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Audiophile Attitudes

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Sound Practices

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This publication exists to encourage audio experimentation and to promote the exchange of related information. Opinions expressed are those of the authors and may not reflect the opinions of any other person or entity.

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Early 1993 Contents

More than meets the EYE

In principle, everybody seems to agree that live music should be the reference by which reproduction is judged. However, one of the great dilemmas which confronts the audiophile is that you get so good at listening, so perceptive of nuance and aware of the characteristics of the media, that you can't easily be fooled into believing there is live music in your room. Paradoxically, the better we learn to hear the farther we stray from oneness with "the music."

Our real break with the audio past is in the ways we listen, not in the new technologies we use. Through methodical self-reflection and meticulous training, the modern audiophile has learned to listen in new ways and for new things. In the 20 or 30 years we have been developing these novel uses for our ears, we have gotten very good at listening analytically and describing what we hear in a bizarre and specialized jargon which only makes sense to those of us in the club.

Because of the studious disbelief the audiophile brings to his or her armchair perception laboratory, critically listening to reproducing systems and critically listening to music have become two very different experiences with divergent criteria, procedures, and assumptions. In pursuing our analytical agenda, we impose templates on the listening experience which are alien to the experience of live music.

Audiophile phenomena irrelevant to live music are central in the evaluative frameworks we use to assess our systems' performance. Even the most crazed audiophile wouldn't describe an actual live performance as "musical." Did anyone ever say "Yeah, that concert had a great soundstage"? When we talk about music, even reproduced music, we talk about different things in different language than we use to assess reproduction. Relative positioning of sounds, image size, and intra-ensemble "air" are not a big part of what gives musical events meaning.

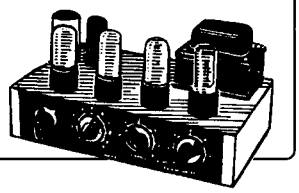
So when we praise our systems excellence at reproduction, we do so in language that highlights precisely those aspects where audio systems fail to pass for the real thing. In both appreciation and criticism, we focus on artifacts of reproduction rather than the musical or performative content of the reproduced material. With "real" music, many of the things we're searching for in our systems either don't matter or are taken for granted. It is only when we suspend "critical" listening that we can really lose ourselves in music. Music is about how well sounds blend together. Too often, we well-schooled audiophiles only focus on how well sounds can be isolated and differentiated. Strange business.

Since it's so *important*, some designers have optimized imaging capabilities to the detriment of "musicality"— a hotter buzz word than "imaging" these days and one worthy of serious discussion. Some music lovers feel that there's too little musicality in many 1993 state-of-the-art systems. Are we finally ready to admit it?

The direction finding/localization function of hearing is not an important component of my enjoyment of most music. Pinpointing images with our ears creates an unnatural division of sensory labor. Ears should be listening to music not localizing sounds. Ears aren't even that good at direction finding—that's why blind people carry sticks. At performances, I can use my eyes to tell where the performers are located, if I care. Good music often makes me want to close my eyes. An even more unnatural act is listening for the many ways in which space is distorted in reproduction— and it is always GROSSLY distorted. Usually not even close.

Visual perception is not an adequate model for musical perception. We don't really go to "see" a concert. Perhaps, all those allusions to photography and optics (focus, transparency, veiling, etc.) provided a convenient metaphorical framework to get a serious reassessment of reproduction moving, but they don't get us too far in our "search for musical ecstasy." Music is more than meets the eye.

New Products



VINTAGE HI-FI SPOTTERS GUIDE: VOLUME 2
Like Volume 1, this book consists of about 90 pages of reproductions of ads and manufacturer's literature on audio electronics and speakers from 1929-1963. Featured equipment ranges from the familiar (Mac, Heath, EICO, etc.) to the rather obscure—ever see a Brainard A-200 binaural amplifier? Compiled by collector Charles Kittleson, who provides some intro level historical commentary, tech tips, and collecting hints for the uninitiated. Available from ***Antique Electronic Supply*** or Kittleson himself. $14.95 + S&H.

CHARLES KITTLESON
PO BOX 691
BELMONT, CA 94002

1993 WELBORNE LABS CATALOG
The new 175 page, spiral bound ***Welborne Labs*** reference catalog features an interesting selection of kits and quality parts for vacuum tube and silicon enthusiasts alike. Ron Welborne is gracious enough to provide complete schematics and parts lists for all of the mods and kits he offers, including some refined mu stage Dynaco mods by Alan Kimmel. Also included are updated classic Acrosound designs and essays by Roger Modjeski on tube matching and why the sound changes when you change tubes. $10 US, $12 International.

WELBORNE LABS
971 E. GARDEN DRIVE, PO BOX 260198
LITTLETON, CO 80126-0198
VOICE 303-470-6585 FAX 303-791-7856

POWER SUPPLY FOR GARRARD/THORENS
Vintage gear expert Haden Boardman of ***Audio Classics, UK*** is offering a limited edition PSU which optimizes performance of the classic Garrard 301/401 and Thorens TD-124 tables. This novel unit consists of an oscillator driven 20 watt transistor amplifier transformer coupled to the turntable motor, providing precise speed regulation. Where were you thirty years ago?

AUDIO CLASSICS, UK
8 LOWE MILL LANE, HINDLEY
WIGAN, LANCASHIRE WN2 3AF, UK
VOICE 0942 57525 FAX 0942 525861

TUBE SUBSTITUTION HANDBOOK
Prompt, a division of Howard Sams bring us this latter day tube substitution guide compiled by William Smith and Barry Buchanan. Remarkably comprehensive, it contains many industrial and European tubes of interest to the audio experimenter and many you couldn't care less about. Basing diagrams are provided for all listed tubes. Unfortunately the authors have not discovered any previously unrecognized cheap substitutes for the 300B. $16.95 from ***Antique Electronic Supply*** or ***Old Colony Sound Lab.***

SINGLE ENDED 845 AMPLIFIER
Bel Canto Design, Ltd. is introducing a single-ended triode monoblock amplifier, called the ***ORFEO***, which uses the 845 triode. These class A amplifiers deliver 30 watts with a 3 dB bandwidth of 4 Hz to 40 kHz, less than 0.3 dB down at 10 Hz and 20 kHz. Distortion at 1 watt is less than 0.1%. The ***Orfeo's*** hand wound US made transformer provides 4 and 8 ohm secondary taps. This amplifier has two triode amplifier stages with the input stage using 12AX7s in a modified SRPP configuration for a low output impedance. No local or loop feedback is employed. The ***Orfeo*** is a third generation design with dual inductor input power supply filters, a balanced inductor input regulator supply for the 845 filament, polypropylene filter caps, and an input transformer which allows single ended or balanced inputs with isolated grounding to avoid system ground loops.

The tubes and electronics are mounted on a floating subchassis, much like an analog turntable, to prevent microphonics from affecting the output. This is a highly refined and powerful implementation of the single ended design concept. Other ***Bel Canto Design*** products include a high quality D/A converter, solid state and tube preamplifiers, and a solid state amplifier borrowing many single ended design concepts in an unusual circuit architecture. Information on these products can be obtained by calling John Stronczer at 616-668-5734 or Larry Harvey at 612-474-3718.

HI-FI WORLD
The April issue of this UK magazine is worth tracking down. It features a review of the Garrard 401 turntable, restoration hints for this classic table, and a short history of the Garrard company. A 30-page DIY supplement provides details on the construction of a modern version of the classic Mullard 5-20 P-P EI 34 amplifier, construction hints for the novice, and a primer which would be useful to the first time constructor. The project is presented in terms of the personal experiences of a few staffers who built this kit amp as a first project. Their excitement and sense of discovery is inspiring. Remember the first time you hooked up an electrolytic cap backwards?

Previous issues contained reviews of UK single ended triode amps and glimpses of exotic British vintage gear, including the Pye Mozart single EL-34 stereo amp. ***Hi-Fi World*** casts a wide net over the sea of audio practice and comes up with a highly refreshing grassroots orientation and a personal feel that is largely absent in the mainstream press in this country. Available at major newsstands or at the US/Canada rate of 52 Pounds yearly.

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SIREN SONG:

A PHONO PREAMPLIFIER FOR HEDONISTS

BY J.C. MORRISON

In philosophy, as in life generally,
it all comes down to what you like...

In his blueprint for the ideal state, Socrates advocated strict censorship of music, lest his citizens be tempted by "weak or voluptuous airs" and thereby be led to indulge in demoralizing emotions (Plato, *The Republic*, bk. III). The same principle is often invoked by the high-end audio press to legitimate the value of 'recommended components' or 'audiophile' recordings. Above all, these things must embody a certain "neutrality" if they are to be considered worthwhile.

For me, the zeal with which this inquisition is carried out recalls all the pomp and celebration of Dan Quayle's family values debate. Thank goodness someone keeps an eye on things!!! It seems that Puritan Hi-Fi is in. . .Bacchus beware!

Could it be that at times people vehemently reject a position, not because it *doesn't* recommend itself, but because it *does*, and because its acceptance threatens deeply held values in some important way?

So what about this siren's song, this un-neutral spell chant, this voodoo rhythm? What lustful impulses, whose earthy terrors, require such righteous and diligent policing?

A MODEST PROPOSAL

This article is dedicated to an openly and proudly libertine phono-preamp. You can build it yourself, or have me or your favorite someone do it for you. Its primary purpose is to play Billie Holiday just as 'enthusiastically' as it will Shaded Dogs or Sex Pistols. In other words, it's an instrument for those of you who like to play records. This design, which we'll call the "Siren Song," is specifically arranged for moving magnet type cartridges. Every effort has been taken to ensure that the performance of this device will be sentimental, agitated, maudlin, tender, but under no circumstances "neutral." This is not to say that it is unsophisticated or sloppy, rather that it tries, above all, to lure the joy out of your records, not sterilize them.

Perhaps a quick word about LP transducers is in order. . . moving magnet (MM) cartridges favor the midrange over the frequency extremes: the bottom is the loser and the top can be crunchy (Shure V15-VMR) or somewhat soft and rolled off (Grado Signature, Promethian). However, MM has a richer and more informational middle than moving coils. Some might say that it's *too* good. This quality, plus the higher output voltage makes MM more suitable for designer debauchery. There are wonderful MCs and tricks for making them sing, but that's another story for another time.

THE CHALLENGE

To my mind, nothing seems more impossible than a preamp, especially one which would satisfy the truly hedonistic listener. LP records contain an amazing quantity of subtle timbral information. This same information is subject to bombastic dynamic shifts, both upwards and toward silence. CD arguably has better dynamic range, from silent to earthshaking, but it doesn't compare on the informational scale. LP portrays both gracefully and with an even-handed balance. This has a lot to do with the lasting appeal and social durability of the LP (...not to mention real liner notes!).

However, dragging both extremes out of the grooves is a real challenge. The sensitivity necessary to hang on to the small, gentle stuff typically causes the preamp to jump in an overstated fashion when the thrashing starts. Likewise, the preamp that clamps on to those "roller coaster" records invariably damps away the little colors and edges one prays for. Compromise is *always* the case with preamps.

For clarity's sake, let me rephrase that part. . . highly sensitive preamps often exaggerate shifts in timbre and intensity in such ways that they "glare" (☹), "sing" (♫), or sound "better than life" (☺). Well damped preamps give us a tight, controlled, and punchy performance but often sound thin and generalized. The art in preamp design lies in understanding the line between these things. The line itself is unreachable because that line is REALITY—preamps are about illusion, not reality.

The criteria we use in our assessment of the hi-fi experience are rooted not in some 'pure objective measure of realness' but in an utterly contingent subjective value system. Reproduced sound is *symbolic of* not *equal to* "reality" (whatever that actually is. . .) The play of symbols and the pleasure of that activity is an aesthetic and moral activity. Without exception, design and evaluation of these reproducers is tied to the values we bring to the experience of sound reproduction. What is to be considered like "real" is subject to interpretation, regardless of what one would say or believe to the contrary.

Unfortunately for us hedonists, at present our musical ethos is under the skillful management of a journalistic elite whose ancestors came from cold northern lands, bringing with them a strict Protestant musical ethic. The Puritans of Hi-Fi preach neutrality, abstinence, self-denial, and economic penitence. The commercial world obeys, promotes, and elaborates on the gospel. We all know what side of the line they stand on: musical austerity.

These Audio Puritans are a smart and highly talented bunch. They are very good at what they do, and they present a coherent, logically argued front. Many converts have joined the puritanical fold. Their ministry is so pervasive that people look at you funny when you propose an alternative vision of the goals of reproduction. Come on, guys, loosen up a bit—take off your bow ties.

Having said this, a few other difficulties crop up that can really interfere with our lusty quest for harmonic narcosis. First off, amplifying devices are always imperfect: they blunt, ring, overshoot, and otherwise deviate from input signals.

Another problem is that a sensitive amp is sensitive to everything, not only the signals originating from the cartridge. Output signals persist which are completely unrelated and irrelevant to the input. In many cases, these undesired signals will trace their roots back to the AC line. Aside from the fact that AC is by nature a troublesome cause of hum in low level circuits, many forms of noise can be coupled into our sonic chain capacitively or inductively through the power line. Other interference signals also work their way in, the most important of which have thermal, mechanical, acoustic, or electromagnetic origins. The preamp exists in a complex and challenging physical and electronic environment which threatens ideal operation in many subtle ways.

The difficulty can be summarized in this way: an extremely high voltage sensitivity is required to portray the more subtle information the transducer supplies. But, high sensitivity leaves the preamp vulnerable to a wide array of interference signals and environmental influences.

Sensitivity in tubes is a function of transconductance. This is the measure of the control grid's influence on the current passing through the tube. A tube with a large transconductance will respond to extraordinarily small changes of grid voltage. This is why the 6DJ8 has been used in so many modern designs: it is actually ten times more sensitive than a 12AX7. The gain in a high transconductance tube is much more independent of changes in current. The gain in a 12AX7 can change 20% as a result of a similar change in plate current or load resistance.

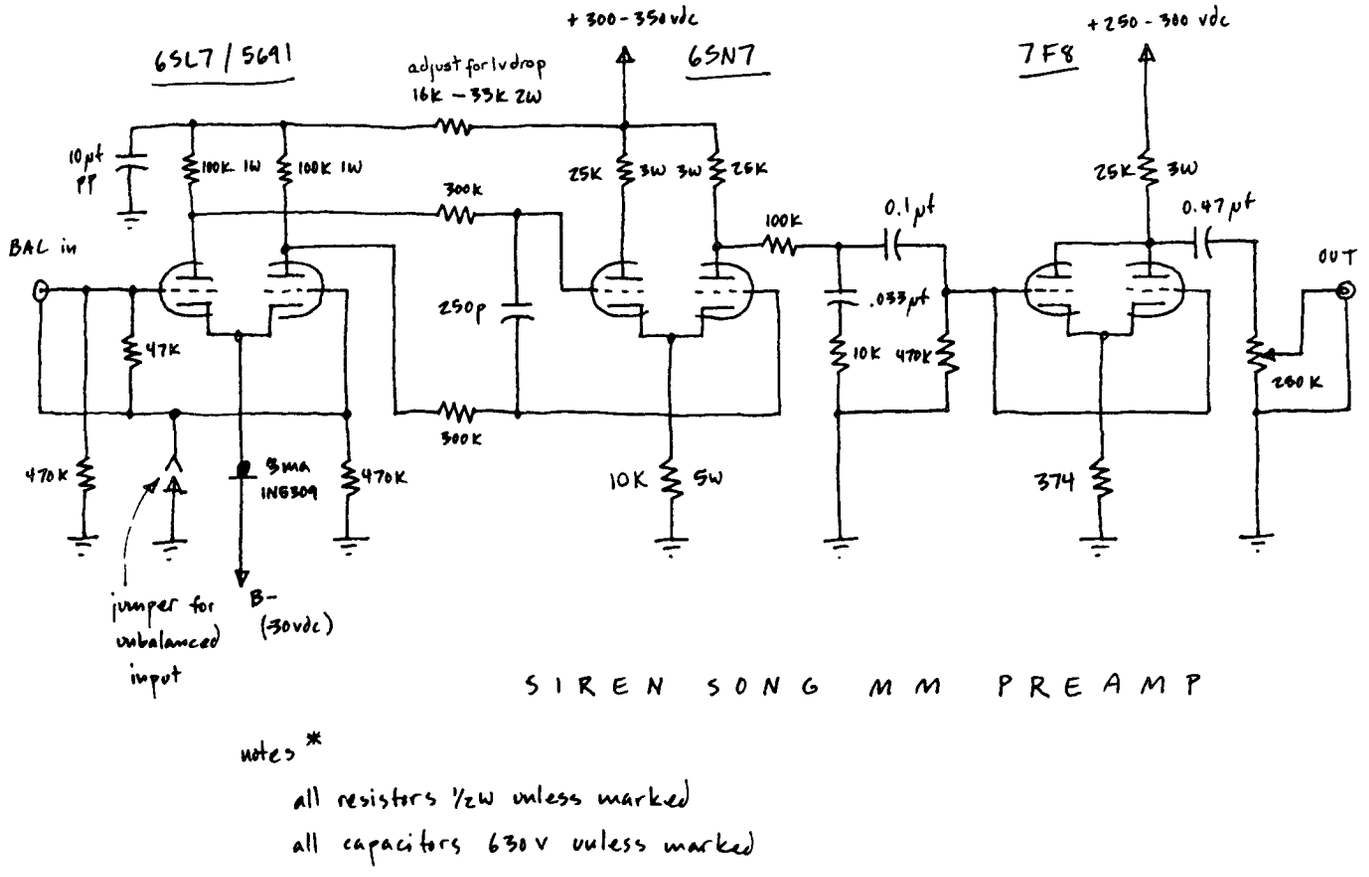
Sensitivity can be considered as the *susceptibility* of an amplifier stage to its input. The responsiveness of the first stage establishes the ultimate level of information resolution any given amp can maintain. In the low level signal environment, subtle but sophisticated mid and high frequency information will be glossed over unless great care is taken by the designer. High gain up front is essential in getting the signal into a more forgiving "size," but the overall distribution of gain and sensitivity must be cleverly managed if great performance is to be achieved. Too much gain and you get intrusive noise; too little and you get sonic mud. The first stage is the arbiter of signal quality and subtlety for the entire system. If it isn't right at the start, it can never be "fixed."

Negative feedback is the traditional fix-all for many of the problems which beset amplification devices. Feedback can also easily provide the damping and bandwidth necessary to cope with any gross dynamic quantity and many of the challenges of interfacing the device with its environment, at least on paper. Unfortunately, it usually spells death for delicacy and ambience. Recombination of unrelated signals is the ultimate blunting. Period. And one finds that, in practice, feedback provides only limited benefits as far as keeping interference signals under control (think of the PAS, Paragon, and Marantz 7C...).

A feedback amplifier is, by definition, *less sensitive* than the same circuit minus feedback. The amplification of feedback amps cannot be increased without limits to make up for lost sensitivity because at some point oscillation will unavoidably occur. This restriction is not present in an amplifier without feedback, although unwanted feedback and oscillation can sneak into the circuit anyway, and they often do.

So, while few makers of commercial audio equipment will admit it, designing a preamp is a thankless task and it always involves making some hard choices. Starting with a very small signal, we need 40 to 70 dBs of musical gain with imperceptibly low noise and distortion plus equalization covering the entire audible range. Yeah, right! Not as easy as it sounds.

Keep in mind that taking a product to market is no simple undertaking. In their quest for predictability and standardization on the assembly line, manufacturers face a set of special challenges that the hedonistic experimenter can happily sidestep. And many of the tactics on which the manufacturer relies are best avoided by the hobbyist who is interested in producing a one off, really tuned up unit.



