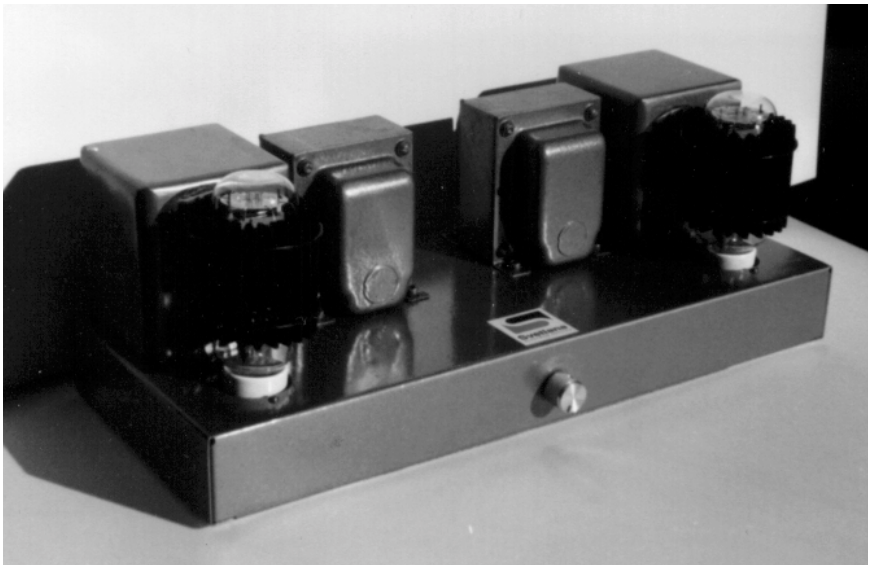
VALVE

Brainiac -
load impedance and operating points - part II

Doc B. -
Soul Sister, a parafeed line stage

Alan Douglas -
when tube testers disagree

Eric Barbour -
SV572-10 line stage!



If this line stage doesn't have enough beans, you have a serious problem!

volume 5 number 4 1998

For Sale: five pairs of amps for $1500

OK, here's the plan:

You buy the basic SEX kit, with its new parallel feed output stage, and choke filtered power supply for just $399. "Gee", you think, "I've spent so little money, I should take that class Tonalities offers and really learn how to build cool tube stuff right."
Total kit expenditure so far- $399

After a few months of enjoying SEX in it's native form, you decide you'd like to find out if the mystique of MagneQuest output transformers is really deserved. You buy a pair of MagneQuest/Peerless TFA-204 transformers, for just $198, and install them on the SEX amps. Now you understand the well deserved reputation of MagneQuest, as you revel in liquid midrange and clean sweet highs.
Total so far-about $600

In a few more months, you have a thirst for more knowledge. This time you pick up a copy of VALVE, and see an article on converting your SEX amps to 300Bs. Cool! You decide to try scrounging up your own parts, pick up some inexpensive 300Bs, some sockets and other parts, and with the detailed schematic in front of you, build your first DIY project from scratch, right on to the existing S.E.X. chassis!
Total so far, maybe $800

Well, a few more months go by, and you get intrigued with the direct coupled, ultra simple circuit of the Afterglow amps. Besides, you want to know if those guys who like 2A3s better than 300Bs are just blowing smoke. So, for $300 you buy the Afterglow upgrade, with Vishay/Dale and Ohmite resistors, custom active load boards, tubes, beautiful new binding posts and RCA jacks, and all new hardware.
Total so far $1100

By this time you know what you like, and how to get it. A few months later, you order the Paraglow parallel feed conversion for your Afterglows, adding plate loading chokes and nickel parafeed output transformers to your amps for just $400.
Or maybe you scored some cool old 45's and you get the 45 parafeed setup for just $370. Either way you can't lose - you are now dealing with the state of the art in SE, comparable to SE amps sold at *any* price.
Total spent, about $1500

For five different amplifiers!

ElectronicTonalities

P.O. Box 2786, Poulsbo, WA 98370 360-697-1936
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Doc's desert island album

If asked the classic audiophile question "You are sent to a desert island and allowed only one album to listen to. What would it be?", this CD would be under my serious consideration. Arne Domnerus, of *Jazz at the Pawnshop* fame, plays sax this time, with pipe organist Gustaf Sjokvist. Recorded in two Swedish churches, this difficult to categorize album reveals an expression of emotion second to none.- *Doc B.*

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VALVE

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of eXtreme audio

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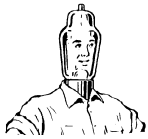


editor's thing

It's finally here!
www.bottlehead.com
Thanks to the efforts of fellow bottlehead Handsome Dave Stagner, we now have a website.
At this writing the site is largely under construction, but there is already some fairly detailed information about VSAC 98 there.
Future plans for the website include improved graphics, more detailed show info, an online catalog for Electronic Tonalities products, and a VALVE page, with subscription info, some of our more notorious articles, and hopefully a lot of cool photos of reader's projects.
Keep checking out the site as it grows. We have already been getting about 100 hits per day, so we are stoked to get this baby up and running!
On the show front, plans are going very nicely, thank you. We have received tentative plans for attendance from about 22 exhibitors so far, up from about 12 at this time last year. Most all of last year's exhibitor's will be back with new surprises, some new folks who are saying they will come include Tube Research Labs, First Impression Music, Moth Audio, Audience, ASUSA, Canary Audio, Glass Audio, Definitive Sound Makers, Audio Artistry, and John Wycoff, who will be showing a new tube headphone amp.
We have also booked the Paul deLay Blues Band for a show Sunday night, and it looks like we will have bigger participation in the Craftsman Room this year, with the newly rekindled Oregon Triode Society offering to lend a hand.
Seminars will include a lot of DIY speaker topics this year, with Fi's Dick Olsher, V&T News' Lynn Olson, and yours truly dealing out info on our favorite public domain designs, as well as a preamp tube tasting!.
Bottom line is, make your hotel reservations NOW. The place will fill up this year, I suspect. Silverdale Resort Hotel, 360-698-1000. Be sure to tell them you will be attending the conference, as we receive special accomodations based on the number of reservations, and they will only know you are attending VSAC if you tell them.

Doc B.

two new tubes of note

Over the last couple months we've had the opportunity to audition a couple of tubes that really got me excited.

The first tube was brought by Ed Fallon to our May meeting, plugged into his new amp project, built in the classic bottlehead style, on a sheet of plywood, and heavy enough to require two guys to haul it into the listening room...

