. With the common class AB amp, the outlet's voltage is modulated to some extent by your music!)

The open question is how high the voltage spike could go. Here I will be tricky. The normal insulation voltage rating for wire is 600V RMS AC. This is 850V peak. Because there are two wires carrying the spike, the insulation must withstand at least 1700V.

I will multiply this by 1.67, which is a fairly normal safety factor for other engineering designs. My experience suggests that 2800V may break over in normal wiring, but 1700V will not. I also expect this spike to be at least partially reduced by the regular AC waveform inversion. So the spike should begin to be reduced in one half of the 60Hz waveform.

So you can now design for a reasonable worst case of 8ms of a 2800V spike into a 300m Ω load delivered to my outlet. If the house has a history of power-line lightning strikes or other service problems, I would place a larger surge protector at the household electrical service point of entry to protect the entire house.

I selected a metal oxide varistor (MOV) that has an 8ms rating of 10,000A. This is a standard item about 1" in diameter and 1/8" thick. They are also available in smaller sizes. My educated guesses about the worst case surge nicely coincided with the size of

parts that are available—a handy double-check!

I need to know a bit about the MOV before I hook it up to my AC line. The metal oxide in the name tells me what it is made of. The varistor means that it is a resistor whose value varies. It is a higher value of resistance until the voltage goes above a certain voltage and then the resistance drops. I will need to select the right voltage for my application or it will be just a short across the line. Note also that because it is a nonlinear load it will produce some harmonics in the AC voltage all by itself.

A good choice is Digi-Key part #495-1444. It costs less than \$1 and has a 140V rating, which means it will not begin to protect at my normal high line voltage design value of 132V. It should limit a spike to 360V. This may damage some equipment, but I will follow this device with a bit more protection circuitry.

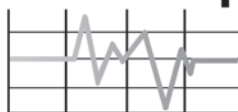
The MOV dissipates some energy, even when not protecting. My arithmetic tells me this should be less than 10mW.

A second bad habit is that if the MOV fails it can go to a low resistance mode. In drastic terms it will be a short circuit directly across the AC line. In the worst case the MOV can catch fire while sinking a mondo spike. It's a good idea to make sure it is surrounded by metal and nothing else flammable for an inch or two around it. Of course, after it burns up it will be an open circuit and no longer provide protection.

It seems prudent to provide a fuse before the MOV in the circuit. Use a 5-8A time delay fuse here to protect the power line cleaner and be reasonably sure the fuse will blow before the building's circuit breaker does. Fuses are easily available and meet most safety standards. If you wanted to use a higher current fuse and be sure to meet all of the standards, you should use a "midget" size fuse, not the smaller common 3AG style.

One of the characteristics to consider is not just the carry current but the interrupt current. If the gap that opens when the circuit protection activates is too small, the electric current can just

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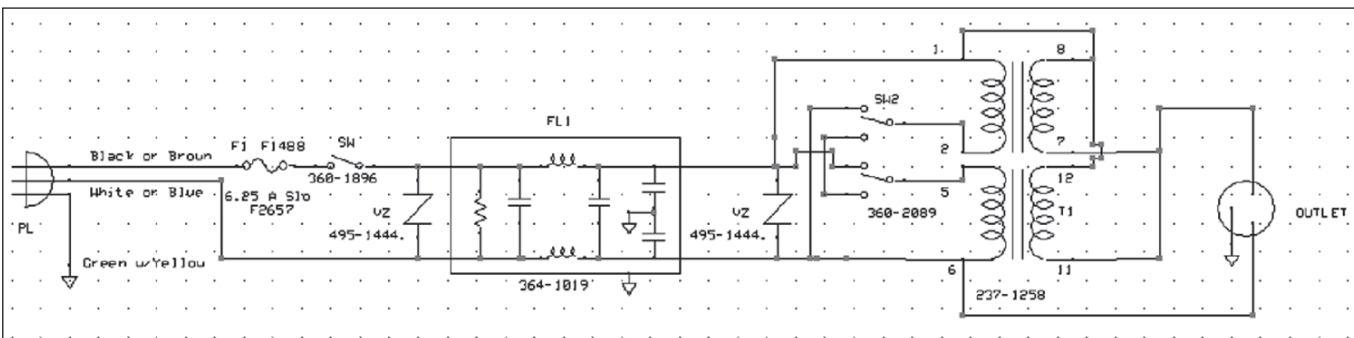


FIGURE 6: LC filter circuit.

arc over and continue with only a small voltage drop. That is why properly sized fuses are often preferred over circuit breakers—not because of cost, but the standoff current and sometimes the speed of action.

A switch on the input line is a nice idea, allowing you to disconnect the circuit if you are going away for a few days. I have selected a switch from Digi-Key that is rated for more current than expected. A smaller switch could weld itself closed.

The slightly tamed AC line can now

go through a filter to remove the highest frequency noise. In the old days this was often a simple 100nF capacitor from the AC line to the chassis. This had the bad habit of being a low current voltage divider and putting hum into the circuit.

A second problem was that sometimes the capacitor would short and put the entire line voltage on the chassis. This was a bad idea that only occasionally surfaces anymore. Of course, from the technical side it only treated interference coming in on one side of the AC line.

BOOSTER CIRCUIT

I have discussed many of the sources of noise. For removing them it is important to note that some of them such as the harmonic generators are effectively unbalanced because one side of the AC supply called the neutral is grounded. Other forms such as transmitter or higher-frequency sources come in on both wires because the inductance to ground is high enough the neutral behaves as though it is not grounded. This noise is called common mode noise.

A better method than just a bypass capacitor is to use an LC circuit to form a simple filter. A common mode RF choke with line-to-line capacitors works even better. Imagine this as a transformer for interference that takes the high-frequency noise on one wire, inverts it, and then applies this correction to the other wire coming in. In addition there is some inductance in the transformer that, combined with capacitance, will form a low-pass filter. The more inductance in the choke, the better the filter action will be. The downside is that the greater inductance also loses more of the desired 60Hz AC line voltage.

Sometimes very small value high surge voltage capacitors also tie to the chassis. There are many safety issues here, so I will go with a premade rated filter. I picked Digi-Key #364-1019 or 364-1020 filters because they filter both types of noise conduction. It is not the highest attenuation filter type, but has some capacitance from the AC lines to the case or ground. It is rated for a high impedance RF load, which is what we have for most of our audio devices.

Because I am following it with more devices, it should do what I need here.