For standardization and availability on demand, commercial makers must limit themselves to parts in current production, whether local, Chinese, or Bosnian/Hercegovinian. There are lots of top flight parts (most of them) which you can't go out and buy with 1993 date codes. The scavenger/recycler has an important advantage. If you're only building one or a few units, there is a vast range of prime quality NOS and surplus materials available at reasonable prices.

Overall, there are a number of concerns that the manufacturer must juggle which the adventurous home constructor can play with or abandon as they suit his/her goals. For example, conventional manufacturing practice almost always opts for: 1) ease and economy of manufacture, 2) standardization among samples, 3) adherence to the dominant, strict Calvinist musical ethic, and 4) "rock and roll" damping. All of these goals are attained in part through liberal application of feedback.

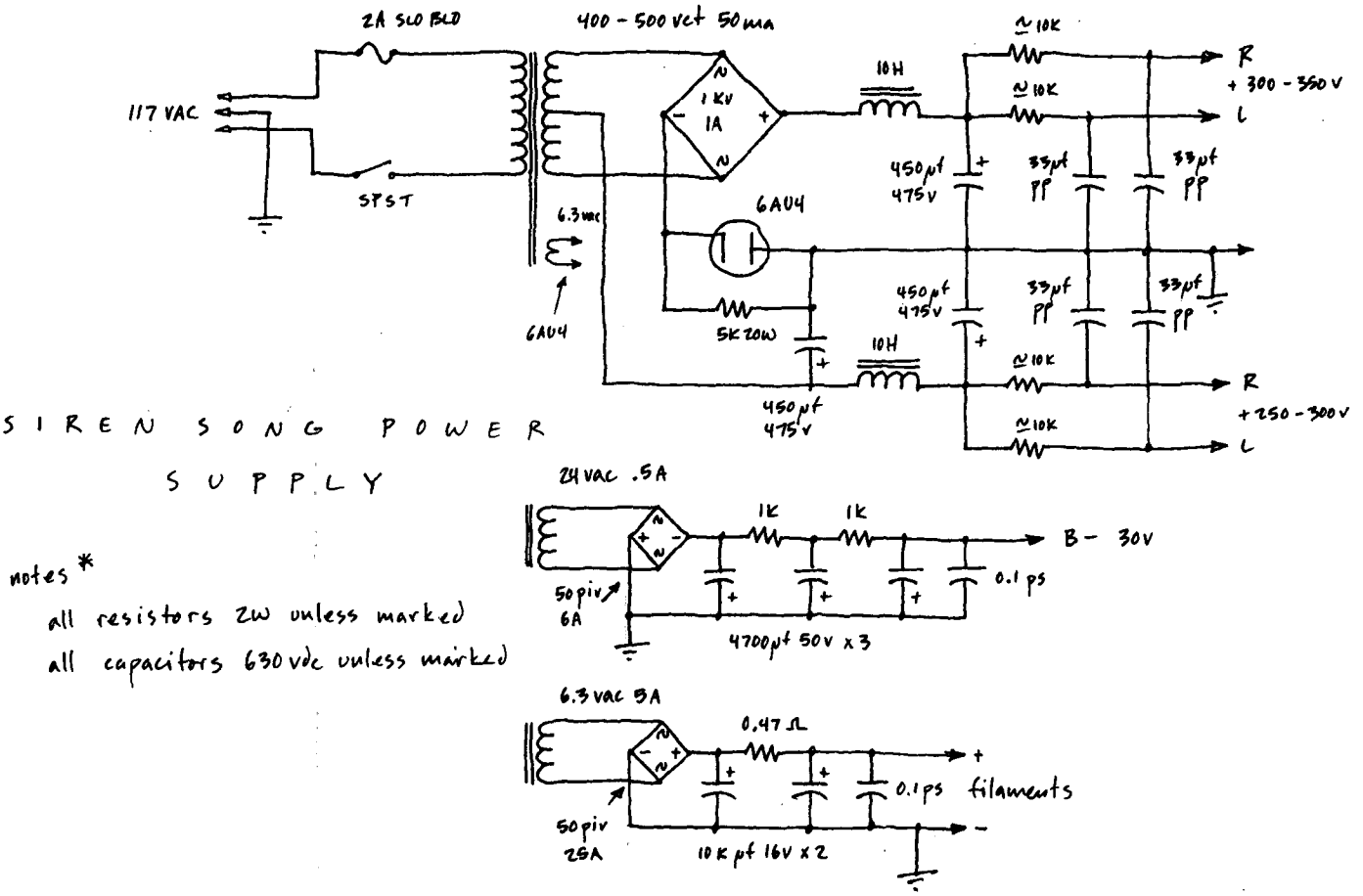
So, big league feedback is an invaluable tool for the manufacturer. It improves signal/noise ratio, bandwidth, and minimizes the effects of component variation. BUT, let us remember that there is NO free sonic lunch. Injudicious use of feedback is how all that "neutrality" comes about. The neutral (i.e., *neutered)* preamp can give a great impression of 'detail' (a category totally up for grabs...) but, nearly always sounds generalized and electronic anyway. The time domain problems of feedback have been mentioned elsewhere and these mutations bear heavily on the reproduction of naturalistic sound. Let's start over with a totally different approach based on a different set of priorities and strategies.

STRATEGIES FOR SONIC REBIRTH

First, we want high voltage sensitivity. The sensitivity of your *entire* audio chain must be increased (preamp and speakers first). That's right, just rip all the guts out of your Krell, Spectral, Mac C-22, or Marantz 7C. Save the mains transformer and the on/off switch. The chassis is reusable.

Second, if we must err, let's err in the direction of *joy and delight*. As difficult and unsettling as it may seem, you've simply got to expel those tweedy ministers of audio penitence and sonic self-denial from your listening room and your life. Let there be Audio Galvanism, not Sonic Calvinism. Base metals into gold, wine from water—that's what hi-fi ought to be! No way you're gonna get that alchemistic pagan vision from the respectable elders of the staunch conservative high end press. Expect to get kicked out of "proper" audiophile afternoon tea parties. No loss.

Next, line up all your tricks for some carefully considered selection and matching of circuits, tubes, and materials. You will be dealing with a narrow window of opportunity which can elude your efforts to identify and navigate. It can take a while before you come up with something that breaks on through to the other side. (Reread Kondo-san's article from SP #2 for insight and inspiration).

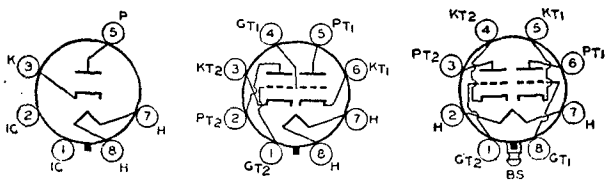


Last, and most important, invite your friends regularly for records, coffee, and eats and observe them closely for behavior which will validate your efforts, like expressions of bliss and uncontrolled foot tapping. This will ease your mind if you are still working to overcome high-end jingoism and fashion slavery.

DESIGN AND REALIZATION

The phono stage is shown in fig. 1. It is perfect for use with your line stage or it can easily drive most power amps as a stand alone unit. Output impedance is in the 5-7K range. The first two stages are balanced differential amplifiers, not push-pull stages. There are Epicurean reasons for this choice.

The effect of changes in the supply voltage is very large with a single ended stage. "DEbb" corresponds with "DEg = -DEbb/GmRl." Even when GmRl has a relatively large value (say 100), a change on the order of 0.1V corresponds to an equivalent "input" signal of a few tenths of a millivolt. This spells trouble in a high sensitivity single ended voltage amp stage.



Personally, I despise the effect voltage regulators have on tube preamps. The bass gets all big and amazing alright but what about the rest of the music? Perhaps it's a question of poor design or implementation in the mass-market stuff, but regulated preamps always sound bleached out and barren to me. Given the high power supply stability requirement for low level single-ended triode stages discussed above, and the musically detrimental effects of regulation which can give us this stability, it is almost mandatory to make the first stage of a sensitive preamp a difference amplifier.

Given the relaxed PS demands of the diff-amp, we can employ a nice choke input supply with a clear conscience. Choke input supplies provide excellent regulation and when used with good quality poly or paper/oil caps you can fully expect lovely results. For economy, electrolytics can be used in the first stage of the filter followed by "fast" caps in the second stage. I used a 6AU4 as a slow turn on device as shown in the PS schematic.

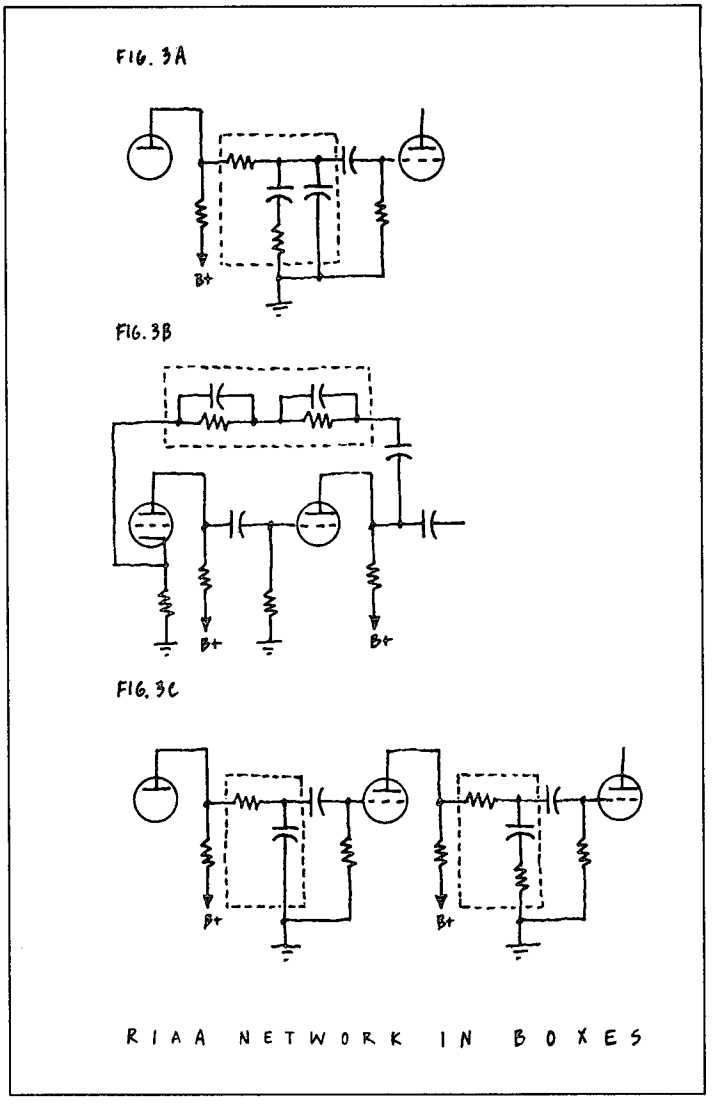
A differential amplifier can be imagined as a single-ended stage with its cathode decoupled by the low internal resistance of the cathode of a second tube, rather than by the low impedance of a capacitor. This decoupling is good all the way to DC, unlike a capacitor. While the decoupling tube operates in parallel 180 degrees out of phase, its balancing act doesn't hinder the lead tube: it is totally decoupled.

This arrangement has many applications and much to recommend it. You don't see it much because it's expensive compared to a single-ended preamp with feedback. Cascading differential stages provides the best common-mode rejection (noise rejection) of any circuit and absolutely no feedback is required to get it. This quality is preserved even if the signal is extracted from one side only several stages down the line (anywhere after the second cascade stage).

The input to this preamp is balanced. You will have to make up a phono cable with an XLR or similar three terminal connector if you want to enjoy the complete absence of hum a balanced phono line provides. For use with a standard RCA cable just connect the unbalancing jumper as shown in the schematic. The preamp is still extremely quiet when operated in the unbalanced input mode. In this preamp, the RIAA equalization is achieved with two simple but separate RC filters, each driven by a differential stage. My experiences with the other methods, feedback EQ and the popular combined passive network, have not really moved the earth beneath my feet.

If you examine fig. 3, you will find three different RIAA circuits; the first two are extremely common and well known. In fig. 3a, both the high and low turnover filters are cascaded together to make the popular combined passive network. My objection to this approach comes from the direct experience of trying to make it work. Complex networks such as these are hard to drive—just think of a power amp struggling with a fourth order crossover. The more reactive, or should we say, *interactive*, a network is, the more likely it will sound like a pair of typical modern multi-way speakers: dumpy.

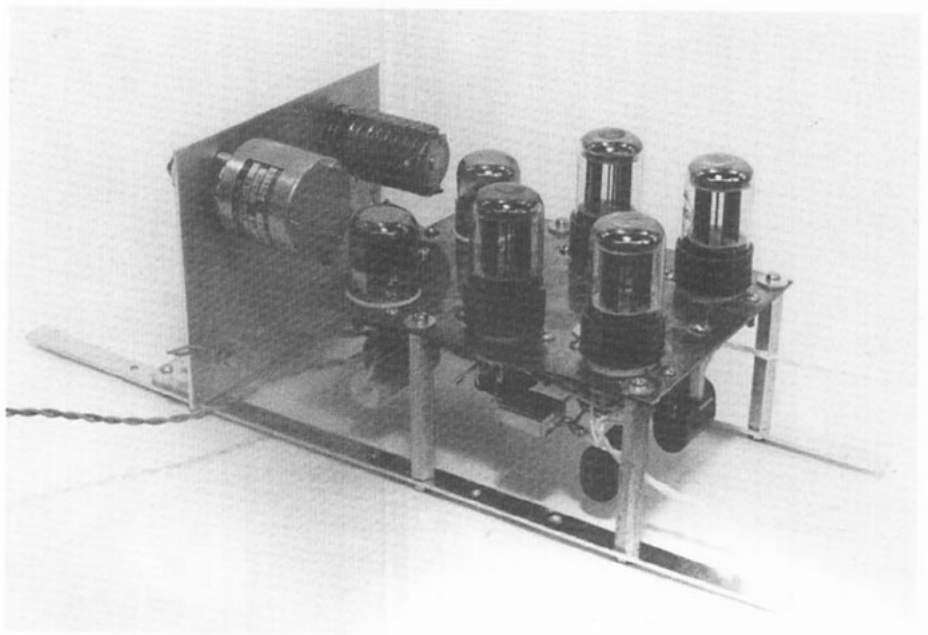
In figure 3b, you will find the popular feedback EQ circuit. Feedback EQ varies with the gain of the tubes employed. Deviation of 5 or 10% is commonplace, even with tubes from the same maker. This is in addition to the sonic difficulties associated with the use of feedback generally.



Split RIAA reduces network parts to the minimum number. The sound is relaxed and leaves space for big delights. The downside is that the loss introduced by the two filters is greater than that of the combined network. You will need more gain with this arrangement.

A careful examination will disclose that the signal sees a very simple path in this preamp. Three tubes, two caps, and three resistors including the volume control—no feedback at all. Take a close look at any popular collectible or currently fashionable preamp, tube or transistor. You are likely to be shocked by the quantity of devices you find in the signal path.

I have tried many, many types of preamp circuits: SRPP, mu followers, cascaded direct-coupled plate loaded/cathode followers, etc., in both self bias and fixed bias arrangements. They all have their merits, but this is the best sounding approach overall I've heard so far. The simplicity and freshness of plate loaded triodes with the symmetry of balanced circuits make a great combination.



Audio section mounted in test jig

As far as tubes go, it's hard to go wrong with some of the classic octal dual triodes. I like nearly all 6SL7s (or 5691s). Some 6SN7s can be a bit on the cool side. But the 6SN7 is one of the most linear amplifiers ever manufactured. Also, highly worthy of consideration is the 7F8, a loktal radio tube common at hamfests and as NOS surplus (loktal tubes in general are pretty deluxe in my book—the 6SL7/6SN7 can be replaced by their loktal versions, 7F7 and 7N7, so that all sockets can be the same). Some may be reluctant to try out these 'weird' tubes. However, they are easy to find in quantity for reasonable prices and the quality of available stocks is high. Note that the pin layout of the loktal tubes is symmetrical. This configuration lends itself to elegant and electrically sound wiring practice.

Parts quality has a great deal to do with the sound and fury of a design. Remember that the simpler the design is, the greater the influence of individual parts and circuit materials generally on the sound. We are dealing with an amplifier which will not disguise these effects, but will depend on them.

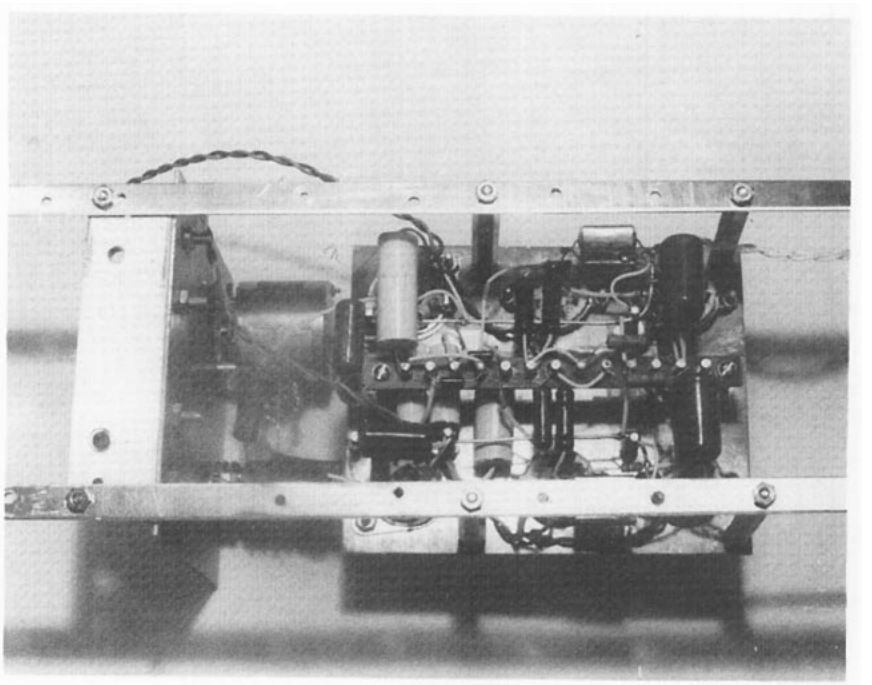
For resistors, I recommend that you always use wire-wound resistors, non-inductive if you can find them. The capacitors you use will also impart a distinct flavor to the resulting sound of your project. Metallized caps are worst. Film and foil, regardless of favored insulator, are always better sounding. Powder, dust, chunks, and aggregates are precisely where "grain" (a completely weird and overworked metaphor if there ever was one...) comes from.

Avoid "graininess" in the literal sense when choosing your materials. The material that sits in the signal path matters most, so spend your money wisely if you're on a limited budget.

Wire is a fascinating subject all by itself. The jury is far from in when it comes to what is good and why. I found that solid core wire, copper or silver, has an earthy, tangible sound to it. At one time, I had a system that was solid-core wired from the turntable to the speakers, and it possessed some of the most tactile sound ever to visit my home. However, it was definitely at a loss in portraying "air." These days, I mix solid-core and stranded wire in my system, moving from finely stranded at the cartridge to solid-core at the drivers. I lost a bit of that "weight" I heard with all solid-core but it is much more delicate in the more critical middle and top with a blend of wire types.

DESIGN CHOICES

The choice of a 6SL7/5691 as the first amplifying device is worth elaborating on. The first stage has more influence on the basic character of a system than any other part except the speakers. This is a high mu (lots of gain) triode of exceptional linearity. Reliable and rugged, its various forms and mutations make an interesting study in tube lore and they all sound just a little different. These qualities, plus the nearly lewd emphasis on midrange warmth this tube brings to the party, make it an ideal candidate for an input tube. If the record has anything good going on the middle, this device will have a field day with it.



This choice also represents the single most important compromise in this design. In order to get the necessary gain in the first stage, while maintaining a low noise floor and low distortion, we must accept a reasonable loss of transient information. The 6SL7 doesn't have the transconductance to compete with a 6SN7, 6DJ8, or 12AT7 in this regard, although it is marginally better than a 12AX7. A touch of 'softness' in attack and decay is a small price to pay to avoid feedback.