The amp is a fairly conventional 6SN7 direct coupled to 6SN7 driving cap coupled 300B type amp, but with a high current handling Hammond output trans. First thing we did was cap couple a Pinstripe to the circuit, letting the Hammond do duty as a 42 H plate choke. This really opened up the sound! The tube? A Valve Arts VA5300 - sort of a Chinese VV52, but quite different, actually. 5V filament only, and a carbon anode. Well, at $88 each from Angela Instruments, these things gave my VV52s a run for their money! Everyone in the room preferred their lack of microphony and greater clarity to the slight background "whooshing" the VV's exhibit on high efficiency speaks.

One caveat: others have said this tube does not have a very good top end. This did not seem to be the case in our experience, but I thought this should be noted.

The next tube to knock me out was the KR2A3, a new single plate 2A3 with an 18 watt plate dissipation, kindly sent to us by Ron Welborne. This tube proves that Ron and the Krons don't just rest on their Laurels (sorry Ron). We plugged a pair of these into stock Afterglows at the June meeting and went to sonic heaven. This tube hits a new level of realism, speed, clarity, and background quiet, even above the other KR tubes.

It's like a 45 in many ways, but with more bass (though just as well controlled). Top end extension is marvelous, and the image is so well defined, without any etching, it definitely hits new highs in the "you are there" department.

It is indeed a direct plug in for any 2A3 amp, although we found the gain to be a bit lower than a Chinese bi-plate. My guess would be that the best will be had from the tube at its maximum dissipation, maybe a 300V and 60 mA operating point.

The downside? $550 a pair, but Ron has a special deal for VALVE subscribers, check out page 14. They are killer in an Afterglow.

Soo, for great sound and good power (15W) at a reasonable price, the VA5300 is a good bet. For the ultimate 2A3, the KR2A3 is king!

Back Issues

Back issues are printed to order - please allow two weeks for delivery - add $5 postage for orders outside the US

Volume 1 - 1994 issues - $20
a Williamson amp; Dyna Stereo 70 mod bakeoff; converting the Stereo 70 to 6GH8's; a QUAD system; triode input Dyna MkIII; MkIII vertical tasting; smoothing impedance curves; Altec A7; Ampexes Nagras and ribbon mikes; Triophoni, a 6CK4 amp; audio at the 1939 World's Fair; books for collectors and builders; V.T. vs. R.M.A. cross reference; FM tuner tube substitutions; Big Mac attack - the MI200; 6L6 shootout; a vintage "audessey"; more FM tuner mods; vintage radio mods; Heathkit rectifiers; PAS heater mod.

Volume 2 - 1995 issues - $20
Rectifier shootout, tube vs. solid; FM 1000 recap and meters; single ended 10 amp; triode output W-4; Optimus 990 - speaker for SE?; star grounds; tuner shootout; Living Stereo, vinyl or CD?; World Audio SE integrated; firin' up - smoke checking; Brook 12A schematic; 6C33 vs. 3C33; Heathkit power transformers; 6B4's + MagneQuest = SEcstasy; W5 mods; triode operating points; Dyna restorations; Marantz 7,8 and Scott LK150 impressions; hackable vintage gear; Quasimodo - PP 805 amp; restoring a Scott 340 in 75 minutes; a dream system for 78's; cartridges and styli for 78's; Restoring a Lowther, Part 1&2; easy tube CD output hack; 6ER5 phono preamp; 304TL & 450TH SE operating points; hypothetical DC ESL amps.

Volume 3 - 1996 - $25:
Single Watt, Single Tube, Single Ended, an amp for Lowthers; the Vintage Speaker Shootout of 1996, QUAD vs. Lowther, vs. A7; the Voigt Loudspeaker, the Single Ended eXperimenter's kit; cathode coupled SE 6AS7 amp; how to build the Superwhamodyne; refoaming AR woofers; mesh plate tubes; rebuilding QUADS; QUAD amp filter surgery; single gain stage amps; the Brooklet, and Brookson, choke loaded PP 6080 amps; transformer coupled PP 6DN7 amp; the Iron Maiden; Building the Lowther Club Medallion; the TQWT, a tapered pipe enclosure; IT 300B amp.

Volume 4 - 1997 - $25:
the Whampipe/Hyperwhamodyne; weird interconnects; winding your own SE output transformer; Tapered Quarter Wave Tubes; battery bias; onetuber 417A and 437A amps; DAC attack; 6BL7/211 SE amp; pro sound speakers at AES; 46 plate curves; what's all this about parallel feed?; parafeed line stage; C.W. horn divided by two; Svetlana meets Brooklyn; parallel feed SE 811A amp; parafeed 2A3 amp; Lowther fixes; Altec vs. the competition; VSAC 97 program guide; VSAC 97 photos; Andy Bartha's cool speaker cables; Paul Joppa's 6DN7 driver stage; S.E.X. kit schematic revealed; an Edgarhorn builder's story; direct coupled active loaded parafeed 45 amp; Brainiac's S.E.X. changes; VSAC 97 seminar notes; tweaking the one tube 6DN7 amp, Lowther drivers, and the Wright preamp; 300B S.E.X. amp conversion; mini monitor for 300B amps,

Load impedance and operating points for single-ended triode amplifier stages

Part Two: Linear Triodes

by Paul Joppa

In Part 1 of this series, I described how the operating point (plate voltage Eo and current Io) and load resistance RL are related. In this part, I will use those observations to look at single-ended amplifier performance for triodes that follow closely the simplest expression for plate current as a function of plate and grid voltages, called "Child's Law". I call these tubes linear because they are capable of higher power output at lower distortion than those that deviate significantly from this behavior. Child's Law states that:

$Ib = K*(Eb + m*Ec)^{3/2}$

In this equation, Ib is plate current, Eb is plate-to-cathode voltage (hereafter called simply "plate voltage"), and Ec is the grid-to-cathode voltage (hereafter called simply "grid voltage"). This formula is based on a number of simplifying assumptions, probably the most important of which is that the cathode/grid/plate geometry is geometrically simple. It has been derived exactly for concentric cylinders and for infinite flat plates. If you look closely at a type 76 tube, you can see that it was designed with a cylindrical structure. Similarly a 300B was clearly designed with a planar structure. Both of these tubes are known for their high degree of linearity.