AROUND the DCX-2496...



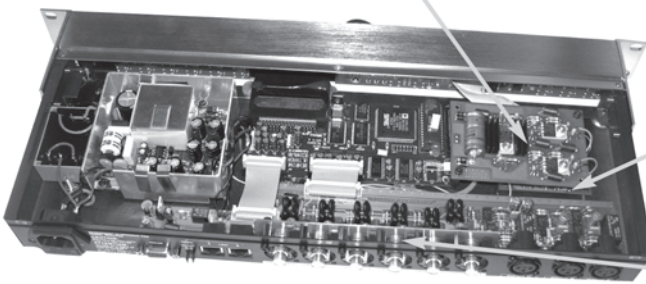
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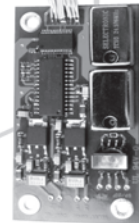
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One is rated for 10A and the other 20A. The lower current rating offers more filtering but has a slightly higher loss.

I could put a second smaller MOV across the output of the filter to knock down any remaining surges, but with the low cost I will use the same type as before. The filter in front of this protector will slow down any fast spikes that may have gotten away from the first one. In addition, I will be using other parts after this stage (Fig. 6).

The next component is a transformer to correct for the voltage peak or even the filter losses. There are two ways to do this. The inexpensive method is to use a boost transformer to bring the peak AC voltage back up. A simple 6V 5 or 10A transformer would do this.

The primary is connected across the line. The trick is that the secondary is then connected in series with the same line. This will either step up the voltage if the windings are phased correctly or step it down if they are wired backwards. If the voltage goes down, reverse the connections on the primary. You could put in a switch to try it both ways. Some folks find their gear sounds better on lower voltages!

In the first design I have included a switch to set the transformers' primary to either 120 or 240V. Note that the double-pole double-throw (DPDT) switch is wired so that there cannot be a short across the incoming line even if the switch does not open one side before closing the other. This switch would give either a 3 or 6V boost. The 6V boost should not do any damage to the equipment being powered by this power line booster, but for the faint of heart the 3V position should be a better match for just compensating for peak distortion.

I have selected a transformer with a 6.3A current rating. Using a 6.25A slow blow fuse will give a power capacity of 750W.

This technique does not greatly reduce the distortion of the waveform. The inductance of the secondary winding filters some of the low-frequency harmonics. If any of the single line high-frequency interferences have made it this far, they will stop here.

This transformer in the circuit actually increases the RMS value of the

voltage delivered to the load.

Note that the flattening of the 60Hz AC waveform is not always a problem! When the voltage spends more time at the peak voltage than on a pure sine wave, there is more time for the power supply capacitors to charge! So stepping up the RMS voltage but leaving the peak voltage the same has many benefits. The rails will be where they should be and the diodes will run a bit cooler.

This booster circuit is most useful for the AC feed to power amplifiers because they are the most susceptible to low line voltage. If you are using a class A, AB, or another efficient audio amp, it could power an amp with an output wattage *rating* of up to 2000W! This circuit would have trouble powering a true Class A amp with an output of 200W or more. You will probably notice the improvement this gives you not just on the bottom end, but also cleaner highs.

You could add a filter to the circuit to clean up the 60Hz waveform. That is where I will begin next month in part 2. *ax*



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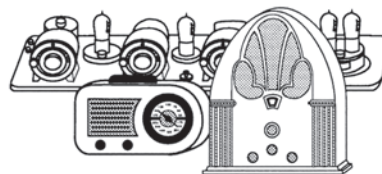
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CORRECTION

In the July issue, there is an error in John Sunier's "Super Fidelity" (p. 45). The Si-belius: Symphony No. 2 was listed with an incorrect number. The correct number is HDTT (DVD-R) 12HDDVD.

Eds.

POWER FACTOR

I read with interest Iain McNeill's article and subsequent letters on the Mains Analyzer (Nov. 2007, p. 8). Readers may be interested in a device called "KILL A WATT," model P4400, available from P3 International (www.p3international.com). I bought one from Harbor Freight for about \$30.

This relatively small device has a US male connector on one side with a female connector on the other. It has an LCD and several buttons and measures voltage, current, watts, volt-amperes, power factor, kilowatt hours, and hours.

Its low-frequency limit is 47Hz by measurement. I could not test it above 100Hz because that is the limit of my variable frequency AC power supply. The label states maximums of 125V, 15A, and 1875W. It uses a shunt resistor and no transformers and is totally enclosed in a plastic case. It does not indicate whether the power factor is leading or lagging.

I have found it to be a useful device in testing all manner of equipment. I have always believed that current consumption is an indicator of the health of electrical equipment. It is also interesting to see what the idle current is on a computer that is supposed to be "off."

Power factor is an item that we will be seeing more of in the future. Simply stated, it is the ratio of real power (watts) to the product of voltage and current (volt-amps, or VA). It is unity for resistive loads and less than unity for reactive loads. Capacitive input power supplies are poor, often with a leading power factor of about 0.6. This is because the current required to charge the filter capacitor is high while the capacitor is charging. When the capacitor is charged to the peak voltage, its charging current is zero.

New regulations—both US and European—are imposing limits on how poor the power factor can be. Most of these rules affect switching power supplies. Ways to improve power factor are beyond the scope of this letter.

Just a note on safety: The TV shop where I worked in the 60s had a large isolation transformer on the outlets that powered the workbenches. Many TVs and most radios of the day had one leg of the AC line tied to the chassis with insulators on the shafts and other metal parts that were on the outside of the cabinet. Most outlets did not provide a ground connection. I do not remember any line voltage shocks, although undischarged filter capacitors were another story, especially the second anode of picture tubes (CRT).

I have an isolation transformer and variable transformer on an outlet that I use for new projects. The remaining outlets are on a ground fault interrupter (GFI). This device switches the power off if the difference in current between the hot and neutral wires is greater than a few milliamps. This means that the current is returning through another path. These devices, however, can be fooled with line filters that have large capacitors to ground.

*Robert Bodmer
Richland, Wash.*

SHUNTS

I enjoyed reading Are Waagbø's article on shunt regulators (Feb. '08, p. 30), but, unfortunately, he doesn't mention the best part about shunt regulation. He does mention that it presents a constant current load to the power supply, but the reason this is so wonderful is that when multiple stages in a device have individual regulation, they do not interact in any way because the shunt is preventing trash from being thrown on the power supply rails.