The impact of this design decision errs totally on the side of delight. The 6SL7, as a plate loaded amplifier, imparts a 'Rubenesque' shimmer to classical music and Opera. The industrial 5691 is THE *ne plus ultra* voltage amplifier for vocal music! (Blues!) We are concerned here with nuance—the tonal balance is close to perfect (the tube is very linear) but slightly forward and more lacy (sensual) than real life. This tube can make bad recordings sound okay.

Note that the 6SL7 is current-sourced. This is important because it provides an increased measure of isolation from the power supply and lower harmonic distortion. The 1N5309 is a Motorola part of high quality—1N5309s can be hard to find; try Homemade Electronics. I am not anti-solid state. I am pro-whatever it takes to make it rock the house. FET current sources work real good. A current source is vastly superior to a resistor in this application and I was very happy with the improvement it provided.

The stages which follow can be much more grid sensitive because we will be dealing with a signal of greater amplitude. A 6SN7 is next in line. It has double the transconductance (3200 umhos) of the input tube. The 6SN7 is the laboratory standard; what goes in is what comes out. It imparts an earthy tangibility to the performance of the preamp and complements the ethereal sweetness of the 6SL7 very nicely.

6SN7s have been unjustly criticized as cold, dry, or overly analytical. Perhaps the overuse of this tube as popularized in the classic Williamson circuit merits some blame for this misconception. One should never use the same type of tube more than once in any system to avoid additive effects. In some cases you can have one stage of a particular tube in a preamp and one and *only* one additional stage using the same tube in the power amp, but this is pushing it. Cascading the same tube type simply multiplies both the flaws *and* the graces. You can get too much of a good thing and that's no good. [Ed.- Thought you were a hedonist! *Poseur*!]

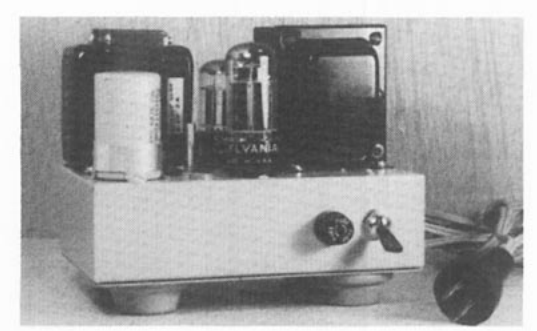
The 6SN7 is probably (along with the 5687 and 6CG7) one of the most linear common audio voltage amplifier tubes. It is really even handed, but gang two or more together and they can rip your ear drums apart. 5692s are warmer but tend to be microphonic so you will have to select them carefully for preamp use. Among 6SN7s, the GE 6SN7GTBs with a side getter and the Sylvania WGBs are my personal favorites.

The third and final stage of the preamp has a particularly demanding role because of the way RIAA equalization is implemented in earlier stages. Most of the actual gain the entire circuit provides comes from this tube. The 7F8 is a Class A RF dual triode that offers relatively high gain *and* high transconductance. The input capacitance is controlled for RF applications and this makes it useful as a wideband amplifier. This is actually a great candidate for an input tube also, but I'll let *you* build that one! In this circuit, both sections of the tube are paralleled to lower source impedance and increase sensitivity. The 7F8's basic character is punchy and focused. It adds drama and a gilt edge to the 6SL7/6SN7 combo.

The power supply is very straightforward. You can practice whatever religion you adhere to. If you're unsure, just do what you see in fig. 3. Be sure to keep the phono stage well isolated from the power supply. Build a separate box if you like (your stripped out Audio Research preamp might do nicely...). Forgive my lack of enthusiasm for well known names and collectibles. The ideal musical preamp has NOT been 'discovered' by the Big Guys of the commercial audio world. This is not to say that it can't be done, but the priorities of the business world do not always completely overlap those of the lover of music and records.

It is important to begin fresh, and the first thing before us is to put some miles between our music and "neutrality," whatever that really means. Preamps, amps, and speakers are a platform for our obsession with music and art, not a faceplate for some ascetic moral position.

THE AUTHOR
J.C. Morisson inhabits the basement workshop at Fi in Lower Manhattan where he subsists on a diet of cold coffee and solder fumes. His projects include artisanal electronics and high sensitivity speaker systems for the hedonistic audiophile.



A 5 WATT 6BX7GT TRIODE AMPLIFIER

by Ed Warden

Here's a simple push-pull triode amplifier I built while I was snowed in during the Great Blizzard of 1993. It provides the silky smooth and vivid sound that triodes are famous for. At 5 watts output, it is a practical amplifier for use in an apartment-sized living room when speakers of reasonable efficiency are used.

This project would provide the newcomer to tube amplifiers an excellent introduction to the advantages of triode output stages. For those of you who are thinking of taking the plunge into triode amps, but remain unconvinced of the real world capabilities of low power triode amplifiers, try this one. This is a project that can be constructed for a minimum outlay of cash which will give you a taste of what it's all about. At comfortably loud (i.e. civilized) volumes, it is a joy to listen to with my old Jensen bass reflex speaker.

The amplifier will provide 5 watts output without clipping using a sine wave test signal. Using a music test signal, the amplifier will provide 6 watts on peaks without clipping. Fixed bias instead of cathode bias is used in order to reduce distortion and to provide a slightly higher power output.

As indicated on the schematic, a B+ plate supply of about 300V should be used. If a much higher voltage (e.g. 400V) is employed, crossover distortion will result because the increased bias voltage required to keep the total plate dissipation within the 12 W rating will move the operating point of the 6BX7 into a non-linear region.

The bias pot should be adjusted so that 0.34 V is measured across the 10 ohm resistor at the cathodes of the 6BX7 under no signal conditions. This will result in a total plate dissipation of about 10 watts and it will put the 6BX7 into a linear operating region.

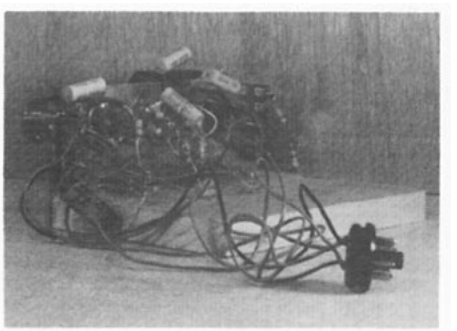
I tried 6 dB of negative feedback in my amplifier but found that it sounded better without it. The distortion of the 6BX7 is already very low without negative feedback. I thought that feedback gave the amp a slight "muffled "sound.

A 1 V RMS input signal will drive the amp to full output. Without any negative feedback, the frequency response of the amplifier is within 1 dB from 10 Hz to 20 KHz at 1 W output.

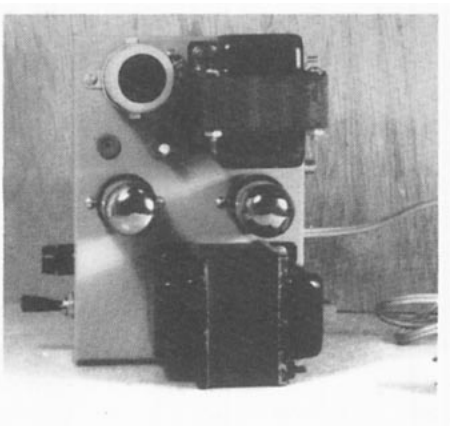
I used the output transformer from a junked Fisher integrated amplifier. I estimate the power rating of the transformer to be about 25 watts—overkill for my amp. The load impedance of triodes is not critical. Any output transformer with a primary impedance of around 5K to 8K should work fine. The output transformer I used measured about 5.5K. A higher load impedance will give you slightly less distortion with a slight decrease in output power. It should be easy to scavenge suitable iron—outputs from just about any 6L6, 6V6, or EL84/6BQ5 amp will do. All other parts are available from Antique Electronic Supply, Radio Shack, or Allied Electronics.

Time required to breadboard the amplifier was under one hour. After testing my circuit on the breadboard, I built the final product on a 5" X 7" X 2" steel chassis as shown in the photo. I built the chassis based amplifier in about four hours.

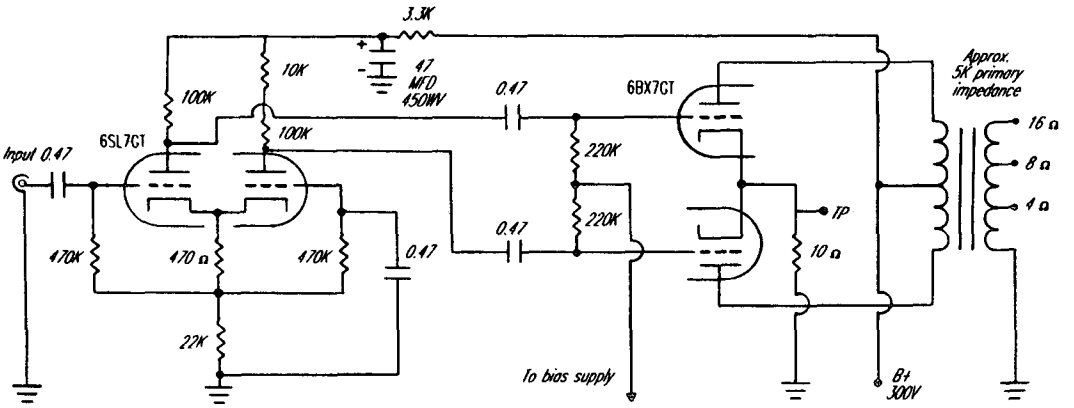
Note that a 10K resistor is in series with a 100K resistor in the plate circuit of the right half of the 6SL7. In this type of phase inverter (cathode coupled Schmidt type), the total resistance in the second half of the tube should be about 10% higher than the plate resistance in the input section in order to obtain equal amplitude signals from both of the phase inverter's outputs. This type of phase inverter has excellent characteristics with respect to low distortion, low phase shift, and equal frequency response for both outputs.



Breadboard set up for testing



Top view of finished amplifier. Note bias test point and bias adjustment pot located next to filter cap.



T1— 650VCT @ 40 ma, 6.3VCT, 5V, Allied Electronics #6K3VG or equivalent.

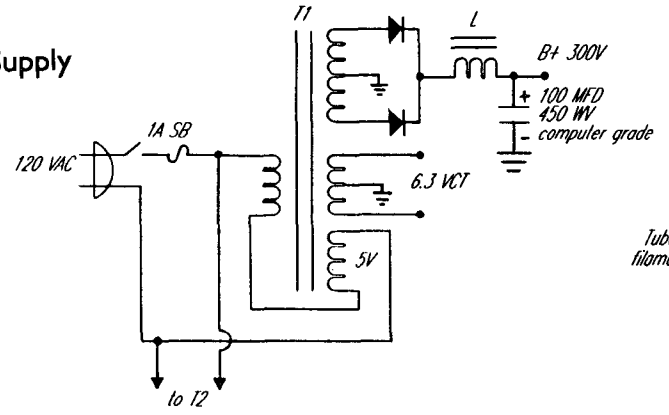
T2— 25.2VCT @ 450 mA Radio Shack #273-1366.

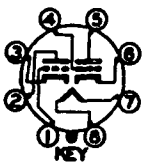
L— 8 H @ 60mA, Antique Electronics Supply #PT-151 or equivalent.

Diodes are 1N5408 (1000 V, 2A), 1N4007, or similar.

All resistors are ½ W carbon film—except where indicated Signal capacitors are 600V plastic film type.

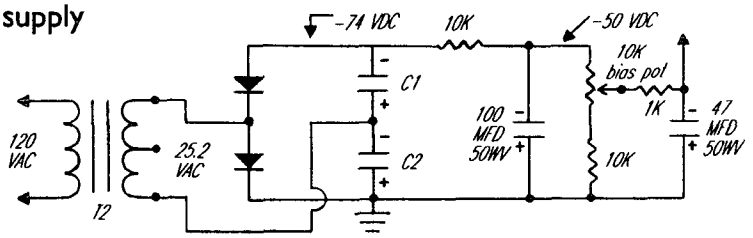
B+ Supply





Base Diagram
6SL7 and 6BX7

Bias supply



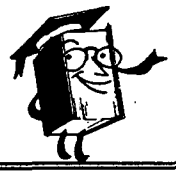
C1, C2— 100 mfd @ 50VDC

NOTES ON POWER SUPPLY

The 5 volt winding is connected in series with the primary of T1 in order to reduce the output voltages slightly so that the B+ will be 300V and the filament voltage will be very close to 6.3V. Without this connection the output voltages were a bit too high with the particular transformer I used.

If output voltages are much higher than indicated *under load*, reverse the connections of the 5 V winding. One way boosts the output voltage, the other way lowers it.

Be sure to observe correct polarity of diodes and electrolytic caps.



from the archives

Passive Crossover Networks for Bi-Amplifier Systems

by Blaine B. Kuist

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

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

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

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

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

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

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

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

SETTLING ON FILTERS

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

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

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

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

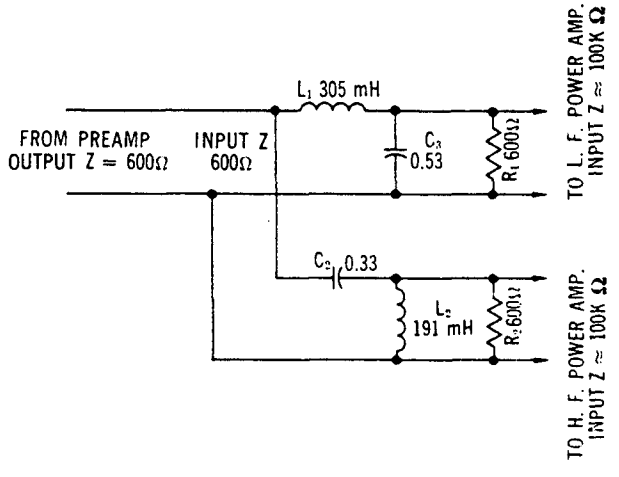
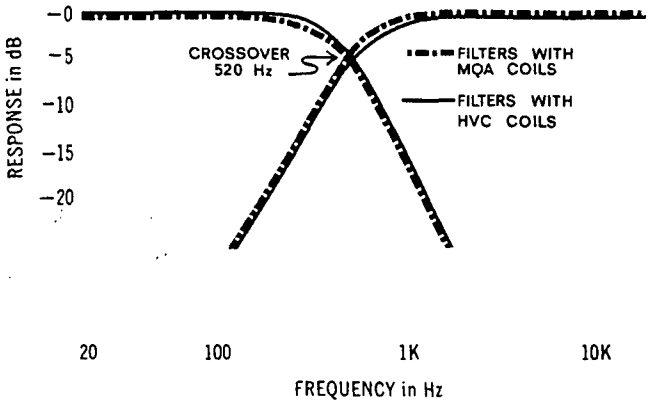


Fig.2— Frequency response curves for the author's passive networks.



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

TABLE I: Comparison of Crossover Alternatives

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

The component values are derived from these formulas:

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

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

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

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

Where R_o = filter characteristic impedance
fc = crossover frequency

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

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

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

A description of the coils used follows:

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

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

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

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

FILTERS ASSEMBLED

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

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

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

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

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

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

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

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

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

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Casual Reactions

by Herb Reichert, Eddy Electric

THE NEED TO PARTY = POTENTIAL DIFFERENCE

About ten years ago, I decided to try to learn electronics so I could build my own amps. I bought a book called *Electronics Made Simple.* A week later, I had to buy a book called *Mathematics Made Simple.* It seemed I couldn't learn electronics without mastering some math concepts. Woe to a misspent youth! If I could have bought Kenn Amdahl's book *There Are No Electrons: Electronics for Earthlings,* I would have known that an amateur can understand electronics better than a pro—without doing a single calculation.

When someone suggested that I review a book where the tireless "need to party" of imaginary beings called "little greenies" represented voltage, I thought I was hitting a premature journalistic bottom. To my surprise, I learned an amazing amount rethinking what I already knew, things that I had learned the hard way.

It works like this: the chicks buy the kegs of beer and turn up their radios. The brothers hear that rock and roll, get in their little green cars, and motivate toward the music. That's current. If there are a bunch of greenies cruising down a wire, you can bet they are heading for a party. Now that you have the concepts of voltage and current, you can read on to discover resistance (traffic jams), heat, work, circuits, swimming ducks (magnetism), pale skinned magicians, jargon, and the beautiful and sensuous Belinda.

This book uses wonderful stories to elucidate difficult concepts. At the end, the reader "owns" these electrical concepts. More importantly, a person in possession of the author's conception will find the world more exciting and magical. *There Are No Electrons: Electronics for Earthlings by* Kenn Amdahl, © 1991, 321 pages, $12.95 (ISBN 0-962-7815-9-2) is available direct from the publisher:

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PO BOX 1153
ARVADA, CO 80001-1153

MIKEY SAYS : "WHODUNIT?"

With audio mags I always read the ads and manufacturers' comments first. Maybe it's like finding out "whodunit" before starting the book, but it's fun. In 1992, Audio Note "done it" with their ads in the back of *Hi-Fi News and Record Review.* Silver foil caps at $1400 and Black Gate caps at $100!! Everybody must have stopped there for a minute. What's next though is just as wild—oil and paper caps at $7 and single ended output transformers for around $160! Compared to Vitamin Q and Tango this seemed a bit on the cheap side. Could they possibly be any good?

I was happy with the Tango and Black Gate products I had been using for years, so I decided to wait until somebody else tried the Audio Note products. Why should I be the first sucker? Here's why—I have a SE amp that allows me to change transformers and coupling caps as quickly as I can change a record. I also have an SRPP passive EQ preamp set up so that I can change caps while the music is playing. That makes me "Mikey," as in "Let Mikey try it: he'll try anything."* Well, in case you were wondering. . . the editor sent me some Audio Note paper-in-oil caps and a pair of A.N. 300B SE outputs.

I compared the oil caps to my reference: Component Research teflon caps. I also compared them to MIT Multicaps (RTX), RT Rel Caps, Roederstein MKP 1845s, and Sprague 192P Vitamin Qs. I auditioned them at both low (preamp) levels and high (power amp driver stage) levels.

In my experiments, I've found that caps usually add a "flavor" consonant with the material of their dielectric. That is, if I were to make little bells out of teflon, polypropylene, polystyrene, and oiled paper, the sound of each would be similar to the coloration each adds to the musical tones. This leads me to speculate that the AC signal is an electromechanical shock wave that excites the resonant quality of the material it passes through. "Well," you say, "the paper and oil probably adds the least to the sound. Those oiled paper bells don't ring too loud." Sure enough, I applied a lot of energy trying to ring them but they simply absorbed the energy from my wrist.

What I mean to say is that oil caps like Vitamin Qs used at low signal levels always gave me dulled transients, a loss of information, and a reduced sense of pace and timing. Tired musicians? But oil caps also provide a beautiful, easy, relaxed quality that is very seductive and "natural." They work well at amplifier signal levels but for preamps, forget it. Death.

Plastic caps always sound like plastic. Polypropylene sound best at high levels and polystyrene at low levels. Teflon almost disappears at any signal level. So I often use teflon at low levels and oils at high levels, working for a pleasing balance. At retail, both of these types cost $20-$40 each. I found that the Audio Note paper-in-oil caps have the speed, transparency, and vanishing qualities of teflon combined with the natural ease of oil caps. Plus, they work everywhere. Mikey likes them. Finally, an oil cap with *life*!

I liked the single ended 300B/2A3 outputs too; in fact, the caps and the transformers seemed to have been made by the same hand. They both have the best qualities of what we sometimes call "the UK sound." If you have a Linn turntable or a pair of LS3/5As, you already know the character of these outputs. In fact, I'd bet the Linn deck, LS3/5As, and 300B SE amps with the Audio Note trannys would make a great little system. To be more specific, the AN transformers were extended but definitely light in the bass, a little bit thin through the mids, almost perfect in the highs, and outstanding rhythm masters overall. As the Brits say, "Very tuneful." As the Americans say, "Best buy."