Based on this formula, I worked out the performance on the computer for a variety of operating conditions. I found that with two non-dimensional ratios I could summarize hundreds of computer analyses. Before introducing them, let me mention the operating resistance R0, which is the ratio Eo/Io, as described in Part 1. I call it a resistance because it has the dimensions of a resistor - in fact, it is the value of a resistor that would draw the same current as the tube if it were substituted. Then the first non-dimensional ratio I will use is R0/rp, where rp is the tube's plate resistance. The second ratio is RL/R0, the ratio of load resistance to operating resistance. In part 1, I said that a load resistance equal to R0 was a good initial guess; now we'll examine some variations of this and see the effect.

The ratio RO/rp should be at least 4 to give a reasonable operating box without risking grid current. Sometimes you are forced to use a lower value, such as when the plate resistance is very high, but the output power and voltage become severely restricted in this case. I evaluated operation for values of R0/rp from 2.5 to 10, which corresponds to a higher Eb than most tubes are rated for.

I varied the load ratio RL/R0 from 0.25 to 1.0. It is not completely impractical to operate as low as 0.25 if R0/rp is small, although at higher values of R0/rp this will result in cutoff for a substantial portion of the cycle and therefore high distortion.

Shown below are contour plots of power (normalized to the plate dissipation PD) and second harmonic distortion at full output. As you can see, low R0 and high RL produce the lowest distortion, but also the lowest power. The best tradeoff is with high RL (for lower distortion) and high R0 (for more power output).

This study has led to a set of "rules of thumb" that approximately summarize these results, and work reasonably well for linear triodes (for nonlinearities, see Part 3.) These give a good starting point, but each tube and circuit is unique. I don't pretend these are the very best operating points, only that they are a pretty good starting point.

R0/rp = 5 RL/R0 = 0.7

actually, as long as R0/rp is greater than 4, RL/R0 = (R0/rp - 1.5)/(R0/rp) is pretty good.

The minimum value of RL/R0 to avoid cutoff is (R0/rp - 3)/(R0/rp)

Incidentally, for a plate dissipation of PD watts, it's handy to know that Eb = sqrt(R0 PD)

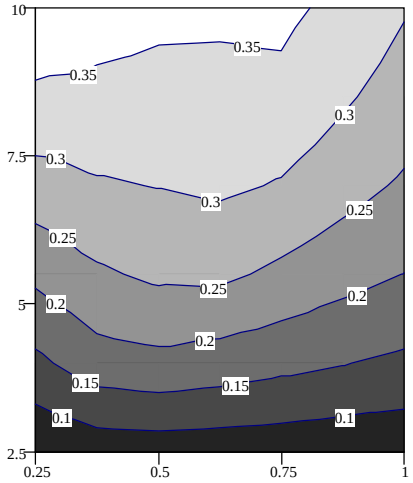
Ec = 0.7 Eb/m for R0/rp = 5

actually, Ec =(Eb/m) (1 - 1.5 rp/R0) in general

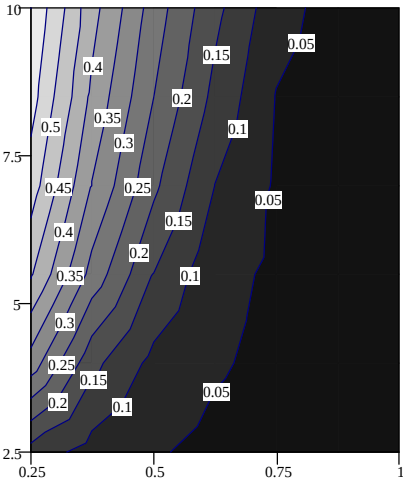
Hence Rk = 3.5 rp/m

R_k is the cathode resistor

actually, Rk = (R0-1.5 rp)/m in general. If RL/R0 = (R0/rp - 1.5)/(R0/rp) as recommended above,



Power



Distortion

then Rk = RL/m.

To complete the circuit for a single stage, we need the values for coupling and bypass capacitors, and for transformer or choke loaded stages, the load inductance. Assuming that the capacitors have a -3dB frequency of 5 Hz, we can estimate:

Bypass capacitor Ck = 65,000/Rk microfarads,

coupling cap Cc = 30,000/Rg microfarads (Rg is the grid resistor)

Now it is not so easy to make large inductors, so I generally assume that the minimum inductance value is that for which the impedance equals RL at 40 Hz. This will give a small-signal frequency response down less than 1 dB at 40 Hz and less than 3 dB at 20 Hz, with a power bandwidth down 3 dB at 40 Hz. This value is:

Minimum choke or transformer primary inductance = RL/250 henries

For a simple example, consider a 2A3 amplifier. The plate resistance rp is 800 ohms according to the RCA manual. If we choose R0 = 5, then Eb/Ib = 4000. For RL/R0 = 0.7, we get a load impedance of 2800 ohms. Plate voltage is sqrt(15 R0) at 15 watts, or 245 volts, and since PD = 15, Ib = 15/245 = 61 mA. Grid voltage should be about -41 volts, if m is 4.2. The cathode resistor would be 667 ohms with a bypass of 97.5 microfarads. These values are pretty close to the RCA recommended operating point of 250 volts at 60 mA into a 2500 ohm load with 45 volts grid bias through a 750 ohm cathode resistor. With a maximum grid resistor of 500k ohms, a coupling cap of 0.06 microfarads would be big enough. Finally, a transformer of at least 10 henry inductance is needed for acceptable bass.

I have found these simple rules of thumb to be very useful when first developing a new design, or examining the possibilities for a particular transformer, tube, or power supply. Often there are reasons for varying these values (for instance, in my 300B amp the power supply and output transformer could not handle the estimated current of 80mA; I dropped it to 55mA which gave me more distortion but was still acceptable), but it's always nice to know where you are to start with. I hope you will find these rules as helpful as I have.

random thoughts

Amp Building Blues

Mike Connly is the first reader to report on his newly completed Blues Master.
After a week long struggle to kill a buzzing sound coming from the amp, Mike found that installing a 30 mfd bypass cap to the cathode resistor of the VV32 solved the problem.
We hope to have pictures of the finished amp soon...

