

# VALVE

VINTAGE AUDIO LISTENERS AND VALVE ENTHUSIASTS

**in this issue -**

**George Wright's 6ER5 preamp**

**Lowther audition results**

**Triode mode-ing the Stereo 70**

**304TL - single ended giant**

**Surplus JBL stash uncovered!**

## **upcoming meetings**

November 5, 1995 10 am  
the Wright Phono Preamp  
at Classic Audio, 7313 Greenwood  
Seattle

Christmas Party  
December 3, 1995  
Time and location TBA

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**1995**

# VALVE

*is the newsletter of  
Vintage Audio Listeners and  
Valve Enthusiasts,  
dedicated to the preservation and  
dissemination of thermionic valve  
and vintage audio knowledge.*

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## editor's thing

I'd like to mention a neat change to our masthead this month, that being the addition of two new members to our editorial staff.

Dave Dintenfass has been our chief member-at-large since VALVE started up almost two years ago. He is one of the more hardcore vintage audio enthusiasts in the country, having been into vintage audio before the rest of us knew there was such a thing.

Dave's knowledge of vintage recording technique and history is a precious resource to our group. A visit to his home, full of Ampex and Nagra tape decks, transcription turntables, and stacks of LP's and 78's makes it clear that this guy is *into* vintage audio.

Dave has lots of gear, but his primary system consists of a pair of QUAD speakers, 24W Ampex ultralinear monoblocks, a passive attenuator or prototype Carver tube preamp, a Sony CD, and, in the future, a Thorens TD 124/SME arm. He just bought some Lowther speakers from Editor Doug, and I suspect these will replace the QUADs for a bit. Dave is working up some single ended amp ideas to use with the Lowthers, and we will see the results in these pages in the future.

Although Dave is now writing full time for Microsoft, he will contribute articles when his schedule allows.

Editor Doug has offered to take some responsibilities as our resident restoration expert. Having been a pro-fesh-unul radio restorer myself for the past four years, my personal pride interfered with my letting anyone else write much about restoration in this newsletter. If you have seen any of the amps, turntables or speakers Doug has restored the last couple of years, you know why I am honored to have Doug share his knowledge with us.

Doug will also be giving us occasional

recommendations for software to show off our vintage gear, and some insights on his journey through tube audio.

At present, Doug listens to soon to be modified AR3's with his fully restored Dyna MkIII's, his Stereo 70, or his mint Mac225.

As with Dave, Doug works full time, for Group Health, and so his contributions will be on a 'time available' basis.

I hope that the new viewpoints brought to VALVE by these two excellent pairs of ears will help to present a broader range of opinion to you readers. While I highly respect the listening abilities of each of these guys, I can tell you that their tastes are very different, and that my taste differs from both of theirs in many ways. So you can pick your vintage audio reviewer now, just like you can pick a vintage wine reviewer who likes the same labels as you...

Don't let the blue smoke out,



## october

By Doug Grove

The rain had stopped for the moment, and the sun came out while the autumn leaves kept falling. (*you're such a romantic - dan*) It was noon on Sunday and the time had arrived to audition the Lowther speakers. Tony Glynn, founder of the Lowther Club of America, was our guest and entertainment with stories from the Jurassic era of audio. Tony acquainted us with Lowther-Voight design principles using a PM6A driver for comparison. I also brought old PM6 cone assemblies for comparison, and to show the famous double-wound voice coil.

We then hauled the Lowthers out of the vintage closet for a look and listen. Comments included: "good cabinet restoration and nice wood finish", "Great funky 50's grille cloth and original emblems", "Wow, do these sound as good as they look?" Dan hooked them up to

his 6080SE amp with its huge 4 watt per channel output, playing CD's through his new tube-driven DAC output. Pretty good sound coming from that little 8" driver in the big horn. Very efficient too, at 100dB sensitivity.

Imaging was excellent. It felt as if we were at center stage. These loudspeakers project really well. All musical venues sounded great. Could this be near perfect midrange reproduction? They were excellent in detail on both instrumental and vocal recordings of individuals and small groups. Complex, high level orchestral passages were a bit muddy, as if the single driver was being asked to perform the impossible. The Lowthers have a gentle high end rolloff and really smooth out CD roughness. Bass takes some getting used to as it really is thin on most all programs. It must be noted that the 6080 amp speaker binding posts were hardwired to the 8 ohm output transformer taps, which might have affected response since the Lowthers are nominal 15 ohm impedance. We all agreed that the speaker would sound best if raised about one foot off the floor.

We listened to some exclusive tunes on the turntable. Tony brought a limited edition brand new direct from master tape pressing of *Getz/Gilberto (The Girl From Ipanema)* by Mobile Fidelity. This was an awesome recording, far superior in balance and detail to the stock Verve pressing, which we also auditioned, an improvement made very clear on the Lowthers. Dan put on his RCA Direct Master recording of Lew Tabakin's *Vintage Tenor*. CD demos included Tuck & Patti and Jazz by the Andre Previn Trio.