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HOVE BUSINESS CENTER
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VOICE 0273 220511 FAX 0273 731498

ANGELA INSTRUMENTS, 10830 GUILFORD RD.,
ANNAPOLIS JUNCTION , MD 20701
VOICE 301-725-0451 FAX 301-776-2892

* Interesting hobby there, Mikey.

A ONE-TUBE REGULATOR

by Mike Vans Evers
Clarus Recording Products

Tube regulators were invented in the 1930s to replace the bulky battery power supplies used with scientific instruments. There were many types, some simple, some complex. The regulator presented in this article is of the simple variety: one tube. The benefits of a single tube regulator are simplicity, compactness, low cost, and minimal heater supply requirements. The disadvantages are limited output current (about 35 mA for the unit described here) and only moderately low output impedance compared to more complex types.

"Why tube regulators?" you're asking yourself. Well, there are good reasons for and against. Some people like the sound of unregulated supplies because "raw" supplies sound more warm and tubey. Others like the sound of regulated supplies because they feel that regulation gives the sound more impact and focus. Some prefer the sound of tube regulators because they find that tube based regulators sound more natural than the solid state variety. All elements in a design affect the sound of that design. The power supply is a major element in any design. The decision to regulate or not to regulate will ultimately be decided on the basis of the resulting sonic qualities—hopefully.

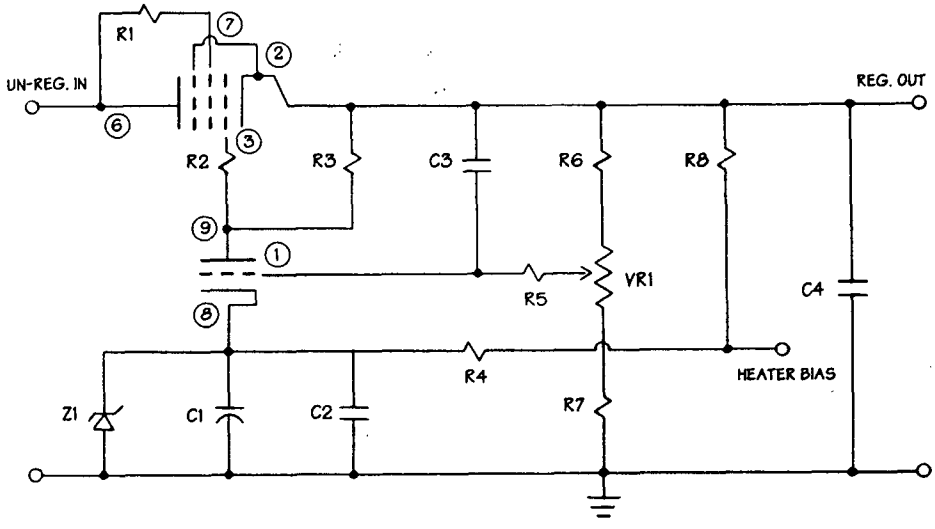
The tube used in this circuit (Fig.1) is the 6BM8/ECL82. It is a power pentode and high mu triode in one envelope. The pentode element is used as the pass element. It is triode wired to reduce its internal impedance, which in turn lowers the internal impedance of the regulator. This pentode has an amazing maximum plate supply rating of 900 volts. Because of the high plate supply rating, silicon diodes can be used for rectification with minimal danger of cathode stripping. Also, since the 6BM8 is an indirectly heated tube, it will provide a slow turn-on characteristic.

The triode section of the 6BM8 is used as the error amplifier. A voltage divider is placed across the output of the regulator in order to sample the DC output voltage. This DC voltage is fed to the grid of the error amplifier.

Because the voltage divider decreases the output voltage to the proper range for input to the grid, it also proportionately reduces the amount of the regulator's residual ripple seen by the error amplifier. This is not good, so we bypass the voltage divider with a capacitor so that all of the ripple is seen by the error amplifier. The cathode of the error amplifier is held above ground with a zener diode. Of course, 50 years ago they used reference tubes like 0A2s to do this, but they take up lots of space and they don't provide as reliable a reference voltage as a zener diode does with only a few mA of current.

The value of the zener can be changed to vary the range of output voltages up or down. However, the maximum heater to cathode voltage is only 100 V, so the maximum output voltage should be limited to the zener voltage plus 200 V.

Zener diodes are noise generators and their internal impedance is far from zero. For these two very good reasons, the zener diode is bypassed with a combination of electrolytic and film capacitors. The plate resistor for the error amplifier is connected to B+ regulated instead of the more usual connection to B+ unregulated. Taking the error amplifier's plate current from the regulated output improves the regulation, while using only a minute portion of the available output current of the pass element.



R1 - 470 - ½ W
R2 - 10K - ½ W
R3 - 270K - ½ W
R4 - 62K - 1W
R5 - 10K - ½ W
R6 - 220K - ½ W
R7 - 120K - ½ W
R8 - 100K - ½ W
VR1 - 100K ½ W 10 turn
C1 - 33µf/250V
C2,3,4 - 1µf /400V polyprop.
(#) tube pin number

Fig. 1— A one tube 6BM8 regulator circuit

When the maximum current is needed from this regulator, B+ unregulated must be at least 70 volts higher than the regulated output. This condition is progressively relaxed as current requirements are lessened, i.e. the less current you need, the fewer volts have to be thrown away across the regulator.

If you decide that you don't like regulation after all, you can rewire this circuit as a nifty line stage with 12 dB or more gain (Fig.2). This circuit will drive 600 ohm 'phones admirably. We may offer stuffed circuit boards, tubes, and kits to those adventurous souls who want to explore the world of tube regulators. For more information, write me care of Clarus Recordng Products, 1248 E. Hillsborough Av., Tampa, FL 33611.

ZENER DIODE SELECTION GUIDE

Voltage rating vs. desired V_{out}

ZENER	Min V_{out}	Max V_{out}
75V	140	240
100V	205	300
120V	240	320
150V	310	350

Do not exceed Max V_{out} listed above for a given zener rating even though adjustment above this value may be possible.

Five watt units are suggested for all zener values above. A 1W zener will work fine electrically but 5W zeners will provide for lower noise performance.

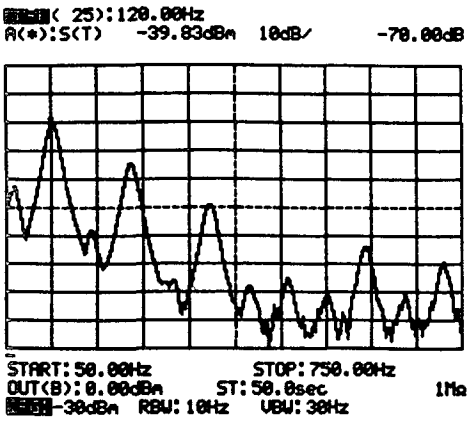
MEASURED REGULATION

from no load to load = RI

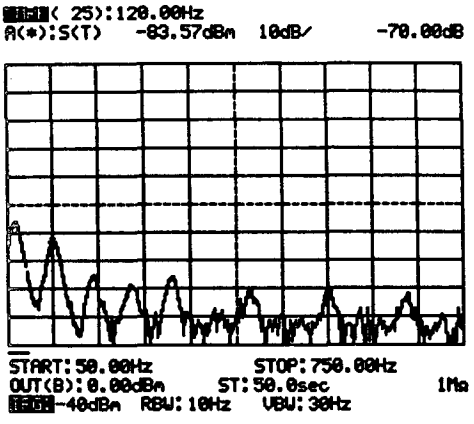
385 V_{in} / 300 V_{out} @ load = RI

Stability from line variations is less than 0.23% change under above range of conditions within an input voltage range of 358 V - 412 V.

RI (ohms)	% change in Vout
50 K	0.096
45 K	0.10
40 K	0.13
35 K	0.13
30 K	0.14
25 K	0.16
20 K	0.19
15 K	0.32
10 K	0.33



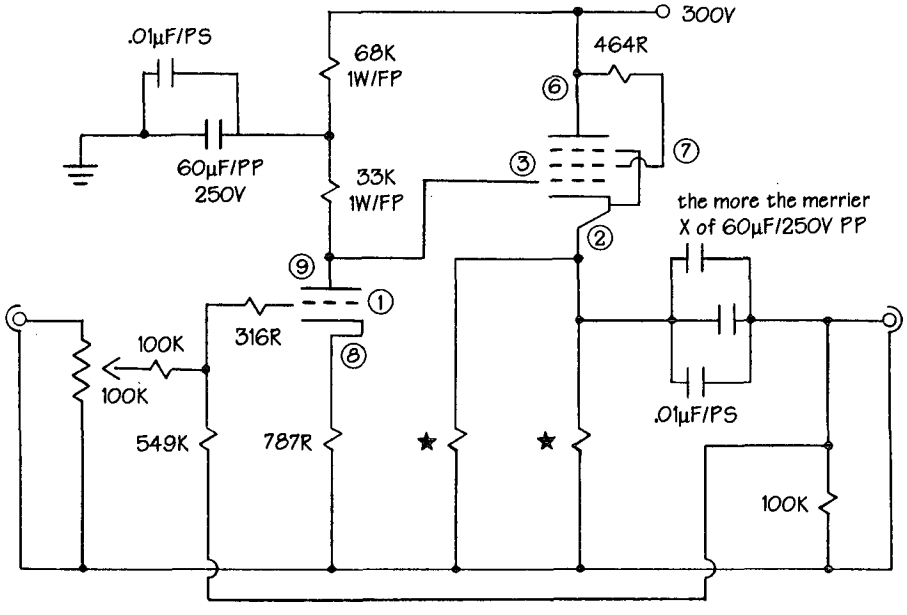
Noise spectrum - Pi filtered unregulated DC



Noise spectrum - 6BM8 regulator with *pi filtered unregulated DC supply*

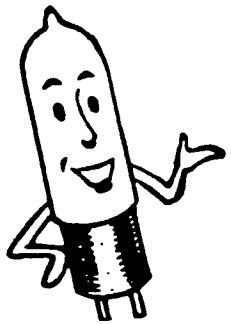
Left: These graphs are spectral analyses of the noise and garbage seen at the output of the 6BM8 line stage described below with a) an unregulated pi-filter supply (80 mF + 50 ohm 10W wirewound + 100mF) and b) the 6BM8 regulator described above installed after the pi filter.

A 40+ dB drop in noise and line harmonics will make the background much quieter, thereby letting much more low level detail through.



★ for line only- 2 of 10-12K 5 or 10W ea.
for 600Ω phones or line- 2 of 8K 10W ea.

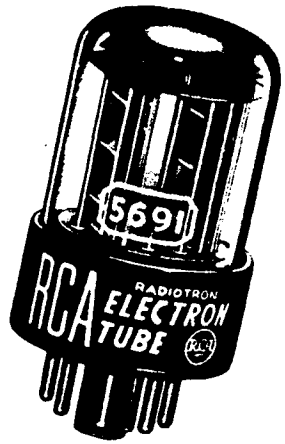
Fig. 2—Schematic of 6BM8 line amplifier derived from the one tube regulator circuit.



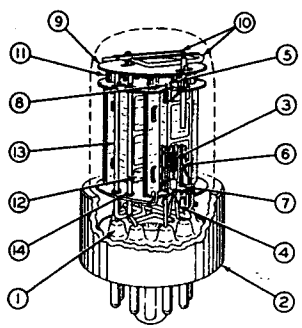
Meet the Tube. . .

RCA *Special Red* TUBES

5691, 5692, 5693



1— Low-leakage button stem.
2— Non-hygroscopic base
3— Pure tungsten heater for high mechanical strength
4— Sleeves on heater legs insure good mechanical and electrical bond between heater and heater leads.
5— Cathode sleeves locked to mica insulator.
6— Grid plated to minimize variation in contact potential.
7— "Stops" prevent vertical movement of grid rods.
8— Grid rods fit tightly onto mica insulators.
9— Extra mica insulator provides getter shield.
10— Two getters for long life.
11— Plates held rigid by plate ears wedged into mica insulators.
12— Plates are designed to minimize electron coupling between units.
13— Mount secured by five supporting rods.
14— Twelve reinforcing eyelets provide a firm bond between mica insulators and supporting rods.



Internal Structure of RCA-5691 and RCA-5692

Sometimes it pays to put your money up front. Like when a $3 part failure can shut down a million dollar operation or cripple vital national defense systems. Or where replacing that $3 part could cost hundreds or even thousands in maintainance fees. Back in the early Sixties, when a garden variety 6SN7 cost $2.60, the 5692 Special Red version went for $8.75. Small change compared with a Saturn V rocket crash or accidental launching of a few ICBMs. The RCA Special Red tubes are parts for applications that matter. They are rated for 10,000 hour service where "extreme dependability and exceptional stability are paramount."

When you see one, you'll recognize that it's SPECIAL at a glance. Bases are bright firehouse red. Internal construction is also top notch. Extra mica spacers and vertical support rods provide mechanical integrity for applications where vibration and high G forces (rated for 500g impact!) are encountered. Everything is braced and tightly connected together. Heaters of the twin triodes are wired in series for fail safe operation. In terms of build quality, they are in a select class among small signal tubes.

There were four red tubes: a high-mu twin triode, 5691, a medium mu twin triode, 5692, a sharp cutoff pentode, 5693, and a full wave rectifier, 5690.

The twin triodes were similar to the standard 6SL7, 6SN7, and 6SJ7, respectively. The 5690, an unusual design in that each half has its own heater and cathode with separate pinouts, is rarely encountered and has no entertainment or industrial grade substitute. Together this group of tubes can meet design requirements for many applications.

This series of tubes was produced by several manufacturers besides RCA: GE, CBS/Hytron, Westinghouse, Tung Sol. Not all suppliers provided the distinctive red base of the RCA. Some used a low-loss light brown mica impregnated base which lacks the visual drama and color symbolism of the RCA version.

Red tubes were typically found in vacuum tube computers, aviation and aerospace instrumentation, laboratory apparatus, vital telecommunications installations and other critical industrial applications.

Although relatively hard to source and expensive compared with standard 6SN7, 6SL7, and 6SJ7 types, they are a favorite of audio experimenters everywhere. It's the tube to use when you care enough to select the very best.

"Whenever the accent is on quality — and quality alone"

RCA 5691
HIGH-MU TWIN TRIODE

RCA-5691 is a high-mu twin triode designed and manufactured for critical industrial applications. In such service, it is particularly useful as a voltage amplifier. In addition to the structural features illustrated above, this type has its heaters for the two triode units connected in series so that failure of either heater in bridge circuits makes both units inoperative.

The 5691 is similar to the 6SL7-GT except that it has twice the heater current (0.6 A). It is recommended as a replacement for the 6SL7-GT only where provision for the increased heater current can be made, only where the operating conditions are within the ratings of 5691, and only where long life, rigid construction and exceptional stability are needed. If the 5691 is operated at the higher maximum ratings of the 6SL7-GT, the full advantages of the 5691 will not be obtained.

RCA 5692
MEDIUM-MU TWIN TRIODE

RCA-5692 is a medium-mu twin triode designed and manufactured for critical industrial applications. It is particularly useful as a balanced DC amplifier, multivibrator, blocking oscillator, and resistace-coupled amplifier. In addition to the structural features illustrated above, this type has its heaters for the two triode units wired in series so that failure of either heater in bridge circuits makes both units inoperative.

The electrical characteristics of the 5692 are similar to those of the 6SN7-GT. The 5692 is recommended as a replacement for the 6SN7-GT only where the operating conditions are within the ratings of the 5692 and only where long life, rigid construction, extreme uniformity, and exceptional stability are needed. If the 5692 is operated at the higher ratings of the higher maximum rating of the 6SN7-GT, the full advantages of the 5692 will not be obtained.

RCA 5693
SHARP-CUTOFF PENTODE

RCA-5693 is a sharp cutoff pentode designed and manufactured for critical industrial applications. In such service, it is particularly useful as a high gain resistance coupled amplifier. This tube can be operated with a grid-No.1 resistor having a value as high as 40 megohms depending on the operating conditions.

The electrical characteristics of the 5693 are similar to those of the 6SJ7. The 5693 is recommended as a replacement for the 6SJ7 only where the operating conditions are within the ratings of the 5693, and only where long life, rigid construction, extreme uniformity, and exceptional stability are needed. If the 5693 is operated at the higher maximum rating of the 6SJ7, the full advantages of the 5693 will not be obtained.

RCA Type	Prototype	Name	Description and/or Difference Between Type and Prototype: Rating or Characteristic	Premium Type	Prototype Type	Special Tests and Controls: Shock	Fatigue	Vibration	Base Tension	AF Noise, Microphonics	Stability	Inoperatives	High-Altitude	Heater-Cycling	Life Test: 500-Hour	Life Test: 1000-Hour
5690	—	Full-Wave Vacuum Rectifierø	Heater-Cathode Type. Each unit has its own heater and cathode with individual base-pin connections. Full ratings up to 40000 feet.			✓	✓	✓	✓	—	✓	✓	✓	✓	✓	✓
5691	6SL7-GT	High-Mu Twin Triodeø	Heater Current	0.6	0.3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
			Max. Plate Volts	275	300											
			Peak H-K Volts	± 100	± 90											
			Heaters in series for fail-safe operation	Yes	No											
			Controlled Plate-Current Balance	Yes	No											
5692	6SN7-GT	Medium-Mu Twin Triodeø	Max. Plate Volts	275	300	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
			Plate Dissip., Watts	1.75	2.5											
			Peak H-K Volts	± 100	± 200											
			Heaters in series for fail-safe operation	Yes	No											
5693	6SJ7	Sharp-Cutoff Pentode‡	Plate Dissip., Watts	2	2.5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
			Grid-No. 2 Input Watts	0.3	0.7											
			Peak H-K Volts	± 100	± 90											

RCA Type	Cathode: Volts	Cathode: Amps.	Maximum Dimensions, Inches: Length	Maximum Dimensions, Inches: Diam.	Class of Service	Maximum Ratings: Plate Volts	Plate Dissipation, Watts	Cathode Current, Ma.	Grid-No. 2 Input, Watts	Operating Conditions: Plate Supply, Volts	Grid-No. 1 Volts(v) or Cathode Resistance, Ohms	Grid-No. 2 Supply, Volts	Plate Current, Ma.	AC Plate Resistance, Ohms	Transconductance, Micromhos	Amplification Factor	Power Output, Watts	RCA Type
5690	12.6 / 6.3	1.2 / 2.4	4¼	1 23/32	Full-Wave Rectifier with Capacitive Input Filter	AC Volts per Plate (RMS), 350 Filter Input Capacitor, 10 μf DC Output Volts at 110 Ma., 355 DC Output Volts at 55 Ma., 415												5690
					Full-Wave Rectifier with Inductive Input Filter	AC Volts per Plate (RMS), 350 Filter Input Choke, 10 henries DC Output Volts at 135 Ma., 300 DC Output Volts at 67.5 Ma., 305												
5691	6.3	0.6	2⅞	1 9/32	Industrial Service (Each Unit)	275	1.0	10	—	250	−2v	—	2.3	44000	1600	70	—	5691
						Max. Plate Current for Grid Volts at −5.5, 15 μa Difference in Plate Current Between Units, 0.9 Max. Ma. at Grid Volts, −2									Max. Reverse Grid Current, 0.2 μa		
5692	6.3	0.6	2⅞	1 9/32	Industrial Service (Each Unit)	275	1.75	15	—	250	−9v	—	6.5	9100	2200	20	—	5692
						Max. Plate Current for Grid Volts at −24, 15 μa Difference in Plate Current Between Units, 2 Max. Ma. at Grid Volts, −9									Max. Reverse Grid μa, 0.2		
5693	6.3	0.3	2⅝	1 5/16	Industrial Service	300	2.0	10	0.3	250	−3v	100	3.0	1.0●●	1650	—	—	5693
						Max. Plate μa 80, at Grid-No. 1 Volts, −7.5 Max. Plate μa 750, at Grid-No. 3 Volts, −70									Max. Reverse Grid-No. 1 Current, 0.1 μa		

ø Glass-octal 8-pin type. ‡ Metal-octal 8-pin type. ●● Minimum megohms.