Coming soon, new Whamo crossover

I finally figured out how to get the nice electret mic Dave Dintenfass loaned me with his HP dynamic signal analyzer to work.
And so I've been running around with hearing protectors on, madly sweeping every set of speaks in the house (about 6 pairs right now).
The first major find was that I have been giving a bad recommendation on modifying the MCM 53-325 titanium dome tweeter used in the Whamos.
I had been suggesting putting a 1/2" dot of felt on the pole piece, and then gluing a 3/8" square, 1-16" thick piece of acoustic foam on top of that.
Turns out the felt is all you want to put in there. It does a nice job of smoothing response, but the foam kills the response from about 9 kHz - 18kHz.
Both the 53-325 tweeter and the 55-1270 5" drivers are showing broad peaks in the 4-8 kHz range, creating quite an overlap peak with the current .39mH choke and 6 mfd cap.
I've been working with slightly different drivers at a lower efficiency, which calls for a somewhat different crossover setup, so I haven't had a chance to work out the details for the Whamos yet.
But here's one interesting result:
A 3 mfd cap tilts things from about 6600 Hz down such that the tweeter's response comes up from the low frequencies at roughly a 24 dB slope to a bit above 2 kHz. From 2kHz up to 20kHz the sucker is flat as a pancake.
If one could come up with a fourth order rolloff for the mids, one might have a neat setup, although I remain a bit skeptical about the sound of the tweeter below 3kHz.
A more successful approach might be to use a much bigger choke, about 1.25 mH, and a smaller cap, maybe 2mfd. Stay tuned for more results. Doc B.

wanted: a few good bottleheads

It's time to plan your trip to VSAC 98, and to consider working as a volunteer this year. The help from friends who stepped in on a moment's notice was admirable last year, but we'd like to be more organized this year.

Also, you will receive a reward this year for your efforts. Volunteers get in free, and will be invited to partcipate in the trade and press only day, Monday, August 24. This will be the day when it really gets cool, with equipment from various rooms getting mixed and matched, and the exhibitors getting a chance to hang out with each other without having to do their "show" thing. This day was requested by many of the exhibitors last year, and promises to have a real party atmosphere.Here's some areas where we need volunteer help:

Hard work, short hours-

- Job 1 - Load in - we need four or five strong backs to load the exhibitor's gear from my warehouse into a truck, and from the truck to the exhibit rooms, on Friday. Load out - ditto, only in reverse, on Monday night and Tuesday morning.
- JOB 2 - VERY CRITICAL - we need an experienced person to supervise setup of the PA for the blues show Sunday night. I'm guessing a crew of four to six will be necessary.

Easy work, longer hours-

- JOB 3 - We need a person or two who can watch exhibit rooms for exhibitors when they need a break.
- JOB 4 - Paul Joppa deserves an assistant this year, don't you think? Help Paul keep the seminars running smoothly.
- JOB 5 - We need about four volunteers to man the craftsman's room, and four more to man the vintage room. Our volunteers pulled long shifts in these rooms last year, so we need more folks in each room working shorter shifts.

Hard work, long hours, but fun

- JOB 6 - As much as Eileen and I like to be in the middle of everything, we really owe it to everyone else to have an assistant this year, someone who can attend to exhibitor's needs, talk to the hotel staff, run to the store when we need supplies, scrounge equipment, put up signs, etc., etc.

So, do your bottlehead duty, call us and volunteer. We'll keep a list of who volunteers for what, so the sooner you volunteer the more choices you'll have. THANKS!

the clearest line stage of all

by Eric Barbour

Ever compared a really good tubed line stage to a passive preamp? Even the best possible design, using tubes with the lowest distortion plus some negative feedback, tends to cause a distinctive "soft" coloration in the sound. Unless you really crank in the feedback, a tube preamp using common indirectly-heated tubes will have at least a little of that "softness". Many tube equipment users feel that this effect is a major component of tube sound. You can get very close to real transparency, but at some cost. Probably, most VALVE readers agree that piling on negative feedback is not the best policy!

In my previous tests of small-signal tubes, some experiments with UX-201A and 01A radio triodes showed me something interesting. The original UX-201A had a thoriated tungsten filament, while the later 01A had an oxide-coated filament. Otherwise, these tubes are supposed to be exact plug-in replacements for each other. And although my distortion tests showed comparable levels of THD for both types, and both types had similar "tubey" distortion, the older version seemed to have much clearer treble and greater detail than the 01A. Subsequent listening comparisons of the SV811 and SV572 triodes versus oxide-filament triodes (such as the 300B) seemed to support the impression that a thoriated filament is more detailed in apparent sound than an oxided filament. Little or no serious comparative listening had been previously given to this difference, especially when the tubes are used as small-signal amplifiers. So there is not much in the way of previous "design art" to follow. (As one dedicated DIYer bluntly put it, "only the truly desperate would use directly-heated tubes in a preamp!" And he has a point. DH tubes are VERY microphonic.)

Small thoriated-filament triodes suitable for low-power use are no longer in production and are becoming difficult to obtain. The recent arrival of Svetlana's SV572 series, however, gives us some interesting experimental possibilities.
These triodes, although power types rated for 125 watts dissipation, are extremely linear. They also come in four different values of mu, allowing some leeway for the requirements of preamp design as well as power-amp design. Although not really intended for small-signal use, my experiments showed that the SV572-10 would make an excellent line-level amplifier at low plate voltages, provided that power-supply noise and microphony issues were addressed.

An interstage transformer would give the best possible performance. Unfortunately, such transformers are usually very expensive or inferior in quality. Electra-Print Audio's recent introduction of a high-quality interstage transformer for SE circuits was perfectly timed. Their 3533-2 tranny has a 1:1 ratio and is rated for a 10k ohm primary load. And unlike many interstages, it was designed for SE operation using a single driver tube, with up to 20 mA DC idle current in the primary. Electra-Print's Jack Elliano was kind enough to loan me a pair of 3533-2s for use in an experimental line stage. Since they would be a perfect load for an SV572-10, I decided to try building the simplest circuit possible, while staying within reasonable parameters for electrical performance.

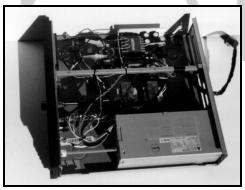
An important thing about this preamp has to be made very clear. The plate, filament and bias supplies MUST be as low in AC hum and noise as possible. The plate power is only 200v, which turns out to be more than enough for a line stage of this type. The "open-frame" power supply shown is a common industrial part, readily available in surplus or from Mouser Electronics. It is more than enough for this stereo preamp. One issue: the manufacturer rates the AC ripple voltage of the supply at 1% of the DC output, even though it is electronically regulated. This is equivalent to 2v RMS, an unacceptably high value for audio circuits. If the builder prefers, a more conventional source of plate supply can be fabricated from a 215v plate transformer, rectifier and filter. Regardless of its source, heavy-duty filtering of the 200v DC is called for. One RC filter (R1 and C10) gets the ripple from about 1.5v RMS down to less than 20 mV. Then, in the preamp chassis, we go through a pair of large Hammond chokes into C2 and C4, further reducing the ripple to much less than 100 uV. Remember, any AC ripple on the plate power will appear on the output at the same level.