More comments compared Lowthers and QUAD ESL's as being similar in midrange and imaging, with QUADs producing more bass. And, when the Lowthers are compared to Dan's Superwhamodynes, midrange was again very close, but the Whamos definitely have more bass and high end. The Lowthers

also had a unique ability to make nearly everything sound good in the mids.

After all the listening and comments, one has to wonder if Lowthers sound better when driven by push-pull pentode amps which tend to be brighter (pentodes) and have more bass punch (push-pull). That poses an interesting contradiction in that their efficiency advantage begs for use with single ended triodes.

We also gave Paul's Optimus 990 mods a listen. He set up one speaker stock, and one sporting a new horn and crossover. Both speakers used a stock woofer while the new horn assembly consisted of a Selenium horn mounted to an Eminence driver. We did A-B comparisons between the two. The Selenium horn clearly improved the speaker's sound. Highs were more defined while mids sounded more natural. Next step for this project will be improved bass drivers.

Dan's customized World Audio 6080SE amp really rocked. Also, his CD tube output sounded very smooth. Excellent tweak - you have to try this one out (sans cardboard chassis?) (*hey, if I change to a metal chassis I may create a paradox in the space enclosed by the cardboard in some parallel universe, seriously degrading the idempotency of the quark flux between the two universes, which obviously could affect the sound of anybody else's future construction projects - that's why I still haven't built a real chassis for this thing - dan*)

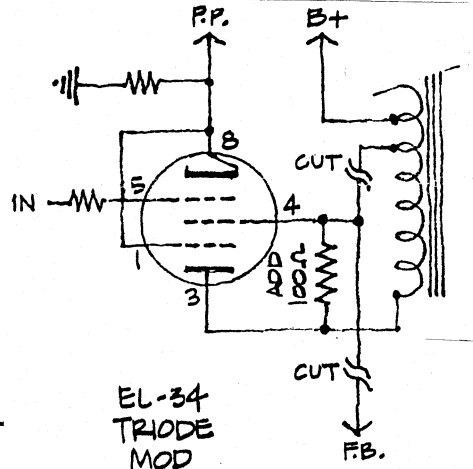
And the Superwhamodynes continue to impress us.

Tony - thank you for joining us at VALVE for this event. Your knowledge and insight helped us understand what we heard. Dan - thanks for the coffee, muffins and sandwiches, and as always, for providing the clubhouse.

## dinkin' around

*Doug rolls the classic Stereo 70 triode mode mod, but doesn't smoke it*

I have always wanted to try this: First, remove the ultralinear tap (and feedback circuit, if used) from pin 4 of each output tube. Then connect pins 4 and 5 with a 1 watt, 100 ohm carbon resistor (all you old time circuit hackers who have been there and done that can stop reading here). I just rewired four EL-34's to push-pull triode output in both channels of a Stereo 70 (refer to hack map below). After a quick readjustment of bias my Stereo 70 now runs at 17 watts. So how does it sound? More midrange detail, a bit less bass, with highs about the same. Overall a very pleasant sound with less power output. My conclusion is that for the Dynaco Stereo 70, conversion to triode operation in the output stage is a modest improvement. And, this conversion confirms my suspicion that Lowther Acousta speakers produce better bass from triode push-pull amplifiers (*than SE*). It was a fun experiment. If you are curious about triode sound from a pentode design, try it. It's non destructive, easy to do, and totally reversible. My inspiration for this tweak was Henry Pasternack's "ST-70 Mod" letter on page 57 of Glass Audio, Fall '95 issue, and confirmation from Dan that there would be a minimum amount of smoke if I tried it.



# Build the “Wright” phono preamp

by George Wright and David Dintenfass

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Here's an outstanding low-noise, moving-magnet phono preamp that features passive RIAA equalization and a regulated power supply. This circuit is adapted from two designs that appeared in the 1963 RCA Receiving Tube Handbook (RC-22) — the RIAA phono preamp and the regulated power supply section of the 50 watt high-fidelity power amplifier.

Designing a low-noise vacuum-tube phono preamp can be a challenge. A good place to start was with this time-tested RCA design (with a few refinements, of course). The most significant change to the original circuit is the use of two 6ER5 frame-grid triodes instead of the 7025 dual triode.

The 6ER5 is a high-mu miniature triode introduced around 1959 as a low-noise RF amplifier in television tuners and in commercial VHF/UHF gear. The 6ER5 and later variants (such as the 6HA5, 6HQ5, 6FY5, and 6GK5) were classified as “frame-grid” tubes since the grid structure is surrounded by a box-like frame with slots on either side of the grid (the slots are as wide as the face of the grid). Since the frame is tied to pin 6 (which should be grounded), the plate is shielded from stray electrons which can add noise. Mechanically, the more rigid components help to minimize microphonics and modulation noise.

Another improvement to the classic RCA design includes the addition of a 12AU7. This provides an extra gain stage and a cathode follower output. The extra gain lets you drive even the most insensitive power amplifier, and the cathode follower ensures good performance with loads down to 10K (making this an ideal preamp for any solid-state or vacuum-tube power amplifier).