Classic Tube Regulated Power Supplies

Better take a winch and dolly to the next swapmeet!

by Alan Douglas

SERIOUS voltage stabilization can be yours for just a few dollars and some manual labor

Why a regulated power supply? What's wrong with a simple transformer, rectifier, and "brute force" filter?

Maybe nothing. But regulated supplies have several advantages over simple filtered ones:

- They can be adjusted to any voltage and, once set, the output voltage is constant, even with variations in line voltage.
- They can make large value electrolytic capacitors unecessary by providing ripple reduction as well as voltage regulation.
- They can allow use of silicon rectifiers while preserving the slow warm-up feature of tubes.
- Their output impedance is low and constant over the entire audio range.

This last feature, low impedance, is the most important. It improves the dynamic voltage regulation, makes decoupling the driver stages easier, and reduces interaction between stereo channels when a common supply is used.

Power supply impedance is directly in series with the output stage audio signal in a single-ended circuit. Now, in comparison to the several thousand ohms of output transformer impedance and tube plate resistance, a few more ohms in the power supply doesn't sound like a big deal. But if you had, for instance, a brute-force filter with 100 microfarads at the output, the impedance at 20 Hz is about 80 ohms.

Not only does this value vary with frequency but it is probably also nonlinear when electrolytic capacitors are used. Most likely the effects are inaudible and a small film bypass cap across the electrolytic would address any audible problem, but there is another way. The output impedance of a regulated supply can be *as low as you want* and it can be held constant over any reasonable bandwidth.

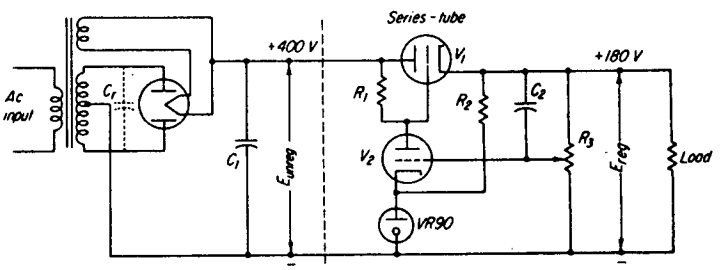
The design of regulated power supplies is far too complex to explain in one magazine article (that is, if I understood it all myself!). And my primary aim is to promote the resurrection of old, already-designed, well built, and available equipment from the 1950s rather than to encourage new designs. However, for those of you unfamiliar with the workings of regulated DC supplies, it may help to think of a regulated supply as a feedback amplifier. Instead of an audio signal, the input is a DC voltage. The output is taken from a cathode follower. If the gain and the bandwidth of the amplifier are high enough, the output impedance will be very low over the entire audio range. Of course, the response must extend down to DC.

Any regulated supply, then, can be divided into four parts:

- An unregulated DC source with minimal filtering.
- A cathode follower whose plate supply is the unregulated source, typically a 6AS7/6080 or paralleled 6L6s.
- A DC amplifier that senses the output, compares it to a stable reference voltage, and drives the cathode follower.
- A stable reference voltage, usually a gas regulator like the 5651. Some older designs which used poorer VR tubes like the OA3 incorporated separate semi-regulated supplies to drive the reference tube.

An understanding of the basic principles should allow you to decipher any circuit you may encounter. Langford-Smith's *Radiotron Designer's Handbook* has a chapter on the subject (with a long bibliography) and Benson's *Voltage Stabilizers* provides still more references.

It is a lot easier to find and restore an existing supply than to assemble components of equal quality and build from scratch. Homemade designs have occasionally appeared in electronics magazines



Schematic of typical vacuum tube series regulated DC supply

Kepco has been around since 1946—still run by the same Kupferberg family too! I had to trace this circuit of this unit myself (see below) and replace several small paper caps that were leaky. It's BIG, but it works fine.

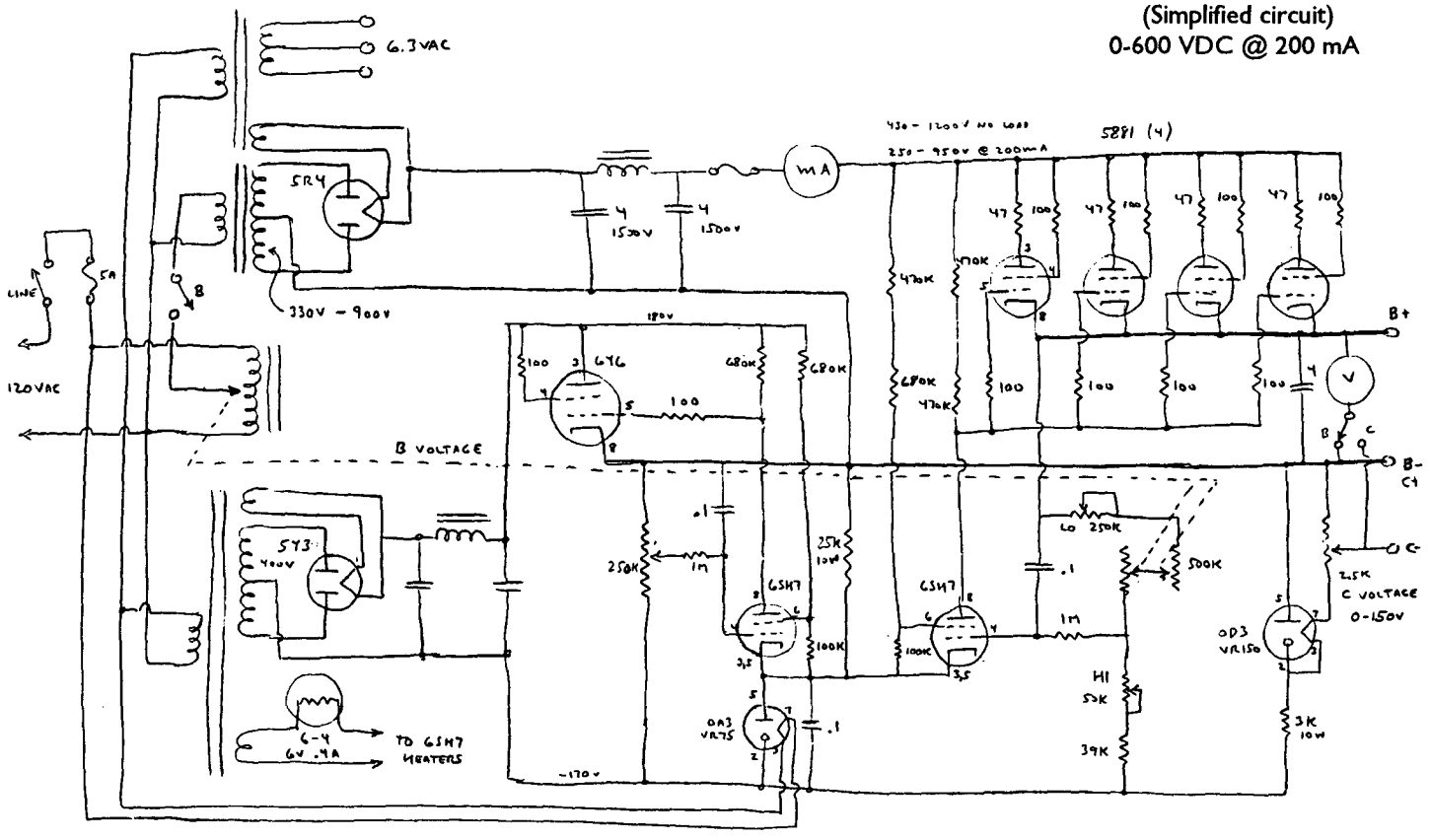
but the BEST circuits were designed for commercial equipment—either as separate supplies or as integral components of precision instruments.

Power supplies come in two basic types: those that go down to zero volts and those that don't. Those that do were intended for bench use by design engineers or technicians. They usually have voltage and current meters, front panel controls and terminals, 6 VAC heater supplies, and often a separate low current bias supply. Kepco, Hewlett-Packard, and Lambda, among others, made excellent DC supplies or you can take your chances with a popularly priced Heathkit model.

Fixed voltage supplies, intended for powering equipment continuously, are variable over a certain range (set by rear panel controls) but rarely go below 150 Volts. They are usually rack mountable with rear terminals and may or may not have panel meters. The very best were made by Lambda. The Lambdas used hermetically sealed transformers and oil capacitors (no electrolytics at all), and have banks of 6L6s or 6080s as

KEPCO 815

(Simplified circuit)
0-600 VDC @ 200 mA



series-pass tubes (cathode followers). Extensive restoration of Lambdas is not necessary, just check the tubes and plug them in!

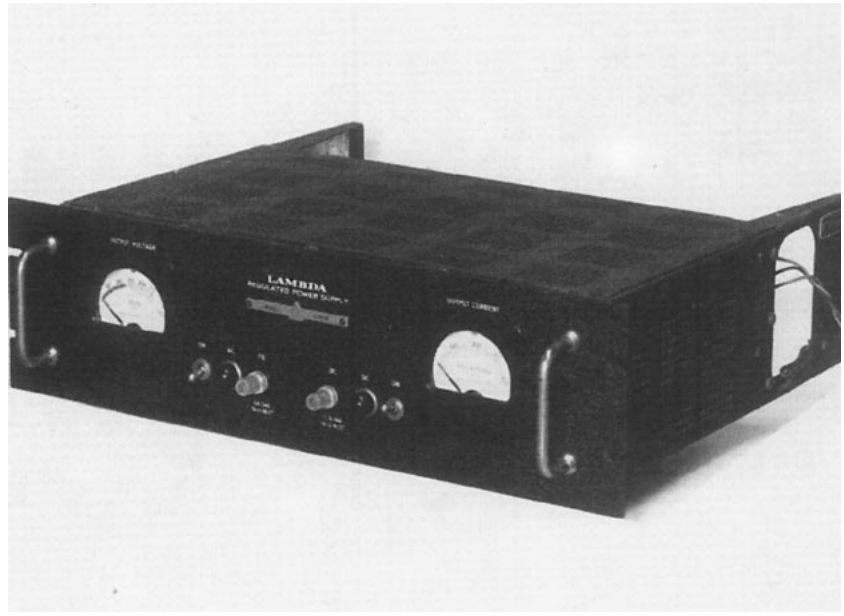
Vacuum tube regulated supplies are nowadays a drug on the market and, when you can find them, they will either be cheap or free. Unfortunately they don't often get "drug" to flea markets because of their considerable weight, so you must ask around. Ham flea markets are a good place to look. I got several from my doctor, who hauled them away from a local research establishment some years earlier. Have faith—and the phone number of a good chiropractor!

References

Langford-Smith, *Radiotron Designer's Handbook*, 4th ed.

Benson, *Voltage Stabilizers*, London 1950, 1957.

The author submitted a nice reprint of National Bureau of Standards recommended regulator circuits plus we added a few we dug up ourselves. To get a copy, send $2.50 US/Canada, $4 overseas airmail.



These industrial strength Lambda supplies come in 200, 400, 800, and 1500 mA versions in three voltage ranges: 0-200V, 125-325V, and 325-525V. Voltage is set by toggle switches that select transformer taps; fine adjustment is by external resistors. They are unbelievably rugged, reliable, *and heavy!*

FEW STONES UNTURNED

A road trip to the state of the art

By Herbert Reichert

The three of us stood looking out of separate windows of my firehouse turned abode. We tried, but were unable to enjoy the beauty of the snowfall making magic of the Manhattan skyline. J.C. looked like a kid who had just crashed his bike. Mike looked concerned.

Then the phone rang. It was the atmosphere scientist telling us that the sky was clear and the roads were dry all the way from White Plains to his house. He also mentioned that the three systems were all gassed up and ready—sitting on the runway, as it were.

The next thing I remember is looking in the rearview mirror. I saw Bruce and Mike in the back seat. Mike appeared to be asleep. Then I noticed the interlocking circles of an Audi grille close up. Strange, one doesn't expect tailgating at 100 m.p.h. I mildly dislike tailgaters. J.C. nodded and smiled so I put Mike's Alfa into fourth and depressed the throttle. Moments later, the tailgater dipped below the horizon like the setting sun.

Thirty minutes down the road, we were crawling around on our hands and knees, turning over amps and fondling solid silver speaker wire. We made it to Arthur's in half the usual time.

We would all have been depressed for two months if we didn't make it to the Professor's house that weekend. Why? Because Dr. Arthur Loesch and his two friends, Bob Cummings and Jon Baier, have three of the most sophisticated, beautiful sounding music reproduction systems in America.

These three men are well known in the audio underground as experienced listeners who have designed and constructed handmade audio systems of the highest caliber. We were looking forward to meeting with them, hearing their systems, talking audio, and gathering the kinds of ideas and inspiration which could follow from such an event.

Some of the side benefits of having "audio friends" are getting to know their record collections and learning to enjoy their system as they themselves do. Because of shared interests, we can actually come to know and understand our audio friends better as people through understanding their music and approach to the art of system organization. An individual's approach to audio communicates a lot about that person to another who understands.

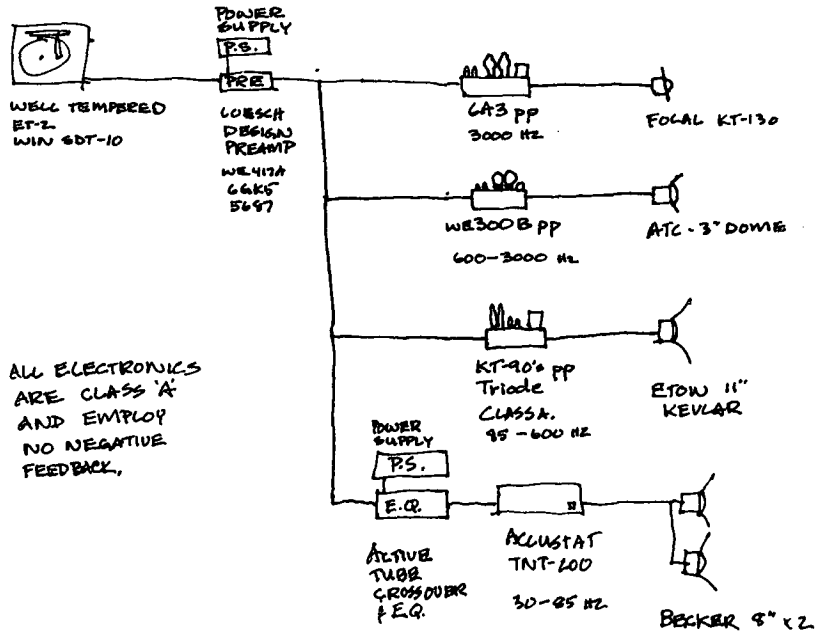
Handmade systems are especially fun and enlightening because they communicate the builder's individuality and distinct view of the art. However, whether the system is hand-crafted or totally store-bought, everyone must select their transducers—and nothing affects the sound of our systems or reflects our personalities more than our choices of speakers and front end components.

Our hosts provided cases in point. Each built his system "to taste" and developed its character through extensive research and experimentation. They are friends and the quality of their systems is raised through an ongoing dialogue involving sharing of discoveries, friendly criticism, and perhaps a touch of competitive spirit. It is a small community of "like minds" with different approaches.

Let's take a tour of each system and meet the artists who constructed them.

BOB'S SYSTEM

Bob Cummings has been listening to quality systems since 1953, starting with an Electro-Voice coaxial in an open-backed Karlson cabinet. He switched to Klipsch horns in 1955. In the 1960s, he put some Hartley 24" drivers in a 14 cu. ft. cabinet and crossed them over to Hartley 10" upper bass units. Midrange was a KEF 5" and so was the tweeter. These were driven by Dyna and Acrosound amps. The 70s brought IMF monitors and Magnaplanars into Bob's home. When I met him in the



Block diagram of Bob Cummings' music lover's system

early 80s, he was using Strathern ribbons, pure triode amps, and a Dynaudio line array as woofers. Just before he set up the system I describe below, he was driving Martin Logan CLSs with push-pull 300B amps and actively equalized subwoofers of his own design.

At Bob's house you are greeted with a warm handshake and the warmest of smiles. As he takes you downstairs, you step into another world. When the music starts in his carefully designed listening room. . .you'll never want to leave. His system has the ability to suspend critical mind functions. All types of music become engaging works of ARTISTS! It's almost hard to think in audiophile terms when listening to Bob's system. Some might criticize the sound saying that it is more beautiful than real life. However, Bob has exquisite taste and it is his greatest asset as a designer. He doesn't focus on the math or engineering but rather on the creation of beauty. Like an artist.

Bob has worked hard to get his room to be an asset to his sound. Linear diffusers, tube traps, and sonic foam are everywhere. The walls are sawtooth patterned with doors that open and close to adjust the sound and provide access to his concealed record collection.

He doesn't have a CD player for the simple reason that he hasn't gotten to that part yet. The same applies to equipment stands (which he just acquired), line conditioners (which I urged him to get), and specialty line cords. What he does have was selected by listening, trial and error, and asking lots of questions.

Starting at the front, Bob uses a Well Tempered table with an Eminent Technology ET-2 arm with a high pressure manifold. He owns several dream cartridges but mostly uses either a Promethian Green or a Win SDT-10. He likes the Win best but feels that the Promethian provides a realistic concentration of energy which he appreciates. He played the Promethian for us. We liked it too.

Phono EQ and gain is provided by an all-tube Arthur Loesch design preamp. This design was legendary back in the 80s and those who built it or heard it often swore that it couldn't be beat. It has two stages of passive EQ and fixed bias (batteries) on two of its three super high transconductance tubes. Each tube has its own B+ supply using chokes and polypropylene caps in this version. Overall, the preamp incorporates twelve separate power supplies and eight transformers!! The tube complement: WE 417A/5842, 6GK5, RCA 5687. Kimber AGSS pure silver wire, non inductive wirewound resistors, and custom teflon and copper foil capacitors are used in the signal path. Similar passive components and design logic are employed in Bob's power amps.

An Acoustat TNT-200 with an all FET front end by Jim Strickland feeds the energy below 85 Hz to a pair of 8" Becker drivers with treated paper cones. An active tube crossover for the low end allows Bob to actively equalize the output for flat in room response to 30 Hz.

In another pair of cabinets, next to the double Beckers, we have the main array. Eleven inch Eton Kevlar drivers present the fundamentals from 85-600Hz. These are driven by push-pull triode connected KT-90s with UTC LS-65 output transformers. High frequencies are generated by a Focal KT-130 crossed over at 3000 Hz by the coupling caps in the push pull 2A3 tweeter amp. This amp, like all others in the system, is bandwidth limited by carefully adjusted interstage R-C filtering. This eliminates the need for additional gain stages or active filtering and provides all the usual advantages of bi-amping. Do not underestimate the importance of this design feature.

I asked Bob what advice he would offer to those assembling high quality systems: "Get the midrange right first and try not to lose it going after the frequency extremes." So what does a man who has listened to a lot of midranges use today? A pro-sound three inch, soft dome by ATC, the SM75-150S. Most designers choose 2" domes for a more present full bodied sound than that provided by typical 3" domes, which can be very recessed. Not this one. This partially horn-loaded driver gives you the bandwidth and air moving qualities of a 3" with even better presence than 2" domes. Bob runs this exotic driver with a push pull Class A WE 300B amp using LS-55 transformers. J.C. thought it was just about the best midrange he had ever heard—he's still talking about it.