Even greater filtering is needed for the filaments of the SV572-10s. ANY noise riding on the filament supply will be amplified by the mu of the tube, because it will act as a grounded-grid amplifier. We have to provide VERY clean DC, and several amps of it. This is very difficult using only a simple transformer-

rectifier-filter circuit, so I would prefer a switching power supply. But the 572's filament needs 6.3 volts and such supplies are scarce and expensive. What to do?

Relax, there is a very low-cost shortcut. In Sash Ohtsuka's MJ article about the SV572 triodes, we find that Sash tested the emission of the filament with less than 6.3v applied to the filament for heating. Sash commonly does this with tubes he tests for MJ, and has found that it is a good measure of the quality of a new tube. As it turned out, operating at 5.04 volts DC caused the plate current to drop only 10%. The decline would be much more if this were a conventional oxide-filament tube or an indirectly-heated tube, often 20-30%. It appears that thoriated filaments are much more tolerant of low filament voltage than oxide emitters. A 10% decrease might be an issue if we were attempting to get maximum power from the triode. However, since we are only going to operate this tube at 200v and 15 mA, such a small decrease will be hardly noticeable. The plate resistance will rise slightly; again, hardly enough to notice. And a major bonus is an enormous lifetime from the SV572-10. In normal operation, a life of 5000 to 10,000 hours can be reasonably expected from the filament of an SV572. In this circuit, with the filament running at well below its normal temperature and emission, life should be comparable to any super-premium preamp tube, or even solid-state devices.

We're in luck! Now we can use a cheap 5-volt personal-computer power supply. I went to a local surplus dealer and bought a used Epson 286 PC for all of $10. The hard drive had already been removed, yet the unit appeared to be in like-new condition. (Maybe it was never used at all--simply junked as obsolete before its time, a common occurrence here in Silicon Valley.) By removing the motherboard and floppy drive, plenty of space was made for the 200v supply and other components. Unlike more recent PCs, this one had a case that was almost entirely heavy-gauge steel. And already mounted inside was a like-new power supply, capable of +5v at 12 amps, +12v at 2 amps and -5v at 100 mA. With suitable filtering, this unit makes an excellent remote power supply for the line stage.



On the main preamp chassis are the tubes,

Listening Impressions of the SV572 Preamp

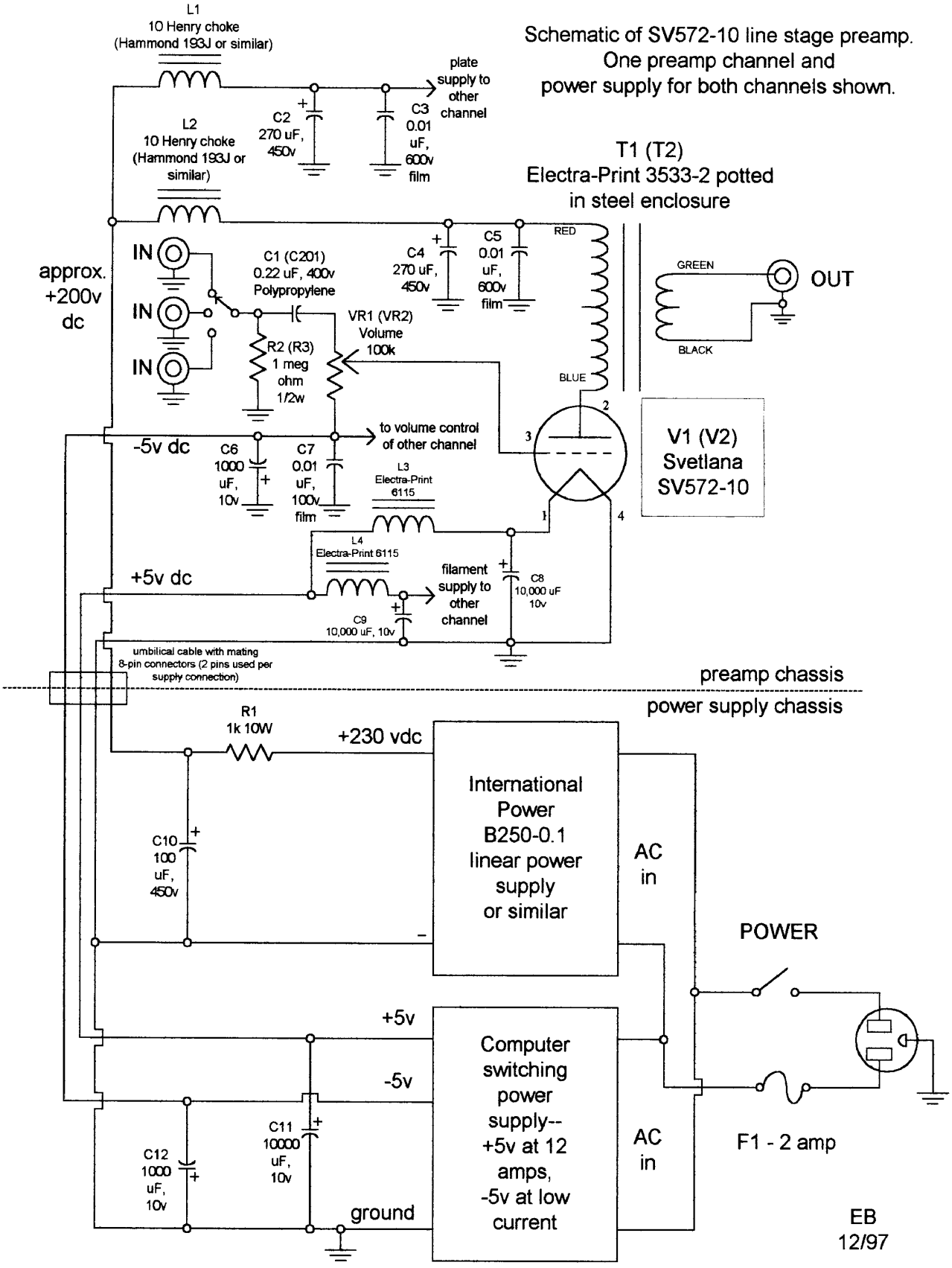
Equipment used: Dynaco CDV-Pro CD player (stock), Dave Wolze custom SV572 SE amps, B&W DM 110 speakers. Comparison based on CD player going straight into amps vs CD player to pre-amp to amps.