Circuit topology is straightforward. The first 6ER5 functions as a voltage amplifier plate-coupled to the passive RIAA equalization network. The second 6ER5 and the first half of the 12AU7 are also voltage amplifiers. The second half of the 12AU7 is a cathode follower. Output voltage is nominally 5 volts rms with a typical moving-magnet phono cartridge.

A few other tricks are used to reduce noise. In addition to using a dc filament supply for the signal tubes, a dropping resistor in the dc filament supply is used to reduce heater voltage from 6.3 v to approximately 6.0 v. This lowers noise slightly since cathode emission is also lowered accordingly. While using *slightly* lowered filament voltages on small signal tubes is harmless (and may even *increase* tube life), don't try this on power tubes since their life is adversely affected with any deviation (either high or low) from rated voltage.

Similarly, the low plate voltage used in this preamp (approximately 200 volts, in contrast to the 250 or 300 volts used in conventional preamplifiers) reduces noise since there's less current going through the plate resistors. Finally, mounting the power transformers, rectifiers, and filters on a separate chassis ensures minimal electromagnetic pickup.

Another nice feature of this preamplifier is the use of a simple 200-volt regulated supply using just two tubes — an OB2 gas reference tube and a 6EM7 combination control/series-pass tube. The 6EM7 is one of a family of combination tubes with a high-mu triode and a low-mu power triode in a single envelope. These tubes were used as combined vertical deflection amplifiers and vertical-deflection oscillators

in television sets. Typical types are the 6EM7 and 6EA7 (octal base), 6GF7 (novar base), and 6FM7 (duodecar base). The oddball base types can be gotten cheaper but obviously require a special socket.

Although many of us avoid the complication of adding a regulated power supply to our home-brew preamps, regulation has considerable merit. Proper regulation stabilizes performance and eliminates low-frequency noise that is sometimes introduced by powerline fluctuations. For ultra-low noise circuits, a vacuum-tube regulator is desirable since it lacks the switching noise common to zener diodes. Admittedly, gas regulator tubes can introduce noise of their own. However, the supply used here avoids that by isolating the 0B2 from the dc output path. Any residual noise that does sneak into the dc path is canceled with negative feedback from the cathode of the series-pass triode section to the grid of the control triode through capacitor C17 (this is an old trick borrowed from regulated power supplies used in military equipment).

As with any preamplifier, good construction practices should be followed. The three prototypes used to finalize this design were wired point-to-point on an 1/8-inch double-sided copper-clad unetched pc board using one side of the copper as a ground plane. Holes were drilled in the board to accommodate tube sockets, but otherwise no etching or drilling was done. This type of construction is fast and convenient, but conventional point-to-point wiring on a metal chassis is perfectly adequate. Use localized star grounds at the cathode of each stage, then tie them together with a heavy piece of wire (don't forget to tie the wire to the shell of both input and output connectors). Also, *don't forget to tie pin 6 of the 6ER5s to ground* (our apologies for not including this detail on the schematic).

To avoid ground loops, you should isolate the *input* connector shell from the chassis, but not the shell of the output connector.

Alternatively, you can use a heavy bus bar instead of localized star grounds (the same suggestions about chassis grounding apply here too).

As far as shielding goes, use tube shields over both 6ER5s and observe good grounding procedures. For example, even though pins 1 and 2 of the octal socket on the power supply are tied together, isolate them on the preamplifier side of this connector cable as shown on the schematic. This minimizes hum induced by ground currents. Use a ground braid over the umbilical cord between the two chassis *but ground it to the preamp chassis only*.

Remember that there's ac on the 6EM7 heater, so use a piece of shielded, twisted pair microphone cable here. Ground the cable shield near the 6EM7 tube socket, and don't let it touch the chassis at any other point (in other words, don't remove the cable jacket). Use the twisted pair to carry the heater current to the 6EM7.

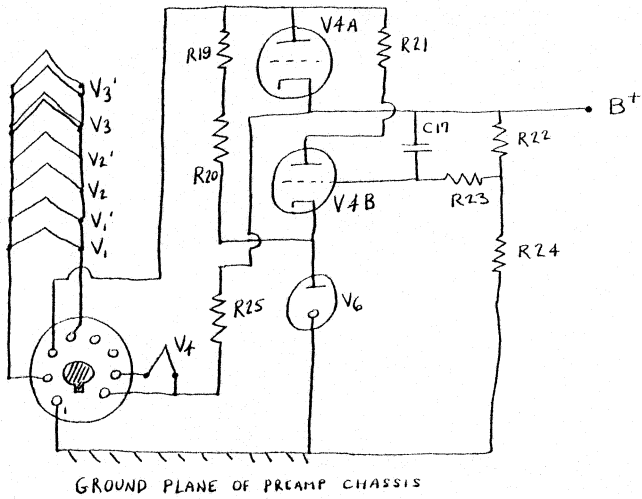
Also note that the 6EM7 and related tubes are asymmetrical, so use the first section as the control tube and the second section as the series-pass tube as shown in the schematic. And if you use a different transformer, make sure it provides between 300 and 400 volts to the regulator input.