All of Bob's amps are Class A designs without negative feedback, using low mu triode drivers (6DJ8, 6SN7) and wide-bandwidth quality vintage iron. Each of the three tube amps per channel has two power transformers: one for the driver stage and one for the output. Counting the preamp, crossover, and FET bass amp, that's THIRTEEN power transformers per channel! The system requires six lengths of interconnect and eight lengths of loudspeaker cable, *all silver*, per channel. Not to mention ten teflon caps and dozens of wirewound resistors per channel. Did I mention the polypropylene caps in the power supply? Whew! Who said avoiding mechanical sound was easy (or free)? You must trust me though; not only was there no mechanical sound, but this conglomeration of metal, teflon, and paper could light up and take you to Carnegie Hall.

This is a short trip and it's getting late, soooo. . . if we can drag ourselves off the sofa and out into the twenty degree weather, we can go over to Jon's for a taste of something simpler.

JON'S SYSTEM

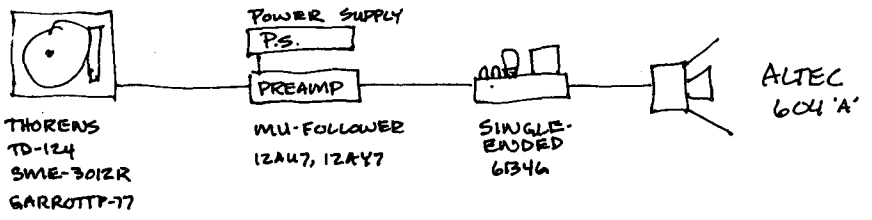
Jon Baier's setup is almost Zen in comparison with Bob's. It has only one amp per channel! Jon has a "to die for" record collection. I always go back to New York and hunt for the records I hear at his house.

I should admit this up front: I may be a poor hi-fi critic because when a system likes a record (plays it well) and I like a record (like the music), then I like the system. The system that likes the most records wins. I can't truly like a component in isolation because it can't play a record in isolation. Jon's system can really play records—lots of them!

Jon usually plays country, blues, rock, or bluegrass when I visit. His 15" Altec 604-B coax speakers are perfect for this type of music. Sometime before this visit, he added some extra baffle area to his homemade bass reflex enclosures to give the lower-mids more body. He also removed the bakelite loading cap on the 604 to cool down the horn a bit. Jon tamed this tricky speaker well.

Several years ago we compared the Thorens TD-124 turntable and the Well tempered in Jon's system. We are both still using the Thorens. He adds a Garrott P-77 cartridge to his SME 3012R arm and connects it to his preamp with homespun shielded silver interconnect.

The preamp is his design using 12AU7s and 12AY7s in a mu follower arrangement. He



Block diagram of Jon Baier's rockin' system

uses separate power transformers and choke input filters (with polypropylene caps) for each tube. Jon says he has tried most everything but settled on the mu follower and low transconductance tubes. Like Bob, he uses teflon caps throughout the signal path. He also likes wirewound resistors best, claiming that they sound the "sweetest."

John is a machinist at heart (and by trade) and his precision metalwork, careful layout and parts mounting, and artful hand-wiring have been an inspiration for my own craft.

In Jon's system, as in each of the systems I describe here, component selection, layout, and craftsmanship are equal in importance to the raw circuits they bring to life. The physical and sonic beauty of this system results from dramatic and effective combinations of old and new: mini-toggles powering up sub mini neon lights and RCA red base tubes connected by gleaming pearl teflon insulated silver wire and teflon caps to vintage black crinkle Jim Lansing speakers. You can't buy this vision at your local "Low-fi Exchange."

The Altec 604s are driven by single-ended 6B4-G triodes which produce three watts. The output transformers are Magnequest FS-030s. They are a ten octave design which works perfectly in a full range application. The driver stage uses red base 5692 tubes in the mu follower configuration. This little "three watter" really loads the room with mike-feed quality sound. Whoever thinks that a flea power single ended amp can't provide convincing bass should hear this setup. The kick drums hurt your chest!

ON TO ARTHUR'S

When I stepped through the door at Arthur's house, he immediately started telling me what he had done to his system and what I should be listening for. I said, "Arthur, why can't we just listen to some records?" He says, "Herb, you didn't drive 100 mph for two hours just to listen to records...you can do that at home!" He is right (as usual), we came to hear THE SYSTEM. Now, it is important to note that Arthur is known by audiophiles and designers as a brilliant man on a mission: to design the best possible music reproduction system—and then improve it. Arthur is always looking, measuring, listening, and asking, "Is there something minor we may have overlooked that might really be important but we just don't know that it is important yet?" This is how a scientist looks at audio. He also reminds me of Edison, who at one point could say only that he knew 10,000 materials which would *not* make a good filament. Arthur has done tireless research in a quest for the perfect gain stage. He claims he has only discovered the limitations of the ones he has tried.

However, his system betrays a preference for very linear, low mu, high transconductance tubes and FETs. Balanced, differential, highly isolated gain stages with passive filtering seen to dominate his designs. Tubes are most often run at low plate voltages with very high plate currents, often exceeding the rated plate dissipation of the tubes. The effect of this strategy is to find the "sweet spot" on the plate curve, the place where the harmonic structure of the distortion products is most attractive to the ear. Most designers choose the absolute lowest distortion point that works with the following stage. This is (usually) the operating point where the second harmonic is lowest. Often this point is unnaturally bright sounding.

Arthur has been a teacher and mentor to many young audio designers. This is his lesson: "Keep an open mind and use the old and new only as far as they serve your purposes."

A lot of what A.L. has learned can be seen in the block diagram of his system. As I describe the hardware that corresponds to the boxes, let me try to relate some of the design principles which shaped his present system.

Arthur keeps a pair of Quad ESLs as a reference but he has tried many high end speakers. Finding a truly outstanding speaker to build a system around is very difficult. There are thousands of designs available, but few are true classics capable of providing long-term satisfaction. The same applies (even more so, perhaps) to front ends. The vast range of choices out there reflects the mediocrity of the field. We must make honest "trust your ears" decisions in these areas.

Photo of Arthur Loesch's modest system

This is where taste comes in. Taste is moral and ethical decision making. Our tastes in music should also be reflected in the transducers we choose. We must prioritize our values and decide accordingly. However, this list of values can only be developed over time by trial and error. I suspect that we actually 'try on' different values until we find some that fit and then arrange them in order of importance. This order can (and does) change.

For instance, we might hear a system that does something we never dreamed possible or maybe never even thought about before the experience. Thereafter, this quality can be added to our list and can we go out and look for components that can bring it to us.

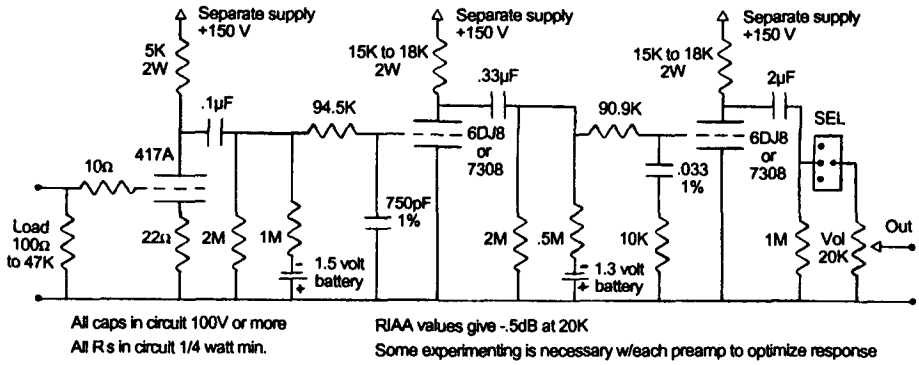
Arthur takes a very specific ethical position in these regards. He is a scientist deep down. He is not a romantic like Bob or a good time, thrill-seeking race car driver like Jon. His criteria for selecting transducers is "Will it follow the signal and add little of its own? Is it compatible with other parts of the system? Will it maintain a consistent level of performance over time? Bottom line: is it accurate?"

His best answer to these questions today includes a Goldring Excel cartridge with a pure silver coil mounted on an ET-2 arm with a high pressure manifold. His turntable is a Linn LP-12.

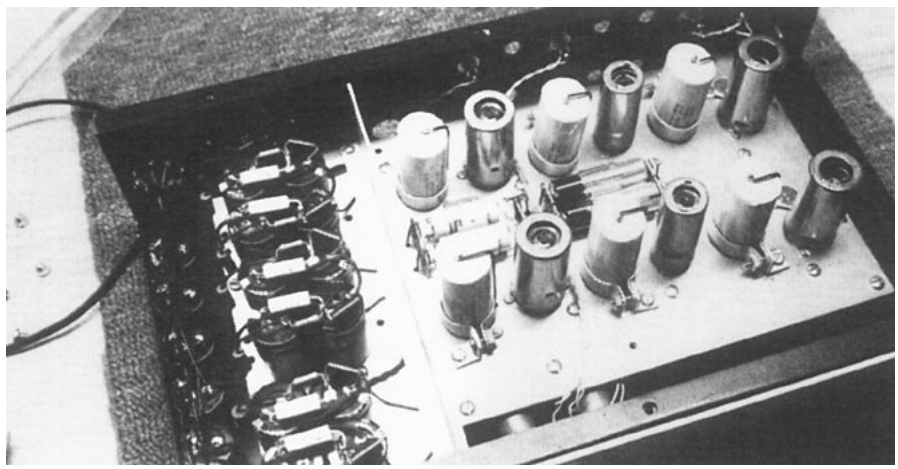
The real creativity and engineering is in the rest of the system. The Focal 122 tweeters are titanium domes with a sputtered oxide coating. They have tuned secondary chambers acting as Helmholtz resonators. Each of the two chambers is approximately 2 cu. in. stuffed with wool. Most of Arthur's guests suggest that the highs are "better than real."

The inverted domes share a recycled SOTA Panorama box with a single Focal 7V. This is a paper cone midrange with glass impregnation and an exponential profile. The Focal 10V617, a 10V with a custom glass impregnated paper cone, is used in a transmission line enclosure for the bass. This combination may not go as low as an IRS-V or a WAMM but it is definitely full range.

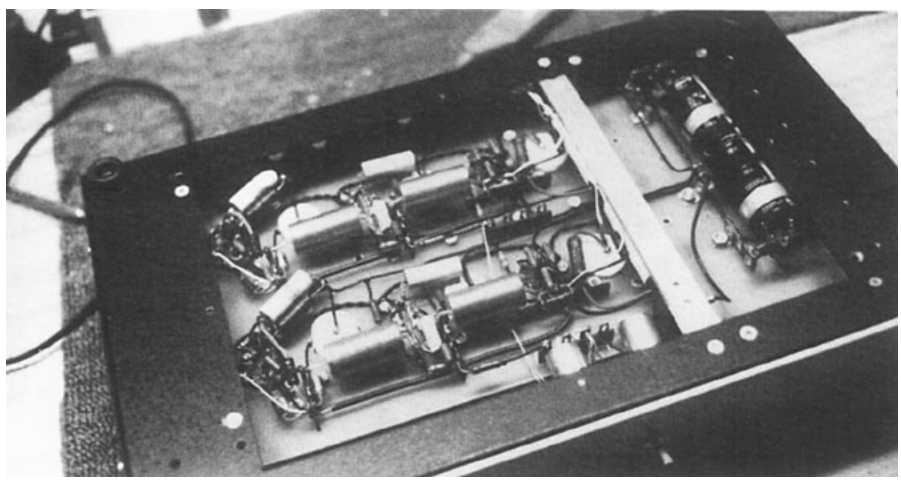
The most unique part of this system is in the finely tuned amplification system. Like Bob's set up, each driver has its own amp. Each amp is optimized to suit the mechanical, electrical, and subjective sonic parameters of its respective speaker. The tweeter is



One version of the 417A preamp. Many experimental versions were built using 6GK5s, 6C4s, 5687s and a wide variety of other tubes in the second and third stages.

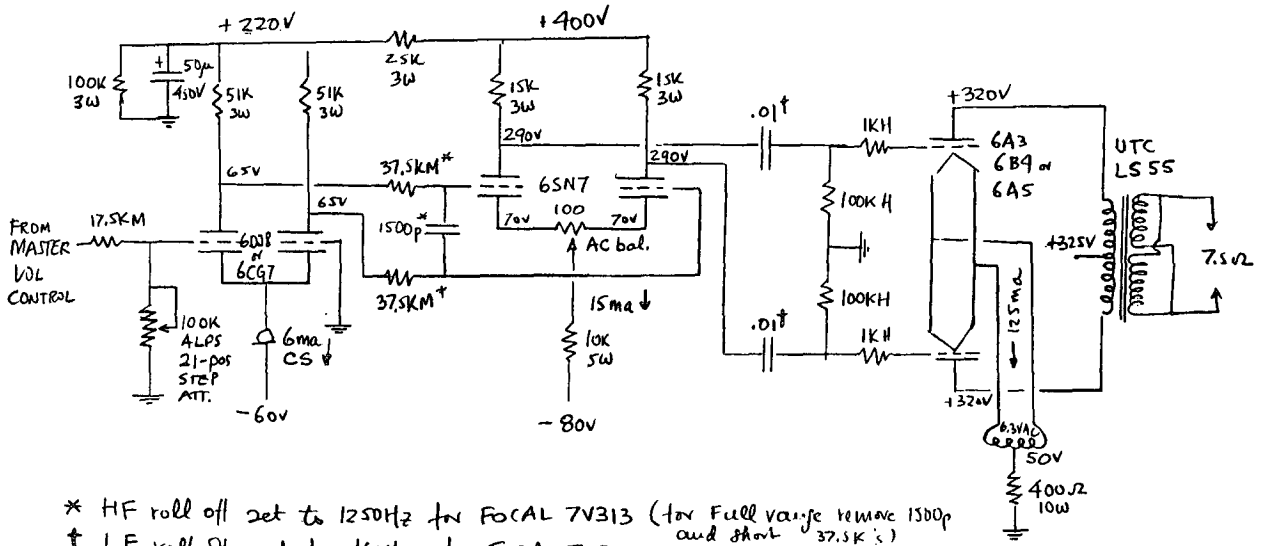


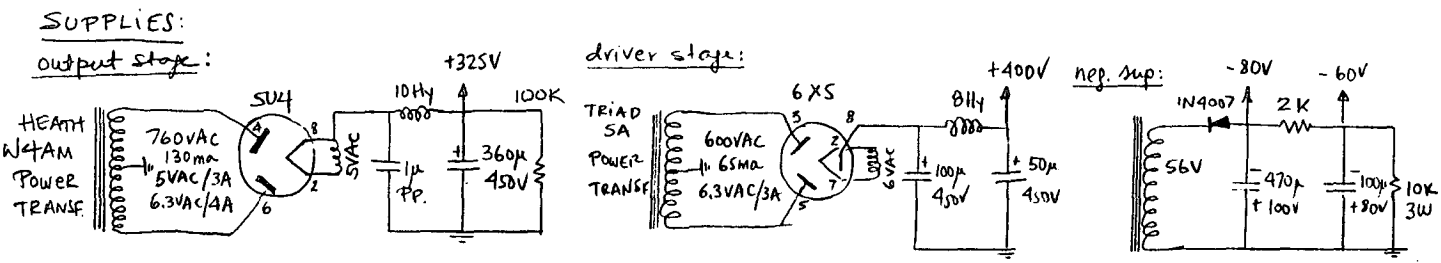
Interior of one version of Arthur's 417A preamp. Note batteries for bias and polypropylene caps for decoupling. Audio circuitry is mounted on a copper ground plane.



Bottom view of Arthur's preamp showing teflon caps, Mills wirewound resistors, and copper ground plane.

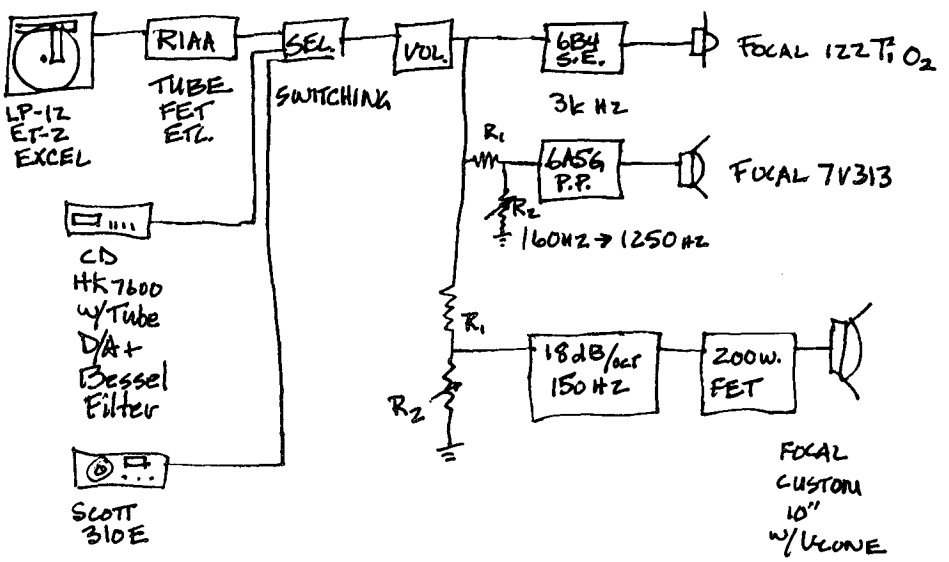
Loesch Audio Design triode amplifier (constructed on Heath W4AM chassis)
Shown bandwidth limited with filters marked * and # to range: 160-1250 Hz





driven by single-ended 6A3 directly heated triodes. This amp uses a Western Electric 348A (like a 6J7) driver tube and Tango FW-20S outputs. Arthur believes that tube amps should be operated in self bias above 150 Hz. Fixed bias subjectively has more punch and authority in the bass but it seems harsher and brighter through the midrange. Self bias also allows for time constant adjustment and bandwidth limiting at the output stage. In these monoblock tweeter amps, the coupling cap between the driver and output stages is chosen for a high pass roll-off at 3000 Hz. Then, more than an octave down, at 1350 Hz, the cathode bypass cap on the input stage rolls the amp off again.

This elegant but simple strategy avoids the dramatic transient and phase shift problems that steep filter slopes can cause and allows for direct connection of amp and speaker. Arthur also provides switchable attenuation at the input of each amp. Driver levels can be set in 1 dB steps. Non inductive wirewound resistors are used in the attenuators.



Block diagram of Arthur's system

The midrange amp operates from 175 to 1250 Hz. Right now, it is a push pull 6A5-G amp using UTC LS-55 outputs with crossovers built into the amps as above. Arthur is planning to replace this amp with a single-ended WE 300B amp. He hopes to gain a little more midrange magic and depth with this change.

There are few "rules" in this sort of exploration and sometimes finding the right amp/speaker combination relies on intuition plus trial and error, regardless of how "scientific" one sets out to be. Clearly, Arthur has discovered that no amp excels subjectively across all ten octaves. Every design favors five octaves or less somewhere in the audio band.

During our visit, we listened to several different amps driving the transmission line bass modules but Arthur's FET design had the beautiful tone of the push pull 6A5s and the weight and punch of a 50 watt bi-polar amp he also designed.

This FET 100-watter is built on an Acoustat TNT-200 chassis and it is direct coupled throughout. The active devices in this amp were selected from about 100 samples, tested for linearity and precisely matched on a curve tracer. Arthur believes that one of the big problems with solid state devices is that sample to sample variation can be enormous. He found that precise matching of components is necessary to get the best sound from transistors. I would really like to hear this FET amp full range.