It is very enlightening to listen to the power supply rails on typical consumer gear, using a signal tracer. There is often a lot of signal that winds up on the supply rails, because the supply impedance is nonzero and the individual loads run

class A or AB and are modulated by the signal passing through them. This is a prime source of subtle degradation, and in extreme cases can be a prime source of stability trouble as well.

Shunt regulation has fallen into disfavor in these days of cheap three-terminal series regulators, but it still has a place in this world, and Mr. Waagbø's overview on shunt topologies is very welcome.

*Scott Dorsey
Kludge Audio
Williamsburg, Va.*

Are Waagbø responds:

Thank you for filling me in and highlighting the best parts of shunting. Using Signal Tracker, looking for signal windings up on the supply rails—that tells me that you are a man who knows what you are talking about. It's another good reason to use shunts in audio!

With the article, I mainly wanted to share this project with other hi-fi enthusiasts: a simple and cheap way to great sound improvement! I did not want it to be a "scientific but more like a practical project" that everyone with electronic skills can make, and have fun.

FLY POOP

I would like to ask the author of the AmpliBass article (Dennis Colin, Dec. '07, p. 22), which I really enjoyed, whether he has stock in the 1% resistor industry. What is his penchant for using 1% resistors, of odd values, in seemingly arbitrary places?

For example, R15, the output protection resistor, is specified at 200Ω, 1%, MF. Why? It seems to me it could be anything from 150 to 330Ω at 5% and still be perfectly functional and less expensive. There are other examples that seem equally questionable, and I'm not referring to any of the filter networks or frequency/phase shift components. Again, the voltage divider network of R9 and R10 specifies 7,870Ω, 1% resistors—when it appears that any pair of like-valued resistors from 2200 to 6800Ω five percenters would be adequate.

I respect Mr. Colin's expertise, but I'm

curious about the overkill of specifying 1% resistors, which most hobbyists don't keep on hand in a large variety. Are we picking the fly poop out of the pepper shaker, or is there a legitimate reason?

Bard Kallestad
bkallestad@mmm.com

Dennis Colin responds:

First, let me say it's very refreshing to *not* be criticized for my using "non-audiophile" resistors (e.g., quantum-aligned unobtainium alloy). To your issue:

1. You are correct about the non-critical-valued resistors; nothing wrong with 5 or even 10% units.
2. 1% MF resistors aren't that much more expensive than 5% carbon film. Because I needed a large assortment, I had purchased five each of all values from 10Ω to 10MΩ (Digi-Key kits).
3. Even in simple gain-setting positions, I like the extra precision (and temporary stability), especially where tolerances of many paths might accumulate.

That said, I used to use 5% carbon films. In my various Intrinsic Fidelity tests (June and Nov. '07 *aX*) I heard *no* audible degradation in some components that used 5% carbon resistors (and my hearing, recently tested, is very good). Audiophiles from certain areas of the planet who claim to "hear" fly poop on their boutique resistors will disagree, but they haven't provided their burden of proof. (I know: "But the stress of testing impairs my brain's quantum physics!") Thanks for your interest.

HELP WANTED

A zobel (capacitor-resistor impedance equalizer circuit) helps to flatten the rising impedance caused by inductive reactance from the woofer voice coil. Good enough. This brings about a nice resistive load that makes life easier for the power amplifier.

My question is—and what I am asking help with—how do I equalize the *impedance drop* caused by capacitive reactance, as in an electrostatic loudspeaker? What kind of circuit can I cobble together that would turn the capacitive load into a resistive load?

Angel Rivera
angelluisrivera@excite.com

CORRECTIONS

There is an error in the "HD-2 Class-A Headphone Amp" (*aX*, June '08) schematic on page 34. D1 and D2 cathodes should be connected together then to C1+, and C1- should go to the T2 center-tap (as shown for D7, D8, C5, T3).

Also, I think the readers will need a translation for the last sentence on page 45 ("A Greek Hybrid in Blue"), "I mounted a magic eye (EM84) to show when the mounter is ready to kill." Also, in Table 1, Amp Parts List, T3 and T1 are shown as type "56." Does this mean MPSA56?

Chuck Hansen
Ocean, NJ

Jim Dungan responds:

Thank you, Mr. Hansen, for noticing the error in my headphone amp article. You are correct that the D1 and D2 cathodes must be connected together, then connected to the C1(+). The center tap of T2 is then connected to the C1(-). My apologies to you, *aX*, and the readers. I reviewed the drafts three times but did not notice what I should have corrected.

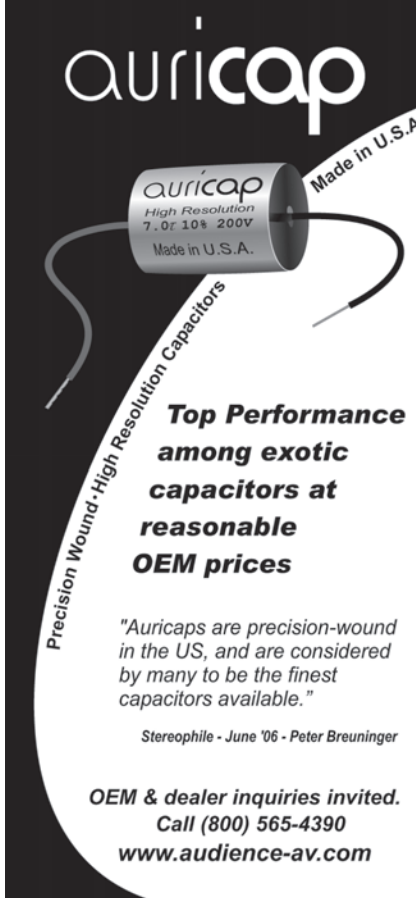
Alex Arion responds:

The right word on page 45 is "Monster." In Table 1, yes, the transistors are MPSA56. I thank Mr. Hansen for reading my little articles. I appreciate this coming from such a known personality as he is.

LINE-ARRAY COSTS

In Mr. Bird's reference to my 20-driver, wide-range column¹, I think he neglected to mention the cost of my system compared to the system in his article². He claimed he had never spent over \$300 for any speaker system, yet my design was only \$200 for all the parts including an adjustable equalizer. This would fit nicely within his maximum budget.

He pointed out that I did not use tweeters. Tweeters were not necessary with response already out to 15kHz³. Adding an extra driver or drivers to fill the range to 20kHz would contribute very little to the design. My system adequately demonstrated the advantages of the unique column such as better coherence, image stability, depth, spaciousness, and so on, without the need



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for tweeters, crossovers, and extra driver locations that could compromise some of the advantages.