by John Atwood,,One Electron Co.:

Effect on tonal balance: very neutral. Subtle expansion of soundstage, more "depth" to sound. A more dynamic sound. Little noticeable hum, although hum and buzz from the Wolze amps may have masked pre-amp noise. Fan noise from power supply is objectionable. Microphonics from tubes is significant when chassis is tapped, or while pre-amp is warming-up. They did not cause problems when listening at normal listening levels. Conclusion: Very good tonal characteristics, very clean. Microphonics and power-supply fan noise keeps this from being a must-have preamp.

by Charles Kittleson, Editor Vacuum Tube Valley Magazine:

Over the last several months, Vacuum Tube Valley has had the opportunity to audition Eric Barbour's SV572 single-ended line stage. Most listeners, including myself were impressed with the detail and clarity of sound. This preamp outclasses the "baby tube" 12AX7 and 6DJ8 line stages we have heard by the dozen. The soundstage is huge with great depth of field. Eric's SV572 line stage, using the Electra-Print interstage transformers, brings a whole new meaning to detailed, clean sound. I nicknamed this preamp "Big Clear" because of these qualities. The only downside of this design is the SV572's sensitivity to vibration that can generate microphonics and instability if if the tube is not carefully isolated from any type of movement or vibration. Through the correct use of tube dampers, chassis layout and rubber mounting of the sockets, this characteristic can be minimized.


Schematic of SV572-10 line stage preamp.
One preamp channel and
power supply for both channels shown.
L1
10 Henry choke
(Hammond 193J or similar)
L2
10 Henry choke
(Hammond 193J or similar)
plate supply to other channel
C2
270 uF, 450v
C3
0.01 uF, 600v film
T1 (T2)
Electra-Print 3533-2 potted
in steel enclosure
RED
GREEN
OUT
BLACK
BLUE
C4
270 uF, 450v
C5
0.01 uF, 600v film
IN
IN
IN
approx. +200v dc
C1 (C201)
0.22 uF, 400v
Polypropylene
VR1 (VR2)
Volume
100k
R2 (R3)
1 meg ohm
1/2w
to volume control of other channel
-5v dc
C6
1000 uF, 10v
C7
0.01 uF, 100v film
L3
Electra-Print 6115
L4
Electra-Print 6115
V1 (V2)
Svetlana
SV572-10
+5v dc
filament supply to other channel
C8
10,000 uF 10v
C9
10,000 uF, 10v
umbilical cable with mating
8-pin connectors (2 pins used per
supply connection)
preamp chassis
power supply chassis
R1
1k 10W
+230 vdc
C10
100 uF, 450v
International
Power
B250-0.1
linear power
supply
or similar
AC in
POWER
+5v
-5v
Computer
switching
power
supply--
+5v at 12
amps,
-5v at low
current
AC in
F1 - 2 amp
C12
1000 uF, 10v
C11
10000 uF, 10v
ground
EB
12/97

KR Enterprise Announces their New Single-Plate 2A3 Vacuum Tube

We finally succeeded in talking the *power-crazed* Dr. Kron into producing a tube for the intuitive listeners of music. A tube for those collective soles courageous enough to venture into the realm of two watt single-ended amplifiers. These KR2A3s are to be admired. Built to the same exacting standards of KR Enterprise's other tubes featuring gold-plated pins and a ceramic base, the best vacuum in the industry, and the new mono-plate design featuring KR Enterprise's patented filament and cathode construction. But wait, Dr. Kron didn't completely give in to the flea-powered hysteria. These new single-plate KR2A3s are powerful. So powerful in fact they can easily pump out 4, 5, 6 watts or more (*you'll have to adjust your circuitry of course*) whilst retaining the delicate balance you expect from a 2A3.

But how do they sound you might ask? They are truly wonderful sounding tubes. Maybe even the best sounding tube in the whole KR Enterprise lineup! The KR2A3 has more of everything...more bottom end...more top end extension... more 3-dimentional sound staging. And smooth, so smooth....*OK, OK* I'm starting to sound like a reviewer in the glossies.

A special introductory price for you Bottleheads of only $395.00 per pair. These babies are brand new so be the first one on your block to own a pair. Limited time offer ($550.00 retail) so don't delay. Warranteed for 1 year from the date of purchase.

The Arizona Capacitor blowout continues:

Paper in Oil caps with axial OFC leads. **$2.50 each any value.**

AZ01	.001uf/400V	AZ09	.33uf/400V
AZ02	.01uf/400V	AZ12	1.0uf/400V
AZ03	.022uf/400V	AZ15	.22uf/600V
AZ04	.047uf/400V	AZ17	.47uf/600V
AZ08	.22uf/400V	AZ19	1.0uf/600V

NOS Oil Caps (while quantities last):

GE Radial Oil Cans	70uf/440Vac/750Vdc (about the size of a beer can)	$8.00 each
Sangamo & CDE Radial Paper in Oils	2uf/600V	$4.00 each
CSI Radial Oil	.26uf/800V	$0.75 each

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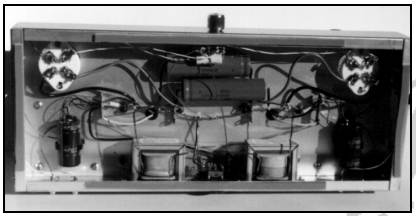
interstage transformers, chokes L1-L4, and some filter capacitors, plus a stereo volume control, input and output jacks and other small components. Chokes L3 and L4 are special Electra-Print models, designed to clean up the 4-amp DC used on filaments like those in the SV572 series. Combined with C8 and C9, the resulting hum and noise appearing across the filament of each tube is so low that



my test equipment has trouble reading it consistently.

Microphonics in the SV572 are a serious matter, so we took serious steps to reduce its influence. The tube sockets were mounted on rubber shock mounts, with extra-long wiring connections to allow the sockets to "float" somewhat. The whole preamp chassis was put on shock mounts. We found that remoting the power supply was the best policy. Not only did its heavy steel box help to cut induced hum to the preamp stages, there was also some mechanical vibration from the power supply and its (very quiet) cooling fan, which could reach the tubes if the fan was in the same enclosure. Finally, putting large Pearl tube coolers on the SV572-10s made the tubes very resistant to airborne vibrations.