While he had us as a captive audience, Arthur asked us to offer opinions on three of his designs and compare them to a very expensive commercial product considered state-of-the-art by the audio press. The three home made preamps were original designs: one all tube, one all FET, and one hybrid. All were silver wired throughout, using custom teflon and copper foil caps, polypropylene filter caps, precisely matched active devices, and super short signal paths. Each piece spent hundreds of hours in front of a scope, spectrum analyzer, and a curve tracer. Each had made the trip from the listening room to the bench dozens of times. This sort of tedious work goes beyond anything we could reasonably expect from a manufacturer but the results plainly demonstrate the value of this sort of perfectionism.

Everybody liked the FET-tube combo, it was like the good porridge—just right. It had thrills and magic but, personally, I preferred the more intense magic of the all tube WE 417A based preamp. Vividness is high on my list of sonic values and Arthur's all-tube pre is vivid and Cinemascope like a 50's movie.

Whatever phono stage you like is connected to a passive volume control followed by a "black box" tube gain stage. There is also an active crossover for the bass. This building block approach makes for LOTS of interconnect, speaker wire, and connectors but it facilitates system upgrades and experimentation. The exclusive use of silver wire and custom silver connectors minimizes the sonic damage this complex arrangement might otherwise cause.

I'm sure I sound like a broken record on this parts stuff, but I suspect that readers who have not experimented with this level of parts quality could easily underestimate its importance. Hiroyasu Kondo still remembers his "deep emotion" when he first listened to an amplifier using silver leaf condenser.

The most valuable lesson we can learn from these three very ambitious and industrious audiophiles is to look at every aspect of the audio chain. Build and listen, then listen some more, then build some more, until your tastes and feelings come into focus. No one can stop us from becoming Tom Edison in the privacy of our homes. Soon you can know ten amps which don't sound right with your Sacred Veil speakers. This is real progress. Someday, music will play in your listening room to goosebumps and tear stained cheeks.

On the way home, all "the high fever guys" were either asleep or lost in dreams about how to improve their hi-fi. J.C. (whose system is a lot like Arthur's) said he thought Arthur had "done it all." Mike thought Jon had used his transformers to create a really "deep" amplifier to power the "best of the three." I had to admit that Bob's system "stole my heart." That makes Bruce the tie breaker. His mono horn system is powered by a SE 10Y amp with a silver ingot for the ground plane. That makes him a neutral fourth vote. He said, "Bob's system stole my heart, but Arthur's system captured my mind."

An excerpt from

The Search for Musical Ecstasy

by Harvey Rosenberg

All of our searching, in whatever form it takes, is full of our humanity. Our predatory/competitive, testosterone based biology is fully active even in our most subtle and profound yearnings. The Greek Gods were constantly feuding for position and all the world's mythology is filled with violence and the struggle of the Gods to be dominant.

Questions of hierarchy are inevitable. Who is the high priest of audio? Who has the best audio system? This is not a bad thing. Let me share with you how I was blessed with discovering the world's best sound system.

I heard this system after I had already become a serious audiophile, but not yet a manufacturer. At this time I earned a great deal of money as a design consultant to America's chemical companies, i.e. Celanese, du Pont, Allied Chemical, and Monsanto, all of which have synthetic fiber divisions. I was an expert on fiber and textile design and it was my job to travel to Europe three or four times a year and report back what textile designs were emerging in Europe that would affect the American market. It was during a trip to Paris that I discovered the system, which became the benchmark home music system and had such a profound effect on me it has acted as a compass through the great audio technology storm—always kindling in me the desire to reproduce that ideal experience. This adventure will also give you insight into my peculiar attitude toward the gestalt of listening to music in the home.

The autumn in France is a special gift: the light, the air, and the aromas of the harvest. There is one compelling reason to go to Paris in October—the cooking reaches a level of sensual excitement that must be rooted in the culinary power of a new harvest and the new wine. Have you ever drunk a few bottles of Beaujolais Nouveau sitting at a small Montmartre cafe watching exquisite French women pass by?

It was during the French autumn that I made the acquaintance of the Contessa de St. Lyon, who had started out life as Rhoda Marcus—a nice Jewish girl from Brooklyn who had the good sense on a ski vacation to fall in love with a Count. The Countess had a good life. An apartment in Paris, a "country home" outside of Paris, and a home in Corsica made life bearable.

Generally speaking, I love France but dislike the French. I find them vain, pompous, nasty, and disdainful of foreigners. Plus I'm jealous of them. A nice Jewish girl from Brooklyn who happened to be an awesomely whimsical, charming, and relaxed real live French Countess was an unbeatable combination for this searching Semitic audiophile.

While having dinner with the Count and the Countess at their 20 room Paris apartment (which again confirmed for me that the French have developed the art of eating to a level of refinement that is beyond the imaginative capacity of primitive Americans) the Count inquired about my interest in music. This lead to an invitation to listen to his sound system, which he assured me would be the finest I had ever heard. Now I knew the Count was not into tube electronics and from my discussion he seemed to be from the Bang and Olufsen school of audio wimps, but every diehard audiophile loves a challenge. Why should the French care about the liquid midrange when they had so many other profound forms of liquidity at their disposal.

Throughout this discussion Rhoda just smirked.

I was invited to spend the weekend with the Count and Countess at their country home to check out the sound system. I was excited because I knew I could give him very scholarly advice on how to improve it. The whole family piled into the Citroen, a favorite car of the French, which proves beyond the shadow of doubt that they are totally out in left field.

Quite frankly I was impressed when we turned off the highway and saw before us a very large house, which appeared to be a mid-eighteenth century home with about 20 rooms. It was the gate house. A mile down a majestic poplar lined road we began to approach the cozy little cabin that was the country home. It looked like an Air France poster. Get this: when we pulled up to the Chateau's front door all the servants were lined up wearing white and black striped aprons! This Chateau had been in the family since the 1600s. I don't know about you, but around that time my relatives were living in a cave eating earthworms and spending rollicking evenings pounding stones together to keep the demons away.

What really pisses me off about this type of old European wealth is that it is so refined. Can you imagine a living room that is filled with masterpieces of art, fine furniture, fireplaces and is large enough to hold a basketball court?

Lunch was served in the backyard overlooking a swan filled lake and the newly harvested fields. A long table was set with a peasant-type lunch—fresh baked breads, cold chicken and meat, salads, pates, mousses, fresh fruit, cheese, superb wine and water served in an old clay jug that had a date inscribed of 1722. Water had been served from this jug since that time. Mr. Piggy the Gizmo had a fine time eating too much of everything.

Lollygagging after lunch in the sparkling autumn air consisted of small talk and the unmitigated joy of harvest fragrances. There is poetry in the French countryside that I have not heard in any other place. Quite frankly I had overstuffed myself during lunch and asked how I could find the bathroom. When I turned the beautiful porcelain handle I was certain I had lost my way because I had just entered a small drawing room and not a bathroom. I wove my way back to the kitchen and asked one of the servants how I could find the bathroom. I was led back to the same room and was shown the potty.

This was the most intimidating bathroom I had ever experienced. The potty was hand painted with scenes of cherubs. The toilet seat was also hand painted with flowers and running deer, circa 1700. Let me try to use an analogy to describe my discomfort. Can you imagine sitting down on a toilet in the main picture gallery of your local museum, one whose floors were covered in rare Persian carpets? I was raised and am comfortable in your basic American bathroom, and felt that any minute a crowd of Japanese tourists would barge into the room and start taking pictures of me.

After a walk around the estate I reminded the Count about the audio system demonstration he had promised me. I simply couldn't imagine what kind of equipment he had that was going to blow me away, but after my experience in the bathroom I was looking forward to something very unusual . . . maybe original McIntosh tube gear.

At about seven o'clock the Count invited us to follow him. We passed through the living room into a 40 X 40 room that was empty but for six high backed chairs, three dining room chairs, and a dozen man-sized candelabra. The windows were open and the white lace drapes were gently blowing. Sitting in my chair I could watch the sun slowly setting on the lakes filled with swans. The air was sweetened by the heavy night fragrances of grass and hay which mingled with the breath of the lake. Because there was no audio equipment or speakers visible I expected the Count to whip out this B&O remote control and demonstrate that he had fourteen thousand small speakers hidden in his ceiling. He left the room, and a servant came in with a tray and served us brandy from a beautiful cut crystal decanter. After we were served all of the candles were lit and the electric lights turned off. I was so delighted to be sitting in his magnificent room, sipping brandy by candlelight while the French perfumed harvest was intoxicating me that I didn't care about the possibility that the Count's system would be a musical flop. I would be kind and understanding as a way of showing my gratitude and that I was not a completely boorish Americano capitalist pig.

A trio of tuxedoed musicians walked in with the Count leading the way. He introduced them as "the finest audio system in the world." Who says people with money can't have fun? I was being treated to the same sound system that Louis I listened to. I was being treated to the sound system that this dickhead of a Count grew up with. I lost the bet.

Sitting in that room and experiencing chamber music in the context for which it was designed was a revelation. The performance was not great. I had heard the best world class chamber trios in New York City. There were parts of the performance that were downright funky, but it was still the most ecstatic performance I have ever experienced. The Count was right.

Have you ever wondered what it was like to be alive during the time of Moses, Jesus Christ, the American Revolution, or what it was like to hear Bach or Beethoven play? I was truly in a time warp. It didn't matter that the playing wasn't the finest I had ever heard. I had forgotten the importance of the context in which we experience music. I had forgotten how deeply affected composers are by the gestalt of their composing. I had forgotten how modern music listening had traveled so far from the warmth and intimacy that is the foundation of our musical roots. This was the proper way, the proper context in which to experience music in the home. Reproducing this experience in the average suburban home must be the goal of every audio engineer.

And therein lies the fundamental aesthetic error that the audio industry keeps on repeating. Yes, audio equipment is important, but the listener's state of being and musical context is just as important. Every instruction manual of every piece of equipment should contain a reminder of how important it is to create a home musical environment which supports the listener's emotional vulnerability that is a precondition for escalating our search for musical ecstasy.

Harvey Rosenberg's book, *The Search for Musical Ecstasy*, will be available June 1993 from Sound Designs, 1242 Fascination Circle, El Sobrante, CA 94803.

FORGETABOUT AMPS!

by Vincent Gallo

The Gallo of Vinny Gallo's "Mono Mia" Fame

I just finished reading a copy of the famous new magazine *Sound Practices* Number 2. I got my copy yesterday, the same day my agent informed me that I brown nosed myself another job acting in a Hollywood movie. She told me I was cast along with Jeremy Irons, Meryl Streep, Glen Close, and Wynona Rider—so I figured I deserved MILLIONS. I had to spend the whole day on the phone with my agent and their lawyer. I told them The Gallo doesn't work for less than a million a film. They offered 10,000. I took 15 K—that's $2,985,000 less than each of the other actors was getting. With all this Hollywood-style schmoozing to do, I couldn't just relax and sit around reading my new SP #2.

The thing is that as soon as I got the job I started to worry. I've worked as an actor for 12 years but I still get it in my mind that I don't know what the hell I'm doing, and I probably don't. I always imagine all the other actors are going to think that I stink and that they will hate me. So I begin hating myself, a little more than usual. I start to feel like I deserved the ten thousand beatings I got from my father and that my mother was right when she said that I wasn't at all handsome enough to be an actor and that I should learn a trade instead, maybe plumbing.

I looked into the mirror. Ohmygod, she was right. I hate my greasy guinea skin, I hate my hair, my big ugly nose. I started feeling like the talentless greasy, slimy little piece of shit that I am. However, in the past I worked with some big stars like Faye Dunaway, Robert De Niro, Jerry Lewis, Johnny Depp and other jerks like that. None of them were intimidating to work with and usually within minutes of starting a new film, I can slip back into my judgemental arrogant cocky self. THANK GOD!

Unfortunately, shooting wouldn't begin for 28 days so I had 28 days of rampant self disgust and giant fears ahead of me. Audio was the last thing on my mind. Sad because my usual neurotic obsession with Hi-Fi helps me kill some of my spare time. Maybe I should get a friend? Anyway, why wasn't I out with some chick celebrating? Why can't I enjoy the whole thing instead of worrying over and over about how much Meryl Streep will hate me?

Anyway, that night I couldn't close my eyes. I flipped on the light and began reading Number 2 to take my mind off Meryl Streep. Suddenly, a miracle! I fell into a deep, deep sleep—deeper than I have ever known. You see, Sound Practices #2 was so boring and dull that it put me out like a light. Thank God for Number 2 and thanks to all you unemployed clowns for those rehashed schematics. Otherwise, I wouldn't have slept for 28 days without the help of a cheap hooker or some big pills.

Yeah, Number 2 was a real snoozer. Number 1 with MY classic article on Mono was much better. Could you believe that Joe Roberts wrote an article on that $60,000 Ongaku amp? For all of you who don't know this, Joe Roberts is the cheapest, penny pinchin', food stampin', pricetag switchin', welfare check cashin', pull out your teeth and nickel and dime you to death Hi-Fi nut in America. If Joe can't trade even for something he found in a dumpster, or buy it outright for a penny, then it just don't go home with Joe. I mean the guy is too cheap to do a glossy cover for the magazine, but he will use up column space to write about a $60,000 amp he never listened to.

Joe, you bottom trawler, you cheap Bacalao, you cheap chiseler, how dare you alienate the working man!!! You have one claim to fame—you are the king of great Hi-Fi sound for under a buck. If you're too cheap to buy it, Joe, don't write about it. Leave the *Ongaku* column for *The Absolute Sound* so all those jerks can go trade in their Cello and Krell junk for it.

Joyce is my favorite writer so I read the magazine starting from the back, Japanese style. Herb Reichert's article was next and not bad either. Herb is sentimental with techno wiz thrown in. His article shed some new light on my childhood memory of the first time I hooked up my Marantz Model 2s in triode; Yes, yes, they did sound a little better—but not by that much. The second I tasted one sip of real triodes (WE 43 with 211 tubes) I shipped those beautiful brown Model 2s off to some brownholed neurotic Marantz collector who had me on the phone for hours discussing the condition of the power cord. I had to guesstimate the number of times it was plugged in and pulled out. The Bastard.

I had to deal with him though because the Japanese would only buy the big overpriced shitty sounding Model 9s. So much for the Japanese paying the most for the best sound. I can still hear echoes of Japanese accents asking for Model 9s. Model 9s stink, period.

Anyway, by the time I read through to the thorazine laced column "Art at the Edge of Science," I was sick of amps and amp talk. It's the same old Audiophile bull crapola—amps, amps, amps, this amp design, that amp design, bigger, fatter, more this, more that, and more and more expensive. Too much amp talk. You're giving me adjida. What about horns, drivers, crossovers, preamps, phono sections, cartridges, records, speaker box design? How about classic turntables and arms, huh? How about some tape machine talk? Listen, you brown stained techno macho audio drag queen fairies, enough is enough!!! Ya hear me?

Amps are not that interesting to talk about; they don't make or break your system by themselves, and choosing an amp is a relatively easy thing to do. So stop aggravating yourself 'cause I'm gonna make the choice simple for you, but I'm gonna tell you just one time, and after this I don't want to hear the word "amp" again, Capisci?

PENTODE - Thank God for pentode amps otherwise you *big cornholes* wouldn't have all that big POWER pentodes were designed to give you, so all you retards could drive your inefficient speakers. Now, I have actually liked a few inefficient speakers in my life. I said *liked* not loved—DQ-10s weren't bad, my classic AR-1 with Janszen tweeter setup was good for a few records, but they are all very forgettable. All the GREAT speakers I've heard we're ultra efficient so to compromise amp sound quality for high power design fundamentally makes no sense.

However, if you must have or are stuck with inefficient speakers (or speaker if you're hip enough to be in mono), there are a few good ones to choose from. If you like brown (and I do love brown), the Marantz Model 2 is neat. The Western Electric 142A is good. But the best pentode amp I've heard is the WE 124C—the early silver ones (not the gray) with the engraved (not ink stamped) number 171C transformers. They are pretty good and I really loved mine but I yelled out "YES" in two seconds when my idol Walt Bender asked to buy them from me. I think he still uses them. He has some of the best ears on the planet (and his checks always clear). So the silver 124s can't be all that bad.

OTLs - I listened to every Futterman piece, the Atmospheres, a home brew 6336 amp, and an 80s German thing called a Diffenbacher. They all give me an image of what it would be like to drive a car with a 64 cylinder engine. Most are below average. The best OTLs are not bad but they are usually expensive and need frequent adjustment. And for what? You only get "not bad." Big deal. I say OTL, schmo-TL.

SOLID STATE - I don't want to be heavy handed and declare that all solid state amps suck. But I have no choice because they do all suck. They are over priced, over designed, unreliable, hard to fix, age horribly, and never not in a billion trillion years will they sound as good as the best tube stuff. Although, if you're into the whole grunge look 70's thing, get yourself a polyester shirt and go out and hunt down a big bad SAE, or a Son of Ampzilla, or a really not too bad Bedini 10/10.

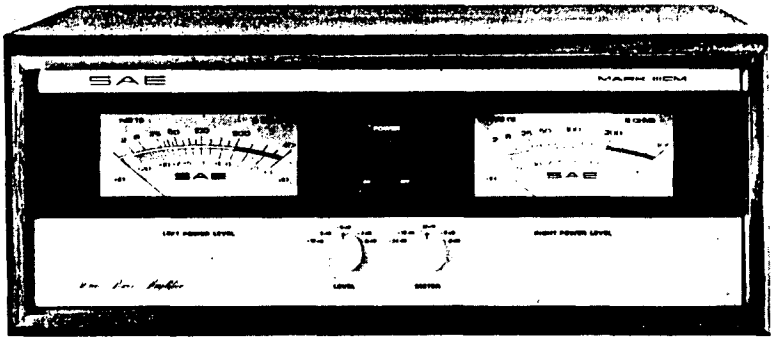
HYBRID - Ha, HA , HA
1/2 tube, 1/2 solid state. This here nor there sensibility doesn't appeal to me. It's mediocre thinking. It's a half-assed compromise. Just say NO!

TRIODES - Ahhh, Triodes. Che bella, triodes. Wonderful, wonderful triodes. Beautiful triodes. Okay, you get the point, they're simple and they sound great. Choosing a triode amp will let you forget about the amp part of your system. All you basically need to know is that the tube type and the output transformer are mostly responsible for the sound. But here are some tips anyway since I know you all really need to obsess on amps . . .

First, you have to choose between push pull and single ended. Both types can sound great. Since the SE types only use one tube they are simpler but usually are very low output. They only work well with real efficient speakers—100 dB/W and up. They absolutely GLOW when hooked up to horns. It's shocking how good they can sound.

My absolute favorite factory builts are the WE 91As (see SP #1). They are super good looking but they usually need some work to get set up and running quietly. All I can say technically is that I had better luck using single ended types without feedback. I took the feedback out of my 91s. Unfortunately 91s are expensive, hard to find, and hard to match up. So maybe this is the "mono moment". . .

Push pull triode amps sound great too. They will give you a little more power without sacrificing sound like the pentode. This extra crumb of power can broaden your speaker choices. I love my WE 86C amps. To my ears, these amps make more speakers sound good than any other amp. They can bring an average speaker to life.



SAE. . .70's GRUNGE CLASSIC

Another way to go is to buy a pair of Magnequest transformers and build a pair of amps or get someone to do it for you. I've heard Mike's latest transformers and they are untouchable, maybe as good as the WE 171A from the 91. Can't believe you did it, Mike. Good work. Anyway, here's a chance for good sound a heck of a lot cheaper than the 91s. If you really want to save money use 6A3 tubes. In my 91s they sound as good as 300Bs. So all you cut throat, price bumping scumbags trying to hawk me your trashpicked 300Bs for top dollar, think again. Even in Japan, you can buy late 300Bs for $275. Actually, WE tubes don't necessarily sound better than other companies' versions of the same tube type, especially the rectifiers. They are only cool to have if you own the original WE amps and you are anal about things—like me and the Japanese. The tubes used in the popular WE amps go for big bucks. Don't build around them. If you're really into Western tubes, try the odd numbers like the 275. Use whatever is cheap and available. By the way, the Chinese 300B copies are not bad at all.