The difference between that system and the later update article was in the use of 25 smaller and higher quality drivers and a few other embellishments⁴. High-frequency response was extended with this updated version.

Mr. Bird seemed concerned about the cost of the 25-driver system that was made into a potentially high-end commercial version priced at \$18,000. However, if he were to try to market a high-end system, I expect he would find that it would also be very expensive, considering the high cost of quality cabinets, drivers, packaging, manual, advertising, and so on. The speaker market is very competitive and speaker companies come and go fairly often over the years. It also means that if the dealers do not get a 50% or more markup, they would not be interested in selling the system.

As a rule of thumb, the selling price should be five times the materials cost.

For the IDS-25, including a custom-dedicated equalizer and all the other material, cost for the pair comes to \$3,600. That is a pretty tight budget to start a new venture.

The final test is in listening. The sound of the IDS-25 system was well received at the 2007 Rocky Mountain Audio Fest and the room was very crowded for three days. We received many compliments and it was favorably mentioned with pictures in several magazine reports. Our first customer sold his \$22,000 Wilson speakers and bought a pair of IDS-25s. Better sound is definitely worth the price for some people.

Of course, you can always build a pair of the 25-driver design for a lot less. All the plans, parts, and equalizer settings are shown in the *aX* article. It uses the same adjustable McIntosh equalizer that was in the 20-driver article but with different settings. After the article was published, the drivers became available at considerable savings from Madisound.

REFERENCES

1. "A Unique Stereo Column System," *aX*, Nov. 2005.
2. "The Sidewoofer Line Array," *aX*, May 2008.
3. Measured with a Bruel & Kjaer 4133 microphone.
4. "Upgrading a Unique Stereo Column System," *aX*, July 2006.

Roger Russell

rogerr4@earthlink.net

AMPLIFIER BUYER'S GUIDE

Readers will note the loudspeaker buyer's guide that appears in this issue (p. 21). This marks the first in a series we will be publishing in upcoming issues. The next buyer's guide of finished equipment will focus on amplifiers. Manufacturers who wish to be included should fill out a form that is available on our website at www.audioXpress.com. Further information is available by contacting Laurel Humphrey at 603-924-9464, or by e-mail at laurel@audioXpress.com. The deadline for the forms is August 29. *aX*

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CONTRIBUTORS

Bruce Brown ("How To Buy Gear on the Web," p. 6) is a registered pharmacist who works in the medical research area for a major pharmaceutical company. He has been experimenting with electronics for over 35 years, remaining actively interested in electronics, building kits, and "home brew" audio. Online auctions have stimulated new interests. He has just recently become interested in restoring vintage audio equipment and writing articles to assist other hobbyists. His wife, Kristin, has been invaluable help with editing his ramblings. He currently uses many restored and homebuilt audio amplifiers and welcomes communication about vintage equipment and restorations. He can be reached at Tuninfork@aol.com.

David Ivan James ("Choosing Cathode Bypass Capacitors," p. 19) is a retired physicist. He began working for Ericsson designing gas regulator tubes and counting valves, before moving to the Rubber and Plastics Research Association. He is also a fellow of the Institute of Physics.

Merlin Blencowe ("Choosing Cathode Bypass Capacitors," p. 19) is a young valve audio fanatic and experimenter. After graduating two years ago, he is now test technician and head of thermionics for Welsh hi-fi company Leema Acoustics.

Ed Simon ("An On-Peak Power Supply, Pt. 1" p. 37) received his B.S.E.E. at Carnegie-Mellon University. He has installed over 500 sound systems at venues including Jacob's Field, Cleveland, Ohio; MCI Center, Washington D.C.; Museum of Modern Art Restaurants, New York; The Coliseum, Nashville, Tenn.; The Forum, Los Angeles; Fisher Cats Stadium, Manchester, N.H.

Joel Cohen (Book Report: *Professor Poor's Guide To Buying HDTV, Second Edition*, p. 48) has worked in the audio and video fields for over 40 years and is currently V.P. of Technology for Crystal View Inc. and its associated companies.

Barry Fox ("Touring Recording's Memory Lane: 1958," p. 50) reports on the audio industry as columnist for the British publication *Hi-Fi News*. His commentary appears in every issue of *Multi Media Manufacturer*.

John Shand ("Jazz Track," p. 54) is a CD reviewer for *Australian HiFi and Home Theatre Technology*.

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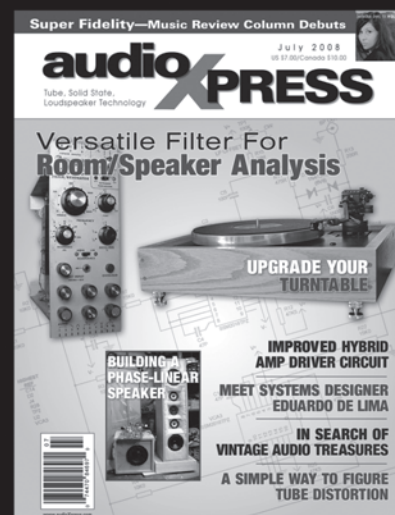
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Ad Index

ADVERTISER	PAGE		
ACO Pacific Inc	39	Parts Connexion.....	9
Antique Radio Classified	43	Parts Express Int'l., Inc.	CV4
Ask Jan First	11	Sanus Systems	23
Audience.....	45	SB Acoustics	27
Audio Engineering Society – AES	52	Selectronic	42
Audio Transformers	18	Sencore	13
Avel Lindberg.....	46	Solen, Inc.	53
CEDIA	CV3	Sonist Loudspeakers	18
DH Labs Audio Cables	31	Tang Band Industries Co.,Ltd.	35
ETI- Eichmann Technologies	CV2	Teresonic, LLC	49
Hammond Manufacturing.....	3	Test Equipment Depot	41
Hypex Electronics B.V.	51	The Lotus Group	5
Jantzen Audio Denmark	33	WBT-USA/ Kimber Kable.....	7
Juicy Music Audio	16		
KAB Electro-Acoustics	43		
Madisound Loudspeakers	8		
Marchand Electronics, Inc.	45		
Mouser Electronics.....	15		
Mundorf EB GmbH.....	17		
			</

Professor Poor's Guide To Buying HDTV, Second Edition



The subtitle of this guidebook to buying an HDTV is "How you can save thousands of dollars and avoid making an expensive mistake when you buy your next TV!" That may have been true when the first edition of this excellent guidebook was published, but by the time this second edition was copyrighted, in September 2007, the quality of all surviving HDTVs had improved and their prices had come down dramatically. As I write this report, few people will actually spend more than \$2000 for an HDTV, and most will spend less than \$1000.