Take care to parallel the filaments for the 12AU7 since this circuit uses a 6-volt filament supply. Lastly, note that some 6ER5 variants (such as the 6HQ5 and 6HA5) have different pin configurations.

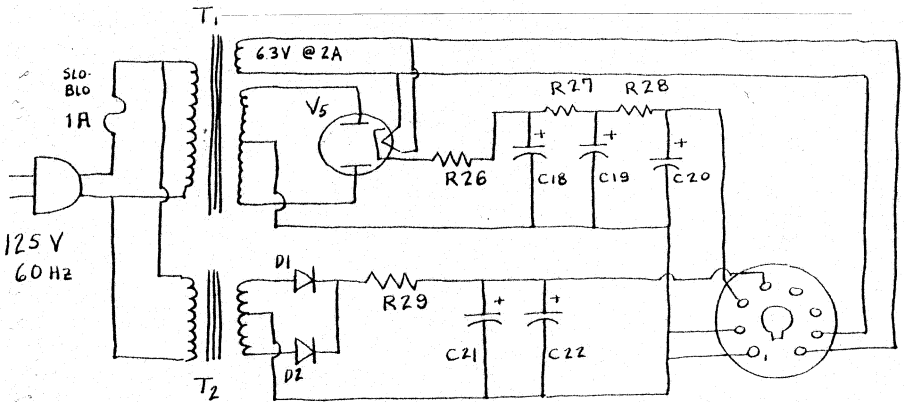
We think the Wright preamp sounds very neutral and transparent, with perhaps a 3 to 5 dB improvement in noise over a typical 12AX7 or 7025 preamp. It also has a smooth, extended high-end, without the slight "dullness" characteristic of many classic tube preamps. If you don't believe us, build your own amp and let us know what you think! And while you're at it, give a moment of thanks to those anonymous folks at RCA whose elegant circuit designs inspired this preamp.