So the word from the Gallo is just get a triode amp, any triode amp. Shoot for WE 91s or 86s if you're into classics. Or buy some transformers and get some amps built. Or talk to Don Garber or J.C. Morrison at Fi in NYC. They understand. There are a million tubes to try like 10s, 50s, and all the 2A3 family. Just do it and forget about it. Worry about the rest of the system. Move on to the fun stuff.

Alright, to get a discussion on speakers underway, I figured I'd throw you cheap lazy Hi-Fi nuts a bone. I, Vinny Gallo, that's right, The Gallo. Me—Vinny G, Vincent Gallo spent $96,329 dollars, drove over 16,238 miles, and yapped on the phone for hours to chisel away gear from some of the biggest bunch of money grubbing, Hi-Fi pimpin', mis-representing, slick, conniving, back stabbing, solid state listening Hi-Fi dealing jerks in the USA just so I could generate some interest and discussion on ANYTHING BUT AMPS.

I managed to collect Western Electric 12A, 13A, 15A, 16A, 22A, 24A/B, 25A/B, and 26 horns. I'll be listening to these with 555, 555W, 594, and 713C drivers and 596 and 597 tweeters. I plan to set these up in a huge loft in Soho, NYC. Me and my super pal Mark Lyons will sit there like two big assholes for hours listening and A/Bing while all you Hi-Fi pimps are sitting around watching primetime TV and eating chips while waiting for the phone to ring so you could make another quick buck selling off some antique gear you finagled off some blind widows. That's right Rick, Larry, Vernon, Scott, Sumner, Hitochi and Joel. Stay tuned for #4.

Chew the fat, shoot the breeze, mull it over, think about it, and please, please forgetabout amps. Love, Vincent.

OPEN LETTER TO TUBE MAKERS: LET'S DEVELOP A MODERN LOW MU TRIODE!

Although the Western Electric 300B is indeed a superb tube, it can be used in home amplifiers only by the fortunate few who can afford them. Small production quantities prohibit economical manufacture so the price is a very high $200 per tube. Other practical drawbacks of the 300B include its obsolete 4 pin base, an unusual 5V filament supply requirement, and a rather low mu which makes the tube somewhat difficult to drive with low distortion unless an expensive interstage/ driver transformer is used.

OK, so large scale production of the original WE 300B is gone. Well, let's develop a modern low mu power triode for the audio amplifier mass market. It could have an octal base, a 6.3 V heater, a 50 watt plate dissipation, a maximum rated plate voltage of 600V, a cathode, a mu of about 8, a plate resistance of about 700 ohms, and be pin compatible (minus the screen grid) with a 6550 or KT-88.

This new tube could be used to upgrade ultralinear 6550 or KT-88 amplifiers to triode operation without any wiring changes. The potential market for such a tube could be enormous. The availability of such a tube is long overdue.

The new tube should be a genuine triode and not a modified 6550 or KT-88 with the screen grid connected to the plate inside the tube. When a "triode connected" pentode is used, the electrons arrive at the plate a short time after the electrons arrive at the screen grid. The difference in arrival times results in a type of phase distortion or signal "clutter". The signal current which flows in the primary of the audio output transformer thus consists of two components which are slightly out of phase with each other. This is a little-known effect which should explain why amplifiers which use "real" triodes sound better than amplifiers using "triode connected" pentodes.

Hey, tube manufacturers! Are you paying attention? Maybe a smaller version of the new tube could also be developed to upgrade 6L6GC and 6CA7/EL-34 pentode amps to triode operation?

Ed Warden
Lynchburg, VA

SEMPER FI

Dear Mr. Roberts-san:

I must respectfully decline to agree with the thesis of superiority of single-ended triode amps, horn speakers, and most all of the other affectations of the Japanese audiogerontophiles now coming to American notice.

If you will recall, either firsthand or from the now-musty books from the old days, the High Fidelity movement started in large part as a rejection of those big chunks of furniture called "hi-fi's" sold in very large number from just before the Hitler war until the early seventies. They were a symbol of all that was evil about consumer culture, because they were expensive, sold by commission salesmen to non-technical people, and were by no means any technical achievement to be proud of.

Sonically, they were considered evil. They had extremely truncated bass response because, in addition to having cheap transformers, the speakers were mounted in the same cabinet as the diecast aluminum record changer and any substantial bass would have meant the unit would have groaned with feedback until it disintegrated. The power output was inadequate, the speakers were trash, stereo separation was poor and in general they were lousy. They were, in a word, low fidelity.

However, they were very popular and sold well. In the early sixties, a first-rate component system could have been had for less than many of these blond monsters. Aside from their value as furniture and the fact that the buyer had no need to connect or fool with anything, it was also a fact that many buyers actually preferred the sound of these units to true hi-fi. They were "rounder", "mellower", and therefore "more musical". Salesmen of the period (and I can remember it well, because I used to badger them) played this up to no end and the buyers indeed loved it.

Changing musical tastes and the Japanese solid state invasion put the big console out to pasture. Within a couple of years, the average consumer was going down to CMC or such like and buying component systems offering measured performance bettering anything the "stereo nuts" had access to in their day. The so-called High End started up shortly thereafter. Its premise was that equipment could measure well and still sound lousy, and that listening to it was the way to sort the wheat from chaff. However, they did make explicit that the goal was reproduction of music, preferably accurately actual recordings of real music (i.e. music performed in real time in a finite space in air as a listener would hear).

To do this, you still had to have certain objective absolutes. You needed amplifiers with the full audio bandwidth, and enough power to provide the requisite headroom so as to never clip the signal. You also had to have speakers with flat, wide response and the capability of handling the excursions of the dynamic range of music. Real music, not some stuff by opiated English layabouts passed through the bowels of Teletronix limiters and Fairchild compressors and Pultec EQ boxes (all worth their weight in Marantz 7s and 9s and 10Bs several times over, alas...).

Now that this idea has, egads, become popular and accepted, as it has because, magic wire and Tice clocks and Peter Belt and Armor All aside, it had merit; you could, and many did, make good-measuring stuff that sounded rotten. (Say "hi" to those nice folks in Binghamton...). Some have a driving need to be more different and esoteric. The same people who used to do things like put Lycoming aircraft engines in Volkswagens have discovered that you can make audio gear out of huge transmitting tubes and other neat-looking industrial junk.

Of course, when the basic lessons of fidelity in audio have to be stepped on a little, we just say that it's better this way. We like the round mellow sound of deficient bass and we like the harmonic flavoring of a little distortion. And if the resulting "system" of surplus high-school-gym speakers, amplifiers that look like something from a bad sci-fi movie of 1959, and a turntable out of an old Jeezus Saves!!! country gospel radio station perform pretty much like those old bleach-blonde squawkers, who cares.

I admire your publication for its do-it-yourself spirit and its willingness to point out some of the old High End's follies. But I think once you depart from the true quest of fidelity, and I think 99% of the

triodephiles have, you wind up where we started pretty quick.

True fidelity, in a musical system or anywhere, is not always pleasant. A less-than-musical recording must come out that way, if the "fi" really is "hi". What the mega-yen Japanese systems, the old blond bombers, (I'm trying real hard not to make any remarks here about a certain female singer from Hawthorne, NJ...) and for that matter an old Rheem Califone AV gramophone plugged into a pair of Fender Tremoluxes have in common, is that the fidelity is deliberately sacrificed for a sound the listener likes better than reality.

Where does it end up? Eventually, once detached from reality, the music system becomes a maze of studio effects boxes, gimmick speakers (Leslies, anyone?) and other outlandishments. I reject this approach and all its empty promises and all its false works. Give me the truth.

Frank O'Connell
Lenexa, KS

Dear Mr. O'Connell-san:

After all these years of great minds working to perfect the fidelity of reproduction systems, if you want *truth* you still have to go to a concert. Hi-Fi is always a LIE. It's reproduction not production. Detachment from reality happened at the moment of recording.

In our culture there is a strong tendency to equate "old" technology with junk. Indeed, astonishing progress has been made in many technological areas. But if you look hard, you will find approaches that were abandoned on the grounds of economics, inefficiency, and other non-performance criteria. This is the story of the high quality triode amplifier, the Alnico speaker, and many bygone audio favorites. On the other hand, junk is junk regardless of its birthdate. So, among the "basic lessons of fidelity," I would include the truism that the chronological age of a technology is not a strict measure of its sonic merit.

The March issue of *Hi-Fi World* measured the Audion Silver Nights, zero feedback single ended parallel 300B amps, at 0.2% distortion at 1 watt, 1% at 8 W, and 4% at 18W full output. Bandwidth was 30-30KHz. Modest but entirely respectable specs in the real world. A product like this, built with quality and performance in mind, is capable of stunning fidelity. It does the things that the "high end" types love exceptionally well. Sometimes, "more musical" means just what it says.

As the reviewer of the Silver Nights put it, "I've seldom heard recorded ambience so tangible, the feel of a hall or studio so clearly pictured." He reported that textures were "...coming through with an accuracy that is unhappily rare..." and that these amps serve to "...make music gloriously real, to endow recordings with that extra dimension that has no-one doubting the living, breathing performer between the loudspeakers." Is this fidelity, or what?

He reports that the 300B SE did NOT perform credibly in the bass with his Quads. But, for a variety of boring technical reasons, SE triode amps can and should produce great bass—when the speaker/amp combo is right, not always a simple challenge with a ten watt amp if you're looking for a modern store bought speaker. By the way, an April '93 HFN&RR review of this same amp noted that this amp could put out a 28 Hz note "with terrifying effortlessness. Not just the note, but all its weight and power, too."

I consider the ability of triode amps to make less than perfect recordings listenable a real plus, not a fault. For instance, I like 50's Cuban music and I can't find any audiophile pressings of Orquestra Chappotin. Frankly, Chappotin still doesn't sound too good with triodes, but at least my ears don't bleed when I turn it up. Great recordings sound great, as one would expect. In short, a good triode amp, like any good amp, doesn't sound like much at all. The syrupy, slow, gluey mess that I half expected to hear (based on preconceptions) before I built my first SE triode just ain't there.

People who listen to triode amps and some of the classier vintage equipment are usually not newcomers to the serious pursuit of good sound reproduction. You don't ask Mom for an 845 amp when you graduate from high school. Most "triodephiles" have owned more "high end" equipment than they care to admit or remember. They're not trading in their Krells and ARCs for Blonde 1962 Magnavox console "Hi-Fi" sets. Neither are they trading in their ability to hear for a 90 pound amp guaranteed to alienate the local spouse. Typically, "conversion" is based on perceived sonic merit.

Accordingly, when somebody who once owned a VPI with a Graham arm tells me that a 30 year old Thorens TD-124 with an Ortofon RMG309 arm/SPU cart (a radio station favorite) sounds great, I take that assessment very seriously.

Often the products of before-the-fact reasoning crumble when the ear is called in to decide. The only way to judge audio is by listening. Sometimes listening based evaluations seem to suggest that everything we know is wrong. Much of it is. Why should hi-fi be different from the rest of human experience? In this crazy pursuit, you can't simply postulate, you've got to listen.

And *then* choose what you like. Why not? The other options are 1) choose what you *don't* like, or 2) choose what *somebody else* likes. The fact that one "likes" a certain sound doesn't necessarily imply that fidelity is sacrificed. Might even imply good taste.

Many sincerely like the currently fashionable sounds and surely some would honestly prefer the typical audio salon thing to triodes and "old gym speakers." But if you

flatly rule it out instead of checking it out, how can you know whether you're missing out? True, most ancient products and technologies deserve obsolescence—but let's not throw out the good with the bad.

DAMPING

After designing several zero feedback single-ended triode tube amplifiers, I would like to offer an additional reason why they sound different than push-pull amplifiers: damping factor. For a given tube, the damping factor is generally four times greater in SE configuration than in PP!

To get an idea of the damping factor in PP, look at the ratio of the tube's plate impedance to the load impedance. The ratio for PP 2A3s or 300Bs with a 3K plate-to-plate load is about 1 (each tube sees 1/4 the plate-to-plate impedance). The ratio for a SE 2A3 with a typical load (2500 ohms) is around 3. You bet you'll hear a difference! For example, into a typical electrostatic speaker, an amplifier with a damping factor of 1 will roll off the high frequencies above 10KHz. Damping factor is defined as the ratio of load impedance to source impedance.

The output of an amplifier with a high output impedance/poor damping factor will follow the speakers impedance curve. Since most dynamic speakers have a rising impedance in the bass and mid to lower treble regions, these frequencies will be boosted. Voila, an audiophile tone control. Sure, the response was flat into a resistor. Negative feedback can be used to reduce the amplifiers output impedance and minimize this effect. A high output impedance will also effect the transient response of closed box woofers which can make the bass sound muddy.

SE pentodes have a very high output impedance. Gordon Rankin's design in *SP* #2 claimed 1.16 ohms output impedance (a damping factor of about 8 referenced to the 8 ohm tap). This is way off! The ratio for an 807 is about 38K to 6K, or 0.16. As an approximation, the output impedance will be 50 ohms on the 8 ohm tap (a damping factor of 0.16). The output of this amplifier will be GREATLY affected by the impedance of the speaker it is connected to. All of this is fine if you want your amplifier to act like a tone control over which you have no control except to change the loudspeaker!

As a slight diversion, note that for a given load impedance the 845 will have better damping than a 211 because of its lower plate impedance. The Ongaku uses a primary load impedance of 16K-20K! This yields good damping! The Cary 211 amp uses a 7.5K plate load (closer to the textbook load) and offers variable feedback, which is necessary to get a flat response into some speakers. Most PP amps do not use a high enough plate-plate impedance to achieve good damping without negative feedback.

Some amplifiers of old (Marantz 2, Altec 340, etc.) had variable damping. Essentially this allowed you to INCREASE the amp's output impedance to allow it to work well with certain speakers. The Heath Legato speaker provided a series resistor to be used with amps having a high damping factor (low output impedance). There are obviously subtleties which we can't go into here (like dynamic impedances).

I prefer the sound of a damping factor of about 4-10 which works well with the speakers I use (QUAD ESL, Altec A7, CLS, Acoustat, among others). This damping factor is easy to achieve with a single-ended triode output stage with zero feedback

Mike Somers
Chicago, IL

Gordon Rankin comments:

After several months of hindsight and further experimentation, I have a few corrections and changes to make to the Single 807 article in *SP* #2. The preparation of the article was a bit rushed in order to meet the publication deadline. [Hope the whip scars have finally healed - Ed.]

First, the amp sounds better with the filter consisting of R5 and C2 removed. This was discovered by the good folks at FI in NY. Also, as Mike Somers points out, my rushed calculations of output impedance were incorrect. I sent the amp off on an East Coast tour shortly after publication so I could not directly measure the output Z but I calculate a maximum Zout of 25.325 @ 10 KHz.

Right after SP #2 went to the printer, I realized that I had a blocking cap between my generator and the amp while doing frequency response measurements, causing a higher rolloff than the amp itself was providing. After re-testing, I found that the amp was actually only 3 dB down at 9 Hz. Yes, this amp had BASS. Not only did it measure good into a resistor but it was very tight, extended, and controlled — not "muddy" at all— driving a properly matched speaker.

The whole point of this exercise was to give this "neglected and rejected" topology a try. When I started out, I really didn't know what to expect. I was surprised at the good subjective results, as were others who have heard it. The most common reaction is "WOW, what bass!" followed by "I can't believe how good it sounds!" Sure, it won't beat my 845SE amp but it turned out to be a really cool piece. So all I can say, Mike, is try it you might be surprised too!

Mike Lefevre will be back next issue with another EXCITING installment of *The Core Issues* :

"POTTED TRANSFORMERS AND POTENT MYTHS"

W.A.F.

by Joyce

Have you noticed lately how this Wife Acceptance Factor thing, (a.k.a. Domestic Interference Factor), keeps on popping up everywhere? Just the other day, I came across "Toys for Boys?" by Barry Willis (*Stereophile*, January '93), another fascinating article written by a male on the perennial problem of women and audio.

What caught my attention this time was the author's solution to the dilemma: "Give women what they want: reliable, affordable, easy-to-use components *in a variety of colors* [original italics]." Oh boy, I thought, shaking my head, a whole article on what women really want in audio is color coordinated stereos (...when what we'd really like is husbands with taste).

I was skeptical. Honestly now, aren't silver and black and walnut brown stereos, that somehow still never manage to blend smoothly into the background, bad enough for you? I had sudden dreadful visions of fuschia tuners, puce speakers and amps of kelly green, all making their merry way into my home.

Then, as I continued reading, I saw the light. Colorized components are *just the beginning*. Hey, all you macho audio designers: take notice! Women, it says in the article, are "...not merely buying music. They're buying furniture and art. And if you want to place your product in their homes, that's what it must be: furniture *and* art."

I say this guy is right. Sisters, it's time to domesticate this audio animal, from those barbaric chassis and cabinets, down to the untidy, feral hardware inside. But why wait another few decades for the male-dominated industry to catch up? Let's bring our feminine talents to the task and start the Audio Revolution today!

Furniture *and* Art, Sisters! This shall be our battle cry!

In short, I've decided to become a professional audio designer. As I see it, when it comes to redoing your audio system, there's no need to limit your imagination to color; all kinds of patterns, shapes, textures and other decorative effects are possible. You'll see that to bring out the best in audio, all it takes is a little ingenuity and a woman's touch.

As Barry Willis put it in his article,

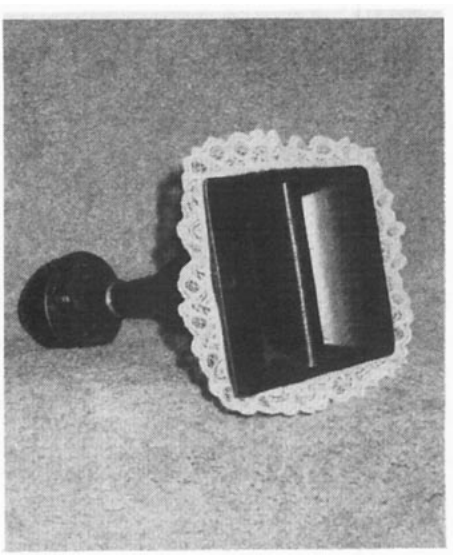
> "Whether our longing is for the good old days of 'family values' or the glory days of 'full employment' or the 'full, rich sound' of a Western Electric amplifier, we need to see such longing for what it is: a long look into a cloudy rearview mirror. Nearing the edge of the 21st century, we need a visionary approach to aesthetic, tactile, and application design. We need products which will carry us happily into the future, because that is where we are going."

Right on, Barry! Meet me at the vanguard, *and bring your wife!*

L'Audio Chez Moi: A Pictorial Gallery of Design

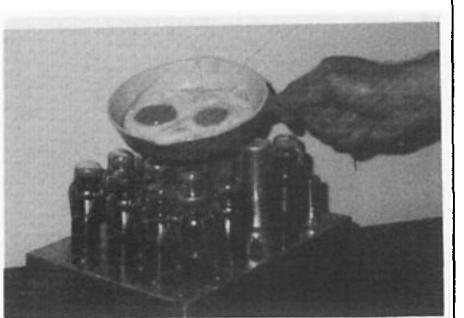
It's Beautiful...

Any piece of audio equipment, I've come to realize, can be transformed into an object of beauty. Among my favorite high fashion audio designs is the nostalgic "Horns 'n' Lace," a subtle fusion of form and function pictured below.



...it's Artistic...

Audio parts are ideal for craft making and other creative pursuits. For those of you still not fully convinced about the musicality of vacuum tubes, I can highly recommend the "Wind-Valve," a wonderful windchime ← *that's guaranteed to fill your home with beautiful sounds.*



...and it's Useful, too!

Finally, I've also discovered that, aside from any musical merits, audio equipment can be put to many creative and practical domestic uses.