That said, Alfred Poor has written the best guide I have seen for explaining what an HDTV is or can be, and for accurately and understandably defining what the profusion of acronyms, that have been generated by this new technology, stand for. The majority of the book is taken up with these explanations. I could find no errors in that information, although he does describe some technologies that are not available and a few that never will be. I am especially impressed with Poor's choice of non-technical analogies wherever they are appropriate. I wish I had thought of a few of them when pressed to explain the same material.

Alfred Poor is well equipped with the knowledge, as well as the test procedures and equipment, to write this book. He has written for over 20 years for *PC Magazine* and other publications, specializing in display technology. He has published at least six other books on computers and works for a major marketing research company, specializing in large screen display applications.

He also maintains a website (<http://hdtvprofessor.com>), where you will find additional, up-to-the-minute information and links to many sites for data and recommended vendors. Originally, this was the only source for the first edition of this book. This second edition is available from booksellers such as Amazon.com and was printed in sufficient quantity to lower its price by more than half.

Short of completely rewriting his guide, Poor has updated the most important areas—those that most directly apply to how to choose the HDTV that best suits your specific requirements. For example, he rightly points out that most buyers neglect to examine the room and location before they buy an HDTV, and that most HDTV returns are therefore because what they bought does not fit where they want to put it. Among other considerations, HDTVs are typically much bigger than the units they replace.

My only quibbles with the book are in the first six chapters, where he describes the implementations of various technologies in terms of what was available some time ago. These are probably left over from the first edition and may be a little confusing to anyone who has kept up with what's happening and reads the book straight through.

His discussion of what detail can be seen at various distances with displays of various resolutions leads to an easily understandable choice of optimum screen size and/or viewing distance. This is very important and usually hard to get across, especially to potential buyers with a predilection to the-larger-the-better.

Once you have absorbed as much background information as you want, from the first six chapters, you come to chapter 7, Making your HDTV decision. This is where the rubber hits the road and the examples are pretty much up to date. The only major change since this was written is the virtual disappearance of the rear projector category—a shame because the last versions with LCOS engines were wonderful and, as he noted, a real bargain.

Also, all HDTVs are now required to include a digital tuner, in spite of the fact that less than 10% of TV viewers do not have cable or satellite reception, with its own separate "tuner" box, and must rely on an antenna, which is the only time a tuner is needed. So you cannot save lots of money by buying an HDTV without a tuner. The exception being

to buy an industrial monitor, which cannot be sold by a retail store and is also missing many of the inputs you will want to have.

On the technical side, with all the details Poor has gathered and clearly explained, the only mistake I found was an instance of describing 1080p HD as running at 30 frames per second instead of 60. Bandwidth restrictions limit the highest resolution you can receive from Broadcast HD to 1080i, which does run at 30 complete frames per second. Currently, and for the foreseeable future, the only source for 1080p HD is Blu-ray High Definition DVDs on a Blu-ray player.

Earlier he indicates that, like a conventional CRT, plasmas inherently can wink out to deep black and LCDs cannot. In fact, the newer plasmas, such as the Pioneer Kuro line, do reach an almost perfect black, but plasmas in general have always dropped to a minimum gray level, necessitated by having to keep the plasma in each pixel slightly energized in order to fire up quickly when the image demands it. The latest LCDs now modulate the backlighting level on the fly to decrease the black level when appropriate, and some now use LEDs for more responsive backlighting, and potentially more accurate color extremes.

Poor also includes an excellent section describing the scaling of incoming video, with other resolutions, to fit the native resolution of the display. As he says, this is a complex function, and the better implementations add some significant cost to the HDTV. The difference in performance is most noticeable when watching non-HD video, which still comprises most of what will be watched on the new HDTV. A poor-looking picture with standard video sources is the second most popular reason that HDTVs are brought back to the store.

Last, he recommends buying the least expensive cables you can find to interconnect the HDTV to other sources. I strongly agree, but these will not likely be available where you buy your HDTV, because expensive cables are the most profitable items in the store.

In summary, I heartily recommend *Professor Poor's Guide to Buying HDTV* to anyone preparing to buy a new HD-capable TV. You can read just the important parts about how to decide what size picture will be best for your room and how to compare the HDTVs in that category, or go deeper and easily assimilate enough technical knowledge to keep any poorly trained salesperson at bay. **AX**



Touring Recording's Memory Lane: 1958

1958 was a good year for music. LPs had been on sale for ten years and liberated recorded music from three-minute limits. Jazz soloists could stretch out and play a dozen choruses, even if they had only enough ideas to fill one.

Photographer Art Kane persuaded the cream of New York's jazz musicians to gather in Harlem at 10 am for the seminal jazz photo that appeared in *Esquire* magazine and has been copied and photocatted ever since. Jean Bach's great movie, "A Great Day in Harlem," tells how many of the musos had never known there were two ten o'clocks in the same day.

At the other end of the musical scale, the Decca Record Company let producer John Culshaw loose in Vienna on a plan to record the entire Ring Cycle of operas, written by Hitler's favorite composer Richard Wagner. The project took seven years to complete and now spans 14 CDs, which will set you back over £150 if you ever get time to listen to them.

Decca's project only happened because on March 25, 1958, the RIAA (Recording Industry Association of America) set the standard for recording two-channel stereo in a single groove of the vinyl LP records which had been introduced by Columbia CBS in spring 1948. Today we think of the RIAA mainly as a trade body that plays Canute by obstructing new technology. But in the 50s things were very different.

FORMAT FIGHTS

The RIAA needed to choose between several competing systems, but the standards battle was played out before commercial launch, rather than afterwards and with the public as guinea pig cannon fodder—as happened later with VHS versus Beta, cassette versus 8-track cartridge, Laservision versus Selectavision video disc, DCC versus Mini Disc, DADC versus DVD-A, and now the

ultimate insanity, Blu-ray versus HD-DVD.