# The Wright Frame-Grid Moving Magnet Preamp

## (transformer chassis and regulated supply)

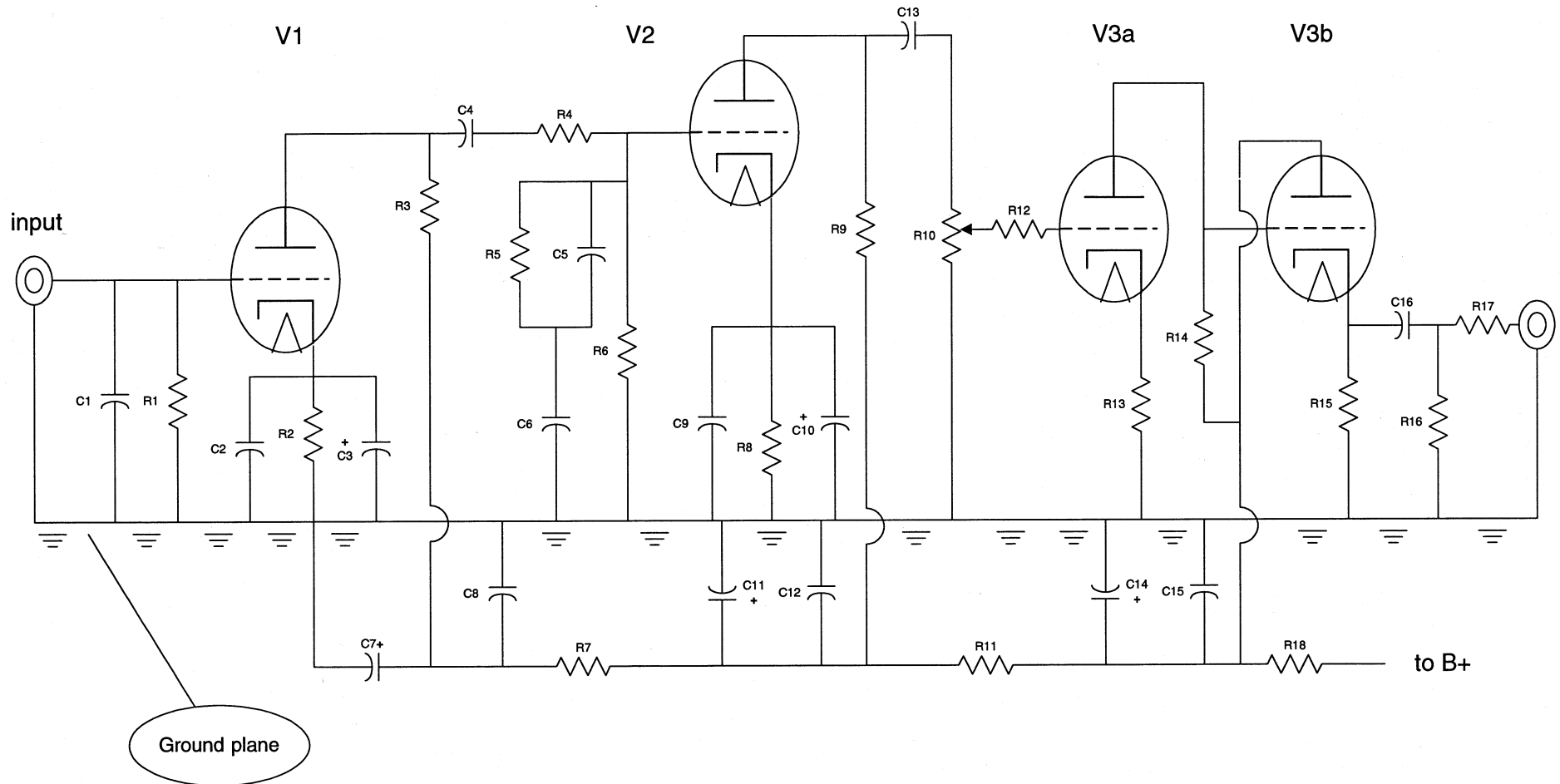


Transformer chassis should be at least three feet from the preamp during use



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### The Wright Frame-Grid Moving Magnet Preamp (one channel)



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## Parts for the Wright moving-magnet frame-grid phono preamp, sheet 1 of 2

Item	Description	Comments
C1, C1'	47 pF or 51 pF silver mica	equalizes response of phono cartridge; should be matched to capacitance of phono cable (typically 47 pF)
C2, C2', C9', C9'	0.22 $\mu$ F/50 v Mylar, 20%	bypass caps
C3, C3', C10, C10'	220 $\mu$ F/16 v electrolytic, 20%	
C4, C4', C13, C13'	0.1 $\mu$ F/400 v polypropelene, 10 %	use low-leakage capacitor (oil types should be okay)
C5, C5'	0.003 $\mu$ F silver mica, 5 % or better	RIAA network
C6, C6'	0.012 $\mu$ F/100 v polystyrene or polypropene, 5% or better	RIAA network
C7, C7', C11, C11'	10 $\mu$ F/450 vdc electrolytic, 20%	use low-ESR type if possible
C8, C8', C12, C12', C15, C15', C17	0.1 $\mu$ F/400 vdc Mylar, 20%	bypass caps
C14, C14', C18, C19, C20	22 $\mu$ F/450 vdc electrolytic, 20%	use low-ESR type if possible
C16, C16'	1 $\mu$ F/250 v Mylar	coupling cap; can also use polypropelene or oil type
C21, C22	22,000 $\mu$ F/16 vdc electrolytic	filter for dc filament supply
D1, D2	1N5403 (3 amp, 200 PIV)	
Fuse	1 amp (slow-blow)	
R1, R1'	51.1K metal film, 1%	use metal film only
R2, R2', R8, R8', R13, R13', R17, R17'	1.2K, 5%	1/2-watt carbon film or metal film
R3, R3', R9, R9'	68K metal film, 5%	1 watt
R4, R4'	402K metal film, 1%	
R5, R5'	20K metal film, 1%	
R6, R6'	536K metal film, 1%	
R7, R7', R11, R11'	15K metal film, 5%	1 watt

## Parts for the Wright moving-magnet frame-grid phono preamp, sheet 2 of 2

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Item	Description	Comments
R10, R10'	250K audio taper	level control
R12, R12'	4.7K, 5%	use metal film or carbon film
R14, R14', R16, R16'	120K metal film, 5%	use metal film only
R15, R15'	27K, 5%	2 watt metal or carbon film
R18, R18'	3.3K, 5%	1 watt, type unimportant
R19, R20	27K, 5%	2 watt
R21	200K, 1%	
R22	56K, 5%	2 watt
R23	2.2K, 5%	1/2 watt
R24	47K, 5%	2 watt
R25	10K	
R26	47 ohm, 10%	1/2 watt
R27, R28	560 ohm, 10%	1 watt
R29	0.33 ohm	10 watt
T1	125 volt primary, 650 to 700 VCT secondary @50 mA	transformer should provide 300 to 400 volts to regulator input
T2	125 volt primary, 12.6 volt secondary @2 A	
V1, V1', V2, V2'	6ER5 or 6HQ5	frame-grid triode
V3, V3'	12AU7/5693/ECC82	twin triode
V4	6EM7 or 6GF7	use any tube in this family
V5	6X4/6202	dual rectifier
V6	0B2	105-volt gas regulator

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*Note: all resistors 1/4 watt unless specified otherwise*

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## 304TL - monster single ended tube?

Jim Dowdy wrote me a note asking if I'd ever gotten plate curves for the 304TL or 304TH. Well, thanks to Fred Suffield and Mike Werner for pointing me toward some info.

I found a binder full of Eimac tube data at the Seattle Public Library. For the 304TL I found four pages of data (see fig.1 for some of this data). A graph of constant current characteristics is included (fig. 2), but not constant grid voltage characteristics. So I made a graph, replotting selected points to give plate current vs. plate voltage for some reasonable grid bias voltages (fig. 3).