The controls on noise and microphony were so successful that another problem cropped up. Even with all these extreme measures, 2 mV of 60 Hz AC hum still appeared in the output. Some experimentation revealed the source: environmental hum was being picked up by the cores of the 3533-2 transformers! Jack Elliano was very helpful, and offered to pot the 3533-2s in massive welded steel cans. Once these heavily-shielded versions were installed, residual hum dropped greatly. The prototype preamp, when completed, showed about 200 microvolts of noise on the audio output jack; comparable to many commercial preamps I've seen in the past. Most of this noise is above 20 kHz, being switching noise from the filament supply. Even a sensitive power amp, such as a vintage Heathkit or Harmon-Kardon, should be compatible with this circuit.

There you have it: a preamp that practically screams "audiophile extremist". It is an excellent test bed for tweaks of the acoustical variety. More important, it demonstrates the amazingly clear, clean sound of the thoriated filament triode at its best, and with not a trace of feedback. This is the kind of DIY project that you will want to show off to friends and family, it's both sonically remarkable and physically attractive.

ELECTRICAL PERFORMANCE OF THE SV572-10 LINE STAGE

Voltage gain at maximum volume setting into 1-megohm load: 9.2
Distortion at 1 kHz, 10v RMS output (28.2 volts peak-to-peak), with 1 megohm load:
THD--0.075% left channel, 0.10% right channel
IMD--0.42% left channel, 0.38% right channel with 10k ohm load: THD 0.39%
Frequency response, 1 megohm load, volume control at maximum:

-1 dB	46 Hz	34 kHz
-3 dB	16.5 Hz	85 kHz

Frequency response, 10 k ohm load, volume control at maximum:

-1 dB	30 Hz	53 kHz
-3 dB	11.4 Hz	190 kHz

Available dynamic range above 1 v RMS at 1 kHz, 1 megohm load: 42 dB

REFERENCES

Hisashi Ohtsuka, "SV572 Test Report: Modernized 211--New DH Audio Power Triode", MJ AUDIO TECHNOLOGY magazine, September 1997, page 108. (English translation available from Svetlana Electron Devices--ask for Technical Bulletin No. 28.)

Eric Barbour, "Audio Preamp Tubes: A Survey", GLASS AUDIO magazine, 6/97 issue, p. 1.

when tube testers disagree

by Alan Douglas

Opinions tend to extremes: there are those who don't believe anything a tube tester tells them, and those who expect all calibrated testers to give the same Gm reading, no matter what. Mutual conductance however is very dependent on operating conditions, and no two tube testers are quite alike. Furthermore, most of them have inherent flaws, especially in dealing with high-mu tubes running at low plate current such as the 12AX7.

Figure 1 is a point-by-point plot of a randomly-selected 12AX7 on a Weston analyzer, model 686 10A, along with the Gm readings at various positions along the curve. This "transfer" characteristic, though not usually given in tube manuals, shows clearly the nonlinear operating area. The mutual conductance at any point is readily determined graphically by the slope of a tangent line (delta plate current divided by delta grid voltage): it goes higher as the curve gets progressively steeper. Evidently a tube tester could give any value from 1000 to 3000 micromhos, depending on the applied grid bias and resulting plate current. And a very small change in the tester's bias setting--one volt is only 10 on a crowded 0--100 bias-pot scale--makes a huge difference in the meter reading.

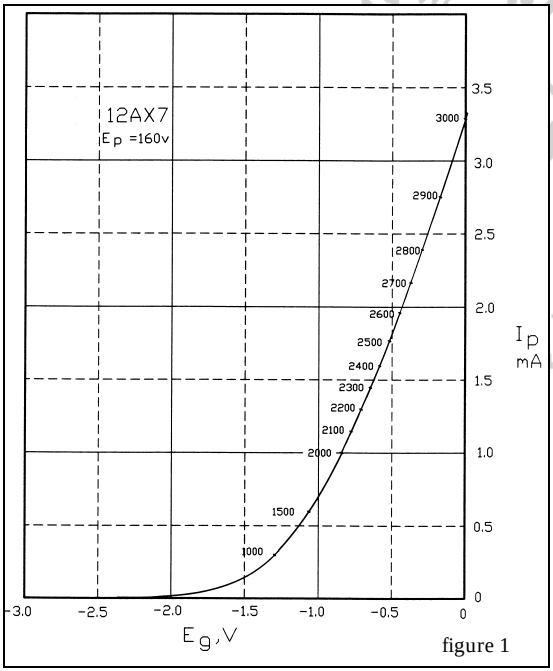


figure 1

The inherent flaw mentioned earlier is the grid signal voltage. In the better laboratory models this can be a tenth of a volt or even less, but in a typical Hickok is much higher. 5 VAC is usual for the older models, down to 1 V for the later ones, but even 1 VAC is 2.8V peak-to-peak, way too much for low-bias tubes. A 2.8 volt swing will drive them from cutoff to grid current; any Gm reading under those conditions is only a crude average.

Figure 2 demonstrates the problem with various Hickoks. Superimposed on the original transfer curve are the actual (measured) operating points for the different models, along with the grid-signal swing and the Gm readout on each tester. Models with a 5 V signal are not shown since the operating points are way off the top of the chart, at 6 mA; this includes the popular I-177, TV3, TV7, TV10, and the pre-1950 commercial models such as the 533. The only testers that come even close to reality are the TV2, 539C, and the lab model 700 (but only on the 6000 range). Even on the 700, you can see the plate current jump upward when the grid signal is switched on, from .7 to .9 mA, indicating nonlinear operation. Note that the TV2 will not read out directly in Gm unless you calibrate the shunt pot.

A 12AX7 is perhaps a worst-case example, but it could very well be the reason why Hickok abandoned the laboratory-model 700 in 1958 just after updating it with regulated power supplies: its Gm meter had only 3 mA sensitivity which could not be increased by further tricks.

The best plan is to get to know your tester, see how it handles weak tubes, and don't put too much stock in the exact numbers. A plate milliammeter is also helpful in setting the operating point, rather than depending on the grid-bias dial.