The industry had learned from the lessons of ten years earlier when, in February 1949, RCA Victor launched a 7" 45 rpm Extended Play disc to rival Columbia's 12" 33.3 rpm disc. The two formats could co-exist only because they solved different problems—the flexible EP replaced the fragile 78 rpm shellac single, and the LP gave much longer playing time—and because it was relatively easy to build a deck that played both kinds of disc.

There were much more basic decisions to be made when setting the stereo standard. Should new stereo discs be compatible with the mono decks sold over the previous ten years, or should the new discs aim for the highest possible audio quality without any compromises to make them usable with existing players—and so oblige the record companies to issue two versions of every recording, one mono and one stereo?

US audio engineer Emory Cook updated an idea used by Bell Labs in the 1930s when Bell boffins [researchers—Eds.] were making test stereo recordings of Leopold Stokowski. Cook used two cartridges to play two separate grooves, one on the inner half of the disc and the other on the outer half. Apart from the increased cost and complexity, recording time was halved; and inner groove distortion unbalanced the left and right channel audio quality.

In the UK Arnold Sugden demonstrated a stereo disc with a single groove, vertically modulated with one channel and laterally modulated with the other. This V/L approach had been used and patented by Alan Blumlein of EMI in the early 30s, but it suffered from poor compatibility with mono pickups which are designed to move only laterally.

Decca in London was working on a

third system, which spans off from research done in the War on the high fidelity recording of submarine sounds. Decca had pushed the recorded bandwidth to 28kHz for mono, and for stereo the band was split in two, with a modulated carrier at 14kHz pushing one channel into the 0 - 13kHz band with the other at 15 - 28kHz. Decca's multiplex stereo system was not compatible with mono players, but the audio quality was good. In fact, much the same technique was later used by JVC for its ill-fated CD-4 "discrete" quadraphonic system; JVC put the rear channels in a higher band than the conventional stereo channels.

Westrex (the manufacturing wing of Bell Labs) proposed the 45/45 system that had been developed and patented by Alan Blumlein at EMI in the UK in the 30s. The left and right channels are recorded at right angles to the groove walls, which are at 45° to the disc surface. Equal and in-phase mono signals result in lateral modulation of the groove so play as mono with a mono pickup; stereo signals add vertical modulation which is tracked by a stereo pickup with vertical compliance.

Arguments raged on whether the RIAA's choice was correct. In the UK *Gramophone* magazine published a blistering article by Technical Editor Percy Wilson, chastising Westrex and the RIAA for failing to acknowledge Blumlein's contribution and calling its system "Westrex stereo."

The truth almost certainly is that the Westrex engineers, and RIAA, had never heard of Alan Blumlein or his work—just as Blumlein knew nothing of the experiments with stereo that Bell Labs was carrying out with Stokowski at the same time as Blumlein's test recordings of Sir Thomas Beecham at Abbey Road. In those days the world was not a global village.

STEREO

Arguments also raged on the relative merits of tape and disc recording, because stereo tape recordings had been sold for home use in both the US and UK (by EMI) since 1955. The soft groove of a vinyl disc could be wiped clean of high

frequencies by just one play with a heavy cartridge and stiff stylus. But even slight azimuth misalignment of stereo heads of a tape player had the same dulling effect; and if the tape heads picked up any permanent magnetism, just one play could add background hiss that masked high frequencies.

"Stereosonic" tapes were not popular, so once the RIAA disc standard was announced, popular magazines in the US promised a flood of stereo players and discs. In fact, nothing very much happened until the end of 1958. There were no pickups to buy and very few stereo amplifier and speaker systems. The record companies needed time to cut and press 45/45 discs.

The first stereo LPs appeared in the autumn of 1958, all from independent labels and many of them of limited appeal such as "Railroad Sounds," "Bullring," "Bagpipes and Drums," and "Marching Along with the Dukes of Dixieland." Recordings were usually issued in two versions, mono and stereo, because the industry was still wary of the mono-stereo compatibility claims.

By the end of the year there were around 200 stereo titles in the US, including one that has truly stood the test of time. Shelley Manne and his Friends playing "My Fair Lady" is still widely available on CD. Manne's friends included pianist Andre Previn and the sessions were taped in Los Angeles, during a single day in August 1956. The re-

cording serves as a nice reminder of the fine stereo quality that was already being captured in commercial recording studios as the record companies got ready for the RIAA to set a disc standard and open the release floodgates.

Because engineers were using only a few microphones, with their sound mixed live into stereo, and because the mikes were placed well away from the instruments, those early recordings achieved far more tonal accuracy than today's close-miked excesses.

It's hard now to imagine the kind of impact the introduction of stereo discs had. I was in Edinburgh for the Fringe Festival when the first playback systems became available and vividly recall going to a hi-fi shop on Princes Street, accompanied by a musician friend (who later went on to mastermind the Three Tenors recording) and saying very honestly to the sales staff: "We aren't going to buy anything but we would really like to hear what this new stereo is all about; can you demonstrate it?"

They did and we were blown away.

RIAA CURVE

The RIAA also stepped in to bring order out of the chaos over equalization. To get equal level at all frequencies from a magnetic moving coil playback cartridge would require very large stylus movements at low frequencies, which in turn means the grooves must undulate wildly and so be very widely spaced—which

would drastically reduce playtime per side. So at the recording stage the bass, below around 1kHz, is reduced to keep groove undulation manageable; then for playback the bass is boosted. At the same time high frequencies above 1kHz are boosted during recording and reduced on playback, to cut background hiss noise. Some bass frequencies are boosted less than others during playback, to avoid boosting unwanted mains hum. Similar techniques are used for magnetic tape recording.

In theory all the boosting and reducing equalization cancels out to give a neutral effect; but this only happens if the record and playback circuits are perfect mirror images. In the early days of the LP different record companies used different equalization curves—over a hundred of them—with radical variations between Europe and the US, and between LP and EP modes.

The Audio Engineering Society had tried in 1951 to set a standard curve but it did not stick. By 1954 the dust was settling and the number of curves reducing. When the RIAA set the standard for stereo in 1958, the world was more than ready for a single equalization standard and the RIAA curve—which was in fact very similar to the curve used by RCA for the EP—became an internationally accepted standard.