The data sheets say 900 mA is maximum allowable current, and 3000 volts maximum plate voltage. Note, however, that figure 2 goes to 5000 volts and 7000 mA!

When the full range of these data are used to derive constant grid voltage curves of figure 3, the useful values for class A single ended audio operation are clustered in the lower left hand corner.

I derived a couple of operating conditions by striking a load line of slope equal but opposite the zero bias curve, from the desired plate voltage on the plate voltage axis to the zero bias curve, constructing an isoscoles triangle. The point of intersection gives the peak current swing.

For 1000V on the plate we get approx. 500 mA peak, and for 1500V we get approx. 890 mA peak, which is near our plate current max. limit.

Output power is r.m.s. signal current x r.m.s. signal voltage, or:

$$\frac{\text{pk. current swing} \times \text{pk. voltage swing}}{2}$$

For 1000V on the plate we get a swing of about 326V, so power is:

$$(.5A \times 326V)/2 = 81.5W$$

and for 1500V we get a swing of about 587.5V, so power is:

$$(.89A \times 587.5V)/2 = 261.4W!$$

Somebody check me, can this be right?

Load resistance should be approx.:

$$\frac{\text{plate voltage swing} \times 2}{\text{plate current swing}}$$

so for 1000V, the load should be about 1304Ω, and for 1500V, the load should be about 1320Ω.. The 1900Ω, 280W transformer from Hammond might work, with an air gap cut as in Dave Wolze's article in VTV, issue 2.

Maximum plate dissipation is 300 watts, so idle current should be 300mA for 1000V at about -62.5V grid bias, and 200 mA at 1500V, with about -93.75V grid bias.

Note that this tube is actually four 75TL assemblies in one envelope, so while directly heated, it is not a single triode but rather four in parallel. You purists may turn up your nose now.

One interesting side effect of stuffing four triodes into one bulb is that the filament current demand goes to the moon. How about 12.5 amps at 10 volts, or 25 amps at 5 volts. At last, a use for all those old mainframe computer power supplies in the surplus stores!

Another small problem with the 304TL is that it uses very special ceramic sockets and finned metal plate and grid caps. If anyone has some of these, I'd be interested in talking you out of them.

Next month I'll do this exercise for the 450TL, a true single DHT with a mu of 18, and a maximum plate dissipation of 450W.

Meantime, I guess I'll start looking for and old Cadillac engine block to use as an output transformer core...

dan

# Eimac

**E I M A C**  
 Division of Varian  
 SAN CARLOS  
 CALIFORNIA

**304TL**  
 LOW-MU TRIODE  
 •  
 MODULATOR  
 OSCILLATOR  
 AMPLIFIER

The EIMAC 304TL is a low-mu. power triode having a maximum plate dissipation rating of 300 watts, and is intended for use as an amplifier, oscillator or modulator, where maximum performance can be obtained at low plate voltage. It can be used at its maximum ratings at frequencies as high as 40 MHz.

Cooling of the 304TL is accomplished by radiation from the plate, which operates at a visible red color at maximum dissipation, and by means of air convection around the envelope.

## GENERAL CHARACTERISTICS

### ELECTRICAL

Filament: Thoriated tungsten	
Voltage	5.0 or 10.0 volts
Current	25.0 or 12.5 amps
Amplification Factor (Average)	12
Direct Interelectrode Capacitances (Average)	
Grid-Plate	8.6 pF
Grid-Filament	12.1 pF
Plate-Filament	.8 pF
Transconductance ( $I_b=1.0$ amp, $E_b=3000$ V, $e_c=-175$ V)	16,700 $\mu$ mhos
Frequency for Maximum Ratings	40 MHz

### MECHANICAL

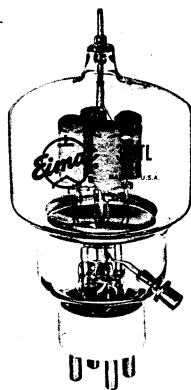
Base	Special 4 pin, No. 5000B
Socket	Johnson No. 124-213 or Equivalent
Mounting	Vertical, base down or up
Cooling	Convection and Radiation

#### Recommended Heat Dissipating Connectors:

Plate	HR-7
Grid	HR-6

#### Maximum Overall Dimensions:

Length	7.625 inches
Diameter	3.563 inches
Net Weight	9 ounces
Shipping Weight (Average)	2 pounds



## AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class B (Sinusoidal wave, two tubes unless otherwise specified)

### MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 VOLTS
MAX-SIGNAL DC PLATE CURRENT, PER TUBE	900 MA
PLATE DISSIPATION, PER TUBE	300 WATTS

### TYPICAL OPERATION, CLASS AB<sub>2</sub>

DC Plate Voltage	1500	2000	2500	3000	Volts
DC Grid Voltage (approx.)*	-118	-170	-230	-290	Volts
Zero-signal DC Plate Current	270	200	160	130	mA
Max-Signal DC Plate Current	572	546	483	444	mA
Effective Load, Plate-to-Plate	2540	5300	8500	12,000	Ohms
Peak AF Grid Input Voltage (per tube)	118	170	230	290	Volts
Max-Signal Peak Driving Power	0	0	0	0	Watts
Max-Signal Plate Power Output	256	490	610	730	Watts