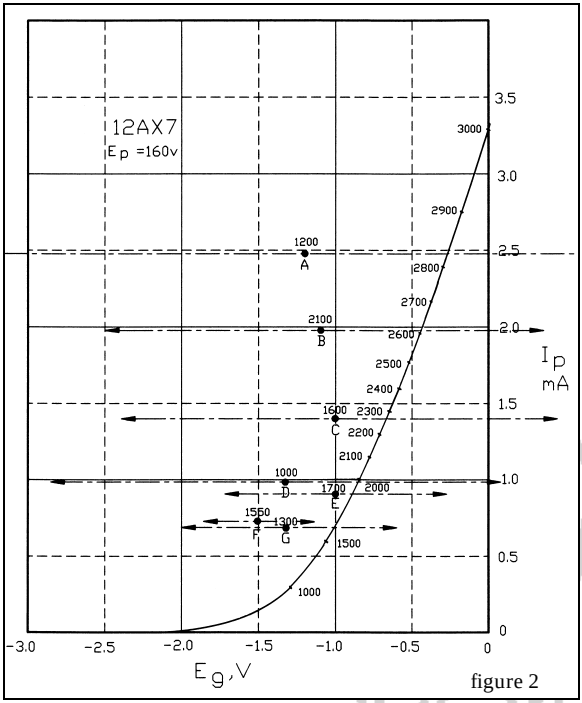


figure 2

Fig. 2 notes

A. Model 6000A, 2.5 VAC signal

B. KS15750 L1, a 539 variant made for Western Electric, 1 VAC signal

C. 700, 1 VAC signal (3000 Gm scale)

D. TV7, 1 VAC, "D" range (15,000 micromhos full scale). B and C ranges (3000 and 6000) use a 5 VAC signal.

E. 700, .5 VAC signal (6000 Gm scale)

F. TV2, .25 VAC signal. The roll chart calls for 225V on the plate but I set it to 155V to match the other models being tested. A transfer curve plotted with the TV2 agrees well with the Weston above .5 mA Ip but is displaced about .2 V to the left. By the way, the TV2 was not actually made by Hickok, but uses the standard Hickok circuit with the addition of a DC screen supply.

G. 539C, .5 VAC signal. A transfer curve plotted with the 539C agrees fairly well with the Weston above 1 mA Ip except that the Gm reads a little high. Reading the 2" bias meter this closely however takes some imagination. Note also that both the 539C and TV2 require an external plate milliammeter (I used a Simpson 260 and a 9-pin socket extender).

The Weston 686 10A uses a .1 VAC signal. For the record, Cardmatics are .22

Afterglow:

While checking my 12AX7 curve against the RCA manual, I realized that it didn't match very well, and in fact I had picked an odd sample tube (it looks like a 1960-ish RCA but is stamped Hewlett Packard). I plotted another RCA and that didn't match the manual too well either. Both are shown in fig.3: the dashed line is a "tube manual" curve, plotted by transferring points from the plate-family curves. Evidently tubes aren't as consistent as we have been told.

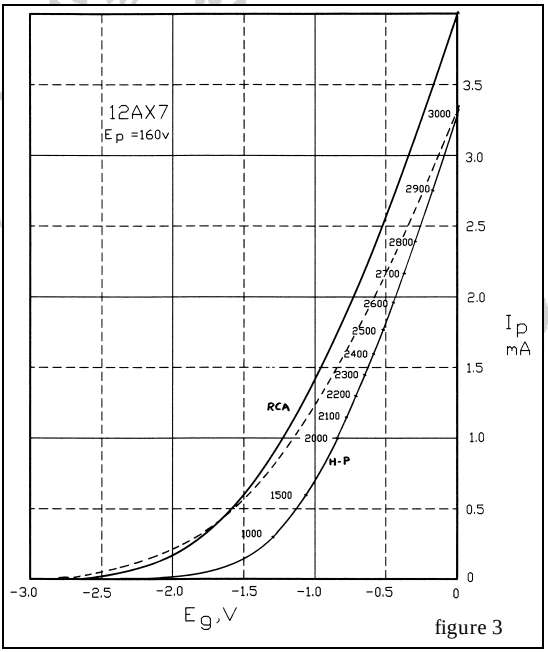


figure 3

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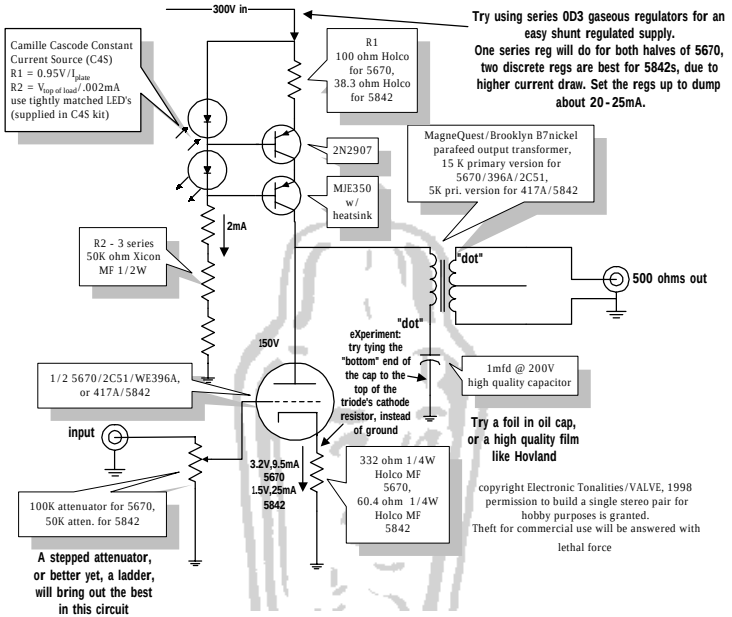
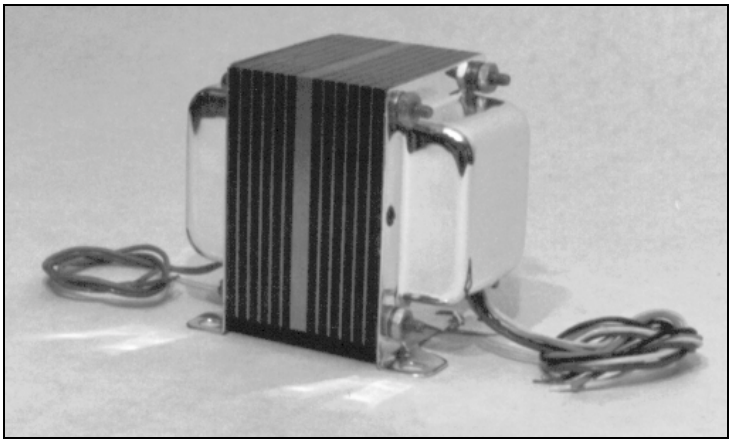


THE PINSTRIPE



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