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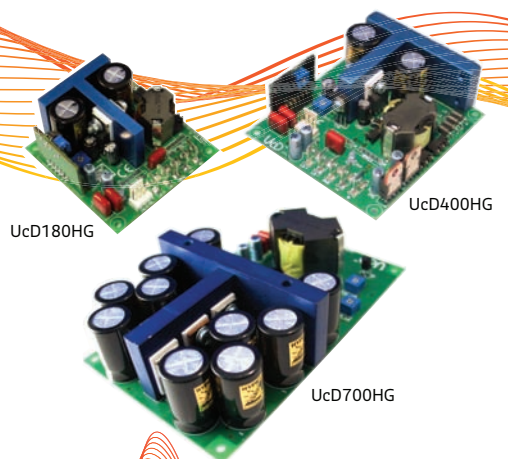
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had been recording stereo in the pre-RIAA years. To try and win back audiences lost to television, Hollywood was using three track 35mm magnetic film to record stereo sound for the Cinemascope widescreen movies that started to appear in 1953, with "How to Marry a Millionaire" and "The Robe."

Audio pioneer Bert Whyte was first to spot the music potential of film. He was born in Belfast, but brought up in the US, and in 1949 was working for Magnecord, the US company which produced the first commercial stereo tape recorder. In 1951 Whyte started making stereo tape recordings, some of which were later issued—first on tape and then on disc—by the Everest label which he co-founded in the mid-50s.

A recently released CD from Music

and Arts (CD 1190) includes live recordings of Leopold Stokowski and the Detroit Symphony Orchestra made by Whyte in November 1952. For these Whyte used a Magnecord PT-6BA2HZ tape deck running at 15 ips, with the stereo heads staggered to avoid crosstalk. The tapes eventually ended up with the Stokowski Society and the stereo image nicely captures the unorthodox orchestra layout that Stokie favored.

Another of Whyte's tapes, of the Stan Kenton big band playing at the Blue Note club in Chicago in September 1952, is almost certainly the earliest live stereo jazz recording (Dynaflo CD 2007-1). Whyte had bribed a waitress to get him as close to the band as possible and set up his trusty Magnecord with two Telefunken U-47 omnidirectional condenser

tube mikes. He was using 5" spools of tape at 7.5 ips, so with only half an hour of recording time he turned the machine off for all announcements. Nevertheless, there are snatches of Kenton's chat with his musicians that give a remarkably intimate feel to the session; and vocalist Kay Brown is so far off mike that she sounds as though she is singing You're Mine You from a different room.

The sleeve note whets appetites with the aside that Bert Whyte went back to the Blue Note a few months later and recorded Woody Herman's band in stereo—but the tapes cannot be found.

Whyte then turned to film, trying 35mm magnetic instead of tape because of the wider tracks and higher recording speed. Everest's recording of Aaron Copland's "Appalachian Spring" and George Gershwin's "An American in Paris" gives a rare opportunity to compare the sound of tape with film (EVC 9003). For both recordings Bert Whyte had three U-47s in a spaced array across the front of the orchestra. He used half inch three track tape to record the London Symphony Orchestra at Walthamstow Assembly Hall and three track 35mm magnetic-coated film for the Pittsburgh Symphony Orchestra in Pittsburgh's Heinz Hall. The recording dates are unclear but pre-RIAA.

Some of the Whyte recordings have been skillfully re-mastered by Mark Obert-Thorn in the UK. It was Obert-Thorn who previously mastered the intriguing "accidental stereo" recording of Sir Edward Elgar conducting the BBC Symphony Orchestra at EMI Abbey Road Studio 1 in April 1933 (Naxos 8.111022). Two master wax disc recordings were made of the same performance of Elgar's Cockaigne Overture and the CD uses one for the left channel and the other for the right. Controversy rages over whether the two waxes shared the same feed from a single microphone, or each had its own mike—thereby inadvertently capturing a stereo image of the original sound. The Naxos recording sounds like stereo, but this may be the result of phase shifts introduced by combining two recordings made on mechanically driven cutters running at slightly irregular speeds.

PRE-RIAA STEREO

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PHOTO PHILLIP ANGERT

reo are, of course, the experimental recordings made by Bell Labs in the US, and EMI in the UK, in the early 30s. Bell was working with Leopold Stokowski and testing a double groove system similar to that later proposed to the RIAA by Emory Cook; at the same time, and without either company knowing it, Alan Blumlein was recording Thomas Beecham at Abbey Road using the single groove stereo system that eventually morphed into the RIAA's "Westrex" standard.

Although rather poor quality excerpts from the Beecham recordings were once issued by EMI on a commemorative LP, there is no sign yet of a CD release. Given the current state of EMI, it would be unwise to hold any breaths.

The Bell Labs Stokowski recordings were released only on limited edition LPs, and the Bell empire breakup leaves little hope of a CD version.

The only lasting legacy of Bell's experiments with Stokowski is "Fantasia," the animated movie made by Disney in 1940. The original sound track—eight track optical mixed to four track for cinema release—was "preserved" when the playback equipment fell into disrepair and the studio piped the sound across Los Angeles by phone lines for dubbing to tape. The lines were of different length and added phase shifts, as well as trimming the high frequencies. Disney later re-recorded the soundtrack with a different orchestra and conductor, and has now re-made the film. So the original audio legacy is lost.

By far the most remarkable example of pre-RIAA stereo remains the commemorative CD produced by the Audio Engineering Society in 1993. This includes a recording made in Berlin in September 1994 by Herbert Von Karajan and the Orchester der Berliner Staatsoper. Although the city was torn by war, Von Karajan conducted while the orchestra fiddled and Helmut Kruger from Berlin's radio station used a modified Telefunken recorder, with AC bias and two heads, to capture Bruckner's Eighth in stereo. Even today the recording leaps off the disc, and across the sound stage. For legal reasons, we are told, the recording is still not available outside the AES.

Expiration of copyrights is the only hope. That's how Obert-Thorn and Naxos were able to release the Elgar "accident" even though EMI had previously

flatly refused to do anything with it.

There are other "is it really pre-RIAA stereo" recordings available, which are a little easier to find. A CD from Viper's Nest in the USA (VN-157) claims to offer the genuine stereo sound of the Glenn Miller Orchestra in early 1941. The band was in Hollywood filming "Sun Valley Serenade" and for the elaborate musical numbers (including "It Happened in Sun Valley" and "Chattanooga Choo Choo") 20th Century Fox's engineers tried out a new use of their three track optical recorders. Three track recording has been traditionally used by the movie industry to keep music, dialogue, and sound effects separate until final mix-down. This makes it much easier to produce different language versions of the movie. The Fox engineers used the three tracks to record different sections of the band and vocalists, and so give more flexibility during final mix-down to a mono music track.