### TYPICAL OPERATION, CLASS AB<sub>2</sub>

DC Plate Voltage	1500	2000	2500	3000	Volts
DC Grid Voltage (approx.)*	-118	-170	-230	-290	Volts
Zero-signal DC Plate Current	270	200	160	130	mA
Max-Signal DC Plate Current	572	546	483	444	mA
Effective Load, Plate-to-Plate	2750	4500	6600	9100	Ohms
Peak AF Grid Input Voltage (per tube)	245	290	340	390	Volts
Max-Signal Peak Driving Power	78	87	95	110	Watts
Max-Signal Nominal Driving Power (approx.)	39	44	48	55	Watts
Max-Signal Plate Power Output	1100	1400	1650	1800	Watts

\*Adjust to give stated zero-signal plate current

\*Adjust to give stated zero-signal plate current. The effective grid circuit resistance for each tube must not exceed 250,000 ohms.



304TL

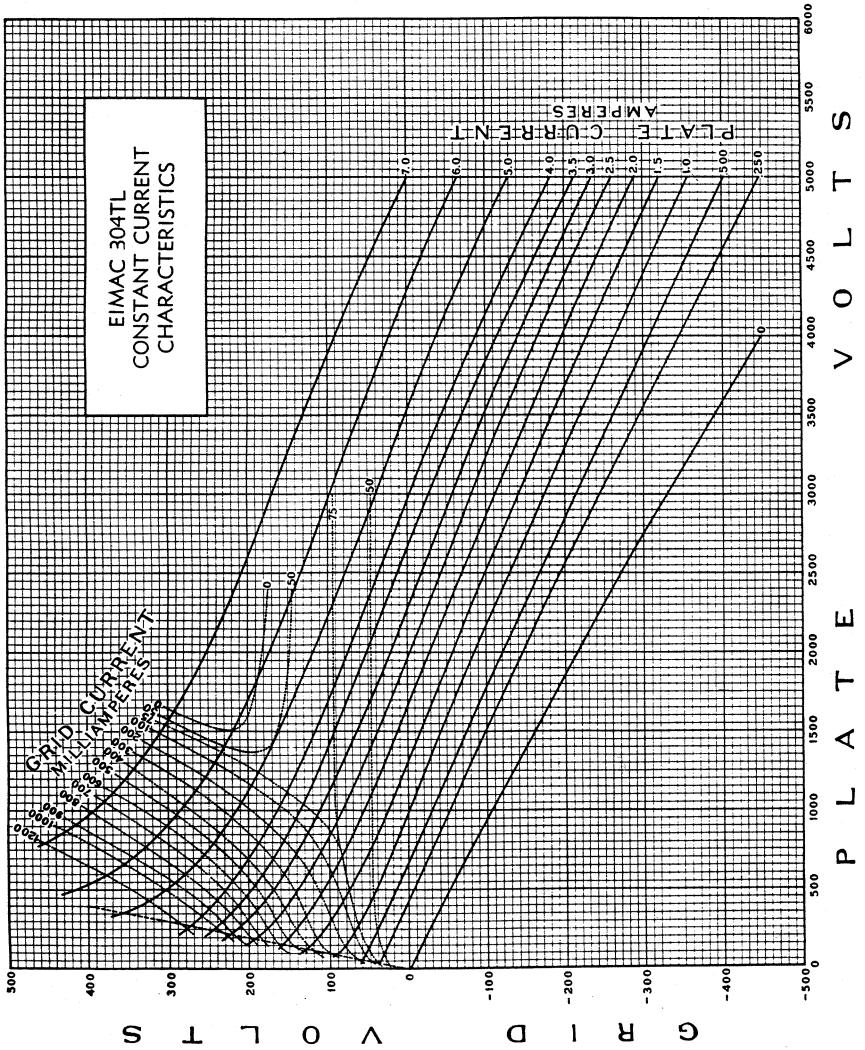


FIGURE 2

# 304TL PLATE CHARACTERISTICS

DERIVED FROM EIMAC CONSTANT CURRENT CHARACTERISTIC CURVES

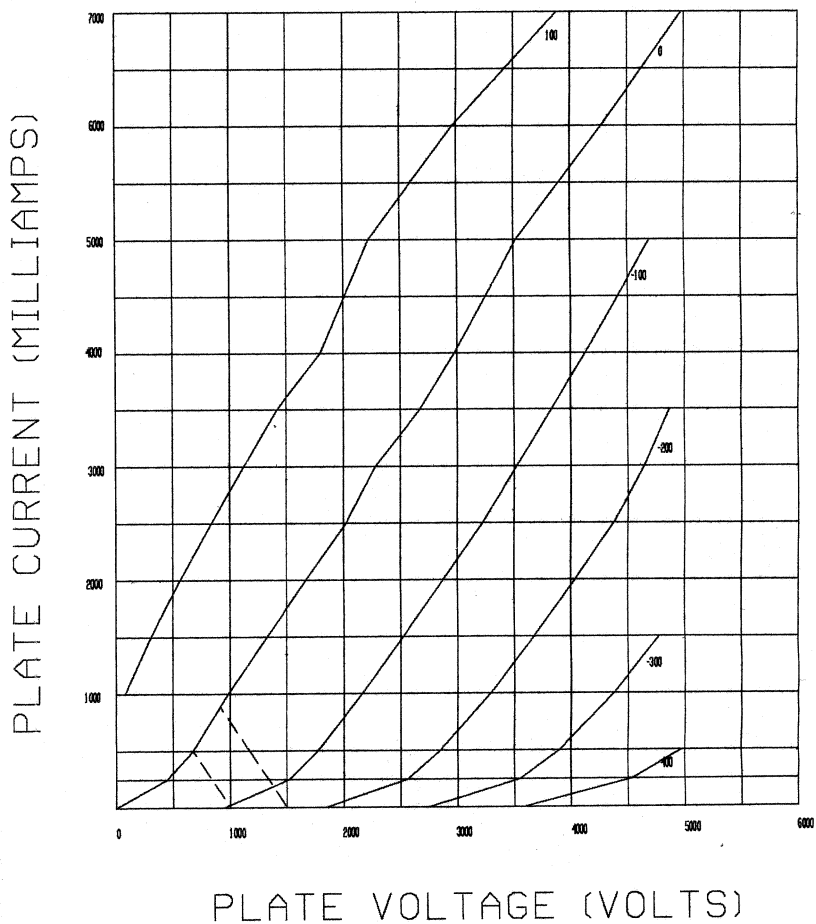


FIGURE 3

## what's brewin'?

Dave has picked up some nice surplus transformers, a few 8000 $\Omega$  c.t., and a few 7500 $\Omega$  s.e.. We're looking at some useful applications. I'll probably cough up a couple 10's, and we're thinking 6BQ5's might be nice. By the way, the amps built from these trannies will power Dave's Lowthers, which used to be Doug's Lowthers.

Paul blew my mind at last month's meeting. We were talking about the hassles of building horns. I jokingly suggested using stereo lithography, where a computer controlled laser beam sweeps across a tank of liquid, selectively solidifying it into plastic to create a 3D model directly from a 3D CAD file. Paul says, "oh yeah, I made a horn that way." Yes, I asked for an article!

Paul also sends us this note:

"Dan -

While looking for a suitable woofer to go with the JBL LE175 horn tweeter, I ran across Morgan Sound (2004 196th SW, Lynwood, WA, 98036, 206-771-7257). They are a commercial sound contractor, but they have some used JBL speaker components that might be of interest to the micro power brigade. It's overkill, it's not cheap, and they are USED - after a decade or two of rock concert touring, break-in should be no problem! Here's a rundown on what I saw:

Model 2220 woofers - no longer in production, these are the last descendants of the D130 and 130 A/B. (Late news flash - I hear there's a new high efficiency 15" in the line as of last week) They are extremely efficient (8.6%, 101 dB/W/M), though you have to work hard to get decent bass from them. Big bass reflex cabinets, plus tube amps with high output impedance might do it. Of course they

are ideal for horn loaded systems! Alnico magnets, 16 ohm, around \$150 (last retail price new was \$335). For a little extra, you could get a pair in giant VOT-type short-horn-loaded vented box.

Model 2205 woofer - ancestor of the current standard 2225. Less efficient (I would guess about 97 dB/W/M) but easier to get good bass from. Ideal for a large (5-10 cu. ft.?) bass reflex cabinet. Also 16 ohms, Alnico magnet, also available in the double giant cabinets. (Seriously - these cabinets make VOT's look like minimonitors!)

Model 2440 and 2441 large format horn drivers - these are BIG, at around 24 pounds: 4 inch voice coil and 2 inch throat. There may be a few left but they are mostly gone now. Presumably descended from the 375 as used in the Hartsfield (which I still regret not hearing!). Did I mention they can play LOUD? With 35 watts input (continuous rms pink noise above 500 Hz, which they will take forever) they will put out 10 acoustic watts. Yes, that's around 125dB at a meter, with a wide angle horn! 16 ohm, Alnico magnets of course, about \$300. Modern equivalents with ceramic magnets run \$550-\$800.

They have some high-frequency packs containing a driver like the above with the 2397 diffraction horn, plus a crossover and a slot-radiator supertweeter. The 2397 has a 26 inch wide, 2 inch high slot mouth, curved nearly to a semicircle, and is made of wood. It's internally divided into 6 exponential sectors (I think Paul Klipsch used a similar design for the high end in his original corner horn paper). These used to have quite a reputation for "smoothness", used as monitors. They also have a couple new in box 2397's (\$132, I think) and some new 2405 slot tweets at \$150."