Details of who exactly got hold of the original optical master tracks and how they remixed them into what the sleeve describes as "the original Glenn Miller Orchestra in true stereo" are sketchy. But the separation between vocalists, brass, and saxes sounds far more realistic than anything that could be achieved with modern electronic trickery.

The same goes for another stereo recreation, which was buried deep among the bonus options of a special edition boxed set of "Wizard of Oz" Laserdiscs released in 1990. Oz was made in 1939 and one of the musical numbers, Ray Bolger's "If I Only Had a Brain," had been recorded on several separate optical tracks from different microphones spaced around the sound stage. Brain was also one of the few songs that was pre-recorded with simple accompaniment and the full orchestra dubbed on later. This gave the re-issue engineers the chance to build a recording of the complete song and dance routine in stereo.

This poses the intriguing question: How much more "true stereo" from the pre-RIAA days is sitting on three track recordings in Hollywood's vaults? Now that Hollywood is desperately looking for any new way to re-package old movies with new DVD and Blu-ray "extras," there is always the hope of new old stereo discoveries. *ax*



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Jazz Track

By John Shand

Reprinted, with permission, from the November/December 2007 issue of *Australian HiFi* and Greg Borrowman.



Phil Slater Quartet|The Thousands|Kimnara NARA007

Weightlessness is not exclusively the domain of astronauts. The Phil Slater Quartet creates it with the phenomenal sense of suspension they achieve. The opening *Burden of Corners* has pianist Matt McMahon, bassist Lloyd Swanton, and drummer Simon Barker implying an insistent pulse, yet seldom overtly stating it, while Slater's trumpet shoots rapid-fire phrases across the rhythmic void. On the beautiful *Crest* there's a tinkling lightness of cymbals, piano, and bass against Slater's legato phrases and also during a three-way dialogue without the horn. *Tedium* has a Necks-like underwater piano figure, against which the percussion surges and crashes, while Slater delivers splintered lines of staggering power. *Rhyme of Knife and Mantra* drifts ominously, and *Lissom* levitates through its own velocity. These are the 21st century implications of Miles Davis's 1960s Quintet.

Paul Motian|Live at the Village Vanguard Vol 1|Winter & Winter|Birdland 910 133-2

Some creative people have a surge of activity in later life, urged on by time trickling away. Now 76, Paul Motian has surely been jazz's most prolific recording artist in recent years. Every few months there is a new disc with him leading one of his bands, or contributing his extraordinary conception on the drums.

This live CD is of the trio with tenor saxophonist Chris Potter and bassist Larry Grenadier, augmented by pianist Masabumi Kikuchi and alto saxophonist Greg Osby. It is a quintet which flares and floats with equal ease. Compared with some of the more rarefied studio sessions, the music is often energetic and the drums sound impressively fat. Motian may be jazz's ultimate expressionist, but he also burns when the music demands it.



Enrico Rava Quintet|The Words and the Days|ECM 1982

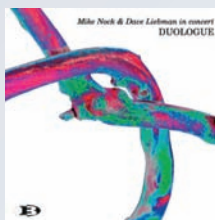
Trumpets can shout at you in scarlet joy, or tear at you in deep-sea-blue desolation. The three great contemporary European trumpeters—Kenny Wheeler, Tomasz Stanko, Enrico Rava—have created career-long blue periods, although Rava is more inclined to balance the wrist-slashing with some jollity. His quintet still has trombonist Gianluca Petrella, bassist Rosario Bonaccorso, and drummer Roberto Gatto, while pianist Andrea Pozza has replaced Stefano Bollani.

Rava can build sadness into his compositions, then perform them so his cries have a detached serenity, partly due to the roundness of his sound. At other times he just impales you on razor-sharp blasts. He can also swing. *Echoes of Duke* beckons a rambunctious foray from Petrella, before Rava slices across Pozza's splintered harmonies with wonderful rhythmic buoyancy.

The Mahavishnu Project|Return to the Emerald Beyond|Cuneiform Rune 242/243

There are tributes, and then there is love, devotion, and surrender. The Mahavishnu Project not only performs the fiendishly difficult repertoire of John McLaughlin's Mahavishnu Orchestra—the 1970s band that instantly made jazz-rock the domain of full-frontal virtuosity—it occasionally raises the stakes.

This third album concentrates on the most extravagant of all Mahavishnu releases, *Visions of the Emerald Beyond*, performed live and in its entirety—something McLaughlin never attempted. Brilliant New York drummer Gregg Bendian has assembled an 11-piece band capable of expanding the tunes' improvising potential, thereby spreading the original LP's contents across two CDs (with three extra tracks). The daunting guitar duties are thrillingly executed by Glenn Alexander, although singer Maria Neckam proves a weak link. Despite this, fans of the original band should definitely have a listen.



Mike Nock & Dave Liebman|Duologue|Birdland BL 009

Collaborators from the 1970s, pianist Mike Nock and saxophonist Dave Liebman were reunited and recorded at the 2004 Wangaratta Festival. The intricacy of their interaction is starkly evident on *Star Crossed Lovers*, as they constantly extend each other's ideas, so the melodic line is a sinuous, continuous whole, here colored by piano, there by saxophone. Liebman obtains a soprano sound that is intrinsically emotive and beautiful, while his mastery of timbre and vowel shape is so thorough as to routinely give his improvising a vocal dimension. Then there are the sudden squalls erupting out of the more languorous lines. Around it all Nock laces such an open weave that he is never corralling Liebman, but liberating him, just as his own glorious solos maintain relevance to the tune, without being hemmed in by it.

Kenny Werner|Lawn Chair Society|Blue Note 74896

The post-Magritte images on the cover suit Kenny Werner's music, in which initial impressions can be turned on their head. Werner has used synthesizers before, but the American pianist has never gone so far down the electronic highway as he does here. A past associate of Joe Lovano, Archie Shepp, and Dizzy Gillespie in a 35-year career, Werner now embraces computers to periodically treat the acoustic instruments, aid textural about-faces, or just to frost the edges of his music with peculiarity. Pull the plug on the computer, and a New York jazz aesthetic is firmly in place. Werner's quirky, surprising compositions and multi-faceted playing spawn thrilling contributions from Dave Douglas (trumpet, cornet), Chris Potter (tenor saxophone, bass clarinet), Scott Colley (bass), and Brian Blade (drums). A modern Blue Note classic.

